Operating Manual

SYNCHROSCOPE

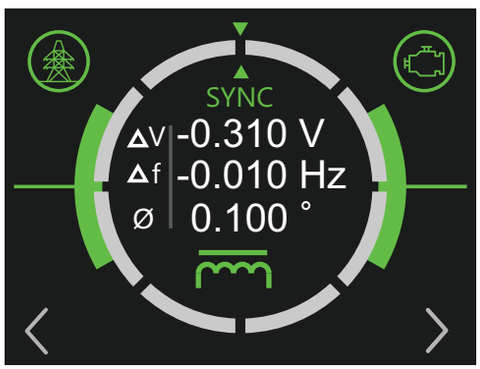
INDEX

Touch Screen Digital Synchroscope Meter
Installation & Operating Instructions

DMAN-00IM-0663 Rev.C - 08/2018

1. Introduction

This instrument is a panel mounted 115x115mm Digital Synchronizing system used for the measurement of important electrical parameters, namely AC Voltage, Frequency and Phase Difference of two alternators for synchronization. The instrument integrates accurate measurement of technology with 320x240 Pixels touch screen TFT LCD display.
The front panel has a 3.5” Touch Screen through which the user can move across the available measurement readings and configure the product settings.



The instrument is used for indication of synchronization between two independent actuators which may include the following:
1) Two different BUS inputs.
2) Two different Generator inputs.
3) A Generator and a BUS input.

The parameters measured (for synchronization of BUS (running) and Generator (incoming) as an application) are given in **Table 1**.

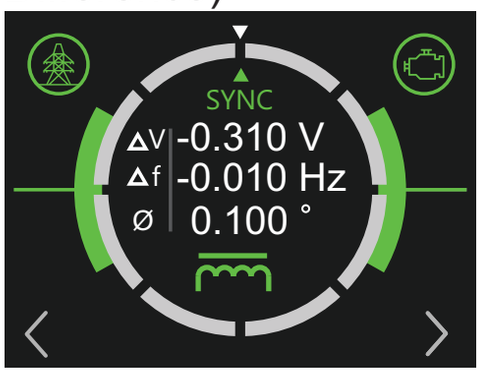
Table 1:

Measured Parameters	**Units of Measurement**
Generator Voltage	Volts
Generator Frequency	Hertz
BUS Voltage	Volts
BUS Frequency	Hertz
Voltage Difference, ΔV	Volts
Frequency Difference, Δf	Hertz
Phase Difference, Ø	Degrees

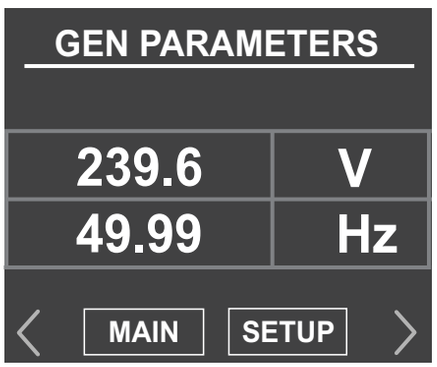
2. Measurement Reading Screens

In normal operation the user is presented with the main measurement reading screen out of three different screens. These screens from particular submenu may be scrolled through one at a time in incremental order by touching the " 〉" key and in decrement order by touching " 〈 " key on that screen.

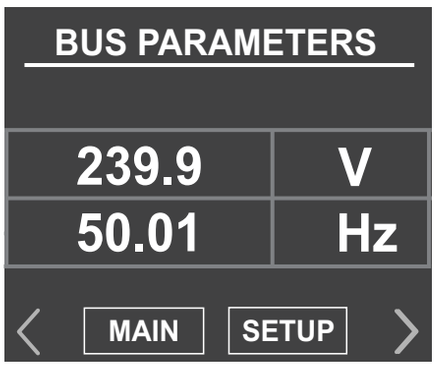
Screen 1 : Main Screen (Voltage Difference, Freq Difference, Phase Difference)



Screen 2 : Generator Parameters (Voltage, Frequency)

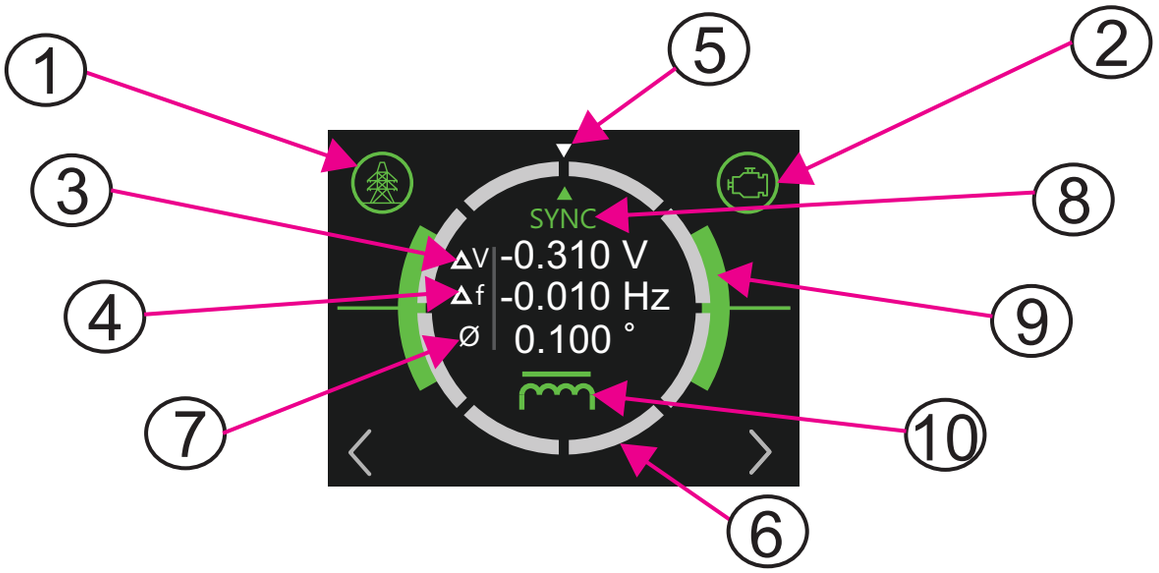


Screen 3 : Bus Parameters (Voltage, Frequency)



2.1 Main Screen

The default screen is the Main Screen and this screen contains indications necessary for synchronizing two AC alternators. These are shown below.



The status of the alternators are indicated by the color of the symbols making the process user friendly. The symbols and their respective colors make it easy to understand the situation in hand. These are explained in section 2.1.1 - 2.1.5. For two AC alternators to be paralleled, they must be synchronized first and this is achieved when corresponding
1. RMS Voltage,
2. Frequency, and
3. Phase
are same. This is achieved by making these three parameters equal in the same order.

2.1.1 Voltage Level Indication

The instrument provides the provision of deciding a voltage band for the individual inputs, namely BUS and Generator. This band lies between a Lower Limit and an Upper Limit which is settable by the user (Section 3.2.1.3 - 3.2.1.6). If the voltage of either of the alternator lies outside the band, then synchro-nization would not happen.
Symbol ① indicates the voltage level of BUS and ② indicates the voltage level of Generator using the following color code:

RED:	Alternator Voltage Absent
GREEN:	Alternator Voltage within user specified band
YELLOW:	Alternator Voltage outside the user specified band but not absent

2.1.2 Voltage Difference Indication

③ gives the numerical value of the voltage difference between the Generator and the BUS. That is, $\Delta V = V_{GEN} - V_{BUS}$. If Generator Voltage is greater than BUS Voltage, then ΔV is a positive value and similarly, it is negative if Generator Voltage is less than the BUS Voltage.

2.1.3 Frequency Difference Indication

④ gives the numerical value of the frequency difference between the Generator and the BUS. That is, Δf = f_{GEN} - f_{BUS}. If Generator Frequency is greater than BUS Frequency, then Δf is a positive value and similarly, it is negative if the Generator Frequency is less than the BUS Frequency.
The frequency difference between the Generator and the BUS is also indicated by object ⑤ ,which is the WHITE pointer that rotates around the circle (Object ⑥).

The speed of rotation of the pointer around the circle indicates the magnitude of Δf and the direction of rotation indicates whether Δf is positive or negative.

Speed of rotation: Δf of 1Hz is indicated by single rotation around the circle in 1 second. Similarly, Δf of 0.1Hz is indicated by single rotation around the circle in 10 seconds and so on.

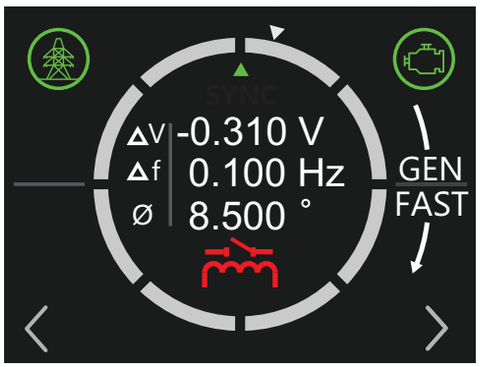
Direction of rotation: Clockwise rotation indicates that Δf is positive and counter-clockwise rotation indicates that Δf is negative.

When Δf is positive, then Generator is said to be fast and when Δf is negative, the Generator is said to be slow which is also indicated on the screen as shown in Figure 1.

Figure 1 shows whether Generator is fast (has higher frequency) or slow (has lower frequency) as compared to the BUS which is indicated on the screen.This indication becomes important particularly when the frequency difference between the Generator and BUS becomes greater enough to make the pointer rotate unnaturally (abnormally).

Figure 1

GEN FAST (WHITE)



Δf < 3 and positive

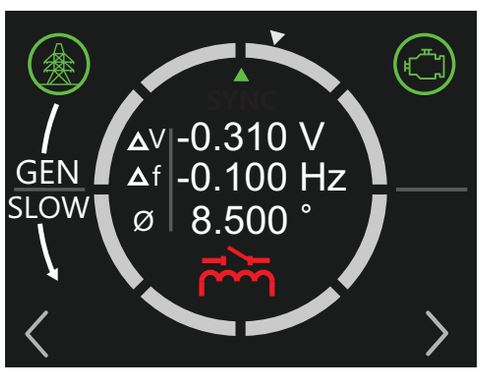
That is, Gen. frequency is greater than BUS frequency but by a value not more than 3 Hz.

TOO FAST (RED)

Δf > 3

That is, Gen. frequency is greater than BUS frequency by a value more than 3 Hz.

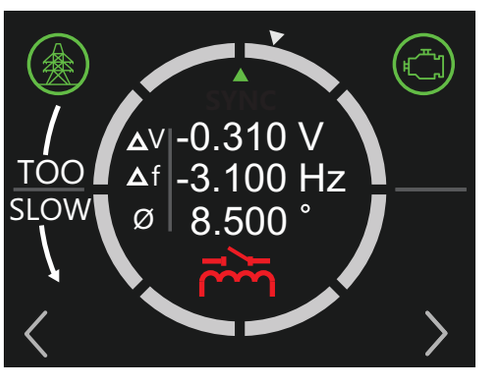
GEN SLOW (WHITE)



Δf > -3 and negative

That is, Gen. frequency is less than BUS frequency but by a value not more than 3 Hz.

TOO SLOW (RED)



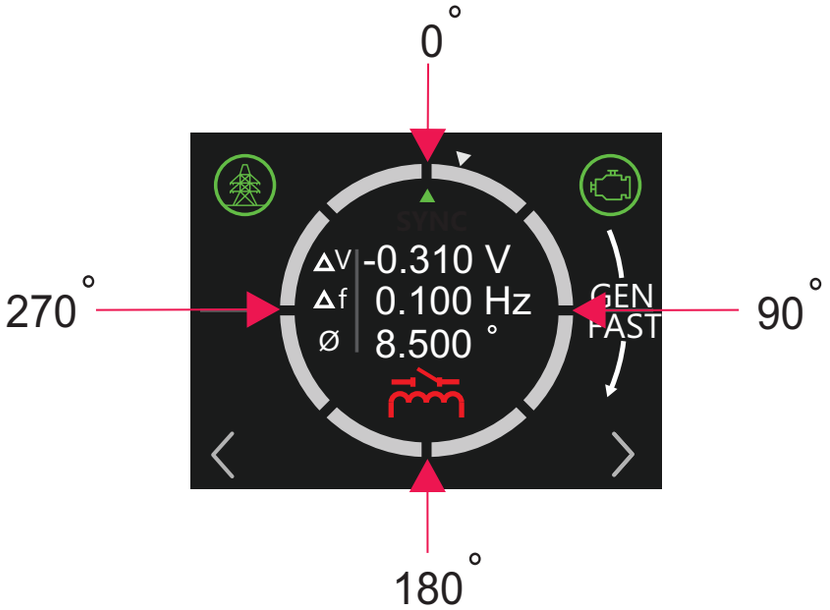
Δf < -3

That is, Gen. frequency is less than BUS frequency by a value more than 3 Hz.

2.1.4 Phase Difference Indication

Object (7) gives the numerical value of the phase difference between the Generator and the BUS. Ø is the phase angle calculated between corresponding zero-crossings by taking BUS as reference. Ø lies between 0 and 360˚.

The phase difference between the Generator and BUS is also indicated by the position of the rotating pointer (object(5)) around the circle (object(6)). The permanent GREEN arrow at 12 o'clock indicates 0˚.



In this way, the numerical value of Ø and the position of the pointer give both digital and analog experience to the user at the same time. Same stands true for frequency difference, Δf (Section 2.1.3).

2.1.5 Synchronization Indication

When ΔV, Δf and Ø lie within the user defined allowed relaxed limits for synchronization (Section 3.2.1.7 - 3.2.1.9), the meter indicates synchronization in two different ways:

1. By glowing the text "SYNC" GREEN (object (8)).
2. By introducing GREEN arcs (object (9)) around the circle.

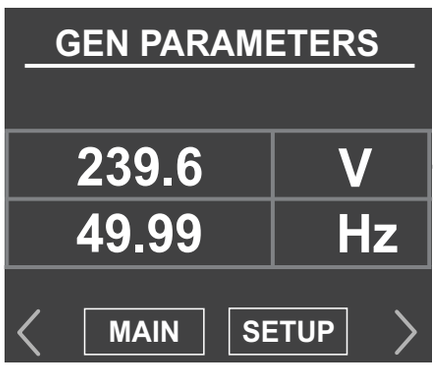
Object (10) is the symbol for Relay status (Section 3.2.2). It changes its state and color in the following manner:

1. Relay OFF and RED : The conditions for synchronization are not yet met.
2. Relay ON and GREEN : The conditions forsynchronization are met.

*A condition may arise when the indications (8) and (9) for sync are shownbut relay (10) is not turned ON (Refer Hysteresis Voltage, Section 3.2.1.10).

2.2 GEN Parameters Screen

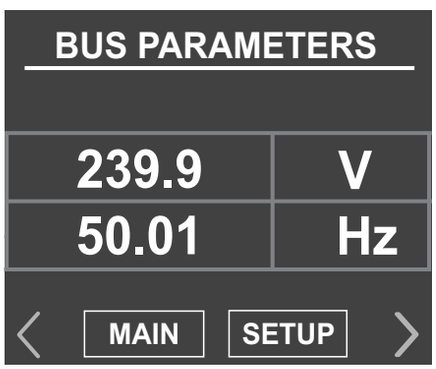
On the main screen, the navigation key at the lower right corner, that is, " 〉" key brings the user to the GEN Parameters Screen. This screen provides the value of Generator Voltage and Generator Frequency.



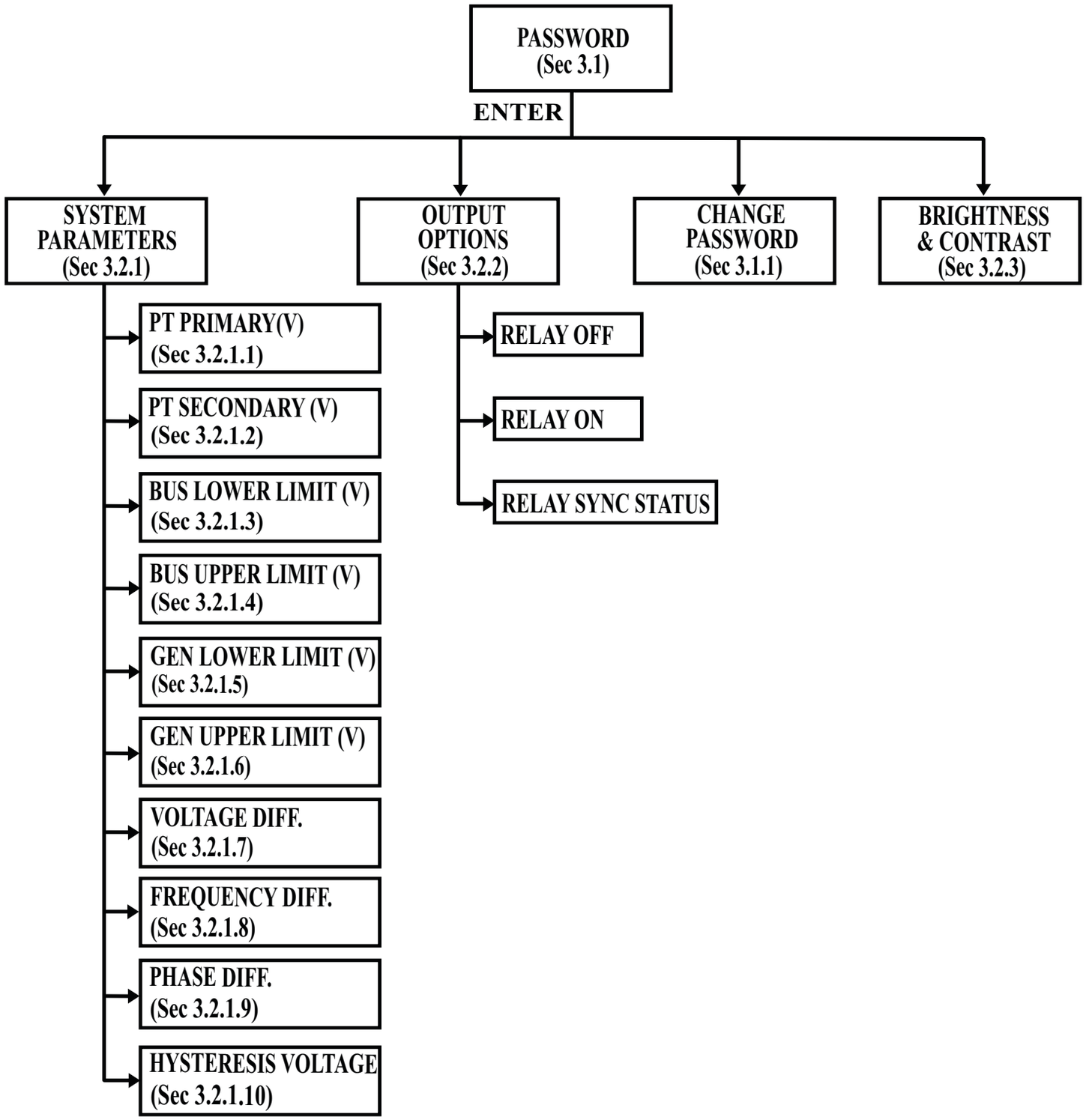
The user can access the SETUP menu by touching the " SETUP " key which takes the user to the password (for setup) screen (Section 3.1).
Touching the " MAIN " key takes the user to the Main Screen. On touching the navigation key " 〈 ", Main Screen (Section 2.1) appears and on touching the " 〉 " key, the BUS PARAMETERS Screen (Section 2.3) appears.

2.3 BUS Parameters Screen

On the main screen, the navigation key at the lower left corner, that is, " 〈 " key brings the user to the BUS Parameters Screen. This screen provides the value of BUS Voltage and BUS Frequency.



The user can access the SETUP menu by touching the " SETUP " key which takes the user to the password (for setup) screen (Section 3.1).
Touching the " MAIN " key takes the user to the Main Screen. On touching the navigation key " 〉 ", Main Screen (Section 2.1) appears and on touching the " 〈 " key, the GEN PARAMETERS Screen (Section 2.2) appears.



Setup Parameter Screens

3. Programming

The following sections comprise step by step procedures for configuring the instrument for individual user requirements.

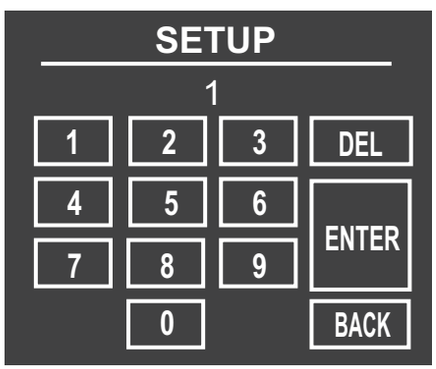
To access the set-up screens touch on the “SETUP ” button either in the “BUS PARAMETERS” screen or the “GEN PARAMETERS” screen. This will take the User into the Password Protection Entry Stage (Section 3.1).

3.1. Password Protection

Password protection can be enabled to prevent unauthorised access to set-up screens; default password is “0000”.

Password protection is enabled by selecting any four digit number.

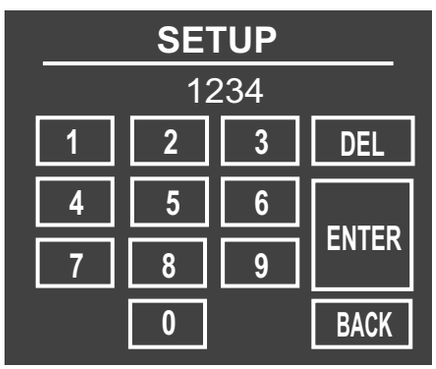
After releasing “SETUP” button Password protection screen is displayed. Screen consists of 0 to 9 digit input keypad for entering the password very similar to any calculator in touchscreen mobile. “Enter Password” is displayed on screen at start so that user can enter password using displayed keypad.



Touching “ 1 ” key will display 1 in display area, similarly user can enter remaining 3 digits.

For deleting any digit while entering password, user can touch

“ DEL ” key.

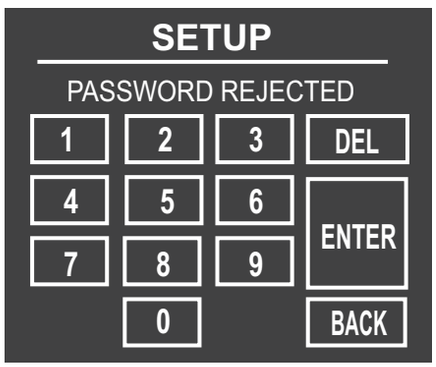


After entering the complete password user needs to confirm password by touching “ ENTER ” key.

The BACK button would take the user to the Main Screen (Section 2.1).

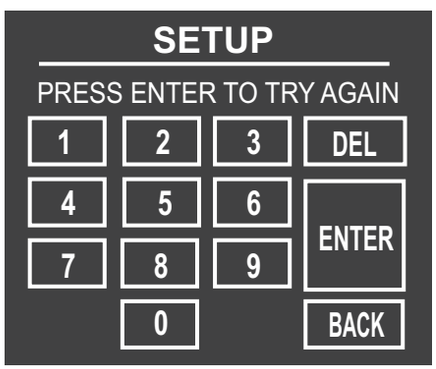
Password confirmed.

If Entered password is correct then “Password Accepted” is displayed on screen & user will enter into setup menu.



Password Incorrect.

If Entered password is wrong then “Password Rejected” is displayed on screen & user would need to re-enter the password.



After wrong password is entered, user needs to touch “ ENTER ” key for trying another password.

3.1.1 Change Password

Change Password Option is the second last option in list of “SETUP” submenu, so can be accessed by a simple touch anywhere in “ Change Password” row.
In this screen user first needs to enter the current password.

After input of correct password,"PASSWORD ACCEPTED" is displayed & now user can enter the new 4 digit password.

New Password confirmed.

After entering new password user needs to touch " ENTER " key to confirm.

After confirming "PASSWORD CHANGED" is displayed on the screen which ensures successful changing of the password.

3.2 Menu selection.

After entering in the SUBMENU - SETUP, user will be asked to enter password & after input of correct password list of following parameters will be displayed on screen :-

3.2.1 SYSTEM PARAMETERS
3.2.2 OUTPUT OPTIONS
3.1.1 CHANGE PASSWORD
3.2.3 BRIGHTNESS & CONTRAST

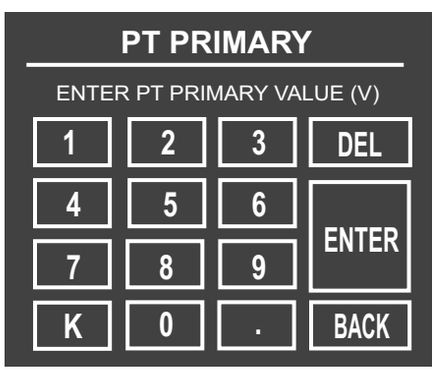
Touching on SYSTEM PARAMETERS will open the System Parameter Selection Screen.

3.2.1 System Parameter Selection Screen

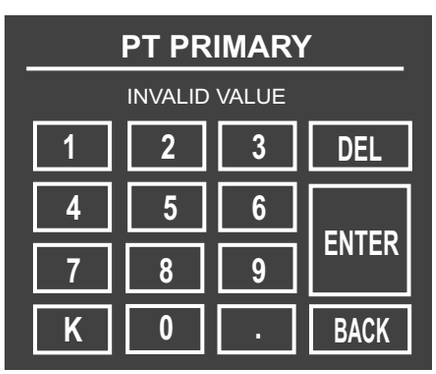
After entering in the “SYSTEM PARAMETERS”, List of following parameters will be displayed :-

3.2.1.1 PT Primary Value
3.2.1.2 PT Secondary Value
3.2.1.3 BUS Voltage Lower Limit
3.2.1.4 BUS Voltage Upper Limit
3.2.1.5 GEN Voltage Lower Limit
3.2.1.6 GEN Voltage Upper Limit
3.2.1.7 Voltage Difference
3.2.1.8 Frequency Difference
3.2.1.9 Phase Difference
3.2.1.10 Hysteresis Voltage

3.2.1.1 PT Primary Value



This screen is used to set the PT Primary value. This screen can be accessed only from System Parameters list menu. Here 0 to 9 digit input keypad is provided to set value of PT Primary & user can confirm this value with a simple touch “ ENTER ”.

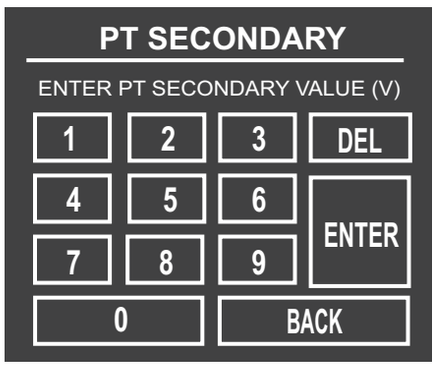


Valid range of PT Primary value is from **100V to 692.8kV.**
If value outside the range is entered, It will display “INVALID VALUE” followed by correct range of parameter.

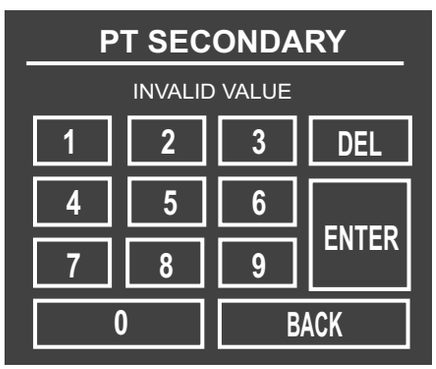
The default value is **500V**.

Note: When PT Primary is changed, then the values of parameters of Subsection 3.2.1.3 to Subsection 3.2.1.7 and that of Subsection 3.2.1.10 will change to default as per PT Ratio (PT Primary/PT Secondary).

3.2.1.2 PT Secondary Value



This screen is used to set the PT Secondary value. This screen can be accessed only from System Parameters list menu. Here 0 to 9 digit input keypad is provided to set value of PT Secondary & user can confirm this value with a simple touch " ENTER ".

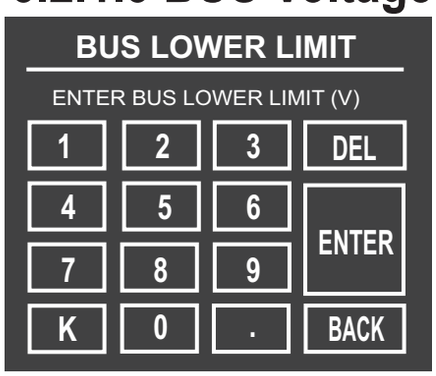


Valid range of PT Secondary value is from **100V to 500V.**
If value outside the range is entered, It will display "INVALID VALUE" followed by correct range of parameter.

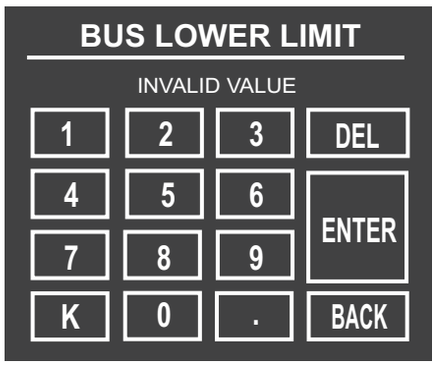
The default value is **500V**.

Note1: When PT Secondary is changed, then the values of parameters of Subsection 3.2.1.3 to Subsection 3.2.1.7 and that of Subsection 3.2.1.10 will change to default as per PT Ratio (PT Primary/PT Secondary).
Note2: The PT Primary and PT Secondary settings are used for the purpose of PT Ratio only.

3.2.1.3 BUS Voltage Lower Limit



This screen is used to set the lower limit of the BUS voltage. This screen can be accessed only from System Parameters list menu.
Here 0 to 9 digit input keypad is provided to set value of the lower limit of the BUS voltage & user can confirm this value with a simple touch " ENTER ".

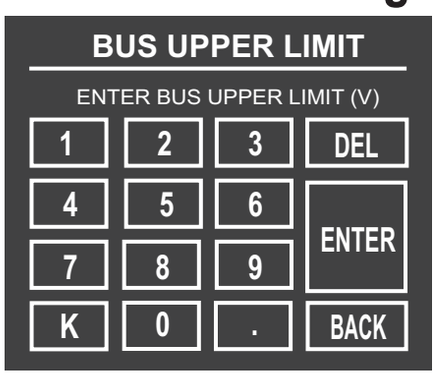


Valid range of BUS Lower Voltage Limit setting value is from **50 to (BUS VOLTAGE UPPER LIMIT - 50) V** for PT Ratio 1.

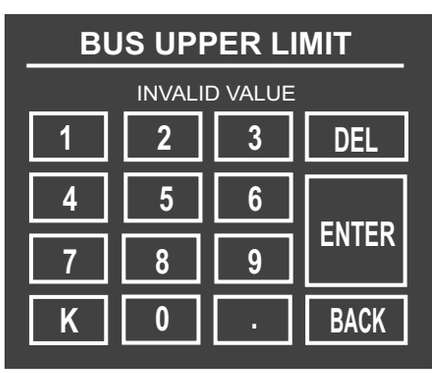
The default value is **100V** for PT Ratio 1.

Note1:For PT Ratio 1, the max. BUS voltage upper limit is 500V, so BUS voltage lower limit cannot go beyond 450V in that case.
If value outside the range is entered, It will display “INVALID VALUE” followed by correct range of parameter.
Note2: The range and limit will change as per the PT Ratio (PT Primary/PT Secondary).The range will be from 50*PT Ratio to (BUS VOLTAGE UPPER LIMIT - 50*PT Ratio) and default value will be 100*PT Ratio.

3.2.1.4 BUS Voltage Upper Limit



This screen is used to set the upper limit of the BUS voltage. This screen can be accessed only from System Parameters list menu. Here 0 to 9 digit input keypad is provided to set value of the lower limit of the BUS voltage & user can confirm this value with a simple touch “ ENTER ”.



Valid range of BUS Upper Voltage Limit setting value is from **(BUS VOLTAGE LOWER LIMIT + 50) to 500V** for PT Ratio 1.

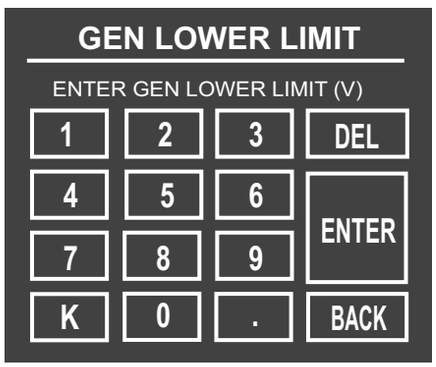
The default value is **500V** for PT Ratio 1.

Note1:For PT Ratio 1, the min. BUS voltage lower limit is 50V, so BUS voltage upper limit cannot go below 100V in that case.

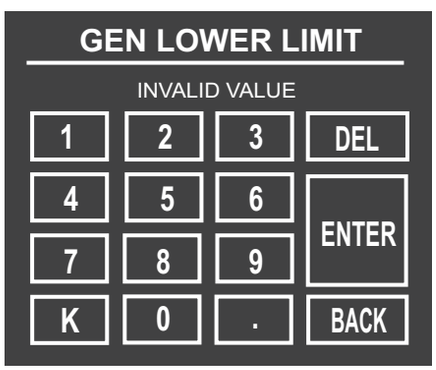
If value outside the range is entered, It will display “INVALID VALUE” followed by correct range of parameter.

Note2: The range and limit will change as per the PT Ratio (PT Primary/PT Secondary).The range will be from (BUS VOLTAGE LOWER LIMIT + 50*PT Ratio) to 500*PT Ratio and default value will be 500*PT Ratio.

3.2.1.5 GEN Voltage Lower Limit



This screen is used to set the lower limit of the GEN voltage. This screen can be accessed only from System Parameters list menu. Here 0 to 9 digit input keypad is provided to set value of the lower limit of the GEN voltage & user can confirm this value with a simple touch “ ENTER ”.



Valid range of GEN Lower Voltage Limit setting value is from **50 to (GEN VOLTAGE UPPER LIMIT - 50) V** for PT Ratio 1**.**

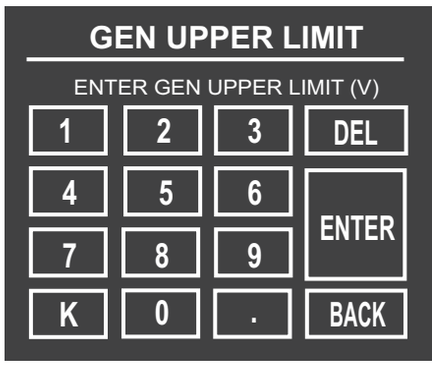
The default value is **100V** for PT Ratio 1.

Note1:For PT Ratio 1, the max. GEN voltage upper limit is 500V, so GEN voltage lower limit cannot go beyond 450V in that case.

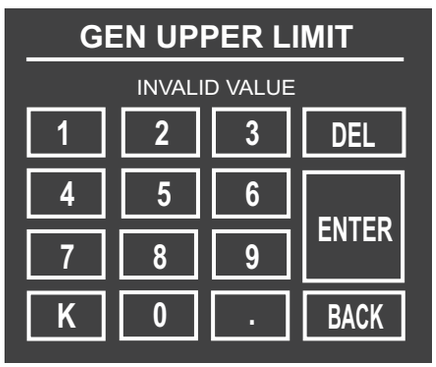
If value outside the range is entered, It will display “INVALID VALUE” followed by correct range of parameter.

Note2: The range and limit will change as per the PT Ratio (PT Primary/PT Secondary).The range will be from 50*PT Ratio to (GEN VOLTAGE UPPER LIMIT - 50*PT Ratio) and default value will be 100*PT Ratio.

3.2.1.6 GEN Voltage Upper Limit



This screen is used to set the upper limit of the GEN voltage. This screen can be accessed only from System Parameters list menu. Here 0 to 9 digit input keypad is provided to set value of the lower limit of the GEN voltage & user can confirm this value with a simple touch " ENTER ".

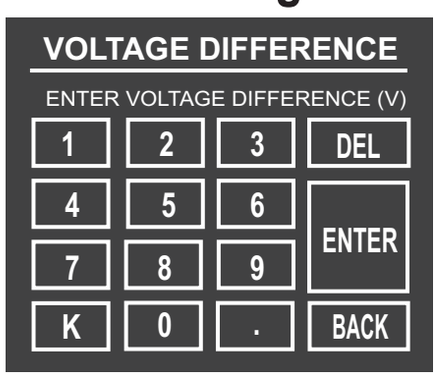


Valid range of GEN Lower Voltage Limit setting value is from **(GEN VOLTAGE LOWER LIMIT + 50) to 500 V** for PT Ratio 1.

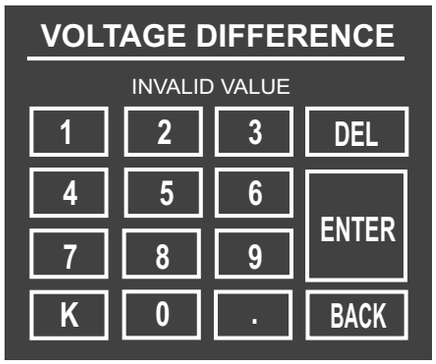
The default value is **500V** for PT Ratio 1.

Note1:For PT Ratio 1, the min. GEN voltage lower limit is 50V, so GEN voltage upper limit cannot go below 100V in that case.
If value outside the range is entered, It will display "INVALID VALUE" followed by correct range of parameter.
Note2: The range and limit will change as per the PT Ratio (PT Primary/PT Secondary).The range will be from (GEN VOLTAGE LOWER LIMIT + 50*PT Ratio) to 500*PT Ratio and default value will be 500*PT Ratio.

3.2.1.7 Voltage Difference



This setting is for the maximum voltage difference between the Generator and the BUS above which synchronization will not be accepted.
The valid range of voltage difference setting is **1 to 100 V** for PT Ratio 1.

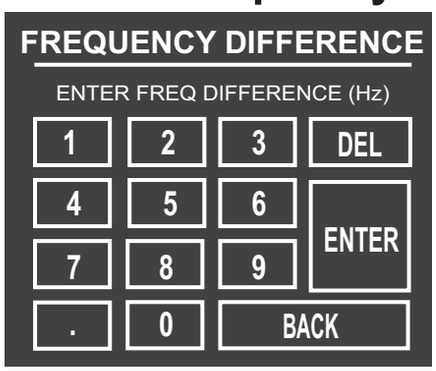


If value outside the range is entered, It will display “INVALID VALUE” followed by correct range of parameter.

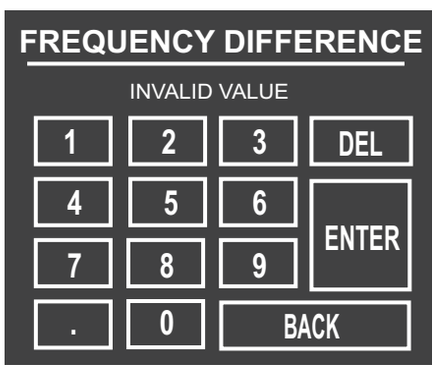
The default value is **10V** for PT Ratio 1.

Note: The range and limit will change as per the PT Ratio (PT Primary/PT Secondary). The range will be from 1*PT Ratio to 100*PT Ratio and default value will be 10*PT Ratio.

3.2.1.8 Frequency Difference



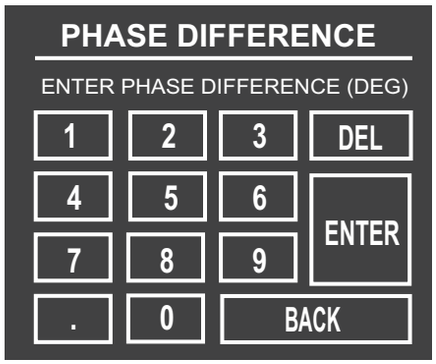
This setting is for the maximum frequency difference between the Generator and the BUS above which synchronization will not be accepted.
The valid range of frequency difference setting is **0.05 to 1.5 Hz.**



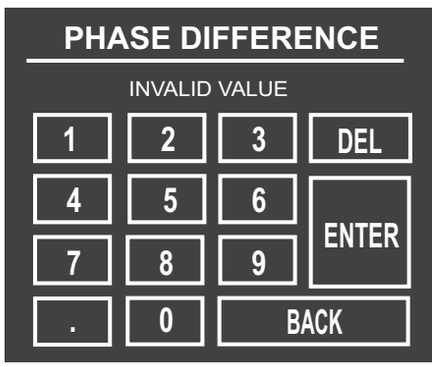
If value outside the range is entered, It will display “INVALID VALUE” followed by correct range of parameter.

The default value is **1 Hz**.

3.2.1.9 Phase Difference



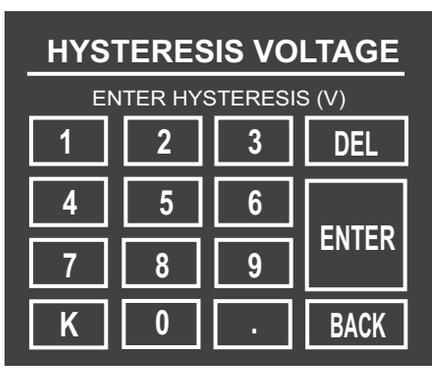
This setting is for the maximum phase difference between the Generator and the BUS above which synchronization will not be accepted.
The valid range of phase difference setting is **3 to 20 degrees.**



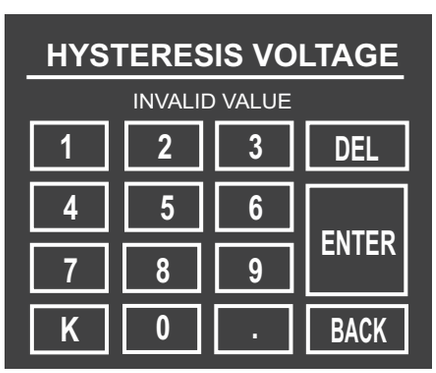
If value outside the range is entered, It will display "INVALID VALUE" followed by correct range of parameter.

The default value is **10 degrees**.

3.2.1.10 Hysteresis Voltage



This screen allows the user to set Hysteresis for input voltage.
Here a 0 to 9 digit input keypad is provided to set value of Hysteresis, & user can confirm this value with a simple touch on " ENTER " key. " BACK " key is used to go back to "SYSTEM PARAMETERS" menu.

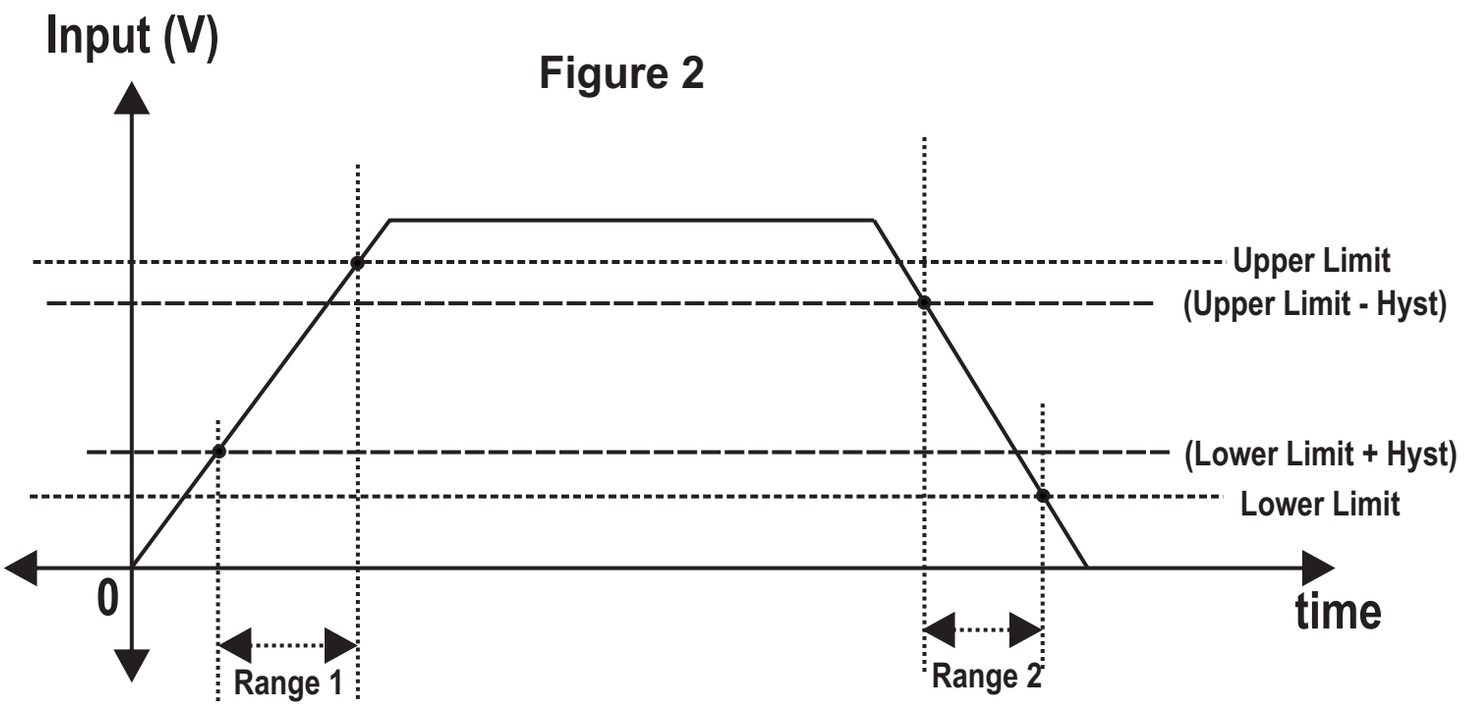


The allowable range is **1 to 15 V** for PT Ratio 1.
If value outside this range is entered, it will display "INVALID VALUE" followed by correct range of parameter.

The default value is **4 V** for PT Ratio 1.

Note: The range and limit will change as per the PT Ratio (PT Primary/PT Secondary). The range will be from 1*PT Ratio to 15*PT Ratio and the default value will be 4*PT Ratio.

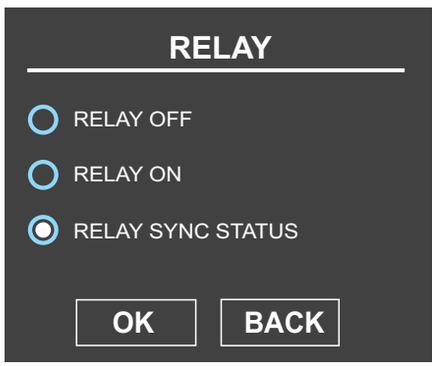
In figure 2, when input voltage of the alternator is not in Range 1 or Range 2, then synchronization may happen, but relay will not turn ON.



3.2.2. Output Option Selection Screen

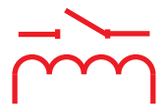
After entering in the “OUTPUT OPTIONS”, the “RELAY” menu will appear and the list of following options will be displayed :-

1. RELAY OFF - The relay will turn off when this option is chosen.
2. RELAY ON - The relay will turn on when this option is chosen.
3. RELAY SYNC STATUS - If this options is chosen, then the relay will turn ON when synchronization is achieved and it will be OFF when synchronization is not achieved.



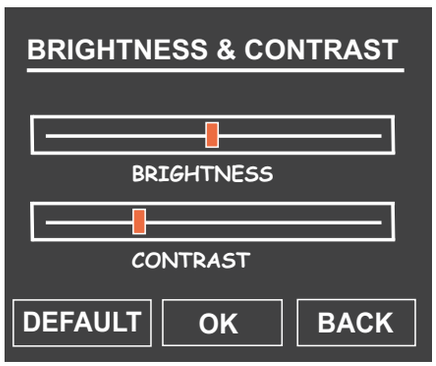
The relay ON/OFF indication in the third option is also given by the relay symbol (Section 2.1.5).

Relay ON (GREEN)



Relay OFF (RED)

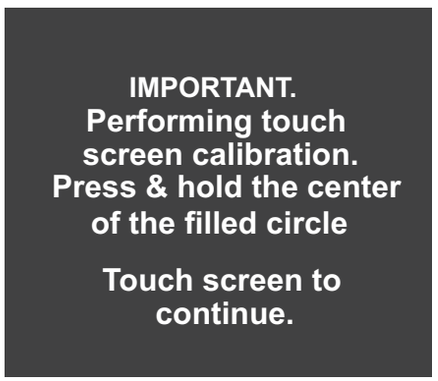
3.2.3 Brightness & Contrast



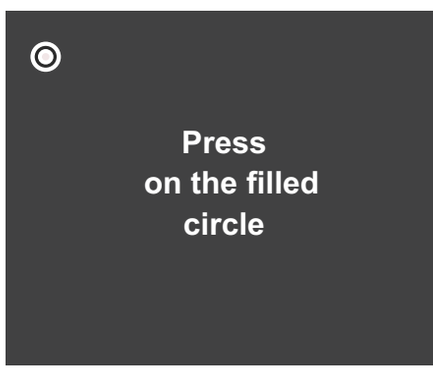
The brightness & contrast of the TFT LCD screen can be varied by the user by sliding the sliders. Touching the “ OK ” key will confirm the current brightness & contrast setting. Touching the “ DEFAULT ” key will set brightness and contrast as per default settings. Touching the “ BACK ” key will move back to the setup menu without making any changes.

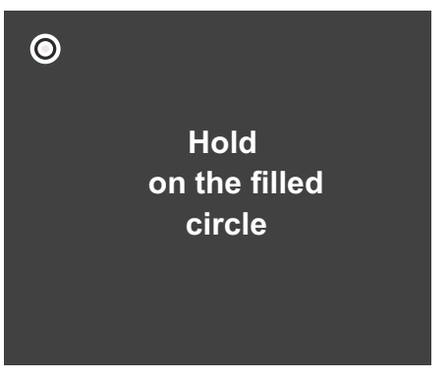
4. Touch Screen Calibration

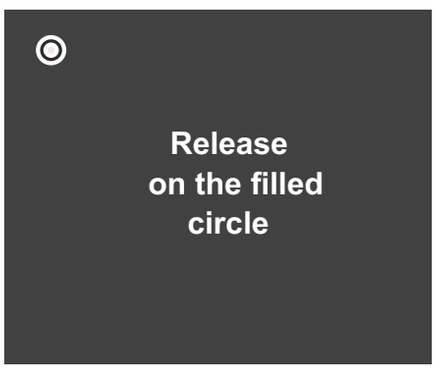
This instrument is able to perform calibration to ensure the proper operation of the units touch screen functionalities. The calibration procedure will correct the problem of out of tolerance touch screen malfunction. Note that errors corrected by this calibration procedure are specific only to touch screen operation.Touch the screen to continue.



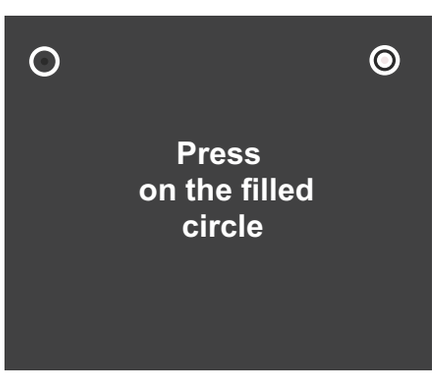
For starting touch screen calibration, touch the screen anywhere for 1 sec at system reset. After that touch screen calibration will start & the message shown besides will be displayed.



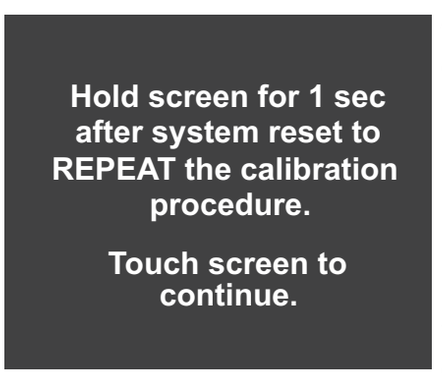




Follow the instructions displayed. Press & hold the center of the filled RED circle for at least 2 seconds. Release when message for release is being displayed. For accurate results try to touch the center of the filled circle.



Repeat the same procedure for the remaining 3 corner circles.



After successful calibration, the message shown besides would be displayed. Touch the screen to continue.

Error in calibration
Touch screen to
re-calibrate.

If the touch screen was not calibrated properly, “Error in calibration” message would be shown & the user will be asked to recalibrate the touch screen. In such case the meter will retain the previously stored touch screen calibration values unless a successful calibration is being performed.

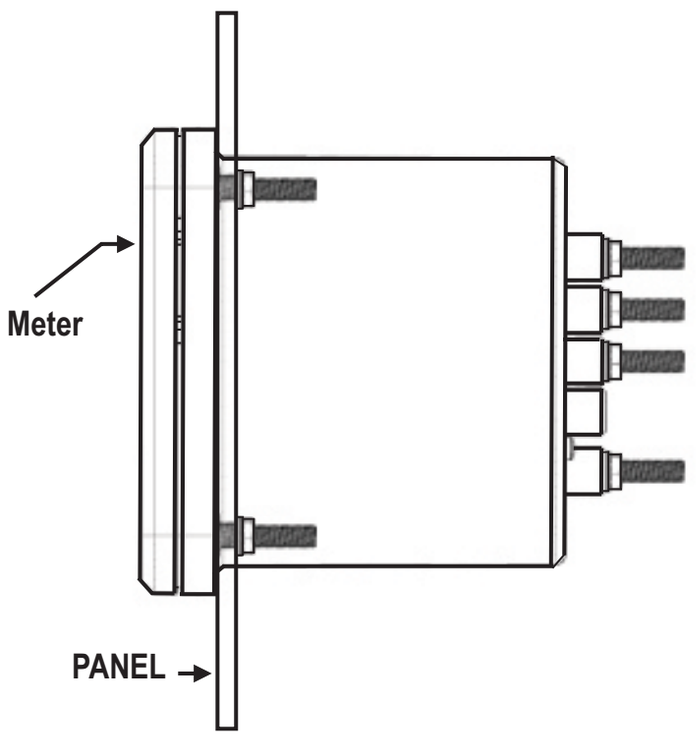
5. Installation

The meter should be installed in line with the requirements of the National Electrical Code (NEC) for USA or Canadian Electrical Code (CEC) for Canada.

These units are only for built in use, with terminals inaccessible to users after installation and should be mounted to an ANSI panel cut-out.

The case must be earthed via one or more of the mounting studs.

Do not tighten the mounting nuts beyond the torque necessary to secure the meter to the panel.



As the front of the enclosure conforms to IP54 it is protected from water spray from all directions, additional protection to the panel may be obtained by the use of an optional panel gasket. The terminals at the rear of the product should be protected from liquids.
The instrument should be mounted in a reasonably stable ambient temperature and where the operating temperature is within the range -10 to 55 °C . Vibration should be kept to a minimum and the product should not be mounted where it will be subjected to excessive direct sunlight.

Caution

1. **In the interest of safety and functionality this product must be installed by a qualified engineer, abiding by any local regulations.**
2. **Voltages dangerous to human life are present at some of the terminal connections of this unit. Ensure that all supplies are de-energised before attempting any connection or disconnection.**
3. **These products do not have internal fuses therefore external fuses must be used to ensure safety under fault conditions.**

5.1 EMC Installation Requirements

This product has been designed to meet the certification of the EU directives when installed to a good code of practice for EMC in industrial environments, e.g.

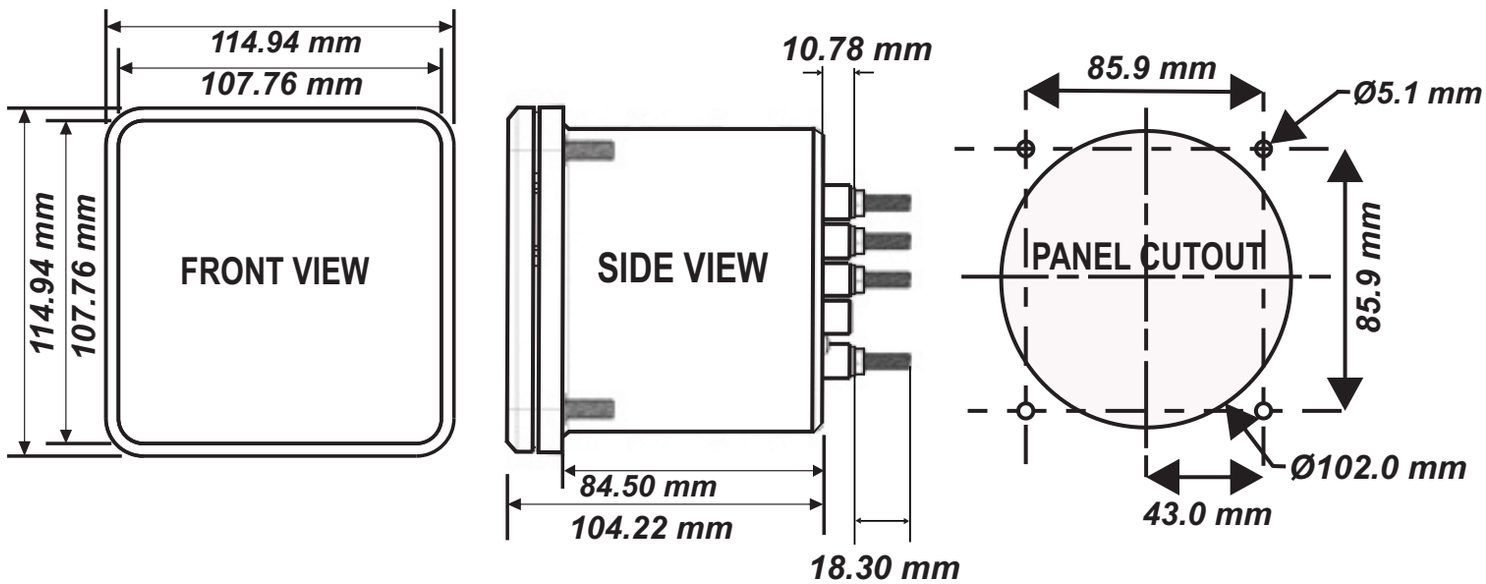
1. Screened output and low signal input leads or have provision for fitting RF suppression components, such as ferrite absorbers, line filters etc., in the event that RF fields cause problems.

Note: It is good practice to install sensitive electronic instruments that are performing critical functions, in EMC enclosures that protect against electrical interference which could cause a disturbance in function.

2. Avoid routing leads alongside cables and products that are, or could be, a source of interference.

3. To protect the product against permanent damage, surge transients must be limited to 2kV pk. It is good EMC practice to suppress differential surges to 2kV at the source. The unit has been designed to automatically recover in the event of a high level of transients. In extreme circumstances it may be necessary to temporarily disconnect the auxiliary supply for a period of greater than 5 seconds to restore correct operation.
   The Current inputs of these products are designed for connection in to systems via Current Transformers only, where one side is grounded.
4. ESD precautions must be taken at all times when handling this product.

5.2 Case Dimension and Panel Cut Out



5.3 Wiring

Input connections are made with use of insulated ring lugs. Ensure a minimum spacing of 0.21 inches (5.5mm) between uninsulated parts of adjacent ring lugs. Numbering is clearly marked in the plastic moulding. Choice of cable should meet local regulations. Tighten terminal nuts to 2Nm (1.5 ft/Lb) only. Cable used for Input and Auxiliary supply should have current rating of 1A and voltage rating no less than highest circuit voltage connected to meter.

5.4 Auxiliary Supply

The instrument should ideally be powered from a dedicated supply, however it may be powered from the signal source, provided the source remains within the limits of the chosen auxiliary voltage.

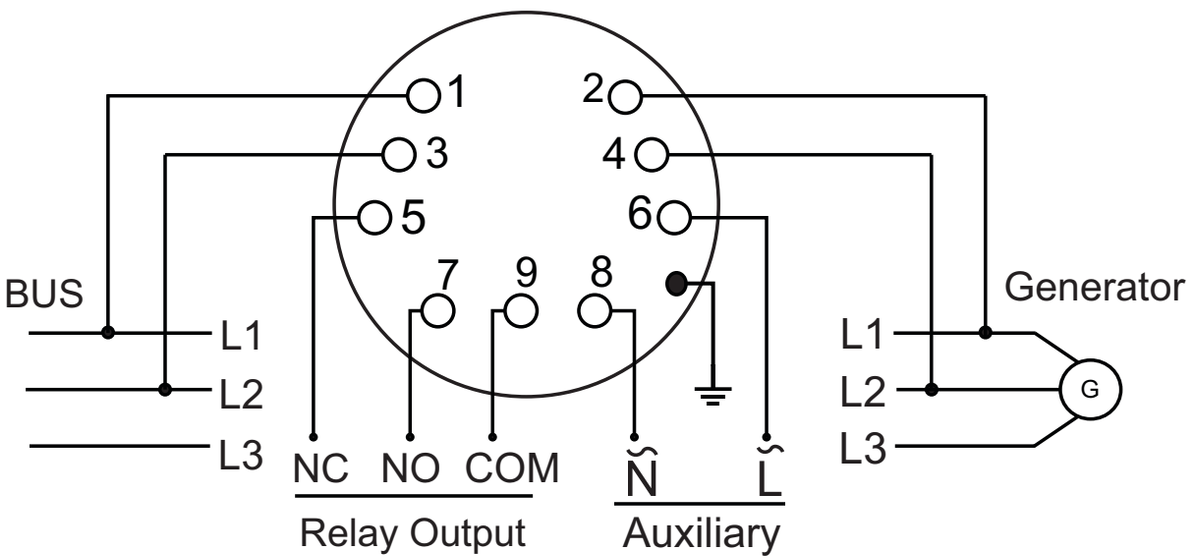
5.5 Fusing

It is recommended that all voltage lines are fitted with 1 amp HRC fuses.

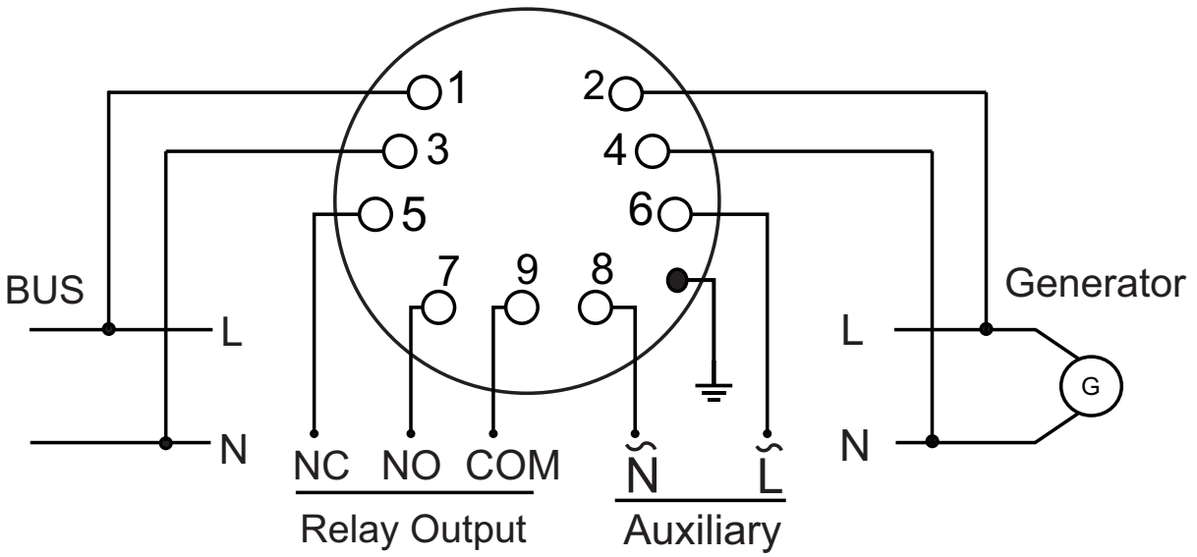
5.6 Earth/Ground Connections

For safety reasons, the case must be earthed via one or more of the mounting studs.

6. Connection Diagrams



Three Phase System



Single Phase System

7. Specification :

System

Single Phase/ Three Phase

Inputs

Nominal input voltage range (AC RMS)	100 - 500 V
Max continuous input voltage	600 V
Max short duration input voltage	2 x Nominal Value (1s application repeated 10 times at 10s intervals)
Nominal input voltage burden	<0.8 VA approx.
Frequency measuring range	45 Hz - 66Hz

Auxiliary

Standard nominal Auxiliary supply voltage	100 - 500 V AC - DC
a.c. supply frequency range	45 to 65 Hz
a.c. supply burden	9.1 VA approx.
d.c. supply burden	7 W approx.

Operating Measuring Ranges

Voltage	100-500 V
Frequency	45 .. 66 Hz

Accuracy

Voltage difference	± 1 % of Nominal value
Frequency difference	±0.15 Hz
Phase difference	± 2°

Reference conditions for Accuracy :

Reference temperature	23 °C ± 2 °C
Input Voltage	Rated Value ± 2 %
Input frequency	50 or 60Hz ± 2%
Input waveform	Sinusoidal (distortion factor 0.005)
Auxiliary supply voltage	Rated Value ± 1 %
Auxiliary supply frequency	Rated Value ± 1 %

Nominal range of use of influence quantities for measurands

Input frequency	Rated Value ± 10 %
Temperature	0 to 50 °C
Auxiliary supply voltage	Rated Value ± 10 %
Auxiliary supply frequency	Rated Value ± 10 %

Temperature Coefficient (For Rated value range of use 0... 50 °C)	0.05% / °C for Voltage
Error change due to variation of an influence quantity	2 * Error allowed for the reference condition applied in the test.

Display

TFT LCD	3.5” Graphical LCD, resolution 320x240 pixels
Update	Approx. 0.2 seconds

Controls

User Interface	Resistive Touch screen

Relay Contact

Contact Rating	240 VAC, 5A

Standards

Safety	IEC 61010-1 , Year 2010
IP for water & dust	(IP 54 for front) IEC 60529
Pollution degree	2
Installation Category	CAT III 300V

Isolation

Dielectric voltage withstand test between circuits and accessible surfaces	2.2 kV RMS 50 Hz for 1 minute between all electrical circuits

Environmental

Operating temperature	-10 to +55 °C
Storage temperature	-20 to +65 °C

Relative humidity	0 .. 95 % Non-condensing
Warm up time	3 minute (minimum)
Shock	15 g in 3 planes
Vibration	10 .. 150 .. 10 Hz, 0.075 mm amplitude
Enclosure (front only)	IP 54 as per IEC 60529

Enclosure

Style	115mm x 115mm ANSI
Material	Thick Steel Sheet EDD grade CR material
Terminals	Screw-type terminals
Depth	< 114 mm
Weight	0.750 kg Approx.

Standards

EMC Immunity	IEC 61326-1:2012, Table 2
Immunity	IEC 61000-4-3. 10V/m - Level 3 industrial Low level
Safety	IEC 61010-1-2010, permanently connected use
IP for water & dust	IEC 60529
Pollution degree	2
Installation Category	III