AEG Numerical Sensitive Over Current Protection RelayHF1021 (HF1021)

Technical Guide

NUMERICAL SENSITIVE OVER CURRENT

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INTRODUCTION

HF1021

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1. INTRODUCTION

The sensitive over current relay type **HF1021**is a Numerical relay. It is over current and sensitive earth fault relay. Sensitive earth fault zone is from 0.002In to In.

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2.   HOW TO USE THIS MANUAL

This manual provides a description of **HF1021**functions and settings. The goal of this manual is to allow the user to become familiar with the application, installation, setting of the relay.

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This manual has the following format:

Introduction
Contents of the manual and general introduction to the relay

Handling and case dimensions
Pre cautions to be taken when handling electronic equipment.

User Guide of the relay as
A detailed description of the features

Menu content table

Technical data and Comprehensive details
On nominal values, setting ranges, specifications.

Connection diagram for HF1021 relay

3. **INTRODUCTION TO THE HF1021RELAY**

The HF1021relay provides comprehensive sensitive overcurrent protection for utilities networks, industrial plants and networks as well as for other applications where sensitive overcurrent protection is required. The earth fault protection is sensitive enough to be applied in electrical networks where the earth fault current is low.

In addition to its protective functions, each relay offers control and recording features. They can be fully integrated to a control system so protection, control, data acquisition and recording of faults, events and disturbances can be made available.

The relay is equipped on the front panel with a liquid crystal display (LCD) with 2 x 16 back-lit alphanumerical characters, a tactile 7 button keypad (to access all settings, clear alarms and read measurements) and 8 LEDs that indicate the status of the relay.

In addition, the use of the RS485 communication port by using protocol mode bus makes it possible to read, reinitialize and change the settings of the relay, if required, from a local or remote PC computer loaded with software.

Its flexibility of use, reduced maintenance requirements and ease of integration allow the
Relay to provide an adaptable solution for the problems of the protection electric networks.

Introduction

4. MAIN FUNCTIONS

The following table shows the functions available for **HF1021** relay.

Functions	ANSI Code	HF1021	No.
one-phase overcurrent	50/51	yes	
Instantaneous/start contact		yes	
Latching output contacts	86	yes	
Measurements (True RMS)		yes	
RS 232 front communication		yes	
Fault Record		yes	25
Event Record			250
RS 485 rear communication (Modbus RTU)		yes	
Disturbance recording		yes	5
Digital inputs		yes	2
Output relays		yes	4

HANDLING

AND

CASE DIMENSION

Handling And Case Dimension

HF1021

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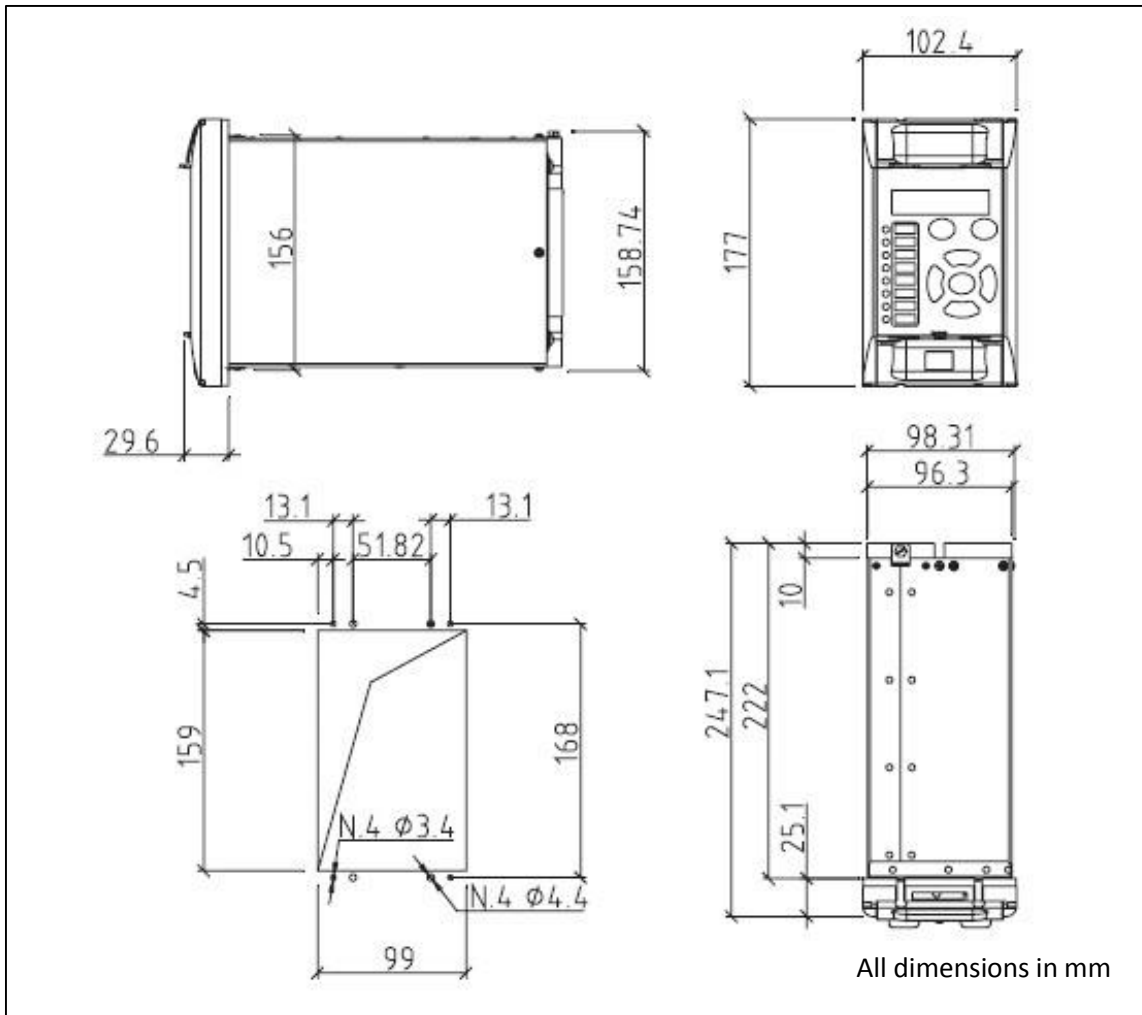
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1. DIMENSIONS

1.1 **Case dimension**

The relay is available in a 4U metal case for panel or flush mounting.

Weight: 1.7 to 2.1 Kg

External size:

	Height	Width	Depth
case	152mm	97mm	226mm
Front panel	177mm	103mm	252mm

All dimensions in mm

Note: The chassis is normally secured in the case by four screws (Self tap screws 6x1,4), to ensure good seating. The fixing screws should be fitted in normal service (do not add washers). Do not discard these screws.

HF1021

2.   COMMUNICATION

2.1   RS232 Port

In the bottom of the front panel, there is a RS232 port; the communication with a computer through the RS232 allows access to the relay all information and setting. It makes the access and changes of any information, setting and configuration.
You can see all events and records by this port on monitor of computer we will explain it by details in the next sections.

2.2   RS485 port

Connections to RS485 are made using annular terminals. It is recommended that a two core screened cable, is used with a maximum total length of 1000 m or a200nF total cable capacitance.

Typical specification:

-       Each core: 16/0.2mm   copper conductor, PVC insulated.
-       Nominal conductor area: 0.5 mm² per core
-       Screen: Overall braid, PVC sheathed
-       Linear capacitance between conductor and earth: 100pF/m

HF1021

3. EARTHING

Each equipment must be connected to a local earth terminal by the intermediary of a M4 earth terminals. We recommend a wire of minimal section of 2,5 mm², with annular terminals on the side of the equipment. Because of the limitations of the annular terminals, the possible maximum section is of 6mm² by wire. If a larger section is necessary, one can use cables connected in parallel, each one ending with an annular terminal separated on the side
of the equipment. One can also use a metal bar.

NOTE: To prevent any electrolytic risk between copper conductor or brass conductor and the back plate of the equipment, it is necessary to take precautions to isolate them one from the other. This can be done in several ways, for example by inserting between the conductor and the case a plated nickel or insulated ring washer or by using a tin terminals.

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1. PRESENTATION OF HF1021RELAY

This relay is fully numerical relays designed to perform electrical protection and control functions. HF1021relay is powered either from a DC or an AC auxiliary power supply.

Using the front panel, the user can easily navigate through the menu and access data, change settings, read measurements, etc.

Eight LEDs situated in the front panel help the user to quickly know the status of the relay and the presence of alarms. Alarms that have been detected are stored and can be displayed on the back-lit LCD.

Any short time voltage interruption (<50ms) is filtered and regulated through the auxiliary power supply.

HF1021relay have 1 earth input available for 1 rated CT. HF1021relay continuously measure earth current.

Output relays are freely configurable and can be activated by any of the control or protection functions available in the relay. Logic inputs can also be assigned to various control functions.

On their rear terminals HF1021have a standard RS485 port available. When ordering, the user can choose between the following communication protocols: Modbus RTU.

Using RS485 communication channel, all stored information (measurements, alarms, and parameters) can be read and settings can be modified when the chosen protocol allows it.

HF1021relay can be connected directly to a digital control system. All the available data can

then be gathered by a substation control system and be processed either locally or remotely.

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2. USER INTERFACE

HF1021relay from panel allows the user to easily enter relay settings, display measured values and alarm and to clearly display the status of the relay.

2 buttons to read and
Clear alarms messages

2 × 16 alphanumerical
backlit display

Trip led
Alarm led
Warning led
Power led

Programmable led

5 buttons to modify the
setting and read vaues

Battery

RS 232
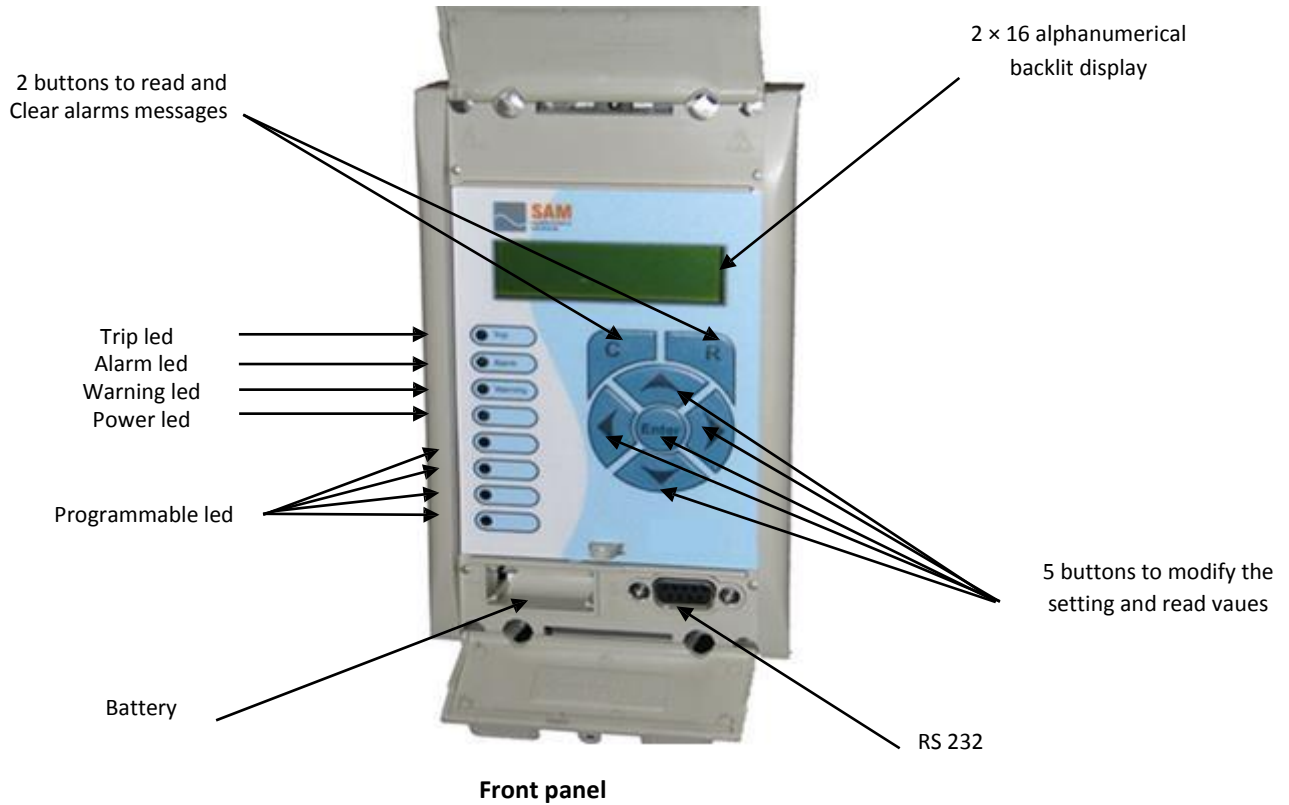
Front panel

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

HF1021

2.1   LCD display and keypad description

2.1.1   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.

2.1.2   Keypad

The keypad has seven keys divided into two groups:

• 		Two keys located just under the screen (keys and).

Keys and are used to read and acknowledge alarms. To display successive alarms, press key . 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 or go to the end of the ALARM menu and acknowledge all the alarms at the same time.

• 		Four main arrow keys 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 enter key is used to validate a choice or a value (modification of settings).

2.2   LEDs

The top four LEDs indicate the status of the relay (Trip condition, alarm LED, equipment failure, Power). 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 			**Color: RED** 			**Label: Trip**

LED 1 indicates that the relay has issued a trip order to the cut-off element (circuit breaker, contactor). This LED recopies the trip order issued to the Trip logic output. As soon as a triggering order is issued, the LED lights up. It is cleared when the associated alarm is acknowledged either through the front panel, or by a remote command, a digital input, or by a new fault (configuration/Alarms menu).

LED 2 			**Color: YELLOW** 			**Label: ALARM**

LED 2 indicates that the relay has detected an alarm. This alarm can either be a threshold crossing (instantaneous), or a trip order (time delayed). As soon as an alarm is detected, the LED starts blinking. After all the alarms have been read, the LED lights up continuously. After acknowledgement of all the alarms, the LED is extinguished. The alarm LED can be reset by the front panel.

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LED 3   **Color: YELLOW**   **Label: Warning**

LED 3 indicates internal alarms of the relay. When the relay detects a « non-critical » internal alarm (typically a communication failure), the LED starts blinking continuously. When the relay detects a fault that is considered as « critical », the LED lights up continuously. Only the disappearance of the cause of the fault can clear this LED (repair of the module, clearance of the Fault).

LED 4:   **Color: GREEN**   **Label: Power**

LED 4 indicates that the relay is powered by an auxiliary source at the nominal range.

LED 5 to 8:   **Color: RED**

These LEDs are user programmable and can be set to display information about instantaneous and time-delayed thresholds as well as the status of the logic inputs. Under the CONFIGURATION/LED menu of the relay, the user can select the information he wishes to associate with each LED. He can affect more than one function to one LED. The LED will then light up when at least one of the associated information is valid (OR gate). The LED is cleared when all the associated alarms are acknowledged.

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

2.3.1   Relay Identification

Under the upper flap, a label identifies the relay according to its model number (order number) and its serial number. This information defines the product in a way that is unique. In all your requests, please make reference to these two numbers.

Under the model and serial number, you will find information about the level of voltage of the auxiliary supply and the nominal earth current value.

There is RS232 port available under the lower flap in the relay. This RS232 port can be used to plug a laptop loaded with setting software.

To withdraw more easily the active part of the relay (i-e the chassis) from its case, open the two flaps, then with a 3mm screwdriver, turn the extractor located under the upper flap, and pulls it out of its case pulling the flaps towards you.

3.   PASSWORD

3.1   Password Protection

An unlock key (up down) is required, when you want to press any key. After 5 minutes that you don't press any key, you must unlock the keys for navigation through menus.
A password is required for relay settings, especially when changing the various thresholds, time delays, and communication parameters, allocation of inputs and outputs relays.
The password consists of four capital characters. When leaving factory, the password is set to AAAA. The user can define his own combination of four characters. Should the password be lost or forgotten, the modification of the stored parameters is blocked. It is then necessary to contact the manufacturer or his representative and a standby password specific to the relay may be obtained.

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3.2   Password entry

The input of the password is requested as soon as a modification of a parameter is made for any one of the six/eight menus and the submenus. The user enters each one of the 4 characters and then validates the entire password with enter keypad. After 5 seconds, the display returns to the point of the preceding menu. If no key is pressed inside of 5 minutes, the password is deactivated. A new password request is associated with any subsequent parameter modification

3.3   Changing the password

To change an active password, go to the OP PARAMETERS menu and then to the Password submenu. Enter the current password and validate it. Then press enter keypad and enter the new password character by character and validate the new password using enter keypad.
The message NEW PASSWORD OK is displayed to indicate that the new password has been accepted**.**

4.   DISPLAYS of ALARM

Alarm messages are displayed directly on the front panel LCD. They have priority over the default display presenting measured current values. As soon as the relay detects an alarm condition (crossing of a threshold for example), the associated message is displayed on the front panel LCD and the LED Alarm (LED 2) lights up**.**
Alarm messages generated by the electrical power network.

4.1   Electrical Network Alarms

Any crossing of a threshold (instantaneous or time delay) generates an "electrical network alarm". The involved threshold is indicated. Regarding the phase thresholds, the phase designation is also displayed.
If several alarms are triggered, they are all stored in their order of appearance and presented on the LCD in reverse order of their detection (the most recent alarm first, the oldest alarm last). Each alarm message is numbered and the total number of alarm messages is displayed.

The user can read all the alarm messages pressing.

The user acknowledges and clears the alarm messages from the LCD pressing.

The user can acknowledge each alarm message one by one or all by going to the end of the list to acknowledge, and clear, all the alarm messages pressing.

The control of the ALARM LED (LED 2) is directly assigned to the status of the alarm
  If all the messages have been ACKNOWLEDGED, and cleared, if the cause that generated the alarm disappears, the ALARM LED (LED 2) is extinguished.

the different electrical system alarms are listed below:

|	
Ie>	1st stage earth fault threshold
Ie>>	2nd stage earth fault threshold
Ie>>>	3rd stage earth fault threshold
tIe>	1st stage earth fault time-out
tIe>>	2nd stage earth fault time-out
tIe>>>	3rd stage earth fault time-out

User Guide

5.   MENU

The menu of HF1021relay is divided into main menus and submenus.

5.1   Default display

By default, the LCD displays the current value measured. As soon as an alarm is detected by the relay, that information is considered as more important and the alarm message is then displayed instead of the default value.

The user can configure the information he wants to display by default going under the CONFIGURATION/Display menu.

5.2   Access To The Menu

Navigation through the different menus is done pressing the arrow keys ◉, ◊, ◊, ◉

The organization of the menus is shown in figure as follows.

There is need of an unlock key when reading parameters and measured values.

Modification of a parameter requires entering a password.

Should an error be made in entering a parameter, press to cancel

5.3   Menu Contents Description

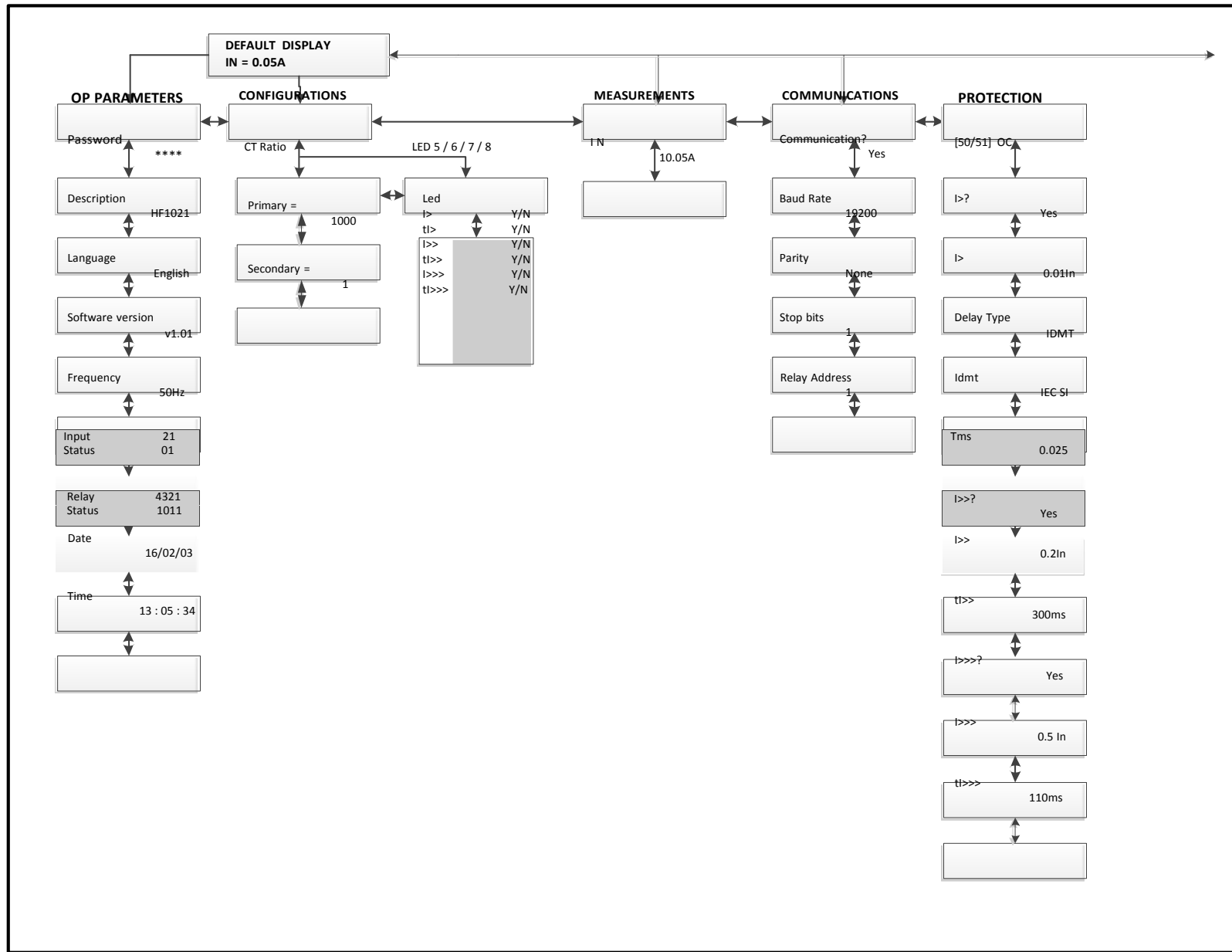The menu of HF1021relay is divided into 8 main sections:

⟹   OP PARAMETERS
⟹   CONFIGURATION
⟹   MEASUREMENTS
⟹   COMMUNICATION
⟹   PROTECTION
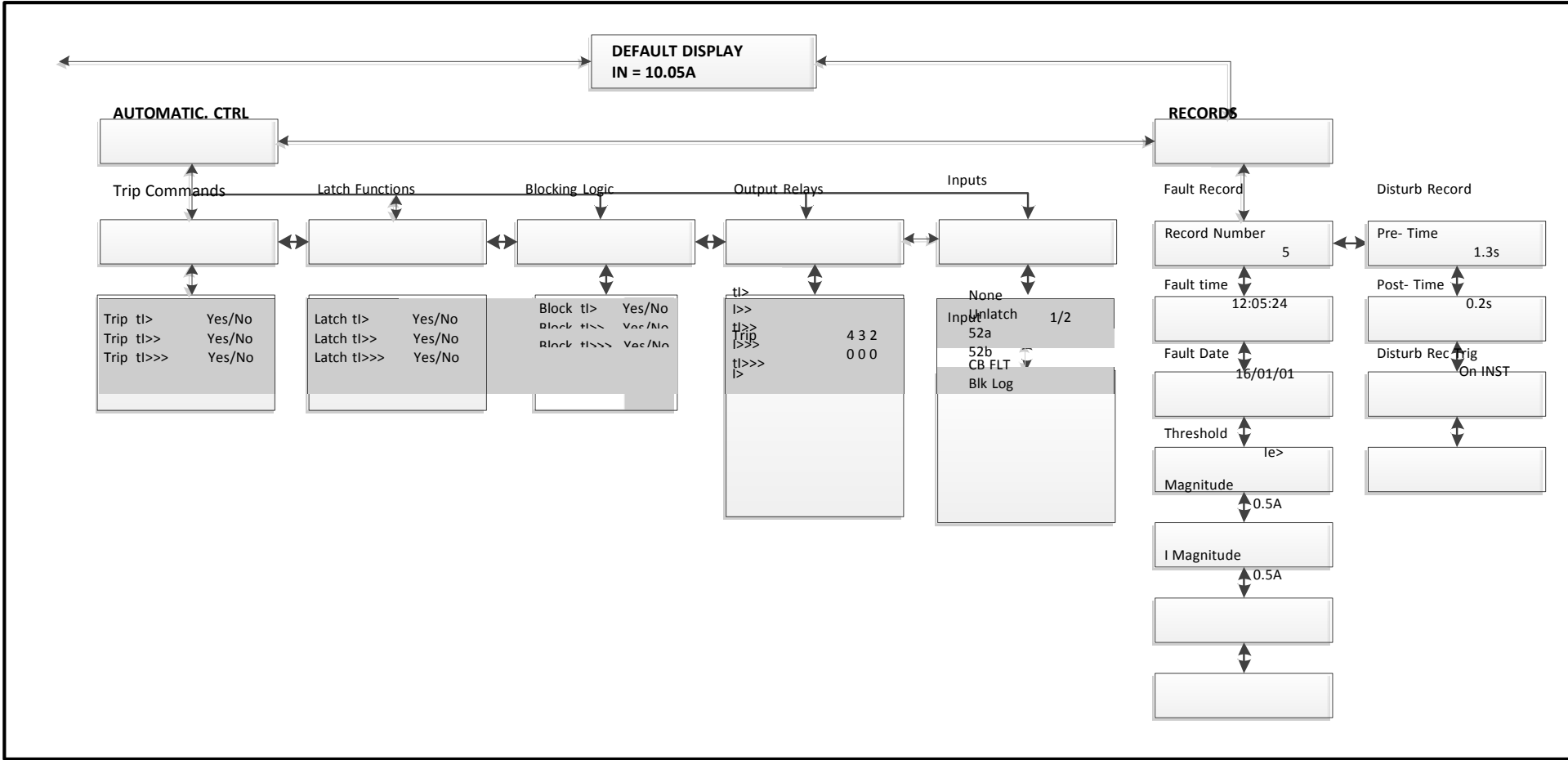⟹   AUTOMATIC CTRL
⟹   RECORDS

To access these menus from the default display press ◉

To return to the default display from this menus or sub-menus press ◉

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Menu content table

DEFAULT DISPLAY
IN = 0.05A

OP PARAMETERS

Password   ****

Description   HF1021

Language   English

Software version   v1.01

Frequency   50Hz

Input   21
Status   01

Relay   4321
Status   1011

Date   16/02/03

Time   13 : 05 : 34

CONFIGURATIONS

CT Ratio

Primary =   1000

Secondary =   1

LED 5 / 6 / 7 / 8

Led
I>   Y/N
tI>   Y/N
I>>   Y/N
tI>>   Y/N
I>>>   Y/N
tI>>>   Y/N

MEASUREMENTS

I N   10.05A

COMMUNICATIONS

Communication?   Yes

Baud Rate   19200

Parity   None

Stop bits   1

Relay Address   1

PROTECTION

[50/51] OC

I>?   Yes

I>   0.01In

Delay Type   IDMT

Idmt   IEC SI

Tms   0.025

I>>?   Yes

I>>   0.2In

tI>>   300ms

I>>>?   Yes

I>>>   0.5 In

tI>>>   110ms

DEFAULT DISPLAY
IN = 10.05A

AUTOMATIC. CTRL

RECORDS

Trip Commands

Latch Functions

Blocking Logic

Output Relays

Inputs

Fault Record

Disturb Record

Trip tI>	Yes/No
Trip tI>>	Yes/No
Trip tI>>>	Yes/No

Latch tI>	Yes/No
Latch tI>>	Yes/No
Latch tI>>>	Yes/No

Block tI>	Yes/No
Block tI>>	Yes/No
Block tI>>>	Yes/No

tI>
I>>
tI>>
Trip   4 3 2
I>>>   0 0 0
tI>>>
I>

None
Input   Unlatch   1/2
52a
52b
CB FLT
Blk Log

Record Number
                    5

Pre- Time
                    1.3s

Fault time
        12:05:24

Post- Time
                    0.2s

Fault Date
        16/01/01

Disturb Rec Trig
                On INST

Threshold
                Ie>
Magnitude

I Magnitude
            0.5A

0.5A

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Technical Data

And

Characteristic Curves

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1.   RATINGS

1.1   Power supply

Nominal auxiliary voltage Vx	48 -150 Vdc / 48-250 Vac
Operating range	DC: ± 20% of Vx AC: − 20%, +10% of Vx
Residual ripple	Up to 12%
Burden	Stand by: <3W DC or <8VA AC Max: <6W DC or <14VA AC

1.2   Frequency

Frequency protection functions	From 45 to 55Hz
Nominal frequency	50Hz

1.3   Current Inputs

Current inputs	1 and 5A by connection	
Operating range	Selected at order (Cortec)	
Burden Current	< 0.25 VA	(1A)
	< 1.5 VA	(5A)
Short time nominal current	100In / 1s	1A
	50In / 1s	5A
Thermal withstand	continuous @ 4 x rated current	

1.4   Logic Inputs

Logic input type	Independent optically insulated
Logic input burden	< 10 mAmps per input
Logic input recognition time	<5ms

1.5   Output Relays

Contact rating	
Contact relay	Dry contact Ag Ni
Make current	Max. 30A and carry for 3s
Rated Voltage	250 Vac

Technical Data and Characteristic Curve

2.   PROTECTION ELEMENTS

2.1   Glossary

I Is	Current
DT	I>, I>>, I>>>
IDMT	Definite Time
	Inverse Definite Minimum Time

Element	Range	Deviation	Trigger	Reset	Time deviation
over current elements I>, I>>, I>>>	0.002 to 1In	± 2%	DT: Is ± 2% or ± 2mA IDMT: 1.1Is ±2% or ± 2mA	0.95 Is ±2% 1.05 Is ±2%	±2% +30…50m ±5%+30…50ms

2.2   Current Measurement

Measurement	Range	Deviation
Current	0.002 to 1 In	Typical ±1.5% at In or ±15mA

2.3   Overcurrent Protection

I	Current
Is	I>, I>>, I>>>
DT	Definite Time

NOTE: When I> are associated to an IDMT curve, the maximum setting is 0.05 In; the maximum of the range (1 In) divided by 20.

Technical Data and Characteristic Curve

HF1021

2.3.1 Protection Setting Ranges

OC	Setting Range		
	Min	**Max**	**Step**
High sensitivity current set			
I>	0.002 In	1 In	0.001 In
I>>	0.002 In	1 In	0.001 In
I>>>	0.002 In	1 In	0.001 In
I>?	No or Yes		
Delay type	DT or IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IIEEE_VI, IEEE_EI, RI)		
tI>	0.02 s	150 s	0.01 s
K (RI)	0.1	10	0.1
I> TMS	0.025	1.5	0.001
I>>?	No or Yes		
tI>>	0.02 s	150 s	0.01 s
I>>>?	No or Yes		
tI>>>	0.02 s	150 s	0.01 s

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2.4 CURVE

2.4.1 GENERAL

Although the curves tend towards infinite when the current approaches is (general   threshold), the minimum guaranteed value of the operating current for all the curves with the inverse time characteristic is 1.1Is (with a tolerance of ± 0.05Is).

2.4.2 Inverse Time Curves

The first stage thresholds for overcurrent can be selected with an inverse definite minimum time (IDMT) characteristic. The time delay is calculated with a mathematical formula.

In all, there are eleven IDMT characteristics available

The mathematical formula applicable to the first ten curves is:

$$t = T \times \left(\frac{K}{\left(I/I_s \right)^{\alpha} - 1} + L \right)$$

t   Operation time
K   Factor (see table)
I   Value of measured current
Is   Value of the programmed threshold (pick-up value)
α   Factor (see table)
L   ANSI/IEEE constant (zero for IEC and RECT curves)
T   Time multiplier setting from 0.025 to 1.5

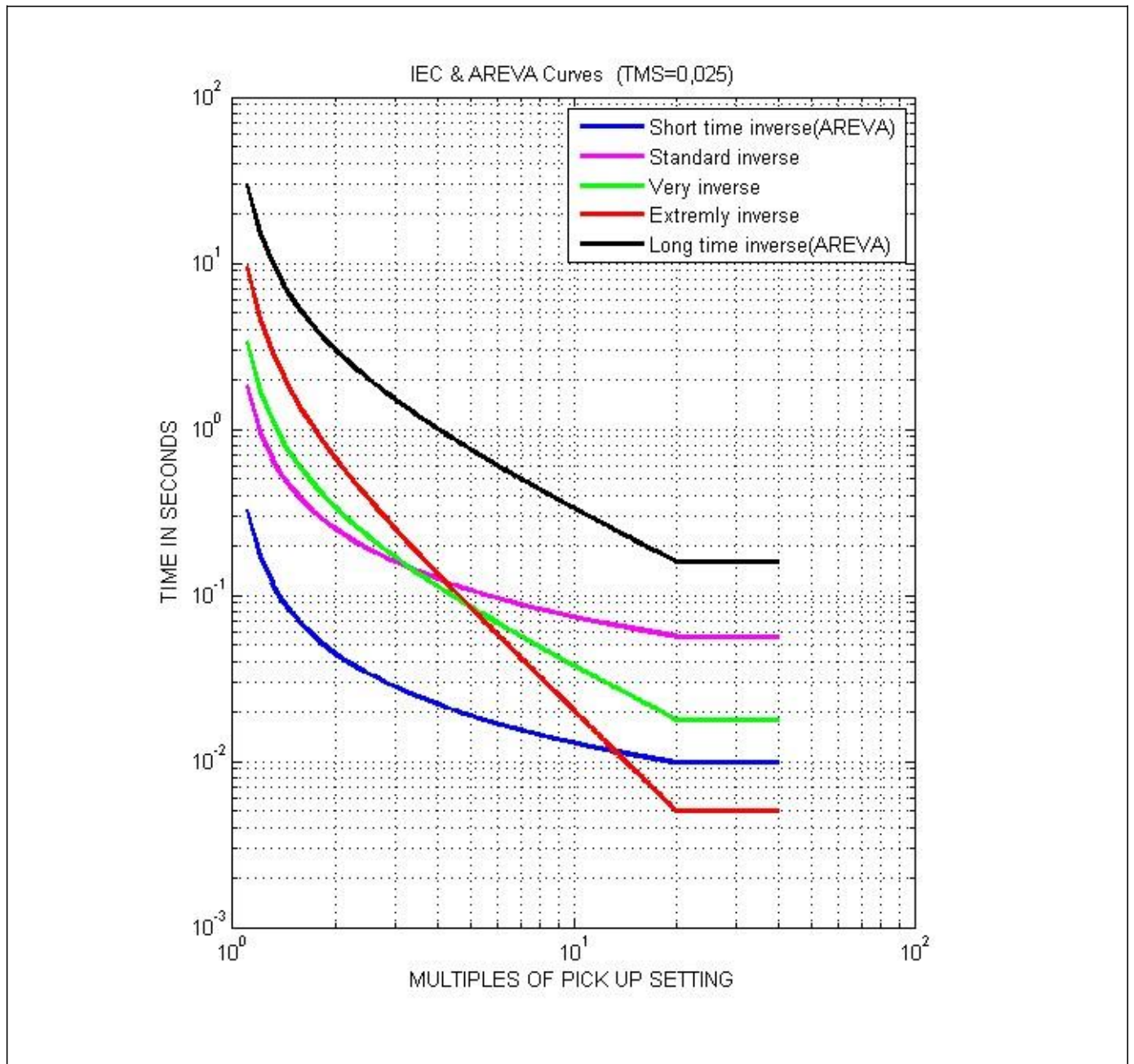| Type of curve	Standard	K factor	α factor	L factor
Short Time Inverse	AREVA	0.05	0.04	0
Standard inverse	IEC	0.14	0.02	0
Very Inverse	IEC	13.5	1	0
Extremely Inverse	IEC	80	2	0
Long Time Inverse	AREVA	120	1	0
Short Time Inverse	C02	0.02394	0.02	0.01694
Moderately Inverse	ANSI/IEEE	0.0515	0.02	0.114
Long Time Inverse	C08	5.95	2	0.18
Very Inverse	ANSI/IEEE	19.61	2	0.491
Extremely Inverse	ANSI/IEEE	28.2	2	0.1217

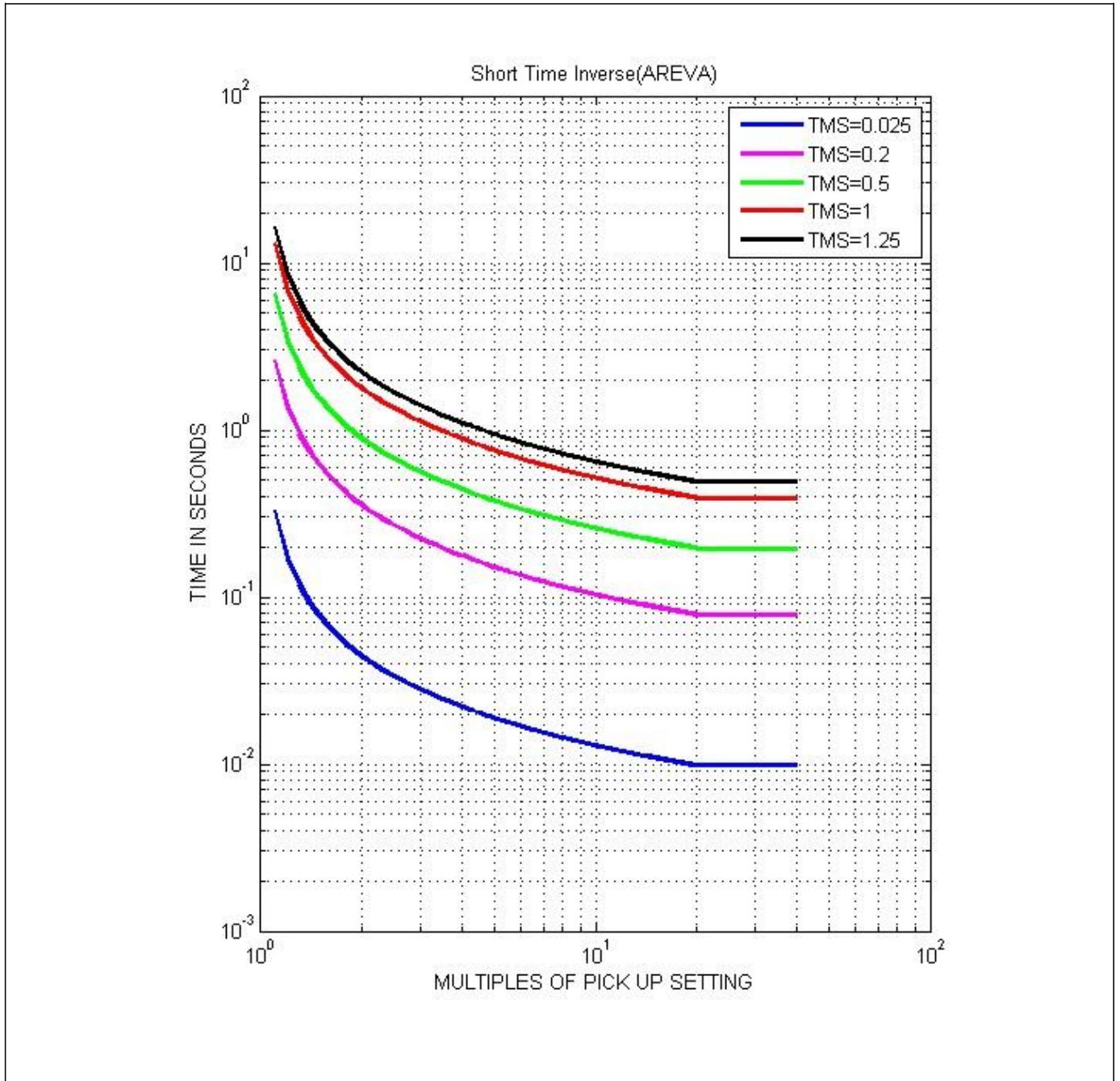**Technical Data and Characteristic Curve**

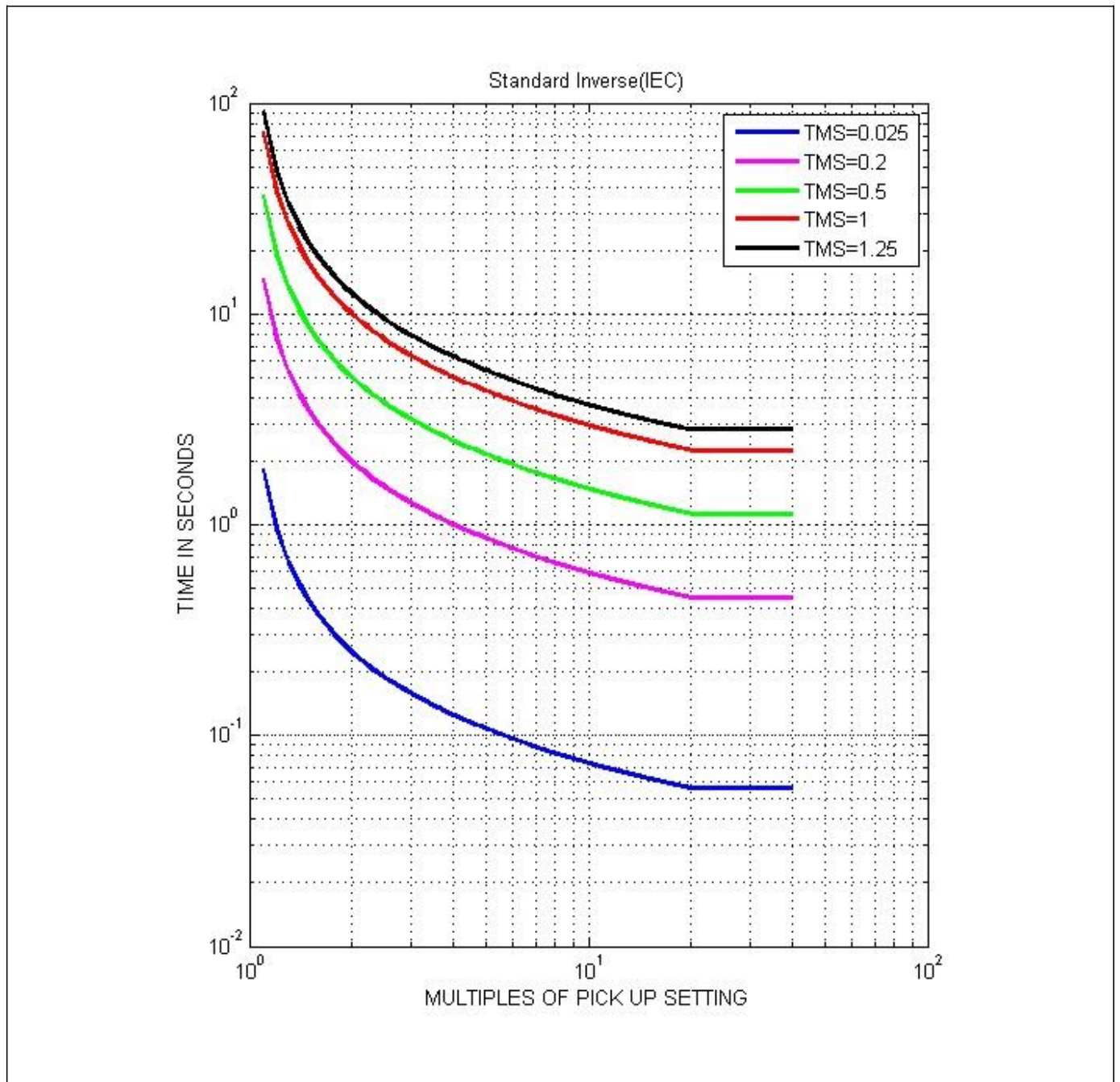**2.4.3**   **RI curve**

The RI curve has the following definition:
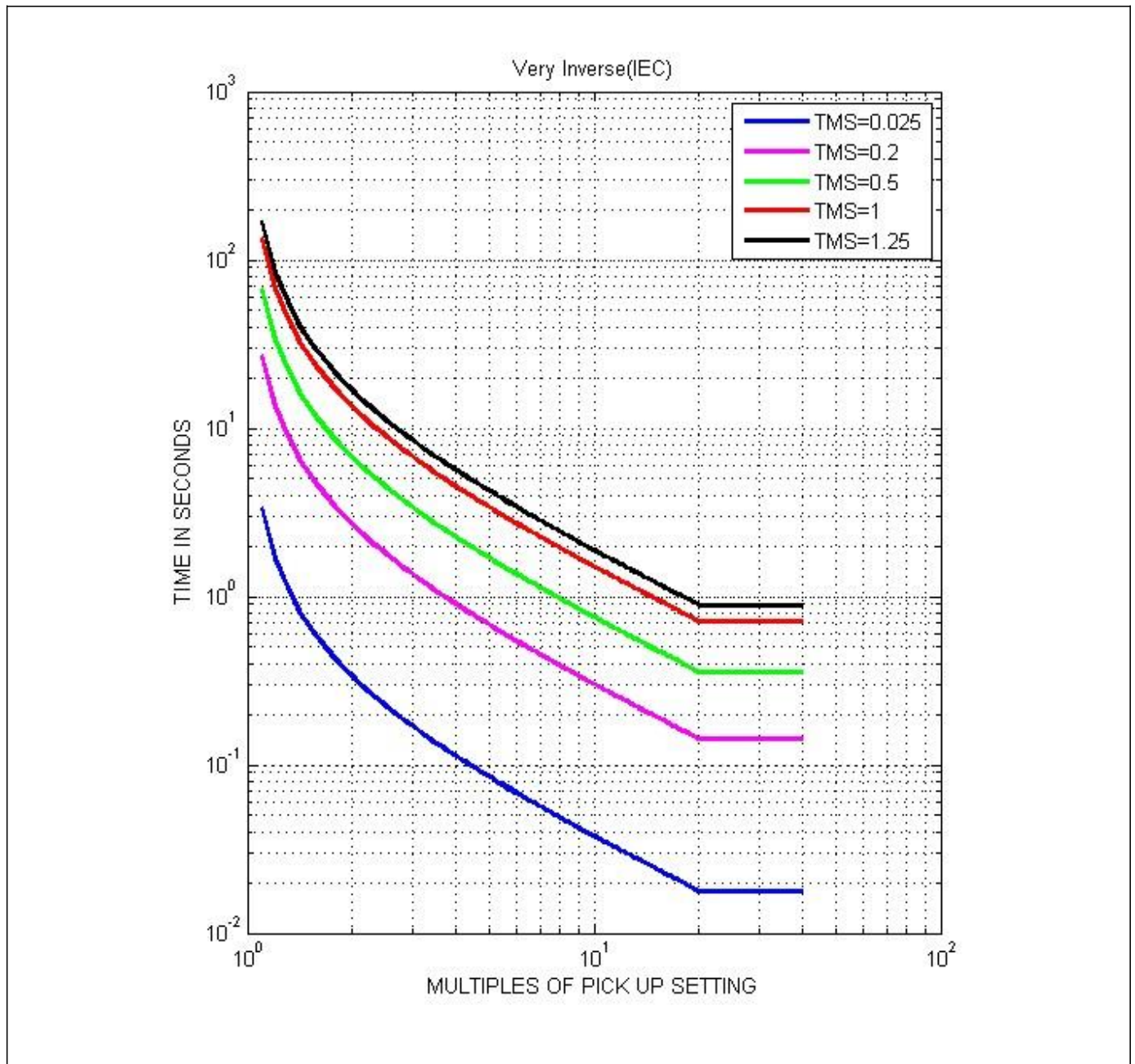
$$t = K \times \frac{1}{0.339 - \frac{0.236}{I/I_s}}$$

K setting is from 0.10 to 10 in steps of 0.05.
The equation is valid for 1.1 ≤ I/Is ≤ 20.

Technical Data and Characteristic Curve

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IEC & AREVA Curves (TMS=0,025)

- Short time inverse(AREVA)
- Standard inverse
- Very inverse
- Extremly inverse
- Long time inverse(AREVA)

TIME IN SECONDS

MULTIPLES OF PICK UP SETTING

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Technical Data and Characteristic Curve

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Technical Data and Characteristic Curve

Standard Inverse(IEC)

Technical Data and Characteristic Curve

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Technical Data and Characteristic Curve

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Extremely Inverse(IEC)

Technical Data and Characteristic Curve

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Technical Data and Characteristic Curve

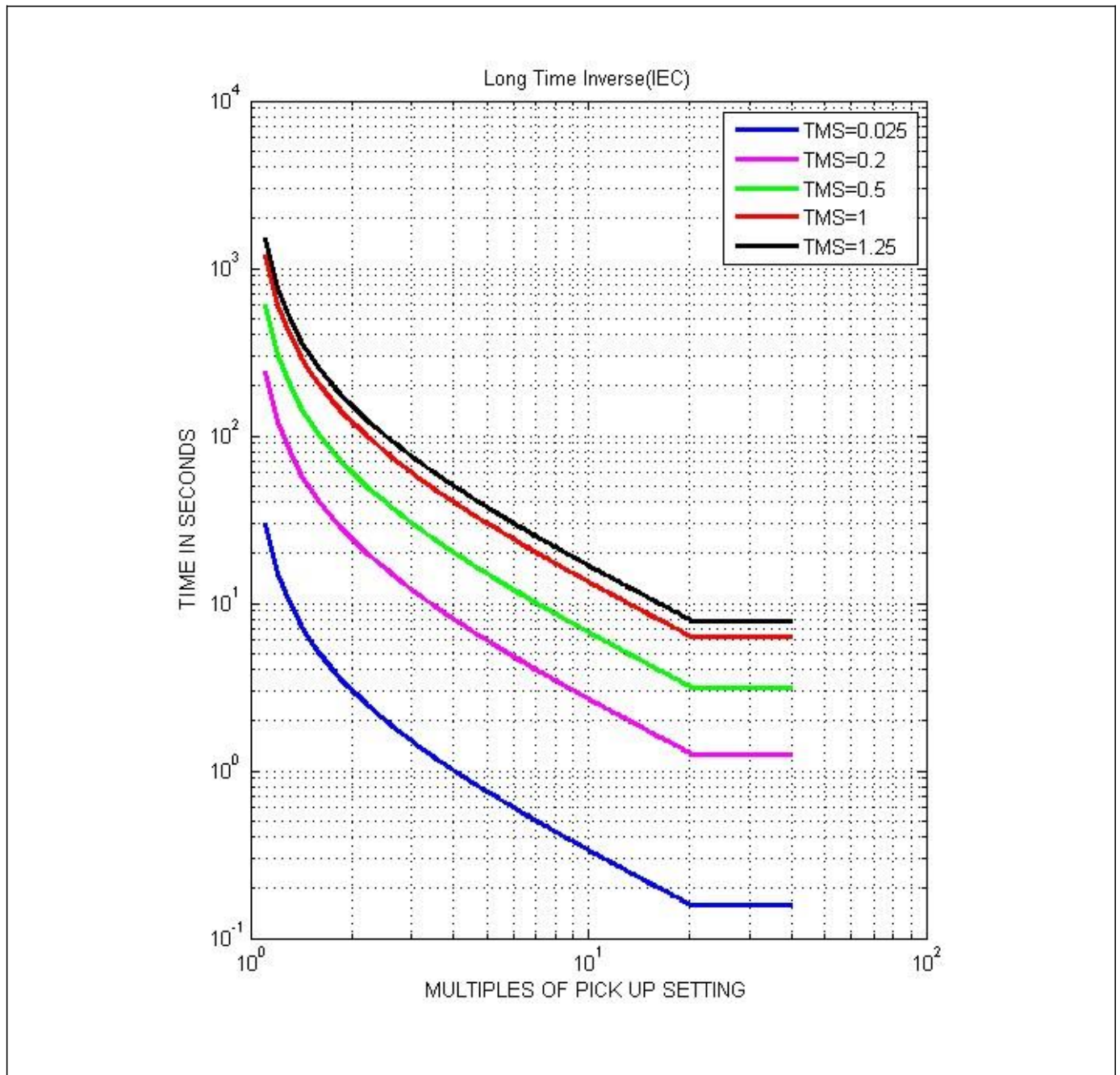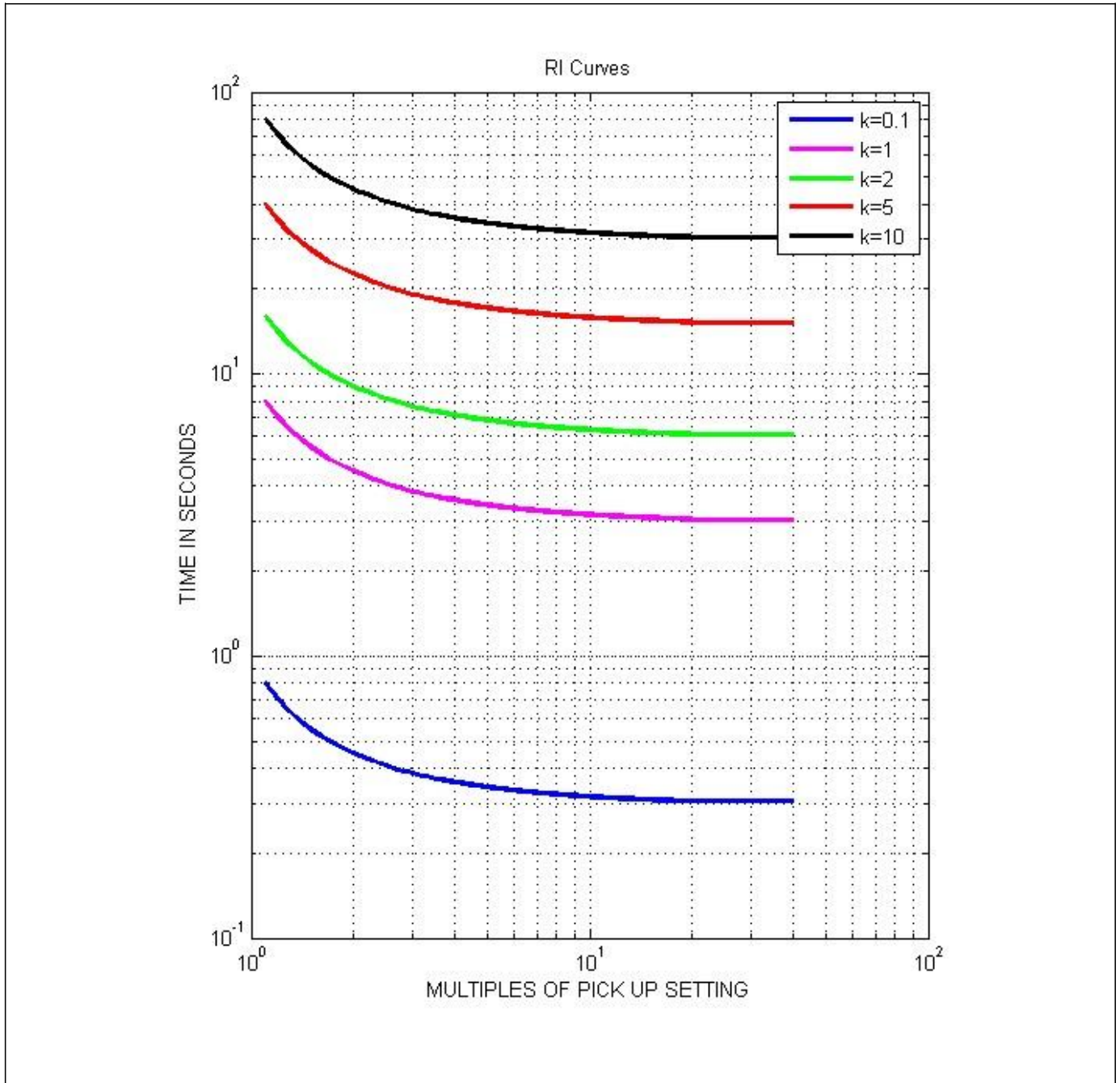**HF1021**

3. AUTOMATION CONTROL FUNCTIONS

3.1 Trip Commands

Assignation of the following thresholds to trip output relay:

− tI>, tI>>, tI>>>

3.2 Latch Functions

Trip output relay programmable with one or many thresholds:

− tI>, tI>>, tI>>>

3.3 Blocking Logic

Possibility to block the following delayed thresholds:

− tI>, tI>>, tI>>>

3.4 Output Relays

Alarm and trip threshold assignation to a logic output: 3 relays

3.4.1 Assignable functions:

− Output signal trip (RL1), I>, tI>, I>>, tI>>, I>>>, tI>>>

3.5 Latch of the auxiliary output relays

Possibility to latch output relays:

− Output 2 to 4

3.6 Inputs

3.6.1 Inputs assignation:

Single function or multiple automation functions assignable to 2 logic inputs:

− None, Unlatch, 52 a, 52 b, CB FLT, Block Logic

4.   RECORDING FUNCTIONS

4.1   Event Records

Capacity	75 events
Time-tag	1 millisecond
Triggers	Any selected protection alarm and threshold Logic input change of state Setting changes

4.2   Fault Records

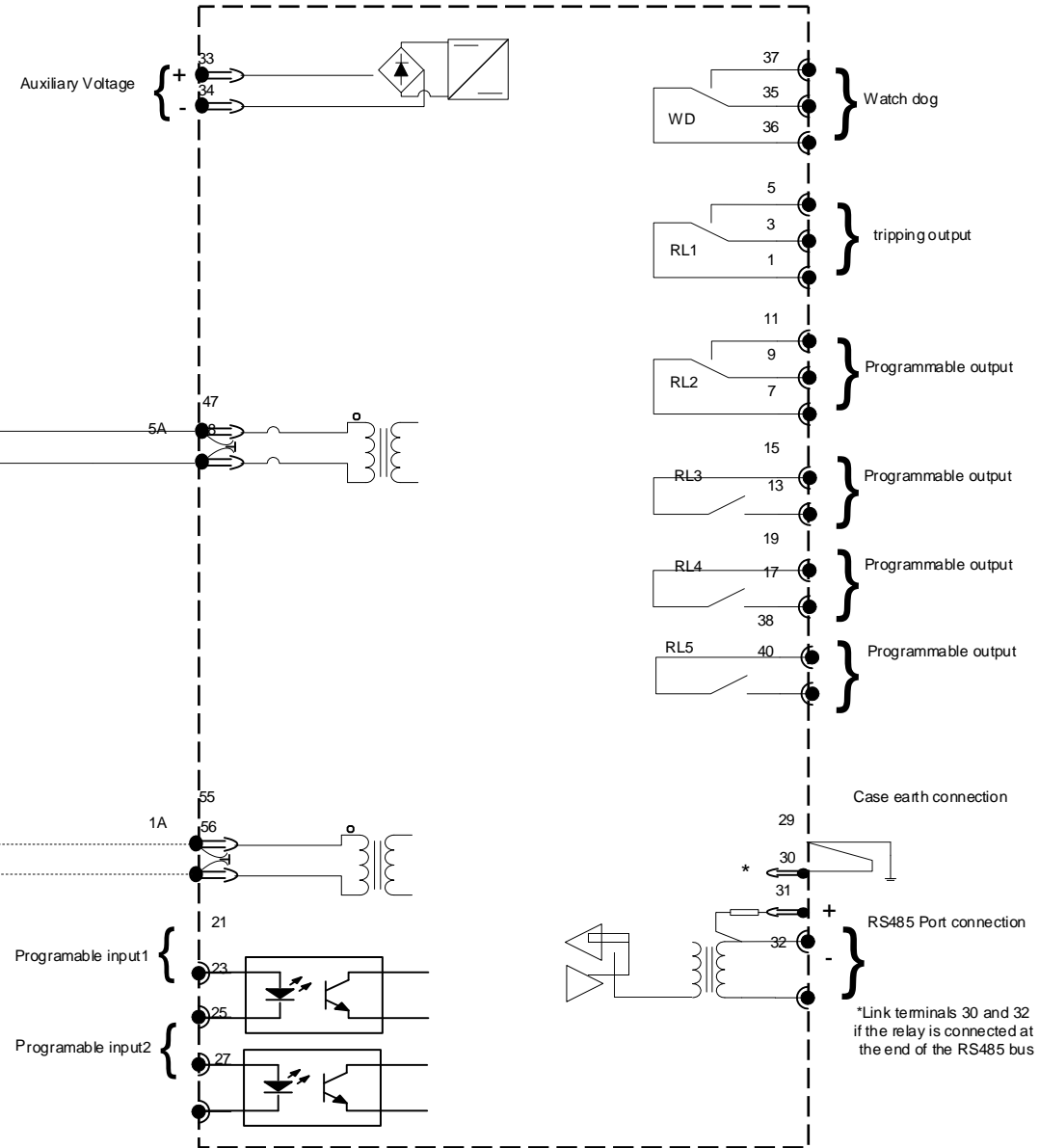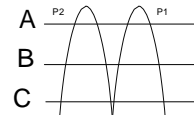| Capacity	5 events
Time-tag	1 millisecond
Triggers	Any selected protection alarm and threshold
Data	Fault time & date Protection thresholds AC inputs measurements (RMS) Fault measurements

4.3   Disturbance Records

Capacity	5 disturbance records			
Triggers	Any selected protection alarm and threshold			
Data	date, hour origin (any protection alarm) length (duration of the instantaneous trip yes or no			
	Setting range			Default value
	Min	Max	Step	HF1021
Pre-Time	0.1	3	0.1	0.1
Post-Time	0.1	3	0.1	0.1
Disturb rec Trig	ON TRIP			ON TRIP

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Technical Data and Characteristic Curve

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5. COMMUNICATION

Type Port	Relay position	Physical Link	Connectors	Data Rate	Protocol
RS485	Rear port	Screened twister pair	Screws	19200 bps	Modbus RTU
RS232	Front port	Screened twister pair	Sub–D 9 pin Female connector	19200 bps	Modbus RTU

CONNECTION DIAGRAM

The current input are connected to core balanced CT

Auxiliary Voltage { + 33 - 34

37 35 36 Watch dog — WD

5 3 1 tripping output — RL1

11 9 7 Programmable output — RL2

15 13 Programmable output — RL3

19 17 38 Programmable output — RL4

40 Programmable output — RL5

A P2 P1
B
C S2 S1

5A 47

1A 55 56

21 Programable input1 { 23 25

Programable input2 { 27

Case earth connection

29 30 * 31

32 + - RS485 Port connection

*Link terminals 30 and 32 if the relay is connected at the end of the RS485 bus

Case Earth

1 2
29 30
3 4
31 32
5 6
33 34
7 8
35 36
9 10
37 38
11 12
39 40
13 14
41 42
15 16
43 44
17 18
45 46
19 20
47 48
21 22
49 50
23 24
51 52
25 26
53 54
27 28
55 56

Module Terminal Blocks
Viwed from rear
(with integral earth link)

Note :
(1) (a)   CT shorting links make before (b) and (c) disconnect
     (b)   Short terminals break before (c)
     (c)   Long terminals
     (d)   Pins terminals (pcb type)

(2) Vx 48-150Vdc or 35-100Vac

	Date: 97/12/15	Page 1/1	Drawn By: S. Maddah
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	HF1021		Approved By:

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