



# THE SIMPLER SOLUTION

Automatic Power Factor Controllers  
for contactor and Thyristor based APFC Panels

# —ABOUT US—

Lauritz Knudsen Electrical & Automation, formerly known as L&T Switchgear, is a leading player in the electrical industry owing to its 70+ years of strong legacy and commitment to the nation's growth. The brand is dedicated to providing a wide range of electrical and automation products and solutions to vital sectors of the economy, including industries, utilities, infrastructure, buildings, and agriculture. Our extensive portfolio includes low-voltage and medium-voltage switchgear, automation solutions, tailored software, and services.

With manufacturing operations in Ahmednagar, Vadodara, and Coimbatore, we adhere to global standards of excellence. Our operations are supported by well-equipped, in-house design and development centers, as well as tooling facilities, ensuring precision in manufacturing.

We proudly operate six Switchgear Training Centers (STCs) across Pune, Lucknow, Coonoor, Vadodara, Delhi, and Kolkata. These centers offer tailor-made classroom courses and lab learning experiences for technicians, customers, engineers, professionals, and students.

With a deep national presence and one of the largest electrical distribution networks, comprising over 1500 partners across the country, we are committed to driving excellence and delivering superior products and solutions that power India's growth journey.

# Power factor correction – now easier than ever.

Brought to you by Lauritz Knudsen - India's largest manufacturer of LT switchgear - the etaSMART & etaULTRA Series automatically corrects the power factor, with the help of contactor & thyristor for the connection and disconnection of capacitor banks.

Packed with a specially formulated optimisation program, the controller ensures accurate power factor control at the set point and hunt free operation.

## etaULTRA Series - 3 CT Input

### The L&T Advantage - etaULTRA

- › 3- Phase Current and Voltage measurement
- › Available upto 16 steps
- › Cascading - Master-slave configuration possible to increase contact output up to 64 steps
- › Dual PF setting for Mains-DG application
- › Individual harmonics measurement up to 31st order
- › PF setting - up to 3rd digit after decimal
- › Display of voltage angles and current angles for ease of troubleshooting
- › Site selectable 2 or 4 quadrant operation for industries with or without Solar plants

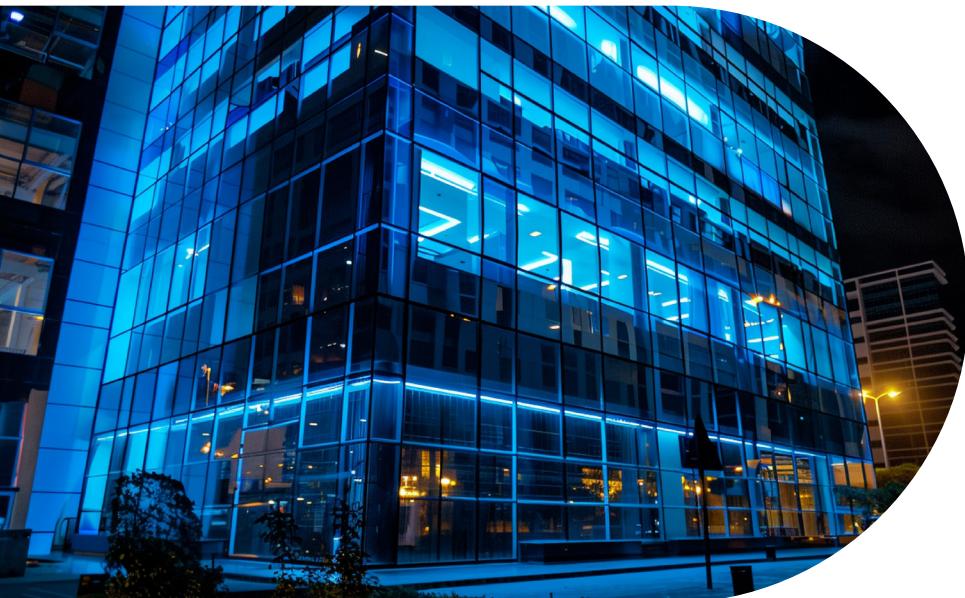


## etaSMART Series - 1 CT Input

### The L&T Advantage - etaSMART

- › Available upto 16 steps
- › Space-saving. Compact size of 96 x 96 mm for controller upto 8 steps
- › CT Secondary 1A/5A
- › Automatic detection of CT polarity saves time and effort. etaSMART detects the CT reversal and automatically corrects it
- › Option of LIFO, FIFO, and Intelligent control mode

- › Site selectable 2 or 4 quadrant operation for industries with or without Solar plants
- › Capacitor health check monitoring function ensures that capacitor is declared faulty if its power falls beyond a certain limit
- › Last relay output contact can be configured as Step or Alarm. Second-last relay output can be configured as Step or Fan control
- › Ambient temperature monitoring via internal sensor

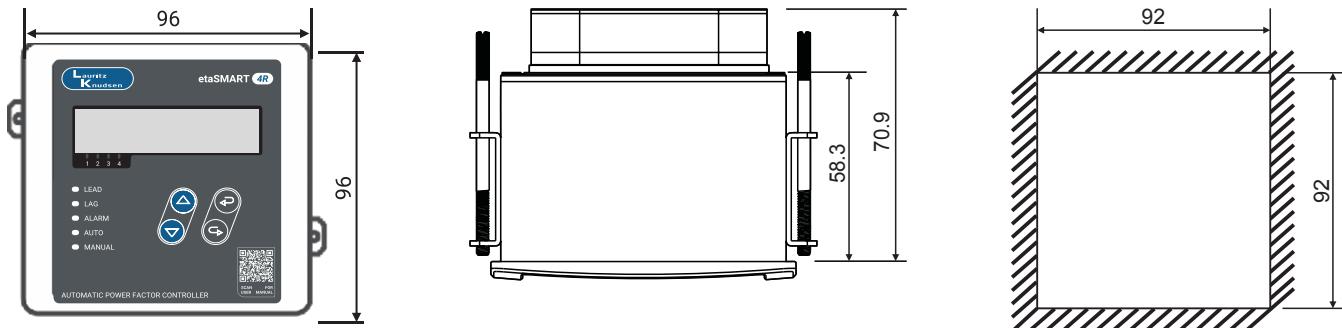


# Technical Specifications

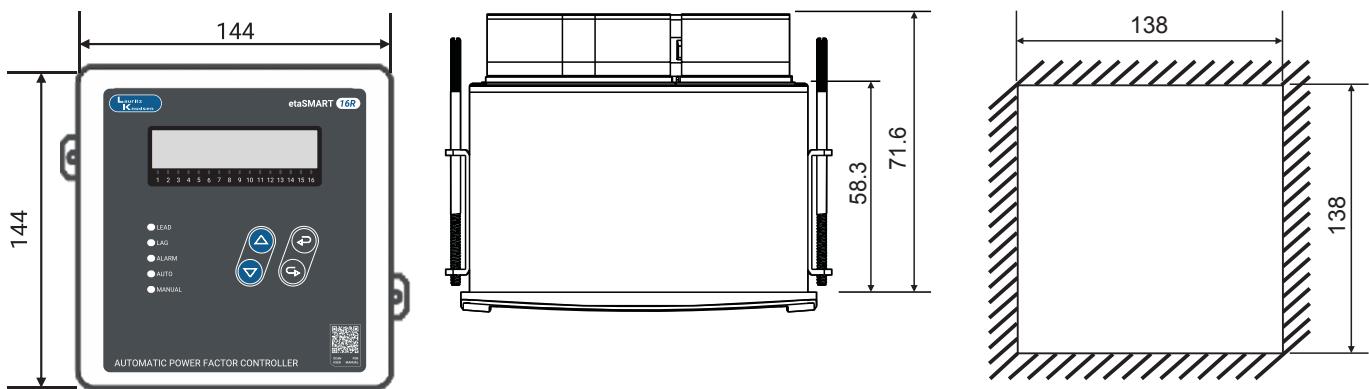
Parameters	etaSMART (1 CT)		etaULTRA (3 CT)	
	etaSMART R (Contactor logic)	etaSMART T (Thyristor logic)	etaULTRA R (Contactor logic)	etaULTRA T (Thyristor + Contactor)
Voltage input (L - L)	415 - 440 VAC		50 - 760 VAC	
Aux. supply	-		85 - 300 VAC/ DC	
Current input	1A / 5A		1A / 5A	
Rated frequency	50 - 60 Hz		50 - 60 Hz	
No of output contact	4, 6, 8, 12, 14, 16 (For Contactor)	6, 8, 12, 15 (For Thyristor)	6, 8, 12, 15 (For Thyristor)	8T + 2R, 14T + 2R, 8T + 8R (T for Thyristor switching, R for Contactor switching)
Output contact rating	Relay, 250 VAC @ 5A	Thyristor, 8 - 48 VDC @ 100 mA	Relay, 250 VAC @ 5A	Relay, 250 VAC @ 5A Thyristor, 8 - 48 VDC @ 100 mA
Communication interface	-		Modbus RTU (RS 485)	
Cascading	-		Upto 64 steps in master slave configuration	
Display parameter	PF, V, I, Required KVA <sub>r</sub> , KVA, KW, KVA <sub>r</sub> , V-THD, I-THD, Hz, Temperature.		System PF, V, I, Required KVA <sub>r</sub> , Voltage angles, Current angles, KVA, KW, KVA <sub>r</sub> , V-THD, I-THD, Hz, Indi- vidual harmonics upto 31st order, Temperature	
Control power factor range	0.3 Lag to 0.3 Lead		0.3 Lag to 0.3 Lead	
Dual PF setting	-		Target PF 1 - Default Target PF 2 -Based on Digital input	
Digital input	-		2 Digital Inputs, Programmable Range:65-285	
Alarms	Over / Under compensation, Over / Under voltage, Over / Under Current, High V - THD, High I - THD, Over / Under frequency, Over temperature.		Over / Under compensation, Over / Under voltage, Over / Under Current, High V - THD, High I - THD, Over / Under frequency, Over temperature, Modbus fail alarm, Capacitor faulty alarm.	
Power consumption	7.5 VA		5.0 VA	
Relative humidity	< 90 %		< 90 %	
Mounting	Flush		Flush	
Degree of protection	IP 20 (Front IP 54)		IP 20 (Front IP 54)	
Operating temperature	20° to +60° C		20° to +60° C	
Storage temperature	30° to +80° C		30° to +80° C	
Humidity	0 to 90%		0 to 90%	
Compliances	EN 61010-1, IEC/EN 61000 - 6 - 2, IEC/EN 61000 - 6 - 4, EN 61326.		EN 61010-1, IEC/EN 61000 - 6 - 2, IEC/EN 61000 - 6 - 4, EN 61326.	

# Product Dimensions

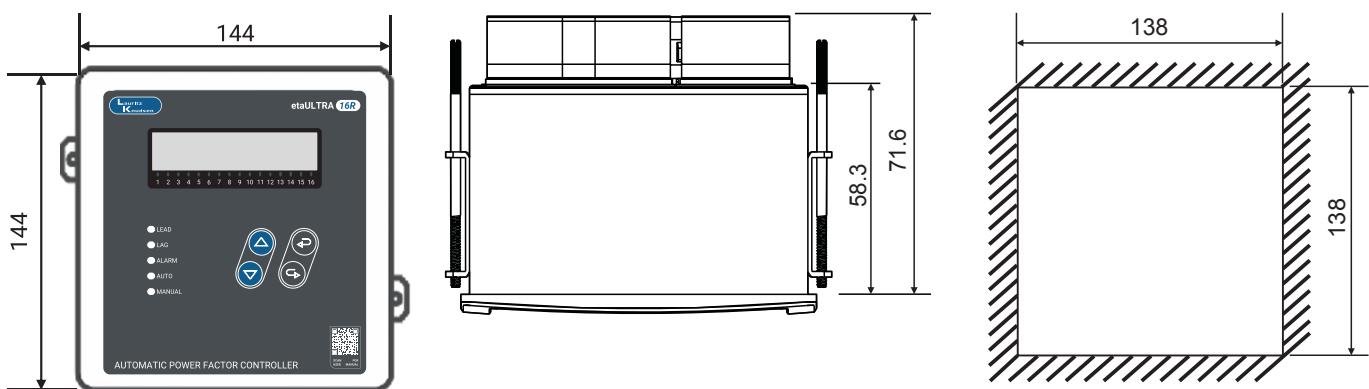
**etaSMART 4R, etaSMART 6R,  
etaSMART 8R and etaSMART 6T**



**etaSMART 12R, etaSMART 14R, etaSMART 16R,  
etaSMART 8T, etaSMART 12T and etaSMART 15T**



**etaULTRA 8R, etaULTRA 16R, etaULTRA 8T+2R,  
etaULTRA 14T+2R & etaULTRA 8T+8R**

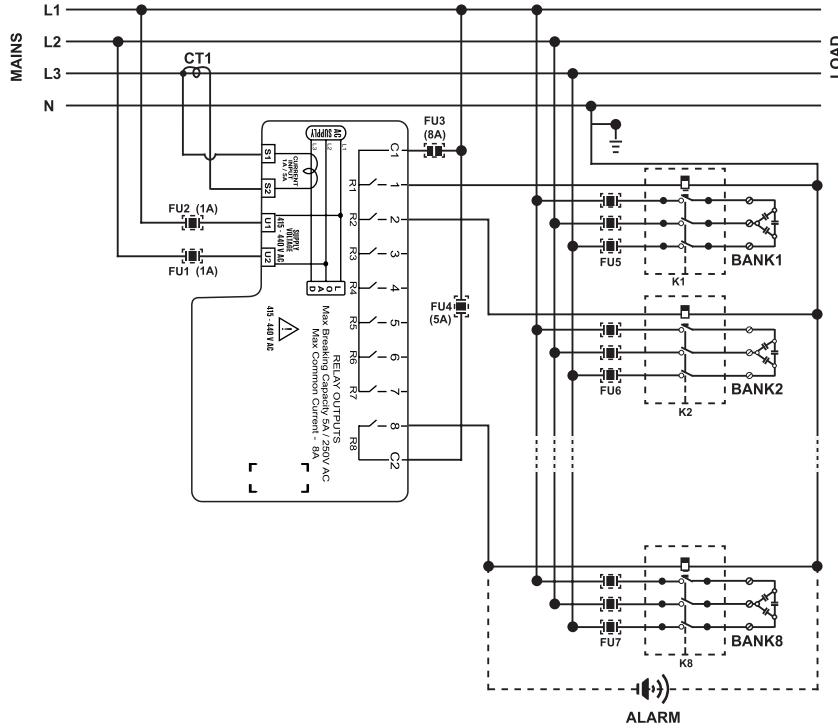


**NOTE:** All dimensions are in mm

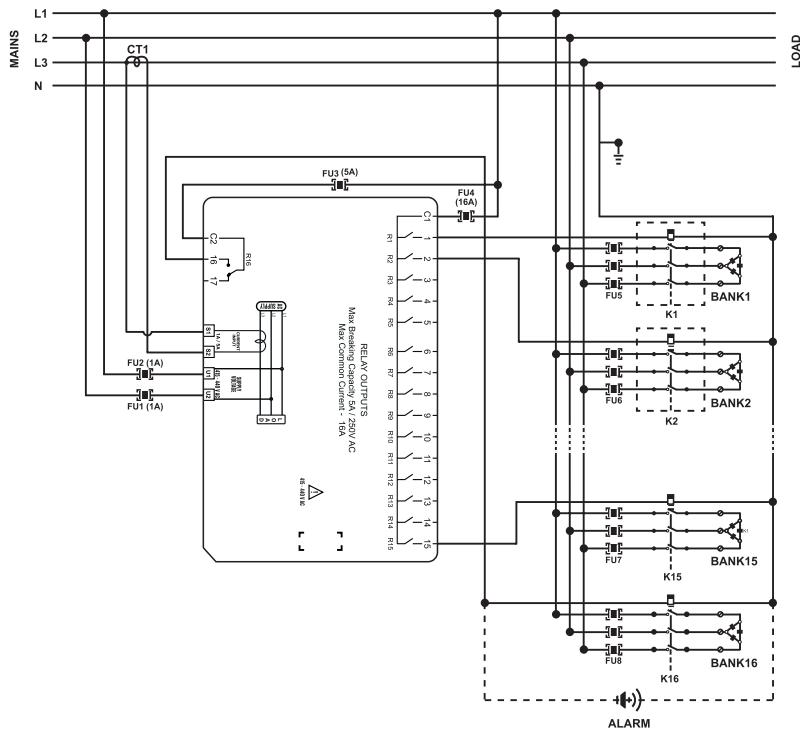
Lauritz Knudsen

## 4.2 Wiring Diagram

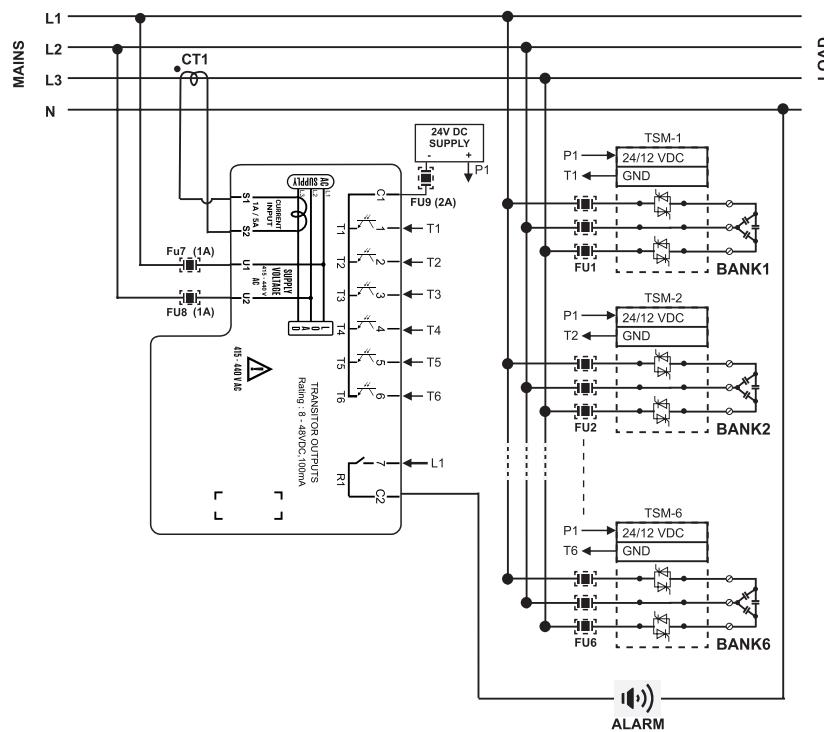
etaSMART 4R, etaSMART 6R, etaSMART 8R



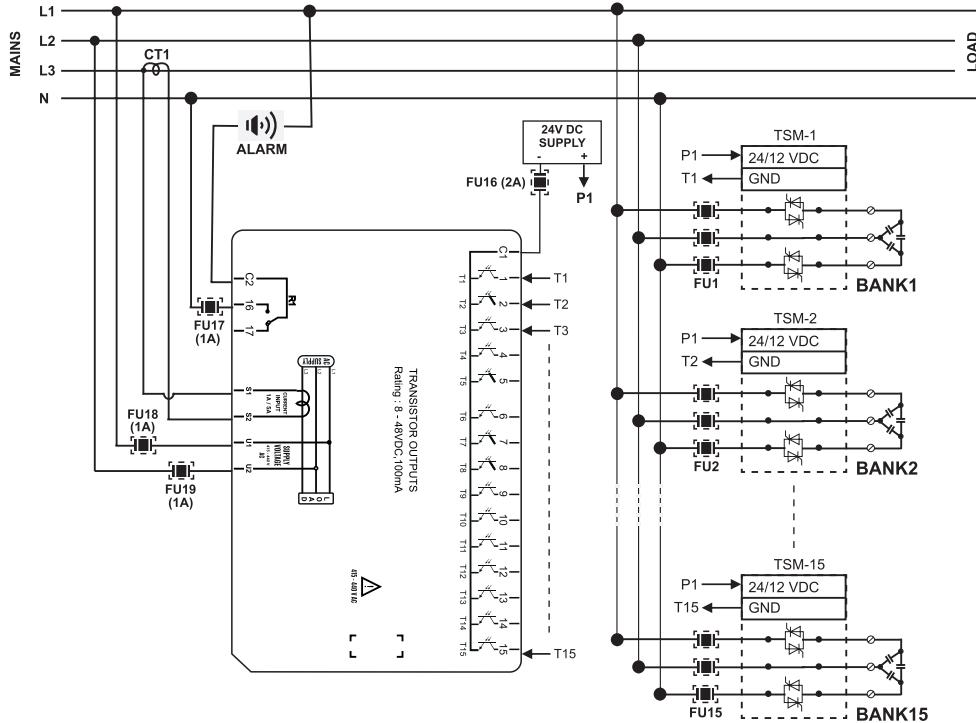
etaSMART 12R, etaSMART 14R, etaSMART 16R



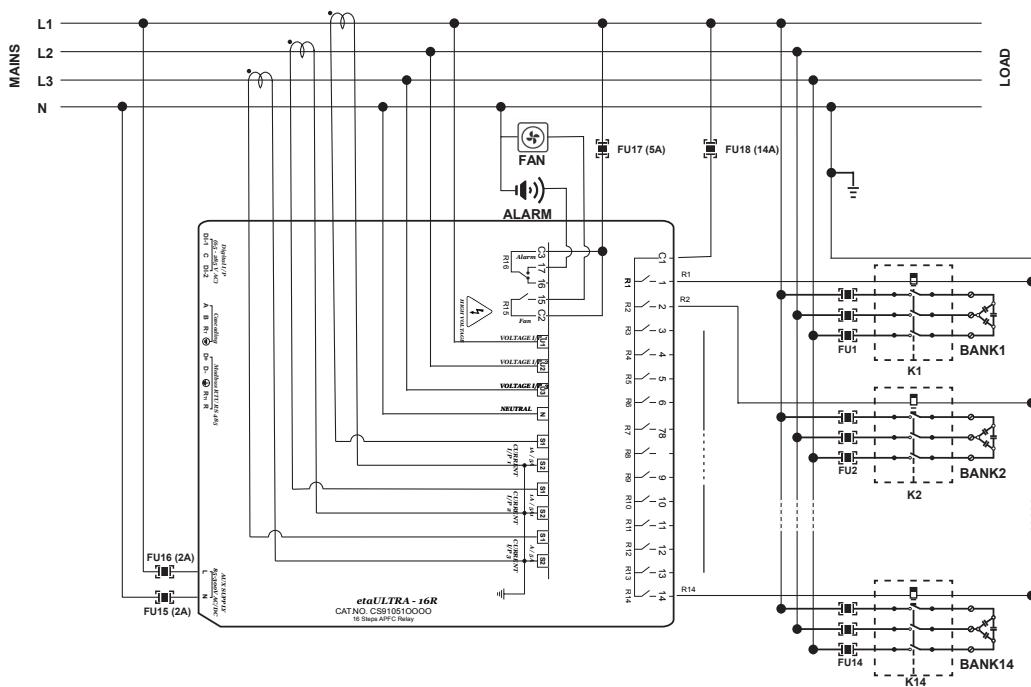
## etaSMART 6T



## etaSMART 8T, etaSMART 12T, etaSMART 15T



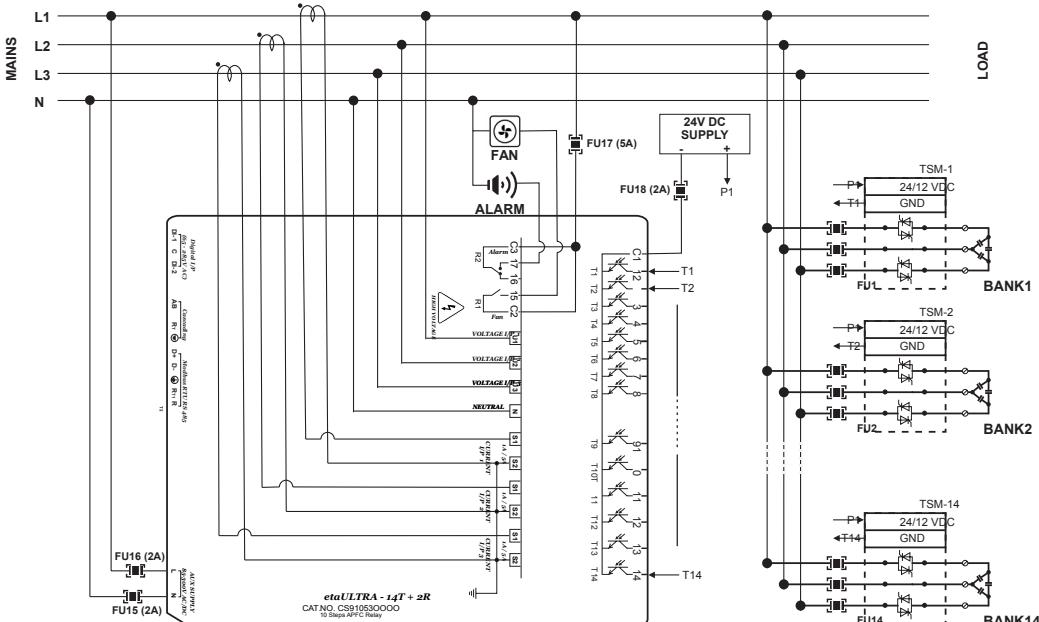
## etaULTRA 8R, etaULTRA 16R



### NOTE:

1. Last two relay output contacts can be configured either to switch the capacitor bank or to energise FAN and ALARM respectively as shown in wiring diagram.
2. All relay terminals, Voltage & current input terminals are suitable for wire range 12-30 AWG stranded or Solid copper wire. Modbus and cascading terminals are suitable for 14-30 AWG

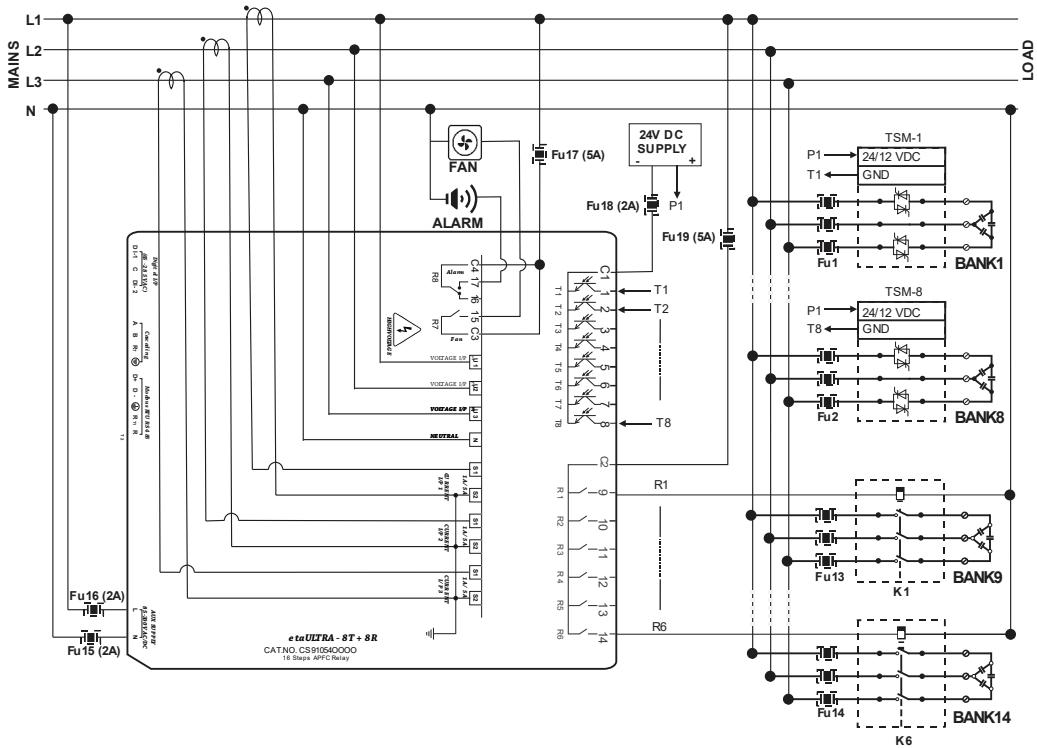
## etaULTRA 14T+2R



### NOTE:

1. Last two relay output contacts can be configured either to switch the capacitor bank or to energise FAN and ALARM respectively as shown in wiring diagram.
2. All relay terminals, Voltage & current input terminals are suitable for wire range 12-30 AWG stranded or Solid copper wire. Modbus and cascading terminals are suitable for 14-30 AWG

## etaULTRA 8T+8R



### NOTE:

1. Last two relay output contacts can be configured either to switch the capacitor bank or to energise FAN and ALARM respectively as shown in wiring diagram.
2. All relay terminals, Voltage & current input terminals are suitable for wire range 12-30 AWG stranded or Solid copper wire. Modbus and cascading terminals are suitable for 14-30 AWG

# Salient features of - etaULTRA



## MANUAL & AUTOMATIC OPERATION

- In auto mode, just initiate AUTO PROGRAM and the controller will configure itself or we can also configure it manually with few simple steps.



## CONTROL MODE

- Option of UFO, FIFO, and Intelligent control mode. Choose any of these control modes. By default, it is set as intelligent; this mode selects the best with combination of capacitor bank for compensation with minimum switching to achieve the desired power factor



## POWER QUALITY INFORMATION

- Instant information on the quality of your power system, etaULTRA measures current THD, and alerts you if levels go beyond set limits.



## CAPACITOR HEALTH CHECK

- Capacitor health check monitoring function ensures that capacitor is declared faulty if its power falls beyond a certain limit.



## RECORD OF STEP-SWITCHING

- You can schedule the maintenance of your installation by reading the record of the number of switching of each step.



## AMBIENT TEMPERATURE MONITORING

- Ambient Temperature Monitoring via Internal Sensor.



## DISPLAY OF CURRENT & VOLTAGE ANGLES

- › Display of current & Voltage angles helps to troubleshoot the wiring-related problem.



## HT Sensing

- › The wide band of input voltage measurement allows etaULTRA to sense the HT voltage with the help of voltage transformers.



## CASCADING OF etaULTRA CONTROLLERS

- › The cascading feature allows the user to extend the output contacts up to 64 output contacts in a master-slave configuration.



## DUAL PF (DIGITAL INPUT BASED)

- › etaULTRA comes with 2 target Power Factor set points, Target PF 1 maintains mains/ EB PF and target PF 2 maintains DG PF.



## INBUILT RS485

- › etaULTRA comes with an inbuilt RS485 port which allows for seamless digital connectivity.



## SITE SELECTABLE 2Q/ 4Q OPERATION

- › With the help of 4 quadrant operation etaULTRA can maintain PF in site with or without solar plant.

# Salient features of - etaSAMRT



## MANUAL & AUTOMATIC OPERATION

- In auto mode, just initiate AUTO PROGRAM and the controller will configure itself or we can also configure it manually with few simple steps.



## CONTROL MODE

- Option of UFO, FIFO, and Intelligent control mode. Choose any of these control modes. By default, it is set as intelligent; this mode selects the best with combination of capacitor bank for compensation with minimum switching to achieve the desired power factor.



## POWER QUALITY INFORMATION

- Instant information on the quality of your power system, etaULTRA measures current THD, and alerts you if levels go beyond set limits.



## CAPACITOR HEALTH CHECK

- Capacitor health check monitoring function ensures that capacitor is declared faulty if its power falls beyond a certain limit.



## RECORD OF STEP-SWITCHING

- You can schedule the maintenance of your installation by reading the record of the number of switching of each step.



## AMBIENT TEMPERATURE MONITORING

- Ambient Temperature Monitoring via Internal Sensor.



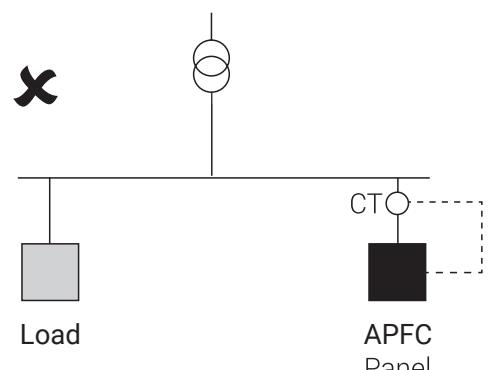
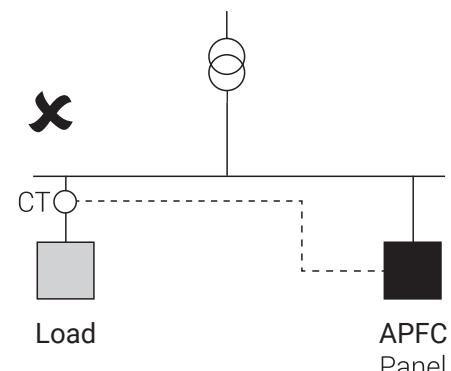
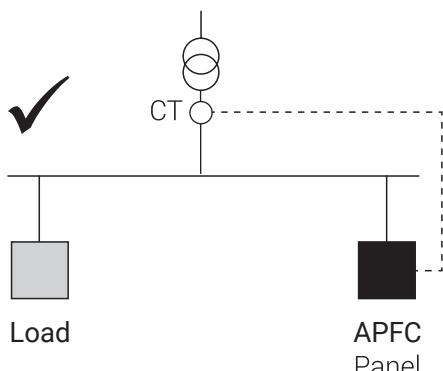
#### SITE SELECTABLE 2Q/ 4Q OPERATION

- With the help of 4 quadrant operation etaSMART can maintain PF in site with or without solar plant.

### Application based Product selection

Application	Available variant
For balanced load/ 1CT	etaSMART series
For Unbalance load/ 3CT	etaULTRA series
For Fast fluctuating load/ Thyristor switching/ Real-time switching	etaSMART T or etaULTRA T
For Solar application/ 4 quadrant operation	etaSMART & etaULTRA
Controller for more than 16 steps	etaULTRA
HT Sensing	etaULTRA
Dual PF – DI based	etaULTRA
Communication – Inbuilt Rs485	etaULTRA

### Guidelines-CT selection and placement



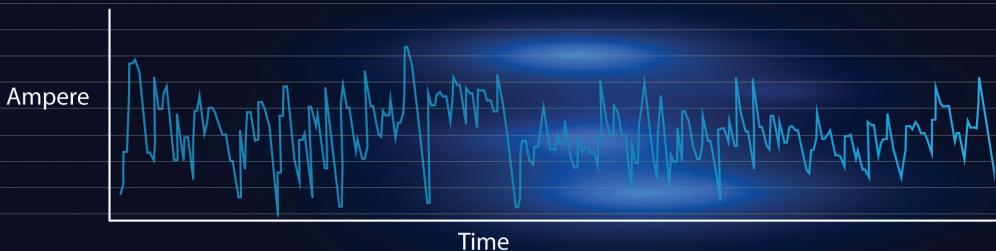
Recommendation - Use CT with 1 Amp secondary in case the distance between CT and Controller is more than 10 meter

**NOTE:** Capacitor duty contactor must be used for capacitor switching

# Application note



IS YOUR EXISTING APFC PANEL ABLE TO MAINTAIN THE TARGET POWER FACTOR  
**UNDER FLUCTUATING LOAD CONDITIONS?**



If the APFC Panel is not designed to take care of these fluctuating load conditions, result is:

**Low Monthly PF**  
Average PF 0.82\*

**High Electricity Bill**  
PF Penalty – ₹ 78,541.00\*

Lauritz Knudsen Electrical & Automation brings to you customised solutions For Dynamic Power Factor Correction Systems.

## etaSMART T

Single CT APFC Controller



## etaULTRA T

Three CT APFC Controller



For Thyristor switched APFC Panels

Ensure significant improvement in monthly PF in case of fluctuating loads.

# Application note



## POWER FACTOR CONTROL IN UNBALANCED LOAD CONDITIONS

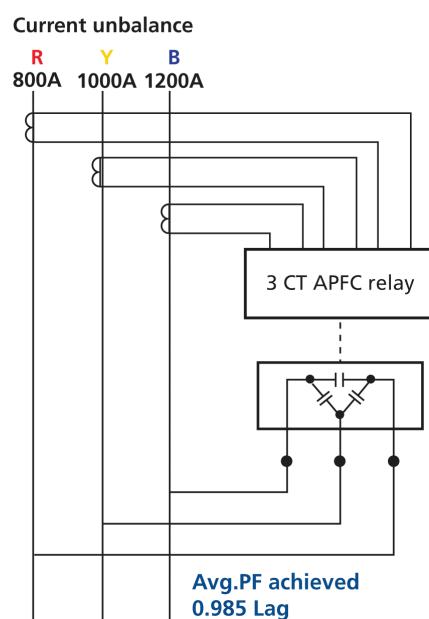
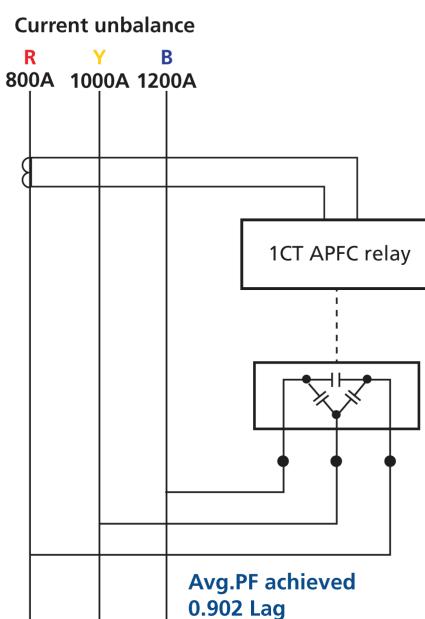
**PROBLEM** ▶ How to control Power Factor in case of Unbalanced Load Conditions?

**SOLUTION** ▶ APFC Controller with 3 CT inputs.  
Controller with 3 CT inputs calculate average value of current.  
This results into better Power Factor than that with 1 CT input.



# etaULTRA

3 CT APFC controller for contactor and thyristor based APFC Panels.



Conclusion- In unbalance load conditions, average PF achieved with 3 CT controller is better than 1 CT controller.

Note: Value of current and PF are for representation only.

# Application note



## CASCADING OF APFC CONTROLLERS

**Requirement - APFC Panel with more than 16 steps.**

### PROBLEM ➤

Use of 2 separate APFC controllers lead to hunting of contactors and malfunction of APFC Panel.

### SOLUTION ➤

**Cascading of APFC Controllers.**  
Multiple APFC controllers with Cascading [Master – slave logic] can be connected together to offer higher number of steps.

## Introducing } etaULTRA

3 CT APFC controller with inbuilt cascading facility

**etaULTRA 16R  
Master**



**etaULTRA 16R  
Slave**



= **32  
Steps**



**etaULTRA can offer up to 64 steps with  
cascading of 4 controllers.**

\*Numbers are just for representation.

# Application note



## etaSMART T & etaULTRA T APFC Controller Series for Thyristor based APFC Panels

- › etaSMART - 1 CT APFC Controller for Thyristor switching
- › etaULTRA - 3 CT APFC Controller for Thyristor switching

### Salient Features of etaSMART T & etaULTRA T Controllers:-

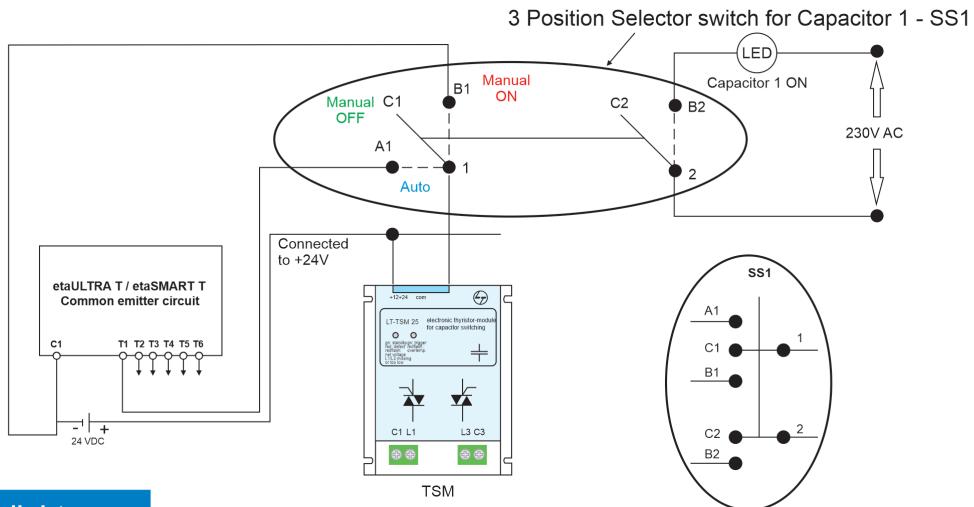
- » Site selectable 2 & 4 Quadrant operation for industries with or without solar plants
- » Common terminal for 1/5 Amp CT input
- » PF setting - upto 3<sup>rd</sup> digit after decimal

### etaULTRA T - Solution for Specific Applications:-

- » Dual PF setting for Mains / DG application
- » Cascading in master - Slave configuration to increase steps up to 64

### Schematic for Thyristor based APFC Panels

- › Auto + Manual control in Thyristor based APFC Panels can be achieved with this scheme



### Highlights :

- › Individual 3 way selector switch is required for Auto/ Manual operation of each TSM feeder. e.g. - In 6 steps thyristor based APFC panel, total 6 selector switches will be required.

### Note :

- › Interposing relays should not be used along with etaSMART T/ etaULTRA T for switching of Thyristor switches.

