IEC 60870-5-104 Outstation PICS

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Content :	This document contains conformance statement for the CimWay IEC 60870-5-104 Outstation driver.

The last revision of the technical content accommodates changes in PcVue 15.0. Unless otherwise stated, this document is valid for releases made publicly available since.

PcVue® Solutions

Authorization

	Name	Stamp	Date
Written by	ED		May 24th, 2016
Checked by	JS/BL		May 25th, 2016
Authorized by	PB		

Revision history

Revision	Author	Action	Editing	Date	Distribution
1.0	ED	Minor updates for PcVue 11.2 Release	BL	July 1st, 2016	Public
1.1	BL	Editorial changes		Nov 5th,2020	Public
1.2	BL	Added support for double spontaneous transmission		April 12th, 2021	Public

Content

1. Introduction

This document describes the specific implementation of the IEC 60870-5-104 outstation driver in CimWay. It is based on the IEC 60870-5-104 edition 2 standard document, starting on page 93.

Selected parameters are marked as follows:

☐ Function or ASDU is not used

[X] Function or ASDU is used as standardized (default)

[R] Function or ASDU is used in reverse mode

[B] Function or ASDU is used in standard and reverse mode

The possible selection (blank, X, R, or B) is specified for each specific clause or parameter.

A black check box indicates that the option cannot be selected in this standard.

2. System or device

(system-specific parameter, indicate the station's function by marking one of the following with 'X')

☐ System definition

☐ Controlling station definition (Master)

[X] Controlled station definition (Slave)

3. Network configuration

(network-specific parameter, all configurations that are used are to be marked 'X')

■ ~~Point-to-point~~   ■ ~~Multipoint~~

■ ~~Multiple point-to-point~~   ■ ~~Multipoint-star~~

4. Physical layer

(network-specific parameter, all interfaces and data rates that are used are to be marked 'X')

Transmission speed (control direction)

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

Transmission speed (monitor direction)

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

5. Link layer

(network-specific parameter, all options that are used are to be marked 'X'. 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.~~

Link transmission	Address field of the link
■ ~~Balanced transmission~~	■ ~~not present (balanced transmission only)~~
■ ~~Unbalanced transmission~~	■ ~~One octet~~
Frame length	■ ~~Two octets~~
■ ~~Maximum length L (number of octets)~~	■ ~~Structured~~
	■ ~~Unstructured~~

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

~~Note: (In response to a class 2 poll, a controlled station may respond with class 1 data when there is no class 2 data available).~~

6. Application layer

Transmission mode for application data

Mode 1 (Least significant octet first), as defined in clause 4.10 of IEC 60870-5-4, is used exclusively in this companion standard.

Common address of ASDU

(system-specific parameter, all configurations that are used are to be marked '**X**')

| ■ | ~~One octet~~ | | X | Two octets |

Information object address

(system-specific parameter, all configurations that are used are to be marked '**X**')

■	~~One octet~~		X	Structured
■	~~Two octets~~		X	Unstructured
X	Three octets			

Cause of transmission

(system-specific parameter, all configurations that are used are to be marked '**X**')

| ■ | ~~One octet~~ | | X | Two octets (with originator address) Originator address is set to zero if not used |

Length of APDU

(system-specific parameter, specify the maximum length of the APDU per system)

The maximum length of APDU for both directions is 253. It is a fixed system parameter.

| ■ | Maximum length of APDU per system in control direction |
| ■ | Maximum length of APDU per system in monitor direction |

Selection of standard ASDUs

Process information in monitor direction

(station-specific parameter, mark each Type ID '**X**' if it is only used in the standard direction, '**R**' if only used in the reverse direction, and '**B**' if used in both directions)

X	<1>	:=	Single-point information	M_SP_NA_1
X	<2>	:=	Single-point information with time tag	M_SP_TA_1
X	<3>	:=	Double-point information	M_DP_NA_1
X	<4>	:=	Double-point information with time tag	M_DP_TA_1
X	<5>	:=	Step position information	M_ST_NA_1
X	<6>	:=	Step position information with time tag	M_ST_TA_1
	<7>	:=	Bitstring of 32 bit	M_BO_NA_1
	<8>	:=	Bitstring of 32 bit with time tag	M_BO_TA_1

X	<9> :=	Measured value, normalized value	M_ME_NA_1
X	<10> :=	Measured value, normalized value with time tag	M_ME_TA_1
X	<11> :=	Measured value, scaled value	M_ME_NB_1
X	<12> :=	Measured value, scaled value with time tag	M_ME_TB_1
X	<13> :=	Measured value, short floating point value	M_ME_NC_1
X	<14> :=	Measured value, short floating point value with time tag	M_ME_TC_1
X	<15> :=	Integrated totals	M_IT_NA_1
X	<16> :=	Integrated totals with time tag	M_IT_TA_1
■	~~<17> :=~~	~~Event of protection equipment with time tag~~	~~M_EP_TA_1~~
■	~~<18> :=~~	~~Packed start 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~~
☐	<20> :=	Packed single-point information with status change detection	M_SP_NA_1
X	<21> :=	Measured value, normalized value without quality descriptor	M_ME_ND_1
X	<30> :=	Single-point information with time tag CP56Time2a	M_SP_TB_1
X	<31> :=	Double-point information with time tag CP56Time2a	M_DP_TB_1
X	<32> :=	Step position information with time tag CP56Time2a	M_ST_TB_1
☐	<33> :=	Bitstring of 32 bit with time tag CP56Time2a	M_BO_TB_1
X	<34> :=	Measured value, normalized value with time tag CP56Time2a	M_ME_TD_1
X	<35> :=	Measured value, scaled value with time tag CP56Time2a	M_ME_TE_1
X	<36> :=	Measured value, short floating point value with time tag CP56Time2a	M_ME_TF_1
X	<37> :=	Integrated totals with time tag CP56Time2a	M_IT_TB_1
☐	<38> :=	Event of protection equipment with time tag CP56Time2a	M_EP_TD_1
☐	<39> :=	Packed start events of protection equipment with time tag CP56Time2a	M_EP_TE_1
☐	<40> :=	Packed output circuit information of protection equipment with time tag CP56Time2a	M_EP_TF_1

Process information in control direction
(station-specific parameter, mark each Type ID '**X**' if it is only used in the standard direction, '**R**' if only used in the reverse direction, and '**B**' if used in both directions)

X	<45> :=	Single command	C_SC_NA_1
X	<46> :=	Double command	C_DC_NA_1
X	<47> :=	Regulating step command	C_RC_NA_1
X	<48> :=	Set point command, normalized value	C_SE_NA_1
X	<49> :=	Set point command, scaled value	C_SE_NB_1
X	<50> :=	Set point command, short floating point value	C_SE_NC_1
☐	<51> :=	Bitstring of 32 bit	C_BO_NA_1

X	<58> :=	Single command with time tag CP56Time 2a	C_SC_TA_1
X	<59> :=	Double command with time tag CP56Time 2a	C_DC_TA_1
X	<60> :=	Regulating step command with time tag CP56Time 2a	C_RC_TA_1
X	<61> :=	Set point command, normalized value with time tag CP56Time 2a	C_SE_TA_1
X	<62> :=	Set point command, scaled value with time tag CP56Time 2a	C_SE_TB_1
X	<63> :=	Set point command, short floating point value with time tag CP56Time 2a	C_SE_TC_1
	<64> :=	Bitstring of 32 bit with time tag CP56Time 2a	C_BO_TA_1

Either the ASDUs of the set <45> – <51> or of the set <58> – <64> are used.

System information in monitor direction
(station-specific parameter, mark with an "X" if it is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions)

X	<70> :=	End of initialization	M_EI_NA_1

System information in control direction
(station-specific parameter, mark with an "X" if it is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions)

X	<100>:=	Interrogation command	C_IC_NA_1
	<101>:=	Counter interrogation command	C_CI_NA_1
	<102>:=	Read command	C_RD_NA_1
	<103>:=	Clock synchronization command (option see 7.6)	C_CS_NA_1
■	~~<104>:=~~	~~Test command~~	~~C_TS_NA_1~~
	<105>:=	Reset process command	C_RP_NA_1
■	~~<106>:=~~	~~Delay acquisition command~~	~~C_CD_NA_1~~
	<107>:=	Test command with time tag CP56time2a	C_TS_TA_1

Parameter in control direction
(station-specific parameter, mark with an "X" if it is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions)

	<110>:=	Parameter of measured value, normalized value	P_ME_NA_1
	<111>:=	Parameter of measured value, scaled value	P_ME_NB_1
	<112>:=	Parameter of measured value, short floating point value	P_ME_NC_1
	<113>:=	Parameter activation	P_AC_NA_1

File Transfer
(station-specific parameter, mark with an "X" if it is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions)

	<120>:=	File ready	F_FR_NA_1
	<121>:=	Section ready	F_SR_NA_1

☐	<123>:= Last section, last segment	F_LS_NA_1
☐	<122>:= Call directory, select file, call file, call section	F_SC_NA_1
☐	<124>:= Ack file, ack section	F_AF_NA_1
☐	<125>:= Segment	F_SG_NA_1
☐	<126>:= Directory {blank or X, only available in monitor (standard) direction}	F_DR_TA_1
☐	<127>:= Query Log – Request archive file	F_SC_NB_1

Type identifier and cause of transmission assignments
(station-specific parameters)

Shaded boxes are not required.
Black boxes are not permitted in this companion standard
Blank: functions or ASDU not used.
Mark Type Identification/Cause of transmission combinations:
'X' if only used in the standard direction
'R' if only used in the reverse direction
'B' if used in both directions

Type identification		periodic, cyclic	background scan	spontaneous	initialized	request or requested	activation	activation confirmation	deactivation	deactivation confirmation	activation termination	return info caused by a remote	return info caused by a local cmd	file transfer	interrogated by group <number>	request by group <n> counter	unknown type identification	unknown cause of transmission	unknown common address of	unknown information object
		1	2	3	4	5	6	7	8	9	10	11	12	13	20 to 36	37 to 41	44	45	46	47
<3>	M_DP_NA_1	X	X	X		X						X	X		X					
<4>	M_DP_TA_1	X	X	X		X						X	X		X					
<5>	M_ST_NA_1	X	X	X		X						X	X		X					
<1>	M_SP_NA_1	X	X	X		X						X	X		X					
<6>	M_ST_TA_1	X	X	X		X						X	X		X					
<2>	M_SP_TA_1	X	X	X		X						X	X		X					
<7>	M_BO_NA_1																			
<8>	M_BO_TA_1			■																
<9>	M_ME_NA_1	X	X	X		X						X	X		X					
<10>	M_ME_TA_1	X	X	X		X						X	X		X					
<11>	M_ME_NB_1	X	X	X		X						X	X		X					
<12>	M_ME_TB_1	X	X	X		X						X	X		X					
<13>	M_ME_NC_1	X	X	X		X						X	X		X					
<14>	M_ME_TC_1	X	X	X		X						X	X		X					
<15>	M_IT_NA_1	X	X	X		X						X	X		X					

Type identification		periodic, cyclic	background scan	spontaneous	initialized	request or requested	activation	activation confirmation	deactivation	deactivation confirmation	activation termination	return info caused by a remote	return info caused by a local cmd	file transfer	interrogated by group <number>	request by group <n> counter	unknown type identification	unknown cause of transmission	unknown common address of	unknown information object
		1	2	3	4	5	6	7	8	9	10	11	12	13	20 to 36	37 to 41	44	45	46	47
<16>	M_IT_TA_1	X	X	X		X						X	X		X	■				
<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	X	X	X		X									X					
<30>	M_SP_TB_1			X		X						X	X							
<31>	M_DP_TB_1			X		X						X	X							
<32>	M_ST_TB_1			X		X						X	X							
<33>	M_BO_TB_1																			
<34>	M_ME_TD_1			X		X														
<35>	M_ME_TE_1			X		X														
<36>	M_ME_TF_1			X		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						X	X	X	X
<48>	C_SE_NA_1						X	X	X	X	X						X	X	X	X
<49>	C_SE_NB_1						X	X	X	X	X						X	X	X	X
<50>	C_SE_NC_1						X	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	X
<59>	C_DC_TA_1						X	X	X	X	X						X	X	X	X
<60>	C_RC_TA_1						X	X	X	X	X						X	X	X	X
<61>	C_SE_TA_1						X	X	X	X	X						X	X	X	X
<62>	C_SE_TB_1						X	X	X	X	X						X	X	X	X
<63>	C_SE_TC_1						X	X	X	X	X						X	X	X	X
<64>	C_BO_TA_1								■	■										
<70>	M_EI_NA_1*					X														

Type identification		Cause of transmission																	
		periodic, cyclic	background scan	spontaneous	initialized	request or requested	activation	activation confirmation	deactivation	deactivation confirmation	activation termination	return info caused by a remote	return info caused by a local cmd	file transfer	interrogated by group <number>	request by group <n> counter	unknown type identification	unknown cause of transmission	unknown common address of	unknown information object
		1	2	3	4	5	6	7	8	9	10	11	12	13	20 to 36	37 to 41	44	45	46	47
<100>	C_IC_NA_1						X	X	X	X	X						X	X	X	X
<101>	C_CI_NA_1																			
<102>	C_RD_NA_1																			
<103>	C_CS_NA_1																			
<104>	C_TS_NA_1																			
<105>	C_RP_NA_1																			
<106>	C_CD_NA_1																			
<107>	C_TS_TA_1																			
<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																			
<121>	F_SR_NA_1																			
<122>	F_SC_NA_1																			
<123>	F_LS_NA_1																			
<124>	F_AF_NA_1																			
<125>	F_SG_NA_1																			
<126>	F_DR_TA_1*																			
<127>	F_SC_NB_1*																			

* Blank or X only

7. Basic application functions

Station initialization
(station-specific parameter, mark 'X' if function is used)

[X] Remote

Cyclic data transmission
(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

[X] Cyclic data transmission

Read procedure
(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

[ ] Read procedure

Spontaneous transmission
(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

[X] Spontaneous

Double transmission of information objects with cause of transmission spontaneous
(station-specific parameter, mark each information type 'X' 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.

[X] Single-point information M_SP_NA_1, M_SP_TA_1, M_SP_TB_1 and M_PS_NA_1

[X] Double-point information M_DP_NA_1, M_DP_TA_1 and M_DP_TB_1

[X] Step position information M_ST_NA_1, M_ST_TA_1 and M_ST_TB_1

[ ] Bitstring of 32 bit M_BO_NA_1, M_BO_TA_1 and M_BO_TB_1 (if defined for a specific project)

[X] Measured value, normalized value M_ME_NA_1, M_ME_TA_1, M_ME_ND_1 and M_ME_TD_1

[X] Measured value, scaled value M_ME_NB_1, M_ME_TB_1 and M_ME_TE_1

[X] Measured value, short floating point number M_ME_NC_1, M_ME_TC_1 and M_ME_TF_1

Station interrogation
(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

X global

X group 1		**X** group 7		**X** group 13	
X group 2		**X** group 8		**X** group 14	
X group 3		**X** group 9		**X** group 15	
X group 4		**X** group 10		**X** group 16	
X group 5		**X** group 11			
X group 6		**X** group 12			

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

Clock synchronization
(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

☐ Clock synchronization

☐ Day of week used

☐ RES1, GEN (time tag substituted/ not substituted) used

☐ SU-bit (summertime) used

Command transmission
(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

X Direct command transmission

X Direct set point command transmission

X Select and execute command

X Select and execute set point command

X C_SE ACTTERM used

X No additional definition

☐ Short pulse duration (duration determined by a system parameter in the outstation)

☐ Long pulse duration (duration determined by a system parameter in the outstation)

X Persistent output

X Supervision of maximum delay in command direction of commands and set point commands

Configurable	Maximum allowable delay of commands and set point commands

Transmission of integrated totals
(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

- [ ] Mode A: Local freeze with spontaneous transmission
- [ ] Mode B: Local freeze with counter interrogation
- [ ] Mode C: Freeze by counter-interrogation commands
- [ ] Mode D: Freeze by counter-interrogation command, frozen values reported spontaneously
- [ ] Counter read
- [ ] Counter freeze without reset
- [ ] Counter freeze with reset
- [ ] Counter reset
- [ ] General request counter
- [ ] Request counter group 1
- [ ] Request counter group 2
- [ ] Request counter group 3
- [ ] Request counter group 4

Parameter loading
(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

- [ ] Threshold value
- [ ] Smoothing factor
- [ ] Low limit for transmission of measured values
- [ ] High limit for transmission of measured values

Parameter activation
(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

- [ ] Act/deact of persistent cyclic or periodic transmission of the addressed object

Test procedure
(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

- [X] Test

File transfer
(station-specific parameter, mark 'X' if function is used)

File transfer in monitor direction

☐ Transparent file

☐ Transmission of disturbance data of protection equipment

☐ Transmission of sequences of events

☐ Transmission of sequences of recorded analog values

File transfer in control direction

☐ Transparent file

Background scan
(station-specific parameter, mark '**X**' if function is only used in the standard direction, '**R**' if only used in the reverse direction, and '**B**' if used in both directions)

☒ Background scan

Acquisition of transmission delay
(station-specific parameter, mark '**X**' if function is only used in the standard direction, '**R**' if only used in the reverse direction, and '**B**' if used in both directions)

■ ~~Acquisition of transmission delay~~

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

Maximum number of outstanding I format APDUs k and latest acknowledge APDUs (w)

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 32767 (2^{15}-1) APDUs, accuracy 1 APDU
Maximum range of values w: 1 to 32767 APDUs, accuracy 1 APDU (Recommendation: w should not exceed two-thirds of k).

Port number

Parameter	Value	Remarks
Port number	2404	Configurable

Redundant connections

Configurable

Number N of redundancy group connections used

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.

X Ethernet 802.3

☐ Serial X.21 interface

☐ Other selection from RFC 2200:

List of valid documents from RFC 2200

   1. ……………………………………………..

   2. ……………………………………………..

   3. ……………………………………………..

   4. ……………………………………………..

   5. ……………………………………………..

   6. etc.

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IEC 60870-5-104 Outstation PICS

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ISO 9001 and ISO 14001 certified