EL-MicroWave srl
Electronics Enclusures Frequency

D1-15 family analog module

User's guide

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1 Installation

1.1 Packaging check

Before starting installation, it is necessary to check that the packaging contents is in compliance with your order. In the packaging there must be:

- n. 1 D1-15 series module
- n. 1 instruction manual

Check that the model code is in compliance with the ordered code and verify that the manual edition correspond to the purchase year.

The series models in the family are:

D1-15 6 voltage (0-10V) or 6 current (0-20/4-20mA) analog inputs 3 three/two wires Pt100 inputs (with cable resistance compensation)

D1-15A-N 6 voltage (0-10V) or 6 current (0-20/4-20mA) analog inputs with power supply 10Vdc-36Vdc

D1-15P-N 6 three/two wires Pt100 inputs (with cable resistance compensation) with power supply 10Vdc-36Vdc

The analog inputs have the following features:

- Precision : ±0,05% full scale
- Resolution : 15 bit
- Input impedance (0-20 mA or 4-20 mA) : 249 ohm

The **D1-15** Pt100/RTD sensor inputs have the following features:

- Temperature range: from -199.9 to +400.0 °C (standard model)
- Precision : ±0,1% full scale
- Resolution : 15 bit
- Max cable resistance: 20 ohm

The **D1-15P-N** Pt100/RTD sensor inputs have the following features:

- Temperature range: from -199.9 to +400.0 °C (standard model)
- Precision : ±0,05% full scale
- Resolution : 15 bit
- Max cable resistance: 20 ohm

D1 series modules are covered by 1 year of warranty except for damages caused by tampering or wrong wiring.

The label on the lateral side of the modules certificates the purchase date.

1.2 Dimensions

The D1-15 modules dimensions are shown in figure 1.1.

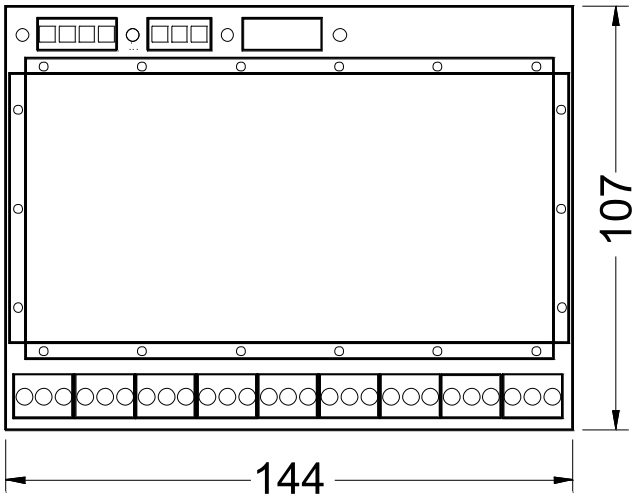

Figure 1.1 - D1-15 modules dimensions

1.3 Fixing method

All D1 series products are provided by a plastic support for fixing on normalized DIN EN rail and by a shielding printed cover.

On the cover there are schematic mounting indications; in grey areas are shown the interface circuits that are inside the module, in yellow areas common use sensors and actuators to be connected externally.

The cover serigraph provides only a general wiring diagram and cannot show every possible connection cases; for this reason it is necessary to read carefully this manual before starting module installation.

Do not use excessive pressure on the cover, mounting or dismounting the module on the rail. Remember to do these operations with supply voltage switched off or not connected.

1.4 Physical module description

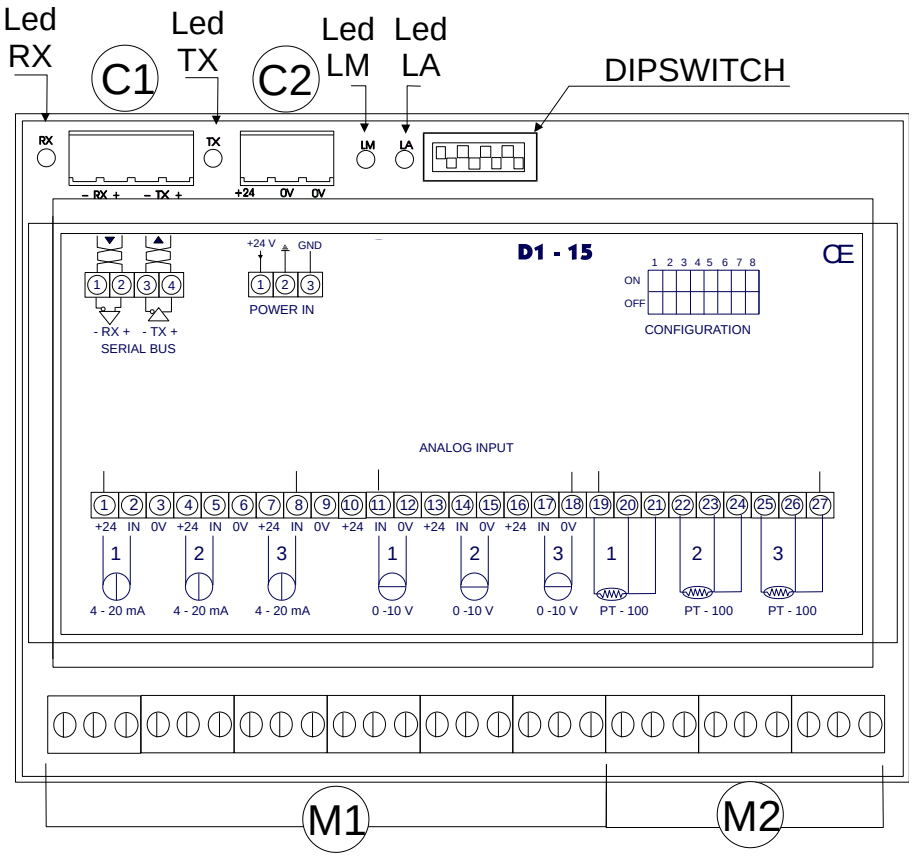

Figure 1.2 - D1-15 family scheme with the possible input connections

	Description
[C1]	RS422/485 serial channel connector
[C2]	+24 Vdc supply connector
[M1]	D1-15 analog input screws
	D1-15A-N analog input screws
	D1-15P-N Pt100/RTD sensors input screws
[M2]	D1-15 Pt100/RTD sensors inputs screws
	D1-15A-N not present
	D1-15P-N not present
DIPSWITCH	Protocol and device address selection dipswitch
Led LA	Supply led
Led LM	Selftest led (normally blinking)
Led TX	Transmitted data led
Led RX	Received data led

[C1] - RS422/485 serial channel connector

	RS422		RS485
1	RX–	1	N.C.
2	RX+	2	N.C.
3	TX–	3	TX–/RX–
4	TX+	4	TX+/RX+

[C2] - +24 Vdc supply connector

	POWER
1	+24 Vdc
2	FIELD GND
3	MECH. GND

1.5 Supply

The module D1-15 needs a 24 Vdc (18V<Vdc<36V) supply by [C2] connector. The modules D1-15A-N (six 0-10V or 0-20mA analog inputs) and the D1-15P-N (six PT100) need a 24Vdc (10V<Vdc<36V) supply by [C2] connector. The D1-15 family absorbs a maximum current Icc=100 mA at 24 Vdc.

The negative power supply for all the D1-15 modules must be connected to pin n.2 of [C2] connector. After power is turned on, check that LA led is on.

1.6 Inputs

1.6.1 Analog inputs for linear sensors

To D1-15 (six analog sensor) and D1-15 modules can be connected 0-10V or 0-20mA/4-20mA linear sensors.

For a 0-10V output sensor connection connect, for each set of three screws, positive sensor signal to the screw called IN and the negative sensor signal to the 0V one, as shown in figure 1.3.

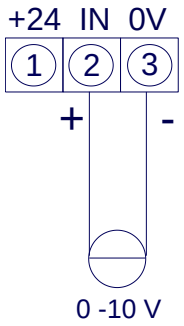

Figure 1.3 - 0-10V linear sensor wiring

For a 0-20mA/4-20mA output sensor connection, it is necessary to distinguish 2 cases for the D1-15 and D1-15A-N modules:

A) linear sensor supplied by the modules; supply the sensor through the screw called +24V and connect the sensor signal to screw called IN (fig. 1.4A);
B) linear sensor externally supplied; supply the sensor through an external power source and connect its negative to the screw called 0V and connect sensor signal to the screw called IN (fig. 1.4B).

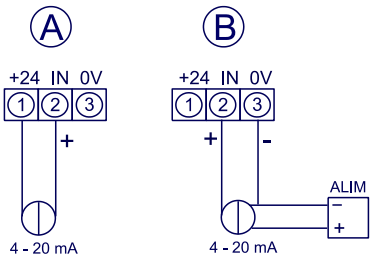

Figure 1.4 - Connection of 4-20 mA linear sensors supplied by the D1-15 or D1-15A-N module (case A) or by an external power source (case B)

Current input impedance is 249 Ω; choose sensor compliant with this specification.

Before connecting sensors, verify whether they are compatible with D1-15 or D1-15A-N models ordered.

In case of disturbance, can be useful to use shielded cable and connect the cable shield to the screw called 0V.

1.6.2 Pt100/RTD sensors inputs

To D1-15 (three Pt100) and D1-15P-N (six Pt100) modules can be connected Pt100 sensors.

WARNING! Be sure that the sensors used are in compliance with IEC 751 standard.

Choosing the sensor, be sure that the wires (3) connected to the sensor are electrically isolated from its metallic case. Dispersion currents towards the sensor metallic case can be detrimental to the precision of the reading. Pt100 sensors must be 3 wires type; for connection see figure 1.5.

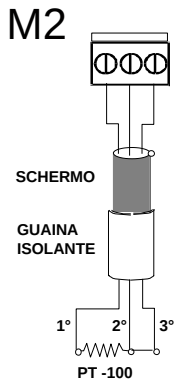

Figure 1.5 – 3 wires Pt100 connections

The cable loop resistance must be less than 20 ohm (measure taken between start loop screw and the end loop screw with a short circuit instead Pt100).

The recommended cable is a twisted pairs conductors cable (the first wire must be twisted with the second) with shielding and self-extinguishing insulating coating.

Do not connect Pt100 using single wires not belonging to the same cable: the outward wire resistance (first wire connected at the first screw of each

set of three) must be the same of the inward wire one (second wire connected at the second screw of each set of three).

1.7 Serial communication

1.7.1 Serial link

To connect to D1 modules, it is necessary to use a RS422/485 serial interface that usually are not standard equipment in personal computers.

EL-MICROWAVE produces the C1 serial adapter family. For example C1-25 model, a RS232-RS422/485 serial interface converter with triple optical isolation, can be connected to PC serial port (COM) and to D1-15 [C1] family connector as shown in table 1.1.

	C1-25		***D1-15 / D1-15A-N / D1-15P-N***		
n.	**RS-422**		**RS-422**	n.	
2	RX–	⟷	TX–	3	C1
3	RX+	⟷	TX+	4	C1
4	TX–	⟷	RX–	1	C1
5	TX+	⟷	RX+	2	C1
6	0 V				
7	+24 V				

	C1-25		***D1-15 / D1-15A-N / D1-15P-N***		
n.	**RS-485**		**RS-485**	**n.**	
1	GND	⟷	GND	2	C2
2	n.c.		n.c.	1	C1
3	n.c.		n.c.	2	C1
4	TX–/RX–	⟷	TX–/RX–	3	C1
5	TX+/RX+	⟷	TX+/RX+	4	C1
6	0 V				
7	+24 V				

Table 1.1 - C1-25 - D1-15 family (RS 422/485) wiring

D1-15 modules are provided with configurable serial interface RS422/485, normally configurated as RS485. To change configuration, remove the

shielding cover and move the jumper placed upper and left on the printed circuit board.

1.7.2 Communication protocol

Software communication protocol is achieved according to ModBus ASCII or RTU standard: protocol selection is made by n.3 selector of dipswitch (ON=RTU, OFF=ASCII).

The baud rate selection is made by n.2 selector of dipswitch (ON=19200, OFF=9600).

ASCII protocol features

Baud rate	9600 / 19200
Data bits	7
Parity bit	even
Stop bit	1

RTU protocol features

Baud rate	9600 / 19200
Data bits	8
Parity bit	none
Stop bit	1

NOTE
At power on, the device waits 4 seconds to communicate.

1.7.3 Device identification

To D1-15 family can be assigned an identification address between 1 and 31 through binary notation, using selector from 4 to 8 of dipswitch (see table 1.2).

	1	2	3	4	5	6	7	8
		BAUD	*PROT.*	2^4	2^3	2^2	2^1	2^0
ON		19200	RTU					
OFF	X	9600	ASCII					

Table 1.2 - Address configuration using dipswitch

NOTE
Address 0 is reserved. Dipswitch n.1 must be kept in OFF position.

1.7.4 Serial cable

Use shielded cable with one (RS-485) or two (RS-422) twisted pair in compliance with EIA RS-485 or EIA RS-422; using the shield for ground.

Recommended cable: *Belden 9841 (RS-485)*; *9842 (RS-422)*
Maximum signal loss: *6 dB*
Maximum line capacitance: *100 nf*
Maximum line length: *1200 m*
Line impedance: *from 100 to 120 ohm*

1.8 Earth wiring and shielding

1.8.1 Earth wiring

It is suggested to make the following earth:

- device mechanical ground (pin n.3 of [C2] connector) goes directly to earth;

- the power supply negative signal (pin n.2 of [C1] connector) must be connected to a local earth.

It is important that device grounds are connected to earth independently; it is also important to avoid to share the same wire path with power devices as inverter, drives etc.

1.8.2 Pt100 wiring

Temperature reading is based on low intensity signal detection coming from Pt100 sensors.

Parasite currents on the shields can induce disturbances that make reading imprecise.

Follow these shielding rules particularly in environment noise affected by power devices (motor driver , power contact etc.).

- use shielded and twisted cables for Pt100 sensors connection;
- keep connection cables as short as possible;
- it's better to make different canalizations for Pt100 signals and power signal conductors;
- connect all metal Pt100 connection cables shields only on the D1-15 side, leaving them non connected by the Pt100 sensor side;
- connect all the metal shield at pin 3 of [C2] connector.

2 Operation

2.1 Application

D1-15 module is provided with 9 input channels for 3 temperatures and 6 analog signals acquisition. D1-15A-N is provided with 6 analog signals acquisition and D1-15P-N is provided with 6 input channels for 6 temperatures.

In D1-15 and D1-15P-N the temperatures are acquired using three or six wires Pt100 sensors with automatic cable resistance compensation; acquired temperature values are recorded in tenth degrees on a range from -1999 to +4000; for example, a value of 275 means a temperature of 27.5°C. For D1-15 the recorded values are available through the numeric reading gates TA, TB and TC. For D1-15P-N (six Pt100) the recorded values are available through the numeric reading gates T1, T2, T3, T4, T5, T6.

In D1-15 the analog signals can be voltage (0-10 V) or current (0-20 mA); in the first case the acquired value is recorded on a range from 0 to 10000; for example the value of 7500 means 7.50 Volt. In current input case, the acquired value is recorded on a range from 0 to 4980 and for example the value of 2988 means 12.00 mA (=2988/249). Recorded values are available through the numeric reading gates J1, J2, J3, J4, J5, J6.

In D1-15A-N the analog signals can be voltage (0-10 V) or current (0-20 mA); in the first case the acquired value is recorded on a range from 0 to 10000; for example the value of 7500 means 7.50 Volt. In current input case, the acquired value is recorded on a range from 0 to 20000 and for example the value of 12000 means 12.000 mA (C1, C2, C3, C4, C5, C6

gates). Numeric values are available through the numeric reading gates N1, N2, N3, N4, N5, N6.

Error gates indicate the presence of an input signals reading alarms: in case of Pt100 error proceed disconnecting Pt100 sensors and checking that there are not any short circuit towards ground.

"Restart number" gate is only for diagnostic use and gives an indication of the electrical disturbances presence.

A Gates list

A.1 Numeric Gates D1-15 (Holding Registers)

Address	Description	ID	Variable	Byte	Range	R/W
00	Restart counter	Rs	U_BYTE	1	0: 255	R/W
01	Temperature PT100 #1	TA	S_WORD	2	-1999:+4000	R
02	Temperature PT100 #2	TB	S_WORD	2	-1999:+4000	R
03	Temperature PT100 #3	TC	S_WORD	2	-1999:+4000	R
04	Analog input J1	J1	U_WORD	2	0:10000	R
05	Analog input J2	J2	U_WORD	2	0:10000	R
06	Analog input J3	J3	U_WORD	2	0:10000	R
07	Analog input J4	J4	U_WORD	2	0:10000	R
08	Analog input J5	J5	U_WORD	2	0:10000	R
09	Analog input J6	J6	U_WORD	2	0:10000	R
10	PT100 errors	eT	U_BYTE	1	00h:FFh	R
11	Analog input errors	eJ	U_BYTE	1	00h:FFh	R

PT100 errors – eT

(for each bit: 0 means regular function, 1 means failure)

bit 0	-	Low sample error
bit 1	-	High sample error
bit 2	-	PT100 #1 resistance error
bit 3	-	PT100 #1 line resistance error
bit 4	-	PT100 #2 resistance error
bit 5	-	PT100 #2 line resistance error
bit 6	-	PT100 #3 resistance error
bit 7	-	PT100 #3 line resistance error

Analog inputs errors – eJ

(for each bit: 0 means regular function, 1 means failure)

bit 0	-	Analog reference error
bit 1	-	Analog error J1
bit 2	-	Analog error J2
bit 3	-	Analog error J3
bit 4	-	Analog error J4
bit 5	-	Analog error J5
bit 6	-	Analog error J6
bit 7	-	Not used

A.1 Numeric Gates D1-15A-N (Holding Registers)

Address	Description	ID	Variable	Byte	Range	R/W
00	Restart counter	Rs	U_BYTE	1	0:255	R/W
08	Channel #1 numeric value	N1	S_WORD	2	0:32767	R
09	Channel #2 numeric value	N2	S_WORD	2	0:32767	R
10	Channel #3 numeric value	N3	S_WORD	2	0:32767	R
11	Channel #4 numeric value	N4	S_WORD	2	0:32767	R
12	Channel #5 numeric value	N5	S_WORD	2	0:32767	R
13	Channel #6 numeric value	N6	S_WORD	2	0:32767	R
14	Channel #1 voltage value (mV)	V1	S_WORD	2	0:10000	R
15	Channel #2 voltage value (mV)	V1	S_WORD	2	0:10000	R
16	Channel #3 voltage value (mV)	V1	S_WORD	2	0:10000	R
17	Channel #4 voltage value (mV)	V1	S_WORD	2	0:10000	R
18	Channel #5 voltage value (mV)	V1	S_WORD	2	0:10000	R
19	Channel #6 voltage value (mV)	V1	S_WORD	2	0:10000	R
20	Channel #1 current value (µA)	C1	S_WORD	2	0:20000	R
21	Channel #2 current value (µA)	C2	S_WORD	2	0:20000	R
22	Channel #3 current value (µA)	C3	S_WORD	2	0:20000	R
23	Channel #4 current value (µA)	C4	S_WORD	2	0:20000	R
24	Channel #5 current value (µA)	C5	S_WORD	2	0:20000	R
25	Channel #6 current value (µA)	C6	S_WORD	2	0:20000	R
26	Analog input errors	eA	U_BYTE	1	00h:FFh	R

Analog inputs errors – eA

(for each bit: 0 means regular function, 1 means failure)

bit 0	-	Analog reference error (reference 10V)
bit 1	-	Analog error channel #1
bit 2	-	Analog error channel #1
bit 3	-	Analog error channel #1
bit 4	-	Analog error channel #1
bit 5	-	Analog error channel #1
bit 6	-	Analog error channel #1
bit 7	-	Not used

A.1 Numeric Gates D1-15P-N (Holding Registers)

Address	Description	ID	Variable	Byte	Range	R/W
00	Restart counter	Rs	U_BYTE	1	0:255	R/W
01	Pt100 #1	T1	S_WORD	2	-1999:+4000	R
02	Pt100 #1	T2	S_WORD	2	-1999:+4000	R
03	Pt100 #1	T3	S_WORD	2	-1999:+4000	R
04	Pt100 #1	T4	S_WORD	2	-1999:+4000	R
05	Pt100 #1	T5	S_WORD	2	-1999:+4000	R
06	Pt100 #1	T6	S_WORD	2	-1999:+4000	R
07	PT100 errors	eT	U_WORD	2	00h:1FFh	R

Pt100 inputs errors – eT

(for each bit: 0 means regular function, 1 means failure)

bit 0	-	Low sample
bit 1	-	High sample
bit 2	-	PT100 #1 resistance error
bit 3	-	PT100 #1 line resistance error
bit 4	-	PT100 #2 resistance error
bit 5	-	PT100 #2 line resistance error
bit 6	-	PT100 #3 resistance error
bit 7	-	PT100 #3 line resistance error
bit 8	-	PT100 #4 resistance error
bit 9	-	PT100 #4 line resistance error
bit 10	-	PT100 #5 resistance error
bit 11	-	PT100 #5 line resistance error
bit 12	-	PT100 #6 resistance error
bit 13	-	PT100 #6 line resistance error
bit 14	-	Not used
bit 15	-	Not used