THYCON

Est.1968

Static Frequency Converter

SFC 10kVA–10 MVA

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Concept

Thycon Static Frequency Converters (SFC) convert supply frequency to load requirement frequency. Typical applications are 50 to 60Hz conversion for naval and 50 to 400Hz conversion for aviation applications, although conversion from and to any frequency are available on request.

Applications

Typical SFC industry applications include:

- aviation industry
- computer installations
- communications
- military installations
- dockyards

SFC features and benefits

- Thycon's Static Flywheel Technology
- continuous, accurate voltage and frequency regulation
- supplies leading power factor load without de-rating
- microprocessor-based diagnostics and controls
- high fault clearing capability
- high overload capacity
- low harmonic distortion
- input unity power factor
- energy saving
- soft-start control
- robust technology
- no moving parts
- fuseless design
- high efficiency
- high reliability
- long life
- cost effective
- low maintenance cost
- compact, modular construction
- indoor or outdoor enclosures
- Australian made
- meets MIL-STD-704E, MIL-STD-461D and AS wiring rules

Principle of operation

Thycon SFC use double conversion methods. A rectifier converts the input frequency to DC and an inverter converts the DC to the required output frequency. Capacitors or a battery bank can be connected to the DC to achieve availability of power during short or long-term supply disturbances. Thycon's Static Flywheel Technology achieves high current capacity, storage efficiency and reliability with lower mean time to repair and running costs than traditional rotary technology.

Installation and testing

SFC offers modular design for quick and easy site installation. All that is required is the installation of power cables and control/ monitoring cabling. The SFC is tested comprehensively prior to delivery and needs minimal site commissioning.

An SFC can also be provided as a complete containerised assembly that can be placed in the harshest Australian conditions and be easily relocated to other sites.

Reliability and maintenance requirements

Thycon has been supplying static frequency converters for 40 years and has demonstrated their high reliability and low maintenance demands in critical applications such as defence and aviation.

Transformers and power electronic converters can be forced or naturally cooled, which contributes to high reliability and low ongoing maintenance. The power components (capacitors, transformers, switchgear and instrument transformers) are all standard commercial products of proven reliability and long life expectancy.

Thycon SFC maintenance requirements are dependent on environmental and application conditions. We accommodate customer requirements from basic to full warranty maintenance. Each maintenance plan ensures the equipment operates in top condition with maximum availability of engineers and parts at minimum cost to the customer. Qualified engineers perform the maintenance with the full back up and resources of Thycon.

Training and support

Training and support can be provided to on-site personnel to ensure that they are fully versed in the operation, maintenance and fault rectification of the Thycon SFC.

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Control and monitoring
Smart digital signal processing provides frequency and voltage regulation of the SFC. The control is automatic, continuous and linear, ensuring an inherently fast transient response.

SFCs can be controlled and monitored from the unit itself and remotely via serial, TCP/IP or SCADA. The system is totally automatic and does not require manual restarting for fault-initiated supply disturbances if desired.

Control and status
The SFC provides a simple control and status interface.

Start and Stop push buttons allow you to operate the equipment and to go online. Power Available and Power On LEDs indicate that the mains power is available and that the SFC is online. A Cancel button is used as an audible silence alarm acknowledge.

Monitoring
The SFC system monitor is a smart LCD panel featuring a simple and effective user interface that incorporates advanced diagnostic facilities enabling immediate access to:

- power monitoring - voltage / current / kW / kVA / power factor / harmonic distortion
- operating status and alarms
- event history
- password protected user defined settings
- service control and test options

The system monitor stores the last 200 system events in a non-volatile information buffer for fast, efficient fault diagnosis and status indication even after a re-start or a complete power outage.

Low-level interface
Operating status of the equipment to a remote monitoring system can be performed in the form of 8 standard voltage-free contacts.

High-level interface
Real-time performance monitoring of the SFC is performed via serial or TCP/IP connection. A basic hardcopy of operating events and data can be obtained by connecting a printer. An optional high-level interface via Modbus, SNMP or web html can be provided for immediate performance monitoring and analysis. Additional features enable you to notify your network server of alarm conditions, perform automatic low battery autonomy shutdowns of the critical load and send emails to designated recipients.

SFC data such as real-time waveforms, alarms and system events can be stored in solid state, non-volatile memory holding up to 500 MBs of information. Connecting the SFC to a PC using any of the available ports allows you to maintain a full history of the equipment over its lifetime.

Options

Active pf and harmonic filtering control

High input impedance reduces voltage notching and input harmonics, thereby minimising required ratings of standby generator equipment.

Typical input power factors are 0.85 for 6-pulse and 0.92 for 12-pulse systems, although a pf of 0.99 is available when combined with a Thycon Active Power Factor Regulator (APR). These values remain stable under varying loads on the SFC.

A Thycon APR can provide additional power factor and harmonic filtering to ensure 0.99 pf and <5% THID (or <1% THVD) at the SFC supply.

Remote monitoring

Modem connection enables the SFC to dial and notify Thycon or a remote user automatically whenever an alarm condition arises. Thycon's Service Centre automatically logs data, performs analysis and diagnostics and then alerts our 24-hour staff if further intervention is required. All SFC utilisation and incidents found or reported are logged and a full report is provided for each occurrence. The report highlights remedial actions, cautions and follow up recommendations. Alternatively, the remote user can interrogate the SFC at will.

Thycon power system monitor

The SFC monitor offers the user a web-based interactive diagnostic tool and database management system for continuous real-time monitoring of SFC system utilisations, alarms, events and variables. The database management logs data to your PC's hard disk for future analysis and display.

Expansion

Future expansion and redundancy can be achieved by parallel connection of the SFC modules. Each module can be isolated manually or automatically from the load bus without affecting availability
of supply.

Container modules

The SFC can be provided as a complete containerised assembly that can be placed in the harshest Australian conditions and easily relocated to other sites. Each module is self-contained enabling use in applications varying from Navy powerhouses to defence and commercial airports.

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Thycon SFC advantages

Design advantages

Simple, reliable design	Uncomplicated design facilitates high strength, durability and reliability. The power circuit uses simple, robust switches to form a sine wave by line commutation control technology. This method of control eliminates the switching stresses, losses and interference that high frequency, forced commutated conversion systems such as IGBT technology experience.
Robust technology	Robust construction achieves reliable performance and long equipment life, as proven by 40 years of Thycon installations.
Component rating	Commercially available standard mains frequency thyristors are used as single devices up to 2.4kA. No series or parallel matching of components is required to achieve high power applications.
Thyristor technology	Use of thyristors (SCRs) eliminates the need for special high-speed semiconductor fuses resulting in a simpler design with increased reliability. Thyristors have the highest power and fault tolerance of all semiconductor devices and can withstand faults of up to 10 times the current for 1000 times the period of IGBT and transistor switching technologies.
Fuseless design	Operates without power fuses. Power components are liberally over-rated so that simple and reliable methods of circuit breaker protection can be used. This greatly reduces down time and eliminates the need for stock control of spare fuses.
Surge protection	Built in surge protection increases the attenuation of over-voltages caused by distribution faults and lightning.
Isolating transformers	Incorporation of these within the input or the bypass supply enable complete isolation from electrical noise and the effects of harmonic currents generated within the distribution network.
Isolation between input and output	Incorporation of full galvanic isolation using an earth-screened transformer provides greater safety levels.
Output source impedance	Low output source impedance eliminates the effect of the load on SFC output voltage waveform and the danger of interaction between loads.
Compatibility	The control panel provides the operator with an efficient, user-friendly interface.
Microprocessor monitoring	Externally monitored microprocessor via multistage hardware ensures that the critical load is not affected should it fail.
Modular construction	Construction from standardised components and modules ensures high mean time between failures (MTBF) and low mean time to repair (MTTR).
Environment	The equipment can be used in computer rooms or in harsher environments without de-rating. Thycon equipment can be containerised to provide a complete solution for extreme environments. In many cases there is no need for special air conditioning, reducing operating and capital costs.

Performance advantages

Input power factor	Typical input power factors are at 0.85 for 6-pulse and 0.92 for 12-pulse systems, with a pf of 0.99 when combined with a Thycon APR. These values remain stable under varying loads on the SFC.
Input current harmonics	High input impedance reduces voltage notching and input harmonics.
Output voltage harmonics	Low output impedance inherently inhibits the effect of non-linear, high harmonic loads on the output voltage waveform. Output harmonic distortion at linear loads < 2%. Output harmonic distortion at non-linear loads < 4%.
Efficiency	System operates up to 94.5% efficiency resulting in lower running costs and heat dissipation.
Load crest factor	Low output impedance allows it to drive high crest factor loads without risking component damage, current limitation or excessive waveform distortion.
Noise attenuation	Common mode high frequency attenuation (line to ground and neutral) is more than 135 dB and more than 70 dB at normal mode (line to neutral). Consequently load switching, mains switching, externally generated industrial noise or storms do not affect the load.
Thycon's Static Flywheel Technology	The SFC uses Thycon's proprietary Static Flywheel Technology to provide fast continuous regulation of voltage and harmonic distortion. This technology also allows the SFC to store substantial reserve power for transient conditions and high crest factor loads.
Transient response	A fast dynamic response enables correction of transient step load changes within one power cycle period.
Fault current capability	Supplies 10-20 times the rated current under load fault short circuit conditions.
Output overload	Voltage is regulated beyond 300% overload and, unlike systems with output current limiting, will not stray outside the allowable tolerances when supplying inrush current.
Leading power factor load	System can operate with a leading power factor load without any de-rating factor.
Parallel operation	Easy paralleling with similar systems at any stage of the SFC lifetime means increased flexibility and permits future growth as required.

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Technical data 90 kVA – 200 kVA

	SFC-90	*SFC-120*	*SFC-150*	*SFC-200*
Input - three phase, three wire & ground	***90kVA***	***120kVA***	***150kVA***	***200kVA***
Voltage	415 VAC	415 VAC	415 VAC	415 VAC
Voltage tolerance	+10% - 15%	+10% - 15%	+10% - 15%	+10% - 15%
Phases	3 + neutral	3 + neutral	3 + neutral	3 + neutral
Frequency	50 Hz ± 5%	50 Hz ± 5%	50 Hz ± 5%	50 Hz ± 5%
Power walk-in	15s	15s	15s	15s
Current output - three phase, four wire				
System rating	90kVA / 72kW	120kVA / 96kW	150kVA / 120kW	200kVA / 160kW
Power factor range (within rated kW)	0.7 lag to 0.8 lead	0.7 lag to 0.8 lead	0.7 lag to 0.8 lead	0.7 lag to 0.8 lead
Overload capacity 125% / 150%	12min. / 2min.	12min. / 2min.	12min. / 2min.	12min. / 2min.
Voltage	415V / 240VAC	415V / 240VAC	415V / 240VAC	415V / 240VAC
Voltage regulation:				
Balanced load	± 1%	± 1%	± 1%	± 1%
100% unbalanced load	± 3%	± 3%	± 3%	± 3%
Voltage adjustment	± 5%	± 5%	± 5%	± 5%
Voltage transient performance:				
50% full load step	± 5%	± 5%	± 5%	± 5%
Maximum recovery time	20ms	20ms	20ms	20ms
Phase displacement:				
Balanced load	120° ± 1°	120° ± 1°	120° ± 1°	120° ± 1°
100% unbalanced load	120° ± 3°	120° ± 3°	120° ± 3°	120° ± 3°
Frequency	60Hz / 400Hz	60Hz / 400Hz	60Hz / 400Hz	60Hz / 400Hz
Frequency regulation	± 0.1%	± 0.1%	± 0.1%	± 0.1%
Frequency tracking rate	10Hz / s	10Hz / s	10Hz / s	10Hz / s
THD	<4% non-linear loads	<4% non-linear loads	<4% non-linear loads	<4% non-linear loads
Efficiency	89%	90%	91%	92%
Environmental				
Ambient temperature range	0 to 40ºC	0 to 40ºC	0 to 40ºC	0 to 40ºC
Heat dissipation at full load	10 kW	12 kW	14 kW	18 kW
Audible noise at 2 metres	<70 dBA	<70 dBA	<70 dBA	<70 dBA
Dimensions				
w x d x h (mm) 60Hz	600 x 1000 x 2000	1200 x 1000 x 2000	1200 x 1000 x 2000	1800 x 1000 x 2000
w x d x h (mm) 400Hz	600 x 1000 x 2000	1200 x 1000 x 2000	1200 x 1000 x 2000	1800 x 1000 x 2000

Specifications are subject to change without notice

Technical data 300 kVA – 600 kVA

	SFC-300	*SFC-400*	*SFC-500*	*SFC-600*
Input - three phase, three wire & ground	*300kVA*	*400kVA*	*500kVA*	*600kVA*
Voltage	415 VAC	415 VAC	415 VAC	415 VAC
Voltage tolerance	+10% - 15%	+10% - 15%	+10% - 15%	+10% - 15%
Phases	3 + neutral	3 + neutral	3 + neutral	3 + neutral
Frequency	50 Hz ± 5%	50 Hz ± 5%	50 Hz ± 5%	50 Hz ± 5%
Power walk-in	15s	15s	15s	15s
Current output - three phase, four wire				
System rating	300kVA / 240kW	400kVA / 320kW	500kVA / 400kW	600kVA / 480kW
Power factor range (within rated kW)	0.7 lag to 0.8 lead	0.7 lag to 0.8 lead	0.7 lag to 0.8 lead	0.7 lag to 0.8 lead
Overload capacity 125% / 150%	12min. / 2min.	12min. / 2min.	12min. / 2min.	12min. / 2min.
Voltage	415V / 240VAC	415V / 240VAC	415V / 240VAC	415V / 240VAC
Voltage regulation:				
Balanced load	± 1%	± 1%	± 1%	± 1%
100% unbalanced load	± 3%	± 3%	± 3%	± 3%
Voltage adjustment	± 5%	± 5%	± 5%	± 5%
Voltage transient performance:				
50% full load step	± 5%	± 5%	± 5%	± 5%
Maximum recovery time	20ms	20ms	20ms	20ms
Phase displacement:				
Balanced load	120° ± 1°	120° ± 1°	120° ± 1°	120° ± 1°
100% unbalanced load	120° ± 3°	120° ± 3°	120° ± 3°	120° ± 3°
Frequency	60Hz / 400Hz	60Hz / 400Hz	60Hz / 400Hz	60Hz / 400Hz
Frequency regulation	± 0.1%	± 0.1%	± 0.1%	± 0.1%
Frequency tracking rate	10Hz / s	10Hz / s	10Hz / s	10Hz / s
THD	<4% non-linear loads	<4% non-linear loads	<4% non-linear loads	<4% non-linear loads
Efficiency	92.5%	93%	94%	94%
Environmental				
Ambient temperature range	0 to 40°C	0 to 40°C	0 to 40°C	0 to 40°C
Heat dissipation at full load	24 kW	26 kW	28 kW	35 kW
Audible noise at 2 metres	<70 dBA	<70 dBA	<70 dBA	<70 dBA
Dimensions				
w x d x h (mm) 60Hz	1800 x 1000 x 2000	2400 x 1000 x 2000	2400 x 1000 x 2000	3000 x 1000 x 2000
w x d x h (mm) 400Hz	1800 x 1000 x 2000	2400 x 1000 x 2000	2400 x 1000 x 2000	2400 x 1000 x 2000

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Technical data 800 kVA – 1600 kVA

	SFC-800	*SFC-1200*	*SFC-1600*
***Input** - three phase, three wire & ground*	***800kVA***	***1200kVA***	***1600kVA***
Voltage	415 VAC	415 VAC	415 VAC
Voltage tolerance	+10% - 15%	+10% - 15%	+10% - 15%
Phases	3 + neutral	3 + neutral	3 + neutral
Frequency	50 Hz ± 5%	50 Hz ± 5%	50 Hz ± 5%
Power walk-in	15s	15s	15s
***Current output** - three phase, four wire*			
System rating	800kVA / 640kW	1200kVA / 960kW	1600kVA / 1280kW
Power factor range (within rated kW)	0.7 lag to 0.8 lead	0.7 lag to 0.8 lead	0.7 lag to 0.8 lead
Overload capacity 125% / 150%	12min. / 2min.	12min. / 2min.	12min. / 2min.
Voltage	415V / 240VAC	415V / 240VAC	415V / 240VAC
Voltage regulation:			
Balanced load	± 1%	± 1%	± 1%
100% unbalanced load	± 3%	± 3%	± 3%
Voltage adjustment	± 5%	± 5%	± 5%
Voltage transient performance:			
50% full load step	± 5%	± 5%	± 5%
Maximum recovery time	20ms	20ms	20ms
Phase displacement:			
Balanced load	120° ± 1°	120° ± 1°	120° ± 1°
100% unbalanced load	120° ± 3°	120° ± 3°	120° ± 3°
Frequency	60Hz / 400Hz	60Hz / 400Hz	60Hz / 400Hz
Frequency regulation	± 0.1%	± 0.1%	± 0.1%
Frequency tracking rate	10Hz / s	10Hz / s	10Hz / s
THD	<4% non-linear loads	<4% non-linear loads	<4% non-linear loads
Efficiency	94.5%	95%	95%
Environmental			
Ambient temperature range	0 to 40°C	0 to 40°C	0 to 40°C
Heat dissipation at full load	40 kW	55 kW	72 kW
Audible noise at 2 metres	<70 dBA	<70 dBA	<70 dBA
Dimensions			
w x d x h (mm) 60Hz	3600 x 1000 x 2000	4200 x 1000 x 2000	4800 x 1000 x 2000
w x d x h (mm) 400Hz	3000 x 1000 x 2000	3600 x 1000 x 2000	4200 x 1000 x 2000

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Notes

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