



# Capacitor-Duty Thyristor Switch(es) (TSCI/TSCC) OPERATIONS MANUAL



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Operations Manual Revision Dated: 23<sup>rd</sup> June 2016.

### NOTE

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation or maintenance.

Should further information be desired or should particular problems arise which are not covered sufficiently for the purchasers purposes, the matter should be referred to our factory.

The contents of this User Manual shall not become part of or modify any prior or existing agreement or relationship. Any statements contained herein do not create new warranties or modify the existing warranty.

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### CAUTIONS:

1. Please note the Circuit Connections where High Voltages are Present.
2. This Product is only to be used indoor or sheltered protected environments.
3. Make sure that the discharge time set in the APFC Unit matches with the actual capacitor bank discharge time.
4. This User Manual corresponds to the TSCI Controller, Firmware Version 1.1.7, and Dated: 14<sup>th</sup> July 2015.

Because of continuous improvements efforts by TAS PowerTek in their Product's Features and Specifications, Product Packaging etc., the Product as well as the content of the User Manual is likely to get updated without any prior notice to the Users.

Therefore, please always refer to the User Manual supplied to the customer along with the Product, at the time of product dispatch.

TAS PowerTek Pvt. Ltd. Reserves all rights to themselves, to change, upgrade, update, enhance, modify, discontinue, or make obsolete, any of their products, without any Prior Notice to the Customers / End-User.

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# Ordering Information

Product Specific Information Number (PSIN)

**TSCI (Standalone Unit):**

**TSCI-02 /  $I_L$  /  $V_L$**

**TSCC (Combipack Unit):**

**TSCC-02 /  $I_L+I_L$  /  $V_L$**

**$I_L$ :** Current Rating:  
Available in  
TSCI: 25 Amp, 40 Amp, 80 Amp,  
120 Amp, 160 Amp.  
TSCC:  
(25+25 Amp), (40+40 Amp),  
(25+80 Amp), (25+40 Amp),  
(40+80 Amp).

**$V_L$ :** Operating Voltage.  
For e.g.: 415 Volts AC, Line-to-Line

# Important Instructions:

- \* Read the following instructions carefully before installing TSCI/TSCC (the Product).
- \* This User Manual covers typical approved use of the Product.
- \* In case, your application requirements are different than specifications & features of the Product, it is important to obtain prior approval of our company before installing for the specific application. Refer to the latest specifications as our company products undergo continuous improvements and upgrading of the Product features & specifications.
- \* Technical Data given in the manual is accurate to the best of our company design know-how. However, in case of any doubts, contact TAS PowerTek specifically.
- \* Human Safety & Product Safety is IMPORTANT at all times. If the guidelines of this User Manual are not strictly followed, there are Hazards to Human safety, Unit's Failure, Fire, and Bursting of Components. In case of doubts, contact TAS PowerTek.
- \* It is the User's Responsibility to select the Product of correct model type and ratings as required specific to their Application. In case of any doubts / clarifications on this, our company must be contacted for any assistance in selection.
- \* Use and / or Storage of the Product in Corrosive Atmosphere and conductive dust is STRICTLY Prohibited, particularly where Iron or Carbon dust, Chloride Gas, Sulfide Gas, Salt, Alkali, Acid or similar substance(s) are present in atmosphere. In such case, product should be used within appropriate enclosures so as to prevent this product from exposing to such corrosive / harmful atmosphere.
- \* It is ESSENTIAL to conduct routine and regular maintenance and clean the dust (conductive as well as non-conductive) to maintain the thermal efficiency and electrical safety of the Product.
- \* In the Application Areas of the Product, use only Flame-Retardant and Self-Extinguishing type of materials nearby to the product. It is likely that there can be hot-spots / instantaneous high-temperature points in the Unit.
- \* Important Caution!: This Product should not be INSTALLED / USED, in case it is observed that any mechanical part and / or component is damaged, at the time of installation or commissioning.

# 1) Introduction:

TAS PowerTek Pvt. Ltd. has designed and manufactured this Capacitor-Duty Thyristor Switch Product; TSCI/TSCC as an Intelligent, Micro-Controller based Unit, specifically suited for Capacitor Bank Switching in Automatic Power Factor Control Schemes, in a Three-Phase AC System, for high-speed, practically in Real-Time, Capacitor Bank Switching Applications.

TSCI/TSCC uses the Solid-State Semiconductor Technology of SCRs (Thyristors) for AC Power On/Off Control of 3-phase Power Capacitors.

In contrast with conventional Contactor based Capacitor Bank Switching, TSCI/TSCC allows switching on without any in-rush current (soft-switching), smooth disconnecting and also faster switching operations.

Therefore, TSCI/TSCC is highly suitable for highly fluctuating loads that demand Real-Time (Dynamic) Power Factor Corrections as typically required in following areas:

- \* Production Lines involving automation and CNC machines.
- \* Lifts / Elevators.
- \* Sheet Metal Press Shops.
- \* Wind Turbines involving induction generators.
- \* Central Air Conditioning Load.
- \* Metal Rolling Mills, Electrical furnaces and Coiling / De-coiling plants.
- \* Printing Presses.
- \* Welding Machines.

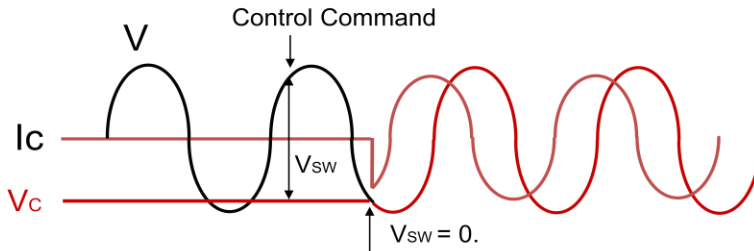
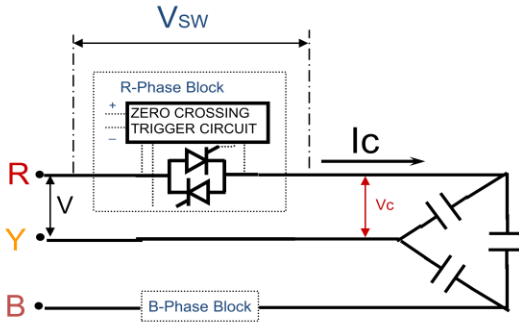
The typical nature of the above loads is highly fluctuating and dynamically changing.

## Benefits of using the TSCI/TSCC Unit:

- \* Capacitive Reactive Power Compensation directly matching to load requirements, almost instantaneously.
- \* Process Voltage Supply becomes more stable.
- \* Process Voltage Drops are reduced.
- \* System Electrical overall efficiency is improved.
- \* Power Factor Improvement with reduced transmission and distribution losses.
- \* Improve System Capacity.
- \* No Mechanical / Electrical Noise during Switching.
- \* Minimal Maintenance because there are no mechanical contacts wear & tear.
- \* Long Operational Life.
- \* **TSCI** is a stand-alone Unit for a Single Capacitor Bank, whereas **TSSC** is a Common Unit of two Capacitor Banks.

# Product Working Philosophy:

Diagram Depicting the Switch-On (surge current free) operation.



Where,

$V_c$  : Voltage across Capacitor.

$V_{sw}$  : Voltage across the Thyristor sensed by the Zero-Crossing Detector.

$I_c$  : Capacitor Current.

Control Command (CMD): Command to Switch-On Capacitor Bank, from APFC Unit.



## 2) Features & Specifications

### 2.1) Features:

- Micro-Controlled based intelligent design.
- Suitable for High kVAr Capacitive Compensation.
- Zero Diff. Voltage Detection based Switch-ON within near zero +/- 6Volt-peak (Typical 3 Volt-peak), giving negligible Switch-On Surge Current.
- Auto Resume after Faults, with additional feature of manual Fault Reset.
- Four Digits, Seven Segment, Bright, Red LED Display.
- Soft-Touch Keys: Enter, Up, Down, for User Interface.
- Auto / Manual (local mode for testing) Mode of Operation.
- Wide Input Supply Range Internal SMPS.
- Capacitor Current Measurement and display.
- Flashing Decimal Point LED as System “Heart-Beat” (I am OK).
- Aux1 O/P N.O. Contact for SCRs Heat-Sink Over-Temperature, for indication on Panel.
- Aux2 O/P N.O. Contact for “Thyristor Short-Circuited” Fault indication.

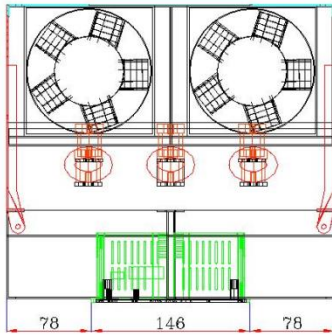
### 2.2) Monitoring & Protection:

- Capacitor Current Spikes due to supply system transients.
- Supply Voltage Transients (High dv/dt disturbances).
- Capacitor Bank Over-Current (either due to harmonics or capacitor damage).
- Capacitor Bank Deterioration or Faulty (zero capacitance).
- Capacitor Bank Earth-Fault.
- Thyristor-Short detection.
- Heat-Sink Over-Temperature.
- AC Mains Power Fail Monitoring during OFF state of Thyristors.
- AC Mains Input Failure while in ON State of Thyristors.
- Capacitor Discharge Device (Resistor) Faulty.

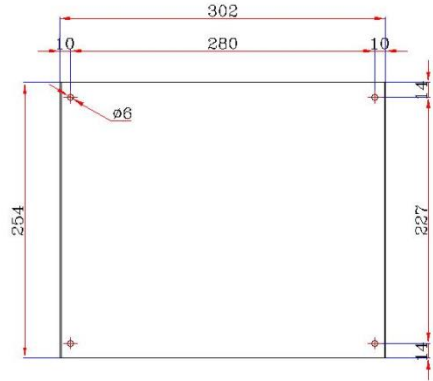
### 2.3) Specifications:

- Three-Phase AC Mains I/P: 200 Vac to 485 Vac (Line-to-Line value)
- Supply operating frequency: 50 Hz +/- 3 Hz
- Auxiliary I/P (Power Supply): 90 Vac to 300 Vac. (47 Hz to 63 Hz)
- Response Time: 1) Turn On: 0 to 10 milli-Second. (cold condition)  
Depending upon Discharge Devices for Hot restart.  
(Refer the chart in further part of this manual)  
2) Turn Off: 0 to 20 milli-Seconds.
- Operating Temp: +5° C to +50° C.
- Operating Altitude: Maximum 2000 Meters, above mean sea level.
- Operating Humidity Range: 10% to 90% R.H. (non-condensing)
- CMD (command) Input Signal:  
(Signal from PF Controller Relay to Switch-ON/OFF Capacitor Bank):  
'0' Logic= 0 to +1 Vdc. '1' Logic= +11 to +26 Vdc.
- Any Fault Feedback Output Signal:  
(Signal from Thyristor Switch to APFC, Fault Condition):  
Current Sourcing (max. 20 mA) PNP Transistor Output.
- Optional Other Fault Feedbacks Output Signals:  
Potential-Free N. O. Relay Contacts as Aux. Digital Outputs:  
Aux. Digital Output 1: SCRs Heat-Sink Over-Temperature fault.  
Aux. Digital Output 2: SCR(s) Short-Circuited. .
- Spike Current Detect: 2.2 times rated Peak Current.
- Watt Loss: Less than 3.6 Watt / Amp up to 80 Amp Product & approx.  
4.6 Watt/Amp for 120 Amp and 160 Amp products.
- Auxiliary O/P Contacts: 1 Amp resistive, 0.5 Amp Inductive Max. 230V  
A.C. or 24V D.C. Max.
- Current Measurement: Accuracy Class-3.

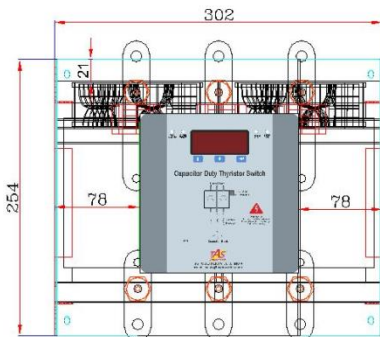
### 3) Mechanical Dimensions: TSCI (Stand Alone) Modules: (All dimensions in mm)



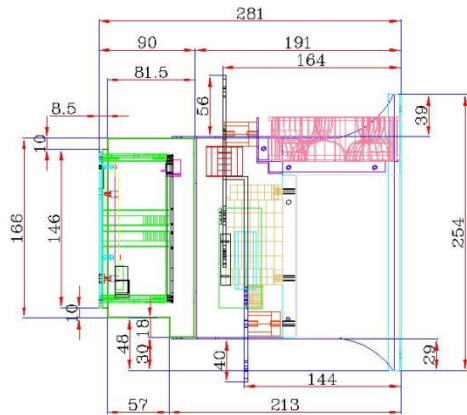
TOP VIEW



MOUNTING DETAILS

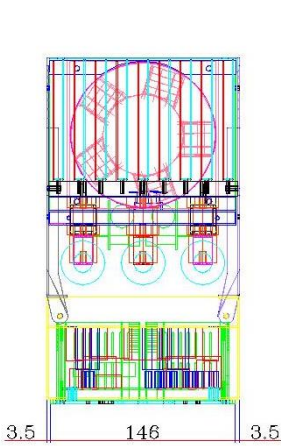


FRONT VIEW

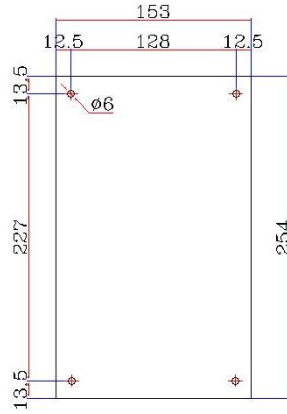


R H SIDE VIEW

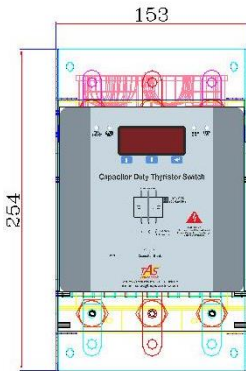
TSCI-160 (160 Amp)



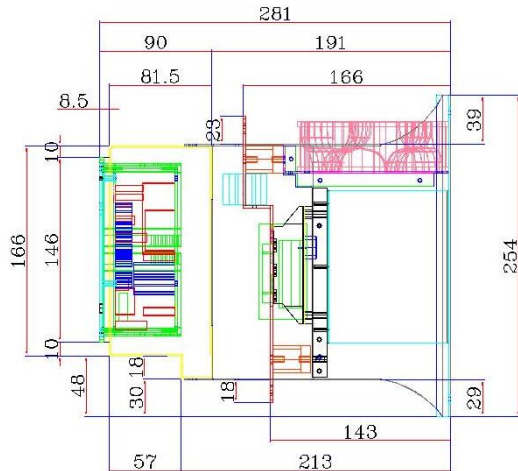
TOP VIEW



MOUNTING DETAILS



FRONT VIEW

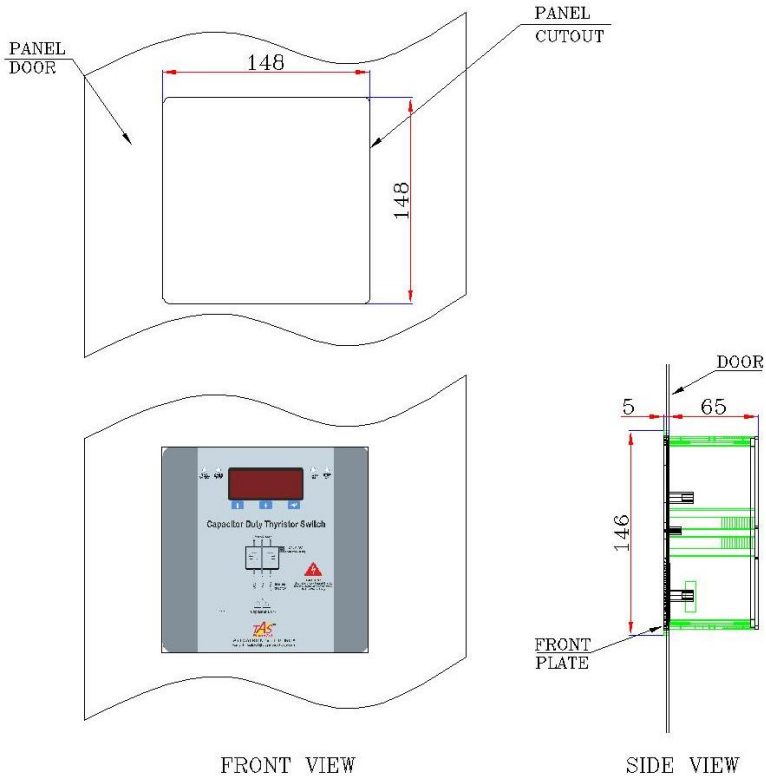


R H SIDE VIEW

## TSCI-25, 40, 80, 120

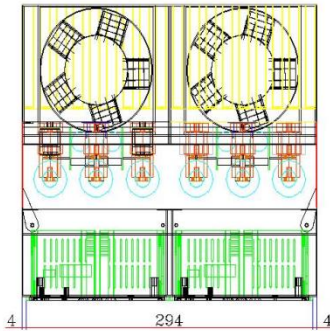
(25 Amp, 40 Amp, 80 Amp & 120 Amp)

## Panel Door Cut-out:

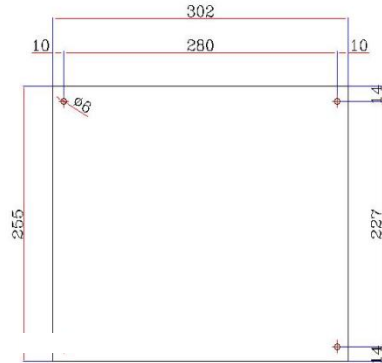


**(TSCI-25, 40, 80, 120,160)**

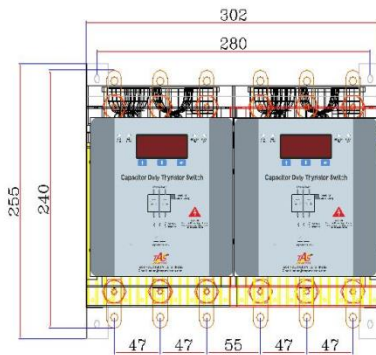
# TSCC (Combi-Pack) Modules: (All Dimensions are in mm)



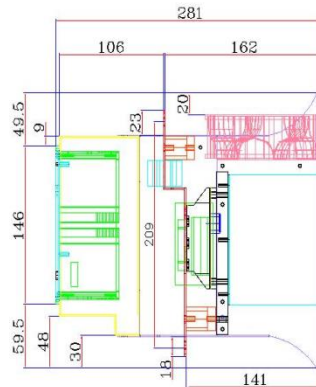
TOP VIEW



MOUNTING DETAILS



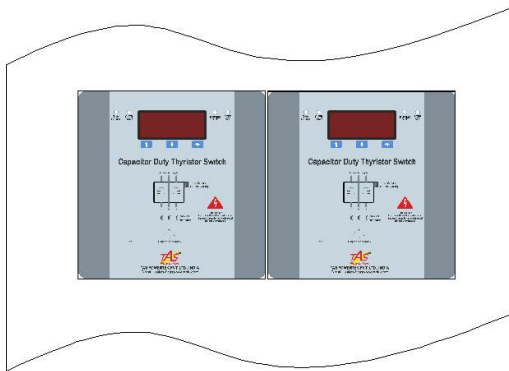
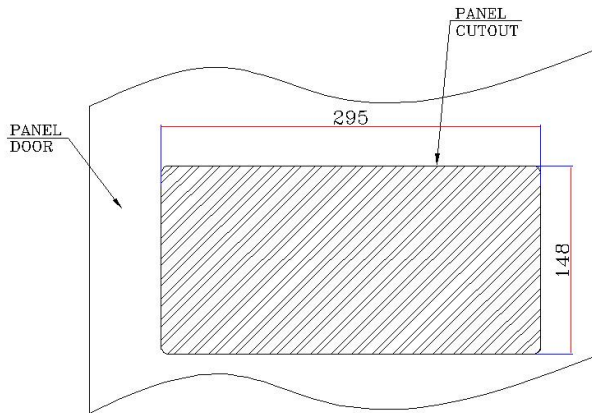
FRONT VIEW



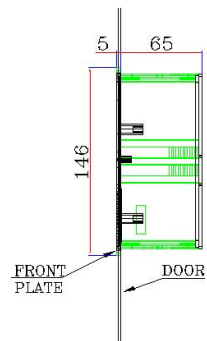
R H SIDE VIEW

**Note:** Views shown are as to be mounted. Keep minimum 150 mm space on top above the cooling fans, and minimum space of 30 mm form all other sides of the unit, for proper air-circulations around the Unit.

## Panel Door Cut-out:



FRONT VIEW



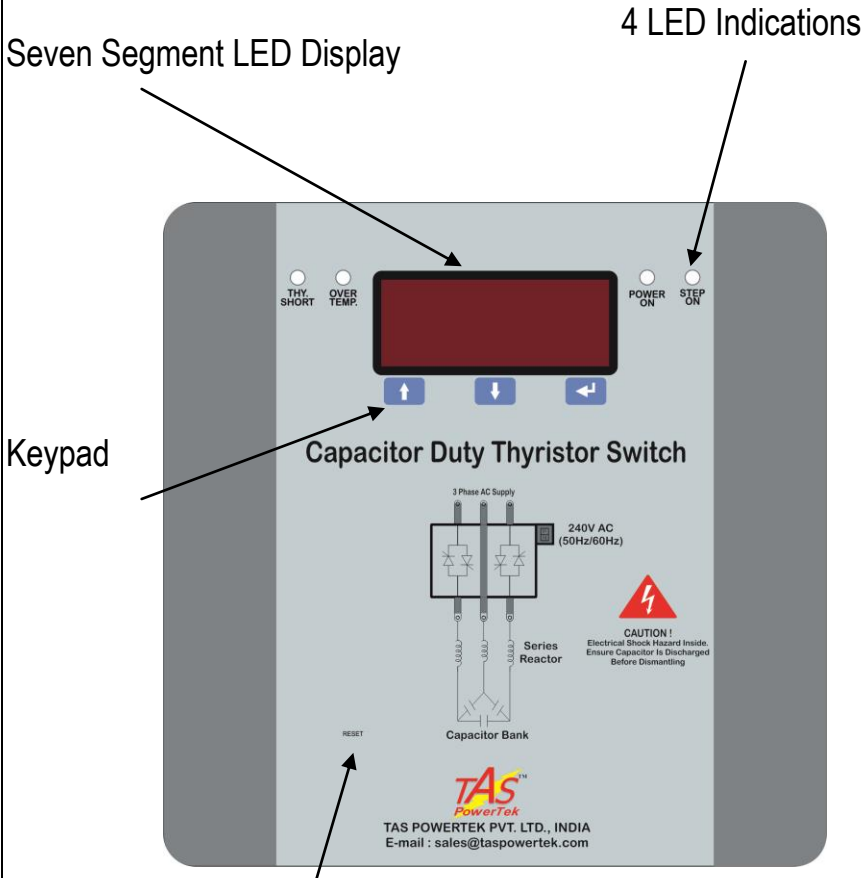
SIDE VIEW

**(TSCC-02)**

All Dimensions are in mm

## 4) Operating Panel / Labels:

Front Face:



Seven Segment LED Display

4 LED Indications

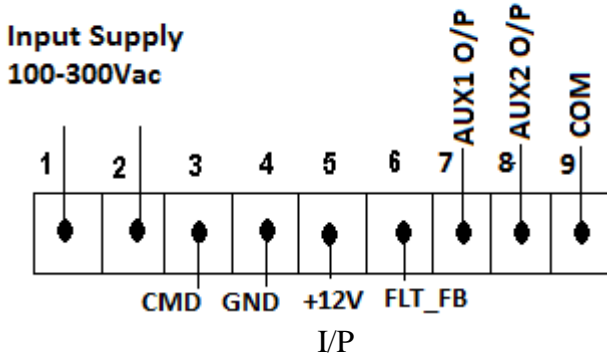
Keypad

Capacitor Duty Thyristor Switch

RESET Key (Hidden)

### 4.1) External Use Terminals:





As viewed from Connector Side.

**GND:** This is Ground Ref. terminal, with respect to this terminal, Input command (CMD) and Output Fault Feedback reference voltages are given.

**CMD:** Signal from PF Controller relay to Switch-ON/OFF Capacitor Bank  
 '0' Logic= 0 to +1 Vdc. '1' Logic= +11 to +26 Vdc.

**Any FLT\_FB:** Signal from Thyristor Switch to APFC, on Fault Condition:

- Any Fault Feedback Output Signal:  
 Current Sourcing (max. 20 mA) PNP Transistor Output.

**+12 V:** External +12 V DC Supply required for driving Fault Feedback Signals.

### OPTIONAL:

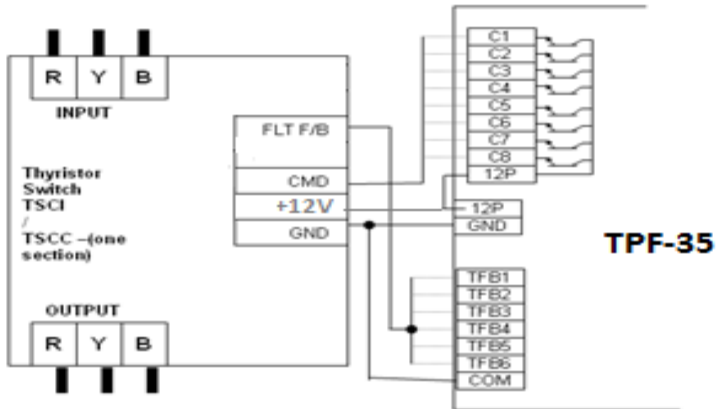
**Auxiliary 1 O/P -** N.O. Contact for SCRs Heat-Sink Over-Temperature.

**Auxiliary 2 O/P -** N.O. Contact for "Thyristor Short-Circuited".

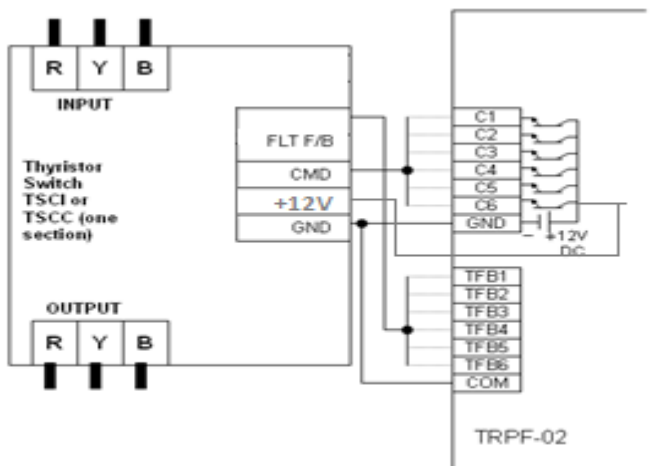
**COM:** This is the "Common" Terminal for the above two Aux. Digital O/Ps.

## 5) Control Wiring Diagram:

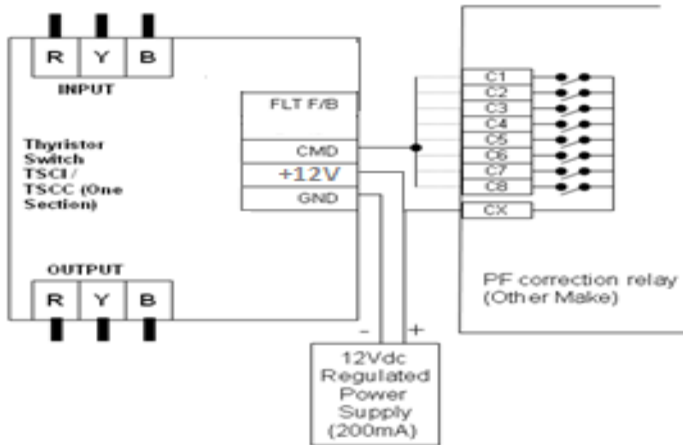
With TAS Make TPF-35 PF correction relay:



With TAS Make TRPF-02 type PF correction relay:

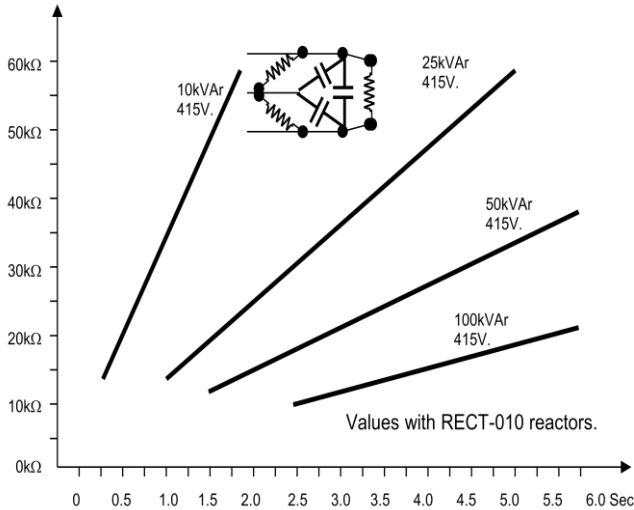


With Other Make PF correction relay:



## 6) Field Installation Guidelines:

- 1) Connect Incoming Supply AC Power to Capacitor bank (R, Y, B Phases) from any one side of Thyristor Switch (Bus-bars). This means Connection of Incoming Supply and Capacitor Bank can be done in any direction, top-bottom or bottom-top. (Transparent – non directional connections)
- 2) Connect exactly opposite side Bus-bars, to Delta Connected Capacitor Bank Through series reactors of appropriate rating.
- 3) Auxiliary Input Supply (Power Supply input) is to be given to Thyristor Switch Unit as shown in **Point 4.1**.
- 4) The Field Wiring between the Product and APFC for Command, Fault Feedback, and Ground, +12V are as shown in Typical Wiring Diagram shown on previous pages.
- 5) It is mandatory to use the series reactors for capacitors that are switched through this Product. The value of series reactors is normally specified in term of % AC voltage drop. This is the voltage drop in one phase series element of reactor and is calculated as  $[(\text{voltage drop across reactor}) / (\text{Supply voltage Phase-Neutral voltage})] \times 100$ .  
The minimum % AC voltage drop for the Product usage is 0.2%. Still, the exact value should be selected depending upon the various considerations to supply system harmonics and resonant condition avoidance.
- 6) For High speed switching response time, it is sometimes important to achieve the faster hot response time. For such applications, usage of appropriate value resistive discharge devices across the Power Capacitors is required. The following selection chart can be used as guidelines for selection of the discharge resistor values.



Note: TSCI Controller as a Product can be internally factory-set to various current ratings, by placing proper jumpers (On TSCI Controller-Front Card) as shown in below table. This facility is only for the TAS Factory and not for the Customer or Application Sites.

TSCI Unit Current Rating	Jumper CN11	Jumper CN10	Jumper CN14
25 Amp	Jumper Placed	Jumper Placed	Jumper Removed
40 Amp	Jumper Placed	Jumper Removed	Jumper Placed
80 Amp	Jumper Placed	Jumper Removed	Jumper Removed
120 Amp	Jumper Removed	Jumper Placed	Jumper Placed
160 Amp	Jumper Removed	Jumper Placed	Jumper Removed
50 Amp	Jumper Removed	Jumper Removed	Jumper Placed
100 Amp	Jumper Removed	Jumper Removed	Jumper Removed
200 Amp	Jumper Placed	Jumper Placed	Jumper Placed

## 7) LED Indications:

●	Power ON (Thyristor Switch is Powered)
●	Step ON (Capacitor Bank is ON)
●	Thyristor Short Detected (Fault).
●	Over-Temperature Fault Detected (Fault).

## 8) Key-pad:



UP key: Used to scroll up the menu screen / Increment the numbers while entering values.



DOWN key: Used to scroll down the menu screen / Decrement numbers while entering values.



ENTER key: Used for entering a sub-menu or for setting up values.

**RESET** RESET key: This key is not high-lighted, but it is given for manual fault resetting. This key is not to be used frequently in case the faults occurrence is frequent.

This key is on front face, at bottom-side, left-hand corner.

## 9) Digital LED Display:

### 9.1) During Power ON:



Power ON Display  
For 1 Minute, "TSCI".



Thyristor Check for 30  
Seconds, "thy?".



Unit is getting  
Ready, "Strt".

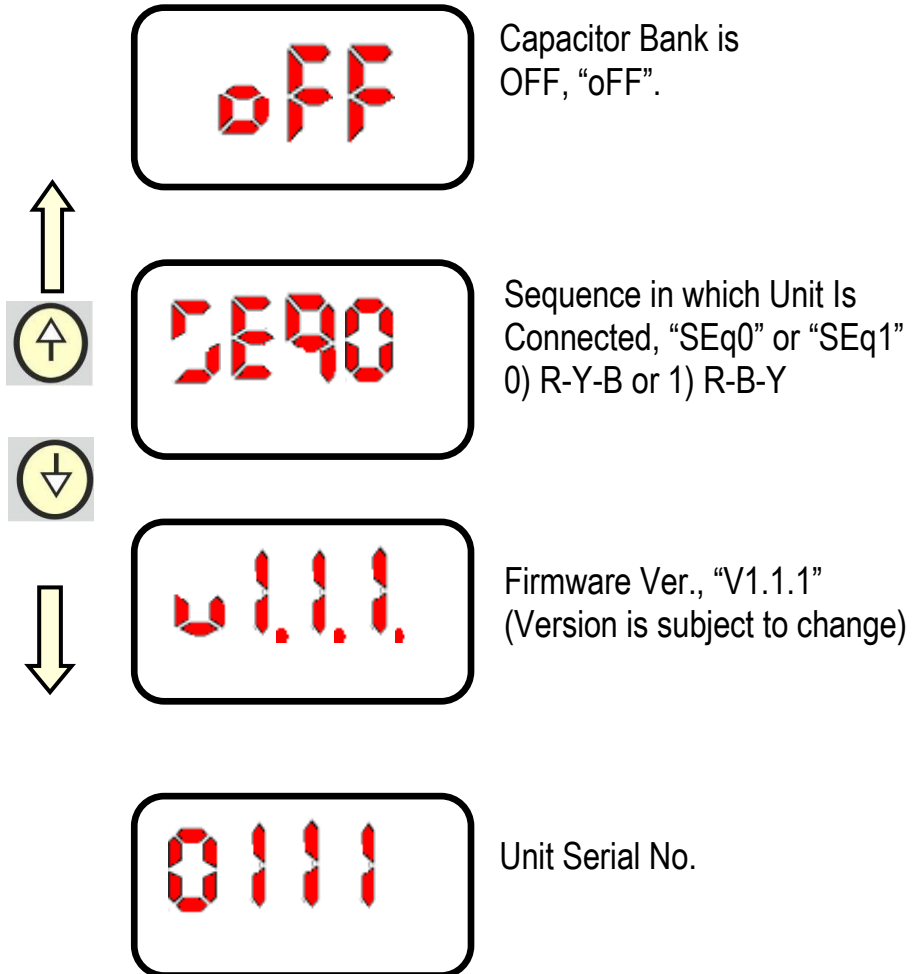


Unit is doing Line  
Synchronization,  
"SynC".

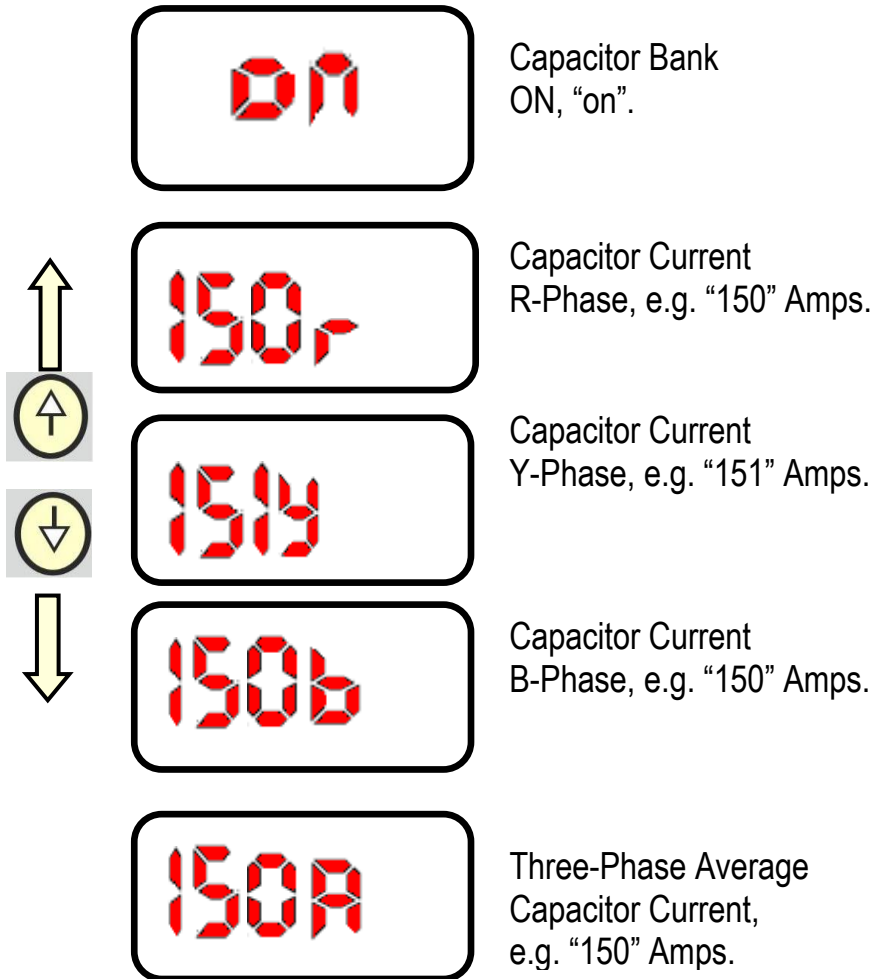


## 9.2) Default Display Screens

(Command signal is absent):





### 9.3) Default Display Screens (Command Signal is Present)



## 10) Mode Selection:

There are THREE modes of operation:


- 1] Manual (Local mode for testing)
- 2] Auto
- 3] Program (Parameters Settings).

Press  Key and use Up  or Down  keys to select one of the three modes as desired.



a) **AUTO Mode.**

b) **MANUAL Mode.**

c) **PROGRAM Mode.**

Having selected the desired mode, then, press Enter Key  to enter the specific mode.

### Auto Mode Selection:


Press  Key on “AUTO” screen and now by pressing  again during “ENABLE”, LED Screen will Select Auto Operation.

### **Auto Mode Operation:**

This Mode accepts a Capacitor Bank On / Off Command Signal coming from the “Power Factor Controller” and accordingly switches the Thyristors On or Off in the proper sequence, to ensure minimum capacitor switching spike current.

The Bank Status Feedback is also made available to the APFC Unit, thru’ “Fault Feedback” signal, and also thru’ the two N.O. Relay Contacts, to the User system, such as PLC / Alarm-Annunciation etc.

## Manual Mode Selection:

Pressing  button on “Manual” display on LED Screen will put Thyristor Switch in Manual mode.

## **Manual Mode Operation:**

In this mode the switch is locally turned ON/OFF and any command from the Power Factor Control relay is neglected.



In this mode, if the capacitor bank is turned ON, the current through the same can be monitored and is a handy feature for maintenance and testing of the system.


Initially, Screen will Show as “**L-OFF**” Bank is OFF, because, the Capacitor Bank is automatically Switched-Off while entering in this Mode of operation.

This Mode is provided to the User to locally test the Capacitor Bank On / Off Operation, under Manual Control, before putting the Switch to Auto Mode of Operation.

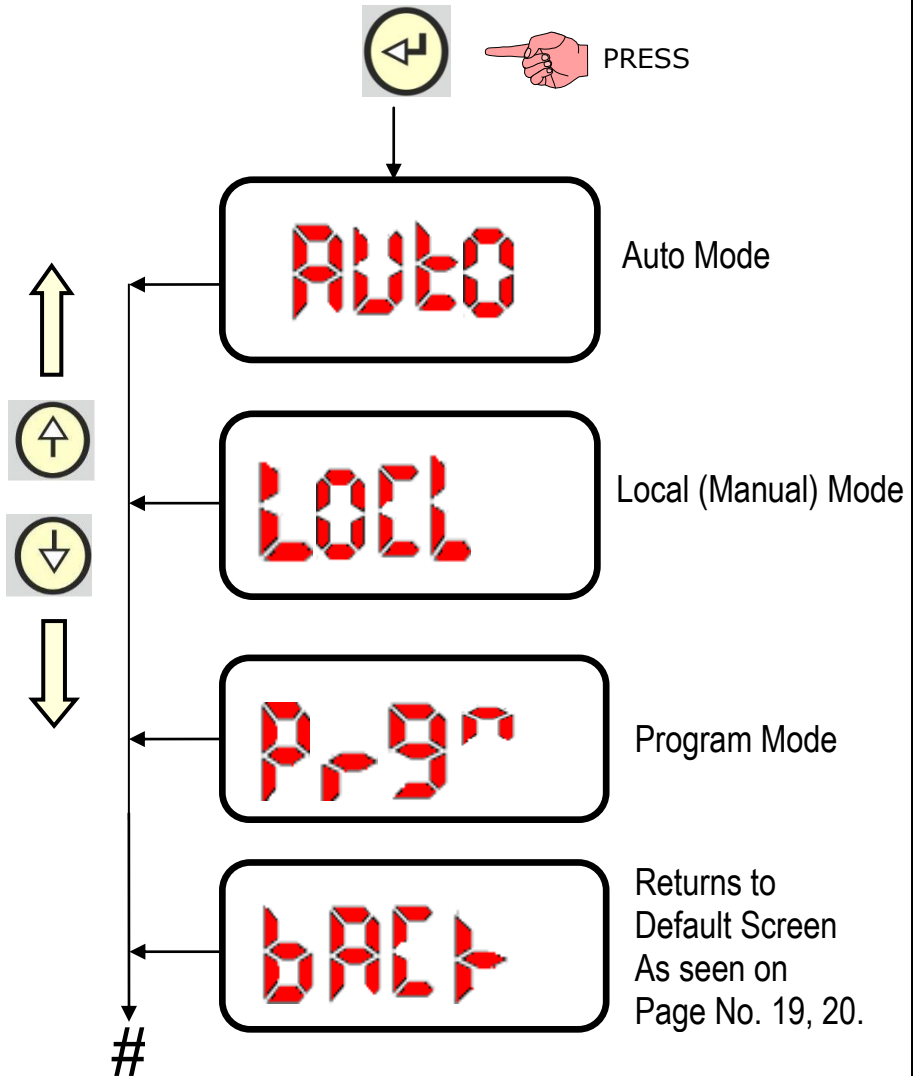
If the User wants now to switch-on the Capacitor Bank, one can just do it by using  Key.

The LED Screen will Show as “**L-ON**” and turns on Bank Manually.

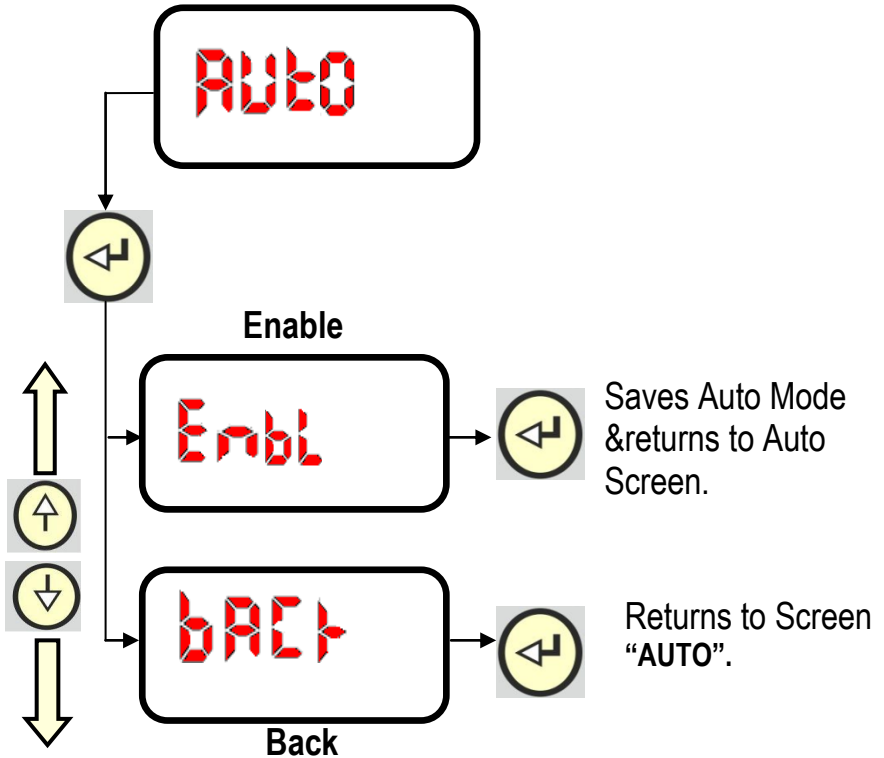
So, just by pressing   keys, Capacitor Bank can be Turned ON and Turned OFF manually and Unit will Display Current of all Three Phases.

Pressing  Key at any Screen will Manually Switch OFF Capacitor Bank, and returns to Default Screen and activates Auto Mode.

# Screen Navigation for Mode Selections.

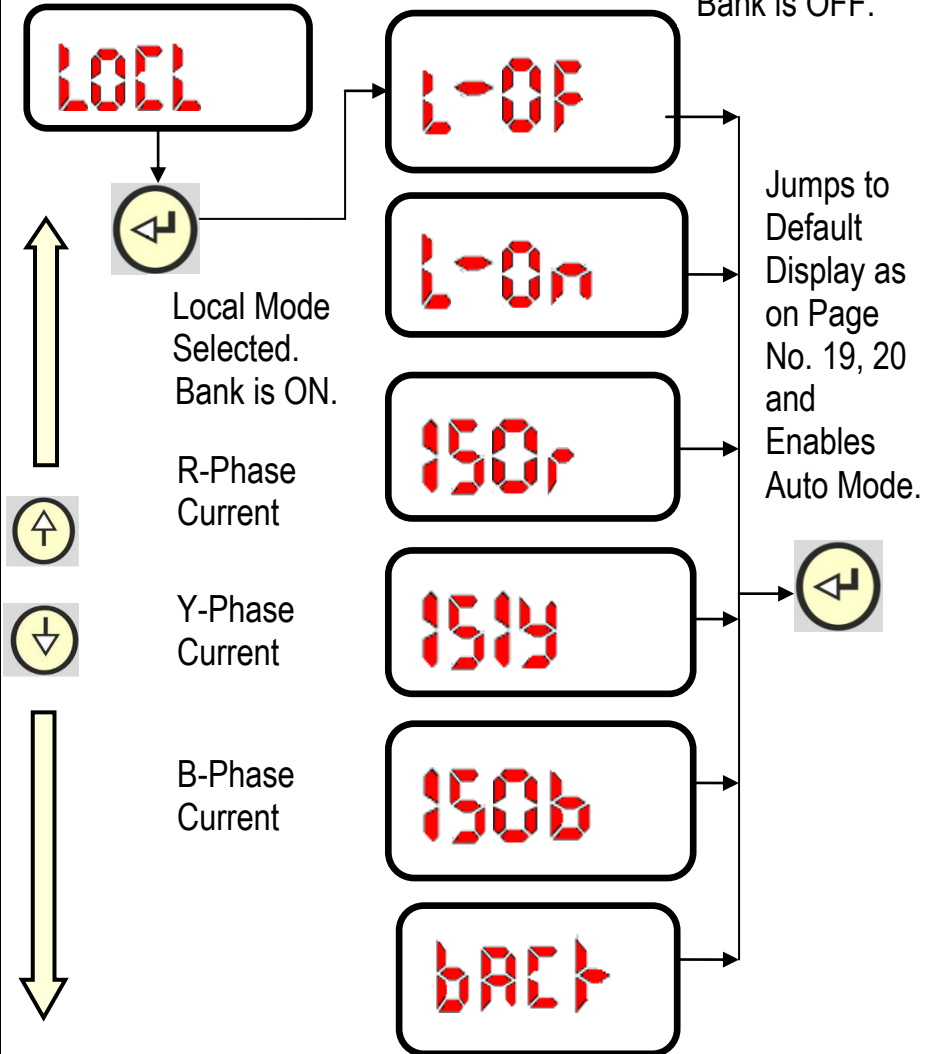


## 10.1) Select Auto Mode:





## 10.2) Select Local (Manual) Mode:

Local Mode Selected.  
Bank is OFF.





# 11) Program Mode:

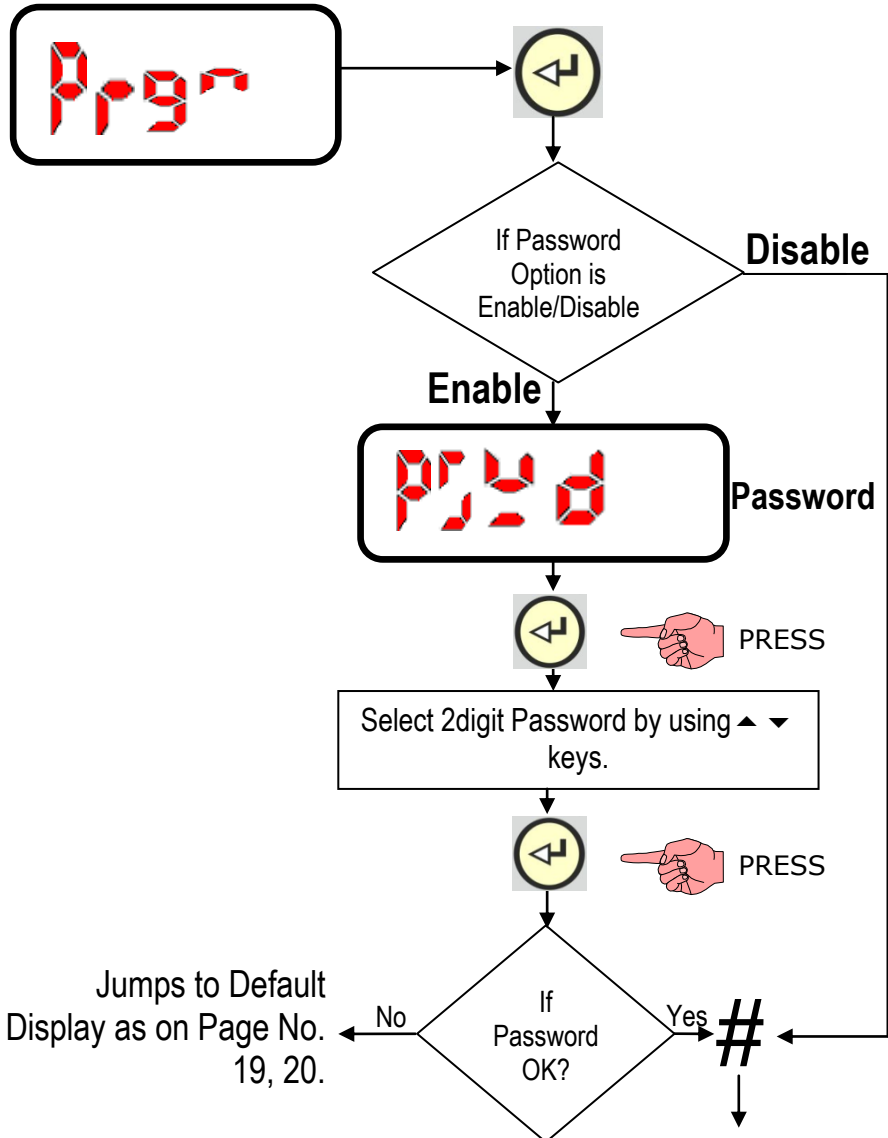
This mode is used to carry out system settings. In this mode, various system settings can be carried out. To do the same, use the keys   and select the type of parameters to be edited by Pressing Enter key on that Screen.

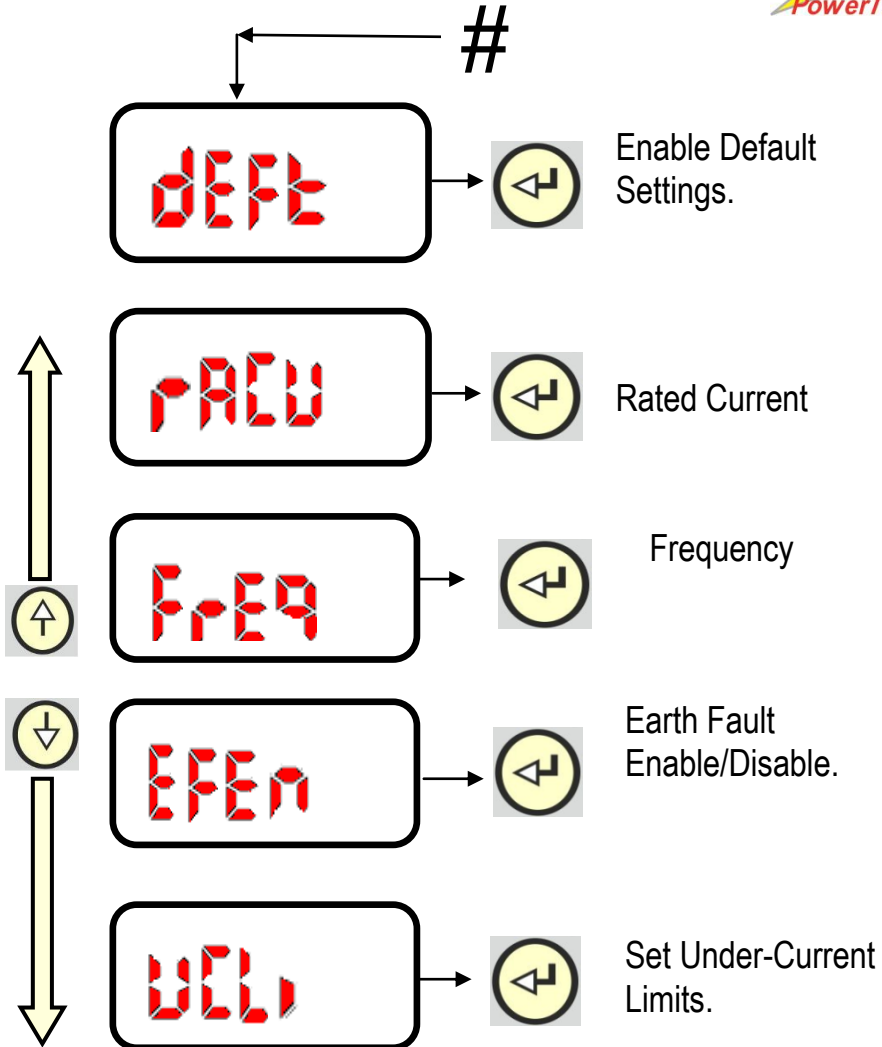
The types of parameters that can be edited are:

Sr.No	Parameters	Selectable Options
1)	Default Settings	a) Enable.
2)	Earth Fault Enable/Disable.	a) Enable. b) Disable.
3)	dV/dt Fault	a) Enable. b) Disable.
4)	Under/Over-Current Limit	Limits Settable in predefined absolute values.
5)	Earth-Current Limit	a) 15% of Rated Current. b) 20% of Rated Current. c) 25% of Rated Current. d) 30% of Rated Current. e) 35% of Rated Current f) 40% of Rated Current.
6)	Change Pass-word (Two Digits)	From 00 to 99 Decimal Number. (Factory Set is 01).

# Programming Mode Navigation

Flowcharts for entering into Programming mode:

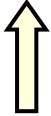




0CL



Set Over-Current Limits.



EAL



Set Earth Fault Limits.



PYEN



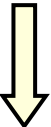
Password Enable/Disable.



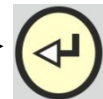
CHPY



Change Password .

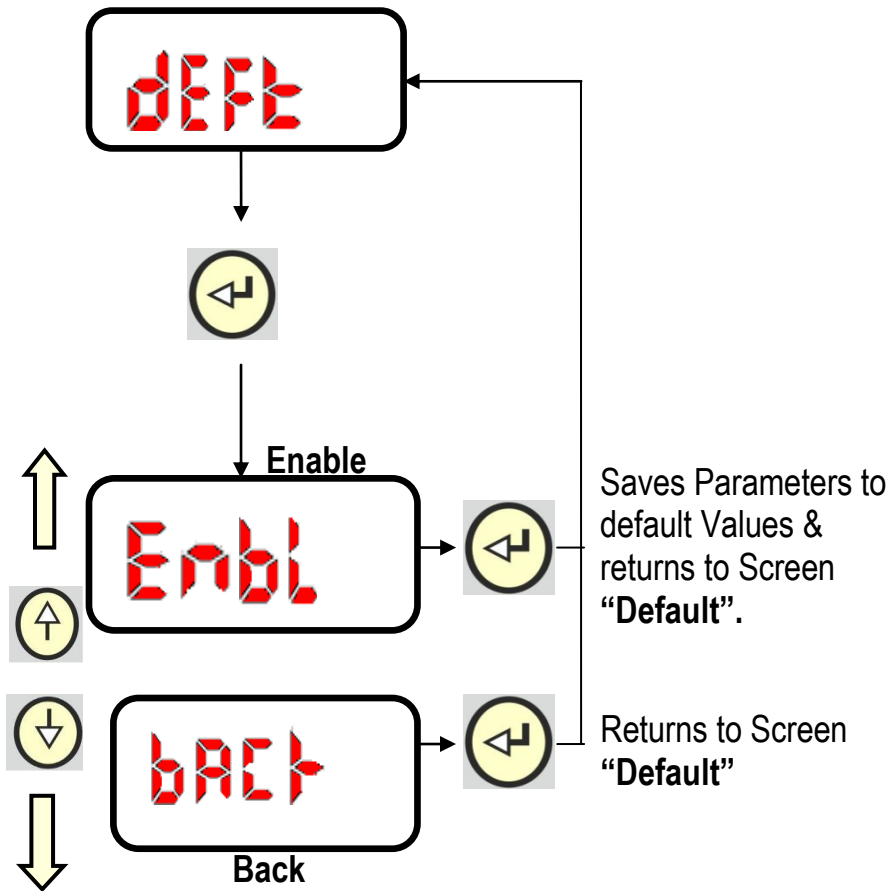


BACK

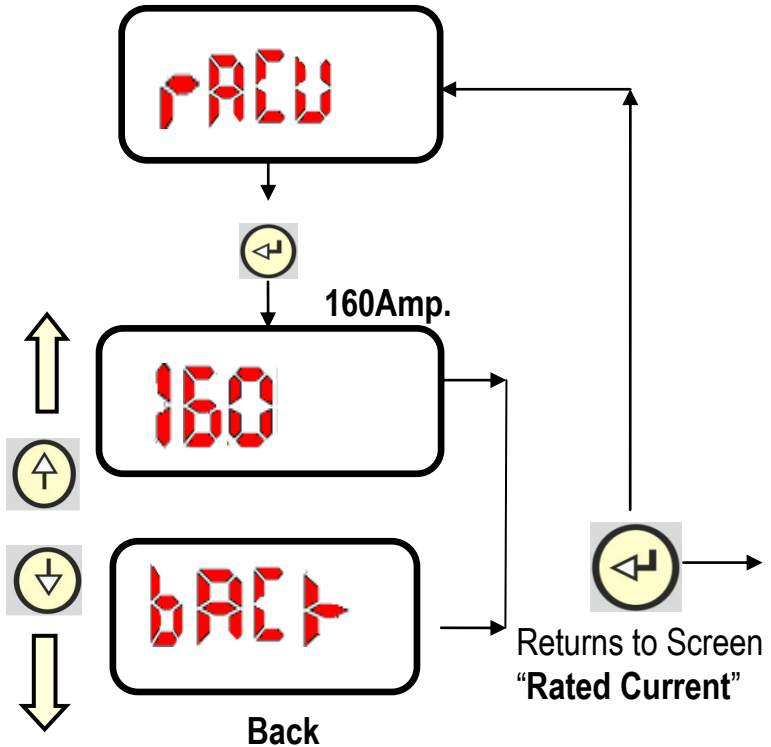


Back, Jumps to Previous Menu.

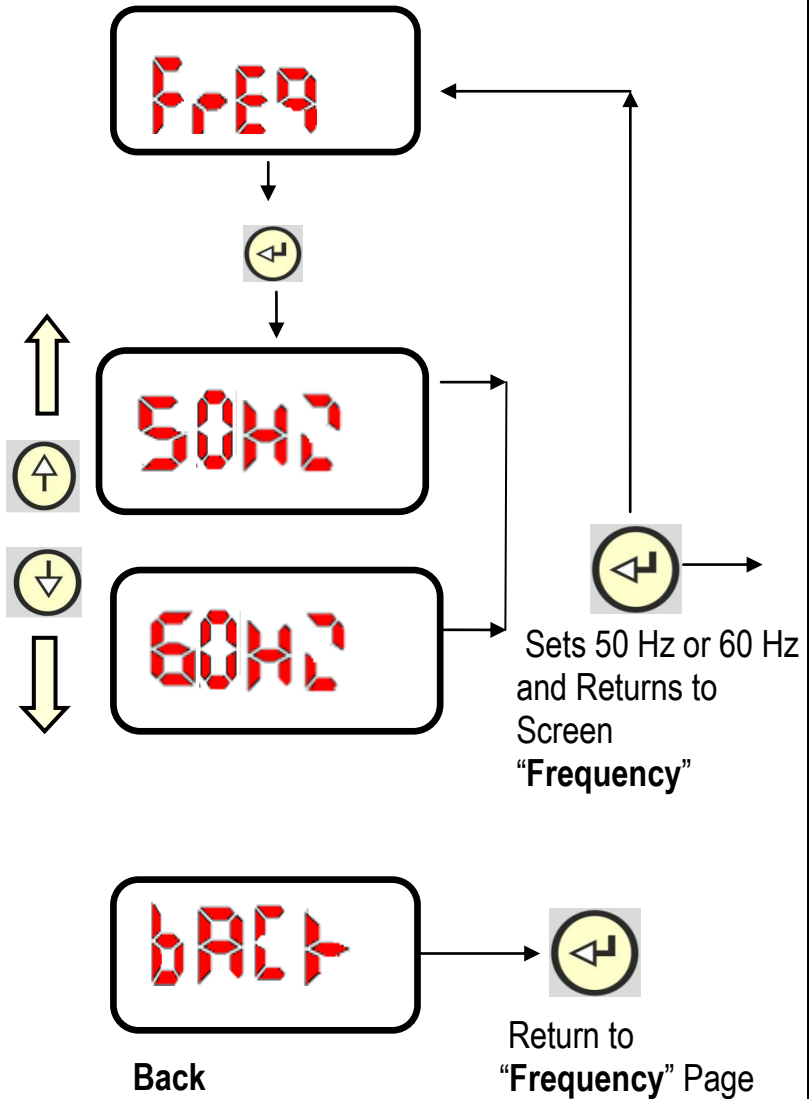
## 11.1) Default Settings:



## 11.2) Displays Rated Current of the Product:



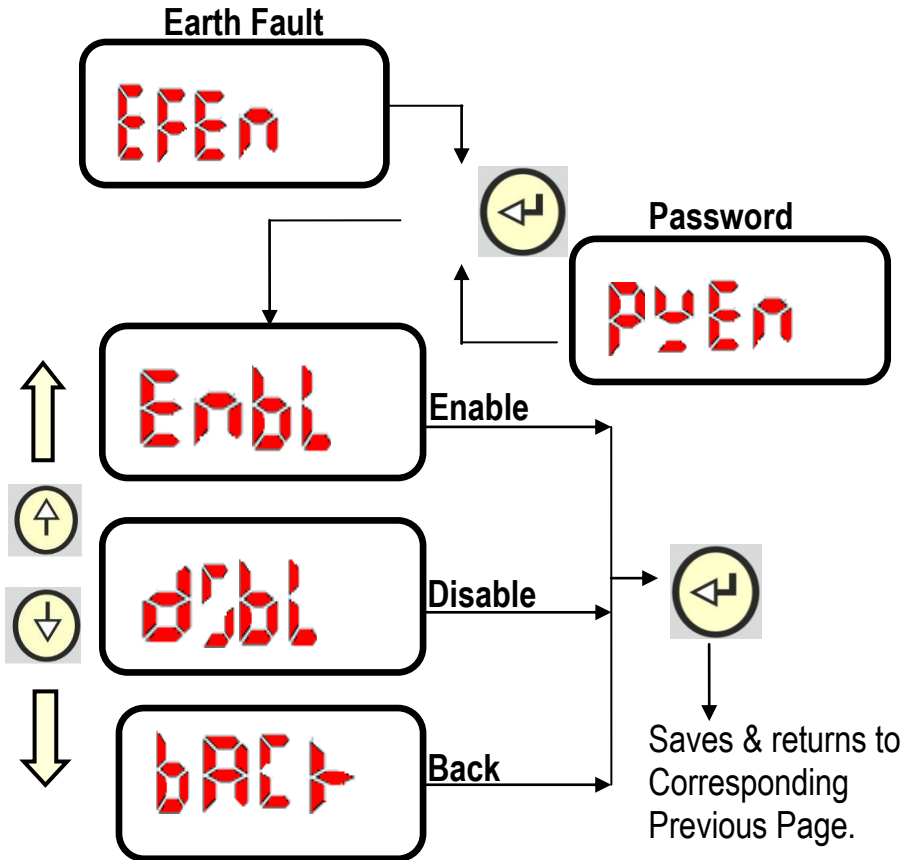
### 11.3) Set Operating Frequency of the Product:



# 11.4) Enable/Disable options:

For a) Earth Fault.

## b) Password.

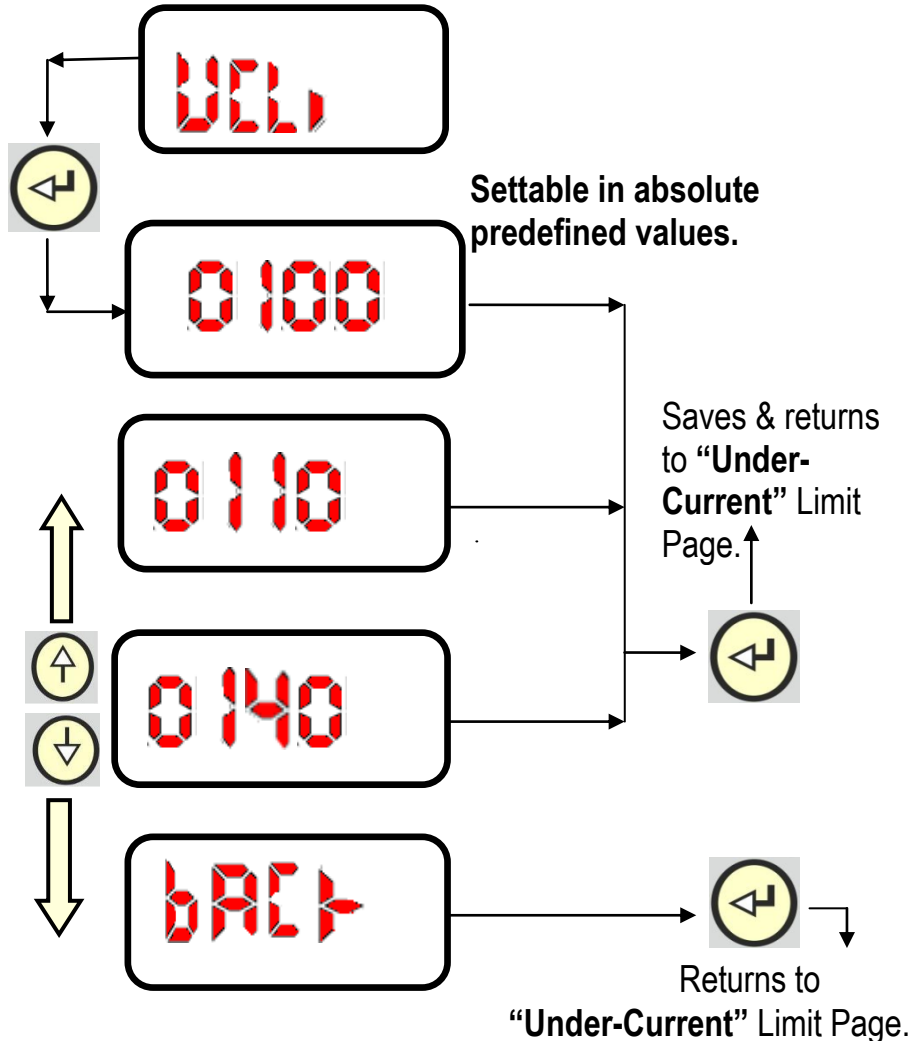




## 11.5) Set Under-Current Limit.

Note: Under-Current Limit Values are settable in Absolute Values.

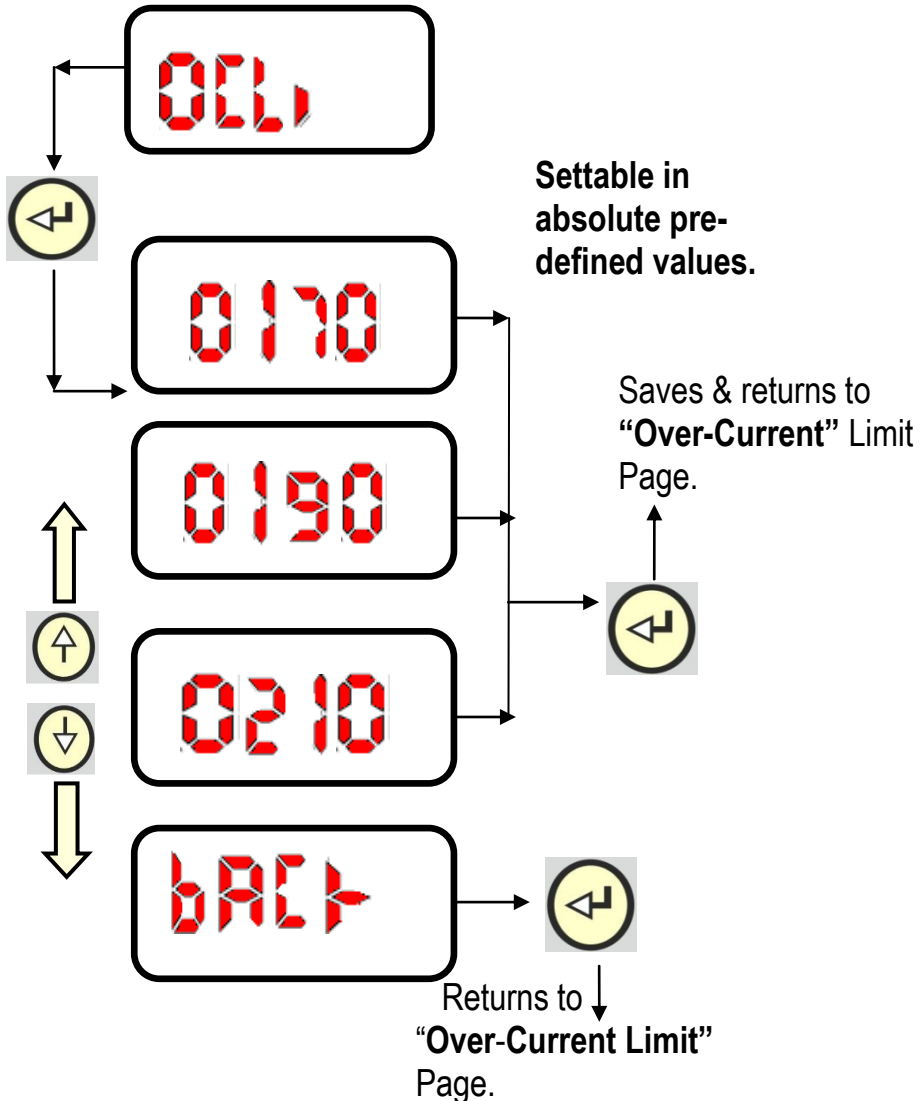
Defined in Program as per Current Rating of Unit. This is important to detect the Capacitor's Capacitance Value degradation / deterioration, thus finding out if Capacitor has become faulty.



## 11.6) Set Over-Current Limit.

Note: Over-Current Limit Values are settable in Absolute Values.

Defined in Program as per Current Rating of Unit.

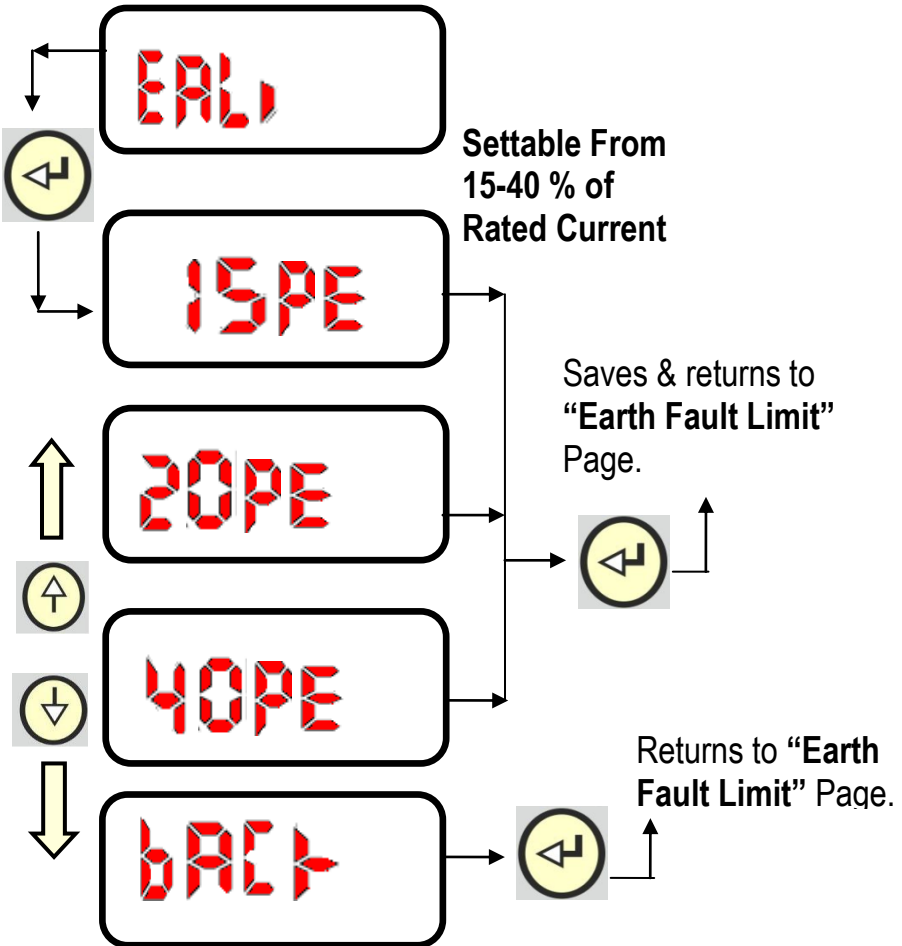


## Pre-defined Limit Settings for Over-Current and Under-Current Limit Settings:

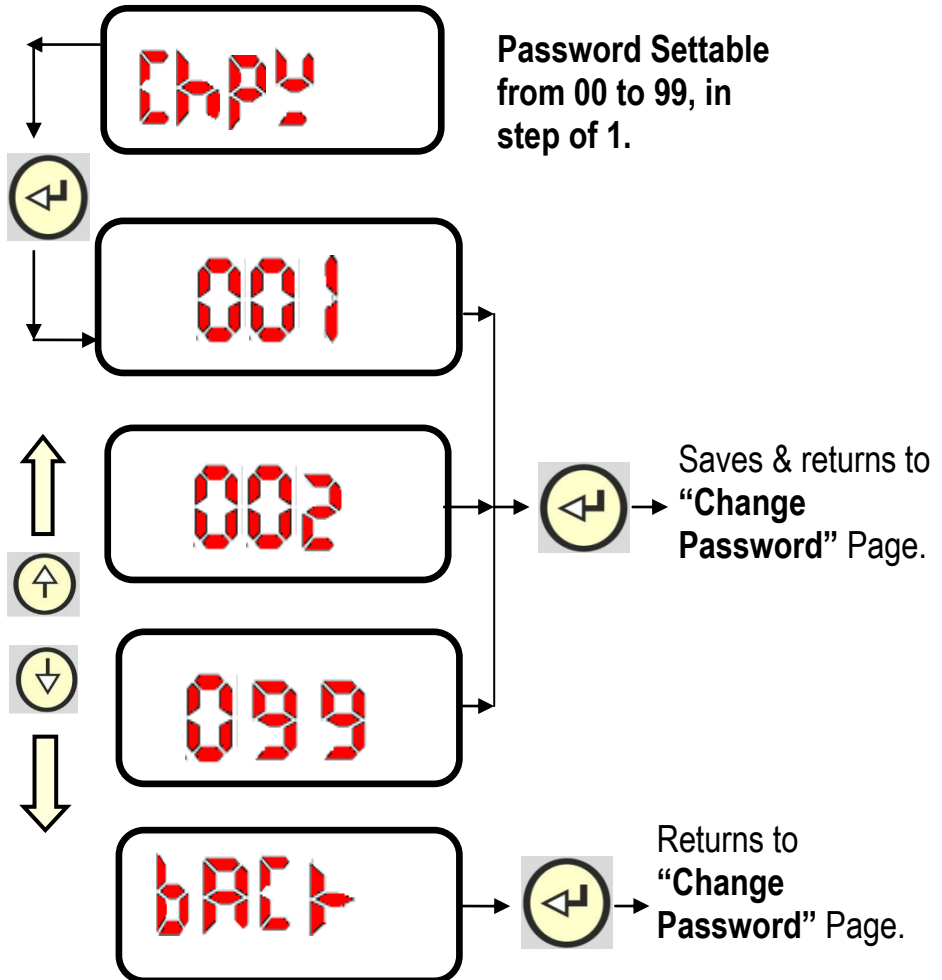
Rated Current	25 Amp	40 Amp	80 Amp	120 Amp	160 Amp
Under-Current Set Limits	5 Amp	8Amp	16 Amp	24 Amp	32 Amp
	9 Amp	14 Amp	28 Amp	42 Amp	56 Amp
	13 Amp	20 Amp	40 Amp	60 Amp	80 Amp
	17 Amp	26 Amp	52 Amp	78Amp	104 Amp
	21 Amp	32 Amp	64 Amp	96 Amp	128 Amp
Over-Current Set Limits	28 Amp	44 Amp	85Amp	125Amp	170 Amp
	30 Amp	46 Amp	88 Amp	130 Amp	180 Amp
	32 Amp	48 Amp	91 Amp	135 Amp	190 Amp
	34 Amp	50 Amp	94 Amp	140Amp	200 Amp
	36 Amp	52 Amp	97 Amp	145 Amp	210Amp

**Note: Over-Current Limits are NOT to be treated as Operating Values.**

## 11.7) Set Earth Fault Limit.



## 11.8) Change Password of Thyristor Switch.






## 11.9) Parameters Default Values





Parameters	Default Value	Minimum set value	Maximum set value
Pass-word (Two Digits)	01	00	99
Password Enable/Disable	Enable	-	-
RATED CURRENT (Amps) Non-Editable Parameter	160  (as per TSCI/TSCC Unit Rating)	-	-
Earth fault Enable/Disable	Disable	-	-
Earth Current Fault Limit (%) of Rated Current	20	15	40

## 12) Faults:



### 12.1) Faults During Capacitor Bank is OFF:

Sr. No	Fault Name	Display ON Screen	Cause Of Fault
1)	Thyristor Short		Thyristor has got Internally Shorted.
2)	Power-Fail		Voltage across Thyristor is Absent.
3)	Capacitor Discharge Devices (Resistors) are Faulty.		During Power On, if Capacitor was not Discharged.

## 12.2) Faults During Capacitor Bank is ON:

Sr. No	Fault Name	Display ON Screen	Cause Of Fault
1)	Capacitor Current Spike.		Capacitor Current Spike greater than 2.2 times of Rated Current.
2)	Capacitor Faulty		Current Flowing through Capacitor is less than set limit for "Under Current".
3)	Over-Current		Current through Capacitor is greater than set limit for "Over Current".
4)	AC Input Failure		Current through Capacitor is less than 10% of Rated Current.



5)	Earth Fault		Earth Leakage Current through Capacitor is greater than Set Limit for Earth Current.
6)	Over-Temperature Fault		Thyristor Heat-Sink Temperature is above +90 Deg. Celsius.

### 12.3) Optional Auxiliary Contacts for fault annunciation:

There are Optional two independent Auxiliary Contacts (N.O.) are provided to allow for use by external PLC / Alarm Annunciation Systems. These TWO Contacts are available on CN1 Connector, with a “COM” Common Terminal.

These N.O. Contact remains “Open” during absence of Power to the Unit.

**Auxiliary Contact-1 is used for “SCRs Heat-Sink Over-Temperature Detected Indication. It is in Open state for Healthy State, & Closed State for Over-Temperature.**

**Auxiliary Contact-2 is used for “Thyristor Short-Circuited” Fault. It is in Open state for Thyristors are OK & Closed State for any or Both Thyristors Short Detect.**

**Please Note that both relays share common end because of three terminals of the output, so user is requested to take necessary care while wiring and using appropriate voltage level & supply type (AC & DC).**

## 13) General Notes:

- 1] The TSCI/TSCC should only be used according to its intended application.
- 2] **The TSCI/TSCC must only be used in coordination with appropriately rated Safety devices such as fast-acting Semiconductor Fuses preferably and HRC Fuses, in case of unavailability of Semiconductor Fuses.**
- 3] The TSCI/TSCC must be installed in such a way that no excessive high currents and / or voltages can appear in case of any faults in Electrical / Mechanical Systems.
- 4] Avoid Installing TSCI in high Relative Humidity area and particularly, avoid moisture condensation which is caused by sudden drop in ambient temperature.

**Special Notes:** 1] The maximum DC Voltage at switched-off Capacitor can be 150% of Peak of Mains AC Voltage.

- 2] Because of the Continuous DC Voltage across disconnected Capacitors, to at least Peak of AC Mains Voltage, the Discharging Devices (High-Wattage, Non-Inductive Resistors, preferably with Heat-Sinks), must be dimensioned for the Resistor Value and the Rated Wattage, correctly, to discharge the Capacitor Bank.
- 3] In practical use, discharging reactors (inductors) are NOT allowed to be used, because, the continuous DC Voltage would destroy them.
- 4] The Discharging Resistors are selected for a permanent connection to DC Voltage in height of Peak Voltage of the AC Mains.
- 5] Ensure that the Discharge Resistor value and wattage is appropriate such that the Capacitors are discharged after disconnecting the system from the AC Mains Voltage, in the necessary stipulated time.
- 6] Install clearly visible "**WARNING SIGNS**", to show the possibility of residual voltage at the disconnected Capacitor Banks.

# 14. Warranty Conditions

## General Warranty Conditions for TAS's product range:

- 1) The product/system is warranted against any manufacturing and design defects. Any other defects in the product/system due to wrong handling, transportation damages, usages of product beyond the specified electrical supply conditions, wrong application, wrong working conditions etc are not covered under the warranty clause.
- 2) TAS PowerTek Private Limited will not accept any liabilities, liquidated damages claims due to usage of these equipments. The proper usage of these products/systems would be sole responsibility of the purchaser of these products and TAS would only give the guidelines for the proper usage.
- 3) Product is warranted against failure of any component as specified in clause no.1 and TAS PowerTek Private Limited would be replacing any faulty components free of cost which would be including the cost of the component and the direct engineering services that are involved with the repair of the said product/system.
- 4) The warranty services offered would be only applicable in the specified territory of our service centers. Any services required outside the specified territory would be on chargeable basis.
- 5) Some of the products can only be serviced at our Manufacturing works at Nasik. With such products, the transportation cost of faulty product to and fro Nasik would be to purchaser's account.
- 6) Normally, the products offered are warranted for a period of 15 months from the product invoice date or 12 months from the first usage date, whichever is earlier. This is valid unless extended term of warranty is explicitly agreed between TAS and the purchaser.
- 7) The warranty is applicable is for rectification of the defective product/system and would not be applicable for the entire product/system replacement.

## Specific Warranty Conditions to the Product:

The said product is intended to be used as a part of the electrical system with specific purpose. Therefore the said product is designed with intention to work with the system which is appropriately designed. Inappropriate application or design of the other components in the system can cause some of the design specification parameters to exceed the product specification design rating and can cause damage to them. Thus, user of this product is strongly advised to follow the guidelines given in this document so as to avoid damage to this product and in turn failures of the systems wherein this product is used.

Unless the said technical guidelines in this document are not followed, the product warranty terms would not be applicable and user would be solely responsible for such failures in the purchased product/s.

### The mandatory requirements to be followed for usage of this product are:

- I. This product is intended to be used for switching ON and switching OFF the Power Capacitors to be used with Power Factor Improvement Capacitor switching system. Usage of this product is restricted to the application of “Power Factor Improvement” capacitors only and not for any other application usage like “Tuned or Partially tuned passive harmonic filters”. For such application, there is a separate product model available from TAS PowerTek Pvt. Ltd. and should be used in case of such specialized application/s.
- II. The product is to be used with 3 phase 50 Hz / 60 Hz supply system with extreme AC RMS line to line voltage range as 200 Vac to 485 Vac.
- III. It is mandatory to use the series reactors with minimum rating of 0.25% and maximum rating not exceeding 16.5% voltage drop at capacitor rated current. These reactors should be placed in series with the capacitors that are required to be switched. User is advised to restrict the usage of reactors with % voltage drops of 11.11%, 4%, 2.04%, 1.23%, 0.83%, 0.59%, 0.44%, 0.35%, 0.28%, 0.23%, 0.19% values as these would tend to match with the harmonic frequencies and can cause undesirable effects.

- IV. In case of supply system is with “Electrical Power Quality Problems”, user is advised to take adequate measures to improve such conditions before usage of this product. The major listed Power Quality Issues can be:
- Harmonics on supply lines exceeding limits and causing over-current in capacitor banks. The harmonic current in capacitor should be restricted to less than 18% THD-F. (THD – Total Harmonic Distortion)
  - Voltage sags and swells beyond the permitted supply voltage levels.
  - Loss of supply mains cycles. ( $\frac{1}{2}$  cycle to 60 cycles)
  - Supply voltage glitches and transients where peak amplitude of voltage not exceeding 1.25 times the rated supply voltage peak value. i.e. for 500 Vac maximum line voltage supply system, the peak voltage is  $500 \times \sqrt{2} = 707$  Volts peak. Then the supply voltage glitch or transient peak should never be beyond  $707 \times 1.25 = 884$  Volts.
  - Sustained high dv/dt voltage components that are deviating instantaneous values of sinusoidal voltages more than 1.2 times its rated instantaneous values (Normally produced by Thyristor / Diode rectifiers used in AC/DC variable speed drives, UPS/Inverters, welding machines, Induction furnaces, Arc furnaces). Normally usage of series reactors (commutation reactors) with such equipment's is mandatory, but if such applications are used without the series reactors, it can cause such disturbances in supply voltage lines.
- V. If capacitors are used in presence of harmonic prone supply system environment, user is advised to use the appropriate detuned series reactors of correct rating and values. The capacitor and reactor (inductor) series tuned frequency should be minimum 25% away from the specific major harmonic components and should be offering inductive impedance to the specific harmonic frequency component on supply system. i.e. in presence of 5<sup>th</sup>, 7<sup>th</sup>, 11<sup>th</sup>, 13<sup>th</sup>, 17<sup>th</sup>, 19<sup>th</sup> etc harmonics, user is advised to use the detuned reactors in series with power capacitors with resonance frequency of 187 Hz for 50 Hz supply system and 225 Hz for 60 Hz supply system. Additionally, in presence of triplen harmonics like 3<sup>rd</sup>, 9<sup>th</sup>, 15<sup>th</sup>, 21<sup>st</sup> etc, user is advised to use the detuned reactors in series with power capacitors with resonance frequency of 134 Hz for 50 Hz supply system and 160 Hz for 60 Hz supply system.
- VI. Due to deterioration of capacitor  $\mu$ F (Micro-Farad) values over time period (longer usage of capacitors), the resonance frequency is likely to be shifted from the recommended values. In such case, user of the system is advised to

correct the capacitor values (by adding parallel capacitors) or by correcting the reactors mH (Milli-Henry) values, so that right resonance frequency is achieved.

- VII. Wrong selection of capacitor and reactors (inductors) values can cause the L-C (inductor-capacitor) series resonance values to come near the harmonic frequency and instead of blocking the harmonics passing through capacitors, it would start filtering the harmonics. This can cause over-voltages and can be detrimental to the thyristor switches causing the MOV (Metal Oxide Varistor) put across the thyristors to fail. Thus, user is strongly advised to take note of this application usage point.
- VIII. When switch is powered up (Power terminals are given the supply), the control supply to the switch (if not taken from the internal Power terminals) should never be switched ON or OFF. User is advised such supply to be normally taken from the switch Power terminals itself, but if taken from other supply points, the stated additional care is to be taken.
- IX. The said product switch is recommended to be mounted in the panel so that flow of air is vertically passing upwards. There are fans built in such units (only 40 Amp and above ratings). The direction of the fans should be facing upwards.
- X. In panel mechanical design, the unit surrounding ambient temperature should not exceed 50° C. The heat from one unit dissipated sometimes can be thrown on another unit in same system. Such condition should be avoided by making the appropriate mechanical mounting arrangement of the said product/s.
- XI. In cold climatic condition, the units mounted in the cabinet should not be powered up unless the ambient temperature inside the cabinet is minimum 5° C. In cold climatic condition, it is advisable to use the space heaters within the cabinet to achieve the specified temperature before the units are powered up. Note that thyristors are likely to misbehave during very cold conditions causing wrong operations and can cause electrical accidents and can cause human safety issues.
- XII. In case of usage of the product in dust prone environment, heavy accumulation of the dust or dust with moisture can cause the flashovers

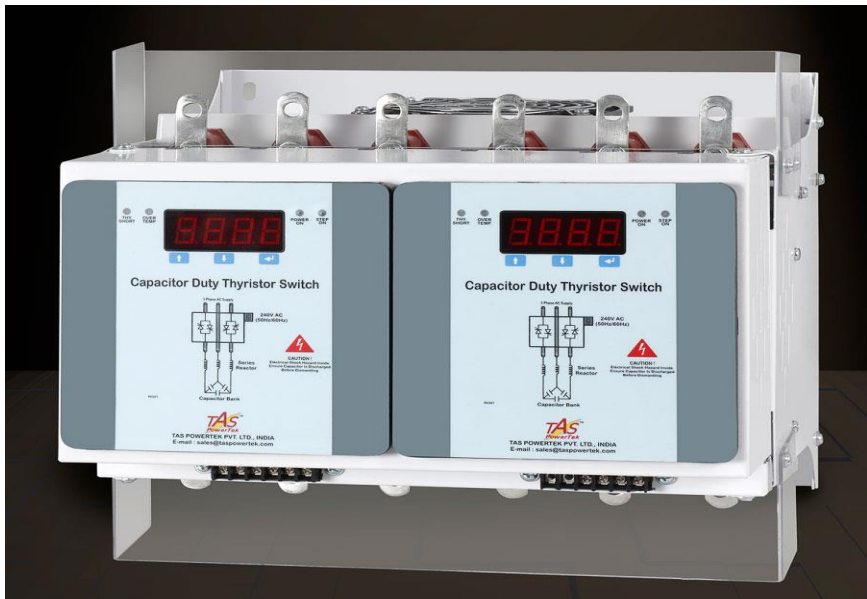
between the Power conductors used within the unit. User is advised to make appropriate arrangement in the system so as to avoid the ingress of dust. In such environments, even with usage of appropriate enclosures, it is advisable the regular cleaning of dust by usage of air blower and vacuum cleaner.

- XIII. In case the supplied system is subjected to HT insulation test, the control supply terminals should be kept isolated if the HT supply test voltage value is exceeding 1.5 kV-ac. The said product then can be subjected to HT insulation test with HT supply test voltage not exceeding 2.5 kV-ac.
- XIV. The control voltage input for Capacitor switch to turn ON and OFF should never exceed the DC supply voltage range of 0V dc to 14 Vdc. The ripple content on such control supply should be restricted to maximum 1 Vpk-pk voltage value. If used with TAS PowerTek make PF controller, this requirement is already looked into. Thus, apart from appropriate connections of control wiring as is given in product manual, no special care is to be taken. Only if the other company's make PF controller is used for giving the control command, then user is advised to ensure the said requirement.
- XV. In case of dead short in capacitors or reactors, there is strong possibility of damage to the said product (thyristors used in the product may get shorted). User is therefore advised to use the good quality capacitors and reactors so as to avoid such situation.
- XVI. The control supply and command wiring (12 Vdc supply and control) in the system is advised to be made to run in separate channels than the 200 Vac to 485 Vac range supply voltage (line to line) or  $\div \sqrt{3}$  line to neutral conductors wiring or bus-bars insulation channels. The distance of about 25 cm should be maintained between these two channels (control and power wiring) if made to run parallel to each other. Putting the control and power wiring in same vicinity can cause the undue noise level in electronics used for control in the said product and can cause mal-function or damage to the product.
- XVII. The product is designed to be used with ambient temperature range of +5° C to +50° C, the relative humidity levels of 10% to 90% R.H. and elevation of 0 to max. 2000 Meters above mean sea level. User is advised to restrict the usage of this product within the stipulated environment.

XVIII. Product is fitted with Tamper Proof sticker. Any attempt by the user to tamper with the internal parts (electronics or power or cooling fan) of the product is not permitted and would mean that warranty stands cancelled.

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Combi-Pack Module – TSCC Picture taken from front.







**Contact:**

**The Sales & Marketing / The Customer Support & Service Dept., and  
Design Dept.**

**TAS PowerTek Pvt. Ltd.**

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Working Hours: 9:30 AM to 6:30 PM. Weekly Off: Saturdays.

**This Product is completely Designed, Developed, Manufactured,  
Assembled, Tested, and Calibrated in India by TAS PowerTek Pvt. Ltd.,  
Nasik – 422 010, India.**



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