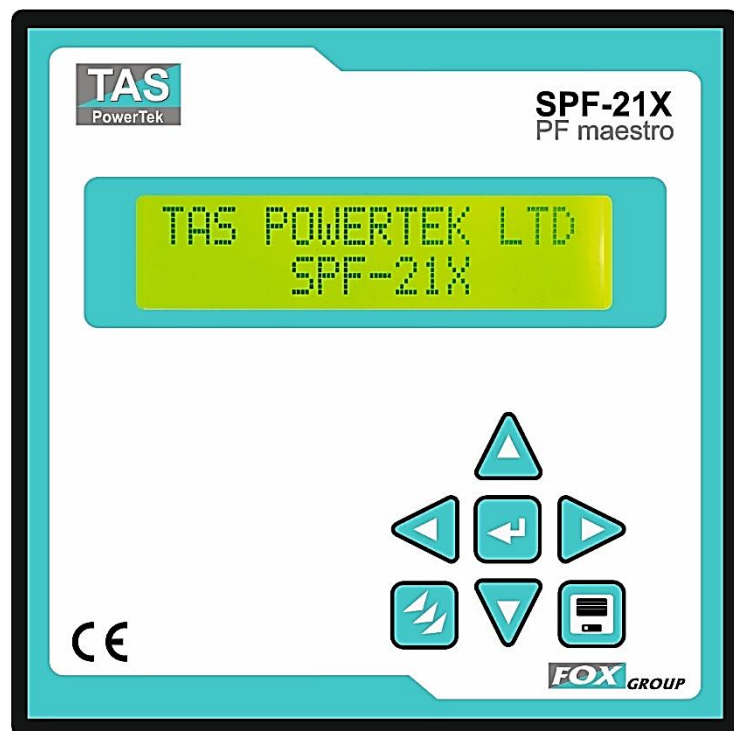




Product Data Sheet

PF maestro – SPF-21X Series
Power Factor Controller



PF maestro – SPF-21X Series is a high-performance, intelligent power factor correction controller designed for modern industrial power systems. It offers real-time, automatic power factor correction with precision up to three decimal places, optimizing energy efficiency and voltage stability. With support for 8+1 capacitor step control, advanced four-quadrant energy metering, and robust communication via MODBUS, this product series enables seamless integration into SCADA and energy management systems. It features built-in harmonic monitoring, capacitor health diagnostics without extra sensors. Engineered for flexibility and durability, it supports wide voltage ranges, operates reliably in harsh environments, and ensures safe, efficient capacitor switching through programmable delays and interleaving. This series is the ideal solution for industrial and commercial users seeking reliable, scalable, and intelligent power factor correction.

PRODUCT FEATURES

- **Real-time Automatic Displacement Power Factor (D-PF) Correction**
SPF-21X intelligently switches capacitor banks to maintain a programmable target PF up to three decimal places, ensuring optimal energy efficiency, improved voltage stability, and reduced utility penalties across dynamic industrial loads.
- **8+1 Capacitor Bank Step Control with Auxiliary Output**
Capable of managing eight capacitor banks plus one auxiliary output for either an additional capacitor or alarm/trip function, providing flexible system expansion without hardware redesign.
- **Four-Quadrant Energy Measurement with IEC-62053 Class 3.0 Compliance**
Accurately measures Active, Reactive, Apparent, and Distortion Power, supporting complex import/export systems and enabling precise energy audits and billing verification.
- **Built-in RS-485 Communication Supporting MODBUS-RTU and MODBUS-ASCII**
Allows real-time remote monitoring and full configuration from SCADA, BMS, or energy management systems, streamlining centralized control and diagnostics.
- **Wide Auxiliary Supply Range of 90-485V AC**
The wide voltage range ensures the meter continues to function safely even during voltage fluctuations, preventing unexpected shutdowns or failures that could lead to electrical hazards, overheating, or damage to connected equipment.
- **Easy Edit Mode for Quick Setup and Expert Edit Mode for Advanced Programming**
Enables fast commissioning for standard systems while providing deep customization options such as CT correction, vector adjustment, step mapping, and generator management for complex installations.
- **Automatic and Manual Current-Voltage Wiring Synchronization**
Corrects CT polarity, phase sequencing, and vector configuration internally without requiring rewiring, reducing installation errors and commissioning time.

- **Dual Programmable Power Factor Targets for Grid and Generator Supply**
Automatically adjusts PF targets based on detected supply type, protecting generators from leading PF damage and maintaining optimal network power factor during transitions.
- **Capacitor Step Utilization Tracking (Switching Count and ON-Time Monitoring)**
Tracks each capacitor step's switching frequency and operating hours, calculates realistic usage levels, and enables predictive maintenance scheduling to prevent unplanned failures.
- **Capacitor Health Monitoring Without Additional Current Sensors**
Analyzes VAR contribution per switching operation to detect faulty capacitors without needing extra CTs, saving installation costs while maintaining system integrity.
- **Programmable Step Usage Limits Based on Capacitor Duty Cycles**
Configurable lifetime thresholds per capacitor step trigger timely maintenance alerts, optimizing asset lifespan and system reliability.
- **Capacitor Discharge Delay Control for Contact Protection**
Applies programmable discharge delays between capacitor switching operations to ensure safe re-energization, protecting contactors from residual voltage damage and extending equipment life.
- **Interleaving Delay Between Capacitor Switching Events**
Introduces adjustable delay between successive step activations, preventing simultaneous inrush surges and stabilizing network voltage levels.
- **Advanced Fault Monitoring with Over 47 Fault Types**
Detects and responds to various system faults with programmable fault reaction strategies, ensuring full protection and uptime.
- **Internal Data Logging and Event Recording**
Records energy usage, fault histories, and operational summaries, enabling data-driven preventive maintenance.
- **Harmonic Monitoring for Voltage and Current up to the 31st Order**
Detects and helps mitigate harmonic-related power quality issues, protecting system components.
- **Fully Configurable Relay and Auxiliary Outputs**
Supports custom assignment for alarms, fans, trips, and extended capacitor control, increasing system flexibility.
- **User-Friendly 2-Line LCD Display with 7-Key Navigation Keypad**
Facilitates easy parameter viewing and device configuration even in poor lighting conditions.
- **Robust Industrial Build with IP54 Front Protection and Fire-Retardant ABS Housing**
Ensures reliable, safe operation in harsh industrial environments.

TECHNICAL SPECIFICATIONS

Function	Parameter	Condition	Minimum	Maximum
Measurement				
Supply	Voltage (V) Sinusoidal	Phase & Neutral - fundamental Phase to Phase - fundamental	50V~ L-N 85V~ L-L	315V~ L-N 550V~ L-L
	Current (I) Sinusoidal	5 Amp IN: - fund. Form fact = sqrt2 1 Amp IN: - fund. Form fact = sqrt2	75mA(cl- 2),25mA<0 15mA(cl- 2),05mA<0	7.5 Amp 1.5 Amp
	Frequency	Frequency (Hz) (Fundamental Supply Voltage measurement of frequency)	47Hz (for 50Hz) 57Hz (for 60Hz) meas range 45Hz	53Hz (for 50Hz) 63Hz (for 60Hz) meas range 65Hz
	Power / Energy	IEC-62053 pt.21 & 23 4 quadrant measurement	5Amp range: Class 2: P & Q 1Amp range >0.2A: Class 2 P & Q	
	Maximum Demand	S (VA) 1 min sliding window P (W) (Window time user set)	Window time 5 - Minutes	Window time 60 - Minutes
	Harmonics	Voltage - L-L & L-N Current - one of three phases	Spectrum: 2nd to 31st Harmonic. For Voltage and Current.	
	VA Burden	Voltage at 550V~ L-L Voltage at 415V~ L-L Voltage at 240V~ L-N Current at 7.5Amp~ S-CT Current at 5.0Amp~ S-CT Current at 1.0Amp~ S-CT	<0.15VA across 2 phases <0.10VA across 2 phases <0.65VA with 1ph & Neutral <1.0VA per ph. <0.5VA per ph. <0.05VA per ph.	
Capacitor Control				
PF Correction	Target PF	Displacement Power Factor setting	Inductive: 0.000	Capacitive: 0.000
	VAR margin	Smallest capacitor bank VAR ... X	... X 1.1	... X 9.9
	Offset to target	% above the target PF Setting	0%	100%
ON/OFF control	Algorithm	Optimal value to target.	Single target PF with adjustable No action VAR tolerance band	
	Bank Utilization	Limit = (Number of switch ON / C) + (On duration in Minutes / T)	C = 01 (00 for Disb.) T = 01 (00 for Disb.)	C = 99 T = 99
	Relay Contacts	8 - numbers of Relay "NO" contacts.	5Amp Resistive / 0.5Amp Inductive Amp~ 250V~ voltage contact rating.	

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Auxiliary Supply				
Voltage	AC supply	for energizing unit	90 V	485 V
	DC supply		100 V	550 V
VA consumption	AC supply VA	90V: 485V: metering	--	7.5 VA
		With full Control loading	--	15.0VA
	DC supply VA	100V to 550V metering	--	7.5 VA
		With full Control loading	--	15.0VA
Auxiliary Functions				
Add-on Fault detection:	Actions	Indicative :Data Log : LDATA Capacitor Regular trip : NTRIP Capacitor Instant trip : INS-X		
	Recovery	Automatic Timer Reset Manual intervention Reset	Depending upon fault type. (Refer details in the further part of this document)	
Auxiliary Input	Voltage~ Rating	AC supply input (abs. max. rating) AC measurement range Digital range	0 - (Zero) Volt ~ 68 Volt ~ 0 (Zero): < 3 Volt~	300 - Volt ~ 290 Volt ~ 1 (One): > 68 Volt
Auxiliary Output	NO contact	Galvanically isolated contacts.	5Amp Resistive / 0.5Amp Inductive Amp~ 250V~ voltage contact rating.	
Enclosure / Display / Keyboard / Connectors				
Enclosure	Type	ABS grade plastic housing		
	Dimensions	Front Facia dimensions + depth Panel cutout dimensions	96 (H) x 96 (W) x 80 (D) mm 92 x 92 mm	
	Weight	Unpacked unit weight Packed unit weight	< 0.8 KG including mounting clamps <= 1 KG	
	IP Class	Front Facia : Back side - Inside Panel :	IP-54 IP-20	
Display	LCD backlit	Yellow-Green with LED Backlit	16 Graphic Character X 2 Lines	
	Contrast	Adjust Min - Max 25 key presses	Left key: Lighter	Right key: Darker
Keyboard	Isolated tact switch	7 - Key - User Friendly	Up, Down, Left, Right: 4 Navigation keys Enter: For value entering Selection: Mode & Parameter selection Save: Saving key	
Connectors	Plug - Socket	Voltage Measuring Current (supply & cap) Measuring Output Control & Aux control Communication	7.62mm pitch - Pin type lugs tightening 5.08mm pitch - Screw lockable plug-socket 7.62mm pitch 7.62mm pitch	

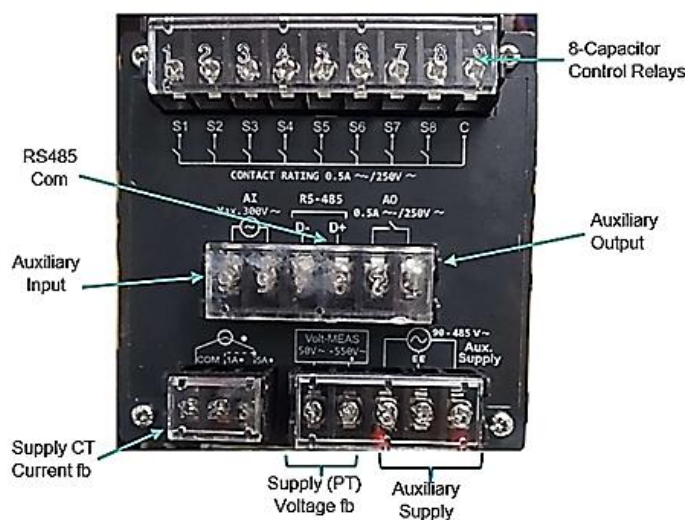
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Communication				
Communication	RS-485	Protocol	MODBUS-(RTU & ASCII), PC App (user settings)	
Temperature sensing				
Internal unit temperature	For Unit right functioning	Range within unit operating temperature	0°C	+65°C
Environmental / Safety - Type tests				
IEC61326-1	EMC	Electromagnetic Compatibility	Compliance	
	EMI	Electromagnetic Interference	Compliance	
IEC61010-1	Safety Standards	Safety Standards with Low Voltage instruments directive (category III)	Compliance	
RoHS	2002/95/EC RoHS 3.0	Regulation on Hazardous Substances usage.	Compliance	
CE			Compliance	
IEC60068-2	Dry Heat	Storage condition +70°C for 72Hrs.	Compliance	
	Cold Test	Storage condition -25°C for 72Hrs.	Compliance	
	Damp Heat Cyclic Test	Power-up condition At RH 93% +40°C & +25°C 12-12Hrs. cyclic 144Hrs.	Compliance	
Temperature	Operating	Surrounding Ambient temperature	0°C	+60°C
	Storage	Surrounding Ambient temperature	-10°C	+70°C
Humidity	RH%	Relative Humidity	10%RH	95%RH (non-cond.)

All specifications are typical and subject to change without notice due to ongoing product development and improvement.

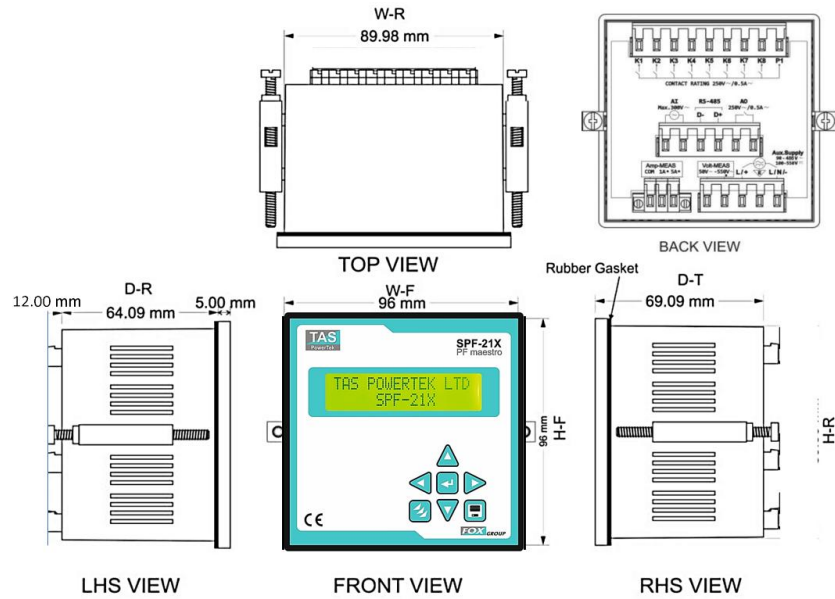
WIRING TERMINALS



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MECHANICAL DIMENSIONS



WIRING RECOMMENDATIONS

