THYCON

Est.1968

# DCM

## Double Conversion Module

## 400kVA - 800kVA

THYCON

The parallel operation of converters for increased output power or redundancy is commonplace but poses problems for large systems. A new approach is presented here which minimises component count, simplifies start and fault-recovery procedures while maintaining a high degree of redundancy.

Designed and Published by Thycon.

## Concept

The growing use of power electronic conversion in all industrial fields is driving the development of reliable, cost and energy-efficient solutions that are easy to source and install.
This has lead to modular solutions where small, standard, "off-the-shelf" converter blocks are parallel-connected to make larger systems. However, when building multi-MVA systems the number of small modules required and the associated complexity can make this approach prohibitive.

To address this situation, Thycon has developed a range of Double Conversion Modules (DCM) with power ratings from 400kVA to 800kVA. This reduces the number of modules required and makes a modular approach to very large systems practicable.

Thycon, with over 40 years experience in high power electronics, specialises in efficient and reliable equipment in order to achieve the highest possible availability as required by Australia's rugged environment (heat, dust, remoteness) and demanding industries (Mining, Oil & Gas).

This is achieved through the following design strategies:

- High power, mature thyristors are favoured over newer IGBTs for their high current and overload capabilities and their inherently low losses.

- Fully rated thyristors are utilised in each DCM thereby avoiding the requirement for series or parallel connections.

- The circuit topologies do not rely on high frequency switching which further minimises losses and allows the use of air-cooling without air-conditioning.

- Minimised number of control boards and components.

- The use of rugged, passive components and mechanics.

- Fuseless power circuit design. Resettable circuit breaker protection is used in favour of single use fuses.

## The DCM

The Thycon DCM concept is aimed at reducing the cost of installation and ownership of power converters used in UPS (Uninterruptible Power Supplies) and SFC (Static Frequency Converters) in the 0.4 – 13 MVA power range. This is achieved using Thycon's new paralleling approach which:

- Achieves a high degree of converter standardisation.

- Allows locally-based customisation (to reduce transportation and importation costs) and local service and support.

- Minimises the number of components for the highest reliability.

- Uses standard components for ease of sourcing and low-cost maintenance.

- Uses low-loss circuitry for efficient operation, simple cooling and easy installation.

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**Uninterruptible Power Supplies**

UPS systems are characterised by the presence of battery banks and a fast acting static bypass switch.

A UPS is built with an internal static switch rated to its inverter capacity as standard. This may cause problems in the case of parallel UPS systems as the bypass switches will not share the load current evenly and may fail if more than one is required to support the load.

The Thycon DCM concept utilises a large centralised fully rated static switch. A secondary static switch may be added for additional redundancy and/or reliability. This results in a large component count reduction and corresponding improvement in reliability in comparison to traditional parallel UPS topologies.

A UPS system using Thycon's new approach is shown in Fig. 1 (page 6). The diagram of Fig. 1 shows the bypass switch in a separate cubicle, which can be co-located with the output transformer(s) if required. Fig. 1 shows four standard modular double-conversion systems.

A module is rated from 400kVA to 800kVA to enable systems of up to 10 MVA (plus redundant units) to be easily composed with as few as twelve (12) standard modules and only one transformer, bypass and control cubicle.

The concept of centralisation is not extended to the batteries, as shown in Fig. 1, for which there are several reasons:

- Lumping the batteries together runs counter to the concept of standard UPS units and would reduce availability through redundancy.

- Predictive battery maintenance becomes less feasible the more battery cells are connected in parallel.

- The DC link is no longer a common point and DC currents will circulate between the various DC points and their connections to the different rectifiers (especially if there are minor differences in their firing angles).

- The fault currents resulting from a single commutation failure (inverter shoot-though) will be very large and possibly exceed the surge rating of the semiconductors.

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The AC output of each UPS inverter is buffered by Thycon's Static Flywheel technology, which is connected to the inverter as shown in Fig. 1. This is a feature of all the Thycon UPS systems and provides a number of unique benefits:

- It acts as a high-speed reactive VAR compensator with a sub-cycle response time.

- It acts as a reservoir of power providing high peak transient capability, as needed for motor starting, transformer magnetization, and high crest factor loads.

- It serves as a harmonic filter, absorbing load harmonics and ensuring the purity of the output voltage waveform even with highly non-linear loads such as those presented by datacentres and industrial loads.

Thus, the Thycon DCM concept for UPS differs radically from conventional approaches in part due to the system architecture, which is customised for high power applications, the industry low component count and our unique static flywheel technology.

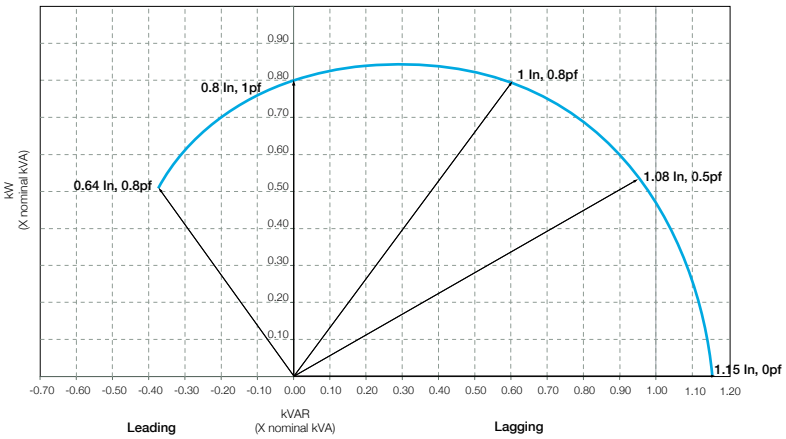


Fig. 2
Output power locus of Thycon "Static Flywheel"

**Static Frequency Converters**

Large static frequency converters are assembled using the same DCMs as described previously, but without the static switch required for UPS functionality.

Large SFCs, such as those used in Shore to Ship power applications, are built using multiple DCM modules, in the same manner as large UPS systems. For very dynamic loads, Thycon can increase the size of the Static Flywheel, avoiding the need to massively increase the size of the equipment. This can be done at any time before or after installation.

Following pages:
Fig. 1. Single-line diagram for a Thycon UPS system
(page 6)

Fig. 3. Single-line diagram for a Thycon SFC system
(page 7)

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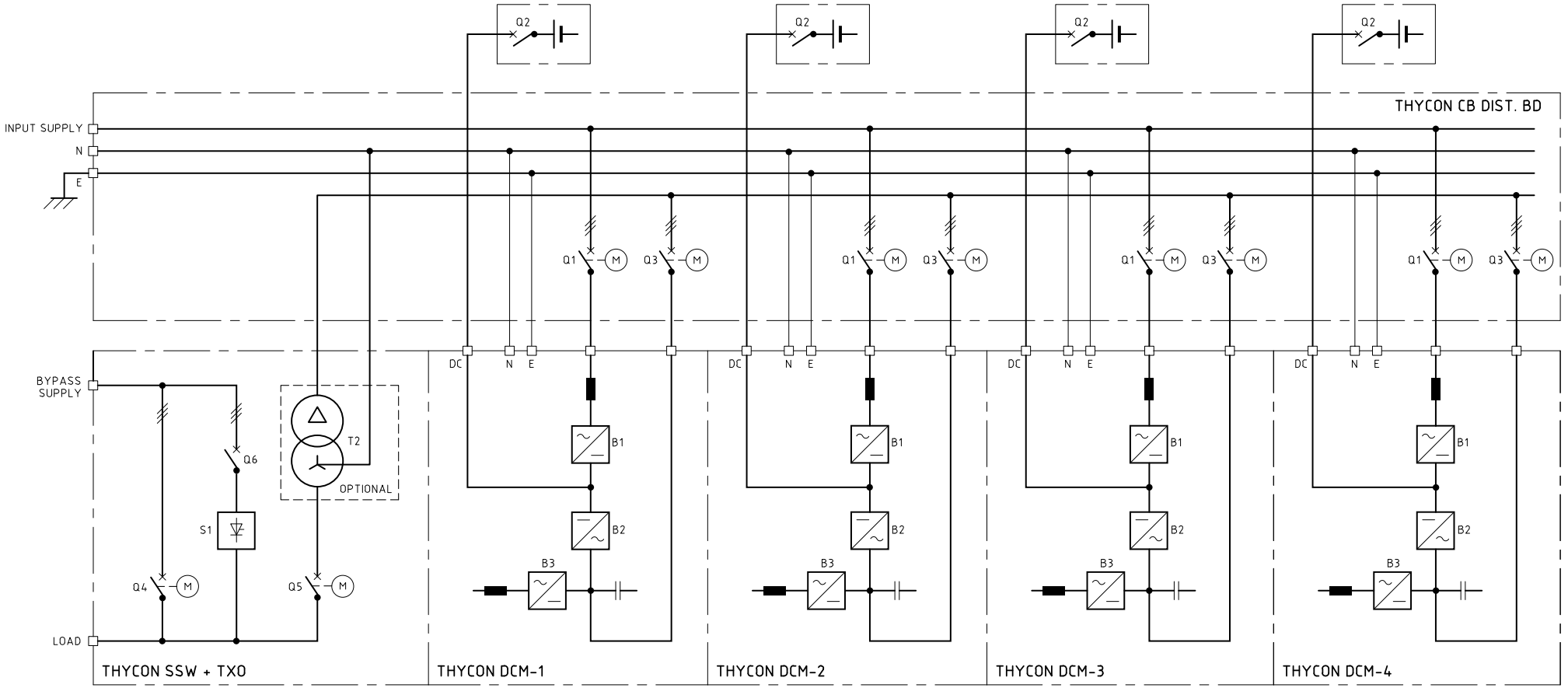


Fig. 1. Single-line diagram for a Thycon UPS system.

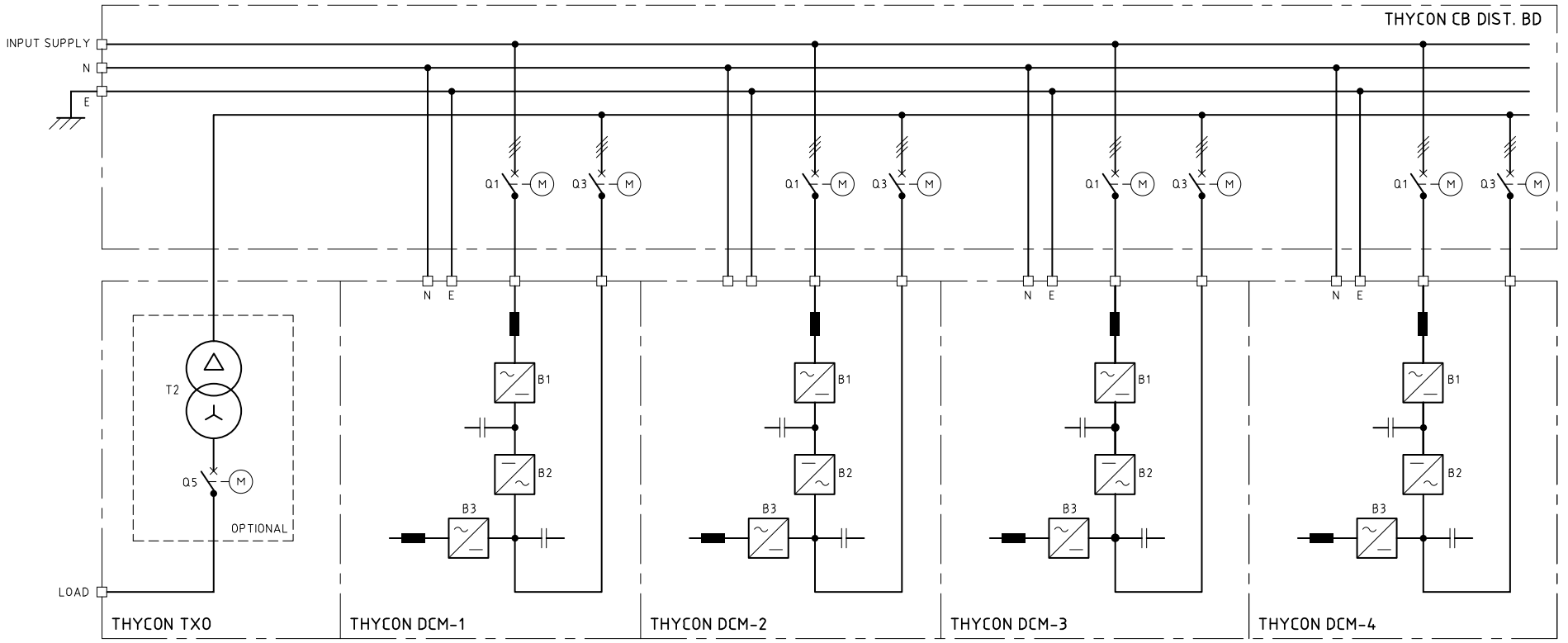


Fig. 3 Single-line diagram for a Thycon SFC system.

| Item | DCM - 400 | DCM - 600 | DCM - 800 |
|---|---|---|---|
| *Input* | | | |
| Rated Voltage (V) | 415 | 415 | 415 |
| Voltage Tolerance (%) | +10 /-15 | +10 /-15 | +10 /-15 |
| Rated Frequency (Hz) | 50/60 | 50/60 | 50/60 |
| Rated Current (A) | 480 | 730 | 980 |
| Phases | 3P+N | 3P+N | 3P+N |
| THID (%) | <5 | <5 | <5 |
| Power Factor | >0.99 | >0.99 | >0.99 |
| Fault Withstand (kA) | <100 | <100 | <100 |
| | | | |
| *Output* | | | |
| Module Rating (kVA / kW) | 400 / 320 | 600 / 480 | 800 / 640 |
| Max Capacity (kVA) | 16 x 400 | 16 x 600 | 16 x 800 |
| Inverter Voltage (V) | 690 | 690 | 690 |
| Voltage Adjustment (±%) | 5 | 5 | 5 |
| THVD (%) | <3 | <3 | <3 |
| Voltage Regulation<br>Balanced load (%)<br>100% Unbalanced load (%) | <br>±1<br>±3 | <br>±1<br>±3 | <br>±1<br>±3 |
| Transient Voltage Performance<br>50% load step (%)<br>Recovery time (ms) | <br>±5<br>20 | <br>±5<br>20 | <br>±5<br>20 |
| Phase Displacement<br>Balanced Load (°)<br>100% Unbalanced Load (°) | <br>120 ±1<br>120 ±3 | <br>120 ±1<br>120 ±3 | <br>120 ±1<br>120 ±3 |
| Rated Frequency (Hz) | 50/60 | 50/60 | 50/60 |
| Frequency Regulation (%) | ±0.1 | ±0.1 | ±0.1 |
| Rated Current (A) | 560 | 840 | 1200 |
| Phases | 3P | 3P | 3P |
| 125% Nominal Current (min) | 12 | 12 | 12 |
| 150% Nominal Current (min) | 2 | 2 | 2 |
| Crest Factor | Unlimited | Unlimited | Unlimited |
| Efficiency (%) | 97 | 97 | 97.8 |
| Power Factor Range | 0.7 lag to 0.8 lead | 0.7 lag to 0.8 lead | 0.7 lag to 0.8 lead |
| IP Rating | IP21 | IP21 | IP21 |
| Weight (kg) | 1700 | 1700 | 2300 |
| Cooling | AN | FA | FA |
| Colour | RAL 7035 | | |
| Panel thickness (mm) | 2 | 2 | 2 |
| Max. Ambient Temperature (°C) | 50 | 50 | 50 |
| Audible Noise at 2m (dBA) | <70 | <70 | <70 |
| Dimensions (ex. fan) W x D x H (mm) | 800 x 1200 x 1925 | 800 x 1200 x 1925 | 800 x 1200 x 1925 |
| Revelant Technical Standard | AS 60146, AS 62040, STANAG | | |
| Quality Management Standard | ISO 9001 | ISO 9001 | ISO 9001 |
| Testing | Routine | Routine | Routine |

| Item | SSW - 2000 | SSW - 4000 |
|---|---|---|
| *Input / Output* | | |
| Rated Voltage (V) | 415 | 415 |
| Rated Frequency (Hz) | 50/60 | 50/60 |
| Rated Current (A) | 5000 | 10000 |
| 125% Nominal Current (sec) | 12 | 12 |
| 150% Nominal Current (sec) | 2 | 2 |
| Fault Withstand (kA) | <70 | <70 |
| Phases | 3P + N | 3P + N |
| Efficiency (%) | 99.7 | 99.7 |
| | | |
| *Performance* | | |
| Transfer Mode | Make before break | |
| Transfer Time (ms) | <2 | <2 |
| Source Failure (ms) | 2 | 2 |
| Cooling | FA | FA |
| Max. Ambient Temperature (°C) | 50 | 50 |
| Quality Management Standard | ISO 9001 | ISO 9001 |
| Testing | Routine | Routine |

Specifications are subject to change without notice.

THYCON

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