

# Contents

## **1. Introduction and Application**

## **2. Features and Characteristics**

## **3. Operating Modes**

- 3.1** Automatic mode
- 3.2** Remote mode
- 3.3** Manual mode
- 3.4** Offline mode
- 3.5** Test mode
- 3.6** Service mode
- 3.7** Default mode

## **4. Mains Supervision**

- 4.1** Parameter selection
  - 4.1.1** Voltage
  - 4.1.2** Frequency
  - 4.1.3** Frequency Blocking Voltage
- 4.2** Circuit Breaker Supervision

## **5. Generator Supervision**

- 5.1** Parameter selection
- 5.2** Battery voltage supervision
- 5.3** Emergency stop
- 5.4** Time circuits
- 5.5** Time elements

## **6. Design**

- 6.1** Connection
- 6.2** Output relays
- 6.3** Inputs
  - 6.3.1** Mains voltage connection
  - 6.3.2** Generator voltage connection
  - 6.3.3** Auxiliary supply
  - 6.3.4** CB feedback contacts
  - 6.3.5** Remote Start/Stop signals
  - 6.3.6** Fault signals
  - 6.3.7** Internally processed fault display
- 6.4** Display
- 6.5** LEDs
- 6.6** Front panel keypad

## **7. Parameter Setting & Display Procedure**

## **8. Terminal Details**

- 8.1** Terminal Arrangement
- 8.2** Terminal Description

## **9. Getting Started**

## **10. Functional Specification**

## **11. Performance Specification**

## **12. Hardware Specification**

## 1. Introduction and Application

### AMF & Engine Control Relay Type – AMR1: -

AMR1 has been designed for the control of emergency and standby power systems. It integrates the functions of engine start/stop relay, engine and alternator supervision and annunciator. The relay has a user friendly MMI in the form of a keypad and a LCD display. The engine start/stop relay element allows the automatic starting of relay when power fails, automatic stopping of the engine when mains return and also the control and interlocking of mains and DG Circuit Breakers. It also includes delayed supervision of oil pressure switch.

## 2. Features & Characteristics

- Micro controller technology.
- Wide range of auxiliary supply: 7 V to 35Vdc.
- Withstands a dip to 0V of auxiliary supply for 1 second.
- Flush mounting.
- Alphanumeric LCD display with keypad for easy of operation.
- Display and supervision of three phase mains voltages for UV, OV & unbalance.
- Display and supervision of D.G voltages for UV, OV.
- Display and supervision of mains & D.G frequency.
- Continuous supervision of mains & D.G breaker status - ensures human /equipment safety.
- Internal interlock for Mains & D.G. breaker for fail safe operation.
- Remote starting and stopping facilities.
- Measuring of different mains and generator parameters.
- True RMS measurement of mains & D.G. voltage.
- Ten internal fault annunciation for start failure, over speed, low battery, stop failure etc.
- Four spare terminals for connecting external fault signals.
- Display and supervision of battery voltage.

- Isolated inputs and outputs.
- Parameter setting from front panel keypad.
- Seven modes: Automatic, Remote, Manual, Offline, Test, Edit Parameters and Default mode.
- Over speed indication / shutdown.
- DG starting process supervision.
- Indication of CB status.
- Wide array of time circuits for start delay, stop delay, mains restoration, re-cooling etc.
- Serial Communication (OPTIONAL).
- Ignition ON input.

## 3. Operating Modes

AMR1 operates in one of the seven modes described below.

Operating mode can be selected from the front keypad.

These seven modes are:

1. **Automatic**
2. **Remote**
3. **Manual**
4. **Offline**
5. **Test**
6. **Service**
7. **Default**

### 3.1 Automatic Mode

In the automatic mode of operation, Gen-set is started automatically, if the mains either fail or exceed operating limits, the main CB is opened and generator CB is closed. Voltages of the three phases are monitored continuously. If voltage of any phase falls below a safe lower limit or exceeds a safe upper limit then AMR1 takes following action: During engine start delay it waits to see if mains has returned to normal. This avoids false tripping. Thereafter engine start relay (meant for operating cranking motor) is activated for a predetermined period (Start Period) and then the system waits for the engine to start and pick up threshold speed within another predetermined period (Wait Period). If the engine does not start within wait period, then another attempt is made.

In this way a certain number of attempts are made. If the engine fails to start after all these attempts, then **"FAIL TO START"** annunciation is displayed. Delayed supervision of oil pressure is provided at the time of starting. This ensures that sufficient time is available for oil pressure to build up. If subsequently oil pressure is found to be low, then annunciation is given. When the main is restored, the generator CB is opened and mains CB is closed after the Mains restoration time. Then after a preset re-cooling time, the Gen-set is shut down. The mains restoration time ensures that the mains supply voltage is stable before it is made available to consumer. While the Gen-set is in operation, it is comprehensively protected against over-speeding, over-voltage and under-voltage conditions.

### 3.2 Remote Mode

In this mode, if mains fail or mains parameters go beyond operating limits, the Gen-set start only after getting a command / pulse to the remote start terminal. Generator parameters are continuously monitored. If any parameter goes beyond the set value, generator is stopped after a set time delay. During running of the generator, the generator is normally stopped either after getting a command / pulse to the remote stop terminal or when mains is restored. The generator CB is opened and mains CB is closed after the preset value of mains restoration time. Then the Gen-set is shut down after re-cooling time.

### 3.3 Manual Mode

In this mode AMR1 ignores mains voltage. It only responds to **Start** and **Stop** commands from the keypad. Similarly generator and mains CBs are also operated from the keypad.

**Precaution:** Before giving Start command to generator, one must ensure that the generator CB is open.

Start key should be held down until the engine reaches threshold speed. The generator CB may now be switched on from

keypad provided that the Mains CB is off. Stop key turns off the engine.

**Precaution:** While pressing stop key, the generator CB must be open. The generator is stopped without going through re-cooling phase.

The mains CB can also be activated from the keypad. Interlocking of mains and generator CBs is built into the firmware.

### 3.4 Off line Mode

If generator is supplying load when off mode is selected, then the generator is switched off. The entire switching off sequence is maintained. It also turns on mains CB. Mains CB can be switched off manually.

### 3.5 Test Mode

In this mode no-load and load test run of the Gen-set is possible. In TEST mode, the engine is automatically started and supervised and it is checked whether the generator has reached its rated voltage.

Mains CB open/close switches are active. Similarly generator CB open/close switches are also active.

### 3.6 Service Mode

For a detailed description read Section 9. Service mode enables the user to change operating mode, to edit operating parameters, to view operating parameters, to view manual diagnostic parameters, to configure input level, to load default parameters, to reset diagnostic parameters & to change service password. This mode can only be accessed holding the "E" key for 2 seconds. On entering service mode relay demands the password. User can edit the parameters if the user enters correct password followed by "E" key. Parameters can be changed by using **Inc ("+" )**, **Dec ("-" )**, **Forward ("→" )** & **Backward ("←" )** keys.

The **Inc** and **Dec** keys work in a special way. If **Inc** key is pressed and released then

parameter is incremented by one. If the key is held down for long time then parameter increment speed is increased. If the key is released at any point and pressed again, then once again it goes into slow mode.

Similarly the **Dec** key changes speed of decrementing, if held down.

### **3.7 Default Mode**

In this mode the current operational mode is displayed along with different generator and mains parameters. Relay resumes this mode if unattended for 90 seconds.

## **4. Mains Supervision**

AMR1 continuously monitors three phase mains supply voltage and detects unhealthy conditions, if unhealthy conditions are detected, then it trips mains CB and initiates starting of Gen-set. Unhealthy condition shall be defined by user in Edit mode.

Unhealthy conditions are defined as follows:

- If voltage of any phase falls below a low limit or exceeds a high limit.
- If difference between voltages of any two phases exceeds a preset limit (% unbalance)
- If frequency falls below a low limit or exceeds a high limit.
- If "Single phase enable" is selected then all the phases must become unhealthy for a valid unhealthy condition.

### **4.1 Parameter Selection**

#### **4.1.1 Voltage**

User selects lower and upper limits of line to neutral voltage in parameter setting mode. AMR1 can be used for single phase / three phase systems. However the user can set under and over voltage values. If mains voltage in any phase either exceeds the upper limit or falls below the lower limit, then it is considered an unhealthy condition. In

Auto mode the relay trips mains CB if the condition prevails continuously for the user defined time delay. AMR1 is also provided with mains voltage unbalance monitoring.

#### **4.1.2 Frequency**

User selects lower and upper limits of acceptable frequency. If the frequency is beyond the limits then it is considered to be an unhealthy condition and the mains CB must trip if the condition prevails longer than user defined time delay.

#### **4.1.3 Frequency Blocking Voltage**

Frequency supervision is disabled below this Voltage.

### **4.2 Circuit Breaker Supervision**

The unit is also equipped with Circuit Breaker Supervision. For supervising the healthiness of circuit breaker the feedback is to be connected at terminal 23 & 24 for Mains Circuit Breaker and for Gen. Circuit Breaker respectively. If after issue of closing command, the check back signal of breaker is not received, the unit will indicate a fault by displaying errors on the LCD display for Mains & Generator respectively.

## **5. Generator Supervision**

While the Gen-set supplies power, it can also show all those abnormalities which were anticipated in mains supervision, (except voltage unbalance) there are however two added parameters: engine speed and battery voltage.

### **5.1 Parameter Selection**

The voltage/frequency limits for the DG set can be set independently of mains settings. The setting procedures are similar to the mains parameters settings. The over-speed is sensed through the frequency of the generating set. In case of over speed the relay trips the generator CB and proceeds to shutdown the engine without entering re-cooling phase. Voltage unbalance of DG is not checked.

## 5.2 Battery Voltage Supervision

AMR1 relay continuously monitors battery voltage and if the voltage falls below a set value, it gives only the visual indication by flashing the LED marked "**Battery Voltage**" on the front plate of the relay. Indication of high battery voltage is also available with fixed settings i.e. if low battery voltage is set below 12 V high battery voltage will be automatically set as 14 V & if low battery voltage is set above 12 V, setting of high battery will be 28V. When the battery voltage returns its operating limit, then the LED marked "**Battery Voltage**" returns to normal state.

## 5.3 Emergency Stop

The Gen-set can be stopped in the event of an emergency by shorting terminal marked "**Emergency Stop**" to the negative terminal of battery. In this case the re-cooling phase is bypassed.

## 5.4 Time Circuits

AMR1 provides a user friendly MMI (Man-Machine Interface) for setting different time circuits for engine start delay, stop delay, mains restoration, re-cooling etc.

Table 1 gives the entire time settings.

## 5.5 Time Elements

### Auto Hooter reset period

It is related to hooter operation and it can be set by the user. It starts as soon as hooter starts. If hooter is not silenced within auto-silence period, then at the expiry of this period hooter is automatically stopped.

### Generator CB on Delay

Generator circuit breaker is not closed immediately after generator exceeds ignition speed. A time delay is introduced. This time delay can be set by the user. During this time AMR1 checks if generator voltage is healthy.

This timer starts after generator voltage reaches safe limit.

### Generator re-cooling Time

Engine is not switched off immediately after GCB is opened. The Gen-set needs time to cool off. If it is stopped, cooling action also stops and the heat stored in its mass starts raising its temperature.

This temperature can attain dangerous levels depending on the duty to which gen-set was subjected to before GCB was opened. Generator is allowed to run at no load for sometime, this is known as recooling time. Re-cooling time can be set by the user.

### Generator Cranking Period

Engine is cranked for the duration of Generator Cranking Period and then waits for engine to start. If engine starts (generator Voltage > Ignition voltage OR Ignition On contact closes), during Generator Cranking Period then also cranking is stopped. This period can be set by the user.

### Generator Cranking Wait Period

It is the time interval between two start attempts. During this period cranking is not repeated.

### Mains Restoration Time

It is the time from mains recovery to closing of mains CB. This timer is started when mains recover. Mains must remain healthy during this period otherwise the timer is reset.

### Generator Start Delay

It is the time between mains failure and initiation of start procedure.

### Delayed Supervision Time

Oil pressure takes time to build up and hence low pressure alarm is initially on. Thus the alarm is not meaningful. We must give time

for oil pressure to build up and then monitor the alarm. The process is called '**Delayed Supervision**' and this time is user settable.

The timer starts after generator voltage exceeds ignition voltage.

### **Generator Tripping Delay**

This is also a form of delayed supervision. When GCB is closed, entire load is taken by the Gen-set. If there are loads which draw heavy starting current then generator voltage will dip as soon as GCB is closed. The dip will persist for some time. During this time generator voltage should not be monitored otherwise AMR1 will decide to trip generator. The time allowed for this delayed supervision is '**Generator tripping delay**'. It is user settable. This timer starts as soon as generator circuit breaker is closed.

### **Generator Run Hours**

This timer is started as soon as GCB is closed and stopped when GCB is opened. It accumulates the time for which Gen-set runs. The time is stored in hours and goes up to 9,999 hours. The hour counter resets on exceeding 9999 hours.

### **Generator Off Delay**

This timer is started as soon as either generator unhealthy condition is detected or mains restoration time is over and generator CB is turned off when the set time elapses. This time is set to Generator Off delay.

### **Stopper Time**

A thirty second timer starts as soon as stopper is operated. Stopper timer is started if

1. Generator voltage falls below ignition voltage or
2. Thirty second timer expires.

In any case stopper remains operated until stopper timer times out.

<b>Description</b>	<b>Displayed As</b>	<b>Range</b>	<b>Steps</b>	<b>Default Setting</b>
Mains Rated Voltage	MAINS RATED VOLT	115-300	1V	230 V
Mains Under Voltage	MAINS UNDER VOLT	115-300	1V	180 V
Mains Over Voltage	MAINS OVER VOLT	115-300	1V	250 V
Mains Rated Frequency	MAINS RATED FREQ	40-70	0.1 Hz	50 Hz
Mains Under Frequency	MAINS UNDER FREQ	40-70	0.1 Hz	47.5 Hz
Mains Over Frequency	MAINS OVER FREQ	40-70	0.1 Hz	52.5 Hz
Generator Rated Voltage	GEN RATED VOLT	115-300	1V	230 V
Generator Under Voltage	GEN UNDER VOLT	115-300	1V	180 V
Generator Over Voltage	GEN OVER VOLT	115-300	1V	250 V
Generator Rated Frequency	GEN RATED FREQ	40-70	0.1 Hz	50 Hz
Generator Under Frequency	GEN UNDER FREQ	40-70	0.1 Hz	47.5 Hz
Generator Over Frequency	GEN OVER FREQ	40-70	0.1 Hz	52.5 Hz
Mains Frequency Blocking Voltage	M FREQ BLK VOLT	100-300	1 V	100 V
Generator Frequency Blocking Voltage	G FREQ BLK VOLT	100-300	1 V	100 V
Over Speed	OVER SPEED	50-70	0.1 Hz	55.0 Hz
Ignition Voltage	IGNITION VOLT	50-100	1 V	60 V
Generator CB on Delay	GEN CB ON DELAY	0-999	1 Sec.	3 Sec
Generator Re-Cooling Time	GEN RECOOL TIME	0-999	1 Sec.	180 Sec
Generator Cranking Wait Period	GEN CK WAIT TIME	0-300	1 Sec.	10 Sec
Mains Restoration Time	MAIN RESTOR TIME	0-999	1 Sec.	30 Sec
Generator start Delay	GEN START DELAY	0-999	1 Sec.	3 Sec
Generator Off Delay	GEN OFF DELAY	0-999	1 Sec.	3 Sec
Delayed Supervision time	DELAY SUPER TIME	0-999	1 Sec.	10 Sec
Generator Tripping Delay	GEN TRIP DELAY	0-999	1 Sec.	5 Sec
Single Phase Enable	1 PHASE ENABLE	0-1	-	0
Auto Hooter Reset Period	HOOTER RST TIME	0-999	1 Sec.	30 Sec
Mains Unbalance Voltage	M UNBALANCE VOLT	15-40	1 %	25 %
Number of Generator Cranking	NO. OF GEN CRANK	1-9	1	3
Generator Cranking Period	GEN CRANK PERIOD	0-60	1 Sec.	10 Sec
Stopper Time	STOPPER TIME	1-40	1 Sec.	10 Sec
Battery low Indication	BAT LOW INDICATN	6-36	1 V	10.5 V
Mains CB Close Time	MCB CLOSE TIME	0-999	1 Sec.	15 Sec

**Table 1: Different Parameter Setting in edit mode**

## 6. Design

### 6.1 Connection

The connection diagram for the AMF relay AMR1 is shown in the Fig.2

### 6.2 Output relays

AMR1 has six output relays. All functions and terminals of these output relays are described in the Table 2 shown below.

Relay No.	Description	Terminal No.
1	Hooter / Alarm	9,10
2	Mains CB release	11,12
3	Generator CB release	13,14
4	Generator starter	15,16
5	Fuel Valve open	17,18
6	Generator stopper	19,20

**Table 2: Output relay description**

## 6.3 Inputs

### 6.3.1 Mains Voltage connection

Mains supply voltage connection to the relay AMR1 is shown in the Fig 2. The mains line voltage supply is connected to terminal number 2, 3 & 4 with neutral at terminal 1 of the AMR1 relay.

### 6.3.2 Generator voltage connection

Gen. supply voltage connection to the relay AMR1 is shown in Fig2. Generator line voltage supply is connected to terminal numbers 5 and gen. neutral at terminal no. 6 of relay.

### 6.3.3 Auxiliary supply

The relay AMR1 has SMPS auxiliary supply, which has the DC supply voltage range **7 - 35 V DC**. This voltage supply is connected positive (+ve) to the terminal No. 21 and negative (-ve) to the terminal No. 22.

### 6.3.4 CB Feedback Contacts

The relay AMR1 has two CB feedback contacts one for mains CB and one for generator CB which are connected to the terminals 23 and 24 respectively.

### 6.3.5 Start/Stop signals

The relay AMR1 has three start/stop input signals. One for emergency generator stop signal which is connected to the terminal number **26** of the relay. The other two signals are used for remote starting and stopping of generator in "**Remote Mode**" only. These signals are connected to the terminal numbers **27** and **25** respectively.

### 6.3.6 Fault signals

There are four external input fault signals provided in relay AMR1. These faults can be programmed in the Setup/Configuration mode as per requirement. Details of these faults are listed in table no. 3.

Description	Type	Default Setting
Fault No. 1 (Pressure input)	0,1,2,3,4	0
Fault No. 2 (Engine temperature input)	0,1,2,3,4	0
Fault No. 3 (Fuel Level input)	0,1,2,3,4	0
Fault No. 4	0,1,2,3,4	0

**Table 3: Fault setting**

0	Disabled.
1	Display only.
2	Display with Hooter / Alarm.
3	Display, Hooter/Alarm with normal shut down of generating set.
4	Display, Hooter/Alarm with emergency shut down of Generating set.

**Table 4: Fault priority level**



## Annunciation

External Fault Inputs	Displayed As
Fault No. 1 (Pressure input)	LOW LUBE OIL PRE
Fault No. 2 (Engine temperature input)	HIGH COOL TEMP
Fault No. 3 (Fuel Level input)	LOW FUEL LEVEL
Fault No. 4	EXT. FAULT I/P 4

### 6.3.7 Internally processed fault display

Different internally processed fault displays in the relay are:

1	Mains CB open fail
2	Mains CB close fail
3	Generator voltage unhealthy
4	Generator fails to start
5	Generator fails to stop
6	Generator CB open fail
7	Generator CB close fail
8	Fail to build
9	Generator over speed
10	Generator Emergency Stop

**Table 5: Internally Processed fault display**

### 6.4 Display

The AMF relay AMR1 is equipped with an alpha numeric LCD display to provide the Man-Machine Interface (MMI). The mains / generator measuring parameters may be checked when required. The relay also displays abnormalities of mains/generator parameters, CBs etc.

### 6.5 LEDs

There are eight LED indication provided in the front panel of the relay AMR1, and all the eight LEDs are red LEDs and are accompanied with a legend. The functions of these LEDs are described in the Table 6.

LEDs	OFF	STEADY	FLASHING
Voltage	Healthy	X	Unhealthy
Frequency	Healthy	X	Unhealthy
Mains CB	CB OFF	CB ON	X
Gen CB	CB OFF	CB ON	X
Battery Voltage	Voltage Healthy	X	Voltage unhealthy
Low Oil Pressure	No Fault	X	Fault Occurred
Engine Temp High	No Fault	X	Fault Occurred
Low Level Fuel	No Fault	X	Fault Occurred

**Table 6: Function/Indication of LEDs**

### 6.6 Front Panel Keypad

The front panel keypad consists of eleven keys which are arranged into two groups. These are

- **Command keys**
- **Edit keys**

The command keys are six in number and are marked as **Gen Start, Gen Stop, Gen CB Open, Gen CB Close, Mains CB Open** and **Mains CB Close**.

There are five Edit Keys marked as **Enter ("E"), Increment ("+"), decrement ("-" ), Forward ("→")** and **Backward ("←")**.

Edit keys serve following functions.

#### "→" Key [Select Forward]

- In service mode, it is used as forward scrolling. The edited parameter is stored in memory only after pressing this key.
- In default mode, it is used to view fault done. When there is no fault, it is not work.

#### "←" Key [Select Backward]

- In service mode, it is used as backward scrolling.
- In presence of a fault, the fault can be reset by holding this key for 4 seconds. The display will come back on the default screen as the acknowledgement of reset.

### **“+” Key [Increment]**

This key increments the value of the parameter being displayed in service mode. This key is also used to view mains parameters display screens.

### **“-” Key [Decrement]**

This key decrements the value of parameters being displayed in service mode. This key is also used to view generator parameters display screens.

### **“E” Key [Enter]**

This key is used to enter in service mode & going in different parameters edit mode as forward scrolling.

### **“GEN START”**

This key is active in Manual mode. It starts the generator.

### **“GEN STOP”**

This key is active in Manual mode only. It stops the generator.

### **“GEN CB OPEN”**

This key is active in Manual and Test modes. It opens generator CB.

### **“GEN CB CLOSE”**

This key is active in Manual and Test modes. It closes generator CB.

### **“MAIN CB OPEN”**

This key is active in Manual, Test and Offline modes. It opens mains CB.

### **“MAINS CB CLOSE”**

This key is active in Manual, Test and Offline modes. It closes mains CB.

## **7. Parameter Setting/Display Procedure**

- To view mains parameters screen press the “+” Key.
- To view generator parameters screen press the “-” Key.
- To Enter in service mode press the “E” key for 2 seconds. Refer Getting Started for details.

## **8. Terminal Details**

### **8.1 Terminal arrangement**

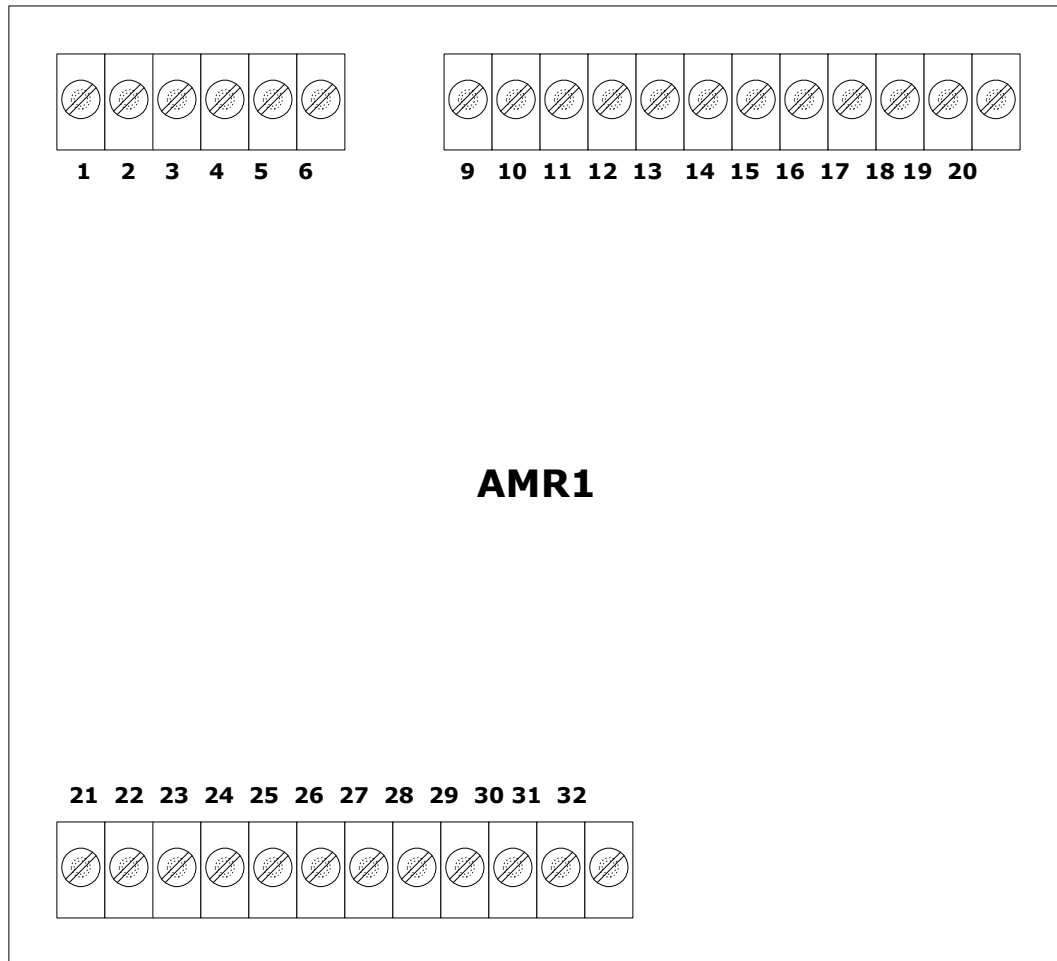
The terminal arrangement of the AMF relay AMR1 is shown in the Fig. 1.

### **8.2 Terminal description**

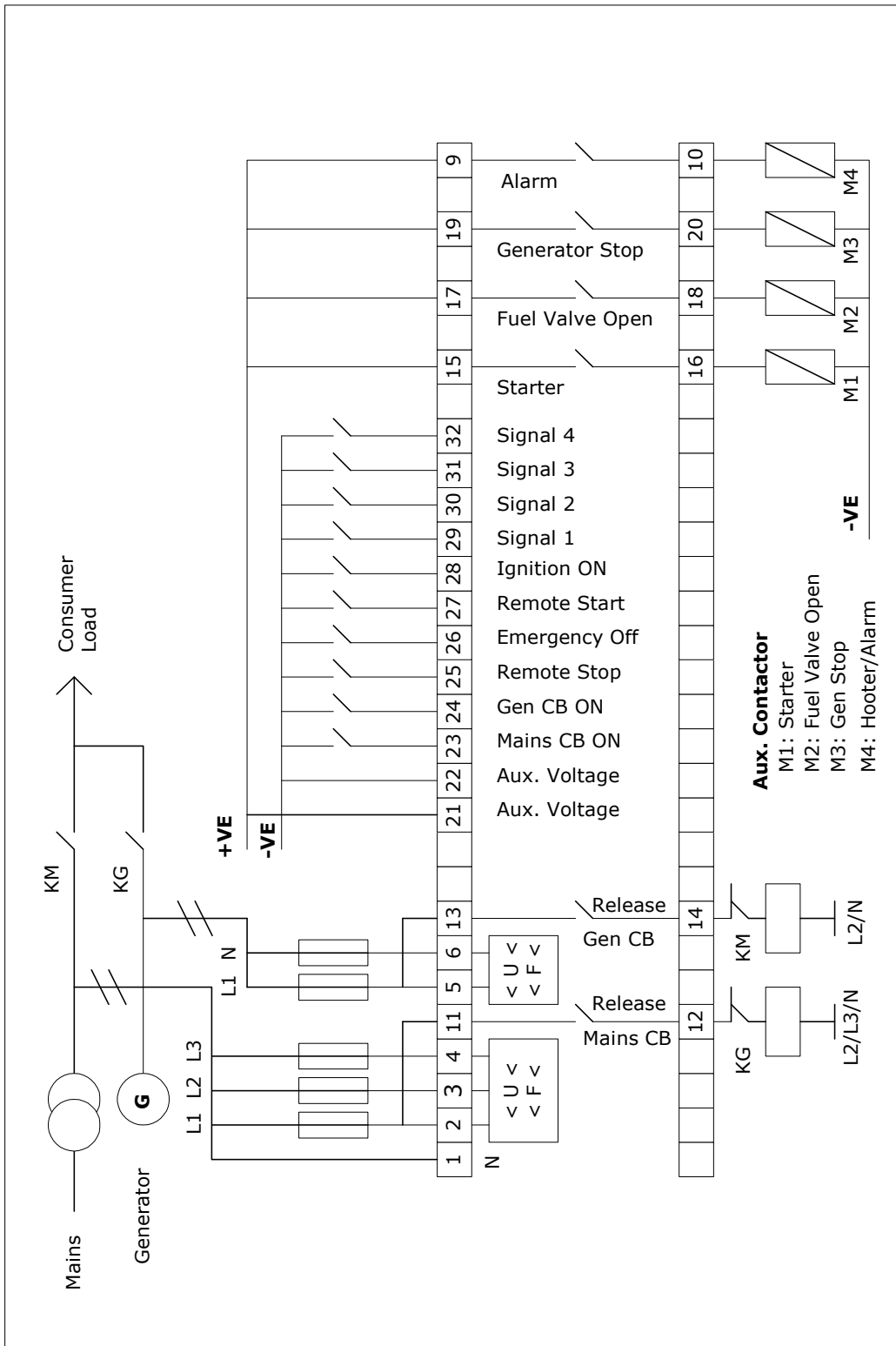
The terminal description of AMF relay AMR1 is:

<b>Terminal No</b>	<b>Description</b>
1	Mains Neutral
2,3,4	Mains Voltage
5	Generator Voltage
6	Generator Neutral
7	Not Connected
8	Earth
9,10 (NO)	Hooter/Alarm contact
11,12 (NO)	Mains CB release contact
13,14 (NO)	Generator CB release contact
15,16 (NO)	Generator Start contact
17,18 (NO)	Fuel Valve on contact
19,20 (NO)	Generator stop contact
21	Auxiliary supply (+ ve)
22	Auxiliary supply (- ve)
23	Mains CB feedback
24	Generator CB feedback
25	Generator remote stop
26	Generator emergency stop
27	Generator remote start
28	Ignition ON Input
29	Fault signal 1
30	Fault signal 2
31	Fault signal 3
32	Fault signal 4

**Fig 1. Terminal Arrangement Viewed From Rear**



**Fig 2. Connection diagram for AMR1**



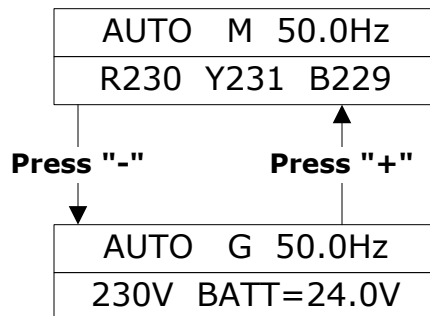
## 9. Getting Started

9.1 AMR1 displays various parameters in "Default Mode"

9.1.1 The current operational mode is displayed in the Mains screen indicated by the "M" in the centre of the first line, followed by the mains frequency and the three line voltages in the second line of the LCD display.

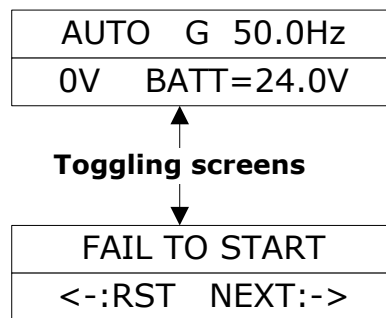
9.1.2 Similarly the current operational mode is displayed in the Generator screen indicated by the "G" in the centre of the first line, followed by the generator frequency and the battery voltage in the second line of the LCD display.

9.1.3 Generator and mains screen can be viewed alternatively by pressing "+/-" keys on keypad.



9.2 AMR1 displays faults along with generator parameters in "Default Mode"

9.2.1 If any external or internal fault comes, then AMR1 comes into fault displaying mode. In this mode default generator and fault screen toggles.



9.2.2 In fault screen, one fault is displayed in the first line and an instruction to reset the fault (by pressing "<" for four seconds) is displayed in second line.

9.2.3 If more than one fault are present they can be viewed by pressing ">" keys.

9.2.4 Mains and generator screens can be viewed by pressing "+/-" keys.

9.3 AMR1 enters in Service Mode by pressing "E" key.

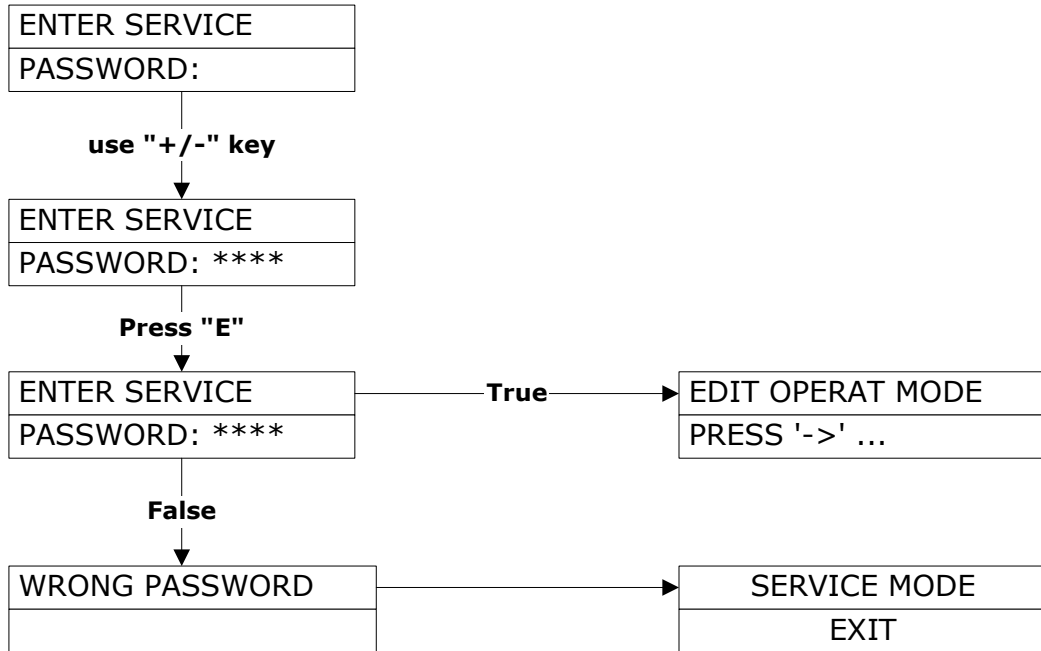
9.3.1 After entering in service mode AMR1 ask for service password.

9.3.2 Password is entered by using "+/-" keys.

9.3.3 Password is accepted after pressing "E" key. If true password is entered then only user can go to next parameter, otherwise default mode screen is displayed (after three try).

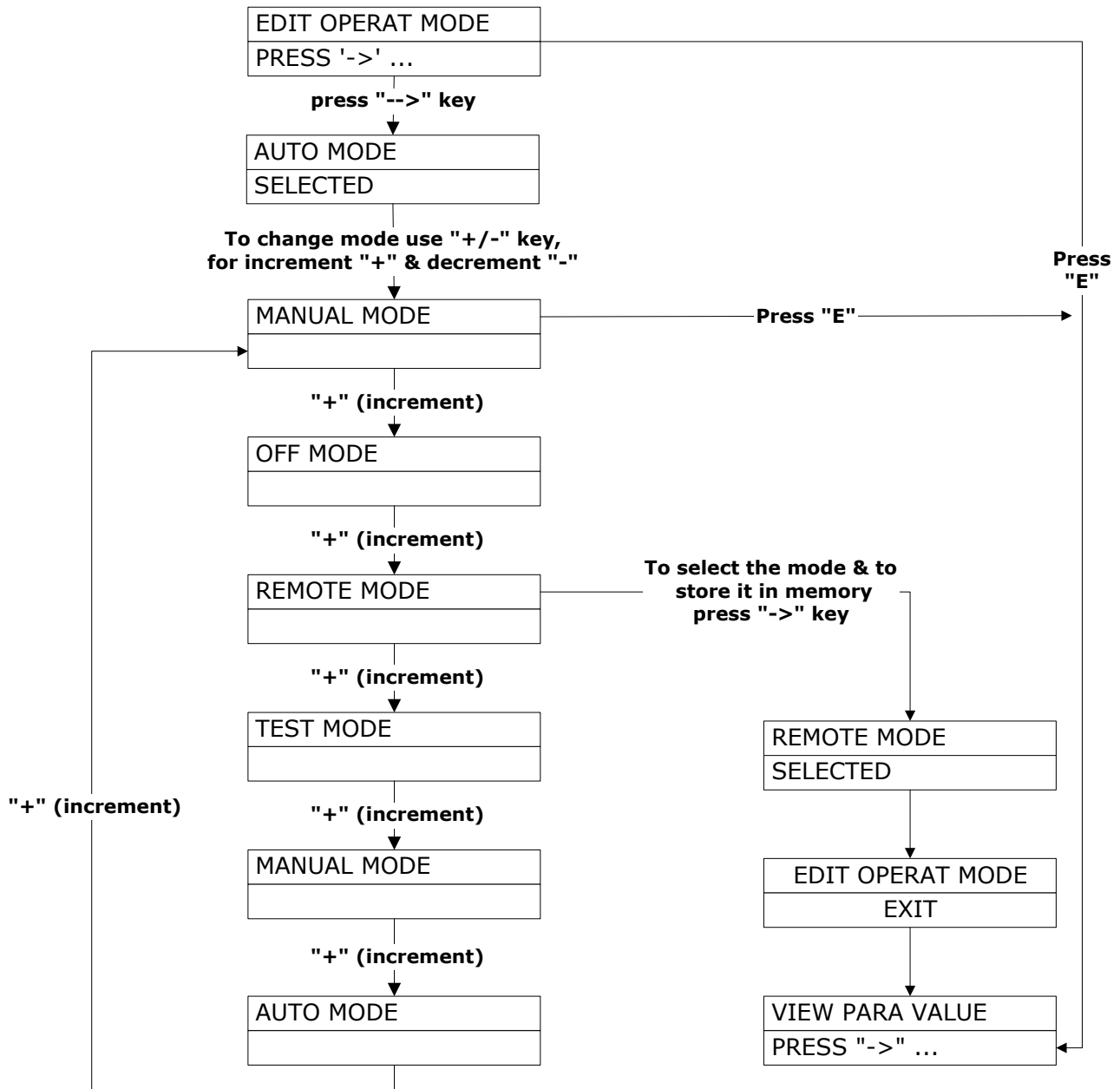
9.3.4 After entering in service mode successfully, user can edit operating mode, view operating parameters, edit operating parameters, view manual diagnostic parameters, edit external

input priority level, load default parameters and reset manual diagnostic parameters, change service password.



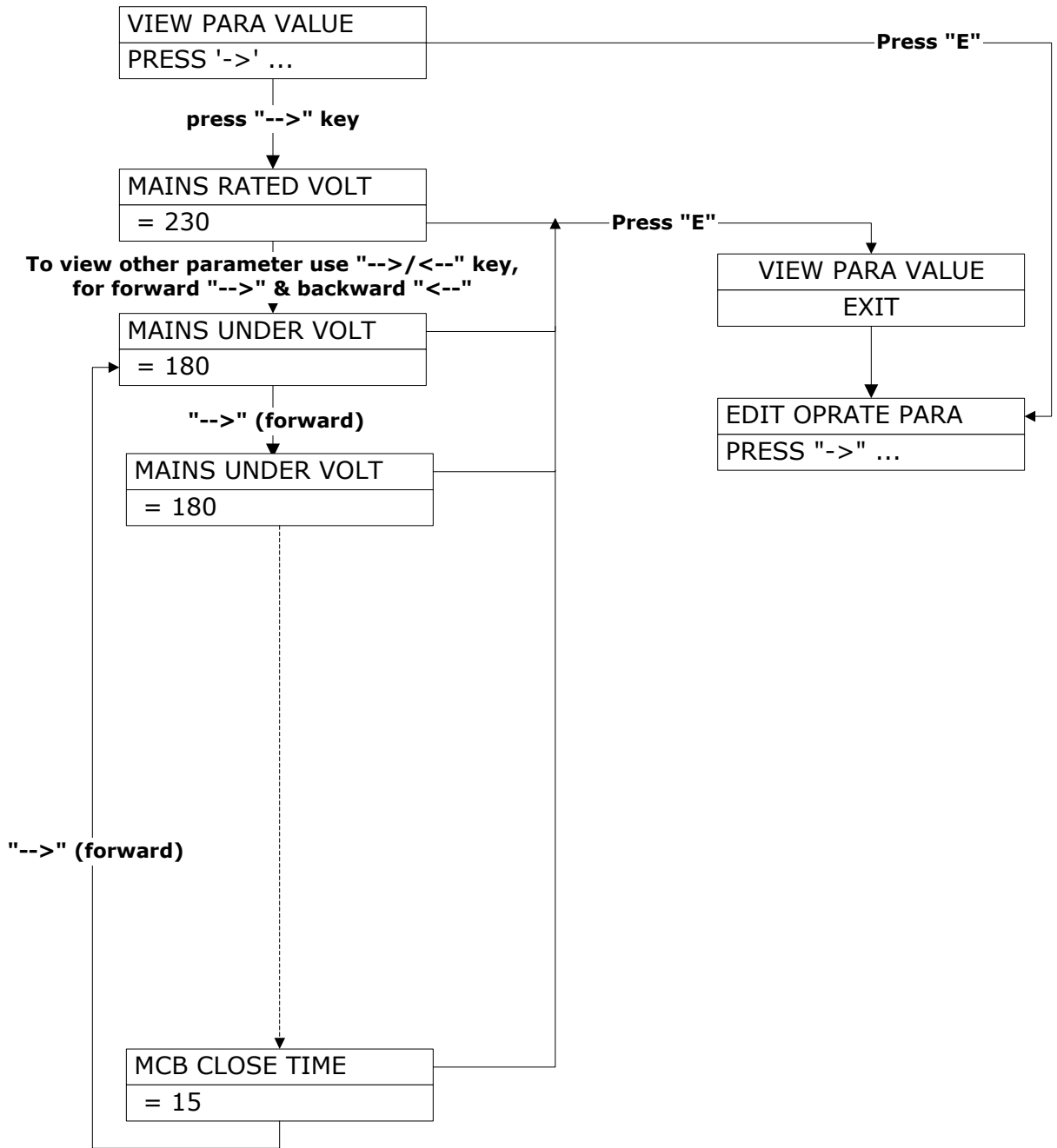
**\*Default service password is 0000.**

## 9.4 Edit operating mode



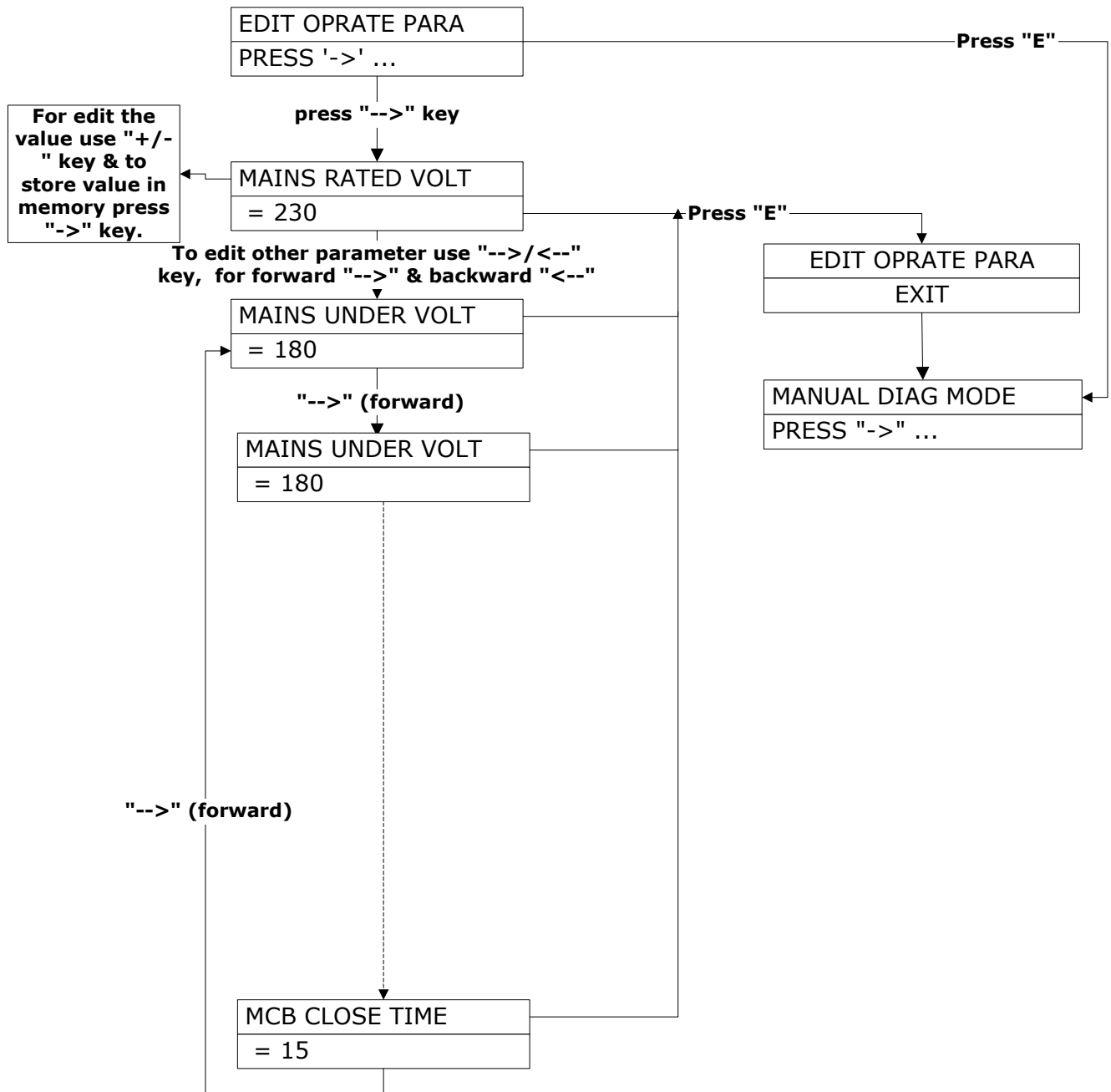
**\*To store selected mode in memory press "-->" key.**

## 9.5 View operating parameters

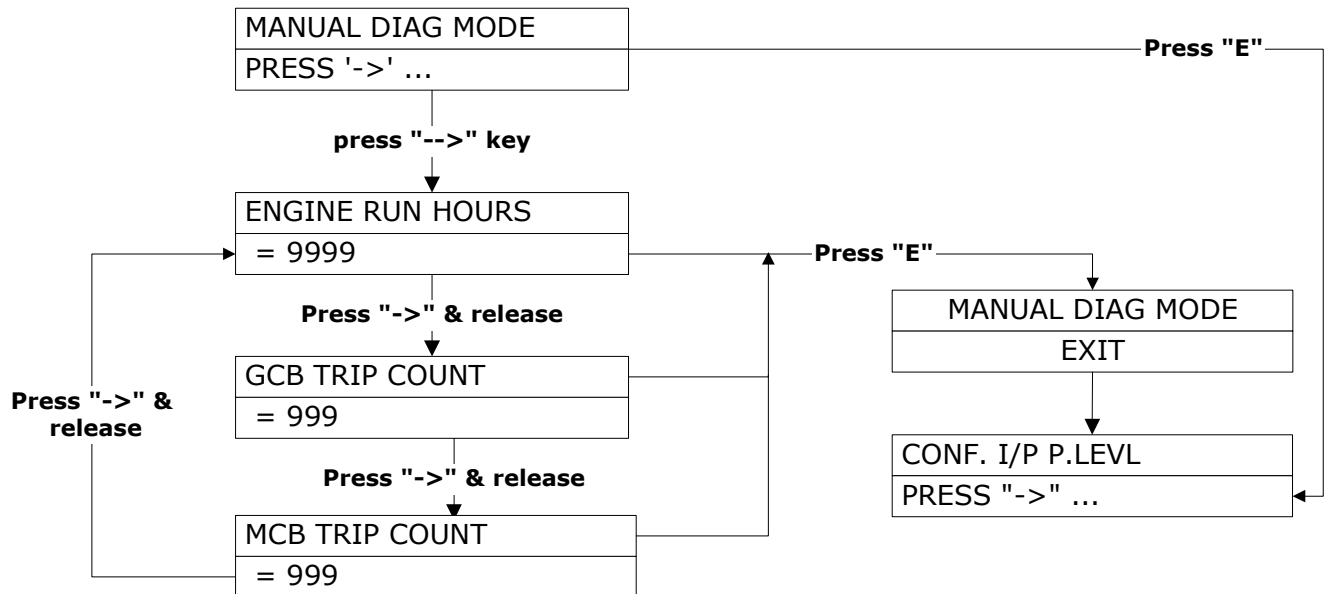




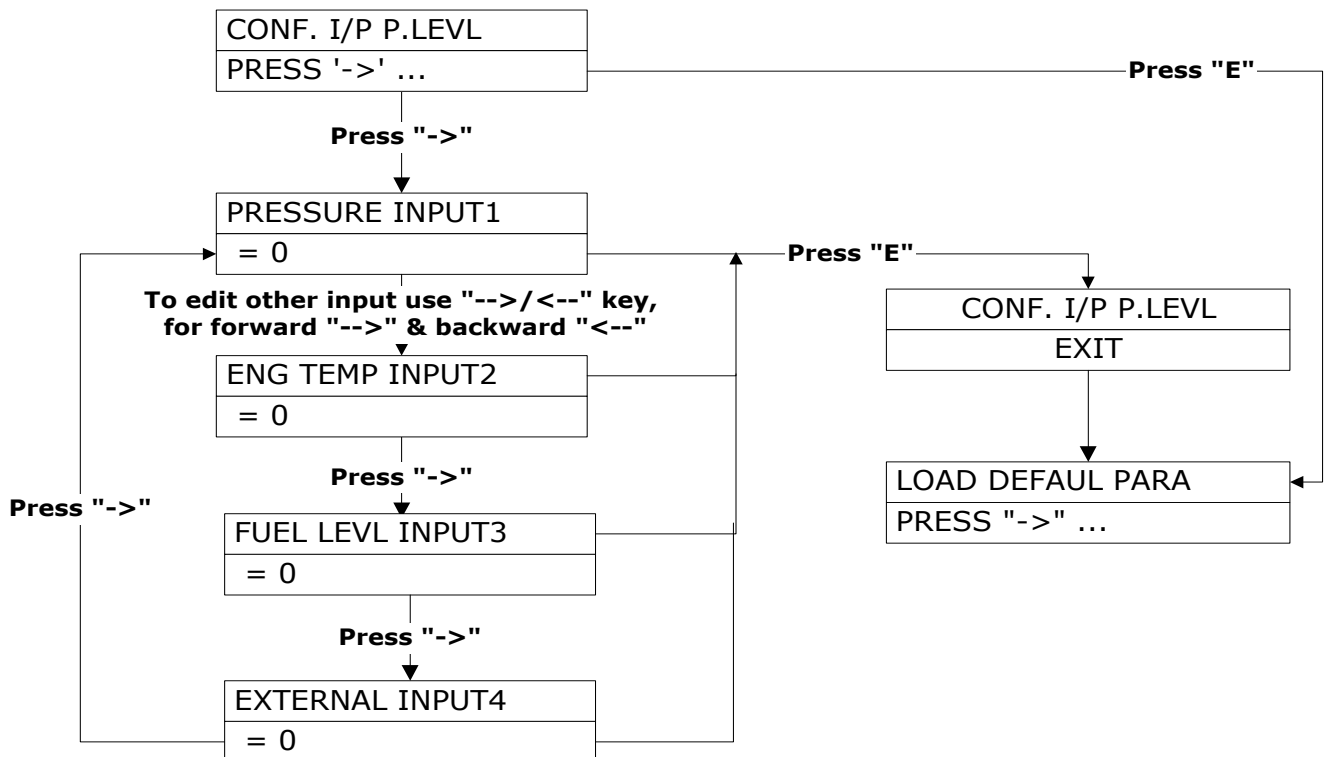
## 9.6 Edit operating parameters



### 9.7 View manual diagnostic parameters

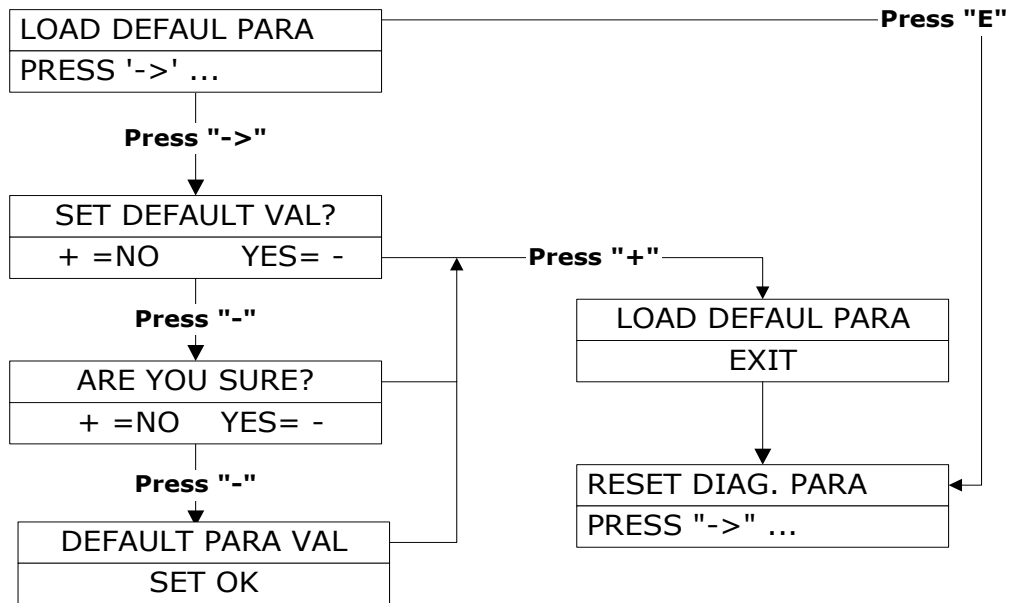


### 9.8 Edit external fault input

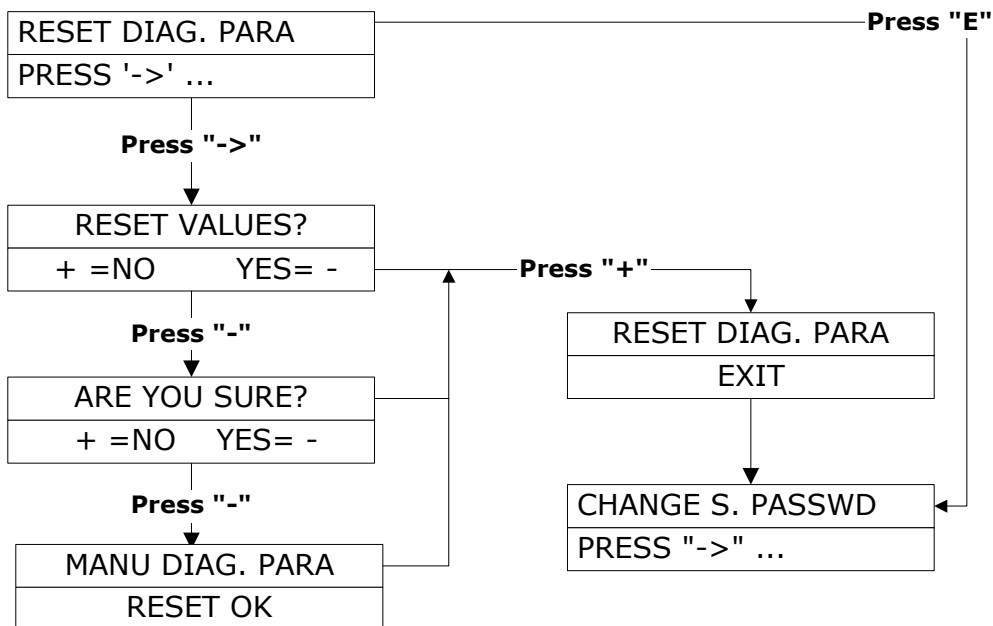


**\*To edit the priority level of external fault input use "+/-" key & to store priority level in memory press "→" key.**

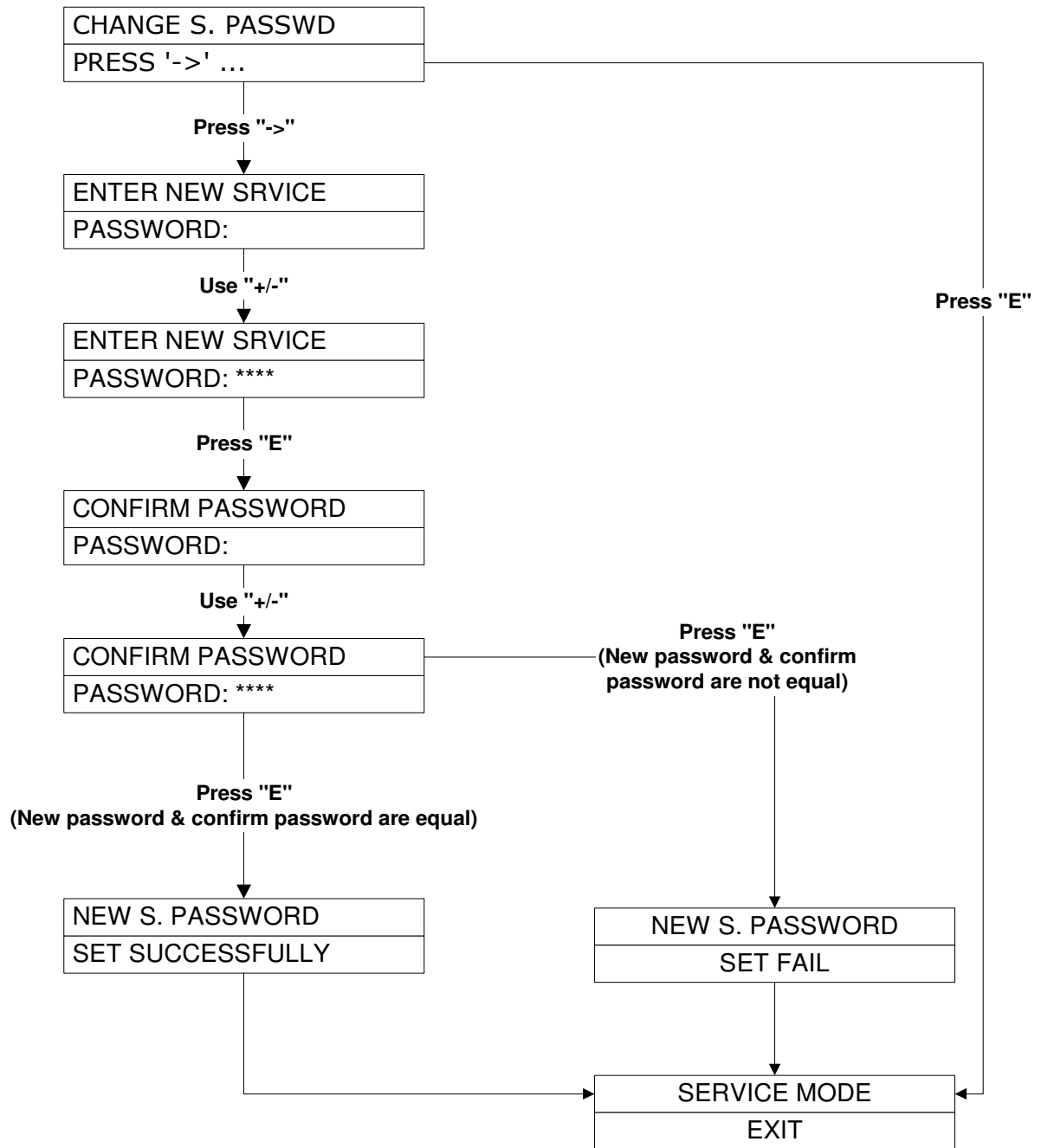
### 9.9 Load default parameters



### 9.10 Reset manual diagnostic parameters



### 9.11 Change service password



## 10. Functional Specifications

Sr. No.	Parameter	Specification		
1	<b>Selection mode</b>	<b>Auto</b>		
2		<b>Manual</b>		
3		<b>Off</b>		
4		<b>Remote</b>		
5		<b>Test</b>		
6	<b>Functions</b>	<b>View actual values (Default Mode)</b>	Mains Voltages	
7			Mains Frequency	
8			Generator Voltage-Phase Voltage	
9			Generator Frequency	
10			Battery Voltage	
11		<b>View Set Parameters (View Para Mode)*</b>	Voltage rated, upper and lower limits for mains and Generator	
12			Frequency rated, upper and lower limits for mains and generator	
13			Unbalance limit for mains voltage	
14			Enable mains operation on single phase	
15			Voltage limit below which frequency of mains/generator is not read	
16			Battery voltage Low value	
17			Ignition voltage	
18			Over speed limit	
19			Number of cranking attempts	
20			Generator start delay	
21			Generator cranking period	
22			Stopper delay	
23			Cranking wait period	
24			Re-cooling Time	
25			Generator CB on delay	
26			Generator Tripping delay	
27			Delayed supervision	
28			Generator off delay	
29			Mains restoration time	
30			Hooter Reset Time	
30			Main CB close time	
31			<b>Edit Parameters (Edit Para Mode)*</b>	Set all above parameters.
32			<b>View values (Manual/Diagnostic Mode)*</b>	Engine Run Hours
				GCB Trip Count
				MCB Trip Count
33		<b>Change Password (Password Mode)*</b>	Service password can be modified.	
34		<b>Load Default Mode*</b>	This mode loads default parameters, service password and resets diagnostics parameter.	
35		<b>Select functional mode (Mode Select Mode)*</b>	Automatic mode	
			Remote mode	
			Manual mode	

			Offline mode
			Test mode
36		<b>Supervision</b>	Three line voltages of mains -Voltage band -Unbalance limit
37			One line voltage of generator -Voltage band
38			Frequency of mains -Frequency band
39			Frequency of generator -Frequency band
40			Battery voltage -Voltage band

**\* This mode is protected by Service Password.**

### 11. Performance Specifications

Sr.No.	Parameter	Specification
1	Aux Supply	7.0-35.0 V DC
2	Aux supply Interruption Time	1 second sustain battery dip down to zero volts for one second without requiring external capacitor bank.
3	Aux supply burden	<3 W @ 24 V DC
4	External cap. bank	Not Required
5	Generator voltage	50 to 300 V AC (Ph-N)
6	Mains voltage	50 to 300 V AC (Ph-N)
7	Rated frequency	50 / 60 Hz
8	Voltage measuring tolerance	+/- 1 %
9	Freq. measuring tolerance	+/- 0.5 %
10	VBatt Supervision	9.0-35.0 V
11	Tolerance of VBatt measurement	+/- 1 %

### 12. Hardware Specifications

Sr.No.	Parameter	Specification		
1	Display	16 characters/row x 2 rows LCD display with built in controller		
2	Annunciation using LEDs	Voltage		
3		Frequency		
4		Mains CB		
5		Gen CB		
6		Battery Voltage		
7		Low Oil Pressure		
8		Engine Temp. High		
9		Low Fuel Level		
10		Key Pad 11 Keys	1	Edit Keys 5 Keys
	2		Control Keys 6 Keys	Gen Start, Gen Stop, Open Mains CB, Close Mains CB, Open DG CB, Close DG CB

11	External faults - 4	Opto-isolated I/Ps	
12	Controls-3	Opto-isolated I/Ps	Emergency Stop Remote Stop Remote Start
13	Feed Back - 3	Opto-isolated I/Ps	MCB check back GCB check back Ignition on
14	Relay - 6 nos. O/P Contact rating (ALL relays) - 250V AC, 4A resistive	N/O Contacts	Starter Motor Fuel Injection Decompression Coil (Stopper) Generator CB Hooter Main CB
15	Storage temp.	-40°C - +75°C	
16	Operating temp.	-20°C - +70°C	
17	Connecting terminals	2.5 mm <sup>2</sup> Recommended 2.5 mm <sup>2</sup> conductor	
18	Enclosure	1. Flush mounting 2. Panel cut-out: (W x H) 144 mm x 144 mm (max.) 3. Installation Depth: 110 mm (max.) 4. Weight: 0.8 Kg approx.	