GE Power Management

Digital Frequency Relay

DFF series 1000

Instructions

GEK 106166B

Anything you can't find?

Anything not clear enough?

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1. GENERAL DESCRIPTION AND APPLICATION

During the last years new technologies have allowed a significant advance in the concept of integration between different components of the electrical system. The reasons for such integration are several:

-Reduce the investment in new equipment.

-Optimize the use of the existing installations.

-Improve the energy management system.

This integration of functions not only includes the switchgear protection and control devices, but also the monitoring elements, the alarm signalling equipment (with its associated treatment) and finally the analysis off all the available information (events, alarms, oscillography, load and demand profiles, etc.).

The DFF is a microprocessor based protection relay used for frequency supervision in an electrical system. It allows to create a customer-defined load shedding scheme.

Frequency variations are originated by unbalance conditions between generation and load. The main reasons for this condition are:

- Inadequate load forecast or deficient generation capacity programming.
- Busbars, generator group or interconnection feeders trip.
- System split in different portions.

When the frequency variation is small, the unbalance condition will be corrected by the generator's regulator. On the contrary, in case of big frequency variations the regulator is not able to correct them itself, and the frequency value will decrease with the danger of losing the generation capacity because of underfrequency tripping.

If this underfrequency condition is not corrected on time a general blackout may occur.

In case of shortage of generation capacity, the only possible way of recovering the stability of the system is through a selective load shedding scheme. The load disconnection is done when the frequency goes down bellow certain thresholds in order to provide reaction time to the generators, by means of the primary speed regulators.

It is important to point out that when the frequency decreases quickly the underfrequency condition is not enough to recover stability. In this case the load shedding scheme must also take into account the frequency change rate. This is done by calculating the frequency derivative over time. Loads are "shed" based not only on an absolute (static) underfrequency threshold, but also on the dynamic frequency change rate.

The DFF is mainly used in medium voltage and distribution substations in order to implement a selective non-critical load shedding scheme. By doing so, frequency recovers stability and we avoid potentially dangerous situations that might affect generators or other parts of the electrical system.

The DFF available functions are:

a) Protection

- Eight underfrequency units, programmable as absolute or change rate values.
- Voltage unit to supervise frequency units.
- Undervoltage unit (Note: All protection functions use phase B for calculation).
- Overvoltage unit (Note: All protection functions use phase B for calculation).

b) Monitorization and Register

- Phase and ground voltage measurement.
- Frequency measurement.
- Frequency change rate (derivative) measurement.
- 17 LED indicators (16 of them user configurable).
- Self-checking and monitoring.

c) Analysis

- Events recording.
- Oscillography waveform capture.
- Alarm register.

d) Interfaces and Communications

The DFF has two communications ports. The front port is RS232 while the rear port can be RS232, RS485, plastic or glass fiber optics.

The DFF associated software is the following:

- Communication software GE-LOCAL, that allows the user to view and modify the protection settings, alarms, internal status etc.
- Configuration software GE-INTRO, that allows the user to configure the inputs, outputs, alarms and LEDs.
- Oscillography software GE-OSC, that allows the user to view and analyze waveform captured data.

These software packages are integral part of GE-NESIS software (General Electric NEtwork Substation Integration System).

2. OPERATING PRINCIPLES

2.1 PROTECTION FUNCTIONS

2.1.1 FREQUENCY UNITS

The DFF relay incorporates 8 underfrequency units. Each unit can be independently set as ABSOLUTE THRESHOLD or as DERIVATIVE. All frequency units are supervised by a voltage unit that disables the frequency unit's operation in case the voltage value decreases below the adjusted threshold. The available settings are:

Name	Limits	Default	Step
FUNCTION TYPE	FREC. or dF/dT	FREC.	N/A
81 PICKUP	40.00 - 70 Hz	50 Hz	0.01 Hz
TIME DELAY	0.00 - 60.00 s	1.00 s	0.01 s
dF/dT	-10.00 to -0.10 Hz/s	- 0.75 Hz/s	0.01 Hz/s
RESET TIME	0.00 - 600.00 s	0.00 s	0.01 s

***NOTE**: The measuring resolution of the DFF equipment is always better than 5 mHz. However, because of esthetical reasons (in order to avoid fluctuations on the display) measures are displayed in steps of 10 mHz. Nevertheless, the measurements in 5 mHz steps are reflected on the oscillogram.*

- The FUNCTION TYPE setting allows to adjust the operation of the frequency unit as ABSOLUTE THRESHOLD or DERIVATIVE
- The 81 PICKUP is the pickup value for both the underfrequency and the change rate units.
- The TIME DELAY is the time during which the fault condition must be present for the unit to trip.
- dF/dT is the instantaneous value of the frequency derivative over time that will cause a trip.
- RESET TIME is the time the frequency units maintain the tripping contacts closed, once the trip command has been issued, and the condition that caused the trip has disappeared.

If we want to adjust a unit as change rate we will select the setting FUNCTION TYPE as dF/dT. In this case the time delay setting is ignored and the trip is instantaneous (only the "number of semi-cycles" setting is taken into account, this setting is common for all units. Please refer to the General Settings section).

In order to issue a trip in this operating mode the frequency has to be lower than the adjusted value in setting 81 PICKUP and also the frequency change rate over time must be higher than the setting value of dF/dT. We have to take into account too that when frequency decreases the dF/dT value is negative and then the trip will be instantaneous.

If we want a unit to operate as absolute frequency then we will select the setting FUNCTION TYPE as FREC. Operating this way the adjusted value of dF/dT is ignored. The operating value of this unit would depend on the adjusted value of TIME DELAY. The pickup will occur once the adjusted "number of semi-cycles" expire, (this is a common setting for all units), and the trip will take place when the time delay ends (note that tripping conditions should persist during all the time delay).

If we want one frequency unit producing two trips: one instantaneous and another time delayed, then we need to address one output to the unit pickup and another independent output to the unit trip.

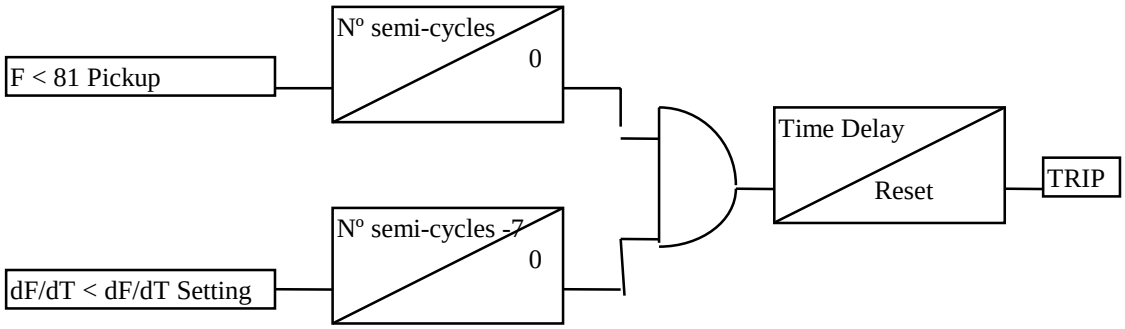
By doing so, as an example, if we have one unit adjusted as absolute underfrequency with a time delay of 10 seconds, the pickup will occur as soon as the frequency goes below the setting value during the adjusted number of semi-cycles. Trip will take place after the 10 seconds' time delay. If the delay is adjusted to 0 seconds, then pickup and trip will take place at the same time.

If we want to adjust the unit as change rate, we will select the FUNCTION TYPE setting as dF/dT. The following conditions are necessary for the unit to pickup in this mode:

- The frequency value must be under the set value for 81 PICKUP during the “number of semi-cycles” set for GENERAL SETTINGS.
- The variation of frequency related to time must be higher (in absolute value) than the set value for dF/dT during seven (7) semi-cycles less than the number of semi-cycles set in SEMY-CYCLES (General Settings)

If these conditions are present during the time set for TIME DELAY, the unit will trip.

In the following diagram, the operation mode for the dF/dT function is illustrated:



For the function set as absolute step, the bottom branch of the figure would always be active.

Comments:

- The set number of semi-cycles is common for all the frequency units
- The substracted semi-cycles in the dF/dT case, are due to the fact that for calculating the frequency, only one cycle is need, while for calculating the dF/dT, we need at least 5 cycles.
- If the voltage is under the value set for the inhibition unit, all the frequency units will be cancelled, but not the voltage units.
- The frequency, voltage, or frequency and voltage units can be disabled using the configurable inputs.
- Once the fault condition has occurred, we must wait for a number of semi-cycles, adjusted in the No SEMICYCLES of the General Settings, before starting the protection function. It may occur that the fault condition disappears during this time; for example, if the dF/dT should be under -0.7Hz/s, and for a moment it is only -0.65Hz/s. In this case, we may not want the protection function to be reset if the time during which the fault condition disappears is very small. That's what the SEMICYCLES RESET setting is for. It allows the semi-cycles counter to "freeze" without resetting during an adjustable time when the fault condition disappears.

2.1.2 VOLTAGE UNITS

The DFF has 3 voltage units.

Inhibition voltage unit :

This unit supervises the phase voltage used for frequency calculation (in this case phase B). This unit is adjusted as a percentage of the nominal voltage. The range goes from 40 to 110 % of the nominal voltage (also adjustable). If the voltage measured in phase B goes below the setting, all frequency units will be inhibited.

Undervoltage unit :

This unit is applied only to phase B, that measures the frequency. The settings are as follows:

Name	Limits	Default	Step
27P PICKUP	20 - 110 Vac	50 Vac	0.01 Vac
27P OPERATION t	0.00 - 30.00 s	5 s	0.01 s
27P RESET t	0 - 1200 s	0 s	1s

- The 27P PICKUP setting is the voltage operating value. If phase B measured voltage value goes below this setting, the unit picks up.
- The 27P OPERATION t setting is the associated time delay for the undervoltage unit. The unit's trip takes place only after this time expires, taking into account that the voltage level should be lower than the setting during the course of the time delay.
- The setting 27P RESET t is the time that the unit maintains the tripping contacts closed once the trip command has been issued. Regardless the trip condition disappears or not, the contact will remain closed until the expiration of this time.

Overvoltage units :

This unit is applied only to phase B, that measures frequency. The settings are the following:

Name	Limits	Default	Step
PICKUP 59 F	50 - 220 Vac	80 Vac	0.01 Vac
59P OPERATION t	0.00 - 30.00 s	5 s	0.01 s
59P RESET t	0.00 - 30.00 s	0 s	0.01 s

- The PICKUP 597F setting is the voltage operating value. If phase B measured voltage value goes below this setting the unit picks up.
- The 59P OPERATION t setting is the associated time delay for the overvoltage unit. The unit's trip takes place only after this time expires, taking into account that the voltage level should be higher than the setting during the course of the time delay.
- The t. RESET 59F setting is the time that the unit maintains the tripping contacts closed once the trip command has been issued. Regardless the trip condition disappears or not the contact will remain closed until the expiration of this time.

2.2 INTERNAL STATUS

The DFF is a microprocessor based relay that samples analog inputs, processes them by means of internal algorithms and activates outputs accordingly. Most of the relay information may be accessed by the user in order to create specific configurations for each application. With all this information the end-user can configure outputs, inputs, LEDs and define alarms. All the programmable logic is based on AND, OR and NOT gates.

The DFF presents all this information as “Internal Status”. This is nothing but logical Boolean states of all the internal variables available inside the relay. Each variable may be a “0” or a “1”. As an example, one internal state is the pickup of a frequency unit. If this unit operates as underfrequency, its internal state will be “1”. This value can be addressed to an output contact, an alarm or a LED.

By the same procedure if one digital input is activated, its “internal state” goes to “1”, and it can be addressed also to an output contact, to an alarm or to a LED.

Programmable AND, OR and NOT logic can be done through the internal states information. For example, activating one output when there is a pickup condition plus a digital input activation.

By adequate use of this “internal states” logic all kind of sophisticated load shedding schemes may be implemented.

The DFF device has two different types of internal states:

- Protection internal states.
- General and communication internal states.

All those available communication internal states are shown in the following table:

TABLE I. COMMUNICATIONS INTERNAL STATES

	Internal States		**Internal States**		**Internal States**		**Internal States**
0	Mode: Remote (1) Local (0)	20		40		60	
1	Rear Connection	21		41		61	
2	Front Connection	22		42		62	
3		23		43		63	
4		24	Protection link	44		64	LED 1
5		25	Control link	45		65	LED 2
6		26		46		66	LED 3
7		27		47		67	LED 4
8		28		48		68	LED 5
9		29		49		69	LED 6
10		30		50		70	LED 7
11		31		51		71	LED 8
12		32	New events	52		72	LED 9
13		33		53		73	LED 10
14		34		54		74	LED 11
15		35		55		75	LED 12
16	Time/date alarm	36		56		76	LED 13
17		37		57		77	LED 14
18	Serial EEPROM alarm	38		58		78	LED 15
19	System Settings	39		59		79	LED 16

All those available protection internal states are shown in the following table:

TABLE II. PROTECCION INTERNAL STATES

	Internal States		Internal States		Internal States		Internal States
0	Program Initiation	40	F1Trip	80	Output 13	120	
1	Settings change	41	F2Trip	81	Output 14	121	
2		42	F3Trip	82	Output 15	122	
3	Configuration change	43	F4Trip	83	Output 16	123	
4	External trigger	44	F5Trip	84	Output 17	124	
5	Communications trigger	45	F6Trip	85	Output 18	125	
6		46	F7Trip	86	Output 19	126	
7		47	F8Trip	87	Output 20	127	
8		48	27 Pickup	88	Output 21	128	
9		49	59 Pickup	89	Output 22	129	
10		50		90	Output 23	130	
11		51		91	Output 24	131	
12		52		92	Output 25	132	
13		53		93	Output 26	133	
14		54		94	Output 27	134	
15		55		95	Output 28	135	
16	Input 14	56	27 Trip	96		136	
17	Input 13	57	59 Trip	97	Parallel E2PROM Alarm	137	
18	Input 12	58		98	Serial E2PROM Alarm	138	
19	Input 11	59		99	Out of order	139	
20	Input 10	60		100	Default general settings	140	
21	Input 9	61		101	Table 1 default settings	141	
22	Input 8	62		102	Table 2 default settings	142	
23		63		103	Table 3 default settings	143	
24	Input 7	64	Output 1	104	Trip contact	144	AND1
25	Input 6	65	Output 2	105	Table 1 active	145	AND2
26	Input 5	66	Output 3	106	Table 2 active	146	AND3
27	Input 4	67	Output 4	107	Table 3 active	147	AND4
28	Input 3	68	Output 5	108	Trips disabled	148	AND5
29	Input 2	69	Output 6	109		149	AND6
30	Input 1	70		110		150	AND7
31		71		111	New events	151	AND8
32	F1 Pickup	72	Output 7	112		152	AND9
33	F2 Pickup	73	Output 8	113		153	AND10
34	F3 Pickup	74	Output 9	114		154	AND11
35	F4 Pickup	75	Output 10	115		155	AND12
36	F5 Pickup	76	Output 11	116		156	AND13
37	F6 Pickup	77	Output 12	117		157	AND14
38	F7 Pickup	78		118		158	AND15
39	F8 Pickup	79		119		159	AND16

***NOTE**: This table shows the internal states for model DFF1000, with 14 inputs and 33 outputs. Models DFF1001 (7 inputs and 25 outputs) and DFF1002 (7 inputs and 13 outputs) will show the associated states in blank.*

2.3 MONITORING AND REGISTERING FUNCTIONS

2.3.1 MEASUREMENT

The DFF provides measurement values for the following magnitudes:

- Three phase and ground voltages
- Frequency
- Frequency change rate over time

The DFF calculates RMS values for each phase. Measurement can be accessed through the local front display or also from the GE_LOCAL communications software under the measurement screen. All the values are affected by the external transformers´ ratio (PT PHASE RATIO and PT GROUND RATIO defined in the General Settings Category).

2.3.2 LED SIGNALIZATION

The relay status provides information about all units inside the equipment (inputs, pickups, alarms, etc.). The available signals in the status are packed together in groups of 16. In the status there are 10 of these groups; the last group corresponds to the 16 configurable AND gates programmable through GE-INTRO software. To this last group AND1....AND16 we can address the internal signals or also the output of another group's AND.

In the DFF we have a total of 17 LEDs available, one bicolor (not configurable) for the internal alarm function plus 16 red. These 16 LEDs form a single column, and all of them are configurable using GE-INTRO software.

All events (32 originated by protection and 16 by communications), or an OR combination of them (maximum 16 inputs coming out from the same group) may be addressed to the LEDs.

Also we can select LED by LED whether we want memory on them or not. This impacts the way LEDs will operate after a loss of the power supply. If they have memory, once the relay is powered up again the LEDs will recover their previous states regardless the condition that made them operate still persists or not.

Also we can program the LEDs to blink just after the power up.

There is also a test facility for the LEDs, by pressing the TARGET RESET button all them will be lit. The same button allows the reset of the LEDs signalling by pressing continuously during three seconds.

The default configuration of the DFF is the following:

LED	DESCRIPTION	LED	DESCRIPTION
1	Frec. Pickup Function. 1	9	Frec. Trip Function. 1
2	Frec. Pickup Function. 2	10	Frec. Trip Function. 2
3	Frec. Pickup Function. 3	11	Frec. Trip Function. 3
4	Frec. Pickup Function 4	12	Frec. Trip Function. 4
5	Frec. Pickup Function. 5	13	Frec. Trip Function. 5
6	Frec. Pickup Function. 6	14	Frec. Trip Function. 6
7	Frec. Pickup Function. 7	15	Frec. Trip Function. 7
8	Frec. Pickup Function. 8	16	Frec. Trip Function. 8

2.3.3 SELF-CHECKING AND DIAGNOSIS

The DFF includes (due to its numerical technology) self-checking and autodiagnosis. These functions guarantee proper operation, signalization in case of internal failure and disable the operation of the protection functions.

These tests are performed not only during the power-up process of the relay but also during normal operation (making use of the so called “background free time”). They check the situation of the power supply, ROM memory, RAM memory, oscillography memory and the EEPROM memory.

Additionally a hardware check for the signalling LEDs is incorporated. By pressing the TARGET RESET button all of them will be lit up.

2.4 ANALYSIS FUNCTIONS

2.4.1 EVENT REGISTER

The DFF relay has a cyclic register of the last 144 events, each event stores the following information: date and time (1 msec time tag), type of event, the voltage, frequency, and dF/dT measurement values at the time event happened and equipment status.

The events are stored in non-volatile EEPROM memory (the events are maintained even in the case of power supply loss).

The generated events are associated with the internal states of protection and communications.

2.4.2 OSCILLOGRAPHY REGISTER.

There are two types of oscillos, selectable by the OSCILLO TYPE setting, between NORMAL or FREC.

NORMAL Type

The DFF unit can store up to 4 oscillography records, with a resolution of 16 samples per cycle. Each record has a maximum capacity of 99 cycles, and the number of pre-fault cycles is selectable between 2 and 10. Each record includes the following information:

- Instantaneous values of voltage inputs (V_A, V_B, V_C, V_N):
- Frequency value
- Digital information (status of protection functions).
- Date and time
- Causes for the oscillography record.
- Active settings table in the moment of the record.

FREC Type

The DFF unit stores up to 4 oscillography records, with a resolution of 2 samples per cycle. Each record has a maximum capacity of 1584 cycles, and the number of pre-fault cycles is selectable between 2 and 80. Each record includes the following information:

- Frequency value
- Digital information (status of protection functions).
- Date and time.
- Causes for the oscillography record.
- Active settings table in the moment of the record.

The trigger conditions for the waveform capture are:

Trigger through Input
Trigger through communications
81 Pickup Unit 1
81 Pickup Unit 2
81 Pickup Unit 3
81 Pickup Unit 4
81 Pickup Unit 5
81 Pickup Unit 6
81 Pickup Unit 7
81 Pickup Unit 8
81 Trip Unit 1
81 Trip Unit 2
81 Trip Unit 3
81 Trip Unit 4
81 Trip Unit 5
81 Trip Unit 6
81 Trip Unit 7
81 Trip Unit 8
27P Pickup
59P Pickup
Trigger Input
Trigger Communications
27P Trip
59P Trip

There is a configurable mask that defines what functions or internal trips can initiate the oscillography capture. The available options are: configurable digital input, communications or local keypad.

The waveform captures registered are stored in COMTRADE format files by using GE-LOCAL communications software. They can be viewed through GE-OSC software, any program that can read COMTRADE files or also as a text file (using for example Microsoft EXCEL). Finally by means of an external format converter they will be accepted by GLOBAL-LAB (a well known mathematical and signal analysis software package).

2.5 SETTING TABLES

The DFF provides three independent setting tables, stored in a non-volatile EEPROM memory. Only one table is active at a time, and it is the one the relay uses.

Of all the settings available in the relay there are some of them common for the three setting tables (General Settings, Active Table, Oscillography Masks and Functions' Enabling). The rest of settings are independent for each table.

There is a setting called "ACTIVE TABLE" that allows to define which is the active table at a certain time.

There is another way of changing the active table. By using two digital inputs, called "TABLE 0 SELECTION" and "TABLE 1 SELECTION" up to four different (0 to 3) combinations are possible. To do this, those inputs must be programmed to perform such function. In applications that require only two different tables only one digital input is needed (leaving the second input free for other uses).

The selected combination is obtained from the following table:

Number	Input 1	Input 0	Active Table
0	0	0	Selected by setting
1	0	1	1
2	1	0	2
3	1	1	3

NOTE: *If any of these two digital inputs is active, the selection will have priority over the "ACTIVE TABLE" setting. That setting will have no meaning.*

2.6 INPUTS AND OUTPUTS

2.6.1 DIGITAL INPUTS

The DFF1000 has 14 digital inputs (two groups of 7 Inputs each with a common terminal for each), being all of them user-configurable through GE-INTRO software program. Models DFF1001 and DFF1002 have only 7 inputs.

Every input may have one of the following values:

- Input non-active
- External Trigger (Pulse)
- Table 0 selection (Level)
- Table 1 selection (Level)
- Frequency trips block (Level)
- Voltage trips block (Level)
- Complete protection trips block (Level)

The external connections diagrams, in figures 1, 2, and 3, show the default inputs configuration.

2.6.2 OUTPUTS

The DFF1000 provides 33 Outputs, five of them are not configurable (four of them are assigned to the protection functions and one of them is for the internal alarm). The rest of the available outputs, 28, are configurable through GE-INTRO software. Models DFF1001 and DFF1002 provide 25 (20 configurable, 5 fixed) and 13 (8 configurable, 5 fixed) outputs each.

The technical characteristics of the outputs are described in chapter 5.

The configurable outputs may be programmed through a logic based on the internal states of the relay (pickups, trips, alarms, etc.). The DFF has 132 different internal states, all of them can be combined through NOT, AND and OR logic gates providing huge flexibility.

The programmable logic is done at different levels. At the first level AND gates (of up to 16 inputs previously grouped, see 2.2.3) can be done. The output of this AND gate is incorporated to a state bit, that can be also incorporated to another AND gate of, again, up to 16 Inputs. This “star-connection” process can be repeated until finishing the 16 bits of the predefined status for this function.

Once finished the AND gates configuration process a second level can be implemented using OR gates of also up to 16 Inputs. In this case the inputs are limited to the previously created bytes groups.

In the external connection drawings (Figures 1, 2, and 3) the default output configurations are shown.

2.7 MAN MACHINE INTERFACE (MMI).

The DFF relay includes a 20-button keypad with a two-line screen (16 characters per line). The screen has background light by LED diodes (the brightness can be adjusted through a power meter accessible at the back of the front board).

Through this interface, the user can change settings, visualize actual values, access the stored information, etc. The description of how to perform these operations is described in the KEYPAD AND DISPLAY section of this book.

2.8 REMOTE COMMUNICATIONS

The relay has two serial communications ports. Port 1 is accessible at the relay front through a DB9 connector 1 (PORT1). Port 2 is accessed at the relay back through another connector (PORT 2).

There are different models depending on the physical media of connector PORT 2 (RS-232, RS-485 or fiber optics). In models “only RS232” all connectors are RS232. For models “RS232 and fiber optics” or “RS-232 and RS-485”, connector PORT1 is RS232 while PORT2 is either a fiber optics connector or a RS-485 one.

Connector for PORT1 has priority above connector PORT2 and is selected once DCD signal (Data Carrier Detect) is activated. In figure 3 there is a sketch of how to make a connection to a personal computer.

Ports 1 and 2 are fully independent and can be used at the same time.

The relay is in local communication when we are using either the MMI or the front port and in remote communication every time we use the rear port.

Both types of communication can be active at the same time, however the possibility of changing settings or performing control operations is limited only to the communication mode with higher priority (local mode). The other channel then will only have access to the information.

Once the local communication is interrupted, either by the disconnection of PORT 1 connector or by returning the MMI to the initial screen (done on purpose or automatically after 15 minutes without any button being pressed), the remote communication mode recovers its lost privileges of being able to change settings or perform control operations.

3. SETTINGS

The following tables contain a complete list of the DFF settings, with their associated ranges, units and steps. The column called DEFAULT shows the factory default settings.

Setting can be viewed and modified in different ways: through keypad and display or through a computer connected to any of the two available serial ports. In order to modify settings manually please refer to section 9 “KEYPAD AND DISPLAY”. To modify settings through a computer the following steps should be followed:

- Make sure the connection cable corresponds to the one described in figure 3, either for DB9 or DB25.
- Connect the cable between the relay (or modem) and the computer serial port.
- Execute GE-LOCAL software. For more information about GE-LOCAL software check with the instruction manual GEK 105595.
- Make sure the configuration parameters of the relay and the ones of the software match. Those settings are :
    - UNIT NUMBER
    - PASSWORD
    - BAUD RATE (different settings for local and remote communications)
    - STOP BIT (different settings for local and remote communications)

To view or modify the configuration settings please go to the configuration menu, please refer to section 9 “KEYPAD AND DISPLAY”

The DFF relay has three independent setting tables stored in non-volatile EEPROM memory. Those tables are selectable through settings or configurable inputs. the following categories contain the common settings to the three tables:

GENERAL SETTINGS

ACTIVE TABLE SETTINGS

OSCILLOGRAPHY MASK

FUNCTION ENABLING

The rest of categories, indicated here below, contain the settings that can be selected independently for every table:

- Undervoltage unit 27P
- Overvoltage unit 59P
- Underfrequency unit or dF/dT 81 U1
- Underfrequency unit or dF/dT 81 U2
- Underfrequency unit or dF/dT 81 U3
- Underfrequency unit or dF/dT 81 U4
- Underfrequency unit or dF/dT 81 U5
- Underfrequency unit or dF/dT 81 U6
- Underfrequency unit or dF/dT 81 U7
- Underfrequency unit or dF/dT 81 U8

It is important to mention that in order to simplify the menu and also for safety reasons, all settings connected to configuration (I/O, LEDs, events) have been taken out from the keypad.

To perform the configuration of those settings the use of GE-INTRO software package is needed (please refer to instruction book GEK-105594). The configuration of all these parameters will be explained in the following chapter.

The following tables contain a complete list of the DFF settings common for the three tables, with their associated ranges, units and steps. The column called DEFAULT shows the factory default settings:

Table III . Common settings for all tables

Setting type	Limit	Default	Step
General Settings			
Relay status	In service /Out of service	Out of service	N/A
Frequency	50 / 60 Hz	50 Hz	N/A
Nominal voltage	90 - 220 Vca	90 Vca	1 V
Inhibition voltage	40 - 110 %	40 %	1 %
Semi-cycles number	3 - 20	3	1
Nº Reset Cycles	0-4	0	1
PT phase ratio	1 - 4000	1000	1
PT ground ratio	1 - 4000	1000	1
Active Table Settings			
Active table	1 - 3	1	1
Function enabling			
27P Function	Enabled / Disabled	Disabled	N/A
59P Function	Enabled / Disabled	Disabled	N/A
81 U1 Function	Enabled / Disabled	Disabled	N/A
81 U2 Function	Enabled / Disabled	Disabled	N/A
81 U3 Function	Enabled / Disabled	Disabled	N/A
81 U4 Function	Enabled / Disabled	Disabled	N/A
81 U5 Function	Enabled / Disabled	Disabled	N/A
81 U6 Function	Enabled / Disabled	Disabled	N/A
81 U7 Function	Enabled / Disabled	Disabled	N/A
81 U8 Function	Enabled / Disabled	Disabled	N/A
27P Trip	YES/NO	YES	N/A
59P Trip	YES/NO	YES	N/A
81 U1 Trip	YES/NO	YES	N/A
81 U2 Trip	YES/NO	YES	N/A
81 U3 Trip	YES/NO	YES	N/A
81 U4 Trip	YES/NO	YES	N/A
81 U5 Trip	YES/NO	YES	N/A
81 U6 Trip	YES/NO	YES	N/A
81 U7 Trip	YES/NO	YES	N/A
81 U8 Trip	YES/NO	YES	N/A
Oscillography Mask			
Type of oscillo	NORMAL/FREC	NORMAL	N/A
Prefault cycles	2- 10 (NORMAL) 2-80 (FREC)	4	1
81 U1 Pickup	YES/NO	YES	N/A

Setting type	Limit	Default	Step
81 U2 Pickup	YES/NO	YES	N/A
81 U3 Pickup	YES/NO	YES	N/A
81 U4 Pickup	YES/NO	YES	N/A
81 U5 Pickup	YES/NO	YES	N/A
81 U6 Pickup	YES/NO	YES	N/A
81 U7 Pickup	YES/NO	YES	N/A
81 U8 Pickup	YES/NO	YES	N/A
81 U1 Trip	YES/NO	YES	N/A
81 U2 Trip	YES/NO	YES	N/A
81 U3 Trip	YES/NO	YES	N/A
81 U4 Trip	YES/NO	YES	N/A
81 U5 Trip	YES/NO	YES	N/A
81 U6 Trip	YES/NO	YES	N/A
81 U7 Trip	YES/NO	YES	N/A
81 U8 Trip	YES/NO	YES	N/A
27P Pickup	YES/NO	YES	N/A
59P Pickup	YES/NO	YES	N/A
Input trigger	YES/NO	YES	N/A
Communications trigger	YES/NO	YES	N/A
27P Trip	YES/NO	YES	N/A
59P Trip	YES/NO	YES	N/A

These are the independent settings for each table:

Table IV. Independent settings for each table

Setting type	Limit	Default	Step
27P Function			
27P Pickup	20-110 Vca	50	1 V
27P Operation t	0 - 30 s	5	0.01 s
27P Reset	0 - 1200 s	0	1 s
59P Function			
59P Pickup	50-220 Vca	80	1 V
59P Operation t	0 - 30 s	5	0.01 s
59P Reset t	0 - 30 s	0	0.01 s
81N Functions			
Function type	FREC / dF/dT	FREC	N/A
81 Pickup	40 a 70 Hz	50 Hz	0.01 Hz
Time delay	0 - 60 s	1.00 s	0.01 s
dF/dT	0.1 - 10 Hz/s	1 Hz/s	0.01 Hz/s
Reset time	0 - 600 s	0	0.01 s

Remarks about settings:

The No of RESET CYCLES setting allows the frequency units (in step or dF/dT mode) to notice the fault conditions and count the semicycles before starting, maintaining the fault condition even if this is present during a shorter time than the adjusted cycles.

The " ACTIVE TABLE" setting allows selecting which is the active table of the DFF at a certain point in time. The selection can also be done through two digital configurable inputs. Those two inputs have priority over the setting in case of discrepancy between them.

The "PREFAULT CYCLES" setting allows to select between 2 and 10 cycles in NORMAL Oscillo mode, or between 2 and 80 in FREC mode. Anyway, the total number of cycles for an oscillography record is pre-selected to 99 (normal), or 1584 (FREC), independently from the selected number of prefault cycles.

4. EQUIPMENT CONFIGURATION

The DFF protection system has inputs, outputs and configurable LEDs. All of them are user configurable. The configurable inputs are adjusted through GE_INTRO software (instruction book GEK-105594A)

4.1 INPUTS CONFIGURATION

Each of the 14 or 7 configurable Inputs (depending on the model) can have any of the following values:

- Input non-active
- External Trigger (Pulse)
- Table 0 selection (Level)
- Table 1 selection (Level)
- Frequency trips block (Level)
- Voltage trips block (Level)
- Complete protection trips block (Level)

Besides these possibilities, the configurable inputs may be used for creating customized load shedding schemes by using logic ANDs gates assigned to inputs and then addressed those states to the outputs. To perform such schemes the inputs have to the configured as “Non-active”.

The operation of each input is as follows:

- External Trigger (Pulse): This input is activated by a pulse and captures the analog waveforms at that moment.
- Table 0 selection 0 (Level): This input is activated by a change in the voltage level. It is used for changing the active setting table. Please refer to section 2.5 for further details.
- Table 1 selection (Level): Same as above.
- Frequency trips block (Level): This input is activated by a change in the voltage level. It is used for blocking the operation of all frequency units.
- Voltage trips block (Level): This input is activated by a change in the voltage level. It is used for blocking the operation of all voltage units.
- Complete protection trip block (Level): This input is activated by a change in the voltage level. It is used for blocking the operation of all protection units.

4.2 OUTPUTS CONFIGURATION

The DFF protection system provides 28, 20 or 8 user configurable outputs (depending on the model) plus five non-programmable factory defined ones. These outputs are identified in the external connections diagram (figure 1) as SP1, SP2, etc.

Any of the internal states of the DFF (shown in table II section 2.2) can be addressed to one of these programmable outputs. The operation of the output can be associated either to activation or deactivation of those internal states. Following the same rules described in previous sections, combinational logic can be done with the outputs.

Let's say we want to configure protection output number 14 as the logic AND of digital input number 8 and the undervoltage trip. We will follow these steps:

- Configure input number 8 as non-active.
- Configure AND number 1 output as the activation of input number 8.
- In the same screen configure AND number 2 output as the trip of the undervoltage unit.
- In the same screen configure AND number 3 as the logic AND of AND number 1 and number 2 gates.
- In the output configuration screen we assign output number 14 as the activation of AND number 3.

4.3 LEDS CONFIGURATION

The DFF system includes 16 user configurable LEDs. Those LEDs can be associated to internal protection states and also to internal communication states. One LED, once activated, may blink or remain lit depending on a customer setting. Also we have the choice of providing memory to the LEDs, this means that it will remain lit even in the case the condition that activated it disappears.

In order to configure a LED it is necessary to associate, first, one internal state to a protection or communication event. Once this is done, we associate a LED to that protection or communication event.

Let's say, for example, we want to program LED number 12 to be lit when the undervoltage function trips. The following procedure should be followed:

- In the "Protection Events Assignation Menu" we assign "Protection Event Number 1" to the undervoltage function trip.
- In the "LEDs Assignation Menu" we assign LED number 12 to "Protection Event Number 1".

5. TECHNICAL CHARACTERISTICS

5.1 MODEL LIST

POSITION	DFF	1	-	0	-	-	C	-	-	0	0	2	A	-	DESCRIPTION
															Comm. Protocols
5			0												P1, P2: Mlink
			2												P1: Mlink ; P2: ModBus RTU
															Inputs/Outputs
7					0										14 inputs / 33 outputs
					1										7 inputs / 25 outputs
					2										7 inputs / 13 outputs
					3										14 inputs / 20 outputs
															Communications
															Point to Point
8						0									RS232
						1									1mm plastic F.O.
						2									62,5/125 glass F.O.
						3									RS-485
															Digital Inputs Power Supply
								0							48 Vdc
10								1							125 Vdc
								2							220 Vdc
															Power Supply
11									G						48/125 Vdc
									H						110/250 Vdc.
15													A		**Revision Level**
															Language
16														-	Spanish
														I	English

5.2 TECHNICAL CHARACTERISTICS

MECHANICAL

- 19 " rack unit 2 units high.
- Protection IP51 (according to IEC 529).
- Local MMI with LCD screen (2 rows of 16 characters each) and 20 button keypad.
- 10 Rear terminal strips of 12 terminal blocks each.
- Dimensions: 437 x 200 x 176 mm.
- Weight: Net 12 kg. Shipping 13 kg
-

FREQUENCY METERING

- Accuracy: ±200 PPM to 20°C
- Repeatability: ±50 PPM
- Temperature error: ±35 PPM from -20°C to +55°C
- Aging: ±5 PPM according to MIL-C3098F
- Hysteresis: 0.04 Hz

(*) When a stable frequency generator is used. For instance the EPOCH20 in 50 or 60 Hz mode.

Frequency is measured at 1 cycle. The relay does not make any average for protection purposes. Therefore, it should be avoided setting the relay at frequencies very close to the rated frequency (i.e. less than 0.05 Hz difference). It should be avoided also utilizing short delays combined with low frequency difference.

ELECTRICAL CHARACTERISTICS

- Frequency: 50 or 60 Hz
- Nominal Voltage: 90 - 220 Vac
- Power Supply: 48/125 Vdc or 100/250 Vdc (depending on model) ± 20%
- Digital Inputs Power Supply: 48, 125,220 Vdc (depending on model)
- Thermal:
  Voltage
  - Continuously: 2 x Un
  - During 1 min: 3.5 x Un
- Temperature:
  - Operation: -20°C to +55°C
  - Storage: -40°C to +70°C
- Humidity: Up to 95% without condensation
- Tripping contacts:
  - Nominal Voltage, maximum operating voltage: 250/440 VAC
  - Continuous current / make and carry. 16/25A
  - Breaking capacity 4000 VA
  - Mechanical life 3 x 10E6 operations
- Burdens:
  - Voltage circuit: 0.2 VA for Un = 90 V
  - DC burden: 12 W
  - Per additional digital input: 8 mA (1 W Vaux = 125 Vdc)

COMMUNICATIONS

- Mode: Half duplex.
- Speed: 1200 to 19200 bauds
- Physical media:

  - RS232 (ports 1,2)
  - Plastic fiber optics (port 2 Optional)
    Connector type : HFBR-4516
    Typical emitted power : -8dBm
    Receiver sensitivity : -39dBm
    Wavelength: 660 nm
  - Glass fiber optics (port 2 Optional)
    Conector type : STA
    Typical emitted power: -17.5 dBm
    Receiver sensitivity: -24.5 dBm
    Wavelength : 820 nm.
  - RS485 (port 2 optional)

STANDARDS

The DFF complies with the IEC relay standards, including also GE dielectric strength test and the European directive of Electromagnetic Compatibility (89/336) for CE marking.

It also fulfills low voltage European directives and standards ANSI C37.90, IEC 255-5, IEC 255-6 e IEC 68.

Test	Standard	Class
• Dielectric Strength (Insulation)	IEC 255-5	600V, 2kV 50/60 Hz 1 minute
• Impulse voltage withstand	IEC 255-5	5 kV, 0.5 J
• 1 Mhz Interference test	IEC 255-22-1	III
• Electrostatic discharge	IEC 255-22-2 EN 61000-4-2	IV 8 kV
• Interference test withstand	IEC 255-22-3	III
• Electromagnetic fields	ENV 50140	10 V/m
• Electromagnetic fields. Common mode.	ENV 50141	10 V/m
• Electromagnetic fields. Frequency modulated.	ENV 50204	10 V/m
• Fast transient	IEC 255-22-4 EN 61000-4-4	IV
• Magnetic fields at industrial frequency	EN 61000-4-8	30 Av/m
• Radio frequency emission	EN 55011	B

6. HARDWARE DESCRIPTION

The DFF incorporates electronic components that might be affected by electrostatic discharge currents flowing through certain component terminals. The main source of electrostatic discharges is human body, specially under low humidity conditions with carpet floors or isolating shoes. If such conditions are present special care should be taken while manipulating DFF´s modules and boards. Operators, before even touching any component, must make sure that their bodies are not charged by either touching a grounded surface or by using an antistatic grounded wrist bracelet.

6.1 MECHANICAL CONSTRUCTION

6.1.1 BOX CONSTRUCTION.

The DFF box is a standard 19" rack four units high, manufactured in stainless steel and painted with grey epoxi resin. It is composed of a backbone structure, that includes the strips where all the modules and boards are connected, plus a rear plate with all the female connectors.

All the boxes have a surge ground connection terminal, essential not only in terms of safety but also on behaviour against electromagnetic interference.

All the modules are of the drawout type, enabling easy maintenance and repair of the equipment.

The DFF also incorporates a plastic antitampering front cover. This cover keeps the relay sealed and provides a high protection against dust and water (IP51 index according IEC 529). The use of a push-button allows access to the main functions without the need of removing the cover.

The front and rear views of the DFF are shown on figures 5 and 6.

6.1.2 ELECTRICAL CONNECTIONS.

All the DFF electrical connections (voltage inputs and digital I/Os) are done through drawout terminal boards of 12 terminal blocks each located at the rear of the device.

Additionally to those terminal blocks, the DFF includes two communication ports. One front DB-9 port for local connection and another located on the rear nameplate, used for remote connection to the PC.

This second port may be used for point-to-point connection with a central computer in the substation by means of a multiplexer.

This second communication port may be, depending on the selected option, a RS232 with a DB-9 connector, a fiber optics (glass or plastic) connector or finally an RS-485.

In the rear plate are also included the terminal blocks for the time synchronization through a demodulated IRIG-B input.

6.1.3 INTERNAL CONSTRUCTION.

The internal architecture of the DFF1000 is composed of the following 4 units high drawout modules:

- 1 Module for the power supply.
- 1 Magnetic module (Analog inputs).
- 1 Module for the protection CPU.
- 1 Module for the communications CPU.
- 2 Modules for the digital Inputs and Outputs.
- 1 Module for extra digital Outputs.

***NOTE**: Models DFF1001 and DFF1002 provide a smaller number of I/O modules.*

Each of these modules has a DIN type front connector for the connection to the internal communication bus. Also, in the case of having connections to the outside (Inputs, Outputs and power supply modules), the male part of the terminal block is incorporated. The female portion of the connector is located in the rear plate of the box.

Besides all these modules there are some other boards mounted in parallel to the front of the box. These boards are:

- Internal bus board.

This is a PCB board that makes the connection between the digital inputs and the power supply through their front DIN connectors.

- Front display board.

This is a PCB that includes the display and the configurable LEDs. Additionally the relay also includes the communication port connector and the two-colour state LED.

The front module is mechanically and solidly connected to the keypad board, the electrical connection is done through a flexible flat cable of 12 pins.

The subgroup formed by these two front boards is connected to the rest of the relay through another flexible flat cable of 40 pins, connected itself to the front of the communications CPU.

- Front keypad board.

It is a printed board which is solidly joined to the front board of the display, as mentioned before, and supports the keypad for the protection operation (20 keys alpha-numeric and functional keypad that acts on the alpha-numeric display) The board also includes a transparent window for the display and for the control board in which the unit identification (model number and serial number) and its more relevant technical characteristics are included.

The group formed by both front boards is mechanically and electrically joined to the box by means of 4 screws placed at upper and lower part of the front. To get the access to the internal electronic modules of the relay the next steps must be followed (once the relay has been disconnected):

1. Remove the plastic cover.
2. Slack the fixed frontal screws till they are untied and only fixed by their fastening sleeve.
3. Let the front part fall softly till the flat cable, that is connected to the communications board, is accessible, and unfasten the extreme connected to this board.
4. Remove the frontal module.
5. Take out the internal bus board which fixes the different modules themselves.

If this process is followed, every relay module can be accessed in order to be taken out, maintained or replaced. In order to assembly the relay again, the procedure is the contrary, that is to say:

1. Make sure that every vertical drawout module has been correctly inserted.
2. Assembly the internal bus board which joins the different modules themselves by pressing from left to right every connector in order to be sure of their right insertion.
3. Connect the flat cable that connects the frontal module with the communications board.
4. Place the frontal module at its position and screw it on the box.
5. Cover again the relay with its protective cover.

6.1.4 IDENTIFICATION.

The identification label of the model is placed at the right of the alpha-numeric keypad. This label includes the model number, serial number and the most important nominal values.

Terminal blocks placed at the rear cover are identified by black colour serigraphy on the cover. Each of the terminals blocks are identified by a letter placed at the upper border of the cover close to the connector. This connector identification is assigned to the different connectors, beginning by A which corresponds to the connector placed on the right extreme (looking at the relay from the back).

In the terminals blocks, each of the 12 terminals of each block is identified from the top to the bottom by a number between 1 and 12 that is serigraphied on the cover close to each connector at the input side of the connection cables. The connector terminals for synchronization are identified by “IRIG-B” serigraphy and the terminals polarity is indicated by “+” and “-”.

For relays with fiber optics communications (plastic or crystal), transmission and reception connectors terminals are identified by TX and RX serigraphy respectively.

6.1.5 MAGNETIC MODULE.

Magnetic module takes voltage signals of the substation conventional transformers, and with these signals performs the following:

- It gives galvanic isolation to external signals by means of relay internal transformers.
- It makes suitable the external signals to the adequate voltage levels for the internal circuitry.

Other elements included in the module are the passive filters. As the magnetic module is an element connected to external equipment signals, it is liable to suffer electromagnetic disturbance. In order to avoid this effect, there are filters in the primary side of the transformer (capacitors connected to the case) and in the secondary side (ferrites), that do not allow the perturbations enter into the relay. This protective elements have a double effect: act like a barrier to the exterior and not allow the disturbance generated inside the relay to go out and affect any other external equipment (emisivity and susceptibility).

The last elements that are included in the magnetic module are the output signals transformers adapters, that consist of resistive attenuates.

6.1.6 PROTECTION CPU MODULE

This module is the main part of the equipment with reference to protection functions. The main functions are:

- Analog signals coming from magnetic module sampling.
- Protection algorithm evaluation.
- Protection logic and auxiliary functions.
- Monitoring functions, events register, oscillography register, etc.
- Equipment auto-checking.
- Protection data communication to the communications CPU.

CPU module nucleus is a 16 bits microprocessor together with its auxiliary associated electronic.

6.1.7 COMMUNICATIONS CPU MODULE.

Communications CPU module nucleus is very similar to the protection CPU module, and it also consists of a 16 bits microprocessor together with the auxiliary electronic.

The main function of the communications CPU module is to maintain and control the communications in the following channels:

- Internal communication with the protection and control CPU modules.
- Local mode communication with a PC by the front communications port.
- Remote mode communication by rear communication port.
- Man-machine interface by means of keypads and displays.

6.1.8 INPUTS MODULE.

The design of the DFF has been done taking the maximum care in assuring reliability against electromagnetic disturbance.

Each of the board inputs has a resistive attenuate which adequates the external voltage battery levels (48 V, 125 V, ...) to the needs of the optocoupler that gives galvanic isolation to each input. As the majority of these inputs come from elements that are connected to the substation equipment, together with the resistive attenuate one passive filter is provided in order to get better behaviour against electromagnetic perturbations.

Inputs modules (as well as the output ones) provide one selectable 4 bits address which allows to include several modules in the same equipment.

6.1.9 OUTPUTS MODULE.

Each of the DFF output boards contents 12 heavy duty relays, 16 Amperes nominal continuous capacity and 4000 VA breaking capacity. Each of these relays has one contact (NC + NO). The contact of each relay can be set separately as normally close or normally open by jumpers (fixed by welding) placed in the board.

In every configuration the contacts are non potential contacts, without common elements and all of them have varistors between their terminals in order to protect them against overvoltages generated by the coils they are connected to. This provides a high immunity against electrical interferences.

6.1.10 POWER SUPPLY.

Power supply module includes the following functions:

- Generation, from the external battery power supply, of the necessary voltages for electronic circuitry. In this case: 8V (later they are regulated to 5V) for logic, and 24V for the trips.
- Four tripping relays, with the same characteristics that the ones included in the outputs board, and assigned to trip functions in the DFF equipment.
- One equipment alarm auxiliary relay.

With reference to the power supply module it is important to point out:

- One passive filter is included in the power supply input in order to avoid any possible electromagnetic disturbances. A current limiter is also included in order to protect the power supply against unintentional groundings.
- The tripping relays are stronger (in capacity and in control operations life) than the normal ones used for similar protection equipment. Besides this, as the output contacts type can be configured, a high versatility is provided.

6.2 RECEPTION, OPERATION AND STORAGE.

DFF relays are supplied to the customer in a special package, which adequately protects it during transportation, as long as this is performed in normal conditions. Immediately after receiving the relay, the customer should check whether it shows any signs of transportation damage. If it is apparent that the relay has been damaged by inappropriate handling,. it must be immediately advised in writing to the carrier, and the damage must be reported to the manufacturer

For unpacking the relay, normal care should be taken in order not to lose the screws, documents and other auxiliary elements also supplied in the box.

If it is not intended to install the relay immediately, it is recommended to store it in its original package, and keep it in a dry, dust free and metal particles free place.

6.3 INSTALLATION

DFF relays must be mounted on a vertical surface which allows the access to the front and rear relay plates. It is not necessary to be able to access to the side surfaces of the relay. Dimensions and panel drilling schemes are shown in Figures 2 and 4.

7. ACCEPTANCE TESTS

In this section the necessary tests to check the proper operation of the relay are described.

7.1 CONNECTION AND NECESSARY EQUIPMENT

Equipment needed:

- 3 power supplies
- 1 voltage source
- 1 multimeter

Connect the relay as shown in the external connection diagram (figure 1).

Power supply must be connected to D11 (Positive) and C11 (Negative) terminals.

Due to safety reasons, the ground terminal must be connected.

7.2 VISUAL CHECK

Unpack the relay and make sure that there are no broken parts and that there are no signs that the relay has been damaged during transportation

Make sure that all the screws are well tightened and the terminal blocks are not damaged.

Make sure that the device type indicated on the front plate matches with the order data.

7.3 INSULATION TESTS.

Apply gradually 2000 Volts between all the terminals of one group (short-circuited themselves) and ground (or the chassis), during one second.

Apply gradually 2000 Volts between groups, during one second.

Insulation groups are the following:

MODEL DFF1000

GROUP	RELAY TERMINALS	TYPE
G1	A7..10, B7..10	Voltage
G2	C5..9, D5..9	Trips
G3	C11, D11	Power Supply
G4	E1.. E4, F1..F4	Inputs
G5	E5..12, F5..12	Outputs
G6	J1..12, K1..12	Outputs
G7	R1..4, I1..4	Inputs
G8	R5..12, I5..12	Outputs

MODEL DFF1001

GROUP	RELAY TERMINALS	TYPE
G1	A7..10, B7..10	Voltage
G2	C5..9, D5..9	Trips
G3	C11, D11	Power Supply
G4	E1.. E4, F1..F4	Inputs
G5	E5..12, F5..12	Outputs
G6	J1..12, K1..12	Outputs

MODEL DFF1002

GROUP	RELAY TERMINALS	TYPE
G1	A7..10, B7..10	Voltage
G2	C5..9, D5..9	Trips
G3	C11, D11	Power Supply
G4	J1.. K1, K1..K4	Inputs
G5	J5..K5, J12..K12	Outputs

7.4 POWER SUPPLY

For safety reasons, A12 terminal must be grounded during functional tests.

Apply nominal voltage (maximum and minimum) to the relay. For each of this voltages, check that the ALARM relay is open when it is powered and close when it is not powered.

Configure as trips all the configurable contacts and produce an underfrequency trip.

When the relay is tripped, measure its DC power consumption and check that it communicates correctly..

Test voltages and average burden are the following ones:

G Model		H Model	
DC Voltage	Consumption (mA)	DC Voltage	Consumption (mA)
39	550	80	550
125	227	250	227
150	205	300	205

7.5 VOLTAGE MEASUREMENT

Set the PT ratios to the following values (Settings relevant to the group of “GENERAL SETTINGS”) :

- PT PHASE RATIO : 1000
- PT GROUND RATIO : 1000
- FREQUENCY : 50 Hz

Apply the following voltages:

Value	1	2	3	4	5	6
Va (V)	5	10	50	100	150	200
Vb (V)	5	10	50	100	150	200
Vc (V)	5	10	50	100	150	200
Vn (V)	5	10	50	100	150	200

Make sure that the equipment measures with a better accuracy than 5 %.

Modify the nominal frequency setting and repeat the test with 60 Hz.

7.6 FREQUENCY MEASUREMENT.

***Note**: Frequency measurements will be done by applying voltage to phase B Inputs.*

Check that the frequency measurement error is not higher than 0.01 Hz for the following frequency and voltage values:

- Voltages: 50,150 and 250 Vac
- Frequencies: 40, 50, 55, 60 and 70 Hz

Make also sure that when a fixed frequency is applied, the frequency variations is not higher than 0.01 Hz when voltage is modified between the above mentioned values.

7.7 DIGITAL INPUTS CHECKING.

For this test, the minimum and maximum admissible voltages will be applied to the inputs with a 20% nominal voltage tolerance.

Apply voltage to an input and check that the equipment detects its activation.

(This can be done by associating one output relay with one input. Each time an input is activated the output relay will be operated too. Other way would be to associate one front LED to the activation of an input. This configuration can be done by means of GE_INTRO software).

Repeat the test with the rest of the Inputs.

7.8 OUTPUTS CHECKING.

1. Trips Outputs checking.

- Enable all the protection functions.
- Enable the trips.
- Make operate one of the underfrequency functions.
- Make sure that trip contacts (TRIP1, TRIP2, TRIP3, TRIP4) are closed while the trip condition exits, and opened when this condition disappears.

2. Alarm Output checking.

- Without applying auxiliary power supply, make sure that the alarm output contact is closed.
- Apply the auxiliary power supply voltage and make sure that there are no alarm conditions, for instance: protection out of service or all protection functions disabled. In such a case, make sure that alarm contact is open.

3. Configurable Outputs checking.

Make one of the configurable contacts close in one of the following ways:

- Configuring the outputs as frequency pickups or trips and producing one underfrequency condition.
- Conditioning the output actuation to an input activation.

Make sure that all the configurable relays close when the closing condition happens and open when this conditions disappears.

7.9 COMMUNICATIONS PORTS CHECKING.

The communication between the two ports and the relay must be checked. The purpose of this acceptance test is to check that the two communications ports of the relay can operate properly.

Connect the relay to the PC by means of the cables of figure 3.

Set in DFF relay and in the PC the following communication parameters:

Number of relay = 1

Rear port baud rate = 9600

Front port baud rate = 9600

Rear port stop bits = 1

Local port stop bits = 1

By using GE_LOCAL communications software establish the connection and check the relay communicates through both communications ports. Repeat this test with different baud rates.

7.10 KEYPAD, DISPLAY AND LEDS CHECKING.

Press Target Reset button and verify that all the leds are lit.

Press the appropriate keys and verify that the following messages are displayed:

KEYS	**MESSAGES**
< SET >	VIEW PROTECTION SETTINGS
< CLR >	DFF GENERAL ELECTRIC
< INF >	STATUS
< ENT >	MODEL
< ↑ >	DATA BASE
< >	MODEL
< CLR >	STATUS
< CLR >	DFF GENERAL ELECTRIC
< ACT >	SET DATE/TIME
< CLR >	DFF GENERAL ELECTRIC
<7169>	REAR PORT BAUD RATE
< ↑ >	REAR PORT STOP BITS

Now clear the display by pressing the **CLR** key. Verify the proper operation of the number keys by pressing one by one and checking that the pressed keys are displayed.

7.11 CONTROL OPERATIONS.

1. Time setting.

Set date and time of the relay and verify the proper operation.

2. Communications Trigger.

Apply to any phase a voltage signal, operate the communication trigger of the oscillography waveform capture function. Retrieve the oscillography register through GE_LOCAL software and display the record using GE_OSC software package. Verify that the captured waveform fits with the applied voltage signal.

7.12 INHIBITION VOLTAGE CHECKING.

***NOTE**: Tests must be done with phase B and 50 Hz frequency .*

- Set the relay to 50 Hz.
- Set one frequency unit as absolute threshold and set the operating value to 60 Hz.
- Set nominal voltage to 90 Vac.
- Set inhibition voltage to 40 %.
- Check that the unit trips with 22.5 Vac and does not trip with 20 Vac
- Set inhibition voltage to 110 %.
- Check that the unit trips with 61.75 Vac and does not trip with 55 Vac.
- Set nominal voltage to 220 Vac.
- Set inhibition voltage to 40 %.
- Check that the unit trips with 54.9 Vac and does not trip with 49 Vac.
- Set inhibition voltage to 110 %.
- Check that the unit trips with 150.9 Vac and does not trip with 135.5 Vac

7.13 VOLTAGE FUNCTIONS CHECKING.

***NOTES**: Voltage functions are only done in phase B. In undervoltage tests, initial voltage must be 10% higher than trip voltage, and in overvoltage ones 10% lower.*

1. 27P FUNCTION CHECKING

Set 27 function as follows:

27P PICKUP : 20 Vac

27P OPERATION t : 0 s.

27P RESET t : 0 s.

Decrease the voltage and check that the relay trips with 19.6 Vac and drops out with 21.6 Vac

Modify the 27P PICKUP to 65 Vac

Decrease the voltage and check that the relay trips with 63.05 Vac and drops out with 70.2 Vac

Modify the 27P PICKUP to 110 Vac

Decrease the voltage and check that the relay trips with 106.7 Vac and drops out with 118.8 Vac

2. 59P FUNCTION CHECKING

Set 59P function as follows:

59P PICKUP: 50 Vac

59P OPERATION t : 0 s.

59P RESET t : 0 s.

Increase the voltage and check that the relay trips with 51.5 Vac and drops out with 46 Vac

Modify the 59P PICKUP to 135 Vac

Increase the voltage and check that the relay trips with 139.05 Vac and drops out with 124.2 Vac

Modify the 59P PICKUP to 220 Vac

Increase the voltage and check that the relay trips with 226.6 Vac and drops out with 202.4 Vac.

7.14 FREQUENCY UNITS CHECKING.

1. Absolute threshold checking

Configure the frequency units as "FREC" and with the following actuation values.

Unit 1 : 49 Hz
Unit 2 : 48 Hz
Unit 3 : 47 Hz
Unit 4 : 46 Hz
Unit 5 : 45 Hz
Unit 6 : 44 Hz
Unit 7 : 43 Hz
Unit 8 : 42 Hz

Decrease gradually the frequency and check that each unit has an error margin not higher than 0.01 Hz.

2. Frequency derivative checking.

Configure the frequency units as "df / dt" and with the following operating values:

Unit 1 : - 0.1 Hz/s

Unit 2 : - 0.2 Hz/s

Unit 3 : - 0.5 Hz/s

Unit 4 : - 1 Hz/s

Unit 5 : - 1.5 Hz/s

Unit 6 : - 2 Hz/s

Unit 7 : - 5 Hz/s

Unit 8 : - 10 Hz/s

Set all units to the same frequency level

Set all the frequency ramps below the adjusted frequency level and check that each ramp has an error margin not higher than 0.05 Hz/s.

8. INSTALLATION AND MAINTENANCE

8.1 INSTALLATION

The place where the relay is to be installed must be clean, dry, free of dust and vibrations, and well illuminated to facilitate inspection and tests.

The relay must be mounted on a vertical surface. Figure 2 represents the drilling diagram in order to do the panel cut out

As DFF design is based on state-of-the-art digital technology and the manufacturing is done under severe control conditions with sophisticated high accuracy equipment, it is completely unnecessary to recalibrate the relay.

8.2 GROUND CONNECTION FOR SAFETY AND PERTURBATION REMOVAL.

A12 ground terminal (see figure 6) must be connected to ground in order to get a right operation of the perturbation removal filters included in the system. For securing the maximum protection, this connection must be as short as possible (preferably 25 cm or less). In this way, the capacitors internally connected between outputs and ground deflect the high frequency perturbations directly to ground without crossing the electronic circuits, so that these circuits are perfectly protected.

Besides, physical safety of the staff who handle the relay is guaranteed by means of this connection, as the whole chassis is grounded.

8.3 MAINTENANCE

Due to the primary role that protection relays have in any installation, it is recommended that a periodic test program is followed. As the intervals between these tests vary for different types of relays and installations, as well as for the experience of the user performing the tests, and given that this equipment provides self-diagnosis functions that allow to detect immediately failures of the circuitry with the only help of the keyboard and the display, it is recommended to test the relay at intervals of 2 years or more. Although this self-diagnosis capability does not reduce the average time between failures, it increases the availability of the protection thanks to the possibility of drastic reduction of the average repairing time which involves the failure detection and the repairing too.

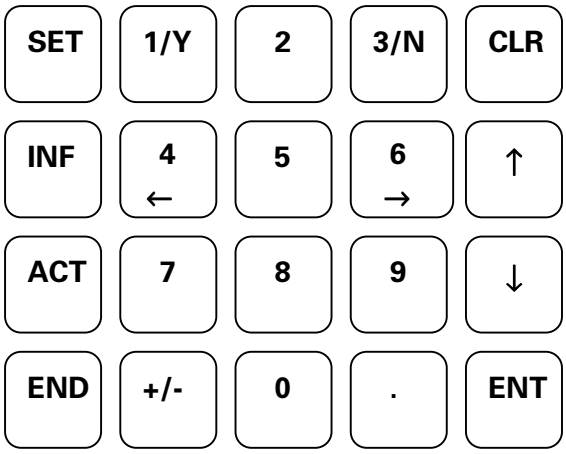
The group of tests that can be done to verify the whole operativity of DFF equipment is deeply described in EVALUATION TESTS chapter

The majority of the protection and communication functions are integrated in two different EPROM based programs, because of this the rate of failures is significantly lower to the ones of previous designs (electromechanical or static analog relays). Besides this there is no need of relay recalibration after a few years of use.

Possible failures of the communication microprocessor do not affect to the protection functions, which are implemented by means of a dedicated microprocessor.

9. KEYPAD AND DISPLAY

DFF relay has a 20 key keypad and a 32 character liquid crystal display, which are distributed in two rows of 16 characters each. The layout of the keypad is displayed in the following figure:



The keypad program uses menus to provide access to the different functions of the relay. These are divided into five big groups, each of them is accessed by means of a different key. These groups are the following:

Information: It gives data about the relay status. To access this menu press the **INF** key.

Control Operations: It allows to synchronize the date and time of the relay and to do communications trigger. To access this menu press the **ACT** key.

Settings: It allows to view and modify all the settings of the relay. To access this menu press the **SET** key.

Configuration Menu: It allows to access to the configuration of the relay, allowing the modification of communication baud rates, passwords, etc. To access this menu press **"7169"** (GE in ASCII code). In order to be able to access this menu, the relay must be in the main screen.

Single Key Menu**:** The DFF relay allows a simplified operating mode by pressing the **ENT** key. It is not necessary to remove the front cover to access to this mode.

In the standby mode, the following message is displayed:

DFF
GENERAL ELECTRIC

Here one of the last five groups must be selected. In order to select other group, you must return to this screen and press the corresponding key.

Once you are in a group, another one can not be selected without leaving first and going back to the standby screen. You can move inside a group by pressing **ENT, CLR**, ↑, ↓, ← and → keys. Their meanings are as follows:

ENT : To accept the option that appears on the screen at that moment. It is equivalent to go down one level in the tree menu.

CLR : To leave the option that appears on the screen at that moment. It is equivalent to go up one level in the tree menu.

↑/↓: Change the option. It is equivalent to a horizontal movement inside a menu. When the desired option appears on the screen, select it by pressing the **ENT** key.

←/→: Show the different possibilities of a particular setting. When the desired option appears on the screen, select it by pressing the **ENT** key.

9.1 TREE MENUS.

The DFF relay has different menus organized in levels. Level 0 is the standby screen. To access to level 1, a group key must be pressed (SET, INF, etc.). To move along a level ↑/↓ keys must be pressed. To go down to levels 2 and 3 **ENT** key must be pressed. To go up along the menu tree, **CLR** key must be pressed.

Level 1, depending on the selected group, provides the following information:

Group	Level 1	Description
SET	• VIEW PROTECTION SETTINGS • MODIFY PROTECTION SETTINGS	• View the settings • Modify the settings
INF	• STATUS	• View the equipment status
ACT	• SET DATE/TIME • COMMUNICATIONS TRIGGER	• Set date and time • Oscillography trigger
ENT	• Va • Vb • Vc • Vn • Frequency • dF/dT • PROTECTION STATUS • ACTIVE TABLE • DATE/TIME	• Primary side phase A voltage value (kV) • Primary side phase B voltage value (kV) • Primary side phase C voltage value (kV) • Primary side ground voltage value (kV) • Frequency value • Frequency derivative value • Protection in or out of service • Active settings table • Date and time
7169	• REAR P BAUD RATE • REAR P STOP BITS • FRONT P BAUD RATE • FRONT P STOP BITS • LOCAL SETT • REMOTE SETT • LOCAL CONTROL • REMOTE CONTROL • UNIT NUMBER • PASSWORD • TIMEOUT t	• Rear port communications baud rate • Rear port stop bits • Front port communications baud rate • Front port stop bits • Local settings change enabled • Remote settings change enabled • Local control operations enabled • Remote control operations enabled • Relay unit number • Relay password • Maximum synchronization time in order not to produce “clock not set” alarm event

9.2 SETTINGS GROUP.

This group allows viewing and modifying the DFF’s settings. To access this group, the **SET** key must be pressed when the DFF is in the standby mode. The following message will be displayed:

VIEW PROTECTION SETTINGS

Pressing the ↑/↓ keys, the following message will be displayed:

CHANGE PROTECT SETTINGS

DFF settings menu tree is represented in the following table. It is important to remember that in order to go down along the tree **ENT** key must be pressed, and that to go up the tree the **CLR** key should be pressed instead.

Level 1	Level 2	Level 3	Description	Valid range
VIEW PROTECTION SETTINGS CHANGE PROTECT SETTINGS	**GENERAL SETTINGS**	**RELAY STATUS**	It takes the relay out of service	In service / Out of service
		FREQUENCY	Nominal frequency	50/60 Hz
		NAME	Alphanumeric string of 20 characters	
		NOMINAL VOLTAGE	Nominal voltage	90 - 220 Vac in 1 Vac steps
		INHIBITION VOLTAGE	Frequency functions voltage inhibition value	40- 110 % of nominal voltage in steps of 1%
		NUMBER OF SEMI-CYCLES	Number of semi-cycles for the frequency units' operation	3-20 in steps of 1
		NUMBER OF RESET CYCLES	Number of reset cycles for the frequency units measure	0-4 in steps of 1
		PHASE PT RATIO	PT phase ratio	1 - 4000 in steps of 1
		GROUND PT RATIO	PT ground ratio	1 - 4000 en Steps de 1
	ACTIVE TABLE SETTINGS	**ACTIVE TABLE**	Allows active table change	1-3
	OSCILLOGRAPHY MASK	**TYPE OF OSCILLO**	Allows to change the type of oscillo	NORMAL / FREC
		PREFAULT CYCLES	Programmable number of prefault cycles	2 - 10
		81 U1 PICKUP	Allows oscillography trigger	YES/NO
		81 U2 PICKUP	Allows oscillography trigger	YES/NO
		81 U3 PICKUP	Allows oscillography trigger	YES/NO
VIEW PROTECTION SETTINGS CHANGE PROTECT SETTINGS	**OSCILLOGRAPHY MASK**	**81 U4 PICKUP**	Allows oscillography trigger	YES/NO
		81 U5 PICKUP	Allows oscillography trigger	YES/NO
		81 U6 PICKUP	Allows oscillography trigger	YES/NO
		81 U7 PICKUP	Allows oscillography trigger	YES/NO
		81 U8 PICKUP	Allows oscillography trigger	YES/NO
		81 U1 TRIP	Allows oscillography trigger	YES/NO
		81 U2 TRIP	Allows oscillography trigger	YES/NO
		81 U3 TRIP	Allows oscillography trigger	YES/NO
		81 U4 TRIP	Allows oscillography trigger	YES/NO
		81 U5 TRIP	Allows oscillography trigger	YES/NO
		81 U6 TRIP	Allows oscillography trigger	YES/NO
		81 U7 TRIP	Allows oscillography trigger	YES/NO
		81 U8 TRIP	Allows oscillography trigger	YES/NO
		27P PICKUP	Allows oscillography trigger	YES/NO
		59P PICKUP	Allows oscillography trigger	YES/NO
		INPUT TRIGGER	Allows oscillography trigger	YES/NO
		COMMUNICATION TRIGGER	Allows oscillography trigger	YES/NO
		27P TRIP	Allows oscillography trigger	YES/NO
		59P TRIP	Allows oscillography trigger	YES/NO
	FUNCTION	**27P FUNCTION**	Allows to enable or to disable the function	Enabled /Disabled

Level 1	Level 2	Level 3	Description	Valid range
	ENABLING			
		59P FUNCTION	Allows to enable or to disable the function	Enabled /Disabled
		81 U1 FUNCTION	Allows to enable or to disable the function	Enabled /Disabled
		81 U2 FUNCTION	Allows to enable or to disable the function	Enabled /Disabled
		81 U3 FUNCTION	Allows to enable or to disable the function	Enabled /Disabled
VIEW PROTECTION SETTINGS CHANGE PROTECT SETTINGS	**FUNCTION ENABLING**	**81 U4 FUNCTION**	Allows to enable or to disable the function	Enabled /Disabled
		81 U5 FUNCTION	Allows to enable or to disable the function	Enabled /Disabled
		81 U6 FUNCTION	Allows to enable or to disable the function	Enabled /Disabled
		81 U7 FUNCTION	Allows to enable or to disable the function	Enabled /Disabled
		81 U8 FUNCTION	Allows to enable or to disable the function	Enabled /Disabled
		27P TRIP	Allows to enable or to disable the function	Enabled /Disabled
		59P TRIP	Allows to enable or to disable the function	Enabled /Disabled
		81 U1 TRIP	Allows to enable or to disable the function	Enabled /Disabled
		81 U2 TRIP	Allows to enable or to disable the function	Enabled /Disabled
		81 U3 TRIP	Allows to enable or to disable the function	Enabled /Disabled
		81 U4 TRIP	Allows to enable or to disable the function	Enabled /Disabled
		81 U5 TRIP	Allows to enable or to disable the function	Enabled /Disabled
		81 U6 TRIP	Allows to enable or to disable the function	Enabled /Disabled
		81 U7 TRIP	Allows to enable or to disable the function	Enabled /Disabled
		81 U8 TRIP	Allows to enable or to disable the function	Enabled /Disabled
	T1, T2, T3 27P PICKUP	**27P PICKUP**	Undervoltage function pickup	20 to 110 Vac in steps of 0.01V
		27P OPERATION t	Undervoltage function time delay	0 to 30 s in steps of 0.01s
		27P RESET t	Undervoltage function reset time	0 a 1200 s in steps of 1s
VIEW PROTECTION SETTINGS CHANGE PROTECT SETTINGS	**T1, T2, T3 59P PICKUP**	**59P PICKUP**	Overvoltage function pickup value	50 to 220 Vac in steps of 0.01V
		59P OPERATION t	Overvoltage function time delay	0 to 30 s in steps of 0.01s
		59P RESET t	Overvoltage function output contacts reset time	0 to 30 s in steps of 1s
	T1, T2, T3 81 U1 PICKUP	**FUNCTION TYPE**	Setting for operation as absolute threshold or as frequency derivative change rate	FREC / dF/dT
	(Same for the rest of	**81 PICKUP**	Underfrequency pickup	40 to 70 Hz in steps of 0.01

Level 1	Level 2	Level 3	Description	Valid range
	units)			Hz
		TIME DELAY	Time delay for operation	0 to 60 s in steps of 0.01s
		dF/dT	Slope setting	0.1 to 10 Hz/s in steps of 0.01 Hz
		RESET TIME	Output contacts reset time	0 to 600s in steps of 0.01s

The DFF relay has some settings groups common to all tables but other groups are particular for each settings table.

The common settings are the following ones:

- General settings
- Active table settings
- Oscillography mask
- Function enabling.

The rest of the setting groups are independent for each of the setting tables.

In order to modify a setting, the following steps must be followed:

1. Press the **SET** key.
2. Select MODIFY PROTECTION SETTINGS option.
3. Select the desired setting in the menu.
4. Press the value to be modified (or select the desired one in the available settings list with $\leftarrow$ $\rightarrow$).
5. Press the **ENT** key. If any other setting is to be modified, inside the same group, third and fifth steps must be repeated.
6. Press **END** key.

The relay will ask for confirmation of the change and the following message will be displayed:

CONFIRM?
(Y/N)

7. To confirm the change, press **1/Y** key . (Otherwise press **3/N** key).
8. Now the following message will be displayed:

SETTINGS CHANGE
EXECUTED

9. Press the **CLR** key repeatedly in order to return to the standby mode.

If during the settings modification any range limit is exceeded, the relay will not accept the change and the following message will be displayed:

SETTING OUT
OF RANGE

Some settings do not require to enter a value through the keypad. They are just a selection of an option among several possibilities. In that case, the different options can be displayed by using ←/→ keys.

9.3 INFORMATION GROUP.

This group provides information related to the DFF internal states. To access this option, press the **INF** key and the following message will be displayed:

STATUS

By pressing the **ENT** key we enter in the status menu. With the é and ê keys we access to the following states:

State	Description
MODEL	Model type
PROT VERSION	Protection program version
COM VERSION	Communications program version
Va	Phase A voltage
Vb	Phase B voltage
Vc	Phase C voltage
Vn	Ground voltage
FREQUENCY	Frequency
dF/dT	Frequency derivative
F1 PICKUP	Underfrequency unit 1 pickup
F2 PICKUP	Underfrequency unit 2 pickup
F3 PICKUP	Underfrequency unit 3 pickup
F4 PICKUP	Underfrequency unit 4 pickup
F5 PICKUP	Underfrequency unit 5 pickup
F6 PICKUP	Underfrequency unit 6 pickup
F7 PICKUP	Underfrequency unit 7 pickup
F8 PICKUP	Underfrequency unit 8 pickup
27 PICKUP	Undervoltage unit pickup
59 PICKUP	Overvoltage unit pickup
PROTECTION STATUS	Protection in service/out of service
ACTIVE TABLE	Active table number (1-3)
LOCAL CONN	Local or remote connection
DATE/TIME (CORRECT)	Date and time correctly (or incorrectly) synchronized
COMM E2PROM (CORRECT)	Error (or absence of error) in communications e2prom
COMM SETT (USER)	Communications settings (Default or User)
PROTEC LINK.	Protection and communication link
DATE&TIME	Date and time

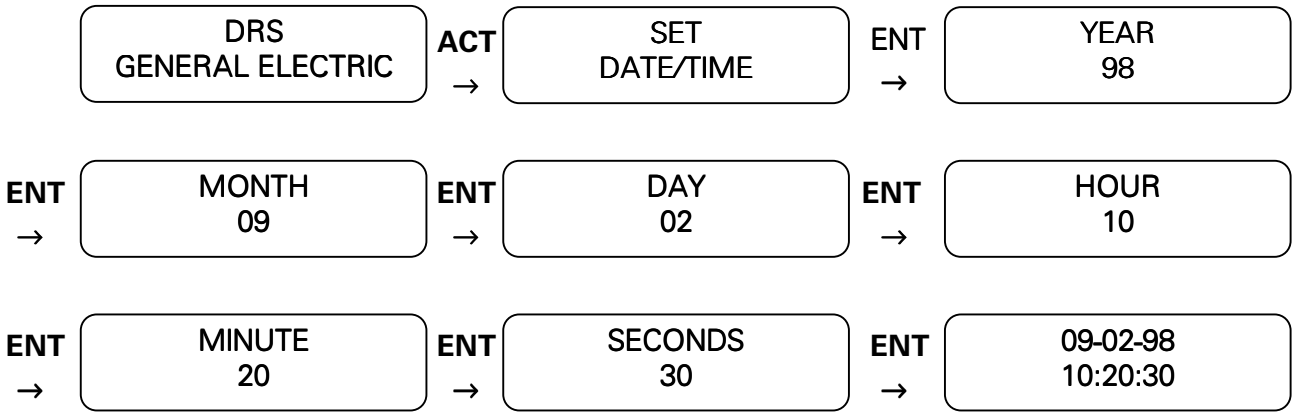
9.4 CONTROL OPERATIONS GROUP.

This group allows setting the date and the time of the relay as well as producing an oscillography trigger.

To access to control operations group, the **ACT** key must be pressed (from the standby screen). These are the available control operations:

- Set date and time.
- Communications trigger.

To change date and time, the following steps must be followed:



***NOTE** : For modifying the numeric default value that is displayed, press **CLR** key in order to clear the actual value.*

The execution of the OSCILLOGRAPHY TRIGGER order causes the start of the oscillography register. With the communication software package GE_LOCAL the last four oscillography records can be downloaded and stored in a Comtrade ASCII format file. To display these oscillography records GE_OSC software may be used.

9.5 SINGLE KEY OPERATIONS.

The DFF relay allows a simplified operation mode through the use of the **ENT** key. This mode allows access to diverse relay information without the necessity to remove the transparent plastic cover. The operation mode consist of pressing consecutively the **ENT** key. To access this mode the relay must be in standby. The available information in this operation mode is shown in the following table in the same order that it is displayed.

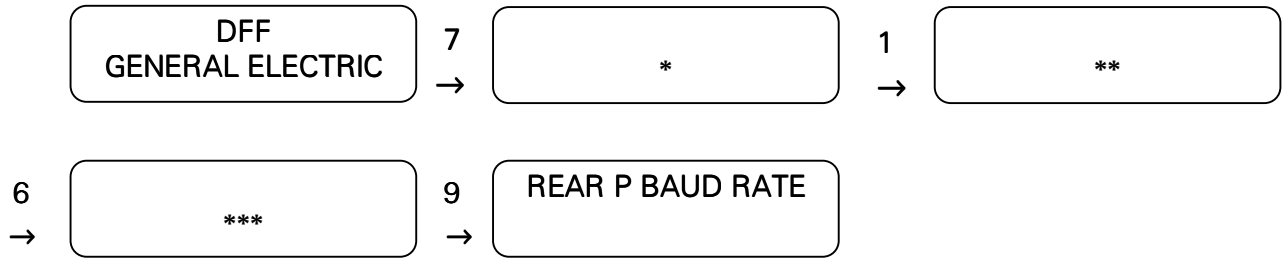
MAGNITUDES	**DESCRIPTION**
Va	Shows phase A primary voltage value (kV)
Vb	Shows phase B primary voltage value (kV)
Vc	Shows phase C primary voltage value (kV)
Vn	Shows ground primary voltage value (kV)
Frequency	Shows frequency value
dF/dT	Shows frequency derivative value
PROTECTION STATUS	Shows whether the protection is in or out of service
ACTIVE TABLE	Shows active table
DATE/TIME	Shows date and time

9.6 CONFIGURATION UNIT.

The DFF relay includes a configuration unit that can be accessed exclusively through the keypad. It is used to select how the DFF will interact with the external environment.

The configuration unit is entered from the standby screen by entering a four digit numerical code. If the code is correct you will enter into the configuration unit, if not the relay will return to the standby screen.

The code is common to all DFF relays. It is not meant to be a password, but a simple measure of security to avoid accidental manipulation of the configuration. The code is **7169,** which was selected because it is the corresponding ASCII code for the initials GE. This is the way to access the configuration unit from the standby screen:



The value and meaning of the settings are as follows: (It is important to mention that to move in this group, ↑/↓ keys must be pressed).

- ***REAR PORT BAUD RATE***: It is the baud rate that DFF relay uses to communicate with the remote end. The possible values for setting are between 300 and 19,200 baud.
- ***REAR PORT STOP BITS***: They are the number of bits added to each byte transmitted across the serial line. It is treated as a logical binary setting with the logical keys **1/Y** for 1, and **3/N** for 2.
- ***FRONT PORT BAUD RATE****:* It is the baud rate that DFF relay uses to communicate with the local end. The possible values for setting are between 1,200 and 19,200 baud.
- ***FRONT PORT STOP BITS***: They are the number of bits added to each byte transmitted across the serial line. It is treated as a logical binary setting with the logical keys **1/Y** for 1, and **3/N** for 3.
- ***LOCAL SETTINGS***: Setting which enables/disables the settings change via local communication.
- ***REMOTE SETTINGS***: Setting which enables/disables the settings change via remote communication.
- ***LOCAL CONTROL***: Setting which enables/disables local mode control operations.
- ***REMOTE CONTROL***: Setting which enables/disables remote control operations.
- ***UNIT NUMBER***: Each DFF is identified by a unit number which serves to identify the messages directed to it when there are several devices connected to the same communication network. This number may be between 1 and 255, both included.
- ***PASSWORD***: The relay provides a password in order to prevent unauthorized personnel from communicating remotely with the relay through the use of GE_LOCAL communications software (which allows settings modifications or control operations). The password may only be viewed through the relay display and it consists of a number between 0 and 99999. The introduced password through GE_LOCAL must be identical to the relay password in order to permit the connection with it.
- ***TIMEOUT t*****:** Maximum synchronization time in order not to produce “clock not set” alarm event

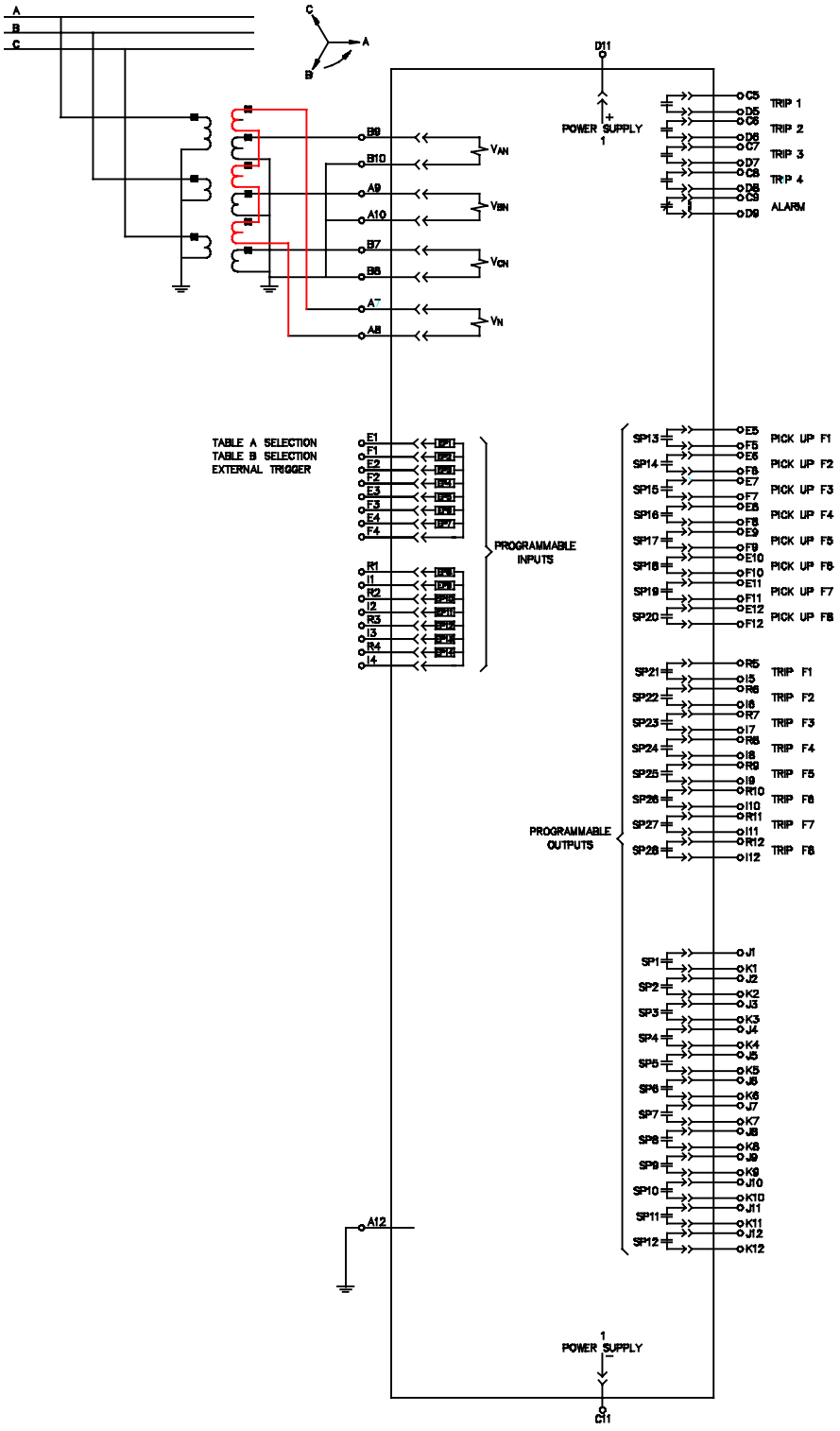


Figure 1: *External Connections for DFF1000 model*

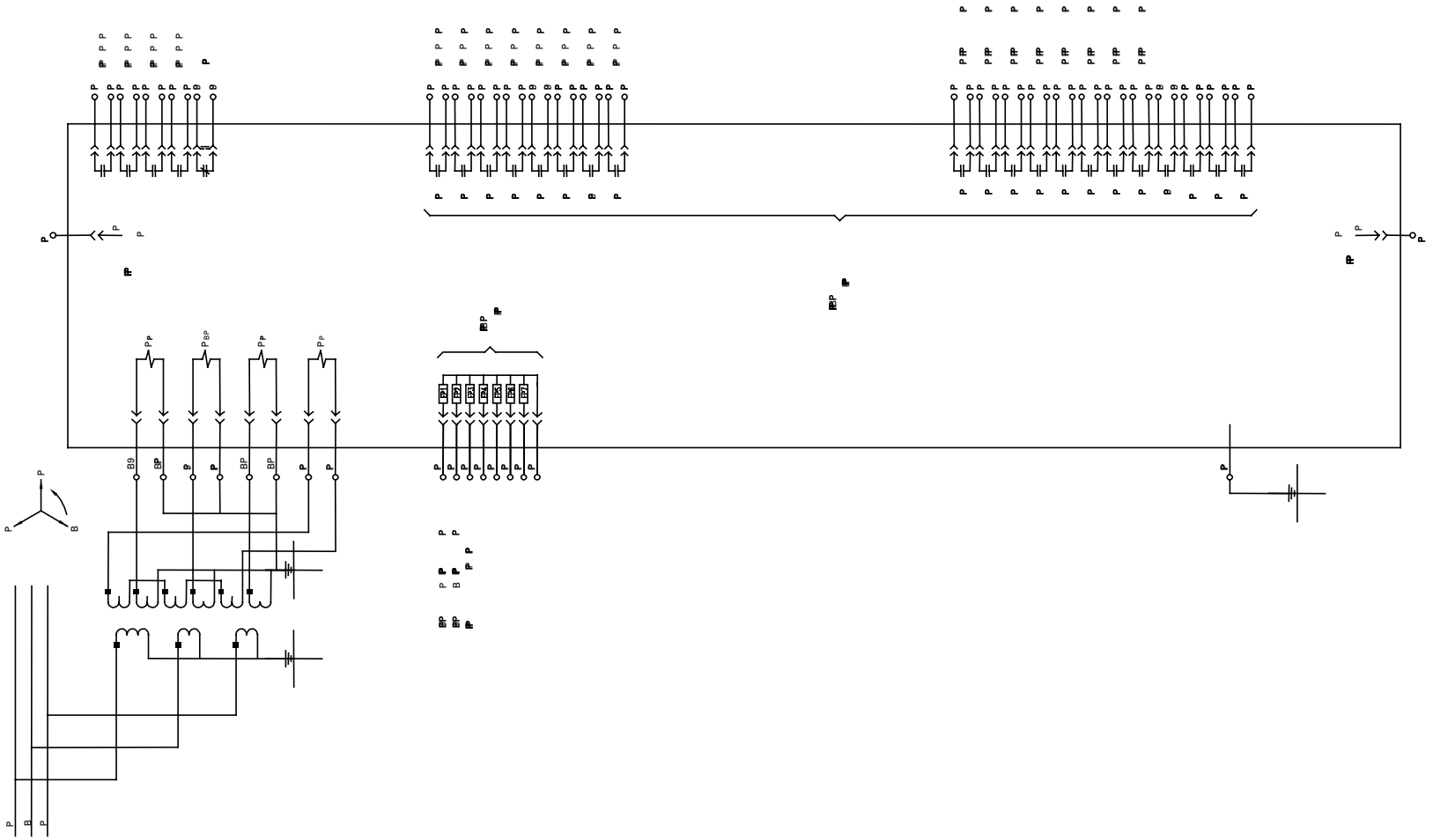


Figure 2: *External Connections for DFF1001 model*

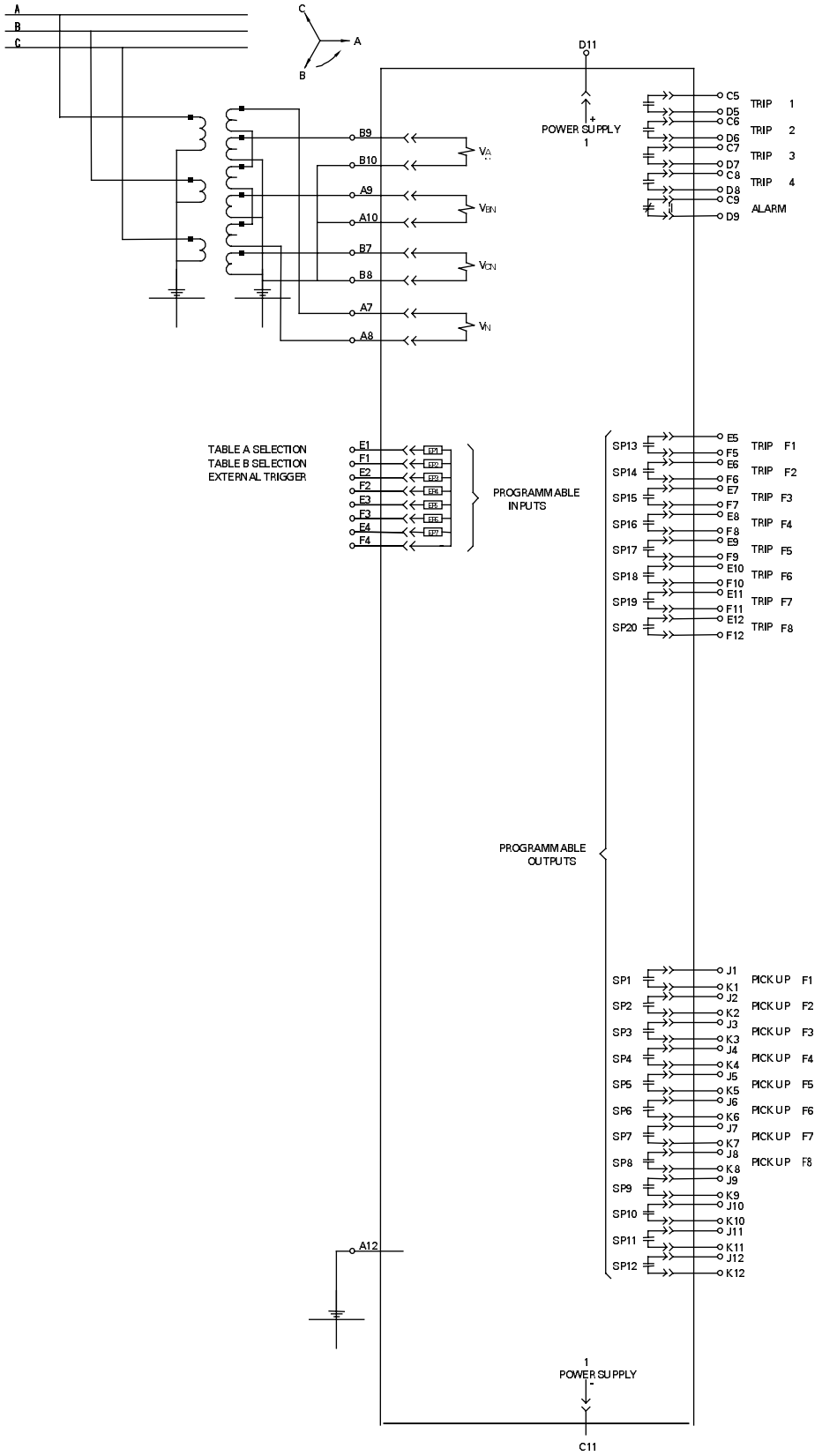


Figure 2: *External Connections for DFF1002 model*

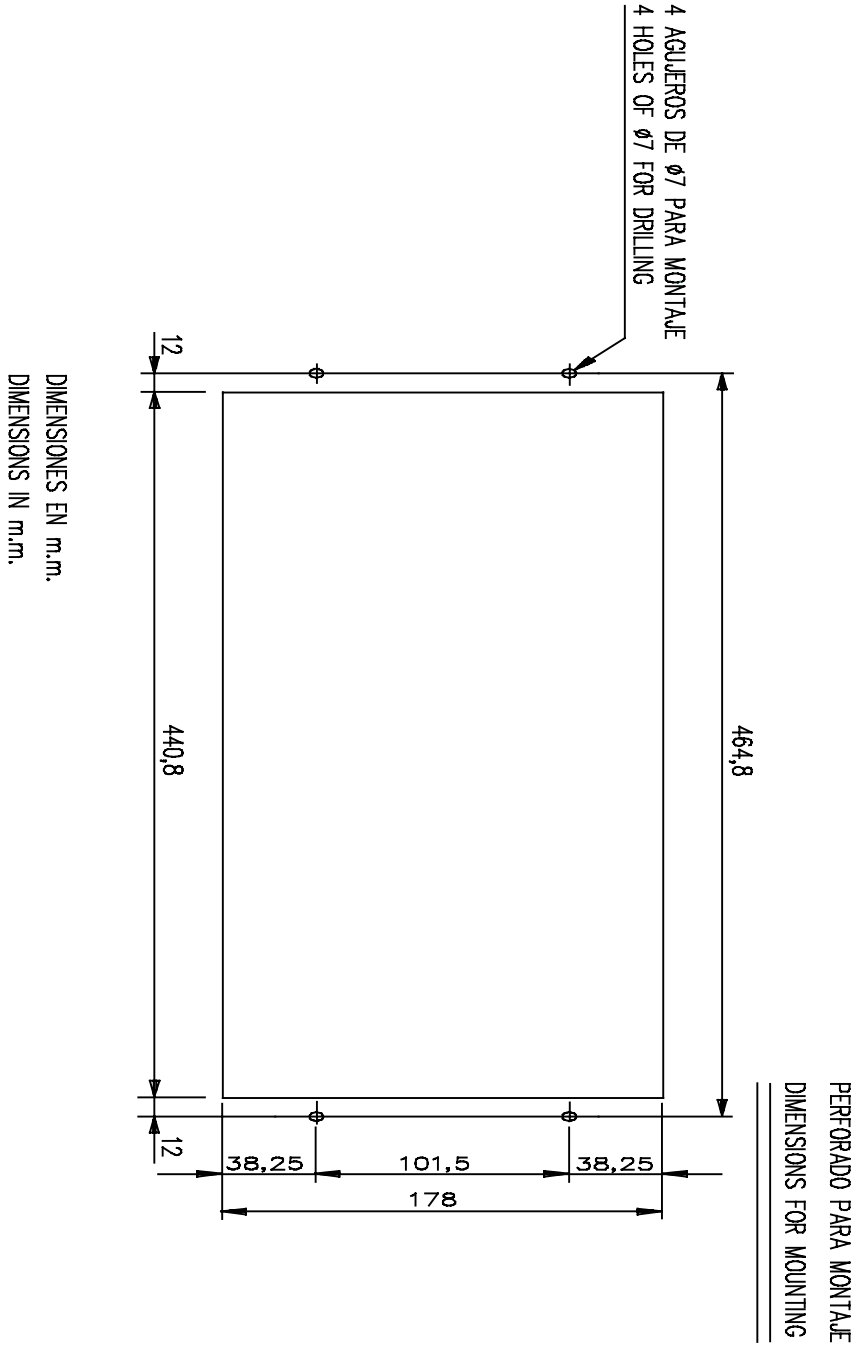


Figure 4: *Panel Mounting*

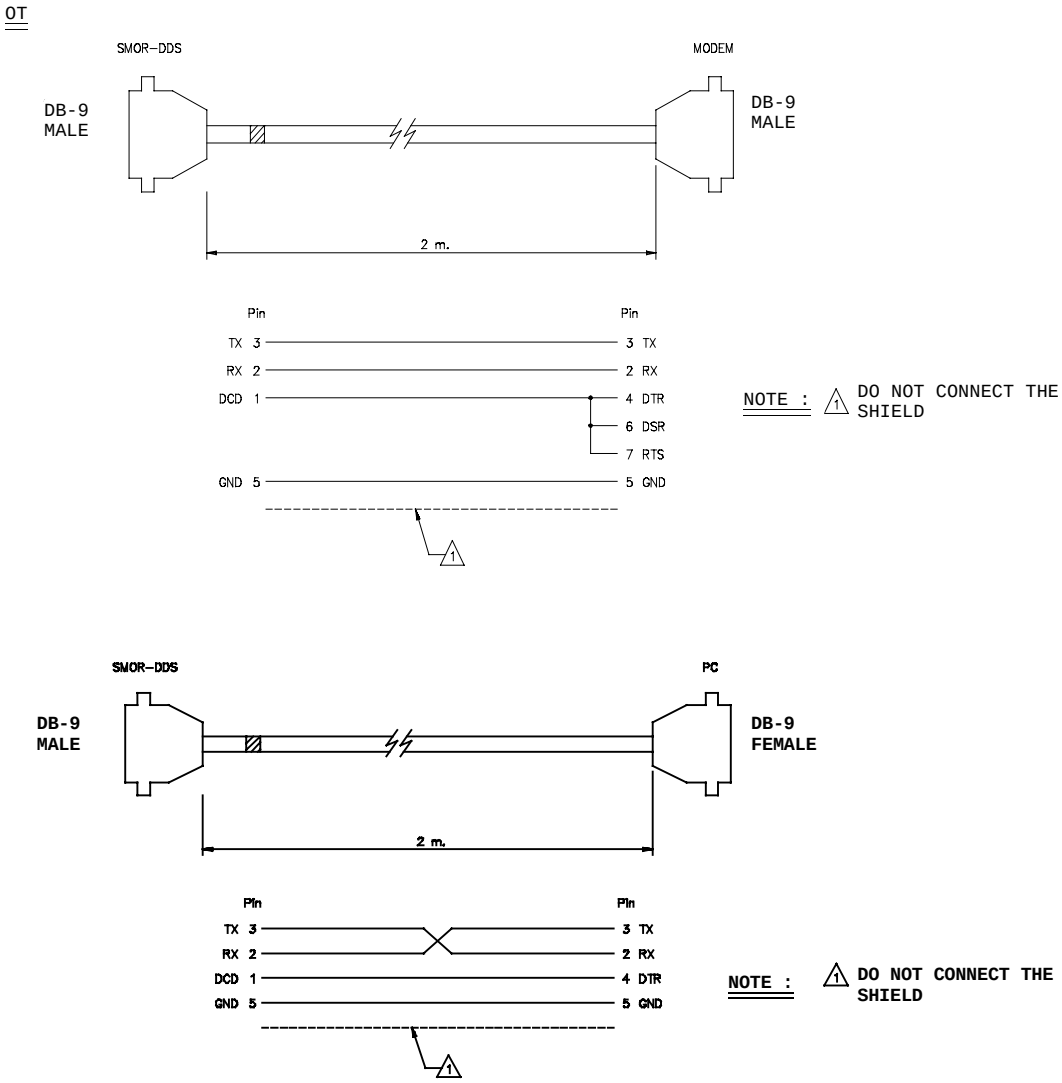


Figure 5. *RS-232 Connection*

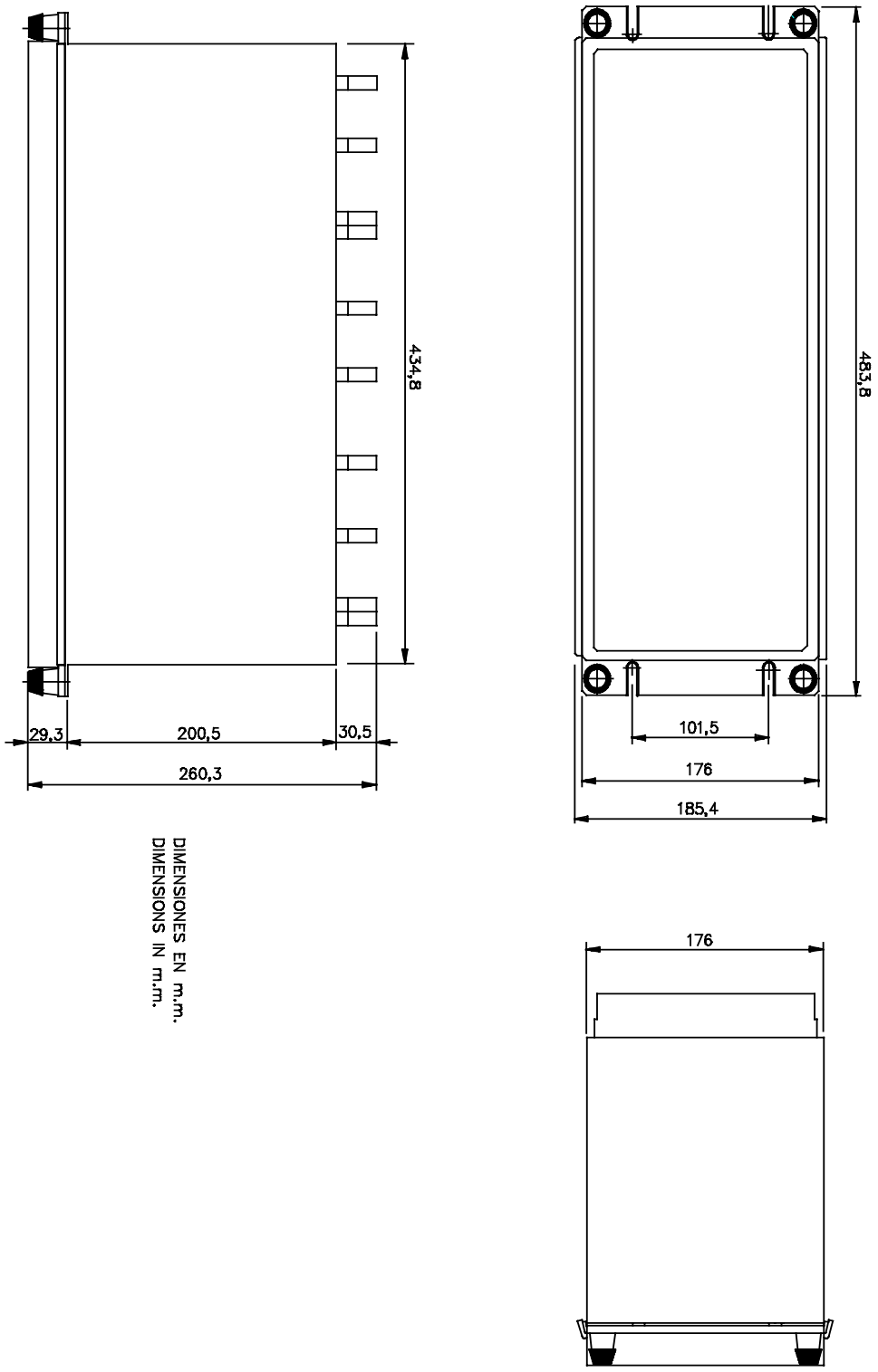


Figure 6: *Dimensions*

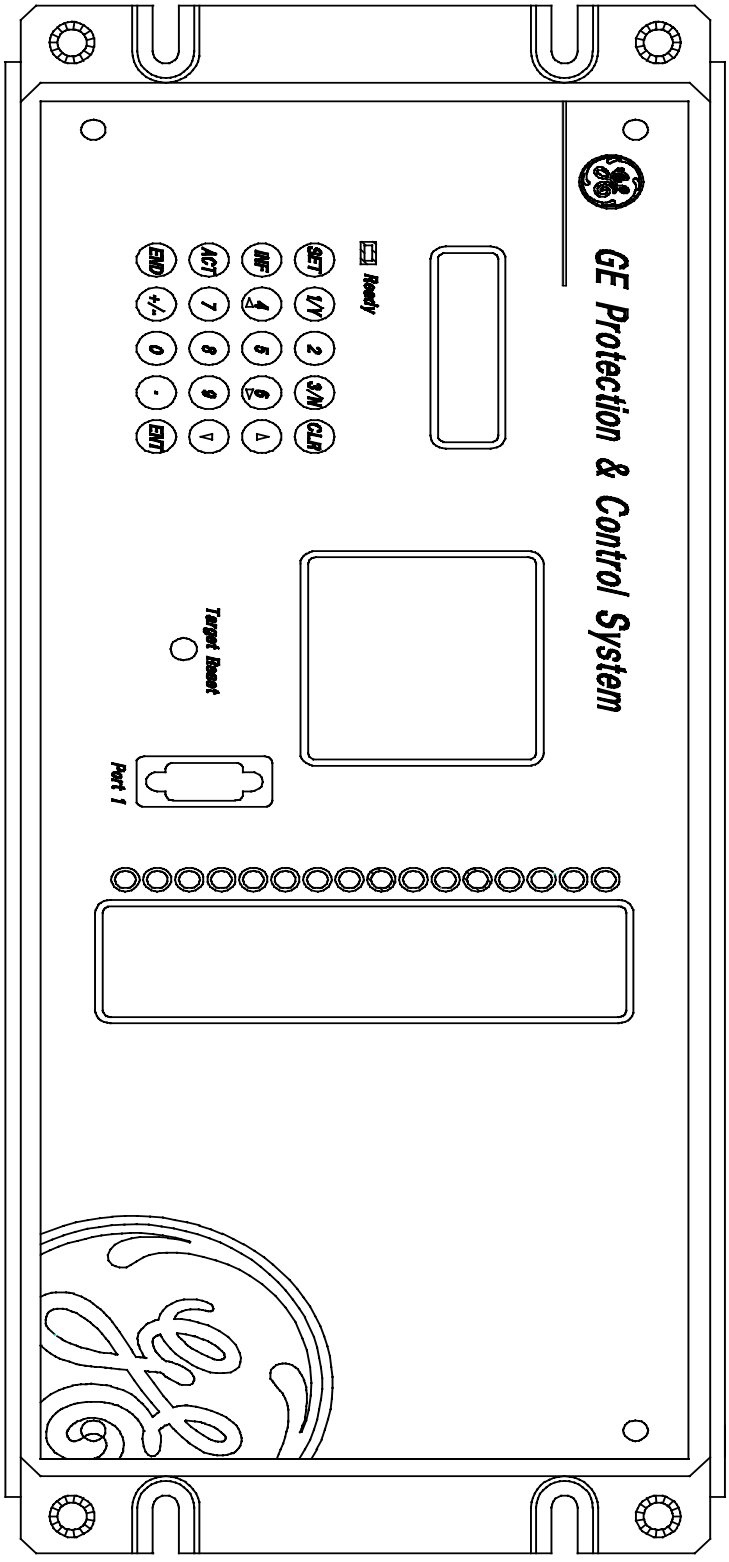


Figure 7: *Front View*

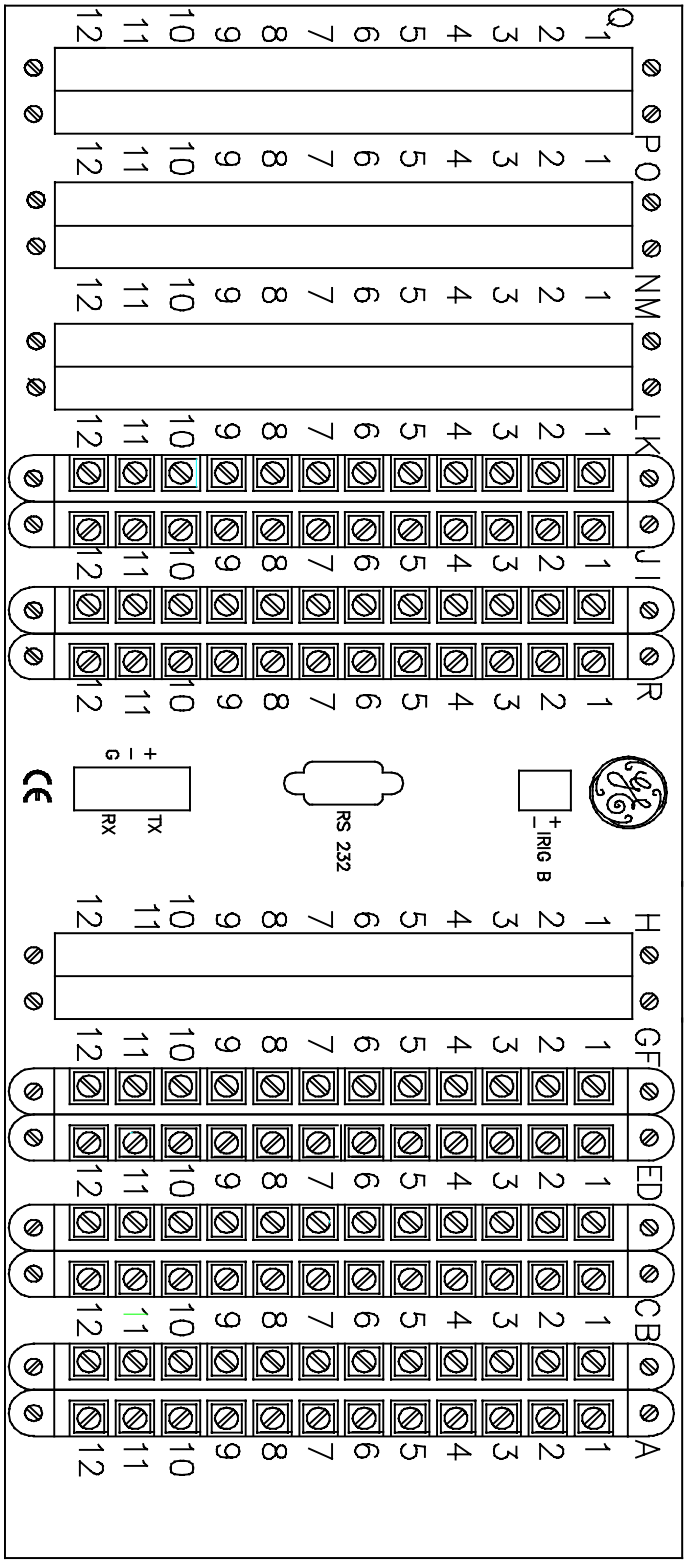


Figure 8: *Rear View*