EC Titanium™ Manual

User’s guide

January 2022

MN448_January_2022

Any trademarks used in this manual are the property of their respective owners.

Note: Baldor Electric Company, became ABB Motors and Mechanical, Inc. on March 1, 2018. Nameplates, Declaration of Conformity and other collateral material may contain the company name of Baldor Electric Company and the brand names of Baldor-Dodge and Baldor-Reliance as well as the company name of ABB until such time as all materials have been updated to reflect our new corporate identity of ABB.

Important:

Be sure to check www.baldor.com for the latest software, firmware and drivers for your EC Titanium product. Also, you can download the latest version of this manual in Adobe Acrobat PDF format.

Table of Contents

Chapter 1
Introduction

1.1 Getting Assistance from ABB 1-1
1.2 Safety Notices. 1-1
1.2.1 Safety in Installation and Maintenance. 1-1
1.2.2 General Safety 1-2
1.2.3 Safe Start-Up and Operation 1-2

Chapter 2
General Information and Ratings

2.1 Type Designation Key 2-1
2.2 Nameplate and Type Designation Label 2-2
2.2.1 Motor Nameplate 2-2
2.2.2 Motor Setup Parameters 2-2
2.2.3 Drive Nameplate and Type Designation Label 2-3
2.2.4 Motor and Drive Nameplate Locations. 2-3
2.3 Model Numbers and Ratings 2-4
2.3.2 Integrated Motor / Drive Model Numbers and Ratings 2-5

Chapter 3
Mechanical Information and Mounting

3.1 Receiving and Inspection 3-1
3.2 Mounting Location 3-1
3.3 Wiring Considerations. 3-1
3.4 Motor Mounting Lifting Positions 3-1
3.4.1 Motor Lifting Provisions 3-2
3.5 Removing Drive Cover 3-3

Chapter 4
Electrical Installation and Planning

4.1 Motor Connections 4-1
4.2 Protective Ground (PE) Connection 4-2
4.2.1 Protective Earth Conductor 4-2
4.2.2 Safety Ground. 4-3
4.2.3 Motor Ground 4-3
4.2.4 Ground Fault Monitoring 4-3
4.3 Incoming Power Connection 4-3
4.3.1 Power Cable Selection 4-3
4.3.2 Fuse / Circut Breaker Selection. 4-4
4.4 Optional Input Choke 4-5
4.5 EMC Compliant Installation 4-5
4.6 CE Marking 4-5
4.6.1 Compliance with the European EMC Directive. 4-5
4.6.2 Compliance with EN 618-3:2004 4-5
4.6.3 EC Titanium EMC Compatibility Guide. 4-6

Chapter 5
Control Wiring & Keypad Interface
5.1 Control Terminal Connections 5-1
5.2 Control Terminal Wiring. 5-1
5.3 Remote Panel Interface 5-2
5.3.1 Cable Requirements 5-2
5.3.2 Hardware Connection 5-3
5.3.3 System Setup 5-3
5.3.4 To setup the communication address. 5-4
5.3.5 Connection to a network of multiple drives 5-4
5.3.6 To setup the REMOTE PANEL device number 5-4
5.4 Control Signals 5-4
5.4.1 Analog Ouput 5-4
5.4.2 Relay Output. 5-4
5.4.3 Analog Inputs 5-4
5.4.4 Digital Inputs. 5-4
5.5 Motor Thermistor Connection. 5-5
5.6 Internal Thermal Overload Protection. 5-5

Chapter 6
Keypad Programming and Basic Operation
6.1 User Interface 6-1
6.2 Real Time Operation 6-1
6.2.1 Pre-setting target speed in keypad mode 6-1
6.2.2 To vary the speed in real time keypad control mode 6-2
6.2.3 To reverse direction of rotation with Parameter 1103=2. 6-2
6.3 Keypad Operation and Remote Monitoring Displays 6-2
6.4 Remote Keypad Monitoring Screens. 6-3

Chapter 7
Quick Startup Guide
7.1 Quick Start Terminal Control 7-1
7.2 Quick Start Motor Parameter Data 7-2
7.3 Customize Your Application. 7-2
7.4 Quick Start Keypad Control. 7-3

Chapter 8
Parameter Navigation and Groups
8.1 Parameter Structure. 8-1
8.2 Parameter Navigation 8-1

Chapter 9
Control Modes
9.1 Configuration Options 9-1
9.2 Terminal Mode (1103 = 0), Parameter 9902 Settings 9-1
9.2.1 Terminal Control Mode 2-Wire Control Start / Stop Control with Forward / Reverse. 9-3
9.2.2 Terminal Control Mode 3 Wire Control Start / Stop with Forward / Reverse 9-4
9.2.3 Terminal Control Mode Motor Thermistor Trip 9-4
9.3 Keypad Mode (1103 = 1 or 2) Parameter 9902 Settings 9-5
9.3.1 Keypad Control Mode MOP (E-Pot Controls) 9-6
9.4 Modbus control mode (1103 = 3 or 4), Parameter 9902 Settings 9-6
9.5 User PI control mode (1103 = 5 or 6) Parameter 9902 Settings 9-7
9.6 Fire Mode 9-7

Chapter 10
Parameter Definitions
First Time Startup & Parameter Details
10.1 Short Parameter Group. 10-1
10.2 Long Parameter Group 10-4
10.3 Advanced Parameter Group 10-16
10.4 Parameter Access Locking and Unlocking System 10-18
10.4.1 Locking access to parameters 10-18
10.4.2 Un-Locking access to parameters 10-18
10.5 Resetting Parameters to Factory Default 10-18

Chapter 11
Standalone Motor & ABB Drive Setup
11.1 Overview EC Titanium Motor Design 11-1
11.2 Identifying the EC Titanium Motor Parameters. 11-2
11.3 ABB Drive Selection Guidelines 11-3
11.4 Motor Setup Parameters with ABB Drives 11-3
11.5 Setting up ABB Drive Parameters 11-4
11.6 Start Mode Selection with FASR Motors 11-5
11.7 Group 30 Limits 11-6
11.8 Speed Control Adjustment 11-7
11.9 Auto-phasing configuration 11-7

Chapter 12
Technical Data
12.1 Environmental 12-1
12.2 Input Power Electrical Data 12-1
12.3 Motor Control Electrical 12-1
12.4 Motor Control Performance 12-1
12.5 Digital & Analog I/O. 12-2
12.6 Output Current Limit 12-2
12.7 Motor Overload Summary 12-3
12.8 Automatic Switching Frequency Reduction 12-3
12.9 Dimensions - EC Titanium - motor only 12-4
12.10 Dimensions - EC Titanium - top mounting 12-5
12.11 Dimensions - EC Titanium - top mounting 12-6

Chapter 13
Troubleshooting
13.1 Fault Codes 13-1
13.2 Periodic Inspection 13-1
13.3 Drive Module Status LED's 13-2
13.4 Drive Module Fault Codes 13-3

Appendix A
Modbus-RTU Example Connection
A.1 Modbus RTU Communications A-1
A.2 Modbus RTU Specification A-1
A.3 RJ45 Connector Configuration A-1
A.4 Modbus Telegram Structure A-1
A.5 RJ45 Data Connection Pin Configuration A-2
A.6 Modbus Register Map A-3
A.7 Control and Status Register Descriptions A-4
A.8 Parameter Registers and Scaling A-5
A.9 Additional Information A-8
A.10 Modbus Exception Response Telegrams A-10
A.11 Dataflow Example A-10
A.12 Drive Fault Code and Information A-11

Appendix B
BacNet Control
B.1 BACnet MS/TP Communications B-1
B.2 Modbus RTU Specification B-1
B.3 RJ45 Connector Configuration B-1
B.4 BACnet Communication Activation B-1
B.5 RJ45 Data Connection Pin Configuration B-2
B.6 Object Dictionary B-3

Appendix C
Options and Kits
C.1 Remote Keypad ECS100L B-1
C.2 Remote Keypad ECS100B B-3
C.3 USB PC Connection Kit ECS100U B-3

Chapter 1
Introduction

The EC Titanium Series of Motors & Integrated Motor Drives (IMDs) are highly efficient, non-rare earth motors with Ferrite Assisted Synchronous Reluctance rotors. The IMD Versions provide an integrated drive which simplifies installation and wiring, reduces cost, and saves valuable panel space. Focused on Variable Torque / Pump, Fan, and Compressor Applications.

This manual is intended to provide information needed for planning the installation, start-up, operating and servicing the IMD. It includes information on:
- Safety Instructions
- Installation and Wiring of the IMD
- Programming the IMD

The reader is expected to know the fundamentals of electricity, wiring, electrical components and electrical schematic symbols.

abb.com can be accessed for a full list of support materials such as literature, firmware, IMD specific parameter sets, and programming software.

1.1 Getting Assistance from ABB

For technical assistance, contact your local ABB representative. Contact phone numbers are located on the inside back cover of this guide. Before calling, review the troubleshooting section later in this manual. You will be asked for the IMD model number or catalog number that is located on the nameplate.

1.2 Safety Notices

This chapter contains the safety instructions which you must follow when installing, operating and servicing the drive. If ignored, physical injury or death may follow, or damage may occur to the IMD or driven equipment. Read the safety instructions before you work on the unit.

USE of WARNINGS:

Warnings caution you about conditions which can result in serious injury or death and/or damage to the equipment and advise on how to avoid the danger. The following warning symbols are used in this manual:



Electricity warning warns of hazards from electricity which can cause physical injury and/or damage to the equipment.



General warning warns about conditions, other than those caused by electricity, which can result in physical injury and/or damage to the equipment.

1.2.1 Safety in Installation and Maintenance

Electrical Safety -These warnings are intended for all who work on the drive, motor cable or motor.



WARNING: Ignoring the following instructions can cause physical injury or death, or damage to the equipment:

- Only qualified electricians are allowed to install and maintain the IMD.
- Never work on the IMD or power cable when input power is applied. After disconnecting the input power, always wait for 10 minutes to let the intermediate circuit capacitors discharge before you start working on the IMD or power cable.

Always ensure by measuring with a multimeter (impedance at least 1 Mohm) that:

1. There is no voltage between the drive input phases L1, L2 and L3 and the ground.
2. There is no voltage between terminals U, V, W (and + and BR if supplied on the IMD) and the ground.

- voltage between drive input phases L1, L2 and L3 and the frame is close to 0V.
- voltage between terminals (+ and BR if supplied on the IMD) and the frame is close to 0V.
- Do not work on the control cables when power is applied to the IMD or to the external control circuits. Externally supplied control circuits may carry dangerous voltage even when the input power of the drive is switched off.
- Do not make any insulation or voltage withstand tests on the drive.

- Be sure the system is properly grounded before applying power. Do not apply AC power before you ensure that all grounding instructions have been followed. Electrical shock can cause serious or fatal injury.

Note:

Even when the motor is stopped, dangerous voltage is present at the power circuit terminals L1, L2, L3 and U, V, W and + and BR.



WARNING: Ignoring the following instructions can cause physical injury or death, or damage to the equipment:

- Do not work on the IMD while the motor is rotating. The rotor contains permanent magnets. A rotating permanent magnet motor generates voltage. This voltage can cause an electrical shock hazard. This voltage will also feed back into the control causing the supply connections to become live.

1.2.2 General Safety

These instructions are intended for all who install and service the drive.



WARNING: Ignoring the following instructions can cause physical injury or death, or damage to the equipment.

- The drive is not field repairable. Never attempt to repair a malfunctioning drive; contact your local ABB representative or Authorized Service Centre for replacement.
- Make sure that dust from drilling does not enter the drive during the installation. Electrically conductive dust inside the drive assembly may cause damage or lead to malfunction.
- Ensure ambient temperature ratings are within specifications. (refer to Appendix A)

1.2.3 Safe Start-Up and Operation

General Safety -These warnings are intended for all who plan the operation of the drive or operate the drive.



WARNING: Ignoring the following instructions can cause physical injury or death, or damage to the equipment:

- Before adjusting the IMD and putting it into service, make sure that all driven equipment is suitable for operation throughout the speed range provided by the IMD.
- Do not activate automatic fault reset functions if dangerous situations can occur. When activated, these functions reset the IMD and resume operation after a fault.
- Do not control the IMD with an AC contactor or disconnecting device (disconnecting means); use instead the keypad start and stop keys and or external commands (I/O). The maximum allowed number of charging cycles of the DC capacitors (that is, power-ups by applying power) is two per minute.

Note:

- When parameter ***1103*** PRIMARY COMMAND SOURCE MODE is not set to 1 or 2, the stop key on the keypad will not stop the IMD. To stop the IMD open terminal 2 of the control terminals.

	Danger: Indicates a risk of electric shock, which, if not avoided, could result in damage to the equipment and possible injury or death.		Danger: Indicates a potentially hazardous situation other than electrical, which if not avoided, could result in damage to property.

	The IMD should be properly installed and commissioned. If installed incorrectly it may present a safety hazard. The IMD uses high voltages and currents, carries a high level of stored electrical energy, and is used to control mechanical plant that may cause injury. Close attention is required to system design and electrical installation to avoid hazards in either normal operation or in the event of equipment malfunction. Only qualified electricians are allowed to install and maintain this product.
	System design, installation, commissioning and maintenance must be carried out only by personnel who have the necessary training and experience. They must carefully read this safety information and the instructions in this Guide and follow all information regarding transport, storage, installation and use of the IMD, including the specified environmental limitations.
	Do not perform any flash test or voltage withstand test on the IMD. Any electrical measurements required should be carried out with the IMD disconnected.
	Electric shock hazard! Disconnect and ISOLATE the IMD before attempting any work on it. High voltages are present at the terminals and within the IMD for up to 10 minutes after disconnection of the electrical supply. Always ensure by using a suitable multimeter that no voltage is present on any drive power terminals prior to commencing any work.
	Where supply to the IMD is through a plug and socket connector, do not disconnect until 10 minutes have elapsed after turning off the supply.
	Ensure correct grounding connections. The ground cable must be sufficient to carry the maximum supply fault current which normally will be limited by the fuses. Suitably rated fuses should be fitted in the mains supply to the IMD, according to any local legislation or codes.
	Do not carry out any work on the IMD control cables when power is applied to the IMD or to the external control circuits.
	Within the European Union, all machinery in which this product is used must comply with the Machinery Directive 2006/42/EC, Safety of Machinery. In particular, the machine manufacturer is responsible for providing a main switch and ensuring the electrical equipment complies with EN60204-1.
	The level of integrity offered by the IMD control input functions – for example stop/start, forward/reverse and maximum speed is not sufficient for use in safety-critical applications without independent channels of protection. All applications where malfunction could cause injury or loss of life must be subject to a risk assessment and further protection provided where needed.
	The IMD can start at power up if the enable input signal is present.
	The STOP function does not remove potentially lethal high voltages. ISOLATE the IMD and wait 10 minutes before starting any work on it. Never carry out any work on the IMD or power cable when the input power is still applied.
	The IMD can be programmed to operate at speeds up to Motor Rated Speed (parameter 9908). Obtain confirmation from the manufacturers of the driven machine about suitability for operation over the intended speed range prior to machine start up.
	Do not activate the automatic fault reset function on any systems whereby this may cause a potentially dangerous situation.
	The IMD has an Ingress Protection rating of IP55 (drive assembly) and IP54 (motor) and must be installed in a suitable environment.
	The IMDs are intended for indoor use only.
	Do not carry out drilling operations with the IMD in place, dust and metal shavings from drilling may lead to damage.
	The entry of conductive or flammable foreign bodies should be prevented. Flammable material should not be placed close to the IMD.
	Relative humidity must be less than 95% (non-condensing).
	Ensure that the supply voltage, frequency and number of phases correspond to the rating of the IMD as delivered.
	Never connect the mains power supply to the Output terminals U, V, W.
	Do not install any type of automatic switchgear between the drive and the motor
	Wherever control cabling is close to power cabling, maintain a minimum separation of 4 in. (100 mm) and arrange crossings at 90 degrees.
	Ensure that all terminals are tightened to the appropriate torque setting
	Do not attempt to carry out any repair of the IMD. In the case of suspected fault or malfunction, contact your local ABB representative for further assistance.

Chapter 2
General Information and Ratings

This chapter contains information about the EC Titanium integrated motor and drive including how to identify the product, general information and ratings.

2.1 Type Designation Key

The type designation contains information on the specifications and configuration of the motor or the drive and motor integrated unit. The type designation label is contained on the motor nameplate. The first digits from left express the basic configuration, followed by module type, voltage, speed and horsepower rating. Figure 2.5 shows the basic stock configurations, refer table 2-3 for details on configured nomenclature.

Figure 2-1 Nomenclature

Product series	Frame	Product code	Variant code
ECS	101	M 1 H 10 F F 4	+
		1 2 3 45 6 7 8	9

Product series	
ECS	EC Titanium

Frame	Description
100	Rolled steel motor frame, plastic fan and drive cover, bluetooth drive, for indoor use
101	Rolled steel motor frame, aluminum fan and drive cover, non-Bluetooth drive, for indoor use/outdoor/and Plenum use, includes (M) motor only

Position 1	Version
M	Motor only
T	Top mount drive
A	Axial mount drive

Position 2	Voltage	
0	230V / 460V	3-phase
1	115V	1-phase
2	230V	3-phase
3	380 – 400V	3-phase
4	460V	3-phase
8	230V	1-phase

Position 3	Power type
H	Horsepower

Position 4, 5	Power rating (HP)
1	1
2	2
3	3
5	5
7	7.5
10	10
15	15
20	20

Position 6	NEMA frame
D	140
E	180
F	210

Position 7	Mounting
F	Foot mount
B	C-Face foot
C	C-Face footless
J	56J stainless threaded shaft
S	Square flange pump mount
D	D-flange
M	JM pump shaft and face
P	JP pump close coupled

Position 8	Base speed
2	3600
4	1800
6	1200
8	900

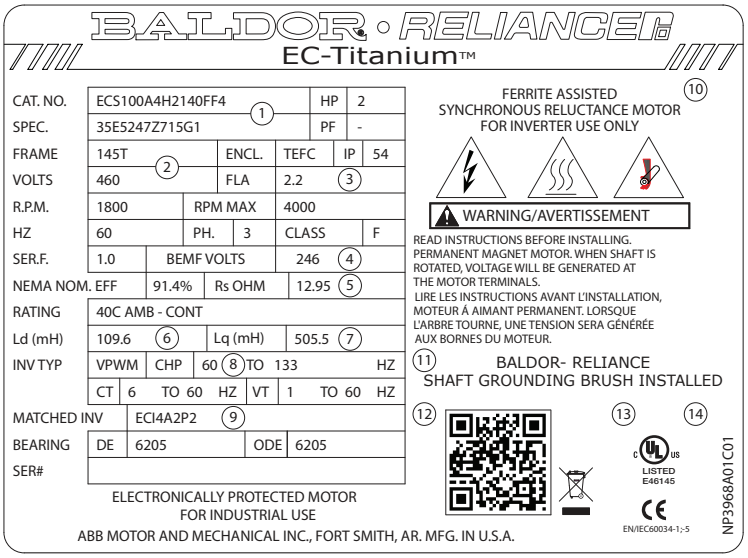
Position 9	Variants
+	"+" designates minor construction variation(s) (e.g. paint color, shaft length, etc.) that do not affect the performance safety of the product

2.2 Nameplate and Type Designation Label

2.2.1 Motor Nameplate

The EC Titanium Motor nameplate is located on the side of the motor and includes NEMA rating, appropriate markings, a type designation and a serial number, which allow identification of each unit. The motor nameplate contains electrical information necessary for proper setup of a drive control, reference Figure 2.2 and Table 2-1 for detail.

Figure 2-2 Motor Nameplate Field Description



Region	Description
1	Catalog Number, see Figure 2.1 Type designation key for details
2	General Motor Information (Frame, Enclosure, IP Rating, Voltage, RPM, etc.)
3	Motor Rated Amps
4	BEMF (Back EMF) Voltage
5	Motor Stator Resistance (Rs)
6	Ld (mH) Motor Inductance (Lsd)
7	Lq (mH) Motor q-axis Inductance (Lsq)
8	Motor Rated Frequency
9	Matched Inverter Model Number
10	PM Motor Warning Information
11	Shaft Ground Provision Marking
12	QR Code for motor information
13	CE Marking
14	UL Agency Listing

2.2.2 Motor Setup Parameters

The following motor values shown on the nameplate and utilized for proper control and setup of a drive used to run the EC Titanium motor. Parameter Numbers listed are for use with the Integrated Motor and Drive packages.

Table 2-1 Motor Setup Parameter Listing

Region	Description	Parameter Number
3	Motor Rated Amps	9906
4	BEMF (Back EMF) Voltage	9905
5	Motor Stator Resistance (Rs)	11201
6	Ld (mH) Motor Inductance (Lsd)	11203
7	Lq (mH) Motor q-axis Inductance (Lsq)	11206
8	Motor Rated Frequency	9907
	Motor Maximum Frequency	2008

Note: Integrated motor and drive units have been factory programmed and parameters in Table 2-1 do not need to be adjusted unless a software reset has been implemented.

2.2.3 Drive Nameplate and Type Designation Label

For Axial and Top Mounted integrated drive and motor units, two drive labels are included to allow identification for IEC and NEMA ratings. The drive type designation label is located on the side of the drive module under the cover. A second Drive Label is located on the outside of the drive enclosure.

Figure 2-3 Enclosure Drive Label

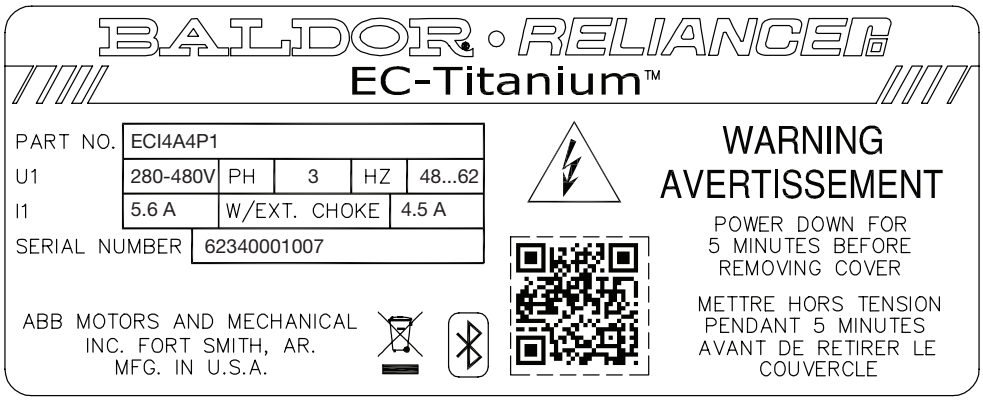
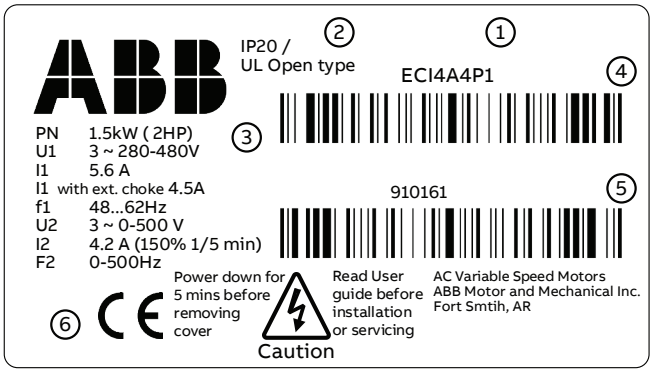


Figure 2-4 Interior Drive Module Label

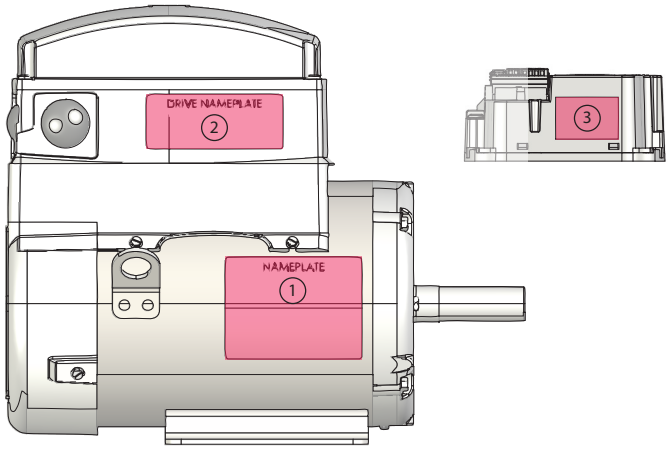


Region	Description
1	Drive Module, see ratings table on page xxx
2	Degree of protection by enclosure (IP and UL/NEMA)
3	Nominal ratings, see ratings table on page xxx
4	ABB MRP code of the drive
5	Drive Date Code*
6	CE marking

*Note: Drive 6 Digit date code, read backwards for example, the number 910161 means 16 January 2019

2.2.4 Motor and Drive Nameplate Locations

Region	Description
1	Figure 2.2 Motor Nameplate
2	Figure 2.3 Drive Enclosure Nameplate
3	Figure 2.4 Drive Module Nameplate (see Section 3.5 removing drive cover)



2.3 Model Numbers and Ratings

The EC Titanium product line includes models to support each motor designed for pump and fan applications. The following table provides the electrical ratings of each of the standard available models. If your need is for a rating not listed below, contact your local ABB representative for support. (Symbols are described below the table.)

2.3.1 Motor Model Numbers and Ratings

The following section provides details on the EC Titanium Stand Alone Motor, rating information and motor data required to properly setup and control the motor from a drive (BEMF, R, Lq and Lq).

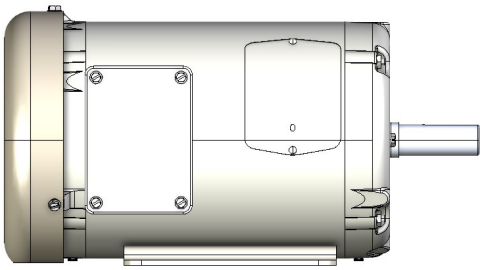


Table 2-2 1800 RPM Motor Ratings, Model Numbers and Data

Type	HP	Motor Frame	Motor Efficiency	Motor Amps	BEMF	Resistance	Ld	Lq
3-phase 230V AC								
ECS101M0H1DF4	1	140	89.3%	2.3	124	5.98	48.7	180.4
ECS101M0H2DF4	2	140	90.7%	4.5	124	2.24	27.1	87.9
ECS101M0H3DF4	3	140	91.4%	7.0	112	1.51	17.2	58.0
ECS101M0H3EF4	3	180	92.8%	7.3	106	0.97	14.4	54.4
ECS101M0H5DF4	5	140	93.0%	10.4	113	0.68	10.2	34.6
ECS101M0H5EF4	5	180	93.7%	10.5	126	0.82	13.5	47.8
ECS101M0H7EF4	7.5	180	94.0%	17.5	106	0.32	6.3	22.9
ECS101M0H7FF4	7.5	210	94.0%	17.4	113	0.35	6.6	20.4
ECS101M0H10F4	10	210	94.8%	22.0	121	0.23	5.5	19.2
ECS101M0H15FF4	15	210	95.6%	34.8	117	0.12	3.2	10.7
ECS101M0H3DF4								
ECS101M0H1DF4	1	140	89.3%	1.2	248	23.91	194.8	721.6
ECS101M0H2DF4	2	140	90.7%	2.3	248	10.48	108.3	351.6
ECS101M0H3DF4	3	140	91.4%	3.5	223	6.02	68.6	231.9
ECS101M0H3EF4	3	180	92.8%	3.7	212	3.88	57.7	217.7
ECS101M0H5DF4	5	140	93.0%	5.2	227	2.73	40.9	138.5
ECS101M0H5EF4	5	180	93.7%	5.3	252	3.30	54.0	191.0
ECS101M0H7EF4	7.5	180	94.0%	8.8	212	1.26	25.0	91.6
ECS101M0H7FF4	7.5	210	94.0%	8.7	225	1.39	26.5	81.4
ECS101M0H10FF4	10	210	94.8%	11.0	241	0.93	21.9	76.7
ECS101M0H15FF4	15	210	95.6%	17.4	234	0.50	12.7	42.6
ECS101M4H20FF4	20	210	95.9%	21.6	241	0.33	10.0	35.9

2.3.2 Integrated Motor / Drive Model Numbers and Ratings

The following section provides details on the EC Titanium Integrated Motor and Drive. Voltage shown is at the input of the drive. All motors are either 3-phase 230V AC or 3-phase 460V AC.

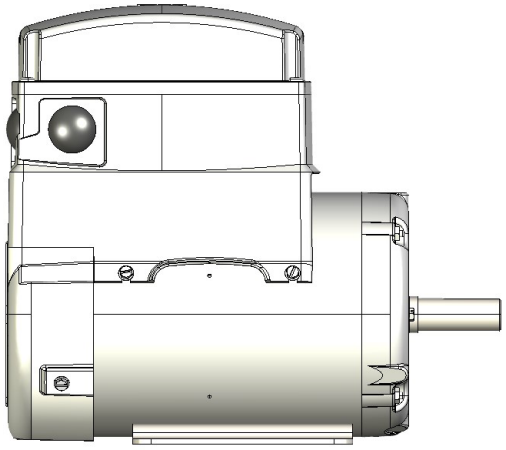


Table 2-3 Top Mount Motor and Drive Ratings

Type	HP	Motor Frame	Motor Efficiency	Motor Amps	Drive Model	Drive Size	Drive Input Amps (I_{1N})	Drive Output Amps (I_{2N})
1-phase 100V…115V AC (+/-10%) - 3 Phase 230V Output								
ECS100T1H1DF4	1	140	89.3%	2.4	ECI1A3P2	1	10.3	3.2
1-phase 200…240V AC (+/-10%) - 3 Phase 230V Output								
ECS100T8H1DF4	1	140	89.3%	2.4	ECI8A7P0	1	7.1	7.0
ECS100T8H2DF4	2	140	90.7%	4.4	ECI8A7P0	1	12.5	7.0
3-phase 200…240V AC (+/-10%) - 3 Phase 230V Output								
ECS100T2H1DF4	1	140	89.3%	2.4	ECI2A4P3	1	3.6	4.3
ECS100T2H2DF4	2	140	90.7%	4.3	ECI2A4P3	1	6.5	4.3
ECS100T2H3EF4	3	180	92.8%	7.3	ECI2A7P0	1	9.3	7.0
ECS100T2H5EF4	5	180	93.7%	10.5	ECI2A10P5	2	12.6	10.5
3-phase 380…480V AC (+/-10%) - 3 Phase 460V Output								
ECS100T4H1DF4	1	140	89.3%	1.2	ECI4A2P2	1	1.8	2.2
ECS100T4H2DF4	2	140	90.7%	2.2	ECI4A2P2	1	3.2	2.2
ECS100T4H3DF4	3	140	91.4%	3.5	ECI4A4P1	1	4.7	4.1
ECS100T4H3EF4	3	180	92.8%	3.7	ECI4A4P1	1	4.7	4.1
ECS100T4H5EF4	5	180	93.7%	5.3	ECI4A5P8	1	7.1	5.8
ECS100T4H7EF4	7.5	180	94.0%	8.8	ECI4A9P5	2	10.0	9.5
ECS100T4H7FF4	7.5	210	94.7%	8.6	ECI4A12P0	2	9.5	12.0
ECS100T4H10FF4	10	210	94.8%	11.0	ECI4A12P0	2	10.1	12.0

Note: EC Titanium integrated motor and drives are factory programmed with the values for BEMF, R, Ld and Lq. If the drive parameters have been reset to factory defaults, refer to the motor nameplate for values used to program the drive unit (see Table 2-1 Motor Setup Parameter Listing).

I_{1N} Continuous rms input current (measured value for integrated motor and drive).

I_{2N} Continuous rms output current. 50% overload is allowed for one minute every ten minutes. Maximum output current is 75% overload for 2.5 seconds of I_{2N}.

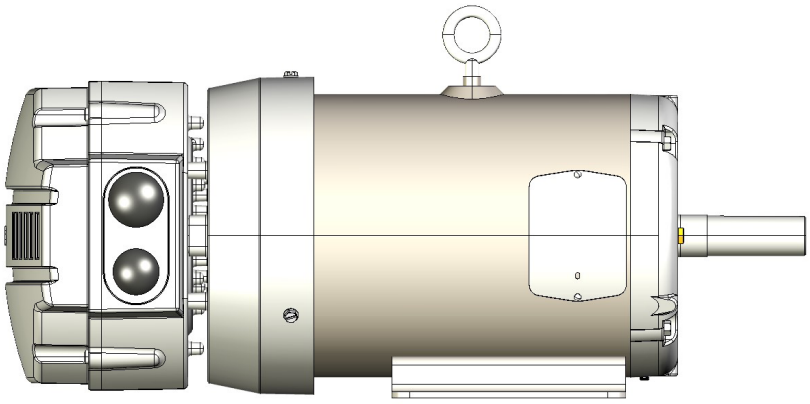


Table 2-4 Axial Mount Motor and Drive Ratings

Type	HP	Motor Frame	Motor Efficiency	Motor Amps	Drive Model	Drive Size	Drive Input Amps (I_{1N})	Drive Output Amps (I_{2N})
1-phase 100V…115V AC (+/-10%) - 3 Phase 230V Output								
ECS100A1H1DF4	1	140	89.3%	2.4	ECI1A3P2	1	10.3	3.2
1-phase 200…240V AC (+/-10%) - 3 Phase 230V Output								
ECS100A8H1DF4	1	140	89.3%	2.4	ECI8A7P0	1	7.1	7.0
ECS100A8H2DF4	2	140	90.7%	4.4	ECI8A7P0	1	12.5	7.0
3-phase 200…240V AC (+/-10%) - 3 Phase 230V Output								
ECS100A2H1DF4	1	140	89.3%	2.4	ECI2A4P3	1	3.6	4.3
ECS100A2H2DF4	2	140	90.7%	4.3	ECI2A4P3	1	6.4	4.3
ECS100A2H3EF4	3	180	92.8%	7.3	ECI2A7P0	1	9.3	7.0
ECS100A2H5EF4	5	180	93.7%	10.5	ECI2A10P5	2	12.6	10.5
3-phase 380…480V AC (+/-10%) - 3 Phase 460V Output								
ECS100A4H1DF4	1	140	89.3%	1.3	ECI4A2P2	1	1.8	2.2
ECS100A4H2DF4	2	140	90.7%	2.2	ECI4A2P2	1	3.2	2.2
ECS100A4H3DF4	3	140	91.4%	3.5	ECI4A4P1	1	4.7	4.1
ECS100A4H3EF4	3	180	92.8%	3.7	ECI4A4P1	1	4.7	4.1
ECS100A4H5EF4	5	180	93.7%	5.3	ECI4A5P8	1	7.1	5.8
ECS100A4H7EF4	7.5	180	94.0%	8.8	ECI4A9P5	2	10.0	9.5

Note: EC Titanium integrated motor and drives are factory programmed with the values for BEMF, R, Ld and Lq. If the drive parameters have been reset to factory defaults, refer to the motor nameplate for values used to program the drive unit (see Table 2-1 Motor Setup Parameter Listing).

I_{1N} Continuous rms input current (measured value for integrated motor and drive).

I_{2N} Continuous rms output current. 50% overload is allowed for one minute every ten minutes. Maximum output current is 75% overload for 2.5 seconds of I_{2N}.

Chapter 3
Mechanical Information and Mounting

This chapter provides information to be considered when planning EC Titanium installation site and provides mounting information and site requirements. If problems arise after installation, please refer to the Diagnostics and Troubleshooting section of this manual.

3.1 Receiving and Inspection

The EC Titanium is thoroughly tested at the factory and carefully packaged for shipment. When you receive your motor or the integrated motor and drive, there are several things you should do immediately.

1. Carefully Unpack the EC Titanium and check for any signs of damage. Notify the shipper immediately if any exist.
2. Check the motor and / or motor and drive rating label to ensure it is of the correct type and power requirements for the application.
3. If the control is to be stored for several weeks before use, be sure that it is stored in a clean and dry environment and within a temperature range of -40ºC to +60ºC.
4. After storage or after unpacking and inspection to see that all parts are in good condition, rotate the motor shaft by hand to be sure there are no obstructions to free rotation.

3.2 Mounting Location

Select a mounting surface for the EC Titanium that allows installation using the mounting holes provided. The area selected should allow for free air circulation around the control. Provide at least two inches of clearance on all sides for maximum cooling efficiency and verify that the operating environment is free of dirt and debris.

Vibration Considerations	Excessive vibration can cause failure of the control when used as an Integrated Motor and Drive. If the control is subjected to vibration levels greater than 1G at 10 to 60 Hz, the control must be shock mounted.
Altitude Derating	Ratings apply to 3300 feet (1000 meters) altitude with no derating required. For installations at higher altitudes de-rate the continuous and peak output currents of the control by 1% for each 330 feet (100 meters) above 3300 feet up to a maximum of 6600 feed (2000 meters).
Temperature Derating	Control ratings apply to 40°C. De-rate output by 2% per °C above 40°C. Maximum ambient is 50°C.

Caution: Avoid locating the EC Titanium immediately above or beside heat generating equipment, or directly below water or steam pipes.

3.3 Wiring Considerations

All electrical connections should be made as detailed in Chapter 4. All external wires for the EC Titanium should be run in a conduit that is separate from all other wiring.

3.4 Motor Mounting and Lifting Positions

Stock EC Titanium Motors are designed to be mounted by the “Mounting Feet” or a Face Mounting such as a C-Face with or without feet. Use appropriate hardware (not furnished). The motor should be installed in a location compatible with the motor enclosure and specific ambient. The motor must be securely installed to a rigid foundation or mounting surface to minimize vibration and maintain alignment between the motor and shaft load. Failure to provide a proper mounting surface may cause vibration, misalignment and bearing damage. All hold down bolts must be the correct grade for the type of mounting and must be torqued to their recommended value.

The standard motor base is designed for horizontal or vertical mounting.

Belted Drive	Motor slide bases or rails, when used, must be securely anchored to the foundation with the proper bolts. The motor shaft and the load shaft must be parallel and the sheaves alligned.
Coupled Drive	Standard EC Titanium Motors will operate successfully mounted on the floor, wall or ceiling, and with the shaft at any angle from horizontal to vertical. Special mountings may have duty or thrust demand that may require a different bearing system.

Note: The motor should be positioned in normal operation with provided drains in the downward position at the lowest point of the motor to prevent water accumulation inside the motor. Mounting the motor in a non-horizontal position may require additional bearing sealing or a shaft guard / slinger to meet the designated IP requirements.

3.4.1 Motor Lifting Provisions

The EC Titanium motors provided in 180 and 210 frames are provided with lifting provisions. Always lift the motor by the lifting bolt eye or lugs provided. 140 Frame Motors do not require lifting provisions and can be set in place manually. (2) Lifting Lugs are provided on Top Drive Units that are offset to balance the motor weight as shown below in Figure 3-1.

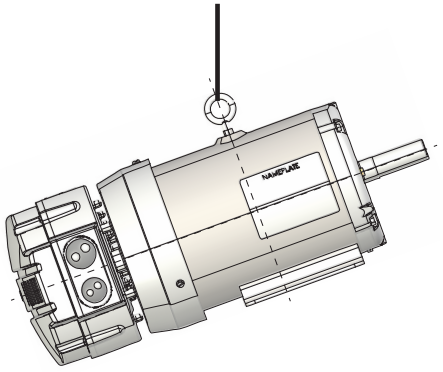
Caution: Do not lift the motor and its driven load by the motor lifting hardware. The motor lifting hardware is adequate for lifting only the motor. Disconnect the driven load from the motor shaft before lifting the motor.

Caution: Do not lift the motor by the shaft. The motor is designed to drive a load but it is not intended to have lifting forces and stresses applied to the motor shaft. Damage to the motor may result

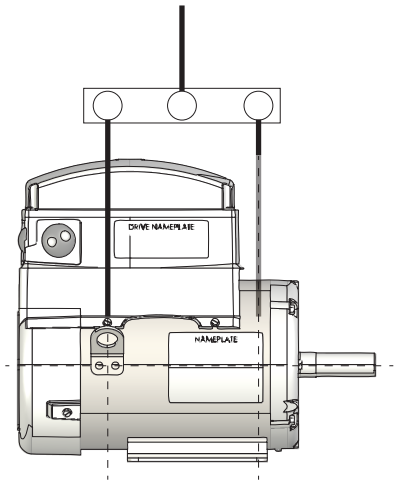
Caution: If eye bolts are used for lifting a motor, be sure they are securely tightened. The lifting direction should not exceed a 20° angle from the shank of the eye bolt or lifting lug. Excessive lifting angles can cause damage.

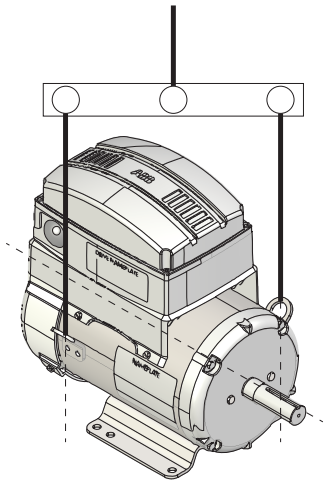
Figure 3-1 Motor Lifting Positions

Single Lifting Bolt
180, 210 Frames EC Motors and Axial Units
20” maximum angle



Dual Offset Lifting Bolts
180, 210 Frame EC Top Units



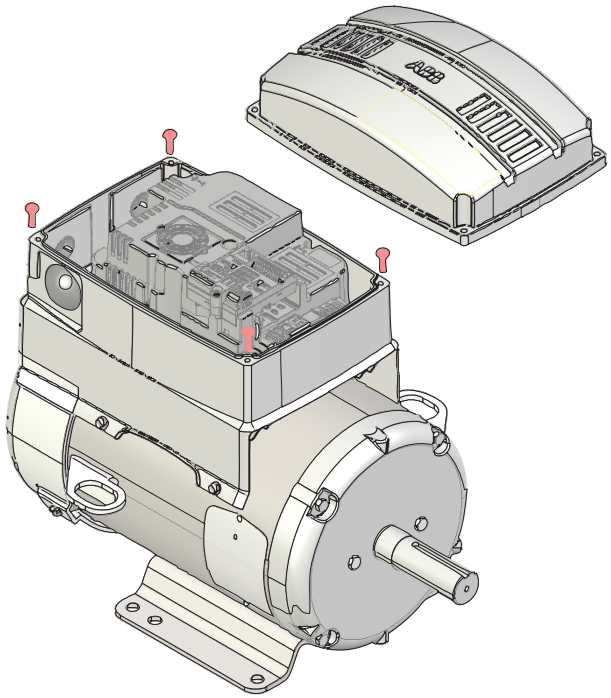


3.5 Removing Drive Cover

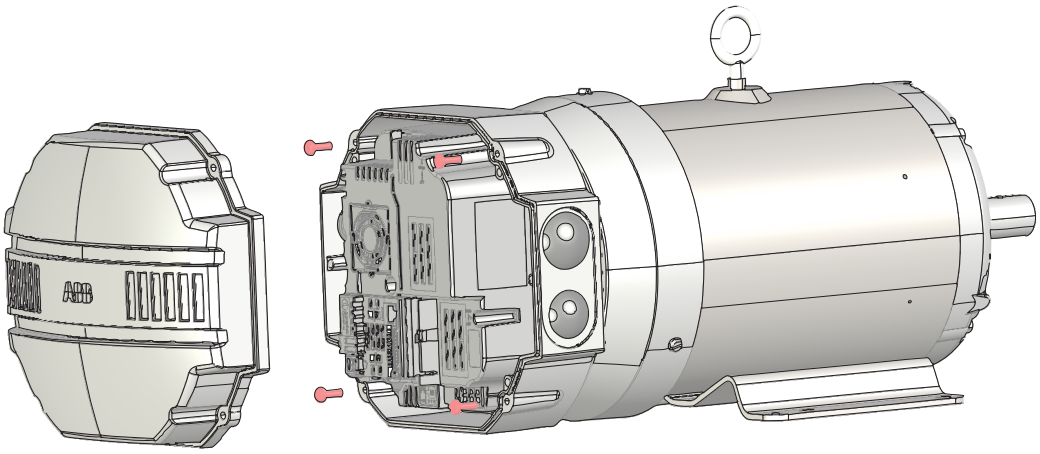
To connect power and signal wiring, the cover must be removed as shown below. For first time setup prior to applying power, remove the four retaining screws and carefully place them aside, then remove the cover to allow access to wiring the drive modules.

Chapter 4 contains details on the internal power connections and Chapter 5 control wiring connections. See Chapter 9 for examples of typical digital control program settings and example wiring diagrams.

Top Mount Drive Unit



Axial Mount Drive Unit



Chapter 4
Electrical Installation and Planning

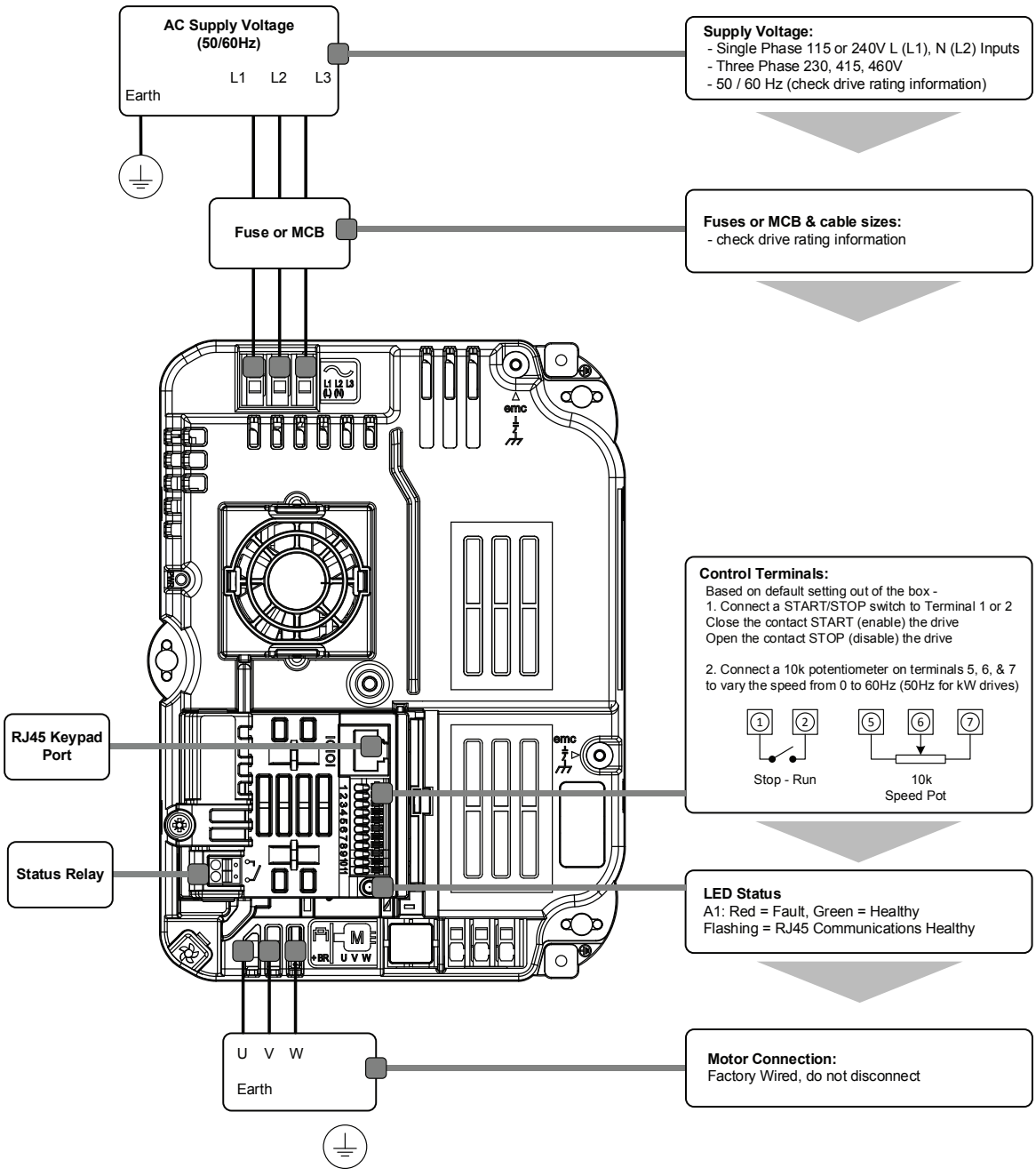
This section outlines the basics of the power wiring for the Integrated EC Titanium Motor and Drive. Sample digital and analog control wiring diagrams are shown later in this guide.

4.1 Motor Connections

The following warnings cover considerations when using a permanent magnet motor over an induction motor. Please review these warnings carefully before operating the permanent magnet motor.

Warning: Motor circuit may have high voltage present whenever AC power is applied, even when motor is not rotating. Electrical shock can cause serious or fatal injury.

Warning: ECM permanent magnet motors can induce voltage and current in the motor leads by rotating the motor shaft. Electrical shock can cause serious or fatal injury. Therefore, do not couple the load to the motor shaft until all motor connections have been made. During any maintenance inspections, be sure the motor shaft will not rotate.



4.2 Protective Ground (PE) Connection

To ensure a safe and trouble-free installation, the EC Titanium Integrated Motor and Drive must be properly grounded. Symmetrical voltage on all three phases relative to ground is optimum and thus it is recommended that the control be supplied from a 4-wire wye connected source. The center-tap of the supply transformer secondary should be solidly grounded per local code. The ground wire from the source should be connected to the ground wire terminated on the EC Titanium Drive as shown below.

Warning: Be sure the system is properly grounded before applying power. Do not apply AC power before you ensure that all grounding instructions have been followed. Electrical shock can cause serious or fatal injury.

- **The ground terminal of the EC Titanium Drive should be individually connected directly to the site ground bus bar. EC Titanium ground connections should not loop from one drive to another, or to, or from any other equipment.**
- **Ground loop impedance must confirm to local industrial safety regulations.**
- **To meet UL regulations, UL approved ring crimp terminals should be used for all ground wiring connections.**
- **The drive Safety Ground must be connected to system ground.**
- **Ground impedance must conform to the requirements of national and local industrial safety regulations and/or electrical codes.**
- **The integrity of all ground connections should be checked periodically.**

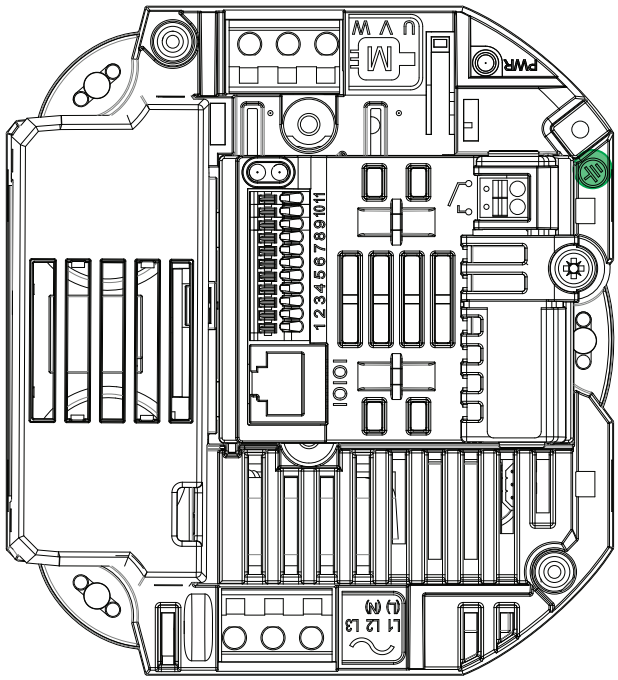
4.2.1 Protective Earth Conductor

The Cross sectional area of the PE Conductor must be at least equal to that of the incoming supply conductor.

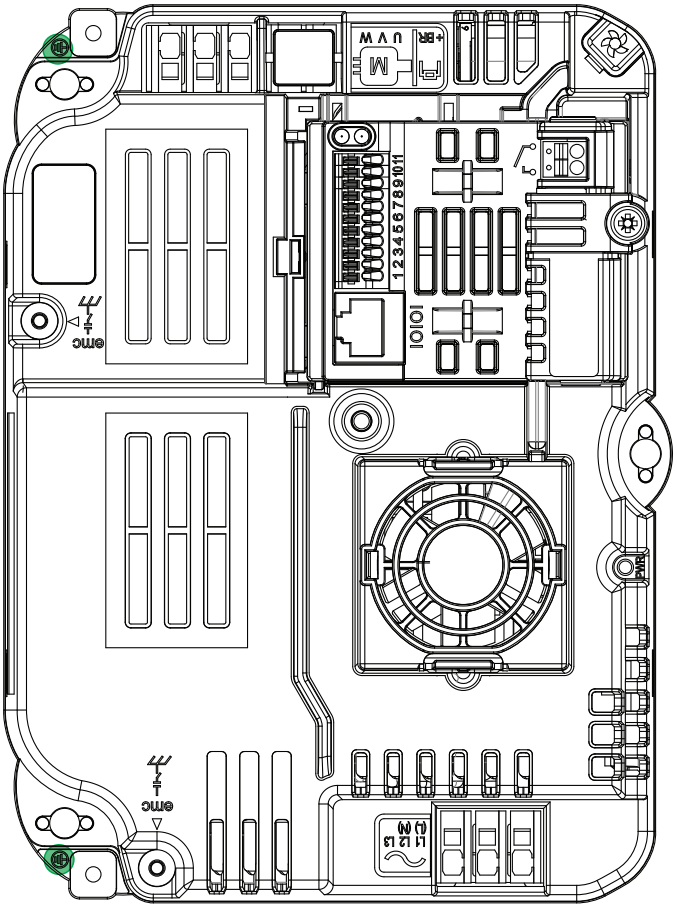
Figure 4-1 PE Connection

The PE connection must be directly connected to ground: connection locations for each model are shown below.

Frame Size 1



Frame Size 2



4.2.2 Safety Ground

This is the safety ground for the drive that is required by code. One of these points must be connected to adjacent building steel (girder, joist), a floor ground rod, or bus bar. Grounding points must comply with national and local industrial safety regulations and/or electrical codes.

The safety ground terminal provides a grounding point for the motor cable shield. The motor cable shield connected to this terminal (drive end) should also be connected to the motor frame (motor end). Use a shield terminating or EMI clamp to connect the shield to the safety ground terminal.

4.2.3 Motor Ground

The motor ground must be connected to one of the ground terminals on the drive.

4.2.4 Ground Fault Monitoring

As with all inverters, a leakage current to earth can exist. The EC Titanium Drive is designed to produce the minimum possible leakage current while complying with worldwide standards. The level of current is affected by motor cable length and type, the effective switching frequency, the earth connections used and the type of RFI filter installed. If a GFCI (Ground Fault Current interrupter) is to be used, the following conditions apply:

- The device must be suitable for protecting equipment with a DC component in the leakage current
- Individual GFCI's should be used for each EC Titanium Drive

Shield Termination (Cable Screen)

The safety ground terminal provides a grounding point for the motor cable shield. The motor cable shield connected to this terminal (drive end) should also be connected to the motor frame (motor end). Use a shield terminating or EMI clamp to connect the shield to the safety ground terminal.

4.3 Incoming Power Connection

The EC Titanium product range has input supply voltage surge suppression components fitted to protect the drive from line voltage transients, typically originating from lightning strikes or switching of high power equipment on the same supply. EC Titanium Drive models are Over Voltage Category III according to EN60664-1:2007. Auxiliary circuits must be Over Voltage category II.

4.3.1 Power Cable Selection

For 1 phase supply, the mains power cables should be connected to L1/L, L2/N. For 3 phase supplies, the mains power cables should be connected to L1, L2, and L3.

Cables should be dimensioned according to any local codes or regulations per Table 4-2. The cable must be sufficient to carry the drive load current. Refer to Table 4-2 Electrical Rating Table.

For compliance with CE and C Tick EMC requirements, refer to section EMC Compliant Installation. A fixed installation is required according to IEC61800-5-1 with a suitable disconnecting device installed between the EC Titanium and the AC Power Source. The disconnecting device must conform to the local safety code / regulations (e.g. within Europe, EN60204-1, Safety of machinery). For UL compliant installation, cables must be rated for continuous conductor temperature of 75ºC, copper only.

The EC Titanium Drive is designed for the incoming power rating listed below.

Table 4-1 Electrical Data

Supply Voltage Range	110 Volt Units – 110 – 115 Volt +10% / -10% 230 Volt Units – 200 – 240 Volt +10% / -10% 400 Volt Units – 380 – 480 Volt +10% / -10%
Imbalance	Maximum 3% voltage variation between phase – phase voltages allowed
Supply Frequency	48 – 62Hz
Short Circuit Capacity	5kA

4.3.2 Fuse / Circuit Breaker Selection

Suitable fuses to provide wiring protection of the input power cable should be installed in the incoming supply line, according to the data in Table 4-2 Electrical Ratings. The fuses must comply with any local codes or regulations in place. In general, type gG (IEC 60269) or UL type J fuses are suitable; however, in some cases type aR fuses may be required.

Check that the operating time of the fuse is below 0.5 seconds. The operating time depends on the fuse type, the supply network impedance as well as the cross sectional area, material and length of the supply cable. In case the 0.5 seconds operating time is exceeded with gG fuses, ultra-rapid (aR) fuses in most cases reduce the operating time to an acceptable level.

Where allowed by local regulations, suitably dimensioned type B MCB circuit breakers of equivalent rating may be utilized in place of fuses, providing that the clearing capacity is sufficient for the installation.

The maximum permissible short circuit current at the drive input power terminals as defined in IEC60439-1 is 5kA.

Table 4-2 Fuse & Wire Size Electrical Specifications

The rated fuse currents given in the table are the maximums for the mentioned fuse types. If smaller fuse ratings are use, check that the fuse rms current rating is larger than the rated input amps shown in the rating tables in Chapter 2.

Drive Type Top (T) / Axial (A)	Power (HP)	Nominal Input Current (A)	Fuse UL (Class J) or MCB (Type B)		Maximum Cable Size (AWG) 1	Nominal Output Current
			Non UL	$UL_{2,3,4}$		
1-phase 100V…115V AC (+/-10%) - 3 Phase 230V Output						
ECS100T/A 1H1DF4	1	15.1	25	20	14	3.2
1-phase 200…240V AC (+/-10%) - 3 Phase 230V Output						
ECS100T/A 8H1DF4	1	12.9	16	17.5	14	7.0
ECS100T/A 8H2DF4	2	12.9	16	17.5	14	7.0
3-phase 200…240V AC (+/-10%) - 3 Phase 230V Output						
ECS100T/A 2H1DF4	1	7.5	10	10	14	4.3
ECS100T/A 2H2DF4	2	7.5	10	10	14	4.3
ECS100T/A 2H3EF4	3	12.9	16	17.5	14	7.0
ECS100T/A 2H5EF4	5	10.5	16	15	10	10.5
3-phase 380…480V AC (+/-10%) - 3 Phase 460V Output						
ECS100T/A 4H1DF4	1	3.5	6	6	14	2.2
ECS100T/A 4H2DF4	2	3.5	10	10	14	2.2
ECS100T/A 4H3DF4	3	5.6	10	10	14	4.1
ECS100T/A 4H3EF4	3	5.6	10	10	14	4.1
ECS100T/A 4H5EF4	5	7.5	10	10	14	5.8
ECS100T/A 4H7EF4	7.5	11.5	16	15	12	9.5
ECS100T/A 4H7FF4	7.5	12	16	15	12	12.0
ECS100T4H10FF4	10	12	16	15	10	12.0

1. Cable sizes shown are the maximum possible that may be connected to the drive. Cables should be selected according to local wiring codes or regulations applicable at the point of installation.
2. Refer to the UL Online Certification Directory for a list of UL Recognized products, File Number E226333.
3. The integral overload protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with applicable local regulations and the National Electrical Code.
4. Fuse type: UL JDDZ Class J.
5. Where permitted, equivalent circuit breakers may be used.
6. Fuse size data and Wire size data can be treated independent from each other in this table.
7. Fuses provide protection for wiring and ensure that if the VFD was to fail, it would fail in a safe manor.
8. 8. Maximum cable size is the maximum wire size that the terminal block can physically accept. A smaller wire size can be used as long as the size meets code for the drive's input amp rating.

4.4 Optional Input Choke

- An optional Input Choke is recommended to be installed in the supply line for drives where any of the following conditions occur. In all other installations, an input choke is recommended to ensure protection of the drive against power supply faults.
- The incoming supply impedance is low or the fault level / short circuit current is high
- The supply is prone to dips or brown outs
- An imbalance exists on the supply (3 phase drives)

Supply	Frame Size	Rated Volts	Rated Amps	Inductance (mH)
115, 230 Volt, 1 Phase	1	230 Max	16	1.8
230 Volt, 1 Phase	2		25	1.1
460 Volt, 3 Phase	1	500 Max	6	4.8
	2		10	2.9

4.5 EMC Compliant Installation

Category	Supply Cable Type	Motor Cable Type	Control Cables	Maximum Permissible Motor Cable Length
$C1_{6}$	$Shielded_{1}$	$Shielded_{1,5}$	$Shielded_{4}$	1M / 1M7
C2	$Shielded_{2}$	$Shielded_{1, 5}$		3M / 3M7
C3	$Unshielded_{3}$	$Shielded_{2}$		$10M / 10M_{7}$

1. A screened (shielded) cable suitable for fixed installation with the relevant mains voltage in use. Braided or twisted type screened cable where the screen covers at least 85% of the cable surface area, designed with low impedance to HF signals. Installation of a standard cable within a suitable steel or copper tube is also acceptable.
2. A cable suitable for fixed installation with relevant mains voltage with a concentric protection wire. Installation of a standard cable within a suitable steel or copper tube is also acceptable.
3. A cable suitable for fixed installation with relevant mains voltage. A shielded type cable is not necessary.
4. A shielded cable with low impedance shield. Twisted pair cable is recommended for analog signals.
5. The cable screen should be terminated at the motor end using an EMC type gland allowing connection to the motor body through the largest possible surface area. Where drives are mounted in a steel control panel enclosure, the cable screen may be terminated directly to the control panel using a suitable EMC clamp or gland, as close to the drive as possible.
6. Compliance with category C1 conducted emissions only are achieved. For compliance with category C1 radiated emissions, additional measures may be required, contact your Sales Partner for further assistance.
7. Permissible cable length with additional external EMC filter.

4.6 CE Marking

The CE mark is attached to the motor nameplate to verify that the integrated drive and motor ratings follow the provisions of the European Low Voltage and EMC Directives.

4.6.1 Compliance with the European EMC Directive

The EMC Directive defines the requirements for immunity and emissions of electrical equipment used within the European Union. The EMC product standard (EN 61800-3:2004) covers requirements stated for drives.

4.6.2 Compliance with EN 61800-3:2004

EMC stands for Electromagnetic Compatibility. It is the ability of electrical/electronic equipment to operate without problems within an electromagnetic environment. Likewise, the equipment must not disturb or interfere with any other product or system within its locality.

First environment includes establishments connected to a low-voltage network which supplies buildings used for domestic purposes. Second environment includes establishments connected to a network not directly supplying domestic premises.

Drive of category C1: drive of rated voltage less than 1000 V, intended for use in the first environment.

Drive of category C2: drive of rated voltage less than 1000 V and intended to be installed and commissioned only by a professional when used in the first environment. Note: A professional is a person or organization having necessary skills in installing and/or commissioning power drive systems, including their EMC aspects.

Category C2 has the same EMC emission limits as the earlier class first environment restricted distribution. EMC standard IEC/EN 61800-3 does not any more restrict the distribution of the drive, but the using, installation and commissioning are defined.

Drive of category C3: drive of rated voltage less than 1000 V, intended for use in the second environment and not intended for use in the first environment. Category C3 has the same EMC emission limits as the earlier class second environment unrestricted distribution.

4.6.3 EC Titanium EMC Compatibility Guide

CE guidelines for EMC compatibility must follow these conditions for compliance. EC Titanium Motors require the following modifications to comply with the Conducted or/and Radiated Emissions requirements (EN 55011, Group 1, Class A).

Enclosure
All EMC Compatible units will need to be Plenum Use ratings, aluminum drive housing covers to be in compliance. Units should be installed with conductive grounded conduit plugs installed in any un-used conduit holes.

Power
Power supplied to the unit will need to be via inverter rated HF shielded cable. Cable Shielding to be grounded to the heatsink via the 360-degree HF conduit fitting. (testing conducted using a Phoenix Contact brass shielded gland fitting with integrated EMC contact spring, or similarly rated equipment).

Note: It is also commonly accepted that the wire braid can be stripped back, twisted and grounded via the drive ground provision. For conducted emissions, it is also necessary to install a Line filter. Tested units passed CE EMC directive using the following filter:

Primary Compliant Filter	Schaffner FN3258-16-45 (or equivalent)
Alternate Filter	Baldor FI0041A01 surge arrestor / filter 08064 BLD23B

Control Wiring
Control wiring is recommended to use a shielded cable grounded to the heatsink, per previous power wiring recommendations. Compliance may also be met by installing a ferrite bead (provided by technology international) on the wiring close to the drive termination. For RJ45 control cable connections it is recommended to install a Fair-Rite 0431167281 or similar filter to be placed inside the drive housing.

Motor Only Recommendation
For motor only installation following the recommended CE EMC guidelines as provided by the drive supplier. Motor power supplied from the drive to be inverter rated HF shielded cable. Cable Shielding to be grounded via the 360-degree HF conduit fitting. Note: It is also commonly accepted that the wire braid can be stripped back, twisted and grounded via the drive ground provision.

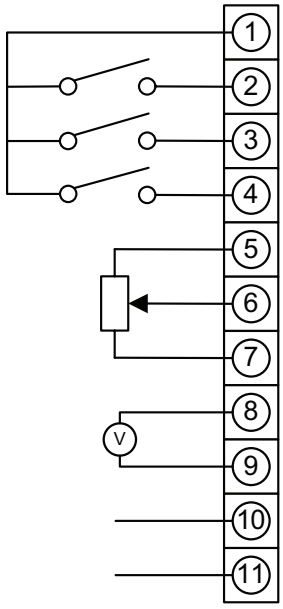
For detailed technical information on installations and CE EMC filter requirements please reference ABB Technical Guide 3AFE61348280_EN_RevD.

Chapter 5
Control Wiring and Keypad Interface

5.1 Control Terminal Connections

The figure below shows the I/O terminals.

Figure 5-1 Input and Output Terminals



Control Terminal	Signal	Description	
1	+24V User Output	+24V, 100mA	
2	Digital Input 1	Positive logic “Logic 1” input voltage range: 8V … 30V DC “Logic 0” input voltage range: 0V … 4V DC	
3	Digital Input 2		
4	Digital Input 3 / Analog Input 2	Digital: Logic 1 = 8 to 30V Analog: 0 to 10V, 0 to 20mA or 4 to 20mA	
5	+10V User Output	+10V, 10mA, 1kΩ minimum	
6	Analog Input 1 / Digital Input 4	Analog: 0 to 10V, 0 to 20mA or 4 to 20mA Digital: 8 to 30V	
7	0V	0 Volt Common, internally connected to terminal 9	
8	Analog Output / Digital Output	Analog: 0 to 10V,	20mA maximum
		Digital: 0 to 24V	
9	0V	0 Volt Common, internally connected to terminal 7	
10	Modbus RTU - /BACnet		
11	Modbus RTU + /BACnet		
RL1-A	Relay Common		
RL1-B	Relay NO Contact	Contact 250Vac, 6A / 30Vdc, 5A	

5.2 Control Terminal Wiring

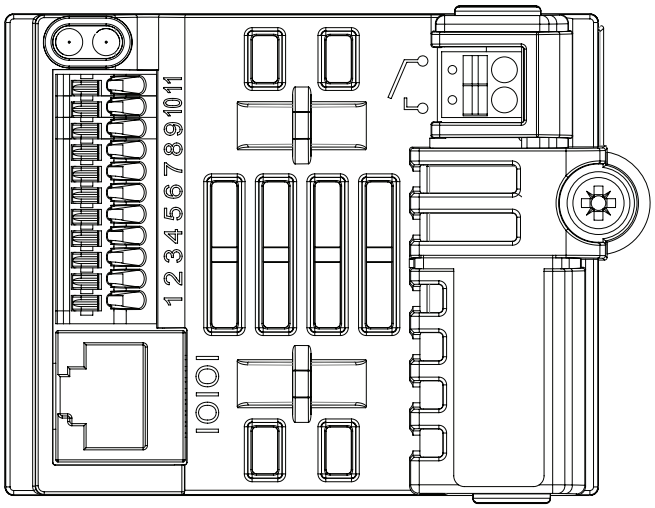
Analog signal (if connected): all analog signals should be connected using suitably shielded, twisted pair cables.

Power and Control Signal cables should be routed separately where possible, and must not be routed parallel to each other.

Signal levels of different voltages e.g. 24 Volt DC and 110 Volt AC, should not be routed in the same cable.

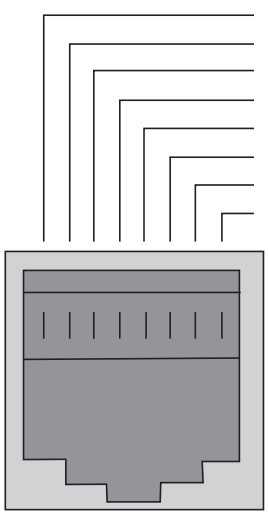
Control Cable entries accept a single conductor,

Maximum size: 0.05 – 0.5mm2 / 20 – 26 AWG.



5.3 Remote Panel Interface

The REMOTE PANEL uses a standard RJ45 6-Way connector as its electrical interface, which provides a simple solution for the user to setup their system using a standard RJ45 6-Way data cable. The signal layout of the connector is as follows:



1	No connection
2	No connection
3	0 Volts
4	-RS485 (PC)
5	+RS485 (PC)
6	+24 Volt
7	-RS485 (Modbu RTU) / BACnet*
8	+RS485 (Modbus RTU) / BACnet*

Warning:

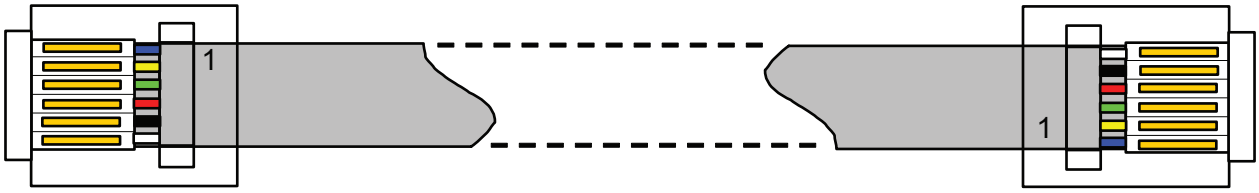
This is not an Ethernet connection. Do not connect directly to an Ethernet port.

*Note: Modbus RTU and BACnet MS/TP cannot operate at the same time

5.3.1 Cable Requirements

If the data cable is made up on site, ensure that the connection pin out is correct: Pin 1 to Pin 1, Pin 6 to Pin 6, etc.

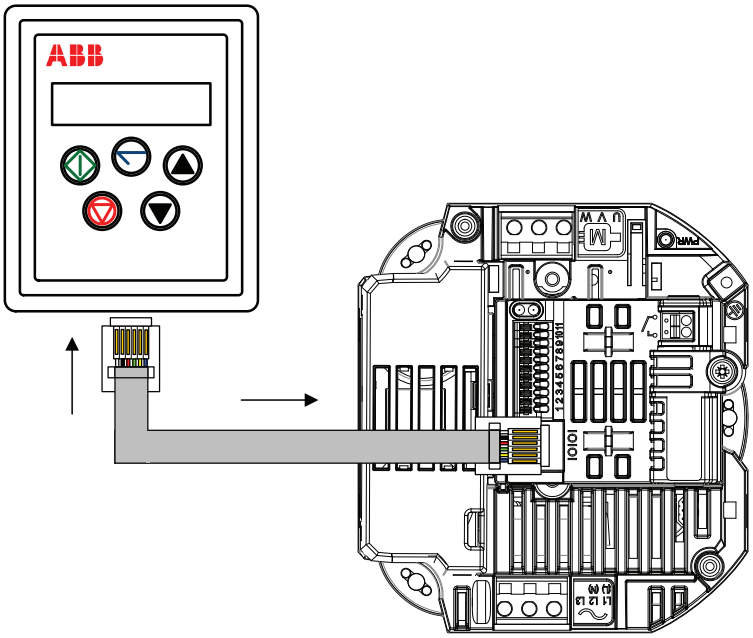
Figure 5-1 8-way ribbon cable with header



CAUTION: Incorrect cable connection may damage the drive. Extra care should be taken when using third party cable.

5.3.2 Hardware Connection

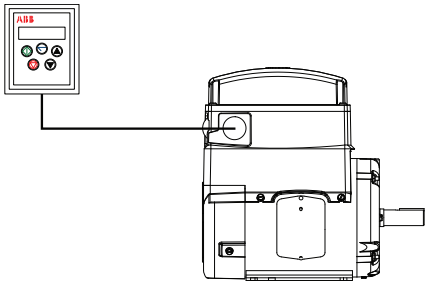
The EC Titanium provides the power supply to the REMOTE PANEL via the RJ45 connection. Once the physical connection has been setup, the system is ready to operate. See picture blow:



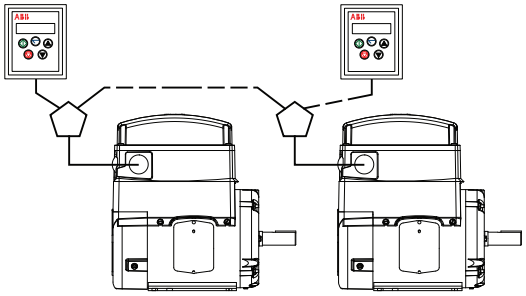
5.3.3 System Setup

Depending on the requirement of the application, the REMOTE PANEL can be used in different configurations outline below:

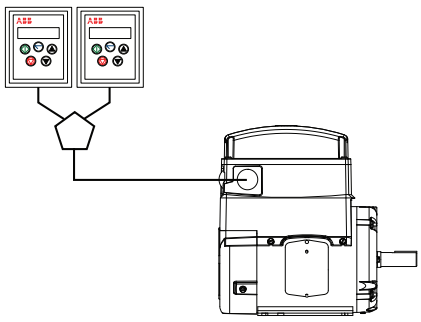
(1) Remote Panel & (1) EC Titanium



(1) or (2) Remote Panels & up to (63) EC Titanium



(2) Remote Panels & (1) (1) EC Titanium



Different drive models can be used on the same Remote Panel network providing a unique communications address is assigned to each. The Remote Panel uses a standard RJ45 6-Way connector as its electrical interface. A standard RJ45 Splitter can be used between the Keypad and multiple drives.

5.3.4 To setup the communication address

On first power up, the REMOTE PANEL will communicate with network drive address 1 and initially display "SCAN.." indicating the REMOTE PANEL is searching for a drive with network address 1.

"Load.." is displayed indicating the keypad is reading configuration information from the drive. After 1~2 seconds, data has been loaded and the REMOTE PANEL will display real time drive status.

If the display shows "Adr-01", the keypad didn't find a drive with address 1 in the network. Use the UP and DOWN buttons to select the correct address from 1 to 63. Once the address has been changed to a correct value, press STOP to initiate search again.

5.3.5 Connection to a network of multiple drives

Selection of the drive address can be changed at any time. Press STOP and DOWN buttons together and message "Adr-XX" is displayed. Use UP or DOWN buttons to select the desired drive address. Select the new address and press STOP and DOWN button together to establish communications with the new drive address.

5.3.6 To setup the REMOTE PANEL device number

A maximum of (2) REMOTE PANELs can be used on the same drive network. To use (2) keypads on one drive, change the Device Number on the second panel from the default value of 1 for correct operation. To change Device Number, press NAVIGATE, STOP and DOWN buttons together. "Port-X" (x = 1 or 2) will be displayed. Use UP or DOWN and change the Device Number to 1 or 2 as required. Press NAVIGATE, STOP and DOWN button together again to return to normal operation.

NOTE: An REMOTE PANEL with Device Number 1 must always be present for the network to function correctly. Change the Device Address to 2 only if multiple keypads are connected.

5.4 Control Signals

5.4.1 Analog Output

The analog output function may be configured using parameter 1501, which is described in Chapter 10 Parameter Definitions. The output has two operating modes, dependent on the parameter selection.

Analog Mode	The output is a 0 – 10 Volt DC signal, 20mA max load current
Digital Mode	The output is 24 Volt DC, 20mA max load current

5.4.2 Relay Output

The relay output function may be configured using parameter 1401, see Chapter 10 Parameter Definitions.

5.4.3 Analog Inputs

Two analog inputs are available, which may also be used as Digital Inputs if required. The signal formats are selected by parameters as follows:

Analog Input 1 Format Selection Parameter 1300

Analog Input 2 Format Selection Parameter 1304

These parameters are described more fully in Chapter 10 Parameter Definitions.

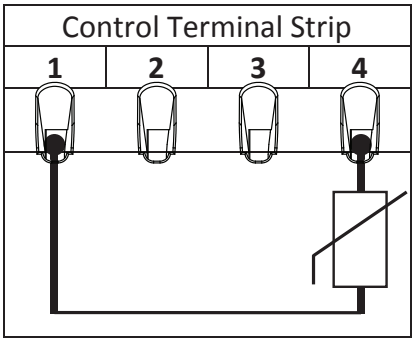
The function of the analog input, for example for speed reference or PID feedback is defined by parameters 1103 Primary Command Source and 9902 Digital Input Function Select. The function of these parameters and available options are described in section the Macro Function Guide.

5.4.4 Digital Inputs

Up to four digital inputs are available. The function of each input is defined by parameters 1103 and 9902, which are explained in Chapter 9 Control Modes.

5.5 Motor Thermistor Connection

When an externally mounted motor thermistor is to be used, connect as follows:



Additional Information

- Compatible Thermistor: PTC Type
- Trip Level: >=2.5 kΩ
- Reset Level: =<1.9 kΩ
- The thermistor input is monitored at all times and the drive may trip even if it is disabled.
- Use suitable settings of parameter 1103 Command Source and 9902 Digital Input Function Select which have Input 3 function as External Trip, (1103 = 0, 9902 = 3) Refer to Chapter 12 for further information.
- Set 1304 Analog Input 2 Format = PtC-th. If this setting is not used, the drive will display E-trP only if the thermistor exceeds the threshold level during operation.

5.6 Internal Thermal Overload Protection

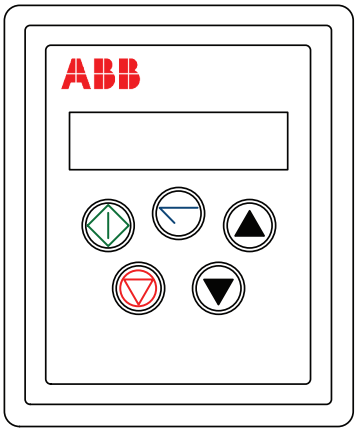
The drive has an in-built motor thermal overload function; this is in the form of an I t-trP trip after delivering >100% of the value set in 9906 Motor Rated Amps for a sustained period of time (150% for 60 seconds).

Chapter 6
Keypad Programming and Basic Operation

The drive is configured and its operation monitored using a remote keypad and display or the PC Tools. Refer to Chapter 5 for proper electrical connection of the keypad to the drive.

6.1 User Interface

	NAVIGATE	Used to display real-time information, to access and exit parameter edit mode and to store parameter changes.
	UP	Used to increase speed in real-time mode or to increase parameter values in parameter edit mode.
	DOWN	Used to decrease speed in real-time mode or to decrease parameter values in parameter edit mode.
	STOP	When drive is in trip mode, this button is used to reset a tripped drive. In normal application, when in Keypad mode, this button is used to stop a running drive.
	START	When in keypad mode, the button is used to start a stopped drive or to reverse the direction of rotation if bi-directional keypad mode is enabled (See drive user guide for more information).



6.2 Real Time Operation

Once the communication has been established between the EC Titanium and REMOTE PANEL, the user can control the EC Titanium by using the control buttons on the front panel of the REMOTE PANEL.

6.2.1 Pre-setting target speed in keypad mode

Setting parameter **1103** to a value of 1 enables keypad mode with forward direction only, while a value of 2 enables keypad mode with forward and reverse rotation.

Set parameter **1100** to 1 or 3 to enable the drive to start from the set keypad reference speed.

While the drive is stopped, press the **STOP** key. The value of the digital potentiometer will be displayed, indicating the target speed. Use the **Up** and **DOWN** keys to select the required target speed.

Press the **STOP** key to return to the real time display showing "StoP" or the START key to start the drive ramping up to the target speed.

6.2.2 To vary the speed in real time keypad control mode

Key	Function	Description
	START	Drive will ramp up to the preset speed set in the digital potentiometer (assuming parameter 1100 = 1)
	UP	Press the UP button to increase speed. The drive will run forward, increasing speed until the UP button is released. The maximum speed is the speed set in parameter 2008.
	DOWN	Press DOWN to decrease speed. The drive will decrease speed until the STOP button is released. The minimum speed is the speed set in parameter 2007.
	STOP	Press the STOP to stop the drive. The drive will decelerate to stop at the selected deceleration ramp. The display will finally show "StoP" at which point the drive is disabled.
	START	Pressing the START key once more results in the drive running back up to the speed at which it was previously running (assuming 1100 =1)

6.2.3 To reverse direction of rotation with Parameter 1103=2

Press the **START** key. The drive ramps up to the preset speed as set in the digital potentiometer (Parameter 1100 = 1).

Press **Up** or **DOWN** to increase or decrease the speed.

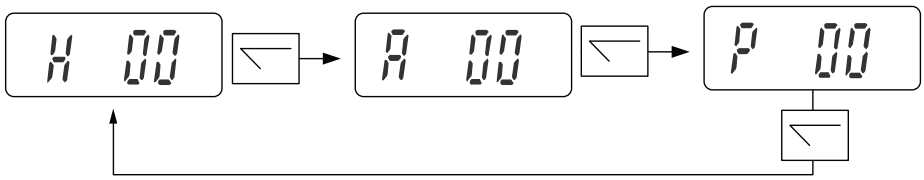
Press the **START** key again. The motor will reverse its direction of rotation.

Press the **STOP** key to decelerate the motor to standstill.

Whenever the drive is started, it will start with a positive speed unless the direction is negated by the digital inputs on the user terminals.

6.3 Keypad Operation and Remote Monitoring Displays

Prior to operation the keypad with show StoP, pressing the **STOP** key allows setting the preset speed shown on the display as H **x.x** and while in operation the following displays can be accessed by briefly pressing the Navigate Key.



6.4 Remote Keypad Monitoring Screens

Display	Description	
StoP	Drive mains power applied, but no Enable or Run signal applied.	
Drive running		
H 0.0.	Display shows output frequency (Hz)	While the drive is running, the following displays can be selected by briefly pressing the **Navigate** button on the keypad. Each press of the button will cycle the display through to the next selection.
A 0.0.	Drive running Display shows motor current (Amps)	
P 0.0.	Drive Running Display shows motor power (kW)	
Drive Running, Speed Reference = 0		
Stndby	If the enable / disable switch is opened the drive will decelerate to stop at which time the display will show StoP. If the potentiometer is turned to zero with the enable /disable closed the display with show H 0.0 (0.0Hz), if left like this for 60 seconds the drive will go into standby mode, display shows Stndby, waiting for a speed reference signal.	

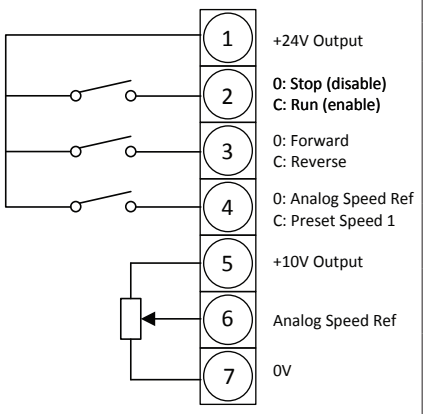
Chapter 7
Quick Startup Guide

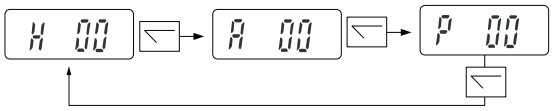
This chapter contains Quick Start information that allows first time users to quickly and easily configure the EC Titanium for operation in either Terminal (Hardwired) or Keypad Control. The step by step instructions will have the EC Titanium running in a matter of minutes. Refer to Chapter 8 for Program Navigation and Chapter 10 for a complete list of the drive parameters along with their definitions and default values.

The parameters can be accessed and programmed either through the keypad or through the EC Titanium PC Software Tool (refer to Chapter 6 Keypad Operation), PC Software Tools to be a future release.

7.1 Quick Start Terminal Control

When delivered, the EC Titanium software parameters are in the factory default state, except for the motor data which was pre-loaded at the factory with parameters that are optimum for the performance of the Motor. A full list of parameters & default values can be found in Chapter 10.

<table>
<tr><td>Step 1</td><td colspan="2">Perform Mechanical and Electrical installation as per Chapters 3 and 4.</td><td rowspan="5">Terminal mode 1103 = 0, 2-Wire Control 9902 = 0

</td></tr>
<tr><td rowspan="3">Step 2</td><td colspan="2">Connect the Remote Keypad as per Chapter 5.</td></tr>
<tr><td colspan="2">Factory Default Settings (no programming change required)</td></tr>
<tr><td>9902 Digital Input Function Select
1103 Command Source Mode</td><td>= 0
= 0 (Terminal Control)</td></tr>
<tr><td>Step 3</td><td colspan="2">Connect a control switch between the control terminals 1 and 2 and ensure that the contact is open (drive disabled).</td></tr>
<tr><td>Step 4</td><td colspan="2">Connect a potentiometer (1kΩ min to 10 kΩ max) between terminals 5 and 7 with the wiper to terminal 6 of the control terminal.</td></tr>
<tr><td>Step 5</td><td colspan="2">With the potentiometer set to zero, switch on the supply to the EC Titanium. The display will show StoP.</td></tr>
<tr><td>Step 6</td><td colspan="2">By default, motor setup parameters have been loaded at the factory. If the drive has been reset to factory defaults proceed to Section 7.2 Enter Motor Data or skip to step 7.</td></tr>
<tr><td>Step 7</td><td colspan="3">Close the control switch, terminals 1-2. The drive is now ‘enabled’ and the output frequency/speed are controlled by the potentiometer. The display shows zero speed in Hertz as H 0.0. with the potentiometer turned to minimum. If the display is not showing H, change it using the (Navigate) key.</td></tr>
<tr><td>Step 8</td><td colspan="3">Turn the potentiometer to maximum. The motor will accelerate to 60Hz (the default value of parameter 2008 MAXIMUM FREQUENCY / SPEED LIMIT) under the control of the accelerating ramp time parameter 2202 ACCELERATION RAMP TIME. The display shows H60.0 at max speed.</td></tr>
<tr><td>Step 9</td><td colspan="3">The drive can display Amps, Hertz and Power (HP) in its default configuration. To change the real time operating display, briefly press the (Navigate) key. Motor current A 0.0. (A) will be displayed. Briefly press the

(Navigate) key a second time to cycle through available displays.</td></tr>
<tr><td colspan="4">
</td></tr>
<tr><td></td><td colspan="3">To change the display from Motor Hertz to display estimated motor speed (RPM), motor nameplate speed (RPM) must be entered in 9908 Motor Rated Speed. When 9908 = 0 the display will show (HZ).</td></tr>
<tr><td>Step 10</td><td colspan="3">STOP the motor, disable the drive by opening the control switch (terminals 1-2).</td></tr>
<tr><td>CAUTION:</td><td colspan="3">If the potentiometer is turned to zero with the enable closed, the display will show H 0.0.. The drive is still active waiting for a speed reference to re-accelerate. If left at zero reference for >= 20 seconds the drive will go into standby mode, display shows StAndbY, waiting for a speed reference signal.</td></tr>
</table>

7.2 Quick Start Motor Parameter Data

If a factory reset has been performed, the motor data will need to be re-entered into the appropriate parameters. Motor Data is available on the Motor Nameplate, see Figure 2.2 for detailed information. For detailed information on parameter navigation see Chapter 8 Parameter Navigation.

Press and hold the navigate key for >1 second to enter parameter view mode and enter motor data from the motor nameplate into the parameters in Table 7-1. Enter the rated RPM (nameplate) of the motor in 9908 MOTOR RATED SPEED to allow the display of the estimated motor speed.

Table 7-1 Factory Motor Setup Parameters

Description	Parameter Number	Factory Settings
BEMF (Back EMF) Voltage	9905	Set to Motor Nameplate Values (see section 2.2)
Motor Rated Amps	9906	
Motor Rated Frequency	9907	
Motor Stator Resistance (Rs)	11201	
Ld (mH) Motor Inductance (Lsd)	11203	
Lq (mH) Motor q-axis Inductance (Lsq)	11206	
Minimum Speed	2007	15 HZ
Maximum Speed	2008	Motor Max Speed
Stop Mode	2102	1 = Coast to Rest
Control Mode	9903	2 = PM Control

7.3 Customizing Your Application

Factory settings may give satisfactory performance; however certain adjustments may be beneficial.

Parameter Name	Parameter	Adjustment
Minimum Frequency Limit	2007	Minimum output frequency
Maximum Frequency Limit	2008	Maximum output frequency
Primary Command Source	1103	Selects the reference input for the drive.
Digital Input Function Select	9902	Defines the function of the digital inputs
Stop Mode	2102	Select method of stopping required when drive is disabled.
Acceleration Ramp	2202	Adjust as need for your application. Short Acceleration or Deceleration times may cause excess motor current and may result in it tripping or the motor stalling.
Deceleration Ramp	2203	
Analog Input Format	1300	Set as required by the application (0-10V, 10-0V, 4-20mA)
Voltage Boost	2603	Any hard to start load will benefit from voltage boost. Permits a boost of up to 25% of full motor voltage to be applied.

NOTE: The Analog Input Value scales with the maximum output frequency setting in 2008.
Example: 0-10V Input motor will run 1800 RPM at a 10VDC reference when 2008 = 60 HZ.

7.4 Quick Start Keypad Control

When delivered, the EC Titanium software parameters are in the factory default state, except for the motor data which was pre-loaded at the factory with parameters that are optimum for the performance of the Motor. A full list of parameters & default values can be found in Chapter 10.

Step 1 Perform Mechanical and Electrical installation as per Chapters 3 and 4.

Step 2 Connect the Remote Keypad as per Chapter 5.

Step 3 Set 1103 Primary Command Source = 1 to allow the EC Titanium to be controlled from the keypad in a forward direction only, or = 2 to allow forward and reverse operation.

Step 4 Reference Chapter 6 on details on how to navigate the keypad.

Step 5 Connect a control switch between the control terminals 1 and 2 ensuring that the contact is open (drive disabled).

Step 6 Switch on the supply to the EC Titanium, Press and hold the navigate key for > 1 second to enter parameter view mode and set Parameter 1103 Primary Command Source Mode = 1 or 2.

Step 7 Enable the drive by closing the switch between control terminals 1 & 2.
The keypad display will show StoP.

Step 8 Press the (Stop) key, the display shows H 0.0.. and the last digit should be flashing.

The value of the digital potentiometer will be displayed, indicating the target speed.
Use the (Up) and (Down) keys to select the required target speed.

Press the STOP key to return to the real time display showing "StoP".

Step 9 Press the (Start) key to start the drive ramping up to the target speed. The drive will run forward,

increasing speed until the target speed is reached. During operation the speed of the drive can be changed in real time by simply using the (Up) and (Down)arrows.

Step 10 STOP the motor, PRESS the (Stop) Key and disable the drive by opening the control switch (terminals 1-2).

CAUTION: If the potentiometer is turned to zero with the enable closed, the display will show H 0.0.. The drive is still active waiting for a speed reference to re-accelerate. If left at zero reference for >= 20 seconds the drive will go into standby mode, display shows StAndbY, waiting for a speed reference signal.

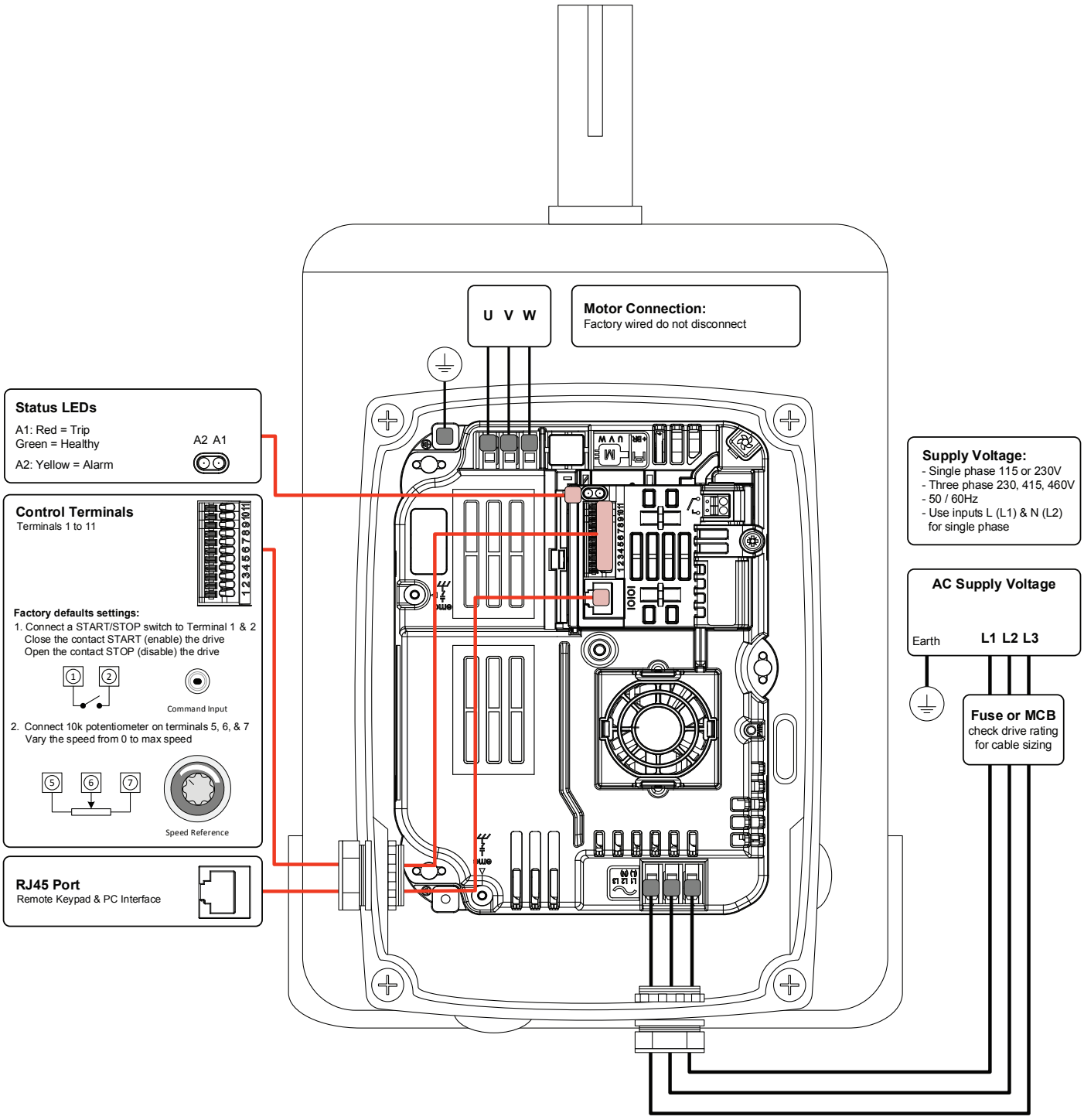
Reverse Direction of Rotation (Parameter 1103 = 2)

While in operation press the (Start) key. The motor will reverse its direction of rotation. Target speed will be the same

as set in the forward direction unless the Up or Down arrows change the set speed value.

CAUTION: Whenever the drive is started, it will start with a positive speed unless the direction is negated by the digital inputs on the user terminals. See Chapter 9 Control Modes for setup instructions.

Figure 7-1 Quick Startup Wiring Guide



Chapter 8

Parameter Navigation and Groups

This section provides an overview of how to access and change drive parameters. To monitor or change a parameter value in the EC Titanium requires either the Remote Keypad described in Chapter 6 or the PC Software Tools detailed in this section.

8.1 Parameter Structure

The parameters are arranged in Groups according the to the following structure.

	Short Parameter Group	Basic Setup Parameters
	Long Parameter Group	Sequential List all Parameters Access to Display Group
	Advanced Group	Advanced Motor Control
	Read Only Display Group	Parameter 0000 Par L Group

8.2 Parameter Navigation

- Press and hold the NAVIGATE key for more than 1 second when the drive is displaying StoP. The display changes to PAr S, indicating the short (S) parameter group.
- Use the ▲ (Up) and ▼ (Down) keys to select between the S, L or A parameter groups.
- To enter a parameter group, press and release the ⌐ (Navigate) key while the group letter is flashing.
- Use the ▲ (Up) and ▼ (Down) keys to change to the desired parameter number.
- To change parameter values, press and hold the ⌐ (Navigate) key then use the Up and Down Keys to change to the required value.
- Press and release the ⌐ (Navigate) key once more to store the change.
- Press and hold the ⌐ (Navigate) key for more than 1s to return to real-time mode. The display shows StoP if the drive is stopped or the real-time information (e.g. speed, current or power) if the drive is running.
- To access Read Only Parameters, navigate to Par L Group and scroll to parameter 0000, then press and release the navigate key.

Figure 8-1 Programming Navigation Remote Keypad

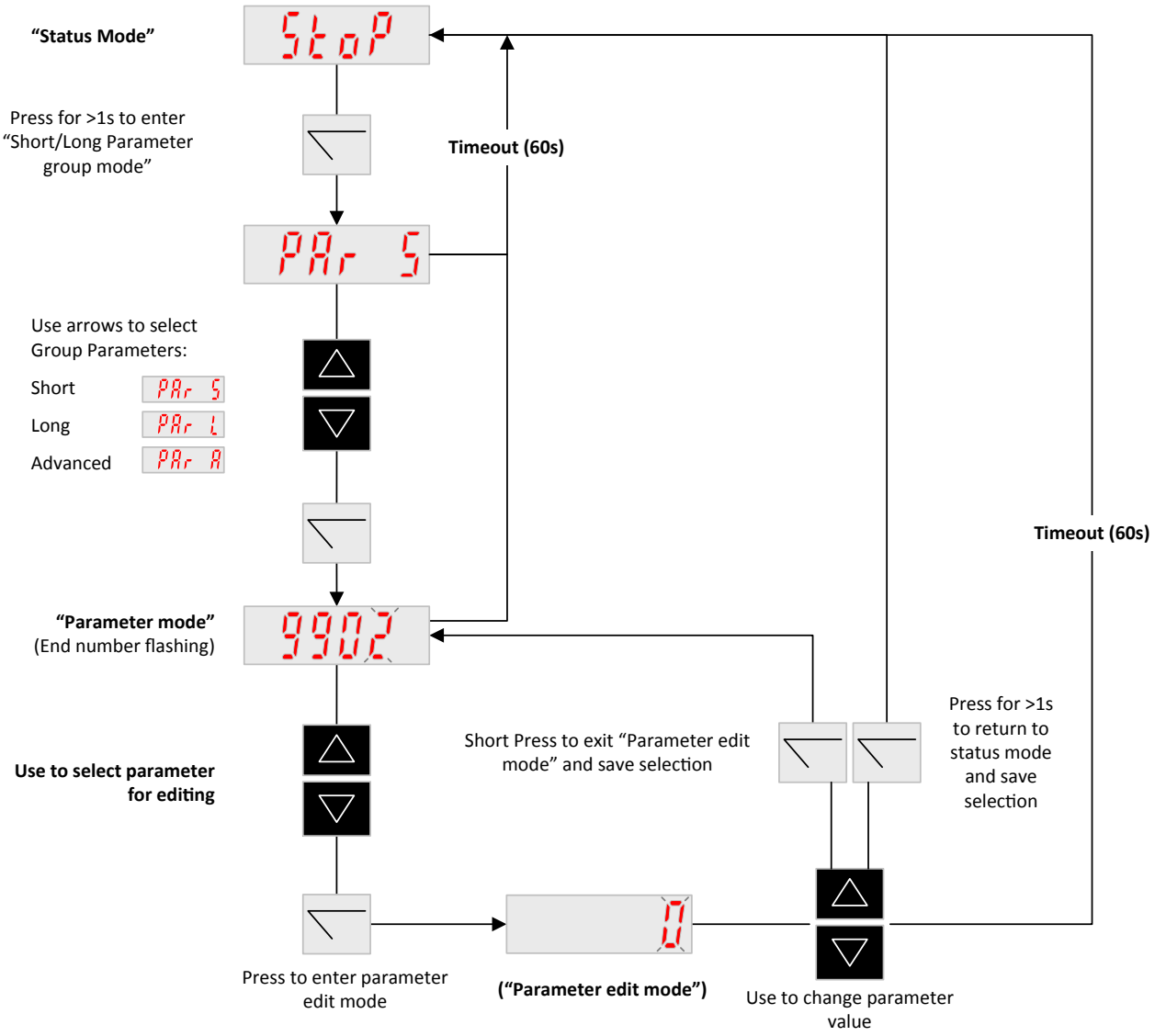
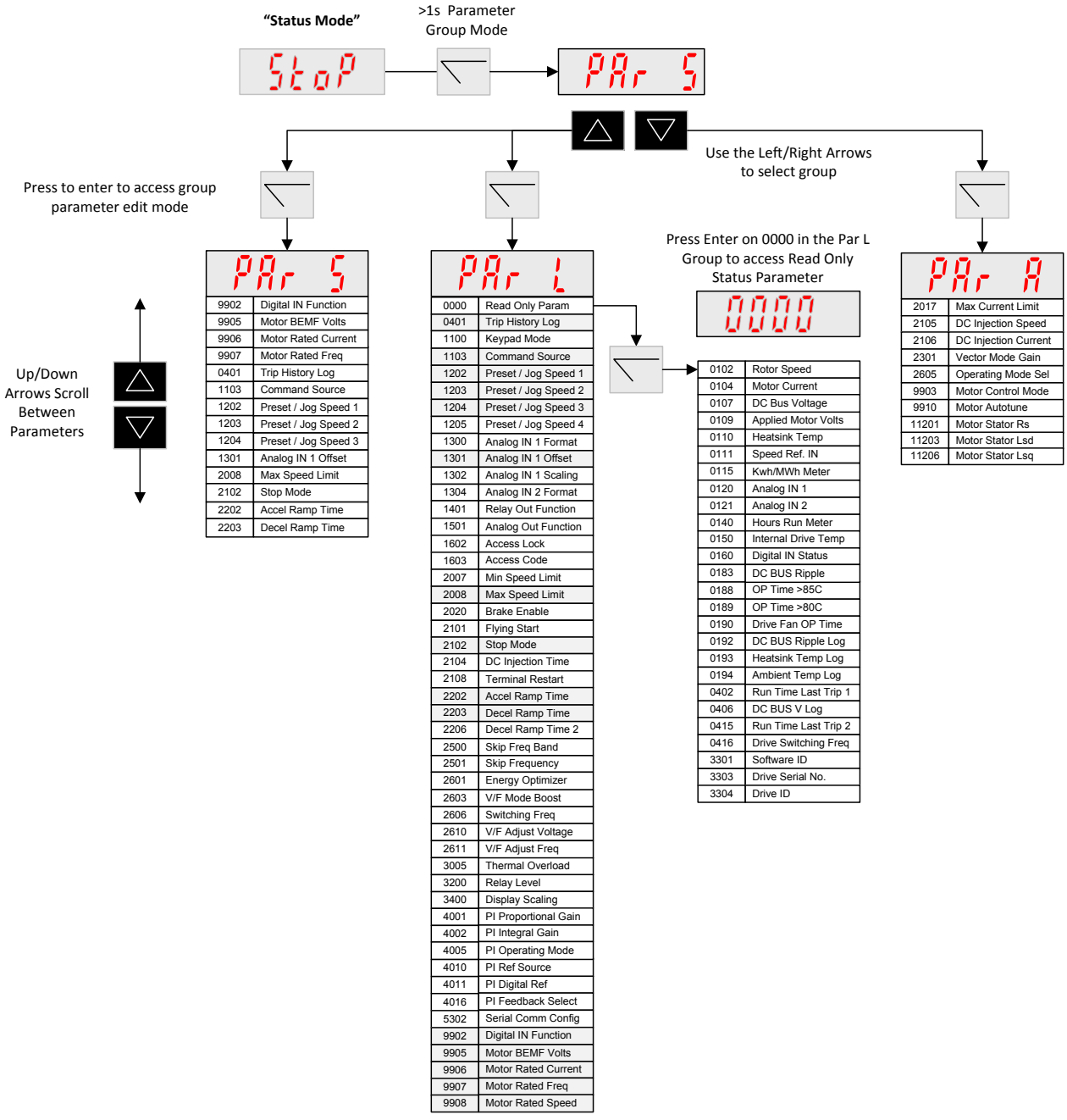


Figure 8-2 Parameter Group Structure and Description



Chapter 9
Control Modes

The mode of operation can be easily selected by changing a couple of parameters. While starting up the drive, the user selects the operating mode best suited for their purpose with parameters 9902 DIGITAL INPUTS FUNCTION SELECT and 1103 PRIMARY COMMAND SOURCE MODE.

9.1 Configuration Options

Common operating modes for Terminal Mode 1103 = 0 and Keypad Mode 1103 = 1 or 2 are in this section.

1103	Control Mode	Selected Speed Reference
0	Terminal Mode	Analog input 1
1	Keypad Mode (Unipolar)	Digital Potentiometer
2	Keypad Mode (Bipolar)	Digital Potentiometer
3	Modbus Network Control with Internal Accel/Decel Ramps	Speed reference via Fieldbus
4	Modbus Network Control with Internal Accel/Decel Ramps	Speed reference via Fieldbus
5	User PI mode	PI controller output
6	User PI Mode with Analog Input 1 Summation	PI controller output

9.2 Terminal Mode (*1103 = 0*), Parameter 9902 Settings

9902	Digital input 1	Digital Input 2	Digital Input 3 (An in 2)	Digital input 4 (An in 1)	Comments
0	Open: Stop (disable) Closed: Run (enable)	Open: Forward run Closed: Reverse run	Open: Analog input 1 Closed: Preset speed 1	Analog input 1	Factory Default 9902 = 0
1	Open: Stop (disable) Closed: Run (enable)	Open: Analog input 1 Closed: Preset speed 1 / 2	Open: Preset speed 1 Closed: Preset speed 2	Analog input 1	
2	Open: Stop (disable) Closed: Run (enable)	Preset speed select 0	Preset speed select 1	Open: Preset speed 1...4 Closed: Max Speed (***2008***)	
3 [1]	Open: Stop (disable) Closed: Run (enable)	Open: Analog input 1 Closed: Preset speed 1	External trip/thermistor input: Open: Trip, Closed: Run	Analog input 1	Connect external thermistor type PT100 or similar to digital input 3
4	Open: Stop (disable) Closed: Run (enable)	Open: Analog input 1 Closed: Analog input 2	Analog input 2	Analog input 1	Switches between selected speed ref and Analog input 2
5	Open: Fwd. Stop Closed: Fwd. Run	Open: Reverse stop Closed: Reverse run	Open: Analog input 1 Closed: Preset speed 1	Analog input 1	Closing digital inputs 1 and 2 together carries out a fast stop
6 [1]	Open: Stop (disable) Closed: Run (enable)	Open: Forward run Closed: reverse run	External trip/thermistor input: Open: Trip, Closed: Run	Analog input 1	Connect ext. thermistor type PT100 or similar to Digi input 3
7 [1]	Open: Fwd. Stop Closed: Fwd. Run	Open: reverse stop Closed: reverse run	External trip/thermistor input: Open: Trip, Closed: Run	Analog input 1	Closing digital inputs 1 and 2 together carries out a fast stop
8	Open: Stop (disable) Closed: Run (enable)	Open: Forward run Closed: Reverse run	Preset speed select 0	Preset speed select 1	
9	Open: Fwd. Stop Closed: Fwd. Run	Open: Reverse stop Closed: Reverse run	Preset speed select 0	Preset speed select 1	Closing digital inputs 1 and 2 together carries out a fast stop

9902	Digital input 1	Digital Input 2	Digital Input 3 (An in 2)	Digital input 4 (An in 1)	Comments
10	Normally Open (NO) Momentary close to run	Normally Closed (NC) Momentary open to stop	Open: Analog input 1 Closed: Preset speed 1	Analog input 1	
11	Normally Open (NO) Momentary close to Fwd	Normally Closed (NC) Momentary open to stop	Normally Open (NO) Momentary close to Rev	Analog input 1	Closing digital inputs 1 and 3 together carries out a fast stop
12	Open: Stop (disable) Closed: Run (enable)	Close to Run Open activates fast stop	Open: Analog input 1 Closed: Preset speed 1	Analog input 1	
13	Normally Open (NO) Momentary close to Fwd	Normally Closed (NC) Momentary open to stop	Normally Open (NO) Momentary close to Rev	Open: Keypad Speed Ref Closed: Preset speed 1	Closing digital inputs 1 and 3 together carries out a fast stop
14 [1]	Open: Stop (disable) Closed: Run (enable)	Preset speed select 0	External trip/thermistor input: Open: Trip, Closed: Run	Preset speed select 1	Preset speed 1 .. 4 selected as defined in this table
15	Open: Stop (disable) Closed: Run (enable)	Open: Preset speed 4 Closed: Analog input 1	Open: Fire Mode	Analog input 1	See section 9.6 Fire Mode
16	Open: Stop (disable) Closed: Run (enable)	Open: Preset speed 4 Closed: Preset speed 2	Open: Fire Mode	Open: Forward Closed: reverse	
17	Open: Stop (disable) Closed: Run (enable)	Open: Preset speed 1 Closed: Preset speed 2	Open: Fire Mode	Preset speed select 3 Close: IN2 & IN4 = Preset Speed 4	
18	Open: Stop (disable) Closed: Run (enable)	Open: Forward run Closed: reverse run	Open: Fire Mode	Analog input 1	

Note:

1. 1. When PTC motor thermistor is used, ***1304*** must set to "PTC-th" mode. Otherwise digital input 3 will be used as external trip input (digital level sensitive). When ***1304*** is set to "PTC-th", drive will display code "F-Ptc" if thermistor value is larger than 2.5kohm. The trip can only be reset if the thermistor value drops below 1.9kohm. Thermistor must be connected between terminal 1 (24V DC) and terminal 4 (2nd analog input). If ***1304*** is set t other value, the input will be used as external trip trigger input and drive will display code "E-trp" instead if the input is open.
   "E-trp" only happens when drive is enabled (running), however thermistor trip can happen at any time.

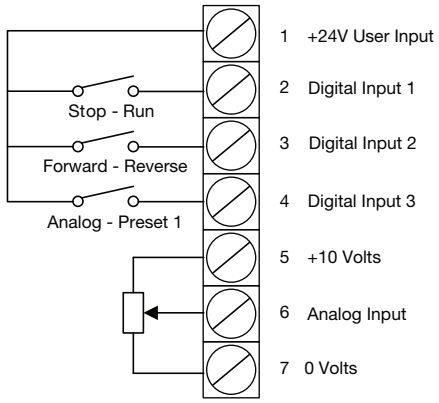
Preset Speed selection table for ***9902*** = 2, 8, 9 or 14:

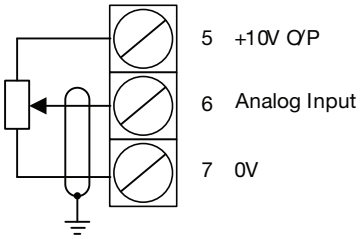
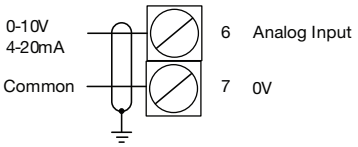
Preset Speed Select 0	Preset Speed Select 1	Preset Speed
Open	Open	Preset Speed 1
Closed	Open	Preset Speed 2
Open	Closed	Preset Speed 3
Closed	Closed	Preset Speed 4

9.2.1 Terminal Control Mode 2-Wire Control Start / Stop Control with Forward / Reverse

Default Configuration Terminal Control Mode (1103 = 0), Digital Input Function Select (9902 = 0)

This is the default digital input configuration. It provides a general purpose I/O setup with a hard wired start / stop enable, forward / reverse input and a selection between an analog speed reference or preset speed input.

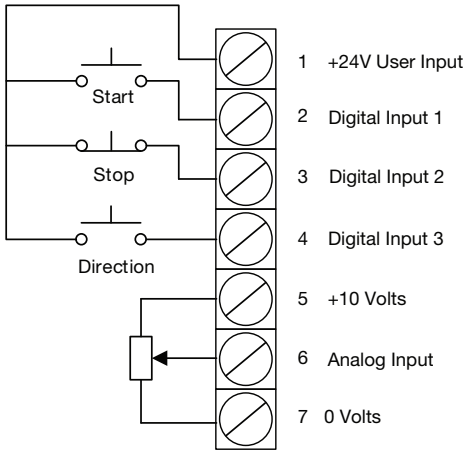
9902 = 0	2-Wire Forward Reverse
Active input across terminal 1 & 2 will cause the drive to run. When terminal 3 is open the drive will operate in the forward direction. Closing input 3 reverses the commanded direction. Closing terminal 4 will force operation at preset speed 1 (parameter 1202) or function as a jog command.	

Speed Reference Input	Connection Example
<u>Potentiometer</u> 1-10K Ohm Potentiometer Recommended (2 Watt Min.)	
Analog Input 1300 (Analog Input Format) used to select Voltage or Current Source. Voltage 0-10 or 10-0 Vdc Current 0-20, 4-20 or 20-4 mA	

9.2.2 Terminal Control Mode 3-Wire Control Start / Stop with Forward / Reverse

Terminal Control Mode (1103 = 0), Digital Input Function Select (9902 = 11)

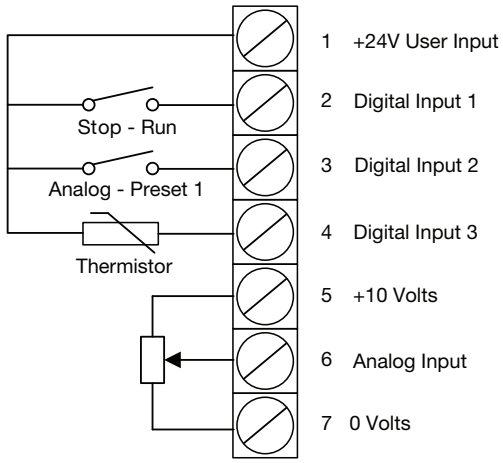
This is the digital input configuration when the drive is controlled using momentary push-buttons. It provides a general purpose I/O setup with a momentary input for start, forward / reverse, stop interlock and an analog speed reference.

9902 = 11	3-Wire Forward Reverse
A momentary input on terminal 2 will start the drive in the forward direction with a closed input on terminal 3. A momentary open input to I/O terminal 3 will stop the drive as specified in 2101 (Stop Mode). A momentary input on terminal 4 will reverse the drive direction.	

9.2.3 Terminal Control Mode Motor Thermistor Trip

Terminal Control Mode (1103 = 0), Digital Input Function Select (9902 = 3)

This is the digital input configuration when an externally motor thermistor is to be used as an overload trip input to the drive, connect as follows. It provides a general purpose I/O setup with a hard wired start / stop enable, thermistor input and a selection between an analog speed reference or preset speed input.

9902 = 11	3-Wire Forward Reverse
Active input across terminal 1 & 2 will cause the drive to run. Closing terminal 3 will force operation at preset speed 1 (parameter 1202) or function as a jog command. Terminal 4 will function as a motor thermistor trip input as defined below.	
Note: When PTC motor thermistor is used, **1304** must set to PtC-th mode. Otherwise digital input 3 will be used as external trip input (digital level sensitive). When **1304** is set to PtC-th, drive will display code F-PtC if thermistor value is larger than 2.5k ohm. The trip can only be reset if the thermistor value drops below 1.9k ohm. Thermistor must be connected between terminal 1 (24V DC) and terminal 4 (2nd analog input). If **1304** is set to other value, the input will be used as external trip trigger input and drive will display code E-trP instead if the input is open. E-trP only happens when drive is enabled (running), however thermistor trip can happen at any time.	

9.3 Keypad Mode: (1103 = 1 or 2) Parameter 9902 Settings

9902	Digital input 1	Digital Input 2	Digital Input 3 (An in 2)	Digital input 4 (An in 1)	Comments
0, 8...13	**Open: Disable Closed: Enable**	**Closed: remote UP push-button**	**Closed: remote DOWN push-button**	**Open: Forward Closed: Reverse**	**Factory Default 9902 = 0**
1	Open: Stop (disable) Closed: Run (enable)	No effect	No effect	No effect	Default speed reference is PI controller speed reference
2	Open: Disable Closed: Enable	Closed: remote UP push-button	Closed: remote DOWN push-button	Open: Keypad speed ref Closed: Preset speed 1	
3	Open: Stop (disable) Closed: Run (enable)	Closed: remote UP push-button	External trip/thermistor input: Open: Trip, Closed: Run	Closed: remote DOWN push-button	Connect external thermistor type PT100 or similar to digital input 3
4	Open: Stop (disable) Closed: Run (enable)	Closed: remote UP push-button	Open: Keypad speed ref Closed: Analog input 1	Analog input 1	
5	Open: Stop (disable) Closed: Run (enable)	Open: Forward run Closed: Reverse run	Open: Keypad speed ref Closed: Analog input 1	Analog input 1	
6	Open: Stop (disable) Closed: Run (enable)	Open: Forward run Closed: Reverse run	External trip/thermistor input: Open: Trip, Closed: Run	Open: Keypad speed ref Closed: Preset speed 1	Connect Ext thermistor type PT100 or similar to Digi input 3
7	Open: Fwd Stop Closed: Fwd Run	Open: Reverse stop Closed: Reverse run	External trip/thermistor input: Open: Trip, Closed: Run	Open: Keypad speed ref Closed: Preset speed 1	Closing digital inputs 1 and 2 together carries out a fast stop
14	Open: Stop (disable) Closed: Run (enable)	No effect	External trip/thermistor input: Open: Trip, Closed: Run	No effect	Connect external thermistor type PT100 or similar to digital input 3
15	Open: Stop (disable) Closed: Run (enable)	Open: Preset speed 4 Closed: Keypad speed ref	Open: Fire Mode	Open: Preset speed 4 Closed: Preset speed 2	See section 9.6 Fire Mode
16	Open: Stop (disable) Closed: Run (enable)	Open: Preset speed 4 Closed: Keypad speed ref	Open: Fire Mode	Open: Forward Closed: reverse	
17	Open: Stop (disable) Closed: Run (enable)	Open: Keypad speed ref Closed: Preset speed	Open: Fire Mode	Open: Forward Closed: reverse	
18	Open: Stop (disable) Closed: Run (enable)	Open: Analog input 1 Closed: Keypad speed ref	Open: Fire Mode	Analog input 1	

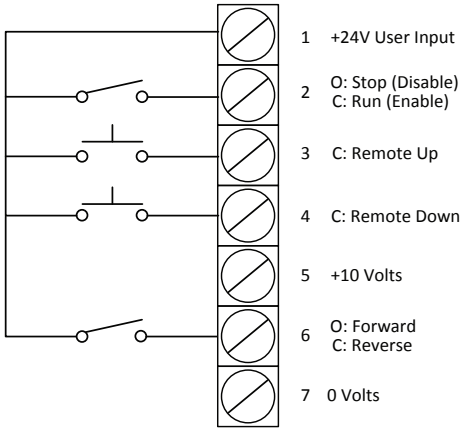
NOTES (keypad mode):

1. When changing from other speed reference (e.g. preset speed or analog speed) back to keypad speed reference (digital pot value) while drive is running, the following behaviour will be expected:
   If 1100 = 0 or 2, digital pot speed value will be set to minimum speed 2007 to start with.
   If 1100 = 1 or 3, digital pot will keep unchanged from last time adjustment.
   If 1100 = 4 or 6, digital pot value will be updated to be the same as current motor running speed.
   If 1100 = 5 or 7, digital pot value will be set to the same value as preset speed 4 to start with.
2. When drive is not running:
   If 1100 = 0, 2, 4 or 6, digital pot speed value will be set to minimum speed 2007.
   If 1100 = 1 or 3, digital pot will keep unchanged.
   If 1100 = 5 or 7, digital pot value will be set to the same value as preset speed 4.
3. If 1100 = 2, 3, 6 or7, closing digital input 1 (or digital input 2 if 9902 = 7) will start the drive (Auto-run). The keypad START and STOP button will not function in this case. The keypad speed can still be adjusted using the UP and DOWN buttons.
4. If 1103 = 1, reverse speed can only be achieved by using preset speed or analog input speed. Reverse speed can also be achieved when using reverse run terminal input. Reverse speed cannot be selected via the local or remote keypad.
5. Where both Remote Up and Remote Down push button inputs are available, closing both inputs will start the drive
6. There is no single-step delay when using the remote push-buttons to change the speed. This delay is only implemented when using the drive keypad directly.

9.3.1 Keypad Control Mode MOP (E-Pot Controls)

Keypad Control Mode (1103 = 1 or 2), Digital Input Function Select (9902 = 2)

This is the digital input configuration when the drive is controlled using the keypad and a MOP input is required. It provides a remote up and remote down MOP control for speed increase and decrease with a run disable and forward reverse input. Keypad controls remain active.

9902 = 2	MOP Control
Keypad controls remain active Closed input 2 enables the drive. A momentary closed input 3 will increase speed and a momentary closed input 4 will decrease speed. Terminal 6 input is used to reverse the drive direction.	

9.4 Modbus / BACNet Control Mode (1103 = 3,4,7,8 or 9*), Parameter 9902 Settings

9902	Digital input 1	Digital Input 2	Digital Input 3 (An in 2)	Digital input 4 (An in 1)	Comments
0, 2, 4, 8...13	Open: Stop (disable) Closed: Run (enable)	No effect	No effect	No effect	Digital input 1 must be closed for the drive to run. Start and stop commands given via the RS485 link
1	Open: Stop (disable) Closed: Run (enable)	No effect	No effect	No effect	Default speed reference is PI controller speed reference
3	Open: Stop (disable) Closed: Run (enable)	Open: Master speed ref Closed: Preset speed 1	External trip/thermistor input: Open: Trip, Closed: Run	No effect	Connect external thermistor type PT100 or similar to digital input 3
5	Open: Stop (disable) Closed: Run (enable)	Open: Master speed ref Closed: Preset speed 1/2	Open: Preset speed 1 Closed: Preset speed 2	No effect	When digital input 2 open, start & stop controlled via Modbus. When digi in 2 closed, drive auto runs if digi in 1 closed, and comms loss control will be disabled.
6	Open: Stop (disable) Closed: Run (enable)	Open: Master speed ref Closed: Analog input	External trip/thermistor input: Open: Trip, Closed: Run	Analog input reference	
7	Open: Stop (disable) Closed: Run (enable)	Open: Master speed ref Closed: keypad speed ref	External trip/thermistor input: Open: Trip, Closed: Run	No effect	
14	Open: Stop (disable) Closed: Run (enable)	No effect	External trip/thermistor input: Open: Trip, Closed: Run	No effect	
15	Open: Stop (disable) Closed: Run (enable)	Open: Preset ref Closed: Master speed ref	Open: Fire Mode	Open: Preset speed 4 Closed: Preset speed 2	See section 9.6 Fire Mode
16	Open: Stop (disable) Closed: Run (enable)	Open: Preset speed 4 Closed: Master speed ref	Open: Fire Mode	Analog input 1	
17	Open: Stop (disable) Closed: Run (enable)	Open: Master speed ref Closed: Preset speed 4	Open: Fire Mode	Analog input 1	
18	Open: Stop (disable) Closed: Run (enable)	Open: Analog input 1 Closed: Master speed ref	Open: Fire Mode	Analog input 1	

Note: If 1100= 2, 3, 6 or 7, start/stop will be controlled by digital input 1 and communication trip will be disabled. (Exception if 9902 = 5, 6 and 7, see comments). For further information on the MODBUS RTU Register Map information and communication setup please refer to Appendix E.

Note: BACnet is activated by selecting 1103 PRIMARY COMMAND SOURCE MODE = 9

Selection of control source can be selected in 9902 to determine if control reference and start/stop control is over the network or the terminal strip of the drive

9.5 User PI control mode: (1103 = 5 or 6), Parameter 9902 Settings

9902	Digital input 1	Digital Input 2	Digital Input 3 (An in 2)	Digital input 4 (An in 1)	Comments
0, 2, 9...13	Open: Stop (disable) Closed: Run (enable)	Open: PI control Closed: Preset speed 1	No effect	No effect	Digital input 1 must be closed for the drive to run.
1	Open: Stop (disable) Closed: Run (enable)	Open: PI control Closed: Analog input 1	No effect	Analog input 1	
3, 7	Open: Stop (disable) Closed: Run (enable)	Open: PI control Closed: Preset speed 1	External trip/thermistor input: Open: Trip, Closed: Run	No effect	Connect external thermistor type PT100 or similar to digital input 3
4	Normally Open (NO) Momentary close to run	Normally Closed (NC) Momentary open to stop	No effect	No effect	
5	Normally Open (NO) Momentary close to run	Normally Closed (NC) Momentary open to stop	Open: PI control Closed: Preset Speed 1	No effect	
6	Normally Open (NO) Momentary close to run	Normally Closed (NC) Momentary open to stop	External trip/thermistor input: Open: Trip, Closed: Run	No effect	
8	Open: Stop (disable) Closed: Run (enable)	Open: Forward Closed: Reverse	PI feedback analog input	No effect	Digital input 1 must be closed for the drive to run.
14	Open: Stop (disable) Closed: Run (enable)	No effect	External trip/thermistor input: Open: Trip, Closed: Run	No effect	
15	Open: Stop (disable) Closed: Run (enable)	Open: Preset speed 4 Closed: PI ref	Open: Fire Mode	Analog input 1 (PI FB)	See section 9.6 Fire Mode
16	Open: Stop (disable) Closed: Run (enable)	Open: Preset speed 4 Closed: Preset speed 2	Open: Fire Mode	Analog input 1 (PI FB)	
17	Open: Stop (disable) Closed: Run (enable)	Fire Mode: Open: Preset speed 4 Closed: Preset speed 2 Normal Operation: PI Ref	Open: Fire Mode Closed: Normal Operation	Analog input 1	
18	Open: Stop (disable) Closed: Run (enable)	Open: Analog input 1 Closed: PI ref	Open: Fire Mode	Analog input 1 (PI FB)	

9.6 Fire Mode

The Fire Mode function is designed to ensure continuous operation of the drive in emergency conditions until the drive is no longer capable of sustaining operation, for example the fire mode input may be linked to a fire control system to allow maintained operation in emergency conditions, e.g. to clear smoke or maintain air quality within that building.

The Fire Mode input is normally closed (open to Activate Fire Mode).

The fire mode function is enabled when 9902 = 15, 16, 17 or 18, with Digital Input 3 assigned to activate fire mode.

When the fire mode input is open, the drive will run regardless of whether there is a trip detected by the drive. Speed reference in Fire Mode is based on the I/O configuration. For example, with 9902 = 15, Digital Input 2 selects between Preset Speed 4 (open) or Analog Input 1 (closed).

Digital Input 1 run must be enabled (closed) for the drive to operate.

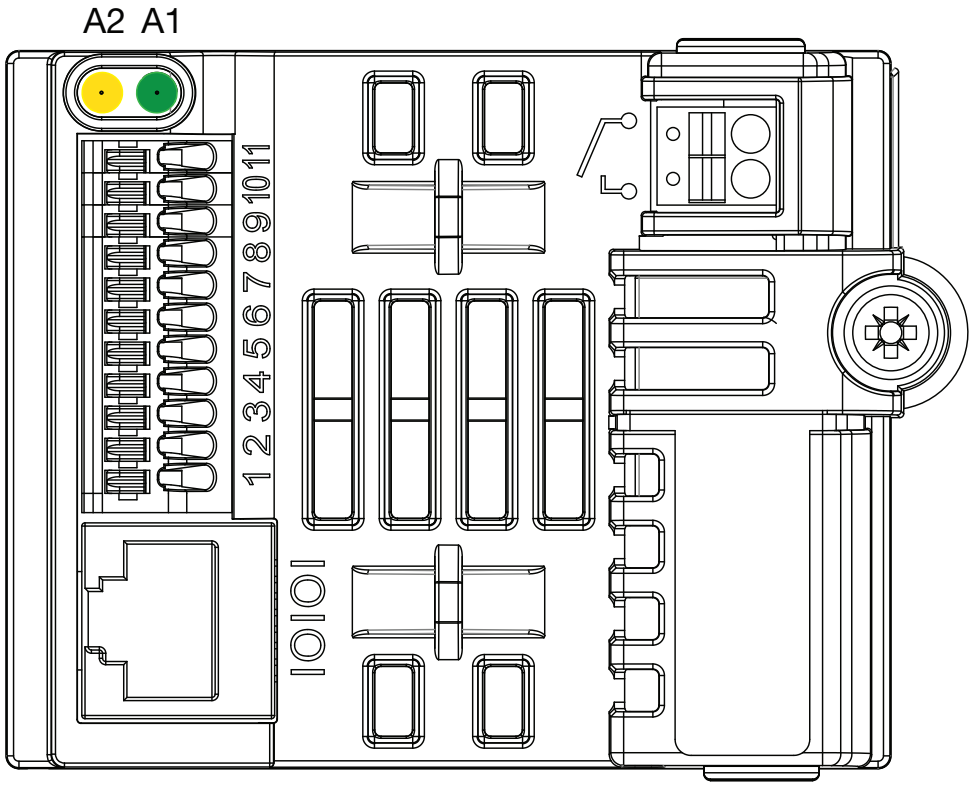
Fire Mode disables the following protection features in the drive: F0003 (Heat-sink Over-Temperature), U-t (Drive Under Temperature), F0018 (Faulty Thermistor on Heat-sink), F0014 (External Trip), F0007(4-20mA fault), F0022 (Input Phase Loss Trip), F0010 (Communications Loss Trip), F0009 (Accumulated overload Trip). The following faults will result in a drive trip, auto reset and restart: F0002 (Over Voltage on DC Bus), F0006 (Under Voltage on DC Bus), F0004 (Fast Over-Current Trip), F0001 (Instantaneous over current on drive output), Out-F (Drive output fault, Output stage trip)

The reference and enable input are active, allowing configurability of the Fireman Speed and signal interlock.

In Fireman Mode, the Yellow A2 LED on the control board will illuminate and the faults listed above are ignored.

LED A1 (Green, Red and Yellow) Drive Status

LED A2 Drive Condition, Fireman Mode Status (Solid Yellow = Active)



Chapter 10
Parameter Definitions

The chapter describes the actual signals and parameters and it also contains a listing of the default parameter values. For a guide on selecting parameter groups see Chapter 8 Parameter Group Navigation. All parameters are presented in detail and sequential order in the Long Parameter Group. Parameters are displayed by number, description, default value and range.

No.	Name/Value	Description	Default
Parameter Number	Parameter Name	General description of parameter's function	Default value
	Input Range	Description of value ranges or reference to other parameters	

10.1 Short Parameter Group

The following tables describes the parameters that are visible in the PAr-S mode (Short Parameters) and contains a basic list of settings for general startup of the drive.

Parameters in the Short parameter mode			
No.	Name/Value	Description	Default
99 Start-Up Data		**Digital Input Configuration and Motor Data Parameter**	
9902	DIGITAL INPUTS FUNCTION SELECT	Defines the function of the digital inputs depending on the value in this parameter and also on the control mode setting in Parameter 1103 Primary Command Source Mode.	0
	Range 0 to 14	See Chapter 9 Control Modes for 9902 parameter selection details	
9905	MOTOR (BEMF) VOLTAGE	This parameter should be set to the rated (nameplate) BEMF voltage of the motor. See Chapter 2 for information on locating motor nameplate data.	Motor Rating Dependent
	110V/230V rated drives 0…250V 400V rated drives 0…500V	Voltage **Note:** The stress on the motor insulation is always dependent on the drive supply voltage. This also applies to the case where the motor voltage rating is lower than the rating of the drive and the supply of the drive.	
9906	MOTOR RATED CURRENT	This parameter should be set to the rated (nameplate) frequency of the motor. See Chapter 2 for information on locating motor nameplate data.	Motor Rating Dependent
	0.25*drive rated output current… 1.0*drive rated output current	Current	
9907	MOTOR RATED FREQUENCY	This parameter should be set to the rated (nameplate) frequency of the motor. See Chapter 2 for information on locating motor nameplate data.	60Hz
	25…500Hz	Frequency	
04 FAULT HISTORY		Fault history (read only)	
0401	TRIP HISTORY LOG	When a fault is detected, it is stored in the fault history. Parameters 0401 Trip History Log can be used to display the last four fault codes for the drive. Press Enter on the Remote Keypad to display the most recent fault. Use the Up Down arrows to scroll through faults, the most recent fault is displayed first. Parameters 0402…0417 show drive operation data at the time of the latest fault and run time since last trip. See Chapter 13 Troubleshooting for a complete list of fault codes and corrective actions.	

Parameters in the Short parameter mode			
No.	Name/Value	Description	Default
11 REFERENCE SELECT		Selects the reference input source for the drive	
1103	PRIMARY COMMAND SOURCE MODE	See Chapter 9 Control Modes for 1103 parameter selection details	0
	0: TERMINAL CONTROL.	The drive responds directly to signals applied to the control terminals.	
	1: UNI-DIRECTIONAL KEYPAD CONTROL	The drive can be controlled in the forward direction only using an external or remote Keypad	
	2: BI-DIRECTIONAL KEYPAD CONTROL.	The drive can be controlled in the forward and reverse directions using an external or remote Keypad. Pressing the keypad START button toggles between forward and reverse.	
	3: MODBUS NETWORK CONTROL.	Control via Modbus RTU (RS485) using the internal accel / decel ramps	
	4: MODBUS NETWORK CONTROL.	Control via Modbus RTU (RS485) interface with accel / decel ramps updated via Modbus	
	5: PI CONTROL	User PI control with external feedback signal	
	6: PI ANALOG SUM CONTROL.	PI control with external feedback signal and summation with analog input 1	
	7: Reserved	Reserved	
	8: Reserved	Reserved	
	9: BACNET MS/TP	Control with internal accel/decel ramps defined by 2202 (accel) and 2203 (decel)	
12 CONSTANT SPEEDS		Constant speeds. Constant speed activation overrides the external speed reference. Constant speed selections are ignored if the drive is in the local control mode. Preset Speeds / Frequencies selected by digital inputs depending on the setting of Parameter ***9902*** DIGITAL INPUTS FUNCTION SELECT. See Chapter 9 for details on configuration of the digital inputs. **Note:** **9908** = 0, the values are entered as Hz. **9908** > 0, the values are entered as RPM. Negative value reverses direction of motor rotation. Momentary input functions as a jog command.	
1202	PRESET SPEED 1 / JOG FREQUENCY	Defines constant speed 1 (that is the drive output frequency)	6.0Hz/RPM
	2007…-2008	Output Frequency	
1203	PRESET SPEED 2 / JOG FREQUENCY	Defines constant speed 2 (that is the drive output frequency)	12.0Hz/RPM
	2007…-2008	Output Frequency	
1204	PRESET SPEED 3/ / JOG FREQUENCY	Defines constant speed 3 (that is the drive output frequency)	18.0Hz/RPM
	2007…-2008	Output Frequency	

<table>
<tr><th colspan="4">Parameters in the Short parameter mode</th></tr>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Default</th></tr>
<tr><td colspan="2">13 ANALOG INPUTS</td><td>Analog input signal offset</td><td></td></tr>
<tr><td>1301</td><td>ANALOG INPUT 1 OFFSET</td><td>Sets an offset, as a percentage of the full-scale range of the input, which is applied to the analog input signal</td><td>0.0%</td></tr>
<tr><td></td><td>-500…500 %</td><td>Value in percent of the full-scale range of the input.
The OFFSET is subtracted from the ANALOG INPUT.

Example: Analog Input 0-10V 1301 Analog Offset = 20%
Analog Level 7 V
Results: Analog Input level (%) = 7/10 = 70%
Result = 70-20 (%) = 50%</td><td></td></tr>
<tr><td colspan="2">20 LIMITS</td><td>Maximum frequency</td><td></td></tr>
<tr><td>2008</td><td>MAXIMUM FREQUENCY / SPEED LIMIT</td><td>Maximum output frequency or motor speed limit – Hz or rpm.
If parameter 9908 MOTOR RATED SPEED > 0, the value entered / displayed is in RPM</td><td>60 Hz</td></tr>
<tr><td></td><td>2007…133.0 Hz</td><td>Maximum frequency</td><td></td></tr>
<tr><td colspan="2">21 STOPPING MODE / POWER LOSS RESPONSE</td><td>Stop mode of the motor</td><td></td></tr>
<tr><td>2102</td><td>STOP MODE</td><td>Selects the motor stop function
<table>
<tr><th>Setting</th><th>On Disable</th><th>On Mains loss</th></tr>
<tr><td>0</td><td>Ramp to Stop</td><td>Ride Through
(Recover energy from load to maintain operation)</td></tr>
<tr><td>1</td><td>Coast</td><td>Coast</td></tr>
<tr><td>2</td><td>Ramp to Stop</td><td>Fast Ramp to Stop</td></tr>
<tr><td>3</td><td>Ramp to Stop
with AC flux braking</td><td>Fast Ramp to Stop</td></tr>
</table>
Note: Ramp to Stop will follow 2203 DECEL RAMP TIME Fast Ramp to Stop uses 2206 2nd DECEL RAMP TIME or will coast to a stop if 2206 = 0</td><td>0</td></tr>
<tr><td colspan="2">22 ACCEL/DECEL</td><td>Acceleration and deceleration times</td><td></td></tr>
<tr><td>2202</td><td>ACCELERATION RAMP TIME</td><td>Acceleration ramp time from 0 to base speed (Parameter 9907 MOTOR RATED FREQUENCY) in seconds.</td><td>15.0 s</td></tr>
<tr><td></td><td>0.00…600.0 s</td><td>Time</td><td></td></tr>
<tr><td>2203</td><td>DECELERATION RAMP TIME</td><td>Deceleration ramp time from base speed (Parameter 9907 MOTOR RATED FREQUENCY) to standstill in seconds. When set to zero, fastest possible ramp time without trip is activated.</td><td>15.0 s</td></tr>
<tr><td></td><td>0.00…600.0 s</td><td>Time</td><td></td></tr>
</table>

10.2 Long Parameter Group

The following tables describes the parameters that are visible in the PAr-L mode (Long Group Parameters) that contain a sequential listing of all available parameters.

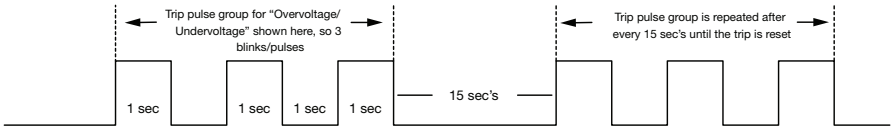
Parameters in the Long parameter mode			
No.	Name/Value	Description	Default
0000	**READ ONLY PARAMETERS**	Pressing the NAVIGATE key when the 0000 parameter is displayed will enter into the Read only status parameter list shown below. Initially 0102 is shown and using the UP and DOWN Arrows will scroll to the required Read only status parameter. Pressing NAVIGATE once more on the will then display the value of that particular Read only status parameter. For those parameters which have multiple values (e.g. software ID parameter 3301), pressing the UP and DOWN keys will display the different values within that parameter. Pressing NAVIGATE returns to the next level up. If NAVIGATE is then pressed again (without pressing UP or DOWN), the display changes to the next level up (main parameter level, i.e. Parameter "0000").	Fault history (read-only)
0102	Rotor Speed (Estimated)	In vector control mode, this parameter displays the estimated rotor speed of the motor.	
0104	Motor Current	8 most recent values prior to trip, updated every 250ms	
0107	DC BUS VOLTAGE	Displays the instantaneous DC Bus Voltage internally within the drive in V DC. (0…1000V dc)	
0109	APPLIED MOTOR VOLTAGE	Displays the instantaneous output voltage from the drive to the motor V AC. (0…600V AC)	
0110	INTERNAL HEATSINK TEMPERATURE	Temperature of heatsink in °C (-20 … 100 °C)	
0111	SPEED REFERENCE INPUT	Displayed in Hz if Parameter 9908 MOTOR RATED SPEED = 0, otherwise displayed in RPM. (-2008 … 2008)	
0115	KWh/MWh METER	Total number of KWh/MWh consumed by the drive.	
0120	ANALOG INPUT 1 APPLIED SIGNAL LEVEL	Displays the signal level applied to analog input 1 (Terminal 6) in % after scaling and offsets have been applied.	
0121	ANALOG INPUT 2 APPLIED SIGNAL LEVEL	Displays the signal level applied to analog input 2 (Terminal 4) in % after scaling and offsets have been applied.	
0126	PI CONTROLLER OUTPUT	Displays the output level of the PI controller in %.	
0140	HOURS RUN METER	Not affected by resetting factory default parameters. (0 to 99 999 hours)	
0150	INTERNAL DRIVE TEMPERATURE	Actual internal ambient temperature in °C	
0160	DIGITAL INPUT STATUS	Binary value. Displays the status of the drive inputs, starting with the left hand side digit = Digital Input 1 etc.	
0183	DC BUS VOLTAGE RIPPLE LEVEL	Displays the level of ripple present on the DC Bus Voltage in V DC. This parameter is used by the ACS255 for various internal protection and monitoring functions.	
0188	OPERATING TIME ACCUMULATED WITH HEATSINK TEMPERATURE ABOVE 85°C	Displays the amount of time in hours and minutes that the ACS255 has operated for during its lifetime with a heatsink temperature in excess of 85°C. This parameter is used by the ACS255 for various internal protection and monitoring functions. (HH:MM:SS)	
0189	OPERATING TIME ACCUMULATED WITH AMBIENT TEMPERATURE ABOVE 80°C	Displays the amount of time in hours and minutes that the DRIVE has operated for during its lifetime with an ambient temperature in excess of 80°C. This parameter is used by the DRIVE for various internal protection and monitoring functions. (HH:MM:SS)	

Parameters in the Long parameter mode			
No.	Name/Value	Description	Default
0000	**READ ONLY PARAMETERS**	Continued	Fault history (read-only)
0190	DRIVE INTERNAL COOLING FAN TOTAL OPERATING TIME	Displays the total operating time of the drive's internal cooling fans. The first value shown is the number of hours. Pressing the Up key will display the minutes and seconds. This is used for scheduled maintenance information (HH:MM:SS)	
0192	DC BUS VOLTAGE RIPPLE LOG (22ms) (V DC)	8 most recent values prior to trip, updated every 22ms.	
0193	HEATSINK TEMPERATURE LOG (30s) (°C)	8 most recent values prior to trip, updated every 30s.	
0194	AMBIENT TEMPERATURE LOG (30s) (°C)	8 most recent values prior to trip, updated every 30s.	
0402	RUN TIME SINCE LAST TRIP (1)	Run-time clock stopped by drive disable (or trip), reset on next enable only if a trip occurred. Reset also on next enable after a drive power down. (0 to 99 999 hours)	
0406	DC BUS VOLTAGE LOG	8 most recent values prior to trip, updated every 250ms. (0 … 1000V)	
0415	RUN TIME SINCE LAST TRIP (2)	Run-time clock stopped by drive disable (or trip), reset on next enable only if a trip occurred (under-volts not considered a trip) – not reset by power down / power up cycling unless a trip occurred prior to power down. (0 to 99 999 hours)	
0416	RUN TIME SINCE LAST DISABLE	Run-time clock stopped on drive disable, value reset on next enable. (0 to 99 999 hours)	
0417	DRIVE EFFECTIVE SWITCHING FREQUENCY	Actual drive effective output switching frequency. This value maybe lower than the selected frequency in parameter 2606 EFFECTIVE SWITCHING FREQUENCY if the drive is too hot. The drive will automatically reduce the switching frequency to prevent an over temperature trip and maintain operation. (4 to 32 kHz)	
3301	SOFTWARE ID, IO & MOTOR CTRL	e.g. "1.00", "47AE" Version number and checksum. "1" on LH side indicates I/O processor, "2"indicates motor control	
3303	DRIVE SERIAL NUMBER	000000 … 999999 00-000 … 99-999 Unique drive serial number e.g. 540102 / 32 / 005	
3304	DRIVE IDENTIFIER		
04	**FAULT HISTORY**	**Fault history (read-only)**	
0401	TRIP HISTORY LOG	When a fault is detected, it is stored in the fault history. Parameters 0401 Trip History Log can be used to display the last four fault codes for the drive. Press Enter on the Remote Keypad to display the most recent fault. Use the Up Down arrows to scroll through faults, the most recent fault is displayed first. Parameters 0402…0417 show drive operation data at the time of the latest fault and run time since last trip. See Chapter 13 Troubleshooting for a complete list of fault codes and corrective actions.	-

Parameters in the Long parameter mode			
No.	Name/Value	Description	Default
11	**REFERENCE SELECT**	**The drive can accept a variety of references in addition to the conventional analog input, potentiometer and keypad signals.**	
1100	KEYPAD MODE RESTART FUNCTION	This parameter is active only when operating in Keypad Control Mode (parameter 1103 PRIMARY COMMAND SOURCE MODE = 1 or 2).	3
	0: MINIMUM SPEED, KEYPAD START	Keypad Start and Stop keys are active, and control terminals 1 and 2 must be linked together. The drive will always start at the Minimum Frequency / Speed (parameter 2007)	
	1: PREVIOUS SPEED, KEYPAD START	Keypad Start and Stop keys are active, and control terminals 1 and 2 must be linked together.	
	2: MINIMUM SPEED, TERMINAL ENABLE	Allows the drive to be started from the control terminals directly, and the keypad Start and Stop keys are ignored. The drive will always start at the Minimum Frequency / Speed (parameter 2007)	
	3: PREVIOUS SPEED, TERMINAL ENABLE	Allows the drive to be started from the control terminals directly, and the keypad Start and Stop keys are ignored. The drive will always start at the last operating Frequency / Speed.	
	4: CURRENT SPEED , KEYPAD START	Keypad Start and Stop keys are active and control terminals 1 and 2 must be linked together. The drive will always start at the current Frequency / Speed.	
	5: PRESET SPEED 4 , KEYPAD START	Keypad Start and Stop keys are active and control terminals 1 and 2 must be linked together. The drive will always start at the Frequency / Speed set in Preset Speed 4 (parameter 1205).	
	6: CURRENT SPEED , TERMINAL START	Control terminals 1 and 2 must be linked together. The drive will always start at the current Frequency / Speed.	
	7: PRESET SPEED 4 , TERMINAL START	Control terminals 1 and 2 must be linked together. The drive will always start at the Frequency / Speed set in Preset Speed 4 (parameter 1205).	
1103	PRIMARY COMMAND SOURCE MODE		0
	0: TERMINAL CONTROL.	The drive responds directly to signals applied to the control terminals.	
	1: UNI-DIRECTIONAL KEYPAD CONTROL	The drive can be controlled in the forward direction only using an external or remote Keypad	
	2: BI-DIRECTIONAL KEYPAD CONTROL.	The drive can be controlled in the forward and reverse directions using an external or remote Keypad. Pressing the keypad START button toggles between forward and reverse.	
	3: MODBUS NETWORK CONTROL.	Control via Modbus RTU (RS485) using the internal accel / decel ramp	
	4: MODBUS NETWORK CONTROL.	Control via Modbus RTU (RS485) interface with accel / decel ramps updated via Modbus	
	5: PI CONTROL	User PI control with external feedback signal	
	6: PI ANALOG SUMMATION CONTROL.	PI control with external feedback signal and summation with analog input 1	
	7: Reserved	Reserved	
	8: Reserved	Reserved	
	9: BACNET MS/TP	Control with internal accel/decel ramps defined by 2202 (accel) and 2203 (decel)	

Parameters in the Long parameter mode			
No.	Name/Value	Description	Default
12	**CONSTANT SPEEDS**	Constant speeds. Constant speed activation overrides the external speed reference. Constant speed selections are ignored if the drive is in the local control mode. Preset Speeds / Frequencies selected by digital inputs depending on the setting of Parameter ***9902*** DIGITAL INPUTS FUNCTION SELECT. If Parameter ***9908*** MOTOR RATED SPEED = 0, the values are entered as Hz. If Parameter ***9908*** > 0, the values are entered as Rpm. Setting a negative value will reverse the direction of motor rotation.	
1202	PRESET / JOG FREQUENCY / SPEED 1	Defines constant speed 1 (that is the drive output frequency)	6.0 Hz/RPM
	2007…-2008	Output Frequency	
1203	PRESET / JOG FREQUENCY / SPEED 2	Defines constant speed 2 (that is the drive output frequency)	12.0 Hz/RPM
	2007…-2008	Output Frequency	
1204	PRESET / JOG FREQUENCY / SPEED 3	Defines constant speed 3 (that is the drive output frequency)	18.0 Hz/RPM
	2007…-2008	Output Frequency	
1205	PRESET / JOG FREQUENCY / SPEED 4	Defines constant speed 4 (that is the drive output frequency)	24.0 Hz/RPM
	2007…-2008	Output Frequency	
13	**ANALOG INPUTS**		
1300	ANALOG IN 1 FORMAT	Selects the type of reference source into terminal 6.	U 0- 10
	U 0- 10	0 to 10 Volt Signal (Uni-polar). The drive will remain at 0.0Hz if the analog reference after scaling and offset are applied is <0.0%.	
	b 0- 10	0 to 10 Volt Signal (Bi-polar). The drive will operate the motor in the reverse direction of rotation if the analog reference after scaling and offset are applied is <0.0%.	
	A 0-20	0 to 20mA Signal	
	t 4-20	4 to 20mA Signal, the DRIVE will trip and show the fault code F0007 if the signal level falls below 3mA	
	r 4-20	4 to 20mA Signal, the DRIVE will ramp to stop if the signal level falls below 3mA	
	t 20-4	20 to 4mA Signal, the DRIVE will trip and show the fault code F0007 if the signal level falls below 3mA	
	r 20-4	20 to 4mA Signal, the DRIVE will ramp to stop if the signal level falls below 3mA	
	U 10-0	10 to 0 Volt Signal (Uni-polar). The drive will operate at maximum frequency / speed if the analog reference after scaling and offset are applied is =<0.0%.	
1301	ANALOG IN 1 OFFSET	Sets an offset, as a percentage of the full-scale range of the input, which is applied to the analog input signal	0.0%
	-500…500 %	Value in percent of the full-scale range of the input. The OFFSET is subtracted from the ANALOG INPUT. Example: If the analog input signal format is 0-10V, offset = 20%. An analog input signal level of 7 Volts gives the following result: Analog input level (%) = 7/10 = 70% Result = 70-20 (%) = 50%	

Parameters in the Long parameter mode			
No.	Name/Value	Description	Default
1302	ANALOG IN 1 SCALING	Scales the analog input by this factor, (as a % of the full scale range of this input).	*100.0*
	0.0…2000.0 %	Example: If parameter ***1300*** ANALOG INPUT 1 FORMAT is set for 0 – 10V, and the scaling factor is set to 200.0%, a 5 Volt input will result in the drive running at maximum speed as set in parameter ***2008*** MAX SPEED LIMIT	
1304	ANALOG IN 2 FORMAT	Selects the type of reference source into terminal 4.	*U 0-10*
	U 0-10	0 to 10 Volt Signal	
	A 0-20	0 to 20mA Signal	
	t 4-20	4 to 20mA Signal, the DRIVE will trip and show the fault code *F0007* if the signal level falls below 3mA	
	r 4-20	4 to 20mA Signal, the DRIVE will ramp to stop if the signal level falls below 3mA	
	t 20-4	20 to 4mA Signal, the DRIVE will trip and show the fault code *F0007* if the signal level falls below 3mA	
	r 20-4	20 to 4mA Signal, the DRIVE will ramp to stop if the signal level falls below 3mA	
	Ptc-th	Use for motor thermistor	

Parameters in the Long parameter mode			
No.	Name/Value	Description	Default
14	**RELAY OUTPUTS**	Status information indicated through relay output and relay operating delays	
1401	OUTPUT RELAY FUNCTION SELECT	Selects the function assigned to the relay output. The relay has two output terminals, Logic 1 indicates the relay is active, and therefore terminals 10 and 11 will be linked together.	1: Drive READY
	0: DRIVE ENABLED (RUNNING)	Logic 1 when the motor is enabled	
	1: DRIVE READY	Logic 1 when power is applied to the drive and no fault exists	
	2: AT TARGET FREQUENCY (SPEED)	Logic 1 when the output frequency matches the setpoint frequency	
	3: DRIVE TRIPPED	Logic 1 when the drive is in a fault condition	
	4: OUTPUT FREQUENCY >= LIMIT	Logic 1 when the output frequency exceeds the adjustable limit set in 3200 RELAY THRESHOLD LEVEL	
	5: OUTPUT CURRENT >= LIMIT	Logic 1 when the motor current exceeds the adjustable limit set in 3200 RELAY THRESHOLD LEVEL	
	6: OUTPUT FREQUENCY < LIMIT	Logic 1 when the output frequency is below the adjustable limit set in 3200 RELAY THRESHOLD LEVEL	
	7: OUTPUT CURRENT < LIMIT	Logic 1 when the motor current is below the adjustable limit set in 3200 RELAY THRESHOLD LEVEL	
	8: ANALOG INPUT 2 > LIMIT	Logic 1 when the signal on analog input 2 exceeds the adjustable limit set in 3200 RELAY THRESHOLD LEVEL	
	9: DRIVE READY TO RUN	Logic 1 when power is applied and the drive is enabled.	
	10: PULSE OUTPUT TO INDICATE DRIVE HAS TRIPPED	The pulsed output timing is to be as per the following diagram:  The number of pulses for a given trip are as follows:	

Blinks/Pulses	Customer description of trip	Trip Code	Notes
3	Overvoltage	F0002	Drive internal DC bus high.
	Under voltage	F0006	Drive internal DC bus Low.
4	Motor Over temperature	F_Ptc or F0009	PTC thermistor connected to drive indicates motor is over temperature or drives internal motor thermal overload shows motor is over temperature
	Drive Over temperature	F0003 or O-HEAt	Drive heatsink or drive internal temp too high.
5	Overcurrent	F0001	Output over current
6	Ext Fault (fault connected to a Digital input)	F0014	External trip as requested on digital input 3
7	Short Circuit	h O-I	Output short circuit
Constant on	Other trip		Any other trip not detailed within this table.

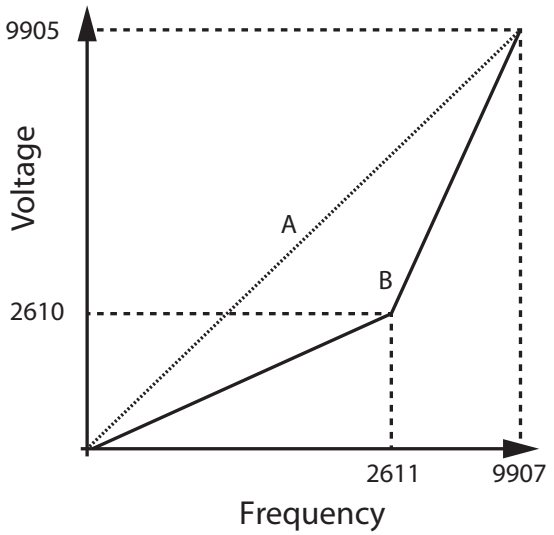
11: BACNET MS/TP	The relay is controlled by the BACnet MS/TP network	

Parameters in the Long parameter mode			
No.	Name/Value	Description	Default
15	**ANALOG/DIGITAL OUTPUTS**	Analog output signal processing	
1501	ANALOG OUTPUT FUNCTION SELECT	Selects the type of output signal information indicated from terminal 8. **Note:** When using settings 0 - 7 the output is a digital format (Logic 1 = 24V). When using settings 8-10 the output is an analog format.	8
	0: DRIVE ENABLED (RUNNING)	Logic 1 when the *DRIVE* is enabled (Running)	
	1: DRIVE READY	Logic 1 When no Fault condition exists on the drive	
	2: AT TARGET FREQUENCY (SPEED)	Logic 1 when the output frequency matches the set-point frequency	
	3: DRIVE TRIPPED	Logic 1 when the drive is in a fault condition	
	4: OUTPUT FREQUENCY >= LIMIT	Logic 1 when the output frequency exceeds the adjustable limit set in parameter *3200* RELAY THRESHOLD LEVEL	
	5: OUTPUT CURRENT >= LIMIT	Logic 1 when the motor current exceeds the adjustable limit set in parameter *3200* RELAY THRESHOLD LEVEL	
	6: OUTPUT FREQUENCY < LIMIT	Logic 1 when the output frequency is below the adjustable limit set in parameter *3200* RELAY THRESHOLD LEVEL	
	7: OUTPUT CURRENT < LIMIT	Logic 1 when the motor current is below the adjustable limit set in parameter *3200* RELAY THRESHOLD LEVEL	
	8: OUTPUT FREQUENCY (MOTOR SPEED)	0 to parameter *2008 MAXIMUM FREQUENCY / SPEED LIMIT*	
	9: OUTPUT (MOTOR) CURRENT	0 to 200% of parameter 9906 MOTOR RATED CURRENT	
	10: MOTOR POWER	0 to 200% of drive rated power.	
	11: BACNET MS/TOP	The digital output is controlled by the BACnet MS/TP network	
16	**SYSTEM CONTROLS**	Parameter lock etc.	
1602	PARAMETER ACCESS UNLOCK	If Parameter ***1603*** has had a value entered, then the matching value needs to be entered here in order to give read-write access to the parameters. Refer to section 10.4 for detailed operation.	0
	0…65535		
1603	PARAMETER ACCESS CODE DEFINITION	To make all parameters Read only, enter a value in this parameter. Refer to section 10.4 for detailed operation.	0
	0…65535		
20	**LIMITS**	**Drive operation limits**	
2007	MINIMUM FREQUENCY / SPEED LIMIT	Minimum output frequency or motor speed limit – Hz or rpm. If ***9908*** MOTOR RATED SPEED >0, the value entered / displayed is in RPM	0.0 Hz
	0.0 HZ…***2008***	Minimum frequency	
2008	MAXIMUM FREQUENCY / SPEED LIMIT	Maximum output frequency or motor speed limit – Hz or rpm. If ***9908*** MOTOR RATED SPEED >0, the value entered / displayed is in RPM	133.0 Hz
	2007…500.0 Hz	Maximum frequency	

<table>
<tr><th colspan="4">Parameters in the Long parameter mode</th></tr>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Default</th></tr>
<tr><td>2020</td><td>BRAKE CHOPPER ENABLE</td><td></td><td>0</td></tr>
<tr><td></td><td>0: MOTOR POWER</td><td></td><td></td></tr>
<tr><td></td><td>1: ENABLED WITH SOFTWARE PROTECTION</td><td>Enables the internal brake chopper with software protection for a 200W continuous rated resistor</td><td></td></tr>
<tr><td></td><td>2: ENABLED WITHOUT SOFTWARE PROTECTION</td><td>Enables the internal brake chopper without software protection. An external thermal protection device should be fitted.</td><td></td></tr>
<tr><td></td><td>3: ENABLED WITH SOFTWARE PROTECTION</td><td>As setting 1, however the Brake chopper is only enabled during a change of the frequency set-point and is disabled during constant speed operation.</td><td></td></tr>
<tr><td></td><td>4: ENABLED WITHOUT SOFTWARE PROTECTION</td><td>As setting 2, however the Brake chopper is only enabled during a change of the frequency set-point and is disabled during constant speed operation.</td><td></td></tr>
<tr><td>21</td><td>START/STOP</td><td>Start and Stop modes of the motor</td><td></td></tr>
<tr><td>2101</td><td>FLYING START</td><td>Starting the drive connected to a rotating motor.
Size 2 drives only, DC injection time on start for Size 1 drives</td><td>2</td></tr>
<tr><td></td><td>0: DISABLED</td><td></td><td></td></tr>
<tr><td></td><td>1: ENABLED</td><td>When enabled, on start up the drive will attempt to determine if the motor is already rotating, and will begin to control the motor from its current speed. A short delay may be observed when starting motors which are not turning/ On Size E1 only this parameter Sets a time for which DC current is injected into the motor to ensure it is stopped when the drive is enabled.</td><td></td></tr>
<tr><td></td><td>2: ENABLED ON TRIP, BROWN OUT OR COAST STOP</td><td>Spin start is only activated following the events listed, otherwise it is disabled</td><td></td></tr>
<tr><td>2102</td><td>STOP MODE</td><td>Selects the motor stop function
<table>
<tr><th>Setting</th><th>On Disable</th><th>On Mains loss</th></tr>
<tr><td>0</td><td>Ramp to Stop (2203 DECEL RAMP TIME)</td><td>Ride Through (Recover energy from load to maintain operation)</td></tr>
<tr><td>1</td><td>Coast</td><td>Coast</td></tr>
<tr><td>2</td><td>Ramp to Stop (2203 DECEL RAMP TIME)</td><td>Fast Ramp to Stop (2206 2nd DECEL RAMP TIME), coast if 2206 is zero.</td></tr>
<tr><td>3</td><td>Ramp to Stop (2203 DECEL RAMP TIME) with AC flux braking</td><td>Fast Ramp to Stop (2206 2nd DECEL RAMP TIME), coast if 2206 is zero.</td></tr>
</table></td><td>0</td></tr>
<tr><td>2104</td><td>DC INJECTION TIME ON STOP</td><td>Defines the time for which a DC current is injected into the motor once the output frequency reaches 0.0Hz. The voltage level is the same as the boost level set in parameter 2603.</td><td></td></tr>
<tr><td></td><td>Duration</td><td>Index 1</td><td>0.0</td></tr>
<tr><td></td><td>0.0…25.0 s</td><td>Defines the time for which DC current is injected into the motor. The voltage level is the same as the boost level set in parameter 2603.</td><td></td></tr>
<tr><td></td><td>DC INJECTION MODE</td><td>Index 2</td><td>0</td></tr>
<tr><td></td><td>0</td><td>DC injection on STOP at the voltage level set in 2603 after the output frequency has reached 0.0Hz and for the time set in Index 1. This can be useful to ensure the motor has reached a complete stop before the drive disables.</td><td></td></tr>
<tr><td></td><td>1</td><td>DC injection on START at the voltage level set in 2603 and for the time set in Index 1 immediately after the drive is enabled, prior to the output frequency ramping up from zero. This can be used to ensure the motor is at a standstill prior to starting.</td><td></td></tr>
<tr><td></td><td>2</td><td>DC injection on STOP and START (at both of the settings 0 and 1 above).</td><td></td></tr>
</table>

Parameters in the Long parameter mode			
No.	Name/Value	Description	Default
2108	*TERMINAL MODE RESTART FUNCTION*	Defines the behavior of the drive relating to the enable digital input and also configures the Automatic Restart function.	AUto-0
	EdGE-r	Following Power on or reset, the drive will not start if Digital Input 1 remains closed. The Input must be closed after a power on or reset to start the drive.	
	AUto-0	Following a Power On or Reset, the drive will automatically start if Digital Input 1 is closed.	
	AUto-1 to AUto-5	Following a trip, the drive will make up to 5 attempts to restart at 20 second intervals. The drive must be powered down to reset the counter. The numbers of restart attempts are counted, and if the drive fails to start on the final attempt, the drive will fault and will require the user to manually reset the fault.	
22	**ACCEL/DECEL**	Acceleration and deceleration times	
2202	ACCELERATION RAMP TIME	Acceleration ramp time from 0 to base speed (Parameter ***9907*** MOTOR RATED FREQUENCY) in seconds.	30.0 s
	0.00…600.0 s	Time	
2203	DECELERATION RAMP TIME	Deceleration ramp time from base frequency (Parameter ***9907*** MOTOR RATED FREQUENCY) to standstill in seconds. **When set to zero, fastest possible ramp time without trip is activated.** When set to 0.00, the value of 2206 is used.	30.0 s
	0.00…600.0 s	Time	
2206	2nd DECELERATION RAMP TIME (FAST STOP)	Parameter programs an alternative deceleration ramp down time for the DRIVE, which can be selected by digital inputs (dependent on the setting of Parameter 9902 DIGITAL INPUTS FUNCTION SELECT or selected automatically in the case of a mains power loss if parameter 2102 STOP MODE = 2.	0.00
	0.00…600 s	When set to 0.00, the drive will coast to stop.	
25	**CRITICAL SPEEDS**	Speed bands with which the drive is not allowed to operate. The Skip Frequency function is used to avoid the DRIVE operating at a certain output frequency, for example at a frequency which causes mechanical resonance in a particular machine.	
2500	SKIP FREQUENCY HYSTERESIS BAND	The drive output frequency will ramp through the defined band at the rates set in parameter ***2202*** and ***2203*** and will not hold any output frequency within the defined band. If the frequency reference applied to the drive is within the band, the drive output frequency will remain at the upper or lower limit of the band.	0.0 Hz/RPM
	0.0…*2008*		
2501	SKIP FREQUENCY	Defines the center point of the skip frequency band, and is used in conjunction with parameter 2500 SKIP FREQUENCY HYSTERESIS BAND	
	0.0…2008		
26	**MOTOR CONTROL**	Motor control variables	
2601	ENERGY OPTIMIZER	Only active when enhanced V/F motor control mode is selected (parameter 9903 MOTOR CONTROL MODE = 2)	1
	0 : DISABLED		
	1 : ENABLED	The Energy Optimizer attempts to reduce the overall energy consumed by the drive and motor when operating at constant speeds and light loads. The output voltage applied to the motor is reduced. The Energy Optimizer is intended for applications where the drive may operate for some periods of time with constant speed and light motor load, whether constant or variable torque.	

Parameters in the Long parameter mode			
No.	Name/Value	Description	Default
2603	V/F MODE VOLTAGE BOOST	Voltage boost is used to increase the applied motor voltage at low output frequencies, in order to improve low speed and starting torque. Excessive voltage boost levels may result in increased motor current and temperature, and force ventilation of the motor may be required. A suitable setting can usually be found by operating the motor under low load or no load conditions at approximately 5Hz, and adjusting parameter ***2603*** until the motor current is no more than 80% of the rated full load current.	3.0 %
	0.0…25.0 %		



The V/f characteristic is defined by several parameters as follows:

Parameter ***9905***: Motor Rated Voltage
Parameter ***9907***: Motor Rated Frequency

The voltage set in parameter ***9905*** is applied to the motor at the frequency set under normal operating conditions, the voltage is linearly reduced at any point below the motor rated frequency to maintain a constant motor torque output as shown by the line 'A' on the graph.

By using parameters parameter ***2610*** and ***2611***, the voltage to be applied at a particular frequency can be directly set by the user, thereby altering the V/F characteristic.

Reducing the voltage at a particular frequency reduces the current in the motor and hence the torque and power, hence this function can be used in fan and pump applications where a variable torque output is desired by setting the parameters as follows:

Parameter ***2610*** = ***9905*** / 4
Parameter ***2611*** = ***9907*** / 2

This function can also be useful if motor instability is experienced at certain frequencies, if this is the case increase or decrease the voltage (Parameter ***2610***) at the speed of instability (Parameter ***2611***).

For applications requiring energy saving, typically HVAC and pumping, the energy optimizer (Parameter ***2601***) parameter can be enabled. This automatically reduces the applied motor voltage on light load.

Parameters in the Long parameter mode			
No.	Name/Value	Description	Default
2606	EFFECTIVE SWITCHING FREQUENCY	Sets maximum effective switching frequency of the drive. If "rEd" is displayed, the switching frequency has been reduced to the level in Parameter 0417 INTERNAL EFFECTIVE SWITCHING FREQUENCY due to excessive drive heat sink temperature. Refer to parameter 0417 INTERNAL EFFECTIVE SWITCHING FREQUENCY for further information regarding operation at higher switching frequency.	Drive Rating Dependent
	4…32 kHz		
2610	V/F CHARACTERISTIC ADJUSTMENT VOLTAGE	Used in conjunction with parameter 2611 V/F CHARACTERISTIC ADJUSTMENT FREQUENCY.	0 V
	0 V…250/500		
2611	V/F CHARACTERISTIC ADJUSTMENT FREQUENCY	This parameter in conjunction with parameter 2610 V/F CHARACTERISTIC ADJUSTMENT VOLTAGE sets a frequency point at which the voltage set in parameter 2611 V/F CHARACTERISTIC ADJUSTMENT FREQUENCY is applied to the motor. Care must be taken to avoid overheating and damaging the motor when using this feature. Refer to section 12.5	0.0 Hz
	0.0 Hz…Value set in ***9907***		

Parameters in the Long parameter mode			
No.	Name/Value	Description	Default
30	**FAULT FUNCTIONS**	Programmable protection functions	
3005	THERMAL OVERLOAD	Enables the drive electronic thermal overload protection. Caution, it is recommended that an alternative means of protecting the motor from thermal overload is used (e.g. PTC thermistor) if ***3005*** is disabled. Press the Navigate key briefly to switch between Index 1 and 2. Then use the UP or DOWN arrow to adjust the value within each Index (Index 1 is displayed first).	0
	VALUE RETENTION	Index 1	
	0: DISABLED		
	1: ENABLED	Drive retains the motor thermal overload value following an input power cycle.	
	THERMAL PROTECTION	Index 2	
	0: DISABLED		
	1: ENABLED	Enables the motor thermal over protection. When the motor thermal overload accumulator reaches 100%, the drive will fault on a F0009 trip.	
32	**SUPERVISION**	Signal supervision. The drive monitors whether certain user selectable variables are within the user-defined limits. The user may set limits for speed, current etc. Supervision status can be monitored with relay output. See parameter group 14 RELAY OUTPUTS.	
3200	**RELAY THRESHOLD LEVEL**	Adjustable threshold level used in conjunction with settings 4 to 7 of parameter 1401 OUTPUT RELAY FUNCTION SELECT	100.0 %
	0.0…200.0 %		
34	**PANEL DISPLAY**	Selection of actual signals to be displayed on the drives front panel e.g. to display conveyer speed in meters per second based on the output frequency.	
3400	**DISPLAY SCALING**	Allow the user to display an alternative output unit scaled from an existing parameter. This function is disabled if ***3400*** = 0.000 Press the Navigate key briefly to switch between Index 1 and 2. Then use the UP or DOWN arrow to adjust the value within each Index (Index 1 is displayed first).	0.000
	SCALING FACTOR	Index 1	
	0.000…16.000		
	SPEED SCALING SOURCE	Index 2	
	0	Motor speed	
	1	Motor current	
	2	Analog Input 2	
	3	PI Feedback	
40	**PROCESS PI SETUP**	Process PI control parameter set	
4001	**PI PROPORTIONAL GAIN**	PI Controller Proportional Gain. Higher values provide a greater change in the drive output frequency in response to small changes in the feedback signal. Too high a value can cause instability	1.0
	0.0…30.0		
4002	**PI INTEGRAL TIME CONSTANT**	PI Controller Integral Time. Larger values provide a more damped response for systems where the overall process responds slowly	1.0 s
	0.0…30.0 S		

Parameters in the Long parameter mode			
No.	Name/Value	Description	Default
4005	**PI OPERATING MODE**		0
	0.0…30.0 S		
	0: DIRECT OPERATION	Use this mode if an increase in the motor speed should result in an increase in the feedback signal	
	1: INVERSE OPERATION	Use this mode if an increase in the motor speed should result in a decrease in the feedback signal	
4010	PI REFERENCE (SETPOINT) SOURCE SELECT	Selects the source for the PID Reference / Setpoint	0
	0	Digital Preset Setpoint. Parameter **4011** PI Digital Reference (Setpoint) is used	
	1	Analog Input 1 Setpoint	
4011	PI DIGITAL REFERENCE (SETPOINT)	When parameter **4010** PID REFERENCE (SETPOINT) SOURCE SELECT = 0, this parameter sets the preset digital reference (setpoint) used for the PID Controller	0 %
	0.0…100.0 %		
4016	PI FEEDBACK SIGNAL SOURCE SELECT		0
	0	Analog Input 2(Terminal 4)	
	1	Analog Input 1(Terminal 6)	
	2	Motor Current	
	3	DC Bus voltage	
	4	Analog 1- Analog 2	
	5	Largest (Analog 1, Analog 2)	
53	**COMMUNICATION PARAMETERS**		
5302	SERIAL COMMUNICATIONS CONFIGURATION	This parameter has three sub settings used to configure the Modbus RTU & BACnet MS/TP Serial Communications. The Sub Parameters are: **Drive Address** : Adr 0 to Adr 63 **Baud Rate** : For Modbus RTU / BACnet MS/TP 9.6kbps to 115.2kbps **Watchdog Timeout** : 0 (Disabled, 30, 100, 1000, 3000 milliseconds) A "**t**" suffix selects trip on loss of communication. An "**r**" suffix means that the drive will coast to stop (output immediately disabled) but will not trip.	Address 1 38.4 kbps
99	**START-UP DATA**	Digital Input Configuration and Motor Data Parameter	
9902	DIGITAL INPUTS FUNCTION SELECT	Defines the function of the digital inputs depending on the control mode setting in Parameter ***1103*** PRIMARY COMMAND SOURCE MODE. See Chapter 9 for detailed examples.	0
	Range 0 to 14	See Chapter 9 Control Modes for 9902 parameter selection details	
9905	MOTOR (BEMF) VOLTAGE	This parameter should be set to the rated (nameplate) BEMF voltage of the motor. See Chapter 2 for information on locating motor nameplate data.	Motor Rating Dependent
	110V/230V rated drives 0…250V 400V rated drives 0…500V	Voltage **Note**: The stress on the motor insulation is always dependent on the drive supply voltage. This also applies to the case where the motor voltage rating is lower than the rating of the drive and the supply of the drive.	

Parameters in the Long parameter mode			
No.	Name/Value	Description	Default
9906	MOTOR RATED CURRENT	This parameter should be set to the rated (nameplate) current of the motor. See Chapter 2 for information on locating motor nameplate data.	Motor Rating Dependent
		Current	
9907	MOTOR RATED FREQUENCY	This parameter should be set to the rated (nameplate) frequency of the motor. See Chapter 2 for information on locating motor nameplate data.	60Hz
	25…500Hz	Frequency	
9908	MOTOR RATED SPEED	This parameter can optionally be set to the rated (nameplate) rpm of the motor. When set to the default value of zero, all speed related parameters are displayed in Hz, and the slip compensation for the motor is disabled. Entering the value from the motor nameplate enables the slip compensation function, and the DRIVE display will now show motor speed in estimated rpm. All speed related parameters, such as Minimum and Maximum Speed, Preset Speeds etc. will also be displayed in RPM.	0 RPM
	0…4000 RPM		

10.3 Advanced Parameter Group

The following tables describes the parameters that are visible in the PAr-A mode (Advanced Parameters).

Parameters in the Long parameter mode			
Index	Name/Selection	Description	Default
2017	Maximum Current Limit	Defines the max current limit in vector control modes.	110 %
	0.1…175.00		
2105	DC Injection Speed	Sets the speed at which DC injection current is applied during braking to Stop, allowing DC to be injected before the drive reaches zero speed if desired.	0.0 Hz/Rpm
	0.0…2008		
2106	DC Injection Current	Sets the level of DC injection braking current applied according to the conditions set in 2104 and 2105.	20 %
	0.0…100.0		
2301	Vector Mode Gain	Single Parameter for Vector speed loop tuning. Affects P & I terms simultaneously. Not active when ***9903*** = 1.	50 %
	0.0…200.0		
2605	Operating Mode Select	Provides a quick set up to configure key parameters according to the intended application of the drive. Parameters are preset according to the table.	2

Setting	Application	Current Limit (2017)	Torque Characteristic (2610 & 2611)	Spin Start (2101)
0	General	150%	Constant	0: Off
1	Pump	110%	Variable	0: Off
2	Fan	110%	Variable	2: On

	0: Industrial Mode	Intended for general purpose applications.	
	1: Pump Mode	Intended for centrifugal pump applications.	
	2: Fan Mode	Intended for Fan applications.	

Parameters in the Long parameter mode			
Index	Name/Selection	Description	Default
9903	Motor Control Mode	Selects the motor control method. For proper control of the EC Titanium parameter ***9903*** should be set to 2 (PM Control).	2
	0	Vector speed control mode	
	1	V/HZ Mode	
	2	PM Motor Vector Speed Control	
	3	BLDC Motor Vector Speed Control	
9910	Motor parameter Autotune **WARNING:** Autotune should not be performed on this product.	Autotune is disabled in the ECM software however it can be accessed through the keypad. In the event an Autotune is performed it will affect performance and possibly make the IMD inoperable. To recover the motor specific parameters will need to be loaded. The necessary parameters and their values can be obtained by scanning the QR Code on the motor with a smart device or you can access the parameters from the ECM software under the File menu (allows the parameter set to be downloaded from the web). **WARNING:** Autotune should not be performed on this product.	0: Disable
	0: Disable		
	1: Enable	Drive immediately carries out a non-rotating autotune, parameter ***9910*** MOTOR PARAMETER AUTO-TUNE ENABLE returns to 0 when completed.	
11201	MOTOR STATOR RESISTANCE (Rs)	Motor Stator Resistance – refer to motor nameplate for value.	-
11203	MOTOR STATOR INDUCTANCE (Lsd)	Ld (mH) Motor Inductance (Lsd) value – refer to motor nameplate for value.	-
11206	MOTOR STATOR q-axis INDUCTANCE (Lsq)	Lq (mH) Motor q-axis Inductance (Lsq) value – refer to motor nameplate for value.	-
96102	BLUETOOTH ENABLE	Turns the on-board Bluetooth On/Off	0
	0: Enabled	On-Board Bluetooth On	
	1: Disabled	On-Board Bluetooth Off	
96103	RTC DATA RECORD RESET	Setting this parameter to a 1 will clear out the RTC store data logging record upon next power up and will reset to 0 on completion Note: for ECIN units this parameter has no effect	0
	0: Disabled		
	1: Enabled	Clear RTC stored data logging record	
5840	DEVICE OBJECT ID LOW	BACnet MS/TP only: The Device object ID must be unique across all BACnet devices in the building network. 5840 and 5899 are used to setup drive device object ID value. Instance ID = 5840 * 65536 + 5899. Range from 0 ~ 65535.	65535
5841	BACNET MAXIMUM MASTERS	BACnet MS/TP only: The highest master address for devices on the BACnet MS/TP bus. Changes to this parameter take effect after the control unit is rebooted. Range 0...127	127
5899	DEVICE OBJECT ID HIGH	Range: 0 ... 63	63

10.4 Parameter Access Locking and Unlocking System

This function can be used to prevent an un-authorized person from changing the drive parameter values; this function is disabled when delivered from the factory.

Relevant Parameters

1602	Parameter Access Unlock
	0…65535
1603	Parameter Access Code
	0…65535

10.4.1 Locking access to parameters

Ensure that the “Long Parameter mode (**Par L**) has been selected as shown in **Real Time Operation**.

1. Go to Parameter **1603** (Long Parameter group) and enter in your chosen parameter access code.
2. Press the Navigate button to exit and parameter **1603** will then be hidden and all parameters will be “Read only” (except for Parameter **1602** which will remain “Read Write”).
3. Access to parameters via the REMOTE PANEL will now be prevented.

NOTE: Operational information (e.g. speed, current, power etc) can still be accessed as normal and the drive can still be controlled from the keypad.

10.4.2 Un-Locking access to parameters

1. Enter into parameter 1602 the same value as 1603 (as chosen above).
2. All parameters will now be “Read Write” and parameter 1603 will become visible and show the value which was originally programmed as the parameter access code.
3. To disable this feature set parameter 1603 to zero and then parameter 1602 to zero.

NOTE: In the event of losing the drive password, please contact ABB for support to be provided with an unlock code. The drive serial number (located on the drive nameplate) is required to be provided.

10.5 Resetting Parameters to Factory Default

The following procedure will reset all drive parameters to their factory default values as defined in the Parameter Definition tables in Chapter 10. This function should only be performed to set the drive back to a known state and is not required for normal use.

Hold down “UP”, “DOWN” and “STOP” for 2 seconds. Drive will now display “p-def”. Now, press the “STOP” key, and stop will be displayed. Drive is now reset to Factory Defaults.

NOTE: Factory Reset of Parameters will remove all pre-programmed factory settings for motor data. Refer to 7.2 Quick Start Parameter Data for a listing of parameters that should be set for proper control and operation of the EC Titanium Motor in the event a factory reset is performed.

Chapter 11

EC Titanium Motor & ABB ACH580 Drive Setup

This document gives basic guidelines on how to identify motor data from the nameplate to set drive parameters in the ACH580 when using the EC Titanium permanent magnet motors. Parameter guidelines for operation are provided basic information for tuning the motor control performance.

For advance drive setup instruction, reference ABB ACH580 Control Firmware Manual (3AXD50000027537).

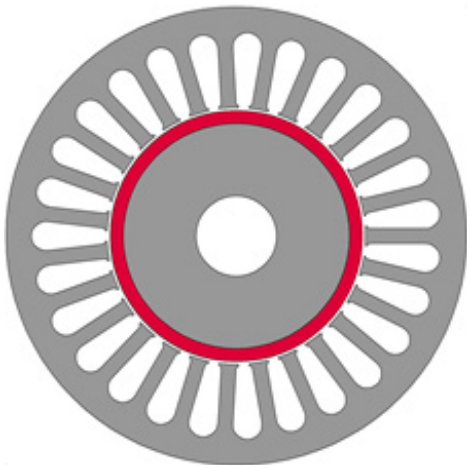
This instructions applies to the EC Titanium Motor and ACH580 products.

11.1 Overview EC Titanium Motor Design

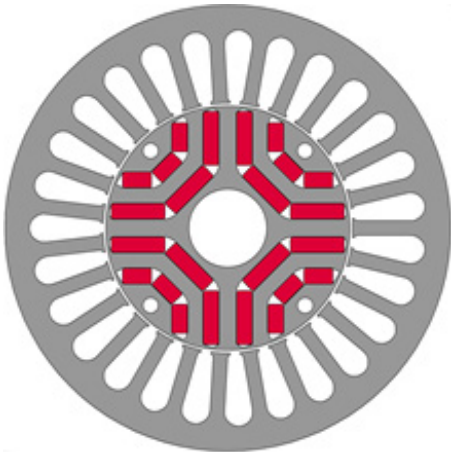
Like the traditional Electronically Commutated motor (ECM), the EC Titanium uses permanent magnets and requires an electronic drive to control properly. Both are synchronous and tend to be more efficient than their induction counterparts. EC Titanium motors uses a synchronous reluctance rotor with imbedded ferrites magnets (FASR) design. The application of ABB variable frequency drives with a EC Titanium motor enables the use of advanced motor control algorithms for higher efficiencies across the speed load range.

The Motor Inductive values and Back EMF Voltage are important values for setting a ABB drive with the EC Titanium to ensure the proper control and optimized performance of the system. Proper program settings are more relevant than with induction motors. Nameplate data provided with each motor should be used to ensure proper setup and of the ABB Drive to control the motor.

One of the most significant difference of PM motors is rotor structure. The figure below compares the rotor design of a standard surface mount PM motor versus the EC Titanium FASR design.



Surface Mount PM Motor Rotor



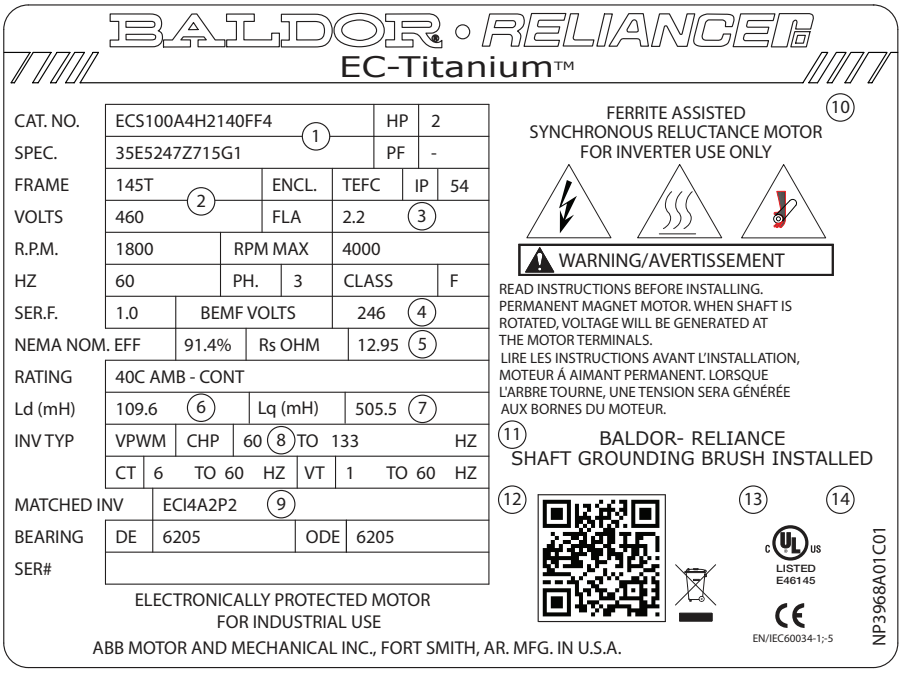
Ferrite Assisted Permanent Magnet

Typically, the Motor torque is in direct relation to the current. Motor speed is in direct relation to the output frequency of the converter. Motor output voltage also called back-EMF is directly proportional to speed of the motor.

As the back-EMF of the motor increases with speed, there is a risk of damaging the frequency converter if the drive coasts to stop or trips at a high speed. Therefore, the speed of a FASR Motor is limited by the drive so that the back-EMF would not charge the DC link above the trip limit. This internal limit is a safety precaution, and it cannot be disabled by the user parameters.

11.2 Identifying the EC Titanium Motor Parameters

The EC Titanium Motor nameplate is located on the side of the motor and includes NEMA rating, appropriate markings, a type designation and a serial number, which allow identification of each unit. The motor nameplate contains electrical information necessary for proper setup of the ABB drive control.



Zone	Description
1	Catalog Number
2	General Motor Information
3	Motor Rated Amps
4	BEMF (Back EMF) Voltage
5	Motor Stator Resistance (Rs)
6	Ld (mH) Motor Inductance
7	Lq (mH) Motor q-axis Inductance
8	Motor Rated Frequency & Maximum Frequency
9	Matched Inverter Model Number
10	PM Motor Warning Information
11	Shaft Ground Provision Marking
12	QR Code for motor information
13	CE Marking
14	UL Agency Listing

11.3 ABB Drive Selection Guidelines

ABB Basic drive selection criteria apply with Permanent Magnet Synchronous Motors. Select an ACH580 drive so that all criteria below are met:

1. Rated drive current I2N is de-rated by ambient, altitude and switching frequency*
2. Motor rated current is less than or equal to the rated drive current I2N of the drive
3. Maximum required motor current is below 1.5 x rated drive current
4. Maximum required motor current is suitable for drive overloading**
5. Average required motor power is less than rated drive power PN
6. Maximum required motor power is less than 1.5 x rated drive power
7. Maximum required motor power is suitable for drive overloading**



* For drive de-rating see ABB User's Manuals

** Maximum current with 110% overload allowed for one minute every ten minutes Maximum current with 150% overload allowed for one minute every ten minutes. ABB drives can supply maximum output current I2max for 2 seconds at start.

11.4 Motor Setup Parameters with ABB Drives

The following parameters should be set based on nameplate data of the EC Titanium™ Motor. It is important to accurately input these values for proper motor control. The ACH580 ID run (Parameter 99.13) is used to setup motor values for Resistance, Ld and Lq and these values are not required for startup.

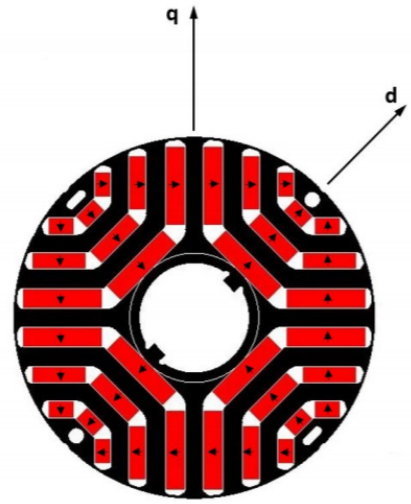


ABB Drive Parameter	Function	Drive Setting
99.03	Motor Type	Permanent Magnet
99.04	Control Mode	Vector
99.06	Rated Current (A)	Nameplate Value
99.07	Motor BEMF Voltage	Nameplate Value
99.08	Motor Rated Frequency (Hz)	Nameplate Value
99.09	Motor Speed	Nameplate Value
99.10	Motor Rated Power (kW)	Nameplate Value
99.13 (ID Run)	Motor Resistance Rs	Auto Tune
99.13 (ID Run)	Motor Inductance Ld	Auto Tune
99.13 (ID Run)	Motor Inductance Lq	Auto Tune

11.5 Setting up ABB Drive Parameters

This section gives basic guidelines on how set the drive parameters when using a ferrite assisted permanent magnet synchronous motor (FASR). In addition, guidelines are provided for setting up the motor control performance.

Basic configuration

Enter the motor data as identified in Section 11.3 Motor Parameters. Vector mode (Parameter 99.04 = 0) is required for EC Titanium Motors. The following table lists the basic parameter settings needed for permanent magnet ferrite assisted synchronous motors. Special attention must be paid to setting correctly the motor nominal values in parameter group 99 Motor data per the motor nameplate values.

Parameter	Name	Value	Description
99.03	Motor type	1	Permanent magnet motor
99.04	Motor control mode	0	Vector control **Warning: Scalar (1) must not be used with FASR Titanium Motors as scalar mode potential could be unstable and damage either process, or motor or drive.** Vector control mode requires motor identification run (ID run) upon setting the parameters 99.06 – 99.10. See parameter 99.13 ID run requested. Note: After changing control mode to Vector, ID run requested (99.13) will automatically change to Standstill. For accurate results, normal ID run is recommended.
99.06	Motor nominal current		Here set the nominal motor current that must be equal to the value on the motor rating nameplate.
99.07	Motor nominal voltage		Here set the BEMF motor voltage that must be equal to the value on the motor rating plate. For EC Titanium motors, the nominal voltage is the back-EMF voltage at nominal speed of the motor. If the voltage is given as voltage per rpm, e.g. 60 V per 1000 rpm, the voltage for a nominal speed of 3000 rpm is 3 × 60 V = 180 V.
99.08	Motor Nominal Frequency		Here set the nominal motor frequency. This setting must match the value on the motor rating nameplate. Note: For base speeds other than 1800 RPM. Motor Nominal Frequency will not be 60 Hz, enter the proper frequency as shown on the motor nameplate.
99.09	Motor Nominal Speed		Here set the nominal mechanical speed of the motor. This setting must match the value on the motor rating plate.
99.10	Motor Nominal Power		Here set the motor nominal power. This setting must match the value on the motor rating plate. If not given, can be calculated from the formula: Power [kW] = Rated torque [Nm] × 2π × Speed [rpm] / 60000
99.13	ID-run requested	Standstill	After changing control mode to Vector (Parameter 99.04 = 0), ID run requested (99.13) automatically changes to Standstill. To perform an ID run, either Standstill or Normal should be selected. Normal ID run is recommended; however, it requires spinning the motor without load. During the ID run the drive will identify the characteristics of the motor for optimum motor control. If no ID run has been performed yet or if default parameter values have been restored using parameter 96.06 Parameter restore, this parameter is automatically set to Standstill signifying that an ID run must be performed. To perform an ID run, either Standstill or Normal should be selected. Note: with PMSM the ID run modes Advanced and Reduced will perform exactly the same ID run as Normal. Perform ID run. After performing the ID run, the drive stops and par 99.13 value reverts back to None.

11.6 Start Mode Selection with FASR Motors

Automatic start

With the ACH580 and EC Titanium Motor, it's recommended to set 21.01 (Vector start mode) = 2 automatic and Parameter 21.03 (Stop mode) = 0 for coast stop. Parameter 21.13 (Autophase mode) should be changed to Turning.

The start of PM motors consists of two parts:

1. Flying start detection: If the motor is rotating, flying start is performed
2. Autophasing detection: If the motor is not rotating, Autophasing is executed after Flying start detection.

After these start routines, the motor is controlled normally with Vector control.

NOTE: Autophasing in this product range is done with DC current injection. The shaft of motor may rotate slightly forward/ backwards during the autophasing, depending on the true orientation of the axis. If axis movement need to be avoided, then Ramp stop & Post-magnetization may help. In this case drive starts the rotation from same phase from where the motor was stopped.

Parameter	Name	Value	Description
21.01	Vector start mode	2	Selects the motor start function for the vector motor control mode, ie. when 99.04 Motor control mode is set to Vector. **Automatic:** With permanent magnet motors, start mode Automatic is recommended. Under Automatic the drive motor control program identifies the flux as well as the mechanical state of the motor and starts the motor instantly under all conditions. Automatic start guarantees optimal motor start in most cases. It includes the flying start function (starting to control the rotating motor and accelerating it to the reference speed) and the automatic restart function (restarting the drive automatically after a short – max. 10 seconds – power supply failure).
21.03	Stop mode	0	Selects the way the motor is stopped when a stop command is received. **Coast stop** Stop by switching off the output semiconductors of the drive. The motor coasts to a stop. It is recommended to use Coast stop if possible when using the ACH580 with the EC Titanium motor for best start performance.
When start performance is critical or shaft movement in start need to be minimized apply the following additional settings.			
21.03	Stop mode	1	Selects the way the motor is stopped when a stop command is received. **Ramp stop** Stop along the active deceleration ramp. See parameter group 23 Speed reference ramp. This mode may be selected if the application requires a faster stopping time then the recommended coast to rest mode.
21.08	DC current control	Bit 0 = 1 Bit 1 = 1	***Bit 0 = 1 Enable DC hold*** ***Bit 1 = 1 Enable post-magnetization***
21.09	DC hold speed	~30 rpm	Depends on the application and motor, but 30rpm is typically ok
21.10	DC current reference	~50%	Depends on the application and motor, but 50% is typically ok.
21.11	Post - magnetization time	~2s	Depends on the application and motor, but 2 s is typically ok.

Parameter	Name	Value	Description
21.13	Autophasing mode	0 1 2	Selects the way autophasing is performed during the ID run. **Turning** This mode is recommended for use with the EC Titanium motor startup. It gives the most accurate autophasing results. This mode can be used if the motor is allowed to rotate during the ID run and the startup is not time critical. **Warning: This mode will cause the motor to rotate during the ID run.** Standstill 1 Faster than Turning mode, but not as accurate. The motor will not rotate Standstill 2 An alternate standstill autophasing mode that can be used if Turning mode cannot be used and the Standstill 1 mode gives erratic results. This mode is considerably slower than Standsitll 1.

11.7 Group 30 Limits

In order to avoid demagnetization of the motor, the maximum current (30.17) should be set to no higher than 150% of the motor nominal current.

Parameter	Name	Value	Description
30.17	Maximum Current	1.5 x Motor Current	Defines the maximum allowed motor current. Range: 0.00….30000.00 A Here set the maximum current value at 1.5 x nominal motor current (150%).
30.19	Minimum torque 1		Defines a minimum torque limit for the drive (in percent of nominal motor torque). Range: -1600.0 … 0.0%
30.20	Maximum torque 1		Defines a maximum torque limit for the drive (in percent of nominal motor torque). Range: 0.0 … 1600.00%

11.8 Speed Control Adjustment

Default tuning with the proportional gain (25.02) setting of 10 may result in unstable performance with EC Titanium motors. Setting the proportional gain to 3 is recommended for smooth operation. Fine tuning the integration time is optional depending on system dynamics.

Parameter	Name	Value	Description
25.02	Speed Proportional Gain	3	Defines the proportional gain (Kp) of the speed controller. Too high a gain may cause speed oscillation. Here set the proportional gain for the drive control to a value of 3. Range: 0.00…250.00
25.03	Speed Integration Time	2.5	Use if fine tuning of the motor performance is required, the default setting of 2.50s is recommended for most applications. Reference ACH580 firmware manual for advanced setup of the speed integration time if required. Range:0.00…1000.00 s
25.33	Speed controller autotune	1	ON Activates (or selects a source that activates) the speed controller autotune function. The autotune will automatically set parameters 25.02 Speed proportional gain, 25.03 Speed integration time and 25.37 Mechanical time constant. The prerequisites for performing the autotune routine are: • the motor identification run (ID run) has been successfully completed • the speed and torque limits (parameter group 30 Limits) have been set • speed feedback filtering (parameter group 90 Feedback selection), speed error filtering (24 Speed reference conditioning) and zero speed (21 Start/stop mode) have been set, and the drive has been started and is running in speed control mode. **WARNING: The motor and machinery will run against the torque and speed limits during the autotune routine. MAKE SURE IT IS SAFE TO ACTIVATE THE AUTOTUNE FUNCTION!** The autotune routine can be aborted by stopping the drive.

For better performance, auto-tuning the speed controller if possible is recommended. Turn the speed controller auto-tune to on. The load should be connected at this point and free and safe to rotate. During the normal ID run, the motor will rotate and perform a Parameter 25.33 auto-tune function.

11.9 Auto-phasing configuration

Enter the service password in parameter 96.2 (170708). Auto-phasing current should be between 0.2 and 0.3 p.u. Auto-phasing time introduces a start delay and with small motors 2 to 3 seconds will be enough to ensure a successful initial rotor positioning. On larger frame motors 4 to 5 seconds may be required.

Parameter	Name	Value	Description
25.20	Auto-phasing current	0.25	Per unit auto-phasing current for rotor alignment prior to starting the motor.
25.21	Auto-phasing time	3	Time in seconds auto-phase current is applied to motor for rotor alignment prior to starting.

Chapter 12
Technical Data

This chapter contains the technical specifications of the drive, the ratings, sizes and technical requirements.

12.1 Environmental

Motor Enclosure Rating	TEFC/IP54 Motor with UL
Drive Enclosure Rating	Type 12/IP55 Drive
Operational ambient temperature ranges:	-10 … 50°C (frost and condensation free)
Storage ambient temperature range:	-40 … 60°C
Maximum Altitude:	2000 meters, de-rate above 1000m: 1% / 100m
Maximum Humidity:	95%, non-condensing
Vibration (Operating)	1 G Peak at 20 Hz
Vibration (Non-Operating)	0.2G Peak at 20 to 50Hz

12.2 Input Power Electrical Data

Supply Voltage Range	110 Volt Units – 110 – 115 Volt +10% / -10% 230 Volt Units – 200 – 240 Volt +10% / -10% 400 Volt Units – 380 – 480 Volt +10% / -10%
Supply Frequency	48 – 62Hz
Inrush Current	< rated input current
Power Up Cycles	>120x /hr, evenly spaced
Single Phase Operation	Three phase drives can be operated from a single phase supply with 50% derating of the maximum output current
Earth Leakage	When operating from a balanced three phase supply with the permissible supply voltage range, touch current according to IEC61800-5-1 does not exceed 3.5mA.

12.3 Motor Control Electrical

Output Frequency Range	0 to 500Hz in 0.1 Hz steps Max Output Frequency = Max Switching Frequency / 16.
Output Voltage Range	0 to Supply Voltage
Speed Regulation	Open Loop < 2% motor rated speed
Torque Control	0 – 175% of rated torque, + / -5% accuracy, Response time <10ms
Effective Switching Frequency	4 – 32kHz
Acceleration Time	0 – 600 seconds, 0.01s resolution
Deceleration Time	Two deceleration ramps 0 – 600 seconds, 0.01s resolution

12.4 Motor Control Performance

V/F Mode

Speed Regulation:	+ / - 20% of motor slip with slip compensation enabled

Vector Mode

Static Speed Accuracy:	+ / - 0.033%
Speed Regulation	0 – 100% Load Range: + / - 1%
Torque Response:	1- 8ms
Torque Linearity	(10 – 90% of motor rated speed, 20 – 100% load torque range): + / - 5%

12.5 Digital & Analog I/O

Digital Inputs Specification

Voltage Range	8 – 30 V dc, Internal or External supply, NPN (positive logic)
Response Time	< 8ms

Analog Inputs Specification

Range	Current:	0-20mA, 4-20mA. 20mA max input current
	Voltage:	-10-10V (Analog Input 1 Only), 0-10V, 0-5V, 0/24V, 30V max input
Resolution	Analog Input 1:	12-bit, <16ms response time (Uni-Polar)
	Analog Input 2:	12-bit, <16ms response time (Uni-Polar)
Impedance	Current Mode:	500R
	Voltage Mode:	> 100kR
Accuracy		Better than 1% of full scale
Scaling & Offset		Parameter adjustable

Analog Output Specification

Range	Current:	0...20mA, 4...20mA, 20mA max
	Analog:	0..10V, 0 / 24V (digital), 20mA max
Resolution	10-bit	
	Accuracy	better than 1% of full scale

Relay Output

Max Switching	Voltage:	250VAC, 30 VDC
Max Switching	Current:	5A at 30 Volt DC, 6A at 250 Volt AC

Response Times

Command Source	Response Time
Digital Input	<8ms
Analog Input	<16ms
Modbus RTU Interface	<8ms from receipt of valid command
CAN Interface	<8ms from receipt of valid command
Master / Slave Function	<8ms, response, 60ms cycle
Power Stage	<10ms to enable output

12.6 Output Current Limit

Overload Operation
EC Titanium provides the following maximum permissible overload current:
- 150% Output current / 60 Seconds Maximum
- 175% Output current / 2.5 Seconds Maximum

Maximum continuous output current and maximum permissible overload time may be adjusted according to the **following:**
- PWM Switching Frequency Selected
- Low Output Frequency
- High Ambient Temperature

12.7 Motor Overload Summary

The EC Titanium Drive features both hardware and software protection of the output stage to prevent damage. In addition, an I x t system is used to monitor motor overload condition and prevent damage to the motor due to operation for prolonged periods at high load. I x t protection is software based, using the value for motor rated current programmed in 9906. An internal accumulator register is used to estimate the point at which damage may occur to the motor, and operates as follows:

Motor Current < 9908	The accumulator value reduces towards zero. The time required depends on the actual load current as explained further below.
Motor Current = 100% P-08	
Motor Current > 100% P-08 < 150% P-08	The accumulator value increases at a rate proportional to the overload level, e.g. (Motor Current / Rated current) – 100%. If the overload limit is reached, the drive will trip, displaying it.trp. to protect the motor.
Motor Current > 150% P-08	For high current levels, the accumulator operates 16 times faster than for current levels below 150% of 9906.

Peak over current trip levels are shown in the table below.

Drive Rated Supply Voltage	Frame Size	Drive Type	DC Bus Voltage Level (Volts DC)				
			Brake Chopper On	Brake Chopper Off	Under Voltage Trip	Minimum Operating (Inrush Disabled)	Over Voltage Trip
100 – 115 VAC	1	Voltage Doubler	N/A	N/A	160	239	418
110 – 240 VAC	1	PFC	N/A	N/A	160	239	418
200 – 240 VAC	1	All	N/A	N/A	160	239	418
380 – 480 VAC	1	All	N/A	N/A	320	478	835
380 – 480 VAC	2	All	780	756	320	478	835

12.8 Automatic Switching Frequency Reduction

The switching frequency selected in 2606 will be automatically reduced based on the heatsink temperature. In addition, switching frequency is reduced under the following conditions:

Output Frequency based Effective Switching Frequency Reduction

At low output frequency, Effective Switching Frequency is automatically reduced. Hysteresis is applied to prevent continuous switching. The operation is according to the following table:

2606	32kHz	24kHz	16kHz	12kHz	8kHz	4kHz
Effective Switching Frequency increases when Output Frequency exceeds	9.0Hz	7.0Hz	5.0Hz	3.0Hz	N/A	N/A
Effective Switching Frequency reduces when Output Frequency reduces below	7.0Hz	5.0Hz	3.0Hz	1.0Hz	N/A	N/A

Output Current Based Effective Switching Frequency Reduction

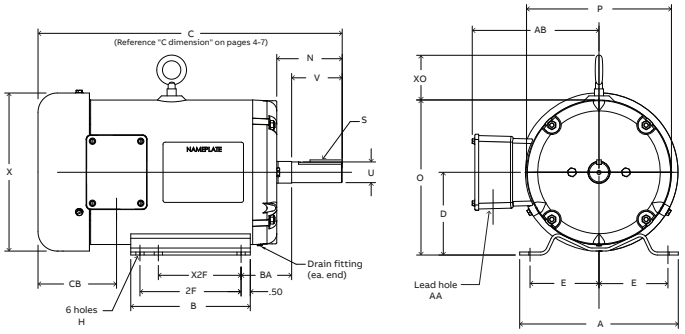
Effective Switching Frequency is automatically reduced based on motor load current as follows:

If 2606 = 12kHz, 16 kHz, 24 kHz, Effective switching frequency is reduced to 8 kHz when motor current exceeds 10.45A (110% of the drive rated current). Switching frequency will return to the value set in 2606 when motor current reduces below 7.6A (80% of drive rated current)

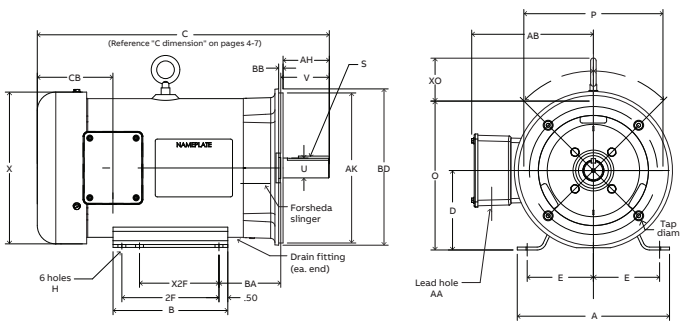
If 2606 = 32kHz, Effective switching frequency is reduced to 8 kHz when motor current exceeds 10.45A (110% of drive rated current). Switching frequency changes to 24 kHz when motor current reduces below 7.6A (80% of drive rated current). Switching frequency will return to the value set in 2606 when motor current reduces below 6.7A (70% of drive rated current)

12.9 Dimensions

EC Titanium - motor only



Foot mounted



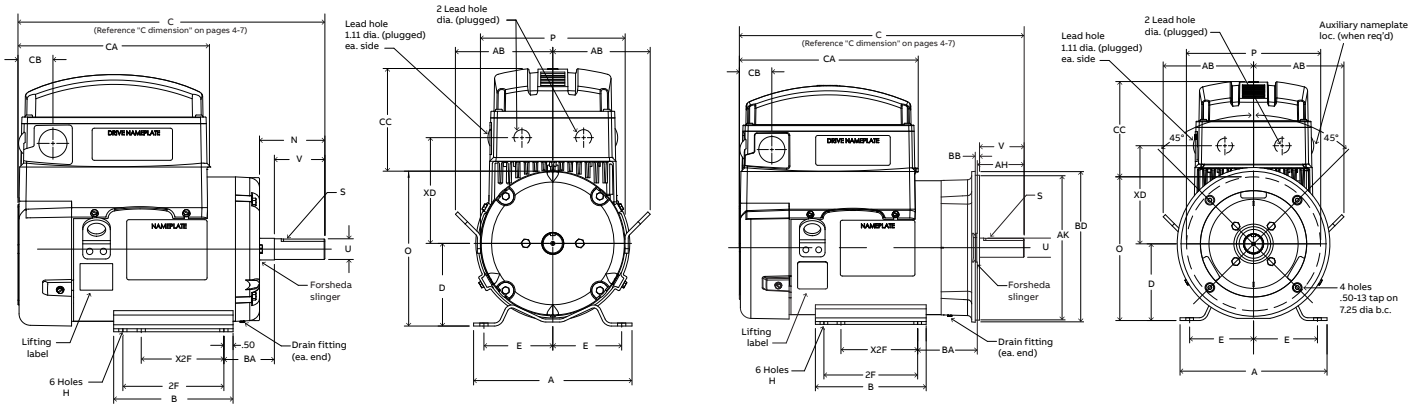
C-Face foot mount

NEMA frame	CB	D	E	2F	X2F	B	H	N	0	X	P	U
Foot mount				**Dual foot mounts**								
140	3.75	3.5	2.75	5.00	4.00	5.94	0.38	2.50	6.81	7.19	6.62	0.875
180	4.26	4.5	3.75	5.50	4.50	6.50	0.41	3.56	8.43	8.60	7.88	1.250
210	5.01	5.25	4.25	7.00	5.50	8.00	0.41	3.88	10.03	10.28	9.57	1.375
C-Face foot mount												
140	3.78	3.5	2.75	5.00	4.00	5.94	0.38	-	6.81	7.19	6.62	0.875
180	4.26	4.5	3.75	5.50	4.50	6.50	0.41	-	8.43	8.60	7.88	1.250
210	5.01	5.25	4.25	7.00	5.50	8.00	0.41	-	10.03	10.28	9.57	1.375
C-Face footless												
140	3.78	-	-	-	-	-	-	-	-	7.19	6.62	0.875
180	4.26	-	-	-	-	-	-	-	-	8.60	7.88	1.250
210	5.01	-	-	-	-	-	-	-	-	10.28	9.57	1.375

NEMA frame	S	V	AA	AB	A	AH	AK	BA	BB	BD	XO	TAP	Diam B.C.
Foot mount													
140	0.19	2.25	1.09	5.71	6.50	-	-	2.25	-	-	-	-	-
180	0.25	2.75	1.09	6.87	8.63	-	-	2.75	-	-	2.43	-	-
210	0.31	3.38	1.38	8.02	9.50	-	-	3.50	-	-	2.39	-	-
C-Face foot mount													
140	0.19	-	1.09	5.71	6.50	2.12	4.50	2.75	0.13	6.49	-	0.38 - 16	5.87
180	0.25	2.75	1.09	6.87	8.63	2.62	8.50	3.50	0.25	8.85	2.43	0.50 - 13	7.25
210	0.31	-	1.38	8.06	9.50	3.12	8.50	4.50	0.25	9.05	2.39	0.50 - 13	7.25
C-Face footless													
140	0.19	-	1.09	5.71	-	2.12	4.50	-	0.13	6.49	-	0.38 - 16	5.87
180	0.25	2.75	1.09	6.87	-	2.62	8.50	-	0.25	8.85	2.43	0.50 - 13	7.25
210	0.31	-	1.38	8.06	-	3.12	8.50	-	0.25	9.05	2.39	0.50 - 13	7.25

12.10

EC Titanium - top mounting

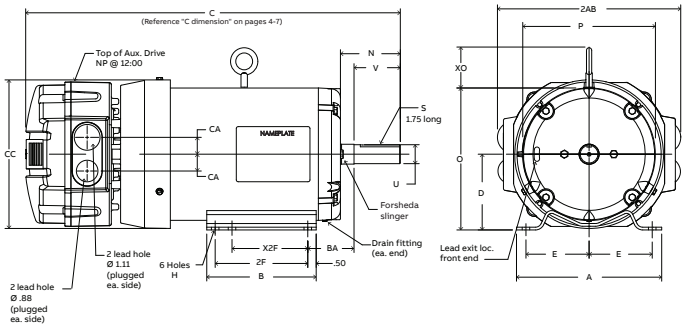


NEMA frame	CB	CA	CC	D	E	2F	X2F	B	H	N	0	XD	P
Foot mount						**Dual foot mounts**							
140	1.79	8.49	5.07	3.5	2.75	5.00	4.00	5.94	0.38	2.50	6.81	5.00	7.16
180	1.9	10.49	5.59	4.5	3.75	5.50	4.50	6.50	0.44	3.56	8.43	5.76	7.88
210	1.9	10.49	5.57	5.25	4.25	7.00	5.50	8.00	0.43	3.88	10.03	6.58	9.57
C-Face foot mount													
140	1.79	8.49	5.07	3.5	2.75	5.00	4.00	5.94	0.38	-	6.81	5.00	6.62
180	1.9	10.49	5.59	4.5	3.75	5.50	4.50	6.50	0.44	-	8.43	5.76	7.88
210	1.9	10.49	5.57	5.25	4.25	7.00	5.50	8.00	0.43	-	10.03	6.58	9.57
C-Face footless													
140	1.77	8.49	5.07	-	-	-	-	-	-	-	-	5.00	6.62
180	1.9	10.49	5.59	-	-	-	-	-	-	-	-	5.76	7.88
210	1.9	10.49	5.57	-	-	-	-	-	-	-	-	6.58	9.57

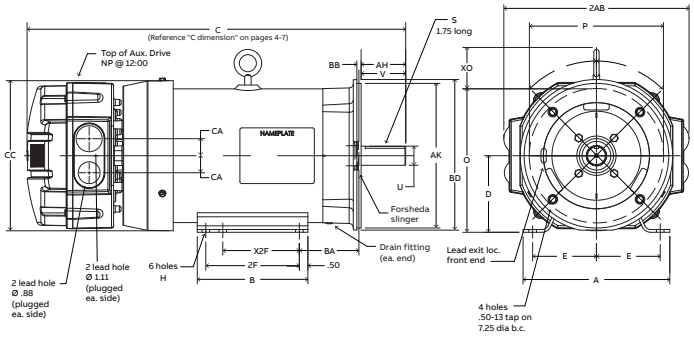
NEMA frame	U	S	V	AB	A	AH	AK	BA	BB	BD	TAP	Diam B.C.
Foot mount												
140	0.875	0.19	2.25	-	6.50	-	-	2.25	-	-	-	-
180	1.250	0.25	2.75	5.30	8.63	-	-	2.75	-	-	-	-
210	1.375	0.31	3.38	5.38	9.50	-	-	3.50	-	-	-	-
C-Face foot mount												
140	0.875	0.19	-	-	6.50	2.12	4.50	2.75	0.13	6.49	0.38 - 16	5.87
180	1.250	0.25	2.75	5.30	8.63	2.62	8.50	3.50	0.25	8.85	0.50 - 13	7.25
210	1.375	0.31	-	5.38	9.50	3.12	8.50	4.50	0.25	9.05	0.50 - 13	7.25
C-Face footless												
140	0.875	0.19	-	-	-	2.12	4.50	-	0.13	6.49	0.38 - 16	5.87
180	1.250	0.25	2.75	5.30	-	2.62	8.50	-	0.25	8.85	0.50 - 13	7.25
210	1.375	0.31	-	5.38	-	3.12	8.50	-	0.25	9.05	0.50 - 13	7.25

12.11 Dimensions

EC Titanium - top mounting



Foot mounted



C-Face foot mount

NEMA frame	CA	CC	D	E	2F	X2F	B	H	N	0	P
Foot mount						**Dual foot mounts**					
140	0.81	7.23	3.5	2.75	5.00	4.00	5.94	0.38	2.50	6.81	6.61
180	1.00	8.82	4.5	3.75	5.50	4.50	6.50	0.44	3.56	8.43	7.88
C-Face foot mount											
140	0.81	7.23	3.5	2.75	5.00	4.00	5.94	0.38	-	6.81	6.61
180	1.00	8.82	4.5	3.75	5.50	4.50	6.50	0.44	-	8.43	7.88
C-Face footless											
140	0.81	7.23	-	-	-	-	-	-	-	-	6.61
180	1.00	8.82	-	-	-	-	-	-	-	-	7.88

NEMA frame	U	S	V	2AB	A	AH	AK	BA	BB	BD	XO	TAP	Diam B.C.
Foot mount													
140	0.875	0.19	2.25	8.06	6.50	-	-	2.25	-	-	-	-	-
180	1.250	0.25	2.75	10.89	8.63	-	-	2.75	-	-	2.43	-	-
C-Face foot mount													
140	0.875	0.19	-	8.06	6.50	2.12	4.50	2.75	0.13	6.49	-	0.38 - 16	5.87
180	1.250	0.25	2.75	10.89	8.63	2.62	8.50	3.50	0.25	8.85	2.43	0.50 - 13	7.25
C-Face footless													
140	0.875	0.19	-	8.06	-	2.12	4.50	-	0.13	6.49	-	0.38 - 16	5.87
180	1.250	0.25	2.75	10.89	-	2.62	8.50	-	0.25	8.85	-	0.50 - 13	7.25

Chapter 13
Troubleshooting

The EC Titanium constantly monitors its status and provides the following ways to determine the status of the drive and to troubleshoot problems that may occur:

LED's one the drive	Table 13-1
Fault codes displayed remote keypad	Table 13-2
Fault History	Parameter 0401

13.1 Fault Codes

An alarm or fault message on the drive LED or Remote Keypad Panel indicates abnormal drive status. Using the information given in this chapter to identify and correct most alarms and fault causes. The drive responds to a fault by initiating a coast-to-stop sequence and turning off motor power.

How to reset

The drive can be reset either by pressing the STOP key on the Remote Keypad, through a digital input, or by switching the supply voltage off for a while. When the fault has been removed, the motor can be restarted.

Remove the condition which caused the trip and press the STOP key or re-enable the drive. The drive will restart according to the mode selected by parameter 2108 Terminal Mode Restart Function. If the motor is stopped and the display shows StoP, there is no fault; the drive output is disabled and the drive is ready to run.

Fault History

When a fault is detected, it is stored in the fault history. Parameters 0401 Trip History Log can be used to display the last four fault codes for the drive. Use the Up Down arrows to scroll through faults, the most recent fault is displayed first.

Parameters 0402…0417 show drive operation data at the time of the latest fault and run time since last trip.

13.2 Periodic Inspection

A periodic inspection schedule for the drive and driven equipment promotes proper operation and reduces down time. The frequency of inspections depends on operating environment. Inspections should be conducted more frequently in hostile conditions where there might be high vibration, dust, dirt, high humidity, or corrosive atmosphere.

- Check for any loose mounting hardware and tighten to specified torque value.
- Check electrical connections are tight and secure.
- Check the cooling fan and heatsink for debris. Remove obstructions as necessary.

13.3 Drive Module Status LED's

Each control module features two status LED's, labelled A1 and A2; these indicate the drive status.

LED A1 (Green, Red and Yellow) Drive Status

LED A2 Drive Condition, Fireman Mode Status (Solid Yellow = Active)

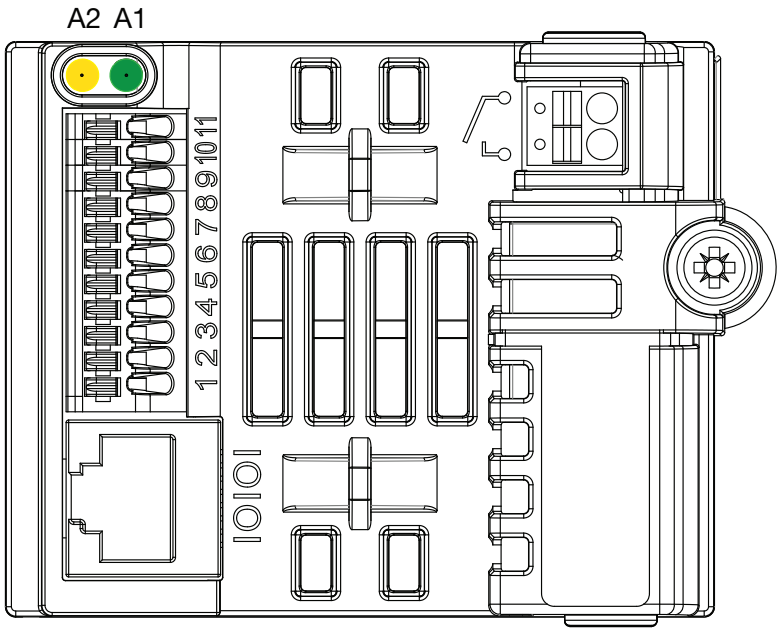


Table 13-1 Drive Model LED Status

Drive Status	LED Status		
	A1		A2
	Green	Red	Yellow
Stop/Inhibit	Slow flashing	Off	Off
Running	Constant On	Off	Off (normal run operation) Slow flashing if overload
Standby	Constant On	Off	Blink every 3s
Trip	Off	Constant On	Off
Power not supported	Off	Blink every 3s	Off
Internal Comms Loss	Off	Red and Yellow slow alternate flashing	
Faulty	Off	Slow flashing	Off
External 24V	Green and Yellow slow flashing at same time	Off	Green and Yellow slow flashing at same time
COPYSTICK2 Transfer Pass	Fast flashing 2s	Off	Off
COPYSTICK2 transfer Fail	Off	Fast flashing 2s	Off
COPYSTICK2 Fail Other	Off	Off	Fast flashing 2s
Fireman Mode	A1 LED functions per table above		Active: Solid Yellow
Power Upgrade	All three LEDs lights up in order (Green->Yellow->Red->Yellow->…)		
IO Upgrade	All LEDs on with weak light – uncontrolled due to bootloader		

13.4 Drive Module Fault Codes

In the event of a trip, the following potential codes can be accessed from the remote keypad. The fault code will be shown and the fault no. will be transferred in the high byte of the drive status word when an external serial communication is used.

Table 13-2 Remote Keypad Fault Codes

Fault Code	No.	Description	Corrective Action
StoP	0x00	Drive is READY and in a stopped condition. The motor is not energized. No enable signal is present to start the drive	
P-dEF	0X0A	Factory Default parameters have been loaded	Press the STOP key, drive is ready to configure for particular application
F0001	0x03	Instantaneous Over Current Excess load or shock load on the motor	**Fault occurs immediately on drive enable or run command** Check the output wiring connections to the motor and the motor for short circuits phase to phase and phase to earth. **Fault occurs during motor starting** Check the motor is free to rotate and there are no mechanical blockages. Ensure the motor nameplate current is correctly entered in parameter ***9906***. Increase acceleration time in parameter ***2202***. Reduce motor boost voltage setting in parameter ***2603***. **Fault occurs when motor operating at constant speed** Investigate overload. **Fault occurs during motor acceleration or deceleration** Accel/Decel times are too short, increase the value of parameter ***2202*** or ***2203***
F0009	0x04	Motor thermal overload protection trip The drive has tripped after delivering >100% of value in 9906 for a period of time to prevent damage to the motor.	Ensure the correct motor nameplate current value is entered in parameter 9906. Check for correct Star or Delta wiring configuration. Check to see when the decimal points are flashing (which indicates the output current > parameter 9906 value) and either increase acceleration ramp (parameter 2202) or decrease motor load. Check the total motor cable length is within the drive specification. Check the load mechanically to ensure it is free, and that no jams, blockages or other mechanical faults exist
F0004	0x05	Hardware Over Current	Check the wiring to motor and the motor for phase to phase and phase to earth short circuits. Disconnect the motor and motor cable and retest. If the drive trips with no motor connected, it must be replaced and the system fully checked and retested before a replacement unit is installed.
F0002	0x06	Over voltage on DC bus	Check the supply voltage is within the allowed tolerance for the drive. If the fault occurs on deceleration or stopping, increase the deceleration time in parameter 2203 or install a suitable brake resistor and activate the dynamic braking function with parameter 2020
F0006	0x07	Under voltage on DC bus	The incoming supply voltage is too low. This trip occurs routinely when power is removed from the drive. If it occurs during running, check the incoming power supply voltage and all components in the power feed line to the drive.
F0003	0x08	Heatsink over temperature	The drive is too hot. Check the ambient temperature around the drive is within the drive specification. Ensure sufficient cooling air is free to circulate around the drive. Increase the panel ventilation if required. Ensure sufficient cooling air can enter the drive, and that the bottom entry and top exit vents are not blocked or obstructed.
U-t	0x09	Under temperature	Trip occurs when ambient temperature is less than -10°C. The temperature must be raised over -10°C in order to start the drive.
F0018	0x10	Faulty thermistor on heatsink.	Refer to your local ABB representative
O-hEAt	0x17	Drive internal temperature too high	Drive ambient temperature too high, check adequate cooling air is provided

Fault Code	No.	Description	Corrective Action
F00 14	0x0B	External trip (on digital input 3)	E-trip requested on control input terminals. Some settings of parameter 9902 DIGITAL INPUTS FUNCTION SELECT require a normally closed contactor to provide an external means of tripping the drive in the event that an external device develops a fault. If a motor thermistor is connected check if the motor is too hot.
F0 10	0x0C	Comms loss trip	Check communication link between drive and external devices. Make sure each drive in the network has its unique address.
F0022	0x0E	Input phase loss trip	Drive intended for use with a 3 phase supply has lost one input phase
SPIn-F	0x0F	Spin start failed	Spin start function failed to detect the motor speed.
F0027	0x11	Internal memory fault.	Parameters not saved, defaults reloaded. Try again. If problem recurs, refer to your local ABB representative
F0007	0x12	Analog input current out of range	Check input current in range defined by parameter 1300.
F002 1	-	Internal drive Fault	Refer to your local ABB representative
FAULTY	-	Internal drive Fault	Refer to your local ABB representative
FLC-dC	-	DC bus ripple too high	Check incoming supply phases are all present and balanced. Check that all power connections are tight and not making intermittent contact (properly seated into connectors).

Appendix A
Modbus-RTU Control

Overview

This chapter gives specific details on how to use Modbus RTU as the communication protocol of the IMD. Below you will find register mapping, telegram structure, and connection details.

ACS255 drives support Modbus RTU communication, allowing a network of drives to be controlled and monitored by any Modbus RTU capable PLC or control system. The drive is always a follower to an external Modbus RTU Master. This document
describes the registers and functions available.

A.1 Modbus RTU Communications

Introduction

The IMD can be connected to a Modbus RTU network via the RJ45 connector or the control terminal strip. The direct physical connection to a Modbus RTU network is made over RS485 via the control terminals T10 (+) & T11 (-).

NOTE: It is recommended for a robust install to use three wires and a 0V connection to T9.

A.2 Modbus RTU Specification

Protocol	Modbus RTU
Error check	CRC
Baud rate	9600bps, 19200bps, 38400bps (default), 57600bps, 115200bps
Data format	1 start bit, 8 data bits, 1 stop bits, no parity.
Physical signal	RS 485 (2-wire)
User interface	RJ45 (see section A.5 for more information)

A.3 RJ45 Connector Configuration

Connection details are shown in section A.5.

A.4 Modbus Telegram Structure

The following Modbus RTU Commands are supported
- 03 Read Holding Registers
- 06 Write Single Holding Register

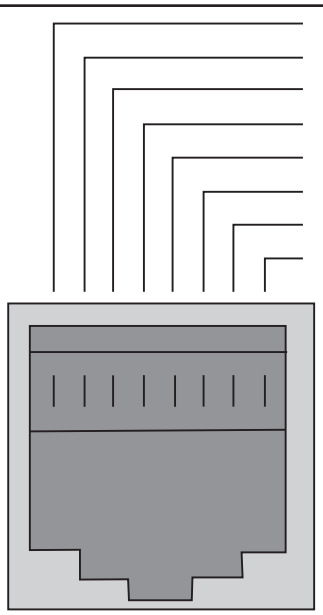
The telegram structure is as follows:

Command 03 – Read Holding Registers						
Master Telegram	Length			Slave Response	Length	
Slave Address	1	Byte		Slave Address	1	Byte
Function Code (03)	1	Byte		Function Code (03)	1	Byte
1st Register Address	2	Bytes		Data Length	2	Bytes
No. Of Registers	2	Bytes		1st Register Value	2	Bytes
CRC Checksum	2	Bytes		2nd Register Value		
				Etc...		
				CRC Checksum	2	Bytes

Command 06 – Write Single Holding Register						
Master Telegram	Length			Slave Response	Length	
Slave Address	1	Byte		Slave Address	1	Byte
Function Code (06)	1	Byte		Function Code (06)	1	Byte
Register Address	2	Bytes		Register Address	2	Bytes
Value	2	Bytes		Register Value	2	Bytes
CRC Checksum	2	Bytes		CRC Checksum	2	Bytes

Modbus command 0x2B (get device ID) can be used to distinguish the drive version type.
Bluetooth version will reply “ABB, ECI, 2.08”
Otherwise it will reply “ABB ECIN 2.08”

A.5 RJ45 Data Connection Pin Configuration



1	No connection
2	No connection
3	0 Volts
4	-RS485 (PC)
5	+RS485 (PC)
6	+24 Volt
7	-RS485 (Modbu RTU) / BACnet*
8	+RS485 (Modbus RTU) / BACnet*

Warning:

This is not an Ethernet connection. Do not connect directly to an Ethernet port.

*Note: Modbus RTU and BACnet MS/TP cannot operate at the same time

A.6 Modbus Register Map

Table A-1 Control and status registers

NOTE: All registers are Holding Registers

Register Number	Parameter Number	Upper Byte	Lower Byte	Format	Min	Max	Command	Type	Scaling
1	-	Control Word		WORD	-	-	03,06	R/W	See Below
2	-	Frequency Setpoint		S16	-5000	5000	03,06	R/W	1dp, e.g. 100 = 10.0Hz
3	-	Reserved		-	-	-	03,06	R/W	No function
4	-	Modbus ramp control time		U16	0	60000	03,06	R/W	2dp, e.g. 500 = 5.00s
5	-	Reserved		-	-	-	03,06	R	No function
6	-	Error code	Drive status	WORD	-	-	03	R	See Below
7	-	Output Frequency		S16	0	5000	03	R	1dp, e.g. 100 = 10.0Hz
8	-	Motor Current		U16	0	-	03	R	1dp, e.g. 100 = 10.0A
9	-	Motor Torque		S16	0	2000	03	R	1dp, e.g. 100 = 10.0%
10	-	Motor Power		U16	0	-	03	R	2dp, e.g. 100 = 1.00kW
11	0160	Digital Input Status		WORD	-	-	03	R	See Below
12	3304	Rating ID		U16	-	-	03	R	Internal Value
13	3304	Power rating		U16	-	-	03	R	2dp, e.g. 37 = 0.37kW / HP
14	3304	Voltage rating		U16	-	-	03	R	See Below
15	0192	IO processor software version		U16	-	-	03	R	2dp, e.g. 300 = 3.00
16	3301	Motor control processor software version		U16	-	-	03	R	2dp, e.g. 300 = 3.00
17	3304	Drive type		U16	-	-	03	R	Internal Value
20	0120	Analog 1 input result		U16	0	1000	03	R	1dp, e.g. 500 = 50.0%
21	0121	Analog 2 input result		U16	0	1000	03	R	1dp, e.g. 500 = 50.0%
22	0111	Pre Ramp Speed Reference Value		S16	0	5000	03	R	1dp, e.g. 500 = 50.0Hz
23	0107	DC Bus Voltage		U16	0	1000	03	R	600 = 600 Volts
24	0110	Drive Power Stage Temperature		S16	-10	150	03	R	50 = 50°C
29	-	Relay Output Status		WORD	0	1	03	R	Bit 0 Indicates Relay Status 1 = Relay Contacts Closed
32	0115	kWh Meter		U16	0	9999	03	R	1dp, e.g. 100 = 10.0kWh
33	0115	MWh Meter		U16	0		03	R	10 = 10MWh
34	0140	Running Time - Hours		U16			03	R	1 = 1 Hour
35	0140	Running Time - Minutes & Seconds		U16			03	R	100 = 100 Seconds
36	0416	Run time since last enable - Hours		U16			03	R	1 = 1 Hour
37	0416	Run time since last enable - Minutes & seconds		U16			03	R	100 = 100 Seconds
38	-	Reserved		U16			03	R	No Function
39	0150	Internal Drive Temperature		S16	-10	100	03	R	20 = 20C
40	-	Speed Reference (Internal Format)		U16	0	2008	03	R	3000 = 50Hz
41	-	Reserved		-	-	-	03	R	No Function
42		Digital Pot / Keypad Reference		U16	0	2008	03	R	3000 = 50Hz
43	0109	Output Voltage		U16	0	-	03	R	100 = 100 Volts AC RMS

Format

WORD = WORD Format, functions assigned to individual bits
S16 = Signed 16 Bit Integer
U16 = Unsigned 16 bit Integer

A.7 Control and Status Register Descriptions

Read-Write Registers

Register 1: Drive Control Word

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
High byte								Low byte							

Bit 0: Run/Stop command: Set to 1 to enable the drive. Set to 0 to stop the drive.

Bit 1:

Bit 2:

User must clear this bit when drive is under normal condition to prevent un-expected reset.

Bit 3:

For normal operation, Bit 3 has the highest priority, bit 0 has the lowest priority (bit 3>bit 1>bit 0). For example if user set command as 0x0009, drive will do a coast stop rather than run. For normal run/start, just set this register to 1.

Note that stat/stop (bit 0), fast stop (bit 1) and coast stop (bit 3) only works if 1100= 0 or 1. Otherwise, start/stop function is controlled by drive control terminals. Reset function (bit 2) works all the time as long as drive is operated under Modbus control mode (1103=3 or 4).

Register 2: Speed Reference

This register holds the speed reference value with one decimal place (200 = 20.0Hz). The maximum speed reference value is limited by 2008. Either register 2 or register 5 can be used for speed reference control, however only one reference should be used in any control system, otherwise unexpected behaviour can result.

Register 4: Acceleration / Deceleration Ramp Time

Active only when 1103 = 4, this register specifies the drive acceleration and deceleration ramp time. The same value is applied simultaneously to the acceleration and deceleration ramp times. The value has two decimal places, e.g. 500 = 5.00 seconds.

Read Only Registers

Register 6: Drive status and error code

High byte gives drive error code. (Valid when the drive is tripped, see Appendix D – Drive Fault Code and Information for further details)

Low byte gives drive status information as follows :-

Bit 0: 0 =Drive Stopped, 1 = Drive Running

Bit 1: 0 = OK, 1 = Drive Tripped

Bit 5: 0 = OK, 1 = In Standby Mode

Bit 6: 0 = Not Ready, 1 = Drive Ready to Run (not tripped, hardware enabled and no mains loss condition)

A.8 Parameter Registers and Scaling

All user adjustable parameters within the drive are accessible by Modbus, and can be Read or Written to. For further information regarding the parameter functions and specific settings, please refer to the User Guide.

Register	Parameter	Description	Format	Min	Max	Data format / scaling
129	0401	Trip Log	U16	-	-	See user guide for details
130	1100	Keypad restart mode	U16	0	7	See user guide for details
131	1103	Control mode	U16	0	6	0: Terminal Control 1: Keypad forward only 2: Keypad forward and reverse 3: Modbus control mode 4: Modbus control with ramp control 5: PID control 6: PID control with analog speed sum 7: CAN Open
132	1202	Preset Speed 1	U16	-2008	2008	Internal value (3000 = 50.0Hz)
133	1203	Preset Speed 2	U16	-2008	2008	Internal value (3000 = 50.0Hz)
134	1204	Preset Speed 3	U16	-2008	2008	Internal value (3000 = 50.0Hz)
135	1205	Preset Speed 4	U16	-2008	2008	Internal value (3000 = 50.0Hz)
136	1300	Analog input format	U16	0	7	0: 0…10V 1: b 0…10V 2: 0…20mA 3: t 4…20mA 4: r4…20mA 5: t 20…4mA 6: r 20…4mA 7: 10…0V
137	1301	Analog iput offset	U16	-5000	5000	1dp,e.g. 300=30.0%
138	1302	Analog Input / Slave Scaling	U16	0	20000	1000 = 100.0%
139	1304	Analog Input 2 Format	U16	0	6	0: 0…10V 1: b 0…10V 2: 0…20mA 3: t 4…20mA 4: r4…20mA 5: t 20…4mA 6: Ptc-th

Register	Parameter	Description	Format	Min	Max	Data format / scaling
140	1401	Relay Output Function	U16	0	9	See user guide for function details
141	1501	Analog Output Function	U16	0	10	See user guide for function details
142	1602	Parameter lock	U16	0	1	0: Unlocked 1: Locked
143	1603	Access code definition	U16	0	9999	
144	2007	Min speed limit	U16	0	2008	Internal value (3000 = 50.0Hz)
145	2008	Max speed limit	U16	0	5*9907	Internal value (3000 = 50.0Hz)
146	2020	Brake circuit enable	U16	0	4	See user guide for function details
147	2101	Spin Start Enable	U16	0	2	See user guide for function details
148	2102	Stop Mode	U16	0	2	0: Ramp to stop + Mains Loss Ride Through 1: Coast to stop 2: Ramp to stop + Fast Stop 3: Ramp to stop + Fast Stop
149	2104	DC Injection	WORD	See Below		
150	2108	Start Mode Select	U16	0	6	0: Edgr-r 1: Auto_0 2...6 : Auto_1 to Auto_5
151	2202	Accel ramp time	U16	0	60000	2dp, e.g. 300=3.00s
152	2203	Decel ramp time	U16	0	60000	2dp, e.g. 300=3.00s
153	2206	2nd Ramp	U16	0	2500	2dp e.g. 250 = 2.50s
154	2500	Skip Frequency Centre	U16	0	2008	Internal value (3000 = 50.0Hz)
155	2501	Skip Frequency Band	U16	0	2008	Internal value (3000 = 50.0Hz)
156	2601	Energy Optimiser	U16	0	1	0: Disabled 1: Enabled
157	2603	Boost Value	U16	0	Drive Rating Dependent	1dp, e.g. 100 = 10.0%
158	2606	Effective switching frequency	U16	0	5 (Drive Rating Dependent)	0 = 4KHz 1 = 8KHz 2 = 12Khz 3 =16KHz 4 = 24KHz 5 = 32KHz
159	2610	V/F Adjust Voltage	U16	0	9905	100 = 100V

Register	Parameter	Description	Format	Min	Max	Data format / scaling
160	2611	V/F Adjust Frequency	U16	0	9907	50 = 50Hz
161	3005	Thermal Overload Retention	U16	0	1	
162	3200	Digital Threshold	U16	0	1000	100 = 10.0%
163	3400	Display Scaling Function	WORD	See Below		
164	4001	User PI P gain	U16	1	300	1dp, e.g. 10 = 1.0
165	4002	User PI I time constant	U16	0	300	1dp, e.g. 10 = 1.0s
166	4005	User PI mode select	U16	0	1	See user guide for more information
167	4010	User PI reference select	U16	0	1	See user guide for more information
168	4011	User PI digital reference	U16	0	1000	1dp, e.g. 100 =10.0%
169	4016	User PI feedback select	U16	0	3	See user guide for more information
170	5302	Communication Settings	WORD	See Below		
171	9902	Digital input function	U16	0	17	See user guide for function details
172	9905	Motor rated Volts	U16	0	250/500	400 = 400 Volts
173	9906	Motor rated current	U16	0	Drive Rating Dependent	1dp, e.g. 100 = 10.0A
174	9907	Motor rated Frequency	U16	25	500	Data unit is in Hz
175	9908	Motor rated speed	U16	0	30000	Maximum value equals to the sync speed of a typical 2-pole motor
176	2017	Maximum Current Limit	U16	0	1750	1dp, e.g. 1000 = 100.0%
177	2105	DC Injection Speed	U16	0	2008	3000 = 50.0Hz
178	2106	DC Injection Current	U16	0	1000	1dp, e.g. 100 = 10.0%
179	2301	Vector Mode Gain	U16	0	2000	1dp, e.g. 500 = 50.0%
180	2605	Application Mode	U16	0	2	0: Industrial Mode 1: Pump Mode 2 Fan Mode
181	9903	Motor Control Mode	U16	0	4	0: IM Vector 1: V/F 2 PM Motor 3 BLDC Motor
182	9910	Motor Parameter Autotune	U16	0	1	
183	11201	Motor Stator Resistance	U16	0	65535	2dp, e.g. 100 = 1.00R

Register	Parameter	Description	Format	Min	Max	Data format / scaling
184	11203	Motor Stator d-axis Inductance (Lsd)	U16	0	65535	1dp, e.g. 1000 = 100.0mH
185	11206	Motor Stator q-axis Inductance (Lsq)	U16	0	65535	1dp, e.g. 1000 = 100.0mH
186	96102	Bluetooth Enable	U16	0	1	0: Bluetooth Enabled (Default) 1: Bluetooth Disabled
187	96103	Data Log Record Erase	U16	0	1	0: Don't erase 1: Erase
188	5840	Device Object ID Low	U16	0	65635	
189	5841	BACnet Maximum Masters	U16	0	127	
190	5899	Device Object ID High	U16	0	63	

A.9 Additional Information

Register 149: DC Injection Configuration

The parameter value is stored as a combined 16 bit word which is constructed as follows:

High byte								Low byte							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DC Injection Mode 0 : DC Injection on Start 1 : DC Injection on Stop 2 : DC Injection on Start & Stop								DC Injection Duration : 1dp, e.g. 0 – 250 = 0.0 – 25.0s							

Register 170: Communications Configuration

This Register entry contains multiple data entries, as follows:

High byte								Low byte							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Trip Configuration				Baud Rate				Drive Address							

Data values can be interpreted as follows:		
Drive Address	1 to 63	
Baud Rate	0	115k2
	1	115k2
	2	9k6
	3	19k2
	4	38k4
	5	57k6
	6	115k2
	7	115k2
	8	115k2
	9	115k2
	10	115k2
Trip Time Set-up	0	Comms Loss Trip Disabled
	1	30ms Watchdog, Trip on Comms Loss
	2	300ms Watchdog, Trip on Comms Loss
	3	1000ms Watchdog, Trip on Comms Loss
	4	3000ms Watchdog, Trip on Comms Loss
	5	30ms Watchdog, Ramp To Stop on Comms Loss
	6	300ms Watchdog, Ramp To Stop on Comms Loss
	7	1000ms Watchdog, Ramp To Stop on Comms Loss
	8	3000ms Watchdog, Ramp To Stop on Comms Loss

Register 163: Display Scaling

The parameter value is stored as a combined 16 bit word which is constructed as follows:

High byte								Low byte							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Display Scaling Source	Display Scaling Factor : 3dp, e.g. 0 – 16000 = 0.000 – 16.000
0 : Motor Speed	
1 : Motor Current	
2 : Analog Input 2 Signal	
3 : PI Feedback	

A.10 Modbus Exception Response Telegrams

Under some circumstances, the drive may reply with an Exception Response (error) in response to a request telegram sent from the network master, for example where the master tries to read a register which does not exist. Exception Responses which can be generated by the drive are listed below:

Exception Code 1: ***Invalid Request***

Exception Code 2: ***Invalid Modbus register***

Exception Code 3: ***Register Value Out of Range***

Exception Code 6: ***Drive Busy***

Exception codes may be returned under the following conditions:

- Network Master sends an unsupported Modbus command (e.g. Read Coils).
- Run command issued to drive whilst the drive is not set for Modbus Control Mode (e.g. 1103 <>4).
- Run command issued to drives whilst the drive is not enabled (e.g. Digital Input 1 is open).
- Run command issued to drive whilst the drive is in a tripped condition.
- Network Master attempts to read or write a register that does not exist within the drive.
- Network Master attempts to write a holding register with a value outside the range of the register
- Drive busy due to internal data transfer. The Network Master should re-send the message after a delay

A.11 Dataflow Example

Read data from register 6

Request:	[01]	[03]	[00] [05]	[00] [01]	[94] [0B]
	(Drive Addr)	(Command)	(Reg start addr)	(No. of Registers)	(Checksum)
Reply:	[01]	[03]	[02]	[00] [00]	[B8] [44]
	(Drive Addr)	(Command)	(No of data bytes)	(Data)	(Checksum)

Note: The actual start address of register 6 is 5. All data in [ ] is in 8bits Hex format.

Write start command to the register 1 (suppose 1103 = 3, 9902 =0 and digital input 1 is closed):

Request:	[01]	[06]	[00] [00]	[00] [01]	[48] [0A]
	(Drive Addr)	(Command)	(Reg addr)	(Data value)	(Checksum)
Reply:	[01]	[06]	[00] [00]	[00] [01]	[48] [0A]
	(Drive Addr)	(Command)	(Reg addr)	(Data value)	(Checksum)

Note: The actual address of register 1 on the data link is 0. All data in [ ] is in 8bits Hex format.

Reply can be error message depending on drive parameter settings and digital input status.

A.12 Drive Fault Code and Information

Error Codes may be returned in the High Byte of Register 6 as below.

Fault Code	No.	Description	Corrective Action
StoP	0x00	Drive is READY and in a stopped condition. The motor is not energized. No enable signal is present to start the drive	
P-dEF	0X0A	Factory Default parameters have been loaded	Press the STOP key, drive is ready to configure for particular application
F0001	0x03	Instantaneous Over current on the drive output. Excess load or shock load on the motor.	**Fault occurs immediately on drive enable or run command** Check the output wiring connections to the motor and the motor for short circuits phase to phase and phase to earth. **Fault occurs during motor starting** Check the motor is free to rotate and there are no mechanical blockages. If the motor has a brake fitted, check the brake is releasing correctly. Check for correct star-delta motor wiring. Ensure the motor nameplate current is correctly entered in parameter ***9906***. Increase acceleration time in parameter ***2202***. Reduce motor boost voltage setting in parameter ***2603*** **Fault occurs when motor operating at constant speed Investigate overload.** **Fault occurs during motor acceleration or deceleration** The accel/decel times are too short requiring too much power. If parameter ***2202*** or ***2203*** cannot be increased, a bigger drive may be required
F0009	0x04	Motor thermal overload protection trip. The drive has tripped after delivering >100% of value in 9906 for a period of time to prevent damage to the motor.	Ensure the correct motor nameplate current value is entered in parameter 9906. Check for correct Star or Delta wiring configuration. Check to see when the decimal points are flashing (which indicates the output current > parameter ***9906*** value) and either increase acceleration ramp (parameter ***2202***) or decrease motor load. Check the total motor cable length is within the drive specification. Check the load mechanically to ensure it is free, and that no jams, blockages or other mechanical faults exist
OL-b	0x01	Brake channel over current (excessive current in the brake resistor)	Check the cabling to the brake resistor and the brake resistor for short circuits or damage. Ensure the resistance of the brake resistor is equal to or greater than the minimum value for the relevant drive shown in the user manual.
OL-br	0x02	Brake resistor thermal overload. The drive has tripped to prevent damage to the brake resistor	Only occurs if parameter ***2020*** = 1. The internal software protection for the brake resistor has activated to prevent damage to the brake resistor. Increase the deceleration time (parameter ***2203***) or 2nd deceleration time (parameter ***2206***). Reduce the load inertia ***For Other Brake Resistors*** Ensure the resistance of the brake resistor is equal to or greater than the minimum value for the relevant drive shown in the table in the user manual. Use an external thermal protection device for the brake resistor. In this case, parameter ***2020*** may be set to 2

F0004	0x05	Hardware Over Current	Check the wiring to motor and the motor for phase to phase and phase to earth short circuits. Disconnect the motor and motor cable and retest. If the drive trips with no motor connected, it must be replaced and the system fully checked and retested before a replacement unit is installed.
F0002	0x06	Over voltage on DC bus	Check the supply voltage is within the allowed tolerance for the drive. If the fault occurs on deceleration or stopping, increase the deceleration time in parameter ***2203*** or install a suitable brake resistor and activate the dynamic braking function with parameter ***2020***
F0006	0x07	Under voltage on DC bus	The incoming supply voltage is too low. This trip occurs routinely when power is removed from the drive. If it occurs during running, check the incoming power supply voltage and all components in the power feed line to the drive.
F0003	0x08	Heatsink over temperature	The drive is too hot. Check the ambient temperature around the drive is within the drive specification. Ensure sufficient cooling air is free to circulate around the drive. Increase the panel ventilation if required. Ensure sufficient cooling air can enter the drive, and that the bottom entry and top exit vents are not blocked or obstructed.
U-t	0x09	Under temperature	Trip occurs when ambient temperature is less than -10°C. The temperature must be raised over -10°C in order to start the drive.
F0018	0x10	Faulty thermistor on heatsink.	Refer to your local ABB representative
O-hEAt	0x17	Drive internal temperature too high	Drive ambient temperature too high, check adequate cooling air is provided
F0014	0x0B	External trip (on digital input 3)	E-trip requested on control input terminals. Some settings of parameter ***9902*** DIGITAL INPUTS FUNCTION SELECT require a normally closed contactor to provide an external means of tripping the drive in the event that an external device develops a fault. If a motor thermistor is connected check if the motor is too hot.
F0010	0x0C	Comms loss trip	Check communication link between drive and external devices. Make sure each drive in the network has its unique address.
F0022	0x0E	Input phase loss trip	Drive intended for use with a 3 phase supply has lost one input phase.
SPIn-F	0x0F	Spin start failed	Spin start function failed to detect the motor speed.
F0027	0x11	Internal memory fault.	Parameters not saved, defaults reloaded. Try again. If problem recurs, refer to your local ABB representative
F0007	0x12	Analog input current out of range	Check input current in range defined by parameter ***1300***.
F0021	-	Internal drive Fault	Refer to your local ABB representative
FAULtY	-	Internal drive Fault	Refer to your local ABB representative
AtF-01	40	Autotune Fault	Measured motor stator resistance varies between phases. Ensure the motor is correctly connected and free from faults. Check the windings for correct resistance and balance.
AtF-02	41		Measured motor stator resistance is too large. Ensure the motor is correctly connected and free from faults. Check that the power rating corresponds to the power rating of the connected drive.
AtF-03	42		Measured motor inductance is too low. Ensure the motor is correctly connected and free from faults.
AtF-04	43		Measured motor inductance is too large. Ensure the motor is correctly connected and free from faults. Check that the power rating corresponds to the power rating of the connected drive.
AtF-05	44		Measured motor parameters are not convergent. Ensure the motor is correctly connected and free from faults. Check that the power rating corresponds to the power rating of the drive.

Appendix B
BACnet Control

Overview

This chapter gives specific details on how to use BACnet MS/TP as the communication protocol of the IMD. Below you will find register mapping, telegram structure, and connection details.

ACS255 drives support BACnet MS/TP communication, allowing a network of drives to be controlled and monitored by any BACnet MS/TP capable PLC or control system. The drive is always a Follower to an external BACnet MS/TP Master. This document describes the registers and functions available.

B.1 BACnet MS/TP Communications

The IMD can be connected to a BACnet MS/TP network via the RJ45 connector or the terminal strip. The direct physical connection to a BACnet MS/TP network is made over RS485 via the control terminals T10 (+) & T11 (-).

NOTE: It is recommended for a robust install to use three wires and a 0V connection to T9.

B.2 BACnet MS/TP Specification

Protocol:	BACnet MS/TP
Physical signal:	RS485, RJ45, half duplex.
Interface:	RJ45
Baudrate:	9.6kbps, 19.2kpbs, 38.4kpbs(default), 57.6kpbs, 115 kbps
Data Format:	8N1

B.3 RJ45 Connector Configuration

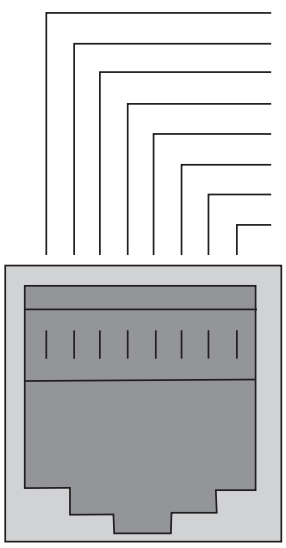
Connection details are shown in section A.5.

B.4 BACnet Communication Activation

BACnet is activated by selecting 1103 PRIMARY COMMAND SOURCE MODE =9

Selection of control source can be selected in 9902 to determine if control reference and start/stop control is over the network or the terminal strip of the drive.

B.5 RJ45 Data Connection Pin Configuration



1	No connection
2	No connection
3	0 Volts
4	-RS485 (PC)
5	+RS485 (PC)
6	+24 Volt
7	-RS485 (Modbu RTU) / BACnet*
8	+RS485 (Modbus RTU) / BACnet*

Warning:

This is not an Ethernet connection. Do not connect directly to an Ethernet port.

*Note: Modbus RTU and BACnet MS/TP cannot operate at the same time

B.6 Object Dictionary

Binary Input Object

Object ID	Object Name	Access	Description	Active/Inactivetext
BI0	R01 – Monitor	R	Status of relay output 1	On / Off
BI5	D01 – Monitor	R	Status of digital output 1 **Note:** Statement will be added to the user manual stating “BI5 is only valid if 1501 is configured to a 0-7 setting” This is because when parameter 1501 is set 8-10 then terminal 8 operates as an analogue output and not digital output.	On / Off
BI6	DI1 – Monitor	R	Status of digital input 1	On / Off
BI7	DI2 – Monitor	R	Status of digital input 2	On / Off
BI8	DI3 – Monitor	R	Status of digital input 3	On / Off
BI8	DI4 – Monitor	R	Status of digital input 4	On / Off

R= Read only, W= Writeable, C=Commandable

Binary Output Object

Object ID	Object Name	Access	Description	Active/Inactivetext
BO0	R01 – Command	R	Output state of relay 1	On / Off
BO5	DO1 – Command	R	Output state of digital output 1	On / Off

R = Read only, W = Writeable, C = Commandable

Binary Value Object

Object ID	Object Name	Access	Description	Active/Inactivetext
BV0	Run / Stop-Monitor	R	Drive’s run status	Run / Stop
BV1	Direction-Monitor	R	Rotational direction of the motor	Reverse / Forward
BV2	OK-Fault-Monitor	R	Actual fault status of the drive	Fault / OK
BV4	Warning-Monitor	R	Actual Operator Mode, Hand = Keypad (1103=1 or 2) Auto = Terminal or BACnet (Fieldbus) (1103 not 1 or 2)	Hand / Auto
BV5	Ready-Monitor	R	Overload status (warning when Output current > Motor rated current)	Warning / OK
BV7	At-Setpoint-Monitor	R	Actual ready status	Ready / Not-Ready
BV8	At-Setpoint-Monitor	R	Actual at setpoint status	Yes / No
BV10	RUN-STOP-Command	C	Command to start drive	Run / Stop
BV11	Direction-Command	C	Command to rotational direction	Reverse / Forward
BV14	Fault-Reset-Command	W	Command to fault reset	Reset / No
BV17	Lock-Parameters	R	Actual status of parameter lock	Lock / Unlock
BV41	Fire Mode	R	Indicates if drive is in Fire Mode	On / Off

R= Read only, W= Writeable, C=Commandable

Analog Input Object Instance

Object ID	Object Name	Access	Description	Units	Min/Max preset value
AI0	AI1 – Monitor	R	Indicates the input level of analog input 1	Percent (%)	0…100%
AI1	AI2 - Monitor	R	Indicates the input level of analog input 2	Percent (%)	0…100%

R = Read only, W = Writeable, C = Commandable

Analog Value Object Instance

Object ID	Object Name	Access	Description	Units
AV0	*Output-RPM	R	Motor speed	Rpm
AV1	Output-Freq	R	Output frequency	Hz
AV2	DC-Voltage	R	DC bus voltage	V
AV3	Output-Voltage	R	AC output voltage	V
AV4	Output-Current	R	Output current of drive	A
AV5	Output-Torque	R	Output torque of motor as a percentage of nominal torque	%
AV6	Output-Power	R	Output power in kW	kW
AV7	Operating-Temp-Range	C	Heatsink temperature	C
AV8	Kilowatt-Hour-Meter-NR	R	Drives cumulative energy usage. This value is not resettable	kW/h
AV9	Running-Hours	R	Drive resettable run time	Hours
AV14	Input-Reference-1	C	Speed setpoint 1	% of maximum speed
AV16	Active-Fault	R	Displays most recent fault currently active	
AV18	Previous-Fault-1	R	Displays most recent stored (non-active) fault	
AV20	Previous-Fault-2	R	Displays the second most recent stored (non-active) fault	
AV21	AO1-Monitor	R	Output level of analog output 1	%
AV23	Accel-1-Seconds	W	Ramp 1 acceleration time	S
AV24	Decel-1-Seconds	W	Ramp 1 deceleration time	S
AV29	Min-Speed	W	Defines the allowed minimum output frequency	Hz
AV30	Max-Speed	W	Defines the allowed maximum output frequency	Hz
AV31	Output-Speed	R	Actual motor speed (as % of motor rated frequency value in 9907)	%
AV32	Output-Current-Range	R	Actual motor current (as % of motor rated current value in 9906)	%
AV33	Max-Current	W	Max motor current (Motor rated current value in 9906)	A
AV40	PID Feedback	R	PID controller feedback value monitor	%
AV41	PID reference	R	PID controller reference value monitor	%

R= Read only, W= Writeable, C=Commandable

*Value only works if motor rated speed has been entered into parameter 9908, otherwise 0 will always be shown.

Appendix A
Options and Kits

Overview

This appendix gives details on the option kits and accessories available for the EC Titanium.

A.1 Remote Keypad ECS100L

The REMOTE PANEL is designed for programming and control of the EC Titanium. Reference MN449 Remote Keypad Manual for detailed information on mounting, wiring and installation of the remote keypad. The kit comes with a 3-meter RJ45 cable.

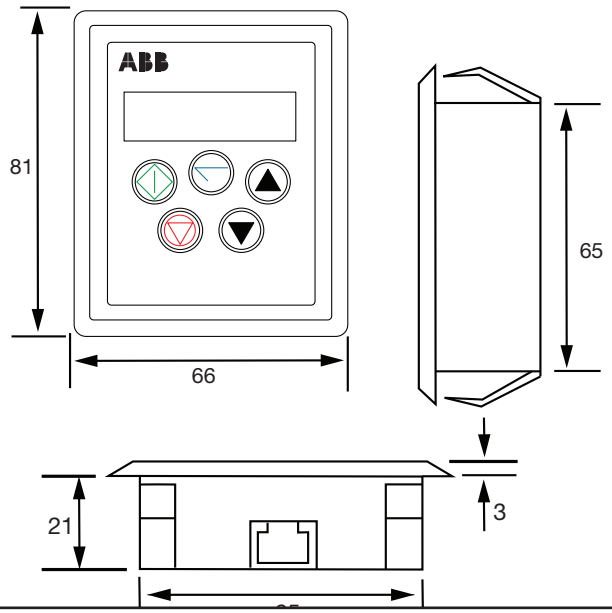


Part Number	Description
ECS100L	EC Titanium Remote LED Keypad
MN449	ECS100L Remote Keypad Instruction Manual

General Specifications

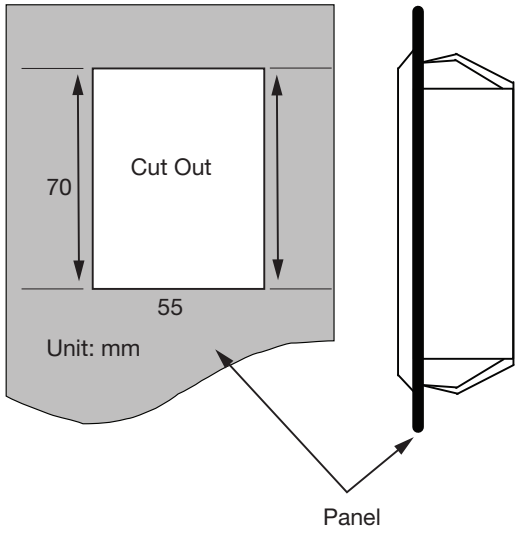
Compatible Drives:	EC Titanium	
Signal Interface:	Standard 6-way RJ45 connector	
Supply Input:	10V … 36V DC, 30mA	
RS485 signal:	Industry standard 2-wire +5V differential	
Environmental:	Operational	0 … 50 °C
	Storage	-40 °C … 60 °C
	Relative Humidity	< 95% (noncondensing)
Protection rating:	IP54	
Max cable length:	20m (unscreened, total length)	
	100m (screened, twisted pair, total length	

Dimensions



Through Panel Mount

The panel on to which the REMOTE PANEL is to be mounted should be cut out in accordance with the diagram below.



A.2 Remote Keypad ECS100B

The COPYSTICK2 is used for fast and accurate repeat drive programming. Reverence MN450 User Guide for detailed information on operation.

Part Number	Description
ECS100B	COPYSTICK2
MN450	ECS100B Instruction Manual



A.3 USB PC Connection Kit ECS100U

The USB PC Connection Kit connects between the RJ45 port on the EC Titanium and a USB PC Port. This kit is used when programming the drive with the PC Software Tools.

Part Number	Description
ECS100U	USB PC Connection Kit

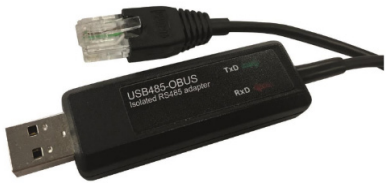


ABB Motors and Mechanical Inc.
5711 R.S. Boreham, Jr. Street
Fort Smith, AR 72901
Ph: 1.479.646.4711

new.abb.com/motors-generators

Additional information
We reserve the right to make technical changes or modify the contents of this document without prior notice. With regard to purchase orders, the agreed particulars shall prevail. ABB does not accept any responsibility whatsoever for potential errors or possible lack of information in this document.

We reserve all rights in this document and in the subject matter and illustrations contained therein. Any reproduction, disclosure to third parties or utilization of its contents – in whole or in parts – is forbidden without prior written consent of ABB.

© Copyright 2022 ABB. All rights reserved.
Specifications subject to change without notice.

448-0122

MN448 January 2022