Impedance-based Capacitor Bank Protection (21C)

Is your cap bank protection scheme reliable? Impedance-based capacitor relay: the ideal complement to your voltage differential elements (87V).

Capacitor bank downtime? Improve bank health monitoring with an impedance-based protection relay.

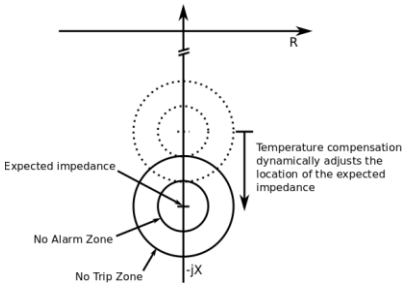
ADVANTAGES OF A 21C PROTECTION ELEMENT

- Applicable to fuseless, fused, grounded and ungrounded systems
- Better localization of the shorted section, reducing maintenance time
- Better availability of the bank because the protection discriminates between capacitor failures in one string versus capacitor failures spread through the bank
- Unaffected by the self-cancelling effect of capacitor element going out on either side of the LV potential transformer
- Protection not affected by bus voltage variations
- Immune to temperature variations and to temperature gradients in the bank due to an advanced temperature compensation algorithm (patent-pending)

PRINCIPLE OF OPERATION

The 21C protection element calculates impedance of the string using the bus voltage and the current flowing through the string using Ohm's law. This impedance is compared to the expected impedance of the capacitor string. A patent-pending algorithm compensates for temperature-related variations of the impedance.

Impedance protection can be complemented with undervoltage (27), overvoltage (59), overcurrent (50/51) or neutral overcurrent (50N/51N) protection elements.

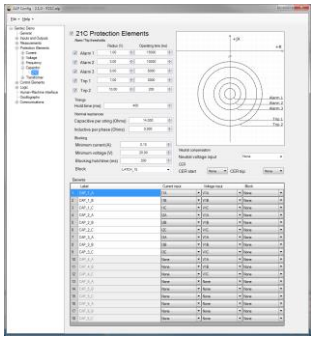


COMPLEMENTARY PROTECTION AND CONTROL ELEMENTS

- Overcurrent (50/51 DT/51 IT/ 67), phase or neutral
- Undervoltage (27)
- Overvoltage (59)
- Voltage peak detector (VPD)
- Over and under-frequency (81)
- Rate of Change of Frequency (81R)
- Overexcitation (24)
- Transformer differential (87T)
- Loss-Of-Voltage (LOV) for fuse failure detection
- Breaker failure (50BF)
- Block-of-Close logic

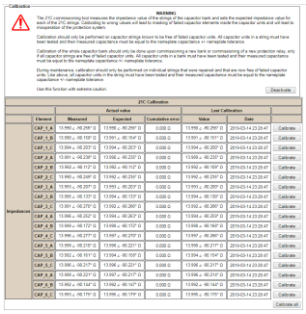
INTERFACE AND CONFIGURATION

User friendly configuration software



The ALP Config software allows the user to set parameters of the capacitor bank and define thresholds. Up to three alarm levels and two trip thresholds can be set, each with a configurable operating delay. Up to 18 capacitor strings can be configured on a single ALP relay.

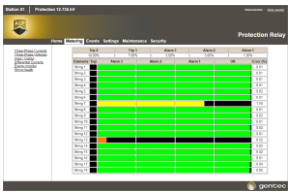
Commissioning tools



Since the actual impedance of capacitor strings can vary from the nominal impedance, the protection relay allows calibration to a measured impedance value. During protection commissioning, the secure web server allows the user to easily record measured impedance and use it from this point.

The secure web server also provides a commissioning tool that allows the user to force the state of the relay physical outputs, and on every value available by remote access through DNP3 or IEC 61850 to test the setup of the master station.

Monitoring made easy



Once operational, the relay provides the health state of each string in real time through its secure web server, and its local LCD screen. Measured impedance value and error can also be accessed remotely using DNP3 or IEC 61850.

KEY FEATURES

PROGRAMMABLE INPUTS/OUTPUTS

Outputs of the ALP-4000 can be configured individually to operate from the value of any of the relay's binary points (e.g. output of a function, timer, flip-flop or latch, logic equation etc.). Similarly, digital inputs of the relay can be used in any element using a binary point as an input (e.g. a logic equation).

HIGH-SPEED & HIGH POWER OUTPUTS

The ALP-4000 features 8 high-speed and high power outputs based on a parallel combination of optocoupled transistors and mechanical relays.

METERING AND MONITORING

Real-time measurements are taken from raw voltages and currents with a sampling rate of 7,680 Hz. The relay can be configured to track the frequency of the network and to adjust its sampling rate to 128 samples per network cycle.

PROGRAMMABLE LOGIC CONTROLLER AND EQUATIONS

Up to 50 logic equations can be configured. Latches, timers and logic functions are available to build complex equations. Complex automation is also available through an optional IEC 61131-3 programmable logic controller (PLC) engine.

SELF-MONITORING

Self-monitoring continuously verifies system integrity in order to effectively detect any hardware malfunction in the device.

SEQUENCE OF EVENTS RECORDER

Up to 1,000 different kinds of events (Protection, Security, Configuration and Maintenance) can be recorded in the ALP-4000. Each event may provide details of the system status at the time of the event.

OSCILLOGRAPHIC RECORDER

The ALP-4000 can support the configuration of 10 oscillographic recorders. Oscillographic files including a maximum duration of 5 seconds of data are stored using IEEE C37.111 format, either in version 1999 or 2013 according to the user's preferences. The increased storage of the ALP enables the user to store raw data at one of the highest sampling rate of the industry (128 samples/cycle), enabling better analysis of the faulted equipment.

SECURE WEB SERVER

Monitoring and maintenance of the protection relay is done through a secure web server. Three user levels are available to secure access for different roles.

COMMUNICATIONS

Complete substation communications solution with optional support of IEC 61850 providing both a MMS server and GOOSE message publishing and subscribing. The relay Ethernet ports also provide standard support for IEEE 1815 (DNP3) with a flexible data point map.

SPECIFICATIONS

MAIN SPECIFICATIONS	ALP-4000	ALP-2000
AC current inputs	6 three-phase groups	1 three-phase 1 single phase (neutral)
AC voltage inputs	2 three-phase groups	1 three-phase 1 single phase (sync.)
Digital inputs	16	6
Digital outputs	16	4
High-speed, high-power digital outputs	8	2
Assignable buttons	8	4
Programmable LEDs	24	12
Synchronization	IRIG-B modulated / unmodulated	
Interface	Secure web / Graphical LCD display	
Communications	HTTPS, DNP3 (with Secure Authentication)	
Power supply	105 Vdc – 140 Vdc 85 Vac – 265 Vac @ 50/60Hz	
Typical power consumption	23 W (dc) / 38 W (ac)	
Maximum power consumption	30 W (dc) / 50 W (ac)	
Independent inputs/outputs	Dielectric strength between channels 2.8 kVdc (1 min)	
Sampling	128 samples / cycle	

METERING (specified at 25°C)			
Voltage RMS Value: Phasor magnitude: Phasor angle: Symmetrical comp. magnitude: Symmetrical comp. angle:	5-300V: 0.1%±12mV 5-300V: 0.1%±12mV 5-300V: ±1° 5-300V: 0.1%±12mV 0.5-100A: ±1°		
Frequency Accuracy : Measuring range :	60 Hz nominal ±0.001 Hz (at 60 Hz) 30 to 90 Hz		
Nominal current	**200mA**	**1A**	**5A**
RMS Value : Phasor magnitude: Phasor angle: Symmetrical comp. magnitude: Symmetrical comp. angle:	0,005-8A: 0.1%±1.6mA 0.04-8A: 0.1%±1.6mA 0.04-8A : ±1° 0.04-8A:0.1%±1.6mA 0.04-8A : ±1°	0.2-20A:0.2%±1mA 0.2-20A:0.2%±1mA 0.05-20A : ±1° 0.2-20A:0.2%±1mA 0.05-20A: ±1°	0.5-100A:0.2%±10mA 0.5-100A:0.2%±10mA 0.5-100A: ±1° 0,5-100A:0.2%±10mA 0.5-100A: ±1°

ENVIRONMENTAL CONDITIONS		
Dry heat – Functional and storage	CEI 60068-2-2 :2007 Bd and Rb	+85°C 16 hours
Cold – Functional and storage	CEI 60068-2-1 :1990 Ab and Ab	-40°C 16 hours
Cyclic temperatures	CEI 60068-2-14 :2009 Nb	-40°C to 85°C 5 cycles
Damp heat, continuous	CEI 60068-2-78 :2012 Cab	+40°C, 240 hours 93% relative humidity
Damp heat, cyclic	CEI 60068-2-30 :2005 Dd	25°C to 55°C 8 cycles 95% relative humidity
Behavior under vibrations and endurance (sinusoidal)	60255-21-1 :1998	Class 1
Response to shocks, resistance to shocks and vibrations	60255-21-2 :1998	Class 1
Seismic tests	60255-21-3 :1993	Class 2
Enclosure protection	IP3X	
Surge category	II	
Pollution degree	2	
Equipment class	1	
Maximum elevation	< 2000 m	
Maximum relative humidity	95% non-condensing	
Operating temperature	-40°C to 70°C	

SECURITY		
Impulse voltage	60255-27 :2013	5 kV, 0,5J
Dielectric voltage	60255-27 :2013	2800 Vdc Copper Ethernet port 2250Vdc
Insulation resistance	60255-27 :2013	> 100 MΩ after damp heat test (CEI 60068-2-78)
Protective bonding resistance	60255-27 :2013	< 0,03 Ω
Thermal short time	60255-27 :2013	4*In (20 A) continuous 100*In (500A) for 1 s 1250Ac for1 cycle

ELECTROMAGNETIC COMPATIBILITY		
Radiated emissions	CISPR 11/CISPR 22	A Class
Conducted emissions	CISPR 22: 2008	A Class
Electrostatic discharge immunity	CEI 6100-4-2:2008 Level 4	±15 kV air ±8 kV contact
Radiated electromagnetic field immunity	CEI 61000-4-3 :2006 A1 :2008 A2 :2010 IEEE C37.90.2 :2004 20 V/m	20V/m
Electrical fast transient/burst immunity	CEI 61000-4-4:2004 IEEE C37.90.1	±4kV
Surge immunity	CEI 61000-4-5 :2005 Levels 3 and 4	±4 kV L-PE ±2kV L-L POWER: ±2 kV L-PE ±1 kV L-L
Immunity to conducted disturbances	CEI 61000-4-6 :2008	20V
Power frequency magnetic field immunity	CEI 61000-4-8-2009	100 A/m for 60s 1000 A/m for 3s (50Hz and 60Hz)
Pulsed magnetic field immunity	CEI 61000-4-9:1993 A1:2000 Level 5	1000 A/m
Damped oscillatory magnetic field immunity	CEI 61000-4-10 :1993 A1: 2000 Level 5	100 A/m for 2s (0.1MHz and 1MHz)
Voltage dips immunity	CEI 61000-4-11:2004 CEI 61000-4-29:2000	DC Supply 40% for 200 ms 70% for 500 ms
Voltage interruptions on power supply voltage immunity	CEI 61000-4-11:2004 CEI 61000-4-29:2009	DC Supply 100% short-circuit for 5s 100% open-circuit for 5s
Gradual shut-down/start-ups	CEI 60255-26:2013	60s ramp
Immunity at the power frequency on the DC inputs	CEI 61000-4-16:2002	Digital input: 300 Vrms L-PE for 10s 60Hz 150 Vrms L-L for 10s 60Hz
DC Ripple immunity at power input	CEI 61000-4-17:2009	25%
Damped oscillatory wave immunity	CEI 61000-4-18:2006 A1:2011	2.5kV L-PE 1kV L-L IRIG-B : 1kV L-PE 0.5kV L-L 100kHz and 1MHz
Surge Withstand capability	IEEE C37.90.1:2002	2.5kV L-PE 2.5kV L-L

AC CURRENT INPUTS			
Nominal current	**200mA**	**1 A**	**5 A**
Continuous maximum current	20 A	20 A	20 A
Measurable maximum current	8 A	40 A	200 A
Maximum current (1 sec thermal)	100 A	500 A	500 A
Maximum current (1 cycle thermal)	1250 AC (peak)		
Frequency	40 – 75 Hz		
Accuracy	0.005 to 8 A : 0.1% ± 1.6 mA	0.2 to 20 A : 0.1% ± 1 mA	0.05 to 100 A : 0.2% ± 10 mA
Frequency response (-3dB)	1500 Hz		
Burden	< 0.15 VA		
Individual inputs	Inter-circuit isolation of 2800Vdc for 1 min		

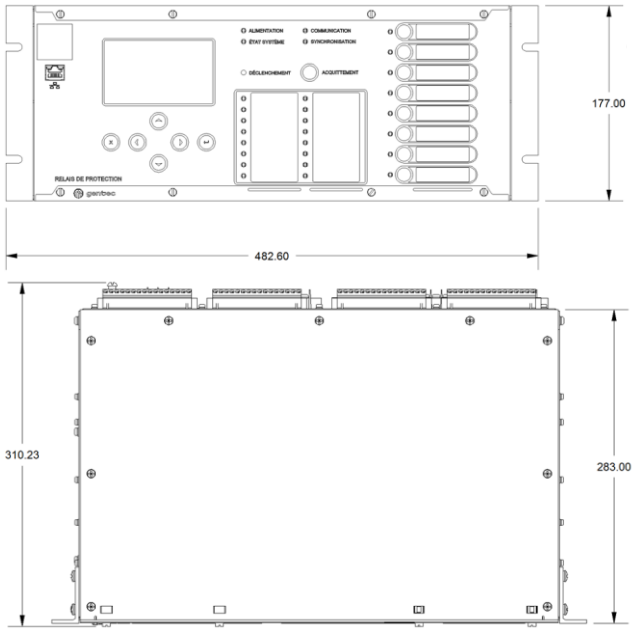
AC VOLTAGE INPUTS	
Nominal voltage	70 V
Continuous maximum voltage	250 V
Measurable maximum voltage	300 V
Maximum voltage (10s thermal)	350 V
Frequency	40 – 75 Hz
Accuracy	5 – 300 V : 0,1% ± 10mV
Frequency response (-3dB)	1500 Hz
Burden	< 0,15 VA
Individual inputs	Inter-circuit isolation of 2.8kVdc for 1 min.

DIGITAL INPUTS	
Operating nominal voltage	125 Vdc
Operation maximum voltage	145 Vdc
Minimum pickup voltage	102 Vdc
Nominal cutoff voltage	85 Vdc
Input impedance	30 kΩ
Input consumption	0,5 W
Individual inputs	Inter-circuit isolation of 2.8kVdc for 1 min.

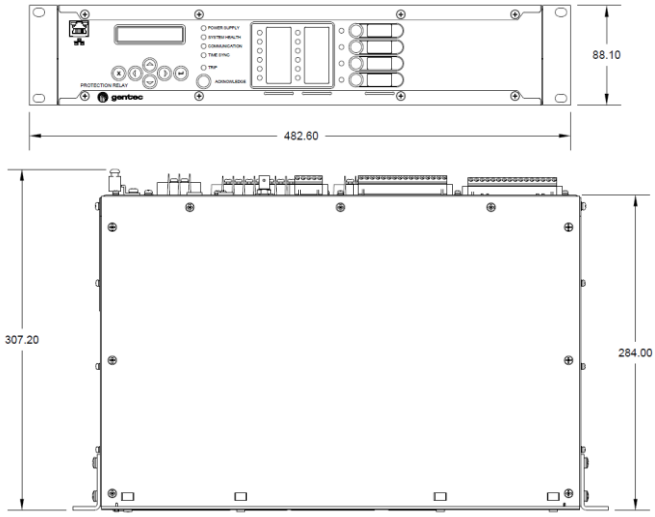
DIGITAL OUTPUTS	
Operating nominal voltage	125 Vdc
Operation maximum voltage	160 Vdc
Minimum pickup voltage	20 Vdc
Continuous maximum current	5 A
Nominal closure power	30 A @ 125 Vdc
Nominal resistive cutoff power	0,3 A @ 125 Vdc
Nominal cutoff power	0,3 A @ 125 Vdc (L/R = 40 ms)
Pickup time	< 9 ms
Cutoff time	< 25 ms
Electrical operations	>1E6 @125Vdc, I=0.3A, L/R=40ms
Individual outputs	Inter-circuit isolation of 2.8kVdc for 1 min.

HIGH-SPEED HIGH-POWER DIGITAL OUTPUTS	
Operating nominal voltage	125 Vdc
Operation maximum voltage	160 Vdc
Minimum pickup voltage	20 Vdc
Continuous maximum current	10 A
Nominal closure power	30 A @ 125 Vdc
Nominal resistive cutoff power	10 A @ 125 Vdc
Nominal cutoff power	10 A @ 125 Vdc (L/R = 40 ms)
Pickup time	< 2 µs
Cutoff time	< 25 ms
Electrical operations	>50 000@125Vdc, I=10A, L/R=40ms
Individual outputs	Inter-circuit isolation of 2.8kVdc for 1 min.

PHYSICAL LAYOUT AND DIMENSIONS – ALP-4000



PHYSICAL LAYOUT AND DIMENSIONS – ALP-2000



Since 1959, Gentec is specialized in custom cutting edge technology electronic and electrical products development. Our sustained effort to exceed utility requirements is one of the reasons why our ingenious and robust solutions are renowned around the world. We are constantly looking for getting ahead in the electrical industry trend.

Gentec is the perfect partner for you!

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