

MiCOM Px3x

Protocol Implementation Extra
Information for Testing (PIXIT)
of the IEC 61850
Communication Interface with
Control

PIXIT with Control

This document does not replace the Technical Manual

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 **Electric**

CONTENT

1	Protocol Implementation Extra Information for Testing	4
1.1	Introduction	4
1.2	Document structure	4
2	Application Association Model	4
2.1	Association parameters	4
2.2	Aborting associations	4
2.3	Maximum Client associations	4
2.4	TCP Keep alive	4
2.5	Authentication	5
2.6	MMS PDU Size	5
2.7	Startup time	5
3	Server Model	5
3.1	Data quality (Measurements and Status Points)	5
3.2	Get / Set data values services	5
3.3	Measurement deadbands	5
4	Data Set Model	6
4.1	Data set structure and content	6
4.2	User definable data sets	6
5	Substitution Model	6
5.1	Measurement and status point substitution	6
6	Setting Group Control Model	6
6.1	Protection configuration	6
6.2	Active data attribute values	6
7	Reporting Model	7
7.1	Supported Report Control Block types	7
7.2	Trigger conditions	7
7.3	Optional fields	7
7.4	Segmented reports	7
7.5	Multi-client support	7
7.6	Data set assignment	7
8	Logging Model	7
8.1	Event logging	7
9	Generic Substation Events Model	8
9.1	Supported GSE models	8
9.2	GOOSE Service support	8
9.3	Subscription to publishing IEDs	8
9.4	Publication	10
10	Transmission of Sampled Values Model	10
10.1	Modes of operation	10
11	Control Model	11

11.1	Modes of operation	11
12	Time and Time Synchronisation	12
12.1	Time quality	12
12.2	Time accuracy	12
12.3	External synchronisation	12
12.4	SNTP server operation	12
13	File Transfer Model	12
13.1	File transfer mode	12
13.2	Directory and file structure	12
13.3	Directory separator	13
13.4	Maximum filename length	13
13.5	Filename case sensitivity	13
13.6	Maximum file size	13
13.7	Supported services	14
14	Sub-station Configuration Language	14
14.1	Conformance level	14
14.2	Private data	14
14.3	IED Name	14
15	IED Configurator	14
15.1	Configuration banks	14

1 Protocol Implementation Extra Information for Testing

1.1 Introduction

This document specifies the protocol implementation extra information for testing (PIXIT) of the IEC 61850 interface in the MiCOM P139, P132 and P439 relays. Together with the PICS and MICS specifications the PIXIT forms the basis for conformance testing in accordance with part 10 of the IEC 61850 standard specifications.

1.2 Document structure

Each section within this specification specifies the PIXIT for each supported ACSI service model as structured in parts 7-2 and 10 of the IEC 61850 standard specifications.

2 Application Association Model

2.1 Association parameters

The following parameters are required to be specified when attempting to initiate an association with MiCOM Px30 relays:

Parameter	Value
Transport selector (<i>tseI</i>)	1
Session selector (<i>sseI</i>)	1
Presentation selector (<i>pseI</i>)	1

The following parameters are only required for OSI based connections only and are not supported:

- AP Title
- AE Qualifier

2.2 Aborting associations

When a client aborts its association the TCP/IP socket is not immediately closed down by the relay. This is a standard operating principle to ensure no more frames are received on the sockets that are delayed or out-of-order.

The time-out period for aborted sockets is approximately sixty (**60**) seconds. For the duration of this time-out period the socket resources are unavailable for new client association requests.

A total of 100 sockets are available but it should be noted that these resources are shared with other network tasks (for example SNTP time synchronisation). If no sockets are available the relay will refuse new association requests from a client.

2.3 Maximum Client associations

The maximum number of simultaneously connected clients supported is sixteen (**16**).

2.4 TCP Keep alive

The TCP_KEEPALIVE function has been implemented according to part 8 of the IEC 61850 standards and the RFCs which the specification references. Acknowledgements received by the relay to keep-alive messages are not processed.

The interval between the keep-alive messages is configurable between one (1) and twenty (20) seconds, with a setting increment of one (1) second.

The default interval for TCP_KEEPALIVE messages transmitted by the relay is five (5) seconds.

2.5 Authentication

Authentication is not supported by MiCOM Px30 relays.

The default access level over the IEC 61850 interface is level 2 although actual setting changes are not supported.

2.6 MMS PDU Size

The maximum supported MMS PDU size is **8000 bytes**, while the minimum supported MMS PDU size is **400 bytes**.

For MMS file transfer the minimum PDU size is **6000 bytes**.

2.7 Startup time

The typical start-up time of basic Ethernet services, following an interruption to the power supply, is approximately 25 seconds.

Full IEC 61850 services are available after an approximate start-up time of 30 seconds.

3 Server Model

3.1 Data quality (Measurements and Status Points)

The MiCOM Px30 range of products support the IEC 61850 quality information only for measurements which can have the quality good or invalid (not available). For signals and events all quality data attributes return a fixed value of zero (0) indicating the quality of data is good.

3.2 Get / Set data values services

The maximum number of data values supported in one *GetDataValues* and *SetDataValues* service request is dependant upon the following elements:

The maximum negotiated size of the MMS PDU

The total length of all *ObjectReferences* to be included within the service request

That is to say, the total length of all *ObjectReferences* must be less than the maximum supported MMS PDU size, taking into accounts any relevant header information.

3.3 Measurement deadbands

MiCOM Px30 relays do not range-limit measurements, as such deadbands become impossible to specify in terms of a *percentage change* based on measurement limits.

For this reason, deadbands are configured based on an absolute value change with the following ranges:

Deadband setting	Comment	Impact
0	Deadbanding disabled	Deadbanded measurements follow the instantaneous measurement value.
1 – 100,000	Absolute value changes of 0.001 to 100.0 respectively. Based on the formula: (Deadband setting / 1000)	Deadbanded measurement will be updated when the instantaneous (absolute) value changes by more than the absolute deadband value.

The main limitation of this implementation is that the maximum deadband value (100,000) may still produce data changes if the change is large enough.

4 Data Set Model

4.1 Data set structure and content

There are no fixed data set definitions within MiCOM Px30 devices.

Data sets are definable using the IED Configurator application. They can exist in any Logical Node of the MiCOM Px30 data model and may contain any Data Object(s) or Data Attribute(s) in the devices data model belonging to the following Functional Constraints:

- ST – Status Information
- MX – Measurands (analogue values)
- CF – Configuration
- SV – Substitution
- EX – Extended definition

4.2 User definable data sets

MiCOM Px30 devices do not support the dynamic creation of any type of user-defined data set, either persistent or non-persistent.

5 Substitution Model

5.1 Measurement and status point substitution

The substitution model for measurements (MX functional constraint) and status points (ST functional constraint) is not supported in MiCOM Px30 relays.

6 Setting Group Control Model

6.1 Protection configuration

MiCOM Px30 devices do not support on-line setting changes of protection elements over the IEC 61850 interface despite supporting multiple setting groups.

Only basic measurements and status point (read-only) information is provided.

Configuration of MiCOM Px30 devices is achieved through the use of the tools provided in the MiCOM S1 configuration software package.

A Setting Group Control Block (SGCB) is provided in the System/LLN0 Logical Node instance and provides services for changing the active setting group only.

6.2 Active data attribute values

The data attribute values returned over the IEC 61850 interface to requesting clients are always taken from the active setting group of the relay.

7 Reporting Model

7.1 Supported Report Control Block types

MiCOM Px30 devices support both buffered (BRCB) and unbuffered (URCB) Report Control Block services.

7.2 Trigger conditions

The following report trigger conditions are supported:

- Integrity
- Data change
- Quality change
- General Interrogation

All other trigger conditions are not supported and an attempt to enable them will result in a negative response being returned by the relay.

7.3 Optional fields

The following optional fields can be included in reports generated by MiCOM Px30 devices:

- Sequence number
- Time-stamp
- Reason for inclusion
- Data set name
- Data reference
- Configuration revision

7.4 Segmented reports

Reports will be segmented, and sent with sub-sequence numbers, if the data is too big to fit into a single MMS frame.

7.5 Multi-client support

MiCOM Px30 devices support a total of sixteen (16) unbuffered Report Control Blocks and eight (8) buffered Report Control Blocks.

Each Report Control Block can only be assigned to a single client.

7.6 Data set assignment

Before a Report Control Block can be used by a client, a data set must be created and assigned to it. This can only be done during configuration time (e.g. from SCL) and is not a supported action of an online/connected client.

8 Logging Model

8.1 Event logging

MiCOM Px30 devices do not support IEC 61850 logging services, hence there are no Log Control Blocks (LCB) exposed within the data model.

The existing relay event log is used to store historical data. This is only available over the front panel user interface or legacy rear port protocols.

9 Generic Substation Events Model

9.1 Supported GSE models

MiCOM Px30 relays support IEC 61850 GOOSE and GSSE, formerly UCA2 GOOSE.

9.2 GOOSE Service support

The following GOOSE services are supported by Px30 devices:

SendGOOSEMessage

GetGoReference

GetGoCBValues

The *SetGoCBValues* service is not supported, although it is possible for connected clients to change the GoEna attribute online.

9.3 Subscription to publishing IEDs

9.3.1 Message validation

The following elements of a GOOSE message header are checked in order to determine the messages validity prior to processing its data within the relays GOOSE scheme:

Destination MAC address, which is expected to match the publishing devices GoCB as set during device configuration (from SCL).

AppID, which is expected to be a valid value as taken from the publishing devices GoCB during device configuration (from SCL).

Frame Ethertype, which is filtered by the CLNP layer.

Time Allowed to Live, which is expected to be a value greater than zero (0). Value 0 is converted to 60 seconds.

DatSet, which is expected to be a valid reference as taken from the publishing devices GoCB during device configuration (from SCL) and not a NULL value.

GoID, which is expected to be a valid reference as taken from the publishing devices GoCB during device configuration (from SCL) and not a NULL value.

numDatSetEntries, but only after an initial message from the publishing device has been received and the device has been enrolled. At this point each subsequent message must contain the same number of data set elements as the first received message.

The following elements of the GOOSE message header are not checked:

- Source MAC address
- VLAN id and priority
- GoCBRef
- ConfRev
- t
- stNum
- sqNum
- test

9.3.2 Data processing

The data received in a GOOSE message is only processed when a change in status number (stNum), taken from the GOOSE message header, is detected.

The data is transferred onto Boolean virtual inputs and BSTR2 device virtual inputs, which are transferred to the application by function assignment in the 103 setting when the data subscription parameters are met.

MiCOM Px30 relays support thirty-two (32) virtual input signals and thirty-two (32) device input signals each with their own GOOSE data set, GOOSE ID, data object index and data attribute index.

Basic data-type attributes and complex data objects, such as the SPS Common Data Class, can be decoded from the incoming GOOSE data set elements. The following data types can be handled from the application:

- Boolean (input 1..16)
- Bit-string 2 (input 17..32)
- SPS – Common Data Class
- DPS – Common Data Class

9.3.3 Duplicated, out-of-order and missed messages

No checks are made for duplicated or out-of-order GOOSE messages. They are validated in accordance with the rules given in section 9.3.1 and the data is transferred onto the virtual inputs as per section 9.3.2. GOOSE messages received with non-contiguous state / sequence numbers will be processed as normal. No alarm or warning conditions are reported for any of these conditions.

9.3.4 Time Allowed to Live (TAL)

If a GOOSE message from one of the subscribed publishers is not received within the TAL taken from the last valid GOOSE message from that publisher a *GOOSE IED Absent* alarm will be raised. This alarm will self-reset as soon as a valid message from the *absent* publisher is received.

It should be noted that this single alarm provides a Logical OR of all publishing IEDs that the MiCOM Px30 relay has subscribed to. This alarm therefore remains set while there are one (1) or more publishers absent. It is not possible from this alarm condition to identify which publishing device has exceeded its TAL and has been classed as absent.

Together with the *GOOSE IED Absent* alarm the corresponding virtual input is reset to the default value defined by setting. This value should always be the safe value for the input, which is preventing the device from maloperation.

9.3.5 Needs commissioning and Test flags

If a GOOSE message is received and the *NdsCom* and/or *test* flags are set the message will be accepted as valid [The TAL will be updated thus ensuring the device is classed as fully subscribed within the relays GOOSE scheme], however the message data will not be extracted and processed within the relays GOOSE scheme logic.

9.3.6 Absent publishing devices

If a GOOSE message isn't received from a publishing device that the relay has subscribed to, or a message is received that is syntactically incorrect, a *GOOSE IED Absent* alarm condition will be raised.

There is also a separate signal indicating the publisher state for each virtual input. This, in combination with the *GOOSE IED Absent* alarm, allows for GOOSE scheme problems to be easily diagnosed and dealt with automatically within scheme logic.

The alarm condition will be reset when valid messages from all publishing devices that are subscribed in the relays GOOSE scheme are received.

9.3.7 Data set reconfiguration

If the relay has subscribed to a device that changes its published data set, it will attempt to extract and decode the data as normal. If successful the data will be processed as described in section 9.3.2 however it should be noted that it will be a different data set element that is now driving the virtual input signal.

No alarm or warning conditions are reported for this situation.

9.4 Publication

9.4.1 Pre-configured attributes

The following pre-configured attributes of the GOOSE Control Block (GoCB) can not be changed, either during device configuration (from SCL) or online by a connected client:

- NdsCom [Needs commissioning]

The following data objects of the GoCB are configurable from SCL but can not be changed online by a connected client:

- DataSet [Data set to transmit]
- DstAddress [Destination Address]

9.4.2 Commissioning

The data set assigned to the GOOSE Control Block is user-configurable and must be created/assigned to the GoCB at system configuration time.

When a GoCB is assigned a data set, the *NdsCom* attribute is fixed to FALSE. At all other times the *NdsCom* attribute is fixed to TRUE.

9.4.3 Transient data attributes

MiCOM Px30 relays will publish both state-transitions (Off->On, On->Off) of transient or pulsed data attribute values (e.g. a trip).

10 Transmission of Sampled Values Model

10.1 Modes of operation

MiCOM Px30 relays do not support transmission of sampled value services using any modes of operation (multicast or unicast). As such there are no Multicast Sample Value Control Blocks (MSVCB) or Unicast Sample Value Control Blocks (USVCB) exposed within the data model.

11 Control Model

11.1 Modes of operation

The following control modes are supported:

- **Status only**
Depends on configuration of the bay, this mode is supported only for switchgears, which are not controllable and have only status of the position.
- **Direct with normal security**
This mode is supported in Logical device System (SPCSO1,..., SPCSO26) , it is Single point control. There is no Status value supported for this mode. C001,..., C026 have to be configured in Function group CMD_1 on P132/P139/P439. Check condition are not supported, DUT ignores it.
- **SBO with normal security** is not supported
- **Direct control with enhanced security** is supported for controlling of switchgears (CSWI1,...,CSWI10,XCBR1,XSWI1,...,XSWI10). It is Double point control with status, the Logical nodes are Online depending on configuration of the bay. There is a setting parameter for the selection of the control mode for the switch gears in Function group IEC on P132/P139/P439 (Does, Sboes). Only one command can be executed at the same time!
- **SBO with enhanced security** is supported for controlling of switchgears (CSWI1,...,CSWI10,XCBR1,XSWI1,...,XSWI10). It is Double point control with status, the Logical nodes are Online depending on configuration of the bay. There is a setting parameter for the selection of the control mode for the switchgears in Function group IEC on P132/P139/P439 (Does, Sboes). Only one object can be selected at the same time !

Time activated operate (operTm) is not supported.

The Test Attribute in SBOw and Oper is not supported. If this attribute is set, DUT ignores it.

The Time (T) attribute in the SelectWithValue and/or Operate request is used only for "Command termination" Reports, otherwise DUT ignores the time value and execute the command as usual.

Pulse configuration is not supported.

"**Operate-many**" is not supported.

Check conditions: Check Interlocking is supported (SBOes, Does).
Synchrocheck is not supported.

The following **service error types** are supported: OBJECT ACCESS DENIED
OBJECT TEMPORARY UNAVAILABLE
OBJECT NON EXISTENT

The following **additional cause diagnosis** are supported:

POSITION-REACHED
BLOCKED-BY-INTERLOCKING
COMMAND-ALREADY-IN- EXECUTION
TIME-LIMIT-OVER
OBJECT NOT SELECTED

Values 0 - 8 in **orCat** are supported. Another Values in SBOes and Does are rejected. There is no other check for orCat!

12 Time and Time Synchronisation

12.1 Time quality

For historical data logged by MiCOM Px30 relays the quality bits Clock synchronized/not synchronized and Time accuracy are supported for all time stamps.

12.2 Time accuracy

The time accuracy of MiCOM Px30 relays is to ten (**10**) significant bits of the *FractionOfSecond* attribute. This equates to approximately one (1) millisecond, meeting the requirements of performance class T1 as defined in part 5 of the IEC 61850 standards.

12.3 External synchronisation

MiCOM Px30 relays can be configured with two (2) external time synchronisation servers, of which only 1 is ever the active time synchronisation source.

If an external source fails to respond to a client synchronisation request, or responds with an invalid/unsupported message, the relay will automatically switch to the unused source, if configured.

When no configured external time source is available the relay will alternately send requests to all configured sources every five (5) seconds. This occurs until a valid response is received.

The status of SNTP time synchronisation is reflected in the time quality flags of each time stamp.

12.4 SNTP server operation

MiCOM Px30 relays are not intended to be used as an external time synchronisation source.

13 File Transfer Model

13.1 File transfer mode

MiCOM Px30 relays use MMS file transfer services for the transfer of disturbance records. The File Transfer Protocol (FTP), as defined by the Internet Engineering Task Force (IETF), is not supported.

13.2 Directory and file structure

The following directory structure is presented by MiCOM Px30 relays:

- Device Root/
 - COMTRADE/
 - dr/
 - dr_unextracted/
 - drbin/
 - LD/
 - {IEDNAME}Control/
 - {IEDNAME}Measurements/
 - {IEDNAME}Protection/
 - {IEDNAME}Records/
 - {IEDNAME}System/

With the exception of the following, all directories will be empty:

dr/
dr_unextracted/

These folders contain all disturbance records held in non-volatile memory, in an ASCII COMTRADE format (*.cfg and *.dat)

COMTRADE/
drbin/

These folders contain all disturbance records held in non-volatile memory, in an BINARY COMTRADE format (*.cfg and *.dat)

dr_bin/
dr_unextracted/

This folder contains disturbance records that have not been downloaded from the relay by a client. A record is classed as downloaded (or extracted) when the *.dat file has been transferred.

Once extracted, disturbance records are removed from this directory.

13.3 Directory separator

MiCOM Px30 relays use a file system based on the UNIX directory separator character '/'. Also the use of MS-DOS directory separator characters ('\') is accepted.

13.4 Maximum filename length

Disturbance record filenames are based around the following fixed format giving a maximum filename length of twenty eight (29) characters:

yyyymmdd_HHMMSS_xxx_rNNNN.*

Where: yyyy = The year, e.g. 2006
mm = The month, e.g. 03 (for March)
dd = The day of month, e.g. 15th
HH = Hours in 24hr format, e.g. 12
MM = Minutes, e.g. 59
SS = Seconds, e.g. 59
xxx = Milli-seconds, e.g. 999
r = A literal 'r' character
NNNN = Disturbance record number, e.g. 0001..9999
* = The file type, either cfg or dat

Taking into account the directory structure presented in section 13.2, this gives a maximum, fully qualified, filename length of forty four (44) characters.

13.5 Filename case sensitivity

Directory and filenames are both case sensitive.

13.6 Maximum file size

The maximum file size is not restricted over the MMS file transfer interface, however it is dependant upon the configuration of the disturbance recorder.

The longer the recording time, the larger the comtrade file will be. The maximum recording time for MiCOM Px30 relays is 15.0 seconds, which equates to an approximate file size of **1.7MB**.

13.7 Supported services

The MMS FileDelete service is not supported by the device

14 Sub-station Configuration Language

14.1 Conformance level

MiCOM Px30 relays are conformant to **SCL.1** as defined by part 8 of the IEC 61850 standards; annex D. ICD template files are available within the MiCOM S1 IED Configurator application.

14.2 Private data

MiCOM Px30 ICD files contain private SCL data. This is required by the IED Configurator tool in order to correctly extract, process and configure a relay.

Any tool that imports Px30 ICD files is required to preserve the private data in accordance with part 6 of the IEC 61850 standards.

14.3 IED Name

The Sub-station Configuration Language (SCL) allows customisable IED names. MiCOM Px30 relays support user-definable IED names however these are restricted to a maximum of **eight** (8) characters in length.

15 IED Configurator

15.1 Configuration banks

MiCOM Px30 relays support two (2) configuration banks for holding IED configurations taken from SCD or CID Substation Configuration Language (SCL) files. This includes IP configuration, SNTP, GOOSE publishing/subscription parameters etc.

The IED Configurator tool only allows a configuration to be downloaded to the inactive bank. This bank can then be made active through the use of a Courier command cell at any time.

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