





1. PRESENTATION OF HF1028

HF1028 is fully numerical relay designed to perform electrical protection and control functions.

The following sections describe content and structure of the menu.

The five keys situated in the middle of the HAMIANFAN relay front panel are dedicated to set parameters.

With the keys     it is possible to move in the direction indicated to the various levels of the menus. The key 5 validates the settings modification.

The two keys © and ® are dedicated to acknowledging/clearing and displaying/reading of data. For example if successive alarms are to be displayed, press on key ®.

The alarms are presented in reverse order of their detection (the most recent alarm first, the oldest last). The user can either acknowledge and clear each alarm from the LCD by using © or go to the end of the ALARM menu and carry out a general acknowledgement.

1.1 User Interface

1.1.1 Relay Overview

The next figures show the HF1028 relay.



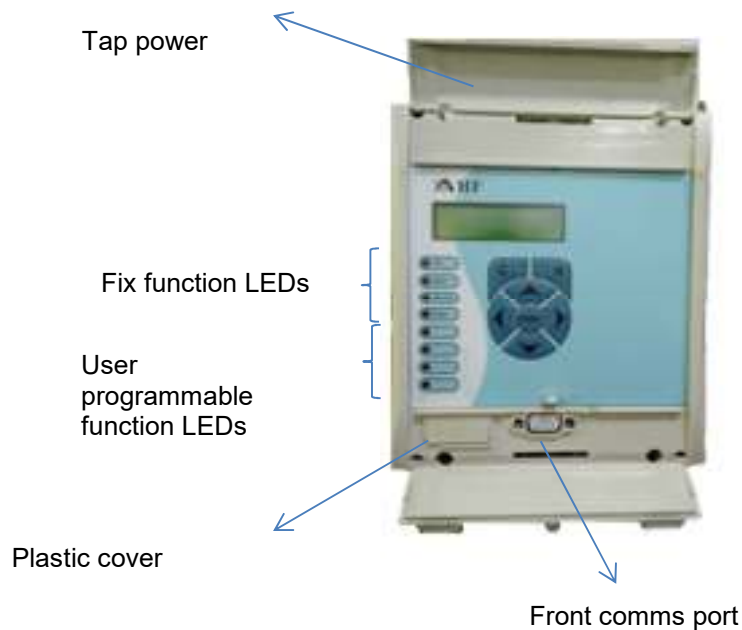
The table shows the case size for the relay.

	Height	Depth	Width
HF1028	4U (177mm)	226mm	30 TE

The hinged covers at the top and bottom of the relay are shown closed. Extra physical protection for the front panel can be provided by an optional transparent front cover; this allows read only access to the relays settings and data but does not affect the relays IP rating. When full access to the relay keypad is required to edit the settings, the transparent cover can be unclipped and removed when the top and bottom hinged covers are open. If the lower cover is secured with a wire seal, this will need to be removed. Using the side flanges of the transparent cover, pull the bottom edge away from the relay front panel until it is clear of the seal tab. The cover can then be moved vertically down to release the two fixing lugs from their recesses in the front panel.

1.1.2 Front Panel Description

HF1028 relay front panel allows the user to easily enter relay settings, display measured values and alarms and to clearly display the status of the relay.



HF1028 relay FRONT PANEL DESCRIPTION

The front panel of the relay has three separate sections:

1. The LCD display and the keypad,
2. The LEDs
3. The two zones under the upper and lower flaps.

NOTE: Starting from Hardware 5, there is no need of battery in the front of the relay. Indeed, disturbance, fault and event records are stored on a flash memory card that doesn't need to be backed up by a battery. The compartment is fitted with a blanking cover.

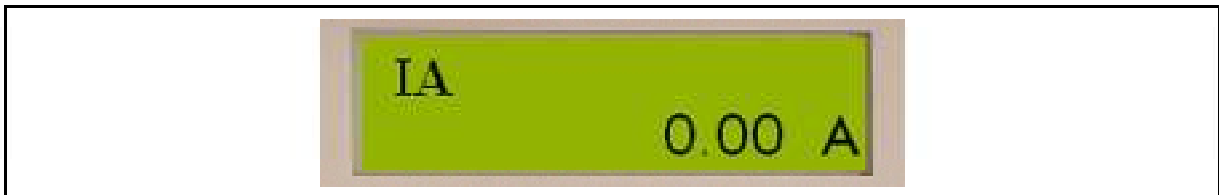
1.1.3 LCD display and keypad description

The front panel components are shown below. The front panel functionality is identical for the HF1028 relays.

1.1.3.1 LCD display

In the front panel, a liquid crystal display (LCD) displays settings, measured values and alarms. Data is accessed through a menu structure.

The LCD has two lines, with sixteen characters each. A back-light is activated when a key is pressed and will remain lit for five minutes after the last key press. This allows the user to be able to read the display in most lighting conditions.



1.1.3.2 Keypad

The keypad has seven keys divided into two groups:

- Two keys located just under the screen (keys ⑩ and ⑪).

Keys ⑩ and ⑪ are used to read and acknowledge alarms. To display successive alarms, press key ⑩. Alarms are displayed in reverse order of their detection (the most recent alarm first, the oldest alarm last). To acknowledge the alarms, the user can either acknowledge each alarm using ⑪ or go to the end of the ALARM menu and acknowledge all the alarms at the same time.

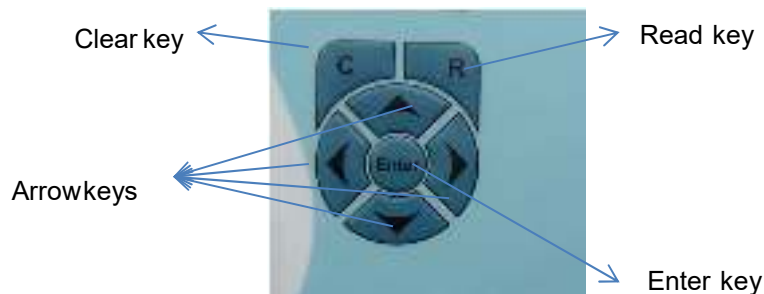
When navigating through submenus, key ⑩ is also used to come back to the head line of the corresponding menu.

NOTE: To acknowledge a relay latched refer to the corresponding submenu section.

- Four main keys ⑫, ⑬, ⑭, ⑮ located in the middle of the front panel.

They are used to navigate through the different menus and submenus and to do the setting of the relay.

The key ⑮ is used to validate a choice or a value (modification of settings).

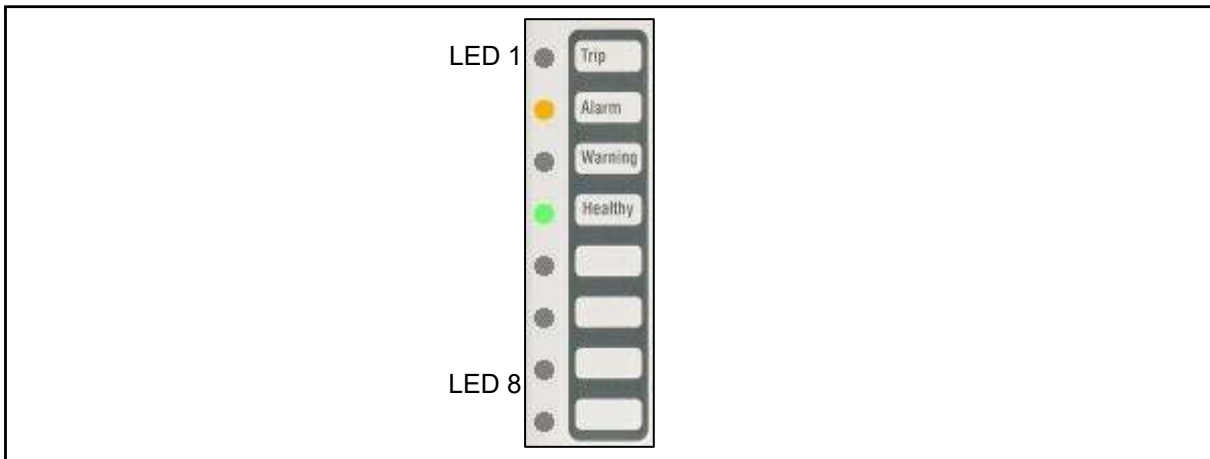


1.1.4 LEDs

The LED labels on the front panel are by default written in English, however the user has self-adhesive labels available with **HAMIANFAN** relays on which it is possible to write using a ball point pen.

The top four LEDs indicate the status of the relay (Trip condition, alarm LED, equipment failure, auxiliary supply).

The four lower LEDs are freely programmable by the user and can be assigned to display a threshold crossing for example (available for all models) or to show the status of the logic inputs. The description of each one of these eight LEDs located in the left side of the front view is given hereafter (numbered from the top to bottom from 1 to 8):



LED 1 **Colour: RED** **Label: Trip**

LED 1 indicates when a trip command has been issued by the relay to the cut-off element (circuit breaker, protection trip). This LED copies the trip command issued to the trip output relay contact (RL1). In its normal state the LED is not lit. It is illuminated as soon as a trip order is issued. It is reset when the associated alarm is acknowledged.

LED 2 **Colour: ORANGE** **Label: Alarm**

LED 2 indicates that an alarm has been registered by MiCOM P125, P126 & HF1028 relays. The alarms are either threshold crossings (instantaneous) or tripping orders (time delayed). The LED will flash until the alarms have been accepted (read key), after which the LED will change to constant illumination. It will extinguish when the alarms have been cleared (clear key) and the trip cause is reset.

LED 3 **Colour: ORANGE** **Label: Warning**

LED 3 is dedicated to the internal alarms of HF1028 relays.

When a "non critical" internal alarm (i.e. a communication fault) is detected, the LED flashes continuously. When the fault is classed as "critical", the LED is illuminated continuously. The LED only extinguishes after the cause that provoked this fault has been removed (i.e. repair of the module, disappearance of the fault).

LED 4 **Colour: GREEN** **Label: Healthy**

LED 4 indicates that HF1028 relay relays are in correct working order and the auxiliary power supply is present.

LED 5 to 8 **Colour: RED** **Label: Aux.1 to 4.**

These LEDs can be programmed by the user on the basis of information on available thresholds (instantaneous and time-delayed). The user selects the information he wishes to see associates with each LED from the menu element (Logic OR). Each LED illuminates when the associated information is valid. The extinguishing of each LED is linked to the acknowledgement of the associated alarms.

1.1.5 Description of the two areas under the top and bottom flaps

1.1.5.1 Relay Identification

Under the top hinged cover there is an adhesive paper label that contains the relay model number, serial number, sensitive earth current range, rating information and the Cortec code for ordering etc.

Each item on the label is described below:

HF1028 CAF11: CORTEC code

This code allows the user to identify the characteristics of the relay.

No.: 0000000: Serial number

Cde: 00000/000: Reference to the purchasing order.

These numbers are needed when contacting HAMIANFAN in case of problems.

Un = 57 – 130V: Voltage input range.

Modbus: Communication protocol of the RS485 communication port situated on the rear of the relay.

0.002 Ien: Sensitivity of the earth fault current (available are three sensitivity levels).

Ua = 48-150V DC: Auxiliary power supply range. In this example, the power supply must be a DC voltage.



1.1.5.2 Battery compartment (no longer used) and Communication Port

Under the bottom hinged cover of the relay there was a battery compartment to hold the ½AA size battery, which is no longer used. Starting from Hardware 5, disturbance, fault and event records are stored on a flash memory card that doesn't need to be backed up by a battery. Therefore battery in the front compartment of the relay are no longer needed. The battery compartment is fitted with a blanking cover.

Next to the (empty) battery compartment there is a 9-pin female D-type socket, which can be used to communicate with a local PC (up to 15m distance) via a RS232 serial data link cable (SK1 port).

1.1.5.3 The USB/RS232 cable (to power and set the relay)

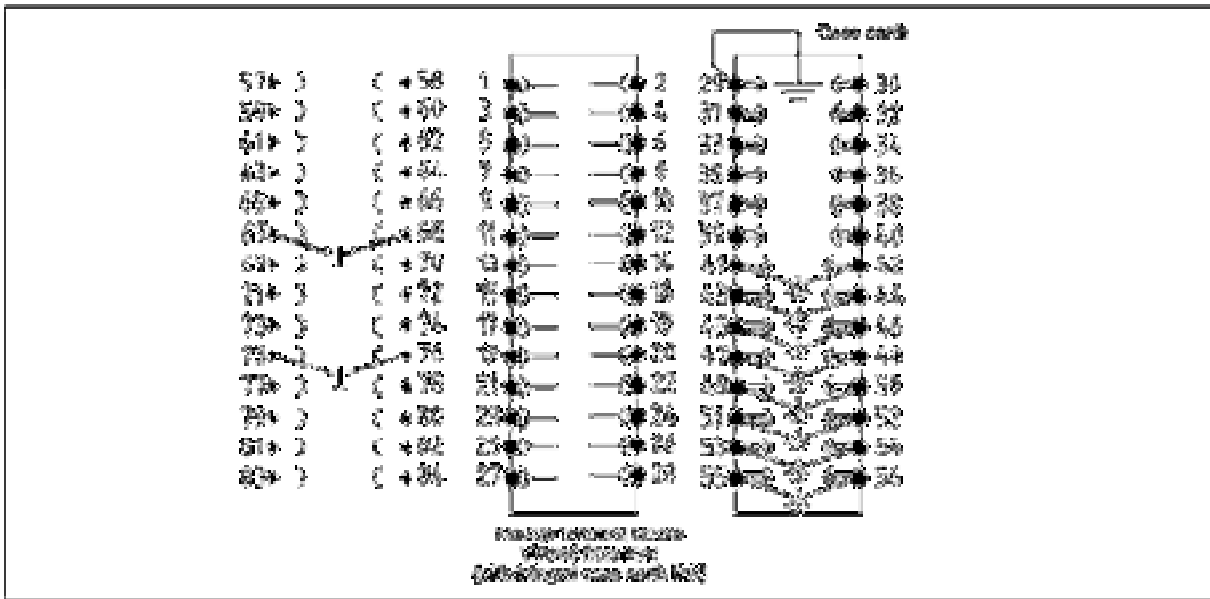
The USB/RS232 cable is able to perform the following functions:

1. It is able to power the relay from its front port. This allows the user to view or modify data on the relay even when the auxiliary power supply of the relay has failed or when the relay is not connected to any power supply. The USB port of the PC supplies the power necessary to energize the relay. This lasts as long as the battery of the PC can last.
2. It provides an USB / RS 232 interface between the relay and the PC. This allows the user to be able to change the setting of the relay using a PC with its USB port.

It eases the use of the relay allowing the retrieval of records and disturbance files for example when the auxiliary supply has failed or is not available.

The associated driver (supplied with the relay) needs to be installed in the PC.

1.1.6.3 Description of rear Terminal Block for HF1028



Input 7 + terminal	57	58	Input 6 + terminal	Output 5	1	2	Common output 1	Case earth connection	29	30	Terminal RS485
Input 7 - terminal	59	60	Input 6 - terminal	Common output 5	3	4	Output 1 (NC)	RS485 - terminal	31	32	RS485 +
Input 8 + terminal ⁽¹⁾	61	62	Input COM - terminal ⁽¹⁾	Output 6	5	6	Output1 (NO)	Vaux + terminal	33	34	Vaux - terminal
Input A + terminal ⁽¹⁾	63	64	Input 9 + terminal ⁽¹⁾	Common output 6	7	8	Common output 2	Relay failed (WD)	35	36	Common "Watchdog"
Input C + terminal ⁽¹⁾	65	66	Input B + terminal ⁽¹⁾	Common output 7	9	10	Output 2 (NC)	Relay healthy (WD)	37	38	
Current I1 ⁽³⁾ meas. 1A/5A	67	68	Current I1 ⁽³⁾ meas. 1A/5A	Output 7	11	12	Output 2 (NO)		39	40	
Voltage input VA	69	70	Voltage input VA	Common output 8	13	14	Output 3	Current input IA (5A)	41	42	Current input IA (5A)
Voltage input VB	71	72	Voltage input VB	Output 8	15	16	Common output 3	Current input IB (5A)	43	44	Current input IB (5A)
Voltage input VC/Vr	73	74	Voltage input VC/Vr	Input 3 + terminal	17	18	Output 4	Current input IC(5A)	45	46	Current input IC(5A)
Current I2 ⁽³⁾ meas. 1A/5A	75	76	Current I2 ⁽³⁾ meas. 1A/5A	Input 3 - terminal	19	20	Common output 4	Current input Ie (5A)	47	48	Current input Ie(5A)
Case earth connection ⁽²⁾	77	78	RS485-2 term. Z ⁽²⁾	Input 4 + terminal	21	22	Input 1 + terminal	Current input IA (1A)	49	50	Current input IA (1A)
RS485-2 - terminal ⁽²⁾	79	80	RS485-2 + terminal ⁽²⁾	Input 4 - terminal	23	24	Input 1 - terminal	Current input IB (1A)	51	52	Current input IB (1A)
IRIG-B mod - terminal ⁽²⁾	81	82	IRIG-B mod + terminal ⁽²⁾	Input 5 + terminal	25	26	Input 2 + terminal	Current input IC (1A)	53	54	Current input IC (1A)
IRIG-B dem - terminal ⁽²⁾	83	84	IRIG-B dem + terminal ⁽²⁾	Input 5 - terminal	27	28	Input 2 - terminal	Current input Ie (1A)	55	56	Current input Ie (1A)

⁽¹⁾ Available only for HF1028 "5 opto-inputs" option (product codes HF1028xx1 or HF1028xx3). "Input COM - terminal" is the common terminal for inputs 8 to 12.

⁽²⁾ Available only for HF1028 "IRIG-B and 2nd rear port option" option (product codes HF1028xx2 or HF1028xx3).

The "81" and "82" terminals are used to connect the optional BNC adaptor. This one must be plugged according to the "+" and "GND" positions marked on the adaptor.

- ⁽³⁾ With I1 = IA or IB or IC and I2 = IA or IB or IC. Available only for HF1028 with additional measurement CT option (product codes HF1028xx4, HF1028xx5, HF1028xx6 or HF1028xx7)

2. MENU ALARMS

The HF1028 IS able to identify the phase where the fault occurs, and the relevant alarm messages are shown in the below listed table.

Menu ALARMS	
I> PHASE	tI> PHASE
A A	A A
B B	B B
C C	C C
A AB AB	A AB AB
A AB ABC	A AB ABC
ABC ABC ABC	ABC ABC ABC
ABC ABC	ABC ABC

The following messages are sorted in alphabetical order

The following table gives the list of alarms (sorted in alphabetical order) with description and type of acknowledgement. The five types of acknowledgement of alarm are:

- Man = alarm must be acknowledged manually (front panel or communication port),
- Self = self reset when time delayed alarm occurs (i.e. I> alarm is acknowledged when tI> occurs),
- Inhib = the alarm can be inhibited by setting (“CONFIGURATION/Alarms” menu),
- Auto = alarm is automatically acknowledged when the event disappears.
- manual reset using “ORDERS / Record Reset” menu.

Alarm	Description	Type
Σ Amps(n)	total Total measured current broken by CB is higher than the value set in AUTOMAT. CTRL/CB Supervision menu.	man
Recloser[79] Blockedint. locked [79] ext. locked	re-close (internal or external) blocking signal. Generated by: – external breaker failure signal (ex. SF6 low). – signal provided via logic input assigned to the CB Fail function in the AUTOMAT. CTRL/Inputs menu. – external blocking signal. External blocking can be set by the user in the PROTECTION G1 / [79] AUTORECLOSE/Ext Block menu. This blocking signal is provided via a logic input assigned to the Block_79 function in the AUTOMAT. CTRL/Inputs menu. – definitive trip. – breaker operating time (or tripping time) longer than the set time, but only if the function is enabled. – Trip of protection (See AP document for further information)	Auto
Brkn.Cond.	Broken conductor signal. I2/I1 element threshold exceeded for longer than tBC; tBC is settable in the AUTOMAT. CTRL/Broken Conductor menu.	man
CB Fail	Circuit breaker failure signal; the CB does not trip on Tbf (time-out). tBF is settable in the AUTOMAT. CTRL/CB Fail menu.	man
CB Open NB	number of circuit breaker operation higher than the value set in the AUTOMAT. CTRL/CB Supervision menu.	man
Conflict Recloser	configuration conflict of the re-close function. This signal is generated by: – None digital input assigned to the position of the CB 52a – no output relay assigned to the CB Close function (AUTOMAT. CTRL/Output Relays menu). – None protection is assigned to the trip command – no re-close cycle assigned to the protection functions (PROTECTION G1/ [79] Autoreclose menu).	auto
CTS	Current Transformer Supervision alarm	auto
dF/dt1 to dF/dt6	Rates of change of frequency (1 to 6).	man
EQU. A to EQU. H	Equation logic A, B, C, D, E, F, G or H set	inhib
F OUT	Frequency out of range	man
F1 to F6	Instantaneous 1 st , 2 nd , 3 rd , 4 th , 5 th and 6 th frequency threshold	man & self
I<	alarm threshold undercurrent fault	man & self
I>>	2 nd alarm threshold directional/non directional overcurrent	man & self

I>>>	3 rd alarm threshold directional/non directional overcurrent	man & self
I2>	1 st alarm threshold negative sequence overcurrent	man & self
I2>>	2 nd alarm threshold negative sequence overcurrent	man & self
I2>>>	3 rd alarm threshold negative sequence current	man & self
Ie>	1 st alarm threshold directional/non directional earth fault	man & self
Ie>>	2 nd alarm threshold directional/non directional earth fault	man & self
Ie>>>	3 rd alarm threshold directional/non directional earth fault	man & self
Ie_d>	First derived earth overcurrent threshold	man & self
Ie_d>>	Second derived earth overcurrent threshold	man & self
Latched Relays	at least one output relay is latched.	auto
Maintenance mode	The relay is in Maintenance mode	auto
P<	1 st alarm threshold active underpower	man & self
P<<	2 nd alarm threshold active underpower	man & self
P>	1 st alarm threshold active overpower	man & self
P>>	2 nd alarm threshold active overpower	man & self
Pe/IeCos>	1 st alarm threshold wattmetric/IeCos earth fault	man & self
Pe/IeCos>>	2 nd alarm threshold wattmetric/IeCos earth fault	man & self
Q<	1 st alarm threshold reactive underpower	man & self
Q<<	2 nd alarm threshold reactive underpower	man & self
Q>	1 st alarm threshold reactive overpower	man & self
Q>>	2 nd alarm threshold reactive overpower	man & self
Recloser Successful	successful re-close signal. Indicates that the fault has been cleared upon circuit breaker re-closure, and has not re- appeared before expiry of the reclaim time.	auto
SF6 Low	faulty circuit breaker signal at assignable logic input (set in AUTOMAT. CTRL/Inputs menu).	auto
t U<	1 st trip threshold undervoltage	inhib
t U<<	2 nd trip threshold undervoltage	inhib
tAux1 to tAuxC	timer t Aux1 (to tAux C) associated with logic input Aux1 (tAux2, 3...C) Alarm occurs when the timer is expired and for any output relay assignment	inhib
tF1 to tF6	Time delayed 1 st , 2 nd , 3 rd , 4 th , 5 th and 6 th frequency threshold	man
Thermal Alarm	threshold thermal alarm	man
Thermal Overload	thermal overload trip	man
tl<	trip threshold undercurrent fault	man
tl>	1 st trip threshold directional/non directional overcurrent	man
tl>>	2 nd trip threshold directional/non directional overcurrent	man

tI>>>	3 rd trip threshold directional/non directional overcurrent	man
tI2>	1 st trip threshold negative sequence overcurrent	man
tI2>>	2 nd trip threshold negative sequence current	man
tI2>>>	3 rd trip threshold negative sequence current	man
tIe>	1 st trip threshold directional/non directional earth fault	man
tIe>>	2 nd trip threshold directional/non directional earth fault	man
tIe>>>	3 rd trip threshold directional/non directional earth fault	man
tIe_d>	Time delayed first derived earth overcurrent threshold	man
tIe_d>>	Time delayed second derived earth overcurrent threshold	man
Toperating CB	operating Operating (or tripping) time of the circuit breaker longer than the value set in the AUTOMAT. CTRL/CB Supervision menu.	man
tP<	1 st trip threshold active underpower	man
tP<<	2 nd trip threshold active underpower	man
tP>	1 st trip threshold active overpower	man
tP>>	2 nd trip threshold active overpower	man
Trip Circuit Super.	Circuit breaker trip circuit failure for longer than the supervision timer t SUP settable in the AUTOMAT. CTRL/CB Supervision menu or RL1 energised (trip circuit supervision not enabled).	man
tU>	1 st trip threshold overvoltage	man
tU>>	2 nd trip threshold overvoltage	man
tUe>>>>	trip threshold residual overvoltage	man
U<	1 st alarm threshold undervoltage	inhib & self
U<<	2 nd alarm threshold undervoltage	inhib & self
U>	1 st alarm threshold overvoltage	man & self
U>>	2 nd alarm threshold overvoltage	man & self
Ue>>>>	alarm threshold residual overvoltage	man & self
VTS	VTS alarm (internal VT fault, overloading, or faults on the interconnecting wiring) if enable (VT Supervision/VTS Alarm? = yes).	auto

3. Analogue Inputs

The analogue inputs for each relay are shown in the following table:

Type of Analogue Inputs	No
Phase current inputs (Protection CTs)	3
Optional phase current inputs (Measurements CTs)	2
Earth current inputs (high, medium, low sensitivity by Cortec code)	1
Residual voltage input	1/0
Phase to neutral or phase to phase voltage inputs	2/3
Total analogue inputs	7

Following is a description of the voltage inputs connection for the HF1028 relay.

4. Submenus to Configure LEDs 5 to 8

To gain access to the CONFIGURATION menu from the default display press 2. Then press 6 until the submenu Led is reached.

To reach the LED configuration submenu press 2 for Led 5. Press 6 to reach Led 6, again to reach Led 7 and again to reach Led 8.

The following table lists the protection functions that can be assigned to the LEDs (5 to 8) for hf1028 relay.

4.1 Directional HF1028 overcurrent protection.

TEXT	Information
I>, I>, I>>>	Instantaneous 1 st , 2 nd and 3 rd phase overcurrent thresholds
tI>, tI>>, tI>>>	Time delayed 1 st , 2 nd and 3 rd phase overcurrent thresholds
tIA>, tIB>, tIC>	Time delayed first threshold trip on phases A, B, C

4.2 Directional earth fault protection

TEXT	Information
Ie>, Ie>>, Ie>>>	Instantaneous 1 st , 2 nd and 3 rd earth thresholds
tIe>, tIe>>, tIe>>>	Time delayed 1 st , 2 nd and 3 rd earth thresholds
Ie_d>, Ie_d>>	Instantaneous 1 st and 2 nd derived earth overcurrent thresholds
tIe_d>, tIe_d>>	Time delayed 1 st and 2 nd derived earth overcurrent thresholds

Displays the rated primary voltage of the earth VT (Cortec

4.3 Negative phase sequence overcurrent protection

TEXT	Information
I2>, I2>>, I2>>>	Instantaneous 1 st , 2 nd and 3 rd negative phase sequence overcurrent thresholds
tI2>, tI2>>, tI2>>>	Time delayed 1 st , 2 nd and 3 rd negative phase sequence overcurrent thresholds

4.4 Thermal protection

TEXT	Information
Therm Trip	Trip on Thermal overload

4.5 Three phase undercurrent protection

TEXT	Information
I<	Instantaneous undercurrent threshold
tI<	Time delayed undercurrent threshold

4.6 Overvoltage protection

TEXT	Information
U>, U>>	Instantaneous 1 st and 2 nd overvoltage thresholds
tU>, tU>>	Time delayed 1 st and 2 nd overvoltage thresholds

4.7 Undervoltage protection

TEXT	Information
U<, U<<	Instantaneous 1 st and 2 nd undervoltage thresholds
tU<, tU<<	Time delayed 1 st and 2 nd undervoltage thresholds

4.8 Residual overvoltage protection

TEXT	Information
Ue>>>>	Instantaneous derived earth overvoltage threshold
tUe>>>>	Time delayed derived earth overvoltage threshold

4.9 Negative overvoltage protection

TEXT	Information
V2>, V2>>	Instantaneous 1 st and 2 nd negative overvoltage thresholds
tV2>, tV2>>	Time delayed 1 st and 2 nd negative overvoltage thresholds

4.10 Broken conductor protection

TEXT	Information
Brkn. Cond	Broken conductor detection

4.11 CB Fail

TEXT	Information
CB Fail	Detection of a Circuit Breaker failure (CB not open at the end of tBF timer)

4.12 Logic inputs

TEXT	Information
Input1 to Input4	Copy of the status of logic inputs no 1, 2, 3 and 4 (“automat ctrl/inputs” menu)
Input5 to Input7	Copy of the status of logic inputs no 5, 6 and 7.
Input8 to InputC	Copy of the status of logic inputs no 8, 9, 10, 11 and 12 (option)

4.13 Autoreclose function

TEXT	Information
79 Run	Signal that Autoreclose cycle is working
79i.Blocked	Autoreclose lock activated by the internal process of the autoreclose
79e.Blocked	Autoreclose lock activated by the input “block 79”

4.14 Auxiliary timers

TEXT	Information
tAux1 to tAux4	Copy of Aux1 to Aux 4 logic input delayed by Aux1 to Aux4 time (Aux1...Aux4 logic input and aux1...aux4 time are set with “automat ctrl/inputs” menu)
tAux5 to tAux7	Copy of Aux5 to Aux7 logic inputs delayed by Aux 5 to Aux7 times
tAux8 to tAuxC	Copy of Aux8 to tAuxC logic inputs delayed by Aux 8 to tAuxC times (option)

4.15 t SOTF FUNCTION

TEXT	Information
t	Switch on to fault timer expired

4.15 Voltage / Current Supervision function

TEXT	P125	P126	HF1028	Information
VTS				Voltage Transformer Supervision alarm, if enabled (VT Supervision/VTS Alarm? = yes)
CTS				Current Transformer Supervision alarm

4.16 Frequency protection

TEXT	Information
F1 to F6	Instantaneous 1 st to 6 th frequency thresholds
tF1 to tF6	Time delayed 1 st to 6 th frequency thresholds
F Out	Frequency out of range signal

4.17 Rate of change of frequency

TEXT	Information
dF/dt1 to dF/dt6	Instantaneous 1 st to 6 th rates of change of frequency.

4. 18 Logic Equation

TEXT	Information
tEQU.A to tEQU.H	Results of equations A to H.

5. MEASUREMENTS menu

By going to the MEASUREMENTS menu various system measurement values can be shown on the LCD.

The displayed voltage measures depend on which wiring scheme is choose.

The direct measure is the signal wires to the terminal.

The derived measure is the calculated.

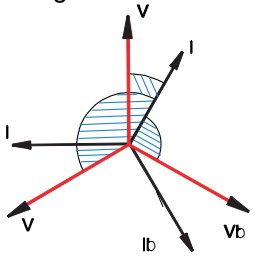
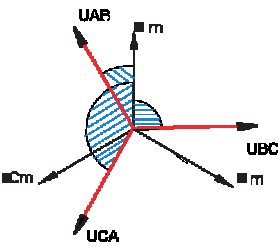
The RMS value is provided for the direct measures.

The fundamental value is provided for the derived (calculated) measures.

To gain access to the MEASUREMENTS menu from the default display, press 2 then 6 until the header of menu is reached.

The following table lists the items available in the measurements menu for the HF1028 relay.

DISPLAY	UNIT	INFORMATION
MEASUREMENTS	Heading Measurements menu	
Frequency 50.00 Hz	Hz	Displays the network frequency taken from analogue inputs having a reliable signal level. In case of non reliable analogue signal input level present the display shows XX.XX Hz.
I A (or I L1, or I R) I B (or I L2, or I S) I C (or I L3, or I T) IN (or I o, or I E)	A	Displays the A (or B, C or N) phase current (true RMS value) taking into account the phase CT ratio (CONFIGURATION/Transfo. Ratio submenu) ⁽¹⁾ . The displayed label depends on the "Configuration / Phase/Earth Text" setting.
I1 I2	A	Displays the positive (I1) or negative (I2) sequence component ⁽¹⁾ .
RATIO I2/I1	%	Displays the ratio of I2/I1. This derived measurement is used by the Broken Conductor detection function. (Automat. Ctrl menu) ⁽¹⁾ .
UA UB UC	V	When a 3Vpn (three phases – neutral) or 2Vpn+Vr (two phase-neutral + open delta connection) connection mode is choosen, displays the RMS voltage value of phase A, or B or C ⁽²⁾ ,
UAB UBC UCA	V	When a 2Vpp+Vr (two phase-phase + open delta connection) connection mode is choosen, displays the calculated fondamental value of the line voltage UAB, or UBC, or UCA (vector calculus) ⁽²⁾ .
UN	V	Displays the earth voltage taking in account the earth VT connection mode and ratio (General Options and Transfo. Ratio submenu).
Pe	W	Displays the neutral power based on neutral current value, neutral voltage and the relevant angle.
IeCos	A	Displays the active neutral current value.
IN ^ UN Angle	°	Displays the angle value between the Zero sequence voltage and earth fault current relevant.
IA ^ IB Angle IA ^ IC Angle	°	Displays the angle value between phase IA and IB, or between IA and IC ⁽¹⁾ .

DISPLAY	UNIT	INFORMATION
IA ^ VA Angle IA ^ VB Angle IA ^ VC Angle	°	When a 3Vpn (three phases – neutral) or 2Vpn+Vr (two phase-neutral + open delta connection) connection mode is chosen, displays the angle value between phase IA and voltage VA, or between phase IA and voltage VB, or between phase IA and voltage VC 
IA ^ VAB Angle IA ^ VBC Angle IN ^ UN Angle	°	When a 2Vpp+Vr (two phase-phase + open delta connection) connection mode is chosen, displays the angle value between phase IA and voltage VAB, or between phase IA and voltage VBC, or between the Zero sequence voltage and earth fault current.relevant. 
IN – fn RST=[C]	A	Displays the earth current I N (true RMS value) minus the earth current value at the fundamental frequency (value of the harmonic). To clear the value, press 0
THERMAL STATUS RST = [C]	%	Displays the % thermal state based on true RMS current phase values. To clear the % value, press 0 ⁽¹⁾ .
MAX & AVERAGE RST = [C]		Allows the user to clear the maximum (peak) and average (rolling) memorised values of the current. To clear these values, press 0 ⁽¹⁾ .
Max IA Rms Max IB Rms Max IC Rms	A	Displays the true RMS maximum current value for phase A, phase B or phase C ⁽¹⁾ .
Average IA Rms Average IB Rms Average IC Rms	A	Displays the true RMS average current value for phase A, phase B or phase C ⁽¹⁾ .
Max UAB Rms Max UBC Rms	V	Displays the true RMS maximum line voltage value for UAB or UBC ⁽²⁾ .
Average UAB Rms Average UBC Rms	V	Displays the true RMS average line voltage value for UAB or UBC ⁽²⁾ .
MAX SUBPERIOD RST = [C]		Allows the user to clear the maximum subperiod values of the 3 currents for each phase To clear the values, press 0 ⁽¹⁾ .
MAX SUBPERIOD IA Rms IB Rms IC Rms	A	Display the IA, IB or IC peak value demand. The value is the true RMS maximum value on a subperiod ⁽¹⁾ .

ROLLING AVERAGE RST = [C]	Allows the user to clear the rolling average values of the 3 currents To clear the values, press 0 ⁽¹⁾ .	
ROLLING AVERAGE IA Rms IB Rms IC Rms	A	Display the IA, IB or IC average value demand. The value is the true RMS average value on a number of subperiod set in Record menu ⁽¹⁾ .
Reclose Stats RST = [C]	Allows the user to clear the statistics stored for the autoreclose function To clear the values, press 0 ⁽¹⁾ .	
Total recloses	Displays the total number of re-closings ⁽¹⁾ .	
Cycle1 Recloses Cycle2 Recloses Cycle3 Recloses Cycle4 Recloses	Displays the total number of re-closings for cycle 1, cycle 2, cycle 3 or cycle 4 ⁽¹⁾ .	
Total Trip & Lockout	Displays the total number of definitive trips issued by the autoreclose function ⁽¹⁾ .	

[67/50/51] Directional/Non-Directional Phase Overcurrent

- Minimum voltage operation 1.0V (Un: 57 to 130V)

NOTE: When I> is associated to an IDMT curve, the maximum setting recommended should be 2In.

Setting Range			
	Min	Max	Step
I> ?	No or Yes or DIR		
I>	0.1 In	25 In	0.01 In
Delay type	DT or IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IEEE_VI, IEEE_EI, RI, RECT curve)		
tI>	0 s	150 s	0.01 s
I> TMS	0.025	1.5	0.001
I> Reset Delay Type	DT or IDMT		
I> RTMS	0.025	3.2	0.025
I> tReset	0.00 s	100 s	0.01 s
I> I>> I>>> Interlock	No or Yes		
I> Torque angle	0°	359°	1°
I> Trip zone	±10°	±170°	1°
I>> ?	No or Yes or DIR		
I>>	0.1 In	40 In	0.01 In
Delay type	DT or IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IEEE_VI, IEEE_EI, RI, RECT curve)		
tI>>	0 s	150 s	0.01 s
I>> TMS	0.025	1.5	0.001
I>> Reset Delay Type	DT or IDMT		
I>> RTMS	0.025	3,2	0.025
I>> tReset	0.00 s	100 s	0.01 s
I>> Torque angle	0°	359°	1°
I>> Trip zone	±10°	±170°	1°
I>>> ?	No or Yes or DIR or Peak		
I>>>	0.1 In	40 In	0.01 In
tI>>>	0 s	150 s	0.01 s
I>>> Torque angle	0°	359°	1°
I>>> Trip zone	±10°	±170°	1°

[67N/50N/51N] Dir./Non-Dir. Earth fault protection

NOTE: When le> or le>> are associated to an IDMT curve, the maximum setting recommended should be the maximum of the range divided by 20.

le>	0.1 len	25 len	0.1 len
le>>	0.5 len	40 len	0.1 len
le>>>	0.5 len	40 len	0.1 len
le_d>	0.1 len	40 len	00.01 len
le_d>>	0.1 len	40 len	00.01 len

[67N] Earth OC		Setting Range		
		Min	Max	Step
le> ?	No or Yes or DIR			
Delay type	DT or IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IEEE_VI, IEEE_EI, RI, RECT curve)			
tle>	0 s	150 s	0.01 s	
le> TMS	0.025	1.5	0.025	
le> Reset Delay Type	DT or IDMT			
le> RTMS	0.025	3.2	0.025	
le> tReset	0.00 s	100 s	0.01 s	
le> le>> le>>> Interlock	No or Yes			
le> Torque angle	0°	359°	1°	
le> Trip zone	±10°	±170°	1°	
Input residual voltage with range from 57 to 130V				
Ue>	1 V	260 V	0.1 V	
le>> ?	No or Yes or DIR			
Delay type	DT or IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IEEE_VI, IEEE_EI, RI, RECT curve)			
tle>>	0 s	150 s	0.01 s	
le>> TMS	0.025	1.5	0.025	
le>> Reset Delay Type	DT or IDMT			
le>> RTMS	0.025	3.2	0.025	
le>> tReset	0.00 s	100 s	0.01 s	
tle>>	0 s	150	0.01 s	
le>> Torque angle	0°	359°	1°	
le>> Trip zone	±10°	±170°	1°	

le>> tReset	0.00 s	100 s	0.01 s
Input residual voltage with range from 57 to 130V			
Ue>>>	1 V	260 V	0.1 V
le>>> ?	No or Yes or DIR or Peak		
tle>>>	0 s	150 s	0.01 s
le>>> Torque angle	0°	359°	1°
le>>> Trip zone	±10°	±170°	1°
le>>> tReset	0.00 s	100 s	0.01 s
Input residual voltage with range from 57 to 130V			
Ue>>>	1 V	260 V	0.1 V
le>>> ?	No or Yes or DIR		
tle>>>	0 s	150 s	0.01 s
le>>> Torque angle	0°	359°	1°
le>>> Trip zone	□10°	□170°	1°
le>>> tReset	0.00 s	100 s	0.01 s

Derived earth fault

le_d> ?	No or Yes or DIR		
Delay type	DT or IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IEEE_VI, IEEE_EI, RI, RECT curve)		
tle_d>	0 s	150 s	0.01 s
le_d> TMS	0.025	1.5	0.025
le> Reset Delay Type	DT or IDMT		
le> RTMS	0.025	3.2	0.025
le_d> tReset	0.00 s	100 s	0.01 s
le_d> Torque	0°	359°	1°
le> Trip zone	±10°	±170°	1°
Input residual voltage with range from 57 to 130V			
Ue(le_d>)	1 V	260 V	0.1 V
le_d>> ?	No or Yes or DIR		
Delay type	DT or IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IEEE_VI, IEEE_EI, RI, RECT curve)		
tle_d>>	0 s	150 s	0.01 s
le_d>> TMS	0.025	1.5	0.025
le>> Reset Delay Type	DT or IDMT		
le>> RTMS	0.025	3.2	0.025
le_d>> tReset	0.00 s	100 s	0.01 s
le_d>> Torque	0°	359°	1°
le>> Trip zone	±10°	±170°	1°
Input residual voltage with range from 57 to 130V			
Ue(le_d>>)	1 V	130 V	0.1 V

Undercurrent Protection

[37] Undercurrent	Setting ranges		
	Min	Max	Step
I< ?	Yes or No		
I<	0.1 In	1 In	0.01 In
tI<	0 s	150 s	0.01 s
I< Inhibited on 52A	Yes or No		
I< inhibited on U<	Yes or No		
I< inhibited on U<	Yes or No		

Negative Sequence Overcurrent Protection (P126 & P127)

□

NOTE: When I2> is associated to an IDMT curve, the maximum setting recommended should be 2In.

[46] Neg.Seq. OC	Setting ranges		
	Min	Max	Step
I2> ?	No or Yes		
I2>	0.1 In	25 In	0.01 In
Delay Type	DT or IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IEEE_VI, IEEE_EI, RI, RECT curve)		
tI2>	0 s	150s	0.01s
I2> TMS	0.025	1.5	0.025
I2> Reset Delay Type	DT or IDMT		
I2> RTMS	0.025	1.5	0.025
I2> tReset	0.04 s	100 s	0.01 s
I2>> ?	No or Yes		
I2>>	0.5 In	40 In	0.01 In
tI2>>	0 s	150s	0.01s
I2>>> ?	No or Yes		
I2>>>	0.5 In	40 In	0.01 In
tI2>>>	0 s	150s	0.01s

Undervoltage Protection (P127)

– Thresholds selection mode **AND** or **OR**

[27] Phase Undervoltage	Setting ranges		
	Min	Max	Step
57–130V Input voltage			
U< ?	No or AND or OR		
U<	2 V	130 V	0.1 V
tU<	0 s	600 s	0.01 s
52a Inhib. U< ?	Yes or No		

U<< ?	No or AND or OR		
U<<	2 V	130 V	0.1 V
tU<<	0 s	600 s	0.01 s
52a Inhib. U<< ?	Yes or No		

Overvoltage Protection (P127)

- Thresholds selection mode **AND or OR**

[59] Phase Overvoltage	Setting ranges		
	Min	Max	Step
57–130V Input voltage			
U> ?	No or AND or OR		
U>	2 V	260 V	0.1 V
tU>	0 s	260 s	0.01 s
U>> ?	No or AND or OR		
U>>	2 V	260 V	0.1 V
tU>>	0 s	600 s	0.01 s

Directional power Function

Phase or phase to phase voltage
 Active overpower (two thresholds P> and P>>),
 Reactive Overpower (two thresholds Q> and Q>>),
 Active Underpower (two thresholds P< and P<<),
 Reactive Underpower (two thresholds Q< and Q<<).

[32] Directional Power	Setting ranges		
	Min	Max	Step
57–130V Input voltage			
“P>?” or “Q>?” or “P<?” or “Q<?”	Yes or No		
P> or Q> or P< or Q<	1 W*k (*)	10000 W*k (*)	1 W*k (*)
Directional angle	0°	359°	1°
tP> or tQ> or tP< or tQ<	0 s	150 s	0.01 s
“P>>?” or “Q>>?” or “P<<?” or “Q<<?”	Yes or No		
P>> or Q>> or P<< or Q<<	1 W*k (*)	10000 W*k (*)	1 W*k (*)

Directional angle	0°	359°	1°
tP>> or tQ>> or tP<< or tQ<<	0 s	150 s	0.01 s

k = 1 if CT secondary ration = 1A

k = 5 if CT secondary ration = 5A

Residual Overvoltage Protection

[59] Residual Overvoltage	Setting range		
	Min	Max	Step
57–130V Input voltage.			
Ue>>>> ?	No or Yes		
Ue>>>>	1 V	260 V	0.1 V
tUe>>>>	0 s	600 s	0.01 s

Negative overvoltage

[47] Negative Overvoltage	Setting range		
	Min	Max	Step
57–130V Input voltage.			
V2> ?	No or Yes		
V2>	1 V	130 V	0.1 V
tV2>	0 s	100 s	0.01 s
V2>> ?	No or Yes		
V2>>	1 V	130 V	0.1 V
tV2>>	0 s	100 s	0.01 s

Multishot Autoreclose Function

Main shots: 4 independent shots.

External logic inputs: 6 inputs (CB opened signal, CB closed signal, manual opening command, manual closing command, blocking order, cycle activation).

Internal programmable trigger from phase and earth fault on all re-closing cycles. External trigger from logic input.

Inhibit time on manual closing.

Programmable dead times and reclaim time setting.

Maximum CB closing control equal to 5s (+t Pulse setting).

[79] Autoreclose	Setting range		
	Min	Max	Step
Autoreclose ?	Yes or No		
Ext. CB Fail ?	Yes or No		
Ext. CB Fail time	0.01 s	600 s	0.01 s
Aux1 ((I>) ?	Yes or No		
Aux2 (Ie>) ?	Yes or No		
Ext Block ?	Yes or No		
Rolling Demand	Yes or No		
Max cycles nb	2	100	1
Time period	10mn	24h	10mn
Dead time			

tD1	0.01 s	300 s	0.01 s
tD2	0.01 s	300 s	0.01 s
tD3	0.01 s	600 s	0.01 s
tD4	0.01 s	600 s	0.01 s
tI>	0.05 s	600 s	0.01 s
tI>>	0.05 s	600 s	0.01 s
tI>>>	0.05 s	600 s	0.01 s
tIe>	0.05 s	600 s	0.01 s
tIe>>	0.05 s	600 s	0.01 s
tIe>>>	0.05 s	600 s	0.01 s
Reclaim time			
tR	0.02 s	600 s	0.01 s
Inhib time			
tI	0.02 s	600 s	0.01 s
Phase Cycles	0	4	1
E/Gnd Cycles	0	4	1
Cycles	4 3 2 1	Settings	
tI>	1 1 1 1	0 or 1 or 2	
tI>>	1 1 1 1	0 or 1 or 2	
tI>>>	1 1 1 1	0 or 1 or 2	
tIe>	1 1 1 1	0 or 1 or 2	
tIe>>	1 1 1 1	0 or 1 or 2	
tIe>>>	1 1 1 1	0 or 1 or 2	
tAux1	1 1 1 1	0 or 1 or 2	
tAux2	1 1 1 1	0 or 1 or 2	

0 = no action on autorecloser: definitive trip

1 = trip on pick up of the protection element, followed by reclosing cycle

2 = no trip on pick up of the protection element also if this has been set in the *CRTL/Trip commands/Trip menu*

Fixed time out for lacking of CB opening signal on trip protection: 2.00 s at 50 Hz

tClose

Pulse(*): from 0.1 to 5.00 s in steps of 0.01 s
 (*) Setting available in CB monitoring menu.

Inrush blocking Logic

Inrush Block	Setting range		
	Min	Max	Step
Inrush Block	Yes or No		
Inrush H2 ration	10 %	35 %	0,1 %
Inrush tReset	0 ms	2 s	0,1 s
Block I>	No	Yes	Yes or No
Block I>>	No	Yes	Yes or No

Block l>>>	No	Yes	Yes or No
Block le>	No	Yes	Yes or No
Block le>>	No	Yes	Yes or No
Block le>>>	No	Yes	Yes or No
Block l2>	No	Yes	Yes or No
Block l2>>	No	Yes	Yes or No
Block l2>>>	No	Yes	Yes or No
Block le_d>, le_d>>	No	Yes	Yes or No