Quin Systems Limited
ABB ACS800/Quin SRV300
Standalone/SERVOnet Drive
Installation Manual

Issue 3.0

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(MAN436)

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Relevant Directives

The product is designed to be incorporated into a system for the control of machinery and needs external equipment to enable it to fulfil this function. It must not be relied upon to provide safety-critical features such as guarding or emergency stop functions.

It must not be put into service until the machinery, into which it has been incorporated, has been declared in conformity with the Machinery Directive 89/392/EEC and/or its relevant amendments.

The installation instructions in this manual should be followed in constructing a system which meets these requirements.

The product has been tested in typical configurations and meets the EMC Directive 89/336/EEC and the Low Voltage Directive 73/23/EEC as amended by 93/68/EEC.

The product, as normally supplied, has low voltages accessible to touch and must be mounted within a suitable cabinet to meet any required IP rating to BS EN 60529.

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Unpacking and Inspection

Inspect the packaging for external signs of damage, if possible before signing the delivery receipt. This may indicate that it has been mishandled in transit. When unpacking the system, keep all the packaging materials if possible. If it is necessary to ship the system to another site, or to return it for service, the original packing can be re-used.

Inspect the system carefully when it is unpacked. Check for any loose parts, any circuit boards loose in their card guides, cables not connected, or any bending of the case or chassis.

If any defect or damage is suspected, do not connect power to the system. Notify the carrier immediately and contact your sales office or the Quin Systems Service Department:

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1. Introduction

1.1 Manual Overview

This manual is presented in five sections.

Section 1 describes the use of this manual.

Section 2 provides background information which details the specification of the equipment and its use. Anyone new to this equipment should read this section before proceeding to section 3.

Section 3 provides a step-by-step installation procedure for the equipment. Installation should only be undertaken by a competent electrical engineer.

Section 4 provides troubleshooting information to solve installation problems and any potential failures which might occur in use.

Section 5 provides a number of equipment interconnection diagrams. These identify the cables, adaptors and ports which are required when building up a system.

1.2 Related Publications

The user should read or refer to the following ABB manuals before attempting to install the equipment.

- The Hardware Manual for the ACS 800 Drive used.
- The Firmware Manual which is compatible with ACS 800 Standard Application Program 7.x.
- Installation and Start-up Guides for the optional devices for the ACS 800.

2. Background Information

2.1 Overview

This section presents background information which must be read or understood in order to ensure a successful installation.

2.2 Equipment Identification

A Quin/ABB ACS800 drive system comprises a number of elementary components. These are identified by the following part numbers.

- SRV300 — Quin Controller board which incorporates the PTS firmware.
- RMIO — ABB motor control and I/O board.
- RDCO-03 Rev B — ABB DDCS link board for fibre optic communications.

A drive system may be supplied complete, with the SRV300 board assembled and pre-configured. Alternatively, the Quin SRV300 board may be supplied separately and will need installing and integrating with the ABB products by the end user. This manual describes the installation procedure.

The interconnection of the above equipment, when installed, is shown in the sketch on the following page for a single, standalone drive.

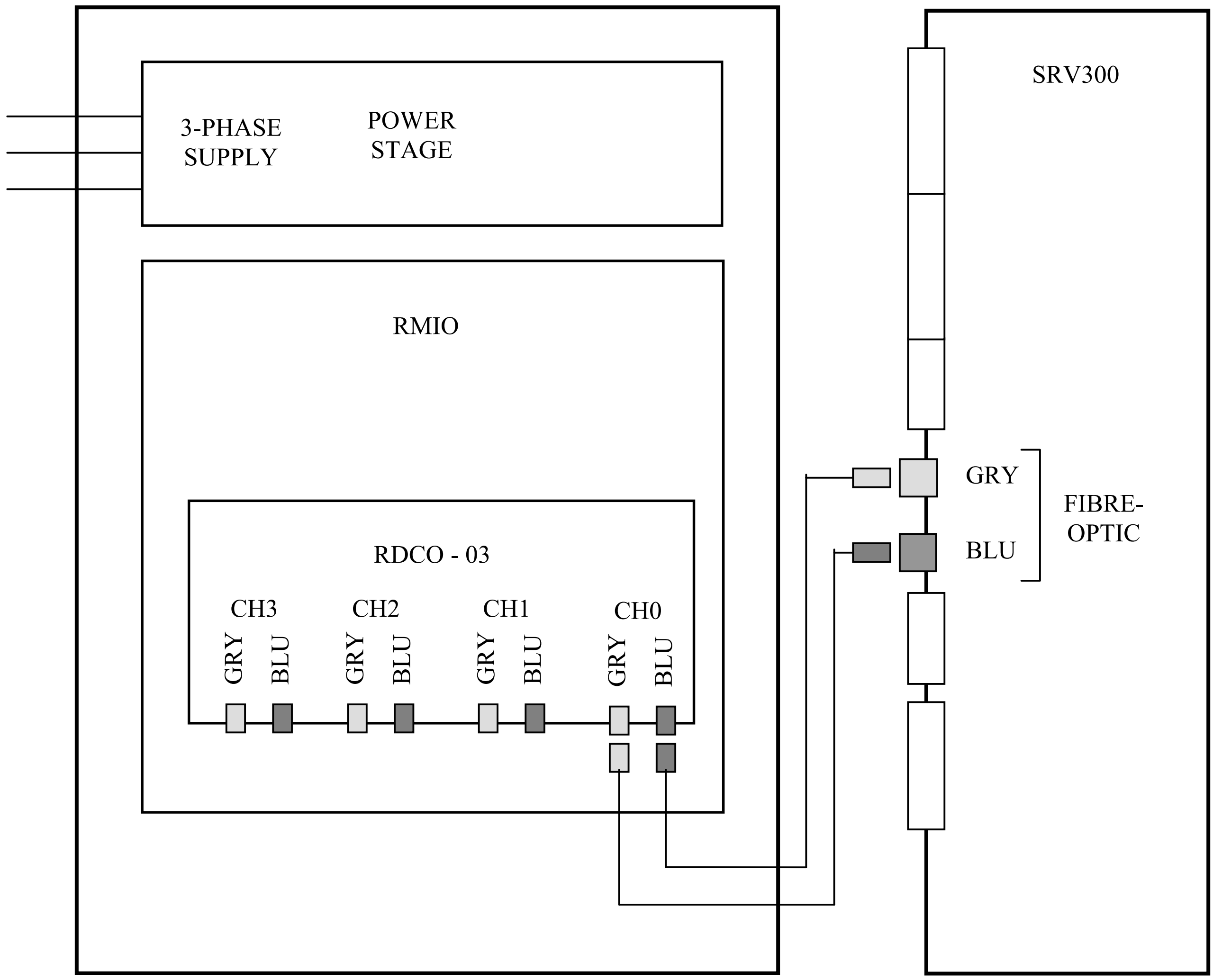
Note: Contactors, fuses and auxiliary power supplies have been omitted at this stage for simplification. The equipment is not drawn to scale. Cable entry positions are pictorial for clarification.

2.2.1 SRV300 Issue Identification

The SRV300 Issue B board is identified as an ACS600 and is silk-screen printed with the code PD0073.

The SRV300 Issue C board is identified as an SRV300 and is silk-screen printed with the code PD0078.

Figure 1. Interconnection of Standalone Drive Elementary Components



The RDCO board detailed above is plugged on top of the RMIO board as shown in the sketch below. The PTS SRV300 controller card is housed within a sheet metal enclosure, which is fixed OUTSIDE the ABB drive. This sketch is drawn face-on to the drive, but with the SRV300 card swivelled 90° to show the fibre optic connectors and cables between it and the drive.

Note that each fibre optic cable will have a "blue" connector at one end, and a "grey" connector on the other, such that a correct connection will be achieved when the coloured ends of the cables are connected to the same colour connectors on the cards, as shown in Figure 1 above.

2.3 System Specification

This section gives the overall specifications of the system, including mechanical details and environmental requirements.

2.3.1 Overview

The SRV300 Servo Controller is a microprocessor-based motion control board. It allows an ABB motor/drive system to be operated in closed-loop position control and gives the end-user access to a range of motion control commands to allow the system to be easily configured to suit an application.

The SRV300 can be used in one of three ways:

- as part of a MultiDrive Installation
- with an ACS800 configured as a Standalone Drive
- with an ACS800 configured as a SERVOnet node

(A separate manual covers MultiDrive Installations).

This manual describes the Installation of an SRV300 when used either as a Standalone Drive or when configured as a SERVOnet node. In both cases, the SRV300 board is installed inside the drive chassis. When used in standalone mode, no other control equipment is required, although an HMI can be connected directly to the SRV300. When used as a SERVOnet node, additional SERVOnet nodes will exist, together with a Quin Machine Manager to control the network. These additional SERVOnet nodes may be further SRV300s or other Quin control products which can be configured as SERVOnet nodes. The two schematics below should clarify these two types of installation.

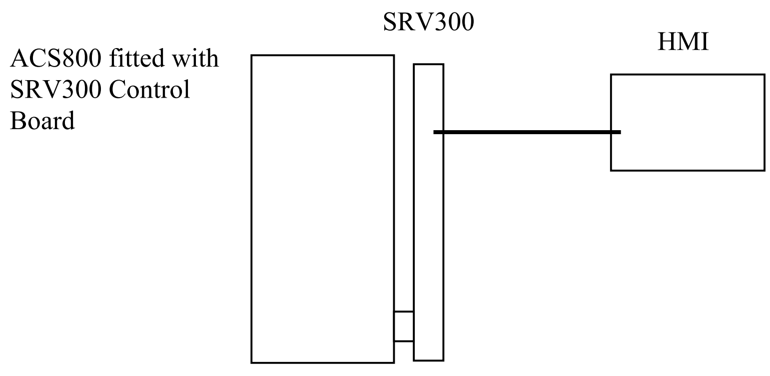


Figure 2. Standalone Installation

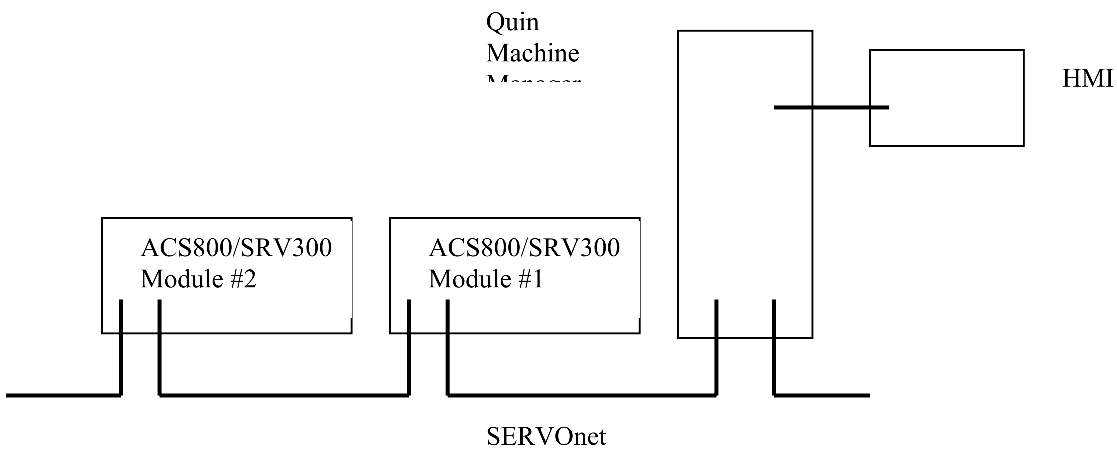


Figure 3. SERVOnet Installation

2.3.2 Mechanical Installation

The dimensions of the SRV300 Servo Controller are as follows:

Height 244 mm

Width 76 mm (97 mm including connectors)

Depth 20 mm

Weight 0.2 kg

The SRV300 board is fitted inside a metal enclosure adjacent to the ACS800 chassis for which an installation kit is available.

Fibre-optic cables are provided for inter-connecting the SRV300 board and the RDCO interface as shown in figure 1 above. These cables have specific lengths and should be installed such that they are allowed to take up their own path.

Refer to section 3 for a detailed description of how to assemble the metal enclosure to the drive chassis.

2.3.3 Environmental Specification

The following operating conditions apply to the Quin SRV300 board when installed vertically for normal convection cooling. Operating conditions for the ABB equipment are detailed in the appropriate ABB manual.

Temperature (storage)	0 to 70°C
Temperature (operating)	0 to 45°C
Relative humidity	20 to 80% non-condensing

Forced air ventilation will be required to operate the board at higher ambient temperatures.

2.3.4 System Hardware Features

The SRV300 provides the following hardware features:

- 2 serial ports (configurable to RS232 or RS485)

- 2 CANbus connectors
- 8 digital inputs
- 8 digital outputs
- 1 analogue input
- 1 auxiliary analogue output
- 1 closed loop motor control channel (using fibre-optic demand signals and encoder feedback)
- 1 master encoder (or virtual) channel

2.4 Connector Pin-outs

Each connector pin-out is tabulated adjacent to a sketch of the SRV300 board. This cross reference clearly identifies the location of each connector and the order of the terminals.

2.4.1 SRV300 Logic Power

The SRV300 requires a 24V d.c. logic supply. (Supply current = 150mA). It is also suggested that RMIO card in the ABB drive is powered from an external 24V supply. Such a modification is documented in the ABB hardware manual. The factory setting is to have the RMIO card powered from the drive's internal supply. However, this approach has a serious limitation: when the power to the drive is lost (as occurs during an E-stop) then the 24V supply is also lost and the drive logic power is lost.

The power connector for the SRV300 should be supplied with the equipment together with a number of crimp pins. (For reference, the connector housing is available from Farnell, order code 630-494. Manufactured by JST, part number VHR-4N. Pins are available from Farnell, order code 630-500. Manufactured by JST, part number BVH-21T-P1.1.) A suitable crimp tool is also available from Farnell, order code 630-512.

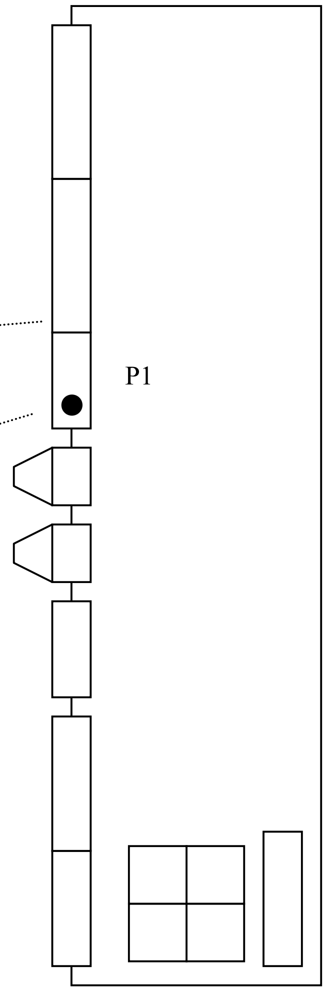
Note: there is no visual indication that an SRV300 board is powered up. The logic power connections are shown below for the power connector P1 on the SRV300. Two pins are provided for the supply rail. These pins are internally linked on the SRV300 board as detailed below:

P1.1 is linked to P1.3 (0V Supply)
P1.2 is linked to P1.4 (+24V d.c. Supply)

It is only necessary, therefore, to connect to one pair of pins (e.g. P1.1 and P1.2).

The following figure shows the location and pinout of the P1 power connector. Subsequent figures show the various wiring options described above.

Pin Number	Signal
P1.4	+24V Supply
P1.3	0V Supply
P1.2	+24V Supply
P1.1	0V Supply



Note: Pin 1 identified as ●
(Pin 1 is at the opposite side of P1 to all the other connectors on the SRV300).

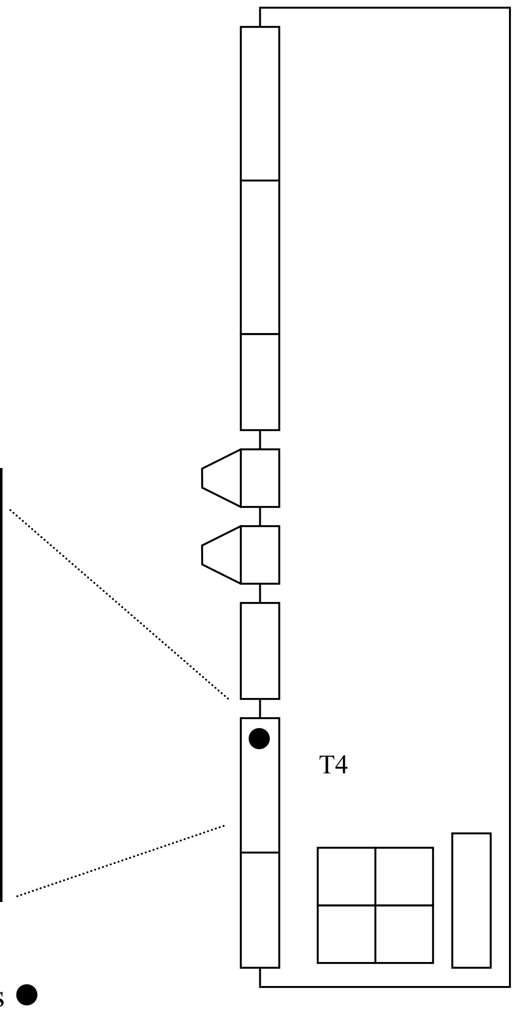
Figure 4. SRV300 Logic Power Connector Pin-out

2.4.2 SRV300 Digital I/O Power and Digital Inputs

The SRV300 provides opto-isolated digital I/O for which it requires an external 24V d.c. supply connected to terminals T4.9 and T4.10 on the 10-way connector T4. The rating of this I/O supply is application-specific since it only needs to provide sufficient current to meet the specific requirements of the digital *outputs*. As an upper limit, each of the eight digital outputs can switch no more than 100mA. There are no LEDs to show the state of the digital I/O.

The I/O supply is reverse voltage protected (to –24V d.c.) using an internal series diode. Clamp diodes are also fitted to both the input and output circuits in order to provide a measure of protection for the opto-isolators themselves. However, if an input needs to monitor the state of a coil directly, then an external series diode should be fitted to protect the input. This will prevent negative voltage spikes from inducing high reverse currents on the input when the coil is switched off.

Pin Number	Signal
T4.1	Digital Input 1
T4.2	Digital Input 2
T4.3	Digital Input 3
T4.4	Digital Input 4
T4.5	Digital Input 5
T4.6	Digital Input 6
T4.7	Digital Input 7
T4.8	Digital Input 8
T4.9	0V I/O Supply
T4.10	+24V I/O Supply



Note: Pin 1 identified as ●

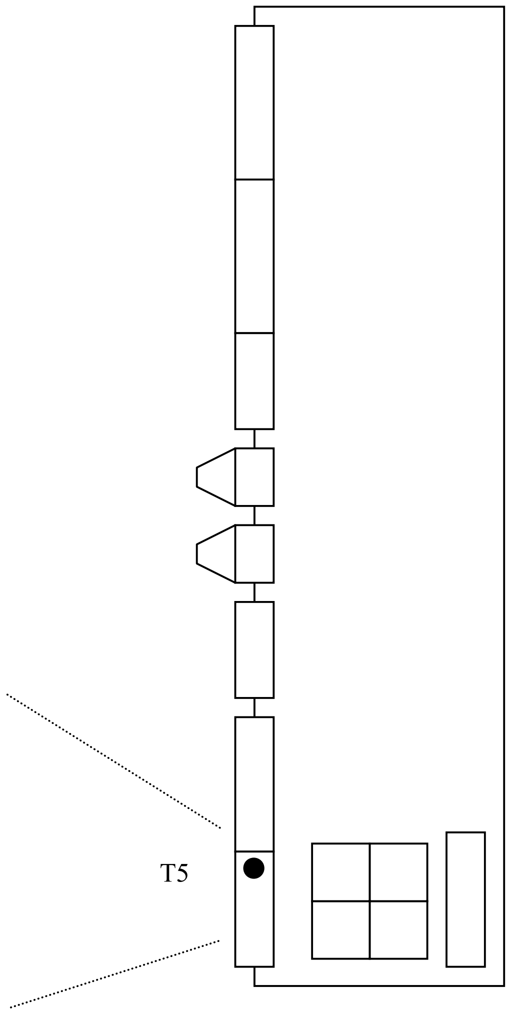
Figure 5. SRV300 Digital I/O Power (to SRV300) and Input Connector Pin-out

2.4.3 SRV300 Digital Outputs

The eight digital outputs from the SRV300 are provided on the 8-way connector T5 as detailed below. Each output can source up to 100mA.

Warning: these outputs are not current-limited or short-circuit protected. If switching a relay, always make sure that a flywheel diode is fitted across the coil to prevent the back EMF from damaging the SRV300.

Pin Number	Signal
T5.1	Digital Output 1
T5.2	Digital Output 2
T5.3	Digital Output 3
T5.4	Digital Output 4
T5.5	Digital Output 5
T5.6	Digital Output 6
T5.7	Digital Output 7
T5.8	Digital Output 8



Note: Pin 1 identified as ●

Figure 6. SRV300 Digital Output Connector Pin-out

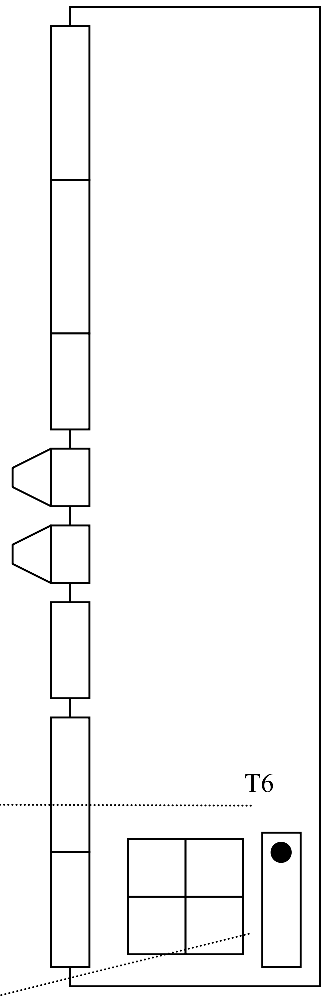
2.4.4 Analogue I/O

Analogue I/O is provided on the 6-way connector T6 as shown below. Terminals T6.1, T6.4 and T6.6 are internally linked together and to the SRV300's 0V supply rail on P1.1 and P1.3. It may be necessary to earth this common 0V rail to ensure a clean signal on the analogue input.

The analogue input voltage is measured across terminals T6.3 to T6.2.

Note: the voltage applied to T6.2 must be within –5V to +10V (relative to T6.1). The voltage applied to T6.3 must be within –15V to +20V (relative to T6.1).

Pin Number	Signal
T6.1	0 Volts
T6.2	Analogue input +
T6.3	Analogue input -
T6.4	0 Volts
T6.5	Analogue output
T6.6	0 Volts



Note: Pin 1 identified as ●

Figure 7. Analogue I/O Connector Pin-out

2.4.5 Encoder Supply

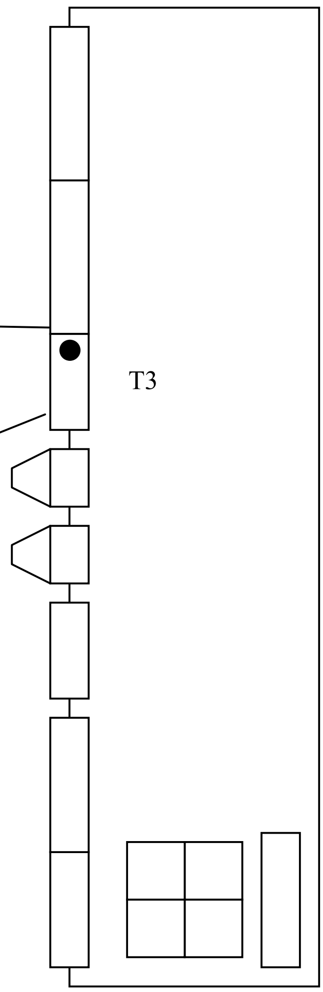
Two encoders can be connected to the SRV300. Each encoder requires an external power supply which must be wired into connector T3 on the SRV300 as detailed below.

Terminals T3.1 and T3.2 accept the supply voltage for the encoder on channel 1 (CH1). These are internally linked to terminals T1.7 and T1.8 respectively. The voltage level must suit the type of encoder used on channel 1. Refer to the Electrical Specification for more details.

Terminals T3.3 and T3.4 accept the supply voltage for the encoder on channel 2 (CH2). These are internally linked to terminals T2.7 and T2.8 respectively. The voltage level must suit the type of encoder used on channel 1. Refer to the Electrical Specification for more details.

Note: Terminals T3.2 and T3.4 are internally linked together and also to the SRV300 logic supply 0V rails on pins P1.1 and P1.3 detailed above.

Pin Number	Signal
T3.1	CH1 Encoder Supply (+)
T3.2	0V Supply
T3.3	CH2 Encoder Supply (+)
T3.4	0V Supply



Note: Pin 1 identified as ●

Figure 8. Encoder Supply (to SRV300) Connector Pin-out

2.4.6 Channel 1 Encoder (CH1)

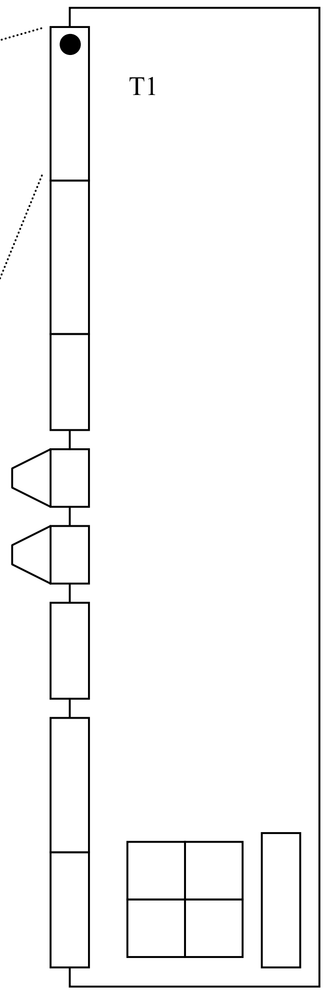
The signal and power terminals for the channel 1 encoder are provided on connector T1. Pin-out details are given below.

The SRV300 allows a range of different encoder types to be connected. For this reason, not all terminals will be required for a given installation.

Terminals T1.7 and T1.8 provide the supply voltage to the encoder. These are internally linked to terminals on connector T3, as described above, which receive the incoming power.

Note: the encoder signals are not opto-isolated. Care must be taken to ensure that screened cable is used from T1 to the encoder and that the screen is cleanly earthed in the electrical cabinet.

Pin Number	Signal
T1.1	A
T1.2	/A
T1.3	B
T1.4	/B
T1.5	Z
T1.6	/Z
T1.7	CH1 Encoder Supply (+)
T1.8	0V Supply
T1.9	ECLK
T1.10	/ECLK
T1.11	EDATA
T1.12	/EDATA



Note: Pin 1 identified as ●

Figure 9. Encoder Channel 1 Connector Pin-out

2.4.7 Channel 2 Encoder (CH2)

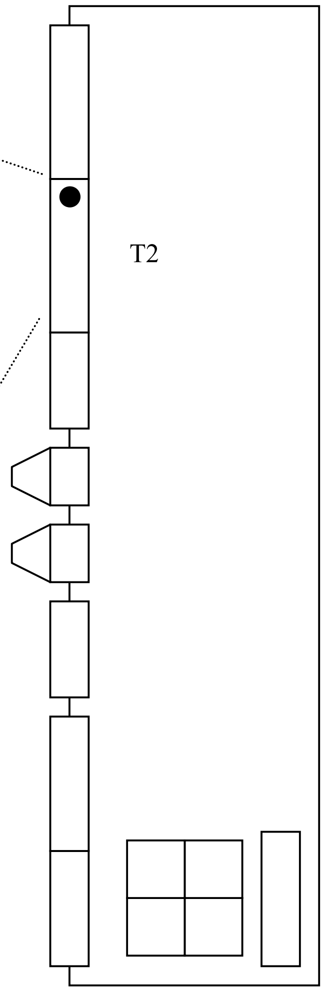
The signal and power terminals for the channel 2 encoder are provided on connector T2. Pin-out details are given below.

The SRV300 allows a range of different encoder types to be connected. For this reason, not all terminals will be required for a given installation.

Terminals T2.7 and T2.8 provide the supply voltage to the encoder. These are internally linked to terminals on connector T3, as described above, which receive the incoming power.

Note: the encoder signals are not opto-isolated. Care must be taken to ensure that screened cable is used from T1 to the encoder and that the screen is cleanly earthed in the electrical cabinet.

Pin Number	Signal
T2.1	A
T2.2	/A
T2.3	B
T2.4	/B
T2.5	Z
T2.6	/Z
T2.7	CH1 Encoder Supply (+)
T2.8	0V Supply
T2.9	ECLK
T2.10	/ECLK
T2.11	EDATA
T2.12	/EDATA



Note: Pin 1 identified as ●

Figure 10. Encoder Channel 2 Connector Pin-out

2.5 Electrical Specification

The electrical characteristics of the SRV300 Servo Controller module are listed below.

External power supplies :

Encoder supply:

+5V for incremental and EnDat
+9V for SinCos and SinCoder
+12V for CANopen
+24V for SSI and EnDat

Digital I/O supply:

+24V d.c. This input, on terminals T4.9 and T4.10, is reverse voltage protected.

Logic supply:

+24V (19 to 36V, 115mA +/- 30mA)

Encoder input :

Incremental:

Maximum input pulse frequency 1 MHz maximum (4 x10^{6} counts per second)
Interface voltage 5V peak to peak max
Track A input leads track B input for positive direction

Analogue:

Level 1V peak to peak nominal
Cycle rate 10^{5} sin/cos cycles per second

SinCos:

Maximum speed 6000 R.P.M.
Interface Hiperface (9600 baud data channel)
Maximum cable length 100m

SSI:

Clock rate 300 kHz (max cable length 70m)
Bits 12 to 24

EnDat:

Clock rate 300kHz (max cable length 70m)

Analogue input :

Input range ±10V (differential)
Input voltage on A+ (relative to system ground) +10V maximum, -5 V minimum
Input voltage on A- (relative to system ground) +20V maximum, -15 V minimum
A to D resolution 10 bits
Input impedance 30kΩ

Analogue output :

Output range 0 to 5V

D to A resolution 12 bits (smoothed PWM)
Output impedance <100Ω

Digital inputs :
Voltage rating +24V nominal
Input current 10–20 mA (typical), 50 mA (maximum)
Threshold voltage 10–16V
Reverse voltage 5V (maximum)
Isolation voltage 250V a.c. peak or d.c.

Digital outputs :
Saturation voltage (output on) 1.9V maximum (at full load current)
Load current 100 mA (maximum)
Isolation voltage 250V a.c. peak or d.c.

2.6 Position Feedback Devices

A position feedback device is used to pass position information back to a control system. This information may be used to close the position loop on a motor or it may inform the control system of the position of some other part of a machine which is not driven by the control system.

Feedback devices are either relative or absolute. A relative device is limited to specifying distance travelled and direction of movement. Using this information, a control system is able to determine the position of a device relative to its position at power-up or to some other user-defined datum. An absolute position feedback device, on the other hand, is able to specify its actual position at any time. The datum for this absolute position data is the encoder’s zero position or a previously-defined position on the machine. At power-up, an absolute device can report its actual position. A system which uses relative feedback, however, will need to be driven to a known position in order to define its datum. This is normally achieved by using an additional reference sensor.

The encoder type is defined using the FS command in the PTS language. Refer to the PTS Reference manual for more details.

SSI and CANopen encoders always report absolute position values. However, it is possible to treat them as relative devices by using the appropriate FS command. When selected as a relative device, an SSI or CANopen encoder will behave like an incremental encoder to the user. As such, the encoder position value will be relative to the encoder’s position at power-up or relative to a zeroed position as defined by the user. Single-turn and multi-turn encoders (both SSI and CANopen) can be defined as relative or absolute devices. The main advantage of a relative SSI or CANopen encoder is that it is not possible for the position to drift, as could an incremental where lost pulses or noise could affect the position counter.

A SinCos is an absolute feedback device in that its actual position can be determined at power-up using its parameter channel. This is done automatically by the PTS firmware. Thereafter, however, the system behaves as a relative device with a user-definable resolution determined by the value of NB. To force a read of the absolute data at any time after power-up, it is necessary to change the FS to 0 and then back to 12 while the encoder is stationary. Alternatively, the IN command can be issued. A SinCos may be a single or a multi-turn device. The maximum cable length for a SinCos device is 100m.

A Sincoder is equivalent to a SinCos except that it is not possible to read its actual position at power-up. No “reference pulse” is provided by a Sincoder, as is available with an incremental encoder. An external reference sensor is therefore required as a check on the position counter in order to prevent possible drifting.

Incremental encoders can provide square wave or sinusoidal output signals. The resolution of an encoder which produces square wave pulses is fixed by the model of the encoder. This resolution is expressed in pulses per revolution (ppr) but the SRV300 is able to count the pulse edges on the two channels in order to increase this by a factor of 4. (A 2500ppr encoder therefore produces 10000 counts per revolution). The maximum output frequency of a given encoder together with its resolution will determine the encoder’s maximum speed. Sinusoidal versions are available with varying resolutions. These resolutions define the number of sinusoidal oscillations per encoder revolution. By increasing the value of the NB command, the SRV300 is able to provide interpolation on these signals and can hence increase this resolution in powers of 2. Again, the output frequency and resolution limit the maximum encoder speed.

An EnDat encoder is similar in specification to a SinCos and may also be used in relative mode thereby making it equivalent to a Sincoder. The maximum cable length for an EnDat encoder is 100m. Unlike a SinCos, an EnDat encoder requires additional clock pulses. This in turn requires an extra screened twisted pair of cores in the cable to it.

2.7 Feedback Options

The SRV300 is designed to accept position feedback signals from a range of devices, both relative and absolute. These are described below. Note, however, that issue B boards are limited to accepting squarewave signals from incremental encoders only. Refer to section 2.2.1 for information of issue identification.

An example connection table is presented for each encoder option. This table provides information for a specific encoder together with the signal descriptions used by the encoder manufacturer. PTS language parameters and configuration settings are also listed. Full details on the PTS language are given in the PTS Reference Manual.

2.7.1 Relative Feedback Devices

2.7.1.1 Incremental Encoders with Squarewave Outputs (Relative)

The following table provides the connection information for a Stegmann DG60L when wired to channel 2's encoder connector T2.

Pin Number	SRV300 Signal	Encoder Signal
T2.1	A	K1
T2.2	/A	/K1
T2.3	B	K2
T2.4	/B	/K2
T2.5	Z	K0
T2.6	/Z	/K0
T2.7	CH2 Encoder Supply (+)	+5V
T2.8	0V Supply	GND
T2.9	ECLK	
T2.10	/ECLK	
T2.11	EDATA	
T2.12	/EDATA	

Table 1. Incremental Encoder Connections (Squarewave)

Screen connections:

The encoder cable should be overall-screened with individually-screened twisted pairs for the signal lines. The outer screen should be tied to the earth star point in the drive and to the screen pin of the encoder. The inner screens should also be tied to the earth star point in the drive but should be left disconnected at the encoder end.

2.7.1.1.1 PTS Language Parameters and Configuration Settings for Squarewave Incremental Encoders

Set FS0 for 4x edge-counting. (This is the default value after an RS parameter reset).

Set FS1 for 2x edge-counting.

Set FS0 for 1x edge-counting.

CW bit 5 specifies the count direction.

(Refer to the encoder cable assembly drawing DRG12 at the end of this manual).

2.7.1.2 Incremental Encoders with Sinusoidal Outputs (Relative)

The following table provides the connection information for a Heidenhain ROD486 when wired to channel 2's encoder connector T2.

Pin Number	SRV300 Signal	Encoder Signal
T2.1	A	A+
T2.2	/A	A-
T2.3	B	B+
T2.4	/B	B-
T2.5	Z	R+
T2.6	/Z	R-
T2.7	CH2 Encoder Supply (+)	+5V
T2.8	0V Supply	0V
T2.9	ECLK	
T2.10	/ECLK	
T2.11	EDATA	
T2.12	/EDATA	

Table 2. Incremental Encoder Connections (Sinusoidal)

Screen connections:

The encoder cable should be overall-screened with individually-screened twisted pairs for the signal lines. The outer screen should be tied to the earth star point in the drive and to the screen pin of the encoder (or its connector depending on the encoder manufacturer). The inner screens should also be tied to the earth star point in the drive but should be left disconnected at the encoder end.

2.7.1.2.1 PTS Language Parameters and Configuration Settings for Sinusoidal Incremental Encoders

Set FS11 to enable sinusoidal incremental encoder feedback.

Use the NB parameter to specify the encoder resolution (in bits).

CW bit 5 specifies the count direction.

(Refer to the encoder cable assembly drawing DRG13 at the end of this manual).

2.7.1.3 SSI (Relative)

The following table provides the connection information for a Stegmann AG612 (single-turn) SSI encoder when wired to channel 2's encoder connector T2.

The NB parameter must be set to a value which matches the number of data bits returned by the encoder. The NZ parameter must be set to a value which specifies the number of leading zeros. Refer to the PTS Reference Manual for more details. Note: the maximum encoder speed is determined by the value of NB. Refer to the *Encoder Speed Limitations* table at the end of this section for full details.

Pin Number	SRV300 Signal	Encoder Signal
T2.1	A	
T2.2	/A	
T2.3	B	
T2.4	/B	
T2.5	Z	
T2.6	/Z	
T2.7	CH2 Encoder Supply (+)	US
T2.8	0V Supply	GND
T2.9	ECLK	CLOCK+
T2.10	/ECLK	CLOCK-
T2.11	EDATA	DATA+
T2.12	/EDATA	DATA-

Table 3. SSI Encoder Connections

Screen connections:

The encoder cable should be overall-screened with individually-screened twisted pairs for the signal lines. The outer screen should be tied to the earth star point in the drive and to the screen pin of the encoder (or its connector depending on the encoder manufacturer). The inner screens should also be tied to the earth star point in the drive but should be left disconnected at the encoder end.

2.7.1.3.1 PTS Language Parameters and Configuration Settings for SSI Encoders

Set FS5 to enable SSI binary encoder feedback.

Set FS6 to enable SSI gray code encoder feedback.

Use the NB parameter to specify the number of data bits.

Use the NZ parameter to specify the number of leading zeros.

(Refer to the encoder cable assembly drawing DRG14 at the end of this manual).

2.7.1.4 CANopen (Relative)

CANopen encoders should be wired onto the SERVOnet network. This network connects into sockets S1 and S4 on the SRV300. An adaptor is available to convert from the 8-way RJ45 sockets (S1 or S4) to a 9-pin D male. Only three connections are required to the encoder, as shown in the following table.

Note: if the CANopen encoder is at the end of the SERVOnet network, then a 120 Ohm terminating resistor and a link must be fitted at the encoder. The terminating resistor should be connected across the CAN_L and CAN_H lines. The link should tie the LINK line to ground. Refer to drawing DRG08 at the end of this manual.

The NB parameter must be set to a value which matches the number of data bits returned by the encoder. The NZ parameter must be set to a value which specifies the number of leading zeros. Note: the maximum encoder speed is determined by the value of NB. Refer to the *Encoder Speed Limitations* table at the end of this section for full details.

The following table provides the connection information for a CANopen encoder when wired onto SERVOnet.

Pin Number	S1,S4 Signal	9-pin D Adaptor	Encoder Signal
1	CAN_L	2	CAN_L
2	CAN_H	7	CAN_H
3	CAN_GND	3	CAN_GND
4	CAN_GND	6	
5	CAN_V+	9	
6	CAN_ERR	8	
7	LINK	4	(LINK TO CAN_GND)
8	CAN_SHLD	5	
	n/c	1	

Table 4. CANopen Encoder Connections

Screen connections:

The encoder cable should be overall-screened. It should be connected to pin 5 of the 9-pin adaptor or to pin 8 of the RJ45 socket if an adaptor is not used.

2.7.1.4.1 PTS Language Parameters and Configuration Settings for CANopen Encoders

Set FS9 to enable CANopen encoder relative feedback.

Use a 500k bits/s baud rate.

If using a CANopen encoder on a SERVOnet system, then set the encoder node number to equal that of the module number of the drive whose channel will be used to read the encoder data. (For example, if CH4 on module 2 is required to read the actual position of the CANopen encoder, then set FS9 on CH4 and set the CANopen node number to 2 using its address switches). It is possible to assign a separate CANopen encoder to each SERVOnet module in a system. It is not possible to assign more than one CANopen encoder to any one SERVOnet module. Example installations are shown as schematics 4 and 7 at the back of this manual.

If using a CANopen encoder on a standalone drive, then set the encoder node number to 1 (using its address switches) and define the drive as module 1 using the CN1 command. It is only possible to use a single CANopen encoder with a standalone drive. It is also necessary to define the drive as a clock master by setting CK1. The CANopen encoder can be read back on either CH1 or CH2 on the standalone drive. Set FS9 on whichever channel is required. An example installation is shown as schematic 9 at the back of this manual.

If using a CANopen encoder on a Synchrolink system, then the PTS configuration is similar to that for a SERVOnet system described above. Each drive needs to be assigned a unique module number but this time by using the CN command. It is also necessary to define one drive as the clock master using the CK command. For example, if two drives are synchrolinked together, then the first should be defined as module 1 using the CN1 command and the second as module 2 using the CN2 command. (It is necessary to connect to port A of each drive in turn). Module 1 can be defined as the clock master using the CK1 command. Channel 1 (CH1) and channel 2 (CH2) will exist on module 1. A different channel 1 (CH1) and channel 2 (CH2) will exist on module 2. Note: this is different to SERVOnet where there is a unique channel number for each PTS channel on the network. If, in the above example, the CANopen encoder is to be read by CH1 on drive module 2, then set the CANopen encoder address to 2 and set FS9 on CH1 of module 2. An example installation is shown as schematic 10 at the back of this manual.

Note: it is not possible to use a CANopen encoder and CANopen I/O at the same time with a standalone drive. If the use of CANopen I/O is enabled using the SK command, then this will automatically prevent the CANopen encoder from working. Hence, if after working through the above configuration procedure it is not possible read position information back from the CANopen encoder, check to see if the CANopen software feature has been enabled by typing SK. To disable the feature, enter CANopen against the prompt **New Feature** and then type <return> when prompted for the version number. It will then be necessary to reboot the drive.

If the CANopen encoder fails to transmit data then PTS error code 102 will be displayed on the programming PC. If this occurs, check the cabling to the encoder, its supply voltage, baud rate setting and address switch setting. The default baud rate is 500k bits/s.

(Refer to the encoder cable assembly drawing DRG08 at the end of this manual).

2.7.1.5 SinCoder (Relative)

A Sincoder is a Hiperface product supplied by Stegmann. It behaves as an incremental encoder but its resolution can be specified by using the NB command to provide interpolation on the analogue signals. For a conventional encoder which produces 1024 cycles per revolution on the SIN and COS signals, then an NB value of 12 will result in a resolution of 4096 counts per encoder revolution. The NB parameter is used to provide interpolation on the analogue signals. For a conventional encoder which produces 1024 cycles per revolution, an NB value of 12 would result in a resolution of 4096 counts per encoder revolution. NB can be increased to a maximum value of 24. This would theoretically produce a resolution of 16.8 million counts per revolution although noise would produce increasing amounts of jitter at higher values of NB. NZ is not required with a SinCos.

The following table provides the connection information for a SinCoder when wired to channel 2's encoder connector T2.

Pin Number	SRV300 Signal	Encoder Signal
T2.1	A	COS
T2.2	/A	REFCOS
T2.3	B	SIN
T2.4	/B	REFSIN
T2.5	Z	
T2.6	/Z	
T2.7	CH2 Encoder Supply (+)	US
T2.8	0V Supply	GND
T2.9	ECLK	
T2.10	/ECLK	
T2.11	EDATA	
T2.12	/EDATA	

Table 5. SinCoder Encoder Connections

Screen connections:

The encoder cable should be overall-screened with individually-screened twisted pairs for the signal lines. The outer screen should be tied to the earth star point in the drive and to the screen pin of the encoder (or its connector depending on the encoder manufacturer). The inner screens should also be tied to the earth star point in the drive but should be left disconnected at the encoder end.

2.7.1.5.1 PTS Language Parameters and Configuration Settings for Sincoders

Set FS11 to enable Sincoder feedback.

Use the NB parameter to specify the resolution.

(Refer to the encoder cable assembly drawing DRG15 at the end of this manual).

2.7.1.6 EnDat (Relative)

An EnDat encoder is a Heidenhain product similar in specification to a SinCos device. In relative mode it behaves, however, as a SinCoder.

A 300kHz clock rate is used. This limits the maximum encoder cable length to 70m.

Two options are available for the supply voltage: 5V d.c. +/- 5% or 10..30V d.c.

The following table provides the connection information for an EnDat encoder when wired to channel 2's encoder connector T2.

Pin Number	SRV300 Signal	Encoder Signal
T2.1	A	A+
T2.2	/A	A-
T2.3	B	B+
T2.4	/B	B-
T2.5	Z	
T2.6	/Z	
T2.7	CH2 Encoder Supply (+)	Up
T2.8	0V Supply	GND
T2.9	ECLK	CLOCK
T2.10	/ECLK	/CLOCK
T2.11	EDATA	DATA
T2.12	/EDATA	/DATA

Table 6. EnDat Encoder Connections

Screen connections:

The encoder cable should be overall-screened. This screen should be tied to the earth star point in the drive.

2.7.1.6.1 PTS Language Parameters and Configuration Settings for EnDat encoders

Set FS11 to enable EnDat encoder feedback.

Use the NB parameter to specify the resolution.

(Refer to the encoder cable assembly drawing DRG16 at the end of this manual).

2.7.2 Absolute Encoders

2.7.2.1 SSI (Absolute)

The following table provides the connection information for a Stegmann AG661 (multi-turn) when wired to channel 2's encoder connector T2.

Pin Number	SRV300 Signal	Encoder Signal
T2.1	A	
T2.2	/A	
T2.3	B	
T2.4	/B	
T2.5	Z	
T2.6	/Z	
T2.7	CH2 Encoder Supply (+)	US
T2.8	0V Supply	GND
T2.9	ECLK	CLOCK+
T2.10	/ECLK	CLOCK-
T2.11	EDATA	DATA+
T2.12	/EDATA	DATA-

Table 7. SSI Encoder Connections

Screen connections:

The encoder cable should be overall-screened with individually-screened twisted pairs for the signal lines. The outer screen should be tied to the earth star point in the drive and to the screen pin of the encoder (or its connector depending on the encoder manufacturer). The inner screens should also be tied to the earth star point in the drive but should be left disconnected at the encoder end.

2.7.2.1.1 PTS Language Parameters and Configuration Settings for SSI Encoders

Set FS7 to enable SSI binary encoder feedback.

Set FS8 to enable SSI gray code encoder feedback.

Use the NB parameter to specify the number of data bits.

Use the NZ parameter to specify the number of leading zeros.

(Refer to the encoder cable assembly drawing DRG14 at the end of this manual).

2.7.2.2 CANopen (Absolute)

CANopen encoders should be wired onto the SERVOnet network. This network connects into sockets S1 and S4 on the SRV300. An adaptor is available to convert from an 8-way RJ45 socket (S1 or S4) to a 9-pin D male. Only four signal connections are required to the encoder, as shown in the following table.

Note: if the CANopen encoder is at the end of the SERVOnet network, then a 120 Ohm terminating resistor and a link must be fitted at the encoder. The resistor may be jumper-selectable within the encoder itself. Alternatively, the resistor should be connected across the CAN_L and CAN_H lines. The link should tie the LINK line to ground. Refer to drawing QDV-2-2-011.

The NB parameter must be set to a value which matches the number of data bits returned by the encoder. The NZ parameter must be set to a value which specifies the number of leading zeros.

The following table provides the connection information for a CANopen encoder when wired onto SERVOnet.

Pin Number	S1,S4 Signal	9-pin D Adaptor	Encoder Signal
1	CAN_L	2	CAN_L
2	CAN_H	7	CAN_H
3	CAN_GND	3	CAN_GND
4	CAN_GND	6	
5	CAN_V+	9	
6	CAN_ERR	8	
7	LINK	4	(LINK TO CAN_GND)
8	CAN_SHLD	5	
	n/c	1	

Table 8. CANopen Encoder Connections

Screen connections:
The encoder cable should be overall-screened. It should be connected to pin 5 of the 9-pin adaptor or to pin 8 of the RJ45 socket if an adaptor is not used.

2.7.2.2.1 PTS Language Parameters and Configuration Settings for CANopen Encoders

Set FS10 to enable CANopen encoder absolute feedback.

Use a 500k bits/s baud rate.

Follow the configuration procedure described above for using CANopen encoders in relative mode.

(Refer to the encoder cable assembly drawing DRG08 at the end of this manual).

2.7.2.3 SinCos (Absolute)

A SinCos is a Hiperface product supplied by Stegmann. It provides absolute position information through its digital parameter channel and incremental encoder signals via its SIN and COS signals. The absolute position is read at power-up and can be read subsequently by setting FS to 0 and back to 12 while the encoder is stationary. The NB parameter is used to provide interpolation on the analogue signals. For a conventional encoder which produces 1024 cycles per revolution, an NB value of 12 would result in a resolution of 4096 counts per encoder revolution. NB can be increased to a maximum value of 24. This would theoretically produce a resolution of 16.8 million counts per revolution although noise would produce increasing amounts of jitter at higher values of NB. NZ is not required with a SinCos.

It is possible to zero the position of a Hiperface encoder or to set a position value corresponding to a specific position of the encoder shaft. This requires the encoder to be powered up and for a PC to be serially connected to its data lines using an RS232 to RS485 converter. Running Stegmann's Hiperface programming tool on the PC will then allow the encoder's position to be read or set.

The following table provides the connection information for a SinCos encoder when wired to channel 2's encoder connector T2.

Pin Number	SRV300 Signal	Encoder Signal
T2.1	A	COS
T2.2	/A	REFCOS
T2.3	B	SIN
T2.4	/B	REFSIN
T2.5	Z	
T2.6	/Z	
T2.7	CH2 Encoder Supply (+)	US
T2.8	0V Supply	GND
T2.9	ECLK	
T2.10	/ECLK	
T2.11	EDATA	DATA-
T2.12	/EDATA	DATA+

Table 9. SinCos Encoder Connections

Screen connections:

The encoder cable should be overall-screened with individually-screened twisted pairs for the signal lines. The outer screen should be tied to the earth star point in the drive and to the screen pin of the encoder (or its connector depending on the encoder manufacturer). The inner screens should also be tied to the earth star point in the drive but should be left disconnected at the encoder end.

2.7.2.3.1 PTS Language Parameters and Configuration Settings for absolute SinCos Encoders

Set FS12 to enable absolute SinCos encoder feedback.

Use the NB parameter to specify the resolution.

(Refer to the encoder cable assembly drawing DRG17 at the end of this manual).

2.7.2.4 EnDat (Absolute)

An EnDat encoder is a Heidenhain product similar in specification to a SinCos device. In absolute mode it behaves as a SinCos.

A 300kHz clock rate is used. This limits the maximum encoder cable length to 70m.

Two options are available for the supply voltage: 5V d.c. +/- 5% or 10..30V d.c.

Encoders are available as single-turn or multi-turn. Note: a different FS value is required for each: FS should be set to 13 for single-turn and should be set to 14 for multi-turn. Refer to the summary in table 11 for more details.

The following table provides the connection information for an EnDat encoder when wired to channel 2's encoder connector T2.

Note: the pin order in the table has been deliberately chosen to match that of connector T2 as shown in figure 10 above.

Pin Number	SRV300 Signal	Encoder Signal
T2.1	A	A+
T2.2	/A	A-
T2.3	B	B+
T2.4	/B	B-
T2.5	Z	
T2.6	/Z	
T2.7	CH2 Encoder Supply (+)	Up
T2.8	0V Supply	GND
T2.9	ECLK	CLOCK
T2.10	/ECLK	/CLOCK
T2.11	EDATA	DATA
T2.12	/EDATA	/DATA

Table 10. EnDat Encoder Connections

Screen connections:

The encoder cable should be overall-screened. This screen should be tied to the earth star point in the drive.

2.7.2.4.1 PTS Language Parameters and Configuration Settings for absolute EnDat Encoders

Set FS13 to enable single-turn absolute EnDat encoder feedback.

Set FS14 to enable multi-turn absolute EnDat encoder feedback.

Use the NB parameter to specify the resolution.

(Refer to the encoder cable assembly drawing DRG16 at the end of this manual).

2.7.3 Feedback Summary Table

Encoder Type	Absolute / Relative	Supply Voltage	FS Value	NB usage	NZ usage
Incremental (squarewave)	Relative	5V d.c.	0, 1 or 2	N/A	N/A
SSI	Relative	10V d.c to 32V d.c.	5 or 6	Data bits	Leading zeros
SSI	Absolute	10V d.c. to 32V d.c.	7 or 8	Data bits	Leading zeros
CANopen	Relative	12V d.c.	9	Data bits	Leading zeros
CANopen	Absolute	12V d.c.	10	Data bits	Leading zeros
Incremental (sinusoidal)	Relative	5V d.c.	11	Resolution	N/A
Sincoder	Relative	7 – 12V d.c.	11	Resolution	N/A
EnDat	Relative	5V d.c. or 10V to 32V d.c	11	Resolution	N/A
SinCos	Absolute	7 – 12V d.c.	12	Resolution	N/A
EnDat	Absolute (Single-turn)	5V d.c. or 10V to 32V d.c.	13	Resolution	N/A
EnDat	Absolute (Multi-turn)	5V d.c. or 10V to 32V d.c.	14	Resolution	N/A

Table 11. Encoder Feedback Summary Table

2.7.4 Encoder Speed Limitations

Number of data bits (NB)	Maximum Speed (Counts/s)
12	500,000
13	1,000,000
14	2,000,000
15-24	4,000,000

The above table shows the relationship between the maximum encoder speed and the number of data bits passed back from the absolute encoder. The limitation is imposed by the 256Hz sampling rate and the need to take at least two samples within one encoder revolution in order to determine the encoder's direction of rotation. For example, the absolute limit with 12-bit data would be 256 x 2048 = 524,288 counts/s. The 500,000 count/s limit provides some headroom but still results in a rotational speed of over 7000rpm.

2.8 Serial port connections

Four serial ports are provided on the SRV300 board as RJ45 sockets. They are identified as S1, S2, S3 and S4. Their location and pinouts are shown on the following figures.

Note: Port A (S2) and port B (S3) can be configured as RS232 or RS485. Tables are given for each of these configurations. Port B is not actually used in SERVOnet installations: the data has been presented below for completeness. HMIs are connected to Port B of the Machine Manager instead.

Pin Number	Signal
1	CAN_L
2	CAN_H
3	CAN_GND
4	CAN_GND
5	CAN_V+
6	CAN_ERR
7	LINK
8	CAN_SHLD

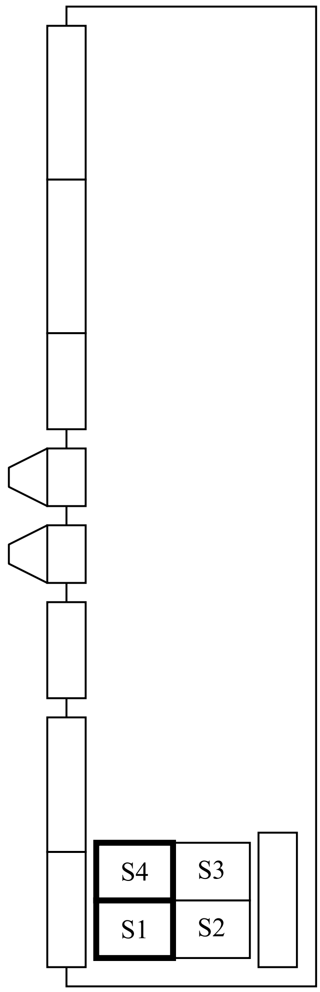


Table 12. S1 and S4 SERVOnet socket pin-outs.

A SERVOnet network comprises a daisy-chain of multi-core connections between the various SERVOnet modules and the Machine Manager. (See figure 3). Terminating connectors must be fitted at each end of this daisy-chain. One of these terminating connectors should also provide the 12V d.c. power for the network. The use of these connectors is described in the schematics at the end of this manual.

Where two SRV300 boards are adjacent modules in a SERVOnet network, then the relevant RJ45 sockets should be connected together using a standard Cat 5 FTP (screened) patch cable. S1 and S4 are physically identical so the two SRV300 boards could be connected as follows: S1 to S1, S4 to S4 or S1 to S4.

Cat 5 FTP patch cables are available from RS against the following stock codes:

1m length 405-4461

2m length	405-4477
3m length	405-4483
5m length	405-4506
10m length	405-4512

These cables are red to identify them as SERVOnet leads.

Where an SRV300 board needs to be connected to a Quin SERVOnet module which requires a 9-pin D connection, then an RJ45 to 9-pin D converter should be used. Quin stock code CBA152/MALE converts from an RJ45 socket to a 9-pin D-type male. This should be used for connecting to a 9-pin D-type female on the SERVOnet module. Quin stock code CBA152/FEMALE converts from an RJ45 socket to a 9-pin D-type female. This should be used for connecting to a 9-pin D-type male on the SERVOnet module.

Pin Number	RS232-signal
1	
2	Tx DATA
3	Rx DATA
4	
5	GND
6	
7	RTS
8	CTS

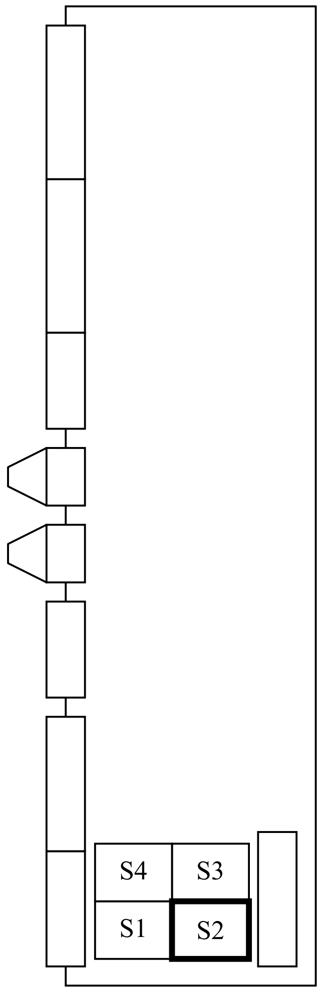
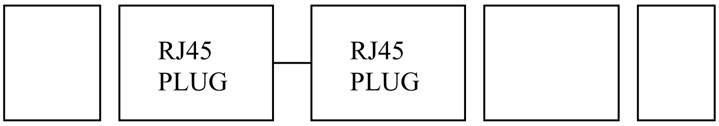


Table 13. S2 Port A Pin-outs for RS232 configuration.

The normal Quin serial lead (Quin stock code CBA139) is a 9-pin D female to a 9-pin D male which connects the serial port on a PC to a 9-pin D serial port on a Quin controller. However, port A on an SRV300 board is presented as an RJ45 socket and a different serial lead is therefore required. Quin stock code CBA139/B connects the 9-pin D male connector on a PC to the RJ45 on the SRV300 using a 3m length of lead. This is shown in the schematic below.



SRV300 CBA139/B (3m Cat 5 cable +adaptor) PC
Port A COM

Note: CBA139/B also provides a separate (external) earth lead. This should be tied to the drive chassis. The connection procedure is as follows:

i) Connect the 9-pin D to the comms port on the PC first.

ii) Connect the earth tag to the drive chassis.

iii) Connect the RJ45 plug into port A on the SRV300.

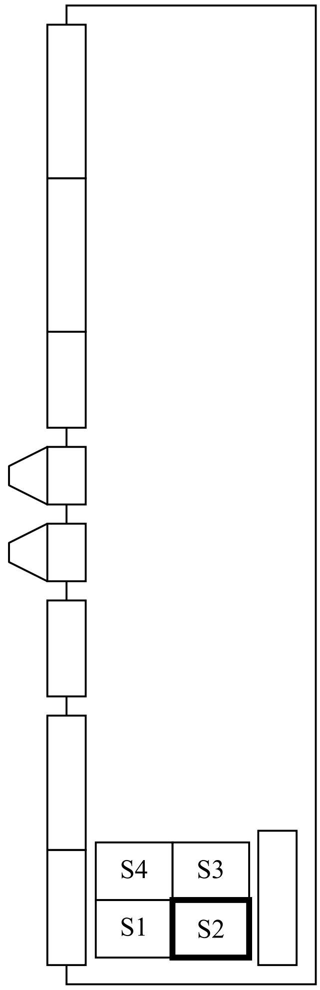
Where commissioning requires the use of a longer serial lead, it is necessary to use CBA139/A together with a standard Quin serial lead (CBA139) as shown in the schematic below. The screen is tied to the bodies of both D-types in CBA139, thereby ensuring that the PC remains earthed to the chassis of the drive.

SRV300 Cat 5 cable CBA139/A Quin Serial Lead PC
Port A CBA139 COM

Once an SRV300 is configured for use in a SERVOnet system, port A on the SRV300 is not required unless the SRV300 needs to be configured back to being a Standalone system.

Pin Number	RS485-signal
1	
2	/Tx DATA
3	/Rx DATA
4	
5	GND
6	
7	Tx DATA
8	Rx DATA

Table 14. S2 Port A pin-outs for RS485 configuration.



Pin Number	RS232-signal
1	
2	RTS
3	CTS
4	
5	GND
6	+V bias
7	Tx DATA
8	Rx DATA

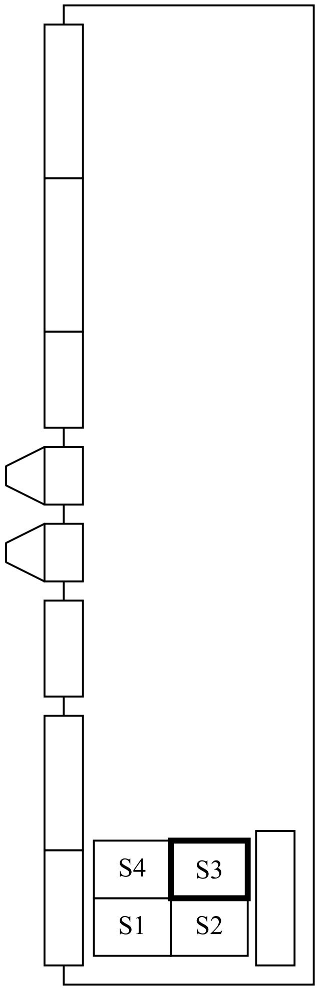
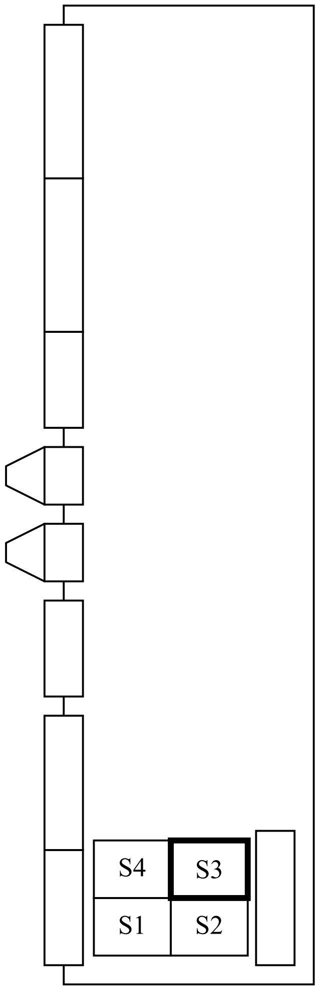


Table 15. S3 Port B pin-outs for RS232 configuration.

Pin Number	RS485-signal
1	TERM_H
2	Tx DATA
3	Rx DATA
4	TERM_L
5	GND
6	+V bias
7	/Tx DATA
8	/Rx DATA

Table 16. S3 Port B pin-outs for RS485 configuration.



The +V bias pin and the termination pins 1 and 4 are used when Port B is configured for RS485 operation in a multi-drop environment. Refer to the Quin Manual (MAN526) *PTS/Modbus Interface Users Manual* for more details and a wiring diagram. Port B can also be used in a half-duplex 2-wire configuration. This is also described in the *PTS/Modbus Interface Users Manual.*

2.9 CANopen I/O

The SRV300 board provides 8 digital inputs, 8 digital outputs, 1 analogue input and 1 analogue output. CANopen I/O modules can be used to increase the amount of digital and analogue I/O in a system. The expansion is limited and there are restrictions in the mix of digital and analogue CANopen modules. CANopen I/O can be added to a standalone drive or to a SERVOnet system. The same restrictions apply in each case. The configuration, however, is different. Refer to the appropriate section below.

2.9.1 CANopen I/O restrictions

It is not possible to use CANopen I/O and a CANopen encoder with a single drive. A separate drive is required for each CANopen device.

It is not possible to mix digital input modules and analogue input modules on the same Synchrolink/SERVOnet network.

It is not possible to mix digital output modules and analogue output modules on the same Synchrolink/SERVOnet network.

A maximum of 64 digital inputs can be used.

A maximum of 64 digital outputs can be used.

A maximum of 4 16-bit analogue inputs can be used.

A maximum of 4 16-bit analogue outputs can be used.

2.9.2 Adding CANopen I/O to a standalone drive

Refer to example installation schematics 10 and 11 at the end of this manual.

Connect a programming PC to port A of the SRV300 in the standalone drive. Use the SK command to enable the CANopen software option as follows:

- type SK <return>. This will display a list of the software options already installed.
- Against the prompt **New Feature**, type **canopen** <return>
- Against the prompt **Version**, type 0 <return>
- Reboot the system

The address setting of the CANopen device must match the CN value of the SRV300. With a standalone drive, CN should be set to 1.

Refer to Appendix B of the SERVOnet manual (MAN529) for specific details on the use of CANopen I/O.

2.9.3 Adding CANopen I/O to a SERVOnet system

Refer to example installation schematic 12 at the end of this manual.

Connect a programming PC to port A of the Machine Manager. Use the SK command to enable the CANopen software option as follows:

- type SK <return>. This will display a list of the software options already installed.
- Against the prompt **New Feature**, type **canopen** <return>

- Against the prompt **Version**, type 0 <return>
- Reboot the system

The address setting of the CANopen I/O must be set to 61. This is the module address of the Machine Manager. It is therefore possible to add a CANopen encoder to the network along with the CANopen I/O and to assign its address equal to the module number of one of the SERVOnet modules whose channel is required to receive the encoder position data.

Refer to Appendix B of the SERVOnet manual (MAN529) for specific details on the use of CANopen I/O.

2.10 Module and Channel Numbering

When configured as a SERVOnet drive, each module (SRV300) requires a unique module number and can appear as one or two channels. Since PTS programs use the channel numbers, as opposed to the module numbers, it is important to know the relationship between them. This is explained in the following table for a 3 module system.

Module Number	Channel (CH) Number	Description
1	1	Motor channel for module 1
1	2	Encoder/virtual channel for module 1
2	3	Motor channel for module 2
2	4	Encoder/virtual channel for module 2
3	5	Motor channel for module 3
3	6	Encoder/virtual channel for module 3

The module number and channel choice is best set up with the SERVOnet network off. This can be done by removing the 12V SERVOnet supply. Connect to Port A of the SRV300. When prompted, type m to set up the module number or c to change the number of channels to be used.

2.11 An Introduction to Motor Tuning

This section provides a background to motor tuning. The tuning procedure is described in section 3.

Each SRV300 is designed to operate a motor in closed-loop position control. This involves calculating where the motor should be (its demand position) and measuring where it actually is (its actual position). The control loops within the SRV300 and within the ABB drive attempt to make the actual position match the demand position i.e. to put the motor where it should be. This applies when the motor is held stationary as well as when it is rotating. Two control loops are available to the user: one in the ABB drive (the speed loop) and one in the SRV300 (the position loop).

The output from the position loop in the SRV300 is a speed demand signal which is passed to the ABB drive via the fibre-optic link. Position feedback from the motor is received by the SRV300. The motor's measured speed is also passed to the ABB drive by the SRV300.

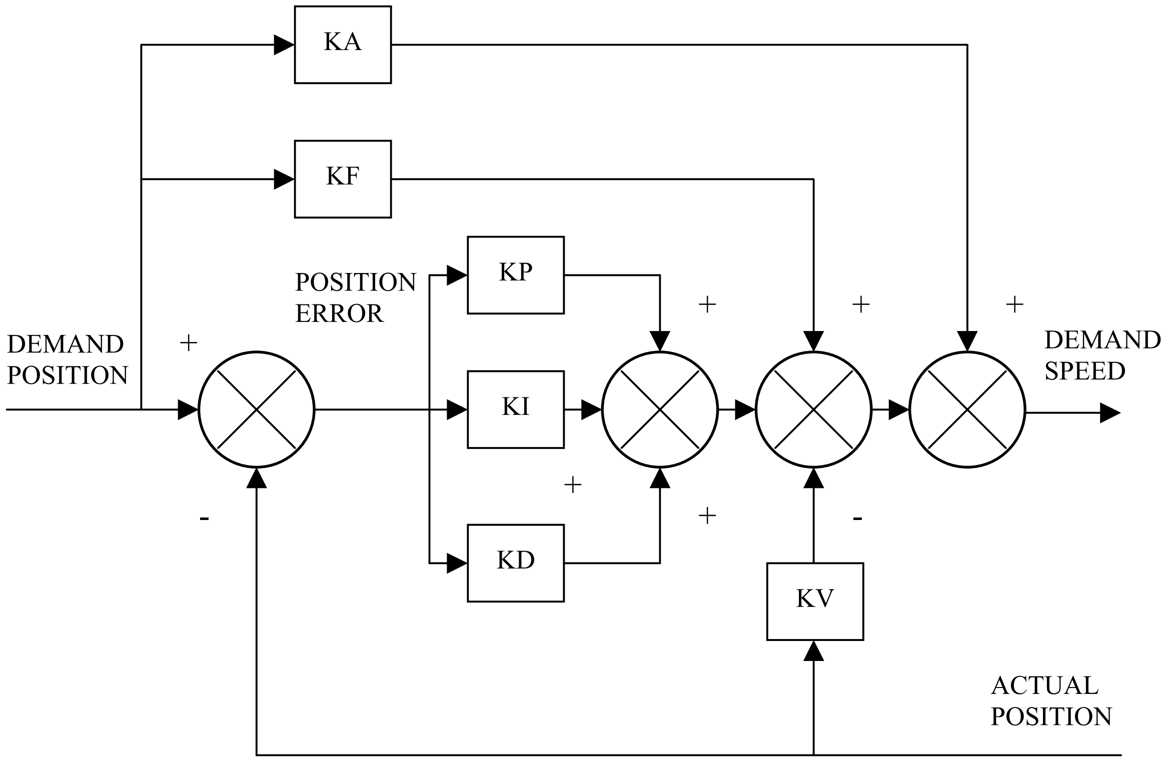
2.12 The Speed Loop

The purpose of the speed loop in the ABB drive is to ensure that the motor rotates at the speed demanded by the SRV300. It calculates a speed error which is then used to accelerate or decelerate the motor in order to correct its speed. Certain parameters within the drive affect how this speed loop performs. These parameters are the gains terms in group 23. Refer to the ACS 800 Firmware Manual (Group 23 parameters) for more information on the speed loop.

2.13 The Position Loop

The purpose of the position loop in the SRV300 is to control the position of the motor. A well-tuned position loop will result in the motor's actual position closely matching its demand position. Six gain terms are available to the user for adjusting the performance of this position loop. These are shown in the figure below and then discussed individually. The six gain terms are identified by two-letter mnemonics which should be used through PTS Toolkit when changing their values. Refer to the PTS Reference Manual for more details.

The demand position is calculated by the PTS firmware 256 times/s.



The above diagram can be summarised by the following expression:

Demand Speed =

$$KPe_i + KI\sum e_i + KD(e_i - e_{i-1}) - KV(p_i - p_{i-1}) + KF(d_i - d_{i-1}) + KA(u_i - u_{i-1})$$

Where

KP = proportional gain constant
KI = integral gain constant
KD = differential gain constant
KV = velocity feedback gain constant
KF = velocity feed-forward gain constant
KA = acceleration feed-forward gain constant
e_i = position error (= demand position – measured position)
d_i = demand position
p_i = measured position
u_i = demand speed (d_i - d_{i-1})

2.13.1 Position Loop Proportional Gain (KP)

This command sets the proportional gain of the system. The proportional gain acts on the measured position error, which is calculated as the difference between the current demand position and the position measured by the encoder. High gain gives the system a faster response and tighter position control, but if the gain is too high the system may oscillate. For best results, the proportional gain should be set as high as possible without inducing severe overshoot or oscillation.

2.13.2 Position Loop Integral Gain (KI)

This command sets the gain for the integral term in the controller transfer function. When integral control is used, the system integrates the position error by adding the current error to a running total. Integral gain is useful to remove a constant position error, due to a steady load or friction, or in steady-state velocity control, but also tends to make the system overshoot the target position at the end of a move because of the error accumulated during the move. This problem is known as “wind-up”. The integral action may be set up to avoid this problem such that it is operative only when the system is static, by setting bit 7 of the control word to a 1.

2.13.3 Position Loop Differential Gain (KD)

This command sets the gain for the differential term in the controller transfer function. This term uses the differential of the position error (=rate of change of error), which represents the velocity error of the system. This is useful where the position error is changing rapidly, for example if the required motion is a step change in position.

2.13.4 Position Loop Velocity Feedback Gain (KV)

This command sets the velocity feedback gain constant. The system uses the measured position to calculate the motor velocity, and this velocity, scaled by KV, is used in the controller transfer function. Note that differential control uses the rate of change of error, while velocity feedback uses the rate of change of position. Adding velocity feedback is similar to the effect of a tachogenerator connected externally to the motor drive, in that it adds damping into the system. This allows higher values of proportional gain to be used without giving excessive overshoot or oscillation, thus improving the speed of response of the system.

2.13.5 Position Loop Velocity Feedforward (KF)

This command allows the user to set the gain for the velocity feedforward term in the controller transfer function. It uses the demand velocity as opposed to the measured velocity, and is particularly useful when following a set position or velocity profile. If a system is using proportional gain only, then there will be a steady position error when running at constant velocity, known as velocity lag. The feedforward gain has the effect of reducing the velocity lag by adding a component dependent on the demand velocity into the demand signal output. The velocity lag error may be easily reduced to zero or even made negative, by increasing the value of the feedforward gain. Alternatively, velocity lag may be reduced to zero by the use of integral gain, but this has other effects as well.

2.13.6 Position Loop Acceleration Feedforwards (KA)

This command allows the user to set the gain for the acceleration feedforward term in the controller transfer function. It uses the demand acceleration as opposed to the measured acceleration, and is useful when following a set position or velocity profile. The effect of KA is to provide a component of the output signal proportional to the required demand acceleration.

2.14 Safety – Using Guards and Limits

A Risk Assessment should be undertaken by the machine designer in order to determine the safety level of the machine. European Standard EN954-1 defines 5 such levels. Establishing the safety level of the machine determines the choice and use of safety equipment. In addition, the Stop Category of the machine should be established. This determines when the power to the motors must be removed.

The following points may also be worth considering when driving reciprocating axes:

- software limits can be used to prevent the user attempting to drive a motor outside of its working stroke.
- proximity switches can be fitted outside of the software limits in order to switch digital inputs. These can be used to trigger quick decelerations and to prevent a motor attempting to drive further outwards. The DI and DL commands in the PTS language can be used to achieve this. Refer to the PTS Reference Manual for more information on the use of these commands.
- hard-wired limit switches can be fitted just short of the physical stroke limits. These could be used to remove the power to the motor. This is normally done by killing the supply to the drive itself rather than breaking the power connectors between the motor and drive. However, most drives incorporate a significant amount of capacitance and killing the power to the drive will not stop a motor immediately since these capacitors will store energy. It may be necessary to apply a zero speed demand signal to the drive and to keep the drive enabled even after removing power to the drive. This will then use the stored energy in the drive to brake the motor. This is particularly important when driving large inertias. A mechanical brake may also be required. The machine designer must also consider how to move off a limit switch. If this can't be done manually, then care must be taken when driving off a limit switch since this will require the switch to be by-passed. During such a recovery operation, it would be advisable to reduce the peak current setting in the drive.
- outside of the limit switches, mechanical shock absorbers may be required in order to absorb any kinetic energy from the load if the motor braking above isn't sufficient.
- finally, bump stops will be required to define an absolute physical limit of travel.

The following points may also be worth considering when driving rotary axes:

- in large-inertia or high-speed applications where the moving load can store large amounts of kinetic energy, it may be necessary to use regenerative braking in order to dissipate this energy in an emergency stop situation.

- in applications where the load is allowed to coast to a stop, the machine designer must ensure that it is not possible for the operator to open a guard and gain access to the moving parts of the machinery during its deceleration.

3. Installation Procedure

3.1 Overview

This procedure provides a step-by-step guide to installing a Quin SRV300 board into an ABB ACS800 drive. It should be read in parallel with the ABB Installation Manuals.

3.2 Equipment Familiarisation

The user should be competent with the use of the following equipment.

3.2.1 Use of the CDP 312 Control Panel

The CDP 312 Control Panel is an ABB product which connects directly to the ABB drive. It allows the drive to be set-up and monitored. Its use is described in the ACS 800 Firmware Manual.

3.2.2 Use of PTS Toolkit

PTS Toolkit is a Windows-based package which allows the user to program and monitor a motion control system manufactured by Quin Systems. This software is supplied together with on-line help files describing its use.

3.2.3 Use of Drives*Window*

Drives*Window* is a PC-based software package, supplied by ABB, to allow the PC to communicate over a high-speed fibre-optic serial link to either a TSU or inverter drive. Full instructions are supplied with the software.

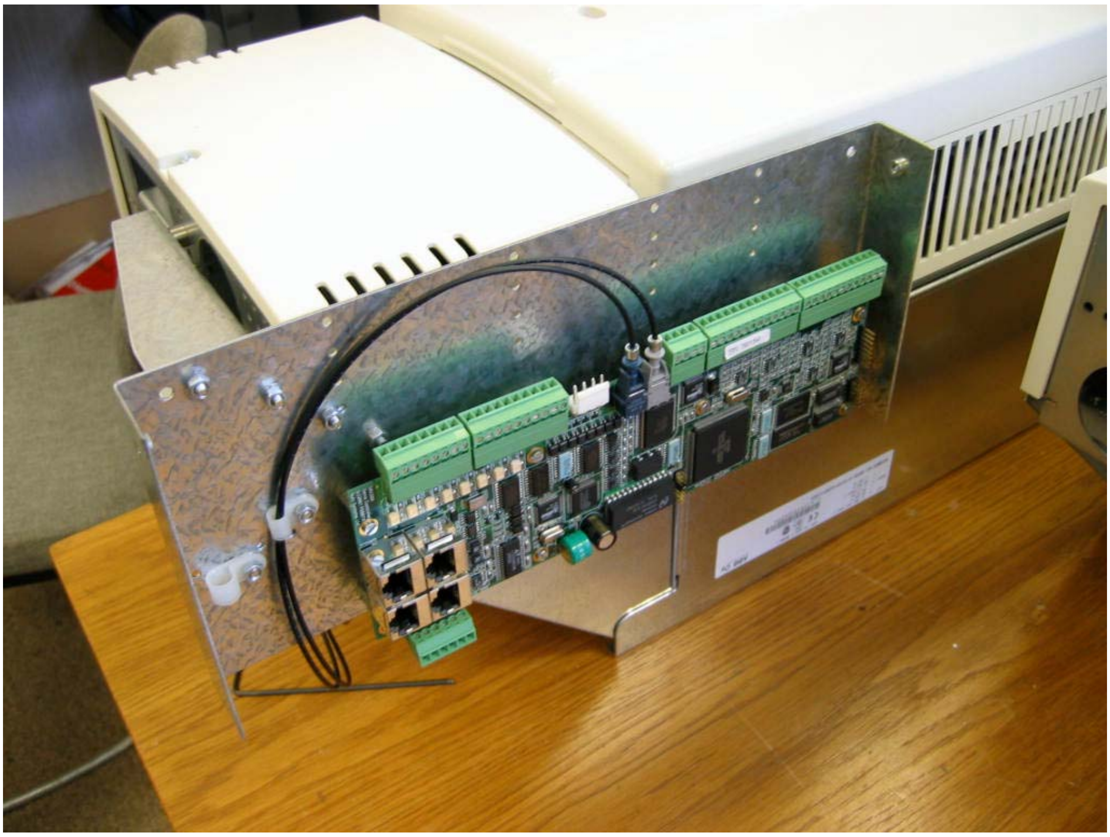
3.3 Mechanical Installation

The mechanical installation of the SRV300 is described in detail below, together with photographs showing it fitted to an ACS800 R5 frame. The installation of additional Quin equipment, e.g. the Machine Manager (in a SERVOnet system) or the Quin Power Supply, is described in the relevant Quin Installation Manuals. The installation of additional ABB equipment is described in the relevant ABB Manuals.

The Quin SRV300 board is supplied pre-mounted inside a metal case. It is therefore necessary to fit the SRV300 case assembly to the drive chassis. The comms link between the SRV300 and the ACS800 drive is provided by two fibre-optic cables. These are supplied with the SRV300 assembly and need to be fitted after the mechanical installation.

A channel-section bracket is attached to the side of the metal case. This needs to be bolted to the base of the gland bracket at the bottom of the drive. This assembly is shown in the following photograph. Although this obscures one of the gland holes, sufficient gland holes are still available for power and signal cables.

The fibre-optic cables should be fitted and routed as shown in the following two photographs.



Care must be taken to route the fibre-optic cables in order to maximise the bend radius.

3.4 Electrical Installation

The electrical installation is described in section 2 above. The installation of additional Quin equipment, e.g. the Machine Manager or Quin Power Supply, is described in the relevant Quin Installation Manuals. The installation of additional ABB equipment is described in the relevant ABB Manuals.

3.5 Pre-power up checks

Before applying power to an installation for the first time, it is important to run through the following checklist:

- Check that the correct supply voltage has been selected for all equipment.
- Check that the E-Stop push-button(s) are in
- Check the Earth continuity
- Check that the MCBs are the correct rating for voltage, current and inrush
- Check that the cabinet isolator is off
- Check that all the MCBs are off
- Check that all the fuses are removed on the d.c. outputs from power supplies

- Remove plugs to P1 and T3 connectors on the SRV300 boards
- Remove the external 24V power from the connector in the drive if external logic power is being used for the ABB RMIO board. (This is a configuration option described in the ABB manuals).
- Remove the 24V supply connector to the Quin Machine Manager (if used)
- Switch the 12V SERVOnet supply off (if fitted)
- Connect the motor power cables, encoder feedback, motor brake and motor fan cables.

3.6 Stage 1 Power-up Procedure and Checks

The following list provides a step by step procedure for the first stage of powering up a system. Checks should be made at each step. If a check fails, refer to the troubleshooting section or the ABB documentation for more help.

Step1: Apply mains supply to cabinet.
Check that the phase-to-phase voltage is within tolerance.

Step 2: Turn Cabinet isolator on.
Check the supply voltage to the MCBs which are not interrupted by the emergency stop contactor.

Step 3: Switch on MCBs for low voltage d.c. power supplies (for Quin Controller boards)
Check output voltage and polarity of power supplies.

Step 4: Fit d.c. fuses on above power supplies. (Cycle the power if required)
Check voltage and polarity at the (unplugged) connectors T1, P3, the Machine Manager (if used), the SERVOnet 9-pin D supply lead (if used) and the external supply for the RMIO board (if used).

Step 5: Power down, fit plugs T1 and P3 to the SRV300 controller(s) plus the external supply for the RMIO (if used). Power-up.
Step 6: If the drive is to be used as a SERVOnet node, then follow step 6 to set the module number.
Note: Operation as a SERVOnet node requires a licence.
Connect the earth tag of the serial lead (Quin stock code CBA139/B) to the chassis of the drive. Plug the serial lead connectors into Port A on the SRV300 and the comms port on the PC. Power-up the SRV300, wait 10 seconds and then run-up PTS Toolkit’s Terminal program.
Click on the connect icon
Select the serial port to be used on the PC
Click on “Abort Detection”
If the SRV300 has been supplied for use as a SERVOnet node, then pressing return will display a prompt line. Type M <return> and enter the required module (node) number. The section “Module and channel numbering” above explains how the two are related.
If the SRV300 has been supplied as a standalone system, then pressing return will display the current channel prompt 1: or 2:. It is possible to re-configure a standalone

system as a SERVOnet node. However, a licence is required. Please contact your local sales office or Quin Systems Ltd. for information.

Step 7. If the drive needs to be configured as a Standalone unit, then follow step 7.
Run-up PTS Toolkit's Terminal program and connect the serial lead from the PC to Port A on the SRV300. (Use the appropriate serial lead: Quin stock code CBA139/B).
Click on the connect icon
Select the serial port to be used on the PC
Click on "Abort Detection"
If the SRV300 has already been supplied as a Standalone Unit, then pressing <return> will display the current channel prompt 1: or 2:. If pressing <return> displays a line prompting for a module number, then this means that the drive is currently set up as a SERVOnet drive. To change it to standalone, type T (for type) and then S (for standalone) and then reboot.

Step 8: If a SERVOnet system is being installed, then follow step 8. Power down, connect the external supply to the RMIO board (if set to external), the 24V supply plug for the Machine Manager and switch the 12V SERVOnet supply on. Power up.
The 24V d.c. supply LED on the Machine Manager should be lit.
Connect the PC to Port A on the Machine Manager. The SERVOnet system should be seen to initialise.
Type VN and check that all the SERVOnet channels are seen.
Type CN and check that there aren't any SERVOnet errors.

Step 9: Configure the RMIO boards for Fieldbus operation by setting parameter 98.02 to Fieldbus. (98.02 = 2)
This needs to be done using the ABB Control Panel.
Step 10: Configure the fibre-optic baud rate by setting 70.01 to 1.
This needs to be done using the ABB Control Panel.

Step 12: Test each encoder.
Refer to the "Feedback Options" section above for connection details. Use the DP command to read the encoder position on a particular channel.

Step 13: Reboot the system.
After the reboot, communication should be established between the SRV300 and the RMIO board in the ABB drive. After rebooting, check that a value of 2 is read back using PTS Toolkit by typing QQ9802 <return> on the motor channel of the drive. On a Standalone drive, the motor channel will be CH1. On a SERVOnet system, the motor channel will be CH1 on module 1, CH3 on module 2, CH5 on module 3 etc. With this parameter set to 2 it will be possible to read other parameters from the PTS using the QQ command. If parameter 9802 is not set to 2 (i.e. the comms has not been set to Fieldbus), then the QQ command will read back parameter values of 0.

3.7 Setting Drive parameters

As well as the parameters listed above, it is also necessary to set or confirm the values of a number of configuration parameters within the drive. These parameters are listed below.

The drive parameters can be set in one of three ways:

a) Using the Control Panel plugged into the ABB drive.

b) Using PTS Toolkit running on a PC. This is connected to Port A of the Machine Manager if using a SERVOnet system or directly to Port A on the SRV300 if using a Standalone drive.

c) Using Drives*Window* running on a PC which is connected to the ABB drive directly using a fibre-optic link

Having followed through the Stage 1 Power-up Procedure described above, then the drive parameters can be conveniently set using the QP command. The use of this command is described in detail in the PTS Reference Manual. An example is given below.

Example: To set parameter 99.05 to 400, first change to CH1 (for a standalone drive) and then type QP9905/400.

Note: The QP command can only be used on an odd numbered (motor) channel. Note also that the 'group.parameter' syntax is not used with the QP command: the dot is not required.

Once the drive parameters have been set, they can be saved to Non Volatile Memory (NVM) by setting parameter 250 to 1 as follows:

Example: To save drive parameters on a standalone drive, type CH1/QP250/1.

Note: This does not save the PTS program: use the SP command to save parameters, profiles, maps and sequences to non volatile memory on the SRV300 board. Refer to the PTS Reference Manual for more details.

Warning: Do not change the value of parameter 98.02 from its required value of 2. This will break the communication between the SRV300 board and the RMIO and it will be necessary to change this value back using the Control Panel or through the Drives*Window* software.

If the ABB Control Panel has been used on an ABB drive, check that the panel status has been returned to R for remote (external) use.

3.7.1 Start-up Data (Parameter Group 99)

Start-up parameters are defined in group 99. This data should be taken from the name plate on the motor. The following table gives values for a typical application. A full description of each parameter is given in the ACS 800 Firmware Manual. Note: it is necessary to enter data for parameter group 99 before data can be entered for parameter group 20. Subsequently changing the nominal motor speed (parameter 99.08) will affect the speed limits for parameters 20.01 and 20.02.

Parameter	Value	Description
99.04	0	Motor Control Mode DTC
99.05	400	Nominal Motor Voltage 400V
99.06	149	Nominal Motor Current 14.9A
99.07	5160	Nominal Motor Frequency 51.6Hz
99.08	1500	Nominal Motor Speed 1500rpm
99.09	75	Nominal Motor Power 7.5kW
99.10	1	No Motor ID Run

The MC parameter in the PTS must be set to a value which is equal to the resolution of the encoder on the back of the motor. This parameter is channel-specific and the resolution must be defined in counts per revolution. For example, a quadrature encoder which provides 2048 pulses per revolution (ppr) on channel 1 should have its MC parameter set as follows:

CH1/MC8192

N.B. Edge-counting provides a x4 multiplication to the encoder's ppr resolution.

3.7.2 Start/Stop/Dir (Parameter Group 10)

Start/stop/dir parameters are defined in group 10. These are set automatically on power-up by the SRV300 board and should correspond to the values given in the following table.

Parameter	Value	Description
10.01	10	Ext 1 = comm module
10.02	10	Ext 2 = comm module
10.03	3	Direction = request

3.7.3 Reference Select (Parameter Group 11)

Reference Select parameters are defined in group 11. Parameters 11.02, 11.03 and 11.06 are set automatically on power-up by the SRV300 board and should correspond to the values given in the following table. Parameters 11.04 and 11.05 are user-defined. The table suggests values for a typical application. A full description of each parameter is given in the ACS 800 Firmware Manual.

Parameter	Value	Description
11.02	9	Ext1/ext2 select = comm module
11.03	20	Ext ref1 select = Comm. ref
11.04	0	Ext ref1 Minimum = value
11.05	2200	Ext ref1 Maximum = value
11.06	20	Ext ref2 select = Comm. ref

3.7.4 Constant Speed Selection (Parameter Group 12)

Parameter group 12 allows pre-set constant speeds to be defined. These are not required when using the SRV300 board. Parameter 12.01 should therefore be set to 1.

Parameter	Value	Description
12.01	1	Constant speed select = not selected

3.7.5 System Control Inputs (Parameter Group 16)

System Control Input parameters are defined in group 16. Parameters 16.01 and 16.04 are set automatically on power-up by the SRV300 board and should correspond to the values given in the following table.

Parameter 16.09 is used to specify whether the RMIO board's 24V power is taken from the drive's internal 24V supply or from an external supply. The choice is up to the end user but if the internal supply is used, then it would be necessary to reboot the SRV300 in the event of an emergency stop condition since this would remove power to the RMIO board and break the comms link to the SRV300.

Parameter	Value	Description
16.01	8	Run enable = Comm. module
16.04	8	Fault reset sel = Comm. module
16.09	1 or 2	(= 1 for internal supply: = 2 for external supply)

3.7.6 Limits (Parameter Group 20)

Limit parameters are defined in group 20. The following table states values for a specific application using a 4-pole 7.5kW motor. The required values must be chosen to suit the user's application. A full description of each parameter is given in the ACS 800 Firmware Manual.

The value for parameters 20.05 and 20.06 depend on whether the drive is fitted with a brake chopper.

Parameter	Value	Description
20.01	-2200	Min motor speed
20.02	2200	Max motor speed
20.03	20000	Max drive output current to motor (= 200%)
20.04	30000	Max allowed motor torque (= 300%)
20.05	0	NO Over-voltage control (OFF)
20.06	0	NO Under-voltage control (OFF)

3.7.7 Start/stop (Parameter Group 21)

Start/stop parameters are defined in group 21. The following table suggests values for a typical application. A full description of each parameter is given in the ACS 800 Firmware Manual.

Parameter	Value	Description
21.01	3	Start function = Cnst DC magn
21.02	105	Const Magn time = (7ms/kW x motor kW)x2
21.03	1	Stop function = Coast
21.04	0	DC Hold = NO

3.7.8 Accel/decel (Parameter Group 22)

Accel/decel parameters are defined in group 22. The following table suggests values for a typical application. A full description of each parameter is given in the ACS 800 Firmware Manual.

Parameter	Value	Description
22.01	1	ACC/DEC 1 / 2 SEL = ACC/DEC 1
22.02	0	ACCEL TIME 1 = 0 s
22.03	0	DECEL TIME 1 = 0 s

3.7.9 Speed Control (Parameter Group 23)

Speed control parameters are defined in group 23. The following table states values for a specific application. These parameters have been produced from a motor ID run and should not be copied through to the user's application. Instead, the user should perform a motor ID run himself, as described later. A full description of each parameter is given in the ACS 800 Firmware Manual.

Following a motor ID run, it is possible to edit these gain term values in order to optimise the speed loop.

Parameter	Value	Description
23.01	1020	GAIN = 10.2 s
23.02	160	Integration time = 0.16 s
23.03	0	Derivation time = 0.0 ms
23.04	1	Acc compensation = 0.1 s
23.05	100	Slip Gain = 100.0%
23.06	0	Autotune Run = NO

3.7.10 Motor Control (Parameter Group 26)

Motor Control parameters are defined in group 26. The following table suggests values for a typical application. A full description of each parameter is given in the ACS 800 Firmware Manual.

Parameter	Value	Description
26.01	0	Flux Optimization = NO
26.02	-1	Flux braking = YES

3.7.11 Brake Chopper Details (Parameter Group 27)

If a brake chopper is being used, then the drive needs to know the electrical specification of the resistor unit. These should be specified in parameter group 27.

3.7.12 Fault Functions (Parameter Group 30)

Fault Function parameters are defined in group 30. The following table suggests values for a typical application. A full description of each parameter is given in the ACS 800 Firmware Manual.

Parameter	Value	Description
30.18	1	Comm FLT FUNC = fault
30.19	10	MAIN REF DS T-OUT = 1.00 s
30.22	1	I/O Config Func = NO

3.7.13 Set TR Address (Parameter Group 92)

TR address parameters are defined in group 92. Parameter 92.02 is set automatically on power-up by the SRV300 board and should correspond to the value given in the following table.

Parameter	Value	Description
92.02	305	Main DS Act 1 = 305 (Fault word 1)

3.7.14 Option Modules (Parameter Group 98)

Option module parameters are defined in group 98. The following table suggests values for a typical application. A full description of each parameter is given in the ACS 800 Firmware Manual.

Parameter	Value	Description
98.02	2	COMM. MODULE LINK = FIELDBUS
98.07	1	Comm Profile = ABB Drives

3.8 Stage 2 Safety Check

Step1: Release emergency stop push-buttons and reset the emergency stop circuit.
Resetting the safety relay should result in a 3-phase supply being switched to the drive(s).

Step 2: Press an emergency stop button
Check that the main emergency stop contactor drops out.

3.9 Motor Tuning

With all the above start-up procedures completed, the motors are now ready for tuning. This is a three-stage operation.

The first stage is described as a “motor ID run” in the ABB Installation Manuals and should be undertaken with the motor off the machine.

The second stage involves setting initial values for the PTS parameters which determine the stability of the position loop. The motor should then be tested by running it in closed-loop. Again this should be undertaken with the motor off the machine.

The third stage involves adjusting the various gain terms in the system in order to fine-tune the performance of the motor once it has been mounted and their loads connected.

In all cases, the user must ensure that the emergency stop circuit is functioning correctly so that the motors can be stopped quickly if necessary. It would be as well to set any safety relay time delay to a minimum at this stage.

3.9.1 Stage 1: Motor ID run and open-loop operation

A motor ID run is required:

- when a system is first commissioned
- if the drive is replaced
- if an ID run is specifically requested by writing to parameter 99.10.

The motor ID run procedure is described in detail in the Start-up data chapter of the ABB ACS800 Firmware Manual. Once complete, it is possible to upload the ID run data to a PC for back-up using the Drives*Window* software. This would need to be done for each motor in the system.

If the drive is replaced, then either the ID run needs to be repeated or the ID run back-up data should be downloaded using the Drives*Window* software. A repeat ID run may require the motor to be dismounted from the machine. For this reason, it is important that the download option is readily available. It is also important that the user does not inadvertently write to parameter 99.10.

The motor should now be tested by running it in open-loop mode. A PC, running PTS Toolkit, should now be connected to Port A of the Machine Manager. The user should be familiar with the use of PTS Toolkit and have an understanding of the mnemonic commands detailed below. These are fully described in the Quin PTS Reference Manual. A procedure for driving a motor in open-loop mode is given below.

Step 1: Motor channel selection
Use the PTS CH command to select the motor channel for testing. This will be CH1 for a Standalone drive. Refer to the section on Module and Channel Numbering above if using a SERVOnet system.

Step 2: Pre-set the demand speed
The demand speed is specified by the value of the OM parameter. This should be set initially to 0.

Step 3: Enable the drive for open-loop operation
Type AO1 to enable the drive. Increasing the value of OM should force the motor to rotate faster in one direction. Each time the OM value is changed, the drive will receive a step change in demand velocity. For this reason, increase OM in increments of 50 to keep the step changes small at this stage. Setting OM to progressively large negative numbers should drive the motor in the opposite direction at increasing speeds. Type AO0 to disable the drive. The motor should be seen to run smoothly in each direction.

3.9.2 Stage 2: PTS Parameter Setup and Close-loop Operation

The initial values for a number of PTS mnemonic parameters should now be set, prior to running the motor in closed-loop mode. A procedure is given below.

Step 1: PTS Parameter Set-up

The following PTS parameters should be defined on the motor channel.

Set the SE parameter to 1000. This defines a limit for the position error, above which the SRV300 will automatically disable the drive. This is a relatively low value to provide an early trip during this commissioning stage.

Set the initial value for the six gain terms as follows:

KP100
KV0
KD0
KF256
KI0
KA0

Set the initial value for the CW control word to 01010000.

Set the initial value for the SB bound parameter to 4000000. This is required for the following encoder test. Type ZC to zero the position counter.

Step 2: Monitor the encoder feedback

The encoder feedback for the motor is received at the odd-numbered channel on the SRV300. Manually turn the motor shaft through one revolution in one direction and type DP to read the encoder's position. The reported value may be negative buts its magnitude should be approximately the number of encoder counts expected for one revolution of the encoder (= 4 x the encoder's ppr). Rotate the motor back to its original position and type DP. The value should be about 0.

Step 3: Set the feedback sense of the position loop

Type PC to enable the drive. The motor should be stationary and hold its position. If the motor moves quickly in one direction and the message "Motor position error" is displayed, then this suggests that the position loop is operating with a positive feedback rather than the required negative feedback. This can be corrected by changing CW from its existing value of 01010000 to 01000000. Type PC again and check that the motor now holds its position.

Step 4: Test the motor in closed loop

Increase the SE parameter to 5000. Set the SV parameter to 20000 on the motor channel. This defines the demand speed for the motor. (For a 10000 count/revolution encoder, an SV value of 20000 will define a required motor speed of 2 revolution per second). Set the acceleration parameter SA and the deceleration parameter DC to the same value. Type PC and then VC+. This should accelerate the motor up to 20000 counts/s. Type ST to decelerate the motor to rest. Type VC- to test the motor in the opposite direction and ST again to stop it. Finally, type MO to disable the drive.

In the above test, the motor should be seen to run smoothly in both directions. If the motor vibrates as it rotates, then the KP parameter may be too high. If, on the other hand the motor is lumpy then the KP may be too low. Determine a value for KP where the motor runs smoothly.

Step 5: Set the KF gain term

Run the motor at 20000 counts/s as described in step 4. Type DM to produce a continuous trace of position data: the third column displays the position error. While the motor is running, increase the value of KF. The position error should be seen to reduce as the KF term is increased. For a given value of KP, a particular value of KF should produce a position error which hovers around 0. Type DO to stop the display mode.

Step 6: Testing the motor at maximum speed

With the motor still running from step 5, the SV parameter can now be increased in order to run it faster. Raise the value of SV until the motor is running at the peak speed required in the application. The KF gain term should be re-established since it can be determined more accurately at higher speed. Stop the motor and check that it can run at the required peak speed in the reverse direction.

3.9.3 Stage 3: Fine-tuning the Motor Performance

The above two stages have established the gain terms for the speed and position loops which will allow the motor to be driven smoothly in both open and closed-loop control. However, these values now need to be adjusted in order to cope with the load inertia of the machine and to suit the motion requirements of the application. For dynamic applications, which require precise motor control, these values need to be determined as accurately as possible. Various tuning and diagnostic tools are available to achieve this. These are first discussed before finally suggesting a procedure for fine-tuning a motor.

3.9.3.1 Display Mode Position Monitoring

This utility has already been used in stage 2/step 5 above. The DM command turns the utility on while the DO command turns it off. This display mode data can be free-running or presented as historical data if a parameter is given after the DM command. Full details are available in the PTS Reference Manual. This command is useful for:

- setting up KF when the motor is driven at a constant speed
- checking the variation of position error
- as a quick check of the spread of position error

3.9.3.2 PTS Toolkit Tuning

The “Tune a Motor” utility is provided under the Tools menu of PTS Scope. It allows the 5 position loop gain terms to be determined empirically by applying a motion stimulus and monitoring the result graphically using two traces. Full details are provided in the help menu within PTS Scope. The speed loop gain terms of parameters 23.01, 23.02, 23.03 and 23.04 can either be accessed using the ABB Control Panel or by using PTS Terminal to address these registers using the QP and QQ commands. (It may not, however, be necessary to adjust these speed loop gains after having performed an ID run).

3.9.3.3 PTS Toolkit Scope

PTS Scope allows 4 parameters to be monitored graphically. The motion stimulus and gain terms can be adjusted using PTS Terminal. The results can be recorded to a resolution of 1 servo loop and the results saved to disk on the PC. Again, full details are provided in the help menu.

3.9.3.4 Fine-tuning Procedure

A motor should be tuned empirically. (Attempting to model a system mathematically would require complex transfer functions to be available and would be difficult to compute due to the control loops being digital and running asynchronously). Tuning a motor empirically essentially involves forcing it to try and make movements which it is unable to follow. The resultant errors can then be monitored and minimised.

As described above, the ACS800/SRV300 drive system incorporates a speed loop in the ABB drive board and a position loop in the SRV300 board. It is important to fine-tune the inner loop (the speed loop) first. The motor ID run will have established initial values for the gain terms in the speed loop. These are:

Parameter 23.01 (proportional gain)
Parameter 23.02 (integral gain)
Parameter 23.03 (derivative gain)
Parameter 23.04 (acceleration feedforward gain)

To fine-tune this inner speed loop, use the AO and OM commands described above in order to force a step change in speed demand to the drive. The result can be monitored graphically using PTS Scope. By adjusting the speed loop gain terms in the drive, the response can be optimised for settling time and overshoot. Drive parameters can be saved using the QP250/1 command.

Once the speed loop gain terms have been optimised, then it is possible to fine tune the position loop by using the “Tune a motor” option within PTS Scope or by running the motion for the application and monitoring the motor’s performance using PTS Scope. The gain terms within the PTS for the position loop can be saved using the SP command.

4. Troubleshooting

This section provides information on troubleshooting an installation. Beyond the limitations of visual diagnostics, the following equipment should be available:

- a PC running PTS Toolkit. Refer to section 3.2.2 for more details.
- an ABB Control Panel
- a multimeter

4.1 Visual Diagnostics

Visual diagnostics provide a quick and easy first step for fault-finding on a system. While they can allow the user to identify a fault without requiring any test equipment they are not, however, comprehensive. The available visual diagnostics are discussed below.

On a SERVOnet system, either a QManager, a Machine Manager or a Mini Machine Manager will be used. Visual diagnostics are provided on these units. These are described below.

4.1.1 QManager

Four 7-segment displays are fitted to the front of the QManager. These will be lit when the 24V supply is present. Refer to the QManager manual for more information on this display.

4.1.2 Machine Manager

Four green LEDs are fitted next to the power connector on the Machine Manager. These should all be lit when the 24V supply is present.

4.1.3 Mini Machine Manager

Three 7-segment displays are provided on the front of the Mini Machine Manager. These should be lit when the unit is powered up. In normal operation, the display should show RDY at power-up followed by the number of channels found on the SERVOnet network. Once SERVOnet has been initialised the word CAN will be displayed. The 7-segment displays are also used to report error codes. These are described in the Machine Manager Installation Manual and in the PTS Reference Manual. The Mini Machine Manager also provides host I/O for which there is a green LED for each digital input and a red LED for each digital output.

4.2 Serial Port Testing

Each SRV300 provides two serial ports: Port A and Port B as shown in tables 13 and 14. A SERVOnet system also incorporates a Quin Machine Manager which itself provides two serial ports: also defined as Port A and Port B.

Port A on the SRV300 can be tested using a PC running PTS Toolkit. On power-up, the SRV300 should identify itself either as an axis module or as a Standalone unit. If the drive is configured as an axis module, then it will prompt for a new module number at power-up. If the drive is configured as a Standalone unit, then the Quin copyright text will be displayed and the SRV300 will complete its power-up procedure by displaying the channel prompt 1:. This serial port test is best undertaken with the SRV300 disconnected from the SERVOnet network since the port is disabled once a SERVOnet system has been initialised. The PC's serial port needs to be configured as 9600 baud, 8 data bits, no parity, 1 stop bit, software handshaking. If PTS Toolkit is not available, Windows Hyperterminal can be used, providing the serial port is configured as above.

Port A on the Machine Manager of a SERVOnet system should report the firmware version number, a copyright prompt and the number of SERVOnet channels on power-up. For example, a SERVOnet system with 3 SRV300 boards would report:

```
Machine Controller Version 2.2
Copyright 2001 Quin Systems Ltd

SERVOnet Initialising...

Motor1 found (Axis module 1)
Motor2 found
Motor3 found (Axis module 2)
Motor4 found
Motor5 found (Axis module 3)
Motor6 found


Restoring sequences - Done
Restoring maps/profiles - Done
Restoring parameters - Done
Modbus Interface Version 2.2.10.1
Modbus Interface : Waiting to read unit number ...
Modbus Interface : Unit number set to 1

Restoring variables | Done
Motion Generator Version 1.1.8.1
1:
```

Note: The "motor found" prompt does not refer to physical motors but SERVOnet channels. Again, Windows Hyperterminal can be used instead of PTS Toolkit if this is not available.

The Port B serial port on an SRV300 is not used in a SERVOnet system. It is used for HMI comms when the SRV300 is configured as a Standalone drive.

The Port B serial port on the Machine Manager is designed for use with an HMI. This is normally configured as RS485 and hence requires equipment which operates with this interface in order to test the port. Only one software feature, as defined using the SK command, can be enabled on Port B at any one time. These features provide communications for:

- the Quin Mini Operator's Panel
- the Quin Operator's Panel
- Modbus protocol

- Data Highway protocol

4.3 PTS Error Messages

Error messages are automatically reported through the serial port (Port A) of the Machine Manager on a SERVOnet system or through Port A of the SRV300 on Standalone units. To see these messages, a PC running PTS Toolkit's Terminal Window, should be connected to the appropriate serial port. A full list of possible error messages is given at the back of the PTS Reference Manual. If the error message relates to a specific channel, then this channel number will precede the error message.

PTS Terminal provides a large circular buffer. It is possible to scroll back to look at error messages which have disappeared off the screen. The LE command can be used to list the last 10 error messages from a circular buffer.

4.4 Testing of Digital Inputs

The digital inputs on the SRV300 board operate at a 24V d.c. level. Applying a 24V signal to an input should switch that input on. Its state can be read using the RI command. This will return a value of 1 for ON or 0 for OFF. Refer to the PTS Reference Manual for more details.

The presence of a 24V signal will have to be tested using a multimeter at connector T4.X measured relative to T4.9: there are no input LEDs. The signal can be conveniently provided by linking T4.10 (+24V I/O supply) to the input under test. The input should draw between 10 and 20mA.

If an input is not switching but a voltage is present at the terminal, check the level of the voltage. The inputs have a threshold voltage of 10 to 16V.

The DB command (debounce) affects the operation of the digital inputs. A 24V signal may correctly switch a digital input on (as confirmed by the RI command) but if the DB value is high then the execution of defined inputs (DI) will be delayed. The MI and BI commands can also prevent the defined input commands from executing until the input has been enabled using the EI command. The RI command will report if the input is block, masked or enabled.

The sketch below shows the input circuitry for one digital input. T4.9 is the 0V I/O supply, as detailed in figure 5. The test input is one of the digital input terminals T4.1 to T4.8.

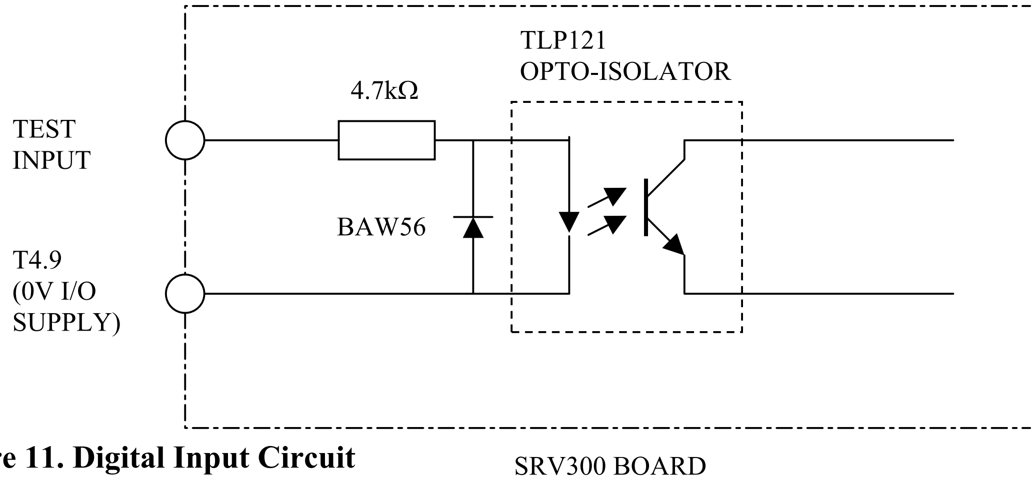


Figure 11. Digital Input Circuit

4.5 Testing of Digital Outputs

The digital outputs on the SRV300 board are PNP devices which can provide a 24V source current up to 100mA. The outputs are switched using the SO (set output) and CO (clear output) commands and their state can be confirmed using the RO (read output) command. The output signal can be checked using a multimeter to measure the voltage between the test output and T4.9 (the I/O 0V supply).

The sketch below shows the output circuitry for one digital output. T4.9 is the 0V I/O supply and T4.10 is the 24V I/O supply, as detailed in figure 5. The test output is one of the digital output terminals T5.1 to T5.8 as detailed in figure 6.

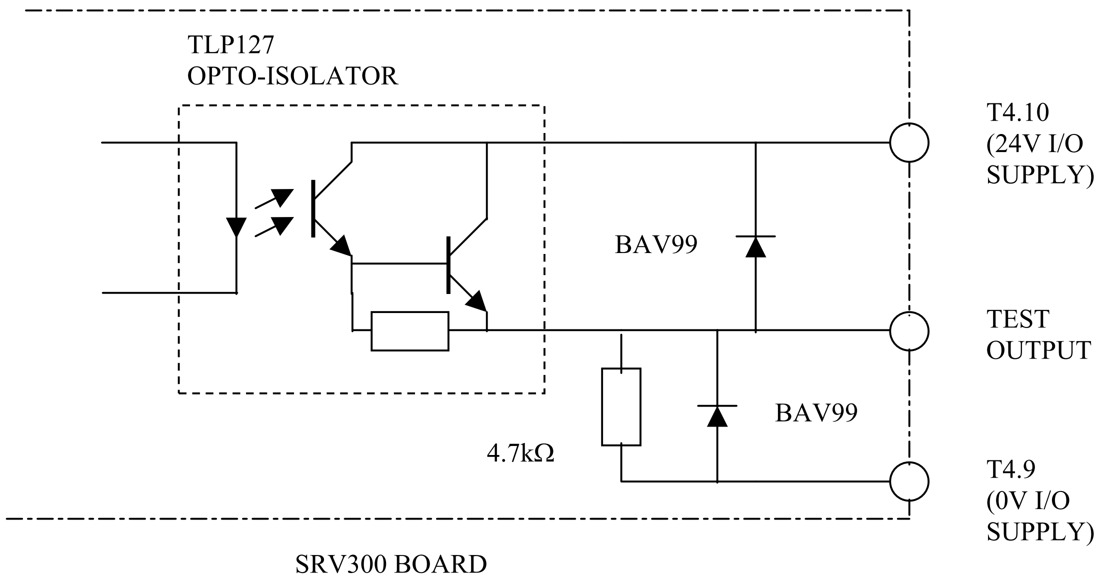


Figure 12. Digital Output Circuit

4.6 Analogue Input/Output Testing

The analogue input and output can be tested at the same time. This is done by linking the output to the input, programming an output voltage and reading it back on the input.

Connect the analogue input - terminal T6.3 to the adjacent 0 Volts terminal T6.4. Connect the analogue input + terminal T6.2 to the analogue output terminal T6.5. Refer to figure 7 for terminal locations.

Enable the analogue output at a 0 volt level with the commands KM0/OM0/AO2 on the even-numbered channel of the SRV300. Monitor the analogue input with the DA command. A value close to zero should be seen.

Set the full-scale positive output (+5 Volts) with the command OM2047, again on the even-numbered channel. Monitor the analogue input with the DA command. This should read about 1024.

Set the full-scale negative output (-5 Volts) with the command OM-2047. DA should now report a value of –1024.

Undefine the output and return its voltage to 0 by typing KM0/OM0/AO0.

Note: This test doesn't actually provide a full test of the analogue input since it will accept a +/- 10V swing and is only tested over a +/- 5V swing.

4.7 Encoder feedback testing

An encoder connector is provided for each of the two channels on the SRV300 as described in sections 2.4.6 and 2.4.7. Encoder testing requires the use of PTS Toolkit. The procedure for testing each channel is the same once the channel has been selected using the CH command. Type CH1 <return> to select channel 1 or CH2 <return> to select channel 2. Use the appropriate FS command to match the encoder type as described in section 2.7.

Check that the encoder value does not change when the encoder is stationary. Type DM to run the display mode and check the value in the P column. A jitter of a few counts is normal, especially for a high-resolution encoder. However, the value should not vary wildly or drift up or down over a period of time. DO will turn the display mode off.

If the encoder provides a marker pulse and is wired up, check that it is being seen. Type RM1, DZ1, RW0, FR0, SR0 to allow the signal to be seen but to prevent it having any effect. TypeWF/DF/RP to force the SRV300 to wait for a marker pulse, display a reference error and then repeat. Rotate the encoder. The PC should display a reference error value (DF) each time the marker pulse is seen. If this is not the case, then the signal should be monitored using an oscilloscope. Type AX/WE to end the test.

Check that the encoder counts in both directions. Run the display mode again (DM) and monitor the position value in the P column as the encoder is rotated forwards and backwards. Check that the encoder value has not changed when the encoder is returned to its original position.

Check that the encoder position value changes by the correct amount for each revolution of the encoder. For an incremental encoder, the value should change by 4 x the resolution of the encoder in pulses per revolution (ppr) providing the default value of FS0 is being used.

For absolute encoders, check that the encoder position value is consistent, for a given encoder position, when the SRV300 is powered up.

From an installation point of view, check that the cable length does not exceed the maximum length recommended for the type of encoder being used. Also check the integrity of the screen connections.

For completeness, the encoder input circuitry is given below.

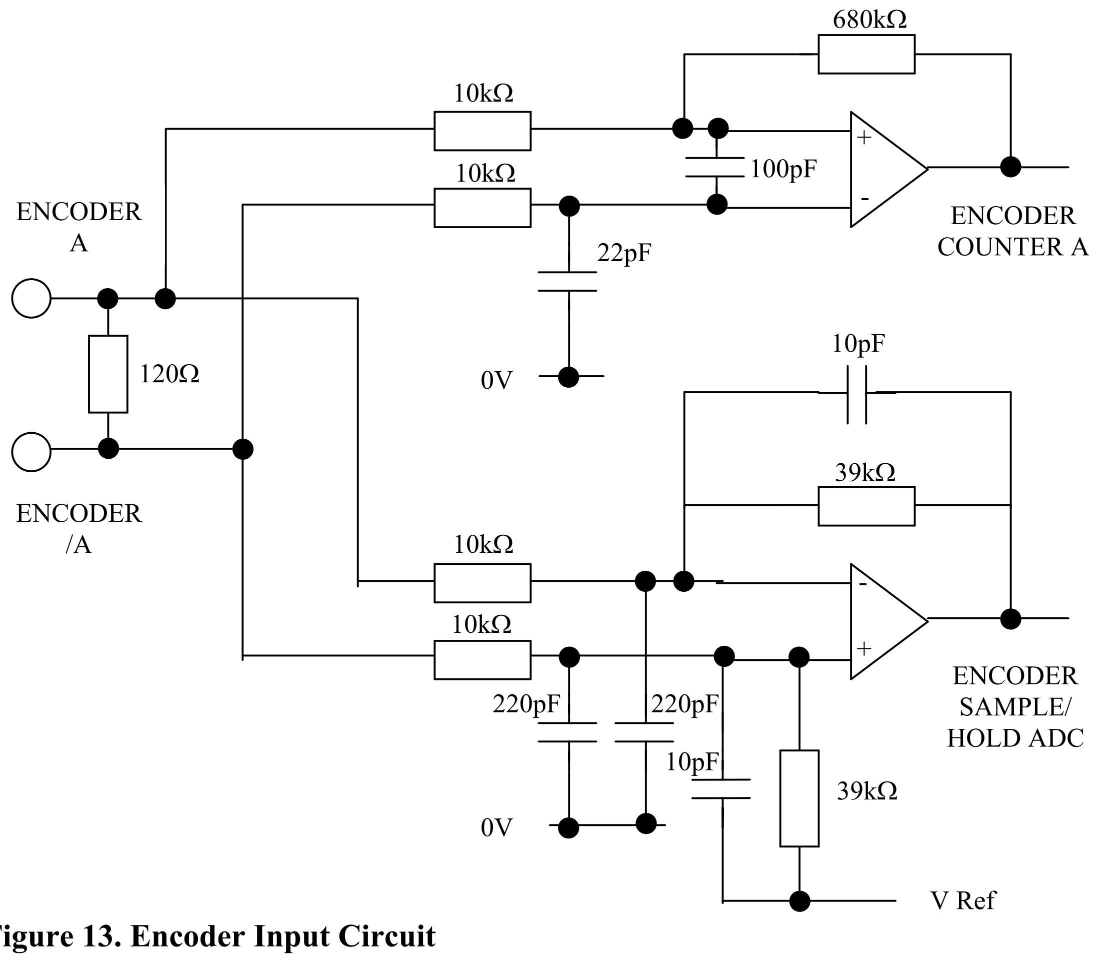


Figure 13. Encoder Input Circuit

4.8 Position monitoring

The DM command can be used to monitor the demand and actual positions of a motor channel. The display will also show the position error. (The DO command will switch this off).

The trace command (TR) together with the trace word (TW) will provide additional diagnostics and can be used to report master axis position information at the same time as a slave axis. Refer to the PTS Reference Manual for more details.

PTS Scope allows position information to be monitored graphically. Four traces are available to allow comparisons between channels. PTS Scope can be used to monitor additional parameters in a system. Refer to the on-line help for more details on the capability of PTS Scope.

4.9 Fault logging

It is often necessary to record the events leading up to an error. The TW, LG and DG commands are available to define what and how much information is to be logged. Full details are provided in the PTS Reference Manual.

Note: the QQ command on the SRV300 will not work and parameters can't be changed from Drives*Window* if there is a fault condition in the drive. This fault can be cleared by from Drives*Window* or the ABB Control Panel by selecting LOCAL and then RESET.

4.10 Board Configuration

Two jumper blocks are provided on the SRV300 board. These are identified as J1 and J2. There should be no need for the end-user to change these jumper settings. The factory settings are shown below.

4.10.1 J1: Reset and interrupt configuration

Jumper J1 is used to set up the power up reset options and interrupt signals for the MC68376 processor. It is factory-set with pins 7 and 8 linked (/DUARTIRQ linked to /IRQ2).

4.10.2 J2: Serial port A override

The serial ports on the SRV300 module can be configured for either RS-232 or RS-485 operation. This is software–selected using the CF command. However, J2 allows this software configuration for port A to be overridden for testing. For normal operation under software control, pins 1 and 2 should be linked. To force RS-232 operation, pins 3 and 4 should be linked.

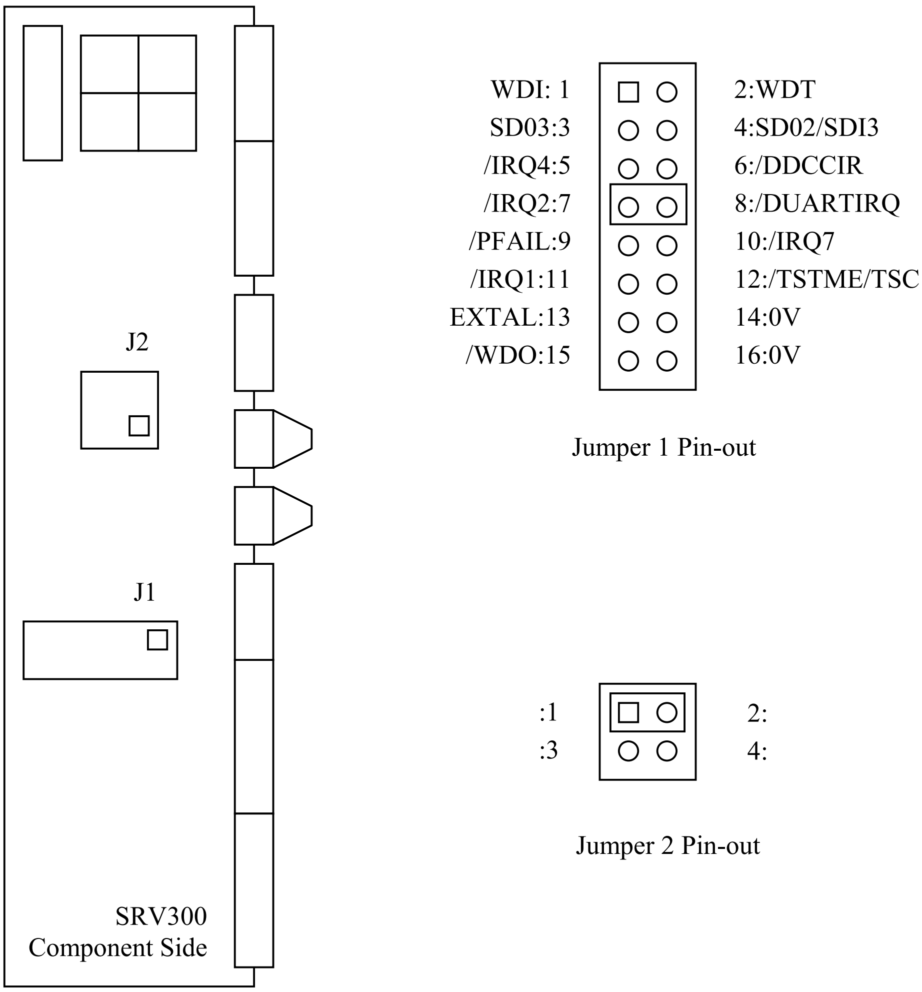


Figure 14. Jumper Locations

4.11 Replacing Equipment

As described in section 2.2 above, each drive requires 3 boards. In the event of a board needing replacing, it is important to understand the implications, over and above the physical replacement of the board itself.

4.11.1 Replacing the SRV300

Following a replacement of the SRV300 board, it will be necessary to define its module number and how many of its channels are to be used. It will then be necessary to download the application software via the Machine Manager.

The module number and the number of channels should be set as described in section 2.8. The system should then be rebooted and the application software downloaded via the Machine Manager. The program should then be saved using the SP command.

Static precautions should be taken when handling the board.

5. Equipment Interconnection Diagrams

The following pages provide equipment interconnection schematic diagrams which identify the cables, adaptors and ports which are required when building up a SERVOnet system using the SRV300. The schematics are grouped in terms of their equipment mix and clarify the where 9-pin D and RJ45 connectors are used.

Contents:

Scheme 1	Machine Manager, 2 x ABB/SRV300 Drives
Scheme 2	Machine Manager, 2 x ABB/SRV300 Drives, 1 x Q-Motion 1
Scheme 3	As scheme 2 but with Q-Motion as last node
Scheme 4	Machine Manager, 2 x ABB/SRV300 Drives, 1 x Q-Motion 1, CANbus encoder
Scheme 5	Mini Machine Manager, 2 x ABB/SRV300 Drives
Scheme 6	Mini Machine Manager, 2 x ABB/SRV300 Drives, 1 x Q-Motion 1
Scheme 7	Mini Machine Manager, 2 x ABB/SRV300 Drives, 1 x Q-Motion 1, CANbus encoder
Scheme 8	2 x ABB/SRV300 Drives (Synchrolink)
Scheme 9	Standalone Drive with HMI, programming PC and CANbus encoder.
Scheme 10	Standalone drive with CANopen I/O.
Scheme 11	Two Standalone Drives Synchrolinked together with CANopen encoder and CANopen I/O.
Scheme 12	Mini Machine Manager, 2 x ABB/SRV300 Drives, CANopen encoder and CANopen I/O.

Cables and connectors in the above 8 schemes are identified using CBA part numbers. For reference, the pin-outs of these cables and connectors are detailed in the subsequent drawings. A separate drawing is used for each part number. These cables and connectors are all available from Quin Systems and it is suggested that Quin-supplied parts are used wherever possible. However, to allow cables/connectors to be checked or made-up “in the field”, the user can make reference to the information in these attached drawings.

The content of each drawing has been taken from the Quin master drawings on the issue date of this manual as shown on the front page. Each drawing in this manual includes a cross reference to the Quin master drawing number. Please check the Quin web site to check for any up issues to these drawings or to this manual. A password is required for access to the web site. Please contact Quin Systems Ltd for help. Contact details are included on page ii of this manual. The drawings are numbered as follows:

DRG01	CBA137/A	SERVOnet feed lead (9-pin D connector)
DRG02	CBA137/B	SERVOnet terminator (9-pin D connector)
DRG03	CBA137/X	SERVOnet lead (9-pin D connectors)
DRG04	CBA151/B	SERVOnet terminator (RJ45 connector)
DRG05	CBA151/X	SERVOnet lead (RJ45 connectors)
DRG06	CBA152/FEMALE	RJ45 to 9-pin D female adaptor
DRG07	CBA152/MALE	RJ45 to 9-pin D male adaptor
DRG08	(No CBA number)	CANbus encoder connections
DRG09	CBA139/A	Serial lead adaptor for ports A and B

DRG10	CBA139/B	Serial lead for port A
DRG11	(No CBA number)	CANopen I/O connections
DRG12	(No CBA number)	Encoder cable assembly (square wave)
DRG13	(No CBA number)	Encoder cable assembly (sinusoidal)
DRG14	(No CBA number)	Encoder cable assembly (SSI)
DRG15	(No CBA number)	Encoder cable assembly (Sincoder)
DRG16	(No CBA number)	Encoder cable assembly (EnDat)
DRG17	(No CBA number)	Encoder cable assembly (SinCos)

Quin Stock Code	Description
CBA137/A	SERVOnet power feed
CBA151/X	RJ45 SERVOnet lead [X = length (m)]
CBA151/B	RJ45 SERVOnet terminator
CBA152/MALE	RJ45 to 9-pin D Male Converter

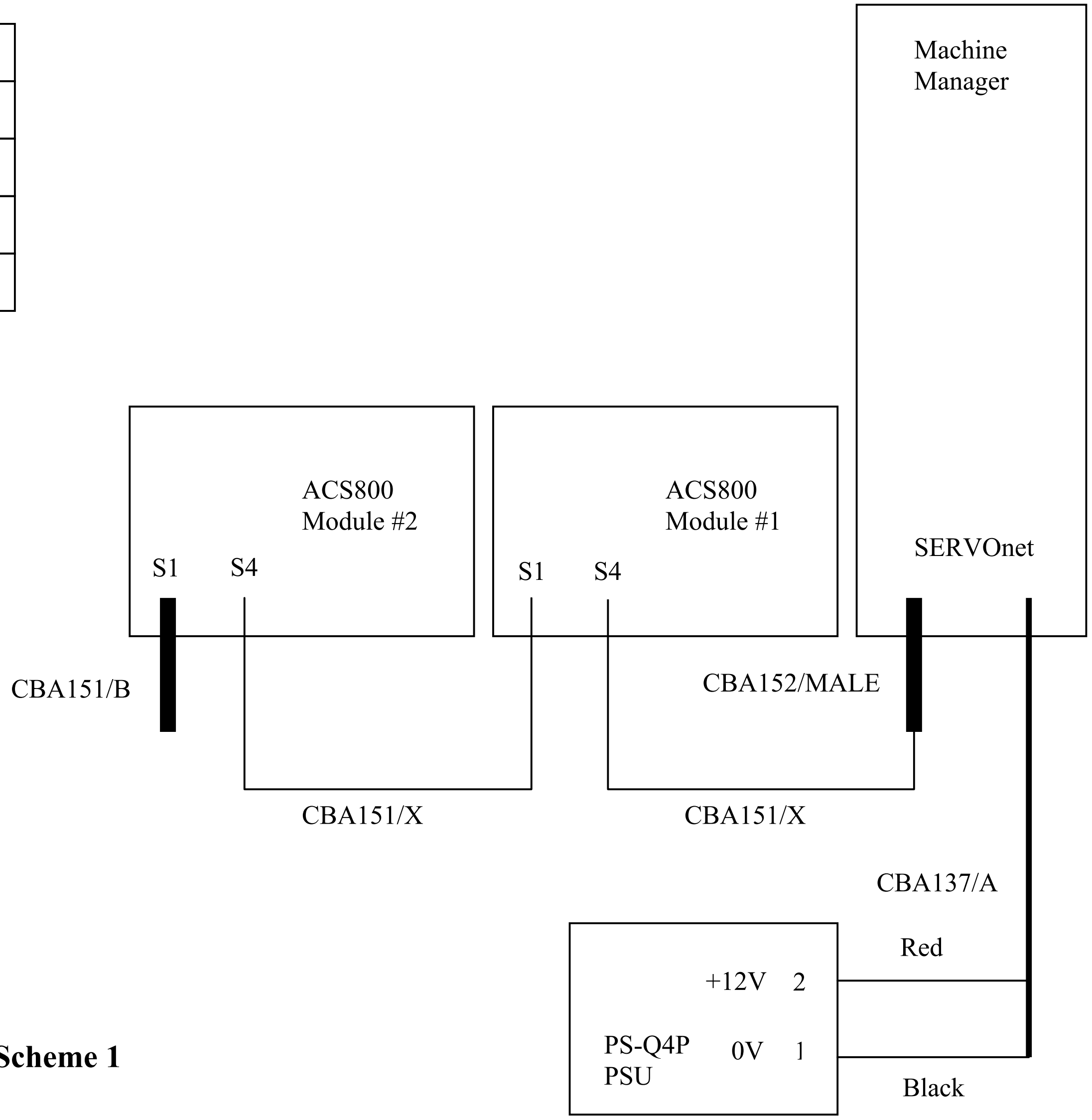


Figure 15 . Equipment Interconnection Diagram - Scheme 1

Quin Stock Code	Description
CBA137/A	SERVOnet power feed
CBA137X	D-type SERVOnet lead [X = length (m)]
CBA151/X	RJ45 SERVOnet lead [X = length (m)]
CBA151/B	RJ45 SERVOnet terminator
CBA152/MALE	RJ45 to 9-pin D Male Converter

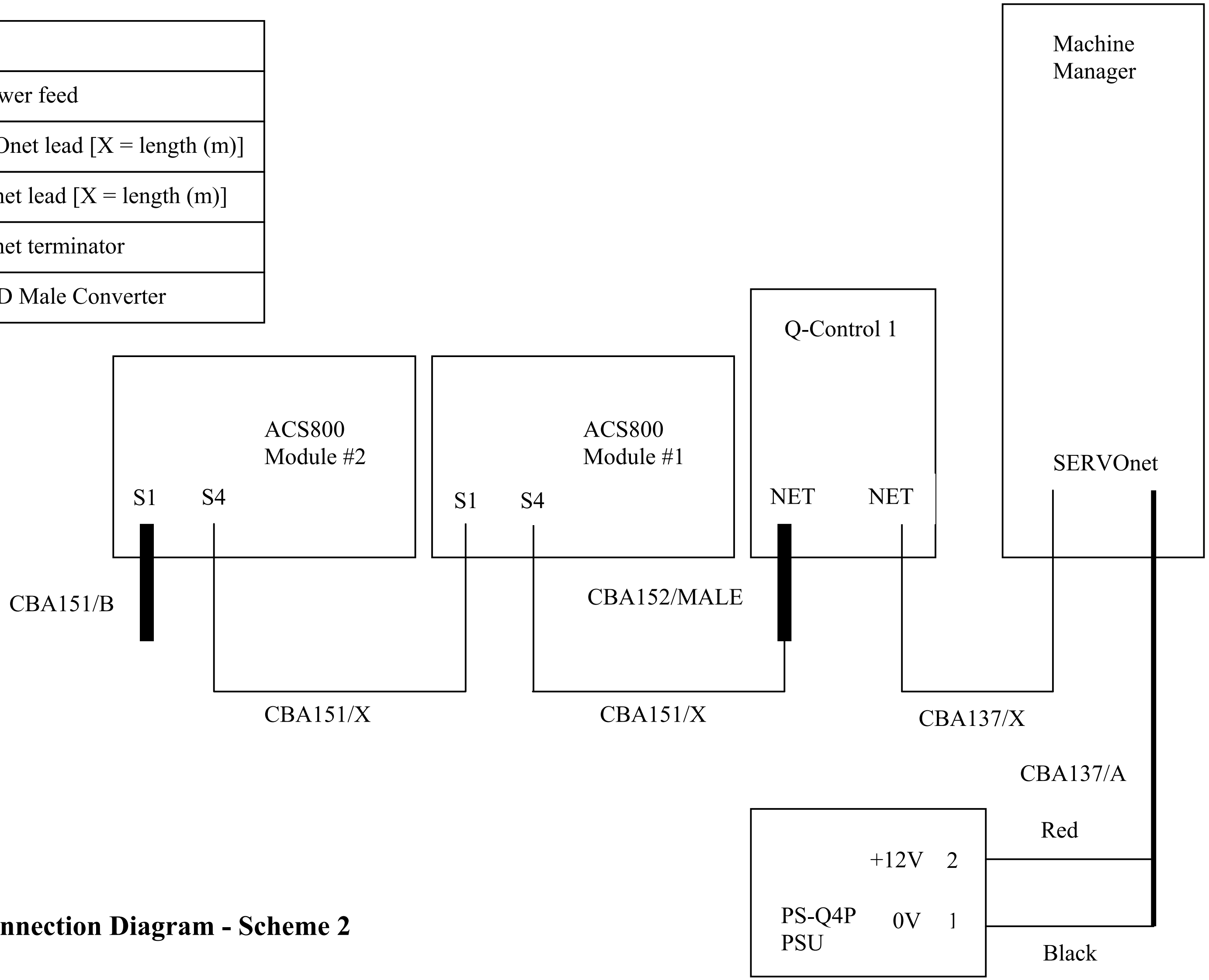


Figure 16. Equipment Interconnection Diagram - Scheme 2

Quin Stock Code	Description
CBA137/A	SERVOnet power feed
CBA137/B	D-type SERVOnet terminator
CBA151/X	RJ45 SERVOnet lead [X = length (m)]
CBA152/MALE	RJ45 to 9-pin D Male Converter

Quin Stock Code	Description
CBA152/FEMALE	RJ45 to 9-pin D Female Converter

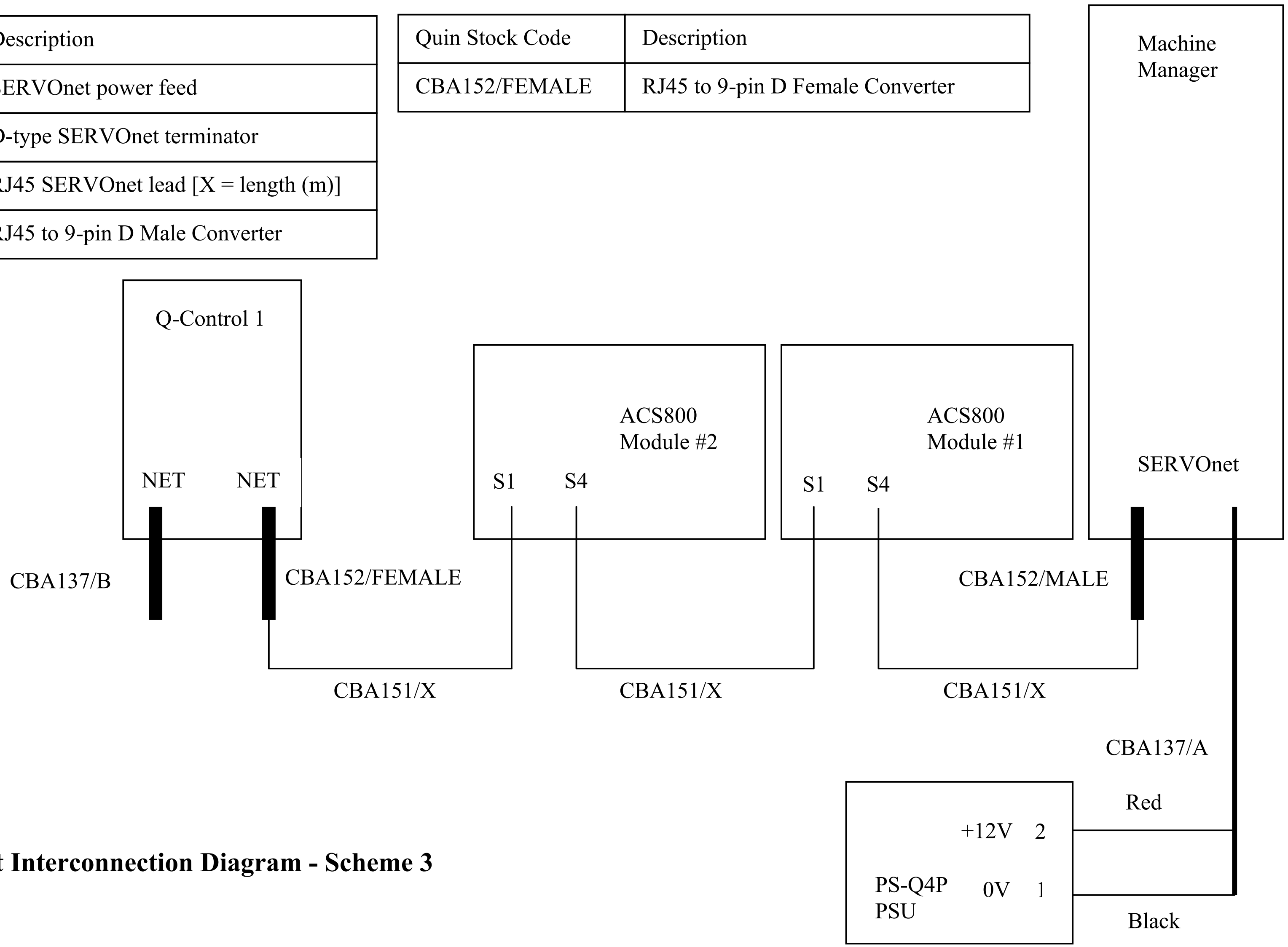
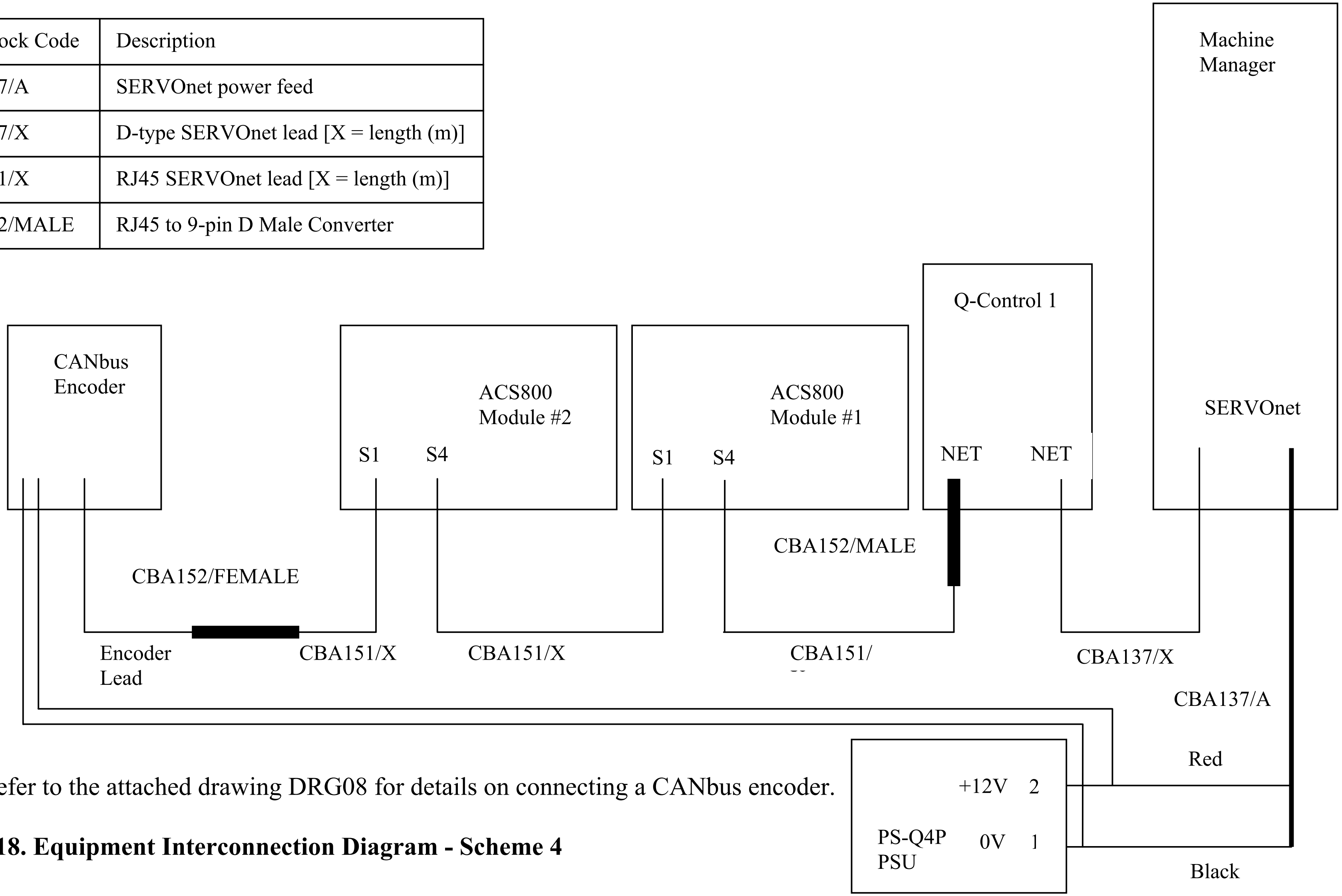


Figure 17. Equipment Interconnection Diagram - Scheme 3

Quin Stock Code	Description
CBA137/A	SERVOnet power feed
CBA137/X	D-type SERVOnet lead [X = length (m)]
CBA151/X	RJ45 SERVOnet lead [X = length (m)]
CBA152/MALE	RJ45 to 9-pin D Male Converter



Note: Refer to the attached drawing DRG08 for details on connecting a CANbus encoder.

Figure 18. Equipment Interconnection Diagram - Scheme 4

Quin Stock Code	Description
CBA137/A	SERVOnet power feed
CBA151/X	RJ45 SERVOnet lead [X = length (m)]
CBA151/B	RJ45 SERVOnet terminator
CBA152/MALE	RJ45 to 9-pin D Male Converter

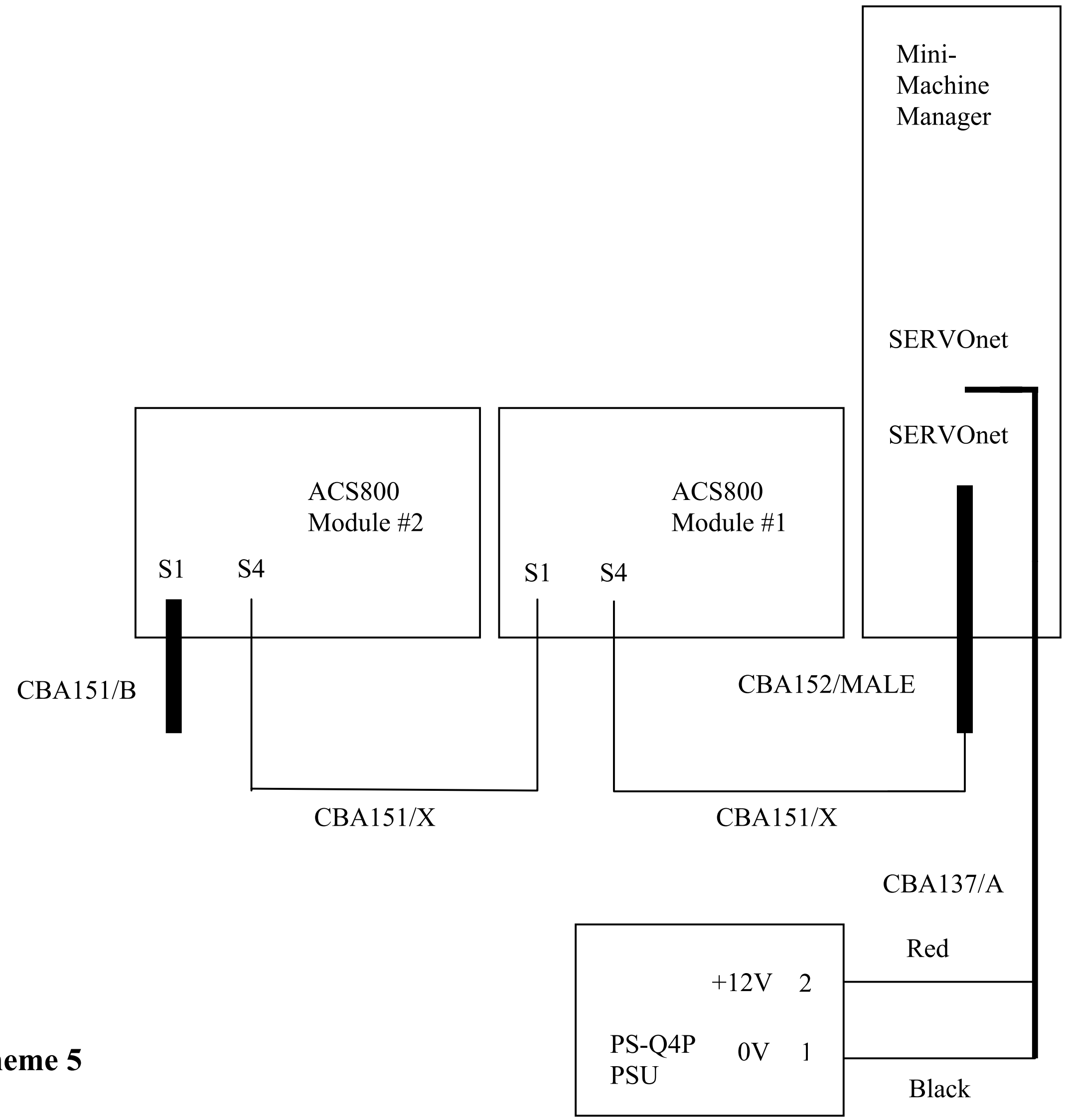


Figure 19. Equipment Interconnection Diagram - Scheme 5

Quin Stock Code	Description
CBA137/A	SERVOnet power feed
CBA137/X	D-type SERVOnet lead [X = length (m)]
CBA151/X	RJ45 SERVOnet lead [X = length (m)]
CBA151/B	RJ45 SERVOnet terminator
CBA152/MALE	RJ45 to 9-pin D Male Converter

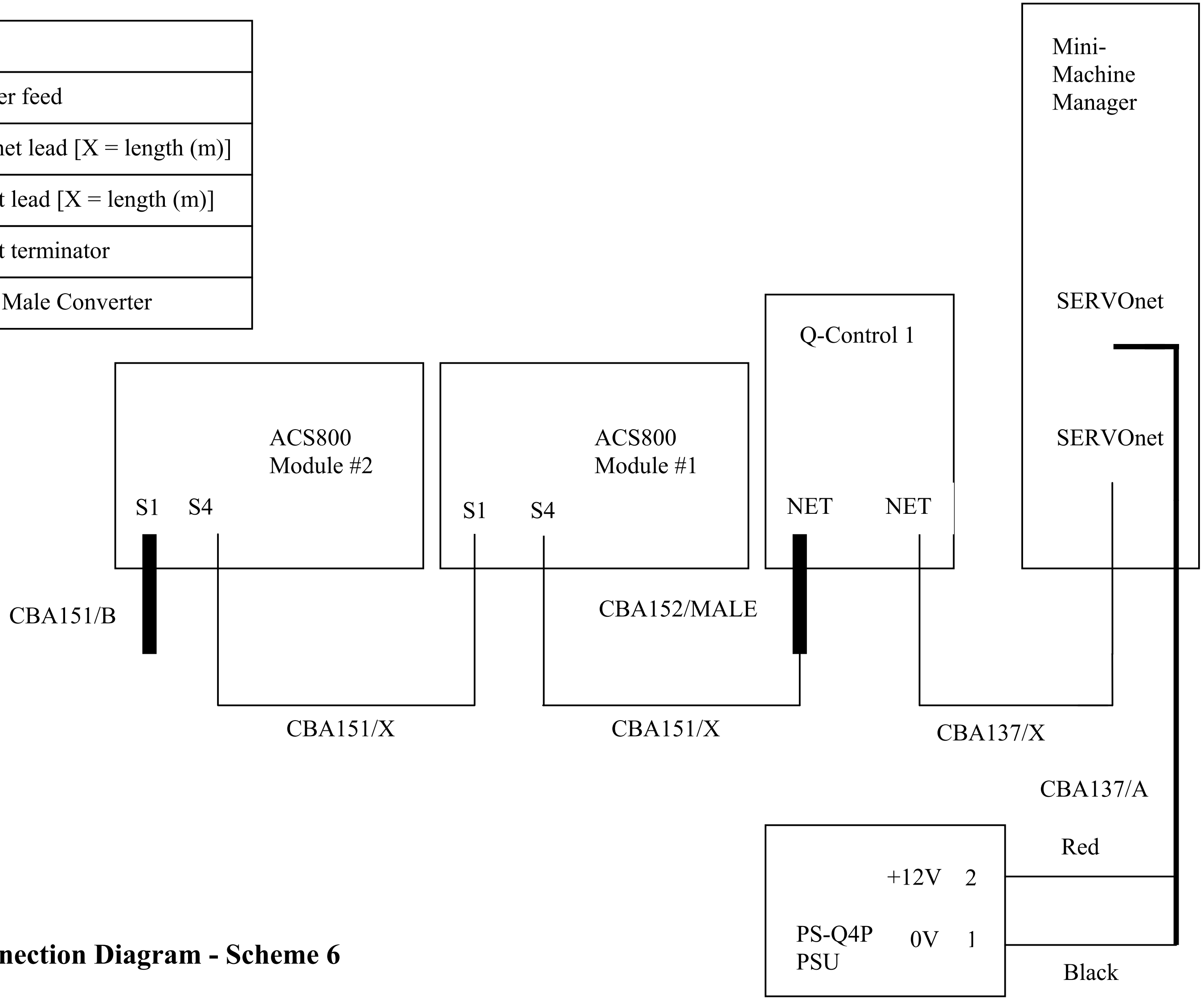
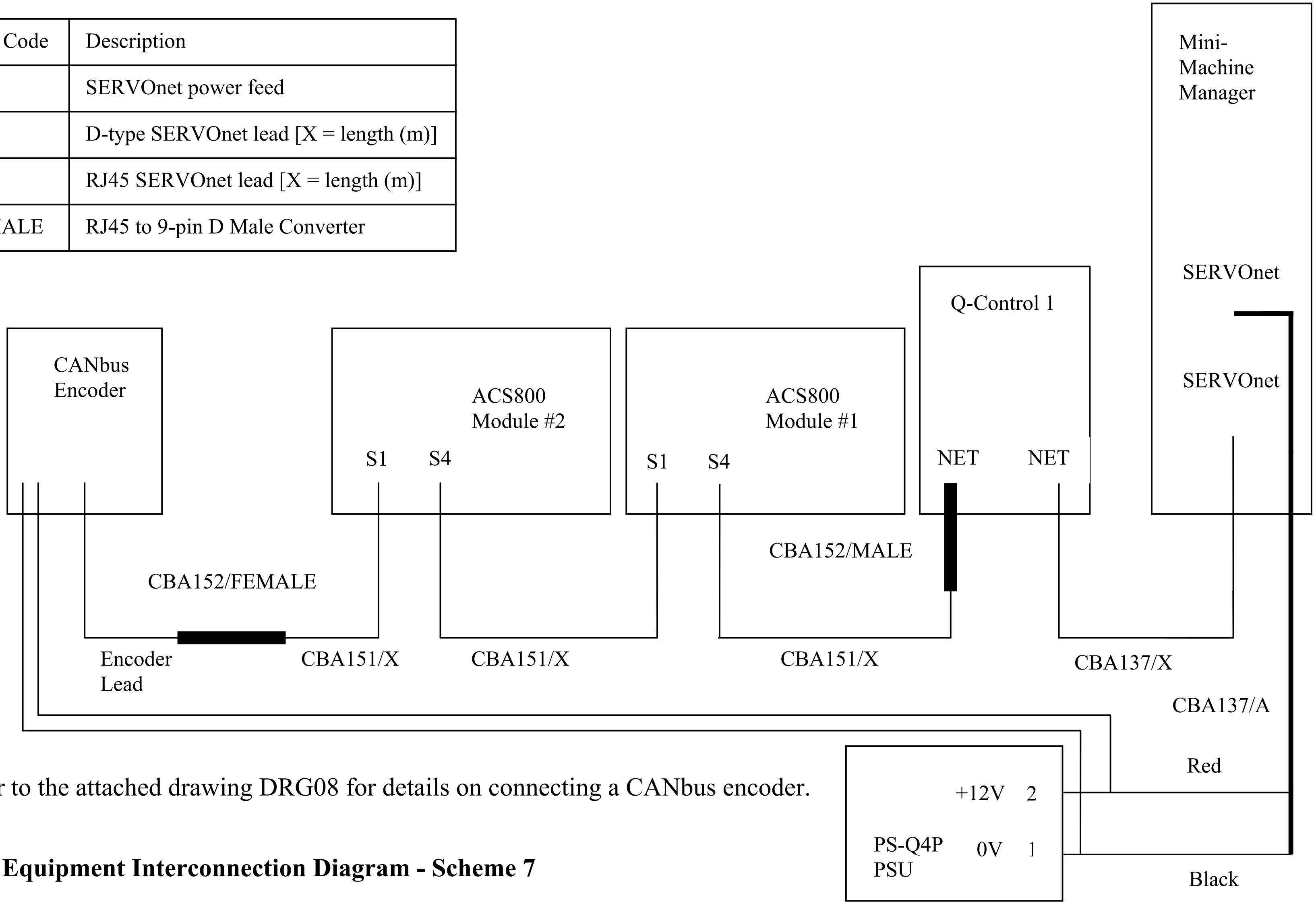


Figure 20. Equipment Interconnection Diagram - Scheme 6

Quin Stock Code	Description
CBA137/A	SERVOnet power feed
CBA137/X	D-type SERVOnet lead [X = length (m)]
CBA151/X	RJ45 SERVOnet lead [X = length (m)]
CBA152/MALE	RJ45 to 9-pin D Male Converter



Note: Refer to the attached drawing DRG08 for details on connecting a CANbus encoder.

Figure 21. Equipment Interconnection Diagram - Scheme 7

Quin Stock Code	Description
CBA137/A	SERVOnet power feed
CBA151/X	RJ45 SERVOnet lead [X = length (m)]
CBA151/B	RJ45 SERVOnet terminator
CBA152/MALE	RJ45 to 9-pin D Male Converter

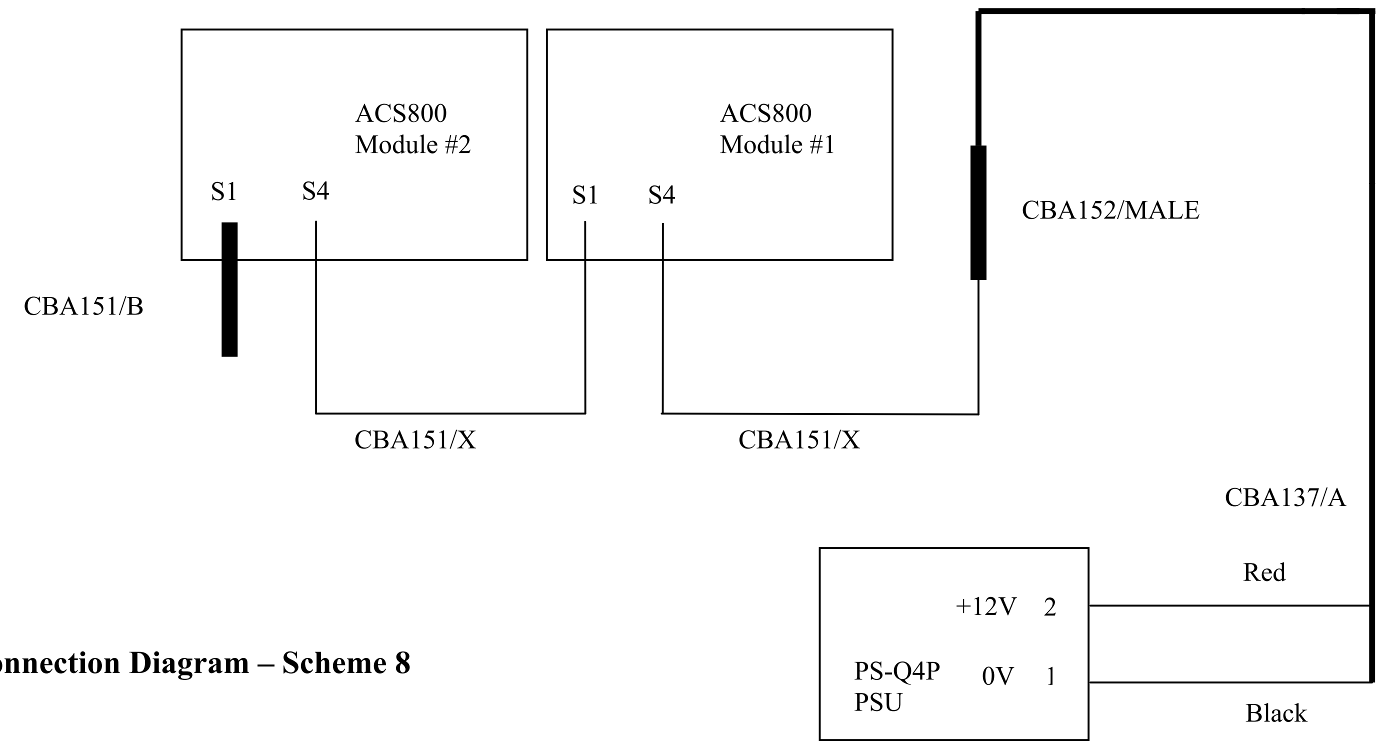
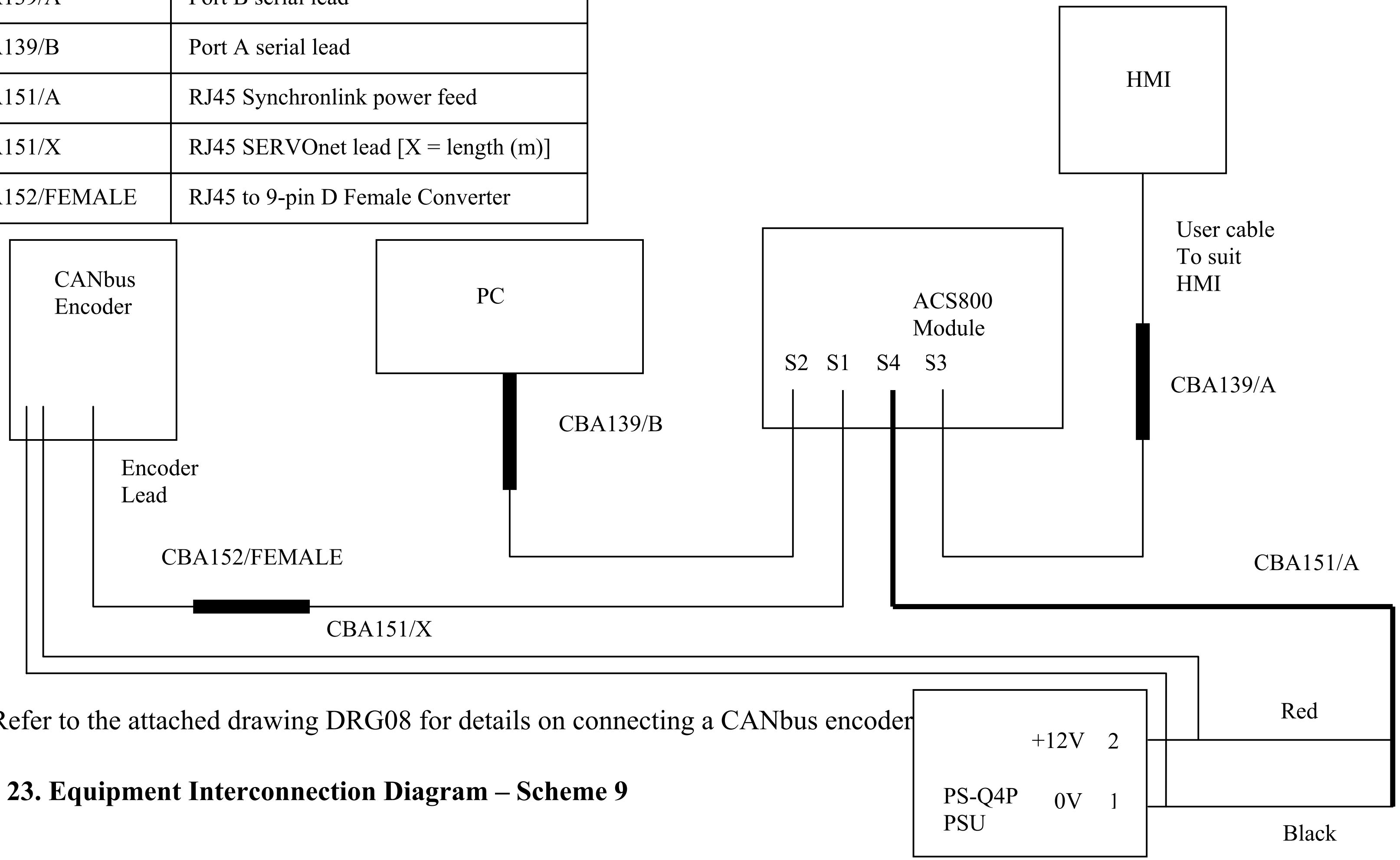


Figure 22. Equipment Interconnection Diagram – Scheme 8

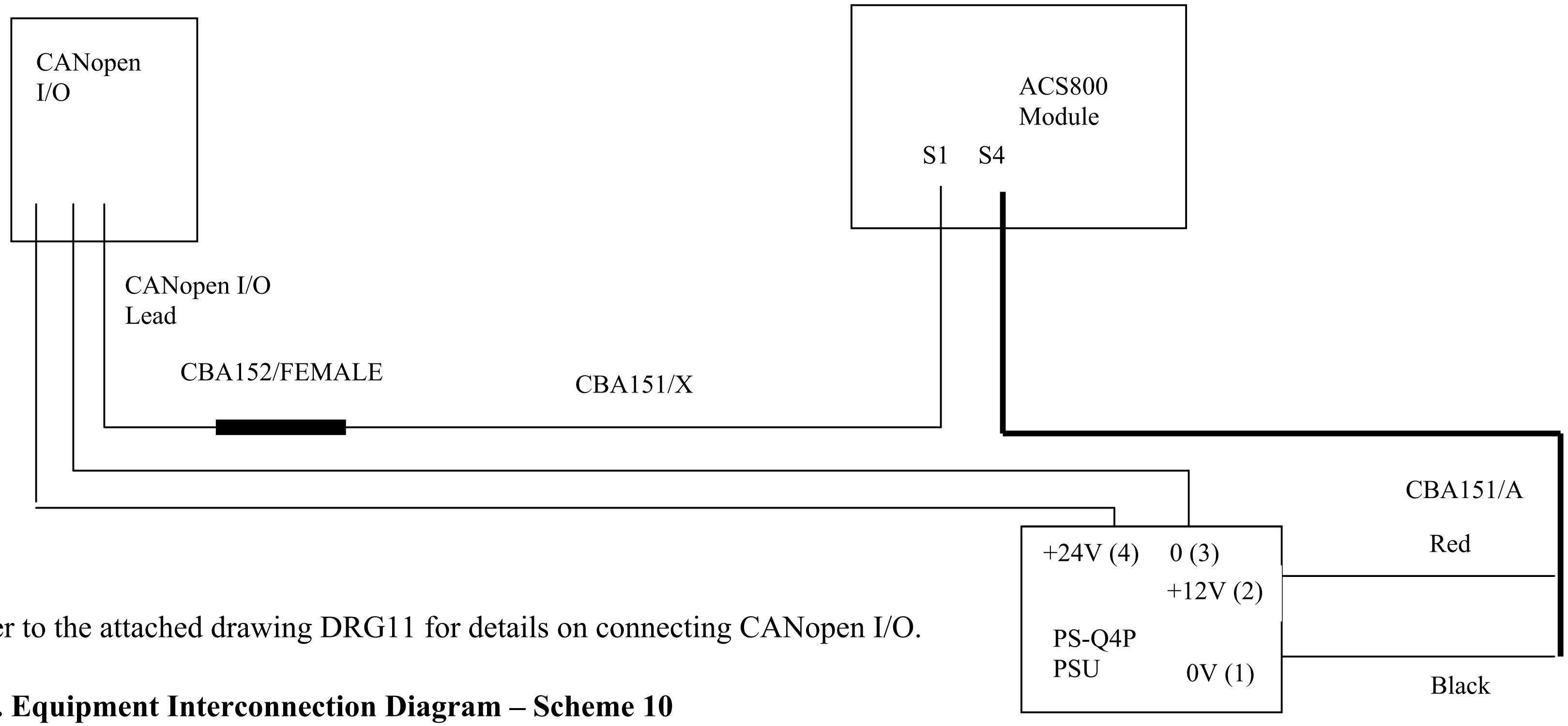
Quin Stock Code	Description
CBA139/A	Port B serial lead
CBA139/B	Port A serial lead
CBA151/A	RJ45 Synchronlink power feed
CBA151/X	RJ45 SERVOnet lead [X = length (m)]
CBA152/FEMALE	RJ45 to 9-pin D Female Converter



Note: Refer to the attached drawing DRG08 for details on connecting a CANbus encoder

Figure 23. Equipment Interconnection Diagram – Scheme 9

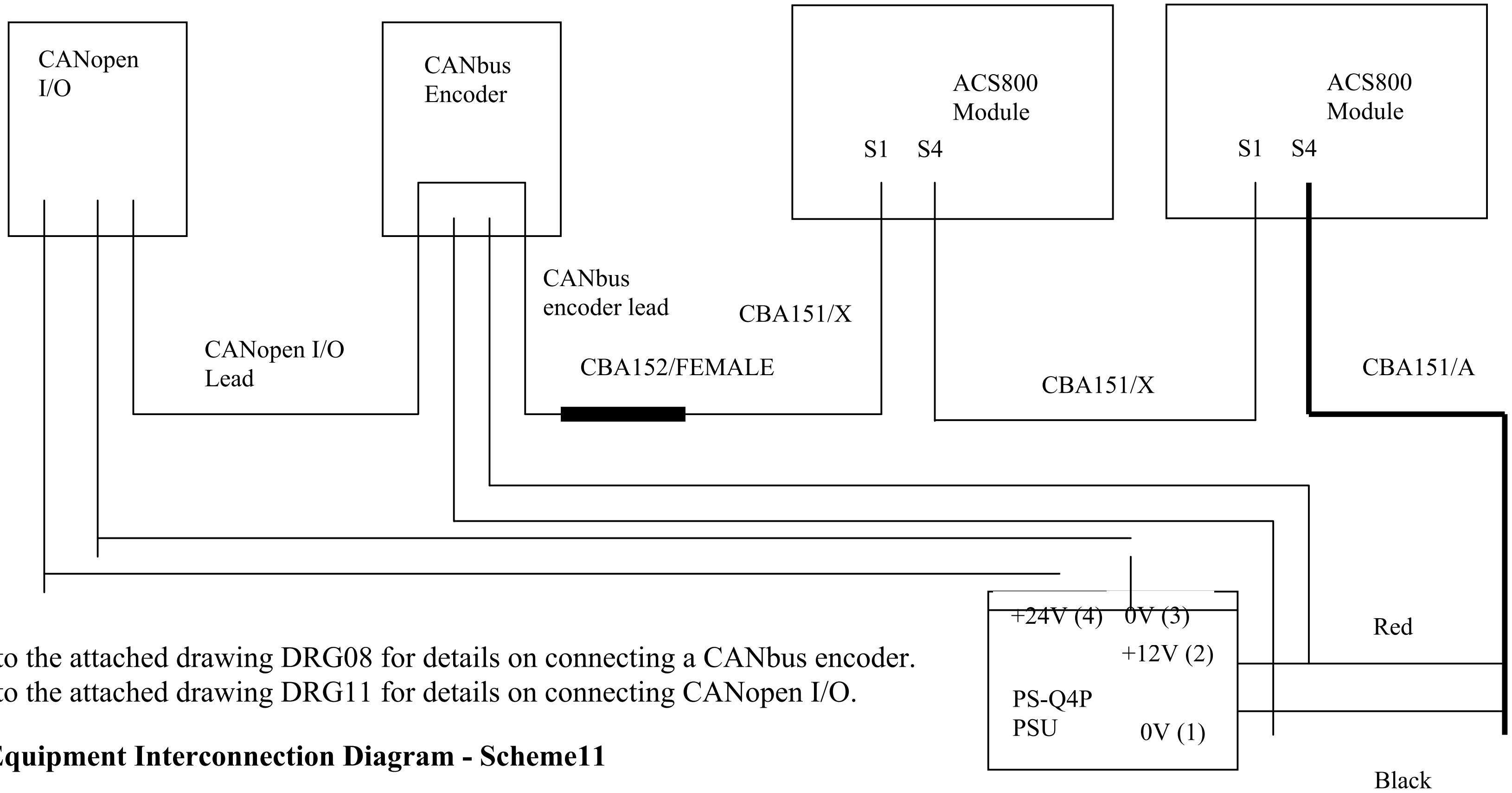
Quin Stock Code	Description
CBA151/A	RJ45 Synchronlink power feed
CBA151/X	RJ45 SERVOnet lead [X = length (m)]
CBA152/FEMALE	RJ45 to 9-pin D Female Converter



Note: Refer to the attached drawing DRG11 for details on connecting CANopen I/O.

Figure 24. Equipment Interconnection Diagram – Scheme 10

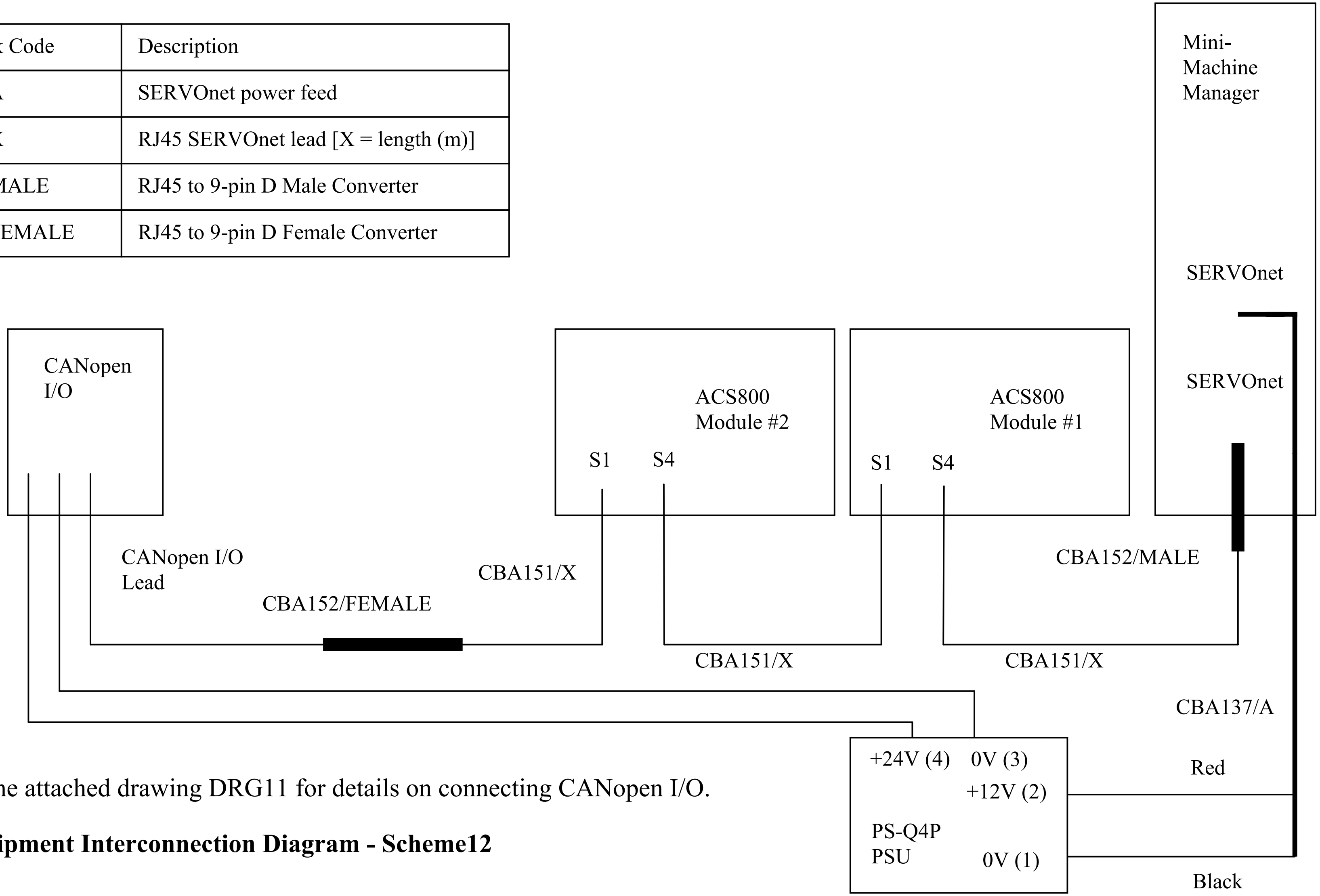
Quin Stock Code	Description
CBA151/A	RJ45 Synchronlink power feed
CBA151/X	RJ45 SERVOnet lead [X = length (m)]
CBA152/FEMALE	RJ45 to 9-pin D Female Converter



Note: Refer to the attached drawing DRG08 for details on connecting a CANbus encoder.
Note: Refer to the attached drawing DRG11 for details on connecting CANopen I/O.

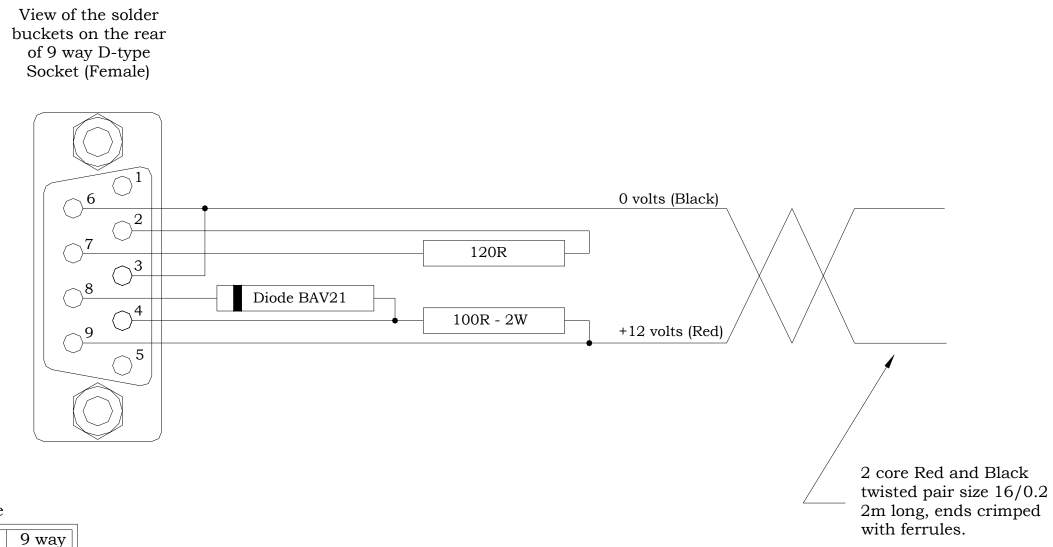
Figure 25. Equipment Interconnection Diagram - Scheme11

Quin Stock Code	Description
CBA137/A	SERVOnet power feed
CBA151/X	RJ45 SERVOnet lead [X = length (m)]
CBA152/MALE	RJ45 to 9-pin D Male Converter
CBA152/FEMALE	RJ45 to 9-pin D Female Converter



Note: Refer to the attached drawing DRG11 for details on connecting CANopen I/O.

Figure 26. Equipment Interconnection Diagram - Scheme12



Pin-Out Table

Function	9 way socket
Reserved	1
CAN_L	2
CAN_GND	3
SERVOnet continuity line	4
CAN_Shield	5
CAN_GND	6
CAN_H	7
Error line	8
CAN_V+	9

NOTES :

1. Quin cable stock no. : CBA137/A.
2. Also shown in Quin drawing no. : QDV-2-2-007.

Issue	Date	Modification Notes	Drawn	Approved
A	30/09/02	First Issue	HO	GCB

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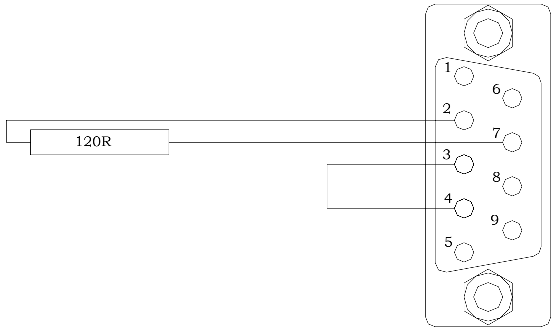
Title

SERVOnet Feed Lead (9-pin D-Connector)

S- No.	N/A	Issue	Scale
Drg. No.	**DRG01**	**A**	**1:1**

View of the solder buckets on the rear of 9 way D-type Plug (Male)



Pin-Out Table

Function	9 way plug
Reserved	1
CAN_L	2
CAN_GND	3
SERVOnet continuity line	4
CAN_Shield	5
CAN_GND	6
CAN_H	7
Error line	8
CAN_V+	9

NOTES :

1. Quin cable stock no. : CBA137/B.
2. Also shown in Quin drawing no. : QDV-2-2-007.

Issue	Date	Modification Notes	Drawn	Approved
A	01/10/02	First Issue	HO	GCB

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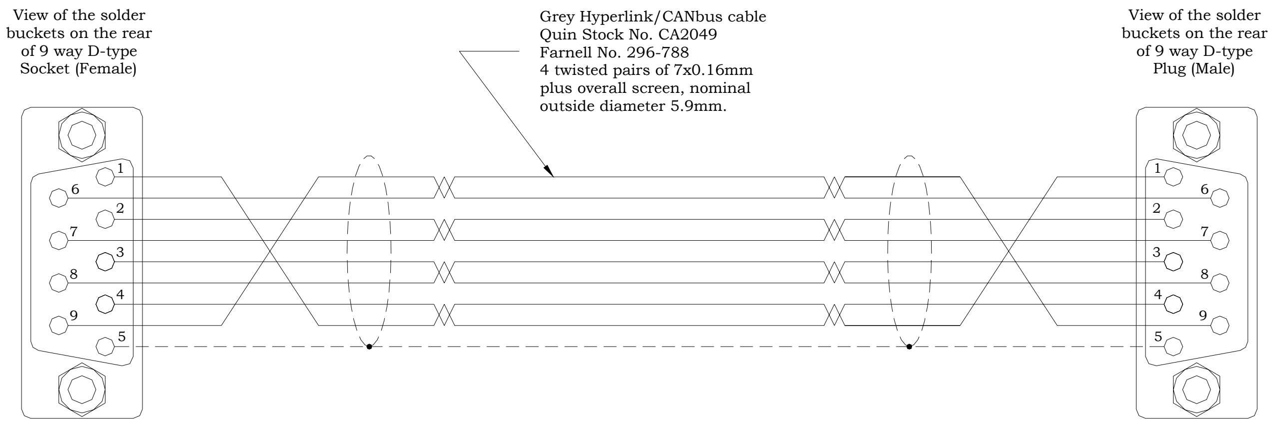
Title: **SERVOnet Terminator (9-pin D-Connector)**

S- No.	N/A	Issue	Scale
Drg. No.	**DRG02**	**A**	**1:1**



Pin-Out Table

Function	Cable colour	9 way socket	9 way plug
Reserved	Brown	1	1
CAN_L	White/Orange	2	2
CAN_GND	White/Green	3	3
SERVOnet continuity line	White/Brown	4	4
CAN_Shield	Screen	5	5
CAN_GND	Blue	6	6
CAN_H	Orange	7	7
Error line	Green	8	8
CAN_V+	White/Blue	9	9

NOTES :

1. Quin cable stock no. : CBA137/(cable length in metres).
2. Also shown in Quin drawing no. : QDV-2-2-007.

Issue	Date	Modification Notes	Drawn	Approved
A	03/10/02	First Issue	HO	GCB

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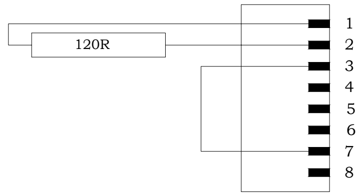
Title: **SERVOnet Lead (9-pin D-Connector)**

S- No.	Drg. No.	Issue	Scale
N/A	DRG03	A	1:1

RJ45 Male connector
viewed from the
contacts side



Use Farnell no. 546-124 or RS no. 455-258
Both use same termination tool AMP ref. no.
734218-3 available from :
Farnell no. 546-148 or RS no. 120-5307

Pin-Out Table

Function	9 way plug
CAN_L	1
CAN_H	2
CAN_GND	3
CAN_GND	4
CAN_V+	5
Error line	6
SERVOnet continuity line	7
CAN_Shield	8

NOTES :

1. Quin cable stock no. : CBA151/B.
2. Also shown in Quin drawing no. : QDV-2-2-011.

Issue	Date	Modification Notes	Drawn	Approved
A	03/10/02	First Issue	HO	GCB

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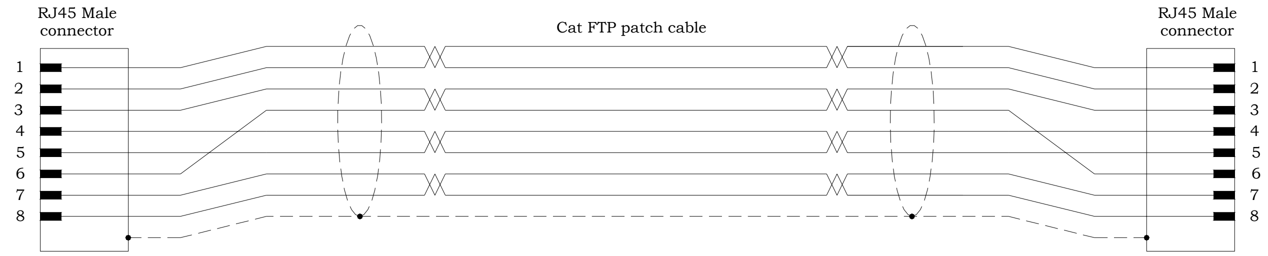
Title
SERVOnet Terminator (RJ45 Connector)

S- No.	Issue	Scale
N/A		
Drg. No. **DRG04**	**A**	**1:1**



Pin-Out Table

Function	9 way plug
CAN_L	1
CAN_H	2
CAN_GND	3
CAN_GND	4
CAN_V+	5
Error line	6
SERVOnet continuity line	7
CAN_Shield	8

Cable Numbers

Quin Stock No.	Length (m)	RS Part No.
CBA151/1	1	RS 405-4461
CBA151/2	2	RS 405-4477
CBA151/3	3	RS 405-4483
CBA151/5	5	RS 405-4506
CBA151/10	10	RS 405-4512

NOTES :

1. Quin cable stock no. : CBA151/cable length in metres. (see cable no. table)
2. Also shown in Quin drawing no. : QDV-2-2-011.

Issue	Date	Modification Notes	Drawn	Approved
A	04/10/02	First Issue	HO	GCB

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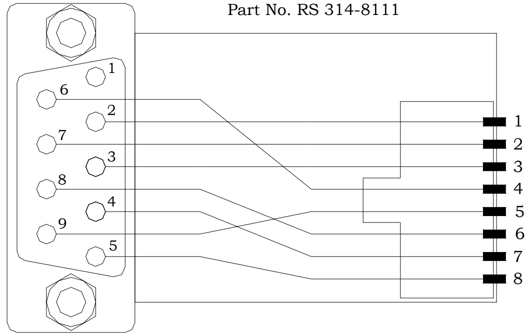
Title

SERVOnet Lead (RJ45 Connector)

S- No.	Issue	Scale
N/A		
Drg. No. **DRG05**	**A**	**1:1**

View inside 9 pin D-type Socket (Female) and the integrated RJ45 socket. Part No. RS 314-8111



Pin-Out Table

Function	Cable colour	9-pin D socket	RJ45 Socket
-	-	1	n/c
CAN_L	Blue	2	1
CAN_GND	Black	3	3
SERVOnet continuity line	Brown	4	7
CAN_Shield	Grey	5	8
CAN_GND	Red	6	4
CAN_H	Orange	7	2
Error line	Yellow	8	6
CAN_V+	Green	9	5

NOTES :

1. Quin cable stock no. : CBA152/FEMALE.
2. Also shown in Quin drawing no. : QDV-2-2-011.

Issue	Date	Modification Notes	Drawn	Approved
A	04/10/02	First Issue	HO	GCB

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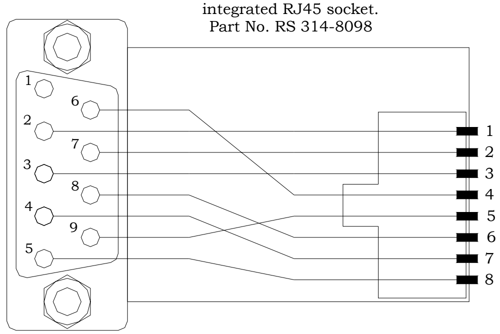
Title
RJ45 Socket to 9-pin D Socket (Female) SERVOnet Lead Adaptor

S- No. N/A | Issue A | Scale 1:1
Drg. No. **DRG06**

View inside 9 pin D-type Plug (Male) and the integrated RJ45 socket.
Part No. RS 314-8098



Pin-Out Table

Function	Cable colour	9-pin D socket	RJ45 Socket
-	-	1	n/c
CAN_L	Blue	2	1
CAN_GND	Black	3	3
SERVOnet continuity line	Brown	4	7
CAN_Shield	Grey	5	8
CAN_GND	Red	6	4
CAN_H	Orange	7	2
Error line	Yellow	8	6
CAN_V+	Green	9	5

NOTES :

1. Quin cable stock no. : CBA152/MALE.
2. Also shown in Quin drawing no. : QDV-2-2-011.

Issue	Date	Modification Notes	Drawn	Approved
A	04/10/02	First Issue	HO	GCB

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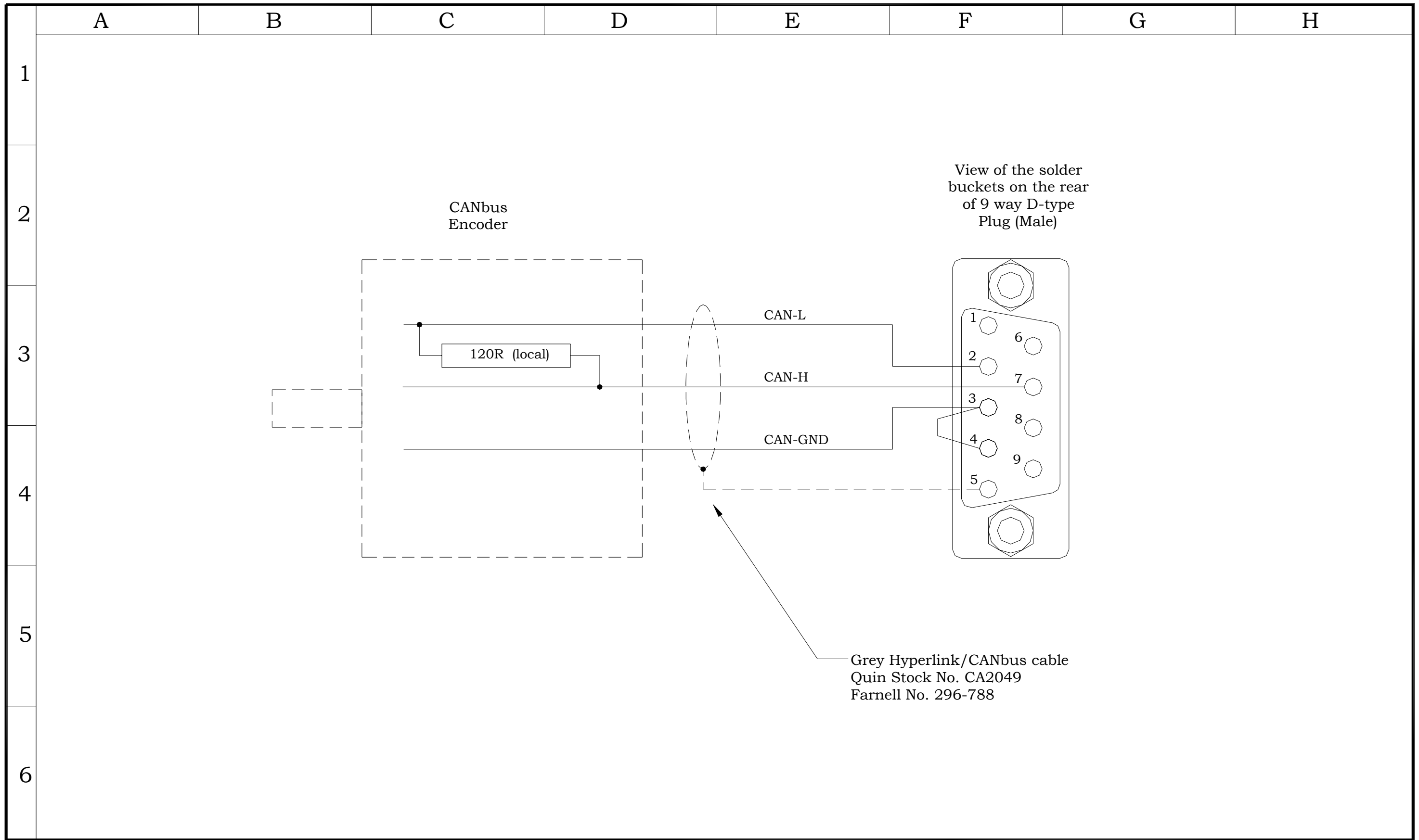
Title
RJ45 Socket to 9-pin D Plug (Male) SERVOnet Lead Adaptor

S- No.	Issue	Scale
N/A		
Drg. No. **DRG07**	**A**	**1:1**



Issue	Date	Modification Notes	Drawn	Approved
A	04/10/02	First Issue	HO	GCB

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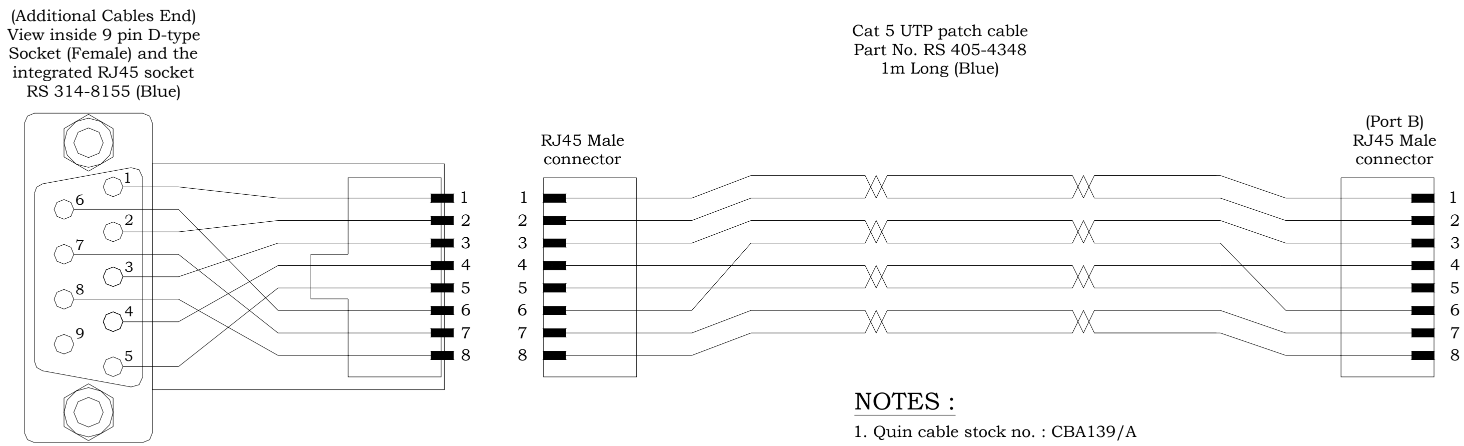
Title

CANbus Encoder connections (9-pin D-Connector)

S- No.	N/A	Issue	Scale
Drg. No.	**DRG08**	**A**	**1:1**



NOTES :

1. Quin cable stock no. : CBA139/A
2. Also shown in Quin drawing no. : QDV-2-2-018.

Pin-Out Table

RS485 Function	RS232 Function	Cable colour	9-pin D socket	RJ45 Socket
TERM-H	--	Blue	1	1
Tx DATA	RTS	Orange	2	2
Rx DATA	CTS	Black	3	3
TERM-L	--	Red	4	4
GND	GND	Green	5	5
+V BIAS	--	Yellow	6	6
/Tx DATA	Tx DATA	Brown	7	7
/Rx DATA	Rx DATA	Grey	8	8
--	--	-	9	--

NOTES FOR PORT (B) CONNECTION :

This Adaptor MUST be used in conjunction with the cables listed below to connect the RJ45 port B in a PTS unit to the following options :

1. OPERATOR PANEL : Extra cable needed **CBA118**
2. Mini Panel : Extra cable needed **CBA127**
3. PROFACE (RS232) : Extra cable needed **CBA169**
4. PROFACE (RS485) : Extra cable needed **CBA194**

NOTES FOR PORT (A) CONNECTION :

This Adaptor MUST be used in conjunction with cable part no. **CBA139** to connect PC Comm port to the RJ45 port A in a PTS unit.
Cable No. **CBA139B** can also be used to connect PC Comm port to the RJ45 port A in a PTS with a MAX length of 3m.

Issue	Date	Modification Notes	Drawn	Approved
A	04/10/02	First Issue	HO	GB
B	04/12/03	Combine tables and change dwg title and notes.	HO	GB

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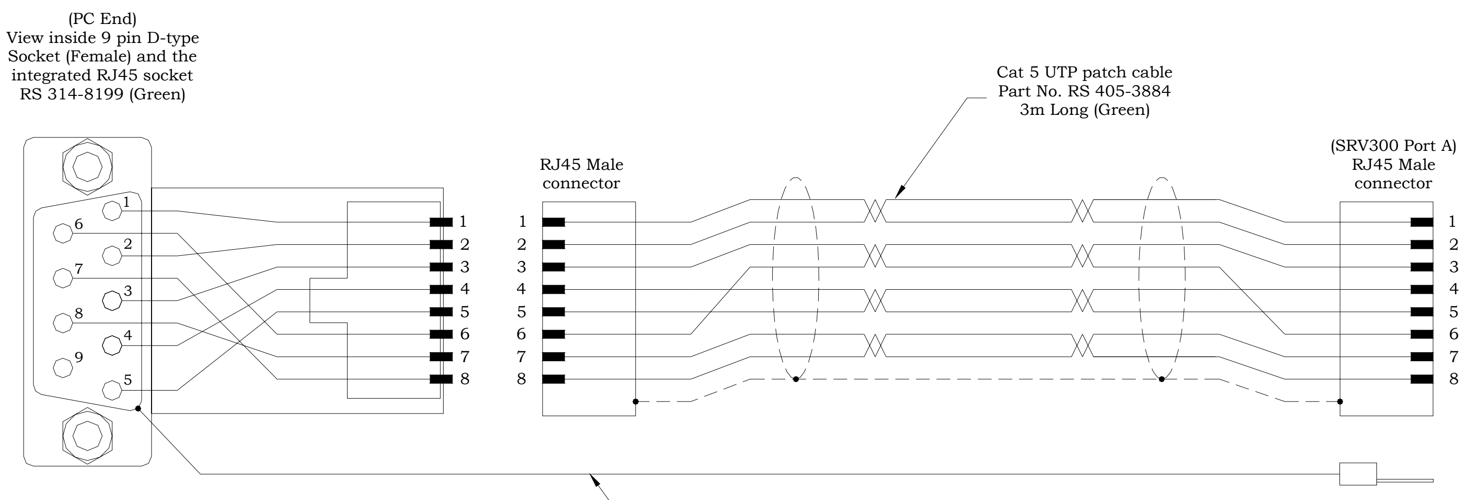
Title: **SRV300 Port A & B Adaptor (RJ45 to 9 Pin D Female)**

S- No. N/A | Issue | Scale
Drg. No. **DRG09** | **B** | **1:1**



RS232 Pin-Out Table

Function	Cable colour	9-pin D socket	RJ45 Socket
-	Blue	1	1
TXD	Orange	2	2
RXD	Black	3	3
-	Red	4	4
GND	Green	5	5
-	Yellow	6	6
CTS	Grey	7	8
RTS	Brown	8	7
-	-	9	n/c

NOTE :

1. This cable is NOT an adaptor, it is NOT suitable for use with further cable, and it is intended to directly connect the PC Comm port to the RJ45 port A in a PTS unit, with a MAX length of 3m.
2. Note the crossed connection at pins 7 & 8.
3. This cable cannot be used for Port B.
4. Refer to Cables no. **CBA139/B**.

Issue	Date	Modification Notes	Drawn	Approved
A	04/10/02	First Issue	HO	
B	04/12/03	Pins 7 & 8 are now crossed & add notes.	HO	
C	05/12/03	Reverse positions of pins 7&8 in both connectors.	HO	

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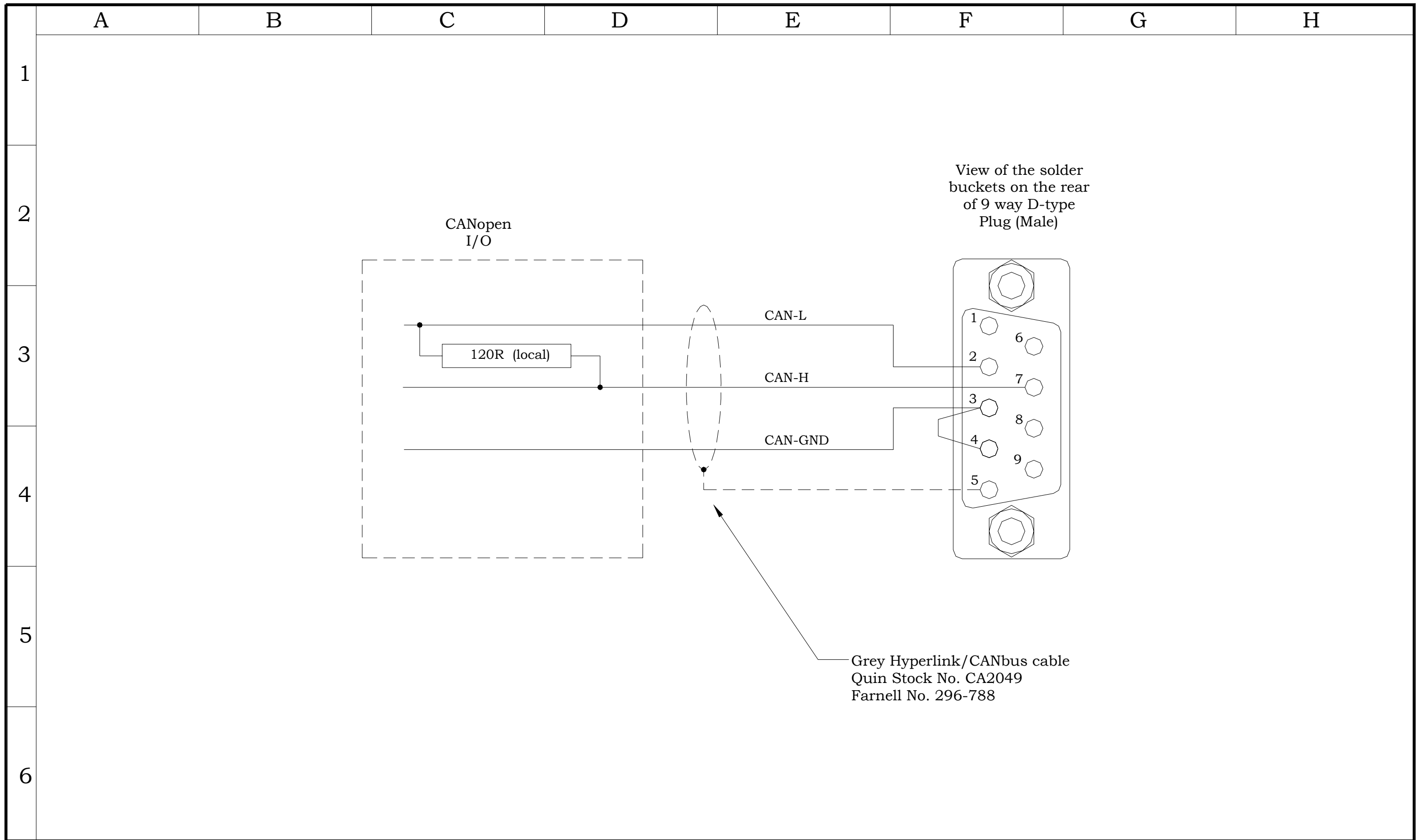
Title **SRV300 Programming Cable from PC COMM Port to SRV300 Port A (RJ45 Connector)**

S- No.	Issue	Scale
N/A		
Drg. No. **DRG10**	**C**	**1:1**



Issue	Date	Modification Notes	Drawn	Approved
A	04/10/02	First Issue	HO	GCB

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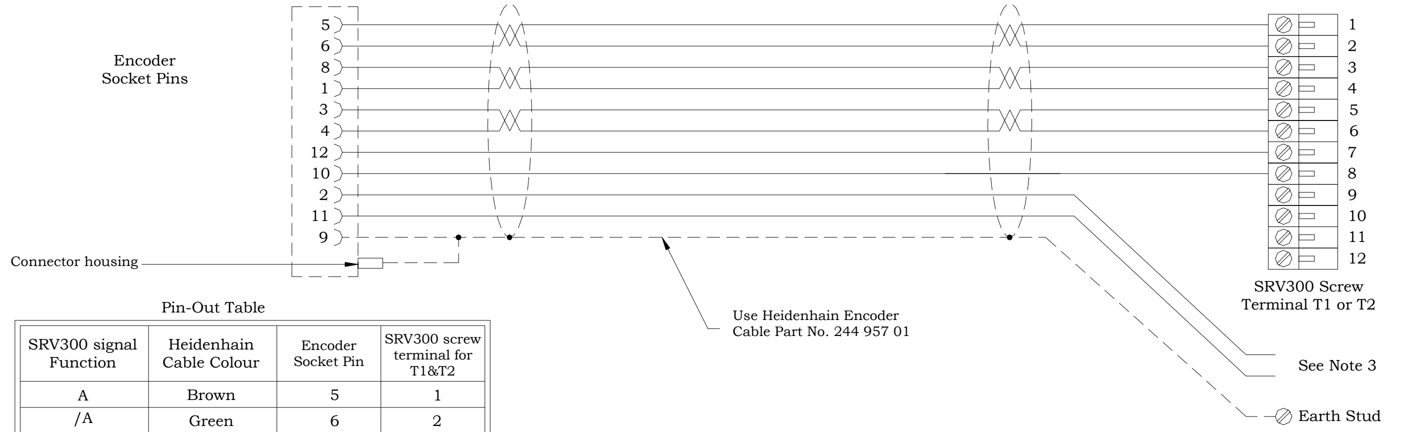
Title

CANopen I/O connections (9-pin D-Connector)

S- No.	Issue	Scale
N/A		
Drg. No. **DRG11**	**A**	**1:1**



Pin-Out Table

SRV300 signal Function	Heidenhain Cable Colour	Encoder Socket Pin	SRV300 screw terminal for T1&T2
A	Brown	5	1
/A	Green	6	2
B	Grey	8	3
/B	Pink	1	4
Z	Red	3	5
/Z	Black	4	6
+5V Supply	Brown/Green	12	7
+5V Sensor	Blue	2	See Note 3
0V Supply	White/Green	10	8
0V Sensor	White	11	See Note 3
Not Used			9
Not Used			10
Not Used			11
Not Used			12
	Screen	Pin 9 & connector housing	Earth Stud on Chassis

NOTES :

1. Connection table for Heidenhain ROD426 or Stegmann DG60L incremental encoders.
2. Also shown in Quin drawing no. : QDV-2-2-019.
3. Guidance for use of encoder pins 2 & 11 :
   a) Pins 2 & 11 need not be used if the PSU voltage is 5V and the volt drop to terminals 12 & 10 is less than 0.25V.
   b) Pins 2 & 11 need not be used if the PSU voltage is 5.25V and the volt drop to terminals 12 & 10 is less than 0.5V. (An adjustable PSU is required).
   c) The Blue core may be connected in parallel with the Brown/Green core by wiring to terminal 7 at the SRV300. The white core may be connected in parallel with the White/Green core by wiring to terminal 8 at the SRV300. This will halve the volt drop. The supply voltage at the PSU could be increased to 5.25V as in (b) above. (An adjustable PSU is required).
   d) The Blue and White cores could be wired to the sense terminals of a PSU. The PSU will adjust its output to maintain 5V at the encoder. (A voltage-sensing PSU is required).

Issue	Date	Modification Notes	Drawn	Approved
A	22/10/02	First Issue	HO	GCB

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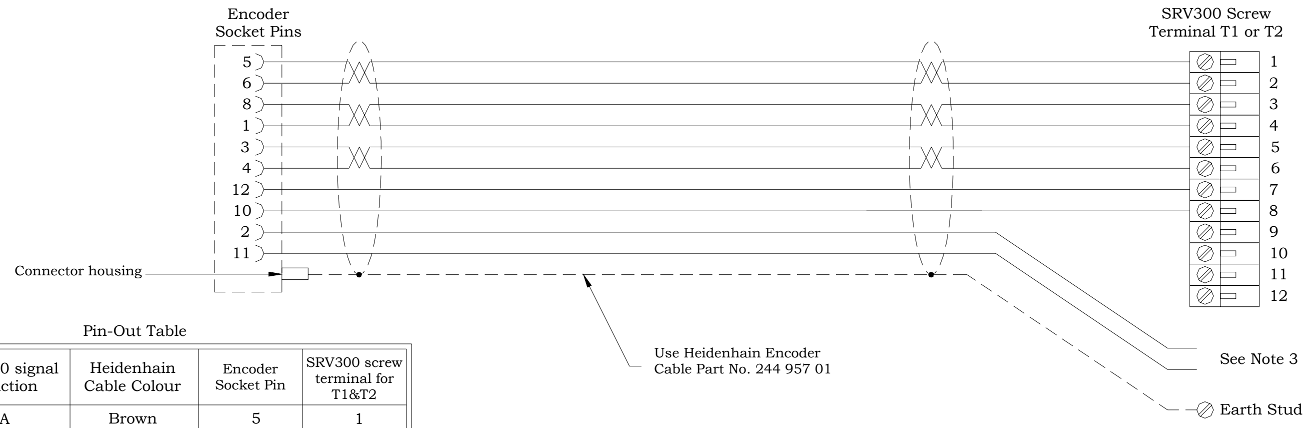
Title: **Incremental Encoder Lead (Square wave signals)**

S- No.	Issue	Scale
N/A		
Drg. No. **DRG12**	**A**	**1:1**



Pin-Out Table

SRV300 signal Function	Heidenhain Cable Colour	Encoder Socket Pin	SRV300 screw terminal for T1&T2
A	Brown	5	1
/A	Green	6	2
B	Grey	8	3
/B	Pink	1	4
Z	Red	3	5
/Z	Black	4	6
+5V Supply	Brown/Green	12	7
+5V Sensor	Blue	2	See Note 3
0V Supply	White/Green	10	8
0V Sensor	White	11	See Note 3
Not Used			9
Not Used			10
Not Used			11
Not Used			12
	Screen	Connector housing	Earth Stud on Chassis

NOTES :

1. Connection table for Heidenhain ROD486 incremental encoders.
2. Also shown in Quin drawing no. : QDV-2-2-019.
3. Guidance for use of encoder pins 2 & 11 :
   a) Pins 2 & 11 need not be used if the PSU voltage is 5V and the volt drop to terminals 12 & 10 is less than 0.25V.
   b) Pins 2 & 11 need not be used if the PSU voltage is 5.25V and the volt drop to terminals 12 & 10 is less than 0.5V. (An adjustable PSU is required).
   c) The Blue core may be connected in parallel with the Brown/Green core by wiring to terminal 7 at the SRV300. The white core may be connected in parallel with the White/Green core by wiring to terminal 8 at the SRV300. This will halve the volt drop. The supply voltage at the PSU could be increased to 5.25V as in (b) above. (An adjustable PSU is required).
   d) The Blue and White cores could be wired to the sense terminals of a PSU. The PSU will adjust its output to maintain 5V at the encoder. (A voltage-sensing PSU is required).

Issue	Date	Modification Notes	Drawn	Approved
A	22/10/02	First Issue	HO	GCB

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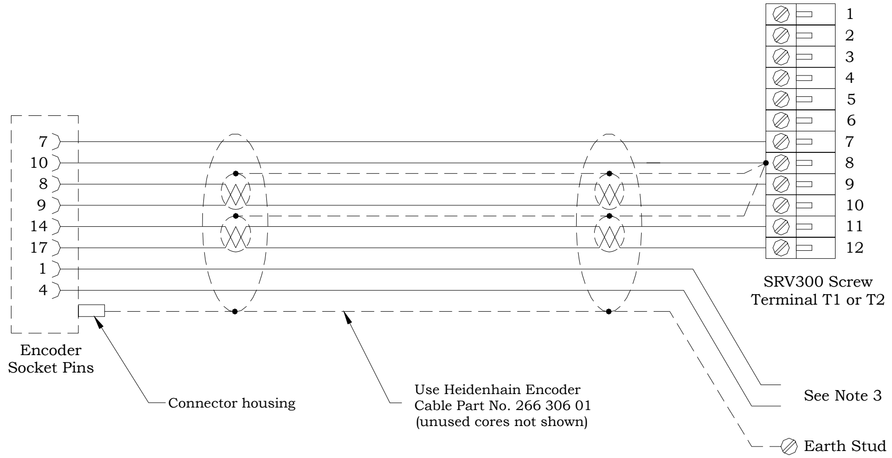
Title
Incremental Encoder Lead (Sinusoidal Signals)

S- No. N/A | Issue | Scale
Drg. No. **DRG13** | **A** | **1:1**

	A	B	C	D	E	F	G	H



Pin-Out Table

SRV300 signal Function	Heidenhain Cable Colour	Encoder Socket Pin	SRV300 screw terminal for T1&T2
Not Used			1
Not Used			2
Not Used			3
Not Used			4
Not Used			5
Not Used			6
+5V Supply	Brown/Green	7	7
+5V Sensor	Blue	1	See Note 3
0V Supply	White/Green	10	8
0V Supply	Inner screen	No connection	8
0V Sensor	White	4	See Note 3
ECLK	Violet	8	9
/ECLK	Yellow	9	10
EDATA	Grey	14	11
/EDATA	Pink	17	12
	Outer screen	Connector housing	Earth Stud on Chassis

NOTES :

1. Connection table for Heidenhain ROC410, ROC412, ROC413, ROQ424, ROQ425
2. Also shown in Quin drawing no. : QDV-2-2-023.
3. Guidance for use of encoder pins 1 & 4 :
   a) Pins 1 & 4 need not be used if the PSU voltage is 5V and the volt drop to terminals 7 & 10 is less than 0.25V.
   b) Pins 1 & 4 need not be used if the PSU voltage is 5.25V and the volt drop to terminals 7 & 10 is less than 0.5V. (An adjustable PSU is required).
   c) The Blue core may be connected in parallel with the Brown/Green core by wiring to terminal 7 at the SRV300. The white core may be connected in parallel with the White/Green core by wiring to terminal 8 at the SRV300. This will halve the volt drop. The supply voltage at the PSU could be increased to 5.25V as in (b) above. (An adjustable PSU is required).
   d) The Blue and White cores could be wired to the sense terminals of a PSU. The PSU will adjust its output to maintain 5V at the encoder. (A voltage-sensing PSU is required).

Issue	Date	Modification Notes	Drawn	Approved
A	22/10/02	First Issue	HO	GCB

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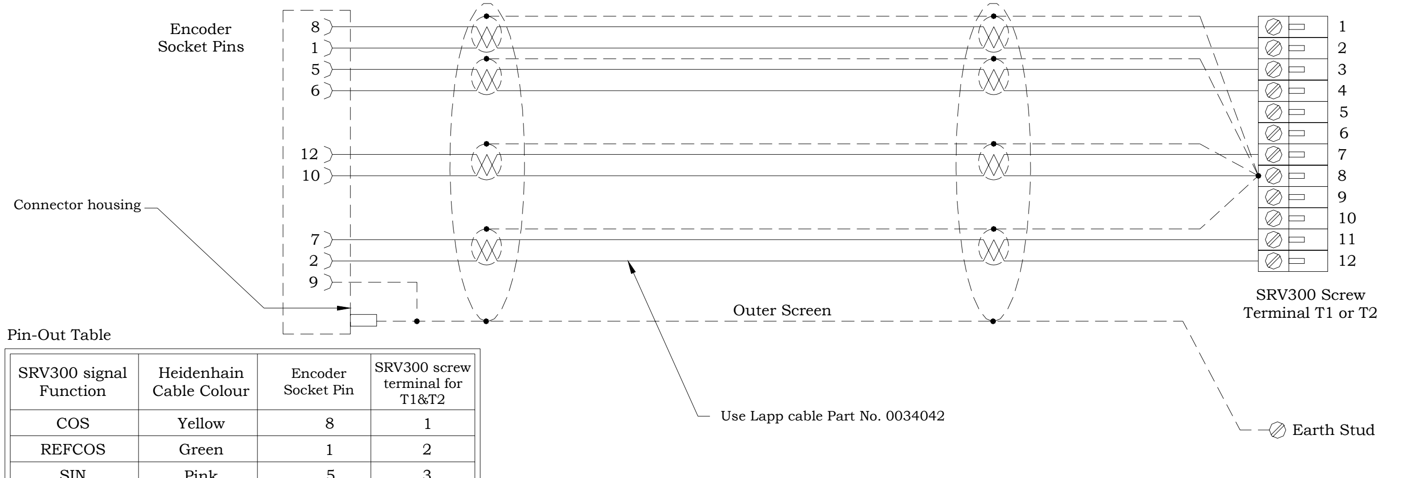
Title

SSI
Encoder Lead

S- No.	N/A	Issue	Scale
Drg. No.	**DRG14**	**A**	**1:1**



Pin-Out Table

SRV300 signal Function	Heidenhain Cable Colour	Encoder Socket Pin	SRV300 screw terminal for T1&T2
COS	Yellow	8	1
REFCOS	Green	1	2
SIN	Pink	5	3
REFSIN	Grey	6	4
Not Used			5
Not Used			6
+9V Supply	Brown	12	7
0V Supply	White	10	8
	Inner Screen	No Connection	8
Not Used			9
Not Used			10
EDATA	Red	7	11
/EDATA	Blue	2	12
	Outer Screen	Pin 9 and Connector housing	Earth Stud on chassis

NOTES :

1. Connection table for Stegmann Sincoder sensor.

Issue	Date	Modification Notes	Drawn	Approved
A	22/10/02	First Issue	HO	GCB

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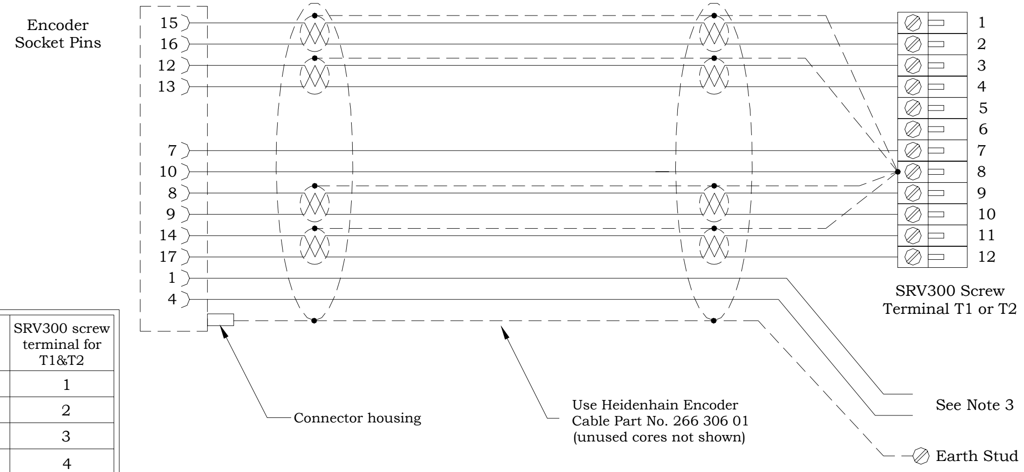
Title: **Sincoder Lead**

S- No. N/A

Drg. No. **DRG15**

Issue: **A**

Scale: **1:1**



Pin-Out Table

SRV300 signal Function	Heidenhain Cable Colour	Encoder Socket Pin	SRV300 screw terminal for T1&T2
A	Green/Black	15	1
/A	Yellow/Black	16	2
B	Blue/Black	12	3
/B	Red/Black	13	4
Not Used			5
Not Used			6
+5V Supply	Brown/Green	7	7
+5V Sensor	Blue	1	See Note 3
0V Supply	White/Green	10	8
0V Supply	Inner screen	No Connection	8
0V Sensor	White	4	See Note 3
ECLK	Violet	8	9
/ECLK	Yellow	9	10
EDATA	Grey	14	11
/EDATA	Pink	17	12
	Outer screen	Connector housing	Earth Stud on Chassis

NOTES :

1. Connection table for Heidenhain ROQ413 and ROQ425.
2. Also shown in Quin drawing no. : QDV-2-2-023.
3. Guidance for use of encoder pins 1 & 4 :
   a) Pins 1 & 4 need not be used if the PSU voltage is 5V and the volt drop to terminals 7 & 10 is less than 0.25V.
   b) Pins 1 & 4 need not be used if the PSU voltage is 5.25V and the volt drop to terminals 7 & 10 is less than 0.5V. (An adjustable PSU is required).
   c) The Blue core may be connected in parallel with the Brown/Green core by wiring to terminal 7 at the SRV300. The white core may be connected in parallel with the White/Green core by wiring to terminal 8 at the SRV300. This will halve the volt drop. The supply voltage at the PSU could be increased to 5.25V as in (b) above. (An adjustable PSU is required).
   d) The Blue and White cores could be wired to the sense terminals of a PSU. The PSU will adjust its output to maintain 5V at the encoder. (A voltage-sensing PSU is required).

Issue	Date	Modification Notes	Drawn	Approved
A	22/10/02	First Issue	HO	GCB

QUIN

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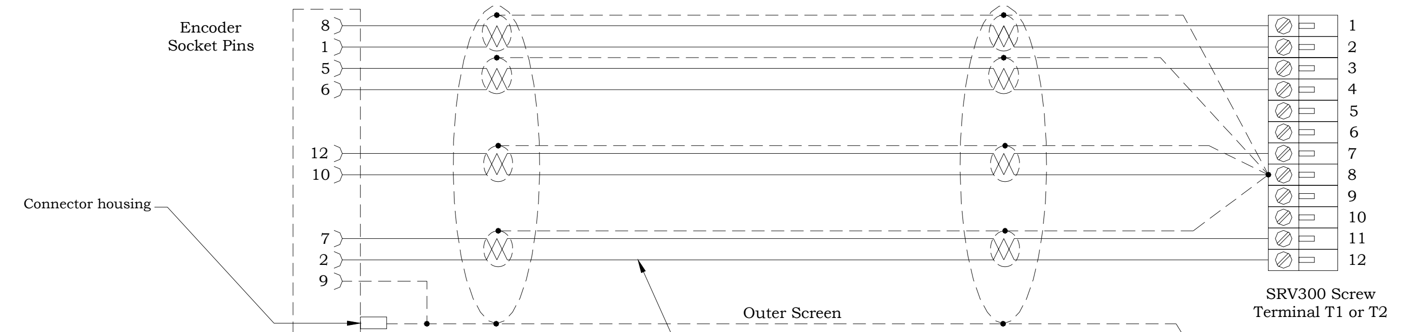
Title: **EnDat Encoder Lead**

S- No.	Drg. No.	Issue	Scale
N/A	DRG16	A	1:1

A	B	C	D	E	F	G	H



Pin-Out Table

SRV300 signal Function	Heidenhain Cable Colour	Encoder Socket Pin	SRV300 screw terminal for T1&T2
COS	Yellow	8	1
REFCOS	Green	1	2
SIN	Pink	5	3
REFSIN	Grey	6	4
Not Used			5
Not Used			6
+9V Supply	Brown	12	7
0V Supply	White	10	8
	Inner Screen	No Connection	8
Not Used			9
Not Used			10
EDATA	Red	7	11
/EDATA	Blue	2	12
	Outer Screen	Pin 9 and Connector Housing	Earth stud on chassis

NOTES :

1. Connection table for Stegmann SinCos sensor.
2. Also shown in Quin drawing no. : QDV-2-2-021.

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Title
SinCos Encoder Lead

S- No.	N/A	Issue	Scale
Drg. No.	**DRG17**	**A**	**1:1**

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