

## **ELR-4C**

Relè differenziale di terra  
multicanale 4 ingressi

## **ELR-4C**

Multipoint earth leakage relay  
4 inputs

## ATTENZIONE!!!

- Leggere attentamente il manuale prima dell'utilizzo e l'installazione.
- Questi strumenti devono essere installati da personale qualificato, nel rispetto delle vigenti normative impiantistiche, allo scopo di evitare danni a persone o cose.
- Prima di qualsiasi intervento sullo strumento, togliere tensione dagli ingressi di alimentazione e dalle uscite relè dove presenti.
- Il costruttore non si assume responsabilità in merito alla sicurezza elettrica in caso di utilizzo improprio del dispositivo.
- I prodotti descritti in questo documento sono suscettibili in qualsiasi momento di evoluzioni o di modifiche.

## Descrizione

- Relè differenziale di terra tipo A
- Misure in vero valore efficace (TRMS)
- Filtro di terza armonica (impostabile)
- Esecuzione modulare, 3 moduli per guida DIN
- LED verde di segnalazione alimentazione (ON)
- Toroide esterno serie CT-1
- Funzionamento con sicurezza positiva per ciascun relè (impostabile)
- Visualizzazione dei valori della corrente differenziale
- Display LCD retroilluminato (verde, giallo, rosso)
- 4 LED rossi per l'indicazione di TRIP
- Pulsanti TEST e RESET sul fronte o chiusura contatto remoto
- 4 relè indipendenti per il controllo degli interruttori dei quattro canali di ingresso
- Grafico andamento istantaneo della misura della corrente per ogni canale
- Log eventi intervento corrente di guasto
- Porta di comunicazione RS-485 (protocollo Modbus RTU)

## Display and LED functions

Grazie al display LCD, l'utente può visualizzare i valori della corrente differenziale, TRMS con filtro, valori MAX, THD, fattore di cresta, grafici a barre, Log eventi, gli allarmi e accedere alle impostazioni.

- Verde: corrente rilevata inferiore alla soglia impostata
- Giallo:
  - rilevata corrente superiore alla soglia di PRE-ALLARME ma inferiore alla soglia TRIP
- Rosso:
  - intervento del relè di TRIP per il superamento della  $I_{\Delta n}$  impostata
  - lettura valore fuori scala
  - TEST, provoca l'intervento del relè
  - circuito aperto del toroide esterno (o collegamento non corretto)

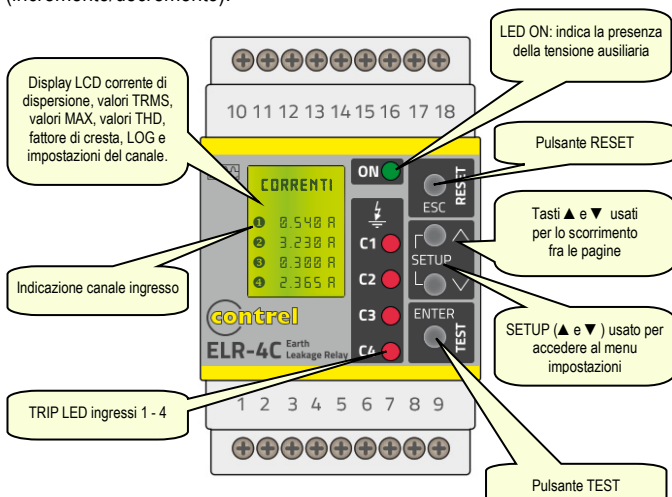
## Funzione dei tasti frontali

Tasto **RESET** – Serve per il ripristino dei relè dopo l'intervento, per uscire dal menu di impostazione.

Tasto **TEST** – Provoca l'intervento dei relè, per confermare una scelta.

Tasto **PROG** – Serve per entrare nel menu di impostazione, per lo scorrimento delle pagine.

Tasti **▲** e **▼** – Servono per lo scorrimento fra le pagine video, per la selezione tra le possibili scelte e per la modifica di impostazioni (incremento/decremento).



## WARNING!

- Carefully read the manual before the installation or use.
- This device is to be installed by qualified personnel, complying to current standards, to avoid damages.
- Before any maintenance operation on the device, remove supply inputs.
- The manufacturer cannot be held responsible for electrical safety in case of improper use of the equipment.
- Products illustrated herein are subject to alteration and changes without prior notice.

## Description

- Earth leakage relay type A
- Measuring in true effective value (TRMS)
- Third harmonic filtering (settable)
- Modular DIN-rail housing, 3 modules
- Green power LED indicator (ON)
- External residual current transformer CT-1 series
- Fail safe function for each four relays (settable)
- Visualization instant leakage values
- Backlighted LCD display (green, yellow, red)
- 4 red indicator LEDs for tripping
- TEST and RESET by front button or remote contact
- Four independent relays to control the circuit breakers of the four channels
- Instantaneous bar-graph of current measurement for each channel
- Log tripped residual current
- RS-485 communication (Modbus RTU protocol)

## Display and LED functions

Thanks to LCD display, the user can view very quickly the measurements (instant leakage values, filter TRMS, MAX values, THD, crest factor), the graph bar, the Log, the alarms and can access to all settings.

- Green: detected current lower than threshold
- Yellow:
  - detected current higher than PRE-ALARM threshold but lower than TRIP threshold
- Red:
  - detected current higher than TRIP threshold and relay activation
  - current leakage read off scale
  - TEST, causes tripping of the relay
  - open residual current transformer circuit (or not right connected)

## Front keyboard

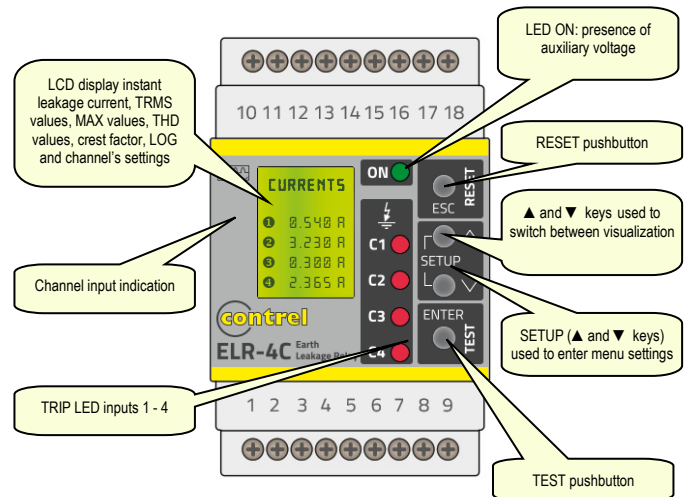
**RESET** key – To reset the relay after tripping, used to exit from settings menu.

**TEST** key – Causes tripping of the relays, to confirm a choice.

**PROG** keys – Used to enter into settings menu, to scroll display pages.

**▲** and **▼** keys – Used to switch between visualization modes,

to select among possible choices and to modify settings (increment/decrement).

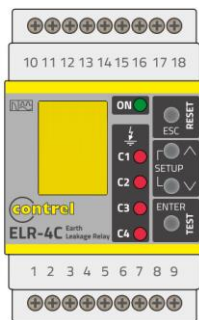
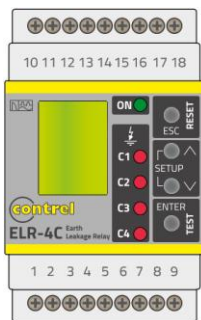


## Indicazioni sul display

Visualizzazione regolare  
(Display Verde)

Visualizzazione pre-allarme  
(Display Giallo)

Visualizzazione intervento  
(Display Rosso)

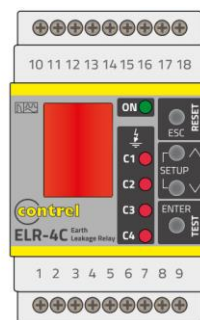
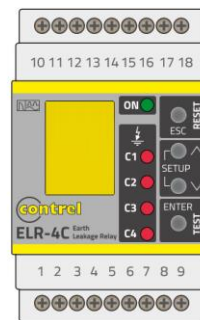
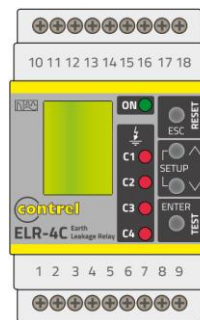


## Display indications

Correct display  
(Green LCD)

Pre-alarm display  
(Yellow LCD)

Trip display  
(Red LCD)

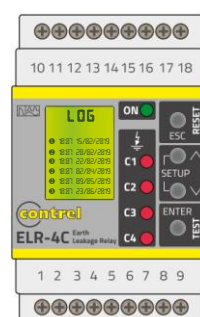
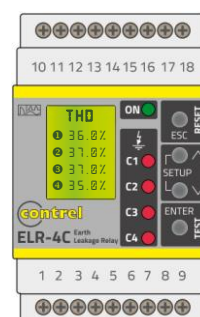
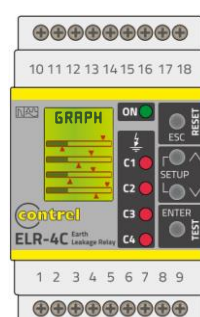
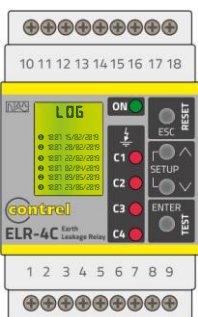
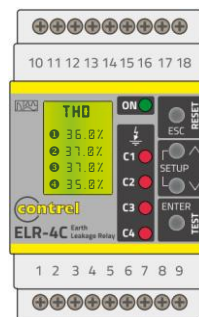
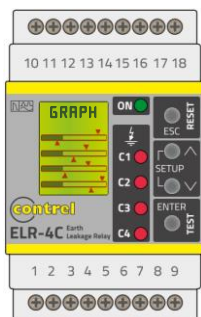


Causa dell'intervento	Messaggio sul display
Test	⚠ / Display rosso
Corrente differenziale	⚠ / Display rosso

Cause of the trip	Display message
Test	⚠ / Red display
Current leakage	⚠ / Red display

Altri messaggi sul display	
Pre-allarme	🔔 / Display giallo
Lettura valore fuori scala	OVR / Display rosso
Errore connessione con sensore	OPEN / Display rosso

Others display messages	
Pre-alarm	🔔 / Yellow display
Current leakage over scale	OVR / Red display
Poor toroidal connection	OPEN / Red display



## Tabella parametri

Di seguito sono elencati tutti i parametri di programmazione. Per ogni parametro sono indicati il possibile intervallo di impostazione, l'impostazione di fabbrica, nonché una descrizione della funzione del parametro. Premere i tasti ▲ e ▼ per selezionare il parametro desiderato. Il parametro selezionato è evidenziato con ►. Premere il tasto TEST per attivare il parametro selezionato. Utilizzare i tasti ▲ e ▼ per selezionare tra le possibili scelte possibili e premere il tasto TEST per confermare una scelta.

### Menu INGRESSI

Configurazione parametri per gli ingressi di corrente (ingressi 1...4).

ABILITAZIONE INGRESSO	Unità di misura	Default	Range
Abilitazione	-	SI	SI - NO

Se impostato NO, l'ingresso per toroide è disabilitato.

FILTRO 3° ARMONICA	Unità di misura	Default	Range
Filtro	-	OFF	ON-OFF

Se impostato ad ON, si abilita il filtro di blocco per la 3a armonica.

CORRENTE DI GUASTO	Unità di misura	Default	Range
I $\Delta$	mA	30	30...30000

Definisce la soglia di intervento per corrente di guasto verso terra.

TEMPO D'INTERVENTO	Unità di misura	Default	Range
Tempo	ms	20	20...10000

Definisce il tempo ritardo di intervento.

## Parameters table

Below are listed all the programming parameters. For each parameter are indicated the possible setting range, the factory default, as well as a description of the function of the parameter.

Press ▲ and ▼ keys to select the required parameter. The selected parameter is highlighted with ►.

Press TEST key to activated the selected parameter. Use ▲ and ▼ keys to select among possible choices and press TEST key to confirm a choice.

### INPUTS menu

Configuration parameters for current inputs (for inputs 1...4).

INPUT ENABLE	Unit of measure	Default	Range
Enable	-	YES	YES - NO

If set to OFF, the toroidal current input is disabled.

3 <sup>RD</sup> HARMONIC FILTER	Unit of measure	Default	Range
3RD filter	-	OFF	ON-OFF

Set to ON if the harmonic blocking filters for 3rd harmonic is used.

FAULT CURRENT	Unit of measure	Default	Range
I $\Delta$	mA	30	30...30000

Select the tripping fault current to earth.

TRIPPING DELAY TIME	Unit of measure	Default	Range
Time	ms	20	20...10000

Select the tripping delay time.

RESET TRIP	Unità di misura	Default	Range
Reset	-	MAN	AUTO-MAN

Se impostato su AUTO, il reset di TRIP sarà automatico. Se impostato su MAN, ripristino manuale tramite il tasto RESET o da remoto.

TEMPO PRE-ALARM	Unità di misura	Default	Range
Tempo	ms	20	20...10000

Definisce il tempo di ritardo del pre-allarme.

SOGLIA PRE-ALARM	Unità di misura	Default	Range
%	%	50	50...90

Definisce la soglia di pre-allarme che è in funzione del valore della corrente di guasto di intervento.

RESET PRE-ALARM	Unità di misura	Default	Range
Reset	-	AUTO	AUTO-MAN

Se impostato su AUTO, il ripristino del pre-allarme sarà automatico. Se impostato su MAN, ripristino manuale tramite il tasto RESET sul frontale.

TRIP RELE' FAILSAFE	Unità di misura	Default	Range
Failsafe	-	OFF	ON-OFF

Se impostato su ON, sicurezza positiva attivata sul relè TRIP dell'ingresso del canale, in questa condizione il relè TRIP è normalmente eccitato; pertanto, in caso di mancanza di tensione ausiliaria, i contatti di uscita si spostano nella condizione di scatto.

ISTERESI	Unità di misura	Default	Range
Isteresi	%	90	50...90

Definisce l'isteresi per la soglia di corrente di guasto di intervento.

### Menu COMUNICAZIONE

Parametri porta di comunicazione (COM1).

RS485	Unità di misura	Default	Range
Indirizzo nodo seriale	-	01	01-247
Baudrate	bps	38400	4800-115200
Bit di stop	-	1	1-2
Formato dati	-	8 bit - n	8 bit, no parity 8 bit, odd 8 bit, even
Tempo di risposta	ms	10	5-100

### Menu UTILITA'

UTILITA'	Unità di misura	Default	Range
Lingua	-	ENG	ENG-ITA
Frequenza di lavoro	Hz	50	50-60

### Menu DATA e ORA

L'ELR-4C gestisce un orologio datario che viene utilizzato per la memorizzazione degli eventi (corrente di guasto).

RESET TRIP	Unit of measure	Default	Range
Reset	-	MAN	AUTO-MAN

If set to AUTO, the reset of TRIP will be automatic. If set to MAN, manual reset through the RESET key on the front.

PRE-ALARM DELAY TIME	Unit of measure	Default	Range
Time	ms	20	20...10000

Select the pre-alarm delay time.

PRE-ALARM THRESHOLD	Unit of measure	Default	Range
%	%	50	50...90

Select the pre-alarm threshold which is a function of the tripping fault current value.

PRE-ALARM RESET	Unit of measure	Default	Range
Reset	-	AUTO	AUTO-MAN

If set to AUTO, the reset of pre-alarm will be automatic. If set to MAN, manual reset through the RESET key on the front.

TRIP RELAY FAILSAFE	Unit of measure	Default	Range
Failsafe	-	OFF	ON-OFF

If set to ON, positive safety activated on TRIP relay of the channel input, in this condition the TRIP relay is normally energised; therefore in the event of the lack of auxiliary voltage the output contacts move to the trip condition.

HYSTERESIS	Unit of measure	Default	Range
Hysteresis	%	90	50...90

Tripping fault current threshold hysteresis.

### COMMUNICATION menu

Communication port parameters (COM1).

RS485	Unit of measure	Default	Range
Serial node address	-	01	01-247
Baudrate	bps	38400	4800-115200
Stop bits	-	1	1-2
Data format	-	8 bit - n	8 bit, no parity 8 bit, odd 8 bit, even
Response time	ms	10	5-100

### UTILITY menu

UTILITY	Unit of measure	Default	Range
Language	-	ENG	ENG-ITA
Operating frequency	Hz	50	50-60

### TIME and DATE menu

The ELR-4C manages the time and date, that is used for the storage of events (tripped current).

## Menu COMANDI

Il menu comandi permette di eseguire operazioni saltuarie quali ripristino impostazioni, azzeramento memoria eventi. Una volta selezionato il comando desiderato, premere **TEST** per eseguirlo. Per annullare l'esecuzione del comando selezionato, premere il tasto **RESET**.

RESET	Descrizione
Parametri a default	Ripristina tutte le impostazioni ai valori di default di fabbrica
Reset MAX e TRIP	Azzerata la lista di eventi trip e i massimi

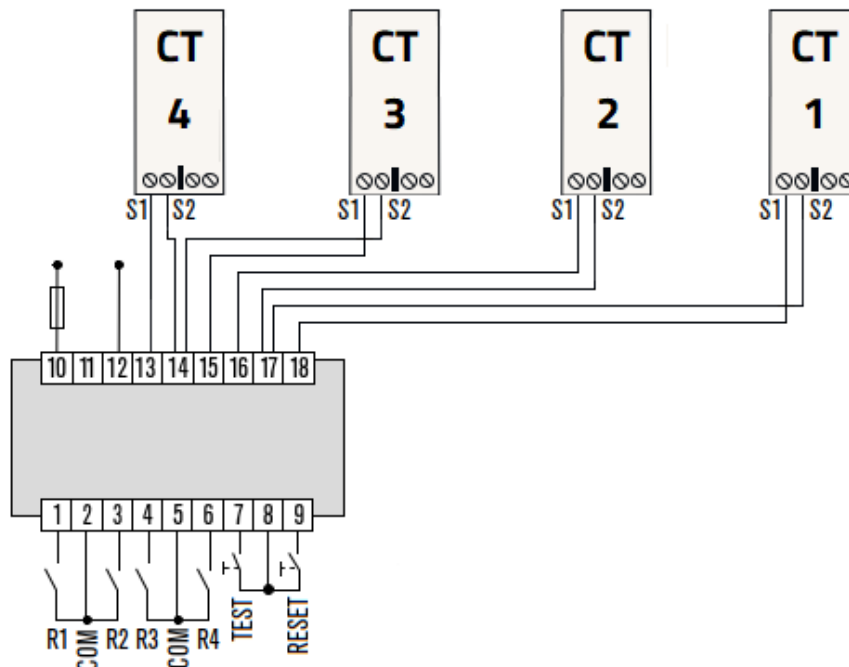
## Menu PASSWORD

La password serve per abilitare o sbloccare l'accesso al menu di impostazione ed al menu comandi (RESET). Per i dispositivi nuovi di fabbrica (default), la password è disabilitata e l'accesso è libero. Se invece la password è stata abilitata ed impostata (0-9999), per ottenere l'accesso bisogna prima inserire il relativo codice di accesso.

PASSWORD	Unità di misura	Default	Range
Valore	-	0	0-9999

Se impostato a 0, la gestione della password è disabilitata.

## Morsettiere di connessione



N°	Descrizione
1	Contatto di uscita allarme R1
2	Contatto di uscita allarme R1,R2 (COMUNE)
3	Contatto di uscita allarme R2
4	Contatto di uscita allarme R3
5	Contatto di uscita allarme R3,R4 (COMUNE)
6	Contatto di uscita allarme R4
7	TEST a distanza (DI1)
8	Comune ingressi digitali (COMUNE)
9	RESET a distanza (DI2)
10	Alimentazione ausiliaria (fase o neutro)
11	Non utilizzato
12	Alimentazione ausiliaria (neutro o fase)
13	Ingresso per sensore corrente toroidale 4-S1
14	Ingresso per sensore corrente toroidale 3,4-S2
15	Ingresso per sensore corrente toroidale 3-S1
16	Ingresso per sensore corrente toroidale 2-S1
17	Ingresso per sensore corrente toroidale 1,2-S2
18	Ingresso per sensore corrente toroidale 1-S1

## COMMANDS menu

The commands menu allows executing some occasional operations like resetting, log events clearing. Once the required command has been selected, press **TEST** to execute it. To cancel the command execution press **RESET** key.

COMMAND	Description
Parameters to default	All setup parameters are reseted to factory default value
Reset MAX & TRIP	Clears the event trip memory and MAX

## PASSWORD menu

The password is used to enable or lock to setting menu and command menu (RESET). For new devices (factory default), the password management is disabled and the access is free. If instead the password has been enabled and defined (0-9999), then to get access, it's necessary to enter the password first, specifying the number code.

PASSWORD	Unit of measure	Default	Range
Value	-	0	0-9999

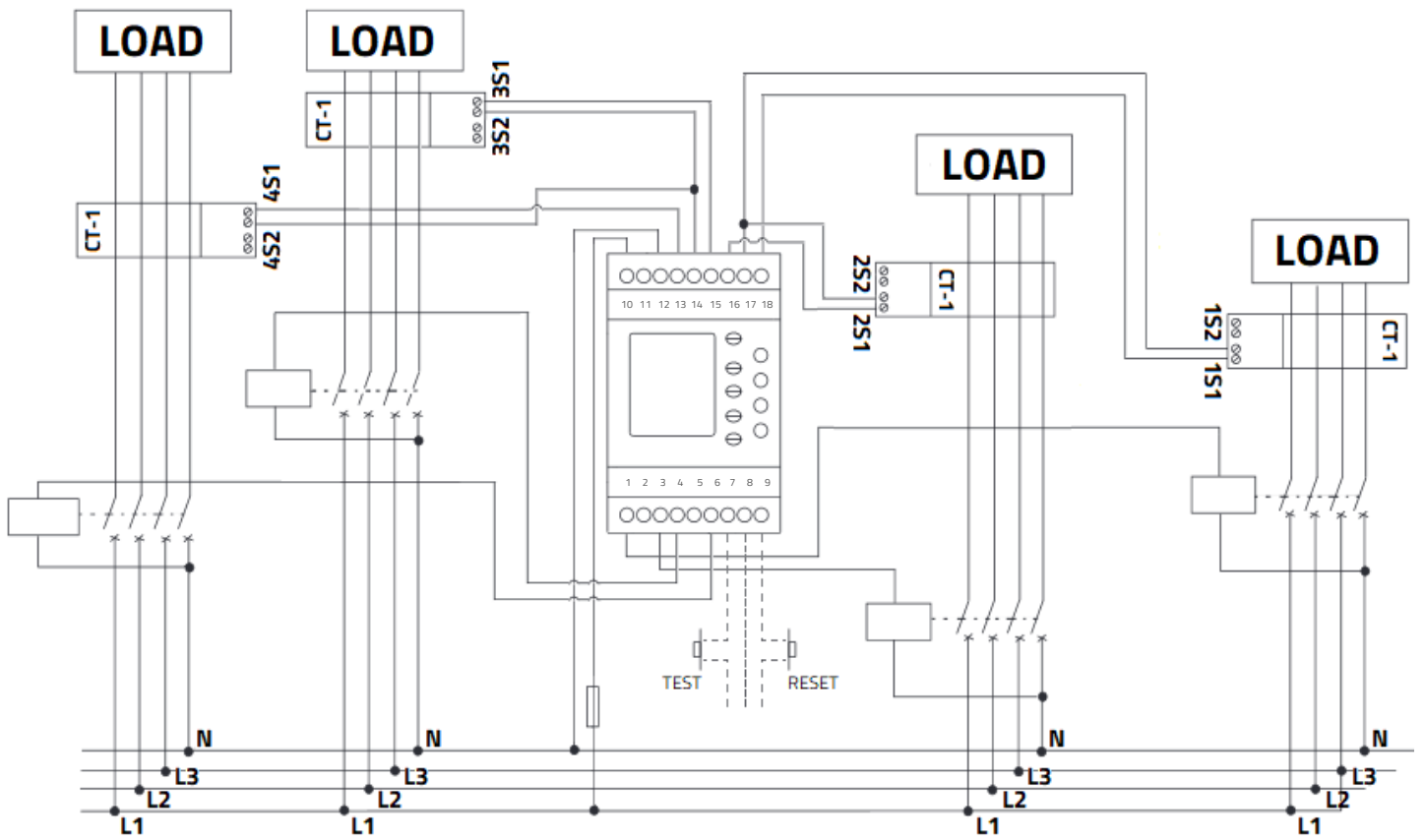
If set to 0, password management is disabled.

## Terminals connection

N°	Description
1	Trip output relay R1
2	Trip output relay R1,R2 (COMMON)
3	Trip output relay R2
4	Trip output relay R3
5	Trip output relay R3,R4 (COMMON)
6	Trip output relay R4
7	External TEST (DI1)
8	Digital input (COMMON)
9	External RESET (DI2)
10	Auxiliary supply (neutral or phase)
11	Not used
12	Auxiliary supply (neutral or phase)
13	Input toroidal current transformer 4-S1
14	Input toroidal current transformer 3,4-S2
15	Input toroidal current transformer 3-S1
16	Input toroidal current transformer 2-S1
17	Input toroidal current transformer 1,2-S2
18	Input toroidal current transformer 1-S1

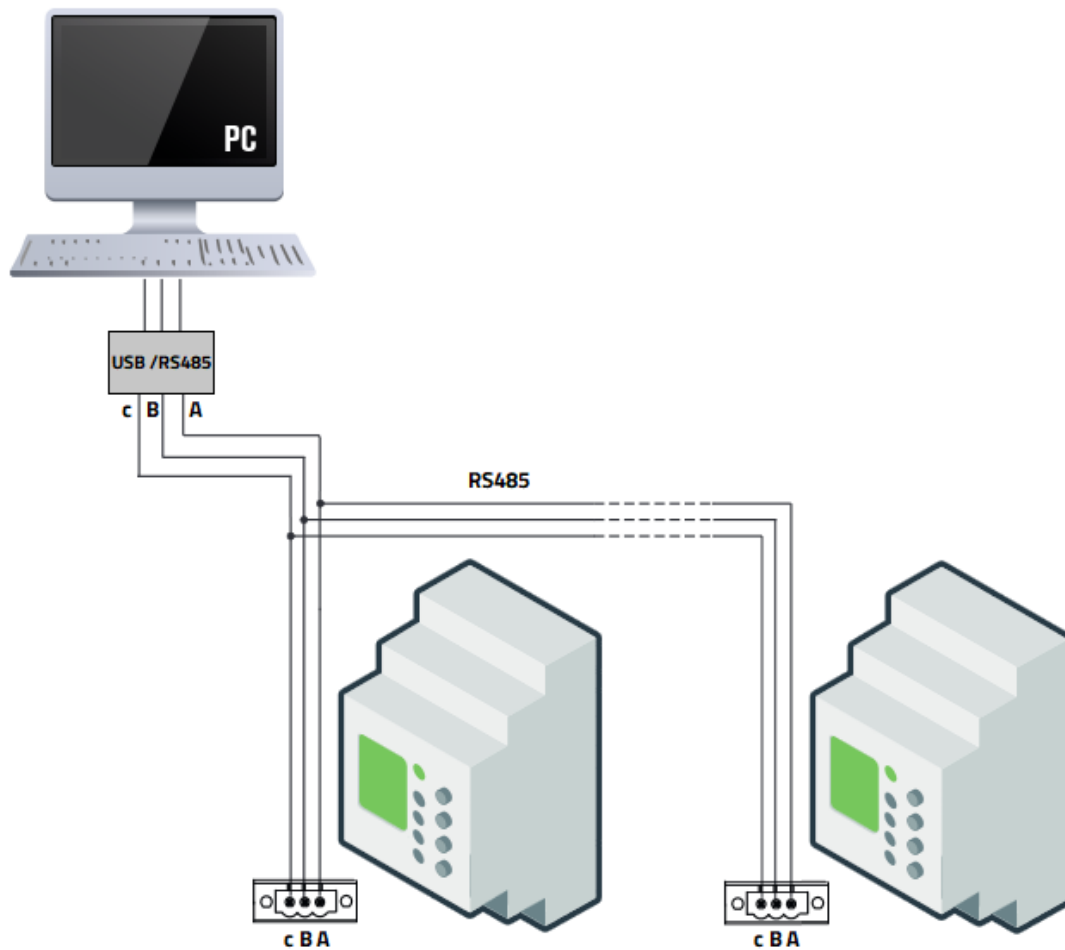
Schema di connessione

Wiring connection

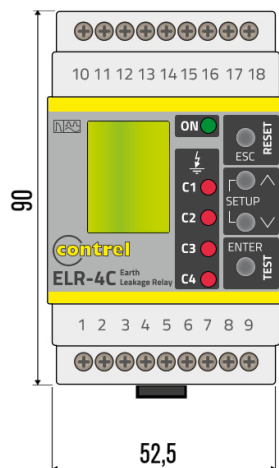


Connessione RS485 (opzionale)

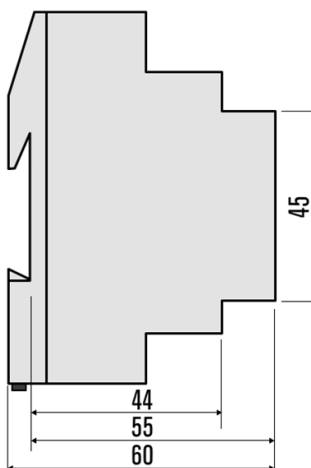
RS485 connection (optional)



## Dimensioni meccaniche (mm)



## Mechanical dimensions (mm)



## Caratteristiche tecniche

Circuito di controllo	
Toroide	Esterno, serie CT-1
Tipologia d'intervento	Tipo A
Set-point intervento ( $I_{\Delta}$ )	0,03÷30A
Set-point preallarme	50÷90%
Tempo di intervento (t)	0,02÷10s
Ripristino	Automatico o manuale con pulsante frontale o remoto
Alimentazione ausiliaria	
Tensione ausiliaria	230 VCA 115 VCA (opzionale) 24-48 VCA/CC (opzionale) 24-230 VCA/CC (opzionale)
Frequenza nominale	50/60Hz
Potenza massima assorbita	6VA
Uscite relè	
Uscite	4
Stato del relè	Impostabile normalmente diseccitati oppure normalmente eccitati
Tensione nominale di lavoro	250 VCA
Corrente nominale	5A
Vita meccanica	10 · 10 <sup>6</sup> cicli
Ingressi digitali	
Numero di ingressi	2
Tensione nominale	Autoalimentati 24 VCA/CC (opzionale)
Display	
Tecnologia	LCD
Interfaccia seriale RS485 (opzionale)	
Protocollo	Modbus-RTU
Baud-rate	Programmabile 4800 – 115200 bps
Connessioni	
Tipo di morsetti	A vite (fissi)
N° morsetti	18
Sezione conduttori	0,127 - 2,082 mm <sup>2</sup>
Coppia di serraggio mors.	0.5 - 0.6 Nm
Lunghezza cavo squainato	7mm
Condizioni ambientali di funzionamento	
Temperatura di impiego	-10÷60°C
Temperatura di stoccaggio	-20÷80°C
Umidità relativa	5÷95%
Contenitore	
Esecuzione	3 moduli DIN
Grado di protezione	IP20 sui morsetti IP40 sul frontale
Peso	200g
Conformità	
Norme di riferimento	EN 61010, EN 61000-6-2, EN 61000-6-3, IEC/TR 60755 EN 60947-2 Annex M

## Technical characteristics

Control circuit	
Toroidal transformer	External, CT-1 series
Tripping type	Type A
Tripping set-point ( $I_{\Delta}$ )	0,03÷30A
Prealarm set-point	50÷90%
Tripping time (t)	0,02÷10s
Resetting	Automatic or manual by pushbutton on front or remote
Auxiliary supply	
Auxiliary voltage	230 VAC 115 VAC (optional) 24-48VAC/DC (optional) 24-230 VAC/DC (optional)
Rated frequency	50/60Hz
Max power consumption	6VA
Output relay	
Number of outputs	4
State	Configurable normally de-energised or energised
Rated operating voltage	250 VAC
Rated current	5A
Mechanical life	10 · 10 <sup>6</sup> cycles
Digital inputs	
Number of inputs	2
Rated voltage	Self powered 24 VAC/DC (optional)
Display	
Type	LCD
RS485 serial interface (optional)	
Protocol	Modbus-RTU
Baud-rate	Programmabile 4800 – 115200 bps
Connections	
Type of terminal	Screw (fixed)
Number of terminals	18
Conductor cross section	0,127 - 2,082 mm <sup>2</sup>
Tightening torque	0.5 - 0.6 Nm
Length of cable to strip	7mm
Ambient operating conditions	
Operating temperature	-10÷60°C
Storage temperature	-20÷80°C
Relative humidity	5÷95%
Housing	
Version	3 module DIN
Degree of protection	IP20 terminals IP40 on front
Weight	200g
Certifications and compliance	
Reference standards	EN 61010, EN 61000-6-2, EN 61000-6-3, IEC/TR 60755 EN 60947-2 Annex M

Per ulteriori informazioni contattare:

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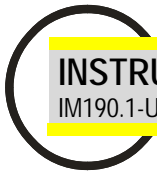
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The logo for Contrel elettronica s.r.l. features the word "contrel" in a bold, lowercase, yellow sans-serif font. The letter "c" is enclosed within a thin black circular outline. To the right of "contrel", the words "elettronica s.r.l." are written in a smaller, black, lowercase sans-serif font.





**Modbus RTU communication protocol for ELR-4C series**

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## Modbus RTU protocol

Modbus is a master-slave communication protocol able to support up to 247 slaves organized as a bus or as a star network. The physical link layer is RS485. The communication is half-duplex. The network messages can be Query-Response or Broadcast type. The Query-Response command is transmitted from the Master to an established Slave and generally it is followed by an answering message. The Broadcast command is transmitted from the Master to all Slaves and is never followed by an answer.

### Generic RTU message structure:

START OF FRAME	=	Starting message marker. (silence on line for time >= 4 characters)
ADDRESS FIELD [1 CHAR]	=	Includes device address in which you need to communicate in Query-Response mode. In case the message is a Broadcast type it includes 00.
FUNCTION CODE [1 CHAR]	=	The operation code that you need to perform.
DATA FIELD [N CHAR]	=	Includes the data field.
ERROR CHECK [2 CHARS]	=	Field for the error correction code.
END OF FRAME	=	End message marker. (silence on line for time >= 4 characters)

### Wait time for response:

Request of 16 register (64 bytes) → typical 15ms / worst 30 ms

Request of 64 register (128 bytes) → typical 15ms / worst 50 ms

Scan rate max recommended: 250 ms

## Reading multiple registers [function code 03h]

Reads the binary contents of holding registers (2X references) in the slave.

Broadcast is not supported. The Query message specified the starting register and quantity of register to be read.

### QUERY:

	0° Byte	1° Byte	2-3° Byte	4-5° Byte	6-7° Byte	
Start of Frame	Address Field	Function Code	Start Address	Number of Registers	Check Sum	End of Frame
START OF FRAME	=	Starting message marker.				
ADDRESS FIELD	=	Device address (0x01... 0xF7)		(1 byte).		
FUNCTION CODE	=	Operation code (0x03)		(1 byte).		
START ADDRESS	=	First register address to be read		(2 byte).		
No. OF REGISTERS	=	Number of registers (max 252 bytes) to read		(4 bytes [1 long] for 1 measure value).		
CHECK SUM	=	Check sum.				
END OF FRAME	=	End message marker.				

### WARNING:

It is possible to read more than one variable at the same time (**max 252 bytes**) only if their addresses are consecutive and the variables on the same line cannot be divided.

The register data in the response message are packet as two bytes per register, with the binary contents right justified within each byte.

For each register, the first byte contains the high order bits and the second contains the low order bits.

### RESPONSE:

	0° Byte	1° Byte	2° Byte	n° Byte	n+1 - n+2° Byte	
Start of Frame	Address Field	Function Code	Number of Bytes	Data	Check Sum	End of Frame
START OF FRAME	=	Starting message marker.				
ADDRESS FIELD	=	Device address (0x01... 0xF7)		(1byte).		
FUNCTION CODE	=	Operation code (0x03)		(1 Byte).		
No. OF SEND BYTES	=	Number of data bytes (0x00...??)		(1 byte). 1 register requires 2 data bytes.		
D0, D1, ..., Dn	=	data bytes (0x00...??)		(Nr. of register x 2 = n. byte).		
CHECK SUM	=	Check sum.				
END OF FRAME	=	End message marker.				

## Write multiple registers [function code 10h]

Write values into a sequence of holding registers (2X references).

**WARNING:** It is possible to write more than one variable at the same time only if their addresses are consecutive and the variables on the same line cannot be divided. (max 64 bytes).

### QUERY:

	0° Byte	1° Byte	2-3° Byte	4-5° Byte	6° Byte	n° Byte	n+1 - n+2° Byte	
Start of Frame	Address Field	Function Code	Start Address	Number of Registers	Number of Bytes	Data	Check Sum	End of Frame

*START OF FRAME* = Starting message marker.  
*ADDRESS FIELD* = Device address (0x01... 0xF7) (1 byte).  
*FUNCTION CODE* = Operation code (0x10) (1 byte).  
*START ADDRESS* = First register address to be written (2 byte).  
*No. OF REGISTER* = Number of registers to be written (1 to 4, ...) (2 byte).  
*No. OF BYTES* = Number of data bytes (HEX) (1 byte): 1 register requires 2 data bytes.  
*D0,D1,...,Dn* = Data bytes (0x00...?) (1 byte) (Nr. of register x 2 = n. byte).  
*CHECK SUM* = Check sum.  
*END OF FRAME* = End message marker.

The normal response returns the slave address, function code, starting address and quantity of register preset.

### RESPONSE:

	0° Byte	1° Byte	2-3° Byte	4-5° Byte	6-7° Byte	
Start of Frame	Address Field	Function Code	Start Address	Number of Registers	Check Sum	End of Frame

*START OF FRAME* = Starting message marker.  
*ADDRESS FIELD* = Device address (0x01... 0xF7) (1 byte).  
*FUNCTION CODE* = Operation code (0x10) (1 byte).  
*START ADDRESS* = First register address to be written (2 byte).  
*No. OF REGISTER* = Number of registers to be written (2 byte).  
*ERROR CHECK* = Check sum.  
*END OF FRAME* = End message marker.

### BROADCAST COMMAND:

It is possible to send a broadcast command (Address Field equal 0x00) for all write command.

### QUERY:

	0° Byte	1° Byte	2-3° Byte	4-5° Byte	6° Byte	n° Byte	n+1 - n+2° Byte	
Start of Frame	0x00	Function Code	Start Address	Number of Registers	Number of Bytes	Data	Check Sum	End of Frame

RESPONSE: No Response.

## Diagnostic [function code 08h]

This function provides a test for checking the communication system. Broadcast is not supported.

The instrument's protocol has only the sub-function 0 of the diagnostics sub-functions set of the standard modbus protocol.

The Query and the Response messages are the following:

### QUERY:

Start of Frame	0° Byte Address Field	1° Byte Function Code	2-3° Byte Sub Function	n° Byte Data	n+1 - n+2° Byte Check Sum	End of Frame
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*START OF FRAME* = Starting message marker.  
*ADDRESS FIELD* = Device address (0x01... 0xF7) (1 byte).  
*FUNCTION CODE* = Operation code (0x08 HEX) (1 byte).  
*SUB FUNCTION* = Sub-function 0 (0x00 0x00) (2 byte).  
*DATA* = Max 10 data bytes.  
*CHECK SUM* = Check sum.  
*END OF FRAME* = End message marker.

### RESPONSE:

The response must be the loopback of the same data.

Start of Frame	0° Byte Address Field	1° Byte Function Code	2-3° Byte Sub Function	n° Byte Data	n+1 - n+2° Byte Check Sum	End of Frame
----------------	--------------------------	--------------------------	---------------------------	-----------------	------------------------------	--------------

*START OF FRAME* = Starting message marker.  
*ADDRESS FIELD* = Device address (0x01... 0xF7) (1 byte).  
*FUNCTION CODE* = Operation code (0x08 HEX) (1 byte).  
*SUB FUNCTION* = Sub-function 0 (0x00 0x00) (2 byte).  
*DATA* = Data bytes.  
*CHECK SUM* = Check sum.  
*END OF FRAME* = End message marker.

### DIAGNOSTIC EXAMPLE:

QUERY		RESPONSE	
Field Name	Example (Hex)	Field Name	Example (Hex)
Slave Address	0x01	Slave Address	0x01
Function Code	0x08	Function Code	0x08
Sub-function Hi	0x00	Sub-function Hi	0x00
Sub-function Lo	0x00	Sub-function Lo	0x00
Data Hi	0xF1	Data Hi	0xF1
Data Lo	0xA7	Data Lo	0xA7
Error Check (CRC)	0x?? 0x??	Error Check (CRC)	0x?? 0x??

## Report slave ID [function code 11h]

This function returns the type of the instrument and the current status of the slave run indicator. Broadcast is not supported.

The Query and the Response messages are the following:

### QUERY:

Start of Frame	0° Byte Address Field	1° Byte Function Code	2 - 3° Byte Check Sum	End of Frame
----------------	--------------------------	--------------------------	--------------------------	--------------

*START OF FRAME* = Starting message marker.  
*ADDRESS FIELD* = Device address (0x01... 0xF7) (1 byte).  
*FUNCTION CODE* = Operation code (0x11) (1 byte).  
*CHECK SUM* = Check sum.  
*END OF FRAME* = End message marker.

### RESPONSE:

Start of Frame	0° Byte Address Field	1° Byte Function Code	2° Byte Byte Count	3° Byte Slave ID	4° Byte Run Indicator Status	5° - 6° Byte Check Sum	End of Frame
----------------	--------------------------	--------------------------	-----------------------	---------------------	---------------------------------	---------------------------	--------------

*START OF FRAME* = Starting message marker.  
*ADDRESS FIELD* = Device address (0x01... 0xF7) (1 byte).  
*FUNCTION CODE* = Operation code (0x11) (1 byte).  
*BYTE COUNT* = Number of data bytes (0x02) (1 byte).  
*SLAVE ID* = Slave ID identifier (0x73) (1 byte).  
*RUN INDICATOR STATUS* = Run indicator status (0xFF) (1 byte).  
*DATA* = Data bytes.  
*CHECK SUM* = Check sum.  
*END OF FRAME* = End message marker.

The normal response has the slave ID identifier (0x73) and the run indicator Status (0xFF).

### REPORT SLAVE ID EXAMPLE:

QUERY		RESPONSE	
Field Name	Example (Hex)	Field Name	Example (Hex)
Slave Address	0xXX	Slave Address	0x01
Function Code	0x11	Function Code	0x11
Error Check (CRC)	0x?? 0x??	Byte count	0x02
		Slave ID	0x73
		Run indicator status	0xFF
		Error Check (CRC)	0x?? 0x??

## Error message from slave to master

When a slave device receives a not valid query, it does transmit an error message.

### RESPONSE:

Start of Frame	0° Byte Address Field	1° Byte Function Code	2° Byte Error Code	3 - 4° Byte Check Sum	End of Frame
<i>START OF FRAME</i>	=	<i>Starting message marker.</i>			
<i>ADDRESS FIELD</i>	=	<i>Device address (0x01... 0xF7)</i>	<i>(1 byte).</i>		
<i>FUNCTION CODE</i>	=	<i>Operation code with bit 7 high</i>	<i>(1 byte).</i>		
<i>ERROR CODE</i>	=	<i>Message containing communication failure</i>	<i>(1 byte).</i>		
<i>CHECK SUM</i>	=	<i>Check sum.</i>			
<i>END OF FRAME</i>	=	<i>End message marker.</i>			

### ERROR EXAMPLE:

#### QUERY

Field Name	Example (Hex)
Slave Address	0x01
Function Code	0x03
Starting Address Hi	0x00
Starting Address Lo	0x00
Number Of Word Hi	0x00
Number Of Word Lo	0x05
Error Check (CRC)	0x??
	0x??

#### RESPONSE

Field Name	Example (Hex)
Slave Address	0x 01
Function Code	0x83 (1)
Error Code	0x02 (2)
Error Check (CRC)	0x??
	0x??

(1): Function Code transmitted by master with bit 7 high.

(2): Error type:

0x01 = Illegal Function

0x02 = Illegal data address

0x03 = Illegal data value

0x0F = Communication Protection Enabled  
(password enabled)

Write PASSWORD parameter before retry.

## Registers

The following tables shown all the device registers.

### Measures – Long format

Register <sup>HEX</sup>	Register <sup>DEC</sup>	Word	Description	R/W	M.U.	Type
100	256	2	CURRENT 1	R	mA	Unsigned
102	258	2	CURRENT 2	R	mA	Unsigned
104	260	2	CURRENT 3	R	mA	Unsigned
106	262	2	CURRENT 4	R	mA	Unsigned
108	264	2	CURRENT FILTERED 1	R	mA	Unsigned
10A	266	2	CURRENT FILTERED 2	R	mA	Unsigned
10C	268	2	CURRENT FILTERED 3	R	mA	Unsigned
10E	270	2	CURRENT FILTERED 4	R	mA	Unsigned
110	272	2	MAX CURRENT 1	R	mA	Unsigned
112	274	2	MAX CURRENT 2	R	mA	Unsigned
114	276	2	MAX CURRENT 3	R	mA	Unsigned
116	278	2	MAX CURRENT 4	R	mA	Unsigned
118	280	2	MAX CURRENT FILTERED 1	R	mA	Unsigned
11A	282	2	MAX CURRENT FILTERED 2	R	mA	Unsigned
11C	284	2	MAX CURRENT FILTERED 3	R	mA	Unsigned
11E	286	2	MAX CURRENT FILTERED 4	R	mA	Unsigned
120	288	2	THD 1	R	% * 100	Unsigned
122	290	2	THD 2	R	% * 100	Unsigned
124	292	2	THD 3	R	% * 100	Unsigned
126	294	2	THD 4	R	% * 100	Unsigned
128	296	2	CREST FACTOR 1	R	[thousandths]	Unsigned
12A	298	2	CREST FACTOR 2	R	[thousandths]	Unsigned
12C	300	2	CREST FACTOR 3	R	[thousandths]	Unsigned
12E	302	2	CREST FACTOR 4	R	[thousandths]	Unsigned
130	304	2	STATUS 1	R	bit 0 set: ALARM bit 1 set: TRIP bit 2 set: OPEN bit 3 set: DISABLE bit 4 set: OVER	-
132	306	2	STATUS 2	R	See STATUS 1	-
134	308	2	STATUS 3	R	See STATUS 1	-
136	310	2	STATUS 4	R	See STATUS 1	-

### Measures – Float format

Register <sup>HEX</sup>	Register <sup>DEC</sup>	Word	Description	R/W	M.U.	Type
200	512	2	CURRENT 1	R	mA	Float
202	514	2	CURRENT 2	R	mA	Float
204	516	2	CURRENT 3	R	mA	Float
206	518	2	CURRENT 4	R	mA	Float
208	520	2	CURRENT FILTERED 1	R	mA	Float
20A	522	2	CURRENT FILTERED 2	R	mA	Float
20C	524	2	CURRENT FILTERED 3	R	mA	Float
20E	526	2	CURRENT FILTERED 4	R	mA	Float
210	528	2	MAX CURRENT 1	R	mA	Unsigned
212	530	2	MAX CURRENT 2	R	mA	Unsigned
214	532	2	MAX CURRENT 3	R	mA	Unsigned
216	534	2	MAX CURRENT 4	R	mA	Unsigned
218	536	2	MAX CURRENT FILTERED 1	R	mA	Unsigned
21A	538	2	MAX CURRENT FILTERED 2	R	mA	Unsigned
21C	540	2	MAX CURRENT FILTERED 3	R	mA	Unsigned
21E	542	2	MAX CURRENT FILTERED 4	R	mA	Unsigned
220	544	2	THD 1	R	% * 100	Float
222	546	2	THD 2	R	% * 100	Float
224	548	2	THD 3	R	% * 100	Float
226	550	2	THD 4	R	% * 100	Float
228	552	2	CREST FACTOR 1	R	-	Float
22A	554	2	CREST FACTOR 2	R	-	Float
22C	556	2	CREST FACTOR 3	R	-	Float
22E	558	2	CREST FACTOR 4	R	-	Float

### Harmonics Input 1

Register <sup>HEX</sup>	Register <sup>DEC</sup>	Word	Description	R/W	Measure Unit	Type
1000	4096	2	1 <sup>ST</sup> HARMONIC ( <i>Fundamental</i> )	R	% * 100	Unsigned
1002	4098	2	2 <sup>ND</sup> HARMONIC	R	% * 100	Unsigned
1004	4100	2	3 <sup>RD</sup> HARMONIC	R	% * 100	Unsigned
1006	4102	2	4 <sup>TH</sup> HARMONIC	R	% * 100	Unsigned
1008	4104	2	5 <sup>TH</sup> HARMONIC	R	% * 100	Unsigned
---	---	---	---	---	---	---
107C	4220	2	63 <sup>TH</sup> HARMONIC	R	% * 100	Unsigned

### Harmonics Input 2

Register <sup>HEX</sup>	Register <sup>DEC</sup>	Word	Description	R/W	Measure Unit	Type
1100	4352	2	1 <sup>ST</sup> HARMONIC ( <i>Fundamental</i> )	R	% * 100	Unsigned
1102	4354	2	2 <sup>ND</sup> HARMONIC	R	% * 100	Unsigned
1104	4356	2	3 <sup>RD</sup> HARMONIC	R	% * 100	Unsigned
1106	4358	2	4 <sup>TH</sup> HARMONIC	R	% * 100	Unsigned
1108	4360	2	5 <sup>TH</sup> HARMONIC	R	% * 100	Unsigned
---	---	---	---	---	---	---
117C	4476	2	63 <sup>TH</sup> HARMONIC	R	% * 100	Unsigned

### Harmonics Input 3

Register <sup>HEX</sup>	Register <sup>DEC</sup>	Word	Description	R/W	Measure Unit	Type
1200	4608	2	1 <sup>ST</sup> HARMONIC ( <i>Fundamental</i> )	R	% * 100	Unsigned
1202	4610	2	2 <sup>ND</sup> HARMONIC	R	% * 100	Unsigned
1204	4612	2	3 <sup>RD</sup> HARMONIC	R	% * 100	Unsigned
1206	4614	2	4 <sup>TH</sup> HARMONIC	R	% * 100	Unsigned
1208	4616	2	5 <sup>TH</sup> HARMONIC	R	% * 100	Unsigned
---	---	---	---	---	---	---
127C	4732	2	63 <sup>TH</sup> HARMONIC	R	% * 100	Unsigned

### Harmonics Input 4

Register <sup>HEX</sup>	Register <sup>DEC</sup>	Word	Description	R/W	Measure Unit	Type
1300	4864	2	1 <sup>ST</sup> HARMONIC ( <i>Fundamental</i> )	R	% * 100	Unsigned
1302	4866	2	2 <sup>ND</sup> HARMONIC	R	% * 100	Unsigned
1304	4868	2	3 <sup>RD</sup> HARMONIC	R	% * 100	Unsigned
1306	4870	2	4 <sup>TH</sup> HARMONIC	R	% * 100	Unsigned
1308	4872	2	5 <sup>TH</sup> HARMONIC	R	% * 100	Unsigned
---	---	---	---	---	---	---
137C	4988	2	63 <sup>TH</sup> HARMONIC	R	% * 100	Unsigned

## Setup Input 1

**Warning:** Must be send the entire parameter length (2 words or 1 word – see the long of each parameter) for a correct command setting.

Register <sup>HEX</sup>	Register <sup>DEC</sup>	Word	Description	R/W	Parameters	Default
2000	8192	2	ENABLE	R/W	0: disable 1: enable	1
2002	8194	2	FILTER	R/W	0: disable 1: enable	0
2004	8196	2	TRIP - mA	R/W	30 ÷ 30'000	30
2006	8198	2	TRIP DELAY - ms	R/W	20 ÷ 10'000 <i>Note: the value must be a multiple of 20 ms.</i>	20
2008	8200	2	TRIP RECOVERY MODE	R/W	0: manual 1: automatic	0
200A	8202	2	WARNING DELAY - ms	R/W	20 ÷ 1'000'000 <i>Note: the value must be a multiple of 20 ms.</i>	20
200C	8204	2	WARNING PERCENT	R/W	20 ÷ 90 percent of trip	50
200E	8206	2	WARNING RECOVERY MODE	R/W	0: manual 1: automatic	1
2010	8208	2	HYSTERESIS <sup>[TRIP &amp; WARNING]</sup>	R/W	95 ÷ 50% over the limit set	90
2012	8210	2	FAIL SAFE	R/W	0: disable 1: enable	0

Setup Input 2: 2100<sup>HEX</sup> to 2113<sup>HEX</sup> / 8448<sup>DEC</sup> to 8467<sup>DEC</sup>

Setup Input 3: 2200<sup>HEX</sup> to 2213<sup>HEX</sup> / 8704<sup>DEC</sup> to 8723<sup>DEC</sup>

Setup Input 4: 2300<sup>HEX</sup> to 2313<sup>HEX</sup> / 8960<sup>DEC</sup> to 8979<sup>DEC</sup>

## Remote reset [trip/warning state]

**Warning:** Must be send the entire parameter length (2 words or 1 word – see the long of each parameter) for a correct command setting.

Register <sup>HEX</sup>	Register <sup>DEC</sup>	Word	Description	R/W	Parameters
2A00	10752	2	MANUAL RESET INPUT 1	W	Write 0x0A0A <sup>hex</sup> (2570 <sup>dec</sup> ) to reset
2A02	10754	2	MANUAL RESET INPUT 2	W	Write 0x0A0A <sup>hex</sup> (2570 <sup>dec</sup> ) to reset
2A04	10756	2	MANUAL RESET INPUT 3	W	Write 0x0A0A <sup>hex</sup> (2570 <sup>dec</sup> ) to reset
2A06	10758	2	MANUAL RESET INPUT 4	W	Write 0x0A0A <sup>hex</sup> (2570 <sup>dec</sup> ) to reset

## Remote test

**Warning:** Must be send the entire parameter length (2 words or 1 word – see the long of each parameter) for a correct command setting.

Register <sup>HEX</sup>	Register <sup>DEC</sup>	Word	Description	R/W	Parameters
2A20	10784	2	MANUAL TEST INPUT 1	W	Write 0x5050 <sup>hex</sup> (20560 <sup>dec</sup> ) to test
2A22	10786	2	MANUAL TEST INPUT 2	W	Write 0x5050 <sup>hex</sup> (20560 <sup>dec</sup> ) to test
2A24	10788	2	MANUAL TEST INPUT 3	W	Write 0x5050 <sup>hex</sup> (20560 <sup>dec</sup> ) to test
2A26	10790	2	MANUAL TEST INPUT 4	W	Write 0x5050 <sup>hex</sup> (20560 <sup>dec</sup> ) to test



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