USER MANUAL

GMR100 Grid Monitoring Relay

CAUTION

Read the user manual carefully before using this device.

TABLE OF CONTENTS

1. GENERAL INFORMATION

INOTEL's GMR series products are multi-functional network monitoring (Loss of Mains) relays located between the electricity network and the power generation plant.

By constantly monitoring the city grid, GMR separates the power plant and the electrical grid within a specified period of time in case of any voltage or frequency disruption that may occur, and ensures that the electricity generation facility is reactivated when the system returns to its nominal value.

GMR100 can be summarized under the following five headings.

1.1 General

- Microprocessor-Based Digital Control
- Supply Voltage: 18-36V DC 0.2A
- Control Voltage: 18-36V DC
- Maximum Measurement Voltage 400V AC RMS (560Vp)
- Frequency Measurement Range: 40-60Hz
- Data Transfer via MODBUS RTU Protocol

1.2 Inputs and Outputs

- 1 x 24V DC Output
- 1 x RS485 Port
- 4 x Control/Feedback Inputs
- 2 x SPDT Relay Output 230V AC / 32V DC 10A
- 3 Phase – Neutral Voltage Measurement Input

1.3 HMI Touch Panel & Led Indicators

- 2.8" TFT-LCD touch panel
- Instantaneous voltage and frequency monitoring
- Setting protection and communication parameters
- Real-time recording and monitoring of alarm conditions
- Power, communication, error and breaker position LED indicators (LED indicators are directly related to the control system, apart from the HMI touch panel. In case of screen failure, the status can be monitored from the LED indicators)

1.4 Functions

- Low and high voltage 1. Step opening/protection
- Low and high voltage 2. Step opening/protection
- Low and high frequency 1. Step opening/protection
- Trip/protect against rate of change of frequency (ROCOF)
- Voltage reading accuracy 30-400V AC 1%
- Frequency range: 40-60Hz

1.5 Compatibility

- TS EN 50178:2003
- TS EN 61000-6-2:2019
- TS EN 61000-6-4:2020
- TS EN 61010-1

2. POWER, INPUTS AND OUTPUTS

2.1 Power Input

GMR100 operates with 18-36V 0.2A DC voltage. It has built-in protection against short circuits and voltage surges.

2.2 Analog Inputs

GMR100 has 1 three-phase voltage measurement input. It can measure up to 560V peak single-phase voltage (400V AC RMS) with ±1% tolerance and frequency range of 40-60Hz with ±1% tolerance.

2.3 Digital Inputs

The GMR100 has 4 control inputs, used for feedback emergency stop, generator operation, and remote on/off. Digital inputs are activated with 9.1mA current for 24V DC input.

2.4 Relay Outputs

The GMR100 has 2 SPDT relays. The relays can be used as NO and NC with contact voltages of 230VAC/32VDC and current capacity of 10A. The relays can be used as backups for each other under the same conditions.

3. OPERATOR PANEL

The operator panel of the GMR100 is used for monitoring active voltage, frequency, and alarm conditions. It has a 2.8" TFT-LCD screen, which allows changing protection and communication parameters.

3.1 System Screen

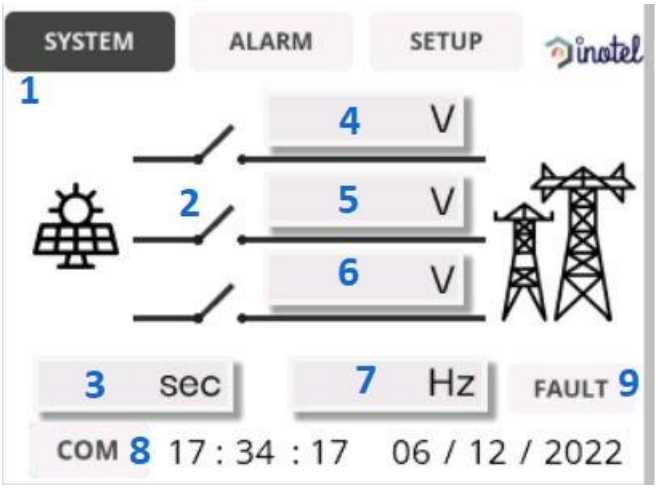


Figure 1: System Display

- **1: "SYSTEM", "ALARM"** and **"SETUP"** screen transition buttons
- **2:** Circuit breaker position information (Displayed as closed and red when the circuit breaker is in the closed switch position)

- **3:** Breaker close timer value
- **4:** Phase A – neutral voltage information
- **5:** Phase B – neutral voltage information
- **6:** Phase C – neutral voltage information
- **7:** Frequency information
- **8:** Communication information between the screen and the control system (Blinks green if there are no issues)
- **9:** Fault information (Displayed in red in case of any fault. The fault message disappears when the system is restarted or returns to normal operation conditions)

3.2 Setup/Parameter Screen

The login password of the setup screen is set to "12345". This password can be updated by changing the "PASSWORD" parameter.

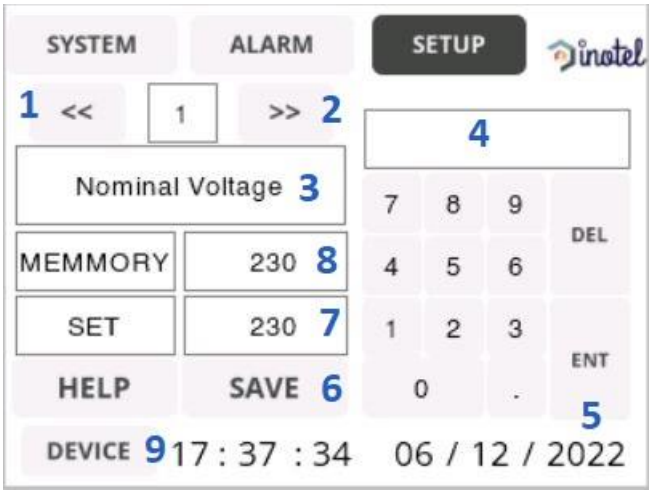


Figure 2: Parameter Display

- **1, 2:** Parameter setting menu switch buttons (for navigating between parameters)
- **3:** Parameter indicator
- **4:** Display panel for the parameter to be set
- **5:** Keyboard for setting parameters (the **DEL** button clears the display panel, and the **ENT** button transfers the numeric value from the display to the **SET** panel)
- **6:** Save button
- **7:** Set value
- **8:** EEPROM value (Indicates the value stored in memory)
- **9:** Device parameters (redirects to the parameter page where device brightness, date and time are set)

3.3 Alarm Screen

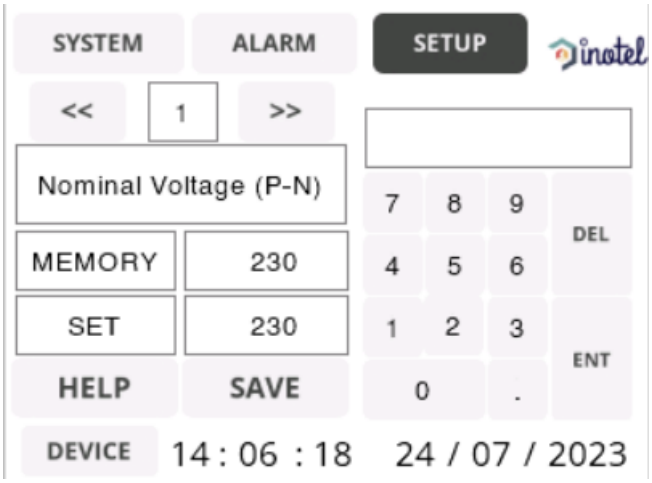
Figure 3: Alarm Screen

- **1:** Alarm display (Designed to list 5 alarms on one page. Up to 15 alarm information can be saved in the list)
- **2:** Buttons to switch between alarm pages
- **3:** Alarm content clearing button (Clears all alarm information)

4. PARAMETERS

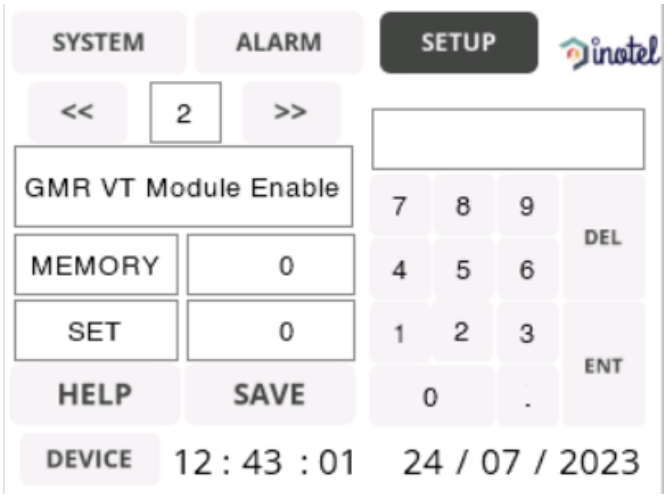
The parameters of the GMR100 electrical grid monitoring and protection relay should be determined considering the values and limits specified below. The characteristics of the field to be used and the specifications to be applied in the field should also be considered.

1)NOMINAL VOLTAGE:



Positive integer or decimal number can be entered.

2)GMR VT Module Enable:

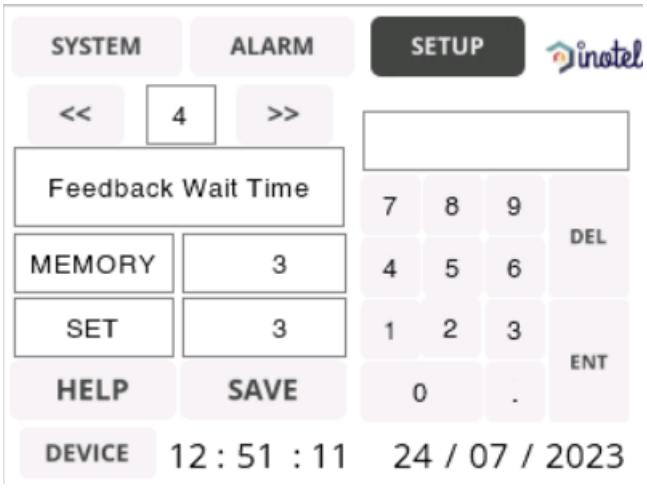


Enables or disables the GMR VT Module. 1: Enable, 2: Disable

3)SWITCH ON DELAY:

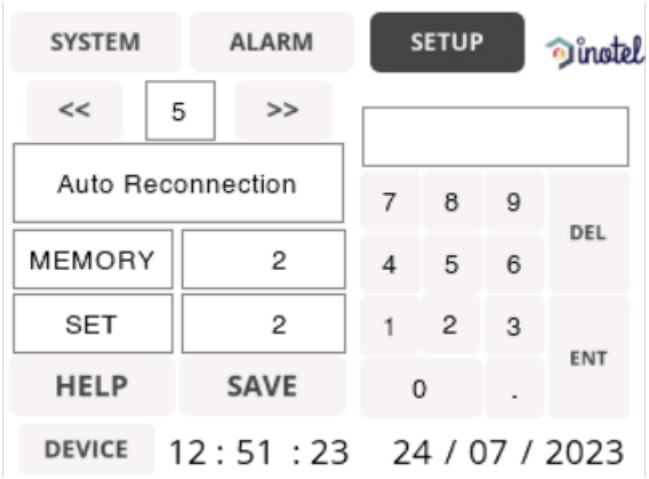
Positive integer; indicates the circuit breaker closing time.

4)FEEDBACK WAIT TIME:



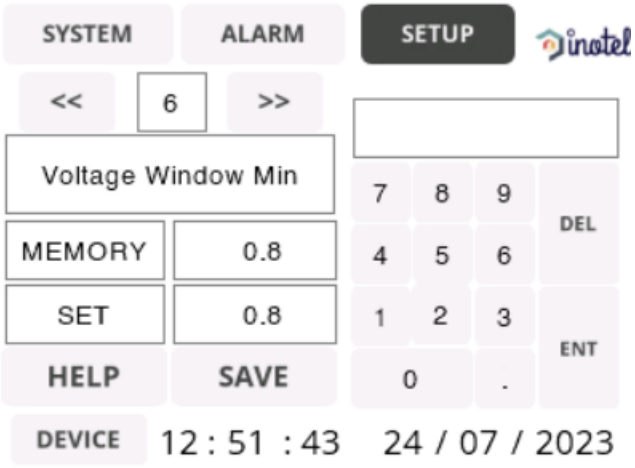
Positive integer; indicates how long to wait for position information after the circuit breaker closes.

5)AUTO RECONNECTION:



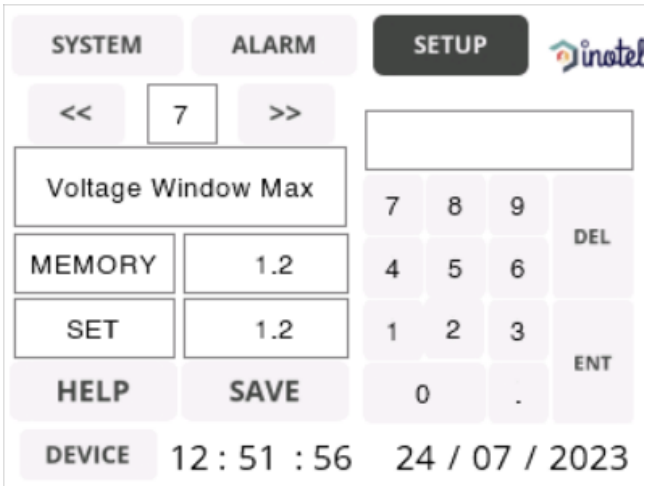
Positive integer; indicates the number of retries if circuit breaker position information is not received.

6)VOLTAGE WINDOW MIN:



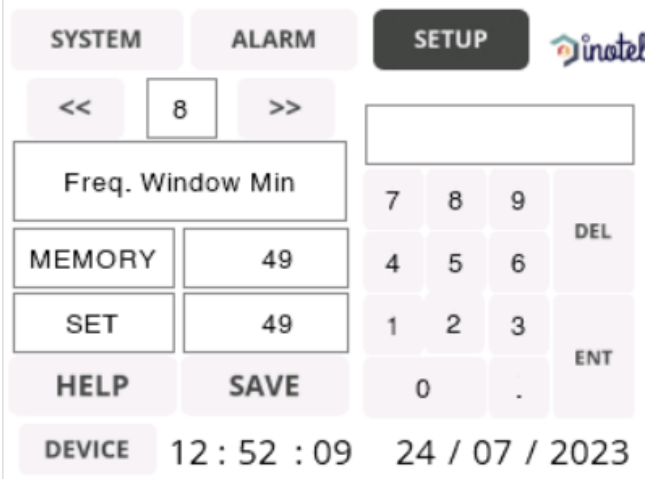
Positive decimal less than 1; for minimum voltage in circuit breaker closure.

7)VOLTAGE WINDOW MAX:



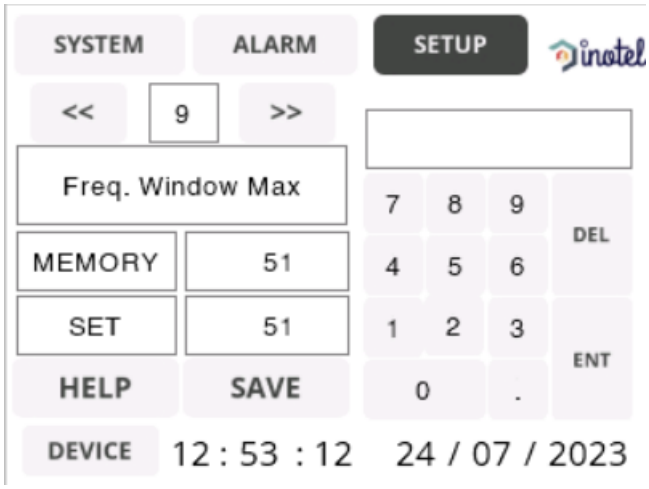
Positive decimal greater than 1; for maximum voltage in circuit breaker closure.

8)FREQ. WINDOW MIN:



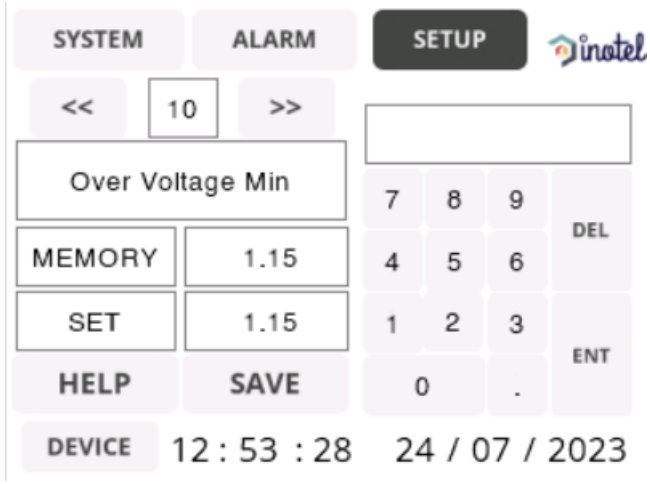
Positive decimal or integer less than 50; for minimum frequency in circuit breaker closure.

9)FREQ. WINDOW MAX:



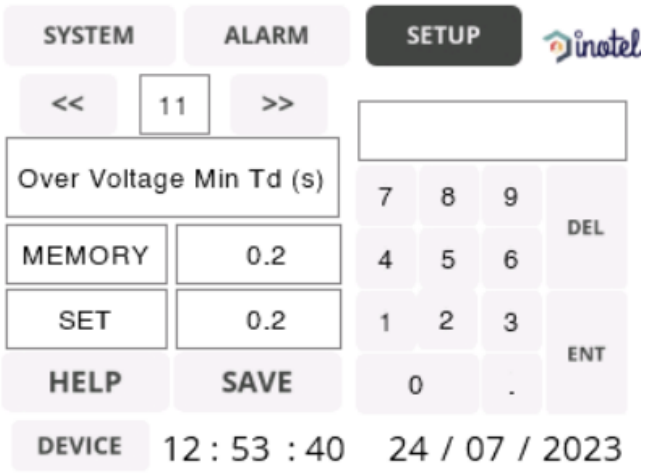
Positive decimal or integer greater than 50; for maximum frequency in circuit breaker closure.

10)OVER VOLTAGE MIN:



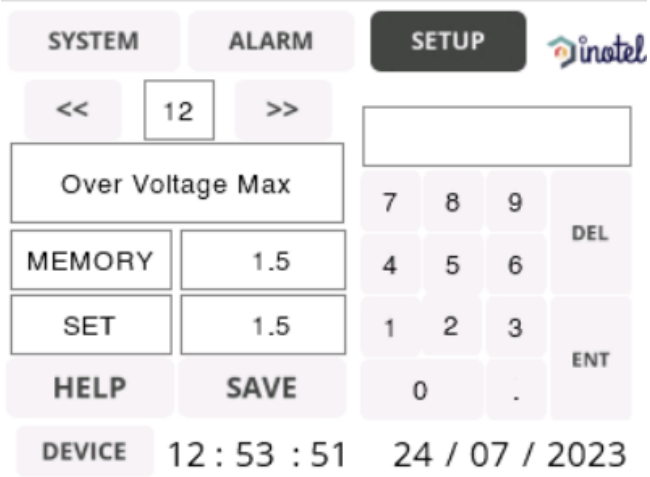
Positive decimal greater than 1; indicates stage 1 over-voltage tripping.

11)OVER VOLTAGE MIN TD:



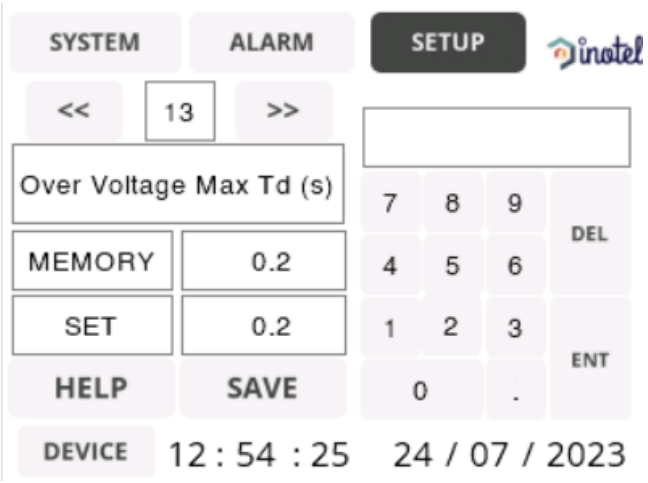
Positive decimal; indicates the time for stage 1 over-voltage tripping in seconds.

12)OVER VOLTAGE MAX:



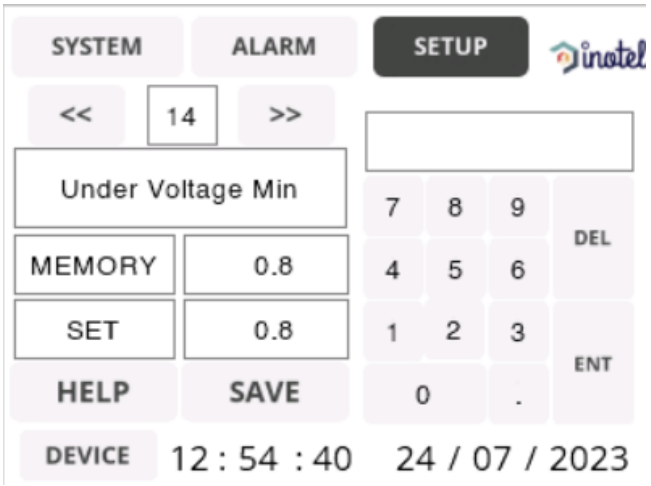
Positive decimal greater than 1; indicates stage 2 over-voltage tripping.

13)OVER VOLTAGE MAX TD:



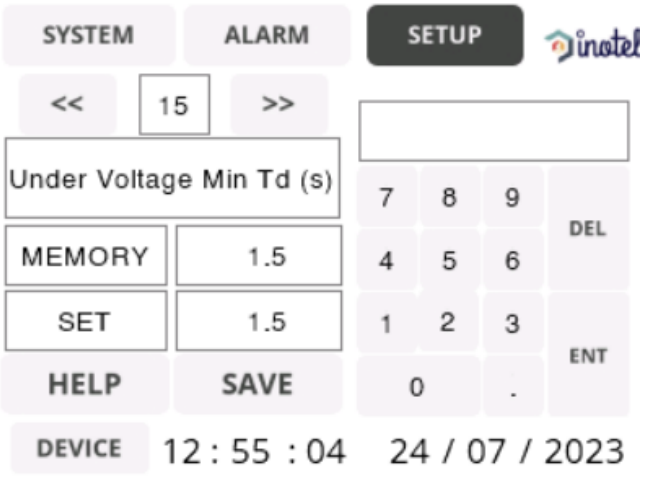
Positive decimal; indicates the time for stage 2 over-voltage tripping in seconds.

14)UNDER VOLTAGE MIN:



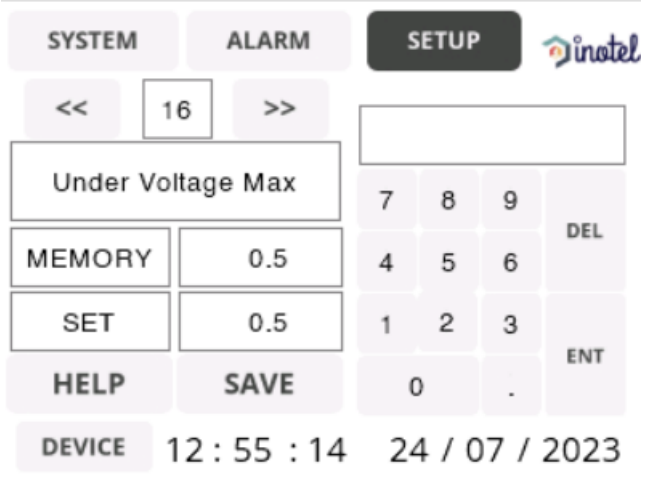
Positive decimal less than 1; indicates stage 1 under-voltage tripping.

15)UNDER VOLTAGE MIN TD:



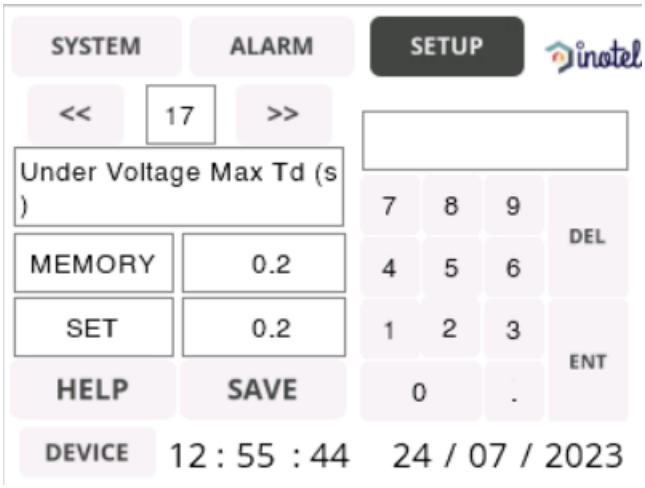
Positive decimal; indicates the time for stage 1 under-voltage tripping in seconds.

16)UNDER VOLTAGE MAX:



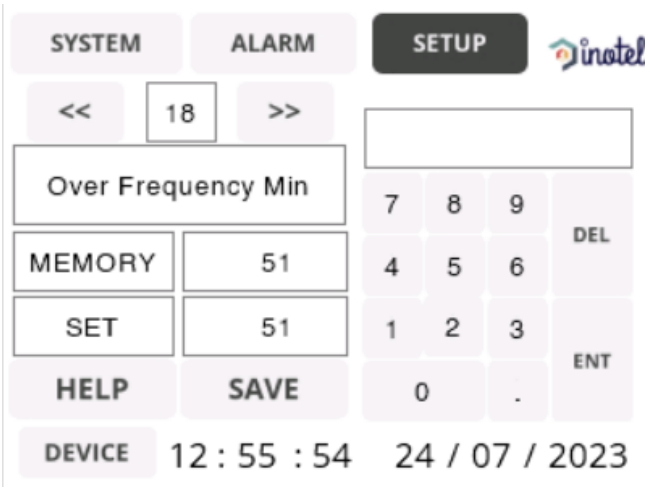
Positive decimal less than 1; indicates stage 2 under-voltage tripping.

17)UNDER VOLTAGE MAX TD:



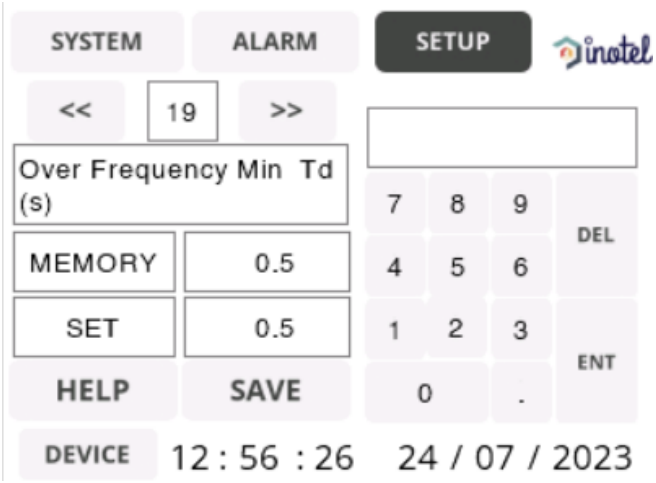
Positive decimal; indicates the time for stage 2 under-voltage tripping in seconds.

18)OVER FREQ MIN:



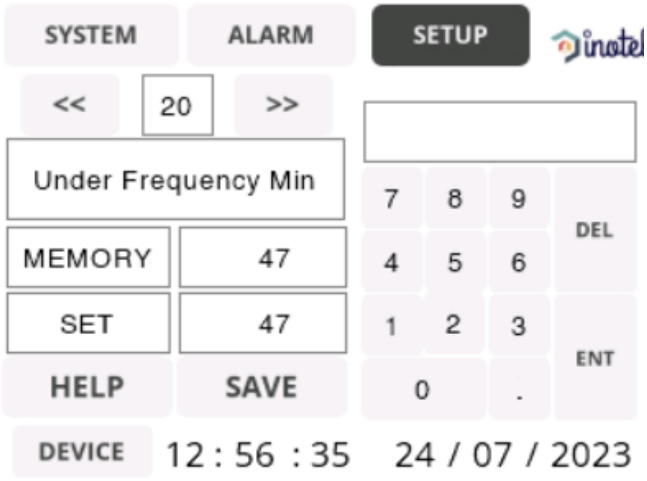
Positive decimal greater than 50; indicates stage 1 high-frequency tripping.

19)OVER FREQ MIN TD:



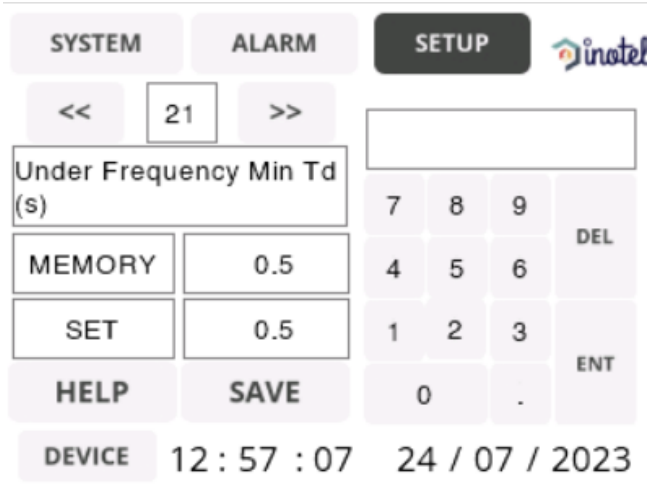
Positive decimal; indicates the time for stage 1 high-frequency tripping in seconds.

20)UNDER FREQ MIN:



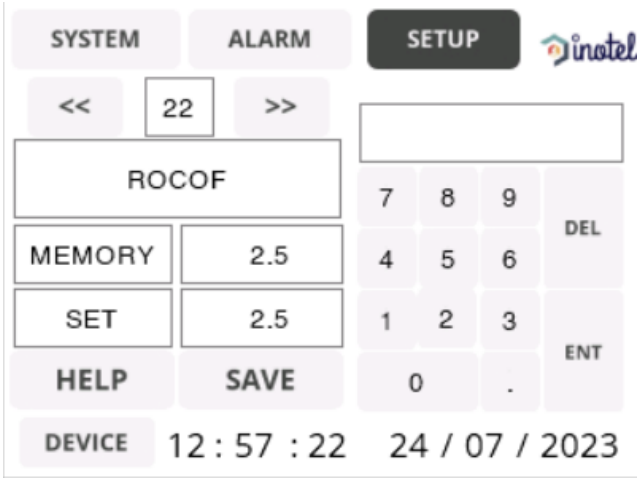
Positive decimal or integer less than 50; indicates stage 1 low-frequency tripping.

21)UNDER FREQ MIN TD:



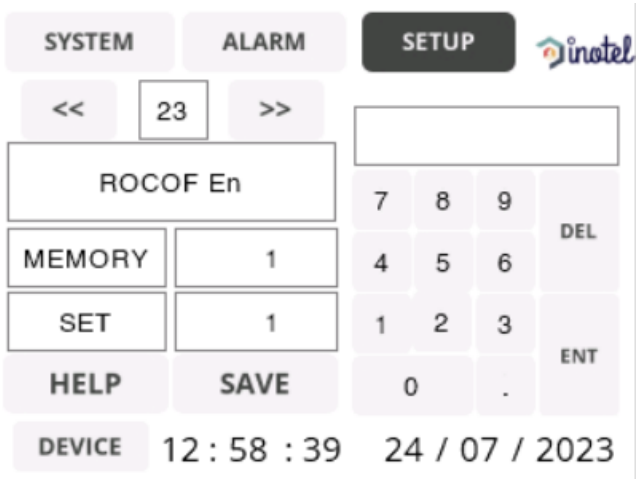
Positive decimal; indicates the time for stage 1 low-frequency tripping in seconds.

22)ROCOF:



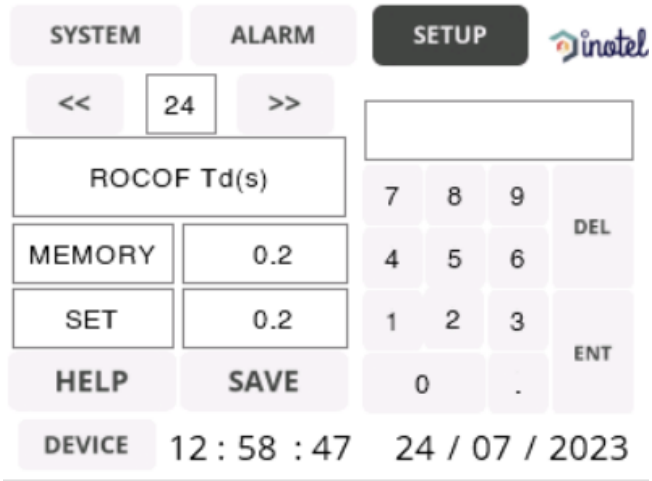
Positive decimal; indicates the rate of change of frequency per second.

23)ROCOF EN:



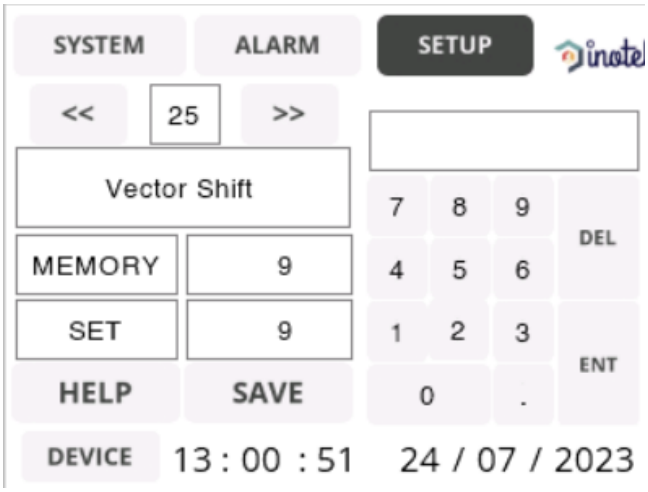
Enables or disables ROCOF. 1: Enabled, 0: Disabled

24)ROCOF TD:



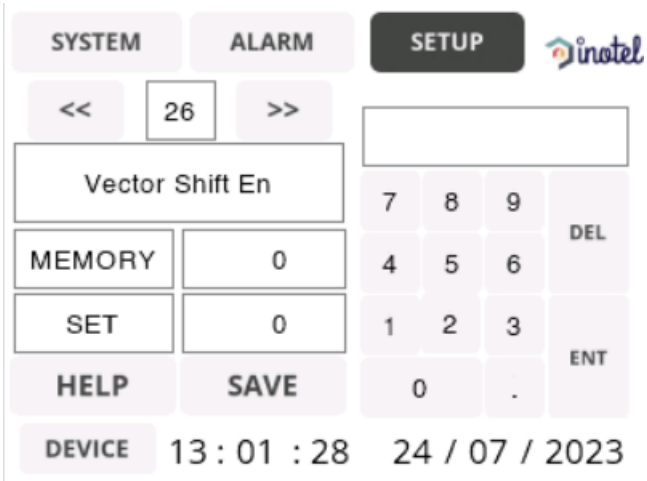
Positive decimal; indicates the time for ROCOF in seconds.

25)Vector Shift:



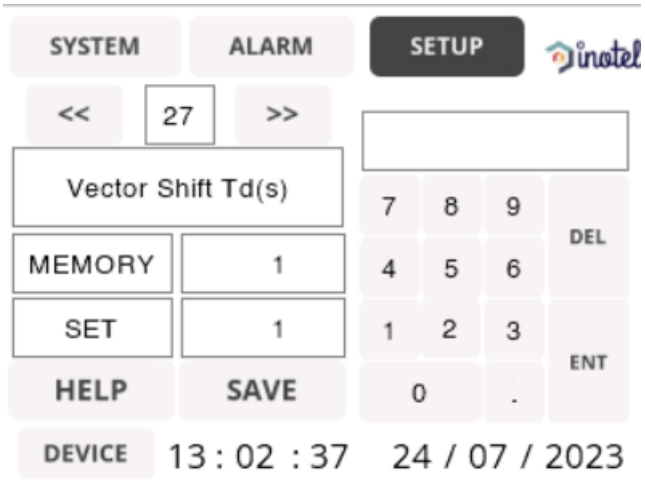
Vector shift. Positive integer between 2 and 40.

26)Vector Shift En:



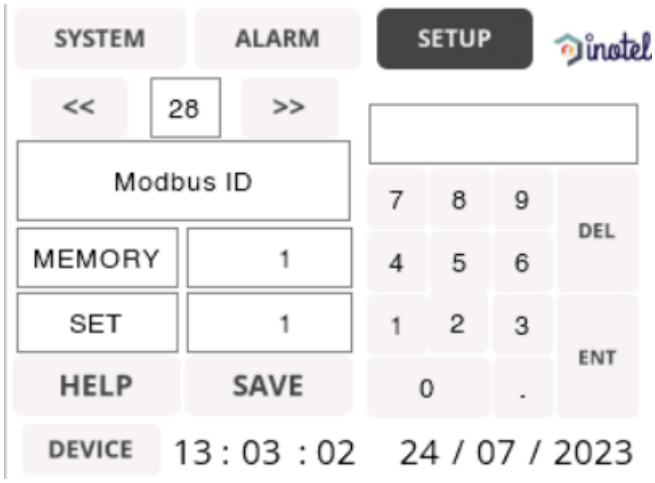
Enables or disables Vector shift. 1: Enabled, 0: Disabled

27)Vector Shift TD:



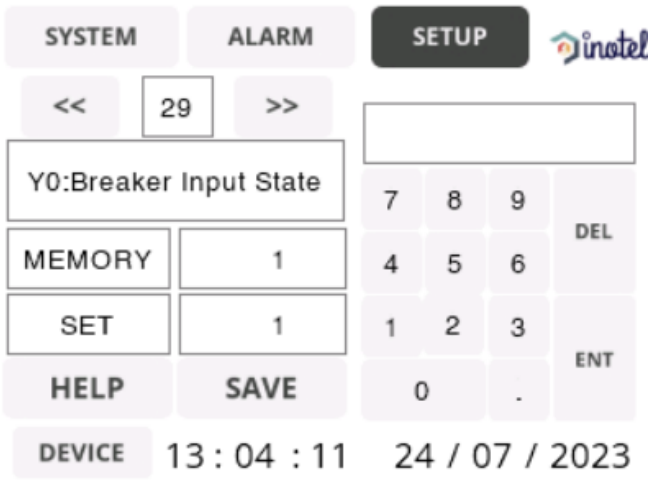
Positive decimal; indicates the time for Vector shift in seconds.

28)MODBUS ID:



Positive integer; determines the MODBUS Slave address.

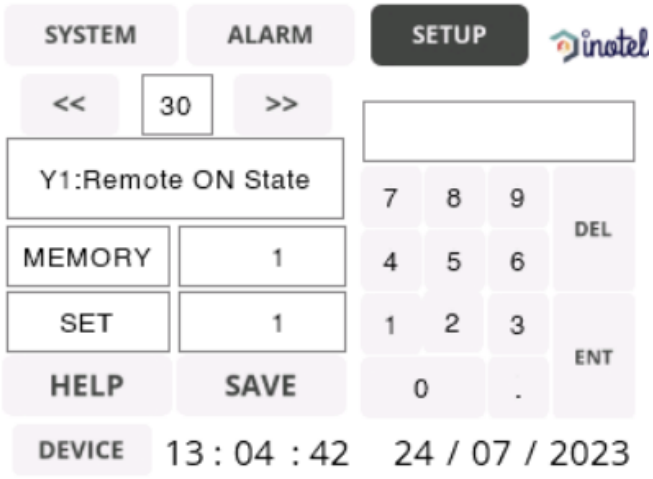
29)Y0 BREAKER INPUT STATE:



Selects the feedback information state for the breaker position

0: Does not perform feedback control.
1: Requests 24V feedback information (uses the normally open contact of the breaker for feedback).
2: Requests 0V feedback information (uses the normally closed contact of the breaker for feedback).

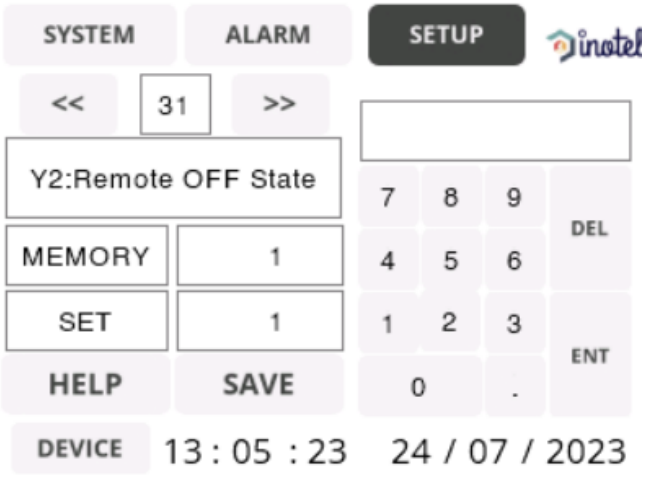
30)Y1 REMOTE ON STATE:



Specifies remote connection breaker closing information.

0: Not used.
1: (activates 24V for 1sec.)

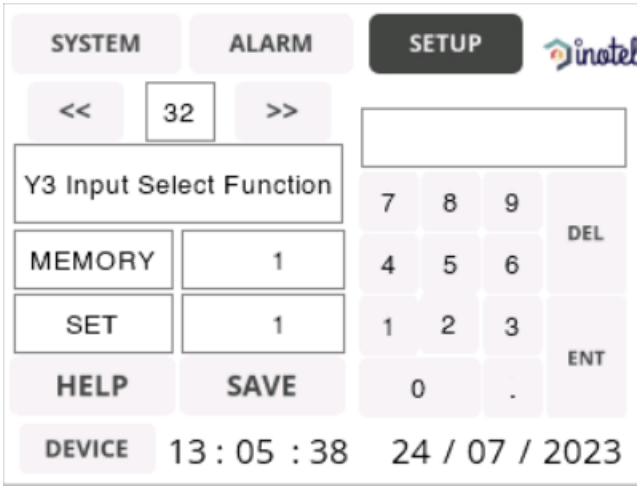
31)Y2 REMOTE OFF STATE:



Specifies remote connection breaker opening information.

0: Not used.
1: (activates 24V for 1sec.)

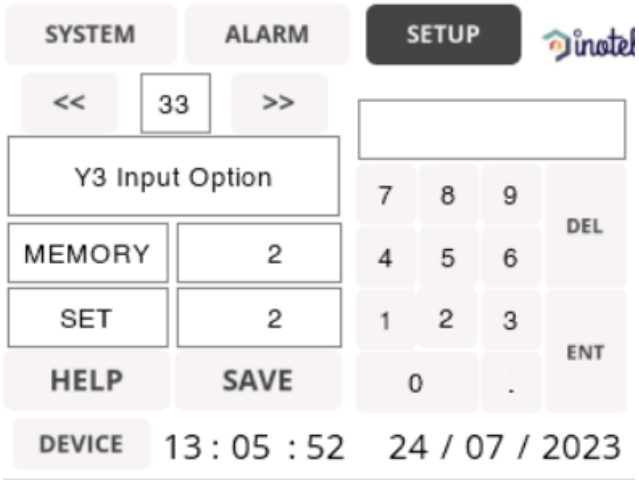
32)Y3 INPUT SELECT FUNCTION:



Used with Y3 Input Option to control the breaker opening/closing state based on emergency stop or generator information

0: Not used.
1: (Emergency Stop Information – 24V.)
2: (Emergency Stop Information – 0V.)
3: (Generator Status Information – 24V.)
4: (Generator Status Information – 0V.)

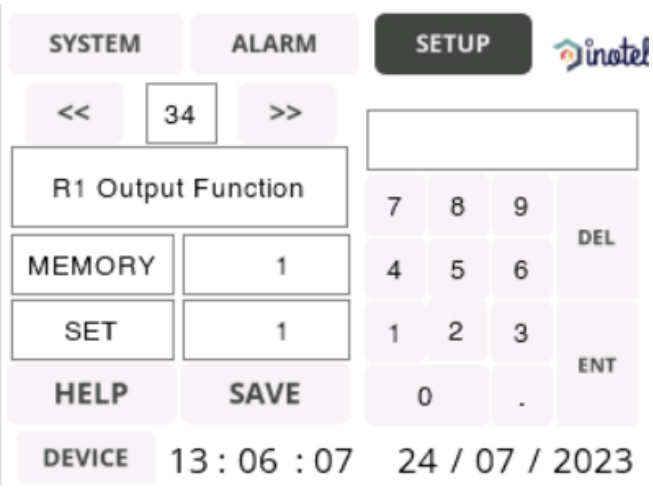
33)Y3 INPUT OPTION:



Used with emergency stop

0: Not used. (Emergency stop disabled)
1: (Waits for remote command in case of Emergency Stop.)
2: Reactivates when emergency stop is cleared

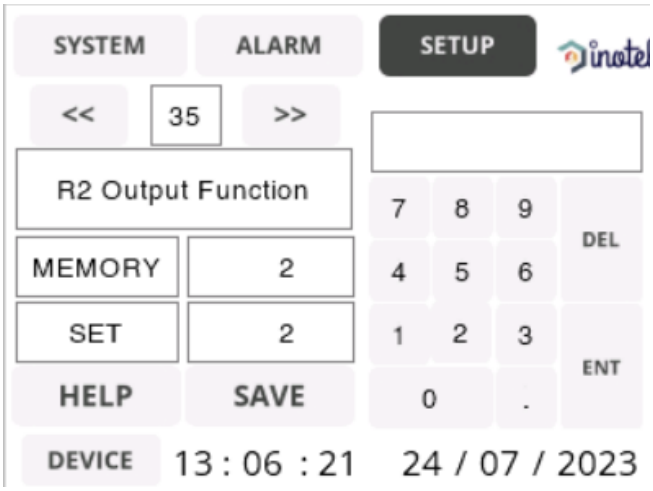
34)R1 OUTPUT FUNCTION:



Used to set parameters for the R1 output relay for opening and closing

0: Not used.
1: 24V information for 5 seconds in breaker closing state
2: 24V information for 5 seconds in breaker opening state
3: Permanent Open/Close - Open at 0V, Close at 24V.

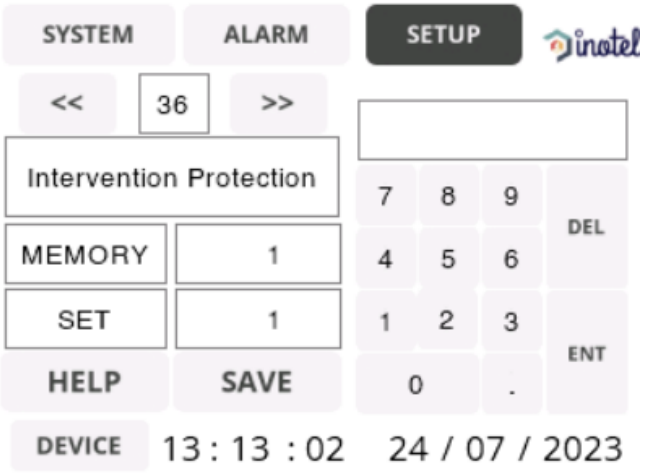
35)R2 OUTPUT FUNCTION:



Used to set parameters for the R2 output relay for opening and closing.

0: Not used.
1: 24V information for 5 seconds in breaker closing state.
2: 24V information for 5 seconds in breaker opening state.
3: Permanent Open/Close - Open at 0V, Close at 24V.

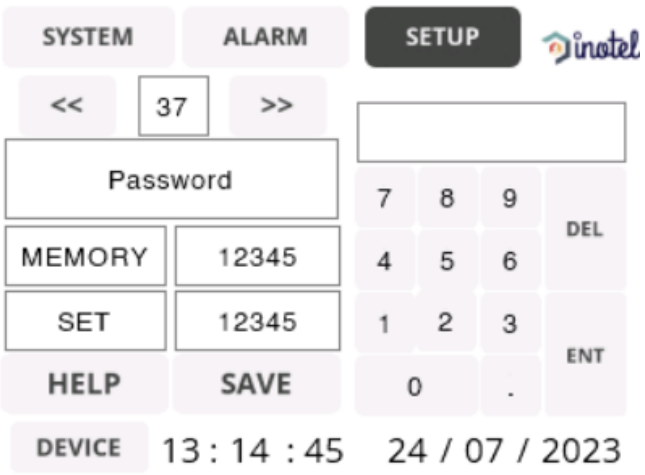
36)Intervention Protection:



Enables or disables intervention protection. 1: Enabled, 0: Disabled

If enabled, after releasing emergency switch, system will keep running

37)PASSWORD:

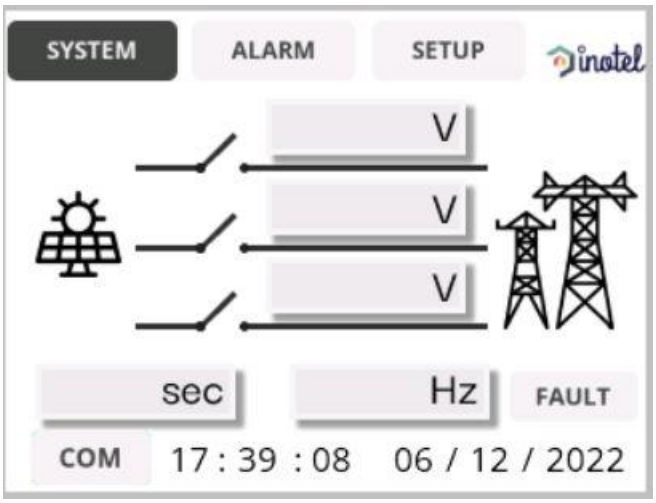


Positive integer; sets up user password

5. SETTING PARAMETERS:

The parameter settings of the GMR100 can be adjusted on the device via the HMI touch panel. Each parameter value can be adjusted within the minimum and maximum limits shown in Table 1. Parameters must be saved after being adjusted.

In order to set the parameters of the network monitoring relays, the "**SETUP**" section shown at the top right of the system screen photo below is pressed.



Then, the preset password of the network monitoring relay **"12345"** is entered in the password section that appears in the screenshot below and the **"ENT"** key is pressed and the login is made.

After logging in, the setup screen opens and the nominal voltage screen, which is the first parameter of the setup, is seen.

To enter parameters in the nominal voltage section, the required value is written on the display panel to be set at the top right and the **"ENT"** key is pressed.

After the **"ENT"** key is pressed, the value which was entered on the display panel is saved in the SET section.

The **"SAVE"** button on the screen is pressed to save the value shown in the **"SET"** section. Thus, the value seen in the **"SET"** section is also seen in the **"EEPROM"** section and the saving process is completed.

Same steps are followed for the remaining parameters to be changed.

To set the date and time, press the **"DEVICE"** button in the **"SETUP"** section.

The brightness of the device screen is adjusted by sliding the green line in the **"DIMMER"** section on the left side of this screen. By pressing the +(plus) and –(minus) in the **"DATE/TIME"** section at the top on the right, the day, month and year are set respectively. It will change automatically in the part that shows the days. For the time setting, the hour, second and second are set respectively by pressing + (plus) and –(minus) from the bottom right.

All parameters can be restored to default by pressing the **"RESET"** button.

To return to the SETUP screen, simply press the **"PRMTR"** button in the lower right corner.

6. ALARMS:

It sends an opening command to the breaker due to instantaneous and long voltage and frequency fluctuations occurring in the electrical network. Sources of tripping errors and breaker failure conditions are displayed on the alarm screen.
The main alarm records and descriptions are as follows.

● 01 Over Voltage Level1:

In case of Over Voltage 1st Stage opening, the alarm is activated. The alarm indicates that the voltage measurement exceeds the threshold percentage set for the 1st Stage and remains below the voltage level set for the 2nd Stage.

● 02 Over Voltage Level2:

In case of Over Voltage 2nd Stage tripping, the alarm is activated. The alarm indicates that the voltage mesaurement exceeds the threshold percentage set for the 2nd Stage.

● 03 Under Voltage Level1:

In case of Low Voltage 1st Stage opening, the alarm is activated. The alarm indicates that the measured voltage is below the percentage threshold value determined for the 1st stage and above the percentage value determined for the 2nd stage.

● 04 Under Voltage Level2:

In case of Low Voltage 2nd Stage opening, the alarm is activated. The alarm indicates that the voltage measured is below the low percentage threshold value determined for the 2nd stage.

● 05 Over Frequency Level1:

Over Frequency 1st Stage is activated in case of opening. Alarm indicates that the frequency value measured exceeds the specified value.

● 07 Under Frequency Level1:

Over Frequency 1st Stage is activated in case of opening. Alarm indicates that the frequency value read is below the specified value.

● 09 Switch Closing Error:

This error occurs when no feedback is being received, when feedback is being received even though close command has not been sent, or because the signal is delayed due to the mechanical switch(es).

In case of a signal delay due to a mechanical switch or many electromechanical devices in between, the "Feedback Wait Time" parameter should be increased by the delay time.

● 10 ROCOF Closing Error:

It becomes active if the change in frequency per second continues for the ROCOF Td period determined on the ROCOF parameter. ROCOF can also be activated or deactivated.

● 11 Emergency Stop Active:

Indicates that the Emergency Stop switch is active. In this case, by deactivating the emergency stop switch according to the situation specified under the "Y3 Input Option" parameter, the device can send reclosure at appropriate values or wait for the remote command.

● 12 Generator Active:

This warning becomes active if the Y3 input parameter "Generator is enabled" option is selected, there is a unit in the network that provides energy to the network, such as any generator, and it sends location information.

● 13 Remote Open Active

If 24V information is continuously sent from the remote device for a certain period of time and the remote shutdown parameter is active, this warning is displayed. Commissioning of the breaker separated by remote closing must be done with a remote command or manually.

7. MODBUS RTU:

GMR100 allows reading instantaneous changes according to the 0x04 function code and the slave ID specified on the parameter page, with the starting address 0 and the ending address 35, via MODBUS RTU Protocol.

UART (Universal Asynchronous Receive/Transmit) parameters determined for MODBUS communication are as follows.

- Baudrate: 9600 bit/s
- Parity: None
- Data Bit:8
- Stop Bit:1

MODBUS Register (MODBUS Data Map) can be read in Table 2. Table data is an unsigned 16bit integer. Analog measurement data was multiplied by the coefficient of 10, meter data was recorded as positive integers and alarm information was recorded in the data map as logical information.

Function Code	Address	Description
0X04	0	VAN*10
0X04	1	Reserved
0X04	2	VBN*10
0X04	3	Reserved
0X04	4	VCN*10
0X04	5	Reserved
0X04	6	Frequency *10
0X04	7	Reserved
0X04	8	Trip Counter
0X04	9	Breaker On/Off Counter
0X04	10	Alarm Overvoltage 1. Stage
0X04	11	Alarm Overvoltage 2. Stage
0X04	12	Reserved
0X04	13	Alarm Undervoltage 1. Stage
0X04	14	Alarm Undervoltage 2. Stage
0X04	15	Reserved
0X04	16	Alarm Overfrequency 1. Stage
0X04	17	Reserved
0X04	18	Alarm Underfrequency 1. Stage
0X04	19	Reserved
0X04	20	TMCB Status
0X04	21	TMCB Trip
0X04	22	Tripping Circuit Fault 74 TCS
0X04	23	Alarm Breaker Opening
0X04	24	Reserved
0X04	25	Reserved
0X04	26	Reserved
0X04	27	Reserved
0X04	28	Alarm ROCOF Opening
0X04	29	Reserved
0X04	30	Reserved
0X04	31	Reserved
0X04	32	Reserved
0X04	33	Reserved
0X04	34	Reserved
0X04	35	Reserved

8. PHYSICAL DIMENSIONS:

DMR100 has dimensions of 86x105x57 (LxWxH) in mm and has a rail type plastic.

9. WIRING DIAGRAM:

General connections to be made with GMR100 are presented in 3 diagrams. For different applications, connections, questions and opinions, please contact INOTEL

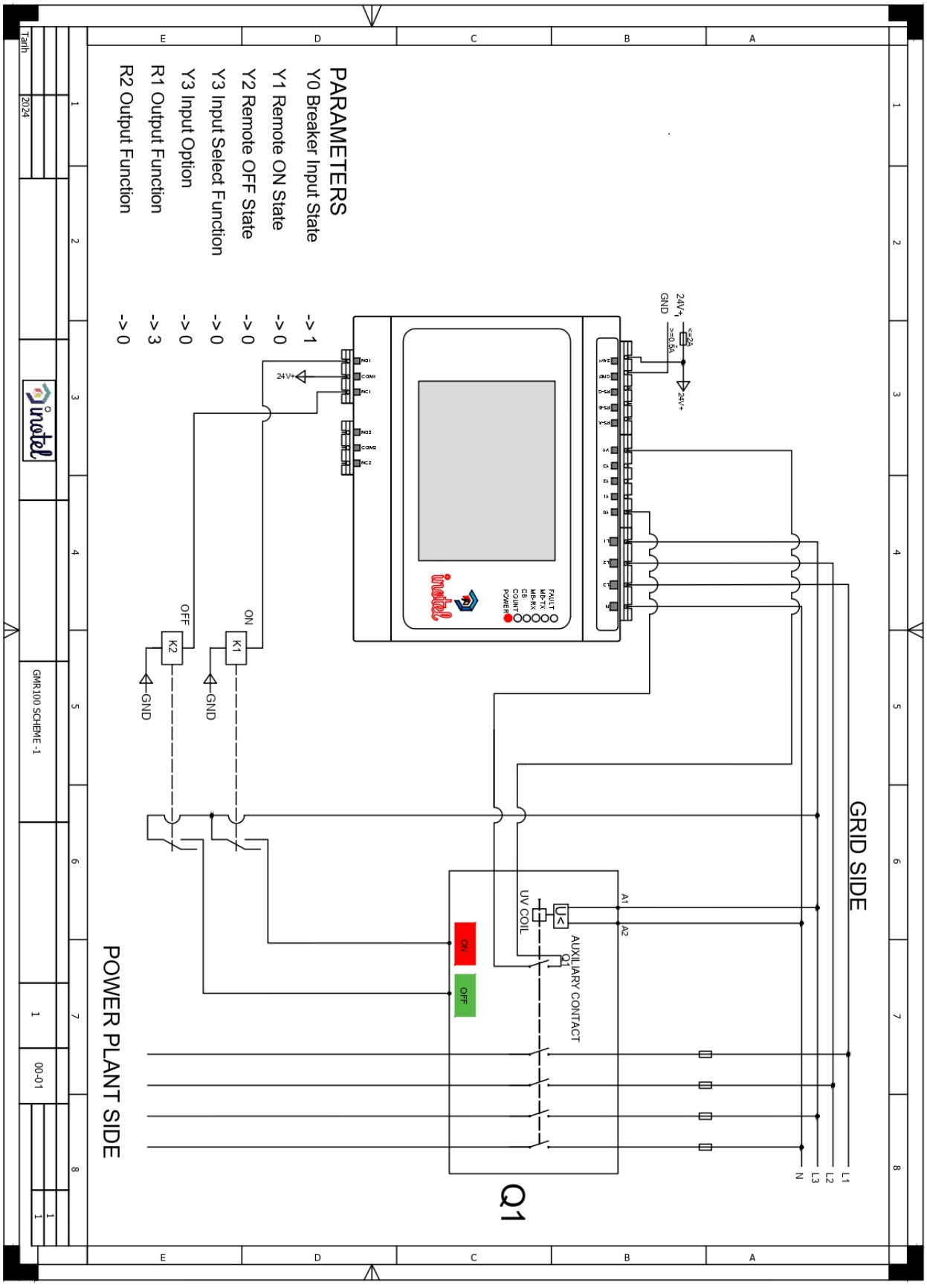
Appendix-1

The GMR100 general wiring diagram is shown in Figure 5. In this form of connection, settings should be;

Y0 Breaker Input State	-> 1
Y1 Remote ON State	-> 1
Y2 Remote OFF State	-> 1
Y3 Input Select Function	-> 1
Y3 Input Option	-> 1
R1 Output Function	-> 3
R2 Output Function	-> 0,

NOTE: See next page for diagram.

CONTACTOR MODE



Appendix 1: GMR100 Sample Connection Diagram

Appendix-2

The connection can be established using the R1 contact output of the auxiliary control system GMR100, as shown in figure below.

Y0 Breaker Input State -> 1

Y1 Remote ON State-> 1

Y2 Remote OFF State-> 1

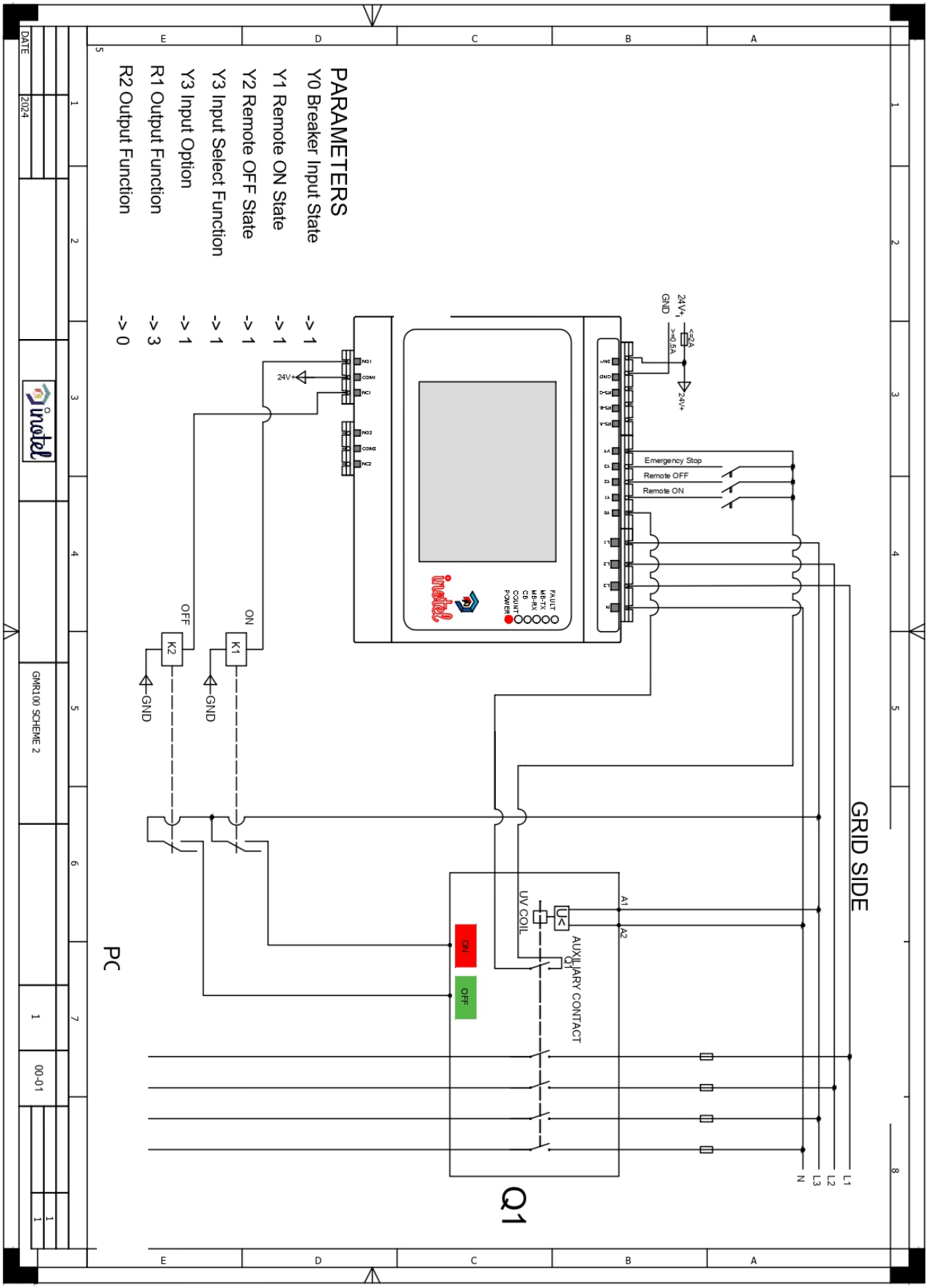
Y3 Input Select Function-> 1

Y3 Input Option -> 1

R1 Output Function-> 3

R2 Output Function-> 0,

NOTE: See next page for diagram.



Appendix 2: GMR100 Sample Connection Diagram

Appendix-3

Example connection for using the GMR100's R1 contact output as closing and R2 contact output as opening using an auxiliary relay is as shown in figure below.

Y0 Breaker Input State -> 1

Y1 Remote ON State -> 1

Y2 Remote OFF State -> 1

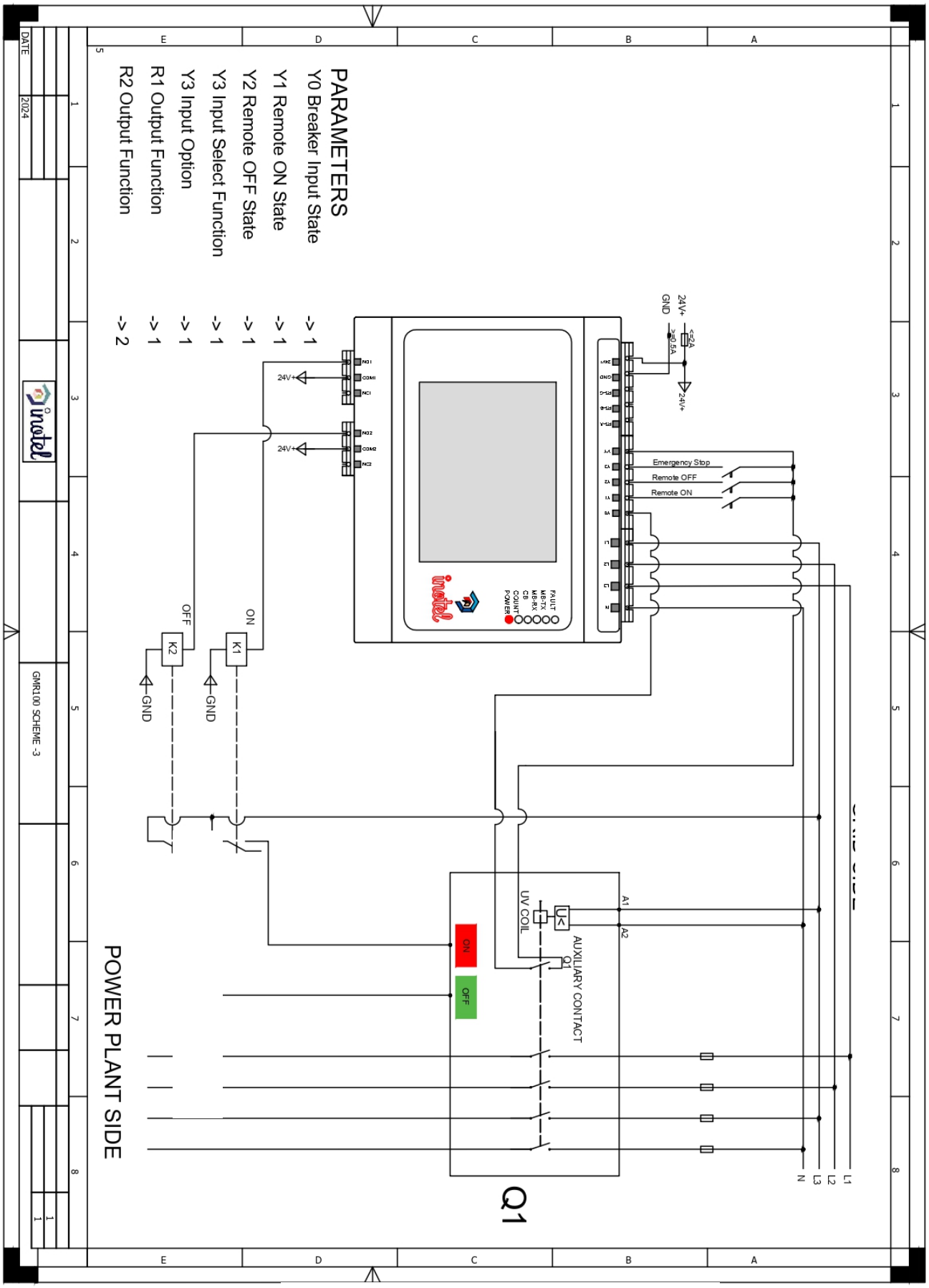
Y3 Input Select Function -> 1

Y3 Input Option -> 1

R1 Output Function -> 1

R2 Output Function -> 2,

NOTE: See next page for diagram.



Appendix 3: GMR100 Sample Connection Diagram

10. FREQUENTLY ASKED QUESTIONS:

1.What is Switch Close Error?

This error occurs when the thermal magnetic switch cannot be turned on after trying the defined "Auto Reconnection" value.

- Reverse connection of on-off relays
- Wrong feedback connection
- It may occur as a result of incorrect setting of relay parameters in the device

2.What is Feedback Error?

This error occurs when the GMR100 device does not open the breaker itself or the "Feedback" information is lost.Kumanda bağlantısında problem oluşması

- Wrong selection of thermal magnetic switch
- Other devices in the field can send trips to the breaker independently of the GMR100

3.Can Feedback Error be Dismissed Remotely?

No, it cannot be closed. Because in the event of a leak in the field or an external intervention during work, employee safety may be endangered and it cannot be closed.

4. What is Emergency Stop Active?

This error occurs as a result of pressing the emergency stop button.

- If you want the reset screen to appear, parameter 29 is set to “1”, otherwise it is set to “2”.

5. What is Remote Open Active?

It occurs as a result of the remote opening signal coming from the SCADA system.

6. Why is GMR100 Not Sending Breaker Open Signal?

- Reverse connection of opening and closing connections.
- Wrong electical connections of the electric panel

7. Can I use a Leakage Current Relay with GMR100?

Yes, your GMR100 device can be used with a “Leakage Current Relay”. The 24VDC signal from the Leakage Current Relay is entered into the “Y3” input. If the relay output is “NO”, it is connected in parallel with the emergency stop. If it is “NC”, it is connected in series.

8. Why Does the Fault Light Come On?

Fault light is on when the device gives an alarm and the phases are below the nominal value.

9. What is the input Voltage of Inputs?

Inputs Y0-Y1-Y2-Y3 works with 24VDC.

11. ANSII Codes:

Table of Current ANSII Codes:

Parameter	ANSII	Function	Status	Value
U>>	59	Overvoltage	Active	460V
U>	59	Overvoltage	Active	430V
U>avg	59AVG	Average Overvoltage	Passive	445V
U<	27	Undervoltage	Active	340V
U<<	27	Undervoltage	Active	300V
f>>	81O	Over Frequency	Passive	55Hz
f>	81O	Over Frequency	Active	51Hz
f<	81U	Under Frequency	Active	49Hz
f<<	81U	Under Frequency	Passive	45Hz
81 Vector Shift			Passive	
81R*	81R	Rate of Change of Frequency	Passive	0.8Hz
	BF	Breaker Failure	Active	
	74TCS	Trip-Circuit Supervision	Active	
	BLOCK1	Logical Set	Active	