3600XRi

SINGLE PHASE 4Q DC MOTOR CONTROLLER

invensys
EUROTHERM

ER101361 ISS4

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

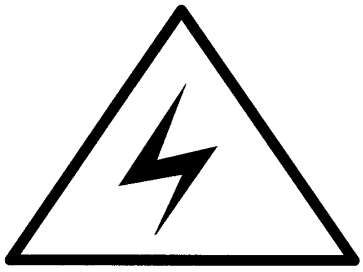
Always use qualified personnel to design, construct and operate your systems and keep SAFETY as your primary concern.

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



DANGER
ELECTRIC SHOCK RISK

CONTENTS

Introduction. Models 3600XRi

The user selects the appropriate model depending on the power requirements and/or the available supply voltage.

DRIVE TYPE 3600XRi	AC SUPPLY dual voltage	NOMINAL OUTPUT V	100% AMPS DC OUTPUT	ISOLATION	MAXIMUM I^2t FOR FUSING
ER-3600XRi/4/LN	240/110	180/90	4 AMPS	ISOLATED	510 A^2 secs
ER-3600XRi/8/LN	240/110	180/90	8 AMPS	ISOLATED	510 A^2 secs
ER-3600XRi/16/LN	240/110	180/90	16 AMPS	ISOLATED	510 A^2 secs
ER-3600XRi/16/LL	415/240	320/180	16 AMPS	ISOLATED	510 A^2 secs
ER-3600XRi/32/LL	415/240	320/180/(90 US)	32 AMPS	ISOLATED	5000 A^2 secs
ER-3600XRi/36/LL	415/240	320/180/(90 US)	36 AMPS	ISOLATED	5000 A^2 secs

All types are of open chassis construction with rear heat fin

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 thermally 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 etc. 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.

The drives are chassis components and must be mounted in a suitable enclosure with a fused supply. The fuses must be semiconductor types with a maximum amps squared seconds rating according to the above table. The fuse current rating must be at least 1.75 times the armature current. The voltage rating must be suitable for the AC supply. Failure to use the correct semiconductor fuse ratings will invalidate any warranty. Special consideration must be given to installations in member states of the EU. See section 3 page 8.

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.

SPEED and CURRENT range are selected by on board function switches and 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.

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	Imax+	Stability
Min speed	Fwd down ramp	Rev down ramp	Imax-	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
b) zero d) reverse speed

EXAMPLE c AND b = tacho loss. SP60-53
LINKED a AND b = show stall at zero.

JUMPER FUNCTIONS

4Q torque limit	Dual supply	Fast stop	Imax 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

PUSHBUTTON FUNCTIONS

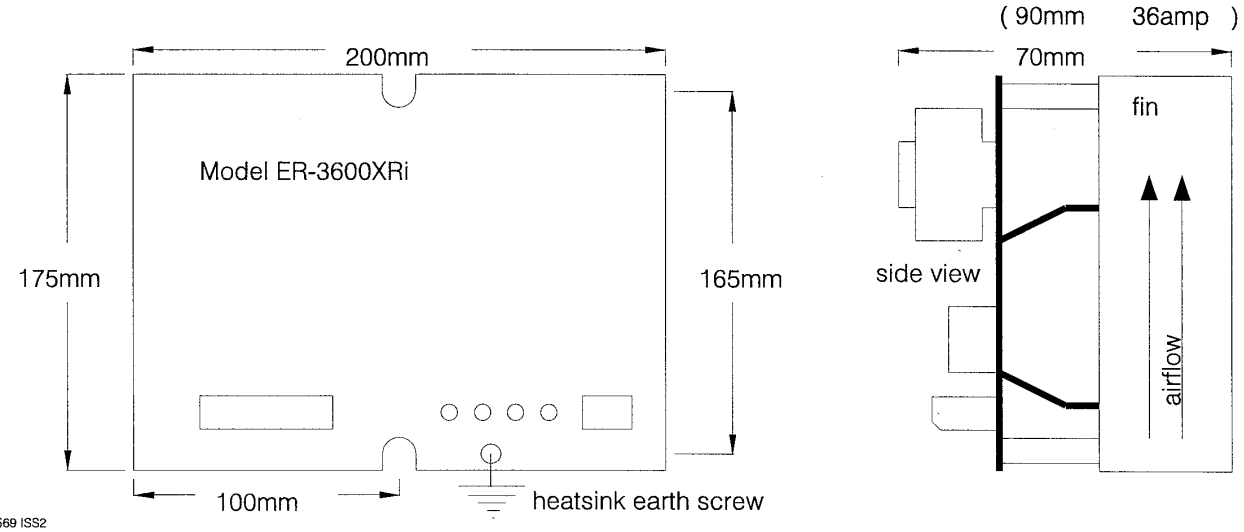
Forward Reverse Stop Start Jog

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.

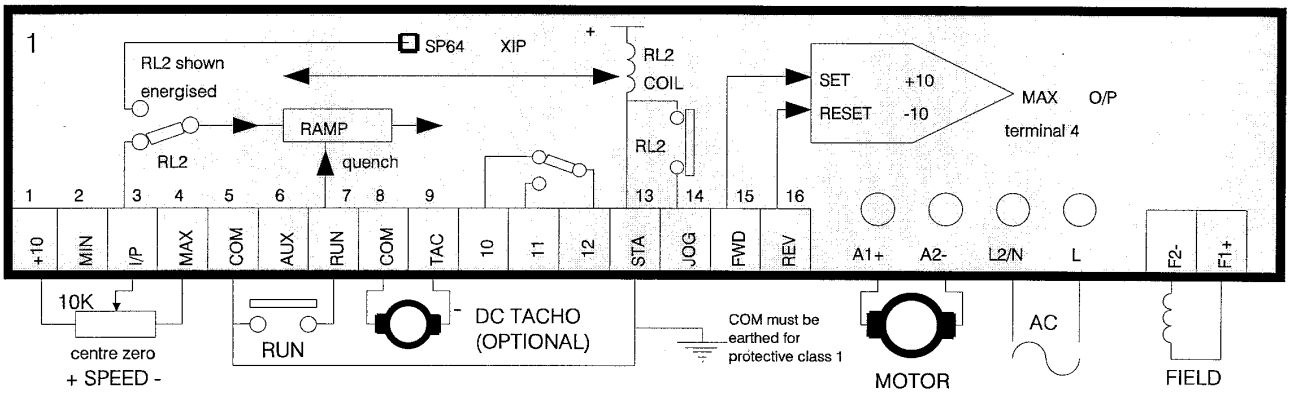
MECHANICAL DIMENSIONS

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.

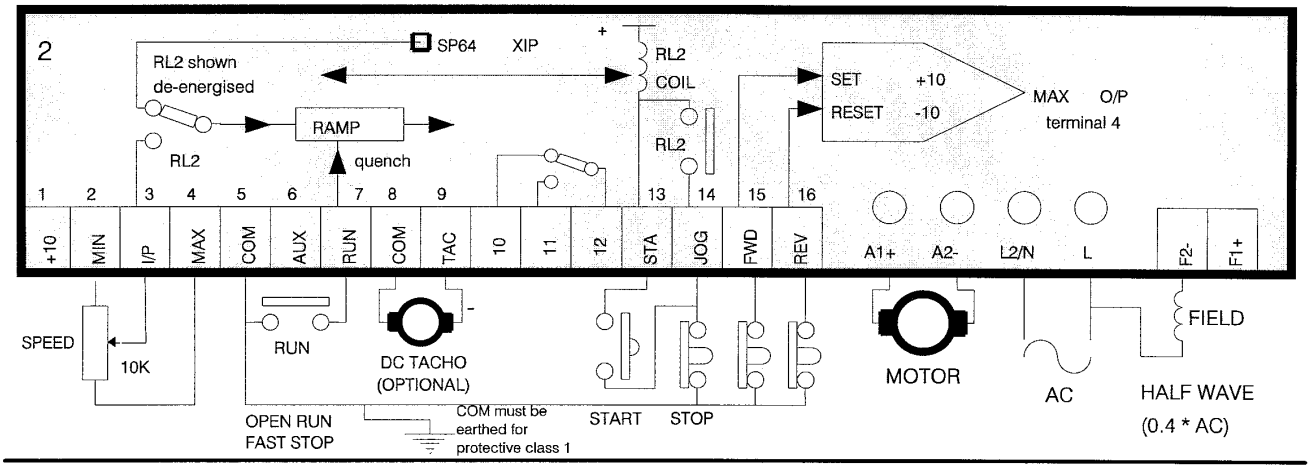


TYPICAL APPLICATIONS

BASIC CONNECTION. FORWARD AND REVERSE SPEED CONTROL BY POTENTIOMETER



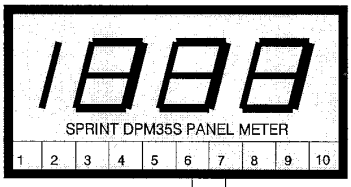
START, STOP, INDEPENDANT FORWARD/REVERSE, RAMPS TO ZERO SPEED ON STOP



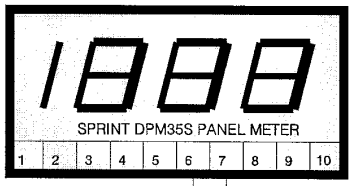
FORWARD, REVERSE, JOG, STOP

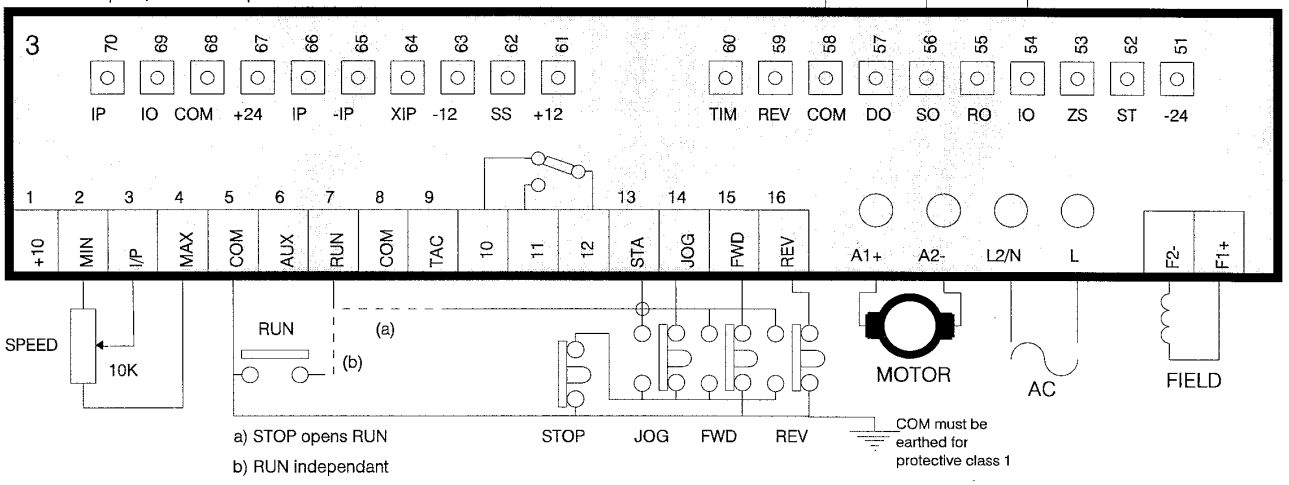
1) Start initiated by FWD/REV buttons
2) Direction change without STOP
3) JOG in either direction
4) Direction change during JOG
5) STOP button also opens RUN.
6) For dual function stopping, rapid or ramped, fit an independant RUN contact. (b)

SPEED DISPLAY



CURRENT DISPLAY





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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1 +10V PRECISION REFERENCE10mA 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

11 RATINGS ACCORDING TO CSA
VOLTAGE RATING OF RELAY
TERMINALS 10/11/12 MUST NOT

12 EXCEED 30V AC OR 42.4V DC.

N/C STOP CONTACT

13 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
N TO SUPPLY SELECT JUMPER

L LINE AC SUPPLY INPUT

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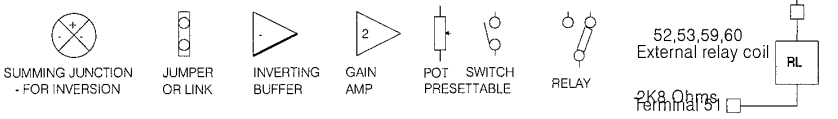
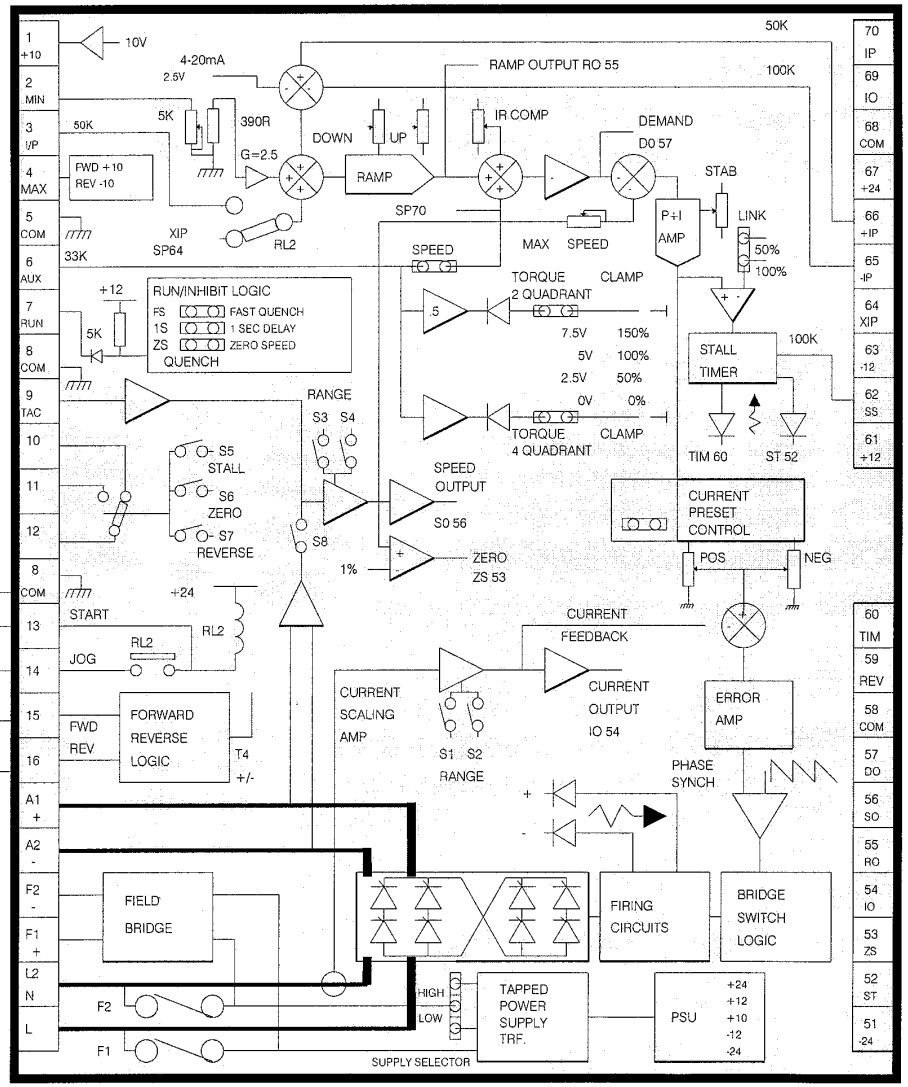
SYMBOLS





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

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.

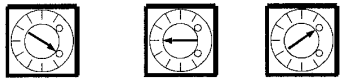
PUSHBUTTONS AND SETPOINT CHECK. BEFORE TURNING ON REMOVE THE RUN LINE CONNECTION TO TERMINAL 7, AND DISCONNECT THE ARMATURE LEADS. MAKE THE LEADS SAFE. Page 3 shows some typical applications, if the pushbutton terminals are left open then terminal 4 MAX remains at -10V. (basic connection). The START 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 decelleration 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 decelleration 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.

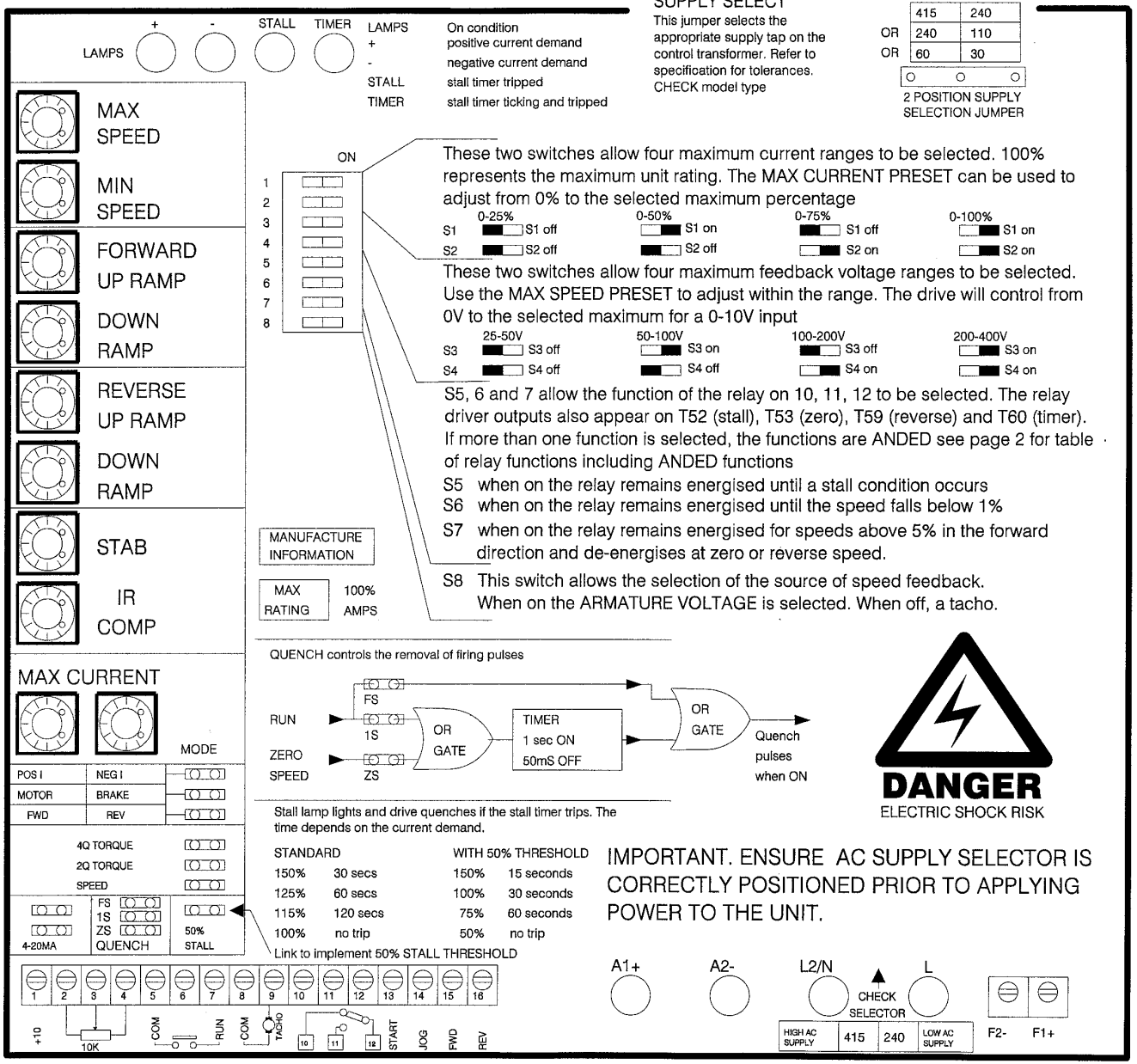
Rotate clockwise to increase current limit, use S1 and S2 to select range, the position of the MODE jumper determines the PRESET function according to the table.

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

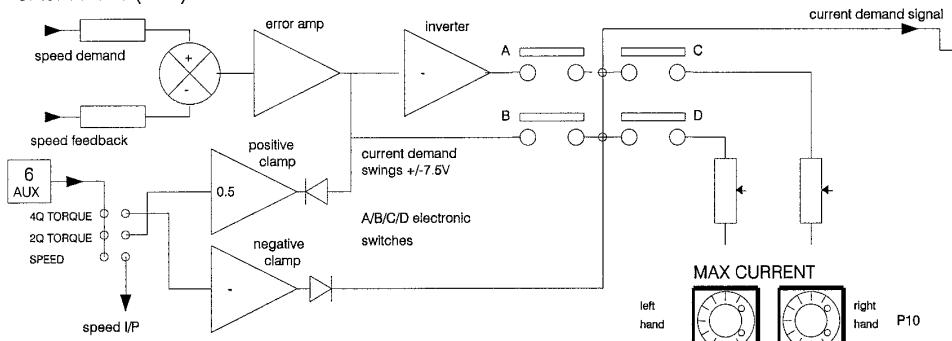
4-20mA link both and terminal 2 is input, 5 is return. MIN SPEED set to give 250 Ohms between T2 and T5.

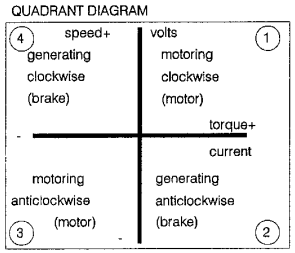


SEE LABEL ON SIDE OF TRANSFORMER FOR MODEL TYPE.

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

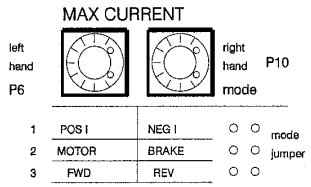




The 2Q TORQUE clamp operates in 1 and 2 on the positive current only

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 refering 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 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.

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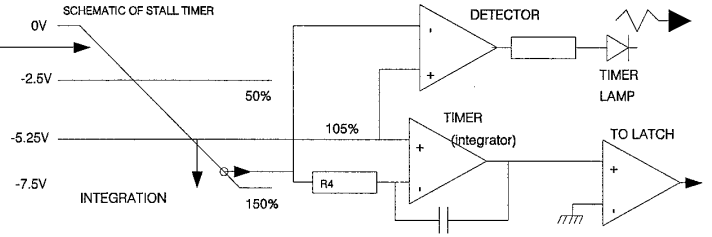
STALL TIMER

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.

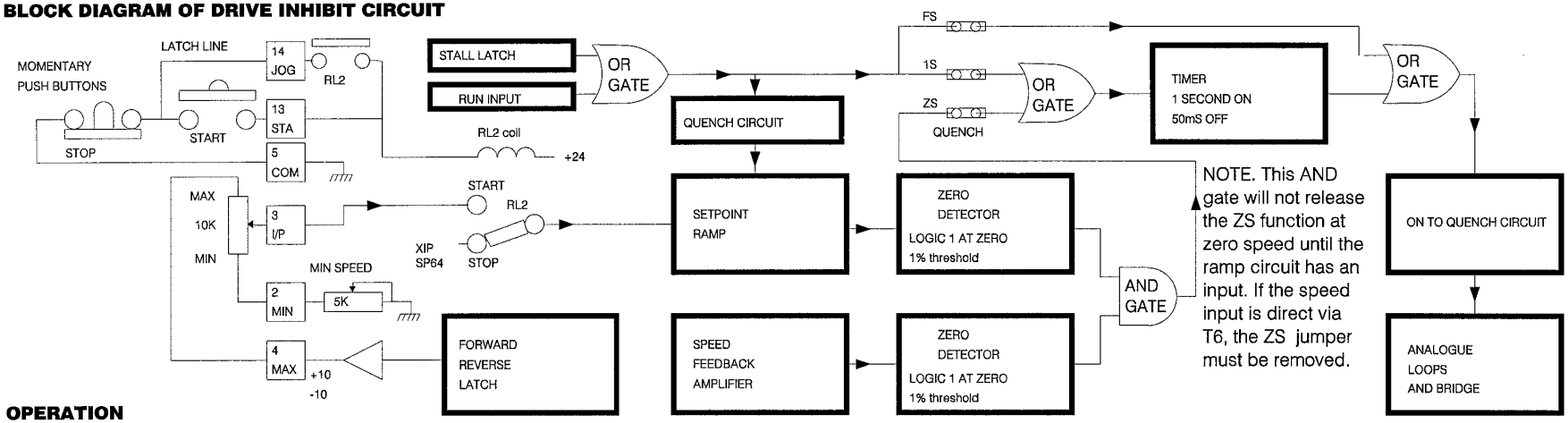
50% STALL THRESHOLD

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



OPERATION

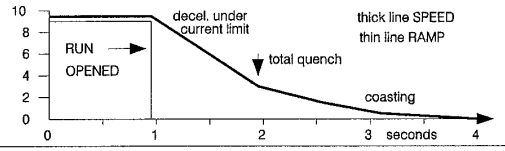
Possible inhibit request sources. 1)Stall timer is latched 2) External run line is opened 3) Zero speed is attained 4)a combination of these. It is also necessary to be able to inhibit the drive quickly or wait until the motor has come to a controlled stop before inhibiting the drive. STALL and RUN quench 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

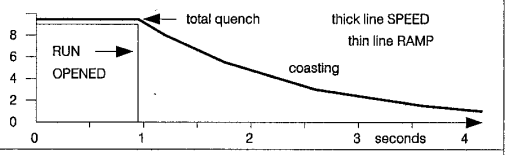
JUMPERS FS 1S ZS QUENCH

QUENCH CONDITION the speed ramp will be quenched by stall or run. The drive will be quenched after 1 sec.OR 1 sec. after zero



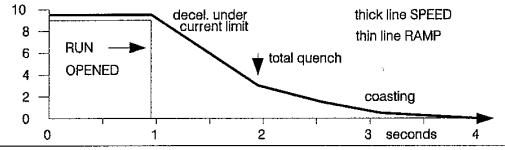
JUMPERS FS 1S ZS QUENCH

QUENCH CONDITION the speed ramp will be quenched by stall or run. The drive will be quenched immediately, OR 1 sec. after zero



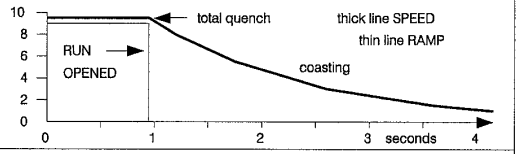
JUMPERS FS 1S ZS QUENCH

QUENCH CONDITION the speed ramp will be quenched by stall or run. The drive will be quenched after 1 sec. ZS function disabled.



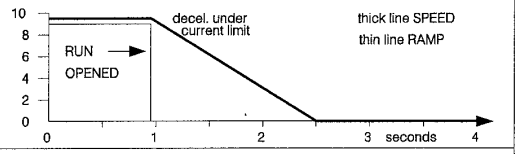
JUMPERS FS 1S ZS QUENCH

QUENCH CONDITION the speed ramp will be quenched by stall or run. The drive will be quenched immediately, ZS function disabled.



JUMPERS FS 1S ZS QUENCH

QUENCH CONDITION the speed ramp will be quenched by stall or run. The drive will remain active.

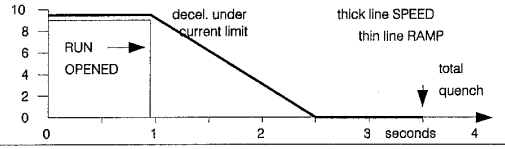


STOPPING MODES USING THE START/JOG CONTROLS ON T13/14

T13/14 control the internal relay RL2. This relay connects the input to the ramp circuit to the outside world. When RL2 is energised, T3 is connected. When RL2 is de-energised T3 is disconnected and SP64 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.

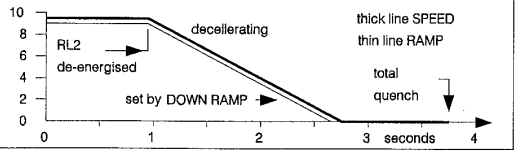
JUMPERS FS 1S ZS QUENCH

QUENCH CONDITION the speed ramp will be quenched by stall or run. The drive quench occurs 1 sec. after speed remains zero



JUMPERS FS 1S ZS QUENCH

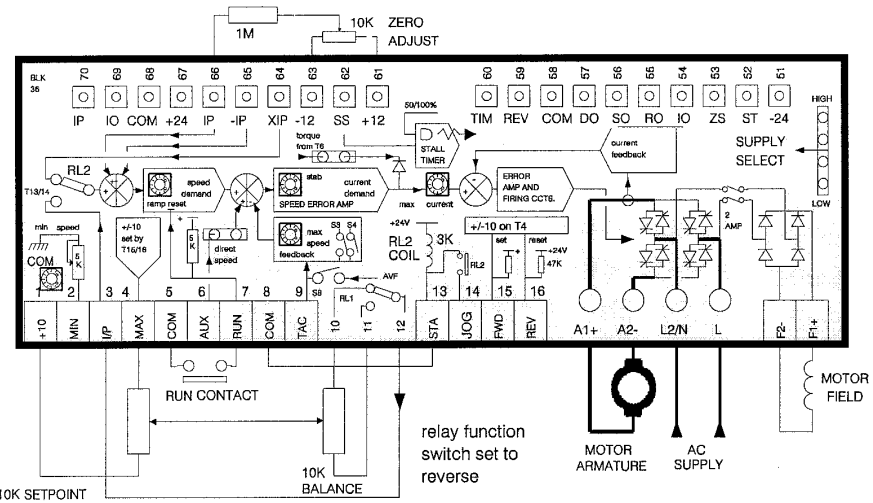
QUENCH CONDITION the speed ramp will be quenched by stall or run. The drive quench occurs 1 sec. after speed remains zero



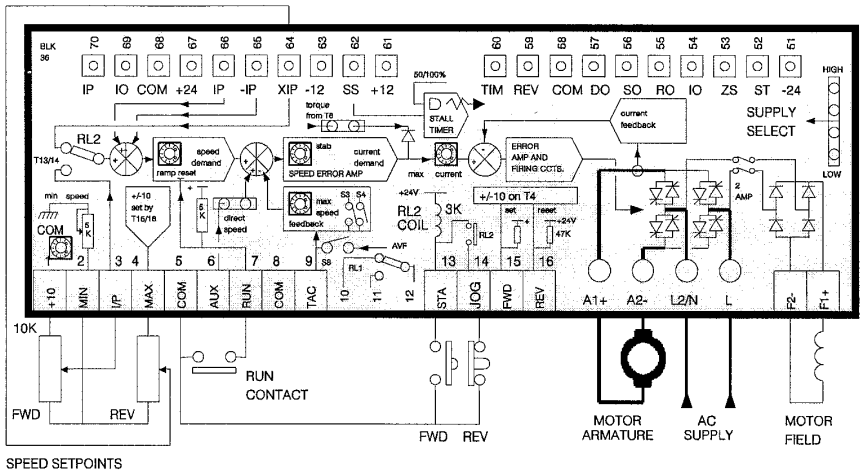
PROBLEM	LIKELY CAUSES	REMEDY
Drive will not power up no ON indication	line fuses blown	POWER OFF, check circuits replace fuses with correct type (see rating table page 1)
	F1, F2 fuses blown	check field wiring
	damaged transformer	check supply select jumper
Fuses blow on power up	short cct. load	check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

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

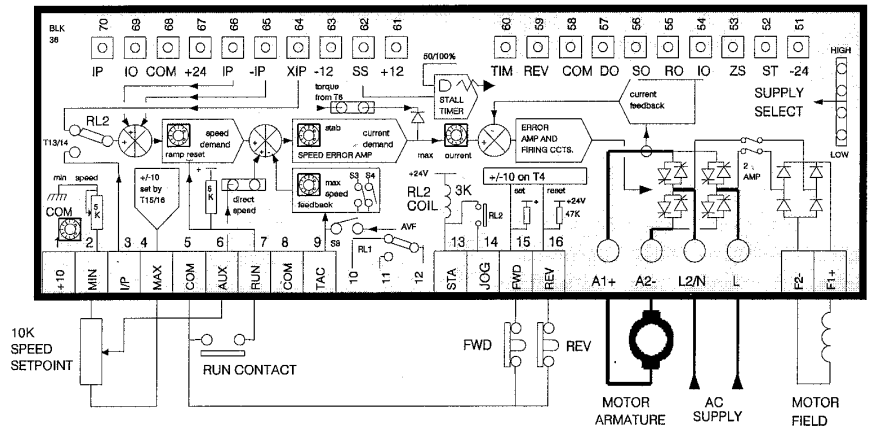
1) FORWARD AND REVERSE ON SETPOINT POT, WITH CENTRE ZERO. BALANCE POT TO GIVE +/-10% SPEED SCALING FOR FORWARD REVERSE. ZERO POT TO GIVE ACCURATE SETTING OF ZERO OFFSET.



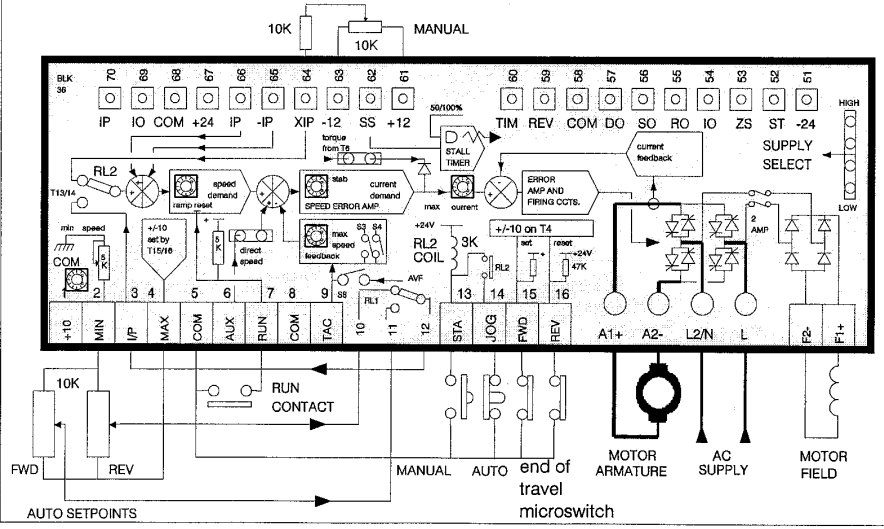
2) INDEPENDANT SETPOINTS FOR FORWARD AND REVERSE WITH THE SAME MINIMUM SPEED. THE SETPOINTS ARE SELECTED BY PUSHBUTTON AND THE DRIVE WILL RAMP BETWEEN THE SELECTED SPEEDS



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



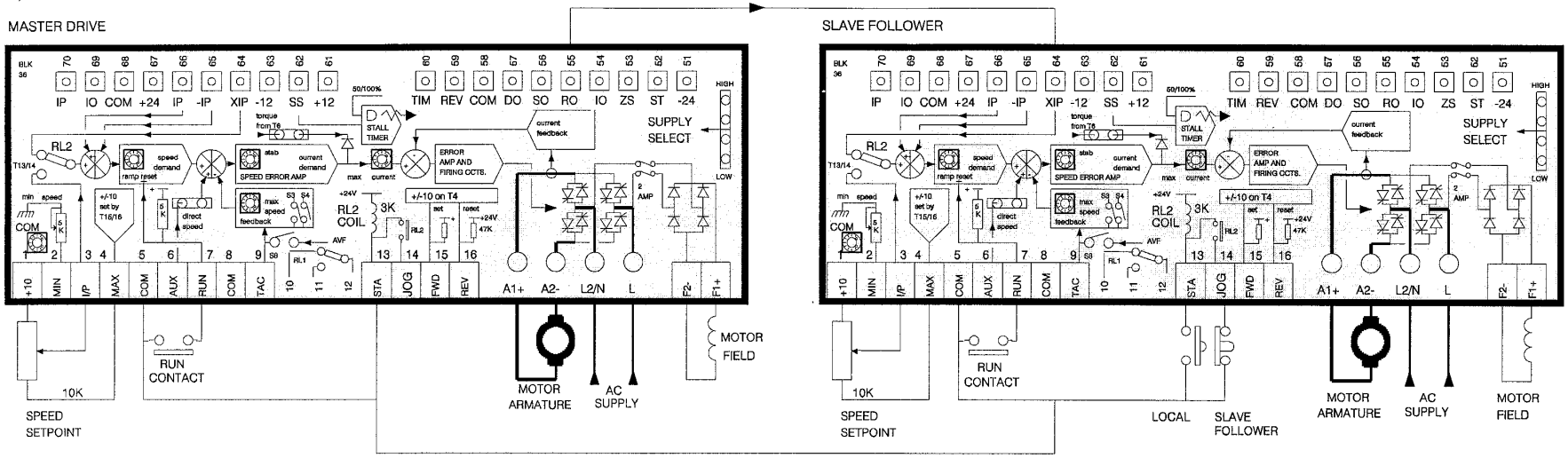
4) INDEPENDANT FORWARD AND REVERSE SPEEDS WITH AUTOMATIC END OF TRAVEL REVERSAL, AND PUSHBUTTON SELECTION OF CENTRE ZERO MANUAL SPEED. RELAY FUNCTION SWITCH SET TO REVERSE.



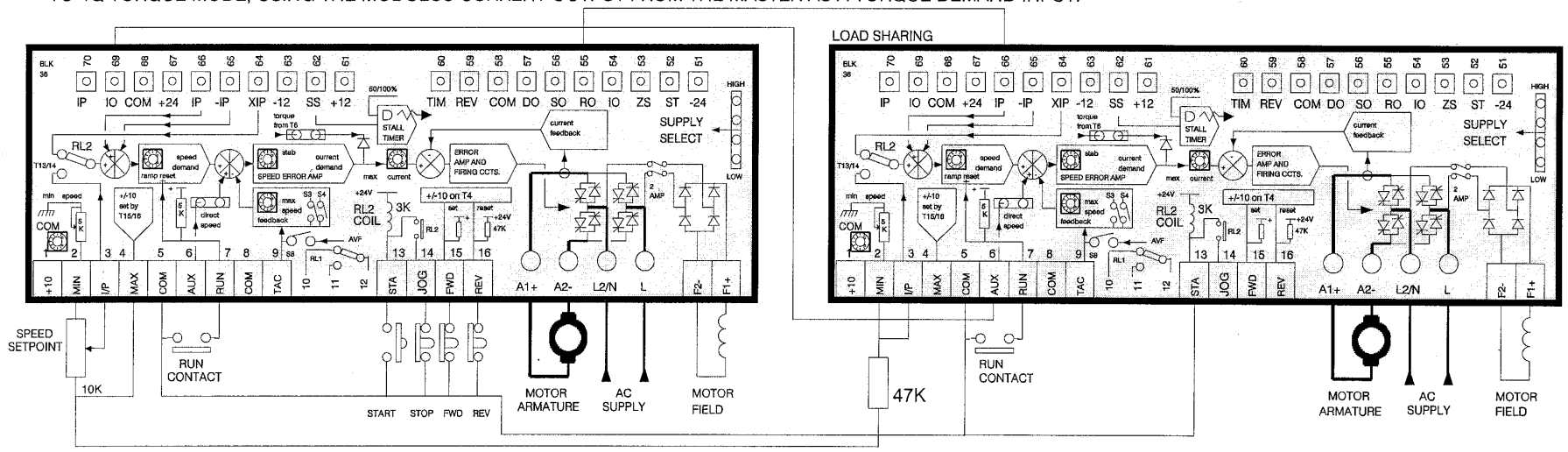
4 BASIC WIRING CONFIGURATIONS FOR THE ER-3600XRi REGENERATIVE CONTROLLER

ER100756 Iss 2

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

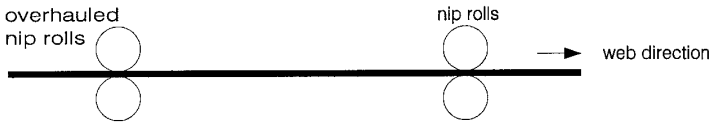


2) FORWARD, REVERSE BY PUSHBUTTON, DIRECTION IS MEMORISED DURING STOP. THE SLAVE DRIVE SPEED REFERENCE HAS A 10% ADDITION (1V VIA T3), THEN PUT IN TO 4Q TORQUE MODE, USING THE MODULUS CURRENT OUTPUT FROM THE MASTER AS A TORQUE DEMAND INPUT.

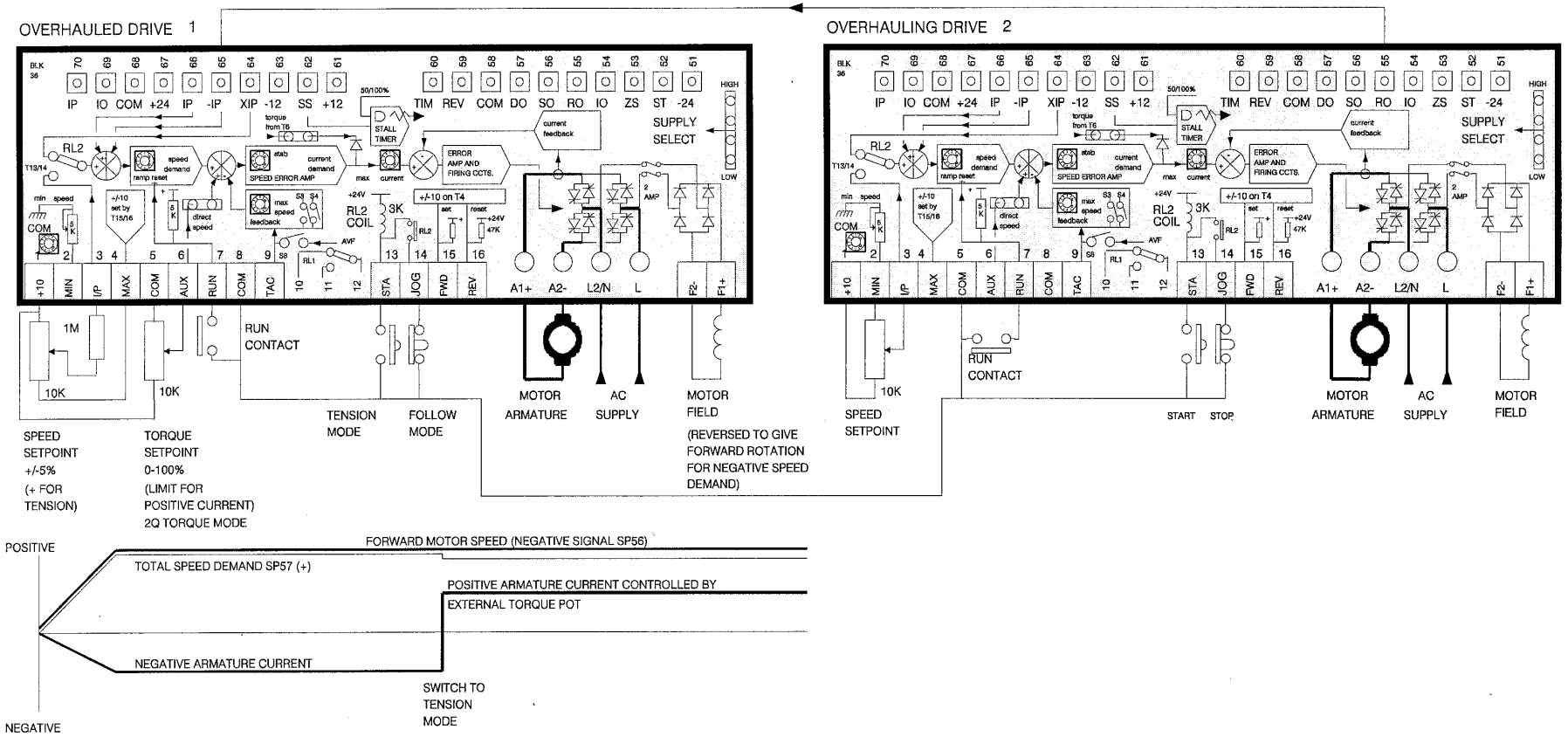


ER-3600XRi 1) SPEED FOLLOWING SCHEME. 2) LOAD SHARING SCHEME

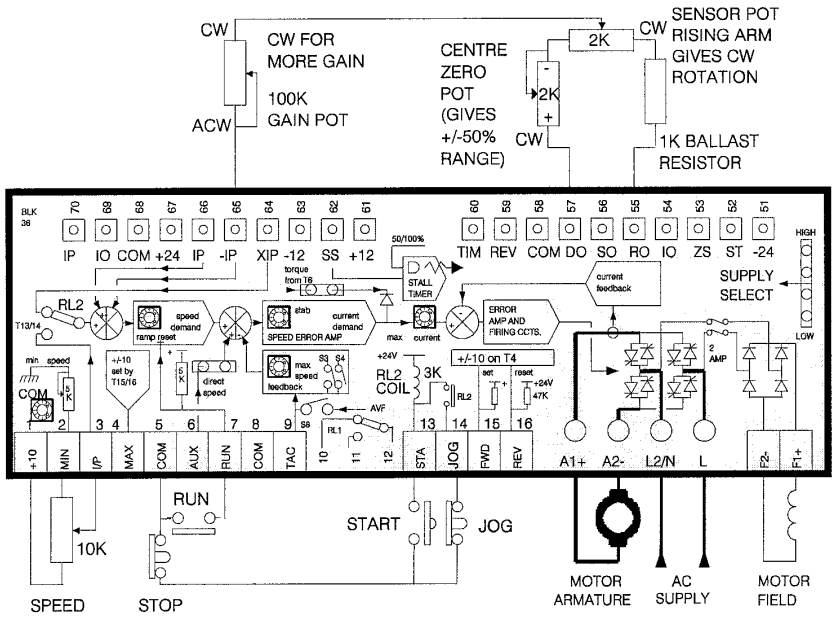
OVERHAULING. Applications which require a force to be applied in opposition to the material direction



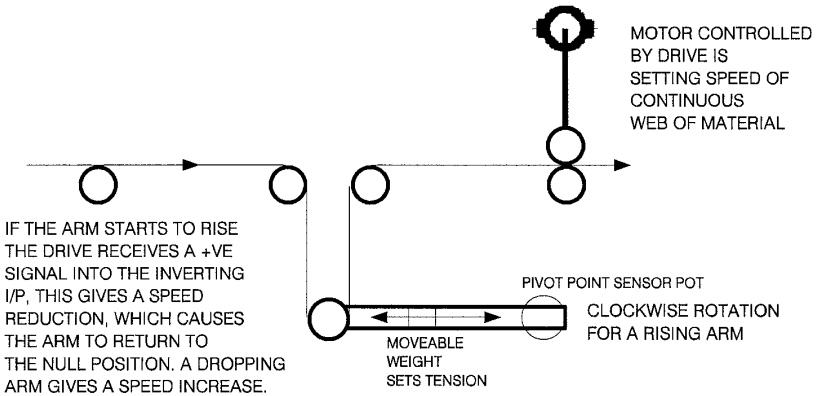
THE NIP ROLLS ARE DRIVEN BY DRIVE 2 IN STANDARD SPEED MODE. THE SETPOINT RAMP OUTPUT IS TAKEN TO DRIVE 1.
DRIVE 1 IS USED TO CONTROL THE OVERHAULED NIP ROLLS. IN ONE OF 2 MODES.
IT IS ARRANGED TO GIVE FORWARD ROTATION FOR A NEGATIVE ARMATURE VOLTAGE
1) AS A SPEED FOLLOWER
2) APPLYING REVERSE FORCE TO 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.

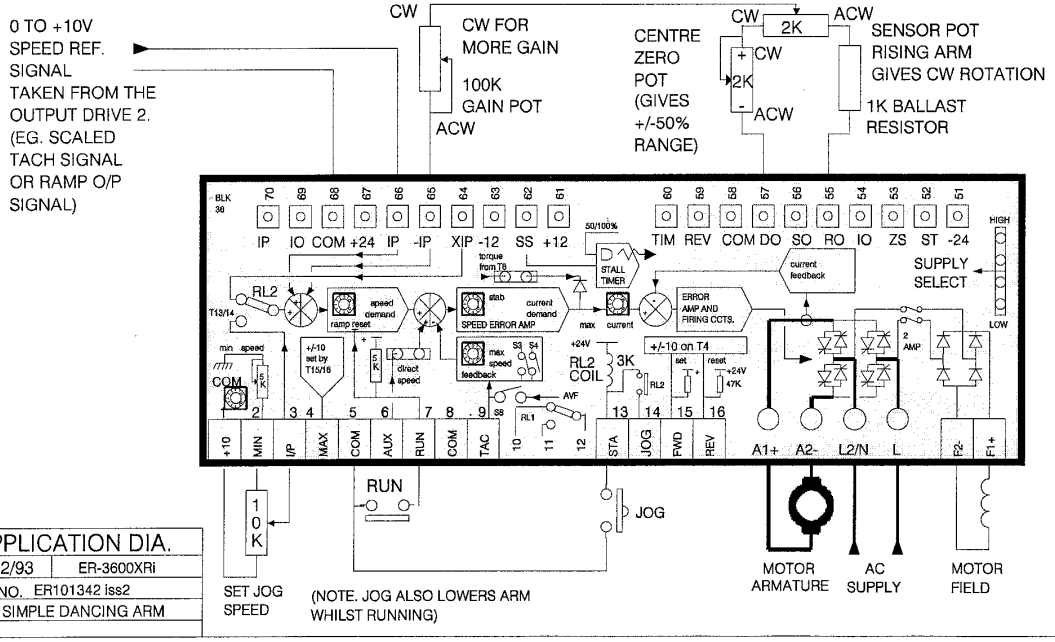


ER-3600XRi controller. Overhauling Follower application.

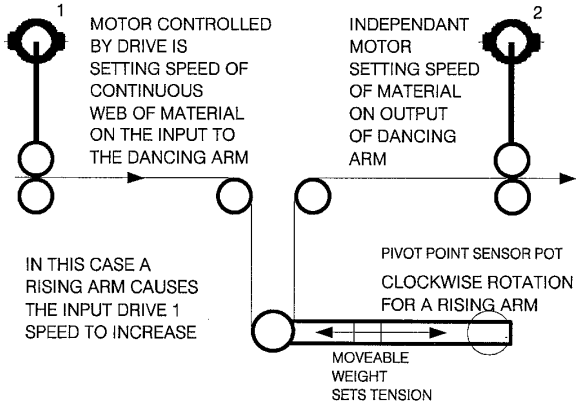


APPLICATION UTILISING DANCING ARM. THE CONTROL SYSTEM IS DESIGNED TO GIVE PROPORTIONAL CLOSED LOOP CONTROL OF THE POSITION OF THE DANCING ARM. THE POSITIVE SETPOINT RAMP OUTPUT AND THE NEGATIVE SETPOINT OUTPUT ARE APPLIED ACROSS THE SENSOR POT. THIS GIVES A SENSOR POT STRENGTH PROPORTIONAL TO LINE SPEED. 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.



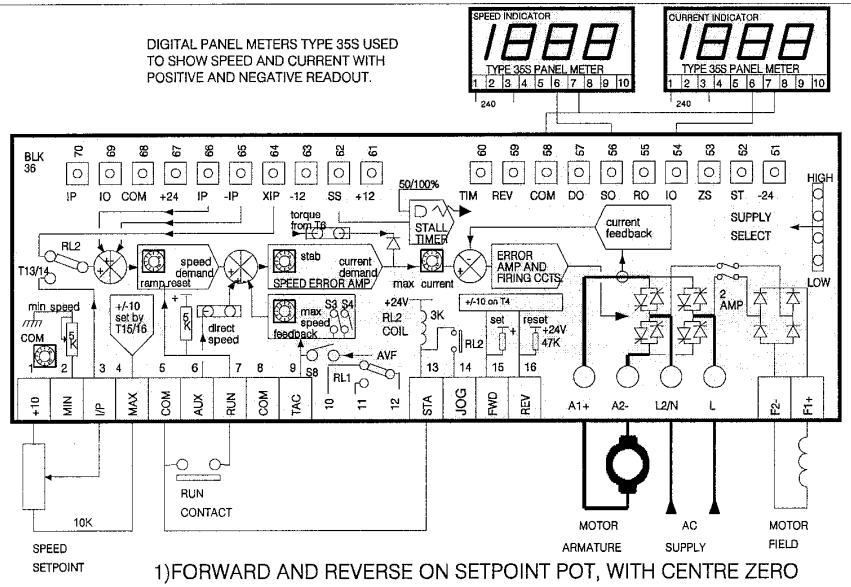


APPLICATION WHERE DANCING ARM POSITION IS CONTROLLED BY INPUT SPEED CHANGE.



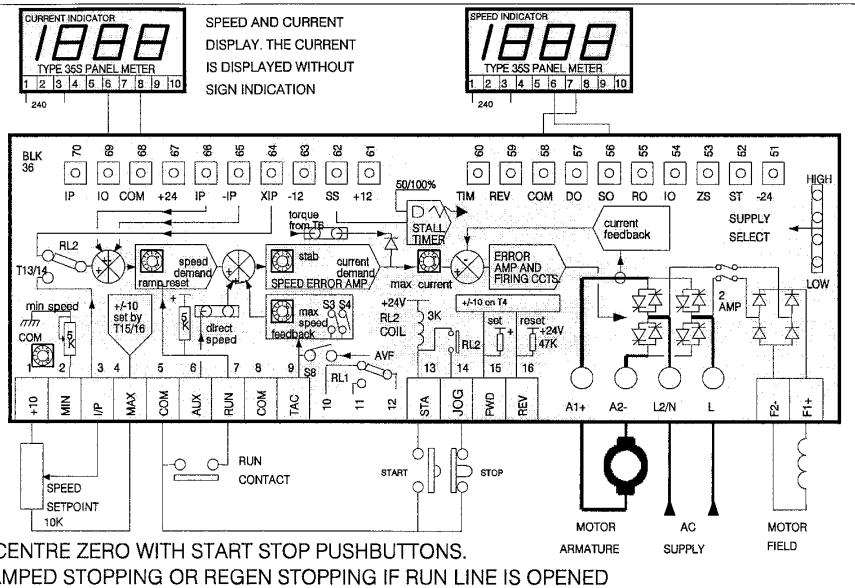
APPLICATION DIA.	
DATE 2/93	ER-3600XRi
DWG. NO. ER101342 iss2	
TITLE SIMPLE DANCING ARM	

DIGITAL PANEL METERS TYPE 35S USED TO SHOW SPEED AND CURRENT WITH POSITIVE AND NEGATIVE READOUT.



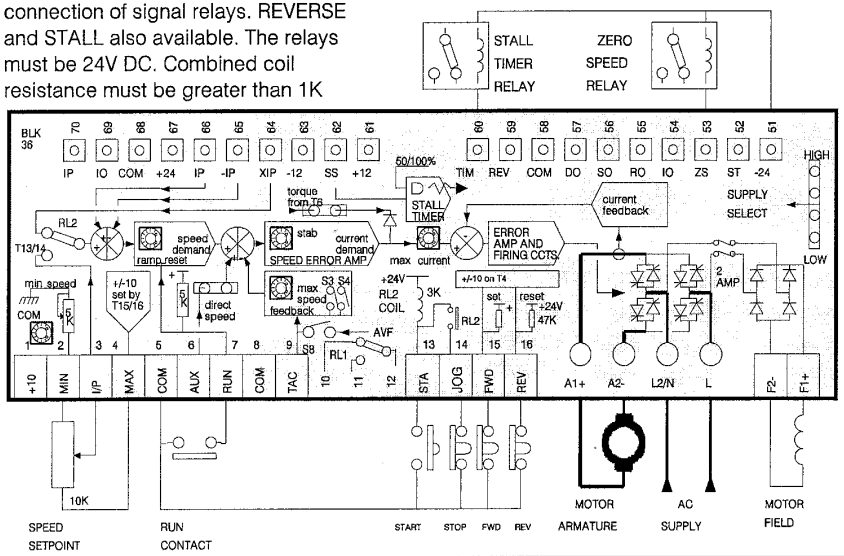
1)FORWARD AND REVERSE ON SETPOINT POT, WITH CENTRE ZERO

SPEED AND CURRENT DISPLAY. THE CURRENT IS DISPLAYED WITHOUT SIGN INDICATION

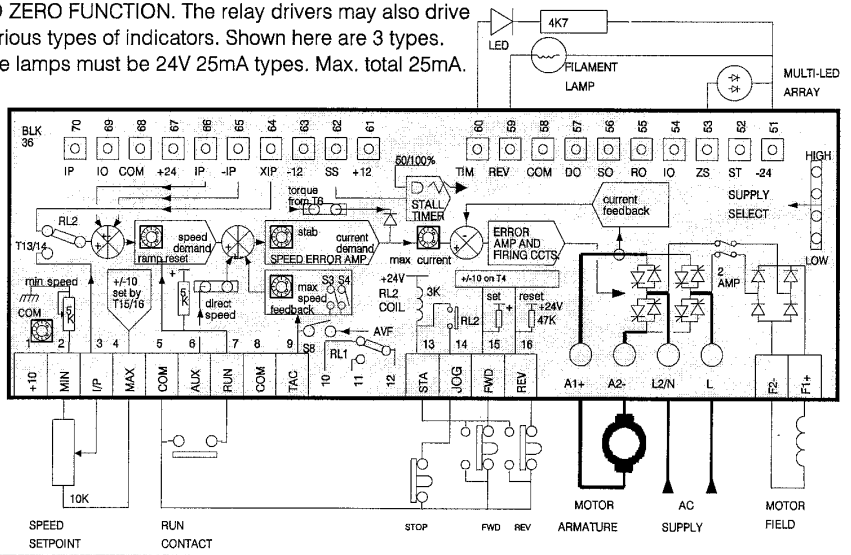


2)CENTRE ZERO WITH START STOP PUSHBUTTONS. RAMPED STOPPING OR REGEN STOPPING IF RUN LINE IS OPENED

3)FORWARD, REVERSE BY PUSHBUTTON, DIRECTION IS MEMORISED DURING STOP connection of signal relays. REVERSE and STALL also available. The relays must be 24V DC. Combined coil resistance must be greater than 1K

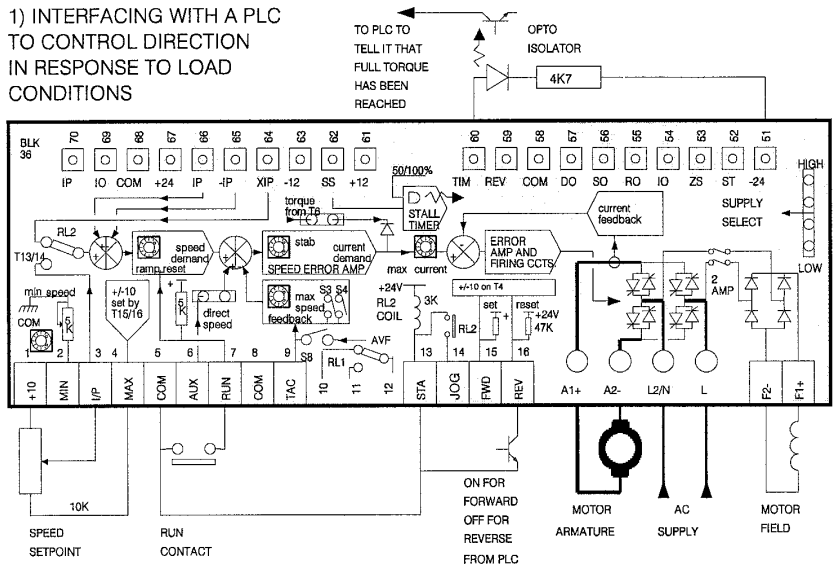


4)START FUNCTION IS INITIATED BY THE DIRECTION PUSHBUTTONS. STOP GIVES RAMP TO ZERO FUNCTION. The relay drivers may also drive various types of indicators. Shown here are 3 types. The lamps must be 24V 25mA types. Max. total 25mA.

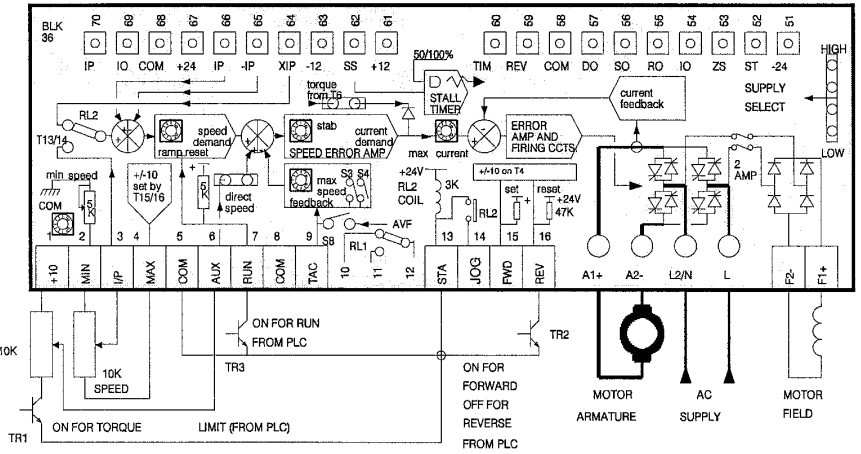


4 BASIC WIRING CONFIGURATIONS FOR THE ER-3600XRi REGENERATIVE CONTROLLER

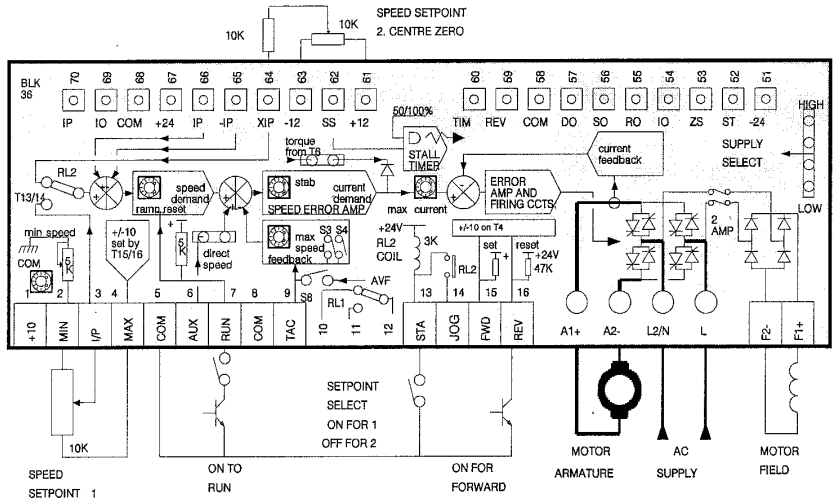
1) INTERFACING WITH A PLC TO CONTROL DIRECTION IN RESPONSE TO LOAD CONDITIONS



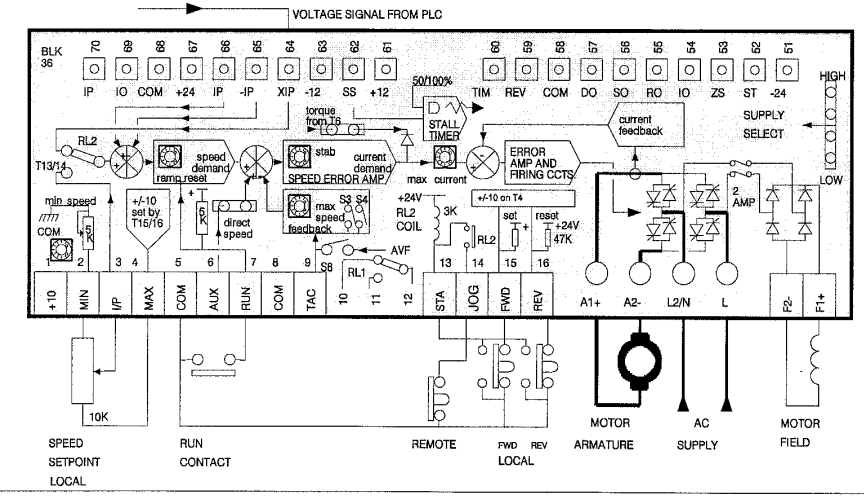
2) CONTROL VIA OPEN COLLECTOR PLC OUTPUTS.
The 4Q TORQUE mode is selected to allow the torque limit to be turned on by TR1. The direction is controlled by TR2. Stop and start is controlled by TR3



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

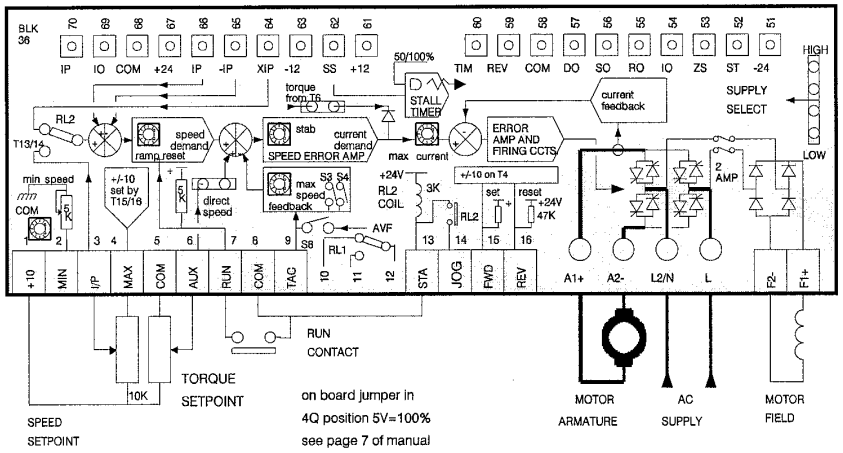


4) THE DRIVE RECEIVES ITS SPEED SETPOINT FROM A REMOTE SOURCE EG. PLC.
LOCAL OPERATION IS AUTOMATICALLY SELECTED BY THE FWD REV PUSHBUTTONS.
A PUSHBUTTON SELECTS THE REMOTE SIGNAL

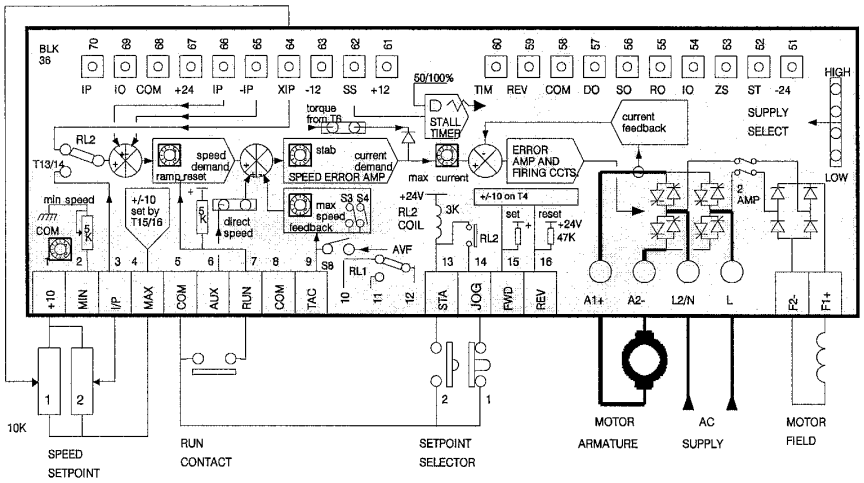


BASIC WIRING CONFIGURATIONS FOR THE ER-3600XRi REGENERATIVE CONTROLLER

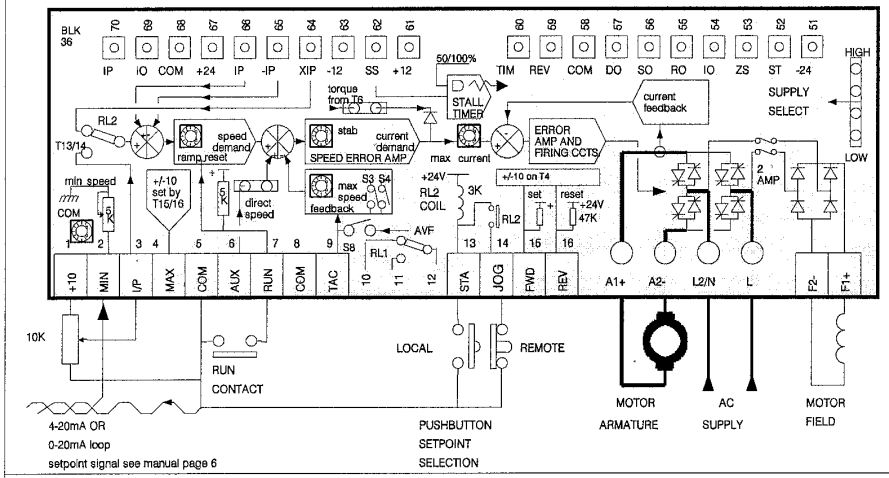
1) FORWARD AND REVERSE ON SETPOINT POT, WITH CENTRE ZERO. EXTERNAL TORQUE CONTROL INPUT. NOTE. THE LOWER SETPOINT HAS PRIORITY. To run in torque limit the speed demand must be sufficient and vica versa.



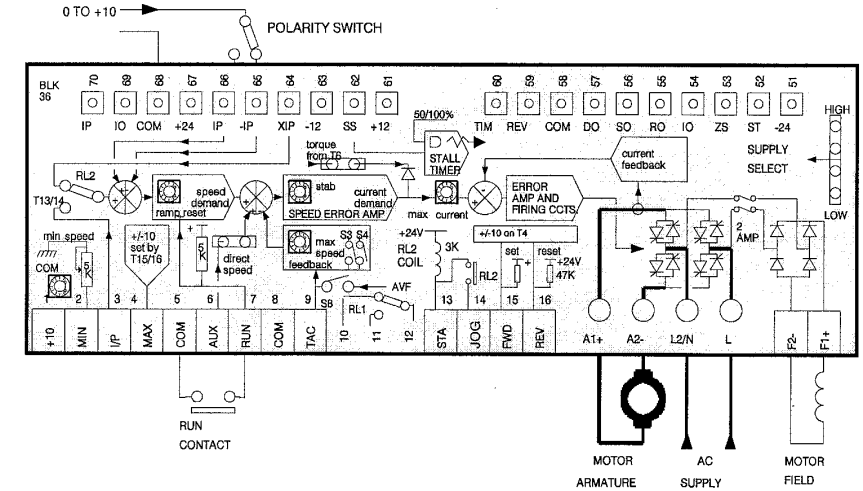
2) DUAL SETPOINT POTS.. SELECTED BY PUSHBUTTONS. BOTH CENTRE ZERO. OPENING RUN LINE GIVES RAPID STOPPING.



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 ER-3600XRi REGENERATIVE CONTROLLER

INSTALLATION GUIDE FOR SYSTEMS USED IN THE EU

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.

CE

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

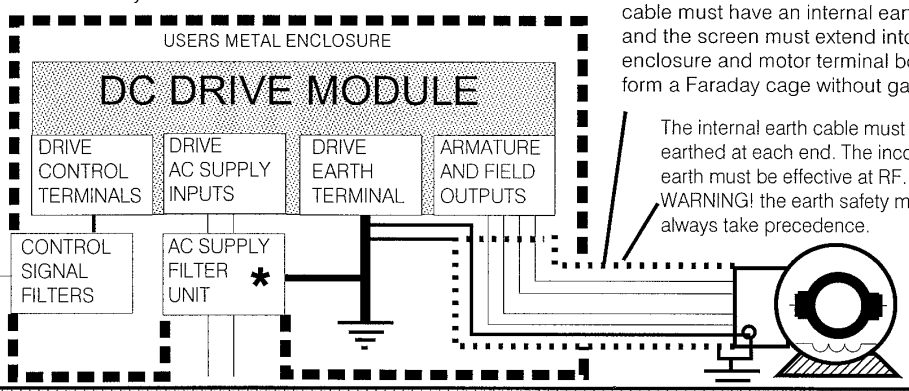
The AC supply filter must have a good earth connection to the enclosure back plane. Take care with painted metal to ensure good conductivity.

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



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

DANGER
ELECTRIC SHOCK RISK

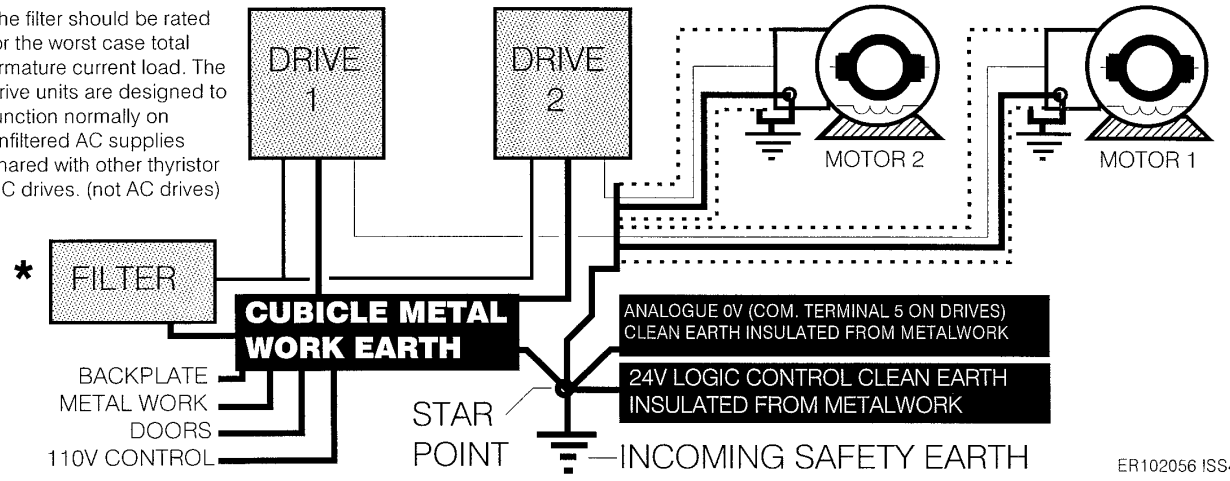
The AC supply filters must not be used on supplies that are un-balanced or float with respect to earth

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)



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