ACTIVAR

Thyristor Switched Capacitor System (TSC)

Fast compensation in 1 second typical (3-4 seconds maximum)

Impact Power Innovations

Energy Efficiency through power quality

ELSPEC When Power Meets Quality

The BlackBox

ACTIVAR

Elspec ACTIVAR vs Electromechanically-Switch Capacitors

Fast and Accurate Compensation

The ACTIVAR achieves full compensation in 1 second typical (3 - 4 seconds maximum). The compensation is based on averaging the FFT analysis of each cycle, resulting in more accurate compensation, even with the presence of harmonics.

Slow Compensation Time

Due to technology limitations, electromechanical switching has slow compensation time. Connecting 1 step in 10 – 30 seconds, and complete compensation can take several minutes.

Simultaneous Group Connection

When load changes require connection or disconnection of more than one step, the ACTIVAR controls the switching of as many steps as required at precisely the same time. Simultaneous connection or disconnection provides the following benefits:

- Faster full compensation.
- For example, a 1:2:2 system configuration and groups 1 and 2 are connected. When 1 more step is required, group 3 will be connected simultaneously while group 1 is disconnected.
- Real binary sizing – 1:2:2 is exactly the same as 1:1:1:1:1.

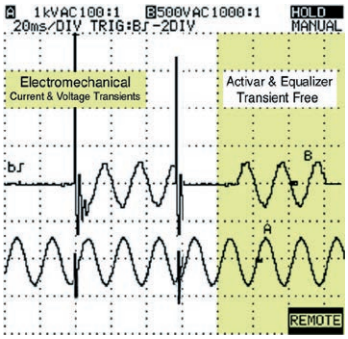
Single-Step Connection

A significant time period elapses between connection or disconnection of a step. As a result, the performance of the compensation system is reduced due to the following:

- Slower compensation, especially when more than one step is required.
- For example, a 1:2:2 system configuration and groups 1 and 2 are connected. When 1 more step is required, group 3 will be connected long after group 1 is disconnected.
- Binary sizing affects performance.

Transient-free Switching

Electronic switching technology prevents any transients typically associated with conventional capacitor switching. This is extremely important in sites with sensitive electronic equipment, such as hospitals, data centers and facilities.



Transients

Contactor-based switching causes significant current and voltage transients. These spikes can cause severe electrical damage and is one of the leading causes of power supply failure.

Fixed Capacity and Filter Characteristics

The capacity of the ACTIVAR capacitors is virtually permanent over the years, which prevents the need to replace capacitors. Moreover, the tuning frequency remains constant over time, which allows system performance to remain at the highest possible level.

Capacity Drop and Filter Variance

The capacity degrades over time and may require replacement of capacitors. Further, the (de-)tuned filters dependent on capacitor-inductor ratings. As the capacitors degrade over time, the (de-)tuning frequency will change, and may create a resonance condition, even though the original system included harmonic inductors.

Long Life and Reduced Maintenance Costs

Elspec ACTIVAR reduces site maintenance costs by increasing the lifetime of:

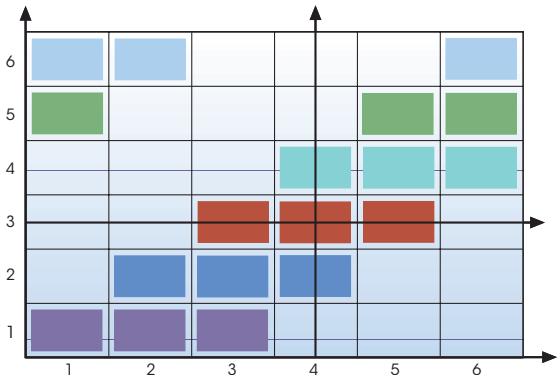
- Switching elements
- Capacitors
- Sensitive electronic equipment

Limited Life and High Maintenance Costs

Contactors have a finite and limited life, and therefore need to be replaced frequently. Transients caused by contactor switching and capacity degradation over time requires repetitive equipment failures and expensive replacements.

Capacitor Duty Cycle - SCAN Mode

The unique SCAN feature protects the ACTIVAR's capacitors, reduces their average current and temperature and extends their life. Simultaneous connection and disconnection of steps in FIFO (First In First Out) manner is shown on the right.



Unequal Duty Cycle

Groups in most conventional systems are engaged dependent on the actual load, but are not equally utilised. The first step generally gets the most usage and is the first to fail due to its high duty cycle compared to the other steps.

Easy-to-Use and Maintain

The advanced DSP and microprocessor-based controller, with its large full graphic LCD display, provide easy-to-use operation. The controller includes a complete electrical measurement system, which can replace a facilities' main monitoring meter. The controller operates the BIT (Built In Test), which reports system or network conditions. The optional PowerIQ software can remotely control all ACTIVAR operation and display additional system power information.

Complicated Use and Maintenance

Electromechanical controllers normally require dip-switch programming and/or hard-to-follow programming manuals. Small display monitoring (or none at all) makes it very difficult to examine system performance. Usually, an additional meter is required to check the network power parameters. The option for remote communication and control does not exist.

Low-Cost Solution

The initial cost of the ACTIVAR system is slightly higher than traditional electro-mechanically-switched solutions. However, when the costs of operating and maintaining a traditional system (contactor and capacitor replacements and/or possible equipment damage) are added, the ACTIVAR's overall costs are far less than an electro-mechanical system.

Low-Cost Solution

The initial cost of an electro-mechanical system quickly changes due to the component replacement and repair. When evaluating electromechanical switching over a period of time, the actual costs and indirect losses become much higher than the initial investment.

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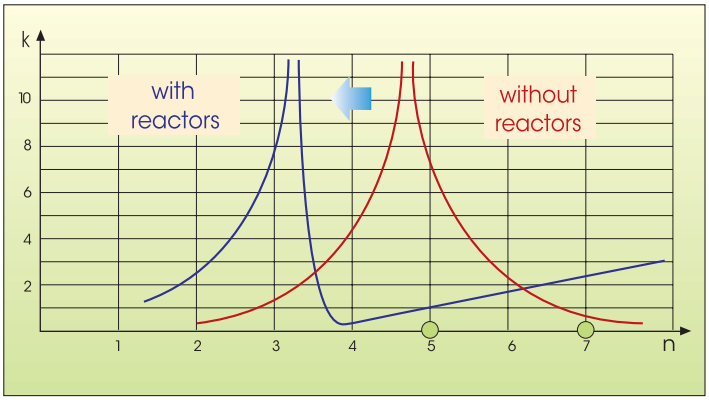
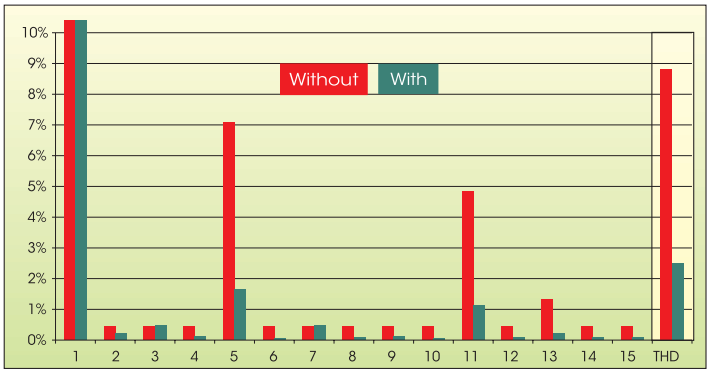
Harmonics Filtration

Utilities generate an almost perfect sinusoidal voltage. Harmonics, created by nonlinear loads such as variable speed drives, power rectifiers, inverters etc., cause nonlinear voltage drops and change the sinusoidal nature of the voltage. When reactive energy is compensated using capacitors, there is a frequency at which the capacitors are in parallel resonance with the power source (high impedance). If the resonant frequency occurs in proximity to one of the harmonic sources, current can circulate between the supply and the capacitors, resulting in high voltage on the line. In this scenario, current levels may exceed the capacitor's rated current by more than two or three times, and can cause transformer burn.

Resonance can occur on any frequency, however in most cases, current harmonic source exist at the 5th, 7th, 11th and 13th harmonic. The ACTIVAR's custom-designed reactors, used in series with the capacitors, prevent resonance by shifting the capacitor/network resonance frequency below the first dominant harmonic (usually 5th).



Shifting Resonance Frequency Below the 5th Harmonic



Voltage Harmonic Filtration Example

Tuned ACTIVAR vs. Active Harmonic Filters

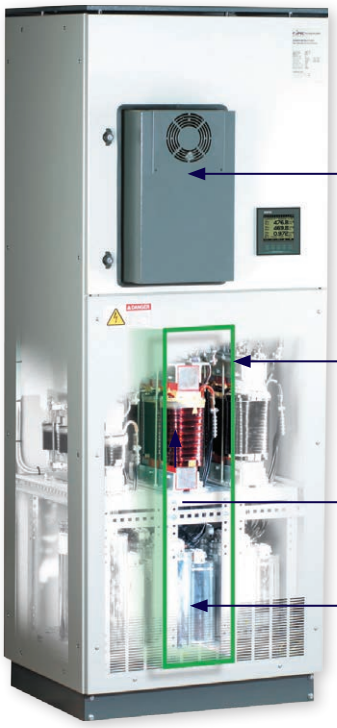
Active filters connect power to the network with an amplitude opposite that of the harmonics. Active filter technology is an expensive solution, and inherently increases system losses. In applications having one or two dominant harmonics, a harmonic tuned Elspec ACTIVAR is the right technical and economic choice, effectively minimising system losses and reducing overall THD (Total Harmonic Distortion).

Applications

The ACTIVAR is the ideal solution for all slow to medium-speed power factor compensation. For fast or ultra-fast applications where the load changes in fractions of seconds, the Elspec EQUALIZER is the right solution.

The following applications dramatically benefit from the ACTIVAR:

- **Hospitals and other Medical Centers**
  Medical equipment includes some of the most sensitive apparatus available. Electromechanical switches transients can cause equipment failure, which may result in serious consequences. The ACTIVAR's transient-free switching, together with its harmonic filtration capabilities, is the only solution for power factor correction at hospitals and other medical centers.
- **Data Centers**
  High availability is the requirement of data centers. Due to the large volume computers, UPS systems and other communications equipment, data centers have very high harmonic population and are extremely sensitive to transients. In order to meet the high availability requirements, data centers use the ACTIVAR transient-free compensation systems with harmonic filtration.
- **Extrusion**
  Extruders create a tremendous amount of harmonics. The harmonics cause energy losses, overheating and may sometimes lead to fire. Using tuned or detuned ACTIVAR systems, customers can reduce the harmonics pollution THD (Total Harmonic Distortion). Decreasing THD both saves energy and prevents potentially dangerous resonance conditions.
- **Office Buildings**
  Office buildings incorporate a significant amount of high harmonic polluting apparatus, including computers, fluorescent lighting and modern elevators. Filtering harmonics saves energy and reduces electrical bills. Using an ACTIVAR system with harmonic filtration assures long life and high performance.
- **Other Industrial Loads**
  Elspec ACTIVAR solutions are successfully installed in thousands of sites with other applications, that due to space limitation were not described in this catalogue. Medium to large factories, regardless of their specific application, will benefit from installing the Elspec ACTIVAR. The advantages for industrial loads are energy saving, harmonic filtration and more.



System Structure

See Elspec EQUALIZER catalogue for more details

Switching Module
Solid state, transient-free switching module for 3 capacitor groups.

Capacitor/Reactor Module
Modular design, designed for ultra high-reliability.

Inductors
Class H insulation and exceptionally low temperature rise (ΔT)

Capacitors
Low loss MKP type with self-healing in a cylindrical aluminium case.

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Complete System Ordering Information

System Type	Total Power	Step Size	Number of Groups	Nominal Voltage	Nominal Frequency	Reactors Percentage	Network Typology	Group Protection	Cable Connec-tion	Cable Entry
AR	1440	120	12	400	50	P7	W	F	C	A

System Type	AR	ACTIVAR Complete System
Total Power		Total power in kVAr
Step Size		Step size in kVAr (Switching Resolution)
Number of Groups		Number of Groups (Physical, max. 12)
Nominal Voltage		Nominal Phase-to-Phase Voltage in Volts
Nominal Frequency		Nominal Frequency in Hz (50 or 60 Hz)
Reactors Percentage	P0	Inrush Limiting Reactors Only
	P#	Percents of Capacity. Example: P7 = 7%.
Network Typology	D	Delta 3 Wires
	W	Wye 4 Wires
	V	Wye 3 Wires
	S	Single phase
Group Protection	F	Groups protected by Fuses
	M	Groups protected by MCCBs
Cable Connection	C	Single Point with Integral Circuit Breaker
	S	Single Connection Point
	M	Multiple Connection Points
Cable Entry	T	Top Cable Entry
	B	Bottom Cable Entry
	A	Top and Bottom Cable Entry
	L	Left-Side Cable Entry
	R	Right-Side Cable Entry

Example: AR 300:60:3-400.50-P7-WFSA
300kVAr transient-free complete ACTIVAR system with 5 steps of 60kVAr with 7% inductors, for 400V/50Hz 4-wires Wye network.
Dimensions (W x D x H): 800 x 600 x 2100, Short Circuit 35kA, IP20.

%	System Size (kVAr)	Output kVAr (Per Step)	Unit Dimensions (cm)	Cable Entry	Product Code
7%	210	30	210 x 80 x 60	Top and Bottom	L5598
7%	250	50	210 x 80 x 60	Top and Bottom	L5599
7%	300	60	210 x 80 x 60	Top and Bottom	L5600
7%	360	50	210 x 100 x 60	Top and Bottom	L5602
7%	420	60	210 x 100 x 60	Top and Bottom	L5605
7%	540	50	210 x 100 x 80	Top and Bottom	L5608
7%	660	60	210 x 100 x 80	Top Only	L5610
7%	780	120	210 x 160 x 60	Top and Bottom	L5614

Controller Ordering Information

Controller Type	Measurement Level	Number of Groups	Communication Card	Power Supply	Special Type
ACR	3	12	2	2	UT

Controller Type	ACR	ACTIVAR Controller
Measurement Level	1	
	2	
	3	
Number of Groups		Number of Groups (Physical, two digits, maximum 12)
Communication Card	0	No Communication
	1	RS 485 ELCOM Protocol
	2	RS 485 ELCOM and MODBUS/RTU Protocols
Power Supply	1	115V
	2	230V
Special Type		See Controller section in the EQUALIZER
		Up to two types can be combined

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Specifications

- **Low Voltage Systems:**
  220V - 690V
  50 or 60 Hz
  Single phase or three-phase
- **Medium Voltage Systems:**
  Up to 69kV
  50 or 60Hz
- **Ambient Temperature:**
  + 40°C: max (< 8 hours)
  + 35°C: max 24 hours average
  + 20°C: yearly average
  - 10°C: minimum
- **Capacitors:**
  Low loss, self healing, IEC 831-1/2
- **Protection Class:**
  IP20/NEMA 1 (Other on request)
- **Controller Display:**
  5" Graphic LCD
  160 x 128 pixels
  High visibility (FSTN)
  Durable LED Backlight
- **Design:**
  Steel sheet cabinet
- **Enclosure Finish:**
  Epoxy powder coated
  Gray (RAL 7032)
- **Internal Parts:**
  Rust-proof alu-zinc
- **EMC Standards:**
  EN 50081-2, EN 50082-2
  EN 55011,
  EN 61000-4-2/3/4/5
  ENV 50204, ENV 50141
- **Safety Standards:**
  EN 61010-1, EN 60439-1
  UL 508 (on request)

Measured Parameters

Parameter	Phases		Measurement Level		
			1	2	3
Frequency	Common	Mains	•	•	•
Phase Current	L1, L2, L3	Mains, Load, Cap.	•	•	•
Neutral Current	Neutral	Mains	•	•	•
Phase to Phase Current*	L1-2, L2-3, L3-1	Mains, Load	•	•	•
Phase Voltage	L1, L2, L3	Mains	•	•	•
Neutral Voltage	Neutral	Mains	•	•	•
Phase to Phase Voltage	L1-2, L2-3, L3-1	Mains	•	•	•
Active Power (kW)	L1, L2, L3, Total	Mains	•	•	•
Reactive Power (kVAr)	L1, L2, L3, Total	Mains, Load, Cap.	•	•	•
Apparent Power (kVA)	L1, L2, L3, Total	Mains, Load, Cap.	•	•	•
Power Factor	L1, L2, L3, Total	Mains, Load, Cap.	•	•	•
Time of Use (TOU) - in, out, net, total:					
Active Energy (kWh)	Total	Mains		•	•
Reactive Energy (kVARh)	Total	Mains		•	•
THD at Phase Current	L1, L2, L3	Mains, Load, Cap.		•	•
THD at Neutral Current	Neutral	Mains		•	•
THD at Phase to Phase Current	L1-2, L2-3, L3-1	Mains, Load		•	•
THD at Phase Voltage	L1, L2, L3	Mains		•	•
THD at Neutral Voltage	Neutral	Mains		•	•
THD at Phase to Phase Voltage	L1-2, L2-3, L3-1	Mains		•	•
Harmonics of Phase Current	L1, L2, L3	Mains, Load, Cap.			•
Harmonics of Neutral Current	Neutral	Mains			•
Harmonics of Phase to Phase Current	L1-2, L2-3, L3-1	Mains, Load			•
Harmonics of Phase Voltage	L1, L2, L3	Mains			•
Harmonics of Neutral Voltage	Neutral	Mains			•
Harmonics of Phase to Phase Voltage	L1-2, L2-3, L3-1	Mains			•
Waveforms of Phase Current	L1, L2, L3	Mains, Load, Cap.			•
Waveforms of Neutral Current	Neutral	Mains			•
Waveforms of Phase to Phase Current	L1-2, L2-3, L3-1	Mains			•
Waveforms of Phase Voltage	L1, L2, L3	Mains			•
Waveforms of Neutral Voltage	Neutral	Mains			•
Waveforms of Phase to Phase Voltage	L1-2, L2-3, L3-1	Mains			•
System Log			•	•	•
Event Log			•	•	•

* Unique feature: metering internal current of feeder transformer (delta secondary).

World Innovator in Power Quality

Since 1988 Elspec has developed, manufactured and marketed proven power quality solutions far exceeding our clients' needs and expectations.

Our innovations not only simplify the understanding of the quality of power itself, but are also highly compatible, making it suitable for any business and or application.

Impact Power Innovations in conjunction with Elspec's international team of professionals have extensive experience in electrical engineering and are ready to provide a tailor made strategy that will enable a sustainable and efficient use of your electrical energy.

Impact Power Innovations

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