## Product Manual 400i and E400i

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Please read and understand this manual prior to installing the unit. Please obtain expert help if you are not qualified to install this equipment. Make the safety of your installation a priority. This component is hazardous.

## Introduction. Models 400, E400I

Sprint Electric offers two versions of a 4 amp isolated DC motor controller. The 400 i is designed for panel mounting, connections being made via screw terminals, and the E400i, a Eurocard format specifically for rack mounting where high packing density is desired.

| DRIVE TYPE | AC SUPPLY VOLTAGE | NOMINAL OUTPUT | MAX. CURRENT | ISOLATION |
| :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { 400i/LV } \\ & 400 i \end{aligned}$ | $\begin{aligned} & 30 / 60 \\ & 110 / 240 \end{aligned}$ | $\begin{aligned} & 24 / 48 \mathrm{~V} \\ & 90 / 180 \mathrm{~V} \end{aligned}$ | 4 AMPS <br> 4 AMPS | ISOLATED ISOLATED |
| $\begin{aligned} & \text { E400i /LV } \\ & \text { E400i } \end{aligned}$ | $\begin{aligned} & 30 / 60 \\ & 110 / 240 \end{aligned}$ | $\begin{aligned} & 24 / 48 \mathrm{~V} \\ & 90 / 180 \mathrm{~V} \end{aligned}$ | 4 AMPS <br> 4 AMPS | ISOLATED ISOLATED |

## GENERAL DESGRIPTION

The units employ closed loop control of both armature current and feedback voltage to give precise control of the motor torque and speed. The motor and drive are protected by a stall timer which automatically removes power after 30 seconds if the required speed cannot be achieved. The drives will provide up to $150 \%$ of the preset maximum current for up to 30 seconds allowing high short term torques during acceleration 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 E400i and E400i/LV models are designed for EUROCARD RACK MOUNTING. The 400i and 400i/LV models are designed for panel mounting, connections are made via screw terminals.

## INPUTS AND OUTPUTS

+aux input -aux input current input 4-20mA input 0 to 10 V input
speed output current output ramp output stall relay driver zero speed driver
rail outputs
+12 V regulated output
+10 V precision reference
-12 V regulated output
-24 V unregulated output

ADJUSTABLE PARAMETERS

JUMPER

FUNGTIONS

Dual supply voltage

4-20mA input

Max speed Up ramp Min speed Down ramp

Maximum feedback
Torque control

Dual loop control Relay driver o/ps

Precision tacho rectifier International compatability

Compact design Integral fusing


TORQUE CONTROL WITH OVERSPEED LIMITING BY SEPERATE SPEED SETPOINT.
If the speed exceeds the level programmed by the speed setpoint, then the current demand comes out of limit and the speed loop takes control. Note: Link the two signal pads 64 together to bring SP64 to terminal 22.


## INSTALLATHON GUIDE FOR SYSTAMS USAD IN THE EU

Special consideration must be given to installations in member states of the European Union regarding noise suppression and immunity. According to IEC 1800-3 (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 REQUREMENTS FOR EMC COMPLANGE

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

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

The AC connections from the filter to the drive must be less than 0.3 m 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 and motor cable screen should connect directly to the metal of the cabinet for best performance

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

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.

CONTROL SIGNAL FILTERS


DANGER:

## 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)



## MAIN TERMINALS

## 32 COMMON

30 OPEN COLLECTOR OUTPUT. 100 mA 30 V . THIS OUTPUT TURNS ON IF THE DRIVE GOES INTO A STALL CONDITION.
$28+10 \mathrm{~V}$ PRECISION REFERENCE 10 mA MAX. SHORT CCT. PROOF
26 MINIMUM END OF SETPOINT POT OR 4-20 mA CURRENT LOOP I/P SPEED DEMAND INPUT 0-10V

240 TO + 10V INPUT FOR 0-100\% SPEED
22 O/P. MAY BE LINKED TO ANY ONE OF THE SIGNAL PADS ON TOP EDGE BY CONNECTING TO ADJACENT PAD
20 CONNECT TO COMMON TO RUN 60 mS ON / 20 mS OFF (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)

18 COMMON (T18 must be connected to earth for protective class1)
16 TACHO INPUT 12-200V FULL SCALE. + OR - POLARITY
14 A1 + ARMATURE OUTPUT
12 AND 10 A2- ARMATURE OUTPUT
8 F2- FIELD OUTPUT
6 F1 + FIELD OUTPUT
For half wave field output voltage connect field between F2- (T8) and N (T4). This gives a field voltage of 0.45 times the AC supply

4 N AC SUPPLY INPUT ACCORDINGTO SUPPLY SELECT JUMPER
2 L LINE AC SUPPLY INPUT

## SIGNAL PADS ON TOP EDGE

66 AUXILIARY SPEED INPUT 0 TO 10V FOR 0-100\% DIRECT SPEED
65 AUX INVERTING SPEED INPUT 0 TO -10V FOR 0-100\% RAMPED SPEED
64 TORQUE INPUT. 0 TO + 10V FOR 0-100\% CURRENT
63 -12V OUTPUT 10mA MAX
62 STOP/START INPUT. CLOSE TO -12V TO ACTIVATE STALL CONDITION. CLOSE TO +12V TO RELEASE STALL CONDITION

61 + 12 V OUTPUT 10 mA MAX
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). OV TO FULL SCALE REPRESENTS 0-100\%. IMPEDANCE 1 k .

55 SETPOINT RAMP OUTPUT 0-10V IMPEDANCE 1 K OHMS
54 CURRENT OUTPUT 0-5V FOR 0-100\% CURRENT. IMPEDANCE 1K
53 ZERO SPEED RELAY DRIVER O/P MAX 100mA
Switches to -24V
52 STALL RELAY DRIVER O/P MAX 100 mA
Switches to -24V
51 -24V RELAY SUPPLY 25mA DO NOT SHORT


NOTE. THE CONTROL CONNECTIONS 16 TO 32, AND THE SIGNAL PADS 51 TO 66 ARE ELECTRICALLY ISOLATED FROM THE POWER TERMINALS 2 TO 14. DO NOT TOUCH THE CARD, DANGEROUS POTENTIAL PRESENT

Ensure supply is disconnected before working on unit

## POWER CABLING

Use correctly rated cable minimum 600V AC 2 times armature current

## FUSING

The drives have built in line fuses for wiring protection (6.3 AMP HRC). The drive thyristor bridge can only be protected by fitting external semi-conductor fuses. See page 8 for details

## CONTROL SIGNALS

All control inputs to the drives are ISOLATED. Do not connect the power terminals to earth or other low voltage. Avoid running signal cables close to power cables.

## 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 0.1 uF cap. is usually adequate in these situations. Refer to page 3 for EMC guidelines.

## SELECTOR SWITCHES AND JUMPERS

Must not be touched with power on.

## MECHANICAL

Optimise heatsink airflow. Avoid vibration and ambient temps outside -10C and +40 C . Protect the drive from pollutants.

## MOTOR

Foot mounted motors must be level and secure. Protect motors from ingress of foreign matter during installation. Ensure accurate alignment of motor shaft with couplings. Do not hammer pulleys or couplings onto the motor shaft. Before running the motor complete the following check list.

1) Correct insulation resistance between all windings and earth with all drive cables disconnected
2) Check inside connection box for foreign objects, damaged terminals etc.
3) Check that brushes are in good condition, correctly seated and free to move in brush boxes. Check correct action of brush springs.
4) Motor vents must be freed of any obstruction or protective covers prior to running.
5) WARNING reversing systems. Do not transpose the armature connections until the motor has stopped.
Failure to heed this warning will cause damage.

## SUPPLY

Please ensure that the supply selection jumper on the drive matches the incoming supply. Failure to do this may result in permanent damage of the drive unit.

## 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 run through switches S1 to S4 and select accordingly.

S1 S2

S3

S4

> SPEED. Calculate desired full scale feedback voltage and select range. Adjust within the range by using the MAX SPEED preset. Feedback may be tacho OR armature.
> Normally off. This switch allows a Torque signal to be entered when on via signal pad 64 (TI) on top edge. Refer to block diagram on page 4 . Wiring page 3 .
> ON for Armature voltage feedback. OFF for Tacho feedback.

## PRESET POT SETTINGS

MAX CURRENT. cw rotation gives 0 to 100\% current limit. eg. 50\% rotation gives 50\% current limit. Check motor rating plate to find correct limit.

| Anticlockwise | MIN SPEED | DOWN RAMP |
| :--- | :--- | :--- |
|  | UP RAMP | IR COMP |
| Midway | STAB |  |

## POWER ON Check ON lamp lights

## CLOSE RUN CONTACT

Gradually increase external setpoint, check motor rotation. If the direction is wrong, TURN OFF and swap $A+, A-$

## INCREASE SETPOINT.

Drive should ramp up to full speed. Fine adjust with MAX SPEED preset. Do not exceed armature voltage rating. Reduce setpoint, drive should ramp down to zero. Adjust MIN SPEED to desired level. Run motor up and down and adjust RAMPS.

## 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 preset. Excessive rotation may lead to instability. No IR COMP is required for systems with tacho feedback.

## TORQUE SYSTEMS

See typical applications. In this mode the lowest setpoint has priority. Hence the speed setpoint is set to demand a speed slightly in excess of the working speed, and then the torque setpoint will always be operating as a limit. In the event of a web break for example, the motor will only run up to the level set on the speed pot.

## LAMPS

ON On indicates AC power is applied

STALL Stall lamp lights and drive quenches if stall timer trips. see below for description of timer characteristics.

MAX Rotate clockwise to increase speed. Change SPEED
STAB Rotate clockwise to increase response. Excessive rotation may cause instability. If rated motor voltage is much lower than AC supply anticlockwise is best.
IR Rotate clockwise to increase level of armature COMP voltage droop compensation. Excessive rotation may cause instability
MAX CURRENT Rotate clockwise to increase current.


Current signal loop links. CUSTOMER PRESETS 4-20mA both pairs 0-20mA this pair only

Terminal 26 becomes loop input and terminal 32 return. MIN SPEED preset trims burden to 250 ohms.

## Layout of 400i <br> E400i has vertical presets.

SUPPLY SELECT 240 gLV60 glv30 110

- signal pads 51 TO 66 ANY ONE OF THE SIGNAL PADS MAY BE CONNECTED TO T22 BY SOLDERING THE APPROPRIATE PAIR OF PADS.


## SUPPLY SELECT

This jumper selects the appropriate supply tap on the control transformer. Refer to specification for tolerances. CHECK model type a) 240/110V AC or b) 60/30V AC S1 These two switches allow four maximum feedback voltage ranges to be S2 selected. Use the MAX SPEED PRESET to adjust within the range. The


## Stall Threshold

To implement the 50\% stall threshold link the two points marked STH. Stall lamp lights and drive quenches if the stall timer trips. The time depends on the current demand

STANDARD
150\% 30 secs
125\% 60 secs
115\% 120 secs 100\% no trip

WITH 50\% THRESHOLD
150\% 15 seconds
100\% 30 seconds
75\% 60 seconds
50\% no trip

HRC FUSE
6.3 A 20 mm

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.

## TROUBLE SHOOTING.

The drive consists of 2 high accuracy feedback control loops.


| SPEED ERROR |
| :--- |
| AMPLIFIER |
| output current |
| demand |


| STALL TIMER |
| :--- |
| timing active |
| while demand |
| $>100 \%$ 30secs |

1 These units have Isolated control terminals 16-32

2 The signal pads are isolated

3 Terminal 22 can be linked to any one of the signal pads.

4 Terminals 2-14 are non isolated.

5 STALL problems shown by stall lamp coming on after running are caused by the drive unit not able to give set speed
6 Typical STALL reasons. a) MAX CURRENT preset not correctly set, hence insufficient torque

7 b) Motor not powerful enough for application.
c) Speed calibration set beyond capability of supply.
8 d) Any factor which prevents motor from rotating at set speed, eg. jammed load, low supply voltage.



9 Pot wired with wiper connected to T26 instead of T24. Motor slows down instead of speeding up

10 Wires to T26 and T28 transposed. Motor slows down for clockwise rotation of pot.

11 Open circuit T26. Motor runs only at full speed.

12 Loose or intermittent tacho coupling causes instability or overspeeding. Make sure coupling is secure and non-elastic

13 Incorrect feedback scaling causes over or underspeeding. Calculate the desired max. tacho volts, adjust S1, S2
14 Tacho failure. Until a replacement is obtained change to AV feedback S4. Rescale with S1, S2

15 Armature resistance should normally be a few ohms. The armature must be isolated from earth and the field coil
16 Shorted turn on motor armature can cause power device failure. Check resistance through 360 deg rotation
17 Brushes should be in good condition, correctly seated, and free to move in brush boxes.

18 Field resistance should normally be a few hundred ohms. The field must be isolated from earth and the armature
19 Do not open circuit the field. Do not open circuit the armature unless RUN is opened first.

20 The AC supply must lie within the limits specified on page 8. Ensure the selection jumper is correct.


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