

MDE 240



DCM2

Diagnostic Communication Master

Rev.3.5

Operative Guide

REVISION LIST

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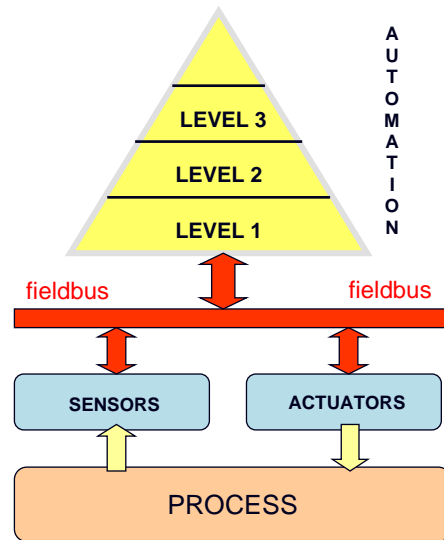
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1. INTRODUCTION

The DCM2 (Diagnostic Communication Master 2) is a component of the plant automation system and acts as an interface between the upper level of the control system and the field devices connected by a fieldbus network.

The DCM2 manages the following tasks by means of a modular architecture:

- ❑ It establishes communication between a field composed of Biffi actuators and the upper level of the control system – DCS or PLC – through a MODBUS interface;
- ❑ By means of the graphical operator interface (HMI: Human Machine Interface), it performs all the plant’s control and maintenance operations by way of a series of dedicated screens of the controlled devices;
- ❑ It is the configuration tool for the fieldbus network including all the functions for the management of all devices. No other tools or licensed software are necessary.



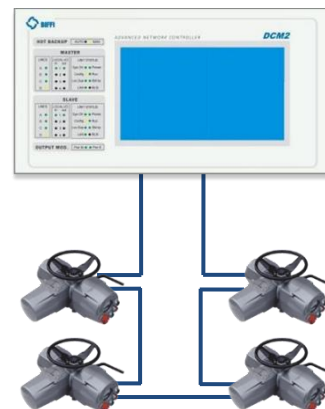
Each device connected to the network is called “node”. The DCM2 unit can sustain a network composed of up to 300 nodes with an appropriate system layout as described in the following paragraphs. The DCM2 can manage the following actuators types:

Name	Description
ICON	Actuator control, integral with Biffi actuators series C and QTC equipped with LonWorks interface card.
ICONFDI	Intelligent actuators which include ICON2000 and ICON3000 actuator series equipped with LonWorks interface card.
ICONMB	Intelligent actuators which include ICON2000 and ICON3000 actuator series equipped with MODBUS interface card.

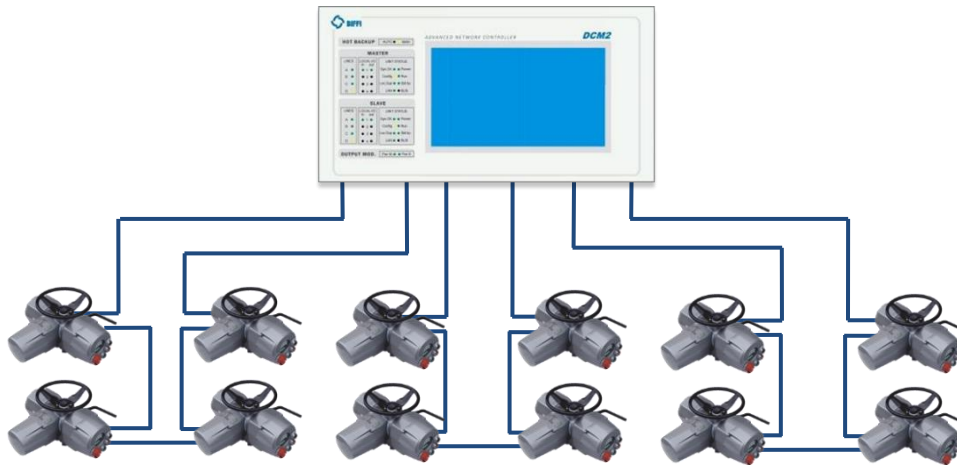
1.1 Typical systems layout

The DCM2 unit is based on a modular architecture and allows several control configurations in accordance with Customer requirements.

Single LonWorks loops in a redundant Master system
 or
Single MODBUS loop in a redundant Master system



from 2 to 6 LonWorks loops in a Multiloop redundant Master system



1.2 LonWorks loop extension

In the typical LonWorks system structure the fieldbus network is composed of “segments”. The characteristics of the “segment” are strongly influenced by the cable used for network communications. The best performances achieved with the recommended cable shall be summarized as follow:

- ❑ $L_{segment}$ = total length up to 800 meters;
- ❑ N_{device} = 60 devices connected;

If other types of cables are adopted the above figures may considerably decrease. In this case please contact Biffi factory to verify actual network layout requirements.

In the DCM2 architecture the segment is a part of the ‘loop’. In case that the total bus length exceeds $L_{segment}$ or the total number of nodes to be connected in the loop is more than N_{device} it is necessary to split the loop in more segments: each segment is connected to the others by means of Repeaters.

The repeater works as an amplifier and consist of two FTT-10A transceivers coupled: data received from one side are regenerated and transmitted to the other side.

Since it is not a microprocessor-based device it is not allocated in the DCM2 memory and does not introduce further failure rate. In case it is power off the system react as in case of a cable interruption.

To guarantee correct functionality of the system in case of a loop composed of two or more segments it is necessary to put a further Repeater between the nodes NET_H and NET_T. This Repeater is indicated as “Internal Repeater” because it is normally hosted in the DCM cabinet.

Each repeater increases the number of segments in the loop. Using the repeaters the total loop capacity varies in the following way:

Number of repeater	Number of segments	Total nodes	Total length in meters
0	1	60	800
1	2	120	1600
2	3	[120]	2400

Theoretically the number of nodes increases with the number of segments, but in case of large network it is recommended to consult Factory for a proper configuration. To manage a large network, it could be considered also a Multiloop structure as a valid alternatives.

2. HOW TO ...

2.1 Discovering DCM2

Operation	Reference in this manual
DCM2 data sheet	Chapter 3: " <i>DCM2 DATA SHEET</i> "
Unit composition	Chapter :4: " <i>IDENTIFICATION OF PARTS AND COMPONENTS</i> "
Typical connection scheme	Par. 4.7: " <i>Summary Of Typical Connection Scheme</i> "
DCM2 Human Machine Interface	Chapter 5 :" <i>OPERATOR INTERFACE</i> "

2.2 Get the DCM2 working

This paragraph shows a synthetic guide about the steps to carry out at the first run of a DCM2 system.

POWER SUPPLY CHECK

Check if the input voltage of PRIMARY and BACKUP lines at DCM2 are in the specified range.
In case the DCM2 is delivered in a control cabinet connect the power supply lines at the terminals as described in the specific drawing supplied with the cabinet.

CONNECTION TO FIELD DEVICES

Connect the field devices in the field network according to the implemented bus structure.
In case the DCM2 is delivered in a control cabinet connect the field bus lines at the terminals as described in the specific drawing supplied with the cabinet.

PRELIMINARY OPERATIONS

- Remove the plastic protection label to the battery of each CPU.
- Power up the unit.

Operation	Log in required	Reference in this manual
Set the current date and time	ADMIN	Par. 6.4.4: " <i>CPU management</i> "
"Clear DCM2" to initialize memory	ADMIN	Par: 6.5.11: " <i>System Reset</i> "
Retrieve the system configuration from Flash memory	ADMIN	Par. 6.5.8: " <i>Configuration files management</i> "

PRINCIPAL CONFIGURATION AND DEVICES MANAGEMENT OPERATIONS

Operation	Log in required	Reference in this manual
Configure a LonWork network	NETWORK MAINT.	Par. 6.4.5: " <i>LonWorks Network Configuration</i> "

Operation	Log in required	Reference in this manual
Configure a MODBUS network	NETWORK MAINT.	Par. 6.4.8: <i>"MODBUS Network Configuration"</i>
Send commands to field devices from HMI screen of DCM2	PLANT OPER.	Par. 6.2.1: <i>"Actuator commands"</i>
Change setup parameters from HMI screen of DCM2	PLANT MAINT.	Par. 6.3.1: <i>"Actuator parameters modification"</i>
Replace field devices	NETWORK MAINT.	Par. 6.4.3: <i>"Nodes Management"</i>
Network modification	ADMIN	Par. 6.5.1: <i>"Routers Management"</i> Par. 6.5.2: <i>"Groups Management"</i> Par. 6.5.3: <i>"Devices Management"</i>
Advanced operations	ADMIN	Par. 6.5.9: <i>"Configuring an empty DCM2"</i> Par. 6.5.10: <i>"Creating a Backup of the configuration file"</i> Par. 6.5.11: <i>"System Reset"</i>

MODBUS COMMUNICATION TO DCS

Operation	Log in required	Reference in this manual
Verify the MODBUS lines set up to DCS	ADMIN.	Par. 6.5.12: <i>"DCM2 connections configuration"</i>
Start DCS interrogation and check communication diagnostics	none	Par. 5.4.7: <i>"DIAGNOSTIC page"</i>

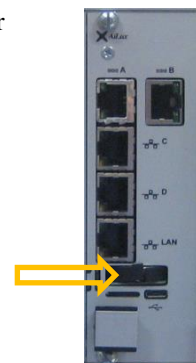
LOOP INTEGRITY CHECK FUNCTION

Operation	Log in required	Reference in this manual
Activate the loop integrity function	NETWORK MAINT.	Par. 6.4.7: <i>"LonWorks Loop Integrity Check Management"</i> Par. 6.4.10: <i>"MODBUS Loop Integrity Check Management"</i>
Manage the devices cable list	ADMIN.	Par. 6.5.5: <i>"LonWorks devices - wiring list management"</i> Par. 6.5.6: <i>"MODBUS devices - wiring list management"</i>

2.3 Replace Batteries

Batteries inside CPU shall be replaced when **Battery** indication on DCM2 System screen shows they are depleted. Battery replacement shall be done when DCM2 is powered on.

1. Push the battery holder on the panel of the CPU card to release the battery drawer
2. Replace the batteries with one CR2032 Lithium battery
3. Insert the batteries in the battery holder
4. Put back the battery drawer in place.



3. DCM2 DATA SHEET

Mains Supply	PRIMARY and BACKUP inputs. Polarity insensitive. 24Vdc +/- 5%		
Requested power	Unit Layout	Req. W	Rem HMI
	Master/Slave 1 loop LonWorks/MODBUS	35W	
	Master/Slave 2 loop LonWorks	40W	
	Master/Slave 3 loop LonWorks	45W	+ 20W
	Master/Slave 4 loop LonWorks	50W	
	Master/Slave 5 loop LonWorks	55W	
	Master/Slave 6 loop LonWorks	60W	+85W
Internal supply protection	resettable fuse (MultiFuse protector)		
Battery	Lithium battery CR2032.		
IMPORTANT: The battery is sized to last 10 years when the DCM2 unit is stored at the nominal storage temperature with the plastic battery protection label in place. After the plastic protection label has been removed the battery has to be replaced after 1 year of power loss.			
In the normal operating condition, the battery must be replaced when the relevant indication is shown in the screen System. This operation must be done while the DCM2 is powered on.			
Communication Protocol to Field Devices	Protocol	LonWORKS: ANSI/IEA 709.1; IEEE 1473-L	
	Transmission media:	Twisted pair FTT-10 @78Kbps Twisted pair TP1.25 @1.25Mbps	
	Protocol	MODBUS	
	Transmission media:	Twisted pair RS485 from 600 to 38.400bps	
Local DI	4 opto-isolated inputs externally supplied Min input isolation: 500Vdc Max voltage input low: 0.2Vdc Min voltage input high: 4.75Vdc; Max input voltage: 24Vdc		
Local DO	4 volt-free contacts, normally open Nominal resistive load: 0.5A @110Vac; 1A @24Vdc Max working voltage: 125Vac, 60Vdc Output isolation: 400Vdc		
Local display	10.1" Touch Screen		
LEDs	MASTER and SLAVE unit:		
	4 green/red LEDs:	status of available inputs	
	4 green/red LEDs:	status of outputs	
	4 green/yellow LEDs:	status of serial lines	
	8 various LEDs:	status of the DCM2	
	Integrated HOT BACKUP unit:		
	2 green and yellow LEDs:	current status	
	POWER SUPPLIES:		
	2 green LEDs:	current status	
Dimensions	width: 483mm; front height: 223mm; depth: 250mm (connectors included);		
Weight	8 kg		
Housing	19" – 5U rack, suitable for cabinet mounting		
Working temperature	0 to +50°C		
Storage temperature	-10 to +70°C		
Humidity	5% to 95% RH, non-condensing		
EMC	IEC/CISPR 22 Class A IEC/EN55022; IEC61000-6-2; IEC61000-6-4		
CE mark	YES		

HOST Communication ports

Channel A	Serial Line:	RS232-C or RS485
	Protocol:	MODBUS RTU
	Connector	DIN 9 pins male and RJ45 jack. Double pinout.
	Baud Rate:	from 300 to 38.400
	Bit No.	7; 8
	Parity	None; Even; Odd
	Stop Bit	1; 2
Channel B	Serial Line:	RS232-C or RS485
	Protocol:	MODBUS RTU
	Connector	DIN 9 pins male and RJ45 jack. Double pinout.
	Baud Rate:	from 300 to 38.400
	Bit No.	7; 8
	Parity	None; Even; Odd
	Stop Bit	1; 2
Channel C	Serial Line	IEEE 802.2 Ethernet 100Base-T
	Connector	RJ45 jack
	Protocol:	MODBUS TCP-IP
Channel D	Serial Line	IEEE 802.2 Ethernet 100Base-T
	Connector	RJ45 jack
	Protocol:	MODBUS TCP-IP

Network Capability

Loop managed up to 18 LonWorks loops or 1 MODBUS loop.

Field devices allocation table 300

Loop arrangement LonWorks loop to field devices

Actuators per segment 60

Segment length 800m (see NOTE 1)

Repeater Up to 2.

Actuators per loop Suggested, but not limited, up to 120.
Maximum 180, limited by traffic sustained by loop with 2 repeaters.

Single loop length example 2400 meter = 800 meter x 3 [3= segments in a loop with 2 repeaters].

WARNING *For optimum setup consult Factory.
In case of large network, a Multiple loop structure must be considered.*

MODBUS loop to field devices

Actuators per loop A 1-channel network can exploit the embedded repeater of ICON3000 and in this case it is possible to reach 247 actuators in the same loop.

Bus length A 1-channel network composed of ICON3000 actuators can manage extended network because each actuator implements "1-channel with repeater" MODBUS interface (see NOTE 1).

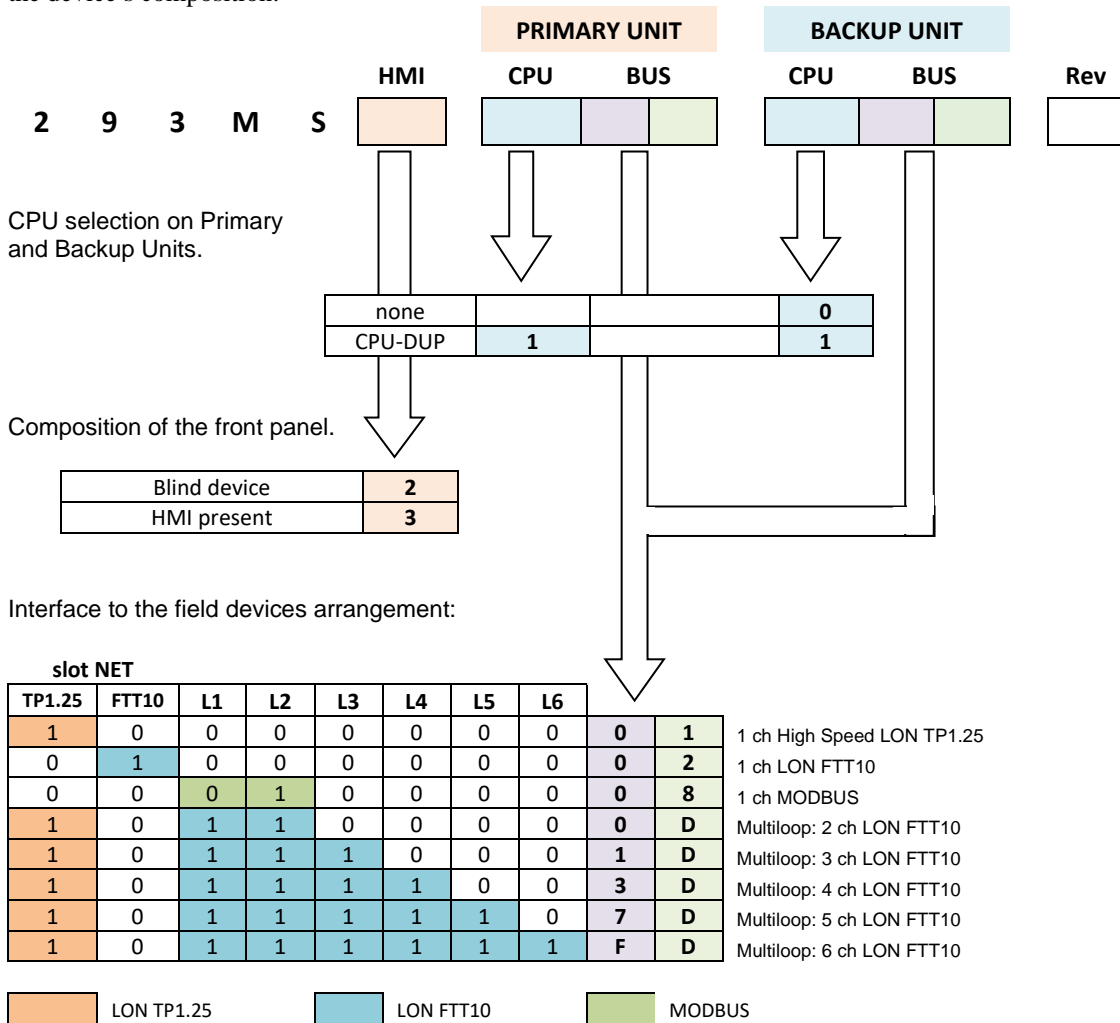
Max actuators per loop MODBUS standard can address up to 247 devices in a network.

NOTE (1) Data is valid only if the characteristics of field cable meets the specification of the relevant protocol as stated on appendix B.1. If different cable is used, the system can't guarantee this performance.

4. IDENTIFICATION OF PARTS AND COMPONENTS

4.1 DCM2 Manufacturing Code

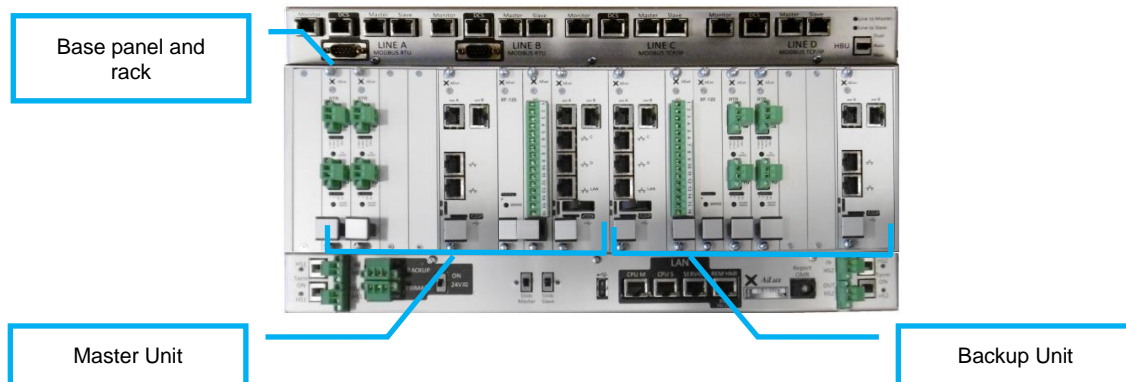
Each DCM2 is equipped with a label on the rear side of the unit, indicating its manufacturing code. This code is generated during order entry, according to specifications and Customer's requirements and report the device's composition.



These indications can help identify the composition of the supplied station and guide the user in reading the relevant parts of this User's Manual.

4.2 Parts identification

The DCM2 unit is made of the following parts:



Basic supplied equipment

- No. 6 Ethernet PATCH cables for the basic connections:

MODBUS LINE "x" – CPU MASTER	MODBUS LINE "x" – CPU SLAVE
MODBUS LINE "y" – CPU MASTER	MODBUS LINE "y" – CPU SLAVE
CPU MASTER – LAN SERVICE switch	CPU SLAVE – LAN SERVICE switch

In case that all four MODBUS lines to Host are used, the further FOUR Ethernet cables (PATCH or CROSS) can be ordered separately.

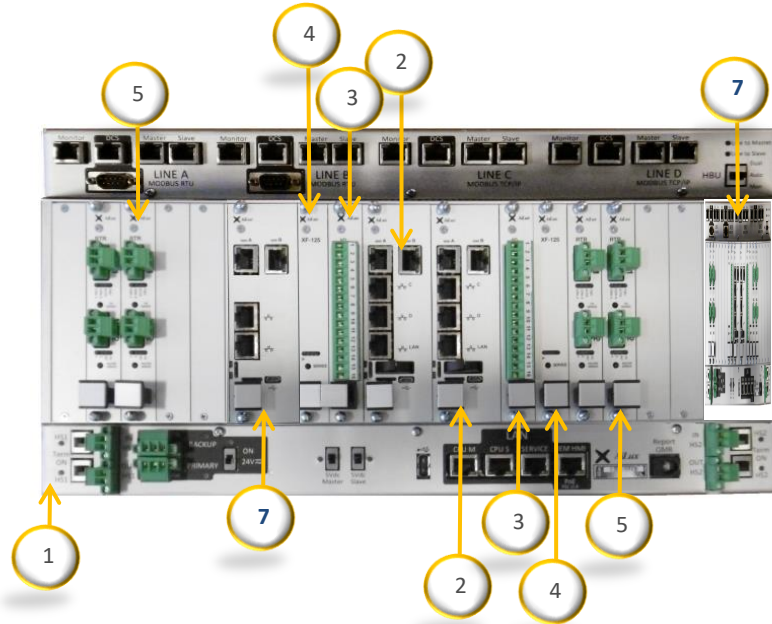
NOTE: the MODBUS RTU connections use only PATCH cables.

Accessories to be ordered separately

- Remote operator panel for mounting in the cabinet
- Remote operator panel for wall mounting

4.3 Coding structure

The DCM2 has a completely modular structure, including removable parts and cards which can be separately ordered as spare parts.



	Rif.	Description	Part code
Base	1	Rack and operator interface	493RCK2010
		Rack w/out operator interface	493RCK2110
	2	CPU-DUP (MODBUS lines: 2x RTU 2xTCP-IP)	493CPU3100
	3	4 in- 4 out Digital Card	493IOD1200
LonWorks bus	4	FTT-10 + FDI interface card	493NET1201
		TP1.25 interface card	493NET2100
	5	Router 1,25TP/ FTT-10 + FDI	493RTF1200
MODBUS bus to field devices	7	Master MODBUS MM_CPU_x	493MMB1000

	Rif.	Description	Part code
Accessories	A1	Remote Operator Interface rack mounted	293DCMA0000
	A2	Remote Operator Interface wall mounted	293DCMA0100

4.4 Front Panel



The DCM2 is equipped with a powerful Human Machine Interface (HMI), which allows the local operator to have full control of the plant even though the other interfaces (DCS or Local supervisor) are not active. The HMI is based on a 10.1” touch screen graphic panel.

4.4.1 LED Signalling

On the front panel, the LED indications of the following functions are available:

- HOT BACKUP status
- Local I/O status for Primary or Backup CPUs; Primary CPU is also named “Master” and Backup CPU is named “Slave”.
- communication lines status for Primary or Backup CPUs
- Power status

4.4.1.1 HOT BACKUP

Name	Colour	Mode	Description
Auto	green	on	HBU selector on Auto : MODBUS lines are connected to the CPU that has the control of the system.
'- - - Man	green	flashing	HBU selector on Man : MODBUS lines are stably connected to the Primary Master.
'----- Dual	green	on	HBU selector on Dual : MODBUS lines A and C are connected to the Primary CPU, while lines B and D are connected to the Backup CPU.

4.4.1.2 MODBUS Lines to Host System

Name	Colour	Mode	Description
Line A		off	MODBUS RTU communication not present
	green	flashing	MODBUS RTU communication OK
	yellow	On	MODBUS RTU communication with errors (1)
Line B		off	MODBUS RTU communication not present
	green	flashing	MODBUS RTU communication OK
	yellow	on	MODBUS RTU communication with errors (1)
Line C		off	MODBUS TCP-IP communication not present
	green	flashing	MODBUS TCP-IP communication OK
	yellow	on	MODBUS TCP-IP communication with errors (1)
Line D		off	MODBUS TCP-IP communication not present
	green	flashing	MODBUS TCP-IP communication OK
	yellow	on	MODBUS TCP-IP communication with errors (1)

NOTE (1) when a MODBUS communication error is found the led remains yellow solid for two seconds.

4.4.1.3 LOCAL I/O

Name	Colour	Mode	Description
In 1		off	No voltage applied at the input
	green	on	At input is applied 5-24Vdc see NOTE (1)
	red	on	At input is applied 5-24Vdc see NOTE (1)
In 2		off	No voltage applied at the input
	green	on	At input is applied 5-24Vdc see NOTE (1)
	red	on	At input is applied 5-24Vdc see NOTE (1)
In 3		off	No voltage applied at the input
	green	on	At input is applied 5-24Vdc see NOTE (1)
	red	on	At input is applied 5-24Vdc see NOTE (1)
In 4		off	No voltage applied at the input
	green	on	At input is applied 5-24Vdc see NOTE (1)
	red	on	At input is applied 5-24Vdc see NOTE (1)
Out 1		off	No equation defined for the output
	green	on	The pilot operated output at value 1 turns on the green LED. See NOTE (2)
	red	on	The pilot operated output at value 1 turns on the red LED. See NOTE (2)
Out 2		off	No equation defined for the output
	green	on	The pilot operated output at value 1 turns on the green LED. See NOTE (2)
	red	on	The pilot operated output at value 1 turns on the red LED. See NOTE (2)
Out 3		off	No equation defined for the output
	green	on	The pilot operated output at value 1 turns on the green LED. See NOTE (2)
	red	on	The pilot operated output at value 1 turns on the red LED. See NOTE (2)
Out 4		off	No equation defined for the output
	green	on	The pilot operated output at value 1 turns on the green LED. See NOTE (2)
	red	on	The pilot operated output at value 1 turns on the red LED. See NOTE (2)

NOTE (1) The digital inputs acquire the field signals and, based to their definitions given by factory setting, activate the RED and GREEN indications.

NOTE (2) The outputs are controlled by equations given by factory settings or by commands received by the MODBUS interface.

4.4.1.4 **UNITS STATUS**

Name	Colour	Mode	Description
Power	green	on	The CPU is correctly powered ON. Presence of 5Vdc
		off	The CPU is powered OFF or there is lack of communication between the CPU and the SERVICE card of the DCM2. In this case, all the LEDs relative to the CPU status are turned off.
Sys OK	green	on	The System is OK
		off	The system is in error
Run	green	flashing	The CPU has the control
		off	The CPU hasn't the control
Stb by	yellow	on	The CPU is in standby
		off	The CPU isn't in standby
Config.		off	The LED is turned off when the CPU is in standby
	yellow	flashing	The receiving of the configuration file is in progress. See NOTE (1)
	With CPU in RUN		
	yellow	flashing	The receiving of the configuration file is in progress. See NOTE (1)
		on	Configuration not terminated. At least one node (router or device) is in NOT CONF or CONF ERR status.
	green	on	The configuration of the entire plant is complete
	green	flashing	Re-reading of all the nodes variables, required by any of the connected HMI
LAN		off	No Ethernet communication
	green	on	Ethernet communication with HMI ok
	yellow	on	Ethernet communication with HMI not ok
BUS	green	on	Unit connected to the bus LonWorks
		off	Unit not connected to the bus LonWorks
Loc. Sup	green	flashing	Communication with DCM-i ok
	yellow	flashing	Communication with DCM-i not ok

NOTE (1) The yellow flashing indication is turned off when the uploading is successful or if, without uploading new configuration file, the DCM2 is turned off and on.

4.4.1.5 **POWER STATUS**

Name	Colour	Mode	Description
Prm	green	on	The PRIMARY supply line is operational
Bkp	green	on	The BACKUP supply line is operational

4.4.2 **USB Port**

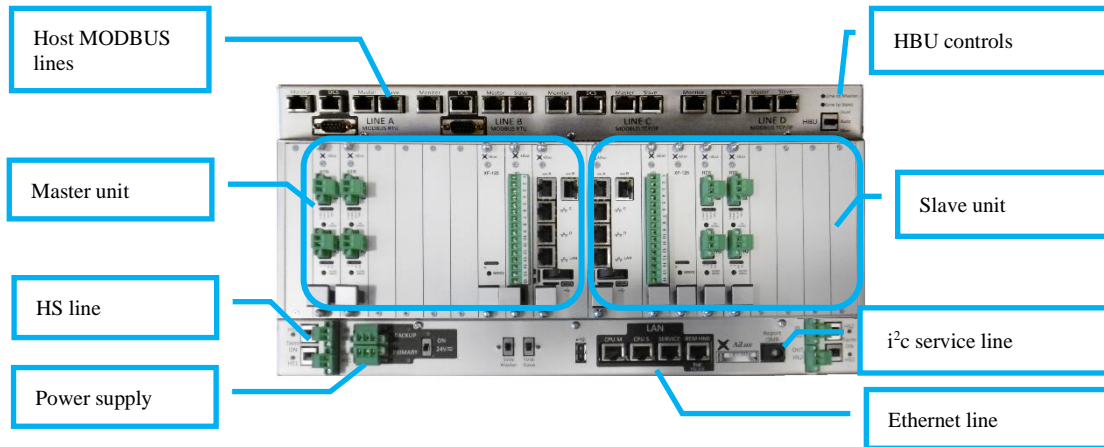
The front USB port allows the connection of external storage media to transfer files or logs. A further USB port is available on the rear panel of DCM2. Both USB ports can be enabled or disabled as per factory setting.

4.4.3 **Presence sensor**

The presence sensor allows the relight on of the screen background.
The screen is turned off by the system after that the programmed inactivity time has elapsed.
All that is needed to activate the screen is to bring a white surface or a hand close to the sensor.

4.5 Rear Panel

From the opposite side of the operator panel, it is accessed to the cards that make up the DCM2 unit. DCM2 is composed of several modules arranged in a rack as shown in the picture:



4.5.1 Power Supply and Grounding

The power system that supply a DCM2 unit shall grant the inrush current and shall comply with the following:

- a DCM2 unit equipped with a single loop shall be powered at 24Vdc, 5A.
- a DCM2 unit in “Multiple loop” configuration with 6 loops; HMI on board and a Remote HMI connected to the PoE port requires max 170W @24Vdc.

On the lower part of the panel are available the PRIMARY and the BACKUP connectors for the power supply input. The connection is insensible to polarity.

The connectors’ central pin shall be connected to Ground as well as the DCM2 chassis.

Both PRIMARY and BACKUP lines can fully power the unit. A continuity module, internal to the DCM2, with nil exchange time, ensures that the loss of a line does not disturb the normal operation.

On the operator panel are present the presence signalling of the PRIMARY and BACKUP power supplies. With appropriate system configuration by factory setting, the digital outputs can be activated in the event of abnormalities in the power supply.



Switch **24Vdc** turns on the entire unit.

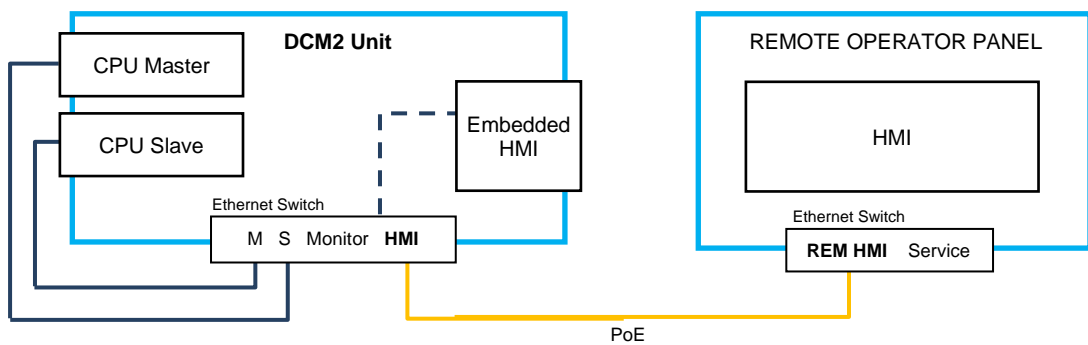
Switches **5Vdc Master** and **5Vdc Slave** control the CPUs and the cards connected to them of the master and slave part.

4.5.2 Ethernet Line

The connection between the HMI and the CPU Master and the CPU Slave is through an Ethernet line that passes through a switch implemented on the HMI hardware. The LAN block makes available the outside connections. The plugs are identified by connection.



The **REM HMI** port implements the standard Power over Ethernet (PoE) PSE class 4 and it is suitable to connect a Remote HMI panel that is powered by the PoE supply.



The Remote HMI is equipped with a PoE plug PD to which the DCM2 is to be connected.

Characteristics

- Max length 100 metres
- Cable standard Standard cable Category 5 UTP.

RJ45 jack		
Pin	EIA/TIA 568B	Front view
1	Orange/White	
2	Orange	
3	White/Green	
4	Blue	
5	White/Blue	
6	Green	
7	White/Brown	
8	Brown	

The metallic connector body is electrically connected to the DCM2 metallic enclosure.

4.5.3 HMI Reset

A push-button and a N.O. contact available at the two-poles terminal offers the possibility to reset the HMI without power off the entire DCM2 unit.



4.5.4 HS Line

In the multi-loop architecture system, the DCM2 interfaces the field loops to an internal high-speed network LonWorks TP1.25 running at 1.25Mbps.

The connections for the expansions towards the Output Modules and the network terminations are available on the rear panel:

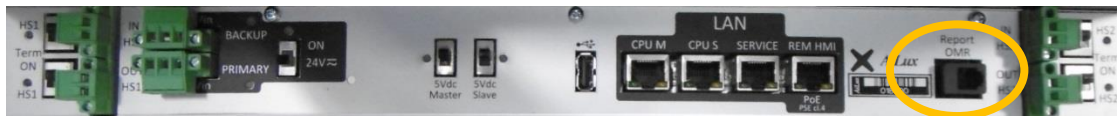
- INHS1 – OUTHS1 = TP1.25 line connected to the master side.
- INHS2 – OUTHS2 = TP1.25 line connected to the slave side.

At each end of the high-speed line it is available a switch that connects the network termination and a LED that signals its connected/not connected status.



4.5.5 I2C Service Line

The i²c service line is used for reading the cards' plate data which make part of the DCM2 system and which are mounted on the modules of the external Output Module.



The connection takes place through a modular RJ9 (4P4C) connector.

ATTENTION Use only the patch cable provided with external Output Module, other cables may damage the unit.

4.5.6 MODBUS Lines to Host System

The DCM2 is equipped with four MODBUS lines: two RTU and two TCP-IP.




The DCM2 can manage simultaneous MODBUS communications over different lines.

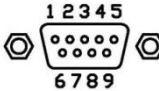
Parameters of each line shall be individually configured during factory commissioning according to Customer's requirement.

The pin-out of the physical ports, depending on the selected serial protocol, is described in the following paragraphs.

4.5.6.1 **MODBUS RTU**

Lines A and B manage RS232 and RS485 MODBUS protocols.
The pinout of both protocols is arranged on both connectors.

RJ45 jack		
Pin	Description	Front view
1	RS 232 Rx	
2	RS 232 Tx	
3	nc	
4	RS 485 Data + (D1/B/B')	
5	RS 485 Data - (D0/A/A')	
6	nc	
7	nc	
8	Common	
The metallic connector body is electrically connected to the DCM2 metallic enclosure.		

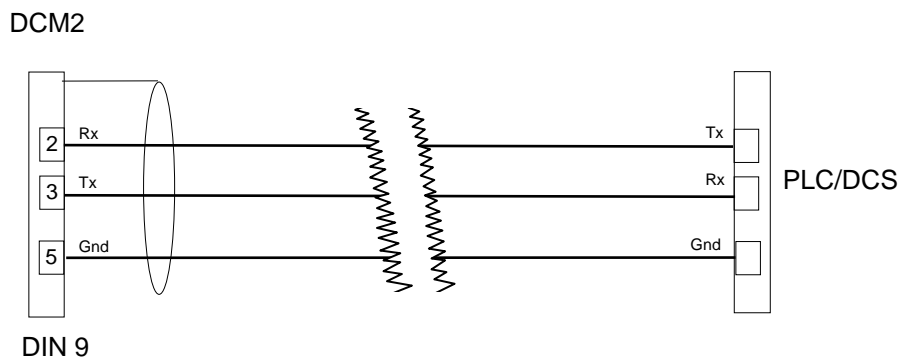
DIN 9 pins male connector		
Pin	Description	Front view
1	RS 485 Data + (D1/B/B')	
2	RS 232 Rx	
3	RS 232 Tx	
4	RS 485 Data - (D0/A/A')	
5	Common	
6	nc	
7	nc	
8	nc	
9	Nc	
The metallic connector body is electrically connected to the DCM2 metallic enclosure.		

The connection to the DCS is possible by the DIN9 poles connector or by RJ45 connector.
The connections to the CPUs Master and Slave are made through CATEGORY 5 - PATCH cables and RJ45 connectors.

To facilitate the field debug operations each line is equipped of a **Monitor** port on which the line data traffic is given in RS232 mode (pin Tx).

4.5.6.1.1 **RTU - RS232-C PROTOCOL Characteristics**

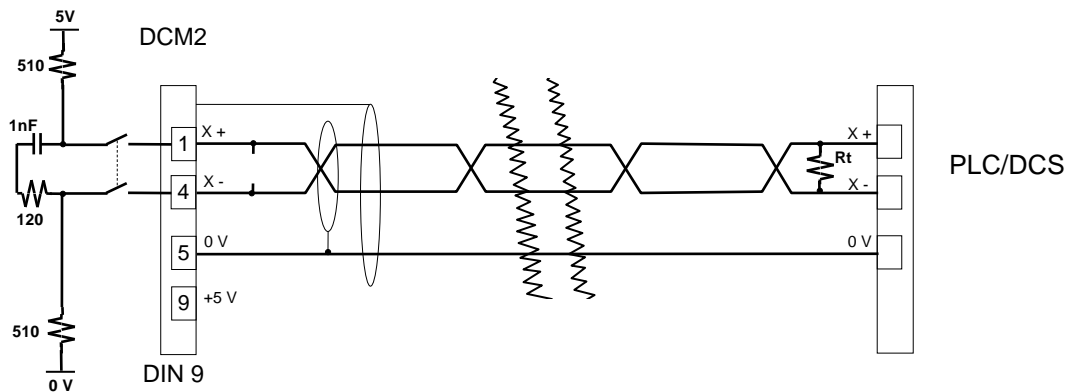
Cable 5 x 22 AWG; the shielding must be connected to the connector metallic enclosure.
Max cable length 15 metres



4.5.6.1.2 RTU - RS485 PROTOCOL Characteristics

Cable 2 x 22 AWG; a pair of twisted pair cables with double shield. The outer shield should be connected to the metallic enclosure of the connector and the inner shield should be connected to “Common” signal (DIN9 - pin 5 or RJ45 – pin 8). In case of a long cable, connect also the 0V reference signal between the stations as shown below.

Max cable length 1200 metres



For the correct functioning of the communication line, it is necessary to put a Line Terminator **Rt** (120 Ohm) on the first and the last device on the RS485 line as indicated in the figure. It is also recommended to implement a line polarization circuit made of pull-up and pull-down resistors. The value of those resistors must be between 450 Ohm and 650 Ohm.

The DCM2 unit offers the proper RS-485 terminations implemented at MODBUS INPUT ports at the DCM2 side which are activated by an operator interface settings menu.

4.5.6.2 MODBUS TCP-IP

The lines C and D are MODBUS TCP-IP lines.

The connection to the DCS is possible with the RJ45 connector.

The connection to the CPUs Master and Slave is made through CATEGORY 5 - PATCH cables and RJ45 connectors.

The presence of the internal switch makes it possible to use also CROSS cables.

To facilitate the field debug operations each line is equipped of a **Monitor** port on which is mirrored the MODBUS TCP-IP traffic of the line.

RJ45 jack		
Pin	EIA/TIA 568B	Front view
1	Orange/White	
2	Orange	
3	White/Green	
4	Blue	
5	White/Blue	
6	Green	
7	White/Brown	
8	Brown	
The metallic connector body is electrically connected to the DCM2 metallic enclosure.		

4.5.6.2.1 MODBUS TCP-IP PROTOCOL Characteristics

Max length 100 metres
Cable standard Standard cable Category 5 UTP.

4.5.7 HBU Controls

The HBU cursor selects the operating mode of the system and the connection of the Host MODBUS lines:

- in **Auto** position, the four MODBUS lines are connected to the Active CPU. In case the control pass from Master to Slave CPU, the lines are switched as well;
- in **Man** position, the lines assigned permanently to the CPU Master;
- in **Dual** position, lines A and C are connected permanently to the CPU Master and lines B and D are connected permanently to the CPU Slave.



The “**Line to Master**” and “**Line to Slave**” LED indications signal the unit to which the MODBUS lines, managed by the Hot Backup Unit, are currently connected.

In **Auto** position, the indications follow the CPU with the control, in **Man** position is turned on only the “**Line to Master**” indication, in **Dual** position both are turned on.

4.5.7.1 HBU operating principle

The following table describes the different operating modes:

Condition	HBU status	Description
CPU Master in ‘Run’ CPU Slave in ‘Stand-by’.	HBU switch on AUTO.	MODBUS lines are routed to the CPU Master ports. The HBU switches are driven by CPU Slave. Until the CPU Master maintains the control and the CPU Slave stays in Stand-by, the MODBUS communications are managed by CPU Master. In case that CPU Slave takes over the control, the MODBUS lines are routed immediately to the CPU Slave ports.
CPU Master not active CPU Slave in ‘Run’.	HBU switch on AUTO.	MODBUS lines are routed to the CPU Slave ports. The HBU switches are driven by CPU Slave. Until CPU Slave maintains the control and CPU Master is not active, the MODBUS communications are managed by CPU Slave. The maintenance service to CPU Master can be performed following these simple steps: <ul style="list-style-type: none"> ○ Switch off the 5Vdc Master switch on the DCM2 rear side; CPU Slave maintains the MODBUS communications. ○ Disconnect the cables linked to the CPU Master. ○ Repair the CPU Master. ○ Reconnect cables to the CPU Master. ○ Switch on the 5Vdc Master switch on the DCM2 rear side; CPU Slave holds the control and updates CPU Master. ○ Transfer the control to CPU Master with the explicit command to the CPU Slave: the MODBUS lines are routed immediately to the CPU Master ports.

Condition	HBU status	Description
CPU Master in 'Run' CPU Slave in 'Stand-by'.	HBU switch on MAN.	<p>MODBUS lines are routed to the CPU Master ports. Due to the MAN position of the HUB switch, CPU Master receives the MODBUS communications and the CPU Slave is not able to control HBU switch.</p> <p>If it is necessary, a maintenance service to CPU Slave can be performed following these simple steps:</p> <ul style="list-style-type: none"> ○ Keep the HBU switch to MAN. ○ Switch off the 5Vdc Slave switch on the DCM2 rear side; CPU Master maintains the MODBUS communications. ○ Disconnect cables linked to the CPU Slave. ○ Repair the CPU Slave. ○ Reconnect cables to the CPU Slave. ○ Switch on the 5Vdc Slave switch on the DCM2 rear side; CPU Slave is updated by the CPU Master that hold the control.
CPU Master in 'Run' CPU Slave in 'Stand-by'.	HBU switch on DUAL.	<p>MODBUS lines A and C are linked to the CPU Master ports. MODBUS lines B and D are linked to the CPU Slave ports.</p> <p>Due to the DUAL position of the HUB switch, the MODBUS communications lines are assigned consistently to CPU Master and Slave ports without relation to the active CPU that holds the control.</p> <p>DCS can interrogate the CPU Master or the CPU Slave; both can reply but only the ones with the control have valid data and can execute the commands.</p> <p>In case that the CPU Slave takes over the control, the CPU Slave gives valid data.</p>

4.5.8 Master and Slave Units

The master and slave units are contained in the 19” 3U rack, in the rear part of the DCM2. To allow a greater integration of the system, the card positions are mandatory as reported in the following diagram.

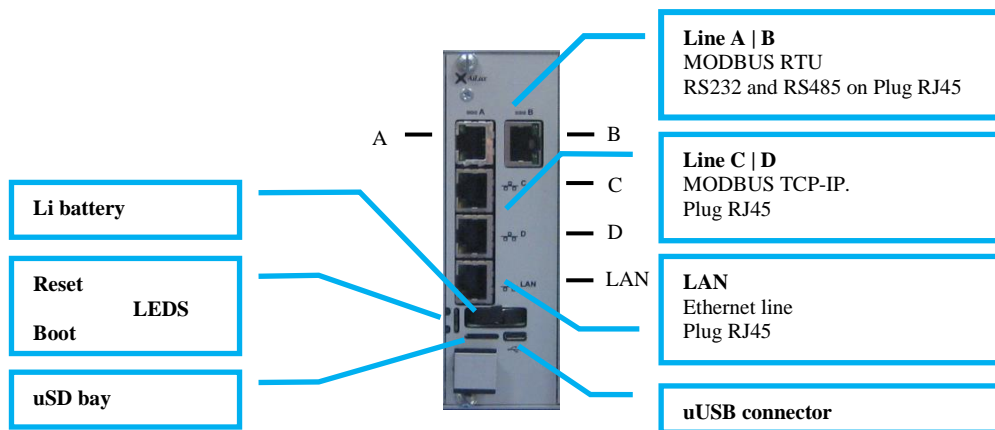
na	IOM - OUT side						MASTER (Primary Unit)			SLAVE (Backup Unit)			IOM - IN side					
	M1		M2		M3		NET	I/O	CPU	CPU	I/O	NET	M1		M2		M3	
	L1	L2	L3	L4	L5	L6							L1	L2	L3	L4	L5	L6
1	2	3	4	5	6	7	8	9	10-11	12-13	14	15	16	17	18	19	20	21

The card positions are indicated on the rack upper rail for easy identification.

4.5.8.1 CPU-DUP Card

The CPU-DUP master card occupies slots 10 and 11 of the rack; the CPU-DUP slave card occupies slots 12 and 13.

On the motherboard card, inside of the DCM2, a high-speed data line connects the two CPU cards and a control signals exchange line.



MODBUS RTU RJ45 jack		
Pin	Description	Front view
1	RS 232 Rx	
2	RS 232 Tx	
3	nc	
4	RS 485 Data + (D1/B/B')	
5	RS 485 Data - (D0/A/A')	
6	nc	
7	nc	
8	Common	
The metallic connector body is electrically connected to the DCM2 metallic enclosure.		

MODBUS TCP-IP RJ45 jack		
Pin	EIA/TIA 568B	Front view
1	Orange/White	
2	Orange	
3	White/Green	
4	Blue	
5	White/Blue	
6	Green	
7	White/Brown	
8	Brown	
The metallic connector body is electrically connected to the DCM2 metallic enclosure.		

The CPU is equipped with a 100MHz Full-Duplex Ethernet channel which makes the LAN, C and D LINES through a 100MHz internal switch.

Lines C and D are equipped with RJ45 plug.

Lines A and B implement both protocols RS232 and RS485 on the same RJ45 plug. The pinout used by the connection to the DCS defines the protocol.

The MODBUS lines can be connected to the corresponding connector of the HBU module or directly to the DCS depending on the type of redundancy that it is desired to be implemented.

The uSD bay allows housing a uSD card on which to store files. The uSD is managed from the operator interface settings menu.

The uUSB connector is used to program the card from a service PC connected with an USB cable. The CPU enters into programming mode if the BOOT pushbutton is held for 3 seconds while CPU program is running, or by pressing the RESET while BOOT pushbutton is kept pressed; in the programming mode the CPU is seen as a memory unit connected to the USB port of the PC.

On the front of the CPU is visible the drawer of the CR2032 lithium battery holder used to keep the clock in the no supply periods.

4.5.8.2 **Digital I/O Interface**



The I/O Interface Module of master unit occupies slot 9; the I/O Interface Module of slave unit occupies slot 14.

The I/O Interface Module manages 4 digital inputs and 4 digital outputs.

Digital inputs can gather signals coming from the cabinet where DCM2 is mounted (e.g. thermostat switch for high temperature, door open switch, etc.) and transmit the current status of these inputs to DCS via MODBUS.

Digital outputs can be managed by 'equations' written in the configuration file of DCM2 or, alternatively, can be controlled by DCS via MODBUS.

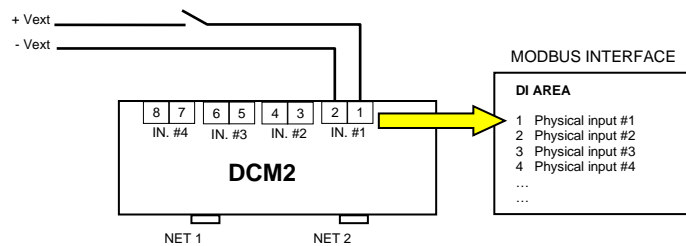
The connector pin-out is described as follows:

Input #	Pin	Description
1	1	Signal +
	2	Signal -
2	3	Signal +
	4	Signal -
3	5	Signal +
	6	Signal -
4	7	Signal +
	8	Signal -

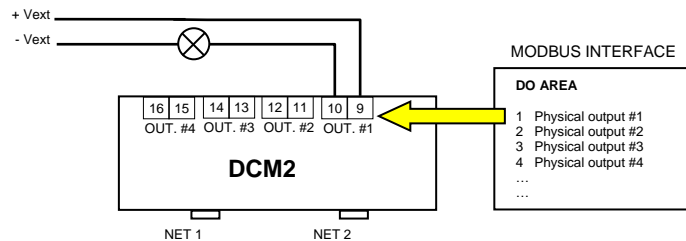
Output #	Pin	Description
1	9	N.O. contact
	10	Common
2	11	N.O. contact
	12	Common
3	13	N.O. contact
	14	Common
4	15	N.O. contact
	16	Common

Examples:

Input signal reading

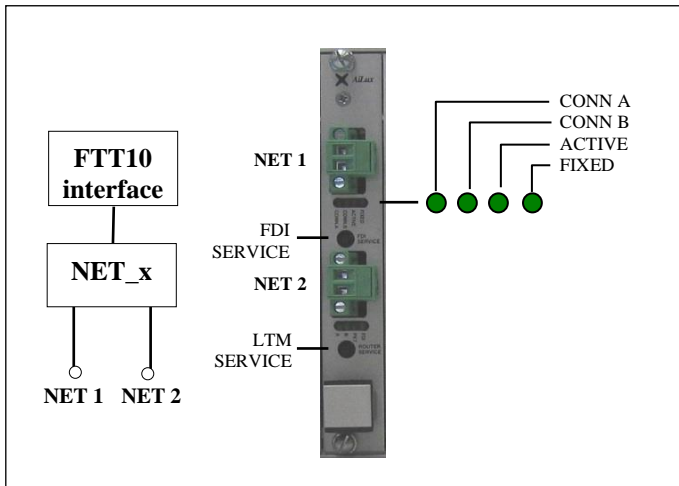
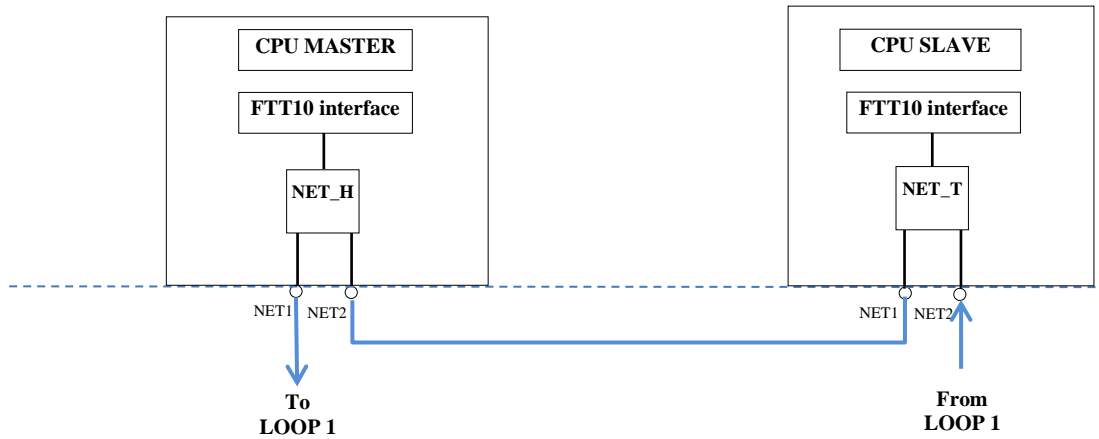


Output signal control

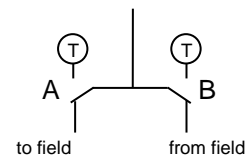


4.5.8.3 **LonWorks Single loop: NET FTT10+FDI Card**

The DCM2 can manage a system consisting of a single loop connecting LonWorks devices with the following general scheme



The .NET FTT10 +FDI card is the first node of a bus structure or is placed at the ends of a single loop that starts from the master unit and ends at the slave unit. On the card are present the hardware of the LonWorks FTT10 interface of the connected CPU and the FDI hardware for the managing of the termination of the field bus.



The NET FTT10+FDI card of the master unit occupies slot 8; the NET FTT10+FDI card of the slave unit occupies slot 15.

LED indications of the FDI operating:

Name	Colour	Description
CONN A	Green	off relay A is turned on the terminator.
		on relay A is connected to the field.
CONN B	Green	off relay B is turned on the terminator.
		on relay B is connected to the field.
ACTIVE	Green	off loop check function is disabled.
		on loop check function enabled but not yet active.
		flashing loop check function is working.
FIXED	Green	Not used by NET_x firmware


Service LED and Service pin of the NET card.

Service LED and Service pin of the FTT10 LonWorks interface of the unit.

Both "services" perform the standard procedures defined by LonWorks protocol.

Name	Colour	Description
SERVICE LED	yellow	Status of the LonWorks communication interface of the DCM2. off node is working regularly flashing node not configured, or watchdog timer tripped on LonWorks interface not working
SERVICE PUSH-BUTTON		When the Service push-button is pressed, the DCM2 internal LonWorks interface sends a network management message containing its 48-bit unique ID (Neuron ID) on the network. This message is used to install and configure the node.

NET 1, NET 2 connections to the field bus network: according to the manufacturing code, one or two ports will be active. The connectors have the following pin-out:

Pin	Description	Front view
1	Bus	
2	Bus	

NOTE: LonWorks communication line is not affected by polarity.

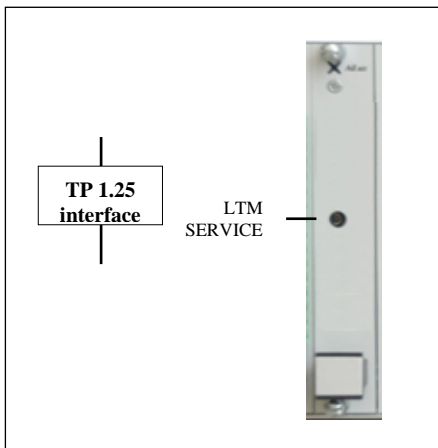
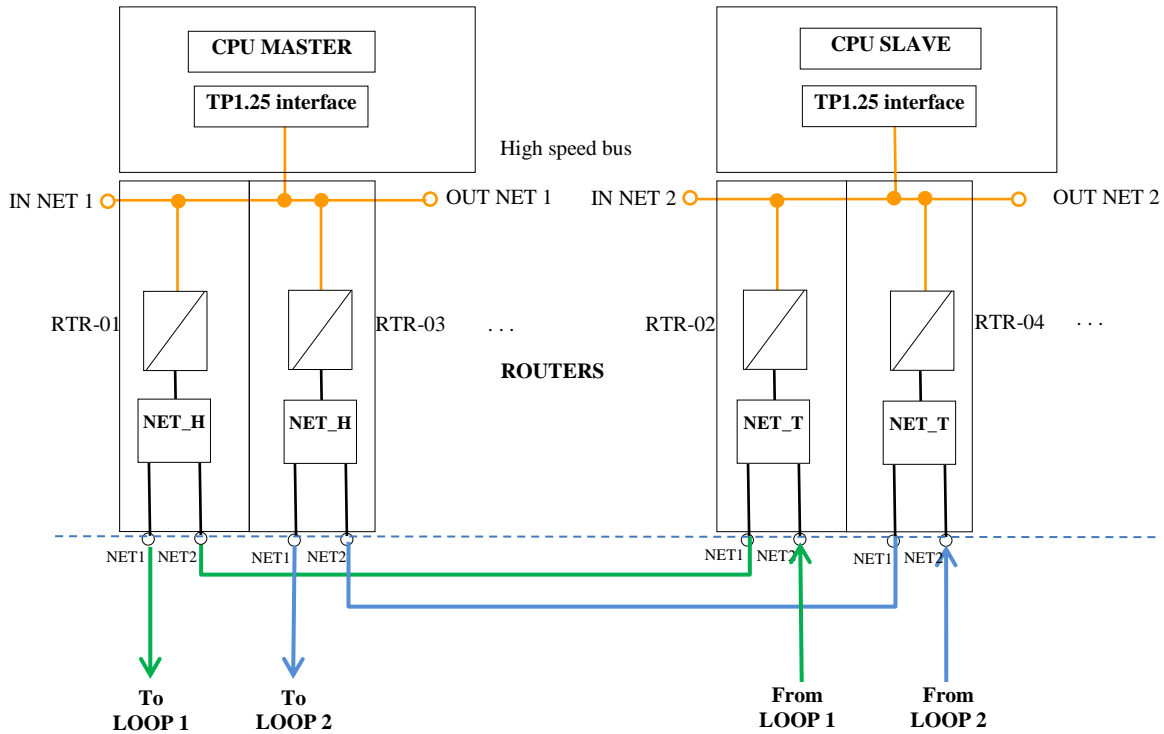
Characteristics

Cable 22AWG/0,65mm twisted pair cable BELDEN 8471

4.5.8.4 **LonWorks Multiple loops: NET TP1.25 Card**

The DCM2 can integrate up to 6 loops connecting LonWorks devices in the same unit. With two additional Output Module Racks, the system can be expandable up to 18 loops.

The general scheme is the following:



The NET TP1.25 card is the interface that allows the master or slave unit to face the TP 1.25 high-speed bus. The connection to the high-speed branch is made internally between the card and the DCM2 motherboard.

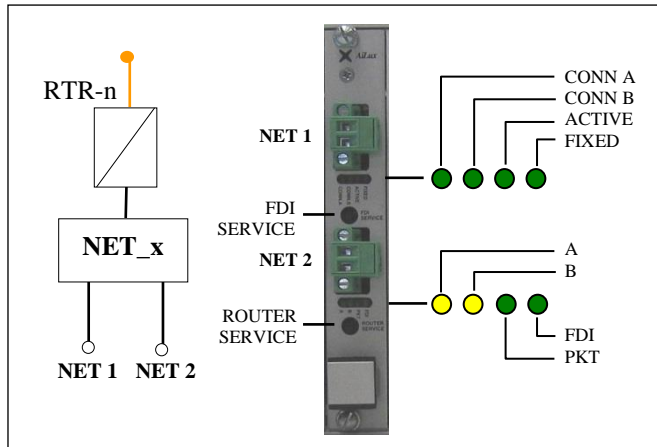
The NET TP1.25 card of the master unit occupies slot 8; the NET TP1.25 card of the slave unit occupies slot 15.

On the card are available the **Service LED** and the **Service pin** of the TP1.25 LonWorks interface of the unit.

The "service" performs the standard procedures defined by LonWorks:

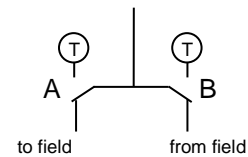
Name	Colour	Description
SERVICE LED	yellow	Status of the LonWorks communication interface of the DCM2. off node is working regularly flashing node not configured, or watchdog timer tripped on LonWorks interface not working
SERVICE PUSH-BUTTON		When the Service push-button is pressed, the DCM2 internal LonWorks interface sends a network management message containing its 48-bit unique ID (Neuron ID) on the network. This message is used to install and configure the node.

4.5.8.5 *LonWorks Multiple loops: RTR+FDI Card*



The RTR+FDI card is the first node of each LonWorks loop, in a multi-loop system architecture.

On the card there are the hardware of the Router that connects the TP1.25 high-speed channel with FTT10 field bus and the FDI hardware for the managing of the termination of the field bus.



The RTR +FDI cards that are controlled by the master unit can indifferently occupy slots from 2 to 7; cards RTR+FDI which are controlled by the slave unit can indifferently occupy slots from 16 to 21.

In the stage of the system configuration the individual cards will be programmed to route the data packets in the network portion under their control.


LED and SERVICE indications of the NET node.

Name	Colour	Description
CONN A	green	off relay A is turned on the terminator. on relay A is connected to the field.
CONN B	green	off relay B is turned on the terminator. on relay B is connected to the field.
ACTIVE	green	off loop check function is disabled. on loop check function enabled but not yet active. flashing loop check function is working.
FIXED	green	Not used by NET_x firmware
FDI SERVICE		When the Service push-button is pressed, the NET-X sends an identification string on the fieldbus.
FDI	yellow	Status of the FDI off node is working regularly flashing node not configured, or watchdog timer tripped on node not working

LED and SERVICE indications of the Router node

Name	Colour	Description
A	yellow	Status of the FTT-10 side of the ROUTER: off node is working regularly flashing node not configured, or watchdog timer tripped on node not working
B	yellow	Status of the TP1,25 side of the ROUTER: off node is working regularly flashing node not configured, or watchdog timer tripped on node not working
PKT	green	flashing packets are passing through the ROUTER
ROUTER SERVICE		When the Service push-button is pressed, the ROUTER sends an identification string on the fieldbus.

NET 1, NET 2 connections to the field bus network: according to the manufacturing code, one or two ports will be active. The connectors have the following pin-out:

Pin	Description	Front view
1	Bus	
2	Bus	

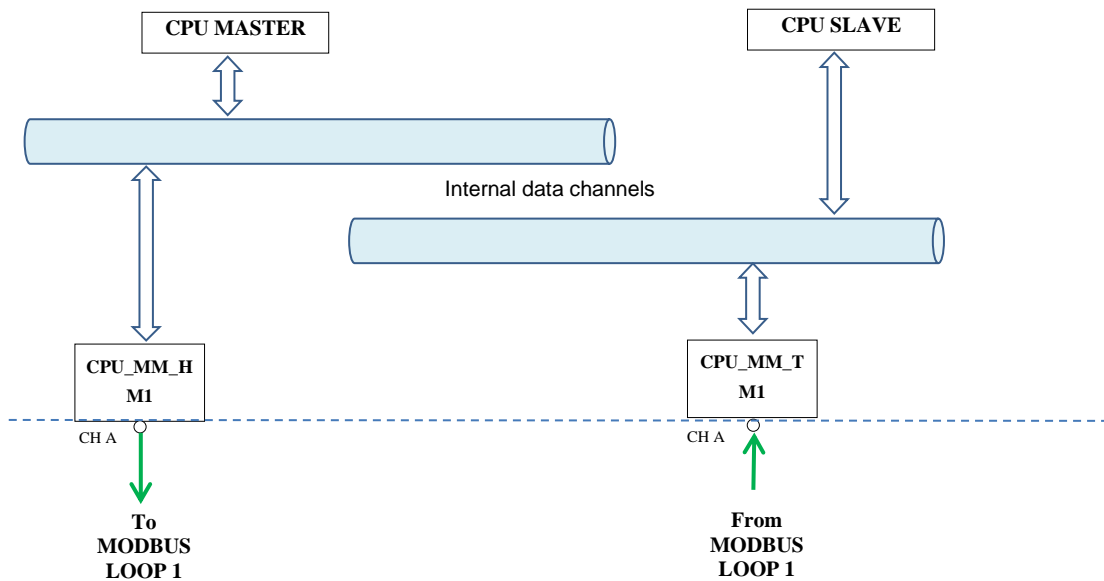
NOTE: LonWorks communication line is not affected by polarity.

Characteristics

Cable 22AWG/0,65mm twisted pair cable BELDEN 8471

4.5.8.6 **MODBUS loops: MM_CPU_x Card**

The MM_CPU_x card is the node at each ends of a MODBUS loop.



The MM_CPU_x card provides double connectors for MODBUS RTU communication to field devices to manage 1-channel indicate with Channel "A".

The MM_CPU_x cards shall be inserted in the DCM2 rack in the slots L1 of the Primary and Backup side.

In case the MM_CPU_x card is inserted in a wrong position (e.g. slot L4-L5), the card will be powered up, but it will not able to work. Anyway, the wrong positioning will not damage the card

MODBUS RTU plugs allow both RS232 or RS485 line MODBUS protocols.

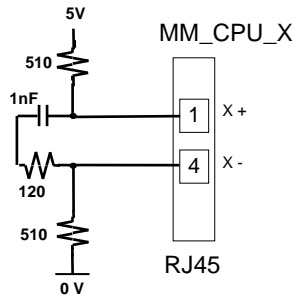
The pinout of both protocols is arranged on both connectors.

For the correct functioning of the RS485 communication line, it is necessary to put a Line Terminator R_t (120 Ohm) on the first and the last device connected to the line.

It is also recommended to implement a line polarization circuit made of pull-up and pull-down resistors. The value of those resistors must be between 450 Ohm and 650 Ohm.

RJ45 jack		
Pin	Description	Front view
1	RS 232 Rx	
2	RS 232 Tx	
3	nc	
4	RS 485 Data + (D1/B/B')	
5	RS 485 Data - (D0/A/A')	
6	nc	
7	nc	
8	Common	

The metallic connector body is electrically connected to the DCM2 metallic enclosure.



Since the MM_CPU-H and the MM_CPU_T are placed at the ends of the RS485 network, the specific line termination circuits are implemented on the RS485 terminals of RJ45 connector to avoid the necessity of external added terminators.

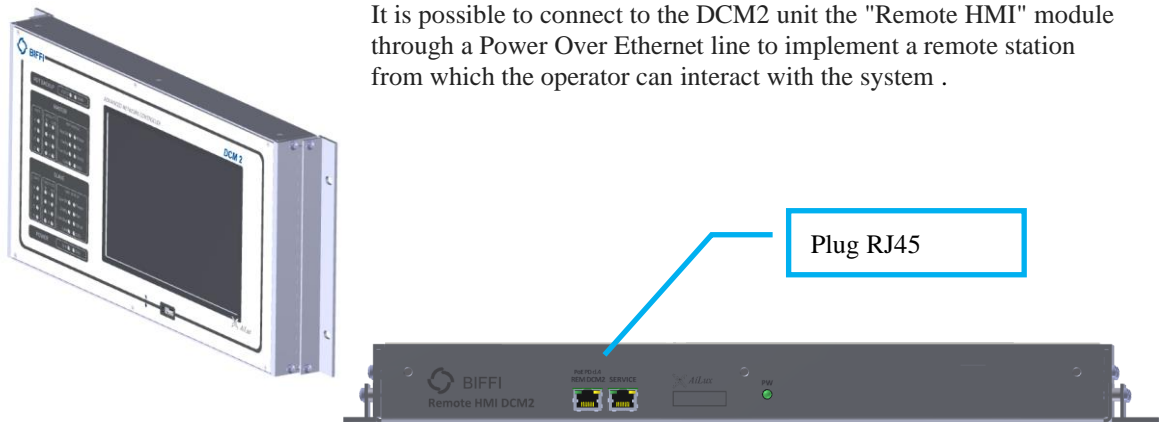
Characteristics of RS-485 line

Cable Specific RS485 cable is recommended. Typical 2 x 22 AWG; a pair of twisted pair cables with double shield. The outer shield should be connected to the metallic enclosure of the connector and the inner shield should be connected to “Common” signal (RJ45 – pin 8). In case of a long cable, connect also the 0V reference signal between the stations.

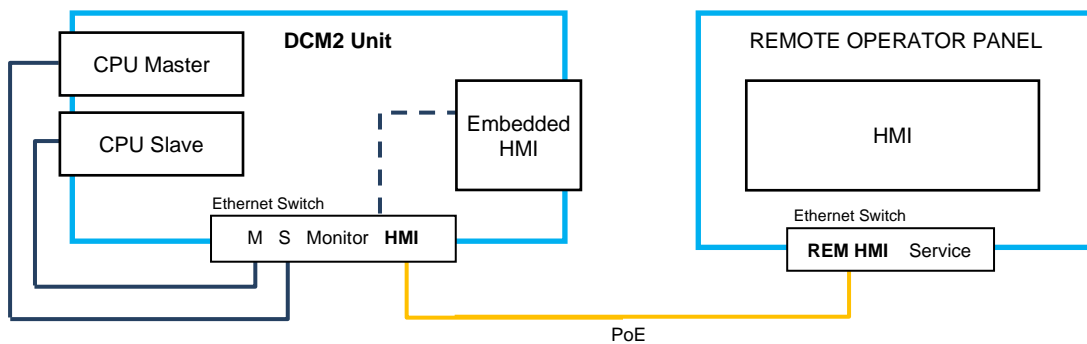
Max cable length 1200 metres

4.6 Remote Operator Panel

It is possible to connect to the DCM2 unit the "Remote HMI" module through a Power Over Ethernet line to implement a remote station from which the operator can interact with the system .

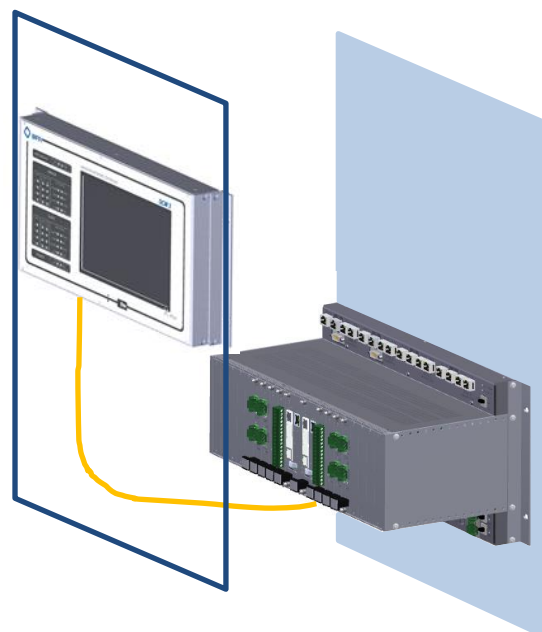


The remote operator panel is available for installation on both the front panel or on the wall. The Service port is a standard ethernet switch and can be used to extend the Ethernet line.



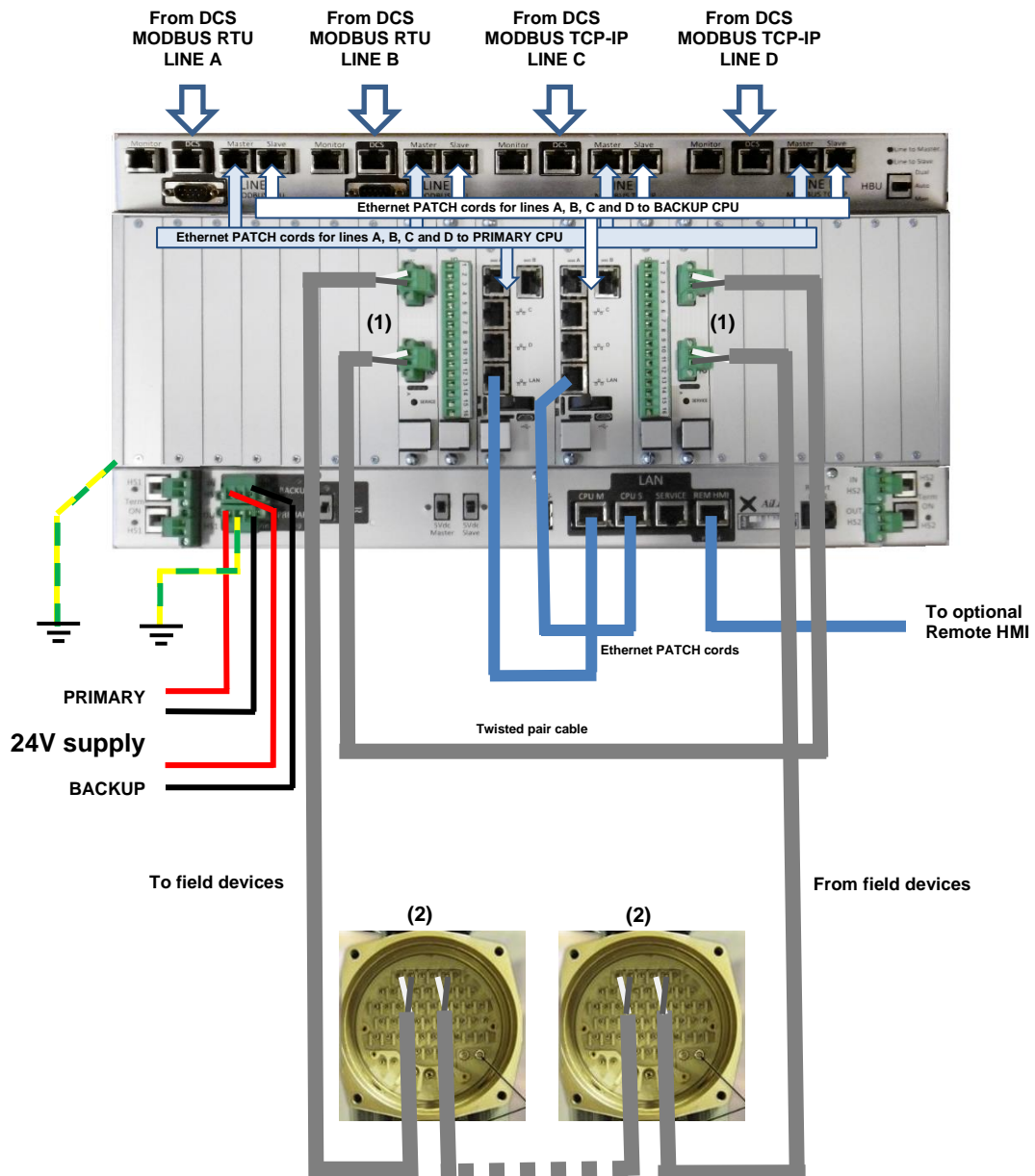
At the opening of a new connection the HMI acquires the operating status of the CPU to which it connects and acts as a second terminal: all system updates are acquired and managed in the same way by all the terminals connected.

Exploiting the Remote HMI interface, it is possible to allow housing of the unit in a cabinet with only front access by using a DCM2 rack with blind front panel. The DCM2 can be fasten on an internal mounting plate and the operator interface housed in a separate module or on the front door of the cabinet just with a Power over Ethernet line.



4.7 Summary Of Typical Connection Scheme

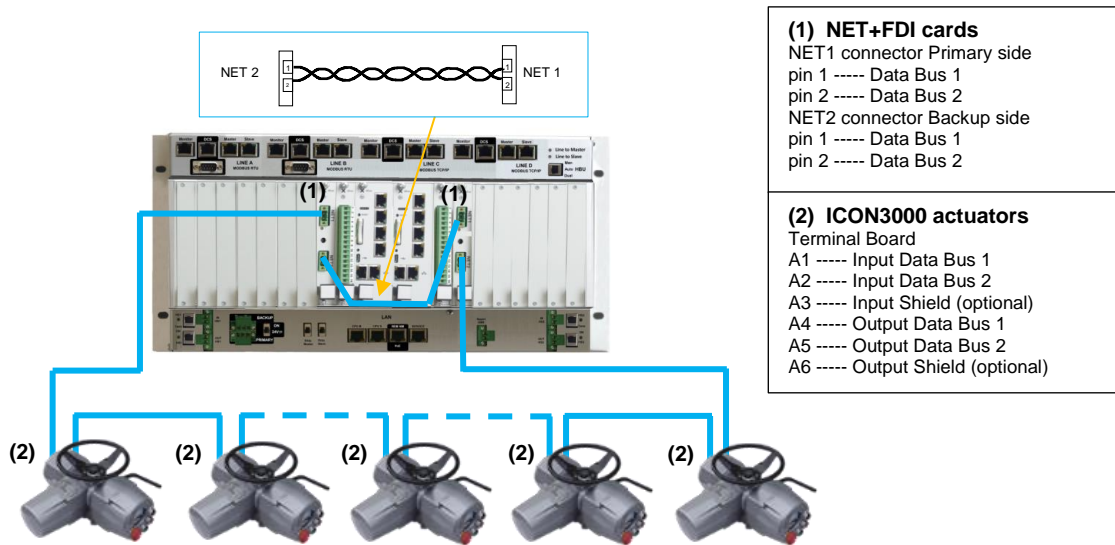
4.7.1 Redundant Master Station with a single LonWorks loop



Note (1) NET+FDI cards
 NET1 connector Primary side
 pin 1 ----- Data Bus 1
 pin 2 ----- Data Bus 2
 NET2 connector Backup side
 pin 1 ----- Data Bus 1
 pin 2 ----- Data Bus 2

Note (2) ICON3000 actuators
 Terminal Board
 A1 ----- Input Data Bus 1
 A2 ----- Input Data Bus 2
 A3 ----- Input Shield (optional)
 A4 ----- Output Data Bus 1
 A5 ----- Output Data Bus 2
 A6 ----- Output Shield (optional)

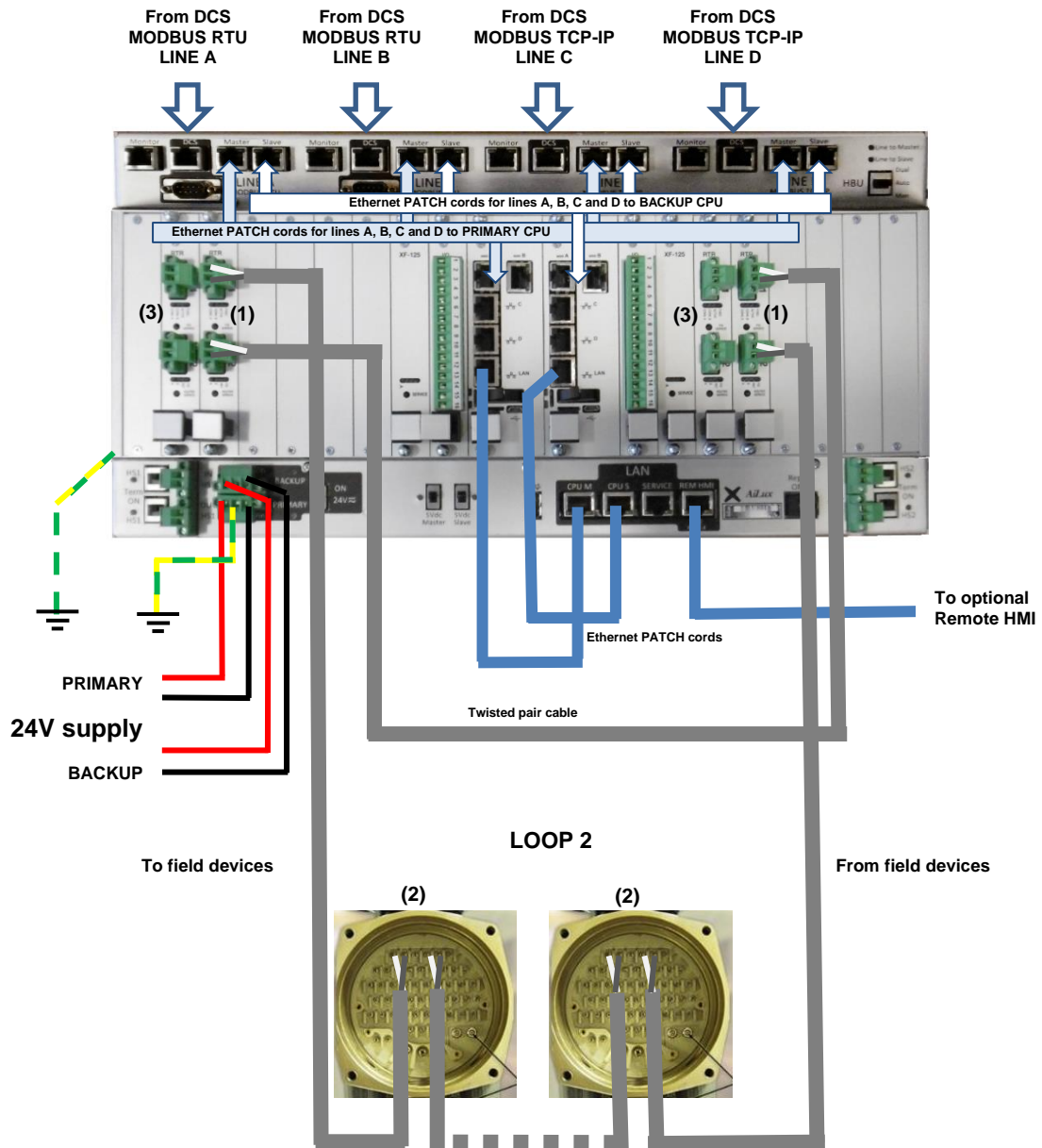
General redundant single loop schematics



NOTE: LonWorks communication line is not affected by polarity.

- Field devices are connected on the same channel to a line that starts from the NET+FDI card of the Primary side and arrives to the correspondent NET+FDI card of the Backup side.
- ICON3000 actuators are equipped with LonWorks Interface Card.
- The network can connect 60 actuators; to extend the networks External Repeater are needed.
- The maximum distance of the bus is 800 meters; to extend the networks External Repeater are needed.
- Communication speed is 78K bit/sec independently on number of actuators and bus length.
- When an actuator is powered off, the communication line is not affected and maintains the bus integrity.
- Should a single cable fault occur, the communication to all the ICON devices is maintained by the redundant DCM2 that activates a specific function to locate the fault and to move the line terminations from the NET+FDI at both ends of the line to the ICON3000 actuators closest to the fault.

4.7.2 Redundant Master Station with Multiple LonWorks loops

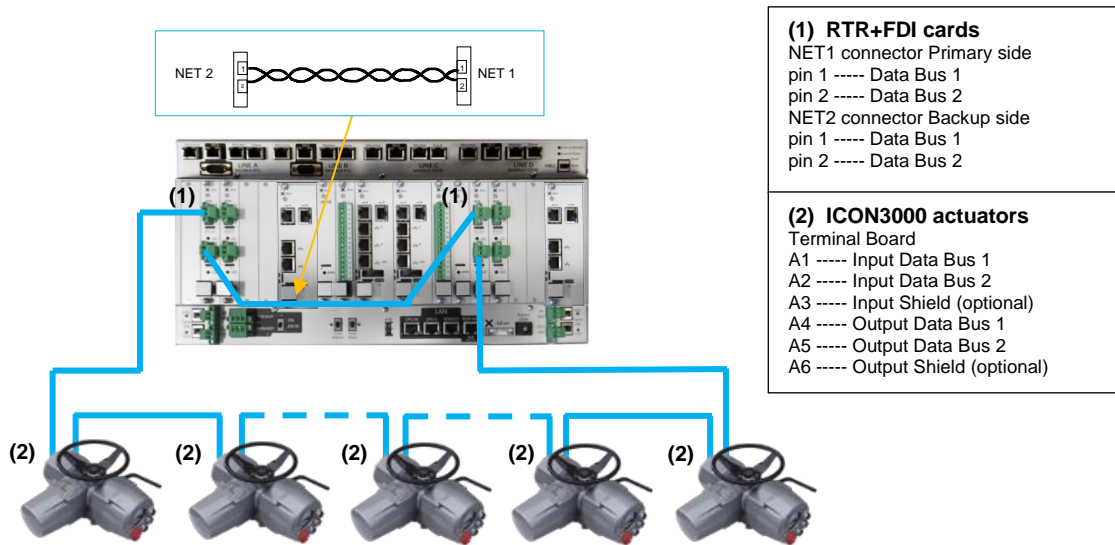


Note (1) RTR+FDI cards
 NET1 connector Primary side
 pin 1 ----- Data Bus 1
 pin 2 ----- Data Bus 2
 NET2 connector Backup side
 pin 1 ----- Data Bus 1
 pin 2 ----- Data Bus 2

Note (2) ICON3000 actuators
 Terminal Board
 A1 ----- Input Data Bus 1
 A2 ----- Input Data Bus 2
 A3 ----- Input Shield (optional)
 A4 ----- Output Data Bus 1
 A5 ----- Output Data Bus 2
 A6 ----- Output Shield (optional)

Note (3) Other Loops connections
 This scheme shows the details of LOOP 2. The other loops arranged in the DCM2 follow the same connections logic with reference to the couple of RTR+FDI cards that define each loop.

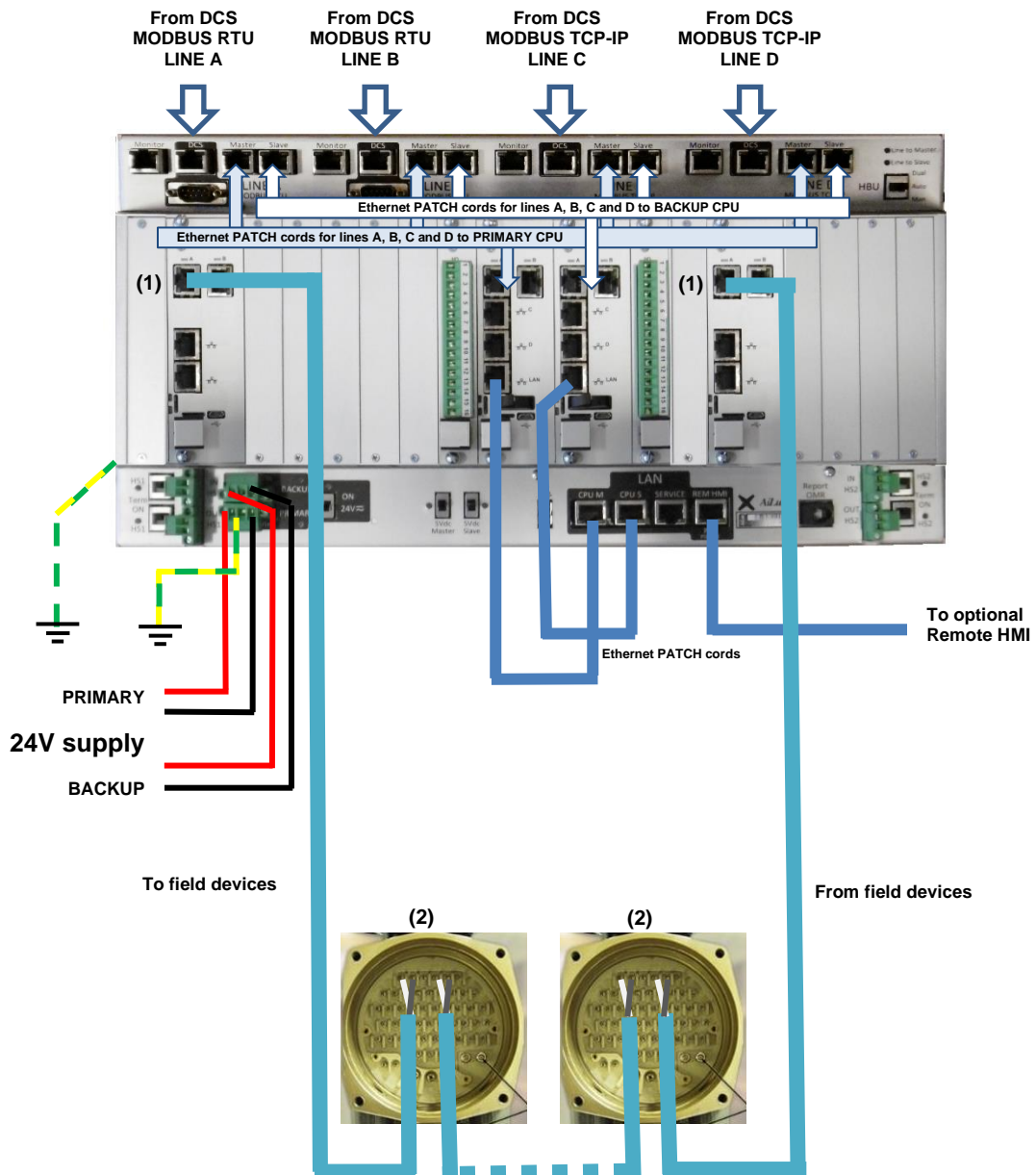
General redundant loop schematics valid for each loop in a Multiloop architecture



NOTE: LonWorks communication line is not affected by polarity.

- Field devices are connected on the same channel to a line that starts from an RTR+FDI card of the Primary side and arrives to the correspondent RTR+FDI card of the Backup side.
- ICON3000 actuators are equipped with LonWorks Interface Card.
- The network can connect 60 actuators; to extend the networks External Repeater are needed.
- The maximum distance of the bus is 800 meters; to extend the networks External Repeater are needed.
- Communication speed is 78K bit/sec independently on number of actuators and bus length.
- When an actuator is powered off, the communication line is not affected and maintains the bus integrity.
- Should a single cable fault occur, the communication to all the ICON devices is maintained by the redundant DCM2 that activates a specific function to locate the fault and to move the line terminations from the RTR+FDI at both ends of the line to the ICON3000 actuators closest to the fault.

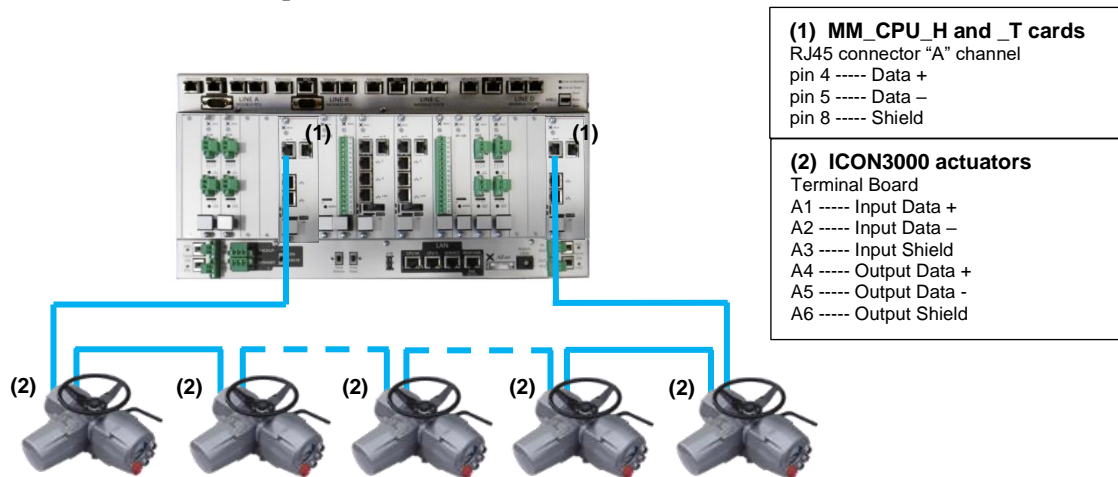
4.7.3 Redundant Master Station with a single MODBUS loop - single channel



Note (1) MM_CPU_H/_T cards
 RJ45 connector "A" channel
 pin 4 ----- Data +
 pin 5 ----- Data -
 pin 8 ----- Shield

Note (2) ICON3000 actuators
 Terminal Board
 A1 ----- Input Data +
 A2 ----- Input Data -
 A3 ----- Input Shield
 A4 ----- Output Data +
 A5 ----- Output Data -
 A6 ----- Output Shield

Redundant 1-channel loop schema



- Field devices are connected on the same channel to a line that starts from MM_CPU_H and arrives to MM_CPU_T.
- ICON3000 actuators are equipped with Modbus Interface Card enabled to 1-channel communication plus internal repeater.
- The network can connect 247 actuators.
- The maximum distance between two powered actuators is 1.2000 meters.
- Communication speed can be set from 600 to 38.400 bit/sec.
- When an actuator is powered off, it is disconnected from the communication line maintaining the bus integrity by means of by-pass relays.
- Should a single cable fault occur, the communication to all the ICON devices is maintained by the redundant DCM2 where each MM_CPU_x takes care of the communication with the devices that are still connected to its side.

5. OPERATOR INTERFACE

The HMI has a graphical designed to make easy and immediate to access to the implemented functions.

The touch screen graphical interface facilitates operator interaction which is bases on a few gestures:

“**Tap**” is the user gesture used to press or select a control or link (analogous to a single click in a desktop application). To tap, users make a quick up-and-down motion with a finger, lightly striking the screen.

“**Flick**” is the user gesture used to scroll or pan quickly a screen composed of several views. To flick, users place a finger on the screen and quickly swipe it in the desired direction.

“**Pinch open**” or “**Pinch close**”. A two-finger user gesture used to zoom in or zoom out a view; they are available on external application e.g. reading a manual with Adobe Reader. To pinch open, users place the thumb and a finger (or two fingers) close together on the screen and move them apart without lifting them from the screen. To pinch close, users place the thumb and a finger (or two fingers) a little distance apart on the screen and move them toward each other without lifting them from the screen.

All display pages consist of a top bar in which there are the references to some of the accessible functions from the current page and an underlying data display area.

Pages often report data in more display tabs: presence of more tabs is highlighted with a list of items given in the bottom part of the top bar and the current display is highlighted with a green line drawn under the item to which refers the contents of the underlying data.

Passing between the various tabs is possible by a tap on the item in the top bar or by flicking horizontally in the data display area.

The first page called after login is the Main screen. It captions "HMI" in the upper left corner of the top bar and, from it lower-level pages can be called that will bring in their own top bar the details of the chosen selection.

From each page it is possible to go to the previous page by a tap on "Back" button in the bottom part of the screen. If the "Back" button is selected by any of the Main screen views, subject to confirmation it is returned to the login splash by disconnecting the current user.

Tap of the “Home” button gives instead the display to the OVERVIEW tab of the main screen.

The pages that enable functions of data or system parameters changes are shown with the typical graphics window, with “Enter” and “Exit” buttons or with the “X” button in the upper right corner. When on these windows, tap on “Back” and “Home” buttons has no effect, but it is necessary to exit from the page with the present buttons, to ensure the integrity of the data possibly in the stage of change.

NOTE: In this chapter, all the functions accessible to all connected users will be described.

5.1 Control of Accesses

The access to DCM2 screens and the availability for the performance of commands is regulated by an access control system based on the identification of users and the password control.

No one can access without authentication, not even to view the data, unless the DCM2 default setting has been modified in case of NO-LOGIN.

The DCM2 defines different access levels assigning to each one only the authorized operations and creates a default user for each level:

Access level	FUNCTIONS Class						
	Login - logout	Page visualization	Field device command	Field device setup	Network maintenance	System management	Reserved function
GUEST	X						
OBSERVER	X	X					
PLANT OPERATOR	X	X	X				
PLANT MAINTENANCE	X	X	X	X			
NETWORK MAINTENANCE	X	X	X	X	X		
SYSTEM ADMINISTRATOR	X	X	X	X	X	X	

Default users are the followings:

NO_LOGIN – role: GUEST

He is the user active when no login has been done. In the DCM2 standard configuration, he cannot view screens: simple reading is not permitted unless the System Administrator doesn't change the configuration for the GUEST level.

OBERVER – role: OBSERVER

He can only view screens but cannot send commands or perform changes.

OPERATOR – role: PLANT OPERATOR

He is in charge of the process and can send operational commands to all connected devices. As example, he can access to details of ICON actuators and send a close command.

PLANT_MAINT - role: PLANT MAINTENANCE

He is in charge of plant maintenance and can access some operational commands and to the configuration of connected devices. As example, he can access to details of ICON200 actuators to change the parameters for the Timer function On Time.

NETWORK_MAINT - role: NETWORK MAINTENANCE

He is in charge of network maintenance and can access network operational commands. As example, he can send network configuration commands.

ADMINISTRATOR – role: SYSTEM ADMINISTRATOR

The System Administrator has the full control of the plant and manages the operating, maintenance and communication network. As example, in addition to the rights of the previous levels, he can modify the communication network by adding or deleting nodes or creating and modifying groups. Furthermore, he can manage existing users right and create new users (maximum 14 users can be present other than the default Guest role user).

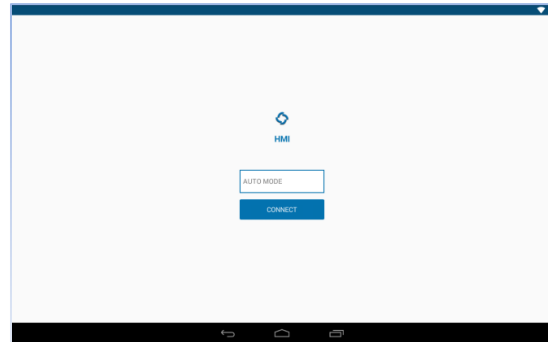
The DCM2 manufacturer delivers passwords for default users only to the personnel authorized by the customer.

5.2 HMI StartUp

At the start-up of the DCM2 no connection to the CPU is active; the HMI shows to the user a connection splash screen for the selection of the connection type to activate.

The operator can select one of the following HMI connection modes:

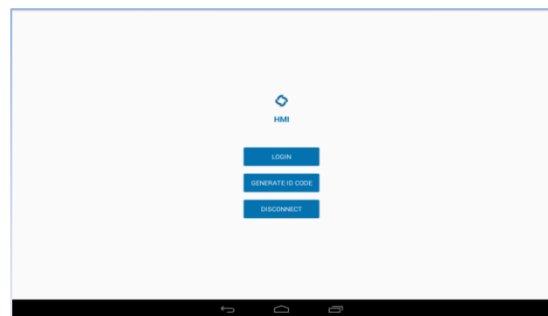
- **AUTO MODE** HMI establish a connection to the CPU which has the control of the system;
- **MANUAL TO MASTER** HMI establish a fixed connection to the CPU MASTER;
- **MANUAL TO SLAVE** HMI establish a fixed connection to the CPU SLAVE.



Tap on “**CONNECT**” button to activate the connection according to the selected mode.

Once the connection is established the user must identify itself; in this regard a splash login is open in which there are the following buttons:

- **LOGIN**
- **DISCONNECT**. Command for close the active connection: it returns to the initial splash to set a new connection.



Tap to “**LOGIN**” button to enter the operator credentials; only after user authentication the HMI main page will be displayed with the authorised functions enabled accordingly to the user right.

There is no recognition request in the case the NO-LOGIN user has been modified by a SYSTEM ADMINISTRATOR user to acquire an access level with more permissions than the own standard role of “GUEST”; in this case it will immediately display the HMI main page with the authorised functions enabled.

Up to 6 consecutive attempts are permitted with incorrect login, after which a user is locked; the reset must be performed according to the release mode defined for that user by the system administrator.

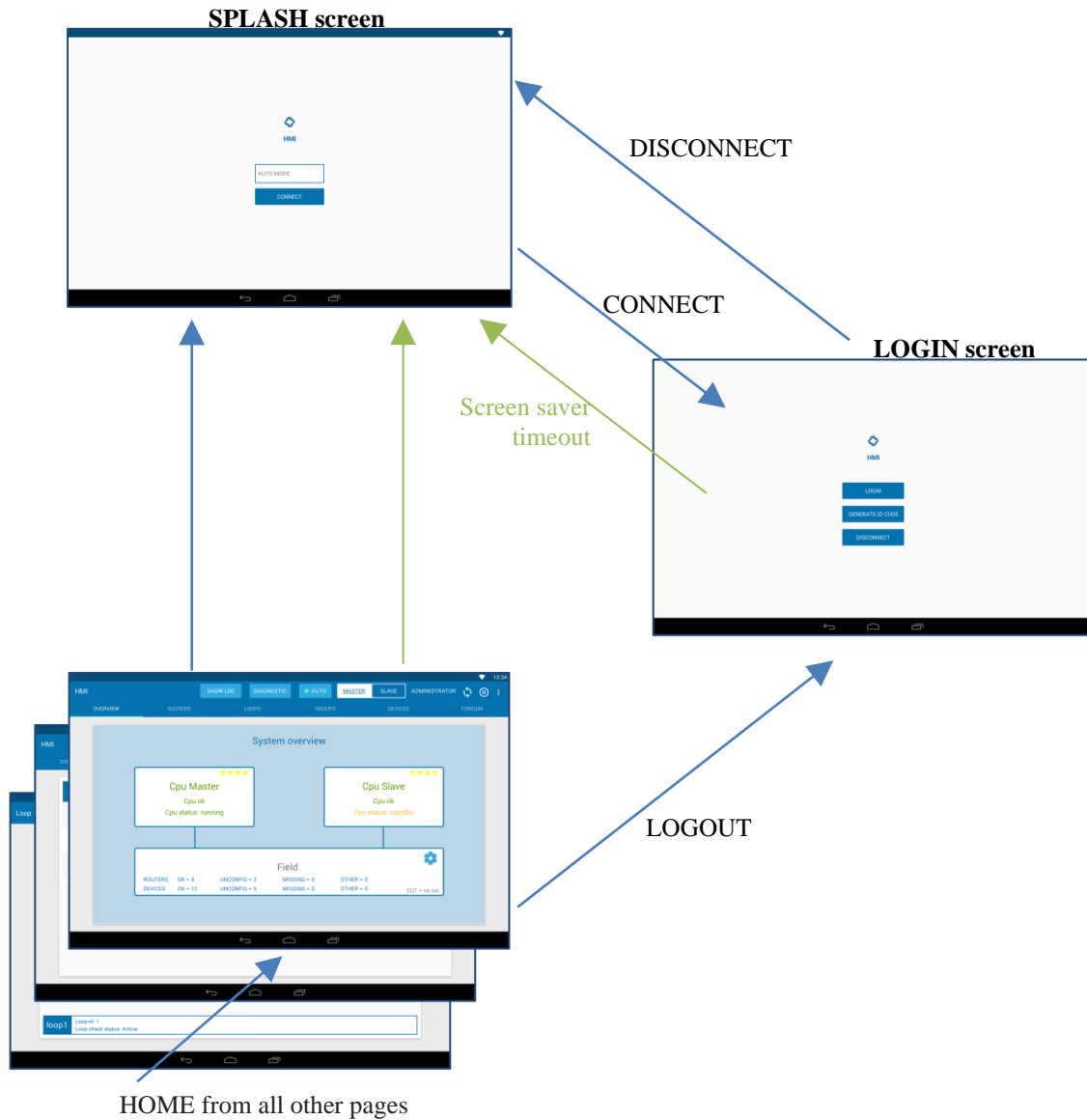
With the authentication, a work session is open to the CPU to which the user is logged in.

The work session ends with a log out operation or after a programmed period without any interaction with the operator interface.

The timeout count cannot be disabled; to keep active the login the NO-LOGIN user's role must be changed.

5.2.1 Access sequence

The access sequence to the programme is as follows:



In the case of connection change, a LOGOUT and a DISCONNECT must be performed in order to return to SPLASH connection.

If during operation the active connection is lost the HMI exits from the current display and return to the initial splash screen or in the login screen if it would succeed to restore the reconnection and reactivate the session.

5.3 Main Screen

The Main Screen is the page displayed to the user after logging in; it consists of the "OVERVIEW", "ROUTERS", "LOOPS", "GROUPS", "DEVICES" and "FOREIGN" tabs, with default selection on the "OVERVIEW" tab.

5.3.1 Main Screen – SYSTEM OVERVIEW

The OVERVIEW display shows the synthetic representation of the plant in its essential elements; it is the initial screen (HOME) of the application.



The page provides a summary of the plant status: it gives in a concise and immediate way the details of **Primary Master** and **Backup Master** CPUs and **Field** that represents the entire field connected to the DCM2.

For each "**Master**" are shown:

- CPU Name: green when on, grey when off.
- CPU Status: "OK" in green when on, "Fault" in orange when off, "Error" in red if there is an open failure of the LonWorks channel implemented in the Master unit.
- CPU operating state: "Running" in green if it has the control, "Standby" in orange if it is in standby, "undefined" in grey if the state is not defined.
- Communication status of the four MODBUS channels to the Host system, through LED that becomes green when the channel is active or yellow otherwise.

The data of the nodes status and the indications of the interruptions in the connections present or resolved are summarized in the block "**Field**".

The status of the nodes is given by indicating the totality of the ROUTERS and DEVICES nodes under the following conditions:

- **OK** operating correctly
- **UNCONFIG** not yet configured
- **MISSING** not communicating
- **OTHER** in other statuses



In the block "**Field**" tap on "Command menu" control to recall the commands menu for managing the entire field: it will be described in a separate chapter dedicated to the authorised functions for each access level.

By tapping the block of the "**CPU**" to which the HMI is connected, it is accessed to the detail page of the selected unit; if, instead, the "**Field**" block is selected it is accessed to the "**Field overview**" page with a larger field display.

5.3.1.1 *Field overview page*



In the page are schematically shown all the loops connected to the DCM2, reachable with a vertical flick of the central part of the page (each row represents a loop).

For each defined loop, three blocks are given.

The blocks at the ends show briefly the status of the Router nodes belonging to the loop by highlighting the name in different colours depending on the status: green when operating correctly, orange if not configured, red if in faulty configuration.

The central block reports the summary data of the status of the devices that make up the loop, NET_x included for the loop made of LonWorks actuators, and the indication of the interruptions in the connections, present or resolved.

The status is given by indicating the totality of the devices belonging to the loop that are found in the following conditions:

- DEV OK devices operating correctly
- UNCONFIG devices not yet configured
- MISSING devices not communicating
- OTHER in other statuses

Tapping the "CPU" block to which the HMI is connected, it is accessed to the detail page of the selected unit; tapping a "ROUTER" block it is accessed to the detail page of the selected router.

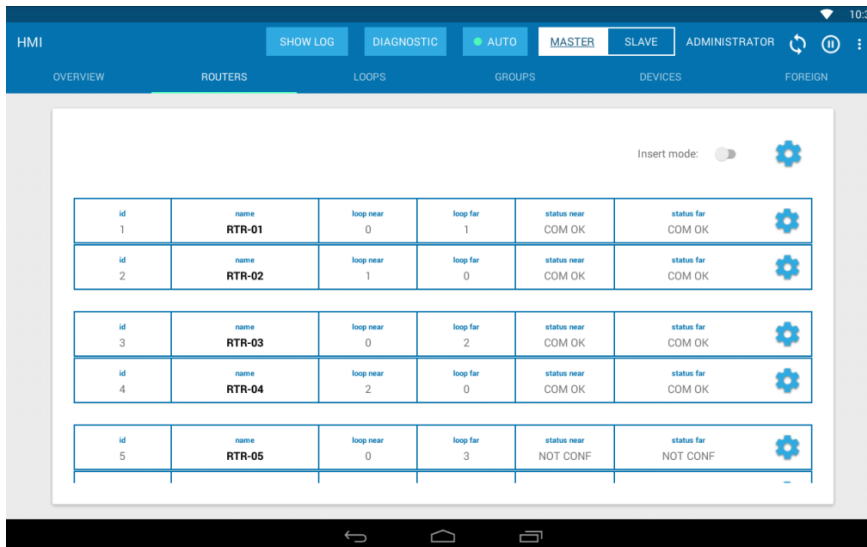
With a tap on "Loop x" block it is accessed to the details page of the loop with an extended display in graphical format.



In the "Loop x" block tap the "Command menu" control to recall the loop management command menu: it will be described in a separate chapter dedicated to authorised functions for each access level.

5.3.2 Main Screen – ROUTERS

In the case of a multi-loop system, the ROUTERS page shows the network infrastructure with the Router list that makes part of the entire system.



The routers placed at the ends of a loop are shown coupled.

The list of Routers shows the following fields:

- id** index of the table
- name** name of the router
- loop near** numeric identifier of the loop connected to the Router from the nearest part of the Master (near side)
- loop far** numerical identifier of the loop connected to the Router from the opposite side of the router (far side)
- status near** status of the near-side node
- status far** status of the far side node

The protocol applicable to a given loop is identified by the Router name (RTRxxx LonWorks; MM_CPUxxx MODBUS). The loop index brings the protocol characteristics.

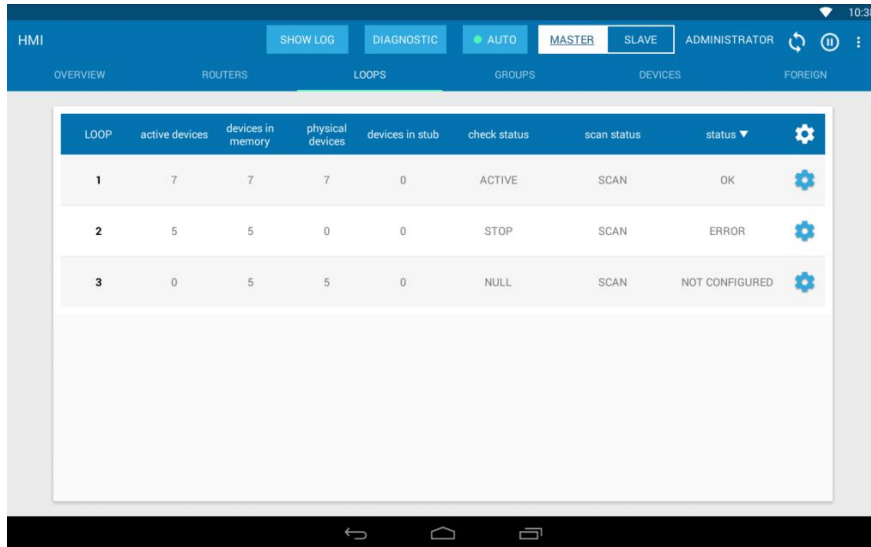
The names of the MM_CPU_X cards are predefined and depend on the slot occupied.

Master side -----						Slave side -----							
Slot #	L1	L2	L3	L4	L5	L6	Slot #	L1	L2	L3	L4	L5	L6
LonWorks	RTR-01	RTR-03	RTR-05	RTR-07	RTR-09	RTR-11	LonWorks	RTR-02	RTR-04	RTR-06	RTR-08	RTR-10	RTR-12
MODBUS	MM_CPU_01						MODBUS	MM_CPU_02					
Loops identification with 6 loop LonWorks													
Loop id	1	2	3	4	5	6	Loop id	1	2	3	4	5	6
Loops identification with 1 MODBUS													
Loop id	1(M)	-					Loop id	1(M)	-				

Tap on a row to show the specific page of the selected router.


5.3.3 Main Screen – LOOPS

The LOOPS page shows in tabular form the list of loops that are part of the whole system.



For each loop, the following general data are shown:

Loop	ordinal of the loop. MODBUS loops are identified with a (M) mark.
active devices	total number of active devices, i.e. ICONFDI, NET_x and FDI_x types that are in the status COM OK, WAIT, TERM_A or TERM_B; ICONMB types in the status COM_OK.
devices in memory	total number of the field devices defined during the configuration stage.
physical devices	total number of the field devices listed in the configuration file.
devices in stub	total number of field devices connected in a "stub" mode
check status	status of Loop Check Function for the LonWorks loops. It can assume the following values: NULL cable list not yet created or NETx temporary not communicating STOP the function is not running ARMED the function has been launched and the NETx nodes at the ends of the loop are going to establish valid communication ACTIVE the function is operative TRIGGERED the function has recognized a network interruption SOLVED the network interruption has been fixed
scan status	status of the scan function on the loop. It can assume the following values: SCAN normal operation; the loop is marked by cyclical queries of the CPU that has the control and that can send configuration commands LOCK operation temporarily blocked: a command that inhibits the periodic queries of the CPUs is in progress (configuration, reconstruction of the cabling sequence, research of the cutting) OFFLINE with an OFFLINE command the communications with all devices in the loop are disabled
Status	general status of the loop nodes

In the "Status" column the control  is the tool to apply a filtering criterion on the displayed data. When a filter is active, the title of the column is shown in green and the applied filter is displayed in brackets.

Tap on a row to enter in the details page of the loop with an extended graphical display.

From the LOOPS page, dedicated controls allow to recall the loop management commands: they will be described in a separate chapter dedicated to authorised functions for each access level.

5.3.3.1 Loop detail page

By tapping an item from the list of the LOOPS page, or a "Loop x" block from the "Field overview" page, it is accessed to the graphical display of the loop.



The page has a bottom area with the identifier of the selected loop and the status of the cut search function, with possible reference to a present or managed cutting.

In the central part of the page are listed all field devices that belong to the loop, in the order of connection defined in the stage of configuration.

The connection is highlighted with a schematisation of the cable that connects the icons.

To view all loop devices, flicking horizontally is used.

An icon represents each device; device details are represented in the vertical portion of the page where the icon is located.

For each device, the following information is given:

- Tag Name (displayed in blue)
- Position in cable list (0 if unknown)
- Node Type (deducted from the icon image)
- State of the node that includes:
 - o State or local selector: REMOTE, OFF, LOCAL
 - o Device diagnostics: OK, ERROR, WARNING
 - o Communication state of the interface
- Position of the valve, for the nodes that provide the acquisition of this data
- Status of the connection
- Presence of a Repeater placed after the node, through display of the graphical symbol and of the TAG associated to it.

By definition, the loop is represented by considering the master CPU at the left end and slave CPU at the right end; any LonWorks loop has the control NET_H will always be displayed on the left and NET_T always on the right.

The devices belonging to a LonWorks loop but still not entered in cable list are presented to the right of NET_T with "0" position.

The terminations are shown by symbol T; the cable is shown symbolically by a continuous line for the configured devices and correctly communicating or dashed otherwise.

When the system for control of the integrity of the LonWorks loop intervenes due to an interruption in the connection sequence the T symbols moves on the icons of the devices indicated with TERM_A and TERM_B and the section of cable between the two T symbols is highlighted in orange to indicate the presence of the interruption.

Tap on the icon of a device to show the selected item detail page.

From the detail page of the loop, dedicated controls allow to recall the commands for the list cabling maintenance: they will be described in a separate chapter dedicated to the authorised functions for each access level.

5.3.3.1.1 Nodes status definition

The CPU that controls the plant defines the status of the nodes.

The graphic attributes of the node names and the colours of the indications change according to the node actual status.

Table for nodes: **ROUTER**

Code	Text	Colour	Description
0	NOT CONF	ORANGE	NOT configured node
1	NO COM	GREY	node NOT communicating
2	CONF ERR	RED	node with a configuration error
3	COM OK	GREEN	node is configured and communicates correctly
7	DELETED	WHITE with a BLACK border	node deleted
9	OFFLINE	BLUE	node declared OFFLINE with a DMC2 command
10	ISOLATED	GREY	node ISOLATED with a DMC2 command

Table for nodes: **ICONFDI, NETx, FDIx**

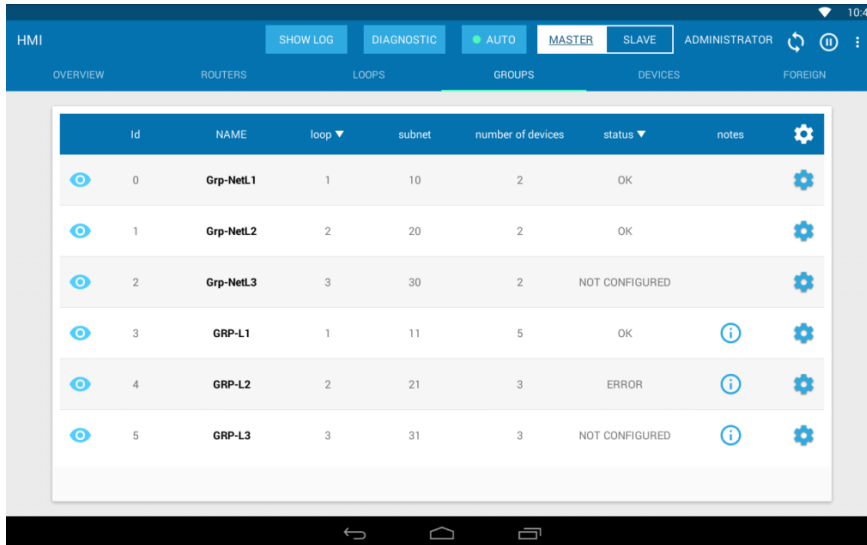
Code	Text	Colour	Description
0	NOT CONF	ORANGE	NON configured device
1	NO COM	GREY	device NOT communicating
2	CONF ERR	RED	device with a configuration error
3	COM OK	GREEN	device is configured and communicates correctly
4	WAIT	GREEN	position of network terminators not acquired
5	TERM_A	GREEN	network terminator active on output side
6	TERM_B	GREEN	network terminator active on input side
7	DELETED	WHITE with a BLACK border	device deleted
8	REVERSE	ORANGE	device is connected reverse
9	OFFLINE	BLUE	device declared OFFLINE with a DMC2 command
10	ISOLATED	GREY	device ISOLATED with a DMC2 command

Table for nodes: **ICONMB**

Code	Text	Color	Description
1	NO COM	GREY	Device not responding
2	CONF ERR	RED	Exception errors received
3	COM OK	GREEN	Device responding to the interrogations
7	DELETED	WHITE border BLACK	Device deleted. device excluded permanently from the devices scan.
9	OFFLINE	BLUE	Device Offline by a command from DCM2 screen. Th device is excluded temporarily from the devices scan.


5.3.4 Main Screen – GROUPS


The GROUPS page shows the groups defined for each loop.



For each group, the following general data are shown:

- id** id of the group. MODBUS groups are identified with a (M) mark.
- Name** name assigned to the group.
- loop** loop in which the group has been entered.
- subnet** subnet assigned to the group by the CPU. The CPU automatically calculates the subnet value; the value is unique for the entire installation and cannot be changed by the operator.
- number of devices** number of field devices defined in the group
- status** overall status of the group devices
- notes** the selection of the "i" symbol, if present, displays the notes entered for the group to which the symbol is associated.

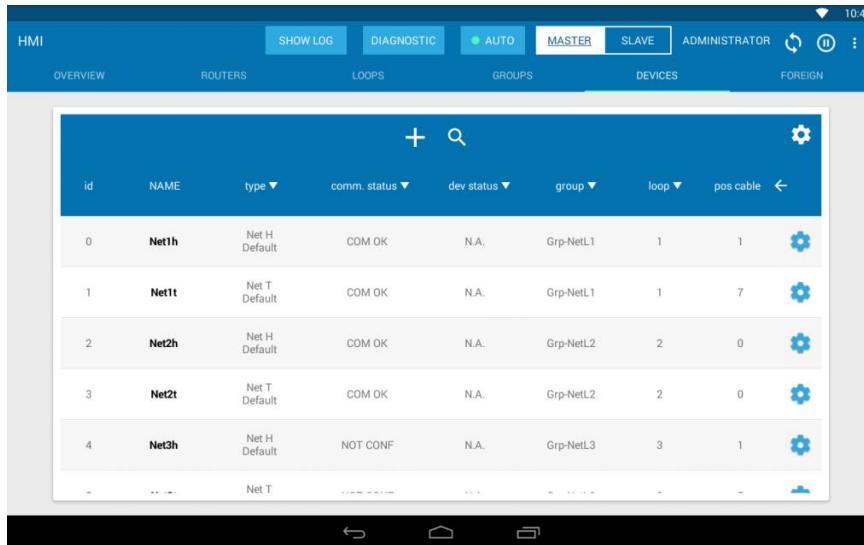
By the control  in "Status" and "Loop" columns it is possible to apply a filtering criterion on the displayed data. When a filter is active, the title of the column is shown in green and the applied filter is displayed in brackets.

By the control  available for each group it is possible to enter in the DEVICES page filtered by the selected group, hence showing in the list of the devices belonging to the group.

From the GROUPS page, dedicated controls allow to recall definition and management command menu: it will be described in a separate chapter dedicated to authorised functions for each access level.

5.3.5 Main Screen – DEVICES

The DEVICES page shows the field devices that are part of the entire system, listed in the order they have been defined.



For each field device the following data are shown:

- id** ordinal of the list (sorting default). MODBUS devices are identified with a (M) mark.
- Name** TAG name with which the user knows the device
- type** identifier of the device type and sub-type (shown as strings)
- comm.status** device communication status
- dev.status** indication of the device diagnostic
- group** group name in which the device is defined
- loop** identifier of the loop in which the device is defined
- pos.cable** position of the device in the cabling sequence, with Increasing- Decreasing-None sorting filter (arrow-shaped symbol)



the controls to show or to hide the following columns from the list:

- neuron id** identifier of the LonWorks card
- subnet** identifier of the subnet in which the device is defined
- node address** address assigned to the device

By the controls  it is possible to apply multiple filtering criteria on the displayed data. When a filter is active, the title of the column is shown in green and the applied filter is displayed in brackets.

Tap on a row to enter in the details page of the selected device.

From the DEVICES page dedicated controls allow to recall the device management commands: they will be described in a separate chapter dedicated to authorised functions for each access level.

5.3.5.1 *Research of a device*



The search tool allows to perform a research of a device inside the device list by the following keys:

by TAG

by entering the entire name or any of its portion. The list will contain only the devices that in the name contain the entered string. The search is applied only to the items displayed in the current list, that is to those reported following the application of a filter.

by Neuron ID

by entering the entire Neuron ID or a portion. In the list are shown only those devices that contain the entered sequence in its own Neuron ID.

The Neuron ID can be acquired directly from the device: while the search page is opened, on the device press the push-button that generates the service message and the Neuron ID is automatically entered in the search field of the page.

ICON, ICON2000 and ICON3000 actuators send the identification message (Service pin message) by pressing STOP push-button while the local selector is in REMOTE position.

5.3.6 Main Screen – FOREIGN

The FOREIGN page shows the list of LonWorks devices that have been registered, but that do not match any identifier in the system.

id	neuron id	program id	
0	000940215300	ICON2_x1	
1	000940230200	ICON2_x1	
2	00A264723700	ICON2_x1	

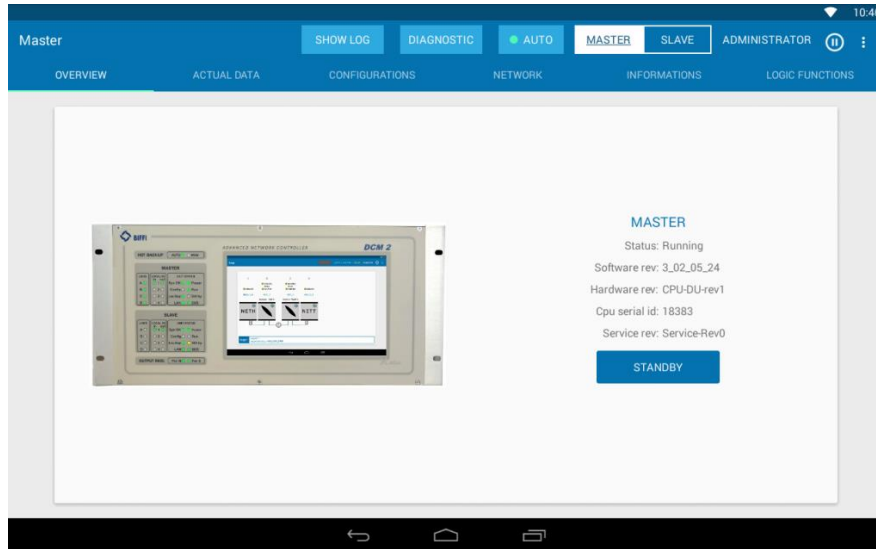
The proposed list has the following fields:

- id** progressive index
- neuron id** identifier of the LonWorks cards that the actuator interface has sent to the DCM2 by the Service Pin Message
- program id** generic name (string) that the LonWorks cards have sent to the DCM2

From the FOREIGN page, dedicated controls allow to recall commands for the management of the not registered devices: they will be described in a separate chapter dedicated to the authorised functions for each access level.

5.3.7 CPU Page

By tapping the "CPU" block, from the "System overview" or "Field overview" pages it is accessed to the data of the CPU to which the HMI is connected.



The details page consists of the "OVERVIEW", "ACTUAL DATA", "CONFIGURATIONS", "NETWORK", "INFORMATION" and "LOGIC FUNCTION" tabs with default selection on the "OVERVIEW" tab.

The various tabs group together a series of information that is accessible by all users. They also contain commands and modifiable parameters enabled according to the connected user; a more detailed description will be provided in a separate chapter dedicated to the authorised functions for each access level.

The data available on display to all authenticated users with reference to the tabs in which they are given are the following.

5.3.7.1 *OVERVIEW tab*

In the OVERVIEW tab are shown the identification data of the selected CPU, the status and the details of the hardware and software versions in use.

By tapping the image on the left, it is possible to access the DCM2 Manual.

5.3.7.2 *ACTUAL DATA tab*

In the ACTUAL DATA tab is shown the status of the selected CPU.

The user can see the CPU memory allocation, the number of nodes (routers and field devices) declared in the configuration file and the status of the internal Lithium battery (when status is not set to **GOOD** is highly recommended to replace it).

The active CPU summary data are also shown; they are related to Master or Slave depending on the active connection. The data related to the connected CPU are listed in column **Local**, while column **Remote** is related to the other CPU.

The followings summary data are reported, either for Local or for Remote CPU:

- Current status of the CPU
- Dimension in bytes of the configuration file loaded
- Date of the configuration file
- Time of the configuration file
- CRC of the configuration file
- FDI/Router: status of the communication with nodes NET_x and ROUTER close to the CPU

- Outbound packets queue. It is the utilization rate of the fieldbus commands queue which gives an indication of the working load of the DCM2. In heavy load condition, this figure should remain to a constant value different from 0%. If it reaches the value 99% the CPU will reply a 'busy' error code to the MODBUS interrogation.
- Cable fault in progress / fixed. Loop integrity summary valid on the active CPU: number of network interruptions detected by the system and not yet fixed and number of network interruptions fixed.

In the bottom side of the page the status of the scan of the network is reported; a green light blink when a refresh of the data is executed. The following values are shown:

- Number of routers linked at the closer and at the opposite side of the CPU which is connected to the HMI, and the number of Routers in error.
- Number of NET devices linked at the closer and at the opposite side of the CPU which is connected to the HMI, and the number of NET devices in error.
- Number of field devices linked to the CPU which is connected to the HMI, and the number of field devices in error

If the two CPUs do not have the configuration file aligned, in the ACTUAL DATA tab a signal will be entered to the user. The same signal will be present also in the "MAIN Page".

5.3.7.3 **CONFIGURATIONS tab**

In the CONFIGURATIONS tab are highlighted the "Synchronisation mode" possibly active and the "Broadcast period" set for time propagation to the actuators enabled to the reception of the time through LonWorks.

5.3.7.4 **NETWORK tab**

In the NETWORK tab are shown the current settings for the network and for the four MODBUS channels.

5.3.7.5 **INFORMATION tab**

The INFORMATION tab provides some information related to the configuration file actually loaded on the DCM2.

5.3.7.6 **LOGIC FUNCTIONS tab**

In the LOGIC FUNCTIONS tab are shown:

- The configuration given to the digital input and the current values of the 4 digital inputs connected to the DCM2.
- The expression and the status of the 3 Groups of Command (GC) defined in the DCM2 configuration.
- The configuration given to the digital output and the status of the 4 digital outputs of the DCM2.

5.3.8 Nodes Detail Pages

All devices managed by the DCM2 have their own page from which the operator can access the parameters of the selected device. The page is accessible only if the node is configured and in a state that allows it to communicate with the DCM2.

Depending on the selected node type, the details page shows different tabs; for all nodes types the OVERVIEW tab is selected by default.

As an example it is shown the details page of an ICONFDI node type.

At the entry in the device details page a full re-reading of the node data is launched in order to acquire possible modifications carried out by a field operator: the display of actual data of the selected node will be shown only at the end of the reading.

The detail of the router nodes type shows read-only data.

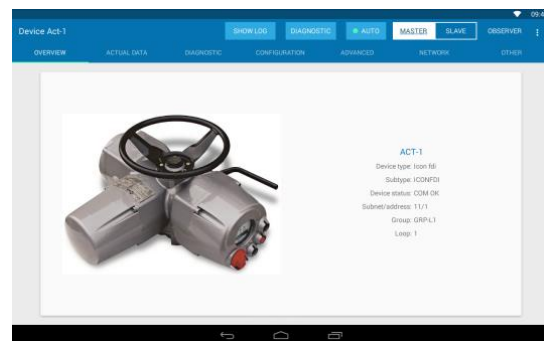
For all other nodes the tabs contain commands and changeable parameters according to the connected user; a more detailed description will be provided in a separate chapter dedicated to the authorised functions for each access level.

The OVERVIEW tab gives information for the identification of the selected node.

The following data are highlighted:

- Type and possible subtype of the node
- Current status of the node
- Identification of network parameters

By tapping the image to the left, it is possible to access the manual associated with the type and subtype of the selected node.



5.3.8.1 Router nodes

For the Routers nodes type the CONFIGURATION tab shows the details about the node configuration:

LonWorks Router

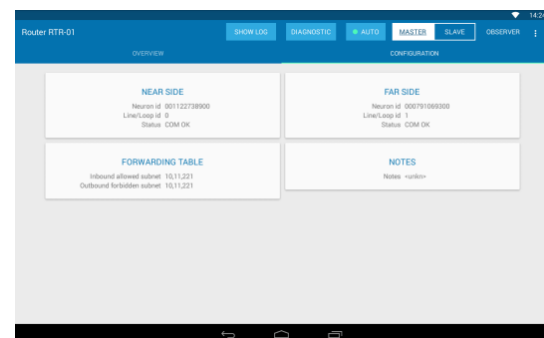
- NEAR SIDE and FAR SIDE data:
 - o Neuron ID: LonWorks interface identifier
 - o Loop identifier
 - o Node Status
- FORWARDING TABLE:
 - o Inbound allowed subnet: list of the subnets which is allowed to communicate with the field
 - o Outbound forbidden subnet: list of the subnets which is not allowed to communicate with the DCM2

MODBUS Router

- FIELD COMMUNICATION data:
 - o Baud rate, bit, parity, stop bit;
 - o Redundancy type
 - o Parameters set

Node Status

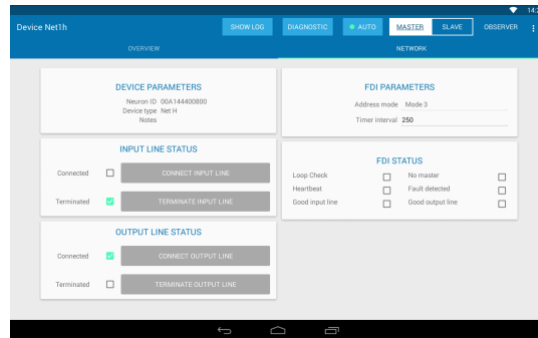
Notes eventually inserted during router definition phase



5.3.8.2 **NETx and FDIx nodes**

For the NETx and FDIx nodes types the NETWORK tab gives the LonWorks network details:

- Device Parameters
- FDI Parameters
- Input and Output Lines Status
- FDI Status



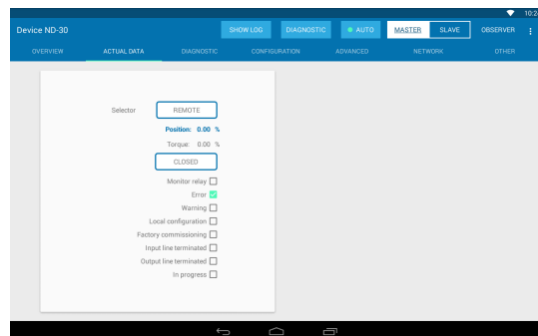
5.3.8.3 **ICONFDI node**

As an example the pictures of an ICONFDI type node is shown.

5.3.8.3.1 **ACTUAL DATA tab**

In the ACTUAL DATA tab of an ICONFDI node types the following information is given:

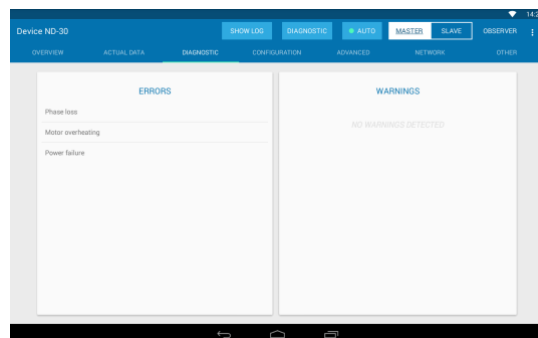
- Selector status: REMOTE is the status that allow the DCM2 to drive the actuator
- Indication of the valve position
- Valve actual Position value
- Actual Torque value (ICONFDI only)
- List of main statuses of the selected device



5.3.8.3.2 **DIAGNOSTIC tab**

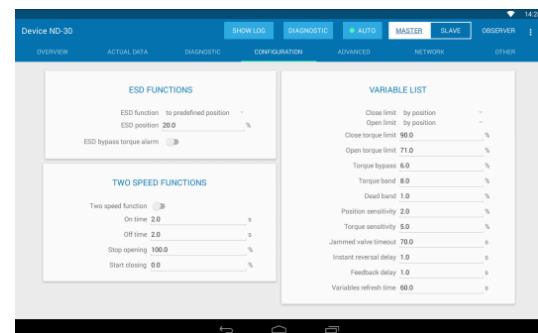
In the DIAGNOSTIC tab, present for ICONFDI nodee, the details of the current node status are shown:

- List of active Errors and Warnings



5.3.8.3.3 **CONFIGURATION tab**

In the CONFIGURATION tab are collected the set-up parameters of the field device.



5.3.8.3.4 ADVANCED tab

The ADVANCED DATA tab shows the details of the current node status:

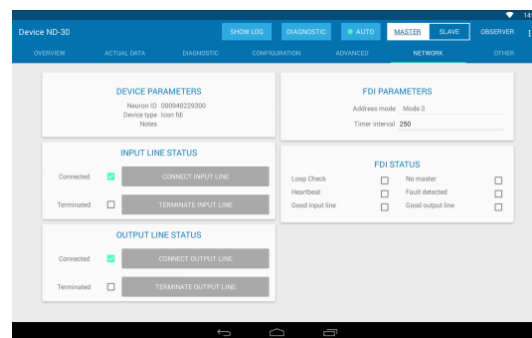
- Nameplate data
- Dates
- Power Supply data
- Actuator Type (ICONFDI only)
- HW/SW revision data
- Maintenance information



5.3.8.3.5 NETWORK tab

The NETWORK tab shows the details of the LonWorks network:

- Device Parameters
- FDI Parameters
- Input and Output Line Status
- FDI Status (ICONFDI only)

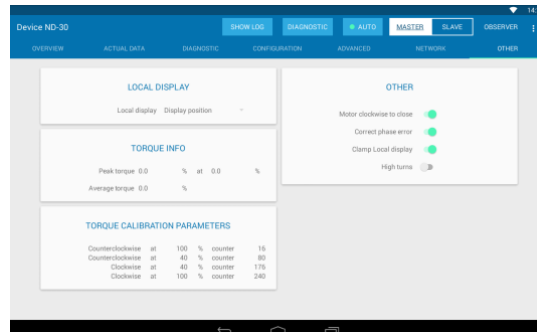


5.3.8.3.6 OTHER tab

The parameters of this group are present for all the ICONFDI nodes but have a meaning only for the ICONFDI nodes implemented on the "Series C" actuators.

The following data are displayed:

- Local Display setting
- Motor clockwise to close setting: on or off
- Correct phase error setting: on or off
- Clamp local display setting: on or off
- High turns setting: on or off
- Torque info
- Torque calibration parameters



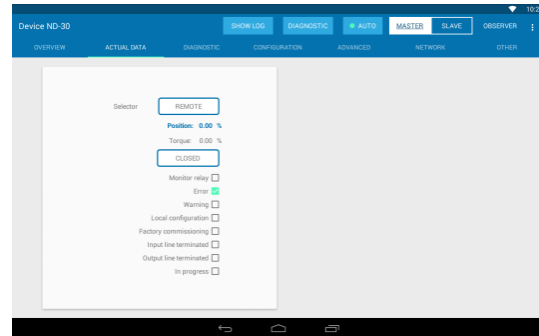
5.3.8.4 **ICONMB node**

As an example the pictures of an ICONMB type node is shown correspondent to ICON3000 actuator equipped with MODBUS interface card.

5.3.8.4.1 **ACTUAL DATA tab**

In the ACTUAL DATA tab of an ICONMB node types the following information is given:

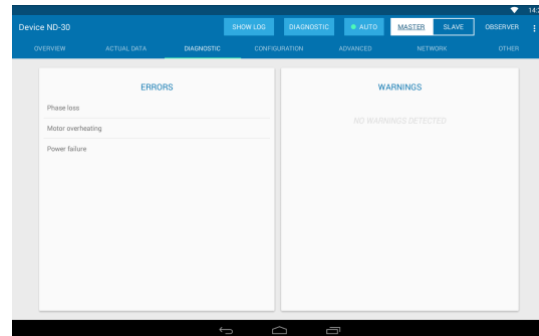
- Selector status: REMOTE is the status that allow the DCM2 to drive the actuator
- Indication of the valve position
- Valve actual Position value
- Actual Torque value (ICONFDI only)
- List of main statuses of the selected device



5.3.8.4.2 **DIAGNOSTIC tab**

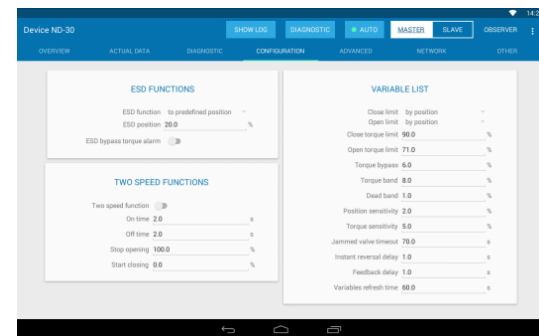
In the DIAGNOSTIC tab, present for ICONMB nodee, the details of the current node status are shown:

- List of active Errors and Warnings



5.3.8.4.3 **CONFIGURATION tab**

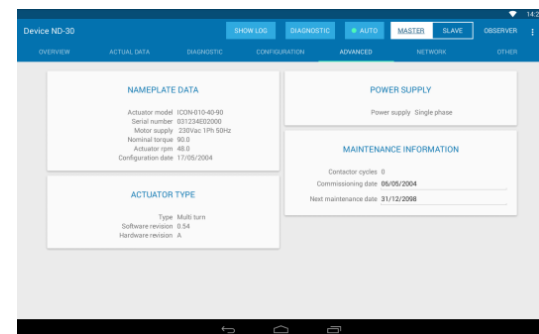
In the CONFIGURATION tab are collected the set-up parameters of the field device.



5.3.8.4.4 **ADVANCED tab**

The ADVANCED DATA tab shows the details of the current node status:

- Nameplate data
- Dates
- Power Supply data
- Actuator Type (ICONMB only)
- HW/SW revision data
- Maintenance information



5.4 Operations on Top Bar

In the top bar are present the indications on the status of the connection between the HMI and the CPU and the commands available to all users.

5.4.1 AUTO



The button highlights the current connection mode.

When in AUTO the GREEN indication is lit; when in MANUAL the indication turns to RED.

When the current mode is MANUAL a tap on AUTO button changes the connection mode to AUTO and the HMI turns the connection to the CPU that has the control.

If the new connection changes the CPU to which the HMI was linked the former connection is closed and a new request of credential is displayed.

5.4.2 MASTER – SLAVE



It highlights the CPU which is currently connected to the HMI by the caption BLUE in WHITE background and offer the controls to set a manual connection to the Master or the Slave CPU.

Tapping a control the HMI establishes a manual connection to the addressed CPU. If the new connection changes the CPU to which the HMI was linked the former connection is closed and a new request of credential is displayed.

5.4.3 Active login



It highlight the current user.

By tapping the item, it is activated the page for entering credentials and change the current login.

5.4.4 Indication of the current operation



During the execution of a command, is displayed a circular icon in motion that signals that there is a command in progress. For long commands that can be interrupted a value is added indicating the percentage of the command progress; by tapping the value a temporary pop-up is displayed indicating the type of command under execution.

5.4.5 Menu



The button on the side activates the HMI settings menu.

The menu contains the functions list available to the current user.

The functions common to all users are the followings:

5.4.5.1 Login

The selection of the item activates the page for entering credentials and changing the current login.

5.4.5.2 Logout

It ends the active session and returns to the "NO LOGIN" status.

5.4.5.3 Change Password

The logged in user can change its password.

5.4.5.4 *Disconnect*

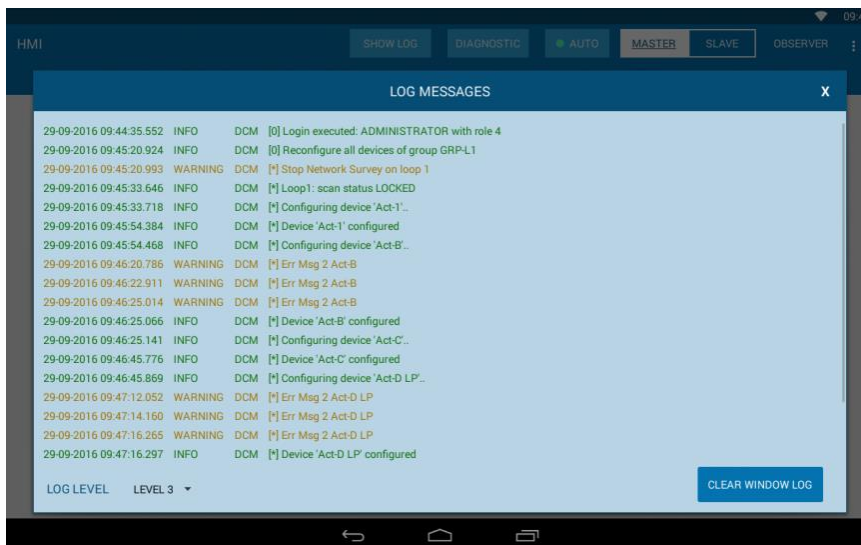
Command to disconnect the user and the HMI from the CPU: it is returned to the initial splash to set a new connection.

5.4.5.5 *About*

Detail the HMI Hardware and Software versions.

5.4.6 SHOW LOG

Tap "SHOW LOG" to display the registered logs from the HMI during the current connection.



The window gives in a scrollable list the incoming messages from the CPU to which the HMI is connected since the beginning of the communication session.

For each message is given the date and time of recording and is used a different colour depending on the importance of the message.

The "LOG LEVEL" parameter defines the log level to be activated and acts on the acquisition of future messages: the list all the messages received from the CPU are always present.

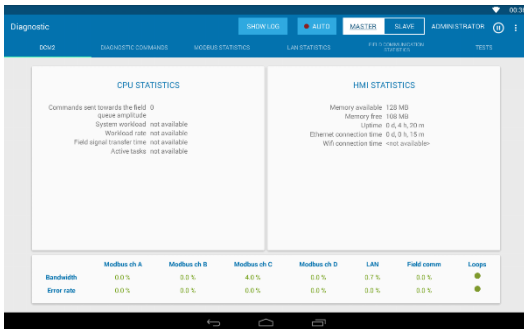
With the "CLEAR WINDOW LOG" button is temporarily cleared the list, so that it can be viewed only the next acquisitions without leaving the window.

The log present on the list is volatile: it is deleted at each time the session is closed.

5.4.7 DIAGNOSTIC page

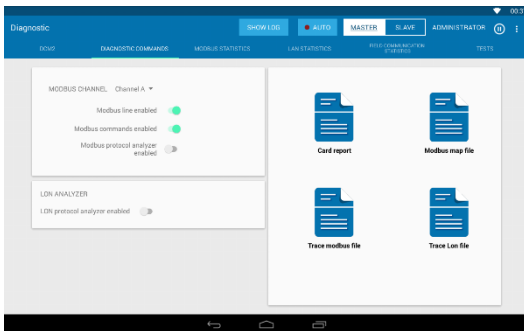
Tap "DIAGNOSTIC" to open a page that provides to the user diagnostic principals of the DCM2 with counts that start from zero when entering in the diagnostic session.
The page consists of the following tabs:

5.4.7.1 DCM2 tab



This tab gives to the user general statistical data related on the DCM2 unit.

5.4.7.2 DIAGNOSTIC COMMANDS tab

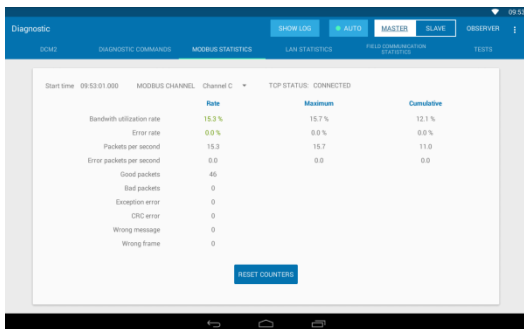


In this tab are displayed the settings active on each Host line about:

- MODBUS line
- MODBUS commands

The setting changes are allowed only to the enabled user.

5.4.7.3 MODBUS STATISTICS tab

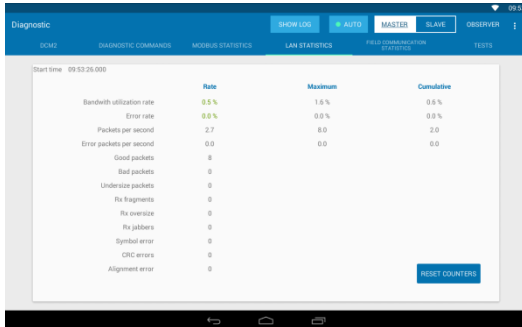


In this tab are proposals to statistics for each Host MODBUS channel and in the case of TCP lines it is also highlighted the connection status.

The "Bandwidth Utilisation Rate" and "Packets per Second" values are coloured according to their value: Green <30%; Yellow <80%; Red.

The **RESET COUNTERS** control resets all the counters.

5.4.7.4 LAN STATISTICS tab



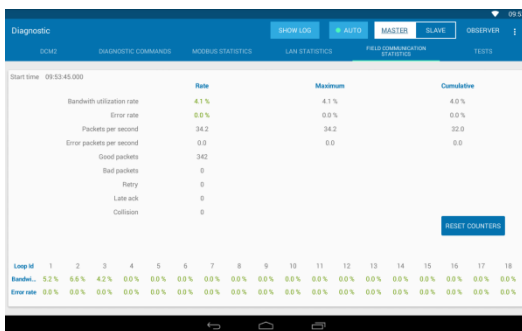
In the tab are shown statistics concerning the Ethernet traffic present on the LAN line.

Sampling is active from the moment in which it is entered in the page.

The "Bandwidth Utilisation Rate" and the "Packets per Second" values are coloured according to their value: Green <30%; Yellow <80%; Red.

The **RESET COUNTERS** control resets all counters.

5.4.7.5 FIELD COMMUNICATION STATISTICS tab



In the tab are shown the communication statistics in the LonWorks field.

The sampling is active from the moment that it is entered in the page.

The page is divided into two areas:

Statistics related to the LonWorks channel of the DCM2

Regardless of the architecture of the system, "Single Loop" or "Multiple Loop", the data are read directly from the LonWorks interface onboard the DCM2.

The "Bandwidth Utilisation Rate" and the "Packets per Second" values are coloured according to their value: Green <30%; Yellow <80%; Red.

The **Cumulative** column gives the average of the last 30 samples received that correspond to the last five minutes of recording.

Statistics related to a loop in "Multiple Loop" architecture.

The data are read by the far interface of the ROUTER facing the selected loop and connected to the CPU with the control to which the statistical data are requested.

For each present loop are provided only Bandwidth and Error rate data.

The "Bandwidth Utilisation Rate" and the "Packets per Second" values are coloured in Green, Yellow or Red according to their value: Green <30%; Yellow <80%; Red.

The **RESET COUNTERS** control resets all counters.

5.4.7.6 TESTS tab

From this tab are activated the hardware test functions available only to the enabled user.

6. DCM2 FUNCTIONS

This chapter describes the functions of the DCM2 by highlighting their authorisation differences among the various access levels.

A user is enabled to execute procedures allowed to users with lower-level rights.

6.1 OBSERVER – Authorized Functions

The OBSERVER access level is assigned to users who can only view data or plant status: to them any change to the system is allowed.

All functions described in the chapter "*OPERATOR INTERFACE*" are allowed to all users therefore also to an OBSERVER.

Unlike the other access levels there may be multiple parallel connections up to 4.

OBSERVER can access to the following functions.

6.1.1 LonWorks Devices Identification – Wink commands

DCM2 implements two methods to identify LonWorks field devices.

The first is provided by the search function accessible from the DEVICES page and already described in the previous chapter.

A second method consists in sending to the device an identification control by the **Wink** command that enables the function to identify one or more devices.

ICON family actuators execute the Wink function by “blinking” the LEDs on the Local operator interface for 10 seconds.

The following Wink commands are available.

6.1.1.1 *Wink devices in all groups*

The command is accessible from the "Command menu" of the Field block present on the "**System Overview**" page.

It enables the function to identify the field devices belonging to the whole system: all the field devices of the system perform the '*Wink*' function.

6.1.1.2 *Wink devices of the loop*

The command is accessible from the "Command menu" of every row of the table present in the **LOOPS** page.

It enables the function to identify the field devices belonging to the selected loop: all the field devices of the loop perform the '*Wink*' function.

6.1.1.3 *Wink devices of the group*

The command is accessible from the "Command menu" of every row of the table present in the **GROUPS** page.

It enables the function to identify the field devices belonging to the selected group: all the devices of the group perform the '*Wink*' function.

6.1.1.4 *Wink device*

The command is accessible from the "Command menu" of every row of the table present in the **DEVICES** page.

It enables the function to identify the selected field device, which perform the '*Wink*' function.

6.1.1.5 *Wink foreign device*

The command is accessible from the "Command menu" of every row of the table present in the **FOREIGN** page.

It enables the function to identify the selected foreign field device, which perform the 'Wink' function.

6.1.1.6 *Wink all foreign devices*

The command is accessible from the general "Control menu" of the **FOREIGN** page.

It enables the function to identify all the field devices belonging to the FOREIGN group: all the foreign devices perform the 'Wink' function.

6.1.2 Data Update – Refresh commands

DCM2 implements commands for update the data relevant to one or more devices.

The following Refresh commands are available.

6.1.2.1 *Refresh all devices data*

The command is accessible from the "Command menu" of the Field block present on the "**System Overview**" page.

It causes the updating of the data area relevant to all groups by reading all communication objects of all field devices configured in the system.

6.1.2.2 *Refresh loop data*

The command is accessible from the "Command menu" of every row of the table present in the **LOOPS** page.

It causes the updating of the data area relevant to the selected loop by reading all communication objects of all nodes belonging to the selected loop.

6.1.2.3 *Refresh group data*

The command is accessible from the "Command menu" of every row of the table present in the **GROUPS** page.

It causes the updating of the data area relevant to the selected group by reading all communication objects of all nodes belonging to the selected group.

6.1.2.4 *Refresh device data*

The command is accessible from the "Command menu" of every row of the table present in the **DEVICES** page.

It causes the updating of the data area relevant to the selected field device by reading all communication objects of the field device.

6.2 PLANT OPERATOR - Authorized Functions

The PLANT OPERATOR access level is assigned to those users who, besides to what is permitted to the rights of the OBSERVER, must be able to send controls to the plant actuators.

When a user with this access level is connected no other user with an access level other than OBSERVER can be connected.

PLANT OPERATOR can access to the following functions.

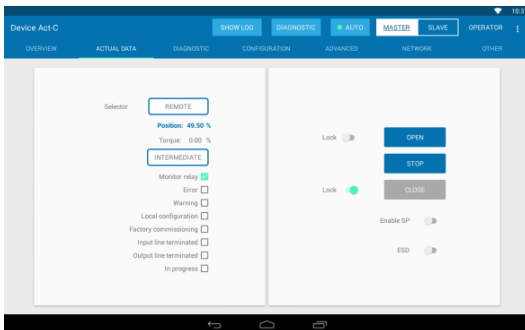
6.2.1 Actuator commands

The commands are grouped together in the ACTUAL DATA tab of an actuator details page.

6.2.1.1 ICONFDI Node Commands

As an example, the image of an ICONFDI type node is shown.

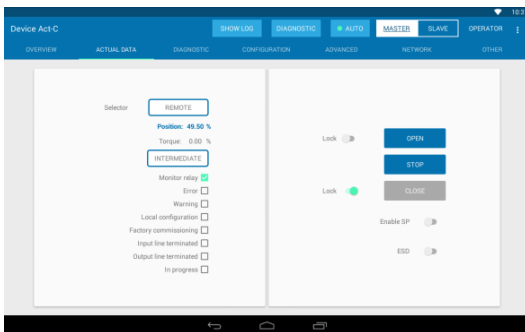
The permitted commands for ICONFDI node are the following:



- Open: it generates the opening of the valve
- Close: it generates the closing of the valve
- Stop: it interrupts the movement in progress
- Open Lock: it inhibits the function of Open
- Close Lock: it inhibits the function of Close
- ESD: it performs an Emergency ShutDown
- Setpoint: enable and setpoint position definition

6.2.1.2 ICONMB Node Commands

The permitted commands for ICONMB node are the following:



- Open: it generates the opening of the valve
- Close: it generates the closing of the valve
- Stop: it interrupts the movement in progress
- Setpoint: enable and setpoint position definition

6.3 PLANT MAINTENANCE - Authorized Functions

The PLANT MAINTENANCE access level is assigned to those users who, besides to what is permitted to the rights of the PLANT OPERATOR, must be able to modify the configuration data of the actuators in the plant.

When a user with this access level is connected no other user with an access level other than OBSERVER can be connected.

PLANT MAINTENANCE can access to the following functions.

6.3.1 Actuator parameters modification

6.3.1.1 Reset Button

In the DIAGNOSTIC tab of the ICONFDI node there is the "RESET" button that forces rereading of the data from the base card.

6.3.1.2 ICONFDI Nodes- Actuator data

In the CONFIGURATION tab of an ICONFDI type node, there can be set:

ESD configuration data

- Selection of the active ESD function
- ESD position percentage
- Selection of the ESD bypass toque alarm

TWO SPEED configuration data

- Selection of the Two speeds function
- On time value (sec)
- Off time value (sec)
- Stop opening percentage
- Stop Closing percentage

VARIABLE list

- Close Limit setting: by torque or by position
- Open Limit setting: by torque or by position
- Close Torque limit percentage
- Open Torque limit percentage
- Torque bypass percentage
- Torque band percentage
- Dead band percentage
- Position sensitivity percentage
- Torque sensitivity percentage
- Jammed valve timeout
- Instant reversal delay
- Feedback delay
- Variable Refresh time (Heartbeat)

In the ADVANCED tab, the following dates may be modified:

- Commissioning date
- Next maintenance date

In the OTHER tab, the following parameters can be set to ON or OFF (only for "Series C"):

- Motor clockwise to close
- Correct phase error
- Clamp local display
- High turns

The parameters in the OTHER tab are applicable only to the ICONFDI nodes implemented on the "Series C" actuators; the current ICON2000/ICON3000 provides predefined data and does not accept the change of these parameters.

6.3.1.3 *ICONMBNodes- Actuator data*

In the CONFIGURATION tab of an ICONMB type node, there can be set:

SAFETY BEHAVIOUR configuration data

- Selection of the active function
- Position percentage
- Delay in activate the function

VARIABLE list

- Dead band percentage
- Motion inhibit time
- Channel mode (only "CH1 enable CH2 disable" is valid)

In the ADVANCED tab no data can be modified.

6.4 NETWORK MAINTENANCE - Authorized Functions

The NETWORK MAINTENANCE access level is assigned to those users who, besides to what is permitted to the rights of the PLANT MAINTENANCE, have to manage the maintenance of the system without changing its characteristics.

When a user with this access level is connected, no other user with an access level other than OBSERVER can be connected.

NETWORK MAINTENANCE can access to the following functions.

6.4.1 Active command interruption



In the top bar is available a control that, subject to the user's confirmation, interrupts the command in execution on the CPU. If the command in progress has been defined "subject to interruption" by tapping the control the interruption of the command is requested at the end of the operation in progress.

6.4.2 Data Synchronization



In the top bar is available a control that forces the full reread of all the variables incoming from the field.

Running of the control acts as a re-initialising of the interface with consequent cancelling of the logs displayed by the HMI, but not those stored in the CPU.

6.4.3 Nodes Management

Following the replacement of routers or field devices, the modification of groups in different loops, or to complete nodes configuration, the user with NETWORK MAINTENANCE privilege can execute the suitable function to manage network operations.

In addition the user can send commands to the nodes to temporarily isolate them and restore them or to set configuration parameters.

The allowed operations are the following:

6.4.3.1 Variable list reading

The user with NETWORK MAINTENANCE privilege can launch a low-level read all the available variables of a selected field devices. This command is not available for Routers.

In the OVERVIEW tab of the detail page of a device, the "Variable list" button opens a window in which are given the following references for each available variable:

- Index index of the NV variable
- Name name of the NV variable
- Value actual value
- Direction variable direction: input or output
- Type variable type
- Selector selector of the NV variable

A Refresh button is on the page to force a reread of the displayed data.

6.4.3.2 Online / Offline commands

The user with NETWORK MAINTENANCE privilege can release temporarily the devices from the network by placing them in the OFFLINE status.

The controls, which are activated after a confirmation by the operator, are applicable only to the nodes with a good communication status.

6.4.3.2.1 Turn loop off-line

The "**Turn loop off line**" command is used to set the OFFLINE status to the loop, and therefore to all the nodes that make it up; it is accessible from the "Command menu" of every row of the table present in the LOOPS page.

The nodes belonging to the loop in the OFFLINE status are not in a condition to communicate; therefore all commands that require a communication with the nodes of the loop are inhibited.

The only possible commands are the data changes that do not require a communication with the nodes and the command to reset the online status of the loop.

6.4.3.2.2 Turn loop on-line

The command "**Turn loop on line**" is applicable to the devices of the selected loop that was previously set in the state **OFFLINE**. By means of the command the nodes belonging to the selected loop (Routers, NET_x and devices) return to the online mode.

The command is accessible from the "Command menu" of every row of the table present in the LOOPS page.

When the loop goes from offline to online it is executed a reread of data in background for all the devices belonging to the loop.

6.4.3.2.3 Turn device off-line

The command "**Turn device off line**" is applicable to a single field device; it causes the selected device to turn in Offline mode and stops its communications; the selected field device shows the state **OFFLINE**.

The command is accessible from the "Command menu" of every row of the table present in the DEVICES page.

A device in the OFFLINE state is not in a condition to communicate; therefore, all commands that require a communication with the node are inhibited; the only possible commands are the data changes that do not require a communication with the node, and the command to reset the online status.

6.4.3.2.4 Turn device on-line

The command "**Turn device on line**" is applicable to a field device that was previously set in the state **OFFLINE**. By means of the command, it is possible return the field device to the On Line mode.

The command is accessible from the "Command menu" of every row of the table present in the DEVICES page.

6.4.3.3 *System data modification*

To the user with NETWORK MAINTENANCE privilege is allowed to modify some routers, groups or actuators static data.

All the commands are activated after confirmation by the operator.

6.4.3.3.1 Modify a Router

The command is accessible from the "Command menu" of every row of the table present in the ROUTERS page and opens a window in which there are only the data fields that can be modified.

Modify of a LonWorks router is generally necessary after the substitution of a router with another unit of the same type, e.g. for a maintenance service.

The new Neuron ID is captured using the Service Pin message coming from the replacement. Once the message is received the DCM2 shows the Neuron ID into the modify screen.

Once confirmed the modify operation, the router remains in the **NOT CONF** status and must be configured.

For the MODBUS router is possible to change its name.

6.4.3.3.2 Modify Group

The command is accessible from the "Command menu" of every row of the table present in the GROUPS page and opens a window in which there are only the data fields that can be modified.

An entire LonWorks or Modbus group can be moved from one loop to another; by changing the **Loop id** identification the group and all its devices are moved to the new loop.

The LonWorks routers of the two loops involved in the displacement are turned in the **NOT CONF** status so that a new configuration update their "routing table".

The field devices instead maintain their configuration.

6.4.3.3.3 Modify a Device

Modify of a device is generally necessary after the substitution of a field device with another unit of the same type, e.g. for a maintenance service.

The command is accessible from "Command menu" of every row of the table present in the DEVICES page and opens a window in which there are only the data fields that can be modified.

For the LonWorks devices is possible to assign the actual Neuron ID to a node which was recorded in the configuration file without its identifier.

The new Neuron ID is captured using the Service Pin message coming from the replacement. Once the message is received, the DCM2 shows the Neuron ID into the modify screen.

Once confirmed the modify operation, the device remains in the **NOT CONF** status and must be configured.

For the MODBUS device is possible to change the Modbus Slave Address.

6.4.3.4 *LonWorks Device network data modification*

6.4.3.4.1 Single device – Network device data

The integrity check system implemented in NETx, FDIx and ICON devices is based on the Fault Detection and Insulation (FDI) cards hardware.

The NETWORK tab of a device detail page shows the current configuration of the selected device. The following fields can be modified by the user which have NETWORK MAINTENANCE privileges in case a different configuration should be necessary.

Address Mode

Timer Interval

these two parameters are used to set the time delay before the communication line is acknowledged as interrupted and the retrieve procedure begins.

The following table shows the wait time in seconds, as calculated in function of the two parameters.

We recommend always setting a 5-seconds value in order to avoid all false signals of interrupted bus.

		Addr Mode			
		0	1	2	3
Timer Int	50	0,25	0,50	0,75	1,00
	100	0,50	1,00	1,50	2,00
	150	0,75	1,50	2,25	3,00
	200	1,00	2,00	3,00	4,00
	250	1,25	2,50	3,75	5,00
	300	1,50	3,00	4,50	6,00
	350	1,75	3,50	5,25	7,00
	400	2,00	4,00	6,00	8,00
	450	2,25	4,50	6,75	9,00
	500	2,50	5,00	7,50	10,00
	550	2,75	5,50	8,25	11,00
	600	3,00	6,00	9,00	12,00
	650	3,25	6,50	9,75	13,00

Commands for manually manage actuator lines are available:

- Connect Input Line** it manually connects the B side (bus in) of the selected node to the network
- Terminate Input Line** it manually disconnects the B side (bus in) of the selected node from the network
- Connect Output Line** it manually connects the A side (bus out) of the selected node to the network
- Terminate Output Line** it manually disconnects the A side (bus out) of the selected node from the network

For ICONFDI nodes are also available the following commands:

- Enable FDI function to all Group devices** do not use for NETx node - this enables the FDI function on all the devices in the same group
- Disable FDI function to all Group devices** do not use for NETx node - this disables the FDI function on all the nodes in the same group
- Enable FDI function to current device** do not use for NETx node - this enables the FDI function on the selected node
- Disable FDI function to current device** do not use for NETx node - this disables the FDI function on the selected node

6.4.3.4.2 LonWorks group of nodes – Commands command

By means of “**Commands**” function the user can send a group of configuration parameters to all the field devices belonging to a group, with a single action.

The command is accessible from "Command menu" of every row of the table present on the GROUPS page and it is activated only the after confirmation by the operator.

According to the characteristics of the selected group a screen containing some of the configuration parameters that are common to the field devices within the group is displayed; for each one of them are proposed default values.

Parameters listed for groups composed of NETx or FDIx field devices types:

- Address Mode
- Timer interval

Parameters listed for groups composed of ICONFDI field device types:

- Address Mode
- Timer interval
- Variable Refresh Time (Haertbeat)

The Variable Refresh Time (Heartbeat) value defines the period of the cyclical update that each device generates; the DCM2 dispatches the heartbeat set commands to each device in the group observing the same time distribution, this to maintain the traffic as regular as possible. The operation will take some time depending on the number of devices connected and on the heartbeat time value.

The command can be stopped: the sequence of operations provided by the command ends at the end of the current operation execution.

6.4.4 CPU management

The functions that allow the CPU setting are available when the user has logged in with the NETWORK MAINTENANCE privileges.

6.4.4.1 *Change of the active CPU*

The OVERVIEW tab contains a button to force the control to be passed between the CPUs.

The button has different text and function depending on the active connection:

“**STANDBY**” when the HMI is connected to the CPU that has the control both in AUTO mode and in MANUAL mode. A tap on the button sends the command to the CPU to which the HMI is connected which releases the control to the other CPU.

“**RUN**” when the HMI is connected in MANUAL mode to the CPU that does not have the control. A tap on the button sends the command to the CPU to which the HMI is connected which takes the control from the other CPU.

If the control is exchanged when the AUTO mode is active the HMI connects to the CPU that takes the control with consequent request to the operator for the credentials.

If instead the control is exchanged when the MANUAL mode is active the text in the button is updated but there is no request for credentials because the connection with the CPU does not change.

6.4.4.2 *System Clock Settings*

In the CONFIGURATIONS tab there is an area called "System Clock Settings" containing the "SetTime" button for the setting of date and time of the CPU to which the HMI is connected.

The date and time can be set only to the CPU that has the control and they are then automatically propagated to the standby CPU and to the HMI.

6.4.5 LonWorks Network Configuration

The user with NETWORK MAINTENANCE privileges can configure the LonWorks network if the DCM2 has been set up with all the nodes of the system and with the Neuron ID of each node.

To be configured a node shall be powered on, in good working order and able to communicate over the network.

The user can send commands to configure nodes regardless they are already configured or can send commands to configure only the nodes that are not yet been configured.

When the command foresees also the configuration of some Routers the process starts configuring the Routers first; if the user need to configure the system group-by-group the group of Routers shall be configured first.

Warning: *a cable interruption in any portion of the loop may cause an un-proper configuration result.*

- ❑ *Before to proceed with a configuration operation of a node in a specific loop it is recommended to verify first the good communication status of the two nodes NET_H and NET_T at both end of the loop.*
- ❑ *In case it is required to configure the whole network, it is recommended first to configure the group of the NET-x nodes. After the two Net-x of a loop are configured and communicating it is possible to proceed with the other groups of the loop.*

Warning: *A configuration command of a node which is not in good communication condition (e.g. it is reported as NO COMM) will not lead to a successful configured status. Most probably at the end the node will be put in the "CONF_ERR" state.*

It is recommended first to investigate on the reasons that are causing the state.

Possible points of investigation are:

1. *Network fault between DCM2 and node;*
2. *Network terminations not in place: this may produce reflection;*
3. *High noise on the communication network;*
4. *A maintenance service at the field device that has cleared the node configuration.*

Warning: *The nodes to whom not correspond a valid Neuron ID assignment will be left not configured.*

Node configuration is a crucial step of a network commissioning and maintenance.

The operator may choose the more appropriate configuration procedure to the different situations among a set of configuration methods available at DCM2 configuration screens as described below.

It is important to remember that the word "device" is used for all field devices, included NETx; "node" is a more generic term and includes also the routers.

All the commands are activated after the confirmation by the operator. The execution of a command that acts on multiple nodes can be interrupted: the sequence of operations planned by the command ends at the end of the current operation execution.

Make sure that the supply of the DCM2 is stable during the configuration operations.

A voltage drop interrupts the commands sequence that will cause the need of the function re-execution from the beginning with possible manual remedial measures.

6.4.5.1 Field Configuration Commands

In the "Command menu" of the block **Field** on the "System Overview" page the following controls related to the nodes configuration are available.

6.4.5.1.1 Initialize unconfigured nodes

It performs the configuration of all the nodes not yet configured present in all the groups.

6.4.5.1.2 Reconfigure all nodes

It performs the configuration of all the nodes present in all the groups, regardless of the current status.

6.4.5.1.3 Check nodes configuration

The function queries the nodes connected to the DCM2 and checks that the current configuration read from the node is identical to that defined (Neuron ID, addresses, selectors, position in the loop). The TAG can change.

In the affirmative, the node is promoted as OK, otherwise it remains in the NOT CONF status.

6.4.5.2 *Routers Configuration Commands*

In the ROUTERS page the following commands related to the configuration of the nodes are available.

6.4.5.2.1 Configure router

The command, accessible from the "Command menu" of every row of the table present on the ROUTERS page, performs a new configuration of the selected router regardless of the current status.

A router FAR side can be configured only if the router NEAR side is already configured.

6.4.5.2.2 Initialize unconfigured routers

The command, accessible from the general "Command menu" of the ROUTERS page, performs the configuration of all routers not yet configured.

6.4.5.2.3 Reconfigure all routers

The command, accessible from the general "Command menu" of the ROUTERS page, performs a new configuration of all routers regardless of the current status.

6.4.5.3 *Loops Configuration Commands*

In the LOOPS page, the following controls related to the node configuration are available.

6.4.5.3.1 Initialize unconfigured nodes of the loop

The command, accessible from the "Command menu" of every row of the table present in the LOOPS page, performs the configuration of all the nodes not yet configured and belonging to the selected loop.

6.4.5.3.2 Reconfigure all nodes of the loop

The command, accessible from the "Command menu" of every row of the table present in the LOOPS page, performs the configuration of all the nodes belonging to the selected loop regardless of the current status.

6.4.5.3.3 Initialize unconfigured nodes of all loops

The command, accessible from the general "Command menu" of the LOOPS page, performs the configuration of all the nodes not yet configured belonging to all loops.

6.4.5.3.4 Reconfigure all nodes of all loops

The command, accessible from the general "Command menu" of the LOOPS page, performs the configuration of all the nodes belonging to all loops regardless of the current status.

6.4.5.4 *Groups Configuration Commands*

In the GROUPS page the following controls related to the configuration of the nodes are available.

6.4.5.4.1 Initialize unconfigured devices of the group

The command, accessible from the "Command menu" of every row of the table present in the GROUPS page, performs the configuration of all field devices not yet configured belonging to the selected group.

6.4.5.4.2 Reconfigure all devices of the group

The command, accessible from the "Command menu" of every row of the table present on the GROUPS page, performs the configuration of all field devices belonging to the selected group regardless of the current status.

6.4.5.4.3 Initialize unconfigured nodes of all groups

The command, accessible from the general "Command menu" of the GROUPS page, performs the configuration of all the nodes not yet configured belonging to all the defined groups.

6.4.5.4.4 Reconfigure all nodes of all groups

The command, accessible from the general "Command menu" of the GROUPS page menu, performs the configuration of all the nodes belonging to all defined groups regardless of the current status.

6.4.5.5 *Devices Configuration Commands*

In the DEVICES page, the following commands related to the configuration of the nodes are available.

6.4.5.5.1 Configure device

The command, accessible from the "Command menu" of every row of the table present in the DEVICES page, performs a new configuration of the selected field device regardless of the current status.

6.4.5.5.2 Exclusive configuration

The command, accessible from the "Command menu" of every row of the table present in the DEVICES page, is a further method available for configuring a field device.

In an Exclusive configuration, the portion of network that follows the node is temporarily disconnected during the configuration procedure, to reduce the possibility of interference due to anomalous conditions and reconnected at the end of the configuration procedure.

When the addressed field device is no more ready to communicate after the exclusion of the portion of network that follows it, it means that the device has been connected reversed. Its Status is set to REVERSE and the portion of the network that follows the device remains excluded. The operator must fix the cable problem and re-execute an "Exclusive configuration" command that restores the correct network connection.

6.4.5.5.3 Initialize unconfigured devices

The command, accessible from the general "Command menu" of the DEVICES page, performs the configuration of all the devices not yet configured belonging to all defined groups.

6.4.5.5.4 Reconfigure all devices

The command, accessible from the general "Command menu" of the DEVICES page, performs the configuration of all the devices belonging to all the defined groups, regardless of the current status.

6.4.6 LonWorks devices - wiring list management

When the DCM2 is set up with all loops and the wiring sequence of all devices in the loops, the user with NETWORK MAINTENANCE privileges can remove or temporarily isolate existing connected devices. Furthermore, he can manage Loop Integrity Check functions for the loop. All the commands are activated after the operator's confirmation.

6.4.6.1 *Remove Tag*

The command is applicable to the LonWorks field devices (ICONFDI, NET_S, FDI_S types) in any communication status that have been already included in a physical list. It is not applicable to NET_H, NET_T, FDI_A or FDI_B devices, because they are the loop ends.

The command is accessible in the graphics display page of a "Loop x", from the "Command menu" present on the icon of a device that is found in cable list.

The selected node is removed from the list: it assumes position "0" and is graphically displayed after the NET_T.

6.4.6.2 *Isolate*

The command **Isolate** is applicable to the LonWorks field devices in any communication status that have been already included in a physical list and consists in the activation of the network terminators of the devices (ICONFDI, NETx or FDIx types) closest to the one to be isolated from the list.

The command is not applicable to NET_H, NET_T, FDI_A or FDI_B that are the loop ends.

The command is accessible in the graphics display page of a "Loop x", from the "Command menu" present on the icon of a device that is found in the cable list.

The selected device is reported as **ISOLATED**.

More devices can be isolated, but it is possible to isolate only a device closest to the one already isolated.

6.4.6.3 *Restore*

When a device is in **ISOLATED** state the command **Restore** returns the selected device to the loop.

The command is accessible, in the graphics display page of a "Loop x", from the "Command menu" present on the icon of an isolated device.

When multiple contiguous devices are in an ISOLATED status, the Restore control can be sent only to the devices placed at the ends.

6.4.6.4 *Check cable list*

The command is accessible from the "Command menu" of every row of the LOOPS list page or on the "Loop x" block present in the "Field Overview" page and is applicable to the LonWorks field devices.

The command **Check cable list** launches a set of interrogations to the nodes to verify if the current Cable List is still valid. The verification is conducted on the nodes that are in good communication condition.

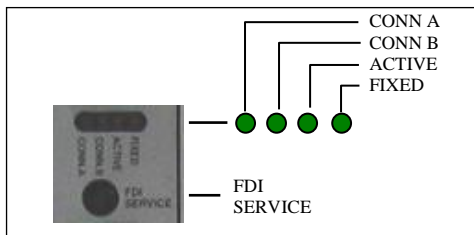
The check includes:

- Correct connection sequence of the nodes in the current wiring list
- correct input-output sequence of each actuator
- verification of the "stub" connections

If a node is no longer reachable a proper message appears and in this case it is advisable to run the automatic procedure to create a new wiring list sequence.

The execution of the command can be interrupted: the sequence of operations planned by the command ends at the end of the current execution of the operation.

6.4.7 LonWorks Loop Integrity Check Management



On the field bus interface card, the DCM2 is equipped with the FDI hardware and the present indications are used to display the status of the NETx nodes.

In the default conditions the two NETx nodes at both loop ends ensure the correct network termination; on the rear panel of the DCM2 the following LED indications will be on:

- CONN A on the Master unit
- CONN B on the Slave unit
-

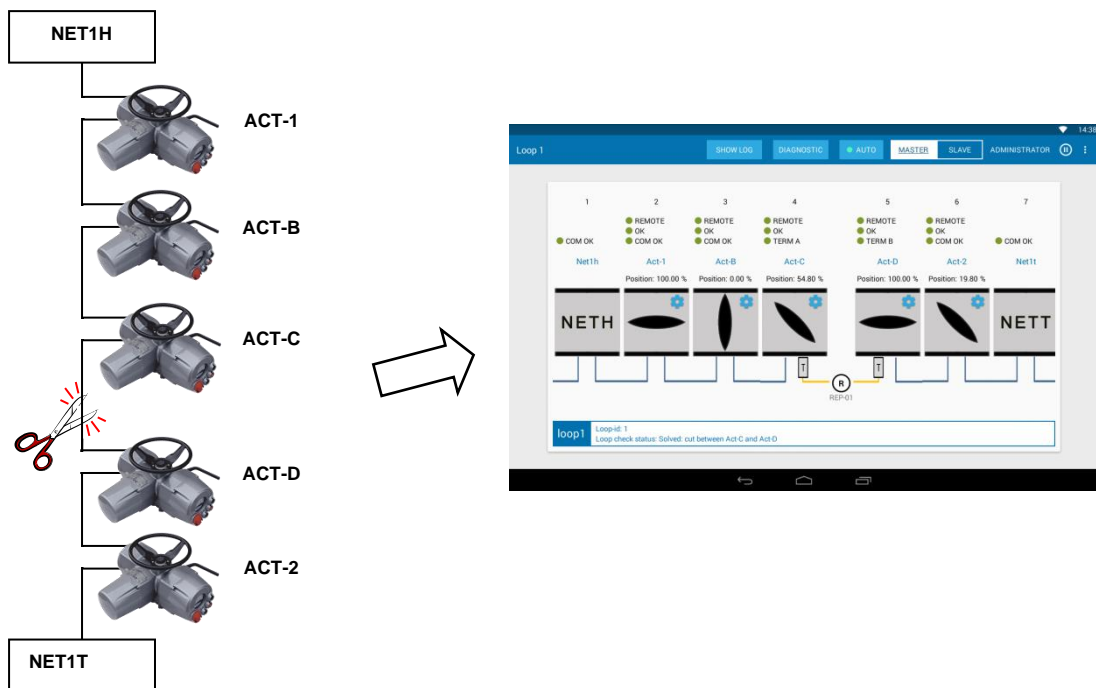
6.4.7.1 Start check

After building the physical wiring list, the system is ready to check the integrity of the communication loops. The check function is started by command **Start Check** which verifies the physical connection of the two NETx nodes at the ends of the loop, while the DCM2 is not charged with this activity. The command is accessible from the "Command menu" of every row of the table present in the LOOPS page, or from the "Command menu" of a "Loop x" block of the "Field Overview" page.

The active check is indicated by the flashing of the ACTIVE LED. The active check is indicated in LOOPS page and in "Loop x" detail page.

When check is active the system manages the power off of one of the two NETx nodes without generating a false bus interruption event. The system starts operating regularly after the re-power on of the NETx.

When there is a bus interruption due to cut-off of a cable, grounding of the communication line or a short circuit between the bus conductors, the two NETx nodes acknowledge this situation and, if malfunctioning lasts for the programmed time, the DCM2 runs the procedure which looks for the fault.



Fault research activates the network terminators of the devices equipped with FDI hardware (ICONFDI) on the closest devices to the fault and re-establishes communication between the DCM2 and all the still reachable nodes. In order to do so, both sides of NETx nodes are connected to the network, and LEDs CONN A and CONN B signal this situation.

Once communication is re-established, a message localizes the fault within the communication loop, and in "Loop-x" detail page the actuators closest to the fault shows the activation of terminators **TrB** and **TrA**.

6.4.7.2 *Restore check*

After the fault is isolated, the loop integrity check system is no longer active. The operator must find the fault in the communication cable on the basis of the info provided by the DCM2.

Once the cable is repaired, the operator can use the command "**Restore check**" to bring the stationary system.

The command is accessible from the "Command menu" of every row of the table present in the LOOPS page, or from the "Command menu" of a "**Loop x**" block of the "Field Overview" page.

The command is activated after a confirmation by the operator that the cause of the interruption has been removed; the confirmation is given by writing the word "RESTORED".

At the end of the Restore function the integrity check system is no more active: it must be re-established with a "Start Check" command.

Warning: *It is highly recommended not to issue any configuration command until the networks has been repaired. After the fault has been isolated the field operator must locate the cable fault and fix it. A configuration command issued in this situation will not restore the cable fault, on the contrary when re-configured the node deactivates its terminators and it may leave the network fault unmanaged. As a result the nodes beyond the network fault that were in good communication status may be turned to CONF_ERR or NOT_CONF status.*

6.4.7.3 *Stop check*

The command **Stop check** stops the check function on the selected loop.

The command is accessible from the "Command menu" of every row of the table present in the LOOPS page, or the "Command menu" of a "Loop x" block of the "Field Overview" page.

Stop Check is used also to return the system to the initial conditions after the intervention of the control function.

6.4.8 MODBUS Network Configuration

The field devices connected to the MODBUS network of the DCM2 do not need a specific configuration procedures or configuration commands to enter in an operative state.

As soon as the DCM2 has been set up with all the MODBUS nodes of the system and with their MODBUS Slave address, he tries to establish the communication and exchange data.

Particular attention must be paid to ensuring that the communication parameters and addresses with which the field devices have been configured coincide with the DCM2 configuration.

6.4.9 MODBUS devices - wiring list management

When the DCM2 is set up with the wiring sequence of all MODBUS devices in the loops, the DCM2 loop screen can shows the MODBUS device wiring sequence and locate the cable fault when it occurs.

The wiring list sequence must be manually edited in the DCM2 configuration file.

6.4.10 MODBUS Loop Integrity Check Management

The following strategy is applicable with MODBUS field devices equipped with on board repeaters and the redundancy method set on <Loop_1Ch> in the configuration file.

The “active” MM_CPU_H (on the Primary Master) scans the field devices while the other MM_CPU_T (on the Backup side) stays in “listening” mode i.e. receiving the request from the active CPU and the responses from field device.

In the event of a cable fault the listening MM_CPU_T does not receive any packet form the active MM_CPU_H and the missing reception condition activates the MM_CPU_T to turn in the active state and both MM_CPU_H and _T start interrogating the portion of networks that is connected to their side on the same line.

The MM_CPU_X can localize the cable interruption giving a proper advice to the user.

When the network is restored the “active” MM_CPU_H continues to work while the other returns in “listening” mode.

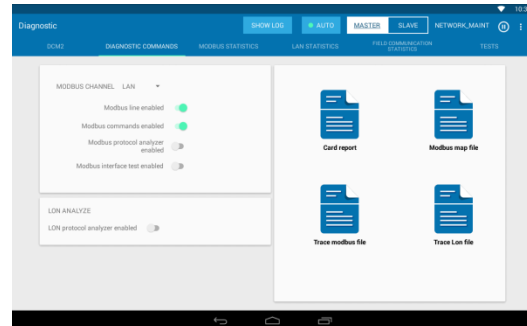
6.4.11 Diagnostic settings

When a user with NETWORK MAINTENANCE privilege is active, in the Diagnostics page, it is possible to change the active setup of the diagnostic functions.

6.4.11.1 *Diagnostic commands tab*

On this page there are settings that, subject to confirmation by the user, activate the following available diagnostic functions:

- **Modbus line enabled:** enabling or disabling one or more MODBUS lines connected to the Host System.
- **Modbus controls enabled:** enabling or disabling the writing function codes of one or more MODBUS lines connected to the Host System, and therefore the sending of commands to the field devices.



A disabled MODBUS line replies a “Slave Busy Exception Error” to the Host interrogations.

The functions for the management of the following diagnostic files are also available:

Card report that contains the data in text format for each card that is part of the DCM2; for each card are collected: serial number, production date, Firmware revision, Neuron ID, final test date, log repairs. The file is generated on the user's request with a command “**Generate file**” present on this page and subsequently “**download**”.

Exit the diagnostic command page and enter the file resources page, in the Card Report screen press “**Export**”, the Card Report will be saved on the USB stick.

Open on a PC the Card Report file with appropriate programs (es: programmer's notepad 2).

Modbus map file that contains the documentation of the MODBUS map allocated according to the uploaded configuration, in text format.

The file is generated on the user's request with a command “**Generate file**” present on this page.

6.4.11.2 *Tests tab*

In this tab, there are the buttons that activate the hardware test functions.

- **Test OUT**
It launches the automatic function that activates for 3 seconds in sequence the four relays of the connected unit. By making a cabled connection from OUT terminals to IN terminals, also the inputs are tested.
- **Test LED**
It launches the automatic function which turns on for 3 seconds in sequence all the LED of the operator's interface.

The following tests are performed on the CPU connected to the HMI. For a full test, they must be performed for both master and slave CPUs.

- **Test BACKPLANE**
It performs checking of the presence of the cards, connected to the CPU on the backplane of the DCM2. For each queried slot is displayed the identification of the present card. If the card is not present NULL is displayed. If an unrecognized code is read ERROR is displayed.
The operator must check the adequacy of the result with the cards actually present.
- **Test MASTER/SLAVE**
It checks the connection between the two CPUs.
- **Test LON**
It checks the status of the LonWorks interface. By connecting a cable between NET1 Master and NET2 Slave it verifies the receiving of the Query status interrogation. The test provides the number of transmissions and the percentage of success.
- **Test SERIAL A - Test SERIAL B**
By connecting the RJ45 ports with a cable in which Tx is closed on Rx, the test of the single serial line is carried out: it is checked whether the received data are identical to that sent. The test provides the number of transmissions and the percentage of success.

6.4.12 Files Management

The user with NETWORK MAINTENANCE privilege is enabled access to and maintenance of the following files available on the DCM2:

MODBUS map file	file that contains the MODBUS map
Card report	file that contains the report card
Log file	file with the CPU log
Configuration file	it allows the transfer operations of the DCM2 configuration file.

By selecting the "Files Resources" item in the menu called up by the "Menu" button, a window opens dedicated to the management of these files; the window gives an icon for each available file.

Tap on an icon to open a menu with the possible operations for the related files.

For all these files, the following controls are possible:

- **Export** transfer of the file from the connected CPU and copy on an USB removable support
- **Open** transfer of the file from the connected CPU and opening with an editor
- **Delete** deletion of the file from the tablet storage

6.5 SYSTEM ADMINISTRATOR - Authorized Functions

The SYSTEM ADMINISTRATOR access level is assigned to those users who, besides to what is permitted to the rights of the NETWORK MAINTENANCE, must be able to change the characteristics of the system. When a user with this access level is connected, no other user with an access level other than OBSERVER can be connected.

All commands are activated after a confirmation by the operator.

SYSTEM ADMINISTRATOR can access to the following functions.

6.5.1 Routers Management

6.5.1.1 Insert router

The command is accessible by the "Insert router" control present in the ROUTERS page.



By tapping the control in the page is displayed one, or more, hatched areas, with the caption "Insert router" inside.

A hatched area drawn in an isolated position allows entering of a "master router" physically connected to the CPU Master; a hatched area coupled to an already existing router inserts the "router child".

Tap in the hatched area to open a page to enter the parameters of the new Router:

Name	By the name it is selected the communication protocol with the field devices connected to the Router: the default RTR - <# ordinal> name is proposed for LonWork Router; Modbus Router are indicated with MM-CPU-<# ordinal>.
Neuron id near	By definition, the Routers with odd ordinal are closed to the CPU Master.
Loop near	Only for LonWorks: Neuron ID of the Router side connected to the CPU Master. not editable: it is "0" for a master router.
Neuron id far	A child router takes the same loop index of the connected master router.
Loop far	Only for LonWork: Neuron ID of the opposite side of the Router. Loop index associated to the loop . Default is 0 for a child router.
Note	Free user notes.

The Neuron IDs of near side and far side of the new LonWorks router are captured using the Service Pin message coming from the router node; the Service Pin Message from the child router is captured only when the master router is defined and configured.

When a child router is added, the master router passes in the **NOT CONF** status.

WARNING

The routers must ALWAYS be added when the PRIMARY unit has the control.

The DCM2 proposes a reference tag to the Routers during the entering operations and it is recommended not to change it.

6.5.1.2 Delete LonWorks router

The command is accessible from the "Command menu" of every row of the table present in the ROUTERS page.

The current configuration of the selected router is cleared and it returns in the condition of unconfigured. On the DCM2 the router keeps the memory allocation but is no longer active and it is indicated in DELETED status.

6.5.2 Groups Management

6.5.2.1 *Add new group*

The command is accessible from the general "Command menu" of the GROUPS page.

With the "**Add new group**" command, a page opens for entering the parameters of the new group:

Name the proposed default name is GRP-<#ordinal>

Note free notes of the user

Loop loop in which the group will be entered.

When a new group is added to an already configured loop the routers of the loop passes in the **NOT CONF** status.

6.5.2.2 *Delete group*

The command is accessible from the "Command menu" of every row of the table present in the GROUPS page.

The nodes that belong to the selected group are unconfigured and return to the default factory condition; the configuration of the NETx nodes terminators is not changed.

On the DCM2 the nodes keep the memory allocation but are no longer active and they are indicated in the DELETED status.

6.5.3 Devices Management

6.5.3.1 *Add device to the group*

The command is accessible from the "Command menu" of every row of the table present in the GROUPS page.

The "**Add device to the group**" command opens a page for entering a new field device in the selected group:

Group Group name from which the command was launched (not editable)

Type Device type, selectable in a list

Subtype Device subtype, selectable in a list

Name Device name

Neuron id LonWorks Device Neuron ID: it can be edited or received through the Service Pin

Message from the device

Notes Free notes from the user

6.5.3.2 *Add new device*

The command is accessible from the general "Command menu" of the DEVICES page.

The "**Add new device**" command opens a page with the same fields described for the "Add device to the group" command, with the difference that the group in which the device have to be associated must be chosen.

6.5.3.3 *Delete device*

The command is accessible from the "Command menu" of every row of the table present in the DEVICES page.

The selected field device is unconfigured and it returns in the default factory condition; the configuration of the NETx nodes terminators is not changed.

On the DCM2 the device keeps the allocation in the memory but it is no longer active, and is indicated in the DELETED status.

6.5.4 Foreign LonWorks devices management

6.5.4.1 *Assign*

The command is accessible from the general "Command menu" of the FOREIGN page.

The “**Assign**” command opens a new window through which all the Devices listed in the Foreign list and not yet known by the DCM2 are entered with default names.

In the window, the user must define:

Group	Group name in which to add the devices, selected from among those already existing
Type	type of device to be assigned to all devices
Subtype	Subtype devices

If the nodes recorded in the list of the foreign devices do not have all the same <program-id> the function returns a notification to the operator who must cancel the non-homogeneous devices.

6.5.4.2 *Clear device*

The command accessible from the "Command menu" of every row of the table present in the FOREIGN page deletes the selected device from the list of the foreign devices.

6.5.4.3 *Clear all devices*

The command accessible from the general "Command menu" of the FOREIGN page cancels all the devices recorded in the list of the foreign devices.

6.5.5 LonWorks devices - wiring list management

6.5.5.1 *Make LonWorks cable list*

The command is accessible from the "Command menu" of every row of the list on the LOOPS page or on the “Loop x” block present in the "Field Overview" page.

By means of command **Make cable list** the DCM2 starts the procedure for reconstruct the physical wiring sequence by interrogating all configured field devices. Before starting the reconstruction of the physical sequence all the actuators must be configured and communicating.

The procedure will exclude from the physical wiring list the field devices not responding to the interrogation because powered down or not communicating. This operation can take several minutes according to the number of configured field devices connected to the DCM2.

During the creation of the physical list the field devices are also checked for the correct input-output sequence: if a field device is found reversely connected, the message ‘**Device <name> not properly connected**’ appears and the device status is set to REVERSE.

The operator must first check the cause of this fault – device reversely connected –, fix it and then run the function again by pressing the command “**Resume**”. The procedure resumes from where it was stopped.

Alternatively, operator may also stop the procedure. In this case it is necessary to restore manually the termination of the field devices that has found reversely connected.

The execution of the command can be interrupted: the command ends at the end of the execution of the current operation.

6.5.5.2 *Clear LonWorks cable list*

The command **Clear cable list** deletes the current cable list.

The command is accessible from the "Command menu" of every row of the LOOPS page list or of the “Loop x” block present in the "Field Overview" page.

6.5.5.3 *Insert LonWorks nodes in cable list*

The command is accessible from the "Command menu" present on the icon of a device NOT yet in the cable list in the graphical display page of a “Loop x”.

The command **Insert in cable list** is applicable to the device types ICONFDI, FDI_S and NET_S in good working order, able to communicate; it allows the manual insertion of the selected device in a Cable List created when the device was not available.

Once launched the command, a page containing the wiring active sequence is displayed and the user must choose the position where the device must be inserted.

6.5.6 MODBUS devices - wiring list management

When the DCM2 is set up with the wiring sequence of all MODBUS devices in the loops, the DCM2 loop screen can show the MODBUS device wiring sequence and locate the cable fault when it occurs.

The wiring list sequence must be manually edited in the DCM2 configuration file.

6.5.7 Clock synchronization settings

In the CONFIGURATIONS tab of the CPU detail screen it is possible to change the active settings for the CLOCK SYNCHRONISATION OPTIONS.

DCM2 clock can be synchronized with an external system clock by the methods described in the document: **MDE240-CS: “DCM2 Advanced Function_ Clock Sync”**.

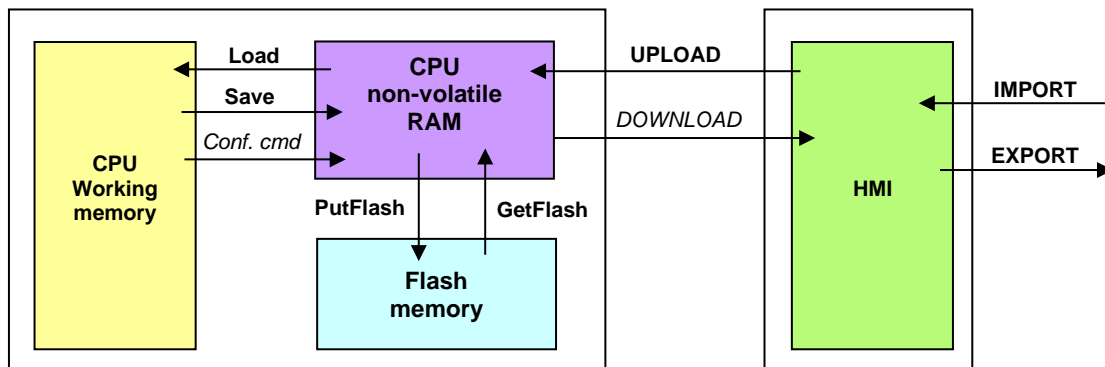
6.5.8 Configuration files management

The DCM2 configuration is stored in an encrypted file, named *desfile.csv*, composed of a list of statements that describe the composition of the network controlled by the DCM2, define the MODBUS map structure and define the selection of the elements available on the MODBUS interface.

The configuration file is edited off-line only by the DCM2 manufacturer.

The active configuration data resides into the CPUs memory and it is automatically updated when configuration changes occurs; a permanent image of a configuration file revision shall be stored in a Flash memory and this copy is not updated in automatic mode.

The user can manage the configuration file with functions available from the CONFIGURATION tab of the CPU detail page and from the File Resources page for the manual local management of the file as shown in the figure below.



6.5.8.1 Import and Load the configuration file

The DCM2 configuration consists in the transferring of the configuration file from an external support to the CPU working memory. The file in the working area is named "desfile.csv": if a file with a generic "desfile*.csv" name is copied in the working area the CPU will rename it in the managed name.

If a configuration file is already present the transferred file will replace the existing one without any confirmation request.

With the following three steps the configuration file shall be moved in the working area of the CPU.

6.5.8.1.1 IMPORT: from USB external support to the HMI

- Transfer the configuration file on a USB pen drive.
- Insert the USB pen drive in the enabled USB port of DCM2.
- Verify on the HMI screen the connection to the addressed CPU.
- Tap "**IMPORT**" associated to the "Configuration File" menu of the File Resources page to copy the file from the USB to the internal area of the HMI.

6.5.8.1.2 UPLOAD: from HMI to the Working area of the CPU

- Tap "**UPLOAD**" associated to the "Configuration File" menu of the File Resources page to copy the file from the internal area of the HMI in the CPU non-volatile memory area.

6.5.8.1.3 Load file in working memory

- Tap the "**Load from RAM**" button, available on the CPU detail page for both CPUs independently by the run/standby status to allocate the memory structures needed for the given configuration. The configuration file undergoes a formal check and in case of error a message reports the problem found.

Warning *a load operation can be critical when executed on a CPU already configured. Excluding some special cases, the load must be always preceded by a memory clear operation.*

6.5.8.2 *Save and Export the configuration file*

With the following three steps the configuration file shall be moved from the working area of the CPU to the external support.

6.5.8.2.1 Save from working memory

- Verify on the HMI screen the connection to the addressed CPU.
- Tap the **“Save to RAM”** button available on the CPU detail page for both CPUs independently by the run/standby status to force an updating of the non-volatile memory of the CPU.
Anyway each modification of the system configuration performed by the user from the graphical operator interface is automatically saved into the configuration file and propagated to the CPU in standby mode.

6.5.8.2.2 EXPORT: from the HMI to the USB external support

- Insert the USB pen drive to the enabled USB port.
- Tap **“EXPORT”** associated to the "Configuration File" menu of the File Resources page to **“DOWNLOAD”** the file from the CPU non-volatile memory to the internal area of the HMI and afterwards, copy the file from the internal area of the HMI to the USB.

6.5.8.3 *Save the original configuration on Flash*

Once the system works satisfactorily it may be useful to save the configuration in the DCM2 Flash memory by means of the **PutFlash** function. The function is executed by tapping the **“Put to Flash”** button available on the CPU detail page for both CPUs independently by the run/standby status.
The command Put to Flash can be executed only with **HBU** on **“Man”** mode.

6.5.8.4 *Retrieve the original configuration from Flash*

Once the configuration has been moved in Flash memory it will be permanently stored.
It is possible to return to the original situation just resetting the DCM2 and retrieve the configuration file by means of the commands **GetFlash**. The configuration file is copied from the Flash memory to the non-volatile buffer and then by a **Load** command the memory structures will be rebuilt.
GetFlash is executed by tapping the **“Get from Flash”** button available on the CPU detail page for both CPUs independently by the run/standby status.
The command GetFlash can be executed only with **HBU** on **“Man”** mode.

6.5.9 Configuring an empty DCM2

An un-configured DCM2 has the CPU memories empty.

The user can see that DCM2 is un-configured because the details of the configuration file on the CPU page are blank for both Local CPU and Remote CPU.

In this case it is necessary first to configure the system. The user has two possibilities:

- load the specific configuration file prepared for the project,
- build up the network system manually, adding new groups and field devices one by one.

The system is not able to control the devices connected to the DCM2 until the end of the field configuration procedure.

6.5.9.1 *From a Configuration file*

When a configuration file has already been prepared the system configuration can be performed in an automatic way with minimum intervention of the DCM2 operator.

- It is first necessary to load the configuration file as explained in previous paragraph **6.5.8.1**: *“Import and Load the configuration file”*.
- After the above operation all the lists are populated accordingly to the pre-defined system set-up and the system configuration can be executed by the several menu described at paragraph **6.4.5**: *“LonWorks Network Configuration”*.

6.5.9.2 *By operator’s commands*

An alternative method consists in building up the network system adding new groups and field devices one by one by exploiting the functions available at DCM2 screen. ADMINISTRATOR shall follow the following procedures:

- Define first all the groups that compose the system as described at paragraph **6.5.2.1**: *“Add new group”*.
- If the network is composed of several loops append the routers one by one as described at paragraph **6.5.1.1**: *“Insert router”*.
- Configure all the routers in order to create the communication infrastructure as described at paragraph **6.4.5.2**: *“Routers Configuration Commands”*.
- Insert in each group the nodes that compose the group, and repeat this operation for all the groups defined as described at paragraph **6.5.3.1**: *“Add device to the group”*.
- Configure all the field devices as described at paragraph **6.4.5.5**: *“Devices Configuration Commands”*.

In this way the MODBUS interface will be populated with the default set of information. To reduce or change the MODBUS interface it is necessary to manipulate the configuration file and return to execute the network configuration after having downloaded the proper configuration file.

Manipulation the configuration file is authorized only to the system manufacturer.

One more method is applicable after the network infrastructure has been established, exploiting the function given in the FOREIGN group.

The correct usage of this function is:

- **Clear** all data already captured;
- send the Service Pin message from all the field devices that compose a group: the Neuron IDs are collected;
- if necessary identify the field devices using the **Wink** function;
- if necessary remove the unnecessary devices from the list.

When the list is complete with the **“Assign”** function all listed devices can be added to a predefined group.

If the list is not composed of homogeneous devices the function returns a notification and the Administrator needs to cancel the nodes that have a different program id.

The presence of repeaters in the loop can be graphically represented in the Loop detail page by editing a definition in the configuration file.

6.5.10 Creating a Backup of the configuration file

Once completed the system configuration it is important to make a copy of the configuration file and DCM2 settings with one of the several functions available:

- Make a copy of the configuration on Flash memory as described at paragraph 6.5.8.3: “*Save the original configuration on Flash*”;
- Make a copy of the configuration on an external memory as described at paragraph 6.5.8.2: “*Save and Export the configuration file*”;

6.5.11 System Reset

On the CONFIGURATION tab of the CPU detail page two buttons for clear memory are present; since both execute critical operations they are activated only after the operator digits a requested word to prove user's will.

Buttons are:

- “**Clear DCM2**” returns the system at the Factory default configuration (working memory, non-volatile memory, configuration file, users, MODBUS settings, all data are deleted)
- “**Clear CPU**” clears memory and configuration file of the selected CPU

The two functions are to be considered an integral part of specific procedures: the single function activated under different conditions generates different system behaviours; therefore, their use must be made by following strictly the procedures given below.

6.5.11.1 Return to the default conditions

To bring back the entire DCM2 system to the default condition, make the two CPUs running and connected to each other and execute the following steps:

- leave the HOT BACKUP module switch in any position;
- connect the HMI to the CPU that has the control;
- tap the “**ClearDCM2**” command from CONFIGURATION tab of the CPU.

The system returns at the Factory default configuration.

It is important that both CPUs are switched ON and in a good communication status otherwise the complete clearing will not be executed correctly.

6.5.11.2 Realignment of the CPU Slave that does not have the control

Cancelling only the CPU Slave which does not have the control allows the Master unit to refresh the status of the Slave and to update it with its own configuration and users:

- set HOT BACKUP module switch on any position;
- connect manually the HMI to the CPU Slave which does not have the control;
- tap the “**ClearCPU**” command from the CONFIGURATION tab of the CPU Slave.

The CPU Slave resets itself and receives from the active Master CPU the users list and the configuration file.

6.5.11.3 Reset of the Master CPU

Cancel only the Master CPU, which has the control, to allow the CPU Slave to send only the list of users:

- set the HOT BACKUP module switch on **Man**; the CPU Slave will not take the control during the cancellation of the Master memory;

- connect the HMI to the CPU Master which has the control;
- send the "**ClearCPU**" command from the CONFIGURATION tab of the CPU Master.

The CPU Master resets itself: it does not releases the control but receives the users list from the CPU Slave. The configuration file is not transferred to the CPU Master, because the CPU Slave is not able to take control.

6.5.12 DCM2 connections configuration

The NETWORK tab of the CPU detail page collects the data about the available communication lines.

6.5.12.1 LAN setting

The ADMINISTRATOR can set the DCM2 parameters of the Ethernet network available at LAN port. As general rule the Master unit has an odd IP address and the Slave the previous even IP address. This line is used for the communication among CPU Master, CPU Slave, HMI and external PC for maintenance purpose.

Data that can be modified are:

- IP address CPU Master default 192.168.200.249,
CPU Slave default 192.168.200.248
- Subnet Mask: default 255.255.255.0
- Gateway: fixed 0.0.0.0
- Master UDP port address: UDP port address for the communication to the Maintenance Station;
default 50520
- Slave UDP port address: UDP port address for the communication to the Maintenance Station;
default 50520
- 2 port switch setting: Hub/Switch: not active; reserved for future use

6.5.12.2 MODBUS RTU LINES A and B Setting

For each MODBUS RTU line, the following parameters can be modified:

- MODBUS Slave address programmable address 1- 247
- Baud rate: 300, 600, 1200, 4800, 9600, 19200, 38400.
- Parity: None- Odd- Even
- Stop bit: 1-2
- Number of bits: 8
- Line Terminator: to enable the terminator of the RS485 line

6.5.12.3 MODBUS TCP-IP LINES C and D Setting

For each MODBUS TCP-IP line, the following parameters can be modified:

- MODBUS Unit Identifier: default is 255 (possible values: from 1 to 255).
- IP Address. CHANNEL C default 192.168.200.250,
CHANNEL D default 192.168.200.251
- Subnet mask. Default 255.255.255.0
- Port number: default 502
- 2 port switch setting: Hub/Switch: not active; reserved for future use

6.5.12.4 DHCP setting

- DHCP Server enabling local DHCP: default Disabled
- Start Address first address managed by local DHCP
- DHCP pool size number of addresses managed by local DHCP (up to 8)

6.5.13 Settings

The user with ADMINISTRATOR privileges has at its disposal a "Settings" page in the "Menu" list which makes available the interfaces to change the following settings related the HMI and the CPU to which it is connected.

HMI NETWORK SETTINGS	It allows to set the connection mode of the HMI module to the CPUs of the DCM2.
BUS SWITCH	if disabled it causes the interruption of the LonWorks output line of the connected CPU.
LOGIN TIMEOUT	Setting of the timeout that closes the current login after the period of inactivity of the interface programmable from 5 to 30 minutes (default 20 minutes) and returns to the initial page that request for a new LOGIN. Every action performed to the HMI reset the counter. The timeout count cannot be disabled; to keep the login active the user's role NO_LOGIN must be changed.
SCREEN TIMEOUT	Setting of the timeout that put the HMI in standby.
UPDATE HMI	It allows updating the HMI software version.

The other settings: ACCESS POINT, REMOTE CONECTION and LAN SERVICE PORT are reserved for future use and are not active.

6.5.14 Users management

The Administrator of the system can define or modify the users which have a lower role.

Multiple users with the ADMINISTRATOR role can be defined: their creation and maintenance is reserved to the manufacturer of the system.

The users' management functions are available in the "User Management" window, called up by the "Menu" button, which lists the visible users: any possible additional users with Administrator privilege will not be visible at the connected user.

Modification of a user is allowed by tapping an element in the list: a page is opened for the definition of the parameters.

Tap the control in the shape of a basket to cancel the related user.

The button down the page with the '+' symbol allows entering of a new user. Its selection opens a window for the definition of the following data:

- Name: min 3 characters - max 16, case insensitive without spaces and character ";"
- Role: among those by default
- Maximum login number
- Login expiry date
- Password: the password must meet the following criteria: minimum length 3 characters and max 28 without spaces and character ";", case SENSITIVE. The passwords cannot be null.
- Release Mode: Default "0" is without release: the user remains locked until the intervention of the ADMINISTRATOR. With the release option, the user is rehabilitated after 10 minutes.

A user is deleted from the DCM2 when the "Maximum login Number" are exhausted or the "Login expiry date" has expired.

A user is locked after 6 consecutive incorrect login attempts: the restoration must be carried out according to defined release mode.

For each user, but not for itself, the ADMINISTRATOR can change the associated name, the password and the other parameters.

The "NO-LOGIN" user will never be subject to deletion, but it can assume a different role to allow anyone to access the functions enabled in that role.

WARNING *After a "ClearDCM2" command from CONFIGURATION tab of the CPU the current user's table is cancelled and the default user list is restored.*

APPENDIX A: DEFINITION OF THE MODBUS INTERFACE

Each activated DCM2 channel has an independent driver to allow the connection of the DCM2 to the higher level via the MODBUS RTU and the MODBUS TCP-IP protocols. The DCM2 MODBUS protocol is developed according to specification **Modbus – IDA: MODBUS Application Protocol Specification V.1.1.b**.

The DCM2 MODBUS interface is configured as Slave and implements the following Function Codes:

Code	Function	QUERY	RESPONSE
01 (01 Hex)	Read Coil Status	2000 coils	2000 coils
02 (02 Hex)	Read Discrete Input	2000 inputs	2000 inputs
03 (03 Hex)	Read Holding Register	125 registers	125 registers
04 (04 Hex)	Read Input Register	125 registers	125 registers
05 (05 Hex)	Write Single Coil	1 coil	1 coil
06 (06 Hex)	Write Single Register	1 register	1 register
08 (08 Hex)	Loop Back Test	n/a	n/a
15 (0F Hex)	Write Multiple Coils	1968 coils	1968 coils
16 (10 Hex)	Write Multiple Registers	120 registers	120 registers
17 (11 Hex)	Report Slave ID	n/a	n/a

The LOOPBACK TEST function implements the following sub-codes:

Sub-Code	Function
00 (00 Hex)	Return Query Data
01 (00 Hex)	Restart Communications Option
10 (0A Hex)	Clear Counter and Diagnostic Register
11 (0B Hex)	Return Bus Message Count
12(0C Hex)	Return Bus Communication Error Count
13 (0D Hex)	Return Bus Exception Error Count
14 (0E Hex)	Return Slave Message Count
18 (12 Hex)	Return Bus Characters Overrun Count

The DCM2 implements a MODBUS data model based on four blocks (DI, DO, AI and AO) and each block is accessible with different MODBUS functions. Each function addresses the relevant data block by its specific Address Code.

Inside each block data are addressed by a 4 digit address and the further details given in the next paragraphs are relevant to the data addressing inside the specific block.

Function Code	Address Code	Data area
2 - Read Discrete Input	1<xxxx>	Function Code used to read discrete inputs refers to data in DI data area. Discrete inputs are associated to digital signals coming in from the field devices.
1 - Read Coil Status 5 - Write Single Coil 15 - Write Multiple Coils	0<xxxx>	Function Codes used to read or write coils refer to data in DO data area. Coils are associated to the digital commands going out to the field devices.
4 - Read Input Register	3<xxxx>	Function Code used to read inputs register refers to data in AI data area. Input registers are associated to analogue or bit-structured data coming in from the field devices.
3 - Read Holding Register 6 - Write Single Register 16 - Write Multiple Register	4<xxxx>	Function Codes used to read or write registers refer to data in AO data area. Registers are associated to analogue commands going out to the field devices.

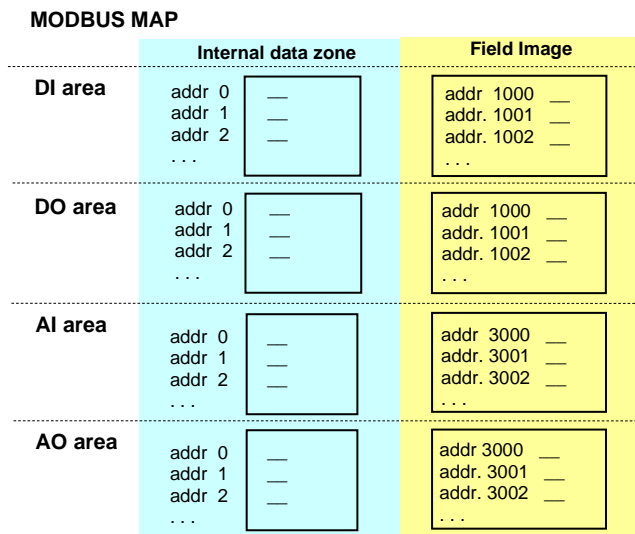
A.1 Typical structure of the DCM2 MODBUS interface to Host System

The DCM2 MODBUS map is divided in two different memory areas:

Internal Data that collects data relevant to DCM2 internal status and communication functioning of the field devices connected to DCM2.

Field Image that collects data relevant to the field devices connected to DCM2 and may have different memory models:

The typical DCM2 MODBUS map is configured in *'Object wise'* mode, where controls and signals are grouped per device (e.g.: all the commands of the first device followed by all the commands of the second and so on).



A.1.1 DI area - Internal Data

The Internal Data zone in MODBUS DI area is composed of a section for current DCM2 internal status and a section that reports the communication status of the devices connected to the DCM2.

The DCM2 internal status is represented by the following signals (correspondent address is input# -1):

Input #	Description	Set to 0	Set to 1
9	DCM2 unit connected	Master	Slave
10	DCM2 status	The unit does not have control	The unit has control
11	reserved		
12	Cable cut fixed	No bus interruption	Bus interruption fixed
13	Back-up unit ready	Back-up unit not available	Back-up unit in stand-by
<p>NOTE. When the DCM2 has been set with HBU selector in DUAL position the above DI inputs may have different values when read from line A- C or B-D. Each line reports the status of the CPU to whom is connected.</p>			

The communication status of the field devices connected is represented by a bit for each field device:

Input #	Description	Set to 0	Set to 1
151	Communication status first node declared in the device section of configuration file	Node communicating	Node not communicating
152	Communication status second node declared in the device section of configuration file	Node communicating	Node not communicating
cont.	...		

NOTE. *The above DI inputs have the same value when read from any Host communication line.*

A.1.2 DI area - Field Image

Each Biffi actuator equipped with the proper interface card can transmit to the DCM2 a set of information related to the current status of the actuator. The communication elements that are represented by digital inputs are stored in the Field Image of the DI area of DCM2 MODBUS map.

In order to minimise the MODBUS map it is possible to select the signals that have to be exchanged between the Host and the DCM2 by means of the configuration file.

Signals are ordered into the MODBUS map in the same sequence defined into the configuration file.

In '*Object wise*' structure all the information related to the first actuator are grouped in a contiguous block of digital inputs. Default starting address is 1000. Then the map continues with the same sequence of information related to the next actuators without leaving any interruption among digital inputs.

The following table shows the sequence for the first two ICON2000/ICON3000 actuators where all the digital inputs available have been selected.

DI	Description	Set to 0	Set to 1
1000	MOV_01 Fully Open	Valve not open	Valve in Fully Open position
1001	MOV_01 Fully Close	Valve not closed	Valve in Fully Closed position
1002	MOV_01 Opening movement	No movement in progress	Valve moving in Open direction
1003	MOV_01 Closing movement	No movement in progress	Valve moving in Closing direction
1004	MOV_01 Monitor relay	Valve not available	Valve available for remote control
1005	MOV_01 Alarm	No alarm present	At least one alarm present
1006	MOV_02 Fully Open	Valve not open	Valve in Fully Open position
1007	MOV_02 Fully Close	Valve not closed	Valve in Fully Closed position
1008	MOV_02 Opening movement	No movement in progress	Valve moving in Open direction
1009	MOV_02 Closing movement	No movement in progress	Valve moving in Closing direction
1010	MOV_02 Monitor relay	Valve not available	Valve available for remote control
1011	MOV_02 Alarm	No alarm present	At least one alarm present
...

A.1.3 DO area – Internal Data

The DCM2 internal DO area is represented by the following structure (correspondent address is coil# -1):

MODBUS DO area – Internal Data zone

Any Mode selected	Description	Set to 0	Set to 1
10	Release the control	CPU releases the control	
11	Get the control	CPU gets the control	

A.1.4 DO area – Field Image

Each Biffi actuator equipped with the proper interface card can receive from DCM2 a set of commands to control the actuator. The communication elements that are represented by digital outputs are stored in the Field Image of the DO area of DCM2 MODBUS map.

In order to minimise the MODBUS map it is possible to select the commands that Host will send to the DCM2 by means of the configuration file.

In ‘*Object wise*’ structure all the commands related to the actuator are grouped in a contiguous block of coils. Default starting address is 1000. The following table shows the sequence for the first two actuators where all the commands available for an ICON or ICON2000/ICON3000 actuator have been selected.

DO	Description	Set to 0	Set to 1
1000	MOV_01 Open command	No command active	Open command active
1001	MOV_01 Close command	No command active	Close command active
1002	MOV_01 Stop command	No command active	Stop command active
1004	MOV_01 Enable Setpoint	ON/OFF functioning enabled	Positioner functioning enabled
1005	MOV_02 Open command	No command active	Open command active
1006	MOV_02 Close command	No command active	Close command active
1007	MOV_02 Stop command	No command active	Stop command active
1008	MOV_02 Enable Setpoint	ON/OFF functioning enabled	Positioner functioning enabled
...

A.1.5 AI area – Internal Data

The typical DCM2 MODBUS map does not have data in the Internal Zone in MODBUS AI area.

A.1.6 AI area – Field Image

The communication elements received from Biffi actuators series ICON or ICON2000/ICON3000 with a proper interface card that are represented by registers are stored in the Field Image of the AI area of DCM2 MODBUS map.

In order to minimise the MODBUS map it is possible to select the signals that have to be exchanged between the Host and the DCM2 by means of the configuration file.

In ‘Object wise’ structure all the information related to the first actuator is grouped in a contiguous block of input registers starting, by default, from Register number 3000. Than the map continues with the same sequence of information related to the next actuators without leaving any interruption among registers.

The following table shows the sequence for the first two actuators where all the input registers available for an ICON or ICON2000/ICON3000 actuator have been selected.

AI	Description	Note
3000	MOV_01 Current position	See Note 1
3001	MOV_01 Current torque	See Note 1
3002	MOV_01 Actuator status	See Note 2
3003	MOV_01 Warning	See Note 3
3004	MOV_01 Alarm	See Note 4
3005	MOV_02 Current position	See Note 1
3006	MOV_02 Current torque	See Note 1
3007	MOV_02 Actuator status	See Note 2
3008	MOV_02 Warning	See Note 3
3009	MOV_02 Alarm	See Note 4
...

Note 1: the coding of analogue quantities for each MODBUS line depends on the conversion factor declared in section **nodetype** of the configuration file.

If the field is set as 0: the resolution of analogue values is as set for the LONWORKS protocol. The real position and torque values are obtained by dividing by 200 the value shown by the corresponding register.

For example: register value = 0 (0x0000) real value = 0.00%
 register value = 5000 (0x1388) real value = 25.00%
 register value = 20000 (0x4E20) real value = 100.00%

If the field is set as 12: the resolution of analogue values is scaled by the DCM2 on 12 bits.

For example: register value = 0 (0x000) real value = 0.00%
 register value = 1023 (0x3FF) real value = 25.00%
 register value = 4095 (0xFFF) real value = 100.00%

Note 2: ‘Actuator status’ has to be considered as 16-bit structures, where bit 0 is the least significant bit.

- bit 15= Selector in “Off” position
- bit 14= Selector in “Local” position
- bit 13= Selector in “Remote” position
- bit 12= Local configuration in progress
- bit 11= ESD command active
- bit 8-10= Reserved
- bit 7= Bus input connected to the network (term. A)
- bit 6= Bus input connected to the network (term. B)
- bit 0-5= Reserved

<p>Note 3:</p>	<p>'Warning' has to be considered as 16-bit structures, where bit 0 is the least significant bit.</p> <ul style="list-style-type: none"> bit 15-13= Reserved bit 12= Actuator in Local configuration bit 11= ESD active bit 10-5= Reserved bit 4= Control card overheated bit 3= High torque in opening bit 2= High torque in closing bit 1= Reserved bit 0= Stopped by local STOP push-button
<p>Note 4:</p>	<p>'Alarm' has to be considered as 16-bit structures, where bit 0 is the least significant bit.</p> <ul style="list-style-type: none"> bit 15-13= Reserved bit 12= Power loss bit 11= Position sensor error bit 10= Reserved bit 9= Motor stalled bit 8= Motor overheating bit 7= K2 contactor error bit 6= K1 contactor error bit 5= Phase loss bit 4= Reserved bit 3= Max torque in opening bit 2= Max torque in closing bit 1= Reserved bit 0= Push-button error

A.1.7 AO area – Internal Data

The typical DCM2 MODBUS map does not have data in the Internal Zone in MODBUS AO area.

A.1.8 AO area – Field Image

Each Biffi actuator series ICON or ICON2000/ICON3000 with the proper interface card can receive from DCM2 a position set point command. The communication elements that are represented by analogue output register are stored in the Field Image of the AO area of DCM2 MODBUS map.

In order to minimise the MODBUS map, if the actuator is not controlled by position set point, is it possible to not select this command in the DCM2 configuration file.

In '*Object wise*' structure all the information related to the first actuator is grouped in a contiguous block of output registers starting, by default, from Register number 3000. Then the map continues with the same sequence of information related to the next actuators without leaving any interruption among registers.

The following table shows the sequence for the first two actuators:

AO	Description	Note
3000	MOV_01 Position set point	See Note 5
3001	MOV_02 Position set point	See Note 5
...

<p>Note 5:</p> <p>the coding of analogue quantities for each MODBUS line depends on the conversion factor declared in section nodetype of the configuration file.</p> <p>If the field is set as 0: the resolution of analogue values is as set for the LONWORKS protocol. It is necessary to write the value of the required position multiplied by 200 in the corresponding register.</p> <p>For example:</p> <table> <tr> <td>set-point = 0.00%</td> <td>value to be written in the register = 0 (0x0000)</td> </tr> <tr> <td>set-point = 25.00%</td> <td>value to be written in the register = 5000 (0x1388)</td> </tr> <tr> <td>set-point = 100.00%</td> <td>value to be written in the register = 20000 (0x4E20)</td> </tr> </table> <p>If the field is set as 12: the resolution of analogue values is scaled by the DCM2 on 12 bits.</p> <p>For example:</p> <table> <tr> <td>set-point = 0.00%</td> <td>value to be written in the register = 0 (0x000)</td> </tr> <tr> <td>set-point = 25.00%</td> <td>value to be written in the register = 1023 (0x3FF)</td> </tr> <tr> <td>set-point = 100.00%</td> <td>value to be written in the register = 4095 (0xFFF)</td> </tr> </table>	set-point = 0.00%	value to be written in the register = 0 (0x0000)	set-point = 25.00%	value to be written in the register = 5000 (0x1388)	set-point = 100.00%	value to be written in the register = 20000 (0x4E20)	set-point = 0.00%	value to be written in the register = 0 (0x000)	set-point = 25.00%	value to be written in the register = 1023 (0x3FF)	set-point = 100.00%	value to be written in the register = 4095 (0xFFF)
set-point = 0.00%	value to be written in the register = 0 (0x0000)											
set-point = 25.00%	value to be written in the register = 5000 (0x1388)											
set-point = 100.00%	value to be written in the register = 20000 (0x4E20)											
set-point = 0.00%	value to be written in the register = 0 (0x000)											
set-point = 25.00%	value to be written in the register = 1023 (0x3FF)											
set-point = 100.00%	value to be written in the register = 4095 (0xFFF)											

A.2 MODBUS Protocol Details

After having described the composition of the MODBUS map, this chapter gives details on how to access the different area data.

Starting address and number of elements to read or write depend on the MODBUS map composition and memory model selected.

A2.1 Function Code 01 (01 Hex) Read Coil Status

This function code is used to read from 1 to 2000 contiguous On/Off status of discrete outputs (coils) in the DO area of DCM2 interface. In the request message the MODBUS Master specifies the address of the first coil and the number of coils. Since in the MODBUS protocol coils are addressed starting from 0, the coils numbered 1-16 are addressed 0-15.

The coils in the response message are packed as one coil per bit of the data field.

This function code is useful to read back the status of the last commands issued by Host system.

Example:

Request to read the status the first 20 discrete outputs

Request		Response		
Field name	(Hex)	Field name	(Hex)	(Binary)
Function	01	Function	01	
Starting Address Hi	00	Byte Count	03	
Starting Address Lo	00	Output status 7-0	CD	1100 1101
Quantity of outputs Hi	00	Output status 15-8	63	0110 0011
Quantity of outputs Lo	14	Output status 20-16	05	0000 0101

A2.2 Function Code 02 (02 Hex) Read Discrete Input

This function code is used to read from 1 to 2000 contiguous status of discrete inputs in the DI area of DCM2 interface. In the request message the MODBUS Master specifies the address of the first input and the number of inputs. Since in the MODBUS protocol inputs are addressed starting from 0, the input numbered 1-16 are addressed 0-15.

The inputs in the response message are packed as one input per bit of the data field.

This function code is useful to read the current status of DCM2 or the field devices.

Example:

Request to read the inputs 1000-1021 (22 inputs)

Request		Response		
Field name	(Hex)	Field name	(Hex)	(Binary)
Function	02	Function	02	
Starting Address Hi	03	Byte Count	03	
Starting Address Lo	E7	Output status 1007-1000	EB	1110 1011
Quantity of outputs Hi	00	Output status 1015-1008	E9	1110 1001
Quantity of outputs Lo	16	Output status 1022-1016	35	0011 0101

A2.3 Function Code 03 (03 Hex) Read Holding Register

This function code is used to read from 1 to 125 contiguous holding registers in the AO area of DCM2 interface. In the request message the MODBUS Master specifies the starting address and the number of registers. Since in the MODBUS protocol registers are addressed starting from 0, the registers numbered 1-16 are addressed 0-15.

The register data in the response message are packed as two bytes per register of the data field.

This function code is used to read back the status of the last commands issued through registers by Host system.

Example:

Request to read the registers 1000-1001 (2 registers)

Request		Response		
Field name	(Hex)	Field name	(Hex)	(Binary)
Function	03	Function	03	
Starting Address Hi	03	Byte Count	04	
Starting Address Lo	E7	Register value Hi (1000)	20	
Quantity of outputs Hi	00	Register value Lo(1000)	E6	
Quantity of outputs Lo	02	Register value Hi (1001)	13	
		Register value Lo(1001)	88	

A2.4 Function Code 04 (04 Hex) Read Input Register

This function code is used to read from 1 to 125 contiguous input registers in the AI area of DCM2 interface. In the request message the MODBUS Master specifies the starting address and the number of registers. Since in the MODBUS protocol registers are addressed starting from 0, the registers numbered 1-16 are addressed 0-15.

The register data in the response message are packed as two bytes per register of the data field.

By means of this function code Host system can read the current status of the analogue and bit-structure data of the actuators connected to DCM2.

Example:

Request to read the registers 1000-1002 (3 registers)

Request		Response		
Field name	(Hex)	Field name	(Hex)	(Binary)
Function	04	Function	04	
Starting Address Hi	03	Byte Count	06	
Starting Address Lo	E7	Register value Hi (1000)	20	
Quantity of outputs Hi	00	Register value Lo(1000)	E6	
Quantity of outputs Lo	03	Register value Hi (1001)	00	
		Register value Lo(1001)	4E	
		Register value Hi (1002)	8C	
		Register value Lo(1002)	26	

A2.5 Function Code 05 (05 Hex) Write Single Coil

This function code is used to write a single output to either ON or OFF in the DO area of DCM2 interface. The requested ON/OFF state is specified by a constant in the request data field. A value of FF00 Hex requests the output to be ON. A value of 0000 Hex requests the output to be OFF. In the request message the MODBUS Master specifies the address of the coil to be forced. Since in the MODBUS protocol coils are addressed starting from 0, the coil numbered 1 is addressed as 0.

The normal response is an echo of the request.

This function code is used to send a single On/Off command to a selected actuator.

Example:

Request to write coil 1000 to ON

Request		Response		
Field name	(Hex)	Field name	(Hex)	(Binary)
Function	05	Function	05	
Output Address Hi	03	Output Address Hi	03	
Output Address Lo	E7	Output Address Lo	E7	
Output value Hi	FF	Output value Hi	FF	
Output value Lo	00	Output value Lo	00	

A2.6 Function Code 06 (06 Hex) Write Single Register

This function code is used to write a single holding register in the AO area of DCM2 interface. In the request message the MODBUS Master specifies the address of the register to be written. Since in the MODBUS protocol registers are addressed starting from 0, the registers numbered 1 is addressed as 0. The normal response is an echo of the request.

This function code is used to send a single set point command to a selected actuator.

Example:

Request to write holding register 3000 to value 4095 (Hex 0FFF)

Request		Response		
Field name	(Hex)	Field name	(Hex)	(Binary)
Function	06	Function	06	
Register Address Hi	0B	Register Address Hi	0B	
Register Address Lo	B7	Register Address Lo	B7	
Register value Hi	0F	Register value Hi	0F	
Register value Lo	FF	Register value Lo	FF	

A2.7 Function Code 08 (08 Hex) Loop Back Test

MODBUS function code 8 provides a series of tests for checking the communication system between the Master MODBUS and the DCS.

The function uses a two-byte sub-function code field in the query to define the type of test to be performed.

Request		Response		
Field name	(Hex)	Field name	(Hex)	(Binary)
Function	08	Function	08	
Sub-function Hi	00	Sub-function Hi	00	
Sub-function Lo	00	Sub-function Lo	00	
Data (any)	0F	Data (any)	0F	

The following sub-function codes are implemented.

Sub-function 00 (00 Hex) Return Query Data

The data passed in the request data field is to be returned (looped back) in the response.

Sub-function	Data field (Request)	Data field (Response)
00 00	Any	Echo request data

Sub-function 01 (00 Hex) Restart Communications Option

The DCM2 that receives the request attempts a communication port restart. Successful completion of the test will bring the port online. A request data field contents of FF00 Hex causes the port's communication event log to be cleared also. Contents of 0000 Hex leave the log as it was prior to the restart.

Sub-function	Data field (Request)	Data field (Response)
00 01	00 00	Echo request data
00 01	FF 00	Echo request data

Sub-function 10 (0A Hex) Clear Counter and Diagnostic Register

All counters in diagnostic registers are cleared. Counters are also cleared upon power-up.

Sub-function	Data field (Request)	Data field (Response)
00 0A	00 00	Echo request data

Sub-function 11 (0B Hex) Return Bus Message Count

The response data field returns the quantity of messages that DCM2 has detected on the communication system since its last restart, clear counter operation or power-up.

Sub-function	Data field (Request)	Data field (Response)
00 0B	00 00	Total message count

Sub-function 12(0C Hex) Return Bus Communication Error Count

The response data field returns the quantity of CRC errors that DCM2 has detected on the communication system since its last restart, clear counter operation or power-up.

Sub-function	Data field (Request)	Data field (Response)
00 0C	00 00	CRC error count

Sub-function 13 (0D Hex) Return Bus Exception Error Count

The response data field returns the quantity of MODBUS exception responses that DCM2 has returned since its last restart, clear counter operation or power-up.

Sub-function	Data field (Request)	Data field (Response)
00 0D	00 00	Exception error count

Sub-function 14 (0E Hex) Return Slave Message Count

The response data field returns the quantity of messages addressed to the DCM2 that the unit has processed since its last restart, clear counter operation or power-up.

Sub-function	Data field (Request)	Data field (Response)
00 0E	00 00	Slave message count

Sub-function 18 (12 Hex) Return Bus Characters Overrun Count

The response data field returns the quantity of messages addressed to the DCM2 that the unit could not handle due to a character overrun condition its last restart, clear counter operation or power-up. A character overrun is caused by data character arriving at the port faster than they can be stored or by the loss of character due to hardware malfunction.

Sub-function	Data field (Request)	Data field (Response)
00 12	00 00	Slave character overrun count

A2.8 Function Code 15 (0F Hex) Write Multiple Coils

This function code is used to force each coil in a sequence of coils (from 1 to 1968 coils) to either ON or OFF in the DO area of DCM2 interface. In the request message the MODBUS Master specifies the address of the first coil to be forced and the numbers of coils and their values. Since in the MODBUS protocol coils are addressed starting from 0, the coil numbered 1 is addressed as 0.

The normal response returns the function code, starting address and quantity of coils forced.

This function code is useful to send in one shot a set of On/Off commands to several actuators.

Example:

Request to write a series of 10 coils starting from 1000

Request		Response		
Field name	(Hex)	Field name	(Hex)	(Binary)
Function	0F	Function	0F	
Starting Address Hi	03	Starting Address Hi	03	
Starting Address Lo	E7	Starting Address Lo	E7	
Quantity of Output Hi	00	Quantity of Output Hi	00	
Quantity of Output Lo	0A	Quantity of Output Lo	0A	
Byte count	02			
Output value Hi (1007-1000)	A5			
Output value Lo (1009 -1008)	01			

A2.9 Function Code 16 (10 Hex) Write Multiple Registers

This function code is used to write a block of contiguous registers (from 1 to 120 registers) in the AO area of DCM2 interface. In the request message the MODBUS Master specifies the address of the first register to be written the number of registers to write and the requested written values. Since in the MODBUS protocol registers are addressed starting from 0, the register numbered 1 is addressed as 0.

The normal response returns the function code, starting address and quantity of register written.

This function code is used to send the set point values to several actuators.

Example:

Request to write register 3000 at 4095 (Hex 0FFF) and register 3001 at 1023 (Hex 03FF)

Request		Response		
Field name	(Hex)	Field name	(Hex)	(Binary)
Function	10	Function	10	
Starting Address Hi	0B	Starting Address Hi	0B	
Starting Address Lo	B7	Starting Address Lo	B7	
Quantity of Register Hi	00	Quantity of Register Hi	00	
Quantity of Register Lo	02	Quantity of Register Lo	02	
Byte count	04			
Register value Hi	0F			
Register value Lo	FF			
Register value Hi	03			
Register value Lo	FF			

A2.10 Function Code 17 (11 Hex) Report Slave ID

This function code is used to read the description of the type, the current status and other information specific of the DCM2.

The format of the response is shown in the following example:

Request		Response		
Field name	(Hex)	Field name	(Hex)	Description
Function	11	Function	11	
		Byte count	18	
		Slave ID	00	
		Run indicator	FF	
		DCM2 specific: data	11 ASCII chr	"BIFFI DCM2r3"
		DCM2 specific: Sw rev	11 ASCII chr	"03.02.01.38"

A2.11 MODBUS Exception Responses

When a MODBUS master, a DCS or a PLC, sends a MODBUS request to the DCM2 that acts as a MODBUS slave, a response is expected. One of four possible events can occur from master's query:

- ❑ If DCM2 receives the request without a communication error and can handle the query normally, it returns a normal response.
- ❑ If DCM2 does not receive the request due to a communication error, no response is returned. Master will eventually process a timeout condition for the request.
- ❑ If DCM2 receives the request, but detects a communication error (parity or CRC), no response is returned. Master will eventually process a timeout condition for the request.
- ❑ If DCM2 receives the request without a communication error, but cannot handle it (for example, if the DCM2 is running a node configuration function), the DCM2 will return an exception response informing the master of the nature of the error.

The exception response message has two fields that differentiate it from a normal response:

Function Code Field: in normal response the DCM2 echoes the function code of the original request in the function code field of the response. In an exception response DCM2 sets the MSB of the function code to 1.

Data Field: the exception error code is returned: this defines the condition that caused the exception. DCM2 manages the following exception codes:

Exception Code	Meaning
01 - ILLEGAL FUNCTION	The function code received in the query is not an allowable action.
02 - ILLEGAL DATA ADDRESS	The data address received in the query is not valid or it is related to a non defined area.
06 - SLAVE DEVICE BUSY	DCM2 cannot respond to master's query because is engaged in a long-duration program command like node configuration.

Example:

Request to read the inputs 1000-1021 (22 inputs) and exception response

Request		Response		
Field name	(Hex)	Field name	(Hex)	(Binary)
Function	02	Function	82	
Starting Address Hi	03	Exception Code	06	
Starting Address Lo	E7			
Quantity of outputs Hi	00			
Quantity of outputs Lo	16			

APPENDIX B: CABLE SELECTION FOR FIELDBUS

B.1 LonWorks Loop

The cable used for the fieldbus network is a crucial item and a wrong choice or a wrong execution may compromise the total system behaviour. The cable used can affect system performance: the larger the system, the more important the choice of the cable. System response depends on a range of factors, for example conductor resistance, conductors' mutual capacity, propagation speed, etc.

This Appendix is based on the following documents:

- ❑ *LONWORKS® FTT-10 Free Topology Transceiver User's Guide - Version 6 - Echelon® Corporation*
- ❑ *LONMARK™ Layers 1-6 Interoperability Guidelines - Version 3.0 - LONMARK™ Interoperability Association*
- ❑ *LONWORKS® Engineering Bulletin - Junction Box and Wiring Guideline for Twisted Pair LONWORKS® Networks - December 2010*

Field devices such as ICON2000/ICON3000 actuators implement LonWorks protocol using the FTT-10A Free Topology Transceiver that is the component that drives the communication function.

The characteristics of this transceiver are stated in the Echelon literature and for what concern the DCM2 application can be summarised as follows:

- the DCM2 LonWorks loop is composed by one or more segment that works in **bus topology** with a double-terminated network;
- fieldbus media is an unshielded twisted pair cable;
- communication speed is set at 78Kbps;

In the light of the above, the cable suitable for our applications and listed in Echelon literature is:

Cable Type AWG/dia	Max Actuators without Repeater	Max bus length [metres] without Repeater	Loop extension
16AWG/1.43mm – Twisted pair cable	60	800	YES by External Repeater (*)

(*) If the loop bus length exceeds the maximum length indicated above, or if the total number of nodes is more than 60 for each segment, it is necessary to install a repeater to increase the limit of the single loop.

The electric characteristics of the recommended **16AWG– Twisted pair cable** are:

Stranded pair (19x29), tinned copper.

	Min	Type	Max	Unit	Condition
DC resistance, each conductor	14.0	14.7	15.5	ohm/km	20°C for ASTM D 4566
DC resistance, unbalanced			5%		20°C for ASTM D 4566
Mutual capacitance			55.9	nF/km	for ASTM D 4566
Characteristic impedance	92	100	108	ohm	64kHz to 1MHz for ASTM D 4566
Attenuation					20°C for ASTM D 4566
20kHz			1.3	dB/km	
64KHz			1.9		
78KHz			2.2		
156KHz			3.0		
256KHz			4.8		
512KHz			8.1		
772KHz			11.3		
1000KHz			13.7		
Propagation delay			5.6	ns/m	78KHz

The Echelon literature indicates the following Belden cables as compliant to the 16AWG; dia 1,43mm; 1,21mm² - twisted pair cable specification:

For installation with Operating Temperature Range: -20°C to +60°C

BELDEN 8471	Stranded (19x29), Tinned copper, 1 pair Twisted Pair, PVC insulated, Chrome PVC Jacket
BELDEN 8471 NH	Stranded (19x29), Tinned copper, 1 pair Twisted Pair, Polyethylene insulated, Chrome FRNC/LSNH Jacket
BELDEN 8471 LS	Stranded (19x29), Tinned Copper, 1 pair Twisted Pair, Polyethylene Insulated, FRNC/LSNH Inner Jacket, Steel Wire Armour, Chrome FRNC/LSNH Outer Jacket

For installation with Operating Temperature Range: -60°C to +150°C

BELDEN 85102	Stranded (19x29), Tinned Copper, 1 pair Twisted Pair, Tefzel® insulated, Clear Tefzel® Jacket. 300V RMS 150°C
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Other selected producers are indicated in Echelon document:

- ❑ *LONWORKS® Engineering Bulletin -Junction Box and Wiring Guideline for Twisted Pair LONWORKS® Networks - December 2010*

B.2 MODBUS Loop

Also for the MODBUS network the cable used for the connection to the field device is a crucial item and a wrong choice or a wrong execution may compromise the total system behaviour.

This Appendix is based on the following documents:

from www.modbus.org

❑ “MODBUS over serial line specification and implementation guide V1.02”

from Biffi Italia

❑ “ICON3000 Instruction Manual, VCIOM-08500” and “MDE 258 – ICON3000 MOD-RTU/ICH+RPT Manual”

ICON3000 actuator implements the MODBUS protocol by RS-485 transceivers with the following characteristics:

- the DCM2 MODBUS loop is composed by one or more segment that works in **bus topology** with a double-terminated network;
- fieldbus media is a shielded twisted pair cable;
- communication speed can be set from 600 to 38.400 bit/sec;
- up to 32 actuators can be connected on each segment;
- the segment length up to 1200 meters;
- if the bus length exceeds the 1200 meters, or if the total number of nodes is more than 32 for each loop, it is necessary to install External Repeater or to use the repeater embedded in the ICON3000 actuator repeater to increase the limit of the single loop.

There are many cables available on the market that meet the MODBUS RS-485 specifications.

The cable section should consider the performance required in term of communication speed and bus length, number of field devices connected and environmental condition where the cable is placed.

For the typical industrial applications where the ICON3000 actuators with MODBUS interface are used the following BELDEN cable are acceptable:

For installation with Operating Temperature Range: -20°C to +60°C

BELDEN 3105A	22AWG Stranded (7x30), Tinned copper, 1 pair Twisted Pair + shield, Datalene ® insulation, UV resistant PVC Jacket, Oil Res II
BELDEN 3107A	22AWG Stranded (7x30), Tinned copper, 2 pair Twisted Pair + shield, Datalene ® insulation, UV resistant PVC Jacket, Oil Res II

The electrical cable characteristics are the following:

	Type	Unit	Condition
DC resistance, each conductor	48,23	ohm/km	@ 20°C
Nom. Capacitance Conductor to Conductor	36,09	nF/km	
Nom. Capacitance Conductor to Conductor & Shield	68,57	nF/km	
Characteristic impedance	120	ohm	
Nominal Attenuation	1,6405	dB/100m	@ 1MHz

APPENDIX C: PERFORMANCES

C.1 DCM2 Memory Capacity

In the standard version the DCM2 memory is suitably sized to manage up to 300 field devices.

C.2 LonWorks Field bus Communications

The nature of field bus communications, according to the LonWorks protocol, makes the system very quick in acquiring the signals from the field and in transmitting controls. Status transmissions from on-field actuators is made by the actuators themselves when a variation occurs, without any polling from the Master Station; there is anyway a periodic transmission, always generated by on-field devices, which refreshes the DCM2 image of the field. The DCM2 sends all controls directly and explicitly.

The field bus implemented by ICON and ICON2000/ICON3000 actuators uses FTT-10A transceivers with a transmission speed of 78Kbps independently of the number of actuators connected and of the total length of the bus.

The following times are recorded:

Launch time of a control:	200 msec	this is calculated from the moment the control appears on the MODBUS bus to the moment the control is performed by the actuator.
Acquisition time of a signal:	600 msec	this is calculated from the moment the signal is sent on the LonWorks bus to the moment the same signal is available to the MODBUS interface. The MODBUS scan time of the DCS must be added to this time, but this does not depend on the DCM2.

C.3 Reset Time after LonWorks Bus Interruption

The communication loop integrity check system is made by a mixed system, which leaves the NETx nodes to check field bus continuity and the DCM2 to research the fault. The fault is detected by the NETx nodes after the interruption lasts for a certain programmable lapse of time, obtained by setting parameters **Addr Mode** and **Timer Int** of NETx nodes.

It is advisable to set these parameters so as to obtain a longer waiting time than **5 seconds** to avoid all false signals of interrupted bus.

Once the fault has been detected, the DCM2 restores connection. The necessary time to localize and isolate the fault by inserting terminators in the closest actuators is in function of the number of actuators connected to the loop. By means of an optimised algorithm, this time is anyway always less than **6 seconds**.

C.4 Time for Control Switching between Master and Slave Units

A redundant system, with two DCM2 stations in back-up, allows the control system to go on working even though the main DCM2 is no longer operational. The Slave DCM2 controls the behaviour of the Master DCM2. When the Master DCM2 shows any signs of bad performance, the Slave DCM2 makes a series of attempts to restore the Master station; if these attempts are not successful and performance is still bad, the Slave DCM2 Slave takes control in **600 msec**s time.



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