6MCV

Bay Control Unit

Instructions Manual for **6MCV** Models
M6MCVA2001Iv02

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Chapter 1.

Description and Start-Up

1.1 Functions

1.1.1 Programmable Logic

An operational logic can be programmed in order to set up blockings, automatic controls, control and trip logic functions, command hierarchy, etc through logic gates combined with any captured or equipment-calculated signal.

All the signals generated by the equipment will be available to the events, fault reports, digital inputs and outputs, HMI and communications according to how their programmable logic has been configured.

The processing of the input signals produces logical outputs that can be assigned to existing connections between the **6MCV** and the exterior: auxiliary output contacts, display, communications, LEDs, HMI…

1.1.2 Ports and Communications Protocols

6MCV relays are provided with different types of communications ports:

- **1** front **Local Port** type RS232C and USB.
- Up to **3 Remote Ports** with following configurations:
  - Remote Port 1: optical fiber interface (glass ST or plastic 1mm) or electrical interface RS232 / RS232 FULL MODEM.
  - Remote Port 2: optical fiber interface (glass ST or plastic 1mm) or electrical interface RS232 / RS485.
  - Remote Port 3: electrical interface RS232 / RS485.
- **2 LAN Ports** with following configurations:
  - LAN 1: RJ45 connector for ETHERNET type communications.
  - LAN 2: RJ45 connector or glass optical fiber MT-RJ for ETHERNET type communications.
- **1 Remote Port** with CAN protocol BUS connection.

The IED also has the following communications protocols: PROCOME 3.0, DNP 3.0 and MODBUS. You can assign any one of them to both remote ports. For PROCOME it can be also assigned to the LAN ports; IEC-61850 (LAN ports) and CAN (electric BUS CAN). The local port supports the PROCOME 3.0 Protocol. It is for parameter setting, configuration and retrieval of information about the IED.

Protocol changeover trailers are totally independent for each port, and two same-protocol instances can be maintained in the two remote ports.

1.1.3 Supervision of the Switching Circuits

The IED has units for verifying the proper operation of the switching circuits of the breaker. They can monitor up to three coils. You can monitor both breaker positions (open and closed) or either one of them.

1.1.4 Selecting the Phase Sequence

You can configure the connection of the IED to the network sequence when the phase sequences are ABC or ACB.

1.1.5 LED Targets

6MCV relay is provided with equipment LEDs on the front panel. The number of LEDs is a function of the enclosure height. Models 4U or 6U are provided with 16 LEDs. Lower enclosures are provided only with 4 LEDs. In any case an additional LED is provided to show whether the relay is **In Service**.

1.1.6 Digital Inputs

The number of digital inputs available will depend on each particular model (see 1.4, Model Selection) and may vary from 8 up to 82.

1.1.7 Auxiliary Outputs

The number of auxiliary outputs available will also depend on each particular model (see 1.4, Model Selection) and may vary from 6 up to 34. One of these outputs is not configurable as it is assigned to the relay “In Service” indication.

1.1.8 Time Synchronization

The IEDs include an internal clock with a resolution of 1 ms. This can be synchronized via GPS (IRIG-B 003 and 123 Protocol) or by communications through remote communications port (PROCOME 3.0 or DNP 3.0 Protocols).

1.1.9 Event Recording and Programmable Metering Data Logging

Storage capacity of 400 annotations in a non-volatile memory. Event-generated signals can be selected by the user and are annotated with 1ms resolution and a maximum of 12 measurements also user-selected.

1.1.10 Historical Metering Data Logging

Historical metering data logging allows for obtaining twelve maximum and twelve minimum values from a group of four magnitudes selected out of all available measurements (captured or calculated), except meters, for each time window. This window can be adapted to the application by adjustment of day and interval masks. Up to 168 records can be saved.

1.1.11 DC Power Monitoring

Some models include a function for monitoring the voltage supplied by the substation’s DC battery and used to power the equipment.

This monitoring allows overvoltage and undervoltage alarms to be generated, also making it possible to generate a log of voltage values and store them in the ocillographic records that can accompany each use of the equipment.

To perform the monitoring, the equipment includes an input transducer specifically designed to measure the prevailing direct current values in the substations.

1.1.12 Alphanumeric Display and Keypad

- Changing and displaying settings.
- Contact input and output status.
- Protection records (displayed via communication):
  - Event recording.
  - Log file of currents, voltages, powers, power factor and energies or other calculated values.
- Control records.
- Metering values used by protection (depending on model):
  - Phase and ground currents and their angles.
  - Voltages of the three phases and ground and their angles.
  - Phase-to-phase voltages.
  - Maximum and minimum current.
  - Maximum and minimum voltage.
  - Positive, negative and zero sequence currents and their angles.
  - Positive, negative and zero sequence voltages and their angles.
  - Active, reactive and apparent powers and power factor.
  - Maximum and minimum powers.
  - Frequency.
  - Energies.
  - 2nd to 8th order harmonics of the current and voltage of phase A.
  - Transducers.

1.1.13 Graphic Display

The graphical display is fully configurable. The possible functions to show could be:

- Position mimic indicating the state of the different elements.
- Local Control of the elements.
- Measurements panel (reals and calculated).
- Alarms panel.
- I/O state information.

1.1.14 Virtual Inputs/Outputs

The virtual inputs/outputs function allows the bi-directional transmission of up to 16 digital signals and 16 analog magnitudes between the two **6MCV** units connected through a digital communications system. This function allows to program logics which contain local and remote information, analog as well as digital.

1.1.15 Self-Test Program

A continuously running diagnostic self-test program verifies the correct operation of the terminal unit and alerts the user of potential problems.

1.2 Local Interface: Alphanumeric Display and Keypad

1.2.1 Alphanumeric Display & Keypad

The liquid crystal alphanumeric display has a 4-row by 20-character matrix. It displays information about relay alarms, settings, metering, states, etc. There are 4 function keys (F1, F2, F3 and F4) under the display. The next section explains their functions. Figure 1.2.1 shows the default graphic display and the function keys.

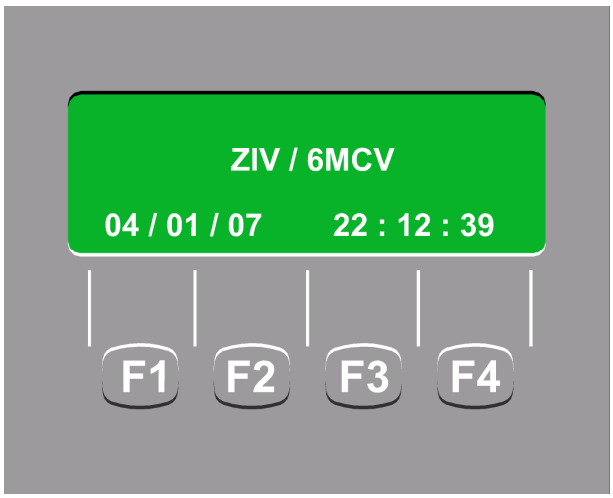


Figure 1.2.1 Alphanumeric Display.

- **Default Display**

Figure 1.2.1 depicts the default display showing the relay model, the date and the time. The upper left corner also indicates the connection mode (if communication has been established):

[PL] Local connection (communication through the front port)
[P1] Remote connection (communication through rear port 1)
[P2] Remote connection (communication through rear port 2)
[P3] Remote connection (communication through rear port 3)
[P4] Remote connection (communication through rear port 4)

- **Keypad Associated with the Display**

The keypad consists of 16 keys arranged in a 4 x 4 matrix. Their properties are specified next. Figure 1.2.2 shows the layout of this keypad.

In addition to the keys corresponding to the digits (keys from 0 to 9), there are the selection keys (↑ and ↓), the confirmation key (ENT), the escape key (ESC) and the contrast key (◑).

Figure 1.2.2 Keypad Layout.

Starting with the default screen, operations can be performed on **6MCV** system functions in two different ways: using one single key (F2) or using the whole keypad.

1.2.2 Keys, Functions and Operation Modes

This section explains the alphanumeric display's function keys and the keypad's digit keys.

1.2.2.a Keypad

Confirmation Key
The ENT key is used to confirm an action: after making a selection or after editing a setting and to advance to view all the records. After any operation (selection, change of settings, information, etc.), pressing ENT again accesses the immediately preceding level.

Escape Key
The ESC key is used to exit a screen if the setting is not to be changed or simply to exit an information screen. In any case, pressing this key returns the display to the immediately preceding screen.

Display Selection Keys
The selection keys are for advancing or returning, in correlative order, to any of the options of a menu or a submenu. When a menu has more than four options, an arrow (↓) will appear in the lower right corner of the display indicating that there are more. The ∇ key brings up the second set of options.

An arrow (↑) will appear in the upper right corner of the display to indicate the existence of the first set of options.

The ∇ key is also used to delete digits within a setting that is being modified. It only has this function when a setting is being entered.

Contrast Key and Minus (-) Sign
Pressing this key brings up the screen for adjusting the contrast of the display. The selection keys modify this contrast value: greater value = less contrast. Also, when setting floating point values, it permits entering a negative sign (-).

1.2.2.b Function Keys

Pressing F1 confirms changes in settings (when the relay requests such confirmation) and confirms the activation of a settings group (when the relay requests this confirmation). When pressed from the stand-by screen, it provides access to the information provided by the sequential events recorder.

The F2 key is used to consult the relay for information relative to measurements of current, voltage, power, etc. and to reset the LEDs.

Pressing F3 displays the state of the relay's digital inputs and outputs.

Pressing the F4 key rejects changes in settings (when the relay requests confirmation of the changes) and rejects the activation of a reserve settings group (likewise when such confirmation is requested).

1.2.2.c Accessing the Options

The digit keys (0 to 9) are used to directly access the options (settings, data, measurements, etc.). This direct access consists in successively pressing the identification numbers that the screen displays prior to each setting or option within the corresponding setting.

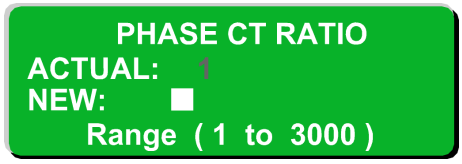
Another way to access the options consists in navigating the menus with the selection keys and then confirming the option selected with ENT.

1.2.2.d Operation

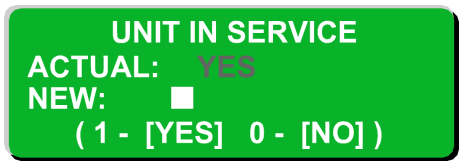
- **Change of Settings (Range)**

The change of settings (Range) presents the following arrangement: the operational value of the setting appears in the place indicated by the word ACTUAL. The new value is entered where a blinking cursor indicates the place in the next line indicated by the word NEW.

The digit keys are used to edit the new value, which must agree with the range specified in the last line of the display. If an error occurs upon inputting a value, the ∇ key will erase it. Once the new value has been edited, pressing ENT confirms it and exits to the preceding menu.

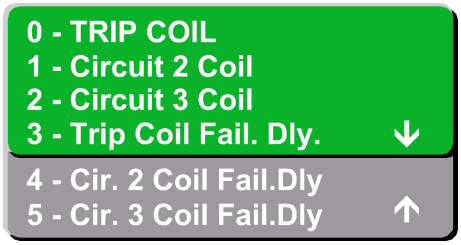


There is a type of setting that follows this outline but with a range limited to the options YES and NO. In this case, the 1 and 0 keys correspond to the values YES and NO. Then pressing ENT confirms the setting and returns to the preceding screen.



- **Change of Settings (Options)**

These settings are presented in an options menu which is selected by either of two already known procedures: with the direct access number associated with the option or by using the selection keys and confirming with ENT. In both cases, the system returns to the preceding screen.



- **Exit Menus and Settings**

Pressing the ESC key exits a menu or a setting without changing it. Pressing either ENT or ESC indistinctly exit an information screen. In either case, the display returns to the preceding menu.

1.3 Local Interface: Graphic Display

1.3.1 Introduction

This chapter describes only the operation of the graphic display and its associated function keys (figure 1.3.1 and figure 1.3.2). The examples depicted are intended to explain display operation.

Please note that the graphic display operates in the same manner for both the horizontal and vertical **6MCV** models.

1.3.2 General

Graphical displays are LCD 114 x 64 mm (240 x 128 pixels). They are provided with own illumination and include five keys with following functions:

Functions	Designation	Color
Configurable	O	Red
Configurable	I	Green
Configurable	TAG	Blue
Selection	NXT	Gray
Information	INF	Gray

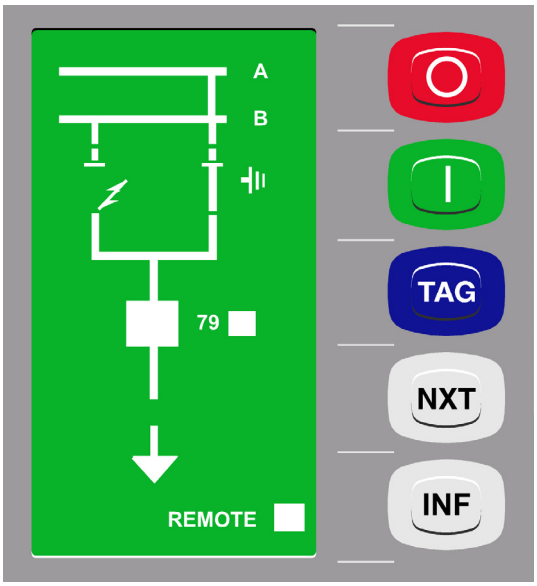


Figure 1.3.1 Local Control Graphic Display.

As shown in table, the first three keys (**O**, **I** and **TAG**) are configurable thus their function must be defined through the programmable logic. That is not so for **NXT** and **INF** keys that already have a function assigned to them.

Two options are available to operate the graphical displays: press function key **INF** to display the information screens or press **NXT** function key to display the different mimic objects and operate on them. Information screens and objects are displayed in sequence. Starting from any information screen, if the **INF** key is not pressed again within an adjustable time the system returns to the default screen. Also, if **NXT** key is not pressed within 10 seconds the system returns to the screen with no element selected.

Press **NXT** within the time-out period to select mimic objects one after the other until the situation of no element selected is reached again. Selected elements are represented graphically by a flashing symbol. This symbol may be created by the user or taken from the databases of the program, as described in figure 1.3.2 (as a function of their state).

Screen sequence can be selected, and a position mimic can be defined indicating the state of the different elements. Elements depicted in the single line diagram depend on the information associated to each of them. All this information is defined in the user configuration loaded into the relay.

1.3.3 Symbols Associated to the Graphic Display

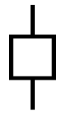
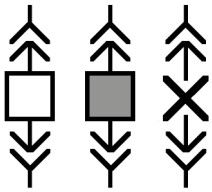
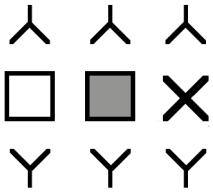
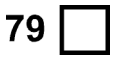
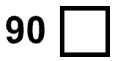
Element	State 1	State 2
Breaker	 Open	 Closed
Breaker	 Unknown (0-0)*	 Unknown (1-1)*
Switch	 Open	 Closed
Position of the Breaker mechanism	 Plugged	 Unplugged
Position of the Breaker mechanism	 Pulled out closed	 Pulled out open
Recloser	 In Service	 Out of Service
Capacitor Bank Control	 Automatic	 Manual
Voltage Regulator	 Automatic	 Manual

Figure 1.3.2 Device Representation Symbols.

Device representation on display will depend on the state of one or several digital signals, the following representation objects being possible:

- Base.
- Command object.
- 2 state object.
- Magnitude object.
- Text object.

- **Base**

This object is the starting point for screen design. It can be created by the user or it can be taken from the program database.

Static parts (Busbars or ground connections) or the different alarm display boxes are base examples.

- **Command Object**

Command objects represent objects able to adopt a number of states varying from 1 to 16. Furthermore they can be operated from graphical HMI provided object attributes are configured as selectable.

Multi-state (Open, Closed and Unknown) breakers able to perform opening or closing operations are examples of command objects.

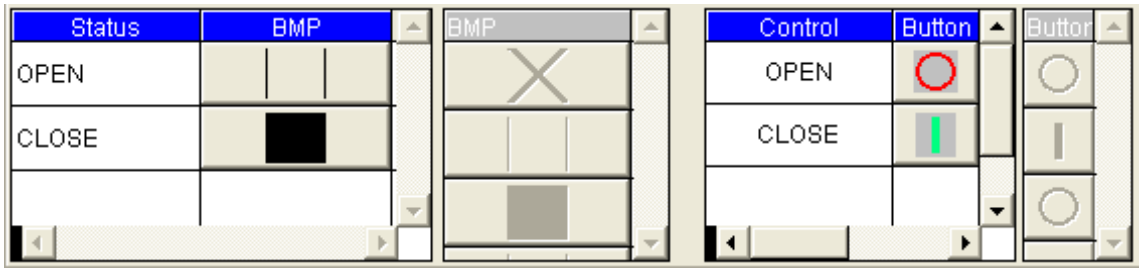


Figure 1.3.3 Example of Breaker State and Operations.

- **2 State Object**

2 state objects represent objects able to adopt one of two states as a function of the value of the digital signal to which it is associated (Deactivated= signal to 0; Activated = signal to 1). Objects may not be operated from graphical HMI their state only being modified when changing the signal value.

Examples of 2 state objects are voltage presence indicators or alarm display signals.

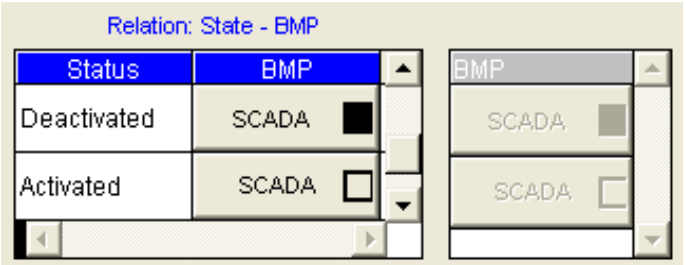


Figure 1.3.4 Example of 2 State Element.

- **Magnitude Object**

Magnitude objects allow displaying both Static (relay default) and User (created through programmable logic) magnitudes.

- **Text Object**

Text objects allow displaying text fields. Maximum number of characters allowed is 16.

It is worth mentioning that all types of objects can be displayed in the same screen, allowing this way for more freedom in screen design.

1.3.4 Access to Information

Press **INF** key for sequential display of accessible information screens on the graphical display.

It is worth highlighting that starting from any information screen, if **INF** is not pressed again within an adjustable time, the system returns to the default screen.

This time setting can only be displayed from the **Configuration** - **Graphical HMI Conf.** its range being from 0 to 60 seconds. A setting of 0 seconds disables the automatic return to the default screen. A **Contrast** setting, within the same option, is available, which affects only the graphical display.

The only default screens are **Digital Output** and **Digital Input** state screens. All other screens and the display sequence are defined through programmable logic.

1.3.4.a Alarm Display

Alarm display appearance as well as the number of screens and alarms to be shown can be designed through programmable logic. Also, digital signals associated to each alarm must be specified as well as the text to be shown on the graphical display.

It is worth mentioning that there are no definite type of screens for alarm display function. Said screens are created in a similar manner than for the rest of graphical display screens, using same objects described in paragraph 1.3.2. This allows maximum flexibility for screen design adapting screens to user needs.

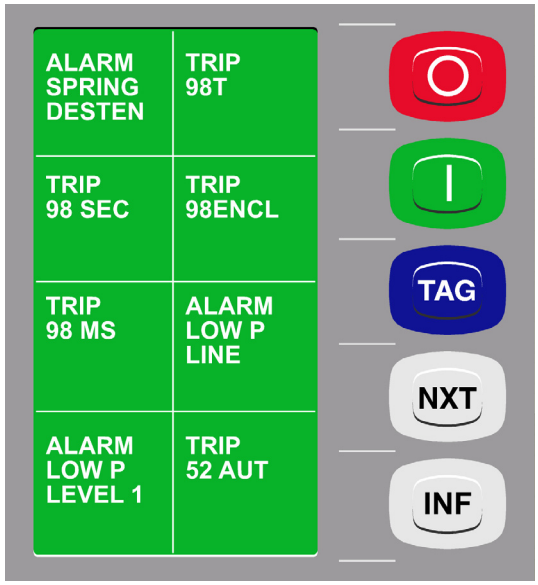


Figure 1.3.5 Example of Alarm Display.

Alarm acknowledgement functions are also defined through programmable logic, which must actuate on the digital signals associated to each alarm.

1.3.4.b I/O State Information

As mentioned in paragraph 1.3.3, **Digital Outputs** and **Digital Inputs** state screens are the only relay default screens. Said screens are not configurable and will thus be different for each model.

New screens can nevertheless be created, in which the state of any digital relay signal whether definite or created through programmable logic is shown.

Digital inputs or outputs are represented by a full rectangle (simulating a LED) if active, whereas the rectangle will be empty if inactive.

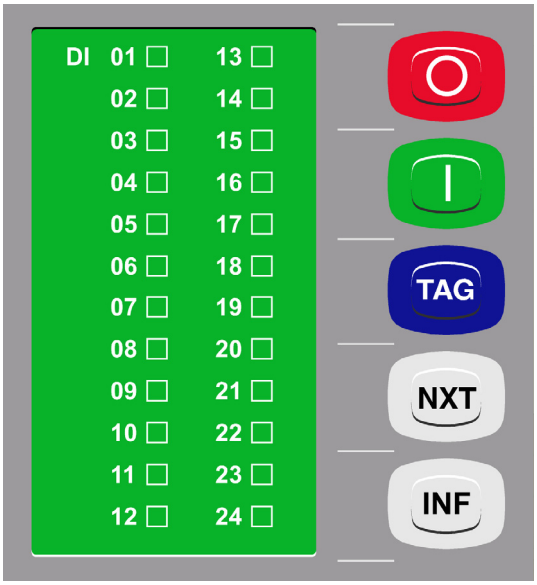


Figure 1.3.6 I/O Display.

1.3.4.c Measurements Information

A screen can be designed for representing relay measurements. As for digital signals, both definite relay measurements (static) and created through programmable logic can be used. No difference exists at the time of using them into the graphical display.

Time is a special measurement. Said static magnitude designated **Present Time** allows representing separately relay date and time.

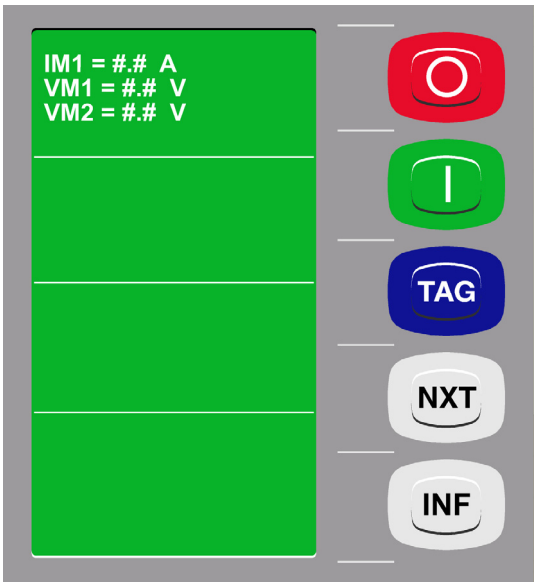


Figure 1.3.7 Example of Display with Measurements.

1.3.5 Control Function Operations

Control functions are mainly performed through graphical displays with the help of the 5 above described control keys.

Action on position elements is conditional on programming a **Command** within the programmable logic and the analysis of said logic on whether said action is feasible or not.

1.3.5.a General Procedure for Command Execution

Command execution always follows the same sequential steps no matter the type of the operated device, allowing for easier relay operation.

Every time after pressing the **NXT** key, existing devices are highlighted in sequence and periodically in the position on which commands can be executed. Said highlighting consists in the device image flashing with a 1 second cadence. If after selecting an image no command is received within ten (10) seconds, the module will automatically cancel the selection, returning to the default state corresponding to no element selected. The image part flashing during the selection corresponds to the entire symbol except associated texts.

The established selection sequence can be configured at the time of performing the programmable logic. For a specific position the following sequence could be taken as an example:

- LOCAL / REMOTE Status
- Panel CONNECTED / DISCONNECTED Status
- Busbars sectionalizing switch
- Breaker
- Associated devices (automatic device recloser etc.)
- Busbars side grounding breakers
- Line side grounding breakers
- By pass breakers and finally nothing

After selecting the element to be commanded press the command key. As a general rule configurable close (**I**) or open (**O**) keys will be used.

If by any reason the command cannot be executed, two text lines will be shown on the relay display stating that execution is impossible as well as the reasons why said command cannot be executed. The following can be some examples:

LINE 1: COMMAND NOT-EXECUTABLE
LINEA 2: TAGGED
INTERLOCK
POSITION IN REMOTE CONTROL

These statements are automatically erased after 5 seconds. No operation may be performed within this time.

The possible causes for a COMMAND NOT EXECUTABLE are defined through programmable logic. To this end, at the time of defining a new command, possible digital signals disabling command execution must also be defined. This way, when trying the command a message is displayed with the name of said signal.

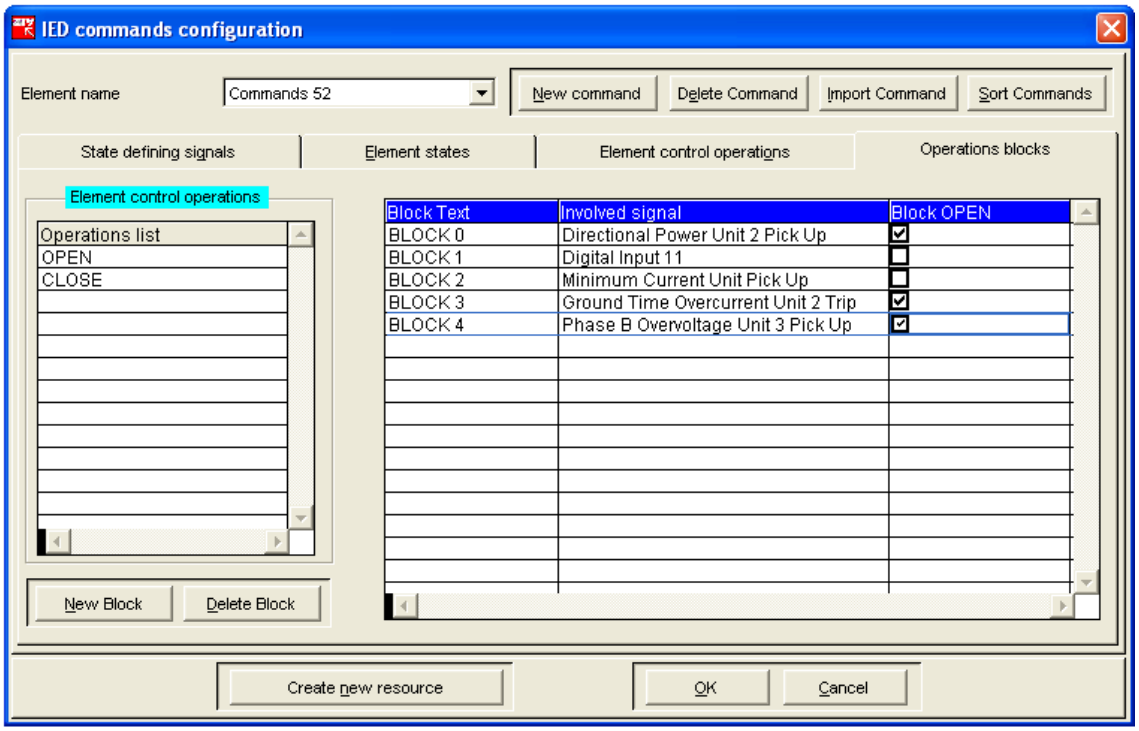


Figure 1.3.8 Example of Command Definition Screen

This blocking signal can be any digital relay signal. That is, both definite (e.g. Digital inputs or Protection unit outputs) and created through programmable logic and as a result of the supervision of a set of data.

After verifying that the command can be executed, the relay checks the correct command execution through digital inputs or internal logic signal monitoring. If after an established time (selectable for each control) the command is detected to have failed, a screen message is displayed corresponding to COMMAND FAILURE of the same characteristics than above mentioned. If the command has been executed correctly, no external statement is displayed.

1.4 Model Selection

1.4.1 Model Selection

6MCV			N								
	1	2		3	4	5	6	7	8	9	10

1	**Functions**			
	A[(1)]	With Graphic Display.	**B**	Without Graphic Display.
2	**Communication Interfaces for IEC 61850**			
	1	None.	**5**	Two 100BASE-FX Connectors (Multimode FOC LC).
	3	Two 100BASE-TX Connectors (RJ45).		
	4	Two 100BASE-FX Connectors (Multimode FOC ST).	**6**	One 100BASE-TX Connector (RJ 45) + One 100BASE-FX Connector (Multimode FOC LC).
3	**Power Supply Voltage**			
	1	24 VDC / VAC (±20%)	**2**	48 - 250 VDC / VAC (±20%)
4	**Digital Inputs**			
	0	24 VDC	**3**	250 VDC
	1	48 VDC	**6**	125 VDC (activat. >65%)
	2	125 VDC	**7**	250 VDC (Von=158VDC / Voff = 132VDC)
5	**Communications Ports [COM1-LOC] [COM 2-REMP1] [COM3-REMP2] [COM4-REMP3] [COM5-REMP4]**			
	0	[RS232 + 2xUSB*] [--] [--] [--] [--]	**J**	[RS232+USB] [ETHERNET] [ETHERNET] [RS232/RS485] [ELECTRIC CAN]
	1	[RS232+USB] [PFO] [RS232/RS485] [ETHERNET] [ELECTRIC CAN]	**K**	[RS232+USB] [RS232 F.M.] [RS232/RS485] [ETHERNET] [ELECTRIC CAN][
	2	[RS232+USB] [GFO ST] [GFO ST] [GFO ST] [ELECTRIC CAN]	**M**	[RS232+2xUSB*] [GFO ST] [GFO ST] [--] [ELECTRIC CAN]
	3	[RS232+USB [GFO ST] [RS232/RS485] [ETHERNET] [ELECTRIC CAN]	**P**	[RS232 + 2XUSB*] [PFO] [RS232/RS485] [ETHERNET] [ELECTRIC CAN]
	9	[RS232+USB] [PFO] [PFO] [--] [ELECTRIC CAN]	**Q**	RS232 + 2XUSB*] [ETHERNET] [RS232/RS485] [RS232/RS485] [ELECTRIC CAN]
	C	[RS232+USB] [GFO ST] [GFO ST] [RS232/RS485] [ELECTRIC CAN]	**R**	[RS232+USB] [RS232 F.M.] [RS232/RS485] [RS232/RS485] [ELECTRIC CAN]
	D	[RS232+USB] [ETHERNET] [RS232/RS485] [RS232/RS485] [ELECTRIC CAN]	**S**	[RS232+2xUSB*] [GFO ST] [RS232/RS485] [ETHERNET] [ELECTRIC CAN]
	E	[RS232+USB] [GFO ST] [RS232/RS485] [RS232/RS485] [ELECTRIC CAN]	**T**	[RS232+USB] [PFO] [GFO ST] [RS232/RS485] [ELECTRIC CAN]
	F	[RS232+USB] [[DOUBLE RING PFO]] [RS232/RS485] [ELECTRIC CAN]	**U**	[RS232+2xUSB*] [PFO] [GFO ST] [RS232/RS485] [ELECTRIC CAN]
	G	[RS232+USB] [PFO] [GFO ST] [GFO ST] [ELECTRIC CAN]	**Y**	[RS232+2xUSB*] [RS232] [RS232/RS485] [ETHERNET] [ELECTRIC CAN]
	H	[RS232+USB] [PFO] [RS232/RS485] [RS232/RS485] [ELECTRIC CAN]	**W**	[RS232+2xUSB*] [GFO ST] [ETHERNET] [ETHERNET] [ELECTRIC CAN]
	I	[RS232+USB] [ETHERNET] [GFO ST] [RS232/RS485] [ELECTRIC CAN]		
	(*) Includes an additional USB FRONT PORT for management of IEC 61850 system.			

(1) Non-compatible with Type M,S, 0 and 1 in 8 digit (Enclosure/Chassis 2U and 3U).

6MCV			N								
	1	2		3	4	5	6	7	8	9	10

6 — Inputs / Outputs

0	8DI + 10DO + 1 Alarm Output + 4 LEDs.	**8**	63DI + 28DO + 1 Alarm Output + 2 Input Transducers (0-5mA or ±2.5mA) + 16 LEDs.
1*	25DI + 16DO + 1 Alarm Output + 2 Input Transducers (0-5mA or ±2.5mA) + 4 LEDs.	**9***	20DI + 23DO + 1 Alarm Output + 4 LEDs.
2*	25DI + 16DO + 1 Alarm Output + 1 Input Transducer (0-5mA or ±2.5mA) + 1 Input Transducer for VDC Supervision (0-300VDC) + 4 LEDs.	**A***	25DI + 16DO + 1 Alarm Output + 2 Input Transducers (4-20mA) + 4 LEDs.
3	44DI + 22DO + 1 Alarm Output + 2 Input Transducers (0-5mA or ±2.5mA) + 16 LEDs.	**B**	44DI + 22DO + 1 Alarm Output + 2 Input Transducers (4-20mA) + 16 LEDs.
4	63DI + 28DO + 1 Alarm Output + 1 Input Transducer (0-5mA or ±2.5mA) + 1 Input Transducer for VDC Supervision (0-300VDC) + 16 LEDs.	**C**	63DI + 28DO + 1 Alarm Output + 2 Input Transducers (4-20mA) + 16 LEDs.
5	82DI + 34DO + 1 Alarm Output + 2 Input Transducers (0-5mA or ±2.5mA) + 16 LEDs.	**D**	82DI + 34DO + 1 Alarm Output + 2 Input Transducers (4-20mA) + 16 LEDs.
6	82DI + 34DO + 1 Alarm Output + 1 Input Transducer (0-5mA or ±2.5mA) + 1 Input Transducer for VDC Supervision (0-300VDC) + 16 LEDs.	**E**	42DI + 22DO + 1 Alarm Output + 4 Input Transducers (4-20mA) + 16 LEDs
7	44DI + 22DO + 1 Alarm Output + 1 Input Transducer (0-5mA or ±2.5mA) + 1 Input Transducer for VDC Supervision (0-300VDC) + 16 LEDs.	**K**	80DI + 34DO + 1 Alarm Output + 3 Input Transducers (0-5mA or ±2.5mA) + 1 Input Transducer for VDC Supervision (0-300VDC) + 16 LEDs.

(*) 16 LEDS in models 6MCV-A. 4 LEDs in models 6MCV-B.

7 — Spare (to be defined in the factory)

00	Standard Model.	**20**	Standard Model and 6V.
06	00 + IEC61850 (MMS services and GOOSE service) v.4 (SBO) with Non-Redundancy, Bonding Redundancy or PRP Redundancy.	**26**	20 + with IEC61850 (MMS services and GOOSE service) v.4 (SBO) with Non-Redundancy, Bonding Redundancy or PRP Redundancy
08	00 + IEC61850 (MMS services and GOOSE service) v.4 (SBO) with Non-Redundancy, Bonding Redundancy or PRP Redundancy or RSTP redundancy + 8 Goose Control Blocks.	**28**	20 + with IEC61850 (MMS services and GOOSE service) v.4 (SBO) with Non-Redundancy, Bonding Redundancy or PRP Redundancyor RSTP redundancy + 8 Goose Control Blocks.
0B	09 + Number of XSWI and CSWI logical nodes increased to 24 and 30 respectively.	**2B**	28 + Number of XSWI and CSWI logical nodes increased to 24 and 30 respectively.
10	Standard Model and 3I+3V (Measures Board).	**30**	10 + binary input synchronization by PPS or PPM.
16	10 + v.4 (SBO) with IEC61850 (MMS services and GOOSE service) with Non-Redundancy, Bonding Redundancy or PRP Redundancy.	**36**	30 + v.4 (SBO) with IEC61850 (MMS services and GOOSE service) with Non-Redundancy, Bonding Redundancy or PRP Redundancy.
18	10 + v.4 (SBO) with IEC61850 (MMS services and GOOSE service) with Non-Redundancy, Bonding Redundancy or PRP Redundancy or RSTP redundancy + 8 Goose Control Blocks.	**38**	30 + v.4 (SBO) with IEC61850 (MMS services and GOOSE service) with Non-Redundancy, Bonding Redundancy or PRP Redundancy or RSTP redundancy + 8 Goose Control Blocks.
1B	18 + Number of XSWI and CSWI logical nodes increased to 24 and 30 respectively.	**3B**	38 + Number of XSWI and CSWI logical nodes increased to 24 and 30 respectively.

8 — Enclosure

M	2U x 1 19” Rack.	**0**	2U x 1 19” Rack + cover.
S	3U x 1 19” Rack - Inputs / Outputs type 1, 2 and A (without graphic display).	**1**	3U x 1 19” Rack + cover - Inputs / Outputs type 1, 2 and A (without graphic display).
Q	4U x 1 19” Rack - Inputs / Outputs type 1, 2, 3, 7, 9, A, B and E. Minimum Size when incorporates graphic display.	**2**	4U x 1 19” Rack + cover - Inputs / Outputs type 1, 2, 3, 7, 9, A, B and E. Minimum Size when incorporates graphic display.
V	6U x 1 19” Rack - Inputs / Outputs type 4, 5, 6, 8, C, D and K.	**4**	6U x 1 19” Rack + cover - Inputs / Outputs type 4, 5, 6, 8, C, D and K.

6MCV			N								
	1	2		3	4	5	6	7	8	9	10

9	**Protocols for Remote Communication** **K** Standard [PROCOME 3.0/DNP 3.0 (Profile v.2)/MODBUS RTU - SERIAL and over ETHERNET for Remote Ports 1, 2 & 3] **M** Standard plus Virtual I/O Protocol for Remote Ports 1 & 2 **N*** Standard plus Virtual I/O Protocol for Remote Ports 1 & 2 + [DNP3 and MODBUS RTU over the IEC61850 ports]
	(*) Not available when the selection in digit 2 (Communication Interfaces for IEC 61850) is 1 (None).
13	**Finishing** **--** Horizontal Rack Mount + [O] Red / [I] Green. **A** Vertical Rack Mount + [O] Red / [I] Green. **L** Horizontal Rack Mount + Conformal Coated Circuit Boards + [O] Red / [I] Green. **M** Horizontal Rack Mount + Conformal Coated Circuit Boards + [O] Red / [I] Green + Texts in English (only for Models with graphic display). **N** Vertical Rack Mount + Conformal Coated Circuit Boards + [O] Red / [I] Green. **P** Vertical Rack Mount + Conformal Coated Circuit Boards + [O] Red / [I] Green + Texts in English (only for Models with graphic display). **Q** Horizontal Rack Mount + Conformal Coated Circuit Boards + [O] Green / [I] Red + For both User Interfaces (with texts in english). **R** Horizontal Rack Mount + Conformal Coated Circuit Boards + [O] Green / [I] Red + Texts in Spanish/Portuguese (only for Models with graphic display). **S** Vertical Rack Mount + Conformal Coated Circuit Boards + [O] Green / [I] Red + For both User Interfaces (with texts in english). **T** Horizontal Rack Mount + Conformal Coated Circuit Boards + [O] Green / [I] Red + Texts in Spanish/Portuguese (only for Models with graphic display) + Box with front IP51.

1.4.2 Models Replaced by others with Higher Functionality and Not Available Options

6MCV			N								
	1	2		3	4	5	6	7	8	9	10

7	**Spare (to be defined in the factory)** **07** 00 + IEC61850 (MMS services and GOOSE service) v.4 (SBO) with Non-Redundancy, Bonding Redundancy or PRP Redundancy or RSTP redundancy. **09** 06 + CID load by frontal port. **17** 10 + v.4 (SBO) with IEC61850 (MMS services and GOOSE service) with Non-Redundancy, Bonding Redundancy or PRP Redundancy or RSTP redundancy. **19** 16 + CID load by frontal port. **27** 20 + with IEC61850 (MMS services and GOOSE service) v.4 (SBO) with Non-Redundancy, Bonding Redundancy or PRP Redundancyor RSTP redundancy. **29** 26 + CID load by frontal port. **37** 30 + v.4 (SBO) with IEC61850 (MMS services and GOOSE service) with Non-Redundancy, Bonding Redundancy or PRP Redundancy or RSTP redundancy. **39** 36 + CID load by frontal port.
9	**Protocols for Remote Communication** **P*** Standard + Virtual I/O Protocol by Remote Ports 1 & 2 + [5 instances by the IEC61850 ports, 1 PROCOME and 4 configurable DNP3 or MODBUS]
	(*) Just when the selection of the Communication interfaces for IEC61850, digit 2, all options except 1 option. Only available with *6 options in 7 digit (Spare).

1.5 Installation and Commissioning

1.5.1 General

Improper handling of electrical equipment is extremely dangerous, therefore, only skilled and qualified personnel familiar with appropriate safety procedures and precautions should work with this equipment. Damage to equipment and injury to personnel can result when proper safety precautions are not followed.

The following general safety precautions are provided as a reminder:

- **High magnitude voltages are present in Power Supply and metering circuits even after equipment has been disconnected.**
- **Equipment should be solidly grounded before handling or operating.**
- **Under no circumstances should the operating limits of the equipment be exceeded (voltage, current, etc.).**
- **The power supply voltage should be disconnected from the equipment before extracting or inserting any module; otherwise damage may result.**

The tests defined next are those indicated for the start-up of a relay. They do not necessarily coincide with the final manufacturing tests to which each manufactured IED is subjected. The number, the type and the specific characteristics of the acceptance tests are model dependent.

1.5.2 Accuracy

The accuracy of the measuring instruments and test source signals (auxiliary power supply voltage, AC currents and AC voltages) is key in electrical testing. Therefore, the information specified in the Technical Data section (2.1) of this manual can only be reasonably verified with test equipment under normal reference conditions and with the tolerances indicated in the UNE 21-136 and IEC 255 standards in addition to using precision instruments.

It is extremely important that there be little or no distortion (<2%) in the test source signals as harmonics can affect internal measuring of the equipment. For example, distortions will affect this IED, made up of non-linear elements, differently from an AC ammeter, because the measurement is made differently in both cases.

It must be emphasized that the accuracy of the test will depend on the instruments used for measuring as well as the source signals used. Therefore, tests performed with secondary equipment should focus on operation verification and not on measuring accuracy.

1.5.3 Installation

- **Location**

The place where the equipment is installed must fulfill some minimum requirements, not only to guarantee correct operation and the maximum duration of useful life, but also to facilitate placing the unit in service and performing necessary maintenance. These minimum requirements are the following:

- Absence of dust
- Absence of humidity
- Absence of vibration
- Good lighting
- Easy access
- Horizontal or vertical mounting

Installation should be accomplished in accordance with the dimension diagrams.

- **Connections**

The first terminal of the terminal block corresponding to the auxiliary power supply must be connected to ground so that the filter circuits can operate. The cable used for this connection should be 14 AWG stranded wire, with a minimum cross section of 2.5 mm^2. The length of the connection to ground should be as short as possible, but not more than 75 inches (30 cm). In addition, the ground terminal of the case, located on the rear of the unit, should be connected to ground.

1.5.4 Preliminary Inspection

The following equipment aspects should be examined:

- The unit is in good physical condition, mechanical parts are securely attached and no assembly screws are missing.
- The unit model number and specifications agree with the equipment order.

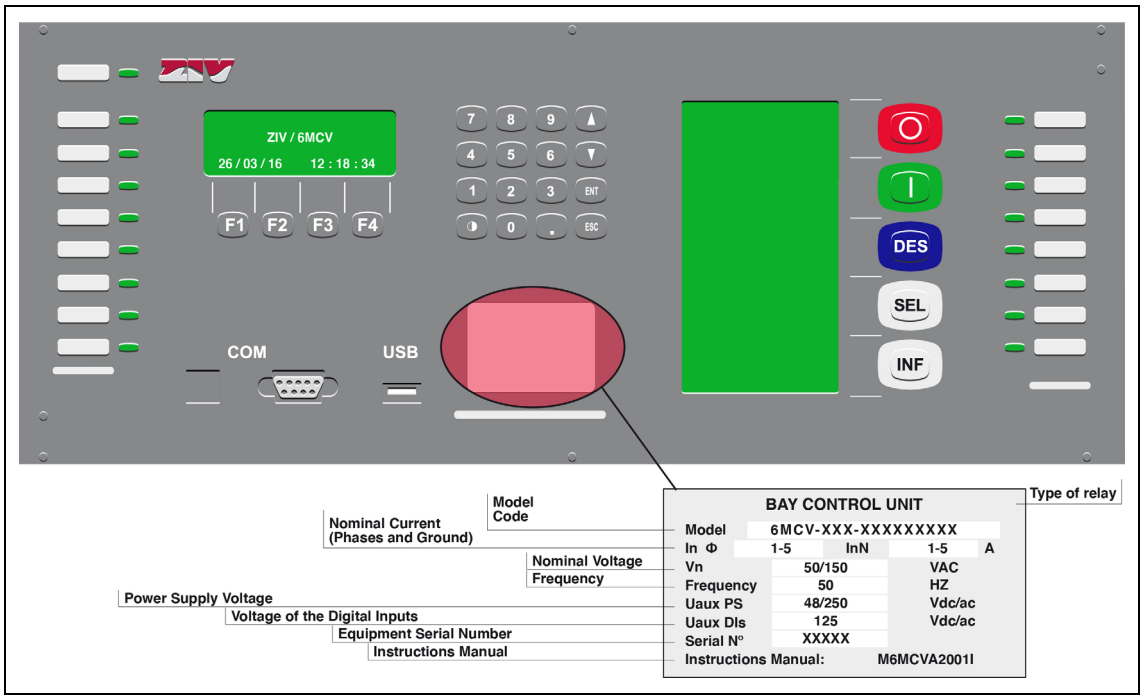


Figure 1.5.1 Name Plate.

1.5.5 Tests

1.5.5.a Isolation Test

While testing for isolation of switchgear and external wiring, the IED must be disconnected to avoid damage in case the test is not performed properly or if there are shorts in the harness, since the manufacturer has performed isolation testing on 100% of the units.

- **Common Mode**

All the terminals of the IED must be short-circuited, except those that relate to the power supply. The enclosure ground terminal must also be disconnected. Then 2000 Vac are applied between the interconnected terminals and the metal case for 1 min or 2500 Vac during 1s between the terminal group and the metal enclosure. When the IED has the inputs, outputs and converters expansion card, terminals of the transducers do not need to be short-circuited (See External Connection Schemes).

- **Between groups**

The isolation groups are made up of the current and voltage inputs (independent channels), digital inputs, auxiliary outputs, trip and close contacts and power supply. Refer to the connection's schematic to identify the terminals to group for performing the test. Then 2500 VAC are applied during 1 sec. between each pair of groups. For the transducers test 1,000 VAC are applied during one second between this group and all the rest.

There are internal capacitors that can generate high voltage if the test points are removed for the insulation test without reducing the test voltage.

1.5.5.b Power Supply Test

Connect the power supply as indicated in following table.

VDC PROT	CON1P	CON2P
C3(+) - C2(-)	D2-D3	D2-D4

It is important to verify that, when the IED is not energized, the contacts designated CON2P in the table mentioned previously are closed, and those designated CON1P are open. Then it is fed its rated voltage and the contacts designated CON1P and CON2P must change state and the “In Service” LED must light up.

1.5.5.c Metering Tests

For this test it should be considered that, if it is required to avoid trips while this is being carried out, the elements should be disabled and the cutoff of the injection of current and/or voltage by the breaker avoided. Subsequently, the currents and voltages which, as an example, are indicated in the following table, will be applied to each of the channels and the following measures will be verified:

Applied Current or Voltage	Measured Current or Voltage	Phase of I or V applied	Phase of I or V measured	Freq. Applied (V > 20 Vac)	Freq. Measured (V > 20 Vac)
X	X ±1%	Y	Y ±1º	Z	Z ±5 mHz

Note: to check high current values, they are applied during the shortest possible time; for example, for 20 A, less than 8 seconds. To be able to view the angles, the phase A voltage must be applied the same as for measuring the frequency.

Chapter 2.

Technical Specifications and Physical Description

2.1 Technical Data

2.1.1 Power Supply Voltage

IEDs have two types of auxiliary power supplies. Depending on the model, their values are selectable:

24 VDC (+20% / -15%)
48 - 250 VDC/VAC (±20%)

Note: In case of power supply failure, a maximum interruption of 100 ms is allowed for 110 VDC input.

2.1.2 Power Supply Burden

Quiescent	**7 W**
Maximum	**<12 W**

2.1.3 Current Analog Inputs

Nominal Value (selectable in the IED)	**In** = **5 A** or **1 A**
Thermal withstand capability	**20 A** (continuously) **250 A** (for 3 s) **500 A** (for 1 s)
Dynamic limit	**1250 A**
Current circuit burden	**<0.2 VA** (In = 5 A or 1 A)

2.1.4 Voltage Analog Inputs

Nominal Value	**Un** = **50** to **230 VAC** (selectable in the IED)
Thermal withstand capability	**300 VAC** (continuously) **600 VAC** (for 10s)
Voltage circuit burden	**0.55 VA** (110/120 VAC)

2.1.5 Frequency

Operating range	**16 - 81 Hz**

2.1.6 Measurement Accuracy

Measured currents (Phase)	**±0.1%** or **±2 mA** (the greater) for In = 1A and 5A
Calculated currents	
Phase - Phase	**±0.2%** or **±6 mA** (the greater)
I_1, I_2 and I_0	**±0.3%** or **±8 mA** (the greater) for In = 1A and 5A
Measured voltages (Phase-Ground)	**±0.1%** or **±50 mV** (the greater)
Calculated voltages	
Phase-Phase (0 to 300V)	**±0.2%** or **±75 mV** (the greater)
V_1, V_2 and V_0	**±0.3%** or **±100 mV** (the greater)
Active and reactive powers (In = 5A and I_{phases}>1A)	
Angles 0º or ±90º or 180º	**±0.33% W/var**
Angles ±45º or ±135º	**±1.6% W/var**
Angles ±75º / ±115º	**±5% W / ±0.65 % var**
Angles	**±0.5º**
Power factor	**±0.013**
Frequency	**±0.005 Hz**

Note: Signal processing

Sampling function adjustment of analog input signals is made by means of zero pass count of one of the measured signals, and works detecting the change in said signal period. The value of the calculated frequency is used to modify the sampling frequency used by the metering device attaining a constant sampling frequency of 32 samples per cycle. The frequency value is saved for later use in Protection and Control tasks.

Zero crossing is detected by the voltage channel VA or VAB. When VA phase voltage falls below 2 volts is not possible to measure frequency. In case of loosing phase voltage the unit operates as follows:

- **If the measured phase voltage is equal or larger than 2V for VB or VC, the last sampling frequency is kept.**
- **If all phase voltages are below 2V, the rated frequency is used as the sampling frequency.**

When Protection and Control tasks are readjusted in accordance with the sampling function, phasor real and imaginary components of analog signals are calculated by means of the Fourier transform. Fourier components are calculated by means of said Discrete Fourier Transform (DFT) using 32 sample/cycle. Using DFT this way the magnitude and phase angle of the fundamental component at power system frequency of every analog input signal is obtained. The rest of measurements and calculations of Protection functions is obtained based on the fundamental components calculated by the Fourier method. DFT gives a precise measurement of the fundamental frequency component and it is an efficient filter for harmonics and noise.

Harmonics are not completely damped for frequencies other than the nominal frequency. This is not a problem for small deviations of ±1Hz but, in order that a greater deviation from the working frequency can be allowed, the above-mentioned automatic adjustment of the sampling frequency is included. On lack of an adequate signal for sampling frequency adjustment, said frequency is adjusted to the corresponding nominal frequency (50/60Hz).

Angles reference for all the measurements displayed on the device corresponds to the channel VA.

2.1.7 Digital Inputs

Configurable inputs with polarity (IN1 is AC; the rest are DC)

Nominal Voltage	Maximum Voltage	Burden	V on	V off
110/125 VAC	250 VAC	350 mW	90 VAC	46 VAC
24 VDC	48 VDC	50 mW	12 VDC	9 VDC
48 VDC	90 VDC	500 mW	30 VDC	25 VDC
125 VDC	300 VDC	800 mW	75 VDC	60 VDC
125 VDC (Act.>65%)	300VDC	800mW	93VDC	83VdDC
250 VDC	500 VDC	1 W	130 VDC	96 VDC

IN3 to **IN8** inputs can be programmed to monitor the switching circuits. Two different ranges are available:

For IEDs with 24 VDC digital inputs: monitoring voltage of 24 VDC
For IEDs with 48 VDC, 125 DC or 250 VDC digital inputs: monitoring voltage of 48 VDC to 250 VDC

Note: digital input IN1, with an AC supply has an approximated activation and deactivation time of 150 ms.

2.1.8 Auxiliary Outputs

2 contacts normally open for each switching, one of them internally configurable to closed and 6 or 12 (depending on the model) auxiliary contacts, normally open.

I DC maximum limit (with resistive load)	**60 A** (1 s)
I DC continuous service (with resistive load)	**16 A**
Close	**5000 W**
Breaking capability (with resistive load)	**240 W** - max. 5 A - (48 VDC) **110 W** (80 VDC - 250 VDC) **2500 VA**
Break (L/R = 0.04 s)	**120 W** at 125 VDC
Switching voltage	**250 VDC**
Momentary close time trip contacts remain closed	**100 ms**
Break delay	**<150 ms**

2.1.9 Input Transducers

Input impedance	**511 Ω**
0-5mA and ±2.5mA input transducer	
Measurement accuracy	**±0.2 %** or **±0.003 mA** (the greater)
4-20 mA input transducers	
Measurement accuracy (between 4mA and 24mA)	**±0.2 %** or **±0.010 mA** (the greater)
Voltage transducers (power supply monitoring for 125VDC and 250VDC)	
Measurement accuracy (between 70VDC and 350VDC)	**±0.2 %** or **±0.5 V** (the greater)
Voltage transducers (power supply monitoring for 24VDC and 48VDC)	
Measurement accuracy (between 10VDC and 70VDC)	**±0.2 %** or **±0.2 V** (the greater)

2.1.10 Communications Link

Local Communications Port (RS232C and USB)
Remote Communications Ports (GFO, PFO, RS232C, RS232-Full MODEM or RS485)
Ports LAN (RJ45)
Electric Bus

Glass Fiber Optics (Remote Ports)

Type	**Multimode**
Wavelength	**820 nm**
Connector	**ST**
Transmitter Minimum Power:	
50/125 Fiber	**- 20 dBm**
62.5/125 Fiber	**- 17 dBm**
100/140 Fiber	**- 7 dBm**
Receiver Sensitivity:	**- 25.4 dBm**

Glass Fiber Optics (Ports LAN)

Type	**Multimode**
Wavelength	**1300 nm**
Connector	**MT-RJ**
Transmitter Minimum Power	
50/125 Fiber	**- 23.5 dBm**
62.5/125 Fiber	**- 20 dBm**
Receiver Sensitivity:	**- 34.5 dBm**

Plastic Fiber Optics (1 mm)

Wavelength	**660 nm**
Transmitter Minimum Power	**- 16 dBm**
Receiver Sensitivity	**- 39 dBm**

RS232C Port Signals

Terminal unit DB-9 (9-pin) connectors	**Pin 5 - GND**
	Pin 2 - RXD
	Pin 3 - TXD

RS232C Full MODEM Port Signals

Terminal unit DB-9 (9-pin) connectors

Pin 1 - DCD
Pin 2 - RXD
Pin 3 - TXD
Pin 4 - DTR
Pin 5 - GND
Pin 6 - DSR
Pin 7 - RTS
Pin 8 - CTS
Pin 9 - RI

RS485 Port Signals

Used signals

Pin 4 - (A) TX+ / RX+
Pin 6 - (B) TX- / RX-

RJ45 Port Signals

Used signals

Pin 1 - TX+
Pin 2 - TX-
Pin 3 - RX+
Pin 4 - N/C
Pin 5 - N/C
Pin 6 - RX-
Pin 7 - N/C
Pin 8 - N/C

Electric Bus

Used signals

Pin 1 - High
Pin 2 - Low
Pin 3 - GND

IRIG-B 123 and 003	B: 100pps	
	1: Amplitude modulated wave	0: By pulse width
	2: 1kHz/1ms	0: Without carrier
	3: BCD, SBS	3: BCD, SBS

Type BNC connector

Input impedance	**41 Ω, 211 Ω** or **330 Ω (*)**
Default impedance	**211 Ω**
Maximum input voltage	**10 V**
Synchronization Accuracy	**± 1ms**

When the device is receiving a IRIG-B signal for synchronization both Date and Time settings will not be available through the HMI.

It is possible to configure one of the auxiliary outputs to check the IRIG-B signal status. This output will remain active as long as the IRIG-B signal reception is correct.

All the devices are also designed to give an indication for both the loss and recovery of such IRIG-B signal by generating the particular event.

(*) Selectable internally by the manufacturer.

2.2 Standards and Type Tests

The equipment satisfies the standards indicated below. When not specified, the standard is UNE 21-136 (IEC-60255).

2.2.1 Insulation

Insulation Test (Dielectric Strength)	*IEC-60255-5*
Between all circuit terminals and ground	**2 kV**, **50/60 Hz**, for 1 min; or **2.5 kV**, **50/60 Hz**, for 1s
Between all circuit terminals	**2 kV**, **50/60 Hz**, for 1min; or **2.5 kV**, **50/60 Hz**, for 1s
Measurement of Insulation Resistance	*IEC-60255-5*
Common mode	**R ≥ 100 MΩ** or **5μA**
Differential mode	**R ≥ 100 kΩ** or **5Ma**
Voltage Impulse Test	*IEC-60255-5 (UNE 21-136-83/5)*
Common mode (analog inputs, DIs, AOs and PS)	**5 kV**; **1.2/50 μs**; **0.5 J**
Differential mode (AOs)	**1 kV**; **1.2/50 μs**
Differential mode (Power Supply)	**3 kV**; **1.2/50 μs**

2.2.2 Electromagnetic Compatibility

1 MHz Burst Test	*IEC-60255-22-1 Class III* *(UNE 21-136-92/22-1)*
Common mode	**2.5kV**
Differential mode	**2.5kV**
Fast Transient Disturbance Test	*IEC-60255-22-4 Class IV* *(UNE 21-136-92/22-4)* *(IEC 61000-4-4)* **4 kV ±10 %**
Radiated Electromagnetic Field Disturbance	*IEC 61000-4-3 Class III*
Amplitude modulated	*(EN 50140)***10 V/m**
Pulse modulated	*(EN 50204)***10 V/m**
Conducted Electromagnetic Field Disturbance	*IEC 61000-4-6 Class III (EN 50141)*
Amplitude modulated	**10 V**
Electrostatic Discharge	*IEC 60255-22-2 Class IV* *(UNE 21-136-92/22-2) (IEC 61000-4-2)*
On contacts	**±8 kV ±10 %**
In air	**±15 kV ±10 %**

Surge Immunity Test	*IEC-61000-4-5 (UNE 61000-4-5)* **(1.2/50µs - 8/20µs)**
Between conductors	**4 kV**
Between conductors and ground	**4 kV**

Radiated Electromagnetic Field Disturbance at Industrial Frequency (50/60 Hz)	*IEC61000-4-8*

Radio Frequency Emissivity	*EN55022* (Radiated) *EN55011* (Conducted)

2.2.3 Environmental Test

Temperature	*IEC 60068-2*
Cold work	*IEC 60068-2-1* **-5º C**, **2 hours**
Cold work limit conditions	*IEC 60068-2-1* **-10º C**, **2 hours**
Dry heat	*IEC 60068-2-2* **+45º C**, **2 hours**
Dry heat limit conditions	*IEC 60068-2-2* **+55º C**, **2 hours**
Humid heat	*IEC 60068-2-78* **+40º C**, **93%** relative humidity, **4 days**
Quick temperature changes	*IEC 60068-2-14 / IEC 61131-2* IED open, **-25º C** for **3h** and **+70º C** for **3h** (**5 cycles**)
Changes in humidity	*IEC 60068-2-30 / IEC 61131-2* **+55º C** for **12h** and **+25º C** for **12h** (**6 cycles**)
Endurance test	**+55º C** for **1000 hours**

Operating range	From **-40ºC** to **+85ºC** (standard model) From **-40ºC** to **+70ºC** (model with IEC61850 communications interface)
Storage range	From **-40ºC** to **+85ºC** (standard model) From **-40ºC** to **+70ºC** (model with IEC61850 communications interface)
Humidity	**95 %** (non-condensing)

Climate Test (55º, 99% humidity, 72 hours)

Time / Current Characteristic	*ANSI C37.60 Class II*

2.2.4 Power Supply

Power Supply Interference and Ripple	*IEC 60255-11 / UNE 21-136-83 (11)* **< 20 %** and **100 ms**
Inverse Polarity of the Power Supply	*IEC 61131-2*
Resistance of Ground Connection	*IEC 61131-2* **< 0.1 Ω**
Gradual Stop / Start Test	*IEC 61131-2* (Test A)
Surge Capacity	*IEC 60044-1*

2.2.5 Mechanical Test

Vibration (sinusoidal)	*IEC-60255-21-1 Class I*
Mechanical Shock and Bump Test	*IEC-60255-21-2 Class I*
External Protection Levels	*IEC-60529 / IEC 60068-2-75*
Front	*IP31 (without protection cover)* *IP51 (with protection cover)*
Rear Protection	*IP10*
Mechanical Protection	*IK07*

The models comply with the EEC 89/336 standard of electromagnetic compatibility.

2.3 Physical Architecture

2.3.1 General

The equipments are made up of the following boards:

- Power Supply.
- Processor module and analog inputs.
- Digital inputs, outputs and transducers input.
- Communications module.

The boards, or modules, are mounted horizontally and can be extracted by removing the front panel. External connections use plug-in terminal blocks on the rear panel of the enclosure, with ring lug connectors. Depending on the terminal configuration, all the contact inputs / outputs may be used or some may remain as spare signals.

Figures 2.3.1 and 2.3.2 represent the external appearance of the 4-unit high (19"-rack) **6MCV** models.

Mounted on the front are the alphanumeric keypad and display, the local communication ports (RS232C and USB), the graphic display and the LED targets.

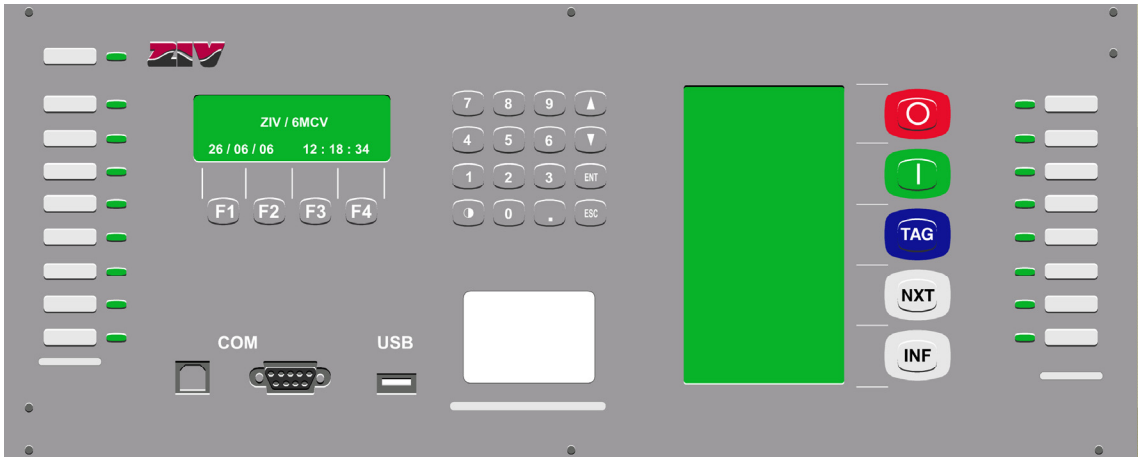


Figure 2.3.1 Front of a 4- Unit High 6MCV.

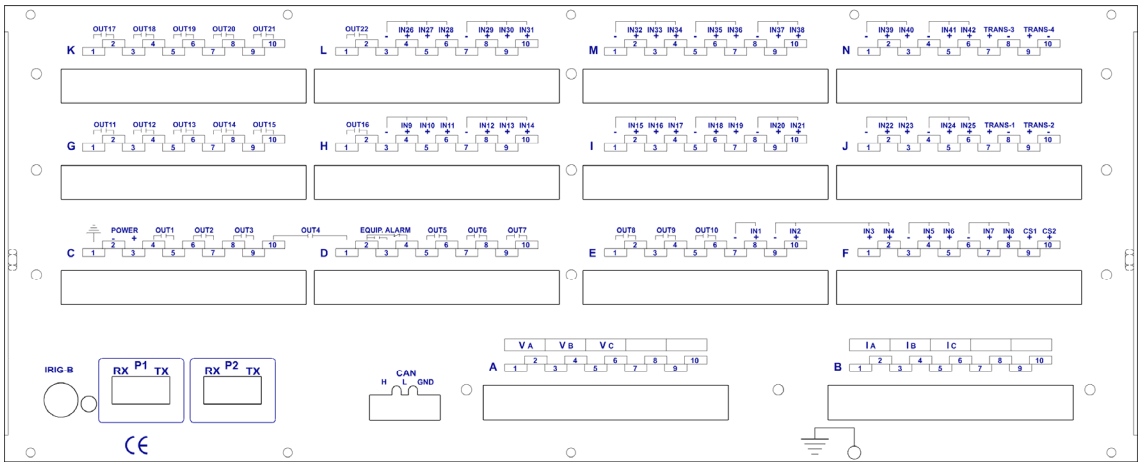


Figure 2.3.2 Rear of a 4-Unit High 6MCV.

There is another model with 6U and 19” rack width with a front panel with that same characteristics and a rear panel with additional terminals for expansion of digital inputs. Figures 2.3.3 and 2.3.4 represent the external appearance of this equipment.

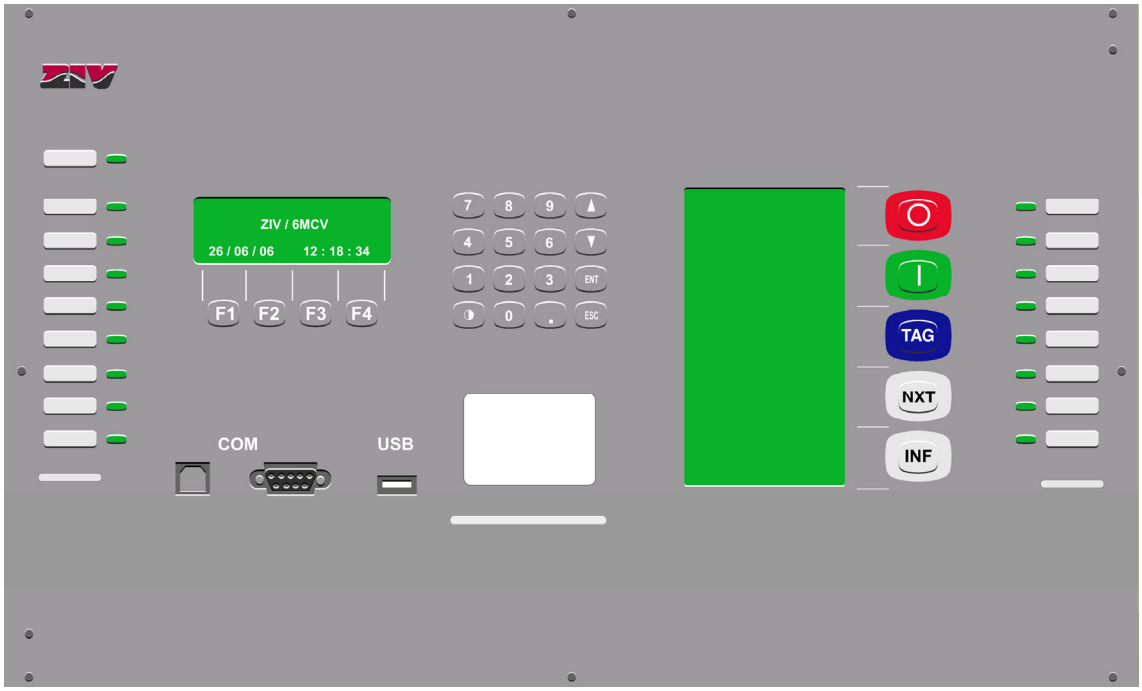


Figure 2.3.3 Front of a 6-Unit High 6MCV.

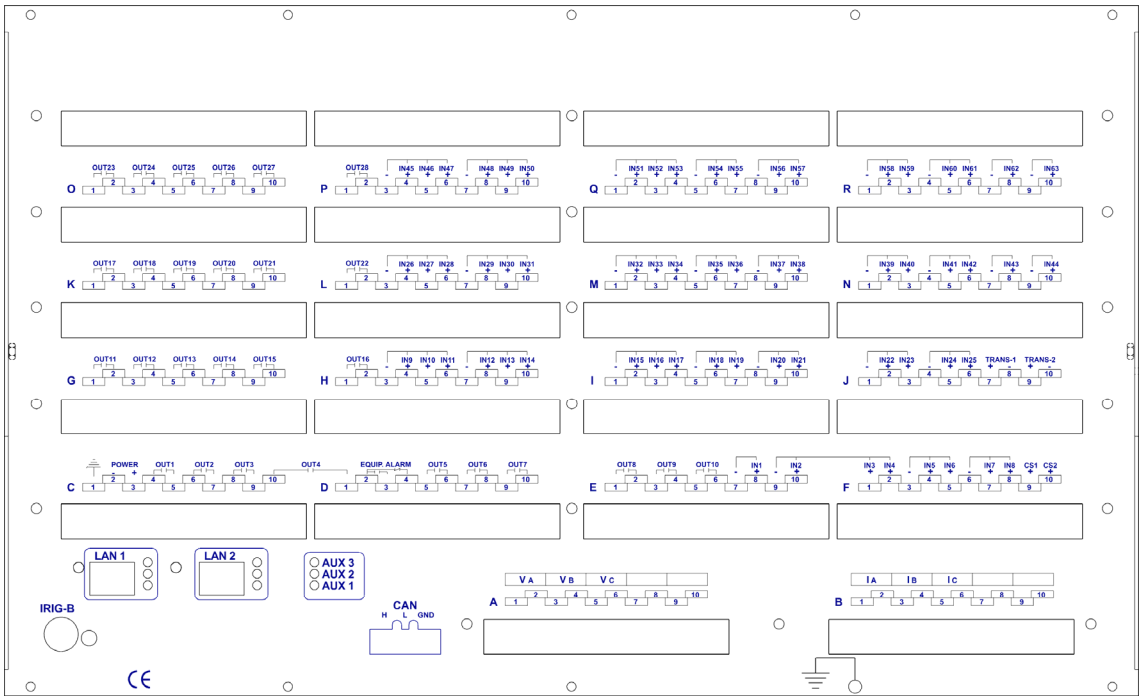


Figure 2.3.4 Rear of a 6-Unit High 6MCV.

There are also 2U and 3U height models. This last configuration is reserved for equipment with no graphic display.

6MCV models can also be installed vertically, 4U high with a 19" wide *rack*, with special features on the front, and a back plate with additional terminals to increase the number of inputs. Figures 2.3.5 and 2.3.6 represent the external appearance of this equipment

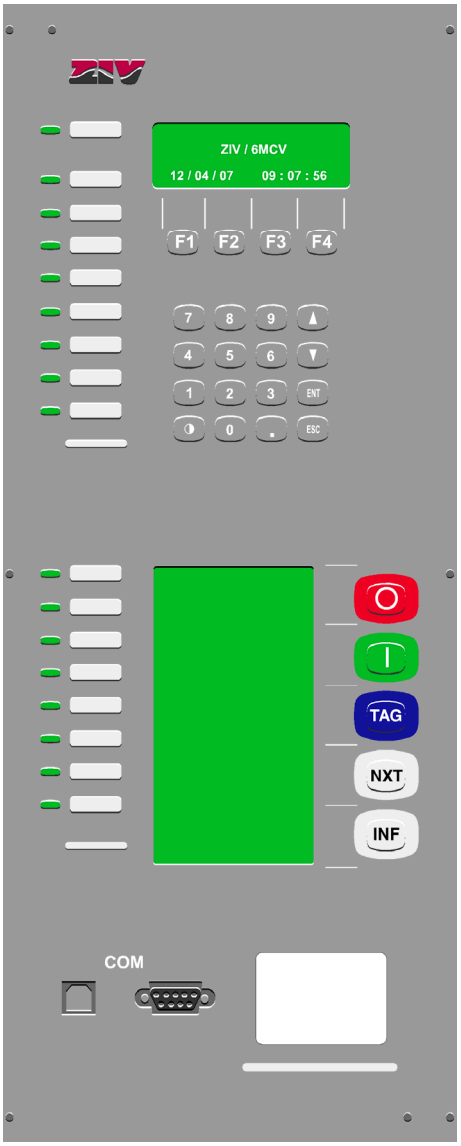


Figure 2.3.5 Front of a 4-Unit High 6MCV in vertical format.

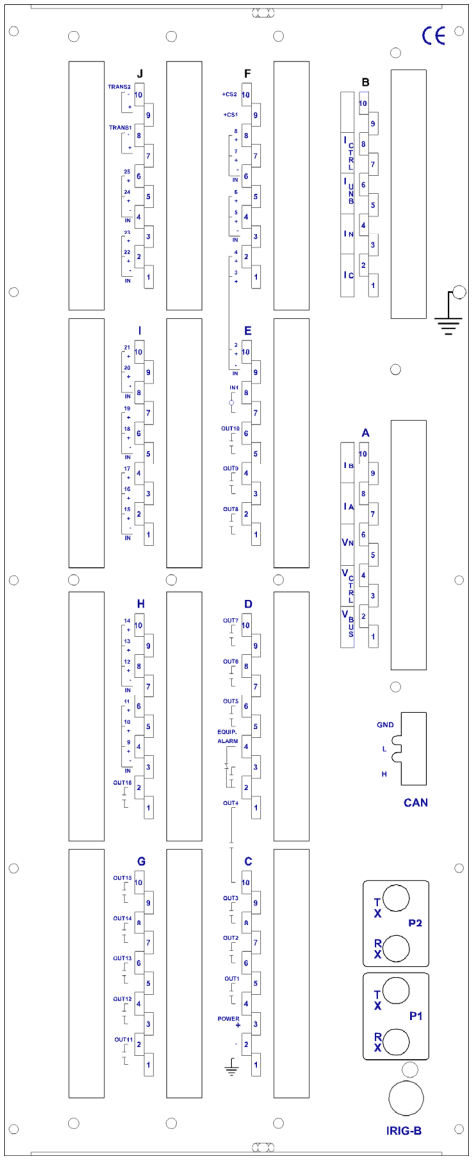


Figure 2.3.6 Rear of a 4-Unit High 6MCV in vertical format.

All **6MCV** relay models (enclosure: 2U, 3U, 4U and 6U) can include, as an option, a front cover with a pushbutton to access the key **F2**. Relay models with 4U and 6U high can include the same front cover with 5 additional pushbuttons to control the bay through the graphical HMI. Figure 2.3.7 show the front cover and pushbuttons supplied, as an option, with relay model of 4U high.

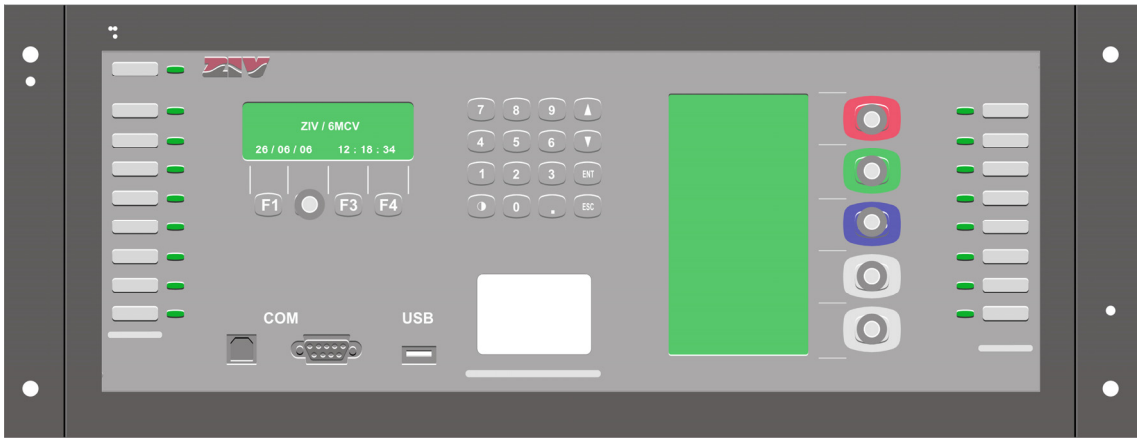


Figure 2.3.7 Front of 4- Unit High 6MCV with Protection Cover.

2.3.2 Dimensions

Depending on the model, the relays are mounted as follows:

- Models in enclosures of 1 19"-, 2 standard units high.
- Models in enclosures of 1 19"-, 3 standard units high.
- Models in enclosures of 1 19"-, 4 standard units high (Minimum size when graphic display is incorporated).
- Models in enclosures of 1 19"-, 6 standard units high.

The equipment is intended to be installed either semi-flush mounted on panels or inside a 19" rack. The enclosure is graphite gray.

2.3.3 Connection Elements

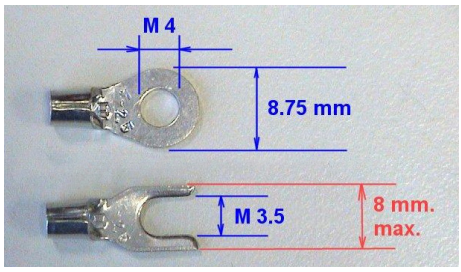
2.3.3.a Terminal Blocks

The number of connectors depends on the number of the model's contact inputs and outputs. Moreover, the terminal blocks are arranged differently depending on the model (2-units or 3-units high).

Terminal blocks are horizontal as shown in the figures 2.3.2 and 2.3.4. The terminal arrangement, for example for the 4-units high **6MCV** model, is as follows:

- 1 row with 2 terminal blocks of 10 inputs each (20 terminals) for analog currents and voltages plus all the communication and synchronization connectors.
- 3 rows with 4 terminal blocks of 10 terminals each (40 terminals) for digital inputs, auxiliary outputs, trip and close contacts and power supply input.

The self-shorting ring lug terminals take wires up to #10 AWG (6 mm^2). We recommend ring lug terminals for these connections. The connectors are plug-in and not self-shorting. They can be assigned to the current circuits supporting a current of 20 A continuously.



2.3.3.b Removing Printed Circuit Boards (Non Self-shorting)

The IED's printed circuit board can be taken out. **WARNING: the current connector is non self-shorting. Consequently, the CT secondaries must be short-circuited externally before board removal.**

The printed circuit board is attached to the case with self-tapping screws. These screws must be removed before the board is withdrawn. This operation always requires the protection to be **not in service**.

2.3.3.c Internal Wiring

The equipment uses traditional printed circuit board connections and internal buses to minimize internal wiring.

Chapter 3.

Functions and Description of Operation

3.1 Frequency Measurement

3.1.1 Introduction

6MCV relays with analog channels are provided with Frequency Measurement from VA voltage channel.

Said measurement is associated to the **Inhibit Voltage** setting. This setting checks whether the voltage is above a given value. If so, the measurement is enabled. Otherwise frequency reading is zero.

Frequency is set to zero when the voltage measured value is equal or less than the pickup value (100% of setting), and resets when the measured value is greater or equal to 105% of the setting value provided this condition is met at least during 10 consecutive cycles. This check over a 10 cycle period guarantees a stable voltage.

In any case, the relay may not measure frequencies for voltages less than 2 volt, so that frequencies are always zero under these circumstances.

3.1.2 Frequency Measurement Settings

Frequency Measurement Settings			
Setting	**Range**	**Step**	**Default**
Inhibit Voltage	2 - 150 V	1 V	2 V

- **Frequency Measurement: HMI Access**

0 - CONFIGURATION	0 - GENERAL	**0 - FREQUENCY**
1 - ACTIVATE GROUP	**1 - METERING**	
2 - CHANGE SETTINGS	2 - CIRCUIT COIL SUPERV	
3 - INFORMATION	…	

0 - FREQUENCY	**0 - INHIBIT VOLTAGE**

3.1.3 Auxiliary Outputs and Events of Frequency Measurement Module

Table 3.1-1: Auxiliary Outputs and Events of Frequency Measurement Module		
Name	**Description**	**Function**
BLK_MIN_V	Frequency disable on lack of voltage	Frequency measurement sets to zero on lack of VA channel voltage.

3.2 Configuration Settings

3.2.1 Introduction

The following setting groups are included into the Configuration group: Nominal Values, access Passwords, Communications, Operation Enable, Date and Time, Contrast adjustment and Graphic MMI Configuration.

3.2.2 Nominal Values (Operation Mode)

Nominal operating values are selected through Operating Mode settings, both for current and voltage. Following parameters can be selected:

- Nominal phase current.
- Nominal phase voltage: nominal phase-to-phase voltage setting is the reference value for all settings expressed in times or % *nominal voltage*.
- Nominal Frequency: to select system nominal frequency, regardless whether the frequency adaptation system is later capable of adjusting to changes produced in this magnitude.

After modification of any of the settings above, only accessible from HMI display, relay resets the same as if it were switched off and then switched on; no setting or information is lost.

3.2.3 Access Passwords

The Passwords option allows changing access passwords for options: Configuration, Operations and Settings.

Select the Configuration option to change access password for configuration group options. Also, different passwords can be configured for operations and settings modification options.

3.2.4 Communications

See paragraph 3.11 on Communications.

3.2.5 Date and Time

Selecting date and time in the configuration menu displays this setting to configure relay date and time.

3.2.5.a Local Time Zone Setting

If **Time Zone IRIG-B** is set to **UTC**, a time correction must be introduced to adapt the relay to the local time zone. Setting **Local Time Zone** allows putting UTC time forward or back as required.

3.2.5.b Summer Time / Winter Time Change

Relay allows configuring the dates when summer time / winter time change takes place. In the first case the relay clock is put one hour forward (+1 Hour). In the second case the relay clock is put one hour back (-1 Hour) for the winter season.

To configure a change of season the following must be specified:

- **Begin Time**: time when change of season takes place. Range 0 to 23 h.
- **Begin Day Type**: type of day when change of season takes place. It can take the following values **First Sunday**, **Second Sunday**, **Third Sunday**, **Fourth Sunday**, **Last Sunday** of the month and **Specific Day**.
- **Begin Day**: in case **Specific Day** is selected, state in which specific day of the month the change of season takes place.
- **Begin Month**: state the month in which the change of season takes place.

These settings are independent for the summer and winter seasons.

Note: if the Begin Day setting value is higher than the number of days of a given month, the last valid day of said month is taken as the day for the change of season.

The change of season function can be activated or deactivated through **Summer Time / Winter Time Change Enable** setting.

3.2.6 Contrast Adjustment

This setting modifies the display contrast value (high value = more contrast).

3.2.7 Configuration Settings

Nominal Values			
Setting	**Range**	**Step**	**Default**
Nominal IABC	1 A / 5 A		5 A
Nominal VABC	50 - 230 V		110 V
Nominal Frequency	50 Hz / 60 Hz		50 Hz

Passwords
The factory-specified access password (full access) is 2140. Nevertheless, you can change the password to access the following options with the keypad: **Configuration**, **Operations** and **Settings**.

Communications
See 3.11

Contrast
Adjustable from the keypad

Graphic HMI Configuration
See 1.3

Date and Time			
Setting	**Range**	**Step**	**Default**
Local Time Zone	GMT+(0, 1, 2, 3, 3:30, 4, 4:30, 5, 5:30, 5:45, 6, 6:30, 7, 8, 9, 9:30, 10, 11, 12) GMT-(1, 2, 3, 3:30, 4, 5, 6, 7, 8, 9, 9:30, 10 ,11)		GMT+01:00
Summer Time / Winter Time Change Enable	YES / NO		NO
Summer Begin Time	0 - 23 Hours	1	2
Summer Begin Day Type	0 = Specific day 1 = First Sunday of the month 2 = Second Sunday of the month 3 = Third Sunday of the month 4 = Fourth Sunday of the month 5 = Last Sunday of the month		Last Sunday of the month
Summer Begin Day	1 - 31	1	1
Summer Begin Month	January, February, March, ...	1	March
Winter Begin Time	0 - 23 Hours	1	3
Winter Begin Day Type	0 = Specific day 1 = First Sunday of the month 2 = Second Sunday of the month 3 = Third Sunday of the month 4 = Fourth Sunday of the month 5 = Last Sunday of the month		Last Sunday of the month
Winter Begin Day	1 - 31	1	1
Winter Begin Month	January, February, March, ...	1	March

- **Configuration Settings: HMI Access**

0 - CONFIGURATION	**0 - NOMINAL VALUES**	**0 - NOMINAL IABC**
1 - ACTIVATE GROUP	1 - PASSWORDS	**1 - NOMINAL VABC**
2 - CHANGE SETTINGS	2 - COMMUNICATIONS	**2 - NOMINAL FREQ.**
3 - INFORMATION	3 - TIME AND DATE	
	4 - CONTRAST	
	5 - HMI DIAGRAM CONF.	

0 - CONFIGURATION	0 - NOMINAL VALUES	**0 - CONFIGURATION**
1 - ACTIVATE GROUP	**1 - PASSWORDS**	**1 - OPERATIONS**
2 - CHANGE SETTINGS	2 - COMMUNICATIONS	**2 - SETTINGS**
3 - INFORMATION	3 - TIME AND DATE	
	4 - CONTRAST	
	5 - HMI DIAGRAM CONF.	

0 - CONFIGURATION	0 - NOMINAL VALUES	**0 - PORTS**
1 - ACTIVATE GROUP	1 - PASSWORDS	**1 - PROTOCOLS**
2 - CHANGE SETTINGS	**2 - COMMUNICATIONS**	
3 - INFORMATION	3 - TIME AND DATE	
	4 - CONTRAST	
	5 - HMI DIAGRAM CONF.	

0 - CONFIGURATION	0 - NOMINAL VALUES	**0 - TIME AND DATE**
1 - ACTIVATE GROUP	1 - PASSWORDS	**1 - LOCAL TIME ZONE**
2 - CHANGE SETTINGS	2 - COMMUNICATIONS	**2 - SUMMER/WINTER ENAB**
3 - INFORMATION	**3 - TIME AND DATE**	**3 - SUMMER START HOUR**
	4 - CONTRAST	**4 - TYPE OF SUMMER DAY**
	5 - HMI DIAGRAM CONF.	**5 - SUMMER STARTINGDAY**
		6 - SUMMER START MONTH
		7 - WINTER START HOUR
		8 - TYPE OF WINTER DAY
		9 - WINTER STARTINGDAY
		10 - WINTER START MONTH

0 - CONFIGURATION	0 - NOMINAL VALUES	**0 - T RETURN**
1 - ACTIVATE GROUP	1 - PASSWORDS	**1 - CONTRAST**
2 - CHANGE SETTINGS	2 - COMMUNICATIONS	
3 - INFORMATION	3 - TIME AND DATE	
	4 - CONTRAST	
	5 - HMI DIAGRAM CONF.	

3.3 General Settings

3.3.1 Introduction

The following settings are included within the General Settings group: Unit in Service, Transformer Ratios, Phase Sequence and Transducer Type selection.

3.3.2 Unit In Service

Relay enabled (**YES**), means that all relay functions work normally (dependent on function settings).

If relay is disabled (**NO**), all functions are restricted to measurement operations only. Measurements are visualized on display and through local and remote communications.

3.3.3 Transformer Ratios

Transformer ratio defines how analog values are displayed on the protection display. If transformer ratio is set to 1, secondary values are displayed. If, on the other hand, the transformer ratio corresponding to analog input adapter transformer is selected, primary values are displayed. Settable Transformer Ratios are:

- Phase current (depending on model).
- Phase voltage (depending on model).

In all cases, all overcurrent and overvoltage protection element settings are referred to secondary values. Programmable logic analog settings could refer both to secondary and primary values.

3.3.4 Input Transducers

Depending on the relay model, input current transducers are included. For the same HW, the following converter options can be selected: 0 to 5mA and –2.5 to +2.5 mA. However, converters from 4 to 20 mA are single type converters and have specific HW.

It is through the programmable logic that the converter can be allocated with a magnitude and a constant to represent the true reading (current, voltage, power,...) and the transformation ratio. The measured current in mA is turned into the actual measured magnitude and shown on the display (V, A, W,...).

Note: if range –2.5 to +2.5mA is selected, transducer measurement reaches +/-3mA. For a setting 0 to 5mA measurement reaches +5.587mA. For a setting 4 to 20mA measurement reaches up to 24mA.

3.3.4.a Models with Power Supply Voltage Monitoring

In models incorporating Power Supply Voltage Monitoring function, the relay is provided with a specific HW that allows direct current measurements. Two types of transducers exist depending on nominal voltage of the digital inputs:

- For 24Vdc and 48Vdc digital input relays.
- For 125Vdc and 250Vdc digital input relays

The measured magnitude is available for display and recording in all functions using “user magnitudes” (HMI, ***Zivercomplus***®, Oscillograms, Events, Logs, Programmable Logic, Protocols,...).

As for the rest of transducers, they have the same characteristics as in paragraph 3.3.3.

3.3.5 Phase Sequence

Power system phase sequence (ABC or ACB) can be selected in order to adequately calculate sequence components.

The **Phase Sequence** setting tells the relay the actual system rotation and all functions operate correctly if analogue current and voltage connections are the same as indicated for A, B and C phases in the external connection scheme.

3.3.6 General Settings

Unit In Service			
Setting	**Range**	**Step**	**Default**
Unit In Service	YES / NO		YES

Transformation Ratio			
Setting	**Range**	**Step**	**Default**
Phase CT Ratio	1 - 3000	1	1
Phase VT Ratio	1 - 4000	1	1

Phase Sequence			
Setting	**Range**	**Step**	**Default**
Phase Sequence	ABC / ACB		ABC

Transducers			
Setting	**Range**	**Step**	**Default**
Transducer Type	0: 0 - 5 mA 1: -2.5 ¸ +2.5 mA		-2.5 ¸ +2.5 mA

Event Mask (Via Communications)	
Event Mask	YES / NO

- **General Settings: HMI Access**

0 - CONFIGURATION	**0 - GENERAL**	**0 - UNIT IN SERVICE**
1 - ACTIVATE GROUP	1 - METERING	**1 - PHASE CT RATIO**
2 - CHANGE SETTINGS	2 - CIRCUIT COIL SUPERV	**2 - PHASE VT RATIO**
3 - INFORMATION	…	**3 - CONVERTERS**
		4 - PHASE SEQUENCE

3.4 Trip and Close Coil Circuit Supervision

3.4.1 Description

This function permits an alarm when an anomalous situation occurs in the breaker's switching circuits: losses of the auxiliary switching power supply voltage or openings in the open and close circuits themselves. Up to three switching circuits can be monitored. Each of them can be set to both breaker positions (open and closed) or only to one of them.

This monitor function can generate three outputs: **Trip Circuit Supervision Failure** (**FAIL_SUPR**), **Switching Circuit Failure 2** (**FAIL_CIR2**) and **Switching Circuit Failure 3** (**FAIL_CIR3**), which the programmable logic can use to activate any of the IED's auxiliary contact outputs, also generating the corresponding events.

The three supervisions are treated separately as independent functions that can be independently set to enabled by means of a setting. Figure 3.4.1 is the block diagram showing the application in the situation of open breaker for two circuits with open and closed monitoring.

3.4.2 Operation Mode

There are settings for supervising the state of three coils: Trip Coil, Coil 2 and Coil 3. Coils 2 and 3 may be trip or close. Hence their generic name.

Each of the coils has an associated pair of configurable digital inputs for monitoring. They can be paired to **Supervision in 2 States**, which is explained next, or individually to **Supervision in 1 State**. In any case, both modes can be combined for different coils (for example, to monitor the trip coil in open and closed, and coil two only in open).

Table 3.4-1 identifies the status contact inputs that must be used to monitor each of the circuits.

Table 3.4-1: Configuration of Digital Inputs for Supervision

Monitored Circuit	Supervision in 2 states	Supervision in one state
Trip Coil	IN3	IN3
	IN4	-
Coil 2	IN5	IN5
	IN6	-
Coil 3	IN7	IN7
	IN8	-

All these digital inputs do not need to be configured in advance to perform the coils supervision function. By enabling any of the coils supervision, each pair of digital inputs will be automatically configured as per the table above.

Moreover, to monitor the Trip Coil and Coil 2, a positive must be entered through terminal CS1+, and to monitor coil 3, a positive must be entered through terminal CS2+.

The IED needs no physical intervention to be able to assign status contact inputs for the Supervision function; they simply need to be set for this purpose.

Each of the three coils can be configured as:

1. **No supervision**: The supervision algorithm is not executed and the status contact inputs associated with the supervision of each of the coils are treated as standard status contact inputs.
2. **Supervision in 2 states**: The algorithm is the one indicated by way of example in figure 3.20.1 and explained in section 3.4.3. Basically, an XOR algorithm supervises the state of the switching circuit in open as well as in closed.
3. **Supervision in 1 state**: The algorithm only takes into account the supervision of the coil in the breaker's position configured in the input used for this purpose (IN3, IN5 or IN7). It does not monitor in the other position and therefore can never detect a fault in the coil.

For each of the monitored coils, it is possible to set a time after which, if there is discordance, the Failure is activated.

Trip and Close Coil Circuit Supervision is not sensitive to the impedance of the circuits seen from the relay. Its operating principle is based on an injection of current pulses that allows detecting continuity in those circuits. Every second a pulse of 100ms is sent, monitoring that the current circulates though the circuit. Current will not circulate if the auxiliary contact is open or the coil circuit is open.

3.4.3 Trip Coil Circuit

In the conditions of figure 3.4.1 (open breaker), current pulses are injected through inputs **IN3** and **IN4**.

Because **IN3** is connected to contact **52/b**, which is closed, current flows through it and this is detected. This current flowing means that the voltage on **IN3** (+) will correspond to the drop of voltage in the coil and then, a too low value to get it activated. Then, **IN3** will not be activated.

There is no current flowing through **IN4** as the contact **52/a** is open. Then, the voltage on **IN4** (+) will almost be the one available on the open circuit and therefore **IN4** will be activated.

Given that the supervision has been programmed for **Supervision in 2 states**, the µController in charge of the management of this supervisory function will send a “0” logic to the main µProcessor and this will set the **FAIL_SUPR** (**Trip Circuit Failure**) signal to “0” logic. In this situation it will be detected that the **IN3** digital input is deactivated and **IN4** is activated.

If the trip coil opens, the input that was deactivated, **IN3**, will activate and **IN4** will remain activated. After the configured reset time for trip circuit failure, the **Trip Circuit Failure** (**FAIL_SUPR**) signal will be given.

If a close or a reclosure occurs while the switching circuit is intact, once the command is executed, the state of the breaker and that of its **52/a** and **52/b** contacts changes. Consequently, the activation or deactivation of inputs **IN3** and **IN4** will invert and the **FAIL_SUPR** output will remain deactivated.

The purpose of the reset time is to compensate for the time gap between the closing of contact **52/a** and the opening of **52/b**. Generally, the **IN3** and **IN4** digital contacts do not change state simultaneously and, therefore, there will be a discordance between the two contacts. This will not modify the state of the **FAIL_SUPR** output as long as its duration is less than the set time.

If a trip occurs with the breaker closed and the breaker opens, inverting the state of contacts **52/a** and **52/b**, the **FAIL_SUPR** signal will not activate regardless of the duration of the trip command. If the breaker does not execute the command and the open command persists longer than the established reset time, the **FAIL_SUPR** signal will activate.

If the switching voltage disappears, the inputs that are energized will de-energize and this will activate both switching circuit failure outputs (**FAIL_SUPR**, **FAIL_CIR2** and **FAIL_CIR3**).

When the supervisory function of the trip coil (**FAIL_SUPR**) detects the rupture of the circuit and, consequently, the impossibility of tripping, the sending of close commands to the breaker through the IED should be impeded, manual as well as from the Recloser.

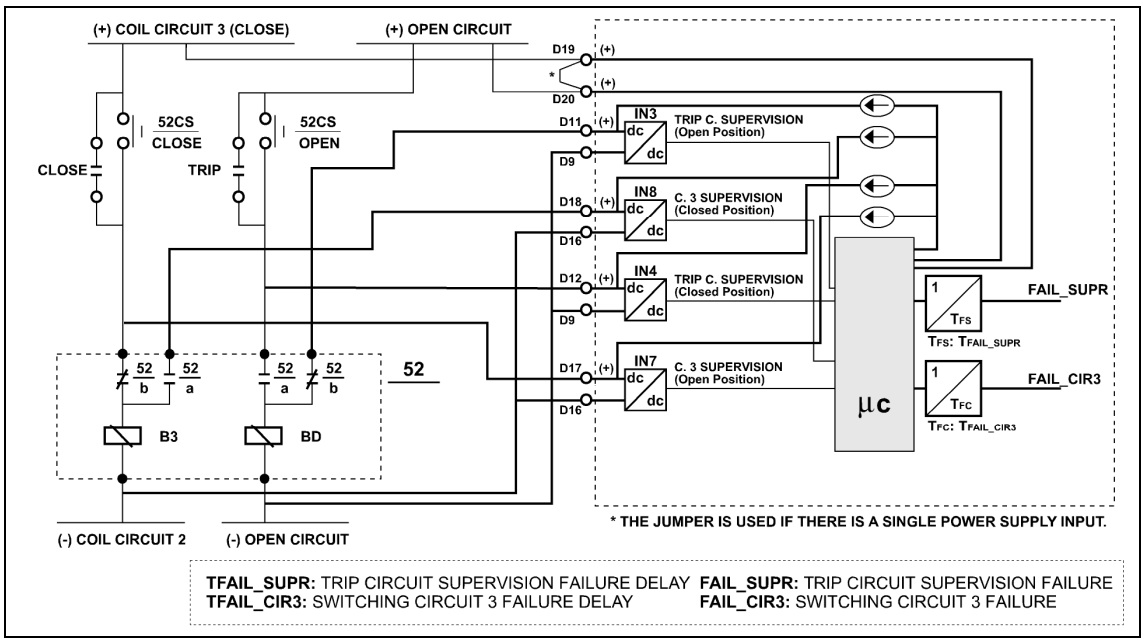


Figure 3.4.1 Trip/Close Coil Circuit Supervision Block Diagram

3.4.4 Coil Circuits 2 and 3

The explanation given for the open circuit is valid for the circuits of coils 2 and 3, referring to a possible close coil and to the corresponding operating circuit and changing the open commands for close commands, or to a second trip coil. Moreover, for coils 2 and 3, the reset times for activating the failure output are independent of that indicated for the open circuit. The failure signal in the switching circuit is called **FAIL_CIR2** and **FAIL_CIR3**.

3.4.5 Trip and Close Coil Circuit Supervision Settings

Trip and Close Coil Circuit Supervision			
Setting	**Range**	**Step**	**Default**
Trip Coil Supervision	0: NO 1: One State 2: Two States		0: NO
Trip Coil Failure Delay	1 - 60 s	1 s	5 s
Coil 2 Circuit	0: NO 1: One State 2: Two States		0: NO
Coil 2 Failure Delay	1 - 60 s	1 s	5 s
Coil 3 Circuit	0: NO 1: One State 2: Two States		0: NO
Coil 3 Failure Delay	1 - 60 s	1 s	5 s

- **Trip and Close Coil Circuit Supervision: HMI Access**

0 - CONFIGURATION	0 - GENERAL	**0 - TRIP COIL**
1 - ACTIVATE GROUP	1 - METERING	**1 - CIRCUIT 2 COIL**
2 - CHANGE SETTINGS	**2 - CIRCUIT COIL SUPERV**	**2 - CIRCUIT 3 COIL**
3 - INFORMATION	…	**3 - TRIP COIL FAIL. DLY.**
		4 - CIR. 2 COIL FAIL.DLY
		5 - CIR. 3 COIL FAIL.DLY

3.4.6 Auxiliary Outputs and Events of the Trip/Close Coil Circuit Supervision Module

Table 3.4-2: Auxiliary Outputs and Events of the Trip/Close Coil Circuit Supervision Module		
Name	**Description**	**Function**
FAIL_SUPR	Trip circuit supervision failure	They activate when an anomaly is detected in one or more of the switching circuits.
FAIL_CIR2	Switching circuit 2 failure	
FAIL_CIR3	Switching circuit 3 failure	

3.5 Power Supply Voltage Monitoring

3.5.1 Introduction

Models where the Input / Output digit for Model Selection shows that the relay is provided with an input voltage transducer (Sup. VDC), feature a DC Voltage Monitoring function for substation batteries.

Overvoltage and undervoltage condition alarms can be generated through said monitoring function, also allowing recording the evolution of said voltage when trips, closing and other control operations requiring power supply from the monitored batteries take place.

3.5.2 Operating Principle

As the measured battery voltage is relay power supply voltage, measurement is obtained through hard connection of said supply voltage to the input transducer arranged for voltage measurement, in parallel with the relay power supply voltage.

Two measurement elements are available, one overvoltage and the other undervoltage, which compare voltage measured through the transducer with pickup settings.

Elements pickup at 100% of setting and reset at 95% in case of overvoltage and 105% in case of undervoltage.

These elements are not provided with output timers; their activation / deactivation log the events and activate / deactivate the signals shown in table 3.5-1.

Output timers can be incorporated through the programmable logic in order to get the necessary logic function, such as obtaining a new signal as a result of gates AND or OR.

Signals obtained through this logic functions can generate their own events and trigger new actions (LED activation, oscillograph starting,...).

When measured voltage is below 10Vdc, transducer power supply is considered unconnected and the oscillograph will not start on undervoltage nor will the event and signal activation corresponding to this undervoltage be generated.

No matter the model (power supply and digital input voltage range), Overvoltage and Undervoltage elements have only one setting (15Vdc to 300Vdc). Nevertheless, 24 Vdc and 48Vdc models will have a common measurement range and 125Vdc and 250Vdc models will have another. Measurement ranges for each of them are shown in Chapter 2.

A Log of said voltages can be saved into oscillographic records attached to each relay operation, logged into the events record, visualized locally or through communications channel and used for the generation of user logic functions in the “programmable logic”.

Note: this monitoring is only valid for direct current power supply, and if the relay works with alternating current power supply, the transducer shall not be connected to said power supply.

3.5.3 Power Supply Voltage Monitoring Settings

DC Power Monitoring			
Setting	**Range**	**Step**	**Default**
DC_OV Pickup	15 - 300 Vdc	0.1 V	
DC_UV Pickup	15 - 300 Vdc	0.1 V	

- **Power Supply Voltage Monitoring: HMI Access**

0 - CONFIGURATION	0 - GENERAL	
1 - ACTIVATE GROUP	…	
2 - CHANGE SETTINGS	**3 - DC POWER MONIT.**	**0 - DC_OV PICKUP**
3 - INFORMATION	…	**1 - DC_UV PICKUP**

3.5.4 Auxiliary Outputs and Events of the Power Supply Voltage Monitoring

Table 3.5-1: Auxiliary Outputs and Events of the Power Supply Voltage Monitoring

Name	Description	Function
OVDC	Power supply overvoltage	These signals activate when relay power supply voltage exceeds battery voltage monitoring overvoltage or undervoltage element settings respectively.
UVDC	Power supply undervoltage	

3.6 Change Settings Groups

3.6.1 Description

Most of settings include four alternative groups (GROUP 1, GROUP 2, GROUP 3 and GROUP 4), which can be activated or deactivated from the keypad, through the communication ports, by using digital inputs or with signals generated in the programmable logic. This function permits modifying the active setting groups and, thereby, the response of the protection. This way, the behavior of the IED can adapt to changes in the external circumstances.

Two logic input signals can block changes in the active group from the HMI as well as via communications. When inputs **INH_CGRP_COM** and **INH_CGRP_MMI** are active, groups can not be changed with commands via communications nor through the HMI.

If the digital inputs are used to change groups, up to four digital inputs may need to be configured through the programmable digital inputs:

- Command to activate Settings Group 1 by digital input (**CMD_GRP1_DI**).
- Command to activate Settings Group 2 by digital input (**CMD_GRP2_DI**).
- Command to activate Settings Group 3 by digital input (**CMD_GRP3_DI**).
- Command to activate Settings Group 4 by digital input (**CMD_GRP4_DI**).

Activating inputs **CMD_GRP1_DI**, **CMD_GRP2_DI**, **CMD_GRP3_DI** and **CMD_GRP4_DI** will activate GROUP 1, GROUP 2, GROUP 3 and GROUP 4 respectively.

If, while one of the inputs is active, either of the other three or several of them are activated, no group change will take place. The status contact settings group control logic will recognize a single input only. If all four inputs are deactivated, however, the IED will remain in the last active settings group.

Note: Groups can be changed by activating T1, T2, T3 and T4 only if the display is in the default screen.

3.6.2 Digital Inputs to Change Settings Groups

Table 3.6-1: Digital Inputs to Change Settings Groups		
Name	**Description**	**Function**
INH_CGRP_COM	Inhibit group change via communications	It blocks any change of the active group by the PROCOME procedure.
INH_CGRP_HMI	Inhibit group change via HMI	It blocks any change of the active group through the HMI menu.
CMD_GRP1_COM	Command to activate Settings Group 1 via communications	Commands to change the active group.
CMD_GRP1_DI	Command to activate Settings Group 1 via DI	
CMD_GRP1_HMI	Command to activate Settings Group 1 via HMI	
CMD_GRP2_COM	Command to activate Settings Group 2 via communications	
CMD_GRP2_DI	Command to activate Settings Group 2 via DI	
CMD_GRP2_HMI	Command to activate Settings Group 2 via HMI	
CMD_GRP3_COM	Command to activate Settings Group 3 via communications	
CMD_GRP3_DI	Command to activate Settings Group 3 via DI	
CMD_GRP3_HMI	Command to activate Settings Group 3 via HMI	
CMD_GRP4_COM	Command to activate Settings Group 4 via communications	
CMD_GRP4_DI	Command to activate Settings Group 4 via DI	
CMD_GRP4_HMI	Command to activate Settings Group 4 via HMI	

3.6.3 Auxiliary Outputs and Events to Change Settings Groups

Table 3.6-2: Auxiliary Outputs and Events to Change Settings Groups

Name	Description	Function
INH_CGRP_COM	Inhibit group change via communications	The same as for the digital input.
INH_CGRP_HMI	Inhibit group change via HMI	The same as for the digital input.
CMD_GRP1_COM	Command to activate Settings Group 1 via communications	The same as for the digital inputs.
CMD_GRP1_DI	Command to activate Settings Group 1 via DI	
CMD_GRP1_HMI	Command to activate Settings Group 1 via HMI	
CMD_GRP2_COM	Command to activate Settings Group 2 via communications	
CMD_GRP2_DI	Command to activate Settings Group 2 via DI	
CMD_GRP2_HMI	Command to activate Settings Group 2 via HMI	
CMD_GRP3_COM	Command to activate Settings Group 3 via communications	
CMD_GRP3_DI	Command to activate Settings Group 3 via DI	
CMD_GRP3_HMI	Command to activate Settings Group 3 via HMI	
CMD_GRP4_COM	Command to activate Settings Group 4 via communications	
CMD_GRP4_DI	Command to activate Settings Group 4 via DI	
CMD_GRP4_HMI	Command to activate Settings Group 4 via HMI	
T1_ACTIVATED	Settings Group 1 activated	Indication of the active group.
T2_ACTIVATED	Settings Group 2 activated	
T3_ACTIVATED	Settings Group 3 activated	
T4_ACTIVATED	Settings Group 4 activated	

3.7 Event Record

3.7.1 Description

The capacity of the recorder is 400 notations in non-volatile memory. The signals that generate the events are user-selectable and are recorded with a resolution of 1 ms together with a maximum of 12 values also selectable from all the available metering values measured or calculated by the IED (“user defined values”, including VDC in models with power supply voltage monitoring).

Each of the functions that the system uses records an event in the Event Record when any of the situations listed in the tables nested in the description of each function occur. Moreover, the events listed in table 3.7-1 (the IED's general services) are also recorded. The tables mentioned above only list the events available with the default configuration. The list of signals can be expanded with those that the user configures in the programmable logic (any signal existing in the programmable logic can be configured to generate an event with the description that the user defines).

Table 3.7-1: Event Record

Name	Description
HMI access	See the description in Auxiliary Outputs.
Clock synchronization	
IRIGB Active	
Digital Input 1	
Digital Input 2	
Digital Input 3	
Digital Input 4	
Digital Input 5	
Digital Input 6	
Digital Input 7	
Digital Input 8	
Digital Input 9	
Digital Input 10	
Digital Input 11	
Digital Input 12	
Digital Input 13	
Digital Input 14	
Digital Input 15	
Digital Input 16	
Digital Input 17	
Digital Input 18	
Digital Input 19	
Digital Input 10	
Digital Input 21	
Digital Input 22	
Digital Input 23	
Digital Input 24	
Digital Input 25 (*)	

(*) The number of Digital Inputs and Auxiliary Outputs available will depend on each particular model.

Table 3.7-1: Event Record	
Name	**Description**
Validity of Digital Input 1	See the description in Auxiliary Outputs.
Validity of Digital Input 2	
Validity of Digital Input 3	
Validity of Digital Input 4	
Validity of Digital Input 5	
Validity of Digital Input 6	
Validity of Digital Input 7	
Validity of Digital Input 8	
Validity of Digital Input 9	
Validity of Digital Input 10	
Validity of Digital Input 11	
Validity of Digital Input 12	
Validity of Digital Input 13	
Validity of Digital Input 14	
Validity of Digital Input 15	
Validity of Digital Input 16	
Validity of Digital Input 17	
Validity of Digital Input 18	
Validity of Digital Input 19	
Validity of Digital Input 20	
Validity of Digital Input 21	
Validity of Digital Input 22	
Validity of Digital Input 23	
Validity of Digital Input 24	
Validity of Digital Input 25 (*)	
Auxiliary Output 1	
Auxiliary Output 2	
Auxiliary Output 3	
Auxiliary Output 4	
Auxiliary Output 5	
Auxiliary Output 6	
Auxiliary Output 7	
Auxiliary Output 8	
Auxiliary Output 9	
Auxiliary Output 10	
Auxiliary Output 11	
Auxiliary Output 12 (*)	

(*) The number of Digital Inputs and Auxiliary Outputs available will depend on each particular model.

Table 3.7-1: Event Record	
Name	**Description**
LEDs reset input	See the description in Auxiliary Outputs.
Power meters reset input	
Maximeters reset command	
Cold load pickup of IED	
Change of settings initialization	
Port 0 communication failure	
Port 1 communication failure	
Port 2 communication failure	
Port 3 communication failure	
Remote	
Local Control	
Panel-controlled	
Critical system error	
Non-critical system error	
System event	
Equipment warm start up	

All the configured events as well as the pre-existing ones in the default configuration can be masked.

The text indicated in the events tables is expanded with the message **Activation of...** when the event is generated by activation of any of the signals or **Deactivation of...** when the event is generated by deactivation of the signal.

3.7.2 Organization of the Event Record

The event record capacity is two hundred and fifty-six events. When the record is full, a new event displaces the oldest one. The following information is stored in each event register:

- Values of the 12 magnitudes selected at the time the event is generated.
- Event date and time.

Event recorder management is optimized so that simultaneous operations generated by the same event occupy a single position in the event memory. However, if the occurrences are not simultaneous, two separate events are generated. Simultaneous events are those operations occurring within a 1 ms interval, the resolution time of the recorder.

3.7.3 Event Mask

Use the **General** settings in communications to mask unneeded or unused events for system behavior analysis. Events are masked by communications within the **General** settings.

Important: Events that can be generated in excess should be masked since they could fill the memory (400 events) and erase more important previous events.

3.7.4 Consulting the Record

The communications and remote management program, ***ZivercomPlus***®, has a completely decoded system for consulting the Event Record.

3.7.5 Event Record Settings (via communications)

Events Mask
IED events may be masked separately

Event Magnitudes				
Up to 12 different magnitudes may be selected to be annotated with each equipment event. Said magnitudes are:				
ACTGRP	FREQ	IA	P	TRANSDUCER C1
ALARMS	HARM2 IA	IAB	P.Active Energy	TRANSDUCER C2
ANG IA	HARM2 VA	IB	P.React.Energy	VA
ANG IB	HARM3 IA	IBC	PF	VAB
ANG IC	HARM3 VA	IC	PMAX	VB
ANG NSC	HARM4 IA	ICA	PMIN	VBC
ANG NSV	HARM4 VA	IMAX	PSC	VC
ANG PSC	HARM5 IA	IMIN	PSV	VCA
ANG PSV	HARM5 VA	N.A.ENGY	Q	VDC
ANG VA	HARM6 IA	N.R.ENGY	QMAX	VMAX
ANG VAAB	HARM6 VA	NSC	QMIN	VMIN
ANG VB	HARM7 IA	NSV	S	ZSC
ANG VC	HARM7 VA	Null	SMAX	ZSV
ANG ZSC	HARM8 IA		SMIN	
ANG ZSV	HARM8 VA			

Note: all magnitudes for each event are stored in secondary values; therefore not affected by any primary-to-secondary ratio except for energy magnitudes that are always recorded in primary values.

3.8 Metering History Log

3.8.1 Operation

This function records the evolution of the values monitored at the point where the IED is installed. It samples each of the 12 values programmed for this purpose and calculates their average over the interval defined as **Sampling Interval**. This time interval is adjustable between 1 and 15 minutes.

The **Recording Interval** is an adjustable period of time between 1 minute and 24 hours. The maximum and minimum averages recorded in the whole interval are recorded with their final time stamp. Figure 3.8.1 shows how the Metering History Log works.

-**SI**: Sampling Interval; the figure shows an SI value of one minute.

-**RI**: Recording Interval; the figure shows a RI of 15 minutes.

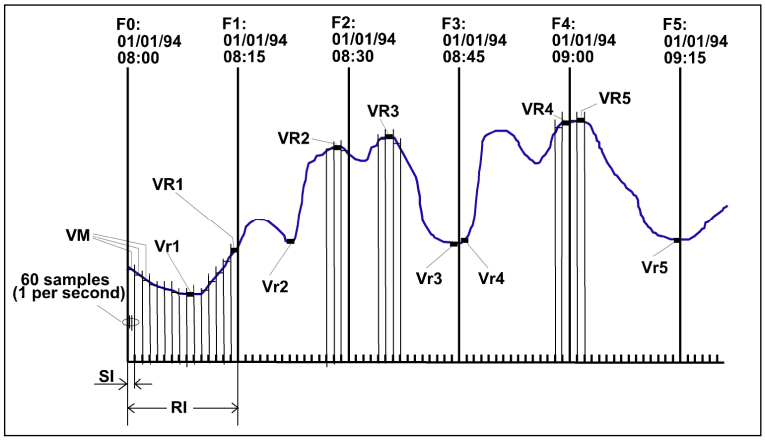


Figure 3.8.1 Explanatory Diagram of the Metering Log.

Each **SI** yields two **MV** values: the maximum and minimum averages. Each **RI** interval takes the maximum and minimum values of all the **MV**s computed. The profile of figure 3.8.1 yields the following values: VR1 - Vr1; VR2 - Vr2; VR3 - Vr3; VR4 - Vr4 and VR5 - Vr5.

As already indicated, twelve (12) values can be configured among all the direct or calculated metering values (“user defined values”, including VDC in models with power supply voltage monitoring) available in the IED (M_i). For each of the 12 values, up to four different metering values can be selected. For each of them, the greatest and the smallest of the three averages calculated along the **Sampling Interval** are found. See figure 3.8.2.

Thus, the greatest and the smallest value of all those calculated for each of the metering values that comprise each magnitude M_i are recorded.

The memory available for the metering log is RAM, large enough for 168 values. The memory can be customized by defining an hour range and **Week Mask** (the same hour range for all the days). No values outside the mask will be recorded.

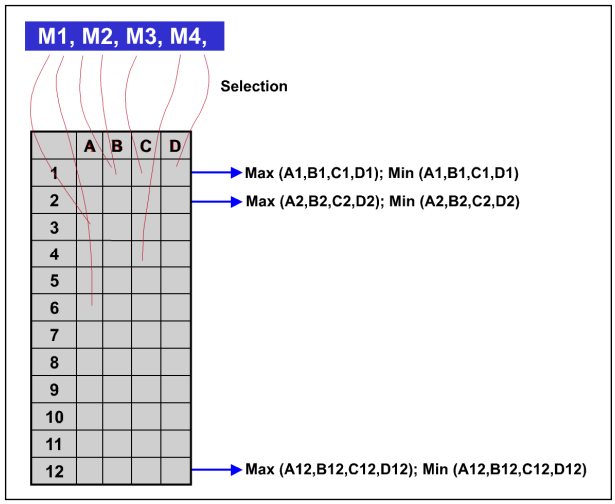


Figure 3.8.2 Metering History Log Logic

Likewise, the phase currents and voltages as well as the powers are constantly sampled. The sampled values are compared with those already stored. This keeps a maximum/minimum demand metering of the phase currents and voltages and of the active, reactive and apparent powers up to date.

These maximum and minimum values are stored in non-volatile memory, so they are reset by the logic input signal, **Maximum Demand Element Reset**.

All this information is only available via communications through the communications and remote management program ***ZivercomPlus***®.

3.8.2 Metering History Log Settings

Metering History Log			
Setting	**Range**	**Step**	**Default**
Sampling Interval	1 - 15 min	1	1 min
Recording Interval	00.00 to 24:00		00:01
Week Mask	Monday to Sunday	YES / NO	YES
Recording Start Time	00.00 to 24:00		00.00
Recording End Time	00.00 to 24:00		24:00

Log Groups				
There are 12 Log Groups. Up to 4 different magnitudes may be defined within each group for historical record calculations. Said magnitudes are:				
ACTGRP	FREQ	IA	P	TRANSDUCER C1
ALARMS	HARM2 IA	IAB	P.Active Energy	TRANSDUCER C2
ANG IA	HARM2 VA	IB	P.React.Energy	VA
ANG IB	HARM3 IA	IBC	PF	VAB
ANG IC	HARM3 VA	IC	PMAX	VB
ANG NSC	HARM4 IA	ICA	PMIN	VBC
ANG NSV	HARM4 VA	IMAX	PSC	VC
ANG PSC	HARM5 IA	IMIN	PSV	VCA
ANG PSV	HARM5 VA	N.A.ENGY	Q	VDC
ANG VA	HARM6 IA	N.R.ENGY	QMAX	VMAX
ANG VAAB	HARM6 VA	NSC	QMIN	VMIN
ANG VB	HARM7 IA	NSV	S	ZSC
ANG VC	HARM7 VA	Null	SMAX	ZSV
ANG ZSC	HARM8 IA		SMIN	
ANG ZSV	HARM8 VA			

Note: all magnitudes for each event are stored in secondary values; therefore not affected by any primary-to-secondary ratio except for energy magnitudes that are always recorded in primary values.

- **Metering History Log: HMI Access**

0 - CONFIGURATION	0 - GENERAL	**0 - SAMPLE INTERVAL**
1 - ACTIVATE GROUP	…	**1 - LOG REC. INTERVAL**
2 - CHANGE SETTINGS	**4 - HISTORY**	**2 - HIST. START TIME**
3 - INFORMATION	…	**3 - HIST. END TIME**

3.9 Inputs, Outputs & LED Targets

3.9.1 Introduction

The **6MCV** has a flexible, user-definable structure of **Inputs** / **Outputs** / **LEDs**. It is described in the following sections. Factory programming included default values. Settings can be changed using the software package ***ZivercomPlus***®.

3.9.2 Digital Inputs

The number of digital inputs available will depend on each particular model. All these inputs can be configured with any input signal to the pre-existing protection and control modules or defined by the user in the programmable logic.

The **Filtering** of the digital inputs can be configured with the following options:

- **Time Between Samplings Filter 1** (**2-10 ms**): to establish the periodicity with which samples of the state of a digital input are taken.
- **Number of Samples with the same Value to Validate a Filter-1 Input** (**1-10**): the number of samples that must be detected consecutively to consider an input deactivated or activated can be set to logical "0" or "1" respectively.
- **Time Between Samplings Filter 2** (**2-10 ms**): to establish the periodicity with which samples of the state of a digital input are taken.
- **Number of Samples with the same Value to Validate a Filter-2 Input** (**1-10**): The number of samples that must be detected consecutively to consider an input deactivated or activated can be set to logical "0" or "1" respectively.
- **Filter Assignation** (**Filter 1 / Filter 2**): Each configurable digital input can be assigned to "filter 1" or to "filter 2." The settings previously defined allow constructing filters 1 and 2 to create fast and slow detection inputs.
- **Number of Changes to Deactivate an Input and its Time Slot** (**2-60/1-30s**): an adjustable time slot is established to keep a digital input in which there is an external or internal malfunction to the relay from generating problems. This time slot monitors the number of times that this digital input changes condition. If this number of changes in state exceeds a set value, it disables and input is frozen into last state. Once an input is disabled, it will be enabled again when the enabling conditions are met or by an enabling command.
- **Number of Changes to Enable an Input and its Time Slot**: as for disabling, to enable an input again, there is also a time slot and a user-definable number of changes within that slot.

Depending on model, the following settings related to Digital Inputs also exist:

- **EDs Supply Voltage Control** (YES / NO): Allows Digital Input validation control enable as a function of relay Supply voltage.
- **EDs Supply Voltage Level** (**24 / 48 / 125 / 125(>65%Vn) / 250 Vdc**): States relay rated supply voltage. When latter setting is set to YES, and relay supply voltage drops below EDs activation threshold, all validation signals are deactivated and the EDs disabled. Validation is reset when relay supply voltage exceeds EDs activation threshold. The supply voltage level is obtained through an input Vcc converter connected in parallel with the relay supply voltage. For EDs activation and deactivation thresholds as appropriate refer to chapter 2.1
- **Automatic ED disable** (YES / NO): There is a separate setting for each Digital Input. If set to YES, allows for Automatic ED Disable on excessive number of changes (see in this same chapter the settings **Number of Changes for Disable** an input and **Time Window**).

The IED's metering elements and logic functions use **Logic Input Signals** in their operation. They are enumerated in the tables nested in the description of each of them. Those corresponding to the IED's general services are listed in table 3.9-1 and can be assigned to the **Physical Digital Inputs** or to logic output signals of opcodes configured in the programmable logic. More than one **Logic Input Signal** can be assigned to a **Single Status Contact Input**, but the same logic input signal can not be assigned to more than one status contact input.

The tables mentioned above only list the inputs available with the default configuration. The list of inputs can be expanded with those that are configured in the programmable logic (any logic input signal created in the programmable logic can be used with the description that the user creates).

3.9.2.a Enable Input

Each protection element module of the relay has a special “logic input signal” to put it “into service” or “out of service” from the HMI (buttons on the front), with a digital input by level and with the communications protocol configured in each port (control command).

This logic input signal is called **Enable Input…**. It combines with the **In Service** setting in this algorithm.

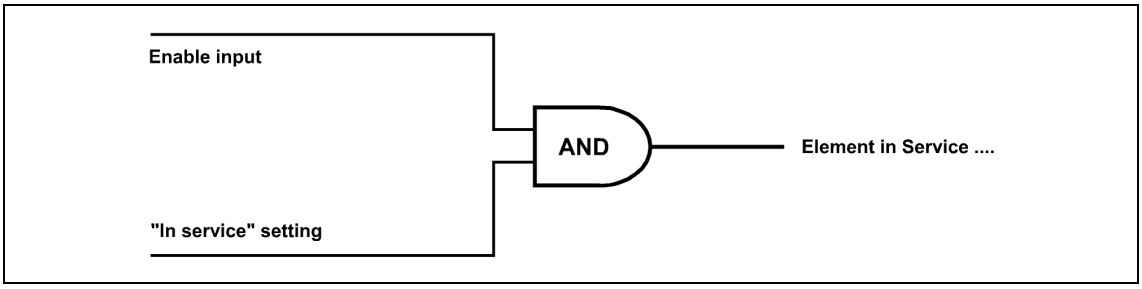


Figure 3.9.1 Element Enable Logic.

The default value of the logic input signal **Element Enable Input**... is a “1.” Therefore, when you do not configure the programmable logic at all, putting the protection elements into service depends only on the value of the **In Service** setting of each of them. The logic configuration to activate or switch off the enabling logic input signal will be as complicated or simple as you wish, from assigning it to a status contact input to building logical schemas with the various logic gates available (flip-flop’s, etc.).

Those protection functions that are put “out of service” by any of these methods will not generate or activate any of their associated logic signals, not even those that may be configured in the programmable logic and are directly related to these functions.

3.9.2.b Digital Inputs Settings

Digital Inputs			
Setting	**Range**	**Step**	**Default**
Time Between Samples (Filter 1)	2 - 10 ms	2	6 ms
Time Between Samples (Filter 2)	2 - 10 ms	2	6 ms
Number of Samples to Validate Changes (Filter 1)	1 - 10 samples	1	2 samples
Number of Samples to Validate Changes (Filter 2)	1 - 10 samples	1	2 samples
Filter Assignation (independent setting for each DI)	0 = Filter 1 1 = Filter 2		0 = Filter 1
Number of Changes to Disable	2 - 60 changes	1	5 changes
Disable Window	1 - 30 s	1	2 s
Number of Changes to Enable	2 - 60 changes	1	5 changes
Enable Window	1 - 30 s	1	2 s
EDs Supply Voltage Control	0: NO 1: YES	1	0: NO
EDs Supply Voltage Level	0: 24 1: 48 2: 125 3: 125(>65%) 4: 250	1	24
Automatic ED disable (separate setting for each relay ED)	0: NO 1: YES	1	1: YES

3.9.2.c Digital Inputs Table

Table 3.9-1: Digital Inputs		
Name	**Description**	**Function**
IN_RST_MAX	Maximeters reset	Its activation sets the content of the current, voltage and power demand elements to zero.
IN_PMTR_RST	Power meters reset	Its activation sets the content of the power meters to zero.
ENBL_PLL	Digital PLL input enable	Enables the operation of the automatic system to adapt to the frequency. By default, when not configured, it is a logic “1.”
LED_1	LED 1	They activate their corresponding LEDs.
LED_2	LED 2	
LED_3	LED 3	
LED_4	LED 4	
LED_5	LED 5	
LED_6	LED 6	
LED_7	LED 7	
LED_8	LED 8	
LED_9	LED 9	

Table 3.9-1: Digital Inputs		
Name	**Description**	**Function**
LED_10	LED 10	They activate their corresponding LEDs.
LED_11	LED 11	
LED_12	LED 12	
LED_13	LED 13	
LED_14	LED 14	
LED_15	LED 15	
LED_16	LED 16	
CMD_DIS_DI1	Command to disable digital input 1	Inputs to the module of digital inputs that activate and deactivate each of the digital inputs.
CMD_DIS_DI2	Command to disable digital input 2	
CMD_DIS_DI3	Command to disable digital input 3	
CMD_DIS_DI4	Command to disable digital input 4	
CMD_DIS_DI5	Command to disable digital input 5	
CMD_DIS_DI6	Command to disable digital input 6	
CMD_DIS_DI7	Command to disable digital input 7	
CMD_DIS_DI8	Command to disable digital input 8	
CMD_DIS_DI9	Command to disable digital input 9	
CMD_DIS_DI10	Command to disable digital input 10	
CMD_DIS_DI11	Command to disable digital input 11	
CMD_DIS_DI12	Command to disable digital input 12	
CMD_DIS_DI13	Command to disable digital input 13	
CMD_DIS_DI14	Command to disable digital input 14	
CMD_DIS_DI15	Command to disable digital input 15	
CMD_DIS_DI16	Command to disable digital input 16	
CMD_DIS_DI17	Command to disable digital input 17	
CMD_DIS_DI18	Command to disable digital input 18	
CMD_DIS_DI19	Command to disable digital input 19	
CMD_DIS_DI20	Command to disable digital input 20	
CMD_DIS_DI21	Command to disable digital input 21	
CMD_DIS_DI22	Command to disable digital input 22	
CMD_DIS_DI23	Command to disable digital input 23	
CMD_DIS_DI24	Command to disable digital input 24	
CMD_DIS_DI25	Command to disable digital input 25 (*)	
REMOTE	Remote	Sets the relay in remote mode. Must be activated to enable DNP 3.0 commands.
LOCAL	Local Control	Means 'Local Commands' enabled, whose performance is defined in user's logic module.
CONTROL_PANEL	Operation Desk control	Means 'Operation Desk Commands' enabled, whose performance is defined in user's logic module.

(*) The number of digital inputs and digital outputs available will depend on each particular model.

Table 3.9-1: Digital Inputs		
Name	**Description**	**Function**
CMD_ENBL_DI1	Command to enable digital input 1	Inputs to the module of digital inputs that activate and deactivate each of the digital inputs.
CMD_ENBL_DI2	Command to enable digital input 2	
CMD_ENBL_DI3	Command to enable digital input 3	
CMD_ENBL_DI4	Command to enable digital input 4	
CMD_ENBL_DI5	Command to enable digital input 5	
CMD_ENBL_DI6	Command to enable digital input 6	
CMD_ENBL_DI7	Command to enable digital input 7	
CMD_ENBL_DI8	Command to enable digital input 8	
CMD_ENBL_DI9	Command to enable digital input 9	
CMD_ENBL_DI10	Command to enable digital input 10	
CMD_ENBL_DI11	Command to enable digital input 11	
CMD_ENBL_DI12	Command to enable digital input 12	
CMD_ENBL_DI13	Command to enable digital input 13	
CMD_ENBL_DI14	Command to enable digital input 14	
CMD_ENBL_DI15	Command to enable digital input 15	
CMD_ENBL_DI16	Command to enable digital input 16	
CMD_ENBL_DI17	Command to enable digital input 17	
CMD_ENBL_DI18	Command to enable digital input 18	
CMD_ENBL_DI19	Command to enable digital input 19	
CMD_ENBL_DI20	Command to enable digital input 20	
CMD_ENBL_DI21	Command to enable digital input 21	
CMD_ENBL_DI22	Command to enable digital input 22	
CMD_ENBL_DI23	Command to enable digital input 23	
CMD_ENBL_DI24	Command to enable digital input 24	
CMD_ENBL_DI25	Command to enable digital input 25 (*)	
DO_1	Digital output 1	They activate their corresponding outputs.
DO_2	Digital output 2	
DO_3	Digital output 3	
DO_4	Digital output 4	
DO_5	Digital output 5	
DO_6	Digital output 6	
DO_7	Digital output 7	
DO_8	Digital output 8	
DO_9	Digital output 9	
DO_10	Digital output 10	
DO_11	Digital output 11	
DO_12	Digital output 12 (*)	

(*) The number of digital inputs and digital outputs available will depend on each particular model.

3.9.3 Auxiliary Outputs

The number of digital outputs available will depend on each particular model. They can all be configured with any input or output signal of the pre-existing protection and control modules or defined by the user in the programmable logic.

The IED's metering elements and logic functions generate a series of logic output signals. Each of these signals has either a “true” or “false” value and this status can be used as an input to either of the combinational logic gates shown in figure 3.9.2. The use of the combinational logic gates described in figure is optional. Its purpose is to facilitate the simplest configurations. To develop more complex algorithms and be able to assign the resulting outputs to auxiliary contact outputs, the necessary opcodes must be programmed in the programmable logic.

The outputs from the blocks described in figure 3.9.2 can be connected to one of the programmable auxiliary contact outputs in the IED. There is an additional, non-programmable auxiliary output contact corresponding to relay **In Service**.

Two blocks of eight inputs are available. One of the blocks performs an **OR** operation with the selected signals (any signal activates the logic gate output). The other block performs an **AND** operation with the selected signals (all signals need to be active to activate the logic gate output). The result of these two blocks is then operated through either an **AND** or an **OR** gate. The pulse option can be added to the result of this operation. It works as follows:

- **Without Pulses**: by adjusting the pulse timer to 0, the output signal remains active as long as the signal that activated it lasts.
- **With Pulses**: once the output signal is activated, it remains the set time whether or not the signal that generated it is deactivated before or remains active.

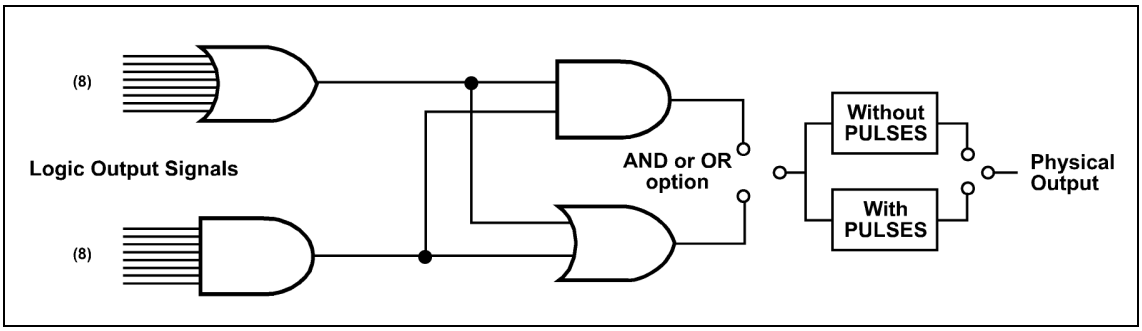


Figure 3.9.2 Auxiliary Contact Output Logic Cell Block Diagram.

All the logic output signals listed in the tables nested in the description of each of the elements are user-definable. Moreover, the signals indicated in Table 3.9-2, all corresponding to the IED's general services, can also be assigned.

The tables mentioned only list the logical outputs available with the default configuration. The list of signals can be expanded with those configured in the programmable logic (any logic signal created in the programmable logic can be used with the description that the user creates).

3.9.3.a Auxiliary Outputs Table

Table 3.9-2: Auxiliary Outputs		
Name	**Description**	**Function**
ACCESS_HMI	HMI access	Indication that the HMI has been accessed.
SYNC_CLK	Clock synchronization	Indication of having received a date / time change.
IN_1	Digital input 1	They indicate that the corresponding input has been activated.
IN_2	Digital input 2	
IN_3	Digital input 3	
IN_4	Digital input 4	
IN_5	Digital input 5	
IN_6	Digital input 6	
IN_7	Digital input 7	
IN_8	Digital input 8	
IN_9	Digital input 9	
IN_10	Digital input 10	
IN_11	Digital input 11	
IN_12	Digital input 12	
IN_13	Digital input 13	
IN_14	Digital input 14	
IN_15	Digital input 15	
IN_16	Digital input 16	
IN_17	Digital input 17	
IN_18	Digital input 18	
IN_19	Digital input 19	
IN_20	Digital input 20	
IN_21	Digital input 21	
IN_22	Digital input 22	
IN_23	Digital input 23	
IN_24	Digital input 24	
IN_25	Digital input 25 (*)	
VAL_DI_1	Validity of digital input 1	They indicate whether the input has been enabled or disabled.
VAL_DI_2	Validity of digital input 2	
VAL_DI_3	Validity of digital input 3	
VAL_DI_4	Validity of digital input 4	
VAL_DI_5	Validity of digital input 5	
VAL_DI_6	Validity of digital input 6	
VAL_DI_7	Validity of digital input 7	
VAL_DI_8	Validity of digital input 8	
VAL_DI_9	Validity of digital input 9	
VAL_DI_10	Validity of digital input 10	
VAL_DI_11	Validity of digital input 11	
VAL_DI_12	Validity of digital input 12	
VAL_DI_13	Validity of digital input 13	

(*) The number of digital inputs and digital outputs available will depend on each particular model.

Table 3.9-2: Auxiliary Outputs		
Name	**Description**	**Function**
VAL_DI_14	Validity of digital input 14	They indicate whether the input has been enabled or disabled.
VAL_DI_15	Validity of digital input 15	
VAL_DI_16	Validity of digital input 16	
VAL_DI_17	Validity of digital input 17	
VAL_DI_18	Validity of digital input 18	
VAL_DI_19	Validity of digital input 19	
VAL_DI_20	Validity of digital input 20	
VAL_DI_21	Validity of digital input 21	
VAL_DI_22	Validity of digital input 22	
VAL_DI_23	Validity of digital input 23	
VAL_DI_24	Validity of digital input 24	
VAL_DI_25	Validity of digital input 25 (*)	
CMD_DIS_DI1	Command to disable digital input 1	The same as for the Digital Inputs.
CMD_DIS_DI2	Command to disable digital input 2	
CMD_DIS_DI3	Command to disable digital input 3	
CMD_DIS_DI4	Command to disable digital input 4	
CMD_DIS_DI5	Command to disable digital input 5	
CMD_DIS_DI6	Command to disable digital input 6	
CMD_DIS_DI7	Command to disable digital input 7	
CMD_DIS_DI8	Command to disable digital input 8	
CMD_DIS_DI9	Command to disable digital input 9	
CMD_DIS_DI10	Command to disable digital input 10	
CMD_DIS_DI11	Command to disable digital input 11	
CMD_DIS_DI12	Command to disable digital input 12	
CMD_DIS_DI13	Command to disable digital input 13	
CMD_DIS_DI14	Command to disable digital input 14	
CMD_DIS_DI15	Command to disable digital input 15	
CMD_DIS_DI16	Command to disable digital input 16	
CMD_DIS_DI17	Command to disable digital input 17	
CMD_DIS_DI18	Command to disable digital input 18	
CMD_DIS_DI19	Command to disable digital input 19	
CMD_DIS_DI20	Command to disable digital input 20	
CMD_DIS_DI21	Command to disable digital input 21	
CMD_DIS_DI22	Command to disable digital input 22	
CMD_DIS_DI23	Command to disable digital input 23	
CMD_DIS_DI24	Command to disable digital input 24	
CMD_DIS_DI25	Command to disable digital input 25 (*)	

(*) The number of digital inputs and digital outputs available will depend on each particular model.

Table 3.9-2: Auxiliary Outputs		
Name	**Description**	**Function**
CMD_ENBL_DI1	Command to enable digital input 1	The same as for the Digital Inputs.
CMD_ENBL_DI2	Command to enable digital input 2	
CMD_ENBL_DI3	Command to enable digital input 3	
CMD_ENBL_DI4	Command to enable digital input 4	
CMD_ENBL_DI5	Command to enable digital input 5	
CMD_ENBL_DI6	Command to enable digital input 6	
CMD_ENBL_DI7	Command to enable digital input 7	
CMD_ENBL_DI8	Command to enable digital input 8	
CMD_ENBL_DI9	Command to enable digital input 9	
CMD_ENBL_DI10	Command to enable digital input 10	
CMD_ENBL_DI11	Command to enable digital input 11	
CMD_ENBL_DI12	Command to enable digital input 12	
CMD_ENBL_DI13	Command to enable digital input 13	
CMD_ENBL_DI14	Command to enable digital input 14	
CMD_ENBL_DI15	Command to enable digital input 15	
CMD_ENBL_DI16	Command to enable digital input 16	
CMD_ENBL_DI17	Command to enable digital input 17	
CMD_ENBL_DI18	Command to enable digital input 18	
CMD_ENBL_DI19	Command to enable digital input 19	
CMD_ENBL_DI20	Command to enable digital input 20	
CMD_ENBL_DI21	Command to enable digital input 21	
CMD_ENBL_DI22	Command to enable digital input 22	
CMD_ENBL_DI23	Command to enable digital input 23	
CMD_ENBL_DI24	Command to enable digital input 24	
CMD_ENBL_DI25	Command to enable digital input 25 (*)	
DO_1	Digital output 1	The same as for the Digital Inputs.
DO_2	Digital output 2	
DO_3	Digital output 3	
DO_4	Digital output 4	
DO_5	Digital output 5	
DO_6	Digital output 6	
DO_7	Digital output 7	
DO_8	Digital output 8	
DO_9	Digital output 9	
DO_10	Digital output 10	
DO_11	Digital output 11	
DO_12	Digital output 12 (*)	

(*) The number of digital inputs and digital outputs available will depend on each particular model.

Table 3.9-2: Auxiliary Outputs		
Name	**Description**	**Function**
LED_1	LED 1	The same as for the Digital Inputs.
LED_2	LED 2	
LED_3	LED 3	
LED_4	LED 4	
LED_5	LED 5	
LED_6	LED 6	
LED_7	LED 7	
LED_8	LED 8	
LED_9	LED 9	
LED_10	LED 10	
LED_11	LED 11	
LED_12	LED 12	
LED_13	LED 13	
LED_14	LED 14	
LED_15	LED 15	
LED_16	LED 16	
IN_RST_LED	LEDs reset input	Resets the LEDs that are active because they are memorized.
IN_PMTR_RST	Power meters reset input	The same as for the Digital Input.
IN_RST_MAX	Maximeters reset	Its activation sets the content of the current, voltage and power demand elements to zero.
ENBL_PLL	Digital PLL input enable	The same as for the digital input.
PU_CLPU	Cold load pickup of relay	It is marked whenever the IED is energized.
PU_WLPU	Warm pickup of relay	It is activated after any reset (configuration loading, manual reset,…), while remaining de device powered-up.
INIT_CH_SET	Change of settings initialization	It is indicated when some setting is modified.
FAIL_COM_L	Port 0 communication failure	They activate when no communication port activity is detected during the set time.
FAIL_COM_R1	Port 1 communication failure	
FAIL_COM_R2	Port 2 communication failure	
FAIL_COM_R3	Port 3 communication failure	
FAIL_COM_CAN	Port CAN communication failure	

Table 3.9-2: Auxiliary Outputs		
Name	**Description**	**Function**
REMOTE	Remote	Sets the relay in remote mode. Must be activated to enable DNP 3.0 commands.
LOCAL	Local Control	Means 'Local Commands' enabled, whose performance is defined in user's logic module.
CONTROL_PANEL	Operation Desk control	Means 'Operation Desk Commands' enabled, whose performance is defined in user's logic module.
ERR_CRIT	Critical system error	They note that some technical problem has cropped up in the IED.
ERR_NONCRIT	Non-critical system error	
EVENT_SYS	System event	Indicates the reset of SW in the IED.

Configuration for outputs can be loaded at the factory. Users can easily program different output configurations using the ***ZivercomPlus***® software via the local communication ports that have the PROCOME protocol configured (the local port is always assigned this protocol).

3.9.4 LED Targets

6MCV relay is provided with 16 LEDs on the front panel for equipment with more than 4U or 6U. Lower enclosures are provided only with 4 LEDs. An additional LED is also provided to show whether the relay is **In Service**.

Each of the user-definable optical indicators is associated to a combinatorial function. These are diagramed in figure 3.9.3. They way they function and are configured is similar to the auxiliary contact outputs. One of the two blocks has eight inputs that perform an OR operation (any signal activates the output). The other block has one input. The two blocks together can perform an OR or an AND operation without the subsequent possibility of using pulses.

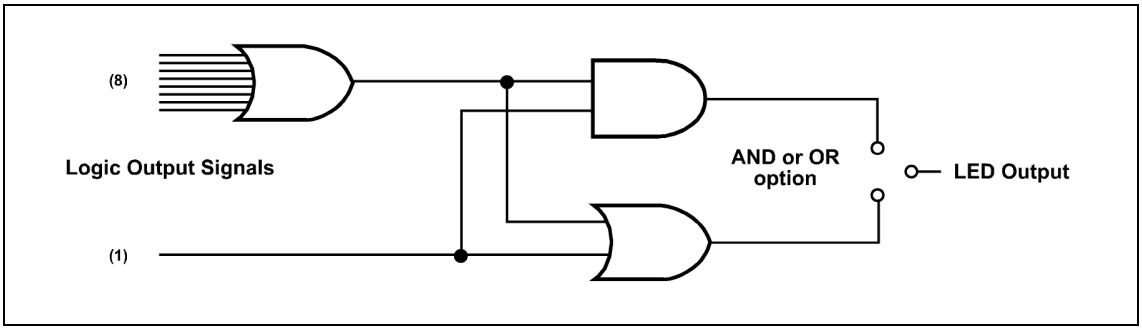


Figure 3.9.3 Target Output Logic Cell Block Diagram.

Each LED can be latched or unlatched. If an LED is latched, it will remain illuminated until reset. It is possible to program one of the programmable buttons, communications command, or digital input with the **Reset LEDs** digital input. Since it is defined as a command it will be available in the operations display menu. The latching function resides in the volatile memory section of the microprocessor. A power supply loss will cause any latched LED to reset.

The LEDs can be associated to any of the available logic output signals indicated in table 3.9-2. Logic equations can be created and modified with the ***ZivercomPlus***® program via the local communication ports that have the PROCOME protocol configured (the local port is always assigned this protocol).

To develop more complex algorithms and be able to assign the resulting outputs to the LEDs, the necessary opcodes must be programmed in the programmable logic. This, for example, allows configuring latched LEDs that do not lose memory after an auxiliary power supply voltage failure. This requires the use of latched bistable circuits.

The IED has another 7 LEDs associated with each of the operating buttons available on the front of the IED. These indicators show the current state of the element governed by each button by its color (user-configurable). In the process of selecting an element and confirming / executing a command, the associated LED blinks. These LEDs must be configured through the programmable logic.

3.9.5 Digital Inputs, Auxiliary Outputs and LED's Test

Apply rated voltage, appropriate for the model. At this time, the **In Service** LED should be lit.

- **Digital Inputs**

For the inputs test, the rated voltage is applied between the terminals corresponding to the inputs (marked in the external connections diagram), always taking the polarity of the contacts into account.

From the inputs screen of the **Information** menu, it is verified that the inputs are activated ("1"). The voltage is removed and the contact inputs must reset ("0").

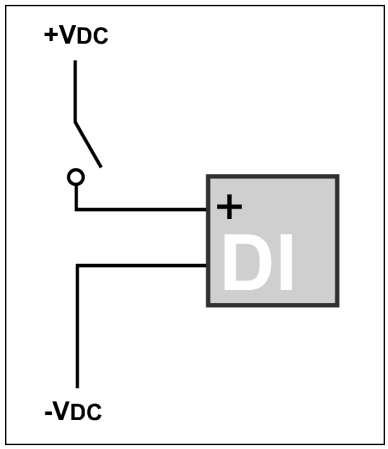


Figure 3.9.4 Digital Inputs Test

- **Auxiliary Outputs**

To test the auxiliary contact outputs, their operation is provoked according to how they are configured. If they are not configured, they can be configured as activation of the status contact inputs. Part of the inputs test consists in verifying the operation of auxiliary output contacts OUT1 to OUT6.

- **LED Targets**

To check the LED targets, the **F2** key must be pressed from the stand-by screen until the Resetting LEDs screen appears. It is held down until all the LEDs light up. When the push-button is released, they must all go off.

3.10 Programmable Logic

3.10.1 Description

One of the functions of **6MCV** models is a fully configurable one called Programmable Logic. The user can freely interconnect this logic digitally and analogically by using the ***ZivercomPlus***® program.

All the signals generated by the equipment will be available to the events, oscillograph records, digital inputs and outputs, HMI and communications according to how their programmable logic has been configured.

From the signals or readings generated by any of the functions of the relay (Protection units, Digital inputs, Communications, Command functions and Analog inputs), the user can define a logical operation using primitive logic functions (AND, OR, XOR, NOT, etc.), bistable circuits (latched or not), timers, comparators, constants, values, etc.

The programming function allows definition of the trip logic, control logic, interlocks, functional modules, local and remote states and control hierarchy required for complete protection and operation of a bay.

Priorities may also be selected in the programmable logic. There are three run cycles, of 2, 10 and 20 milliseconds, and priorities may be allocated placing the logics in either cycle. In this way, control logic can be carried out and use them as protection functions as they can be run with a priority similar to the functions implemented into the equipment firmware itself. For more information, please refer to the ***ZivercomPlus***® manual.

The processing of the input signals produces logical outputs that can be assigned to existing connections between the IED and the exterior: auxiliary output contacts, display, LEDs, communications, HMI, etc.

Maximum size for the programmable logic will be 64kb; i.e. around 1000 primitive logic gates.

3.10.2 Functional Characteristics

The IEDs can execute local programmable control functions associated with the bay as well as the logic associated with internal and external interlockings, treatment and generation of alarms and processing of signals. They are all programmable.

The execution of interlockings towards the external circuits implies being able to execute continuously active outputs depending on the combination of the state of various input signals through logic gates. These interlocking outputs are used for interrupting / continuing an exterior command circuit. These interlockings are the consequence of the logic capacity pointed out in the following sections.

The execution of internal interlockings implies being able to obtain logic outputs of permission / blocking of commands towards the external circuits according to the combination of the state of various input signals through logic gates. These processed logic signals affect the permissions / lockouts of commands generated both from the unit's local control module and from the Central Unit originating in the control display, central programmable control functions and/or remote

Logical alarms can be generated with data from the combination of the state of various input signals through logic gates as well as from "timers" of presence / absence of a given signal, either physical or logic.

The processing of analog signals offers the possibility of comparing analog inputs with set points and of generating digital ON/OFF signals as a result of this comparison as well as the possibility of adding and multiplying analog signals. Analog values can be used in primary or secondary values.

Logic configurations can also generate user defined values such as counters. These values are the result of the user defined logic algorithms. User defined values can be displayed on the HMI, sent via communications and retrieved using ***ZivercomPlus***®.

Likewise, it is also possible to define new user settings in the IED associated with the logic. These settings can be consulted afterwards from the HMI or communications.

In addition, the logic configurations can disable protection elements of the IED. The disabling of an element allows it to be replaced by another that operates under user-defined algorithms.

Basically, the system takes input signals from various sources, both external to the IED (communications or HMI) and internal; processes these signals according to the configuration that has been loaded and the pre-established settings and activates certain output signals that will be used for sending information messages or measurements to the central unit as well as commands to relays, LEDs and protection or logic units.

The **Programmable Logic** and its **Configuration** comprise the engine of this whole system. The logic has a set of *blocks* that encompass a series of logic operations. Each of these blocks determines an *outcome* (state of one or more signals) depending on the state of the inputs of that *block*. The **Configuration** determines the use of one or another block.

The operation chosen to obtain a given output determines the input signals to the *blocks*. The **Input Connection** process is the software process that connects the inputs of the *blocks* with the appropriate inputs to the control subsystem according to the **Configuration**.

Likewise, the output signals from the *blocks* are associated with the appropriate outputs. This is done in the **Output Connecting** process according to the **Configuration**.

If the required input signals are signals that arrive through communications, they arrive encoded according to the PROCOME, MODBUS or DNP 3.0 communications protocol, which forces associating each necessary signal with its corresponding protocol. This process is performed in **Input Tagging** and the associations are made in one form or another according to the configuration. The same happens with the signals sent through communications; the software process is carried out in **Output Tagging** and is also determined by the **Configuration**.

New logic-generated values can be redirected to the IED's different communication protocols as well as to the HMI.

The **Programmable Logic** can be used to generate events with any available digital signal that the IED can capture with the PROCOME communications protocol and the program. It doesn't matter if this signal is a digital input or a signal received via communications from the central unit or, on the contrary, is the outcome of internal operations included in the programmed algorithm itself. Moreover, there is the option of recording the event by the rising edge of the chosen signal, by the falling edge or by both.

Once the event is generated, it can be captured the same as the rest of the events generated by the IED with the ***ZivercomPlus***® communications program.

There is an exclusive option to simplify the task of configuring the Digital Inputs, Digital Outputs and LEDs. This voids the need to work with complex algorithms that would make the task unnecessarily difficult.

3.10.3 Primitive Functions (Opcodes)

The following logic operations can be used in the algorithm.

AND	Pulse	Adder	Digital/Analog Converter
OR	Timer A	Subtracter	BCD/Analog Converter
XOR	Timer B	Multiplier	Binary/Analog Converter
NOT	DFF	Divisor	Analog/BCD Converter
Cable	RSFF	Comparator	Analog/Binary Converter
Multifiber Cable	Analog Cable	Level Comparator	Pulse train
Multiplexer	Counter		Rising edge

- **AND**

Performs an AND operation between digital signals.

Operands:

From 2 to 16 digital input signals

Results:

Digital output signal, the outcome of the operation

- **OR**

Performs an OR operation between digital signals.

Operands:

From 2 to 16 digital input signals

Results:

Digital output signal, the outcome of the operation

- **XOR**

Performs an XOR operation between two digital signals.

Operands:

Two digital input signals.

Results:

Digital output signal, the outcome of the operation.

- **NOT**

Moves to a digital signal the outcome of negating another.

Operands:

Digital input signal.

Results:

Digital input signal.

- **Cable**

Moves to a digital signal the value of another.

Operands:

Digital input signal.

Results:

Digital input signal.

- **Multifiber Cable**

Moves to a digital signal the value of another.

Operands:

Digital input signal.

Results:

From 1 to 16 digital output signals.

- **Multiplexer**

Based on a selector, it establishes the value of an output signal with the value of one of the two inputs.

Operands:

Digital input selector signal.
2 digital input signals.

Results:

Digital output signal.

- **Analog Selector**

Based on a selector, it establishes the value of an analog output magnitude with the value of one of the two analog input magnitudes.

Operands:

Digital input selector signal.
2 analog input magnitudes.

Results:

Analog output magnitude.

- **Pulse**

When the input signal goes from 0 to 1, the output signal is activated during the time specified as parameter.

Operands:

Digital input signal.
Setting or pulse time constant in seconds.

Results:

Digital output signal.

Limits:

The maximum time must be set between 0.0 and 2147483.648 seconds (24 days).

- **Timer A**

When the time set since the input signal went from 0 to 1 is up, the output goes to one until the input resets.

Operands:

Digital input signal.
Setting or delay time constant in seconds.

Results:

Digital output signal.

Limits:

The maximum time must be set between 0.0 and 2147483.648 seconds (24 days).

- **Timer B**

The output is activated as long as the input is active or has been deactivated after a time no greater than the time set.

Operands:

Digital input signal.
Setting or delay time constant in seconds.

Results:

Digital output signal.

Limits:

The maximum time must be set between 0.0 and 2147483.648 seconds (24 days).

- **DFF**

Type D bistable. Whenever a rising edge occurs in the clock signal, the bistable takes the value of the input.

Operands:

Digital clock signal.
Digital input signal.

Results:

Digital output signal

- **RSFF**

Type RS bistable. As long as the S signal is active, the bistable takes the value of the input. When the R input is activated, the bistable takes value 0.

Operands:

Digital signal R.
Digital signal S.

Results:

Digital output signal.

- **Analog Cable**

Moves to an analog magnitude the value of another.

Operands:

Input magnitude.

Results:

Output magnitude.

- **Counter**

It manages a counter that increases with each rising edge of the clock signal. When the reset input is activated, the counter resets to 0.

Operands:

Digital reset signal.
Digital clock signal.

Results:

Magnitude of counter value.

Limits:

The counter has a saturation value of 65535. Subsequent increments do not modify the output value of the counter.

- **Adder**

It establishes the value of the output magnitude with the result of the sum of the input values.

Operands:

2 input values, settings or constants.

Results:

Output magnitude.

- **Subtracter**

It establishes the value of the output magnitude with the result of the subtraction of the input values.

Operands:

2 input values, settings or constants.

Results:

Output magnitude.

- **Multiplier**

It establishes the value of the output magnitude with the result of the product of the input values.

Operands:

2 input values, settings or constants.

Results:

Output magnitude.

- **Divisor**

It establishes the value of the output magnitude with the result of the division of the input values.

Operands:

2 input values, settings or constants.

Results:

Output magnitude.

- **Comparator**

Compares two input values and establishes the value of the digital output signal according to the outcome of the comparison.

Operands:

2 input values, settings or constants.
Type of comparison as a constant value inserted in the opcode:
Greater than.
Less than.
Equal to.
Not equal to.
Greater than or equal to.
Less than or equal to.

Results:

Digital output signal.

- **Level Comparator**

It compares the input magnitude with respect to a minimum and maximum reference value and establishes the output according to it. Thus:

The output is 1 if the input is greater than the maximum reference value.
The output is 0 if the input is less than the minimum reference value.
Otherwise, the output keeps the same value.

Operands:

Input magnitude (magnitude, setting or constant).
Minimum reference value (magnitude, setting or constant).
Maximum reference value (magnitude, setting or constant).

Results:

Digital output signal.

- **Digital / Analog Converter**

It converts a digital signal to an analog magnitude with value 0 or 1.

Operands:

Digital input signal.

Results:

Analog output magnitude.

- **BCD / Analog Converter**

With 16 digital inputs, it generates an analog magnitude using BCD code.

Operands:

16 digital input signals.

Results:

Analog output magnitude.

- **Binary / Analog Converter**

With 16 digital inputs, it generates an analog magnitude using binary code.

Operands:

16 digital input signals.

Results:

Analog output magnitude.

- **Analog / BCD Converter**

It converts an analog magnitude into 16 digital signals by converting to BCD code.

Operands:

Analog input magnitude.

Results:

16 digital output signals.

- **Analog / Binary Converter**

It converts an analog magnitude into 16 digital signals by converting to binary code.

Operands:

Analog input magnitude.

Results:

16 digital output signals.

- **Pulse Train**

Logic block produced by a pulse train while the digital input signal is active.

Operands:

Digital signal enabling pulse train.
Magnitude, setting or time constant of active pulse in seconds.
Magnitude, setting or time constant of inactive pulse in seconds.

Results:

Digital output signal.

- **Rising Edge**

The output is activated when a change from 0 to 1 is detected in the input.

Operands:

Digital input signal.

Results:

Digital output signal.

3.10.3.a Logic Operations with Memory

Certain logical functions can be configured to preserve the internal state of the function after a shut down. Not all the logical functions have internal states that require this treatment:

Table 3.10-1: Logic Operations with Memory

Logical function	Can be memorized
AND	-
OR	-
XOR	-
NOT	-
Cable	-
Multifiber cable	-
Pulse	Y
Timer A	Y
Timer B	Y
DFF	Y
RSFF	Y
Analog cable	-
Counter	Y
Adder	-
Subtracter	-
Multiplier	-
Divisor	-
Comparator	-
Level comparator	Y
Digital to analog	-
RSFF with timed reset	Y
Pulse train	Y

Memorization mode is selected by means of a memory field inserted in the opcode when configuring with the ***ZivercomPlus***® program.

3.11 Communications

3.11.1 Communications Ports

6MCV relays are provided with different types of communications ports as a function of the selected model:

- **1** front **Local Port** type RS232C and USB.
- Up to **3 Remote Ports** with following configurations:
  - Remote Port 1: optical fiber interface (glass ST or plastic 1mm), electrical interface RS232 / RS232 FULL MODEM and RJ45 connector for ETHERNET communications.
  - Remote Port 2: optical fiber interface (glass ST or plastic 1mm), electrical interface RS232 / RS485 and RJ45 connector for ETHERNET communications.
  - Remote Port 3: electrical interface RS232 / RS485 and RJ45 connector for ETHERNET communications.
- **2 LAN Ports** with following configurations:
  - LAN 1: RJ45 connector for ETHERNET type communications.
  - LAN 2: RJ45 connector or glass optical fiber MT-RJ for ETHERNET type communications.
- **1 Remote Port** with CAN protocol BUS connection.

Technical data for these communications links can be found in Chapter 2.1 (Technical Data). Information on model ports can be found in chapter 1.5 (Model selection).

3.11.2 Communication with *ZivercomPlus®*

Protection, loading or reading programmable logic configuration and reading out protection data (events, fault reports, oscillograms,...) can be configured through communications ports set for PROCOME protocol. The local port is always assigned this protocol, whereas for remote ports it depends on settings.

Communications are established through ***ZivercomPlus***® communications program, which allows dialog between the **6MCV** family and other relays, whether locally (via a PC connected to front port) or remotely (via rear serial ports with PROCOME protocol), covering all needs regarding programming, settings, recording, reports, etc..

Local and remote communications ports are configured through HMI.

6MCV model features three controllers, one for each communications port, so that communications can be established through all of them at the same time.

The ***ZivercomPlus***® communications program that involves the application of the model involved is protected against non-authorized users through access passwords. The ***ZivercomPlus***®, that runs in WINDOWS™ environment is easy to operate and uses buttons or keys to display the different submenus.

3.11.3 Synchronization by IRIG-B 123 and 003

6MCV relays are provided with a BNC type input for IRIG-B 123 or 003 standard time synchronization signals. Said input is located at the relay rear panel. Synchronization accuracy is ±1ms.

In case the relay is receiving an IRIG-B synchronization signal, access from HMI to **Date and Time** settings is denied.

An output can be configured to show IRIG-B signal received status. This output remains active while the relay receives correctly said signal.

Relays are also prepared for indication of both the loss and recovery of IRIG-B signal by generating events associated to each of these circumstances.

3.11.3.a UTC / Local Time Configuration

Discerning whether the time received through BNC connector corresponds to **UTC Time** or a given **Time Zone (Local)** is possible through **IRIG-B Time Zone** setting.

In the first case, a correction must be introduced to adapt the UTC time to the time zone of the relay site. The **Local Time Zone** setting within the **Date and Time** settings group is used for this purpose, which allows putting UTC time forward or back as required.

In the second case, the relay receives the time signal already adapted to the local time zone and no correction is needed. In this case local **Local Time Zone** has no effect.

3.11.3.b IRIG-B Function Settings

IRIG-B Function Settings			
Setting	**Range**	**Step**	**Default**
IRIG-B Time Zone	0 = Local Time 1 = UTC Time	1	0 = Local Time

3.11.3.c Auxiliary Outputs of the IRIG-B Function

Table 3.11-1: Auxiliary Outputs of the IRIG-B Function		
Name	**Description**	**Function**
SIGNAL_IRIGB	IRIGB Active	Signal indicates that IRIG-B signal is being received.

3.11.4 Communications Protocol

All **6MCV** relays are provided with rear communications ports for remote access and one front port for local access. Depending on model, rear ports feature several communications protocols:

- **Local Port**: uses only PROCOME protocol.
- **Remote Ports 1 and 2**: options PROCOME, DNP3.0, MODBUS and Virtual Inputs / Outputs are available.
- **Remote Port 3**: options PROCOME, DNP3.0 and MODBUS are available.
- **Remote Port 4**: options CAN and CAN MULTI-MAESTRO are available.
- **Ports LAN 1 and 2**: can communicate through IEC61850 and PROCOME.

It is worth mentioning that communications through all ports can be maintained simultaneously.

PROCOME protocol complies with IEC-870-5 standards and is used, the same as for IEC61850, for both protection and control information management. On the other hand, protocols DNP 3.0, CAN and MODBUS are used for control information management.

For more details on protocols refer to the applicable protocol paragraph.

3.11.4.a Control Change Recording

Depending on signals configured into the programmable logic through the ***ZivercomPlus***® program, the different system events make changed-state signals to be written.

Different signal lists for PROCOME 3.0 and DNP 3.0 protocols can be configured through the programmable logic, saving changes into different and separate **6MCV** relay files for each of the communications ports. This implies that although the tail of changes of one port is emptied after collecting said information, the same information is available at the other port for collection through the allocated protocol, whether it is the same as for the first port or not.

Also, from the signals configured in PROCOME, DNP 3.0 or both, signals to be displayed through the HMI can be selected. They are also saved into separate files, so that even if tails of control changes of communications ports are emptied, the information is still available through HMI. Between 100 and 115 records are saved depending on their simultaneity.

Information on the Control Change Record is displayed from the HMI or pressing F1 key through **Information** option, the changes list view or delete options being available. If the view option is selected, the last change generated is always displayed (the most recent). Information is presented as follows:

AA/MM/DD|HH:MM:SS
000 text1 □ or ■
001 text2 □ or ■

AA/MM/DD|HH:MM:SS
000 text3 □ or ■
001 text4 □ or ■

Namely, events are grouped by “date” and “time”. Then, in the following line, the milliseconds corresponding to each control change and the label defined through the ***ZivercomPlus***® (maximum of 13 characters) are shown. And at the end of the line, a filled or blank square indicates ACTIVATION-ON (■) or DEACTIVATION-OFF (□) respectively. Default signal text labels are defined in input and output tables; in case of new signals generated into the programmable logic, said text must be defined. In any case, in order to use the names required by each user, the creation of a logic record card allocating a personalized name to every signal to be displayed is recommended.

The date and time stamp will be generated every time a new event occurs in it.

The MODBUS allows to display the actual value of the configured digital signals but do not record their changes.

3.11.5 Communications Settings

As the below described settings are independent for each port, they are grouped as follows: **Local Port**, **Remote Port 1**, **Remote Port 2**, **Remote Port 3**, **LAN1**, **LAN2** and **CAN**. Finally specific settings for each protocol are described.

Whenever communication is established through one of these ports, the following codes are displayed on relay alphanumeric HMI:

- Local port: **[PL]** code.
- Remote port 1, Remote port 2, Remote port 3: **[P1]**, **[P2]** and **[P3]** codes.
- Remote ports LAN1 and LAN 2: no display on MMI.
- Remote port CAN: **[P4]** code.

These codes, in case of PROCOME 3.0 protocol, remain displayed during **Communications Password TimeOut** setting indicated in paragraph 3.11.4.d after the last communication carried out; in case of MODBUS, DNP V3.00 and CAN protocols, the message remains displayed for one minute after the last communication.

There are three timer settings, one for each communications port (**Communication Failure Time Indication**), which, no matter the assigned protocol, allow configuring the period without communication activity before generating the alarms (digital signals and events) **Communication Failure Port 0**, **1**, **2**, **3** and **CAN**.

3.11.5.a Local Port

The setting options of the local communications port are:

- **Baud Rate**: a value from 300 bauds to 38400 bauds can be chosen, default value being 38400 bauds.
- **Stop Bits**: one of two stop bits can be selected.
- **Parity**: even, odd or no parity (None) can be selected. No parity is configured by default.
- **Character Reception Time** (0-60000 ms): maximum time between characters allowed during the receiving of a message. The current message will be considered cancelled if it exceeds the set time between the reception of two characters.
- **Communication Failure Indication Time** (0-600 s.): maximum time between messages without indication of communication channel blocking.

3.11.5.b Remote Port 1

Remote port 1 has fiber optic and electrical access RS232 / RS232 FULL MODEM. Access through RS232 FULL MODEM has all the MODEM lines in format DB9. The settings available for configuring this port are:

- **Baud Rate, Stop Bits, Parity** and **Character Reception Time**, the same as the local port.
- **Protocol**: depending on model, PROCOME 3.0, DNP 3.0, MODBUS Protocols and Virtual Inputs Outputs can be selected. The default protocol is PROCOME.
- **Advanced settings**:

  1. Flow Control

  CTS Flow (NO / YES): It specifies whether the **Clear To Send** signal is monitored to control the data transmission flow. If the setting is YES and the CTS signal falls to “0”, the transmission is suspended until the CTS signal resets.

  DSR Flow (NO / YES): It specifies whether the **Data Set Ready** signal is monitored to control the data transmission flow. If the setting is YES and the DSR signal falls to “0”, the transmission is suspended until the DSR signal resets.

  DSR Sensitive (NO / YES): It specifies whether the communications port is sensitive to the state of the DSR signal. If the setting is YES, the communications driver ignores any byte received unless the DSR line is active.

  DTR Control (INACTIVE / ACTIVE / ENABLE SEND):

  Inactive: It sets the DTR control signal to permanently inactive.

  Active: It sets the DTR control signal to permanently active.

  Enable Send: The DTR signal remains active as long as the receiving of new characters is allowed.

  RTS Control (INACTIVE / ACTIVE / ENABLE SEND / SOL. SEND):

  Inactive: It sets the RTS control signal to permanently inactive.

  Active: It sets the RTS control signal to permanently active.

  Enable Send: The RTS signal remains active as long as the receiving of new characters is allowed.

  Solicit Send: The RTS signal remains active as long as there are characters pending transmission.

  2. Time

  Transmission Time Factor (0-100 characters): Per-character time factor, which determines when the transmission ends by time-out.

  TRANSMISSION TIME CONSTANT (0-60000 ms): Fixed time in seconds that is added to the per-character time factor, and that determines when the transmission ends by time-out.

3. Message modification

Number of Zeros (0-255): Number of zeros to insert as preamble to each message.

4. Collisions

Type of Collision (NO / ECHO / DCD):

NO: Collision detection disabled.

ECHO: A collision is considered to have occurred when the characters received do not coincide with the characters transmitted.

DCD: A collision is considered to have occurred when the DCD line is activated.

Number of Retries (0-3): Maximum number of retries in the transmission when collisions are detected.

Minimum Time Between Retries (0-60000 ms): Minimum time between retransmissions on collision detection.

Maximum Time Between Retries (0-60000 ms): Maximum time between retries on collision detection.

3.11.5.c Remote Ports 2 and 3

Remote ports 2 and 3 have fiber optic and electrical access RS232 / RS485. Available configuration settings for these ports are similar to the local port settings, and it is possible to select the communications protocol and a specific parameter for RS485 application. Thus, settings are:

- **Baud Rate, Stop Bits, Parity** and **Character Reception Time**.
- **Protocol**: Depending on model, PROCOME 3.0, DNP 3.0, MODBUS protocols and Virtual Inputs / Outputs (this last option is only available for remote port 2) can be selected. The default protocol is PROCOME.
- **Advanced settings**:

  1. Operation Mode (RS232 / RS485): This setting allows selecting the operation mode of DB9 interface of remote port 2 or 3 as a RS232 port or RS485 port.

  2. Time

  Transmission Time Factor (0-100 characters): Per-character time factor which determines when the transmission ends by time-out.

  Transmission Time Constant (0-60000 ms): Fixed time in seconds that is added to the per-character time factor, and that determines when the transmission ends by time-out.

  Number of 485 Stop Bytes (0-4 bytes): It specifies the number of stop bytes between transmit and receive when the port is configured as RS485.

  3. Message modification

  Number of Zeros (0-255): Number of zeros to insert as preamble to each message.

  4. Collisions

  Type of Collision (NO / ECHO / DCE):

  NO: Collision detection disabled.

  ECHO: A collision is considered to have occurred when the characters received do not coincide with the characters transmitted.

  Number of Retries (0-3): Maximum number of retries in the transmission when collisions are detected.

  Minimum Time between Retries (0-60000 ms): Minimum time between retransmissions on collision detection.

  Maximum Time between Retries (0-60000 ms): Maximum time between retries on collision detection.

3.11.5.d Ethernet Remote Ports 1, 2 and 3

- **Protocol**: Depending on model, PROCOME 3.0, DNP 3.0, MODBUS protocols and Virtual Inputs / Outputs (this last option is only available for remote port 2) can be selected. The default protocol is PROCOME.
- **Ethernet**
  1. Enabling the Ethernet Port (YES-NO): enables (YES) or disables (NO) the Ethernet Port.
  2. IP Address (ddd.ddd.ddd.ddd): Ethernet device ID number.
  3. Net mask (128.000.000.000 – 255.255.255.254): number that indicates to the device what part of the IP address is the network number, and what part of the IP address corresponds to the device.
  4. Port Number (0 - 62235): number used to indicate the delivery route of the data received, to the destination device.
  5. Max. Time between Messages TCP (0-65 sec.): number of seconds between Keepalive packages - if zero then Keepalive packages were not sent. These Packages inform the server if a client is still present on the Ethernet Network.
  6. RX Car Time (0-60000 milliseconds): maximum time between characters allowed while receiving a message through the Ethernet. The message is timed out if the set time is exceeded between the receipt of two characters.
  7. Communication fault indication time (0-600 sec.): maximum time between messages via the Ethernet port before an indication that communications have stopped.

3.11.5.e Remote Port 4

Remote port 4 of BUS CAN has the following configuration settings available:

- **Baud Rate** (100, 125, 250, 500 and 100 Kbaud).
- **Trip Indication Time** (1 - 10sg).

3.11.5.f PROCOME 3.0 Protocol Settings

The configuration settings of the PROCOME 3.0 protocol are:

- **Relay Number** (0-254): it specifies the address of the **6MCV** relay (acting as RTU or Remote Terminal Unit) in relation to the rest of equipment that communicate with the same master station (MTU or Master Terminal Unit).
- **Communications Password Enable** (YES-NO): this setting allows to enable the access password function to establish communication with the relay through the rear port: YES means enabling the permission and NO, disabling.
- **Communications Password TimeOut** (1-10 minutes): this setting allows establishing a period of time for activating a communication blocking with the relay (whenever communication is via the rear port): if the set time expires with no activity taking place in the communications program, the system blocks, and the communication must be reinitiated.
- **Communications Password**: the communications password allows establishing a specific password to access communications with the relay through the rear port. This password must have 8 characters, which will be entered using the numerical keys and the key corresponding to a dot.

3.11.5.g DNP 3.0 Protocol Settings

The DNP 3.0 protocol configuration settings include the definition of:

- **Relay Number** (0-65519): it specifies the address of the **6MCV** relay (acting as RTU or Remote Terminal Unit) in relation to the rest of equipment that communicate with the same master station (MTU or Master Terminal Unit). The 0xFFF0 to 0xFFFF addresses are reserved for the Broadcast addresses.
- **T. Confirm TimeOut** (100-65535): it specifies the time lapse (in milliseconds) from the time the **6MCV** sends a message requesting the master to confirm the Application layer (Level 7), until this confirmation is considered lost. The **6MCV** requests confirmation of the Application Layer when it sends spontaneous (Unsolicited) messages or in response to requests for Class 1 or Class 2 Data. When this time expires, the message is retransmitted the number of times specified in the N. Retries parameter.
- **N. Retries** (0-65535): number of retries of the Application Layer (N7). The default value is 0 (zero), indicating that no retransmission will be attempted.
- **Master Number Unsolicited** (0-65535): it specifies the address of the master station (MTU or Master Terminal Unit) to which the **6MCV** relay will send spontaneous (Unsolicited) messages. It is used in combination with Enable Unsolicited parameter. Addresses 0xFFF0 to 0xFFFF are reserved for Broadcast addresses.
- **Enable Unsolicited** (YESI/NO): enables (YES) or disables (NO) sending spontaneous messages (Unsolicited); it is used in combination with the MTU Number parameter. For the **6MCV** relay to begin sending spontaneous messages the master must also enable them with the Function Code FC = 20.
- **Unsolicited Start Enable** (YES/NO): enables (YES) or disables (NO) sending spontaneous start messages (Unsolicited after Restart); it is used in combination with the MTU Number parameter. For the **6MCV** relay to begin sending spontaneous start messages there is not need for the master to enable them.
- **Time Grouping Unsolicited** (100-65535): it specifies the time interval between the generation of a first event for an unsolicited message and the transmission of the message, with the purpose of grouping several events that may occur within this time interval in a single transmission message, in order not to saturate the communications line with multiple messages.
- **Sync. Interval** (0-120 minutes): it specifies the maximum time interval between two synchronizations. If no synchronization occurs within the interval, the need for synchronization is set in Internal Indication (IIN1-4 NEED TIME). This setting has no effect if the Sync. Interval is 0.
- **Unsolicited Start Activation** (YES/NO): enables (YES) or disables (NO) sending Forced Unsolicited messages (for compatibility with versions pre DNP3-1998). When Unsolicited Start is activated, the **6MCV** relay begins to transmit the existing spontaneous messages without additional enabling by the level 2. For this setting to have effect Enable Unsolicited Start must be enabled.
- **DNP3 Revision** (STANDARD ZIV/2003): indicates the DNP3 certification revision to use. STANDARD ZIV or 2003 (DNP3-2003 Intelligent Electronic Device (IED) Certification Procedure Subset Level 2 Version 2.3 29-Sept-03).

Up to 64 measurements or analog magnitudes can be set for DNP3 transmission. Among them, up to 16 measurements can be set for transmission upon a change request.

To select the measurements to transmit upon a change request, enable the **DNP3 Measurement Change** control configuration option using ***Ziverlog***®.

The measurement change transmission is set through two parameters for each measurement: **Upper Limit** (in profile I relays) or **Maximum Value** (in profile II relays) setting values and the **Band** setting value set for that measurement. Up to 16 band values may be configured through ***ZivercomPlus***®, which will be associated to the measurements enabled for change transmission in the same sequence as they are ordered in ***Ziverlog***®. Namely: band value 000 will be assigned to the first measurement enabled for change transmission, 001 to the second, and so on up to the last measurement enabled, with the limit of 16. The band represents a percentage of the **Maximum Value**, so that when a measurement change exceeds that band, the measurement value is annotated to be sent as change. When the relay receives a measurement change request, it will send all changes annotated.

Analog changes will not be annotated for measurements with option **DNP3 Measurement Change** enabled but with the band set to 100%, or measurements with option **DNP3 Measurement Change** not enabled, they being deemed disabled for change transmission.

Additionally, these are other settings defined for the **DNP3.0 Profile II and Profile II Ethernet protocols**:

- **Class for binary changes** (CLASS..., NONE). Assigns the class to the binary changes.
- **Class for analog changes** (CLASS..., NONE). Assigns the class to the analog changes.
- **Class for counter changes** (CLASS..., NONE). Assigns the class to the counter changes.
- ***Status* type binary inputs** (YES-NO). Binary inputs used are according to *status* type inputs (YES) or binary inputs used are not sent according to *status* type inputs (NO).
- **32 bits analog inputs** (YES-NO). Analog inputs used are 32 bits resolution (YES) or analog inputs used are 16 bits resolution (NO).
- **Change in DNP3 Counter** (1 to 32767). The setting value shows the minimum increase of counts needed to send a new DNP3 message stating a new change in the counter. 20 counters can be configured as maximum under the **DNP3.0 Profile II and Profile II Ethernet protocols**.

3.11.5.h MODBUS Protocol Setting

The only configuration setting of the MODBUS protocol is the **Relay Number** (0-254), which the same as for the other protocols specifies the **6MCV** relay address (acting as RTU or Remote Terminal Unit) with reference to the rest of relays communicating with the same master station (MTU or Master Terminal Unit).

3.11.5.i TCP/IP Protocol Settings

TCP/IP protocol configuration settings include the definition of:

- **Ethernet Channel 0** (**LAN 1**). The following settings are available within the channel:
  - IP Address (ddd.ddd.ddd.ddd).
  - DHCP Enable (YES/ NO).
  - Default Gateway (ddd.ddd.ddd.ddd).
  - Network Mask (ddd.ddd.ddd.ddd).
  - DNS Address (ddd.ddd.ddd.ddd).
- **Ethernet Channel 1** (**LAN 2**). The following settings are available within the channel:
  - IP Address (ddd.ddd.ddd.ddd).
  - DHCP Enable (YES/ NO).
  - Default Gateway (ddd.ddd.ddd.ddd).
  - Network Mask (ddd.ddd.ddd.ddd).
  - DNS Address (ddd.ddd.ddd.ddd).
- **SNTP** The following settings are available within SNTP:
  - SNTP enable (YES / NO).
  - Broadcast Synchronization Enable (YES / NO).
  - Unicast Synchronization Enable (YES / NO).
  - IP address of Primary SNTP Server (ddd.ddd.ddd.ddd).
  - IP address of Slave SNTP Server (ddd.ddd.ddd.ddd).
  - Unicast Validity Timer (10 - 1000000).
  - Unicast Error Timer (10 - 1000000).
  - Number of Connection Retries (1 - 10).
  - Tuning period (1 - 1000000).
  - Retry Period (1 - 1000000).
  - Broadcast validity Timer (0 - 1000000).
  - Broadcast Error Timer (0 - 1000000).
  - Maximum Synchronism Time Delay (0 - 1000000).
  - Ignore Synchronization Leap Indicator (YES / NO).
  - Synchronism State Calculation (Timing / Leap Indicator).

Settings related to the Ethernet Redundancy (depending on the model):

- **Redundancy mode** (No Redundancy / Bondng Redundancy / PRP Redundancy / RSTP Redundancy).
- **Channel status time** (1 - 60).
- **Bonding Redundancy**
  - Link check interval (25 - 500).
- **PRP Redundancy**
  - Transmission time of supervision frames (0 - 30000).
  - LSB of supervision frame destination MAC address (0 - 255).
- **RSTP Redundancy**: settings are found in the web server. Refer to section Communications Protocol IEC61850.

3.11.6 IEC61850 Communications Protocol

3.11.6.a Introduction

IEC61850 communications equipment of the 'V' family is provided with functions additional to those provided by protection and control equipment.

This equipment may become independent from communications, performing their protection or control functions independently or may be used for data reports, set or receive specific data.

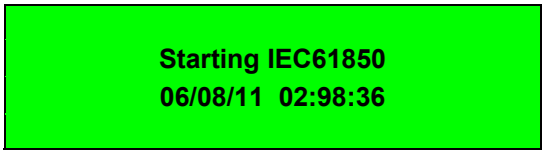
IEC61850 communications provide the following additional services:

- Report device-generated data (Starting, tripping, blocking, etc.) to higher level equipment (Central unit, remote control, HMI, etc.).
- Report prompt data (GOOSE) to other same level equipment (protections, control equipment, auxiliary services) or even to other higher level equipment.
- MMS communications that allows any MMS browser to receive the model of equipment data and be able to operate with it to edit settings and parameters and execute commands to the equipment.
- Handle a single configuration file (CID) that allows having a backup of all parameters whether they are protection, control and communications.
- Web server to provide data about equipment status, errors and state and measurement values.

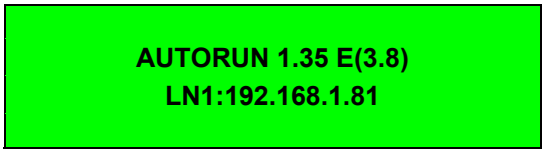
3.11.6.b Starting Communications

Unlike protection and control functions that start in less than 3 seconds, **IEC61850** communications start in a variable time as a function of the data configured. In a reboot, the main **IEC61850** communications screens are as follows:

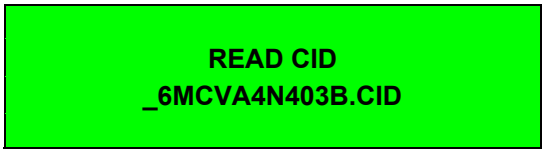
Initial moment in which the basic data of the operating system are loaded.



Autorun screen that manages the IP and allows to stop booting or carry out other maintenance tasks.



Screens to create the **IEC61850** model and read **CID**.

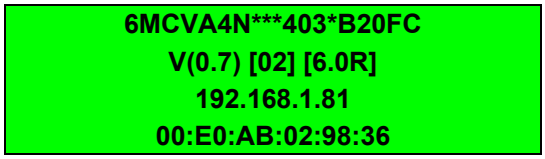


Equipment home screen that indicates the equipment is fully booted and ready for communications.

3.11.6.c Information Screens

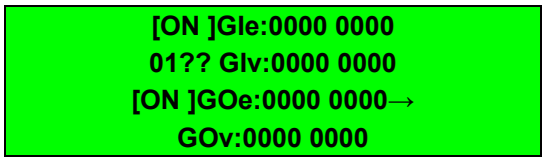
Equipment with **IEC61850** communications include a data Menu, access of which is gained pressing the key combination: Up Scroll Arrow and Dot from the HMI default screen.

This screen displays in the first line the equipment software model, in the second line, versions of the active **IEC61850** application, the third, the equipment IP (if no network cable were connected, it will show 0.0.0.0) and the last line, the MAC of the network adapter.

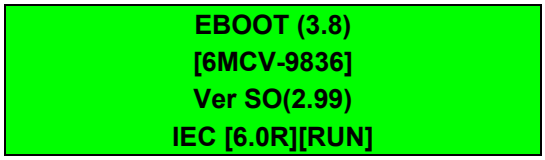


From this screen more data can be displayed through the function keys F2, F3 and F4.

Pressing F2 displays a screen with Goose message data. This screen displays information on whether Goose message transmission is activated: [ON]GO, if receive is configured [ON]GI, and if so, the message that is not being received: 01??
The arrow → indicates the moment when a Goose message is sent.



Pressing F3 displays a screen with expanded data.



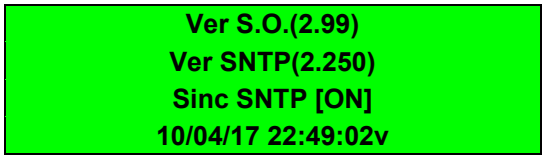
It is a screen that can be scrolled down using the scroll arrows, the complete data being: Data on the Eboot, Operating System, application, checksums versions and network adapter data, etc.

```
EBOOT (3.8)
[6MCV -9836]
Ver SO(2.99)
IEC [6.0R][RUN]
CRC:[4720E6D0]
BLD[Sep 28 2011]
BLD[08:46:05]
MMS<->IEC<->6MCV
6MCVA4N***403*K20FC
(0.7)[02]
[BOND_ETHBOND]
192.168.1.81
00:E0:AB:02:98:36
DHCP[0]
Type[6]
GWY[192.168.1.10]
CONNECTIONS 0

[BOND:ETHBOND]
RxERR:[0]
TxERR:[0]

FiFoE:0 Use:1
FiFoM:0 Use:68
NmRtr:0 Mxmed:4
```

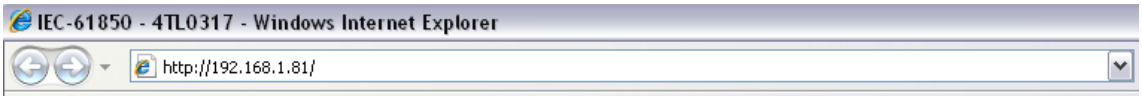
Pressing F4 displays the SNTP client data screen. The screen shows the version of the Operating System, the version of the SNTP client, whether the client is switched off, switched on or in Error and the receive time and whether is valid (v) or invalid (i).



Press ESC to return to the default screen from any screen.

3.11.6.d Web Server

Through the web server access can be gained to firmware versions, boot status and useful relay data. Write the equipment IP address in a web browser for access:



The following data are displayed:

(C) ZIV http://www.ziv.es	
EBOOT	See (3.8) ID[6MCV-9836]
Version NK	2.99
Version IEC	[6.2R][RUN]
Build EXE	[Sep 28 2011][4720E6D0]
Model 6MCV	6MCVA4N***403*B20FC
Version API	(0.6)[01]
HTML	APPLICATION
HTML	EXECUTION
HTML	MAPPING
HTML	CIDLOAD
	CONNECTIONS
	LIST DIGITALS
	LIST ANALOGS
	LIST OSCILOS
TXT	APLERROR.LOG
TXT	MAPERROR.LOG
TXT	EXECERROR.LOG
TXT	CIDERROR.LOG
CID ACTIVE	_DBCC1A612P.CID

ETHERNET ADAPTERS						
LAN2	**BOND_ETHBOND**	128.127.50.152	00:E0:AB:02:98:36	DHCP ON	Type[6]	GATEWAY:[128.127.0.102]

That corresponds to firmware versions, network adapter data, boot data, which can be displayed in web page (HTML) format or in downloadable text file (TXT) format.

Also, information on the active MMS connections (MMS clients), a list of internal signals and their value in IEC61850 standard format with their actual description is provided.

Generated oscillograms (DAT and CFG files) can be displayed and downloaded from the link.

Also, the active CID will be available, which can be downloaded from the link.

3.11.6.e Communications Port Configuration

Relays with IEC61850 communications use Ethernet network, using TCP/IP protocol for MMS communications (used to pack network data). Therefore, regardless of the physical medium and the connection (fiber, copper, etc.) the IP used by the relay in the network must be configured. For this, knowing the type of Ethernet redundancy implemented in each relay is vital, there being currently three possibilities:

- **No redundancy**

The relay is provided with 2 separate network adapters with different MAC address and different IP address. Both adapters are independent, it being possible to access the MMS data through both adapters. GOOSE messages will be sent and received only through one of the two adapters.

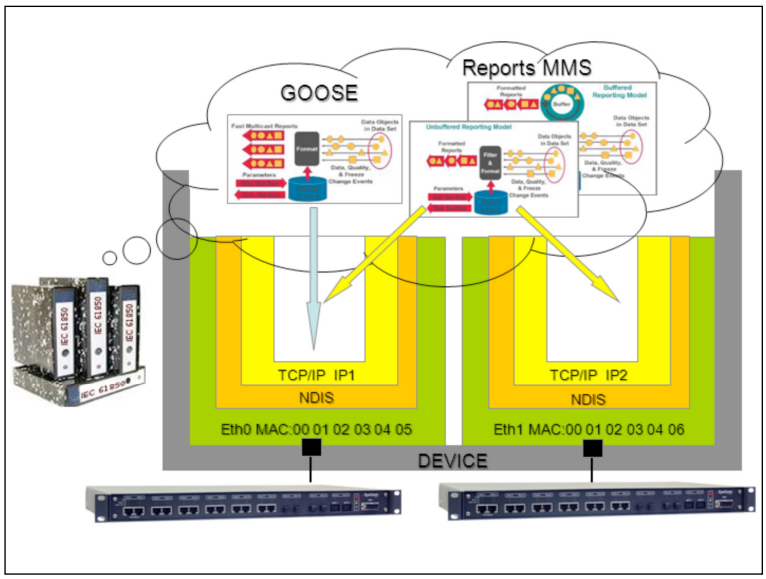


Figure 3.11.1 Configuration of Communications Ports for Relays without Ethernet Redundancy.

- **Bonding Type Redundancy**

The relay is provided with 2 network adapters both operating with the same MAC address and the same IP address, only one of them being active as a function of the medium detection (a broken connection to the adapter results in switching to the other adapter that has a good connection). Both MMS data and GOOSE messages will be sent and received only by the active adapter.

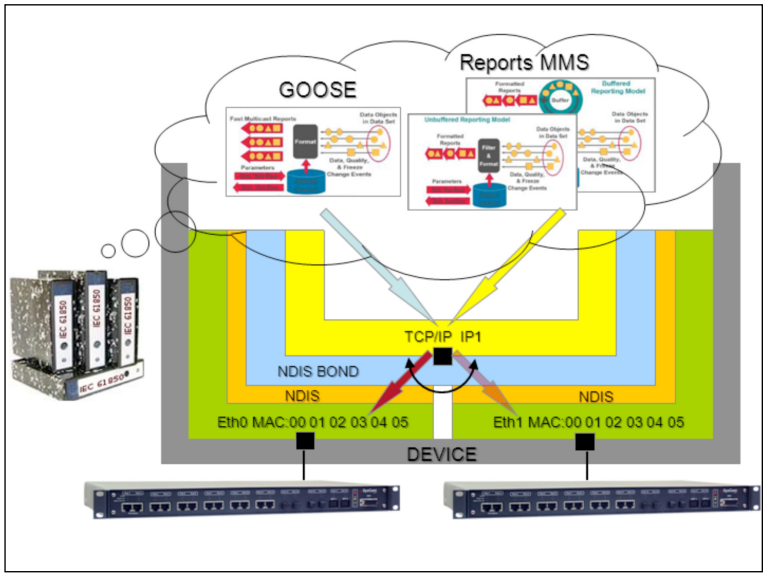


Figure 3.11.2 Configuration of Communications Ports for Relays with Bonding Type Redundancy.

- **PRP Type Redundancy**

The relay is provided with 2 network adapters both operating with the same MAC address and the same IP address, both adapters being active at any time and sending the same data through both adapters using the IEC 62439-3 protocol Parallel Redundancy Protocol (PRP).

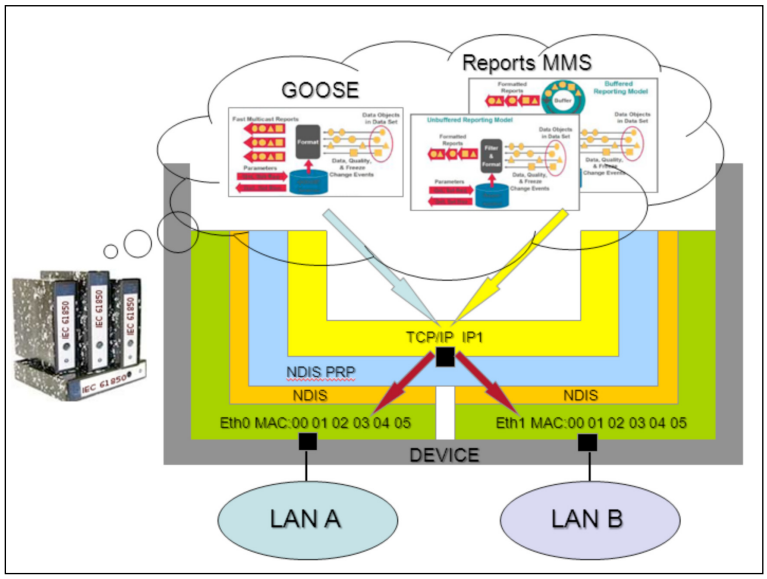


Figure 3.11.3 Configuration of Communications Ports for the Relay with PRP Type Redundancy.

This protocol is based on connecting the relays to two separate Ethernet networks (LAN), not connected to each other. The same data are sent through both adapters at the same time, adding 6 bytes to each Ethernet frame for the PRP protocol. These bytes enable discarding duplicate data, as the same data are received through both adapters and the idea is discarding the duplicate packet at the lowest possible level within the communications stack. The relay will send PRP supervision frames periodically (multicast) to enable system monitoring. Both MMS data and GOOSE messages will be sent through both adapters at the same time.

- **RSTP Type Redundancy**

The relay includes 2 network adapters, both operating with the same MAC address and the same IP address, and both adapters are active at all times. Relays define, together, the optimal path to send messages opening the ring to prevent loop formation. Also, they reconfigure the path when some type of relay or link failure occurs.

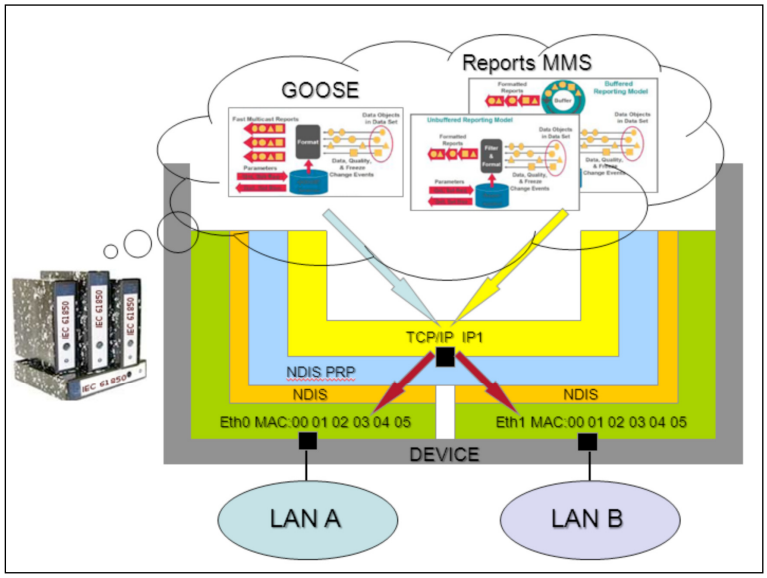


Figure 3.11.4 Configuration of Communications Ports for Relays with RSTP Type Redundancy

RSTP type redundancy is based on connecting relays with each other with single ring, star or star-ring instead of using switches. The relays themselves are in charge of defining and opening the ring, as well as deleting messages from the same preventing their indefinite recirculation.

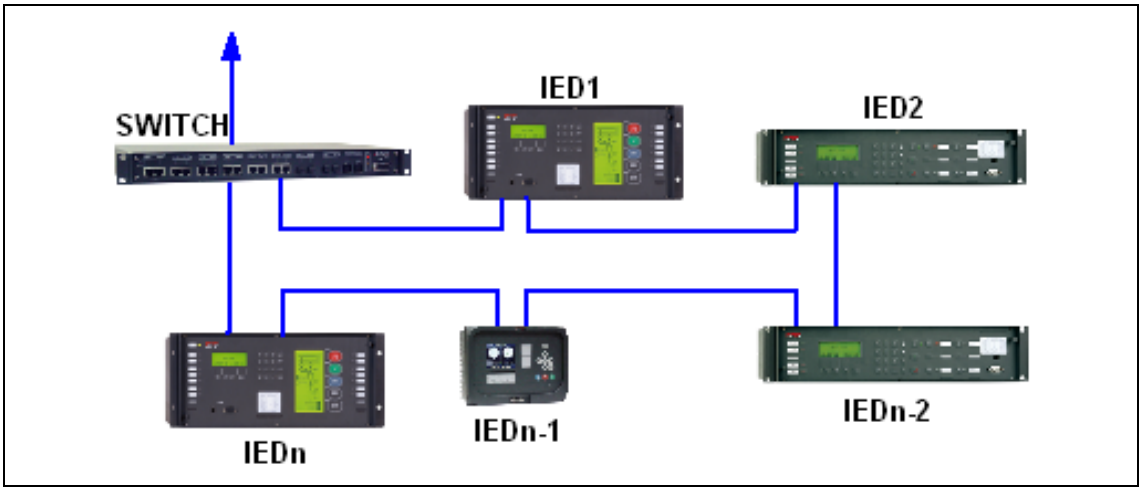


Figure 3.11.5 Example of Connecting Relays with RSTP Redundancy with Simple Ring

Relays **6MCV-***-*****1*****, **6MCV-***-*****2***** and **6MCV-***-*****3***** have no Ethernet redundancy, so they are provided with 2 physical ports with separate IPs, thus separate configuration settings. They will have the following settings per adapter:

- IP Address.
- DHCP Enable.
- Default Gateway.
- Network Mask.
- DNS Address.

6MCV-*-*****0***** Model settings are described below.

- **Goose Channel** (**Ethernet Channel 1** - **Ethernet Channel 2**): it selects the Goose message transmission / reception channel in IEC-61850.
- **Input Gooses**. The following settings are available within each IED:
  - **Subscription data**:
    Input Goose (from **1** to **32**):
    - Goose ID (Up to 65 characters): Input Goose identifier.
    - Goose CB ref (Up to 64 characters).
    - MAC Address (00.00.00.00.00.00 - FF.FF.FF.FF.FF.FF): Ethernet card address.
    - AppID (0 – 16383).
  - **Connections with Logic Inputs**:
    Logic Input Goose (from **1** to **32**):
    - Associated Goose: Input Goose from 1 to 32.
    - Object number (0 - 1024).
  - **Output Goose**.
    Goose Out Enable (YES / NO): it enables output Gooses.
    Goose Out ID (up to 65 characters): output Goose identifier.
    MAC Address (01.0C.CD.01.00.00 - 01.0C.CD.01.01.FF).
    Priority (0 -1).
    VID (0 - 4095).
    App. ID (0 - 16383).
    Revision (0 - 999999999).
    First Retry Timer (1 - 100 ms).
    Retry Time Multiplier (1 - 100).
    Maximum Retry Time (0.1 - 30 s).

6MCV-*-*****2***** and **6MCV-***-*****3***** relays do not include most of these settings, as they are used for Gooses configuration, configuration file IEC 61850 (**CID**).

The following settings can still be defined:

- **Goose Channel** (**Channel Ethernet 1** - **Channel Ethernet 2**): selects Goose message transmission / reception channel according to IEC-61850.
- **Output Goose**.
  - **Goose Out Enable**(YES / NO): enables output Gooses.

Relays **6MCV-***-*****4***** count on Bonding type redundancy, whereby they have 2 physical ports with only one IP with only one set of setting:

- IP Address.
- DHCP Enable.
- Default Gateway.
- Network Mask.
- DNS Address.

Since there is no setting to configure the GOOSE send / receive channel, as it always occurs through the active adapter, it incorporates only the following setting:

- **Output Goose**.
  - **Goose Out Enable** (YES / NO): it enables output Gooses.

It also includes a setting to configure the medium switching time (from 25 to 1000 ms).

Models **6MCV-***-*****6** or higher implement different types of redundancy. They will have a setting to configure this mode of redundancy:

- If no redundancy is selected (**No Redundancy**), they will have 2 physical ports with separate IPs, thus, separate configuration settings. They will have the following settings per adapter:

○ IP Address.	○ Network Mask.
○ DHCP Enable.	○ DNS Address.
○ Default Gateway.	

  The following settings can also be defined:

  - ○ **Goose Channel** (**Channel Ethernet 1** - **Channel Ethernet 2**): selects Goose message transmission / reception channel according to IEC-61850.
  - ○ **Output Goose**.
    - ▪ **Goose Out Enable**(YES / NO): enables output Gooses.

- If Bonding type redundancy is selected (**Bonding Redund.**), they will have 2 physical ports with only one IP and only one set of settings:

○ IP Address.	○ Network Mask.
○ DHCP Enable.	○ DNS Address.
○ Default Gateway.	

  As there is no setting to configure the GOOSE send / receive channel, as it always is produced through the active adapter, they incorporate the following settings:

  - ○ **Output Goose**.
    - ▪ **Goose Out Enable**(YES / NO): enables output Gooses.
  - ○ **Channel Status Time Delay** (1 – 60 s): time without medium detection to indicate the channel is down.
  - ○ **Link Check Interval** (25 – 500 ms): time to determine that no medium is available switching to the other adapter.

- If PRP type redundancy is selected (**PRP Redund.**), it will have 2 physical ports with only one IP and only one set of settings:

○ IP Address.	○ Network Mask.
○ DHCP Enable.	○ DNS Address.
○ Default Gateway.	

  As there is no setting to configure the GOOSE send / receive channel, as it is always produced through both adapters, they have the following settings:

  - ○ **Output Goose**.
    - ▪ **Goose Out Enable**(YES / NO): enables output Gooses.
  - ○ **Channel Status Time Delay** (1 - 60 s): time without receiving frames to indicate that the channel is down.
  - ○ **Transmission Time of Supervision Frames** (0 - 30000): send interval of PRP supervision frames.
  - ○ **LSB of Supervision Frame Destination MAC Address** (0 - 255): last octet of the PRP supervision frame destination MAC (destination MAC address will be 01-15-4E-00-01-XX).

- In case of **RSTP** type redundancy, the relay will be provided with 2 physical ports with only one IP and with only one set of settings as for Bonding type redundancy. All settings related to the switch, VLANes, priorities, etc., will be available through the web server from the moment when the relay setting is selected as **RSTP** and the relay has been booted. In this way, access can be gained to the settings below through the web server:

    - ***Version***: operation with protocol RSTP or STP.
    - ***Bridge Priority***: node priority.
    - ***Max Age***, ***Hello Time***, ***Forward Delay***: timers of the protocol RSTP itself (seconds).
    - ***Tx Hold Count***: maximum burst of messages sent per second.
    - For each port:
        - ***Priority***: priority.
        - ***Cost***: link cost.
        - ***Edge*** (On, Off, Auto): port with a host connected to it.
        - ***PtP*** (On, Off, Auto): point to point.
        - ***Edge Tx Filter***: deletion of Tx in case of an Edge port.

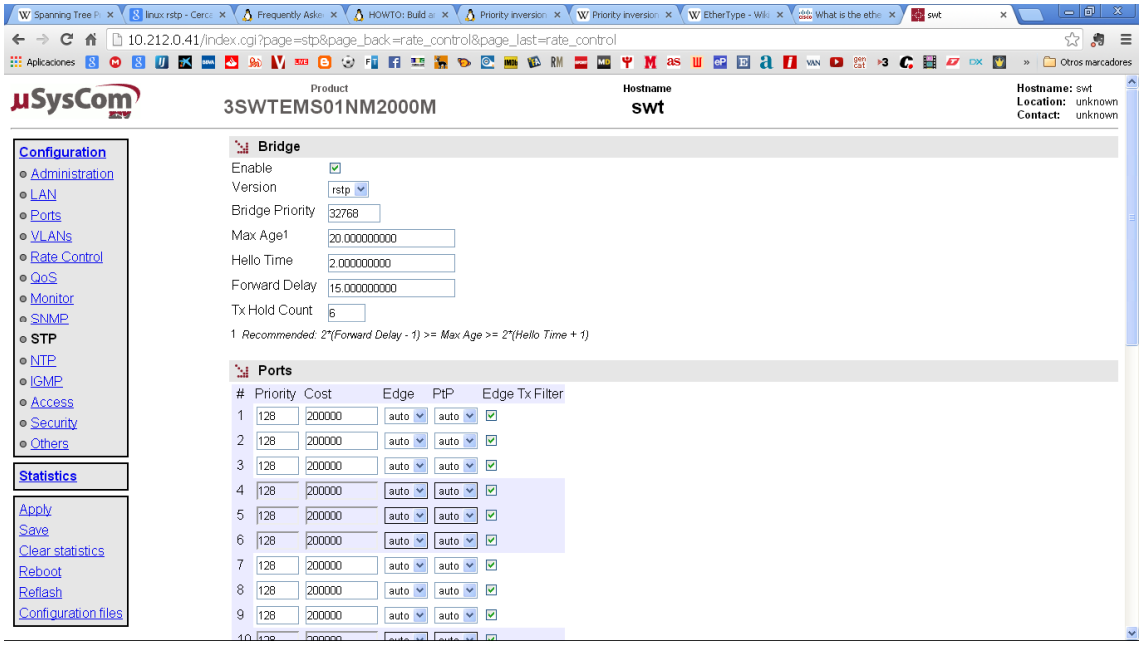


Figure 3.11.6 Image of the RSTP Settings available in the Web Server.

3.11.6.f FTP Access

The FTP access will allow having a number of equipment folders available. There will be different folders as a function of the user and password:

For IEC61850 versions previous tan the 7.7R, logging in as user: *info* and password: *info*, a directory structure similar to the one on the right will be displayed.

For IEC61850 versions equals or higher than the 7.7R the level of security has increased and a username and password to perform the loading of a CID and thus to change the control settings and protection settings will be necessary. In the same way, with the appropriate username and password, you can access to a directory in which you will only be able to copy a new CID (see Changing CID Configuration File section). For the user and password, please contact the manufacturer.

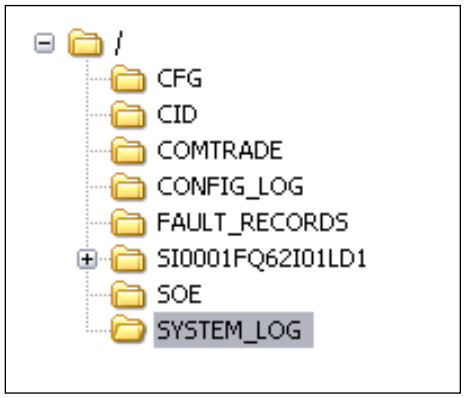


Figure 3.11.7 Directory Structure.

These are read-only folders and the information can be downloaded.

Directories will contain the same data provided by the web server: Boot data, active CID, oscillogram files, etc.

3.11.6.g CID Configuration File

The equipment includes a file (**CID**) in **IEC61850** standard format according to part 6 (SCL). This file allows knowing the equipment data model in node, data and attribute format.

Also, it allows to configure GOOSE message parameters, receive other GOOSES, create datasets and assign them to Reports, edit settings, change the control logic, descriptions, parameters, etc.

This file can be edited through a SCL file editing program, the ***ZiverCID***®.

This program allows configuring this file to be sent later to the equipment through FTP or USB port.

- **Loading the CID trough FTP**

In order to gain access to the equipment through FTP an FTP client program is required. The Windows browser itself allows making an FTP to the equipment address. For this, enter the equipment IP address in the Address bar in the following way:

For IEC61850 versions previous tan the 7.7R, the **CID** configured can be copied to the FTP root directory without entering user and password, as write access is gained only to the directory NotValidated. For IEC61850 versions higher than the 7.7R, the level of security has increased and a username and password to perform the action.

The equipment will validate the **CID**, that is, checks it is a correct SCL and the CID IP coincide with the IP configured in the equipment). After a certain version IEC61850 also checks that the IED matches the relay model that is within the CID.

Once it has been validated, the equipment carries out a backup and reboot process, rebooting communications and using a new **CID**. If the **CID** fails validation it will be rejected and deleted from the directory, and it will continue to operate in the normal way with the already loaded **CID** without ever losing communications.

If problems arise during loading the new **CID** (control reconfiguration process or loading protection settings), the relay will display a screen that will allow recovering the previous **CID** (refer to the errors section).

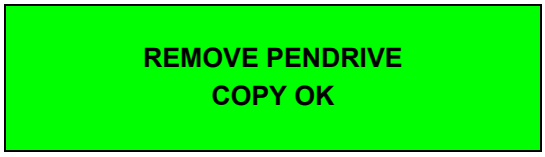
- **Loading the CID through USB by means of a Pendrive**

To load a new **CID** to the equipment through the HMI USB, an empty Pendrive is needed to copy the new CID to the root directory.

With the equipment fully booted and from the home screen, insert the Pendrive and wait for it to be detected.

Then confirmation to copy is requested.

Confirm by pressing F1.



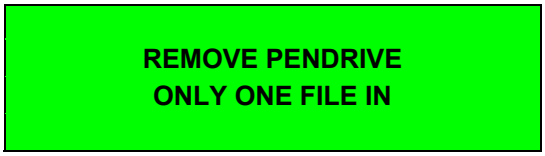
When removing the Pendrive, the equipment will copy the **CID** to a temporary directory (NotValidated directory) where it will be validated (it will check it is a correct SCL and **CID** IP matches that of the equipment).

For versions higher than the 7.7R the level of security has increased and a password to perform the loading of a new CID will be necessary.

Once it has been validated, the equipment carries out a backup and reboot process, rebooting communications and using the new **CID**. If the **CID** fails validation it will be rejected and deleted from the directory, and it will continue to operate in the normal way with the already loaded **CID** without ever losing communications.

If problems arise during loading the new **CID** (control reconfiguration process or loading protection settings), the relay will display a screen that will allow recovering the previous **CID** (refer to the errors section).

If the USB contains more files or directories apart from the **CID,** the relay will display the message below, refusing to load:



- **Backup**

For a backup protection of the relay data, namely, obtaining the CID, logs, oscillograms and other data, the methods below can be used

- FTP with access as user: *info* and password: **info** (refer to FTP access section)
- Web server (refer to section)
- USB. With the relay booted and with no error messages displayed on the screen, insert an empty USB in the relay to automatically copy the active CID. Then, three screens will be displayed giving the user the option to download the rest of the data:

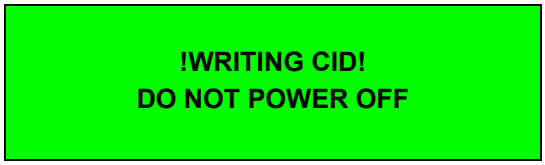
- **CID Load by Frontal Port**

CID file can be also loaded by the frontal serial port of the IED using the configuration tool ***ZIV e-NET TOOL*** (available depending on model selection).

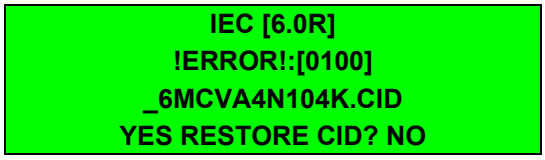
- **Errors**

During equipment configuration, actions may be carried out resulting in errors that can be identified and corrected.

- **Switching the equipment off during the process of CID write to a Flash memory**: during operation, the equipment writes the CID to Flash type non volatile memory.



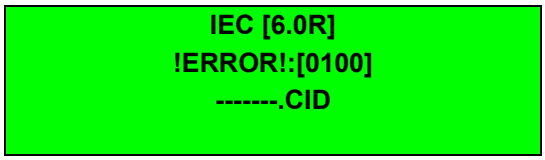
If during this process, the equipment is switched off, it is likely that the CID copied to the Flash is lost. In this case, in the next boot up the type of message below will be displayed on the screen, **_6MCVA4N104K.CID** being the active **CID** file.



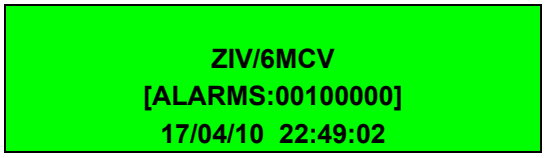
For a few seconds, it will be possible to recover the backup copy of the **CID** available in the equipment just before the settings were last changed. The equipment will offer the same option after an incomplete attempt to load a new **CID**.

If F1 is pressed to recover the **CID**, the equipment will use this backup copy to boot up. If F4 or no key is pressed, the equipment will remain waiting for a new CID through any of the **CID** loading methods (FTP or USB).

- **In case of multiple undue shutdowns** (e.g. shutdown after CID recovery), the backup copy of the CID could also be lost. In this case the message on the right will be displayed, waiting for a new **CID** to be introduced by any of the **CID** loading methods (FTP or USB).



- **100000 Alarm**. This means there is a problem with IEC61850 communications that does not affect the protection and control function.
  In this case, please contact the technical service to identify the nature of the failure.



3.11.6.h Code Errors

- **HMI of the relay**

ERROR CODE	DESCRIPTION
0x00003010	General error generated while loading the Data Model of the relay. Reasons: the CID file does not match the relay model, the CID version does not match the FW version of the relay…
0x00003020	IDS does not match the relay model. Reason: the IEC 61850 FW relay model and version does not match the protection FW relay model and version.
0x00003060	Error in the GOOSE subscription configuration. Reason: there is any kind of error in the GIGGIO logical node (setRef or intAddr). Check the webser log, it indicates exactly where the problem is.
0x00003070	Error in RFC1006.CFG file. Reason: IEC 61850 FW error, this file belongs to the set of files of the FW and it is loaded to the relay when updating the FW.
0x00003080	Error in the interface version of the relay. Reason: IEC 61850 FW error.
0x00003011	Error when loading a new CID file. Reason: the control logic inside the CID file has any kind of error.
0x00003200	Error in IRQs of DPRAM. Reason: IEC 61850 and/or protection FW error.

- **Webserver**

TEXT	DESCRIPTION
ERROR_SUSGOOSE	Error in the GOOSE subscription configuration.
ERROR_CFGPERFIL	Error while loading the Data Model of the relay.
ERROR_CFGLOG	Error when asking for the information of the control logic which is loaded in the relay.
ERROR_MEMCFGLOG	Error when reserving memory for the control logic configuration.
ERROR_CFGLOGREAD	Error when reading the control logic nodes loaded.
ERROR_VER_PERFIL	Error in the compatibility of the profiles loaded.
ERROR_DB_REFNVL	Error in the generation of Data Sets.
ERROR_CFGERROR	Error while mapping the Data Model.
ERROR_CRC_PERFIL	Error in the CRC.
ERROR_OPENPERFIL	Error when opening the profile.
ERROR_RUN_SRVCOMPRESS	Error when executing the compression server.
ERROR_OPEN_CID	Error when opening or Reading the CID file.
ERROR_HEAD_CID	Error when reading the head of the CID file.
ERROR_IED_NAME_CID	Error when reading the IED name in the CID file.
ERROR_DATASET_ITEM_CID	Error when reading elements of a Data Set.
ERROR_RCB_CID	Error when reading the list of RCBs.
ERROR_GOOSE_ID_CID	Error when reading the elements of a GOOSE.
ERROR_READ_SP_CID	Error when reading the data of a SP.
ERROR_WRITE_SP_CID	Error when writing data of a SP.
ERROR_WRITE_PRM_REV_CID	Error when writing the ParamRev in the CID.
ERROR_6MCV_RD_CID	Error when reading protection settings.
ERROR_6MCV_WR_CID	Error when writing protection settings.
ERROR_HEAD_LOGICA	Error when reading data of the control logic from the CID.

TEXT	DESCRIPTION
ERROR_READ_CF_CID	Error when reading the CF values from CID.
ERROR_CACHE_CID	Error when generating the copy in RAM of the CID once uncompressed.
ERROR_CONNECT_AP_IP	Error when read in the IP address from CID.
ERROR_ATTR_IN_CID	There is one (or more) elements in one Data Set whose reference does not exist (it is located in no logical node).
ERROR_LCB_CID	Error when Reading data of LCB.
ERROR_CREATE_MAPLOG	Error when generating the MAPLOG.BIN file.
ERROR_READ_PRM_REV_CID	Error when Reading the ParamRev of the CID.
ERROR_GEN_LOG_CID	Error when generating the control logic.
ERROR_EXTRACT_LOG_CID	Error when extracting the files of the control logic.
ERROR_CONF_LOG_CID	Error in the control configuration loaded to the relay.
ERROR_APIXML_INIT	Error when initialization the XML library

3.11.6.i PROCOME, DNP3 and MODBUS Protocols on IEC-61850 Ports

6MCV-*-*******N** relays can communicate through LAN1 and LAN2 ports with IEC61850, PROCOME, MODBUS and DNP v3.0. TCP/IP ports for these communications links are allocated to the following values and cannot be configured:

- PROCOME: port 32001.
- MODBUS: port 502.
- DNP v3.0: port 20000.

This does not affect to the port selection for other physical ports (local port, remote ports 1-3).

6MCV-*-*******P** relays include five communications instances for other than IEC61850 protocols through LAN IEC61850 ports. One instance is always PROCOME (proprietary protocol) and the other four can be configured to communicate with DNP3.0 or MODBUS simultaneously (the same protocol can be selected for the four instances).

TCP/IP ports for these communications links will be configurable, except the proprietary protocol, PROCOME, which will have fixed TCP/IP port (32001).

This does not affect to the port selection for other physical ports (local port, remote ports 1-3).

3.11.7 CAN Communications Protocol

3.11.7.a Introduction

In view of the large number of signals acquired and controlled in power substations, remote real time device inputs and outputs must be connected via high speed serial communication protocols, so as to reduce the cost and simplify the hard wiring in the power substation environment.

The above is achieved through the communication of **ZIV** Master Relays with other Slave Relays using the CAN protocol, this way increasing the number of inputs and outputs available in **ZIV** Master Relays, said signals behaving as if they were internal to **ZIV** Master Relay.

3.11.7.b General Data

- **Physical Level**

Description	Value
Can Version	2.0b
Baud Rate	125 kbits
Bit Time	8 micro s
Maximum Distance	500 meters
Id Size	11 bits

When CAN 2.0b with 16 bit ID messages are transmitted the following bits corresponding to the extended CAN are sent:

- RTR to 1 (recessive).
- r0 to 1(recessive).
- r1 1 0(dominant).

All transmitted messages are acknowledged by writing one dominant bit of the first of the two recessive bits sent by the transmitter in the acknowledge field.

NRZ bits coding (Non-Return-to-Zero).

In data frames with 5 consecutive bits, a sixth bit with opposite sign is inserted.

CAN bus electrical characteristics are defined in ISO 11898.

- **Link Level**

It uses media access CSMA/CD+CR (Carrier Sense Multiple Access Collision Resolution).

- In Ethernet (CSMA), upon a collision, all messages are lost.
- In CAN (CSMA/CD+CR), upon a collision, the highest priority message survives (defined by dominant bits).

The state of a node can be Active, Passive or Cancelled as a function of errors detected.

- **Application Level**

The Application Layer uses an optimized protocol for power substation Protection and Control applications, with messages of 1 to 8 bytes.

Implemented protocol messages are used to achieve the following functions:

- **LOGIN Message**. Allows the **ZIV** Master Relay to know the availability of Slave Relays.
- **CHANGE Message**. Allows the **ZIV** Master Relay to receive spontaneously the state of Slave Relay inputs and outputs.
- **READ Message**. Allows the **ZIV** Master Relay to request the state of Slave Relay inputs and outputs.
- **TICK Message**. Allows the **ZIV** Master Relay to synchronize with Slave Relays.
- **DIGITAL OUTPUT WRITE Message**. Allows the **ZIV** Master Relay to send the state of digital outputs to Slave Relays.
- **SETTINGS WRITE Message**. Allows the **ZIV** Master Relay to send the Settings value to Slave Relays.

3.11.7.c Digital Inputs of the CAN Function

Table 3.11-2: Digital Inputs of the CAN Function		
Name	**Description**	**Function**
RDO_1	Remote digital output 1	Activates said remote digital output in the CAN port.
RDO_2	Remote digital output 2	
RDO_3	Remote digital output 3	
RDO_4	Remote digital output 4	
RDO_5	Remote digital output 5	
RDO_6	Remote digital output 6	
RDO_7	Remote digital output 7	
RDO_8	Remote digital output 8	
RDO_9	Remote digital output 9	
RDO_10	Remote digital output 10	
RDO_11	Remote digital output 11	
RDO_12	Remote digital output 12	
RDO_13	Remote digital output 13	
RDO_14	Remote digital output 14	
RDO_15	Remote digital output 15	
RDO_16	Remote digital output 16	

3.11.7.d Auxiliary Outputs of the CAN Function

Table 3.11-3: Auxiliary Outputs of the CAN Function		
Name	**Description**	**Function**
RIN_1	Remote digital input 1	Activates said remote digital input in the CAN port.
RIN_2	Remote digital input 2	
RIN_3	Remote digital input 3	
RIN_4	Remote digital input 4	
RIN_5	Remote digital input 5	
RIN_6	Remote digital input 6	
RIN_7	Remote digital input 7	
RIN_8	Remote digital input 8	
RIN_9	Remote digital input 9	
RIN_10	Remote digital input 10	
RIN_11	Remote digital input 11	
RIN_12	Remote digital input 12	
RIN_13	Remote digital input 13	
RIN_14	Remote digital input 14	
RIN_15	Remote digital input 15	
RIN_16	Remote digital input 16	
RIN_17	Remote digital input 17	
RIN_18	Remote digital input 18	
RIN_19	Remote digital input 19	
RIN_20	Remote digital input 20	
RIN_21	Remote digital input 21	
RIN_22	Remote digital input 22	
RIN_23	Remote digital input 23	

Table 3.11-3: Auxiliary Outputs of the CAN Function		
Name	**Description**	**Function**
RIN_24	Remote digital input 24	Activates said remote digital input in the CAN port.
RIN_25	Remote digital input 25	
RIN_26	Remote digital input 26	
RIN_27	Remote digital input 27	
RIN_28	Remote digital input 28	
RIN_29	Remote digital input 29	
RIN_30	Remote digital input 30	
RIN_31	Remote digital input 31	
RIN_32	Remote digital input 32	
VAL_RIN_1	Validity of remote digital input 1	Activates said validity of remote digital input.
VAL_RIN_2	Validity of remote digital input 2	
VAL_RIN_3	Validity of remote digital input 3	
VAL_RIN_4	Validity of remote digital input 4	
VAL_RIN_5	Validity of remote digital input 5	
VAL_RIN_6	Validity of remote digital input 6	
VAL_RIN_7	Validity of remote digital input 7	
VAL_RIN_8	Validity of remote digital input 8	
VAL_RIN_9	Validity of remote digital input 9	
VAL_RIN_10	Validity of remote digital input 10	
VAL_RIN_11	Validity of remote digital input 11	
VAL_RIN_12	Validity of remote digital input 12	
VAL_RIN_13	Validity of remote digital input 13	
VAL_RIN_14	Validity of remote digital input 14	
VAL_RIN_15	Validity of remote digital input 15	
VAL_RIN_16	Validity of remote digital input 16	
VAL_RIN_17	Validity of remote digital input 17	
VAL_RIN_18	Validity of remote digital input 18	
VAL_RIN_19	Validity of remote digital input 19	
VAL_RIN_20	Validity of remote digital input 20	
VAL_RIN_21	Validity of remote digital input 21	
VAL_RIN_22	Validity of remote digital input 22	
VAL_RIN_23	Validity of remote digital input 23	
VAL_RIN_24	Validity of remote digital input 24	
VAL_RIN_25	Validity of remote digital input 25	
VAL_RIN_26	Validity of remote digital input 26	
VAL_RIN_27	Validity of remote digital input 27	
VAL_RIN_28	Validity of remote digital input 28	
VAL_RIN_29	Validity of remote digital input 29	
VAL_RIN_30	Validity of remote digital input 30	
VAL_RIN_31	Validity of remote digital input 31	
VAL_RIN_32	Validity of remote digital input 32	

Table 3.11-3: Auxiliary Outputs of the CAN Function		
Name	**Description**	**Function**
RDO_1	Remote digital output 1	Activates said remote digital output in the CAN port.
RDO_2	Remote digital output 2	
RDO_3	Remote digital output 3	
RDO_4	Remote digital output 4	
RDO_5	Remote digital output 5	
RDO_6	Remote digital output 6	
RDO_7	Remote digital output 7	
RDO_8	Remote digital output 8	
RDO_9	Remote digital output 9	
RDO_10	Remote digital output 10	
RDO_11	Remote digital output 11	
RDO_12	Remote digital output 12	
RDO_13	Remote digital output 13	
RDO_14	Remote digital output 14	
RDO_15	Remote digital output 15	
RDO_16	Remote digital output 16	

3.11.8 Virtual Inputs / Outputs

Virtual inputs / outputs function allows the bidirectional transmission of up to 16 digital signals and 16 analog magnitudes between two **6MCV** relays connected through a digital communications system. Said function allows programming logic functions of local and remote information whether analog or digital.

Among the main applications of virtual inputs / outputs is the optimizing of teleprotection schemes: they reduce digital signal transfer time between terminals, give more security in said transfer, allow exchanging a greater number of signals, etc.

The exchange of information between relays is made through frames sent every 2 ms, which include 16 digital signals and ½ analog magnitude. It is apparent that the transmission speed of the 16 digital signals is very high, as they are considered high priority signals; so that they can be used within teleprotection schemes.

The virtual inputs / outputs function allows detecting communication failure that generate errors in the frame contents (some of which are corrected by using a redundancy code) or errors in the frame reception sequence. The number of errors detected is recorded by a counter that resets after the **Error Detection Period** time setting. There is an input exists to reset this counter.

Depending on the model, relay rear ports Remote 1 and Remote 2 can be configured as virtual inputs / outputs ports. To this end, **Protocol Selection** setting of this port must be set to Virtual Inputs / Outputs.

Once the protocol Virtual Inputs / Outputs has been selected for one of the ports, the relay ignores all settings associated to said port shown in the Communications field, and only the settings introduced into the Inputs / Outputs field are considered as settings of the port selected as virtual.

Virtual inputs and outputs are configured exactly the same as for digital inputs and outputs, through the programmable logic incorporated into the ***ZivercomPlus***® program.

3.11.8.a Virtual Port 1

Virtual Port 1 settings:

- **Enable**: enables virtual inputs / outputs function for this port.
- **Baud Rate**: a value from 9600 to 115200 bauds can be selected, default value being 9600 bauds.
- **Error detection period**: time after which the communications error counter is reset.
- **Time Out**: time without receiving a complete frame before a communications error is generated.
- **CTS flow** (NO / YES): it specifies whether the Clear to Send signal is monitored for data transmission flow control. If it set to YES and the CTS signal falls to “0”, the transmission is interrupted until the CTS signal is reset.
- **DSR flow** (NO / YES): it specifies whether the Data Set Ready signal is monitored for data transmission flow control. If it set to YES and the DSR signal falls to “0”, the transmission is interrupted until the DSR signal is reset.
- **DSR Sensitive** (NO / YES): it specifies whether the communications port is sensitive to DSR signal state. If it is set to YES, the communications driver ignores any bit received unless the DSR line is active.
- **DTR Control** (Inactive/ Active/ Enable Send):
  Inactive: sets DTR control signal to permanent inactive state.
  Active: sets DTR control signal to permanent active state.
  Enable Send: DTR signal remains enabled while receiving new characters is allowed.
- **DTR Control** (INACTIVE / ACTIVE / ENABLE SEND):
  Inactive: It sets the DTR control signal to permanently inactive.
  Active: It sets the DTR control signal to permanently active.
  Enable Send: The DTR signal remains active as long as the receiving of new characters is allowed.
- **RTS Control** (INACTIVE / ACTIVE / ENABLE SEND / SOL. SEND):
  Inactive: It sets the RTS control signal to permanently inactive.
  Active: It sets the RTS control signal to permanently active.
  Enable Send: The RTS signal remains active as long as the receiving of new characters is allowed.
  Solicit Send: The RTS signal remains active as long as there are characters pending transmission.

3.11.8.b Virtual Port 2

Virtual port 2 settings:

- **Enable**: enables virtual inputs / outputs function for this port.
- **Baud Rate**: a value from 9600 to 115200 bauds can be selected, default value being 9600 bauds.
- **Error Detection Period**: time after which the communications error counter is reset.
- **Time Out**: time without receiving a complete frame before a communications error is generated.

3.11.8.c Virtual Measurements

Virtual magnitudes corresponding to rear ports Remote 1 and Remote 2 can also be configured in the Inputs / Outputs field, and any of the magnitudes calculated by the relay can be selected, including the magnitudes calculated into the programmable logic through the ***ZivercomPlus***® program.

3.11.8.d Digital Inputs of the Virtual Inputs / Outputs Function

Table 3.11-4: Digital Inputs of the Virtual Inputs / Outputs Function		
Name	**Description**	**Function**
RST_CO_ERR1	Error counter 1 reset	Activation of this input resets the communications error counter associated to port 1.
RST_CO_ERR2	Error counter 2 reset	Activation of this input resets the communications error counter associated to port 2.
OUT_VIR1_1	Virtual digital output_1 1	Activates said virtual digital output of port 1.
OUT_VIR1_2	Virtual digital output_1 2	
OUT_VIR1_3	Virtual digital output_1 3	
OUT_VIR1_4	Virtual digital output_1 4	
OUT_VIR1_5	Virtual digital output_1 5	
OUT_VIR1_6	Virtual digital output_1 6	
OUT_VIR1_7	Virtual digital output_1 7	
OUT_VIR1_8	Virtual digital output_1 8	
OUT_VIR1_9	Virtual digital output_1 9	
OUT_VIR1_10	Virtual digital output_1 10	
OUT_VIR1_11	Virtual digital output_1 11	
OUT_VIR1_12	Virtual digital output_1 12	
OUT_VIR1_13	Virtual digital output_1 13	
OUT_VIR1_14	Virtual digital output_1 14	
OUT_VIR1_15	Virtual digital output_1 15	
OUT_VIR1_16	Virtual digital output_1 16	
OUT_VIR2_1	Virtual digital output_2 1	Activates said virtual digital output of port 2.
OUT_VIR2_2	Virtual digital output_2 2	
OUT_VIR2_3	Virtual digital output_2 3	
OUT_VIR2_4	Virtual digital output_2 4	
OUT_VIR2_5	Virtual digital output_2 5	
OUT_VIR2_6	Virtual digital output_2 6	
OUT_VIR2_7	Virtual digital output_2 7	
OUT_VIR2_8	Virtual digital output_2 8	
OUT_VIR2_9	Virtual digital output_2 9	
OUT_VIR2_10	Virtual digital output_2 10	
OUT_VIR2_11	Virtual digital output_2 11	
OUT_VIR2_12	Virtual digital output_2 12	
OUT_VIR2_13	Virtual digital output_2 13	
OUT_VIR2_14	Virtual digital output_2 14	
OUT_VIR2_15	Virtual digital output_2 15	
OUT_VIR2_16	Virtual digital output_2 16	

3.11.8.e Auxiliary Outputs of the Virtual Inputs / Outputs Function

Table 3.11-5: Auxiliary Outputs of the Virtual Inputs / Outputs Function		
Name	**Description**	**Function**
VAL_DI1	Validity of virtual digital inputs 1	
VAL_AI1	Validity of virtual analog inputs 1	
VAL_DI2	Validity of virtual digital inputs 2	
VAL_AI2	Validity of virtual analog inputs 2	
IN_VIR1_1	Virtual Digital Input_1 1	Shows that said virtual input of port 1 is activated.
IN_VIR1_2	Virtual Digital Input_1 2	
IN_VIR1_3	Virtual Digital Input_1 3	
IN_VIR1_4	Virtual Digital Input_1 4	
IN_VIR1_5	Virtual Digital Input_1 5	
IN_VIR1_6	Virtual Digital Input_1 6	
IN_VIR1_7	Virtual Digital Input_1 7	
IN_VIR1_8	Virtual Digital Input_1 8	
IN_VIR1_9	Virtual Digital Input_1 9	
IN_VIR1_10	Virtual Digital Input_1 10	
IN_VIR1_11	Virtual Digital Input_1 11	
IN_VIR1_12	Virtual Digital Input_1 12	
IN_VIR1_13	Virtual Digital Input_1 13	
IN_VIR1_14	Virtual Digital Input_1 14	
IN_VIR1_15	Virtual Digital Input_1 15	
IN_VIR1_16	Virtual Digital Input_1 16	
IN_VIR2_1	Virtual Digital Input_2 1	Shows that said virtual input of port 2 is activated.
IN_VIR2_2	Virtual Digital Input_2 2	
IN_VIR2_3	Virtual Digital Input_2 3	
IN_VIR2_4	Virtual Digital Input_2 4	
IN_VIR2_5	Virtual Digital Input_2 5	
IN_VIR2_6	Virtual Digital Input_2 6	
IN_VIR2_7	Virtual Digital Input_2 7	
IN_VIR2_8	Virtual Digital Input_2 8	
IN_VIR2_9	Virtual Digital Input_2 9	
IN_VIR2_10	Virtual Digital Input_2 10	
IN_VIR2_11	Virtual Digital Input_2 11	
IN_VIR2_12	Virtual Digital Input_2 12	
IN_VIR2_13	Virtual Digital Input_2 13	
IN_VIR2_14	Virtual Digital Input_2 14	
IN_VIR2_15	Virtual Digital Input_2 15	
IN_VIR2_16	Virtual Digital Input_2 16	

Table 3.11-5: Auxiliary Outputs of the Virtual Inputs / Outputs Function		
Name	**Description**	**Function**
OUT_VIR1_1	Virtual digital output_1 1	Activates said virtual digital output of port 1.
OUT_VIR1_2	Virtual digital output_1 2	
OUT_VIR1_3	Virtual digital output_1 3	
OUT_VIR1_4	Virtual digital output_1 4	
OUT_VIR1_5	Virtual digital output_1 5	
OUT_VIR1_6	Virtual digital output_1 6	
OUT_VIR1_7	Virtual digital output_1 7	
OUT_VIR1_8	Virtual digital output_1 8	
OUT_VIR1_9	Virtual digital output_1 9	
OUT_VIR1_10	Virtual digital output_1 10	
OUT_VIR1_11	Virtual digital output_1 11	
OUT_VIR1_12	Virtual digital output_1 12	
OUT_VIR1_13	Virtual digital output_1 13	
OUT_VIR1_14	Virtual digital output_1 14	
OUT_VIR1_15	Virtual digital output_1 15	
OUT_VIR1_16	Virtual digital output_1 16	
OUT_VIR2_1	Virtual digital output_2 1	Activates said virtual digital output of port 2.
OUT_VIR2_2	Virtual digital output_2 2	
OUT_VIR2_3	Virtual digital output_2 3	
OUT_VIR2_4	Virtual digital output_2 4	
OUT_VIR2_5	Virtual digital output_2 5	
OUT_VIR2_6	Virtual digital output_2 6	
OUT_VIR2_7	Virtual digital output_2 7	
OUT_VIR2_8	Virtual digital output_2 8	
OUT_VIR2_9	Virtual digital output_2 9	
OUT_VIR2_10	Virtual digital output_2 10	
OUT_VIR2_11	Virtual digital output_2 11	
OUT_VIR2_12	Virtual digital output_2 12	
OUT_VIR2_13	Virtual digital output_2 13	
OUT_VIR2_14	Virtual digital output_2 14	
OUT_VIR2_15	Virtual digital output_2 15	
OUT_VIR2_16	Virtual digital output_2 16	

3.11.8.f Magnitudes of the Virtual Inputs / Outputs Function

Table 3.11-6: Magnitudes of the Virtual Inputs / Outputs Function		
Name	**Description**	**Units**
MV1 01	Virtual Quantity 1 for communication channel 1	Depend on the magnitude configurated
MV2 01	Virtual Quantity 2 for communication channel 1	Depend on the magnitude configurated
MV1 03	Virtual Quantity for communication channel 1	Depend on the magnitude configurated
MV1 04	Virtual Quantity 4 for communication channel 1	Depend on the magnitude configurated
MV1 05	Virtual Quantity 5 for communication channel 1	Depend on the magnitude configurated
MV1 06	Virtual Quantity 6 for communication channel 1	Depend on the magnitude configurated
MV1 07	Virtual Quantity 7 for communication channel 1	Depend on the magnitude configurated
MV1 08	Virtual Quantity for communication channel 1	Depend on the magnitude configurated
MV1 09	Virtual Quantity 9 for communication channel 1	Depend on the magnitude configurated
MV1 10	Virtual Quantity 10 for communication channel 1	Depend on the magnitude configurated
MV1 11	Virtual Quantity 11 for communication channel 1	Depend on the magnitude configurated
MV1 12	Virtual Quantity 12 for communication channel 1	Depend on the magnitude configurated
MV1 13	Virtual Quantity 13 for communication channel 1	Depend on the magnitude configurated
MV1 14	Virtual Quantity 14 for communication channel 1	Depend on the magnitude configurated
MV1 15	Virtual Quantity 15 for communication channel 1	Depend on the magnitude configurated
MV1 16	Virtual Quantity 16 for communication channel 1	Depend on the magnitude configurated
MV2 01	Virtual Quantity 1 for communication channel 2	Depend on the magnitude configurated
MV2 01	Virtual Quantity 2 for communication channel 2	Depend on the magnitude configurated
MV2 03	Virtual Quantity 3 for communication channel 2	Depend on the magnitude configurated
MV2 04	Virtual Quantity 4 for communication channel 2	Depend on the magnitude configurated
MV2 05	Virtual Quantity 5 for communication channel 2	Depend on the magnitude configurated
MV2 06	Virtual Quantity 6 for communication channel 2	Depend on the magnitude configurated
MV2 07	Virtual Quantity 7 for communication channel 2	Depend on the magnitude configurated
MV2 08	Virtual Quantity 8 for communication channel 2	Depend on the magnitude configurated
MV2 09	Virtual Quantity 9 for communication channel 2	Depend on the magnitude configurated

Table 3.11-6: Magnitudes of the Virtual Inputs / Outputs Function		
Name	**Description**	**Units**
MV2 10	Virtual Quantity 10 for communication channel 2	Depend on the magnitude configurated
MV2 11	Virtual Quantity 11 for communication channel 2	Depend on the magnitude configurated
MV2 12	Virtual Quantity 12 for communication channel 2	Depend on the magnitude configurated
MV2 13	Virtual Quantity 13 for communication channel 2	Depend on the magnitude configurated
MV2 14	Virtual Quantity 14 for communication channel 2	Depend on the magnitude configurated
MV2 15	Virtual Quantity 15 for communication channel 2	Depend on the magnitude configurated
MV2 16	Virtual Quantity 16 for communication channel 2	Depend on the magnitude configurated
N E FA 1	Cumulative number of fatal errors detected in analog frame in communication channel 1	
N E FA 2	Cumulative number of fatal errors detected in analog frame in communication channel 2	
N E FD 1	Cumulative number of fatal errors in communication channel 1	
N E FD 2	Cumulative number of fatal errors in communication channel 2	
N ERR C 1	Cumulative number of fatal errors detected and repaired in communication channel 1	
N ERR C 2	Cumulative number of fatal errors detected and repaired in communication channel 2	
ACUM ERR 1	Cumulative number of fatal errors detected in the last N seconds in communication channel 1	
ACUM ERR 2	Cumulative number of fatal errors detected in the last N seconds in communication channel 2	
T SIN ACT 1	Time without activity in communication channel 1	
T SIN ACT 2	Time without activity in communication channel 2	

3.11.9 Communications Settings

Local Port Communications			
Setting	**Range**	**Step**	**Default**
Baud Rate	300 - 38400 Baud		38400
Stop Bits	1 - 2		1
Parity	0: None 1: Even		0: None
RX Time Between Character	1 - 60000 ms	0.5 ms	40 ms
Communication Failure Indication Time	0 - 600 s	0.1 s	60 s

Remote Communications Port 1			
Setting	**Range**	**Step**	**Default**
Protocol Selection	0: PROCOME 1: DNP 3.0 2: MODBUS		0: PROCOME
Baud Rate	300 - 38400 Baud		38400 Baud
Stop Bits	1 - 2		1
Parity	0: None 1: Even 2: Odd		0: None
RX Time between Character	1 - 60000 ms	0.5 ms	40 ms
Communication Failure Indication Time	0 - 600 s	0.1 s	60 s
Advanced Settings			
Flow Control			
CTS Flow	0 (NO) - 1 (YES)		NO
DSR Flow	0 (NO) - 1 (YES)		NO
DSR Sensitive	0 (NO) - 1 (YES)		NO
DTR Control	0: Inactive 1: Active 2: Permit send		0: Inactive
RTS Control	0: Inactive 1: Active 2: Permit send 3: Solicit send		0: Inactive
Time			
Tx Time Factor	0 -100 characters	0.5	1
Tx Time Constant	0 - 60000 ms	1 ms	0 ms
Message Modification			
Number of Zeros	0 - 255	1	0
Collisions			
Type of Collision	0: NO 1: DCD 2: ECO		NO
Number of Retries	0 - 3	1	0
Minimum Retry Time	0 - 60000 ms	1 ms	0 ms
Maximum Retry Time	0 - 60000 ms	1 ms	0 ms

Remote Communications Port 2			
Setting	**Range**	**Step**	**Default**
Protocol Selection	0: Procome 1: DNP V3.0 2: Modbus		0: Procome
Baud Rate	300 - 38400 Baud		38400 Baud
Stop Bits	1 - 2		1
Parity	0: None 1: Even 2: Odd		0: None
RX Time Between Character	1 - 60000 ms	0.5 ms	40 ms
Communication Failure Indication Time	0 - 600 s	0.1 s	60 s
Advanced Settings			
Operation Mode	0: RS232 1: RS485		0: RS232
Time			
Tx Time Factor	0 -100 characters	0.5	1
Tx Time Constant	0 - 60000 ms	1 ms	0 ms
Number of 485 Stop Bytes	0 - 4 bytes	1 byte	0 bytes
Message Modification			
Number of Zeros	0 - 255	1	0
Collisions			
Type of Collision	0: NO 1: ECO		0: NO
Number of Retries	0 - 3	1	0
Minimum Retry Time	0 - 60000 ms	1 ms	0 ms
Maximum Retry Time	0 - 60000 ms	1 ms	0 ms

Remote Communications Ports 1, 2 and 3 Ethernet			
Setting	**Range**	**Step**	**Default**
Protocol Selection	PROCOME DNP 3.0 MODBUS Virtual Inputs / Outputs (*)		PROCOME
Enabling the Ethernet Port	NO / YES		YES
IP Address	ddd. ddd. ddd. ddd		192.168.1.151(PR1) 192.168.1.61(PR2) 192.168.1.71(PR3)
Net Mask	128.000.000.000 - 255.255.255.254		255.255.255.0
Port Number	0 - 65535	1	20000
Max. Time between Messages TCP	0 - 65 s	1	30
RX Car. Time	0 - 60000 ms	0.5 ms	1 ms
Communication fault indication time	0 - 600 s	0.1 s	60 s

(*) The Virtual Inputs / Outputs function is only for the Remote Port 2.

Communications Protocols			
Setting	**Range**	**Step**	**Default**
PROCOME Protocol			
IED Address	0 - 254	1	0
Communications Password Enable	YES / NO		NO
Communications Password Timeout	1 - 10 min	1	10 min
Communications Password	8 characters		
DNP 3.0 Protocol			
IED Address	0 - 65519	1	1
T. Confirm Timeout	100 - 65535 ms	1	1000 ms
Max. Retries	0 - 65535	1	0
Enable Unsolicited	YES / NO		NO
Unsolicited Start Enable	YES / NO		
Unsolic. Master No.	0 - 65519	1	1
Unsolic. Grouping Time.	100 - 65535 ms	1	1000 ms
Sync Interval	0 - 120 min	1	0 min
Unsolicited Start Activation	YES / NO		
DNP 3.0 Revision	Standard ZIV / 2003		
DNP 3.0 Protocol: Measurements (16 Deadband Measurements Change)	0.01 - 100	0.01	100
DNP 3.0 Profile II Protocol: Measurements (16 Deadband Measurements Change)	0.0001 - 100	0.0001	100
Digital Changes Class (DNP 3.0 Profile II and Profile II Ethernet)	CLASS 1 CLASS 2 CLASS 3 NONE		CLASS 1
Analog Changes Class (DNP 3.0 Profile II and Profile II Ethernet)	CLASS 1 CLASS 2 CLASS 3 NONE		CLASS 2
Counters Changes Class (DNP 3.0 Profile II and Profile II Ethernet)	CLASS 1 CLASS 2 CLASS 3 NONE		CLASS 3
Validity Status for Digital Inputs (DNP 3.0 Profile II and Profile II Ethernet)	YES / NO		YES
32 Bits Measurements (DNP 3.0 Profile II and Profile II Ethernet)	YES / NO		YES
Counters (max. 20) (DNP 3.0 Profile II and Profile II Ethernet)	1 - 32767	1	1
MODBUS Protocol			
IED Address	0 - 247	1	1

Communications Protocols			
Setting	**Range**	**Step**	**Default**
IEC-61850 Protocol			
Goose Channel	Ethernet Channel 1 Ethernet Channel 2		Ethernet Channel 1
Input Gooses			
Subscription data			
Input Goose (from 1 to 32)			
Goose ID	Up to 65 characters		
Goose CB ref	Up to 64 characters		
MAC Address	00.00.00.00.00.00 – FF.FF.FF.FF.FF.FF		00.00.00.00.00.00
AppID	0 - 16383	1	0
Connections with Virtual Input Gooses			
Virtual Input Goose (from 1 to 32):			
Associated Goose	Input Goose from 1 to 32		
Object number	0 - 1024	1	0
Output Goose			
Goose Out Enable	YES / NO		
Goose Out ID	Up to 65 characters		
MAC Address	01.0C.CD.01.00.00 - 01.0C.CD.01.01.FF		01.0C.CD.01.00.C1
Priority	0 - 1	1	0
VID	0 - 4095	1	0
App. D	0 - 16383	1	0
Revision	0 - 999999999	1	0
First Retry Timer	1 - 100 ms	1	4
Retry Time Multiplier	1 - 100	1	2
Maximum Retry Time	0.1 - 30 sc	0.01	10
IP			
IP Address	ddd.ddd.ddd.ddd		
DHCP Enable	YES / NO		YES
Default Gateway	ddd.ddd.ddd.ddd		
Network Mask	ddd.ddd.ddd.ddd		
DNS Address	ddd.ddd.ddd.ddd		

Communications Protocols			
Setting	**Range**	**Step**	**Default**
IEC-61850 Protocol			
SNTP			
SNTP enable	YES / NO		NO
Broadcast Synchronizing Enable	YES / NO		NO
Unicast Synchronizing Enable	YES / NO		NO
IP Address of Main SNTP Server	Ddd.Ddd.Ddd.Ddd		
IP Address of Secondary SNTP Server	Ddd.Ddd.Ddd.Ddd		
Time Delay of Unicast Validation	10 - 1000000 S	1 S	30 S
Time Delay of Unicast Error	10 - 1000000 S	1 S	30 S
Number of Connection Retries	1 - 10	1	3
Synchronizing Period	10 - 1000000 S	1 S	10 S
Period between Retries	10 - 1000000 S	1 S	10 S
Time Delay of Broadcast Validation	0 - 1000000 S	1 S	0 S
Time Delay of Broadcast Error	0 - 1000000 S	1 S	0 S
Maximum Synchronizing Time Difference	0 - 1000000 S	1 S	0 S
Ignore Synchronizing Leap Indicator	YES / NO		NO
Calculation of Synchronizing Status	Time delay Leap Indicator		Time delay
Ethernet			
Redundancy Mode	No Redundancy Bondng Redund. PRP Redund. RSTP Redund.		No Redundancy
Channel Status Time	1 - 60 s	1 s	5 s
Bonding			
Link Check Interval	25 - 500 ms	25 ms	100 ms
PRP			
Supervision Frame Send Interval	0 - 30000 ms	500 ms	2000 ms
LSB of Destination MAC for Supervision Frames	0 - 255	1	0

- **Communications: HMI Access**

0 - CONFIGURATION	0 - NOMINAL VALUES	**0 - PORTS**
1 - OPERATIONS	1 - PASSWORDS	**1 - PROTOCOLS**
2 - CHANGE SETTINGS	**2 - COMMUNICATIONS**	
3 - INFORMATION	3 - TIME AND DATE	
	4 - CONTRAST	
	5 - HMI DIAGRAM CONF.	

Ports / Local Port

0 - PORTS	**0 - LOCAL PORT**	**0 - BAUDRATE**
1 - PROTOCOLS	1 - REMOTE PORT 1	**1 - STOP BITS**
	2 - REMOTE PORT 2	**2 - PARITY**
	3 - REMOTE PORT 3	**3 - RX TIME BTW. CHAR**
	4 - IRIG-B	**4 - COMMS FAIL IND. TIME**

Ports / Remote Port 1

0 - PORTS	0 - LOCAL PORT	**0 - PROTOCOL SELECT.**
1 - PROTOCOLS	**1 - REMOTE PORT 1**	**1 - BAUDRATE**
	2 - REMOTE PORT 2	**2 - STOP BITS**
	3 - REMOTE PORT 3	**3 - PARITY**
	4 - IRIG-B	**4 - RX TIME BTW. CHAR**
		5 - COMMS FAIL IND. TIME
		6 - ADVANCED SETTINGS

0 - PROTOCOL SELECT.	
1 - BAUDRATE	
2 - STOP BITS	
3 - PARITY	**0 - FLOW CONTROL**
4 - RX TIME BTW. CHAR	**1 - TIME**
5 - COMMS FAIL IND. TIME	**2 - MESSAGE MODIF.**
6 - ADVANCED SETTINGS	**3 - COLLITIONS**

Remote Port 2

0 - PORTS	0 - LOCAL PORT	**0 - PROTOCOL SELECT.**
1 - PROTOCOLS	1 - REMOTE PORT 1	**1 - BAUDRATE**
	2 - REMOTE PORT 2	**2 - STOP BITS**
		3 - PARITY
		4 - RX TIME BTW. CHAR
		5 - COMMS FAIL IND. TIME
		6 - STOP BYTES 485
		7 - ADVANCED SETTINGS

0 - PROTOCOL SELECT.	
1 - BAUDRATE	
2 - STOP BITS	
3 - PARITY	**0- FLOW CONTROL**
4 - RX TIME BTW. CHAR	**1 - OPERATING MOD**
5 - COMMS FAIL IND. TIME	**2 - TIME**
6 - STOP BYTES 485	**3 - MESSAGE MODIF.**
7 - ADVANCED SETTINGS	**4 - COLLITIONS**

Ports / Remotes Ports 1, 2 and 3 Ethernet

0 - PORTS	0 - LOCAL PORT	**0 - PROTOCOL SELECT.**
1 - PROTOCOLS	**1 - REMOTE PORT 1**	**1 - UART**
	2 - REMOTE PORT 2	**2 - ETHERNET**
	3 - REMOTE PORT 3	
	4 - IRIG-B	

0 - PROTOCOL SELECT.	**0 - BAUDRATE**
1 - UART	**1 - STOP BITS**
2 - ETHERNET	**2 - PARITY**
	3 - RX TIME BTW. CHAR
	4 - COMMS FAIL IND. TIME
	5 - ADVANCED SETTINGS

0 - BAUDRATE	
1 - STOP BITS	
2 - PARITY	**0 - FLOW CONTROL**
3 - RX TIME BTW CHAR	**1 - TIME**
4 - COMMS FAIL IND. TIME	**2 - MESSAGE MODIF.**
5 - ADVANCED SETTINGS	**3 - COLLITIONS**

0 - PROTOCOL SELECT.	**0 - ENAB. ETHERNET PORT**
1 - UART	**1 - IP ADDRESS**
2 - ETHERNET	**2 - NET MASK**
	3 - PORT NUMBER
	4 - MAX. TIME TCP MESSAG
	5 - RX CAR. TIME
	6 - TPO. IND. FALLO COMS

Protocols / Procome Protocol

0 - PORTS	**0 - PROCOME PROTOCOL**	**0 - UNIT NUMBER**
1 - PROTOCOLS	1 - DNP 3.0 PROTOCOL	**1 - COMMS PASSW. ENABLE**
	2 - MODBUS PROTOCOL	**2 - COMMS PASSW. TIMEOUT**
	3 - IEC 61850	**3 - COMMS PASSW.**
	4 - TCP/IP	

Protocols / DNP 3.0 Protocol

0 - PORTS	0 - PROCOME PROTOCOL	**0 - RELAY NUMBER**
1 - PROTOCOLS	**1 - DNP 3.0 PROTOCOL**	**1 - T. CONFIRM TIMEOUT**
	2 - MODBUS PROTOCOL	**2 - MAX RETRIES**
	3 - IEC 61850	**3 - HAB. UNSOLICITED**
	4 - TCP/IP	**4 - UNSOL. PICKUP ACT.**
		5 - UNSOLIC. MASTER NO.
		6 - UNSOL. GROUPING TIME
		7 - SYNCR. INTERVAL
		8 - REV DNP 3.0
		9 - MEASURES

Protocols / DNP 3.0 Protocol (Profile II and Profile II Ethernet)

0 - PORTS	0 - PROCOME PROTOCOL	**0 - RELAY NUMBER**
1 - PROTOCOLS	**1 - DNP 3.0 PROTOCOL**	**1 - T. CONFIRM TIMEOUT**
	2 - MODBUS PROTOCOL	**2 - MAX RETRIES**
	3 - IEC 61850	**3 - HAB. UNSOLICITED**
	4 - TCP/IP	**4 - UNSOL. PICKUP ACT.**
		5 - UNSOLIC. MASTER NO.
		6 - UNSOL. GROUPING TIME
		7 - SYNCR. INTERVAL
		8 - REV DNP 3.0
		9 - DIGITAL CHANGES CLASS
		10 - ANAL. CHANGES CLASS
		11 - COUN. CHANGES CLASS
		12 - STATUS VALIDEZ ED
		13 - MEASURES 32 BITS
		14 - MEASURES
		15 - COUNTERS

Protocols / Modbus Protocol

0 - PORTS	0 - PROCOME PROTOCOL	
1 - PROTOCOLS	1 - DNP 3.0 PROTOCOL	
	2 - MODBUS PROTOCOL	**0 - UNIT NUMBER**
	3 - IEC 61850	
	4 - TCP/IP	

Protocols / IEC 61850 Protocol

0 - PORTS	0 - PROCOME PROTOCOL	
1 - PROTOCOLS	1 - DNP 3.0 PROTOCOL	
	2 - MODBUS PROTOCOL	**0 - GOOSE CHANNEL**
	3 - IEC 61850	**1 - ENBLGOOSEOUT**
	4 - TCP/IP	

Protocols / TCP/IP Protocol

0 - PORTS	0 - PROCOME PROTOCOL	
1 - PROTOCOLS	1 - DNP 3.0 PROTOCOL	
	2 - MODBUS PROTOCOL	**0 - LAN 1**
	3 - IEC 61850	**1 - LAN 2**
	4 - TCP/IP	**2 - SNTP**

0 - PROCOME PROTOCOL		**0 - IP ADDRESS**
1 - DNP 3.0 PROTOCOL		**1 - ENABLE DHCP**
2 - MODBUS PROTOCOL	**0 - LAN 1**	**2 - DEFAULT GATEWAY**
3 - IEC 61850	**1 - LAN 2**	**3 - NETWORK MASK**
4 - TCP/IP	2 - SNTP	**4 - DNS ADDRESS**

0 - PROCOME PROTOCOL		**0 - ENABLESNTP**
1 - DNP 3.0 PROTOCOL		**1 - ENBL_BROADCASTSNTP**
2 - MODBUS PROTOCOL	0 - LAN 1	**2 - ENBL_UNICASTSNTP**
3 - IEC 61850	1 - LAN 2	**3 - MAINSNTPSRV**
4 - TCP/IP	**2 - SNTP**	**4 - BACKUPSNTPSRV**
		5 - UNICAST VALID TIME
		6 - UNICAST ERROR TIME
		7 - RETRY ATTEMPTS
		8 - SYNC PERIOD
		9 - RETRY PERIOD
		10 - BRDCST VALID TIME
		11 - BRDCST ERROR TIME
		12 - MAX TIME DIF
		13 - SNTP_IGNORELEAPIND
		14 - SNTP_SYNCSTATECALC

Protocols / IEC 61850 Protocol (6MCV-***-*****6)

0 - PORTS	0 - PROCOME PROTOCOL	**0 - ETHERNET**
1 - PROTOCOLS	1 - DNP 3.0 PROTOCOL	**1 - IP**
	2 - MODBUS PROTOCOL	**2 - GOOSE**
	3 - IEC 61850	**3 - SNTP**

0 - ETHERNET	**0 - REDUNDANCY MODE**
1 - IP	**1 - CHANNEL LIVE TIME**
2 - GOOSE	**2 - BONDING**
3 - SNTP	**3 - PRP**

0 - ETHERNET	0 - REDUNDANCY MODE	
1 - IP	1 - CHANNEL LIVE TIME	
2 - GOOSE	**2 - BONDING**	**0 - LINK CHK INTERVAL**
3 - SNTP	3 - PRP	

0 - ETHERNET	0 - REDUNDANCY MODE	
1 - IP	1 - CHANNEL LIVE TIME	
2 - GOOSE	2 - BONDING	**0 - SUPERV TX INTERVAL**
3 - SNTP	**3 - PRP**	**1 - SUP LSB DEST MAC**

0 - ETHERNET		**0 - IP ADDRESS**
1 - IP	**0 - LAN 1**	**1 - ENABLE DHCP**
2 - GOOSE	**1 - LAN 2**	**2 - DEFAULT GATEWAY**
3 - SNTP		**3 - NETWORK MASK**
		4 - DNS ADDRESS

0 - ETHERNET	
1 - IP	**0 - GOOSE CHANNEL**
2 - GOOSE	**1 - ENBLGOOSEOUT**
3 - SNTP	

0 - ETHERNET	**0 - ENABLESNTP**
1 - IP	**1 - ENBL_BROADCASTSNTP**
2 - GOOSE	**2 - ENBL_UNICASTSNTP**
3 - SNTP	**3 - MAINSNTPSRV**
	4 - BACKUPSNTPSRV
	5 - UNICAST VALID TIME
	6 - UNICAST ERROR TIME
	7 - RETRY ATTEMPTS
	8 - SYNC PERIOD
	9 - RETRY PERIOD
	10 - BRDCST VALID TIME
	11 - BRDCST ERROR TIME
	12 - MAX TIME DIF
	13 - SNTP_IGNORELEAPIND
	14 - SNTP_SYNCSTATECALC

3.11.10 Outputs and Events of the Communications Module (6MCV-***-*****6)

Table 3.11-7:Outputs and Events of the Communications Module (6MCV-***-*****6)		
Name	**Description**	**Function**
RESET REQ	Reset Required for Reconfiguration	Indicates that it is necessary to reset the relay in order for the configuration changes to take effect.
WRITING FLASH	Writing to Flash in Progress	Indicates that a write to FLASH is in progress (ON: In progress / OFF: End).
SNTP NO SYNC	SNTP Not Synchronized	Indicates the synchronizing status of the SNTP module. (ON: Not Synchronized / OFF: Synchronized).
LAN1 STATUS	LAN1 Communications Port Status	Indicates the status of the applicable communications port LAN. It is only used when the relay is redundancy configured, whether bonding or PRP (if there is no redundancy, the value is always OFF): - Bonding: Indicates whether LAN detects medium during a settable time. If medium is not detected during this time, it takes the value OFF. As soon as it detects medium, it switches to ON. - PRP: Indicates whether LAN receives frames during a settable time. If it receives any frame, it takes the value ON. If no frames are received during this time, it takes the value OFF.
LAN2 STATUS	LAN2 Communications Port Status	
BOND ACT LAN	Active LAN Communications Port (bonding)	Indicates the active LAN when the configured redundancy is bonding (OFF: LAN1 active / ON: LAN2 active).
LAN1 NET OVFL	Network Congestion Detected on LAN1	Indicates whether a network congestion is taking place (abnormal network avalanche) in the corresponding LAN (ON: Congestion present / OFF: No congestion present).
LAN2 NET OVFL	Network Congestion Detected on LAN2	

3.11.11 Communications Test

In order to proceed with the communications testing the relay must be supplied with the nominal voltage. Then the “In Service” LED must light up.

3.11.11.a PROCOME Protocol Test

The testing shall be performed through the three communications ports (one front and two rear [P1 and P2] ports), which must be set as follows:

Baud rate	**38,400 bauds**
Stop bits	**1**
Parity	**1** (even)

All ports shall be assigned the PROCOME protocol in order to use the ***ZivercomPlus***® communications program in all of them.

Connect with the relay through the front port via a male DB9 cable. Synchronize the time through the ***ZivercomPlus***® program. Disconnect the relay and wait for two minutes. Then, supply power to the relay again and connect with the relay through both rear ports. Finally set the ***ZivercomPlus***® program to cyclic and check that the time updates properly with both P1 and P2 connected.

3.11.11.b DNP v3.0 Protocol Tests

The main objects to test are:

1	0	Binary Input – All variations
1	1	Binary Input

The relay is asked about the state in that instant of the IED's status contact input signals (digital inputs, digital outputs, logic signals) configured to be sent via DNP v3.0.

2	0	Binary Input Change – All variations
2	1	Binary Input Change without Time
2	2	Binary Input Change with Time
2	3	Binary Input Change with Relative Time

The relay is asked about the control changes generated by the status contact input signals configured to be sent via DNP v3.0. They can be all the changes, without time, with time or with relative time.

10	0	Binary Outputs – All variations

The relay is asked about the state of the writings of outputs configured in the relay.

12	1	Control Relay Output Block

The operations sent through communications are tested on the IED.

20	0	Binary Counter – All variations
20	1	32-bit Binary Counter
21	0	Frozen Counter – All variations
21	1	32-bit Frozen Counter
22	0	Counter Change Event – All variations

A request is made for the value of the counters included in the IED's logic. These counters can be 32-bits binary or frozen counters. A request is also made for the changes generated by the value of these counters.

30	0	Analog Input – All variations
30	2	16-Bit Analog Input

A request is made for the value of the IED's analog inputs at that precise moment.

32	0	Analog Change Event – All variations
32	4	16-Bit Analog Change Event with Time

A request is made for the control changes generated by the variation in the value of the IED's analog channels.

40	0	Analog Output Status – All variations

The relay is asked about the state at that precise moment of the value of the IED's analog outputs.

41	2	16-Bit Analog Output Block

The relay is asked about the state at that precise moment of the value of the IED's 16-bit analog outputs.

50	1	Time and Date

The IED's date and time are synchronized.

52	2	Time Delay Fine

The relay is asked about the communications delay time. It is measured from the time the relay receives the first bit of the first byte of the question until the transmission of the first bit of the first byte of the IED's response.

60	1	Class 0 Data
60	2	Class 1 Data
60	3	Class 2 Data
60	4	Class 3 Data

The relay is asked about the various data defined in the relay as Class 0, Class 1, Class 2 and Class 3.

Within these requests, the IED's generation and sending of Unsolicited Messages for each of the different kinds of data is tested.

80	1	Internal Indications

The IED's Internal Indication bit (IIN1-7 bit Device Restart) is reset.

--	--	No Object (Cold Start)

When the IED receives a “Cold Load Pickup” object, it must answer with a message object “Time Delay Fine” and with a reset of the internal indication bit IIN1-7 (Device Restart).

--	--	No Object (Warm Start)

When the IED receives a “Warm Load Pickup” object, it must answer with a message object “Time Delay Fine” and with a reset of the internal indication bit IIN1-7 (Device Restart).

--	--	No Object (Delay Measurement)

The IED must answer with a communications object “Time Delay Fine.”

The Broadcast addresses are tested and the indications corresponding to “All Stations” with each of them.

3.12 Alarm Codes

3.12.1 Introduction

6MCV models notify the occurrence of alarms by 3 routes:

- Activation of an Alarm Generation Signal and Event.
- Update of the Alarm Status Magnitude.
- Indication on the HMI Stand-by Screen.

3.12.2 Activation of Signal and Alarm Generation Event

The IED has 2 digital signals to indicate critical and non-critical level alarms:

- Non-critical system error: ERR_NONCRIT
- Critical system error: ERR_CRIT

The activation of any of these signals generates its associated event. These signals can be used as inputs to be processed by the user-developed algorithms. Likewise, these signals can be connected to any of the communications protocols for their remote notification.

3.12.3 Update of the Alarm Status Magnitude

The IED has a magnitude whose value is determined by the combination of active alarms in the IED. This magnitude can be used as input to be processed by the user-developed algorithms. Likewise, a user-developed algorithm can connect this magnitude or the outcome of its processing to any of the communications protocols for transmission. Table 3.12-1 shows the possible causes of alarm coded by alarm magnitude, together with their level of severity.

Table 3.12-1: Alarm Status Magnitude and Severity Level

Alarm	Value	Severity
Error read/write settings	0x00000001	CRITICAL
Protection operation error	0x00000020	CRITICAL
Error read/write from E2PROM	0x00000040	CRITICAL
Non-critical error in A/D converter	0x00000080	NON-CRITICAL
Critical error in A/D converter	0x00000100	CRITICAL
Loss of content in non-volatile RAM	0x00000200	NON-CRITICAL
Error in internal clock operation	0x00000400	NON-CRITICAL
Error read/write from FLASH	0x00008000	CRITICAL
Error in configuration	0x00800000	NON-CRITICAL

In the case of more than one alarm at once, the sum of the codes of these alarms is seen in hexadecimal form.

3.12.4 Indication on the HMI Stand-By Screen

The activation of the Critical System Error signal produces the display of the current magnitude of the status of alarms of the IED in hexadecimal format on the stand-by display of the HMI.

Warning: contact the manufacturer if the unit displays any of these alarms codes.

3.12.5 General Alarm Counter

The relay is provided with three counters on the HMI to inform on the number of starts, re-starts and Traps:

- Number of starts (NARRANQS) Informs on the number of times the relay has been cold restarted (relay power supply failure).
- Number of restarts (NREARRAQS) Informs on the number of times the relay has been hot restarted (manually through change in configuration, or change of any nominal setting or relay reset).
- Number of Traps (NTRAPS) Number of exceptions produced in the relay followed by a reset.

Warning: contact the manufacturer if the unit displays any of these alarm codes or Traps counter increment.

A. PROCOME 3.0 Protocol

A.1 Control Application Layer

- **Application Functions**

- ☑ **Initialization of the secondary station**
- ☑ **Clock synchronization**
- ☑ **Control functions**
  - ☑ Control interrogation
  - ☑ Refreshing of digital control signals
  - ☑ Write outputs
  - ☑ Enabling and disabling of inputs
  - ☑ Overflow
  - ☑ Force single coil

- **Compatible ASDUs in Secondary-to-Primary Direction**

☑	**<5>**	**Identification**
☑	**<6>**	**Clock synchronization**
☑	**<100>**	**Transmission of metering values and digital control signal changes**
☑	**<101>**	**Transmission of counters**
☑	**<103>**	**Transmission of digital control states**
☑	**<110>**	**Write binary outputs**
☑	**<121>**	**Force single coil**

- **Compatible ASDUs in Primary to Secondary Direction**

☑	**<6>**	**Clock synchronization**
☑	**<100>**	**Control data request (Metering values and control changes INF=200)**
☑	**<100>**	**Control data request (Capture of counters INF=202)**
☑	**<100>**	**Control data request (Request for counters INF=201)**
☑	**<103>**	**Request for digital control states**
☑	**<110>**	**Write binary outputs**
☑	**<112>**	**Enable/disable binary inputs**
☑	**<121>**	**Force single coil**

A.2 Control Data

- **Control Metering (MEA-s)**

Configurable through the ***ZivercomPlus***®: any value measured or calculated by the protection or generated by the programmable logic. It is possible to select between primary and secondary values, taking into account the corresponding transformation ratios.

All the full scale values of the magnitudes are definable, and these magnitudes can be used to create **user values**. Some typical values are:

- Phase and sequence currents and harmonics: **Rated value I_{PHASE} + 20**% sends 4095 counts.
- Line-to-neutral and sequence voltages and harmonics: **(Rated value V / √3) + 20%** sends 4095 counts.
- Phase-to-phase voltages: **Rated value V + 20%** sends 4095 counts.
- Powers: 3 x 1.4 x Rated value I_{PHASE} x Rated value / √3 sends 4095 counts.
- Power factor: from **–1** to **1** sends from –4095 to 4095 counts.
- Frequency: from **0 Hz** to **1.2 x Frequency$_{RATED}$** (50Hz / 60Hz) sends 4095 counts.

With the ***ZivercomPlus***® program, it is possible to define the full-scale value to be used to transmit each magnitude in counts, the unit that all the protocols use. There are three definable parameters that determine this range:

- **Offset value**: the minimum value of the magnitude for which 0 counts are sent.
- **Limit**: the length of the range of the magnitude on which it is interpolated to calculate the number of counts to send. If the offset value is 0, it coincides with the value of the magnitude for which the defined maximum of counts (4095) is sent.
- **Nominal flag**: this flag allows determining whether the limit set is proportional to the rated value of the magnitude or not. The rated value of the new magnitudes defined by the user in the programmable logic can be configured, while the rest of the existing magnitudes are fixed.

The expression that allows defining this full-scale value is the following:

- When the Nominal flag is enabled,

$$CommunicationsMeasurement = \frac{Measurement - Offset}{Nominal} \times \frac{4095}{Limit}$$

- When the Nominal flag is NOT enabled,

$$CommunicationsMeasurement = (Measurement - Offset) \times \frac{4095}{Limit}$$

- **Counters**

Configurable through the ***ZivercomPlus***®: Counters can be created with any signal configured in the programmable logic or from the protection modules. The default counters are those of the real energies (positive and negative) and the reactive energies (capacitive and inductive).

The metering range of energies in primary values is from 100wh/varh to 99999 MWh/Mvarh. The magnitude transmitted via communications is this same primary value; that is, one (1) count represents 100 wh/varh.

- **Force Single Coil (ISE-s)**

Configurable through the ***ZivercomPlus***®: A command can be made on any input from the protection modules and on any signal configured in the programmable logic.

- **Write Control Outputs (ISS-s)**

Configurable through the ***ZivercomPlus***®: A writing can be made on any input from the protection modules and on any signal configured in the programmable logic.

- **Digital Control Signals (ISC-s)**

Configurable through the ***ZivercomPlus***®: Any input or output logic signal from the protection modules or generated by the programmable logic.

B. DNP V3.00 Device Profiles Document

Dnp3 Basic Profile

(Version 02.44.00 is the last Software Version that supports this Profile)

DNP V3.00 Basic Profile

DEVICE PROFILE DOCUMENT

This document must be accompanied by: **Implementation Table** and **Point List**.

Vendor Name: **ZIV Aplicaciones y Tecnología S.A.**

Device Name: **MCV**

Highest DNP Level Supported:	Device Function:
For Requests **2** For Responses **2**	☐ Master ☒ Slave

Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the attached table):

1) Supports Enable/Disable Unsolicited Responses (FC=20 and 21), for classes 1 and 2.
2) Supports Write operations (FC=2) on Time and Date objects.
3) Supports Delay measurement Fine (FC=23).
4) Supports Warm Start command (FC=14).
5) Supports Unsolicited after Restart (for compatibility with terminals whose revision is before DNP3-1998)
6) Supports selection of DNP3 Revision.
7) Supports indication of no synchronization in time.
8) Supports simultaneous communications with two different Master devices

Maximum Data Link Frame Size (octets):	Maximum Application Fragment Size (octets):
Transmitted **292** Received **292**	Transmitted **2048** (if >2048, must be configurable) Received **249** (must be <= 249)
Maximum Data Link Re-tries:	**Maximum Application Layer Re-tries:**
☒ None ☐ Fixed at _____ ☐ Configurable, range ___ to _____	☐ None ☒ Configurable, range **0** to **3** (Fixed is not permitted)

Requires Data Link Layer Confirmation:

☒ Never
☐ Always
☐ Sometimes. If 'Sometimes', when? _____
☐ Configurable. If 'Configurable', how? _____

Requires Application Layer Confirmation:

- ☐ Never
- ☐ Always (not recommended)
- ☒ When reporting Event Data (Slave devices only) **For unsolicited, Class 1 and Class 2 responses that contain Event Data.** **(If there is no Event Data reported into a Class 1 or 2 response, Application Layer Confirmation is not requested)**
- ☐ When sending multi-fragment responses (Slave devices only)
- ☐ Sometimes. If 'Sometimes', when?
- ☐ Configurable. If 'Configurable', how?

Timeouts while waiting for:

Data Link Confirm	☒ None	☐ Fixed at ____	☐ Variable	☐ Configurable
Complete Appl. Fragment	☒ None	☐ Fixed at ____	☐ Variable	☐ Configurable
Application Confirm	☐ None	☐ Fixed at ____	☐ Variable	☒ Configurable
Complete Appl. Response	☒ None	☐ Fixed at ____	☐ Variable	☐ Configurable

Others

_____

Attach explanation if 'Variable' or 'Configurable' was checked for any timeout

Application Confirm timeout setting (*MMI*): Range 50 ms. 65.535 ms.

Sends/Executes Control Operations:

- Maximum number of CROB (obj. 12, var. 1) objects supported in a single message **1**
- Maximum number of Analog Output (obj. 41, any var.) supported in a single message **0**

☐ Pattern Control Block and Pattern Mask (obj. 12, var. 2 and 3 respectively) supported.
☐ CROB (obj. 12) and Analog Output (obj. 41) permitted together in a single message.

WRITE Binary Outputs	☒ Never	☐ Always	☐ Sometimes	☐ Configurable
SELECT (3) / OPERATE (4)	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
DIRECT OPERATE (5)	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
DIRECT OPERATE - NO ACK (6)	☐ Never	☒Always	☐ Sometimes	☐ Configurable

Count > 1	☐ Never	☐ Always	☒ Sometimes	☐ Configurable
Pulse On	☐ Never	☒Always	☐ Sometimes	☐ Configurable
Pulse Off	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
Latch On	☐ Never	☒Always	☐ Sometimes	☐ Configurable
Latch Off	☐ Never	☒Always	☐ Sometimes	☐ Configurable

Queue	☒ Never	☐ Always	☐ Sometimes	☐ Configurable
Clear Queue	☒ Never	☐ Always	☐ Sometimes	☐ Configurable

Attach explanation:

- **All points support the same Function Codes: (3) Select, (4) Operate, (5) Direct Operate and (6) Direct Operate - No ACK.**
- **Maximum Select/Operate Delay Time: 60 seconds.**
- **Count can be >1 only for PULSE ON and PULSE OFF**

<table>
<tr><th colspan="2">FILL OUT THE FOLLOWING ITEMS FOR SLAVE DEVICES ONLY:</th></tr>
<tr><td>Reports Binary Input Change Events when no specific variation requested:

☐ Never
☒ Only time-tagged
☐ Only non-time-tagged
☐ Configurable to send both, one or the other (attach explanation)</td><td>Reports time-tagged Binary Input Change Events when no specific variation requested:

☐ Never
☒ Binary Input Change With Time
☐ Binary Input Change With Relative Time
☐ Configurable (attach explanation)</td></tr>
<tr><td>Sends Unsolicited Responses:

☐ Never
☒ Configurable (See Note D)
☒ Only certain objects (Class 1 and 2)
☐ Sometimes (attach explanation)

☒ ENABLE/DISABLE UNSOLICITED Function codes supported</td><td>Sends Static Data in Unsolicited Responses:

☒ Never
☐ When Device Restarts
☐ When Status Flags Change

No other options are permitted.</td></tr>
<tr><td>Default Counter Object/Variation:

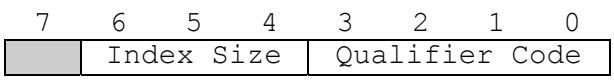
☐ No Counters Reported
☐ Configurable (attach explanation)
☒ Default Object 20,21
Default Variation 1
☐ Point-by-point list attached</td><td>Counters Roll Over at:

☐ No Counters Reported
☐ Configurable (attach explanation)
☐ 16 Bits
☐ 32 Bits
☒ Other Value 31 Bits
☐ Point-by-point list attached</td></tr>
<tr><td colspan="2">Sends Multi-Fragment Responses: ☒ Yes ☐ No</td></tr>
</table>

QUICK REFERENCE FOR DNP3.0 LEVEL 2 FUNCTION CODES & QUALIFIERS

Function Codes

1	Read
2	Write
3	Select
4	Operate
5	Direct Operate
6	Direct Operate-No ACK
7	Immediate Freeze
8	Immediate Freeze no ACK
13	Cold Start
14	Warm Start
20	Enable Unsol. Messages
21	Disable Unsol. Messages
23	Delay Measurement
129	Response
130	Unsolicited Message



Index Size

0- No Index, Packed
1- 1 byte Index
2- 2 byte Index
3- 4 byte Index
4- 1 byte Object Size
5- 2 byte Object Size
6- 4 byte Object Size

Qualifier Code

0- 8-Bit Start and Stop Indices
1- 16-Bit Start and Stop Indices
2- 32-Bit Start and Stop Indices
3- 8-Bit Absolute address Ident.
4- 16-Bit Absolute address Ident.
5- 32-Bit Absolute address Ident.
6- No Range Field (all)
7- 8-Bit Quantity
8- 16-Bit Quantity
9- 32-Bit Quantity
11-(0xB) Variable array

IMPLEMENTATION TABLE

OBJECT			REQUEST (MCV will parse)		RESPONSE (MCV will respond)		
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes (dec)	Qual Codes (hex)	Notes
1	0	Binary Input – All variations	1	6			
1	1	Binary Input			129	1	Assigned to Class 0.
2	0	Binary Input Change – All variations	1	6,7,8			
2	1	Binary Input Change without Time	1	6,7,8	129		B
2	2	Binary Input Change with Time	1	6,7,8	129,130	28	Assigned to Class 1.
2	3	Binary Input Change with Relative Time	1	6,7,8	129		B
10	0	Binary Outputs – All variations	1	6	129		A
12	1	Control Relay Output Block	3,4,5,6	17,28	129	17,28	
20	0	Binary Counter – All variations	1	6	129		~~A~~
20	1	32 Bits Binary Counter			129	1	
21	0	Frozen Counter – All variations	1	6	129		~~A~~
21	1	32 Bits Frozen Counter			129	1	
22	0	Counter Change Event – All variations	1	6,7,8	129		B
30	0	Analog Input – All variations	1	6			
30	2	16-Bit Analog Input			129	1	Assigned to Class 0.
32	0	Analog Change Event – All variations	1	6,7,8			
32	4	16-Bit Analog Change Event with Time			129,130	28	Assigned to Class 2.
40	0	Analog Output Status – All variations	1	6	129		A
41	2	16-Bit Analog Output Block	3,4,5,6	17,28	129		A
50	1	Time and Date	2	7 count=1	129		C
52	2	Time Delay Fine	23		129	1	F,G

OBJECT			REQUEST (MCV will parse)		RESPONSE (MCV will respond)		
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes (dec)	Qual Codes (hex)	Notes
60	1	Class 0 Data	1	6	129	1	
60	2	Class 1 Data	1	6,7,8	129,130	28	D
			20,21	6			
60	3	Class 2 Data	1	6,7,8	129,130	28	D
			20,21	6			
60	4	Class 3 Data	1	6,7,8	N/A		B
			20,21	6			
80	1	Internal Indications	2	0 index=7			E
--	--	No Object (Cold Start)	13				F
--	--	No Object (Warm Start)	14				F
--	--	No Object (Delay Measurement)	23				G

NOTES

A: Device implementation level does not support this group and variation of object or, for static objects, it has no objects with this group and variation. **OBJECT UNKNOWN** response (IIN2 bit 1 set).

B: No point range was specified, and device has no objects of this type. **NULL response** (no IIN bits set, but no objects of the specified type returned).

C: Device supports write operations on Time and Date objects. Time Synchronization-Required Internal Indication bit (IIN1-4) will be cleared on the response.

D: The device can be configured to send or not, unsolicited responses depending on a configuration option by means of ***MMI*** (Man-Machine Interface or front-panel user interface). Then, the Master can Enable or Disable Unsolicited messages (for Classes 1 and 2) by means of requests (FC 20 and 21).
If the unsolicited response mode is configured "on", then upon device restart, the device will transmit an initial Null unsolicited response, requesting an application layer confirmation. While waiting for that application layer confirmation, the device will respond to all function requests, including READ requests.

E: Restart Internal Indication bit (IIN1-7) can be cleared explicitly by the master.

F: The outstation, upon receiving a ***Cold or Warm Start*** request, will respond sending a Time Delay Fine object message (which specifies a time interval until the outstation will be ready for further communications), restarting the DNP process, clearing events stored in its local buffers and setting IIN1-7 bit (Device Restart).

G: Device supports Delay Measurement requests (FC = 23). It responds with the Time Delay Fine object (52-2). This object states the number of milliseconds elapsed between Outstation receiving the first bit of the first byte of the request and the time of transmission of the first bit of the first byte of the response.

DEVICE SPECIFIC FEATURES

- Internal Indication IIN1-6 (Device trouble): **Set to indicate a change in the current DNP configuration in the outstation. Cleared in the next response. Used to let the master station know that DNP settings have changed at the outstation. Note that some erroneous configurations could make impossible to communicate this condition to a master station.**

  This document also states the DNP3.0 settings currently available in the device. If the user changes whatever of these settings, it will set the *Device Trouble Internal Indication* bit on the next response sent.
- Event buffers**: device can hold as much as** 50 Binary Input Changes **and** 50 Analog Input Changes**. If these limits are reached the device will set the *Event Buffers Overflow Internal Indication* bit on the next response sent. It will be cleared when the master reads the changes, making room for new ones.**
- Configuration ➔ Operation Enable **menu: the device can enable or disable** permissions **for the operations over al Control Relay Output Block. In case permissions are configured off (disabled) the response to a command (issued as Control Relay Output Block) will have the Status code NOT_AUTHORIZED. In case the equipment is** blocked **the commands allowed are the configured when permitted. While blocked, the relay will accept commands over the configured signal. If the equipment is in** operation inhibited state**, the response to all commands over the configured signal will have the Status code NOT_AUTHORIZED.**
- Configuration ➔ Binary Inputs/Outputs **menu: contains the default configuration (as shipped from factory or after a reset by means of F4 key), but customers can configure Inputs/Outputs to suit their needs, by means of** *ZIVercomPlus*® **software.**

POINT LIST

BINARY INPUT (OBJECT 1) -> Assigned to Class 0. BINARY INPUT CHANGE (OBJECT 2) -> Assigned to Class 1.		
Index	**Description**	
0	***Configure by ZIVercomPlus®* 2048 points**	
1	***Configure by ZIVercomPlus®* 2048 points**	
2	***Configure by ZIVercomPlus®* 2048 points**	
3	***Configure by ZIVercomPlus®* 2048 points**	
4	***Configure by ZIVercomPlus®* 2048 points**	
5	***Configure by ZIVercomPlus®* 2048 points**	
6	***Configure by ZIVercomPlus®* 2048 points**	
7	***Configure by ZIVercomPlus®* 2048 points**	
8	***Configure by ZIVercomPlus®* 2048 points**	
9	***Configure by ZIVercomPlus®* 2048 points**	
10	***Configure by ZIVercomPlus®* 2048 points**	
11	***Configure by ZIVercomPlus®* 2048 points**	
12	***Configure by ZIVercomPlus®* 2048 points**	
13	***Configure by ZIVercomPlus®* 2048 points**	
14	***Configure by ZIVercomPlus®* 2048 points**	
15	***Configure by ZIVercomPlus®* 2048 points**	
16	***Configure by ZIVercomPlus®* 2048 points**	
17	***Configure by ZIVercomPlus®* 2048 points**	
...	***Configure by ZIVercomPlus®* 2048 points**	
253	***Configure by ZIVercomPlus®* 2048 points**	
254	***Configure by ZIVercomPlus®* 2048 points**	
255	***Configure by ZIVercomPlus®* 2048 points**	

CONTROL RELAY OUTPUT BLOCK (OBJECT 12)		
Index	**Description**	
0	***Configure by ZIVercomPlus®* 256 points**	
1	***Configure by ZIVercomPlus®* 256 points**	
2	***Configure by ZIVercomPlus®* 256 points**	
3	***Configure by ZIVercomPlus®* 256 points**	
4	***Configure by ZIVercomPlus®* 256 points**	
5	***Configure by ZIVercomPlus®* 256 points**	
6	***Configure by ZIVercomPlus®* 256 points**	
7	***Configure by ZIVercomPlus®* 256 points**	
8	***Configure by ZIVercomPlus®* 256 points**	
9	***Configure by ZIVercomPlus®* 256 points**	
10	***Configure by ZIVercomPlus®* 256 points**	
11	***Configure by ZIVercomPlus®* 256 points**	
12	***Configure by ZIVercomPlus®* 256 points**	
13	***Configure by ZIVercomPlus®* 256 points**	
14	***Configure by ZIVercomPlus®* 256 points**	
15	***Configure by ZIVercomPlus®* 256 points**	
16	***Configure by ZIVercomPlus®* 256 points**	
17	***Configure by ZIVercomPlus®* 256 points**	
...	***Configure by ZIVercomPlus®* 256 points**	
253	***Configure by ZIVercomPlus®* 256 points**	
254	***Configure by ZIVercomPlus®* 256 points**	
255	***Configure by ZIVercomPlus®* 256 points**	

ANALOG INPUT (OBJECT 30) -> Assigned to Class 0. ANALOG INPUT CHANGE (OBJECT 32) -> Assigned to Class 2.		
Index	**Description**	**Deadband**
0	*Configure by ZIVercomPlus*® 512 points	Deadband_1.
1	*Configure by ZIVercomPlus*® 512 points	Deadband_2.
2	*Configure by ZIVercomPlus*® 512 points	Deadband_3.
3	*Configure by ZIVercomPlus*® 512 points	Deadband_4.
4	*Configure by ZIVercomPlus*® 512 points	Deadband_5.
5	*Configure by ZIVercomPlus*® 512 points	Deadband_6.
6	*Configure by ZIVercomPlus*® 512 points	Deadband_7.
7	*Configure by ZIVercomPlus*® 512 points	Deadband_8.
8	*Configure by ZIVercomPlus*® 512 points	Deadband_9.
9	*Configure by ZIVercomPlus*® 512 points	Deadband_10.
10	*Configure by ZIVercomPlus*® 512 points	Deadband_11.
11	*Configure by ZIVercomPlus*® 512 points	Deadband_12.
12	*Configure by ZIVercomPlus*® 512 points	Deadband_13.
13	*Configure by ZIVercomPlus*® 512 points	Deadband_14.
14	*Configure by ZIVercomPlus*® 512 points	Deadband_15.
15	*Configure by ZIVercomPlus*® 512 points	Deadband_16.

Additional assign with *ZIVercomPlus*®:

ANALOG INPUT (OBJECT 30) -> Assigned to Class 0.	
Index	**Description**
16	***Configure by ZIVercomPlus® 512 points***
17	***Configure by ZIVercomPlus® 512 points***
18	***Configure by ZIVercomPlus® 512 points***
19	***Configure by ZIVercomPlus® 512 points***
20	***Configure by ZIVercomPlus® 512 points***
21	***Configure by ZIVercomPlus® 512 points***
22	***Configure by ZIVercomPlus® 512 points***
23	***Configure by ZIVercomPlus® 512 points***
24	***Configure by ZIVercomPlus® 512 points***
25	***Configure by ZIVercomPlus® 512 points***
26	***Configure by ZIVercomPlus® 512 points***
27	***Configure by ZIVercomPlus® 512 points***
....	***Configure by ZIVercomPlus® 512 points***
254	***Configure by ZIVercomPlus® 512 points***
255	***Configure by ZIVercomPlus® 512 points***

The full scale ranges are adjustable and user's magnitudes can be created. It's possible to choose between primary and secondary values, considering CT and PT ratios. Typical ranges in secondary values are:

Description	**Full Scale Range**		
	Engineering units	**Counts**	
Currents (Phases, sequences, harmonics)	0 to 1,2 x In_{PHASE} A	0 to 32767	**Deadband**
Voltages (Phase to ground, sequences, harmonics)	0 to 1,2 x Vn/√3 V	0 to 32767	**Deadband**
Voltages(Phase to phase)	0 to 1,2 x Vn V	0 to 32767	**Deadband**
Power (Real, reactive, apparent)	0 to 3 x 1,4 x In_{PHASE} x Vn/√3 W	-32768 to 32767	**Deadband**
Power factor	-1 to 1	-32768 to 32767	**Deadband**
Frequency	0 to 1,2 x Rated frequency (50/60 Hz)	0 to 32767	**Deadband**

With ***ZIVercomPlus®*** program it's possible to define the ***Full Scale Range*** that is desired to transmit each magnitude in *counts*, which is the unit used by the protocol. There are three parameters to determine the distance range covered:

- **Offset:** minimum value of each magnitude to transmit 0 counts.
- **Limit:** it's the length of the magnitude range used to calculate the number of counts to transmit. If **offset** is 0, it's the same as the value of the magnitude for which the maximum number of counts defined by the protocol is sent (32767 counts).
- **Nominal Flag:** this *flag* defines if the **limit** is proportional to the rated value of the magnitude or not. The rated value of the new magnitudes defined by the user is a setting, while for the pre-defined magnitudes is a fix value.

Mathematical expression to describe the ***Full Scale Range*** is:

- When **Nominal Flag** is actived,

$$MeasureComm = \frac{Measure - Offset}{RatedValue} \times \frac{32767}{Limit}$$

- When **Nominal Flag** is NOT actived,

$$MeasureComm = (Measure - Offset) \times \frac{32767}{Limit}$$

Deadbands

- Deadbands are used for configuring *Analog Input Change* objects (Object 32).
- A Deadband is defined as a percentage over the **Full Scale Range (FSR)**.
- The Deadband can be adjusted to the device by means of ***MMI*** (Man-Machine Interface or front-panel user interface), between 0.00% and 100.00%, in steps of 0.01%. Default value is 100.00%, meaning that generation of Analog Change Events is **DISABLED** for that input. There is an independent setting for each Analog Input.

Energy counters

The range for the energy counters in primary values is from 100wh/varh to 99999Mwh/Mvarh, and these are the values transmitted by protocol.

DNP3 PROTOCOL SETTINGS

DNP3 Protocol Settings						
DNP Protocol Configuration						
Setting Name	**Type**	**Minimum Value**	**Maximum Value**	**Default Value**	**Step/ Select**	**Unit**
Relay Number	Integer	0	65519	1	1	
T Confirm Timeout	Integer	1000	65535	1000	1	msec.
Max Retries	Integer	0	65535	0	1	
Enable Unsolicited.	Boolean	0 (No)	1 (Yes)	0 (No)	1	
Enable Unsol. after Restart	Boolean	0 (No)	1 (Yes)	0 (No)	1	
Unsolic. Master No.	Integer	0	65519	1	1	
Unsol. Grouping Time	Integer	100	65535	1000	1	msec.
Synchronization Interval	Integer	0	120	0	1	min.
DNP 3.0 Rev.	Integer	2003 ST.ZIV	2003 ST.ZIV	2003	2003 ST.ZIV	
DNP Port 1 Configuration						
Setting Name	**Type**	**Minimum Value**	**Maximum Value**	**Default Value**	**Step/ Select**	**Unit**
Protocol Select	**Uinteger**	**Procome Dnp3 Modbus**	**Procome Dnp3 Modbus**	**Procome**	**Procome Dnp3 Modbus**	
Baud rate	**Integer**	**300**	**38400**	**38400**	**300 600 1200 2400 4800 9600 19200 38400**	**baud**
Stop Bits	**Integer**	**1**	**2**	**1**	**1**	
Parity	**Integer**	**None Odd Even**	**None Odd Even**	**None**	**None Odd Even**	
Rx Time btw. Char	**Float**	**1**	**60000**	**0.5**	**40**	**msec.**
Comms Fail Ind. Time	**Float**	**0**	**600**	**0.1**	**60**	**s**

Advaced settings						
Flow control						
CTS Flow	Bool	No Yes	No Yes	No	No Yes	
DSR Flow	Bool	No Yes	No Yes	No	No Yes	
DSR Sensitive	Bool	No Yes	No Yes	No	No Yes	
DTR Control	Integer	Inactive Active Rec. Req.	Inactive Active Rec. Req.	Inactive	Inactive Active Rec. Req.	
RTS Control	Integer	Inactive Active Rec. Req. Sen. Req.	Inactive Active Rec. Req. Sen. Req.	Inactive	Inactive Active Rec. Req. Sen. Req.	
Times						
Tx Time Factor	Float	0	100	1	0.5	
Tx Timeout Const	Uinteger	0	60000	0	1	
Message modification						
Number of Zeros	Integer	0	255	0	1	
collision						
Collision Type	Integer	NO ECHO DCD	NO ECHO DCD	NO	NO ECHO DCD	
Max Retries	Integer	0	3	0	1	
Min Retry Time	Uinteger	0	60000	0	1	msec.
Max Retry Time	Uinteger	0	60000	0	1	msec.

DNP Port 2 Configuration

Setting Name	Type	Minimum Value	Maximum Value	Default Value	Step/ Select	Unit
Protocol Select	Uinteger	Procome Dnp3 Modbus	Procome Dnp3 Modbus	Procome	Procome Dnp3 Modbus	
Baud rate	Integer	300	38400	38400	300 600 1200 2400 4800 9600 19200 38400	baud
Stop Bits	Integer	1	2	1	1	
Parity	Integer	None Odd Even	None Odd Even	None	None Odd Even	
Rx Time btw. Char	Float	1	60000	0.5	40	msec.
Comms Fail Ind. Time	Float	0	600	0.1	60	s

Advaced settings						
Operating Mode	**Integer**	**RS-232 RS-485**	**RS-232 RS-485**	**RS-232**	**RS-232 RS-485**	
Times						
Tx Time Factor	**Float**	**0**	**100**	**1**	**0.5**	
Tx Timeout Const	**Uinteger**	**0**	**60000**	**0**	**1**	
Wait N Bytes 485	**Integer**	**0**	**4**	**0**	**1**	
Message modification						
Number of Zeros	**Integer**	**0**	**255**	**0**	**1**	
collision						
Collision Type	**Integer**	**NO ECHO**	**NO ECHO**	**NO**	**NO ECHO**	
Max Retries	**Integer**	**0**	**3**	**0**	**1**	
Min Retry Time	**Uinteger**	**0**	**60000**	**0**	**1**	**msec.**
Max Retry Time	**Uinteger**	**0**	**60000**	**0**	**1**	**msec.**

Analog Inputs (Deadbands)

Setting Name	Type	Minimum Value	Maximum Value	Default Value	Step	Unit
Deadband AI#0	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#1	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#2	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#3	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#4	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#5	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#6	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#7	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#8	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#9	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#10	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#11	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#12	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#13	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#14	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#15	Float	0 %	100 %	100 %	0.01 %	

- ✓ **All settings remain unchanged after a power loss.**

DNP Protocol Configuration

- **Relay Number** (**RTU Address**):
  Remote Terminal Unit Address. Addresses 0xFFF0 to 0xFFFF are reserved as *Broadcast Addresses*.
- **T Confirm Timeout** (**N7 Confirm Timeout**) :
  Timeout while waiting for Application Layer Confirmation. It applies to Unsolicited messages and Class 1 and Class 2 responses with event data.
- **Max Retries** (**N7 Retries**) :
  Number of retries of the Application Layer after timeout while waiting for Confirmation.
- **Enable Unsolicited** (**Enable Unsolicited Reporting**) :
  Enables or disables Unsolicited reporting.
- **Enable Unsol. after Restart** :
  Enables or disables Unsolicited after Restart (for compatibility with terminals whose revision is before DNP3-1998). It has effect only if Enable Unsolicited after Restart is set.

- **Unsolic. Master No.** (**MTU Address**) :
  Destination address of the Master device to which the unsolicited responses are to be sent. Addresses 0xFFF0 to 0xFFFF are reserved as *Broadcast Addresses*. It is useful only when Unsolicited Reporting is enabled.
- **Unsol. Grouping Time** (**Unsolicited Delay Reporting**) :
  Delay between an event being generated and the subsequent transmission of the unsolicited message, in order to group several events in one message and to save bandwidth.
- **Synchronization Interval**
  Max interval time between two synchronization. If no synchronizing inside interval, indication IIN1-4 (NEED TIME). This setting has no effect if Synchronization Interval is zero.
- **DNP 3.0 Rev.**
  Certification revision STANDARD ZIV or **2003** (DNP3-2003 Intelligent Electronic Device (IED) Certification Procedure Subset Level 2 Version 2.3 29-Sept-03)

DNP Port 1 and Port 2 Configuration

- **Number of Zeros (Advice_Time) :**
  Number of zeros before the message.
- **Max Retries (N1 Retries) :**
  Number of retries of the Physical Layer after collision detection.
- **Min Retry Time (Fixed_delay) :**
  Minimum time to retry of the Physical Layer after collision detection.
- **Max Retry Time :**
  Maximum time to retry of the Physical Layer after collision detection.
- **Collision Type :**

  Port 1:
  NO
  ECHO based on detection of transmitted data (monitoring all data transmitted on the link).

  Port 2:
  NO
  ECHO based on detection of transmitted data (monitoring all data transmitted on the link.
  DCD (Data Carrier Detect) based on detecting out-of-band carrier.

  If the device prepares to transmit and finds the link busy, it waits until is no longer busy, and then waits a backoff_time as follows:
  backoff_time = Min Retry Time + random(Max Retry Time - Max Retry Time)
  and transmit. If the device has a collision in transmission the device tries again,up to a configurable number of retries (Max Retries) if has news collision.

- **Wait N Bytes 485:**

Number of wait bytes between Reception and transmission Use Port 2 Operate Mode RS-485.

Dnp3 Basic Extended Profile

(Version 02.45.00 is the first Software Version that supports this Profile)

DNP V3.00 Basic Extended Profile

DEVICE PROFILE DOCUMENT

This document must be accompanied by: **Implementation Table** and **Point List**.

Vendor Name: **ZIV Aplicaciones y Tecnología S.A.**

Device Name: **MCV**

Highest DNP Level Supported:	Device Function:
For Requests **2** For Responses **2**	☐ Master ☒ Slave

Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the attached table):

1) Supports Enable/Disable Unsolicited Responses (FC=20 and 21), for classes 1 and 2.
2) Supports Write operations (FC=2) on Time and Date objects.
3) Supports Delay measurement Fine (FC=23).
4) Supports Warm Start command (FC=14).
5) Supports Unsolicited after Restart (for compatibility with terminals whose revision is before DNP3-1998)
6) Supports selection of DNP3 Revision.
7) Supports indication of no synchronization in time.
8) Supports simultaneous communications with two different Master devices
9) Supports respond to Multiple Read Request with multiple object types in the same Application Fragment .

Maximum Data Link Frame Size (octets):	Maximum Application Fragment Size (octets):
Transmitted **292** Received **292**	Transmitted **2048** (if >2048, must be configurable) Received **249** (must be <= 249)
Maximum Data Link Re-tries:	**Maximum Application Layer Re-tries:**
☒ None ☐ Fixed at _____ ☐ Configurable, range ___ to _____	☐ None ☒ Configurable, range **0** to **3** (Fixed is not permitted)

Requires Data Link Layer Confirmation:

☒ Never
☐ Always
☐ Sometimes. If 'Sometimes', when? _____
☐ Configurable. If 'Configurable', how? _____

Requires Application Layer Confirmation:

- ☐ Never
- ☐ Always (not recommended)
- ☒ When reporting Event Data (Slave devices only) **For unsolicited, Class 1 and Class 2 responses that contain Event Data**. **(If there is no Event Data reported into a Class 1 or 2 response, Application Layer Confirmation is not requested)**
- ☐ When sending multi-fragment responses (Slave devices only)
- ☐ Sometimes. If 'Sometimes', when?
- ☐ Configurable. If 'Configurable', how?

Timeouts while waiting for:

Data Link Confirm	☒ None	☐ Fixed at ____	☐ Variable	☐ Configurable
Complete Appl. Fragment	☒ None	☐ Fixed at ____	☐ Variable	☐ Configurable
Application Confirm	☐ None	☐ Fixed at ____	☐ Variable	☒ Configurable
Complete Appl. Response	☒ None	☐ Fixed at ____	☐ Variable	☐ Configurable

Others

_____

Attach explanation if 'Variable' or 'Configurable' was checked for any timeout

Application Confirm timeout setting (*MMI*): Range 50 ms. 65.535 ms.

Sends/Executes Control Operations:

- Maximum number of CROB (obj. 12, var. 1) objects supported in a single message **1**
- Maximum number of Analog Output (obj. 41, any var.) supported in a single message **0**

☐ Pattern Control Block and Pattern Mask (obj. 12, var. 2 and 3 respectively) supported.
☐ CROB (obj. 12) and Analog Output (obj. 41) permitted together in a single message.

WRITE Binary Outputs	☒ Never	☐ Always	☐ Sometimes	☐ Configurable
SELECT (3) / OPERATE (4)	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
DIRECT OPERATE (5)	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
DIRECT OPERATE - NO ACK (6)	☐ Never	☒Always	☐ Sometimes	☐ Configurable

Count > 1	☐ Never	☐ Always	☒ Sometimes	☐ Configurable
Pulse On	☐ Never	☒Always	☐ Sometimes	☐ Configurable
Pulse Off	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
Latch On	☐ Never	☒Always	☐ Sometimes	☐ Configurable
Latch Off	☐ Never	☒Always	☐ Sometimes	☐ Configurable

Queue	☒ Never	☐ Always	☐ Sometimes	☐ Configurable
Clear Queue	☒ Never	☐ Always	☐ Sometimes	☐ Configurable

Attach explanation:

- **All points support the same Function Codes: (3) Select, (4) Operate, (5) Direct Operate and (6) Direct Operate - No ACK.**
- **Maximum Select/Operate Delay Time: 60 seconds.**
- **Count can be >1 only for PULSE ON and PULSE OFF**

<table>
<tr><th colspan="2">FILL OUT THE FOLLOWING ITEMS FOR SLAVE DEVICES ONLY:</th></tr>
<tr><td>Reports Binary Input Change Events when no specific variation requested:

☐ Never
☒ Only time-tagged
☐ Only non-time-tagged
☐ Configurable to send both, one or the other (attach explanation)</td><td>Reports time-tagged Binary Input Change Events when no specific variation requested:

☐ Never
☒ Binary Input Change With Time
☐ Binary Input Change With Relative Time
☐ Configurable (attach explanation)</td></tr>
<tr><td>Sends Unsolicited Responses:

☐ Never
☒ Configurable (See Note D)
☒ Only certain objects (Class 1 and 2)
☐ Sometimes (attach explanation)

☒ ENABLE/DISABLE UNSOLICITED Function codes supported</td><td>Sends Static Data in Unsolicited Responses:

☒ Never
☐ When Device Restarts
☐ When Status Flags Change

No other options are permitted.</td></tr>
<tr><td>Default Counter Object/Variation:

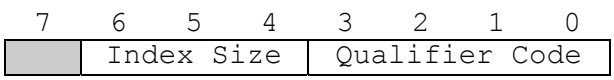
☐ No Counters Reported
☐ Configurable (attach explanation)
☒ Default Object 20,21
Default Variation 1
☐ Point-by-point list attached</td><td>Counters Roll Over at:

☐ No Counters Reported
☐ Configurable (attach explanation)
☐ 16 Bits
☐ 32 Bits
☒ Other Value 31 Bits
☐ Point-by-point list attached</td></tr>
<tr><td colspan="2">Sends Multi-Fragment Responses: ☒ Yes ☐ No</td></tr>
</table>

QUICK REFERENCE FOR DNP3.0 LEVEL 2 FUNCTION CODES & QUALIFIERS

Function Codes

1	Read
2	Write
3	Select
4	Operate
5	Direct Operate
9	Direct Operate-No ACK
10	Immediate Freeze
11	Immediate Freeze no ACK
13	Cold Start
14	Warm Start
20	Enable Unsol. Messages
21	Disable Unsol. Messages
23	Delay Measurement
129	Response
130	Unsolicited Message



Index Size

0- No Index, Packed
1- 1 byte Index
2- 2 byte Index
3- 4 byte Index
4- 1 byte Object Size
5- 2 byte Object Size
6- 4 byte Object Size

Qualifier Code

0- 8-Bit Start and Stop Indices
1- 16-Bit Start and Stop Indices
2- 32-Bit Start and Stop Indices
3- 8-Bit Absolute address Ident.
4- 16-Bit Absolute address Ident.
5- 32-Bit Absolute address Ident.
6- No Range Field (all)
7- 8-Bit Quantity
8- 16-Bit Quantity
9- 32-Bit Quantity
11-(0xB) Variable array

IMPLEMENTATION TABLE

OBJECT			REQUEST (MCV will parse)		RESPONSE (MCV will respond)		
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes (dec)	Qual Codes (hex)	Notes
1	0	Binary Input – All variations	1	6			
1	1	Binary Input			129	1	Assigned to Class 0.
2	0	Binary Input Change – All variations	1	6,7,8			
2	1	Binary Input Change without Time	1	6,7,8	129		B
2	2	Binary Input Change with Time	1	6,7,8	129,130	28	Assigned to Class 1.
2	3	Binary Input Change with Relative Time	1	6,7,8	129		B
10	0	Binary Outputs – All variations	1	6	129		A
12	1	Control Relay Output Block	3,4,5,6	17,28	129	17,28	
20	0	Binary Counter – All variations	1	6	129		~~A~~
20	1	32 Bits Binary Counter			129	1	
21	0	Frozen Counter – All variations	1	6	129		~~A~~
21	1	32 Bits Frozen Counter			129	1	
22	0	Counter Change Event – All variations	1	6,7,8	129		B
30	0	Analog Input – All variations	1	6			
30	2	16-Bit Analog Input			129	1	Assigned to Class 0.
32	0	Analog Change Event – All variations	1	6,7,8			
32	4	16-Bit Analog Change Event with Time			129,130	28	Assigned to Class 2.
40	0	Analog Output Status – All variations	1	6	129		A
41	2	16-Bit Analog Output Block	3,4,5,6	17,28	129		A
50	1	Time and Date	2	7 count=1	129		C
52	2	Time Delay Fine	23		129	1	F,G

OBJECT			REQUEST (MCV will parse)		RESPONSE (MCV will respond)		
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes (dec)	Qual Codes (hex)	Notes
60	1	Class 0 Data	1	6	129	1	
60	2	Class 1 Data	1	6,7,8	129,130	28	D
			20,21	6			
60	3	Class 2 Data	1	6,7,8	129,130	28	D
			20,21	6			
60	4	Class 3 Data	1	6,7,8	N/A		B
			20,21	6			
80	1	Internal Indications	2	0 index=7			E
--	--	No Object (Cold Start)	13				F
--	--	No Object (Warm Start)	14				F
--	--	No Object (Delay Measurement)	23				G

NOTES

A: Device implementation level does not support this group and variation of object or, for static objects, it has no objects with this group and variation. **OBJECT UNKNOWN** response (IIN2 bit 1 set).

B: No point range was specified, and device has no objects of this type. **NULL response** (no IIN bits set, but no objects of the specified type returned).

C: Device supports write operations on Time and Date objects. Time Synchronization-Required Internal Indication bit (IIN1-4) will be cleared on the response.

D: The device can be configured to send or not, unsolicited responses depending on a configuration option by means of ***MMI*** (Man-Machine Interface or front-panel user interface). Then, the Master can Enable or Disable Unsolicited messages (for Classes 1 and 2) by means of requests (FC 20 and 21).
If the unsolicited response mode is configured "on", then upon device restart, the device will transmit an initial Null unsolicited response, requesting an application layer confirmation. While waiting for that application layer confirmation, the device will respond to all function requests, including READ requests.

E: Restart Internal Indication bit (IIN1-7) can be cleared explicitly by the master.

F: The outstation, upon receiving a ***Cold or Warm Start*** request, will respond sending a Time Delay Fine object message (which specifies a time interval until the outstation will be ready for further communications), restarting the DNP process, clearing events stored in its local buffers and setting IIN1-7 bit (Device Restart).

G: Device supports Delay Measurement requests (FC = 23). It responds with the Time Delay Fine object (52-2). This object states the number of milliseconds elapsed between Outstation receiving the first bit of the first byte of the request and the time of transmission of the first bit of the first byte of the response.

DEVICE SPECIFIC FEATURES

- Internal Indication IIN1-6 (Device trouble): **Set to indicate a change in the current DNP configuration in the outstation. Cleared in the next response. Used to let the master station know that DNP settings have changed at the outstation. Note that some erroneous configurations could make impossible to communicate this condition to a master station.**

  This document also states the DNP3.0 settings currently available in the device. If the user changes whatever of these settings, it will set the *Device Trouble Internal Indication* bit on the next response sent.
- Event buffers**: device can hold as much as** 50 Binary Input Changes **and** 50 Analog Input Changes**. If these limits are reached the device will set the *Event Buffers Overflow Internal Indication* bit on the next response sent. It will be cleared when the master reads the changes, making room for new ones.**
- Configuration ➔ Operation Enable **menu: the device can enable or disable** permissions **for the operations over al Control Relay Output Block. In case permissions are configured off (disabled) the response to a command (issued as Control Relay Output Block) will have the Status code NOT_AUTHORIZED. In case the equipment is** blocked **the commands allowed are the configured when permitted. While blocked, the relay will accept commands over the configured signal. If the equipment is in** operation inhibited state**, the response to all commands over the configured signal will have the Status code NOT_AUTHORIZED.**
- Configuration ➔ Binary Inputs/Outputs **menu: contains the default configuration (as shipped from factory or after a reset by means of F4 key), but customers can configure Inputs/Outputs to suit their needs, by means of** *ZIVercomPlus*® **software.**

POINT LIST

BINARY INPUT (OBJECT 1) -> Assigned to Class 0. BINARY INPUT CHANGE (OBJECT 2) -> Assigned to Class 1.		
Index	**Description**	
0	***Configure by ZIVercomPlus®* 2048 points**	
1	***Configure by ZIVercomPlus®* 2048 points**	
2	***Configure by ZIVercomPlus®* 2048 points**	
3	***Configure by ZIVercomPlus®* 2048 points**	
4	***Configure by ZIVercomPlus®* 2048 points**	
5	***Configure by ZIVercomPlus®* 2048 points**	
6	***Configure by ZIVercomPlus®* 2048 points**	
7	***Configure by ZIVercomPlus®* 2048 points**	
8	***Configure by ZIVercomPlus®* 2048 points**	
9	***Configure by ZIVercomPlus®* 2048 points**	
10	***Configure by ZIVercomPlus®* 2048 points**	
11	***Configure by ZIVercomPlus®* 2048 points**	
12	***Configure by ZIVercomPlus®* 2048 points**	
13	***Configure by ZIVercomPlus®* 2048 points**	
14	***Configure by ZIVercomPlus®* 2048 points**	
15	***Configure by ZIVercomPlus®* 2048 points**	
16	***Configure by ZIVercomPlus®* 2048 points**	
17	***Configure by ZIVercomPlus®* 2048 points**	
...	***Configure by ZIVercomPlus®* 2048 points**	
253	***Configure by ZIVercomPlus®* 2048 points**	
254	***Configure by ZIVercomPlus®* 2048 points**	
255	***Configure by ZIVercomPlus®* 2048 points**	

CONTROL RELAY OUTPUT BLOCK (OBJECT 12)		
Index	**Description**	
0	***Configure by ZIVercomPlus*® 256 points**	
1	***Configure by ZIVercomPlus*® 256 points**	
2	***Configure by ZIVercomPlus*® 256 points**	
3	***Configure by ZIVercomPlus*® 256 points**	
4	***Configure by ZIVercomPlus*® 256 points**	
5	***Configure by ZIVercomPlus*® 256 points**	
6	***Configure by ZIVercomPlus*® 256 points**	
7	***Configure by ZIVercomPlus*® 256 points**	
8	***Configure by ZIVercomPlus*® 256 points**	
9	***Configure by ZIVercomPlus*® 256 points**	
10	***Configure by ZIVercomPlus*® 256 points**	
11	***Configure by ZIVercomPlus*® 256 points**	
12	***Configure by ZIVercomPlus*® 256 points**	
13	***Configure by ZIVercomPlus*® 256 points**	
14	***Configure by ZIVercomPlus*® 256 points**	
15	***Configure by ZIVercomPlus*® 256 points**	
16	***Configure by ZIVercomPlus*® 256 points**	
17	***Configure by ZIVercomPlus*® 256 points**	
...	***Configure by ZIVercomPlus*® 256 points**	
253	***Configure by ZIVercomPlus*® 256 points**	
254	***Configure by ZIVercomPlus*® 256 points**	
255	***Configure by ZIVercomPlus*® 256 points**	

ANALOG INPUT (OBJECT 30) -> Assigned to Class 0. ANALOG INPUT CHANGE (OBJECT 32) -> Assigned to Class 2.		
Index	**Description**	**Deadband**
0	***Configure by ZIVercomPlus®*** **512 points**	**Deadband_1.**
1	***Configure by ZIVercomPlus®*** **512 points**	**Deadband_2.**
2	***Configure by ZIVercomPlus®*** **512 points**	**Deadband_3.**
3	***Configure by ZIVercomPlus®*** **512 points**	**Deadband_4.**
4	***Configure by ZIVercomPlus®*** **512 points**	**Deadband_5.**
5	***Configure by ZIVercomPlus®*** **512 points**	**Deadband_6.**
6	***Configure by ZIVercomPlus®*** **512 points**	**Deadband_7.**
7	***Configure by ZIVercomPlus®*** **512 points**	**Deadband_8.**
8	***Configure by ZIVercomPlus®*** **512 points**	**Deadband_9.**
9	***Configure by ZIVercomPlus®*** **512 points**	**Deadband_10.**
10	***Configure by ZIVercomPlus®*** **512 points**	**Deadband_11.**
11	***Configure by ZIVercomPlus®*** **512 points**	**Deadband_12.**
12	***Configure by ZIVercomPlus®*** **512 points**	**Deadband_13.**
13	***Configure by ZIVercomPlus®*** **512 points**	**Deadband_14.**
14	***Configure by ZIVercomPlus®*** **512 points**	**Deadband_15.**
15	***Configure by ZIVercomPlus®*** **512 points**	**Deadband_16.**

Additional assign with *ZIVercomPlus*®:

ANALOG INPUT (OBJECT 30) -> Assigned to Class 0.	
Index	**Description**
16	***Configure by ZIVercomPlus® 512 points***
17	***Configure by ZIVercomPlus® 512 points***
18	***Configure by ZIVercomPlus® 512 points***
19	***Configure by ZIVercomPlus® 512 points***
20	***Configure by ZIVercomPlus® 512 points***
21	***Configure by ZIVercomPlus® 512 points***
22	***Configure by ZIVercomPlus® 512 points***
23	***Configure by ZIVercomPlus® 512 points***
24	***Configure by ZIVercomPlus® 512 points***
25	***Configure by ZIVercomPlus® 512 points***
26	***Configure by ZIVercomPlus® 512 points***
27	***Configure by ZIVercomPlus® 512 points***
....	***Configure by ZIVercomPlus® 512 points***
254	***Configure by ZIVercomPlus® 512 points***
255	***Configure by ZIVercomPlus® 512 points***

The full scale ranges are adjustable and user's magnitudes can be created. It's possible to choose between primary and secondary values, considering CT and PT ratios. Typical ranges in secondary values are:

Description	**Full Scale Range**		
	Engineering units	**Counts**	
Currents (Phases, sequences, harmonics)	0 to 1,2 x In_{PHASE} A	0 to 32767	**Deadband**
Voltages (Phase to ground, sequences, harmonics)	0 to 1,2 x Vn/√3 V	0 to 32767	**Deadband**
Voltages(Phase to phase)	0 to 1,2 x Vn V	0 to 32767	**Deadband**
Power (Real, reactive, apparent)	0 to 3 x 1,4 x In_{PHASE} x Vn/√3 W	-32768 to 32767	**Deadband**
Power factor	-1 to 1	-32768 to 32767	**Deadband**
Frequency	0 to 1,2 x Rated frequency (50/60 Hz)	0 to 32767	**Deadband**

With ***ZIVercomPlus®*** program it's possible to define the ***Full Scale Range*** that is desired to transmit each magnitude in *counts*, which is the unit used by the protocol. There are three parameters to determine the distance range covered:

- **Offset:** minimum value of each magnitude to transmit 0 counts.
- **Limit:** it's the length of the magnitude range used to calculate the number of counts to transmit. If **offset** is 0, it's the same as the value of the magnitude for which the maximum number of counts defined by the protocol is sent (32767 counts).
- **Nominal Flag:** this *flag* defines if the **limit** is proportional to the rated value of the magnitude or not. The rated value of the new magnitudes defined by the user is a setting, while for the pre-defined magnitudes is a fix value.

Mathematical expression to describe the ***Full Scale Range*** is:

- When **Nominal Flag** is actived,

$$MeasureComm = \frac{Measure - Offset}{RatedValue} \times \frac{32767}{Limit}$$

- When **Nominal Flag** is NOT actived,

$$MeasureComm = (Measure - Offset) \times \frac{32767}{Limit}$$

Deadbands

- Deadbands are used for configuring *Analog Input Change* objects (Object 32).
- A Deadband is defined as a percentage over the **Full Scale Range (FSR)**.
- The Deadband can be adjusted to the device by means of ***MMI*** (Man-Machine Interface or front-panel user interface), between 0.00% and 100.00%, in steps of 0.01%. Default value is 100.00%, meaning that generation of Analog Change Events is **DISABLED** for that input. There is an independent setting for each Analog Input.

Energy counters

The range for the energy counters in primary values is from 100wh/varh to 99999Mwh/Mvarh, and these are the values transmitted by protocol.

DNP3 PROTOCOL SETTINGS

DNP3 Protocol Settings						
DNP Protocol Configuration						
Setting Name	**Type**	**Minimum Value**	**Maximum Value**	**Default Value**	**Step/ Select**	**Unit**
Relay Number	Integer	0	65519	1	1	
T Confirm Timeout	Integer	1000	65535	1000	1	msec.
Max Retries	Integer	0	65535	0	1	
Enable Unsolicited.	Boolean	0 (No)	1 (Yes)	0 (No)	1	
Enable Unsol. after Restart	Boolean	0 (No)	1 (Yes)	0 (No)	1	
Unsolic. Master No.	Integer	0	65519	1	1	
Unsol. Grouping Time	Integer	100	65535	1000	1	msec.
Synchronization Interval	Integer	0	120	0	1	min.
DNP 3.0 Rev.	Integer	2003 ST.ZIV	2003 ST.ZIV	2003	2003 ST.ZIV	
DNP Port 1 Configuration						
Setting Name	**Type**	**Minimum Value**	**Maximum Value**	**Default Value**	**Step/ Select**	**Unit**
Protocol Select	**Uinteger**	**Procome Dnp3 Modbus**	**Procome Dnp3 Modbus**	**Procome**	**Procome Dnp3 Modbus**	
Baud rate	**Integer**	**300**	**38400**	**38400**	**300 600 1200 2400 4800 9600 19200 38400**	**baud**
Stop Bits	**Integer**	**1**	**2**	**1**	**1**	
Parity	**Integer**	**None Odd Even**	**None Odd Even**	**None**	**None Odd Even**	
Rx Time btw. Char	**Float**	**1**	**60000**	**0.5**	**40**	**msec.**
Comms Fail Ind. Time	**Float**	**0**	**600**	**0.1**	**60**	**s**

Advaced settings						
Flow control						
CTS Flow	Bool	No Yes	No Yes	No	No Yes	
DSR Flow	Bool	No Yes	No Yes	No	No Yes	
DSR Sensitive	Bool	No Yes	No Yes	No	No Yes	
DTR Control	Integer	Inactive Active Rec. Req.	Inactive Active Rec. Req.	Inactive	Inactive Active Rec. Req.	
RTS Control	Integer	Inactive Active Rec. Req. Sen. Req.	Inactive Active Rec. Req. Sen. Req.	Inactive	Inactive Active Rec. Req. Sen. Req.	
Times						
Tx Time Factor	Float	0	100	1	0.5	
Tx Timeout Const	Uinteger	0	60000	0	1	
Message modification						
Number of Zeros	Integer	0	255	0	1	
collision						
Collision Type	Integer	NO ECHO DCD	NO ECHO DCD	NO	NO ECHO DCD	
Max Retries	Integer	0	3	0	1	
Min Retry Time	Uinteger	0	60000	0	1	msec.
Max Retry Time	Uinteger	0	60000	0	1	msec.

DNP Port 2 Configuration

Setting Name	Type	Minimum Value	Maximum Value	Default Value	Step/ Select	Unit
Protocol Select	Uinteger	Procome Dnp3 Modbus	Procome Dnp3 Modbus	Procome	Procome Dnp3 Modbus	
Baud rate	Integer	300	38400	38400	300 600 1200 2400 4800 9600 19200 38400	baud
Stop Bits	Integer	1	2	1	1	
Parity	Integer	None Odd Even	None Odd Even	None	None Odd Even	
Rx Time btw. Char	Float	1	60000	0.5	40	msec.
Comms Fail Ind. Time	Float	0	600	0.1	60	s

Advaced settings						
Operating Mode	**Integer**	**RS-232 RS-485**	**RS-232 RS-485**	**RS-232**	**RS-232 RS-485**	
Times						
Tx Time Factor	**Float**	**0**	**100**	**1**	**0.5**	
Tx Timeout Const	**Uinteger**	**0**	**60000**	**0**	**1**	
Wait N Bytes 485	**Integer**	**0**	**4**	**0**	**1**	
Message modification						
Number of Zeros	**Integer**	**0**	**255**	**0**	**1**	
collision						
Collision Type	**Integer**	**NO ECHO**	**NO ECHO**	**NO**	**NO ECHO**	
Max Retries	**Integer**	**0**	**3**	**0**	**1**	
Min Retry Time	**Uinteger**	**0**	**60000**	**0**	**1**	**msec.**
Max Retry Time	**Uinteger**	**0**	**60000**	**0**	**1**	**msec.**

Analog Inputs (Deadbands)

Setting Name	Type	Minimum Value	Maximum Value	Default Value	Step	Unit
Deadband AI#0	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#1	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#2	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#3	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#4	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#5	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#6	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#7	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#8	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#9	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#10	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#11	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#12	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#13	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#14	Float	0 %	100 %	100 %	0.01 %	
Deadband AI#15	Float	0 %	100 %	100 %	0.01 %	

- ✓ **All settings remain unchanged after a power loss.**

DNP Protocol Configuration

- **Relay Number** (**RTU Address**):
  Remote Terminal Unit Address. Addresses 0xFFF0 to 0xFFFF are reserved as *Broadcast Addresses*.
- **T Confirm Timeout** (**N7 Confirm Timeout**) :
  Timeout while waiting for Application Layer Confirmation. It applies to Unsolicited messages and Class 1 and Class 2 responses with event data.
- **Max Retries** (**N7 Retries**) :
  Number of retries of the Application Layer after timeout while waiting for Confirmation.
- **Enable Unsolicited** (**Enable Unsolicited Reporting**) :
  Enables or disables Unsolicited reporting.
- **Enable Unsol. after Restart** :
  Enables or disables Unsolicited after Restart (for compatibility with terminals whose revision is before DNP3-1998). It has effect only if Enable Unsolicited after Restart is set.

- **Unsolic. Master No.** (**MTU Address**) :
  Destination address of the Master device to which the unsolicited responses are to be sent. Addresses 0xFFF0 to 0xFFFF are reserved as *Broadcast Addresses*. It is useful only when Unsolicited Reporting is enabled.
- **Unsol. Grouping Time** (**Unsolicited Delay Reporting**) :
  Delay between an event being generated and the subsequent transmission of the unsolicited message, in order to group several events in one message and to save bandwidth.
- **Synchronization Interval**
  Max interval time between two synchronization. If no synchronizing inside interval, indication IIN1-4 (NEED TIME). This setting has no effect if Synchronization Interval is zero.
- **DNP 3.0 Rev.**
  Certification revision STANDARD ZIV or **2003** (DNP3-2003 Intelligent Electronic Device (IED) Certification Procedure Subset Level 2 Version 2.3 29-Sept-03)

DNP Port 1 and Port 2 Configuration

- **Number of Zeros (Advice_Time) :**
  Number of zeros before the message.
- **Max Retries (N1 Retries) :**
  Number of retries of the Physical Layer after collision detection.
- **Min Retry Time (Fixed_delay) :**
  Minimum time to retry of the Physical Layer after collision detection.
- **Max Retry Time :**
  Maximum time to retry of the Physical Layer after collision detection.
- **Collision Type :**

  Port 1:
  NO
  ECHO based on detection of transmitted data (monitoring all data transmitted on the link).

  Port 2:
  NO
  ECHO based on detection of transmitted data (monitoring all data transmitted on the link.
  DCD (Data Carrier Detect) based on detecting out-of-band carrier.

  If the device prepares to transmit and finds the link busy, it waits until is no longer busy, and then waits a backoff_time as follows:
  backoff_time = Min Retry Time + random(Max Retry Time - Max Retry Time)
  and transmit. If the device has a collision in transmission the device tries again,up to a configurable number of retries (Max Retries) if has news collision.

- **Wait N Bytes 485:**
  Number of wait bytes between Reception and transmission Use Port 2 Operate Mode RS-485.

Dnp3 Profile II

(Version 02.46.00 is the first Software Version that supports this Profile)

DNP V3.00 Profile II

DEVICE PROFILE DOCUMENT

This document must be accompanied by: **Implementation Table** and **Point List**.

Vendor Name: **ZIV Aplicaciones y Tecnología S.A.**

Device Name: **MCV**

Highest DNP Level Supported:	Device Function:
For Requests **2** For Responses **2**	☐ Master ☒ Slave

Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the attached table):

1) Supports Enable/Disable Unsolicited Responses (FC=20 and 21), for classes 1 and 2.
2) Supports Write operations (FC=2) on Time and Date objects.
3) Supports Delay measurement Fine (FC=23).
4) Supports Warm Start command (FC=14).
5) Supports Unsolicited after Restart (for compatibility with terminals whose revision is before DNP3-1998)
6) Supports selection of DNP3 Revision.
7) Supports indication of no synchronization in time.
8) Supports simultaneous communications with two different Master devices
9) Supports assign event Class for Binary, Analog and Counter events: Class 1 , Class 2, Class 3, None
10) Supports respond to Multiple Read Request with multiple object types in the same Application Fragment .

Maximum Data Link Frame Size (octets):	Maximum Application Fragment Size (octets):
Transmitted **292** Received **292**	Transmitted **2048** (if >2048, must be configurable) Received **249** (must be <= 249)
Maximum Data Link Re-tries:	**Maximum Application Layer Re-tries:**
☒ None ☐ Fixed at _____ ☐ Configurable, range ___ to _____	☐ None ☒ Configurable, range **0** to **3** (Fixed is not permitted)

Requires Data Link Layer Confirmation:

☒ Never
☐ Always
☐ Sometimes. If 'Sometimes', when? _____
☐ Configurable. If 'Configurable', how? _____

Requires Application Layer Confirmation:

- ☐ Never
- ☐ Always (not recommended)
- ☒ When reporting Event Data (Slave devices only) **For unsolicited, Class 1 Class 2 and Class 3 responses that contain Event Data**. **(If there is no Event Data reported into a Class 1 2 or 3 response, Application Layer Confirmation is not requested)**
- ☐ When sending multi-fragment responses (Slave devices only)
- ☐ Sometimes. If 'Sometimes', when?
- ☐ Configurable. If 'Configurable', how?

Timeouts while waiting for:

Data Link Confirm	☒ None	☐ Fixed at ____	☐ Variable	☐ Configurable
Complete Appl. Fragment	☒ None	☐ Fixed at ____	☐ Variable	☐ Configurable
Application Confirm	☐ None	☐ Fixed at ____	☐ Variable	☒ Configurable
Complete Appl. Response	☒ None	☐ Fixed at ____	☐ Variable	☐ Configurable

Others

_____

Attach explanation if 'Variable' or 'Configurable' was checked for any timeout

Application Confirm timeout setting (*MMI*): Range 50 ms. 65.535 ms.

Sends/Executes Control Operations:

- Maximum number of CROB (obj. 12, var. 1) objects supported in a single message **1**
- Maximum number of Analog Output (obj. 41, any var.) supported in a single message **0**

☐ Pattern Control Block and Pattern Mask (obj. 12, var. 2 and 3 respectively) supported.
☐ CROB (obj. 12) and Analog Output (obj. 41) permitted together in a single message.

WRITE Binary Outputs	☒ Never	☐ Always	☐ Sometimes	☐ Configurable
SELECT (3) / OPERATE (4)	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
DIRECT OPERATE (5)	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
DIRECT OPERATE - NO ACK (6)	☐ Never	☒Always	☐ Sometimes	☐ Configurable

Count > 1	☐ Never	☐ Always	☒ Sometimes	☐ Configurable
Pulse On	☐ Never	☒Always	☐ Sometimes	☐ Configurable
Pulse Off	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
Latch On	☐ Never	☒Always	☐ Sometimes	☐ Configurable
Latch Off	☐ Never	☒Always	☐ Sometimes	☐ Configurable

Queue	☒ Never	☐ Always	☐ Sometimes	☐ Configurable
Clear Queue	☒ Never	☐ Always	☐ Sometimes	☐ Configurable

Attach explanation:

- **All points support the same Function Codes: (3) Select, (4) Operate, (5) Direct Operate and (6) Direct Operate - No ACK.**
- **Maximum Select/Operate Delay Time: 60 seconds.**
- **Count can be >1 only for PULSE ON and PULSE OFF**

<table>
<tr><th colspan="2">FILL OUT THE FOLLOWING ITEMS FOR SLAVE DEVICES ONLY:</th></tr>
<tr><td>Reports Binary Input Change Events when no specific variation requested:

☐ Never
☒ Only time-tagged
☐ Only non-time-tagged
☐ Configurable to send both, one or the other (attach explanation)</td><td>Reports time-tagged Binary Input Change Events when no specific variation requested:

☐ Never
☒ Binary Input Change With Time
☐ Binary Input Change With Relative Time
☐ Configurable (attach explanation)</td></tr>
<tr><td>Sends Unsolicited Responses:

☐ Never
☒ Configurable (See Note D)
☒ Only certain objects (Class 1 2 and 3)
☐ Sometimes (attach explanation)

☒ ENABLE/DISABLE UNSOLICITED Function codes supported</td><td>Sends Static Data in Unsolicited Responses:

☒ Never
☐ When Device Restarts
☐ When Status Flags Change

No other options are permitted.</td></tr>
<tr><td>Default Counter Object/Variation:

☐ No Counters Reported
☐ Configurable (attach explanation)
☒ Default Object 20,21
Default Variation 1
☐ Point-by-point list attached</td><td>Counters Roll Over at:

☐ No Counters Reported
☐ Configurable (attach explanation)
☐ 16 Bits
☐ 32 Bits
☒ Other Value 31 Bits
☐ Point-by-point list attached</td></tr>
<tr><td colspan="2">Sends Multi-Fragment Responses: ☒ Yes ☐ No</td></tr>
</table>

QUICK REFERENCE FOR DNP3.0 LEVEL 2 FUNCTION CODES & QUALIFIERS

Function Codes

1	Read
2	Write
3	Select
4	Operate
5	Direct Operate
6	Direct Operate-No ACK
7	Immediate Freeze
8	Immediate Freeze no ACK
13	Cold Start
14	Warm Start
20	Enable Unsol. Messages
21	Disable Unsol. Messages
23	Delay Measurement
129	Response
130	Unsolicited Message

7	6	5	4	3	2	1	0
	Index Size			Qualifier Code			

Index Size

0- No Index, Packed
1- 1 byte Index
2- 2 byte Index
3- 4 byte Index
4- 1 byte Object Size
5- 2 byte Object Size
6- 4 byte Object Size

Qualifier Code

0- 8-Bit Start and Stop Indices
1- 16-Bit Start and Stop Indices
2- 32-Bit Start and Stop Indices
3- 8-Bit Absolute address Ident.
4- 16-Bit Absolute address Ident.
5- 32-Bit Absolute address Ident.
6- No Range Field (all)
7- 8-Bit Quantity
8- 16-Bit Quantity
9- 32-Bit Quantity
11-(0xB) Variable array

IMPLEMENTATION TABLE

OBJECT			REQUEST (MCV parse)		RESPONSE (MCV respond)		
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes (dec)	Qual Codes (hex)	Notes
1	0	Binary Input – All variations	1	0,1,6,7,8			Assigned to Class 0.
1	1	Binary Input	1	0,1,6,7,8	129	0,1	
2	0	Binary Input with Status	1	0,1,6,7,8	129	0,1	
2	0	Binary Input Change – All variations	1	6,7,8			
2	2	Binary Input Change with Time	1	6,7,8	129,130	17,,28	Assign to Event Class .
12	1	Control Relay Output Block	3,4,5,6	17,28	129	17,28	Echo of request
20	0	Binary Counter – All variations	1	0,1,6,7,8			Assigned to Class 0.
20	1	32 Bits Binary Counter			129	0,1	
21	0	Frozen Counter – All variations	1	0,1,6,7,8			
21	1	32 Bits Frozen Counter			129	0,1	
22	0	Counter Change Event – All variations	1	6,7,8			
22	5	32 Bits Counter Change Event With Time			129,130	17,,28	Assign to Event Class
30	0	Analog Input – All variations	1	0,1,6,7,8			Assigned to Class 0.
30	1	32-Bit Analog Input	1	0,1,6,7,8	129	1	
30	2	16-Bit Analog Input	1	0,1,6,7,8	129	1	
32	0	Analog Change Event – All variations	1	6,7,8			
32	3	32-Bit Analog Change Event with Time	1	6,7,8	129,130	28	Assign to Event Class
32	4	16-Bit Analog Change Event with Time	1	6,7,8	129,130	28	Assign to Event Class
50	1	Time and Date	2	7 count=1	129		C
52	2	Time Delay Fine	23		129	1	F,G

OBJECT			REQUEST (MCV parse)		RESPONSE (MCV respond)		
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes (dec)	Qual Codes (hex)	Notes
60	1	Class 0 Data	1	6	129	1	
60	2	Class 1 Data	1	6,7,8	129,130	28	D
			20,21	6			
60	3	Class 2 Data	1	6,7,8	129,130	28	D
			20,21	6			
60	4	Class 3 Data	1	6,7,8	129,130	28	D
			20,21	6			
80	1	Internal Indications	2	0 index=7			E
--	--	No Object (Cold Start)	13				F
--	--	No Object (Warm Start)	14				F
--	--	No Object (Delay Measurement)	23				G

NOTES

C: Device supports write operations on Time and Date objects. Time Synchronization-Required Internal Indication bit (IIN1-4) will be cleared on the response.

D: The device can be configured to send or not, unsolicited responses depending on a configuration option by means of ***MMI*** (Man-Machine Interface or front-panel user interface ***ZIVercomPlus***). Then, the Master can Enable or Disable Unsolicited messages (for Classes 1, 2 and 3) by means of requests (FC 20 and 21).
If the unsolicited response mode is configured "on", then upon device restart, the device will transmit an initial Null unsolicited response, requesting an application layer confirmation. While waiting for that application layer confirmation, the device will respond to all function requests, including READ requests.

E: Restart Internal Indication bit (IIN1-7) can be cleared explicitly by the master.

F: The outstation, upon receiving a ***Cold or Warm Start*** request, will respond sending a Time Delay Fine object message (which specifies a time interval until the outstation will be ready for further communications), restarting the DNP process, clearing events stored in its local buffers and setting IIN1-7 bit (Device Restart).

G: Device supports Delay Measurement requests (FC = 23). It responds with the Time Delay Fine object (52-2). This object states the number of milliseconds elapsed between Outstation receiving the first bit of the first byte of the request and the time of transmission of the first bit of the first byte of the response.

DEVICE SPECIFIC FEATURES

- Internal Indication IIN1-6 (Device trouble): **Set to indicate a change in the current DNP configuration in the outstation. Cleared in the next response. Used to let the master station know that DNP settings have changed at the outstation. Note that some erroneous configurations could make impossible to communicate this condition to a master station.**

  This document also states the DNP3.0 settings currently available in the device. If the user changes whatever of these settings, it will set the *Device Trouble Internal Indication* bit on the next response sent.
- Event buffers**: device can hold as much as 128** Binary Input Changes**,** 64 Analog Input Changes and 64 Counter Input Change. **If these limits are reached the device will set the *Event Buffers Overflow Internal Indication* bit on the next response sent. It will be cleared when the master reads the changes, making room for new ones.**
- Configuration ➔ Operation Enable **menu: the device can enable or disable** permissions **for the operations over al Control Relay Output Block. In case permissions are configured off (disabled) the response to a command (issued as Control Relay Output Block) will have the Status code NOT_AUTHORIZED. In case the equipment is** blocked **the commands allowed are the configured when permitted. While blocked, the relay will accept commands over the configured signal. If the equipment is in** operation inhibited state**, the response to all commands over the configured signal will have the Status code NOT_AUTHORIZED.**
- **Customers can configure Inputs/Outputs to suit their needs, by means of** *ZIVercomPlus*® **software.**

POINT LIST

BINARY INPUT (OBJECT 1) -> Assigned to Class 0. BINARY INPUT CHANGE (OBJECT 2) -> Assign to Class.		
Index	**Description**	
0	***Configure by ZIVercomPlus®* 2048 points**	
1	***Configure by ZIVercomPlus®* 2048 points**	
2	***Configure by ZIVercomPlus®* 2048 points**	
3	***Configure by ZIVercomPlus®* 2048 points**	
4	***Configure by ZIVercomPlus®* 2048 points**	
5	***Configure by ZIVercomPlus®* 2048 points**	
6	***Configure by ZIVercomPlus®* 2048 points**	
7	***Configure by ZIVercomPlus®* 2048 points**	
8	***Configure by ZIVercomPlus®* 2048 points**	
9	***Configure by ZIVercomPlus®* 2048 points**	
10	***Configure by ZIVercomPlus®* 2048 points**	
11	***Configure by ZIVercomPlus®* 2048 points**	
12	***Configure by ZIVercomPlus®* 2048 points**	
13	***Configure by ZIVercomPlus®* 2048 points**	
14	***Configure by ZIVercomPlus®* 2048 points**	
15	***Configure by ZIVercomPlus®* 2048 points**	
16	***Configure by ZIVercomPlus®* 2048 points**	
17	***Configure by ZIVercomPlus®* 2048 points**	
...	***Configure by ZIVercomPlus®* 2048 points**	
253	***Configure by ZIVercomPlus®* 2048 points**	
254	***Configure by ZIVercomPlus®* 2048 points**	
255	***Configure by ZIVercomPlus®* 2048 points**	

CONTROL RELAY OUTPUT BLOCK (OBJECT 12)		
Index	**Description**	
0	***Configure by ZIVercomPlus®* 256 points**	
1	***Configure by ZIVercomPlus®* 256 points**	
2	***Configure by ZIVercomPlus®* 256 points**	
3	***Configure by ZIVercomPlus®* 256 points**	
4	***Configure by ZIVercomPlus®* 256 points**	
5	***Configure by ZIVercomPlus®* 256 points**	
6	***Configure by ZIVercomPlus®* 256 points**	
7	***Configure by ZIVercomPlus®* 256 points**	
8	***Configure by ZIVercomPlus®* 256 points**	
9	***Configure by ZIVercomPlus®* 256 points**	
10	***Configure by ZIVercomPlus®* 256 points**	
11	***Configure by ZIVercomPlus®* 256 points**	
12	***Configure by ZIVercomPlus®* 256 points**	
13	***Configure by ZIVercomPlus®* 256 points**	

CONTROL RELAY OUTPUT BLOCK (OBJECT 12)		
Index	**Description**	
14	***Configure by ZIVercomPlus*® 256 points**	
15	***Configure by ZIVercomPlus*® 256 points**	
16	***Configure by ZIVercomPlus*® 256 points**	
17	***Configure by ZIVercomPlus*® 256 points**	
...	***Configure by ZIVercomPlus*® 256 points**	
253	***Configure by ZIVercomPlus*® 256 points**	
254	***Configure by ZIVercomPlus*® 256 points**	
255	***Configure by ZIVercomPlus*® 256 points**	

ANALOG INPUT (OBJECT 30) -> Assigned to Class 0. ANALOG INPUT CHANGE (OBJECT 32) -> Assign to Class		
Index	**Description**	**Deadband**
0	***Configure by ZIVercomPlus*® 256 points**	**Deadband_1.**
1	***Configure by ZIVercomPlus*® 256 points**	**Deadband_2.**
2	***Configure by ZIVercomPlus*® 256 points**	**Deadband_3.**
3	***Configure by ZIVercomPlus*® 256 points**	**Deadband_4.**
4	***Configure by ZIVercomPlus*® 256 points**	**Deadband_5.**
5	***Configure by ZIVercomPlus*® 256 points**	**Deadband_6.**
6	***Configure by ZIVercomPlus*® 256 points**	**Deadband_7.**
7	***Configure by ZIVercomPlus*® 256 points**	**Deadband_8.**
8	***Configure by ZIVercomPlus*® 256 points**	**Deadband_9.**
9	***Configure by ZIVercomPlus*® 256 points**	**Deadband_10.**
10	***Configure by ZIVercomPlus*® 256 points**	**Deadband_11.**
11	***Configure by ZIVercomPlus*® 256 points**	**Deadband_12.**
12	***Configure by ZIVercomPlus*® 256 points**	**Deadband_13.**
13	***Configure by ZIVercomPlus*® 256 points**	**Deadband_14.**
14	***Configure by ZIVercomPlus*® 256 points**	**Deadband_15.**
15	***Configure by ZIVercomPlus*® 256 points**	**Deadband_16.**

Additional assign with ***ZIVercomPlus***®:

Index	Description
16	***Configure by ZIVercomPlus® 256 points***
17	***Configure by ZIVercomPlus® 256 points***
18	***Configure by ZIVercomPlus® 256 points***
19	***Configure by ZIVercomPlus® 256 points***
20	***Configure by ZIVercomPlus® 256 points***
21	***Configure by ZIVercomPlus® 256 points***
22	***Configure by ZIVercomPlus® 256 points***
23	***Configure by ZIVercomPlus® 256 points***
24	***Configure by ZIVercomPlus® 256 points***
25	***Configure by ZIVercomPlus® 256 points***
26	***Configure by ZIVercomPlus® 256 points***
27	***Configure by ZIVercomPlus® 256 points***
....	***Configure by ZIVercomPlus® 256 points***
62	***Configure by ZIVercomPlus® 256 points***
63	***Configure by ZIVercomPlus® 256 points***

The full scale ranges are adjustable and user's magnitudes can be created. It's possible to choose between primary and secondary values, considering CT and PT ratios. Typical ranges in secondary values are:

Description	Full Scale Range		
	Engineering units	Counts	
Currents (Phases, sequences, harmonics)	0 to 1,2 x In_{PHASE} A	0 to 32767	**Deadband**
Voltages (Phase to ground, sequences, harmonics)	0 to 1,2 x Vn/√3 V	0 to 32767	**Deadband**
Voltages(Phase to phase)	0 to 1,2 x Vn V	0 to 32767	**Deadband**
Power (Real, reactive, apparent)	0 to 3 x 1,4 x In_{PHASE} x Vn/√3 W	-32768 to 32767	**Deadband**
Power factor	-1 to 1	-32768 to 32767	**Deadband**
Frequency	0 to 1,2 x Rated frequency (50/60 Hz)	0 to 32767	**Deadband**

Communication Measure in Counts

With ***ZIVercomPlus*** program is possible to define the ***Full Scale Range*** that is desired to transmit each magnitude in *counts*. Parameters necessary to configure the Mathematical expression are:

- **Offset:** A number indicating the compensation of de Magnitude.
- **Limit:** it's the Maximum value of magnitude range.
- **Max Communication:** it's a constant that depend of the Number Bits of Analog Input.
  Max Communication=2(Number Bits Analog Input - 1)**
  For 16-Bit Analog Input (Obj 30 Var. 2) 2**(15) = 32.767 counts
  For 32-Bit Analog Input (Obj 30 Var. 1) 2**(31) = 2.147.483.647 counts
- **Rated value:** Nominal Value of the magnitude.
- **Nominal Flag:** This *flag* defines if the **limit** is proportional to the **rated value** of the magnitude.
- **TR:** Secondary to Primary Transformation Ratio.

Mathematical expression to describe the ***Full Scale Range*** is:

- When **Nominal Flag** is actived,

$$MeasureCom = TR \times \frac{Measure - Offset}{RatedValue} \times \frac{MaxComunication}{Limit}$$

- When **Nominal Flag** is NOT actived,

$$MeasureCom = TR \times (Measure - Offset) \times \frac{MaxComunication}{Limit}$$

Communication Measure in Engineering Units

With ***ZIVercomPlus*** program **also** it's possible to transmit each magnitude in Engineering Units. Parameters necessary to configure the Mathematical expression are:

- **Offset:** A number indicating the compensation of de magnitude.
- **Limit:** it's the Maximum value of magnitude range.
- **Rated value:** Nominal Value of the magnitude.
- **Nominal Flag:** this *flag* defines if the **limit** is proportional to the **rated value** of the magnitude or not. The rated value of the new magnitudes defined by the user is a setting, while for the pre-defined magnitudes is a fix value.
- **TR:** Secondary to Primary Transformation Ratio.
- **Scaling Factor:** Multiply Factor of magnitude.

Mathematical expression to obtain **Measure in Engineering Units** is:

- When **Nominal Flag** is actived,

$$MeasureCom = TR \times \frac{Measure - Offset}{RatedValue} \times ScalingFactor$$

- When **Nominal Flag** is NOT actived,

$$MeasureCom = TR \times (Measure - Offset) \times ScalingFactor$$

DeadBands

- Deadband is an area of a magnitude range or band where no generate magnitude change (the magnitude is dead). Meaning that no generation of Analogical Change Events if difference with value of generation of previous change is not equal or greater that DeadBand calculated. There is an independent setting for each 16 Measures with change.
- A Deadband is calculated as a percentage defined in DeadBand Setting over value of **parameter Limit**.
- The Deadband can be adjusted to the device by means of ***MMI*** (Man-Machine Interface or front-panel user interface *ZIVercomPlus*), between 0.0000% and 100.00%, in steps of 0.0001%. Default value is 100.00%, meaning that generation of Analog Change Events is **DISABLED** for that input. There is an independent setting for each Magnitude with change.

BINARY COUNTER (OBJECT 20) -> Assigned to Class 0. FROZEN COUNTER (OBJECT 21) 32 BIT COUNTER CHANGE EVENT (OBJECT 22) -> Assign to Class		
Index	**Description**	**Deadband**
0	***Configure by ZIVercomPlus*® 256 points**	**CounterDeadBand_1.**
1	***Configure by ZIVercomPlus*® 256 points**	**CounterDeadBand_2.**
2	***Configure by ZIVercomPlus*® 256 points**	**CounterDeadBand_3.**
3	***Configure by ZIVercomPlus*® 256 points**	**CounterDeadBand_4.**
4	***Configure by ZIVercomPlus*® 256 points**	**CounterDeadBand_5.**
5	***Configure by ZIVercomPlus*® 256 points**	**CounterDeadBand_6**
6	***Configure by ZIVercomPlus*® 256 points**	**CounterDeadBand_7.**
7	***Configure by ZIVercomPlus*® 256 points**	**CounterDeadBand_8.**
8	***Configure by ZIVercomPlus*® 256 points**	**CounterDeadBand_9.**
9	***Configure by ZIVercomPlus*® 256 points**	**CounterDeadBand_10.**
10	***Configure by ZIVercomPlus*® 256 points**	**CounterDeadBand_11.**
11	***Configure by ZIVercomPlus*® 256 points**	**CounterDeadBand_12.**
12	***Configure by ZIVercomPlus*® 256 points**	**CounterDeadBand_13.**
13	***Configure by ZIVercomPlus*® 256 points**	**CounterDeadBand_14.**
14	***Configure by ZIVercomPlus*® 256 points**	**CounterDeadBand_15.**
15	***Configure by ZIVercomPlus*® 256 points**	**CounterDeadBand_16.**
16	***Configure by ZIVercomPlus*® 256 points**	**CounterDeadBand_17.**
17	***Configure by ZIVercomPlus*® 256 points**	**CounterDeadBand_18.**
18	***Configure by ZIVercomPlus*® 256 points**	**CounterDeadBand_19.**
19	***Configure by ZIVercomPlus*® 256 points**	**CounterDeadBand_20.**

CounterDeadBands

- CounterDeadband is an area of a counter magnitude range or band, where no generate counter magnitude change (the communication counter magnitude is dead).Meaning that no generation of Counter Change Events if difference with value of generation of previous change is not equal or greater that CounterDeadBand setting. There is an independent setting for each Counter.

- The CounterDeadband can be adjusted to the device by means of ***MMI*** (Man-Machine Interface or front-panel user interface *ZIVercomPlus*), between 1 and 32767, in steps of 1, default value is 1.

DNP3 PROTOCOL SETTINGS

DNP3 Protocol Settings						
DNP Protocol Configuration						
Setting Name	**Type**	**Minimum Value**	**Maximum Value**	**Default Value**	**Step/ Select**	**Unit**
Relay Number	Integer	0	65519	1	1	
T Confirm Timeout	Integer	1000	65535	1000	1	msec.
Max Retries	Integer	0	65535	0	1	
Enable Unsolicited.	Boolean	0 (No)	1 (Yes)	0 (No)	1	
Enable Unsol. after Restart	Boolean	0 (No)	1 (Yes)	0 (No)	1	
Unsolic. Master No.	Integer	0	65519	1	1	
Unsol. Grouping Time	Integer	100	65535	1000	1	msec.
Synchronization Interval	Integer	0	120	0	1	min.
DNP 3.0 Rev.	Integer	2003 ST.ZIV	2003 ST.ZIV	2003	2003 ST.ZIV	
Binary Changes CLASS	Integer	None Class 1 Class 2 Class 3	None Class 1 Class 2 Class 3	Class 1	None Class 1 Class 2 Class 3	
Analog Changes CLASS	Integer	None Class 1 Class 2 Class 3	None Class 1 Class 2 Class 3	Class 2	None Class 1 Class 2 Class 3	
Counter Changes CLASS	Integer	None Class 1 Class 2 Class 3	None Class 1 Class 2 Class 3	Class 3	None Class 1 Class 2 Class 3	
Binary Status Change	Boolean	0 (No)	1 (Yes)	1 (Yes)	1	
32 Bits Analog Input	Boolean	0 (No)	1 (Yes)	1 (Yes)	1	
Analog Inputs (Deadbands)						
Setting Name	**Type**	**Minimum Value**	**Maximum Value**	**Default Value**	**Step**	**Unit**
Deadband AI#0	Float	0 %	100 %	100 %	0.0001 %	
Deadband AI#1	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#2	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#3	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#4	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#5	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#6	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#7	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#8	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#9	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#10	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#11	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#12	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#13	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#14	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#15	Float	0 %	100 %	100 %	0. 0001 %	

Counter Inputs (CounterDeadbands)						
Setting Name	**Type**	**Minimum Value**	**Maximum Value**	**Default Value**	**Step**	**Unit**
Deadband Cont.I#0	Integer	1	32767	1	1	
Deadband Cont.I#1	Integer	1	32767	1	1	
Deadband Cont.I#2	Integer	1	32767	1	1	
Deadband Cont.I#3	Integer	1	32767	1	1	
Deadband Cont.I#4	Integer	1	32767	1	1	
Deadband Cont.I#5	Integer	1	32767	1	1	
Deadband Cont.I#6	Integer	1	32767	1	1	
Deadband Cont.I#7	Integer	1	32767	1	1	
Deadband Cont.I#8	Integer	1	32767	1	1	
Deadband Cont.I#9	Integer	1	32767	1	1	
Deadband Cont.I#10	Integer	1	32767	1	1	
Deadband Cont.I#11	Integer	1	32767	1	1	
Deadband Cont.I#12	Integer	1	32767	1	1	
Deadband Cont.I#13	Integer	1	32767	1	1	
Deadband Cont.I#14	Integer	1	32767	1	1	
Deadband Cont.I#15	Integer	1	32767	1	1	
Deadband Cont.I#16	Integer	1	32767	1	1	
Deadband Cont.I#17	Integer	1	32767	1	1	
Deadband Cont.I#18	Integer	1	32767	1	1	
Deadband Cont.I#19	Integer	1	32767	1	1	

DNP Port 1 Configuration						
Setting Name	**Type**	**Minimum Value**	**Maximum Value**	**Default Value**	**Step/ Select**	**Unit**
Protocol Select	**Uinteger**	**Procome Dnp3 Modbus**	**Procome Dnp3 Modbus**	**Procome**	**Procome Dnp3 Modbus**	
Baud rate	**Integer**	**300**	**38400**	**38400**	**300 600 1200 2400 4800 9600 19200 38400**	**baud**
Stop Bits	**Integer**	**1**	**2**	**1**	**1**	
Parity	**Integer**	**None Odd Even**	**None Odd Even**	**None**	**None Odd Even**	
Rx Time btw. Char	**Float**	**1**	**60000**	**0.5**	**40**	**msec.**
Comms Fail Ind. Time	**Float**	**0**	**600**	**0.1**	**60**	**s**

Advanced Settings						
Flow control						
CTS Flow	Bool	No Yes	No Yes	No	No Yes	
DSR Flow	Bool	No Yes	No Yes	No	No Yes	
DSR Sensitive	Bool	No Yes	No Yes	No	No Yes	
DTR Control	Integer	Inactive Active Rec. Req.	Inactive Active Rec. Req.	Inactive	Inactive Active Rec. Req.	
RTS Control	Integer	Inactive Active Rec. Req. Sen. Req.	Inactive Active Rec. Req. Sen. Req.	Inactive	Inactive Active Rec. Req. Sen. Req.	
Times						
Tx Time Factor	Float	0	100	1	0.5	
Tx Timeout Const	Uinteger	0	60000	0	1	
Message modification						
Number of Zeros	Integer	0	255	0	1	
collision						
Collision Type	Integer	NO ECHO DCD	NO ECHO DCD	NO	NO ECHO DCD	
Max Retries	Integer	0	3	0	1	
Min Retry Time	Uinteger	0	60000	0	1	msec.
Max Retry Time	Uinteger	0	60000	0	1	msec.

DNP Port 2 and 3 Configuration

Setting Name	Type	Minimum Value	Maximum Value	Default Value	Step/ Select	Unit
Protocol Select	Uinteger	Procome Dnp3 Modbus	Procome Dnp3 Modbus	Procome	Procome Dnp3 Modbus	
Baud rate	Integer	300	38400	38400	300 600 1200 2400 4800 9600 19200 38400	baud
Stop Bits	Integer	1	2	1	1	
Parity	Integer	None Odd Even	None Odd Even	None	None Odd Even	
Rx Time btw. Char	Float	1	60000	0.5	40	msec.
Comms Fail Ind. Time	Float	0	600	0.1	60	s

Advanced Settings						
Operating Mode	Integer	RS-232 RS-485	RS-232 RS-485	RS-232	RS-232 RS-485	
Times						
Tx Time Factor	Float	0	100	1	0.5	
Tx Timeout Const	Uinteger	0	60000	0	1	
Wait N Bytes 485	Integer	0	4	0	1	
Message modification						
Number of Zeros	Integer	0	255	0	1	
collision						
Collision Type	Integer	NO ECHO	NO ECHO	NO	NO ECHO	
Max Retries	Integer	0	3	0	1	
Min Retry Time	Uinteger	0	60000	0	1	msec.
Max Retry Time	Uinteger	0	60000	0	1	msec.

✓ All settings remain unchanged after a power loss. F4

DNP Protocol Configuration

- **Relay Number (RTU Address):**
  Remote Terminal Unit Address. Addresses 0xFFF0 to 0xFFFF are reserved as *Broadcast Addresses*.
- **T Confirm Timeout (N7 Confirm Timeout) :**
  Timeout while waiting for Application Layer Confirmation. It applies to Unsolicited messages and Class 1 and Class 2 responses with event data.
- **Max Retries (N7 Retries) :**
  Number of retries of the Application Layer after timeout while waiting for Confirmation.
- **Enable Unsolicited (Enable Unsolicited Reporting) :**
  Enables or disables Unsolicited reporting.
- **Enable Unsol. after Restart :**
  Enables or disables Unsolicited after Restart (for compatibility with terminals whose revision is before DNP3-1998). It has effect only if Enable Unsolicited after Restart is set.
- **Unsolic. Master No. (MTU Address) :**
  Destination address of the Master device to which the unsolicited responses are to be sent. Addresses 0xFFF0 to 0xFFFF are reserved as *Broadcast Addresses*. It is useful only when Unsolicited Reporting is enabled.
- **Unsol. Grouping Time (Unsolicited Delay Reporting) :**
  Delay between an event being generated and the subsequent transmission of the unsolicited message, in order to group several events in one message and to save bandwidth.
- **Synchronization Interval**
  Max interval time between two synchronization. If no synchronizing inside interval, indication IIN1-4 (NEED TIME). This setting has no effect if Synchronization Interval is zero.
- **DNP 3.0 Rev.**
  Certification revision **STANDARD ZIV** or **2003** (DNP3-2003 Intelligent Electronic Device (IED) Certification Procedure Subset Level 2 Version 2.3 29-Sept-03)
- **Binary Changes CLASS.**
  Selection to send Binary Changes as CLASS 1 CLASS 2 CLASS 3 or None.
- **Analog Changes CLASS.**
  Selection to send Analog Changes as CLASS 1 CLASS 2 CLASS 3 or None.
- **Counter Changes CLASS.**
  Selection to send Counter Changes as CLASS 1 CLASS 2 CLASS 3 or None.
- **Binary Status .**
  Send Binary with status otherwise without status
- **32 Bits Analog Input .**
  Send Analog All Variations and Analog Change Event Binary Changes with 32 bits otherwise with 16 bits

DNP Port 1 Port 2 and Port 3 Configuration

- **Number of Zeros (Advice_Time) :**
  Number of zeros before the message.
- **Max Retries (N1 Retries) :**
  Number of retries of the Physical Layer after collision detection.
- **Min Retry Time (Fixed_delay) :**
  Minimum time to retry of the Physical Layer after collision detection.
- **Max Retry Time :**
  Maximum time to retry of the Physical Layer after collision detection.
- **Collision Type :**

  Port 1:
  NO
  ECHO based on detection of transmitted data (monitoring all data transmitted on the link).

  Port 2:
  NO
  ECHO based on detection of transmitted data (monitoring all data transmitted on the link.
  DCD (Data Carrier Detect) based on detecting out-of-band carrier.

  If the device prepares to transmit and finds the link busy, it waits until is no longer busy, and then waits a backoff_time as follows:
  backoff_time = Min Retry Time + random(Max Retry Time - Max Retry Time)
  and transmit. If the device has a collision in transmission the device tries again ,up to a configurable number of retries (Max Retries) if has news collision.

- **Wait N Bytes 485:**
  Number of wait bytes between Reception and transmission Use Port 2 Operate Mode RS-485 .

Dnp3 Profile II Ethernet

(Version 02.60.00 is the first Software Version that supports this Profile)

DNP V3.00 Dnp3 Profile II Ethernet

DEVICE PROFILE DOCUMENT
This document must be accompanied by: **Implementation Table** and **Point List**.

Vendor Name:	**ZIV Aplicaciones y Tecnología S.A.**
Device Name:	**MCV**

Highest DNP Level Supported:	Device Function:
For Requests **2** For Responses **2**	☐ Master ☒ Slave

Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the attached table):

1) Supports Enable/Disable Unsolicited Responses (FC=20 and 21), for classes 1 and 2.
2) Supports Write operations (FC=2) on Time and Date objects.
3) Supports Delay measurement Fine (FC=23).
4) Supports Warm Start command (FC=14).
5) Supports Unsolicited after Restart (for compatibility with terminals whose revision is before DNP3-1998)
6) Supports selection of DNP3 Revision.
7) Supports indication of no synchronization in time.
8) Supports simultaneous communications with two different Master devices
9) Supports assign event Class for Binary, Analog and Counter events: Class 1 , Class 2, Class 3, None
10) Supports respond to Multiple Read Request with multiple object types in the same Application Fragment .

Maximum Data Link Frame Size (octets):	Maximum Application Fragment Size (octets):
Transmitted **292** Received **292**	Transmitted **2048** (if >2048, must be configurable) Received **249** (must be <= 249)

Maximum Data Link Re-tries:	Maximum Application Layer Re-tries:
☒ None ☐ Fixed at _____ ☐ Configurable, range ___ to _____	☐ None ☒ Configurable, range **0** to **3** (Fixed is not permitted)

Requires Data Link Layer Confirmation:

☒ Never
☐ Always
☐ Sometimes. If 'Sometimes', when? _____
☐ Configurable. If 'Configurable', how? _____

Requires Application Layer Confirmation:

- ☐ Never
- ☐ Always (not recommended)
- ☒ When reporting Event Data (Slave devices only) **For unsolicited, Class 1 Class 2 and Class 2 responses that contain Event Data**. **(If there is no Event Data reported into a Class 1 2 or 3 response, Application Layer Confirmation is not requested)**
- ☐ When sending multi-fragment responses (Slave devices only)
- ☐ Sometimes. If 'Sometimes', when?
- ☐ Configurable. If 'Configurable', how?

Timeouts while waiting for:

Data Link Confirm	☒ None	☐ Fixed at ____	☐ Variable	☐ Configurable
Complete Appl. Fragment	☒ None	☐ Fixed at ____	☐ Variable	☐ Configurable
Application Confirm	☐ None	☐ Fixed at ____	☐ Variable	☒ Configurable
Complete Appl. Response	☒ None	☐ Fixed at ____	☐ Variable	☐ Configurable

Others

_____

Attach explanation if 'Variable' or 'Configurable' was checked for any timeout

Application Confirm timeout setting (*MMI*): Range 50 ms. 65.535 ms.

Sends/Executes Control Operations:

- Maximum number of CROB (obj. 12, var. 1) objects supported in a single message **1**
- Maximum number of Analog Output (obj. 41, any var.) supported in a single message **0**

☐ Pattern Control Block and Pattern Mask (obj. 12, var. 2 and 3 respectively) supported.
☐ CROB (obj. 12) and Analog Output (obj. 41) permitted together in a single message.

WRITE Binary Outputs	☒ Never	☐ Always	☐ Sometimes	☐ Configurable
SELECT (3) / OPERATE (4)	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
DIRECT OPERATE (5)	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
DIRECT OPERATE - NO ACK (6)	☐ Never	☒Always	☐ Sometimes	☐ Configurable

Count > 1	☐ Never	☐ Always	☒ Sometimes	☐ Configurable
Pulse On	☐ Never	☒Always	☐ Sometimes	☐ Configurable
Pulse Off	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
Latch On	☐ Never	☒Always	☐ Sometimes	☐ Configurable
Latch Off	☐ Never	☒Always	☐ Sometimes	☐ Configurable

Queue	☒ Never	☐ Always	☐ Sometimes	☐ Configurable
Clear Queue	☒ Never	☐ Always	☐ Sometimes	☐ Configurable

Attach explanation:

- **All points support the same Function Codes: (3) Select, (4) Operate, (5) Direct Operate and (6) Direct Operate - No ACK.**
- **Maximum Select/Operate Delay Time: 60 seconds.**
- **Count can be >1 only for PULSE ON and PULSE OFF**

<table>
<tr><th colspan="2">FILL OUT THE FOLLOWING ITEMS FOR SLAVE DEVICES ONLY:</th></tr>
<tr><td>Reports Binary Input Change Events when no specific variation requested:

☐ Never
☒ Only time-tagged
☐ Only non-time-tagged
☐ Configurable to send both, one or the other (attach explanation)</td><td>Reports time-tagged Binary Input Change Events when no specific variation requested:

☐ Never
☒ Binary Input Change With Time
☐ Binary Input Change With Relative Time
☐ Configurable (attach explanation)</td></tr>
<tr><td>Sends Unsolicited Responses:

☐ Never
☒ Configurable (See Note D)
☒ Only certain objects (Class 1 2 and 3)
☐ Sometimes (attach explanation)

☒ ENABLE/DISABLE UNSOLICITED Function codes supported</td><td>Sends Static Data in Unsolicited Responses:

☒ Never
☐ When Device Restarts
☐ When Status Flags Change

No other options are permitted.</td></tr>
<tr><td>Default Counter Object/Variation:

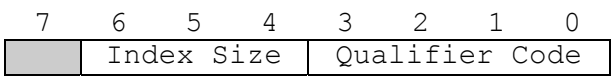
☐ No Counters Reported
☐ Configurable (attach explanation)
☒ Default Object 20,21
Default Variation 1
☐ Point-by-point list attached</td><td>Counters Roll Over at:

☐ No Counters Reported
☐ Configurable (attach explanation)
☐ 16 Bits
☐ 32 Bits
☒ Other Value 31 Bits
☐ Point-by-point list attached</td></tr>
<tr><td colspan="2">Sends Multi-Fragment Responses: ☒ Yes ☐ No</td></tr>
</table>

QUICK REFERENCE FOR DNP3.0 LEVEL 2 FUNCTION CODES & QUALIFIERS

Function Codes

1	Read
2	Write
3	Select
4	Operate
5	Direct Operate
9	Direct Operate-No ACK
10	Immediate Freeze
11	Immediate Freeze no ACK
13	Cold Start
14	Warm Start
20	Enable Unsol. Messages
21	Disable Unsol. Messages
23	Delay Measurement
24	Record Current Time
129	Response
130	Unsolicited Message



Index Size

0- No Index, Packed
1- 1 byte Index
2- 2 byte Index
3- 4 byte Index
4- 1 byte Object Size
5- 2 byte Object Size
6- 4 byte Object Size

Qualifier Code

0- 8-Bit Start and Stop Indices
1- 16-Bit Start and Stop Indices
2- 32-Bit Start and Stop Indices
3- 8-Bit Absolute address Ident.
4- 16-Bit Absolute address Ident.
5- 32-Bit Absolute address Ident.
6- No Range Field (all)
7- 8-Bit Quantity
8- 16-Bit Quantity
9- 32-Bit Quantity
11-(0xB) Variable array

IMPLEMENTATION TABLE

OBJECT			REQUEST (MCV parse)		RESPONSE (MCV respond)		
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes (dec)	Qual Codes (hex)	Notes
1	0	Binary Input – All variations	1	0,1,6,7,8			Assigned to Class 0.
1	1	Binary Input	1	0,1,6,7,8	129	0,1	
2	0	Binary Input with Status	1	0,1,6,7,8	129	0,1	
2	0	Binary Input Change – All variations	1	6,7,8			
2	2	Binary Input Change with Time	1	6,7,8	129,130	17,,28	Assign to Event Class .
12	1	Control Relay Output Block	3,4,5,6	17,28	129	17,28	Echo of request
20	0	Binary Counter – All variations	1	0,1,6,7,8			Assigned to Class 0.
20	1	32 Bits Binary Counter			129	0,1	
21	0	Frozen Counter – All variations	1	0,1,6,7,8			
21	1	32 Bits Frozen Counter			129	0,1	
22	0	Counter Change Event – All variations	1	6,7,8			
22	5	32 Bits Counter Change Event With Time			129,130	17,,28	Assign to Event Class
30	0	Analog Input – All variations	1	0,1,6,7,8			Assigned to Class 0.
30	1	32-Bit Analog Input	1	0,1,6,7,8	129	1	
30	2	16-Bit Analog Input	1	0,1,6,7,8	129	1	
32	0	Analog Change Event – All variations	1	6,7,8			
32	3	32-Bit Analog Change Event with Time	1	6,7,8	129,130	28	Assign to Event Class
32	4	16-Bit Analog Change Event with Time	1	6,7,8	129,130	28	Assign to Event Class
50	1	Time and Date	2	7 count=1	129		C
50	3	Time and Date at Last Recorded Time	2	7 count=1	129		C
52	2	Time Delay Fine	23		129	1	F,G

OBJECT			REQUEST (MCV parse)		RESPONSE (MCV respond)		
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes (dec)	Qual Codes (hex)	Notes
60	1	Class 0 Data	1	6	129	1	
60	2	Class 1 Data	1	6,7,8	129,130	28	D
			20,21	6			
60	3	Class 2 Data	1	6,7,8	129,130	28	D
			20,21	6			
60	4	Class 3 Data	1	6,7,8	129,130	28	D
			20,21	6			
80	1	Internal Indications	2	0 index=7			E
--	--	No Object (Cold Start)	13				F
--	--	No Object (Warm Start)	14				F
--	--	No Object (Delay Measurement)	23				G

NOTES

C: Device supports write operations on Time and Date objects. Time Synchronization-Required Internal Indication bit (IIN1-4) will be cleared on the response.

D: The device can be configured to send or not, unsolicited responses depending on a configuration option by means of ***MMI*** (Man-Machine Interface or front-panel user interface ***ZIVercomPlus***). Then, the Master can Enable or Disable Unsolicited messages (for Classes 1, 2 and 3) by means of requests (FC 20 and 21).
If the unsolicited response mode is configured "on", then upon device restart, the device will transmit an initial Null unsolicited response, requesting an application layer confirmation. While waiting for that application layer confirmation, the device will respond to all function requests, including READ requests.

E: Restart Internal Indication bit (IIN1-7) can be cleared explicitly by the master.

F: The outstation, upon receiving a ***Cold or Warm Start*** request, will respond sending a Time Delay Fine object message (which specifies a time interval until the outstation will be ready for further communications), restarting the DNP process, clearing events stored in its local buffers and setting IIN1-7 bit (Device Restart).

G: Device supports Delay Measurement requests (FC = 23). It responds with the Time Delay Fine object (52-2). This object states the number of milliseconds elapsed between Outstation receiving the first bit of the first byte of the request and the time of transmission of the first bit of the first byte of the response.

DEVICE SPECIFIC FEATURES

- Internal Indication IIN1-6 (Device trouble): **Set to indicate a change in the current DNP configuration in the outstation. Cleared in the next response. Used to let the master station know that DNP settings have changed at the outstation. Note that some erroneous configurations could make impossible to communicate this condition to a master station.**

  This document also states the DNP3.0 settings currently available in the device. If the user changes whatever of these settings, it will set the *Device Trouble Internal Indication* bit on the next response sent.
- Event buffers**: device can hold as much as 128** Binary Input Changes**,** 64 Analog Input Changes and 64 Counter Input Change**. If these limits are reached the device will set the *Event Buffers Overflow Internal Indication* bit on the next response sent. It will be cleared when the master reads the changes, making room for new ones.**
- Configuration ➔ Operation Enable **menu: the device can enable or disable** permissions **for the operations over al Control Relay Output Block. In case permissions are configured off (disabled) the response to a command (issued as Control Relay Output Block) will have the Status code NOT_AUTHORIZED. In case the equipment is** blocked **the commands allowed are the configured when permitted. While blocked, the relay will accept commands over the configured signal. If the equipment is in** operation inhibited state**, the response to all commands over the configured signal will have the Status code NOT_AUTHORIZED.**
- **Customers can configure Inputs/Outputs to suit their needs, by means of** *ZIVercomPlus*® **software.**

POINT LIST

BINARY INPUT (OBJECT 1) -> Assigned to Class 0. BINARY INPUT CHANGE (OBJECT 2) -> Assign to Class.		
Index	**Description**	
0	***Configure by ZIVercomPlus®* 2048 points**	
1	***Configure by ZIVercomPlus®* 2048 points**	
2	***Configure by ZIVercomPlus®* 2048 points**	
3	***Configure by ZIVercomPlus®* 2048 points**	
4	***Configure by ZIVercomPlus®* 2048 points**	
5	***Configure by ZIVercomPlus®* 2048 points**	
6	***Configure by ZIVercomPlus®* 2048 points**	
7	***Configure by ZIVercomPlus®* 2048 points**	
8	***Configure by ZIVercomPlus®* 2048 points**	
9	***Configure by ZIVercomPlus®* 2048 points**	
10	***Configure by ZIVercomPlus®* 2048 points**	
11	***Configure by ZIVercomPlus®* 2048 points**	
12	***Configure by ZIVercomPlus®* 2048 points**	
13	***Configure by ZIVercomPlus®* 2048 points**	
14	***Configure by ZIVercomPlus®* 2048 points**	
15	***Configure by ZIVercomPlus®* 2048 points**	
16	***Configure by ZIVercomPlus®* 2048 points**	
17	***Configure by ZIVercomPlus®* 2048 points**	
...	***Configure by ZIVercomPlus®* 2048 points**	
253	***Configure by ZIVercomPlus®* 2048 points**	
254	***Configure by ZIVercomPlus®* 2048 points**	
255	***Configure by ZIVercomPlus®* 2048 points**	

CONTROL RELAY OUTPUT BLOCK (OBJECT 12)		
Index	**Description**	
0	***Configure by ZIVercomPlus®* 256 points**	
1	***Configure by ZIVercomPlus®* 256 points**	
2	***Configure by ZIVercomPlus®* 256 points**	
3	***Configure by ZIVercomPlus®* 256 points**	
4	***Configure by ZIVercomPlus®* 256 points**	
5	***Configure by ZIVercomPlus®* 256 points**	
6	***Configure by ZIVercomPlus®* 256 points**	
7	***Configure by ZIVercomPlus®* 256 points**	
8	***Configure by ZIVercomPlus®* 256 points**	
9	***Configure by ZIVercomPlus®* 256 points**	
10	***Configure by ZIVercomPlus®* 256 points**	
11	***Configure by ZIVercomPlus®* 256 points**	
12	***Configure by ZIVercomPlus®* 256 points**	
13	***Configure by ZIVercomPlus®* 256 points**	

CONTROL RELAY OUTPUT BLOCK (OBJECT 12)		
Index	**Description**	
14	***Configure by ZIVercomPlus*® 256 points**	
15	***Configure by ZIVercomPlus*® 256 points**	
16	***Configure by ZIVercomPlus*® 256 points**	
17	***Configure by ZIVercomPlus*® 256 points**	
...	***Configure by ZIVercomPlus*® 256 points**	
253	***Configure by ZIVercomPlus*® 256 points**	
254	***Configure by ZIVercomPlus*® 256 points**	
255	***Configure by ZIVercomPlus*® 256 points**	

ANALOG INPUT (OBJECT 30) -> Assigned to Class 0. ANALOG INPUT CHANGE (OBJECT 32) -> Assign to Class		
Index	**Description**	**Deadband**
0	***Configure by ZIVercomPlus*® 256 points**	**Deadband_1.**
1	***Configure by ZIVercomPlus*® 256 points**	**Deadband_2.**
2	***Configure by ZIVercomPlus*® 256 points**	**Deadband_3.**
3	***Configure by ZIVercomPlus*® 256 points**	**Deadband_4.**
4	***Configure by ZIVercomPlus*® 256 points**	**Deadband_5.**
5	***Configure by ZIVercomPlus*® 256 points**	**Deadband_6.**
6	***Configure by ZIVercomPlus*® 256 points**	**Deadband_7.**
7	***Configure by ZIVercomPlus*® 256 points**	**Deadband_8.**
8	***Configure by ZIVercomPlus*® 256 points**	**Deadband_9.**
9	***Configure by ZIVercomPlus*® 256 points**	**Deadband_10.**
10	***Configure by ZIVercomPlus*® 256 points**	**Deadband_11.**
11	***Configure by ZIVercomPlus*® 256 points**	**Deadband_12.**
12	***Configure by ZIVercomPlus*® 256 points**	**Deadband_13.**
13	***Configure by ZIVercomPlus*® 256 points**	**Deadband_14.**
14	***Configure by ZIVercomPlus*® 256 points**	**Deadband_15.**
15	***Configure by ZIVercomPlus*® 256 points**	**Deadband_16.**

Additional assign with ***ZIVercomPlus***®:

Index	Description
16	***Configure by ZIVercomPlus® 256 points***
17	***Configure by ZIVercomPlus® 256 points***
18	***Configure by ZIVercomPlus® 256 points***
19	***Configure by ZIVercomPlus® 256 points***
20	***Configure by ZIVercomPlus® 256 points***
21	***Configure by ZIVercomPlus® 256 points***
22	***Configure by ZIVercomPlus® 256 points***
23	***Configure by ZIVercomPlus® 256 points***
24	***Configure by ZIVercomPlus® 256 points***
25	***Configure by ZIVercomPlus® 256 points***
26	***Configure by ZIVercomPlus® 256 points***
27	***Configure by ZIVercomPlus® 256 points***
....	***Configure by ZIVercomPlus® 256 points***
62	***Configure by ZIVercomPlus® 256 points***
63	***Configure by ZIVercomPlus® 256 points***

The full scale ranges are adjustable and user's magnitudes can be created. It's possible to choose between primary and secondary values, considering CT and PT ratios. Typical ranges in secondary values are:

Description	Full Scale Range		
	Engineering units	Counts	
Currents (Phases, sequences, harmonics)	0 to 1,2 x In_{PHASE} A	0 to 32767	**Deadband**
Voltages (Phase to ground, sequences, harmonics)	0 to 1,2 x Vn/√3 V	0 to 32767	**Deadband**
Voltages(Phase to phase)	0 to 1,2 x Vn V	0 to 32767	**Deadband**
Power (Real, reactive, apparent)	0 to 3 x 1,4 x In_{PHASE} x Vn/√3 W	-32768 to 32767	**Deadband**
Power factor	-1 to 1	-32768 to 32767	**Deadband**
Frequency	0 to 1,2 x Rated frequency (50/60 Hz)	0 to 32767	**Deadband**

Communication Measure in Counts

With ***ZIVercomPlus*** program is possible to define the ***Full Scale Range*** that is desired to transmit each magnitude in *counts*. Parameters necessary to configure the Mathematical expression are:

- **Offset:** A number indicating the compensation of de Magnitude.
- **Limit:** it's the Maximum value of magnitude range.
- **Max Communication:** it's a constant that depend of the Number Bits of Analog Input.
  Max Communication=2(Number Bits Analog Input - 1)**
  For 16-Bit Analog Input (Obj. 30 Var. 2) 2**(15) = 32.767 counts
  For 32-Bit Analog Input (Obj. 30 Var. 1) 2**(31) = 2.147.483.647 counts
- **Rated value:** Nominal Value of the magnitude.
- **Nominal Flag:** This *flag* defines if the **limit** is proportional to the **rated value** of the magnitude.
- **TR:** Secondary to Primary Transformation Ratio.

Mathematical expression to describe the ***Full Scale Range*** is:

- When **Nominal Flag** is actived,

$$MeasureCom = TR \times \frac{Measure - Offset}{RatedValue} \times \frac{MaxComunication}{Limit}$$

- When **Nominal Flag** is NOT actived,

$$MeasureCom = TR \times (Measure - Offset) \times \frac{MaxComunication}{Limit}$$

Communication Measure in Engineering Units

With ***ZIVercomPlus*** program **also** it's possible to transmit each magnitude in Engineering Units. Parameters necessary to configure the Mathematical expression are:

- **Offset:** A number indicating the compensation of de magnitude.
- **Limit:** it's the Maximum value of magnitude range.
- **Rated value:** Nominal Value of the magnitude.
- **Nominal Flag:** this *flag* defines if the **limit** is proportional to the **rated value** of the magnitude or not. The rated value of the new magnitudes defined by the user is a setting, while for the pre-defined magnitudes is a fix value.
- **TR:** Secondary to Primary Transformation Ratio.
- **Scaling Factor:** Multiply Factor of magnitude.

Mathematical expression to obtain **Measure in Engineering Units** is:

- When **Nominal Flag** is actived,

$$MeasureCom = TR \times \frac{Measure - Offset}{RatedValue} \times ScalingFactor$$

- When **Nominal Flag** is NOT actived,

$$MeasureCom = TR \times (Measure - Offset) \times ScalingFactor$$

DeadBands

- Deadband is an area of a magnitude range or band where no generate magnitude change (the magnitude is dead). Meaning that no generation of Analogical Change Events if difference with value of generation of previous change is not equal or greater that DeadBand calculated. There is an independent setting for each 16 Measures with change.
- A Deadband is calculated as a percentage defined in DeadBand Setting over value of **parameter Limit**.
- The Deadband can be adjusted to the device by means of ***MMI*** (Man-Machine Interface or front-panel user interface *ZIVercomPlus*), between 0.0000% and 100.00%, in steps of 0.0001%. Default value is 100.00%, meaning that generation of Analog Change Events is **DISABLED** for that input. There is an independent setting for each Magnitude with change.

BINARY COUNTER (OBJECT 20) -> Assigned to Class 0.
FROZEN COUNTER (OBJECT 21)

32 BIT COUNTER CHANGE EVENT (OBJECT 22) -> Assign to Class

Index	Description	Deadband
0	***Configure by ZIVercomPlus®*** **256 points**	**CounterDeadBand_1.**
1	***Configure by ZIVercomPlus®*** **256 points**	**CounterDeadBand_2.**
2	***Configure by ZIVercomPlus®*** **256 points**	**CounterDeadBand_3.**
3	***Configure by ZIVercomPlus®*** **256 points**	**CounterDeadBand_4.**
4	***Configure by ZIVercomPlus®*** **256 points**	**CounterDeadBand_5.**
5	***Configure by ZIVercomPlus®*** **256 points**	**CounterDeadBand_6**
6	***Configure by ZIVercomPlus®*** **256 points**	**CounterDeadBand_7.**
7	***Configure by ZIVercomPlus®*** **256 points**	**CounterDeadBand_8.**
8	***Configure by ZIVercomPlus®*** **256 points**	**CounterDeadBand_9.**
9	***Configure by ZIVercomPlus®*** **256 points**	**CounterDeadBand_10.**
10	***Configure by ZIVercomPlus®*** **256 points**	**CounterDeadBand_11.**
11	***Configure by ZIVercomPlus®*** **256 points**	**CounterDeadBand_12.**
12	***Configure by ZIVercomPlus®*** **256 points**	**CounterDeadBand_13.**
13	***Configure by ZIVercomPlus®*** **256 points**	**CounterDeadBand_14.**
14	***Configure by ZIVercomPlus®*** **256 points**	**CounterDeadBand_15.**
15	***Configure by ZIVercomPlus®*** **256 points**	**CounterDeadBand_16.**
16	***Configure by ZIVercomPlus®*** **256 points**	**CounterDeadBand_17.**
17	***Configure by ZIVercomPlus®*** **256 points**	**CounterDeadBand_18.**
18	***Configure by ZIVercomPlus®*** **256 points**	**CounterDeadBand_19.**
19	***Configure by ZIVercomPlus®*** **256 points**	**CounterDeadBand_20.**

CounterDeadBands

- CounterDeadband is an area of a counter magnitude range or band, where no generate counter magnitude change (the communication counter magnitude is dead).Meaning that no generation of Counter Change Events if difference with value of generation of previous change is not equal or greater that CounterDeadBand setting. There is an independent setting for each Counter.

- The CounterDeadband can be adjusted to the device by means of ***MMI*** (Man-Machine Interface or front-panel user interface *ZIVercomPlus*), between 1 and 32767, in steps of 1, default value is 1.

DNP3 PROTOCOL SETTINGS

DNP3 Protocol Settings

DNP Protocol Configuration

Setting Name	Type	Minimum Value	Maximum Value	Default Value	Step/ Select	Unit
Relay Number	Integer	0	65519	1	1	
T Confirm Timeout	Integer	1000	65535	1000	1	msec.
Max Retries	Integer	0	65535	0	1	
Enable Unsolicited.	Boolean	0 (No)	1 (Yes)	0 (No)	1	
Enable Unsol. after Restart	Boolean	0 (No)	1 (Yes)	0 (No)	1	
Unsolic. Master No.	Integer	0	65519	1	1	
Unsol. Grouping Time	Integer	100	65535	1000	1	msec.
Synchronization Interval	Integer	0	120	0	1	min.
DNP 3.0 Rev.	Integer	2003 ST.ZIV	2003 ST.ZIV	2003	2003 ST.ZIV	
Binary Changes CLASS	Integer	None Class 1 Class 2 Class 3	None Class 1 Class 2 Class 3	Class 1	None Class 1 Class 2 Class 3	
Analog Changes CLASS	Integer	None Class 1 Class 2 Class 3	None Class 1 Class 2 Class 3	Class 2	None Class 1 Class 2 Class 3	
Counter Changes CLASS	Integer	None Class 1 Class 2 Class 3	None Class 1 Class 2 Class 3	Class 3	None Class 1 Class 2 Class 3	
Binary Status Change	Boolean	0 (No)	1 (Yes)	1 (Yes)	1	
32 Bits Analog Input	Boolean	0 (No)	1 (Yes)	1 (Yes)	1	

Analog Inputs (Deadbands)

Setting Name	Type	Minimum Value	Maximum Value	Default Value	Step	Unit
Deadband AI#0	Float	0 %	100 %	100 %	0.0001 %	
Deadband AI#1	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#2	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#3	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#4	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#5	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#6	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#7	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#8	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#9	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#10	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#11	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#12	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#13	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#14	Float	0 %	100 %	100 %	0. 0001 %	
Deadband AI#15	Float	0 %	100 %	100 %	0. 0001 %	

Counter Inputs (CounterDeadbands)						
Setting Name	**Type**	**Minimum Value**	**Maximum Value**	**Default Value**	**Step**	**Unit**
Deadband Cont.I#0	Integer	1	32767	1	1	
Deadband Cont.I#1	Integer	1	32767	1	1	
Deadband Cont.I#2	Integer	1	32767	1	1	
Deadband Cont.I#3	Integer	1	32767	1	1	
Deadband Cont.I#4	Integer	1	32767	1	1	
Deadband Cont.I#5	Integer	1	32767	1	1	
Deadband Cont.I#6	Integer	1	32767	1	1	
Deadband Cont.I#7	Integer	1	32767	1	1	
Deadband Cont.I#8	Integer	1	32767	1	1	
Deadband Cont.I#9	Integer	1	32767	1	1	
Deadband Cont.I#10	Integer	1	32767	1	1	
Deadband Cont.I#11	Integer	1	32767	1	1	
Deadband Cont.I#12	Integer	1	32767	1	1	
Deadband Cont.I#13	Integer	1	32767	1	1	
Deadband Cont.I#14	Integer	1	32767	1	1	
Deadband Cont.I#15	Integer	1	32767	1	1	
Deadband Cont.I#16	Integer	1	32767	1	1	
Deadband Cont.I#17	Integer	1	32767	1	1	
Deadband Cont.I#18	Integer	1	32767	1	1	
Deadband Cont.I#19	Integer	1	32767	1	1	

DNP Port 1 Port 2 and 3 DNP 3 Profile II Ethernet Configuration						
Setting Name	**Type**	**Minimum Value**	**Maximum Value**	**Default Value**	**Step**	**Unit**
Protocol Select	**Uinteger**	**Procome Dnp3 Modbus**	**Procome Dnp3 Modbus**	**Procome**	**Procome Dnp3 Modbus**	
Enable Ethernet Port	**Boolean**	**0 (No)**	**1 (Yes)**	**1 (Yes)**	**1**	
IP Address Port 1	**Byte[4]**	**ddd.ddd.ddd.ddd**	**ddd.ddd.ddd.ddd**	**192.168.1.51**	**1**	
IP Address Port 2	**Byte[4]**	**ddd.ddd.ddd.ddd**	**ddd.ddd.ddd.ddd**	**192.168.1.61**	**1**	
IP Address Port 3	**Byte[4]**	**ddd.ddd.ddd.ddd**	**ddd.ddd.ddd.ddd**	**192.168.1.71**	**1**	
Subnet Mask	**Byte[4]**	**128.0.0.0**	**255.255.255.254**	**255.255.255.0**	**1**	
Port Number	**Uinteger**	**0**	**65535**	**20000**	**1**	
Keepalive Time	**Float**	**0**	**65**	**30**	**60**	**s.**
Rx Time Characters	**Float**	**1**	**60000**	**1**	**0.5**	**ms.**
Comms Fail Timer	**Float**	**0**	**600**	**60**	**0.1**	**s.**

- ✓ **All settings remain unchanged after a power loss.**

DNP Protocol Configuration

- **Relay Number (RTU Address):**
  Remote Terminal Unit Address. Addresses 0xFFF0 to 0xFFFF are reserved as *Broadcast Addresses*.
- **T Confirm Timeout (N7 Confirm Timeout) :**
  Timeout while waiting for Application Layer Confirmation. It applies to Unsolicited messages and Class 1 and Class 2 responses with event data.
- **Max Retries (N7 Retries) :**
  Number of retries of the Application Layer after timeout while waiting for Confirmation.
- **Enable Unsolicited (Enable Unsolicited Reporting) :**
  Enables or disables Unsolicited reporting.
- **Enable Unsol. after Restart :**
  Enables or disables Unsolicited after Restart (for compatibility with terminals whose revision is before DNP3-1998). It has effect only if Enable Unsolicited after Restart is set.
- **Unsolic. Master No. (MTU Address) :**
  Destination address of the Master device to which the unsolicited responses are to be sent. Addresses 0xFFF0 to 0xFFFF are reserved as *Broadcast Addresses*. It is useful only when Unsolicited Reporting is enabled.
- **Unsol. Grouping Time (Unsolicited Delay Reporting) :**
  Delay between an event being generated and the subsequent transmission of the unsolicited message, in order to group several events in one message and to save bandwidth.
- **Synchronization Interval**
  Max interval time between two synchronization. If no synchronizing inside interval, indication IIN1-4 (NEED TIME). This setting has no effect if Synchronization Interval is zero.
- **DNP 3.0 Rev.**
  Certification revision **STANDARD ZIV** or **2003** (DNP3-2003 Intelligent Electronic Device (IED) Certification Procedure Subset Level 2 Version 2.3 29-Sept-03)
- **Binary Changes CLASS.**
  Selection to send Binary Changes as CLASS 1 CLASS 2 CLASS 3 or None.
- **Analog Changes CLASS.**
  Selection to send Analog Changes as CLASS 1 CLASS 2 CLASS 3 or None.
- **Counter Changes CLASS.**
  Selection to send Counter Changes as CLASS 1 CLASS 2 CLASS 3 or None.
- **Binary Status .**
  Send Binary with status otherwise without status
- **32 Bits Analog Input .**
  Send Analog All Variations and Analog Change Event Binary Changes with 32 bits otherwise with 16 bits

DNP PROFILE II ETHERNET Port 1 Port 2 and Port 3 Configuration

- **Enable Ethernet Port :**
  Enables or disables Ethernet Port.

- **IP Address :**
  Identification Number of Ethernet device.

- **Subnet Mask :**
  Indicate the part of IP Address is the Net Address and the part of IP Address is the Device Number.

- **Port Number :**
  Indicate to Destinatión Device the path to send the recived data.

- **Keepalive Time :**
  Number of second between Keepalive paquets, if zero no send packages Keepalive. These packages allow to Server know if a Client is present in the Net.

- **Rx Time Between Characters :**
  Maximum time between Characters.

- **Comm Fail Timer :**
  Maximum time between Messages without indicate Communication Fail.

C. MODBUS RTU Documentation Address Map

Annex C. MODBUS RTU Documentation Address Map

C.1 Preliminary Information

This a reference document for implementing the MODBUS RTU protocol in the **6MCV** IED.

This document provides a detailed MODBUS address map (input status, coil status, input registers and force single coil) and their equivalent in the **6MCV** relay.

The functions that will be implemented are:

ModBus Function	Meaning
01	Read Coil Status
02	Read Input Status
04	Read Input Registers
05	Force Single Coil

Any other function not among those indicated will be considered illegal and will return exception code 01 (Illegal function).

C.2 Function 01: Read Coil Status

C.2.1 Modbus Address Map for 6MCV

The MODBUS coil status address map for the **6MCV** relay will be:

Address	Description
Configurable through the *ZivercomPlus*®	Any input or output logic signal from the protection modules or generated by the programmable logic.

The content of the addresses is variable (reflection of each relay's configuration). The range of addresses is from 0 to 1023 and they are assigned automatically by the ***ZivercomPlus***® program.

Non-configured addresses will be considered illegal and will return exception code 02 (Illegal Data Address).

C.3 Function 02: Read Input Status

C.3.1 Modbus Address Map for 6MCV

The MODBUS input status address map for the **6MCV** relay will be:

Address	Description
Configurable through the *ZivercomPlus*®	Any input or output logic signal from the protection modules or generated by the programmable logic.

The content of the addresses is variable (reflection of each relay's configuration). The range of addresses is from 0 to 1023 and they are assigned automatically by the ***ZivercomPlus***® program.

Non-configured addresses will be considered illegal and will return exception code 02 (Illegal Data Address).

C.4 Function 03: Read Holding Registers

C.4.1 Modbus Address Map for 6MCV

The MODBUS read holding registers address map for the **6MCV** relay will be:

Address	Description
Configurable through the *ZivercomPlus*®	Any input or output logic signal from the protection modules or generated by the programmable logic whose number of changes is to be measured.

Configurable through the ***ZivercomPlus***®: Counters can be created with any signal configured in the programmable logic or from the protection modules. The default counters are those of the real energies (positive and negative) and the reactive energies (capacitive and inductive).

The metering range of energies in primary values is from 100wh/varh to 6553.5 kWh/kVArh. This is the magnitude transmitted via communications. That is, one (1) count represents 100 wh/varh.

To obtain an energy counter with a higher maximum value, a “user magnitude” must be created using this counter. For example, dividing the value of the counter by 1000 and making the output of the divider the new magnitude yields an energy counter with a range from 100 kWh/kVArh to 6553.5 MWh/Mvarh; that is, one (1) count represents 100 kWh/varh.

The content of the addresses is variable (reflection of each relay's configuration). The range of addresses is from 0 to 255 and they are assigned automatically by the ***ZivercomPlus***® program.

Non-configured addresses will be considered illegal and will return exception code 02 (Illegal Data Address).

C.5 Function 04: Read Input Registers

C.5.1 Modbus Address Map for 6MCV

The MODBUS read input registers address map for the **6MCV** relay will be:

Address	Description
Configurable through the *ZivercomPlus*®	Any magnitude measured or calculated by the protection or generated by the programmable logic. It is possible to select between primary and secondary values, taking into account the corresponding transformation ratios.

All the full scale values of the magnitudes are definable, and these magnitudes can be used to create **user values**. Some typical values are:

- Phase and sequence currents and harmonics: **Rated value I_{PHASE} + 20**% sends 32767 counts.
- Line-to-neutral and sequence voltages and harmonics: **(Rated value V / √3) + 20%** sends 32767 counts.
- Phase-to-phase voltages: **Rated value V + 20%** sends 32767 counts.
- Powers: 3 x 1.4 x Rated value I_{PHASE} x Rated value / √3 sends 32767 counts.
- Power factor: from **-1** to **1** sends from -32767 to 32767 counts.
- Frequency: from **0 Hz** to **1.2 x Frequency$_{RATED}$** (50Hz / 60Hz) sends 32767 counts.

With the ***ZivercomPlus***® program, it is possible to define the full-scale value to be used to transmit each magnitude in counts, the unit that all the protocols use. There are three definable parameters that determine the range:

- **Offset value**: the minimum value of the magnitude for which 0 counts are sent.
- **Limit**: the length of the range of the magnitude on which it is interpolated to calculate the number of counts to send. If the offset value is 0, it coincides with the value of the magnitude for which the defined maximum of counts (32767) is sent.
- **Nominal flag**: this flag allows determining whether the limit set is proportional to the rated value of the magnitude or not. The rated value of the new magnitudes defined by the user in the programmable logic can be configured, while the rest of the existing magnitudes are fixed.

The expression that allows defining this full-scale value is the following:

- When the Nominal flag is enabled,

$$CommunicationsMeasurement = \frac{Measurement - Offset}{Nominal} \times \frac{32767}{Limit}$$

- When the Nominal flag is NOT enabled,

$$CommunicationsMeasurement = (Measurement - Offset) \times \frac{32767}{Limit}$$

The content of the addresses is variable (reflection of each relay's configuration). The range of addresses is from 0 to 255 and they are assigned automatically by the ***ZivercomPlus®*** program.

Non-configured addresses will be considered illegal and will return exception code 02 (Illegal Data Address).

C.6 Function 05: Force Single Coil

C.6.1 Modbus Address Map for 6MCV

The MODBUS force single coil address map of the **6MCV** relay will be:

Address	Description
Configurable through the *ZivercomPlus®*	A command can be made on any input from the protection modules and on any signal configured in the programmable logic.

The content of the addresses is variable (reflection of each relay's configuration). The range of addresses is from 0 to 255 and they are assigned automatically by the ***ZivercomPlus®*** program.

Non-configured addresses will be considered illegal and will return exception code 02 (Illegal Data Address).

Any value other than 00H or FFH will be considered illegal and will return exception code 03 (Illegal Data Value).

Annex C. MODBUS RTU Documentation Address Map

D. Schemes and Drawings

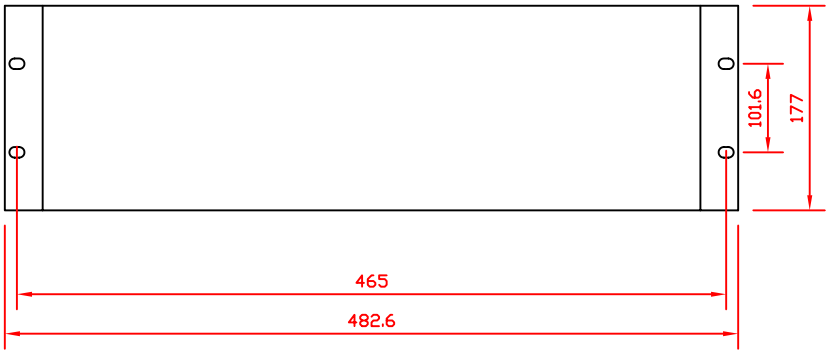
Dimension and Drill Hole Schemes

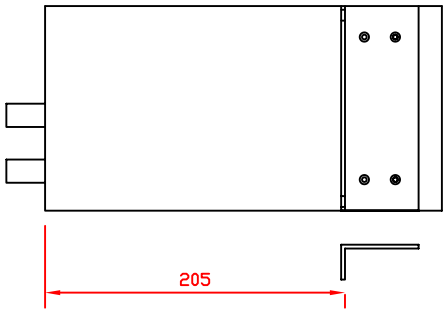
6MCV (4U x 1 19” rack)	>>	4BF0100/0037
6MCV (6U x 1 19” rack)	>>	4BF0100/0043
6MCV (2U x 1 19” rack)	>>	4BF0100/0040
6MCV (3U x 1 19” rack)	>>	4BF0100/0041

External Connection Schemes

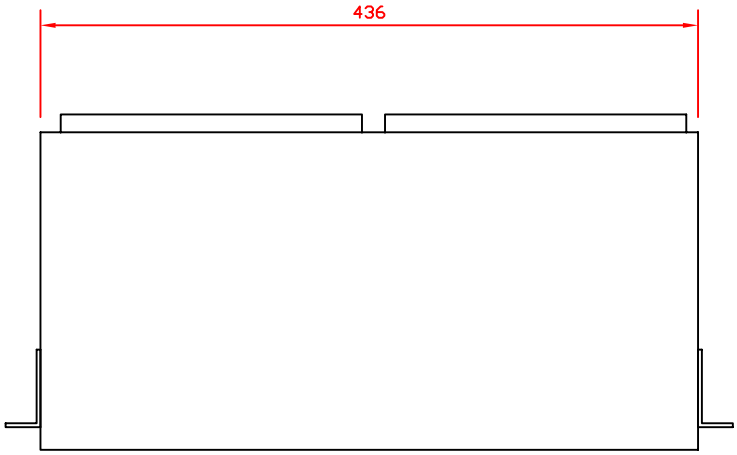
6MCV (410) 6U IEC	>>	3RX0189/0008
6MCV (210) 4U IEC	>>	3RX0189/0009
6MCV (E10)	>>	3RX0189/00010

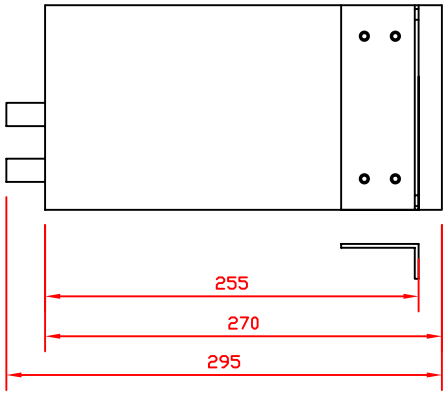
CAJA TIPO "Q"
ENCLOSURE TYPE "Q"
CAIXA TIPO "Q"

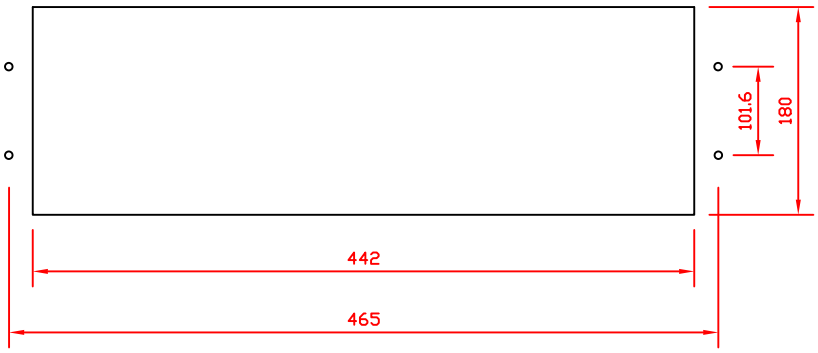




NOTA 1







TALADROS 8mm ø
8mm ø DRILLING
FUROS 8mm ø

NOTA 1:
LA PIEZA ADMITE LAS 2 POSICIONES MOSTRADAS PARA FACILITAR UN MONTAJE DEL EQUIPO MÁS Ó MENOS SALIENTE

REVISIONES	0	CD0407129	1	CD0504115
2	3		4	
5	6		7	
8	9		10	
11	12		13	
14	15		16	

ZIV Aplicaciones y Tecnologia S.A.

TITULO: DIMENSIONES Y TALADRADO

PROYECTO: CAJA TIPO "Q" 4U 1RACK (IDV)

Rev.0
Rev.1 12/4/05

NUMERO: 4BF0100/0037

	Fecha	Nombre
Dibujado	07/09/04	J.C.S.
Aprobado	07/09/04	J.M.Y.

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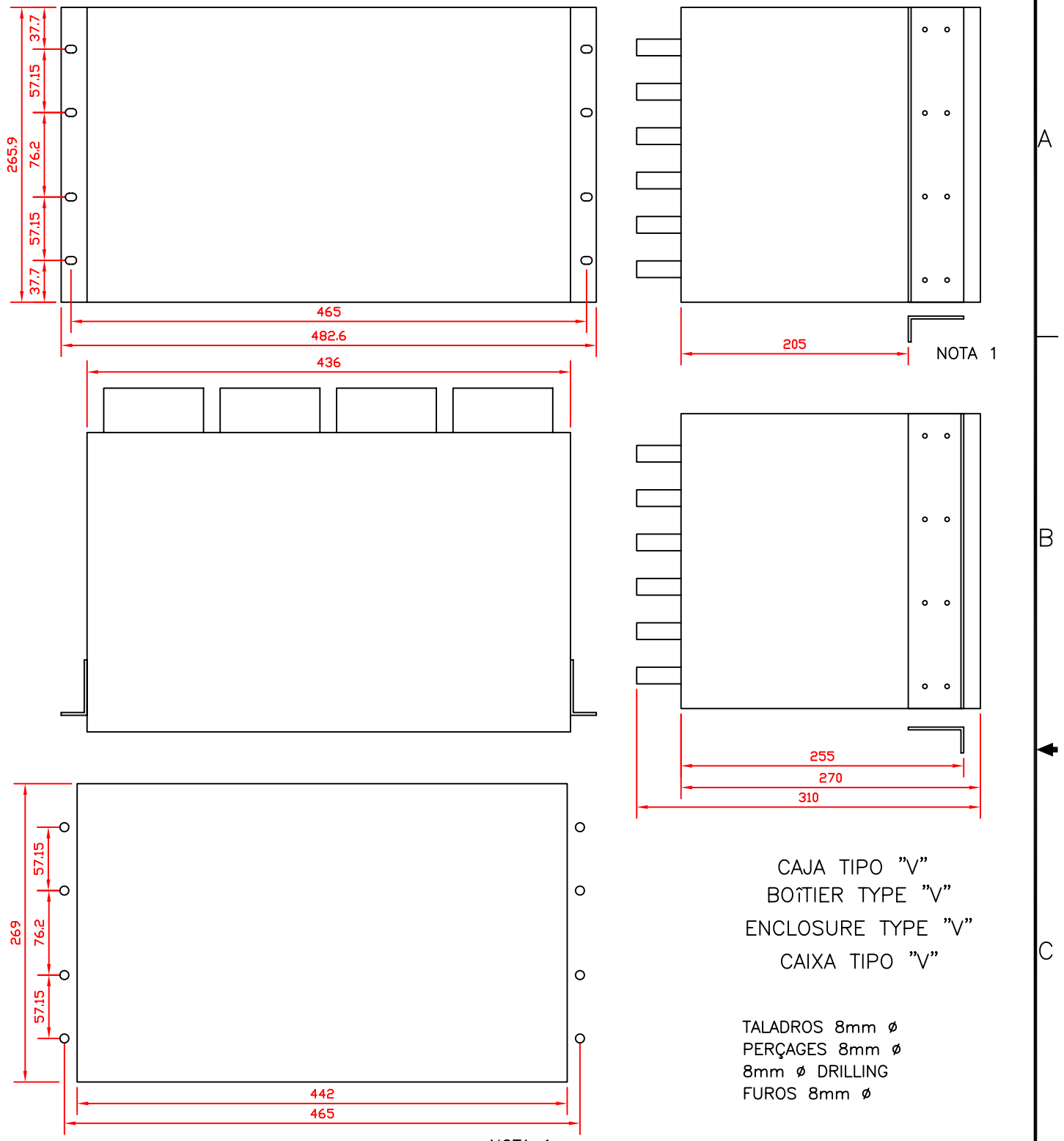

CAJA TIPO "V"
BOÎTIER TYPE "V"
ENCLOSURE TYPE "V"
CAIXA TIPO "V"

TALADROS 8mm ø
PERÇAGES 8mm ø
8mm ø DRILLING
FUROS 8mm ø

NOTA 1:
LA PIEZA ADMITE LAS 2 POSICIONES MOSTRADAS PARA FACILITAR UN MONTAJE DEL EQUIPO MÁS Ó MENOS SALIENTE

REVISIONES	0	CD0504145	1	
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5		6		7
8		9		10
11		12		13
14		15		16

Z I V Aplicaciones y Tecnologia S.A.

TITULO: DIMENSIONES Y TALADRADO

PROYECTO: CAJA TIPO "V" 6U 1RACK

Rev.0

NUMERO: 4BF0100/0043

	Fecha	Nombre
Dibujado	27/04/05	U.G.
Aprobado	27/04/05	C.G.G.

Hoja: 1
Continua en Hoja:

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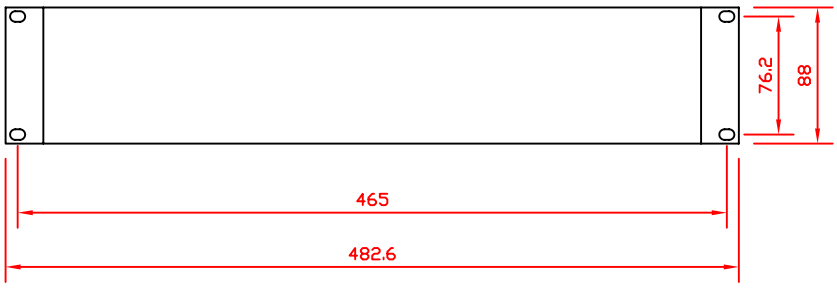
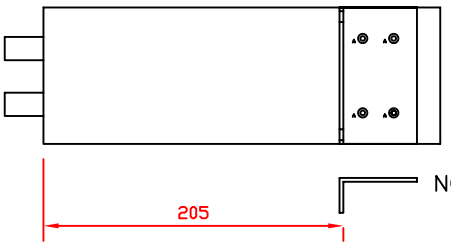
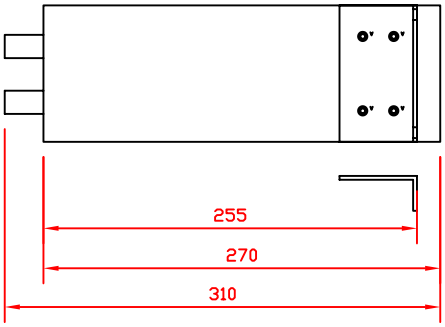
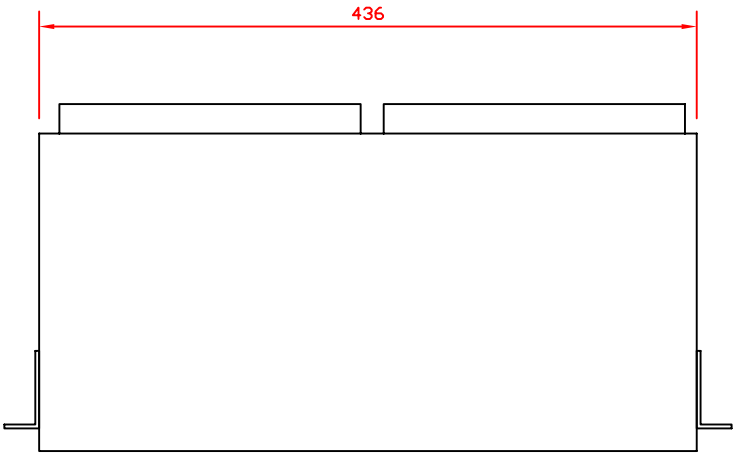
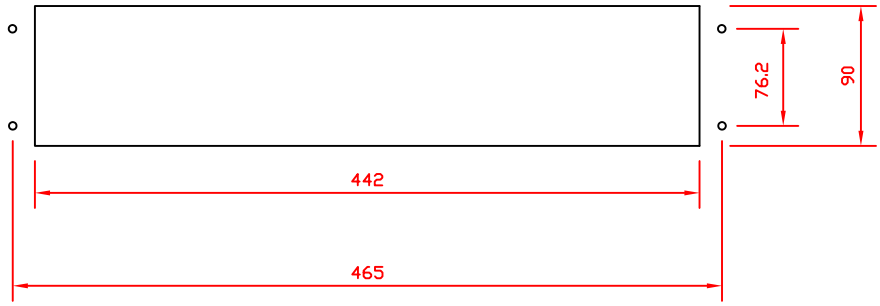
BOÎTIER TYPE "M"
ENCLOSURE TYPE "M"
CAIXA TIPO "M"











TALADROS 8mm ø
8mm ø DRILLING
FUROS 8mm ø

NOTA 1:
LA PIEZA ADMITE LAS 2 POSICIONES MOSTRADAS PARA FACILITAR UN MONTAJE DEL EQUIPO MÁS Ó MENOS SALIENTE

REVISIONES	0	CD0504145	1	
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8		9		10
11		12		13
14		15		16

Z I V Aplicaciones y Tecnologia S.A.

TITULO: DIMENSIONES Y TALADRADO

PROYECTO: CAJA TIPO "M" 2U 1RACK

Rev.0

NUMERO: 4BF0100/0040

	Fecha	Nombre
Dibujado	28/04/05	U.G.
Aprobado	28/04/05	C.G.G.

Hoja: 1
Continua en Hoja:

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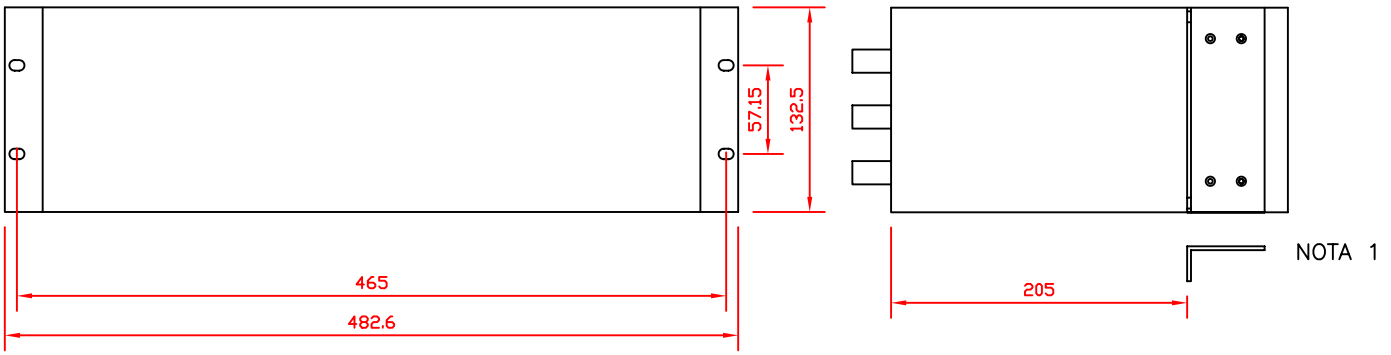
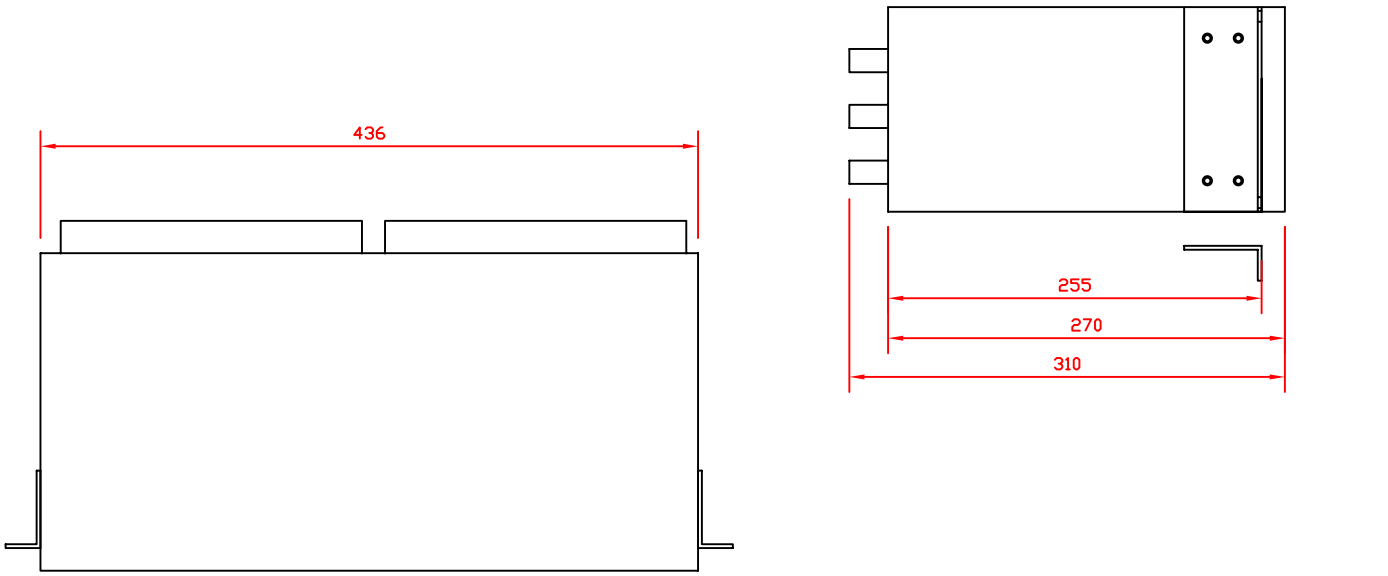
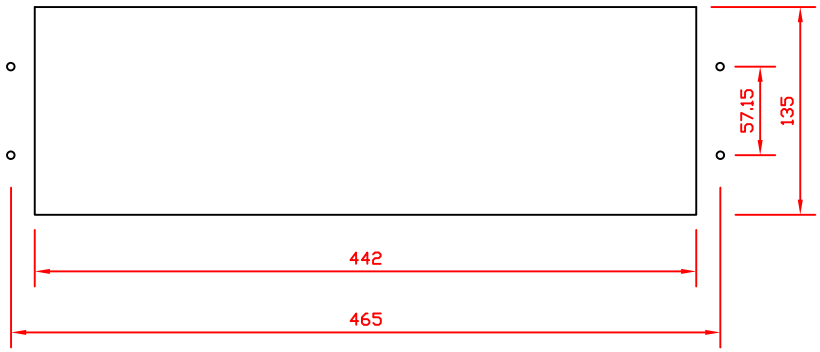
BOÎTIER TYPE "S"
ENCLOSURE TYPE "S"
CAIXA TIPO "S"







TALADROS 8mm ø
8mm ø DRILLING
FUROS 8mm ø

NOTA 1:
LA PIEZA ADMITE LAS 2 POSICIONES MOSTRADAS PARA FACILITAR UN MONTAJE DEL EQUIPO MÁS Ó MENOS SALIENTE

REVISIONES	0	CD0504145	1	
2		3		4
5		6		7
8		9		10
11		12		13
14		15		16

Z I V Aplicaciones y Tecnologia S.A.

TITULO: DIMENSIONES Y TALADRADO

PROYECTO: CAJA TIPO "S" 3U 1RACK

Rev.0

NUMERO: 4BF0100/0041

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Aprobado	28/04/05	C.G.G.

Hoja: 1

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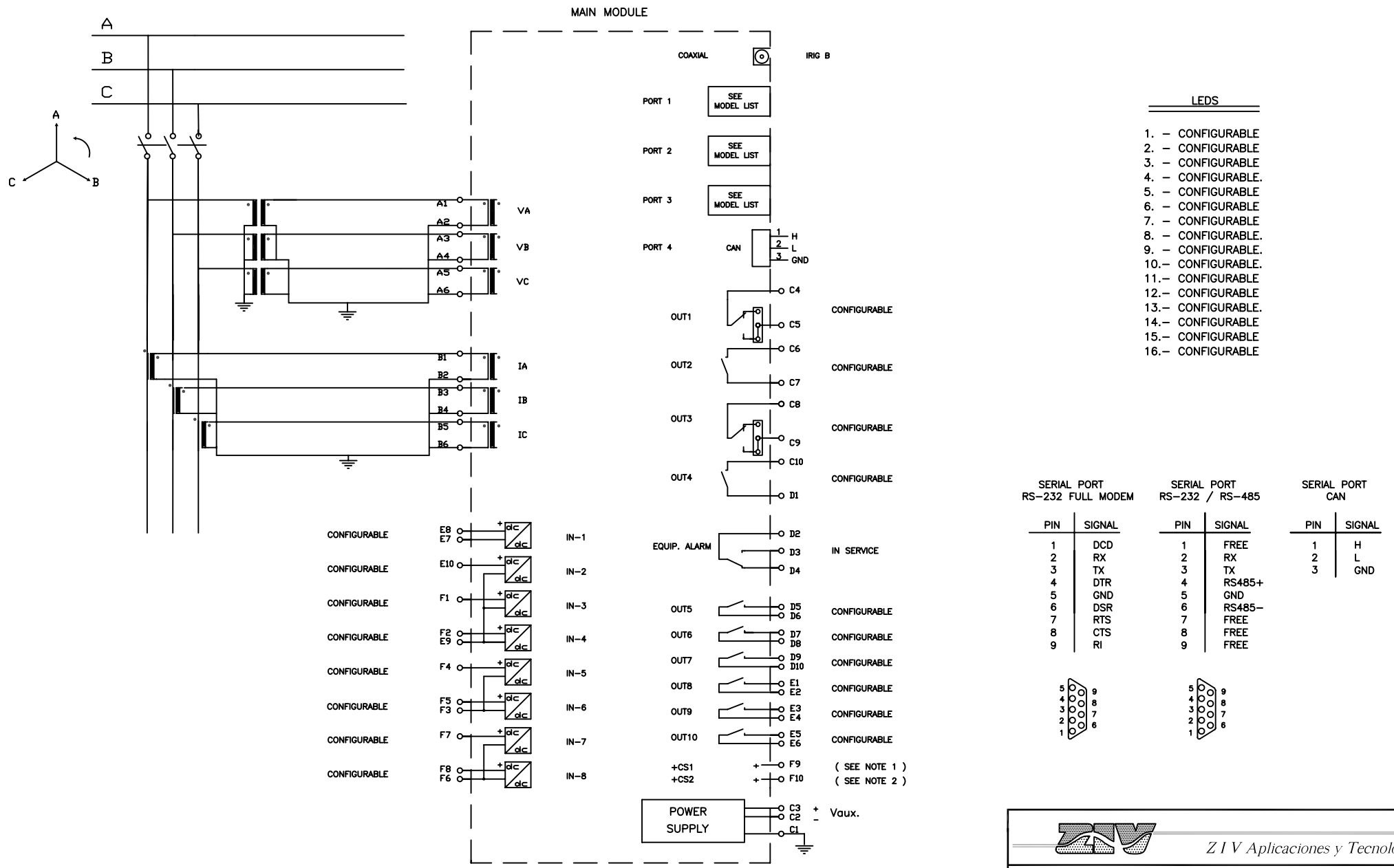

LEDS

1. – CONFIGURABLE
2. – CONFIGURABLE
3. – CONFIGURABLE
4. – CONFIGURABLE.
5. – CONFIGURABLE
6. – CONFIGURABLE
7. – CONFIGURABLE
8. – CONFIGURABLE.
9. – CONFIGURABLE.
10. – CONFIGURABLE.
11. – CONFIGURABLE
12. – CONFIGURABLE
13. – CONFIGURABLE.
14. – CONFIGURABLE
15. – CONFIGURABLE
16. – CONFIGURABLE

SERIAL PORT
RS-232 FULL MODEM

PIN	SIGNAL
1	DCD
2	RX
3	TX
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	RI

SERIAL PORT
RS-232 / RS-485

PIN	SIGNAL
1	FREE
2	RX
3	TX
4	RS485+
5	GND
6	RS485–
7	FREE
8	FREE
9	FREE

SERIAL PORT
CAN

PIN	SIGNAL
1	H
2	L
3	GND

NOTE 1: TERMINAL F9 SHOULD BE CONNECTED TO POSITIVE WHEN ANY OF THE INPUTS IN3, IN4, IN5 OR IN6 ARE BEING USED FOR THE BREAKER COIL SUPERVISION FUNCTION.
NOTE 2: TERMINAL F10 SHOULD BE CONNECTED TO POSITIVE WHEN ANY OF THE INPUTS IN7 OR IN8 ARE BEING USED FOR THE BREAKER COIL SUPERVISION FUNCTION.

REVISIONS	0	CD0703116	1		2		3		4	
5		6		7		8		9		10	
11		12		13		14		15		16	

Z I V Aplicaciones y Tecnologia S.A.

TITLE: EXTERNAL CONNECTIONS 6MCV (410) 6U

PROJECT: 6MCV

Rev.0

NUMBER: 3RX0189/0008

	Date	Name
Drawn	09/03/07	J.C.S.
Approved	09/03/07	J.M.Y.

Sheet:1

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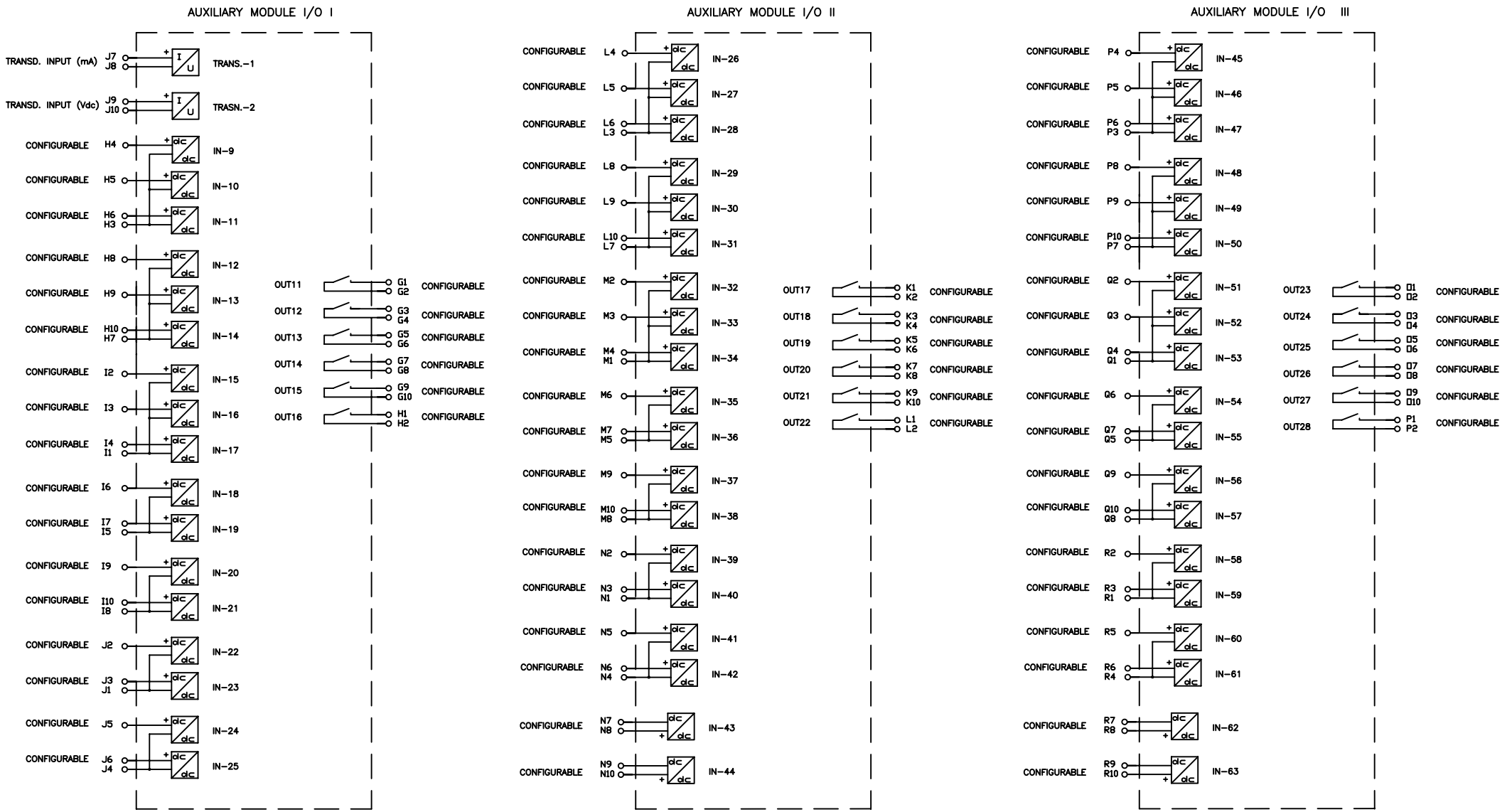

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5		6		7		8		9		10
11		12		13		14		15		16

Z I V Aplicaciones y Tecnologia S.A.

TITLE: EXTERNAL CONNECTIONS 6MCV (410) 6U

PROJECT: 6MCV

Rev. 0

NUMBER: 3RX0189/0008

	Date	Name
Drawn	09/03/07	J.C.S.
Approved	09/03/07	J.M.Y.

Sheet: 2

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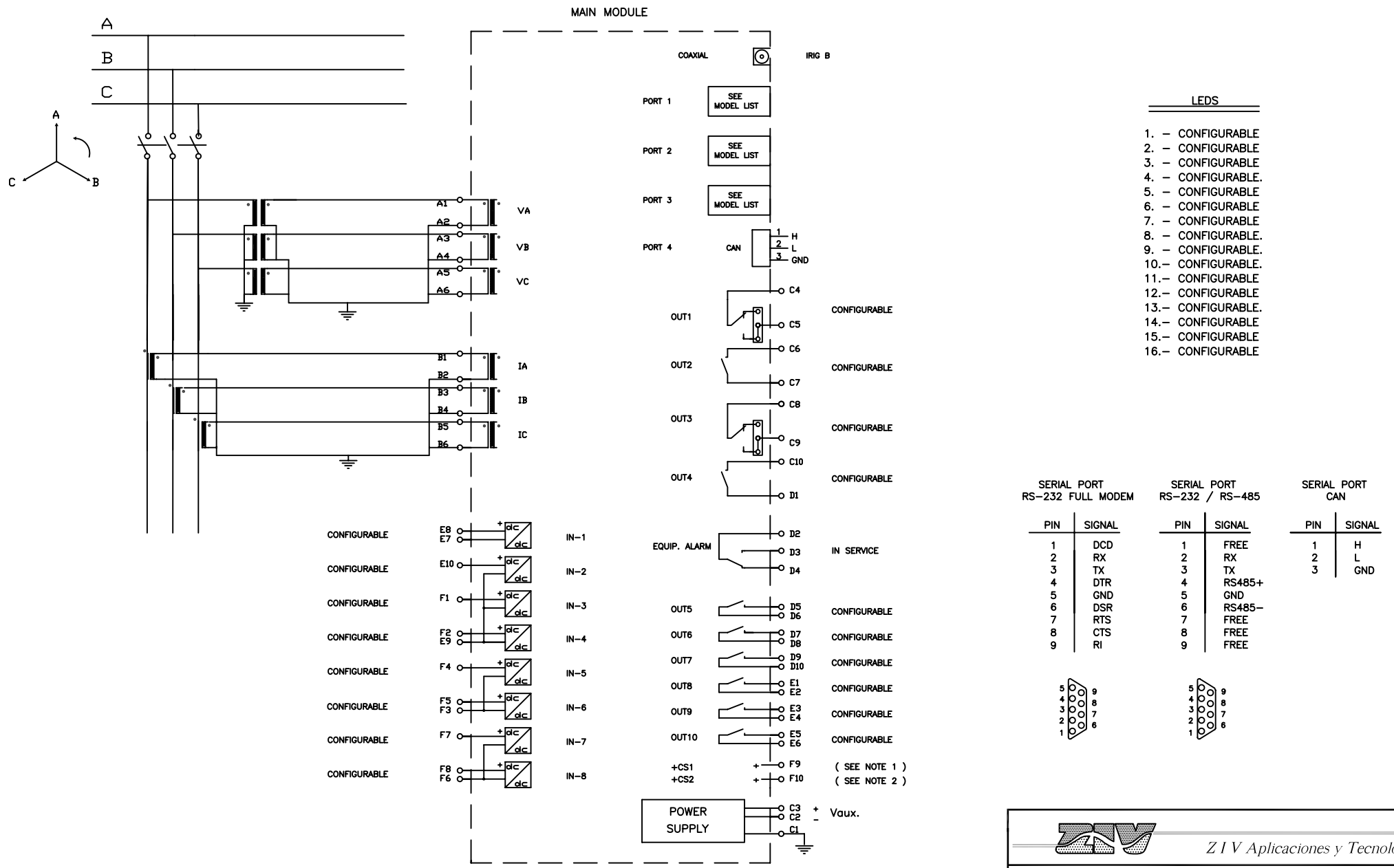

LEDS

1. – CONFIGURABLE
2. – CONFIGURABLE
3. – CONFIGURABLE
4. – CONFIGURABLE.
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15. – CONFIGURABLE
16. – CONFIGURABLE

SERIAL PORT
RS-232 FULL MODEM

PIN	SIGNAL
1	DCD
2	RX
3	TX
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	RI

SERIAL PORT
RS-232 / RS-485

PIN	SIGNAL
1	FREE
2	RX
3	TX
4	RS485+
5	GND
6	RS485–
7	FREE
8	FREE
9	FREE

SERIAL PORT
CAN

PIN	SIGNAL
1	H
2	L
3	GND

NOTE 1: TERMINAL F9 SHOULD BE CONNECTED TO POSITIVE WHEN ANY OF THE INPUTS IN3, IN4, IN5 OR IN6 ARE BEING USED FOR THE BREAKER COIL SUPERVISION FUNCTION.
NOTE 2: TERMINAL F10 SHOULD BE CONNECTED TO POSITIVE WHEN ANY OF THE INPUTS IN7 OR IN8 ARE BEING USED FOR THE BREAKER COIL SUPERVISION FUNCTION.

REVISIONS	0	CD0703116	1		2		3		4	
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TITLE: EXTERNAL CONNECTIONS 6MCV (210) 4U

PROJECT: 6MCV

Rev.0

NUMBER: 3RX0189/0009

	Date	Name
Drawn	09/03/07	J.C.S.
Approved	09/03/07	J.M.Y.

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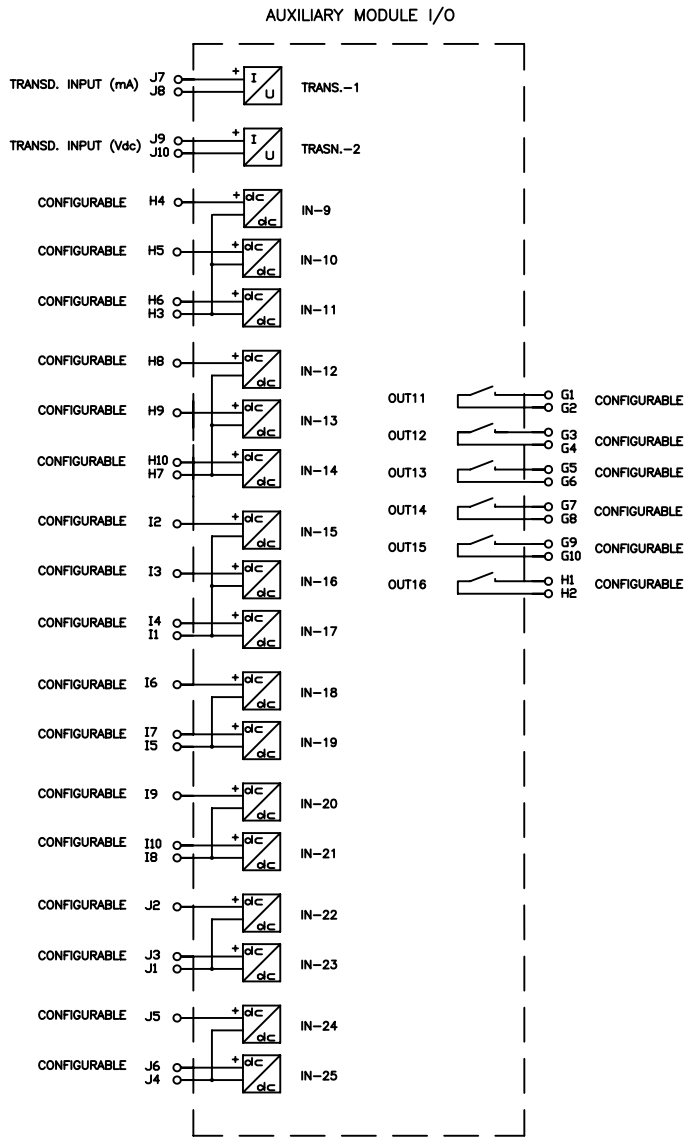

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11		12		13		14		15		16	

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TITLE: EXTERNAL CONNECTIONS 6MCV (210) 4U

PROJECT: 6MCV

Rev. 0

NUMBER: 3RX0189/0009

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Drawn	09/03/07	J.C.S.
Approved	09/03/07	J.M.Y.

Sheet: 2

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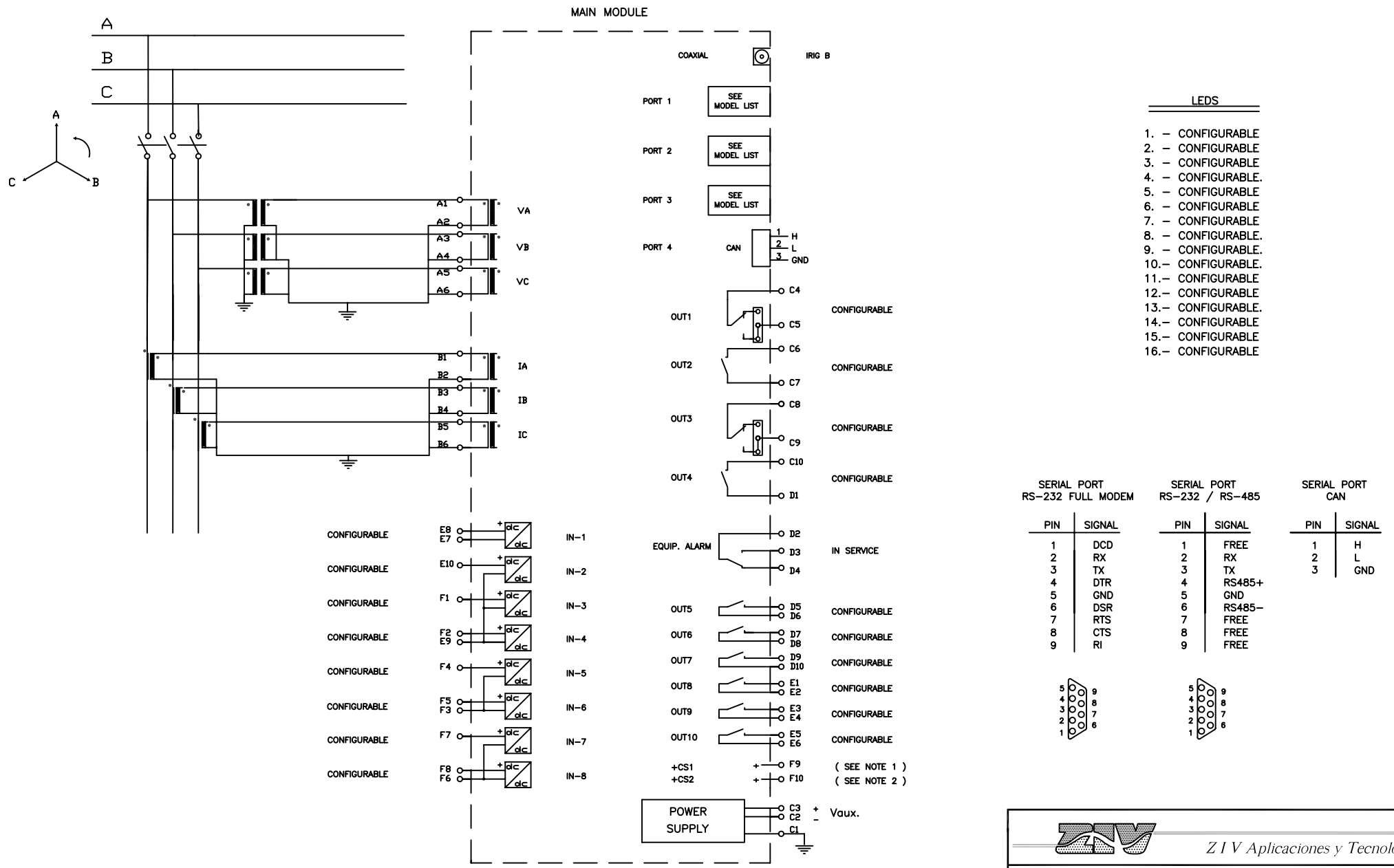

LEDS

1. – CONFIGURABLE
2. – CONFIGURABLE
3. – CONFIGURABLE
4. – CONFIGURABLE.
5. – CONFIGURABLE
6. – CONFIGURABLE
7. – CONFIGURABLE
8. – CONFIGURABLE.
9. – CONFIGURABLE.
10. – CONFIGURABLE.
11. – CONFIGURABLE
12. – CONFIGURABLE
13. – CONFIGURABLE.
14. – CONFIGURABLE
15. – CONFIGURABLE
16. – CONFIGURABLE

SERIAL PORT
RS-232 FULL MODEM

PIN	SIGNAL
1	DCD
2	RX
3	TX
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	RI

SERIAL PORT
RS-232 / RS-485

PIN	SIGNAL
1	FREE
2	RX
3	TX
4	RS485+
5	GND
6	RS485-
7	FREE
8	FREE
9	FREE

SERIAL PORT
CAN

PIN	SIGNAL
1	H
2	L
3	GND

NOTE 1: TERMINAL F9 SHOULD BE CONNECTED TO POSITIVE WHEN ANY OF THE INPUTS IN3, IN4, IN5 OR IN6 ARE BEING USED FOR THE BREAKER COIL SUPERVISION FUNCTION.
NOTE 2: TERMINAL F10 SHOULD BE CONNECTED TO POSITIVE WHEN ANY OF THE INPUTS IN7 OR IN8 ARE BEING USED FOR THE BREAKER COIL SUPERVISION FUNCTION.

REVISIONS	0	CD0703116	1		2		3		4	
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TITLE: EXTERNAL CONNECTIONS 6MCV (E10) 4U

PROJECT: 6MCV

Rev.0

NUMBER: 3RX0189/0010

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Drawn	09/03/07	J.C.S.
Approved	09/03/07	J.M.Y.

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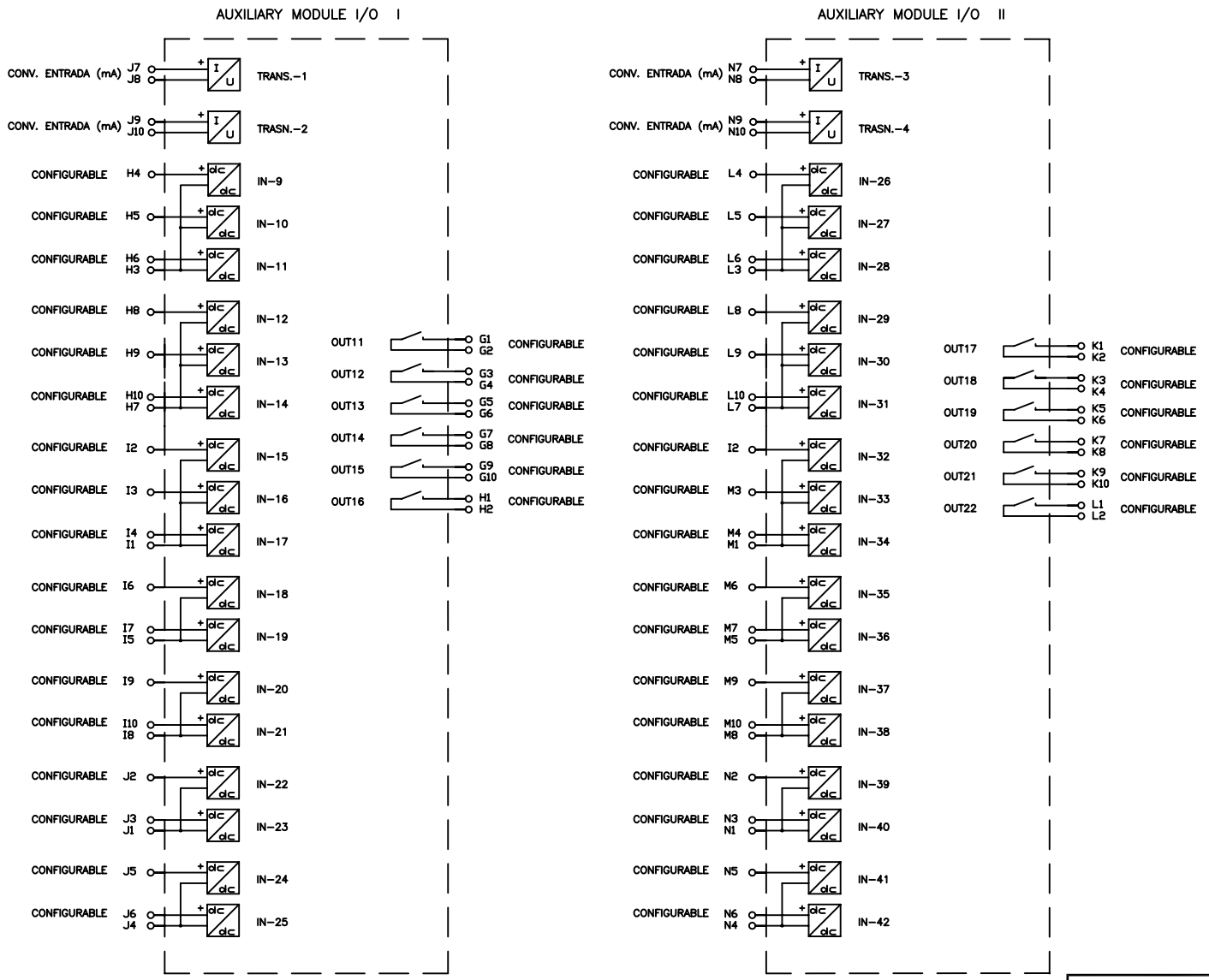

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TITLE: EXTERNAL CONNECTIONS 6MCV (E10) 4U

PROJECT: 6MCV

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Approved	09/03/07	J.M.Y.

Sheet: 2

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E. List of Illustrations and Tables

Annex E. List of Illustrations and Tables

E.1 List of Figures

E.2 List of Tables

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