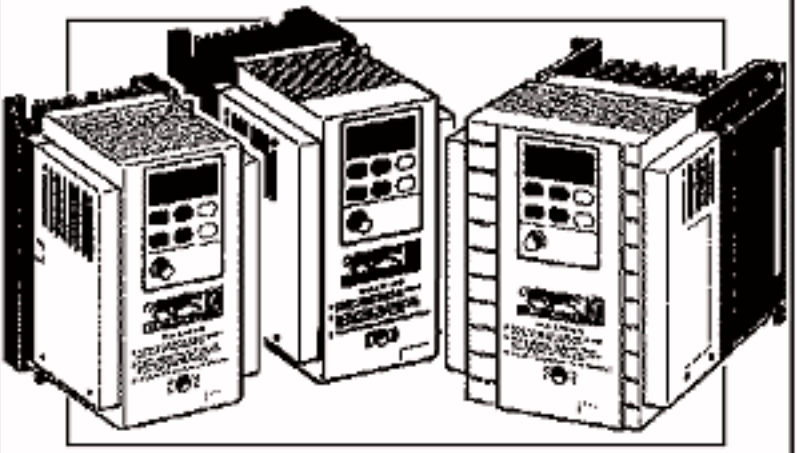


IMO Jaguar CUB

Jaguar Cub Micro-verter

High specification, sub-compact, single-phase inverters

Cub C40-EN Cub C75-EN Cub C150-EN

Power ratings: 0.4kW, 0.75kW and 1.5kW

User's Guide

NOTE - Failure to read and comply with these instructions prior to installation and use of the inverter may result in damage to the drive and/or driven equipment and subsequent invalidation of the warranty.

IMO JAGUAR CUB

Safety Precautions

Safety at Work

It is the responsibility of the owner, installer and user to ensure that the installation of the equipment and the way in which it is operated and maintained complies with the requirements of the Health & Safety at Work Act in the United Kingdom and other applicable legislation, regulations and codes of practice in the UK or elsewhere.

Only qualified personnel should install this equipment, after first reading and understanding the information in this publication. The installation instructions should be adhered to. Any question or doubt should be referred to IMO Precision Controls Ltd.

Operational Safety

Users and operators of the equipment must take all necessary precautions to prevent damage to equipment and especially to prevent the risk of injury to personnel working on or near the motor and the driven equipment.

The stop and start inputs should not be relied upon alone to ensure the safety of personnel. If a safety hazard could arise from the unexpected starting of the motor, an interlock mechanism should be provided to prevent the motor from running except when it is safe for it to do so.

In line with IMO's policy of continuous improvement, the contents of this document are subject to change without prior notice.

Part no. CUBMAN. Doc. ref. SWK C40-C150.
Issue IMO-2 May 1998

Warnings, Cautions and Notes

'WARNING', 'CAUTION' and 'NOTE' paragraphs appear in the text of this instruction manual wherever they are applicable as precautionary reminders to installers and operators.

WARNING
Denotes operating procedures which, if not correctly followed and strictly observed, may result in danger, personal injury or loss of life.

CAUTION
Denotes operating procedures and practices which, if not correctly followed and strictly observed, may result in damage to or destruction of equipment.

NOTE Notes call attention to information that is especially significant in understanding and operating the equipment.

Documentation

Every effort has been made by IMO Precision Controls Ltd to ensure that this document accurately and completely represents the *Jaguar Cub* range of inverters at the time of going to press. Information with respect to installation is necessarily generalised, and the supplier accepts no liability for contingencies over which he has no control in respect of the selection, installation and/or operation of equipment.

Product revisions may mean that certain information in this manual is not applicable to inverters manufactured before May 1998.

CAUTION
Read with care and fully understand this manual before wiring and using a *Jaguar Cub* inverter.

CAUTION
Jaguar Cub inverters use negative-logic techniques for control input circuits, and therefore may not be directly compatible with *Jaguar VX* and *VXS* inverters for some applications. Consult IMO Precision Controls Ltd for further information.

1 Contents

NOTE **— EMC and LVD Conformity —** A detailed statement appears on page 46

1 Inspection, Handling and Storage

1.1 Product Enquiries

If at any time you have a difficulty or a question regarding the inverter, please contact IMO Precision Controls Ltd at the address on the back cover of this Manual. The following information will be required:

(a) Inverter type (from the rating plate).

(b) Serial number (from the rating plate).

(c) Date of purchase.

(d) The nature of the problem — for instance, the location and extent of damage, the point which is unclear or the circumstances under which a malfunction occurred.

1.2 Inspection

Immediately after unpacking the inverter, please inspect as follows:

Check the rating plate on the side of the inverter cover to ensure that the inverter specification corresponds to the order specification.

Inspect the inverter to determine whether the unit has been damaged in transit. Look for loose components and damage to any part of the cover, side panels, mounting brackets or other components.

1.3 Storage Environment

- Temperature -25^{o}C to +65^{o}C (-13^{o}F to +149^{o}F) short-term during transport or storage.
- Relative humidity 20% to 90% non-condensing.
- *Avoid places where large variations in temperature occur, even if the relative humidity is within the specified limits. Such places could cause condensation or freezing and should be avoided.*
- The inverter should not be placed in direct sunlight. The surrounding atmosphere should ideally be dry, free from dust, corrosive or inflammable gases or vapours, oil mist, steam, dripping water and vibration.
- A salt-laden atmosphere is especially deleterious.

1.4 Storage Precautions

- Do not place the inverter directly onto the floor. It should always be placed on a stand or shelf.
- If the inverter is being stored in a less-than-ideal environment, cover it with a plastic sheet for protection.
- If there is a likelihood of humidity affecting the inverter, place a desiccating agent (such as silica gel) inside the inverter, and then cover it with a plastic sheet for protection.

1.5 Handling

CAUTION Hold and lift the inverter by the chassis/heatsink, **not** by the cover. The cover is a protective shield only, and is not intended for lifting and carrying. Lifting the inverter by the cover or other front parts may result in damage.

2 Specifications

Inverter type		*C40*	*C75*	*C150*
2.1 Output Ratings (3-phase)				
Nominal applied motor	kW	0.4	0.75	1.5
Rated capacity at 230V	kVA	0.95	1.7	3.3
Voltage range	V	0V to V_L		
Frequency range	Hz	0Hz to 120Hz		
Maximum continuous current	A	2.1	3.7	6.4
Overload capability		150% of rated current for 60s		
2.2 Input Ratings (1-phase)				
Rated current (rms) at 230V	A	4.1	7.2	14
Minimum supply capacity (1)	kVA	1.2	2.0	3.6
MCCB ratings	A	10	16	20
Fuse ratings	A	6	10	20
Phase; Voltage; Frequency		1-ph; 220-240V; 50/60Hz		
Variations	Voltage	+10% to -10%		
	Frequency	+5% to -5%		
2.3 Output Frequency				
Maximum Frequency	Hz	120Hz		
Base Frequency Setting Range	Hz	50Hz to 120Hz		
Starting Frequency Setting Range	Hz	1Hz to 6Hz		
Accuracy (Stability)	Analog	±1.0% of Max. O/P Freq., 25^{O}C ±10^{O}C		
	Digital	±0.01% of Max. O/P Freq., -10^{O}C to +50^{O}C		
Setting resolution	Analog	1/255 of Maximum O/P Frequency (8-bit)		
	Digital	0.1Hz up to 99.9Hz output frequency;		
		1Hz from 100Hz output frequency upwards.		
2.4 DC Injection Braking				
Braking torque % of full load torque		100%	100%	50%
Braking start frequency		3Hz		
Braking time		0.1s to 30s		
Braking level		0 to 100% of rated current		
2.5 General				
Enclosure		IP20		
Cooling method		Convection	Convection	Fan-assisted
Weight	kg	0.7	0.9	1.7

(1) $\text{kVA} = \dfrac{\text{Rated input current (rms) x Input voltage (rms)}}{1000}$

2.6 Carrier (PWM) Frequency Setting Range and approx. Inverter Heat Losses

When Function 15…			*= 0*	*= 1*	*= 2*	*= 3*	*= 4*	*= 5*
Carrier (PWM) Frequency		kHz	2.56	5.12	7.68	10.24	12.8	15.36
Heat Loss	*Inverter type C40*	W	33	38	39	44	47	50
	Inverter type C75	W	51	56	60	66	72	77
	Inverter type C150	W	84	93	99	108	116	123

3 Common Specifications

3.1 Control

Control features	PWM	Sinusoidal PWM output voltage/frequency control. Ultra-low acoustic noise realised by high-frequency carrier.
Operation facilities	Keypad	RUN, STOP.
	External	FWD, REV, coast-to-stop BX, external fault trip THR, alarm/trip reset RST, preset speed selection (X1)(X2).
Speed ref.	Keypad	Raise and lower speed by ∧ and ∨ keys.
	On-board pot.	Manually-adjustable potentiometer on keypad.
	External pot.	1kΩ, 1W.
	Analog input	0 to +5V DC, 0 to +10V DC or 4-20mA DC.
	Preset speeds	Three preset speeds selectable by configuration of terminals THR to X1 and BX to X2.
Accel/Decel	Time	0.01 to 60s manually independently selectable.
	Characteristic	Linear.
Frequency	Limiter	Output frequency can be held within selectable high and low limits.
	Bias	Analog frequency reference can be biased from 0 to 100% with respect to input reference.
	Gain	Analog frequency reference gain adjustable for 0V to +10V or 0V to +5V input reference, to give 100% output frequency.
	Skip-frequency	Three preset skip frequencies, 0 to 120Hz in steps of 1Hz. Bandwidth (hysteresis) for skip frequencies, 0 to 10Hz in steps of 1Hz.
Restart modes	Mains loss	Mains dip ride-through — selectable.
	OU or OC trip	Auto-restart attempts (5 max.) after overvoltage or over-current trip

Torque boost	Manual	32 proportional (V/f) patterns selectable from zero (no boost) to 31, high boost.
	Starting	Up to 150%+ at 1Hz.

3.2 Indication

Dynamic data (RUN)	Either frequency or current output can be selected to view on the LED display at the keypad and/or analog output at terminal FM.
Programming mode	LED display: Function number and data.
Trip mode	LED display: Trip code; last four trips recorded.

3.3 Protection

Supply surge voltage	L to earth: 1.2 x 50µs x 7kV. L to N: 1.2 x 50µs x 3kV.
Inverter overload trip	Non-selectable internal electronic overload protecting the power output IGBTs.
Overvoltage trip	Detection of overvoltage in the DC bus circuit at 410V DC.
Undervoltage trip	Detection of undervoltage in the DC bus circuit at 190V DC.
Overtemperature trip	Overtemperature detection of inverter heat sink.
Output short circuit trip	Inverter output circuit, factory-set instantaneous short circuit protection.
Earth (grnd) fault trip	Inverter output circuit, factory-set earth fault protection.
Motor thermal O/L trip	Internal electronic thermal overload relay, user-adjustable for motor type and rating.
Stall prevention	By temporary adjustment of V/f ratio, helps prevent the inverter tripping on overcurrent when O/P current exceeds preset limiting level during acceleration, deceleration, or at steady speed.
Alarm *Output*	Changeover contacts operate when a protective function is activated. Rating: 48V DC, 0.3A.
Reset	Alarm cancelled by either RESET key on keypad or terminal RST.
History	The last four alarms are recorded and can be viewed.

3.4 Operating Environment

Altitude	Derate the inverter if installed above 1000m (3280ft).
Location	The inverter is designed for installation in a shielded metal enclosure. Do not install the inverter in a dusty location or expose to corrosive gases, oil or water, or direct sunlight.
Ambient temperature	-10^{O}C to +50^{O}C (+14^{O}F to +122^{O}F) maximum.
Ambient humidity	20% to 90% non-condensing.
Vibration	5.9m/s^2 (0.6G) maximum.

4 Mechanical Installation

4.1 Environment

- The inverter should be installed in an adequately-ventilated steel enclosure.
- The inverter is designed to operate at full rating at an altitude not above 1000m (3280 ft). Derate if installed above this.

Install the inverter in a location that meets the following requirements:

- Ambient temperature between -10^{O}C and +50^{O}C (+14^{O}F to +122^{O}F).

For other operating environment specifications, refer to Section 3.4, page 5.

4.2 Position and Materials

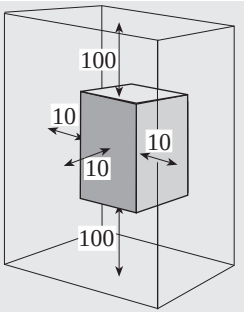
- Position the inverter vertically so that the inscriptions on the keypad panel are the right way up.
- Bolt the inverter firmly to a rigid structure.
- The material of the mounting panel should be able to tolerate the temperature attainable by the inverter heatsink, up to 90^{O}C (194^{O}F).
- The fixing bolts should be used with nuts or washers that will resist vibration.
- **Do not overtighten the fixing bolts.**

4.3 Cooling and Ventilation

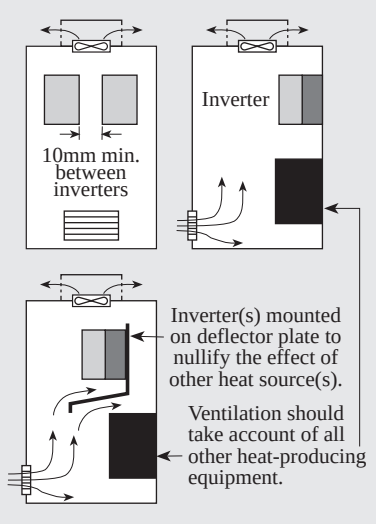
The inverter should be installed in an enclosure. The minimum clearances to adjacent equipment must be allowed as shown in the adjacent diagram.

If two or more inverters are to be installed in the same enclosure, they should ideally be side by side at a minimum spacing of 10mm.

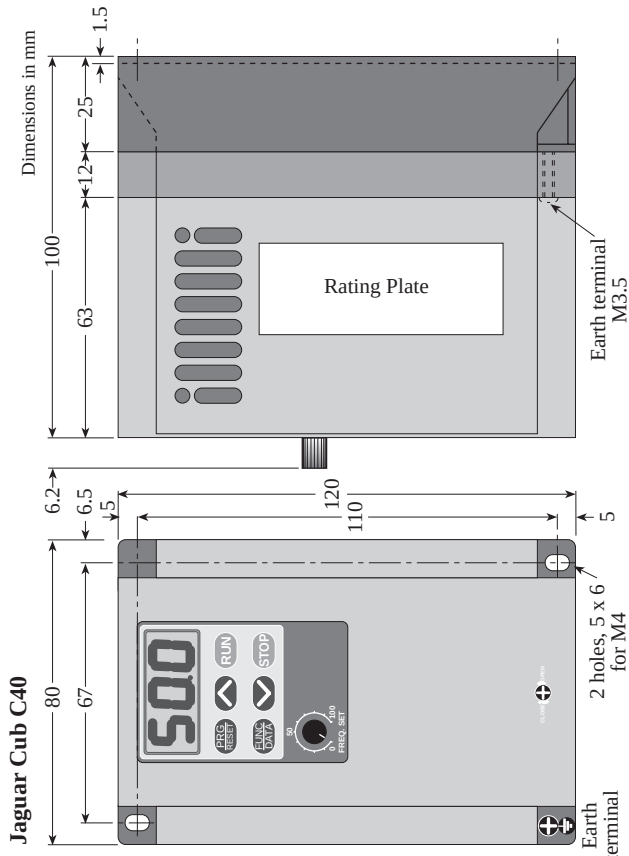
If an inverter is to be mounted above heat-producing equipment of any type, precautions should be taken to ensure that the heat generated by the lower unit does not affect the upper. A deflector plate may be fitted below the inverter to nullify the heating effect, as illustrated below.



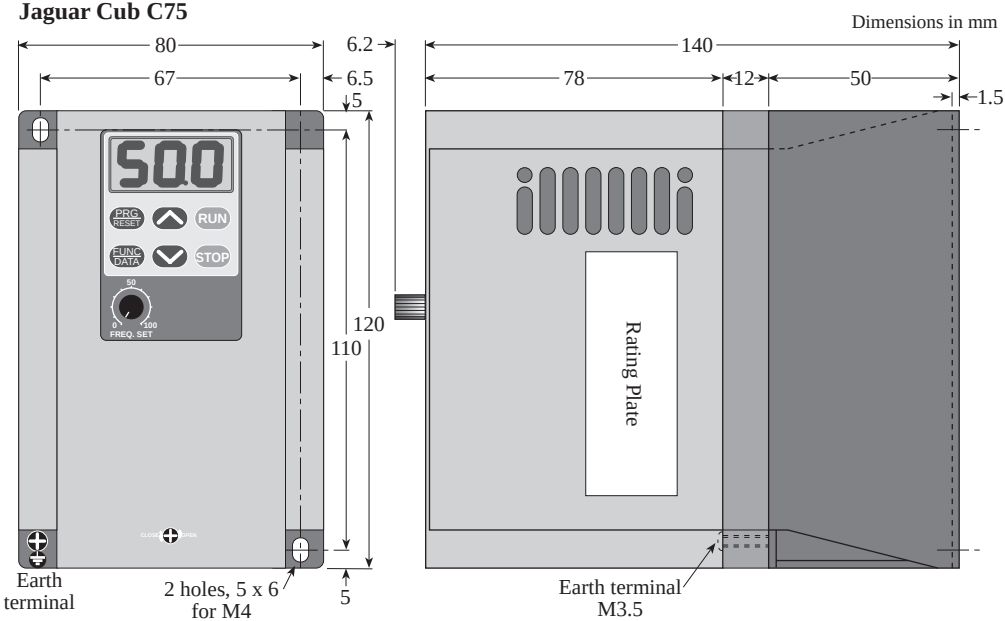
Minimum clearances (mm) *from the inverter to any other equipment.*



4.4 Dimensions

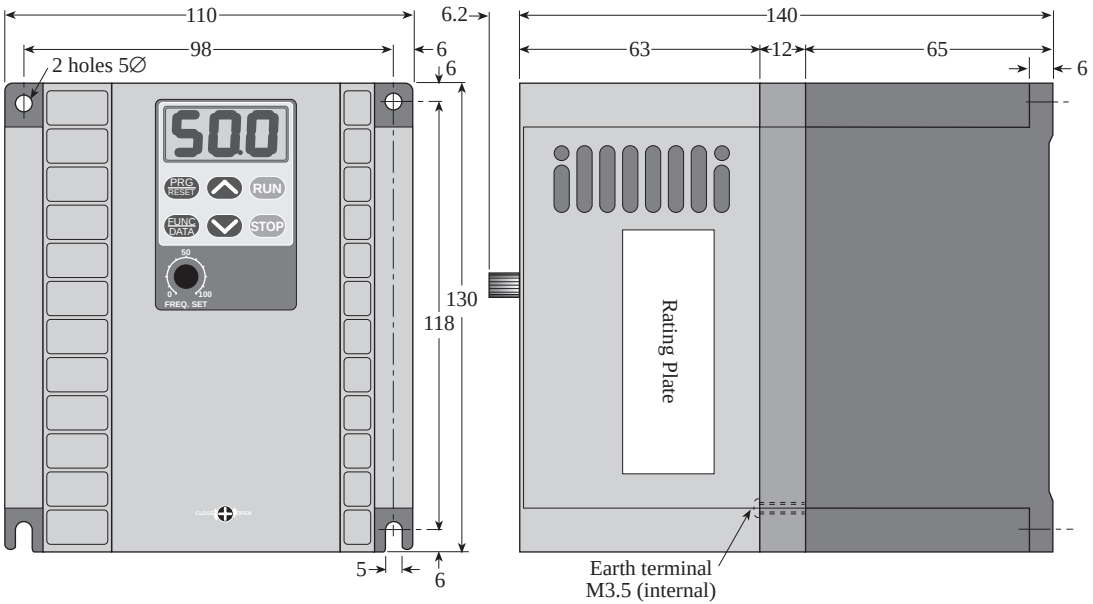


Jaguar Cub C75



Jaguar Cub C150

Dimensions in mm



5 Electrical Installation

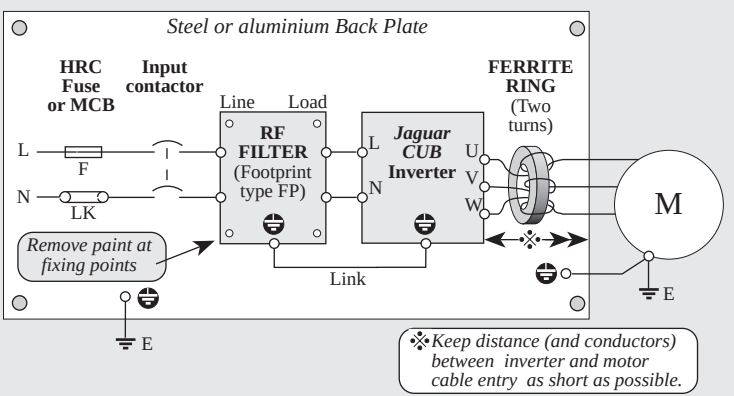
WARNING — SHOCK HAZARD
Do not touch any electrical parts of the inverter when the power supply is connected, even if the inverter is in STOP mode. After the power supply has been disconnected, the DC smoothing capacitor will hold a residual charge. It takes up to 5 minutes to discharge completely. To avoid danger, wait until the charge (CRG) LED is extinguished. (For location, refer to page 12).

WARNING — SAFETY EARTHING
The inverter chassis, motor base and equipment enclosure structure should be earthed in accordance with the national and local safety specifications in force.

CAUTION Do not connect a supply voltage that exceeds the standard voltages and variations specified on page 3, or the inverter will be damaged and the Warranty will be invalidated.

5.1 Power Connections Block Diagram

The diagram below is schematic for power connections only. For Electromagnetic Compatibility (EMC), refer to page 40.
For the Table of Cable Sizes and Maximum Lengths, refer to page 45.



5.2 Power Circuits

Access to Terminals

To remove the front cover, release the single captive screw near the lower edge of the cover, grasp the lower part of the cover firmly, pull downward to release the lower catches then lift towards you and upward. Power terminals are now accessible from the front.

Disconnect the keypad wiring at connector CN2 and lift the keypad off the locating pedestals. Control terminals are now accessible from the front. Set the keypad aside safely.

Power Input/Output Terminal Blocks

⏚	L	—	N	U	V	W

Power input and output terminal block.
NOTE
On C40 and C75 models the earth terminal is external.

CAUTION
Connect the power supply to the power terminals L, N, NOT to any of the the output terminals U, V, W, or to the control terminals.

CAUTION
Do not overtighten terminal screws.

Power Input Circuit

It is essential that the incoming supply circuit to the inverter is properly protected against short-circuit and earth faults.

The alternatives are a fused contactor or an MCB to ensure that the line and neutral are operated simultaneously. For ratings refer to page 3 or 45.

Power Output Circuit

CAUTION
Motor thermal overload protection is desirable. Use either the inverter electronic overload protection, or an external thermal overload relay.

CAUTION
Do not install filter capacitors, power factor correction capacitors, a surge absorber or any form of automatic switchgear on the output side of the inverter.

Connect a three-phase squirrel-cage motor to the output terminals U, V, W in the correct sequence, preferably using screened or armoured cable. If the operational commands FWD and REV do not match the desired direction of motor rotation, interchange any two of the U, V, W connections.

The motor circuit is protected by the inverter software. The installation of any type of automatic or semi-automatic switchgear in the inverter output circuit is generally not recommended unless early-break late-make switching can be provided. Consult IMO Precision Controls Ltd if in any doubt.

Power Output Circuit Isolation

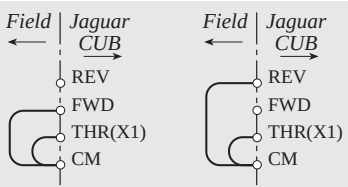
An isolator may be installed in the inverter output circuit for reasons of operational safety. Auxiliary contacts (early break, late make), should interface with the inverter control terminals. **On no account should the isolator be used to control the start/stop operation of the motor.** Consult IMO Precision Controls Ltd if in any doubt.

5.3 Control Circuits

WARNING
The STOP pushbutton on the keypad is effective ONLY when Function 02 = 0. If Function 02 is set to 1, an external RUN/STOP control circuit may be required at terminals FWD or REV for safety. The factory-fitted link, shown below, should be replaced by an external control contact.

WARNING
The RUN and STOP inputs, whether at the keypad or terminals FWD or REV, should not be relied upon to ensure the safety of personnel. If a safety hazard could arise from the unexpected starting of the motor, an interlock mechanism should be provided to prevent the motor from starting except when it is safe for it to do so.

FWD/REV Input Terminals



Terminals linked (as shipped). *Reverse motor direction.*

At the time of shipment, terminals FWD-CM are connected by a solid link and Function 02 is set to the default value 0. This puts the inverter into the mode in which it is operated by the RUN and STOP keys. To reverse, change the link.

NOTE Whilst terminal FWD or REV is connected to terminal CM, Function 02 cannot be changed.

Control Terminal Blocks

C40 and C75

⊗ CRG

BX (X2)	RST	REV	FWD	THR (X1)	CM	—	30C	30B
11	12	—	—	13	FM	C1	—	30A

C150

BX (X2)	RST	REV	FWD	THR (X1)	CM	—	30C	30B
—	—	11	12	13	FM	C1	—	30A

Control terminal blocks and location of CRG LED.

Control Circuits

Use 0.75mm^2 wiring. All control circuits should be screened as shown in the illustrations on pages 13 and 15. If possible, control wiring should be <20m in length to minimise pickup of unwanted 'noise'.

NOTE If control signals originate from a process controller, the screening should be terminated at the **source** end, NOT at the inverter as shown in all illustrations in this manual.

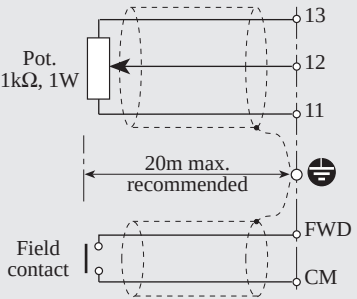
Control wiring should be installed at least 300mm distant from any power system cables, and if the two types of conductors must cross they should be arranged as nearly as possible at right angles to each other.

The function of each control terminal is given in the table on page 14 and illustrated in the diagram on page 15.

Control Input Circuit Components

Contactors or switch contacts should be carefully selected for high reliability and absence of closing defects. All coils should be fitted with suppressors. Refer to the diagram on page 13.

Screening of Control Circuits



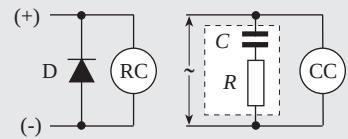
Screening of typical external control circuits.

Control screening should be connected to the earth terminal at the inverter end only, as shown above. If an external process controller or PLC is used, it is recommended that the screening should be connected at the end remote from the inverter.

CAUTION
Do not overtighten terminal screws.

Suppression of Control Circuits

Sudden changes of flux in the operating coils of relays and magnetic contactors induce high transient EMFs which may cause 'noise' on the control circuits, resulting in possible malfunction of internal or external circuits. It is advisable to suppress these coils in the manner shown below.



D = flywheel diode
RC = relay coil
C = capacitor
R = resistor
CC = contactor coil

Typically,
$R = 100\Omega$, $C = 0.1\mu f$

Surge suppression for relay and contactor operating coils.

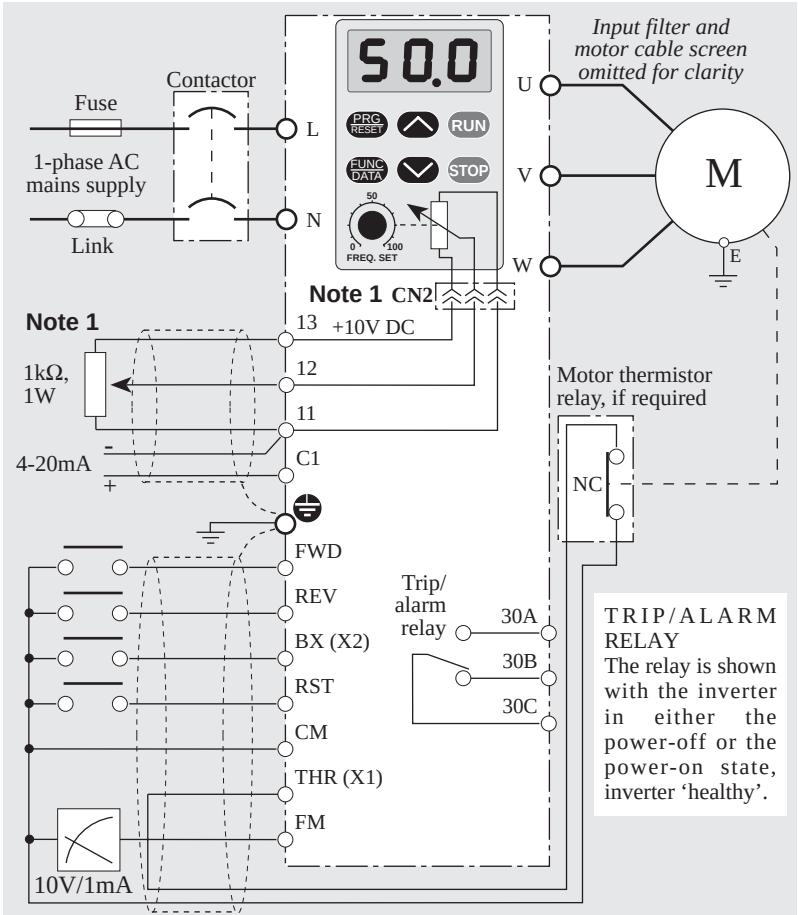
5.4 Terminals Functions List

Terminal	*Function*	*Description*
Inverter Power Circuits		
L, N	Power supply input	Single phase supply, 220V to 240V AC.
U, V, W	3-ph. power output	Variable voltage and frequency output.
⏚	Safety earth and screen terminal	**WARNING! Inverter must be earthed.**
Frequency Input Reference		
11*	Common 0V	Current sink for terminals 12, 13 and C1.
12	Reference input voltage	0 to +10V DC = 0Hz to max. freq. Z = 22kΩ.
13	Pot. (1kΩ, 1W) power supply	+10V DC power supply; max output 10mA.
C1	Reference input current	4 to 20mA DC = 0Hz to max. freq. Z = 250Ω.
Control Inputs		
FWD	RUN/STOP command	FWD-CM **closed** = RUN forward.
REV	RUN/STOP command	REV-CM **closed** = RUN reverse.
THR	External fault/alarm trip command	THR-CM **open** = OH2 trip and coast. Second function, preset speed X1.
BX	Coast-to-stop command	BX-CM **closed** = coast to stop. Second function, preset speed X2.
RST	Reset after trip	RST-CM **closed** momentarily = reset inverter.
CM*	Common 0V	Current sink for external control monitor circuits.
Monitor Output		
FM	Analog monitor	0V to +10V DC, **1mA max. output**, proportional to the value of either: Output frequency up to f_{max}, or Motor current, where +10V = 150% of I_{rated}. *Use either:* Voltmeter, 7V to 10V FSD, 10kΩ minimum, or Ammeter, 1mA FSD, with 0.5W 10kΩ series resistor. NOTE This output is pulsed at a constant 38.1Hz, with a modulated mark/space ratio.
Control Outputs		
30A, 30B 30C	Trip alarm relay	30B-30C normally closed (no alarm). 30A-30C closes when inverter trip operates. Rating 48V DC, 0.3A.

* Terminal CM is at the same potential as terminal 11.

5.5 Control Circuits and Terminals

NOTE Under no circumstances should this diagram be referred to for EMC. Refer to Chapter 9.



Note 1 CAUTION If using an external potentiometer, the keypad MUST be disconnected at connector CN2. If not, the inverter may be damaged. Access to CN2 requires removal of the front cover. Page 11, Section 5.2.

6 Keypad Functions

6.1 Keypad

At Power-on

When power is first switched on and whenever the inverter is stopped, the 7-segment LED display flashes.

The display normally shows frequency. This can be changed to show motor current. Refer to **Changing the Inverter Output Display** in the next column.

The selected parameter is displayed until changed; it is not affected by power-off.

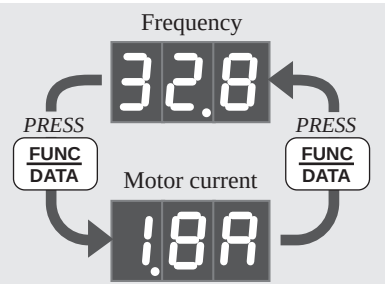
The frequency displayed is the actual frequency output if the inverter is running, or the frequency input reference when the inverter is stopped.

Keypad Mode

The inverter is factory-set in Keypad Mode, Function 02 = 0, and is locked into that mode by the standard link applied to terminal FWD-CM. **If it is desired to operate the inverter in terminal mode, this link must first be removed before Function 02 can be changed.**

6.2 Keypad Procedures

Changing the Inverter Output Display



RUN Mode Display (inverter running)

The 7-segment LED display, not flashing, shows:

- Output frequency or
- Motor current, *eg* 1.8A.

STOP command (keypad or terminal)**.** The following will be observed:

The motor decelerates;

The 7-segment LED display shows the decreasing frequency or current output;

When the output stops, the display flashes;

The display shows either frequency input reference or current output, as selected.

STOP Mode Display

The 7-segment LED display, flashing, shows:

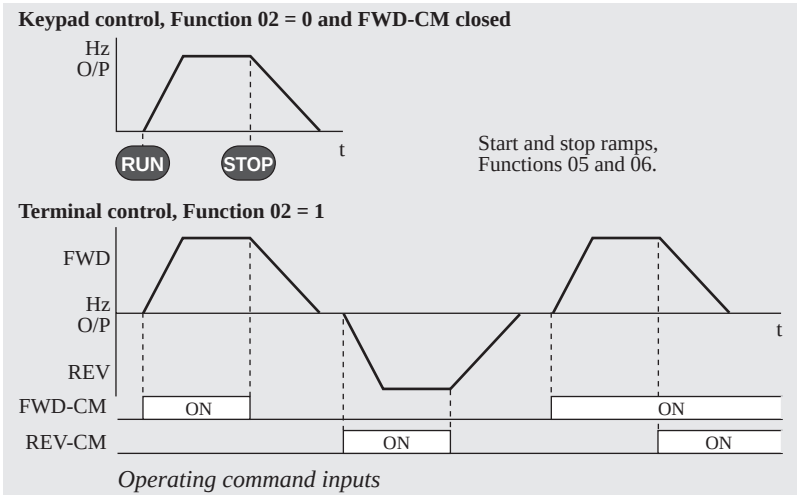
- Frequency input reference or
- Motor current, *ie* 0.0A when stopped.

RUN command (keypad or terminal)**.** The following will be observed:

The LED display stops flashing, becomes steady;

The motor accelerates;

The display shows the increasing out-



Operating command inputs

put frequency or motor current, as selected.

RUN/STOP Inputs

Refer to the diagram above.

- ***Keypad Mode*** *(Function 02 = 0)*

Terminals FWD-CM and REV-CM are disabled. Start and stop commands are given by the RUN and STOP keys on the keypad.

RUN Mode

The inverter will accelerate and decelerate in the time set in Functions 05 and 06.

STOP Mode

The inverter will decelerate when the STOP key is pressed whether it has reached full speed or not, and re-accelerate when the RUN key is pressed, whether it has reached zero speed or not.

- ***Terminal Mode*** *(Function 02 = 1)*

The keypad RUN and STOP keys are disabled. Start and stop commands are given at terminals FWD-CM or REV-CM. Both inputs ON = STOP.

Frequency Reference Inputs

- **∧ and ∨** ***Mode*** *(Function 01 = 0)*

The ∧ and ∨ keys control the maximum output frequency, forward and reverse equally.

- ***Analog Mode*** *(Function 01 = 1)*

Use either the FREQ. SET control on the keypad, or analog input terminals 12-11 or C1-11.

If both inputs 12-11 and C1-11 are used, the resulting reference is the sum of the two.

For Local/Remote control, arrange a changeover switch between these two inputs.

CAUTION
If terminals 12-11 and/or C1-11 are to be used, the keypad potentiometer **must first be disconnected at connector CN2**, otherwise the inverter may be damaged. Refer to the diagram on page 15.

PRG/RESET key

Irrespective of the settings of Functions 01 and 02, and provided that the inverter is not in TRIP mode, the PRG/RESET key sets the inverter into PROGRAM mode, allowing the operator to select the menu of Inverter Functions (Chapter 7).

When PRG mode is selected, the LED display shows the Function available, *eg* F00.

For the explanation of procedures and the use of the ∧ and ∨ keys, refer to the diagrams on this and the following pages.

- *TRIP Mode*

In TRIP mode, the PRG/RESET key resets the inverter. Refer to Chapter 8.

FUNC/DATA key

- *PROGRAM mode*

The Function/Data key calls up the Data of the Function selected in PROGRAM mode.

For the explanation of procedures and the use of the ∧ and ∨ keys, refer to the diagrams on this and the following pages.

- *RUN mode or STOP mode*

The FUNC/DATA key selects frequency or current for display on the 7-segment LED display.

Refer to **Changing the Inverter Output Display**, page 16.

NOTES

1 All Functions can be read in both RUN and STOP modes, and all Functions can be adjusted in STOP mode. In RUN mode, some Functions are 'read only'. Refer to Chapter 7.

2 If Function Data is protected by Function 00 = 1, adjustment is not possible. Refer to Function 00 pages 20 and 22.

To SELECT a Function

Flashing in STOP mode S0.0

PRESS PRG/RESET to SELECT next Function → F00

then either

PRESS ∧ …to move to next Function → F01

or *PRESS and HOLD* ∧ to scroll forwards. At F 33, the sequence continues from F 00.

or *PRESS and HOLD* ∨ to scroll backwards. At F 00, the sequence continues from F 33.

PRESS PRG/RESET to exit and return to operating-function data screen at any time.

NOTE
Next selected Function will be F00.

To READ Function data

Example —

Function selected…

PRESS

FUNC DATA

present data value

PRESS

FUNC DATA

to ACCEPT without change and step to next Function.

PRESS

PRG RESET

to exit and return to operating-function data screen at any time.

NOTE
Next selected Function will be F00.

To ADJUST Function data

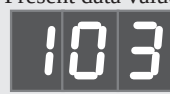
Example —

Function selected

PRESS

FUNC DATA

Present data value



then either

PRESS

or *PRESS*

PRESS

FUNC DATA

to STORE the data and go to the next Function.

PRESS

PRG RESET

to exit and return to operating-function data screen at any time.

NOTE
Next selected Function will be F00.

NOTE Some Functions are 'read only' when the inverter is running, and can be adjusted only when the inverter is stopped. Refer to Chapter 7.

To RESTORE Function Data to Default

Refer to Function 17, page 20 or 26.

7 Inverter Functions

7.1 Functions Data

Function		*Setting Range*	*Unit*	*Resol.*	*Def.*	
No.	*Name*					
00	Data protection	0 = No protection 1 = Data protected (read only)	—	—	0	
01	Freq. input reference — *mode*	0 = ∧ and ∨ mode 1 = Analog mode, FREQ. SET or 12/C1-11	—	—	1	
02	Control — *mode*	0 = Keypad mode, RUN, STOP keys 1 = Terminal mode, CM-FWD/REV	—	—	0	
03	Max. output freq.	50 to 120	Hz	1	50	
04	Base frequency	50 to 120	Hz	1	60	
05	Acceleration time	0.0 to 60	s	0.1	3.0	
06	Deceleration time	0.0 to 60	s	0.1	5.0	
07	Torque boost	0 (low boost) to 31 (high boost)	—	1	13	
08	Electronic thermal overload — *mode*	0 = Inactive 1 = Active (standard 4-pole motors) 2 = Active (inverter-rated motors)	—	—	2	
09	Electronic thermal overload — *level*	30% to 105% of inverter rated current	%	1	100	
10	Restart mode — *mains loss*	0 = Inactive; no restart 1 = Active	—	—	0	
11	Freq. input reference — *gain*	0 = Normal, for 0V to 10V input 1 = Fixed gain for 0V to 5V input	—	—	0	
12	DC injection braking — *level*	0 to 100 % of inverter rated current	%	1	50	
13	DC injection braking — *time*	0.0 = Inactive 0.1 to 30	s	0.1	0.0	
14	Starting frequency	1 to 6	Hz	1	1	
15	PWM carrier freq.	0 = 2.56kHz, to 5 = 15.36kHz	—	—	0	
16	Protection history	Last 4 protection trips, last trip first	—	—	—	
17	Data initialisation	0 = Hold custom settings 1 = Reinstate factory default values	—	—	0	

Functions in ☐ can be adjusted while the inverter is running.
Resol. = resolution; *Def.* = Factory-set default — refer to Function 17.

Function		*Setting Range*		*Unit*	*Resol.*	*Def.*	
No.	*Name*						
18	Restart mode *— OU and OC trip*	0 = Inactive 1 = Active; 5 attempts max., 1st attempt 0.5s after trip		—	—	0	
19	O/P current stability	0 to 10		—	1	4	
20	Skip frequency *— hysteresis*	0 to 10		Hz	1	3	
21	Skip frequency 1	0 to 120		Hz	1	0	
22	Skip frequency 2	0 to 120		Hz	1	0	
23	Skip frequency 3	0 to 120		Hz	1	0	
24	Freq. limiter — high	0 to 100% of max. frequency		%	1	100	
25	Freq. limiter — low	0 to 100% of max. frequency		%	1	0	
26	Freq. input reference *— bias*	0 to 100% of max. frequency		%	1	0	
27	THR terminal *— function*	0 = External alarm input 1 = Preset speed selector X1		—	—	0	
28	BX terminal *— function*	0 = Coast-to-stop input 1 = Preset speed selector X2		—	—	0	
29	Preset speed 1	0.0 to 120	0.0 to 99.9	Hz	0.1	0.0	
			100 to 120	Hz	1	0.0	
30	Preset speed 2	0.0 to 120	0.0 to 99.9	Hz	0.1	0.0	
			100 to 120	Hz	1	0.0	
31	Preset speed 3	0.0 to 120	0.0 to 99.9	Hz	0.1	0.0	
			100 to 120	Hz	1	0.0	
32	FM terminal V adjust	0 to 99 (full scale)		—	1	85	
33	FM terminal *— selector*	0 = Frequency output 1 = Current output		—	1	0	

Functions in ☐ can be adjusted while the inverter is running.
Resol. = resolution; *Def.* = Factory-set default — refer to Function 17.

7.2 Descriptions of Functions

XX Function	Title boxes with a **heavy type and border** indicate Functions which can be adjusted while the inverter is in RUN mode.
XX Function	Adjustable only in STOP mode.

Data Protection

00 Data protection

Function data settings can be protected against accidental changes. When Function 00 = 1, all data becomes 'read-only'.

To change Function 00 from 0 to 1, stop the inverter, select Function 00, press FUNC/DATA press the STOP and ∧ keys together, then FUNC/DATA. Press the STOP and ∨ keys to change back.

Operating Functions

01 Frequency input reference

Jaguar Cub inverters can be controlled entirely at the keypad, or by inputs to control terminals only, or, as a third option, by a combination of keypad inputs and terminal inputs. (Refer also to Function 02.) As delivered, Function 01 = 1.

Keypad reference mode (∧ and ∨ keys)

When Function 01 = 0, the frequency input reference is provided by the keypad ∧ and ∨ keys.

Analog reference mode

When Function 01 = 1, the ∧ and ∨ keys are disabled and the frequency input reference is provided by the setting of the manual potentiometer control knob, FREQ. SET, on the keypad, or by a 0V to +10V (or 0V to +5V, see Function 11) analog voltage input at terminals 13-12-11 or a 4-20mA analog input at terminals C1-11.

The output frequency may be further modified by the Input Frequency Reference Gain, Function 11 and the Bias Frequency, Function 26.

NOTE If both a voltage and a current input signal are applied at terminals 12-11 and C1-11, the input reference is the sum of the two.

CAUTION
If terminals 12-11 and/or C1-11 are to be used, the keypad pot. **must first be disconnected at connector CN2**, otherwise the inverter may be damaged. Refer to the diagram on page 15.

02 Control mode

Jaguar Cub inverters can be controlled entirely at the keypad, or by inputs to control terminals only, or, as a third option, by a combination of keypad inputs and terminal inputs. (Refer also to Function 01.)

Function 02 cannot be changed while the link at terminals FWD-CM is in place. If the link has been removed and replaced by external RUN/STOP control circuits (FWD/REV), the contacts must be open.

Keypad control mode

When Function 02 = 0, start/stop commands can be given only by the RUN and STOP keys at the keypad.

When terminals FWD and CM are linked (as delivered), the inverter will run in a forward direction only. To reverse the motor direction, remove the link from FWD-CM and link terminals REV-CM.

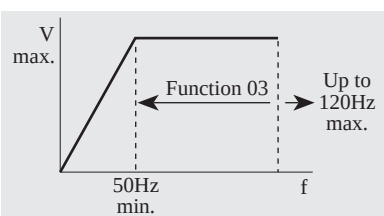
Terminal control mode

When Function 02 = 1, the RUN and STOP keys are disabled and start/stop commands can be given only at terminals FWD and REV.

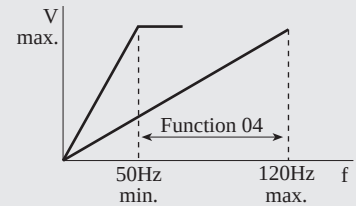
03 Maximum output frequency

WARNING *Jaguar Cub* inverters can deliver output frequencies up to 120Hz. It is relatively simple to apply an input reference that could overspeed the motor or driven equipment, and so create danger. Check the capability of the motor and the driven equipment before changing this Function.

The maximum frequency function limits the inverter output frequency, regardless of frequency input reference. Maximum frequency can be set from 50Hz to 120Hz in steps of 1Hz.



04 Base frequency



The output voltage and frequency of the inverter are proportional up to base frequency, giving a theoretically constant torque output at the motor shaft.

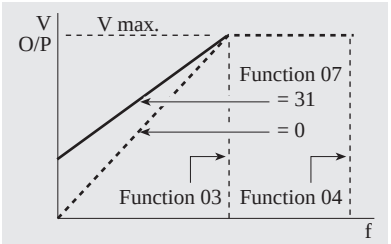
NOTE If base frequency is set higher than maximum frequency (Function 03), the output voltage cannot rise to rated voltage.

05 Acceleration time

06 Deceleration time

Factory-set default values are 3 seconds for acceleration time and 5 seconds for deceleration time. The two times can be set independently in the range from zero to 60s.

07 Torque boost



Torque boost enables the motor to develop increased torque at low frequency. The boost characteristic is linear, tapering to zero boost at full V/f. For fans and centrifugal pumps use 0 or 1. The factory-set default value of Function 07 is 1.

08 Thermal overload — mode

Protects the motor against overload. The characteristic is 'inverse time'.

There are three modes of Function 08:

0 **Inactive.**

1 **Active.** Suitable for 'standard' 4-pole induction motors running at rated frequency.

2 **Active.** The factory-set default. For inverter-rated motors running at reduced frequency.

09 Thermal overload — level

Function 09 permits the overload level to be set within the range of 30% to 105% of motor full load current rating.

Setting: Function 09 (%)

$$= \frac{\text{Motor rated current}}{\text{Inverter rated current}} \times 100$$

For very long motor cables it may be necessary to increase the calculated value slightly. For further information, please consult IMO Precision Controls Ltd.

10 Restart mode — mains loss

WARNING Automatic restarting may be a hazard to personnel working in the vicinity of the motor or the driven machine.

There are two modes of Function 10. The response in the inactive mode depends on whether the inverter is in STOP or RUN mode when the power-loss occurs:

0 **Inactive.** This is the factory-set default.

Inverter in STOP mode

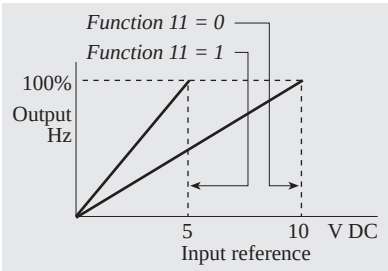
The inverter remains stopped after power is restored. The LED display shows no alarm indication.

Inverter in RUN mode

The motor does **not** restart. The LED display will indicate an LU (undervoltage trip) when the voltage is restored.

1 **Active.** Valid only if the inverter is in RUN mode and the power supply is restored while the LED display shows LU. The motor restarts 0.5s after the power supply is restored.

11 Frequency input reference — gain



Enables the inverter to accept either a 0V to +10V input reference, or 0V to +5V. Function 11 = 0 is the 0V to +10V setting — factory-set default.

12 DC Injection braking — level

Sets the braking level at a selected percentage of inverter rated current. The braking torque will be dependent on the motor characteristics.

0 = No braking current applied
…increasing in steps of 1% to…
100 = 100% of inverter rated current.

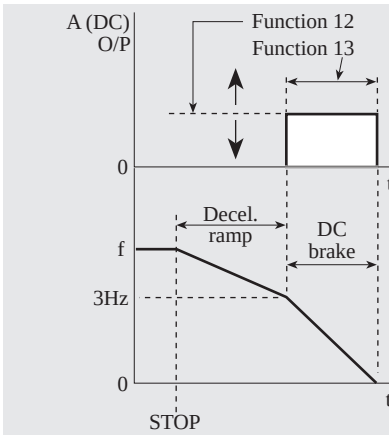
The factory-set default value is 50%.

13 DC Injection braking — time

Sets the time (max. 30s) during which braking will be applied to bring the motor to rest.

When Function 13 = 0.0 (the factory-set default) braking is not applied. Braking time can be set from 0.1s to 30s in steps of 0.1s.

If the load inertia is high, it is possible that the drive system cannot absorb the rate of energy dissipation if a low time value is set. In such a case, the driven machine may continue to rotate after the braking cycle is complete.



14 Starting frequency

Starting frequency can be set at any value from zero up to 6Hz in steps of 1Hz.

Factory-set default is 1.

15 PWM carrier frequency

The PWM carrier frequency is adjustable from 2.56kHz to 15.36kHz.

Setting Ranges

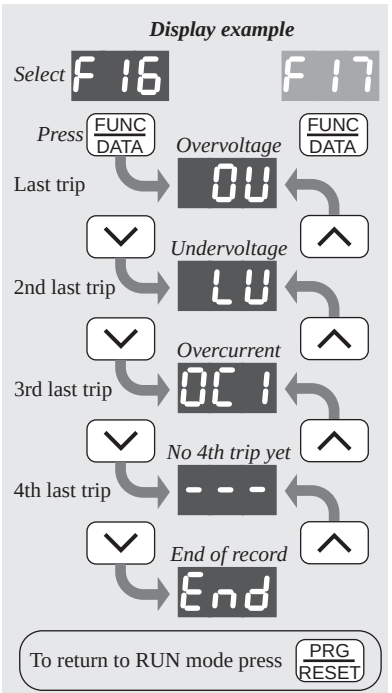
0 = 2.56kHz
1 = 5.12kHz
2 = 7.68kHz
3 = 10.24kHz
4 = 12.8kHz
5 = 15.36kHz

The factory-set default is 0.

The higher the PWM frequency, the more

closely the output current wave approximates to a pure sine wave. Audible noise at the motor is lower at the higher PWM frequencies, but care should be taken to allow for higher losses within the inverter and increased RF emissions from the motor cables. Refer to Chapter 9.

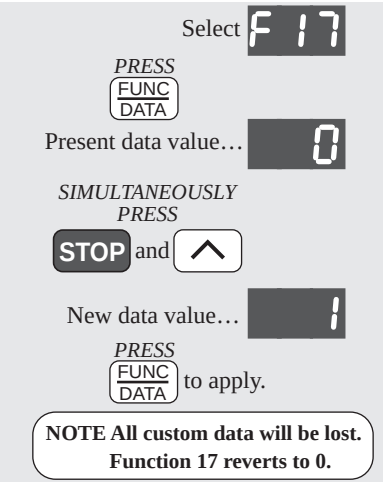
16 Protection history



The inverter holds the trip codes of the last four trips in memory. These are accessed as shown in the diagram above. When a new trip occurs, it is stored as a 'new' 1st trip and the existing 4th trip is deleted. For trip codes refer to page 30.

17 Data initialisation

Restores the factory-set default values and clears the protection history.



18 Restart mode — OU or OC trip

Function 18 allows the inverter to restart after either an overcurrent trip or overvoltage trip occurring during RUN mode.

0 **Inactive.** The inverter does **not** restart. This is the factory-set default.

1 **Active.** 0.5s after the trip has occurred, the inverter will make a series of attempts to restart. If restart has not occurred after 5 attempts, the inverter will go into STOP mode.

WARNING Automatic restarting may be a hazard to personnel working in the vicinity of the motor or the driven machine.

19 Output current stability

When induction motors are lightly-loaded, instability can occur due to torque pulses corresponding to the 'dead time' of the inverter IGBTs. Output current can be controlled to compensate for this effect by modifying the gain of the internal damping factor, Function 19, to stabilise the output current waveform.

To compensate for instability, set Function 19 lower if the motor has more than 4 poles, higher if the loading is low.

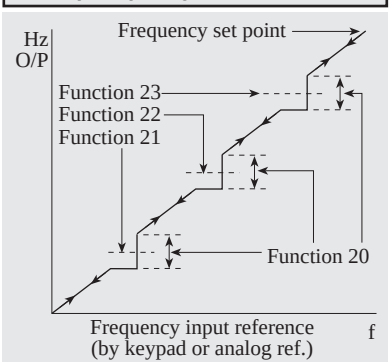
The setting range is 0 to 10, and the factory-set default is 4.

20 Skip frequency hysteresis

21 Skip frequency 1

22 Skip frequency 2

23 Skip frequency 3



Up to 3 frequencies can be set so that during acceleration and deceleration the inverter output skips from one level to another to avoid any frequencies that give rise to mechanical resonance. The hysteresis bandwidth is the same for all three. The skip frequencies are at the mid-point of the hysteresis band.

Setting ranges:

Hysteresis: 0Hz to 10Hz in steps of 1Hz.

Skip frequencies (subject to limits imposed by Functions 03, 24 and 25):

0Hz to 120Hz in steps of 1Hz.

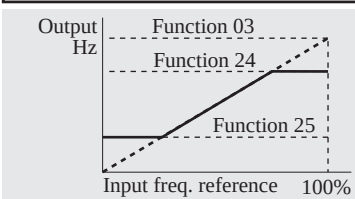
Factory-set defaults are:

hysteresis 3Hz, skip frequencies 0Hz.

NOTE Skip frequency 1 may be lower or higher than skip frequency 2 and/or 3. Values assigned need not correspond to the numerical sequence.

24 Frequency limiter — high

25 Frequency limiter — low



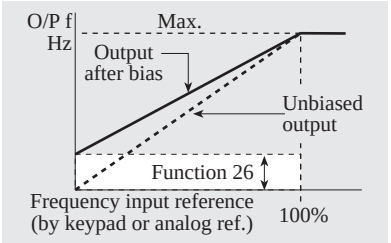
Output frequency can be restricted by setting high and low limits as percentages of maximum frequency, Function 03.

If the low limit is set to a value above that of the high limit, the high limit has priority and the low limit is ignored.

When the low limit is set ≠ 0 and if the frequency input reference = 0, the motor accelerates to the low limit when a RUN command is given. It will run at that frequency until the frequency input reference is increased.

WARNING If a low limit is set, the motor will rotate when a RUN command is given, keypad or terminal — **even if the input reference is zero**.

26 Frequency input reference — bias



Function 26 adds a positive bias to the frequency input reference. The input reference can be biased from zero to 100% of maximum frequency in steps of 1%.

WARNING If a bias is set, the motor may rotate when a RUN command is given, keypad or terminal — **even if the input reference is zero**.

27 THR terminal — function

28 BX terminal — function

The functions of terminals THR and BX can be changed to enable them to be used as control inputs for preset speeds 1, 2, 3. Refer to Functions 29, 30, 31.

Terminal THR (Function 27)

0 **External Alarm Input.** This is the factory-set default.

1 **Preset Speed selector X1.**

Terminal BX (Function 28)

0 **Coast-to-stop Command Input.** This is the factory-set default.

1 **Preset Speed selector X2.**

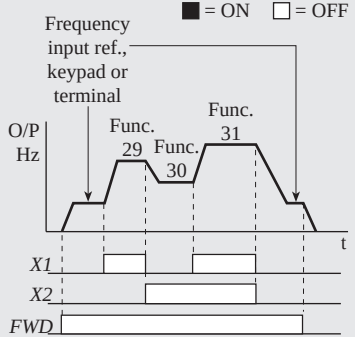
29 Preset speed 1

30 Preset speed 2

31 Preset speed 3

Func.	*Frequency setting*	*X1*	*X2*
Analog input freq. reference		□	□
29	Preset speed 1	■	□
30	Preset speed 2	□	■
31	Preset speed 3	■	■

■ = ON □ = OFF



Preset speeds can be used to form an operation pattern of up to four steps. The desired pattern is activated in the desired sequence by input signals at terminals THR (X1) and BX (X2), as shown in the diagram. Refer also to Functions 27 and 28.

Each preset speed can be allotted any value from zero to 120Hz in steps of 1Hz.

The first frequency step is always the analog frequency input reference. This will normally be the input at terminals 12 or C1, although it can be a keypad input.

All frequencies are subject to any limits imposed by Functions 03, 21, 22, 23, 24 and 25.

32 FM terminal voltage adjustment

Adjusts the voltage output at terminal FM to enable the full scale of a 10V or a 1mA instrument to be used.

The factory-set default value is 85.

0 = 6.5V DC approx. at full scale
99 = 10.5V DC approx. at full scale

NOTES

1 The FM terminal output is a constant frequency (38.1Hz), of variable mark-space ratio.

2 For loading data refer to page 14.

33 FM terminal — selector

Data output voltage is selectable to represent either the output frequency or the motor current.

0 = Frequency (factory-set default).

1 = Current.

8 Troubleshooting

8.1 Electronic Protection

When a trip occurs, the inverter will remain disabled (provided that the restart function is not in use, refer to Function 18) until the conditions that caused the trip are removed and the inverter is reset by pressing the PRG/RESET key or applying a reset command input at terminal RST.

NOTE If the electronic protection acts to trip the inverter, investigate the cause of the trouble by using the appropriate flow diagram on the following pages. If you cannot identify and correct the problem in this way, or if you think the inverter may have been damaged, please consult IMO Precision Controls Ltd.

8.2 Trip Alarm Functions

All protective functions cause a trip code to be displayed on the 7-segment LED panel.

All protective functions operate the internal trip/alarm relay to close circuit 30A-30C and open circuit 30B-30C.

Effects of a trip

- Inverter output stops.
- Motor coasts to rest.
- Trip code displayed and stored in memory (Function 16).
- Alarm relay output.

NOTES

1 *Alarm signal holding*

If the input power supply is switched off or lost after a protective function has operated, the internal control power supply is lost and the output at the alarm relay 30A/B/C is lost also.

2 *Trip code memory*

The four last trips are stored in Function 16, and are not affected by loss of the power supply. History is cleared if Function 17 is set to 1.

8.3 Trip Alarm Codes

OC1 Overcurrent trip during accel.

OC2 Overcurrent trip during decel.

OC3 Overcurrent trip at steady speed.

Protects the inverter against momentary overcurrent, short circuits or earth faults occurring internally and in the motor circuit.

OU Overvoltage trip

Trips the inverter when momentary overvoltage occurs across the DC capacitor, usually due to regeneration.

NOTE **The inverter may restart automatically after an overcurrent or overvoltage trip, see Function 18.**

OLU Overload trip

Protects the inverter against overloading of the inverter output devices (IGBTs).

OL Overload trip

Electronic thermal overload. Protects a standard 4-pole motor against overload.

OH1 Inverter overtemperature trip

Protects the inverter against overheating caused by overloading, high ambient temperature, or cooling fan failure (inverter type C150 only).

OH2 External alarm input trip

Operates when a trip command signal is input at terminal THR.

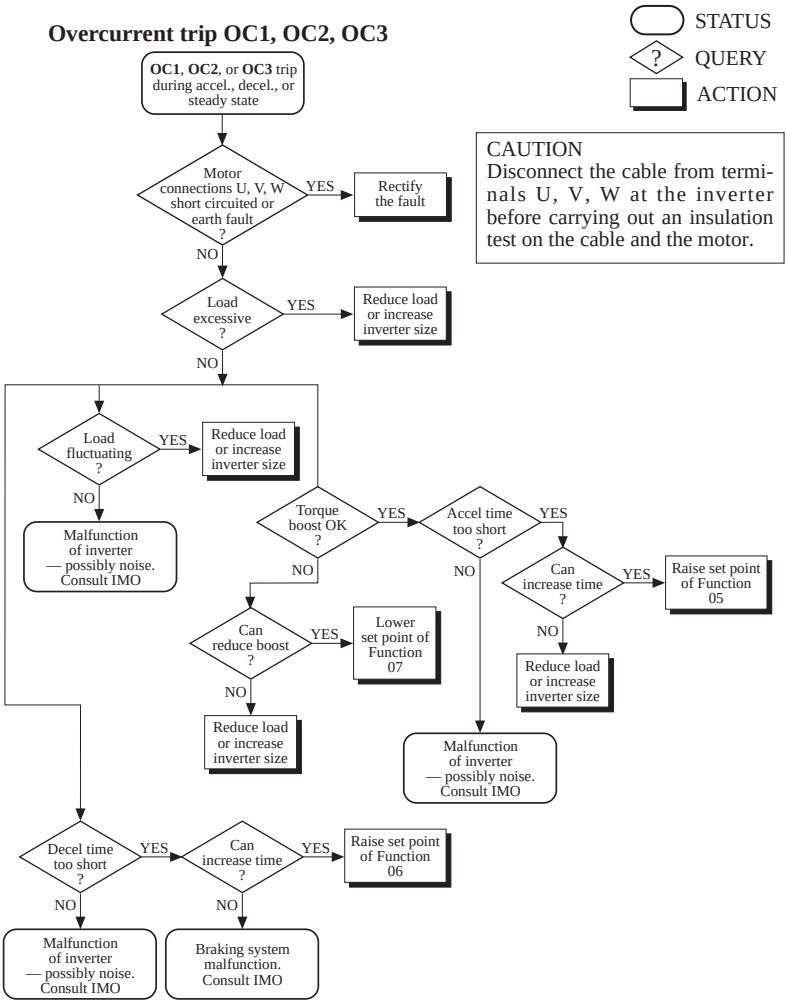
LU Undervoltage trip

Trips the inverter if the supply voltage falls momentarily below 135V.

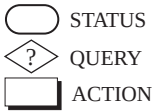
The inverter is designed to 'ride through' a momentary voltage dip (≤15ms at 85% 'motoring' load). However, if the load is of high inertia, the ride-through time could be substantially greater. For further information please consult IMO Precision Controls Ltd.

Er1 **Memory error**
Er3 **CPU error**

Overcurrent trip OC1, OC2, OC3



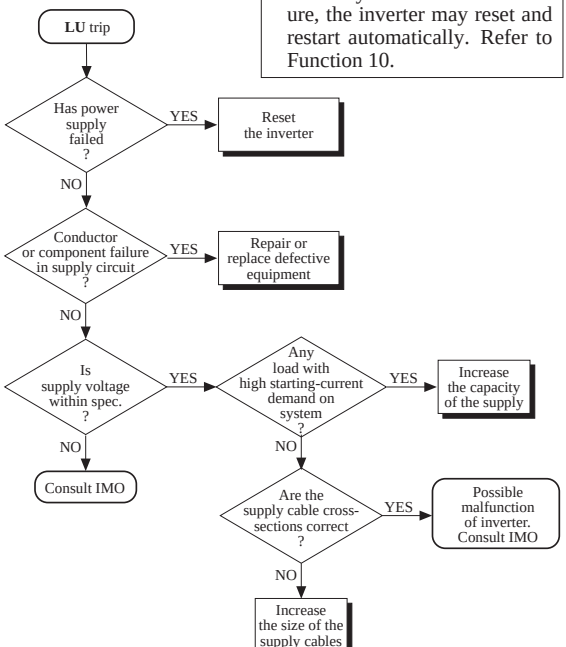
CAUTION
Disconnect the cable from terminals U, V, W at the inverter before carrying out an insulation test on the cable and the motor.



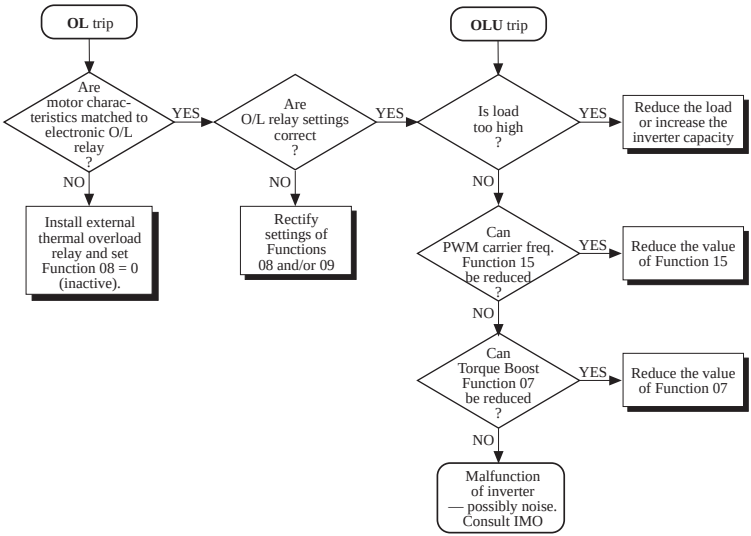
CAUTION
If the power supply is automatically restored after a failure, the inverter may reset and restart automatically. Refer to Function 10.

NOTE
Because supply interruptions can be of very short duration, an oscilloscope or other dedicated equipment may be required to detect mains dip or loss.

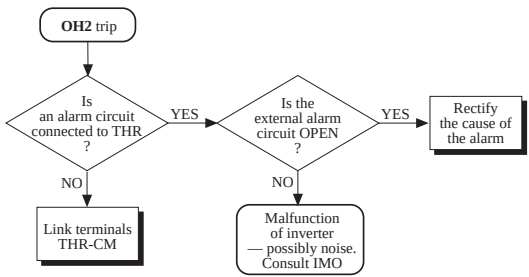
Undervoltage trip LU

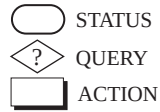


Motor overload OL
Inverter overload OLU

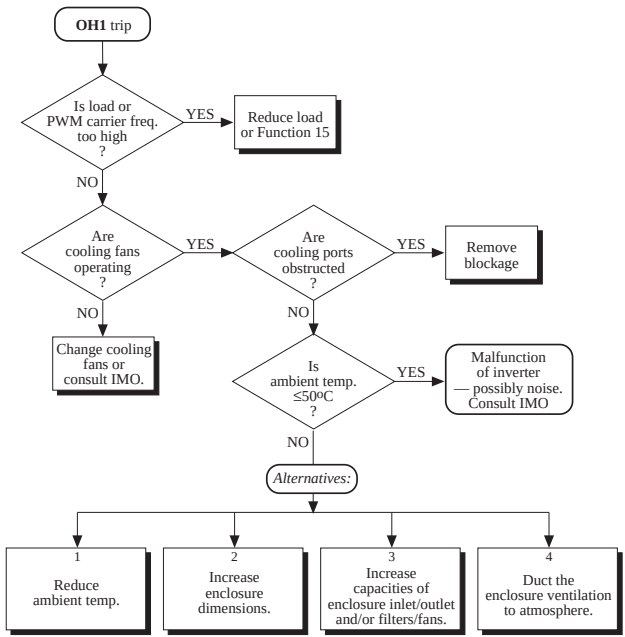


External trip alarm input OH2



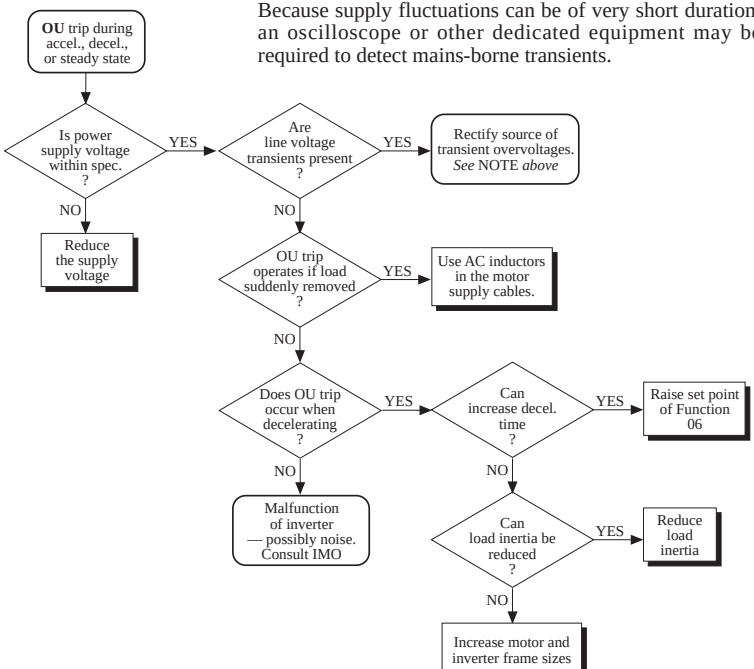


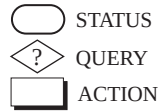
Inverter overtemperature OH1



Overvoltage trip OU

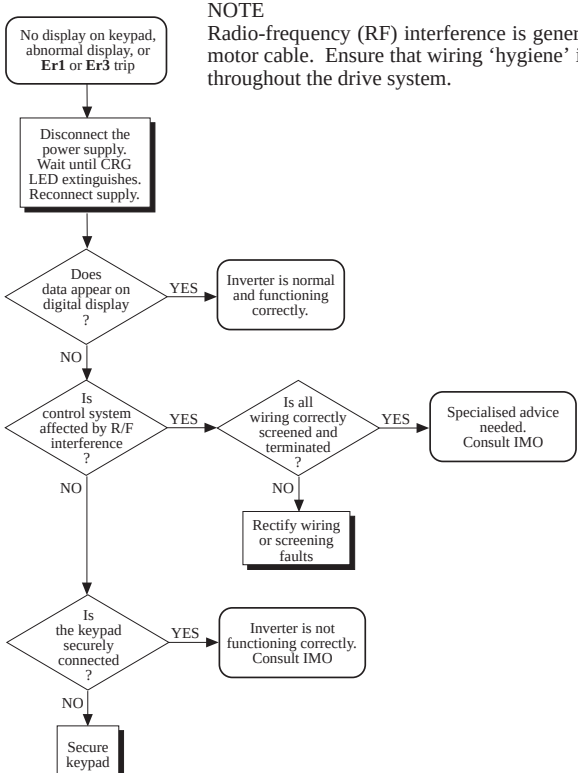
NOTE
Because supply fluctuations can be of very short duration, an oscilloscope or other dedicated equipment may be required to detect mains-borne transients.



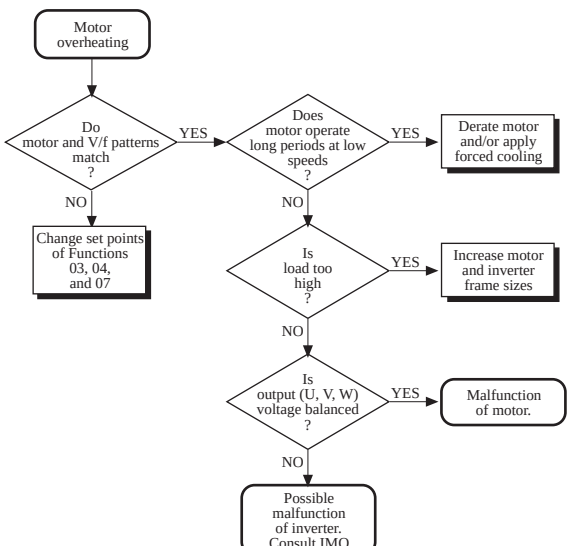


Memory error Er1
CPU error Er3

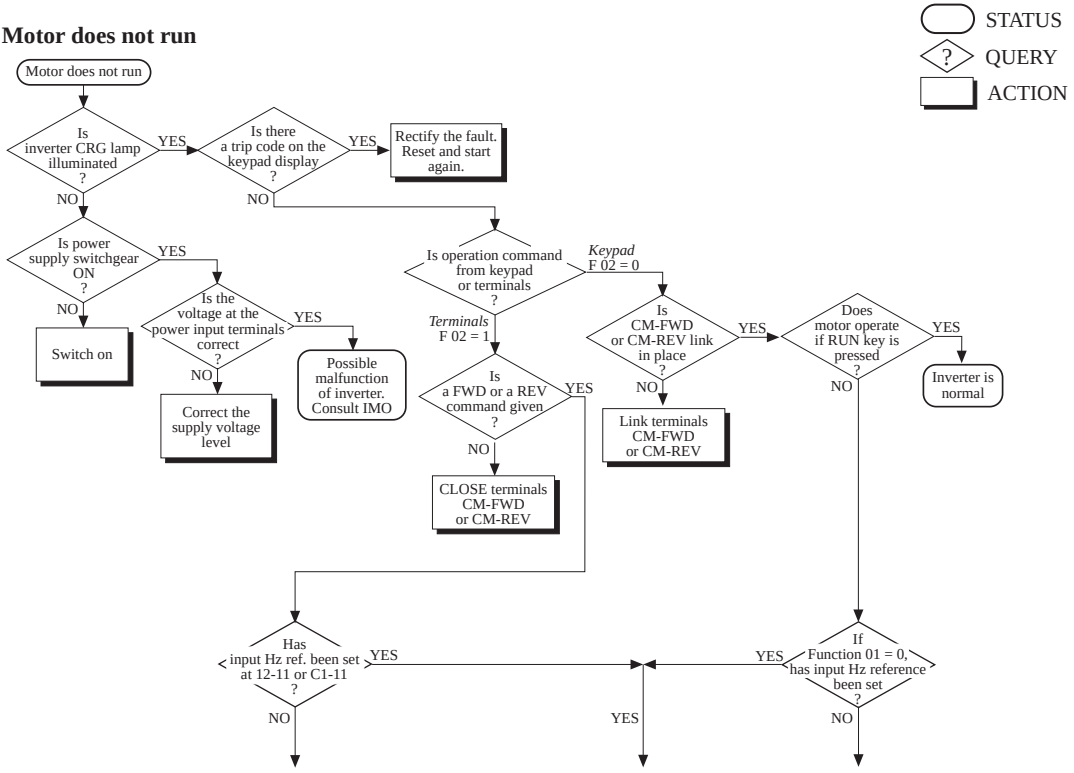
NOTE
Radio-frequency (RF) interference is generated in the motor cable. Ensure that wiring 'hygiene' is adequate throughout the drive system.

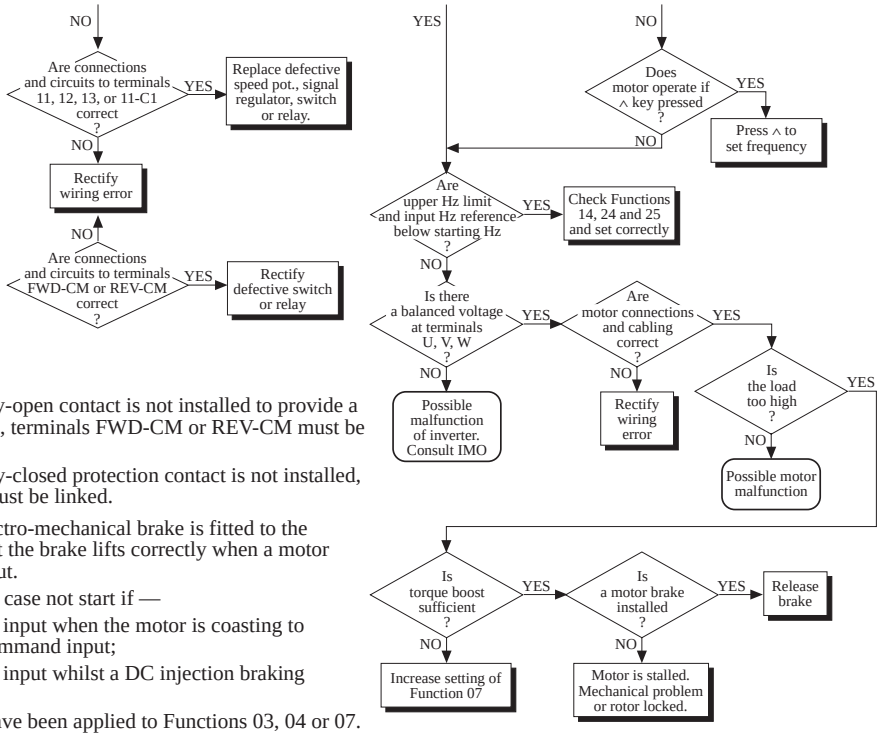


Motor overheats



Motor does not run





NOTES

1 If an external normally-open contact is not installed to provide a RUN command signal, terminals FWD-CM or REV-CM must be linked.

2 If an external normally-closed protection contact is not installed, terminals THR-CM must be linked.

3 If a mechanical or electro-mechanical brake is fitted to the motor, first ensure that the brake lifts correctly when a motor RUN command is input.

4 The motor may in any case not start if —

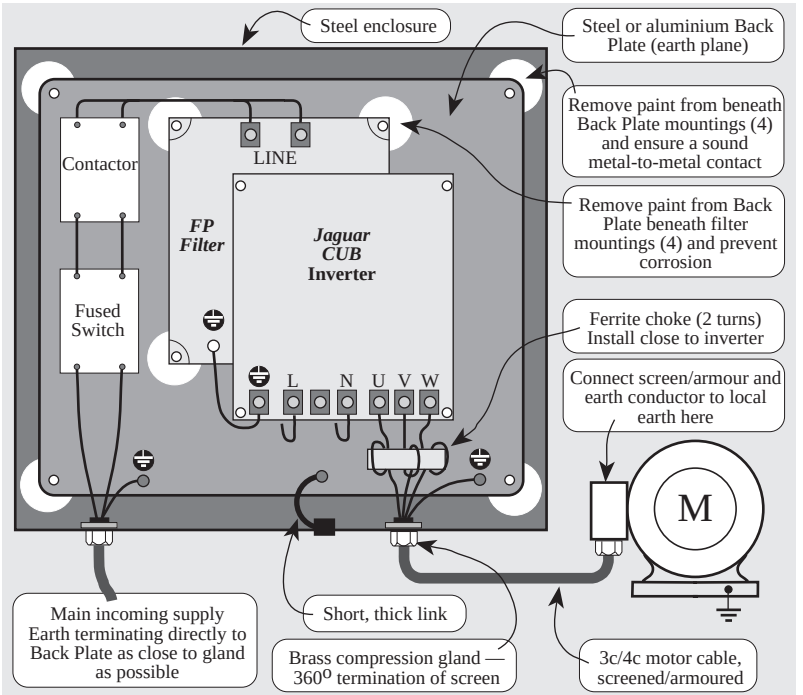
A RUN command is input when the motor is coasting to rest on a BX-CM command input;

A RUN command is input whilst a DC injection braking command is active;

Unsuitable values have been applied to Functions 03, 04 or 07.

9 EMC, RFI and Filters

9.1 Electromagnetic Compatibility (EMC)



Complex Components

In accordance with the provisions described in the European Commission Guidelines Document on Council Directive 89/336/EEC, IMO Precision Controls Ltd has chosen to classify the *Jaguar Cub* range of inverters as "Complex Components". The objective of this decision is to enable IMO Precision Controls Ltd to maximise their support for customers' own implementation of the EC directives.

Classification as a "Complex Component" allows a product to be treated as an "apparatus", and thus permits *compliance with the essential requirements of the EMC Directive to be demonstrated* to both an integrator of *Jaguar Cub* inverters (a constructor of switchboards, for example) and to his customer or the installer and the user.

Standards and Marking

It is intended that *Jaguar Cub* inverters be supplied with a CE-marked declaration of conformity, signifying compliance with EC Directive 89/336/EEC when fitted with specified filter units installed and earthed in accordance with the data in this Product Manual.

The *"EC Declaration of Conformity"*, citing conformity with European Harmonised Standard EN60 947-1, "Specification for Low Voltage Switchgear and Controlgear", will be available upon application to IMO Precision Controls Ltd.

This specification requires the following performance criteria to be met:

Immunity

Fast transient bursts (IEC801-4)

Electromagnetic (IEC801-3)

Electrostatic disturbances (IEC801-2)

Surges: 1.2 x 50µs (IEC1000-4-5 para. 8/20)

Emissions

EN50081-1 or EN50081-2, as specified in the *EC Declaration of Conformity* related to the inverter.

Normally, *Jaguar Cub* inverters will offer compliance with the more severe level of EN50081-1 although the less-arduous option of EN50081-2 would be adequate for industrial applications. Reference must, however, be made to the *EC Declaration of Conformity* for precise details, as there are differences between models.

Power Input Filters and Output Ferrites

It is strongly recommended that that the appropriate *Jaguar Cub* input filter is used, as shown on pages 40 and 43, to limit RF current flowing into the main supply circuit. Without an input filter a *Jaguar Cub* installation may not meet statutory requirements.

At the time of going to press, it is intended to supply a toroidal ferrite output choke, page 44, with every input filter as an 'EMC Compliance' kit.

Electromagnetic Emissions — general

Jaguar Cub inverters contain high-power semiconductor devices which are switched at high speeds to synthesise a near-sinusoidal current waveform across the frequency range of the output. Typically, the transition time from the OFF state to fully-conducting is of the order of 200ns (200 x 10^{-9}s) for these devices. Such rapidly-changing voltages and currents will generate some degree of electromagnetic emission.

Emissions will be predominantly conducted through the motor cables and the mains supply cables, although some radiated emissions will be detected in close proximity to the drive system.

It is *essential* that precautions are taken both at the design stage and at the time of installation to prevent radio-frequency (RF) emissions from the drive system interfering with sensitive equipment in close proximity.

continued…

General Precautions

It is strongly recommended that a metallic Back Plate is used as an earth plane for all the safety earth and EMC earth-bonding connections. This very powerful technique meets all the safety earthing requirements and gives *vastly* improved EMC performance.

- The incoming protective earth conductor should be connected directly to the backplate, and green-yellow conductors should be taken from individual studs on the Back Plate to the enclosure as required to bond each panel that does not get a guaranteed safety bond through the cabinet structure.
- Remove any paint or other insulating film from the enclosure and the Back Plate, and from the Back Plate at the mounting points for the FP Filter. Refer to the illustration on page 40.
- All metal-bodied components are to be bolted directly to the Back Plate, **metal to metal**. Any safety or other earth conductors should be as short and as thick as possible, and should connect directly from their component to a stud on the back plate close by, with only a single earth connection per stud as directed by EN 60204-1:1993 — the EU harmonised electrical safety standard for the electrical equipment of machines (also the most relevant electrical safety standard for almost all industrial electrical control cabinets which are not installed in explosive atmospheres). Additional guidance on EMC Good Wiring Practice is available from IMO Precision Controls Ltd on application.
- Use the correct filtering equipment and arrangements as recommended by IMO Precision Controls Ltd and illustrated below and on pages 43 and 44.
- Use screened or armoured cable for the motor supply, taking care to connect the screen to earth at *both* ends as shown in the diagram on page 40.
- Segregate power cables from control wiring by at least 300mm.
- Avoid parallel cable runs to minimise 'noise coupling'. Wherever runs of power and control cables must cross, try to achieve this at right angles.
- Wherever possible, do not share earth conductors.
- **Important! All conductors between a free-standing RF filter and the inverter MUST be as short and as thick as practicable.**
- Always use screened control wiring. For local control circuits, as illustrated on page 15, terminate the screen at the drive end ***only.*** If using an external controller (*eg* a PLC or similar) terminate the screen at the non-drive end.
- Use the lowest possible switching (carrier) frequency that will operate the application satisfactorily. Refer to Function 15, pages 20 and 25.
- ***Jaguar Cub*** **inverters should be installed, and are designed to operate, within an electrically-shielded metal enclosure.**

9.2 RFI-FP Filter

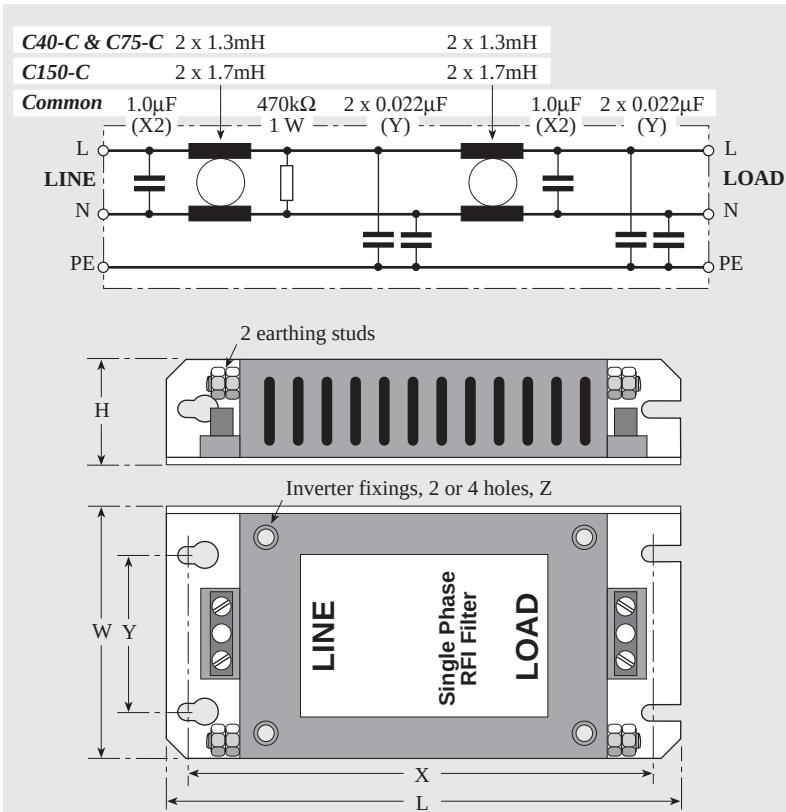
WARNING The RF filter must be earthed in accordance with the circuit diagram on page 40.

A *Jaguar Cub* inverter may be mounted on the face of the Flatpack Filter using the integral tapped mounting points.

Alternatively, the filter may be mounted upright beside the inverter.

Refer to the diagram on page 40 for details of connections and screening.

Earth Leakage Current
Under normal running conditions, the effective leakage is 3.5mA approx. at 50Hz.



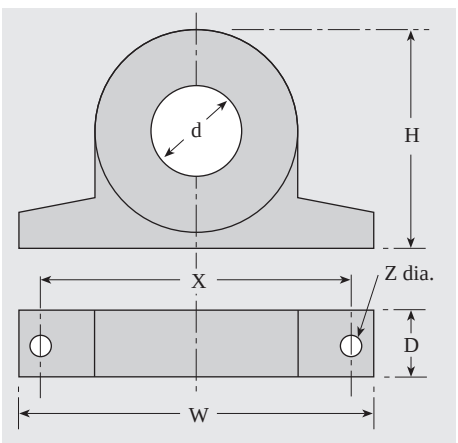
NOTE To ensure the optimum performance of the input filter, remove any paint or other insulating film from the surface of the Back Plate under the mounting points of the filter base as shown on page 40.

9.3 RFI-FP Physical Data

Part number	*Jaguar Cub inverter range*	*Rated current at 40ºC*	*Dimensions* (mm) L	W	H	X	Y	Z	*Weight* kg
RFI75-C	C40 to C75	10A	170	86	36	156	50	M4	0.4
RFI150-C	C150	16A	180	117	37	165	89	M4	0.5

9.4 RF Ferrite Dimensions

Part number	*Jaguar Cub inverter range*	*Dimensions* (mm) W	H	D	X	Z dia.	d dia.
OC1	C40 and C75	85	46	22	70	5	21
OC2	C150	105	62	25	90	5	28.5



CAUTION
Do not overtighten the fixing screws through the base flanges of the ferrite (at 'Z').

Table of Cable Sizes and Maximum Lengths

Inverter type		*C40*	*C75*	*C150*
Cable Sizes				
Mains supply cable, LN	mm^2	1.5	2.5	4.0
Motor cable, UVW	mm^2	2.5	2.5	2.5
Earth cable	mm^2	2.5	2.5	2.5
Control cable	mm^2	0.75	0.75	0.75
Maximum Length of Motor Cables				
Screened cable (1)	m	30	30	60
Screened cable (2)	m	100	100	100
Unscreened cable (1)	m	50	50	100
Unscreened cable (2)	m	200	200	200
Related Fuse and MCB Sizes				
MCB trip rating	A	10	16	20
Fuse rating (3)	A	10	20	32

(1) Without motor line reactors.
(2) The quoted figures have been obtained using dedicated specially-tuned motor line reactors. In practice, it may be possible to use standard reactors.
(3) Use a fuse for which the I^2t is $\geq 20 \times A^2s$.

NOTES

1 The above data is for guidance only. If in doubt, please consult local cable regulations and applicable current ratings.
2 The above data for cable, fuse and MCB sizes applies only to installations NOT equipped with AC supply line reactors.
3 The length of motor cable may be extended by the installation of motor line reactors.
4 Longer cables **without** motor line reactors may be achieved by reducing the PWM carrier frequency, Function 15.
5 If the length of the motor cable is greater than 50m, it may be necessary to reduce the PWM carrier frequency, Function 15, to 0 to reduce the effect of leakage current.
6 Long cables may reduce starting torque of the motor due to cable voltage drop.
7 It is recommended that MICC-type cable is NOT used due to high capacitance and thus greater limitation of maximum length, or nuisance-tripping of a residual current device (RCD) if fitted.
8 The above data is based on the use of standard 4-pole squirrel cage induction motors.
9 If a non-standard motor is to be used, or cables in excess of 100m, consult IMO Precision Controls Ltd.

EMC and LVD Conformity

IMO *Jaguar Cub* Inverters carrying the suffix -EN as part of their model number conform to EN 60 947-1:1992, Emissions to EN50081-1 and -2 and Immunity to EN50082-1 and -2, and therefore meet Directive 89/336/EEC relating to Electromagnetic Compatibility. Additionally, they also comply with DIN VDE 0160/1988 for Over Voltage Category II, Pollution Degree 2, and hence conform to the protection requirements of Council Directive 73/23/EEC, Low Voltage Directive. Conformity requires the *Cub* inverter to be wired and earthed in accordance with the installation instructions in this User's Guide and installed within a steel enclosure which satisfies the requirements of Pollution Degree 2 and used in conjunction with an AC power supply which is recognised Over Voltage Category II and has an earthed neutral point. Throughout this manual the -EN suffix has been omitted for simplicity and for economy of space.

Earth terminals. *Jaguar Cub*…-EN inverters now carry the standard symbol as well as the lettering E(G).

IMO JAGUAR DRIVES

5 YEAR WARRANTY

IMO JAGUAR drives are covered by a unique 5 year warranty against failure arising as a result of inferior material or workmanship.

In the event of a unit failing with 5 years of despatch from IMO, we will repair or replace the drive free of charge.

Whenever possible, in the interest of providing the fastest service to our customers, we will replace the failed drive with a new or service exchange unit at IMO's discretion. This may not be possible, however, if the failed unit is in poor condition owing to abuse or neglect. In such circumstances, the customer may elect to have the unit repaired within the warranty if viable, but physical refurbishment will be chargeable.

IMO will, upon request, provide a service exchange unit in advance of receipt of the failed unit if an order number is provided along with details of the failed unit. Replacements will be despatched at IMO's cost and credit will be issued upon receipt of the failed unit in good physical condition. Full credit will not be given if in IMO's judgment the unit has been physically or electrically abused. A no-fault-found charge will be levied upon units returned and found not to be faulty.

The terms of warranty do not provide for on-site service although a service engineer will be provided upon receipt of an order. IMO may elect to waive any charge should the findings on site indicate that any problem found lies within the scope of the warranty.

Out-of-hours telephone contacts:

Technical Manager, Drives	(Mobile) 0831 207220
Product Support Engineer *UK North*	(Mobile) 0836 259108
Product Support Engineer *UK South*	(Mobile) 0831 207221