



# 3600XRi

SINGLE PHASE

DC MOTOR CONTROLLER

4Q

WORLD CLASS IN DESIGN · WORLD BEATING IN FUNCTION

**SPRINT** / *Electric*

## IMPORTANT SAFETY NOTES

READ AND UNDERSTAND THIS MANUAL  
BEFORE APPLYING POWER TO THE UNIT

This 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



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 unit.

## INPUTS AND OUTPUTS

+ aux input ramped	speed output	relay drivers	+24V rail
-aux input ramped	current output +	drive stall	+12V rail
+ aux input direct	current output +/-	imminent stall	+/- 10V
4-20mA input	ramp output	zero speed	-12V rail
+/-10V input	demand output	shaft reverse	-24V rail

## ADJUSTABLE PARAMETERS

Max speed	Fwd up ramp	Rev up ramp	I <sub>max</sub> +	Stability
Min speed	Fwd down ramp	Rev down ramp	I <sub>max</sub> -	IR comp

## SWITCHED FUNCTIONS

Max current range	Relay function	stall/zero/reverse
Maximum feedback	Feedback source	tacho/arm. volts

## RELAY DRIVER FUNCTIONS

a) stall	c) overload timer	EXAMPLE LINKED	c AND b = tacho loss. SP60-53 a AND b = show stall at zero.
b) zero	d) reverse speed		

## JUMPER FUNCTIONS

4Q torque limit	Dual supply	Fast stop	I <sub>max</sub> mode
2Q torque limit	50% stall level	Stop at zero	Pos I, neg I
Aux speed I/P	4-20mA input	Half wave field	Motor brake

## LAMPS

Positive bridge	Negative bridge	Stall timer operating	Stalled
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## PUSHBUTTON FUNCTIONS

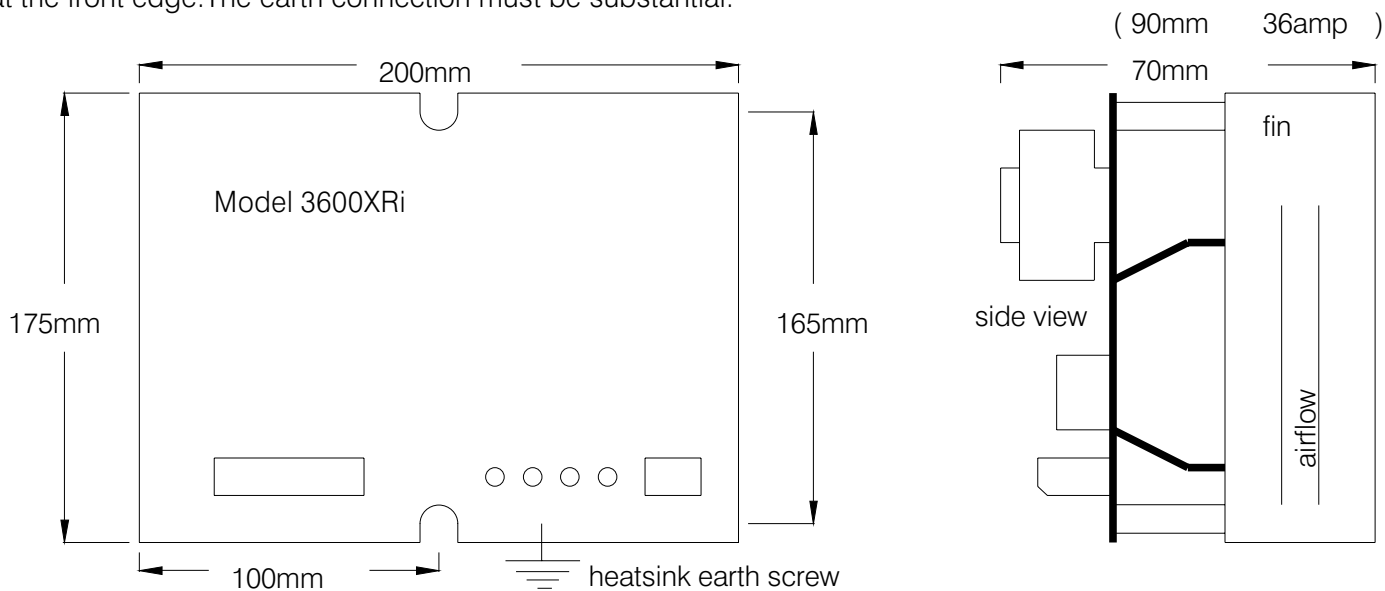
Forward   Reverse   Stop   Start   Jog

## PERFORMANCE FEATURES

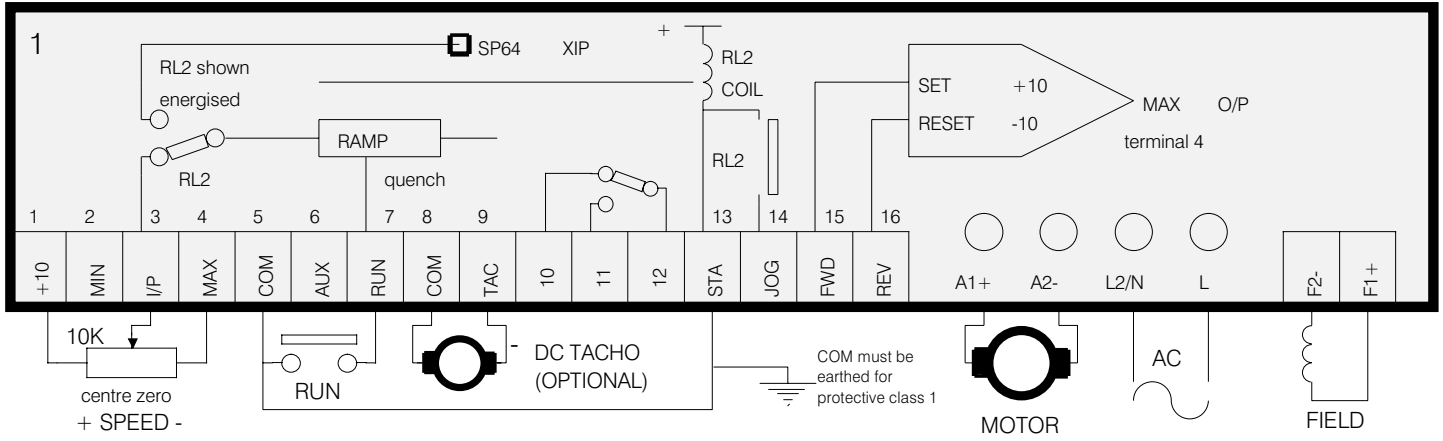
Dual loop control	International compatibility	Small size
Fused field supply	Electrically isolated control	Dual voltage
PLC compatible	Independant up/down ramps	4-20mA I/P
Torque or speed	Pushbutton control functions	Precision ref.

## MECHANICAL DIMENSIONS

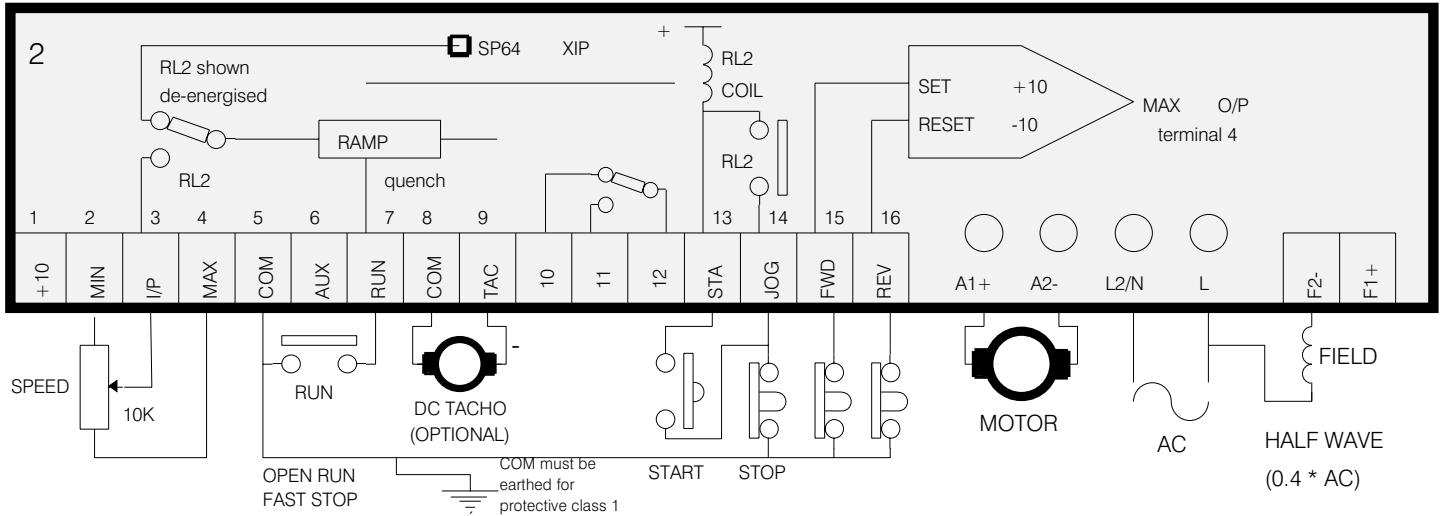
Two centre fixing slots are provided to mount the unit. The unit should be mounted to allow a satisfactory supply of cooling air to flow over the fins. (vertically with 50mm end space) Fixing bolts are M5 by 35mm for the 4/8/16/32 amp units, and M5 by 50mm for the 36 amp. Earth the heatsink with the 5mm screw provided at the front edge. The earth connection must be substantial.



*BASIC CONNECTION. FORWARD AND REVERSE SPEED CONTROL BY POTENTIOMETER*



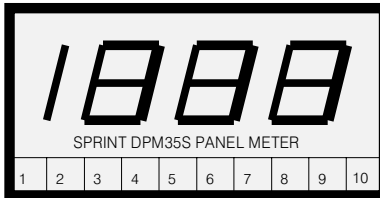
*START, STOP, INDEPENDANT FORWARD/REVERSE, RAMPS TO ZERO SPEED ON STOP*



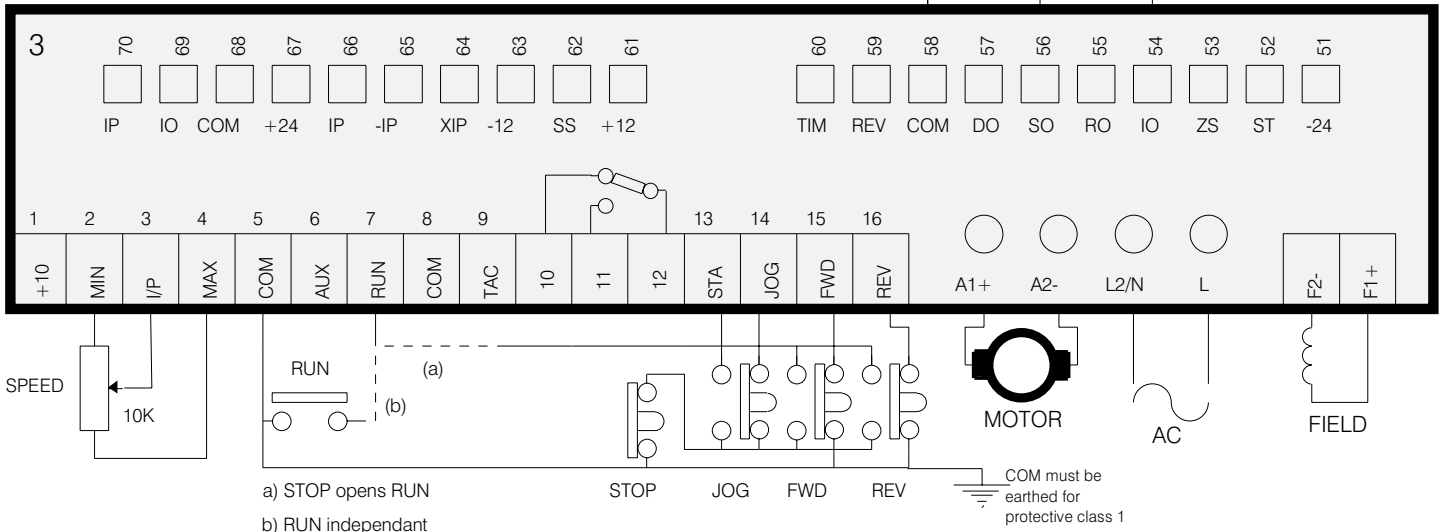
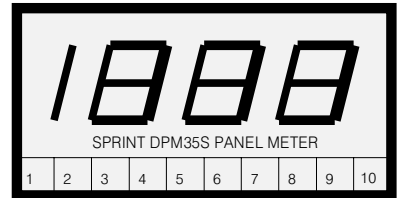
*FORWARD, REVERSE, JOG, STOP*

- 1) Start initiated by FWD/REV buttons
- 2) Direction change without STOP
- 3) JOG in either direction
- 4) Direction change during JOG
- 5) STOP button also opens RUN.
- 6) For dual function stopping, rapid or ramped, fit an independent RUN contact.

**SPEED DISPLAY**



**CURRENT DISPLAY**



- a) STOP opens RUN
- b) RUN independent

To ensure safe operation of the unit it is important to apply the AC supply before closing the RUN contact. This will prevent spurious firing due to erratic mains contactor operation. Do not remove the AC supply whilst armature current is flowing. Quench the drive first using the RUN contact.

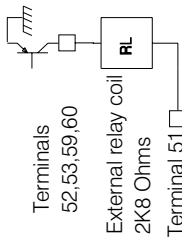
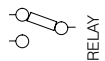
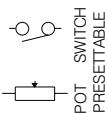
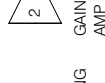
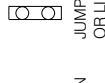
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HEALTH AND SAFETY AT WORK. ELECTRICAL DEVICES CONSTITUTE A SAFETY HAZARD. IT IS THE RESPONSIBILITY OF THE USER TO ENSURE COMPLIANCE WITH ANY ACTS OR BYLAWS IN FORCE. ONLY SKILLED PERSONS SHOULD INSTALL THIS EQUIPMENT.

**SYMBOLS**



70 DIRECT AUX SPEED INPUT ALSO SELECTABLE ON T6

69 CURRENT OUTPUT 0-5V FOR 0 TO +/-100% CURRENT RANGE. THIS IS A MODULUS OUTPUT. IMPEDANCE 1K.

68 DRIVE COMMON

67 +24V OUTPUT 25mA MAX. DO NOT SHORT

66 AUXILIARY SPEED INPUT 0 TO +/-10V FOR 0 TO +/-100%

65 AUXILIARY INVERTING SPEED INPUT 0 TO +/-10V FOR 0 TO +/-100%

64 WHEN THE SPEED INPUT RELAY RL2 IS OFF, THIS INPUT IS SELECTED.

63 -12V OUTPUT 10mA MAX

62 STOP/START INPUT. CLOSE TO -12V TO ACTIVATE STALL CONDITION. CLOSE TO +12V TO RELEASE STALL CONDITION

61 +12V OUTPUT 10mA MAX

60 RELAY DRIVER. OFF WHEN STALL TIMER IS TICKING. (CURRENT DEMAND > 105%).  
Switches to -24V

59 RELAY DRIVER. OFF WHEN SPEED REVERSE OR ZERO. Switches to -24V

58 DRIVE COMMON

57 INVERTED TOTAL SPEED DEMAND OUTPUT. 1K IMPEDANCE. 0 TO +/-10V FOR 0 TO +/-100%

56 SPEED OUTPUT. TYPICALLY 7.5V FULL SCALE. ADJUSTMENT OF MAX SPEED PRESET WILL ALTER THE FULL SCALE READING FROM 4V (ACW) TO 9V (CW). 0V TO +/- FULL SCALE FOR 0 TO +/- 100% SPEED. 1K OUTPUT IMPEDANCE

55 SETPOINT RAMP OUTPUT. 0 TO +/-10V FOR 0 TO +/-100%. 1K OUTPUT IMPEDANCE.

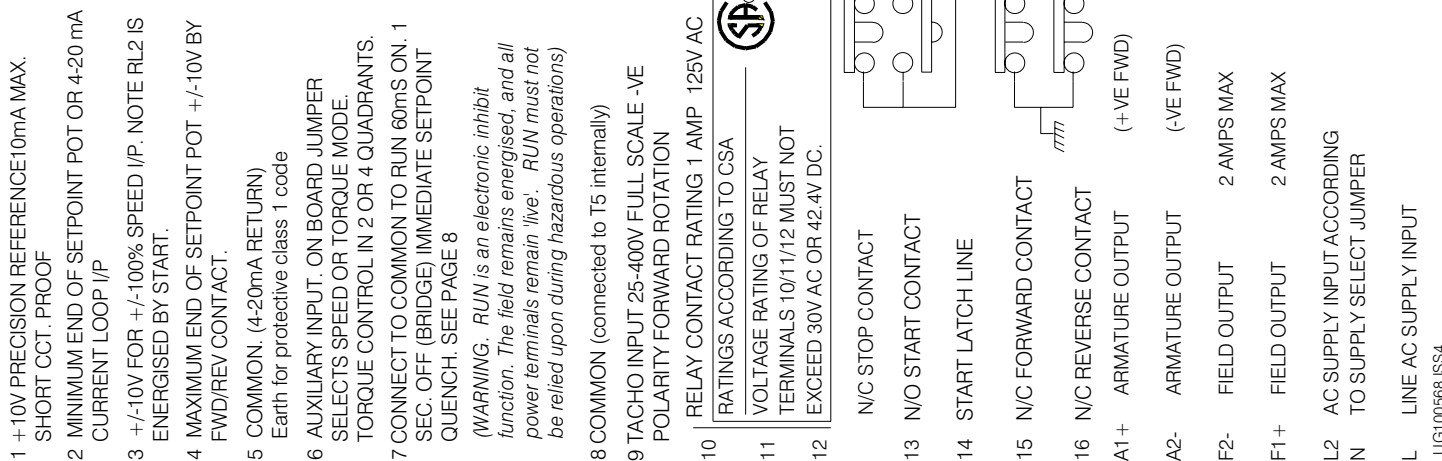
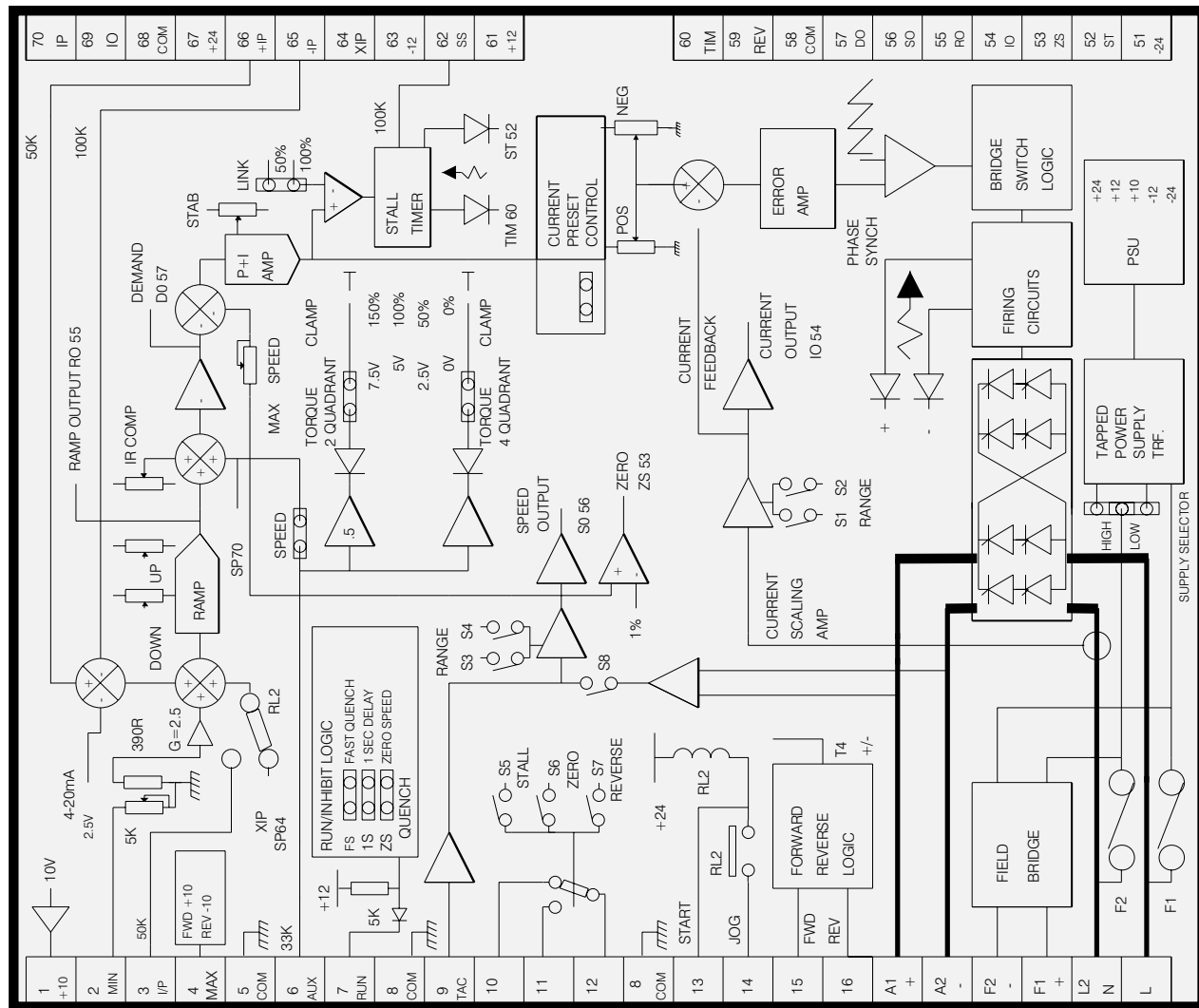
54 CURRENT OUTPUT. 0 TO +/-5V FOR 0 TO +/-100%. 1K OUTPUT IMPEDANCE.

53 ZERO SPEED RELAY DRIVER O/P MAX 25mA turns off at zero speed. switches to -24V

52 STALL RELAY DRIVER O/P MAX 25mA turns off when stall timer trips. switches to -24V

51 -24V RELAY SUPPLY 25mA. DO NOT SHORT

- 1 +10V PRECISION REFERENCE 10mA MAX. SHORT CCT. PROOF
- 2 MINIMUM END OF SETPOINT POT OR 4-20 mA CURRENT LOOP I/P
- 3 +/-10V FOR +/-100% SPEED I/P. NOTE RL2 IS ENERGISED BY START.
- 4 MAXIMUM END OF SETPOINT POT +/-10V BY FWD/REV CONTACT.
- 5 COMMON. (4-20mA RETURN)  
Earth for protective class 1 code
- 6 AUXILIARY INPUT. ON BOARD JUMPER SELECTS SPEED OR TORQUE MODE. TORQUE CONTROL IN 2 OR 4 QUADRANTS.
- 7 CONNECT TO COMMON TO RUN 60ms ON. 1 SEC. OFF (BRIDGE) IMMEDIATE SETPOINT QUENCH. SEE PAGE 8  
*(WARNING. RUN is an electronic inhibit function. The field remains energised, and all power terminals remain 'live'. RUN must not be relied upon during hazardous operations)*
- 8 COMMON (connected to T5 internally)
- 9 TACHO INPUT 25-400V FULL SCALE -VE POLARITY FORWARD ROTATION
- 10 RELAY CONTACT RATING 1 AMP 125V AC RATINGS ACCORDING TO CSA
- 11 VOLTAGE RATING OF RELAY TERMINALS \*10/11/12 MUST NOT EXCEED 30V AC OR 42.4V DC.
- 13 N/C STOP CONTACT
- 14 N/O START CONTACT
- 14 START LATCH LINE
- 15 N/C FORWARD CONTACT
- 16 N/C REVERSE CONTACT
- A1+ ARMATURE OUTPUT (+VE FWD)
- A2- ARMATURE OUTPUT (-VE FWD)
- F2- FIELD OUTPUT 2 AMPS MAX
- F1+ FIELD OUTPUT 2 AMPS MAX
- L2 AC SUPPLY INPUT ACCORDING TO SUPPLY SELECT JUMPER
- N LINE AC SUPPLY INPUT



**Refer to page 3 for typical applications** Ensure supply is disconnected before working on unit

**POWER CABLING.** Use correctly rated cable minimum 600V AC, twice times armature current, enclosed in metal conduit or trunking or screened. The screen must be earthed at the motor and drive. EMC installation guidelines section 3 page 8.

**FUSING.** Semiconductor fuses rated at least 1.75 times the armature current must be used in the AC supply. Failure to do so will invalidate any warranty. If the DC output is fused, due care must be taken to commutate inductive energy with snubber.

**CONTROL SIGNALS.** Avoid running signal cables close to power cables. Screens may be earthed at the drive end only.

**SUPPRESSION.** The drives have excellent noise immunity. However installations involving electrical welding or RF induction heating may require further filters on the line and armature terminals. Contactor coils and sparking contacts may also require suppression. A 100R in series with 0.1uF cap. is usually adequate in these situations

**MECHANICAL.** Optimise heatsink airflow. Avoid vibration and ambient temperature outside -10 to +45C. protect the drive from pollutants.

**MOTOR.** Ensure motor is correctly wired and that the motor and load are free and safe to rotate. The motor must ideally have a minimum armature time constant of approximately 10mS ( $T = L/R$ ). For motors with lower time constants eg. servo-motors, use an armature choke in series with the motor (Refer to motor supplier for choke data). Failure to do this may cause damage.

**INITIAL SETTINGS.** The drive units are shipped to run on the highest supply option at nominal speed in ARMATURE VOLTAGE feedback mode. To change this, alter SWITCHES S1 to S8 as required. S1 S2, SET TO MINIMUM RANGE THAT INCLUDES MOTOR RATING CURRENT. START INITIALLY WITH THE MAX CURRENT PRESETS AT HALF FINAL SETTING. FINAL ADJUSTMENT LATER. S3 off, S4 on. MAX SPEED ACW. *This sets feedback full scale to 100V, which is a good general starting point.* S5 S6 S7 SELECT ACCORDING TO DESIRED RELAY FUNCTION, S8 On for arm. volts feedback. The safest strategy for first time running with tach feedback systems is to start in ARMATURE VOLTAGE feedback mode (S8 on), with the tach disconnected from T9. The tach connection procedure is described in CLOSE RUN CONTACT below. WARNING. Do not allow the armature voltage to exceed the appropriate nominal output ratings for the AC supply. See page 1.

**OTHER PRESETS.** Safe starting conditions. Anticlockwise FORWARD UP AND DOWN RAMPS, REVERSE UP AND DOWN RAMPS, MIN SPEED, IR COMP. Midway STAB

**SETTING JUMPERS AND LINKS.** The function of the various jumpers and links is described on page 6. It is recommended to set up the drive in simple speed mode first, and then proceed to implement the extra functions provided, as a second stage.

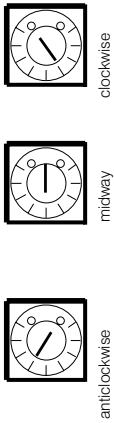
**PUSHBUTTONS AND SETPOINT CHECK.** BEFORE TURNING ON REMOVE THE RUN LINE CONNECTION TO TERMINAL 7, AND DISCONNECT THE ARMATURE LEADS. MAKE THE LEADS SAFE. Page 3 shows some typical applications, if the pushbutton terminals are left open then terminal 4 MAX remains at -10V. (basic connection). The START function causes the speed setpoint voltage to be entered via terminal 3 I/P. The JOG terminal 14 allows the START to be latched (diagram 2). This combination of features gives great versatility. if the FWD function is operated then the MAX output on terminal 4 switches to +10V, and -10V if REV. is operated. Monitor the resulting speed demand on terminal 3 to verify correct operation. REMOVE SUPPLY, RECONNECT ARMATURE LEADS, POWER ON.

**CLOSE RUN CONTACT.** Select FWD and gradually increase the setpoint whilst watching motor rotation, speed should be stable and should respond to the setpoint pot. (If direction is wrong REMOVE SUPPLY, swap A+ A-). Check timer lamp, if ON then increase MAX CURRENT. Progressively use MAX SPEED, S3, S4 to set final maximum armature voltage as desired. DURING THE ABOVE PROCEDURE TAKE CARE NOT TO EXCEED THE DRIVE AND MOTOR ARMATURE VOLTAGE AND CURRENT RATINGS. Reduce setpoint, drive should ramp down to zero. Adjust MIN SPEED to desired level. Run the motor up and down and adjust the forward RAMPS. Select REVERSE and set the REVERSE RAMPS in a similar fashion. For systems using tach feedback, now is the time to measure the full scale tach voltage and determine the polarity. The wire that goes to T9 must be negative when the speed demand into T3 is positive. Having confirmed the machine speed, reset S3, S4, MAX SPEED, to approx. match the full scale tach output. making sure the drive SUPPLY is off first. Now re-connect T9, and fine adjust MAX SPEED. The MAX CURRENT presets should now be increased to correspond to the motor armature current.

**STABILITY.** Adjust STAB to improve response if necessary. Clockwise rotation gives faster response. Excessive rotation in either direction may lead to instability depending on load.

**IR COMP.** Speed droop may occur where armature voltage feedback is used. This is compensated for by clockwise rotation of IR COMP. Too much may cause instability. Set IR COMP fully anticlockwise if tach feedback is used.

**TORQUE CONTROL.** The best strategy is to set up in speed mode first, to establish the correct operating limits. Then proceed to implement torque control with a signal into T6. See page 7 for torque control.



- 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 390R 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 armature voltage droop compensation. Excessive rotation may cause instability.
- Rotate clockwise to increase current limit, use S1 and S2 to select range, 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 and terminal 2 is input, 5 is return.
- MIN SPEED** set to give 250 Ohms between T2 and T5.

**SUPPLY SELECT**  
This jumper selects the appropriate supply tap on the control transformer. Refer to specification for tolerances.  
CHECK model type

HIGH	LOW
415	240
OR	240
OR	110
	60
2 POSITION SUPPLY SELECTION JUMPER	

ON condition positive current demand  
negative current demand  
stall timer tripped  
stall timer ticking and tripped

LAMPS  
+  
-  
STALL  
TIMER

	<b>MAX SPEED</b>
	<b>MIN SPEED</b>
	<b>FORWARD UP RAMP</b>
	<b>DOWN RAMP</b>
	<b>REVERSE UP RAMP</b>
	<b>DOWN RAMP</b>
	<b>STAB</b>
	<b>IR COMP</b>

These two switches allow four maximum current ranges to be selected. 100% represents the maximum unit rating. The MAX CURRENT PRESET can be used to adjust from 0% to the selected maximum percentage

0-25%	S1 on	S1 off	S1 on
0-50%	S2 on	S2 off	S2 on

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

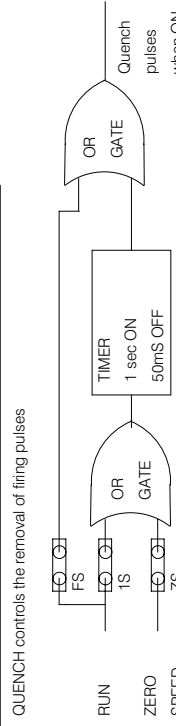
25-50V	S3 on	S3 off	S3 on
50-100V	S4 on	S4 off	S4 on
100-200V	S5 on	S5 off	S5 on
200-400V	S6 on	S6 off	S6 on

S5, 6 and 7 allow the function of the relay on 10, 11, 12 to be selected. The relay driver outputs also appear on T52 (stall), T53 (zero), T59 (reverse) and T60 (timer).

If more than one function is selected, the functions are AND'ED see page 2 for table of relay functions including AND'ED functions

S5 when on the relay remains energised until a stall condition occurs  
 S6 when on the relay remains energised until the speed falls below 1%  
 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.

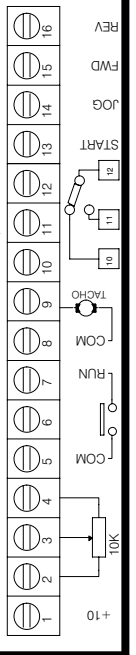
MANUFACTURE INFORMATION  
MAX RATING 100% AMPS



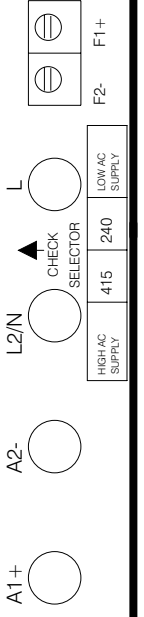
Stall lamp lights and drive quenches if the stall timer trips. The time depends on the current demand.

STANDARD	WITH 50% THRESHOLD
150%	150%
125%	100%
115%	75%
100%	50%
30 secs	30 seconds
60 secs	60 seconds
120 secs	60 seconds
no trip	no trip

Link to implement 50% STALL THRESHOLD



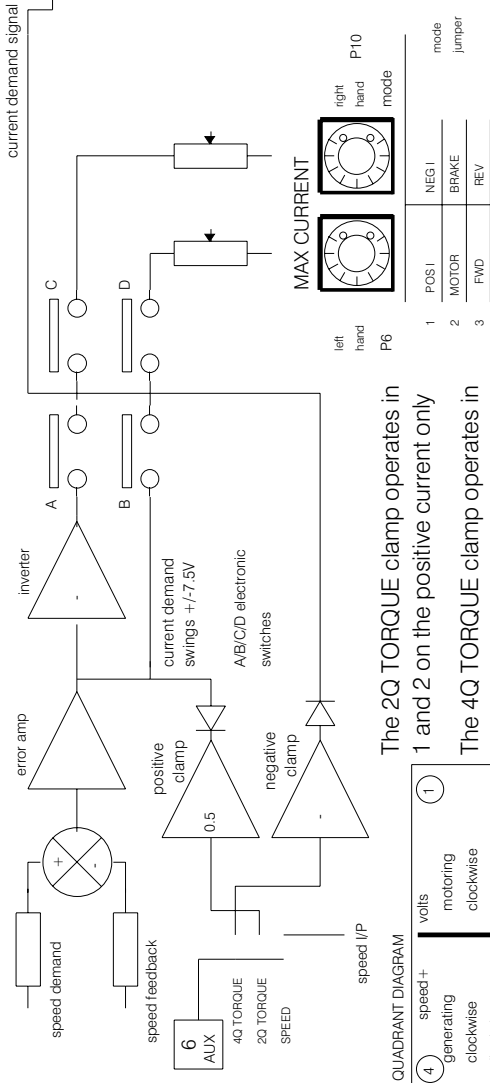
**IMPORTANT. ENSURE AC SUPPLY SELECTOR IS CORRECTLY POSITIONED PRIOR TO APPLYING POWER TO THE UNIT.**



SEE LABEL ON SIDE OF TRANSFORMER FOR MODEL TYPE.

**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.

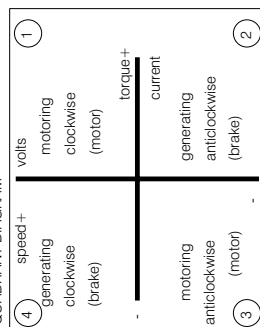
**TORQUE/SPEED JUMPER.** This is a 3 position jumper which controls the function of terminal 6 (AUX). A schematic is shown below



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

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

The 4Q TORQUE mode can be used for load sharing by inputting the modulus current signal from SP69 on a master drive.

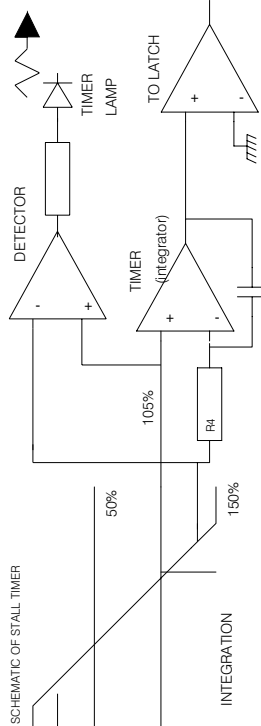


**MAX CURRENT MODE.** The electronic switches C and D select which MAX CURRENT limit preset is enabled according to the position of the current MODE jumper. By referring to the quadrant diagram the physical effect can be seen.

- 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 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 P10 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 the opposite 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 whilst 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%.



The time taken to integrate a 150% level is approximately 30 seconds, 125% 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, then the integrator starts to integrate back down again. This feature provides a historical store of the behaviour of the current demand. If the timer has come close to tripping then the demand falls below 105%, it will need to spend at least 30 seconds at 50% to reset the integrator. 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**

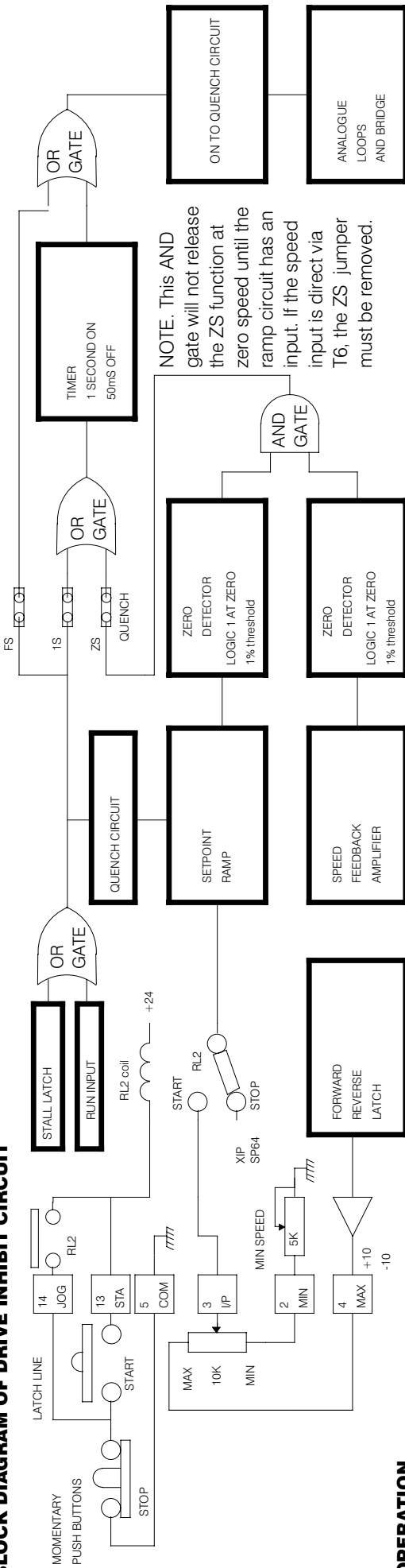
This function allows high peak currents. A link is provided to change the level at which integration starts to 52.5%. The advantage of this feature is it allows the 150% current to be achieved, but provides protection above 50%. The stall time is reduced by half. When using this feature it is important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

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

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%



**BLOCK DIAGRAM OF DRIVE INHIBIT CIRCUIT**



**NOTE.** This AND gate 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 removed.

**OPERATION**

Possible inhibit request sources. 1) Stall timer is latched. 2) External run line is opened. 3) Zero speed is attained. 4) a combination of these. 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. STALL and RUN quench requests may be routed directly or via a timer which takes 1 second to react but is released in 50ms. The purpose of the 1 second timer is to prevent ZERO SPEED (ZS) quenching from being a nuisance during shaft reversals, and to allow 1 second of regenerative braking to occur after the setpoint ramp has been reset by a stall or run command. When the RUN line operation must be rapid, use the FS (fast) jumper.

*(WARNING. RUN is an electronic inhibit function. The field remains energised, and all power terminals remain 'live'. RUN must not be relied upon during hazardous operations)*

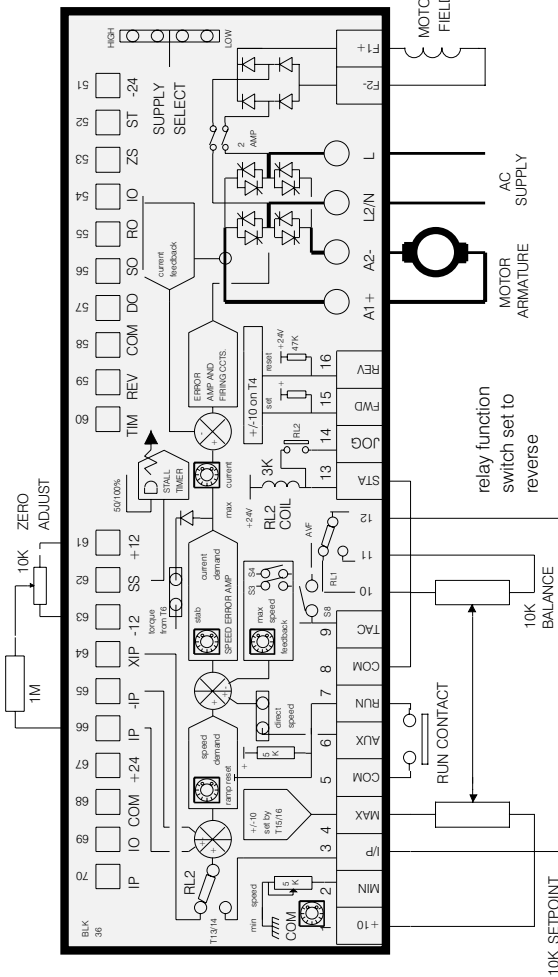
**TABLE OF OPERATING MODES**

JUMPERS	QUENCH CONDITION	thick line SPEED thin line RAMP
FS <input type="checkbox"/> <input type="checkbox"/>	the speed ramp will be quenched by stall or run. The drive will be quenched after 1 sec. OR 1 sec. after zero	decel. under current limit RUN OPENED total quench coasting
1S <input type="checkbox"/> <input type="checkbox"/>	the speed ramp will be quenched by stall or run. The drive will be quenched after 1 sec. ZS function disabled.	decel. under current limit RUN OPENED total quench coasting
ZS <input type="checkbox"/> <input type="checkbox"/>	the speed ramp will be quenched by stall or run. The drive will remain active.	decel. under current limit RUN OPENED total quench coasting
QUENCH <input type="checkbox"/> <input type="checkbox"/>	the speed ramp will be quenched by stall or run. The drive quench occurs 1 sec. after speed remains zero	decel. under current limit RUN OPENED total quench coasting

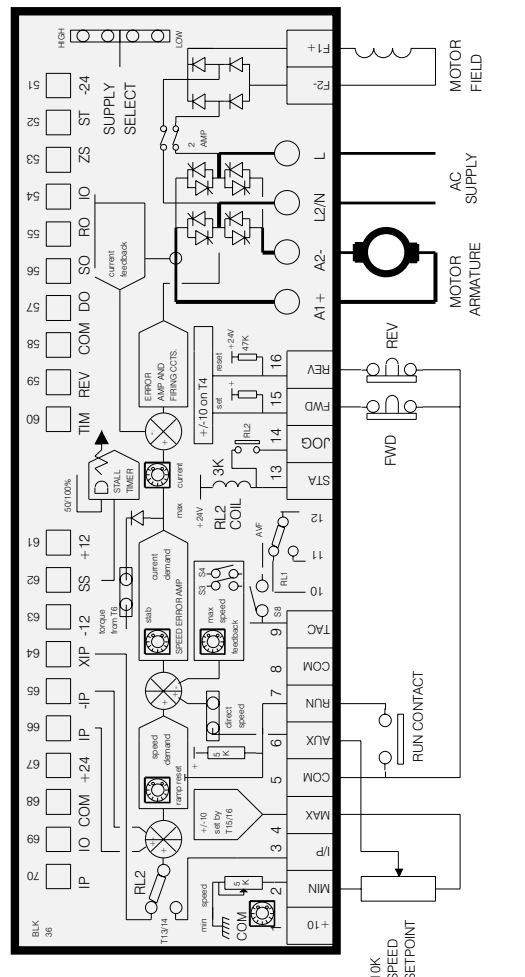
<b>PROBLEM</b>	<b>LIKELY CAUSES</b>	<b>REMEDY</b>
<p>Drive will not power up no ON indication</p> <p>Fuses blow on power up</p> <p>Fuses blow during running</p>	<p>line fuses blown</p> <p>F1, F2 fuses blown damaged transformer</p> <p>short cct. load damaged unit</p> <p>Excessive armature voltage due to incorrect speed scaling</p>	<p>POWER OFF, check circuits replace fuses with correct type (see rating table page 1) check field wiring check supply select jumper</p> <p>check load circuit replace unit</p> <p>Reduce armature voltage. check speed scaling is correct</p>
<p>Motor accelerates out of control with small setpoint and tacho feedback</p> <p>Motor runs too fast or too slow</p>	<p>tacho polarity incorrect</p> <p>tacho linkage</p> <p>tacho faulty</p> <p>incorrect speed scaling (S3, S4 MAX SPEED)</p>	<p>swap terminal 8 and 9</p> <p>check tacho coupling to motor</p> <p>replace, in emergency change to AVF (S8) and rescale feedback voltage (S3, S4). Remove tacho connection from terminal</p> <p>refer to set up procedure</p>
<p>Stall lamp ON</p>	<p>insufficient torque timer lamp shows that stall timer is integrating</p> <p>no field, motor jammed</p> <p>no armature current</p>	<p>re-check current settings (S1, S2 MAX CURRENT) is motor powerful enough.</p> <p>check ccts. and motor</p> <p>check armature circuit</p>
<p>Motor still won't turn</p> <p>Motor rotates in wrong direction</p>	<p>no run circuit no setpoint</p> <p>transposed armature connections</p>	<p>check run circuit T7 to T5 check external setpoint T3 check operation of FWD REV pushbuttons. swap armature connections</p>
<p>Motor growls</p>	<p>unstable drive</p> <p>armature voltage rating of motor too low for AC supply</p>	<p>rotate STAB anticlockwise</p> <p>rotate stab anticlockwise</p> <p>insert choke in series with armature new motor or supply</p>
<p>Motor response</p> <p>1) large overshoots</p> <p>2) speed related stability</p>	<p>high inertia low friction loads.</p> <p>tacho couplings elastic misaligned tacho eccentric load</p>	<p>rotate STAB pot clockwise</p> <p>reduce ramp rates</p> <p>current set too high</p> <p>improve tacho coupling</p> <p>re-align balance load</p>

FUNCTION	SPECIFICATION						COMMENTS
CONTROL ACTION FEEDBACK METHOD 0-100% REGULATION MAX TORQUE SPEED RANGE OVERLOAD	DUAL LOOP PROPORTIONAL + INTEGRAL ARMATURE VOLTS                      TACHOMETER 2% TYPICAL                              0.1% TYPICAL 20 : 1    100 : 1 150% CONTINUOUS CURRENT FOR 30s						SWITCH SELECT  BEWARE MOTOR HEAT AT LOW SPEED
<u>CUSTOMER PRESETS</u> MAX SPEED MIN SPEED FORWARD RAMPS REVERSE RAMPS STABILITY IR COMPENSATION MAX CURRENT	25 VOLTS TO 400 VOLTS FEEDBACK 0-50% OF MAX SPEED INDEPENDANT UP AND DOWN, 1 TO 30s INDEPENDANT UP AND DOWN, 1 TO 30s VARIES SPEED LOOP GAIN 0-30% OF ARMATURE VOLTAGE 0-25%, 0-50%, 0-75%, 0-100% SEPERATE MAX CURRENT PRESETS FOR CONTROL OF POSITIVE AND NEGATIVE I						SWITCH SELECT NON-INTERACTIVE  LINEAR RAMPS  SWITCH SELECT 3 MODES OF OPERATION
<u>SWITCH SELECTABLE</u> CURRENT RANGE SPEED RANGE RELAY FUNCTION TACHO/AVF	FOUR RANGES OF CURRENT RANGE FOUR RANGES OF FEEDBACK VOLTAGE DRIVE STALL, ZERO SPEED, REVERSE SELECT TACHO OR AV. FEEDBACK						S1, S2  S3, S4  S5, S6 S7  S8
<u>JUMPER FUNCTIONS</u> SPEED/TORQUE 4-20mA LOOP 50% STALL LEVEL CURRENT MODE QUENCH SUPPLY SELECT	SETS OPERATING MODE OF TERMINAL 6 ALLOWS 4-20mA LOOP SIGNAL INPUT ALLOWS LARGE PEAK CURRENTS SETS FUNCTION OF CURRENT LIMITS SETS MODE OF DRIVE QUENCH DUAL SUPPLY VOLTAGE SELECTOR						3 MODES 5V COMPLIANCE 150% PEAK 3 MODES 3 MODES
SUPPLY RANGES 45HZ TO 65HZ AUTO RANGING		LV30 MAX 36V MIN 27V	LV60 72V 54V	110 130V 100V	240 264V 200V	415 440V 360V	OVER FULL TEMP RANGE WITH OUTPUTS LOADED
AC POWER UP RESET	MINIMUM OFF TIME BEFORE RE-SUPPLY 500mS						
SIGNAL OUTPUTS RELAY OUTPUTS RAIL OUTPUTS	SPEED, CURRENT, RAMP, DEMAND STALL, ZERO SPEED, REVERSE, TIMER +24V, -24V UNREGULATED                      25mA +12, +/-10, -12 REGULATED                      10mA						ALL BUFFERED O/C PNP +/- 20% 0.01%/DEG C                      5%
FIELD OUTPUT UNIT DISSIPATION (Dw) ALTITUDE DERATING HUMIDITY FORM FACTOR MAX I <sup>2</sup> t FUSING	0.9 TIMES AC SUPPLY                      2 AMPS MAX HALF WAVE OPTION 0.4 TIMES AC SUPPLY Dw (Watts) = 3 X Arm Amps (approximately) 3000 METRES MAX FOR FULL RATING 2.5% PER DEG C ABOVE 40 DEG C 85% R.H AT 40 C, NON-CONDENSING TYPICAL 1.5 AT MAX. OUTPUT 510 UP TO 16A, 5000 32/36A MODELS see page 1						DC VOLTS  DERATE 1%/100M ABOVE 3000M  CONTACT SUPPLIER

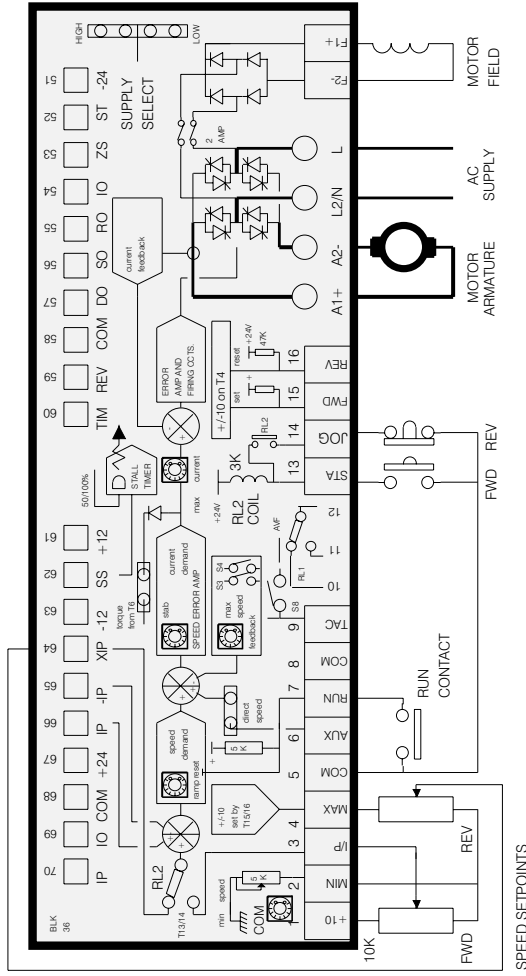
1) FORWARD AND REVERSE ON SETPOINT POT. WITH CENTRE ZERO. BALANCE POT TO GIVE +/-10% SPEED SCALING FOR FORWARD REVERSE. ZERO POT TO GIVE ACCURATE SETTING OF ZERO OFFSET.



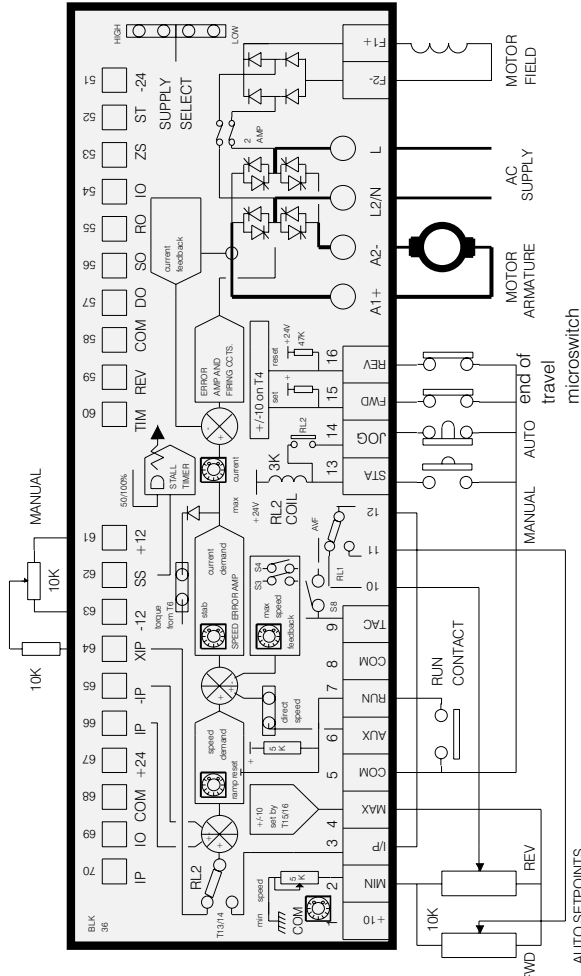
3) FORWARD, REVERSE BY PUSHBUTTON, DIRECTION IS MEMORISED DURING STOP SEQUENCE. SETPOINT BYPASSES THE RAMP FOR FAST RESPONSE. Remove the ZS jumper



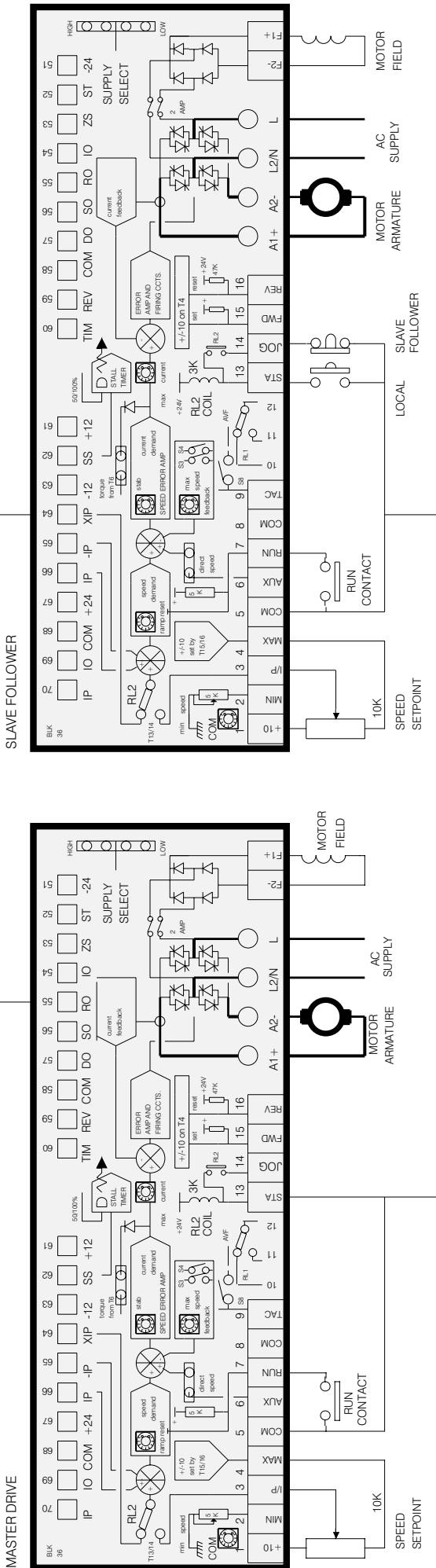
2) INDEPENDANT SETPOINTS FOR FORWARD AND REVERSE WITH THE SAME MINIMUM SPEED. THE SETPOINTS ARE SELECTED BY PUSHBUTTON AND THE DRIVE WILL RAMP BETWEEN THE SELECTED SPEEDS



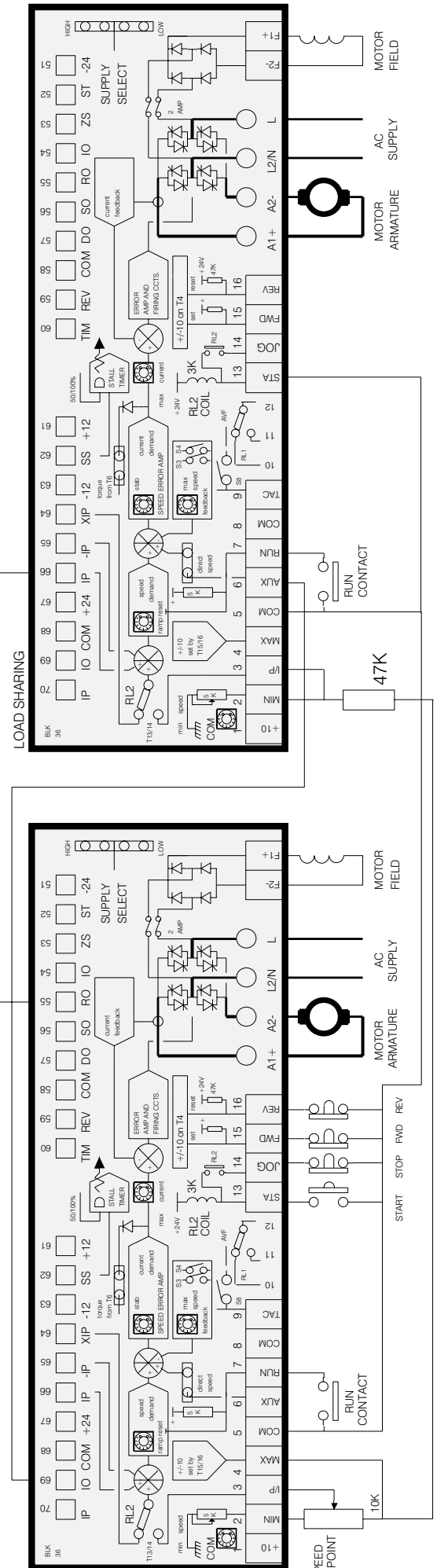
4) INDEPENDANT FORWARD AND REVERSE SPEEDS WITH AUTOMATIC END OF TRAVEL REVERSAL, AND PUSHBUTTON SELECTION OF CENTRE ZERO MANUAL SPEED. RELAY FUNCTION SWITCH SET TO REVERSE.



1) FORWARD AND REVERSE ON SETPOINT POT, WITH CENTRE ZERO. SLAVE DRIVE FOLLOWS MASTER. A LOCAL SETPOINT POT CAN BE SELECTED BY PUSHBUTTONS.



2) FORWARD, REVERSE BY PUSHBUTTON, DIRECTION IS MEMORISED DURING STOP. THE SLAVE DRIVE SPEED REFERENCE HAS A 10% ADDITION (1V VIA T3), THEN PUT IN TO 4Q TORQUE MODE, USING THE MODULUS CURRENT OUTPUT FROM THE MASTER AS A TORQUE DEMAND INPUT.



**SPRINT/Electric** 3600XRi 1) SPEED FOLLOWING SCHEME. controller 2) LOAD SHARING SCHEME

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



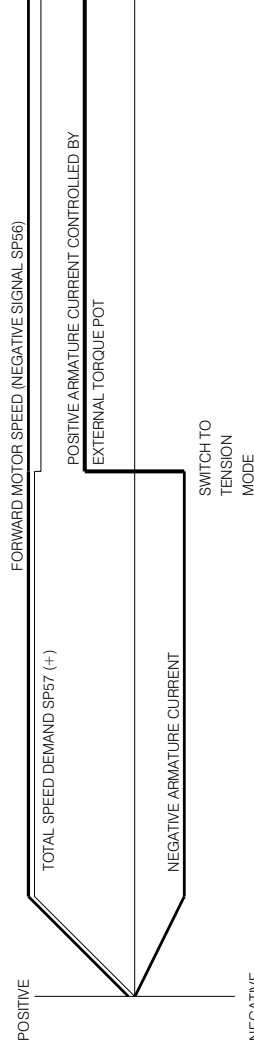
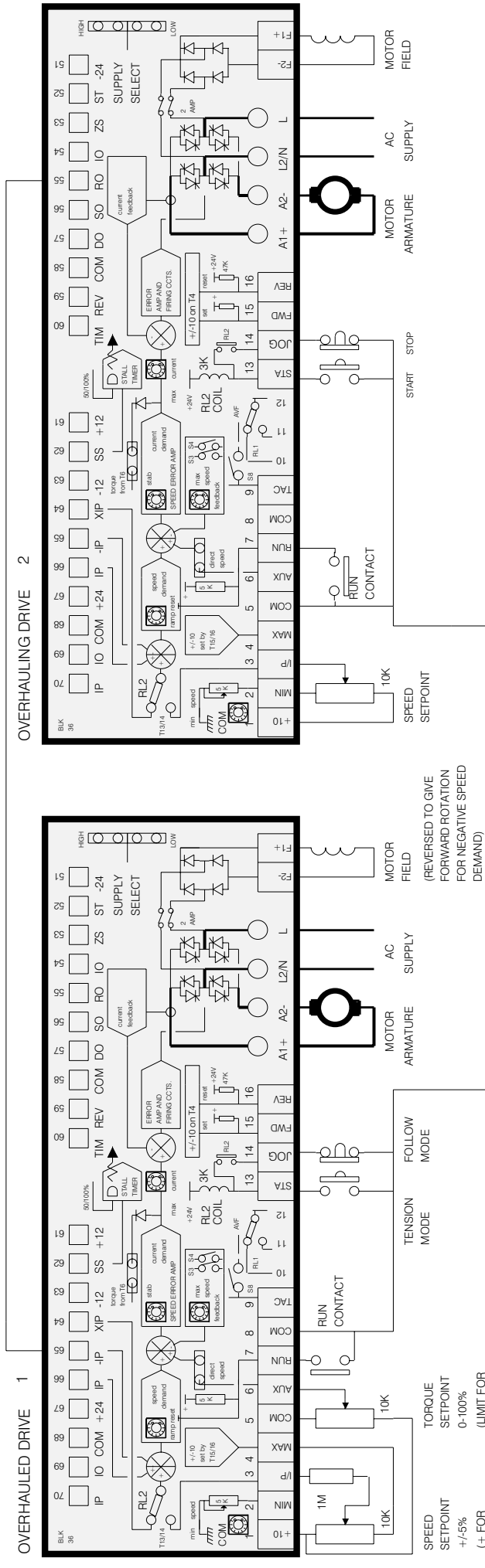
THE NIP ROLLS ARE DRIVEN BY DRIVE 2 IN STANDARD SPEED MODE. THE SETPOINT RAMP OUTPUT IS TAKEN TO DRIVE 1.

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.



POSITIVE

NEGATIVE

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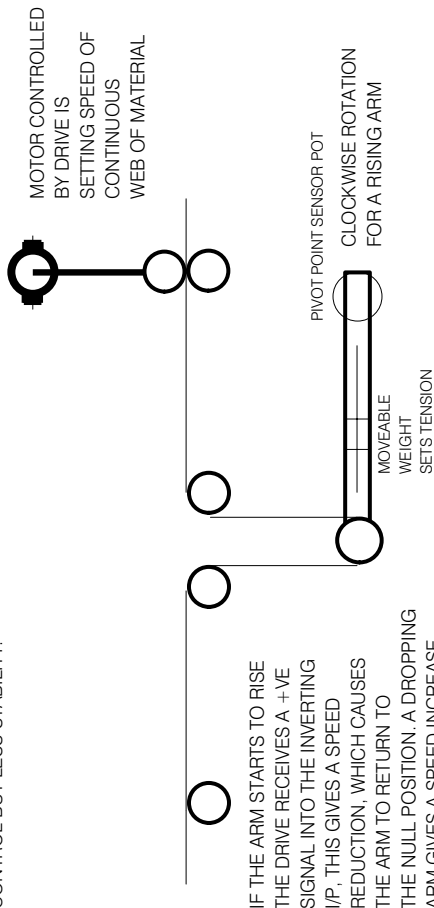


**3600XRi controller. Overhauling Follower application.**

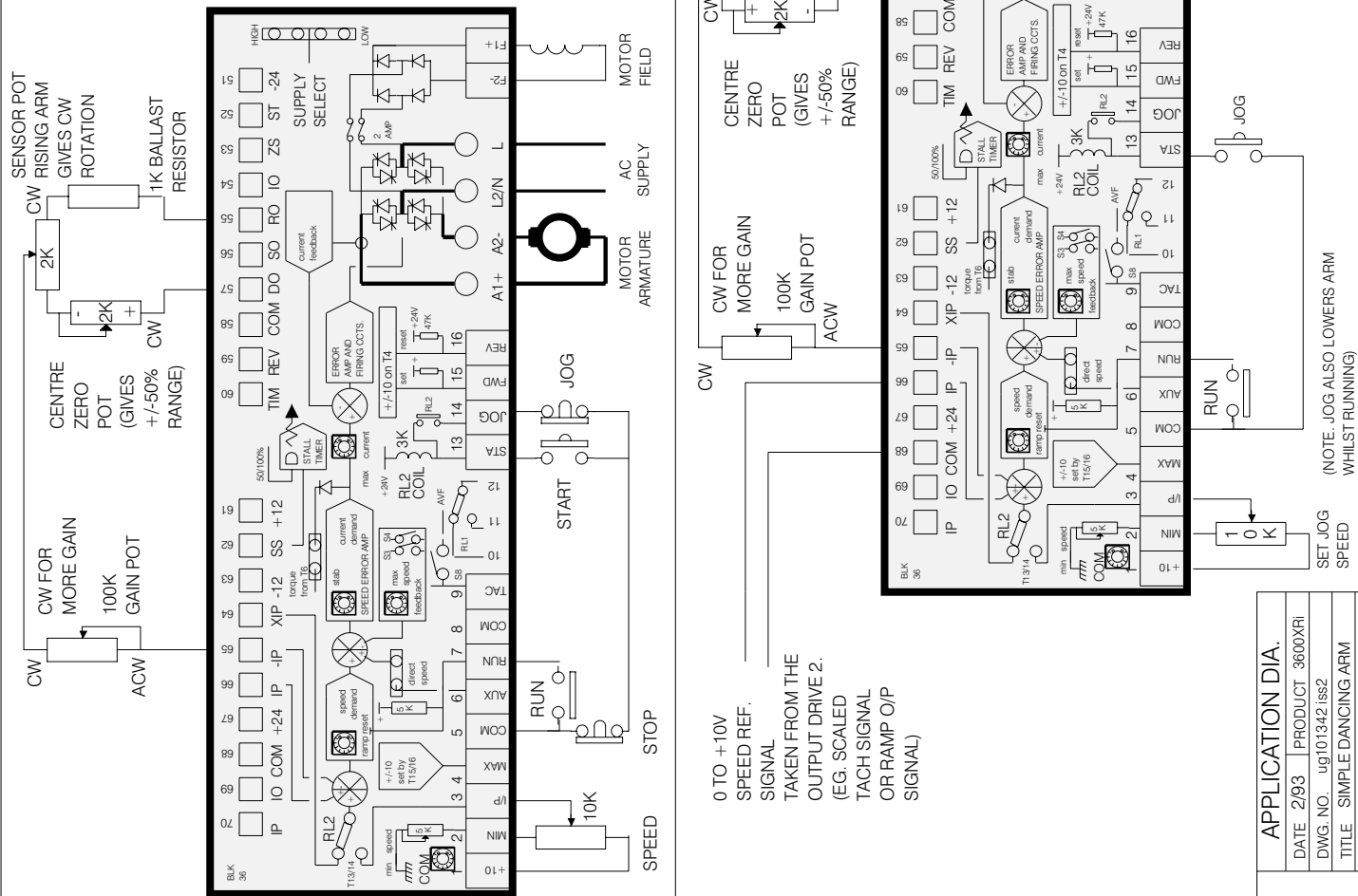
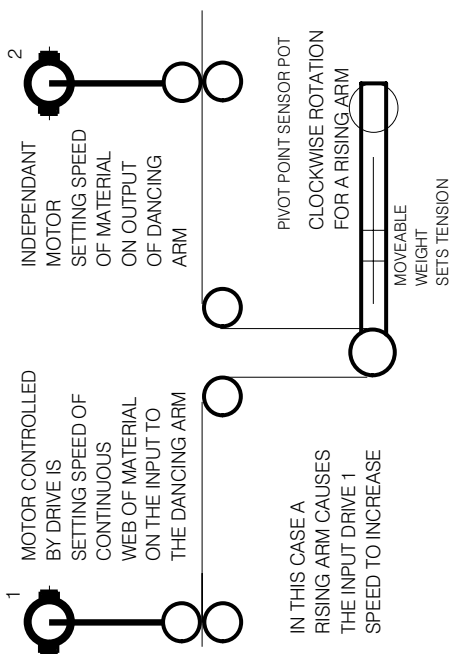


UG100794 IBS 1

**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.



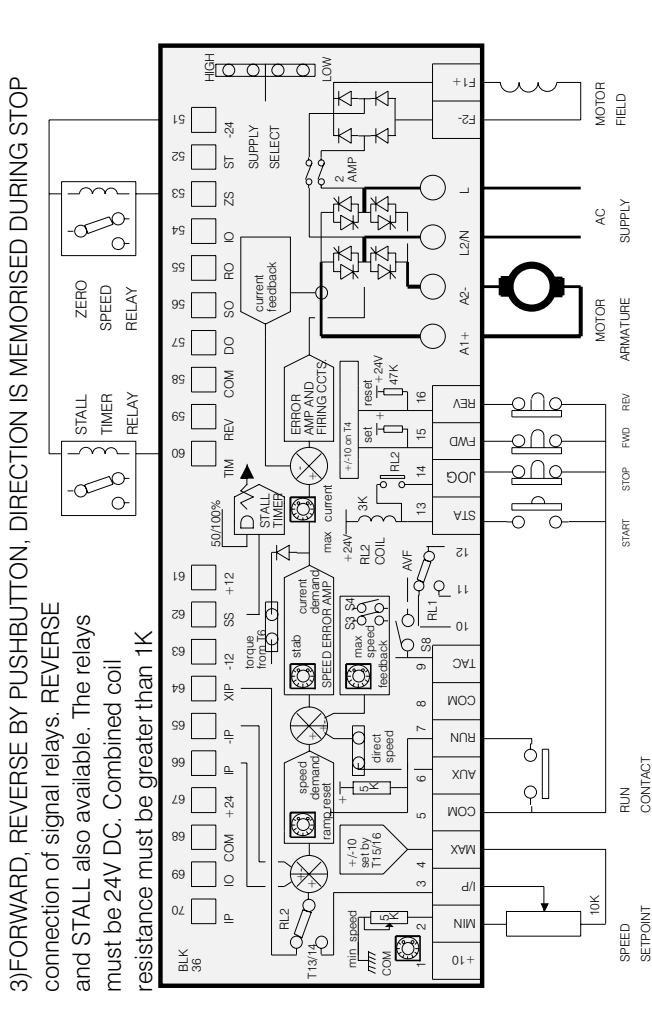
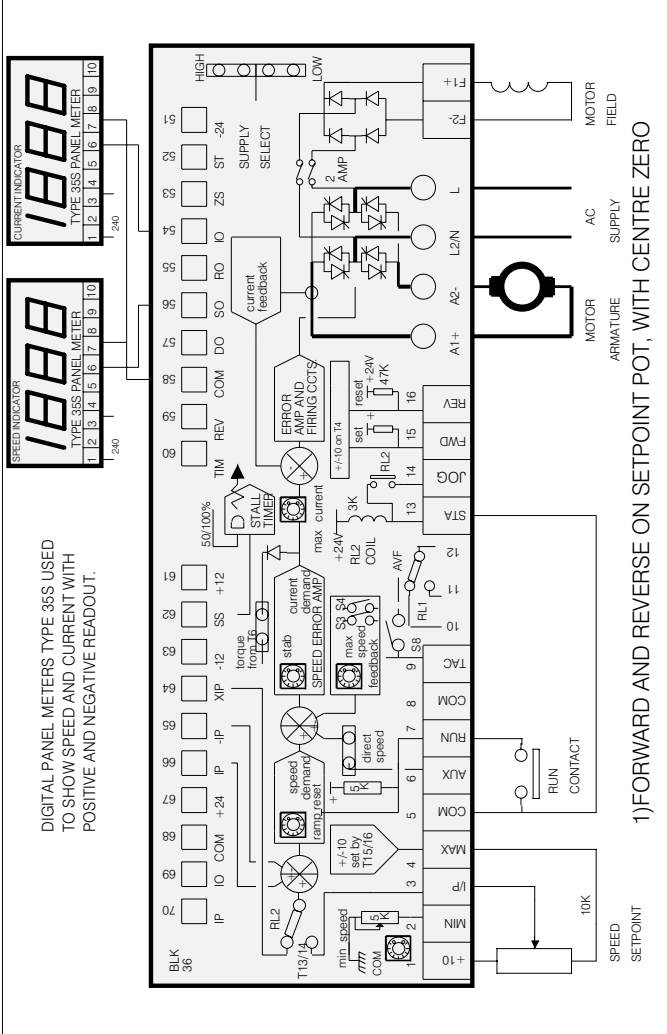
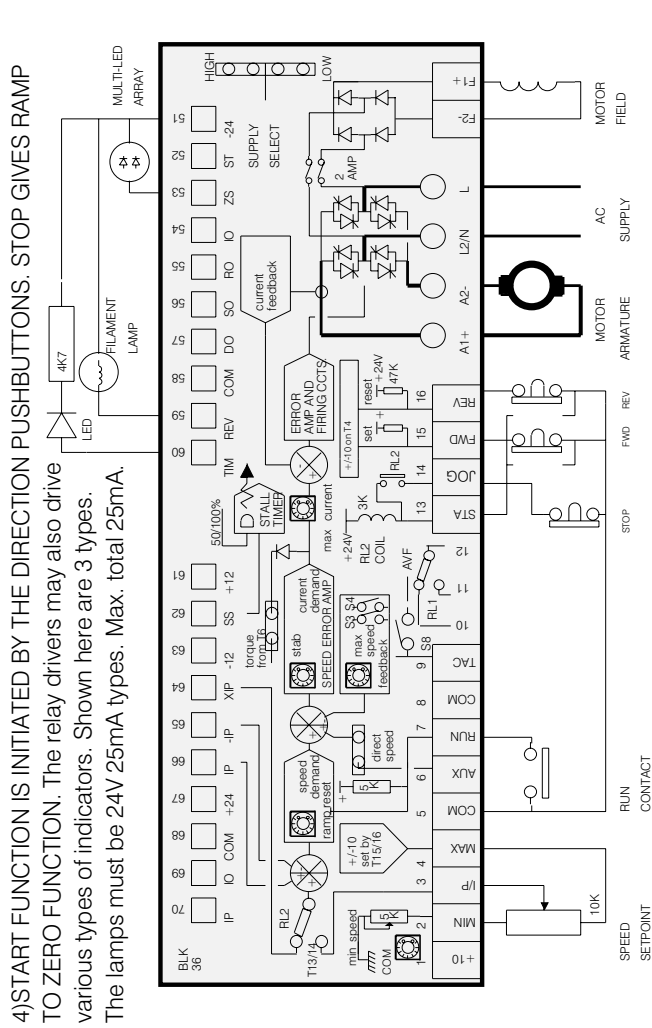
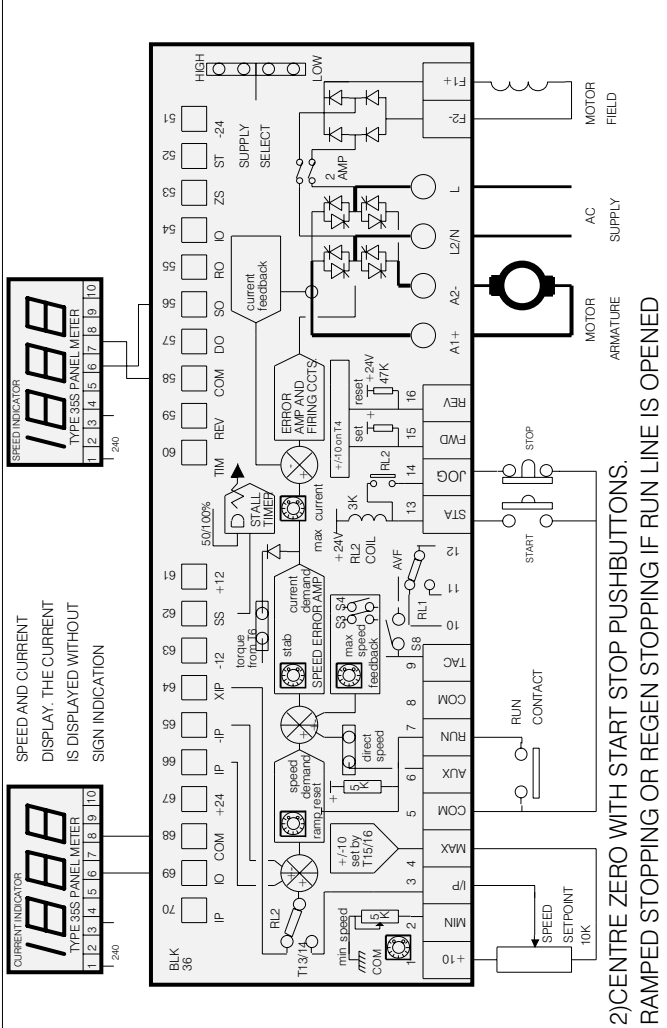
**APPLICATION WHERE DANCING ARM POSITION IS CONTROLLED BY INPUT SPEED CHANGE.**



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DATE	2/93
PRODUCT	3600XRI
DWG. NO.	ug101342 Iss2
TITLE	SIMPLE DANCING ARM
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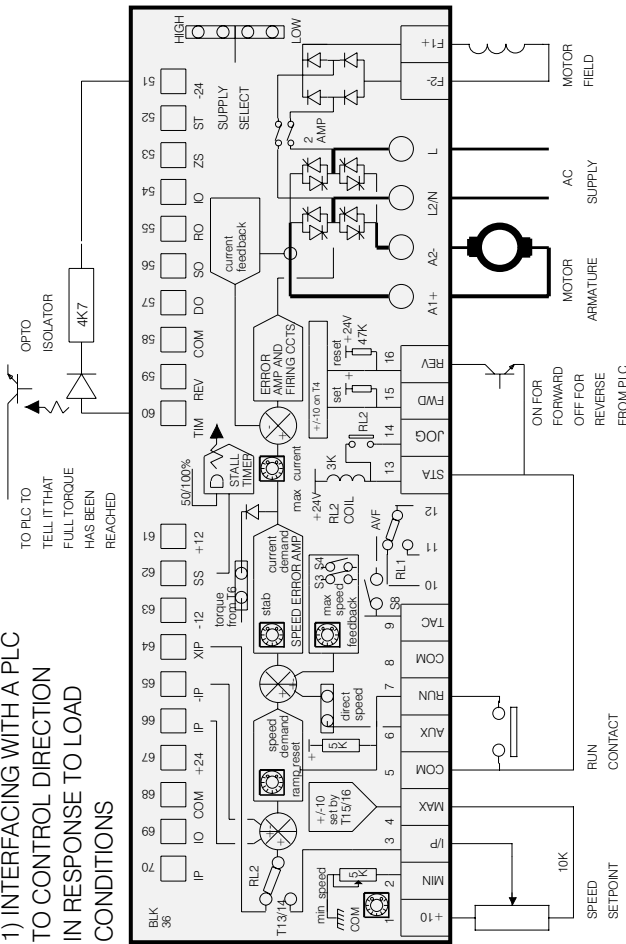
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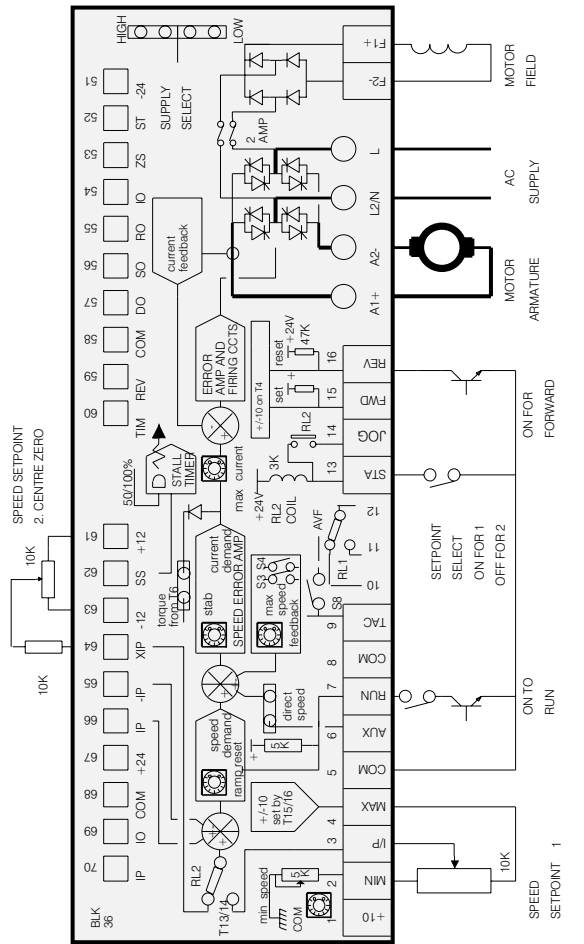
**4 BASIC WIRING CONFIGURATIONS FOR THE 3600XRI REGENERATIVE CONTROLLER**



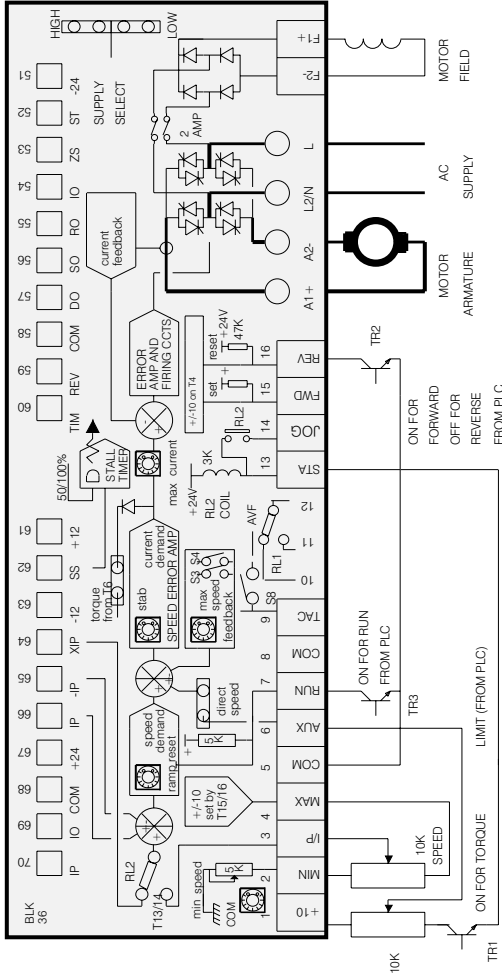
1) INTERFACING WITH A PLC TO CONTROL DIRECTION IN RESPONSE TO LOAD CONDITIONS



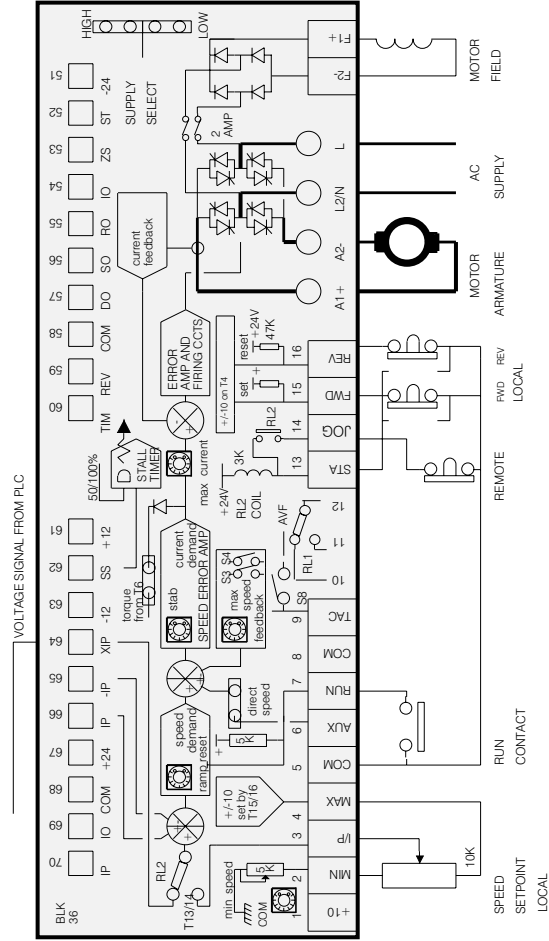
3) PLC CONTROL OF DIRECTION VIA SETPOINT 1. A SWITCH SELECTS SETPOINT 2 THE DRIVE CAN BE STOPPED BY THE PLC OR A SWITCH.



2) CONTROL VIA OPEN COLLECTOR PLC OUTPUTS. The 4Q TORQUE mode is selected to allow the torque limit to be turned on by TR1. The direction is controlled by TR2. Stop and start is controlled by TR3



4) THE DRIVE RECEIVES ITS SPEED SETPOINT FROM A REMOTE SOURCE EG. PLC. LOCAL OPERATION IS AUTOMATICALLY SELECTED BY THE FWD REV PUSHBUTTONS. A PUSHBUTTON SELECTS THE REMOTE SIGNAL

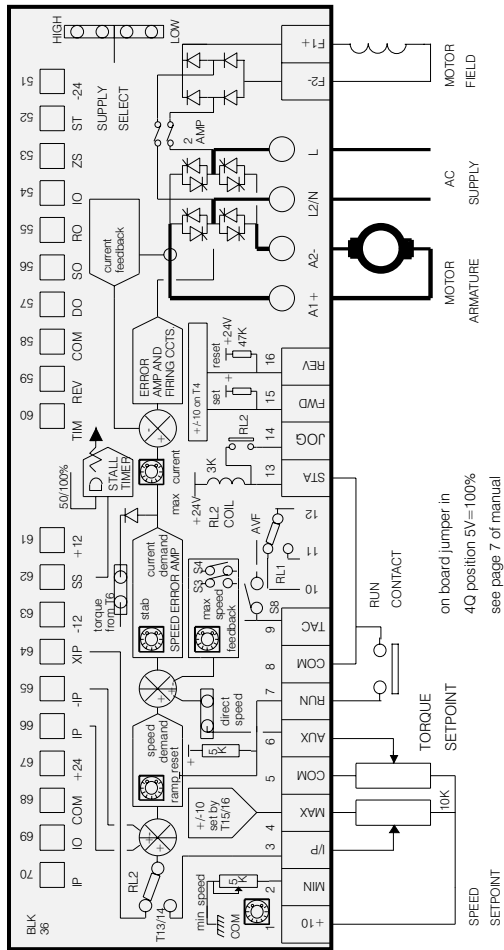


**SPRINT/Electric** BASIC WIRING CONFIGURATIONS FOR THE 3600XRi REGENERATIVE CONTROLLER

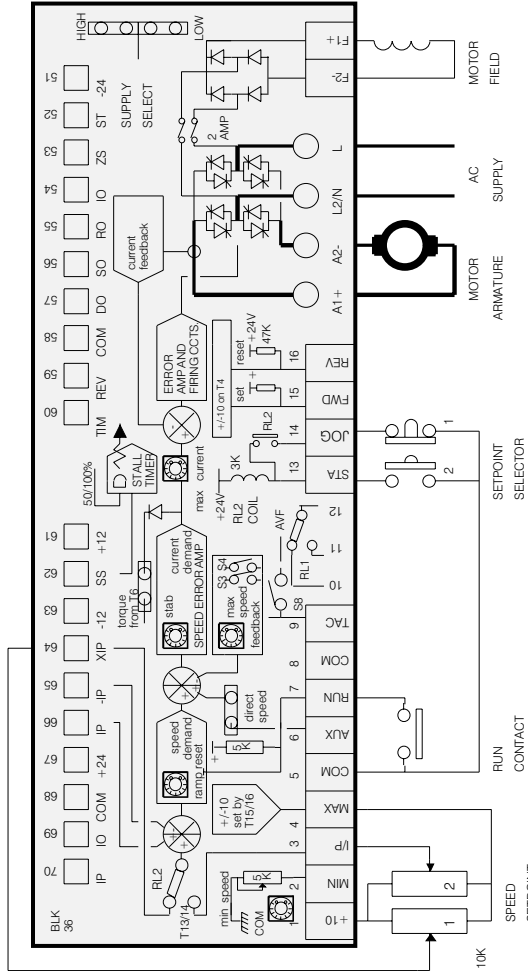
SPRINT Electric 1984  
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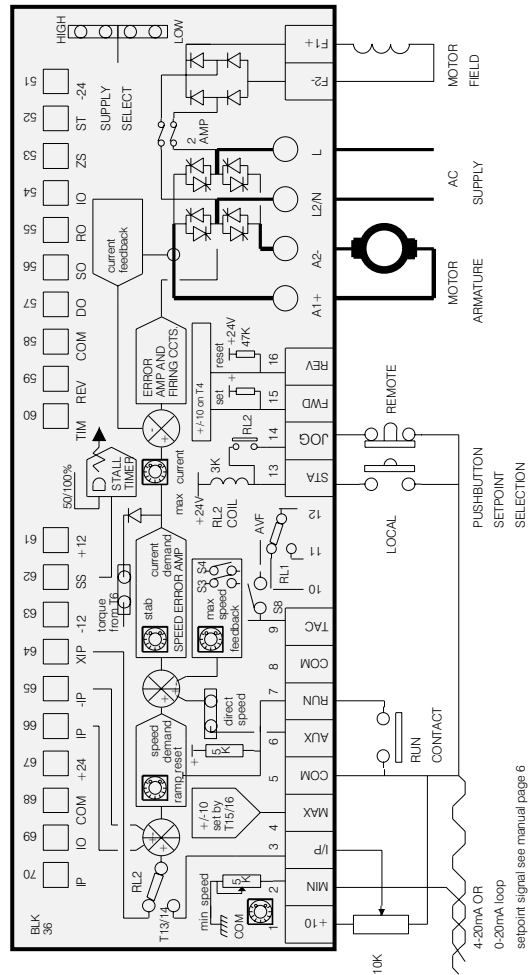
1) FORWARD AND REVERSE ON SETPOINT POT, WITH CENTRE ZERO. EXTERNAL TORQUE CONTROL INPUT. NOTE. THE LOWER SETPOINT HAS PRIORITY. To run in torque limit the speed demand must be sufficient and vice versa.



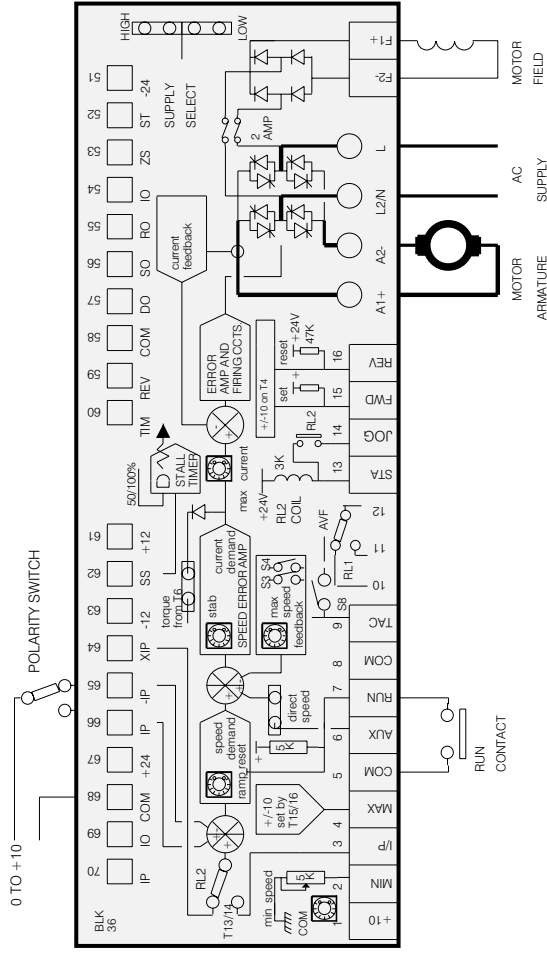
2) DUAL SETPOINT POTS.. SELECTED BY PUSHBUTTONS. BOTH CENTRE ZERO. OPENING RUN LINE GIVES RAPID STOPPING.



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.



**4 BASIC WIRING CONFIGURATIONS FOR THE 3600XRI REGENERATIVE CONTROLLER**



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Special consideration must be given to installations in member states of the European Union regarding noise suppression and immunity. According to IEC1800-3 (EN61800-3) the drive units are classified as complex components only for professional assemblers, with no CE marking for EMC. The drive manufacturer is responsible for the provision of installation guidelines. The resulting EMC behaviour is the responsibility of the manufacturer of the system or installation. The units are subject to the LOW VOLTAGE DIRECTIVE 73/23/EEC and are CE marked accordingly.



Following the procedures outlined below will normally be required for the drive system to comply with the European regulations, some systems may require different measures. Installers must have a level of technical competence to correctly install. Although the drive unit itself is not subject to the EMC directive, considerable development work has been undertaken to ensure that the noise emissions and immunity are optimised.

\* EN61800-3 specifies 2 alternative operating environments. These are the domestic (1st environment) and industrial (2nd environment). There are no limits specified for conducted or radiated emissions in the industrial environment, hence it is usual for the filter to be omitted in industrial systems.

Definition of an industrial environment. All establishments other than those directly connected to a low-voltage power supply network which supplies buildings used for domestic purposes.

**DRIVE INSTALLATION REQUIREMENTS FOR EMC COMPLIANCE**

Keep parallel runs of power and control cables at least 0.3m apart. Crossovers must be at right angles

Keep sensitive components at least 0.3m from the drive and power supply cables

The AC connections from the filter to the drive must be less than 0.3m or if longer correctly screened

Do not run filtered and unfiltered AC supply cables together

Control signals must be filtered or suppressed eg control relay coils and current carrying contacts. The drive module has built in filters on signal outputs

The AC supply filter must have a good earth connection to the enclosure back plane. Take care with painted metal to ensure good conductivity.

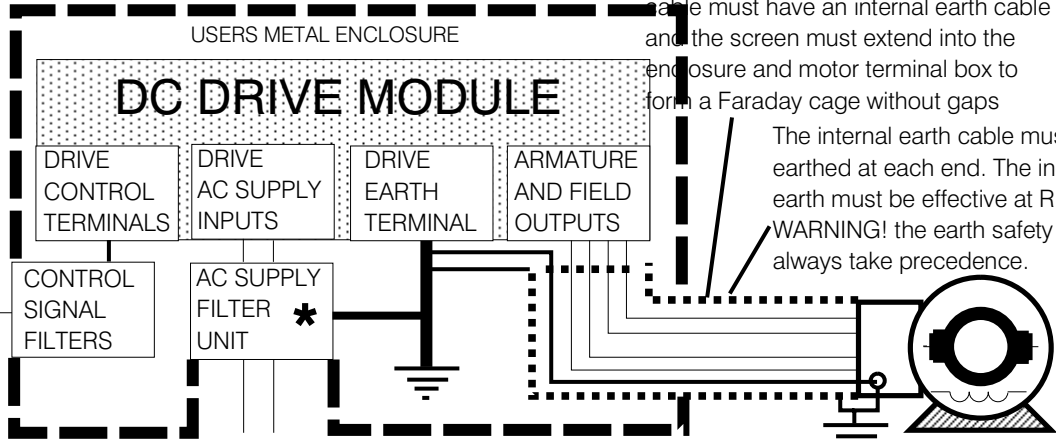
The AC input filter has earth leakage currents. Earth RCD devices may need to be set at 5% of rated current

The metal enclosure will be the RF ground. The AC filter, drive earth and motor cable screen should connect directly to the metal of the cabinet for best performance

Linear control signal cables must be screened with the screen earthed at the drive end only. Minimise the length of screen stripped back and connect it to an analogue earth point

The motor cable must be screened or armoured with 360 degree screen terminations to earth at each end. The cable must have an internal earth cable and the screen must extend into the enclosure and motor terminal box to form a Faraday cage without gaps

The internal earth cable must be earthed at each end. The incoming earth must be effective at RF. **WARNING!** the earth safety must always take precedence.



**IMPORTANT SAFETY WARNINGS**



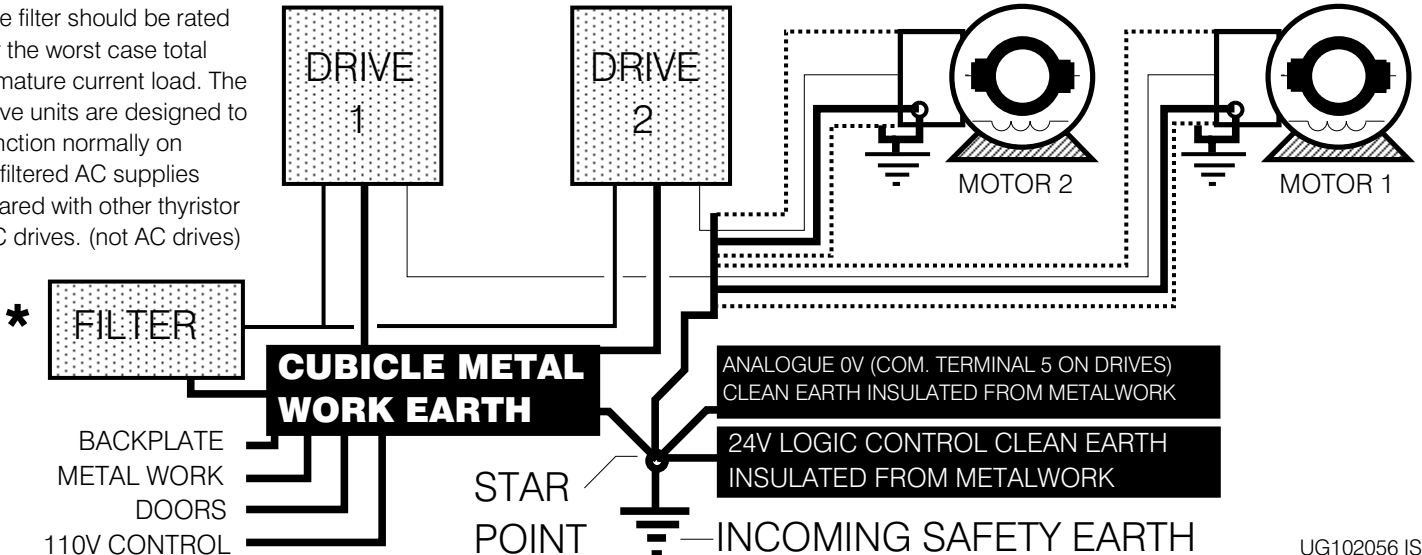
The AC supply filters must not be used on supplies that are un-balanced or float with respect to earth

The drive and AC filter must only be used with a permanent earth connection. No plugs/sockets are allowed in the AC supply

The AC supply filter contains high voltage capacitors and should not be touched for a period of 20 seconds after the removal of the AC supply

**MULTIPLE DRIVES WITH ONE FILTER AND EARTHING METHODS**

The filter should be rated for the worst case total armature current load. The drive units are designed to function normally on unfiltered AC supplies shared with other thyristor DC drives. (not AC drives)



ANALOGUE 0V (COM. TERMINAL 5 ON DRIVES)  
CLEAN EARTH INSULATED FROM METALWORK

24V LOGIC CONTROL CLEAN EARTH  
INSULATED FROM METALWORK

WORLD CLASS IN DESIGN



WORLD BEATING IN FUNCTION

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