Contents

Section 1 Caution Statements

This symbol is used throughout this manual to draw attention to topics of special importance to the installation and operation of IMS2 Series soft starters.

Caution Statements cannot cover every potential cause of equipment damage but can highlight common causes of damage. It is the installer's responsibility to read and understand all instructions in this manual prior to installing, operating or maintaining the starter, to follow good electrical practice including applying appropriate personal protective equipment and to seek advice before operating this equipment in a manner other than as described in this manual.

- Isolate the soft starter completely from the power supply before attempting any maintenance work.
- Metal swarf in the cabinet can cause equipment failure.
- Do not apply voltage to the control input terminals. These are active 24 VDC inputs and must be controlled with potential free contacts.
- Contacts or switches operating the control inputs must be suitable for low voltage, low current switching (ie gold flash or similar).
- Cables to the control inputs must be segregated from mains voltage and motor cabling.
- Some electronic contactor coils are not suitable for direct switching with PCB mount relays. Consult the contactor manufacturer/ supplier to confirm suitability.
- Do not connect power factor correction capacitors to the output of IMS2 soft starters. If static power factor correction is employed, it must be connected to the supply side of the soft starter.
- Before installing the IMS2 without a main contactor, ensure this meets local regulations.
- If installing the IMS2 in a non-ventilated enclosure, a bypass contactor must be used to prevent excessive heat build-up.
- If installing a bypass contactor, ensure phase connections are correctly made (ie L1B-T1, L2B-T2, L3B-T3).
- Removing control voltage resets the thermal model.

The examples and diagrams in this manual are included solely for illustrative purposes. The information contained in this manual is subject to change at any time and without prior notice. In no event will responsibility or liability be accepted for direct, indirect or consequential damages resulting from the use or application of this equipment.

WARNING - ELECTRICAL SHOCK HAZARD

IMS2 soft starters contain dangerous voltages when connected to mains voltage. Only a competent electrician should carry out the electrical installation. Improper installation of the motor or the soft starter may cause equipment failure, serious injury or death. Follow this manual and local electrical safety codes.

GROUNDING AND BRANCH CIRCUIT PROTECTION

It is the responsibility of the user or person installing the soft starter to provide proper grounding and branch circuit protection according to local electrical safety codes.

Section 2 Introduction

The IMS2 is a microcontroller based soft starter incorporating the latest technologies. It has been designed to provide a complete range of the most advanced soft start, soft stop and motor protection features.

2.1 Feature List

Starting
- Constant current
- Current ramp
- Torque control
- Kickstart

Stopping
- Soft stop
- Pump stop
- Soft braking

Protection
- Motor overload (thermal model)
- Motor thermistor input
- Phase imbalance
- Phase rotation
- Electronic shearpin
- Undercurrent
- Auxiliary trip input
- Starter heatsink overtemperature
- Excess start time
- Supply frequency
- Shorted SCR
- Power circuit
- Motor connection
- Serial interface failure

Interface
- Remote control inputs (3 x fixed, 1 x programmable)
- Relay outputs (1 fixed, 3 x programmable)
- 4-20 mA output (1 x programmable)
- RS485 serial link

Human interface
- Local pushbuttons (Start, Stop, Reset, Local/Remote)
- Local programming pushbuttons (Function, Up, Down, Store)
- LED parameter display
- Starter status LEDs

Power connection
- In-line or inside delta
- Bypass connections to retain motor protection even when bypassed
- 18 A to 1574 A (in-line) 27 A to 2361 A (inside delta)
- 200 VAC to 525 VAC (V5 models)
- 200 VAC to 690 VAC (V7 models)

Sundry features
- IP42 or IP54 (≤ 253 A)
- IP00 (≥ 302 A)
- Current read-out
- Motor temperature read-out
- Trip log (eight position)
- Multiple function sets
- Restart delay
- High and low current flags
- Motor temperature flag
- Auto-reset
- Auto-stop
- Start counter
- Function lock/Password protection
- Store/Restore function settings
- Emergency mode operation
- Thermal model override

Section 3 | Basic Setup Procedure

For simple applications, IMS2 soft starters can be installed using the three simple steps outlined below. For applications with advanced control, protection or interface requirements, a comprehensive review of this User Manual is recommended.

1. Installation and connection

WARNING
IMS2 soft starters contain dangerous voltages when connected to mains voltage. Only a competent electrician should carry out the electrical installation. Improper installation of the motor or the soft starter may cause equipment failure, serious injury or death. Follow this manual and local electrical safety codes.

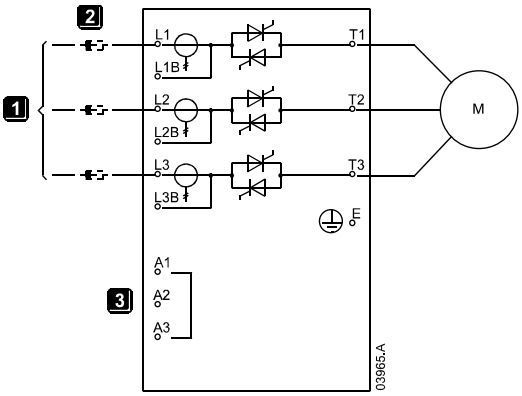
1 Ensure the correct IMS2 model has been selected for the connected motor and application type.

2 Mount the IMS2, making sure to allow adequate clearance top and bottom for free circulation of air through the starter. (Refer to *Mounting Instructions* for details.)

3 Connect mains voltage to starter input terminals L1, L2, L3.

4 Connect the motor cables to starter output terminals T1, T2, T3.

5 Connect control voltage to starter input terminals A1-A2 or A2-A3. (Refer to *Control Supply* for details.)



1	Mains voltage
2	Semiconductor fuses (optional)
3	Control voltage

2. Programming

For basic applications, the IMS2 only needs to be programmed with the nameplate full load current (FLC) of the motor:

1 Select Function 1 *Motor Full Load Current* by holding down the <FUNCTION> pushbutton and pressing the <UP> pushbutton repeatedly until the display shows "1".

2 Release the <FUNCTION> pushbutton. The display will show the currently stored value of Function 1 *Motor Full Load Current*.

3 Use the <UP> and <DOWN> pushbuttons to adjust the FLC setting to match the FLC of the motor.

4 Press the <STORE> pushbutton to store the new FLC setting.

5 Exit Programming Mode by holding down the <FUNCTION> pushbutton, pressing the <DOWN> pushbutton until the display shows "0", then releasing the <FUNCTION> pushbutton.

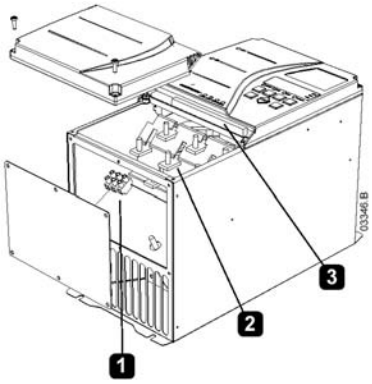
3. Operation

The IMS2 is now ready to control the motor. Motor operation can be controlled using the <START> and <STOP> pushbuttons on the IMS2 local control panel. Two other functions that may be useful for basic installations are Function 2 *Current Limit* and Function 5 *Stop Ramp Time*. These functions can be adjusted as described above. (For a more detailed description of the programming procedure, refer to *Programming Procedure*.)

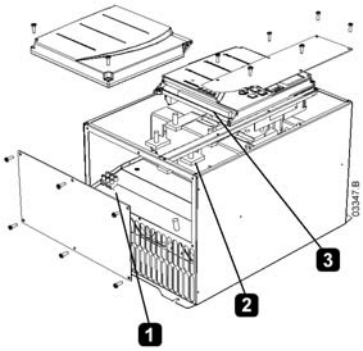
Section 4 | Installation

4.1 General Layout

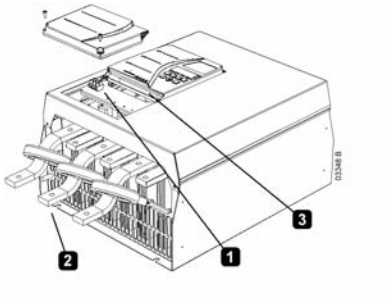
IMS20018 ~ IMS20125



IMS20141 ~ IMS20253



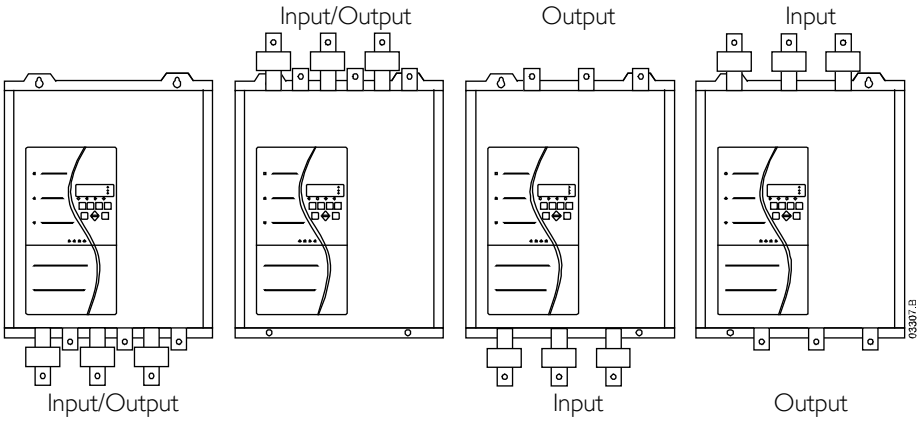
IMS20302 ~ IMS21574



1	Control voltage terminals	2	Power terminals	3	Control terminals

4.2 Power Termination Configuration

The bus bars on models IMS20302 ~ IMS21574 can be adjusted to provide four different input/output power terminal configurations.



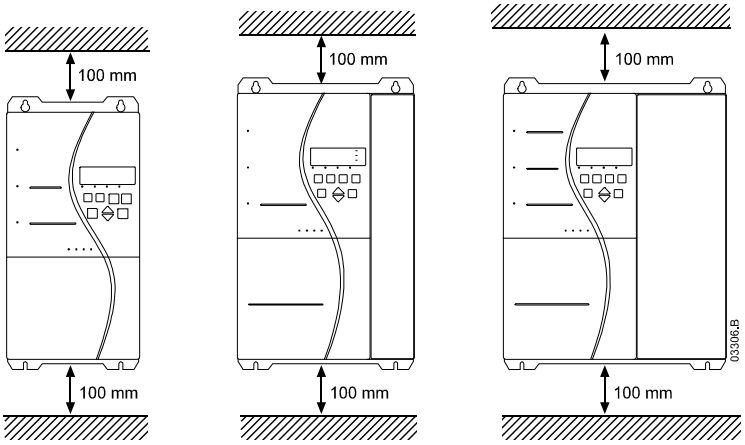
To adjust the bus bar configuration:

1. Remove the IMS2 covers and main control module.
2. Loosen and remove the bus bar fixing bolts.
3. Remove the bus bars and replace in the desired configuration. When re-orienting bus bars L1, L2, L3, the current transformers must also be relocated.
4. Refit and tighten the fixing bolts. The torque requirements are:
   IMS20302~IMS20897: 12 Nm
   IMS21153~IMS21574: 20 Nm

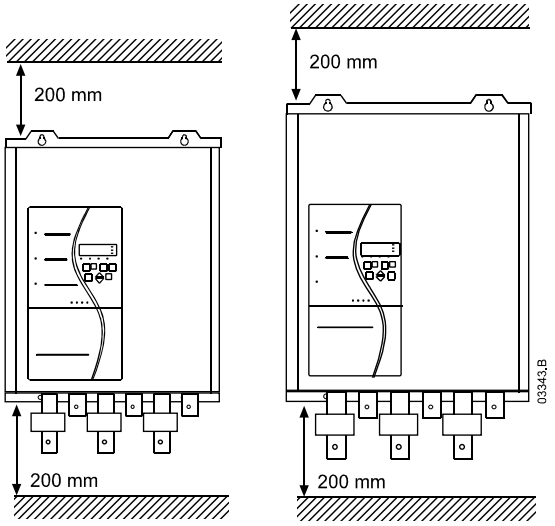
Ensure that foreign matter does not contaminate the jointing compound and become trapped between the bus bar and its mounting plate. If the paste does become contaminated, clean and replace with a jointing compound suitable for aluminium to aluminium, or aluminium to copper joints.

4.3 Mounting Instructions

Models IMS20018 ~ IMS20253 can be wall mounted or installed inside another enclosure. These models can be mounted side by side with no clearance but a 100 mm allowance must be made top and bottom for air intake and exhaust.



Models IMS20302 ~ IMS21574 have an IP00 rating and must be mounted in another enclosure. These models can be mounted side by side with no clearance but a 200 mm allowance must be made top and bottom for air intake and exhaust.



4.4 Ventilation

When installing IMS2 starters in an enclosure there must be sufficient airflow through the enclosure to limit heat rise. Temperature within the enclosure must be kept at, or below, the IMS2 maximum ambient temperature rating.

If installing an IMS2 within a totally sealed enclosure, a bypass contactor is necessary to eliminate heat dissipation from the soft starter during run.

Soft starters dissipate approximately 4.5 watts per motor ampere. The table below shows airflow requirements for selected motor currents. If other heat sources are installed in an enclosure along with the IMS2, an additional airflow allowance must be made for these items. Heat generation from semiconductor fuses can be avoided by installing these within the bypass loop.

Motor Current (A)	Heat (W)	Required Airflow			
		m^3/minute		m^3/hour	
		5 °C Rise	10 °C Rise	5 °C Rise	10 °C Rise
10	45	0.5	0.2	30	15
20	90	0.9	0.5	54	27
30	135	1.4	0.7	84	42
40	180	1.8	0.9	108	54
50	225	2.3	1.1	138	69
75	338	3.4	1.7	204	102
100	450	4.5	2.3	270	135
125	563	5.6	2.8	336	168
150	675	6.8	3.4	408	204
175	788	7.9	3.9	474	237
200	900	9.0	4.5	540	270
250	1125	11.3	5.6	678	339
300	1350	13.5	6.8	810	405
350	1575	15.8	7.9	948	474
400	1800	18.0	9.0	1080	540
450	2025	20.3	10.1	1218	609
500	2250	22.5	11.3	1350	675
550	2475	24.8	12.4	1488	744
600	2700	27.0	13.5	1620	810

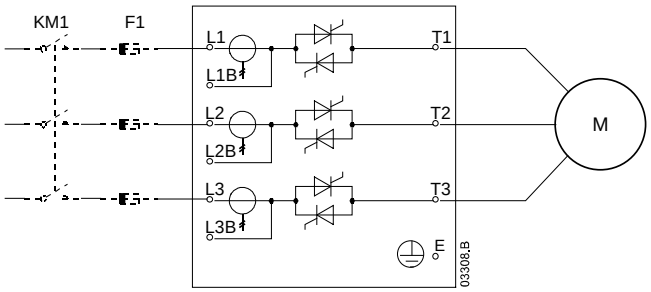
Section 5 Power Circuits

5.1 Overview

IMS2 soft starters can be wired with a number of different power circuits depending on application requirements.

5.2 In-Line Connection

The standard connection format is in-line (also known as three-wire). Mains voltage is connected to the starter input terminals L1, L2, L3. The motor cables are connected to the soft starter output terminals T1, T2, T3.

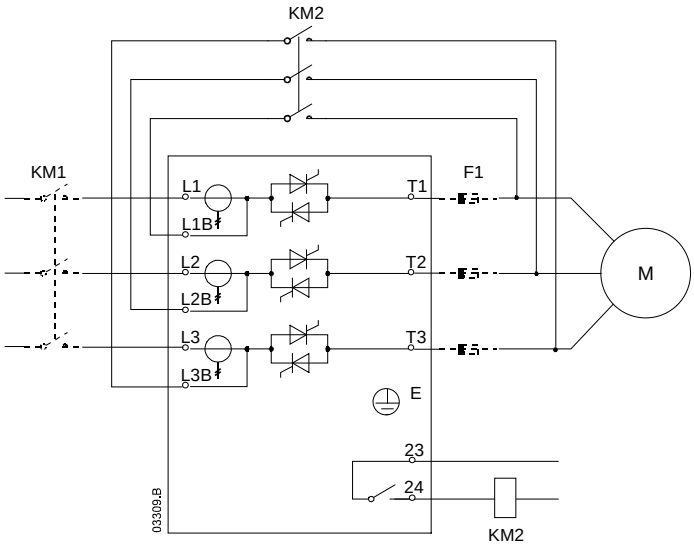


KM1	Main contactor (optional)
F1	Fuses (optional)

5.3 In-Line Connection (Bypassed)

IMS2 soft starters can be bypassed while the motor is running. Special terminals (L1B, L2B, L3B) are provided for connecting the bypass contactor. These terminals allow the IMS2 to provide all protection and current monitoring functions even when bypassed.

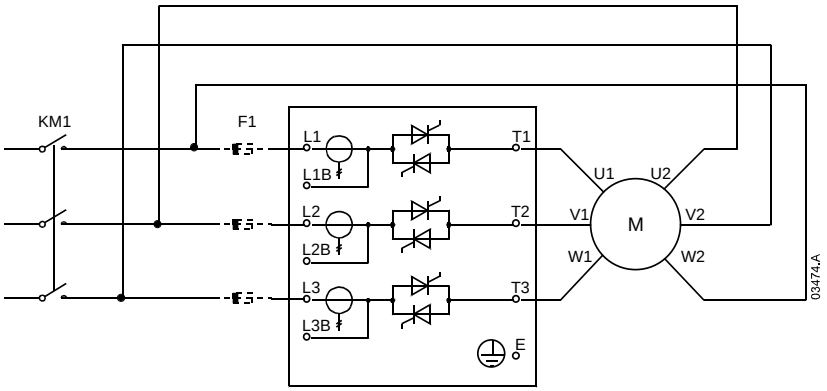
The Run Output (terminals 23, 24) should be used to control operation of the bypass contactor. The bypass contactor can be AC1 rated for the motor full load current.



KM1	Main contactor (optional)
KM2	Bypass contactor
F1	Fuses (optional)

5.4 Inside Delta Connection

IMS2 soft starters support inside delta (six-wire) connection. When connected in inside delta configuration, the soft starter carries only phase current. This means the IMS2 can be used with motors which have a full load current rating up to 50% greater than the soft starter's standard current rating.



KM1	Main contactor
F1	Fuses (optional)

A motor usually has two rows of three terminals in the motor termination box.

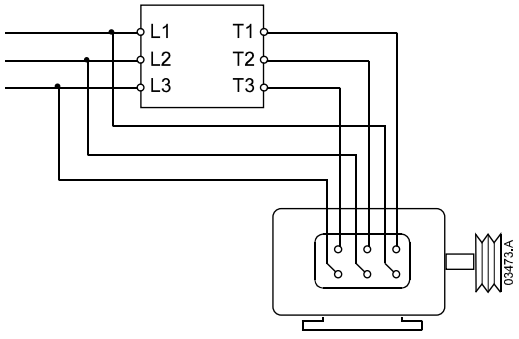
If the motor windings are connected in delta, there will be three links fitted. Each link is connected from a terminal in the top row to one in the bottom row.

If the motor windings are connected in star, there will be one link fitted. This link is connected to all three terminals in one row.

For inside delta connection, remove all links from the motor termination box. Connect the three output terminals of the soft starter (T1, T2, T3) to one end of each motor winding. Connect the opposite end of each motor winding to a different phase on the starter's input.

For example:

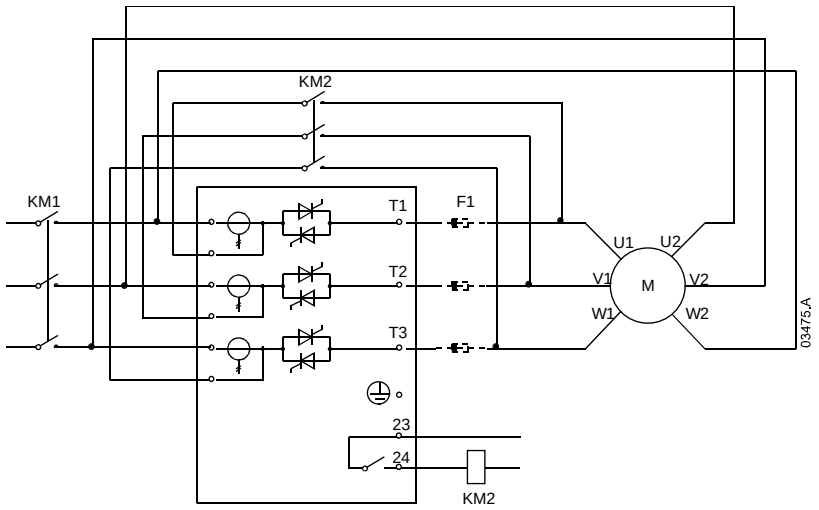
- Remove the links from the motor termination box.
- Connect the incoming phases to L1, L2, L3 on the IMS2.
- Connect each output phase from the IMS2 to one end of an individual motor winding: T1-U1, T2-V1, T3-W1.
- Connect the other end of each individual motor winding to a different phase on the soft starter's input: U2-L2, V2-L3, W2-L1.



CAUTION
When connecting the IMS2 in inside delta configuration, always install a main contactor or shunt trip circuit breaker.

5.5 Inside Delta Connection (Bypassed)

IMS2 starters support inside delta connection with bypass.



KM1	Main contactor
KM2	Bypass contactor
F1	Fuses (optional)

5.6 Power Factor Correction

If power factor correction is used, a dedicated contactor should be used to switch in the capacitors. Power factor correction capacitors must be connected to the input side of the soft starter. Connecting power factor correction capacitors to the output side will damage the soft starter.

5.7 Main Contactor

The IMS2 is designed to operate with or without a main contactor. In many regions, statute requires a main contactor to be used with electronic motor control equipment. This is not necessary for starter operation, but provides safety benefits. Using a main contactor also isolates the soft starter SCRs in the off state, when they are most susceptible to damage from voltage transients.

A main contactor should always be used when the IMS2 is installed in inside delta configuration.

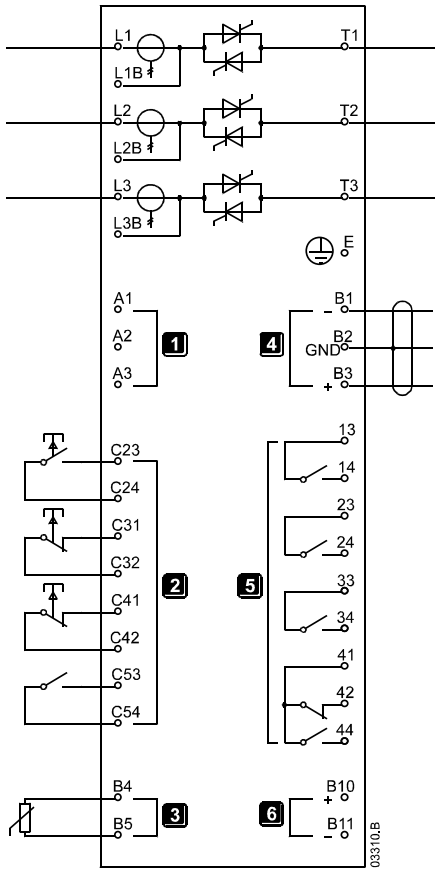
The IMS2 can directly control a main contactor by assigning one of the relay outputs to Main Contactor control.

As an alternative to a main contactor, either a circuit breaker with a no volt release coil operated by the soft starter's trip output, or a motor operated circuit breaker can be considered. If a motor operated circuit breaker is used as a main contactor, the potential delay between the breaker being told to close and phase power being applied to the IMS2 could cause the IMS2 to trip on Power Circuit fault. To avoid this, close the motorised breaker directly and use the breaker's auxiliary contacts (or a slave relay with gold flash contacts) to control the soft starter.

Select a main contactor with AC3 rating is equal to or greater than the full load current rating of the connected motor.

Section 6 | Control Circuits

6.1 Electrical Schematic



1	Control voltage
2	Remote control inputs
C23-C24	Start
C31-C32	Stop
C41-C42	Reset
C53-C54	Programmable input A
3	Thermistor input

4	RS485 serial interface
5	Relay outputs
13-14	Programmable output A
23-24	Run output
33-34	Programmable output B
41, 42, 44	Programmable output C
6	Analog output

6.2 Control Voltage

Voltage must be connected to the soft starter's control voltage terminals. The correct control voltage depends on the soft starter model.

- IMS2xxxx-xx-C12-xx-xx models: 110 VAC (A1-A2) or 230 VAC (A2-A3)
- IMS2xxxx-xx-C24-xx-xx models: 230 VAC (A2-A3) or 400 VAC (A1-A2)
- IMS2xxxx-xx-C45-xx-xx models: 460 VAC (A1-A2) or 575 VAC (A2-A3)

IMS2 Model	Maximum VA
IMS20018 ~ IMS20047	11 VA
IMS20067 ~ IMS20125	18 VA
IMS20141 ~ IMS20238	24 VA
IMS20253 ~ IMS20897	41 VA
IMS21153 ~ IMS21574	56 VA

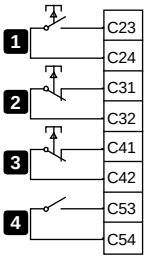
6.3 Control Wiring

IMS2 operation can be controlled using the local control pushbuttons, remote control inputs or the serial communications link. The <LOCAL/REMOTE> pushbutton can be used to switch between local and remote control. Refer to Function 20 *Local/Remote Operation* for details.

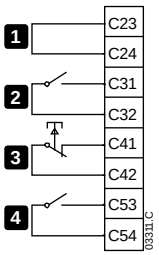
Remote Control Inputs

The IMS2 has four remote control inputs. Contacts used for controlling these inputs should be low voltage, low current rated (gold flash or similar).

Remote pushbutton control



Two-wire control



1	Start
2	Stop
3	Reset
4	Input A

CAUTION
Do not apply voltage to the control input terminals. These are active 24 VDC inputs and must be controlled with potential free contacts.

Contacts or switches operating the control inputs must be suitable for low voltage, low current switching (ie gold flash or similar).

Cables to the control inputs must be segregated from mains voltage and motor cabling.

Relay Outputs

The IMS2 provides four relay outputs, one fixed and three programmable.

The Run output closes when the soft start is complete (when the starting current falls below 120% of the programmed motor full load current) and remains closed until the beginning of a stop (either soft stop or coast to stop).

Operation of the programmable outputs is determined by the settings of Functions 21, 22 and 23.

- If assigned to Main Contactor, the output activates as soon as the soft starter receives a start command and remains active while the soft starter is controlling the motor (until the motor starts a coast to stop, or until the end of a soft stop).
- If assigned to Start/Run, the output activates when the soft starter completes its pre-start tests and remains active while the soft starter is controlling the motor (until the motor starts a coast to stop, or until the end of a soft stop).
- If assigned to a trip function, the output activates when the specified trip occurs.
- If assigned to a flag, the output activates when the specified flag is active (refer to Functions 40, 41 and 42).

CAUTION
Some electronic contactor coils are not suitable for direct switching with PCB mount relays. Consult the contactor manufacturer/ supplier to confirm suitability.

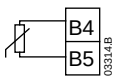
Motor Thermistors

Motor thermistors (if installed in the motor) may be connected directly to the IMS2. The soft starter will trip when the resistance of the thermistor circuit exceeds approximately 2.8 kΩ. The IMS2 can be reset once the thermistor circuit resistance falls below approximately 2.8 kΩ.

No motor thermistors

Thermistor input

Motor thermistors

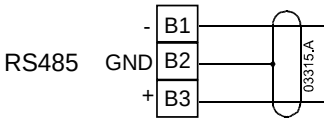


NOTE
If the thermistor circuit is open, the IMS2 will not run.
The thermistor circuit should be run in screened cable and must be electrically isolated from earth and all other power and control circuits.
If no motor thermistors are connected to the IMS2 there must be a link across the thermistor input terminals B4-B5 or Function 34 *Motor Thermistor* must be set to 1 (Off).

Section 7 Serial Communication

7.1 RS485 Serial Communication

The IMS2 has a non-isolated RS485 serial communication link.



The serial link can be used to:

- control IMS2 operation
- query IMS2 status and operating data
- read (download) function values from the IMS2
- write (upload) function values to the IMS2

Three serial protocols are available: AP ASCII, Modbus RTU and Modbus ASCII. Select the relevant protocol using Function 63 *Serial Protocol*.

NOTE
Power cabling should be kept at least 300 mm away from communications cabling. Where this separation is not possible, magnetic shielding should be provided to reduce induced common mode voltages.

The IMS2 can be programmed to trip if the RS485 serial link fails. This is done by setting Function 60 *Serial Timeout*. Baud rate is set by Function 61 *Serial Baud Rate*. The starter address is assigned using Function 62 *Serial Satellite Address*.

NOTE
Slave addresses must be two digits. Addresses less than 10 must have a leading zero (0).

The IMS2 may take up to 250 ms to respond. The host software timeout should be set accordingly.

The satellite address and baud rate may also be altered through the serial interface. The new settings will take effect after the current serial programming session is terminated by the master. The serial master application must ensure that altering these function values does not cause communication problems.

7.2 AP ASCII Protocol

The message fragments used in communicating with the IMS2 are shown below. The message fragments may be assembled into complete messages as described in the sections that follow.

NOTE
Data must be transmitted in 8-bit ASCII, no parity, one stop bit.

Message Fragment Type	ASCII Character String or (Hexadecimal Character String)			
Send address	EOT (04h	[nn] [nn]	[lrc] [lrc]	ENQ or 05h)
Send command	STX (02h	[ccc] [ccc]	[lrc] [lrc]	ETX or 03h)
Send request				
Receive data	STX (02h	[dddd] [dddd]	[lrc] [lrc]	ETX or 03h)
Receive status	STX (02h	[ssss] [ssss]	[lrc] [lrc]	
ACK (acknowledge)	ACK (06h)	or		
NAK (negative acknowledge)	NAK (15h)	or		
ERR (error)	BEL (07h)	or		

nn = two byte ASCII number representing the soft starter address where each decimal digit is represented by n.
lrc = two byte longitudinal redundancy check in hexadecimal.
ccc = three byte ASCII command number where each character is represented by c.
dddd = four byte ASCII number representing the current or temperature data where each decimal digit is represented by d.
ssss = four byte ASCII number. The first two bytes are ASCII zero. The last two bytes represent the nibbles of a single byte of status data in hexadecimal.

Commands

Commands can be sent to the soft starter using the following format:

Send address | ACK | Send command | ACK

Possible error responses: NAK (Invalid LRC)

= Master = Slave (soft starter)

Command	ASCII	Comment
Start	B10	Initiates a start
Stop	B12	Initiates a stop
Reset	B14	Resets a trip state
Quick stop	B16	Initiates an immediate removal of voltage from the motor. Any soft stop settings are ignored.
Forced communication trip	B18	Causes a communications trip

Status Retrieval

Starter status can be retrieved from the soft starter using the following format:

Send address | ACK | Send request | Receive status

Possible error responses: NAK (Invalid LRC)

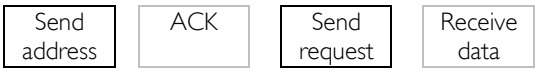
= Master = Slave (soft starter)

Request	ASCII	Receive Status (ssss)	
Version	C16	Serial protocol version number.	
Trip Code	C18	Requests the trip status of the IMS2. 255 = No trip 0 = Shorted SCR 1 = Excess start time 2 = Motor overload (thermal model) 3 = Motor thermistor 4 = Phase imbalance 5 = Supply frequency 6 = Phase sequence 7 = Electronic shearpin 8 = Power circuit fault 9 = Undercurrent 10 = Heatsink overtemperature (F) 11 = Invalid motor connection (P) 12 = Auxiliary input (J) 13 = Out of range FLC (L) 14 = Incorrect main control module (Y) 15 = RS485 communication fault (C) 16 = Forced communication trip (H) 17 = CPU error (U)	
Product Version	C20	Bit No.	Description
		0 - 2	Function list version
		3 - 7	Starter type (2 = IMS2)

Starter Status	C22	Bit No.	Description
		0 - 3	0 = Not used 1 = Waiting 2 = Starting (incl. Pre-start tests) 3 = Running 4 = Stopping 5 = Restart Delay 6 = Tripped 7 = Programming Mode
		4	1 = Positive phase sequence detected
		5	1 = Current exceeds the FLC
		6	0 = Uninitialised 1 = Initialised *nb: bit 4 is not valid unless bit 6 = 1*
		7	0 = Communication connection status OK 1 = Communication connection fault

Data Retrieval

Data can be retrieved from the soft starter using the following format:



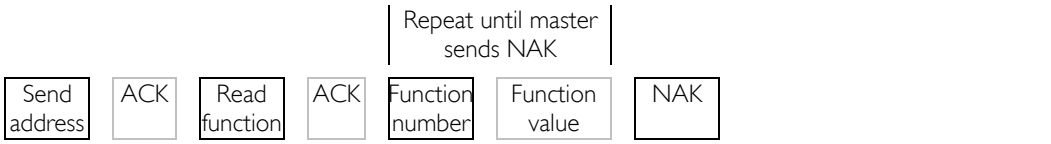
Possible error responses: NAK (Invalid LRC)

= Master = Slave (soft starter)

Request	ASCII	Receive Data (dddd)
Motor current	D10	Requests motor current. The data is four byte decimal ASCII. Minimum value 0000 A, maximum value 9999 A.
Motor temperature	D12	Requests the calculated value of the motor thermal model as a % of motor thermal capacity. The data is four byte decimal ASCII. Minimum value is 0000%. Trip point is 0105%.

Read Function Values from the IMS2

Function values may be read (downloaded) from the soft starter at any time using the following format:



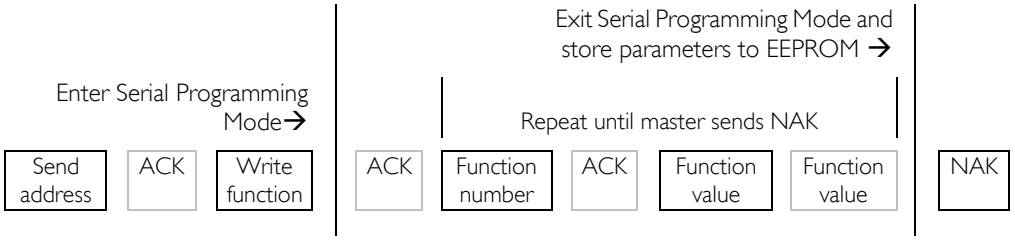
Possible error messages 1 1, 2 1:NAK = Invalid LRC
2: ERR = Invalid function number

= Master = Slave (soft starter)

Read Function	ASCII	Comment
Download Functions	P10	Readies the IMS2 to download function values.

Write Function Values to the IMS2

Function values may be written (uploaded) to the soft starter only when it is in the off state, ie not starting, running, stopping or tripped. Use the following format to write function values:



Possible error responses: 1, 2 1, 3 1, 4

1: NAK = Invalid LRC
2: ERR = Unable to program (motor running)
3: ERR = Invalid function number
4: ERR = Function value out of range

[ ] = Master [ ] = Slave (soft starter)

Write Function	ASCII	Comment
Upload Functions	P12	Readies the IMS2 to upload function values.

When the IMS2 receives a Write Function command it enters Serial Programming Mode. In Serial Programming Mode, the local control pushbuttons and remote inputs are inoperative, the serial start command is unavailable and the soft starter's display flashes the letters 'SP'.

When the Write Function command is terminated by the master or with an error or timeout, the functions are written to the EEPROM and the IMS2 exits Serial Programming Mode.

NOTE
Serial Programming Mode will time out in 500 ms if there has been no serial activity.

The following functions may not be adjusted:
Function 100, 101, 102, 103, 110, 111, 112, 113 and 117.
If values for these functions are uploaded to the IMS2 there will be no effect and an error will be generated.

Calculating the Checksum (LRC)

Each command string sent to and from the starter includes a checksum. The form used is the longitudinal redundancy check (LRC) in ASCII hex. This is an 8-bit binary number represented and transmitted as two ASCII hexadecimal characters.

To calculate LRC:

1. Sum all ASCII bytes
2. Mod 256
3. 2's complement
4. ASCII convert

For example Command String (Start):

ASCII	STX	B	1	0	
or	02h	42h	31h	30h	
ASCII	Hex	Binary			
STX	02h	0000 0010			
B	42h	0100 0010			
1	31h	0011 0001			
0	30h	0011 0000			
	A5h	1010 0101			SUM (1)
	A5h	1010 0101			MOD 256 (2)
	5Ah	0101 1010			1's COMPLEMENT
	01h	0000 0001			+ 1 =
	5Bh	0101 1011			2's COMPLEMENT (3)
ASCII	5	B			ASCII CONVERT (4)
or	35h	42h			LRC CHECKSUM

The complete command string becomes:

ASCII	STX	B	1	0	5	B	ETX
or	02h	42h	31h	30h	35h	42h	03h

To verify a received message containing an LRC:

1. Convert last two bytes of message from ASCII to binary
2. Left shift 2nd to last byte four bits
3. Add to last byte to get binary LRC
4. Remove last two bytes from message
5. Add remaining bytes of message
6. Add binary LRC
7. Round to one byte
8. The result should be zero

Response or status bytes are sent from the starter as an ASCII string:

STX	[d1]h	[d2]h	[d3]h	[d4]h	LRC1	LRC2	ETX
d1 =	30h						
d2 =	30h						
d3 =	30h plus upper nibble of status byte right shifted by four binary places						
d4 =	30h plus lower nibble of status byte						

For example status byte = 1Fh, response is:

STX	30h	30h	31h	46h	LRC1	LRC2	ETX

7.3 Modbus Protocols

The soft starter can communicate using either Modbus RTU or Modbus ASCII. Use Function 63 *Serial Protocol* to select the protocol and Function 64 *Modbus Parity* to select the parity.

All the functionality of the IMS2 serial protocol is implemented in the Modbus RTU and ASCII protocols using the Modbus register structure as follows.

NOTE
Command, Starter Status, Trip Code, Current, Temperature, Product type/version, RS485 Protocol version, and Function Upload (write) must be sent individually, ie one data word request at a time (single read/write).
The Modbus ASCII protocol is restricted to transferring one function download at a time (single read).
The Modbus RTU protocol is restricted to transferring a maximum of six function downloads at a time (multiple read).

Refer to the Modbus standard at http://www.modbus.org for protocol details.

Register Address	Register	Type	Description	
40002	Command	Single write	1 = Start 2 = Stop 3 = Reset 4 = Quick Stop 5 = Forced Communication Trip	
40003	Starter Status	Single read	Bit No.	Description
			0 - 3	0 = Not used 1 = Waiting 2 = Starting (incl. Pre-start tests) 3 = Running 4 = Stopping 5 = Restart delay 6 = Tripped 7 = Programming Mode
			4	1 = Positive phase sequence detected
			5	1 = Current exceeds the FLC
			6	0 = Uninitialised 1 = Initialised *nb: bit 4 is not valid unless bit 6 = 1*
			7	0 = Communication connection status OK 1 = Communication connection fault
40004	Trip Code	Single read	255 = No trip 0 = Shorted SCR 1 = Excess start time 2 = Motor thermal model 3 = Motor thermistor 4 = Phase imbalance 5 = Supply frequency 6 = Phase sequence 7 = Electronic shearpin 8 = Power circuit fault 9 = Undercurrent 10 = Heatsink overtemperature (F) 11 = Invalid motor connection (P) 12 = Auxiliary Input (J) 13 = Out of range FLC (L) 14 = Incorrect control module (Y) 15 = RS485 communication fault (C) 16 = Forced communication trip (H) 17 = CPU error (U)	
40005	Current	Single read		
40006	Temperature	Single read		
40007	Product type and version	Single read	Bit No.	Description
			0 - 2	Function list version
			3 - 7	IMS2 = 2
40008	RS485 protocol version	Single read	RS485 serial protocol version	
40009 to 40125	Function 1 to Function 117	Multiple read / Single write	Refer to *Function Descriptions* for detail	

Modbus HEX Functions

Two Modbus HEX functions are supported: 03 Single / Multiple Read
06 Single Write

The IMS2 does not accept broadcast functions.

Examples of Modbus protocol

NOTE
Least significant bit is transmitted first.

Command:
Start

Slave Address	Function Code	Register Address	Data	Checksum
20	06	40002	1	(LRC or CRC)

Starter status:
Starter running

Slave Address	Function Code	Register Address	Data	Checksum
20	03	40003	xxxx0011	(LRC or CRC)

Trip code:
Overcurrent trip

Slave Address	Function Code	Register Address	Data	Checksum
20	03	40004	00000010	(LRC or CRC)

Read function from the soft starter:
Read from Function 3 Initial Start Current, 350%

Slave Address	Function Code	Register Address	Data	Checksum
20	03	40011	350	(LRC or CRC)

Write function to the soft starter:
Write to Function 12 Soft Stop Mode, set = 1 (Pump Control)

Note: Returns error if out of range

Slave Address	Function Code	Register Address	Data	Checksum
20	06	40020	1	(LRC or CRC)

Section 8 | Programmable Parameters

8.1 Programming Procedure

Step 1. Enter Programming Mode and select the function to be viewed or adjusted.

1 Press and hold the <FUNCTION> pushbutton.

2 Use the <UP> and <DOWN> pushbuttons to select the required function number. Function numbers are left justified and flash.

3 When the required function number is displayed, release the <FUNCTION> pushbutton. The display will show the currently stored setting. Settings are right justified and do not flash.

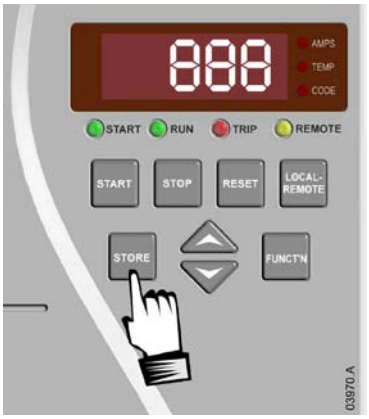
Step 2. Alter the function setting.

1 Use the <UP> and <DOWN> pushbuttons to adjust the setting. To cancel changes, press the <FUNCTION> pushbutton.

Step 3. Store the new setting.

1 Press the <STORE> pushbutton to store the displayed setting.

2 To check that the new value has been correctly stored, press then release the <FUNCTION> pushbutton. The display will show the new setting.



Step 4. Exit Programming Mode.

1 Once all changes have been made, exit Programming Mode by using the <FUNCTION> and <DOWN> pushbuttons to select Function 0 (Run Mode).

8.2 Function List

No.	Function	Factory default	User set 1	User set 2
	Primary Motor Settings			
1	Motor Full Load Current	-		
2	Current Limit	350		
3	Initial Start Current	350		
4	Start Ramp Time	1		
5	Stop Ramp Time	0		
6	Motor Start Time Constant	10		
7	Phase Imbalance Sensitivity	5		
8	Undercurrent Protection	20		
9	Electronic Shearpin Protection	400		
	Start/Stop Formats			
10	Torque Control	0		
11	Kickstart	0		
12	Soft Stop Mode	0		
13	Auto-Stop – Run Time	0		
	Starter Functionality			
20	Local/Remote Operation	0		
21	Relay Output A Functionality	11		
22	Relay Output B Functionality	10		
23	Relay Output C Functionality	0		
24	Input A Functionality	0		
	Protection Settings			
30	Excess Start Time	20		
31	Phase Sequence	0		
32	Restart Delay	1		
33	Phase Imbalance	0		
34	Motor Thermistor	0		
35	Heatsink Overtemperature	0		
36	Auxiliary Trip Mode	0		
	Set Points			
40	Low Current Flag	50		
41	High Current Flag	105		
42	Motor Temperature Flag	80		
43	Field Calibration	100		
	Analogue Output			
50	4-20 mA Output Functionality	0		
51	4-20 mA Output Range – Max	100		
52	4-20 mA Output Range – Min	0		
	Serial Communications			
60	Serial Timeout	0		
61	Serial Baud Rate	4		
62	Serial Satellite Address	20		
63	Serial Protocol	1		
64	Modbus Parity	0		
	Auto-Reset			
70	Auto-Reset – Configuration	0		
71	Auto-Reset – Number of Resets	1		
72	Auto-Reset – Group A & B Delay	5		
73	Auto-Reset – Group C Delay	5		

No.	Function	Factory default	User set 1	User set 2
	Secondary Motor Settings			
80	Motor Full Load Current	-		
81	Current Limit	350		
82	Initial Start Current	350		
83	Start Ramp Time	1		
84	Stop Ramp Time	0		
85	Motor Start Time Constant	10		
86	Phase Imbalance Sensitivity	5		
87	Undercurrent Protection	20		
88	Electronic Shearpin Protection	400		
	Protection Delays			
90	Phase Imbalance Trip Delay	3		
91	Undercurrent Trip Delay	5		
92	Electronic Shearpin Delay	0		
93	Out Of Frequency Trip Delay	0		
94	Auxiliary Trip Delay	0		
	Read Only Data			
100	Model Number	-		
101	Start Counter (1000's)	-		
102	Start Counter (1's)	-		
103	Trip Log	-		
	Restricted Functions			
110	Access Code	0		
111	Update Access Code	0		
112	Function Lock	0		
113	Restore Function Settings	0		
114	Emergency Mode – Format	0		
115	Emergency Mode – Trip Relay	0		
116	Thermal Model – Override	-		
117	Thermal Model – Override Count	-		

Application Detail	
IMS2 model	
IMS2 serial number	
IMS2 connection format	☐ In-line
	☐ Inside delta
	☐ Bypassed
Motor current	A
Motor kW	kW
Driven machine	
Start current (%FLC)	% FLC
Start time (seconds)	s
Starts per hour	
Ambient temperature (°C)	°C
Application Reference	

If you require assistance during commissioning or troubleshooting, please fill in this table and give the information to your supplier.

8.3 Function Descriptions

Primary Motor Settings

1 – Motor Full Load Current

Range: Model dependent

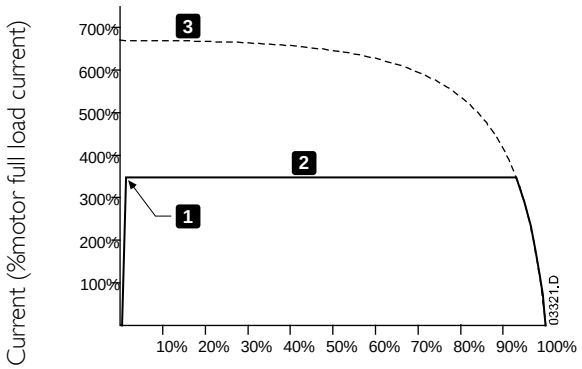
Description: Sets the IMS2 for the connected motor's full load current.
Set to the full load current rating (in amperes) shown on the motor nameplate.

2 – Current Limit

Range: 100 – 550% FLC **Default:** 350%

Description: Sets the current limit for constant current soft starting.

Constant current is the traditional form of soft starting, which raises the current from zero to a specified level and keeps the current stable at that level until the motor has accelerated.



1: Initial current (Function 3)
2: Current limit (Function 2)
3: Full voltage current

Constant current starting is ideal for applications where the start current must be kept below a particular level.

Set the current limit so that:

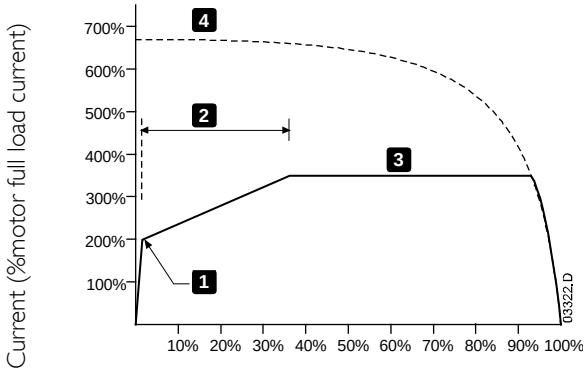
- The motor is supplied with sufficient start current to enable it to produce enough torque to easily accelerate the connected load.
- Desired starting performance is obtained.
- IMS2 ratings are not exceeded.

3 – Initial Start Current

Range: 100 – 550% FLC **Default:** 350%

Description: Sets the initial start current level for current ramp start mode. Function 3 Initial Start Current and Function 4 *Start Ramp Time* are used together to activate and control the current ramp start mode.

Current ramp soft starting raises the current from a specified starting level (1) to a maximum limit (3), over an extended period of time (2).



1: Initial current (Function 3)
2: Start ramp time (Function 4)
3: Current limit (Function 2)
4: Full voltage current

Current ramp starting can be useful for applications where:

- the load can vary between starts (for example a conveyor which may start loaded or unloaded). Set the initial current (Function 3) to a level that will start the motor with a light load, and the current limit (Function 2) to a level that will start the motor with a heavy load.
- the load breaks away easily, but starting time needs to be extended (for example a centrifugal pump where pipeline pressure needs to build up slowly).
- the electricity supply is limited (for example a generator set), and a slower application of load will allow greater time for the supply to respond.

4 – Start Ramp Time

Range: 1 – 30 seconds **Default:** 1 second

Description: Sets the ramp time for current ramp start mode.
Set the start ramp time to optimise start performance.

5 – Stop Ramp Time

Range: 0 – 100 seconds **Default:** 0 seconds

Description: Sets the soft stop ramp time for soft stopping the motor. The soft stop mode is selected using Function 12. Setting Function 5 to 0 disables soft stop.
If using soft stop and a main contactor, the contactor must remain closed until the end of the stop ramp time. The IMS2 programmable outputs A, B or C can be set to control the main contactor. Refer to Functions 21, 22, 23 for programmable output assignment details.

6 – Motor Start Time Constant

Range: 0 – 120 seconds **Default:** 10 seconds

Description: Sets the motor thermal capacity used by the IMS2's motor thermal model.

NOTE
A setting of 0 seconds disables the soft starter's motor thermal model. Use this setting only if another form of motor protection is used.

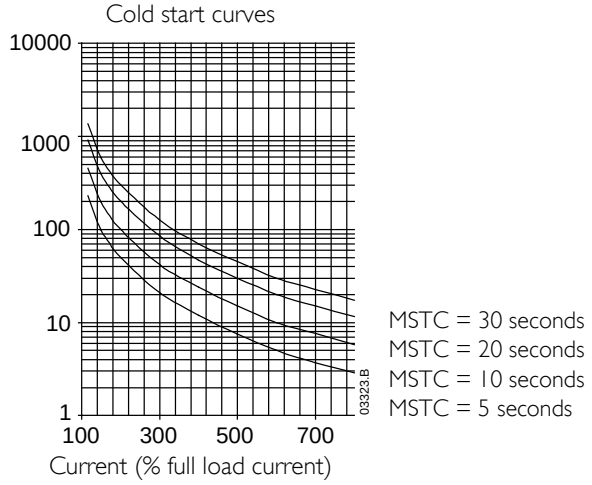
A motor's thermal capacity (also known as maximum locked rotor time or maximum DOL start time) is the maximum time a motor can maintain locked rotor current from cold. This information is available from the motor datasheet or the motor supplier.

The IMS2's motor thermal model assumes a locked rotor current of 600%. If the connected motor's locked rotor current differs from this, greater accuracy can be achieved by using a normalised MSTC figure:

$$\text{MSTC} = \left(\frac{\%\text{LRC}}{600}\right)^2 \times \text{maximum start time}$$

03324.B

NOTE
Setting Function 6 *Motor Start Time Constant* according to the motor's actual thermal capacity allows safe use of the motor's full overload capability both to start the load and ride through overload conditions.



A more conservative approach can be taken by setting a reduced MSTC for easy to start loads that will not experience transient operating overloads as a part of normal operation. Using a reduced

MSTC figure has the advantage of maximising motor life. The life of a motor is strongly influenced by its maximum winding temperature, and the expected life span of a motor is roughly halved for every ten degree rise in temperature. The temperature rise depends on the motor losses and the motor cooling. The highest stress on the motor is during start, and can be minimised by restricting the duration and frequency of starts. A reduced MSTC setting will also cause the soft starter's protection functions to operate before the motor is thermally stressed.

A suitable reduced MSTC figure can be established by observing the modelled motor temperature as shown on the IMS2's display, and adjusting the MSTC parameter such that after a normal start which has been preceded by a period of running at maximum load, the calculated motor temperature is approaching 90%.

7 – Phase Imbalance Sensitivity

Range: 1 – 10
1 = Highest sensitivity (lowest imbalance)
|
5 = Normal sensitivity (**default**)
|
10 = Lowest sensitivity (highest imbalance)

Description: Sets the sensitivity of the phase imbalance protection.

8 – Undercurrent Protection

Range: 0% – 100% FLC **Default:** 20%

Description: Sets the trip point for undercurrent protection as a percentage of motor full load current. Set to a level below the motor's normal working range and above the motor's magnetising (no load) current (typically 25% - 35% of rated full load current). A setting of 0% disables the protection.

NOTE
Undercurrent protection only operates while the soft starter is running.

9 – Electronic Shearpin Protection

Range: 80% – 550% FLC **Default:** 400 %

Description: Sets the trip point for electronic shearpin protection as a percentage of motor full load current.

NOTE
Electronic shearpin protection only operates while the soft starter is running. The activation of this trip can be delayed by setting Function 92 *Electronic Shearpin Delay.*

Start/Stop Formats

10 – Torque Control

Options: 0 = Off (**default**)
1 = On

Description: Enables or disables the torque control function. Torque control provides a more linear acceleration than current limit or current ramp start modes alone.

11 – Kickstart

Options: 0 = Off (**default**)
1 = On

Description: Activates the kickstart function. Kickstart provides extra torque at the beginning of a start and can be useful for accelerating loads that require high breakaway torque but then accelerate easily.

NOTE
Kickstart subjects the mechanical equipment to increased torque levels. Ensure the motor, load and couplings can handle the additional torque before using this feature.

12 – Soft Stop Mode

Options: 0 = Standard soft stop (**default**)
1 = Pump control

Description: Selects the active soft stop mode.
The standard soft stop mode automatically monitors motor deceleration and will provide optimum control for most applications. Pump control may offer superior performance in some applications and can be of particular benefit in some pumping applications.
To disable soft stop, set Function 5 *Soft Stop Time* to 0.

13 – Auto-Stop Run Time

Range: 0 – 255 units **Default:** 0 units (off)
1 unit = 6 minutes

Description: Sets the run time for the auto-stop function. The soft starter will automatically stop after running for the specified period. The maximum run time is before auto-stop is 25 hours, 30 minutes (6 minutes x 255), measured from the last start signal. A value of 0 disables auto-stop.
For a short-cut to this function, refer to *Operation*.

Starter Functionality

20 – Local/Remote Operation

Options: 0 (IMS2 **<LOCAL/REMOTE>** pushbutton always enabled, **default**)
1 (IMS2 **<LOCAL/REMOTE>** pushbutton disabled while motor running)
2 (Local control only: IMS2 pushbuttons enabled, remote inputs disabled)
3 (Remote control only: IMS2 pushbuttons disabled, remote inputs enabled)

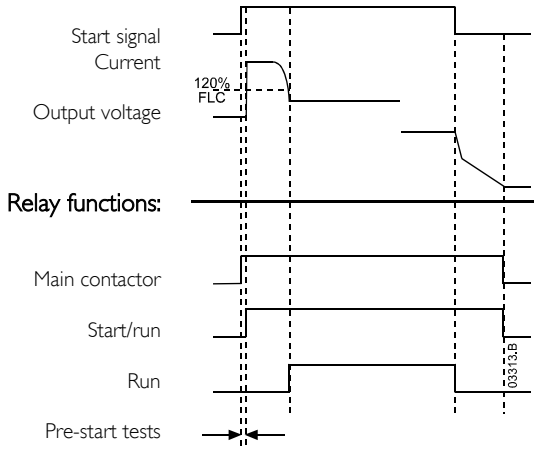
Description: Enables and disables the local pushbuttons and remote control inputs. Also determines when and if the **<LOCAL/REMOTE>** pushbutton can be used to switch between local and remote control.

21 – Relay Output A Functionality

Options:

0 = Tripped
1 = Overcurrent trip
2 = Undercurrent trip
3 = Motor thermistor trip
4 = Heatsink overtemperature trip
5 = Phase imbalance trip
6 = Electronic shearpin trip
7 = Low current flag
8 = High current flag
9 = Motor temperature flag
10 = Start/Run
11 = Main contactor (**default**)
12 = Auxiliary trip

Description: Selects the functionality of programmable Relay Output A.



22 – Relay Output B Functionality

Range: 0 – 12 **Default:** 10 (Start/Run)

Description: Assigns the functionality of programmable Relay Output B. Refer to Function 21 *Relay Output A Functionality* for details.

23 – Relay Output C Functionality

Range: 0 – 12 **Default:** 0 (Tripped)

Description: Assigns the functionality of programmable Relay Output C. Refer to Function 21 *Relay Output A Functionality* for details.

24 – Input A Functionality

Description: Determines the functionality of programmable Input A.

Options:

0 (Parameter set selection, **default**)	The IMS2 can be programmed with two separate sets of motor and starting data. The primary parameter set is programmed using Functions 1 ~ 9. The secondary parameter set is programmed using Functions 80 ~ 88. To use the secondary parameter set, Function 24 *Input A Functionality* must be set to 0 and there must be a closed circuit across Input A when a start is called for.
1 (Auxiliary trip (normally open)	The IMS2 can be tripped by a remote circuit connected to Input A when Function 24 *Input A Functionality* is set = 1 (Auxiliary trip - normally open). A closed circuit across Input A trips the IMS2. Functionality of the auxiliary trip feature can be adjusted using Function 94 *Auxiliary Trip Delay* and Function 36 *Auxiliary Trip Mode*.
2 (Auxiliary trip (normally closed)	The IMS2 can be tripped by a remote circuit connected to Input A when Function 24 *Input A Functionality* is set = 2 (Auxiliary trip - normally closed). An open circuit across Input A trips the IMS2. Functionality of the auxiliary trip feature can be adjusted using Function 94 *Auxiliary Trip Delay* and Function 36 *Auxiliary Trip Mode*.
3 (Emergency run)	In emergency run the soft starter continues to run until stopped, ignoring specified protection functions are ignored. Closing the circuit across Input A activates emergency run. The IMS2 will start the motor, if not already running, and continue operation ignoring the trip conditions specified in Function 114 *Emergency Mode - Format*. Opening the circuit across Input A ends emergency run and returns control to the normal control circuits. Functionality of the trip relay during emergency run operation is determined by Function 115 *Emergency Mode - Trip Relay Operation*.

Protection Settings

30 – Excess Start Time

Range: 0 – 255 seconds **Default:** 20 seconds

Description: Sets the maximum time allowed for the motor to start. If the motor does not reach full speed within the programmed limit, the starter will trip. Set for a period slightly longer than required for a normal healthy start. A setting of 0 disables this protection.

NOTE
Ensure the excess start time setting is within the soft starter's rated capability. This ensures the soft starter is also protected from overloads caused by stalled motors.

31 – Phase Sequence

Range:
0 = Off (forward and reverse rotation accepted, **default**)
1 = Forward rotation only (reverse rotation prohibited)
2 = Reverse rotation only (forward rotation prohibited)

Description: Selects the valid phase sequences for phase sequence protection. The IMS2 examines the sequence of the phases at its input terminals and trips if the actual sequence does not match the selected option.

32 – Restart Delay

Range: 0 – 254 units **Default:** 1 (10 seconds)
1 unit = 10 seconds

Description: Sets the minimum time between the end of a stop and the beginning of the next start. During the restart delay, the AMPS or TEMP LED will flash, indicating the motor cannot yet be restarted.

NOTE
A setting of 0 selects the minimum restart delay period (1 second).

33 – Phase Imbalance

Options: 0 = On (**default**)
1 = Off

Description: Enables or disables the phase imbalance protection.

34 – Motor Thermistor

Options: 0 = On (**default**)
1 = Off

Description: Enables or disables the thermistor protection feature.

35 – Heatsink Overtemperature

Options: 0 = On (**default**)
1 = Off

Description: Enables or disables the IMS2's heatsink overtemperature protection.

NOTE
Defeating the protection may compromise starter life and should only be done in the case of emergency.

36 – Auxiliary Trip Mode

Options:
0 = Active at all times (**default**)
1 = Active during starting, run and stopping (disabled while stopped)
2 = Active during run only
3 = Active 30 seconds after the start command
4 = Active 60 seconds after the start command
5 = Active 90 seconds after the start command
6 = Active 120 seconds after the start command
7 = Active 180 seconds after the start command
8 = Active 240 seconds after the start command
9 = Active 300 seconds after the start command
10 = Active 600 seconds after the start command
11 = Active 900 seconds after the start command
12 = Active 1200 seconds after the start command

Description: Determines when the IMS2 monitors the auxiliary trip input. Refer to Function 24 *Input A Functionality* for further detail.

Set Points

40 – Low Current Flag

Range: 1 – 100% FLC **Default:** 50%

Description: Sets the current level (% FLC) at which the low current flag operates.
The low current flag can be assigned to programmable Relay Outputs A, B or C, to indicate that motor current has fallen below the programmed value.

41 – High Current Flag

Range: 50 – 550% FLC **Default:** 105%

Description: Sets the current level (% FLC) at which the high current flag operates.
The high current flag can be assigned to programmable Relay Outputs A, B or C, to indicate that motor current has exceeded the programmed value.

42 – Motor Temperature Flag

Range: 0 – 105% Motor Temperature **Default:** 80%

Description: Sets the temperature (%) at which the motor temperature flag operates.
The motor temperature flag can be assigned to programmable Relay Outputs A, B or C to indicate that motor temperature (as calculated by the motor thermal model) has exceeded the programmed value.
The soft starter trips when motor temperature reaches 105%.

43 – Field Calibration

Range: 85% – 115% **Default:** 100%

Description: Adds a gain to the soft starter's current monitoring circuits. The IMS2 is factory calibrated with an accuracy of ± 5%. The field calibration function can be used to match the IMS2 current readout with an external current metering device.
Use the following formula to calculate the setting required.

$$\text{Calibration (\%)} = \frac{\text{Current shown on IMS2 display}}{\text{Current measured by external device}}$$

$$\text{eg } 102\% = \frac{66\text{ A}}{65\text{ A}}$$

NOTE
This adjustment affects all current-based functions.

Analogue Ouptut

50 – 4-20 mA Output Functionality

Options: 0 = Current (% FLC, **default**)
1 = Motor temperature (% maximum temperature of trip point, ie 105%)

Description: Selects the functionality of the analogue output.
Performance of the 4-20 mA signal can be adjusted using Functions 51 and 52 *Analogue Output Range - Maximum* and *Minimum*.

51 – 4-20 mA Output Range - Maximum

Range: 0 – 255% **Default:** 100%

Description: Determines the value represented by a 20 mA signal from the analogue output.

52 – 4-20 mA Output Range - Minimum

Range: 0 – 255% **Default:** 0%

Description: Determines the value represented by a 4 mA signal from the analogue output.

Serial Communications

60 – Serial Timeout

Range: 0 – 100 seconds **Default:** 0 (off)

Description: Sets the maximum allowable period of RS485 serial inactivity.

NOTE
A setting of 0 seconds disables the serial timeout protection and enables the IMS2 to continuing operating even if the RS485 serial link becomes inactive.

61 – Serial Baud Rate

Options: 1 = 1200 baud
2 = 2400 baud
3 = 4800 baud
4 = 9600 baud (**default**)
5 = 19200 baud

Description: Selects the baud rate for RS485 serial activity.

62 – Serial Satellite Address

Range: 1 – 99 **Default:** 20

Description: Assigns the IMS2 an address for RS485 serial communication.

63 – Serial Protocol

Options:
1 = AP ASCII (**default**)
2 = Modbus RTU
3 = Modbus ASCII

Description: Selects the protocol for RS485 serial communication.

64 – Modbus Parity

Options:
0 = No parity (**default**)
1 = Odd parity
2 = Even parity
3 = 10-bit transmission

Description: Selects the parity for the Modbus protocol (when this protocol has been selected using Function 63 *Serial Protocol*).

Auto-Reset

The IMS2 can be programmed to automatically reset certain trips, which can help minimise operating downtime. Trips are divided into three categories for auto-reset, depending on the risk to the soft starter:

Trip Group	Trip Conditions
A	Phase imbalance, Phase loss
B	Undercurrent, Electronic shearpin, Auxiliary trip
C	Overcurrent, Motor thermistor, Heatsink overtemperature

70 – Auto-Reset – Configuration

Options:
0 = Off (**default**)
1 = Reset Group A trips
2 = Reset Group A & B trips
3 = Reset Group A, B & C trips

Description: Selects which trips will be automatically reset.
If the start signal is still present, the IMS2 will attempt to start the motor after a delay.

CAUTION
If the start signal is still present when the soft starter auto-resets, the motor will restart. Before enabling auto-reset, ensure that personal safety is not endangered and that all relevant safety measures and/or regulations are complied with.

71 – Auto-Reset – Number of Resets

Range: 1 – 5 **Default:** 1

Description: Sets maximum number of reset attempts for the auto-reset function.
The auto-reset counter increases by one after each trip, up to the maximum number of resets set in Function 71 *Auto-Reset – Number of Resets*. The fault is then latched and a manual reset is required.
The auto-reset counter decreases by one, to a minimum of zero, after each successful start/stop cycle.

72 – Auto-Reset – Group A & B Delay

Range: 5 – 999 seconds **Default:** 5 seconds

Description: Sets the delay for resetting Group A & B trips.

73 – Auto-Reset – Group C Delay

Range: 5 – 60 minutes **Default:** 5 minutes

Description: Sets the delay for resetting Group C trips.

Secondary Motor Settings

IMS2 soft starters can be programmed with two separate sets of motor data. The primary motor settings are adjusted using Functions 1 ~ 9. The secondary motor settings are adjusted using Functions 80 ~ 88. Refer to Function 24 *Input A Functionality* for detail on enabling the secondary function set.

80 – Motor Full Load Current

Range: Model Dependent (A)

Description: Sets the IMS2 for the connected motor's full load current. Refer to Function 1 for details.

81 – Current Limit

Range: 100 – 550% FLC **Default:** 350%

Description: Sets the start current limit. Refer to Function 2 for details.

82 – Initial Start Current

Range: 100 – 550% FLC **Default:** 350%

Description: Sets the initial start current level for current ramp start mode. Refer to Function 3 for details.

83 – Start Ramp Time

Range: 1 – 30 seconds **Default:** 1 second

Description: Sets the ramp time for current ramp start mode. Refer to Function 4 for details.

84 – Stop Ramp Time

Range: 0 – 100 seconds **Default:** 0 seconds

Description: Sets the soft stop ramp time for soft stopping the motor. Refer to Function 5 for details.

85 – Motor Start Time Constant

Range: 0 – 120 seconds **Default:** 10 seconds

Description: Sets the motor thermal capacity used by the IMS2 motor thermal model. Refer to Function 6 for details.

NOTE
A setting of 0 seconds disables the IMS2 motor thermal model. Use this setting only if another form of motor protection is used.

86 – Phase Imbalance Sensitivity

Range: 1 – 10 **Default:** 5

Description: Sets the sensitivity of the phase imbalance protection. Refer to Function 7 for details.

87 – Undercurrent Protection

Range: 0% – 100% FLC **Default:** 20%

Description: Sets the trip point for undercurrent protection as a percentage of motor full load current. Refer to Function 8 for details.

88 – Electronic Shearpin Protection

Range: 80% – 550% FLC **Default:** 400%

Description: Sets the trip point for electronic shearpin protection as a percentage of motor full load current. Refer to Function 9 for details.

Protection Delays

The IMS2 can be figured with delays, to slow the soft starter's response to selected protection conditions. This helps avoid nuisance tripping due to momentary fluctuations outside the normal operating range.

90 – Phase Imbalance Trip Delay

Range: 3 – 254 seconds **Default:** 3 seconds

Description: Slows the IMS2's response to phase imbalance (refer to Functions 7 and 86 *Phase Imbalance Sensitivity*).

91 – Undercurrent Trip Delay

Range: 0 – 60 seconds **Default:** 5 seconds

Description: Slows the IMS2's response to undercurrent (refer to Functions 8 and 87 *Undercurrent Protection*).

92 – Electronic Shearpin Delay

Range: 0 – 60 seconds **Default:** 0 seconds

Description: Slows the IMS2's response to electronic shearpin (refer to Functions 9 and 88 *Electronic Shearpin Protection)*.

93 – Out of Frequency Trip Delay

Range: 0 – 60 seconds **Default:** 0 seconds

Description: Controls the IMS2's response to low supply frequency while the motor is running. This setting controls both the delay before the IMS2 trips and also the level of variation the soft starter will allow. For applications where the supply frequency regularly drops below the trip level, it may be necessary to desensitise the IMS2 to avoid nuisance tripping.

Set to allow continued motor operation during extreme but temporary under frequency conditions that endanger motor life.

	50 Hz mains supply		60 Hz mains supply	
Function 93 setting:	Time delay trip	Instantaneous trip	Time delay trip	Instantaneous trip
0 ~ 59 seconds	45 Hz ~ 48 Hz	< 45 Hz	55 Hz ~ 58 Hz	< 55 Hz
60 seconds	36 Hz ~ 48 Hz	< 36 Hz	46 Hz ~ 58 Hz	< 46 Hz

NOTE
If the supply frequency drops below the instantaneous trip level the IMS2 will trip immediately, regardless of the delay setting.

94 – Auxiliary Trip Delay

Range: 0 – 240 seconds **Default:** 0 seconds

Description: Slows the IMS2's response to an auxiliary trip (refer to Function 24 *Input A Functionality*).

Read Only Data

Read Only Data contains information on the soft starter's model and operating history. These functions cannot be adjusted.

100 – Model Number

Range: 1 – 22

Description: A diagnostic parameter used to identify the power assembly type. 1 = IMS20018 and 22 = IMS21574.

101 – Start Counter (1000's)

Range: 1(,000) – 999(,000)

Description: Displays the number of successful starts. Read in conjunction with Function 102 for total start count.

102 – Start Counter (1's)

Range: 0 – 999

Description: Displays the number of successful starts. Read in conjunction with Function 101 for total start count.

NOTE
It is normal for the IMS2 to record a small number of starts during factory testing.

103 – Trip Log

Range: 1-x – 8-x

Description: Displays the IMS2 trip log. Use the **<UP>** and **<DOWN>** pushbuttons to scroll through the trip log.
Refer to *Troubleshooting* for a description of the trip log and fault conditions.

Restricted Functions

110 – Access Code

Range: 0 – 999 **Default:** 0

Description: The access code prevents unauthorised changes to critical parameters. Enter the correct access code to:

- Temporarily change the function lock to read/write irrespective of the state specified by Function 112 *Function Lock*. This allows function settings to be adjusted during the current programming session. When the current programming session finishes, function settings are again protected according to Function 112 *Function Lock*.
- Access Functions 111 - 117.

The default access code is 0. Contact your supplier if you lose or forget the access code.

111 – Update Access Code

Range: 0 – 999

Description: Changes the current access code.

112 – Function Lock

Options: 0 = Read/write (**default**)
1 = Read only

Description: Allows protection of all function settings. Changes to the function lock setting take effect when Programming Mode is exited.

113 – Restore Function Settings

Options: 50 = Load default settings
60 = Archive current function settings
70 = Load archived function settings

Description: Allows function adjustments be returned to the factory defaults. Additionally users can archive their own function settings and then restore these at a later date.

114 – Emergency Mode – Format

Options: 0 = Off (**default**)
1 = Trip Group A
2 = Trip Group A & B
3 = Trip Group A, B & C
4 = All trips

Description: Sets which trip conditions are ignored during Emergency Mode operation (Refer to Function 24 *Input A Functionality* for a description of Emergency Mode operation).

Trip Group	Trip Conditions
A	Phase imbalance, Phase loss
B	Undercurrent, Electronic shearpin, Auxiliary trip
C	Overcurrent, Motor thermistor, Heatsink overtemperature

115 – Emergency Mode – Trip Relay Operation

Options: 0 = Trips not indicated (**default**)
1 = Trips indicated

Description: Sets whether or not output relays assigned to the trip function (refer to Functions 21, 22 & 23) change state if the soft starter trips which operating in Emergency Mode. Refer to Function 24 *Input A Functionality* for a description of Emergency Mode operation.

116 – Thermal Model – Override

Range: 0 – 150%

Description: Allows the motor thermal model to be manually adjusted. In emergency situations the motor thermal model can be manually decreased to allow a restart of the motor.

CAUTION
Adjusting the motor thermal model may compromise motor life and should only be done in the case of emergency.

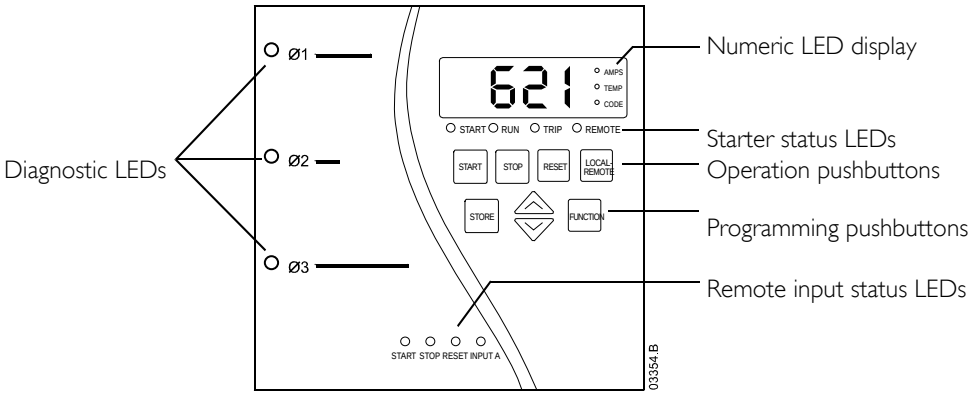
117 – Thermal Model – Override Count

Range: 0 – 255

Description: Displays the number of times the motor thermal model has been manually adjusted.

Section 9 Operation

9.1 Local Control Panel



Numeric LED display

The display consists of a numeric information area and three LEDs to the right. During operation, the display can show either motor current (amperes) or the motor temperature (calculated by the soft starter and shown as a percentage of the motor's thermal capacity). The LEDs at the right of the display indicate which information is being shown. Use the <UP> and <DOWN> pushbuttons to select current or temperature display.

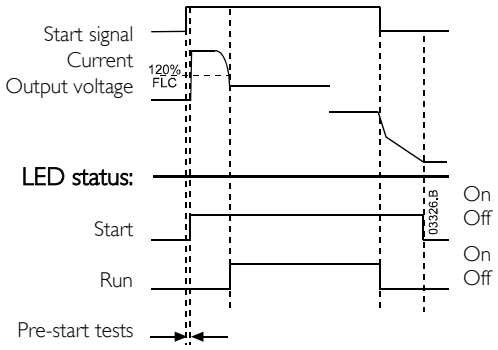
- If the motor current exceeds the display area, the display will show dashes – – –.

- If the soft starter trips, the Code LED will activate and the display will show the appropriate trip code.
- When the IMS2 is in Programming Mode, all display LEDs are on.
- If the Amps or Temp LED is flashing while the IMS2 is stopped, the soft starter is waiting for the restart delay to elapse (refer to Function 32 for details).

Starter status LEDs

Start: Voltage is being applied to the motor terminals.
Run: Full voltage is being applied to the motor terminals.
Trip: The IMS2 has tripped.
Remote: The IMS2 is in remote control mode.

If the Start and Run LEDs are both flashing while the IMS2 is running, the soft starter is operating under auto-stop control. The soft starter will continue to run for the time selected in Function 13 *Auto-Stop Run Time*.



Operation pushbuttons

These pushbuttons can be used to control the IMS2 in local control mode. The <LOCAL/REMOTE> pushbutton can be used to switch between local and remote control modes.

NOTE
When control power is applied, the IMS2 may be in either local or remote control mode depending on the mode it was in when control power was removed. The factory default is local control.

NOTE
Function 20 *Local/Remote Operation* can be used to limit operation to either local or remote mode operation. If the <LOCAL/REMOTE> pushbutton is pressed, the numeric display will show 'OFF'.

NOTE
Simultaneously pressing the <STOP> and <RESET> pushbuttons causes the IMS2 to immediately remove voltage from the motor, resulting in a coast to stop. Any soft stop settings are ignored.

Programming pushbuttons

Refer to Programming Procedure.

Remote input status LEDs

These LEDs indicate the state of the circuits across the IMS2 remote control inputs, in both local and remote control modes.

NOTE
All LEDs and the Numeric Display are illuminated for approximately one second to test their operation when control power is first applied.

Diagnostic LEDs

The diagnostic LEDs indicate the voltage across the SCRs on each phase of the soft starter. The LEDs should be brightly lit when the soft starter is powered up but not running, and should gradually fade to off while the IMS2 is performing a soft start.

If the LEDs are not behaving as expected, or if one LED is behaving differently from the other two, this helps identify which phase may be faulty.

Each LED relates to the input phases as follows:

LED	IMS2-0018 ~ IMS2-0253	IMS2-0302 ~ IMS2-1574
Ø1	L3	L1
Ø2	L2	L2
Ø3	L1	L3

9.2 Remote Control

IMS2 operation can be controlled via the remote control inputs when the soft starter is in remote mode. Use the <LOCAL/REMOTE> pushbutton to switch between local and remote modes. Refer to *Control Wiring* on page 12 for further detail.

9.3 Restart Delay

Function 32 *Restart Delay* sets the minimum period between the end of a stop and the beginning of the next start. During the restart delay period a LED to the right of the numeric display will flash, indicating that a restart cannot be attempted yet.

9.4 Pre-Start Tests

Before applying voltage to the motor when a start is initiated, the IMS2 first performs a series of tests to check the motor connection and supply conditions.

9.5 Secondary Motor Settings

IMS2 starters can be programmed with parameter sets for two motors. The primary motor settings are adjusted using Functions 1 ~ 9. The secondary motor settings are adjusted using Functions 80 ~ 88.

Programmable Input A can be used to select between the two function sets. Refer to Function 24 *Input A Functionality* for further detail.

9.6 Auto-Stop Short-Cut

A short-cut allows fast access to the auto-stop function (Function 13).

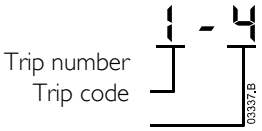
1. Press the <STOP> and <FUNCTION> pushbuttons at the same time.
   This enters Programming Mode and displays the value of Function 13 *Auto-Stop Run Time.*
2. Use the <UP> and <DOWN> pushbuttons to set the run time.
3. To store the new run time, press the <STOP> and <FUNCTION> pushbuttons together. The new setting will be saved and Programming Mode will close.

When a start is next initiated the IMS2 will run for the prescribed time. While running under in auto-stop, the Start and Run LEDs will both flash.

Section 10 Troubleshooting

10.1 Trip Codes

When the IMS2 trips, the Code LED lights up and the LED display indicates the trip code.

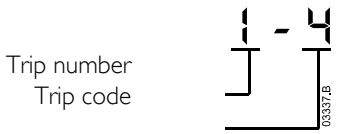


Code	Description
0	Shorted SCR The IMS2 has detected shorted SCRs. Use the three phase indicator LEDs (located on the left hand side of the IMS2 cover) to determine which phase is affected. All three LEDs should be on when mains voltage is present but the motor is not running. If an LED is off, an SCR on that phase is damaged. SCR damage can be verified using the Power Circuit Test described in *Tests and Measurements*. Contact your local supplier for assistance.
1	Excess start time trip Motor start time has exceeded the limit set in Function 30 *Excess Start Time*. The load may be jammed or the starting load may have increased since the soft starter was commissioned. Verify that the start current is as expected using the Start Performance Test described in *Tests and Measurements*.
2	Motor overload trip The motor has been overloaded and has reached its thermal limit (as calculated by the IMS2 thermal model). Remove the cause of the overload and let the motor cool before restarting. NOTE If the motor needs to be immediately restarted in an emergency situation and motor life can be risked, the IMS2 motor thermal model can be overridden using Function 116 *Thermal Model - Override*.
3	Motor thermistor trip The motor thermistors have indicated an overtemperature situation. 2 Identify and correct the cause of the motor overheating. 3 If no thermistors are connected to the IMS2, ensure there is a closed circuit across the motor thermistor input (terminals B4- B5) or that the motor thermistor protection is turned off by (set Function 34 *Motor Thermistor* = 1).
4	Phase imbalance trip An imbalance in the phase currents has exceeded the limits set in Function 7 *Phase Imbalance Sensitivity*. Check the motor circuit and monitor the mains voltage.
5	Supply frequency trip Supply frequency has varied outside the IMS2's specified range. Check for other equipment in the area that could be affecting the mains supply (particularly variable speed drives). Check the mains supply to the IMS2. If all three phases are lost while running, the IMS2 will detect 0 Hz and trip on supply frequency. If temporary fluctuations in frequency regularly occur while the motor is running, Function 93 *Out of Frequency Trip Delay* can be used to ride through the situation. NOTE Running a motor below its designed frequency increases motor heating and should only be allowed for short periods.
6	Phase sequence trip The phase sequence on the soft starter's input terminals (L1, L2, L3) is not valid. Change the incoming phase sequence or adjust Function 31 *Phase Sequence*.
7	Electronic shearpin trip The motor has experienced a sharp rise in motor current, probably caused by a locked rotor condition (shearpin) while running. This may indicate a jammed load.
8	Power circuit fault The IMS2 has detected a fault in the power circuit. Ensure that the motor is correctly connected to the IMS2 and verify the circuit. Check that voltage is correctly applied to all three IMS2 input terminals (L1, L2, L3). Test the IMS2's power circuit using the Power Circuit Test described in *Tests and Measurements*.

9	**Undercurrent trip** The IMS2 has measured a run current lower than the limit set in Function 8 *Undercurrent Protection*. Identify and correct the cause of the undercurrent event, then reset and restart the IMS2. If the problem persists, the main control module may be damaged. Contact your local supplier for assistance.
C	**RS485 communication fault** The RS485 serial link connected to the IMS2 has been inactive for a period of time greater than set in Function 60 *Serial Timeout*. Restore the RS485 serial link.
E	**EEPROM read/write failure** The IMS2 has failed to read or write to the internal EEPROM. Remove then reapply control voltage. If the problem persists, contact your supplier.
F	**Heatsink overtemperature trip** The IMS2 heatsink temperature sensor has activated. Check that: • the IMS2 has sufficient ventilation. • cooling air is able to freely circulate through the IMS2. • the IMS2 cooling fans (if fitted) are operating. Allow the IMS2 to cool, then attempt to restart. If the problem persists, contact your local supplier.
H	**Forced communications trip** The IMS2 has been tripped by a command from the RS485 serial communications network. Reset and restart the IMS2.
J	**Auxiliary trip** Input A has been assigned to the auxiliary trip function (refer to Function 24 *Input A Functionality*) and the IMS2 has detected a trip indication on the circuit across Input A. Identify and correct the cause of the trip condition on Input A.
L	**Out of range FLC** The IMS2 has detected that the motor is connected in-line and that the setting for Function 1 or 80 *Motor Full Load Current* is greater than the IMS2's maximum capability for this connection format. Reduce the programmed value then reset the IMS2. The IMS2 cannot be reset until the full load current setting has been corrected. Alternatively, remove control voltage from the IMS2 and reconnect the motor in inside delta configuration.
P	**Invalid motor connection** The IMS2 cannot detect a valid motor circuit connection. Ensure the motor is connected to the IMS2 in a valid configuration (either in-line or inside delta). Refer to *Power Circuits* for further detail.
U	**CPU error** Reset the trip condition be removing and re-applying control voltage to the IMS2. If the problem persists, contact your local supplier.
Y	**Incorrect main control module** The IMS2 is fitted with an incompatible main control module. Contact your local supplier for assistance.

10.2 Trip Log

The IMS2 includes a trip log that records the last eight trip events. Each trip is numbered. Trip 1 is the most recent trip and Trip 8 is the oldest recorded trip.



1 = Most recent trip
2 = Previous trip
. . .
8 = Oldest stored trip

The trip log can be viewed by selecting Function 103 *Trip Log* and using the **<UP>** and **<DOWN>** pushbuttons to scroll.

NOTE
The IMS2 records trips in the trip log immediately after they are detected. This requires control voltage to be present after the trip. Trips caused by or involving a loss of control voltage are not recorded.

Trip Log Marker

A marker can be inserted in the trip log to identify trips that have occurred after the marker was placed. To insert a marker, enter Programming Mode and select Function 103 *Trip Log*. To set the marker, simultaneously press the **<UP>**, **<DOWN>** and **<STORE>** pushbuttons. The marker is added as the most recent trip and is displayed as three horizontal lines:

NOTE
Trip markers must be separated by at least one trip. Markers cannot occur consecutively in the trip log.

10.3 General Faults

Symptom	Cause
IMS2 will not operate	**Local pushbuttons not active.** The IMS2 may be in remote control mode (refer to Function 20 *Local/Remote Operation*). **Remote control inputs not active.** The IMS2 may be in local control mode (refer to Function 20 *Local/Remote Operation*). **Faulty start signal.** Verify any circuits connected to the IMS2 remote control inputs. The state of the remote circuits is indicated by the IMS2 remote input status LEDs. The LEDs are illuminated when there is a closed circuit. To start successfully, there must be a closed circuit across the start, stop and reset circuits. **No, or incorrect, control voltage.** Ensure the correct control voltage is applied to the inputs A1, A2, A3. **Restart delay active.** The IMS2 cannot be started during the restart delay period. The period of the restart delay is set using Function 32 *Restart Delay*. **Auto-reset function active.** If there has been a trip and the Auto-reset function is active, the fault must be manually reset before a manual restart can be attempted (refer to Functions 70, 71, 72, 73 *Auto-Reset*). **IMS2 in Programming Mode.** The IMS2 will not run while in Programming Mode.
Uncontrolled start	**Power factor correction capacitors connected to the IMS2 output.** Remove any power factor correction from the output of the soft starter. Connecting power factor correction capacitors to the output of a soft starter can cause damage to the SCRs so they should be checked using the Power Circuit Test described in *Tests and Measurements*. **Damaged SCRS.** Verify soft starter operation using the Power Circuit Test described in *Tests and Measurements*. **Damaged firing circuit.** Verify the IMS2 SCR firing circuit using the Power Circuit Test described in *Tests and Measurements*.
IMS2 display shows an "h"	**The <START> pushbutton on the local control panel is stuck.** Release the pushbutton to restore normal operation. **Start command given during the restart delay period.** Wait for the restart delay to elapse.
The motor will not accelerate to full speed	**Start current too low.** Check the load is not jammed. Increase start current using Function 2 *Current Limit*.
Erratic motor operation and tripping	**SCRs not latching.** SCRs require a minimum current flow to latch on. In situations where large soft starters are controlling very small motors, the current drawn may be insufficient to latch the SCRs. Reduce soft starter size or increase motor size.
Soft stop ends before the programmed ramp time	**Motor will not stall.** The IMS2 has significantly reduced the voltage applied to the motor without detecting a reduction in motor speed. This indicates that with present motor loading, further control of the voltage will be ineffectual. The IMS2 has terminated the soft stop.
IMS2 will not enter Programming Mode	**The IMS2 is running.** The IMS2 must be stopped before Programming Mode can be accessed. **No, or incorrect, control voltage.** Ensure the correct control voltage is applied to the inputs A1, A2, A3.
Function settings cannot be made or are not recorded	**Incorrect programming procedure.** Function settings must be stored using the <STORE> button. Refer to *Programming Procedure* for further detail. **Function settings are locked.** Ensure that Function 112 *Function Lock* is set to Read/Write.

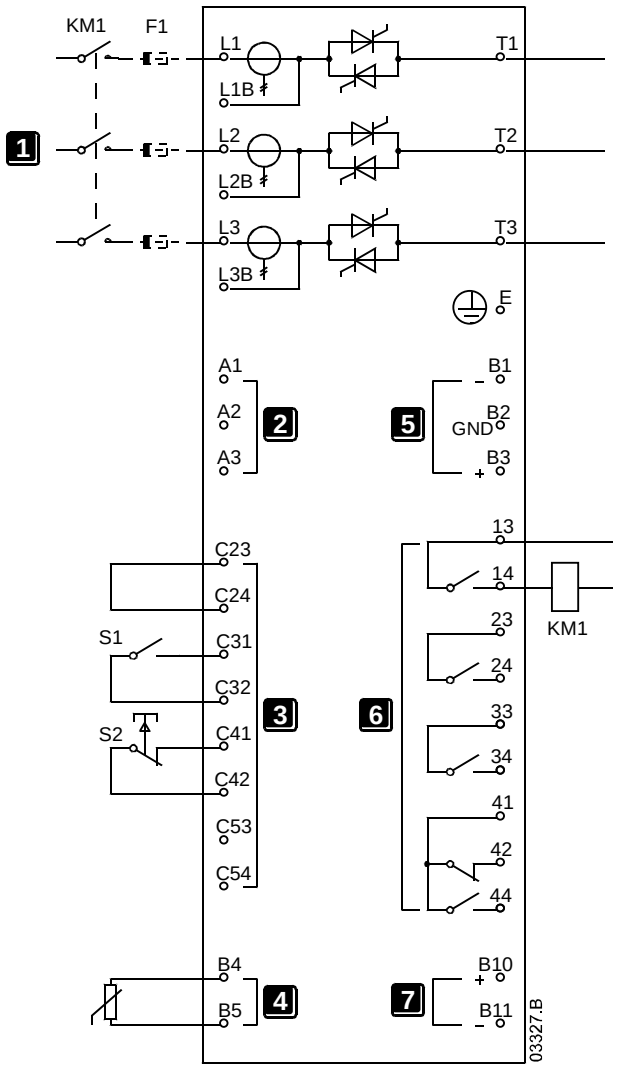
10.4 Tests and Measurements

Test	Procedure
Power circuit test	This test verifies the IMS2 power circuit including the SCR, firing loom, and control module snubber circuits. 1. Remove the incoming mains supply from the IMS2 (L1, L2, L3 and control supply). 2. Remove the motor cables from the output terminals of the IMS2 (T1, T2, T3). 3. Use a 500 VDC insulation tester to measure the resistance between the input and output of each phase of the IMS2 (L1-T1, L2-T2, L3-T3). Note that low voltage ohmmeters or multimeters are not adequate for this measurement. 4. The measured resistance should be close to 33 kΩ and approximately equal on all three phases. 5. If a resistance of less than 10 kΩ is measured across the SCR, the SCR should be replaced. 6. If a resistance greater than 60 kΩ is measured across the SCR there could be a fault with the IMS2 control module or firing loom.
Power transformer test	This test verifies operation of the IMS2 power transformer. Remove the Main Control Module from the starter and measure the power transformer output voltage to the Main Control Module. The values should be: • Green/yellow: earth • Purple: 0 VAC • Orange: 13~16 VAC
Control input test	This test verifies circuits connected to the IMS2 remote control inputs (Start, Stop, Reset and Input A). • Measure the voltage across each input. With the remote circuit closed there should be 0 VDC measured. If 24 VDC is measured, the switch/control is incorrectly connected or faulty.
Start performance test	This test verifies correct operation of the IMS2 during start. 1. Determine the expected start current by multiplying the settings made in Function 1 Motor Full Load Current and Function 2 Current Limit. 2. Start the motor and measure the actual start current. 3. If the expected start current and the actual start current are the same, the IMS2 is performing correctly.
Run performance test	This test verifies correct operation of the IMS2 during run. • Measure the voltage drop across each phase of the IMS2 (L1-T1, L2-T2, L3-T3). The voltage drop will be less than approximately 2 VAC when the IMS2 is operating correctly.

Section 11 Application Examples

11.1 Installation with Main Contactor

The IMS2 is installed with a main contactor (AC3 rated). Control voltage must be supplied from the input side of the contactor.

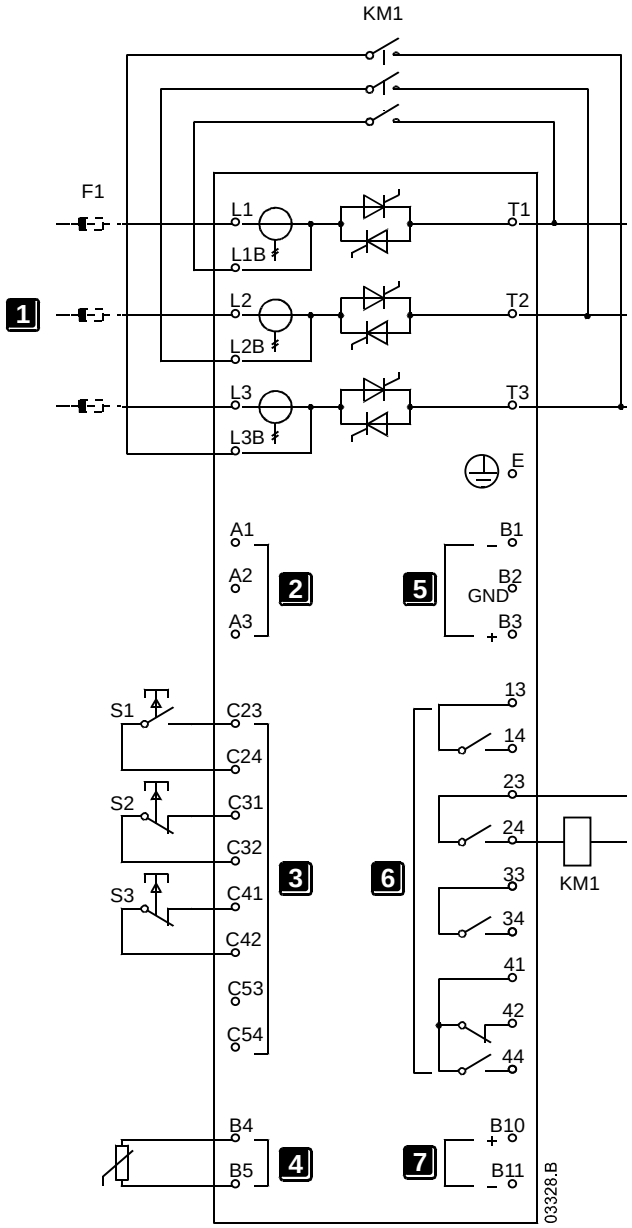


1	Mains voltage
KM1	Main contactor
F1	Semiconductor fuses (optional)
2	Control voltage
3	Remote control inputs
C23-C24	Start
C31-C32	Stop
C41-C42	Reset
C53-C54	Programmable input A
S1	Start/stop switch
S2	Reset pushbutton
4	Thermistor input
5	RS485 serial interface
6	Relay outputs
13-14	Programmable output A
23-24	Run output
33-34	Programmable output B
41, 42, 44	Programmable output C
7	Analog output

The main contactor is controlled by the IMS2 Main Contactor output, which by default is assigned to Output Relay A (terminals 13, 14).

11.2 Installation with Bypass Contactor

The IMS2 is installed with a bypass contactor (AC1 rated). The bypass contactor is controlled by the IMS2 Run Output (terminals 23, 24).

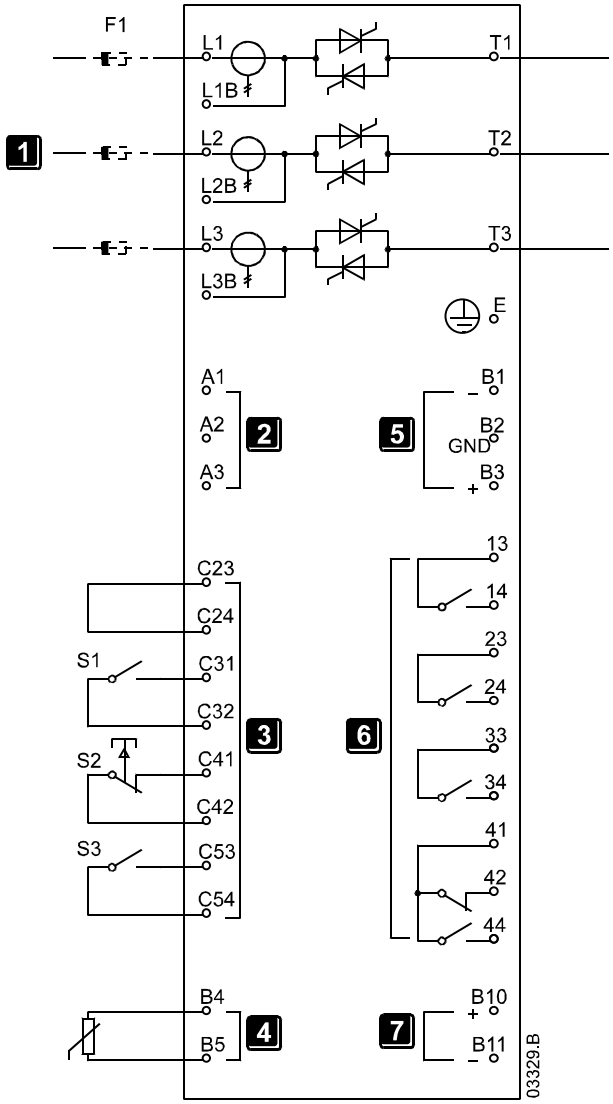


1	Mains voltage
KM1	Bypass contactor
F1	Semiconductor fuses (optional)
2	Control voltage
3	Remote control inputs
C23-C24	Start
C31-C32	Stop
C41-C42	Reset
C53-C54	Programmable input A
S1	Start pushbutton
S2	Stop pushbutton
S3	Reset pushbutton
4	Thermistor input
5	RS485 serial interface
6	Relay outputs
13-14	Programmable output A
23-24	Run output
33-34	Programmable output B
41, 42, 44	Programmable output C
7	Analog output

11.3 Emergency Mode Operation

In normal operation the IMS2 is controlled via a remote two wire signal (terminals C31-C32).

Emergency Mode is controlled by a two wire circuit connected to Input A (terminals C53-C54). Closing Input A causes the IMS2 to run the motor and ignore certain trip conditions.



1	Mains voltage
F1	Semiconductor fuses (optional)
2	Control voltage
3	Remote control inputs
C23-C24	Start
C31-C32	Stop
C41-C42	Reset
C53-C54	Programmable input A
S1	Start/stop switch
S2	Reset pushbutton
S3	Emergency start contact
4	Thermistor input
5	RS485 serial interface
6	Relay outputs
13-14	Programmable output A
23-24	Run output
33-34	Programmable output B
41, 42, 44	Programmable output C
7	Analog output

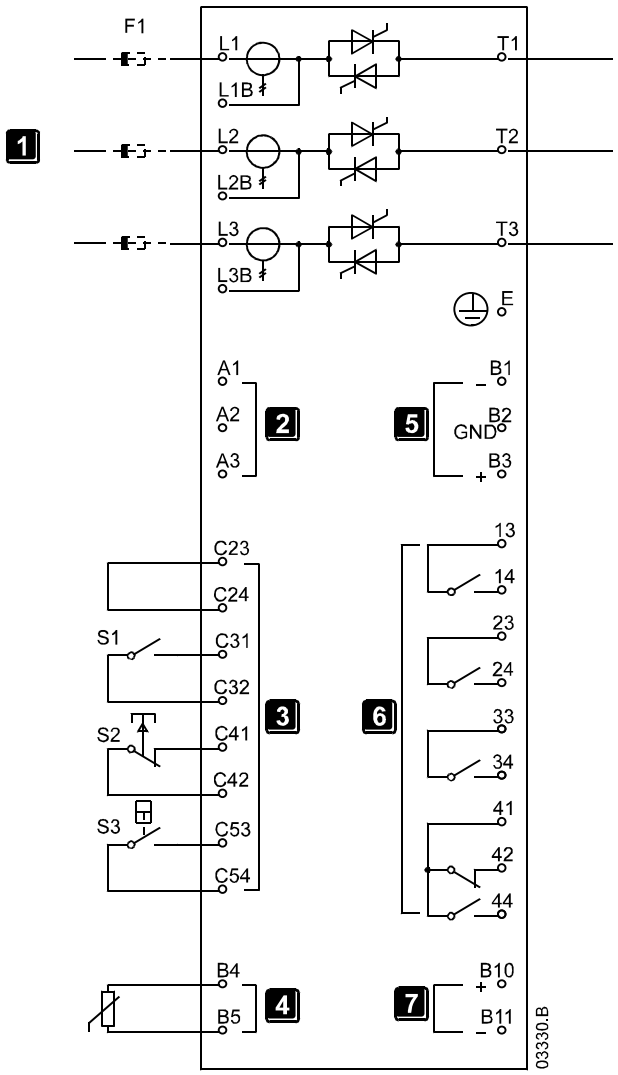
Function settings:

- Function 24 *Input A Functionality* = 3 (Emergency Mode Operation).
- Function 114 *Emergency Mode Format* (sets which trip types are ignored during emergency mode operation).
- Function 115 *Emergency Mode - Trip Relay Operation* (determines if the trip relay operates when a fault is detected during emergency mode operation).

11.4 Auxiliary Trip Circuit

In normal operation the IMS2 is controlled via a remote two wire signal (terminals C31-C32).

Input A (terminals C53-C54) is connected to an external trip circuit (such as a low pressure alarm switch for a pumping system). When the external circuit activates, the soft starter trips, which stops motor.



1	Mains voltage
F1	Semiconductor fuses (optional)
2	Control voltage
3	Remote control inputs
C23-C24	Start
C31-C32	Stop
C41-C42	Reset
C53-C54	Programmable input A
S1	Start/stop switch
S2	Reset pushbutton
S3	Auxiliary trip contact (eg pressure switch)
4	Thermistor input
5	RS485 serial interface
6	Relay outputs
13-14	Programmable output A
23-24	Run output
33-34	Programmable output B
41, 42, 44	Programmable output C
7	Analog output

Function settings:

- Function 24 *Input A Functionality* = 1 (Auxiliary Trip (normally open)).
- Function 36 *Auxiliary Trip Mode* = 6 (limits operation of the Auxiliary Trip function to 120 seconds after the start command, so that pressure has time to build up in the piping before the low pressure alarm becomes active).
- Function 94 *Auxiliary Trip Delay* can be used to provide a further delay for pressure to build up before the low pressure alarm becomes active.

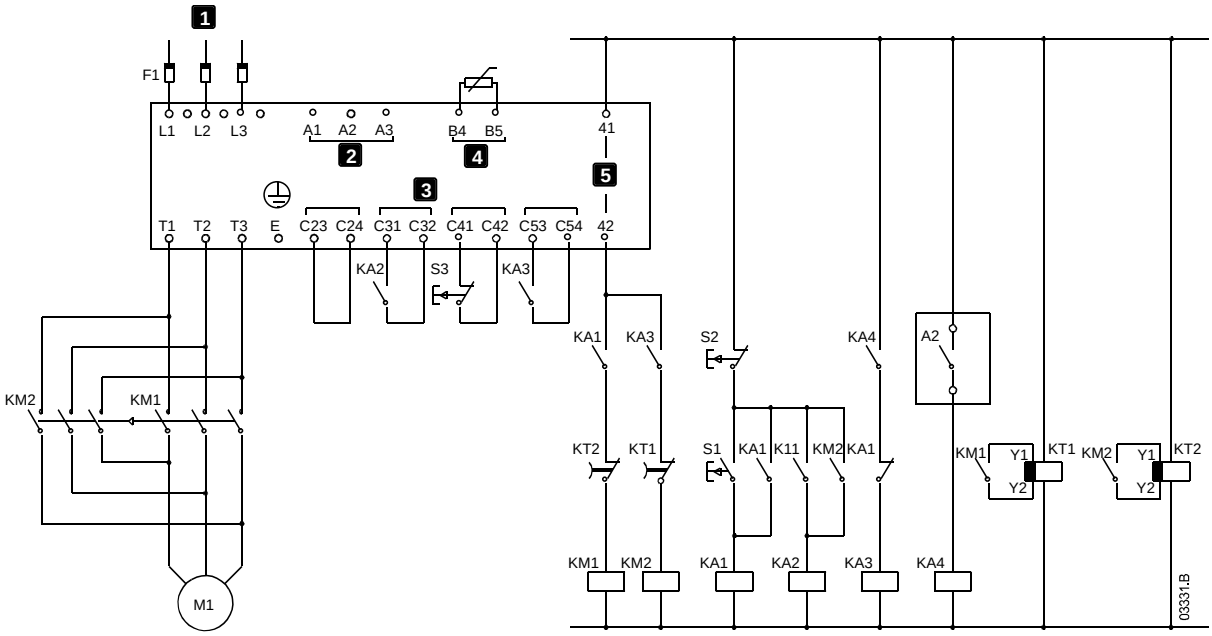
11.5 Soft Braking

For high inertia loads the IMS2 can be configured for soft braking.

In this application the IMS2 is employed with forward run and braking contactors. When the IMS2 receives a start signal (pushbutton S1), it closes the forward run contactor (KM1) and controls the motor according to the programmed primary motor settings.

When the IMS2 receives a stop signal (pushbutton S2), it opens the forward run contactor (KM1) and closes the braking contactor (KM2) after a delay of approximately 2-3 seconds (KT1). KA3 is also closed to activate the secondary motor settings, which should be user programmed for the desired stopping performance characteristics.

When motor speed approaches zero, the shaft rotation sensor (A2) stops the soft starter and opens the braking contactor (KM2).



K1M and K2M must be mechanically interlocked.

1	Mains voltage
2	Control voltage
3	Remote control inputs
C23-C24	Start
C31-C32	Stop
C41-C42	Reset
C53-C54	Programmable input A
4	Thermistor input
5	Relay outputs
41, 42	Programmable output C

A2	Shaft rotation sensor
F1	Semiconductor fuses (optional)
KA1	Run relay
KA2	Start relay
KA3	Brake relay
KA4	Rotation sensing relay
KM1	Main contactor (run)
KM2	Main contactor (brake)
KT1	Run delay timer
KT2	Brake delay timer
S1	Start pushbutton
S2	Stop pushbutton
S3	Reset pushbutton

Function settings:

- Function 23 *Relay Output C Functionality* = 0 (Trip).
- Function 24 *Input A Functionality* = 0 (Parameter Set Selection).
- Functions 1 to 9 (set starting performance characteristics).
- Functions 80 to 88 (set braking performance characteristics).

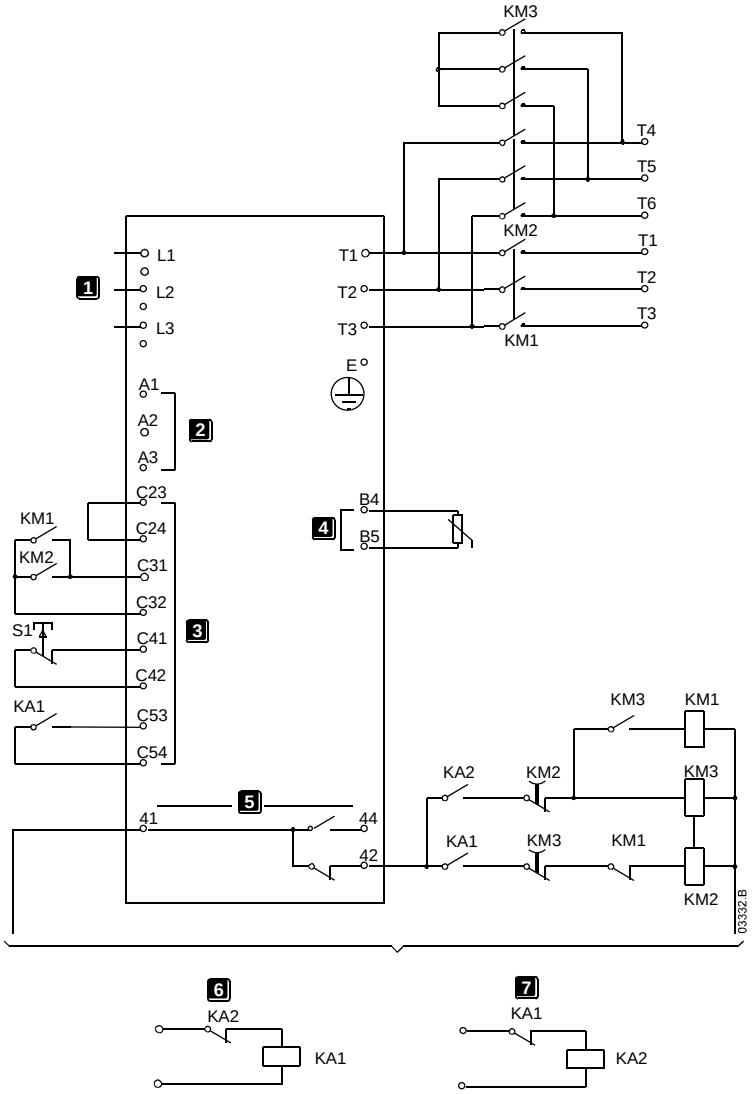
NOTE
If the IMS2 trips on supply frequency (trip code 5) when the braking contactor KM2 opens, increase the setting of Function 93 *Out of Frequency Trip Delay.*

11.6 Two-Speed Motor

The IMS2 can be configured for control of dual speed Dahlander type motors, using a high speed contactor (KM1), low speed contactor (KM2) and a star contactor (KM3).

When the soft starter receives a high speed start signal, it closes the high speed contactor (KM1) and star contactor (KM3), then controls the motor according to the primary motor settings (Functions 1 to 9).

When the soft starter receives a low speed start signal, it closes the low speed contactor (KM2). This closes Input A and the IMS2 controls the motor according to the secondary motor settings (Functions 80 to 88).



1	Mains voltage
2	Control voltage
3	Remote control inputs
C23-C24	Start
C31-C32	Stop
C41-C42	Reset
C53-C54	Programmable input A
4	Thermistor input
5	Relay outputs
41, 42, 44	Programmable output C

6	Remote low speed start input
7	Remote high speed start input
KA1	Remote start relay (low speed)
KA2	Remote start relay (high speed)
KM1	Main contactor (high speed)
KM2	Main contactor (low speed)
KM3	Start contactor (high speed)
S1	Reset pushbutton

Contactors KM2 and KM3 must be mechanically interlocked.

Function Settings:

- Function 23 *Relay Output C Functionality* = 0 (Trip).
- Function 24 *Input A Functionality* = 0 (Parameter Set Selection).

11.7 Typical Start Current Requirements

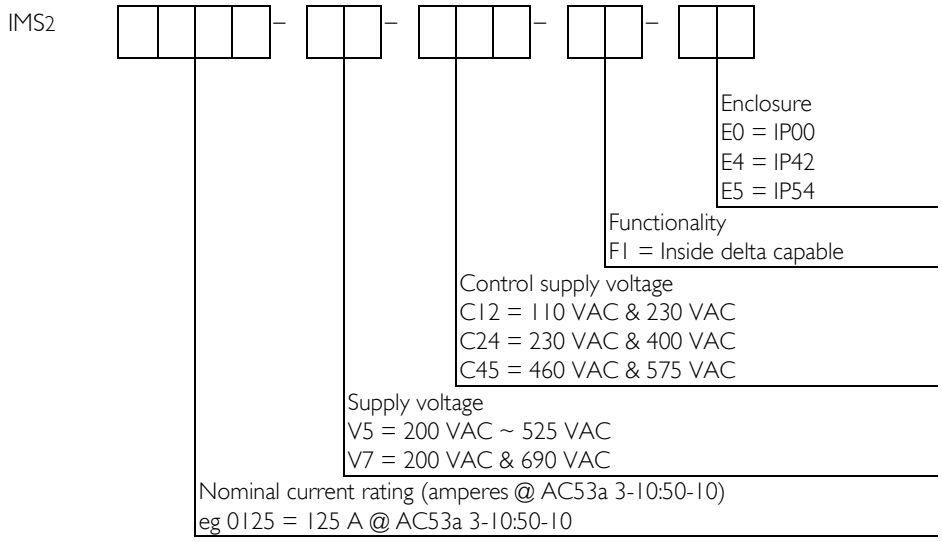
	300%	350%	400%	450%
Agitator			●	
Atomiser			●	
Bottle Washer	●			
Centrifuge				●
Chipper				●
Compressor - Reciprocal (loaded)				●
Compressor - Reciprocal (unloaded)			●	
Compressor - Screw (loaded)			●	
Compressor - Screw (unloaded)		●		
Conveyor - Belt				●
Conveyor - Roller		●		
Conveyor - Screw			●	
Crusher - Cone		●		
Crusher - Jaw				●
Crusher - Rotary		●		
Crusher - Vertical Impact		●		
Debarker		●		
Dryer				●
Dust Collector		●		
Edger		●		
Fan - Axial (damped)		●		
Fan - Axial (un-damped)				●
Fan - Centrifugal (damped)		●		
Fan - Centrifugal (un-damped)				●

	300%	350%	400%	450%
Fan - High Pressure				●
Grinder		●		
Hydraulic Power Pack		●		
Mill				●
Mill - Ball				●
Mill - Hammer				●
Mill - Roller				●
Mixer				●
Pelletiser				●
Planer		●		
Press		●		
Pump - Bore	●			
Pump - Centrifugal		●		
Pump - Positive Displacement			●	
Pump - Slurry				●
Re-pulper				●
Rotary Table			●	
Sander			●	
Saw - Bandsaw				●
Saw - Circular		●		
Separator				●
Shredder				●
Slicer	●			
Tumbler			●	

This information is intended as a guide only. Actual start current requirements will depend on individual machine and motor characteristics.

Section 12 Specifications

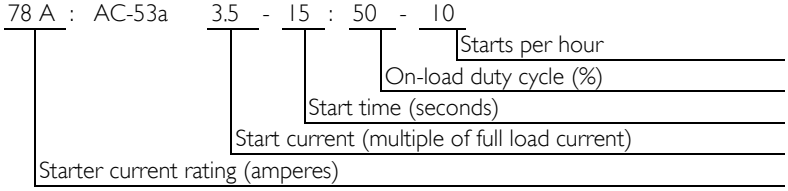
12.1 Model Codes



12.2 Current Ratings

Non-bypassed Operation

	3.0 x FLC AC53a 3-10:50-10 45 °C <1000 metres		3.5 x FLC AC53a 3.5-15:50-10 45 °C <1000 metres		4.0 x FLC AC53a 4-20:50-10 45 °C <1000 metres		4.5 x FLC AC53a 4.5-30:50-10 45 °C <1000 metres	
	In-line	Inside delta	In-line	Inside delta	In-line	Inside delta	In-line	Inside delta
IMS20018	18	27	16	25	14	22	12	19
IMS20034	34	51	32	48	28	42	24	36
IMS20041	41	62	39	58	34	51	28	42
IMS20047	47	71	44	66	39	58	33	50
IMS20067	67	101	60	90	52	79	46	69
IMS20088	88	132	78	116	68	102	59	88
IMS20096	96	144	85	127	74	111	64	96
IMS20125	125	188	112	168	97	146	84	125
IMS20141	141	212	122	183	107	161	94	141
IMS20202	202	303	177	266	155	233	135	202
IMS20238	238	357	211	317	185	277	160	241
IMS20253	253	379	218	327	191	286	167	251
IMS20302	302	453	275	413	239	358	205	308
IMS20405	405	608	376	564	324	486	274	412
IMS20513	513	769	481	722	411	616	342	513
IMS20585	585	878	558	837	474	711	392	587
IMS20628	628	942	595	893	508	762	424	636
IMS20775	775	1163	756	1134	637	956	521	782
IMS20897	897	1346	895	1342	749	1123	604	906
IMS21153	1153	1730	1049	1574	917	1376	791	1187
IMS21403	1403	2105	1302	1953	1135	1703	970	1454
IMS21574	1574	2361	1486	2229	1290	1936	1091	1637



Starter Current Rating: The full load current rating of the soft starter given the parameters detailed in the remaining sections of the utilisation code.

Start Current: The maximum available start current.

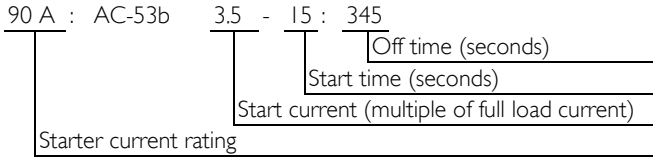
Start Time: The maximum allowable start time.

On-load Duty Cycle: The maximum percentage of each operating cycle that the soft starter can operate.

Starts Per Hour: The maximum allowable number of starts per hour.

Bypassed Operation

	3.0 x FLC AC53b 3-10:350 45 °C <1000 metres		3.5 x FLC AC53b 3.5-15:345 45 °C <1000 metres		4.0 x FLC AC53b 4-20:340 45 °C <1000 metres		4.5 x FLC AC53b 4.5-30:330 45 °C <1000 metres	
	In-line	Inside delta	In-line	Inside delta	In-line	inside delta	In-line	Inside delta
IMS20018	18	27	18	27	16	24	14	20
IMS20034	34	51	34	51	34	51	28	42
IMS20041	41	62	41	62	41	62	34	52
IMS20047	47	71	47	71	47	71	39	59
IMS20067	67	101	62	94	54	82	47	71
IMS20088	88	132	82	122	71	106	61	91
IMS20096	96	144	90	136	78	117	66	99
IMS20125	125	188	120	181	103	155	88	132
IMS20141	141	212	127	190	111	166	96	145
IMS20202	202	303	187	281	162	243	140	210
IMS20238	238	357	224	336	194	290	166	250
IMS20253	253	381	228	342	198	297	172	259
IMS20302	302	453	285	427	245	368	209	314
IMS20405	405	608	395	592	336	504	282	424
IMS20513	513	770	513	770	435	653	356	534
IMS20585	585	878	585	878	504	756	410	614
IMS20628	628	942	626	939	528	793	436	654
IMS20775	775	1163	775	1163	672	1009	542	813
IMS20897	897	1346	897	1346	798	1197	632	948
IMS21153	1153	1730	1153	1730	1006	1509	850	1276
IMS21403	1403	2105	1403	2105	1275	1912	1060	1591
IMS21574	1574	2361	1574	2361	1474	2212	1207	1811



Starter Current Rating: The full load current rating of the soft starter given the parameters detailed in the remaining sections of the utilisation code.

Start Current: The maximum available start current.

Start Time: The maximum allowable start time.

Off Time: The minimum allowable time between the end of one start and the beginning of the next start.

Contact your local supplier for ratings under operating conditions not covered by the above ratings charts.

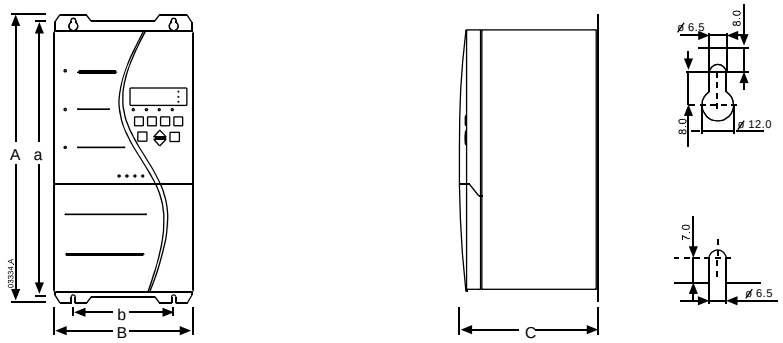
IMS2 Minimum and Maximum Current Settings

The minimum and maximum settings for Function 1 *Motor Full Load Current* are model dependent. The minimum and maximum values for different IMS2 models are shown in the table below (all values in amperes).

	In-line connection		Inside delta connection	
Model	Minimum	Maximum	Minimum	Maximum
IMS20018	2	18	3	31
IMS20034	4	34	7	59
IMS20041	5	41	8	71
IMS20047	5	47	10	82
IMS20067	8	67	14	117
IMS20088	11	88	19	154
IMS20096	12	96	21	168
IMS20125	15	125	27	218
IMS20141	17	141	30	246
IMS20202	25	202	44	353
IMS20238	29	238	52	416
IMS20253	31	254	55	444
IMS20302	37	302	66	528
IMS20405	50	405	88	708
IMS20513	64	513	112	897
IMS20585	73	585	127	1023
IMS20628	78	628	137	1099
IMS20775	96	775	169	1356
IMS20897	112	897	196	1569
IMS21153	144	1153	252	2017
IMS21403	175	1403	306	2455
IMS21574	196	1574	344	2754

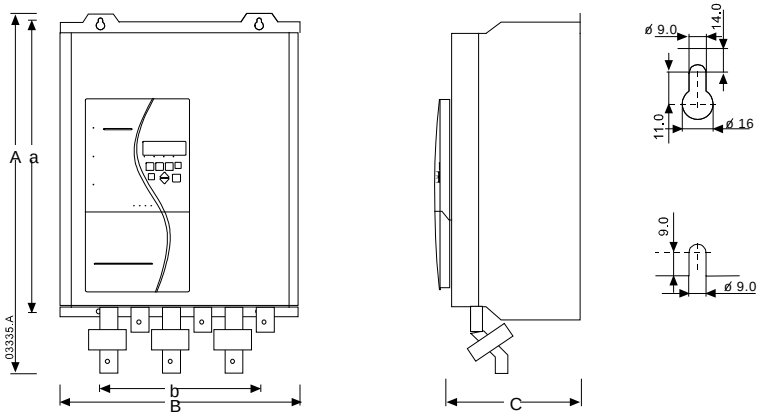
12.3 Dimensions and Weights

IMS20018 ~ IMS20253



	A	B	C	a	b	Weight
	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)	kg (lb)
IMS20018	380 (14.96)	185 (7.28)	180 (7.09)	365 (14.37)	130 (5.12)	6 (13.2)
IMS20034						
IMS20041						
IMS20047						
IMS20067	380 (14.96)	185 (7.28)	250 (9.84)	365 (14.37)	130 (5.12)	10 (22)
IMS20088						
IMS20096						
IMS20125						
IMS20141	425 (16.73)	270 (10.63)	275 (10.83)	410 (16.14)	200 (7.87)	18 (39.6)
IMS20202						
IMS20238						
IMS20253	425 (16.73)	390 (15.35)	275 (10.83)	410 (16.14)	300 (11.81)	23 (50.6)

IMS20302 ~ IMS21574



	A	B	C	a	b	Weight
	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)	kg (lb)
IMS20302	690 (27.16)	430 (16.93)	294 (11.58)	522 (20.55)	320 (12.60)	38 (83.6)
IMS20405						
IMS20513						50 (110)
IMS20585						
IMS20628						53 (116.6)
IMS20775						
IMS20897						
IMS21153	855 (33.27)	574 (22.60)	353 (13.90)	727 (27.83)	500 (19.68)	121 (266.2)
IMS21403						
IMS21574						

12.4 Fuses

The IMS2 can be installed with fuses to protect the soft starter and to provide Type 1 or Type 2 protection. HRC fuses can be used for Type 1 coordination and semiconductor fuses can be used for Type 2 coordination and to reduce the risk of damage to SCRs from transient overload currents.

Maximum Fuse Sizes

The maximum fuse sizes for IMS20018~IMS20897 at 600 VAC are (values in amperes):

	Type 2 short circuit protection	Type 1 short circuit protection (HRC fuses)	
	Class HSJ high speed fuse	Class J or Class L time delay fuse	Class J or Class L non-time delay fuse
IMS20018	**40	45	80
IMS20034	**80	80	150
IMS20041	**100	100	175
IMS20047	**110	100	200
IMS20067	**125	150	300
IMS20088	**175	200	350
IMS20096	175	250	400
IMS20125	225	300	500
IMS20141	**250	350	600
IMS20202	350	500	800
IMS20238	**450	600	900
IMS20253	**450	600	1000
IMS20302	-	700	1200
IMS20405	-	900	1600
IMS20513	-	1200	2000
IMS20585	-	1350	2500
IMS20628	-	1400	2500
IMS20775	-	1800	2500
IMS20897	-	2000	3000

** Two series connected fuses required per phase.

Semiconductor Fuses

Semiconductor fuses can be used with the IMS2 to reduce the potential for damage to SCRs from transient overload currents and for Type 2 coordination.

- F Series Fuses

	Supply Voltage ≤ 415 VAC	Supply Voltage ≤ 525 VAC	Supply Voltage ≤ 575 VAC	Supply Voltage ≤ 695 VAC	SCR I^2t
IMS20018	63AFE	63AFE	63AFE	63AFE	1,150
IMS20034	160AFEE	160AFEE	160AFEE	160AFEE	10,500
IMS20041	200FM	180FM	180FM	180FM	15,000
IMS20047	200FM	180FM	180FM	180FM	18,000
IMS20067	200FM	180FM	180FM	180FM	15,000
IMS20088	250FM	250FM	250FM	250FM	51,200
IMS20096	250FM	250FM	250FM	250FM	80,000
IMS20125	250FM	250FM	250FM	250FM	97,000
IMS20141	280FM	280FM	280FM	280FM	97,000
IMS20202	500FMM	450FMM	450FMM	450FMM	245,000
IMS20238	630FMM	630FMM	630FMM	630FMM	320,000
IMS20253	630FMM	630FMM	630FMM	630FMM	320,000
IMS20302	630FMM	500FMM	500FMM	500FMM	202,000
IMS20405	630FMM	630FMM	630FMM	630FMM	320,000
IMS20513	700FMM	700FMM	700FMM	700FMM	781,000
IMS20585	*500FMM	*500FMM	*500FMM	*500FMM	1,200,000
IMS20628	*500FMM	*500FMM	*500FMM	*500FMM	1,200,000
IMS20775	*700FMM	*700FMM	*700FMM	*700FMM	2,532,000
IMS20897	-	-	-	-	4,500,000
IMS21153	-	-	-	-	4,500,000
IMS21403	-	-	-	-	6,480,000
IMS21574	-	-	-	-	12,500,000

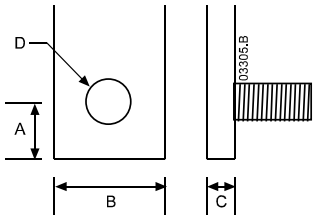
* Two parallel connected fuses required per phase

- 170M Fuses

	Supply Voltage ≤ 415 VAC	Supply Voltage ≤ 525 VAC	Supply Voltage ≤ 575 VAC	Supply Voltage ≤ 695 VAC	SCR I^2t
IMS20018	170M1315	170M1314	170M1314	170M1314	1,150
IMS20034	170M1319	170M1317	170M1317	170M1317	10,500
IMS20041	170M1319	170M1318	170M1318	170M1318	15,000
IMS20047	170M1319	170M1318	170M1318	170M1318	18,000
IMS20067	170M1319	170M1318	170M1318	170M1318	15,000
IMS20088	170M3017	170M3017	170M3017	170M3017	51,200
IMS20096	170M1322	170M1321	170M1321	170M1321	80,000
IMS20125	170M1322	170M1322	170M1322	170M1322	97,000
IMS20141	170M1322	170M1322	170M1322	170M1322	97,000
IMS20202	170M6141	170M6141	170M6141	170M6141	245,000
IMS20238	170M3023	170M3023	170M3023	170M3023	320,000
IMS20253	170M3023	170M3023	170M3023	170M3023	320,000
IMS20302	170M5144	170M5144	170M5144	170M5144	202,000
IMS20405	170M6012	170M4016	170M6011	170M6011	320,000
IMS20513	170M6014	170M6014	170M4018	170M4018	781,000
IMS20585	170M5017	170M6015	170M6014	170M6014	1,200,000
IMS20628	170M6019	170M6018	170M6017	170M6017	1,200,000
IMS20775	170M6019	170M6018	170M6017	170M6017	2,532,000
IMS20897	170M6020	170M6019	170M6151	170M6151	4,500,000
IMS21153	170M6020	170M6019	170M6151	170M6151	4,500,000
IMS21403	170M6021	170M6021	*170M5018	*170M5018	6,480,000
IMS21574	*170M6018	*170M6018	*170M5018	*170M5018	12,500,000

* Two parallel connected fuses required per phase

12.5 Power Terminations



	A	B	C	D	Tightening torque
	mm	mm	mm	mm	Nm
IMS20018	8	14	3	6	3.5
IMS20034					
IMS20041					
IMS20047					
IMS20067	9	16	4	6	3.5
IMS20088					
IMS20096					
IMS20125					
IMS20141	11	20	5	8	8.5
IMS20202	13	26	6	8	8.5
IMS20238					
IMS20253	13	28	6	10	17
IMS20302	23	32	13	10.5	n/a
IMS20405					
IMS20513					
IMS20585					
IMS20628					
IMS20775					
IMS20897					
IMS21153	25	51	16	12.5	n/a
IMS21403					
IMS21574					

12.6 General Technical Data

Supply	
Mains voltage	
IMS2xxxx-V5	3 x 200 VAC - 525 VAC (in-line connection) 3 x 200 VAC - 440 VAC (inside delta connection)
IMS2xxxx-V7	3 x 200 VAC - 690 VAC (in-line connection) 3 x 200 VAC - 440 VAC (inside delta connection)
Control voltage	
IMS2xxxx-xx-C12	110 VAC or 230 VAC (+ 10% / - 15%)
IMS2xxxx-xx-C24	230 VAC or 400 VAC (+ 10% / - 15%)
IMS2xxxx-xx-C45	460 VAC or 575 VAC (+ 10% / - 15%)
Mains frequency	
at start	50 Hz (± 2 Hz) or 60 Hz (± 2 Hz)
during start	> 45 Hz (50 Hz supply) or > 55 Hz (60 Hz supply)
during run	> 48 Hz (50 Hz supply) or > 58 Hz (60 Hz supply)

Control Inputs	
Start (Terminals C23, C24)	Active 24 VDC, 8 mA approx
Stop (Terminals C31, C32)	Active 24 VDC, 8 mA approx
Reset (Terminals C41, C42)	Active 24 VDC, 8 mA approx
Programmable Input A (Terminals C53, C54)	Active 24 VDC, 8 mA approx

Outputs	
Relay Outputs	5 A @ 30 VDC or 250 VAC resistive 360 VA inductive
Run Output (Terminals 23, 24)	Normally Open
Programmable Relay Output A (Terminals 13, 14)	Normally Open
Programmable Relay Output B (Terminals 33, 34)	Normally Open
Programmable Relay Output C (Terminals 41, 42, 44)	Changeover
Analogue Output (Terminals B10, B11)	4-20 mA (maximum burden 500 Ω)

Sundry	
Enclosure rating	
IMS2xxxx-xx-xxx-xx-E0	IP00 (open chassis)
IMS2xxxx-xx-xxx-xx-E4	IP42
IMS2xxxx-xx-xxx-xx-E5	IP54
Rated short circuit current IMS20018 ~ IMS20897 [1,2]	42 kA
Rated insulation voltage	690 V
Surges	2 kV line to earth, 1 kV line to line
Fast transients	2 kV / 5 kHz
Form designation	Form 1
Electrostatic discharge	4 kV contact discharge, 8 kV air discharge
Equipment class (EMC)	Class A [3]
Radio-frequency electromagnetic field	0.15 MHz – 80 MHz: 140 dBµV 80 MHz – 1 GHz: 10 V/m
Pollution degree	Pollution Degree 3
Operating temperatures	- 5 °C – + 60 °C
Relative humidity	5% – 95% (max non-condensing)

Standards Approvals	
CE IEC 60947-4-2 [1]	
UL and C-UL	UL 508 [2]
C✓	IEC 60947-4-2

[1] Refer to *Fuses* on page 52 for details of maximum fuses sizes required for Type 1 and Type 2 short circuit protection.

[2] Suitable for use on circuits capable of not more than 42,000 RMS symmetrical amperes, when protected by maximum fuse sizes (refer to *Fuses* on page 52).

[3] This product has been designed and certified as Class A equipment. Use of this product in domestic environments may cause radio interference, in which case the user may be required to employ additional mitigation methods.

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