bramco ELECTRONICS

TWISTER
- A00533

Fan Control Module

Operation Manual

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Index

Overview

The *Twister* Fan Control module is a dynamic leap forward in the area of fan control and protection. It is an addition to Bramco's range of control and protection modules, utilising the very latest in microprocessor technology.

The module can function independently or in a dual networked operation. In dual fan operation a selector switch nominates how the system is to function. This can range from one fan only, to a fully automated sequenced start of both networked fans.

The *Twister* unit also has a fully programmable "Burping" operation. Burping allows the fan to get under way via a number of Burp starts. The number and duty cycle of these Burps is all Menu selectable.

Twister's overload protection system provides an incredible range of current and curve settings. Current settings from 1A through to 995A are available with the same set of CT's! There are also 25 different curve choices all matched to IEC255. This broad spectrum of possible settings will provide the necessary protection for all your motor needs. The overload package will also record the maximum current that has passed through the system since it was last powered up. This will be helpful when setting the motor start and short circuit settings and will assist in fault diagnosis.

The module also touts one of the fastest Short Circuit protection schemes available. The module can trip in less than one cycle. Due to the rapid clearance of faults from a system, damage to associated equipment could be significantly reduced saving time and money.

The Short Circuit protection system also incorporates Motor Start. This allows a higher short circuit setting for the initial starting of the fan, after which it switches over to a lower setting when the fan is under way. This is a flexible and powerful tool enhancing system grading.

Another feature supported by the *Twister* Fan Control Module is Earth Leakage. Earth Leakage protection is available from 50-500mA and 50-500ms. The Earth Leakage unit will also trip on an Open Toroid condition. A recent addition to the powerful Fan Control Module is the provision of a Thermistor input. The Thermistor function can be enabled or disabled and set to trip between 500 and 2500 Ohms.

The module provides a 120 time and date stamped event log. This useful tool will retain the last 120 events in non-volatile memory. This allows the operator to review recent trip conditions, when power was last applied to the module and a multitude of other conditions. Modbus communications is also available. This provision will allow communications to the surface detailing all the module settings and the running parameters. This facility will allow an operator on the surface to not only monitor the operation of various machines, but to modify any adjustable parameter.

All these features provide an incredibly powerfully yet simple to operate control and protection system totally dedicated to the flexible operation of fans.

1. Functions in Detail

A more detailed description of the Fan Control Module features follows. The LCD display gives a continuous descriptive overview of the current module status, including all trip conditions. These are also recorded in the fault log and are available through the remote communication facility.

1.1. Motor Overload (OL)

Current settings from 1A through to 995A are available with the same set of CT's. This actually involves four distinct ranges as follows:-

RANGE	OL SETTING
1	1.0 - 4.9A
2	5.0 – 24A
3	25 – 124A
4	125 – 995A

To increase the user friendliness of the system, the ranges are transparent to the user.

There are also 25 different curve choices all matched to IEC255. The curve selection is simple. Bramco has historically chosen the twice full load current point as a point of reference. All the curves are intervals of 10 seconds from 10 to 250 seconds at this twice full load current point (2 x FLC).
To select a curve the user just has to nominate one of these values. The curves are in Appendix B.

The overload protection software utilizes thermal memory like techniques. This enhances the motor protection by reducing the trip time for a motor which has been regularly operating above the overload set point.

The overload package will also record the maximum current that has passed through the system since it was last powered up. This will be helpful when setting the motor start and short circuit settings and will assist in fault diagnosis. This value will only be reset when power has been removed from the module.

1.2. Short Circuit (SC)

This function provides high speed over current protection able to trip in less than a single cycle (<20ms). The nominated Overload (OL) trip point will automatically determine the range which will govern the Short Circuit/Motor Start Settings. Once again it is noted that these ranges are transparent to the user. Possible settings are from 4 to 5000 Amps.

RANGE	SC/MS SETTING
1	4 - 50A
2	20 - 250A
3	100 – 1250A
4	400 – 5000A

Motor Start is a part of the Short Circuit facility. Basically the Short Circuit unit uses this parameter whilst a motor is starting, then utilizes the Short Circuit parameter while ever the motor remains in this running state (Refer to *Figures 2.2.1* and *2.2.2*). The trip relay and corresponding circuitry are the same, only the trip point varies to allow flexible motor start and short circuit settings. A “SC trip” condition could therefore be caused by a motor start. This provides better control over system fault levels since the user can set SC value below the MS value. For cases such as transformers or other load types which may not require such trip setting variations, just set the MS and SC settings to identical values. The Short Circuit function is latched such that once tripped a manual reset is required.

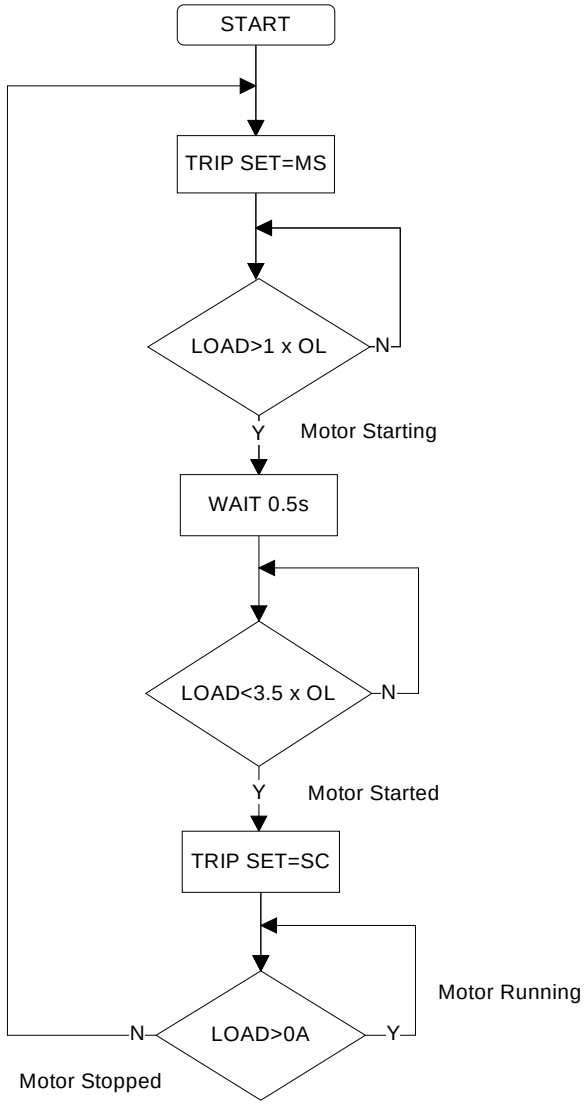


Figure 2.2.1 – MS/SC Sequence

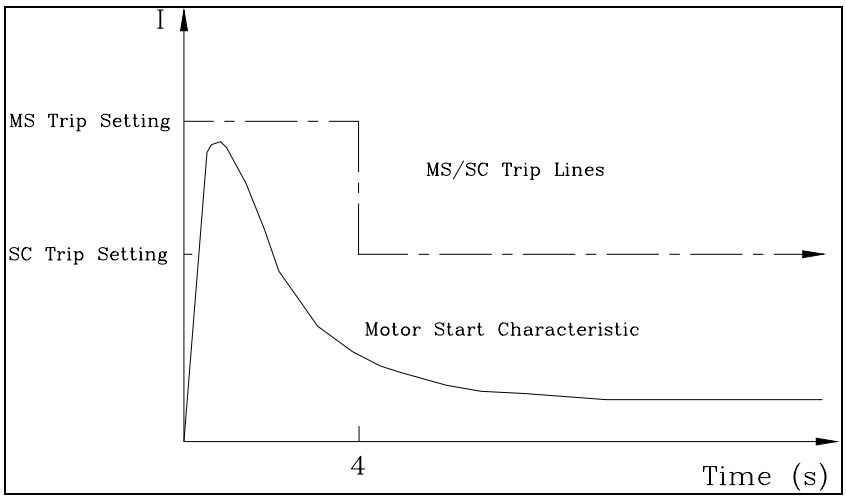


Figure 2.2.2 - An example of MS/SC Trip point setting

1.3. Earth Leakage (EL)

The Earth Leakage function is designed to detect earth fault currents flowing in the power system. The unit is user adjustable from 50 to 500 mA. The time delay is adjustable from 50 ms to 500 ms in 10 ms increments. The card is fitted with a latching relay. Detection of an earth leakage fault will cause the relay to release and the latching relay to lock out the circuit. The latching will prevent closure of the control contactor until the module has been manually reset. The toroid is integral to the function. Disconnection or open circuiting the toroid will result in the relay tripping and latching out.

1.4. Thermistor (TH)

The thermistor function is an optional feature, which can be enabled or disabled via the menu function or remote communications. If enabled the thermistor function will continuously monitor the resistance between its input terminal and the ground reference. If the resistance surpasses the set point then the module will trip.

The range of the thermistor trip points are as follows:-

Minimum	500 Ohms
Maximum	2500 Ohms
Increment	100 Ohms

The thermistor unit will also trip on thermistor short circuit if a resistance of less than 40 ohms is detected.

When enabled the Display gives a constant indication of the actual resistance value versus the trip point so that thermistor monitoring can be achieved.

1.5. Shutdown Timer

The Shutdown Timer function is an optional feature, which can be enabled/disabled and the shutdown timer hours adjusted via the menu function. When enabled, the *Twister* module will stop the fan after the menu preset Shutdown Delay Time, i.e. 1 – 12 hours. Shutdown Timer status is displayed on the default screen.

1.6. Burp Starting

The Burp Starting function has been incorporated into the *Twister* unit to provide a means of gradually introducing air pressure into the bags. Burping is basically the repeated action of starting and stopping the fan for a limited number of "Burps" before running continuously.

The number and duty cycle of these Burps is both Menu and Remote communication selectable. The range of settings is as follows: -

Description	Min	Max
Burp Quantity	1	5
Burp 'On' time (s)	1	5
Burp 'Off' time (s)	1	5

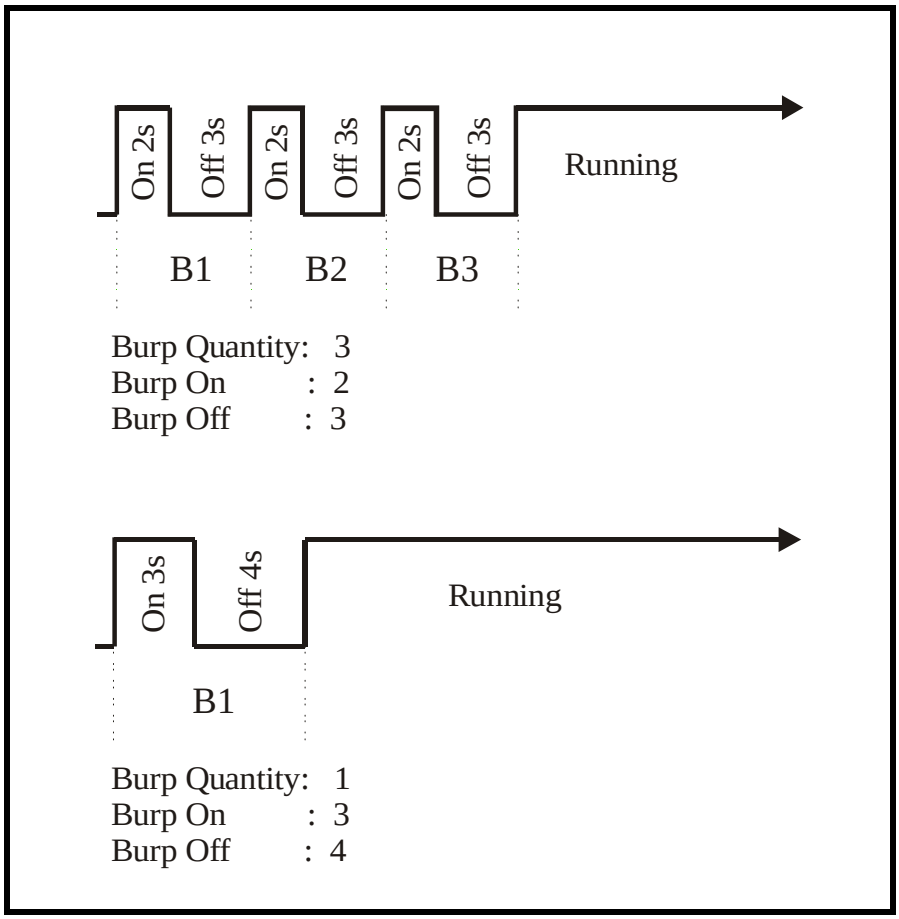


Figure 2.6.1 – Burping examples.

2. Operation

2.1. Duel Fan Operating Modes

Dual Fan operation is a fundamental feature of the *Twister* Fan Control Module. It is achieved by networking two *Twister* units together and selecting the mode of operation via a 5 pole cam switch. The network connection enables handshaking of sequence information between the two modules to occur.

This feature gives the operator a variety of options. The selection options are as follows:-

Switch Position	Description
1	Fan 1 only
2	Fan 2 only
3	Fan 1 start first
4	Fan 2 start first
5	Automatic

NOTE: To ensure switch selection the **Stop button/s should be pressed prior to switching**. The switch position is acknowledged only when **entering** the run state.

'Fan 1 only' and 'Fan 2 only' modes are self-explanatory except for one key point. Once selected and *Start* has been pressed, the fan selected not to run will enter a "Fan Held Off" mode. As discussed above, to change this mode the *Stop* button must be pressed.

'Fan 1 start first' and 'Fan 2 start first' function in the following manner. The nominated fan to start first will go through the motions of burping then the second fan will start DOL (Direct Online).

'Automatic' is identical to the previous two modes except that the first fan to start is alternated between both fans. This has the advantage of sharing the burping action between the two fan contactors and hence extending the lifetime of the equipment. The memory of the next fan to start is stored in RAM and will be cleared upon the removal of power from the *Twister* module.

If the switch selection was 3, 4 or 5 and one of the fans is stopped, it can be re-started DOL as long as the other fan is still running.

For independent fan operation the switch and network connections should be left unconnected. For connection details refer to the typical system drawing in the appendix.

2.2. Operation Screen

The operation screen is the screen where all the necessary operation information is given. All fault and trip conditions are given here as well as current parameters and status. Lines 1 and 2 display the type of module, time and module number (which is also the Modbus communication address). Lines 3 and 4 give the basic functional status of the system. It displays the protection settings, outlet state and several diagnostic values. Some typical screens are as follows:-

Bramco 08:36:23	-	8:36 a.m
Fan Control #02	-	Bramco Fan Control module, Address number 2.
READY TO START	-	No faults or trips registered > Ready to start.
TH: 325 / 1000 R	-	Thermistor registering 325 ohms, will trip at 1000 ohms.

Bramco 13:56:23	-	1:56 p.m
Fan Control #24	-	Bramco Fan Control module, Address number 24.
SC Trip	-	A short circuit has occurred. Press reset to clear.
OL: 100A 80S	-	Overload is set for 100A, overload curve is the 80 second.

Bramco 08:36:23	-	8:36 a.m
Fan Control #02	-	Bramco Fan Control module, Address number 2.
Thermistor Short	-	Thermistor short has occurred.
TH: 0000 / 1000 R	-	Thermistor resistance is 0 ohms.

Bramco 08:36:23	-	8:36 a.m
Fan Control #02	-	Bramco Fan Control module, Address number 2.
FAN HOLD OFF	-	Mode selected is for this fan **not** to run. 'Stop' to change.
EL: 0 / 500mA	-	There is no Earth Leakage. Trip point is 500mA.

Bramco 12:34:18	-	12:34am
Fan Control #05	-	Bramco Fan Control module, Address number 5.
I : 17 / 100 A	-	17 amps of current flowing, Overload trip point 100A
SC: 800 MS:1000A	-	Short Circuit trip point 800A, Motor Start at 1000A

Bramco 12:34:18	-	12:34am
Fan Control #05	-	Bramco Fan Control module, Address number 5.
I : 3.4 / 4.2 A	-	3.4 amps of current flowing, Overload trip point 4.2A
Im : 10.5A	-	Maximum current since power up was 10.5 amps

Bramco 12:34:18	-	12:34am
Fan Control #05	-	Bramco Fan Control module, Address number 5.
Fan Low Current	-	Fan current went below 1/3 of Overload trip point
SC: 800 MS:1000A	-	Short Circuit trip point 800A, Motor Start at 1000A

Bramco 12:34:18	-	12:34am
Fan Control #05	-	Bramco Fan Control module, Address number 5.
Waiting 2nd Fan	-	Other fan starting, will start DOL when it has finished.
Im : 820.5A	-	Maximum current since power up was 820.5 amps

2.3. Menu Operation

Twister module status can be monitored via the LCD and access to the operator menu is via a series of five push buttons (Up, Down, Left, Right and Enter). The setting of all the parameters of the module is via these buttons and a menu on the display. The menu is invoked by pressing the Enter **E** key on the front panel. The menu will be displayed and the various options may be selected by using the ⇑ (UP) and ⇓ (DOWN) keys to select the option, and the **E** (ENTER) key to enter that particular option.
To change any numerical values the ⇐ (LEFT) and ⇒ (RIGHT) keys are used to select the digit requiring change and then the ⇑ and ⇓ keys to alter its value.

After the correct value has been obtained the **E** key is used to enter its value. Once values have been altered the new setting **must be saved** before they will take effect.
The saving of new values is achieved by selecting the second item on the menu list. A code number or password will be required before any changes are saved.
This number is factory set to a three digit number. The Password is 567. This number will allow the operator to change any variable parameter.

2.4. Menu Structure

Following is the arrangement of the menu structure:-

Main Menu

Exit	- Return to main screen
Change Settings	- Go to Change Settings menu
Fault Log	- Go to Fault Log display
Set Clock	- Adjust date and time screen
Diagnostics	- Bramco Diagnostic screens

Change Settings

Exit	- Return to the main screen without saving
Save Changes	- Use the correct password (567) to save all the new Settings.
Outlet Number	- Select outlet number / Communication address
Current Setting	- Set motor overload, motor start and short circuit.
EL Setting	- Set Earth Leakage trip level and time.
Therm Setting	- Enable or disable thermistor, set thermistor trip level.
Burp Setting	- Set up quantity, time on and time off for Burp control.
Shutdown Timer	- Enable or disable shutdown timer, set timer.
Save Changes	- Use the correct password (567) to save all the new Settings.

Figure 3.4.1 – Menu Structure

2.5. Fault Log

The fault log retains in non-volatile memory important events that have occurred. The log retains the 120 most recent events with a date and time stamp. Following is a descriptive list of these events:-

Event	Description
Power On	Power applied to module
Aux Open	Aux Relay opens
Aux Closed	Aux Relay closed
OL Tripped	Overload trip
TH Tripped	Thermistor trip
SC Tripped	Short Circuit trip
EL Tripped	Earth leakage trip
OL Reset	Overload reset
TH Reset	Thermistor reset
SC Reset	Short Circuit reset
EL Reset	Earth Leakage reset

Table 3.5.1

Note that the oldest event stored is Log #1 and the most recent addition is Log #120. Since the log is circular the next recorded event will cause Log #1 to be discarded. A typical log recording would be as follows.

Review Datalog
Log #17
16-jul-98 12.21
Aux Closed

This log recording simply means that on the 16th of July at 12:21pm the auxiliary relay closed.

2.6. Diagnostics

The Twister module incorporates two diagnostic screens. Bramco personnel use these screens for calibration and testing purposes. They are also helpful in-service diagnostic tools.

2.7. Remote Display and Push Buttons

A remote display and/or buttons may be connected to the module via the DB25 connector on the module top. It is also possible to utilize a common remote display and/or buttons such that multiple modules can use the single remote unit. To implement the latter a dual pole selector switch is required to switch the two communication wires to the appropriate module.

The Twister module uses RS485 as its Module to Display communication layer. RS485 is robust, removing the impact of noise induced screen corruption. In addition, the remote display is “Smart”. It uses advanced noise rejection techniques providing smooth module switch transitions. It also has a touch activated LED backlight.

The remote buttons can operate independent of the display. This enables flame proof buttons to be easily utilised.

3. Communications Interface

A complete communication package is provided with the Twister. This communication package allows the user to remotely configure protection settings as well as to monitor various system parameters. The network can comprise of up to fifteen protection modules. Each module using a multidrop RS-232 serial communication port and acting as a slave on the Modbus ASCII serial network. The PLC/PC/Bramco Datahub interface must be configured as a master to talk to each address in turn. Each module will monitor the data on the serial line until it receives a command for its unique address, at which time it will respond with the data requested and an acknowledgment.

3.1. Connection

All the networked units are to be daisy chained together RX to RX (pin 2) and TX to TX (Pin 3). The Master (PLC/PC/Datahub) has these pins swapped, that is, RX to TX and TX to RX. The connections are as follows:

Master	FCM
TX	Pin 2 RX
RX	Pin 3 TX
0V	Pin10 0V

FCM (1)	FCM (n)
Pin 2 RX	Pin 2 RX
Pin 3 TX	Pin 3 TX
Pin10 0V	Pin10 0V

Please note that if other pins are to be connected to the Twister please consult Bramco. **Do not use a standard computer interface cable.**

Each module being connected to the network must have its own unique communication address (Outlet Number)**.** DO NOT USE ADDRESS 0**.** This address is the outlet number (refer chapter 2). Bramco has Address buffers available which can physically provide the communication address. This will remove the possibility of two modules being accidentally provided with the same number.

3.2. Communication Protocol

Modbus ASCII is the communication protocol used by the Twister. Operation is at 9600 baud with 7 data, even parity and 1 stop bit. Single or multiple register groups may be read or written to. Consult Bramco for more comprehensive advice on communication compatibility with all protection modules.

A typical communication request for a complete table read and write operation is following together with all the relevant tables and descriptions. Please note that selective writes to individual or particular groups of registers is possible and may be more efficient, dependant on circumstances.

Please note that all numerical values are in Hexadecimal.

Table Read

Colon	Address	Function	Start Address	No. Registers	Checksum	
:	XX	03	0000	001A	XX	CRLF

Table Write

Colon	Add	Funct	Start Add	No. Regs	Bytes	Data	Checksum
:	XX	10	0000	0012	24	*	XX	CRLF

** = 18 Data Packets of XXXX*

Error Handling

If an incorrect function code or a function with the wrong parameters is received by the Twister, it will respond with the except message - negative acknowledge.

eg.	:	XX	81	07	XX	CRLF
	Colon	Address	Function	Code	CHKSUM	

HEX	Register
0	Earth Leakage Trip (50 - 500) mA
1	Earth Leakage Time (50 - 500) ms
2	Reserved
3	Overload Trip (1.0 – 995) A (*Note A)*
4	Overload Time (10 - 250) s
5	Short Circuit Trip (Refer section 2.2)
6	Motor Start Trip (Refer section 2.2)
7	Reserved
8	Reserved
9	Reserved
A	Outlet Number (1-99)
B	Reserved
C	Reserved
D	Reserved
E	Thermistor Trip (0/500 – 2500) 0 = OFF.
F	Burp Quantity (1 – 5)
10	Burp On time (1 – 5) seconds
11	Burp Off time (1 – 5) seconds

Hex	Register	Description
0	Relay status	Relay Status. (Refer Table 5.2.3)
1	EL value	Earth Leakage Current (mA)
2	Load current	Load Current (A)
3	EL trip	Earth Leakage Trip Current Setting (mA)
4	EL time	Earth Leakage Trip Time Setting (mS)
5	OL trip	Overload Trip Current Setting (A) (*Note A)*
6	OL time	Overload Trip Time @ 2 x Full Load Current
7	SC trip	Short Circuit trip Current Setting (A)
8	MS trip	Motor Start Trip Current Setting (A)
9	TH trip	Thermistor Trip Setting (ohms)
A		Reserved
B		Reserved
C	Outlet No.	Outlet Number/Communication Address (1-99)
D		Reserved
E		Reserved
F		Reserved
10	EL status	Earth Leakage Status (Refer Table 5.2.5)
11	Micro status	Microprocessor Status (Refer Table 5.2.6)
12	SCOL status	Short Circuit Overload Status (Refer Table 5.2.7)
13		Reserved
14		Reserved
15	Max Current	Maximum Load Current registered (A)
16	TH Value	Actual Thermistor Value (ohms)
17	Burp No.	Number of Burps selected
18	Burp On	Burp ‘On’ time selected (s)
19	Burp Off.	Burp ‘Off’ time selected (s)

Table 4.2.2 – Read Registers

Bit No.	Description	1=
0	Auxiliary Relay	Open
1	Earth Leakage Latch Relay	Healthy
2	Reserved	
3	Reserved	
4	Reserved	
5	Overload Latch Relay	Healthy
6	Short Circuit Latch Relay	Healthy
7	Reserved	

Table 4.2.3 – Relay States Description

Bit No.	Description	1=
0	Reserved	
1	Reserved	
2	EL Relay (True = EL Healthy)	True
3	EL Latch Relay	True
4	Open Circuit Toroid	True
5	Reserved	
6	Reserved	
7	Reserved	

Table 4.2.4 – Earth leakage Status Description

Bit No.	Description	1=
0	Reserved	
1	Reserved	
2	Micro to SCOL Card Comm Failure	True
3	Reserved	
4	Reserved	
5	Reserved	
6	Reserved	
7	Micro to EL Card Comm. Failure	True

Table 4.2.5 – Microprocessor Status Description

Bit No.	Description	1=
0	Micro to SCOL Comm. Failure	True
1	Overload relay tripped	True
2	Motor Starting	True
3	Motor Running	True
4	Undercurrent condition	True
5	Thermistor Trip	True
6	Thermistor Short Circuit	True
7	Reserved	

Table 4.2.6 – Short Circuit Overload Status Description

Note A: Since values like 1.3A can be set on the lower ranges it is necessary to multiply the set point by 10 such that fraction elements are allowed for, hence 1.9A is 19 and 890A is 8900. This is for both transmission to and reception from the module. Please consult Bramco for further information in this regard.

3.3. The Bramco Datahub

The Bramco Datahub is designed to interface with up to 15 Protection Modules. The Datahub can transfer information to and from any of the networked modules to an external location such as a SCADA system on the surface. This facility gives enormous power to the mine. It will enable personnel to monitor the operation of specific machines from their PC on the surface. It will also enable remote parameter changes. An example being if the Engineer has decided to decrease the Overload trip point for a particular machine it is now possible with the touch of a button within the confines of his office.

The Datahub itself is a powerful microprocessor driven communication package. It comes with a bright 10.4" LCD display. It has a fully menu driven structure with various levels of password access. It has user defined machine definition capability, network configuration options and much much more. For more detailed information on the Datahub contact Bramco.

3.4. Communication Compatibility

Another option to establish communication between a module network and the external world is via a PLC or PC equipped with the necessary hardware and software. This is relatively simple provided the protocol discussed in this chapter is adhered to. A whole variety of PLC brands such as Allen Bradley, Modicon and Siemens can provide the necessary hardware for such communication. Bramco also has for sale pre-written software for an Allen Bradley PLC. This will assist in removing the development overhead for establishing communication with Bramco product.

4. Installation

Supply Voltage	110V 50/60 Hz or 40/50Hz (factory set)
Earth Leakage	Trip range 50 to 500mA in 10mA steps Time range 50 to 500mS in 10mS steps Uses Bramco EL toroids (40mm - 300mm.)
Overload	1.0 - 995 Amps 4 ranges (transparent to user)
Overload Curves	25 curves matched to IEC255-C Curves 10 – 250s referenced at two times the Full load current (2 x FLC). Curves 40 and 80 correspond to the previous **normal** and **extended** CPM1 curves. Requires two Bramco CT's. 1000:1
Motor Start/Short Circuit	Dependent on overload range 4 - 5000Amps Operating times as fast as 10mS. Uses same pair of CT's as Overload.
Thermistor	Optional feature, 500 – 2500 ohms when enabled. Thermistor short circuit detection (<40 ohms).
Burp Control	5. 1 – 5 Burps 6. 1 – 5 second 'On' time. 7. 1 – 5 second 'Off' time.
Shutdown Timer	Optional feature, ON or OFF Shuts off fan after delay when anabled. - 1 – 12 hours, 0.5 hr intervals.
Dual Fan Control	Optional dual fan control operation. 8. Fan 1 only 9. Fan 2 only 10. Fan 1 start first 11. Fan 2 start first 12. Automatic start (alternate starting fan)

Display	Local and/or Remote Display and buttons Remote Display communication is RS485 Practical operating distances over 100m.
Serial Communication	9600 baud multidrop RS232 Modbus ASCII protocol
Relay Contacts	5A 250VAC 100VA max
Material	Powder coated steel construction
Module Size	205 x 115 x 160 deep In Module Base 205 x 125 x 160 deep
Remote Display	96 x 96 x 100 deep 70mm behind panel Cut out 92 x 92 for facia mount

5. Installation Recommendations

For optimum performance of the Fan Control module, good installation practices are essential. Following is a list of some key recommendations for installation. A typical wiring system drawing is included in Appendix A.

5.1. Fan Control Module

The module can be mounted in either the horizontal or vertical planes. It is recommended that a Bramco Twister Base be utilised for this purpose. Ensure when fitting the module that the mating terminals are seated correctly.

Bramco recommends that the Fan Control module be located a practical distance away from phase switching elements such as contactors. This is to provide maximum EM noise immunity. It is also recommended that all contactors / relays have varistors fitted across their coils.

5.2. Remote Display/Buttons

The Remote Display/Buttons is an optional feature. It requires a 4 core screened cable. **The screen cable should be terminated at one end only**. It is recommended that the Display, like the module, be mounted in such a fashion as to maximise EM noise immunity.

The network connection between the module and the Remote display is made via the 4 core screened cable. The module end requires a male DB25 connection wired as per Appendix A.

The Remote Display terminal block has provision for externally wired buttons. This option is ideal for flame proof applications. Connection is made from the Remote Display terminal block to the appropriate external push button. The other side of the button is simply connected to earth. Short cable runs are recommended. The voltage selector switch on the remote display should be in the 12V position for the Twister Unit.

5.3. Earth Leakage Test Circuit

An Earth Leakage test circuit may be arranged to have up to 10 turns around the toroid. The advantage of providing multiple turns is that this will give a corresponding decrease in the power rating required for the test resistor. An example of this is as follows. If the EL test current is to be 600mA to trip but we have given the toroid 10 turns, the amount of current required is 60mA. This means that the test resistor required at 110V control voltage is 1800Ω 6.5W instead of 180Ω 65W if a single pass of the test circuit was made.

5.4. Earth Leakage Toroid

The EL Toroid can be mounted in both the horizontal and vertical planes. It is important that the silicon filled side of the Toroid is not mounted flush against the enclosure. This has the effect of making the toroid enclosure behave like a “shorted turn” and is detrimental to EL circuit sensitivity. It is also important to mount the toroid several core diameters away from devices which may generate large quantities of EM interference (such as contactors, transformers etc).

Since toroids are not ideal entities, care should be taken to run the cables symmetrically through the centre of the toroid. It is also advisable to utilise the smallest diameter toroid for the task at hand. Bramco has Earth Leakage Toroids with internal diameters ranging from 40mm up to 300mm.

Bramco recommends connection from the module to the toroid to be made with a twisted two core screened cable. The screen should be terminated to 0V at the module end only.

5.5. Overload CT

Bramco’s standard overload current transformer (CT) is 1000:1. Installation requirements are identical to the previous section on the Earth Leakage Toroid.

5.6. Network Connection

The network connection port is a DB9 connector and is necessary for dual fan control and Modbus communications. It must be a shielded cable terminated at one end only. All care should be taken in the cable route. Cable length should be kept to a minimum and segregation from contactor / relays kept to a maximum.

5.7. General

It is recommended that all other wiring to the Fan Control module be twisted cable. It is also recommended to minimise cable run lengths whilst maintaining maximum clearance from high voltage cables as much as practically possible.

By following these guidelines optimal performance of the Fan Control module will be obtained by reducing the possibility of electromagnetic interference.

6. Commissioning

- Do not have the Twister plugged into the base when you first connect the 110V control to the panel. It is possible to damage the module if a mistake has been made whilst wiring up the panel. Double check everything, presume that it all may be wired incorrectly.

- Do not connect a Remote Screen to the module till the correct polarity of the power supply has been confirmed.

- Confirm that the EL toroid has been mounted with the correct orientation i.e., open side away from the enclosure body. Confirm that 2 core screened cable has been wired to the EL toroid and that the cable has been segregated from heavy power cables and that the earth screen has been connected to earth at the module end only.

- Test the Overload function using an AC injection testing method at 15amps and 100amps.

- Test the Motor Start/Short Circuit function using an AC injection testing method at 100amps test current with MS/SC trip value set at 90amps.

- The EL test circuit current should be confirmed taking in to account multiple turns around the toroid of the test circuit wiring. It is recommended that the Earth Leakage test circuit be operated at the start of each shift on top of all commissioning tests.

- Ensure that all Dual Fan Switch positions function correctly.

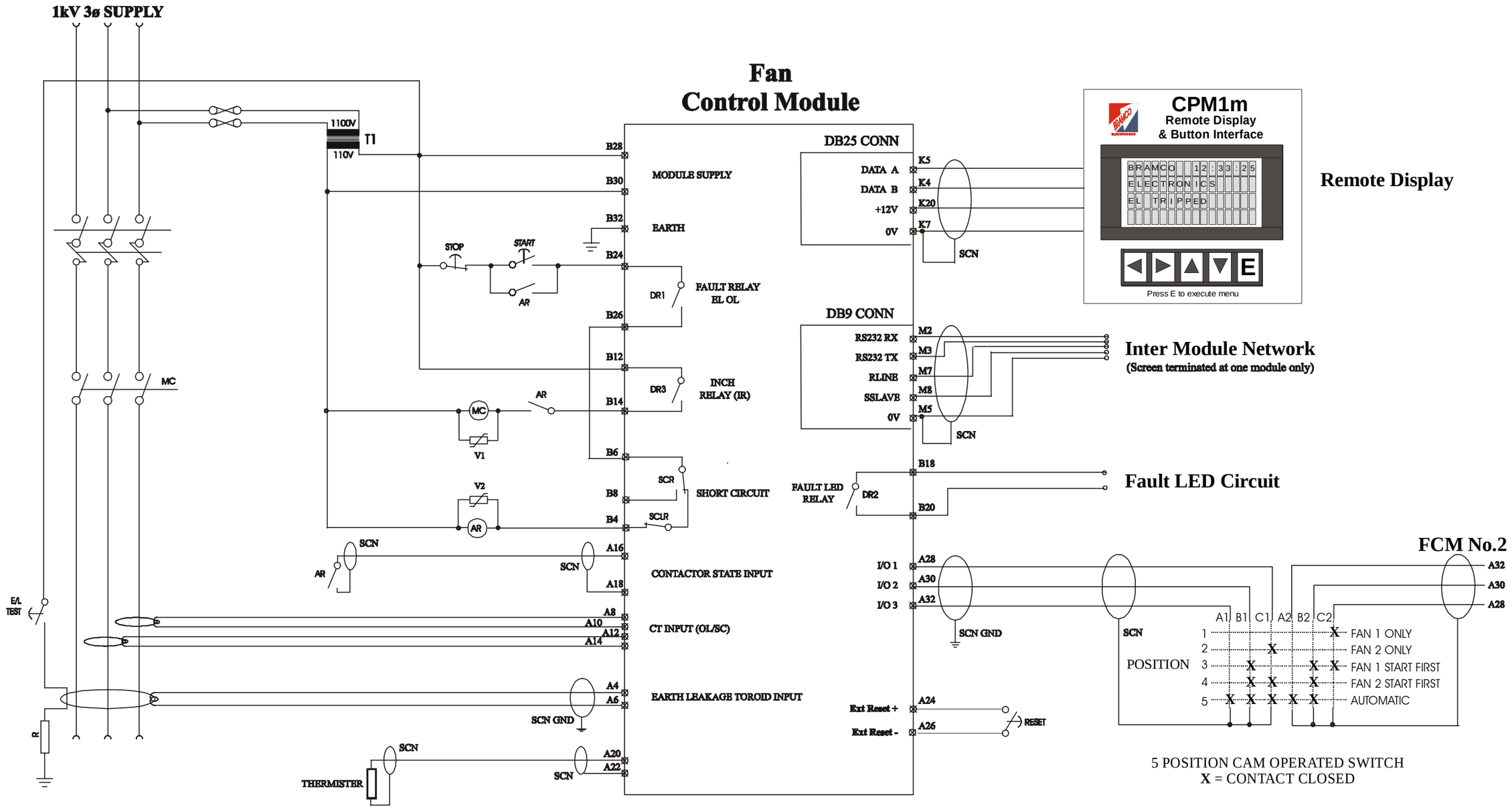
- Short circuit the Thermistor output terminals and ensure that the Twister unit trips on “Thermistor Short”.

7. Fault Diagnosis

To assist in the fault diagnosis of screen display messages, a large variety of typical fault messages are following giving possible solutions to the problems.

Message	Condition/Suggestion
Waiting 2nd Fan	- This fan is being held off from running whilst it waits for the other fan to run. - Network connection is not plugged in correctly on one of the two units. - A wire cross over within the network connection. - Internal card not seated correctly within the module
Low Fan Current	-The Fan has been started but the registered load current is less than 1/3 of the Overload trip point. -Overload set point has been set too high for the motor. -Motor has a true undercurrent condition. -CT connections absent or incorrectly fitted.
Fan Held Off	-Dual fan mode switch requesting fan to be held off. Press “Stop” and change switch position. -Faulty connection between switch and Twister unit.
TH Tripped	-Thermistor has tripped and is in a latched condition. -Thermistor has exceeded its trip temperature. -A short circuit (<40 ohms) has occurred between the thermistor terminals. -An open circuit has occurred between the thermistor terminals.
EL Tripped	-The Earth Leakage latch relay is in the latched condition. -An Earth Leakage fault has occurred, a suitably qualified person should investigate further before resetting.
OL Tripped	-The Overload Latch relay is in the latched condition -OL latch condition will always occur when first applying power to the module. -The load has exceeded the overload trip point for more than the respective time setting. -Ensure that the correct settings are in place for the corresponding load.
SC Tripped	-The Short Circuit/Motor Start latch relay is in the latched condition. -Either the Motor Start setting has been exceeded whilst the fan is starting or a Short Circuit has occurred thereafter. -Ensure that the correct settings are in place for the corresponding load.
Thermistor Trip	-Thermistor tripped. -Temperature exceeded set point. -Resistance set point set too low -Open circuit between the input terminals.
Thermistor Short	-Resistance between thermistor terminals is less than 40 ohms. -A short circuit in the wiring has occurred.
Open EL Toroid	-There is an open circuit somewhere in the earth leakage toroid circuit, be it a bad connection or a genuine open. -Test the EL connections and do a continuity check on the toroid itself (0-1R) -Ensure the EL card is properly secured to the top of the EC card and the pair are seated correctly in the module base.
SCOL COMM FAIL	-The microprocessor cannot communicate with the short circuit overload card -Ensure that the SCOL card is properly seated in the module base. -Interchange the SCOL card with a test sample to see if the card is faulty
EL COMM FAIL	-The microprocessor cannot communicate with the Earth Leakage card -Ensure that the EL card is properly seated in the module base. -Interchange the EL card with a test sample to see if the card is faulty

APPENDIX

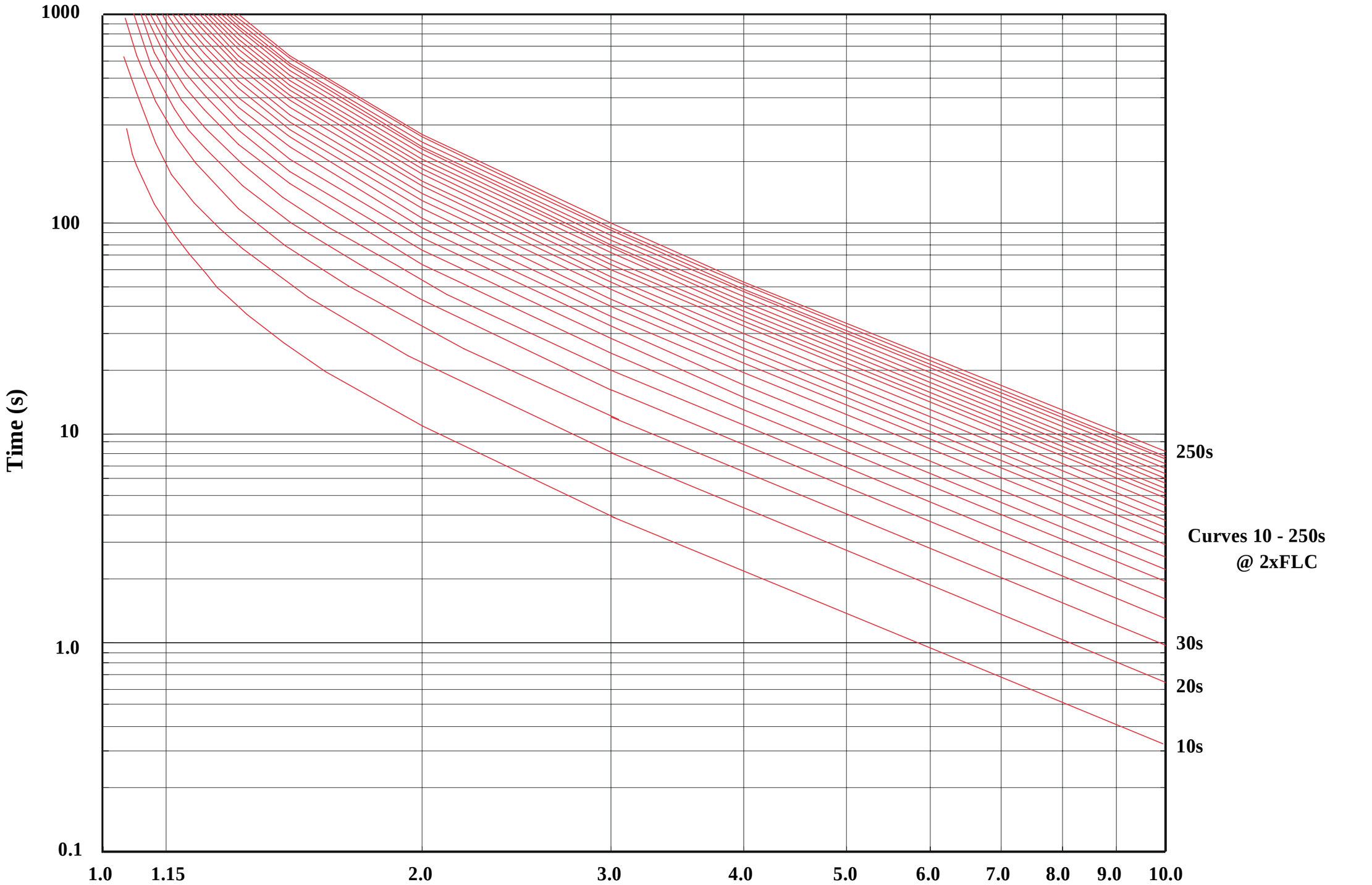


Note: 1/ Screened cables to be terminated as specified.
2/ All other wiring to be twisted where possible.
3/ Minimise cable run lengths whilst maintaining maximum clearance from high voltage cables and equipment.
4/ Driver relays 240VAC 5A MAXIMUM.

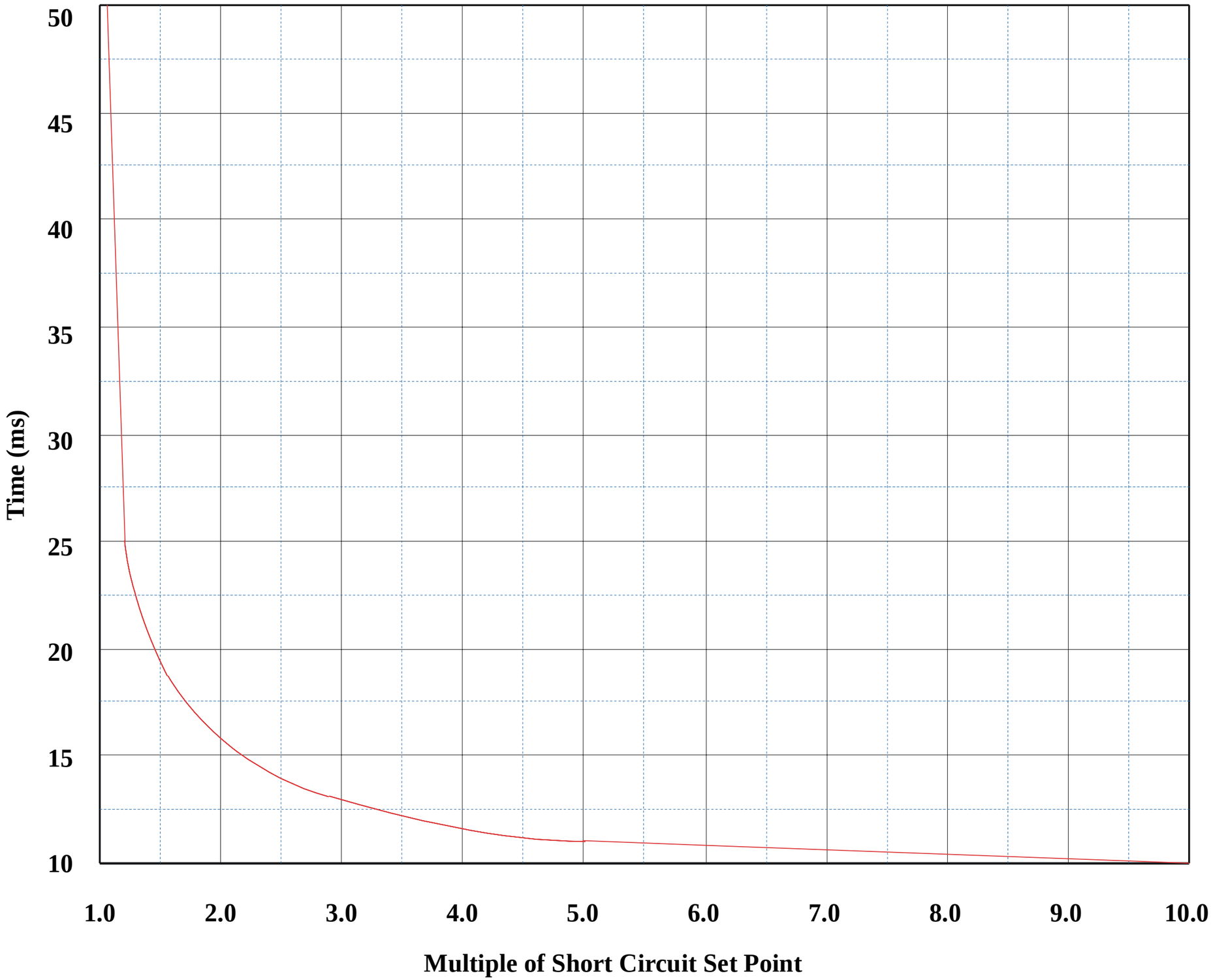
REV D: 14-08-00 - ADDED VARISTORS TO AR AND MC COILS
REV E: 20-09-00 - ADDED CONNECTOR NUMBERS FOR FCM No.2

Drawing Title	**Fan Control Module**	47 Orlando Rd Lambton 2299 Ph +61 2 4952 5366 Fax +61 2 49 524600	
Drawing Number	**A0053300**	DRW: SDM	Revision
		CHK: SDM	**E**
		DATE: 03-03-00	

APPENDIX B - OVERLOAD INVERSE TIME CURVES



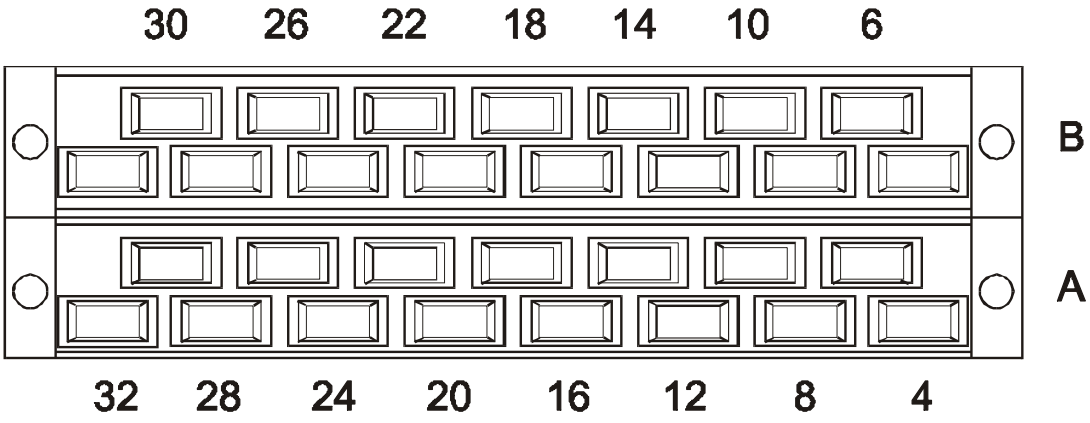
Short Circuit Curve



Appendix C - Twister Base Connection Diagram

A4	EL IN1	B4	DR4 NC
A6	EL IN2	B6	DR4 COM
A8	CT1 IN 1	B8	DR4 NO
A10	CT1 IN 2	B10	DR3 NC
A12	CT2 IN 1	B12	DR3 COM
A14	CT2 IN 2	B14	DR3 NO
A16	AR	B16	DR2 NC
A18	AR GND	B18	DR2 COM
A20	THERM	B20	DR2 NO
A22	THERM GND	B22	DR1 NC
A24	RESET	B24	DR1 COM
A26	RESET GND	B26	DR1 NO
A28	I/O 1	B28	NEUTRAL
A30	I/O 2	B30	ACTIVE
A32	I/O 3	B32	EARTH

Bottom view of connector



A00509

L20001

Appendix D – Twister Accessories/Options

STANDARD ACCESSORIES (TWISTER KIT)

PART NUMBER	DESCRIPTION
A00035	72mm ID Earth leakage toroid with foot mount
A00509	Single Twister unwired base
A00533	Twister Fan Control Relay
T10006	1000:1 Current transformers (2 required)

OPTIONAL ACCESSORIES

PART NUMBER	DESCRIPTION
A00034	40mm ID Earth leakage toroid
A00036	130mm ID Earth leakage toroid
A00037	200mm ID Earth leakage toroid
A00363	300mm ID Earth leakage toroid
A00156	Remote button plate (Option for A00259)
A00259	Remote flameproof button operation set
A00487	Remote Display
A00501	Communication Datahub
A00507	Communication buffer and port address