Modicon Edge I/O NTS

Motion Expert Modules

User Guide

Original instructions

EIO0000005254.02
04/2026

www.se.com

Legal Information

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Safety Information

Important Information

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a "Danger" or "Warning" safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER
DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

WARNING
WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

CAUTION
CAUTION indicates a hazardous situation which, if not avoided, **could result** in minor or moderate injury.

NOTICE
NOTICE is used to address practices not related to physical injury.

Please Note

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

Before You Begin

Do not use this product on machinery lacking effective point-of-operation guarding. Lack of effective point-of-operation guarding on a machine can result in serious injury to the operator of that machine.

⚠WARNING

UNGUARDED EQUIPMENT

- Do not use this software and related automation equipment on equipment which does not have point-of-operation protection.
- Do not reach into machinery during operation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

This automation equipment and related software is used to control a variety of industrial processes. The type or model of automation equipment suitable for each application will vary depending on factors such as the control function required, degree of protection required, production methods, unusual conditions, government regulations, etc. In some applications, more than one processor may be required, as when backup redundancy is needed.

Only you, the user, machine builder or system integrator can be aware of all the conditions and factors present during setup, operation, and maintenance of the machine and, therefore, can determine the automation equipment and the related safeties and interlocks which can be properly used. When selecting automation and control equipment and related software for a particular application, you should refer to the applicable local and national standards and regulations. The National Safety Council's Accident Prevention Manual (nationally recognized in the United States of America) also provides much useful information.

In some applications, such as packaging machinery, additional operator protection such as point-of-operation guarding must be provided. This is necessary if the operator's hands and other parts of the body are free to enter the pinch points or other hazardous areas and serious injury can occur. Software products alone cannot protect an operator from injury. For this reason the software cannot be substituted for or take the place of point-of-operation protection.

Ensure that appropriate safeties and mechanical/electrical interlocks related to point-of-operation protection have been installed and are operational before placing the equipment into service. All interlocks and safeties related to point-of-operation protection must be coordinated with the related automation equipment and software programming.

NOTE: Coordination of safeties and mechanical/electrical interlocks for point-of-operation protection is outside the scope of the Function Block Library, System User Guide, or other implementation referenced in this documentation.

Start-up and Test

Before using electrical control and automation equipment for regular operation after installation, the system should be given a start-up test by qualified personnel to verify correct operation of the equipment. It is important that arrangements for such a check are made and that enough time is allowed to perform complete and satisfactory testing.

⚠WARNING

EQUIPMENT OPERATION HAZARD

- Verify that all installation and set up procedures have been completed.
- Before operational tests are performed, remove all blocks or other temporary holding means used for shipment from all component devices.
- Remove tools, meters, and debris from equipment.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Follow all start-up tests recommended in the equipment documentation. Store all equipment documentation for future references.

Software testing must be done in both simulated and real environments.

Verify that the completed system is free from all short circuits and temporary grounds that are not installed according to local regulations (according to the National Electrical Code in the U.S.A, for instance). If high-potential voltage testing is necessary, follow recommendations in equipment documentation to prevent accidental equipment damage.

Before energizing equipment:

- Remove tools, meters, and debris from equipment.
- Close the equipment enclosure door.
- Remove all temporary grounds from incoming power lines.
- Perform all start-up tests recommended by the manufacturer.

Operation and Adjustments

The following precautions are from the NEMA Standards Publication ICS 7.1-1995:

(In case of divergence or contradiction between any translation and the English original, the original text in the English language will prevail.)

- Regardless of the care exercised in the design and manufacture of equipment or in the selection and ratings of components, there are hazards that can be encountered if such equipment is improperly operated.
- It is sometimes possible to misadjust the equipment and thus produce unsatisfactory or unsafe operation. Always use the manufacturer's instructions as a guide for functional adjustments. Personnel who have access to these adjustments should be familiar with the equipment manufacturer's instructions and the machinery used with the electrical equipment.
- Only those operational adjustments required by the operator should be accessible to the operator. Access to other controls should be restricted to prevent unauthorized changes in operating characteristics.

About the Document

Document Scope

This guide describes the implementation of Modicon Edge I/O NTS Motion Expert modules. It provides the description, characteristics, wiring diagrams and configuration details for Modicon Edge I/O NTS Motion Expert modules.

Validity Note

This document has been updated for the release of Modicon Edge I/O NTS Motion Expert modules firmware V1.1.0.

The characteristics of the products described in this document are intended to match the characteristics that are available on www.se.com. As part of our corporate strategy for constant improvement, we may revise the content over time to enhance clarity and accuracy. If you see a difference between the characteristics in this document and the characteristics on www.se.com, consider www.se.com to contain the latest information.

Product Related Information

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Disconnect all power from all equipment including connected devices prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires except under the specific conditions specified in the appropriate hardware guide for this equipment.
- Always use a properly rated voltage sensing device to confirm the power is off where and when indicated.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to the unit.
- Use only the specified voltage when operating this equipment and any associated products.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

LOSS OF CONTROL

- Perform a Failure Mode and Effects Analysis (FMEA), or equivalent risk analysis, of your application, and apply preventive and detective controls before implementation.
- Provide a fallback state for undesired control events or sequences.
- Provide separate or redundant control paths wherever required.
- Supply appropriate parameters, particularly for limits.
- Review the implications of transmission delays and take actions to mitigate them.
- Review the implications of communication link interruptions and take actions to mitigate them.
- Provide independent paths for control functions (for example, emergency stop, over-limit conditions, and error conditions) according to your risk assessment, and applicable codes and regulations.
- Apply local accident prevention and safety regulations and guidelines.[1]
- Test each implementation of a system for proper operation before placing it into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

[1] For additional information, refer to NEMA ICS 1.1 (latest edition), "Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control" and to NEMA ICS 7.1 (latest edition), "Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems" or their equivalent governing your particular location.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Only use software and hardware components approved by Schneider Electric for use with the system.
- Update your application program every time you change the physical hardware configuration.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

General Cybersecurity Information

In recent years, the growing number of networked machines and production plants has seen a corresponding increase in the potential for cyber threats, such as unauthorized access, data breaches, and operational disruptions. You must, therefore, consider all possible cybersecurity measures to help protect assets and systems against such threats.

To help keep your Schneider Electric products secure and protected, it is in your best interest to implement the cybersecurity best practices as described in the Cybersecurity Best Practices document.

Schneider Electric provides additional information and assistance:

- Subscribe to the Schneider Electric security newsletter.
- Visit the Cybersecurity Support Portal web page to:
  - Find Security Notifications.
  - Report vulnerabilities and incidents.
- Visit the Schneider Electric Cybersecurity and Data Protection Posture web page to:
  - Access the cybersecurity posture.
  - Learn more about cybersecurity in the cybersecurity academy.
  - Explore the cybersecurity services from Schneider Electric.

Environmental Data

For product compliance and environmental information, refer to the Schneider Electric Environmental Data Program.

Available Languages of the Document

The document is available in these languages:

- English (EIO0000005254)
- French (EIO0000005255)
- Chinese (EIO0000005259)

Related Documents

Title of Documentation	Reference Number
Modicon Edge I/O - System Planning and Installation Guide	EIO0000004786 (ENG) EIO0000004787 (FRE) EIO0000004791 (CHS)
Modicon Edge I/O - Configurator and Web Interface - User Guide	EIO0000004810 (ENG) EIO0000004811 (FRE) EIO0000004815 (CHS)
Modicon Edge I/O - Software Integration and Compatibility - User Guide	EIO0000004818 (ENG) EIO0000004819 (FRE) EIO0000004823 (CHS)
Modicon Edge I/O - Diagnostic Data - User Guide	EIO0000004826 (ENG) EIO0000004827 (FRE) EIO0000004831 (CHS)
Modicon Edge I/O NTS - Network Interface Modules - User Guide	EIO0000004794 (ENG) EIO0000004795 (FRE) EIO0000004799 (CHS)
Modicon Edge I/O NTS - Discrete Modules - User Guide	EIO0000005238 (ENG) EIO0000005239 (FRE) EIO0000005243 (CHS)
Modicon Edge I/O NTS - Analog Modules - User Guide	EIO0000005246 (ENG) EIO0000005247 (FRE) EIO0000005251 (CHS)
Modicon Edge I/O NTS - Counting Modules - User Guide	EIO0000005262 (ENG) EIO0000005263 (FRE) EIO0000005267 (CHS)
Modicon Edge I/O NTS - Field Device Master Modules - User Guide	EIO0000005270 (ENG) EIO0000005271 (FRE) EIO0000005275 (CHS)

To find documents online, visit the Schneider Electric download center (www.se.com/ww/en/download/).

Information on Non-Inclusive or Insensitive Terminology

As a responsible, inclusive company, Schneider Electric is constantly updating its communications and products that contain non-inclusive or insensitive terminology. However, despite these efforts, our content may still contain terms that are deemed inappropriate by some customers.

Terminology Derived from Standards

The technical terms, terminology, symbols and the corresponding descriptions in the information contained herein, or that appear in or on the products themselves, are generally derived from the terms or definitions of international standards.

In the area of functional safety systems, drives and general automation, this may include, but is not limited to, terms such as *safety*, *safety function*, *safe state*, *fault*, *fault reset*, *malfunction*, *failure*, *error*, *error message*, *dangerous*, etc.

Among others, these standards include:

Standard	Description
IEC 61131-2:2007	Programmable controllers, part 2: Equipment requirements and tests.
ISO 13849-1:2023	Safety of machinery: Safety related parts of control systems. General principles for design.
EN 61496-1:2020	Safety of machinery: Electro-sensitive protective equipment. Part 1: General requirements and tests.
ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN 60204-1:2006	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
ISO 14119:2013	Safety of machinery - Interlocking devices associated with guards - Principles for design and selection
ISO 13850:2015	Safety of machinery - Emergency stop - Principles for design
IEC 62061:2021	Safety of machinery - Functional safety of safety-related electrical, electronic, and electronic programmable control systems
IEC 61508-1:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: General requirements.
IEC 61508-2:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: Requirements for electrical/electronic/programmable electronic safety-related systems.
IEC 61508-3:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: Software requirements.
IEC 61784-3:2021	Industrial communication networks - Profiles - Part 3: Functional safety fieldbuses - General rules and profile definitions.
2006/42/EC	Machinery Directive
2014/30/EU	Electromagnetic Compatibility Directive
2014/35/EU	Low Voltage Directive

In addition, terms used in the present document may tangentially be used as they are derived from other standards such as:

Standard	Description
IEC 60034 series	Rotating electrical machines
IEC 61800 series	Adjustable speed electrical power drive systems
IEC 61158 series	Digital data communications for measurement and control – Fieldbus for use in industrial control systems

Finally, the term *zone of operation* may be used in conjunction with the description of specific hazards, and is defined as it is for a *hazard zone* or *danger zone* in the *Machinery Directive* (*2006/42/EC*) and *ISO 12100:2010*.

NOTE: The aforementioned standards may or may not apply to the specific products cited in the present documentation. For more information concerning the individual standards applicable to the products described herein, see the characteristics tables for those product references.

General Overview

Motion Expert Modules

The following table presents the Motion Expert modules, with the corresponding description and terminal type. For information on the configuration of these modules, refer to Functions, page 171.

Reference	Number of Channels	Expert Function	Discrete Inputs	Discrete Outputs	Signal Type	Terminal Type / Pitch
NTSEHE0221, page 22	2	Incremental SSI BiSS-C Preset sub-function Capture sub-function Reflex output and compare sub-function	4	8	RS-422 Encoder Input	Removable screw/spring terminal block / 3.81 mm
NTSEME0101, page 38	1	Incremental SSI BiSS-C Preset sub-function Capture sub-function	2	-	RS-422 Encoder Input	Removable screw/spring terminal block / 3.81 mm
NTSEME0102, page 58	1	SinCos EnDat Hiperface	2	-	RS-485 Encoder Input 1 Vpp	Removable screw/spring terminal block / 3.81 mm
NTSECS0121, page 76	1	Incremental SSI BiSS-C CAM sub-function Preset sub-function Capture sub-function	2	8	RS-422 Encoder Input	Removable screw/spring terminal block / 3.81 mm
NTSEME0110(1), page 98	1	Output encoder	2	-	RS-422 Encoder Output	Removable screw/spring terminal block / 3.81 mm
NTSEDT0800(1), page 111	8	Timestamp input	8	-	24 Vdc	Removable screw/spring terminal block / 3.81 mm
NTSEDT0810(1), page 121	8	Timestamp output	-	8	24 Vdc	Removable screw/spring terminal block / 3.81 mm
NTSEDO0810(1), page 132	8	Oversampling output	-	8	24 Vdc	Removable screw/spring terminal block / 3.81 mm
NTSEDM0822(1), page 143	8	Output pulse after input event Oversampling input Timestamp input Oversampling output Timestamp output	4	4	24 Vdc	Removable screw/spring terminal block / 3.81 mm
NTSEMP0220, page 157	2	PTO PWM Frequency Generator	8	2	RS-422 pulse output	Removable screw/spring terminal block / 3.81 mm
(1) These modules must be used with a network interface module using the Sercos III communication protocol.						

Performances Summary

The following table presents the available functions, with corresponding performances.

For more information on the input and output characteristics, refer to the characteristics of each module.

For information on the configuration of these functions, refer to Functions, page 171.

Function	Performances
Discrete I/O	
Input filter	The filter accuracy is: • ± 4 µs for 500 µs and 1 ms filters • ± 14 µs for a 4 ms filter • ± 42 µs for a 12 ms filter The filter accuracy is neglected for input filters less than or equal to 80 µs.
Fast inputs	When the input filter is less than or equal to 80 µs, the synchronous mode accuracy is: 1 µs + filter delay. When the input filter is greater than 80 µs, the synchronous mode accuracy is: 1 µs + filter delay + filter accuracy.
Fast outputs	Synchronous mode accuracy: 1 µs
NTSEMP0220 module regular output	Synchronous mode accuracy: 1 µs
Encoders	
Incremental encoder	When the input filter is less than or equal to 80 µs, the synchronous mode accuracy is: 1 µs + filter delay. When the input filter is greater than 80 µs, the synchronous mode accuracy is: 1 µs + filter delay + filter accuracy. Timestamp accuracy: 1 µs
SSI, Biss-C, SinCos, EnDat, and Hiperface encoders	Synchronous mode accuracy: 1 µs Timestamp accuracy: 1 µs
Incremental counting frequency	Up to 1 MHz
SSI transmission speed	500 kHz
BiSS-C transmission speed	500 kHz / 1 MHz
SinCos signal frequency	Up to 400 kHz
EnDat transmission speed	1 MHz
Hiperface transmission speed	9,600 bauds
Preset / Capture	
Preset input Capture input	Accuracy: 1 µs + filter delay + filter accuracy
Compare and Reflex / CAM	
Reflex output CAM output	Accuracy: 1 µs
Timestamp / Oversampling	
Timestamp input	When the input filter is less than or equal to 80 µs, the synchronous mode accuracy is: 1 µs. When the input filter is greater than 80 µs, the synchronous mode accuracy is: 1 µs + filter accuracy.

Function	Performances
Oversampling input	When the input filter is less than or equal to 80 μs, the synchronous mode accuracy is: 1 μs + filter delay. When the input filter is greater than 80 μs, the synchronous mode accuracy is: 1 μs + filter delay + filter accuracy.
Output pulse after input event	Accuracy: 1 μs + filter delay + filter accuracy Synchronous mode accuracy for Oversampling cycle: 1 μs
Timestamp output Oversampling output	Accuracy: 1 μs Synchronous mode accuracy for Oversampling cycle: 1 μs
Pulse Width Modulation (PWM)	
PWM frequency	From 0.1 Hz to 20 kHz with a step of 0.1 Hz Accuracy ± 0.1%
PWM duty	From 0 to 100 % with a step of 0.1 % Accuracy ± 0.1 percentage point
PWM enable input PWM synchronization input	Accuracy: 1 μs + filter delay + filter accuracy
Frequency Generator	
Frequency Generator frequency	From 0.1 Hz to 100 kHz with a step of 0.1 Hz Accuracy ± 0.5%
Frequency Generator duty	50 % Accuracy ± 0.5 percentage point
Frequency Generator enable input Frequency Generator synchronization input	Accuracy: 1 μs + filter delay + filter accuracy
Pulse Train Output (PTO)	
PTO frequency	From 1 Hz to 400 kHz with a step of 1 Hz Accuracy ± 1%
PTO duty	50 % Accuracy ± 1 percentage point
Output Encoder	
Output Encoder frequency	From 0.1 Hz to 400 kHz with a step of 0.1 Hz
Output Encoder duty	50 % Accuracy ± 1 percentage point
Output Encoder Z pulse	Accuracy: 1 μs
Output Encoder update	Synchronous mode accuracy: 1 μs

Motion Expert Modules

What’s in This Part

NTSEHE0221 Encoder Input Module, 2 RS422 Incremental 1 MHz, SSI 500 kHz, or BiSS-C, 4 Inputs, 8 Outputs

What's in This Chapter

NTSEHE0221 Presentation

Overview

This section provides a presentation of the NTSEHE0221 module.

The following functions are supported by the NTSEHE0221 module:

- Incremental Mode Principle Description, page 177.
- SSI Mode Principle Description, page 187.
- BiSS-C Mode Principle Description, page 192.

The following sub-functions are supported by the NTSEHE0221 module:

- Preset Sub-Function Configuration, page 322.
- Capture Sub-Function Configuration, page 325.
- Reflex Output and Compare Sub-Function, page 328.

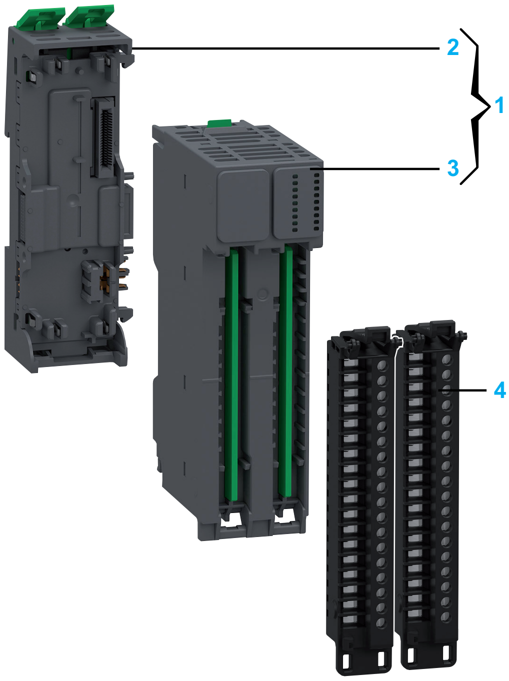
Main Characteristics

The following table describes the main characteristics of the NTSEHE0221 module.

Main Characteristics		Value
Product or component type		High performance encoder input module
Number of input/output channels		4 fast discrete inputs, page 29 8 fast discrete outputs, page 30
Number of encoder input channels		2
Supported encoder	Incremental encoder	A+/A-, B+/B-, Z+/Z-, page 30
	SSI encoder	Data+/Data-, Clk+/Clk-, page 30
	BiSS-C encoder	Data+/Data-, Clk+/Clk-, page 30
Number of encoder power channels		2
Encoder power type		5 Vdc, page 31
		24 Vdc, page 32
		Power return, page 32
Operating mode		Synchronous

Purchasing Information

The following figure presents the elements of the Modicon Edge I/O NTS NTSEHE0221 module:

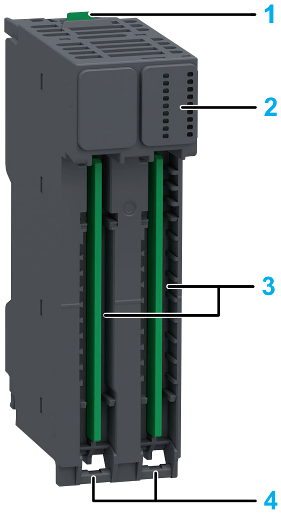


Number	Reference	Description
1	NTSEHE0221K	Base + Module (kit) **NOTE:** The module and its corresponding base can be purchased as a kit.
2	NTSXBA0200H	Spare Base, 2 Slots, for Input/Output Common/Expert/Safety Module, Hardened
3	NTSEHE0221	Encoder Input Module, 2 RS422 Incremental 1 MHz, SSI 500 kHz, or BiSS-C, 4 Inputs, 8 Outputs
4	NTSXTB18000H	Screw Terminal Block, 18 Points, 3.81 mm Pitch, Without Cover, use on Low Height Module, Hardened
	NTSXTB18001H	Screw Terminal Block, 18 Points, 3.81 mm Pitch, With Cover, use on Low Height Module, Hardened
	NTSXTB18200H	Spring Terminal Block, 18 Points, 3.81 mm Pitch, Without Cover, use on Low Height Module, Hardened
	NTSXTB18201H	Spring Terminal Block, 18 Points, 3.81 mm Pitch, With Cover, use on Low Height Module, Hardened **NOTE:** The terminal blocks are purchased separately.

NOTE: For more information on accessories and spare parts, refer to Appendix E Modicon Edge I/O NTS Spare Bases and Terminal Blocks (see Modicon Edge I/O - System Planning and Installation Guide).

Physical Description

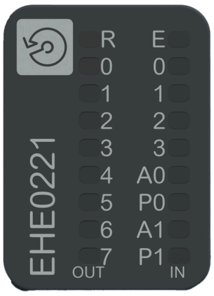
The following figure presents the elements of the module:



1: Release button for disengaging the module from the base
2: Status LEDs
3: Slot for the terminal block
4: Hinge for the terminal block installation

Status LEDs

The following figure presents the NTSEHE0221 status LEDs:

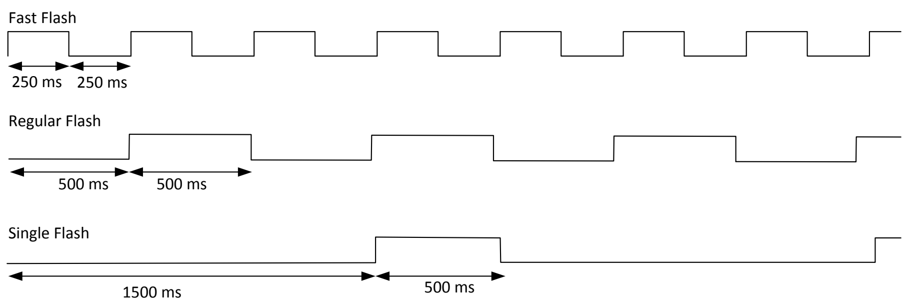


The following table describes the status of LEDs:

R (Green)	E (Red)	IN0...3 (Green)	OUT0...7 (Green)	A0...1 (Green)	P0...1 (Green)	Description
Initialization and non-operational states						
OFF	OFF	-	-	-	-	Indicates that the module is not energized.
OFF	ON	-	-	-	-	Indicates that an internal error is detected.
OFF	Regular Flash	-	-	-	-	Indicates that a system error is detected.
Single Flash	OFF	-	-	-	-	Indicates that the module is not configured.
Regular Flash	OFF	-	-	-	-	Indicates that the firmware is being updated.
Regular Flash	ON	-	-	-	-	Indicates that a module mismatch is detected.
Fast Flash	-	-	-	-	-	Indicates that the module is in commissioning mode.
Operational state						
ON	OFF	-	-	-	-	Indicates that the module is powered, configured and operational.
ON	OFF	ON	-	-	-	Indicates that the corresponding input channel is activated.
ON	OFF	OFF	-	-	-	Indicates that the corresponding input channel is deactivated.
ON	OFF	-	ON	-	-	Indicates that the corresponding output channel is activated.
ON	OFF	-	OFF	-	-	Indicates that the corresponding output channel is deactivated.
ON	OFF	-	-	OFF	-	Indicates that the corresponding counting channel is disabled.
ON	OFF	-	-	ON	-	Indicates that the corresponding counting channel is enabled, and the position did not change.
ON	OFF	-	-	Fast Flash	-	Indicates that the corresponding counting channel is enabled, and the position changed.
ON	OFF	-	-	-	OFF	Indicates one of the following: • The corresponding channel power supply monitor is disabled. • The corresponding channel power supply monitor is enabled, and the feedback is not OK.
ON	OFF	-	-	-	ON	Indicates that the corresponding channel power supply monitor is enabled, and the feedback is OK.
ON	Single Flash	-	-	-	-	Indicates one of the following: • The module is restarting. • An advisory is detected.

R (Green)	E (Red)	IN0...3 (Green)	OUT0...7 (Green)	A0...1 (Green)	P0...1 (Green)	Description
ON	Regular Flash	-	-	-	-	Indicates one of the following: • An error is detected at the channel level. • The module is in fallback state.
ON	ON	-	-	-	-	Indicates that an error is detected at the module level.
ON	Regular Flash	-	OFF	-	-	Indicates that an error is detected in the 24 Vdc field power.
ON	Regular Flash	-	Regular Flash	-	-	Indicates that a short circuit is detected on the output.

The following graphic depicts the system status of LEDs during module operation:



NTSEHE0221 Characteristics

Overview

This section provides a general description of the characteristics of the module.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

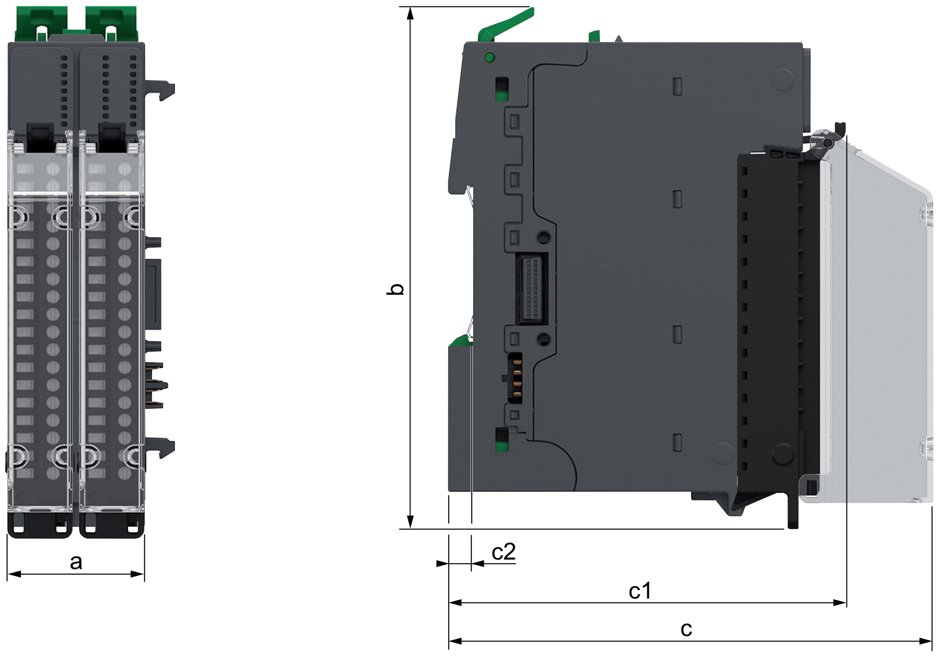
Do not exceed any of the rated values specified in the environmental and electrical characteristics tables.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

For more information on environmental characteristics, refer to Modicon Edge I/O - System Planning and Installation Guide.

Dimensions

The following figure presents the external dimensions for the assembled module:



a: 30 mm (1.18 in)
b: 116.6 mm (4.57 in)
c: 107.5 mm (4.21 in)
c1: 88.2 mm (3.46 in)
c2: 5.6 mm (0.2 in)

Weight

- NTSEHE0221: 79 g (2.78 oz)
- NTSEHE0221K: 125 g (4.4 oz)

General Characteristics

The following table describes the general characteristics of the NTSEHE0221 module:

Characteristics		**Value**
Rated supplied voltage		24 Vdc
Power supplied voltage range		20.4...28.8 Vdc
Bus current consumption		43.9 mA
Field current consumption		2,794.8 mA
Power dissipation		2.8 W
Field power supply	Encoder channel	Encoder supply provided from power distribution module
	Discrete outputs	Internal
Isolation	Between input channels	No isolation
	Between internal logic and input channels	1,000 Vac
	Between internal logic and encoder signals	
	Between internal logic and encoder power	
	Between internal logic and output channels	
	Between internal logic and ground	
	Between input channels and encoder signals	850 Vac
	Between input channels and encoder power	
	Between input and outputs channels	
	Between input channels and ground	1,500 Vac
	Between encoder signals and ground	
	Between encoder power and ground	
Hot swap supported		Yes
Operating ambient temperature derating		No derating

Fast Discrete Inputs Characteristics

The following table describes the fast discrete inputs characteristics:

Characteristics		Value
Rated input voltage		24 Vdc
Input voltage range		0...30 Vdc
Rated input current		2.25 mA
Input logic		Sink
Input compatibility		Type 3 according to IEC 61131-2
Input wiring mode		2-wire
Input voltage	Logic state 1	> 11 Vdc
	Logic state 0	< 11 Vdc for I < 1.5 mA < 5 Vdc for I > 1.5 mA
Input current	Logic state 1	> 2 mA
	Logic state 0	< 15 mA
Response time on input	Logic state 1 to logic state 0	500 ns + filter delay
	Logic state 0 to logic state 1	500 ns + filter delay
Input filter time	Software	Configurable: 200 ns, 500 ns 1 µs, 2 µs, 5 µs, 10 µs, 50 µs, 80 µs, 500 µs, 1 ms, 4 ms, or 12 ms
Protection	Overvoltage	Up to ±60 Vdc
	Reverse polarity	Yes
Cable	Type	Shielded
	Maximum length	20 m (65.6 ft)

Fast Discrete Output Characteristics

The following table describes the fast discrete output characteristics:

Characteristics		Value
Rated output voltage		24 Vdc
Output type		Push-pull
Maximum output current per output		250 mA when the output is in steady state 50 mA when the output is oversampled
Output logic		Source
Output wiring mode		2-wire
Output supply		Internal
Output voltage	At logic state 1	24 Vdc field supply - voltage drop Maximum voltage drop: 1.81 Vdc
	At logic state 0	0 Vdc field supply + voltage drop Maximum voltage drop: 1 Vdc
Load type	Resistive	Lamp: 1 W maximum
	Inductive	1 H maximum
Response time on output	Logic state 1 to logic state 0	750 ns
	Logic state 0 to logic state 1	750 ns
Protection	Overload	1.6 A...1.94 A with a typical value of 1.84 A Protection by group of 4 outputs In compliance with the IEC61131-2 standard, the overload testing pattern is 1.5 x IE (IE = 250 mA per output) applied during 1 s ON, then 9 s OFF.
	Short circuit	4 A typical Protection by group of 4 outputs
Cable	Type	Shielded
	Maximum length	20 m (65.6 ft)

Discrete Encoder Inputs Characteristics

The following table describes the discrete encoder inputs characteristics:

Characteristics		Value
Encoder signals		Differential signal
Line termination		AC termination: 150 Ω - 220 pF
Signal frequency		Maximum 1 MHz
Driver	Protection	Short circuit protection by thermal shutdown with autoretry
Cable	Type	0.2 mm^2 (24 AWG) twisted pair - shielded
	Maximum length	20 m (65.6 ft)

Encoder Power Supply

5 Vdc Encoder Power Supply Characteristics

The following table describes the 5 Vdc encoder power supply characteristics:

Characteristics		**Value**
Output voltage	Voltage at logic state 1	5.13 Vdc ± 2.6 %
	Voltage at logic state 0	HighZ with flyback diode
Power supply		Internal
Maximum ripple		2 % of nominal value
Maximum output current		• For a one-slot module (one encoder connected): 200 mA • For a two-slot module (up to two encoders connected): 400 mA
Load type		Encoder power rails are dedicated to supply encoders
Output Slew Rate		500 µs
Protection	Overcurrent	• For a one-slot module (one encoder): Minimum 230 mA - Typically 254 mA - Maximum 282 mA • For a two-slot module (up to two encoders): Minimum 450 mA - Typically 510 mA - Maximum 560 mA In the event of an overload, the encoder power rail switches to power limitation mode. If the overload persists, the encoder power rail goes into shutdown for one second, then returns to normal operation.
	Short circuit	Yes The encoder power rail goes into shutdown for one second, then returns to normal operation.
	Reverse polarity	Yes The encoder power rail goes into shutdown until the reverse condition is removed.
Cable	Type	Shielded, including encoder power wires and encoder signal wires.
	Maximum length	20 m (65.6 ft)(1)

(1) Maximum cable length [m] = maximum voltage drop for the cable [V] x wire cross section (mm^2) / (Encoder current [A] x 0.0171 [Ω mm^2/m]), where: maximum voltage drop for the cable = (minimum module output voltage - minimum encoder input voltage) / 2.

24 Vdc Encoder Power Supply Characteristics

The following table describes the 24 Vdc encoder power supply characteristics:

Characteristics		Value
Output voltage	Voltage at logic state 1	Output voltage = 24 Vdc Field Supply - Voltage drop Maximum voltage drop: 2.1 Vdc
	Voltage at logic state 0	HighZ with flyback diode
Power supply		Internal
Maximum ripple		5 % of nominal value
Maximum output current		• For one-slot module (one encoder connected on 24 Vdc): 150 mA • For two-slot module (up to two encoders connected on 24 Vdc): 300 mA
Load type		Encoder power rails are dedicated to supply encoders
Output Slew Rate		500 µs
Protection	Overcurrent	• For one-slot module (one encoder): Minimum 200 mA - Typical 225 mA - Maximum 251 mA • For two-slot module (up to two encoders): Minimum 420 mA - Typical 469 mA - Maximum 521 mA In the event of an overload, the encoder power rail switches to power limitation mode. If the overload persists, the encoder power rail goes into shutdown for one second, then returns to normal operation.
	Short circuit	Yes The encoder power rail goes into shutdown for one second, then returns to normal operation.
	Reverse polarity	Yes The encoder power rail goes into shutdown until the reverse condition is removed.
Cable	Type	Shielded, including encoder power wires and encoder signal wires.
	Maximum length	20 m (65.6 ft)(1)
(1) Maximum cable length [m] = maximum voltage drop for the cable [V] x wire cross section (mm²) / (Encoder current [A] x 0.0171 [Ω mm²/m]), where: maximum voltage drop for the cable = (minimum module output voltage - minimum encoder input voltage) / 2.		

Power Return

The power return allows to detect if a voltage higher than 4.28 Vdc is present on the encoder power return wire.

Characteristics	Value
Voltage range	0...30 Vdc
Voltage detection	4.28 Vdc ± 2 %
Input impedance	499 kΩ
Input current	100 µA

NTSEHE0221 Wiring

Overview

This section provides the wiring diagrams for the NTSEHE0221 module.

Wiring Rules

For more information on the wiring, refer to Modicon Edge I/O - System Planning and Installation Guide.

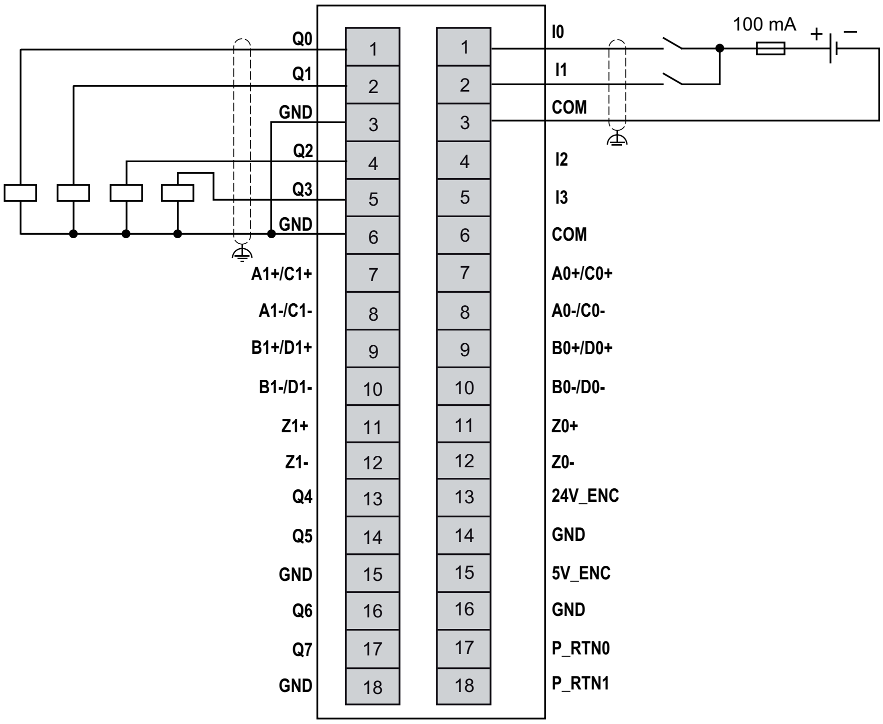
Pin Assignment

This table describes the pin assignment of the terminal blocks:

Terminal Block 1			Terminal Block 2		
Pin	**Signal**	**Description**	**Pin**	**Signal**	**Description**
1	Q0	Fast output channel 0	1	I0	Fast input channel 0
2	Q1	Fast output channel 1	2	I1	Fast input channel 1
3	GND	Ground for fast output	3	COM	Common for fast input
4	Q2	Fast output channel 2	4	I2	Fast input channel 2
5	Q3	Fast output channel 3	5	I3	Fast input channel 3
6	GND	Ground for fast output	6	COM	Common for fast input
7	A1+/C1+	Incremental A+ or SSI clock+ of the encoder 1	7	A0+/C0+	Incremental A+ or SSI clock+ of the encoder 0
8	A1-/C1-	Incremental A- or SSI clock- of the encoder 1	8	A0-/C0-	Incremental A- or SSI clock- of the encoder 0
9	B1+/D1+	Incremental B+ or SSI data+ of the encoder 1	9	B0+/D0+	Incremental B+ or SSI data+ of the encoder 0
10	B1-/D1-	Incremental B- or SSI data- of the encoder 1	10	B0-/D0-	Incremental B- or SSI data- of the encoder 0
11	Z1+	Incremental Z+ corresponding to the positive side of the zero pulse signal of the encoder 1	11	Z0+	Incremental Z+ corresponding to the positive side of the zero pulse signal of the encoder 0
12	Z1-	Incremental Z- corresponding to the negative side of the zero pulse signal of the encoder 1	12	Z0-	Incremental Z- corresponding to the negative side of the zero pulse signal of the encoder 0
13	Q4	Fast output channel 4	13	24V_ENC	24 Vdc supply for encoder
14	Q5	Fast output channel 5	14	GND	Ground for 24 Vdc encoder supply
15	GND	Ground for fast output	15	5V_ENC	5 Vdc supply for encoder
16	Q6	Fast output channel 6	16	GND	Ground for 5 Vdc encoder supply
17	Q7	Fast output channel 7	17	P_RTN0	Power return of the encoder 0
18	GND	Ground for fast output	18	P_RTN1	Power return of the encoder 1

Fast Input/Output Wiring Diagram

The following figure illustrates the wiring diagram of the fast discrete inputs and outputs:

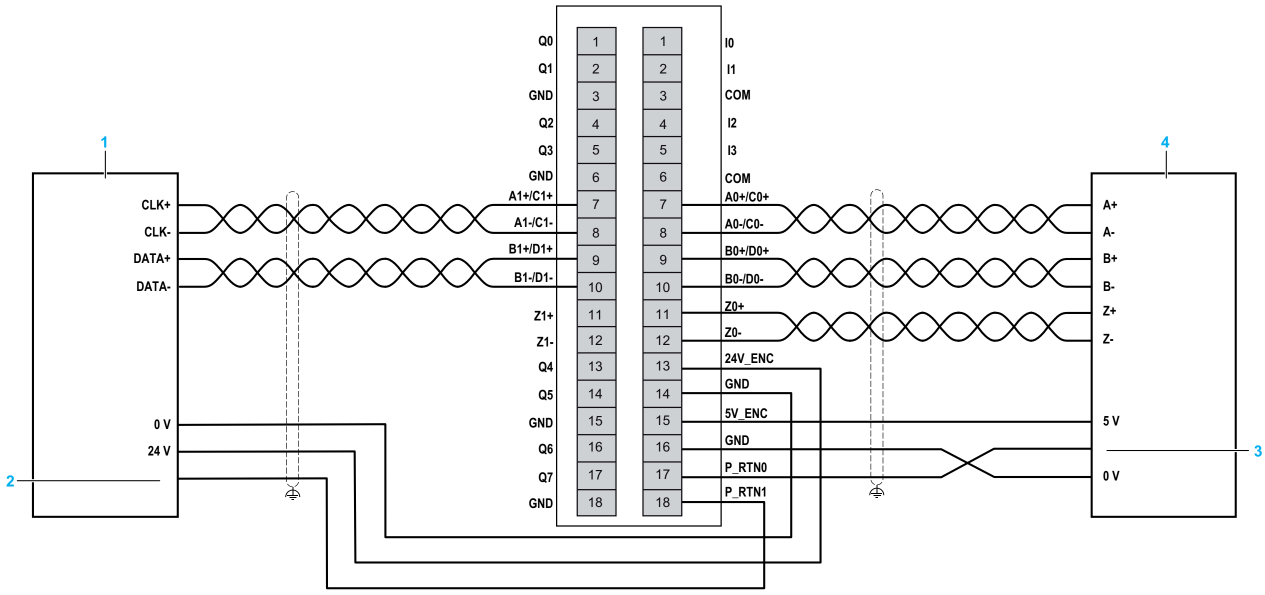


NOTE:

- An external fuse of type T, 100 mA, 24 Vdc is mandatory for inputs and must be chosen in compliance with the IEC60269 standard.
- The fast discrete outputs are internally protected, no fuse is needed.

Encoder Wiring Diagram

The following figure illustrates the wiring diagram of an encoder (RS-422 / 5 Vdc / 24 Vdc):



1: 24 V SSI Encoder
2: Optional encoder power return
3: Optional encoder power return
4: 5 V Incremental Encoder

NOTE:

- No need of fuse on power encoder lines, these interfaces are internally protected.
- Encoder wiring is flexible, various combinations are possible (one or two encoder(s), two SSI, two incrementals or mix of both).

NTSEHE0221 Parameters

Overview

The NTSEHE0221 module is equipped with:

- 4 fast discrete inputs.
- 8 fast discrete outputs.

For information on the configuration of this module, refer to Inputs and Outputs Configuration, page 172.

Alternatively, you can add up to two expert functions to your module using the **Add a function** button. You can configure only one channel at a time. The following expert functions are available:

- Incremental Encoder Interface, page 183.
- SSI Encoder Interface, page 189.
- BiSS-C Encoder Interface, page 194.

After you have defined your function, you can add the following sub-functions:

- Preset Sub-Function, page 321.
- Capture Sub-Function, page 323.
- Reflex Output and Compare Function, page 328.

Parameters Description

Configurable Parameters

The following table presents the configurable parameters for the NTSEHE0221 module:

Displayed Name ***Parameter Name***	Value	Data Type	Description
Device Mode *DeviceMode*	0: **Normal*** 1: **Optional** 2: **Virtual reserved** 3: **Virtual absent**	ENUM	Allows you to select the device mode: • **Normal**: The module is part of the software configuration and is physically installed in the cluster. • **Optional**: The module is part of the software configuration. A dummy module or the configured module must be physically installed in the cluster. Whether either module is present does not cause a configuration error to be detected. • **Virtual reserved**: The module is part of the software configuration. A dummy module must be physically installed in the cluster. If the virtual reserved module is physically installed in the cluster, a configuration error is detected. • **Virtual absent**: The module is part of the software configuration. A base must not be physically installed in the cluster. If a module is physically installed in the cluster, a configuration error is detected.
Load Consumption *LoadConsumption*	0...2,300 **2300***	UINT16	Sets the estimated load consumption value (in mA) of your module. This value is used for the estimation of your field power segment consumption. The default value is the maximum load current consumption. For more information about the current consumption for your Modicon Edge I/O module, refer to the Modicon Edge I/O - System Planning and Installation Guide.
Rearming Output Mode *RearmOutputMode*	0: **Latched Off** 1: **Auto Recovery***	ENUM	Allows you to select the rearming mode for an output channel which is latched off due to a detected error. Two modes are available: • **Latched Off**: The channel is rearmed if the cause of the error is no longer present, and a rising edge on **RearmOutputCmd** is applied. • **Auto Recovery**: The output channel is rearmed automatically if the cause of the error is no longer present for a predefined delay.
* Parameter default value			

Implicit Data

The following table presents the input implicit data for the NTSEHE0221 module:

Parameter Name	**Value**	**Data Type** **Size in Bytes** **R/W**	**Description**
GCS	0...255	BYTE 1 R/-	Group Cyclic Status Bit 0: Data quality Bit 1: General module status Bit 2: I/O status Bit 3: Receive status Bit 4: Output status Bit 5: Advisory status Bit 6: N/A Bit 7: Data freshness **NOTE:** For more information, refer to Modicon Edge I/O - Diagnostic Data - User Guide.
IValue0_7	0...255	BYTE 1 R/-	Value of the input channels (Bit field). Bit 0...7 = Value of channel 0...7 **NOTE:** Unused bits are reserved.
ChannelHealthOut0_7[(1)]	0...255	BYTE 1 R/-	Bit 0...7 = Status of channel 0...7 • Bit = 0: Channel is invalid • Bit = 1: Channel is valid **NOTE:** Unused bits are set to 1.

[(1)] This parameter is not part of the implicit data if the optimized I/O profile is selected. For more information on the **IO Profile** parameter, refer to the Modicon Edge I/O NTS - Network Interface Modules - User Guide.

The following table presents the output implicit data for the NTSEHE0221 module:

Parameter Name	**Value**	**Data Type** **Size in Bytes** **R/W**	**Description**
LatchAck0_7	0...255	BYTE 1 R/W	At rising edge, resets the latch value of the input on the channel 0...7. Bit 0...7 = Value of channel 0...7 **NOTE:** Unused bits are reserved.
QValue0_7	0...255	BYTE 1 R/W	Value of the output channels (Bit field). Bit 0...7 = Value of channel 0...7 **NOTE:** Unused bits are reserved.
RearmOutputCmd	TRUE FALSE*	BOOL R/W	If the **Rearming Output Mode** parameter is set to **Latched Off** and the cause of the detected error is no longer present, then on a rising edge, it rearms the output channels.

NTSEME0101 Encoder Input Module, 1 RS422 Incremental 1 MHz, SSI 500 kHz, or BiSS-C, 2 Inputs

What's in This Chapter

NTSEME0101 Presentation

Overview

This section provides a presentation of the NTSEME0101 module.

The following functions are supported by the NTSEME0101 module:

- Incremental Mode Principle Description, page 177.
- SSI Mode Principle Description, page 187.
- BiSS-C Mode Principle Description, page 192.

The following sub-functions are supported by the NTSEME0101 module:

- Preset Sub-Function, page 321.
- Capture Sub-Function, page 323.

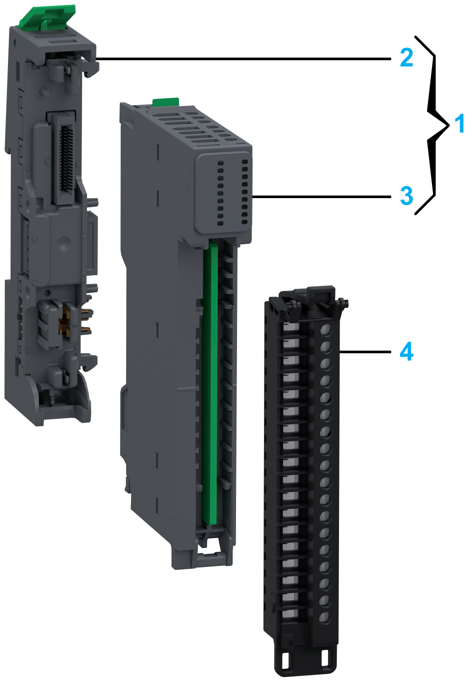
Main Characteristics

The following table describes the main characteristics of the NTSEME0101 module.

Main Characteristics		Value
Product or component type		Encoder input module
Number of Input channels		2 fast discrete inputs, page 45
Number of encoder input channels		1
Supported encoder	Incremental encoder	A+/A-, B+/B-, Z+/Z-, page 45
	SSI encoder	Data+/Data-, Clk+/Clk-, page 45
	BiSS-C encoder	Data+/Data-, Clk+/Clk-, page 45
Number of encoder power channels		2
Encoder power type		5 Vdc, page 46
		24 Vdc, page 47
		Power return, page 47
Operating mode		Synchronous

Purchasing Information

The following figure presents the elements of the Modicon Edge I/O NTS NTSEME0101 module:

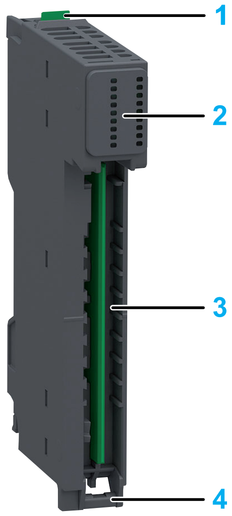


Number	Reference	Description
1	NTSEME0101K	Base + Module (kit) **NOTE:** The module and its corresponding base can be purchased as a kit.
2	NTSXBA0100H	Spare Base, 1 Slot, for Input/Output Common or Expert Module, Hardened
3	NTSEME0101	Encoder Input Module, 1 RS422 Incremental 1 MHz, SSI 500 kHz, or BiSS-C, 2 Inputs
4	NTSXTB18000H	Screw Terminal Block, 18 Points, 3.81 mm Pitch, Without Cover, use on Low Height Module, Hardened
	NTSXTB18001H	Screw Terminal Block, 18 Points, 3.81 mm Pitch, With Cover, use on Low Height Module, Hardened
	NTSXTB18200H	Spring Terminal Block, 18 Points, 3.81 mm Pitch, Without Cover, use on Low Height Module, Hardened
	NTSXTB18201H	Spring Terminal Block, 18 Points, 3.81 mm Pitch, With Cover, use on Low Height Module, Hardened **NOTE:** The terminal blocks are purchased separately.

NOTE: For more information on accessories and spare parts, refer to Modicon Edge I/O - System Planning and Installation Guide.

Physical Description

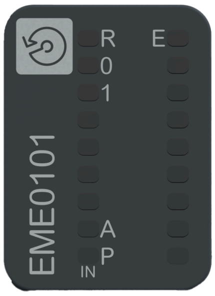
The following figure presents the elements of the module:



1: Release button for disengaging the module from the base
2: Status LEDs
3: Slot for the terminal block
4: Hinge for the terminal block installation

Status LEDs

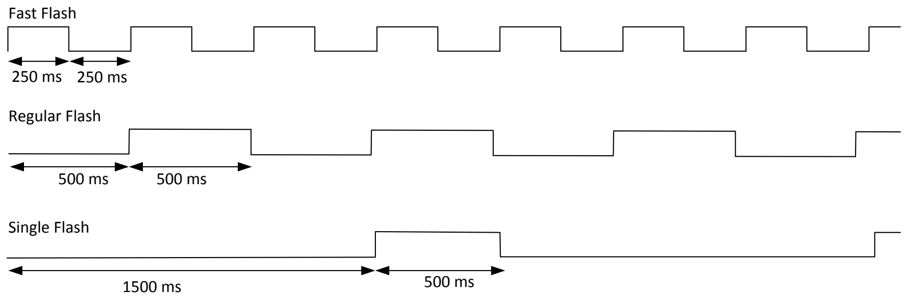
The following figure presents the NTSEME0101 status LEDs:



The following table describes the status of LEDs:

R (Green)	E (Red)	IN0...1 (Green)	A (Green)	P (Green)	Description
Initialization and non-operational states					
OFF	OFF	-	-	-	Indicates that the module is not energized.
OFF	ON	-	-	-	Indicates that an internal error is detected.
OFF	Regular Flash	-	-	-	Indicates that a system error is detected.
Single Flash	OFF	-	-	-	Indicates that the module is not configured.
Regular Flash	OFF	-	-	-	Indicates that the firmware is being updated.
Regular Flash	ON	-	-	-	Indicates that a module mismatch is detected.
Fast Flash	-	-	-	-	Indicates that the module is in commissioning mode.
Operational state					
ON	OFF	-	-	-	Indicates that the module is powered, configured and operational.
ON	OFF	ON	-	-	Indicates that the corresponding input channel is activated.
ON	OFF	OFF	-	-	Indicates that the corresponding input channel is deactivated.
ON	OFF	-	OFF	-	Indicates that the corresponding counting channel is disabled.
ON	OFF	-	ON	-	Indicates that the corresponding counting channel is enabled, and the position did not change.
ON	OFF	-	Fast Flash	-	Indicates that the corresponding counting channel is enabled, and the position changed.
ON	OFF	-	-	OFF	Indicates one of the following: • The corresponding channel power supply monitor is disabled. • The corresponding channel power supply monitor is enabled, and the feedback is not OK.
ON	OFF	-	-	ON	Indicates that the corresponding channel power supply monitor is enabled, and the feedback is OK.
ON	Single Flash	-	-	-	Indicates one of the following: • The module is restarting. • An advisory is detected.
ON	Regular Flash	-	-	-	Indicates one of the following: • An error is detected at the channel level. • The module is in fallback state.
ON	ON	-	-	-	Indicates that an error is detected at the module level.

The following graphic depicts the system status of LEDs during module operation:



NTSEME0101 Characteristics

Overview

This section provides a general description of the characteristics of the module.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

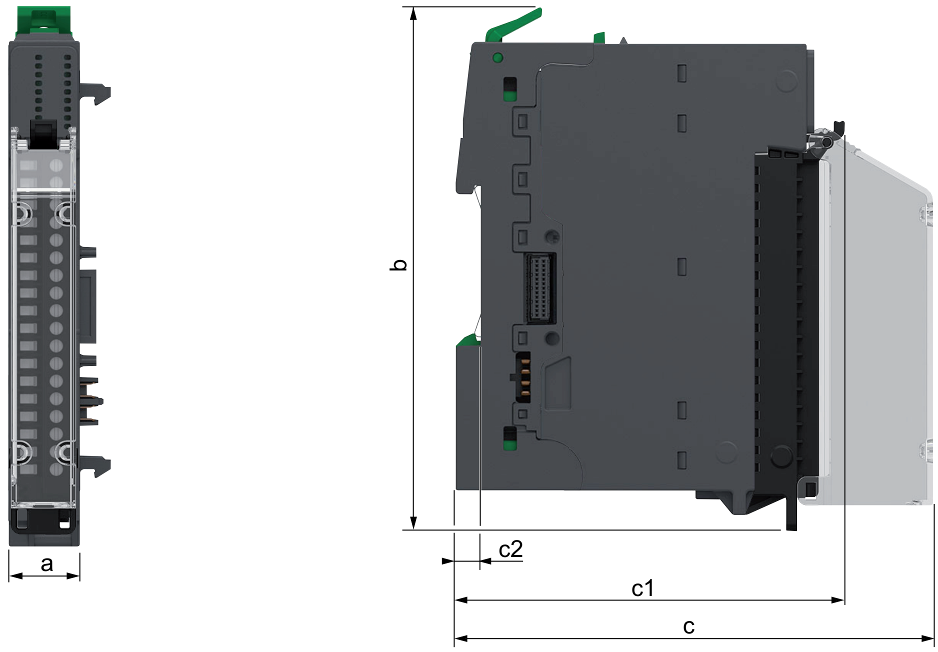
Do not exceed any of the rated values specified in the environmental and electrical characteristics tables.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

For more information on environmental characteristics, refer to Modicon Edge I/O - System Planning and Installation Guide.

Dimensions

The following figure presents the external dimensions for the assembled module:



a: 15 mm (0.59 in)
b: 116.6 mm (4.57 in)
c: 107.5 mm (4.21 in)
c1: 88.2 mm (3.46 in)
c2: 5.6 mm (0.2 in)

Weight

- NTSEME0101: 48 g (1.69 oz)
- NTSEME0101K: 73 g (2.57 oz)

General Characteristics

The following table describes the general characteristics of the NTSEME0101 module:

<table>
<tr><th colspan="2">Characteristics</th><th>Value</th></tr>
<tr><td colspan="2">Rated supplied voltage</td><td>24 Vdc</td></tr>
<tr><td colspan="2">Power supplied voltage range</td><td>20.4...28.8 Vdc</td></tr>
<tr><td colspan="2">Bus current consumption</td><td>29.3 mA</td></tr>
<tr><td colspan="2">Field current consumption</td><td>207.4 mA</td></tr>
<tr><td colspan="2">Power dissipation</td><td>1.5 W</td></tr>
<tr><td rowspan="2">Field power supply</td><td>Encoder channel</td><td>Encoder supply provided from power distribution module</td></tr>
<tr><td>Discrete inputs</td><td>No supply provided</td></tr>
<tr><td rowspan="9">Isolation</td><td>Between input channels</td><td>N/A</td></tr>
<tr><td>Between internal logic and input channels</td><td rowspan="4">1,000 Vac</td></tr>
<tr><td>Between internal logic and encoder signals</td></tr>
<tr><td>Between internal logic and encoder power</td></tr>
<tr><td>Between internal logic and ground</td></tr>
<tr><td>Between input channels and encoder signals</td><td rowspan="2">850 Vac</td></tr>
<tr><td>Between input channels and encoder power</td></tr>
<tr><td>Between input channels and ground</td><td rowspan="2">1,500 Vac</td></tr>
<tr><td>Between encoder power and ground</td></tr>
<tr><td colspan="2">Hot swap supported</td><td>Yes</td></tr>
<tr><td colspan="2">Operating ambient temperature derating</td><td>No derating</td></tr>
</table>

Fast Discrete Inputs Characteristics

The following table describes the fast discrete inputs characteristics:

Characteristics		Value
Rated input voltage		24 Vdc
Input voltage range		0...30 Vdc
Rated input current		2.25 mA
Input logic		Sink
Input compatibility		Type 3 according to IEC 61131-2
Input wiring mode		2-wire
Input voltage	Logic state 1	> 11 Vdc
	Logic state 0	< 11 Vdc for I < 1.5 mA < 5 Vdc for I > 1.5 mA
Input current	Logic state 1	> 2 mA
	Logic state 0	< 15 mA
Response time on input	Logic state 1 to logic state 0	500 ns + filter delay
	Logic state 0 to logic state 1	500 ns + filter delay
Input filter time	Software	Configurable: 200 ns, 500 ns 1 μs, 2 μs, 5 μs, 10 μs, 50 μs, 80 μs, 500 μs, 1 ms, 4 ms, or 12 ms
Protection	Overvoltage	Up to ±60 Vdc
	Reverse polarity	Yes
Cable	Type	Shielded
	Maximum length	20 m (65.6 ft)

Discrete Encoder Inputs Characteristics

The following table describes the discrete encoder inputs characteristics:

Characteristics		Value
Encoder signals		Differential signal
Line termination		AC termination: 150 Ω - 220 pF
Signal frequency		Maximum 1 MHz
Driver	Protection	Short circuit protection by thermal shutdown with autoretry
Cable	Type	0.2 mm^2 (24 AWG) twisted pair - shielded
	Maximum length	20 m (65.6 ft)

Encoder Power Supply

5 Vdc Encoder Power Supply Characteristics

The following table describes the 5 Vdc encoder power supply characteristics:

Characteristics		Value
Output voltage	Voltage at logic state 1	5.13 Vdc ± 2.6 %
	Voltage at logic state 0	HighZ with flyback diode
Power supply		Internal
Maximum ripple		2 % of nominal value
Maximum output current		• For a one-slot module (one encoder connected): 200 mA • For a two-slot module (up to two encoders connected): 400 mA
Load type		Encoder power rails are dedicated to supply encoders
Output Slew Rate		500 µs
Protection	Overcurrent	• For a one-slot module (one encoder): Minimum 230 mA - Typically 254 mA - Maximum 282 mA • For a two-slot module (up to two encoders): Minimum 450 mA - Typically 510 mA - Maximum 560 mA In the event of an overload, the encoder power rail switches to power limitation mode. If the overload persists, the encoder power rail goes into shutdown for one second, then returns to normal operation.
	Short circuit	Yes The encoder power rail goes into shutdown for one second, then returns to normal operation.
	Reverse polarity	Yes The encoder power rail goes into shutdown until the reverse condition is removed.
Cable	Type	Shielded, including encoder power wires and encoder signal wires.
	Maximum length	20 m (65.6 ft)(1)

(1) Maximum cable length [m] = maximum voltage drop for the cable [V] x wire cross section (mm^2) / (Encoder current [A] x 0.0171 [Ω mm^2/m]), where: maximum voltage drop for the cable = (minimum module output voltage - minimum encoder input voltage) / 2.

24 Vdc Encoder Power Supply Characteristics

The following table describes the 24 Vdc encoder power supply characteristics:

Characteristics		Value
Output voltage	Voltage at logic state 1	Output voltage = 24 Vdc Field Supply - Voltage drop Maximum voltage drop: 2.1 Vdc
	Voltage at logic state 0	HighZ with flyback diode
Power supply		Internal
Maximum ripple		5 % of nominal value
Maximum output current		• For one-slot module (one encoder connected on 24 Vdc): 150 mA • For two-slot module (up to two encoders connected on 24 Vdc): 300 mA
Load type		Encoder power rails are dedicated to supply encoders
Output Slew Rate		500 µs
Protection	Overcurrent	• For one-slot module (one encoder): Minimum 200 mA - Typical 225 mA - Maximum 251 mA • For two-slot module (up to two encoders): Minimum 420 mA - Typical 469 mA - Maximum 521 mA In the event of an overload, the encoder power rail switches to power limitation mode. If the overload persists, the encoder power rail goes into shutdown for one second, then returns to normal operation.
	Short circuit	Yes The encoder power rail goes into shutdown for one second, then returns to normal operation.
	Reverse polarity	Yes The encoder power rail goes into shutdown until the reverse condition is removed.
Cable	Type	Shielded, including encoder power wires and encoder signal wires.
	Maximum length	20 m (65.6 ft)(1)
(1) Maximum cable length [m] = maximum voltage drop for the cable [V] x wire cross section (mm^2) / (Encoder current [A] x 0.0171 [Ω mm^2/m]), where: maximum voltage drop for the cable = (minimum module output voltage - minimum encoder input voltage) / 2.		

Power Return

The power return allows to detect if a voltage higher than 4.28 Vdc is present on the encoder power return wire.

Characteristics	Value
Voltage range	0...30 Vdc
Voltage detection	4.28 Vdc ± 2 %
Input impedance	499 kΩ
Input current	100 µA

NTSEME0101 Wiring

Overview

This section provides the wiring diagrams for the NTSEME0101 module.

Wiring Rules

For more information on the wiring, refer to Modicon Edge I/O - System Planning and Installation Guide.

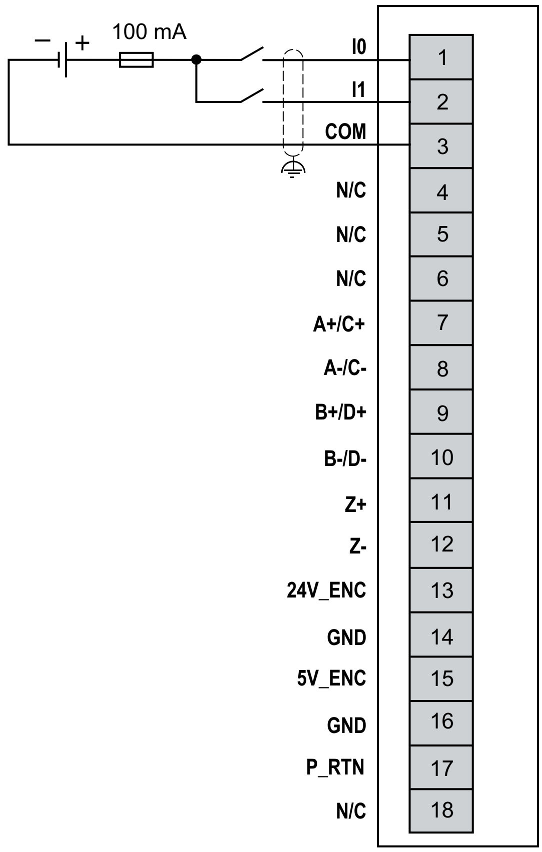
Pin Assignment

This table describes the pin assignment of the terminal block:

Pin	Signal	Description
1	I0	Fast input channel 0
2	I1	Fast input channel 1
3	COM	Common for fast input
4	N/C	No Connection
5	N/C	No Connection
6	N/C	No Connection
7	A+/C+	Incremental A+ or SSI clock+
8	A-/C-	Incremental A- or SSI clock-
9	B+/D+	Incremental B+ or SSI data+
10	B-/D-	Incremental B- or SSI data-
11	Z+	Incremental encoder - Positive side of the zero pulse signal
12	Z-	Incremental encoder - Negative side of the zero pulse signal
13	24V_ENC	24 Vdc supply for encoder
14	GND	Ground for 24 Vdc encoder supply
15	5V_ENC	5 Vdc supply for encoder
16	GND	Ground for 5 Vdc encoder supply
17	P_RTN	Power return
18	N/C	No Connection

Fast Input Wiring Diagram

The following figure illustrates the wiring diagram of the fast discrete inputs:



N/C: No Connection

NOTE: An external fuse of type T, 100 mA, 24 Vdc is mandatory and must be chosen in compliance with the IEC60269 standard.

⚠ WARNING

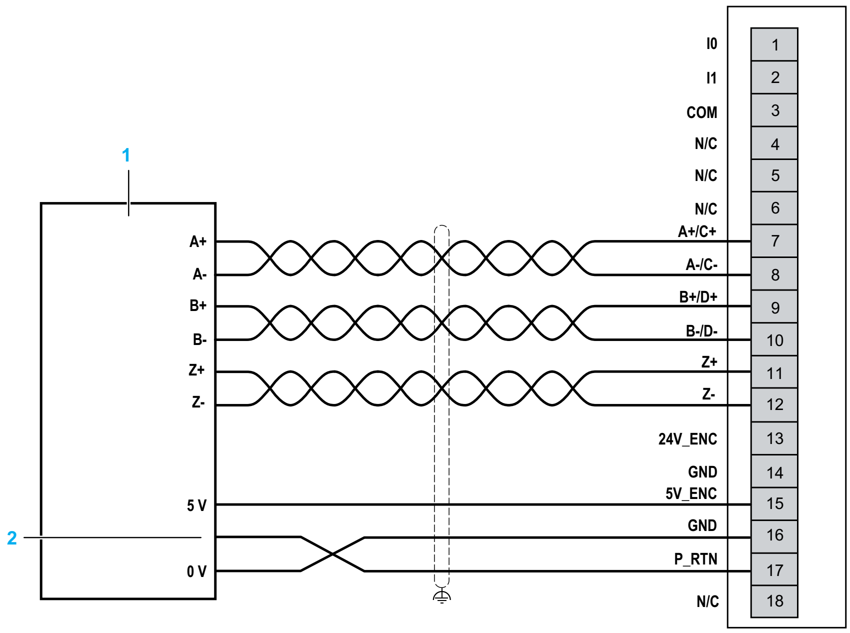
UNINTENDED EQUIPMENT OPERATION

Do not connect wires to unused terminals and/or terminals indicated as “No Connection (N/C)”.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Incremental Encoder Wiring Diagrams

The following figure illustrates the wiring diagram of an incremental encoder (RS-422/5 Vdc):



1: 5 V Incremental Encoder
2: Optional encoder power return
N/C: No Connection

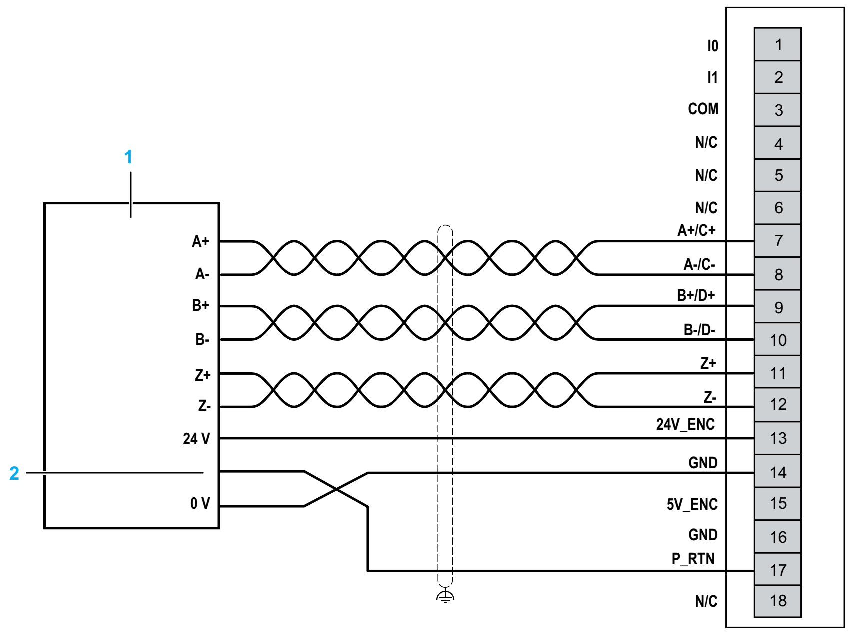
⚠WARNING

UNINTENDED EQUIPMENT OPERATION

Do not connect wires to unused terminals and/or terminals indicated as “No Connection (N/C)”.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The following figure describes the wiring diagram of an incremental encoder (RS-422/24 Vdc):



1: 24 V Incremental Encoder
2: Optional encoder power return
N/C: No Connection

⚠WARNING

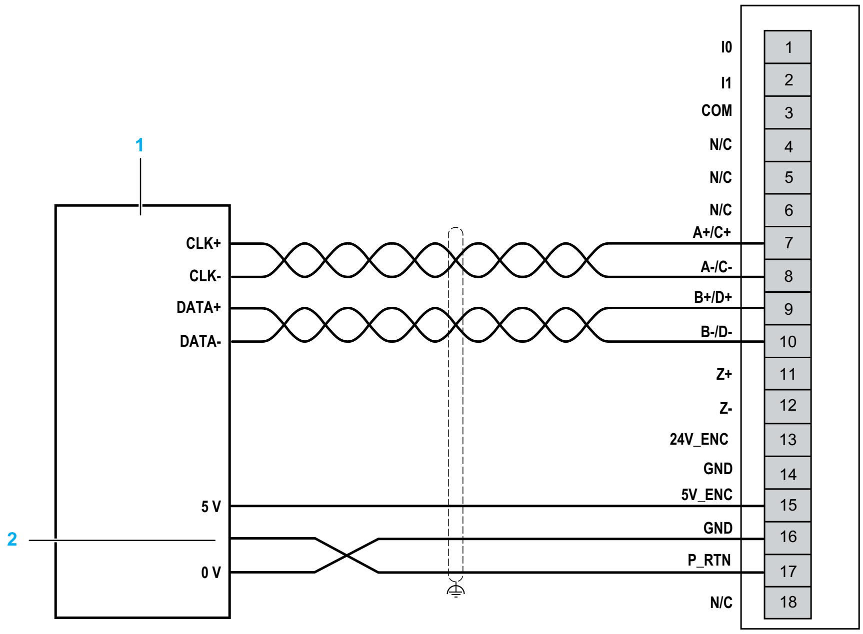
UNINTENDED EQUIPMENT OPERATION

Do not connect wires to unused terminals and/or terminals indicated as “No Connection (N/C)”.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

SSI Encoder Wiring Diagrams

The following figure illustrates the wiring diagram of an absolute (SSI) encoder (5 Vdc):



1: 5 V SSI Encoder
2: Optional encoder power return
N/C: No Connection

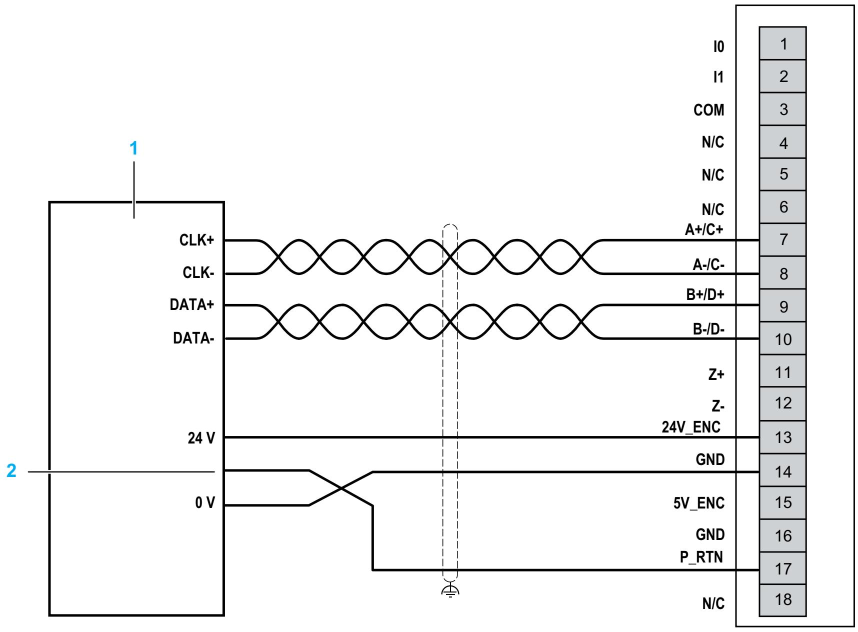
⚠WARNING

UNINTENDED EQUIPMENT OPERATION

Do not connect wires to unused terminals and/or terminals indicated as “No Connection (N/C)”.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The following figure illustrates the wiring diagram of an absolute (SSI) encoder (24 Vdc):



1: 24 V SSI Encoder
2: Optional encoder power return
N/C: No Connection

⚠WARNING

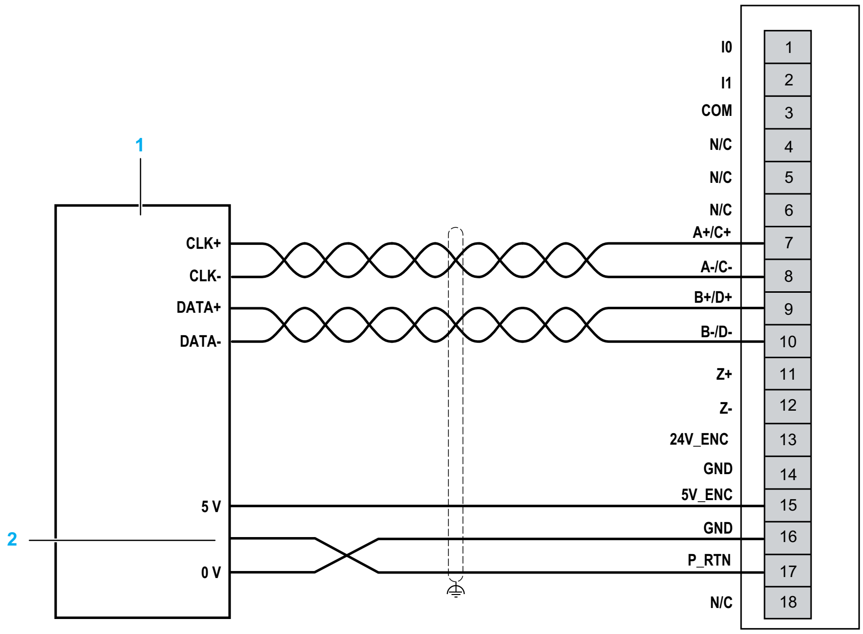
UNINTENDED EQUIPMENT OPERATION

Do not connect wires to unused terminals and/or terminals indicated as “No Connection (N/C)”.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

BiSS-C Encoder Wiring Diagrams

The following figure illustrates the wiring diagram of an absolute (BiSS-C) encoder (5 Vdc):



1: 5 V BiSS-C Encoder
2: Optional encoder power return
N/C: No Connection

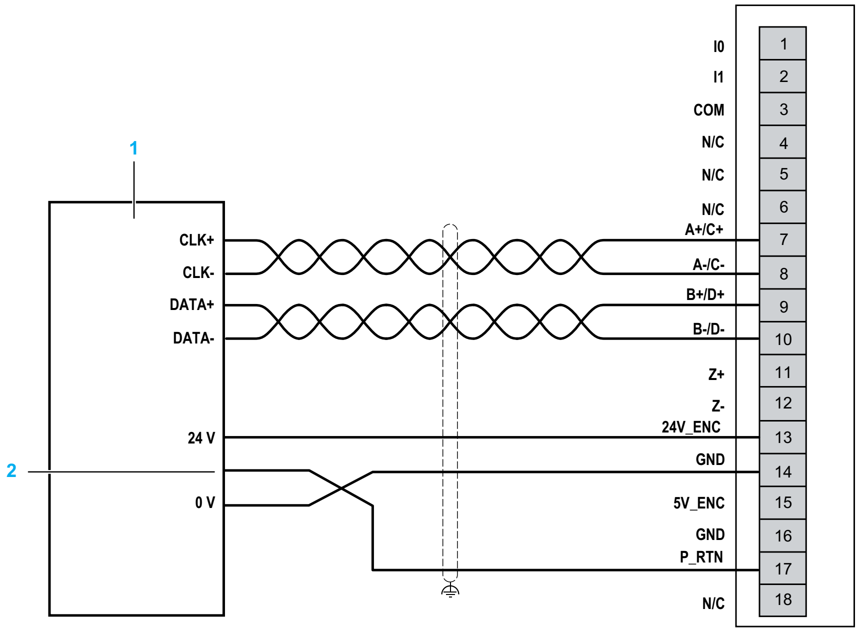
⚠WARNING

UNINTENDED EQUIPMENT OPERATION

Do not connect wires to unused terminals and/or terminals indicated as “No Connection (N/C)”.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The following figure illustrates the wiring diagram of an absolute (BiSS-C) encoder (24 Vdc):



1: 24 V BiSS-C Encoder
2: Optional encoder power return
N/C: No Connection

NOTE: To protect the module, the power supply of each encoder is limited to 250 mA without a fuse.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

Do not connect wires to unused terminals and/or terminals indicated as “No Connection (N/C)”.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NTSEME0101 Parameters

Overview

The NTSEME0101 module is equipped with two fast discrete inputs. For information on the configuration of this module, refer to Fast Discrete Input Configuration, page 172.

Alternatively, you can add a maximum of one expert function to your module using the **Add a function** button. You can configure only one channel at a time. The following expert functions are available:

- Incremental Encoder Interface, page 183.
- SSI Encoder Interface, page 189.
- BiSS-C Encoder Interface, page 194.

After you have defined your function, you can add the following sub-functions:

- Preset Sub-Function, page 321.
- Capture Sub-Function, page 323.

Parameters Description

Configurable Parameters

The following table presents the configurable parameters for the NTSEME0101 module:

Displayed Name ***Parameter Name***	**Value**	**Data type**	**Description**
Device Mode *DeviceMode*	0: **Normal*** 1: **Optional** 2: **Virtual reserved** 3: **Virtual absent**	ENUM	Allows you to select the device mode: • **Normal**: The module is part of the software configuration and is physically installed in the cluster. • **Optional**: The module is part of the software configuration. A dummy module or the configured module must be physically installed in the cluster. Whether either module is present does not cause a configuration error to be detected. • **Virtual reserved**: The module is part of the software configuration. A dummy module must be physically installed in the cluster. If the virtual reserved module is physically installed in the cluster, a configuration error is detected. • **Virtual absent**: The module is part of the software configuration. A base must not be physically installed in the cluster. If a module is physically installed in the cluster, a configuration error is detected.
Load Consumption *LoadConsumption*	0...150 **150***	UINT16	Sets the estimated load consumption value (in mA) of your module. This value is used for the estimation of your field power segment consumption. The default value is the maximum load current consumption. For more information about the current consumption for your Modicon Edge I/O module, refer to the Modicon Edge I/O - System Planning and Installation Guide.
* Parameter default value			

Implicit Data

The following table presents the input implicit data for the NTSEME0101 module:

Parameter Name	**Value**	**Data type** **Size in bytes** **R/W**	**Description**
GCS	0...255	BYTE 1 R/-	Group Cyclic Status Bit 0: Data quality Bit 1: General module status Bit 2: I/O status Bit 3: N/A Bit 4: N/A Bit 5: Advisory status Bit 6: N/A Bit 7: Data freshness **NOTE:** For more information, refer to Modicon Edge I/O - Diagnostic Data - User Guide.
IValue0_7	0...255	BYTE 1 R/-	Value of the input channels (Bit field). Bit 0...7 = Value of channel 0...7 **NOTE:** Unused bits are reserved.

The following table presents the output implicit data for the NTSEME0101 module:

Parameter Name	**Value**	**Data type** **Size in bytes** **R/W**	**Description**
LatchAck0_7	0...255	BYTE 1 R/W	At rising edge, resets the latch value of the input on the channel 0...7. Bit 0...7 = Value of channel 0...7 **NOTE:** Unused bits are reserved.

NTSEME0102 Encoder Input Module, 1 SinCos 400 kHz, Hiperface 400 kHz, or EnDat 1 MHz, 2 Inputs

What's in This Chapter

NTSEME0102 Presentation

Overview

This section provides a presentation of the NTSEME0102 module.

The following functions are supported by the NTSEME0102 module:

- SinCos Mode Principle Description, page 197.
- Hiperface Mode Principle Description, page 209.
- EnDat Mode Principle Description, page 204.

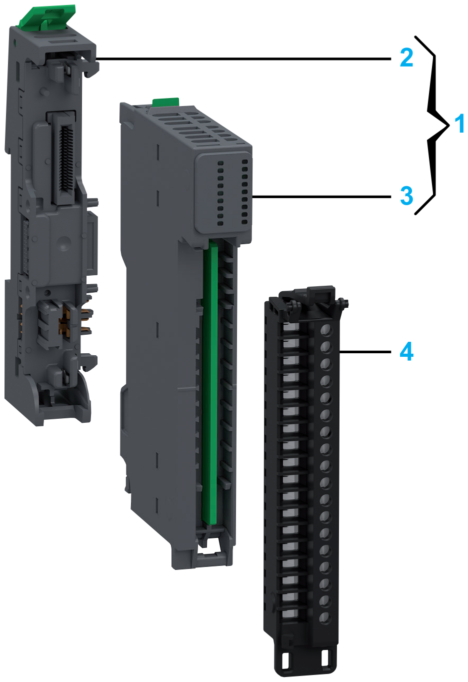
Main Characteristics

The following table describes the main characteristics of the NTSEME0102 module.

Main Characteristics		**Value**
Product or component type		Encoder input module
Number of input channels		2 fast discrete inputs, page 65
Number of encoder input channels		1
Supported encoder	SinCos encoder	1 Vpp - 12 bits, page 66
	Hiperface encoder	1 Vpp + RS485, page 65
	EnDat encoder	RS485, page 65
Number of encoder power channels		1
Encoder power type		5 Vdc, page 67
		8 Vdc, page 68
		Power return, page 68
Operating mode		Synchronous

Purchasing Information

The following figure presents the elements of the Modicon Edge I/O NTS NTSEME0102 module:

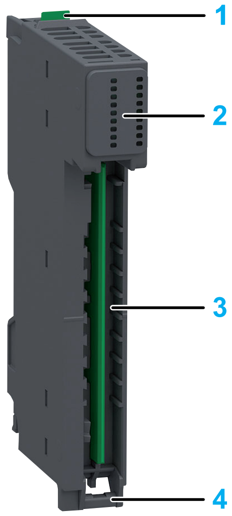


Number	Reference	Description
1	NTSEME0102K	Base + Module (kit) **NOTE:** The module and its corresponding base can be purchased as a kit.
2	NTSXBA0100H	Spare Base, 1 Slot, for Input/Output Common or Expert Module, Hardened
3	NTSEME0102	Encoder Input Module, 1 SinCos 400 kHz, Hiperface 400 kHz, or EnDat 1 MHz, 2 Inputs
4	NTSXTB18000H	Screw Terminal Block, 18 Points, 3.81 mm Pitch, Without Cover, use on Low Height Module, Hardened
	NTSXTB18001H	Screw Terminal Block, 18 Points, 3.81 mm Pitch, With Cover, use on Low Height Module, Hardened
	NTSXTB18200H	Spring Terminal Block, 18 Points, 3.81 mm Pitch, Without Cover, use on Low Height Module, Hardened
	NTSXTB18201H	Spring Terminal Block, 18 Points, 3.81 mm Pitch, With Cover, use on Low Height Module, Hardened **NOTE:** The terminal blocks are purchased separately.

NOTE: For more information on accessories and spare parts, refer to Modicon Edge I/O - System Planning and Installation Guide.

Physical Description

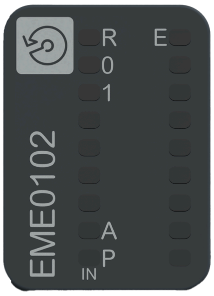
The following figure presents the elements of the module:



1: Release button for disengaging the module from the base
2: Status LEDs
3: Slot for the terminal block
4: Hinge for the terminal block installation

Status LEDs

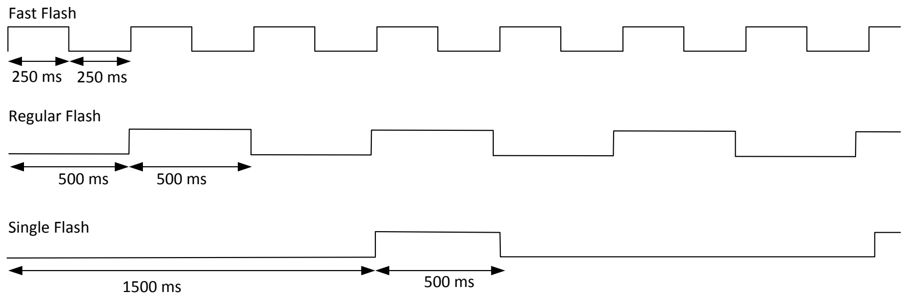
The following figure presents the NTSEME0102 status LEDs:



The following table describes the status of LEDs:

R (Green)	E (Red)	IN0...1 (Green)	A (Green)	P (Green)	Description
Initialization and non-operational states					
OFF	OFF	-	-	-	Indicates that the module is not energized.
OFF	ON	-	-	-	Indicates that an internal error is detected.
OFF	Regular Flash	-	-	-	Indicates that a system error is detected.
Single Flash	OFF	-	-	-	Indicates that the module is not configured.
Regular Flash	OFF	-	-	-	Indicates that the firmware is being updated.
Regular Flash	ON	-	-	-	Indicates that a module mismatch is detected.
Fast Flash	-	-	-	-	Indicates that the module is in commissioning mode.
Operational state					
ON	OFF	-	-	-	Indicates that the module is powered, configured and operational.
ON	OFF	ON	-	-	Indicates that the corresponding input channel is activated.
ON	OFF	OFF	-	-	Indicates that the corresponding input channel is deactivated.
ON	OFF	-	OFF	-	Indicates that the corresponding counting channel is disabled.
ON	OFF	-	ON	-	Indicates that the corresponding counting channel is enabled, and the position did not change.
ON	OFF	-	Fast Flash	-	Indicates that the corresponding counting channel is enabled, and the position changed.
ON	OFF	-	-	OFF	Indicates one of the following: • The corresponding channel power supply monitor is disabled. • The corresponding channel power supply monitor is enabled, and the feedback is not OK.
ON	OFF	-	-	ON	Indicates that the corresponding channel power supply monitor is enabled, and the feedback is OK.
ON	Single Flash	-	-	-	Indicates one of the following: • The module is restarting. • An advisory is detected.
ON	Regular Flash	-	-	-	Indicates one of the following: • An error is detected at the channel level. • The module is in fallback state.
ON	ON	-	-	-	Indicates that an error is detected at the module level.

The following graphic depicts the system status of LEDs during module operation:



NTSEME0102 Characteristics

Overview

This section provides a general description of the characteristics of the module.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

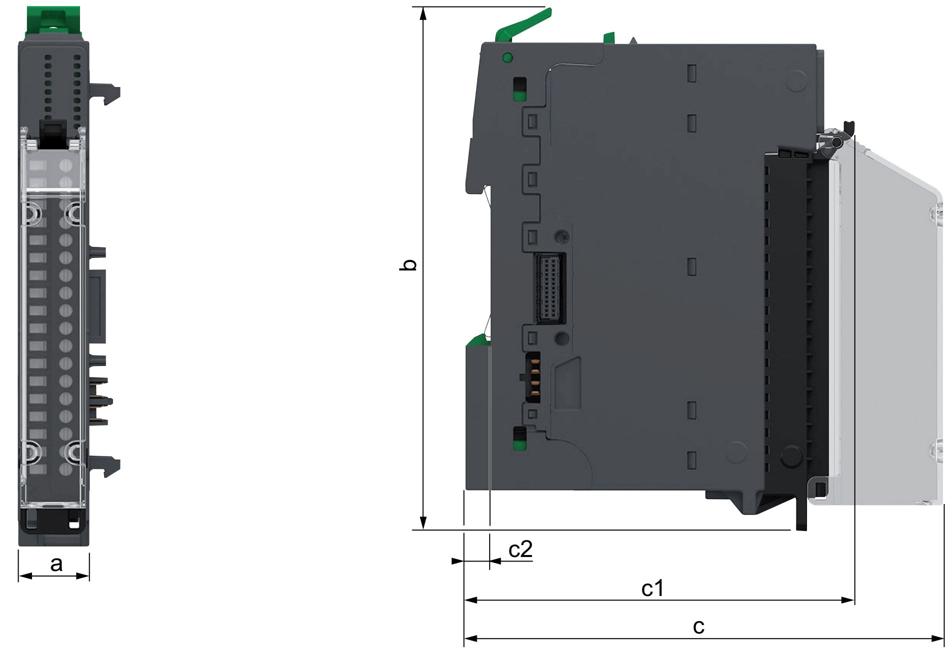
Do not exceed any of the rated values specified in the environmental and electrical characteristics tables.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

For more information on environmental characteristics, refer to Modicon Edge I/O - System Planning and Installation Guide.

Dimensions

The following figure presents the external dimensions for the assembled module:



a: 15 mm (0.59 in)
b: 116.6 mm (4.57 in)
c: 107.5 mm (4.21 in)
c1: 88.2 mm (3.46 in)
c2: 5.6 mm (0.2 in)

Weight

- NTSEME0102: 48 g (1.69 oz)
- NTSEME0102K: 73 g (2.57 oz)

General Characteristics

The following table describes the general characteristics of the NTSEME0102 module:

Characteristics		Value
Rated supplied voltage		24 Vdc
Power supplied voltage range		20.4...28.8 Vdc
Bus current consumption		30.7 mA
Field current consumption		131.5 mA
Power dissipation		1.6 W
Field power supply	Encoder channel	Encoder supply provided from power distribution module
	Discrete inputs	Internal
Isolation	Between input channels	No isolation
	Between internal logic and input channels	1,000 Vac
	Between internal logic and encoder signals	
	Between internal logic and encoder power	
	Between internal logic and ground	
	Between input channels and encoder signals	850 Vac
	Between input channels and encoder power	
	Between input channels and ground	1,500 Vac
	Between encoder signals and ground	
	Between encoder power and ground	
Hot swap supported		Yes
Operating ambient temperature derating		No derating

Fast Discrete Inputs Characteristics

The following table describes the fast discrete inputs characteristics:

Characteristics		Value
Rated input voltage		24 Vdc
Input voltage range		0...30 Vdc
Rated input current		2.25 mA
Input logic		Sink
Input compatibility		Type 3 according to IEC 61131-2
Input wiring mode		2-wire
Input voltage	Logic state 1	> 11 Vdc
	Logic state 0	< 11 Vdc for I < 1.5 mA < 5 Vdc for I > 1.5 mA
Input current	Logic state 1	> 2 mA
	Logic state 0	< 15 mA
Response time on input	Logic state 1 to logic state 0	500 ns + filter delay
	Logic state 0 to logic state 1	500 ns + filter delay
Input filter time	Software	Configurable: 200 ns, 500 ns 1 µs, 2 µs, 5 µs, 10 µs, 50 µs, 80 µs, 500 µs, 1 ms, 4 ms, or 12 ms
Protection	Overvoltage	Up to ±60 Vdc
	Reverse polarity	Yes
Cable	Type	Shielded
	Maximum length	20 m (65.6 ft)

Discrete Encoder Inputs Characteristics

The following table describes the discrete encoder inputs characteristics:

Characteristics		Value	
Encoder signals		Differential signal	
Input type		Hiperface encoder	1 Vpp + RS485
		EnDat encoder	1 RS485
Line termination		AC termination: 150 Ω - 220 pF	
Signal frequency		Maximum 1 MHz	
Driver	Protection	Short circuit protection by thermal shutdown with autoretry	
Cable	Type	0.2 mm^2 (24 AWG) twisted pair - shielded	
	Maximum length	20 m (65.6 ft)	

NOTE: EnDat does not take into account the analog 1 Vpp signal, only the digital RS-485 signal.

Analog Encoder Inputs Characteristics

The following table describes the analog encoder input characteristics:

Characteristics		**Value**
Interface type	Sin,Cos,Z	Pure SinCos - Hiperface
Input type	Sin,Cos	SinCos: 1 Vpp differential signals 12-bit resolution Hiperface: 1 Vpp pseudo-differential signal
	Z	0.5 Vpp differential signal
Line termination	Sin,Cos,Z	150 Ω
Signal amplitude	Sin,Cos	1 Vpp nominal (0.6...1.2 Vpp) with 2.5 Vdc ± 0.3 Vdc offset to ground.
	Z	0.2 Vpp minimum - 0.5 Vpp nominal with 2.5 Vdc ± 0.3 Vdc offset to ground.
Signal frequency	Sin and Cos	Maximum 400 kHz
Phase angle	Sin versus Cos	90° ± 10%
Top Z marker window	Z	Second quadrant

Encoder Power Supply

5 Vdc Encoder Power Supply Characteristics

The following table describes the 5 Vdc encoder power supply characteristics:

Characteristics		Value
Output voltage	Voltage at logic state 1	5.13 Vdc ± 2.6 %
	Voltage at logic state 0	HighZ with flyback diode
Power supply		Internal
Maximum ripple		2 % of nominal value
Maximum output current		• For a one-slot module (one encoder connected): 200 mA • For a two-slot module (up to two encoders connected): 400 mA
Load type		Encoder power rails are dedicated to supply encoders
Output Slew Rate		500 µs
Protection	Overcurrent	• For a one-slot module (one encoder): Minimum 230 mA - Typically 254 mA - Maximum 282 mA • For a two-slot module (up to two encoders): Minimum 450 mA - Typically 510 mA - Maximum 560 mA In the event of an overload, the encoder power rail switches to power limitation mode. If the overload persists, the encoder power rail goes into shutdown for one second, then returns to normal operation.
	Short circuit	Yes The encoder power rail goes into shutdown for one second, then returns to normal operation.
	Reverse polarity	Yes The encoder power rail goes into shutdown until the reverse condition is removed.
Cable	Type	Shielded, including encoder power wires and encoder signal wires.
	Maximum length	20 m (65.6 ft)(1)

(1) Maximum cable length [m] = maximum voltage drop for the cable [V] x wire cross section (mm^2) / (Encoder current [A] x 0.0171 [Ω mm^2/m]), where: maximum voltage drop for the cable = (minimum module output voltage - minimum encoder input voltage) / 2.

8 Vdc Encoder Power Supply Characteristics

The following table describes the 8 Vdc encoder power supply characteristics:

Characteristics		**Value**
Output voltage	Voltage at logic state 1	8 Vdc ± 3.3 %
	Voltage at logic state 0	HighZ with flyback diode
Power supply		Internal
Maximum ripple		2% of nominal value
Maximum output current		250 mA
Load type		Encoder power rails are dedicated to supply encoders
Output Slew Rate		500 µs
Protection	Overcurrent	Yes, at 560 mA In the event of an overload, the encoder power rail switches to power limitation mode. If the overload persists, the encoder power rail goes into shutdown for one second, then returns to normal operation.
	Short circuit	Yes, at 660 mA The encoder power rail goes into shutdown for one second, then returns to normal operation.
	Reverse polarity	Yes The encoder power rail goes into shutdown until the reverse condition is removed.
Cable	Type	Shielded, including encoder power wires and encoder signal wires.
	Maximum length	20 m (65.6 ft)(1)
(1) Maximum cable length [m] = maximum voltage drop for the cable [V] x wire cross section (mm^2) / (Encoder current [A] x 0.0171 [Ω mm^2/m]), where: maximum voltage drop for the cable = (minimum module output voltage - minimum encoder input voltage) / 2		

Power Return

The power return allows to detect if a voltage higher than 4.28 Vdc is present on the encoder power return wire.

Characteristics	**Value**
Voltage range	0...30 Vdc
Voltage detection	4.28 Vdc ± 2 %
Input impedance	499 kΩ
Input current	100 µA

NTSEME0102 Wiring

Overview

This section provides the wiring diagrams for the NTSEME0102 module.

Wiring Rules

For more information on the wiring, refer to Modicon Edge I/O - System Planning and Installation Guide.

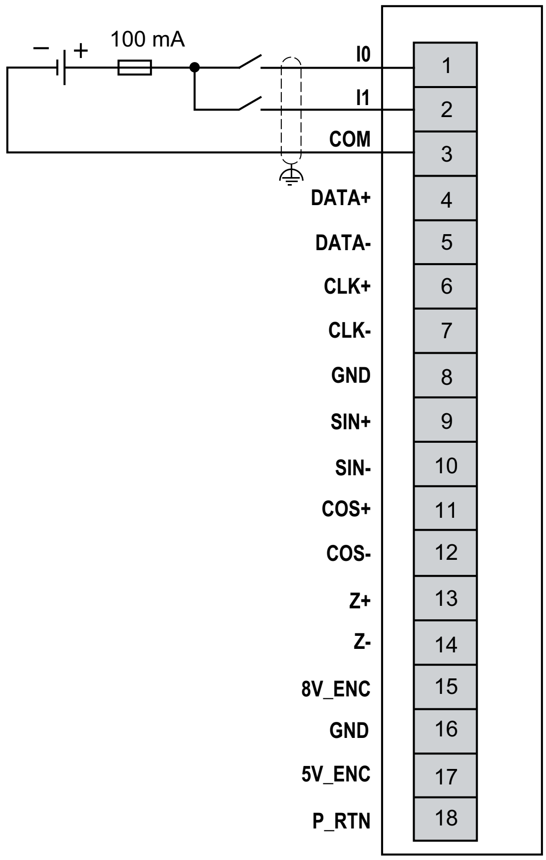
Pin Assignment

This table describes the pin assignment of the terminal block:

Pin	Signal	Description
1	I0	Fast input channel 0
2	I1	Fast input channel 1
3	COM	Common for fast input.
4	DATA+	Discrete differential SinCos line - Data+
5	DATA-	Discrete differential SinCos line - Data-
6	CLK+	Discrete differential SinCos line- Clock+
7	CLK-	Discrete differential SinCos line - Clock-
8	GND	0 Vdc for SinCos
9	SIN+	Incremental differential SinCos Line - Sine+
10	SIN-	Incremental differential SinCos Line - Sine-
11	COS+	Incremental differential SinCos Line - Cosine+
12	COS-	Incremental differential SinCos Line - Cosine-
13	Z+	Differential SinCos - Positive side of the zero pulse signal
14	Z-	Differential SinCos - Negative side of the zero pulse signal
15	8V_ENC	8 Vdc supply for Hiperface encoder type
16	GND	0 Vdc for encoder supply
17	5V_ENC	5 Vdc supply for Pure SinCos or EnDat encoder type
18	P_RTN	Power return

Fast Input Wiring Diagram

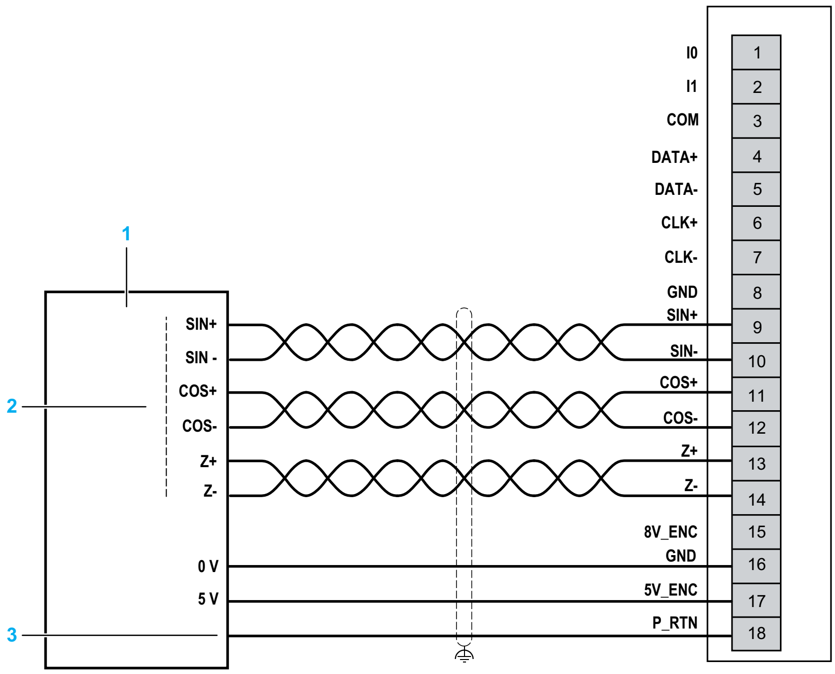
The following figure illustrates the wiring diagram of the fast discrete inputs:



NOTE: An external fuse of type T, 100 mA, 24 Vdc is mandatory and must be chosen in compliance with the IEC60269 standard.

Pure SinCos Encoder Wiring Diagram

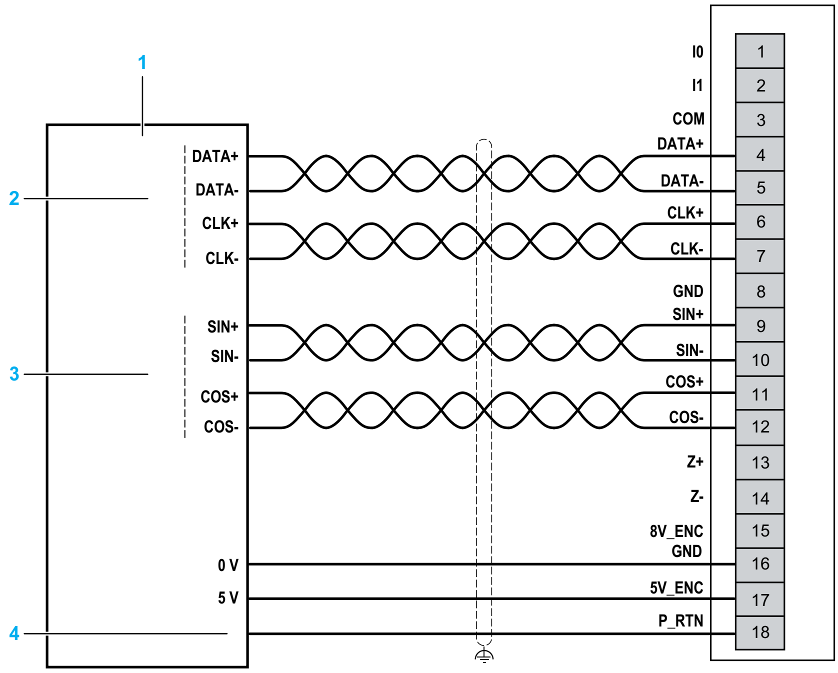
The following figure illustrates the wiring diagram of pure SinCos encoder (5 Vdc):



1: 5 V Pure SinCos Encoder
2: Incremental
3: Optional encoder power return

EnDat Encoder Wiring Diagram

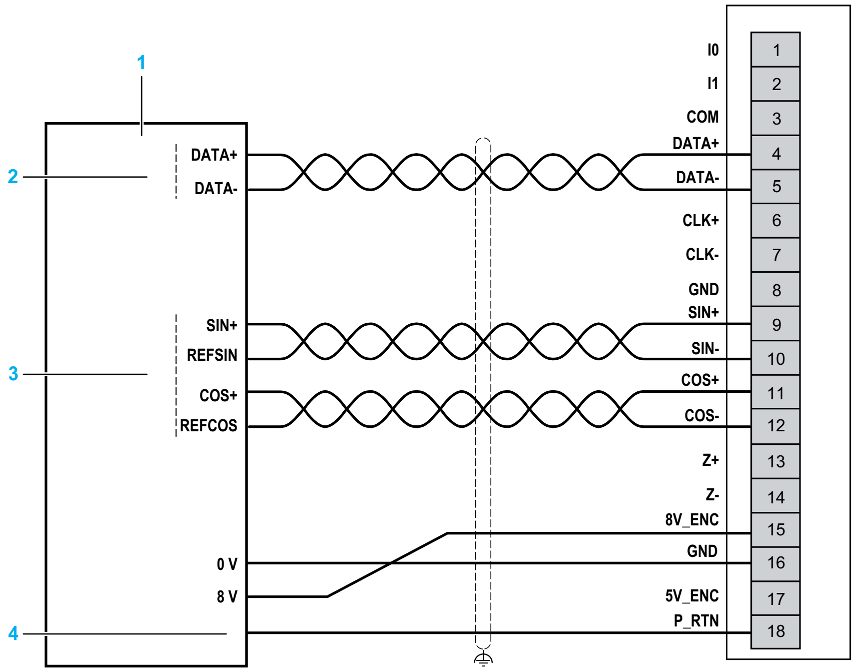
The following figure illustrates the wiring diagram of EnDat encoder (5 Vdc):



1: 5 V EnDat Encoder
2: Digital
3: Incremental
4: Optional encoder power return

Hiperface Encoder Wiring Diagram

The following figure illustrates the wiring diagram of Hiperface encoder (8 Vdc):



1: 8 V Hiperface Encoder
2: Digital
3: Incremental
4: Optional encoder power return
REFSIN: Sine reference signal
REFCOS: Cosine reference signal

NTSEME0102 Parameters

Overview

The NTSEME0102 module is equipped with two fast discrete inputs. For information on the configuration of this module, refer to Fast Discrete Input Configuration, page 172.

Alternatively, you can add a maximum of one expert function to your module using the **Add a function** button. You can configure only one channel at a time. The following expert functions are available:

- SinCos Encoder Interface, page 199.
- EnDat Encoder Interface, page 205.
- Hiperface Encoder Interface, page 210.

Parameters Description

Configurable Parameters

The following table presents the configurable parameters for the NTSEME0102 module:

Displayed Name ***Parameter Name***	**Value**	**Data type**	**Description**
Device Mode *DeviceMode*	0: **Normal*** 1: **Optional** 2: **Virtual reserved** 3: **Virtual absent**	ENUM	Allows you to select the device mode: • **Normal**: The module is part of the software configuration and is physically installed in the cluster. • **Optional**: The module is part of the software configuration. A dummy module or the configured module must be physically installed in the cluster. Whether either module is present does not cause a configuration error to be detected. • **Virtual reserved**: The module is part of the software configuration. A dummy module must be physically installed in the cluster. If the virtual reserved module is physically installed in the cluster, a configuration error is detected. • **Virtual absent**: The module is part of the software configuration. A base must not be physically installed in the cluster. If a module is physically installed in the cluster, a configuration error is detected.
* Parameter default value			

Implicit Data

The following table presents the input implicit data for the NTSEME0102 module:

Parameter Name	**Value**	**Data type** **Size in bytes** **R/W**	**Description**
GCS	0...255	BYTE 1 R/-	Group Cyclic Status Bit 0: Data quality Bit 1: General module status Bit 2: I/O status Bit 3: N/A Bit 4: N/A Bit 5: Advisory status Bit 6: N/A Bit 7: Data freshness **NOTE:** For more information, refer to Modicon Edge I/O - Diagnostic Data - User Guide.
IValue0_7	0...255	BYTE 1 R/-	Value of the input channels (Bit field). Bit 0...7 = Value of channel 0...7 **NOTE:** Unused bits are reserved.

The following table presents the output implicit data for the NTSEME0102 module:

Parameter Name	**Value**	**Data type** **Size in bytes** **R/W**	**Description**
LatchAck0_7	0...255	BYTE 1 R/W	At rising edge, resets the latch value of the input on the channel 0...7. Bit 0...7 = Value of channel 0...7 **NOTE:** Unused bits are reserved.

NTSECS0121 Cam Switch Output Module, 1 RS422 Incremental 1 MHz, SSI 500 kHz, or BiSS-C, 2 Inputs, 8 Outputs

What's in This Chapter

NTSECS0121 Presentation

Overview

This section provides a presentation of the NTSECS0121 module.

The following functions are supported by the NTSECS0121 module:

- Incremental Mode Principle Description, page 177.
- SSI Mode Principle Description, page 187.
- BiSS-C Mode Principle Description, page 192.

The following sub-functions are supported by the NTSECS0121 module:

- CAM Sub-Function, page 308.
- Preset Sub-Function, page 321.
- Capture Sub-Function, page 323.

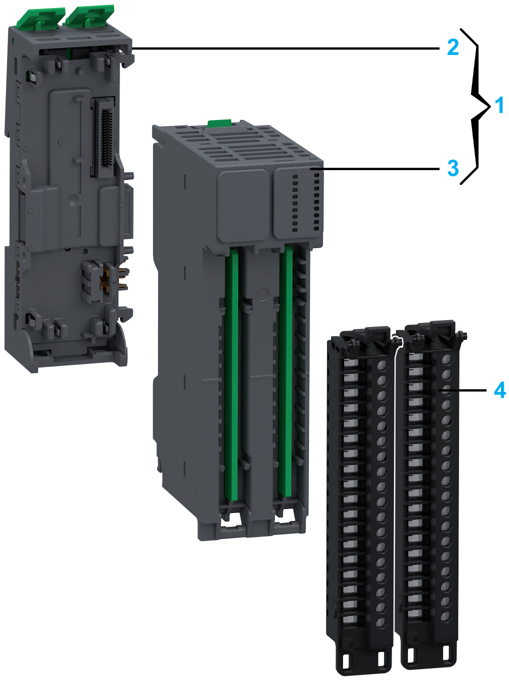
Main Characteristics

The following table describes the main characteristics of the NTSECS0121 module.

Main Characteristics		Value
Product or component type		Cam Switch output module
Number of input/output channels		2 fast discrete inputs, page 83 8 fast discrete outputs, page 84
Number of encoder input channels		1
Supported encoder	Incremental encoder	A+/A-, B+/B-, Z+/Z-, page 83
	SSI encoder	Data+/Data-, Clk+/Clk-, page 83
	BiSS-C encoder	Data+/Data-, Clk+/Clk-, page 83
Number of encoder power channels		2
Encoder power type		5 Vdc, page 85
		24 Vdc, page 86
		Power return, page 86
Operating mode		Synchronous

Purchasing Information

The following figure presents the elements of the Modicon Edge I/O NTS NTSECS0121 module:

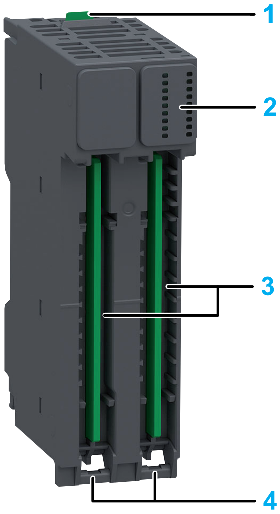


Number	Reference	Description
1	NTSECS0121K	Base + Module (kit) **NOTE:** The module and its corresponding base can be purchased as a kit.
2	NTSXBA0200H	Spare Base, 2 Slots, for Input/Output Common/Expert/Safety Module, Hardened
3	NTSECS0121	Cam Switch Output Module, 1 RS422 Incremental 1 MHz, SSI 500 kHz, or BiSS-C, 2 Inputs, 8 Outputs
4	NTSXTB18000H	Screw Terminal Block, 18 Points, 3.81 mm Pitch, Without Cover, use on Low Height Module, Hardened
	NTSXTB18001H	Screw Terminal Block, 18 Points, 3.81 mm Pitch, With Cover, use on Low Height Module, Hardened
	NTSXTB18200H	Spring Terminal Block, 18 Points, 3.81 mm Pitch, Without Cover, use on Low Height Module, Hardened
	NTSXTB18201H	Spring Terminal Block, 18 Points, 3.81 mm Pitch, With Cover, use on Low Height Module, Hardened **NOTE:** The terminal blocks are purchased separately.

NOTE: For more information on accessories and spare parts, refer to Appendix E Modicon Edge I/O NTS Spare Bases and Terminal Blocks (see Modicon Edge I/O - System Planning and Installation Guide).

Physical Description

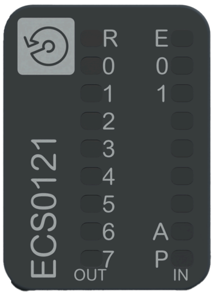
The following figure presents the elements of the module:



1: Release button for disengaging the module from the base
2: Status LEDs
3: Slot for the terminal block
4: Hinge for the terminal block installation

Status LEDs

The following figure presents the NTSECS0121 status LEDs:

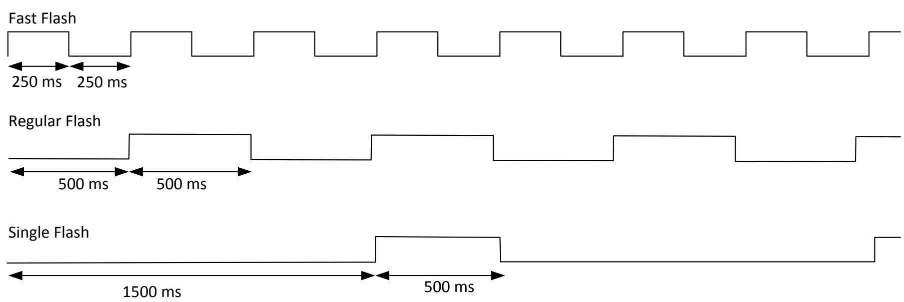


The following table describes the status of LEDs:

R (Green)	E (Red)	IN0...1 (Green)	OUT0...7 (Green)	A (Green)	P (Green)	Description
Initialization and non-operational states						
OFF	OFF	-	-	-	-	Indicates that the module is not energized.
OFF	ON	-	-	-	-	Indicates that an internal error is detected.
OFF	Regular Flash	-	-	-	-	Indicates that a system error is detected.
Single Flash	OFF	-	-	-	-	Indicates that the module is not configured.
Regular Flash	OFF	-	-	-	-	Indicates that the firmware is being updated.
Regular Flash	ON	-	-	-	-	Indicates that a module mismatch is detected.
Fast Flash	-	-	-	-	-	Indicates that the module is in commissioning mode.
Operational state						
ON	OFF	-	-	-	-	Indicates that the module is powered, configured and operational.
ON	OFF	ON	-	-	-	Indicates that the corresponding input channel is activated.
ON	OFF	OFF	-	-	-	Indicates that the corresponding input channel is deactivated.
ON	OFF	-	ON	-	-	Indicates that the corresponding output channel is activated.
ON	OFF	-	OFF	-	-	Indicates that the corresponding output channel is deactivated.
ON	OFF	-	-	OFF	-	Indicates that the corresponding counting channel is disabled.
ON	OFF	-	-	ON	-	Indicates that the corresponding counting channel is enabled, and the position did not change.
ON	OFF	-	-	Fast Flash	-	Indicates that the corresponding counting channel is enabled, and the position changed.
ON	OFF	-	-	-	OFF	Indicates one of the following: • The corresponding channel power supply monitor is disabled. • The corresponding channel power supply monitor is enabled, and the feedback is not OK.
ON	OFF	-	-	-	ON	Indicates that the corresponding channel power supply monitor is enabled, and the feedback is OK.
ON	Single Flash	-	-	-	-	Indicates one of the following: • The module is restarting. • An advisory is detected.

R (Green)	E (Red)	IN0...1 (Green)	OUT0...7 (Green)	A (Green)	P (Green)	Description
ON	Regular Flash	-	-	-	-	Indicates one of the following: • An error is detected at the channel level. • The module is in fallback state.
ON	ON	-	-	-	-	Indicates that an error is detected at the module level.
ON	Regular Flash	-	OFF	-	-	Indicates that an error is detected in the 24 Vdc field power.
ON	Regular Flash	-	Regular Flash	-	-	Indicates that a short circuit is detected on the output.

The following graphic depicts the system status of LEDs during module operation:



NTSECS0121 Characteristics

Overview

This section provides a general description of the characteristics of the module.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

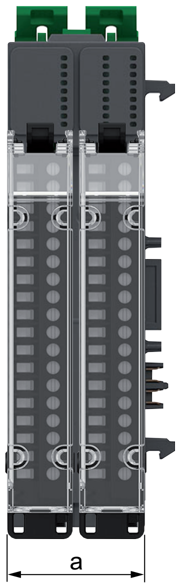
Do not exceed any of the rated values specified in the environmental and electrical characteristics tables.

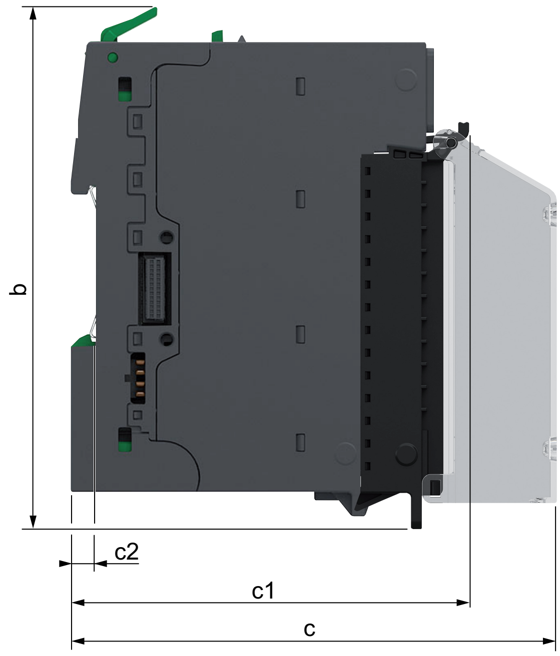
Failure to follow these instructions can result in death, serious injury, or equipment damage.

For more information on environmental characteristics, refer to Modicon Edge I/O - System Planning and Installation Guide.

Dimensions

The following figure presents the external dimensions for the assembled module:





a: 30 mm (1.18 in)
b: 116.6 mm (4.57 in)
c: 107.5 mm (4.21 in)
c1: 88.2 mm (3.46 in)
c2: 5.6 mm (0.2 in)

Weight

- NTSECS0121: 79 g (2.78 oz)
- NTSECS0121K: 125 g (4.4 oz)

General Characteristics

The following table describes the general characteristics of the NTSECS0121 module:

Characteristics		**Value**
Rated supplied voltage		24 Vdc
Power supplied voltage range		20.4...28.8 Vdc
Bus current consumption		38.9 mA
Field current consumption		2,607.4 mA
Power dissipation		2.2 W
Field power supply	Encoder channel	Encoder supply provided from power supply module.
	Discrete outputs	Internal
Isolation	Between input channels	No isolation
	Between internal logic and input channels	1,000 Vac
	Between internal logic and encoder signals	
	Between internal logic and encoder power	
	Between internal logic and output channels	
	Between internal logic and ground	
	Between input channels and encoder signals	850 Vac
	Between input channels and encoder power	
	Between input and outputs channels	
	Between input channels and ground	1,500 Vac
	Between encoder signals and ground	
	Between encoder power and ground	
Hot swap supported		Yes
Operating ambient temperature derating		No derating

Fast Discrete Inputs Characteristics

The following table describes the fast discrete inputs characteristics:

Characteristics		Value
Rated input voltage		24 Vdc
Input voltage range		0...30 Vdc
Rated input current		2.25 mA
Input logic		Sink
Input compatibility		Type 3 according to IEC 61131-2
Input wiring mode		2-wire
Input voltage	Logic state 1	> 11 Vdc
	Logic state 0	< 11 Vdc for I < 1.5 mA < 5 Vdc for I > 1.5 mA
Input current	Logic state 1	> 2 mA
	Logic state 0	< 15 mA
Response time on input	Logic state 1 to logic state 0	500 ns + filter delay
	Logic state 0 to logic state 1	500 ns + filter delay
Input filter time	Software	Configurable: 200 ns, 500 ns 1 µs, 2 µs, 5 µs, 10 µs, 50 µs, 80 µs, 500 µs, 1 ms, 4 ms, or 12 ms
Protection	Overvoltage	Up to ±60 Vdc
	Reverse polarity	Yes
Cable	Type	Shielded
	Maximum length	20 m (65.6 ft)

Discrete Encoder Inputs Characteristics

The following table describes the discrete encoder inputs characteristics:

Characteristics		Value
Encoder signals		Differential signal
Line termination		AC termination: 150 Ω - 220 pF
Signal frequency		Maximum 1 MHz
Driver	Protection	Short circuit protection by thermal shutdown with autoretry
Cable	Type	0.2 mm^2 (24 AWG) twisted pair - shielded
	Maximum length	20 m (65.6 ft)

Fast Discrete Output Characteristics

The following table describes the fast discrete output characteristics:

Characteristics		Value
Rated output voltage		24 Vdc
Output type		Push-pull
Maximum output current per output		250 mA when the output is in steady state 50 mA when the output is oversampled
Output logic		Source
Output wiring mode		2-wire
Output supply		Internal
Output voltage	At logic state 1	24 Vdc field supply - voltage drop Maximum voltage drop: 1.81 Vdc
	At logic state 0	0 Vdc field supply + voltage drop Maximum voltage drop: 1 Vdc
Load type	Resistive	Lamp: 1 W maximum
	Inductive	1 H maximum
Response time on output	Logic state 1 to logic state 0	750 ns
	Logic state 0 to logic state 1	750 ns
Protection	Overload	1.6 A...1.94 A with a typical value of 1.84 A Protection by group of 4 outputs In compliance with the IEC61131-2 standard, the overload testing pattern is 1.5 x IE (IE = 250 mA per output) applied during 1 s ON, then 9 s OFF.
	Short circuit	4 A typical Protection by group of 4 outputs
Cable	Type	Shielded
	Maximum length	20 m (65.6 ft)

Encoder Power Supply

5 Vdc Encoder Power Supply Characteristics

The following table describes the 5 Vdc encoder power supply characteristics:

Characteristics		Value
Output voltage	Voltage at logic state 1	5.13 Vdc ± 2.6 %
	Voltage at logic state 0	HighZ with flyback diode
Power supply		Internal
Maximum ripple		2 % of nominal value
Maximum output current		• For a one-slot module (one encoder connected): 200 mA • For a two-slot module (up to two encoders connected): 400 mA
Load type		Encoder power rails are dedicated to supply encoders
Output Slew Rate		500 µs
Protection	Overcurrent	• For a one-slot module (one encoder): Minimum 230 mA - Typically 254 mA - Maximum 282 mA • For a two-slot module (up to two encoders): Minimum 450 mA - Typically 510 mA - Maximum 560 mA In the event of an overload, the encoder power rail switches to power limitation mode. If the overload persists, the encoder power rail goes into shutdown for one second, then returns to normal operation.
	Short circuit	Yes The encoder power rail goes into shutdown for one second, then returns to normal operation.
	Reverse polarity	Yes The encoder power rail goes into shutdown until the reverse condition is removed.
Cable	Type	Shielded, including encoder power wires and encoder signal wires.
	Maximum length	20 m (65.6 ft)(1)
(1) Maximum cable length [m] = maximum voltage drop for the cable [V] x wire cross section (mm^2) / (Encoder current [A] x 0.0171 [Ω mm^2/m]), where: maximum voltage drop for the cable = (minimum module output voltage - minimum encoder input voltage) / 2.		

24 Vdc Encoder Power Supply Characteristics

The following table describes the 24 Vdc encoder power supply characteristics:

Characteristics		**Value**
Output voltage	Voltage at logic state 1	Output voltage = 24 Vdc Field Supply - Voltage drop Maximum voltage drop: 2.1 Vdc
	Voltage at logic state 0	HighZ with flyback diode
Power supply		Internal
Maximum ripple		5 % of nominal value
Maximum output current		• For one-slot module (one encoder connected on 24 Vdc): 150 mA • For two-slot module (up to two encoders connected on 24 Vdc): 300 mA
Load type		Encoder power rails are dedicated to supply encoders
Output Slew Rate		500 µs
Protection	Overcurrent	• For one-slot module (one encoder): Minimum 200 mA - Typical 225 mA - Maximum 251 mA • For two-slot module (up to two encoders): Minimum 420 mA - Typical 469 mA - Maximum 521 mA In the event of an overload, the encoder power rail switches to power limitation mode. If the overload persists, the encoder power rail goes into shutdown for one second, then returns to normal operation.
	Short circuit	Yes The encoder power rail goes into shutdown for one second, then returns to normal operation.
	Reverse polarity	Yes The encoder power rail goes into shutdown until the reverse condition is removed.
Cable	Type	Shielded, including encoder power wires and encoder signal wires.
	Maximum length	20 m (65.6 ft)(1)
(1) Maximum cable length [m] = maximum voltage drop for the cable [V] x wire cross section (mm^2) / (Encoder current [A] x 0.0171 [Ω mm^2/m]), where: maximum voltage drop for the cable = (minimum module output voltage - minimum encoder input voltage) / 2.		

Power Return

The power return allows to detect if a voltage higher than 4.28 Vdc is present on the encoder power return wire.

Characteristics	**Value**
Voltage range	0...30 Vdc
Voltage detection	4.28 Vdc ± 2 %
Input impedance	499 kΩ
Input current	100 µA

NTSECS0121 Wiring

Overview

This section provides the wiring diagrams for the NTSECS0121 module.

Wiring Rules

For more information on the wiring, refer to Modicon Edge I/O - System Planning and Installation Guide.

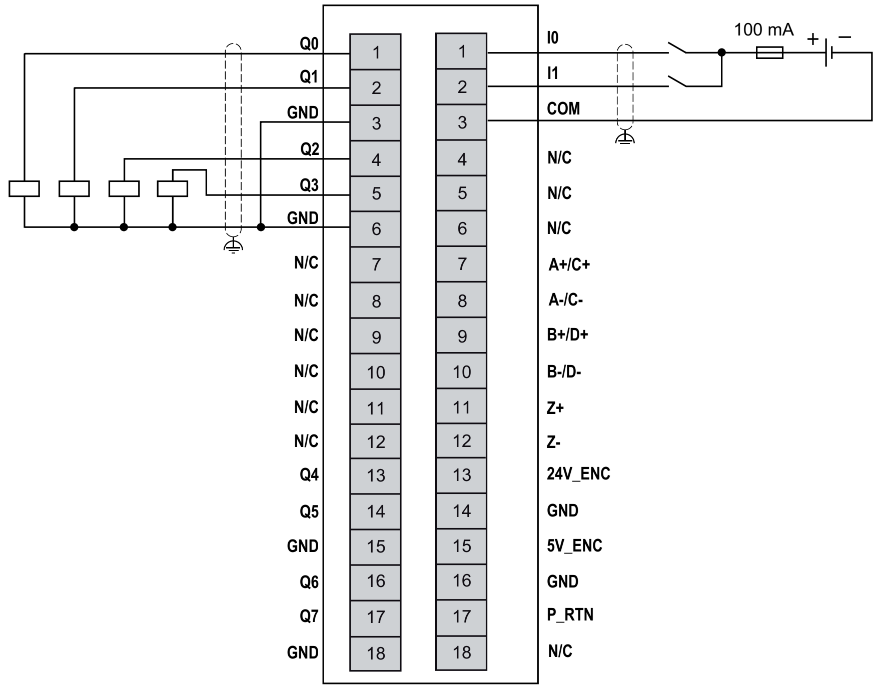
Pin Assignment

This table describes the pin assignment of the terminal blocks:

Terminal Block 1			Terminal Block 2		
Pin	**Signal**	**Description**	**Pin**	**Signal**	**Description**
1	Q0	Fast output channel 0	1	I0	Fast input channel 0
2	Q1	Fast output channel 1	2	I1	Fast input channel 1
3	GND	Ground for fast output	3	COM	Common for fast input
4	Q2	Fast output channel 2	4	N/C	No Connection
5	Q3	Fast output channel 3	5	N/C	No Connection
6	GND	Ground for fast output	6	N/C	No Connection
7	N/C	No Connection	7	A+/C+	Incremental A+ or SSI clock+ of the encoder 0
8	N/C	No Connection	8	A-/C-	Incremental A- or SSI clock- of the encoder 0
9	N/C	No Connection	9	B+/D+	Incremental B+ or SSI data+ of the encoder 0
10	N/C	No Connection	10	B-/D-	Incremental B- or SSI data- of the encoder 0
11	N/C	No Connection	11	Z+	Incremental Z+ corresponding to the positive side of the zero pulse signal of the encoder 0
12	N/C	No Connection	12	Z-	Incremental Z- corresponding to the negative side of the zero pulse signal of the encoder 0
13	Q4	Fast output channel 4	13	24V_ENC	24 Vdc supply for encoder
14	Q5	Fast output channel 5	14	GND	Ground for 24 Vdc encoder supply
15	GND	Ground for fast output	15	5V_ENC	5 Vdc supply for encoder
16	Q6	Fast output channel 6	16	GND	Ground for 5 Vdc encoder supply
17	Q7	Fast output channel 7	17	P_RTN0	Power return of the encoder 0
18	GND	Ground for fast output	18	N/C	No Connection

Fast Input/Output Wiring Diagram

The following figure illustrates the wiring diagram of the fast discrete inputs and outputs:



N/C: No Connection

NOTE:

- An external fuse of type T, 100 mA, 24 Vdc is mandatory for inputs and must be chosen in compliance with the IEC60269 standard.
- The fast discrete outputs are internally protected, no fuse is needed.

⚠ WARNING

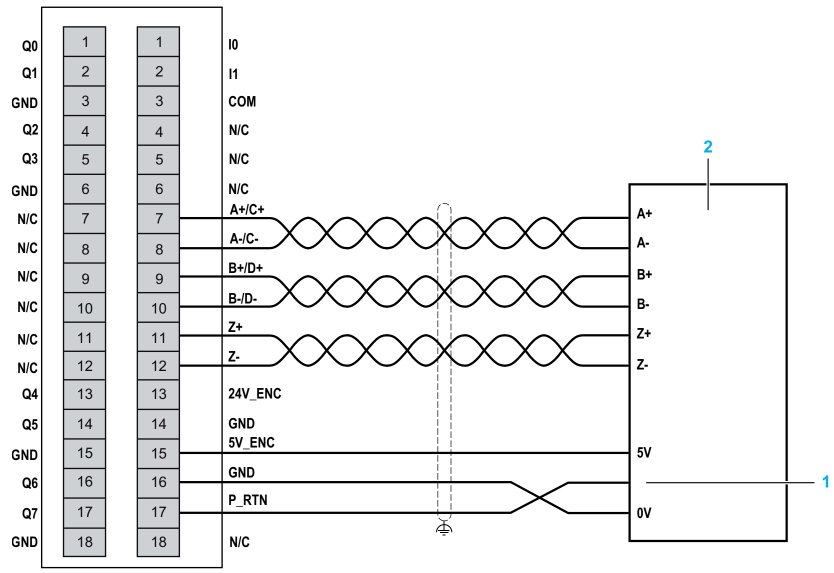
UNINTENDED EQUIPMENT OPERATION

Do not connect wires to unused terminals and/or terminals indicated as “No Connection (N/C)”.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Incremental Encoder Wiring Diagrams

The following figure illustrates the wiring diagram of an incremental encoder (5 Vdc):



1: Optional encoder power return
2: 5 V Incremental Encoder
N/C: No Connection

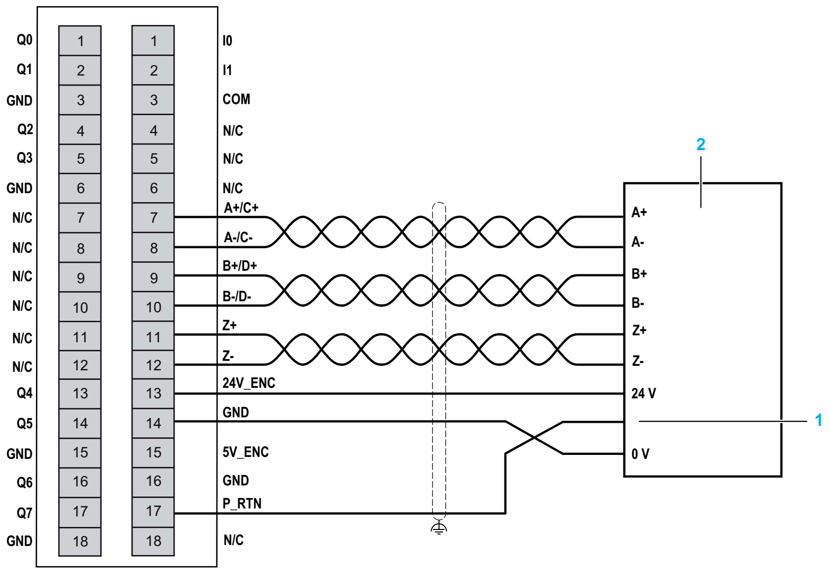
⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Do not connect wires to unused terminals and/or terminals indicated as “No Connection (N/C)”.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The following figure illustrates the wiring diagram of an incremental encoder (24 Vdc):



1: Optional encoder power return
2: 24 V Incremental Encoder
N/C: No Connection

⚠WARNING

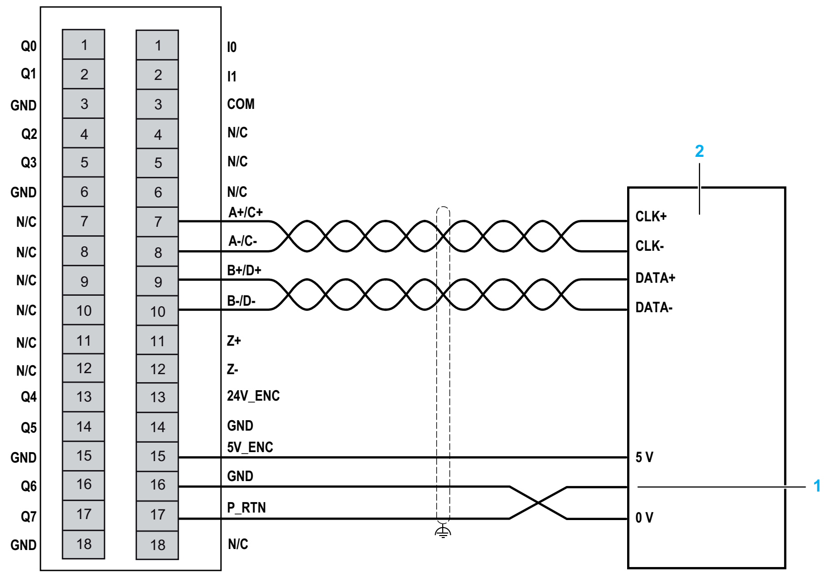
UNINTENDED EQUIPMENT OPERATION

Do not connect wires to unused terminals and/or terminals indicated as “No Connection (N/C)”.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

SSI Encoder Wiring Diagrams

The following figure illustrates the wiring diagram of an absolute (SSI) encoder (5 Vdc):



1: Optional encoder power return
2: 5 V SSI Encoder
N/C: No Connection

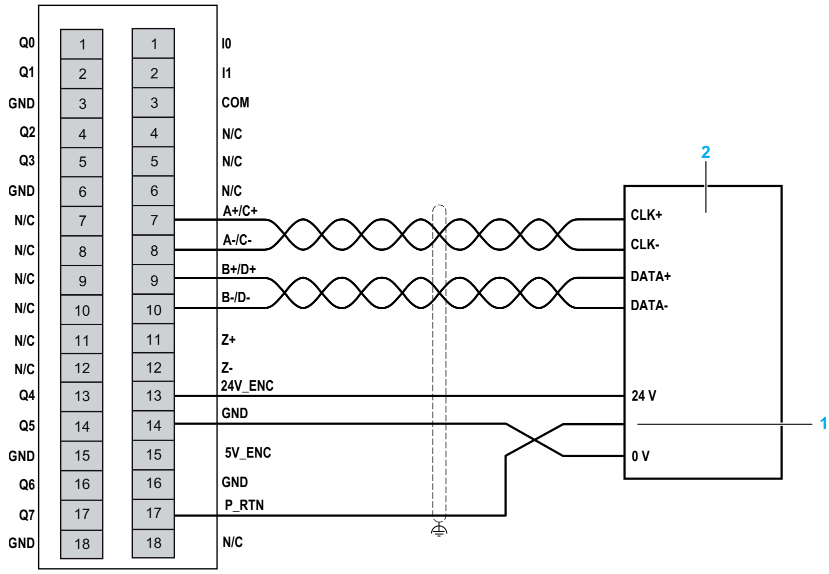
⚠WARNING

UNINTENDED EQUIPMENT OPERATION

Do not connect wires to unused terminals and/or terminals indicated as “No Connection (N/C)”.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The following figure illustrates the wiring diagram of an absolute (SSI) encoder (24 Vdc):



1: Optional encoder power return
2: 24 V SSI Encoder
N/C: No Connection

⚠ WARNING

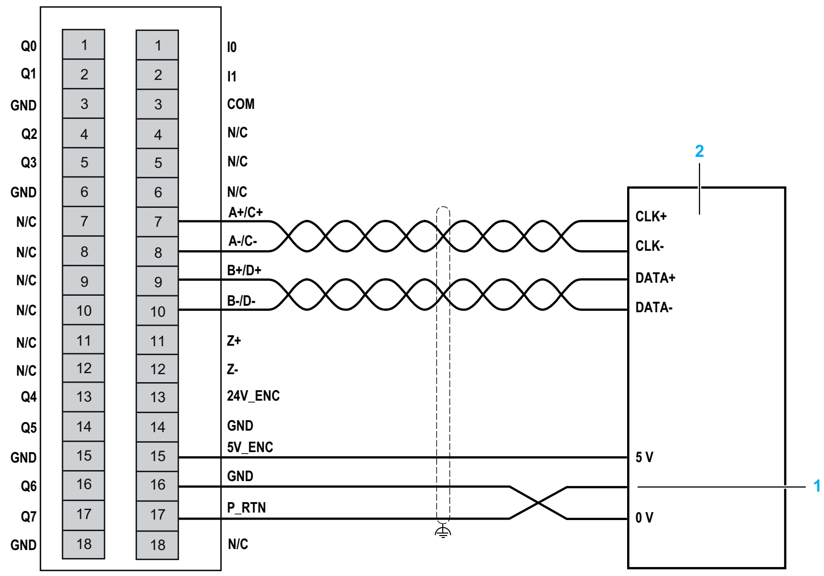
UNINTENDED EQUIPMENT OPERATION

Do not connect wires to unused terminals and/or terminals indicated as “No Connection (N/C)”.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

BiSS-C Encoder Wiring Diagrams

The following figure illustrates the wiring diagram of an absolute (BiSS-C) encoder (5 Vdc):



1: Optional encoder power return
2: 5 V BiSS-C Encoder
N/C: No Connection

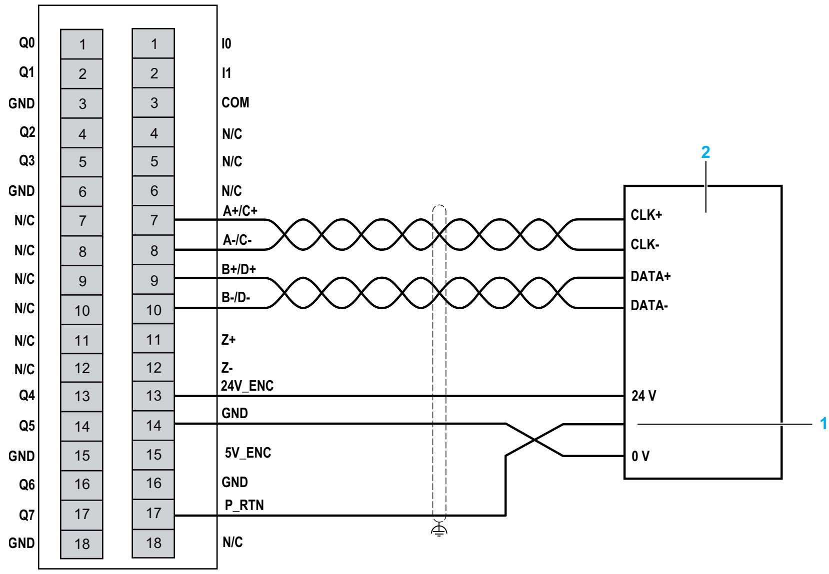
⚠WARNING

UNINTENDED EQUIPMENT OPERATION

Do not connect wires to unused terminals and/or terminals indicated as "No Connection (N/C)".

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The following figure illustrates the wiring diagram of an absolute (BiSS-C) encoder (24 Vdc):



1: Optional encoder power return
2: 24 V BiSS-C Encoder
N/C: No Connection

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Do not connect wires to unused terminals and/or terminals indicated as “No Connection (N/C)”.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NTSECS0121 Parameters

Overview

The NTSECS0121 module is equipped with:

- 2 fast discrete inputs.
- 8 fast discrete outputs.

For information on the configuration of this module, refer to Inputs and Outputs Configuration, page 172.

Alternatively, you can add a maximum of one expert function to your module using the **Add a function** button. You can configure only one channel at a time. The following expert functions are available:

- Incremental Encoder Interface, page 183.
- SSI Encoder Interface, page 189.
- BiSS-C Encoder Interface, page 194.

After you have defined your function, you can add the following sub-functions:

- Preset Sub-Function, page 321.
- Capture Sub-Function, page 323.
- CAM Sub-Function Interface, page 316

Parameters Description

Configurable Parameters

The following table presents the configurable parameters for the NTSECS0121 module:

Displayed Name ***Parameter Name***	**Value**	**Data type**	**Description**
Device Mode *DeviceMode*	0: **Normal*** 1: **Optional** 2: **Virtual reserved** 3: **Virtual absent**	ENUM	Allows you to select the device mode: • **Normal**: The module is part of the software configuration and is physically installed in the cluster. • **Optional**: The module is part of the software configuration. A dummy module or the configured module must be physically installed in the cluster. Whether either module is present does not cause a configuration error to be detected. • **Virtual reserved**: The module is part of the software configuration. A dummy module must be physically installed in the cluster. If the virtual reserved module is physically installed in the cluster, a configuration error is detected. • **Virtual absent**: The module is part of the software configuration. A base must not be physically installed in the cluster. If a module is physically installed in the cluster, a configuration error is detected.
Load Consumption *LoadConsumption*	0...2,150 **2150***	UINT16	Sets the estimated load consumption value (in mA) of your module. This value is used for the estimation of your field power segment consumption. The default value is the maximum load current consumption. For more information about the current consumption for your Modicon Edge I/O module, refer to the Modicon Edge I/O - System Planning and Installation Guide.
Rearming Output Mode *RearmOutputMode*	0: **Latched Off** 1: **Auto Recovery***	ENUM	Allows you to select the rearming mode for an output channel which is latched off due to a detected error. Two modes are available: • **Latched Off**: The channel is rearmed if the cause of the error is no longer present, and a rising edge on **RearmOutputCmd** is applied. • **Auto Recovery**: The output channel is rearmed automatically if the cause of the error is no longer present for a predefined delay.
* Parameter default value			

Implicit Data

The following table presents the input implicit data for the NTSECS0121 module:

Parameter Name	**Value**	**Data type** **Size in bytes** **R/W**	**Description**
GCS	0...255	BYTE 1 R/-	Group Cyclic Status Bit 0: Data quality Bit 1: General module status Bit 2: I/O status Bit 3: Receive status Bit 4: Output status Bit 5: Advisory status Bit 6: N/A Bit 7: Data freshness **NOTE:** For more information, refer to Modicon Edge I/O - Diagnostic Data - User Guide.
IValue0_7	0...255	BYTE 1 R/-	Value of the input channels (Bit field). Bit 0...7 = Value of channel 0...7 **NOTE:** Unused bits are reserved.
ChannelHealthOut0_7(1)	0...255	BYTE 1 R/-	Bit 0...7 = Status of channel 0...7 • Bit = 0: Channel is invalid • Bit = 1: Channel is valid **NOTE:** Unused bits are set to 1.

(1) This parameter is not part of the implicit data if the optimized I/O profile is selected. For more information on the **IO Profile** parameter, refer to the Modicon Edge I/O NTS - Network Interface Modules - User Guide.

The following table presents the output implicit data for the NTSECS0121 module:

Parameter Name	**Value**	**Data type** **Size in bytes** **R/W**	**Description**
LatchAck0_7	0...255	BYTE 1 R/W	At rising edge, resets the latch value of the input on the channel 0...7. Bit 0...7 = Value of channel 0...7 **NOTE:** Unused bits are reserved.
QValue0_7	0...255	BYTE 1 R/W	Value of the output channels (Bit field). Bit 0...7 = Value of channel 0...7 **NOTE:** Unused bits are reserved.
RearmOutputCmd	TRUE FALSE*	BOOL R/W	If the **Rearming Output Mode** parameter is set to **Latched Off** and the cause of the detected error is no longer present, then on a rising edge, it rearms the output channels.

NTSEME0110 Encoder Output Module, 1 RS422 Incremental 400 kHz, 2 Inputs

What's in This Chapter

NTSEME0110 Presentation

Overview

This section provides a presentation of the NTSEME0110 module.

The following function is supported by the NTSEME0110 module:

- Output Encoder Mode Principle Description, page 214.

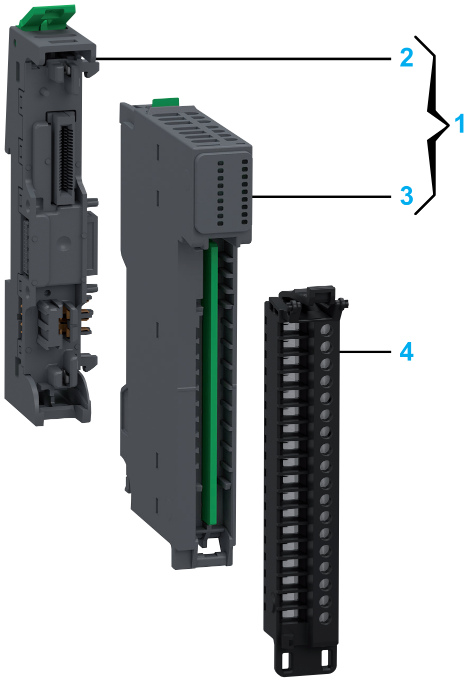
Main Characteristics

The following table describes the main characteristics of the NTSEME0110 module.

Main Characteristics		Value
Product or component type		Encoder output module
Number of input channels		2 fast discrete inputs, page 105
Number of encoder output channels		1
Supported encoder	Incremental encoder	A+/A-, B+/B-, Z+/Z-, page 105
Operating mode		Synchronous

Purchasing Information

The following figure presents the elements of the Modicon Edge I/O NTS NTSEME0110 module:

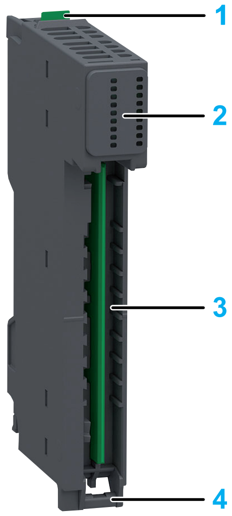


Number	Reference	Description
1	NTSEME0110K	Base + Module (kit) **NOTE:** The module and its corresponding base can be purchased as a kit.
2	NTSXBA0100H	Spare Base, 1 Slot, for Input/Output Common or Expert Module, Hardened
3	NTSEME0110	Encoder Output Module, 1 RS422 Incremental 400 kHz, 2 Inputs
4	NTSXTB18000H	Screw Terminal Block, 18 Points, 3.81 mm Pitch, Without Cover, use on Low Height Module, Hardened
	NTSXTB18001H	Screw Terminal Block, 18 Points, 3.81 mm Pitch, With Cover, use on Low Height Module, Hardened
	NTSXTB18200H	Spring Terminal Block, 18 Points, 3.81 mm Pitch, Without Cover, use on Low Height Module, Hardened
	NTSXTB18201H	Spring Terminal Block, 18 Points, 3.81 mm Pitch, With Cover, use on Low Height Module, Hardened **NOTE:** The terminal blocks are purchased separately.

NOTE: For more information on accessories and spare parts, refer to Modicon Edge I/O - System Planning and Installation Guide.

Physical Description

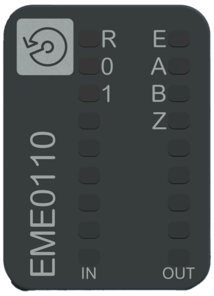
The following figure presents the elements of the module:



1: Release button for disengaging the module from the base
2: Status LEDs
3: Slot for the terminal block
4: Hinge for the terminal block installation

Status LEDs

The following figure presents the NTSEME0110 status LEDs:

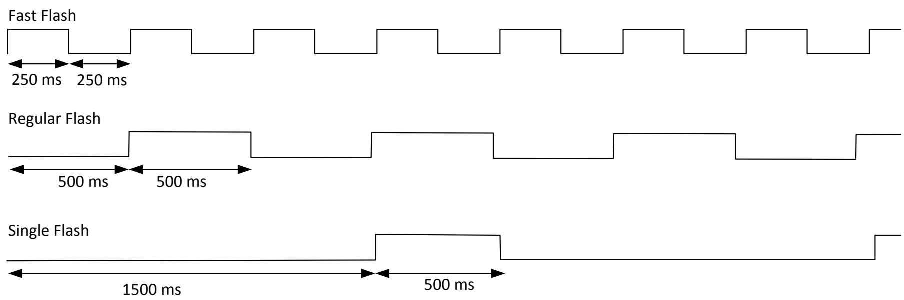


The following table describes the status of LEDs:

R (Green)	E (Red)	IN0...1 (Green)	QA (Green)	QB (Green)	QZ (Green)	Description
Initialization and non-operational states						
OFF	OFF	-	-	-	-	Indicates that the module is not energized.
OFF	ON	-	-	-	-	Indicates that an internal error is detected.
OFF	Regular Flash	-	-	-	-	Indicates that a system error is detected.
Single Flash	OFF	-	-	-	-	Indicates that the module is not configured.
Regular Flash	OFF	-	-	-	-	Indicates that the firmware is being updated.
Regular Flash	ON	-	-	-	-	Indicates that a module mismatch is detected.
Fast Flash	-	-	-	-	-	Indicates that the module is in commissioning mode.
Operational state						
ON	OFF	-	-	-	-	Indicates that the module is powered, configured and operational.
ON	OFF	ON	-	-	-	Indicates that the corresponding input channel is activated.
ON	OFF	OFF	-	-	-	Indicates that the corresponding input channel is deactivated.
ON	OFF	-	OFF	-	-	Indicates that no frequency is generated on line A output.
ON	OFF	-	Regular Flash	-	-	Indicates that a frequency from 0.1 Hz to 100 Hz is generated on line A output.
ON	OFF	-	Fast Flash	-	-	Indicates that a frequency from 100.1 Hz to 1000 Hz is generated on line A output.
ON	OFF	-	ON	-	-	Indicates that a frequency from 1000.1 Hz to maximum frequency is generated on line A output.
ON	OFF	-	-	OFF	-	Indicates that no frequency is generated on line B output.
ON	OFF	-	-	Regular Flash	-	Indicates that a frequency from 0.1 Hz to 100 Hz is generated on line B output.
ON	OFF	-	-	Fast Flash	-	Indicates that a frequency from 100.1 Hz to 1000 Hz is generated on line B output.
ON	OFF	-	-	ON	-	Indicates that a frequency from 1000.1 Hz to maximum frequency is generated on line B output.
ON	OFF	-	-	-	OFF	Indicates that the top Z line output is OFF.
ON	OFF	-	-	-	ON	Indicates that the top Z line output is ON.

R (Green)	E (Red)	IN0...1 (Green)	QA (Green)	QB (Green)	QZ (Green)	Description
ON	Single Flash	-	-	-	-	Indicates one of the following: • The module is restarting. • An advisory is detected.
ON	Regular Flash	-	-	-	-	Indicates one of the following: • An error is detected at the channel level. • The module is in fallback state.
ON	ON	-	-	-	-	Indicates that an error is detected at the module level.

The following graphic depicts the system status of LEDs during module operation:



NTSEME0110 Characteristics

Overview

This section provides a general description of the characteristics of the module.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

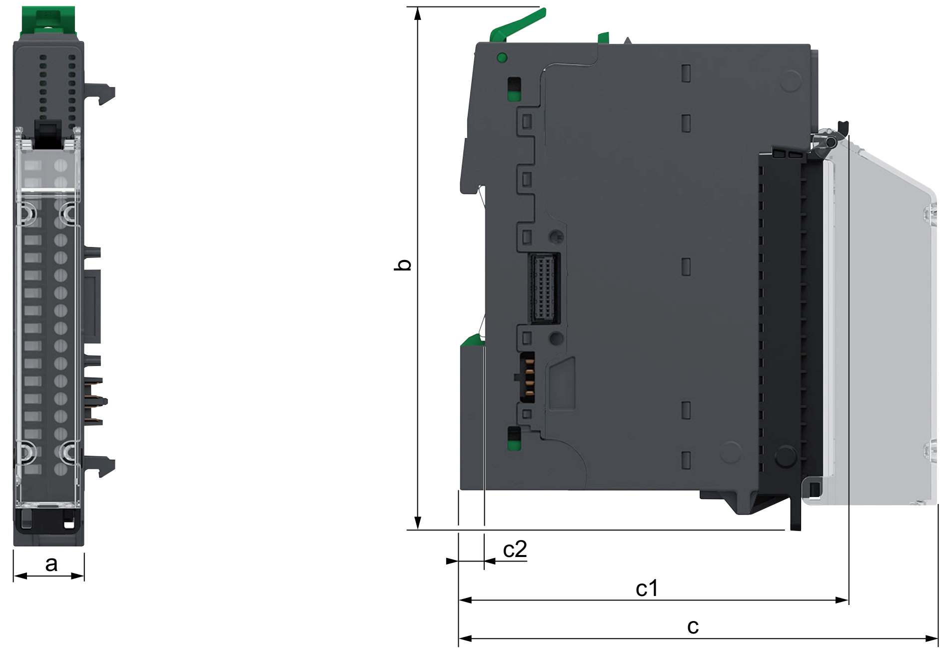
Do not exceed any of the rated values specified in the environmental and electrical characteristics tables.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

For more information on environmental characteristics, refer to Modicon Edge I/O - System Planning and Installation Guide.

Dimensions

The following figure presents the external dimensions for the assembled module:



a: 15 mm (0.59 in)
b: 116.6 mm (4.57 in)
c: 107.5 mm (4.21 in)
c1: 88.2 mm (3.46 in)
c2: 5.6 mm (0.2 in)

Weight

- NTSEME0110: 48 g (1.69 oz)
- NTSEME0110K: 73 g (2.57 oz)

General Characteristics

The following table describes the general characteristics of the NTSEME0110 module:

Characteristics		Value
Rated supplied voltage		24 Vdc
Power supplied voltage range		20.4...28.8 Vdc
Bus current consumption		29.5 mA
Field current consumption		64.8 mA
Power dissipation		2.1 W
Field power supply	Encoder channel	Encoder supply provided from power supply module.
	Discrete outputs	Internal
Isolation	Between input channels	No isolation
	Between internal logic and input channels	1,000 Vac
	Between internal logic and encoder signals	
	Between internal logic and encoder power	
	Between internal logic and output channels	
	Between internal logic and ground	
	Between input channels and encoder signals	850 Vac
	Between input channels and encoder power	
	Between input and outputs channels	
	Between input channels and ground	1,500 Vac
	Between encoder signals and ground	
	Between encoder power and ground	
Hot swap supported		Yes
Operating ambient temperature derating		No derating

Fast Discrete Inputs Characteristics

The following table describes the fast discrete inputs characteristics:

Characteristics		Value
Rated input voltage		24 Vdc
Input voltage range		0...30 Vdc
Rated input current		2.25 mA
Input logic		Sink
Input compatibility		Type 3 according to IEC 61131-2
Input wiring mode		2-wire
Input voltage	Logic state 1	> 11 Vdc
	Logic state 0	< 11 Vdc for I < 1.5 mA < 5 Vdc for I > 1.5 mA
Input current	Logic state 1	> 2 mA
	Logic state 0	< 15 mA
Response time on input	Logic state 1 to logic state 0	500 ns + filter delay
	Logic state 0 to logic state 1	500 ns + filter delay
Input filter time	Software	Configurable: 200 ns, 500 ns 1 µs, 2 µs, 5 µs, 10 µs, 50 µs, 80 µs, 500 µs, 1 ms, 4 ms, or 12 ms
Protection	Overvoltage	Up to ±60 Vdc
	Reverse polarity	Yes
Cable	Type	Shielded
	Maximum length	20 m (65.6 ft)

Pulse Output Characteristics

The following table describes the pulse generator output characteristics:

Characteristics		Value
Output type		RS-422
Maximum output current		60 mA
Maximum short circuit output current		250 mA
Signal frequency		Maximum 400 kHz
Line termination	AC Termination	150 Ω - 220 pF
RS-422 Cable	Type	0.2 mm² (24 AWG) twisted pair - Shielded
	Maximum length	20 m (65.6 ft)
Protection	Short circuit	Yes, thermal shutdown with autoretry

NTSEME0110 Wiring

Overview

This section provides the wiring diagrams for the NTSEME0110 module.

Wiring Rules

For more information on the wiring, refer to Modicon Edge I/O - System Planning and Installation Guide.

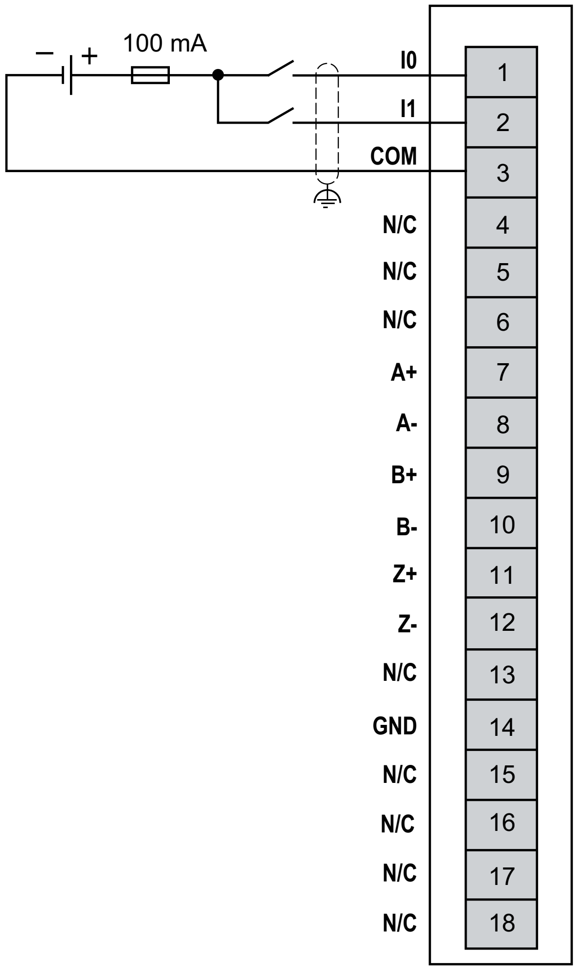
Pin Assignment

This table describes the pin assignment of the terminal block:

Pin	Signal	Description
1	I0	Fast input channel 0
2	I1	Fast input channel 1
3	COM	Common for fast input
4	N/C	No Connection
5	N/C	No Connection
6	N/C	No Connection
7	A+	Channel A positive differential incremental output
8	A-	Channel A negative differential incremental output
9	B+	Channel B positive differential incremental output
10	B-	Channel B negative differential incremental output
11	Z+	Channel Z positive differential incremental output
12	Z-	Channel Z negative differential incremental output
13	N/C	No Connection
14	GND	Ground reference for the differential output line
15	N/C	No Connection
16	N/C	No Connection
17	N/C	No Connection
18	N/C	No Connection

Fast Discrete Inputs Wiring Diagram

The following figure illustrates the wiring diagram of the fast discrete inputs:



N/C: No Connection

NOTE: An external fuse of type T, 100 mA, 24 Vdc is mandatory and must be chosen in compliance with the IEC60269 standard.

⚠ WARNING

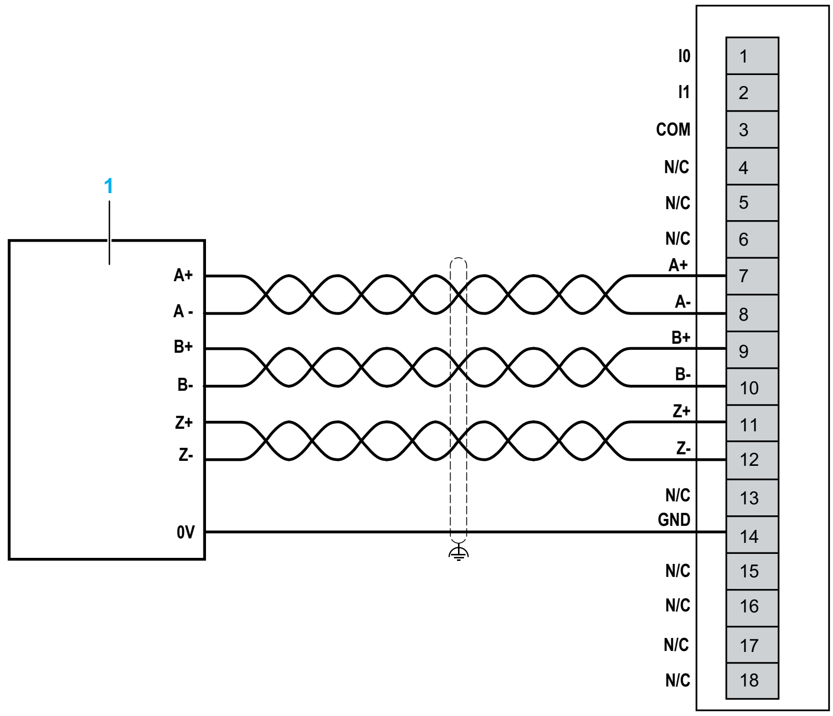
UNINTENDED EQUIPMENT OPERATION

Do not connect wires to unused terminals and/or terminals indicated as “No Connection (N/C)”.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Encoder Output Wiring Diagram

The following figure illustrates the wiring diagram of an encoder output:



1: Incremental Input Device
N/C: No Connection

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Do not connect wires to unused terminals and/or terminals indicated as “No Connection (N/C)”.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NTSEME0110 Parameters

Overview

The NTSEME0110 module is equipped with two fast discrete inputs. For information on the configuration of this module, refer to Fast Discrete Input Configuration, page 172.

Alternatively, you can add a maximum of one expert function to your module using the **Add a function** button. You can configure only one channel at a time. For more information on expert functions configuration, refer to Output encoder Interface, page 219.

Parameters Description

Configurable Parameters

The following table presents the configurable parameters for the NTSEME0110 module:

Displayed Name ***Parameter Name***	**Value**	**Data type**	**Description**
Device Mode *DeviceMode*	0: **Normal*** 1: **Optional** 2: **Virtual reserved** 3: **Virtual absent**	ENUM	Allows you to select the device mode: • **Normal**: The module is part of the software configuration and is physically installed in the cluster. • **Optional**: The module is part of the software configuration. A dummy module or the configured module must be physically installed in the cluster. Whether either module is present does not cause a configuration error to be detected. • **Virtual reserved**: The module is part of the software configuration. A dummy module must be physically installed in the cluster. If the virtual reserved module is physically installed in the cluster, a configuration error is detected. • **Virtual absent**: The module is part of the software configuration. A base must not be physically installed in the cluster. If a module is physically installed in the cluster, a configuration error is detected.
* Parameter default value			

Implicit Data

The following table presents the input implicit data for the NTSEME0110 module:

Parameter Name	**Value**	**Data type** **Size in bytes** **R/W**	**Description**
GCS	0...255	BYTE 1 R/-	Group Cyclic Status Bit 0: Data quality Bit 1: General module status Bit 2: I/O status Bit 3: N/A Bit 4: N/A Bit 5: Advisory status Bit 6: N/A Bit 7: Data freshness **NOTE:** For more information, refer to Modicon Edge I/O - Diagnostic Data - User Guide.
IValue0_7	0...255	BYTE 1 R/-	Value of the input channels (Bit field). Bit 0...7 = Value of channel 0...7 **NOTE:** Unused bits are reserved.

The following table presents the output implicit data for the NTSEME0110 module:

Parameter Name	**Value**	**Data type** **Size in bytes** **R/W**	**Description**
LatchAck0_7	0...255	BYTE 1 R/W	At rising edge, resets the latch value of the input on the channel 0...7. Bit 0...7 = Value of channel 0...7 **NOTE:** Unused bits are reserved.

NTSEDT0800 Timestamped Discrete Input Module, 8 Inputs

What's in This Chapter

NTSEDT0800 Presentation

Overview

This section provides a presentation of the NTSEDT0800 module.

The following function is supported by the NTSEDT0800 module:

- Timestamp Input Mode Principle Description, page 234.

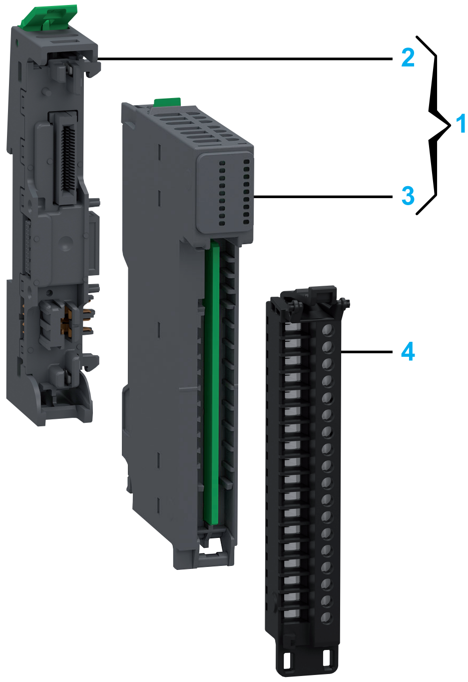
Main Characteristics

The following table describes the main characteristics of the NTSEDT0800 module.

Main Characteristics	Value
Product or component type	Expert discrete timestamped input module
Number of input channels	8 fast discrete inputs, page 116
Operating mode	Synchronous

Purchasing Information

The following figure presents the elements of the Modicon Edge I/O NTS NTSEDT0800 module:

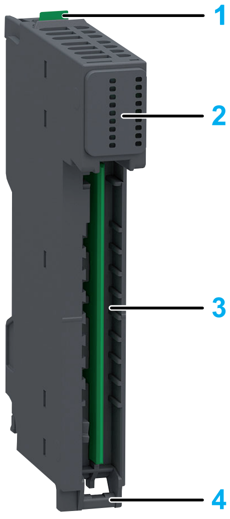


Number	Reference	Description
1	NTSEDT0800K	Base + Module (kit) **NOTE:** The module and its corresponding base can be purchased as a kit.
2	NTSXBA0100H	Spare Base, 1 Slot, for Input/Output Common or Expert Module, Hardened
3	NTSEDT0800	Timestamped Discrete Input Module, 8 Inputs
4	NTSXTB18000H	Screw Terminal Block, 18 Points, 3.81 mm Pitch, Without Cover, use on Low Height Module, Hardened
	NTSXTB18001H	Screw Terminal Block, 18 Points, 3.81 mm Pitch, With Cover, use on Low Height Module, Hardened
	NTSXTB18200H	Spring Terminal Block, 18 Points, 3.81 mm Pitch, Without Cover, use on Low Height Module, Hardened
	NTSXTB18201H	Spring Terminal Block, 18 Points, 3.81 mm Pitch, With Cover, use on Low Height Module, Hardened **NOTE:** The terminal blocks are purchased separately.

NOTE: For more information on accessories and spare parts, refer to Modicon Edge I/O - System Planning and Installation Guide.

Physical Description

The following figure presents the elements of the module:



1: Release button for disengaging the module from the base
2: Status LEDs
3: Slot for the terminal block
4: Hinge for the terminal block installation

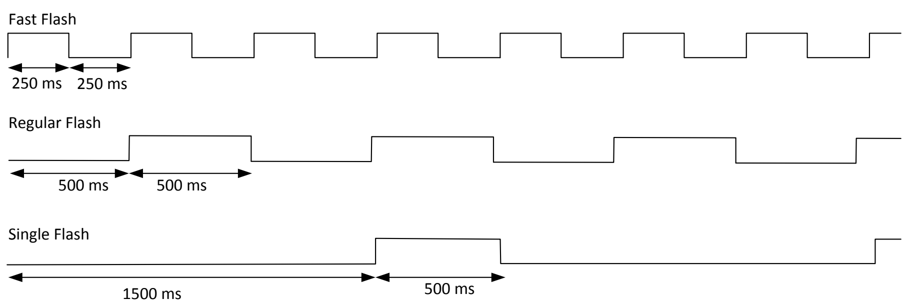
Status LEDs

The following figure presents the NTSEDT0800 status LEDs:

The following table describes the status of LEDs:

R (Green)	E (Red)	IN0...7 (Green)	Description
Initialization and non-operational states			
OFF	OFF	-	Indicates that the module is not energized.
OFF	ON	-	Indicates that an internal error is detected.
OFF	Regular Flash	-	Indicates that a system error is detected.
Single Flash	OFF	-	Indicates that the module is not configured.
Regular Flash	OFF	-	Indicates that the firmware is being updated.
Regular Flash	ON	-	Indicates that a module mismatch is detected.
Fast Flash	-	-	Indicates that the module is in commissioning mode.
Operational state			
ON	OFF	-	Indicates that the module is powered, configured and operational.
ON	OFF	ON	Indicates that the corresponding input channel is activated.
ON	OFF	OFF	Indicates that the corresponding input channel is deactivated.
ON	Single Flash	-	Indicates one of the following: • The module is restarting. • An advisory is detected.
ON	Regular Flash	-	Indicates one of the following: • An error is detected at the channel level. • The module is in fallback state.
ON	ON	-	Indicates that an error is detected at the module level.

The following graphic depicts the system status of LEDs during module operation:



NTSEDT0800 Characteristics

Overview

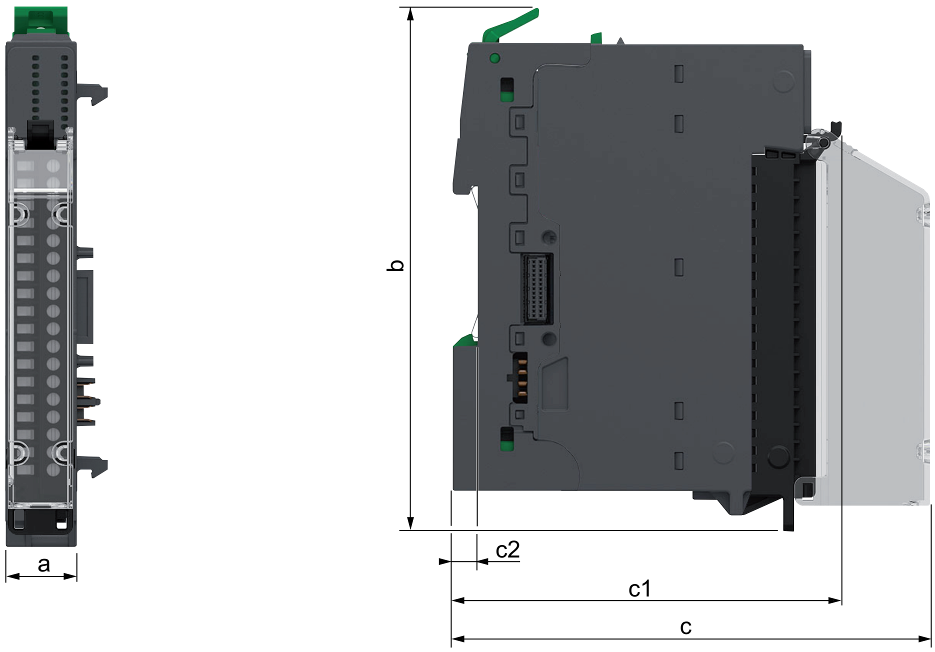
This section provides a general description of the characteristics of the module.

⚠ WARNING
UNINTENDED EQUIPMENT OPERATION Do not exceed any of the rated values specified in the environmental and electrical characteristics tables. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

For more information on environmental characteristics, refer to Modicon Edge I/O - System Planning and Installation Guide.

Dimensions

The following figure presents the external dimensions for the assembled module:



a: 15 mm (0.59 in)
b: 116.6 mm (4.57 in)
c: 107.5 mm (4.21 in)
c1: 88.2 mm (3.46 in)
c2: 5.6 mm (0.2 in)

Weight

- NTSEDT0800: 48 g (1.69 oz)
- NTSEDT0800K: 73 g (2.57 oz)

General Characteristics

The following table describes the general characteristics of the NTSEDT0800 module:

Characteristics		Value
Rated supplied voltage		24 Vdc
Power supplied voltage range		20.4...28.8 Vdc
Bus current consumption		30.8 mA
Field current consumption		0 mA
Power dissipation		1.3 W
Field power supply	Discrete inputs	Internal
Isolation	Between input channels	No isolation
	Between groups of input channels	850 Vac
	Between internal logic and input channels	1,000 Vac
	Between internal logic and ground	
	Between input channels and ground	1,500 Vac
Hot swap supported		Yes
Operating ambient temperature derating		No derating

Fast Discrete Inputs Characteristics

The following table describes the fast discrete inputs characteristics:

Characteristics		Value
Rated input voltage		24 Vdc
Input voltage range		0...30 Vdc
Rated input current		2.25 mA
Input logic		Sink
Input compatibility		Type 3 according to IEC 61131-2
Input wiring mode		2-wire
Input voltage	Logic state 1	> 11 Vdc
	Logic state 0	< 11 Vdc for I < 1.5 mA < 5 Vdc for I > 1.5 mA
Input current	Logic state 1	> 2 mA
	Logic state 0	< 15 mA
Response time on input	Logic state 1 to logic state 0	500 ns + filter delay
	Logic state 0 to logic state 1	500 ns + filter delay
Input filter time	Software	Configurable: 200 ns, 500 ns 1 μs, 2 μs, 5 μs, 10 μs, 50 μs, 80 μs, 500 μs, 1 ms, 4 ms, or 12 ms
Protection	Overvoltage	Up to ±60 Vdc
	Reverse polarity	Yes
Cable	Type	Shielded
	Maximum length	20 m (65.6 ft)

NTSEDT0800 Wiring

Overview

This section provides the wiring diagrams for the NTSEDT0800 module.

Wiring Rules

For more information on the wiring, refer to Modicon Edge I/O - System Planning and Installation Guide.

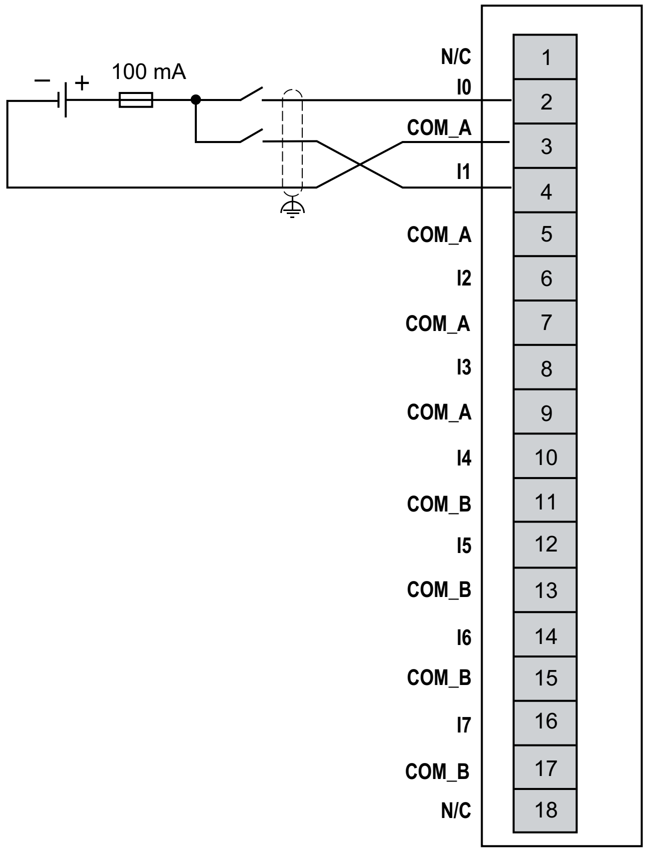
Pin Assignment

This table describes the pin assignment of the terminal block:

Pin	Signal	Description
1	N/C	No Connection
2	I0	Fast input channel 0
3	COM_A	Common for fast input of group A
4	I1	Fast input channel 1
5	COM_A	Common for fast input of group A
6	I2	Fast input channel 2
7	COM_A	Common for fast input of group A
8	I3	Fast input channel 3
9	COM_A	Common for fast input of group A
10	I4	Fast input channel 4
11	COM_B	Common for fast input of group B
12	I5	Fast input channel 5
13	COM_B	Common for fast input of group B
14	I6	Fast input channel 6
15	COM_B	Common for fast input of group B
16	I7	Fast input channel 7
17	COM_B	Common for fast input of group B
18	N/C	No Connection

Fast Discrete Inputs Wiring Diagram

The following figure illustrates the wiring diagram of the fast discrete inputs:



N/C: No Connection

NOTE: An external fuse of type T, 100 mA, 24 Vdc is mandatory and must be chosen in compliance with the IEC60269 standard.

⚠ WARNING
UNINTENDED EQUIPMENT OPERATION Do not connect wires to unused terminals and/or terminals indicated as “No Connection (N/C)”. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

NTSEDT0800 Parameters

Overview

The NTSEDT0800 module is equipped with eight fast discrete inputs. For information on the configuration of this module, refer to Inputs and Outputs Configuration, page 172.

Alternatively, you can add up to eight expert functions to your module using the **Add a function** button. For more information on expert functions configuration, refer to Timestamp Input Configuration, page 236.

Parameters Description

Configurable Parameters

The following table presents the configurable parameters for the NTSEDT0800 module:

Displayed Name ***Parameter Name***	**Value**	**Data type**	**Description**
Device Mode *DeviceMode*	0: **Normal*** 1: **Optional** 2: **Virtual reserved** 3: **Virtual absent**	ENUM	Allows you to select the device mode: • **Normal**: The module is part of the software configuration and is physically installed in the cluster. • **Optional**: The module is part of the software configuration. A dummy module or the configured module must be physically installed in the cluster. Whether either module is present does not cause a configuration error to be detected. • **Virtual reserved**: The module is part of the software configuration. A dummy module must be physically installed in the cluster. If the virtual reserved module is physically installed in the cluster, a configuration error is detected. • **Virtual absent**: The module is part of the software configuration. A base must not be physically installed in the cluster. If a module is physically installed in the cluster, a configuration error is detected.
* Parameter default value			

Implicit Data

The following table presents the input implicit data for the NTSEDT0800 module:

Parameter Name	**Value**	**Data type** **Size in bytes** **R/W**	**Description**
GCS	0...255	BYTE 1 R/-	Group Cyclic Status Bit 0: Data quality Bit 1: General module status Bit 2: I/O status Bit 3: N/A Bit 4: N/A Bit 5: Advisory status Bit 6: N/A Bit 7: Data freshness **NOTE:** For more information, refer to Modicon Edge I/O - Diagnostic Data - User Guide.
IValue0_7	0...255	BYTE 1 R/-	Value of the input channels (Bit field). Bit 0...7 = Value of channel 0...7 **NOTE:** Unused bits are reserved.

The following table presents the output implicit data for the NTSEDT0800 module:

Parameter Name	**Value**	**Data type** **Size in bytes** **R/W**	**Description**
LatchAck0_7	0...255	BYTE 1 R/W	At rising edge, resets the latch value of the input on the channel 0...7. Bit 0...7 = Value of channel 0...7 **NOTE:** Unused bits are reserved.

NTSEDT0810 Timestamped Discrete Output Module, 8 Outputs

What's in This Chapter

NTSEDT0810 Presentation

Overview

This section provides a presentation of the NTSEDT0810 module.

The following function is supported by the NTSEDT0810 module:

- Timestamp Output Mode Principle Description, page 245.

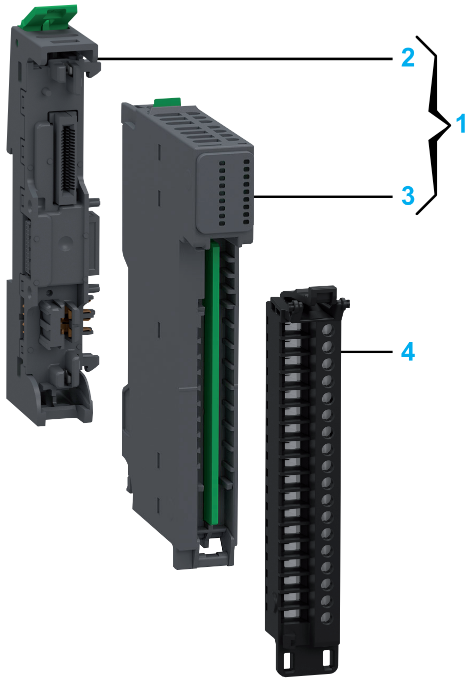
Main Characteristics

The following table describes the main characteristics of the NTSEDT0810 module.

Main Characteristics	Value
Product or component type	Timestamped discrete output module
Number of output channels	8 fast discrete outputs, page 127
Operating mode	Synchronous

Purchasing Information

The following figure presents the elements of the Modicon Edge I/O NTS NTSEDT0810 module:

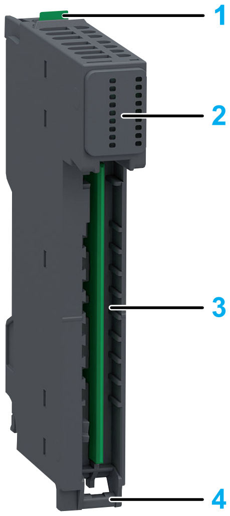


Number	Reference	Description
1	NTSEDT0810K	Base + Module (kit) **NOTE:** The module and its corresponding base can be purchased as a kit.
2	NTSXBA0100H	Spare Base, 1 Slot, for Input/Output Common or Expert Module, Hardened
3	NTSEDT0810	Timestamped Discrete Output Module, 8 Outputs
4	NTSXTB18000H	Screw Terminal Block, 18 Points, 3.81 mm Pitch, Without Cover, use on Low Height Module, Hardened
	NTSXTB18001H	Screw Terminal Block, 18 Points, 3.81 mm Pitch, With Cover, use on Low Height Module, Hardened
	NTSXTB18200H	Spring Terminal Block, 18 Points, 3.81 mm Pitch, Without Cover, use on Low Height Module, Hardened
	NTSXTB18201H	Spring Terminal Block, 18 Points, 3.81 mm Pitch, With Cover, use on Low Height Module, Hardened **NOTE:** The terminal blocks are purchased separately.

NOTE: For more information on accessories and spare parts, refer to Modicon Edge I/O - System Planning and Installation Guide.

Physical Description

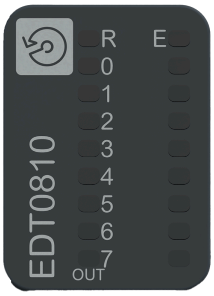
The following figure presents the elements of the module:



1: Release button for disengaging the module from the base
2: Status LEDs
3: Slot for the terminal block
4: Hinge for the terminal block installation

Status LEDs

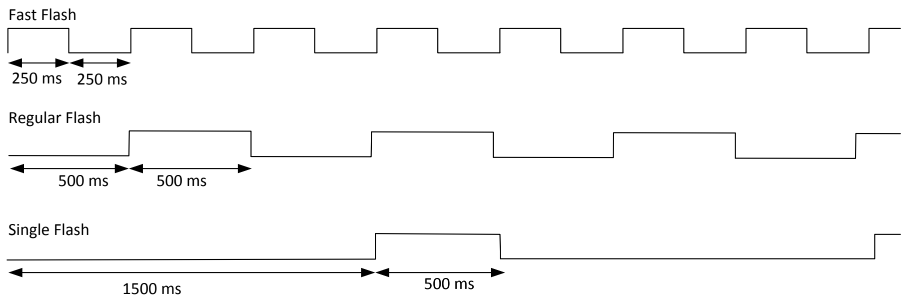
The following figure presents the NTSEDT0810 status LEDs:



The following table describes the status of LEDs:

R (Green)	E (Red)	OUT0...7 (Green)	Description
Initialization and non-operational states			
OFF	OFF	-	Indicates that the module is not energized.
OFF	ON	-	Indicates that an internal error is detected.
OFF	Regular Flash	-	Indicates that a system error is detected.
Single Flash	OFF	-	Indicates that the module is not configured.
Regular Flash	OFF	-	Indicates that the firmware is being updated.
Regular Flash	ON	-	Indicates that a module mismatch is detected.
Fast Flash	-	-	Indicates that the module is in commissioning mode.
Operational state			
ON	OFF	-	Indicates that the module is powered, configured and operational.
ON	OFF	ON	Indicates that the corresponding output channel is activated.
ON	OFF	OFF	Indicates that the corresponding output channel is deactivated.
ON	Single Flash	-	Indicates one of the following: • The module is restarting. • An advisory is detected.
ON	Regular Flash	-	Indicates one of the following: • An error is detected at the channel level. • The module is in fallback state.
ON	ON	-	Indicates that an error is detected at the module level.
ON	Regular Flash	OFF	Indicates that an error is detected in the 24 Vdc field power.
ON	Regular Flash	Regular Flash	Indicates that a short circuit is detected on the output.

The following graphic depicts the system status of LEDs during module operation:



NTSEDT0810 Characteristics

Overview

This section provides a general description of the characteristics of the module.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

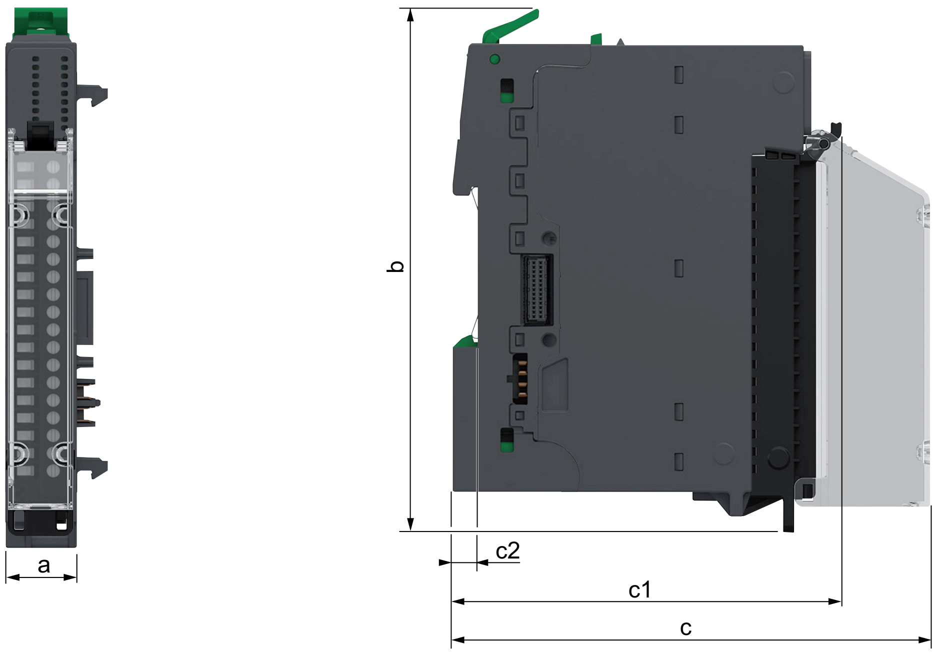
Do not exceed any of the rated values specified in the environmental and electrical characteristics tables.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

For more information on environmental characteristics, refer to Modicon Edge I/O - System Planning and Installation Guide.

Dimensions

The following figure presents the external dimensions for the assembled module:



a: 15 mm (0.59 in)
b: 116.6 mm (4.57 in)
c: 107.5 mm (4.21 in)
c1: 88.2 mm (3.46 in)
c2: 5.6 mm (0.2 in)

Weight

- NTSEDT0810: 48 g (1.69 oz)
- NTSEDT0810K: 73 g (2.57 oz)

General Characteristics

The following table describes the general characteristics of the NTSEDT0810 module:

Characteristics		**Value**
Rated supplied voltage		24 Vdc
Power supplied voltage range		20.4...28.8 Vdc
Bus current consumption		33.6 mA
Field current consumption		2,411.5 mA
Power dissipation		1.5 W
Field power supply	Discrete outputs	Internal
Isolation	Between input channels	No isolation
	Between internal logic and output channels	1,000 Vac
	Between internal logic and ground	
	Between output channels and ground	1,500 Vac
Hot swap supported		Yes
Operating ambient temperature derating		No derating

Fast Discrete Output Characteristics

The following table describes the fast discrete output characteristics:

Characteristics		Value
Rated output voltage		24 Vdc
Output type		Push-pull
Maximum output current per output		250 mA when the output is in steady state 50 mA when the output is oversampled
Output logic		Source
Output wiring mode		2-wire
Output supply		Internal
Output voltage	At logic state 1	24 Vdc field supply - voltage drop Maximum voltage drop: 1.81 Vdc
	At logic state 0	0 Vdc field supply + voltage drop Maximum voltage drop: 1 Vdc
Load type	Resistive	Lamp: 1 W maximum
	Inductive	1 H maximum
Response time on output	Logic state 1 to logic state 0	750 ns
	Logic state 0 to logic state 1	750 ns
Protection	Overload	1.6 A...1.94 A with a typical value of 1.84 A Protection by group of 4 outputs In compliance with the IEC61131-2 standard, the overload testing pattern is 1.5 x IE (IE = 250 mA per output) applied during 1 s ON, then 9 s OFF.
	Short circuit	4 A typical Protection by group of 4 outputs
Cable	Type	Shielded
	Maximum length	20 m (65.6 ft)

NTSEDT0810 Wiring

Overview

This section provides the wiring diagrams for the NTSEDT0810 module.

Wiring Rules

For more information on the wiring, refer to Modicon Edge I/O - System Planning and Installation Guide.

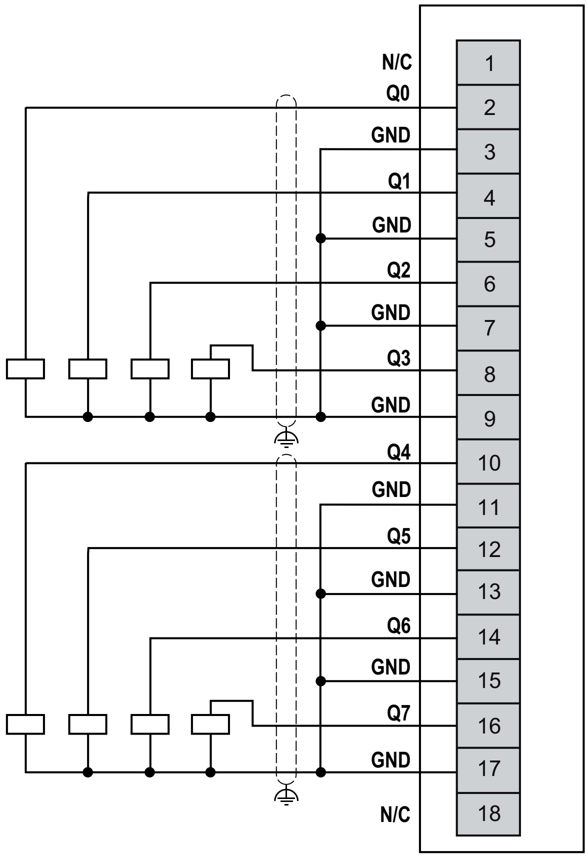
Pin Assignment

This table describes the pin assignment of the terminal block:

Pin	Signal	Description
1	N/C	No Connection
2	Q0	Fast output channel 0
3	GND	Ground for fast output
4	Q1	Fast output channel 1
5	GND	Ground for fast output
6	Q2	Fast output channel 2
7	GND	Ground for fast output
8	Q3	Fast output channel 3
9	GND	Ground for fast output
10	Q4	Fast output channel 4
11	GND	Ground for fast output
12	Q5	Fast output channel 5
13	GND	Ground for fast output
14	Q6	Fast output channel 6
15	GND	Ground for fast output
16	Q7	Fast output channel 7
17	GND	Ground for fast output
18	N/C	No Connection

Fast Discrete Output Wiring Diagram

The following figure illustrates the wiring diagram of the fast discrete outputs:



N/C: No Connection

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Do not connect wires to unused terminals and/or terminals indicated as “No Connection (N/C)”.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NTSEDT0810 Parameters

Overview

The NTSEDT0810 module is equipped with 8 fast discrete outputs. For information on the configuration of this module, refer to Inputs and Outputs Configuration, page 172.

Alternatively, you can add up to eight expert functions to your module using the **Add a function** button. For more information on expert functions configuration, refer to Timestamp Output Configuration, page 246.

Parameters Description

Configurable Parameters

The following table presents the configurable parameters for the NTSEDT0810 module:

<table>
<tr><th>Displayed Name
Parameter Name</th><th>Value</th><th>Data type</th><th>Description</th></tr>
<tr><td>Device Mode
DeviceMode</td><td>0: Normal*
1: Optional
2: Virtual reserved
3: Virtual absent</td><td>ENUM</td><td>Allows you to select the device mode:
Normal: The module is part of the software configuration and is physically installed in the cluster.
Optional: The module is part of the software configuration. A dummy module or the configured module must be physically installed in the cluster. Whether either module is present does not cause a configuration error to be detected.
Virtual reserved: The module is part of the software configuration. A dummy module must be physically installed in the cluster. If the virtual reserved module is physically installed in the cluster, a configuration error is detected.
Virtual absent: The module is part of the software configuration. A base must not be physically installed in the cluster. If a module is physically installed in the cluster, a configuration error is detected.</td></tr>
<tr><td>Load Consumption
LoadConsumption</td><td>0...2,000
2000*</td><td>UINT16</td><td>Sets the estimated load consumption value (in mA) of your module.
This value is used for the estimation of your field power segment consumption.
The default value is the maximum load current consumption.
For more information about the current consumption for your Modicon Edge I/O module, refer to the Modicon Edge I/O - System Planning and Installation Guide.</td></tr>
<tr><td>Rearming Output Mode
RearmOutputMode</td><td>0: Latched Off
1: Auto Recovery*</td><td>ENUM</td><td>Allows you to select the rearming mode for an output channel which is latched off due to a detected error.
Two modes are available:
Latched Off: The channel is rearmed if the cause of the error is no longer present, and a rising edge on RearmOutputCmd is applied.
Auto Recovery: The output channel is rearmed automatically if the cause of the error is no longer present for a predefined delay.</td></tr>
<tr><td colspan="4">* Parameter default value</td></tr>
</table>

Implicit Data

The following table presents the input implicit data for the NTSEDT0810 module:

Parameter Name	**Value**	**Data type** **Size in bytes** **R/W**	**Description**
GCS	0...255	BYTE 1 R/-	Group Cyclic Status Bit 0: Data quality Bit 1: General module status Bit 2: I/O status Bit 3: Receive status Bit 4: Output status Bit 5: Advisory status Bit 6: N/A Bit 7: Data freshness **NOTE:** For more information, refer to Modicon Edge I/O - Diagnostic Data - User Guide.
ChannelHealthOut0_7(1)	0...255	BYTE 1 R/-	Bit 0...7 = Status of channel 0...7 • Bit = 0: Channel is invalid • Bit = 1: Channel is valid **NOTE:** Unused bits are set to 1.
(1) This parameter is not part of the implicit data if the optimized I/O profile is selected. For more information on the **IO Profile** parameter, refer to the Modicon Edge I/O NTS - Network Interface Modules - User Guide.			

The following table presents the output implicit data for the NTSEDT0810 module:

Parameter Name	**Value**	**Data type** **Size in bytes** **R/W**	**Description**
QValue0_7	0...255	BYTE 1 R/W	Value of the output channels (Bit field). Bit 0...7 = Value of channel 0...7 **NOTE:** Unused bits are reserved.
RearmOutputCmd	TRUE FALSE*	BOOL R/W	If the **Rearming Output Mode** parameter is set to **Latched Off** and the cause of the detected error is no longer present, then on a rising edge, it rearms the output channels.
* Parameter default value			

NTSEDO0810 Oversampled Discrete Output Module, 8 Outputs

What's in This Chapter

NTSEDO0810 Presentation

Overview

This section provides a presentation of the NTSEDO0810 module.

The following function is supported by the NTSEDO0810 module:

- Oversampling Output Mode Principle Description, page 239.

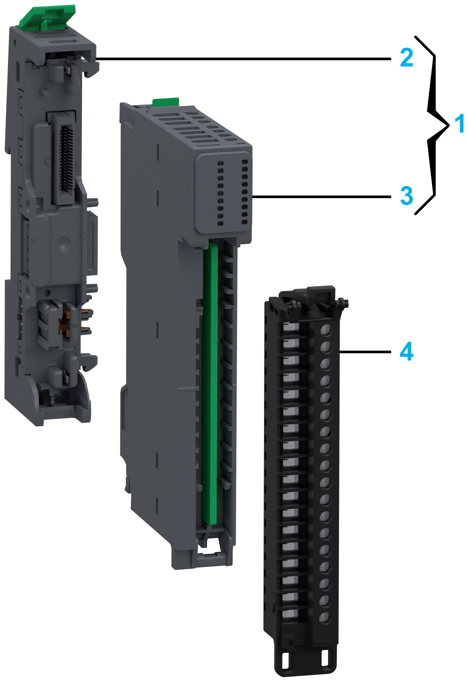
Main Characteristics

The following table describes the main characteristics of the NTSEDO0810 module.

Main Characteristics	Value
Product or component type	Oversampled discrete output module
Number of output channels	8 fast discrete outputs, page 138
Operating mode	Synchronous

Purchasing Information

The following figure presents the elements of the Modicon Edge I/O NTS NTSEDO0810 module:

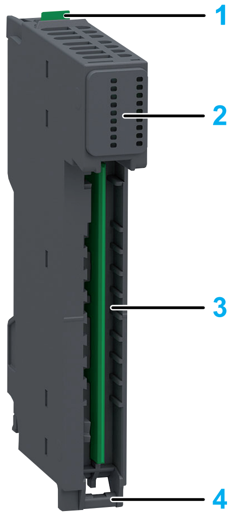


Number	Reference	Description
1	NTSEDO0810K	Base + Module (kit) **NOTE:** The module and its corresponding base can be purchased as a kit.
2	NTSXBA0100H	Spare Base, 1 Slot, for Input/Output Common or Expert Module, Hardened
3	NTSEDO0810	Oversampled Discrete Output Module, 8 Outputs
4	NTSXTB18000H	Screw Terminal Block, 18 Points, 3.81 mm Pitch, Without Cover, use on Low Height Module, Hardened
	NTSXTB18001H	Screw Terminal Block, 18 Points, 3.81 mm Pitch, With Cover, use on Low Height Module, Hardened
	NTSXTB18200H	Spring Terminal Block, 18 Points, 3.81 mm Pitch, Without Cover, use on Low Height Module, Hardened
	NTSXTB18201H	Spring Terminal Block, 18 Points, 3.81 mm Pitch, With Cover, use on Low Height Module, Hardened **NOTE:** The terminal blocks are purchased separately.

NOTE: For more information on accessories and spare parts, refer to Modicon Edge I/O - System Planning and Installation Guide.

Physical Description

The following figure presents the elements of the module:



1: Release button for disengaging the module from the base
2: Status LEDs
3: Slot for the terminal block
4: Hinge for the terminal block installation

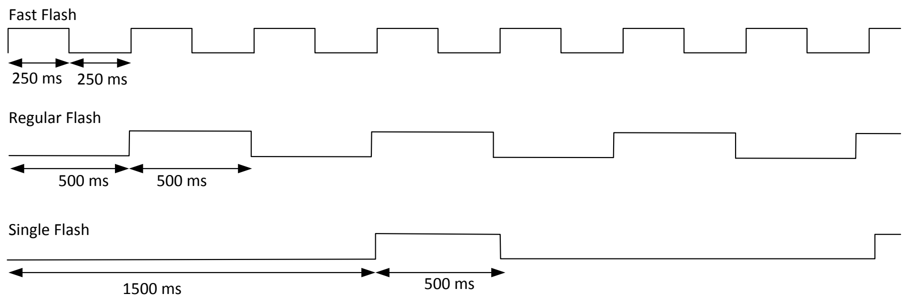
Status LEDs

The following figure presents the NTSEDO0810 status LEDs:

The following table describes the status of LEDs:

R (Green)	E (Red)	OUT0...7 (Green)	Description
Initialization and non-operational states			
OFF	OFF	-	Indicates that the module is not energized.
OFF	ON	-	Indicates that an internal error is detected.
OFF	Regular Flash	-	Indicates that a system error is detected.
Single Flash	OFF	-	Indicates that the module is not configured.
Regular Flash	OFF	-	Indicates that the firmware is being updated.
Regular Flash	ON	-	Indicates that a module mismatch is detected.
Fast Flash	-	-	Indicates that the module is in commissioning mode.
Operational state			
ON	OFF	-	Indicates that the module is powered, configured and operational.
ON	OFF	ON	Indicates that the corresponding output channel is activated.
ON	OFF	OFF	Indicates that the corresponding output channel is deactivated.
ON	Single Flash	-	Indicates one of the following: • The module is restarting. • An advisory is detected.
ON	Regular Flash	-	Indicates one of the following: • An error is detected at the channel level. • The module is in fallback state.
ON	ON	-	Indicates that an error is detected at the module level.
ON	Regular Flash	OFF	Indicates that an error is detected in the 24 Vdc field power.
ON	Regular Flash	Regular Flash	Indicates that a short circuit is detected on the output.

The following graphic depicts the system status of LEDs during module operation:



NTSEDO0810 Characteristics

Overview

This section provides a general description of the characteristics of the module.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

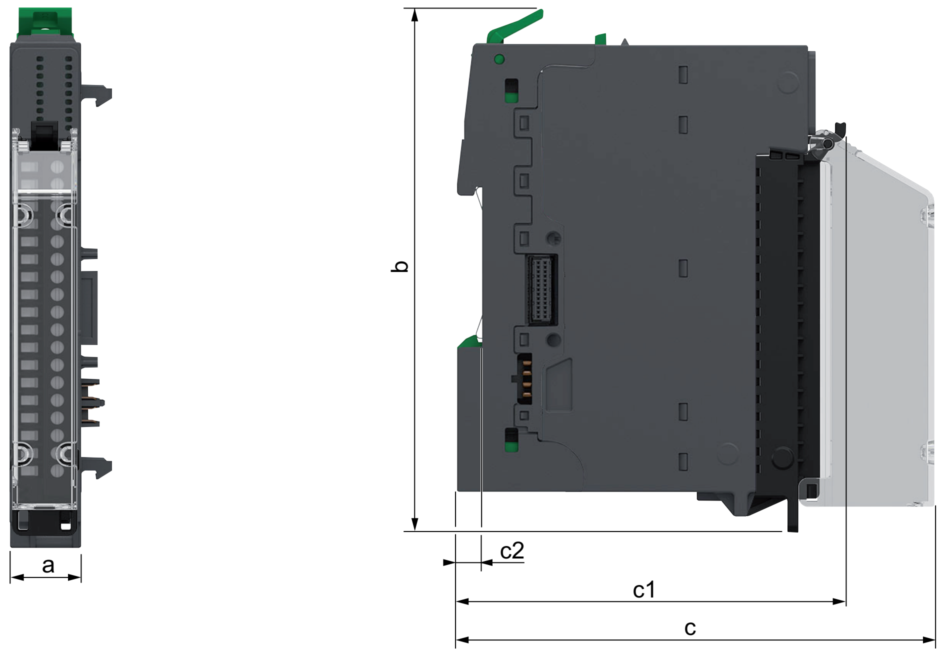
Do not exceed any of the rated values specified in the environmental and electrical characteristics tables.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

For more information on environmental characteristics, refer to Modicon Edge I/O - System Planning and Installation Guide.

Dimensions

The following figure presents the external dimensions for the assembled module:



a: 15 mm (0.59 in)
b: 116.6 mm (4.57 in)
c: 107.5 mm (4.21 in)
c1: 88.2 mm (3.46 in)
c2: 5.6 mm (0.2 in)

Weight

- NTSEDO0810: 48 g (1.69 oz)
- NTSEDO0810K: 73 g (2.57 oz)

General Characteristics

The following table describes the general characteristics of the NTSEDO0810 module:

Characteristics		Value
Rated supplied voltage		24 Vdc
Power supplied voltage range		20.4...28.8 Vdc
Bus current consumption		33.6 mA
Field current consumption		2,411.5 mA
Power dissipation		1.5 W
Field power supply	Discrete outputs	Internal
Isolation	Between input channels	No isolation
	Between internal logic and output channels	1,000 Vac
	Between internal logic and ground	
	Between output channels and ground	1,500 Vac
Hot swap supported		Yes
Operating ambient temperature derating		No derating

Fast Discrete Output Characteristics

The following table describes the fast discrete output characteristics:

Characteristics		Value
Rated output voltage		24 Vdc
Output type		Push-pull
Maximum output current per output		250 mA when the output is in steady state 50 mA when the output is oversampled
Output logic		Source
Output wiring mode		2-wire
Output supply		Internal
Output voltage	At logic state 1	24 Vdc field supply - voltage drop Maximum voltage drop: 1.81 Vdc
	At logic state 0	0 Vdc field supply + voltage drop Maximum voltage drop: 1 Vdc
Load type	Resistive	Lamp: 1 W maximum
	Inductive	1 H maximum
Response time on output	Logic state 1 to logic state 0	750 ns
	Logic state 0 to logic state 1	750 ns
Protection	Overload	1.6 A...1.94 A with a typical value of 1.84 A Protection by group of 4 outputs In compliance with the IEC61131-2 standard, the overload testing pattern is 1.5 x IE (IE = 250 mA per output) applied during 1 s ON, then 9 s OFF.
	Short circuit	4 A typical Protection by group of 4 outputs
Cable	Type	Shielded
	Maximum length	20 m (65.6 ft)

NTSEDO0810 Wiring

Overview

This section provides the wiring diagrams for the NTSEDO0810 module.

Wiring Rules

For more information on the wiring, refer to Modicon Edge I/O - System Planning and Installation Guide.

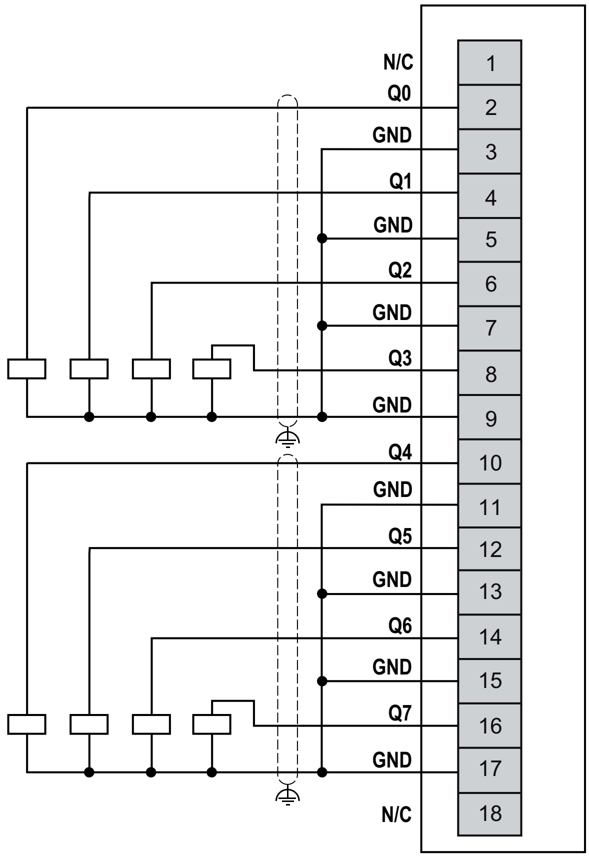
Pin Assignment

This table describes the pin assignment of the terminal block:

Pin	Signal	Description
1	N/C	No Connection
2	Q0	Fast output channel 0
3	GND	Ground for fast output
4	Q1	Fast output channel 1
5	GND	Ground for fast output
6	Q2	Fast output channel 2
7	GND	Ground for fast output
8	Q3	Fast output channel 3
9	GND	Ground for fast output
10	Q4	Fast output channel 4
11	GND	Ground for fast output
12	Q5	Fast output channel 5
13	GND	Ground for fast output
14	Q6	Fast output channel 6
15	GND	Ground for fast output
16	Q7	Fast output channel 7
17	GND	Ground for fast output
18	N/C	No Connection

Fast Discrete Output Wiring Diagram

The following figure illustrates the wiring diagram of the fast discrete outputs:



N/C: No Connection

⚠ WARNING
UNINTENDED EQUIPMENT OPERATION Do not connect wires to unused terminals and/or terminals indicated as “No Connection (N/C)”. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

NTSEDO0810 Parameters

Overview

The NTSEDO0810 module is equipped with eight fast discrete outputs. For information on the configuration of this module, refer to Inputs and Outputs Configuration, page 172.

Alternatively, you can add up to eight expert functions to your module using the **Add a function** button. For more information on expert functions configuration, refer to Oversampling Output Configuration, page 240.

Parameters Description

Configurable Parameters

The following table presents the configurable parameters for the NTSEDO0810 module:

Displayed Name ***Parameter Name***	**Value**	**Data type**	**Description**
Device Mode *DeviceMode*	0: **Normal*** 1: **Optional** 2: **Virtual reserved** 3: **Virtual absent**	ENUM	Allows you to select the device mode: • **Normal**: The module is part of the software configuration and is physically installed in the cluster. • **Optional**: The module is part of the software configuration. A dummy module or the configured module must be physically installed in the cluster. Whether either module is present does not cause a configuration error to be detected. • **Virtual reserved**: The module is part of the software configuration. A dummy module must be physically installed in the cluster. If the virtual reserved module is physically installed in the cluster, a configuration error is detected. • **Virtual absent**: The module is part of the software configuration. A base must not be physically installed in the cluster. If a module is physically installed in the cluster, a configuration error is detected.
Load Consumption *LoadConsumption*	0...2,000 **2000***	UINT16	Sets the estimated load consumption value (in mA) of your module. This value is used for the estimation of your field power segment consumption. The default value is the maximum load current consumption. For more information about the current consumption for your Modicon Edge I/O module, refer to the Modicon Edge I/O - System Planning and Installation Guide.
Rearming Output Mode *RearmOutputMode*	0: **Latched Off** 1: **Auto Recovery***	ENUM	Allows you to select the rearming mode for an output channel which is latched off due to a detected error. Two modes are available: • **Latched Off**: The channel is rearmed if the cause of the error is no longer present, and a rising edge on **RearmOutputCmd** is applied. • **Auto Recovery**: The output channel is rearmed automatically if the cause of the error is no longer present for a predefined delay.
* Parameter default value			

Implicit Data

The following table presents the input implicit data for the NTSEDO0810 module:

Parameter Name	**Value**	**Data type** **Size in bytes** **R/W**	**Description**
GCS	0...255	BYTE 1 R/-	Group Cyclic Status Bit 0: Data quality Bit 1: General module status Bit 2: I/O status Bit 3: Receive status Bit 4: Output status Bit 5: Advisory status Bit 6: N/A Bit 7: Data freshness **NOTE:** For more information, refer to Modicon Edge I/O - Diagnostic Data - User Guide.
ChannelHealthOut0_7(1)	0...255	BYTE 1 R/-	Bit 0...7 = Status of channel 0...7 • Bit = 0: Channel is invalid • Bit = 1: Channel is valid **NOTE:** Unused bits are set to 1.
(1) This parameter is not part of the implicit data if the optimized I/O profile is selected. For more information on the **IO Profile** parameter, refer to the Modicon Edge I/O NTS - Network Interface Modules - User Guide.			

The following table presents the output implicit data for the NTSEDO0810 module:

Parameter Name	**Value**	**Data type** **Size in bytes** **R/W**	**Description**
QValue0_7	0...255	BYTE 1 R/W	Value of the output channels (Bit field). Bit 0...7 = Value of channel 0...7 **NOTE:** Unused bits are reserved.
RearmOutputCmd	TRUE FALSE*	BOOL R/W	If the **Rearming Output Mode** parameter is set to **Latched Off** and the cause of the detected error is no longer present, then on a rising edge, it rearms the output channels.
* Parameter default value			

NTSEDM0822 Oversampled and Timestamped Mixed Module, 4 Inputs, 4 Outputs

What's in This Chapter

NTSEDM0822 Presentation

Overview

This section provides a presentation of the NTSEDM0822 module.

The following functions are supported by the NTSEDM0822 module:

- Timestamp Input Mode Principle Description, page 234.
- Timestamp Output Mode Principle Description, page 245.
- Oversampling Input Mode Principle Description, page 229.
- Oversampling Output Mode Principle Description, page 239.
- Output Pulse After Input Event Mode Principle Description, page 225.

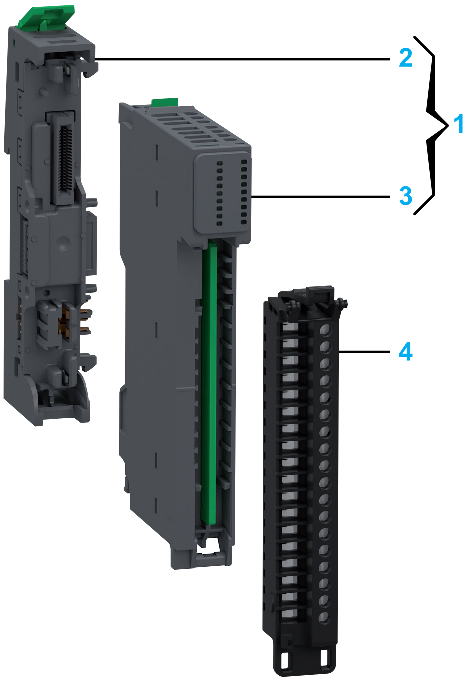
Main Characteristics

The following table describes the main characteristics of the NTSEDM0822 module.

Main Characteristics	Value
Product or component type	Oversampled and Timestamped input/output module
Number of input/output channels	4 fast discrete inputs, page 150 4 fast discrete outputs, page 151
Operating mode	Synchronous

Purchasing Information

The following figure presents the elements of the Modicon Edge I/O NTS NTSEDM0822 module:

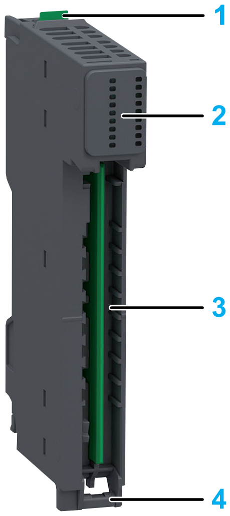


Number	Reference	Description
1	NTSEDM0822K	Base + Module (kit) **NOTE:** The module and its corresponding base can be purchased as a kit.
2	NTSXBA0100H	Spare Base, 1 Slot, for Input/Output Common or Expert Module, Hardened
3	NTSEDM0822	Oversampled and Timestamped Mixed Module, 4 Inputs, 4 Outputs
4	NTSXTB18000H	Screw Terminal Block, 18 Points, 3.81 mm Pitch, Without Cover, use on Low Height Module, Hardened
	NTSXTB18001H	Screw Terminal Block, 18 Points, 3.81 mm Pitch, With Cover, use on Low Height Module, Hardened
	NTSXTB18200H	Spring Terminal Block, 18 Points, 3.81 mm Pitch, Without Cover, use on Low Height Module, Hardened
	NTSXTB18201H	Spring Terminal Block, 18 Points, 3.81 mm Pitch, With Cover, use on Low Height Module, Hardened **NOTE:** The terminal blocks are purchased separately.

NOTE: For more information on accessories and spare parts, refer to Modicon Edge I/O - System Planning and Installation Guide.

Physical Description

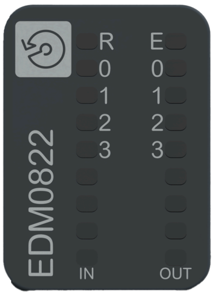
The following figure presents the elements of the module:



1: Release button for disengaging the module from the base
2: Status LEDs
3: Slot for the terminal block
4: Hinge for the terminal block installation

Status LEDs

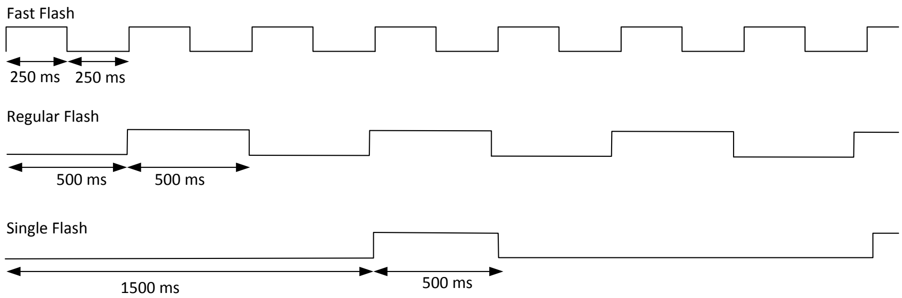
The following figure presents the NTSEDM0822 status LEDs:



The following table describes the status of LEDs:

R (Green)	E (Red)	IN0...3 (Green)	OUT0...3 (Green)	Description
Initialization and non-operational states				
OFF	OFF	-	-	Indicates that the module is not energized.
OFF	ON	-	-	Indicates that an internal error is detected.
OFF	Regular Flash	-	-	Indicates that a system error is detected.
Single Flash	OFF	-	-	Indicates that the module is not configured.
Regular Flash	OFF	-	-	Indicates that the firmware is being updated.
Regular Flash	ON	-	-	Indicates that a module mismatch is detected.
Fast Flash	-	-	-	Indicates that the module is in commissioning mode.
Operational state				
ON	OFF	-	-	Indicates that the module is powered, configured and operational.
ON	OFF	ON	-	Indicates that the corresponding input channel is activated.
ON	OFF	OFF	-	Indicates that the corresponding input channel is deactivated.
ON	OFF	-	ON	Indicates that the corresponding output channel is activated.
ON	OFF	-	OFF	Indicates that the corresponding output channel is deactivated.
ON	Single Flash	-	-	Indicates one of the following: • The module is restarting. • An advisory is detected.
ON	Regular Flash	-	-	Indicates one of the following: • An error is detected at the channel level. • The module is in fallback state.
ON	ON	-	-	Indicates that an error is detected at the module level.
ON	Regular Flash	-	OFF	Indicates that an error is detected in the 24 Vdc field power.
ON	Regular Flash	-	Regular Flash	Indicates that a short circuit is detected on the output.

The following graphic depicts the system status of LEDs during module operation:



NTSEDM0822 Characteristics

Overview

This section provides a general description of the characteristics of the module.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

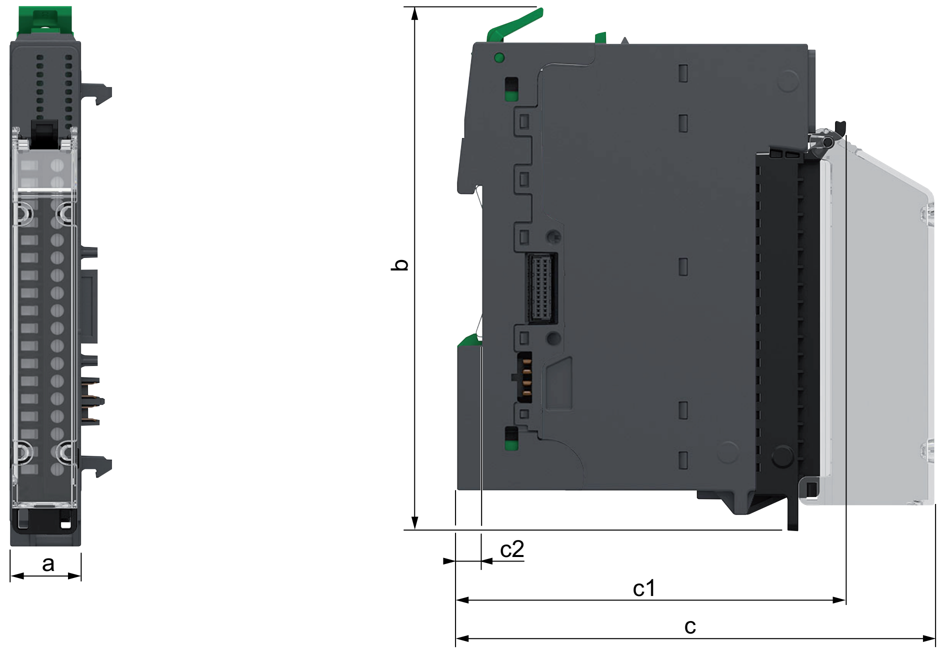
Do not exceed any of the rated values specified in the environmental and electrical characteristics tables.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

For more information on environmental characteristics, refer to Modicon Edge I/O - System Planning and Installation Guide.

Dimensions

The following figure presents the external dimensions for the assembled module:



a: 15 mm (0.59 in)
b: 116.6 mm (4.57 in)
c: 107.5 mm (4.21 in)
c1: 88.2 mm (3.46 in)
c2: 5.6 mm (0.2 in)

Weight

- NTSEDM0822: 48 g (1.69 oz)
- NTSEDM0822K: 73 g (2.57 oz)

General Characteristics

The following table describes the general characteristics of the NTSEDM0822 module:

<table>
<tr><th colspan="2">Characteristics</th><th>Value</th></tr>
<tr><td colspan="2">Rated supplied voltage</td><td>24 Vdc</td></tr>
<tr><td colspan="2">Power supplied voltage range</td><td>20.4...28.8 Vdc</td></tr>
<tr><td colspan="2">Bus current consumption</td><td>32.9 mA</td></tr>
<tr><td colspan="2">Field current consumption</td><td>1,205.8 mA</td></tr>
<tr><td colspan="2">Power dissipation</td><td>1.36 W</td></tr>
<tr><td>Field power supply</td><td>Discrete outputs</td><td>Internal</td></tr>
<tr><td rowspan="7">Isolation</td><td>Between input channels</td><td>No isolation</td></tr>
<tr><td>Between internal logic and input channels</td><td rowspan="3">1,000 Vac</td></tr>
<tr><td>Between internal logic and output channels</td></tr>
<tr><td>Between internal logic and ground</td></tr>
<tr><td>Between input and outputs channels</td><td>850 Vac</td></tr>
<tr><td>Between input channels and ground</td><td rowspan="2">1,500 Vac</td></tr>
<tr><td>Between output channels and ground</td></tr>
<tr><td colspan="2">Hot swap supported</td><td>Yes</td></tr>
<tr><td colspan="2">Operating ambient temperature derating</td><td>No derating</td></tr>
</table>

Fast Discrete Inputs Characteristics

The following table describes the fast discrete inputs characteristics:

Characteristics		Value
Rated input voltage		24 Vdc
Input voltage range		0...30 Vdc
Rated input current		2.25 mA
Input logic		Sink
Input compatibility		Type 3 according to IEC 61131-2
Input wiring mode		2-wire
Input voltage	Logic state 1	> 11 Vdc
	Logic state 0	< 11 Vdc for I < 1.5 mA < 5 Vdc for I > 1.5 mA
Input current	Logic state 1	> 2 mA
	Logic state 0	< 15 mA
Response time on input	Logic state 1 to logic state 0	500 ns + filter delay
	Logic state 0 to logic state 1	500 ns + filter delay
Input filter time	Software	Configurable: 200 ns, 500 ns 1 µs, 2 µs, 5 µs, 10 µs, 50 µs, 80 µs, 500 µs, 1 ms, 4 ms, or 12 ms
Protection	Overvoltage	Up to ±60 Vdc
	Reverse polarity	Yes
Cable	Type	Shielded
	Maximum length	20 m (65.6 ft)

Fast Discrete Output Characteristics

The following table describes the fast discrete output characteristics:

Characteristics		Value
Rated output voltage		24 Vdc
Output type		Push-pull
Maximum output current per output		250 mA when the output is in steady state 50 mA when the output is oversampled
Output logic		Source
Output wiring mode		2-wire
Output supply		Internal
Output voltage	At logic state 1	24 Vdc field supply - voltage drop Maximum voltage drop: 1.81 Vdc
	At logic state 0	0 Vdc field supply + voltage drop Maximum voltage drop: 1 Vdc
Load type	Resistive	Lamp: 1 W maximum
	Inductive	1 H maximum
Response time on output	Logic state 1 to logic state 0	750 ns
	Logic state 0 to logic state 1	750 ns
Protection	Overload	1.6 A...1.94 A with a typical value of 1.84 A Protection by group of 4 outputs In compliance with the IEC61131-2 standard, the overload testing pattern is 1.5 x IE (IE = 250 mA per output) applied during 1 s ON, then 9 s OFF.
	Short circuit	4 A typical Protection by group of 4 outputs
Cable	Type	Shielded
	Maximum length	20 m (65.6 ft)

NTSEDM0822 Wiring

Overview

This section provides the wiring diagrams for the NTSEDM0822 module.

Wiring Rules

For more information on the wiring, refer to Modicon Edge I/O - System Planning and Installation Guide.

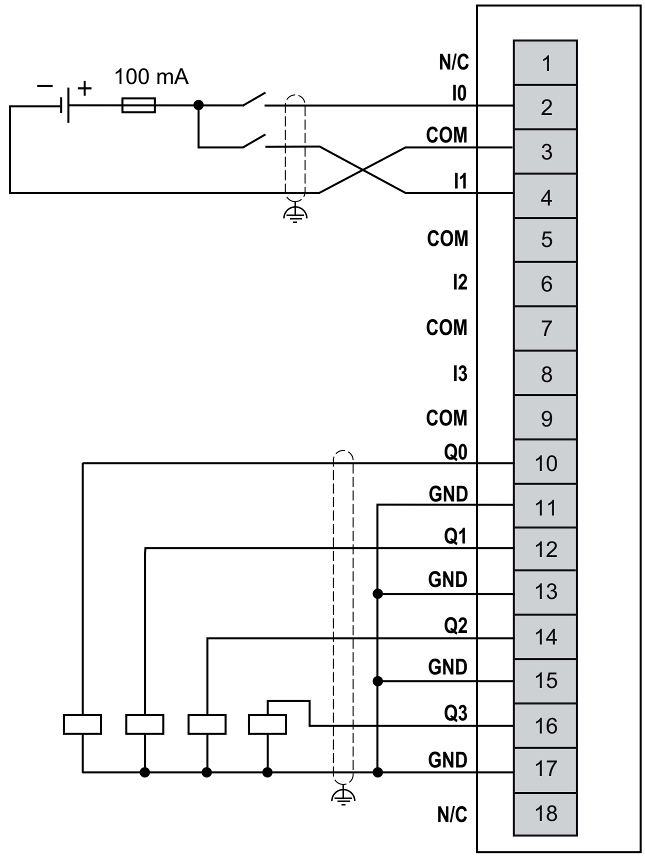
Pin Assignment

This table describes the pin assignment of the terminal block:

Pin	Signal	Description
1	N/C	No Connection
2	I0	Fast input channel 0
3	COM	Common for fast input
4	I1	Fast input channel 1
5	COM	Common for fast input
6	I2	Fast input channel 2
7	COM	Common for fast input
8	I3	Fast input channel 3
9	COM	Common for fast input
10	Q0	Fast output channel 0
11	GND	Ground for fast output
12	Q1	Fast output channel 1
13	GND	Ground for fast output
14	Q2	Fast output channel 2
15	GND	Ground for fast output
16	Q3	Fast output channel 3
17	GND	Ground for fast output
18	N/C	No Connection

Fast Input/Output Wiring Diagram

The following figure illustrates the wiring diagram of the fast discrete input and output:



N/C: No Connection

NOTE:

- An external fuse of type T, 100 mA, 24 Vdc is mandatory for inputs and must be chosen in compliance with the IEC60269 standard.
- The fast discrete outputs are internally protected, no fuse is needed.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Do not connect wires to unused terminals and/or terminals indicated as "No Connection (N/C)".

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NTSEDM0822 Parameters

Overview

The NTSEDM0822 module is equipped with:

- 4 fast discrete inputs.
- 4 standard discrete outputs.

For information on the configuration of this module, refer to Inputs and Outputs Configuration, page 172.

Alternatively, you can add up to eight expert functions to your module using the **Add a function** button. The following expert functions are available:

- Output Pulse After Input Event Interface, page 226.
- Oversampling Input Configuration, page 231.
- Timestamp Input Configuration, page 236.
- Oversampling Output Configuration, page 240.
- Timestamp Output Configuration, page 246.

Parameters Description

Configurable Parameters

The following table presents the configurable parameters for the NTSEDM0822 module:

Displayed Name ***Parameter Name***	Value	Data type	Description
Device Mode *DeviceMode*	0: **Normal*** 1: **Optional** 2: **Virtual reserved** 3: **Virtual absent**	ENUM	Allows you to select the device mode: • **Normal**: The module is part of the software configuration and is physically installed in the cluster. • **Optional**: The module is part of the software configuration. A dummy module or the configured module must be physically installed in the cluster. Whether either module is present does not cause a configuration error to be detected. • **Virtual reserved**: The module is part of the software configuration. A dummy module must be physically installed in the cluster. If the virtual reserved module is physically installed in the cluster, a configuration error is detected. • **Virtual absent**: The module is part of the software configuration. A base must not be physically installed in the cluster. If a module is physically installed in the cluster, a configuration error is detected.
Load Consumption *LoadConsumption*	0...1,000 **1000***	UINT16	Sets the estimated load consumption value (in mA) of your module. This value is used for the estimation of your field power segment consumption. The default value is the maximum load current consumption. For more information about the current consumption for your Modicon Edge I/O module, refer to the Modicon Edge I/O - System Planning and Installation Guide.
Rearming Output Mode *RearmOutputMode*	0: **Latched Off** 1: **Auto Recovery***	ENUM	Allows you to select the rearming mode for an output channel which is latched off due to a detected error. Two modes are available: • **Latched Off**: The channel is rearmed if the cause of the error is no longer present, and a rising edge on **RearmOutputCmd** is applied. • **Auto Recovery**: The output channel is rearmed automatically if the cause of the error is no longer present for a predefined delay.
* Parameter default value			

Implicit Data

The following table presents the input implicit data for the NTSEDM0822 module:

Parameter Name	**Value**	**Data type** **Size in bytes** **R/W**	**Description**
GCS	0...255	BYTE 1 R/-	Group Cyclic Status Bit 0: Data quality Bit 1: General module status Bit 2: I/O status Bit 3: Receive status Bit 4: Output status Bit 5: Advisory status Bit 6: N/A Bit 7: Data freshness **NOTE:** For more information, refer to Modicon Edge I/O - Diagnostic Data - User Guide.
IValue0_7	0...255	BYTE 1 R/-	Value of the input channels (Bit field). Bit 0...7 = Value of channel 0...7 **NOTE:** Unused bits are reserved.
ChannelHealthOut0_7(1)	0...255	BYTE 1 R/-	Bit 0...7 = Status of channel 0...7 • Bit = 0: Channel is invalid • Bit = 1: Channel is valid **NOTE:** Unused bits are set to 1.
(1) This parameter is not part of the implicit data if the optimized I/O profile is selected. For more information on the **IO Profile** parameter, refer to the Modicon Edge I/O NTS - Network Interface Modules - User Guide.			

The following table presents the output implicit data for the NTSEDM0822 module:

Parameter Name	**Value**	**Data type** **Size in bytes** **R/W**	**Description**
LatchAck0_7	0...255	BYTE 1 R/W	At rising edge, resets the latch value of the input on the channel 0...7. Bit 0...7 = Value of channel 0...7 **NOTE:** Unused bits are reserved.
QValue0_7	0...255	BYTE 1 R/W	Value of the output channels (Bit field). Bit 0...7 = Value of channel 0...7 **NOTE:** Unused bits are reserved.
RearmOutputCmd	TRUE FALSE*	BOOL R/W	If the **Rearming Output Mode** parameter is set to **Latched Off** and the cause of the detected error is no longer present, then on a rising edge, it rearms the output channels.
* Parameter default value			

NTSEMP0220 Pulse Output Generator Module, 2 RS422 400 kHz, 8 Inputs, 2 Outputs

What's in This Chapter

NTSEMP0220 Presentation

Overview

This section provides a presentation of the NTSEMP0220 module.

The following functions are supported by the NTSEMP0220 module:

- Pulse Train Output Mode Principle Description, page 249.
- Pulse Width Modulation Mode Principle Description, page 294.
- Frequency Generator Mode Principle Description, page 301.

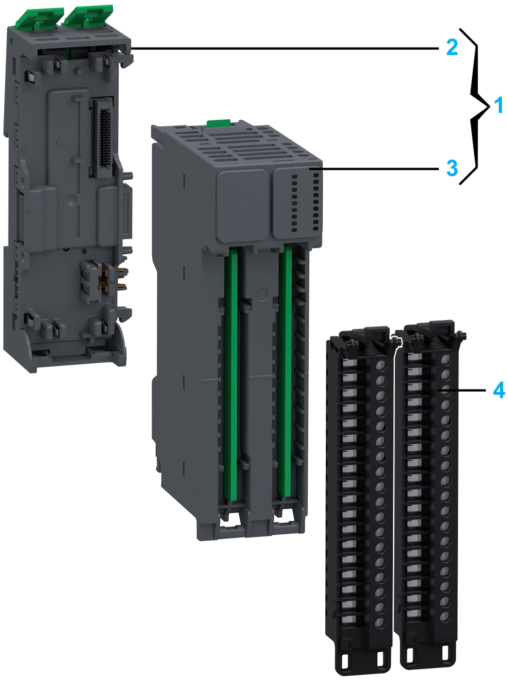
Main Characteristics

The following table describes the main characteristics of the NTSEMP0220 module.

Main Characteristics	Value
Product or component type	Pulse output generator module
Number of input/output channels	8 fast discrete inputs, page 164 2 standard discrete outputs, page 165 2 channels for PTO, PWM or Frequency Generator, page 165
Number of pulse generator output channels	2
Operating mode	Synchronous

Purchasing Information

The following figure presents the elements of the Modicon Edge I/O NTS NTSEMP0220 module:

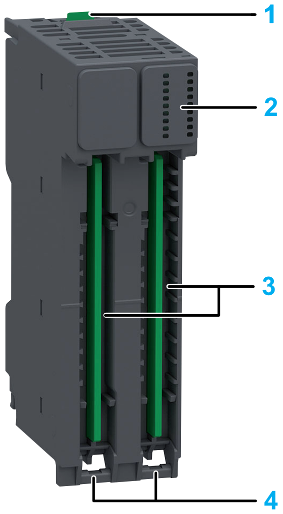


Number	Reference	Description
1	NTSEMP0220K	Base + Module (kit) **NOTE:** The module and its corresponding base can be purchased as a kit.
2	NTSXBA0200H	Spare Base, 2 Slots, for Input/Output Common/Expert/Safety Module, Hardened
3	NTSEMP0220	Pulse Output Generator Module, 2 RS422 400 kHz, 8 Inputs, 2 Outputs
4	NTSXTB18000H NTSXTB18001H NTSXTB18200H NTSXTB18201H	Screw Terminal Block, 18 Points, 3.81 mm Pitch, Without Cover, use on Low Height Module, Hardened Screw Terminal Block, 18 Points, 3.81 mm Pitch, With Cover, use on Low Height Module, Hardened Spring Terminal Block, 18 Points, 3.81 mm Pitch, Without Cover, use on Low Height Module, Hardened Spring Terminal Block, 18 Points, 3.81 mm Pitch, With Cover, use on Low Height Module, Hardened **NOTE:** The terminal blocks are purchased separately.

NOTE: For more information on accessories and spare parts, refer to Appendix E Modicon Edge I/O NTS Spare Bases and Terminal Blocks (see Modicon Edge I/O - System Planning and Installation Guide).

Physical Description

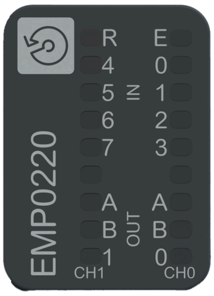
The following figure presents the elements of the module:



1: Release button for disengaging the module from the base
2: Status LEDs
3: Slot for the terminal block
4: Hinge for the terminal block installation

Status LEDs

The following figure presents the NTSEMP0220 status LEDs:

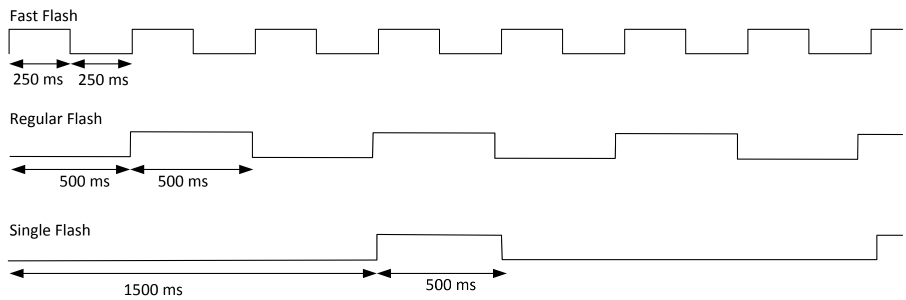


The following table describes the status of LEDs:

R (Green)	E (Red)	IN0...7 (Green)	OUT0...1 (Green)	CH0...1 A (Green)	CH0...1 B (Green)	Description
Initialization and non-operational states						
OFF	OFF	-	-	-	-	Indicates that the module is not energized.
OFF	ON	-	-	-	-	Indicates that an internal error is detected.
OFF	Regular Flash	-	-	-	-	Indicates that a system error is detected.
Single Flash	OFF	-	-	-	-	Indicates that the module is not configured.
Regular Flash	OFF	-	-	-	-	Indicates that the firmware is being updated.
Regular Flash	ON	-	-	-	-	Indicates that a module mismatch is detected.
Fast Flash	-	-	-	-	-	Indicates that the module is in commissioning mode.
Operational state						
ON	OFF	-	-	-	-	Indicates that the module is powered, configured and operational.
ON	OFF	ON	-	-	-	Indicates that the corresponding input channel is activated.
ON	OFF	OFF	-	-	-	Indicates that the corresponding input channel is deactivated.
ON	OFF	-	ON	-	-	Indicates that the corresponding output channel is activated.
ON	OFF	-	OFF	-	-	Indicates that the corresponding output channel is deactivated.
ON	OFF	-	-	OFF	-	When the channel is configured as **PTO Output** or **Frequency Generator Output**, it indicates that no frequency is generated. When the channel is configured as **PWM Output**, it indicates that the duty cycle is 0%.
ON	OFF	-	-	Regular Flash	-	When the channel is configured as **PTO Output** or **Frequency Generator Output**, it indicates that a frequency from 0.1 Hz to 100 Hz is generated. When the channel is configured as **PWM Output**, it indicates that the frequency is generated, and the duty cycle is from 0.1% to 50%.
ON	OFF	-	-	Fast Flash	-	When the channel is configured as **PTO Output** or **Frequency Generator Output**, it indicates that a frequency from 100.1 Hz to 1000 Hz is generated. When the channel is configured as **PWM Output**, it indicates that the frequency is generated, and the duty cycle is from 50.1% to 99.9%.

R (Green)	E (Red)	IN0...7 (Green)	OUT0...1 (Green)	CH0...1		Description
				A (Green)	B (Green)	
ON	OFF	-	-	ON	-	When the channel is configured as **PTO Output** or **Frequency Generator Output**, it indicates that a frequency from 1000.1 Hz to maximum frequency is generated. When the channel is configured as **PWM Output**, it indicates that the frequency is generated, and the duty cycle is 100%.
ON	OFF	-	-	-	OFF	Indicates that the **PTO Output** channel is negative (reverse direction).
ON	OFF	-	-	-	ON	Indicates that the **PTO Output** channel is positive (forward direction).
ON	Single Flash	-	-	-	-	Indicates one of the following: • The module is restarting. • An advisory is detected.
ON	Regular Flash	-	-	-	-	Indicates one of the following: • An error is detected at the channel level. • The module is in fallback state.
ON	ON	-	-	-	-	Indicates that an error is detected at the module level.
ON	Regular Flash	-	OFF	-	-	Indicates that an error is detected in the 24 Vdc field power.
ON	Regular Flash	-	Regular Flash	-	-	Indicates that a short circuit is detected on the output.

The following graphic depicts the system status of LEDs during module operation:



NTSEMP0220 Characteristics

Overview

This section provides a general description of the characteristics of the module.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

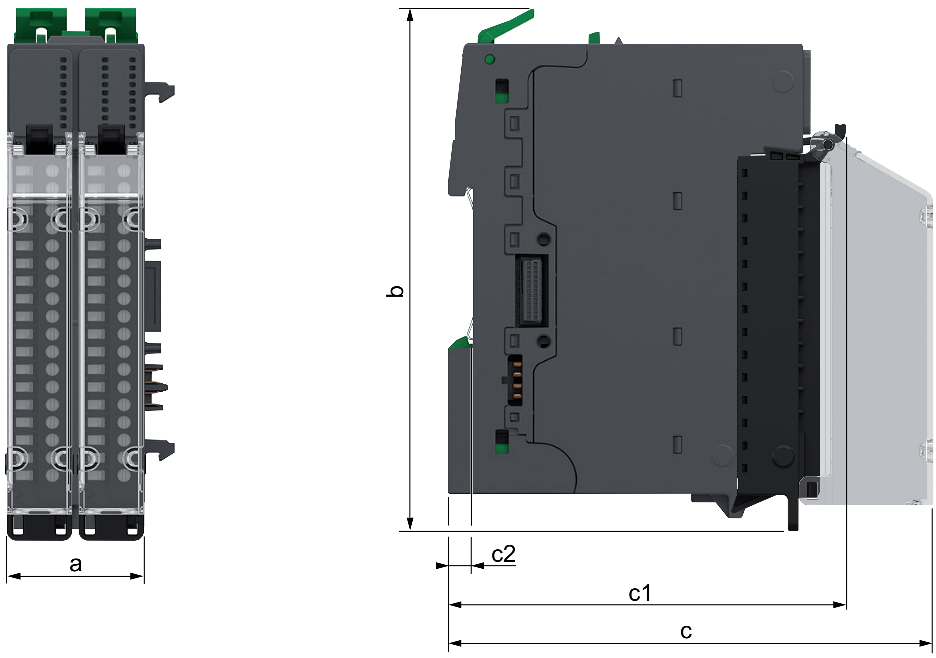
Do not exceed any of the rated values specified in the environmental and electrical characteristics tables.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

For more information on environmental characteristics, refer to Modicon Edge I/O - System Planning and Installation Guide.

Dimensions

The following figure presents the external dimensions for the assembled module:



a: 30 mm (1.18 in)
b: 116.6 mm (4.57 in)
c: 107.5 mm (4.21 in)
c1: 88.2 mm (3.46 in)
c2: 5.6 mm (0.2 in)

Weight

- NTSEMP0220: 79 g (2.78 oz)
- NTSEMP0220K: 125 g (4.4 oz)

General Characteristics

The following table describes the general characteristics of the NTSEMP0220 module:

<table>
<tr><th colspan="2">Characteristics</th><th>Value</th></tr>
<tr><td colspan="2">Rated supplied voltage</td><td>24 Vdc</td></tr>
<tr><td colspan="2">Power supplied voltage range</td><td>20.4...28.8 Vdc</td></tr>
<tr><td colspan="2">Bus current consumption</td><td>41.7 mA</td></tr>
<tr><td colspan="2">Field current consumption</td><td>192.0 mA</td></tr>
<tr><td colspan="2">Power dissipation</td><td>2.4 W</td></tr>
<tr><td>Field power supply</td><td>Discrete outputs</td><td>Internal</td></tr>
<tr><td rowspan="12">Isolation</td><td>Between input channels</td><td>No isolation</td></tr>
<tr><td>Between internal logic and input channels</td><td rowspan="4">1,000 Vac</td></tr>
<tr><td>Between internal logic and pulse outputs</td></tr>
<tr><td>Between internal logic and output channels</td></tr>
<tr><td>Between internal logic and ground</td></tr>
<tr><td>Between groups of input channels</td><td rowspan="4">850 Vac</td></tr>
<tr><td>Between input channels and encoder signals</td></tr>
<tr><td>Between input channels and pulse outputs</td></tr>
<tr><td>Between input and outputs channels</td></tr>
<tr><td>Between input channels and ground</td><td rowspan="3">1,500 Vac</td></tr>
<tr><td>Between outputs channels and ground</td></tr>
<tr><td>Between pulse outputs and ground</td></tr>
<tr><td colspan="2">Hot swap supported</td><td>Yes</td></tr>
<tr><td colspan="2">Operating ambient temperature derating</td><td>No derating</td></tr>
</table>

Fast Discrete Inputs Characteristics

The following table describes the fast discrete inputs characteristics:

Characteristics		Value
Rated input voltage		24 Vdc
Input voltage range		0...30 Vdc
Rated input current		2.25 mA
Input logic		Sink
Input compatibility		Type 3 according to IEC 61131-2
Input wiring mode		2-wire
Input voltage	Logic state 1	> 11 Vdc
	Logic state 0	< 11 Vdc for I < 1.5 mA < 5 Vdc for I > 1.5 mA
Input current	Logic state 1	> 2 mA
	Logic state 0	< 15 mA
Response time on input	Logic state 1 to logic state 0	500 ns + filter delay
	Logic state 0 to logic state 1	500 ns + filter delay
Input filter time	Software	Configurable: 200 ns, 500 ns 1 μs, 2 μs, 5 μs, 10 μs, 50 μs, 80 μs, 500 μs, 1 ms, 4 ms, or 12 ms
Protection	Overvoltage	Up to ±60 Vdc
	Reverse polarity	Yes
Cable	Type	Shielded
	Maximum length	20 m (65.6 ft)

Standard Discrete Outputs Characteristics

The following table describes the standard discrete output characteristics:

Characteristics		Value
Rated output voltage		24 Vdc
Output type		High Side
Maximum output current per channel		50 mA
Output logic		Source
Output wiring mode		2-wire connection
Output supply		Internal
Output voltage	At logic state 1	24 Vdc Field Supply - Voltage drop Maximum voltage drop: 1.85 Vdc
	At logic state 0	HighZ with flyback diode
Load type		Resistive
Response time on output	Logic state 1 to logic state 0	8 ms typical on Type 3 input
	Logic state 0 to logic state 1	21 ms typical delay / 500 µs slew rate
Overload Protection		99 mA...123 mA with a typical value of 111 mA Protection by group of 4 outputs In compliance with the IEC61131-2 standard, the overload testing pattern is 1.5 x IE (IE = 50 mA per output) applied during 1 s ON, then 9 s OFF.
Cable	Type	Shielded
	Maximum length	20 m (65.6 ft)

Pulse Generator Output Characteristics

The following table describes the pulse generator output characteristics:

Characteristics		Value
Output type		RS-422
Maximum output current		60 mA
Maximum short circuit output current		250 mA
Signal frequency		Maximum 400 kHz
Line termination	AC Termination	150 Ω - 220 pF
RS-422 Cable	Type	0.2 mm² (24 AWG) twisted pair - Shielded
	Maximum length	20 m (65.6 ft)
Protection	Short circuit	Yes, thermal shutdown with autoretry

NTSEMP0220 Wiring

Overview

This section provides the wiring diagrams for the NTSEMP0220 module.

Wiring Rules

For more information on the wiring, refer to Modicon Edge I/O - System Planning and Installation Guide.

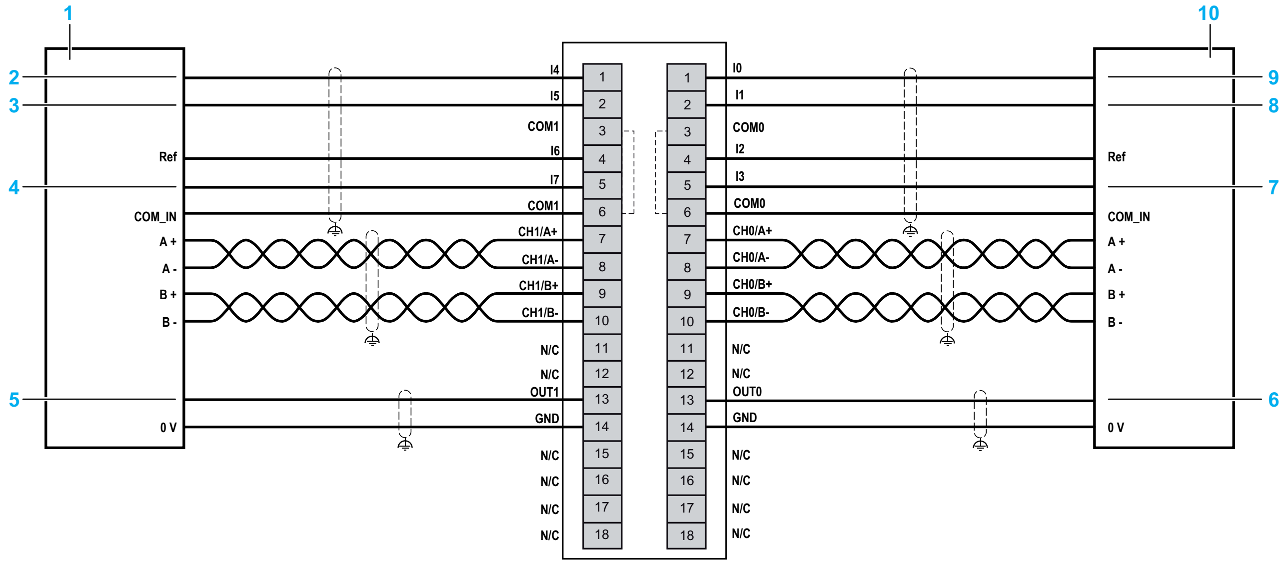
Pin Assignment

This table describes the pin assignment of the terminal blocks:

Terminal Block 1			Terminal Block 2		
Pin	**Signal**	**Description**	**Pin**	**Signal**	**Description**
1	I4	Fast input channel 4 related to PTO channel 1	1	I0	Fast input channel 0 related to PTO channel 0
2	I5	Fast input channel 5 related to PTO channel 1	2	I1	Fast input channel 1 related to PTO channel 0
3	COM1	Common for fast inputs I4 and I5, related to PTO channel 1	3	COM0	Common for fast inputs I0 and I1, related to PTO channel 0
4	I6	Fast input channel 6 related to PTO channel 1	4	I2	Fast input channel 2 related to PTO channel 0
5	I7	Fast input channel 7 related to PTO channel 1	5	I3	Fast input channel 3 related to PTO channel 0
6	COM1	Common for fast inputs I6 and I7, related to PTO channel 1	6	COM0	Common for fast inputs I2 and I3, related to PTO channel 0
7	CH1/A+	Incremental A+ of the positive differential PTO output channel 1	7	CH0/A+	Incremental A+ of the positive differential PTO output channel 0
8	CH1/A-	Incremental A- of the negative differential PTO output channel 1	8	CH0/A-	Incremental A- of the negative differential PTO output channel 0
9	CH1/B+	Incremental B+ of the positive differential PTO output channel 1	9	CH0/B+	Incremental B+ of the positive differential PTO output channel 0
10	CH1/B-	Incremental B- of the negative differential PTO output channel 1	10	CH0/B-	Incremental B- of the negative differential PTO output channel 0
11	N/C	No Connection	11	N/C	No Connection
12	N/C	No Connection	12	N/C	No Connection
13	OUT1	Regular output 1 related to PTO channel 1	13	OUT0	Regular output 0 related to PTO channel 0
14	GND	Ground for differential output line and regular output 0	14	GND	Ground for differential output line and regular output 0
15	N/C	No Connection	15	N/C	No Connection
16	N/C	No Connection	16	N/C	No Connection
17	N/C	No Connection	17	N/C	No Connection
18	N/C	No Connection	18	N/C	No Connection

Wiring Diagram

The following figure illustrates the wiring diagram of the NTSEMP0220 module:



1: Drive Device 1
2: Limit +
3: Limit -
4: Drive Ready
5: Drive Enable
6: Drive Enable
7: Drive Ready
8: Limit -
9: Limit +
10: Drive Device 2
Ref: Reference signal
N/C: No Connection

NOTE:

- Drive outputs signals (Limit-, Limit+, Ref and Drive ready) are given as an example.
- Drive device must provide overcurrent protection for outputs signals.

⚠ WARNING
UNINTENDED EQUIPMENT OPERATION
Do not connect wires to unused terminals and/or terminals indicated as “No Connection (N/C)”.
Failure to follow these instructions can result in death, serious injury, or equipment damage.

NTSEMP0220 Parameters

Overview

The NTSEMP0220 module is equipped with:

- 8 fast discrete inputs.
- 2 standard discrete outputs.

For information on the configuration of this module, refer to Inputs and Outputs Configuration, page 172.

Alternatively, you can add a maximum of two expert functions to your module using the **Add a function** button. The following expert functions are available:

- PTO, page 254
- PWM, page 297
- Frequency Generator, page 303

Parameters Description

Configurable Parameters

The following table presents the configurable parameters for the NTSEMP0220 module:

Displayed Name ***Parameter Name***	Value	Data type	Description
Device Mode *DeviceMode*	0: **Normal*** 1: **Optional** 2: **Virtual reserved** 3: **Virtual absent**	ENUM	Allows you to select the device mode: • **Normal**: The module is part of the software configuration and is physically installed in the cluster. • **Optional**: The module is part of the software configuration. A dummy module or the configured module must be physically installed in the cluster. Whether either module is present does not cause a configuration error to be detected. • **Virtual reserved**: The module is part of the software configuration. A dummy module must be physically installed in the cluster. If the virtual reserved module is physically installed in the cluster, a configuration error is detected. • **Virtual absent**: The module is part of the software configuration. A base must not be physically installed in the cluster. If a module is physically installed in the cluster, a configuration error is detected.
Load Consumption *LoadConsumption*	0...100 **100***	UINT16	Sets the estimated load consumption value (in mA) of your module. This value is used for the estimation of your field power segment consumption. The default value is the maximum load current consumption. For more information about the current consumption for your Modicon Edge I/O module, refer to the Modicon Edge I/O - System Planning and Installation Guide.
Rearming Output Mode *RearmOutputMode*	0: **Latched Off** 1: **Auto Recovery***	ENUM	Allows you to select the rearming mode for an output channel which is latched off due to a detected error. Two modes are available: • **Latched Off**: The channel is rearmed if the cause of the error is no longer present, and a rising edge on **RearmOutputCmd** is applied. • **Auto Recovery**: The output channel is rearmed automatically if the cause of the error is no longer present for a predefined delay.
* Parameter default value			

Implicit Data

The following table presents the input implicit data for the NTSEMP0220 module:

Parameter Name	**Value**	**Data type** **Size in bytes** **R/W**	**Description**
GCS	0...255	BYTE 1 R/-	Group Cyclic Status Bit 0: Data quality Bit 1: General module status Bit 2: I/O status Bit 3: Receive status Bit 4: Output status Bit 5: Advisory status Bit 6: N/A Bit 7: Data freshness **NOTE:** For more information, refer to Modicon Edge I/O - Diagnostic Data - User Guide.
IValue0_7	0...255	BYTE 1 R/-	Value of the input channels (Bit field). Bit 0...7 = Value of channel 0...7 **NOTE:** Unused bits are reserved.
ChannelHealthOut0_7[(1)]	0...255	BYTE 1 R/-	Bit 0...7 = Status of channel 0...7 • Bit = 0: Channel is invalid • Bit = 1: Channel is valid **NOTE:** Unused bits are set to 1.
[(1)] This parameter is not part of the implicit data if the optimized I/O profile is selected. For more information on the **IO Profile** parameter, refer to the Modicon Edge I/O NTS - Network Interface Modules - User Guide.			

The following table presents the output implicit data for the NTSEMP0220 module:

Parameter Name	**Value**	**Data type** **Size in bytes** **R/W**	**Description**
LatchAck0_7	0...255	BYTE 1 R/W	At rising edge, resets the latch value of the input on the channel 0...7. Bit 0...7 = Value of channel 0...7 **NOTE:** Unused bits are reserved.
QValue0_7	0...255	BYTE 1 R/W	Value of the output channels (Bit field). Bit 0...7 = Value of channel 0...7 **NOTE:** Unused bits are reserved.
RearmOutputCmd	TRUE FALSE*	BOOL R/W	If the **Rearming Output Mode** parameter is set to **Latched Off** and the cause of the detected error is no longer present, then on a rising edge, it rearms the output channels.
* Parameter default value			

Functions

What's in This Part

Inputs and Outputs Configuration

What's in This Chapter

Overview

This chapter describes the parameters to configure the expert I/O modules.

Fast Discrete Input Configuration

Configurable Parameters

The following table presents the configurable parameters of each fast discrete input for the channels of the expert I/O modules:

Displayed Name ***Parameter Name***	**Value**	**Data Type**	**Description**
Latch *Latch*	0: **No*** 1: **Rising Edge – Automatic Acknowledge** 2: **Falling Edge – Automatic Acknowledge** 3: **Both Edges – Automatic Acknowledge** 4: **Rising Edge – Manual Acknowledge** 5: **Falling Edge – Manual Acknowledge** 6: **Both Edges – Manual Acknowledge**	ENUM	Allows incoming pulses with a pulse width shorter than the network interface module scan time to be captured and recorded. For more information, refer to Latch, page 173. The shortest latch pulse is limited by the filter time.
Filter *Filter*	0: **0** 1: **0.0002** 2: **0.0005** 3: **0.001** 4: **0.002*** 5: **0.005** 6: **0.01** 7: **0.05** 8: **0.08** 9: **0.5** 10: **1** 11: **4** 12: **12**	ENUM	Allows reducing the effect of bounce on the input. Changes to the signal are only detected if the pulse width of the input signal is longer than the filter time (ms).
* Parameter default value			

Fast Discrete Output Configuration

Configurable Parameters

The following table presents the configurable parameters of each fast discrete output for the channels of the expert I/O modules:

Displayed Name ***Parameter Name***	**Value**	**Data Type**	**Description**
Fallback Mode *OutputFallbackMode*	0: **Fallback Value*** 1: **Maintain**	ENUM	Allows you to select the behavior for the output of a communication interruption: **Fallback Value**: Sets the output at the configured **Predefined Fallback Value** value. **Maintain**: The output remains in its present state.
Predefined Fallback Value *OutputFallbackValue*	0: **0*** 1: **1**	ENUM	Determines the state for the output of a communication interruption and **Fallback Mode** parameter is set to **Predefined Fallback Value**.
* Parameter default value			

Explicit Parameters

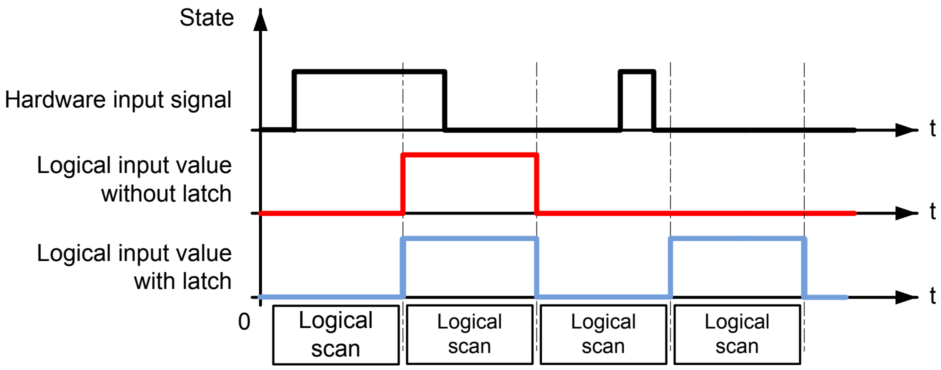
The following table presents the explicit data for the channels of the expert I/O modules:

Parameter Name	**Value**	**Data Type** **Size in Bytes** **R/W**	**Description**
ChannelErrorOut	0...255	BYTE 1 R/-	Provides the following errors detected on the channel: • Bit 1: Short Circuit Error • Bit 4: Internal Power Supply Error **NOTE:** Unused bits are reserved.

Input Latch

Overview

The **Latch** parameter allows incoming pulses with a pulse width shorter than the network interface module scan time to be captured and recorded as depicted in the following diagram:



The shortest input pulse detected is determined by the bounce filter time.

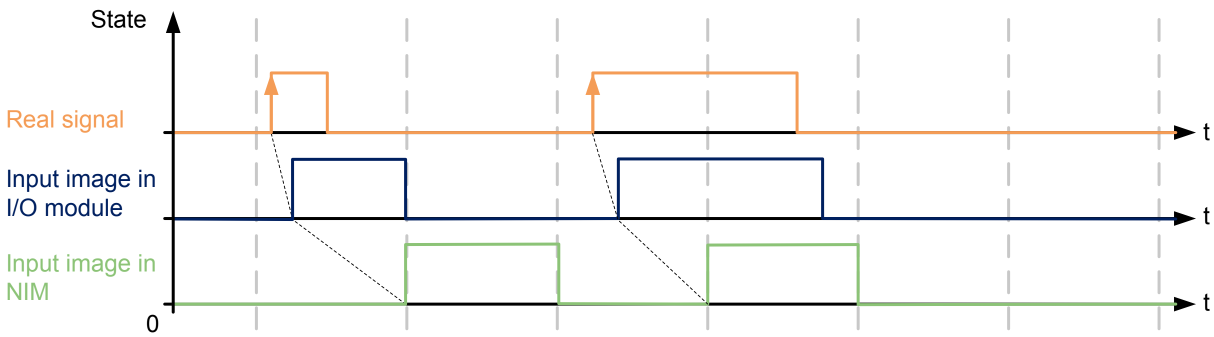
A pulse can be captured either on a rising edge, a falling edge or on both edges. An acknowledge action is necessary before a new latch value can be captured.

Automatic Acknowledge

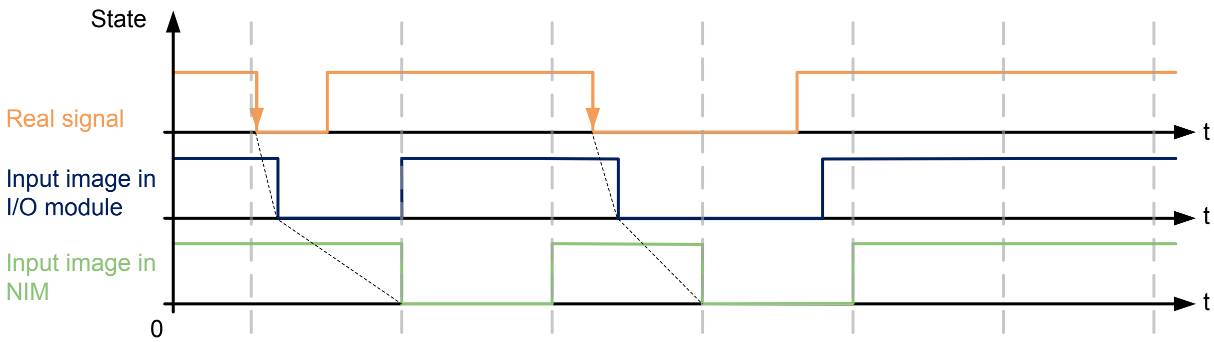
A rising edge on the **LatchAck** is done at each I/O bus cycle.

The following diagrams depicts the behavior of the input image in automatic acknowledge:

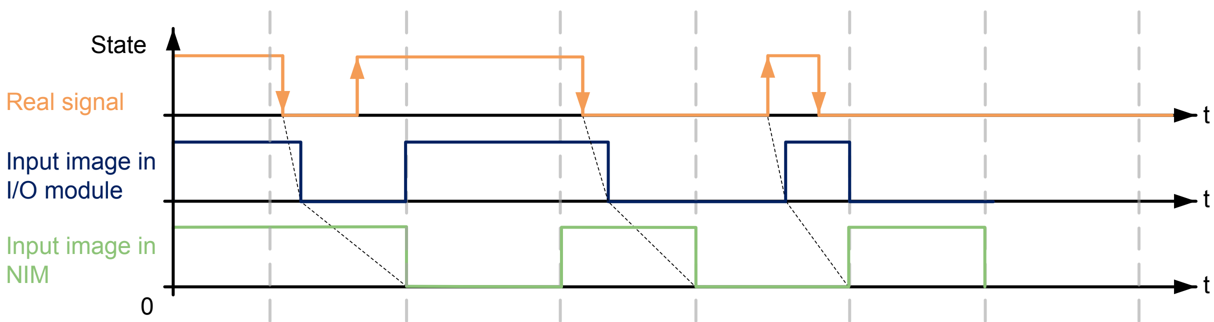
Rising Edge - Automatic Acknowledge:



Falling Edge - Automatic Acknowledge:



Both Edges - Automatic Acknowledge:



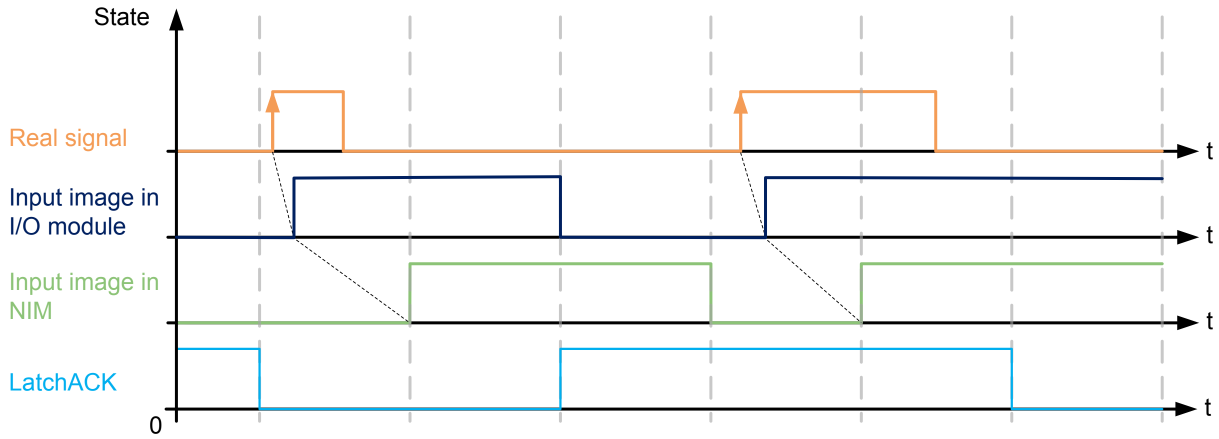
Manual Acknowledge

When an input value is latched, the input image in the I/O module is maintained at the latched value and a new value cannot be latched.

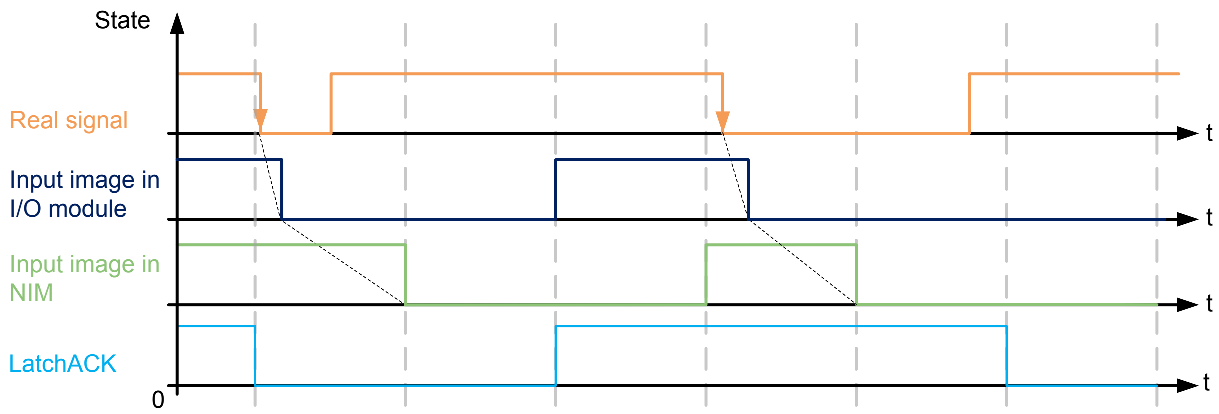
On a rising edge of the **LatchAck** bit, the input image in the I/O module is no longer maintained and a new value can be latched.

The following diagrams depict the behavior of the input image in manual acknowledge:

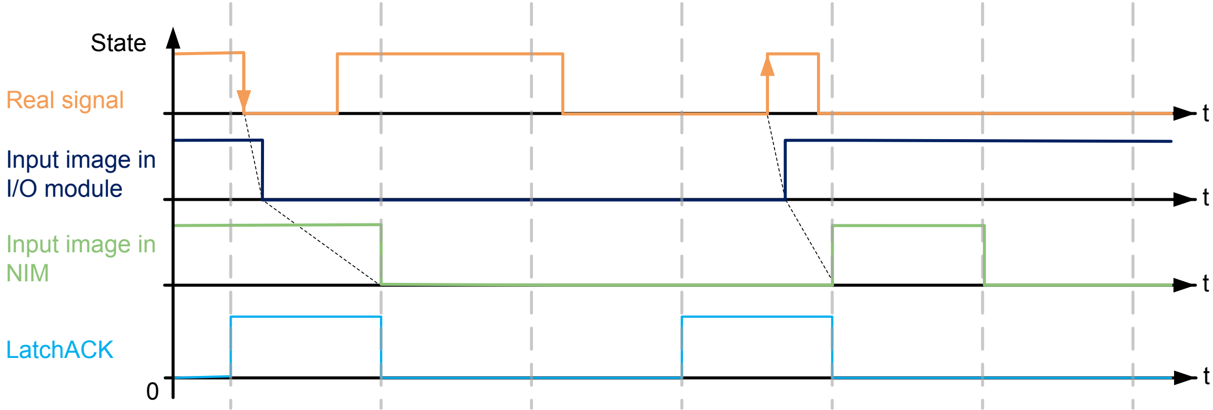
Rising Edge - Manual Acknowledge:



Falling Edge - Manual Acknowledge:



Both Edges - Manual Acknowledge:



Motion Expert Functions

What's in This Chapter

Incremental Mode Principle Description

Overview

This section describes the use of the Incremental mode to connect incremental encoders.

Principle

The Incremental mode behaves like a typical up/down counter, using pulses and counting these pulses.

Positions must be preset and counting must be initialized to implement and manage the Incremental mode.

The counter value can be stored in the register by configuring an external event.

Axis Types

The following table presents the two available axis types and the corresponding counting modes:

Axis Type	Counting Mode
Linear	Finite counter
Rotary	Infinite counter

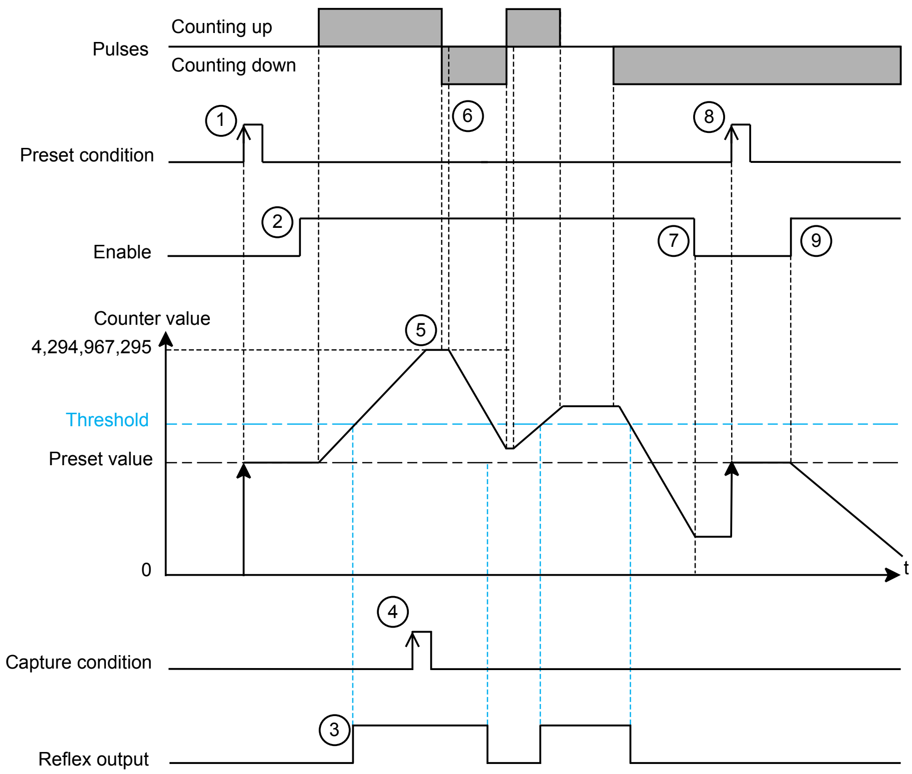
Principle Diagram

Counting Mode

Free Large:

In the **Free Large** counting mode, the counter value (= *SingleTurnPos*) starts from 0 and it is in a range from 0 to 4,294,967,295. The counter can count up and down.

The following diagram and table depict an example on how an incremental encoder operates in **Free large** mode:



In this example, the following sub-functions are added to the **Incremental Encoder** configuration:

- A **Preset** sub-function.
- A **Capture** sub-function
- A **Reflex Output** sub-function

Stage	Action
1	On the rising edge of the preset condition, the counter value is set to the preset (= *PresetSingleTurnPos*) value. For more information about the **Preset** sub-function, refer to Preset Sub-Function Configuration, page 322.
2	While *Enable* is TRUE, each pulse increments the counter value.
3	The reflex output is set to TRUE when the counter value is above the configured threshold value. For more information about the **Reflex outputs** sub-function, refer to Reflex Output and Compare Sub-Function, page 328.
4	On the rising edge of the capture condition, the counter value is captured into the capture register. For more information about the **Capture** sub-function, refer to Capture Sub-Function Configuration, page 325.
5	In this example, the parameter **Lock on limits** is configured as TRUE, when the limit is reached the counter value does not increase.
6	A number of pulses equal to the **Backlash** configuration value is ignored to take into account the mechanical backlash of this example, and then the counter value decrements. For more information about backlash compensation, refer to Backlash Compensation, page 181.

Stage	Action
7	While *Enable* is FALSE, the counter ignores the pulses and retains its counter value. While *Enable* is TRUE, the counter resumes counting the pulses.
8	At any time, a rising edge of the preset condition sets the counter value to the preset (= *PresetSingleTurnPos*) value.
9	While the *Enable* is TRUE, the counter resumes counting the pulses.

Modulo Loop:

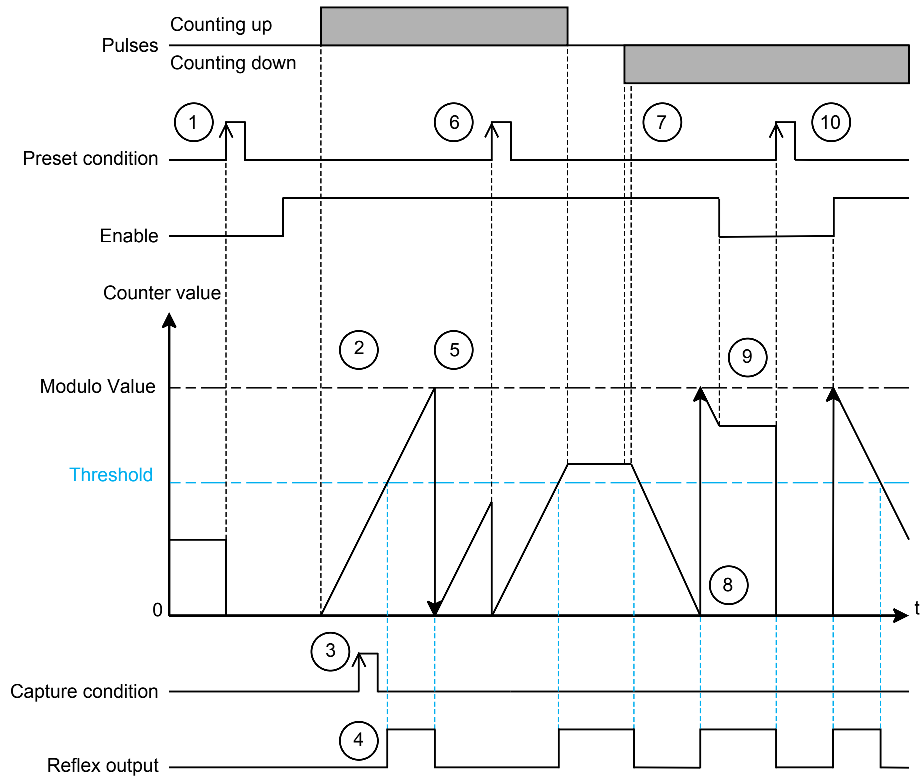
In the **Modulo-loop** counting mode, the counter value (= *SingleTurnPos*) starts from 0. The counter can count up and down.

While counting up, when the counter value reaches the configured **Modulo value** - 1, the counter value is set to 0 at the next pulse and the rollover counter (=*MultiTurnPos*) increments by one.

While counting down, when the counter value reaches 0, the value is set to **Modulo value** - 1 at the next pulse and the rollover counter decrements by one.

> **NOTE:** If the rollover counter value is 0 and decrements, the rollover value is set to **Number Of Turns** - 1.

The following diagram and table depict an example on how an incremental encoder operates in **Modulo-loop** mode:



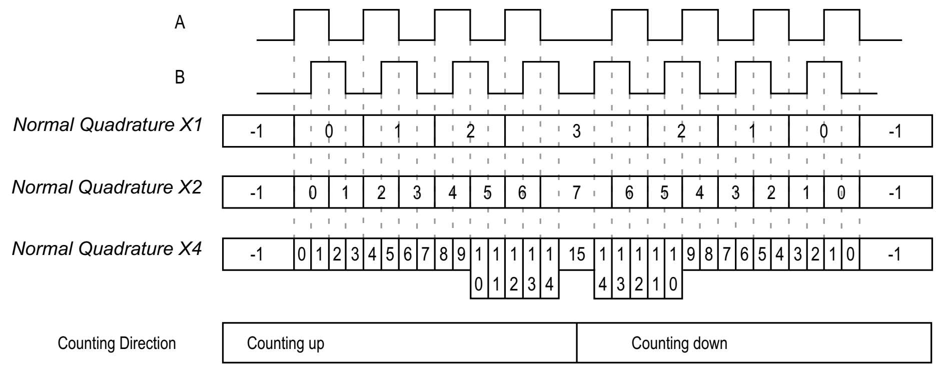
In this example, the following sub-functions are added to the **Incremental Encoder** configuration:

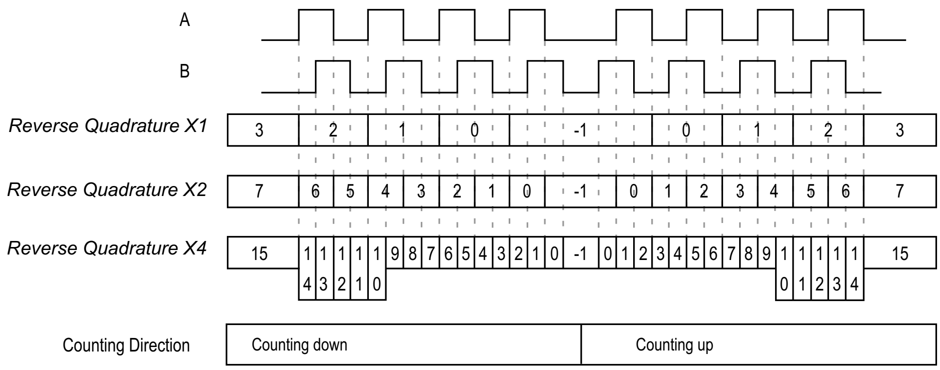
- A **Preset** sub-function.
- A **Capture** sub-function
- A **Reflex Output** sub-function

Stage	Action
1	When a preset condition is satisfied, the counter value is set to the *PresetSingleTurnPos* value, and the rollover counter value is set to 0. For more information about the **Preset** sub-function, refer to Preset Sub-Function Configuration, page 322. While *Enable* is FALSE, the counter ignores the pulses and retains its value.
2	While *Enable* is TRUE, each pulse increments the counter value.
3	On the rising edge of the capture condition, the counter value is captured into the capture register. For more information about the **Capture** sub-function, refer to Capture Sub-Function Configuration, page 325.
4	The reflex output is set to TRUE when the counter value is above the configured threshold value. For more information about the **Reflex outputs** sub-function, refer to Reflex Output and Compare Sub-Function, page 328.
5	When the value reaches the configured **Modulo value** - 1, the counter value is set to 0 at the next pulse and the turn counter value increments by 1. The reflex output is set to FALSE when the counter value is below the threshold value.
6	At any time, a rising edge of the preset condition sets the counter value and the turn counter value to 0.
7	A number of pulses equal to the **Backlash** configuration value is ignored to take into account the mechanical backlash of this example. For more information about backlash compensation, refer to Backlash Compensation, page 181.
8	When the value reaches 0, the counter value is set to the configured **Modulo value** - 1 at the next pulse and the turn counter value decrements by 1. The reflex output is set to TRUE when the counter value is above the configured threshold value.
9	While *Enable* is FALSE, the counter ignores the pulses and retains its counter value. While *Enable* is TRUE, the counter resumes counting the pulses.
10	When the value reaches 0, the counter value is set to the configured **Modulo value** - 1 at the next pulse and the turn counter value decrements by 1. The reflex output is set to TRUE when the counter value is above the configured threshold value.

Input Mode

The input mode in the Incremental mode is always quadrature:



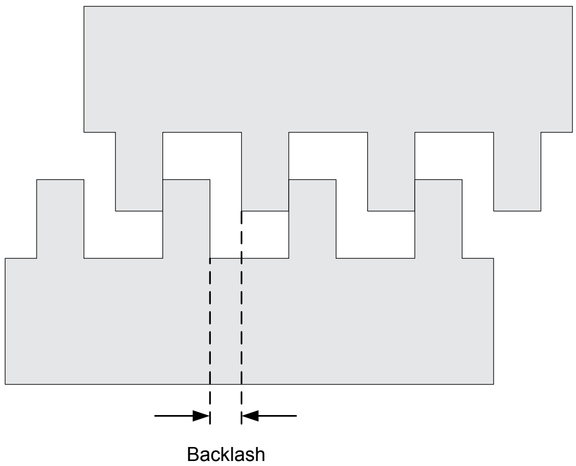


Backlash Compensation

The backlash compensation is a pulse compensation that occurs due to the mechanical clearance.

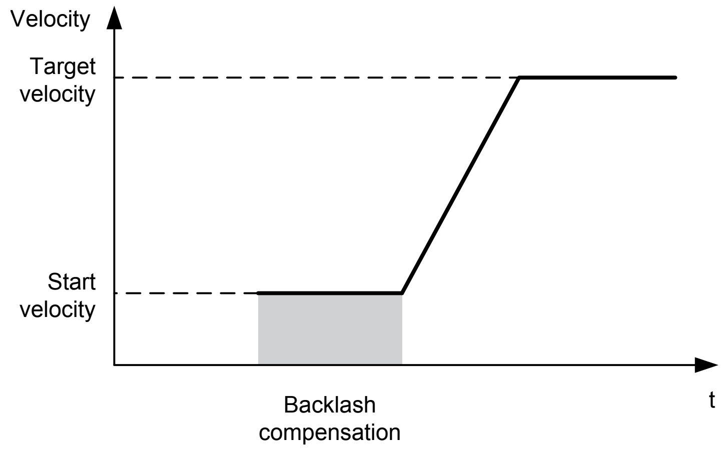
At each change of direction, the counting is stopped until the fully slack correction pulses are received. Then, it resumes counting.

The following figure illustrates the backlash:



The backlash compensation is performed when the encoder is enabled, and a first preset is done. When the encoder is disabled, this resets the preset condition.

The following figure illustrates the backlash compensation:



Incremental Encoder Interface

Incremental Encoder Configuration

Configurable Parameters

The following table presents the configurable parameters for the incremental encoder:

Displayed Name ***Parameter Name***	Value	Data Type	Description
Channel Location *ChannelLocation*	0: **Channel 0** 1: **Channel 1** 255: **Channel Disabled**	ENUM	Selects the location of the channel. A channel can be used once. The available parameter list and the default value depend on the module reference associated to the function.
Voltage Selection *VoltageSelection*	0: **None*** 1: **5** 2: **24**	ENUM	Selects the voltage value used to supply the encoder.
Power Supply Monitor *PowerSupplyMonitor*	0: **Disabled*** 1: **Enabled**	ENUM	Enables the power supply monitor.
Counting Mode *CountingMode*	0: **Free Large*** 1: **Modulo Loop**	ENUM	Selects the counting mode.
Input Mode *InputMode*	0: **Normal Quadrature X1*** 1: **Normal Quadrature X2** 2: **Normal Quadrature X4** 3: **Reverse Quadrature X1** 4: **Reverse Quadrature X2** 5: **Reverse Quadrature X4**	ENUM	Selects the counting measurement interval.
Modulo Value *ModuloValue*(1)	**1...4294967295***	UINT32	Defines the maximum counting value with the counting range from 0 to **Modulo Value** - 1. The **Modulo Value** is the number of increments per turn. When modified online, the value is updated at the next preset or at the next modulo loop (in either direction). **NOTE:** Grayed if counting mode is **Free Large**.
Number Of Turns *NumberOfTurn*	**1*...65535**	UINT16	Number of turns for a multi-turn encoder. **NOTE:** Grayed if counting mode is **Free Large**.
Lock On Limits *LockOnLimits*	**FALSE*** **TRUE**	BOOL	When **FALSE**, the position rolls over at limits. When **TRUE**, the position is locked at limits. **NOTE:** Grayed if counting mode is **Modulo Loop**.
Backlash *Backlash*	**0*...65535**	UINT16	Number of pulses for the **Backlash** compensation function. The **Backlash** compensation function is deactivated if the parameter is set to **0**. Refer to Backlash Compensation, page 181 for more information.

Displayed Name ***Parameter Name***	Value	Data Type	Description
A B Filter *A-BFilter*	0: **0** 1: **0.0002** 2: **0.0005** 3: **0.001** 4: **0.002*** 5: **0.005** 6: **0.01** 7: **0.05** 8: **0.08** 9: **0.5** 10: **1** 11: **4** 12: **12**	ENUM	Allows reducing the effect of bounce on the input. Changes to the signal are only detected if the pulse width of the input signal is longer than the filter time (ms).
Z Filter *ZFilter*	0: **0** 1: **0.0002** 2: **0.0005** 3: **0.001** 4: **0.002*** 5: **0.005** 6: **0.01** 7: **0.05** 8: **0.08** 9: **0.5** 10: **1** 11: **4** 12: **12**	ENUM	Allows reducing the effect of bounce on the input. Changes to the signal are only detected if the pulse width of the input signal is longer than the filter time (ms).
* Parameter default value (1) Online modification is allowed.			

Implicit Parameters

The following table presents the input implicit data for the incremental encoder:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
SingleTurnPos	0*...4,294,967,295	UINT32 R/-	Indicates the present position of the axis in pulses. Refreshed at each I/O bus cycle.
MultiTurnPos	0*...65,535	UINT16 R/-	Indicates the number of counter value rollovers, incremented or decremented, at each *Modulo Loop* depending on the direction. Resets to 0 at a preset. **NOTE:** Grayed if counting mode is **Free Large**.
PosTimestamp	0*...999,999,999	UINT32 R/-	Indicates the absolute time(1) of the position.
EnabledFlag	FALSE* TRUE	BOOL R/-	TRUE indicates that the encoder is enabled, and *CurrentValue* is valid.
ErrorFlag	FALSE* TRUE	BOOL R/-	TRUE indicates that an error is detected.
ErrorId	*0**: No Error detected *1*: Internal Field Power Supply *2*: Encoder Power *3*: Encoder Error *10*: Quadrature	ENUM R/-	Indicates the error type. When *ErrorFlag* = TRUE, the *ErrorId* parameter provides the error detected.
* Parameter default value (1) The absolute time value refers to the internal time domain of the I/O island. It contains the fractional portion in nanoseconds according to IEEE 802.1AS-2020 timestamp data type.			

The following table presents the output implicit data for the incremental encoder:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
Output			
Enable	FALSE* TRUE	BOOL R/W	When *Enable* = TRUE, the encoder is enabled.
* Parameter default value			

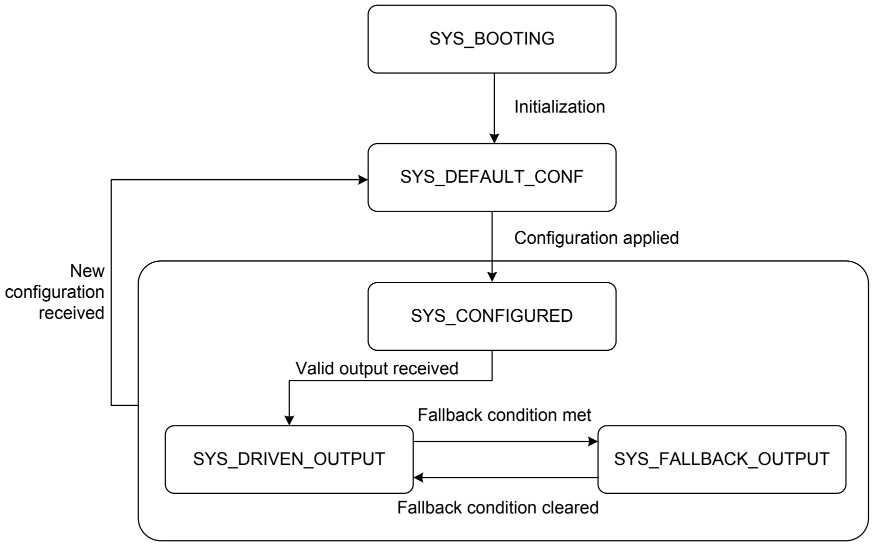
Explicit Parameters

The following table presents the explicit data for the incremental encoder:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
ModuloValue	0...4,294,967,295	UINT32 R/W	Defines the maximum counting value with the counting range from 0 to **Modulo Value** - 1. **NOTE:** Grayed if counting mode is **Free Large**.

Operating Mode

IOM Operating Modes



Incremental Encoder Regarding IOM Operating Modes

Module Transition to State	Incremental Callback Operations	Incremental Resulting State
SYS_BOOTING	-	Not configured
SYS_DEFAULT_CONF	-	Not configured
SYS_CONFIGURED	Configures SSI according to the received configuration	Configured
SYS_DRIVEN_OUTPUT	Operates according to the received data	Driven_Operational
SYS_FALLBACK_OUTPUT	-	No change

Incremental States

Incremental State	Incremental Data Exchange	Incremental Status
Not configured	-	-
Configured	Produce data: Input image	*SingleTurnPos* = 0 *MultiTurnPos* = 0 *PosTimestamp* = 0 *EnabledFlag* = FALSE *ErrorFlag* = FALSE *ErrorId* = No Error detected
Driven_Operational	Receive data: Output image Produce data: Input image	Refer to Driven_Operational, page 187.

Driven_Operational

Incremental Commands	Condition	Incremental Status	Behavior
Enable = TRUE	No error detected	*EnabledFlag* = TRUE. *SingleTurnPos* is updated. *MultiTurnPos* is updated. *PosTimestamp* is updated. *ErrorFlag* = FALSE. *ErrorId* = No Error detected.	Enables counting
Enable = TRUE	Error detected	*EnabledFlag* = FALSE. *SingleTurnPos* is not updated and returns the last valid value. *MultiTurnPos* is not updated and returns the last valid value. *PosTimestamp* is not updated and returns the last valid value. *ErrorFlag* = TRUE. *ErrorId* is updated.	Disables counting. **NOTE:** To acknowledge the error and resume counting, *Enable* must be set to FALSE then to TRUE (after the error condition is removed). *EnabledFlag* = TRUE / *ErrorFlag* = FALSE.
Enable = FALSE	-	*EnabledFlag* = FALSE. *SingleTurnPos* is not updated and returns the last valid value. *MultiTurnPos* is not updated and returns the last valid value. *PosTimestamp* is not updated and returns the last valid value. *ErrorFlag* = FALSE. *ErrorId* = No Error detected.	Disables counting.

ErrorId Priority

ErrorId	Priority
Internal Field Power Supply	0
Encoder Power	1
Encoder Error	1
Quadrature	2

SSI Mode Principle Description

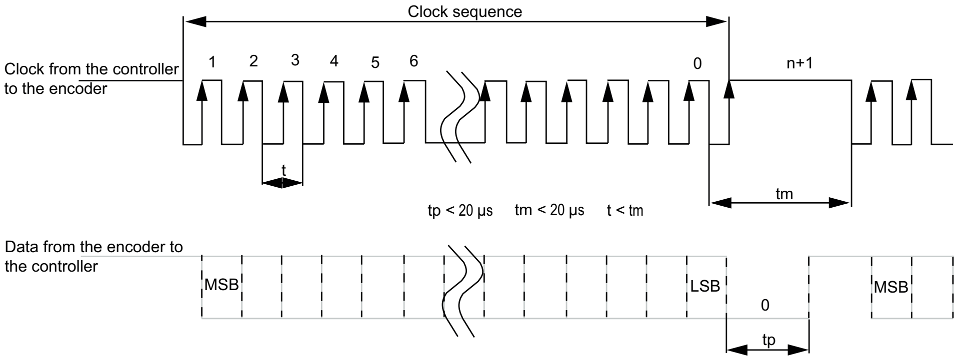
Overview

The SSI (Synchronous Serial Interface) mode allows the connection of an absolute encoder.

The position of the absolute encoder is read by an SSI link.

Principle Diagram

The following figure represents an SSI frame:



SSI Encoder Interface

SSI Encoder Configuration

Configurable Parameters

The following table presents the configurable parameters for the SSI encoder:

Displayed Name ***Parameter Name***	**Value**	**Data Type**	**Description**
Channel Location *ChannelLocation*	0: **Channel 0** 1: **Channel 1** 255: **Channel Disabled**	ENUM	Selects the location of the channel. A channel can be used once. The available parameter list and the default value depend on the module reference associated to the function.
Voltage Selection *VoltageSelection*	0: **None*** 1: **5** 2: **24**	ENUM	Selects the voltage value used to supply the encoder.
Power Supply Monitor *PowerSupplyMonitor*	0: **Disabled*** 1: **Enabled**	ENUM	Enables the power supply monitor.
Transmission Speed *TransmissionSpeed*	2: **500***	ENUM	Sets the speed of data transmission for SSI encoders. **NOTE:** The maximum speed of data transmission depends on the cable length and its characteristics.
Number Of Data Bits Per Turn *NumberOfDataBitsPerTurn*	**4...32** **8***	BYTE	Sets the number of data bits to count points per turn.
Number Of Multiturn Bits *NumberOfMultiturnBits*	**0*...32**	BYTE	Sets the number of multi-turn bits to count at each turn.
Number Of Header Bits *NumberOfHeaderBits*	**0*...15**	BYTE	Sets the number of header bits.
Number Of Status Bits *NumberOfStatusBits*	**0*...15**	BYTE	Sets the number of bits to be reserved for the status.
Parity *Parity*	0: **None*** 1: **Even** 2: **Odd**	ENUM	Allows to select the parity.
Resolution Reduction *ResolutionReduction*	**0*...17**	BYTE	Allows to filter data. The least significant bits are ignored.
Binary Coding *BinaryCoding*	0: **Binary*** 1: **Gray**	ENUM	Defines the type of position coding of the SSI encoder: • **Binary**: Binary - code • **Gray**: Gray - code
TM Interframe Time *TMInterframeTime*	**15...2560000** **22***	UINT32	Minimum interframe time (µs).
* Parameter default value			

Implicit Data

The following table presents the input implicit data for the SSI encoder:

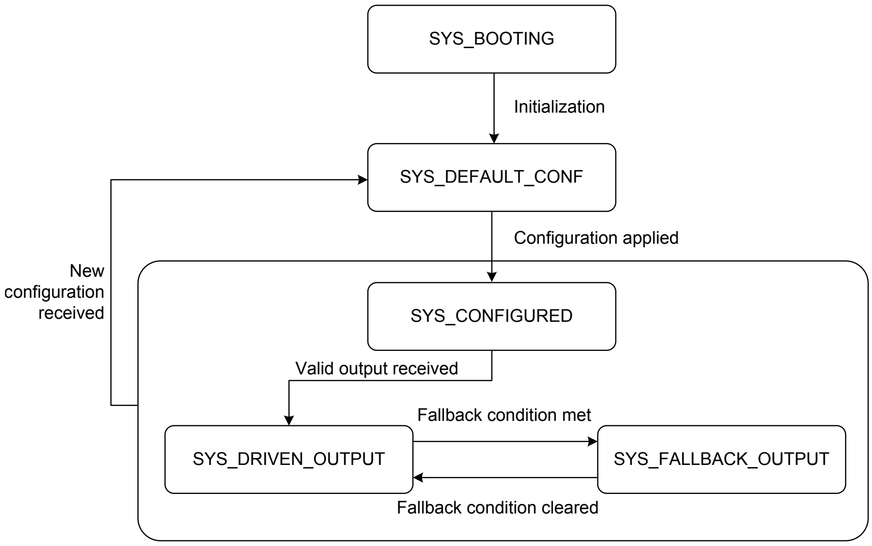
Parameter Name	**Value**	**Data Type** **R/W**	**Description**
SingleTurnPos	0*...4,294,967,295	UINT32 R/-	Indicates a single-turn position of the axis in pulses. Refreshed at each I/O bus cycle.
MultiTurnPos	0*...4,294,967,295	UINT32 R/-	Indicates a multi-turn position of the axis in pulses. Refreshed at each I/O bus cycle.
PosTimestamp	0*...999,999,999	UINT32 R/-	Indicates the absolute time(1) of the position.
EnabledFlag	FALSE* TRUE	BOOL R/-	TRUE indicates that the encoder is enabled, and *CurrentValue* is valid.
ErrorFlag	FALSE* TRUE	BOOL R/-	TRUE indicates that an error is detected.
ErrorId	*0**: No Error detected *1*: Internal Field Power Supply *2*: Encoder Power *3*: Encoder Error *5*: Fallback *20*: Frame Format *21*: Frame Parity *22*: Frame Start *23*: Frame Stuck at 1	ENUM R/-	Indicates the error type. When *ErrorFlag* = TRUE, the *ErrorId* parameter provides the error detected.
* Parameter default value (1) The absolute time value refers to the internal time domain of the I/O island. It contains the fractional portion in nanoseconds according to IEEE 802.1AS-2020 timestamp data type.			

The following table presents the output implicit data for the SSI encoder:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
Enable	FALSE* TRUE	BOOL R/W	When *Enable* = TRUE, the encoder is enabled.
* Parameter default value			

Operating Mode

IOM Operating Modes



SSI Encoder Regarding IOM Operating Modes

Module Transition to State	SSI Callback Operations	SSI Resulting State
SYS_BOOTING	-	Not configured
SYS_DEFAULT_CONF	-	Not configured
SYS_CONFIGURED	Configures SSI according to the received configuration	Configured
SYS_DRIVEN_OUTPUT	Operates according to the received data	Driven_Operational
SYS_FALLBACK_OUTPUT	-	No change

SSI States

SSI State	SSI Data Exchange	SSI Status
Not configured	-	-
Configured	Produce data: Input image	*SingleTurnPos* = 0 *MultiTurnPos* = 0 *PosTimestamp* = 0 *EnabledFlag* = FALSE *ErrorFlag* = FALSE *ErrorId* = No Error detected
Driven_Operational	Receive data: Output image Produce data: Input image	Refer to Driven_Operational, page 192.

Driven_Operational

SSI Commands	Condition	SSI Status	Behavior
Enable = TRUE	No error detected	*EnabledFlag* = TRUE. *SingleTurnPos* is updated. *MultiTurnPos* is updated. *PosTimestamp* is updated. *ErrorFlag* = FALSE. *ErrorId* is not updated and returns the last error code.	Enables counting.
Enable = TRUE	Error detected	*EnabledFlag* = FALSE. *SingleTurnPos* is not updated and returns the last valid value. *MultiTurnPos* is not updated and returns the last valid value. *PosTimestamp* is not updated and returns the last valid value. *ErrorFlag* = TRUE. *ErrorId* is updated.	Disables counting. **NOTE:** When the error is resolved, *Status. EnabledFlag* is automatically set to TRUE, *ErrorFlag* is automatically set to FALSE and counting resumes automatically.
Enable = FALSE	-	*EnabledFlag* = FALSE. *SingleTurnPos* is not updated and returns the last valid value. *MultiTurnPos* is not updated and returns the last valid value. *PosTimestamp* is not updated and returns the last valid value. *ErrorFlag* = FALSE. *ErrorId* = No Error detected.	Disables counting.

ErrorId Priority

ErrorId	Priority
Internal Field Power Supply	0
Encoder Power	1
Encoder Error	1
Frame Format	3
Frame Parity	3
Frame Start	3
Frame Stuck at 1	3

BiSS-C Mode Principle Description

Overview

The BiSS-C mode allows the connection of an absolute encoder.

The position of the absolute encoder is read by a BiSS-C link.

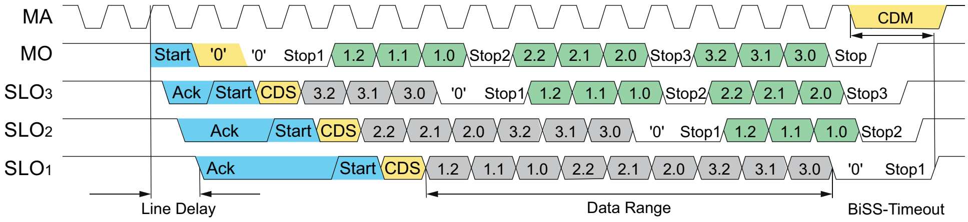
Principle

The BiSS-C mode is a serial interface protocol for the isochronous, fast and reliable exporting of sensor data, real-time writing of actuator data and simultaneous accessing of the register of the server.

The BiSS-C protocol supports SCD (Single Cycle Data) frame to get the position and point-to-point topology.

Principle Diagram

The following figure represents the BiSS-C counting principle:



BiSS-C Encoder Interface

BiSS-C Encoder Configuration

Configurable Parameters

The following table presents the configurable parameters for the BiSS-C encoder:

Displayed Name ***Parameter Name***	**Value**	**Data Type**	**Description**
Channel Location *ChannelLocation*	0: **Channel 0** 1: **Channel 1** 255: **Channel Disabled**	ENUM	Selects the location of the channel. A channel can be used once. The available parameter list and the default value depend on the module reference associated to the function.
Voltage Selection *VoltageSelection*	0: **None*** 1: **5** 2: **24**	ENUM	Selects the voltage value used to supply the encoder.
Power Supply Monitor *PowerSupplyMonitor*	0: **Disabled*** 1: **Enabled**	ENUM	Enables the power supply monitor.
Transmission Speed *TransmissionSpeed*	0: **500** 1: **1000***	ENUM	Selects the speed of data transmission for BiSS-C encoders. **NOTE:** The maximum speed of data transmission depends on the cable length and its characteristics.
Number Of Data Bits Per Turn *NumberOfDataBitsPerTurn*	**4...32 bits** **8***	BYTE	Sets the number of data bits to count points per turn.
Number Of Multiturn Bits *NumberOfMultiturnBits*	**0*...32**	BYTE	Sets the number of multi-turn bits to count at each turn.
Number Of Header Bits *NumberOfHeaderBits*	**0*...15**	BYTE	Sets the number of header bits.
Number Of Status Bits *NumberOfStatusBits*	**0*...15**	BYTE	Sets the number of bits to reserve for the status.
Parity *Parity*	0: **None*** 1: **Even** 2: **Odd**	ENUM	Allows to select the parity.
Resolution Reduction *ResolutionReduction*	**0*...17 bits**	BYTE	Allows to filter data. The least significant bits are ignored.
Binary Coding *BinaryCoding*	0: **Binary*** 1: **Gray**	ENUM	Defines the type of position coding of the BiSS-C encoder: • **Binary**: Binary - code • **Gray**: Gray - code
* Parameter default value			

Implicit Data

The following table presents the input implicit data for the BiSS-C encoder:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
SingleTurnPos	0*...4,294,967,295	UINT32 R/-	Indicates a single-turn position of the axis in pulses. Refreshed at each I/O bus cycle.
MultiTurnPos	0*...4,294,967,295	UINT32 R/-	Indicates a multi-turn position of the axis in pulses. Refreshed at each I/O bus cycle.
PosTimestamp	0*...999,999,999	UINT32 R/-	Indicates the absolute time(1) of the position.
EnabledFlag	FALSE* TRUE	BOOL R/-	TRUE indicates that the encoder is enabled, and *CurrentValue* is valid.
ErrorFlag	FALSE* TRUE	BOOL R/-	TRUE indicates that an error is detected.
ErrorId	*0**: No Error detected *1*: Internal Field Power Supply *2*: Encoder Power *3*: Encoder Error *5*: Fallback *20*: Frame Format *21*: Frame Parity *22*: Frame Start *23*: Frame Stuck at 1	ENUM R/-	Indicates the error type. When *ErrorFlag* = TRUE, the *ErrorId* parameter provides the error detected.

* Parameter default value

(1) The absolute time value refers to the internal time domain of the I/O island. It contains the fractional portion in nanoseconds according to IEEE 802.1AS-2020 timestamp data type.

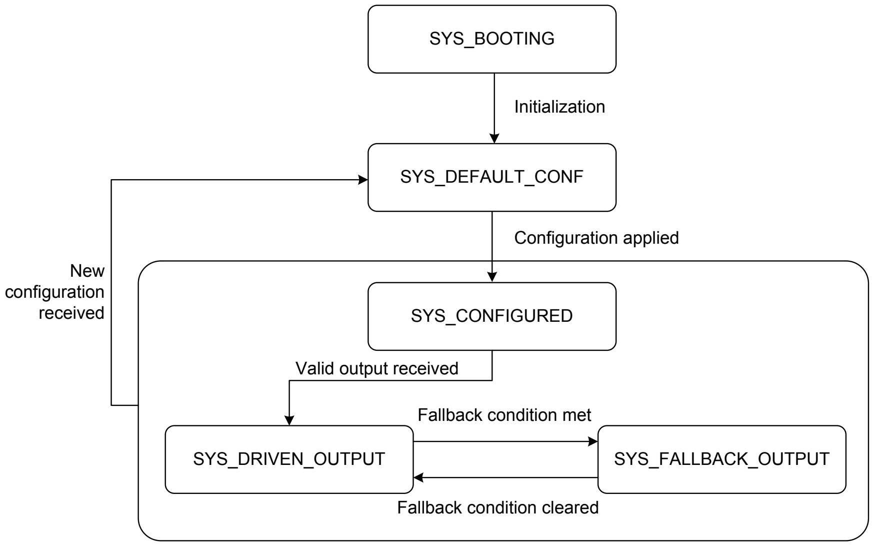
The following table presents the output implicit data for the BiSS-C encoder:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
Enable	FALSE* TRUE	BOOL R/W	When *Enable* = TRUE, the encoder is enabled.

* Parameter default value

Operating Mode

IOM Operating Modes



BiSS-C Encoder Regarding IOM Operating Modes

Module Transition to State	BiSS-C Callback Operations	BiSS-C Resulting State
SYS_BOOTING	-	Not configured
SYS_DEFAULT_CONF	-	Not configured
SYS_CONFIGURED	Configures BiSS-C according to the received configuration	Configured
SYS_DRIVEN_OUTPUT	Operates according to the received data	Driven_Operational
SYS_FALLBACK_OUTPUT	-	No change

BiSS-C States

BiSS-C State	BiSS-C Data Exchange	BiSS-C Status
Not configured	-	-
Configured	Produce data: Input image	*SingleTurnPos* = 0 *MultiTurnPos* = 0 *PosTimestamp* = 0 *EnabledFlag* = FALSE *ErrorFlag* = FALSE *ErrorId* = No Error detected
Driven_Operational	Receive data: Output image Produce data: Input image	Refer to Driven_Operational, page 197.

Driven_Operational

BiSS-C Commands	Condition	BiSS-C Status	Behavior
Enable = TRUE	No error detected	*EnabledFlag* = TRUE. *SingleTurnPos* is updated. *MultiTurnPos* is updated. *PosTimestamp* is updated. *ErrorFlag* = FALSE. *ErrorId* is not updated and returns the last error code.	Enables counting
Enable = TRUE	Error detected	*EnabledFlag* = FALSE. *SingleTurnPos* is not updated and returns the last valid value. *MultiTurnPos* is not updated and returns the last valid value. *PosTimestamp* is not updated and returns the last valid value. *ErrorFlag* = TRUE. *ErrorId* is updated.	Disables counting. **NOTE:** When the error is resolved, *Status. EnabledFlag* is automatically set to TRUE, *ErrorFlag* is automatically set to FALSE and counting resumes automatically.
Enable = FALSE	-	*EnabledFlag* = FALSE. *SingleTurnPos* is not updated and returns the last valid value. *MultiTurnPos* is not updated and returns the last valid value. *PosTimestamp* is not updated and returns the last valid value. *ErrorFlag* = FALSE. *ErrorId* = No Error is detected	Disables counting

ErrorId Priority

ErrorId	Priority
Internal Field Power Supply	0
Encoder Power	1
Encoder Error	1
Frame Format	2
Frame Parity	2
Frame Start	2
Frame Stuck at 1	2

SinCos Mode Principle Description

Overview

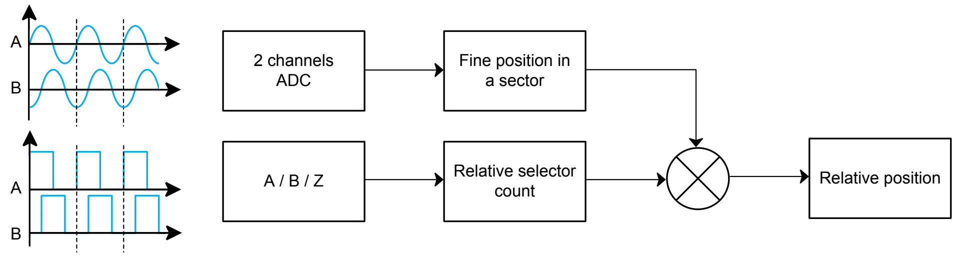
The SinCos mode provides an accurate relative position value, interpolated from the sine and cosine analog signals.

The analog signals are converted into discrete quadrature A/B signals, and the continuously provided range of values allows to improve the A/B relative position resolution. To provide an absolute position value, a serial absolute value must be acquired using Hiperface or EnDat protocol.

Principle

The position value is computed from serial data EnDat, Hiperface, or analog signals. sine and cosine analog signals are used for counting, and Z analog signal is used for the preset.

The following diagram depicts an overview of the counting principle (relative position synchronization):



NOTE: The encoder must be at standstill during the initialization for synchronization.

SinCos Encoder Interface

SinCos Encoder Configuration

Configurable Parameters

The following table presents the configurable parameters for the SinCos encoder:

Displayed Name ***Parameter Name***	Value	Data Type	Description
Voltage Selection *VoltageSelection*	0: **None*** 1: **5** 2: **8**	ENUM	Selects the voltage value used to supply the encoder.
Power Supply Monitor *PowerSupplyMonitor*	0: **Disabled*** 1: **Enabled**	ENUM	Enables the power supply monitor.
Number Of Periods Per Turn *NumberOfPeriodPerTurn*	**1...1073741823***	UINT32	Indicates the number of periods per turn. Defines the counting range 0...(Period/Turn - 1).
Number Of Angle Bits *NumberOfAngleBits*	**2...14** **9***	BYTE	Sets the number of angle bits.
Number Of Turns *NumberOfTurn*	**1*...65535**	UINT16	Indicates the number of turns for a multi-turn encoder.
Low Vpp *LowVpp*	**0.6...1.0** **0.8***	FLOAT	Sets the low limit of the SinCos signal (Vdc).
High Vpp *HighVpp*	**1.0...1.2** **1.2***	FLOAT	Set the high limit of the SinCos signal (Vdc).
Preset Condition *PresetCondition*	0: **None*** 1: **Z Rising** 2: **Z Falling** 3: **Z Both**	ENUM	Sets the condition to preset the function.
Z Filter *ZFilter*	0: **0** 1: **0.0002** 2: **0.0005** 3: **0.001** 4: **0.002*** 5: **0.005** 6: **0.01** 7: **0.05** 8: **0.08** 9: **0.5** 10: **1** 11: **4** 12: **12**	ENUM	Allows reducing the effect of bounce on the input. Changes to the signal are only detected if the pulse width of the input signal is longer than the filter time (ms).
* Parameter default value			

Implicit Parameters

The following table presents the input implicit data for the SinCos encoder:

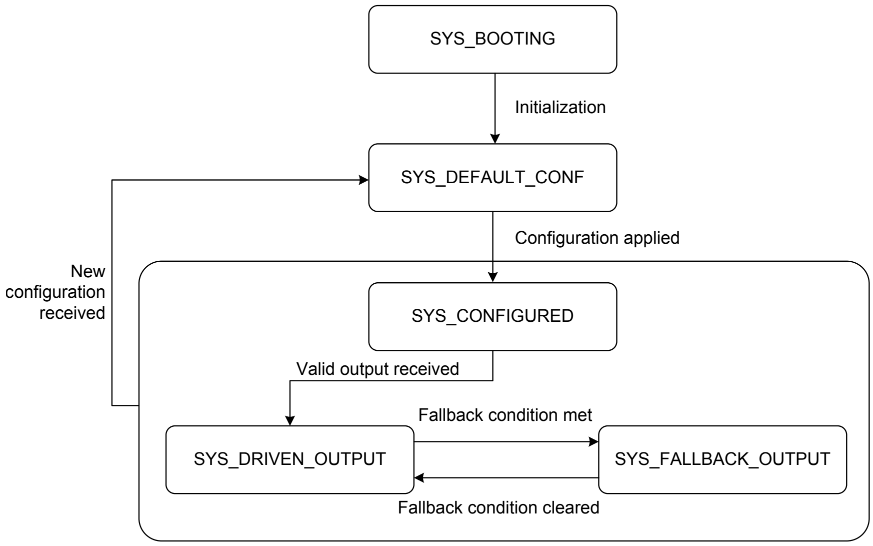
Parameter Name	**Value**	**Data Type** **R/W**	**Description**
SingleTurnPos	0*...4,294,967,295	UINT32 R/-	Indicates a present position of the axis in pulses. Refreshed at each I/O bus cycle.
MultiTurnPos	0*...4,294,967,295	UINT32 R/-	Indicates a number of counter value rollovers of the axis, incremented or decremented, at each modulo loop depending on the direction. Resets to 0 at preset.
PosTimestamp	0*...999,999,999	UINT32 R/-	Indicates the absolute time[1] of the position.
Status	*0*...15*	BYTE R/-	*Status* bit field: Bit 0: *EnableFlag*, when TRUE, the encoder is enabled, and the value is valid. Bit 1: N/A Bit 2: *WarningLowVpp*, when TRUE, the low Vpp is not respected. Bit 3: *WarningHighVpp*, when TRUE, the high Vpp is not respected. Bit 4: *ErrorFlag*, when TRUE, an error is detected. The counting is disabled.
ErrorId	*0**: No Error detected *1*: Internal Field Power Supply *2*: Encoder Power *3*: Encoder Error *40*: SinCos Signal *41*: SinCos Synchro	ENUM R/-	Indicates the error type. When *ErrorFlag* = TRUE, the *ErrorId* parameter provides the error detected.
PresetFlag	FALSE* TRUE	BOOL R/-	TRUE indicates that a preset is performed.
* Parameter default value (1) The absolute time value refers to the internal time domain of the I/O island. It contains the fractional portion in nanoseconds according to IEEE 802.1AS-2020 timestamp data type.			

The following table presents the output implicit data for the SinCos encoder:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
Enable	FALSE* TRUE	BOOL R/W	When *Enable* = TRUE, the encoder is enabled.
WarningAck	FALSE* TRUE	BOOL R/W	At rising edge, resets *WarningLowVpp* and *WarningHighVpp*.
PresetEnable	FALSE* TRUE	BOOL R/W	When TRUE, the preset event triggers and sets *PresetFlag*.
PresetForce	FALSE* TRUE	BOOL R/W	At rising edge, forces the preset and sets *PresetFlag* independently of the preset event.
PresetAck	FALSE* TRUE	BOOL R/W	At rising edge, resets *PresetFlag*.
PresetSingleTurnPos	0*...4,294,967,295	UINT32 R/W	Sets a position as the present position. The position out of range is ignored.
* Parameter default value			

Operating Mode

IOM Operating Modes



SinCos Encoder Regarding IOM Operating Modes

Module Transition to State	SinCos Callback Operations	SinCos Resulting State
SYS_BOOTING	-	Not configured
SYS_DEFAULT_CONF	-	Not configured
SYS_CONFIGURED	Configures SinCos and presets according to the received configuration	Configured
SYS_DRIVEN_OUTPUT	Operates according to the received data	Driven_Operational
SYS_FALLBACK_OUTPUT	-	No change

SinCos States

SinCos State	SinCos Data Exchange	SinCos Status
Not configured	-	-
Configured	Produce data: Input image	*SingleTurnPos* = 0 *MultiTurnPos* = 0 *PosTimestamp* = 0 *Status.EnabledFlag* = FALSE *Status.WarningLowVpp* = FALSE *Status.WarningHighVpp* = FALSE *Status.ErrorFlag* = FALSE *ErrorId* = No Error detected *PresetFlag* = FALSE
Driven_Operational	Receive data: Output image Produce data: Input image	Refer to Driven_Operational, page 202.

Driven_Operational

SinCos Commands	Condition	SinCos Status	Behavior
Enable = TRUE	No error detected	*Status.EnabledFlag* = TRUE. *SingleTurnPos* is updated. *MultiTurnPos* is updated. *PosTimestamp* is updated. *Status.ErrorFlag* = FALSE. *Status.WarningLowVpp* is updated *Status.WarningHighVpp* is updated *ErrorId* is not updated and returns the last *ErrorId* value.	Enables counting. **NOTE:** The encoder must be in the standstill mode when *Enable* is set. The encoder is allowed to move if *Status.EnabledFlag* = TRUE.
Enable = TRUE	Any detected error except SinCos Synchro error	*Status.EnabledFlag* = FALSE. *SingleTurnPos* is not updated and returns the last valid value. *MultiTurnPos* is not updated and returns the last valid value. *PosTimestamp* is not updated and returns the last valid value. *Status.WarningLowVpp* is maintained. *Status.WarningHighVpp* is maintained. *Status.ErrorFlag* = TRUE. *ErrorId* is updated.	Disables counting. **NOTE:** To acknowledge the error and to resume counting, *Enable* must be set to FALSE then to TRUE (after the error condition is removed).

SinCos Commands	Condition	SinCos Status	Behavior
Enable = TRUE	SinCos Synchro error detected	*Status.EnabledFlag* = FALSE. *SingleTurnPos* is not updated and returns the last valid value. *MultiTurnPos* is not updated and returns the last valid value. *PosTimestamp* is not updated and returns the last valid value. *Status.WarningLowVpp* is maintained. *Status.WarningHighVpp* is maintained. *Status.ErrorFlag* = TRUE. *ErrorId* = SinCos Synchro.	Disables counting. **NOTE:** When the error SinCos Synchro is resolved, *Status.EnabledFlag* is automatically set to TRUE, *ErrorFlag* is automatically set to FALSE and counting resumes automatically.
Enable = FALSE	-	*Status.EnabledFlag* = FALSE. *SingleTurnPos* is not updated and returns the last valid value. *MultiTurnPos* is not updated and returns the last valid value. *PosTimestamp* is not updated and returns the last valid value. *Status.WarningLowVpp* is maintained. *Status.WarningHighVpp* is maintained. *Status.ErrorFlag* = FALSE. *ErrorId* = No Error detected.	Disables counting.
WarningAck rising edge	-	*Status.WarningLowVpp* = FALSE Or *Status.WarningHighVpp* = FALSE.	Resets *Status.WarningLowVpp* and *Status.WarningHighVpp*.
PresetEnable = TRUE	No error detected	*PresetFlag* is updated	At preset event trigger: • *PresetSingleTurnPos* is set to *PresetSingleTurnPos*. • *MultiTurnPos* is set to 0. • *PresetFlag* is set to TRUE.
PresetForce rising edge	No error detected	*PresetFlag* = TRUE	• *PresetSingleTurnPos* is set to *PresetSingleTurnPos*. • *MultiTurnPos* is set to 0. • *PresetFlag* is set to TRUE.
-	Error detected	*PresetFlag* = No change	Preset cannot be performed as long as an error is detected.
PresetAck rising edge	-	*PresetFlag* = FALSE	Resets *PresetFlag*.

ErrorId Priority

ErrorId	Priority
Internal Field Power Supply	0
Encoder Power	1
Encoder Error	1
SinCos Signal	2
SinCos Synchro	2

EnDat Mode Principle Description

Overview

The EnDat interface is a point-to-point synchronous serial communication channel for encoder position transmission with optionally a SinCos additional interface.

The following table describes the EnDat protocols:

EnDat Interface	EnDat Protocol	Description
EnDat 2.1	EnDat 01	EnDat protocol of the encoder with incremental signals.
	EnDat 21	EnDat protocol of the encoder without incremental signals.
EnDat 2.2	EnDat 02	EnDat protocol of the encoder with incremental signals.
	EnDat 22	EnDat protocol of the encoder without incremental signals.

The supported encoder types are:

- Single-turn encoder
- Multi-turn encoder
- Incremental linear encoder
- Absolute linear encoder

NOTE: The encoder type, resolution, and position computation are automatically managed by the module without requesting configuration.

Principle

Communication Principle

The data transmissions are categorized based on mode commands, which determine whether the transmitted information consists of position values, position values with additional details, or parameters.

The frame is divided into several parts:

- Header containing the request
- Waiting period
  The EnDat master waits for the encoder answer
- Encoder answer
- Checksum field
- Complementary answers from the EnDat subordinate with checksum field (optionally depending on the request)

Performance

The maximum supported cable length is 20 meters, and the corresponding clock frequency is 1 MHz.

NOTE: The propagation delay compensation is not required with a 20 meters cable length and 1 MHz clock frequency.

EnDat Encoder Interface

EnDat Encoder Configuration

Configurable Parameters

The following table presents the configurable parameters for the EnDat encoder:

Displayed Name ***Parameter Name***	**Value**	**Data Type**	**Description**
Voltage Selection *VoltageSelection*	0: **None*** 1: **5** 2: **8**	ENUM	Selects the voltage value used to supply the encoder.
Power Supply Monitor *PowerSupplyMonitor*	0: **Disabled*** 1: **Enabled**	ENUM	Enables the power supply monitor.
* Parameter default value			

Implicit Parameters

The following table presents the input implicit data for the EnDat encoder:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
SingleTurnPos	0*...4,294,967,295	UINT32 R/-	Indicates a single-turn position of the axis in pulses. Refreshed at each I/O bus cycle.
MultiTurnPos	0*...4,294,967,295	UINT32 R/-	Indicates a multi-turn position of the axis in pulses. Refreshed at each I/O bus cycle.
PosTimestamp	0*...999,999,999	UINT32 R/-	Indicates the absolute time(1) of the position.
EnabledFlag	FALSE* TRUE	BOOL R/-	TRUE indicates that the encoder is enabled, and *CurrentValue* is valid.
ErrorFlag	FALSE* TRUE	BOOL R/-	TRUE indicates that an error is detected. Disables counting.
ErrorId	*0**: No Error detected *1*: Internal Field Power Supply *2*: Encoder Power *3*: Encoder Error *30*: Timeout *31*: Protocol *32*: CRC *33*: Configuration not supported	ENUM R/-	Indicates an error type. When *ErrorFlag* = TRUE, the *ErrorId* parameter provides the error detected. If *ErrorId* = *Protocol*, refer to *ErrorCode*.
ErrorCode	0*...65,535	UINT16 R/-	Error code sent by the connected device. When *ErrorFlag* is TRUE and *ErrorId* = *Protocol*.
BusyFlag	FALSE* TRUE	BOOL R/-	TRUE indicates that the encoder is being enabled.
* Parameter default value (1) The absolute time value refers to the internal time domain of the I/O island. It contains the fractional portion in nanoseconds according to IEEE 802.1AS-2020 timestamp data type.			

The following table presents the output implicit data for the EnDat encoder:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
Enable	FALSE* TRUE	BOOL R/W	When *Enable* = TRUE, the encoder is enabled.
* Parameter default value			

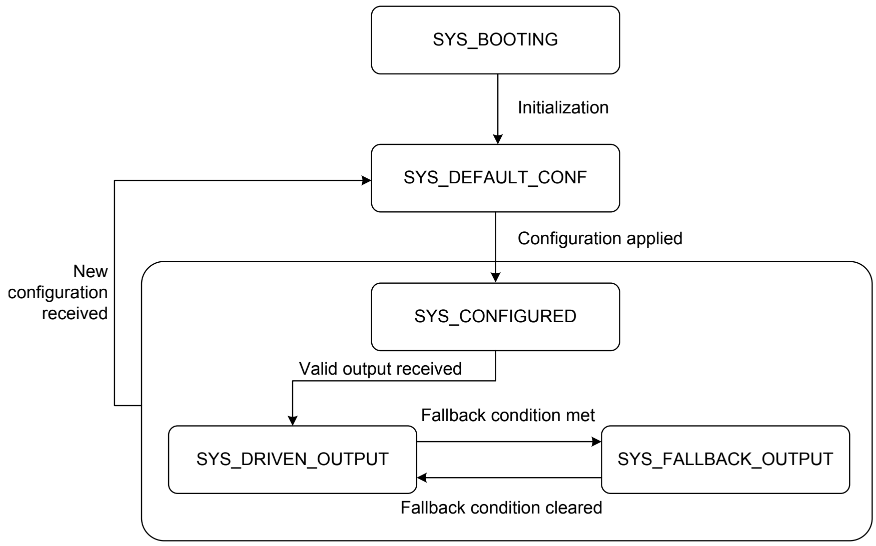
Explicit Parameters

The following table presents the explicit data for the EnDat encoder:

Parameter Name	**Value**	**Data type** **R/W**	**Description**
EnDat Protocol	*1*: EnDat01 *2*: EnDat02 *21*: EnDat21 *22**: EnDat22	ENUM R/-	EnDat protocol of the encoder.
Encoder Type	*0**: Singleturn *1*: Multiturn *2*: Incremental Linear *3*: Absolute Linear *4*: Not supported	ENUM R/-	Encode type of the encoder.
Toral number of bits	0*...64	BYTE R/-	Total number of data bits of the position of the encoder.
Number of singleturn bits	0*...64	BYTE R/-	Number of data bits to count periods within a turn of the encoder.
Number of multiturn bits	0*...32	BYTE R/-	Number of data bits to count turns of the encoder.
Rotary Factor	0*...4,294,967,295	UINT32 R/-	Conversion factor to calculate degrees out of the position value.
Linear Factor	0*...4,294,967,295	UINT32 R/-	Conversion factor to calculate mm out of the position value.
* Parameter default value			

Operating Mode

IOM Operating Modes



EnDat Encoder Regarding IOM Operating Modes

Module Transition to State	EnDat Callback Operations	EnDat Resulting State
SYS_BOOTING	-	Not configured
SYS_DEFAULT_CONF	-	Not configured
SYS_CONFIGURED	Configures EnDat according to the received configuration	Configured
SYS_DRIVEN_OUTPUT	Operates according to the received data	Driven_Operational
SYS_FALLBACK_OUTPUT	-	No change

EnDat States

EnDat state	EnDat Data Exchange	EnDat Status
Not configured	-	-
Configured	Produce data: Input image	*SingleTurnPos* = 0 *MultiTurnPos* = 0 *PosTimestamp* = 0 *EnabledFlag* = FALSE *BusyFlag* = FALSE *ErrorFlag* = FALSE *ErrorId* = No Error detected *ErrorCode* = 0
Driven_Operational	Receive data: Output image Produce data: Input image	Refer to Driven_Operational, page 208.

Driven_Operational

EnDat Commands	Condition	EnDat Status	Behavior
Enable = TRUE	No error detected	*EnabledFlag* = TRUE. *BusyFlag* = FALSE. *SingleTurnPos* is updated. *MultiTurnPos* is updated. *PosTimestamp* is updated. *ErrorFlag* = FALSE. *ErrorId* is not updated and returns the last recorded *ErrorId* value. *ErrorCode* is not updated and returns the last recorded *ErrorCode* value.	Enables counting. **NOTE:** • The encoder must be in the standstill mode when *Enable* is set. • The encoder is allowed to move only when *EnabledFlag* = TRUE.
Enable = TRUE	No error detected	*EnabledFlag* = FALSE. *BusyFlag* = TRUE. *SingleTurnPos* is updated. *MultiTurnPos* is updated. *PosTimestamp* is updated. *ErrorFlag* = FALSE. *ErrorId* is not updated and returns the last recorded *ErrorId* value. *ErrorCode* is not updated and returns the last recorded *ErrorCode* value.	Counting is being enabled.
Enable = TRUE	Error detected	*EnabledFlag* = FALSE. *BusyFlag* = FALSE. *SingleTurnPos* is not updated and returns the last valid value. *MultiTurnPos* is not updated and returns the last valid value. *PosTimestamp* is not updated and returns the last valid value. *ErrorFlag* = TRUE. *ErrorId* is updated. *ErrorCode* is updated.	Disables counting. **NOTE:** When the error is resolved, *Status.EnabledFlag* is automatically set to TRUE, *ErrorFlag* is automatically set to FALSE and counting resumes automatically.
Enable = FALSE	-	*EnabledFlag* = FALSE. *BusyFlag* = FALSE. *SingleTurnPos* is not updated and returns the last valid value. *MultiTurnPos* is not updated and returns the last valid value. *PosTimestamp* is not updated and returns the last valid value. *ErrorFlag* = FALSE. *ErrorId* = No Error detected. *ErrorCode* = 0	Disables counting

ErrorId Priority

ErrorId	Priority
Internal Field Power Supply	0
Encoder Power	1
Encoder Error	1
Timeout	2
CRC	3
Protocol	4

Hiperface Mode Principle Description

Overview

A single electrical interface enables the motor controller for all applications with only one cable connecting the controller to the motor feedback system. This hybrid interface includes an analog process data channel for differential transmission of sine and cosine signals with minimal delay, as well as a bidirectional parameter channel adhering to the EIA-485 specification and UART standard for transmitting absolute position information and other parameters.

The supported encoder types are:

- Single-turn encoder
- Multi-turn encoder

  NOTE: The encoder type, resolution and position computation are automatically managed by the module without requesting configuration.

Principle

Communication Principle

The Hiperface protocol uses serial communication for transmitting data.

The Hiperface protocol default settings are:

- 9,600 bauds
- 8 data bits
- 1 start bit
- 1 stop bit
- Even parity

Protocol Frames

The Hiperface module supports the following frames from the Hiperface protocol:

- Read Absolute Position: To read the encoder position (singleturn position or multiturn position).
- Read Data: To read the encoder parameter.
- Read Out Type Label: To read the encoder type.
- Read Encoder Status: To read the encoder status.
- Encoder Reset: To reset the encoder.

NOTE: The module has a Hiperface application layer based on the previous frames.

Hiperface Encoder Interface

Hiperface Encoder Configuration

Configurable Parameters

The following table presents the configurable parameters for the Hiperface encoder:

Displayed Name ***Parameter Name***	**Value**	**Data Type**	**Description**
Voltage Selection *VoltageSelection*	0: **None*** 1: **5** 2: **8**	ENUM	Selects the voltage value used to supply the encoder.
Power Supply Monitor *PowerSupplyMonitor*	0: **Disabled*** 1: **Enabled**	ENUM	Enables the power supply monitor.
Number Of Angle Bits *NumberOfAngleBits*	**2...14** **9***	BYTE	Sets the number of angle bits.
Low Vpp *LowVpp*	**0.6...1.0** **0.8***	FLOAT	Sets the low limit of SinCos signal (Vdc).
High Vpp *HighVpp*	**1.0...1.2** **1.2***	FLOAT	Sets the high limit of SinCos signal (Vdc).
* Parameter default value			

Implicit Parameters

The following table presents the input implicit data for the Hiperface encoder:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
SingleTurnPos	0*...2^64 - 1	UINT64 R/-	Indicates a single-turn position of the axis in pulses (period/turn + angle bits). Refreshed at each I/O bus cycle.
MultiTurnPos	0*...65,535	UINT16 R/-	Indicates a multi-turn position of the axis in pulses. Refreshed at each I/O bus cycle.
PosTimestamp	0*...999,999,999	UINT32 R/-	Indicates the absolute time[(1)] of the position.
Status	0*...15	BYTE R/-	*Status* bit field: • Bit 0: Enabled flag: When TRUE, the encoder is enabled, and the value is valid. • Bit 1: Busy Flag: When TRUE, the encoder is being enabled. • Bit 2: *WarningLowVpp*: When TRUE, the *LowVpp* limit is not respected. • Bit 3: *WarningHighVpp*: When TRUE, the *HighVpp* limit is not respected. • Bit 4: *ErrorFlag*: When TRUE, an error is detected. Disables counting.
ErrorId	*0**: No Error detected *1*: Internal Field Power Supply *2*: Encoder Power *3*: Encoder Error *4*: Short circuit *30*: Timeout *31*: Protocol *32*: CRC *33*: Configuration not supported *40*: SinCos Signal *41*: SinCos Synchro	ENUM R/-	Indicates an error type. When *ErrorFlag* = TRUE, the *ErrorId* parameter provides the error detected. If *ErrorId* = *Protocol*, refer to *ErrorCode*.
ErrorCode	0*...65,535	UINT16 R/-	An error code sent by the connected device. Valid when *ErrorFlag* is *TRUE* and *ErrorId* = *Protocol*.
* Parameter default value [(1)] The absolute time value refers to the internal time domain of the I/O island. It contains the fractional portion in nanoseconds according to IEEE 802.1AS-2020 timestamp data type.			

The following table presents the output implicit data for the Hiperface encoder:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
Enable	FALSE* TRUE	BOOL R/W	When *Enable* = TRUE, the encoder is enabled.
WarningAck	FALSE* TRUE	BOOL R/W	At rising edge, resets *WarningLowVpp* and *WarningHighVpp*.
* Parameter default value			

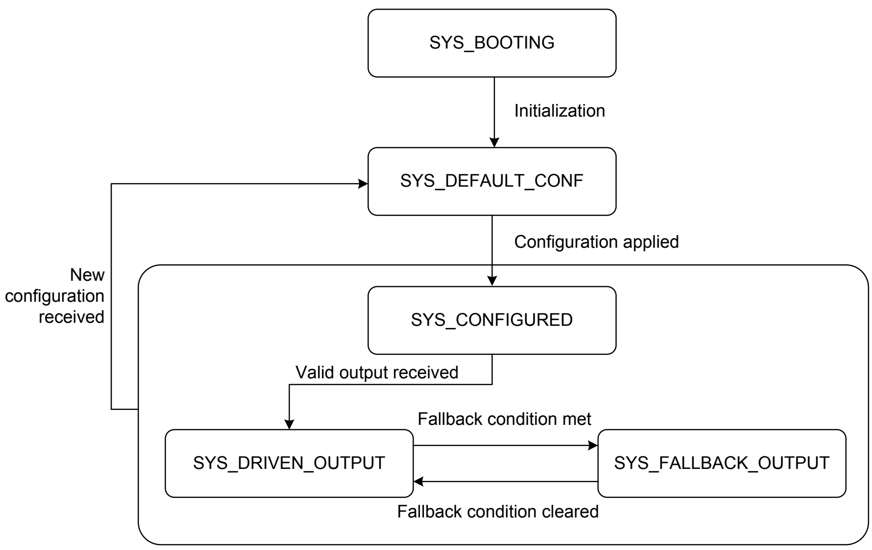
Explicit Parameters

The following table presents the explicit data for the Hiperface encoder:

Parameter Name	**Value**	**Data type** **R/W**	**Description**
Encoder Type	*0**: Singleturn *1*: Multiturn *2*: Not supported	ENUM R/-	Type of the encoder.
Total Number of Bits	0*...64	BYTE R/-	Total number of data bits of the position of the encoder.
Number of Singleturn Bits	0*...32	BYTE R/-	Number of data bits to count periods within a turn of the encoder.
Number of Multiturn Bits	0*...16	BYTE R/-	Number of data bits to count turns of the encoder.
* Parameter default value			

Operating Mode

IOM Operating Modes



Hiperface Encoder Regarding IOM Operating Modes

Module Transition to State	**Hiperface Callback Operations**	**Hiperface Resulting State**
SYS_BOOTING	-	Not configured
SYS_DEFAULT_CONF	-	Not configured
SYS_CONFIGURED	Configures Hiperface according to the received configuration	Configured
SYS_DRIVEN_OUTPUT	Operates according to the received data	Driven_Operational
SYS_FALLBACK_OUTPUT	-	No change

Hiperface States

Hiperface State	Hiperface Data Exchange	Hiperface Status
Not configured	-	-
Configured	Produce data: Input image	*SingleTurnPos* = 0 *MultiTurnPos* = 0 *PosTimestamp* = 0 *Staus.EnabledFlag* = FALSE *Status.BusyFlag* = FALSE *Status.WarningLowVpp* = FALSE *Status.WarningHighVpp* = FALSE *Status.ErrorFlag* = FALSE *ErrorId* = No Error detected *ErrorCode* = 0
Driven_Operational	Receive data: Output image Produce data: Input image	Refer to Driven_Operational, page 213.

Driven_Operational

Hiperface Commands	Condition	Hiperface Status	Behavior
Enable = TRUE	No error detected	*Status.EnabledFlag* = TRUE. *SingleTurnPos* is updated. *MultiTurnPos* is updated. *PosTimestamp* is updated. *Status.WarningLowVpp* is updated. *Status.WarningHighVpp* is updated. *Status.ErrorFlag* = FALSE. *ErrorId* is not updated and returns the last *ErrorId* value.	Enables counting. **NOTE:** • The encoder must be in the standstill mode when *Enable* is set. • The encoder is allowed to move only when *EnabledFlag* = TRUE.
Enable = TRUE	Any detected error except SinCos Synchro error	*Status.EnabledFlag* = FALSE. *Status.BusyFlag* = TRUE. *SingleTurnPos* is updated. *MultiTurnPos* is updated. *PosTimestamp* is updated. *Status.WarningLowVpp* is updated. *Status.WarningHighVpp* is updated. *Status.ErrorFlag* = FALSE. *ErrorId* is updated.	Disables counting. **NOTE:** To acknowledge the error and to resume counting, *Enable* parameter must be set to FALSE then to TRUE.

Hiperface Commands	Condition	Hiperface Status	Behavior
Enable = TRUE	SinCos Synchro error detected	*Status.EnabledFlag* = FALSE. *Status.BusyFlag* = FALSE. *SingleTurnPos* is not updated and returns the last valid value. *MultiTurnPos* is not updated and returns the last valid value. *PosTimestamp* is not updated and returns the last valid value. *Status.WarningLowVpp* is maintained. *Status.WarningHighVpp* is maintained. *Status.ErrorFlag* = TRUE. *ErrorId* = SinCos Synchro.	Disables counting. **NOTE:** When the error SinCos Synchro is resolved, *Status.EnabledFlag* is automatically set to TRUE, *ErrorFlag* is automatically set to FALSE and counting resumes automatically.
Enable = FALSE	-	*Status.EnabledFlag* = FALSE. *Status.BusyFlag* = FALSE. *SingleTurnPos* is not updated and returns the last valid value. *MultiTurnPos* is not updated and returns the last valid value. *PosTimestamp* is not updated and returns the last valid value. *Status.WarningLowVpp* is maintained. *Status.WarningHighVpp* is maintained. *Status.ErrorFlag* = FALSE. *ErrorId* = No Error detected. *ErrorCode* = 0	Disables counting
WarningAck rising edge	-	*Status.WarningLowVpp*= FALSE OR *Status.WarningHighVpp* = FALSE.	Resets *Status.WarningLowVpp* and *Status.WarningHighVpp*.

ErrorId Priority

ErrorId	Priority
Internal Field Power Supply	0
Encoder Power	1
Encoder Error	1
Hiperface Timeout	2
SinCos Signal	3
SinCos Synchro	3
Hiperface Protocol	4

Output Encoder Mode Principle Description

Overview

The Output Encoder generates pulses and returns positions.

A move profile with a linear acceleration or deceleration is applied to reach the target frequency. It is also possible to stop the generation at a stop position, and a Z pulse can be generated according to the encoder position.

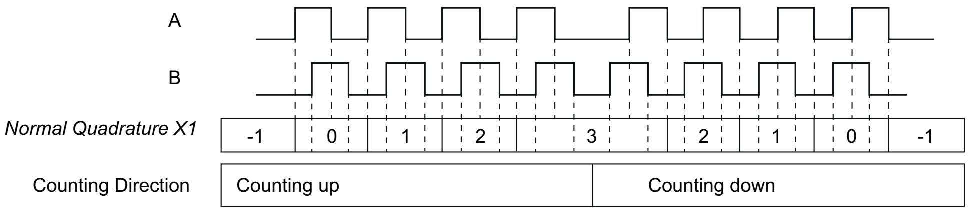
The control of speed and position is achieved in open loop mode.

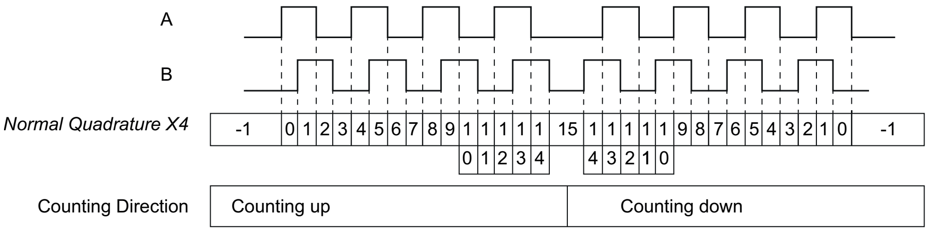
The duty cycle of the pulse is always 50%.

Principle

Output Mode

The following diagrams depict two signals (A and B) generated in the quadrature phase on the output encoder:





The phase sign depends on motor direction.

Position

The position is readable through the I/O image.

You can perform the *ExecuteSetPosition* command through the I/O image to overwrite the position.

NOTE:

- Ensure that the values of *NewSingleTurnPos* and *NewMultiTurnPos* respect the configured limits for single-turn and multi-turn positions.
- The *ExecuteSetPosition* command is allowed when the output generation is in stop.

Frequency

The frequency is from 0 Hz to 400 kHz (step 0.1 Hz), and the maximum frequency is 400 kHz.

Setting a negative frequency means generating pulses in the reverse direction.

The frequency is updated through the I/O Image.

NOTE: When starting a generation from frequency 0, the requested frequency is applied directly without considering acceleration, and when stopping a generation to frequency 0, frequency 0 is applied directly without considering deceleration.

Generation Stop

There are three ways to stop the generation:

- Stop position:
  The output encoder stops the generation when the configured stop position is reached and *EnableStop* is TRUE. The associated parameters can be updated through the I/O Image.

  NOTE:

  - Ensure that the values of *StopSingleTurnPos* and *StopMultiTurnPos* respect the configured limits for single-turn and multi-turn positions.
  - The stop frequency 0 is not applied when *StopPosFlag* is TRUE.
- Stop frequency 0:
  The output encoder stops the generation when the frequency is equal to 0 Hz.

  NOTE: The stop frequency is applied directly without considering deceleration.
- Disable function:
  Immediate stop of the generation.

NOTE: The last pulse finishes without any disturbance.

Acceleration and Deceleration

The acceleration and deceleration are expressed in Hz/ms and represent the frequency increment and decrement per ms, until the commanded frequency is reached.

The acceleration and deceleration can be updated through the I/O image.

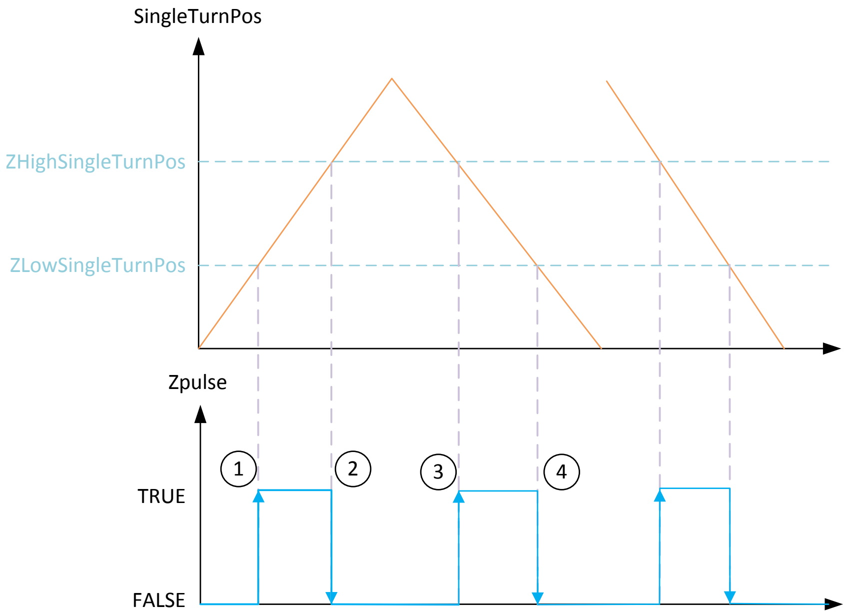
The maximum value of acceleration and deceleration is 400 kHz/ms.

Z Pulse

A Z pulse is set according to the given low and high positions. For example, when an present position is low, Z is TRUE. Z low and Z high positions are described by the single-turn position and the multi-turn position.

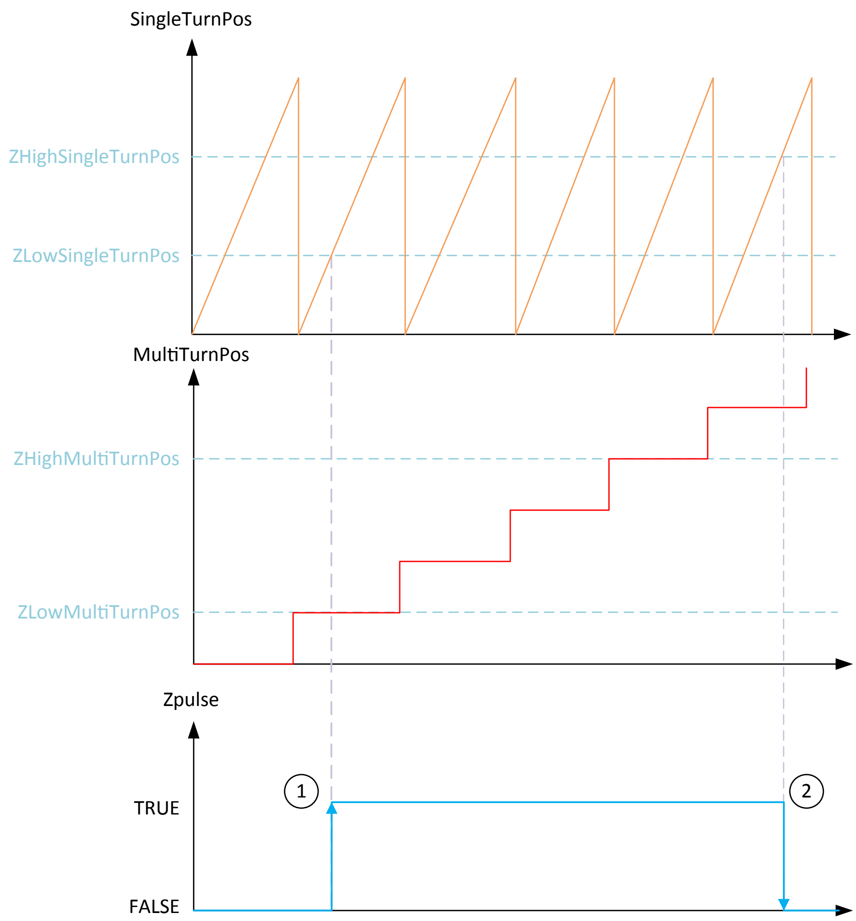
NOTE: Ensure that the values of *ZLowSingleTurnPos*, *ZLowMultiTurnPos*, *ZHighSingleTurnPos*, and *ZHighMultiTurnPos* respect the configured limits for single-turn and multi-turn positions.

The following diagram depicts an example of the single-turn encoder:



Stage	Description	
1	Counting is in a positive direction.	Z pulse rises to TRUE when *SingleTurnPos* = *ZLowSingleTurnPos*
2		Z pulse falls to FALSE when *SingleTurnPos* = *ZHighSingleTurnPos*
3	Counting is in a negative direction.	Z pulse rises to TRUE when *SingleTurnPos* = *ZHighSingleTurnPos*
4		Z pulse falls to FALSE when *SingleTurnPos* = *ZLowSingleTurnPos*

The following diagram depicts an example of the multi-turn encoder:



Stage	Description
1	Z pulse rises to TRUE when the following conditions are met: • *SingleTurnPos = ZLowSingleTurnPos* • *MultiTurnPos = ZLowMultiTurnPos*
2	Z pulse falls to FALSE when the following conditions are met: • *SingleTurnPos = ZHighSingleTurnPos* • *MultiTurnPos = ZHighMultiTurnPos*

Output Encoder Interface

Output Encoder Configuration

Configurable Parameters

The following table presents the configurable parameters for the output encoder:

Displayed Name ***Parameter Name***	**Value**	**Data Type**	**Description**
Output Mode *OutputMode*	0: **Normal Quadrature X1*** 1: **Normal Quadrature X4**	ENUM	Selects the counting measurement interval.
Number Of Data Bits *NumberOfDataBits*	**8*...32**	BYTE	Sets the number of bits to count turns and sets bits to count points per turn.
Number Of Data Bits Per Turn *NumberOfDataBitsPerTurn*	**8*...32**	BYTE	If **Number Of Data Bits** = **Number Of Data Bits Per Turn** : Single turn encoder. If **Number Of Data Bits** > **Number Of Data Bits Per Turn** : Multi turn encoder. **NOTE:** The number of data bits that defines the number of turns is equal to **Number Of Data Bits** – **Number Of Data Bits Per Turn**
* Parameter default value			

Implicit Parameters

The following table presents the input implicit data for the output encoder:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
EnabledFlag	FALSE* TRUE	BOOL R/-	When TRUE, the generation is in progress and the present position and frequency are valid.
SingleTurnPos	0*...4,294,967,295	UINT32 R/-	Single-turn position of the axis in pulses. Refreshed each cycle.
MultiTurnPos	0*...16,777,215	UINT32 R/-	Multi-turn position of the axis in pulses. Refreshed each cycle.
Warning	0*...15	BYTE R/-	Describes the output encoder advisory bits: Bit 0: *WarningFreq*: When TRUE, the input *Frequency* is over the maximum *Frequency*. The generation starts with the maximum *Frequency*. Bit 1: *WarningAccDec*: When TRUE, the input *AccDec* is over the maximum *AccDec* or 0. The generation starts with the maximum *AccDec*. Bit 2: *WarningZPos*: When TRUE, the Z position is invalid. The generation does not start until a new valid Z position is applied. Bit 3: *WarningStopPos*: When TRUE, the stop position is invalid. The generation does not start until a new valid stop position is applied. Bit 4: *WarningSetPos*: When TRUE, the set position is invalid and not applied.
PosTimestamp	0*...999,999,999	UINT32 R/-	Absolute time(1) of the position.
CurrentFrequency	-4,000,000...4,000,000 *0**	INT32 R/-	Frequency of the output encoder with a step of 0.1 Hz. Refreshed each cycle.
ErrorFlag	FALSE* TRUE	BOOL R/-	When TRUE, an error is detected. Disables the pulse generation and Z pulse.
ErrorId	*0**: No Error detected *1*: Internal Field Power Supply *2*: Fallback	ENUM R/-	Error type. When *ErrorFlag* = TRUE, the *ErrorId* parameter provides the error detected.
ZFlag	FALSE* TRUE	BOOL R/-	When TRUE, indicates that a Z pulse is generated.
StopPosFlag	FALSE* TRUE	BOOL R/-	When TRUE, the generation is stopped due to the stop position. The present position is valid and *EnabledFlag* = FALSE. Resets when *EnableStopPosition* = FALSE, or when a reset of *ExecuteSetPosition* to a new position is performed.
SetPosFlag	FALSE* TRUE	BOOL R/-	When TRUE, indicates that the set position is performed. Flag is reset at the *ExecuteSetPos* falling edge.

* Parameter default value

(1) The absolute time value refers to the internal time domain of the I/O island. It contains the fractional portion in nanoseconds according to IEEE 802.1AS-2020 timestamp data type.

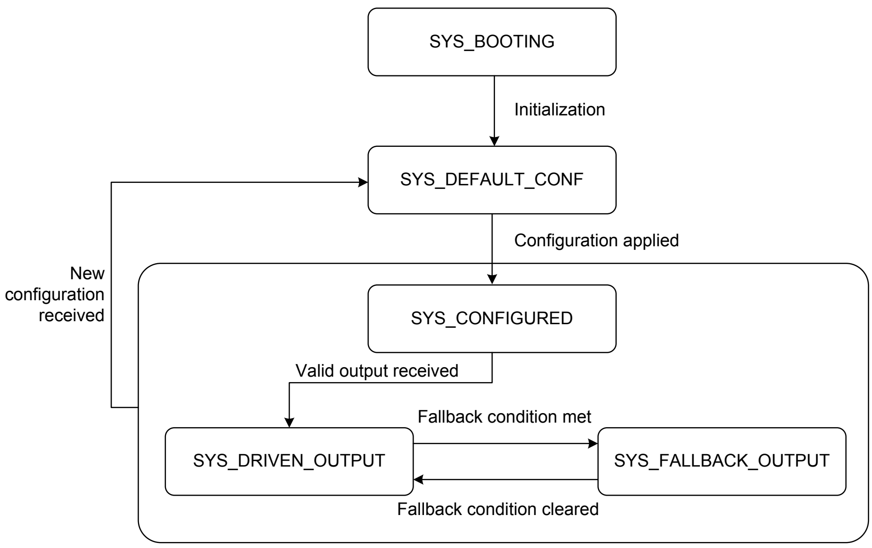
The following table presents the output implicit data for the output encoder:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
EnableGen	FALSE* TRUE	BOOL R/W	When TRUE, enables the generation regarding *Frequency* and *AccDec*.
Frequency	-4,000,000...4,000,000 0*	INT32 R/W	Frequency to apply at the pulse generation. Step: 0.1 Hz.
AccDec	1...4,000,000*	UINT32 R/W	Sets the pulse output start velocity. Step: 0.1 Hz. 4,000,000 means that the new frequency is applied directly.
EnableZ	FALSE* TRUE	BOOL R/W	When TRUE, Z physical output is TRUE when position is: - in *ZLowSingleTurnPos* and *ZHighSingleTurnPos* range while for a single turn encoder. - in *ZLowSingleTurnPos* and *ZHighSingleTurnPos* range and in *ZLowMultiTurnPos* and *ZHighMultiTurnPos* while range for a multi turn encoder. FALSE otherwise.
ForceZ	FALSE* TRUE	BOOL R/W	When TRUE, Z physical output is forced to TRUE.
ZAck	FALSE* TRUE	BOOL R/W	At rising edge, resets *ZFlag*.
ZLowSingleTurnPos	0*...4,294,967,295	UINT32 R/W	Low single-turn position threshold of Z pulse generation. *ZLowSingleTurnPos* < *ZHighSingleTurnPos* < $2^{\text{Number Of Data Bits Per Turn}}$
ZLowMultiTurnPos	0*...16,777,215	UINT32 R/W	Low multi-turn position threshold of Z pulse generation. *ZLowMultiTurnPos* < *ZHighMultiTurnPos* < $2^{(\text{Number Of Data Bits - Number Of Data Bits Per Turn})}$
ZHighSingleTurnPos	0*...4,294,967,295	UINT32 R/W	High single-turn position threshold of Z pulse generation. *ZLowSingleTurnPos* < *ZHighSingleTurnPos* < $2^{\text{Number Of Data Bits Per Turn}}$
ZHighMultiTurnPos	0*...16,777,215	UINT32 R/W	High multi-turn position threshold of Z pulse generation. *ZLowMultiTurnPos* < *ZHighMultiTurnPos* < $2^{(\text{Number Of Data Bits - Number Of Data Bits Per Turn})}$
EnableStopPosition	FALSE* TRUE	BOOL R/W	At TRUE, *StopSingleTurnPos* and *StopMultiTurnPos* are applied. At FALSE, *StopSingleTurnPos* and *StopMultiTurnPos* are ignored. The transition from FALSE to TRUE when the generation is stopped due to the stop position leads to restarting the generation.
StopSingleTurnPos	0*...4,294,967,295	UINT32 R/W	When *StopSingleTurnPos* and *StopMultiTurnPos* are reached, the generation stops. *StopSingleTurnPos* < $2^{\text{Number Of Data Bits Per Turn}}$
StopMultiTurnPos	0*...16,777,215	UINT32 R/W	When *StopSingleTurnPos* and *StopMultiTurnPos* are reached, the generation stops. *StopMultiTurnPos* < $2^{(\text{Number Of Data Bits - Number Of Data Bits Per Turn})}$

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
ExecuteSetPos	FALSE* TRUE	BOOL R/W	At rising edge, *NewSingleTurnPos* and *NewMultiTurnPos* are applied. **NOTE:** The *ExecuteSetPosition* command is allowed when the output generation is in stop.
NewSingleTurnPos	0*...4,294,967,295	UINT32 R/W	Single-turn position to apply when *ExecuteSetPos* is triggered. *NewSingleTurnPos* < $2^{\text{Number Of Data Bits Per Turn}}$
NewMultiTurnPos	0*...16,777,215	UINT32 R/W	Multi-turn position to apply when *ExecuteSetPos* is triggered. *NewMultiTurnPos* < $2^{(\text{Number Of Data Bits - Number Of Data Bits Per Turn})}$
* Parameter default value			

Operating Mode

IOM Operating Modes



Output Encoder Regarding IOM Operating Modes

Module Transition to State	Output Encoder Callback Operations	Output Encoder Resulting State
SYS_BOOTING	-	Not configured
SYS_DEFAULT_CONF	-	Not configured
SYS_CONFIGURED	Configures Output Encoder according to the received configuration.	Configured
SYS_DRIVEN_OUTPUT	Operates according to the received data.	Driven_Operational
SYS_FALLBACK_OUTPUT	Aborts pulse generation. Applies fallback value to the output.	Driven_Fallback

Output Encoder States

Output Encoder State	Output Encoder Data Exchange	Output Encoder Status
Not configured	-	-
Configured	Produce data: Input image	*EnabledFlag* = FALSE *SingleTurnPos* = 0 *MultiTurnPos* = 0 *PosTimestamp* = 0 *CurrentFrequency* = 0 *Warning* = 0 *ErrorFlag* = FALSE *ErrorId* = No Error detected *ZFlag* = FALSE *StopPosFlag* = FALSE *SetPosFlag* = FALSE
Driven_Operational	Receive data: Output image Produce data: Input image	Refer to Driven_Operational, page 224.
Driven_Fallback	Produce data: Input image	*EnabledFlag* = FALSE. *SingleTurnPos* is not updated and returns the last valid value *MultiTurnPos* is not updated and returns the last valid value *PosTimestamp* is not updated and returns the last valid value *CurrentFrequency* = 0 *Warning* = 0 *ErrorFlag* = TRUE *ErrorId* = Fallback (or a more prior *ErrorId*) *ZFlag* = No change *StopPosFlag* = FALSE *SetPosFlag* no change

Driven_Operational

Output Encoder Commands	Condition	Output Encoder Status	Behavior
Enable = TRUE	No error detected	*EnabledFlag* = TRUE *SingleTurnPos* is updated *MultiTurnPos* is updated *PosTimestamp* is updated *CurrentFrequency* is updated *Warning* is updated *ErrorFlag* = FALSE *ErrorId* = No Error detected *StopPosFlag* = FALSE	Enables the output encoder.
Enable = TRUE AND *EnableStopPosition* = TRUE	No error detected *SingleTurnPos* = *StopSingleTurnPos* *MultiTurnPos* = *StopMultiTurnPos*	*EnabledFlag* is updated *SingleTurnPos* is updated *MultiTurnPos* is updated *PosTimestamp* is updated *CurrentFrequency* is updated *Warning* is updated *ErrorFlag* = FALSE *ErrorId* = No Error detected *StopPosFlag* = TRUE	Stop position reached: stops the generation.
Enable = TRUE	Error detected	*EnabledFlag* is updated *SingleTurnPos* is not updated and returns the last valid value *MultiTurnPos* is not updated and returns the last valid value *PosTimestamp* is not updated and returns the last valid value *CurrentFrequency* = 0 *Warning* = 0 *ErrorFlag* = TRUE *ErrorId* is updated *StopPosFlag* = FALSE	Disables the output. Encoder with Z output. **NOTE:** To acknowledge the error and enable the output encoder, *Enable* must be set to FALSE then to TRUE (after the error condition is removed).
Enable = FALSE	-	*EnabledFlag* = FALSE *SingleTurnPos* is not updated and returns the last valid value *MultiTurnPos* is not updated and returns the last valid value *PosTimestamp* is not updated and returns the last valid value *CurrentFrequency* = 0 *Warning* = 0 *ErrorFlag* = FALSE *ErrorId* = No Error detected *StopPosFlag* = FALSE	Disables the output encoder.
ZEnable = TRUE	Output generation in progress	*ZFlag* is updated	Between *_ZlLowPos* and *_ZHighPos*, sets Z output and sets *ZFlag*.

Output Encoder Commands	Condition	Output Encoder Status	Behavior
ZForce rising edge	Output generation in progress	*ZFlag* = TRUE	Immediately forces Z output and sets *ZFlag*.
ZForce falling edge	Output generation in progress	-	Immediately releases Z output.
ZAck rising edge	-	*ZFlag* = FALSE	Resets *ZFlag*.
ExecuteSetPos rising edge	No output generation in progress	*SetPosFlag* = TRUE	Sets the position with *SingleTurnPos* and *MultiTurnPos*, and sets *SetPosFlag*.
ExecuteSetPos falling edge	-	*SetPosFlag* = FALSE	Resets *SetPosFlag*.

ErrorId Priority

ErrorId	Priority
Internal Field Power Supply	0
Fallback	1

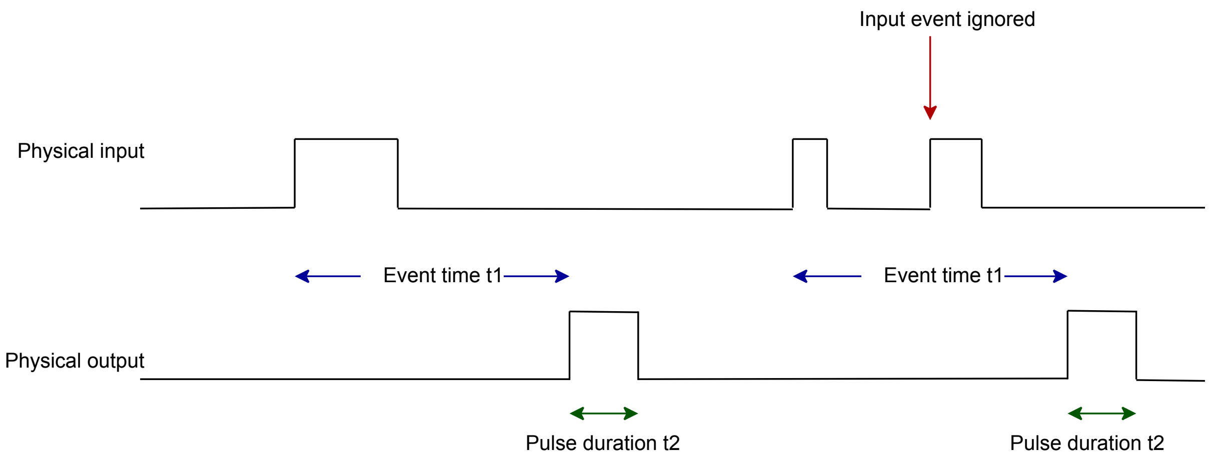
Output Pulse After Input Event Mode Principle Description

Overview

The Output Pulse After Input Event mode generates an output pulse after an input edge and a delay.

Principle Diagram

The following diagram depicts an overview of the Output Pulse After Input Event mode:



The input event can be triggered on rising/falling/both edges:

- 0 nominal, 1 pulse

The Event and Pulse Time are part of the I/O variable, and can be modified each cycle.

The number of generated pulses is counted. This number is part of the I/O variable and increments at the end of the pulse. During Event and Pulse Time, any other input events are ignored.

Output Pulse After Input Event Interface

Output Pulse After Input Event Configuration

Configurable Parameters

The following table presents the configurable parameters for the Output Pulse After Input Event mode:

Displayed Name ***Parameter Name***	**Value**	**Data Type**	**Description**
Input Location *InputLocation*	0: **I0** 1: **I1** 2: **I2** 3: **I3** 4: **I4** 5: **I5** 6: **I6** 7: **I7** 255: **Disabled***	ENUM	Location of the input.
Output Location *OutputLocation*	0: **Q0** 1: **Q1** 2: **Q2** 3: **Q3** 4: **Q4** 5: **Q5** 6: **Q6** 7: **Q7** 255: **Disabled***	ENUM	Location of the output.
Input Edge *InputEdge*	0: **Rising*** 1: **Falling** 2: **Both**	ENUM	Sets the input event edge to react and generate the output pulse.
Input Filter *InputFilter*	0: **0** 1: **0.0002** 2: **0.0005** 3: **0.001** 4: **0.002*** 5: **0.005** 6: **0.01** 7: **0.05** 8: **0.08** 9: **0.5** 10: **1** 11: **4** 12: **12**	ENUM	Allows reducing the effect of bounce on the input. Changes to the signal are only detected if the pulse width of the input signal is longer than the filter time (ms). The physical input signal is delayed by the configured input filter time.
* Parameter default value			

Implicit Parameters

The following table presents the input implicit data for the Output Pulse After Input Event mode:

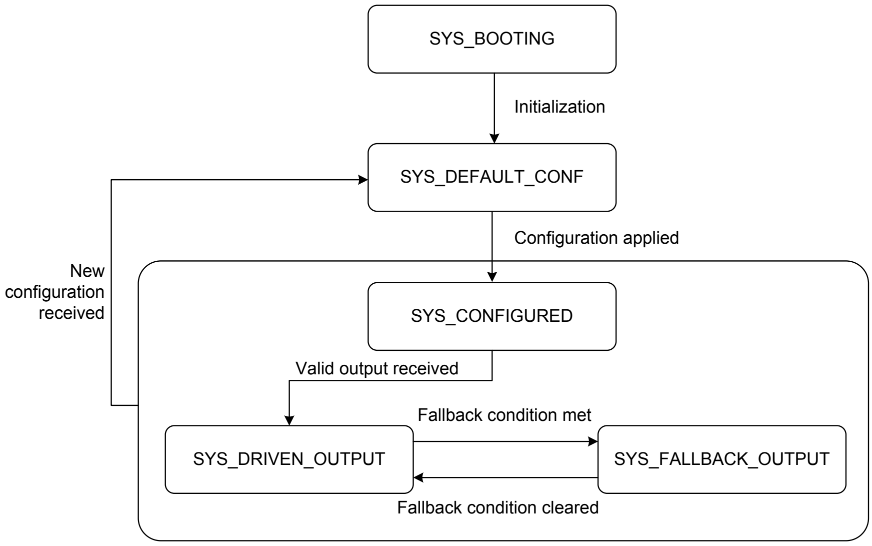
Parameter Name	**Value**	**Data Type** **R/W**	**Description**
EnabledFlag	FALSE* TRUE	BOOL R/-	When TRUE, catches the input and the pulse generation is enabled.
PulseNb	0*...255	BYTE R/-	Counts the number of pulses generated to react at an input event.
ErrorFlag	FALSE* TRUE	BOOL R/-	When TRUE, an error is detected. Disables the function.
ErrorId	*0**: No Error detected *1*: Internal Field Power Supply *2*: Short circuit *3*: Fallback	ENUM R/-	Error type. When *ErrorFlag* = TRUE, the *ErrorId* parameter provides the error detected.
* Parameter default value			

The following table presents the output implicit data for the Output Pulse After Input Event mode:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
Enable	FALSE* TRUE	BOOL R/W	When TRUE, starts to catch the input event and the pulse generation.
Event Time	0*...4,294,967,295	UINT32 R/W	Time between the input event and the output pulse generation in nanoseconds (ns).
Pulse Time	0*...4,294,967,295	UINT32 R/W	Duration of the output pulse in nanoseconds (ns).
* Parameter default value			

Operating Mode

IOM Operating Modes



Output Pulse After Input Event Regarding IOM Operating Modes

Module Transition to State	Output Pulse After Input Event Callback Operations	Output Pulse After Input Event Resulting State
SYS_BOOTING	-	Not configured
SYS_DEFAULT_CONF	-	Not configured
SYS_CONFIGURED	Configures Output Pulse After Input Event according to the received configuration.	Configured
SYS_DRIVEN_OUTPUT	Operates according to the received data.	Driven_Operational
SYS_FALLBACK_OUTPUT	Applies the fallback value to the output.	Driven_Fallback

Output Pulse After Input Event States

Output Pulse After Input Event State	Output Pulse After Input Event Data Exchange	Output Pulse After Input Event Status	Output Pulse After Input Event Physical Output
Not configured	-	-	0
Configured	Produce data: Input image	*EnabledFlag* = FALSE *PulseNb* = 0 *ErrorFlag* = FALSE *ErrorId* = No Error detected	0
Driven_Operational	Receive data: Output image Produce data: Input image	Refer to Driven_Operational, page 229.	Output Pulse After Input Event value
Driven_Fallback	Produce data: Input image	*EnabledFlag* = FALSE *PulseNb* is not updated and it returns to the last valid value *ErrorFlag* = TRUE *ErrorId* = Fallback (or a more prior *ErrorId*)	Fallback value

Driven_Operational

Output Pulse After Input Event Commands	Condition	Output Pulse After Input Event Status	Behavior
Enable = TRUE	No error detected	*EnabledFlag* = TRUE *PulseNb* is updated *ErrorFlag* = FALSE *ErrorId* = No Error Detected	Enables the Output Pulse After Input Event mode.
Enable = TRUE	Error detected	*EnabledFlag* = FALSE *PulseNb* is not updated and it returns to the last valid value *ErrorFlag* = TRUE *ErrorId* is updated	Disables the Output Pulse After Input Event mode. **NOTE:** To acknowledge the error and enable the Output Pulse After Input Event mode, *Enable* must be set to FALSE then to TRUE (after the error condition is removed).
Enable = TRUE	-	*EnabledFlag* = FALSE *PulseNb* is not updated and it returns to the last valid value *ErrorFlag* = FALSE *ErrorId* = No Error Detected	Disables the Output Pulse After Input Event mode.

ErrorId Priority

ErrorId	Priority
Internal Field Power Supply	0
Short circuit	1
Fallback	2

Oversampling Input Mode Principle Description

Overview

The Oversampling Input mode is used to sample a physical digital input based on a sampling step.

The number of samples per cycle can be 8 bits, 16 bits, or 32 bits.

The sampling step time value depends on the configured **IO Bus Cycle Time** and **Sampling step mode**, the following table lists the possible combinations:

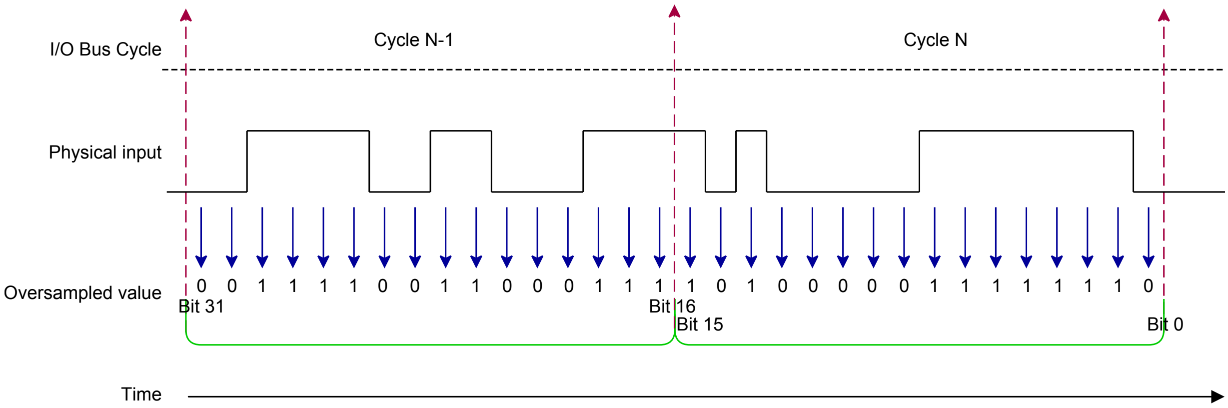
Sampling step mode	IO Bus Cycle Time		
	1 ms	**2 ms**	**4 ms**
8-bit	125 µs	250 µs	500 µs
16-bit	62.5 µs	125 µs	250 µs
32-bit	31.25 µs	62.5 µs	125 µs

NOTE: For a correct oversampling of your input, ensure that your **Input Filter** value is shorter than your sampling step value.

Principle Diagram

In the following diagram, the oversampling Input mode is configured with the following parameters:

- **IO Bus Cycle Time** = 1 ms
- **Sampling Step Mode** = 16 bits



The physical input is divided into 16 steps of 62.5 µs and recorded into in the *OversampledInputValue* word.

At each cycle, *OversampledInputValue* is updated and is a combination of the value recorded during the cycle N-1 with the value recorded during the cycle N.

In the example provided, *OversampledInputValue* = 0011 1100 1100 0111 1010 0000 1111 1110 bin (or 1,019,715,838 dec).

Oversampling Input Configuration

Configurable Parameters

The following table presents the configurable parameters for the Oversampling Input mode:

Displayed Name ***Parameter Name***	**Value**	**Data Type**	**Description**
Input Location *InputLocation*	0: **I0** 1: **I1** 2: **I2** 3: **I3** 4: **I4** 5: **I5** 6: **I6** 7: **I7** 255: **Disabled***	ENUM	Location of the input.
Sampling Step Mode *SamplingStepMode*	0: **8*** 1: **16** 2: **32**	ENUM	Sets the number of steps per cycle.
Input Filter *InputFilter*	0: **0** 1: **0.0002** 2: **0.0005** 3: **0.001** 4: **0.002*** 5: **0.005** 6: **0.01** 7: **0.05** 8: **0.08** 9: **0.5** 10: **1** 11: **4** 12: **12**	ENUM	Allows reducing the effect of bounce on the input. Changes to the signal are only detected if the pulse width of the input signal is longer than the filter time (ms). The physical input signal is delayed by the configured input filter time.
* Parameter default value			

Implicit Parameters

The following table presents the input implicit data for the Oversampling Input mode:

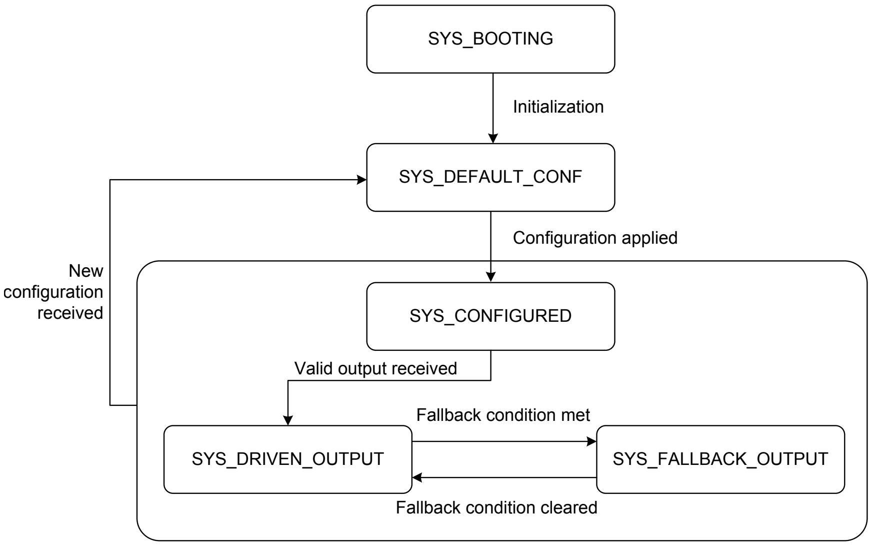
Parameter Name	**Value**	**Data Type** **R/W**	**Description**
EnabledFlag	FALSE* TRUE	BOOL R/-	When TRUE, the capture is in progress and the oversampling input values are valid.
OversampledInputValue	0*...4,294,967,295	UINT32 R/-	Cyclic oversampled input value. • Sampling step 8: ◦ Bit 0-7: Cycle n input status (bit 0 is the most recent) ◦ Bit 8-15: Cycle n-1 input status (bit 8 is the most recent) ◦ Bit 16-23: Cycle n-2 input status (bit 16 is the most recent) ◦ Bit 24-31: Cycle n-3 input status (bit 24 is the most recent) • Sampling step 16: ◦ Bit 0-15: Cycle n input status (bit 0 is the most recent) ◦ Bit 16-31: Cycle n-1 input status (bit 15 is the most recent) • Sampling step 32: ◦ Bit 0-31: Cycle n input status (bit 0 is the most recent)
* Parameter default value			

The following table presents the output implicit data for the Oversampling Input mode:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
Enable	FALSE* TRUE	BOOL R/W	When TRUE, starts to capture the oversampling input values.
* Parameter default value			

Operating Mode

IOM Operating Modes



Oversampling Input Regarding IOM Operating Modes

Module Transition to State	Oversampling Input Callback Operations	Oversampling Input Resulting State
SYS_BOOTING	-	Not configured
SYS_DEFAULT_CONF	-	Not configured
SYS_CONFIGURED	Configures Oversampling Input according to the received configuration.	Configured
SYS_DRIVEN_OUTPUT	Operates according to the received data.	Driven_Operational
SYS_FALLBACK_OUTPUT	-	No change

Oversampling Input States

Oversampling Input state	Oversampling Input data exchange	Oversampling Input status
Not configured	-	-
Configured	Produce data: Input image	*EnabledFlag* = FALSE *OversampledInputValue* = 0
Driven_Operational	Receive data: Output image Produce data: Input image	Refer to Driven_Operational, page 234.

Driven_Operational

Oversampling Input Commands	Condition	Oversampling Input Status	Behavior
Enable = TRUE	No error detected	EnabledFlag = TRUE *OversampledInputValue* is updated.	Enables the Oversampling Input mode.
Enable = FALSE	-	EnabledFlag = FALSE *OversampledInputValue* is updated and returns the last valid value.	Disables the Oversampling Input mode.

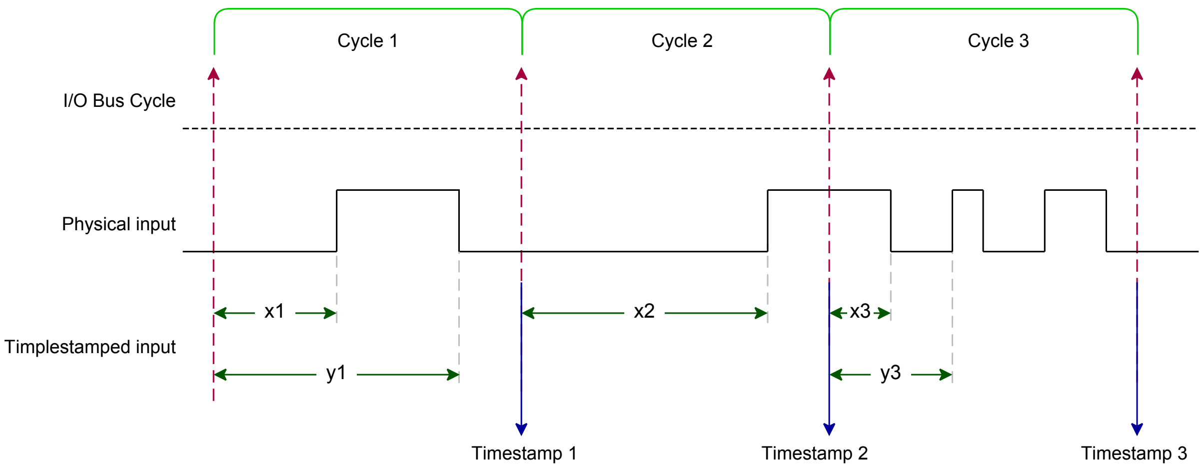
Timestamp Input Mode Principle Description

Overview

The Timestamp Input mode allows to read a physical digital input and to save the timestamp.

Principle Diagram

The following diagram depicts an overview of the Timestamp Input mode:



When *Enable* is TRUE, at each cycle, the values of the timestamp function are updated:

Timestamp 1	*TimestampInputRisingEdge* = x1 *TimestampInputFallingEdge* = y1 *TimestampInputNbRising* = 1 *TimestampInputNbFalling* = 1
Timestamp 2	*TimestampInputRisingEdge* = x2 *TimestampInputFallingEdge* = y1 *TimestampInputNbRising* = 2 *TimestampInputNbFalling* = 1
Timestamp 3	*TimestampInputRisingEdge* = x3 *TimestampInputFallingEdge* = y3 *TimestampInputNbRising* = 4 *TimestampInputNbFalling* = 4

Timestamp Input Configuration

Configurable Parameters

The following table presents the configurable parameters for the Timestamp Input mode:

Displayed Name ***Parameter Name***	Value	Data Type	Description
Input Location *InputLocation*	0: **I0** 1: **I1** 2: **I2** 3: **I3** 4: **I4** 5: **I5** 6: **I6** 7: **I7** 255: **Disabled***	ENUM	Location of the input.
Input Filter *InputFilter*	0: **0** 1: **0.0002** 2: **0.0005** 3: **0.001** 4: **0.002*** 5: **0.005** 6: **0.01** 7: **0.05** 8: **0.08** 9: **0.5** 10: **1** 11: **4** 12: **12**	ENUM	Allows reducing the effect of bounce on the input. Changes to the signal are only detected if the pulse width of the input signal is longer than the filter time (ms). The physical input signal is delayed by the configured input filter time. The accuracy of the input filter impacts the timestamped data and is determined by the selected **Input Filter** value. For more information on the input filter accuracy, refer to Performances Summary, page 19.
* Parameter default value			

Implicit Parameters

The following table presents the input implicit data for the Timestamp Input mode:

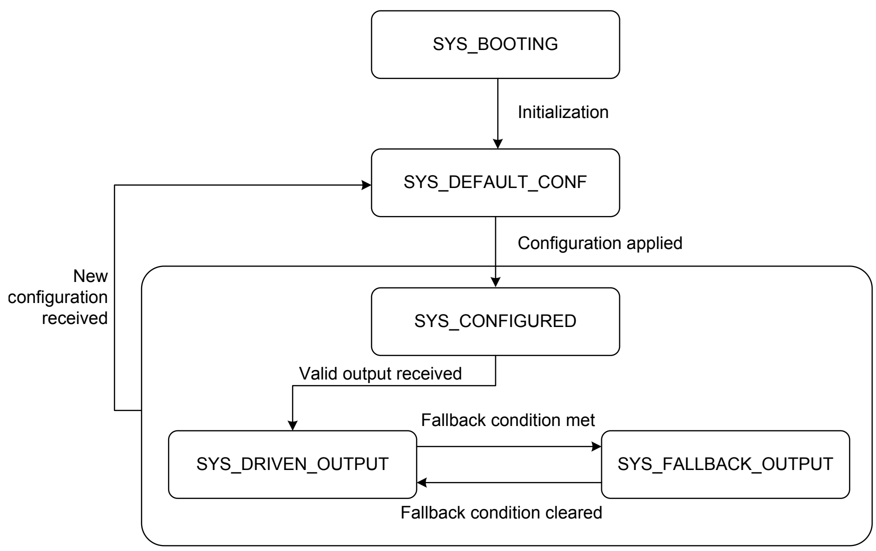
Parameter Name	**Value**	**Data Type**	**Description**
EnabledFlag	FALSE* TRUE	BOOL R/W	When TRUE, the capture is in progress and the timestamp input values are valid.
TimestampInputRisingEdge	0*...999,999,999	UINT32 R/-	Absolute time(1) of the rising edge captured on the input in nanoseconds (ns). If no edge detected, retains the last valid value.
TimestampInputFallingEdge	0*...999,999,999	UINT32 R/-	Absolute time(1) of the falling edge captured on the input in nanoseconds (ns). If no edge detected, retains the last valid value.
TimestampInputNbRising	0*...255	BYTE R/-	Total number of rising edges on the input.
TimestampInputNbFalling	0*...255	BYTE R/-	Total number of falling edges on the input.
* Parameter default value (1) The absolute time value refers to the internal time domain of the I/O island. It contains the fractional portion in nanoseconds according to IEEE 802.1AS-2020 timestamp data type.			

The following table presents the output implicit data for the Timestamp Input mode:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
Enable	FALSE* TRUE	BOOL R/W	When TRUE, starts to capture the timestamp input values.
* Parameter default value			

Operating Mode

IOM Operating Modes



Timestamp Input Regarding IOM Operating Modes

Module Transition to State	Timestamp Input Callback Operations	Timestamp Intput Resulting State
SYS_BOOTING	-	Not configured
SYS_DEFAULT_CONF	-	Not configured
SYS_CONFIGURED	Configures Timestamp Input according to the received configuration	Configured
SYS_DRIVEN_OUTPUT	Operates according to the received data	Driven_Operational
SYS_FALLBACK_OUTPUT	-	No change

Timestamp Input States

Timestamp Input State	Timestamp Input Data Exchange	Timestamp Input Status
Not configured	-	-
Configured	Produce data: Input image	*EnabledFlag* = FALSE *TimestampInputRisingEdge* = 0 *TimestampInputFallingEdge* = 0 *TimestampInputNbRising* = 0 *TimestampInputNbFalling* = 0
Driven_Operational	Receive data: Output image Produce data: Input image	Refer to Driven_Operational, page 238.

Driven_Operational

Timestamp Input Commands	Condition	Timestamp Input Status	Behavior
Enable = TRUE	No error detected	EnabledFlag = TRUE TimestampInputRisingEdge is updated TimestampInputFallingEdge is updated TimestampInputNbRising is updated TimestampInputNbFalling is updated	Enables the Timestamp Input
Enable = FALSE	-	EnabledFlag = FALSE TimestampInputRisingEdge is not updated and returns the last valid value TimestampInputFallingEdge is not updated and returns the last valid value TimestampInputNbRising is not updated and returns the last valid value TimestampInputNbFalling is not updated and returns the last valid value	Disables the Timestamp Input

Oversampling Output Mode Principle Description

Overview

The Oversampling Output mode generates an output profile based on the sampling step and the required profile defined by *OversampledOutputValue*.

The number of samples per cycle can be 8 bits, 16 bits, or 32 bits.

The duration of each step depends on the configured **IO Bus Cycle Time** and **Sampling step mode**, the following table lists the possible combinations:

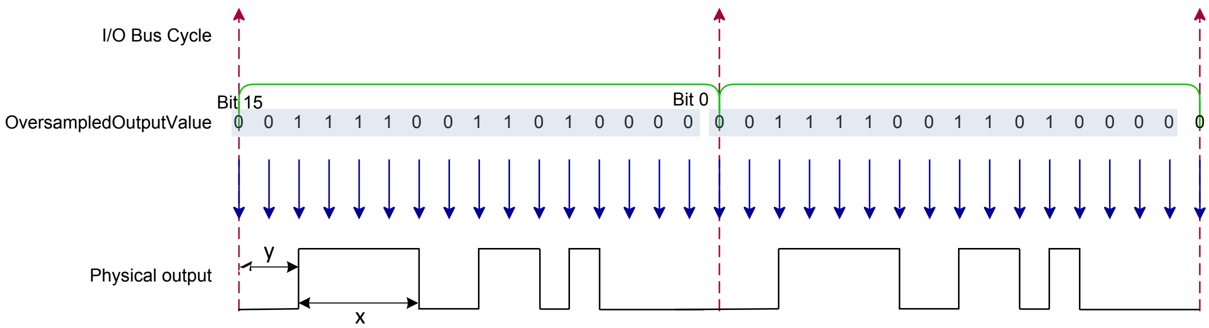
Sampling step mode	IO Bus Cycle Time		
	1 ms	**2 ms**	**4 ms**
8-bit	125 µs	250 µs	500 µs
16-bit	62.5 µs	125 µs	250 µs
32-bit	31.25 µs	62.5 µs	125 µs

Principle Diagram

In the following diagram, the oversampling Input mode is configured with the following parameters:

- **IO Bus Cycle Time** = 1 ms
- **Sampling Step Mode** = 16 bits
- *OversampledOutputValue* = 0011 1100 1101 0000 bin (15,568 dec)
- *NbCycle* = 0

The **Oversampling Output** mode divides the **IO Bus Cycle Time** into 16 steps of 62.5 µs and generates the output profile defined by *OversampledOutputValue*:



In this example, the output profile starts by 2 steps at FALSE for a duration of y = 125 µs (2 x 62.5 µs) and continues with 4 steps at TRUE for a duration of x = 250 µs (4 x 62.5 µs) and so on. The output generation is set to infinite generation (*NbCycle* = 0), the output profile is repeated at the next **IO Bus Cycle Time**.

The generation can be performed:

- Continuously: An infinite generation
- For a number of cycles: The generation stops when the number of cycles to generate is reached

It is possible to abort the generation by the software in both cases.

The output profile can be adjusted dynamically between each cycle during the generation.

Oversampling Output Configuration

Configurable Parameters

The following table presents the configurable parameters for the oversampling output:

Displayed Name *Parameter Name*	Value	Data Type	Description
Output Location *OutputLocation*	0: **Q0** 1: **Q1** 2: **Q2** 3: **Q3** 4: **Q4** 5: **Q5** 6: **Q6** 7: **Q7** 255: **Disabled***	ENUM	Location of the output.
Sampling Step Mode *SamplingStepMode*	0: **8*** 1: **16** 2: **32**	ENUM	Sets the number of steps per cycle.
* Parameter default value			

Implicit Parameters

The following table presents the input implicit data for the oversampling output:

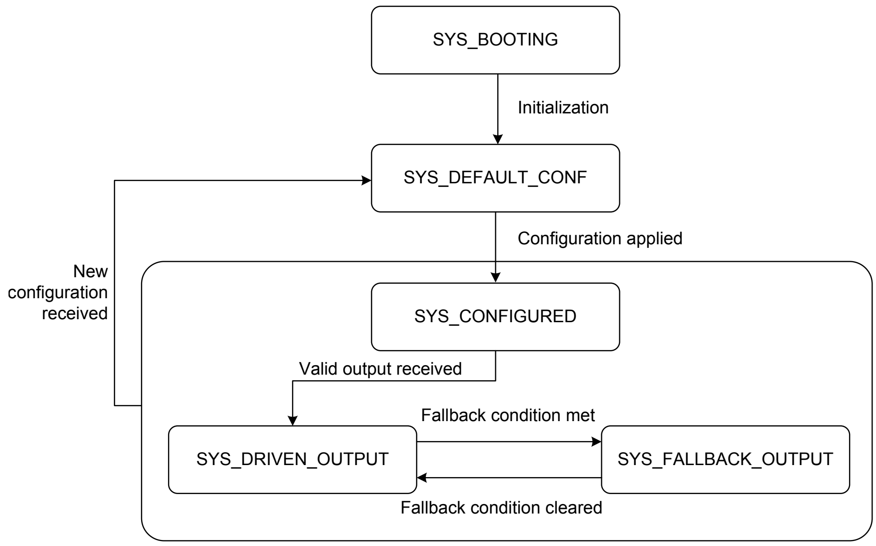
Parameter Name	Value	Data Type R/W	Description
Status	0*...15	BYTE R/-	Describes the status (bit field). Bit 0: *DoneFlag*: When TRUE, the output profile generation is ended (NbCycle is reached). Bit 1: *BusyFlag*: When TRUE, the output profile generation is in progress; resets when the generation is done or aborted, or when an error is detected. Bit 2: *AbortedFlag*: When TRUE, the output profile generation is aborted. Bit 3: *ErrorFlag*: When TRUE, an error is detected. Disables the output profile generation.
ErrorId	*0**: No Error detected *1*: Internal Field Power Supply *2*: Short circuit *3*: Fallback *4*: Abort Flag	ENUM R/-	Error type. When *ErrorFlag* = TRUE, the *ErrorId* parameter provides the error detected.
NbExecute	0*...255	BYTE R/-	Incremented at each executed rising edge and *Status.BusyFlag* = FALSE.
* Parameter default value			

The following table presents the output implicit data for the oversampling output:

Parameter Name	Value	Data Type R/W	Description
Command	0*...7	BYTE R/W	Sets the command (bit field). Bit 0: Execution: At rising edge, starts the output profile generation. Bit 1: Abort: At rising edge, aborts the output profile generation (no impact if the generation is not in progress).
NbCycle	0*...65,535	UINT16 R/W	Number of cycles to generate the output profile (0 corresponds to infinite generation). This parameter can be updated during IDLE state.
OversampledOutputValue	0*...4,294,967,295	UINT32 R/W	Defines the output profile. Bit 0: Last output to apply. Bit 7/15/31: Next output to apply (depending on the sampling step). Unused bits are ignored. This parameter can be updated during IDLE state.
* Parameter default value			

Operating Mode

IOM Operating Modes



Oversampling Output Regarding IOM Operating Modes

Module Transition to State	Oversampling Input Callback Operations	Oversampling Input Resulting State
SYS_BOOTING	-	Not configured
SYS_DEFAULT_CONF	-	Not configured
SYS_CONFIGURED	Configures Oversampling Output according to the received configuration.	Configured
SYS_DRIVEN_OUTPUT	Operates according to the received data.	Driven_Operational
SYS_FALLBACK_OUTPUT	Applies the fallback value to the output.	Driven_Fallback

Oversampling Output States

Oversampling Output State	Oversampling Output Data Exchange	Oversampling Output Status	Oversampling Output Physical Output
Not configured	-	-	0
Configured	Produce data: Input image	*Status.DoneFlag* = FALSE *Status.BusyFlag* = FALSE *Status.AbortedFlag* = FALSE *Status.ErrorFlag* = FALSE *ErrorId* = No Error detected *NbExecute* = 0	0
Driven_Operational	Receive data: Output image Produce data: Input image	Refer to Driven_ Operational, page 242.	Oversampling Output value
Driven_Fallback	Produce data: Input image	*Status.DoneFlag* = FALSE *Status.BusyFlag* = FALSE *Status.AbortedFlag* = FALSE *Status.ErrorFlag* = TRUE *ErrorId* = Fallback *NbExecute* = No change	Fallback value

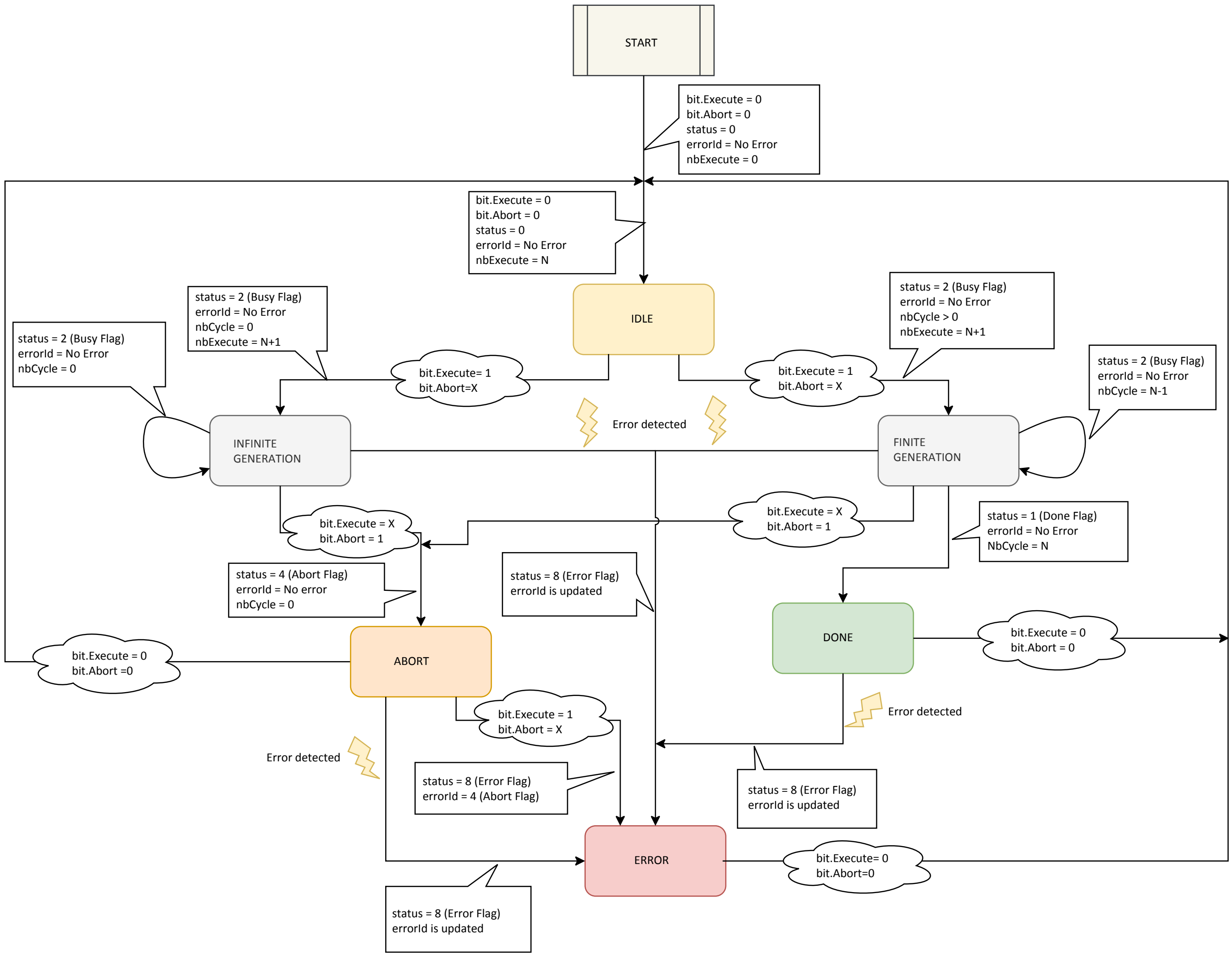
Driven_Operational

Oversampling Output Commands	Condition	Oversampling Output Status	Behavior
Command.Execute rising edge	No error detected. *Status.AbortedFlag* = FALSE.	*Status.DoneFlag* = FALSE *Status.BusyFlag* = TRUE *Status.AbortedFlag* = FALSE *Status.ErrorFlag* = FALSE *ErrorId* = No Error detected *NbExecute* = *NbExecute* + 1	Output profile generation with *OversampledOutputValue*. *NbCycle* defines if the generation is finite or infinite.
-	Finite output profile generation ended.	*Status.DoneFlag* = TRUE *Status.BusyFlag* = FALSE *Status.AbortedFlag* = FALSE *Status.ErrorFlag* = FALSE *ErrorId* = No Error detected *NbExecute* = No change	Aborts the output profile generation.

Oversampling Output Commands	**Condition**	**Oversampling Output Status**	**Behavior**
Command.Abort rising edge	Output profile generation in progress.	*Status.DoneFlag* = FALSE *Status.BusyFlag* = FALSE *Status.AbortedFlag* = TRUE *Status.ErrorFlag* = FALSE *ErrorId* = No Error detected *NbExecute* = No change	Aborts the output profile generation.
Command.Execute rising edge	Error detected.	*Status.DoneFlag* = FALSE *Status.BusyFlag* = FALSE *Status.AbortedFlag* = FALSE *Status.ErrorFlag* = TRUE *ErrorId* is updated *NbExecute* = *NbExecute* + 1	Aborts the output profile generation.
-	Error detected. Output profile generation in progress.	*Status.DoneFlag* = FALSE *Status.BusyFlag* = FALSE *Status.AbortedFlag* = FALSE *Status.ErrorFlag* = TRUE *ErrorId* is updated *NbExecute* = No change	Aborts the output profile generation.
Command.Execute rising edge	No error detected. *Status.AbortedFlag* = TRUE and *Status.BusyFlag* = FALSE.	*Status.DoneFlag* = FALSE *Status.BusyFlag* = FALSE *Status.AbortedFlag* = FALSE *Status.ErrorFlag* = TRUE *ErrorId* = *ABORT_FLAG* *NbExecute* = *NbExecute* + 1	Aborts the output profile generation.
Command.Execute = FALSE	From *SYS_CONFIGURED*.	*Status.DoneFlag* = FALSE *Status.BusyFlag* = FALSE *Status.AbortedFlag* = FALSE *Status.ErrorFlag* = FALSE *ErrorId* = No Error detected *NbExecute* = No change	Initializes all output flags.
Command.Execute = FALSE	Except from *SYS_CONFIGURED*.	*Status.DoneFlag* is updated *Status.BusyFlag* is updated *Status.AbortedFlag* is updated *Status.ErrorFlag* is updated *ErrorId* is updated *NbExecute* = No change	Maintains all output flags.
Command.Execute rising/falling edge	Output profile generation in progress.	-	Ignored.

Oversampling Output Commands	Condition	Oversampling Output Status	Behavior
Command.Abort rising edge	No output profile generation.	-	Ignored.
Command.Abort falling edge	No output profile generation. *ErrorId* = *ABORT_FLAG*.	*Status.DoneFlag* = FALSE *Status.BusyFlag* = FALSE *Status.AbortedFlag* = FALSE *Status.ErrorFlag* = FALSE *ErrorId* = No Error detected *NbExecute* = No change	Clears the Abort Error flags.

The following diagram depicts a global view of the Driven_Operational table:



ErrorId Priority

ErrorId	Priority
Internal Field Power Supply	0
Short circuit	1
Fallback	2
Abort Flag	3

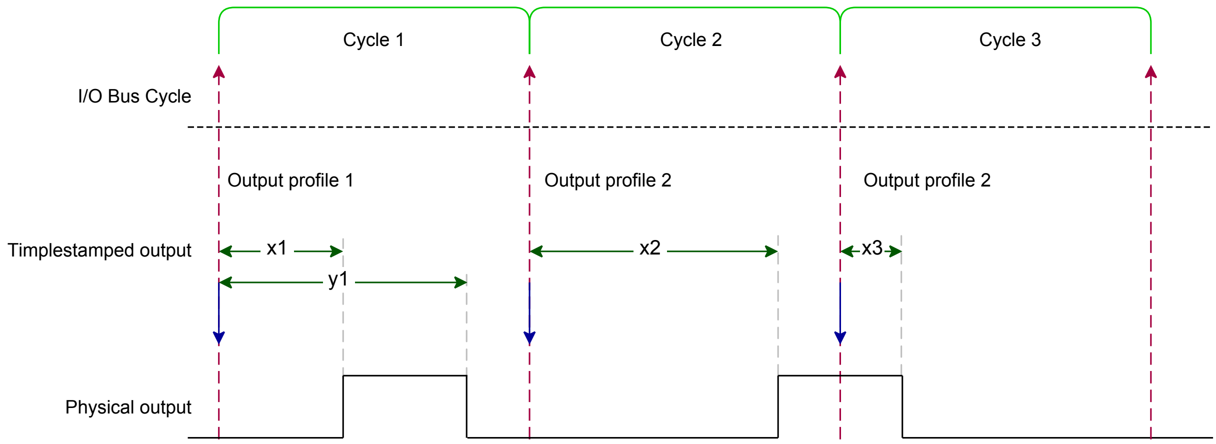
Timestamp Output Mode Principle Description

Overview

The Timestamp Output mode allows to update a physical digital output based on the timestamped profile.

Principle Diagram

The following diagram depicts an overview of the Timestamp Output mode:



The rising edge and falling edge timestamps are sent to the module each cycle, and the module evaluates in which cycle to apply them. For example, the parameters applied to obtain the diagram above are the following:

Output profile 1	*Command* = 7 *TimestampOutEdgeRising* = x1 *TimestampOutEdgeFalling* = y1
Output profile 2	*Command* = 3 *TimestampOutEdgeRising* = x2 *TimestampOutEdgeFalling* = Not relevant
Output profile 3	*Command* = 5 *TimestampOutEdgeRising* = Not relevant *TimestampOutEdgeFalling* = x3

NOTE: Sending a new valid timestamp during generation overwrites the previous one.

Timestamp Output Configuration

Configurable Parameters

The following table presents the configurable parameters for the Timestamp Output mode:

Displayed Name ***Parameter Name***	**Value**	**Data Type**	**Description**
Output Location *OutputLocation*	0: **Q0** 1: **Q1** 2: **Q2** 3: **Q3** 4: **Q4** 5: **Q5** 6: **Q6** 7: **Q7** 255: **Disabled***	ENUM	Location of the output.
* Parameter default value			

Implicit Parameters

The following table presents the input implicit data for the Timestamp Output mode:

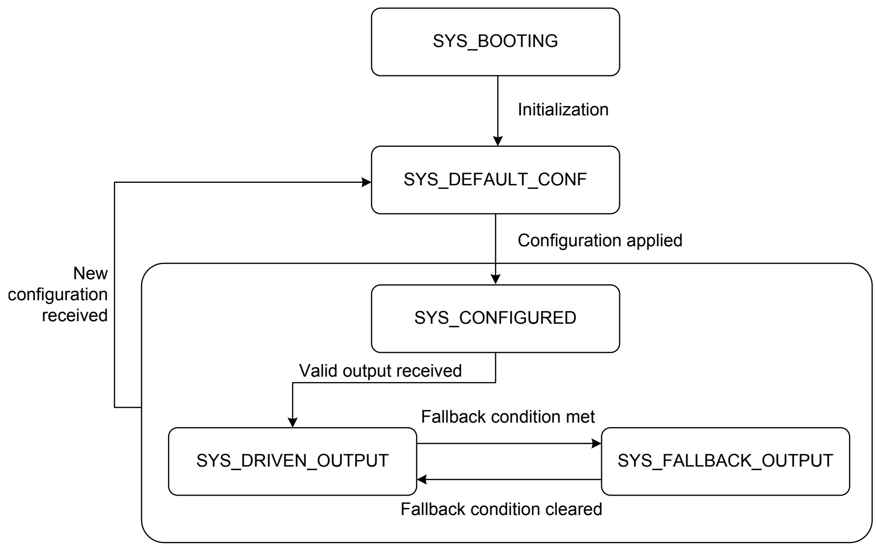
Parameter Name	**Value**	**Data Type** **R/W**	**Description**
Status	0*...15	BYTE R/-	Bit 0: *EnabledFlag*: When TRUE, the output profile generation is ended (*NbCycle* is reached). Bit 1: *WarningRising*: When TRUE, a rising edge that is not yet generated is overwritten, or *TimestampOutEdgeRising* is out of the timing range. Resets after the generation is done or aborted, or when an error is detected. Bit 2: *WarningFalling:* When TRUE, a falling edge, that is not yet generated, is overwritten, or *TimestampOutEdgeRising* is out of the timing range. Bit 3: *ErrorFlag*: When TRUE, an error is detected. Disables the timestamp output. **NOTE:** Unused bits are reserved.
ErrorId	*0**: No Error detected *1*: Internal Field Power Supply *2*: Short circuit *3*: Fallback	ENUM R/-	Error type. When *ErrorFlag* = TRUE, the *ErrorId* parameter provides the error detected.
* Parameter default value			

The following table presents the output implicit data for the Timestamp Output mode:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
Command	0*...15	BYTE R/W	Bit 0: *EnableGeneration*: When TRUE, starts to apply the timestamp output values. A falling edge sets *ErrorFlag* to FALSE. Bit 1: *EnableRising*: When TRUE, the edge rising time is applied. Bit 2: *EnableFalling*: When TRUE, the edge falling time is applied. Bit 3: *WarningAck*: At rising edge, resets *WarningRising* and *WarningFalling*. **NOTE:** Unused bits are reserved.
TimestampOutEdgeRising	0*...999,999,999	UINT32 R/W	Absolute time(1) of the rising edge to apply on the output in nanoseconds (ns).
TimestampOutEdgeFalling	0*...999,999,999	UINT32 R/W	Absolute time(1) of the falling edge to apply on the output in nanoseconds (ns).
* Parameter default value (1) The absolute time value refers to the internal time domain of the I/O island. It contains the fractional portion in nanoseconds according to IEEE 802.1AS-2020 timestamp data type.			

Operating Mode

IOM Operating Modes



Timestamp Output Regarding IOM Operating Modes

Module Transition to State	Timestamp Output Callback Operations	Timestamp Output Resulting State
SYS_BOOTING	-	Not configured
SYS_DEFAULT_CONF	-	Not configured
SYS_CONFIGURED	Configures Timestamp Output according to the received configuration.	Configured

Module Transition to State	Timestamp Output Callback Operations	Timestamp Output Resulting State
SYS_DRIVEN_OUTPUT	Operates according to the received data.	Driven_Operational
SYS_FALLBACK_OUTPUT	Applies fallback value to the output.	Driven_Fallback

Timestamp Output States

Timestamp Output State	Timestamp Output Data Exchange	Timestamp Output Status	Timestamp Output Physical Output
Not configured	-	-	0
Configured	Produce data: Input image	*Status.EnabledFlag* = FALSE *Status.ErrorFlag* = FALSE *ErrorId* = No Error detected *Status.WarningRising* = FALSE *Status.WarningFalling* = FALSE	0
Driven_Operational	Receive data: Output image Produce data: Input image	Refer to Driven_Operational, page 248.	Timestamp output value.
Driven_Fallback	Produce data: Input image	*Status.EnabledFlag* = FALSE *Status.ErrorFlag* = TRUE *ErrorId* = Fallback	Fallback value.

Driven_Operational

Timestamp Output Commands	Condition	Timestamp Output Status	Behavior
Enable.Generation = TRUE	No error detected	*Status.EnabledFlag* = TRUE *Status.ErrorFlag* = FALSE *ErrorId* = No Error detected *Status.WarningRising* is updated *Status.WarningFalling* is updated	Enables the Timestamp Output mode. **NOTE:** The *TimestampOutEdgeRising* and *TimestampOutEdgeFalling* parameters are applied if respectively: • *Enable.Rising* = TRUE • *Enable.Falling* = TRUE
Enable.Generation = TRUE	Error detected	*Status.EnabledFlag* = FALSE *Status.ErrorFlag* = TRUE *ErrorId* is updated *Status.WarningRising* = No change *Status.WarningFalling* = No change	Disables the Timestamp Output mode and the physical output = 0. **NOTE:** To acknowledge the error and enable the Timestamp Output mode, *Enable.Generation* must be set to FALSE then to TRUE (after the error condition is removed).

Timestamp Output Commands	Condition	Timestamp Output Status	Behavior
Enable.Generation = FALSE	-	*Status.EnabledFlag* = FALSE *Status.ErrorFlag* = FALSE *ErrorId* = No Error detected *Status.WarningRising* = No change *Status.WarningFalling* = No change	Disables the Timestamp Output mode and the physical output = 0.
-	*WarningAck* rising edge	*Status.WarningRising* = FALSE *Status.WarningFalling* = FALSE	Acknowledges advisory flags.

ErrorId Priority

ErrorId	Priority
Internal Field Power Supply	0
Short circuit	1
Fallback	2

Pulse Train Output (PTO) Principle Description

Overview

The NTSEMP0220 module provides up to two pulse train output (PTO) channels.

There are three possible output modes:

- A Clockwise / B Counterclockwise
- A Pulse / B Direction
- Quadrature

The PTO function can be configured on any output channel of the module not already configured for use by another PTO function.

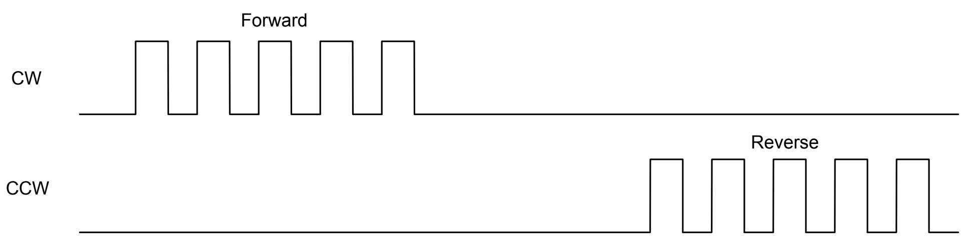
Each PTO channel can use:

- Up to six inputs, if optional interface signals for homing (REF/INDEX), event (PROBE), hardware limits, or drive interface (DriveReady) are used.
- One physical output, if optional drive interface signal is used (DriveEnable).

A ClockWise (CW) / B CounterClockwise (CCW) Mode

This mode generates two signals on the PTO outputs:

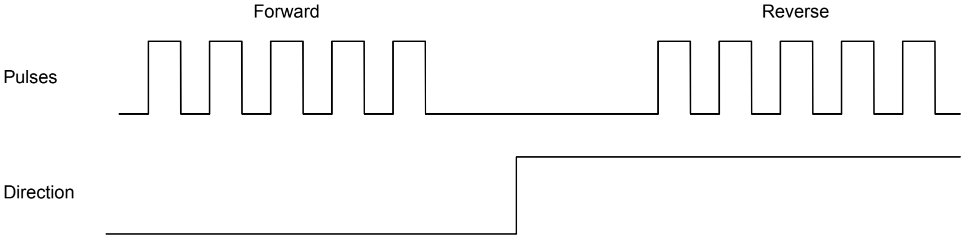
- The motor operating speed is defined by the pulse frequency of the output.
- The motor rotation direction is set whether it is the PTO output A or B emitting the pulse.



A Pulse / B Direction Mode

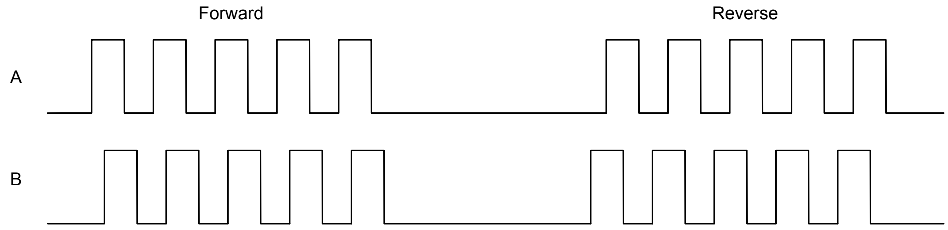
This mode generates two signals on the PTO outputs:

- Output A: Pulse which provides the motor operating speed.
- Output B: Direction which provides the motor rotation direction.



Quadrature Mode

This mode generates two signals in quadrature phase on the PTO outputs (the phase sign depends on motor direction).



Principle

Description

The PTO module is used to control the positioning or speed of up to two independent linear single-axis stepper or servo drives in open loop mode.

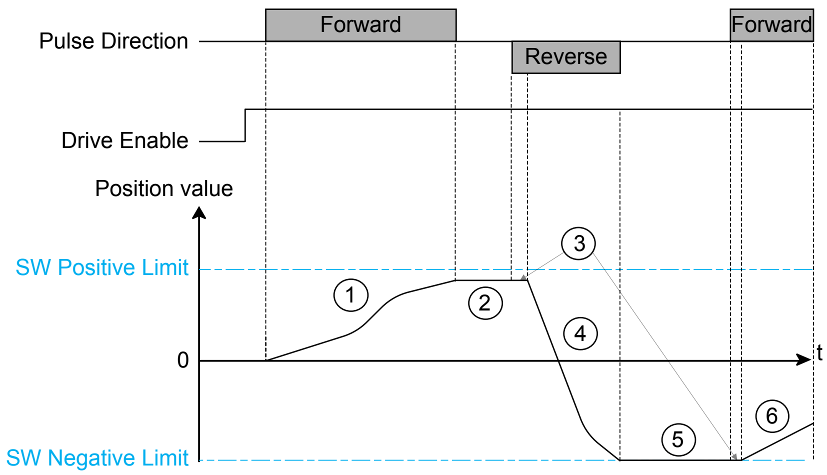
The PTO module does not have any position feedback information from the process.

The PTO channels support the following functions:

- Three output modes, including quadrature
- Single axis moves (velocity and position)
- Relative and absolute positioning
- Automatic trapezoidal and S-curve acceleration and deceleration (jerk ratio)
- Homing (seven modes with offset compensation)
- Dynamic acceleration, deceleration, velocity, and position modification (continuous move)
- Switch from velocity to position mode and vice versa
- Move queuing (buffer of one move)
- Position capture and move trigger on event (using probe input)
- Backlash compensation (in quadrature mode)
- Limits (hardware and software)
- Diagnostics

PTO Position Mode

The position increments or decrements. The start value is 0 and it is in a range from -2,147,483,648 to 2,147,483,647.



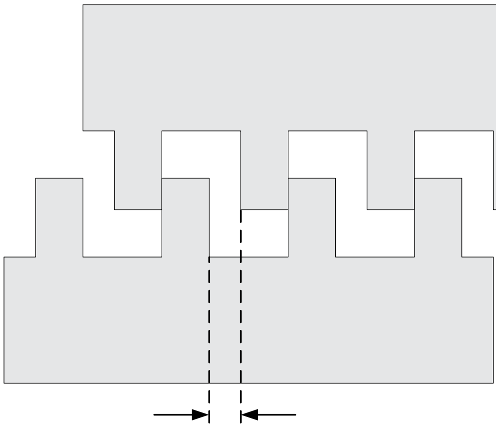
Stage	Description
1	Ongoing motion commands with different *Velocity* values and a positive *Direction* are sent. The *CurrentPosition* increases at different rates depending on the types and parameters of the sent motion commands. For more information about motion commands, refer to Operating Mode, page 271.
2	There are no ongoing motion commands, *CurrentVelocity* = 0 and the position does not change.
3	A new motion command with an opposite *Direction* is sent. There is a change of direction, the *CurrentPosition* ignores a number of pulses equivalent to your **Backlash** parameter value.
4	Ongoing motion commands with different *Velocity* values and a negative *Direction* are sent. The *CurrentPosition* decreases at different rates depending on the types and parameters of the sent motion commands. For more information about motion commands, refer to Operating Mode, page 271.
5	When the **SW Negative Limit** is reached, an implicit stop command is sent with a deceleration value of **Fast Stop Deceleration**. The PTO axis enters the *ErrorStop* state, no motion command can be sent. For more information about the PTO axis state, refer to the axis state description, page 272.
6	When the PTO axis enters the *Standstill* state, only motion commands with a positive *Direction* can be sent and the *CurrentPosition* increases.

Backlash Compensation

The backlash compensation is a pulse compensation that occurs due to the mechanical clearance.

At each change of direction, the position does not change until the fully slack correction pulses are received. Then, it resumes.

The following figure illustrates the backlash:



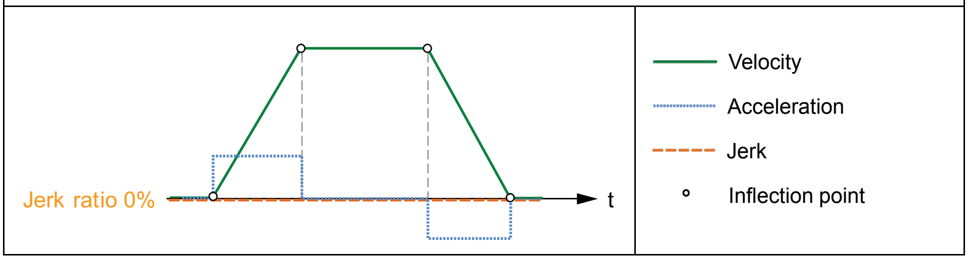
NOTE:

- At start-up the direction is defined as positive.
- If a command is aborted before the end of the backlash execution, the remaining compensation is taken into account on the next move.

Acceleration/Deceleration Ramp

When the jerk ratio parameter is set to 0, the acceleration/deceleration ramp has a trapezoidal profile.

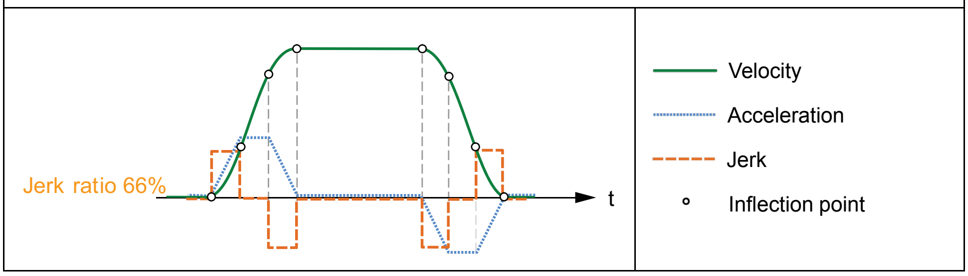
`JerkRatio` 0%: Constant acceleration / deceleration.



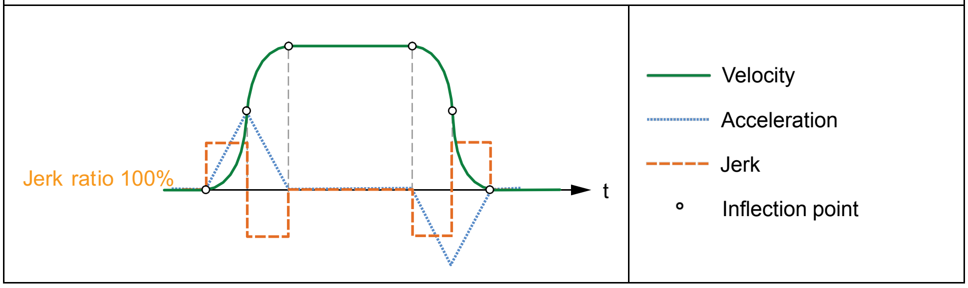
When the jerk ratio parameter is greater than 0, the acceleration /deceleration ramp has an S-curve profile.

The S-curve ramp is used in applications controlling high inertia, or in those that manipulate fragile objects or liquids. The S-curve ramp enables a smoother and progressive acceleration / deceleration, as demonstrated in the following graphics:

`JerkRatio` 66%: 2/3 of the acceleration and deceleration time is spent in increasing and decreasing the acceleration and deceleration value.



`JerkRatio` 100%: The entire time is spent in increasing and decreasing the acceleration and deceleration value.



NOTE: The `JerkRatio` parameter value is common for acceleration and deceleration so that concave time and convex time are equal.

Pulse Train Output Interface

PTO Configuration

Configurable Parameters

The following table presents the configurable parameters for the Pulse Train Output (PTO) interface:

Displayed Name ***Parameter Name***	**Value**	**Data Type**	**Description**
Channel Location *ChannelLocation*	0: **Channel 0** 1: **Channel 1** 255: **Channel Disabled**	ENUM	Selects the pulse output channel. The available parameter list and the default value depend on the module reference associated to the function.
Output Mode *OutputMode*	0: **A Clockwise - B Counterclockwise** 1: **A = Pulse - B = Direction** 2: **Quadrature***	ENUM	Selects the pulse output mode.
Maximum Velocity *MaximumVelocity*(1)	**1...400000***	UINT32	Sets the maximum velocity (in Hz) of the pulse output.
Start Velocity *StartVelocity*	**0*...400000**	UINT32	Sets the start velocity (in Hz) of the pulse output. 0 if not used. When you configure the **Start Velocity** parameter to a value different than 0, and if the *CurrentVelocity* is 0, upon executing a new motion command: • If the value of *Velocity_HighVelocity* of your motion command is greater than the **Start Velocity** parameter value then the *CurrentVelocity* is set to the **Start Velocity** parameter value and the motion command is executed with the defined parameters. • If the value of *Velocity_HighVelocity* of your motion command is less than the **Start Velocity** parameter value then the parameter is ignored, and the motion command is executed with the defined parameters and starts with a *CurrentVelocity* of 0.
Stop Velocity *StopVelocity*	**0*...400000**	UINT32	Sets the stop velocity (in Hz) of the pulse output. 0 if not used. **Stop Velocity** is the maximum frequency at which a stepper motor stops producing movements with a load applied and without skipping steps. **Stop Velocity** is used when moving down to velocity 0 from a velocity which is higher than **Stop Velocity**.
Acceleration/Deceleration Unit *Acc/DecUnit*	0: **Hz/ms*** 1: **ms**	ENUM	Defines if the acceleration and deceleration values are set as rates (Hz/ms) or as time constants from 0 to the **Maximum Velocity** (ms). The velocity change is implicitly managed by the PTO function in accordance with the *Acceleration*, *Deceleration*, and *JerkRatio* parameters. For more information about acceleration / deceleration ramps, refer to Acceleration/ Deceleration Ramp, page 252.
Maximum Acceleration *MaximumAcceleration*(1)	**1...400000***	UINT32	Sets the acceleration maximum value in **Acceleration/Deceleration Unit**. Acceleration is the rate of velocity change, starting from **Start Velocity** to target velocity.

Displayed Name ***Parameter Name***	Value	Data Type	Description
Maximum Deceleration *MaximumDeceleration*(1)	**1...400000***	UINT32	Sets the deceleration maximum value in **Acceleration/Deceleration Unit**. Deceleration is the rate of velocity change, starting from the velocity to **Stop Velocity**.
Fast Stop Deceleration *FastStopDeceleration*	**1...400000** **5000***	UINT32	Sets the deceleration value of the implicit stop motion command when an error is detected (in **Acceleration/Deceleration Unit**).
Delay *Delay*(1)	**0*...65535**	UINT16	Sets the time delay (in ms) before the execution of a new motion command when the *BufferMode* parameter is set to *seBufferedDelay*.
Direction Positive Enabled *EnableDirPos*(1)	**FALSE** **TRUE***	BOOL	Enables or disables motion commands with a positive direction. When **FALSE**: • Motion commands with a positive direction are rejected • *MovePrevious•Status* is set to 3 • *MovePrevious•ErrorId* is set to *InvalidDirectiveValue*
Direction Negative Enabled *EnableDirNeg*(1)	**FALSE** **TRUE***	BOOL	Enables or disables motion commands with a negative direction. When **FALSE**: • Motion commands with a negative direction are rejected • *MovePrevious•Status* is set to 3 • *MovePrevious•ErrorId* is set to *InvalidDirectiveValue*
Backlash *Backlash*	**0*...65535**	UINT16	Number of pulses for the **Backlash** compensation function. The **Backlash** compensation function is deactivated if this parameter is set to **0**. For more information about backlash compensation, refer to Backlash Compensation, page 251.
SW Limit Positive Enabled *EnableSWLimitPos*(1)	**FALSE*** **TRUE**	BOOL	Selects whether to use the positive software limits or not. When **TRUE** and if *CurrentPosition* ≥ **SW Positive Limit**: • The motion command is canceled by an implicit stop motion command • *MovePrevious•Status* is set to 3 • *MovePrevious•ErrorId* is set to *SwPositionLimitP* • *AxisState* is set to *ErrorStop*
SW Positive Limit *SWPosLimit*(1)	**-2147483648...2147483647***	INT32	Sets the positive software limit position value.
SW Limit Negative Enabled *EnableSWLimitNeg*(1)	**FALSE*** **TRUE**	BOOL	Selects whether to use the negative software limits or not. When **TRUE** and if *CurrentPosition* ≤ **SW Negative Limit**: • The motion command is canceled by an implicit stop motion command • *MovePrevious•Status* is set to 3 • *MovePrevious•ErrorId* is set to *SwPositionLimitN* • *AxisState* is set to *ErrorStop*
SW Negative Limit *SWNegLimit*(1)	**-2147483648*...2147483647**	INT32	Sets the negative software limit position value.

Displayed Name ***Parameter Name***	Value	Data Type	Description
HW Positive Enabled *HWPosEnable*	0: **Disabled*** 1: **I0** 2: **I1** 3: **I2** 4: **I3** 5: **I4** 6: **I5** 7: **I6** 8: **I7**	ENUM	Sets the physical input used as a hardware limit to detect in the positive direction. When the input is **TRUE**: • The ongoing motion command is stopped with an implicit stop motion command • *MovePrevious•Status* is set to 3 • *MovePrevious•ErrorId* is set to *HwPositionLimitP* • *AxisState* is set to *ErrorStop*
HW Positive Filter *HWPosFilter*	0: **0** 1: **0.0002** 2: **0.0005** 3: **0.001** 4: **0.002*** 5: **0.005** 6: **0.01** 7: **0.05** 8: **0.08** 9: **0.5** 10: **1** 11: **4** 12: **12**	ENUM	Allows reducing the effect of bounce on the input. Changes to the signal are only detected if the pulse width of the input signal is longer than the filter time (ms).
HW Positive Type *HWPosType*	0: **Normally open** 1: **Normally closed***	ENUM	Selects whether the switch contact default state is open or closed.
HW Negative Enabled *HWNegEnable*	0: **Disabled*** 1: **I0** 2: **I1** 3: **I2** 4: **I3** 5: **I4** 6: **I5** 7: **I6** 8: **I7**	ENUM	Sets the physical input used as a hardware limit to be detected in the negative direction. When the input is **TRUE**: • The ongoing motion command is stopped with an implicit stop motion command • *MovePrevious•Status* is set to 3 • *MovePrevious•ErrorId* is set to *HwPositionLimitN* • *AxisState* is set to *ErrorStop*

Displayed Name ***Parameter Name***	Value	Data Type	Description
HW Negative Filter *HWNegFilter*	0: **0** 1: **0.0002** 2: **0.0005** 3: **0.001** 4: **0.002*** 5: **0.005** 6: **0.01** 7: **0.05** 8: **0.08** 9: **0.5** 10: **1** 11: **4** 12: **12**	ENUM	Allows reducing the effect of bounce on the input. Changes to the signal are only detected if the pulse width of the input signal is longer than the filter time (ms).
HW Negative Type *HWNegType*	0: **Normally open** 1: **Normally closed***	ENUM	Selects whether the switch contact default state is open or closed.
DriveReady Enabled *DriveReadyEnable*	0: **Disabled*** 1: **I0** 2: **I1** 3: **I2** 4: **I3** 5: **I4** 6: **I5** 7: **I6** 8: **I7**	ENUM	Selects the output used for the DriveReady signal.
DriveReady Filter *DriveReadyFilter*	0: **0** 1: **0.0002** 2: **0.0005** 3: **0.001** 4: **0.002*** 5: **0.005** 6: **0.01** 7: **0.05** 8: **0.08** 9: **0.5** 10: **1** 11: **4** 12: **12**	ENUM	Allows reducing the effect of bounce on the input. Changes to the signal are only detected if the pulse width of the input signal is longer than the filter time (ms).
DriveReady Type *DriveReadyType*	0: **Normally open*** 1: **Normally closed**	ENUM	Selects whether the switch contact default state is open or closed

Displayed Name ***Parameter Name***	Value	Data Type	Description
REF Enabled *REFEnable*	0: **Disabled*** 1: **I0** 2: **I1** 3: **I2** 4: **I3** 5: **I4** 6: **I5** 7: **I6** 8: **I7**	ENUM	Selects the input used for the REF signal during a homing command.
REF Filter *REFFilter*	0: **0** 1: **0.0002** 2: **0.0005** 3: **0.001** 4: **0.002*** 5: **0.005** 6: **0.01** 7: **0.05** 8: **0.08** 9: **0.5** 10: **1** 11: **4** 12: **12**	ENUM	Allows reducing the effect of bounce on the input. Changes to the signal are only detected if the pulse width of the input signal is longer than the filter time (ms).
REF Type *REFType*	0: **Normally open*** 1: **Normally closed**	ENUM	Selects whether the switch contact default state is open or closed.
INDEX Enabled *INDEXEnable*	0: **Disabled*** 1: **I0** 2: **I1** 3: **I2** 4: **I3** 5: **I4** 6: **I5** 7: **I6** 8: **I7**	ENUM	Selects the input used for the INDEX signal during a homing command.

Displayed Name ***Parameter Name***	**Value**	**Data Type**	**Description**
INDEX Filter *INDEXFilter*	0: **0** 1: **0.0002** 2: **0.0005** 3: **0.001** 4: **0.002*** 5: **0.005** 6: **0.01** 7: **0.05** 8: **0.08** 9: **0.5** 10: **1** 11: **4** 12: **12**	ENUM	Allows reducing the effect of bounce on the input. Changes to the signal are only detected if the pulse width of the input signal is longer than the filter time (ms).
INDEX Type *INDEXType*	0: **Normally open*** 1: **Normally closed**	ENUM	Selects whether the switch contact default state is open or closed.
PROBE Enabled *PROBEEnable*	0: **Disabled*** 1: **I0** 2: **I1** 3: **I2** 4: **I3** 5: **I4** 6: **I5** 7: **I6** 8: **I7**	ENUM	Sets the physical input used for the probe event. Use the *TouchProbe* administrative command to define the probe event conditions. By default, the probe event is triggered on the rising edge of the **PROBE Enabled** input. For more information, refer to Administrative Commands, page 276.
PROBE Filter *PROBEFilter*	0: **0** 1: **0.0002** 2: **0.0005** 3: **0.001** 4: **0.002*** 5: **0.005** 6: **0.01** 7: **0.05** 8: **0.08** 9: **0.5** 10: **1** 11: **4** 12: **12**	ENUM	Allows reducing the effect of bounce on the input. Changes to the signal are only detected if the pulse width of the input signal is longer than the filter time (ms).

Displayed Name ***Parameter Name***	Value	Data Type	Description
DriveEnabled Enabled *DriveEnableEnable*	**FALSE*** **TRUE**	BOOL	Enables or disables the PTO function to control the output: • Q0 when **Channel Location** is set to **Channel 0** • Q1 when **Channel Location** is set to **Channel 1** The output is TRUE when *PowerEnable* is TRUE and no error is detected. The output is FALSE when *PowerEnable* is FALSE or one of the errors 1000, 1001, 1006, 1007 or 1009 is detected. For more information about error codes, refer to ErrorId Values Description, page 270.
DriveEnabled Type *DriveEnabledType*	0: **Normally open*** 1: **Normally closed**	ENUM	Selects whether the switch contact default state is open or closed.
* Parameter default value (1) Online modification is allowed.			

Implicit Data

The following table presents the input implicit data for the PTO status:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
PowerStatus	FALSE* TRUE	BOOL R/-	Indicates whether motion commands are possible or not. When FALSE, sets *AxisState* to *Disabled*. For more information about *AxisState* values, refer to Driven_Operational, page 272.
CurrentPosition	-2,147,483,648...2,147,483,647 0*	INT32 R/-	Provides the present position of the axis.
CurrentVelocity	-400,000...400,000 0*	INT32 R/-	Provides the present velocity of the axis.
AxisErrorId	*0**: NoError *1000...3010*: ErrorId	ENUM R/-	Provides an ID of the error detected when the *AxisState* is set to *ErrorStop*. This value is reset to 0 (NoError) when a *Reset* administrative command is executed and no error is detected. For more information about error IDs, refer to ErrorId Values Description, page 270.
MotionState	*0**: ConstantVelocity *1*: Accelerating *2*: Decelerating	ENUM R/-	Provides the PTO motion state. *MotionState* is set to: • *Accelerating* during the acceleration • *Decelerating* during the deceleration • *ConstantVelocity* when the *Velocity_HighVelocity* value is reached
AxisState	*0**: Disabled *1*: Standstill *2*: DiscreteMotion *3*: ContinuousMotion *4*: Homing *5*: Stopping *6*: ErrorStop	ENUM R/-	Provides the present state of the axis. For more information about *AxisState*, refer to Driven_Operational, page 272.
isHomed	FALSE* TRUE	BOOL R/-	When TRUE, the reference point is valid and *Relative* and *Absolute* motion commands are possible.
QueueFull	FALSE* TRUE	BOOL R/-	When TRUE, new motion commands are rejected, their *MovePrevious•Status* parameter is set to 3 and their *PreviousError•Id* parameter is set to *MotionQueueFull*. For more information about buffer modes, refer to *BufferMode* Parameter Description, page 277.
* Parameter default value			

The following table presents the input implicit data for the PTO motion commands:

Parameter Name	**Value**	**Data Type**	**Description**
MoveNextCmdId	1*...255	BYTE R/-	Indicates the transaction ID value of the next motion command. The value is updated at each received new motion command. For more information on sending a motion command, refer to How to Execute a PTO Command, page 274.
MoveActiveId	0*...255	BYTE R/-	Indicates the transaction ID of the ongoing motion command.
MoveBufferId	0*...255	BYTE R/-	Indicates the transaction ID of the buffered motion command.
MoveTriggerId	0*...255	BYTE R/-	Indicates the transaction ID of the motion command waiting for a probe event.
MovePrevious0Id ... *MovePrevious4Id*	0*...255	BYTE R/-	Indicates the transaction ID of the last 5 motion commands. This is a circular buffer of the final status of the previous finished motion commands. For example, if the status of the motion command with a transaction ID of 5 is recorded in *MovePrevious4Id*, then the motion command with a transaction ID of 6 is recorded in *MovePrevious0Id*, and so on. *MovePrevious•Id*, *MovePrevious•Status*, and *MovePrevious•ErrorId* are linked together and provide the transaction ID, the final status, and the error ID of a motion command with the *MovePrevious•Id* transaction ID.
MovePrevious0Status ... *MovePrevious4Id*	0*...255	BYTE R/-	Indicates the final status of the last 5 motion commands: • Idle: 0 • Done: 1 • Aborted: 2 • Error: 3
MovePrevious0ErrorId ... *MovePrevious4ErrorId*	*0**: NoError *1000...3010*: ErrorId	ENUM R/-	Indicates the error ID of the last 5 motion commands. For more information about error IDs, refer to ErrorId Values Description, page 270.
* Parameter default value			

The following table presents the input implicit data for the PTO administrative commands:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
AdminNextCmdId	1*...255	BYTE R/-	Indicates the transaction ID value of the next administrative command. The value is updated at each new received administrative command.
AdminBusyId	0*...255	BYTE R/-	Indicates the transaction ID of the ongoing administrative command.
AdminPrevious0Id	0*...255	BYTE R/-	Indicates the transaction ID of the previous finished administrative command. This is a circular buffer of the final status of the previous finished administrative commands. For example, if the status of the administrative command with a transaction ID of 5 is recorded in *AdminPrevious0Id*, then the administrative command with a transaction ID of 6 is recorded in *AdminPrevious1Id*, and so on. *AdminPrevious•Id*, *AdminPrevious•Status*, and *AdminPrevious•ErrorId* are linked together and provide the transaction ID, the final status, and the error ID of an administrative command with the *AdminPrevious•Id* transaction ID.
AdminPrevious0Status	0*...255	BYTE R/-	Indicates the final status of the previous finished administrative command: • Idle: 0 • Done: 1 • Aborted: 2 • Error: 3
AdminPrevious0ErrorId	*0**: NoError *1000...3010*: ErrorId	ENUM R/-	Indicates the error ID of the previous finished administrative command. For more information about error IDs, refer to ErrorId Values Description, page 270.
AdminPrevious1Id	0*...255	BYTE R/-	Indicates the transaction ID of the previous finished administrative command. This is a circular buffer of the final status of the previous finished administrative commands. For example, if the status of the administrative command with a transaction ID of 6 is recorded in *AdminPrevious1Id*, then the administrative command with a transaction ID of 7 is recorded in *AdminPrevious0Id*, and so on. *AdminPrevious•Id*, *AdminPrevious•Status*, and *AdminPrevious•ErrorId* are linked together and provide the transaction ID, the final status, and the error ID of an administrative command with the *AdminPrevious•Id* transaction ID.
AdminPrevious1Status	0*...255	BYTE R/-	Indicates the final status of the previous finished administrative command: • Idle: 0 • Done: 1 • Aborted: 2 • Error: 3
AdminPrevious1ErrorId	*0**: NoError *1000...3010*: ErrorId	ENUM R/-	Indicates the error ID of the previous finished administrative command. For more information about error IDs, refer to ErrorId Values Description, page 270.

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
AdministrativeRecordedPosition	-2,147,483,648...2,147,483,647 0*	INT32 R/-	Indicates the position where the probe event is detected.
* Parameter default value			

The following table presents the output implicit data for the PTO motion commands:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
PowerEnable	FALSE* TRUE	BOOL R/W	When TRUE, sets *PowerStatus* to TRUE if *AxisState* is *Disabled* and no error is detected. When FALSE, sets *PowerStatus* to FALSE.
MoveCmdId	0*...255	BYTE R/W	Sets the transaction ID of the new motion command. When the transaction ID is equal to *MoveNextCmdId*, a new motion command is sent to the module. If the transaction ID is different than *MoveNextCmdId*, no motion command is sent. For more information about sending a motion commands, refer to How to Execute a PTO Command, page 274.
MoveType	*0*: Idle *1*: Velocity *2*: Absolute *3*: Relative *4*: Stop *5**: Halt *6*: Homing *7*: SetPosition *8*: From Stop To Standstill	ENUM R/W	Sets the type of motion command to perform. For more information about motion commands, refer to Motion Commands, page 275.
Distance_Position	-2,147,483,648...2,147,483,647 0*	INT32 R/W	Depending on the motion command, sets the following: • For a *Relative* motion command: The distance of the move in number of pulses. • For an *Absolute* motion command: The target position in number of pulses. • For a *Homing* motion command: The position when the origin event is detected.
ContinuousUpdate	FALSE* TRUE	BOOL R/W	When TRUE, during the execution of a *Velocity* motion command, *Velocity_HighVelocity*, *Acceleration*, *Deceleration*, *JerkRatio*, and *Direction* values are updated at each I/O bus cycle and applied to the ongoing *Velocity* motion command.
Velocity_HighVelocity	0*...4,294,967,295	UINT32 R/W	Depending on the motion command, sets the following: • For a *Velocity* motion command: The target velocity. • For a *Homing* motion command: The high velocity for searching the limit or the reference switch. If the provided parameter value is above the **Maximum Velocity** parameter value, the motion command is executed with a *Velocity_HighVelocity* of **Maximum Velocity** and an advisory is issued.

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
Acceleration	0*...4,294,967,295	UINT32 R/W	Sets the acceleration in Hz/ms or in ms (according to configuration). • Range (Hz/ms): 1...**Maximum Acceleration** If the provided parameter value is above the **Maximum Acceleration** parameter value, the motion command is executed with an *Acceleration* of **Maximum Acceleration** and an advisory is issued. • Range (ms): **Maximum Acceleration**...400,000. If the provided parameter value is above 400,000, the motion command is executed with an *Acceleration* of 400,000 and an advisory is issued.
Deceleration	0*...4,294,967,295	UINT32 R/W	Sets the deceleration in Hz/ms or in ms (according to configuration). • Range (Hz/ms): 1...**Maximum Deceleration** If the provided parameter value is above the **Maximum Deceleration** parameter value, the motion command is executed with an *Deceleration* of **Maximum Deceleration** and an advisory is issued. • Range (ms): **Maximum Deceleration**...400,000. If the provided parameter value is above 400,000, the motion command is executed with a *Deceleration* of 400,000 and an advisory is issued. **NOTE:** For other commands, a value of ZERO is detected as an error, requiring you to set an appropriate value for the parameter.
Direction	*-1*: mcNegativeDirection *1**: mcPositiveDirection *2*: mcCurrentDirection	ENUM R/W	Sets the initial direction for a motion command. For a *Homing* motion command, either *mcPositiveDirection* or *mcNegativeDirection* are valid. These parameters define the starting direction for searching the limit or the reference switch.
Mode	*0**: PositionSetting *1*: LongReference *10*: LongReference And Index *20*: ShortReference Reversal *21*: ShortReference No Reversal *30*: ShortReference And Index Outside *31*: ShortReference And Index Inside	ENUM R/W	Defines the homing mode of the *Homing* motion command to perform. For more information about homing modes, refer to Homing Modes Description, page 285.
LowVelocity	0*...4,294,967,295	UINT32 R/W	Sets the return velocity when searching for the reference switch or index signal. The movement stops when a switching point is detected. If the provided parameter value is above the **Maximum Velocity** parameter value, the motion command is executed with a *LowVelocity* of **Maximum Velocity** and an advisory is issued.

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
Offset	-2,147,483,648...2,147,483,647 0*	INT32 R/W	Sets the number of pulses to move at the end of the *Homing* motion command. The sign defines the direction of the move, and *LowVelocity* is the velocity at which the move is executed. The parameter is only used during a reference movement without an index pulse. **NOTE:** The offset movement is part of the *Homing* motion command and it is executed 500 ms after *CurrentVelocity* reaches 0.
BufferMode	*0**: mcAborting *1*: mcBuffered *3*: mcBlendingPrevious *10*: seTrigger *11*: seBufferedDelay	ENUM R/W	Sets the module behavior for a new motion command while there is an ongoing motion command. For more information about the movement transition and buffer modes, refer to Motion Command Abort Table, page 278 and *BufferMode* Parameter Description, page 277.
JerkRatio	0*...65,535	UINT16 R/W	Sets the percentage used to create an S-curve profile in percent 0...100 (0%...100%). If the provided value is above 100, the *JerkRatio* is set to 100 and an advisory is issued. If the *JerkRatio* parameter is set to 100%, then the acceleration and deceleration values are double the value defined in the acceleration and deceleration parameters. For example, if *JerkRatio* is set to 100%, then the acceleration and deceleration values equal to the value defined in the *Acceleration* and *Deceleration* parameters multiplied by 2. The duration for the acceleration and deceleration is maintained regardless the value of the *JerkRatio* parameter. To maintain this duration, the acceleration or deceleration provided to the motion command is adjusted accordingly. **NOTE:** If the new calculated acceleration or deceleration exceeds the **Maximum Acceleration** or **Maximum Deceleration** parameter value, an advisory is issued and the *JerkRatio* value is changed to the closest possible *JerkRatio* value. For more information about acceleration and deceleration ramps, refer to Acceleration/ Deceleration Ramp, page 252.
* Parameter default value			

The following table presents the output implicit data for the PTO administrative commands:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
AdminCmdId	0*...255	BYTE R/W	Sets the transaction ID of the next administrative command. When the transaction ID is equal to *AdminNextCmdId*, a new administrative command is sent to the module. For more information, refer to How to Execute a PTO Command, page 274. When the transaction ID is different than *AdminNextCmdId*, no administrative command is sent.
AdminType	*0*: Idle *1**: Reset *2*: TouchProbe *3*: AbortTrigger	ENUM R/W	Sets the type of the administrative command to perform. For more information, refer to Administrative Commands, page 276.
WindowOnly	FALSE* TRUE	BOOL R/W	When TRUE, the probe event is detected only if *CurrentPosition* is within the position window defined by the *FirstPosition* and *LastPosition* parameters.
FirstPosition	-2,147,483,648...2,147,483,647 0*	INT32 R/W	Sets the first position (positive direction) where the trigger event can be detected.
LastPosition	-2,147,483,648...2,147,483,647 0*	INT32 R/W	Sets the last position (positive direction) where the trigger event can be detected.
TriggerLevel	FALSE TRUE*	BOOL R/W	When FALSE, the probe event is executed at the falling edge of the **PROBE Enabled** input. When TRUE, the probe event is executed at the rising edge of the **PROBE Enabled** input.
* Parameter default value			

Explicit Parameters

The following table presents the PTO explicit data:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
CommandedPosition	-2,147,483,648...2,147,483,647 0*	INT32 R/-	Provides the distance traveled during the previous motion command.
CommandedVelocity	0...400,000*	UINT32 R/-	Provides the target velocity value of the previous motion command.
SWPosLimit	-2,147,483,648... 2,147,483,647*	INT32 R/W	Sets a new value for the **SW Limit Positive Enabled** parameter.
SWNegLimit	-2,147,483,648*... 2,147,483,647	INT32 R/W	Sets a new value for the **SW Positive Limit** parameter.
EnableSWLimitPos	FALSE* TRUE	BOOL R/W	Sets a new value for the **SW Limit Negative Enabled** parameter.
EnableSWLimitNeg	FALSE* TRUE	BOOL R/W	Sets a new value for the **SW Negative Limit** parameter.
MaximumVelocity	0...400,000*	UINT32 R/W	Sets a new value for the **Maximum Velocity** parameter.
MaximumAcceleration	0...400,000*	UINT32 R/W	Sets a new value for the **Maximum Acceleration** parameter.
MaximumDeceleration	0...400,000*	UINT32 R/W	Sets a new value for the **Maximum Deceleration** parameter.
Delay	0*...65,535	UINT16 R/W	Sets a new value for the **Delay** parameter.
EnableDirPos	FALSE TRUE*	BOOL R/W	Sets a new value for the **Direction Positive Enabled** parameter.
EnableDirNeg	FALSE TRUE*	BOOL R/W	Sets a new value for the **Direction Negative Enabled** parameter.
* Parameter default value			

NOTE:

- Parameter values changed through explicit exchanges are reset to their configured values by a module reboot.
- The parameters changed with the explicit exchange commands are updated when *AxisState* is in the *Standstill* state or when *MotionState* is equal to *ConstantVelocity* in the *Continuous* state.

ErrorId Values Description

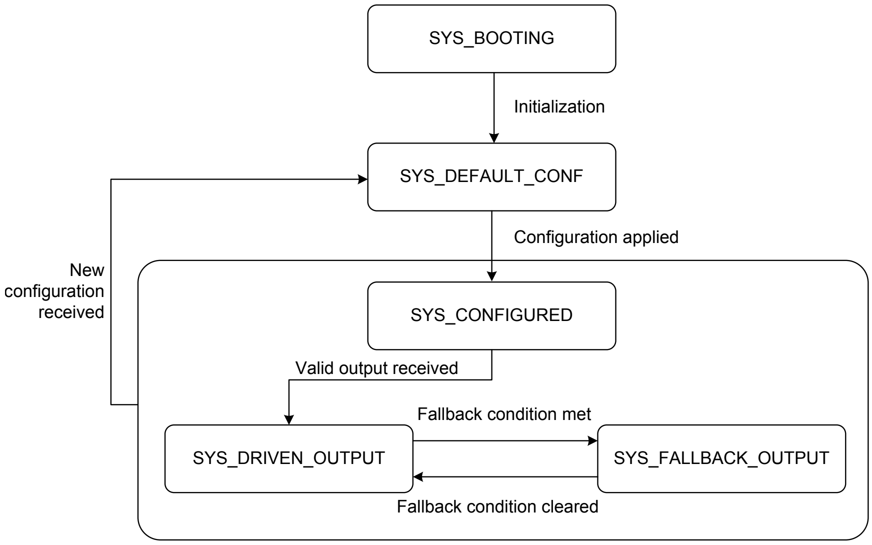
The following table presents the PTO *ErrorId* values:

ErrorId Value	Error Enum	Description
0	*NoError*	-
1000	*InternalError*	Module internal error detected. This error sets the *AxisState* to *ErrorStop*.
1001	*DisabledAxis*	The motion command could not be started or was aborted because *AxisState* is equal to *Disable*.
1002	*HwPositionLimitP*	Hardware positive position limit **HW Positive Enabled** is reached. This error sets the *AxisState* to *ErrorStop*.
1003	*HwPositionLimitN*	Hardware negative position limit **HW Negative Negative** is reached. This error sets the *AxisState* to *ErrorStop*.
1004	*SwPositionLimitP*	Software positive position limit **SW Positive Limit** is reached. This error sets the *AxisState* to *ErrorStop*.
1005	*SwPositionLimitN*	Software negative position limit **SW Negative Limit** is reached. This error sets the *AxisState* to *ErrorStop*.
1006	*ApplicationStopped*	Application execution has been stopped. This error sets the *AxisState* to *ErrorStop*.
1007	*OutputProtection*	Short-circuit output protection is active on the PTO channels. This error sets the *AxisState* to *ErrorStop*.
1008	*Internal Field Power Error*	Internal field power supply is not detected. This error sets the *AxisState* to *ErrorStop*.
1009	*Fallback*	Outputs are in fallback state. This error sets the *AxisState* to *ErrorStop*.
1100	*WarningVelocityValue*	Commanded *Velocity* parameter is out of range.
1101	*WarningAccelerationValue*	Commanded *Acceleration* parameter is out of range.
1102	*WarningDecelerationValue*	Commanded *Deceleration* parameter is out of range.
1104	*WarningJerkValue*	Commanded *JerkRatio* parameter is limited by the configured maximum acceleration or deceleration. In this case, *JerkRatio* is recalculated to respect these maximums.
2000	*ErrorStopActive*	The motion command could not be started or was aborted because *AxisState* is equal to *ErrorStop*.
2001	*StoppingActive*	The motion command could not be started because *AxisState* is equal to *Stopping*.
2002	*InvalidTransition*	Transition is not allowed, refer to the Motion Command Abort Table, page 278.
2003	*SetPositionInvalid*	To execute a *Homing* motion command, *AxisState* must be equal to *Standstill*.
2004	*HomingError*	Homing sequence cannot start on the CAM reference in this mode.
2005	*InvalidProbeConf*	**PROBE Enabled** must be configured.
2006	*InvalidHomingConf*	The homing inputs (**REF Enabled**, **INDEX Enabled**) must be configured for this homing mode.
2007	*AbsoluteInvalid*	The *Absolute* motion command cannot be executed when *isHomed* is set to FALSE.
2008	*MotionQueueFull*	The motion command could not be buffered because the buffer queue is full.
3000	*InvalidAxis*	The function block is not applicable for the specified axis.
3001	*InvalidPositionValue*	The *Position* parameter is out of limits, or the *Distance* parameter gives an out-of-limits position.
3002	*InvalidVelocityValue*	The *Velocity* parameter is out of range. The value must be greater than 0.

ErrorId Value	Error Enum	Description
3003	*InvalidAccelerationValue*	The *Acceleration* parameter is out of range.
3004	*InvalidDecelerationValue*	The *Deceleration* parameter is out of range.
3005	*InvalidBufferModeValue*	Incorrect *BufferMode* parameter value.
3006	*InvalidDirectionValue*	Incorrect *Direction* parameter value, the direction is not allowed, or a limit (hardware or software) is exceeded.
3007	*InvalidHomeMode*	Incorrect homing *Mode* parameter value.
3008	*InvalidParameter*	The parameter number does not exist for the specified axis.
3009	*InvalidParameterValue*	Parameter value is out of range.
3010	*ReadOnlyParameter*	Parameter is read-only.

Operating Mode

IOM Operating Modes



PTO Regarding IOM Operating Modes

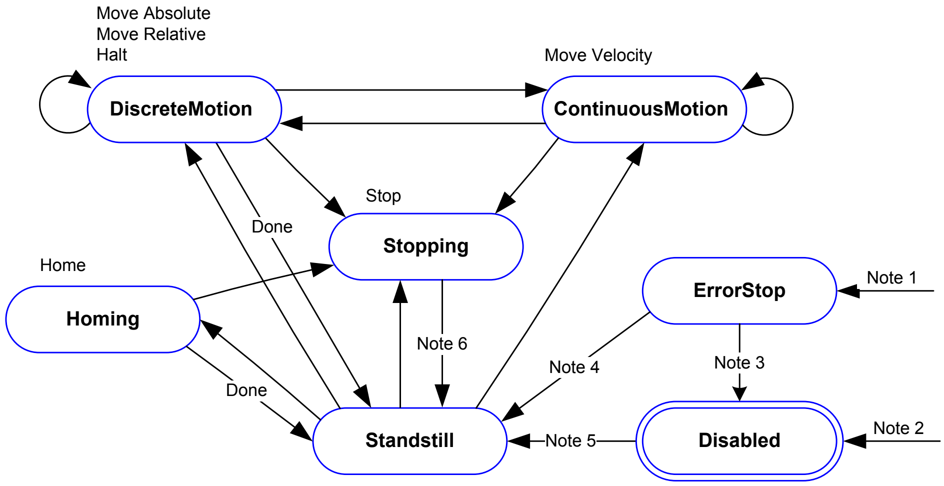
Module Transition to State	PTO Callback Operations	PTO Resulting State
SYS_BOOTING	-	Not configured
SYS_DEFAULT_CONF	-	Not configured
SYS_CONFIGURED	Configures PTO according to the received configuration.	Configured
SYS_DRIVEN_OUTPUT	Operates according to the received data.	Driven_Operational
SYS_FALLBACK_OUTPUT	-	No change

PTO States

PTO State	PTO Data Exchange	PTO Status
Not configured	-	-
Configured	Produce data: Input image	Implicit exchange data parameter values are set to their default values.
Driven_Operational	Receive data: Output image Produce data: Input image	Refer to Driven_Operational, page 272.

Driven_Operational

In Driven_Operational state, the PTO state is defined by the *AxisState* parameter as depicted in the following diagram:



The following table describes the axis states:

***AxisState* Value**	**Description**
Disabled	The axis is in this state on start-up. When entering this state: *isHomed* is set to FALSE. While in this state: • New motion commands are rejected • *MovePrevious•Status* is set to 3 • *MovePrevious•ErrorId* is set to *Disabled Axis* **Note 2**: Set *PowerStatus* to FALSE in order to change the state to *Disabled*. This can be done from any state except *ErrorStop*. **Note 5**: Set *PowerStatus* to TRUE in order to change the state to *Standstill*.
Standstill	The axis is in this state when: • *PowerStatus* is TRUE • No detected errors • No active motion commands While in this state: New motion commands are accepted.
ErrorStop	The axis is in this state when an error (1000...1009) is detected. While in this state: • New motion commands are rejected • *MovePrevious•Status* is set to 3 • *MovePrevious•ErrorId* is set to *ErrorStop Active* **Note 1**: Upon entering this state from any other state, any ongoing motion command is aborted by an implicit stop command using the **Fast Stop Deceleration** parameter value defined in the configuration. When this occurs, the ongoing motion command *MovePrevious•Status* is set to 3 and *MovePrevious•ErrorId* is set to the detected error value. **Note 3**: Set *PowerStatus* to FALSE in order to change the state to *Disabled*, then perform the *Reset* command. **Note 4**: Set *PowerStatus* to TRUE in order to change the state to *Standstill*, then perform the *Reset* command.
Homing	The axis is in this state when a valid *Home* motion command is sent. While in this state: New motion commands are rejected. When the *Home* motion command finishes without detecting an error: *isHomed* is set to TRUE.
DiscreteMotion	The axis is in this state when a valid *Relative*, *Absolute*, or *Halt* motion command is sent. While in this state: New motion commands are accepted.
ContinuousMotion	The axis is in this state when a valid *Velocity* motion command is sent. While in this state: New motion commands are accepted.
Stopping	The axis is in this state when a valid *Stop* motion command is sent. While in this state: New motion commands are rejected. **Note 6**: When *CurrentVelocity* is equal to 0, perform the *From Stop To Standstill* motion command in order to change the state to *Standstill*.

How to Execute a PTO Command

Follow this procedure to execute a PTO command, whether it is an administrative or a motion command:

Step	Action
1	Define the motion (or administrative) command you want to execute by setting the *MoveType* (or *AdminType*) value. For more information about the type of motion command your *MoveType* does, refer to Motion Commands Description, page 278. For more information about the type of administrative command your *AdminType* does, refer to Administrative Commands, page 276.
2	Update the required settings in relation with your command. For more information about the required settings, refer to Motion Commands, page 275 and Administrative Commands, page 276.
3	Set *MoveCmdId* = *MoveNextCmdId* (respectively, *MoveCmdId* = *AdminNextCmdId* for administrative commands).
4	On the next I/O bus cycle, the new motion command is executed with the provided settings and according to the provided *BufferMode*. For more information about buffer modes, refer to *BufferMode* Parameter Description, page 277. **NOTE:** When a motion command is followed or interrupted by another motion command with an opposite direction, the *CurrentVelocity* decelerates at the *Deceleration* parameter value of the new motion command.
5	*MoveNextCmdId* (or *AdminNextCmdId*) is incremented by one.

Motion Commands

The following table describes the required settings for each PTO motion command:

Motion Command	Required Settings
Idle	-
Velocity	*ContinuousUpdate* *Velocity_HighVelocity* *Acceleration* *Deceleration* *Direction* *BufferMode* *JerkRatio*
Absolute	*Distance_Position* *Acceleration* *Deceleration* *Direction* *BufferMode* *JerkRatio* *isHomed* = TRUE
Relative	*Distance_Position* *Acceleration* *Deceleration* *Direction* *BufferMode* *JerkRatio* *isHomed* = TRUE
Stop	*Deceleration* *JerkRatio*
Halt	*Deceleration* *BufferMode* *JerkRatio*
Homing	*Mode* *Distance_Position* *Direction* *Velocity_HighVelocity* *LowVelocity* *Acceleration* *Deceleration* *Offset* *JerkRatio*
SetPosition	*Distance_Position*
FromStopToStandstill	*AxisState = Stopping* *CurrentVelocity* = 0

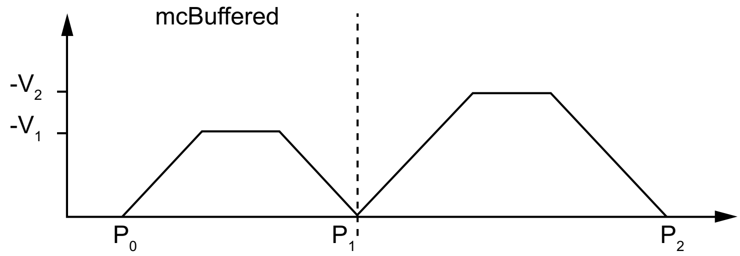
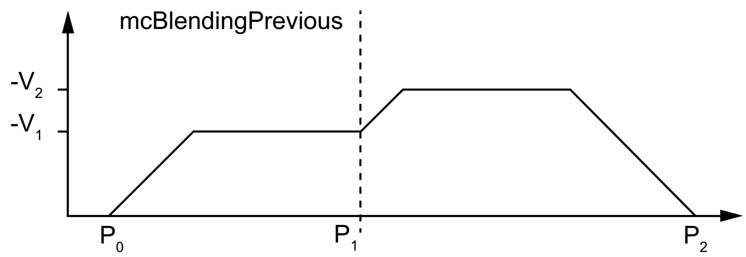
Administrative Commands

The following table describes the behavior and the required settings for each PTO administrative command:

Administrative Command	Required Settings	Behavior/Description
Idle	-	No action.
Reset	-	Resets axis-related detected errors, if possible, allowing a transition from the *ErrorStop* state to the *Standstill* state.
TouchProbe	*WindowOnly* *FirstPosition* *LastPosition* *TriggerLevel*	This administrative command is used to activate a trigger event on the PROBE input. The trigger conditions are defined by the settings of the command. When the trigger conditions are met, *AdministrativeRecordedPosition* is set to the *CurrentPosition* value and the motion command stored in *MoveTriggerId* is executed. The *TouchProbe* command is done when the trigger event is detected. **NOTE:** When the command is done, you must execute the *TouchProbe* administrative command to activate a new trigger event.
AbortTrigger	-	This administrative command aborts the *TouchProbe* administrative command..

BufferMode Parameter Description

The *Velocity*, *Absolute*, *Relative*, and *Halt* commands have a parameter called *BufferMode*. When there is an ongoing motion command, the buffer mode determines how the module reacts to a new motion command:

Parameter Value	Behavior / Description
mcAborting	If possible, aborts the ongoing motion command and starts the new motion command. For more information about aborting a motion command, refer to Motion Command Abort Table, page 278. The *MovePrevious•Status* parameter of the ongoing motion command is set to 2. The new motion command starts with the *CurrentVelocity* at which the ongoing motion command is aborted.
mcBuffered	Stores the new motion command. *MoveBufferId* is set to the *MoveCmdId* parameter of the stored motion command. **NOTE:** Only one motion command can be stored. When a new motion command can be sent, then the stored motion command is executed:  *MoveBufferId* is set to 0 when the motion command is finalized.
mcBlendingPrevious	Stores the new motion command. *MoveBufferId* is set to the *MoveCmdId* parameter of the stored motion command. When a new motion command can be sent, then the stored motion command is executed. The deceleration phase of the ongoing motion command is canceled. The new motion command blends with the ongoing motion command and starts at the *CurrentVelocity* of the ongoing motion command:  *MoveBufferId* is set to 0 when the motion command is finalized.
seTrigger	Stores the new motion command. *MoveTriggerId* is set to the *MoveCmdId* of the stored motion command. **NOTE:** Only one motion command can be stored. The motion command is executed when the probe event trigger conditions are met. If possible, aborts the ongoing motion command and starts the new motion command. The *MovePrevious•Status* parameter of the ongoing motion command is set to 2. The new motion command starts with the *CurrentVelocity* at which the ongoing motion command is aborted. *MoveTriggerId* is set to 0 when the motion command is finalized.
seBufferedDelay	This buffer mode operates like the *mcBuffered* but the execution of the motion command starts after the **Delay** parameter value duration. **NOTE:** You can change the **Delay** parameter value with explicit exchanges.

NOTE:

- Only a motion command with valid parameters can be queued. If the motion command is valid, the motion command is queued and *QueueFull* is set to TRUE.
- When the buffered motion command is executed, *QueueFull* is set to FALSE.

Motion Command Abort Table

A new motion command can abort an ongoing motion command as described in the following table:

Motion Command		New					
		Home	***Velocity***	***Relative***	***Absolute***	***Halt***	***Stop***
Ongoing	*Home*	No	No	No	No	No	Yes
	Velocity	No	Yes	Yes	Yes	Yes	Yes
	Relative	No	Yes	Yes	Yes	Yes	Yes
	Absolute	No	Yes	Yes	Yes	Yes	Yes
	Halt	No	Yes	Yes	Yes	Yes	Yes
	Stop	No	No	No	No	No	No
Yes: The ongoing motion command is aborted and the new motion command begins execution. No: The new motion command is rejected. *MovePrevious•Status* is set to 3 and *MovePrevious•ErrorId* is updated with the detected error.							

Motion Commands Description

Overview

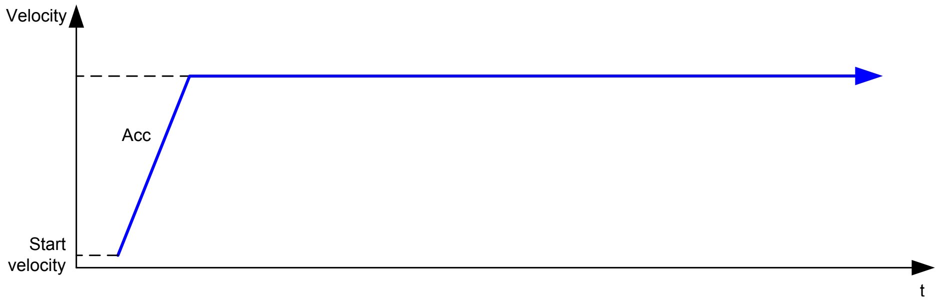
This section describes the PTO behavior with the different motion commands:

- Velocity, page 278
- Absolute, page 280
- Relative, page 281
- Stop, page 283
- Halt, page 283
- Homing, page 284
- Set Position, page 284
- From Stop To Standstill, page 285

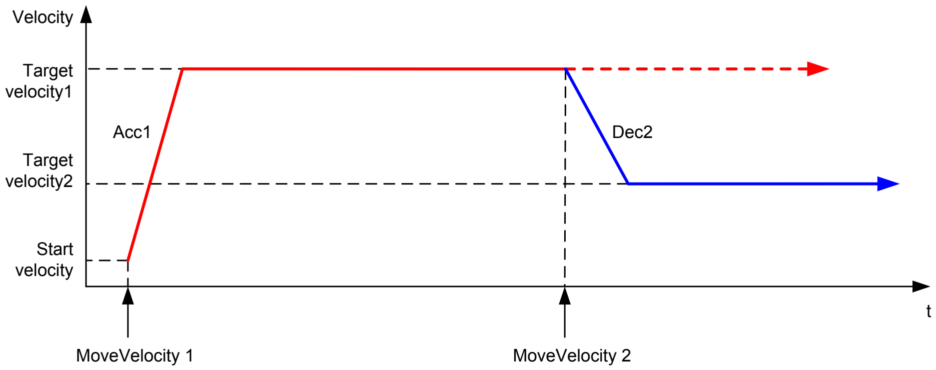
Motion Command: Velocity

When a *Velocity* motion command is sent, the motion profile varies with the present state of the *AxisState*.

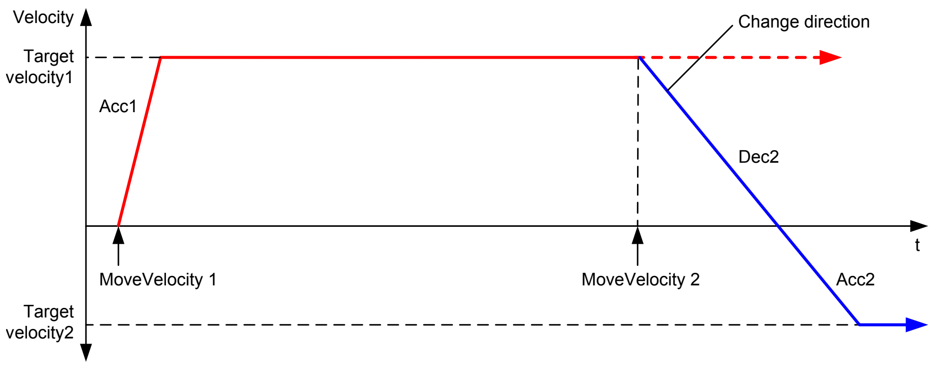
The following diagram depicts the profile of the motion command when *AxisState* is in *Standstill* state:



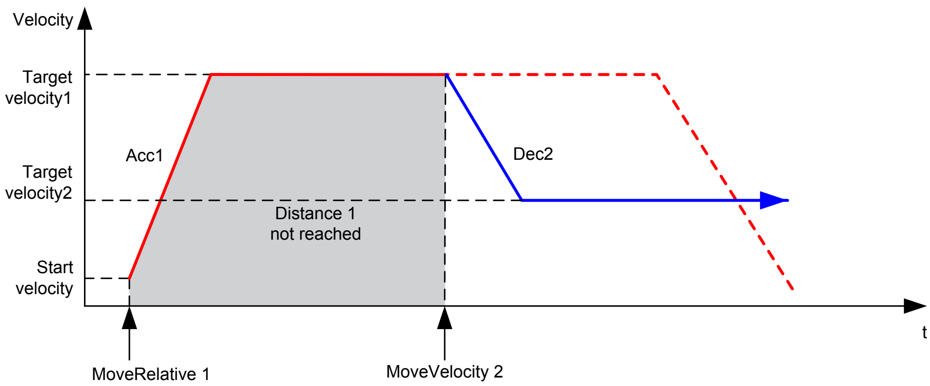
The following diagram depicts the profile of the motion command when *AxisState* is in *Continuous* state:



The following diagram depicts the profile of the motion command when *AxisState* is in *Continuous* state and there is a direction change:



The following diagram depicts the profile of the motion command when *AxisState* is in *Discrete* state:



NOTE: In this diagram, *BufferMode* of the *Velocity* motion command is set to *mcAborting*.

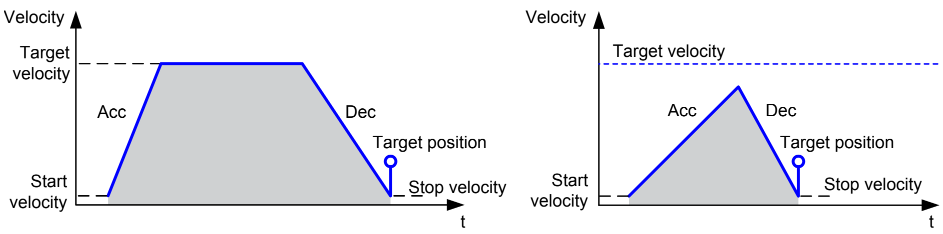
The *MovePrevious•Id*, *MovePrevious•Status*, and *MovePrevious•ErrorId* parameters are set when:

- The motion command is completed (*MotionState* = *ConstantVelocity*)
- The motion command is aborted.
- An error is detected.

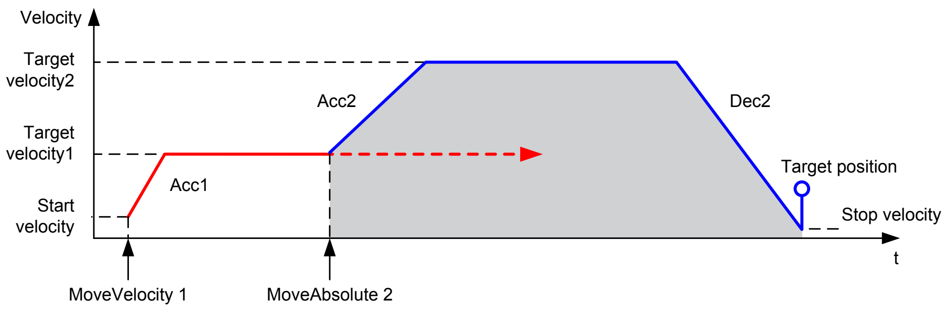
Motion Commands: Absolute

When an *Absolute* motion command is sent, the motion profile varies with the present state of the *AxisState*.

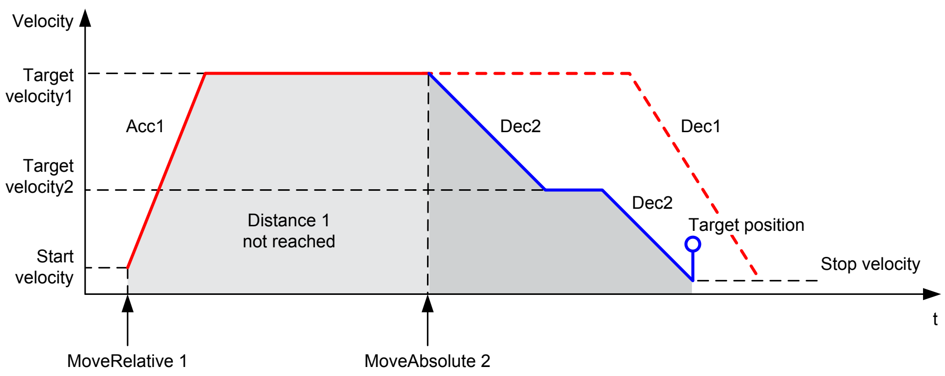
The following diagram depicts the profile of the motion command when *AxisState* is in *Standstill* state:



The following diagram depicts the profile of the motion command when *AxisState* is in *Continuous* state:

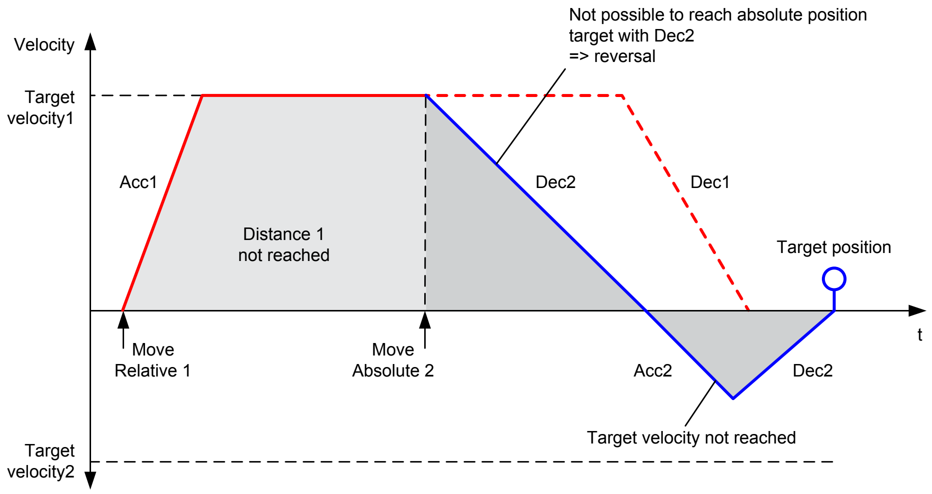


The following diagram depicts the profile of the motion command when *AxisState* is in *Discrete* state:



NOTE: In this diagram, *BufferMode* of the *Absolute* motion command is set to *mcAborting*.

The following diagram depicts the profile of the motion command when *AxisState* is in *Discrete* state and there is a direction change:



NOTE: In this diagram, *BufferMode* of the *Absolute* motion command is set to *mcAborting*.

The *MovePrevious•Id*, *MovePrevious•Status*, and *MovePrevious•ErrorId* parameters are set when the configured limit is reached, the movement is interrupted, or the motion command is completed.

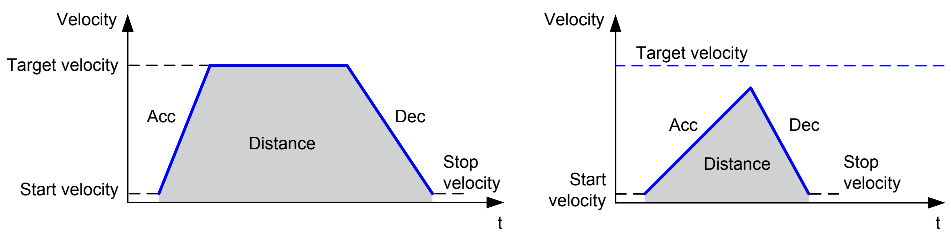
The *MovePrevious•Id*, *MovePrevious•Status*, and *MovePrevious•ErrorId* parameters are set when:

- The motion command is completed (*CurrentPosition* = *Distance_Position*)
- The motion command is aborted.
- An error is detected.

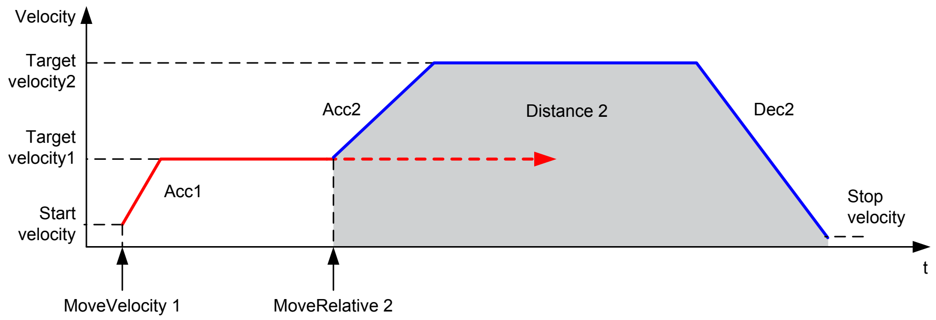
Motion Command: Relative

When a *Relative* motion command is sent, the motion profile varies with the present state of the *AxisState*.

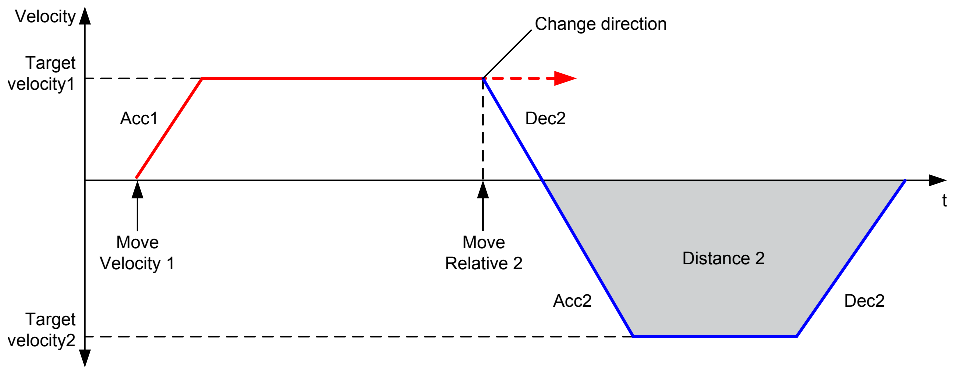
The following diagram depicts the profile of the motion command when *AxisState* is in *Standstill* state:



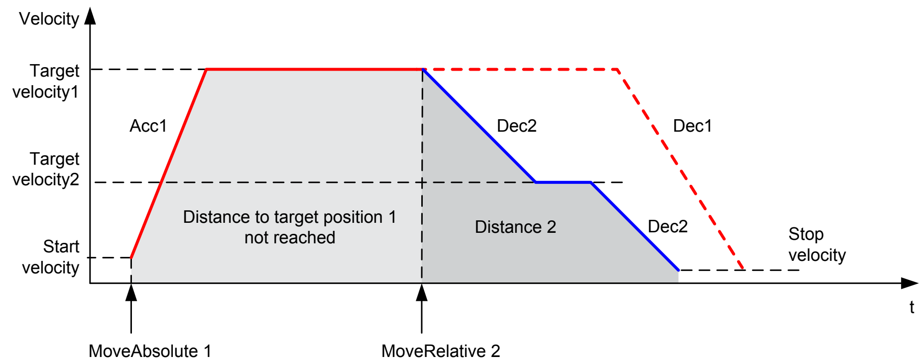
The following diagram depicts the profile of the motion command when *AxisState* is in *Continuous* state:



The following diagram depicts the profile of the motion command when *AxisState* is in *Continuous* state and there is a direction change:

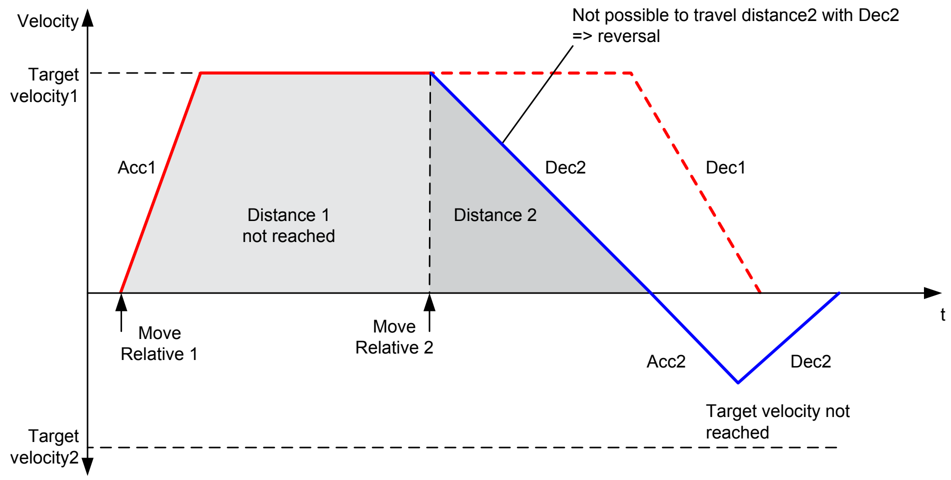


The following diagram depicts the profile of the motion command when *AxisState* is in *Discrete* state:



NOTE: In this diagram, *BufferMode* of the *Relative* motion command is set to *mcAborting*.

The following diagram depicts the profile of the motion command when *AxisState* is in *Discrete* state and there is a direction change:



NOTE: In this diagram, *BufferMode* of the *Relative* motion command is set to *mcAborting*.

The *MovePrevious•Id*, *MovePrevious•Status*, and *MovePrevious•ErrorId* parameters are set when:

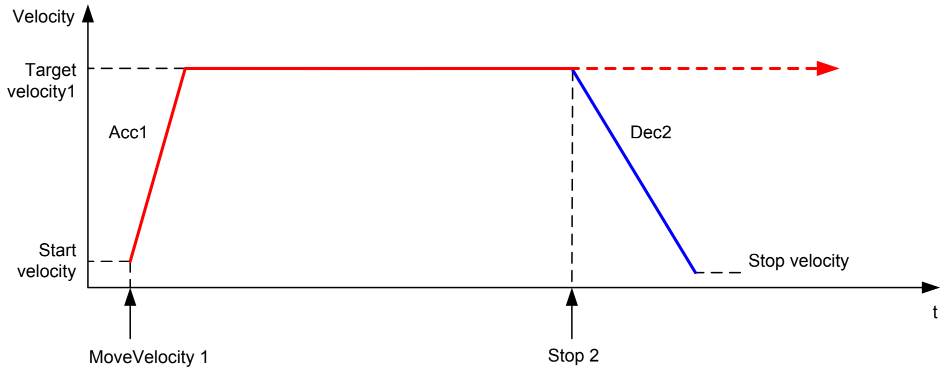
- The motion command is completed.
- The motion command is aborted.
- An error is detected.

Motion Command: Stop

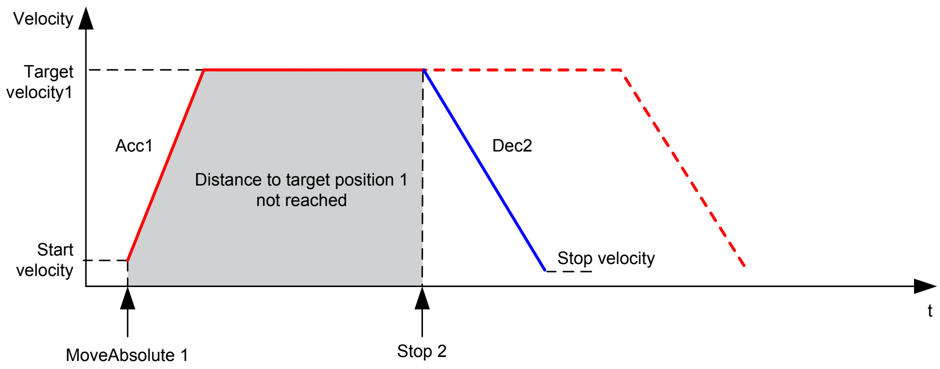
When a *Stop* motion command is sent, the velocity of the PTO decelerates to 0. At the end of the *Stop* motion command, the *AxisState* remains in the *Stopping* state.

A *Stop* motion command always aborts the ongoing motion command.

The following diagram depicts the profile of the motion command when *AxisState* is in *Continuous* state:



The following diagram depicts the profile of the motion command when *AxisState* is in *Discrete* state:



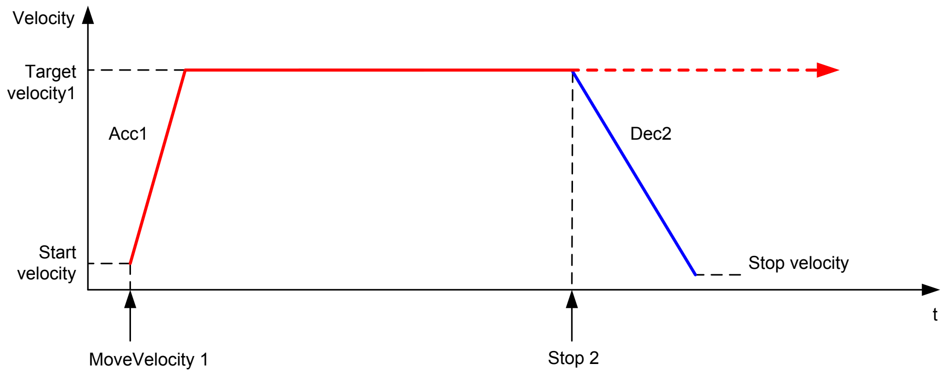
The *MovePrevious•Id*, *MovePrevious•Status*, and *MovePrevious•ErrorId* parameters are set when:

- The motion command is completed (*CurrentVelocity* is equal to 0).
- An error is detected.

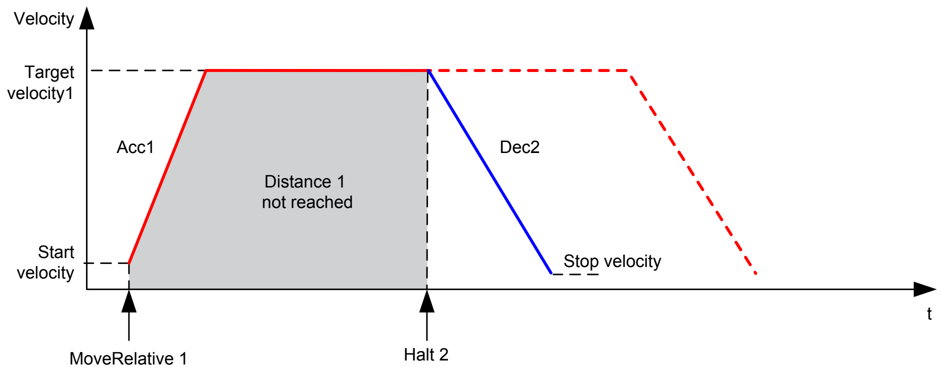
Motion Command: Halt

When a Stop motion command is sent, the velocity of the PTO decelerates to 0.

The following diagram depicts the profile of the motion command when *AxisState* is in *Continuous* state:



The following diagram depicts the profile of the motion command when *AxisState* is in *Discrete* state:



NOTE: In this diagram, *BufferMode* of the *Absolute* motion command is set to *mcAborting*.

The *MovePrevious•Id*, *MovePrevious•Status*, and *MovePrevious•ErrorId* parameters are set when:

- The motion command is completed (*CurrentVelocity* is equal to 0).
- The motion command is aborted.
- An error is detected.

Motion Command: Homing

Homing is done with an external switch (REF input) and the homing position is defined on the switch edge. Then the motion is decelerated until stop.

There are seven different homing modes:

- PositionSetting, page 285
- LongReference, page 286
- LongReference And Index, page 287
- ShortReference Reversal, page 288
- ShortReference No Reversal, page 290
- ShortReference And Index Outside, page 291
- ShortReference And Index Inside, page 293

The *MovePrevious•Id*, *MovePrevious•Status*, and *MovePrevious•ErrorId* parameters are set when:

- The motion command is completed.
- The motion command is aborted.
- An error is detected.

If the *Homing* motion command finishes without interruption and without detecting an error, *isHomed* is set to TRUE.

Motion Command: Set Position

This motion command does not generate a movement. The *CurrentPosition* parameter is set to the provided *Distance_Position* value.

The *MovePrevious•Id*, *MovePrevious•Status*, and *MovePrevious•ErrorId* parameters are set when:

- The motion command is completed.
- An error is detected.

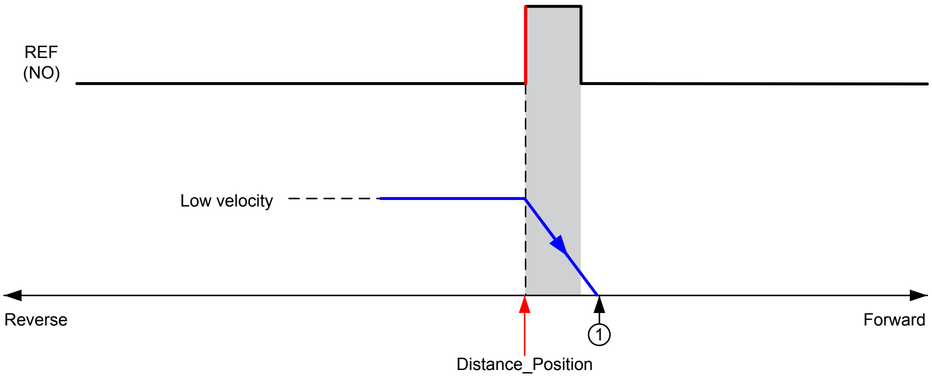
Motion Command: From Stop to Standstill

This motion command does not generate a movement. Use this motion command to set the *AxisState* parameter to *Standstill* after a *Stop* motion command.

Homing Modes Description

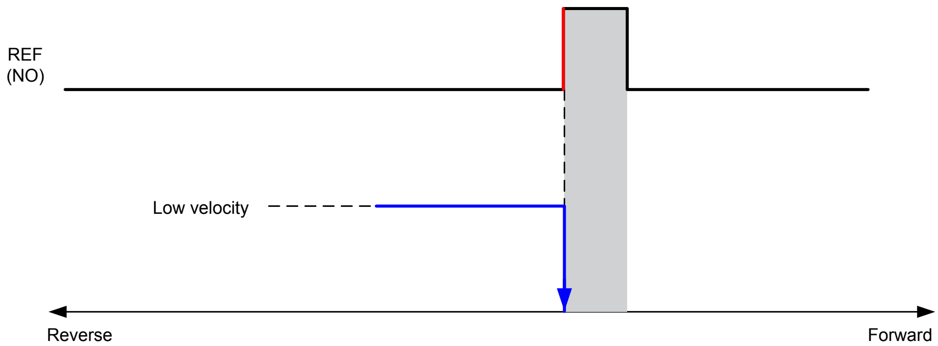
Overview

The homing is done with an external switch (REF input), and the homing position is defined on the switch edge. Then the motion is decelerated until stopped. The present position of the axis at the end of the motion sequence may therefore differ from the position parameter set on the motion command:



REF (NO): REF input (Normally Open)
1: Position at the end of the motion command = *Distance_Position* + “deceleration to stop” distance.

To simplify the representation of a stop in the homing mode diagrams, the following presentation is made to represent the present position of the axis:



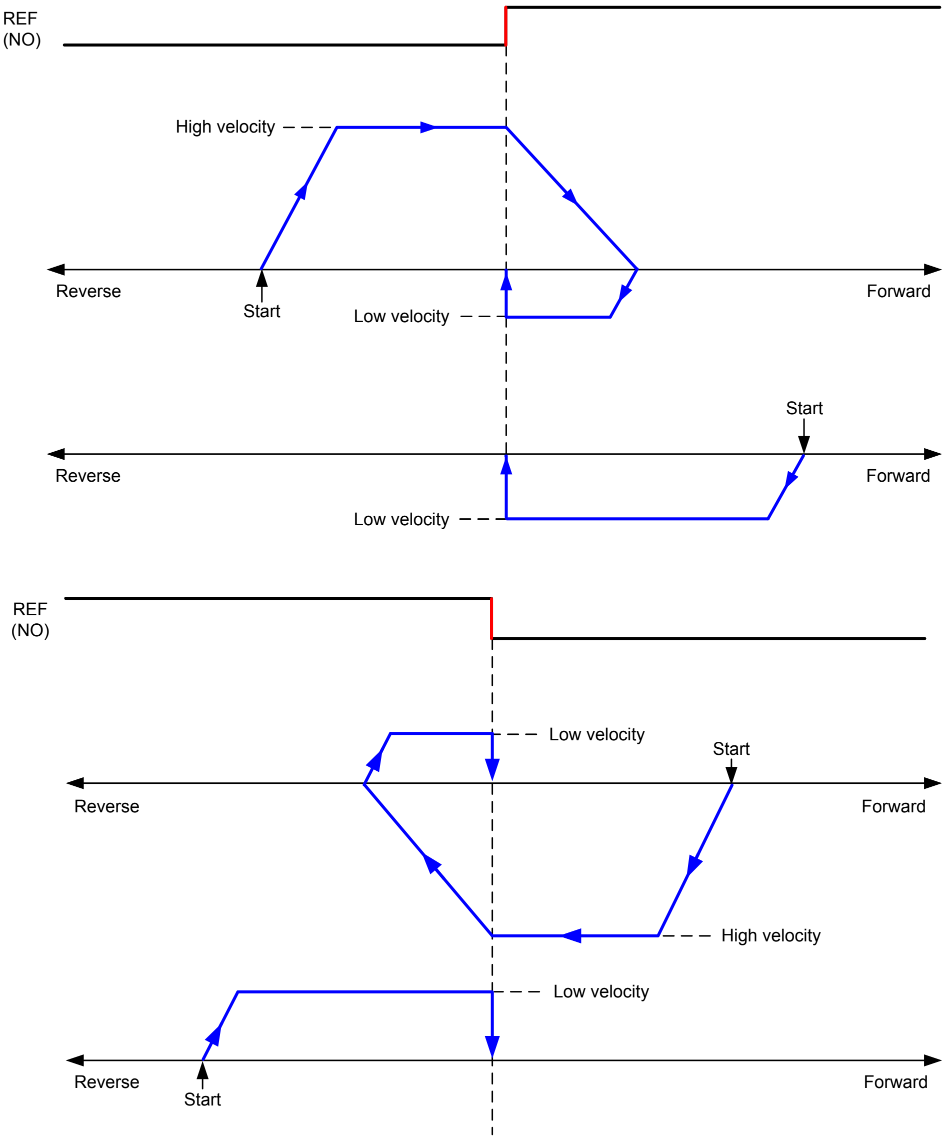
REF (NO): REF input (Normally Open)

Homing Mode: PositionSetting

In the case of position setting, the *CurrentPosition* parameter is set to the *Distance_Position* value. No move is performed.

Homing Mode: LongReference

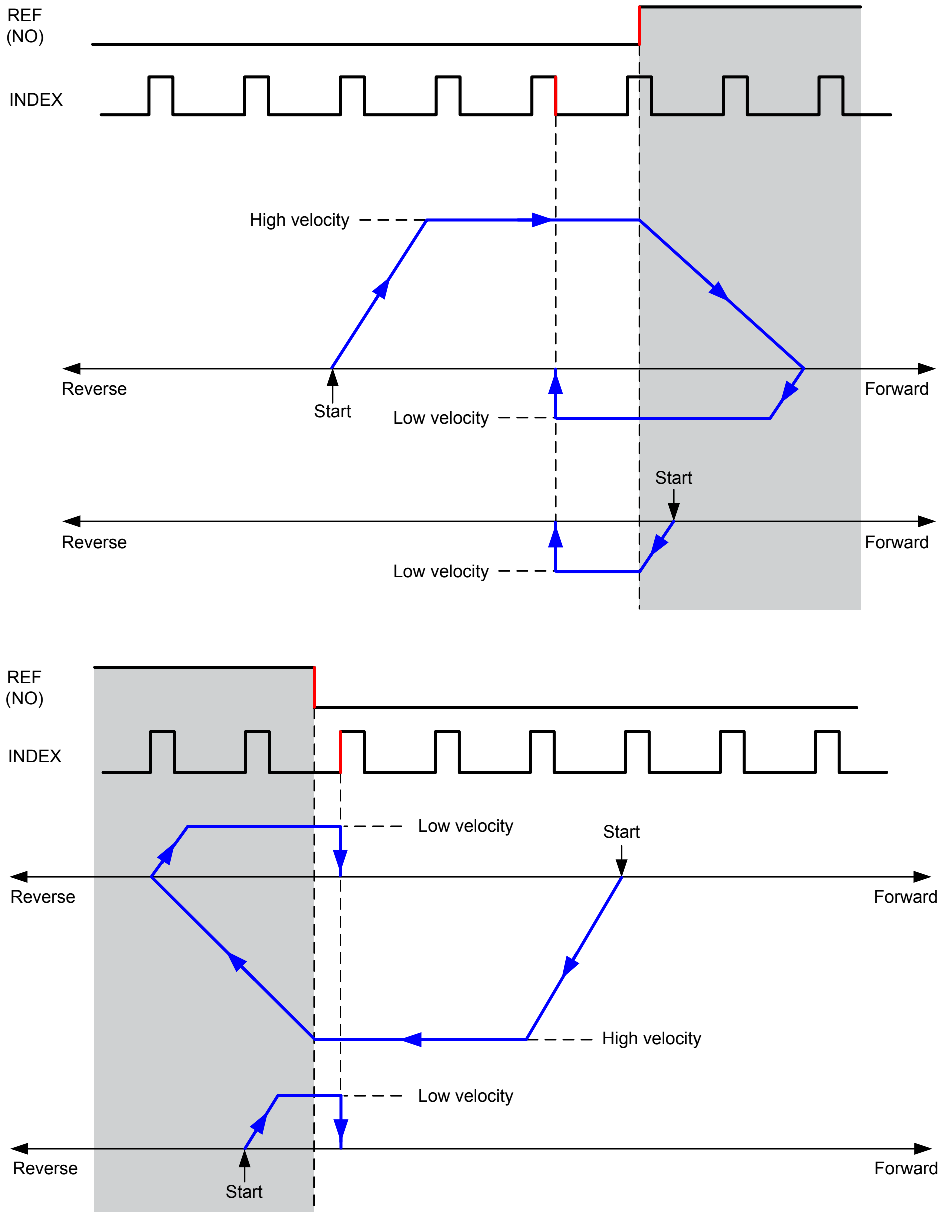
The homing profile depends on the REF input signal:



REF (NO): REF input (Normally Open)

Homing Mode: LongReferenceAndIndex

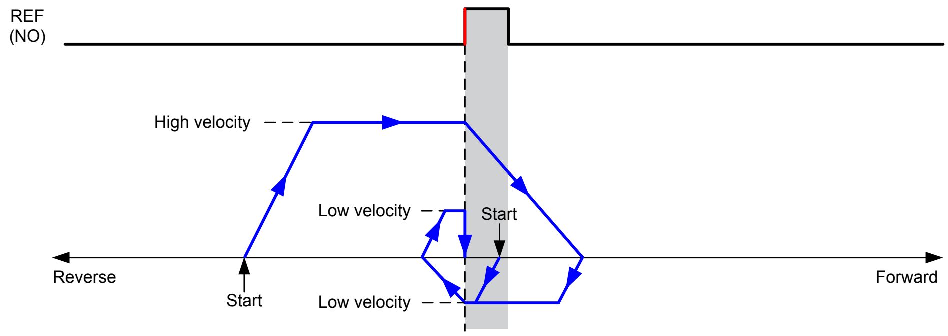
The homing profile depends on the REF input and the INDEX input signal:

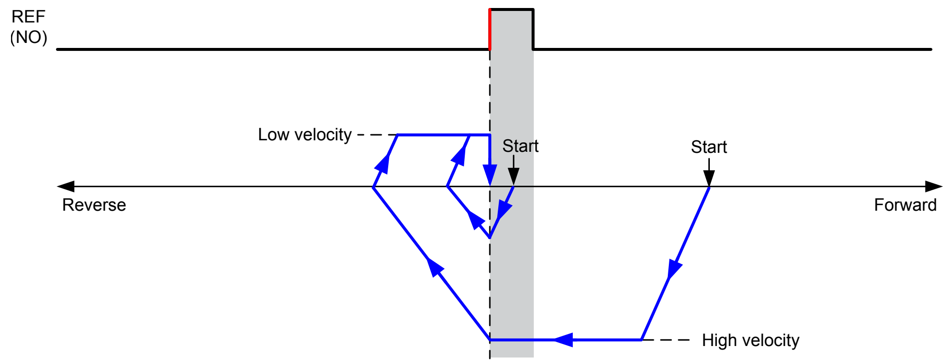


REF (NO): REF input (Normally Open)
INDEX: INDEX input

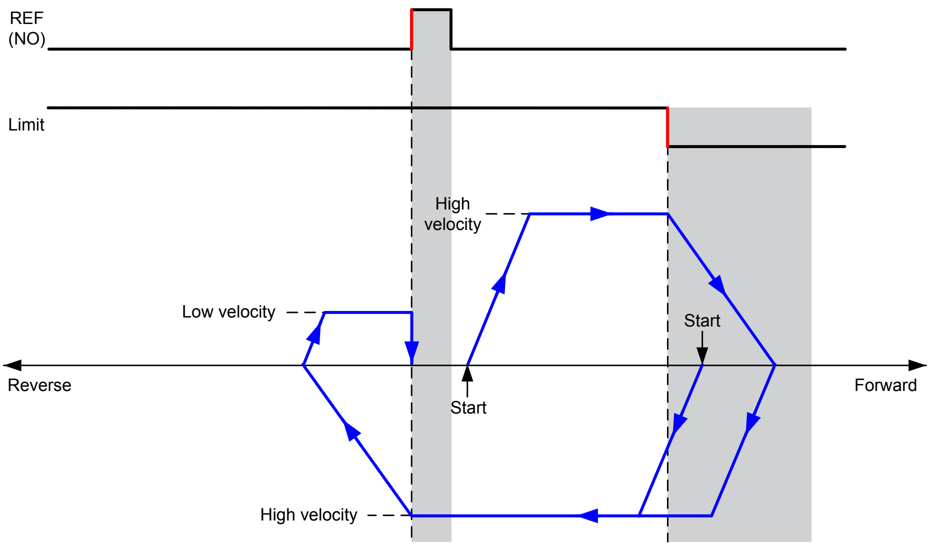
Homing Mode: ShortReference_Reversal

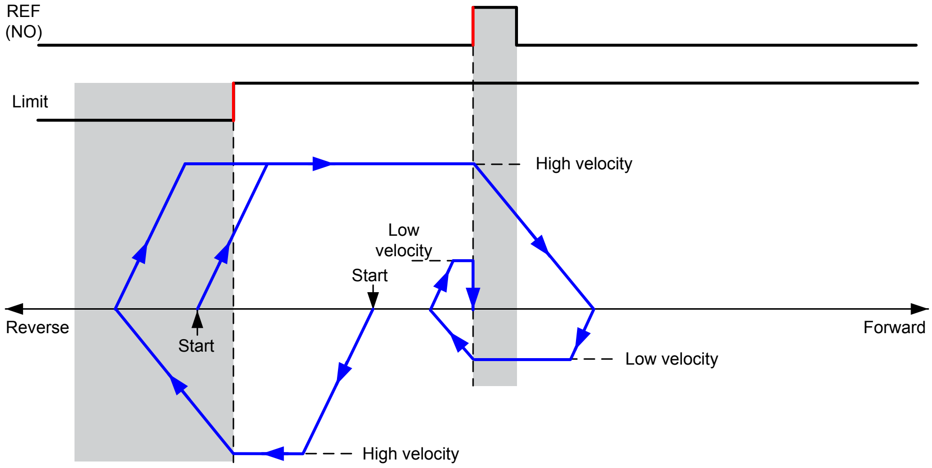
The homing profile depends on the REF input signal:





If limits (hardware or software) are configured, the movement reverses to continue searching for the REF input signal:

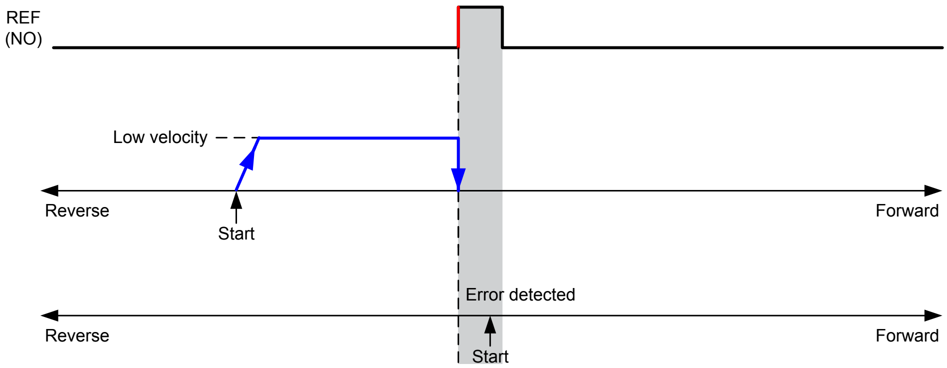


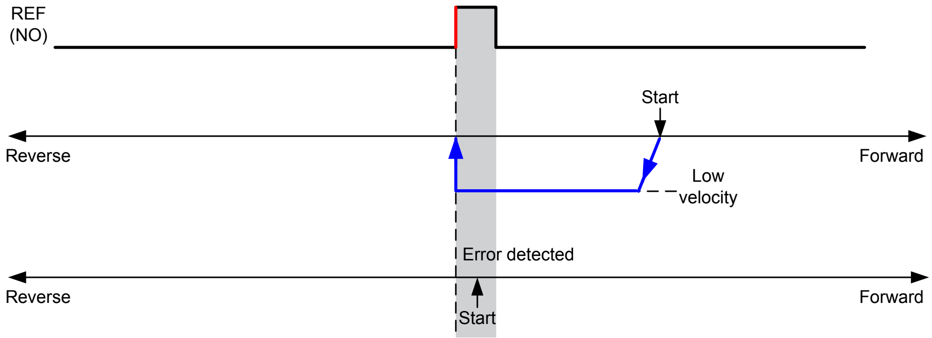


REF (NO): REF input (Normally Open)

Homing Mode: ShortReference_NoReversal

The homing profile searches the REF input at *LowVelocity* with no reversal:

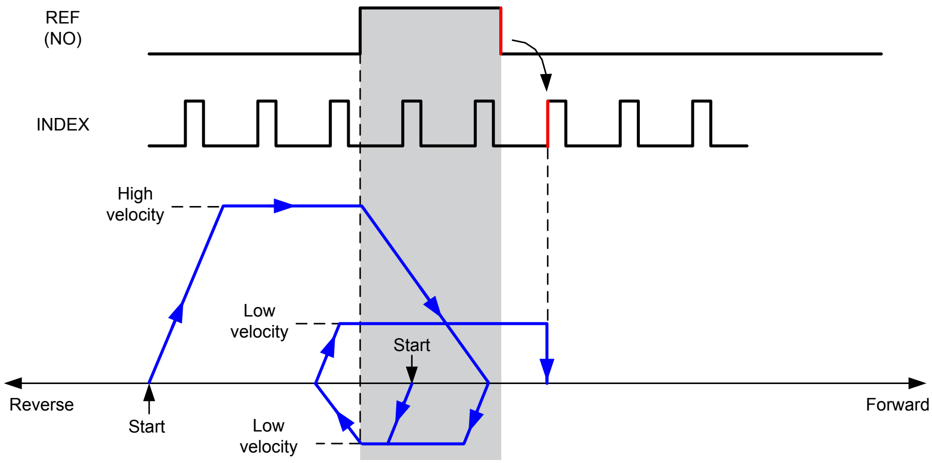


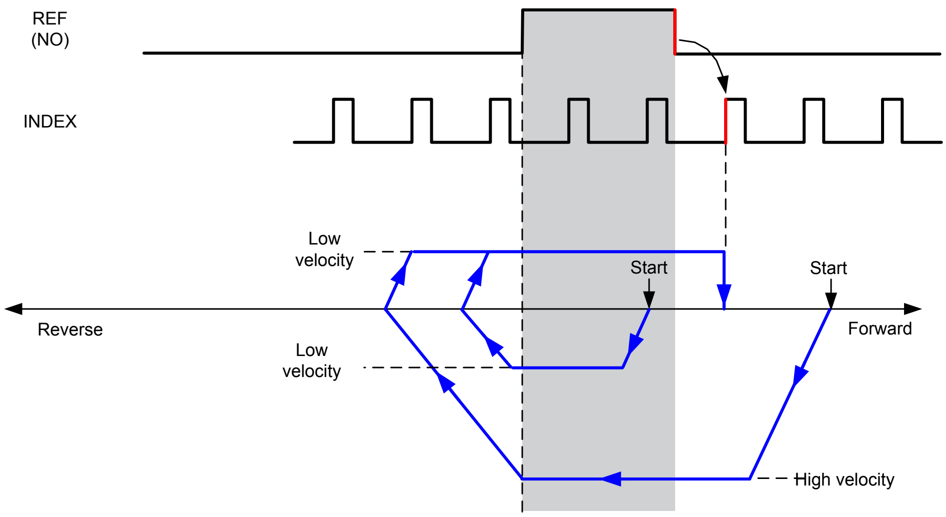


REF (NO): REF input (Normally Open)

Homing Mode: ShortReferenceAndIndex_Outside

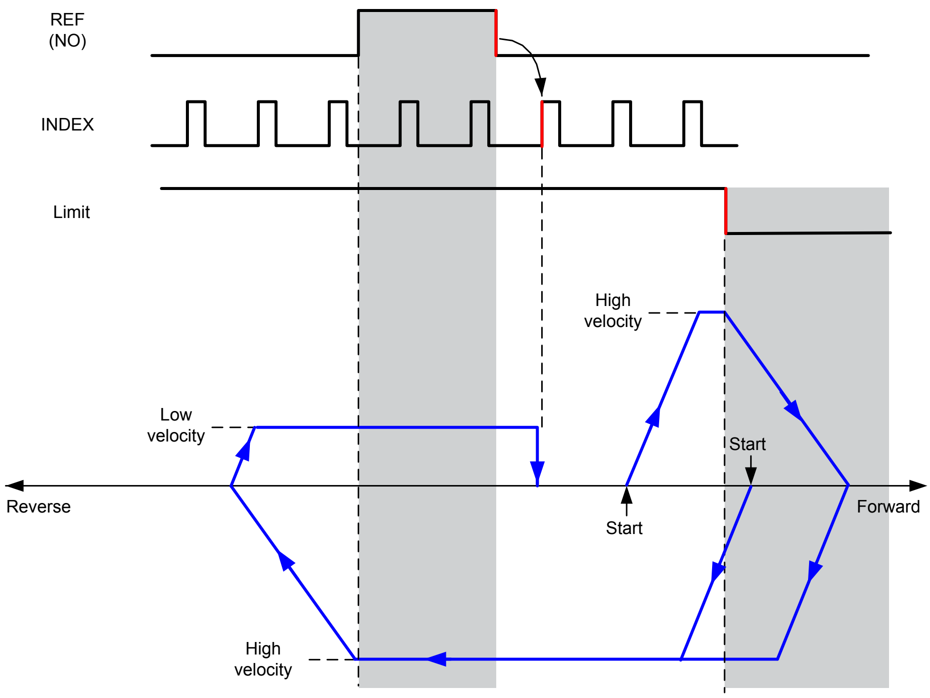
The homing profile depends on the REF input and the INDEX input signal:

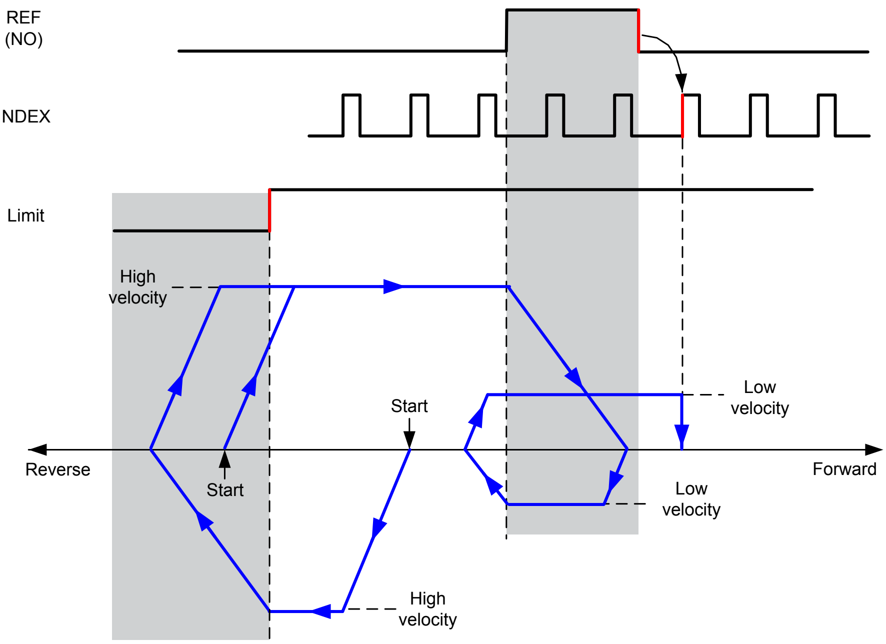




REF (NO): REF input (Normally Open)

If limits (hardware or software) are configured, the movement reverses to continue searching for the REF input signal:

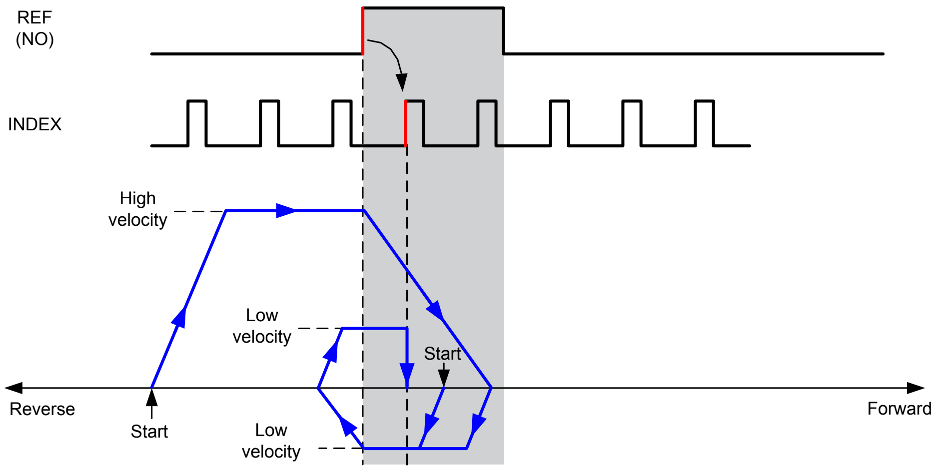


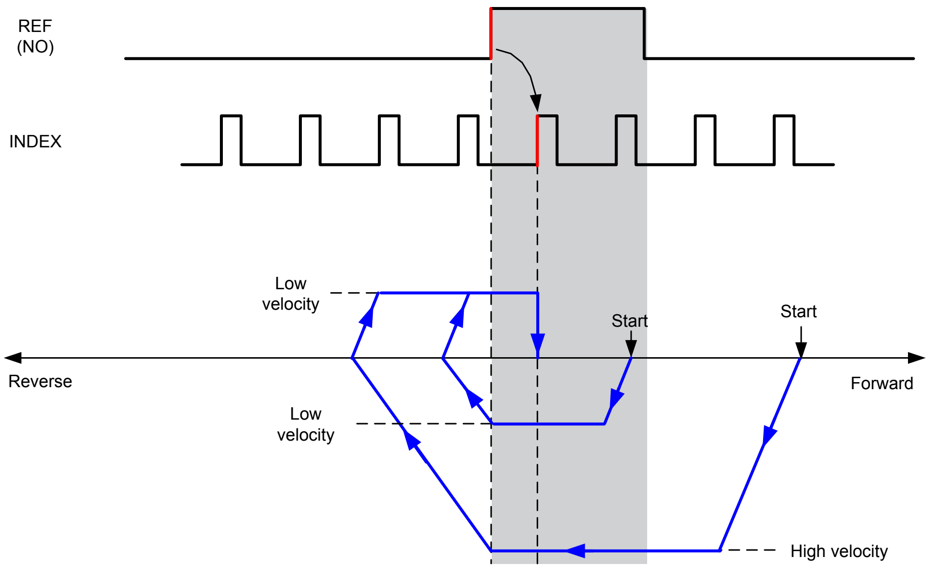


REF (NO): REF input (Normally Open)

Homing Mode: ShortReferenceAndIndex_Inside

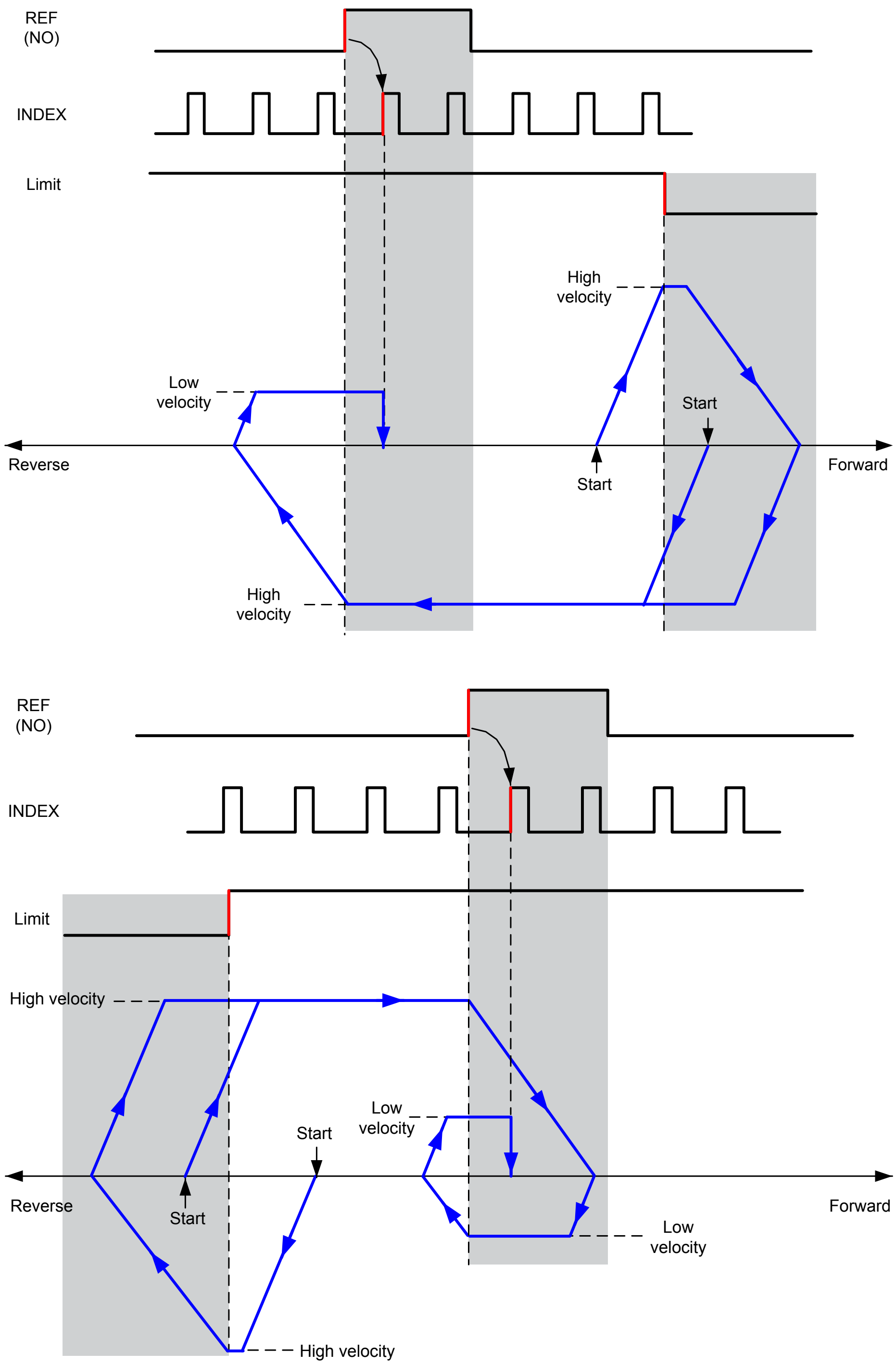
The homing profile depends on the REF input and the INDEX input signal:





REF (NO): REF input (Normally Open)

If limits (hardware or software) are configured, the movement reverses to continue searching for the REF input signal:



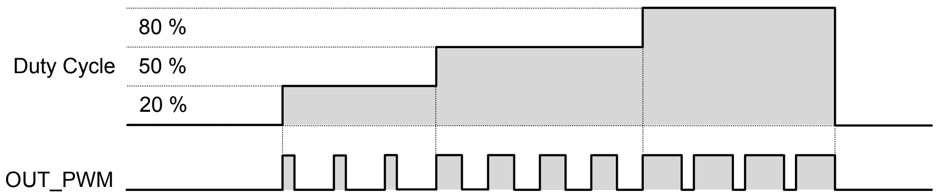
REF (NO): REF input (Normally Open)

Pulse Width Modulation (PWM) Mode Principle Description

Overview

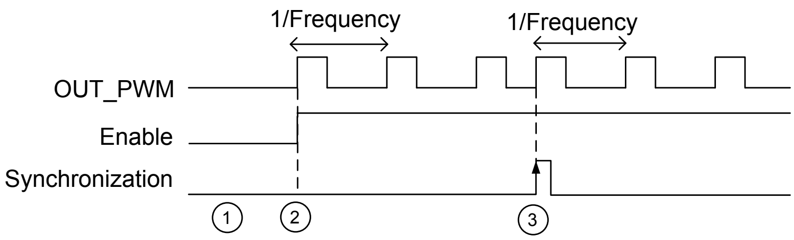
The **Pulse Width Modulation** mode generates a square wave signal with a frequency from 0.1 Hz to 20 kHz (step 0.1 Hz) and a duty cycle of 0 to 100% (step 0.1%).

Modifying the duty cycle in the program modulates the width of the signal. Below is an illustration of an output signal with varying duty cycles:



Principle Diagram

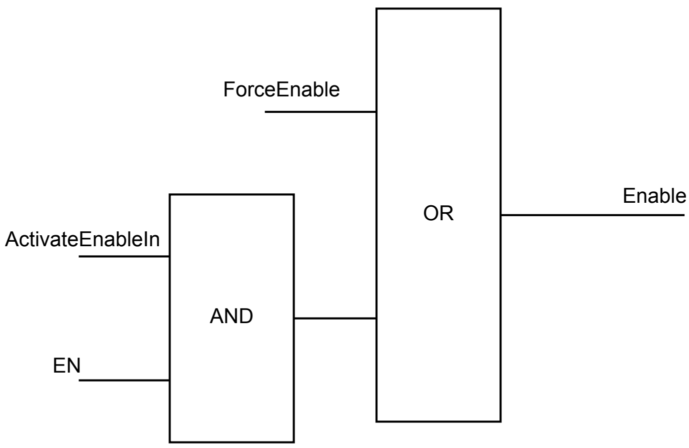
The following diagram depicts an overview of the **Pulse Width Modulation** mode with enable and synchronization functions:



Stage	Description
1	When enable is FALSE, the module does not generate a pulse.
2	When enable is TRUE, the module generates the pulse with the parameters provided (frequency / duty cycle).
3	When synchronization is TRUE, the pulse is interrupted. If enable is TRUE, the module generates new pulses with the defined parameters provided (frequency / duty cycle).

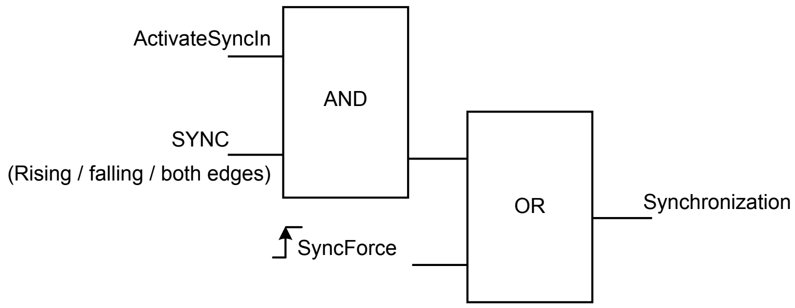
Enable and synchronization states depend on the configuration of your application as described below:

Enable:



ForceEnable: *Command* bit 0.
ActiveEnableIn: *Command* bit 1.
EN: Physical input assigned to the **EN Configured** parameter.

Synchronization:



ActiveSyncIn: *Command* bit 3.
SYNC: Physical input assigned to the **SYNC Configured** parameter.
Rising / falling / both edges: **SYNC Condition** parameter setting.
SyncForce: *Command* bit 2.

Pulse Width Modulation Interface

PWM Configuration

Configurable Parameters

The following table presents the configurable parameters for the Pulse Width Modulation (PWM) interface:

Displayed Name ***Parameter Name***	**Value**	**Data Type**	**Description**
Channel Location *ChannelLocation*	0: **Channel 0** 1: **Channel 1** 255: **Channel Disabled**	ENUM	Selects the location of the channel. A channel can be used once. The available parameter list and the default value depend on the module reference associated to the function.
EN Configured *EnConfigured*	0: **Disabled*** 1: **I0** 2: **I1** 3: **I2** 4: **I3** 5: **I4** 6: **I5** 7: **I6** 8: **I7**	ENUM	Configures the enable input on the pulse generator.
EN Filter *EnFilter*	0: **0** 1: **0.0002** 2: **0.0005** 3: **0.001** 4: **0.002*** 5: **0.005** 6: **0.01** 7: **0.05** 8: **0.08** 9: **0.5** 10: **1** 11: **4** 12: **12**	ENUM	Allows reducing the effect of bounce on the input. Changes to the signal are only detected if the pulse width of the input signal is longer than the filter time (ms).
SYNC Configured *SyncConfigured*	0: **Disabled*** 1: **I0** 2: **I1** 3: **I2** 4: **I3** 5: **I4** 6: **I5** 7: **I6** 8: **I7**	ENUM	Configures the synchronization input on the pulse generator.

Displayed Name *Parameter Name*	Value	Data Type	Description
SYNC Condition *SyncCondition*	0: **REF Rising Edge*** 1: **REF Falling Edge** 2: **REF Both Edges**	ENUM	Selects the condition to synchronize the generation.
SYNC Filter *SyncFilter*	0: **0** 1: **0.0002** 2: **0.0005** 3: **0.001** 4: **0.002*** 5: **0.005** 6: **0.01** 7: **0.05** 8: **0.08** 9: **0.5** 10: **1** 11: **4** 12: **12**	ENUM	Allows reducing the effect of bounce on the input. Changes to the signal are only detected if the pulse width of the input signal is longer than the filter time (ms).
* Parameter default value			

Implicit Parameters

The following table presents the input implicit data for the Pulse Width Modulation (PWM) interface:

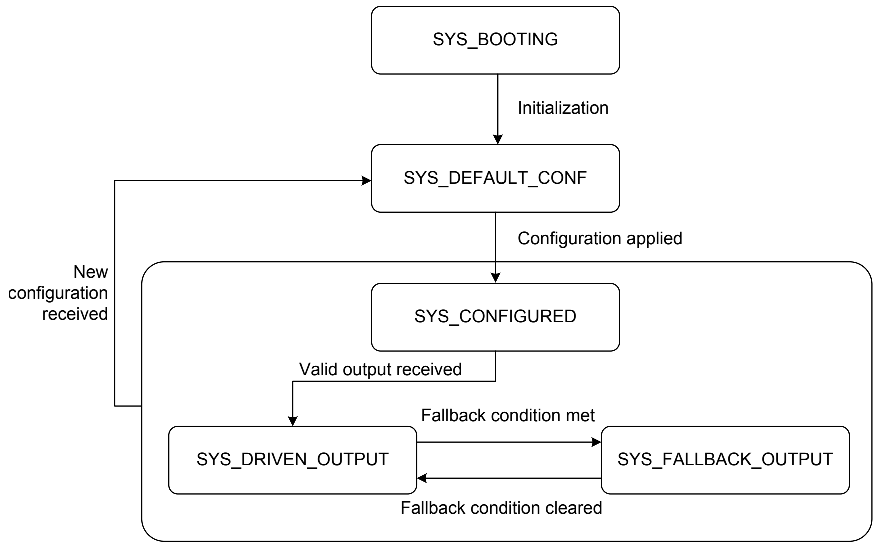
Parameter Name	Value	Data Type R/W	Description
Status	0*...255	BYTE R/-	Status of the bit field: • Bit 0: *EnabledFlag*: When TRUE, the pulse generation is in progress. • Bit 1: *WarningFreq*: When TRUE, the input frequency is over the maximum frequency. The applied frequency is the maximum frequency. • Bit 2: *WarningDuty*: When TRUE, the input duty is over the maximum duty. The applied duty is the maximum duty. • Bit 3: *ErrorFlag*: When TRUE, an error is detected, the pulse generation is stopped. • Bit 4: *SyncFlag*: When TRUE, a synchronization is performed. • Bit 5...7: N/A
ErrorId	*0**: No Error detected *1*: Internal Field Power Supply *2*: Short circuit *3*: Fallback	ENUM R/-	Indicates the error type. When *ErrorFlag* = TRUE, the *ErrorId* parameter provides the error detected.
* Parameter default value			

The following table presents the output implicit data for the Pulse Width Modulation (PWM) interface:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
Command	0*...255	BYTE R/W	Command of the bit field: • Bit 0: *ForceEnable*: When TRUE, forces the pulse generation (**EN Configured** input is ignored). • Bit 1: *ActivateEnableIn*: When TRUE, enables the pulse generation when **EN Configured** input = TRUE. • Bit 2: *ActivateSyncIn*: When TRUE, the synchronization input event triggers the synchronization and sets *SyncFlag*. • Bit 3: *SyncForce*: At rising edge, forces the synchronization and sets *SyncFlag*, independently of the synchronization input. • Bit 4: *SyncAck*: At rising edge, resets *SyncFlag*. • Bit 5...7: N/A
Frequency	0*...200,000	UINT32 R/W	Frequency to apply to the pulse generation. Step: 0.1 Hz.
Duty	0*...1,000	UINT16 R/W	Duty to apply to the pulse generation. Step: 0.1 %.
* Parameter default value			

Operating Mode

IOM Operating Modes



PWM Regarding IOM Operating Modes

Module Transition to State	PWM Callback Operations	PWM Resulting State
SYS_BOOTING	-	Not configured
SYS_DEFAULT_CONF	-	Not configured
SYS_CONFIGURED	Configures PWM according to the received configuration	Configured

Module Transition to State	PWM Callback Operations	PWM Resulting State
SYS_DRIVEN_OUTPUT	Operates according to the received data	Driven_Operational
SYS_FALLBACK_OUTPUT	Aborts pulse generation Applies the fallback value to the output	Driven_Fallback

PWM States

PWM State	PWM Data Exchange	PWM Status
Not configured	-	-
Configured	Produce data: Input image	*Status.EnabledFlag* = FALSE *Status.WarningFreq* = FALSE *Status.ErrorFlag* = FALSE *ErrorId* = No Error detected *Status.SyncFlag* = FALSE
Driven_Operational	Receive data: Output image Produce data: Input image	Refer to Driven_Operational, page 300.
Driven_Fallback	Produce data: Input image	*Status.EnabledFlag* = FALSE *Status.WarningFreq* = FALSE *Status.ErrorFlag* = TRUE *ErrorId* = Fallback (or a more prior *ErrorId*) *Status.SyncFlag* = FALSE

Driven_Operational

PWM Commands	Condition	PWM Status	Behavior
Command.ForceEnable = TRUE OR *Command.ActivateEnableIn* = TRUE and EN input = TRUE	No error detected	*Status.EnabledFlag* = TRUE *ErrorId* = No Error Detected *Status.ErrorFlag* = FALSE	Frequency generation. *Frequency* and *Duty* are applied and can be changed each cycle during the generation (with a clean last pulse). *Frequency* = 0 means that the physical output generation is stopped with a clean last pulse. *Duty* = 0 means physical output is 0. *Duty* = 1,000 means physical output is 1.
Command.ForceEnable = TRUE OR *Command.ActivateEnableIn* = TRUE and EN input = TRUE	Error detected	*Status.EnabledFlag* = FALSE *Status.ErrorFlag* = TRUE *ErrorId* is updated.	Aborts the pulse generation. **NOTE:** To acknowledge the error and restart generation, *Command.ForceEnable* and/or *Command.ActivateEnableIn* must be set to FALSE then to TRUE (after the error condition is removed).
Command.ForceEnable = FALSE AND *(ActivateEnableIn* = FALSE OR *Command.ActivateEnableIn* = TRUE AND EN input = FALSE)	-	*Status.EnabledFlag* = FALSE *Status.ErrorFlag* = FALSE *ErrorId* = No Error Detected	Aborts the pulse generation.

PWM Commands	Condition	PWM Status	Behavior
Frequency <= Maximum Frequency	Generation in progress	*Status.WarningFreq* = FALSE	*Frequency* is applied.
Frequency > Maximum Frequency	Generation in progress	*Status.WarningFreq* = TRUE	Maximum frequency is applied.
Duty <= Maximum Duty	Generation in progress	*WarningDuty* = FALSE	*Duty* is applied.
Duty > Maximum Duty	Generation in progress	*WarningDuty* = TRUE	Maximum duty is applied.
Command.SyncForce rising edge OR *Command.ActivateSyncIn* = TRUE AND SYNC Input edge (regarding Configuration)	Generation in progress	*Status.SyncFlag* = TRUE	Performs a synchronization.
Command.SyncAck rising edge	-	*Status.SyncFlag* = FALSE	Resets *Status.SyncFlag*.

NOTE: Even if *Status.SyncFlag* = TRUE, it is still possible to perform a synchronization.

ErrorId Priority

ErrorId	Priority
Internal Field Power Supply	0
Short circuit	1
Fallback	2

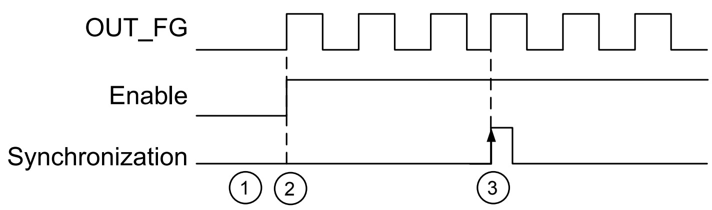
Frequency Generator Mode Principle Description

Overview

The **Frequency Generator** mode generates a square wave signal with a frequency from 0.1 Hz to 100 kHz (step 0.1 Hz) and a duty cycle of 50%.

Principle Diagram

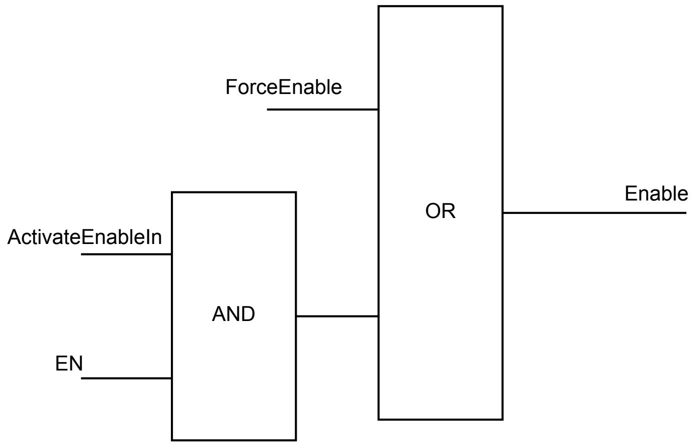
The following diagram depicts an overview of the **Frequency Generator** mode with the enable and synchronization functions:



Stage	Description
1	When enable is FALSE, the module does not generate a pulse.
2	When enable is TRUE, the module generates the pulse with the parameters provided (frequency / duty cycle).
3	When synchronization is TRUE, the pulse is interrupted. If enable is TRUE, the module generates new pulses with the defined parameters provided (frequency / duty cycle).

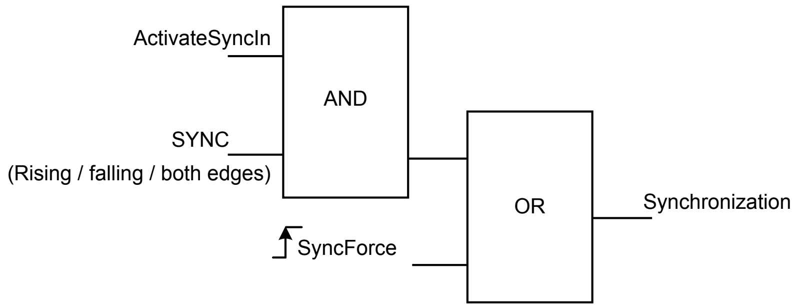
Enable and synchronization state depend on the configuration of your application as described below:

Enable:



ForceEnable: *Command* bit 0.
ActiveEnableIn: *Command* bit 1.
EN: Physical input assigned to the **EN Configured** parameter.

Synchronization:



ActiveSyncIn: *Command* bit 3.
SYNC: Physical input assigned to the **SYNC Configured** parameter.
Rising / falling / both edges: **SYNC Condition** parameter setting.
SyncForce: *Command* bit 2.

Frequency Generator Interface

Frequency Generator Configuration

Configurable Parameters

The following table presents the configurable parameters for the Frequency Generator:

Displayed Name ***Parameter Name***	**Value**	**Data Type**	**Description**
Channel Location *ChannelLocation*	0: **Channel 0** 1: **Channel 1** 255: **Channel Disabled**	ENUM	Selects the location of the channel. A channel can be used once. The available parameter list and the default value depend on the module reference associated to the function.
EN Configured *EnConfigured*	0: **Disabled*** 1: **I0** 2: **I1** 3: **I2** 4: **I3** 5: **I4** 6: **I5** 7: **I6** 8: **I7**	ENUM	Configures the enable input on the pulse generator.
EN Filter *EnFilter*	0: **0** 1: **0.0002** 2: **0.0005** 3: **0.001** 4: **0.002*** 5: **0.005** 6: **0.01** 7: **0.05** 8: **0.08** 9: **0.5** 10: **1** 11: **4** 12: **12**	ENUM	Allows reducing the effect of bounce on the input. Changes to the signal are only detected if the pulse width of the input signal is longer than the filter time (ms).
SYNC Configured *SyncConfigured*	0: **Disabled*** 1: **I0** 2: **I1** 3: **I2** 4: **I3** 5: **I4** 6: **I5** 7: **I6** 8: **I7**	ENUM	Configures the synchronization input on the pulse generator.

Displayed Name ***Parameter Name***	**Value**	**Data Type**	**Description**
SYNC Condition *SyncCondition*	0: **REF Rising Edge*** 1: **REF Falling Edge** 2: **REF Both Edges**	ENUM	Selects the condition to synchronize the generation.
SYNC Filter *SyncFilter*	0: **0** 1: **0.0002** 2: **0.0005** 3: **0.001** 4: **0.002*** 5: **0.005** 6: **0.01** 7: **0.05** 8: **0.08** 9: **0.5** 10: **1** 11: **4** 12: **12**	ENUM	Allows reducing the effect of bounce on the input. Changes to the signal are only detected if the pulse width of the input signal is longer than the filter time (ms).
* Parameter default value			

Implicit Parameters

The following table presents the input implicit data for the Frequency Generator:

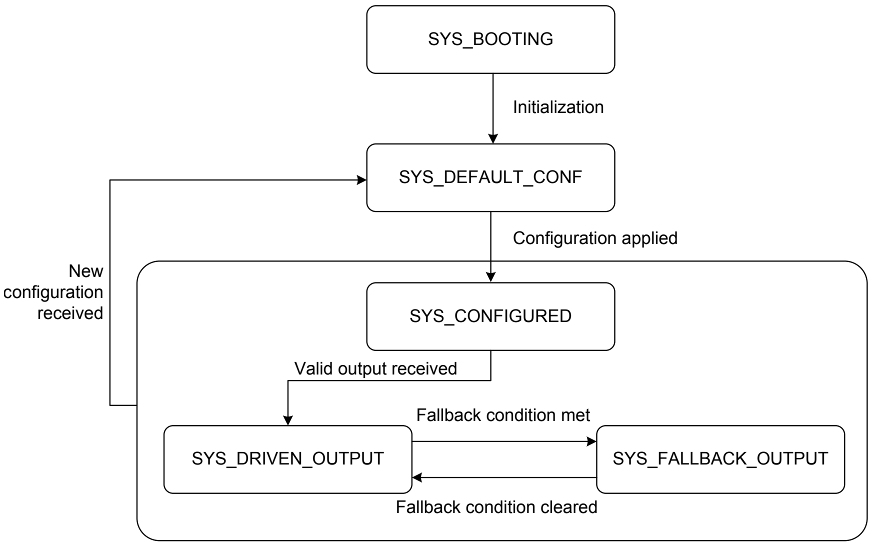
Parameter Name	**Value**	**Data Type** **R/W**	**Description**
Status	0*...255	BYTE R/-	Status of the bit field: • Bit 0: *EnabledFlag*: When TRUE, the pulse generation is in progress. • Bit 1: *WarningFreq*: When TRUE, the input frequency is over the maximum frequency. The applied frequency is the maximum frequency. • Bit 2: N/A • Bit 3: *ErrorFlag*: When TRUE, an error is detected and the pulse generation is stopped. • Bit 4: *SyncFlag*: When TRUE, a synchronization was performed. • Bit 5...7: N/A
ErrorId	*0**: No Error detected *1*: Internal Field Power Supply *2*: Short circuit *3*: Fallback	ENUM R/-	Indicates the error type. When *ErrorFlag* = TRUE, the *ErrorId* parameter provides the error detected.
* Parameter default value			

The following table presents the output implicit data for the Frequency Generator:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
Command	0*...255	BYTE R/W	Command of the bit field: • Bit 0: *ForceEnable*: When TRUE, forces the pulse generation (**EN Configured** input is ignored). • Bit 1: *ActivateEnableIn*: When TRUE, enables the pulse generation when **EN Configured** input = TRUE. • Bit 2: *ActivateSyncIn*: When TRUE, the synchronization input event triggers the synchronization and sets *SyncFlag*. • Bit 3: *SyncForce*: At rising edge, forces the synchronization and sets *SyncFlag*, independently of the synchronization input. • Bit 4: *SyncAck*: At rising edge, resets *SyncFlag*. • Bit 5...7: N/A
Frequency	0*...100,000	UINT32 R/W	Frequency to apply to the pulse generation. Step: 0.1 Hz.
* Parameter default value			

Operating Mode

IOM Operating Modes



Frequency Generator Regarding IOM Operating Modes

Module Transition to State	Frequency Generator Callback Operations	Frequency Generator Resulting state
SYS_BOOTING	-	Not configured
SYS_DEFAULT_CONF	-	Not configured
SYS_CONFIGURED	Configures Frequency Generator according to the received configuration	Configured
SYS_DRIVEN_OUTPUT	Operates according to the received data	Driven_Operational
SYS_FALLBACK_OUTPUT	Aborts pulse generation Applies the fallback value to the output	Driven_Fallback

Frequency Generator States

Frequency Generator State	Frequency Generator Data Exchange	Frequency Generator Status
Not configured	-	-
Configured	Produce data: Input image	*Staus.EnabledFlag* = FALSE *Status.WarningFreq* = FALSE *Status.ErrorFlag* = FALSE *ErrorId* = No Error detected *Status.SyncFlag* = FALSE
Driven_Operational	Receive data: Output image Produce data: Input image	Refer to Driven_Operational, page 306.
Driven_Fallback	Produce data: Input image	*Staus.EnabledFlag* = FALSE *Status.WarningFreq* = FALSE *Status.ErrorFlag* = TRUE *ErrorId* = Fallback (or a more prior *ErrorId*) *Status.SyncFlag* = FALSE

Driven_Operational

Frequency Generator Commands	Condition	Frequency Generator Status	Behavior
Command.ForceEnable = TRUE OR *Command.ActivateEnableIn* = TRUE and EN input = TRUE	No error detected	*Status.EnabledFlag* = TRUE *ErrorId* = No Error detected *Status.ErrorFlag* = FALSE	Frequency generation. *Frequency* and *Duty* are applied and can be changed each cycle during the generation (with a clean last pulse). *Frequency* = 0 means that the physical output generation is stopped with a clean last pulse.
Command.ForceEnable = TRUE OR *Command.ActivateEnableIn* = TRUE and EN input = TRUE	Error detected	*Status.EnabledFlag* = FALSE *Status.ErrorFlag* = TRUE *ErrorId* updated.	Aborts the pulse generation. **NOTE:** To acknowledge the error and restart generation, *Command.ForceEnable* and/or *Command.ActivateEnableIn* must be set to FALSE then to TRUE (after the error condition is removed).
Command.ForceEnable = FALSE AND (*ActivateEnableIn* = FALSE OR *Command.ActivateEnableIn* = TRUE AND EN input = FALSE)	-	*Status.EnabledFlag* = FALSE *Status.ErrorFlag* = FALSE *ErrorId* = No Error detected	Aborts the pulse generation.
Frequency <= Maximum Frequency	Generation in progress	*Status.WarningFreq* = FALSE	*Frequency* is applied.
Frequency > Maximum Frequency	Generation in progress	*Status.WarningFreq* = TRUE	Maximum frequency is applied.

Frequency Generator Commands	Condition	Frequency Generator Status	Behavior
Command.SyncForce rising edge OR *Command.ActivateSyncIn* = TRUE AND SYNC Input edge (regarding Configuration)	Generation in progress	*Status.SyncFlag* = TRUE	Performs a synchronization.
Command.SyncAck rising edge	-	*Status.SyncFlag* = FALSE	Resets *Status.SyncFlag*.

NOTE: Even if *Status.SyncFlag* = TRUE, it is still possible to perform a synchronization.

ErrorId Priority

ErrorId	Priority
Internal Field Power Supply	0
Short circuit	1
Fallback	2

Optional Sub-Functions

What's in This Chapter

CAM Sub-Function

CAM Mode Principle Description

Overview

The CAM sub-function defines an action on the output in a position reading interval and controls the outputs depending on this position.

This function is designed for constant velocity applications. The velocity is constant during movement, or varies slowly in relation to the axis rate.

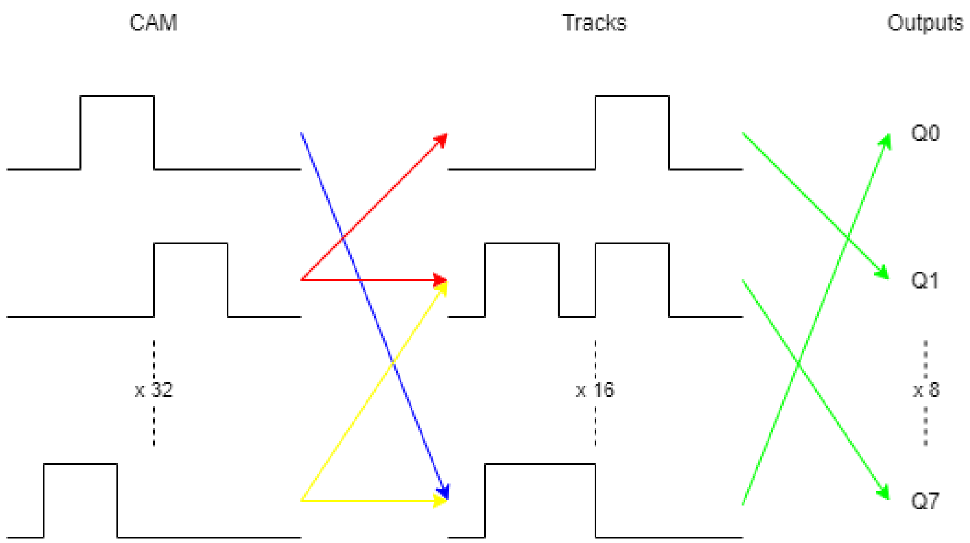
The following table describes the main characteristics of the CAM sub-function:

Main Characteristics	Value
Number of CAMs	32
Number of tracks	16
Number of physical outputs	8
Position encoder inputs	Incremental encoder SSI encoder BiSS-C encoder

Principle

The CAM sub-function process is done by a maximum of 32 CAMs shared across 16 tracks. The tracks are associated with the physical outputs.

Each CAM can be associated to one or more of the 16 tracks, and each track can be associated to one or more of the 8 physical outputs as depicted in the following diagram example:



CAM Processing Operation

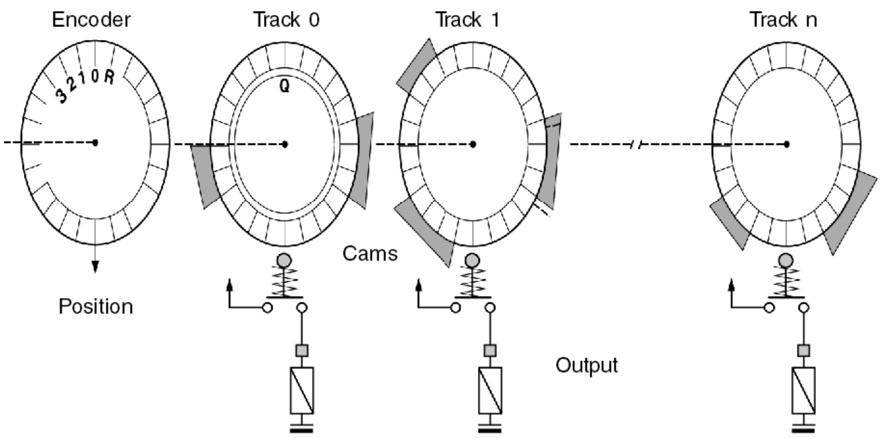
Role of the CAMs and the Tracks

A CAM defines an action on the output in a position reading interval.

A track is made up of one or more CAMs. It controls a physical output of the module.

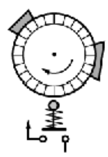
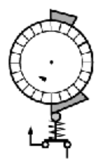
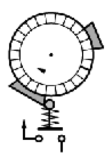
Analogy with Mechanical CAMs

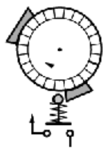
The following illustration presents a mechanical equivalent of the electronic CAM.



Operation

The following table describes the operation of a track to which 2 CAMs are associated:

Phase	Description	Phase
1	The axis turns forward and drives the position encoder. The module calculates the position reading by evaluating the encoder increments. Track i is not active, output Qxy.i is at 0.	
2	When threshold X1 on CAM 0 is reached: • Track i becomes active, • Output Qxy.i switches to 1.	
3	When threshold X2 on CAM 0 is reached: • Track i becomes inactive, • Output Qxy.i switches to 0.	

Phase	Description	Phase
4	When threshold X1 on CAM 1 is reached, • Track i becomes active, • Output Qxy.i switches to 1.	
5	When threshold X2 on CAM 1 is reached, • Track i becomes inactive, • Output Qxy.i switches to 0.	
6	The axis continues to rotate and the process is repeated (returns to phase no. 1).	

Types of CAM

The following sections describe the three types of available CAMs. These CAMs can be activated in a forward direction, reverse direction, or both directions simultaneously.

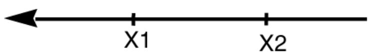
Position Type

A position CAM is a CAM whose logic state depends on the position of the encoder within X1 and X2 thresholds.

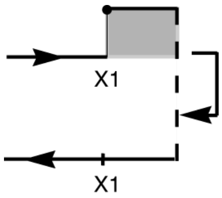
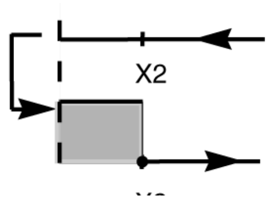
A Position type CAM is at state 1 when the position of the axis is between the 2 thresholds. The 2 thresholds, low threshold X1 and high threshold X2 must be defined (Both between 0 and the number of pulses/cycles and X1 < X2). The CAM is then active between two cycles.

One type of activation from the 3 suggested: forward, reverse and forward/ reverse, must be selected.

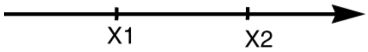
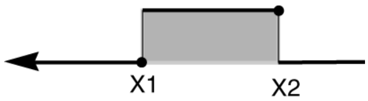
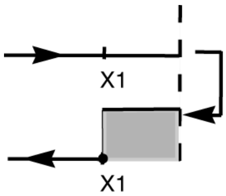
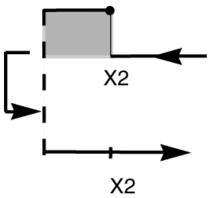
Operation of a CAM which is active in the forward direction

Description	Illustration
If the movement is forward, the CAM changes to 1 when threshold X1 is crossed and returns to 0 when threshold X2 is crossed.	
If the movement is reverse, the CAM remains at 0.	

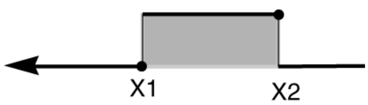
Operation of a CAM which is active in the forward direction (Continued)

Description	Illustration
If the movement is: • Forward (without crossing threshold X2), the CAM changes to 1 when threshold X1 is crossed • Then reverse, the CAM returns to 0 as soon as the direction of movement changes.	
If the movement is: • reverse, the CAM remains at 0 • then forward, the CAM returns to 1 when threshold X2 is crossed.	

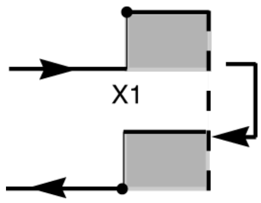
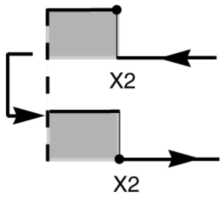
Operation of a CAM which is active in the reverse direction

Description	Illustration
If the movement is forward, the CAM remains at 0.	
If the movement is reverse, the CAM changes to 1 when threshold X2 is crossed and returns to 0 when threshold X1 is crossed.	
If the movement is: • Forward, the CAM remains at 0 • Then reverse, the CAM returns to 1 until threshold X1 is crossed.	
If the movement is: • reverse, the CAM changes to 1 when threshold X2 is crossed • then forward, the CAM returns to 0 as soon as the direction of movement changes.	

Operation of a CAM which is active in forward and reverse directions

Description	Illustration
If the movement is forward, the CAM changes to 1 when threshold X1 is crossed and returns to 0 when threshold X2 is crossed.	
If the movement is reversed, the CAM changes to 1 when threshold X2 is crossed and returns to 0 when threshold X1 is crossed.	

Operation of a CAM which is active in forward and reverse directions (Continued)

Description	Illustration
If the movement is: • Forward (without crossing threshold X2), the CAM changes to 1 when threshold X1 is crossed. • Then reverse, the CAM returns to 0 when threshold X1 is crossed.	
If the movement is: • Reverse (without crossing threshold X1), the CAM changes to 1 when threshold X2 is crossed • Then forward, the CAM returns to 0 when threshold X2 is crossed	

Monostable Type

A Monostable type CAM is one that changes to 1 when a threshold is crossed and returns to 0 after a time delay.

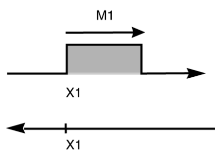
It is characterized by:

- A value of threshold X1 expressed in a number of pulses (X1 is between 0 and the number of pulses/cycles)
- An M1 time delay expressed in 1/10 ms (0 to 16383, i.e. 1.6383 s maximum)
- An activation type: forward/reverse, forward or reverse.

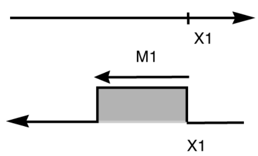
  NOTE:
  - The confirmation condition must be at state 1 for the time delay to be set when the threshold is crossed. If the confirmation condition changes to 0, the time delay in progress ends normally.
  - If the time delay is in progress at a subsequent crossing of threshold X1, the time delay is reset with the setpoint value. The output remains at 1.

One type of activation from the 3 suggested: forward, reverse and forward/ reverse, must be selected.

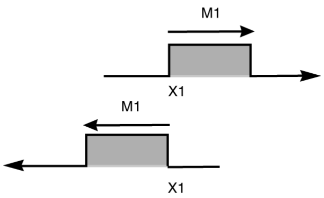
Operation of a CAM which is active in the forward direction

Description	Illustration
The monostable is only set in forward movement.	

Operation of a CAM which is active in the reverse direction

Description	Illustration
The monostable is only set in reverse movement.	

Operation of a CAM which is active in forward and reverse directions

Description	Illustration
The monostable is set or reset in both directions.	

Braking Type

A Braking type CAM is one that changes to 1 when a threshold is crossed and returns to 0 when the same threshold is crossed in the opposite direction.

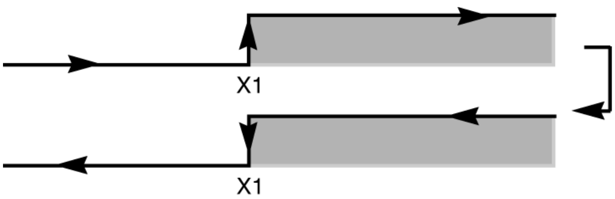
It is characterized by:

- A forward threshold value X1 (value of the angle which sets the brake when the threshold is crossed in the forward direction)
- A reverse threshold value X2 (value of the angle which sets the brake when the threshold is crossed in the reverse direction)
- An activation type: forward/reverse, forward or reverse activation type.

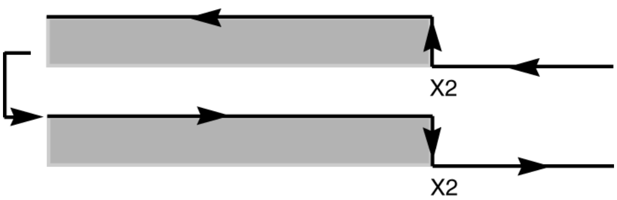
Threshold X1 can be greater than X2 (it is thus possible to set the brake CAM either in the cycle or between 2 cycles).

One type of activation from the 3 suggested: forward, reverse and forward/ reverse, must be selected.

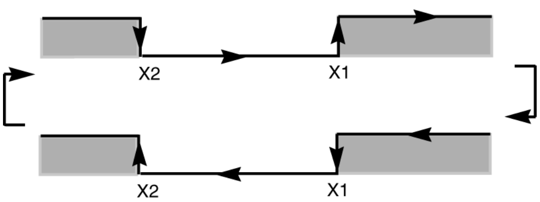
Operation of a CAM which is active in the forward direction

Description	Illustration
The brake is activated when threshold X1 is crossed in the forward direction. The brake is deactivated when threshold X1 is crossed in the reverse direction.	

Operation of a CAM which is active in the reverse direction

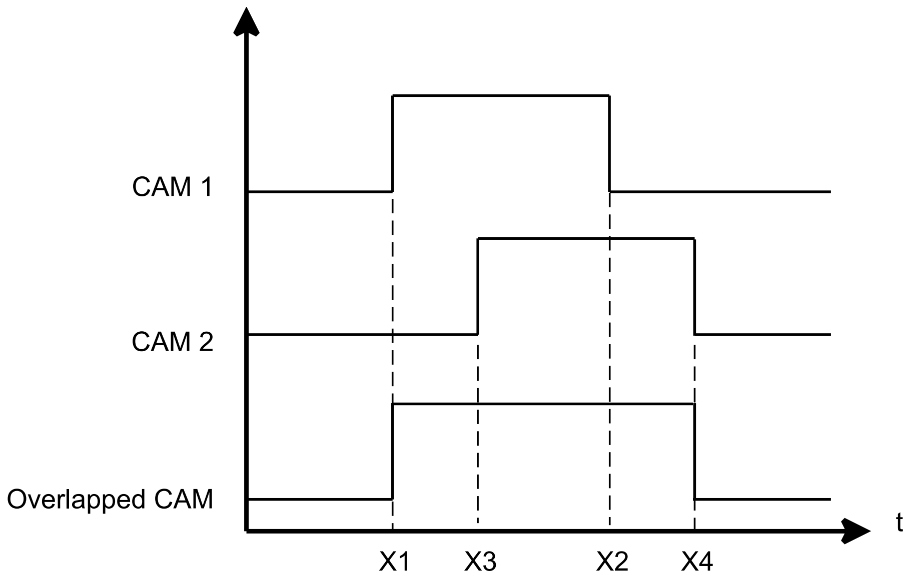
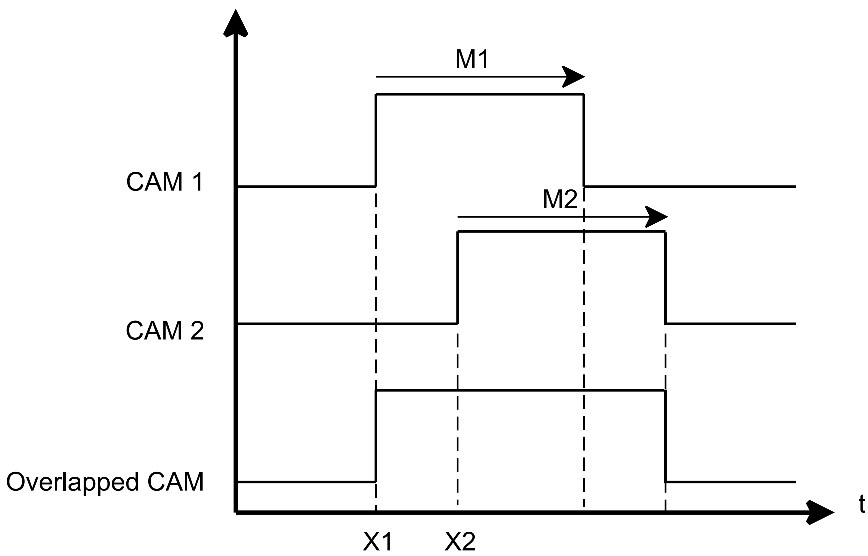
Description	Illustration
The brake is activated when threshold X2 is crossed in the reverse direction. The brake is deactivated when threshold X2 is crossed in the forward direction.	

Operation of a CAM which is active in forward and reverse directions

Description	Illustration
The brake is activated when: • Threshold X1 is crossed in the forward direction. • Threshold X2 is crossed in the reverse direction. The brake is deactivated when these thresholds are crossed in the opposite direction.	

CAM Overlap

Two CAMs can be overlapped inside a track.

Type of CAM	Behavior
Position	If CAM 1 (X1; X2) and CAM 2 (X3; X4) are overlapped inside a track, it results to a single CAM (X1;X4). 
Monostable	If CAM 2 (X2;M2) is crossed with another CAM 1 (X1;M1) which is already active, the CAM stays active during MAX (remaining M1; M2). 
Braking	Not supported.

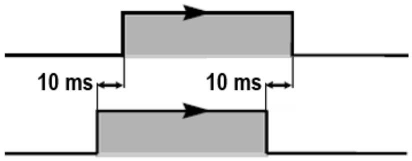
Feedforward

Feedforward is used for fast axes to correct the CAM position. The feedforward factor allows you to anticipate the changes in order to compensate the delay of the axis.

Enter a feedforward factor value from 0 to 32767. The value entered is multiplied by 50 µs.

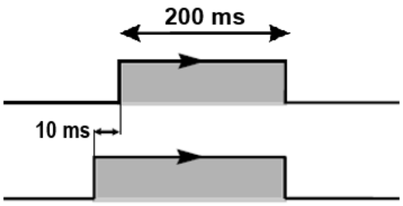
The following diagram illustrates a CAM with the parameters set as:

- Feedforward ON = 10 ms
- Feedfoward OFF = 10 ms
- CAM type = Position



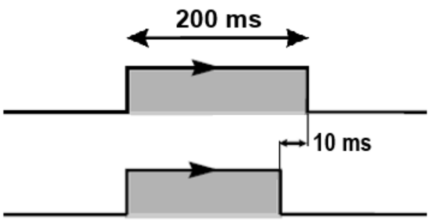
The following diagram illustrates a CAM with the parameters set as:

- M1 = 200 ms
- Feedforward ON = 10 ms
- Feedfoward OFF = 0 ms
- CAM type = Monostable



The following diagram illustrates a CAM with the parameters set as:

- M1 = 200 ms
- Feedforward ON = 0 ms
- Feedfoward OFF = 10 ms
- CAM type = Monostable



CAM Sub-Function Interface

CAM Sub-Function Configuration

Configurable Parameters

The following table presents the configurable parameters for the CAM Sub-Function:

Displayed Name ***Parameter Name***	**Value**	**Data Type**	**Description**
Number Of CAMs *NumberOfCAMs*	**0*...32**	BYTE	Selects the number of CAMs (0...32).
CAM 0 Type *CAM0Type*	0: **Position*** 1: **Monostable** 2: **Braking**	ENUM	Type of CAM 0. Unavailable when the number of CAMs < 1.
CAM 0 Direction *CAM0Direction*	0: **Both*** 1: **Forward** 2: **Reverse**	ENUM	Direction to apply to CAM 0. Unavailable when the number of CAMs < 1.
CAM 0 X1 Position *CAM0X1Position*	**0*...4294967295**	UINT32	Sets the value of CAM 0 X1 (*SingleTurnPos*). Unavailable if: • The number of CAMs < 1 • **CAM 31 Type** is **Braking** and **CAM 0 Direction** is **Reverse**.
CAM 0 X2 Position *CAM0X2Position*	**0...4294967295***	UINT32	Sets the value of CAM 0 X2 (*SingleTurnPos*). Unavailable if: • The number of CAMs < 1. • **CAM 31 Type** is **Braking** and **CAM 0 Direction** is **Forward**.
CAM 0 M1 Time *CAM0M1Time*	**0*...20000**	UINT16	Sets the time of CAM 0 M1. Available when **CAM 0 Type** is **Monostable**. Time compensation value to apply to CAM 0 M1 with a step of 100 µs.
...	...	...	...
CAM 31 Type *CAM31Type*	0: **Position*** 1: **Monostable** 2: **Braking**	ENUM	Type of CAM 31. Unavailable when the number of CAMs < 32.
CAM 31 Direction *CAM31Direction*	0: **Both*** 1: **Forward** 2: **Reverse**	ENUM	Direction to apply to CAM 0. Unavailable when the number of CAMs < 32.
CAM 31 X1 Position *CAM31X1Position*	**0*...4294967295**	UINT32	Sets the value of CAM 31 X1 (*SingleTurnPos*). Unavailable if: • The number of CAMs < 32. • **CAM 31 Type** is **Braking** and **CAM 31 Direction** is **Reverse**.
CAM 31 X2 Position *CAM31X2Position*	**0...4294967295***	UINT32	Sets the value of CAM 31 X2 (*SingleTurnPos*). Unavailable if: • The number of CAMs < 32. • **CAM 31 Type** is **Braking** and **CAM 31 Direction** is **Forward**.

Displayed Name ***Parameter Name***	Value	Data Type	Description
CAM 31 M1 Time *CAM31M1Time*	**0*...20000**	UINT16	Sets the time of the CAM 31 M1. Available when the **CAM 31 Type** is **Monostable**. Time compensation value to apply to CAM 31 M1 with a step of 100 µs.
Track 0 *Track0*	**0*...4294967295**	UINT32	Bit field(1): Each bit represents a CAM which is associated to the track 0 when bit = 1. Bit 0: CAM 0 ... Bit 31: CAM 31
...	...	...	...
Track 15 *Track15*	**0*...4294967295**	UINT32	Bit field(1): Each bit represents a CAM which is associated to the track 0 when bit = 1. Bit 0: CAM 0 ... Bit 31: CAM 31
Output 0 Track *Output0Track*(2)	0: **No track*** 1...16: **Track 0**...**Track 15**	ENUM	Track associated to the output 0.
...	...	...	...
Output 7 Track *Output7Track*(2)	0: **No track*** 1...16: **Track 0**...**Track 15**	ENUM	Track associated to the output 7.
ON Output 0 *ONOutput0*	**0*...32767**	UINT16	ON time of the output 0. Feedforward compensation value to apply to the CAM with a step of 50 µs.
OFF Output 0 *OFFOutput0*	**0*...32767**	UINT16	OFF time of the output 0. Feedforward compensation value to apply to the CAM with a step of 50 µs.
...	...	...	...
ON Output 7 *ONOutput7*	**0*...32767**	UINT16	ON time of the output 7. Feedforward compensation value to apply to the CAM with a step of 50 µs.
OFF Output 7 *OFFOutput7*	**0*...32767**	UINT16	OFF time of the output 7. Feedforward compensation value to apply to the CAM with a step of 50 µs.

* Parameter default value

(1) A build error is detected when a not configured CAM is associated.

(2) The online modification is allowed.

Implicit Parameters

The following table presents the input implicit data for the CAM sub-function:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
OutputValue	0*...255	BYTE R/-	Bit field: Each bit represents the value of the output. Bit 0: Output 0 ... Bit 7: Output 7
TrackStatus	0*...65,535	UINT16 R/-	Bit field: Each bit represents the status of the track. Bit 0: Track 0 ... Bit 15: Track 15
OutputEnabledFlag	FALSE* TRUE	BOOL R/-	When TRUE, the CAM output can be set.
OutputErrorFlag	FALSE* TRUE	BOOL R/-	When TRUE, an error is detected. Disables CAM output.
OutputErrorId	*0**: No Error detected *1*: Internal Field Power Supply *2*: Encoder Power *3*: Encoder Error *4*: Short circuit *5*: Fallback *10*: Quadrature *20*: Frame Format *21*: Frame Parity *22*: Frame Start *23*: Frame Stuck at 1	ENUM R/-	Error detection type. When *OutputErrorFlag* = TRUE, the *OutputErrorId* parameter provides the error detected. **NOTE:** The list of possible values of the *OutputErrorId* depends on the selected expert function.
* Parameter default value			

The following table presents the output implicit data for the CAM sub-function:

Parameter Name	**Value**	**Data type** **R/W**	**Description**
OutputEnable	0*...255	BYTE R/W	Bit field: When TRUE, sets an output value regarding the associated track when the present value is valid. Bit 0: Output 0 ... Bit 7: Output 7
OutputForce	0*...255	BYTE R/W	Bit field: When TRUE, forces the output value regarding *OutputForcedValue*. Bit 0: Output 0 ... Bit 7: Output 7
OutputForcedValue	0*...255	BYTE R/W	Bit field: The value to apply when *OutputForce* is set. Bit 0: Output 0 ... Bit 7: Output 7
* Parameter default value			

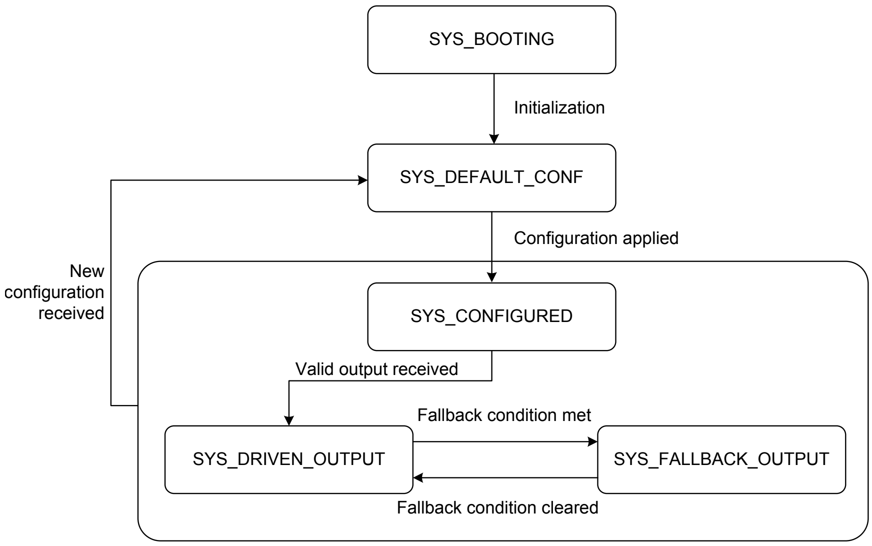
Explicit Parameters

The following table presents the explicit data for the CAM sub-function:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
Output0Track	*0**: No track *1...16*: Track 0...Track 15	ENUM R/W	Track associated to the output 0.
...	...	...	...
Output7Track	*0**: No track *1...16*: Track 0...Track 15	ENUM R/W	Track associated to the output 7.
* Parameter default value			

Operating Mode

IOM Operating Modes



CAM Function Regarding IOM Operating Modes

Module Transition to State	CAM Callback Operations	CAM Resulting State
SYS_BOOTING	-	Not configured
SYS_DEFAULT_CONF	-	Not configured
SYS_CONFIGURED	Configures CAM according to the received configuration	Configured
SYS_DRIVEN_OUTPUT	Operates according to the received data	Driven_Operational
SYS_FALLBACK_OUTPUT	Applies the fallback value to the output	Driven_Fallback

CAM States

CAM State	CAM Data Exchange	CAM Status	CAM Physical Output
Not configured	-	-	0
Configured	Produce data: Input image	*OutputValue* = 0 *TrackStatus* = 0 *OutputEnabledFlag* = FALSE *OutputErrorFlag* = FALSE *OutputErrorId* = NO_ERROR	0
Driven_Operational	Receive data: Output image Produce data: Input image	Refer to Driven_ Operational, page 320.	CAM value
Driven_Fallback	Produce data: Input image	*OutputValue* = 0 *TrackStatus* updated *OutputEnabledFlag* = FALSE *OutputErrorFlag* = TRUE *OutputErrorId* = FALLBACK	0

Driven_Operational

CAM Commands	Condition	CAM Status	Behavior
OutputEnable bit • = TRUE and *OutputForce* bit • = FALSE	No error detected	*OutputValue* bit • is updated *TrackStatus* is updated *OutputEnabledFlag* = TRUE *OutputErrorFlag* = FALSE *OutputErrorId* = NO_ERROR	Selected output is updated regarding the CAM thresholds and the encoder value.
OutputForce bit • = TRUE	No error detected	*OutputValue* bit • = *OutputForceValue* bit • *TrackStatus* is updated *OutputEnabledFlag* = TRUE *OutputErrorFlag* = FALSE *OutputErrorId* = NO_ERROR	Selected output is forced to the corresponding *OutputForcedValue* bit •. **NOTE:** The • value is a value from 0 to 7.
-	Error detected	*OutputValue* bit • = FALSE *TrackStatus* is updated *OutputEnabledFlag* = FALSE *OutputErrorFlag* = TRUE *OutputErrorId* is updated	Disables all outputs as long as the encoder is in the error state. **NOTE:** To acknowledge the error, *OutputEnable* and *OutputForce* must be set to 0.
OutputEnable bit • = FALSE and *OutputForce* bit • = FALSE	No error detected	*OutputValue* bit • = FALSE *TrackStatus* is updated *OutputEnabledFlag* = FALSE *OutputErrorFlag* = FALSE *OutputErrorId* = NO_ERROR	Selected output is at 0.

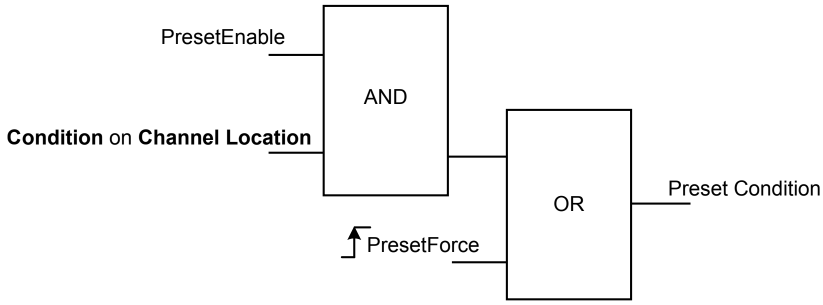
Preset Sub-Function

Overview

The **Preset** sub-function is used to preset the encoder with a reference position value. The sub-function configuration defines the conditions of the preset.

Principle Diagram

The following diagram depicts how the configuration of the sub-function defines the preset condition:



PresetEnable, *PresetForce* are implicit data exchanges.

Condition and **Channel Location** are configured in the sub-function configuration.

The following table describes the behavior of the encoder modes when the preset condition occurs:

Encoder mode	Behavior
Incremental Encoder when the counting mode is in **Free Large**	*PresetFlag* is set to TRUE. *SingleTurnPos* is set to the *PresetSingleTurnPos* value.
Incremental Encoder when the counting mode is in **Modulo Loop**	*PresetFlag* is set to TRUE. *SingleTurnPos* is set to *PresetSingleTurnPos* value. *MultiTurnPos* is set to 0.
SSI Encoder	*PresetFlag* is set to TRUE. *SingleTurnPos* is set to the *PresetSingleTurnPos* value. *MultiTurnPos* is set to the *PresetMultiTurnPos* value.
BiSS-C Encoder	

NOTE: A rising edge of *PresetAck* sets *PresetFlag* to FALSE.

Preset Sub-Function Configuration

Configurable Parameters

The following table presents the configurable parameters for the preset sub-function:

Displayed Name ***Parameter Name***	**Value**	**Data Type**	**Description**
Channel Location *ChannelLocation*	0: **Channel 0** 1: **Channel 1** 255: **Channel Disabled**	ENUM	This parameter is defined by the function to which the sub-function is associated.
Condition *Condition*	0: **None*** 1: **REF Rising** 2: **REF Falling** 3: **REF Both** 4: **Z Rising** 5: **Z Falling** 6: **Z Both** 7: **Z Rising & REF** 8: **First Z Rising & REF** 9: **First Z Rising & !REF**	ENUM	Sets the condition of the physical inputs to trigger a preset event. **NOTE: Z** is only used for incremental mode. The location of the REF input depends on the **Channel Location** value: • **Channel 0**: I0 • **Channel 1**: I2 **NOTE:** Setting the REF input disables register 1 of the capture function. For more information about capture function, refer to Capture Sub-Function, page 323.
REF Filter *Filter*	0: **0** 1: **0.0002** 2: **0.0005** 3: **0.001** 4: **0.002*** 5: **0.005** 6: **0.01** 7: **0.05** 8: **0.08** 9: **0.5** 10: **1** 11: **4** 12: **12**	ENUM	Allows reducing the effect of bounce on the input. Changes to the signal are only detected if the pulse width of the input signal is longer than the filter time (ms).
* Parameter default value			

Implicit Parameters

The following table presents the input implicit data for the preset sub-function:

Parameter Name	**Value**	**Data Ttype** **R/W**	**Description**
PresetFlag	FALSE* TRUE	BOOL R/-	Indicates if the preset condition was set to TRUE. • TRUE on a rising edge of the preset condition. • FALSE on a rising edge of *PresetAck*.
* Parameter default value			

The following table presents the output implicit data for the preset sub-function:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
PresetEnable	FALSE* TRUE	BOOL R/W	When TRUE, the physical inputs defined by the **Condition** parameter can set the preset condition to TRUE. **NOTE:** The selection is grey and inactive if the preset **Condition** is set to **None**.
PresetForce	FALSE* TRUE	BOOL R/W	On a rising edge, the preset condition is TRUE.
PresetAck	FALSE* TRUE	BOOL R/W	A rising edge sets *PresetFlag* to FALSE.
PresetSingleTurnPos	0*...4,294,967,295	UINT32 R/W	Sets the preset position for single-turn bits. Position out of range is ignored.
PresetMultiTurnPos	0*...4,294,967,295	UINT32 R/W	Sets the preset position for multi-turn bits. Position out of range is ignored.
* Parameter default value			

Capture Sub-Function

Overview

The capture sub-function allows you to record the encoder position when the capture condition occurs. The capture condition is defined by the configuration and is performed with the use of a physical input.

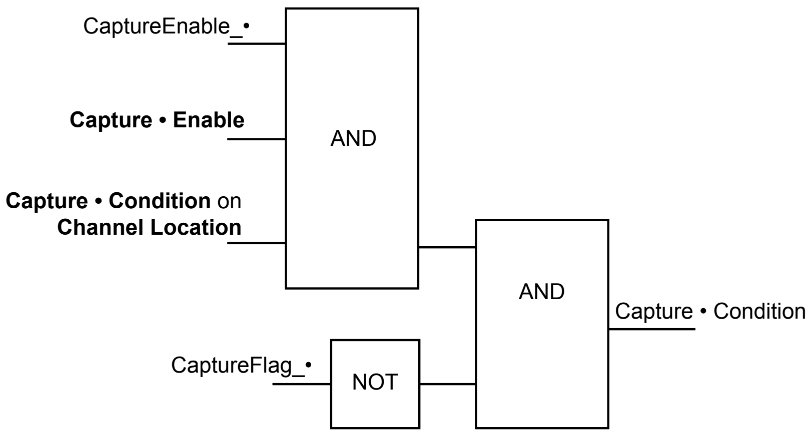
For each encoder channel, there are two capture registers available, each using a different input as described below:

Capture register	**Input used**
Capture 0	• Channel 0: I1 • Channel 1: I3
Capture 1	• Channel 0: I0 • Channel 1: I2

NOTE: The capture 1 register is not available if the **Preset** sub-function uses a **Condition** parameter value set with a REF input condition.

Principle Diagram

The following diagram depicts how the configuration of the sub-function defines the capture condition:



CaptureEnable_• and *CaptureFlag_•* are implicit data exchanges.

Capture • Enable, **Capture • Condition** and **Channel Location** are configured in the sub-function configuration.

The following table describes the behavior of the encoder modes when the capture condition occurs:

Encoder mode	Behavior
Incremental Encoder when the counting mode is in **Free Large**	*CaptureFlag_•* is set to TRUE. *CapturedSingleTurnPos_•* is set to the *SingleTurnPos* value. *CapturedTimestamp_•* is set to the *PosTimestamp* value.
Incremental Encoder when the counting mode is in **Modulo Loop**	*CaptureFlag_•* is set to TRUE. *CapturedSingleTurnPos_•* is set to the *SingleTurnPos* value. *CapturedMultiTurnPos_•* is set to the *MultiTurnPos* value. *CapturedTimestamp_•* is set to the *PosTimestamp* value.
SSI Encoder **BiSS-C Encoder**	*CaptureFlag_•* is set to TRUE. *CapturedSingleTurnPos_•* is set to the *SingleTurnPos* value. *CapturedMultiTurnPos_•* is set to the *MultiTurnPos* value. *CapturedTimestamp_•* is set to the *PosTimestamp* value.

NOTE: Setting *CaptureFlag_•* to FALSE depends on the **Autolock** parameter value:

- When **Autolock** is **FALSE**, *CaptureFlag_•* is set to FALSE at the next I/O Bus cycle.
- When **Autolock** is **TRUE**, *CaptureFlag_•* is set to FALSE on the rising edge of *CaptureAck_•*.

Capture Sub-Function Configuration

Configurable Parameters

The following table presents the configurable parameters for the capture sub-function:

Displayed Name ***Parameter Name***	**Value**	**Data Type**	**Description**
Channel Location *ChannelLocation*	0: **Channel 0** 1: **Channel 1** 255: **Channel Disabled**	ENUM	This parameter is defined by the function to which the sub-function is associated.
Autolock *Autolock*	**FALSE** **TRUE***	BOOL	Defines how *CaptureFlag_•* is set to FALSE.
Capture 0 Enable *Capture0_Enable*	**FALSE*** **TRUE**	BOOL	Enables the capture function on the register 0. Input location: • **Channel 0**: I1 • **Channel 1**: I3
Capture 0 Filter *Capture0_Filter*	0: **0** 1: **0.0002** 2: **0.0005** 3: **0.001** 4: **0.002*** 5: **0.005** 6: **0.01** 7: **0.05** 8: **0.08** 9: **0.5** 10: **1** 11: **4** 12: **12**	ENUM	Allows reducing the effect of bounce on the input. Changes to the signal are only detected if the pulse width of the input signal is longer than the filter time (ms). **NOTE:** The selection is grey and inactive if **Capture 0 Enable** parameter is set to **FALSE**.
Capture 0 Condition *Capture0_Condition*	0: **Rising*** 1: **Falling** 2: **Both**	ENUM	Sets the condition of the physical input to trigger a capture event. **NOTE:** The selection is grey and inactive if **Capture 0 Enable** parameter is set to **FALSE**.
Capture 1 Enable *Capture1_Enable*	**FALSE*** **TRUE**	BOOL	Enables the capture function on the register 1. Input location: • **Channel 0**: I0 • **Channel 1**: I2 **NOTE:** The selection is grey and inactive if **Condition** parameter of the **Preset** sub-function is set to a value using the REF input. For more information about the **Preset** sub-function, refer to Preset Sub-Function, page 321.

Displayed Name ***Parameter Name***	**Value**	**Data Type**	**Description**
Capture 1 Filter *Capture1_Filter*	0: **0** 1: **0.0002** 2: **0.0005** 3: **0.001** 4: **0.002*** 5: **0.005** 6: **0.01** 7: **0.05** 8: **0.08** 9: **0.5** 10: **1** 11: **4** 12: **12**	ENUM	Allows reducing the effect of bounce on the input. Changes to the signal are only detected if the pulse width of the input signal is longer than the filter time (ms). **NOTE:** The selection is grey and inactive if **Capture 1 Enable** parameter is set to **FALSE**.
Capture 1 Condition *Capture1_Condition*	0: **Rising*** 1: **Falling** 2: **Both**	ENUM	Sets the condition of the physical input to trigger a capture event. **NOTE:** The selection is grey and inactive if **Capture 1 Enable** parameter is set to **FALSE**.
* Parameter default value			

Implicit Parameters

The following table presents the input implicit data for the capture sub-function:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
CapturedSingleTurnPos_0	0*...4,294,967,295	UINT32 R/-	*SingleTurnPos* value captured at the capture condition 0 event.
CapturedMultiTurnPos_0	0*...4,294,967,295	UINT32 R/-	*MultiTurnPos* value captured at the capture 0 condition event.
CapturedTimestamp_0	0*...4,294,967,295	UINT32 R/-	*PosTimestamp* value captured at the capture 0 condition event.
CaptureFlag_0	FALSE* TRUE	BOOL R/-	When FALSE, indicates no capture condition event is detected. When TRUE, indicates a capture condition event is detected. **NOTE:** Setting *CaptureFlag_0* to FALSE depends on the **Autolock** parameter value: • When **Autolock** is **FALSE**, *CaptureFlag_0* is set to FALSE at the next I/O Bus cycle. • When **Autolock** is **TRUE**, *CaptureFlag_0* is set to FALSE on the rising edge of *CaptureAck_0*.
CapturedSingleTurnPos_1	0*...4,294,967,295	UINT32 R/-	*SingleTurnPos* value captured at the capture 1 condition event.
CapturedMultiTurnPos_1	0*...4,294,967,295	UINT32 R/-	*MultiTurnPos* value captured at the capture 1 condition event.
CapturedTimestamp_1	0*...4,294,967,295	UINT32 R/-	*PosTimestamp* value captured at the capture 1 condition event.
CaptureFlag_1	FALSE* TRUE	BOOL R/-	When FALSE, indicates no capture event is detected. When TRUE, indicates a capture event is detected. **NOTE:** Setting *CaptureFlag_1* to FALSE depends on the **Autolock** parameter value: • When **Autolock** is **FALSE**, *CaptureFlag_1* is set to FALSE at the next I/O Bus cycle. • When **Autolock** is **TRUE**, *CaptureFlag_1* is set to FALSE on the rising edge of *CaptureAck_1*.
* Parameter default value			

The following table presents the output implicit data for the capture sub-function:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
CaptureEnable_0	FALSE* TRUE	BOOL R/W	When TRUE, the physical inputs can set the capture 0 condition to TRUE.
CaptureAck_0	FALSE* TRUE	BOOL R/W	When **Autolock** is **TRUE**, a rising edge of *CaptureAck_0* sets *CaptureFlag_0* to FALSE.
CaptureEnable_1	FALSE* TRUE	BOOL R/W	When TRUE, the physical inputs can set the capture 1 condition to TRUE.
CaptureAck_1	FALSE* TRUE	BOOL R/W	When **Autolock** is **TRUE**, a rising edge of *CaptureAck_1* sets *CaptureFlag_1* to FALSE.
* Parameter default value			

Reflex Output and Compare Sub-Function

Overview

The **Incremental Encoder**, **SSI Encoder** and **BiSS-C Encoder** functions of the NTSEHE0221 module can manage up to 4 reflex outputs that can be triggered during the operation of the module.

Reflex outputs can be used when the compare function of the module is enabled. To enable the compare function, the **Number of Thresholds** parameter value must be different than 0.

There are four configurable thresholds available that can define up to five counting zones.

Up to four reflex outputs can be enabled with the **Enable** parameter.

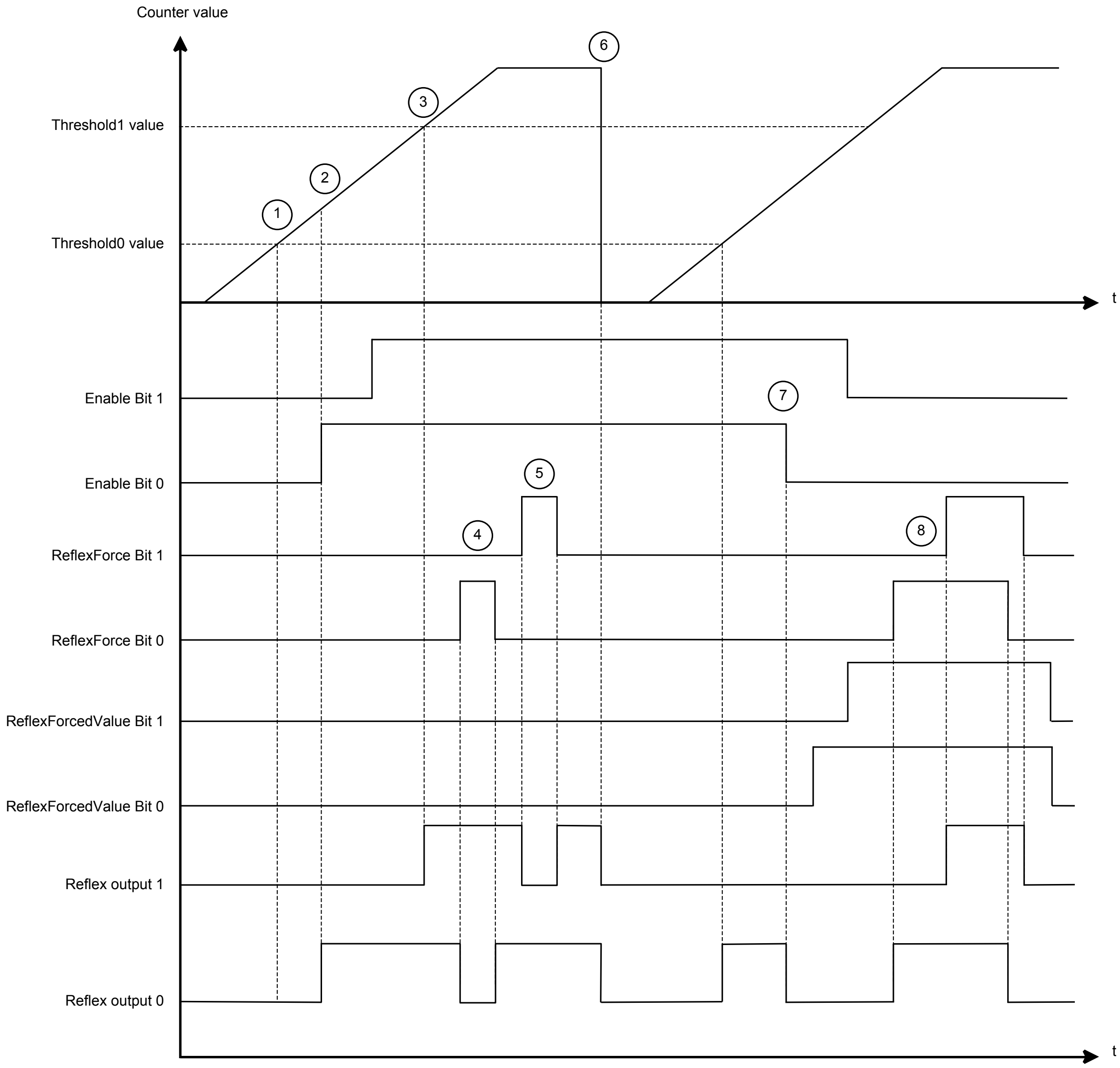
When enabled, there are two ways to operate your reflex outputs:

- With the compare function, by defining a trigger condition for your reflex outputs with the **Reflex 0 Value**...**Reflex 3 Value** parameters.
- With the *ReflexForce* and *ReflexForcedValue* commands.

When using the compare function, the outputs are independent of the I/O bus cycle and have an update rate depending on the comparison trigger but less than 1 µs.

Principle Diagram

The following diagram and table depict an example of the behavior of 2 reflex outputs used with an **Incremental Encoder** function:



In this example:

- 2 reflex outputs are configured:
  - Reflex output 0 with a **Reflex 0 Value** of 6 (bit 1, bit 2 are TRUE).
  - Reflex output 1 with a **Reflex 1 Value** of 4 (bit 2 is TRUE).
- 2 threshold values are configured: **Threshold 0 Value** and **Threshold 1 Value**.

Stage	Action
1	When *ReflexEnable* bit 0 is FALSE, the compare function for the reflex output 0 is disabled, *ReflexValue* bit 0 is FALSE even if the counter value is above **Threshold 0 Value**.
2	When *ReflexEnable* bit 0 is TRUE, the compare function for the reflex output 0 is enabled, *ReflexValue* bit 0 is TRUE when the counter value is above **Threshold 0 Value**.
3	When *ReflexEnable* bit 1 is TRUE, the compare function for the reflex output 1 is enabled, *ReflexValue* bit 0 and bit 1 are TRUE when the counter value is above **Threshold 1 Value**.
4	When *ReflexForce* bit 0 is TRUE and *ReflexForcedValue* bit 0 is FALSE, *ReflexValue* bit 0 is set to FALSE even if the counter value is above **Threshold 0 Value**.

Stage	Action
5	When *ReflexForce* bit 1 is TRUE and *ReflexForcedValue* bit 1 is FALSE, *ReflexValue* bit 1 is set to FALSE even if the counter value is above **Threshold 0 Value**.
6	A preset is performed, the counting value is below **Threshold 0 Value**, *ReflexValue* bit 0 and bit 1 are set to FALSE.
7	When *ReflexEnable* bit 0 is FALSE, the compare function for the reflex output 0 is disabled, *ReflexValue* bit 0 is FALSE even if the counter value is above **Threshold 0 Value**.
8	When *ReflexForce* bit 0 is TRUE, *ReflexValue* bit 0 is set to the *ReflexForcedValue* bit 0 value even if *ReflexEnable* bit 0 is FALSE. When *ReflexForce* bit 1 is TRUE, *ReflexValue* bit 1 is set to the *ReflexForcedValue* bit 1 value even if *ReflexEnable* bit 1 is FALSE.

Reflex Output and Compare Sub-Function Configuration

Configurable Parameters

The following table presents the configurable parameters for the reflex output and compare sub-function:

Displayed Name *Parameter Name*	Value	Data Type	Description
Channel Location *ChannelLocation*	0: **Channel 0** 1: **Channel 1** 255: **Channel Disabled**	ENUM	This parameter is defined by the function to which the sub-function is associated.
Number Of Thresholds *NumberOfThresholds*	0: **0*** 1: **1** 2: **2** 3: **3** 4: **4**	ENUM	Selects the number of thresholds (0..4). When **0**, no threshold is configured and reflex outputs are disabled.
Threshold 0 Value(2) *Threshold0Value*(1)(2)	**0...4294967295***	UINT32	Sets the value of the threshold 0.
Threshold 1 Value(2) *Threshold1Value*(1)(2)	**0...4294967295***	UINT32	Sets the value of the threshold 1.
Threshold 2 Value(2) *Threshold2Value*(1)(2)	**0...4294967295***	UINT32	Sets the value of the threshold 2.
Threshold 3 Value(2) *Threshold3Value*(1)(2)	**0...4294967295***	UINT32	Sets the value of the threshold 3.
Enable *Enable*	**0*...15**	BYTE	Enables the output used for the reflex output (Bit field). Set the bit to TRUE to enable the reflex output: • Bit 0: Reflex 0 • Bit 1: Reflex 1 • Bit 2: Reflex 2 • Bit 3: Reflex 3 The reflex output location depends on the configured channel: • **Channel 0**: ◦ Reflex 0: Q0 ◦ Reflex 1: Q1 ◦ Reflex 2: Q2 ◦ Reflex 3: Q3 • **Channel 1**: ◦ Reflex 0: Q4 ◦ Reflex 1: Q5 ◦ Reflex 2: Q6 ◦ Reflex 3: Q7

Displayed Name ***Parameter Name***	**Value**	**Data Type**	**Description**
Reflex 0 Value *Reflex0Value*(1)	**0*...31**	BYTE	Defines the counting zones when you want the reflex output to trigger (Bit field). Set the bit to TRUE for the reflex output to trigger when the counter value is between: • Bit 0: Minimum value and **Threshold 0 Value** - 1 • Bit 1: **Threshold 0 Value** and **Threshold 1 Value** - 1 • Bit 2: **Threshold 1 Value** and **Threshold 2 Value** - 1 • Bit 3: **Threshold 2 Value** and **Threshold 3 Value** - 1 • Bit 4: **Threshold 3 Value** and the maximum value
Reflex 1 Value *Reflex1Value*(1)	**0*...31**	BYTE	
Reflex 2 Value *Reflex2Value*(1)	**0*...31**	BYTE	
Reflex 3 Value *Reflex3Value*(1)	**0*...31**	BYTE	
* Parameter default value (1) Online modification is allowed. (2) Threshold 0 < Threshold 1 < Threshold 2< Threshold 3 and threshold values cannot exceed the measurement range of each counting function.			

Implicit Parameters

The following table presents the input implicit data for the reflex output and compare sub-function:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
ReflexValue	0*...15	BYTE R/-	Provides the physical value of the reflex output (Bit field). When the bit is TRUE, the physical output Q• is TRUE: • Bit 0: Reflex output 0 • Bit 1: Reflex output 1 • Bit 2: Reflex output 2 • Bit 3: Reflex output 3
ReflexEnabledFlag	FALSE* TRUE	BOOL R/-	Set to TRUE when *ReflexEnable* is above zero.
ReflexErrorFlag	FALSE* TRUE	BOOL R/-	Set to TRUE when an error is detected. When TRUE, the reflex outputs are set to FALSE. To set to FALSE, *ReflexEnable* and *ReflexForce* must be set to FALSE.
ReflexErrorId	*0**: No Error detected *1*: Internal Field Power Supply *2*: Encoder Power *3*: Encoder Error *4*: Short circuit *5*: Fallback *10*: Quadrature *20*: Frame Format *21*: Frame Parity *22*: Frame Start *23*: Frame Stuck at 1	ENUM R/-	Error detection type. When *ReflexErrorFlag* = TRUE, the *ReflexErrorId* parameter provides the error detected. **NOTE:** The list of possible values of the *ReflexErrorId* depends on the selected expert function.
* Parameter default value			

The following table presents the output implicit data for the reflex output and compare sub-function:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
ReflexEnable	0*...15	BYTE R/W	Each bit enables the compare function to operate the *ReflexValue* bit 0...3.
ReflexForce	0*...15	BYTE R/W	Each bit forces the *ReflexValue* bit 0...3 to the *ReflexForcedValue* bit 0...3 value.
ReflexForcedValue	0*...15	BYTE R/W	Value to apply to *ReflexValue* 0...3 when *ReflexValue* 0...3 is forced by *ReflexForce* 0...3.
SuspendCompare	FALSE* TRUE	BOOL R/W	When TRUE, the compare function is suspended and the *ReflexValue* 0...3 are maintained at their present values. **NOTE:** *ReflexValue* 0...3 can be forced with *ReflexForce* 0...3 even if *SuspendCompare* is TRUE.
* Parameter default value			

Explicit Parameters

The following table presents the explicit data for the reflex output and compare sub-function:

Parameter Name	**Value**	**Data Type** **R/W**	**Description**
Threshold0Value(1)	0...4,294,967,295*	UINT32 R/W	Sets the value of the threshold 0.
Threshold1Value(1)	0...4,294,967,295*	UINT32 R/W	Sets the value of the threshold 1.
Threshold2Value(1)	0...4,294,967,295*	UINT32 R/W	Sets the value of the threshold 2.
Threshold3Value(1)	0...4,294,967,295*	UINT32 R/W	Sets the value of the threshold 3.
Reflex0Value	0*...31	BYTE R/W	Defines the counting zones when you want the reflex output to trigger (Bit field). Set the bit to TRUE for the reflex output to trigger when the counter value is between: • Bit 0: Minimum value and **Threshold 0 Value**-1 • Bit 1: **Threshold 0 Value** and **Threshold 1 Value** - 1 • Bit 2: **Threshold 1 Value** and **Threshold 2 Value** - 1 • Bit 3: **Threshold 2 Value** and **Threshold 3 Value** - 1 • Bit 4: **Threshold 3 Value** and the maximum value
Reflex1Value	0*...31	BYTE R/W	
Reflex2Value	0*...31	BYTE R/W	
Reflex3Value	0*...31	BYTE R/W	
* Parameter default value (1) Threshold 0 < Threshold 1 < Threshold 2< Threshold 3 and threshold values cannot exceed the measurement range of each counting function.			

NOTE: Values updated through explicit exchanges are updated at the next I/O bus cycle.

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