Packaged dc servo motor systems

SM9000 series

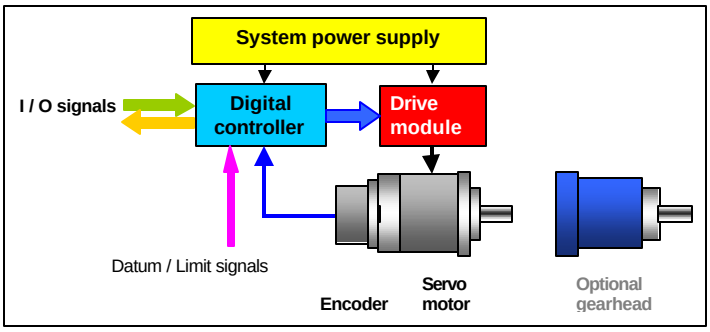
SM9000 series dc servo motor control systems are fully cased free standing units that are also suitable for mounting in a 19 in Rack system. Based on Mclennan's in-service proven modular technology the units incorporate a system power supply, servo amplifiers and powerful, yet easy to use, digital motion controllers. The use of modular technology ensures maximum flexibility in meeting customers' needs together with improved serviceability

All connections are via multi-pin connectors to provide a 'plug & run' solution for a wide variety of industrial, scientific & laboratory applications that require accurate positioning of the driven mechanism.

Modular technology provides maximum system flexibility

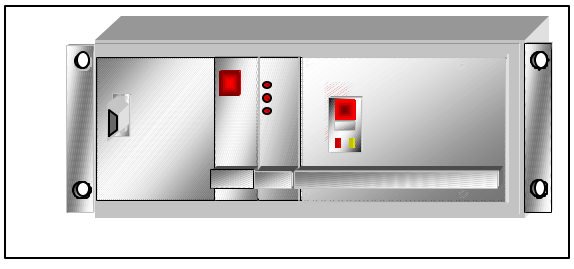
SM9000 series systems may be used to provide conventional open loop control or, closed loop control when an encoder is fitted to the motor or the driven mechanism

The use of modular technology enables the optimum drive to be selected to suite the motors to be driven while a wide range of gearheads can be specified to match the load requirements.

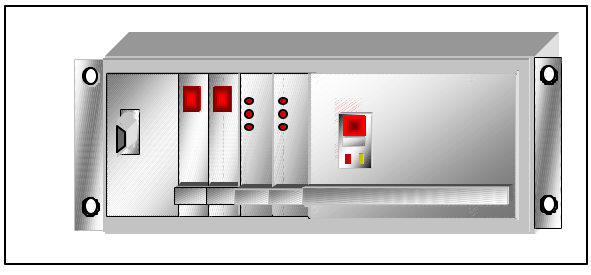


High performance servo motor control systems in 19 in x 4U high enclosures

SM9000 series systems are constructed using robust EMC compliant enclosures and include a fan to provide forced cooling. Air is drawn through vents at the bottom front of the case and exits at the rear so no additional space is required above or below the unit for air convection. This design is beneficial for both free standing and rack mounting installations.



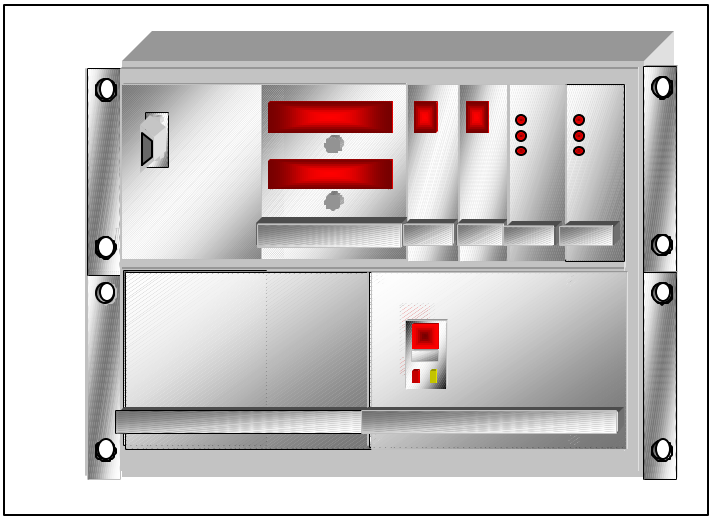
Single axis SM9000 series system
up to 400 watts motor shaft power



2axis SM9000 series system
up to 100 watts motor shaft power

Servo motor control systems in 19 in x 7U high enclosures

400 watt 2 Axis SM9000 series
with optional digital display



SM9000 series Specification

Number of motor axes		**1**	**1**	**1**	**1**	**1**
Motor Power per axis	kW	0.02	0.06	0.09	0.15	0.4
Cabinet size	Width	19 in across flanges (482.6 mm) Eurocrate enclosure				
	Height	4U (177.8 mm)				
Motor voltage	Vdc	24	24	48	24	48
Max rated current	Amps	2	4	4	8	8
Max Peak current	Amps	4	14	14	20	20
Drive type		PM421	PMD7/14	PMD7/14	PMD10/20	PMD10/20
Number of motor axes		**2**	**2**	**2**	**2**	**2**
Motor Power per axis	kW	0.02	0.06	0.09	0.15	0.4
Cabinet size	Width	19 in across flanges (482.6 mm) Eurocrate enclosure				
	Height	4U (177.8 mm)			7U (311.15 mm)	
Motor voltage	Vdc	24	24	48	24	48
Max rated current	Amps	2	4	4	8	8
Max Peak current	Amps	4	14	14	20	20
Drive type		PM421	PMD7/14	PMD7/14	PMD10/20	PMD10/20
Supply	Vac	110-230 Vac 50 or 60Hz (to be specified when ordered)				
Motion control features		Programmable via RS232 interface (Ethernet : Optional)				
Position	counts	± 2000 million range as absolute or relative move				
Velocity	counts/sec.	1-409,600				
Acceleration	counts/sec^2	1-20,480,000				
Deceleration	counts/sec^2	1-20,480,000				
Feedback		closed loop using encoder feedback up to 3 encoders per axis				
Encoder scaling		Range: 1-32000/1-32000				
End of travel limits		2 directional sensitive limits per axis				
Datum Search		High speed registration of datum capture				
Number of digital I/O		16 Opto isolated per axis				
Number of Analogue inputs		2 per axis				
Pre-programmable sequences		8 per axis				
Diagnostics		Front panel 9 bit display & 8 bit digital string via RS232 interface				

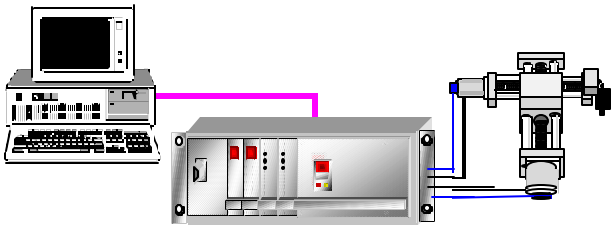
Special features

- Dual encoder feedback when using encoders mounted remotely from motor
- Dual encoder feedback for electronic gearbox operation
- Dual encoder feedback for electronic cam
- Triple encoder feedback for master/slave control using remotely mounted encoding

Signal Connections	Via colour coded 'D' connectors
Motor connections	Via multi-pin heavy duty connector

Servo motor control systems: Programme Guide

The control systems utilise a powerful motion controller per axis that provide accurate motion control and integration with other machine functions. The system may be programmed via an RS232 interface to provide motion in real time on receipt of a movement command.



Alternatively a series of sequences can be programmed to enable the unit to operate as a stand-alone system, interfaced to other machine functions.

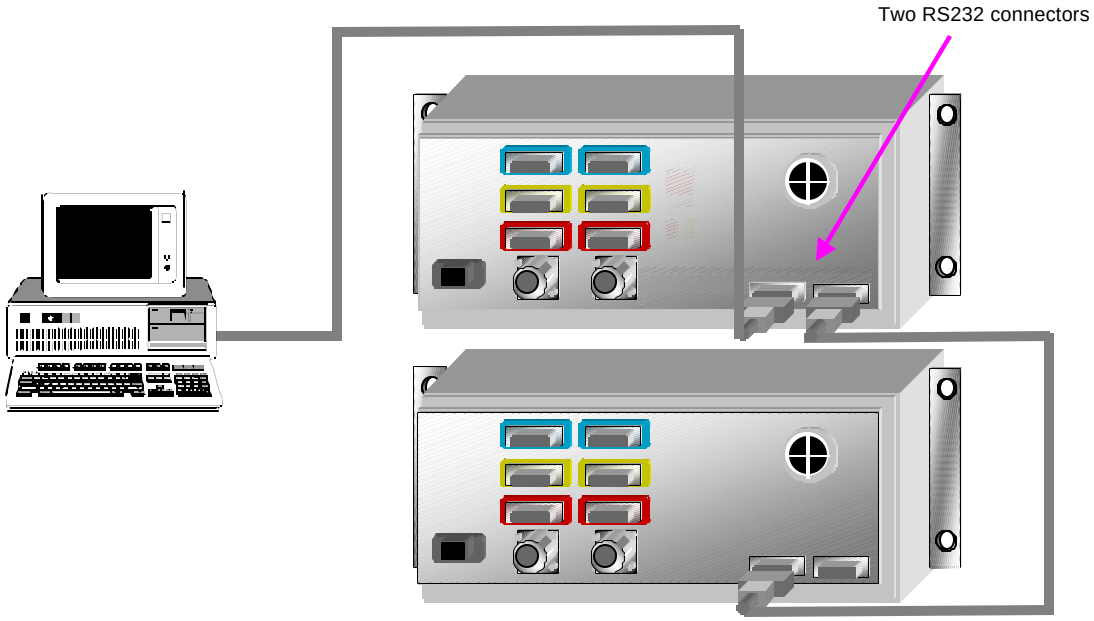
A precise of commands is shown below:

GETTING STARTED COMMANDS			
HE	***HE***lp pages	**HN**	Display ***N***ext Page
HP	Display ***P***revious Page	**IN**	***IN***itialise
TUNE	Auto ***TUNE***	**QA**	***Q***uery ***A***ll
QK	***Q***uery constants (***K***)	**QS**	***Q***uery ***S***peeds
ABORT, STOP & RESET COMMANDS			
CONTROL **C**	Hard Stop	**ESC**	Soft Stop
AM<mode>	Set ***A***bort ***M***ode	**AB**	Command ***AB***ort
RS	***R***e***S***et	**QM**	**Q**uery **M**ode
ST	Soft ***ST***op		
INFORMATION			
CO	Display the ***C***urrent ***O***peration	**ID**	***ID***entify Version
OC	***O***utput ***C***ommand position	**OA**	***O***utput ***A***ctual position (Encoder 1)
OT	***O***utput Auxiliary Position (Encoder 2)	**OI**	***O***utput ***I***nput position (Encoder 3)
OD	***O***utput ***D***atum position	**OV**	***O***utput ***V***elocity
OS	***O***utput ***S***tatus string	**OF**	***O***utput ***F***ollowing Error
QA	***Q***uery ***A***ll	**QK**	***Q***uery constants (***K***)
QS	***Q***uery ***S***peeds	**QP**	***Q***uery ***P***ositions
QM	***Q***uery ***M***odes	**QL**	***Q***uery Privelge ***L***evel
SET UP			
CM<mode>	Set ***C***ommand ***M***ode	**ER**<numerator>/<denominator>	Set ***E***ncoder ***R***atio
BO<steps>	Set ***B***ack***O***ff Steps	**CR**<steps>	Set ***Cr***eep steps
TO<value>	Set ***T***ime***O***ut	**SE**<steps>	Set ***SE***ttling time
WI<time>	Set settling ***Wi***ndow		
SAFETY FEATURES			
SL<mode>	Set ***S***oft ***L***imits	**TH**<value>	Set Motor Stalled ***Th***reshold
TR<value>	Set ***TR***acking window		
SERVO COEFFICIENTS			
KF<value>	Set ***F***eedforward coefficient	**KP**<value>	Set ***P***roportional gain coefficient
KS<value>	Set ***S***um coefficient	**KV**<value>	Set ***V***elocity damping coefficient
KX<value>	Set e***X***tra velocity feedback coefficient	**QK**	***Q***uery constants (***K***)
DATUMING			
CD	***C***lear Captured ***D***atum Position	**OD**	***O***utput ***D***atum position
HD<direction>	Go ***H***ome to ***D***atum	**MD**	***M***ove to ***D***atum Position
SH<position>	***S***et ***H***ome Position	**DM**<mode>	Se ***D***atum ***M***ode
QM	***Q***uery ***M***odes		
POSITION COMMANDS			
AP<position>	Set ***A***ctual ***P***osition	**CP**<value>	Set ***C***ommand ***P***osition
IP<position>	Set ***I***nput encoder's ***P***osition	**TP**<position>	Set Auxiliary ***P***osition
DA<position>	***D***ifference ***A***ctual position	**DI**<position>	***D***ifference ***I***nput encoder's position
SPEED, ACCELERATION AND DECELERATION			
CV<velocity>	***C***onstant ***V***elocity mode	**SC**<speed>	***S***et ***C***reep speed
SF<speed>	***S***et ***F***ast jog speed	**SJ**<speed>	***S***et slow ***J***og speed
SV<speed>	***S***et ***V***elocity	**SA**<acceleration>	***S***et ***A***cceleration
SD<deceleration>	***S***et ***D***eceleration	**LD**<deceleration>	Set ***L***imit ***D***eceleration

MOVES			
BO<steps>	Set ***B***ack***O***ff Steps	**CR**<steps>	Set ***Cr***eep steps
MA<position>	***M***ove ***A***bsolute	**MR**<position>	***M***ove ***R***elative
GM<steps>	***G***earbox Offset ***M***ove	**HD**<direction>	Go ***H***ome to ***D***atum
MD	***M***ove to ***D***atum Position	**DE**<time>	Set ***DE***lay time
SOFT LIMITS			
LL<position>	Set ***L***ower *soft* ***L***imit	**UL**<position>	Set ***U***pper *soft* ***L***imit
SL<mode>	Set ***S***oft ***L***imits		
GEARBOX			
GA	***G***earbox ***A***bsolute mode	**GB**	***G***ear***B***ox mode
GR<numerator>**/**<denominator>	***G***earbox ***R***atio	**GM**<steps>	***G***earbox Offset ***M***ove
GD<value>	Set ***G***earbox ***D***enominator	**GN**<value>	Set ***G***earbox ***N***umerator
WS	***W***ait for ***S***ynchronisation		
END OF MOVE			
SE<steps>	Set ***SE***ttling time	**WI**<TIME>	Set settling ***Wi***ndow
WE	***W***ait for ***E***nd of current move		
READ & WRITE PORTS			
RP	***R***ead ***P***ort	**WP**<bit pattern>	***W***rite ***P***ort
WA<bit pattern>	***WA***it for input event		
JOG			
JM<mode>	Set ***J***og ***M***ode		
SF<speed>	***S***et ***F***ast jog speed	**SJ**<speed>	***S***et slow ***J***og speed
JC<value>	Set ***J***oystick ***C***entre Position	**JR**<value>	Set ***J***oystick ***R***ange
JS<speed>	Set ***J***oystick ***S***peed	**JT**<value>	Set ***J***oystick ***T***hreshold
QJ	***Q***uery ***J***oystick Settings		
ANALOGUE INPUT AND OUTPUTS			
AI<channel>	Query ***A***nalogue ***I***nput	**AO**<channel/value>	Set ***A***nalogue ***O***utput
AL<channel/value>	Wait for ***A***nalogue ***L***ess than Value	**AG**<channel/value>	Wait for ***A***nalogue ***G***reater than Value
SEQUENCES			
AE<sequence no.>	***A***uto-***E***xecute sequence	**AD**	***A***uto-Execute ***D***isable
DS<sequence no.>	***D***efine ***S***equence	**ES**	***E***nd ***S***equence definition
LS<sequence no.>	***L***ist ***S***equence	**XS**<sequence no.>	E***X***ecute ***S***equence
BS	***B***ackup ***S***equence	**US**<sequence no.>	***U***ndefine ***S***equence
IF	Do next command ***If F***alse	**IT**	D next command ***If T***rue
PROFILES			
DP<profile no.>	***D***efine ***P***rofile	**EP**	***E***nd ***P***rofile definition
LP<profile no.>	***L***ist ***P***rofile	**XP**<profile no.>	E***X***ecute ***P***rofile
BP	***B***ackup ***P***rofiles	**UP**<profile no.>	***U***ndefine ***P***rofile
PT<value>	***P***rofile ***T***ime		
CAMS			
DC<cam no.>	***D***efine ***C***am	**EC**	***E***nd ***C***cam definition
LC<cam no.>	***L***ist ***C***am	**XC**<cam no.>	E***X***ecute ***C***am
BC	***B***ackup ***C***ams	**UC**<cam no.>	***U***ndefine ***C***am
XY<x position>/<y position>	Cam co-ordinates	**IM**	Set Cam ***I***ndex
PRIVELEGE LEVEL			
NP<new PIN>	***N***ew ***P***in	**PI**	Enter ***PI***N
PL	Set ***P***rivelege ***L***evel	**QL**	***Q***uery Privelge ***L***evel
HELP			
HE	Display ***HE***lp Pages	**HN**	Display ***N***ext Page
HP	Display ***P***revious Page	**HM**	Dislplay ***H***elp with ***M***odes Commands
BACKUP			
BA	***B***ackup ***A***ll	**BC**	***B***ackup ***C***ams
BD	***B***ackup ***D***igiloop parameters	**BP**	***B***ackup ***P***rofiles
BS	***B***ackup ***S***equence		

Connecting the RS232 interface to SM9000 series controllers

Communication with the SM9000 series system is via a full duplex RS232 interface.
Two RS232 connectors are fitted to the SM9000 series systems so that further units may be added and daisy-chained to a single RS232 port.

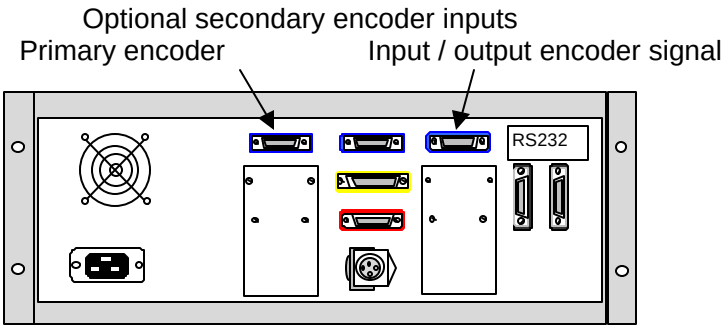


Each SM9000 series Eurocrate is provided with two RS232 connectors so that communication via a single RS232 port can be maintained with additional units that are subsequently added. Up to 99 motor axis can be controlled using a single RS232 port.

Closed loop control system connections

The rear panel of the SM9000 series controller is provided with colour coded connectors to simplify connections. A typical rear panel layout is shown below. Where the system is to be used under open-loop control the encoder connectors are not utilised.

Typical rear panel connections for single axis system



Standard Connectors

Motor encoder

I / O connector

Datum / limits connector

Motor connector

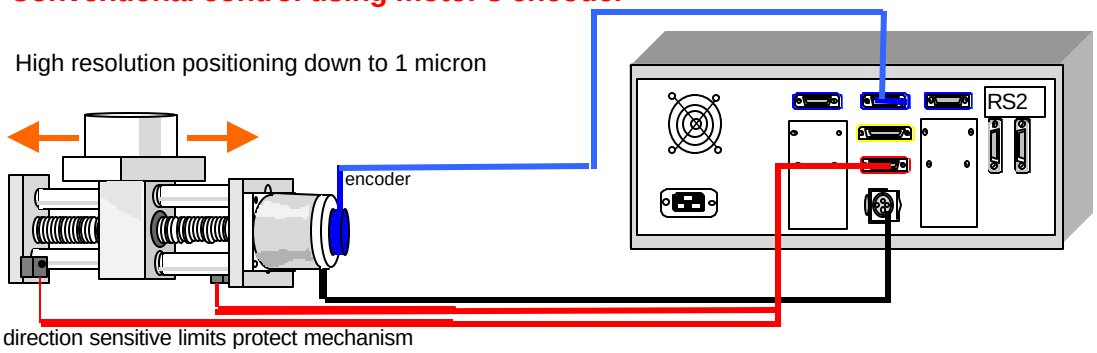
Absolute positioning

Note: The encoder input is pre-wired to accept a dual track incremental encoder with differential outputs.
The PM600 controller utilises these signals to memorise the absolute position of each motor axis relative to a zero datum position Where necessary a second encoder input may be specified for use with motor driven axes that utilise dual encoder feedback.

Typical single axis positioning

The controller is an ideal high accuracy positioner for use with modern servo systems. It enables very high accuracy combined with fast response to be obtained. Standard features include datum signal inputs and directional sensitive limits to protect the driven mechanism against an over-travel condition. Software limits are also provided to eliminate possible programming errors.

Conventional control using motor's encoder



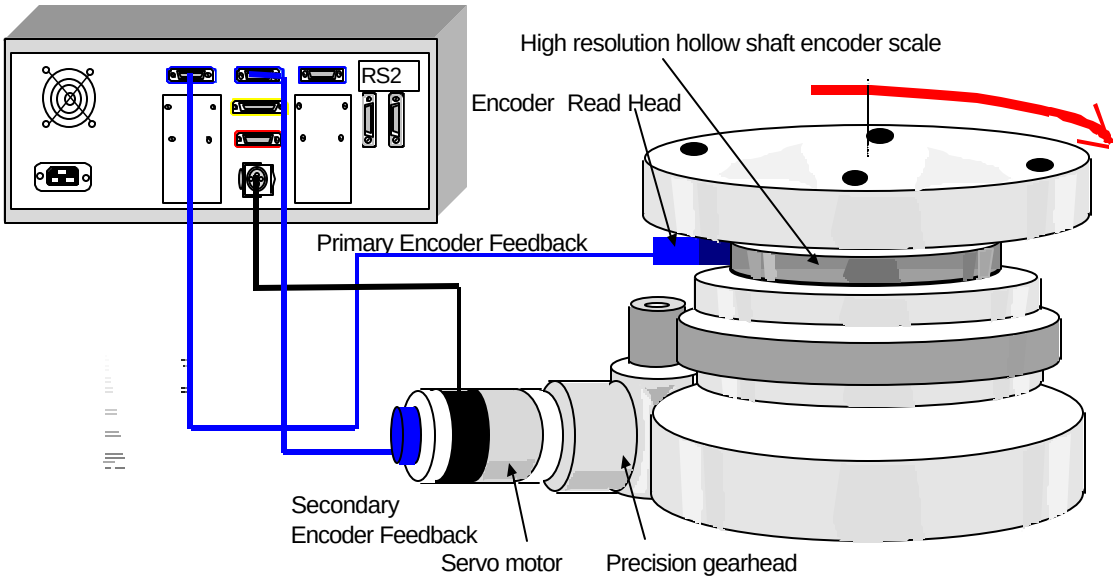
Optional dual encoder input for each axis

Dual Encoder feedback for use with encoders mounted remotely from the motor

When high accuracy positioning is required a high resolution encoder can be mounted directly on the output of the driven mechanism. However, compliance and backlash in the transmission system can lead to instability which may require a deadband and reduced positioning velocity in order to maintain stable operation. The dual encoder system, damps instability, enables the deadband to be eliminated and increased positioning velocity to be achieved.

Using this technique a positioning accuracy of 1 arc second and repeatability of better than 0.18 arc seconds have been achieved.

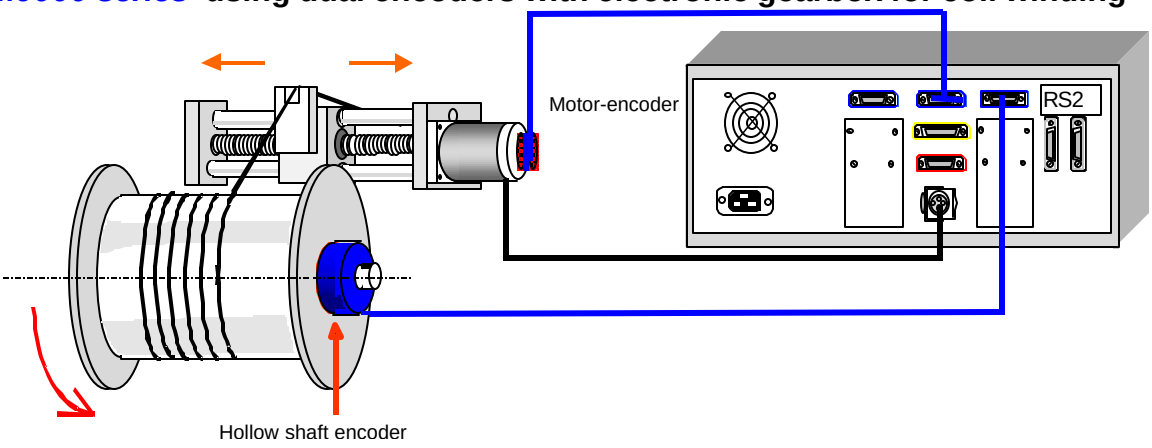
Precision rotary table drive using dual encoder feedback



Dual encoder feedback & variable ratios for slaving drives to a master encoder

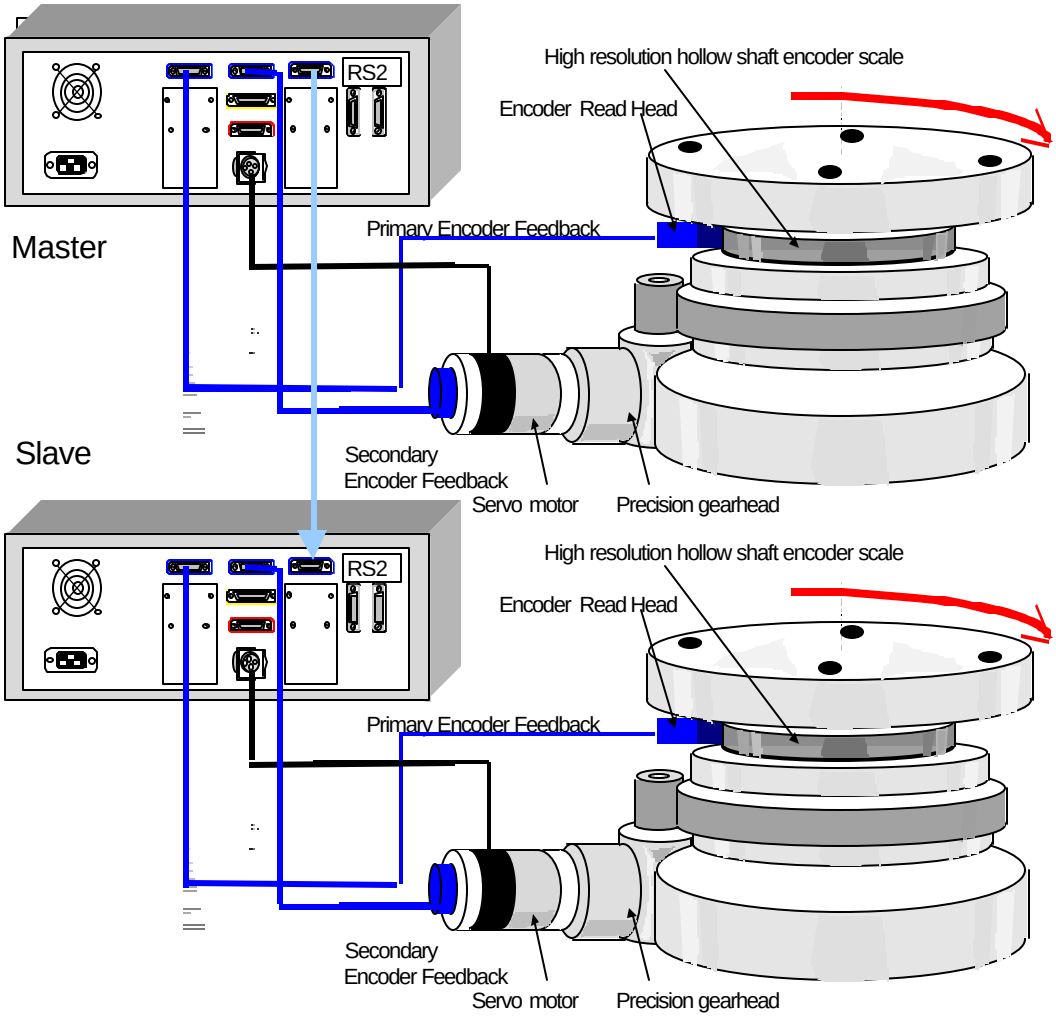
The use of 'electronic gearbox' is so called because it enables the controlled axis to be slaved to another axis of motion with a variable ratio. The ratio is entered as a nominator and denominator value, each being selectable from 1 to 32,000. This enables a different number of encoder counts on the master and slave axes to be accommodated and synchronised motion to be realised.

SM9000 series using dual encoders with electronic gearbox for coil winding



Triple encoder feedback for slaving drives using remote encoders

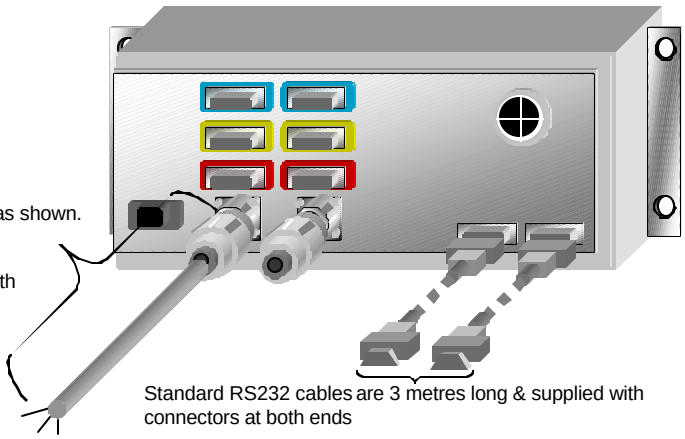
A unique feature of the latest PM600 based Mclennan Servo controller is the ability to combine master slave operation with the dual encoder feedback technique as shown ion the diagram below. In this example the Primary encoder signal form the encoder input/output connector to that of the slave axis controller.



Optional cables:

The cable the cost is based on the supply of a cable with the connector fitted to the end that plugs into the control system as shown.

The free end that is connected to the motor is usually supplied with flying leads for connection to the motor via a terminal box.

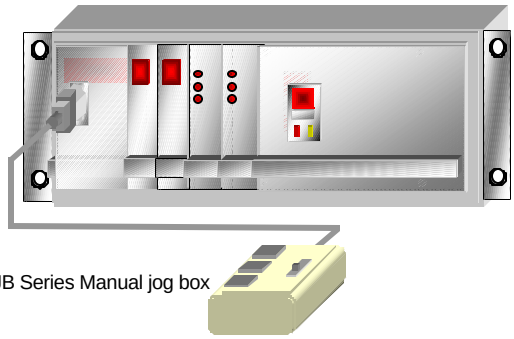


Standard RS232 cables are 3 metres long & supplied with connectors at both ends

Optional manual control JB series

The JB series manual jog box may be specified where manual control of the motor axes is required. In multi axis systems the unit enables each axis to be selected and independently controlled.

The control system is programmed as part of the commissioning procedure to define the rates at which each axis moves when under manual control using the following buttons:



JB Series Manual jog box

+	Causes the motor to take 1 step forward each time this button is depressed. When the button is held the motor will run forward at a programmable slow speed.
F	When this button is depressed in conjunction with either the '+' or '-' buttons the motor will run at the fast speed that has been pre-programmed for the motor channel selected..
-	Causes the motor to take 1 step backwards each time this button is depressed. When the button is held the motor will run forward at a programmable slow speed