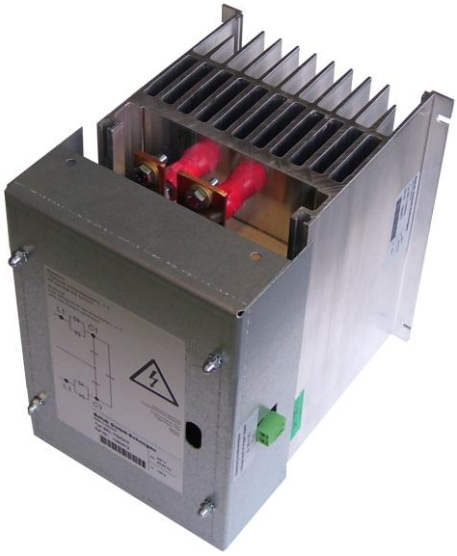
POWER SURVEY INTERNATIONAL INC.

Serving you since 1948

''Real time / Fast Switching'' Thyristor Switched automatic Harmonic Filter Bank And Power Factor Correction Capacitor

Standard specification - 600v and below

Dynamic PowerVar Filter



1. Application

Static contactors PS-BEL-TS are used for switching dynamically capacitors in 3-phase-systems. In comparison with standard contactors, Power Survey dynamic thyristor switches the capacitors without any inrush current and also provides smooth disconnection. Power Survey PS-BEL-TS thyristor switches are used when rapid (real time/fast switching) switching of capacitors is required providing no network disturbances.

Several applications for this type of capacitor switching are:

- Spot welders
- DC Drives
- Windmill Plants
- Lifts and Cranes
- Any other rapid varying load

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2. Explanation of Static Contactors

PS-BEL-TS basic components are: Thyristor, diodes, heat sink and firing unit. Thyristors are semi-conducting units, which may be controlled by firing impulse at gate from locked into semi-conducting condition. Semi-conduction means current may flow in “one way” direction from anode to cathode. Thyristor will lock again if the flowing current decreases to zero. To control alternating current, thyristor and diode in anti parallel mode are required as provided with PS-BEL-TS. As with all active components, on-state voltage and resistance generate power losses between anode and cathode semi-conductors, which results in heat that will be dissipated through heat sink.
The firing unit generates firing impulses to control thyristor into semi-conducting condition. Firing impulses will be initiated by an external DC-voltage 8 – 30 V. To avoid any inrush currents, the impulses will be transmitted to the gate of the thyristor(s) when the voltage between anode and cathode are zero. The capacitor voltage at its terminal will be synchronized to grid’s voltage in order to avoid any transients during switching procedure.

The maximum DC voltage when switching ‘’OFF’’ the capacitors can be up to 150% of peak network voltage. Due to the continuous DC voltage of the disconnected capacitors, the discharging devices must be dimensioned correctly. In practical use, it means that discharging reactors are not allowed to be used because the continuous DC-voltage would destroy the capacitor. It is recommended to use discharging resistors that are dimensioned for permanent connection to DC-voltage during peak voltage.

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Section 16--- **PART I GENERAL:**

1.1 Scope of work

1.1.1 This specification contains the minimum requirements for the design, manufacture and testing of automatic, polyphase, harmonic filter / power factor correction capacitors using ‘‘real time / fast swiching’’ thyristors rated _____ volts.

1.1.2 This specification shall apply if the thyristor switched harmonic filter / power factor correction equipment is supplied to this purchaser, or as part of other equipment.

1.1.3 Should the vendor take exception to any part of this specification, he shall so state in his bid, by reference to each item number.

1.2 Related work

1.3 Standards

1.3.1 The equipment covered by these specifications shall be designed and tested in accordance with the latest standards of EEMAC, CEC, CSA, IEC, IEEE and ANSI.

1.3.2 The capacitor shall be rated for continuous duty between -40°C/-40°F and +46°C/+115°F ambient at 3300 ft. (1,000 meters) and below.

1.3.2 Total Harmonic Distortion (THD) of 5% on the voltage and 25% on current waveforms shall not affect the life of capacitors, contactors or controller.

1.3.4 A +/- 10% variation in line voltage shall not effect the life of the capacitor.

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Section 16356 PART I GENERAL:

1.3.6 References:

- IEEE 519, ANSI C37.20, ANSI C55.1, ANSI C57-16, ANSI C57-99, CSA C22.2 No 31

1.4 Submittals

1.4.1 Submit the following information when contract is awarded:

- Outline dimension drawings including weights
- Sectional view of equipment of the different cubicle
- Single line diagram of capacitor / filter bank
- Descriptive literature
- List of factory tests and type tests
- List of exceptions and clarifications

1.5 Commissioning and start-up (Optional)

Submit commissioning and start-up procedures and make allowance for necessary assistance by a qualified field service representative. Associated costs should be identified separately.

1.6 Quality assurance: testing

1.6.1 All capacitor cells shall be traceable through construction and testing.

1.6.2 The thyristor switched automatic filter bank shall be tested for proper operation prior to leaving the factory. The following checks, measurements, and operations must be confirmed and recorded for each stage.

1.6.3 The certified record of these tests shall become part of the permanent documentation package that travels with the thyristor switched harmonic filter bank.

- Wire connections
- Torque connections
- Phase to phase, resistance checks
- Phase to phase, capacitance checks
- Controller operation, manual operation
- Controller operation, automatic operation

1.6.4 All other tests as prescribed by the applicable standard namely:

- High potential test
- Control wiring checks
- Etc

1.6.5 Submit design calculations including losses calculations

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'Real time / Fast Switching'' automatic harmonic filter bank / Power Factor Correction Capacitor 600v and below

Section 16--- **PART II PRODUCTS:**

2.1 Manufacturers

2.1.1 Acceptable manufacturers: Power Survey International model Dynamic PowerVar Filter

2.2 Ratings

2.2.1 Systems

Nominal voltage:	_____	volts
Maximum voltage:	_____	volts
Frequency:	_____	Hz
Symmetrical fault level:	_____	kA
Grounding type:	_____	
BIL:	_____	kV
60 Hz insulation level:	_____	kV
Source symmetrical fault level:	_____	MVA

2.2.2 Capacitor / filter

Total capacity:	_____	kvar
Capacity of each step:	_____	kvar
Capacity of fixed capacitor:	_____	kvar
Capacity for future expansion:	_____	step(s) or kvar
Filter tuned to:	227	Hz
Switching reaction:	<1	Cycle

2.3 Reactor for harmonic filters

2.3.1 The reactor/capacitor system shall be tuned to the 3.8^{th} harmonic

2.3.2 Reactor should be designed for: Vh3 = 0.5%, Vh5 = Vh7 = 5% based on Vn

2.3.3 The reactor shall have aluminum bands coil windings for better heat dissipation with copper bus bar termination. Bus bars coil windings are not acceptable due to low heat dissipation.

2.3.4 The insulation construction shall be class H.

2.3.5 The reactor shall be iron core designed with open frame construction

2.3.6 Thermal protection shall be normally closed auto reset thermostats which open at 145°C / 293°F

2.3.7 The reactor shall be CSA approved and UL listed

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2.4 Capacitor cells

2.4.1 Individual capacitors shall be self-healing utilizing polypropylene as a dielectric with vacuum deposited conductors on the polypropylene as electrodes.

2.4.2 Capacitors shall be contained in hermetically sealed metal cans to prevent atmospheric contaminants from shortening the useful life.

2.4.3 Dielectric material shall be low loss, less than 0.5 watts per KVAR.

2.4.4 Dielectric fluid shall be non-PCB biodegradable with a flash point in excess of 212°C/415°F

2.4.5 Terminal bushings shall withstand 2.2 kV AC to ground and be rated 10 kV BIL or greater.

2.4.6 Nominal design life of individual capacitor cells shall be 20 years.

2.4.7 Individual capacitor cells shall be covered by a one year warranty.

2.4.8 All capacitor cells shall have threaded terminals for wire connection.

2.4.9 Capacitor cells shall be designed in delta configuration

2.4.10 Capacitor cells shall be designed to handle the increase in voltage from the reactor.

2.4.11 All three phase capacitors shall be CSA approved or UL listed.

2.5 Capacitor life indicator / Blown fuse pilot lights

2.5.1 Three LED, one per phase, door mounted to indicate a low capacitance and/or blown fuse condition

2.5.2 Capacitor life indicator will continuously monitor the current drawn from your capacitor. When the current of the capacitor is above 70% of its rated value a LED will stay ON. If the current falls below 70% of its rated value then the LED will switch OFF.

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2.6 Controller

2.6.1 Controller shall measure the reactive current on every passage of the voltage through zero.

2.6.2 A led display shall be provided to indicate the stages that are on.

2.6.3 To prevent leading power factor the controller shall be provided with a programmable target cosine selector.

2.6.4 The switching time of each capacitor step shall be within 1 cycle.

2.6.5 All output contacts shall be disabled within 15 milliseconds of main power interruption. The controller shall retain its programming after the restoration of supply voltage. The controller shall bring the capacitor bank on line in a step, phased, normal sequence.

2.6.6 Controller shall be able to select 1:1:1, 1:1:2 and 1:2:2 switching sequence of filter steps.

2.6.7 Controller shall be able to display power factor with indication for an inductive or capacitive power factor.

2.7 ''Real time / fast switching'' thyristors type PS-BEL-TS

2.7.1 Each thyristor step shall be capable of switching the capacitor within 1 cycle

2.7.2 Voltage level of trigger shall be 8 – 30 Vdc

2.7.3 Consumption of trigger signal shall be 2 mA at 12 Vdc

2.7.4 Temperature range must be within -10 deg. C (14 deg. F) to + 60 deg. C (140 deg. F).

2.7.5 Maximum altitude is 1000 M (3280 feet) above sea level

2.8 Enclosure

2.8.1 The enclosure shall be NEMA ____ or EEMAC ____, fabricated from 12 gauge cold rolled steel.

2.8.2 An internal grounding lug shall be provided in each cubicle.

2.8.3 A dry powder enamel textured finish ANSI 61 switchgear grey color shall be used.

2.8.4 Capacitor cells and reactors shall be easily accessible for visual inspection and replacement from the front of the cabinet.

2.8.5 Removable lifting eyes shall be provided.

2.8.6 The enclosure door shall have a three point latch with key locking handle.

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2.9 General construction

2.9.1 All power wiring shall have a thermoplastic insulation rated 105°C/221°F at 600 volts.

2.9.2 System wiring connections shall be made to copper bus bars braced for 65,000 amps or greater.

2.9.3 All wiring connections shall be mechanically fixed with nut or screw.

2.10 Discharge resistors

2.10.1 Capacitor cells shall be provided with discharge resistors to reduce residual voltage to less than 50 volts within one minute after de-energization.

2.10.2 Resistors shall be chosen to insure a 20 year minimum life.

2.11 Fuses

2.11.1 For major fault protection, line fuses shall be provided on all three phases of each switched stage and fixed bank.

2.11.2 Line fuses shall be current limiting. Minimum interrupting ratings shall be 200,000 amps for fuses 30 amps and above.

2.11.3 Fuses shall be designed for filter applications and shall be rated not less than 150% filter current rating.

2.12 Other elements

2.12.1 The system will be equipped with a control transformer, protected at the primary and secondary sides.

2.12.2 A current transformer ____ / 5A must be supplied by the capacitor bank manufacturer. The CT will be installed by the contractor or the electrician.

2.12.3 The system will be equipped with a testing switch for measurement transformers.

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