SLX Series

THREE PHASE 4Q CONTROLLER

WORLD CLASS IN DESIGN · WORLD BEATING IN FUNCTION

SPRINT Electric

UG101526 Iss 3

IMPORTANT SAFETY NOTES

READ AND UNDERSTAND THIS MANUAL BEFORE APPLYING POWER TO THE SLX MOTOR DRIVE UNIT

SPRINT Electric

The SLX motor drive controller is an open chassis component for use in a suitable enclosure

Drives and process control systems are a very important part of creating better quality and value in the goods for our society, but they must be designed, installed and used with great care to ensure everyone's SAFETY.

Remember that the equipment you will be using incorporates...

High voltage electrical equipment

Powerful rotating machinery with large stored energy

Heavy components

... and your process may involve ...

Hazardous materials

Expensive equipment and facilities

Interactive components

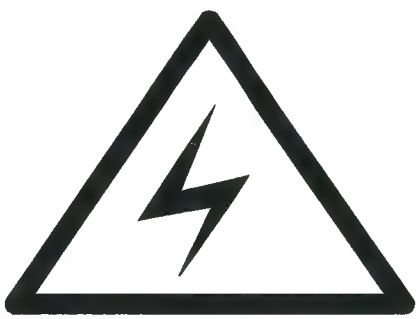
Always use qualified personnel to design, construct and operate your systems and keep SAFETY as your primary concern.

Thorough personnel training is an important aid to SAFETY and productivity.

SAFETY awareness not only reduces the risk of accidents and injuries in your plant, but has a direct impact on improving product quality and costs.

If you have any doubts about the SAFETY of your system or process, consult an expert immediately. Do not proceed without doing so.

HEALTH AND SAFETY AT WORK
Electrical devices can constitute a safety hazard. It is the responsibility of the user to ensure the compliance of the installation with any acts or bylaws in force. Only skilled personnel should install and maintain this equipment after reading and understanding this instruction manual. If in doubt refer to the supplier



DANGER

ELECTRIC SHOCK RISK

Note. The contents of this manual are believed accurate at the time of printing. The manufacturers, however, reserve the right to change the content and product specification without notice. No liability is accepted for omissions or errors. No liability is accepted for the installation or fitness for purpose or application of the SLX motor drive unit.

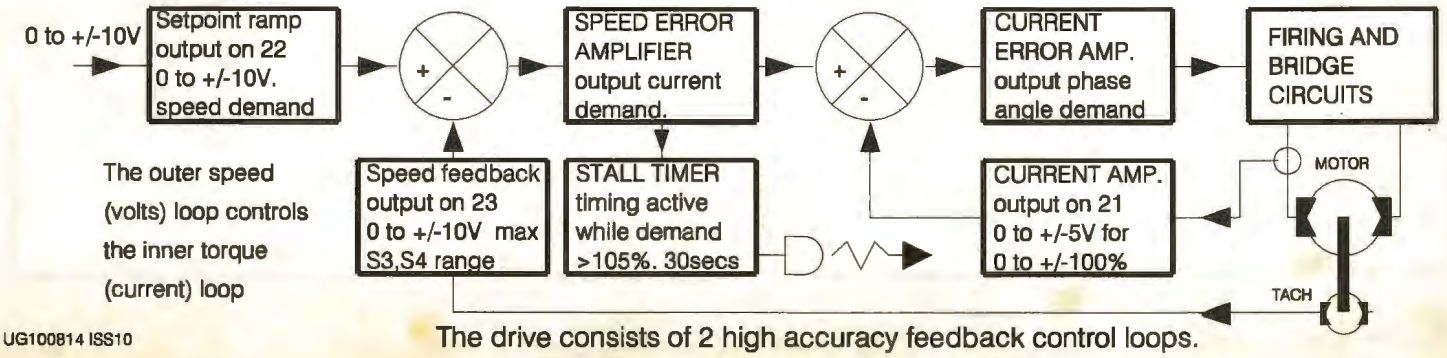
CONTENTS

GENERAL DESCRIPTION

The units employ closed loop control of both armature current and feedback voltage to give precise control of the motor torque and speed. The motor and drive are protected by a stall timer which automatically removes power after 30 seconds if the required speed cannot be achieved. The drives will provide up to 150% of the preset maximum current for up to 30 seconds allowing high short term torques during acceleration or other changes in load. Independant control of either the current or speed loops by external inputs allows torque or speed control applications with overspeed or overcurrent protection. The demand signal may be derived from a potentiometer, 0-10V signal or 4-20mA loop. The speed feedback signal may be selected to be the ARMATURE VOLTAGE or a shaft mounted TACHOMETER.

A fully regulated field bridge is provided. This may be switched to provide constant field current for accurate armature voltage feedback, or automatic field weakening for extended speed range. Both these functions are fully adjustable by on board presets, and the field output voltage is displayed.

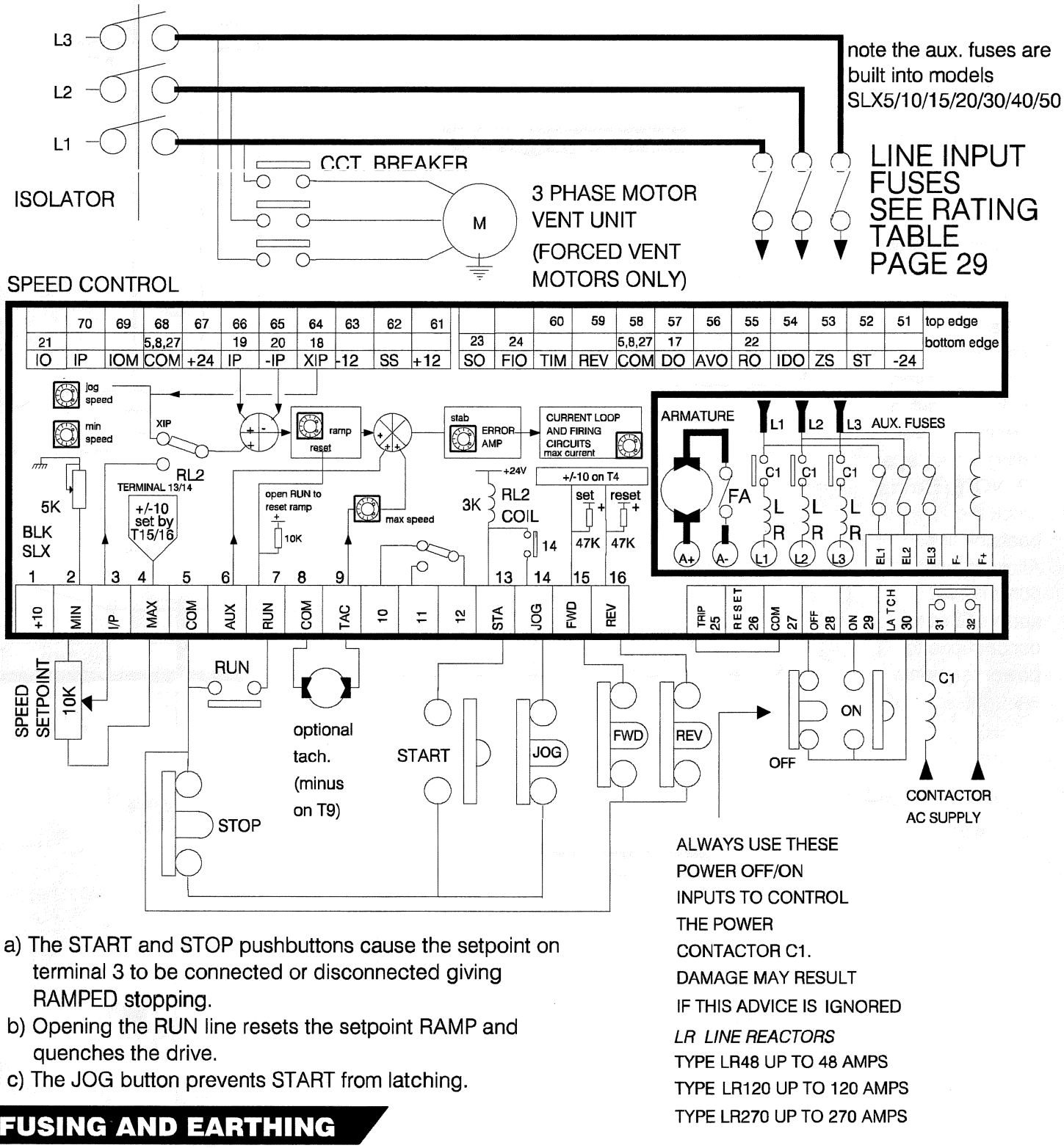
Control of shaft direction may be by linear voltage signals or convenient pushbuttons. Direct connection to PLC logic controllers is also possible. Braking of the motor may be fast or ramped, and facilities exist which allow choice of action dependant on direction of rotation. Braking energy is returned to the supply. Independant adjustment presets are provided for FORWARD UP RAMP, FORWARD DOWN RAMP, REVERSE UP RAMP, REVERSE DOWN RAMP. The positive and negative current limit is also independantly adjustable. Provision is made to adjust motoring and braking torque independant of rotation direction. There is a comprehensive range of extra inputs and outputs and the unit has electrically isolated control circuits to allow interfacing to external sources. The electonic control cards are manufactured using modern automation and surface mount techniques. This gives superb accuracy and stability and is only made possible by the high production volumes of SPRINT Electric drives.



The drive consists of 2 high accuracy feedback control loops.

BASIC APPLICATION

This diagram shows a simple form of speed control wiring. Please refer to Appendix section 4 for more complex functions.



ALWAYS USE THESE POWER OFF/ON INPUTS TO CONTROL THE POWER CONTACTOR C1. DAMAGE MAY RESULT IF THIS ADVICE IS IGNORED

LR LINE REACTORS

TYPE LR48 UP TO 48 AMPS

TYPE LR120 UP TO 120 AMPS

TYPE LR270 UP TO 270 AMPS

a) The START and STOP pushbuttons cause the setpoint on terminal 3 to be connected or disconnected giving RAMPED stopping.

b) Opening the RUN line resets the setpoint RAMP and quenches the drive.

c) The JOG button prevents START from latching.

FUSING AND EARTHING

All incoming main power supply connections must be protected by the correct semiconductor fuses. A substantial earth connection must be made to the earth terminal of the drive. For systems involving frequent or continuous regeneration or high inertia loads, fit a DC rated semiconductor fuse in series with the armature (FUSE marked FA in diagram above). See page 29 for fuse rating tables.

POWER ON/POWER OFF

IMPORTANT WARNING

The POWER ON/OFF facilities integral to the drive must always be used to energise the main contactor. This ensures correct power sequencing. The armature current may not be commutated to zero and could cause damage if this advice is ignored. (See application sheet in Appendix. Section 4 page 7)

ELECTRICAL SPECIFICATION

SUPPLY VOLTAGE

		low tap	high tap
3 phase	+/- 5%	200/240	380/480

separate in phase supply to stack

ARMATURE VOLTS 1.1 times AC MAX.

AC supply	240	380	415	480
AV DC max	265	420	460	530

FIELD output volts 0.9 times AC MAX
adjustable output voltage with trend display
current regulation for high accuracy AVF speed control
automatic weakening mode switch selectable
delayed quench for emergency dynamic braking
economy mode for motor climate control

TEMPERATURE

0-50C operating, -10 to 50 storage

ALTITUDE AND RELATIVE HUMIDITY

3000M max, 85% non-condensing

THYRISTOR BRIDGE

3 Phase fully controlled anti-parallel

ELECTRICAL ISOLATION

high voltage power circuits are
isolated from control circuits

PUSHBUTTON INPUTS

POWER ON	FORWARD
POWER OFF	REVERSE
STOP	JOG
START	SPEED 2

PRESET CONTROLS

MAX SPEED
MIN SPEED
FORWARD UP RAMP
FORWARD DOWN RAMP
REVERSE UP RAMP
REVERSE DOWN RAMP
SPEED STABILITY
ZERO SPEED
MAXIMUM CURRENT pos I
MAXIMUM CURRENT neg I
FIELD CURRENT
AUTOMATIC FIELD WEAKENING
JOG SPEED

LINK OPTIONS

50% Stall level
S shaped ramps
0/4 - 20mA loop
speed mode
torque mode
zero standstill
zero ref. interlock
quench mode
current mode

PRESET SWITCHES

1 field mode	5 relay 1 stall
2 relay 1 timer	6 relay 1 zero
3 speed scale	7 relay 1 reverse
4 speed scale	8 tac/av

CONTACT RATINGS

1A AT 240V AC | main contactor
slave

PERFORMANCE SPECIFICATION

TYPE	KW	HP	ARMATURE amps	FIELD amps
SLX5	5	6.6	12	2.5
SLX10	10	13.3	24	2.5
SLX15	15	20	36	2.5
SLX20	20	26.6	48	2.5
SLX30	30	40	72	5.0
SLX40	40	53.3	96	5.0
SLX50	50	66.6	120	5.0
SLX65	65	90	155	10.0
SLX85	85	115	205	10.0
SLX115	115	155	270	10.0

TYPICAL MAXIMUM OUTPUT RATINGS FOR 460 VOLT DC MOTOR

SPEED RANGE

100:1 with tacho speed feedback
20:1 with armature volts feedback

STEADY STATE ACCURACY

0.1% with tacho feedback

OVERLOAD CAPACITY

150% full load current for 30 secs.

TORQUE LIMIT CONTROL (arm. current)

0 to 100% of max current setting (link selectable)
2 quadrants only option jumper

DYNAMIC INDICATORS

positive demand
negative demand
stall
timer
field voltage
weakening threshold

LATCHED INDICATORS

field loss	peak current
tacho loss	aux input

all latched with individual overide
and internal or external reset

SIGNAL OUTPUTS
linear isolated

speed
current
setpoint ramp
total setpoint
field current
rectified arm. volts
rectified arm. amps
current demand

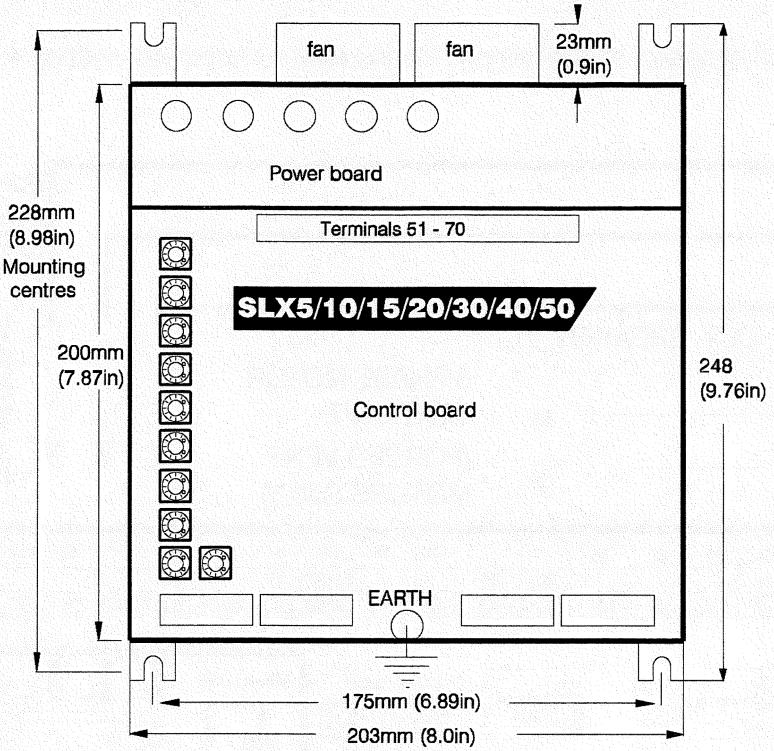
RAILS AND DRIVERS

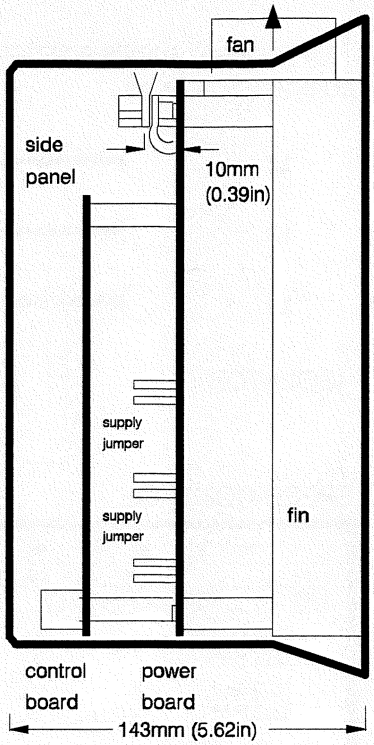
+10 +12 +24
-10 -12 -24

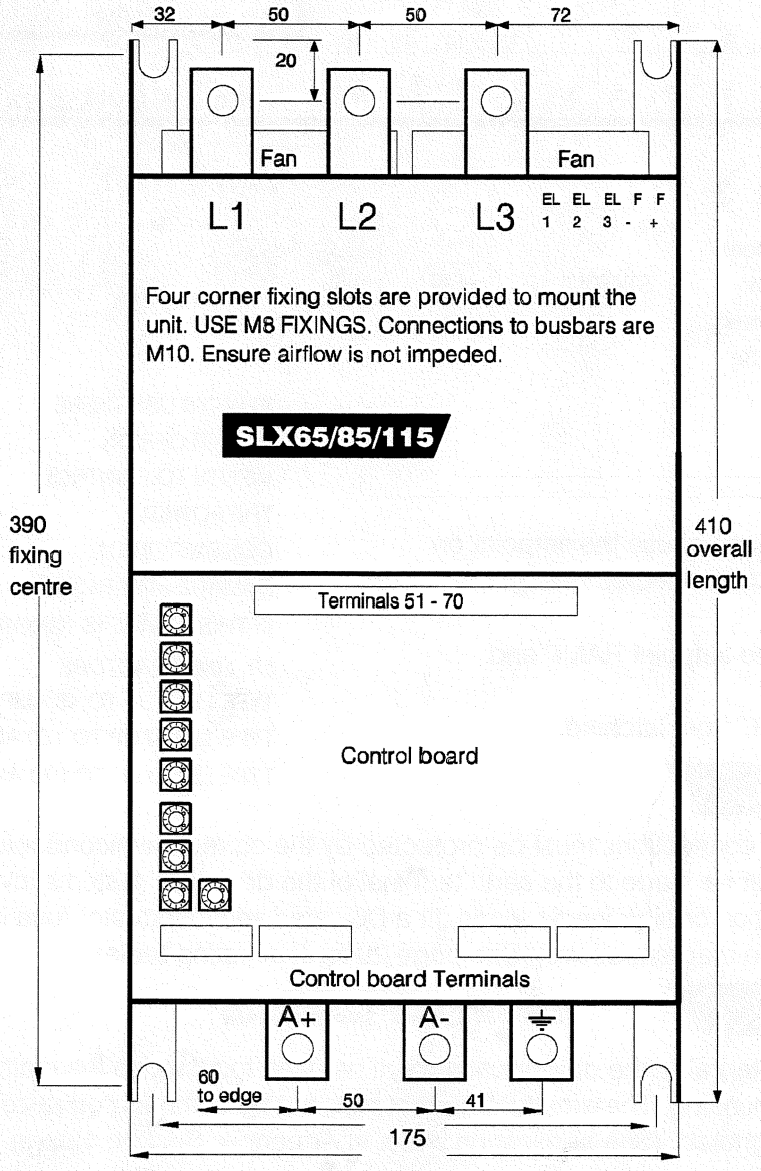
1)stall 2)timer
3)zero 4)reverse

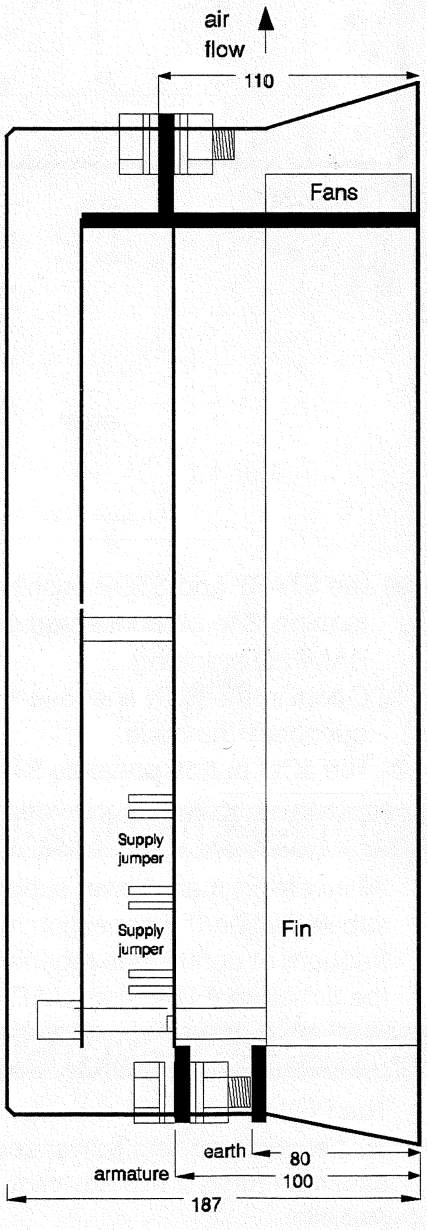
field loss
tacho loss
peak amps
aux trip

Four corner mounting slots are provided to mount the unit. Use M6 (1/4in) screws on models up to SLX50, and M8 (5/16in) on models SLX65/85/115. A substantial earth connection should be made to the stud provided. Nominal cooling air throughput is specified in the rating table page 29. NOTE: Do not block the heatsink fins. Allow at least 50mm (2 in) space. Ensure connections to power terminals are tight.









Control card (isolated). Top edge terminal listing on page 26

A. Precision low drift speed pot reference

mmon. Also accepts 4-20mA LOOP signals

0V. This input is ramped.

ggled by FWD 15 REV 16

t speed or torque

4Q/2Q/SPEED.

s open. Connect to

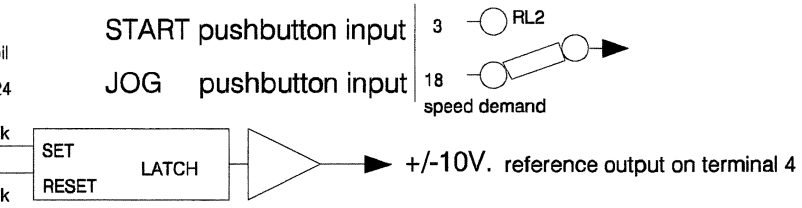
-12V via 4K7.

d as tacho common.

speed scaling by switches S3/4

ON	RL1	de-energises if current demand > 105%
ON	RL1	de-energises if stall timer latches out.
ON	RL1	de-energises if speed remains below 1%
ON	RL1	de-energises for zero or reverse rotation

If more than one switch is ON the functions are "ANDED"



INVERTED) -/+10V. 1KOhm.

ected by RL2. see T13/14. Also JOG SPEED reference +/-1V 470K impedance

/-10V FOR +/-100% SPEED

ED INPUT +/-10V , -/+100%

5V for 0 to +/-100%.

T. +/-10V. 1KOhm.

scale. 1K Ohm.

to 5V for 0 to 5 Amps up to SLX50. 0 to 5V for 0 to 10 Amps SLX65/85/115.

ance to 0V > 2K

LL when taken to 0V. 47K pull up to +24V.

25mA DC relay driver

POWER ON/0FF this configuration causes contactor drop out if any alarm is triggered. 24V DC operating voltage on 28, 29, 30

See Application notes in appendix.

E RELAY to drive main supply

A max. (suppression of the external contactor coil is recommended)

NCING

rive.

CONTACTOR. (REMOVE CONTROL

ne controller prior to checking with a

n (if fitted).

azard and that nobody else working on

ng axis with no slippage on the shafts.

must be the same as L1 L2 L3. Check
and line reactor). Repeat check for

presets may be found on Page 22.
ent in torque mode. For complete

FUNCTION SWITCH CHECKING

FUNCTION SWITCH checking. Switches S1 to S8.

SWITCH 1

FIELD CONTROL switch. When OFF this sets the field control circuit to standard current regulation. For systems requiring field weakening, it is necessary to operate initially in the standard mode. (OFF). Refer to page 23 for field set up description.

SWITCH 2

When ON, de-energises relay 1 (T10/11/12) when stall timer commences. (See S5/6/7)

SWITCH 3 and 4

SPEED FEEDBACK SCALING.

TACHO.	3,4	off	30V	-	60V
or	3	on	60V	-	125V
ARM	4	on	125V	-	250V
VOLTS	3,4	on	250V	-	500V

The MAX SPEED preset gives fine adjustment within the switch range.

FOR SYSTEMS UTILISING TACHO FEEDBACK, THE SAFEST PROCEDURE IS TO COMMISSION THE DRIVE FOR THE FIRST TIME IN ARMATURE VOLTAGE FEEDBACK MODE, WITH THE TACHOMETER CONNECTION REMOVED FROM TERMINAL 9. THIS WILL PREVENT A RUN-AWAY MOTOR IN THE EVENT OF INCORRECT TACHO POLARITY OR COUPLING. IT ALSO ALLOWS THE FULL SCALE TACHO VOLTAGE TO BE MEASURED PRIOR TO USE.

THE SUGGESTED STARTING POINT IS: S3 ON, S4 ON, MAX SPEED FULLY ANTI-CLOCKWISE. GIVES 250V MAXIMUM ARMATURE VOLTAGE.

SWITCH 5, 6 and 7

RELAY 1. (volt free changeover relay on T10/11/12). Switches 5, 6 and 7 (and S2) control the function of Relay 1. If more than one function is selected then these functions are logically ANDED.

5,6 off	Relay 1 permanently de-energised
5 on	Relay 1 de-energises on stall condition
6 on	Relay 1 de-energises at zero speed
5,6 on	Relay 1 de-energises on stall condition and speed = zero
7 off	Relay 1 permanently de-energised
7 on	Relay 1 energised at zero speed and during reverse rotation.

SWITCH 8

Switch 8 selects the method of feedback. When first commissioning start in armature voltage feedback (AVF). Ensure tacho is disconnected from terminal 9 when using armature voltage feedback.

8 off	OFF for Tacho feedback
8 on	ON for Armature voltage feedback

JUMPERS AND LINKS

MAX CURRENT MODE JUMPER

The Max current mode jumper determines the mode of operation of the Max current presets. A full description is given on page 19 and 20, refer to this and select the mode required according to the application.

TORQUE/SPEED JUMPER

The torque control operates by clamping the current demand from the speed loop. See block diagram. Hence the loop with the lower demand has control. This allows torque control with overspeed limiting, or speed control with over torque limiting. A full description of this function is given on page 19 and 20. It is recommended to set the drive up initially in SPEED mode and then when the speed operation is satisfactory, to commence the TORQUE commissioning.Temporarily park the jumper on one pin to disable.

50% STALL THRESHOLD. A full description of this function is given on page 21. Link the solder pads if the function is required.

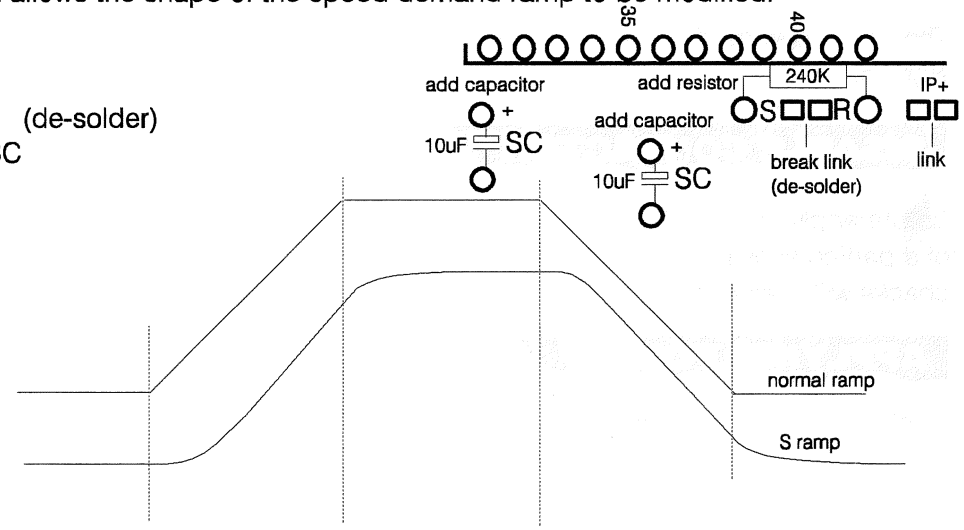
QUENCH JUMPERS

These jumpers govern the behaviour of the drive inhibit logic. (FS fast quench of both speed and current loops, 1S 1 second delay to current loop quench, ZS speed and current loops quenched if setpoint and speed remain at zero for 1 second). Rapid stopping, ramped stopping and coasting to stop are enabled according to requirements. Please refer to the BLOCK DIAGRAM OF DRIVE INHIBIT CIRCUIT on page 17, and description of RAMP FUNCTIONS on page 18 in order to choose the correct mode for your application.

S RAMP

The S RAMP function is an option that allows the shape of the speed demand ramp to be modified.

To implement the S RAMP function
1) link the solder pads marked IP+
2) break the solder pads marked S R (de-solder)
3) add 2 10uF electrolytic capacitors. SC
4) add a 240K resistor
Note this function utilises the auxiliary input which appears on terminal 70. (the length of the S shaped tails is roughly proportional to the capacitor size. Other values may be used if desired. The 10uF caps give tails of 1 second approximately)
The S ramp output can be seen inverted on terminals 17 and 57.



4-20mA SIGNAL INPUT LINK.

Link the 2 pairs of solder pads to allow terminal 2 to become the loop input, terminal 5 the return and adjust MIN SPEED to change the gain. For 0-20mA signals link only the lower pair of solder pads.

ALARM DEFEAT

The drive has 4 fast latched alarms:

Field loss
Tacho loss
Peak amps
Aux. trip

If any one of these is triggered, then the drive is immediately inhibited and the main contactor is de-energised. Any alarm may be defeated by linking the appropriate jumper. A full description is given on page 15 and 16.

THERMISTOR or MICROTHERM.

Terminal 25 is an external trip input. If the resistance to 0V exceeds 2.0 KOhms, then the AUX. TRIP ALARM will trip the main CONTACTOR. This may be used for interpole motor protection devices. If not used, the feature must be inhibited by connecting T25 to COM. The alarm will not trip for resistances to 0V less than 200 Ohms.

SAFETY CONSIDERATIONS

Before proceeding to the next stages which involve applying power to the drive, check the following items:

All relavent safety precautions have been observed.

There must be no unqualified or unauthorised personnel allowed near the drive or machine or load.

Do not work on the drive without safety assistance.

PART 2 INITIAL POWER UP

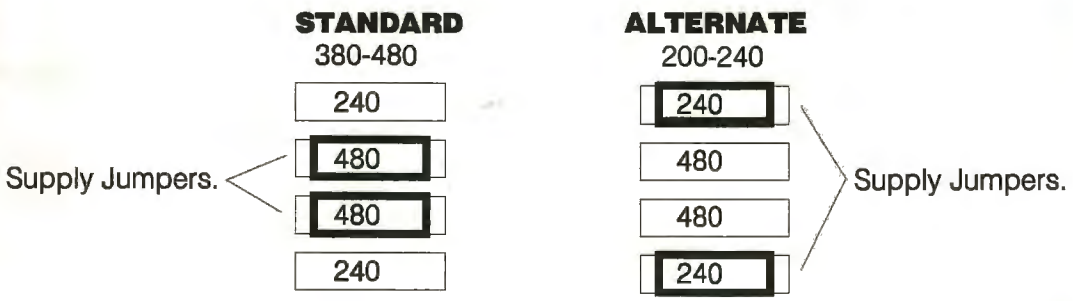
The unit is now ready to receive auxiliary power. At this stage it is necessary to use a voltmeter to measure certain signals.

DISABLE CONTACTOR

Before applying power, check that the main CONTACTOR is still disabled. If there is any doubt about the integrity of a particular system, insert a high wattage resistor in series with the armature e.g. a fire element. The following checks will involve measuring certain signals with power applied to the drive.

APPLYING POWER

Verify that the supply jumpers match your supply. Also check drive rating label. The six supply jumpers can be seen at the lower right hand side of the power board. See page 25 for details for removing the top card. Note, new units are shipped from the factory with the jumpers in the STANDARD position (380-480V).



THE FIRST TIME YOU APPLY POWER BE READY TO TURN OFF QUICKLY IN THE EVENT OF A PROBLEM.

1) Apply Power
2) Observe illuminated bridge lamp
3) All alarm lamps should be off
4) Check the following voltages

SUPPLY CHECKING

All 3 auxiliary phases should match model and tap selection.

EL1-EL2 EL2-EL3 EL3-EL1	Correct phase to phase AC VOLTS should be present 200-240V or 380-480V.

ELECTRIC SHOCK RISK

10 VOLT REFERENCES

The remaining measurements are taken with respect to 0V (com)

T4 -10V Reverse selected.
T4 +10V Forward selected.
T1 +10V
T3 +10V to -10V adjustable by speed demand pot. Leave at 0 volts.

POWER ON / OFF CIRCUIT

The next stage is to check the POWER ON/POWER OFF circuit.

WARNING. ENSURE THE MAIN CONTACTOR IS STILL DISABLED.

When the POWER ON function is activated, the field voltage will increase to provide the preset field current. When POWER OFF is selected the field voltage will stay on for a further 15 seconds and then go off. If the economy field mode is selected the field current will reduce to 40% of the preset level.

Operate the POWER ON/POWER OFF buttons and check that the slave (T31-T32) opens and shuts .

The Slave Contact lamp comes on when the contact closes. The SLAVE CONTACT lamp is in the top right hand corner. Note, if any alarm lamp is on, the POWER ON function is inhibited.

Check that any other contacts in the POWER OFF line operate correctly.

With POWER ON active, adjust the field see page 23

The next stage will establish that a current demand signal is present. To do this the run contact must be temporarily shorted (T5-T7) and also START (T5-T13). Note, the STALL lamp may come on during this sequence of tests, this is normal. To prevent this from causing interruptions, temporarily put the TORQUE jumper in the 4Q position, activate POWER ON.

Increase the the speed demand and observe the RAMP (T22). This should follow the setpoint at the slowest rate. The speed demand may be derived from numerous sources depending on application, and the analogue processing inputs (T18, T19, T20) may be utilised. Refer to the BLOCK DIAGRAM and follow the signal path. NOTE. the resultant RAMP output may be the bi-polar summation of more than one input. More accurate adjustment of the up and down ramps is possible now.

Check that an inverted version of the RAMP output appears on the TOTAL SETPOINT OUTPUT (T17). If the S RAMP function has been implemented, the inverted output can be monitored on T17.

SPEED ERROR LOOP

After being satisfied that the the speed demand is functioning, it is possible to check the next stage. This compares the speed demand with the speed feedback and integrates the error to produce a voltage signal. (Current demand IDO on T 54, 0 to -7.5V represents 0 to 150%., This is the Torque demand.) The signal can be made to integrate up by arranging for a small speed demand.

Re-park TORQUE jumper on one pin to release current demand.

TIMER LAMP

The TIMER lamp should come on as the current demand exceeds -5.25V (105%).

STALL LAMP

The stall lamp should come on approximately 30 seconds later causing the slave contact to drop out and the TIMER lamp to latch on.

The stall alarm may be reset by removing and re-applying auxiliary power, or by momentarily shorting T61 to T62.

TORQUE CONTROL

For systems involving TORQUE control it should be possible at this stage to establish correct operation of a 0 to +10V input to T6. With the torque link in 2Q TORQUE position and a speed demand input (+) the current demand signal should be controlled between 0 to -5V.

Operating the POWER OFF button or opening the RUN line will reset the ramp and current demand circuits.

With the Torque link in the 4Q position and a speed demand of + or -, the current demand signal should be controlled between 0 to -5V for a 0 to +5V input on T6. The current demand lamps should change according to the sign of the speed demand during this test. The timer lamp should come on for an input of 5.25V on T6. (It is possible to allow a negative 4Q input signal, see pages 20, 22).

PART 3 APPLICATION OF POWER TO THE MOTOR

Turn off all power and refit the MAIN CONTACTOR COIL SUPPLY FUSE.

SLAVE RELAY

The switching capability of the slave relay is 1A at 240V AC. For contactor coils with higher ratings, an intermediate slave relay should be utilised. A coil suppressor should be fitted to the main CONTACTOR.

Ensure all speed demands are set to minimum. Turn on the supply to the drive. Press the POWER ON button. The main CONTACTOR should pull in.

POWER OFF

Press the POWER OFF button. The main CONTACTOR should drop out.

SAFETY WARNING

WARNING. The main contactor should never be operated by any means other than the internal contactor control circuit provided. Any warranty will be invalidated if this warning is not heeded.

DO NOT PROCEED FURTHER UNLESS THE POWER ON/OFF CIRCUITS AND CONTACTOR OPERATE CORRECTLY.

POWER ON

POWER ON and close the RUN contact.

LOW SPEED CHECK

Press START and then set the speed demand to about +5%. Then slowly rotate the MAX CURRENT (POSI) clockwise to about 20%. The motor should rotate at 5% of full speed (initially full speed is 250V on armature). If the direction of rotation is incorrect, POWER OFF and remove the supply to the drive. Swap the field connections. Continue as before and progressively increase the speed DEMAND to 50%. During this stage an increase in MAX CURRENT may be required if the TIMER lamp remains on.

MAX SPEED

Increase the speed demand to 100% and adjust MAX SPEED to give the desired full speed. DO NOT ALLOW ARMATURE VOLTAGE TO EXCEED RATING. Monitor the armature voltage output on T56. 0 to 10V for 0 to +/-500V AV. The rating will be found on the motor rating plate. If the motor rating is excessive for the supply used, then do not exceed the ratings on page 2.
FOR SYSTEMS WITH TACHO FEEDBACK. With the motor at the correct max speed for the application (this need not be the maximum capable speed) check the tacho voltage and polarity. STOP THE DRIVE and POWER OFF. Re-connect the tacho with the -ve wire to T9. Select S3, S4 range to suit tacho voltage. Turn off S8. See worked example page 27. For a low voltage tacho, the full scale voltage ranges can be reduced by 50% by a link on the control card. There is also an optional tacho differential term mode.(see layout page 23).

ZERO SPEED

Temporarily remove the ZS jumper for accurate ZERO SPEED calibration. Re-adjust MAX SPEED for correct tacho voltage. Reduce the speed demand to zero and adjust the ZERO SPEED preset until the motor just turns, then back off until it just stops.

MIN SPEED and JOG SPEED

Reduce the speed demand to zero and rotate MIN SPEED to give the desired minimum motor speed. If the JOG SPEED function is required, operate the JOG mode (see section 4 page 11 for typical jogging systems) and adjust the JOG SPEED preset clockwise to the desired level. (+/-5% max)

MAX CURRENT

Refer to page 19 to determine the appropriate preset. Adjust the MAX CURRENT preset to the desired level. (Clockwise rotation gives a linear increase in current limit) Full rotation corresponds to the maximum nominal rating of the drive. (note, the TIMER lamp comes on if the current demand exceeds 105%. While adjusting the MAX CURRENT preset, the lamp may be used to approximate the load current. Note the preset rotation percentage as the lamp changes state)

UP AND DOWN RAMPS

Final adjustment of the up and down ramps can now take place.

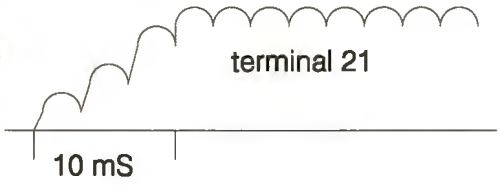
STABILITY

Tthe stability of the SPEED and CURRENT loops can be adjusted. The initial setting of midway is usually optimum for the speed STAB preset. Clockwise rotation of the STAB preset increases the response of the drive. Excessive rotation may cause instability. Adjustment of the current loop (TORQUE) stability should not be attempted without the aid of an oscilloscope. (Adjustment is not normally needed, anti-clockwise optimum)

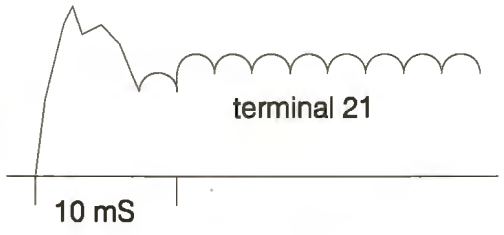
CURRENT RESPONSE

Arrange for a small square wave perturbation (20%) to be imposed on the speed demand. This may be derived from a waveform generator and input via T6 in SPEED mode.

Ideal current response



Excessive overshoot



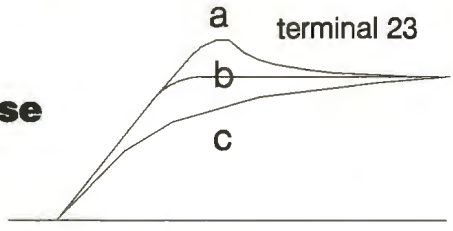
Overshoot may be reduced by anticlockwise rotation of the speed or current stability presets. Best strategy for adjustment is to set up speed response first with current stability anticlockwise (factory setting).

SPEED RESPONSE

a) Overshoot

b) Ideal response

c) Undershoot



CURRENT REDUCTION
When customer systems are being tested prior to shipping it is sometimes only possible to use a small unloaded motor. This may lead to speed instability. A current reduction jumper has been provided to reduce the current scaling by 50%. This will improve speed stability whilst testing is in progress. See layout on page 22.

Clockwise rotation of STAB to increase speed of response. Do not allow excessive overshoot to occur. Note if there is excessive overshoot in tacho feedback mode check tacho couplings are stiff and not slipping. Extra response can be gained by adding a 0.1uF capacitor in the DIFF position. (see block diagram page 28 and layout page 23). This provides feed forward of the tacho signal and allows the STAB preset further rotation. Re-check the current response after adding the differential term to make sure there is no excessive overshoot. If the tacho signal is noisy then adding the differential term may lead to erratic current stability. Ensure the tacho signal is clean by observing it on an oscilloscope before implementing the differential term.

Repeat the tests for negative speed inputs, Reverse ramps, NEG I. etc.
Start at the Power On section Page 13.

POWER OFF

The drive should now be set up and ready to operate. Press the POWER OFF button. The main CONTACTOR should drop out and the motor will coast to rest.

END OF PROCEDURE

These set up procedures are intended as a general guide and can not be expected to cover all possible configurations.

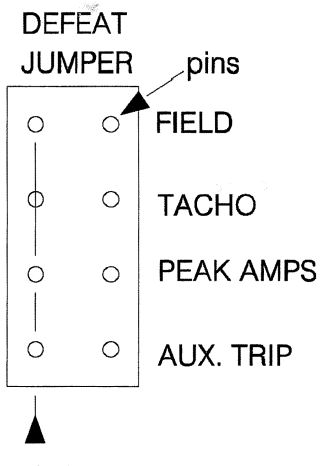
ALARMS

The drive provides protection for the system in the event of certain dangerous conditions. If an alarm is triggered the drive is instantly quenched followed by automatic de-energisation of the main CONTACTOR. The alarm condition remains latched and is indicated by a lamp on the drive. There is provision to defeat any individual alarm, and an external RESET terminal is provided. It is also possible to gain access to the individual lamp outputs for external indication if required. (page 23)

LAMPS	ALARM FUNCTION
○ FIELD LOSS	If the field current drops below 100mA on models up to SLX50 and 200mA on models SLX65/85/115, then this alarm will be triggered. This alarm is inhibited during a POWER off sequence
○ TACHO LOSS	If there is a loss of tacho feedback causing the motor to overspeed this alarm will trigger. An internal circuit continually monitors the current demand and the armature voltage and operates when both parameters indicate loss of feedback. This function is automatically inhibited in ARMATURE VOLTAGE feedback mode.
○ PEAK AMPS	If the current reaches 400% of the maximum drive rating this alarm will trigger. If this occurs on initial power up, suspect a wiring fault. If it occurs during running suspect a motor fault. If it occurs repeatedly a damaged thyristor may be the cause. This alarm can only be reset by removing the supply.
○ AUX. TRIP (heatsink temp)	This alarm is provided for external use and is connected via terminal 25. The terminal possesses a 1K Ohm pull up resistor to +12V. The alarm will trigger when the resistance to 0V (com). exceeds 2K Ohm. It will not trigger if the resistance to 0V remains below 200 Ohms. It is also triggered by excessive heatsink temperature.

DEFEATING THE ALARMS

If an alarm is not required to operate it may be defeated.



A double row of pins located on the control card provides the function. Locate the jumper across the appropriate pair of horizontal pins. The COM pins are at 0V and used to park the jumper when the defeat function is not required. The pins may also be wire wrapped. Any number of alarms may be defeated. (NOTE: if the AUX. TRIP is defeated then the heatsink temperature alarm is also defeated)

RESETTING ALARMS.

A triggered alarm may be reset via terminal 26 and is achieved by momentarily shorting to 0V (com). T26 has a 47K Ohm pull up to +24V. (Remove supply for PEAK AMPS)

WARNING! DO NOT DEFEAT ANY ALARM WITHOUT DUE CONSIDERATION TO SAFETY.

STALL TIMER

The STALL alarm has the same effect as the other alarms, but due to the important nature of this alarm it is not able to be defeated or reset in the same way.

It is triggered by a timer according to the current demand. (150% for 30secs, 125% for 60secs, 110% for 120secs). The timer starts timing when the current demand exceeds 105%. This is indicated by the TIMER LAMP.
A number of conditions can lead to excess demand and hence STALL. Incorrect current calibration, incorrect speed calibration, underated motor, jammed or excessive load, incorrect feedback scaling, slipping tacho coupling, supply too low for required output, incorrect motor wiring, excessive speed demand input, in fact any reason that prevents the speed loop from achieving what it is being asked to do.

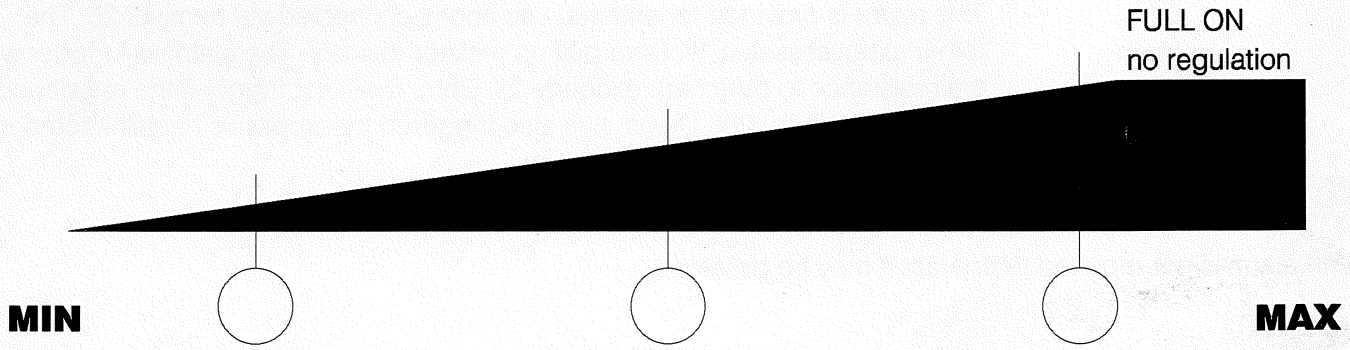
The only way to inhibit the STALL alarm is to prevent the current demand exceeding 100%. To do this the drive must be in TORQUE mode with the external current demand input via terminal 6 below 100%. The STALL alarm may be reset by momentarily shorting T62 (SS) to T61 (+12V)

\+ −

These lamps indicate the polarity of the current demand. One lamp will remain on while the auxiliary supply is energised by two or more lines. WARNING: do not assume that the supply is disconnected if the lamp is off.

FIELD VOLTAGE DISPLAY

100% represents 0.9 times AC supply.



This lamp starts to come on at 25% field voltage and gets brighter as the voltage increases beyond 25%.

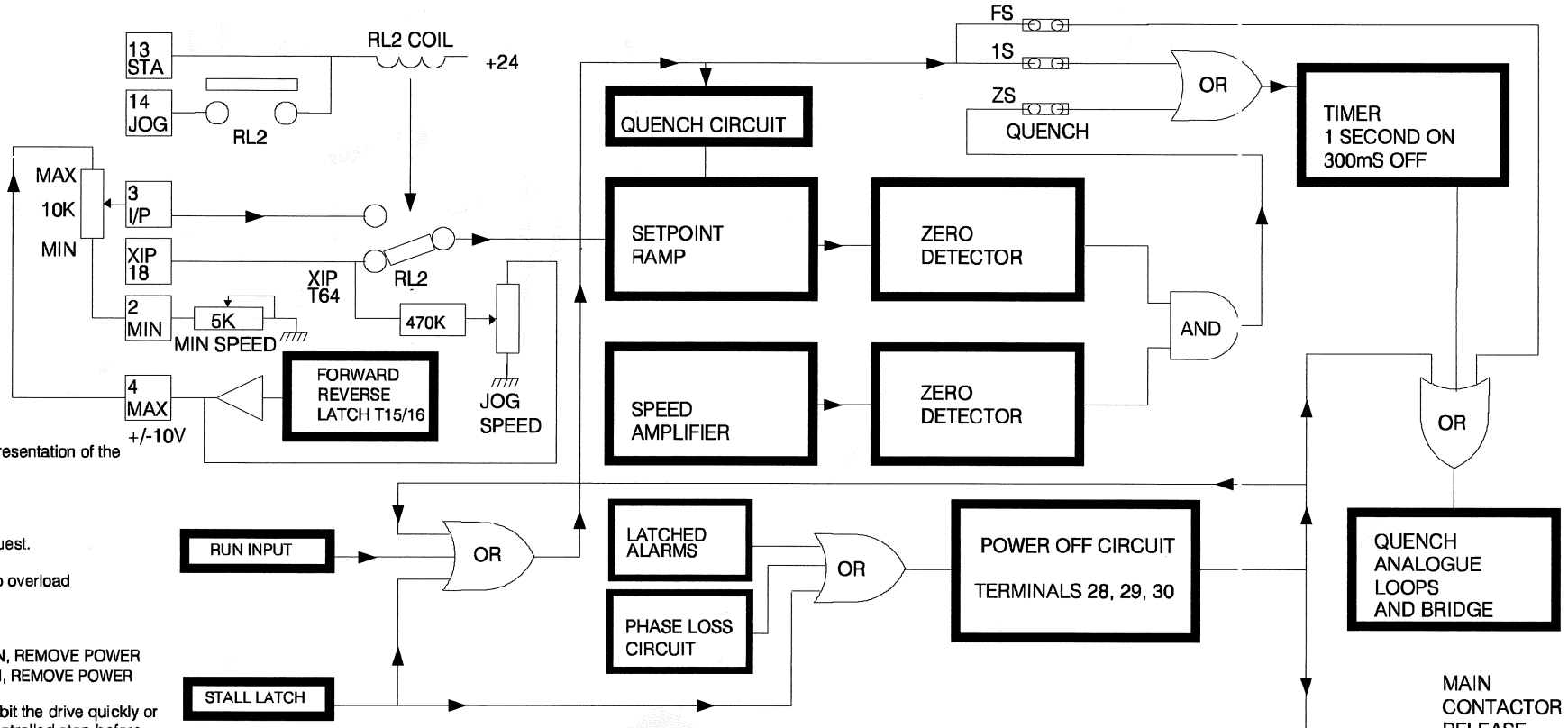
This lamp starts to come on at 50% field voltage and gets brighter as the voltage increases beyond 50%.

This lamp comes on at a field voltage of 95%. Below 95% the lamp remains off. When it is just turning off, the regulated region has been entered.

REGULATED REGION

The first two lamps are used to show a dynamic trend of the field voltage by changes in intensity.

The third lamp has sharp action.



Refer to page 18 for a graphical representation of the stopping modes.

OPERATION

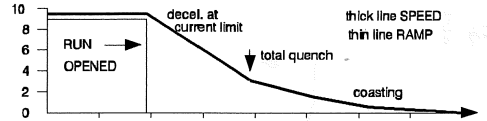
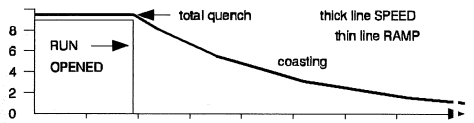
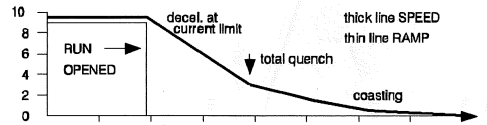
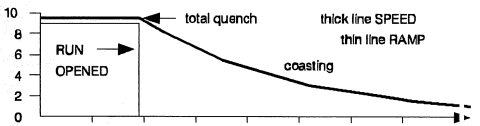
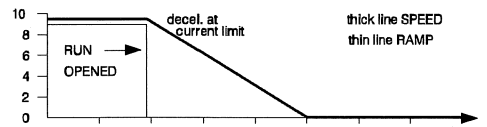
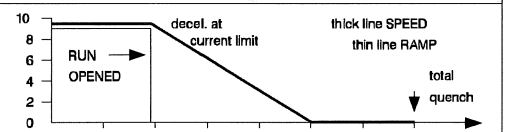
list of possible sources of inhibit request.

1) Stall timer latch is triggered due to overload
2) external run line is opened
3) zero speed is attained

4) latched alarm FAST ACTION, REMOVE POWER
5) Power off request FAST ACTION, REMOVE POWER

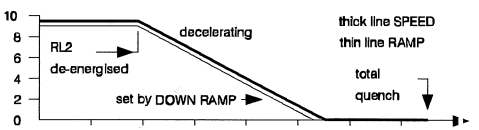
It is also necessary to be able to inhibit the drive quickly or wait until the motor has come to a controlled stop before inhibiting the drive.

TABLE OF OPERATING MODES

JUMPERS	QUENCH CONDITION	
FS ○○ 1S ○● ZS ○○ QUENCH	the speed ramp will be quenched by stall or run. The drive will be quenched after 1 sec.OR 1 sec. after zero	
FS ○○ 1S ○● ZS ●○ QUENCH	the speed ramp will be quenched by stall or run. The drive will be quenched immediately, OR 1 sec. after zero	
FS ○○ 1S ●○ ZS ○○ QUENCH	the speed ramp will be quenched by stall or run. The drive will be quenched after 1 sec. The drive will not be quenched by zero speed.	
FS ○○ 1S ●○ ZS ●○ QUENCH	the speed ramp will be quenched by stall or run. The drive will be quenched immediately. The drive will not be quenched by zero speed.	
FS ○○ 1S ○○ ZS ○○ QUENCH	the speed ramp will be quenched by stall or run. The drive will remain active.	
FS ○○ 1S ○○ ZS ●○ QUENCH	the speed ramp will be quenched by stall or run. The drive quench occurs 1 sec. after speed remains zero	

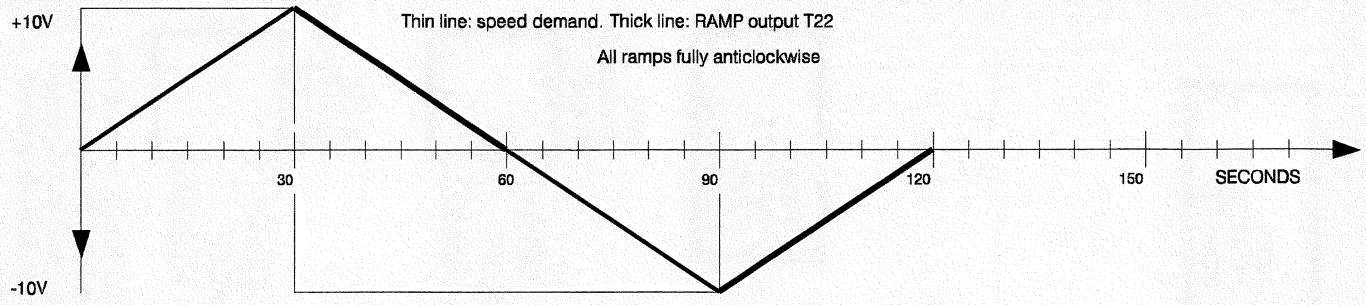
STOPPING MODES USING THE START/JOG CONTROLS ON T13/14

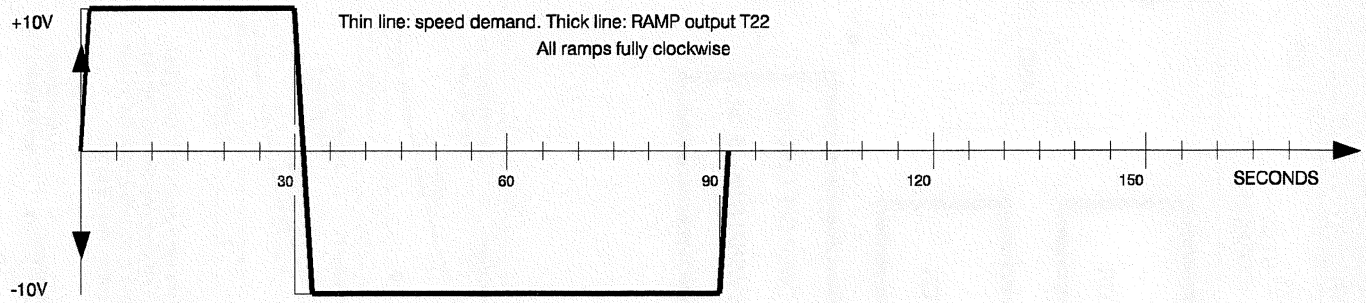
T13/14 control the internal relay RL2. This relay connects the input of the ramp circuit to T3 OR T18/64. When RL2 is energised, T3 is connected. When RL2 is de-energised T3 is disconnected and T18/64 is connected. The effect of removing the input to the ramp circuit causes it to ramp to zero at the chosen DOWN rate. The graph below shows the effect of operating the stop button, and ZS jumper.

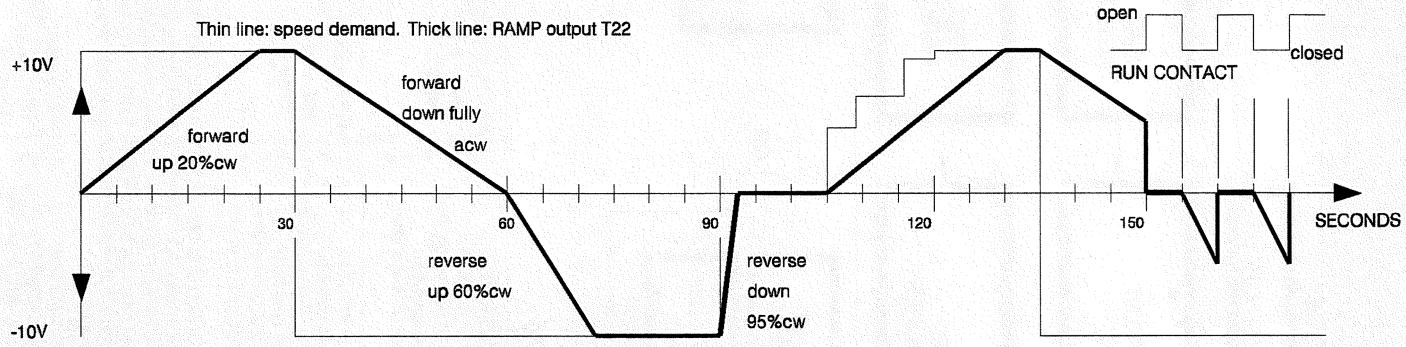
JUMPERS	ZERO SPEED QUENCH CONDITION	
FS ○○ 1S ○○ ZS ●○ QUENCH	the speed ramp will be quenched by stall or run. The drive quench occurs 1 sec. after speed AND setpoint both remain at zero.	

NOTE. The ZS logic will not release the ZS function at zero speed until the ramp circuit has an input. If the speed input is direct via T6, the ZS jumper must be parked on one pin.

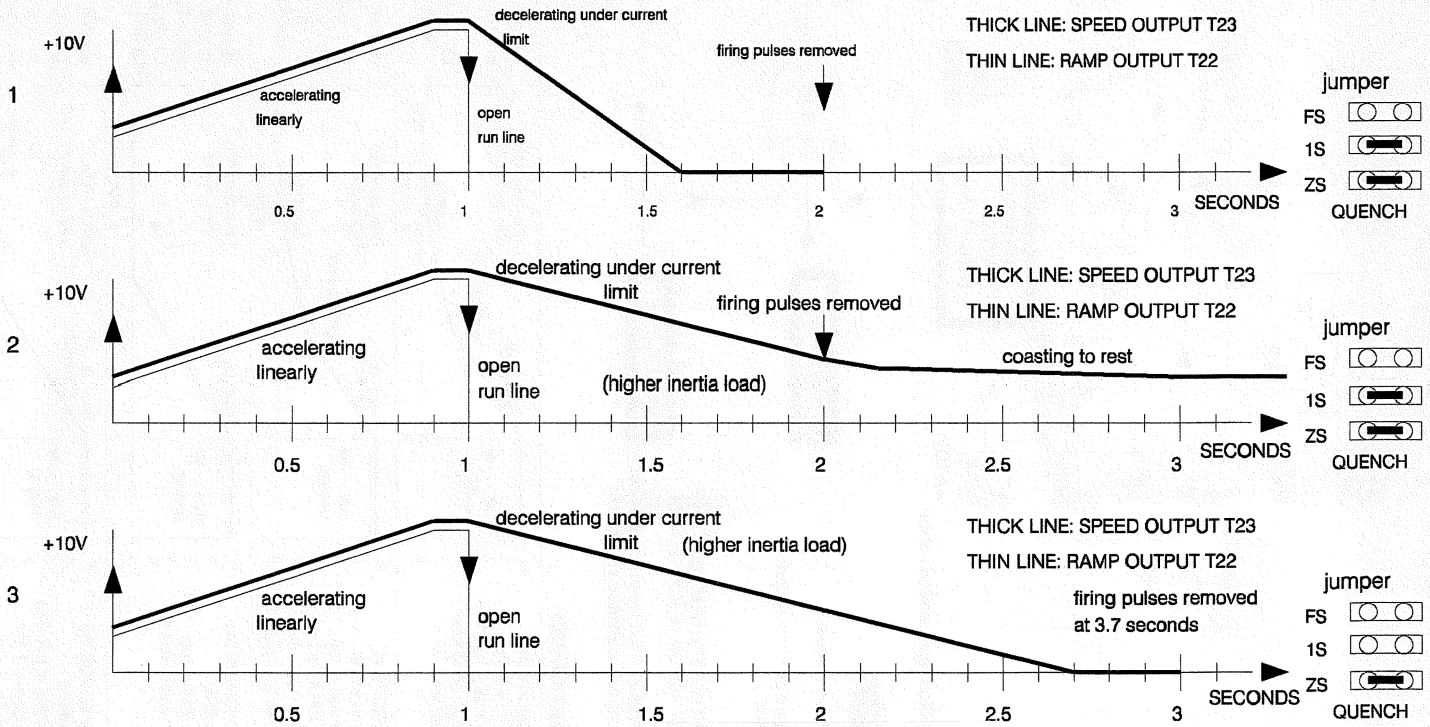
RAMPS







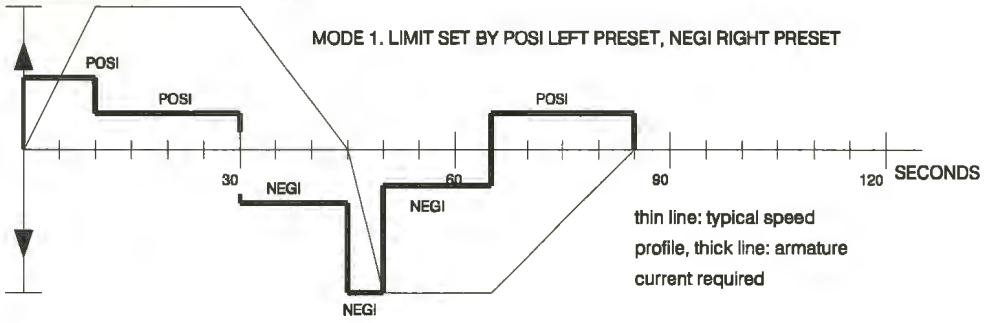
STOPPING MODES

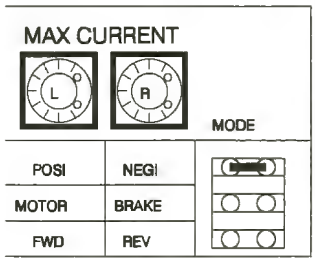


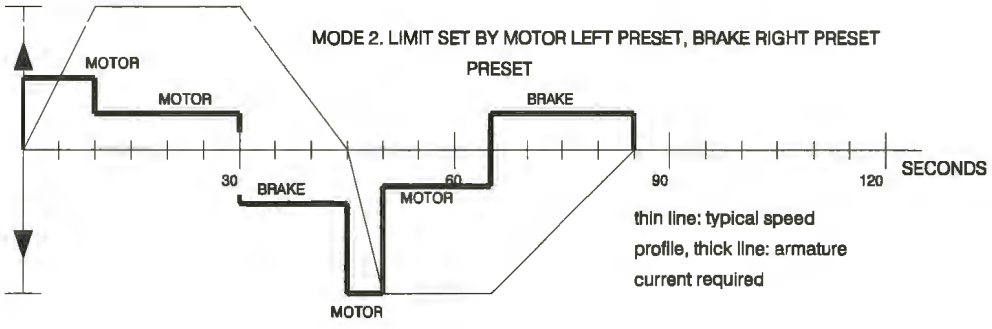
The above traces show the effect of opening the RUN terminal 7. The setpoint ramp is immediately reset, and the load regeneratively braked. In cases 1 and 2, the firing pulses are removed after 1 sec. In case 3, 1 sec. after reaching zero speed.

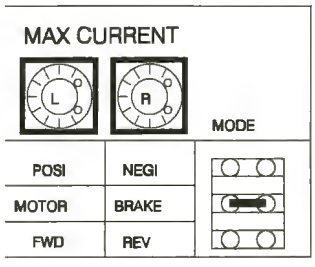
To ramp down under control of the DOWN RAMP preset, operate the STOP function on T13. This removes the speed setpoint

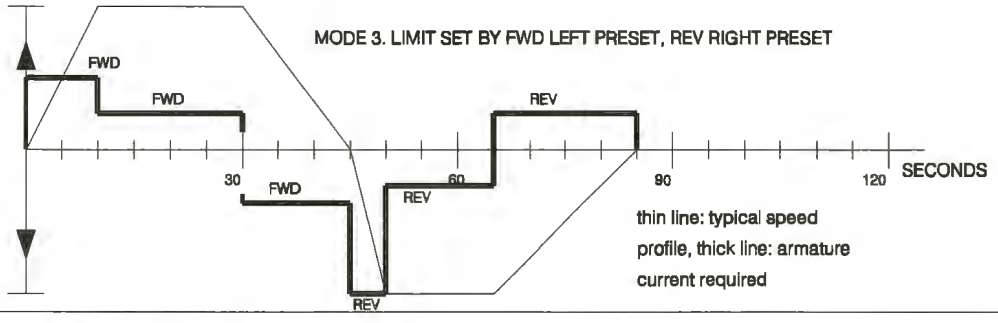
MAX CURRENT

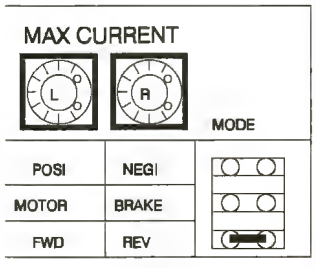








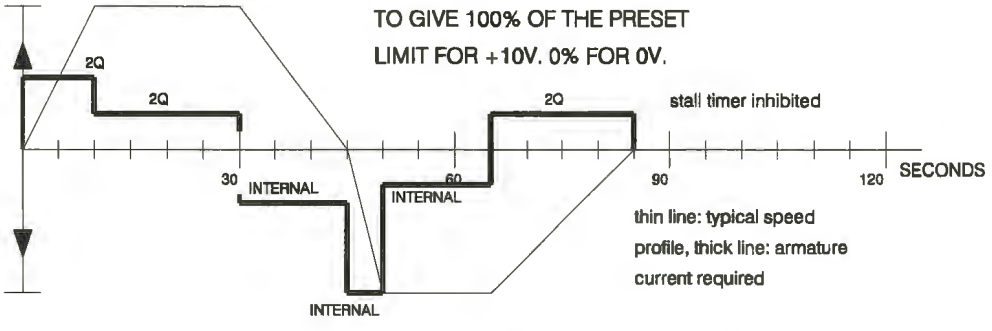




TORQUE FUNCTIONS

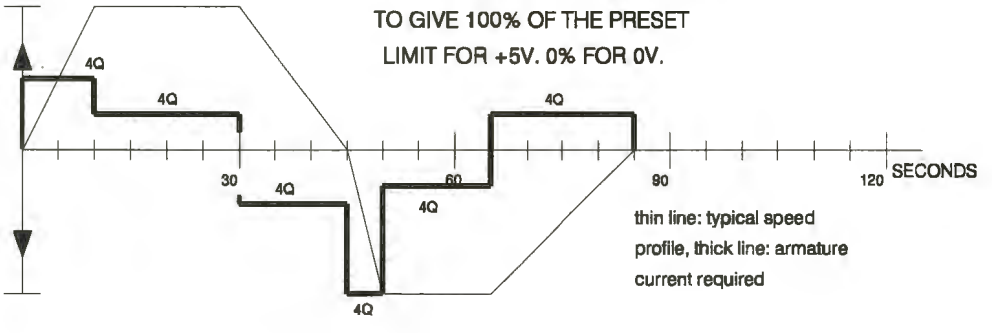
SIGNAL INPUT TERMINAL 6.

THE EXTERNAL SIGNAL IS SCALED TO GIVE 100% OF THE PRESET LIMIT FOR +10V. 0% FOR 0V.



THE 2Q TORQUE JUMPER ALLOWS THE CURRENT LIMIT TO BE PROGRAMMED BY AN EXTERNAL SIGNAL FOR THE POSITIVE CURRENT ONLY. THE NEGATIVE LIMIT IS PRESET ADJUSTED

THE EXTERNAL SIGNAL IS SCALED TO GIVE 100% OF THE PRESET LIMIT FOR +5V. 0% FOR 0V.



THE 4Q TORQUE JUMPER ALLOWS THE CURRENT LIMIT TO BE PROGRAMMED BY AN EXTERNAL SIGNAL FOR BOTH POSITIVE AND NEGATIVE CURRENT.

NOTES. The torque input signal is used to clamp the upper limit of the internal current demand signal before it is fed to the MAX. CURRENT presets The relevant preset is set by the MODE jumper

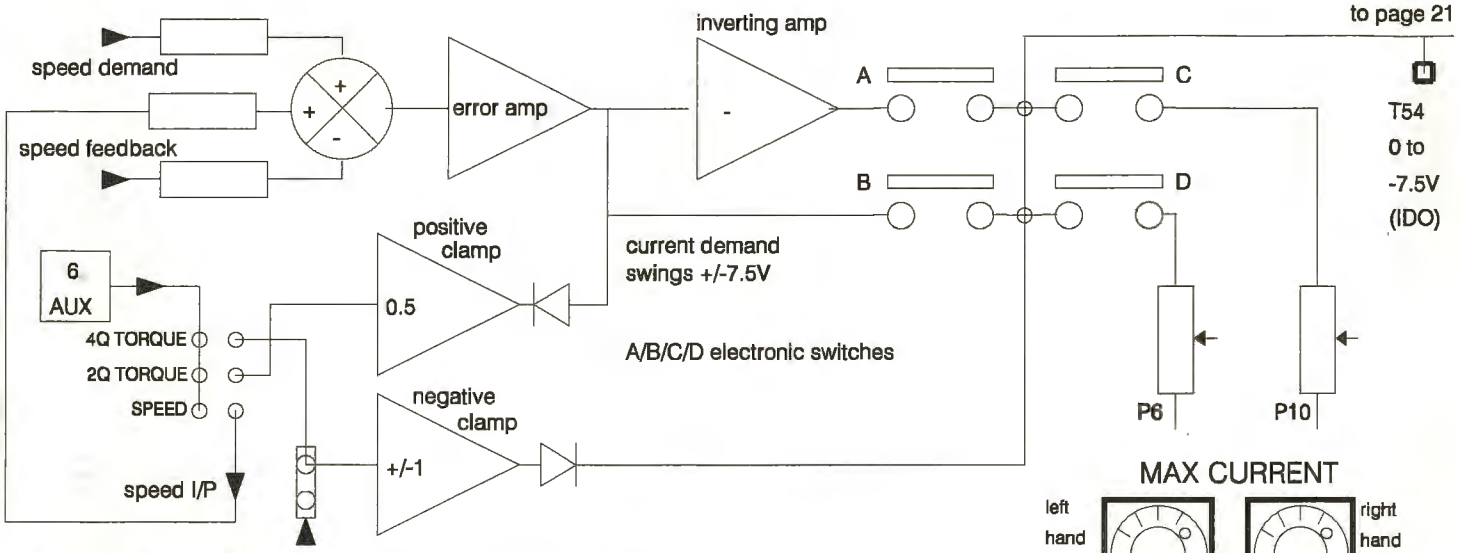
If the speed loop does not require current greater than the clamp level, then it will have control.

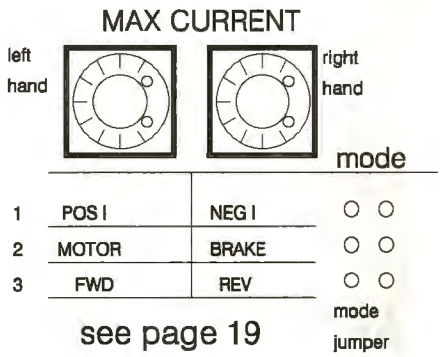
TORQUE CONTROL

Facilities are provided for controlling the torque (current) instead of the speed (volts) of the motor. This is achieved by allowing the current demand to be clamped by an external input. NOTE the current demand is provided by the speed loop and hence the speed loop must always be asking for more current than the clamp level. This technique gives automatic overspeed limiting.

TORQUE / SPEED JUMPER

This is a 3 position jumper which controls the function of terminal 6 (AUX). A schematic is shown below





see page 19

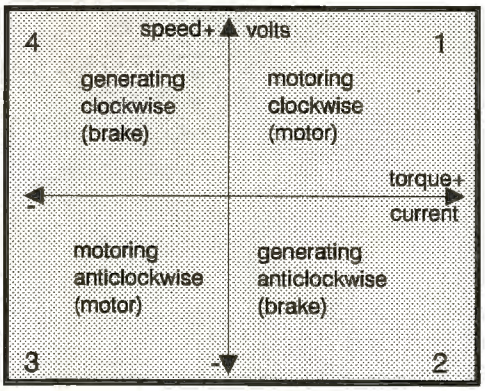
Break the +/- link to allow a negative 4Q input. (see layout page 22)

The 4Q TORQUE mode can be used for load sharing by using the rectified current signal IOM on T69 from the master drive as the torque reference input The negative current demand signal IDO on T54 may also be used by breaking the +/- link. (page 22)

The 4Q TORQUE clamp operates in all 4 quadrants on positive and negative currents

The 2Q TORQUE clamp operates in 1 and 2 on the positive current only

QUADRANT DIAGRAM



MAX CURRENT MODE

The electronic switches C and D select which MAX CURRENT limit preset is enabled according to the position of the current MODE jumper. see page 19. The sign of the setpoint ramp output determines the preset selection.

1 P6 POS I, quadrants 1 and 2 *P10 NEG I, quadrants 3 and 4*

This is the classical mode of operation. The disadvantage of this arrangement is that the the current limit for braking in the forward direction, becomes the same limit for motoring in the reverse direction.

2 P6 MOTOR, quadrants 1 and 3 *P10 BRAKE quadrants 2 and 4*

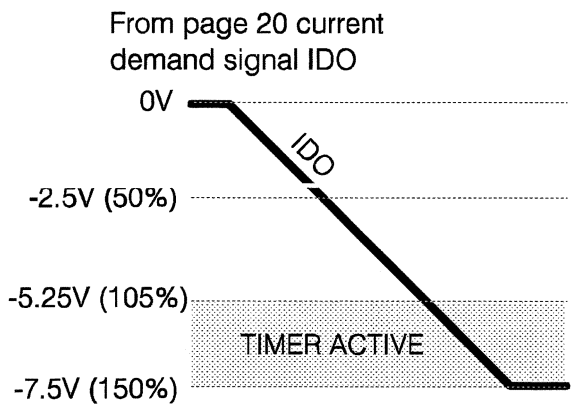
This mode allows one preset to control the motoring current limit in both directions of rotation, and the other preset to control the braking current limit in both directions of rotation.

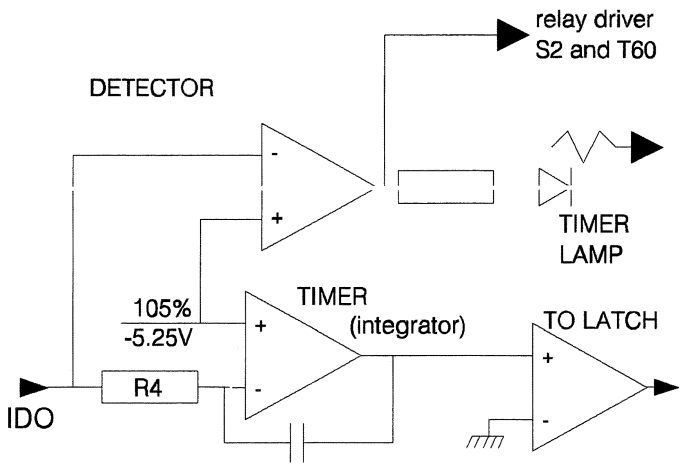
3 P6 FWD, quadrants 1 and 4 *P6 REV, quadrants 2 and 3*

This mode allows one preset to control the current limit for both motoring and braking in one direction of rotation, and the other preset controls current in the other direction.

STALL TIMER

To achieve the desired speed, the outer speed loop provides the current loop with a CURRENT DEMAND signal. The timer itself is inhibited while the current demand signal lies below -5.25V (-5V represents 100%). Whenever the signal traverses into the area between -5.25V and -7.5V the stall timer starts to integrate. The rate of integration is proportional to the magnitude of the signal over 105%.





SCHEMATIC OF STALL TIMER

The time taken to integrate a 150% level is approximately 30 seconds , 125% for 60 seconds etc. Thus the stall timer allows smaller overloads for longer periods. When the current demand falls below 105% after being in overload, providing the timer has not timed out, the integrator starts to integrate back down again. This feature provides an historical store of the behaviour of the current demand. If the timer has come close to tripping, and then the demand falls below 105% , the demand will need to spend at least 30 seconds at 50% to totally reset the timer. The effect of this feature is to have the ability to provide complex overload behaviour, and trip only when the time average overload is exceeded.

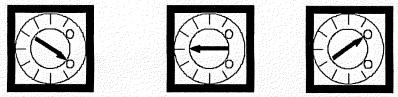
50% STALL THRESHOLD

FUNCTION: TO ALLOW HIGH PEAK CURRENTS

This changes the level at which the stall timer integration starts to 52.5%. The advantage of this feature is it allows the 150%, current to be achieved, but provides protection above 50%. The stall time is reduced by half. When using this feature it is important to remember that the maximum current rating of any model is unchanged, and the trip level is reduced.

RESISTOR	THRESHOLD	OVERLOAD	RATIO	PEAK %
LINK	50%	150%	1 : 3	300%
100K	60%	150%	1 : 2.5	250%
220K	70%	150%	1 : 2.1	210%
470K	80%	150%	1 : 1.87	187%
1M	90%	150%	1 : 1.66	166%
OPEN	100%	150%	1 : 1.5	150%

Other threshold levels can be implemented if a resistor is used instead of a link.



Anticlockwise Midway Clockwise

Rotate clockwise to increase speed. Change range with S3 and S4.

Rotate clockwise to increase minimum speed. Use to adjust 4-20mA loop burden resistor between 0 and 360 Ohms if 4-20mA mode is selected.

Rotate clockwise to increase drive acceleration in forward direction. (+) span is approx. 1 to 30 seconds.

Rotate clockwise to increase drive deceleration in forward direction (+) span is approx. 1 to 30 seconds.

Rotate clockwise to increase drive acceleration in reverse direction (-) span is approx. 1 to 30 seconds.

Rotate clockwise to increase drive deceleration in reverse direction (-) span is approx. 1 to 30 seconds.

Rotate clockwise to increase response. Excessive rotation may cause instability.

Rotate clockwise to increase level of positive zero speed adjustment, and anti-clockwise for negative adjustment. (+/-5% span)

Rotate clockwise to increase current limit. Eg 50% rotation gives 50% current limit.

The position of the MODE jumper determines the PRESET function according to the table

POSITIVE CURRENT MOTORING fwd/rev FORWARD + and -	NEGATIVE CURRENT BRAKING fwd/rev REVERSE + and -

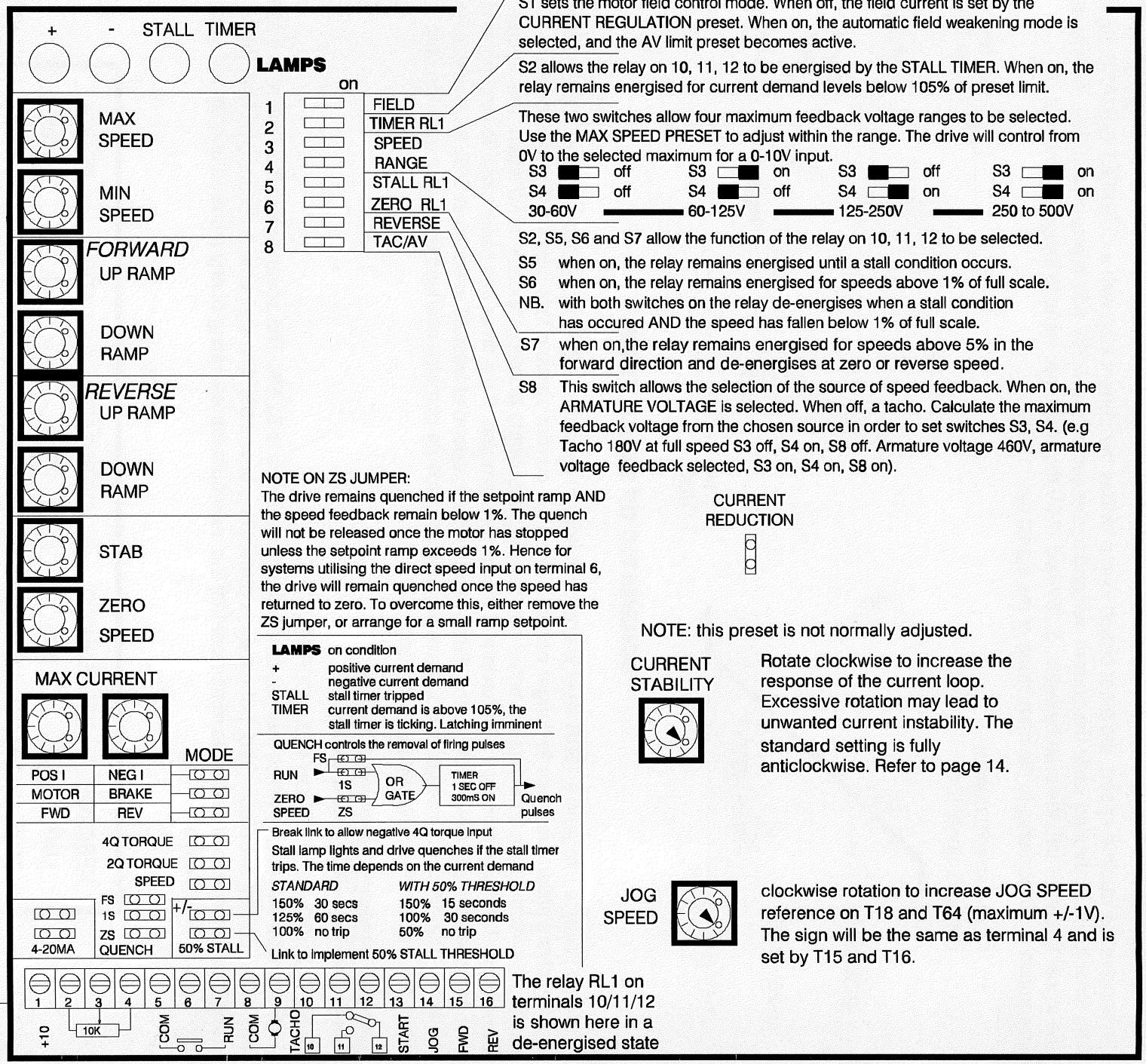
TORQUE OR SPEED MODE JUMPER: This jumper alters the function of the AUX input on terminal 6.

4Q TORQUE: 0 to +5V for 0 to 100% positive and negative current limit.

2Q TORQUE: 0 to +10V for 0 to 100% positive current limit

SPEED: 0 to +/-10V for 0 to +/-100%

4-20mA. Link both pairs of pads and terminal 2 is input, 5 return. MIN SPEED to set zero. Link the lower pair of pads only for 0 - 20mA loop signals.



The relay RL1 on terminals 10/11/12 is shown here in a de-energised state

S1 sets the motor field control mode. When off, the field current is set by the CURRENT REGULATION preset. When on, the automatic field weakening mode is selected, and the AV limit preset becomes active.

S2 allows the relay on 10, 11, 12 to be energised by the STALL TIMER. When on, the relay remains energised for current demand levels below 105% of preset limit.

These two switches allow four maximum feedback voltage ranges to be selected. Use the MAX SPEED PRESET to adjust within the range. The drive will control from 0V to the selected maximum for a 0-10V input.

S3 off	S3 on	S3 off	S3 on
S4 off	S4 off	S4 on	S4 on
30-60V	60-125V	125-250V	250 to 500V

S2, S5, S6 and S7 allow the function of the relay on 10, 11, 12 to be selected.

S5 when on, the relay remains energised until a stall condition occurs.

S6 when on, the relay remains energised for speeds above 1% of full scale.

NB. with both switches on the relay de-energises when a stall condition has occured AND the speed has fallen below 1% of full scale.

S7 when on,the relay remains energised for speeds above 5% in the forward direction and de-energises at zero or reverse speed.

S8 This switch allows the selection of the source of speed feedback. When on, the ARMATURE VOLTAGE is selected. When off, a tacho. Calculate the maximum feedback voltage from the chosen source in order to set switches S3, S4. (e.g Tacho 180V at full speed S3 off, S4 on, S8 off. Armature voltage 460V, armature voltage feedback selected, S3 on, S4 on, S8 on).

NOTE ON ZS JUMPER:
The drive remains quenched if the setpoint ramp AND the speed feedback remain below 1%. The quench will not be released once the motor has stopped unless the setpoint ramp exceeds 1%. Hence for systems utilising the direct speed input on terminal 6, the drive will remain quenched once the speed has returned to zero. To overcome this, either remove the ZS jumper, or arrange for a small ramp setpoint.

CURRENT REDUCTION

NOTE: this preset is not normally adjusted.

CURRENT STABILITY

Rotate clockwise to increase the response of the current loop. Excessive rotation may lead to unwanted current instability. The standard setting is fully anticlockwise. Refer to page 14.

JOG SPEED

clockwise rotation to increase JOG SPEED reference on T18 and T64 (maximum +/-1V). The sign will be the same as terminal 4 and is set by T15 and T16.

FIELD CONTROL ADJUSTMENTS

LAMPS + - STALL TIMER

MAX SPEED

MIN SPEED

FORWARD UP RAMP

DOWN RAMP

REVERSE UP RAMP

DOWN RAMP

STAB

ZERO SPEED

MAX CURRENT

MODE

POS I	NEG I
MOTOR	BRAKE
FWD	REV

4Q TORQUE
2Q TORQUE
SPEED
FS
1S
ZS
QUENCH
+/-
4-20MA
50% STALL

CURRENT REGULATION (linear output on terminal 24 field current 0 - 5V for 0 - 100%)

Rotate clockwise to increase field current. NOTE: When the MAX lamp on the field voltage display changes state the field voltage is at 95%. Any further clockwise rotation will be unable to increase the field current, and the constant current regulation facility will be over-ridden. If the field output is to be set up by refering to field voltage, then the current regulation preset may be used to move the initial voltage to the required level. The control loop will then regulate at the current that was initially established by the applied field voltage. This will provide an enhanced level of speed control when ARMATURE VOLTAGE FEEDBACK is being used, by eliminating field flux variations due to changes in the field current.

AUTOMATIC WEAKENING S1 ON

This function monitors the armature voltage and after the preset level has been reached, any further speed demand reduces the motor field current . Thus the motor speed may be increased without exceeding the rated armature voltage. This function must only be used with TACHO feedback. To set up the system, first adjust the field current to the correct maximum using the current regulation preset. Then with the automatic preset fully clockwise and the drive set to provide maximum armature voltage at the reduced setpoint, rotate the AUTOMATIC WEAKENING preset anticlockwise until the field starts to reduce as shown by the display. Any further increase in speed demand should now result in a further reduction in the field volts. Typically the speed demand is 75% for full armature volts. (linear signal output on terminal 56, 0 - 10V for 0 to +/-500V armature)

DELAYED FIELD QUENCH

The unit provides automatic control of the field output. When the main power contactor is de-energised by the POWER OFF function, the field current is quenched. The quench action is delayed by 15 seconds to allow dynamic braking systems to operate.

ECONOMY FIELD MODE (the field current must be set up first for accurate operation)

The field is quenched 15sec. after the main power contactor is de-energised. The economy field mode allows the quench level to be set to 40% rather than 0%. This feature is used in cold climates to keep the motor warm when it is not rotating. To implement the economy field mode, remove the resistor marked 'ECONOMY FIELD'

lamp on shows slave contact energised (T31, T32)

SLAVE CONTACT

FIELD VOLTAGE DISPLAY

MIN MAX

CURRENT REGULATION

FIELD CURRENT 10% → 100%

AUTOMATIC WEAKENING

ARMATURE VOLTAGE LIMIT S1 ON 250 → 500V

ALARMS

DEFEAT JUMPER

COM

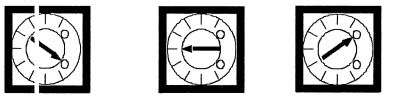
FIELD LOSS
TACHO LOSS
PEAK AMPS
AUX TRIP

FIELD VOLTAGE DISPLAY (page 16)

This indicates the approximate level of the motor field voltage. The MIN lamp starts to come on at 25% and gets brighter as the level increases. The middle lamp comes on at 50% and gets brighter as the level increases. The MAX lamp comes on at 95% at full brightness.

NOTE the maximum available FIELD VOLTAGE is 0.9 times the AC supply.

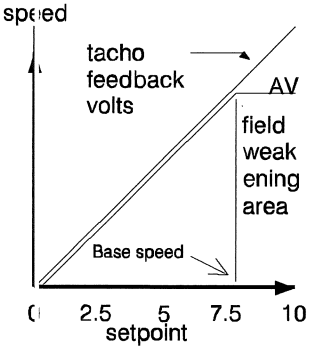
The MAX lamp is a useful indication of the field bridge just coming out of full phase angle, and into the controlled region. The other two lamps give a dynamic indication of the changing field voltage.



anticlockwise midway clockwise

Notes on automatic field weakening:

1) If the acceleration rate of the drive is too fast, then the field may overweaken and trip the FIELD LOSS alarm. To prevent this, rotate the UP RAMP anticlockwise.



This connector allows special applications and diagnostics.

2) T3 speed I/P	4) T18 speed I/P	6) T6 aux I/P	8) T7 run I/P	10) power on	12) field I/P	14) T24 field O/P	16) T5 common	18) +12	20) -12
1) T22 ramp O/P	3) T17 total O/P	5) T23 speed O/P	7) T54 I demand	9) T21 I O/P	11) RL1	13) field loss	15) tacho loss	17) peak A	19) aux. trip

DIFF

1) Link this pair of pads to reduce full scale tacho volts by 50%

2) Add a 0.1uF capacitor as shown to implement a differential term on the tacho feedback (see page 14)

INTERFACE CONNECTOR

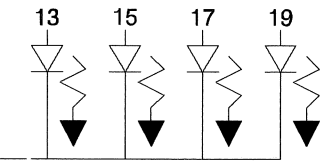
2 4 6 8 10 12 14 16 18 20

1 3 5 7 9 11 13 15 17 19

drive interface connector

these four signals can drive an external LED to show alarm status

External LED lamps to show alarm status.



1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

+10 10K COM RUN COM TACHO 10 11 12 START JOG FWD REV

17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32

DO/P XIP I/P+ I/P- IO/P RO/P SO/P FIO/P TRIP RESET COM OFF ON LATCH SLAVE

FAULT FINDING CHART

If the problem is not covered by this chart, repeat the set up procedure and try to determine at which step the problem is highlighted.

Symptom	*possible reason*	page	*possible remedy*	page
1 main contactor will not energise	1 alarm tripped	15	1 find alarm cause, use defeat if able	15
2 no alarms but still no main contactor	2 power on/off not properly configured	28	2 check system and wiring of T28/29/30	28
3 slave contact lamp comes on but no main contactor	3 wiring or contactor coil supply problem	3	3 coil supply fuse or wrong supply volts	

Symptom	*possible reason*	page	*possible remedy*	page
1 speed too low stall timer trips	1 insufficient motor torque for load	19/20 21/28	1 check current cal. of drive and motor	19/20 21/28
2 same as above but current cal. correct	2 field current is too low	23	2 check field current calibration	23
3 speed too high and stall timer trips	3 excessive speed demand due to feedback cal.	22/27 28	3 check feedback source full scale	22/27 28

Symptom	*possible reason*	page	*possible remedy*	page
1 speed changes when ancilliaries energised	1 interference coupled onto tacho feedback		1 suppress noise or screen/filter tach	
2 incorrect speed and stall timer lamp off	2 speed calibration not correct	22/27 28	2 check feedback source full scale	22/27 28
3 incorrect speed and speed feedback cal. is correct	3 speed demand is incorrect	27/28	3 trace all speed I/P sources to total setpoint O/P. T17	27/28

Symptom	*possible reason*	page	*possible remedy*	page
1 deceleration too slow and timer lamp flashes	1 braking current too low for load inertia	18/20	1 re-check current calibration	18/20
2 deceleration too slow timer lamp stays off	2 down ramp preset needs adjustment	18/22	2 adjust down ramp preset clockwise	18/22
3 deceleration too fast and/or uncontrolled behaviour	3 the stopping mode is incorrect for the chosen application	17/18 28	3 rapid stopping with run line OR ramped using stop/start	17/18 28

Symptom	*possible reason*	page	*possible remedy*	page
1 intermittent stall trip after some months	1 original current setting marginal		1 re-check current calibration	
2 field loss alarm in field weakening mode	2 armature voltage changing rapidly	16/23	2 limit acceleration, 10 secs. for 100%	16/23
3 aux. trip triggered, thermistor on T25	3 overheated motor OR heatsink temp.		3 increased cooling for motor or drive. (heatsink lamp L1)	29/15 25

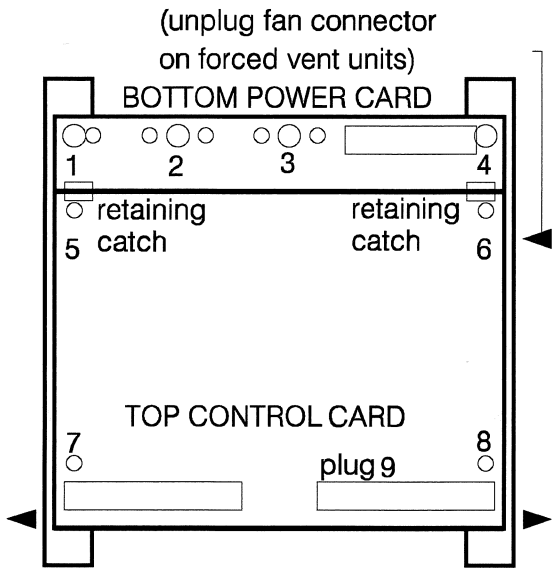
For further information on the cause of problems, refer to the block diagram on page 28. This is surrounded by boxes from 1 to 24, which contain keynote comments relating to each section of the drive unit. OBSERVE SAFETY

Apart from relays, the unit is completely static and requires little routine maintenance. Periodic cleaning should be done with a vacuum cleaner and small soft paint brush. Check all connections for tightness and discoloration which might indicate localised heat.

It is recommended that units requiring service be returned to the supplier. However in the event that the unit must be dis-assembled, only qualified personnel familiar with power engineering should be employed.

To dis-assemble models up to SLX50, follow the sequence outlined below. Models SLX65/85/115 have more complex high current stack assemblies and it is recommended that units requiring service be returned to the supplier for inspection and servicing.

Plan view of unit with cover removed. To remove the cover, unclip top catches and apply slight outward force to side panels at hinge



1) To remove top control card, remove plastic screws 7/8, and release the retaining catches 5/6. Carefully lift off the top card vertically from the bottom card. Avoid stressing the 20 way interconnection plug 9.

STEPS 2 AND 3 REFER TO MODELS UP TO SLX50 ONLY

2) To remove the power card, remove plastic screws 1/2/3/4 and threaded pillars 7/8. Disconnect 12 faston plugs from thyristors. These may be fairly tight, avoid damaging the red and yellow wires. Remove 4 long busbars by removing thyristor screws.Remove remaining exposed thyristor screws.

3) Lift off power card, and recover 6 supporting pillars. Unscrew temp sensor for total removal. Assemble in reverse order taking care to observe correct torque (3.1 Nm, 0.31kpm, 2.3 lbft +/-20%) when tightening thyristors. Make sure interconnection plugs are properly mated.

MAIN FUSES

The main external supply fuses must be semi-conductor fuses of the correct rating. Use of any other type may not afford adequate protection and may result in damage to the unit. Product warranty will be invalidated unless the correct type and rating of fuse is used. See rating table for INPUT FUSE. (See Page 29)

SPARES

Recommended minimum spares for models up to SLX50

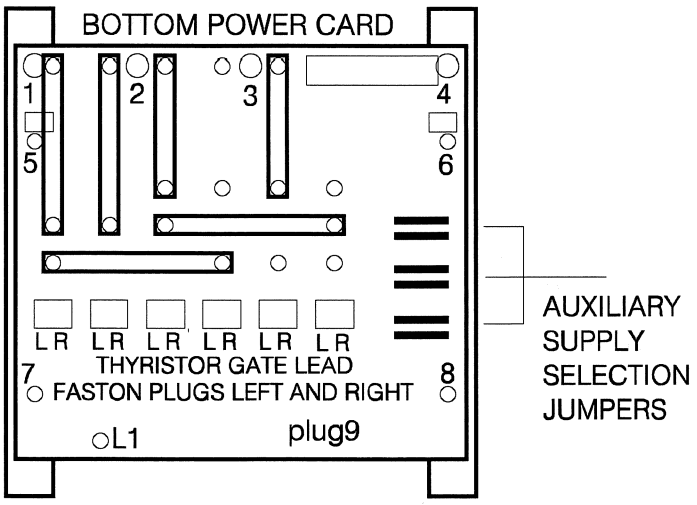
2 Thyristors	MCC 72-16io1
5 Aux. Fuses	20mm 6.3A sand filled types
3 Main fuses	(see rating table page 29)

1 Fan assembly (forced vent units)

LINE REACTORS

All thyristor 3 phase convertors commutate the load current between devices and lines. During the process of commutation which lasts approximately 100 microseconds, notching will appear on the incoming supply lines. To prevent possible disturbance to the supply it is necessary to use a 3 phase LINE REACTOR between the POWER connections of the drive and the supply lines. Sprint has developed a range of Line Reactors to suit all models in the SLX range. See section 4 page 17 for supply condition information.

It is essential that all three phase drive systems incorporate the appropriate Line Reactor. See rating table on page 29, dimensions page 30.



L1 lamp, off if the heatsink is too hot

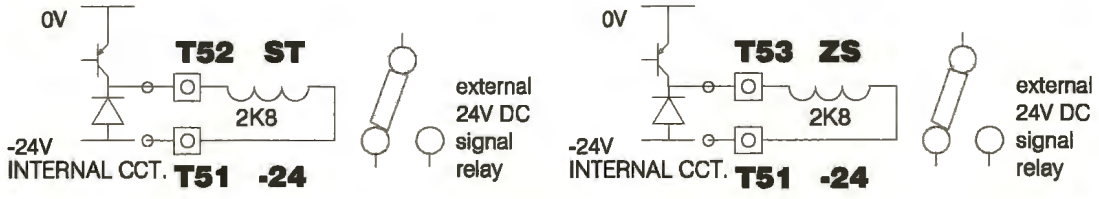
Top edge terminals

All models have terminals on the top edge of the control card, marked 51 to 70. NOTE the terminal numbering system is common to the whole range. The prefix T refers to a terminal.

T51 -24 volt rail. unregulated, unprotected, may vary between -35V and -18V depending on loading and supply. This rail is primarily provided to supply external signal relays used in conjunction with T52 ,T53, T59, T60. Output capability 25mA. Do not overload or short.

T52 ST Stall relay driver. PNP open collector output. -40V max voltage when off. 100mA max current when on. Note a flyback diode for the relay coil is included internally.

T53 ZS Zero speed relay driver. PNP open collector output. -40V max voltage when off, 100mA max current when on. Note a flyback diode for the relay coil is included internally.



T54 IDO Rectified current demand output. 0 to -5V represents 0 to +/-100% current demand. 1K series buffer resistor. Maximum output -7.5V for 150% demand.

T55 RO Ramp output. 0 to +/-10V represents 0 to +/-100%. 1K series buffer resistor. Short circuit protected.

T56 AV Armature voltage modulus output. 0 to +10V for 0 to +/-500V. 1K series buffer resistor

T57 DO Demand output. 0 to -/+10V represents 0 to +/-100% speed demand. This is the final summation of all the speed demand inputs. 1K series buffer resistor.

T58 COM Common. 0V for drive electronics.

T59 REV Reverse relay driver. PNP open collector output. -40V max. voltage when off, 100mA max. current when on. A flyback diode is included. This driver is de-energised for speeds below 5% OR reverse rotation.

T60 TIM TIMER relay driver. PNP open collector output. -40V max. voltage when off, 100mA max. current when on. A flyback diode is included internally. This driver is de-energised when the stall timer starts to integrate. (current demand exceeds 105% of preset level)

T61 +12 regulated rail. 10mA capability, short circuit protected. This rail provides power to the drive electronics, the drive will not function while this rail is shorted. If it is used for external circuitry please ensure that it is buffered from possible interference by inserting a series resistor as close as possible to T61. A value between 10 and 100 Ohms should be adequate.

T62 SS STOP/START this input can be used to latch or unlatch the stall circuit. It may be necessary to de-couple this with a 0.1uF capacitor to COM. To unlatch or reset the stall circuit, momentarily connect T62 to T61 +12V. To latch the stall circuit, momentarily connect T62 to T63 -12V.

T63 -12 regulated rail. 10mA capability, short circuit protected. This rail provides power to the drive electronics, The drive will not function while this rail is shorted. If it is used for external circuitry please ensure that it is buffered from possible interference by inserting a series resistor as close as possible to T63. A value between 10 and 100 Ohms should be adequate.

T64 XIP alternate speed input via RL2 de-energised. Also on terminal 18. 0 to +/-10V for 0 to +/-100% speed demand summing input. The JOG SPEED preset (0 to +/-1V) is connected to this terminal via a 470K resistor.

T65 -IP ramped aux inverting speed input -/+10V represents +/-100%. 100K input impedance summing input.

T66 IP ramped auxiliary speed input +/-10V represents +/-100%. 50K input impedance summing input.

T67 +24 volt rail. Unregulated, unprotected. may vary between 35V and 18V depending on loading and supply. Output capability 25mA. Do not overload or short this rail.

T68 COM common. 0V for drive electronics.

T69 IOM Modulus armature current output. 0 to +5V for 0 to +/-100% armature current. 1K series buffer resistor.

T70 IP Direct speed input. 0 to +/-10V for 0 to +/-100% demand. This input by-passes the setpoint ramp circuit. It is connected to the speed jumper pin so that the direct speed input may be used when the drive is in torque mode. (470K Ohms input impedance)

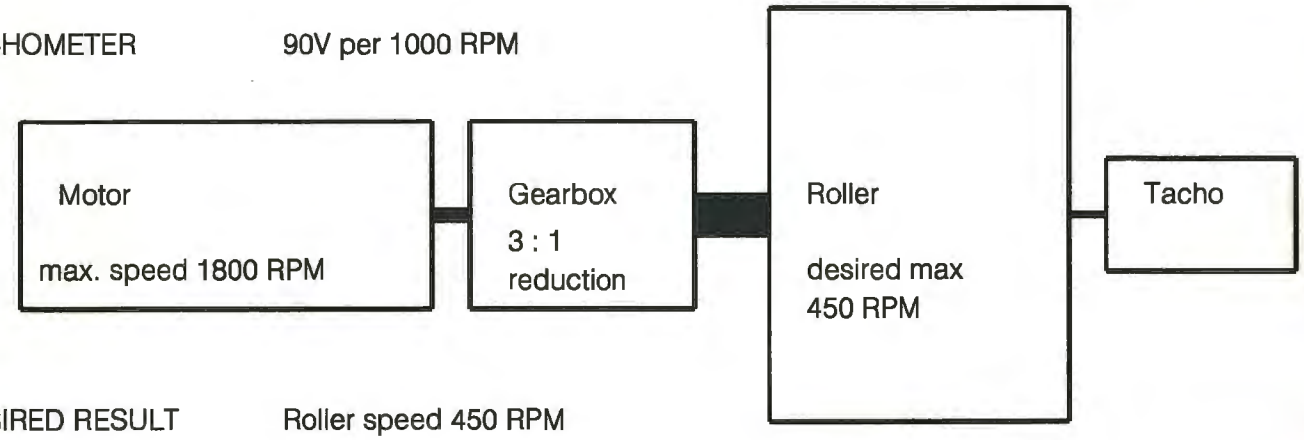
WARNING. TAKE CARE NOT TO TOUCH ANY HIGH POTENTIAL PARTS OF THE UNIT ON THE LOWER POWER CARD WHILST PROBING THESE TERMINALS. THE FOLLOWING TERMINALS ARE ALSO CONNECTED TO OTHER TERMINALS AS FOLLOWS:T17-T57 DO, T18-T64 XIP, T19-T66 IP, T20-T65 -IP, T22-T55 RO.

TO ILLUSTRATE SPEED SCALING CONSIDERATIONS

MOTOR DETAILS — Max. armature volts 460V. Field voltage 210V
Max. armature current 20 amps. Field current 1 amp
Max. speed at full armature volts is 1800 RPM.

SYSTEM DETAILS — The motor is driving a roller via a 3 : 1 reduction gearbox. a tachometer is connected to the roller shaft.

TACHOMETER — 90V per 1000 RPM



DESIRED RESULT — Roller speed 450 RPM

step 1) Calculate inferred motor speed (maximum). Roller speed 450rpm therefore motor speed must be 450 times 3 = 1350rpm.

step 2) Calculate tachometer output voltage and inferred armature voltage.
Tachometer output = 90V times 450/1000 = 40.5V
Inferred arm. volts = 460 times 1350/1800 = 345V

step 3) Calculate max. possible drive output voltages in order to find out if the supply is suitable for the application.

Armature. ac times 1.1 which is 415 times 1.1 = 460V
Field. ac times 0.9 which is 415 times 0.9 = 370V

Armature volts required 345, maximum available 460V hence OK
Field volts required 210, maximum available 370 hence OK

Note, in this case the maximum volts available exceed the required levels by a considerable margin, hence care must be taken to approach the limits from the right direction. Follow the set up procedure to ensure this.

Set up field regulator section to give correct output, refer to page 23.

step 4) Commissioning according to preferred set up procedure.

Initially in armature voltage feedback mode with tacho wire removed (T9).

Set up to 345 armature volts for+10V speed demand. Measure tacho volts and confirm,
a) voltage is -40.5V measured with respect to common (terminal 8).
b) polarity is negative for positive demand, and correct rotation sense. Independant speed verification using hand held tachometer or known speed monitor is advisable.

Rescale S3, S4 for correct range (30-60) both off . Re-connect tacho and set feedback source to tacho. S8 off. Set MAX SPEED preset ACW. initially, then recalibrate final max speed to give tacho volts of -40.5 .

BLOCK DIAGRAM

1) CORRECT OPERATION OF MAIN CONTACTOR

2) CORRECT SCALING OF SPEED AND CURRENT

3) ARMATURE WIRING FIELD WIRING

4) SPEED DEMAND 0K, CURRENT DEMAND OK

5) RUN LINE, START STOP, POWER ON/OFF

6) SAFETY PRECAUTIONS !

1 MAX OUTPUT T4
THIS IS A PRECISION REFERENCE OUTPUT 10mA MAX. AND IS ABLE TO SUPPLY POTS 1K OR HIGHER. 10K IS RECOMMENDED. IT IS EITHER + OR - 10V SET BY T15 OR T16

2 THE MIN SPEED T2 HAS AN INTERNAL 5K POT TO COMMON. IT LIFTS THE BOTTOM END OF THE EXTERNAL SPEED POT. IT ALSO TRIMS THE BURDEN RESISTOR IN 4-20mA LOOP MODE OF OPERATION

3 +10 VOLT REFERENCE
THIS PRECISION +10V SOURCE CAN PROVIDE UP TO 10mA, AND IS ABLE TO SUPPLY POTS WITH RESISTANCE 1K OR HIGHER. 10K IS RECOMMENDED.

4 SUMMING SPEED I/P.
T19 IS NON-INVERTING AND ACCEPTS + OR - SIGNALS. T20 INVERTS AND ACCEPTS + OR - SIGNALS. SATURATION OF THE RAMP CIRCUIT IS +/-10.5V.

5 RAMP O/P T22
BUFFERED SUMMATION OF RAMPED SPEED DEMAND INPUTS.
TOTAL DEMAND O/P T17. IS AN INVERTED TOTAL SUMMATION OF ALL THE SPEED I/PS

6 STALL TIMER (page 21)
THIS DETECTOR LOOKS AT CURRENT DEMAND.
AFTER TIMING, THE STALL OUTPUT LATCH TRIPS THE MAIN CONTACTOR. BOTH ARE AVAILABLE ON RL1

7 MAX CURRENT
THE OUTPUT FROM THE SPEED ERROR AMP IS SCALED BY THE MAX CURRENT PRESETS. THE CURRENT DEMAND IS FED INTO THE CURRENT LOOP

8 CURRENT OUTPUT T21
+/-5V = +/-100% OF THE MODEL RATING
A MODULUS VERSION IS ON T69.
THE MAX LEVEL WILL DEPEND ON MAX CURRENT PRESETS

9 MAIN POWER INPUTS.
PHASE ROTATION IS NOT IMPORTANT.
FUSING REACTORS CABLE SIZES, FUSE RATING S AND LINE REACTORS PAGE 29

10 POWER CONTACTOR.
IT IS ESSENTIAL THAT THE POWER TO L1/2/3 IS CONTROLLED BY A CONTACTOR WHICH IS ENERGISED FROM THE SLAVE RELAY ON T31 AND T32.

11 THIS WILL ENSURE THAT WHEN THE POWER OFF COMMAND OCCURS, THE MAIN CONTACTOR REMAINS ENERGISED WHILE THE ARMATURE CURRENT IS COMMUTATED TO ZERO

12 MOTOR ARMATURE.
CHECK THE RATING PLATE TO CONFIRM CALIBRATION PROCEDURE CURRENT AND VOLTAGE SETTINGS ARE VERY IMPORTANT. MAKE SURE WIRING IS CORRECT.

13 FIELD (page 16, 23)
THE FIELD BRIDGE IS CONTROLLED BY A CLOSED LOOP CURRENT REGULATOR. ONCE SET, THE FIELD VOLTAGE WILL AUTOMATICALLY ADJUST IN ORDER TO MAINTAIN CONSTANT CURRENT

14 FIELD CURRENT O/P
THE FIELD CURRENT SIGNAL IS OUTPUT ON T24.
0 TO 5V = 0 TO 100%
AUTOMATIC WEAKENING FUNCTION S1

15 AUXILIARY SUPPLY EL1, EL2, EL3. THESE MUST HAVE SAME RESPECTIVE PHASING AS L1, L2, L3, THIS IS PARAMOUNT. DOUBLE CHECK THIS. MODELS SLX65/85/115 MUST HAVE EXTERNAL FUSES F1 F2 F3. SEE TABLE ON PAGE 29

16 AUXILIARY SUPPLY INPUT TRANSFORMERS ARE DUAL TAPPED. 3 PAIRS OF JUMPERS ON THE POWER BOARD MUST BE SET TO MATCH THE SUPPLY. SEE PAGE 10

17 NOTE. THE MAIN POWER INPUTS NEED NOT BE THE SAME AS THE AUXILIARY SUPPLY AS LONG AS THEY HAVE THE SAME PHASING. EG BATTERY CHARGING SYSTEMS

18 ON MODELS UP TO SLX50 THE AUXILIARY SUPPLY IS FUSED WITH 20mm 3 AMP FUSES WHICH CAN BE FOUND AT THE TOP RIGHT HAND CORNER OF THE UNIT. F2 AND F3 ALSO FUSED THE FIELD BRIDGE

19 MAIN CONTACTOR SLAVE T31 T32.
THIS MUST BE USED TO CONTROL THE MAIN POWER SUPPLY CONTACTOR
WARNING. DAMAGE MAY OTHERWISE OCCUR USE T28 T29 T30

20 POWER ON/OFF (page 11, 15)
RL3 ENERGISED BY T29
RL3 LATCHED BY T30
RL3 DE-ENERGISED T28
RL4 IS DELAYED OFF TO ALLOW CURRENT COMMUTATION

21 THIS TRANSISTOR IS TURNED OFF BY A STALL OR ALARM CONDITION. IT OPENS THE POWER OFF LINE WHICH CAUSES THE MAIN CONTACTOR TO DE-ENERGISE. NOTE, ALARMS LATCH. T28 CAN DRIVE 24V 25mA RELAY.

22 ALARMS (page 15)
CLOSE T26 TO COM TO RESET. (EXCEPT PEAK AMPS AND STALL)
AUX. TRIP ON T25 FOR THERMISTOR INPUT.
ALARMS MAY BE DEFEATED BY JUMPER

23 ZS JUMPER (page 17 18) THIS IS USED TO QUENCH THE DRIVE AT ZERO SPEED. THE THRESHOLD IS 1%.
TO PREVENT QUENCHING REMOVE THE ZS JUMPER

24 IF THE ZS JUMPER IS IN POSITION, AND THE SPEED INPUT RAMP IS UNUSED, THE FIRING PULSES WILL NOT BE RELEASED. PARK THE JUMPER ON 1 PIN TO RUN

25 STOP/START (page 5, 11, 17, 18)
THE RUN TERMINAL MAY BE CONNECTED TO T13 (START). THE DRIVE IS QUENCHED BY THE STOP FUNCTION INSTEAD OF RAMPED.

26 STOP/START (page 5, 11, 17, 18)
T13 TO COM TO TURN ON RL2 (see T3/T18)
T14 IS A LATCHING INPUT. RL2 CAN BE USED FOR RAMPED STOPPING/JOGGING

27 RL1 (page 8, 26, 27)
THE FUNCTION OF THIS RELAY IS SET BY S2, S5, S6, S7.
THE RELAY IS SHOWN DE-ENERGISED. ALL THE FUNCTIONS ALSO HAVE DRIVER OUTPUTS

28 RUN 7 (page 17, 18)
1) CLOSE TO RUN
2) OPEN FOR RAPID STOPPING MODES
TACHO INPUT POLARITY MUST BE OPPOSITE TO T3 (SAME AS T17).
SCALING ON S3, S4

29 INPUT 8 (page 20)
1) IN TORQUE MODES, THE DRIVE NEEDS A SPEED INPUT T3 ASWELL AS TORQUE DEMAND IN T6
2) LOWEST WINS, SCALE CORRECTLY

30 (page 11, 17 18, 5)
VOLTAGE INPUT 3 I/P, 5 COM
RL2 MUST BE ENERGISED FOR T3
USE RL2 FOR RAMPED STOPPING OR DUAL SPEED T18

THE COMMENT BOXES SURROUNDING THE BLOCK DIAGRAM ARE INTENDED TO GIVE A BRIEF DESCRIPTION ONLY OF THE KEY FEATURES.
PLEASE REFER TO THE MANUAL FOR A MORE COMPLETE DESCRIPTION.
THE CHECKLIST AT THE TOP OF THE PAGE HIGHLIGHTS THE KEY AREAS OF CONCERN FOR COMMISSIONING.

RATING TABLES

SEMICONDUCTOR FUSE RATING TABLE FOR SLX DRIVES

MODEL	MAX I^2t OF FUSE	AC I/P AMPS	DC O/P AMPS	LITTLEFUSE UP TO 250V AC SUPPLY	LITTLEFUSE UP TO 500V AC SUPPLY	BUSS UP TO 250V AC SUPPLY	BUSS UP TO 500V AC SUPPLY	IR American Style UP TO 250V AC SUPPLY	IR American Style UP TO 500V AC SUPPLY	IR BS88 UP TO 250V AC SUPPLY	IR BS88 UP TO 500V AC SUPPLY	FERRAZ UP TO 250V AC SUPPLY	FERRAZ UP TO 500V AC SUPPLY
SLX 5	600	10	12	L25S 12	L50S 12	FWX 12	FWH 12	XL25X15	XL50F015	L350-12	661RF0025	URE 12 P 97487	6,600 CP URD 22-58/25 B 93 956
SLX 10	600	20	24	L25S 25	L50S 25	FWX 25	FWH 25	XL25X25	XL50F025	L350-25	661RF0025	URE 25 X 97494	6,600 CP URD 22-58/25 B 93 956
SLX 15	600	30	36	L25S 40	L50S 40	FWX 40	FWH 40	XL25X40	XL50F040	L350-40	661RF0035	URGS 35 T 76653	6,600 CP URD 22-58/40 S 94 822
SLX 20	5000	40	48	L25S 50	L50S 50	FWX 50	FWH 50	XL25X50	XL50F050	L350-50	661RF0050	URGS 50 V 76654	6,600 CP URD 22-58/50 W 94 779
SLX 30	5000	60	72	L25S 80	L50S 80	FWX 80	FWH 80	XL25X80	XL50F080	L350-80	661RF0080	URGS 75 X 76656	6,600 CP URD 22-58/80 A 94 829
SLX 40	5000	80	96	L25S 100	L50S 100	FWX 100	FWH 100	XL25X100	XL50F100	L350-100	661RF00100	URZ 100 Y 85658	6,600 CP URD 22-58/100 Y 94 827
SLX 50	11850	100	120	L25S 125	L50S 125	FWX 125	FWH 125	XL25X125	XL50F125	L350-125	661RF00125	URZ 125 G 97526	6,600 URGD 27-60/125
SLX 65	108000	124	155	L25S 175	L50S 175	FWX 175	FWH 175	XL25X175	XL50F175	L350-180	661RF00160	URZ 160 H 97527	6,600 URGD 27-60/160
SLX 85	108000	164	205	L25S 225	L50S 225	FWX 250	FWH 250	XL25X250	XL50F250	T350-250	661RF00250	URY 250 N 97670	6,600 URGD 27-60/250
SLX 115	128000	216	270	L25S 275	L50S 275	FWX 300	FWH 300	XL25X300	XL50F300	T350-315	661RF00315	URY 300 P 97625	6,600 URGL 36-55/280

IN GENERAL THE AC SUPPLY CURRENT PER PHASE IS 0.8 TIMES THE DC OUTPUT CURRENT, AND THE FUSE RATING SHOULD BE APPROX. 1.25 TIMES THE INPUT CURRENT. THE FUSES SPECIFIED IN THIS TABLE HAVE BEEN RATED TO INCLUDE THE 150% OVERLOAD CAPABILITY AND OPERATE UP TO 50C AMBIENT AT THE MAXIMUM DRIVE RATING. TO SELECT A FUSE AT OTHER RATINGS FOR EXAMPLE WHEN USING A MOTOR RATED AT A LOWER POWER THAN THE DRIVE UNIT OR OPERATING AT A REDUCED MAXIMUM CURRENT LIMIT SETTING. SELECT A FUSE WITH A CURRENT RATING CLOSEST TO THE ARMATURE CURRENT AND WITH AN I^2t RATING LESS THAN THE MAXIMUM SHOWN IN THE TABLE. IF A DC FUSE IS FITTED IN SERIES WITH THE ARMATURE IT MUST BE A DC RATED SEMICONDUCTOR TYPE WITH CURRENT RATING 1.2 TIMES THE MOTOR FULL LOAD CURRENT, DC VOLTAGE RATING SUITABLE FOR THE MAXIMUM ARMATURE VOLTAGE AND WITH AN I^2t RATING LESS THAN THE MAXIMUM SHOWN IN THE TABLE .

RATING TABLE UP TO SLX50

(Rating depends on motor type) (35 cubic ft./min = 1 cubic m/min)

DRIVE MODEL NUMBER	MOTOR O/P AT 460V KW	HP	MAXIMUM CONTINUOUS AMPS Input	Output	MAX FIELD AMPS	MAIN FUSES I^2t	TYPICAL CABLE SIZE	LINE REACTOR TYPE	COOLING N= natural F= forced cfm	watts
SLX5	5	6.6	10 AC	12 DC	2.5	600	$4mm^2$	LR48	17	N 45
SLX10	10	13.3	20 AC	24 DC	2.5	600	$4mm^2$	LR48	17	N 80
SLX15	15	20	30 AC	36 DC	2.5	600	$6mm^2$	LR48	17	N 120
SLX20	20	26.6	40 AC	48 DC	2.5	5000	$6mm^2$	LR48	17	N 120
SLX30	30	40	60 AC	72 DC	5.0	5000	$16mm^2$	LR120	35	F 200
SLX40	40	53.3	80 AC	96 DC	5.0	5000	$25mm^2$	LR120	35	F 300
SLX50	50	66.6	100 AC	120DC	5.0	11850	$35mm^2$	LR120	35	F 320

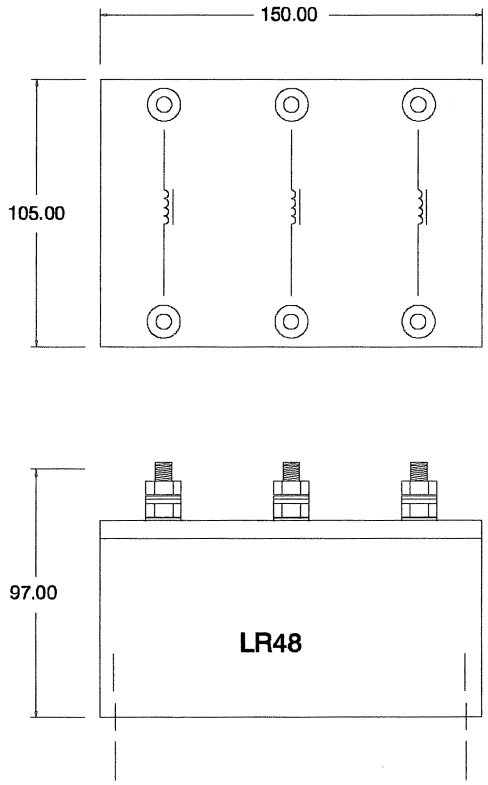
RATING TABLE SLX65/85/115

(Rating depends on motor type) (NOTE 60cfm = 2 cubic m/min)

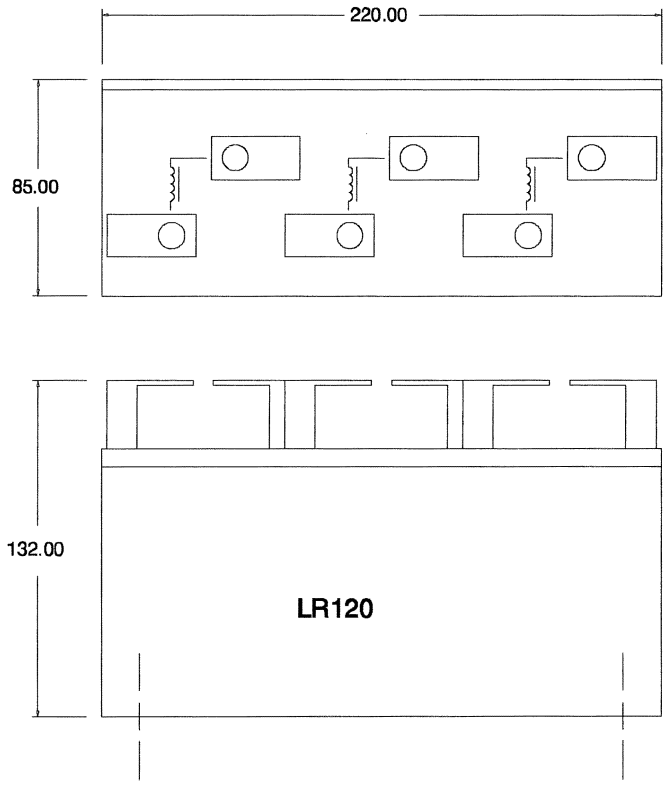
MODEL NUMBER	MOTOR O/P AT 460V KW	HP	MAXIMUM CONT. AMPS I/P	O/P	MAX FIELD AMPS	MAIN FUSES I^2t	AUXILIARY FUSE RATING AMPS	I^2t	LINE REACTOR TYPE	COOLING AIR FLOW	MAX WATTS
SLX65	65	90	124 AC	155 DC	10 A	108000	12A	140	LR270	6Ocfm	350
SLX85	85	115	164 AC	205 DC	10 A	108000	12A	140	LR270	6Ocfm	475
SLX115	115	155	216 AC	270 DC	10 A	128000	12A	140	LR270	6Ocfm	650

IMPORTANT WARNING. DO NOT ALLOW ARMATURE CURRENT LIMIT TO EXCEED MOTOR RATING. IF THE MOTOR CURRENT RATING IS LESS THAN THE DRIVE RATING, USE MAX CURRENT PRESET TO REDUCE THE CURRENT LIMIT. ALTERNATIVELY THE DRIVE MAY BE DE-RATED BY RE-BURDENING THE CURRENT TRANSFORMERS ACCORDING TO THE FORMULA. :- R (KOhms) = 2/IMAX. The burden resistors R100/R101/R102 are in parallel, and are found on the bottom edge of the lower power board.

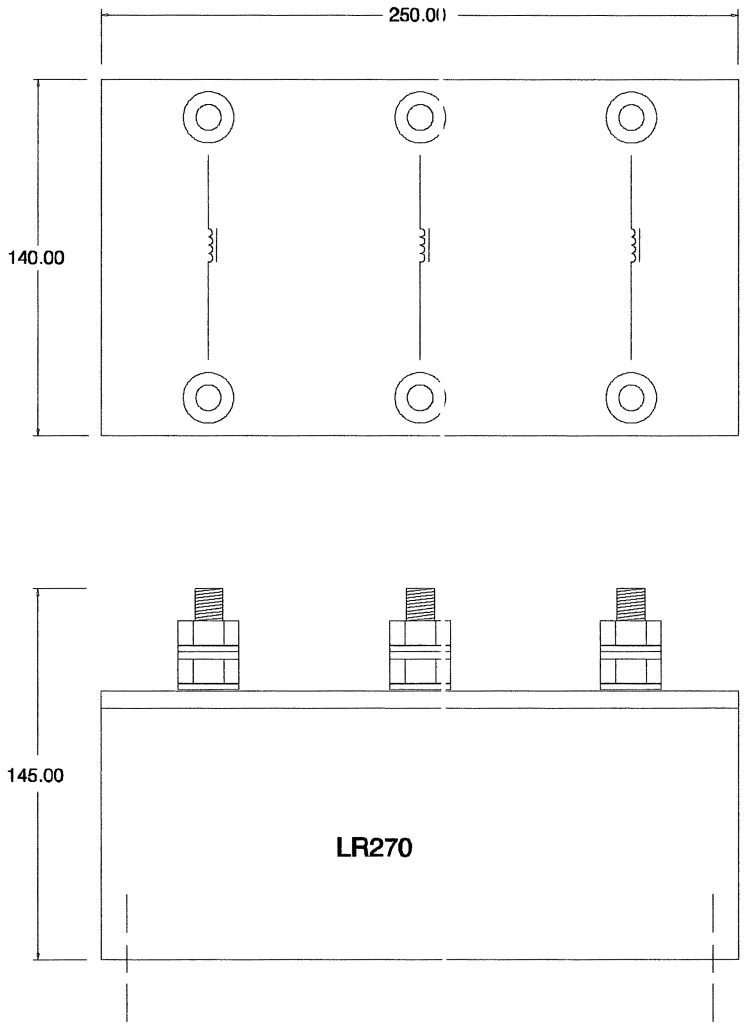
TOL. X +/-0.4 X.X +/-0.2 X.XX +/-0.1 HOLES < 7DIA -0.02 +0.07 ALL DIMENSIONS IN MM UNLESS OTHERWISE STATED.



LR48:
RATING: UP TO 48A
TERMINALS: M6 STUDS
MOUNTING HOLES: 4 OFF, 4MM
MOUNTING CENTRES: 137 X 44MM



LR120:
RATING: UP TO 120A
TERMINALS: M10 LUGS
MOUNTING HOLES: 4 OFF, 5MM
MOUNTING CENTRES: 190 X 63MM



LR270:
RATING: UP TO 270A
TERMINALS: M10 STUDS
MOUNTING HOLES: 4 OFF M5
MOUNTING CENTRES: 230 X 78MM

ISS	DESCRIPTION	APPD	DATE

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TITLE
3 PHASE LINE REACTOR
OUTLINE DIAGRAM

DRAWN	CHECKED	APPROVED	DATE
RIB			4-11-94

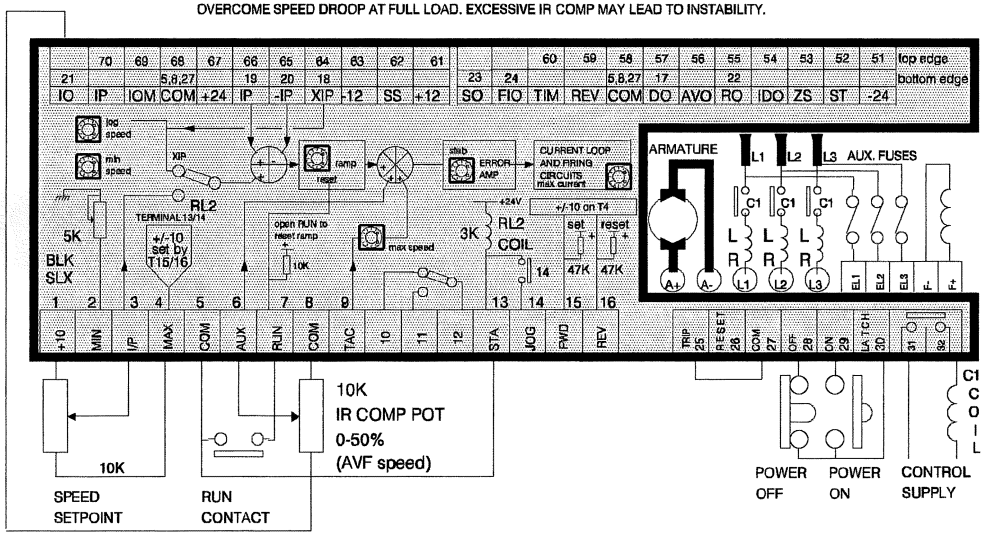
DRG No UC101915 ISS 10

These application notes are strictly for assistance in the general implementation of Sprint products, and are provided for general guidance in system applications. It is entirely the users responsibility to ensure that any system is suitable for the application in question and all due care is taken with regard to overall safety of the installation. Sprint Electric does not accept any liability in respect of the application.

Section 4
Application diagrams for model SLX

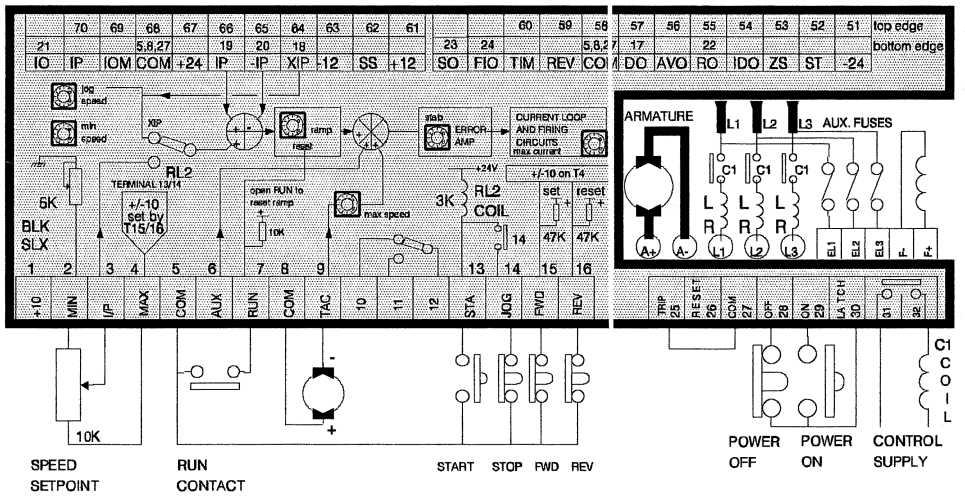
1) ARMATURE VOLTAGE FEEDBACK. FORWARD AND REVERSE ON SETPOINT POT, WITH CENTRE ZERO

FOR HIGH ACCURACY ARMATURE VOLTAGE FEEDBACK THE FIELD REGULATOR MUST BE PRESET IN LINEAR MODE. EXTERNAL IR COMPENSATION MAY BE NECESSARY FOR IMPROVED LOAD REGULATION. INCREASE THE IR COMP TO OVERCOME SPEED DROOP AT FULL LOAD. EXCESSIVE IR COMP MAY LEAD TO INSTABILITY.



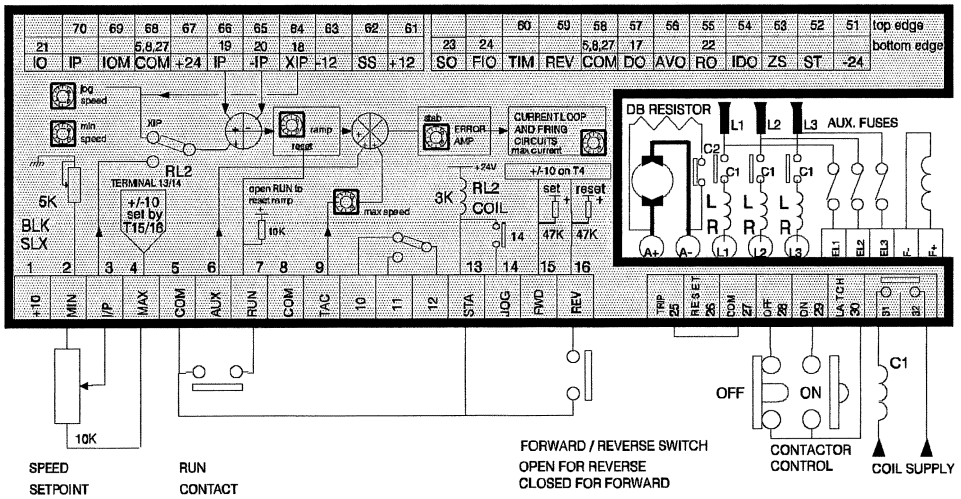
2) TACHO FEEDBACK. FORWARD / REVERSE BY PUSHBUTTON, DIRECTION MEMORISED DURING STOP MODE. RAPID BRAKING WITH RUN CONTACT. RAMPED BRAKING WITH STOP PUSHBUTTON.

(tacho polarity on terminal 9 must be negative for positive demand)



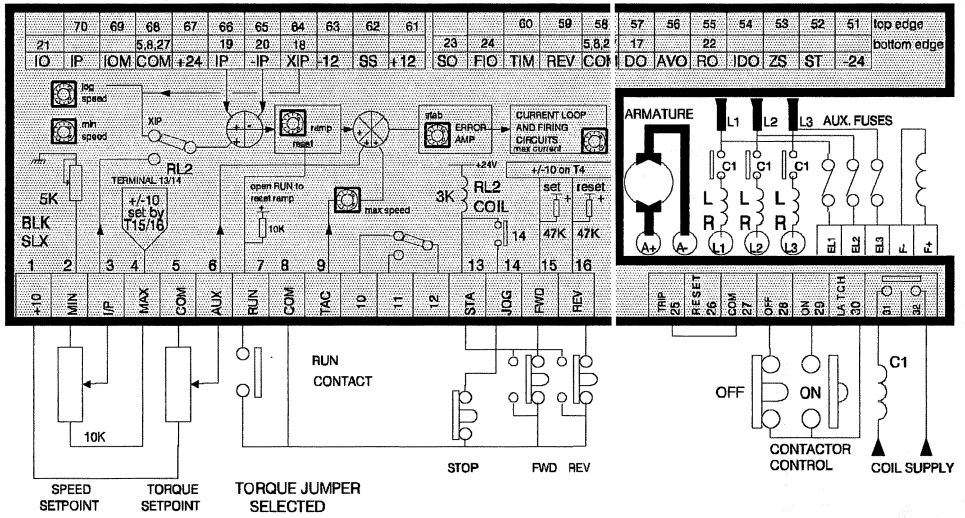
3) BASIC CONNECTION. DYNAMIC BRAKING

C1 normally open. C2 normally closed. The relays operate together. The peak braking current should not exceed 2 times the nominal armature current (refer to motor manufacturer). The resistor must be able to dissipate the waste heat.



4) TORQUE CONTROL, OVERSPEED LIMITING BY SEPERATE SPEED SETPOINT

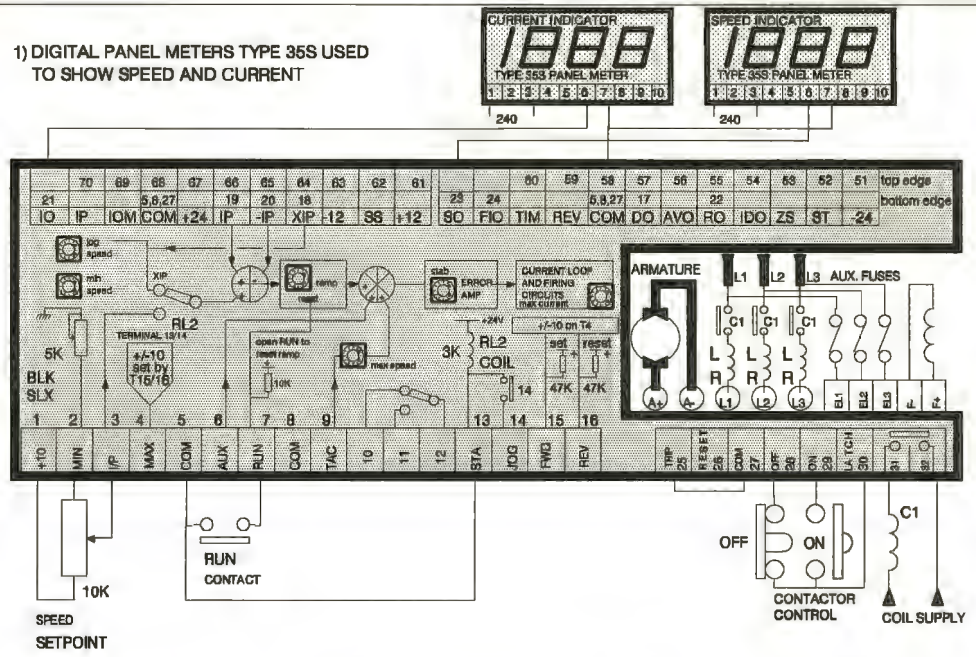
If the speed exceeds the level programmed by the speed setpoint, the current demand comes out of limit and the speed loop takes control. The start function is initiated by the direction pushbuttons.



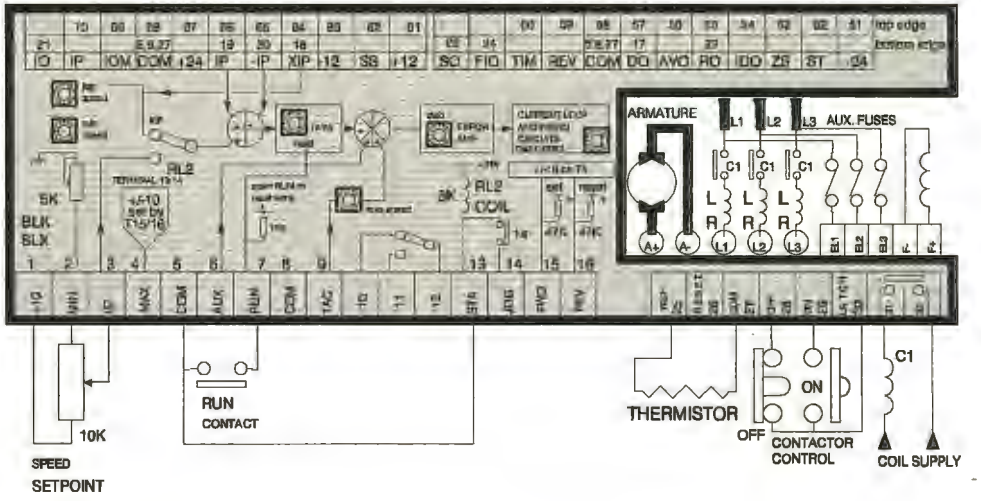
SLX

1) ARMATURE VOLTAGE FEEDBACK. FORWARD / REVERSE ON SETPOINT POT WITH CENTRE ZERO.
2) TACHO FEEDBACK. FORWARD / REVERSE BY PUSHBUTTON. DIRECTION MEMORISED DURING STOP.
3) DYNAMIC BRAKING. FORWARD / REVERSE CONTROLLED BY SWITCH OR CONTACT.
4) TORQUE CONTROL. START INITIATED BY FORWARD / REVERSE PUSHBUTTONS.

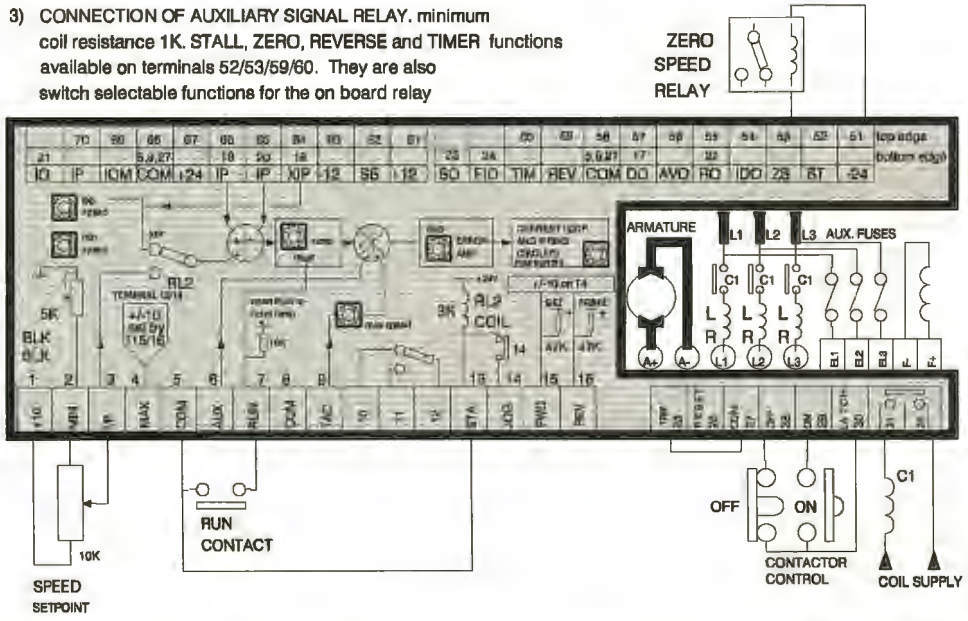
1) DIGITAL PANEL METERS TYPE 35S USED TO SHOW SPEED AND CURRENT



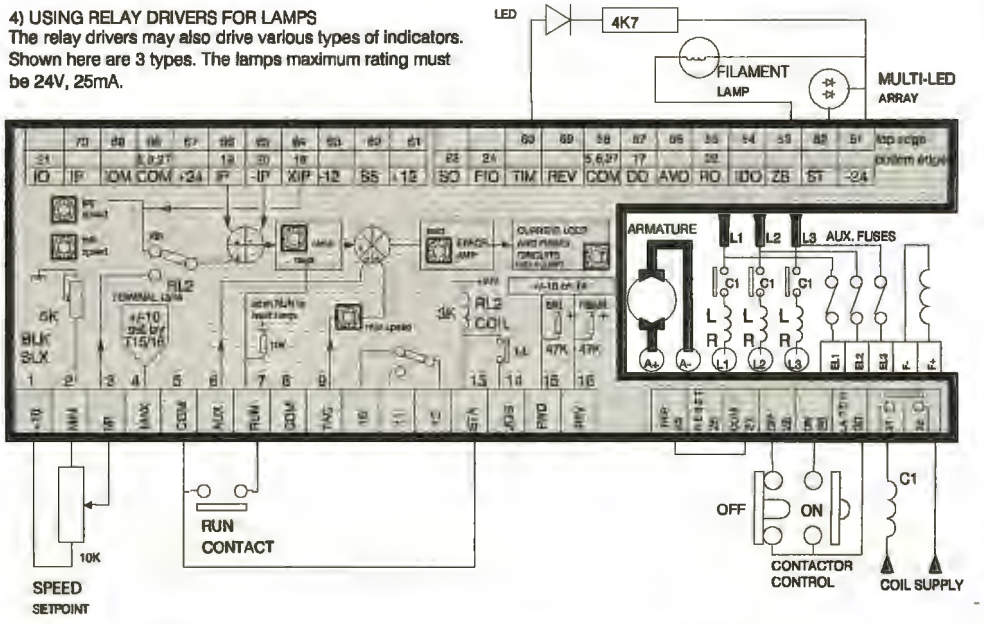
2) MOTOR THERMISTOR CONNECTION.
THE AUX ALARM WILL TRIGGER IF THE RESISTANCE OF THE THERMISTOR EXCEEDS 2K Ohms. THE ALARM WILL NOT TRIGGER IF THE RESISTANCE OF THE THERMISTOR REMAINS BELOW 200 Ohms.



3) CONNECTION OF AUXILIARY SIGNAL RELAY. minimum coil resistance 1K. STALL, ZERO, REVERSE and TIMER functions available on terminals 52/53/59/60. They are also switch selectable functions for the on board relay



4) USING RELAY DRIVERS FOR LAMPS
The relay drivers may also drive various types of indicators. Shown here are 3 types. The lamps maximum rating must be 24V, 25mA.

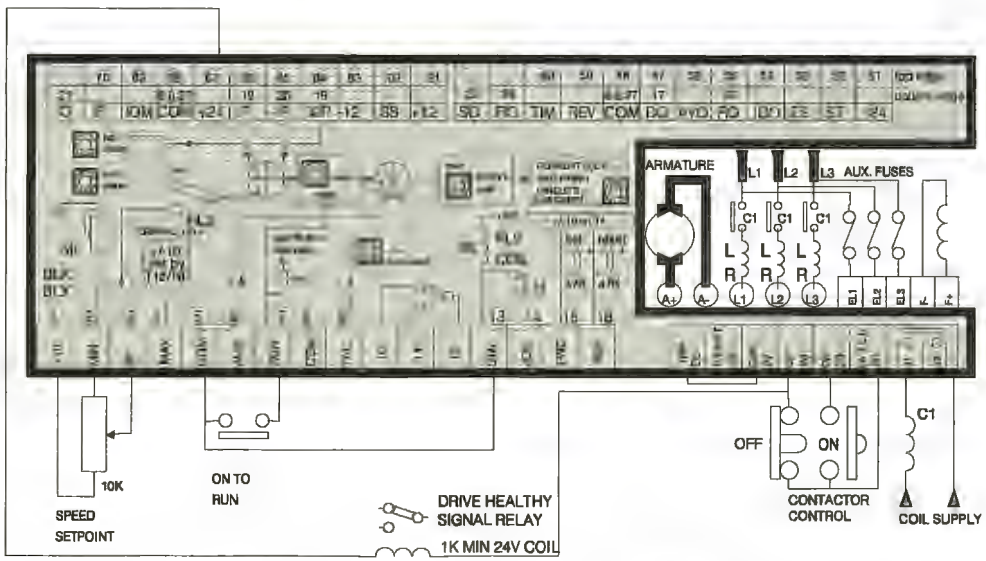


SPRINT Electric

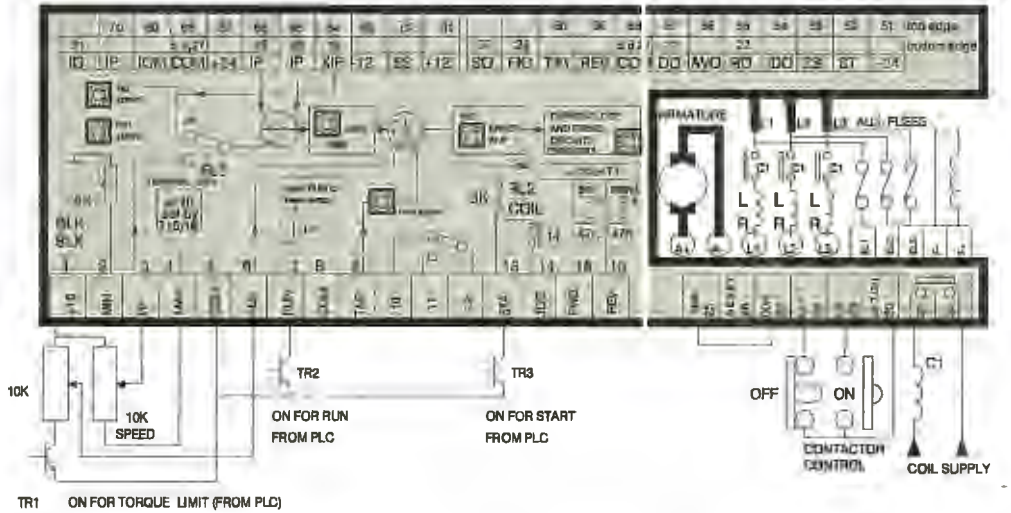
BASIC CONNECTIONS MODEL SLX

1) Digital panel meters showing speed and current
2) Connection of motor thermistor
3) Connection of auxiliary signal relays
4) Using relay drivers for lamps

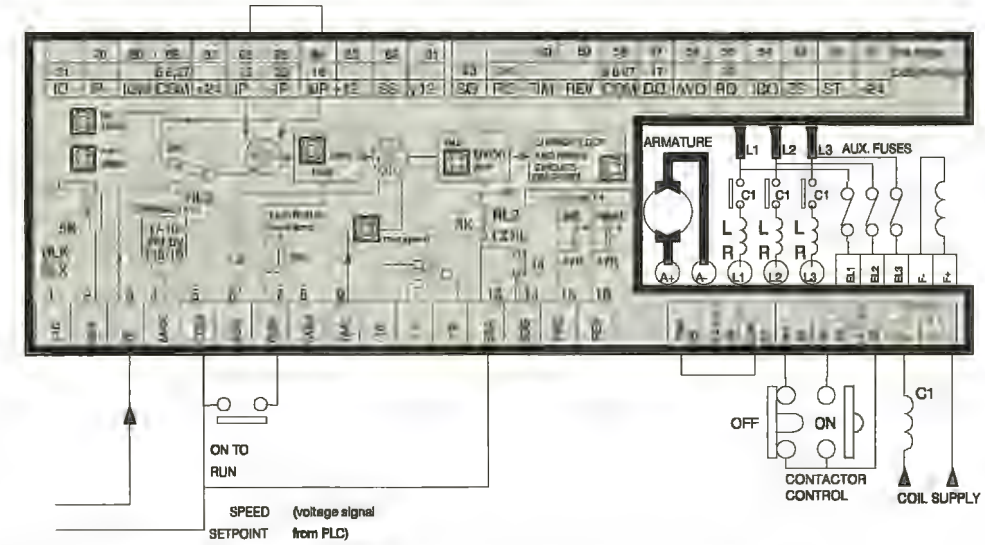
1) DRIVE HEALTHY SIGNAL RELAY



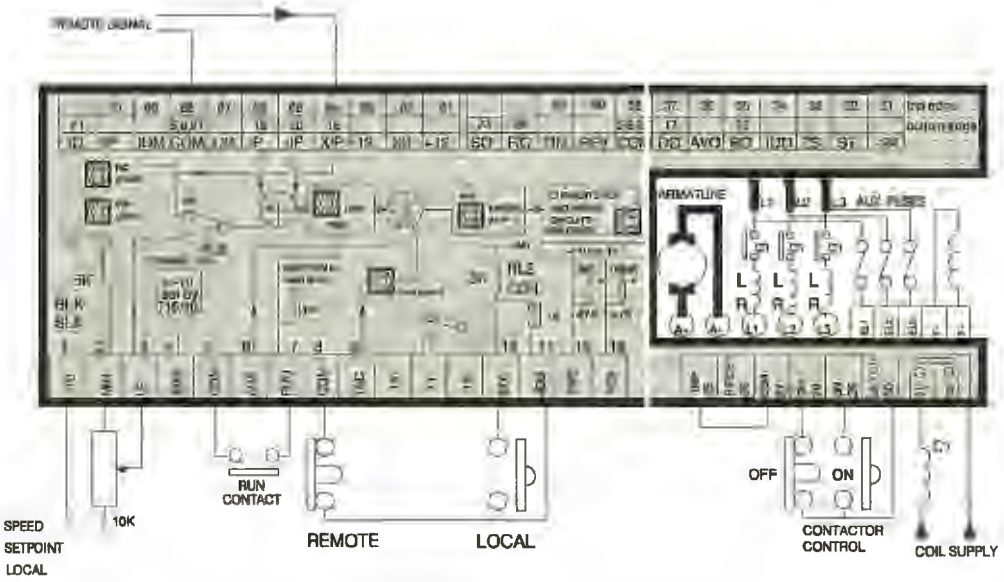
2) CONTROL VIA OPEN COLLECTOR PLC OUTPUTS.



3) THE DRIVE SPEED IS SET BY A REMOTE 0 TO +10 VOLT SIGNAL. THE LOCAL MIN SPEED IS SET BY THE JOG SPEED PRESET.



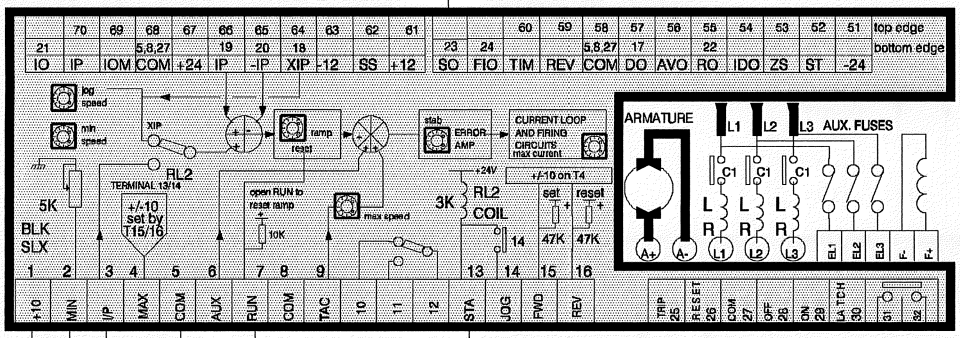
4) LOCAL OR REMOTE SPEED DEMAND SELECTED BY PUSHBUTTON, THE DRIVE WI .L RAMP BETWEEN THE SETPOINTS



SPRINT Electric **BASIC CONNECTIONS**
MODEL SLX

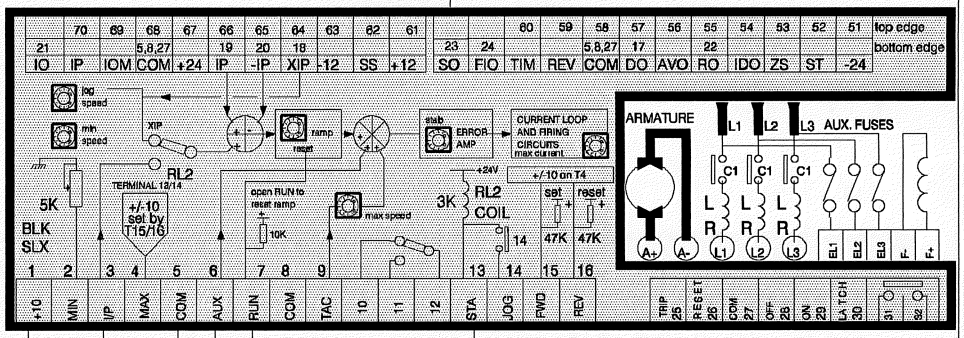
1) Drive healthy relay
2) Control via open collector outputs
3) Remote speed setpoint
4) Local or remote setpoint selected by pushbutton

WEB DRIVE IN SPEED MODE



REEL DRIVE IN TORQUE MODE

SET ZERO SPEED CLOCKWISE
TO GIVE POSITIVE SPEED OFFSET



C1 CLOSE TO RUN

10K

WEB SPEED

CLOSE TO RUN
C2

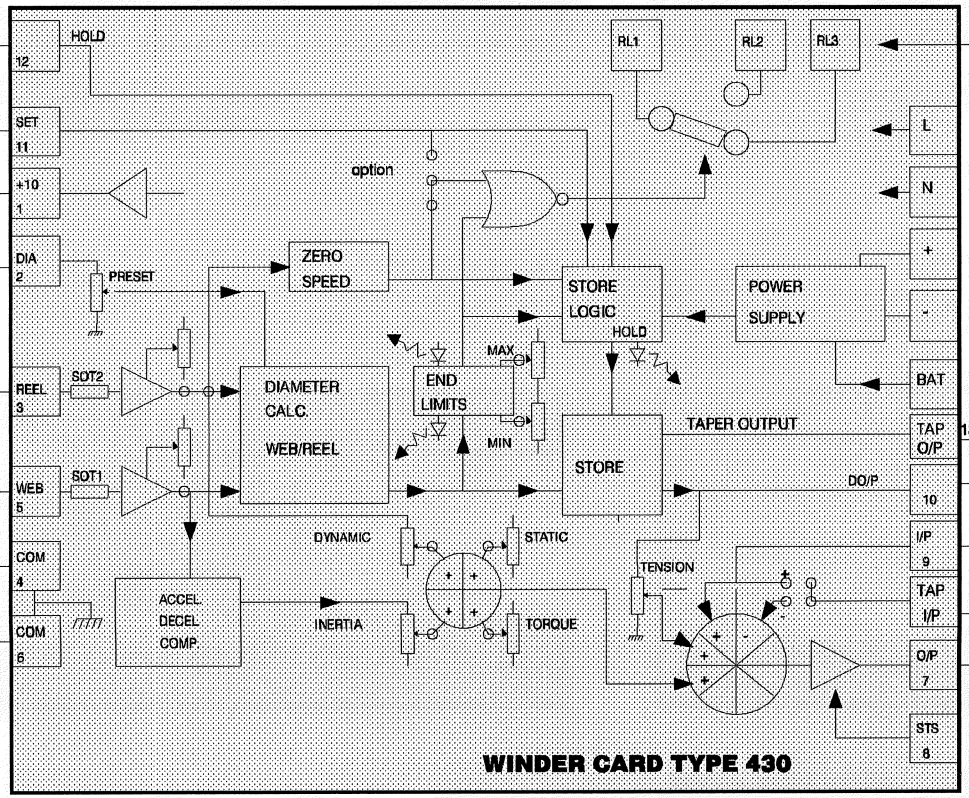
100% CURRENT DEMAND

JOG

REEL DRIVE MUST BE IN TORQUE MODE.
THE 100% SPEED SCALING SHOULD ACCOMMODATE THE MAXIMUM WEB SPEED AT MINIMUM DIAMETER.
(SET THIS UP FIRST IN SPEED MODE INITIALLY)

CURRENT DEMAND FROM WINDER UNIT

C3 CLOSE TO RUN



THE RELAY CAN BE USED TO INDICATE THAT THE REEL SPEED IS BELOW THE THRESHOLD FOR CALCULATION. THIS CAN EASILY HAPPEN EG. FOR A 10:1 DIAMETER CHANGE AND A 2.5% THRESHOLD THE DIAMETER CALCULATION WILL HOLD AT 25% OF LINE SPEED WHEN THE REEL IS NEARLY FULL.

EXTERNAL TAPER ADJUST
10K

EXTERNAL TENSION ADJUST
10K

WINDER CARD TYPE 430

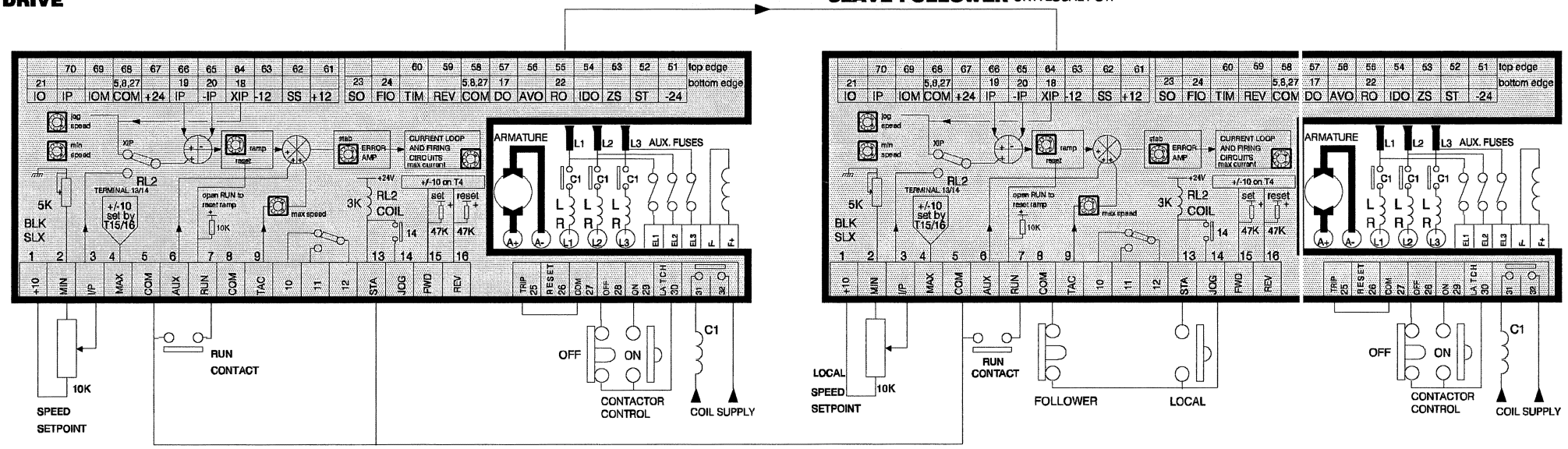
WINDER APPLICATION. MODEL SLX

UG101880 ISS10

1) MASTER DRIVE WITH SLAVE FOLLOWING IN SPEED MODE. THE SPEED DEMAND FOR THE SLAVE CAN BE SELECTED TO BE THE RAMP OUTPUT FROM THE MASTER.

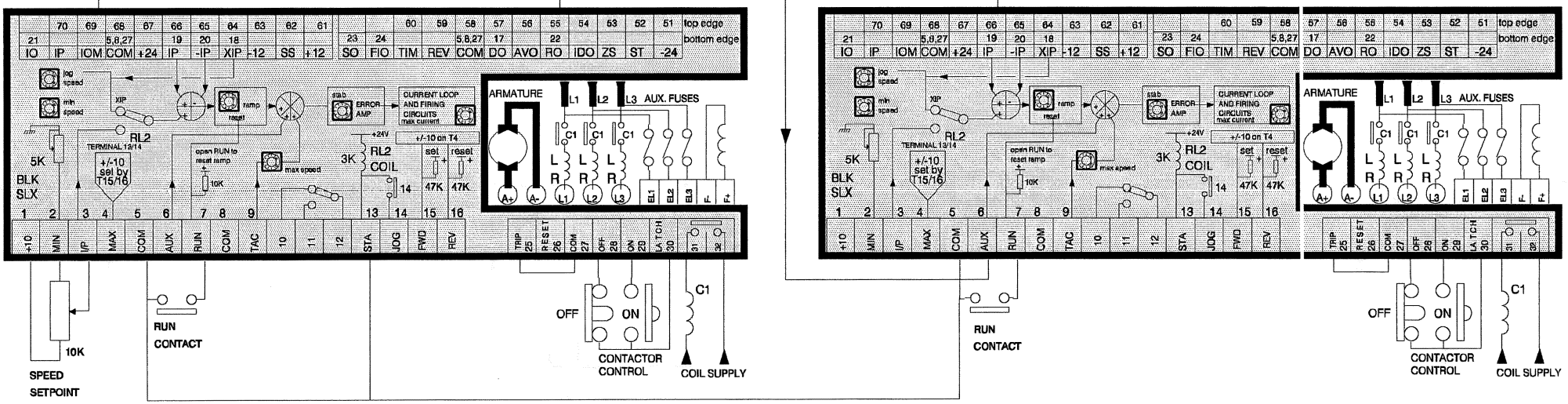
MASTER DRIVE

SLAVE FOLLOWER OR A LOCAL POT.



2) LOAD SHARING WITH TWO MOTORS MECHANICALLY LOCKED. THE MODULUS CURRENT OUTPUT SIGNAL FROM THE MASTER PROVIDES A TORQUE DEMAND INPUT TO THE SLAVE. THE SPEED LOOP OF THE SLAVE IS OFFSET POSITIVELY FOR OVERSPEED PROTECTION.

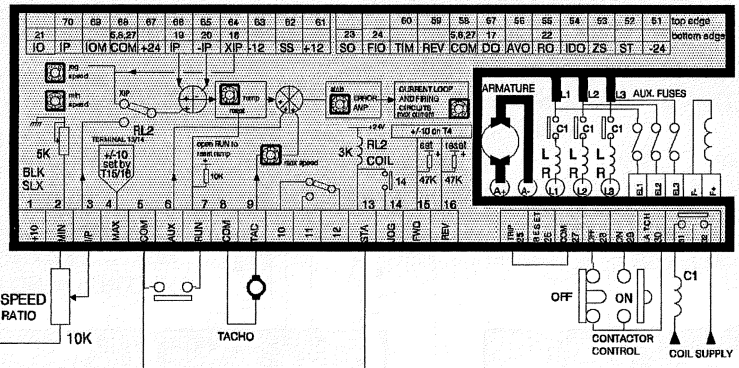
Make speed scaling of both drives matched then adjust ZERO SPEED clockwise to give positive offset to speed demand

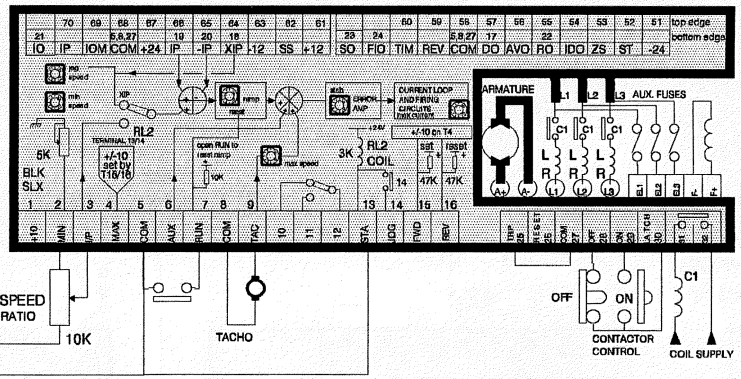


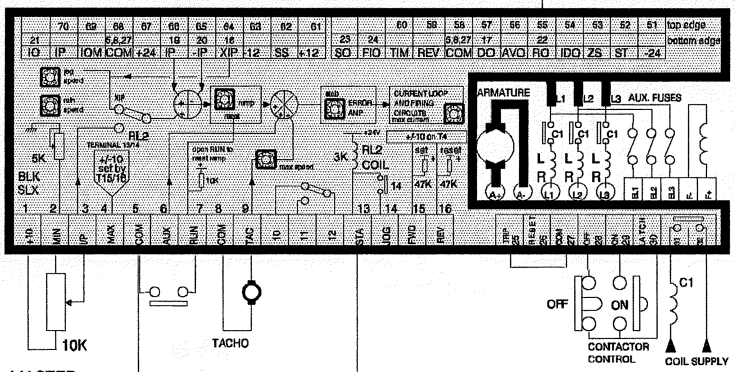
SPRINT Electric

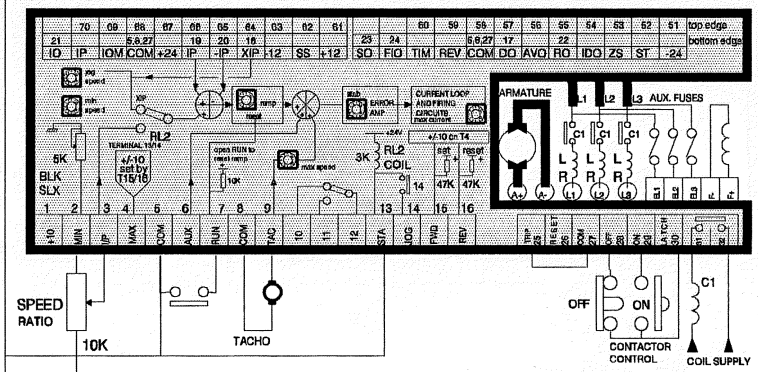
UG101881 ISS10

MODEL SLX
1) SPEED FOLLOWING SCHEME.
2) LOAD SHARING

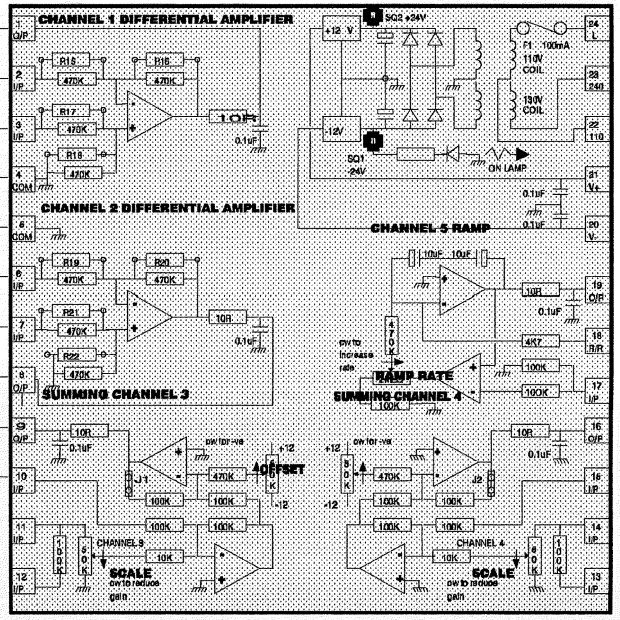








THE RAMP SETTINGS ON THIS DRIVE WILL BE FOLLOWED BY THE OTHERS

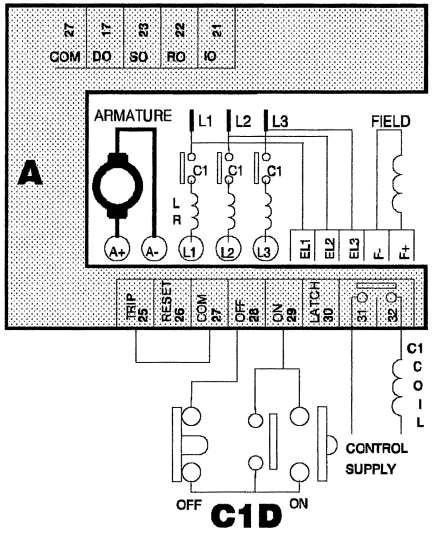


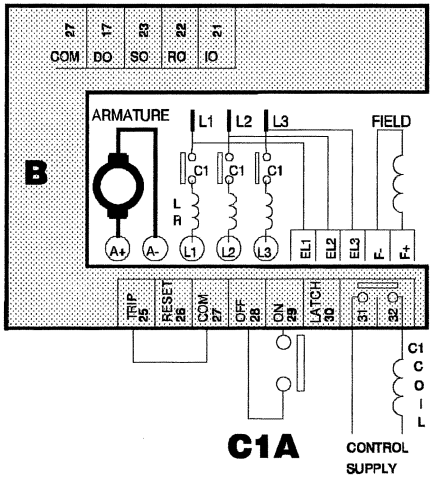
THIS DRAWING SHOWS HOW THE BUFFER CARD CAN BE USED TO PROVIDE A MASTER SETPOINT TO MULTIPLE DRIVES WITH A RATIO POT FOR EACH OF THE FOLLOWERS

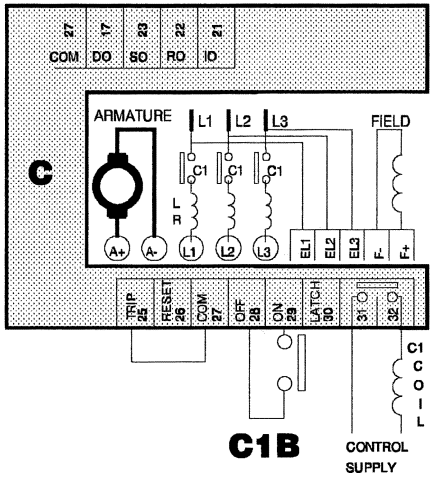
Master Setpoint application.
Model SLX

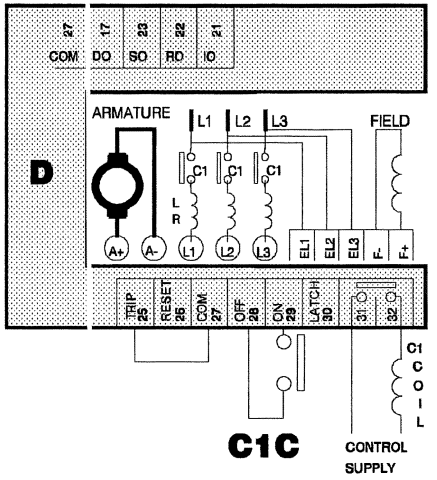
UG101882 ISS10

1 METHOD FOR ENABLING POWER ON FOR MULTIPLE DRIVES WITH ONE SET OF POWER ON, POWER OFF PUSHBUTTONS. NOTE. THE PROPOGATION DELAY FOR TRIPPING IS APPROX. 100 millisecs. PER DRIVE. (note, the main contactor can be rated AC1, thermal)

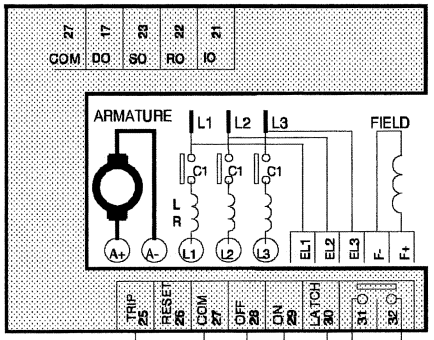






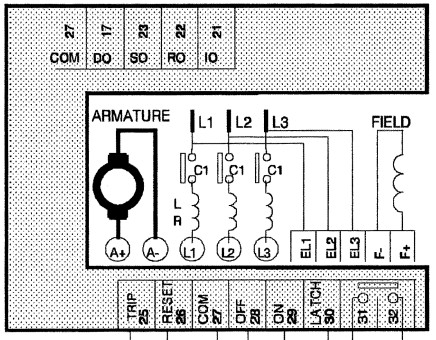


2



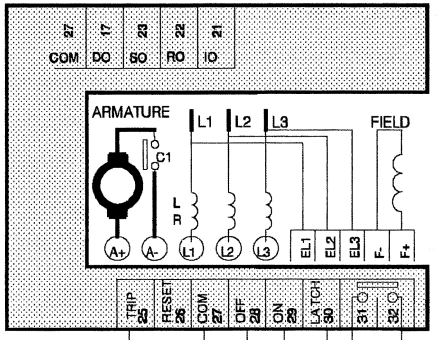
POWER ON INTERLOCK THE MAIN CONTACTOR CAN ONLY BE ENERGISED IF C2 IS CLOSED AT POWER ON. EG. ZERO REFERENCE INTERLOCK.

3



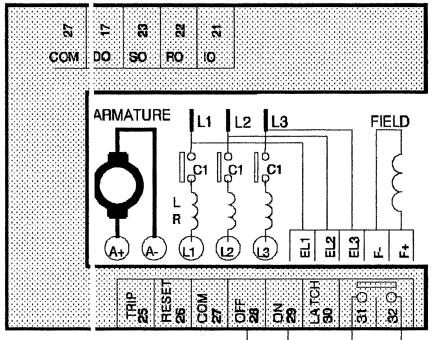
THERMISTOR ALARM TRIPS IF THE RESISTANCE EXCEEDS 2K Ohms. IT WILL NOT TRIP IF THE RESISTANCE IS BELOW 200 Ohms.

4



THE MAIN CONTACTOR MAY BE INSERTED IN THE ARMATURE CIRCUIT INSTEAD OF OR ASWELL AS THE SUPPLY

5



A SWITCH OR MAINTAINED CONTACT MAY BE USED. IF THE SWITCH IS CLOSED WHEN AUX. POWER IS APPLIED THEN THE MAIN CONTACTOR WILL ENERGISE IMMEDIATELY. WARNING! THIS MAY BE DANGEROUS.

1) Linking Drives together, one trips, all trip.
2) Power On interlock.
3) Thermistor with Reset button.
4) Contactor in Armature circuit.
5) Power On with maintained contact.

ZERO or REVERSE REFERENCE INTERLOCK

A common requirement to prevent drive enable on turn on if the setpoint reference is POSITIVE and greater than 5%.

Provision has been made on the MICRO ANALOG PROCESSOR to have this feature selectable.

The SLX is provided with a REVERSE or ZERO speed function. A link on the PROCESSOR is remade and the REVERSE speed detector becomes a REVERSE or ZERO reference detector.

A layout of the MICRO ANALOG PROCESSOR is shown below. (Located on the top edge of the control card).

To implement the zero or reverse reference function the S link must be opened and the R link made. The links are made by solder bridges. Take great care not to damage the tracks when removing the solder.

Once the link has been altered it can be tested by selecting the REVERSE speed relay function (S7) and then applying a setpoint to terminal 3. The relay output should change state at 0.5V.The relay will be energised for voltages > than 0.5V.

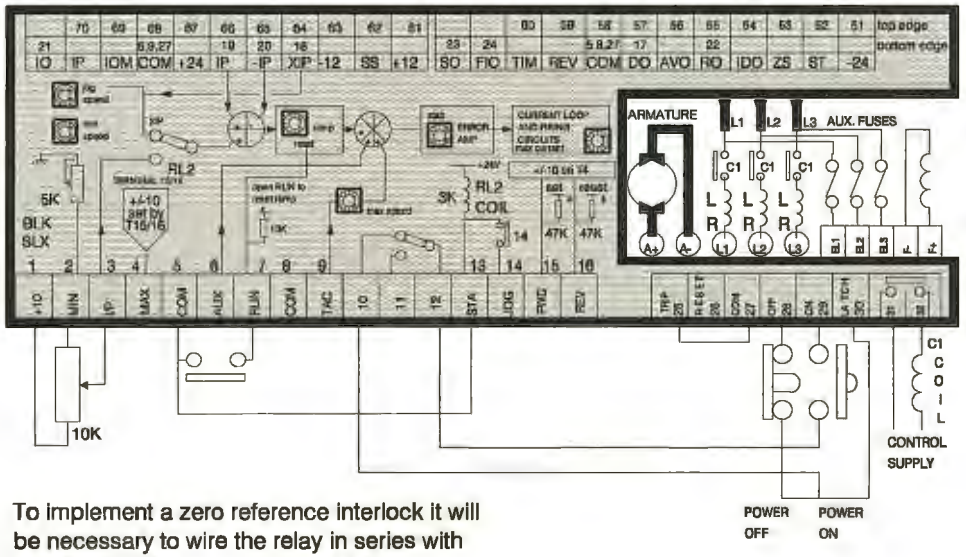
The R link is normally open

R

S

The S link is normally made for the speed function.

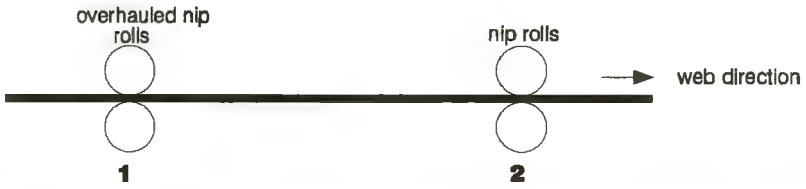
71	RCO		-IP	81
72	TCI		OFS	82
73	IO		IP3	83
74	RUN		RIA	84
75	TDO		RST	85
76	DO		RO	86
77	DIP		SO	87
78	+10		COM	88
79	-24		+12	89
80	+24		-12	90



To implement a zero reference interlock it will be necessary to wire the relay in series with the POWER ON pushbutton as shown.

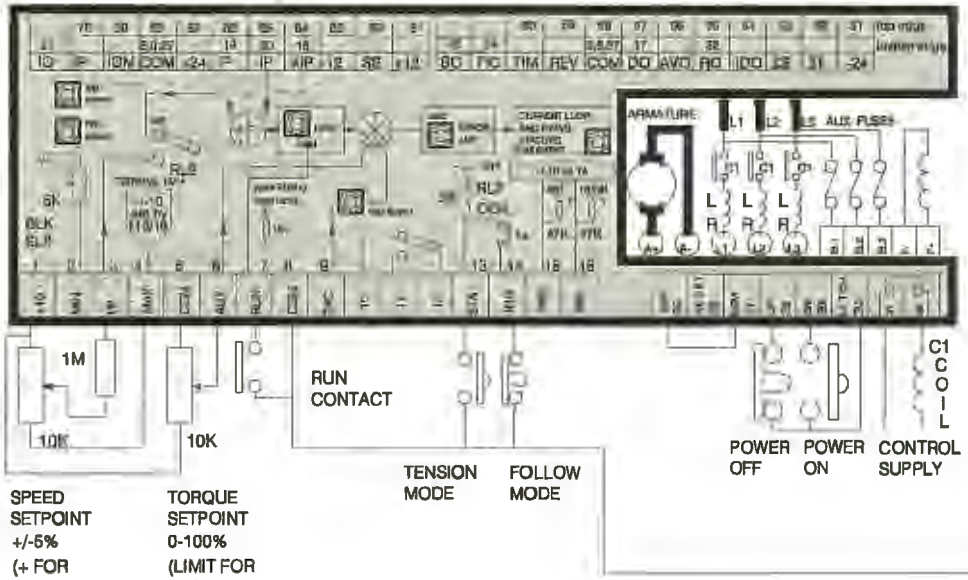
If this function is implemented by the user, please add a label to indicate the change.

OVERHAULING. Applications which require a force to be applied in opposition to the material direction

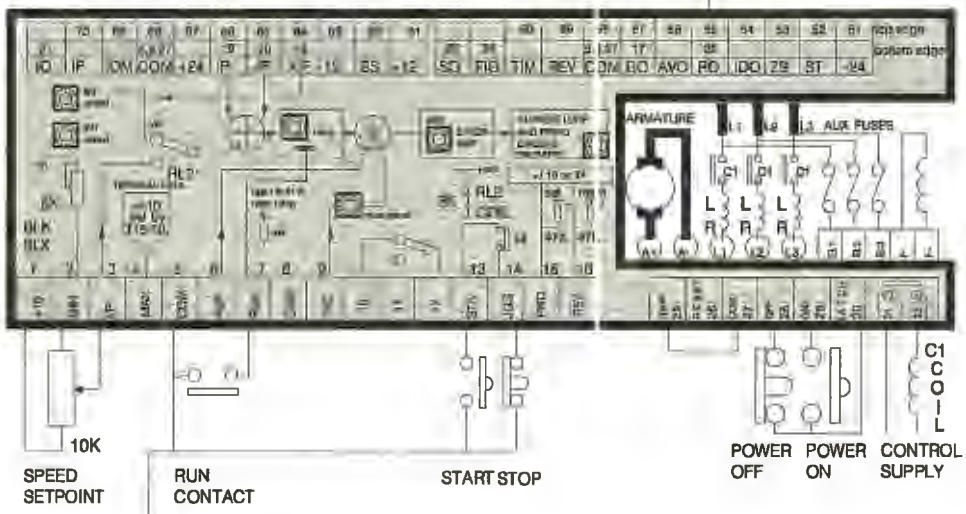


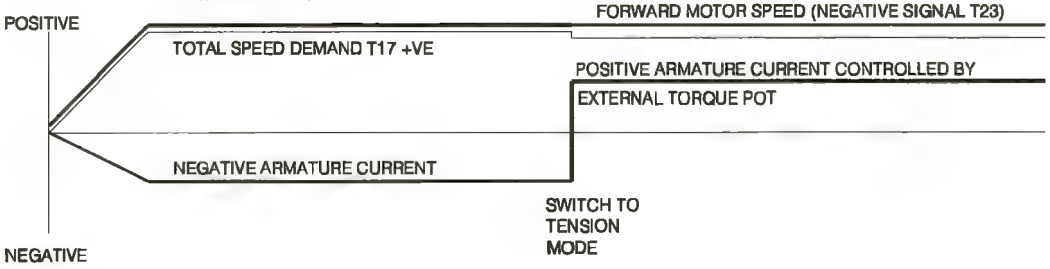
THE NIP ROLLS ARE DRIVEN BY DRIVE 2 IN STANDARD SPEED MODE. THE SETPOINT RAMP OUTPUT IS TAKEN TO DRIVE 1.
DRIVE 1 IS USED TO CONTROL THE OVERHAULED NIP ROLLS. IN ONE OF 2 MODES. IT IS ARRANGED TO GIVE FORWARD ROTATION FOR A NEGATIVE ARMATURE VOLTAGE
1) AS A SPEED FOLLOWER
2) APPLYING REVERSE FORCE TO THE WEB. A REDUCED SPEED DEMAND CAUSES THE DRIVE TO TRY AND SLOW DOWN. TO DO THIS IT ASKS FOR POSITIVE CURRENT, WHICH IS LIMITED BY THE EXTERNAL TORQUE POT. NOTE, THE STALL TIMER IS AUTOMATICALLY INHIBITED IN THIS MODE.

OVERHAULED DRIVE 1



OVERHAULING DRIVE 2

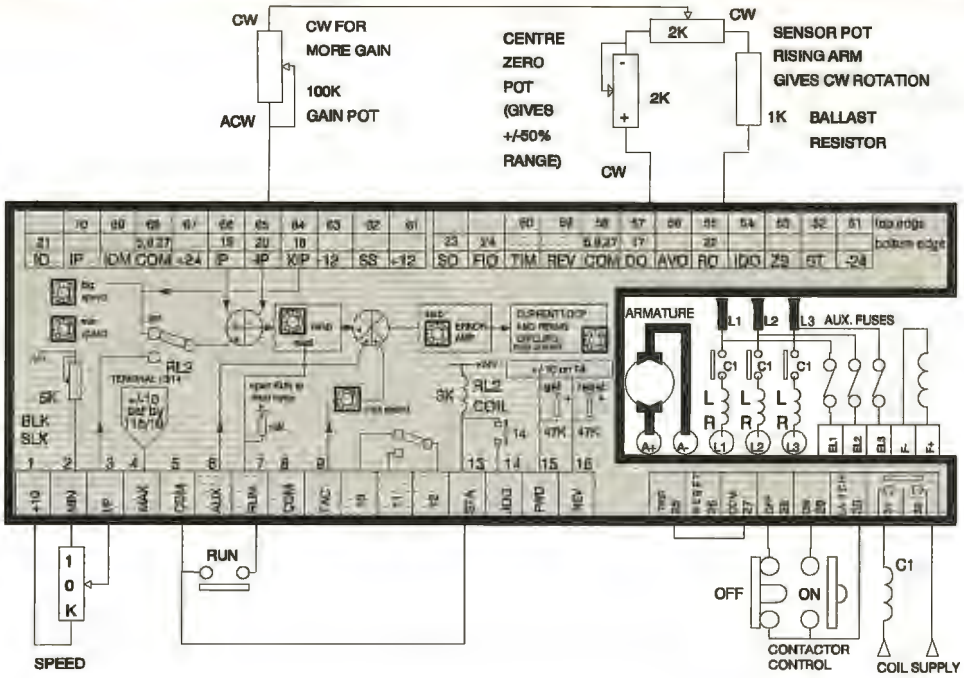




SPRINT Electric

UG101889 ISS10

OVERHAULING APPLICATION.



APPLICATION UTILISING DANCING ARM

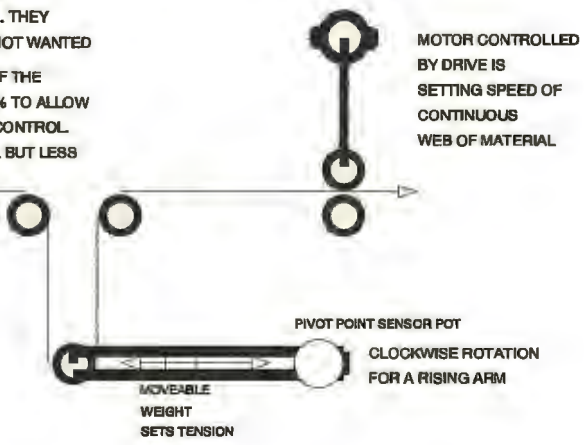
THE CONTROL SYSTEM IS DESIGNED TO GIVE PROPORTIONAL CLOSED LOOP CONTROL OF THE POSITION OF THE DANCING ARM

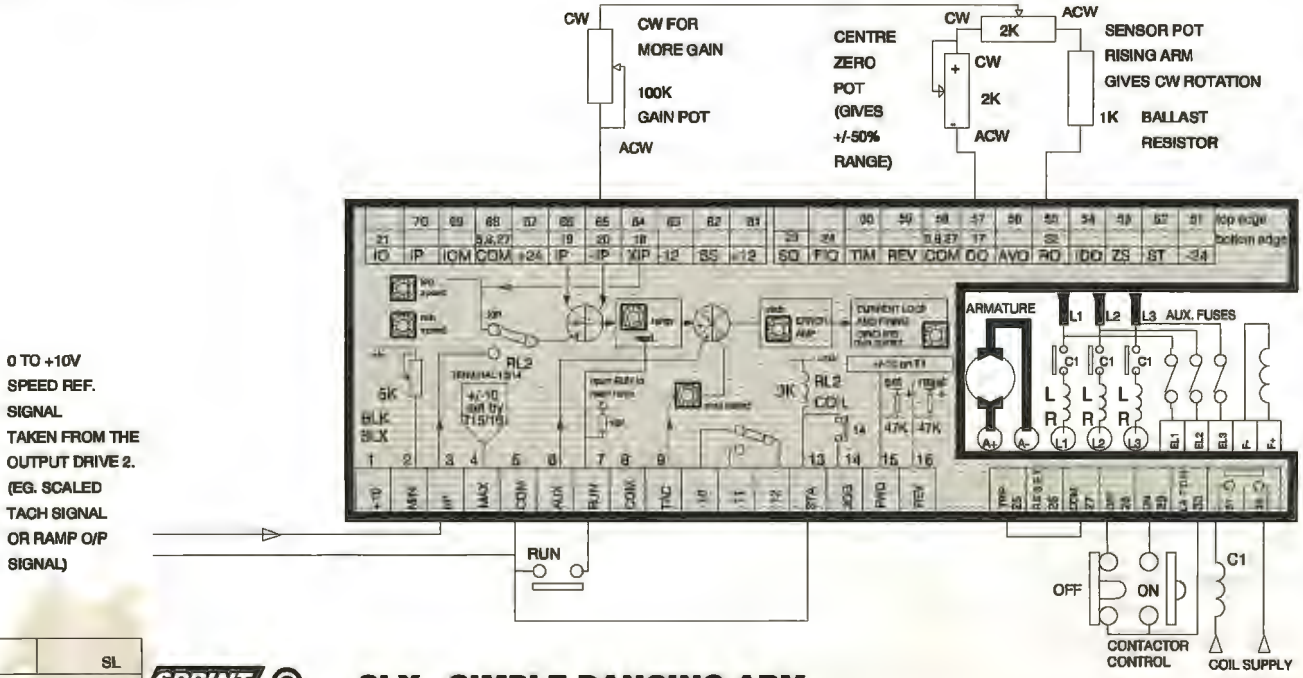
THE POSITIVE SETPOINT RAMP OUTPUT AND THE NEGATIVE SETPOINT OUTPUT ARE APPLIED ACROSS THE SENSOR POT. THIS GIVES A SENSOR POT STRENGTH PROPORTIONAL TO LINE SPEED.

THE CENTRE ZERO POT AND BALLAST RESISTOR ALLOW ADJUSTMENT OF THE NULL POSITION BY +/-50% OF THE SENSOR POT TRAVEL. THEY CAN BE OMITTED IF THIS FUNCTION IS NOT WANTED

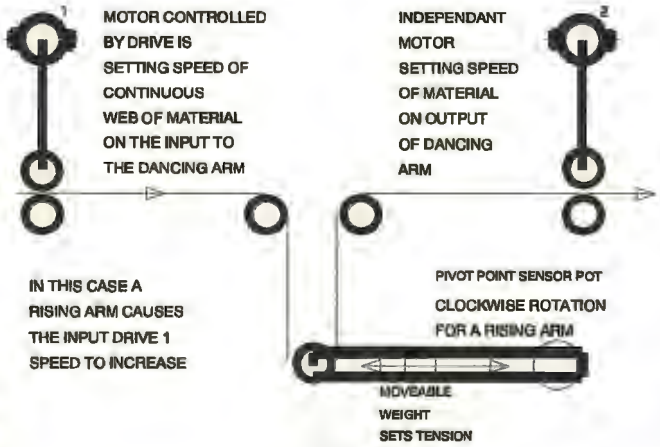
THE GAIN POT ALLOWS ADJUSTMENT OF THE SENSOR POT SIGNAL STRENGTH BY 50% TO ALLOW STABILITY ADJUSTMENT AND/OR GAIN CONTROL. HIGHER GAIN GIVES TIGHTER CONTROL BUT LESS STABILITY.

IF THE ARM STARTS TO RISE THE DRIVE RECEIVES A +VE SIGNAL INTO THE INVERTING I/P, THIS GIVES A SPEED REDUCTION, WHICH CAUSES THE ARM TO RETURN TO THE NULL POSITION. A DROPPING ARM GIVES A SPEED INCREASE.





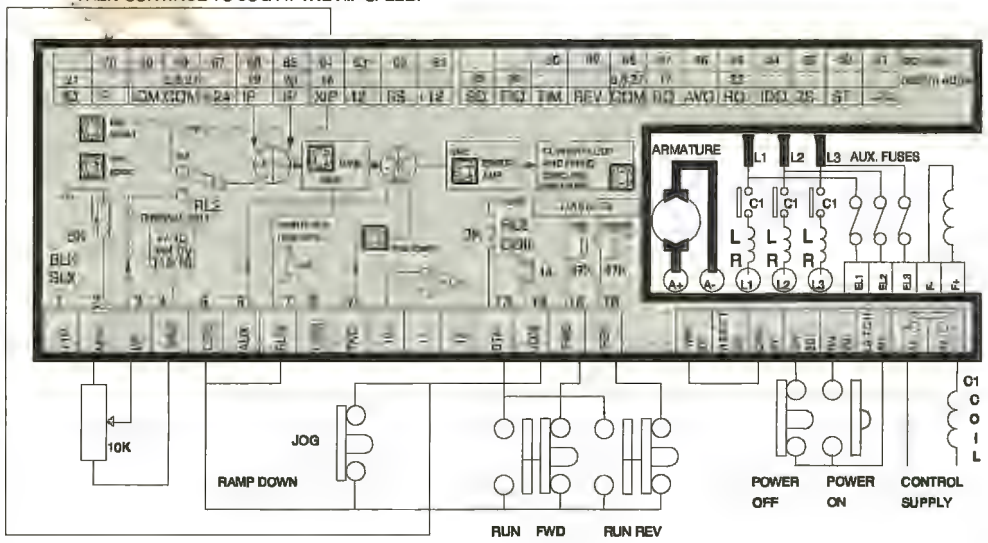
APPLICATION WHERE DANCING ARM POSITION IS CONTROLLED BY INPUT SPEED CHANGE.



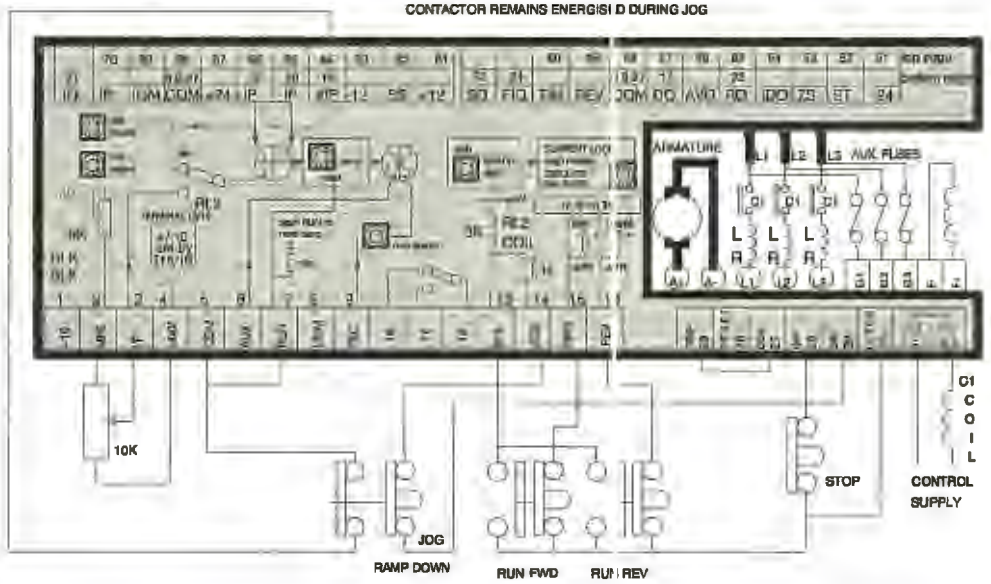
8/94 SL
UG101690 ISS10
SIMPLE DANCING ARM

SLX SIMPLE DANCING ARM

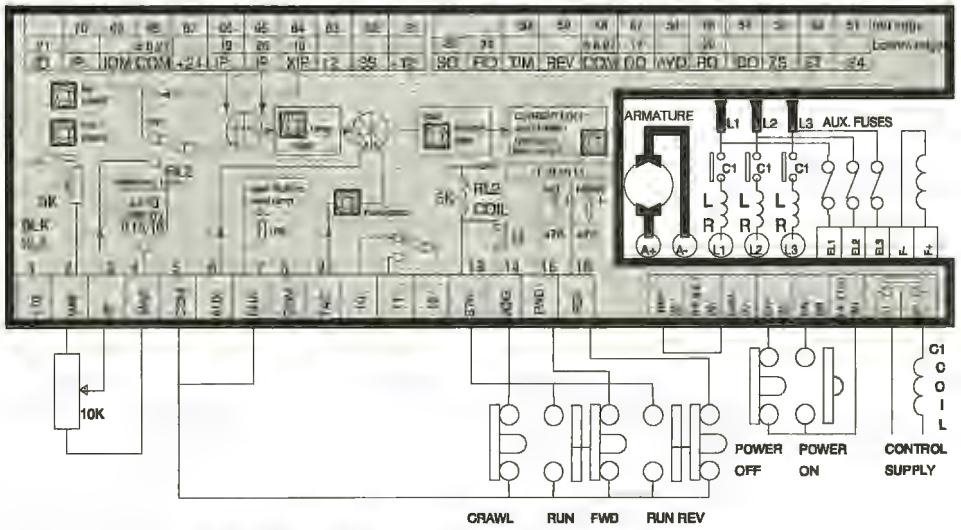
1) THE JOG BUTTON WILL RAMP THE DRIVE DOWN TO STANDSTILL IF MOMENTARILY PRESSED, AND THEN CONTINUE TO JOG AT THE XIP SPEED.



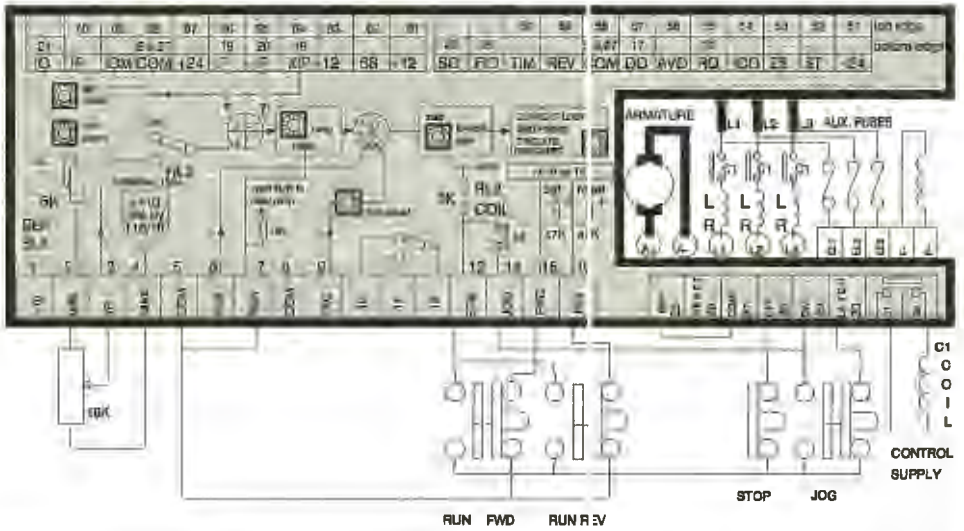
2) CONTACTOR REMAINS ENERGISED DURING JOG. THE POWER ON AND START FUNCTIONS ARE COMBINED.



3) CRAWL OR RUN SELECT.



4) JOGGING ON MAIN CONTACTOR.
Reduce speed to minimum before selecting jog



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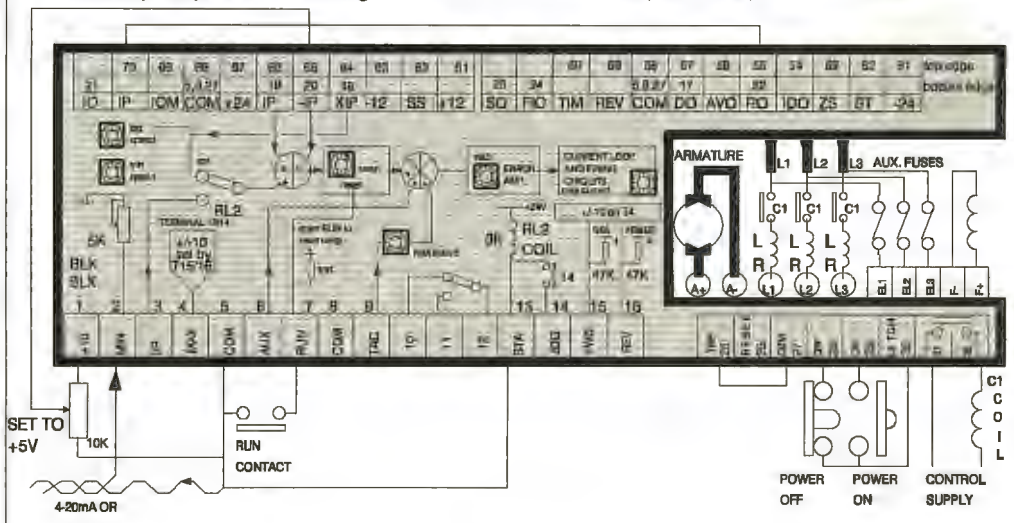
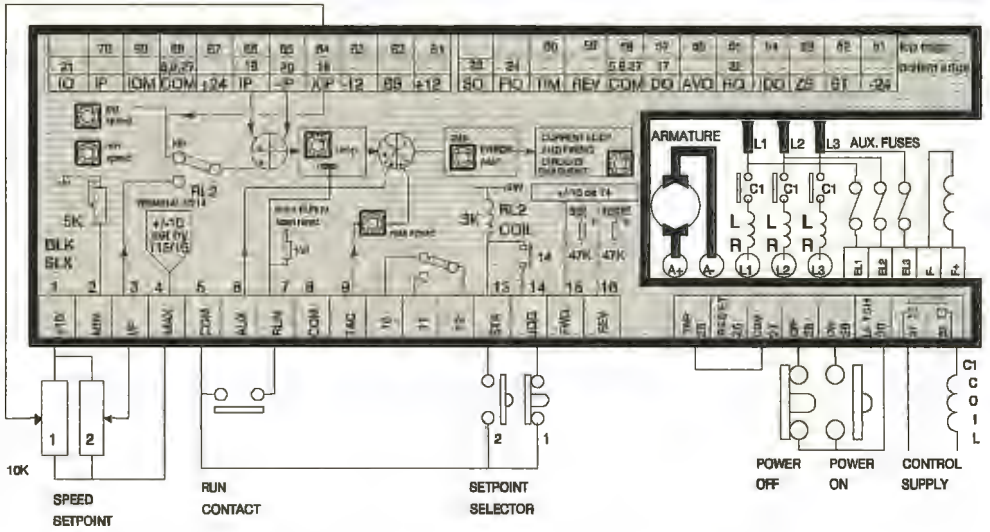
UG101891 ISS10

SLX
1) JOGGING WITH MAIN CONTACTOR PERMANENTLY ENERGISED
2) JOGGING WITH START AND POWER ON FUNCTIONS COMBINED
3) CRAWL OR RUN SELECT
4) JOGGING ON MAIN CONTACTOR

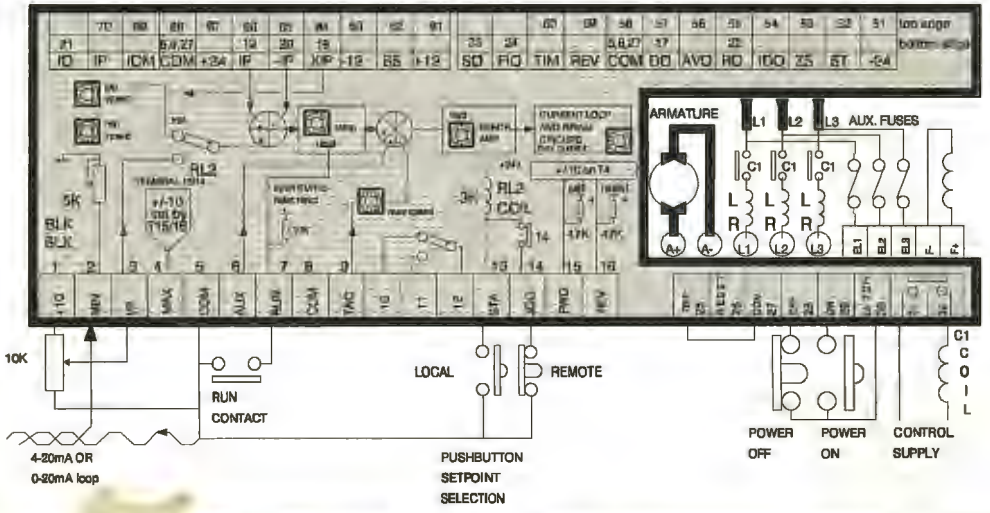
1) FORWARD AND REVERSE USING 4-20mA LOOP SIGNAL. 12mA REPRESENTS ZERO.
The ramp output on T55 swings -5V to +5V. -5V = -100%, 0V = 0%, +5V = +100%.



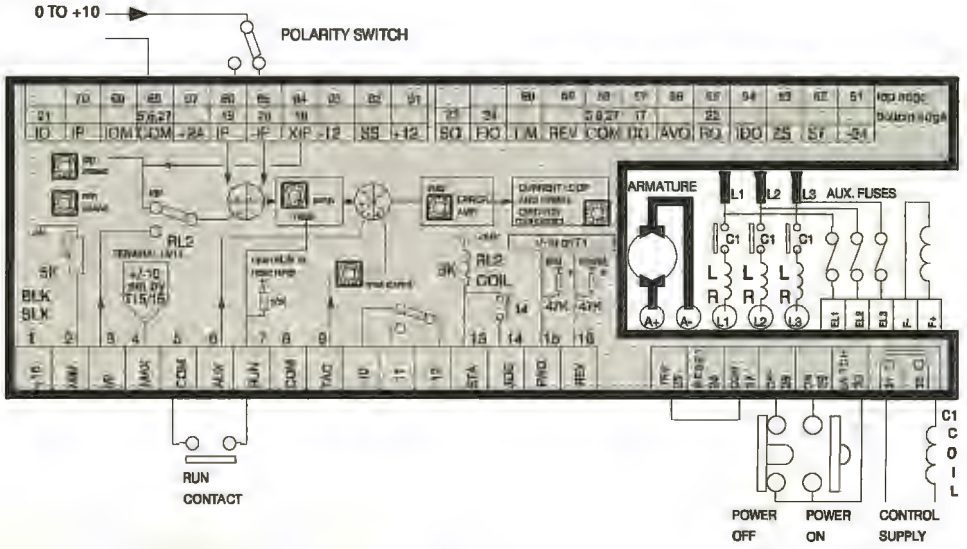
2) DUAL SETPOINT POTS. SELECTED BY PUSHBUTTONS. BOTH CENTRE ZERO.
OPENING RUN LINE GIVES RAPID STOPPING.



3) FORWARD SPEED SET BY 4-20mA signal loop. LOCAL SETPOINT IS ADDED
IN BY LOCAL BUTTON AND DESELECTED BY REMOTE BUTTON.



4) BI-DIRECTION CONTROL WITH A UNIDIRECTIONAL SETPOINT 0 TO +10V AND A
POLARITY SWITCH.



SPRINT Electric **SLX**

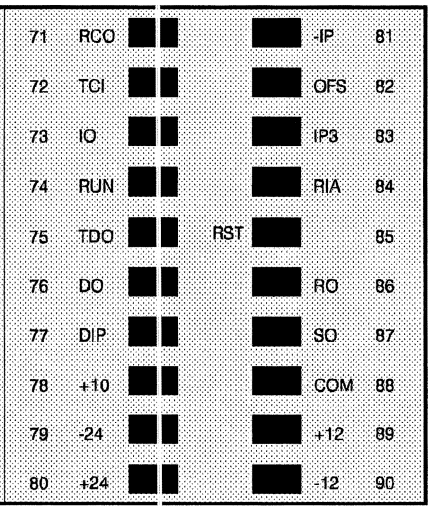
1) 4-20mA LOOP FORWARD AND REVERSE
2) DUAL SETPOINT POTS WITH PUSHBUTTON SELECTION.
3) 4-20mA LOOP WITH LOCAL SPEED POT SELECTED BY PUSHBUTTON
4) FORWARD REVERSE WITH UNIPOLAR SIGNAL AND DIRECTION SWITCH.

MODEL SLX
SIGNAL PADS

Provision has been made on the MICRO ANALOG PROCESSOR to enable monitoring of some useful signals.

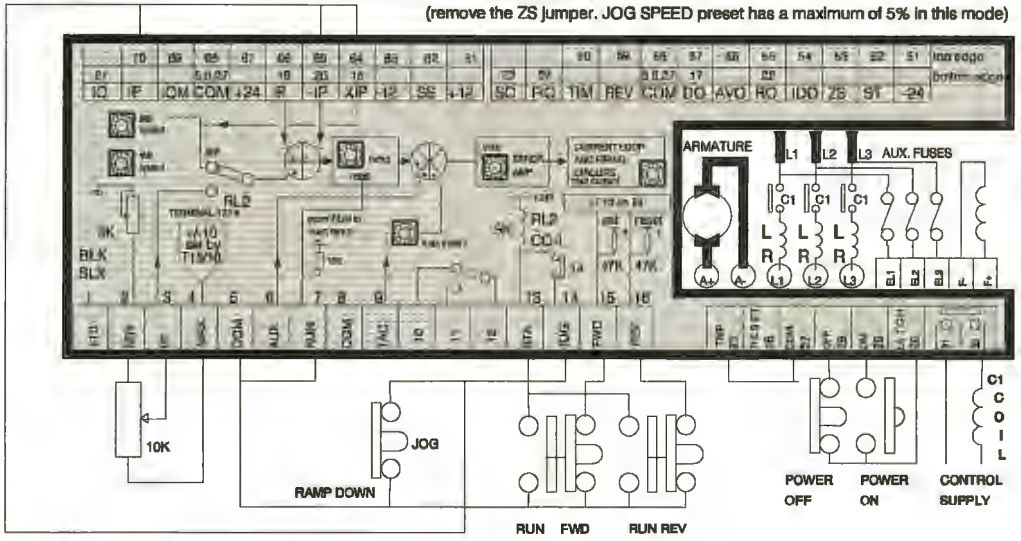
A layout of the MICRO ANALOG PROCESSOR is shown below. (Located on the top edge of the control card).

The rectangular signal pads on the processor are able to accept a standard 2 by 10 surface mount pin header.

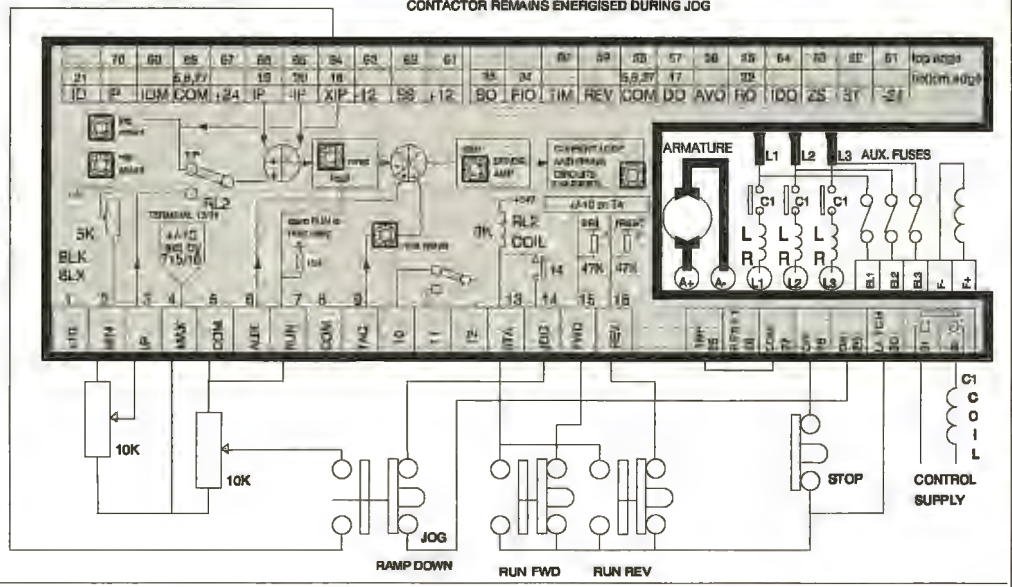


Ramp Control Output. This signal indicates the setpoint ramp status and is -11V when ramping up and 0V when the ramp has finished	71	RCO	-IP	81	Inverting ramped speed input. Also on T65 and T20. 0 to -10V represents 0 to +100% ramped speed demand. True bi-polar arithmetic summing.
Torque Command Input. This signal pad is connected to terminal 6 and shows the level of the auxiliary reference 0 to +/-10V	72	TCI	OFS	82	Offset speed input. 0 to +10V represents 0 to -25% speed demand. This input is used for the 4-20mA signal loop offset function.
Field Output. This signal is connected to terminal 24 and shows the magnitude of the Field current. 0 to +5V for 0 -100% current.	73	IO	IP3	83	Input terminal 3. This signal is the main speed demand signal normally input via terminal 3. 0 to +10V for 0 to +100% speed demand.
Run. Shows the status of the RUN signal within the drive. 0 to +11.5V when the RUN terminal 7 is open or main contactor disabled, 0V to run	74	RUN	RIA	84	Ramp input Auxiliary. Non-inverting speed input also on T66 and T19. 0 to +10V for 0 to +100% speed demand. True bi-polar arithmetic summing.
Torque Demand Output. 0 to +7.5V represents 0 to150% torque demand (armature current). +5V represents 100%.	75	TDO	RST	85	Ramp sum total. This signal is the summation of all the speed ramp inputs. 0 to -/+5V represents 0 to +/-100% speed demand prior to ramping.
Demand Output. 0 to -10V represents 0 to +100% speed demand. This signal is also on terminal 57 and terminal 17.	76	DO	RO	86	Ramp Output. This signal is the ramped version of the signal on 85. 0 to +10V represents 0 to 100% speed demand. It is also on T55 and T22.
Direct speed Input. This signal is also on terminal 70, and terminal 6 if the drive is in speed mode. 0 to +10V represents 0 to 100% speed.	77	DIP	SO	87	AV output. This signal represents the armature voltage signal. Also on terminal 56. 0 to +10V represents 0 to +/-500V at the armature terminals.
+10V. ultra stable speed reference voltage. Also on terminal 1. Absolute value 10V +/-5%. Output capability 10mA maximum.	78	+10	COM	88	Common. Electronic 0V
-24V. Unregulated -24V power supply. May vary between -18V and -35V depending on unit supply voltage and loading. 25mA max, T51	79	-24	+12	89	+12V regulated rail. 10mA maximum available. Tolerance 5%.
+24V. Unregulated +24V power supply. May vary between +18V and +35V depending on unit supply voltage and loading. 25mA max. T67	80	+24	-12	90	+12V regulated rail. 10mA maximum available. Tolerance 5%.

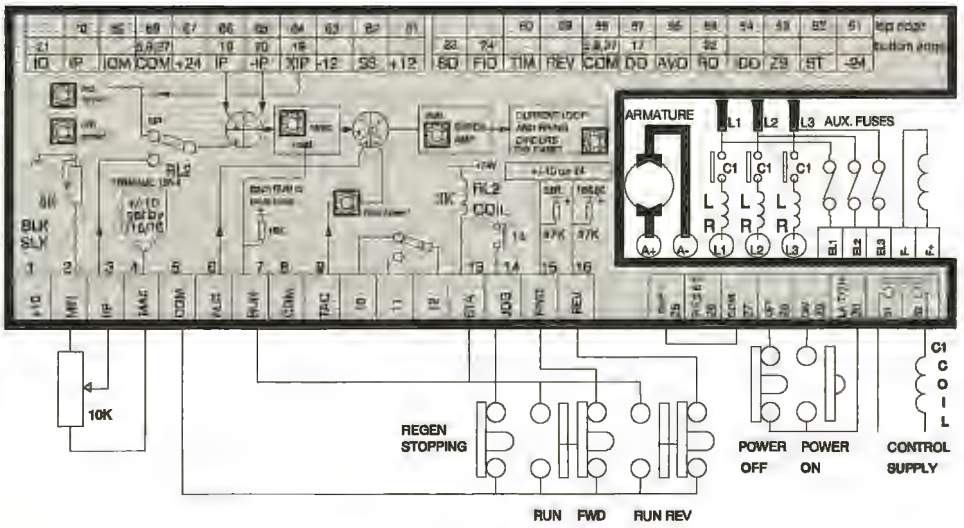
1) THE JOG BUTTON WILL RAMP THE DRIVE DOWN TO STANDSTILL IF MOMENTARILY PRESSED, AND THEN CONTINUE TO JOG AT THE XIP SPEED VIA THE DIRECT SPEED INPUT ON T70.
(remove the ZS jumper. JOG SPEED preset has a maximum of 5% in this mode)



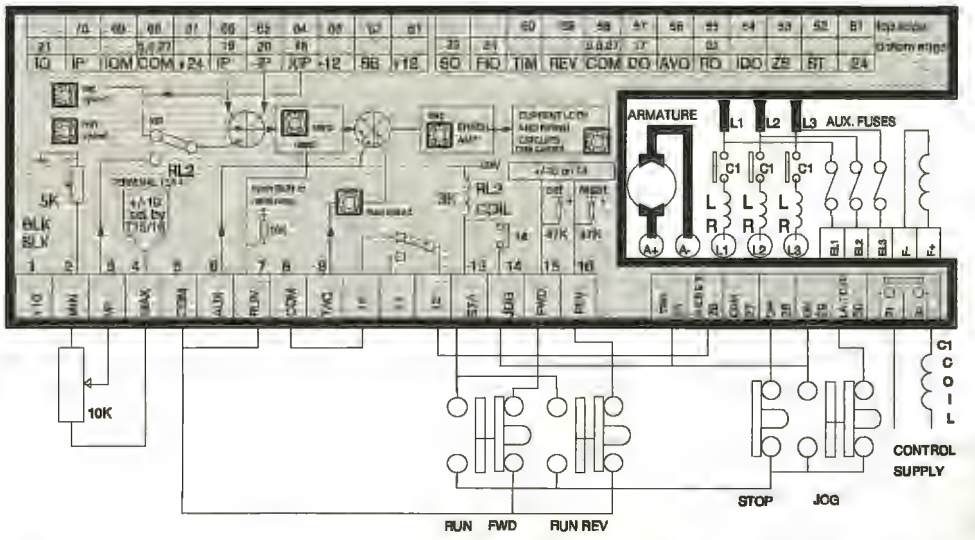
2) CONTACTOR REMAINS ENERGISED DURING JOG. THE POWER ON AND START FUNCTIONS ARE COMBINED. JOG SPEED IS SET BY EXTERNAL POT.



3) STOP OR RUN SELECT. REGEN DOWN USING 1S AND/OR ZS JUMPER



4) JOGGING ON MAIN CONTACTOR WITH AUTOMATIC ZERO SPEED JOG INTERLOCK. (S6 on and S2/5/7 off)



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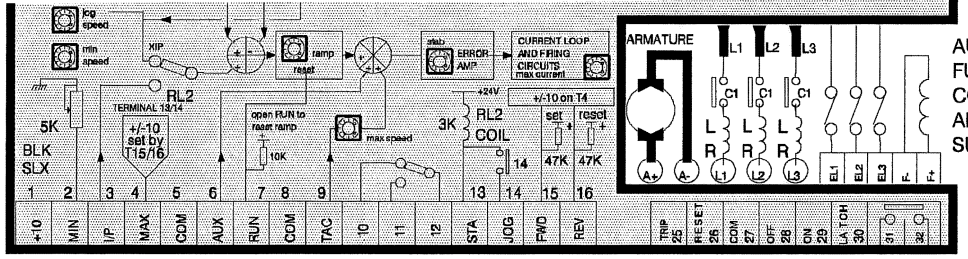
UG101894 ISS10

SLX 1) JOGGING WITH MAIN CONTACTOR PERMANENTLY ENERGISED VIA DIRECT SPEED INPUT
2) JOGGING WITH START AND POWER ON FUNCTIONS COMBINED AND EXTERNAL JOG SPEED REFERENCE
3) STOP OR RUN SELECT. REGEN DOWN.
4) JOGGING ON MAIN CONTACTOR WITH ZERO SPEED INTERLOCK

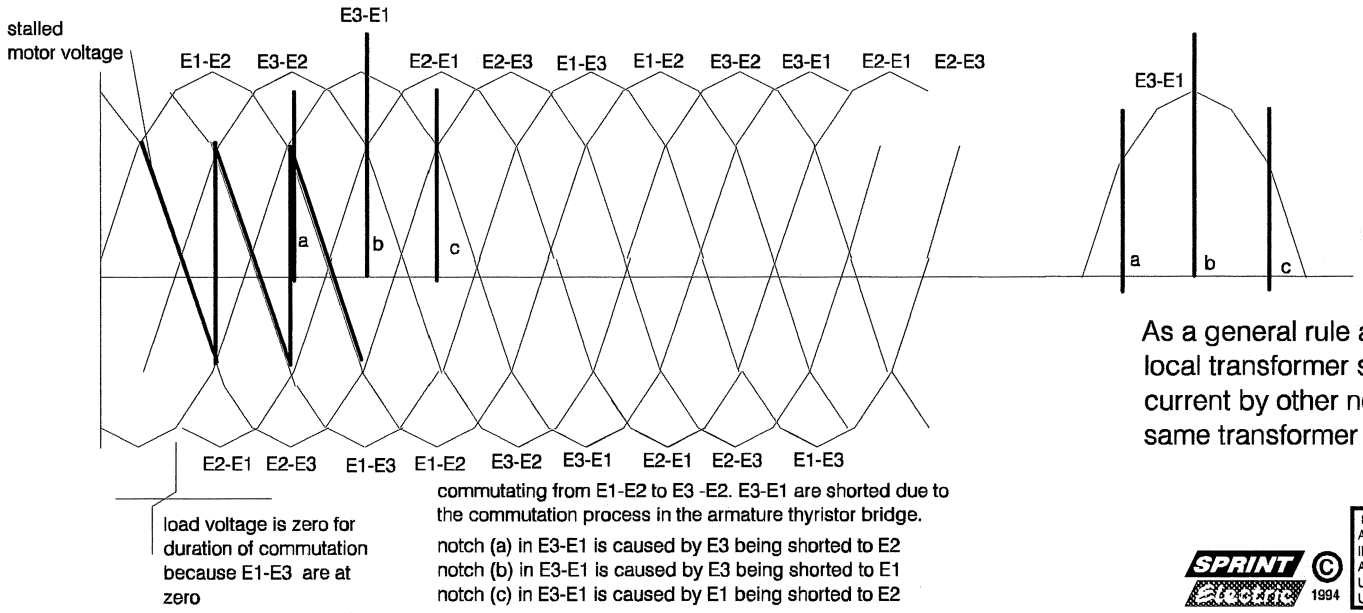


AUXILIARY FUSES FOR CONTROL AND FIELD SUPPLY

When the drive is being supplied from a local transformer, the commutation process in the thyristor bridge will cause high voltage overshoots to occur on the incoming supply. This is due to the inductance of the transformer and the lack of any other substantial load to absorb the high energy spikes.

The high energy spikes may cause damage to other equipment, the drive auxiliary inputs, the blower motor or unwanted thyristor triggering. To prevent this it is necessary to fit a supply conditioning BUCKET circuit to the drive supply.

The BUCKET circuit will soak up the spikes and prevent damage.



As a general rule a BUCKET circuit will be required with local transformer supplies unless the consumption of current by other non-inductive loads connected to the same transformer exceeds the drive current at any time.

TERMINAL LISTING

1 +10 volts +/- 5% output. 10mA.

2 MIN INPUT. 5K preset to com

3 Main SPEED INPUT. 0 to +/-1

4 +/-10 volts output. 10mA. Tog

5 COMMON. 0 volts

6 AUX. INPUT 0 to +10V. Direc
according to jumper on card.

7 RUN. Drive is inhibited if T7 is
0V to run. Internal pull up to +

8 COMMON (0V). normally use

9 TACHO feedback input. Full s

10 a) S2

11 b) S5

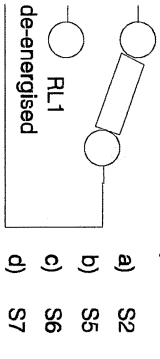
12 RL1 de-energised c) S6 d) S7

13

14

15 FORWARD

16 REVERSE



17 TOTAL SETPOINT OUTPUT (

18 XIP speed demand input. sel

19 AUXILIARY SPEED INPUT +,

20 AUXILIARY INVERTING SPE

21 CURRENT OUTPUT. 0 to +/-

22 RAMPED SETPOINT OUTPU

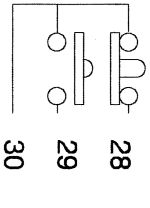
23 SPEED OUTPUT. +/-10V full

24 FIELD CURRENT OUTPUT. 0

25 AUX. TRIP Trips drive if resist

26 RESET. All alarms except STA

27 COMMON (0V).



28 POWER OFF. 24V

29 POWER ON

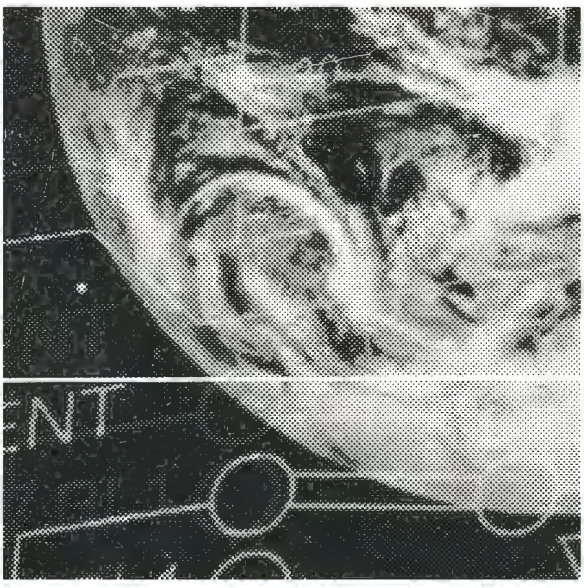
30 POWER LATCH

31 INTERNAL SLAVE

32 contactor. 240V 1

INDEX

WORLD CLASS IN DESIGN



WORLD BEATING IN FUNCTION

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