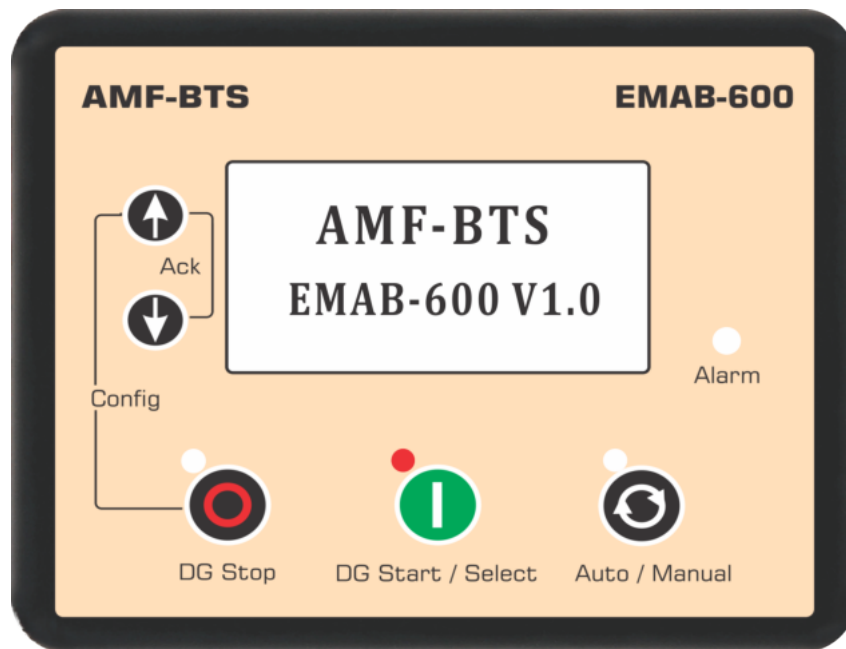


**User Manual  
for  
AMF-BTS Controller  
Model No - EMAB-600**



**Version - 1.0**

**Release of Date- 15/04/2021**

## **INTRODUCTION**

AMF - BTS Controller is an advanced Micro controller based DG Protection unit and has been specially designed to meet the harsh requirement of Indian conditions.

The EMAB-600 series module has been designed to allow the operator to start and stop the generator, and EMAB-600 transfer the load to the generator automatically. Additionally, the EMAB-600 automatically starts and stops the generator set depending upon the status of the mains (utility) supply and BTS battery voltage.

The EMAB-600 Module monitors the engine, indicating the operational status and fault conditions, automatically shutting down the engine and giving a true first up fault condition of an engine failure by the LCD display.

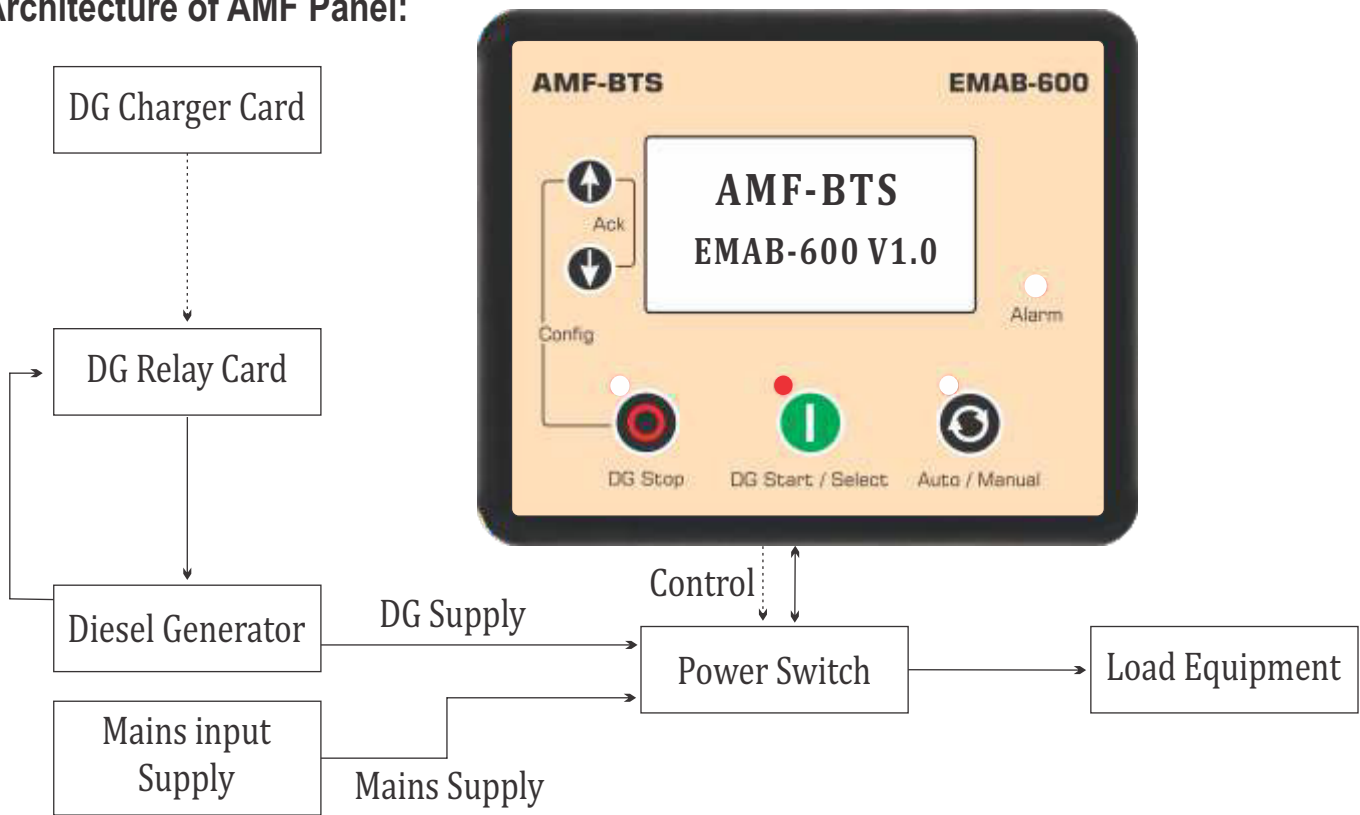
### **PRODUCT DESCRIPTION:**

“AMF” can manage and control the power requirements at the existing unmanned BTS and provide a single point control & monitoring facility for superior, efficient operational performance over conventional AMF and Servo Systems. High speed micro controller based controlling & monitoring Interface.

AMF also controls & monitors the generator performance. With the input mains supply failure; the unit automatically switches ON the diesel generator unit and transfers the load to DG. AMF is built with operational logic, where user can set generator Max Run Time based on 48V DC Power Plant Battery voltage status and Shelter Temperature status.

If Mains any phase coming down 140V (Phase Voltage), all three phases should cutoff, system will sense mains fail followed by “site on battery” and DG will trigger as per the DG saver logic.

## Architecture of AMF Panel:



### Master Control Card (EMAB-600):

EMAB-600 primary function is to monitor, display and control the AMF operation. EMAB-600 is interfaced with mains input supply, DG supply and load.

If the mains supply voltage is within the pre-defined voltage range, the mains supply is given to load at the output. When mains supply voltage is off or out of the predefined voltage range then, EMAB-600 will switch on the DG, if 48V DC Battery Bank low or Temp high condition occurs. DG control unit will switch 'ON' the DG and report the same to EMAB-600. Now, EMAB-600 will switch the load to DG.

## Technical Information

Description	Specification
AMF Logic	If Mains all 3 phase are in the range than "MAINS OK" Otherwise Start DG Set if BTS Voltage Low.
Mechanical	Having approximate dimension(LXBXH) : (138.50x113x40 mm)
Event Logs	Last 100 events
RS 485	Data Communication through RS-485
Energy Measurement	Shall be able to measure the DG energy (Cumulative KWH & Hrs.)
	Shall be able to measure Mains energy (Cumulative KWH & Hrs.).
	Shall be able to measure battery running hours (Cumulative).
	Mains and DG cumulative running Hours .
<b>DG Protection system:</b>	
Low lube oil Pressure	Provided
Low Fuel level	Provided
Voltage Protection	High Voltage - 250 volts & Low Voltage - 190 volts
DG Over speed protection	Provided
<b>Settings:</b>	
DG cooling time	1-5 minutes settable
DG start attempts	Default setting - Three attempts of 2, 3 & 4 sec with delay between attempts (10 -10 -10 sec).
Stop Command duration	Settable from 10 to 30 seconds Default -15 secs.
DG Trigger voltage	47 volts (Settable)

DG trigger temperature	35°C to 65°C 35°C-----(INDOOR Application) DISABLE -----(OUTDOOR Application)
Room Temperature Alarm	OUTDOOR:-ST-55°C RST- 50°C
	INDOOR :-ST-37°C RST -34°C
DG CUT OFF	High Cut Off at 280 volts
	Low Cut Off at 160 volts
EB CUT OFF	High Cut Off at 290 volts
	Low Cut Off at 150 volts
	High Cut In at 280 volts
	Low Cut In at 160 volts
Smoke Detector	System is enable to sense the F&S sensing of the shelter. If there is fire & smoke alarm , whole system is shutdown.
DG Over speed Protection	Provided
Room temperature sensor	Provided

## Safety Instructions:

Safety rules of this document are applied for installation, test, maintenance and repair of AMF.

## Basic Information:

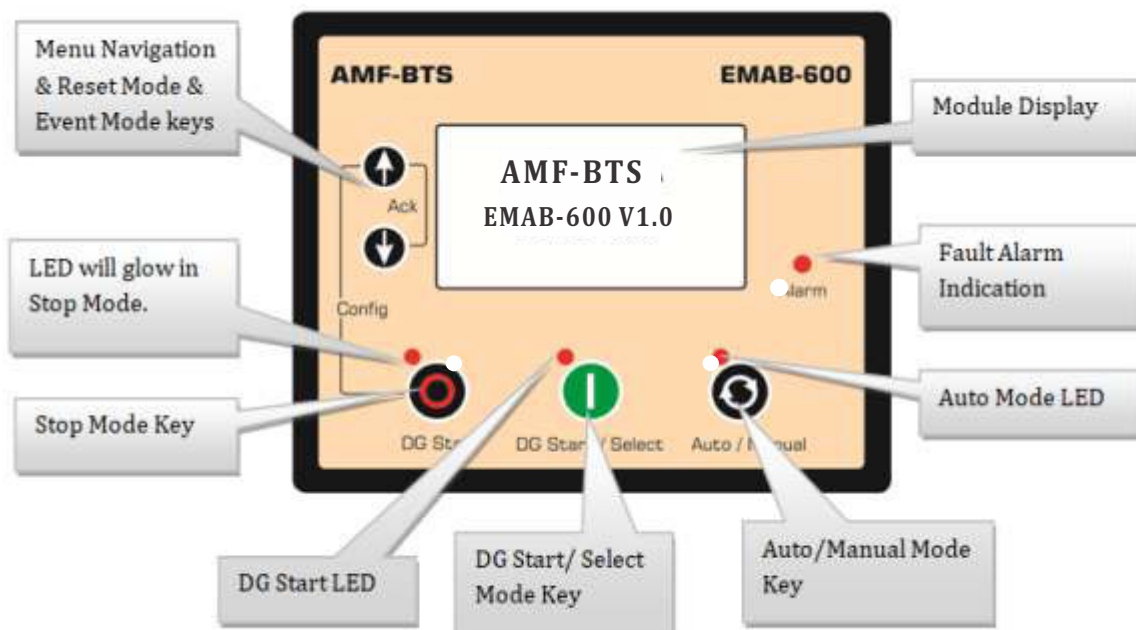
- ☞ No material should be left inside the panel.
- ☞ Tools to be used must be insulated covering or to be insulated with insulating tape.
- ☞ Always provide a free airflow in front of and above the cabinets / individual units.
- ☞ Equipment with unprotected, live parts must not be left unattended.
- ☞ Take off Metal bracelets; rings etc. That can cause short circuits in equipment.

## Installation Instructions:

- ☞ Separate DC & AC cables at AMF.
- ☞ Verify the connection at alternator of DG.
- ☞ Give the connections LLOP, HCT, Fuel and GND from DG.
- ☞ Give the connection of -48V from rectifier to AMF (-48V, GND).
- ☞ Check the load distribution at output.
- ☞ Give the connections to Fire & Smoke detector.

## Display:

Display contains Liquid Crystal Display; LED's to display Alarms, Measurement data and Fault logs & Keys to control and to set the parameters etc.



## Configuration Parameters

User can read & configure programming parameter settings through only GUI.

Sr. No.	Configuration Page		Parameter Name	Default
1	Module	General	Power on Mode	Auto
			Power Save Mode	Disable
			Power on LAMP Test	Enable
			Application	Outdoor
		Communication	COMM Mode	RS 485
			Slave ID	001
		Site Bat Configuration	Battery Monitoring	Enable
			Low BTS Threshold	47.3 Volt
			Low Battery Monitoring Delay	10 sec
		2	Input	Digital Input A
Name	Digital Input A			
Polarity	Close to Activate			
Action	Shut Down			
Activation	Always			
Activation Delay	05 sec			
Digital Input B	Source			Emergency
	Name			Digital Input B
	Polarity			Close to Activate
	Action			Shut Down
	Activation			Always
	Activation Delay			05 sec
Digital Input C	Source			F&S
	Name			Digital Input C
	Polarity			Close to Activate
	Action			Shutdown
	Activation			Always
	Activation Delay			05 sec
Digital Input D	Source			RWL
	Name			Digital Input D
	Polarity			Close to Activate
	Action			Shutdown
	Activation			Always
	Activation Delay			05 sec
Digital Input H	Source			FL 15%
	Name			Digital Input H
	Polarity			Close to Activate
	Action			Shutdown
	Activation			Always
	Activation Delay			05 sec
Digital Input I	Source	Canopy		
	Name	Digital Input I		

3			Polarity	Close to Activate
			Action	Shutdown
			Activation	Always
			Activation Delay	05 sec
		<b>Fuel / DIG E</b>	Sensor Selection (Analog/Digital)	Digital
			AIP_A DIP Source	SPD
			Polarity	Close to Activate
			Action	None
			Activation	Always
			Activation Delay	05 sec
			Shutdown	Disable
			Open Circuit Action	Disable
			Threshold	10 %
			R1 (Resistance)	10 ohm
			L1 (FUEL LEVEL)	0 %
			R2 (Resistance )	29 ohm
			L2 (FUEL LEVEL)	10 %
			R3 (Resistance)	48 ohm
			L3 (FUEL LEVEL)	20 %
			R4 (Resistance )	67 ohm
			L4 (FUEL LEVEL)	30 %
			R5 (Resistance)	86 ohm
			L5 (FUEL LEVEL)	40 %
			R6 (Resistance)	105 ohm
		L6(FUEL LEVEL)	50 %	
		R7 (Resistance )	124 ohm	
		L7 (FUEL LEVEL)	60 %	
		R8 (Resistance)	143 ohm	
		L8 (FUEL LEVEL)	70 %	
		R9 (Resistance)	181 ohm	
		L9 (FUEL LEVEL)	90 %	
		R10 (Resistance)	200 ohm	
		L10 (FUEL LEVEL)	100 %	
<b>Shelter Temperature/ Digital Input F</b>	Sensor Selection	Analog Shelter Temperature		
	DG Start Temp	Enable		
	Threshold	35 Deg		
	Open Circuit Action	Enable		
	Hysteresis	08 Deg		
	High Temp. Alarm	Enable		
	Indoor High Temperature Threshold	37 Deg		
	Indoor High Temperature Reset	34 Deg		
	Outdoor Over Temp.	Enable		



			Outdoor High Temperature Threshold	55 Deg
			Outdoor Over Temp. Reset	50 Deg
			R1 (Resistance)	40 ohm
			T1 (Temperature)	90 °C
			R2 (Resistance)	345 ohm
			T2 (Temperature)	55 ° C
			R3 (Resistance)	407 ohm
			T3 (Temperature)	50 ° C
			R4 (Resistance)	482 ohm
			T4 (Temperature)	45 ° C
			R5 (Resistance)	574 ohm
			T5 (Temperature)	40 ° C
			R6 (Resistance)	687 ohm
			T6 (Temperature)	35 °C
			R7 (Resistance)	826 ohm
			T7 (Temperature)	30 ° C
			R8 (Resistance)	1000 ohm
			T8 (Temperature)	25 ° C
			R9 (Resistance)	1217 ohm
			T9 (Temperature)	20 ° C
			R10 (Resistance)	1500 ohm
			T10 (Temperature)	14 ° C
		<b>Cabinet Temperature/ Digital Input G</b>	Sensor Selection	Analog Input Cabinet Temperature
			Open Circuit Action	Enable
			Threshold	37 Deg
			Reset	34 Deg
			R1 (Resistance)	40 ohm
			T1 (Temperature)	90 ° C
			R2 (Resistance)	345 ohm
			T2 (Temperature)	55 ° C
			R3 (Resistance)	407 ohm
			T3 (Temperature)	50 °C
			R4 (Resistance )	482 ohm
			T4 (Temperature)	45 ° C
			R5 (Resistance)	574 ohm
			T5 (Temperature )	40 ° C
			R6 (Resistance )	687 ohm
			T6 (Temperature)	35 ° C
			R7 (Resistance )	826 ohm
		T7 (Temperature )	30 ° C	
		R8 (Resistance )	1000 ohm	
		T8 (Temperature)	25 ° C	

			R9 (Resistance)	1217 ohm		
			T9 (Temperature)	20 ° C		
			R10 (Resistance )	1500 ohm		
			T10 (Temperature)	14 ° C		
4	Output	Output A	Source	GCB Close		
			On Activation	Energize		
		Output B	Source	MCB Close		
			On Activation	Energize		
		Output C	Source	Crank		
			On Activation	Energize		
		Output D	Source	DG Common Fault		
			On Activation	Energize		
		Output E	Source	Energise to Stop		
			On Activation	Energize		
		Output F	Source	High Shelter Temperature		
			On Activation	Energize		
		Output G	Source	High Cabinet Temperature		
			On Activation	Energize		
Output H	Source	Aviation Lamp Control				
	On Activation	Energize				
Output I	Source	Site on Battery				
	On Activation	Energize				
Output J	Source	None				
	On Activation	Energize				
5	Timers	Cranking Timers	Crank 1 Hold Time	2.0 sec		
			Crank 1 Reset Time	10 sec		
			Crank 2 Hold Time	3.0 sec		
			Crank 2 Reset Time	10 sec		
			Crank 3 Hold Time	4.0 sec		
			Crank 3 Reset Time	10 sec		
			Crank Start Delay	01 sec		
		General Timers	<b>General</b>			
			Load Transfer Delay		03 sec	
			Power Save Mode Delay		60 sec	
			Screen Change Over Delay		180 sec	
			Aviation LAMP on AT		17:00	
			Aviation LAMP Off AT		06:30	
			<b>Generator</b>			
			ALT Detect Delay		10 sec	
			Warm up Delay		15 sec	
Engine Cool Time			01 minutes			
Stop Action Time		15 sec				
DG Max Run Time		240 Min				

6	Generator		DG Max Rest Time	1 Min
			Safety Monitoring Delay	10 Sec
			<b>Mains</b>	
			Mains Detect Delay	10 Sec
		<b>ALT CONFIG</b>	Number of Poles	04 Poles
			AC System	3- Phase
			Minimum Healthy Voltage	100
			Minimum Healthy Frequency	40.0 Hz
		<b>Voltage Monitor</b>	Under Voltage Shutdown	Enable
			Under Voltage Shutdown Threshold	160
			Under Voltage Warning	Enable
			Under Voltage Warning Threshold	160
			Under Voltage Delay	60 sec
			Over Voltage Warning	Enable
			Over Voltage Warning Return	275
			Over Voltage Warning Threshold	280
			Over Voltage Shutdown Thresh	280
			Over Voltage Delay	60 sec
		<b>Frequency Monitor</b>	Under Frequency Shutdown	Enable
Under Frequency Shutdown Threshold	47.5			
Under Frequency Warning	Enable			
Under Frequency Warning Threshold	47.5			
Under Frequency Delay	60 sec			
Over Frequency Warning	Enable			
Over Frequency Warning Return	52.5			
Over Frequency Warning Threshold	53.5			
Engine of Trip EN	Enable			
Over Frequency Shutdown Threshold	53.5			
Over Frequency Delay	60 sec			
<b>Current Monitor</b>	Over Current Activation	Enable		
	CT Primary	0100		
	KVA Rating	15		
	Over Current Threshold	20 Amp per phase		

			Over Current Action	Shutdown
			Over Current Delay	10 sec
		<b>DG Tamper</b>	Start Wave Detect	Disable
			MIN Load on DG	100 W
7	Mains	<b>Mains Configuration</b>	Mains AC System	3 Phase
		<b>Under Voltage Monitor</b>	Monitoring	Enable
			TRIP	150
			Return	160
			Delay	05 sec
		<b>Over Voltage Monitor</b>	Monitoring	Enable
			TRIP	290
			Return	280
			Delay	10 sec
		<b>Under Frequency Monitor</b>	Monitoring	Enable
			TRIP	47.5
			Return	48.0
			Delay	010 sec
		<b>Over Frequency Monitor</b>	Monitoring	Enable
			TRIP	54.5
			Return	52.5
			Delay	10 sec
		<b>Current Monitor</b>	Over Current Action	Enable
			Over Current Threshold	50 Amp Per Phase
			Over Current Delay	10 Sec
		8	Engine	<b>Crank Disconnection</b>
Monitoring LOP before Crank	Disable			
Disconnection on LOP Sensor	Disable			
Disconnect Pressure Threshold	01.0			
LLOP Switch Transient Time	20 sec			
Alternator Frequency Threshold	30.0 Hz			
Engine Speed Threshold	600 RPM			
<b>Battery Monitor</b>	Low Voltage Action			Disable
	Low Voltage Threshold			8.0
	Low Voltage Return			10.0
	Low Voltage Delay			30 sec
	High Voltage Action			Disable
	High Voltage Return			15.0
	High Voltage Threshold			16.0
High Voltage Delay	10 sec			
9	Maintenance	<b>Maintenance Alarm</b>	Service Due	Disable
			Action	Buzzer
			Due at Engine HRS	0050 hrs

## ACTION

<b>Index</b>	<b>Action</b>
0	Electrical Trip (With Cool down)
1	Shutdown ( Without Cool down)
2	Warning
3	None









## INPUT SOURCE

<b>Sr. No.</b>	<b>Description</b>
1	LLOP
2	HCT
3	LFL15 %
4	LFL 50 %
5	F & S
6	EMERGENCY
7	RWL
8	CANOPY
9	SPD FAULT
10	NONE





## Output Sources

Sr. No.	Description
1	Start Relay
2	Stop Solenoid
3	Open Mains Contactor
4	Open Gen Contactor
5	Close Mains Contactor
6	Close Gen Contactor
7	Aviation LAMP
8	DG Common Fault
9	Fail to Start/ Stop
10	High Shelter Temperature
11	Cabinet Temperature High
12	Site on Battery
13	Fuel Relay
14	Choke Relay
15	None

## INSTRUMENTATION ICONS

Icon	Details
	Generator voltage and frequency
	Mains voltage and frequency
	Load power
	Battery voltage
	Coolant temperature
	Information Icon
	Alarm Icon
	Engine Icon

## LOAD SWITCHING ICON

Icon	Details
	The generator breaker is closed.
	The mains breaker is closed.
	The mains breaker is open.
	The generator breaker is open.

## Manual Mode Operation:

### DG Manual Mode:

DG Auto/Manual switch is provisioned on the front of controller. In manual mode , DG can be start or stop manually by pressing the 'Start', 'Stop' buttons on the front side on the display. After Switch ON the DG in manual mode, load can be transferred to DG.

### Instructions to follow:

- ☞ AMF earth connection is mandatory before AMF is Power ON.
- ☞ DG and PANEL supply connections are to be connected as per the marking. Any phase and neutral reverse connection will lead to short circuit.
- ☞ DG Battery connection should be according to polarity.
- ☞ In case of Mains unavailability, if DG turns ON in DG Manual Mode condition, it should be switched OFF in Manual mode only.
- ☞ During DG maintenance, keep the DG in Manual mode.
- ☞ BTS Battery sensing connection should be place in right slot with right polarity. Connection in wrong slot may lead to failure.
- ☞ OUTPUT Load should not exceed more than the rated current. Anything excess will lead to panel failure.
- ☞ DG Battery is recommended to be charged with existing Battery Charger of AMF.
- ☞ It is strongly recommended to avoid any external Neutral (Input Mains) connection directly to load neutral.

## Operation logic:

### Mains Supply ON -

- ☞ If there is Mains Availability & Voltage is within the range ( $> 140V$  and  $< 290V$ ), Mains OK show on display .
- ☞ After sensing the input voltages, Mains Contactor Holds & supply is feed to the load.
- ☞ The Voltages & Currents on available phases are displayed on the Display Screen.

### Real Time Clock Setting:

- ☞ RTC Clock needs one time setting to capture the alarms and run hours

### Mains Supply OFF – Crank the DG (ON):

- ☞ If Mains Supply is unavailable OR the voltages are out of range, the system senses the 48V DC battery bank voltage, If the voltage is ( $>47V$ ) the system runs on system battery
- ☞ AMF controller will look for DG in Auto Mode. In Manual Mode, DG will be turn ON or OFF through START & STOP keys provided on the display.
- ☞ AMF crank's the DG if the shelter temperature becomes above DG trigger temperature or system battery voltage becomes low.

- ☞ Before cranking the DG, AMF checks the DG alarm (LLOP, HCT, and Fuel).
  - ☞ After cranking, AMF monitors the DG Voltages.
  - ☞ If DG Voltages is within the range (190V-250V), DG Contactor will be switch ON.
  - ☞ DG Voltage & Currents are displayed on LCD and controller continuously monitors DG Faults.

### **Mains Supply Restored / ON – Stop the DG (OFF):**









































































- ☞ Considering that DG is ON, & Mains supply is restored.
- ☞ System senses the Mains Voltages, if the voltage is within the range display show Mains OK.
- ☞ DG is allowed to run for the minimum time 1 Min.
- ☞ On completion of DG minimum running time, load is shifted to MAINS.
- ☞ Now, load on DG is shifted to MAINS & DG cooling time has been started (1 Min), On completion of DG cooling time stop pulse is given to Turn OFF DG.
- ☞ After stop pulse if DG voltage becomes zero declare DG OFF. If the voltage is greater than 100V then declare DG fail to Stop.

### **DG in Manual Mode:**

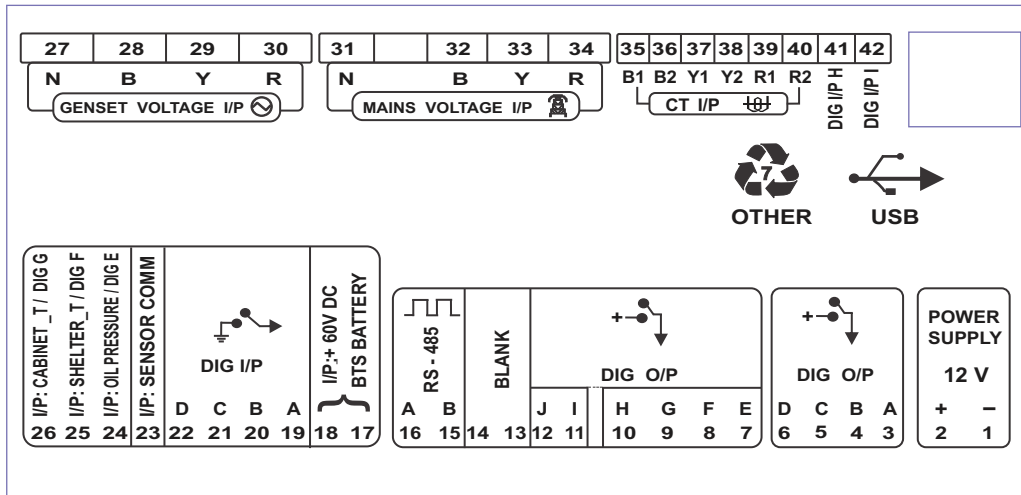
- ☞ A Switch is provided to select DG Manual / DG Auto Mode. Manual Mode is used only in case of maintenance and emergency condition.
- ☞ AMF will sense the DG Manual mode. No action is initiated by AMF regarding DG cranking.
- ☞ DG OFF / ON is possible only with Start / Stop buttons on the AMF display.
- ☞ After DG becomes healthy, load will be shifted to DG if, Mains supply is not available.
- ☞ DG in Manual Mode message appears on LCD display.



## LCD Display Screen:

SCREEN-1	SCREEN-2	SCREEN-3	SCREEN-4																																				
<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>AMF-BTS</p> <p>EMAB-600 V1.0</p> </div>	<div style="border: 1px solid black; padding: 5px;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;"></td> <td style="text-align: center;"><b>SITE INFO</b></td> </tr> <tr> <td>25KVA</td> <td>INDOOR</td> </tr> <tr> <td>DG 3P</td> <td>30KVA</td> </tr> <tr> <td>APPLICATION</td> <td>OUTDOOR</td> </tr> </table> </div>		<b>SITE INFO</b>	25KVA	INDOOR	DG 3P	30KVA	APPLICATION	OUTDOOR	<div style="border: 1px solid black; padding: 5px;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;"></td> <td style="text-align: center;"><b>STATUS</b></td> </tr> <tr> <td colspan="2" style="text-align: center;">ENGINE OFF :READY</td> </tr> <tr> <td colspan="2" style="text-align: center;">MANUAL :BTS BATT OPEN</td> </tr> </table> </div>		<b>STATUS</b>	ENGINE OFF :READY		MANUAL :BTS BATT OPEN		<div style="border: 1px solid black; padding: 5px;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;"></td> <td style="text-align: center;"><b>CONTACTORS</b></td> </tr> <tr> <td colspan="2" style="text-align: center;">  </td> </tr> </table> </div>		<b>CONTACTORS</b>																				
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# Connection Description



## Terminal Description

Pin No.	Name	Description
1	BAT-	Battery Ground
2	BAT+	Battery Positive
3	Digital O/PA	High side driver Digital O/P A
4	Digital O/PB	High side driver Digital O/P B
5	Digital O/PC	High side driver Digital O/P C
6	Digital O/PD	High side driver Digital O/P D
7	Digital O/PE	High side driver Digital O/P E
8	Digital O/PF	High side driver Digital O/P F
9	Digital O/PG	High side driver Digital O/P G
10	Digital O/PH	High side driver Digital O/P H
11	Digital O/PI	High side driver Digital O/P I
12	Digital O/PJ	High side driver Digital O/P J
13	Blank	Blank
14	Blank	Blank
15	RS-485 B	Communication Port B
16	RS-485 A	Communication Port A
17	BTS BAT	BTS Voltage Measurement
18	BTS BAT	BTS Voltage Measurement
19	Digital I/P A	Connect to ground for activation Digital Input A
20	Digital I/P B	Connect to ground for activation Digital Input B
21	Digital I/P C	Connect to ground for activation Digital Input C
22	Digital I/P D	Connect to ground for activation Digital Input D
23	Sensor Com	Sensor Common
24	LLOP	Oil Pressure Sensor (OPTIONAL) / DIG E
25	Shelter Temp.	Shelter Temperature / DIG F
26	Cabinet Temp.	Cabinet Temperature /DIG G
27	N-Ph (DG)	Neutral _ Generator
28	B-Ph (DG)	B Phase _ Generator
29	Y-Ph (DG)	Y Phase _ Generator
30	R-Ph (DG)	R Phase _ Generator
31	N (Mains)	Neutral _ Mains
32	B-Ph (Mains)	B Phase _ Mains
33	Y-Ph (Mains)	Y Phase _ Mains
34	R-Ph (Mains)	R Phase _ Mains
35	B-CT	Load Current Sensing _ CT B1
36	B-CT	Load Current Sensing _ CT B2
37	Y_CT	Load Current Sensing _ CT Y1
38	Y_CT	Load Current Sensing _ CT Y2
39	R_CT	Load Current Sensing _ CT R1
40	R_CT	Load Current Sensing _ CT R2
41	DIG I/P H	Connect to ground for activation Digital Input H
42	DIG I/P I	Connect to ground for activation Digital Input I