TERCO

SCAN DRIVE SYSTEM
SD 2000

Scan Drive System - Mobile Motor Drive Teaching Unit

SD 2000

A complete mobile system for teaching electrical machines and drives. The system covers everything from basic electrical machines to computerized 4-quadrant drive of induction motor.

The TERCO Scan Drive System is a learning system including both hardware and courseware, integrated to cover complete education in electrical machines and motor drives,
thus opening a new path where teaching could reach the necessary goals to move industry ahead.

The Scan Drive System is designed and adapted for compatibility and flexibility in pedagogical work for technical and vocational education as well as for engineering courses.
It is designed for active participation by the student who can work independently, which creates a high degree of student motivation.

Courses, that by tradition are treated separately, like electrical machines and power electronics, can with advantage be taught in an integrated way using the Scan Drive System.

Scan Drive System
SD 2000

Highlights of Terco Scan Drive Systems

- Four quadrant **industrial** drive Systems AC + DC
- Covers most common electrical machines, static and rotary
- Microprocessor based measuring system. Can display 26 different signals simultaneously
- Vector visualization of electrical parameters
- Digital Torque and Power meter
- Equipped with double PC:s including 19” flat screens
- Unique connection / experiment board, protected by microprocessor controlled blocking unit
- Mobile main frame fabricated in steel and finished in baked blue enamel
- Separate mobile machine bed with high torsional strength
- Student surface 830 x 2000 mm
- Full protection against over temp and over current
- Outlets for oscilloscope measurements
- 1-2-3-6 pulse rectifier
- Separate torque meter to measure start torque
- Machine set including 4 special made test machines allowing 20% overload during min 10 min.
- Single and 3-phase variable transformer
- 3-phase capacitive, inductive and resistive variable load banks
- Build in UIP-unit to visualize, by multiplexer, immediate values of voltage, current and power simultaneously on a two channel oscilloscope explaining the 4Q operation in a unique way.
- Complete power supply
- Teachers manual, students experiment manual and technical description with diagrams.

AC and DC Drives

Engineers and technicians concerned with modern drive technology are today confronted with a whole complex of subjects like mechanics, electro mechanics, power conversion, electrical machines, power electronics, electronics, microcomputers, control theory, sensors and transducers, etc.

With the Scan Drive System essential elements of these subjects can be integrated in a single course in electronic motion control. By use of new methodology of learning, integrated with the TERCO Scan Drive System, the course work, will be much easier for the teacher and more efficient for the student.

4 Q frequency converter with MOS FET technique and a fixed intermediate DC-link

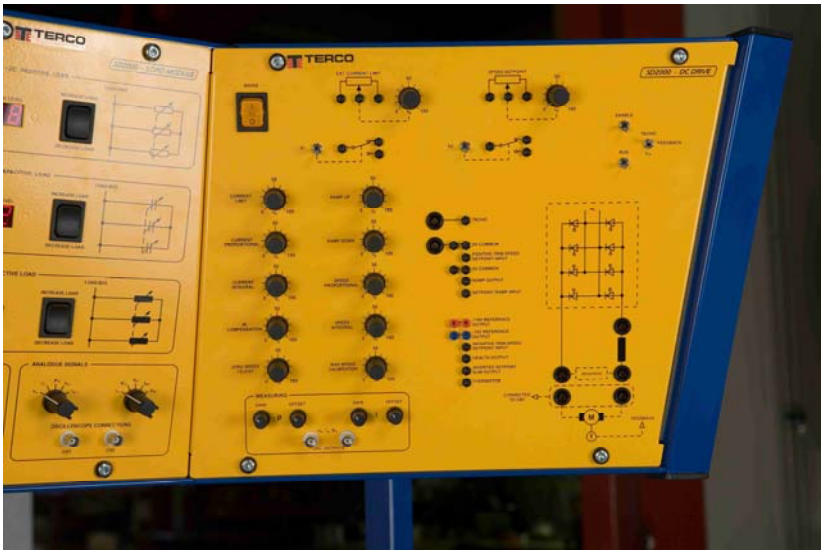
Industrial converter, covers latest development in AC motor operation with frequency converters. The converter is designed to work according to different function principles and it is possible to explain several different types of frequency converters existing today.
The converter is also suitable for experiments and tests in industries far beyond the area that the experiments show. When braking, the energy is transferred by the DC-link and a brake chopper to a built in load resistor. There is also an additional adjustable DC-injection brake.

Operation can be done in three ways: manually, by alpha numeric display or from the built in PC.

Built in Instruments and Oscilloscope functions.
The enclosed software will make it possible to configure the internal connections and operating principles through the build in computer. On the screen it is possible to monitor 3 analogue instruments and scroll a number of signals /parameters in parallel, which can be saved and printed. The number of parameters/tags possible to study exceeds 200.

Standard Settings and Advanced Settings.
Most parameters are set by default but settings can also be done manually from the front controls. Typically: Speed, Max Seed, Acc ramp, Flux Ret ramp, Lim, etc.

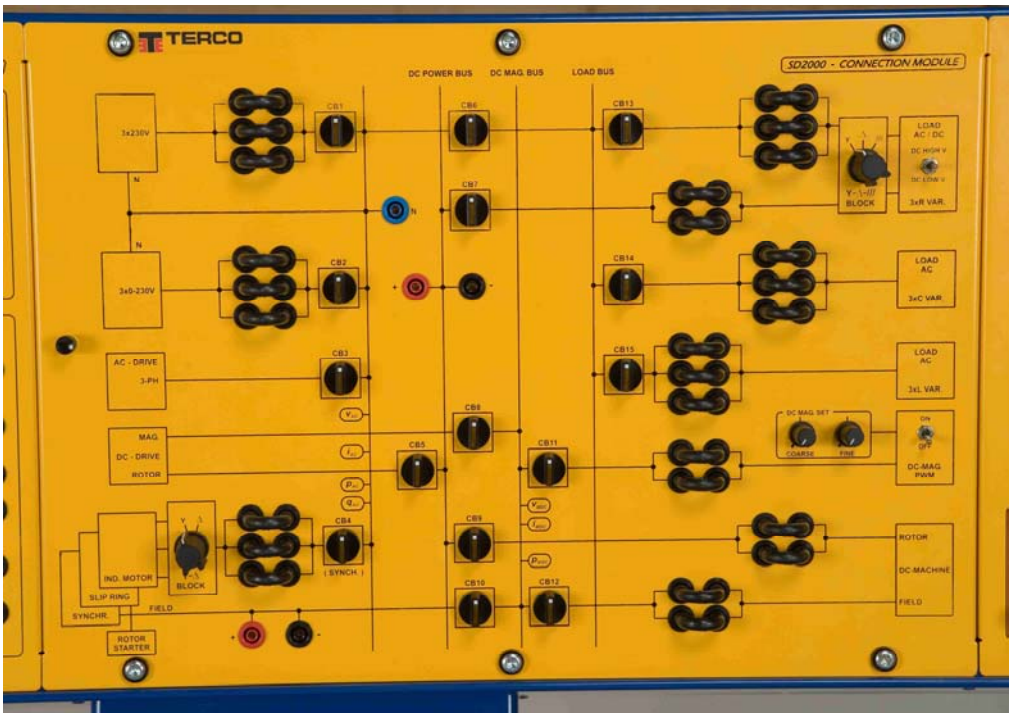
4-Q DC motor Drive Module



This Rectifier covers the latest development in DC motor operation with analogue control.
The equipment is designed to work according to different industrial environments.
The drive has signal in-and outputs for connections to slave and/or master drives.
The design will enhance the possibilities of learning the theory and practice of understanding the operation of 4Q-drives for both single drives and the basic understanding of three bridges and their commutation.
The 4Q-DC Drive can be used in the conception of speed/torque control versus electro machine theory.
When braking the energy is transferred directly to the supplying network by operating in all four quadrants.

Standard Settings
12 Parameters are set manually.
Typically: Speed, Max Speed, Acc ramp, Flux, Ret ramp, Lim, Current/Speed proportional, Current demand in/out, etc.
Floating switches and potentiometers are used to study step response and stability.
The results of the dynamic response regarding voltage, current and immediate power can be studied fully isolated on a standard oscilloscope via the built in isolation amplifier and multiplexer.

Connection Module

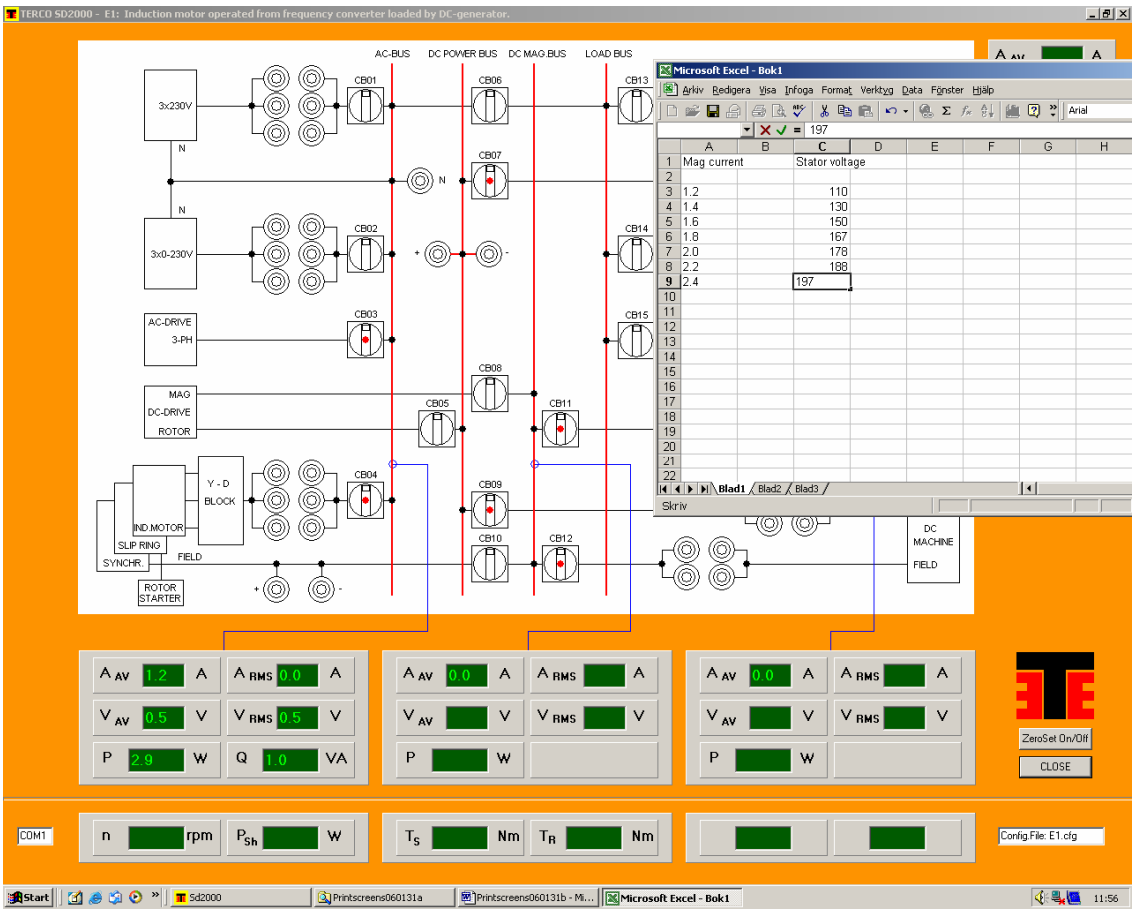


Scan Drive connection board includes preset exercises on screen and automatic blocking system.

- The unique connection board of the control unit will make it possible to connect most experiment configurations in less than a minute.
- The connection board switches are controlled by a microprocessor controlled blocking unit, to prevent faulty connections between power supplies and drives.
- The connection board is monitored on one of the fixed PC screens and indicating which switches are to be operated. The current path is indicated in red.
- After finishing an experiment the connection board is reset by a push button. At resetting all used switches will lit up indicting how to restart.
- The main 3-phase variac will automatically (by servo) reset to 0-voltage after finishing an experiment.
- Automatic blocking of DC-circuits when operating AC-and DC-drives or PWM-field circuits, to avoid over voltage and destroying of equipment

Measuring system

The SCAN DRIVE measuring system is developed to cover all needs for measurement and studies of electrical machine drives, electric power and power electronics. It is designed with education in mind.



The measuring system can show 26 different values simultaneously

The picture also shows the connection board and current paths.
It also shows how to integrate excel sheet for easy calculations.

Power Module

Power module including starting resistors for DC and Slip ring machines. Synchronizing unit, 1-2-3-6 pulse bridge diode block,' 1-phase transformer and 3-phase power supply
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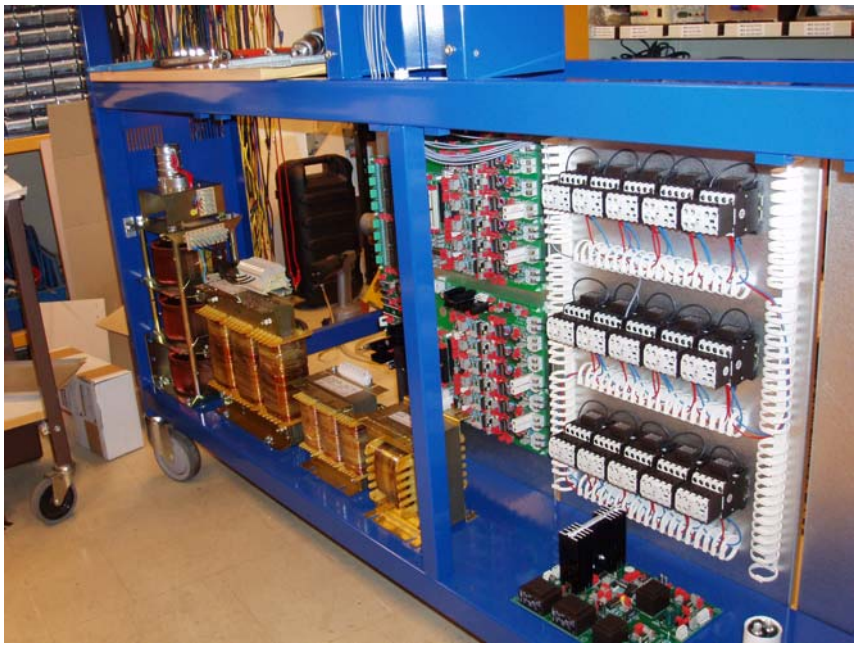
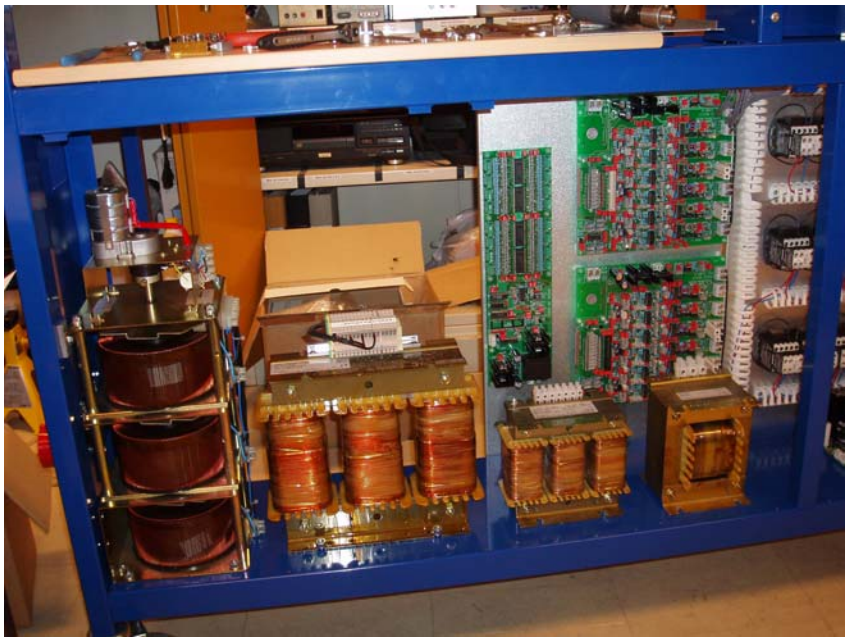
Load module

Load module including:
3-phase DC resistive Load 0-1.5 kW in 13 steps
3-phase Capacitive Load 0-1.5 KVAr ind in 13 steps
3-phase Inductive Load 0-1.5 kVAr cap in 13 steps.
Also including torque meter set and 2 - outgoing signals for oscilloscope.

The pictures below shows the inside of SD 2000, which is stacked with a lot of electronics and electrical components to provide for electrical and electronic signals required, as well as for maximum safety and control. The total weight of SD 2000 is more than 300 kgs.





Scan Drive Machine Set with Torque and Power Meter.

Machine Set with especially made test machines allowing overload of 20 % during min. 10 minutes without damaging the machines.

One DC-Machine:
Generator : 1.2 kW 1400 rpm
Shunt motor : 1.0 kW 1400 rpm
Series motor : 1.0 kW 1150 rpm
Rotor : 220 V 5.5 A
Excitation : 220 V 0.55 A
Shaft height : 162 mm
Weight : 45 kgs
Open shunt and series winding for connections of separate-, shunt-, series and compound excitation.

The series winding has an extra terminal at 2/3 of the winding. The DC-machine is equipped with commutating poles.

One 4-pole Synchronous Machine with DC magnetized cylindrical rotor, including a damping winding that will counteract and also facilitate return to synchronism if the rotor falls out of phase.

Synch. Gen. : 1.2 kVA x 0.8
Synch. Motor : 1.0 kW
Star conn. : 220 - 240 V, 3.5 A
Delta conn. : 127 - 140 V, 6.1 A
Weight : 39 kg

One 1.1 kW Squirrel Cage Induction Motor
4-pole machine : 1.1 kW 1400 rpm
Start (Y) : 380 - 415, 3.0 A
Delta (D) : 220 - 240 V, 5.2 A
Weight : 19 kg

One 1.1 kW Slip Ring Induction Motor
4-pole : 1:1 kW 1400 rpm
Star conn. : 380 -415 V, 3.2 A
Delta conn. : 220 - 240 V, 5.5 A
Weight : 42 kg

One Digital Torque and Power Meter is fixed on the bed enabling torque measurements down to 120 rpm and speed measurement between 120 rpm and 4000 rpm.

Nominal torque 0-12 Nm
Max. calibrated reading torque 15.0 Nm
Max. mechanical load torque 25 Nm

One separate torque meter for measuring of start torque.

EXAMPLES OF EXPERIMENT

1. To determine torque, speed and efficiency-curves for a separately excited DC-motor at rotor voltage control and also at field voltage control.

2. To determine characteristic curves for a separately excited DC-Generator.

3. To carry out basic standard measurements on the synchronous machine for the purpose of gaining insight into the construction, function and operation features of the machine.

4. To investigate the operational features of the synchronous generator by performing a load test.

5. To determine some of the characteristic graphs for a free running synchronous generator and determine the synchronous reactance of the machine.

6. To verify the theoretical relationships for the various connections between diode configurations and rectifiers.

7. Structure of a static converter for regulating rotation speed.

8. Function controls of a frequency converter.

9. Introduction of the UIP unit.

10. Measurements with the UIP unit on the bus system with a sine-shape voltage with static loads

11. Measurements with the UIP unit on a three-phase network with a none-sine-shape voltage.

12. Measurements with the UIP unit on the network from the frequency converter.

13. To study the function of a static frequency converter during induction motor operation.

14. To study the frequency converter controlled manually during induction motor operation.

15. To study the frequency converter controlled from Operator Station during induction motor operation.

16. To study the frequency converter controlled from the built-in PC during induction motor operation.

17. To study the function of the system during motor- and generator operation and at the same time determine operational / technical relations that are important for drive systems.

18. To demonstrate the four quadrant operation of different electric machines.

19. To investigate the operational features of the synchronous machine after synchronizing, both as a generator and as a motor during operation against a strong bus system.

20. To investigate the operational features of a synchronous motor fed from a static frequency converter.

21. To investigate the operational features in a synchronous machine network connected to a frequency converter, and to understand which control requirements the converter should fulfill during practical application.