# PACiS SPP T104

Gateway and C264

SPP/EN T104/D10

PACiS V5

Slave Protocol Profile
T104

Issue A1

Schneider Electric

# CONTENTS

# 1. SCOPE OF THE DOCUMENT

This document is a chapter of PACiS Gateway and MiCOM C264 documentation binders. It describes in parallel the communication T104 protocol implemented on PACiS Gateway-PC and MiCOM C264.

This document deals with communication with an upper level SCADA system.

# 2. IEC 60870-5-104 PROFILE - INTEROPERABILITY

According to “60870-5-104, Clause 9: Interoperability”, ***the interoperability list is defined as in IEC 60870-5-101 and extended with parameters used in this standard***.

**Paragraphs in grey are those which are not applicable for the IEC 60870-5-104 profile.** The text descriptions of such parameters which are not applicable to this companion standard are strike-through.

This companion standard presents sets of parameters and alternatives from which subsets have to be selected to implement particular telecontrol systems. Certain parameter values, such as the choice of “structured” or “unstructured” fields of the INFORMATION OBJECT ADDRESS of ASDU represent mutually exclusive alternatives. This means that only one value of the defined parameters is admitted per system. Other parameters, such as the listed set of different process information in command and in monitor direction allow the specification of the complete set or subsets, as appropriate for given applications. This clause summarises the parameters of the previous clauses to facilitate a suitable selection for a specific application. If a system is composed of equipment stemming from different manufacturers it is necessary that all partners agree on the selected parameters.

The selected parameters should be filled up (**N** => **S**).

To simplify the profile Interoperability document, we use the following conventions:

| | |
|---|---|
| **N** | Not supported |
| **S** | Supported |
| **C** | This is configurable |
| | Black shaded boxes stand for “not supported by T104” |
| | ~~text description of parameter not applicable to this companion standard~~ |

NOTE: In addition, the full specification of a system may require individual selection of certain parameters for certain parts of the system, such as the individual selection of scaling factors for individually addressable measured values.

## 2.1 System or device

| | |
|---|---|
| **N** | System definition |
| **N** | Controlling station definition (Master) |
| **S** | Controlled station definition (Slave) |

## 2.2 Network configuration (Network-specific parameter)

| | | | |
|---|---|---|---|
| | ~~Point-to-point~~ | | ~~Multipoint party line~~ |
| | ~~Multiple point-to-point~~ | | ~~Multipoint star~~ |

## 2.3 Physical layer (Network-specific parameter)

**~~Transmission speed (control direction):~~**

| Unbalanced interchange circuit V.24/V.28 Standard | | Unbalanced interchange circuit V.24/V.28 Recommended if >1 200 bit/s | | Balanced interchange circuit X.24/X.27, V35 | |
|---|---|---|---|---|---|
| | ~~100 bit/s~~ | | ~~2 400 bit/s~~ | | ~~2 400 bit/s~~ |
| | ~~200 bit/s~~ | | ~~4 800 bit/s~~ | | ~~4 800 bit/s~~ |
| | ~~300 bit/s~~ | | ~~9 600 bit/s~~ | | ~~9 600 bit/s~~ |
| | ~~600 bit/s~~ | | ~~19 200 bit/s~~ | | ~~19 200 bit/s~~ |
| | ~~1 200 bit/s~~ | | | | ~~38 400 bit/s~~ |
| | | | | | ~~56 000 bit/s~~ |
| | | | | | ~~64 000 bit/s~~ |

**~~Transmission speed (monitor direction):~~**

| Unbalanced interchange circuit V.24/V.28 Standard | | Unbalanced interchange circuit V.24/V.28 Recommended if >1 200 bit/s | | Balanced interchange circuit X.24/X.27, V35 | |
|---|---|---|---|---|---|
| | ~~100 bit/s~~ | | ~~2 400 bit/s~~ | | ~~2 400 bit/s~~ |
| | ~~200 bit/s~~ | | ~~4 800 bit/s~~ | | ~~4 800 bit/s~~ |
| | ~~300 bit/s~~ | | ~~9 600 bit/s~~ | | ~~9 600 bit/s~~ |
| | ~~600 bit/s~~ | | ~~19 200 bit/s~~ | | ~~19 200 bit/s~~ |
| | ~~1 200 bit/s~~ | | | | ~~38 400 bit/s~~ |
| | | | | | ~~56 000 bit/s~~ |
| | | | | | ~~64 000 bit/s~~ |

### 2.3.1 Link layer (Network-specific parameter)

(Network-specific parameter, all options that are used should be filled up (**N => S**).Specify the maximum frame length. If a non-standard assignment of class 2 messages is implemented for unbalanced transmission, indicate the type ID and COT of all messages assigned to class 2.)

Frame format FT 1.2, single character 1 and the fixed time out interval are used exclusively in this companion standard.

### 2.3.2 Link transmission procedure

| | |
|---|---|
| | ~~Balanced transmission~~ |
| | ~~Unbalanced transmission~~ |

2.3.3 Address field of the link

| | |
|---|---|
| | ~~Not present (balanced transmission only)~~ |
| | ~~One octet~~ |
| | ~~Two octets~~ |
| | ~~Structured~~ |
| | ~~Unstructured~~ |

2.3.4 Frame length

Maximum length L (number of bytes)

| | |
|---|---|
| | ~~Maximum length L (number of bytes)~~ |

When using an unbalanced link layer, the following ASDU types are returned in class 2 messages (low priority) with the indicated causes of transmission:

~~The standard assignment of ASDUs to class 2 messages is used as follows:~~

| ~~Type Identification~~ | ~~Cause of transmission~~ |
|---|---|
| ~~9,11,13,21~~ | ~~<1>~~ |

~~A special assignment of ASDUs to class 2 messages is used as follows:~~

| ~~Type Identification~~ | ~~Cause of transmission~~ |
|---|---|
| ~~1,3,5~~ | ~~<20> TO <41>~~ |

~~NOTE: In response to a class 2 poll, a controlled station prevent the controlling station with ACD parameter, when there is no class 2 data available.~~

## 2.4 Protocol Requirements

### 2.4.1 Event

The following types of information are to be configured at the controlled station to be Event:

| C264 | GTW | |
|---|---|---|
| **S** | **S** | Single point information with or without time tag (on change) |
| **S** | **S** | Double point information with or without time tag (on change) |
| **S** | **S** | Step position information with or without time tag (on change) |
| **S** | **S** | Measured value, normalised with or without time tag (on change) |
| **S** | **S** | Measured value, scaled with or without time tag (on change) |
| **S** | **S** | Measured value, floated with or without time tag (on change) |
| **S** | **S** | Integrated totals with or without time tag (on change) |

### 2.4.2 Static

The following types of information are to be configured at the controlled station to be Static:

| C264 | GTW | |
|---|---|---|
| **S** | **S** | Single point information (GI scan, or BackGroundScan cycle) |
| **S** | **S** | Double point information (GI scan, or BackGroundScan cycle) |
| **S** | **S** | Measured values, normalised (GI scan, or Periodic cycle, or BackGroundScan cycle) |
| **S** | **S** | Measured values, scaled (GI scan, or Periodic cycle, or BackGroundScan cycle) |
| **S** | **S** | Measured values, floated (GI scan, or Periodic cycle, or BackGroundScan cycle) |
| **S** | **S** | Step position values (GI scan, or BackGroundScan cycle) |
| **S** | **S** | Integrated totals (Counter GI scan) |

## 2.5 Application layer

2.5.1 Transmission mode for application data

Mode 1 (Least significant octet first), as defined in clause 4.10 of IEC 870-5-4, is used exclusively in this companion standard.

2.5.2 Common address of ASDU

(System-specific parameter)

The address field of the link and the common address of ASDU could have a different number of bytes

| C264 | GTW | |
|---|---|---|
| | | ~~One octet~~ |
| **S** | **S** | Two octets |

2.5.3 Information object address

2.5.4 (System-specific parameter)

| C264 | GTW | |
|---|---|---|
| | | ~~One octet~~ |
| | | ~~Two octets~~ |
| **S** | **S** | Three octets |
| **S** | **S** | Structured |
| **S** | **S** | Unstructured |

2.5.5 Cause of transmission

(System-specific parameter)

| C264 | GTW | |
|---|---|---|
| | | ~~One octet~~ |
| **S** | **S** | Two octets (with originator address) |

2.5.6 Length of APDU

(System-specific parameter)

The maximum length of APDU is 253 (fixed)

| C264 | GTW | |
|---|---|---|
| **≤ 253** | **≤ 253** | Maximum length of ASDU per system in control direction. |
| **≤ 253** | **≤ 253** | Maximum length of ASDU per system in monitor direction. |

2.5.7 Selection of standard ASDUs

2.5.7.1 Process information in monitor direction

(Station-specific parameter)

| C264 | GTW | | | |
|---|---|---|---|---|
| **S** | **S** | <1>: = | Single-point information | M-SP-NA-1 |
| | | ~~<2>: =~~ | ~~Single-point information with time tag~~ | ~~M-SP-TA-1~~ |
| **S** | **S** | <3>: = | Double-point information | M-DP-NA-1 |
| | | ~~<4>: =~~ | ~~Double-point information with time tag~~ | ~~M-DP-TA-1~~ |
| **S** | **S** | <5>: = | Step position information | M-ST-NA-1 |
| | | ~~<6>: =~~ | ~~Step position information with time tag~~ | ~~M-ST-TA-1~~ |
| **N** | **N** | <7>: = | Bit-string of 32 bit | M-BO-NA-1 |
| | | ~~<8>: =~~ | ~~Bit-string of 32 bit with time tag~~ | ~~M-BO-TA-1~~ |
| **S** | **S** | <9>: = | Measured value, normalised value | M-ME-NA-1 |
| | | ~~<10>: =~~ | ~~Measured value, normalised value with time tag~~ | ~~M-ME-TA-1~~ |
| **S** | **S** | <11>: = | Measured value, scaled value | M-ME-NB-1 |
| | | ~~<12>: =~~ | ~~Measured value, scaled value with time tag~~ | ~~M-ME-TB-1~~ |
| **S** | **S** | <13>: = | Measured value, short floating point value | M-ME-NC-1 |
| | | ~~<14>: =~~ | ~~Measured value, short floating point value with time tag~~ | ~~M-ME-TC-1~~ |
| **S** | **S** | <15>: = | Integrated totals | M-IT-NA-1 |
| | | ~~<16>: =~~ | ~~Integrated totals with time tag~~ | ~~M-IT-TA-1~~ |
| | | ~~<17>: =~~ | ~~Event of protection equipment with time tag~~ | ~~M-EP-TA-1~~ |
| | | ~~<18>: =~~ | ~~Packed starts events of protection equipment with time tag~~ | ~~M-EP-TB-1~~ |
| | | ~~<19>: =~~ | ~~Packed output circuit information of protection equipment with time tag~~ | ~~M-EP-TC-1~~ |
| **N** | **N** | <20>: = | Packed single-point information with status change detection | M-PS-NA-1 |
| **N** | **N** | <21>: = | Measured value, normalised value without quality descriptor | M-ME-ND-1 |

2.5.7.2 Process information in monitor direction with the Extension of time tag

(Station-specific parameter)

| C264 | GTW | | | |
|---|---|---|---|---|
| **S** | **S** | <30>: = | Single-point information with time tag CP56Time2a | M-SP-TB-1 |
| **S** | **S** | <31>: = | Double-point information with time tag CP56Time2a | M-DP-TB-1 |
| **S** | **S** | <32>: = | Step position information with time tag CP56Time2a | M-ST-TB-1 |
| **N** | **N** | <33>: = | Bit-string of 32 bit with time tag CP56Time2a | M-BO-TB-1 |
| **S** | **S** | <34>: = | Measured value, normalised value with time tag CP56Time2a | M-ME-TD-1 |
| **S** | **S** | <35>: = | Measured value, scaled value with time tag CP56Time2a | M-ME-TE-1 |
| **S** | **S** | <36>: = | Measured value, short floating point value, time tag CP56Time2a | M-ME-TF-1 |
| **S** | **S** | <37>: = | Integrated totals with time tag CP56Time2a | M-IT-TB-1 |
| **N** | **N** | <38>: = | Event of protection equipment with time tag CP56Time2a | M-EP-TD-1 |
| **N** | **S** | <39>: = | Packed start event of protection equipment, time tag CP56Time2a | M-EP-TE-1 |
| **N** | **S** | <40>: = | Packed output circuit information of protection equipment with time tag CP56Time2a | M-EP-TF-1 |

2.5.7.3 Process information in control direction

(Station-specific parameter)

| C264 | GTW | | | |
|---|---|---|---|---|
| **S** | **S** | <45>: = | Single command | C-SC-NA-1 |
| **S** | **S** | <46>: = | Double command | C-DC-NA-1 |
| **S** | **S** | <47>: = | Regulating step command | C-RC-NA-1 |
| **S** | **S** | <48>: = | Set point command normalised value | C-SE-NA-1 |
| **S** | **S** | <49>: = | Set point command scaled value | C-SE-NB-1 |
| **S** | **S** | <50>: = | Set point command, short floating point value | C-SE-NC-1 |
| **N** | **N** | <51>: = | Bit-string of 32 bit | C-BO-NA-1 |
| **S** | **S** | <58>: = | Single command with time tag CP56Time2a | C_SC_TA_1 |
| **S** | **S** | <59>: = | Double command with time tag CP56Time2a | C_DC_TA_1 |
| **S** | **S** | <60>: = | Regulating step command with time tag CP56Time2a | C_RC_TA_1 |
| **S** | **S** | <61>: = | Set point command normalized value with time tag CP56Time2a | C_SE_TA_1 |
| **S** | **S** | <62>: = | Set point command scaled value with time tag CP56Time2a | C_SE_TB_1 |
| **S** | **S** | <63>: = | Set point command short floating point value with time tag CP56Time2a | C_SE_TC_1 |
| **N** | **N** | <64>: = | Bitstring of 32 bits with time tag CP56Time2a | C_BO_TA_1 |

**NOTE**: Time tag command (ASDU 58 to 63) are managed as standard command (ASDU 45 to 50), i.e. the time tag is not used.

2.5.7.4 System information in monitor direction

(Station-specific parameter)

| C264 | GTW | | | |
|---|---|---|---|---|
| **S** | **S** | <70>: = | End of initialisation | M-EI-NA-1 |

2.5.7.5 System information in control direction

(Station-specific parameter)

| C264 | GTW | | | |
|---|---|---|---|---|
| **S** | **S** | <100>: = | Interrogation commands | C-IC-NA-1 |
| **S** | **S** | <101>: = | Counter interrogation command | C-CI-NA-1 |
| **N** | **S** | <102>: = | Read command | C-RD-NA-1 |
| **S** | **S*** | <103>: = | Clock synchronisation command | C-CS-NA-1 |
| | | ~~<104>: =~~ | ~~Test command~~ | ~~C-TS-NA-1~~ |
| **N** | **S**** | <105>: = | Reset process command | C-RP-NA-1 |
| | | ~~<106>: =~~ | ~~Delay acquisition command~~ | ~~C-CD-NA-1~~ |
| **S** | **S** | <107>: = | Test command with time tag CP56time2a | C-TS-TA-1 |

* Received but not managed. See T101 interoperability.

**Note applicable for Gateway PC:

Following Reset Process, the controlled station has two possible behaviours (according to configurable parameter in the Windows Registry database):

- only the controlling station restart (soft restart )
- the PC restarts (hard restart )

2.5.7.6 Parameter in control direction

(Station-specific parameter)

| C264 | GTW | | | |
|---|---|---|---|---|
| **N** | **N** | <110>: = | Parameter of measured value, normalised value | P-ME-NA-1 |
| **N** | **N** | <111>: = | Parameter of measured value, scaled value | P-ME-NB-1 |
| **N** | **N** | <112>: = | Parameter of measured value, short floating point value | P-ME-NC-1 |
| **N** | **N** | <113>: = | Parameter activation | P-AC-NA-1 |

2.5.7.7 File transfer

(Station-specific parameter)

| C264 | GTW | | | |
|---|---|---|---|---|
| **S*** | N | <120>: = | File ready | F-FR-NA-1 |
| **S*** | N | <121>: = | Section ready | F-SR-NA-1 |
| **S*** | N | <122>: = | Call directory, select file, call file, call section | F-SC-NA-1 |
| **S*** | N | <123>: = | Last section, last segment | F-LS-NA-1 |
| **S*** | N | <124>: = | Ack file, ack section | F-AF-NA-1 |
| **S*** | N | <125>: = | Segment | F-SG-NA-1 |
| **S*** | N | <126>: = | Directory | F-DR-TA-1 |

(*) Transfer is only implemented on standalone MiCOM C264 (non PACIS C264 multi-rack) and from Slave to SCADA.

2.5.7.8 Special use

(Private range)

| C264 | GTW | | | |
|---|---|---|---|---|
| N | N | <136>: = | Data base version | M-DB-NA-1 |
| **S** | N | <137>: = | Regulating delay command | C-RC-NB-1 |
| **S** | N | <138>: = | Regulating delay command with time tag CP56Time2a | C-RC-NB-1 |

2.5.7.9 Type identifier and cause of transmission assignments

(Station-specific parameters)

| | |
|---|---|
| **X** | Mark type identification/cause of transmission combinations: ‘X’ if used by GTW and C264 |
| **C** | Used only by C264 |
| **G** | Used only by GTW |
| | Shaded boxes are not required |
| | Black shaded boxes for Type ID not supported by T104 |
| | Blank = function or ASDU is not used |

| Type ID | | Cause of transmission | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 20 to 36 | 37 to 41 | 44 | 45 * | 46 | 47 |
| <1> | M_SP_NA_1 | | X | X | | G | | | | | | X | X | | X | | | | | |
| ~~<2>~~ | ~~M_SP_TA_1~~ | | | | | | | | | | | | | | | | | | | |
| <3> | M_DP_NA_1 | | X | X | | G | | | | | | X | X | | X | | | | | |
| ~~<4>~~ | ~~M_DP_TA_1~~ | | | | | | | | | | | | | | | | | | | |
| <5> | M_ST_NA_1 | | X | X | | G | | | | | | X | X | | X | | | | | |
| ~~<6>~~ | ~~M_ST_TA_1~~ | | | | | | | | | | | | | | | | | | | |
| <7> | M_BO_NA_1 | | | | | G | | | | | | | | | | | | | | |
| ~~<8>~~ | ~~M_BO_TA_1~~ | | | | | | | | | | | | | | | | | | | |
| <9> | M_ME_NA_1 | X | X | X | | G | | | | | | | | | X | | | | | |
| ~~<10>~~ | ~~M_ME_TA_1~~ | | | | | | | | | | | | | | | | | | | |
| <11> | M_ME_NB_1 | X | X | X | | G | | | | | | | | | X | | | | | |
| ~~<12>~~ | ~~M_ME_TB_1~~ | | | | | | | | | | | | | | | | | | | |
| <13> | M_ME_NC_1 | X | X | X | | G | | | | | | | | | C | | | | | |
| ~~<14>~~ | ~~M_ME_TC_1~~ | | | | | | | | | | | | | | | | | | | |
| <15> | M_IT_NA_1 | | | X | | | | | | | | | | | | X | | | | |
| ~~<16>~~ | ~~M_IT_TA_1~~ | | | | | | | | | | | | | | | | | | | |
| ~~<17>~~ | ~~M_EP_TA_1~~ | | | | | | | | | | | | | | | | | | | |
| ~~<18>~~ | ~~M_EP_TB_1~~ | | | | | | | | | | | | | | | | | | | |
| ~~<19>~~ | ~~M_EP_TC_1~~ | | | | | | | | | | | | | | | | | | | |
| <20> | M_PS_NA_1 | | | | | | | | | | | | | | | | | | | |
| <21> | M_ME_ND_1 | | | | | | | | | | | | | | | | | | | |
| <30> | M_SP_TB_1 | | | X | | | | | | | | X | X | | | | | | | |
| <31> | M_DP_TB_1 | | | X | | | | | | | | X | X | | | | | | | |
| <32> | M_ST_TB_1 | | | X | | | | | | | | X | X | | | | | | | |
| <33> | M_BO_TB_1 | | | | | | | | | | | | | | | | | | | |
| <34> | M_ME_TD_1 | | | X | | | | | | | | | | | | | | | | |
| <35> | M_ME_TE_1 | | | X | | | | | | | | | | | | | | | | |
| <36> | M_ME_TF_1 | | | X | | | | | | | | | | | | | | | | |
| <37> | M_IT_TB_1 | | | X | | | | | | | | | | | | | | | | |
| <38> | M_EP_TD_1 | | | | | | | | | | | | | | | | | | | |
| <39> | M_EP_TE_1 | | | | | | | | | | | | | | | | | | | |
| <40> | M_EP_TF_1 | | | | | | | | | | | | | | | | | | | |
| <45> | C_SC_NA_1 | | | | | | X | X | X | X | X | | | | | | X | X | X | X |
| <46> | C_DC_NA_1 | | | | | | X | X | X | X | X | | | | | | X | X | X | X |
| <47> | C_RC_NA_1 | | | | | | X | X | X | X | X | | | | | | C | X | X | X |
| <48> | C_SE_NA_1 | | | | | | X | X | X | X | X | | | | | | | X | X | X |
| <49> | C_SE_NB_1 | | | | | | X | X | X | X | X | | | | | | | X | X | X |

| Type ID | | Cause of transmission | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 20 to 36 | 37 to 41 | 44 | 45 * | 46 | 47 |
| <50> | C_SE_NC_1 | | | | | | X | X | X | X | X | | | | | | | X | X | X |
| <51> | C_BO_NA_1 | | | | | | | | | | | | | | | | | | | |
| <58> | C_SC_TA_1 | | | | | | X | X | X | X | X | | | | | | | X | X | X |
| <59> | C_DC_TA_1 | | | | | | X | X | X | X | X | | | | | | | X | X | X |
| <60> | C_RC_TA_1 | | | | | | X | X | X | X | X | | | | | | | X | X | X |
| <61> | C_SE_TA_1 | | | | | | X | X | X | X | X | | | | | | | X | X | X |
| <62> | C_SE_TB_1 | | | | | | X | X | X | X | X | | | | | | | X | X | X |
| <63> | C_SE_TC_1 | | | | | | X | X | X | X | X | | | | | | | X | X | X |
| <64> | C_BO_TA_1 | | | | | | | | | | | | | | | | | | | |
| <70> | M_EI_NA_1 | | | | X | | | | | | | | | | | | | | | |
| <100> | C_IC_NA_1 | | | | | | X | X | C | X | X | | | | | | X | X | X | C |
| <101> | C_CI_NA_1 | | | | | | X | X | | | X | | | | | | | X | X | C |
| <102> | C_RD_NA_1 | | | | | G | | | | | | | | | | | | C | C | C |
| <103> | C_CS_NA_1 | | | | | | C | C | | | | | | | | | | C | C | C |
| ~~<104>~~ | ~~C_TS_NA_1~~ | | | | | | | | | | | | | | | | | | | |
| <105> | C_RP_NA_1 | | | | | | G | G | | | | | | | | | | G | G | |
| ~~<106>~~ | ~~C_CD_NA_1~~ | | | | | | | | | | | | | | | | | | | |
| <107> | C_TS_TA_1 | | | | | | X | X | | | | | | | | | X | X | G | |
| <110> | P_ME_NA_1 | | | | | | | | | | | | | | | | | | | |
| <111> | P_ME_NB_1 | | | | | | | | | | | | | | | | | | | |
| <112> | P_ME_NC_1 | | | | | | | | | | | | | | | | | | | |
| <113> | P_AC_NA_1 | | | | | | | | | | | | | | | | | | | |
| <120> | F_FR_NA_1 | | | | | | | | | | | | | X | | | | C | | |
| <121> | F_SR_NA_1 | | | | | | | | | | | | | X | | | | C | | |
| <122> | F_SC_NA_1 | | | | | X* | | | | | | | | X | | | | X | | |
| <123> | F_LS_NA_1 | | | | | | | | | | | | | X | | | | C | | |
| <124> | F_AF_NA_1 | | | | | | | | | | | | | X | | | | C | | |
| <125> | F_SG_NA_1 | | | | | | | | | | | | | X | | | | C | | |
| <126> | F_DR_TA_1 | | | X | | X | | | | | | | | | | | | | | |
| <136> | M_DB_NA_1 | | | | | | | | | | | | | | | | | | | |
| <137> | C_RC_NB_1 | | | | | | C | C | C | C | C | | | | | | | C | C | C |
| <138> | C_RC_TB_1 | | | | | | C | C | C | C | C | | | | | | | C | C | C |

***** *COT <44>:= Unknown Type Identification*
*COT <45>:= Unknown Cause of Transmission*
*COT <46>:= Unknown Common Address of ASDU*
*COT <47>:= Unknown Information Object Address*

NOTE: For ASDU 122 COT 5 is used only for Call Directory and COT 13 is used for all except Call Directory

## 2.6 Basic application functions

2.6.1 Station initialisation

(Station-specific parameter)

| C264 | GTW | |
|---|---|---|
| N | S | Remote initialisation |

(Using Reset User ASDU)

2.6.2 Cyclic data transmission

(Station-specific parameter)

| C264 | GTW | |
|---|---|---|
| S | S | Cyclic data transmission |

(It's the same cyclic for all data).

2.6.3 Read procedure

(Station-specific parameter)

| C264 | GTW | |
|---|---|---|
| N | S | Read procedure |

2.6.4 Spontaneous transmission

(Station-specific parameter)

| C264 | GTW | |
|---|---|---|
| S | S | Spontaneous transmission |

The default for all status changes are reported with COT=3 (spontaneous).

For all status changes following a control (feedback of control), COT = 12 (LOCAL COMMAND) except if the control has been sent by this protocol (OrIdent = name_of_link) COT=11 (REMOTE_COMMAND)

2.6.5 Double transmission of information objects with cause of transmission spontaneous

(station-specific parameter), each information is marked where both a Type ID without time and corresponding Type ID with time are issued in response to a single spontaneous change of a monitored object

The following type identifications may be transmitted in succession caused by a single status change of an information object. The particular information object addresses for which double transmission is enabled are defined in a project-specific list.

| C264 | GTW | | |
|---|---|---|---|
| N | N | Single point information | M_SP_NA_1, M_SP_TA_1, M_SP_TB_1 and M_PS_NA_1 |
| N | N | Double point information | M_DP_NA_1, M_DP_TA_1 and M_DP_TB_1 |
| N | N | Step position information | M_ST_NA_1, M_ST_TA_1 and M_ST_TB_1 |
| N | N | Bitstring of 32 bit | M_BO_NA_1, M_BO_TA_1 and M_BO_TB_1 (if defined for a specific project) |
| N | N | Measured value, normalized value | M_ME_NA_1, M_ME_TA_1, M_ME_ND_1 and M_ME_TD_1 |
| N | N | Measured value, scaled value | M_ME_NB_1, M_ME_TB_1 and M_ME_TE_1 |
| N | N | Measured value, short floating point number | M_ME_NC_1, M_ME_TC_1 and M_ME_TF_1 |

2.6.6 General interrogation

(System or station-specific parameter)

| C264 | GTW | | C264 | GTW | | C264 | GTW | |
|---|---|---|---|---|---|---|---|---|
| S | S | Global | | | | | | |
| S | S | Group 1 | S | S | Group 7 | S | S | Group 13 |
| S | S | Group 2 | S | S | Group 8 | S | S | Group 14 |
| S | S | Group 3 | S | S | Group 9 | S | S | Group 15 |
| S | S | Group 4 | S | S | Group 10 | S | S | Group 16 |
| S | S | Group 5 | S | S | Group 11 | | | |
| S | S | Group 6 | S | S | Group 12 | | | |

Information Object Addresses assigned to each group must be shown in a separate table

2.6.7 Counter General interrogation

(System or station-specific parameter)

| C264 | GTW | | C264 | GTW | |
|---|---|---|---|---|---|
| S | S | Global | | | |
| S | S | Group 1 | S | S | Group 3 |
| S | S | Group 2 | S | S | Group 4 |

2.6.8 Clock synchronisation

(Station-specific parameter)

| C264 | GTW | |
|---|---|---|
| **S** | **N** | Clock synchronisation |
| **N** | **N** | Day of week used |
| **N** | **N** | RES1, GEN (Time tag substituted/notsubstituted) used |
| **S** | **S** | SU-bit (summertime) used |

2.6.9 Command transmission

(Object-specific parameter)

| C264 | GTW | | C264 | GTW | |
|---|---|---|---|---|---|
| **S** | **S** | Direct command transmission | **S** | **S** | Select and execute command |
| **S** | **S** | Direct set point command transmission | **S** | **S** | Select and execute set point command |
| | | | **S** | **S** | C-SE ACTTERM used |

| C264 | GTW | |
|---|---|---|
| **S** | **S** | No additional definition |
| **S*** | **S*** | Short pulse duration (**) |
| **S*** | **S*** | Long pulse duration (**) |
| **S*** | **S*** | Persistent output (***) |

** Supported by link level but is not transmitted to application level.*
*(**) Pulse duration shall be defined in configuratio of the outstation..*
*(***) Type pulse or persistent is defined in the configuration of the outstation.*

2.6.10 Transmission of integrated totals

(Station or object-specific parameter)

| C264 | GTW | |
|---|---|---|
| **S** | **S** | Mode A: local freeze with spontaneous. |
| **N** | **S** | Mode B: local freeze with counter. |
| **S** | **S** | Mode C: freeze and transmit by counter interrogation. |
| **N** | **N** | Mode D: freeze by counter interrogation command, frozen values reported. |

| C264 | GTW | | C264 | GTW | |
|---|---|---|---|---|---|
| **S** | **S** | Counter read | **S** | **S** | General request counter |
| **S** | **S** | Counter freeze without reset | **S** | **S** | Request counter group 1 |
| **S** | **S** | Counter freeze with reset | **S** | **S** | Request counter group 2 |
| **S** | **S** | Counter reset | **S** | **S** | Request counter group 3 |
| | | | **S** | **S** | Request counter group 4 |

2.6.11 Parameter loading

(Object-specific parameter)

| C264 | GTW | |
|---|---|---|
| **N** | **N** | Threshold value |
| **N** | **N** | Smoothing factor |
| **N** | **N** | Low limit for transmission of measured value |
| **N** | **N** | High limit for transmission of measured value |

2.6.12 Parameter activation

(Object-specific parameter)

| C264 | GTW | |
|---|---|---|
| **N** | **N** | Act/Deactivation of persistent cyclic or periodic transmission of the addressed object |

2.6.13 Test procedure

(Station-specific parameter)

| C264 | GTW | |
|---|---|---|
| **S** | **S** | Test procedure |

2.6.14 File transfer

(Station-specific parameter)

File transfer in monitor direction

| C264 | GTW | |
|---|---|---|
| **S** | **S** | Transparent file (only for disturbance file) |
| **N** | **N** | Transmission of disturbance data of protection equipment |
| **S** | **S** | Transmission of sequences of events |
| **N** | **N** | Transmission of sequences of recorded analog values |

File transfer in control direction

| C264 | GTW | |
|---|---|---|
| **N** | **N** | Transparent file |

2.6.15 Background scan

(Station-specific parameter)

| C264 | GTW | |
|---|---|---|
| **S** | **S** | Background scan |

2.6.16 Acquisition of transmission delay

(Station-specific parameter)

| C264 | GTW | |
|---|---|---|
| | | ~~Acquisition of transmission delay~~ |

2.6.17 Management events priorities

(Station-specific parameter)

| C264 | GTW | |
|---|---|---|
| **N** | **N** | Digital Inputs, Step-position, Analogs Inputs and Integrated Totals, management events priorities. |

2.6.18 Definition of time outs

| Parameter | Default value | Remarks | Selected value |
|---|---|---|---|
| $t_0$ | 30s | Time out of connection establishment | configurable |
| $t_1$ | 15s | Time out of send or test APDUs | configurable |
| $t_2$ | 10s | Time out for acknowledges in case of no data messages $t_2 < t_1$ | configurable |
| $t_3$ | 20s | Time out for sending test frames in case of a long idle state | configurable |

Maximum range of values for **all** time outs: 1 to 255 s, accuracy 1 s

2.6.19 Maximum number of outstanding I format APDUs k and latest acknowledge

| Parameter | Default value | Remarks | Selected value |
|---|---|---|---|
| k | 12 APDUs | Maximum difference receive sequence number to send state variable | configurable |
| w | 8 APDUs | Latest acknowledge after receiving w I-format APDUs | configurable |

Maximum range of values k: 1 to 255 APDUs (NOT 1 to 32767), accuracy 1 APDU

Maximum range of values w: 1 to 255 APDUs (NOT 1 to 32767), accuracy 1 APDU (Recommendation: w should not exceed 2/3 of k).

2.6.20 Portnumber

| Parameter | Value | Remarks |
|---|---|---|
| Port number | 2404 | In all cases, but configurable in Registry for PACIS Gateway only. |

2.6.21 RFC 2200 suite

RFC 2200 is an official Internet Standard which describes the state of standardization of protocols used in the Internet as determined by the Internet Architecture Board (IAB). It offers a broad spectrum of actual standards used in the Internet. The suitable selection of documents from RFC 2200 defined in this standard for given projects has to be chosen by the user of this standard.

| C264 | GTW | |
|---|---|---|
| **S** | **S** | Ethernet 802.3 |
| **N** | **N** | Serial X.21 interface |
| **N** | **N** | Other selection from RFC 2200 |

2.6.22 SOE file management

C264 SOE files management:

The SOE is a circular file where are stored Events of the computer. There is one SOE for each SCADA link.

The Events which can be stored in SOE are single or double Binary Input. The choice of BI to store in SOE is done by configuration.

Following information in Computer configuration are used to manage SOE file:

- ✓ for each SCADA link
  - A flag indicating if SOE file have to be managed
  - Identification of the SOE file on the link (Name, Address, …)
  - The maximum size of the file
  - The percentage of filling from which the Computer will try to transmit the SOE file
- ✓ for each BI
  - A flag indicating if the BI must be stored in SOE

Rules for the SOE management are the following:

- ✓ At starting of the computer, the SOE file is Empty
- ✓ When the SOE is full, the oldest Event is deleted and the new one is added
- ✓ As soon as the percentage of filling indicated in configuration is reached, the Computer tries to up-load the SOE file
- ✓ Once a SOE file has been successfully up-loaded, all Event sent are deleted from SOE

NOTE: For further reference, it is to be noticed that SOE structure is inherited from S900.

**GTW SOE files management:**

The number of SOE files, SOE104 files, in the directory defined by keys Drive+Path is limited. When the limit is reached, the oldest file is replaced with a new one.

*A SOE file creation is divided into 3 steps:*

- until the maximum number of events in a SOE number is reached, events are stored in a *xxxx.tmp* file, where *xxxx* is the IEC name (number in [1…65535]),
- when the *xxxx.tmp* file is filled up, it is immediately rename as *xxxx.tmp_ready*,
- every 20 seconds the *IEC104.DLL* (IEC 104 "engine") looks for any *.tmp_ready* files: whenever such file is present, IEC104.DLL tries to rename it as "*.SOE104*" file. If the file can't be renamed, a new trial will be done 20 seconds later, and so on. In a normal processing, the only thing which prevents such renaming is when the directory is full and the oldest file is being read by the SCADA (i.e. this oldest file cannot be deleted and replaced by the new *.tmp_ready*). When the file is successfully renamed, a "directory" ASDU is sent with Cause of Transmission = spontaneous.

When the dll starts, some *.tmp* and *.tmp_ready* files can be present in the directory: *.tmp* will be then renamed as *.tmp_ready*, and *.tmp_ready* will be renamed as "*.SOE104*", as in the normal processing, but no "directory" ASDU will be sent (whatever is the case, "directory" ASDU is never sent on dll starting).

"directory" ASDU is sent when a new SOE file appears in the directory or, if delete_file_after_read registry key is set to 1, after a file deletion. "directory". ASDU is not sent if the SCADA deletes a file explicitly with ASDU F_SC_NA_1 (122).

*IOA and file name management:*

The directory content is ordered by increasing file name: base IOA generally fit to oldest file, which name (=IEC name = a number) is the smallest (exception if files a 1, 2, 65534, 65535). Example (="dir" ASDU content):

- 25.SOE104 ←→ IOA = 1000
- 26.SOE104 ←→ IOA = 1001
- 27.SOE104 ←→ IOA = 1002
- 28.SOE104 ←→ IOA = 1003

If file 25.SOE104 is read and deleted, the "dir." ASDU content will become:

- 26.SOE104 ←→ IOA = 1000
- 27.SOE104 ←→ IOA = 1001
- 28.SOE104 ←→ IOA = 1002

Or if file 25.SOE104 is replaced by 29.SOE104

- 26.SOE104 ←→ IOA = 1000
- 27.SOE104 ←→ IOA = 1001
- 28.SOE104 ←→ IOA = 1002
- 29.SOE104 ←→ IOA = 1003

Only one file can be transferred at a time, it's not possible to read 2 files or more simultaneously: i.e. if a file is currently selected, a selection on a second file will be refused.

If a loss of communication with the SCADA occurs while a transfer is in progress, on communication recovery the processing has to be resumed from the beginning.

A SOE104 file is a binary file, which contains only the ASDUs (no other information is present in the file).

CAUTION: IF THE DIRECTORY IS FULL, WHILE THE OLDEST FILE IS LOCKED BY SCADA (FILE SELECTED AND NOT ACKNOWLEDGED) IT IS NOT POSSIBLE TO RENAME THE NEW .TMP_READY IN .SOE104

→ IN THIS CASE, IF THIS SITUATION LAST A VERY LONG TIME, THE NUMBER OF .TMP_READY FILE CAN INCREASE, WITHOUT LIMIT. SUCH A SITUATION SHOULD NEVER HAPPEN IF WITH A WELL WORKING SCADA

Remark: From dll point of view there are no correlation between the way a digital input is sent to SCADA, and the way it is stored in the SOE file: an event, if configured as 'to-be-recorded', is always time tagged in the SOE file (even if in SCE user chooses to sent it with no date to the SCADA).

2.6.23 Disturbance file

C264 disturbance file:

*Computer disturbance file:*

Only Slow Wave Form is implemented for T104. Maximum five slow wave form files can be available at any time. The IOA of the first file is configured and the others are consecutive. The type of file is 1 (Transparent file). When a slow wave form file is available, an ASDU Directory (F_DR_TA_1 (126)) is sent by the computer with cause of transmission = spontaneous (3). From now on, the file is available until a new file is created and replaces it. The SCADA can identify the file only with its date. The size of file must be <= size of one section.

*IED disturbance file:*

Not implemented.

GTW disturbance file:

Disturbances files are not produced by the gateway. The producer has to put the files in the disturbance directory, naming them 1.tmp_ready, 2. tmp_ready, etc. If any file named x.DIS104 is present when producer starts to write the disturbance file in the disturbance directory, the first file he has to add shall be named x+1.tmp_ready. .tmp_ready files are after managed exactly as SOE files, except their extension is DIS104.

2.6.24 SBMC mode

Specific treatment:

Suppressed state does not exist in T104. So when bay turns to SBMC mode, the protocol will tag data with quality “Substituted” and state value given in configuration for suppressed state..

2.6.25 Redundancy

Both C264 and PC-Gateway have 2 redundancy types.

- Protocol Redundancy * i.e. same protocol on the 2 apparatus .Events are synchronised at the connection of the controlling station.
- Equipment Redundancy i.e. 2 apparatus with the same data. Events are synchronised on SBUS.

  *only available with standalone MiCOM C264 (non PACIS C264 multi-rack)

In all cases, only controlling station decides which line, protocol or equipment to use.

2.6.26 Buffer overflow: C264 only

An SPS can be configured to indicate the SCADA event queue overflow.

For C264 computer 3 kinds of behaviours are available through configuration:

- C264 will delete oldest event and add new event in the events queue if overflow has occurred in event queue,
- C264 will delete full event queue and add new event in the events queue if overflow has occurred in event queue,
- C264 deletes full event queue and add new event in the events queue if overflow has occurred in event queue. Upon reconnection of SCADA queue is flushed out.

Event queue size is fixed to 1000 events on a per event type basis

If buffer overflow is not configured there are no information about the overflow. As a result, oldest events are replaced with the new ones.

2.6.27 Reset process: GTW PC only

- The registry key Reset_Process_Hard should always be set to 1

On reset process command from SCADA, the behavior is different according QRP:

- QRP = 0 the GTW do nothing (but still POS ACK the frame)
- QRP = 1, the GTW clear all events
- QRP = 2, the GTW reboots

2.6.28 PSE-POC:

ASDU 18/39 (PSE) and ASDU 19/40 (POC) are used to convert "start event" and "output circuit" information of protection equipments with time tag from IEC-103 to IEC-101 (or IEC-104) in monitoring direction.

2.6.29 Counters

C264 counter management:

T101 defines four modes of counter transmission: from **A** to **D**. Only the modes **A** and **C** are managed by the computer:

Mode **A**: Local freeze with spontaneous transmission
periodically, the slave freezes counters and send them spontaneously.

Mode **C**: Freeze and transmission on request
In order to get counters value, Master must freeze them and then read them.

Management of mode 'A' in Computer in done in the following way:

Every 10 minutes, the computer freeze counters and sends them spontaneously. [Only counter marked in configuration as to be send spontaneously are managed in this mode.]

Management of mode '**C'** in Computer in done in the following way:

To read counters, Master must:

- ✓ Send a command C_CI_NA (with RQT≠0 and FRZ≠0) in order to freeze and/or reset all or a group of counters [this command doesn't cause the counter values to be transmitted].
- ✓ Send a command C_CI_NA (with RQT≠0 and FRZ=0) in order to read frozen values of counters.

Consequences:

- ✓ Current values of counters are not directly accessible from SCADA T101 link (only frozen values are readable).
- ✓ A command of reading counter [C_CI_NA with RQT≠0 and FRZ=0] may be rejected under the following conditions:
  - No [remote] freeze operation has been performed before,
  - There are no counters defined for transmission.

2.6.30 Double controls with pulse duration

C264 pulse duration management:

A SCADA can send a control with pulse duration by private ASDU <137> C_RC_NB_1 or ASDU <138> C_RC_TB_1 (with time tag)

The pulse duration given by the SCADA to the computer will be used only if the computer carries out the output control.

These messages are available only for double contacts output or tap changer controls, and will be used with the Select before operate command procedure. The master center cannot send a deactivation because double control is fugitive.

The C_RC_NB_1 message is defined as follow:

| 7 | | | 0 |
|---|---|---|---|
| Function code | | | |
| 0 | 0 | | 1 |
| 0 | P/N | Cause of transmission | |
| Common address of ASDU | | | |
| Information object address | | | |
| S/E | QU | | RCS or DCS |
| Relay duration time | | | $2^0$ |
| | | | $2^8$ |

The C_RC_TB_1 message is defined as follow:

| 7 | | | 0 |
|---|---|---|---|
| Function code | | | |
| 0 | 0 | | 1 |
| 0 | P/N | Cause of transmission | |
| Common address of ASDU | | | |
| Information object address | | | |
| S/E | QU | | RCS or DCS |
| Relay duration time | | | $2^0$ |
| | | | $2^8$ |
| CP56Time2a | | | |

Field Descriptions:

Function code = 137

- In control direction (SCADA -> Computer)
  - COT = 6 Activation
  - P/N = 0 Positive acknowledge
- In monitor direction (Computer ->SCADA)

The Computer->SCADA message is similar to the SCADA->Computer message, except the COT field and the P/N bit which are updated by the RTU to specify the acknowledgement as follows:

| | | |
|---|---|---|
| - P/N | 0 | Positive acknowledge |
| | 1 | Negative acknowledge |
| - COT | 7 | Activation confirmed |
| | 10 | Activation terminated |
| - S/E | 0 | Execute |
| | 1 | Select |

- QU Command operation field can only be 0. Other values are ignored by the Computer.
- RCS or DCS field , values 0 and 3 are not permitted

| | | |
|---|---|---|
| - RCS State | 1 | LOWER |
| | 2 | HIGHER |
| - DCS State | 1 | OFF/OPEN |
| | 2 | ON/CLOSE |

- Relay duration time field: pulse duration may range from 10ms to 60s by one ms step

2.6.31 Database downloading and switching: *C264 RTU only*

The SCADA can upload a database and only a database. The type of file is 1 (Transparent file) and the IOA (information object address) must be 1. The database uploaded will set as standby database. To switch over this database, the SCADA must send a reset process command (C_RP_NA_1 (105)) with cause of transmission=6 (activation) and QRP=1 (general reset of process)

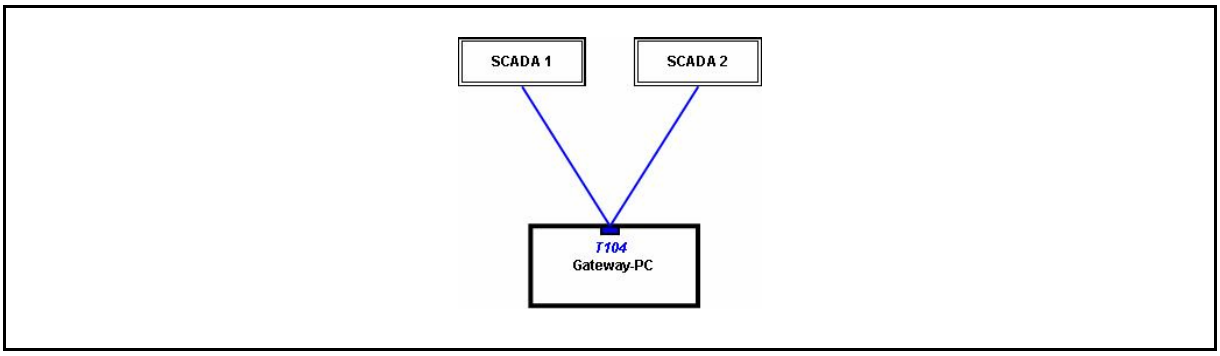
2.6.32 Multi protocol management: GTW only

GTW-PC may manage up to four independent T104 protocols.

The different protocols have separate configurations. Configurations may hold same data.

2.6.33 Multi client management: GTW only, with limitations regarding the T104 NUC

GTW-PC can manage 2 connections on one T104 protocol.

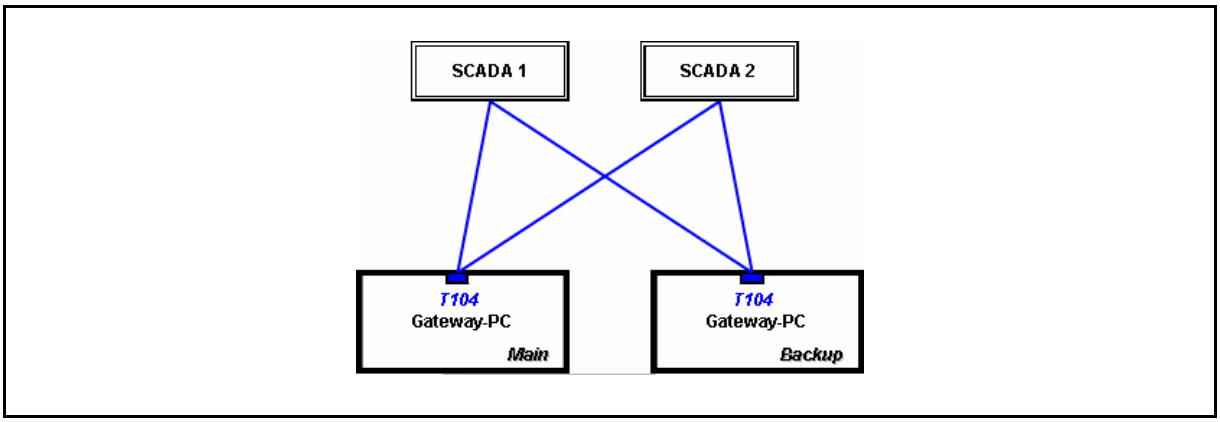



One link is called "*active link*" and the other one is called "*passive link*".

The *active link* is the last one that receives a STARDT.

The *passive link* only receives TESTFR.

Combined with Equipment Redundancy, this option leads to the following allowed configuration:




2.6.34 Multi protocol management: C264 only

C264 may manage up to two T104 protocols with a computer using CPU card type II, and four protocols with a computer CPU card type III

The different protocols have separate configurations but may hold same data.

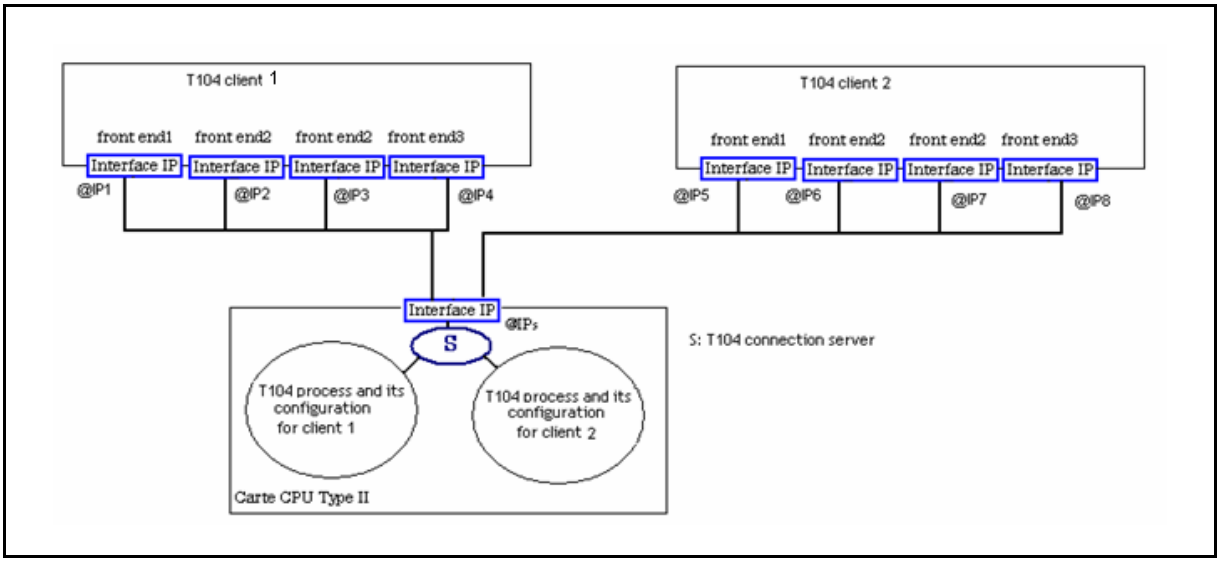
In CPU type III board the two TCP/IP port can be used.

If several clients are communicating with the computer, these clients must manage their own redundancy in order to perform controls with coherency.

For compatibility, when there is only one T104 protocol, you can set in configuration the IP address 255.255.255.255 to allow access from any client. This is the default configuration. When several protocols are configured, the user must set the proper expected IP addresses in configuration in order to avoid conflicts between several T104 configurations. When starting the computer, a message warns about IP addresses conflicts.

2.6.35 Redundancy group: C264 only

A controlling station may connect the server with maximum 4 different connections, but only one is active at a time, all others being passive.




Two modes are implemented in the computer:

1) Automatic mode

If automatic mode is set, when a STARTDT is received on a passive connection, this one becomes active, and the old active one becomes passive. Of course in automatic mode, SCADA may send a STOPDT on an active line before switching if needed, but this is not mandatory. Automatic mode is the default mode in configuration.

2) Manual mode

If manual mode is set, it is mandatory to receive a STOPDT on the active line before doing a STARTDT on a passive line. If an active line is communicating, Gateway does not reply to STARTDT or STOPDT on passive lines in this mode.

When a connection drop occurs, it will be detected by TCP/IP layer, and as a result, the connection will be closed. If this connection was the active one, any other connections may now accept a STARTDT.

All T104 messages and information are accepted on an active connection. On a passive connection, only TESTFR messages are accepted, (or STARTDT). Controls on a passive line are not accepted.

Upon a switch-over from an active connection to another active one, computer accepts the subsequent sequence number gotten from the former active connection (i.e. sequence number may not be reset but may follow what it was on previous – and now inactive – connection).

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