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BENSHAW
ADVANCED CONTROLS & DRIVES

RSi S4 Series

Sensorless Vector Drive
User Manual

1 HP - 115V
1 to 30HP - 230V
1 to 200HP - 460V
1 to 200HP - 600V

The Leader In

Solid State Motor Control

Technology

Dec 2007
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Congratulations on the purchase of your new Benshaw RSi S4 Sensorless Vector Drive (SVD). The RSi S4 Sensorless Vector Drive is a solid-state AC drive that features Vector Control Algorithm, True Torque Control
This manual gives handling information and precautions for use of this equipment.
Incorrect handling of the drive may result with an unexpected fault or damage to the drive. For best results on operating the RSi S4 drive, carefully read this manual and all warning labels attached to the drive before installation and operation. Keep this manual on hand for reference.

Do not attempt to install, operate, maintain or inspect the drive until you have thoroughly read this manual and related documents carefully and can use the equipment correctly.
Do not use the drive until you have a full knowledge of the equipment, safety procedures and instructions.
This instruction manual classifieds safety instruction levels under "WARNING" and "CAUTION".

Electrical Hazard that could result in injury or death.

Caution that could result in damage to the drive.
Highlight marking an important point in the documentation.

Please follow the instructions of both safety levels as they are important to personal safety.

High Voltage

Motor control equipment and electronic controllers are connected to hazardous line voltages. When servicing drives and electronic controllers, there may be exposed components with housings or protrusions at or above line potential. Extreme care should be taken to protect against shock.
Stand on an insulating pad and make it a habit to use only one hand when checking components. Always work with another person in case an emergency occurs. Disconnect power before checking controllers or performing maintenance. Be sure equipment is properly grounded. Wear safety glasses whenever working on electronic controllers or rotating machinery.

TRADEMARK NOTICE

Benshaw and BENSHAW ADVANCED CONTROLS & DRIVES are registered trademarks of Benshaw Incorporated.
ModBus is a registered trademark of Modicon.
DeviceNet is a registered trademark of the Open DeviceNet Vendor Association (ODVA).
Metasys is a registered trademark of Johnson Controls, Inc.
UL is a trademark of Underwriters Laboratories, Incorporated.

SAFETY PRECAUTIONS

Electric Shock Prevention

- While power is on or drive is running, do not open the front cover. The capacitor bank may remain charged even when power is not applied, and you may get an electrical shock.
- This drive contains high voltage which can cause electric shock resulting in personal injury or loss of life.
- Be sure all AC power is removed from the inverter before servicing.
- Wait at least 5 minutes after turning off the AC power for the bus capacitors to discharge. Measure the DC Bus voltage between B+ and B- terminals, and ensure DC voltage is below 30V before proceeding.
- Do not connect or disconnect the wires to or from drive when power is applied.
- Make sure ground connection is in place.
- Always install the drive before wiring. Otherwise, you may get an electrical shock or be injured.
- Operate the switches with dry hands to help prevent an electrical shock.
- Risk of Electric Shock - More than one disconnect switch may be required to de-energize the equipment before servicing.

Injury Prevention

- Service only by qualified personnel.
- Make sure power-up restart is off to prevent any unexpected operation of the motor.
- Make certain proper shield installation is in place.
- Apply only the voltage that is specified in this manual to the terminals to prevent damage.

Fire Prevention

- If the drive is faulty, switch off the drive power. A continuous flow of large current could cause a fire.
- Mount the drive on a non-flammable surface. Installing the drive directly on or near a flammable surface could lead to a fire.
- Do not connect a resistor directly to the DC terminals. This could cause a fire.

Transportation and Installation

- Use proper lifting gear when carrying products, to prevent injury.
- Make certain that the installation position and materials can withstand the weight of the drive. Refer to the installation information in this manual for correct installation.
- If parts are missing or drive is damaged, do not operate the drive.
- Do not hold the drive by the front cover as it may fall off.
- Do not stand or rest heavy objects on the drive, as damage to the drive may result.
- Do not subject the drive to impact or dropping.
- Make certain to prevent screws, wire fragments, conductive bodies, oil or other flammable substances from entering the drive.

Trial Run

- Check all parameters, and ensure that the application will not be damaged by a sudden start-up.

Emergency Stop

- To prevent the machine and equipment from hazardous conditions if the drive fails, provide a safety backup such as an emergency brake.

Disposing of the Drive

- Never dispose of electrical components via incineration. Contact your state environmental agency for details on disposal of electrical components and packaging in your area.

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1 Introduction

USING THIS MANUAL

Layout

This manual is divided into 7 sections. Each section contains topics related to the section. The sections are as follows:

- Introduction
- Technical Specifications
- Installation
- Connection
- Keypad Operation and Programming
- Troubleshooting & Maintenance
- Appendices

Symbols

There are 2 symbols used in this manual to highlight important information. The symbols appear as follows:

Electrical Hazard that warns of situations in which a high voltage can cause physical injury, death and/or damage equipment.

Caution that warns of situations in which physical injury and/or damage to equipment may occur by means other than electrical.

Highlight marking an important point in the documentation.

BENSHAW SERVICES

General Information

Benshaw offers its customers the following:

- Start-up services
- On-site training services
- Technical support
- Detailed documentation
- Replacement parts

⌘ **NOTE:** Information about products and services is available by contacting Benshaw.

Start-Up Services

Benshaw technical field support personnel are available to customers with the initial start-up of the RSi S4 drive. Information about start-up services and fees are available by contacting Benshaw.

On-Site Training Services

Benshaw technical field support personnel are available to conduct on-site training on RSi S4 operations and troubleshooting.

Technical Support

Benshaw technical support personnel are available (at no charge) to answer customer questions and provide technical support over the telephone. For more information about contacting technical support personnel, refer to Contacting Benshaw on page 4.

Documentation

Benshaw provides all customers with:

- Operations manual.
- Wiring diagram.

All drawings are produced in AutoCAD© format. The drawings are available on standard CD / DVD or via e-mail by contacting Benshaw.

On-Line Documentation

All RSi S4 documentation is available on-line at **http://www.benshaw.com**.

Replacement Parts

Spare and replacement parts can be purchased from Benshaw Technical Support.

Software Number

This manual pertains to the software version number 1.94.

Warranty

Benshaw provides a 1 year standard warranty with its drives. A 2 year warranty extension is provided when a Benshaw or Benshaw authorized service technician completes the installation and initial start up. The warranty data sheet must also be signed and returned. This information is also available by going online to register at www.benshaw.com. The cost of this service is not included in the price of the Benshaw VFD and will be quoted specifically to each customers needs. All recommended maintenance procedures must be followed throughout the warranty period to ensure validity.

CONTACTING BENSHAW

1.1 Contacting Benshaw

Contacting Benshaw

Information about Benshaw products and services is available by contacting Benshaw at one of the following offices:

Benshaw Inc. Corporate Headquarters
1659 E. Sutter Road
Glenshaw, PA 15116
Phone: (412) 487-8235
Toll Free: (800) 203-2416
Fax: (412) 487-4201

Benshaw Canada Controls Inc.
550 Bright Street East
Listowel, Ontario N4W 3W3
Phone: (519) 291-5112
Toll Free: (877) 236-7429 (BEN-SHAW)
Fax: (519) 291-2595

Benshaw West
14715 North 78th Way, Suite 600
Scottsdale, AZ 85260
Phone: (480) 905-0601
Fax: (480) 905-0757

Ben-Tech Industrial Automation
2904 Bond Street
Rochester Hills, MI 48309
Phone: (480) 905-0601
Fax: (480) 905-0757

Benshaw High Point
EPC Division
645 McWay Drive
High Point, NC 27263
Phone: (336) 434-4445
Fax: (336) 434-9682

Benshaw Mobile
CSD Division
5821 Rangeline Road, Suite 202
Theodor, AL 36582
Phone: (251) 443-5911
Fax: (251) 443-5966

Benshaw Pueblo
Trane Division
1 Jetway Court
Pueblo, CO 81001
Phone: (719) 948-1405
Fax: (719) 948-1445

E-mail:
usatechsupport@benshaw.com
cantechsupport@benshaw.com

Technical support for the RSi S4 Series is available at no charge by contacting Benshaw's customer service department at one of the above telephone numbers. A service technician is available Monday through Friday from 8:00 a.m. to 5:00 p.m. EST.

⌘ **NOTE:** An on-call technician is available after normal business hours and on weekends by calling Benshaw and following the recorded instructions.

To help assure prompt and accurate service, please have the following information available when contacting Benshaw:
- Name of Company
- Telephone number where the caller can be contacted
- Fax number of caller
- Benshaw product name
- Benshaw model number
- Benshaw serial number
- Name of product distributor
- Approximate date of purchase
- Voltage of motor attached to Benshaw product
- FLA of motor attached to Benshaw product
- A brief description of the application

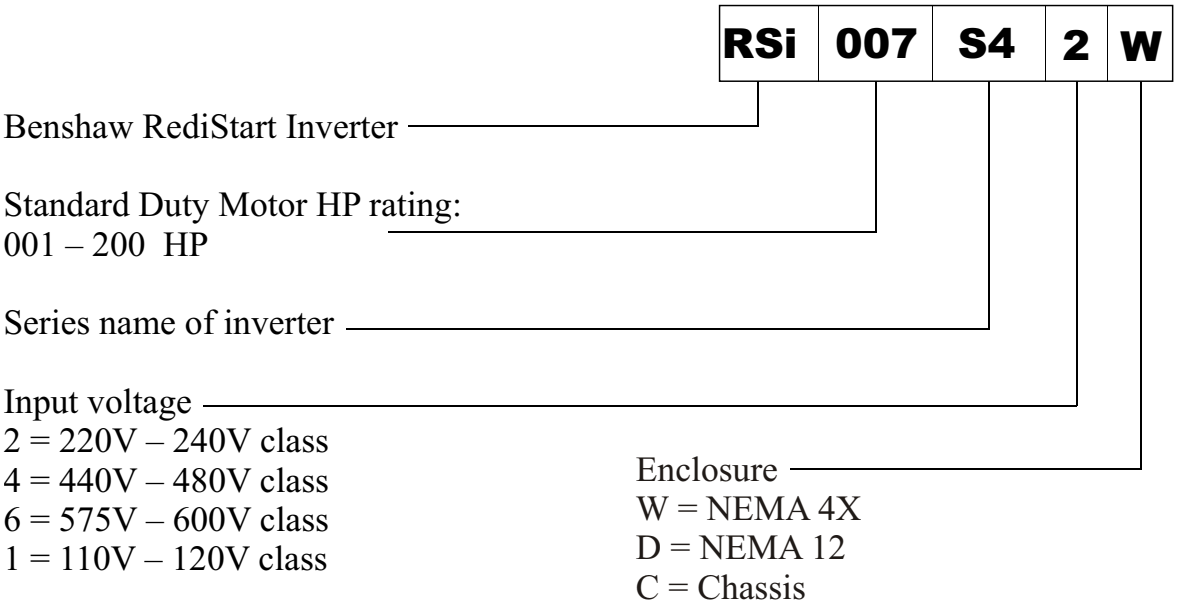
INTERPRETING MODEL NUMBERS

1.2 Interpreting Model Numbers

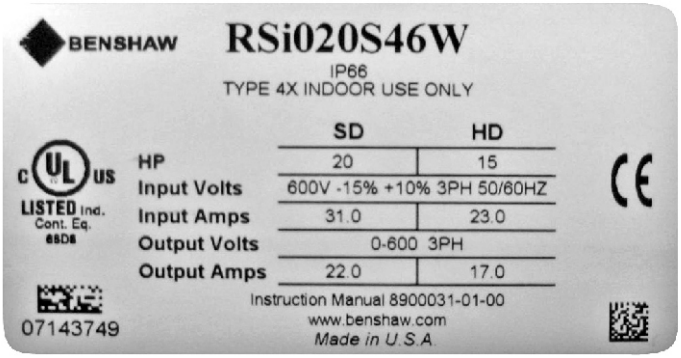
Model Numbers

The model number of the RSi S4 drive appears on the shipping carton label and on the technical data label affixed to the model. Read the technical data label affixed to the drive and ensure that the correct horsepower and input voltage for the application has been purchased. The numbering system for a Benshaw inverter is shown below.

Figure 1: RSi S4 Drive Model Numbers



Name Plate Example



PRODUCT OVERVIEW

1.3 Product Overview

Although the S4 AC drive is small in size, it is big on performance. It is an economical yet powerful solution for many industrial applications. It features remote communications capability (using Modbus protocol), a keypad for easy configuration, and standard NEMA 4X enclosures that eliminate the need for mounting in a separate enclosure.

The S4 product family includes a wide variety of models to suit almost any input voltage requirement. An 'x' in the following table indicates what models are currently available.

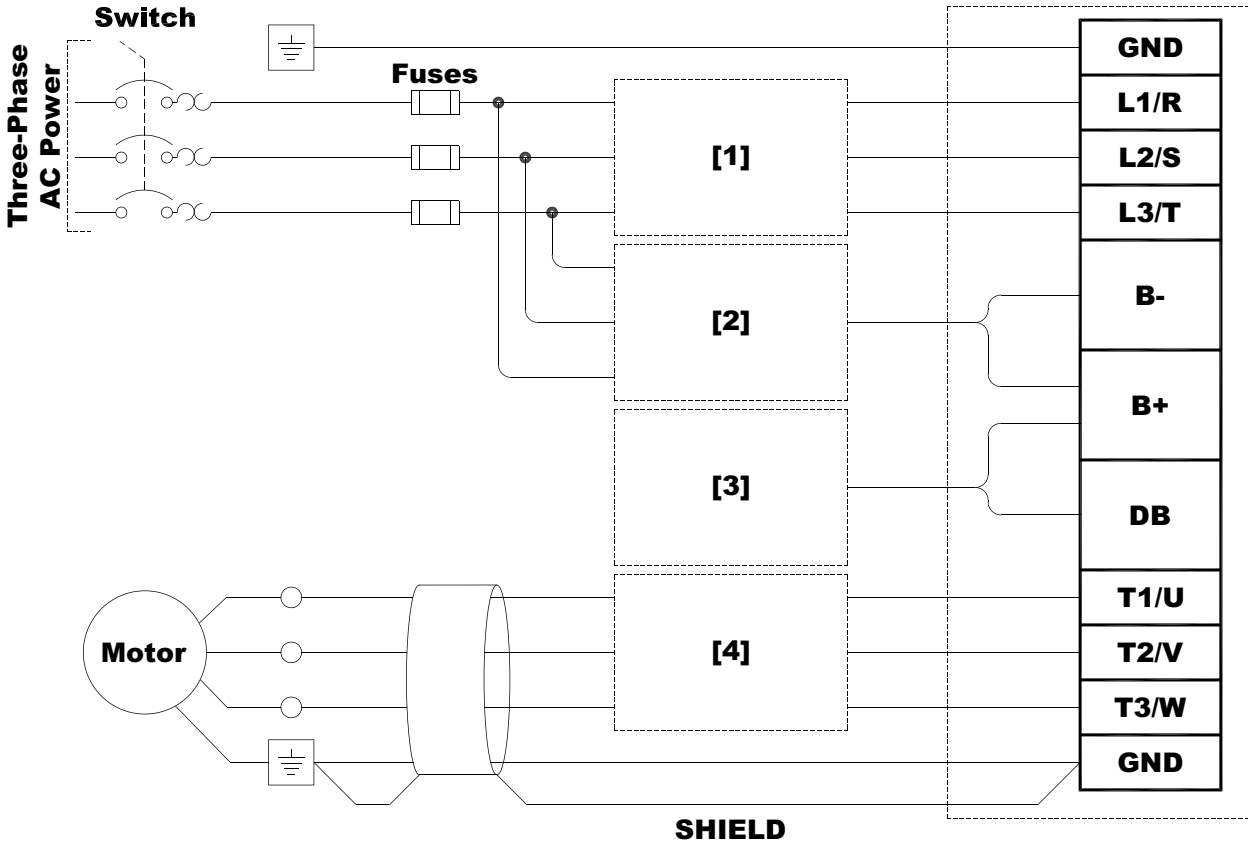
Horsepower	Input Voltage			
	115 Vac 1 Phase	230 Vac 3 Phase	460 Vac 3 Phase	575 Vac 3 Phase
1	x	x[1]	x	x
2		x[1]	x	x
3		x[1]	x	x
5		x[1]	x	x
7.5		x	x	x
10		x	x	x
15		x	x	x
20		x	x	x
25		x	x	x
30		x	x	x
40			x	x
50			x	x
60			x	x
75			x	x
100			x	x
125			x	x
150			x	x
200			x	x

⌘ **NOTE:** [1] Do not need to derate for single phase operation

BASIC CONFIGURATION

1.4 Basic Configuration

The following devices are required to operate the drive. Proper peripheral devices must be selected and correct connections made to ensure proper operation. An incorrectly applied or installed drive can result in system malfunction or reduction in product life as well as component damage. You must read and understand this manual thoroughly before proceeding.



[1] 3 or 5% Line Reactor EMI RFI Suppression Isolation Transformer Passive Filter Active Filter	[2] DC Bus Voltage - Connection for 18 pulse frontend - Multi-Drives DBR Dynamic Braking Module Line Regeneration Module	[3] B+/DB Connection	[4] 3 or 5% Line Reactor Long Lead Filter Sine Wave Filter

NOTES

2 Technical Specifications

POWER AND CURRENT RATINGS

2.1 Power and Current Ratings

Table 1: Ratings for 115VAC

Model number	Frame Size	Normal Duty		Input current (A)		Output current (A)		Heavy Duty		Input current (A)		Output current (A)	
	0	HP	kW	-	115VAC	-	230VAC	HP	kW	-	115VAC	-	230VAC
RSi001S415W		1.0	0.75	-	0.75	-	4.2	0.5	0.37	-	11	-	2.2

Table 2: Ratings for 230VAC

Model number	Frame Size	Normal Duty		Input current (A)		Output current (A)		Heavy Duty		Input current (A)		Output current (A)	
		HP	kW	200VAC	230VAC	200VAC	230VAC	HP	kW	200VAC	230VAC	200VAC	230VAC
RSi001S42W	**0**	1	0.75	5.6	4.8	4.8	4.2	0.5	0.37	2.9	2.5	2.5	2.2
RSi002S42W	**0**	2	1.5	9	7.8	7.8	6.8	1	0.75	5.6	4.8	4.8	4.2
RSi003S42W	**0**	3	2.2	12.7	11	11	9.6	2	1.5	9	7.8	7.8	6.8
RSi005S42W	**1**	5	4	20.2	17.5	17.5	15.2	3	2.2	12.7	11	11	9.6
RSi007S42W	**1**	7.5	5.5	29.2	25.3	25.3	22	5	4	20.2	17.5	17.5	15.2
RSi010S42W	**2**	10	7.5	37.2	32.2	37.2	28	7.5	5.5	29.2	25.3	25.3	22
RSi015S42W	**2**	15	11	52.1	46.4	48.3	42	10	7.5	37.2	32.2	37.2	28
RSi020S42W	**3**	20	15	68.3	57.4	62.1	54	15	11	52.1	46.4	48.3	42
RSi025S42W	**3**	25	18	82.3	73.8	78.2	68	20	15	68.3	57.4	62.1	54
RSi030S42W	**3**	30	22	96	84	92	80	25	18.5	82.3	73.8	78.2	68

Table 3: Ratings for 460VAC

Model number	Frame Size	Normal Duty		Input current (A)		Output current (A)		Heavy Duty		Input current (A)		Output current (A)	
		HP	kW	380VAC	460VAC	380VAC	460VAC	HP	kW	380VAC	460VAC	380VAC	460VAC
RSi001S44W	**0**	1	0.75	3	2.4	2.4	2.1	0.5	0.37	1.6	1.3	1.3	0.9
RSi002S44W	**0**	2	1.5	5.2	3.9	3.8	3.4	1	0.75	3	2.4	2.4	2.1
RSi003S44W	**0**	3	2.2	7.2	5.6	5.1	4.8	2	1.5	5.2	3.9	3.8	3.4
RSi005S44W	**1**	5	4	12	8.8	8.9	7.6	3	2.2	7.2	5.6	5.1	4.8
RSi007S44W	**1**	7.5	5.5	15	12.8	12	11	5	4	12	8.8	8.9	7.6
RSi010S44W	**1**	10	7.5	19.7	16.3	15.6	14	7.5	5.5	15	12.8	12	11
RSi015S44W	**2**	15	11	30.9	25.8	23	21	10	7.5	19.7	16.3	15.6	14
RSi020S44W	**2**	20	15	40	33.3	31	27	15	11	30.9	25.8	23	21
RSi025S44W	**2**	25	18	46.3	40	37	34	20	15	40	33.3	31	27
RSi030S44W	**2**	30	22	57.5	47.8	43	40	25	18	46.3	40	37	34
RSi040S44W	**3**	40	30	73	62	61	52	30	22	57.5	47.8	43	40
RSi050S44W	**3**	50	37	82	78	71	65	40	30	73	62	61	52
RSi060S44W	**4**	60	45	94	80	86	77	50	37	82	78	71	65

Table 5: Ratings for 460VAC

RSi075S44W	**4**	75	55	114	99	105	96	60	45	94	80	86	77
RSi100S44W	**4**	100	75	149	129	140	124	75	55	114	99	105	96
RSi125S44D	**5**	125	90	168	156	168	156	100	75	140	124	140	124
RSi150S44D	**5**	150	110	205	180	205	180	125	90	168	156	168	156
RSi200S44D	**5**	200	132	240	240	240	240	150	110	205	180	205	180

Table 4: Ratings for 600VAC

Model number	Frame Size	Normal Duty		Input current (A)		Output current (A)		Heavy Duty		Input current (A)		Output current (A)	
		HP	kW	-	600VAC	-	600VAC	HP	kW	-	600VAC	-	600VAC
RSi001S46W	**1**	1	0.75	-	2.0	-	1.7	0.5	0.37	-	1.2	-	0.9
RSi002S46W	**1**	2	1.5	-	3.6	-	2.7	1	0.75	-	2.0	-	1.7
RSi003S46W	**1**	3	2.2	-	5.0	-	3.9	2	1.5	-	3.6	-	2.7
RSi005S46W	**1**	5	4	-	7.6	-	6.1	3	2.2	-	5.0	-	3.9
RSi007S46W	**1**	7.5	5.5	-	10.4	-	9.0	5	4	-	7.6	-	6.1
RSi010S46W	**1**	10	7.5	-	14.1	-	11.0	7.5	5.5	-	10.4	-	9.0
RSi015S46W	**2**	15	11	-	23	-	17	10	7.5	-	14.1	-	11
RSi020S46W	**2**	20	15	-	31	-	22	15	11	-	23	-	17
RSi025S46W	**2**	25	18	-	37	-	27	20	15	-	31	-	22
RSi030S46W	**2**	30	22	-	39.5	-	32	25	18	-	37	-	27
RSi040S46W	**3**	40	30	-	49	-	41	30	22	-	39.5	-	32
RSi050S46W	**3**	50	37	-	58	-	52	40	30	-	49	-	41
RSi060S46W	**4**	60	45	-	68	-	62	50	37	-	58	-	52
RSi075S46W	**4**	75	55	-	82	-	77	60	45	-	68	-	62
RSi100S46W	**4**	100	75	-	107	-	99	75	55	-	82	-	77
RSi125S46D	**5**	125	90	-	125	-	125	100	75	-	99	-	99
RSi150S46D	**5**	150	110	-	144	-	144	125	90	-	125	-	125
RSi200S46D	**5**	200	132	-	192	-	192	150	110	-	144	-	144

ENVIRONMENTAL

2.2 Environmental Specifications

Operating temperature	For **003S42W,005S42W,030S42W,030S44W,005S46W,030S46W** models: –10 C to +35 C (14 F to 95 F) –10 C to +40 C (14 F to 104 F) - **All other models**
Storage temperature	–20°C to +65°C (-4°F to 149°F)
Humidity	0% to 95% non-condensing
Altitude	1000m (3300ft) without derating
Maximum vibration	per EN50178 (1g @ 57-150 Hz)
Acoustic noise	80 dBa sound power at 1m (3ft), max
Cooling	1 to 5 HP models: Natural convection 7.5 to 50.0 HP models: Forced air Note: 600Vac 5 HP model has a fan.

ELECTRICAL

2.3 Electrical Specifications

Input Voltage	115V Models: 115 Vac 1 phase, +/– 10% 230V Models: 200-230 Vac, 3 phase, +/– 15% 460V Models: 380-460 Vac, 3 phase, +/– 15% 600V Models: 600 Vac, 3 phase, +10 – 15%			
Line Frequency	50 / 60Hz ± 2Hz			
Source kVA (max)	10 times the unit rated kVA (see Note below)			
DC Bus Voltage for:	115VAC Models	230 VAC Models	460VAC Models	600VAC Models
Overvoltage Trip	406VDC	406VDC	814VDC	1017VDC
Dynamic Brake Activation	388VDC	388VDC	776VDC	970VDC
Nominal Undervoltage (UV) Trip	199VDC	199VDC	397VDC	497VDC
Control System	V/Hz or SVC Carrier frequency = 1 – 16 kHZ, programmable			
Output Voltage	0 to 100% of line voltage, 3 phase			
Overload Capacity	120% of rated normal duty rms current for 60 seconds 150% of rated heavy duty rms current for 60 seconds			
Frequency range	0.1 to 400 Hz			
Frequency stability	0.1 Hz (digital), 0.1% (analog) over 24 hours +/– 10 C			
Frequency setting	By keypad or by external signal (Speed Pot 0 to 5VDC; 0 to 10VDC; 0 to 20mA, or 4 to 20mA) OR by pulse train up to 100 kHz			

⌘ **NOTE:** Unit Rated kVA = $\frac{\text{rated Voltage x rated Current x 1.732}}{1000}$

2.4 Control Features Specifications

Vin1 reference input	0-5/10 Vdc, 0/4-20 mAdc (250 Ohm load) 6FS pulse train input, 0-1/10/100 kHz pulse input, inverted function, 0-5-10 bipolar input, broken wire detection. Span and offset adjustment.
Vin2 reference input	0-5/10 Vdc, 0-5-10 bipolar input, inverted function, broken wire detection, span and offset adjustment. Programmable for frequency reference or current limit input
Cin reference input	0/4-20 mAdc (50 Ohm load), inverted function, span and offset adjustment. Programmable for frequency reference or current limit input
Reference voltage	10 Vdc (10 mAdc maximum)
Digital inputs - 10	Off=0 to 3 Vdc; On=10 to 32 Vdc (pullup logic), selectable between pullup and pulldown logic
Digital supply voltage	24 Vdc (150 mA maximum)
Preset frequencies	3 inputs for seven preset frequencies (selectable)
Digital outputs	2 SPDT relay output - 130 Vac, 1 A/250 Vac, 0.5 A 2 open collector outputs 50 mA per device
Digital pulse train output	Open collector output pulse train proportional to output frequency
Vmet analog output	0 to 10 Vdc (5mAdc maximum)
Imet analog output	0-20 mAdc output into a 500 Ohm load (maximum)
DC holding / injection braking	At start, stop, by frequency with adjustable current level and time or continuous DC injection by digital input.
Current limit	Four quadrant adjustable from 5 to 150%
Speed ramps	Primary and alternate adjustable from 0.1 to 3200 seconds
Voltage boost	Fixed boost adjustable from 0% to 50% or auto boost
Voltage characteristic (V/Hz)	Linear, pump, fan or 2-piece linear
Timed overload	Adjustable inverse time trip (shear pin, 30 sec, 60 sec, 5 min), standard or inverter-duty motors
Protective features	Overcurrent, overvoltage fault, ground fault, short circuit, dynamic brake overload, drive temperature, power wiring fault, drive timed overload, input voltage quality, overvoltage ridethrough
Program Sequence Logic Controller (PSLC)	9-step PLC type functionally that can control speed, direction, and ramps based on time, analog input, digital input, or pulse input

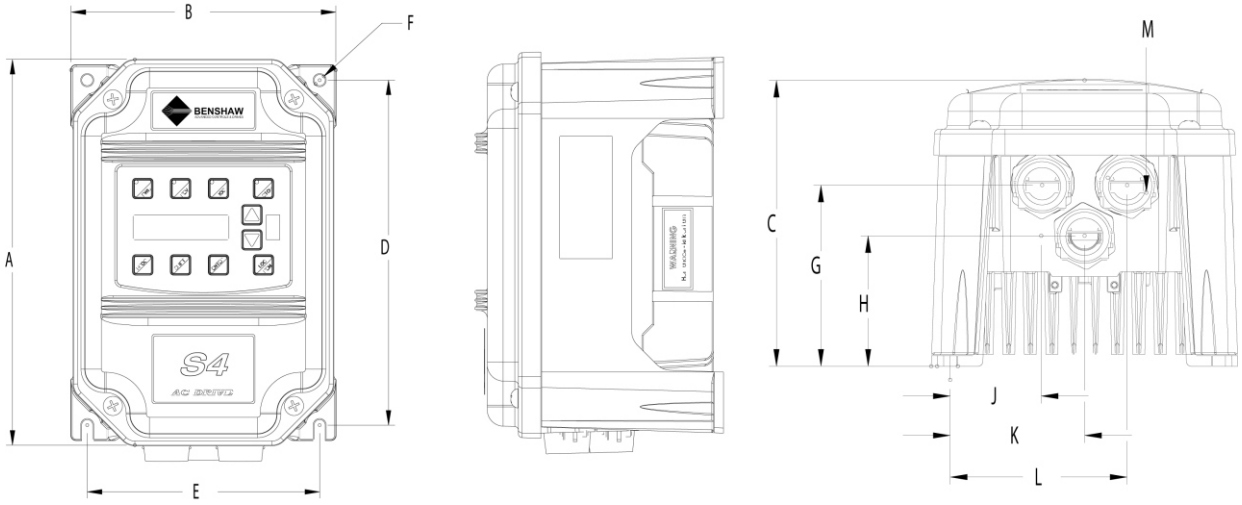
Dimensions and Weights

2.5 Dimensions and Weights

2.5.1 Frame 0 specifications

Frame		0		
Voltage		115 VAC	230 VAC	460 VAC
Standard Duty Horsepower		1	1-3	
Dimensions (in/mm)	A	9.47 (241)		
	B	6.50 (165)		
	C	6.08 (155)		
	D	8.45 (215)		
	E	5.69 (145)		
	F	0.28 (7.11)		
	G	3.84 (98)		
	H	2.77 (70)		
	J	1.93 (49)		
	K	2.85 (72)		
	L	3.75 (95)		
	M	Opening for 1/2 inch conduit		
	N	N/A		
Weight (lb/kg)		8.5 (3.85)		

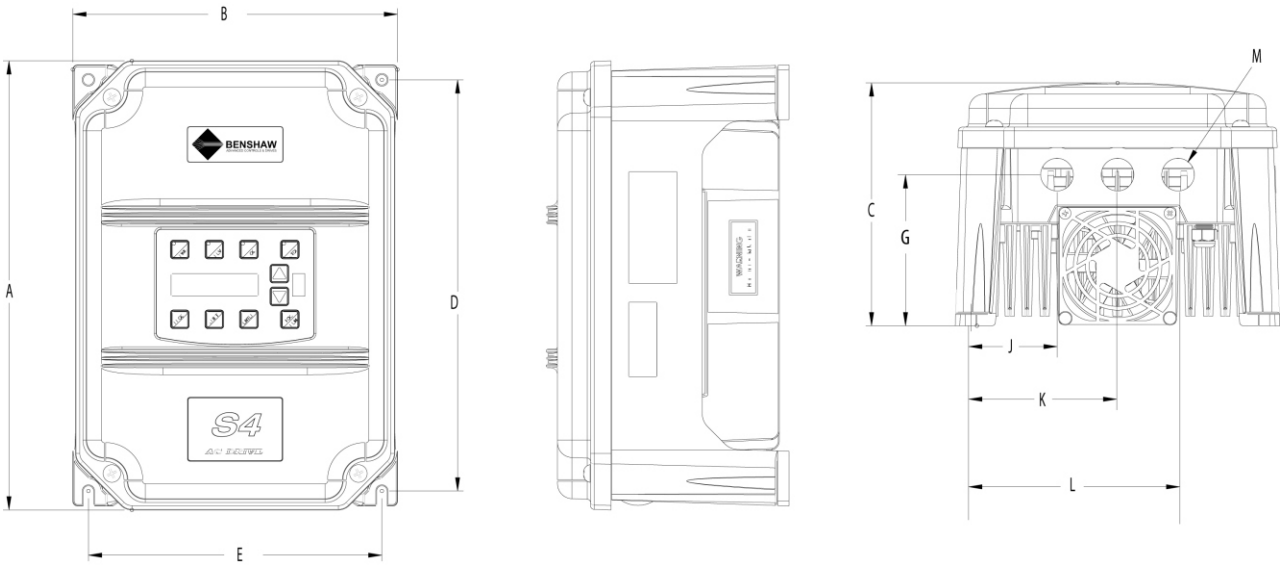
Figure 2: S4 Frame size 0 models



2.5.2 Frame 1 specifications

Frame		1		
Voltage		230 VAC	460 VAC	600 VAC
Standard Duty Horsepower		5 - 7.5	5 - 10	1 - 10
Dimensions (in/mm)	A	12.01 (306)		
	B	8.72 (221)		
	C	6.51 (166)		
	D	11.03 (280)		
	E	7.88 (200)		
	F	0.28 (7.11)		
	G	4.05 (103)		
	H	N/A		
	J	2.31 (59)		
	K	3.94 (100)		
	L	5.56 (1.41)		
	M	Opening for 1/2 inch conduit		
	N	N/A		
Weight (lb/kg)		14.0 (6.35)		

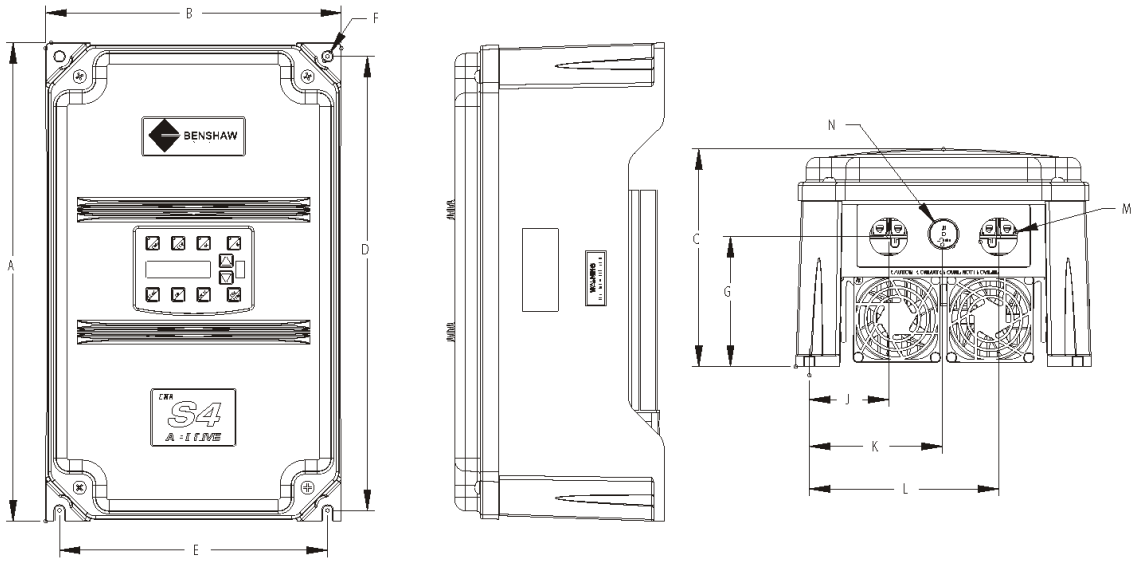
Figure 3: S4 Frame size 1 models



2.5.3 Frame 2 specifications

Frame		2		
Voltage		230 VAC	460 VAC	600 VAC
Standard Duty Horsepower		10 - 15	15 - 30	15 - 30
Dimensions (in/mm)	A	17.375 (435)		
	B	10.75 (269)		
	C	7.875 (198)		
	D	16.50 (413)		
	E	9.75 (244)		
	F	0.375 (10)		
	G	4.75 (119)		
	H	N/A		
	J	2.875 (72)		
	K	4.875 (122)		
	L	6.875 (172)		
	M	Opening for 1" conduit		
	N	Opening for ¾" conduit		
Weight (lb/kg)		29.5 (13.38)		

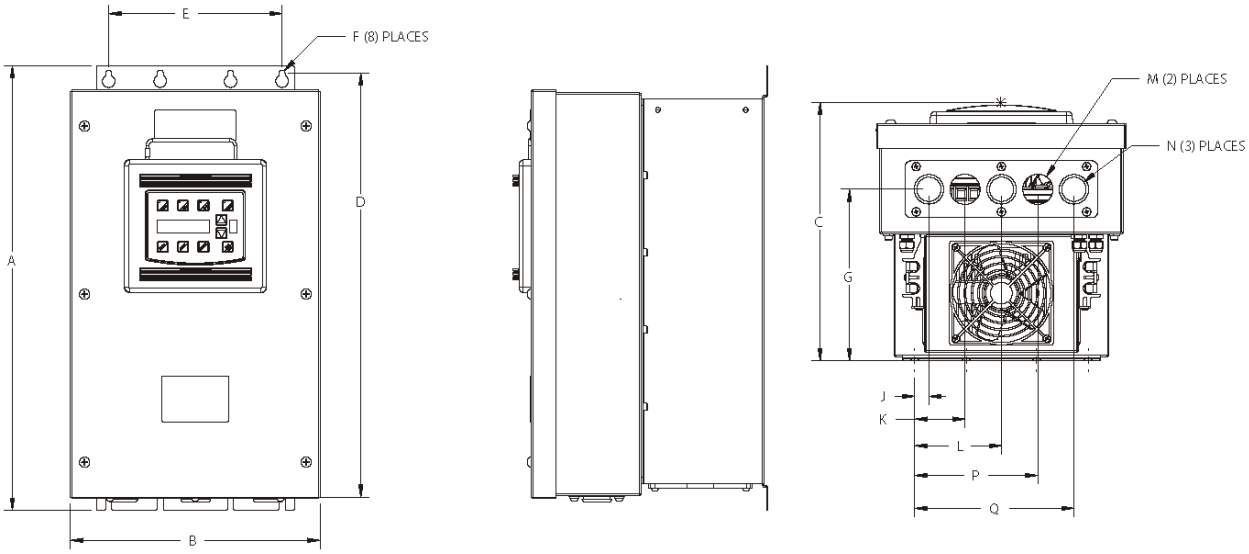
Figure 4: S4 Frame size 2 models



2.5.4 Frame 3 specifications

Frame		3		
Voltage		230 VAC	460 VAC	600 VAC
Standard Duty Horsepower		20 - 25	40 - 50	40 - 50
Dimensions (in/mm)	A	20.19 (513)		
	B	11.35 (288)		
	C	11.73 (298)		
	D	19.25 (489)		
	E	7.88 (200)		
	F	0.14 (4)		
	G	7.78 (198)		
	H	N/A		
	J	0.65 (13)		
	K	2.29 (58)		
	L	3.95 (100)		
	M	Opening for 1 inch conduit		
	N	Opening for 3/4 inch conduit		
	P	5.60 (142)		
	Q	7.24 (184)		
Weight (lb/kg)		50.0 (22.68)		

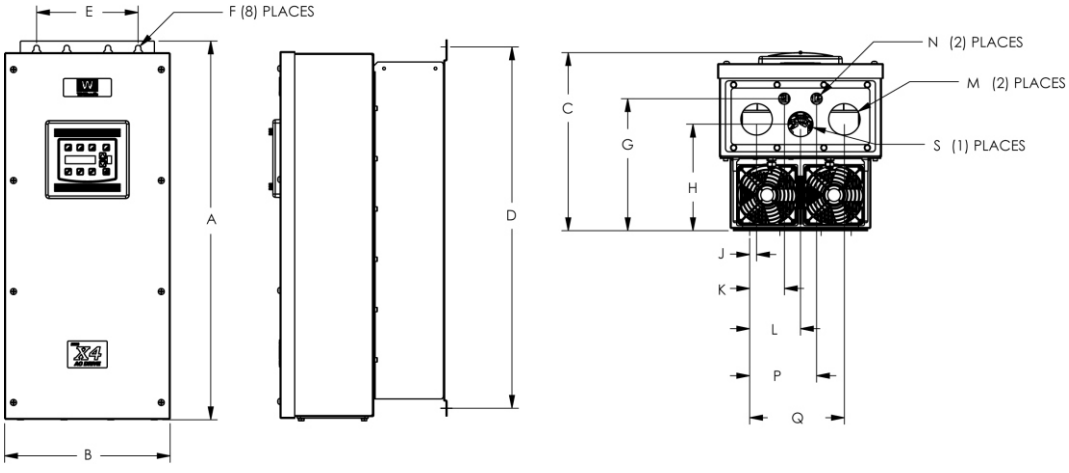
Figure 5: S4 Frame size 3 models



2.5.5 Frame 4 Specifications

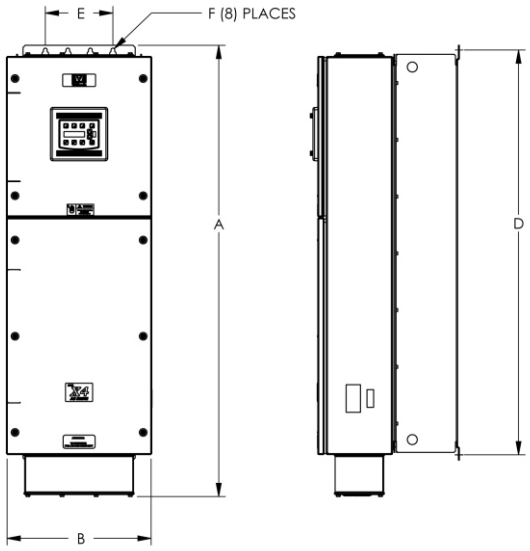
Frame		4	
Voltage		460 VAC	600 VAC
Standard Duty Horsepower		60 - 100	60 - 100
Dimensions (in/mm)	A	29.35 (745)	
	B	12.84 (326)	
	C	13.80 (351)	
	D	28.00 (711)	
	E	7.88 (200)	
	F	0.42 (11)	
	G	8.63 (219)	
	H	8.26 (210)	
	J	0.53 (14)	
	K	2.69 (68)	
	L	3.94 (100)	
	M	Opening for 2 inch conduit	
	N	Opening for 1/2 inch conduit	
	P	5.19 (132)	
	Q	7.35 (187)	
	R	10.23 (260)	
	S	1.94 (49)	
Weight (lb/kg)		95.0 (43.1)	

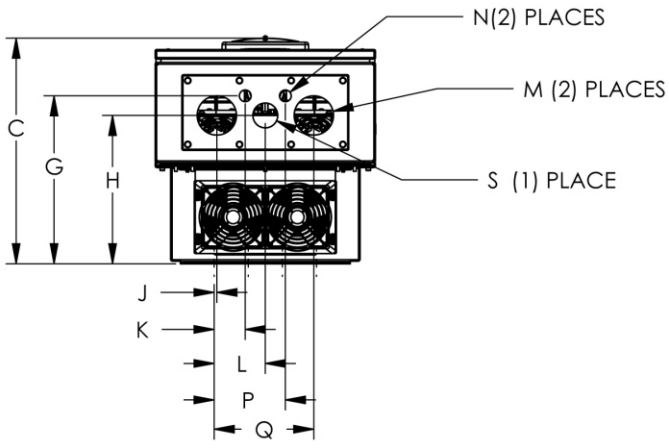
Figure 6: S4 Frame size 4 models



2.5.6 Frame 5 Specifications

Frame		5	
Voltage		460 VAC	600 VAC
Standard Duty Horsepower		125 - 200	125 - 200
Dimensions (in/mm)	A	51.02 (1296)	
	B	16.31 (414)	
	C	16.88 (429)	
	D	45.77 (1163)	
	E	7.65 (194)	
	F	0.42 (11)	
	G	12.57 (319)	
	H	11.10 (282)	
	J	0.20 (5)	
	K	2.32 (59)	
	L	3.82 (97)	
	M	Opening for 2.5 inch conduit	
	N	Opening for 1/2 inch conduit	
	P	5.32 (135)	
	Q	7.45 (189)	
	R	n/a	
	S	1.86 (47)	
Weight (lb/kg)		305 (138)	





NOTES

3 Installation

PRELIMINARY INSPECTION

3.1 Preliminary Inspection

Before storing or installing the RSi S4 drive, thoroughly inspect the device for possible shipping damage. Upon receipt:

- Remove the drive from its package and inspect exterior for shipping damage. If damage is apparent, notify the shipping agent and your sales representative.
- Remove the cover and inspect the drive for any apparent damage or foreign objects. Ensure that all mounting hardware and terminal connection hardware is properly seated, securely fastened, and undamaged.
- Read the technical data label affixed to the drive and ensure that the correct horsepower and input voltage for the application has been purchased. The numbering system for a Benshaw inverter is shown on page 5.
- If you will store the drive after receipt, place it in its original packaging and store in a clean, dry place free from direct sunlight or corrosive fumes, and where the ambient temperature is not less than -20 C(-4 F) or greater than +65 C (+149 F).

⚠ CAUTION

EQUIPMENT DAMAGE HAZARD
Do not operate or install any drive that appears damaged.
Failure to observe this instruction can result in injury or equipment damage.

⚠ ATTENTION

RISQUE DE DOMMAGES MATÉRIELS
Ne faites pas fonctionner et n'installez pas tout variateur de vitesse qui semble être endommagé.
Si cette directive n'qest pas respectée, cela peut entraîner des blessures corporelles ou des dommages matériels.

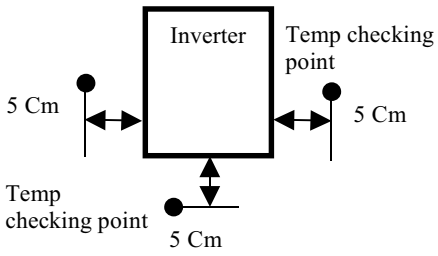
INSTALLATION PRECAUTIONS

3.2 Installation Precautions

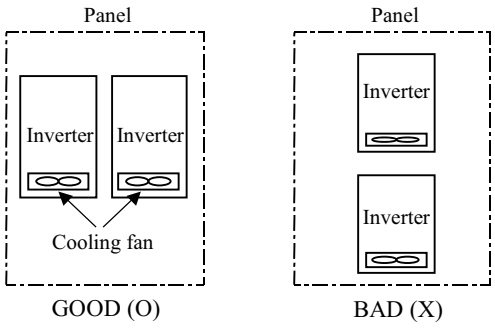
Improper installation of the RSi S4 drive will greatly reduce its life. Be sure to observe the following precautions when selecting a mounting location. **Failure to observe these precautions may void the warranty!**

- Do not install the drive in a place subjected to high temperature (-10 to 40C while running), high humidity, excessive vibration (installed on a press or other moving equipment), corrosive gases or liquids, or airborne dust or metallic particles. See Section 2.2 on page 11 for temperature, humidity, and maximum vibration limits.
- Do not mount the drive near heat-radiating elements or in direct sunlight.
- The drive generates heat. Allow sufficient space around the unit for heat dissipation as seen below.
- Verify the ambient condition of the mounting location. Ambient temperature should not be below -20 C (-4 F) and must not exceed +65 C (+149 F). Relative humidity should be less than 95% (non-condensing). The altitude should be below 3,300ft (1,000m) without derating.

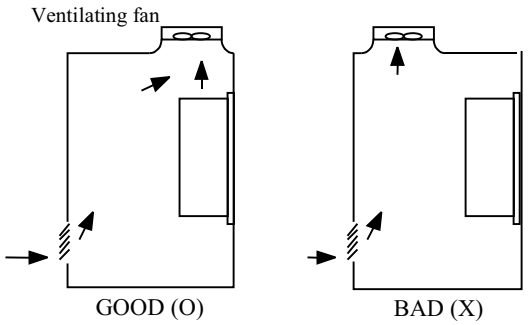
Figure 7: Temperature checking points



- See ARCTIC mode (below -10 C) on page 87 (DB Config)
- Mount the drive on a non-combustible, flat, level, vertical surface and do not restrict the air flow to the heat sink fins as seen below.
- If the drive is going to be installed in an environment with a high probability of dust, metallic particles, mists, corrosive gases, or other contaminates, the drive must be located inside the appropriate electrical enclosure of the proper NEMA or IP rating.
- When two or more drives are installed or a ventilation fan is mounted in the drive panel, the drives and ventilation fan must be installed in proper positions with extreme care taken to keep the ambient temperature of the drives below the permissible value. If they are installed in improper positions, the ambient temperature of the drives will rise.



[When installing several drives in a panel]



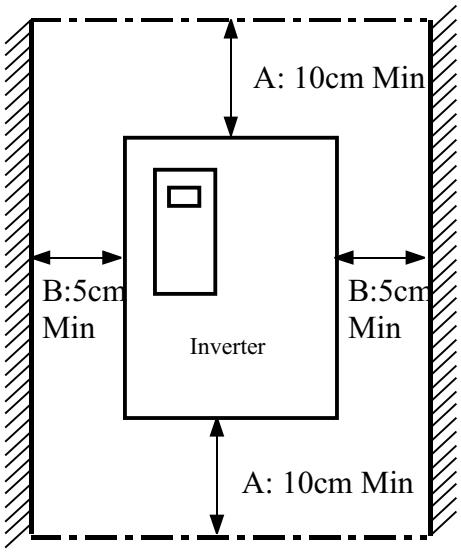
[When installing a ventilation fan in a panel]

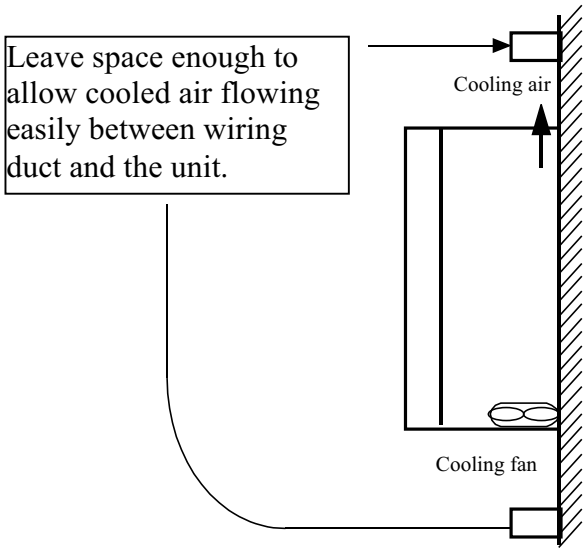
- Install the drive using appropriate sized screws or bolts to insure the drive is firmly fastened.

Risk of Electric Shock
-More than one source of power may be present.
-More than one disconnect switch may be required to de-energize the equipment before servicing.

3.3 Clearance between Drives

On drives 40HP and larger, A = 20 inch (50cm) and B = 8 inch (20cm)





⌘ **NOTE:** These are the minimum ventilation requirements for a single unit. If units are installed in close proximity, dimensions A and B must be doubled to allow proper air ventilation.

⌘ **NOTE:** Ensure that the ventilation openings are not obstructed.

MOUNTING CONSIDERATIONS

3.4 Considerations for Mounting in Host Enclosures

When RSi S4 drives are mounted in a host enclosure the heat dissipated by the drives must be dissipated by the host enclosure. If this is not accomplished, the control circuitry of the RSi S4 drives will be damaged.

Two techniques are available for mounting RSi S4 drives in a host enclosure:
- The drives may be entirely enclosed in the host enclosure; or
- The drives may be mounted with their cooling fins outside of the host enclosure. (Frames 3,4,5 only)

The following two sections discuss these two mounting techniques in greater detail.

3.4.1 Models Entirely Enclosed in the Host Enclosure

When an RSi S4 drive is entirely enclosed in a host enclosure, the host enclosure must be properly sized to dissipate the heat generated by the drive and any other power-dissipating devices also mounted in the host enclosure. Tables 8, 9, and 10 on pages 26 to 28 provide the heat dissipated by the various models of RSi S4 drives. Use this information to adequately size the host enclosure.

3.4.2 Models with Fins External to the Host Enclosure (only on Frames 3, 4, 5)

By mounting an RSI S4 drive so that its heatsink fins are outside of the host enclosure, you may select a smaller host enclosure than that required when the drive is mounted entirely inside the host enclosure. For most applications with this type of mounting, typically you will not need such additional cooling devices as fans, heat exchangers, or air conditioners. Tables 8, 9, and 10 on pages 26 to 28 also provide the heat dissipated by the various models of RSi S4 drives when the fins are external to the drive.

3.4.3 Minimum Torque Values to Secure Cover

If you remove the cover of an RSi S4 drive, it is imperative that the cover be re-secured with an air tight seal. Table 7 specifies the torque values for the bolts that secure the covers on the various RSi S4 models.

Table 7: RSi S4 Model Torque Values

RSi S4 Enclosure Type		Torque Value	
		English	Metric
NEMA 4X	1-10HP, 230VAC input	18 in-lbs	2.03Nm
	15-30HP, 230VAC input	12 in-lbs	1.35Nm
	1-20HP, 460 and 600VAC input	18 in-lbs	2.03Nm
	25-150HP, 460 and 600VAC input	12 in-lbs	1.35Nm

3.5 Conduit Usage

The S4 drive in the NEMA 4X enclosure is rated for 1000 psi washdown from 6 inches. To keep this rating, the use of a sealed conduit is required. The use of a Romex-type conduit will not prevent water entry into the enclosure. If the approved conduit is not used, all warrenty claims against water damage will be void.

The arrows in Figure 8 show the location of the S4 cover screws. Torque specifications for control terminals and power terminals are listed on page 31 & 32.

⌘ **NOTE:** Ensure that the ventilation openings are not obstructed.

⌘ **NOTE:** Avoid using sealed connectors around rubber-coated cables to seal the drive. These do not allow any air transfer and can create condensation around the display.

Figure 8: Cover Assembly

HEAT DISSIPATION

3.6 Heat Dissipation

Table 8: Heat Dissipation for Models Entirely Inside an Enclosure at 200 - 230VAC

RSi S4 Model	Required Dissipation for Models Entirely Inside an Enclosure at Rated Current, 3KHz Carrier Frequency (Watts)	Required Dissipation when Fins are External to the Enclosure (Watts)
RSi001S42W	48	14
RSi002S42W	71	17
RSi003S42W	92	16
RSi005S42W	132	20
RSi007S42W	177	23
RSi010S42W	263	67
RSi015S42W	362	68
RSi020S42W	550	97
RSi025S42W	653	96
RSi030S42W	779	103

Table 9: Heat Dissipation for Models Entirely Inside an Enclosure at 380 - 460VAC

RSi S4 Model	Required Dissipation for Models Entirely Inside an Enclosure at Rated Current, 3KHz Carrier Frequency (Watts)	Required Dissipation when Fins are External to the Enclosure
RSi001S44W	34	13
RSi002S44W	46	16
RSi003S44W	71	20
RSi005S44W	91	21
RSi007S44W	114	28
RSi010S44W	155	30
RSi015S44W	304	77
RSi020S44W	393	76
RSi025S44W	459	78
RSi030S44W	458	77
RSi040S44W	695	95
RSi050S44W	834	100
RSi060S44W	776	130
RSi075S44W	988	135
RSi100S44W	1638	155
RSi125S44D	1656	353
RSi150S44D	1891	372
RSi200S44D	2302	382

Table 10: Heat Dissipation for Models Entirely Inside an Enclosure at 600VAC

RSi S4 Model	Required Dissipation for Models Entirely Inside an Enclosure at Rated Current, 3KHz Carrier Frequency (Watts)	Max. Carrier Frequency for Rated Current (kHz)
RSi001S46W	32	15
RSi002S46W	50	22
RSi003S46W	66	21
RSi005S46W	112	33
RSi007S46W	159	37
RSi010S46W	187	54
RSi015S46W	334	124
RSi020S46W	431	143
RSi025S46W	528	154
RSi030S46W	597	155
RSi040S46W	742	160
RSi050S46W	877	170
RSi060S46W	766	200
RSi075S46W	913	200
RSi100S46W	1542	275
RSi125S46D	1988	337
RSi150S46D	2282	349
RSi200S46D	3043	355

[1] Dissipation at rated current and maximum switching frequency.

4 Connections

CONNECTION PRECAUTIONS

DANGER

HAZARDOUS VOLTAGE

- Read and understand this manual in its entirety before installing or operating the RSi S4 Sensorless Vector Drive. Installation, adjustment, repair, and maintenance of these drives must be performed by qualified personnel.
- Disconnect all power before servicing the drive. **WAIT 5 MINUTES** until the DC bus capacitors discharge. Then measure the DC bus capacitor charge between the B+ and B– terminals to verify that the DC voltage is less than 45VDC. **The DC Bus LED is not a definitive indication of the absence of DC voltage.**
- DO NOT short across DC bus capacitors or touch unshielded components or terminal strip screw connections with voltage present.
- Install all covers and close door before applying power or starting and stopping the drive.
- The user is responsible for conforming to all applicable code requirements with respect to grounding all equipment.
- Many parts in this drive, including printed circuit boards, operate at line voltage. **DO NOT TOUCH**. Use only electrically-insulated tools.

Before servicing the electrical system:

- Disconnect all power.
- Place a “DO NOT TURN ON” label on the drive disconnect.
- Lock the disconnect in the open position.

Failure to observe these precautions will cause shock or burn, resulting in severe personal injury or death.

DANGER

TENSION ELECTRIQUE DANGEREUSE

- Lisez et comprenez ces directives dans leurs intégralité avant d’installer ou de faire fonctionner le variateur de vitesse Sensorless Vector Drive RSi S4. L’installation, le réglage, les réparations et l’entretien des ces variateurs de vitesse doivent être effectuées par du personnel qualifié.
- Coupez toutes les alimentations avant de travailler sur le variateur de vitesse. **ATTENDEZ CINQ MINUTE** pour que la décharge des condensateurs du bus cc s’effectue. Ensuite, mesurez la tension des condensateurs du bus cc entre les bornes B+ et B–, afin de vérifier que la tension cc soit inférieure à 45VDC. **La DÉL du bus cc ne fournit pas une indication définitive de l’absence de tension cc.**
- NE court-cuitez PAS les condensateurs du bus cc ou ne touchez pas aux composantes non blindées ou aux connexions des vis du bornier si l’appareil est sous tension.
- Installez tous les couvercles et fermez la porte avant de mettre le variateur de vitesse sous tension, de le mettre en marche ou de l’arrêter.
- L’utilisateur est responsable de la conformité avec tous les codes électriques en vigueur concernant la mise à la terre de tous les appareils.
- De nombreuses pièces de ce variateur de vitesse, y compris les cartes de circuits imprimés, fonctionnent à la tension du secteur. **N’Y TOUCHEZ PAS**. N’utilisez que des outils dotés d’une isolation électrique.

Avant tout entretien ou réparation sur le variateur de vitesse:

- Coupez toutes les alimentations.
- Placez une étiquette «NE PAS METTRE SOUS TENSION» sur le sectionneur du variateur de vitesse.
- Verrouillez le sectionneur en position ouverte.

Si ces précautions ne sont pas respectées, cela causera une électrocution ou des brûlures, ce qui entraînera des blessures graves ou la mort.

GENERAL WIRING INFORMATION

4.1 General Wiring Information

4.1.1 Wiring Practices

When making power and control connections, the following precautions should be observed:

- Never connect input AC power to the motor output terminals T1/U, T2/V, or T3/W, as damage to the drive will result.
- Power wiring to the motor must have the maximum possible separation from all other power wiring. Do not run in the same conduit; this separation reduces the possibility of coupling electrical noise between circuits.
- Cross conduits at right angles whenever power and control wiring cross.
- Good wiring practice also requires separation of control circuit wiring from all power wiring. Since power delivered from the drive contains high frequencies which may cause interference with other equipment, do not run control wires in the same conduit or raceway with power or motor wiring.

⌘ **NOTE:** Local electrical codes must be adhered to for all wiring practices.

4.1.2 Considerations for Control Wiring

Control wiring refers to the wires connected to the control terminal strip. Select control wiring as follows:

- Shielded wire is recommended to prevent electrical noise interference from causing improper operation or nuisance tripping.
- Use only UL or CSA recognized wire.
- Control wire voltage rating must be at least 300V for 230VAC systems. It must be at least 600V for 460 or 600 VAC systems.

See table below for a summary of power terminal control wiring specifications.

S4 Size / Models	Specifications
All sizes / Models	4.4 in-lbs maximum torque 12-24 awg wire 9/32" strip length

4.1.3 Considerations for Power Wiring

Power wiring refers to the line and load connections made to terminals L1/R, L2/S, L3/T, and T1/U, T2/V, T3/W respectively. Select power wiring as follows:

- Use only UL or CSA recognized wire.
- Wire voltage rating must be a minimum of 300V for 230VAC systems or 600V (Class 1 wire) for 460VAC or 750V (Class 1 wire) for 600VAC systems .
- Grounding must be in accordance with NEC and CEC. If multiple RSi S4 drives are installed near each other, each must be connected to ground. Take care to not form a ground loop.
- Wire gauge must be selected based on 125% of the continuous input current rating of the drive. Wire gauge must be selected from wire tables for 75 C insulation rating, and must be of copper construction. The 230V 7.5 and 15 HP models, and the 460V 30 HP models require 90 C wire to meet UL requirements. See chapter 2 on page 10 for the continuous output ratings for the drive.

⌘ **NOTE:** For conduit installations, based on NEC table 310-16 ambient temperature of drive at 40 C.

⌘ **NOTE:** Refer to page 34 for information on motor lead lengths.

See table below for a summary of power terminal wiring specifications.

S4 Size / Models (Frame #)	Specifications
Frame 0	12 in-lbs nominal torque or 13 in-lbs maximum torque 12-24 awg wire 5/16" (0.3125') strip length
Frame 1	16 in-lbs nominal torque or 18 in-lbs maximum torque 8-18 awg wire 5/16" (0.3125") strip length
Frame 2	30 in-lbs nominal torque 6-8 awg wire 3/8" (0.38") strip length
Frame 3	35 in-lbs nominal torque 3 awg wire
Frame 4	65 in-lbs nominal torque 3/0 wire max
Frame 5	132 in-lbs nominal torque 250MCM wire max

⌘ **NOTE:** Wire type not specified by the manufacturer. Some types of wire may not fit within the constraints of the conduit entry and bend radius inside the drive.

4.1.4 Grounding and Ground wire sizes

- The drive contains high power and high frequency switching devices, leakage current may flow between the drive and ground. Ground the drive to avoid electrical shock.
- Connect only to the dedicated ground terminal of the drive. Don't use the case or chassis screw for grounding.
- If multiple drives are installed near each other, each must be connected to ground directly. Take care not to form a ground loop between the drives and the grounding location.
- The protective earth conductor must be the first one in being connected and the last one in being disconnected.
- The grounding wire shall comply with all local regulations. As a minimum, the grounding wire should meet the specificationis listed below. The grounding wire should be as short as possible and should be connected to a ground point as near as possible to the drive.

Drive Capacity	230V Class AWG or (mm^2)	460V Class AWG or (mm^2)	600V Class AWG or (mm^2)
7.5 – 10HP	10 (5.5)	12 (3.5)	12 (3.5)
15 – 20HP	6 (14)	8 (8)	8 (8)
25 – 40HP	4 (22)	6 (14)	6 (14)
50 – 75HP	-	4 (22)	4 (22)
100 – 125HP	-	2 (38)	2 (38)

4.2 Input Line Requirements

4.2.1 Line Voltage

See the Power and Current Ratings tables on page 10 for the allowable fluctuation of AC line voltage for your particular RSi S4 model. A supply voltage above or below the limits given in the table will cause the drive to trip with either an overvoltage or undervoltage fault.

Exercise caution when applying the RSi S4 AC drive on low-line conditions.

For example, an RSi S4 Series VFD will operate properly on a 208VAC line - but the maximum output voltage will be limited to 208VAC. Now if a motor rated for 230VAC line voltage is controlled by this drive, higher motor currents and increased heating will result.

Therefore, ensure that the voltage rating of the motor matches the applied line voltage. If other than 60Hz output is desired, proper V/Hz can be programmed into the RSi S4 drive by setting FUN 01 (Nom Mtr Volt) and AFN 01 (Nom Mtr Freq) parameters.

4.2.2 Line Capacity

If the source of AC power to the RSi S4 drive is greater than 10 times the kVA rating of the drive shown in Table 11, an isolation transformer or line reactor is recommended. Consult the factory for assistance in sizing the reactor.

Table 11: Transformer Sizing for RSi S4 Sensorless Drive

Drive HP	1	2	3	5	7.5	10	15	20	25
Transformer kVA	2	4	5	9	13	18	23	28	36
Drive HP	30	40	50	60	75	100	125	150	200
Transformer kVA	42	57	70	90	112	150	180	220	250

⌘ **NOTE:** *RSi S4 Drives are suitable for use on a circuit capable of delivering not more than 65,000 rms symmetrical Amperes at maximum rated Voltage.*

4.2.3 Use of Isolation Transformers and Line Reactors

In nearly all cases, the RSi S4 drive may be connected directly to a power source. However, in the following cases, a properly-sized isolation transformer or line reactor should be utilized to minimize the risk of drive malfunction or damage:

- When the line capacity exceeds the ratings of the drive (*see Section 4.2.2).*
- When power factor correction capacitors are used on the drive's power source.
- When the power source experiences transient power interruptions or voltage spikes.
- When the power source supplying the drive also supplies large devices (such as DC drives) that contain controlled rectifiers.
- When the drive is powered from an ungrounded (floating) Delta connected source. In this case a drive isolation transformer utilizing a grounded secondary should be used.

4.2.4 Phase Imbalance

Phase voltage imbalance of the input AC source can cause unbalanced currents and excessive heat in the drive's input rectifier diodes and DC bus capacitors. Phase imbalance can also damage motors running directly across the line. The phase imbalance should not exceed 2% of the voltage rating.

⚠ CAUTION

EQUIPMENT DAMAGE HAZARD
Never use power-factor correction capacitors on motor terminals T1/U, T2/V, or T3/W of the RSi S4 Sensorless Vector Drive. Doing so will damage the semiconductors.

Failure to observe this instruction can result in injury or equipment damage.

⚠ ATTENTION

RISQUE DE DOMMAGES MATÉRIELS
Ne raccordez jamais de condensateurs de correction du facteur de puissance aux bornes T1/U, T2/V, ou T3/W du moteur du variateur de vitesse Sensorless Vector Drive RSi S4. Car cela endommagera les semiconducteurs.

Si cette directive n'qest pas respectée, cela peut entraîner des blessures corporelles ou des dommages matériels.

4.2.5 Single Phase Operation

S4 AC drive 230 VAC models ranging from 1 to 5 HP are designed for both three-phase and single-phase input power. If one of these models is operated with single-phase power, use any two line input terminals. The output of the device will always be three-phase.

The safe derating of the S4 series of drives is 50% of the nominal current (HP) rating. Consult the factory with the particular application details for exact derating by model.

⌘ **NOTE:** Parameter AFN 28 (Single Phase on page 134) must be activated.

4.2.6 Ground Fault Circuit Interrupters

S4 drives rated for 115VAC are NOT designed to operate with ground fault circuit interrupters (GFCI). The GFCI breakers are designed for residential use to protect personnel from stray currents to ground. Most GFCI breakers will shut off at 5 mA of leakage. It is not uncommon for an AC drive to have 30 to 60 mA of leakage.

4.2.7 Motor Lead Length

Adhere to the NEC/CEC and any local codes during the installation of VFD and motor systems. Excessive lead lengths may adversely effect the performance of the motor. Shielded symmetrical motor cables are recommended. Lead lengths from VFD to the motor in excess of those listed in table 12 may require filters to be added to the output of the VFD. Table 12 lists the suggested maximum lead lengths for the listed motor types. As a rule of thumb the distance from the S4 drive to the motor should not exceed 300 meters (1000 feet).

The voltage of the pulses can be almost double at the motor terminals, depending on the motor cable properties. This in turn can cause additional stress of the motor insulation. Nuisance trips can occur due to capacitive current flow to ground.

Some applications can have a restricted lead length because of type of wire, motor type or wiring placement. **Consult the motor manufacturer for more information.**

⌘ **NOTE:** Any non-inverter duty motor should have a reactor or filter added when the motor lead length exceeds 20 feet. The carrier frequency for the drive should also be reduced using parameter AFN 05 (Carrier Freq on page 122).

Table 12: Lead Length Specifications

Model	PWM Carrier Frequency	Maximum Distance
230 Volt	All	1000 feet
460 Volt	5kHz	600 feet
	> 5kHz	300 feet
600 Volt	5kHz	200 feet
	> 5kHz	100 feet

⌘ **NOTE:** The chart above refers to NEMA MG-1-1998 Section IV Part 31 Compliant Motors[2].

⌘ **NOTE:** Refer to page 46 for information on Input Power Cables.

POWER TERMINALS

4.3 Terminals Found on the RSi S4 Power Board

Figure 9: RSi S4 Power Terminals: Frame 0 & Frame 1

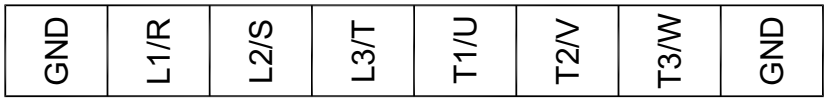


Figure 10: RSi S4 Power Terminals: Frame 2

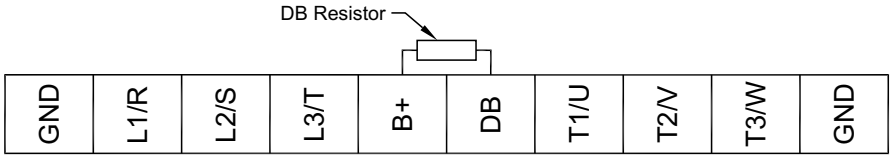


Figure 11: RSi S4 Power Terminals: Frame 3

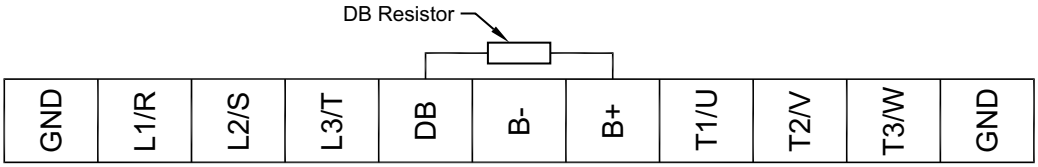
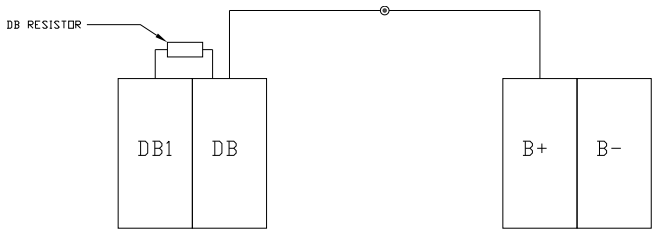


Figure 12: Dynamic Braking Terminals: Frame 4



4.3.1 Description of Power Terminals

Figures 9 – 13 show the power terminals for the RSi S4 drives. Table 13 describes the terminals.

Table 13: Description of RSi S4 Power Terminals

Terminal	Description
GND	Earth ground.
L1\R L2/S L3/T	These terminals are the line connections for three-phase models. (Single-phase models will only have the L1\R terminal, with the other two terminals being replaced by a terminal labeled N.)
B-/B+	The B-/B+ terminals or B- terminals (depending on the model[1]) provide a connection to the DC Bus. They may be used for common DC Bus connections or for powering the drive from a DC source. Alternately, by connecting a Benshaw dynamic brake unit to these terminals, braking capacity may be enhanced.
DB/B+	The DB/B+ terminals or DB terminals (depending on the model[1]) are the connection points for the dynamic brake resistor. If an external resistor is used for dynamic braking, the internal resistor must be disconnected; see page 38 for more information.
T1/U T2/V T3/W	These terminals are for motor connections.

4.3.2 Typical Power Connections & Fuse Ratings

See section 4.2 starting on page 33 for input line requirements.

Note that when testing for a ground fault, do not short any motor lead (T1/U, T2/V, or T3/W) back to an input phase (L1/R, L2/S, or L3/T).

It is necessary to provide fuses and a disconnect switch for the input AC line in accordance with all applicable electrical codes. The S4 AC drive is able to withstand a 150% overload for 60 seconds for heavy duty rating, and 120% overload for standard duty rating.

The fusing and input protection of the drive must always meet UL, NEC (National Electric Code), and CEC (Canadian Electric Code) requirements. All fuse ratings included in the table below are for reference only and do not supersede code requirements. The recommended supplier is Bussman or (Ferraz).

Model Number	Fuse Size 115 Vac JJS/JJN (A6T/A3T)	Fuse Size 208 Vac JJS/JJN (A6T/A3T)	Fuse Size 230 Vac JJS/JJN (A6T/A3T)	Fuse Size 380 Vac JJS (A6T)	Fuse Size 460 Vac JJS (A6T)	Fuse Size 600 Vac JJS (A6T)
RSi001S415W	20	–	–	–	–	–
RSi001S42W	–	10	6	–	–	–
RSi002S42W	–	15	10	–	–	–
RSi003S42W	–	20	15	–	–	–
RSi005S42W	–	30	25	–	–	–
RSi007S42W	–	40	35	–	–	–
RSi010S42W	–	50	40	–	–	–
RSi015S42W	–	70	60	–	–	–
RSi020S42W		90	80			
RSi025S42W	–	100	90			–

Model Number	Fuse Size 115 Vac JJS/JJN (A6T/A3T)	Fuse Size 208 Vac JJS/JJN (A6T/A3T)	Fuse Size 230 Vac JJS/JJN (A6T/A3T)	Fuse Size 380 Vac JJS (A6T)	Fuse Size 460 Vac JJS (A6T)	Fuse Size 600 Vac JJS (A6T)
RSi030S42W	–	125	110			–
RSi001S44W	–	–	–	6	6	–
RSi002S44W	–	–	–	10	6	–
RSi003S44W	–	–	–	10	10	–
RSi005S44W	–	–	–	15	15	–
RSi007S44W	–	–	–	20	20	–
RSi010S44W	–	–	–	25	20	–
RSi015S44W	–	–	–	40	35	–
RSi020S44W	–	–	–	50	40	–
RSi025S44W				60	50	–
RSi030S44W				80	60	–
RSi040S44W	–	–	–	100	80	–
RSi050S44W	–	–	–	110	100	–
RSi060S44W	–	–	–	125	100	–
RSi075S44W	–	–	–	150	125	–
RSi100S44W	–	–	–	200	175	–
RSi125S44D	–	–	–	225	200	–
RSi150S44D	–	–	–	250	225	–
RSi200S44D	–	–	–	300	300	–
RSi001S46W	–	–	–	–	–	6
RSi002S46W	–	–	–	–	–	6
RSi003S46W	–	–	–	–	–	10
RSi005S46W	–	–	–	–	–	10
RSi007S46W	–	–	–	–	–	15
RSi010S46W	–	–	–	–	–	20
RSi015S46W	–	–	–	–	–	30
RSi020S46W	–	–	–	–	–	40
RSi025S46W	–	–	–	–	–	50
RSi030S46W	–	–	–	–	–	50
RSi040S46W	–	–	–	–	–	70
RSi050S46W	–	–	–	–	–	80
RSi060S46W	–	–	–	–	–	90
RSi075S46W	–	–	–	–	–	110
RSi100S46W	–	–	–	–	–	150

RSi125S46D	–	–	–	–	–	175
RSi150S46D	–	–	–	–	–	200
RSi200S46D	–	–	–	–	–	250

DYNAMIC BRAKING

4.4 Dynamic Braking

The RSi S4 Sensorless Vector Drive is supplied with an integrated dynamic braking (DB) resistor, and is designed to have adequate dynamic braking for most applications. In cases where short stopping times or high inertia loads require additional braking capacity, install an external resistor.

If an external resistor is used for dynamic braking (not applicable for Size/Frame 0 models), the **internal resistor must be disconnected**. Internal DB resistors are connected with fast-on terminals up to Frame size 3. **Consult Benshaw if you are installing external resistors.**

To install an external resistor, first disconnect the internal DB resistor (or resistors in 460 and 600 Vac models) and properly terminate the wires leading to it. Then connect the external resistor fast-on terminals where the internal resistor had been connected. Changes to FUN 05 must be made when using external DB resistors.

Verify with the manufacturer of the selected resistor that the resistor is appropriate for your application. Contact Benshaw for further assistance with other possible sizing limitations.

⌘ **NOTE:** It's recommended to have thermal protection wired back to a digital input to protect the DBR.

Table 14: S4 Dynamic Braking Capacity
⌘ ***NOTE: (Asterisked S4 model numbers cannot have external braking added)***

Model	KW	Standard Resistance	Standard DB % of Drive	Min. Allowed Res.	Max. Peak Watts	Max.Ext. DB% of Drive
1S010*	.75	125	164%	125	1,223	164%
RSi001S42W	.75	125	164%	125	1,223	164%
RSi002S42W	1.5	125	82%	125	1,223	82%
RSi003S42W	2.2	125	55%	125	1,223	55%
RSi005S42W	3.7	60	68%	43	3,555	95%
RSi007S42W	5.5	60	45%	30	5,096	91%
RSi010S42W	7.5	60	34%	27	5,662	76%
RSi015S42W	11	60	23%	20	7,644	68%
RSi020S42W	15	30	34%	10	15,288	102%
RSi025S42W	18	30	27%	10	15,288	82%
RSi030S42W	22	30	23%	10	15,288	68%

Table 15: S4 Dynamic Braking Capacity

Model	KW	Standard Resistance	Standard DB% of Drive	Min. Allowed Res.	Max. Peak Watts	Max. Ext. DB% of Drive
RSi001S44W	.75	500	163%	270	2,253	302%
RSi002S44W	1.5	500	82%	270	2,253	151%
RSi003S44W	2.2	500	54%	270	2,253	101%
RSi005S44W	3.7	120	136%	100	6,084	163%
RSi007S44W	5.5	120	91%	75	8,112	145%
RSi010S44W	7.5	120	68%	75	8,112	109%
RSi015S44W	11	120	45%	57	12,944	116%
RSi020S44W	15	120	34%	47	12,944	87%
RSi025S44W	18	120	27%	47	12,944	69%
RSi030S44W	22	120	23%	39	15,600	70%
RSi040S44W	30	120	34%	20	30,420	102%
RSi050S44W	37	120	27%	20	30,420	82%
RSi060S44W	45	60	23%	15	40,560	91%
RSi075S44W	55	60	18%	10	60,840	109%
RSi100S44W	75	60	14%	10	60,840	82%
RSi125S44D	90	60	11%	10	60,840	65%
RSi150S44D	110	60	9%	10	60,840	54%
RSi200S44D	132	60	7%	10	60,840	41%
RSi001S46W	.75	120	1058%	110	8,607	1154%
RSi002S46W	1.5	120	529%	110	8,607	577%
RSi003S46W	2.2	120	353%	110	8,607	385%
RSi005S46W	3.7	120	212%	110	8,607	231%
RSi007S46W	5.5	120	141%	91	10,404	186%
RSi010S46W	7.5	120	106%	91	10,404	139%
RSi015S46W	11	120	71%	62	15,269	136%
RSi020S46W	15	120	53%	62	15,269	102%
RSi025S46W	18	120	42%	62	15,269	82%
RSi030S46W	22	120	35%	62	15,269	68%
RSi040S46W	30	60	53%	24	39,447	132%
RSi050S46W	37	60	42%	24	39,447	106%

Table 16: S4 Dynamic Braking Capacity

RSi060S46W	45	60	35%	15	63,115	141%
RSi075S46W	55	60	28%	15	63,115	113%
RSi100S46W	75	60	21%	20	63,115	85%
RSi125S46D	90	60	17%	10	94,672	102%
RSi150S46D	110	60	14%	10	94,672	85%
RSi200S46D	132	60	11%	10	94,672	63%

CONTROL TERMINALS

4.5 Terminals Found on the RSi S4 Control Board

4.5.1 Description of the Control Terminals

Figure below shows the control terminals found on the I/O board of the S4 AC drive. See "Electrical Specifications" on page 12 for specifications. The drive's control terminals are referenced to earth ground through a resistor / capacitor network. Use caution when connecting analog signals not referenced to earth ground, especially if the communications port (J3) is being used. The J3 port includes a common reference that can be connected to earth ground through the host PLC or computer.
See page 13 for specification information concerning these features. Table 17 starting on page 41 describes the control terminals.

Figure 13: RSi S4 Control Terminals

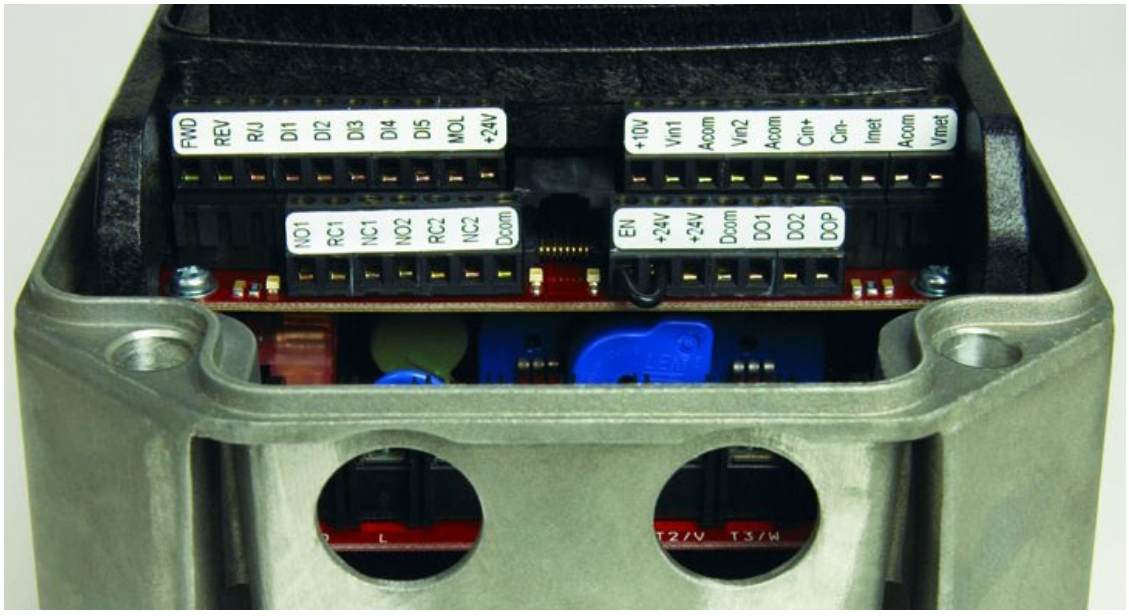


Table 17: Description of RSi S4 Control Terminals

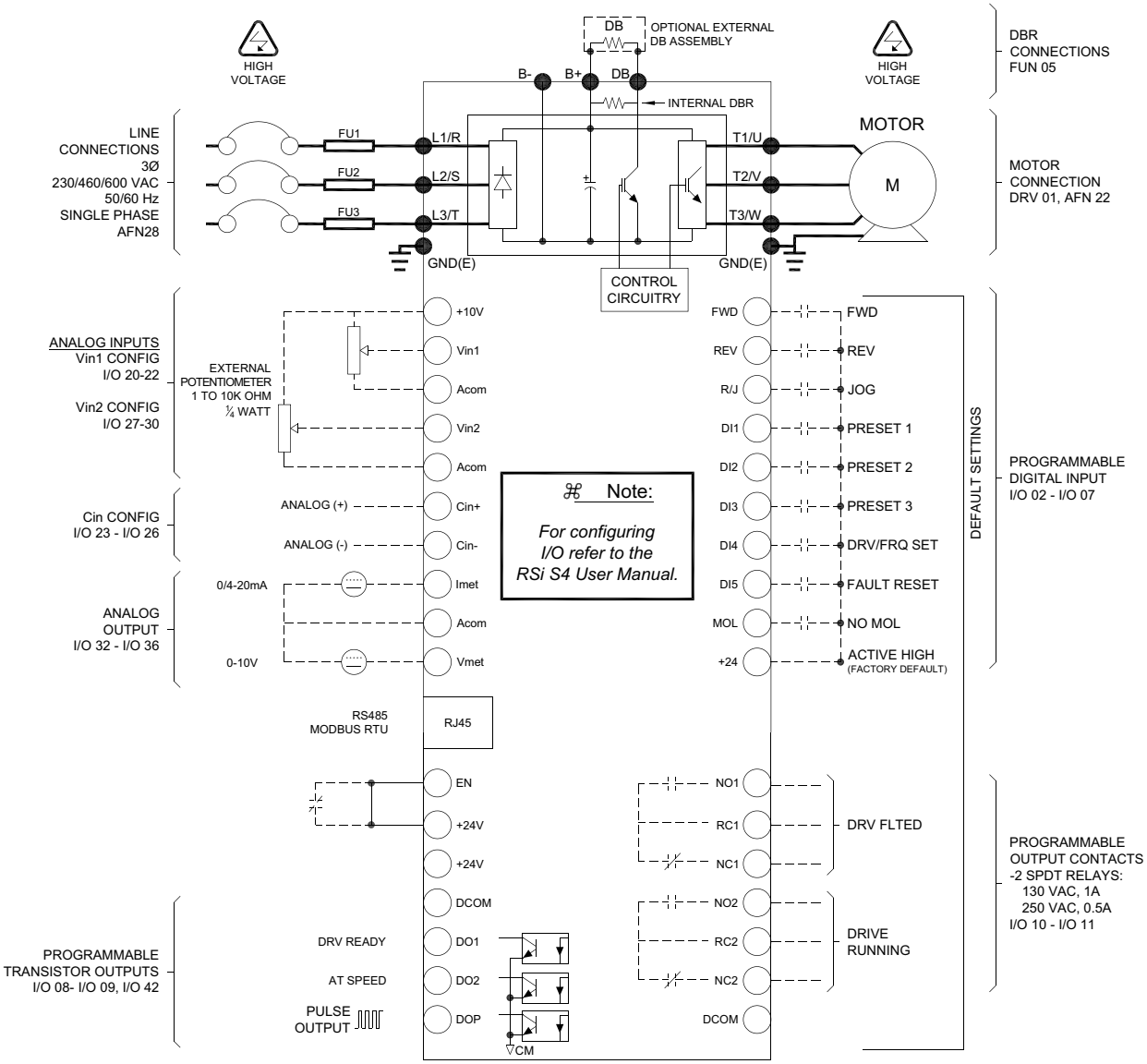
Terminal	Description
Vmet	Analog output 1, which is a dedicated voltage output. The default signal range is from 0 to 10 Vdc (5 mA maximum). It is proportional to the variable configured by parameter I/O 32 (Vmet/Imet). It may be calibrated while the drive is running via parameter I/O 34 (Vmet Span).
Imet	Analog output 2, which is a dedicated current output. The default signal ranges from 0 to 20 mAdc (50 to 500 Ohms). It is proportional to the variable configured by parameter I/O 33 (Vmet/Imet) (see page 112). It may be calibrated while the drive is running via parameters I/O 36 (Imet Offset) and I/O 35 (Imet Span).
Vin1	Analog Input 1, which is used to provide speed references. The default input signal is 0 to 10 Vdc (the type of input signal is selected with parameter I/O 19 (Vin1 Config). Parameters I/O 20 (Vin1 Span) and I/O 21 (Vin1 Offset) may be used to offset the starting value of the range and the size of the range, respectively; see parameter DRV 05 also. If a 0 to 20 mAdc input signal is configured, the burden is 250 Ohms. If a 0 to 10 Vdc input signal is configured, the input impedance is 10 kOhms. A potentiometer with a range of 1 to 10 kOhms is suggested for this input.
+10	This terminal is a +10 Vdc source for customer-supplied potentiometers. The maximum load on this supply cannot exceed 10 mAdc.
Cin+ / Cin-	Current Input. The default input signal is 4-20 mA, although this range may be adjusted by using parameters I/O 25 (Cin Offset) (which configures an offset for the range) and I/O 24 (Cin Span) (to reduce or enlarge the range — for example, setting Cin Span to 50% results in a range of 0-10 mA). The burden for this terminal is 50 Ohms.
Vin2	Voltage Input 2, which is used to provide speed references. The default input signal is 0 to 10 Vdc (the type of input signal is selected with parameter I/O 27 (Vin2 Config). Parameters I/O 28 (Vin2 Span) and I/O 29 (Vin2 Offset) may be used to offset the starting value of the range and the size of the range, respectively. If a 0 to 20 mAdc input signal is configured, the burden is 250 Ohm. If a 0 to 10 Vdc input signal is configured, the input impedance is 10 kOhms. A potentiometer with a range of 1 to 10 kOhms is suggested for this input.
Acom	Common for the Analog Inputs and Outputs. Note that while there are two Acom (common) terminals, they both connect to the same electrical point.
+24	A source for positive nominal 24 Vdc voltage, and has a source capacity of 150 mA.
FWD	Forward Direction Selection terminal. This may be connected for two-wire maintained or three-wire momentary operation.
REV	Reverse Direction Selection Terminal. This may be connected for two-wire maintained or three-wire momentary operation.
R/J	Run/Jog Selector. When this terminal is connected to +24 or common (depending upon Active Logic setting), momentarily connecting either FWD or REV to +24 results in a latched run mode (3-wire operation).
MOL	Motor Overload input terminal. This requires a N/O or N© contact for operation, referenced to +24 or COM, depending on Active Logic setting.
EN	Enable terminal. A jumper is placed between this terminal and the +24 terminal at the factory. You may replace this with a contact, if desired. The circuit from EN to +24 must be closed for the drive to operate. Note that unlike all other terminals, this terminal cannot be configured for "pull-down logic." That is, a high input to this terminal is always regarded as true, and must be present for the drive to operate.
Dcom	Digital Common for use with digital inputs and +24 internal power.
DI1-DI5	Digital inputs. The selectable digital inputs are from I/O 02 - I/O 06.
NC1 **NO1** **RC1**	The first auxiliary relay. The function of the relay is set by parameter **I/O 10 (R1 Config)**. The default setting is for the relay to activate when the motor is faulted. Terminal NO1 is the normally-open contact, which closes when the relay is activated. Terminal NC1 is the normally-closed contact, which opens when the relay is activated. Terminal RC1 is the common terminal.

Table 18: Description of RSi S4 Control Terminals

NC2 **NO2** **RC2**	The second auxiliary relay. The function of the relay is set by parameter **I/O 11 (R2 Config)**. The default setting is for the relay to activate when the drive is running. Terminal NO2 is the normally-open contact; it will close when the relay is activated. RC2 is the common terminal.
DO1 **DO2**	Digital Outputs 1 and 2. The function of the outputs is set by parameter **I/O 08 (D1 Config)** and **I/O 09 (D2 Config)**. The default setting for DO1 is Drive Ready; for DO2 it is At Speed.
DOP	Open collector transistor output that supplies a pulse train proportional to speed. The frequency of the output is set by parameter **I/O 42** to either 6x or 48x the running frequency. The output has a maximum rating of 28 Vdc and requires a pull-up resistor (4.7 kOhms) if using the drive's internal supply.

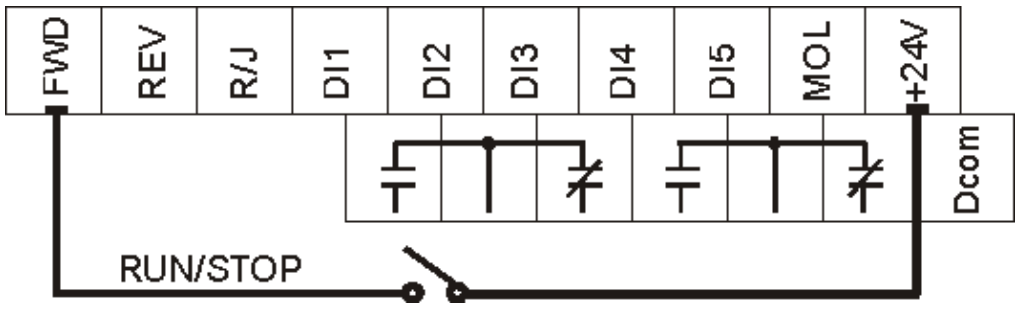
4.5.2 S4 Wiring Diagram

S4 Series Wiring Diagram

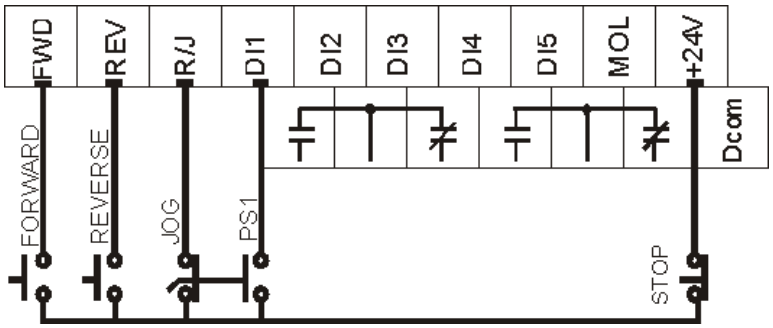


4.5.3 Typical Connection Diagrams for Digital Inputs

Typical connection for 2-wire control



Typical connection for 3-wire control



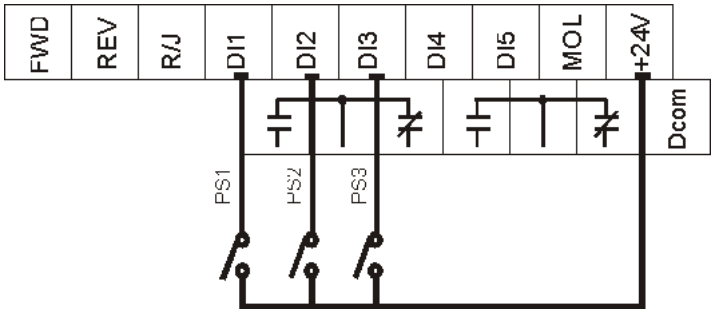
Preset Speeds

Table 19: Selection of Preset Speeds

PS3 (Bit 3)	PS2 (Bit 2)	PS1 (Bit 1)	Speed Selected
0	0	0	Normal reference speed as defined by parameter **DRV05(Freq Mode 1)** or operate screen
0	0	1	Preset frequency F1 (I/O 13).
0	1	0	Preset frequency F2 (I/O 14).
0	1	1	Preset frequency F3 (I/O 15).
1	0	0	Preset frequency F4 (I/O 16).
1	0	1	Preset frequency F5 (I/O 17).
1	1	0	Preset frequency F6 (I/O 18).
1	1	1	Maximum frequency (AFN 04)

⌘ **NOTE**: Connections of Preset Speeds is on next page.

Figure 15: Connections for Preset Speeds



4.5.4 Typical Connection Diagrams for Analog Inputs

Figure 16: Connections for Speed Potentiometer

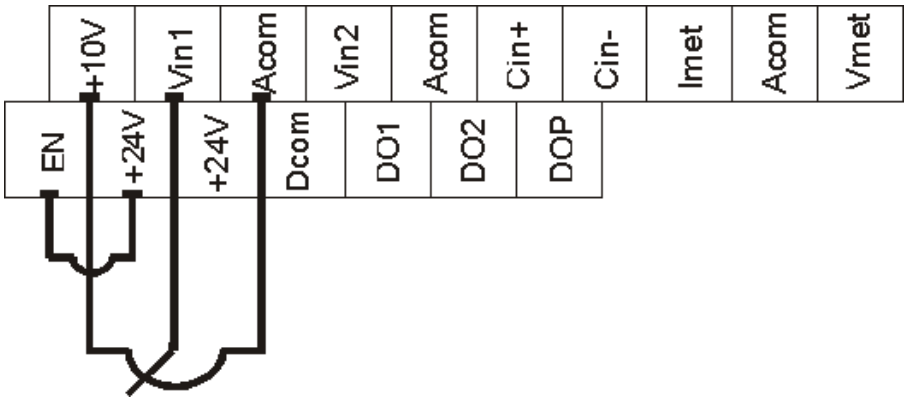
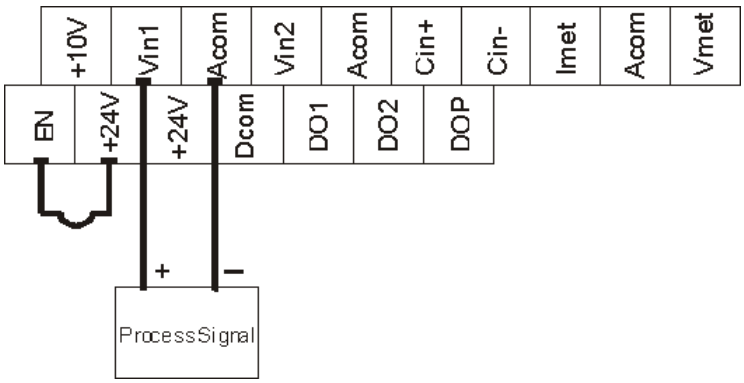
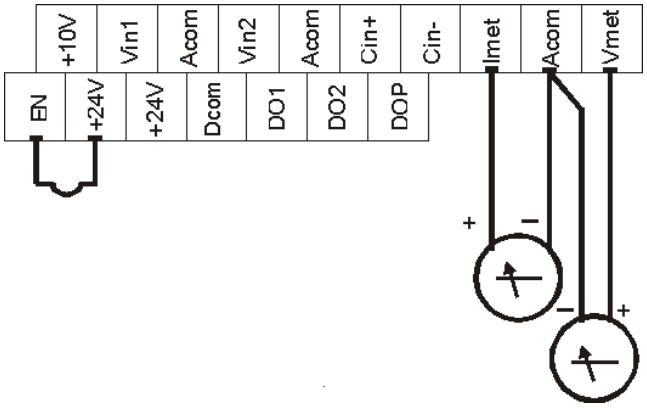


Figure 17: Connections for Process Signal



4.5.5 Typical Connection Diagrams for Analog Outputs

Figure 18: Connections for Process Meters



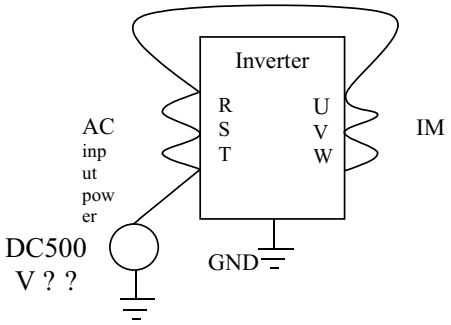
4.6 Power Lugs for 100-150-200HP CT

Wire Size	Burndy Manufacturer Part Number
1/0	YA25-L6BOX
3/0	YA27-LBOX
4/0	YA28-LBOX
300	YA30-L
350	YA31-L

4.7 Megger/Dielectric Test

Perform a megger test after the drive wiring has been disconnected. High test voltages should not be applied to the drive.

A megger test should be conducted only for the main power circuit, never the low voltage control circuit. Connect the test jumpers as shown below and use a DC 600V megger voltage. Higher voltage dielectric tests should never be conducted on the drive. Otherwise, the power semiconductors, surge suppressors (MOVs), and/or other components may be damaged. Damage due to improper hi-pot or megger testing is not covered under warrenty.



POWER CABLES

4.8 Power Cables

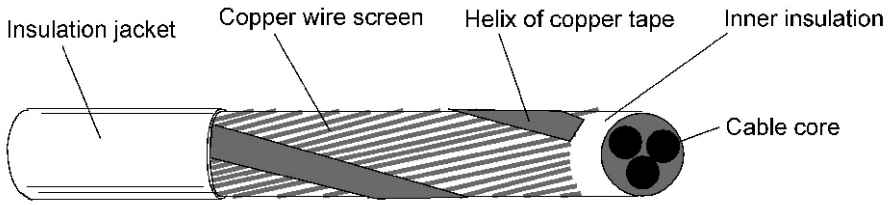
4.8.1 Power System Configuration

Before connecting line power to an RSi S4 drive, determine the configuration of the power system. If the configuration cannot be determined with exactitude, at least have a solid understanding of how the power system is configured. Numerous configurations of distribution transformers are in use today throughout the world. The principal difference between these various configurations is the means used to introduce a connection to earth ground.

The primary consideration should be to measure the voltages from line to line (all combinations in a three-phase system) and the voltage from each line connection to earth ground. Ensure that each voltage measurement does not exceed the input voltage rating (including tolerance) for your particular model.

If you discover different results than expected, contact Benshaw for assistance. **Failure to observe these precautions may void the warrenty.**

Motor Cable Shield
To effectively suppress radiated and conducted radio-frequency emissions, the shield conductivity must be at least 1/10 of the phase conductor conductivity. The requirements are easily met with a copper or aluminum shield. The minimum requirement of the motor cable shield of the drive is shown below. It consists of a concentric layer of copper wires with an open helix of copper tape. The tighter and better the shield is, the lower the emission level.



General Rules
Dimension the mains (input power) and the motor cables **according to local regulations**:

- The cable must be able to carry the drive load current. See Power and Current Ratings starting on page 10.
- The cable must be rated for at least 70 C maximum permissible temperature of conductor in continuous use.
- The inductance and impedance of the PE conductor/cable (grounding wire) must be rated according to permissible touch voltage appearing under fault conditions (so that the fault point voltage will not rise excessively when a ground fault occurs).
- 600VAC cable is accepted for up to 500VAC. 750VAC cable is accepted for up to 600VAC. For 690VAC rated equipment, the rated voltage between the conductors of the cable should be minimum 1 kV.

4.9 Interference Suppression Measures

Electrical/electronic devices are capable of influencing or disturbing each other through connecting cables or other metallic connections. Interference suppression measures (electromagnetic compatibility) consists of two elements: interference resistance and interference emission.

Correct installation of the inverter in conjunction with any possible local interference suppression measures has a crucial effect on minimizing or suppressing mutual interference.

4.9.1 Guidelines for Interference Suppression

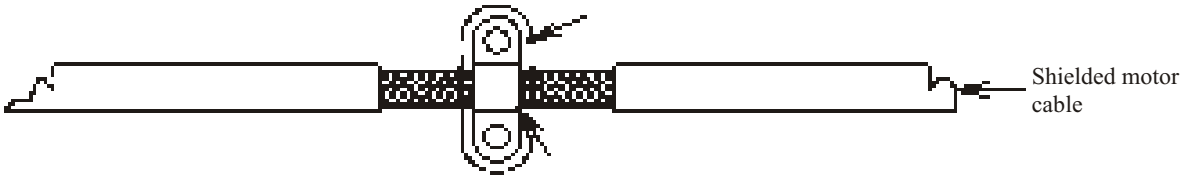
The following guidelines assume a power source that is not contaminated by high frequency interference. Other measures may be necessary to reduce or suppress interference if the power source is contaminated, and no general recommendations can be given for such cases. Please consult Benshaw's Electrical Application Engineering Department if the following recommended interference suppression measures do not produce the desired result.

Guidelines are as follows:

- When dealing with RFI (radio frequency interference), the surface area of the conductors is a more critical consideration than its cross sectional area. Since high frequency interference does not flow through the entire cross section of the conductor, but tends to stay toward its outer surface (skin effect), braided copper tapes of equal cross section should be used.

A central grounding point should be used for interference suppression. Route the ground cables radially from this point, avoiding loops which may lead to interference. The inverter and all components used for interference suppression, particularly the shield of the motor cable, should be connected over as large a surface area as possible when passing over metallic surfaces. Remove the paint from contact surfaces to ensure a good electrical connection. See Figure 19 for recommended connection technique.

Figure 19: Recommended Connection Technique



- Take care not to damage the shield cross section when connecting it to the continuing lines. This raises the RF resistance of the shield and radiates rather than discharges the RF energy traveling on the shield. Shields, particularly those on control cables, must not be routed through pin contacts (plug connectors).

  When shielded cables must pass through a plug connection, use the metallic hand guard of the plug for the continuation of the shield. It is strongly recommended that the shield be uninterrupted whenever possible.

- Use a shielded motor cable which is grounded over a large surface area at both ends. The shield on this cable should be uninterrupted. If a shielded motor cable cannot be used, the unshielded motor line should be laid in a metal conduit or duct which is uninterrupted and grounded at both ends.

When selecting shielded cable for use as motor leads, it is important to select a cable which is designed for operation at the frequencies and power levels involved. Improper selection of motor cable can cause high potential to exist on the shield. This could cause damage to the inverter and other equipment, and could pose a safety hazard.

- The following cables are acceptable for this purpose: OLFlex Series 150CY, 110CY, 110CS, 100CY, 100CS, and 540CP. Siemens CordaflexSM is also acceptable. Some of these cables are VDE-approved only; others carry VDE, UL, CSA, and combinations of these ratings. Be sure to confirm that the cable you are using meets the certification of the agency required.

  OLFlex cables are available from OLFlex Wire & Cable, 30 Plymouth Street, Fairfield NJ 07004, (800)-774-3539.

  Cordaflex cables are available from Siemens Energy and Automation, Inc., Power Cables, 3333 State Bridge Road, Atlanta GA 30202, (800)-777-3539.

- If the installation requires the use of an output reactor then the reactor, like the line filter, should be placed as close as possible to the inverter.

- Control wires longer than 3 feet (1 meter) must be run in shielded cable, and the shield must be terminated at circuit common (Acom) on the inverter. Note that connection to (Dcom) rather than earth ground is allowed because RSi S4 inverters have isolated control inputs. If the signal run exceeds 30 feet (9 meters), a 0-20 mA or 4-20 mA signal should be used, as it will have better noise immunity than a low level voltage.

- Other loads connected to the power source may produce voltage transients (spikes) that may interfere with or damage the inverter. Line reactors or filters can be used on the input power to protect the inverter from such transients.

- If the inverter is operated from switchgear devices or is in close proximity to switchgear devices (in a common cabinet), the following procedures are recommended as a precaution to prevent these devices from interfering with the inverter's operation:
  - ➜ Wire the coils of DC devices with freewheeling diodes. The diodes should be placed as close as possible to the physical coil of the device.
  - ➜ Wire the coils of AC devices with RC type snubber networks. Place the snubbers as close as possible to the physical coil of the device.
  - ➜ Use shielded cables on all control and monitoring signals.

Route distribution cables (for example, power and contactor circuits) separately and as far away from control and monitoring signal cables as possible.

5 Keypad Operation and Programming

INTRODUCTION

5.1 Introduction

The S4 AC drive is pre-programmed to run a standard, 4-pole AC induction motor. For many applications, the drive is ready for use right out of the box with no additional programming needed. The digital keypad controls all operations of the unit. The ten input keys allow “press and run” operation of the motor (Operation mode) and straightforward programming of the parameters (Program mode).

Figure 20: The S4 Keypad

⌘ **NOTE:** To see operation of each button go to page 54.

KEYPAD OPERATION

5.2 Alpha-Numeric Display

The RSi S4 uses a 32-character alpha-numeric LCD display for its human-machine interface. All drive functions can be accessed by the keypad. The keypad allows easy access to drive programming with parameter descriptions on the LCD display.

The following three figures are examples of what is shown in the display window of the Standard Keypad during Drive (DRV), Function (FUN), Input/Output (I/O), Advanced Function (AFN) and Fault Modes (FLT).

Figure 21: Operate Screen

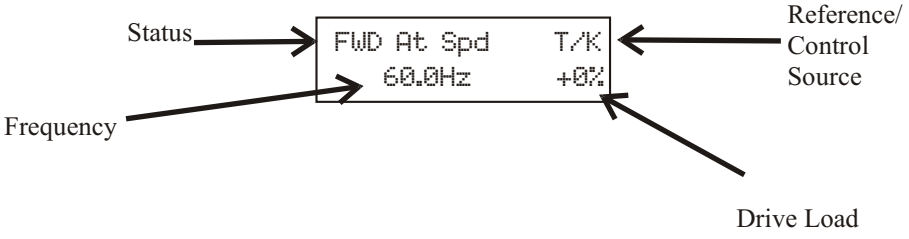


Figure 22: DRV, FUN, I/O, AFN, APP groups

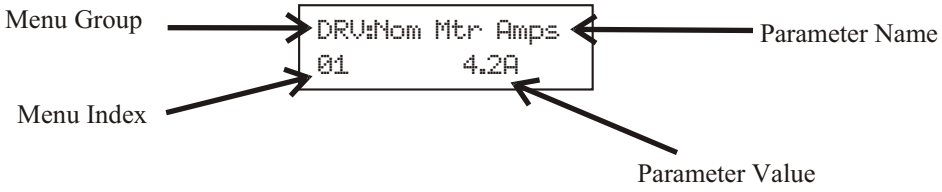
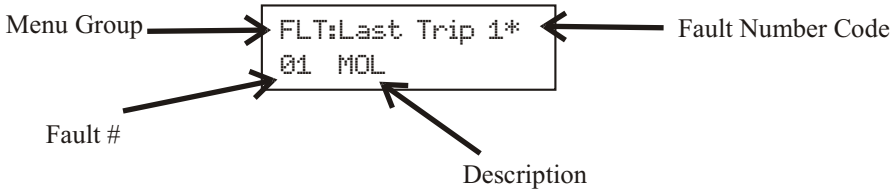


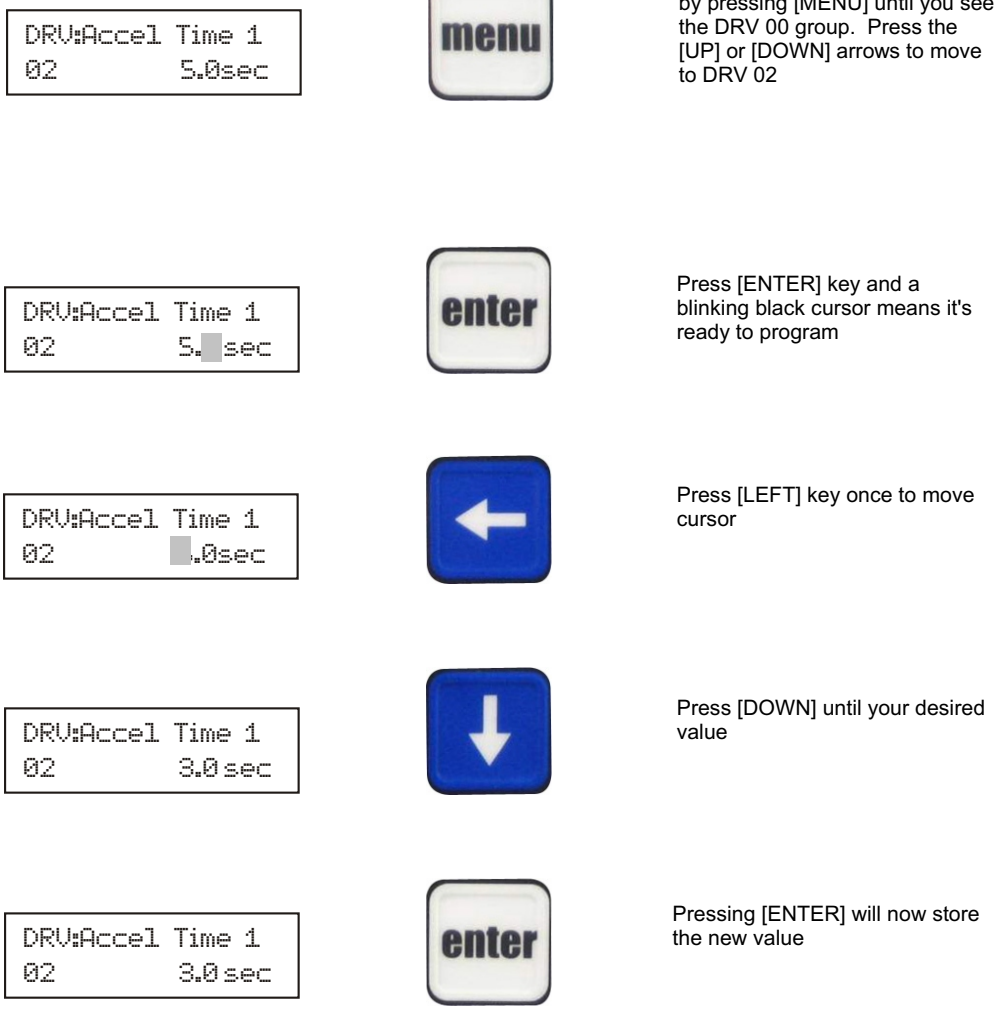
Figure 23: Fault Screen (1-5)



Procedure for Setting Data

5.3 Procedure of Setting Data

To change Accel Time 1 (DRV 02) from 5.0sec to 3.0 sec.



The same procedure is applied to all other parameters. While the drive is running, the output frequency can be changed to a new command frequency.

⌘ **NOTE:** Some parameters cannot be changed while the VFD is running.

5.3.1 Jump Code

By changing the value of this parameter and pressing [ENTER], you can jump directly to any parameter within the group.

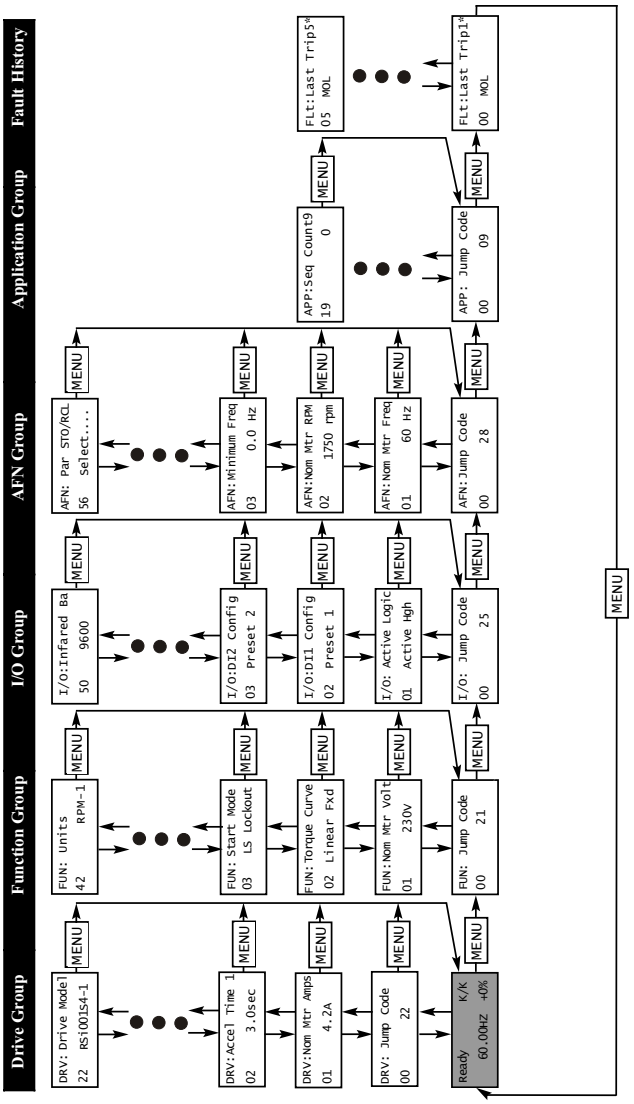
```
AFN: Jump Code
00          28
```

⌘ **NOTE:** All groups have a jump code screen.

Parameter Navigation

5.4 Parameter Navigation

Figure 24: Parameter Navigation



In any of the parameter groups, the user can jump to a specific parameter code by following these steps:

- Select a parameter group that requires a change.
- At the beginning of each program group the menu will read [Jump Code]. Press the [MENU] key.
- Enter the code number of the parameter needed to be changed then press [ENTER].

Keypad Button Descriptions

5.5 Keypad Button Descriptions

The following describes each button on the Standard Keypad.

This key causes the drive to begin spinning the motor in the Forward direction if this direction is enabled (SeeAFN 19, Run Prevent) and if the keypad is the active control source (See DRV 04, Drive Mode 1)
NOTE: Drive enable (EN) terminal input must be active

This key causes the drive to begin spinning the motor in the Reverse direction if this direction is enabled (See AFN 19, Run Prevent) and if the keypad is the active control source (See DRV 04, Drive Mode 1)
NOTE: Drive enable (EN) terminal input must be active

Press the Jog button to enter Jog mode. The green Jog indicator in the key illuminates when the drive is in Jog mode. To jog the motor in either direction, press either the FWD or REV. The motor will operate at the speed programmed in parameter I/O 12 (Jog Speed). To exit Jog mode, press Jog again. Must be set to LOCal.

The [UP] arrow key is used in a variety of ways:
- Increase the value of a numeric parameter (including drive speed)
- Select the next value of an enumerated parameter
- It scrolls forward through a list of parameter groups or parameters within a group
  (When the last group or parameter is displayed, it scrolls to the beginning of the list)
- When a list of faults is displayed, it moves from one fault to the next. After the last fault is displayed, it returns to the first fault

The [DOWN] arrow key is used in a variety of ways:
- Decrease the value of a numeric parameter (including drive speed)
- Select the next value of an enumerated parameter
- It scrolls reverse through a list of parameter groups or parameters within a group
  (When the last group or parameter is displayed, it scrolls to the beginning of the list)
- When a list of faults is displayed, it moves from one fault to the previous fault. After the first fault is displayed, it returns to the last fault

When editing a numeric parameter, the [LEFT] arrow key moves the cursor one digit to the left. If cursor is already at the most significant digit, it will scroll to the least significant digit on the right.
- When in Menu mode, the LEFT arrow allows menu groups to be scrolled through in the opposite direction of the menu key.

The STOP/RESET key halts the operation of the RSi S4 drive unless it is disabled by parameter AFN 20 (Stop key). This parameter also determines the type of stop (coast, ramp or DCI) that occurs when STOP is pressed. This button works (unless disabled) with any control source. ⌘ **NOTE:** See parameter AFN 20 (Stop key)

- Menu scrolls between the operate screen and the available parameter groups.
- When viewing a parameter, pressing [MENU] will jump to the top of the menu. For the DRV, FUN, I/O, AFN and APP menu groups, it will return you to the Jump Code.
- When a parameter is being programmed (cursor), and [MENU] is pressed, the change is aborted and the old value is restored.

- When the Drive is in the Operate Mode, pressing [ENTER] will allow you to change the speed reference if the drive is configured to use the keypad for the reference source.
- Pressing while a parameter is shown will put in program mode. Stores the new value of a parameter.

Pressing this key toggles drive control between the LOCal and REMote control modes.
It can be configured to shift: a) the Run/Stop command (FWD or REV) b) the speed reference signal or both a and b.
It can also be set to "disabled". It will operate either in Stop mode or while the drive is running. If power is removed and reapplied, the memory will retain the last selected function.
⌘ **NOTE:** See page 55 (Control loc/rem button) for information on this key.

5.6 LCD Displays

5.6.1 Control (loc/rem) button

The 3 characters in the top right hand corner of the operate screen show the source of control for the drive:

Figure 27: Modes (loc/rem) key can be set as

Display Value for Remote Mode	Meaning
LOC	Local control via the keypad
K/K	Keypad control / Keypad reference
K/T	Keypad control / Terminal reference
T/K	Terminal control / Keypad reference
T/T	Terminal control / Terminal reference
S/K	Serial control / Keypad reference
S/T	Serial control / Terminal reference
S/S	Serial control / Serial reference
T/S	Terminal control / Serial reference
K/S	Keypad control / Serial reference

Figure 25: Drive is in LOCal mode

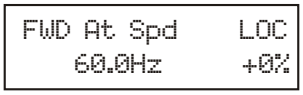


Figure 26: Drive is in REMote mode

In figure 25 the drive is in LOCal mode which means the Start/Stop & Speed reference control paths come from the keypad.

In figure 26 the T/K is an example of one of the control sources during REM mode. The chart above shows all the paths that may be set. The first letter (T in example) is for parameter DRV 04 (Drive Mode 1) and will set the control (FWD or REV) source. The second letter (K in example) is for DRV 05 (Freq Mode 1) and will set the reference (Speed) source.

⌘ **NOTE:** If the drive is running and the "loc/rem" button is pressed, and the new control source does not have a run command, then the drive will stop.

⌘ **NOTE:** To disable this button go to page 129 "loc/rem button".

5.6.2 S4 Keypad Status Messages

Figure 28: S4 Keypad Status Messages

Message	Meaning
Stopped	The drive is not spinning the motor or injecting DC voltage. The drive is ready to run when given the proper signal
FWD Accel	The drive is spinning the motor in the forward direction and the speed of the motor is increasing
REV Accel	The drive is spinning the motor in the reverse direction and the speed of the motor is increasing
FWD Decel	The drive is spinning the motor in the forward direction and the speed of the motor is decreasing
REV Decel	The drive is spinning the motor in the reverse direction and the speed of the motor is decreasing.
Jog FWD	The drive is jogging in the forward direction
Jog REV	The drive is jogging in the reverse direction
FWD At Spd	The drive is spinning the motor in the forward direction and the speed of the motor is at the reference frequency
REV at Spd	The drive is spinning the motor in the reverse direction and the speed of the motor is at the reference
Zero Speed	The drive has an active run signal but the motor is not spinning because the reference speed to the drive must be 0.0 Hz
DC Inject Faulted	The drive is injecting DC voltage into the motor
Faulted	The drive is faulted
Reset-Fit	The drive is faulted, but has the possibility of being automatically reset
LS Lockout	Line-Start Lockout functionality has become active. This means there was an active run signal during power-up or when a fault was reset. This run signal must be removed before the Line-Start Lockout functionality will be removed
Catch Fly	The Catch on the Fly functionality is actively searching for the motor frequency
Forward	The drive is running forward without accelerating, decelerating or residing at the reference frequency. This means that something is keeping the drive from the reference frequency (for example, Current Limit)
Reverse	The drive is running in reverse without accelerating, decelerating or residing at the reference frequency. This means that something is keeping the drive from the reference frequency (for example, Current Limit)
Not Enabled	The drive is not allowed to run either because the digital input enable is not active or because ARCTIC mode has shut down the run operation
Volt Range	The drive has not met the input voltage requirements that it needs to be able to run. In other words, the Bus Voltage of the drive is either too low or too high
Low Voltage	The drive has reached an undervoltage state
Kpd Stop	A stop command was given from the keypad when the keypad was not the active control source. To remove this condition, the run signal to the drive must be removed

5.6.3 S4 Keypad Warning Messages

Figure 29: S4 Keypad Warning Messages

Message	Meaning
DB Active	The DB Resistor is being actively pulsed
Curr Limit	The drive is operating in current limit
HS Fan Err	Either the heatsink fan should be on and is off, or vice-versa
Addr XXX	This is the node address of the drive when it receives a valid message through the IR port address to another node. The XXX will be replaced with the node address.
High Temp	The temperature of either the heatsink or the control board is nearing a high temperature limit that will fault the drive
Low Temp	The temperature of either the heatsink or the control board is nearing a low temperature limit that will fault the drive
Vac Imblnce	Either the drive has lost an input phase or the input voltage is unbalanced more than 2%
Power Supp	A power supply short occurred
Seq Dwell	The sequencer is active, but the transition to the next step is halted
Int Fan Err	Either the internal fan is on and should be off, or vice-versa
DB OverTemp	The temperature of the DB Resistor is nearing a high temperature and will fault the drive
ARCTIC Mode	The ARCTIC DB Resistor mode is actively pulsing the DB Resistor
CPU Warning	A system error occurred in the software of the S4
Mtr Measure	An RS Measurement is armed or active
IR Active	Valid IR communications are occurring
Seq Running	The program sequencer functionality is active

5.6.4 Operate Mode

The Operate mode is entered automatically approximately one second after the power-up display is shown, which provides information about the software version of the drive.

The operate mode is the principle mode for the standard keypad. The display for this mode provides operational information about the RSi S4 drive. Figure 28 on the previous page shows the typical operate display and notes what the various codes in the display mean. Note that if more than one status is active, the higher-priority status will be shown.

Also note that you may select a different display for the Operate mode. Parameter FUN 40 (Display Mode) allows you to select a display that shows a custom unit instead of output frequency. Alternately, this parameter allows you to choose to display retention time. See page 98 for more information on this parameter.

5.7 Programming Mode

As described on page 52, programming mode is entered by pressing the [MENU] key or [UP} and [DOWN] keys to access QuickStart items.

To program a parameter's value, perform the following steps:
1. Press [MENU] to enter the first parameter group.
2. As you use the arrow keys, the parameters and their values will scroll on the display. If you wish to change the parameter's value, press the [ENTER] key.

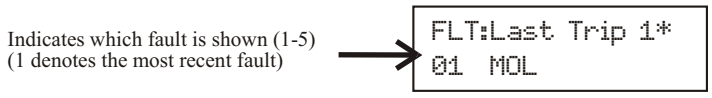
After the [ENTER] key is pressed, the parameter will enter edit or program mode, unless it is a read-only. The RSi S4 drive uses two types of parameters. One type is assigned a numerical value, while the second type is assigned a function.

For example, parameter AFN 04 (Maximum Freq) may range from 0 to 400Hz, and you may configure any value within that range for the maximum frequency of the drive. On the other hand, parameter AFN 20 (Stop Key) only allows you to choose from one of three functions: Coast, Ramp or Disabled.

5.7.1 Active Fault / Warning and Fault History Mode

When a fault or warning occurs, the Operate mode automatically changes to the Active Fault mode. The drive stores up to 5 active faults or warnings, and provides a separate display for each.
Once the active fault display is shown, you must correct the condition causing the fault and then reset the drive to return to the Operate mode.

Figure 30: Fault Screen (1-5)



In addition to the active faults, the drive maintains a history of faults. The 5 most recent faults are kept in the fault history log.

5.7.2 Jog Control

Press the Jog button to enter Jog mode. The green Jog indicator in the key illuminates when the drive is in Jog mode. To jog the motor in either direction, press and hold either the FWD or REV. The motor will operate at the frequency programmed in parameter I/O 12 (Jog Speed). To exit Jog mode, press Jog again.

⌘ **NOTE:** Must be set to LOCal. Press the "loc/rem" key if you are in REMote mode. See page 55 for more information on control modes.

5.7.3 Measuring Stator Resistance (RS Measurement) for Vector Control

- Make sure there is no load applied to the motor and that the motor shaft is free to spin without damage.
- Set the following parameters to the data on nameplate of motor: FUN 01 (Nom Mtr Volt), DRV 01 (Nom Mtr Amps), AFN 02 (Nom Mtr RPM), AFN 12 (Power Factor).
- Change parameter AFN 11 (Auto-tune) to "Motor RS". At this point, the RS measurement will be armed.
- The operate screen shows in two ways that an RS Measurement is ready to be made. First, the Control path status field displays "MEA". Second, a "Mtr Measure" warning flashes.
- Start the RS Measurement by pressing the "FWD".
- The measurement will begin as the drive injects voltage to the motor at zero freq. This lasts 2 seconds.
- If the test was successful, AFN 10 (Motor RS) will contain the new Motor RS.
- If the tests fails, you may want to try the test again with a different "Rated Mtr FLA" or Current Limit %.

DESCRIPTION OF THE LEDS ON THE STANDARD KEYPAD

5.8 Description of the LEDs on the Standard Keypad

The display window on the digital keypad has three LEDs. The LEDs provide information about the drive's operating condition as shown in the table below.

LED Name	State	Operating Condition
fwd	Steady-On	The drive is at frequency (forward)
rev	Steady-On	The drive is at frequency (reverse)
jog	Steady-On	The drive is in jog mode
stop **reset**	Flashing	The drive has detected a fault and has stopped the motor
	Steady-On	The drive has stopped operation

UPGRADING FIRMWARE BY REFLASHING

5.9 Upgrading Firmware by Reflashing

The firmware of the RSi S4 Sensorless Vector Drive can by upgraded by a process called "reflashing." This allows the latest features to be implemented in existing hardware.

The procedure for upgrading firmware by reflashing is as follows:
- Stop the drive, and clear any faults
- Press [stop/reset] and [menu] buttons simultaneously
- Connect the reflash cable to the RJ45 jack on the TSP board
- Connect the other end of the cable to the PC
- Open the reflash software on the PC
- Open the new code file
- Click the reflash button
- When reflashing is complete press [stop/reset] button and load the new factory defaults. See parameter AFN 56 (Par STO/RCL).

⌘ **NOTE:** See page 175 for more information on the RJ45 jack.

QUICK START

5.10 Quick Start

These QuickStart Up instructions are for those applications where:
- The user wants to get the RSi S4 Series inverter started quickly
- The factory default values are suitable for the user application

The factory default values are shown on Page 64 "Parameter Groups" of this manual. The factory setting is for the drive to run a typical NEMA B induction motor to a maximum speed of 60.00Hz with acceleration and deceleration times of 5s. The jog frequency is set for 5.0Hz. If the application requires co-ordinated control with other controllers, it is recommended the user become familiar with all parameters and features of the inverter before applying AC power.

WARNING: Connecting input power to terminals T1/U, T2/V and T3/W will cause severe damage to the VFD.

1. Apply power to the VFD.

2. Verify power up. The display should read as follows:

```
Stopped          LOC
   0.0Hz        +0%
```

3. Set FUN 02 (Torque Curve) to the setting that best describes your application.

⌘ **NOTE:** If you are uncertain of the application's load characteristics, leave the FUN 02 (Torque Curve) parameter at it's default value: Linear Fxd.

```
FUN: Torque Curve
02   Linear Fxd
```

4. Set the correct Motor Amps from the nameplate of motor into parameter DRV 01 (Nom Mtr Amps) by pressing [MENU] then [UP] until you have the screen shown below:

```
DRV: Nom Mtr Amps
01          x.xA
```

5. Press the [ENTER] key to edit the parameter. You will see a flashing cursor. Use the arrow keys to select the motor's rated full load Amperage. Press the [ENTER] key again to write the data to memory.

WARNING: Setting the Acceleration time too low can cause OVERCURRENT faults.
Setting the Deceleration time too low can cause OVERVOLTAGE faults.

6. Set the desired Acceleration Time by setting parameter DRV 02 (Accel Time 1).

```
DRV: Accel Time 1
02          5.0sec
```

Press the [ENTER] key to edit the parameter. You will see a flashing cursor, use the arrow keys to select the desired acceleration time. Press the [ENTER] key to write the value to memory.

7. Set the desired Deceleration Time by pressing the [UP] arrow key to change the LCD screen to:

```
DRV: Decel Time 1
03          5.0sec
```

Press the [ENTER] key to edit the parameter. You will see a flashing cursor, use the arrow keys to select the desired deceleration time. Press the [ENTER] key to write the value to memory.

8. Press the [MENU] button to return to the Operate screen:

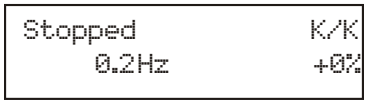
```
Stopped          LOC
   60.0Hz        +0%
```

Use the arrow keys to select to the desired output frequency. You can change the frequency while the motor is running.

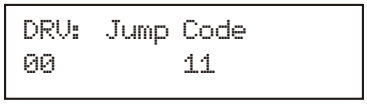
9. Press the [FWD] button. The Green LED on the "fwd" button will turn on when the motor has reached the desired speed.

5.10.1 Easy Start Up (Operation from a Two Wire Start/Stop Circuit & Analog Input)

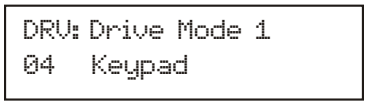
1. First press the loc/rem button to switch the control mode from "LOC" to "K/K".



2. Press [MENU] key until the following screen appears:



3. Using the [UP] arrow key scroll to the following parameter:



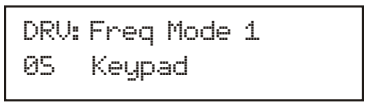
4. Press [ENTER] key to select.

5. Using the [UP] arrow key select "Terminal 1".

6. Press the [ENTER] key to save the setting.

7. The VFD can now start and stop via a dry contact closure. This contact closure should be between the terminals FWD and +24 control.

8. After you have DRV 04 set to "Terminal 1" press the [UP] button to have the display screen shown below.

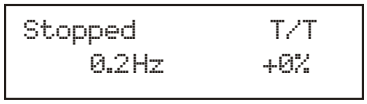


9. Press [ENTER] key to select.

10. Using the [UP] arrow key select "Vin1".

11. Press the [ENTER] key to save the setting.

12. Press [MENU] button until the following screen is displayed.



⌘ **NOTE:** See page 55 for more information on Control Modes.

⌘ **NOTE:** See page 42 to see the S4 Wiring Diagram.

6 S4 Parameter Groups

6.1 S4 Parameter Groups

6.1.1 DRV Group

Code	Parameter Name	Default	Range (Options)	Modbus	View Only	Page
DRV 01	Nom Mtr Amps	Nominal for Drive	Model Dependant	40001		76
DRV 02	Accel Time 1	5.0 sec	0.1 - 3200.0 sec	40002		77
DRV 03	Decel Time 1	5.0 sec	0.1 - 3200.0 sec	40003		77
DRV 04	Drive Mode 1	0="Keypad"	0="Keypad" 1="Terminal 1" 2="Terminal 2" 3="Serial"	40004		78
DRV 05	Freq Mode 1	0="Keypad"	0="Keypad" 1="Vin1" 2="Cin" 3="Vin2" 4="Vin1 6FS" 5="Vin1 48FS" 6="Vin1+Cin" 7="Vin1+Vin2" 8="Vin1-Cin" 9="Vin1-Vin2" 10="Vin1+k*Cin" 11="Vin1+k*Vin2" 12="Max Input" 13="EMOP" 14="Serial"	40005		79
DRV 06	Drive Mode 2	2="Terminal 2"	0="Keypad" 1="Terminal 1" 2="Terminal 2" 3="Serial"	40006		79
DRV 07	Freq Mode 2	1="Vin1"	0="Keypad" 1="Vin1" 2="Cin" 3="Vin2" 4="Vin1 6FS" 5="Vin1 48FS" 6="Vin1+Cin" 7="Vin1+Vin2" 8="Vin1-Cin" 9="Vin1-Vin2" 10="Vin1+k*Cin" 11="Vin1+k*Vin2" 12="Max Input" 13="EMOP" 14="Serial"	40007		80
DRV 08	Output Curr.	Read-Only	0.0 to 999.9 A	40008	X	80
DRV 09	Output Volts	Read-Only	0 to 1000 V	40009	X	80
DRV 10	Output Power	Read-Only	0.0 to 655.35 kW	40010	X	80
DRV 11	MWh Meter	Read-Only	0 to 32767 MWh	40011	X	81
DRV 12	kWh Meter	Read-Only	0.0 to 999.9 kWh	40012	X	81
DRV 13	Run Time	Read-Only	0.0 to 6553.5 h	40013	X	81
DRV 14	Power Time	Read-Only	0 to 65535 h	40014	X	81
DRV 15	Output Freq	Read-Only	0.0-400.0 Hz	40015	X	81
DRV 16	Drive Load	Read-Only	-250.0 to 250.0 %	40016	X	82
DRV 17	Drive Temp	Read-Only	-20.0 to 125.0 Celcius	40017	X	82
DRV 18	Bus Voltage	Read-Only	0 to 1000 Vdc	40018	X	82

Code	Parameter Name	Default	Range (Options)	Modbus	View Only	Page
DRV 19	Stator Freq	Read-Only	0.0 Hz	40019	X	82
DRV 20	Load Torque	Read-Only	-250.0 to 250.0 %	40020	X	83
DRV 21	SW Manual	Read-Only		40021	X	83
DRV 22	Drive Model	Read-Only	1 - single phase 120VAC "RSi001S4-1" 2 - three phase 240VAC "RSi001S4-2" to "RSi030S4-2" 4 - three phase 460VAC "RSi001S4-4" to "RSi200S4-4" 6 - three phase 600VAC "RSi001S4-6" to "RSi200S4-6"	40022	X	83

6.1.2 FUN Group

Code	Parameter Name	Default	Range (Options)	Modbus	View Only	Page
FUN 00	Jump Code					
FUN 01	Nom Mtr Volt	Model Dependant	Model Dependant	40101		84
FUN 02	Torque Curve	1="Linear Fxd"	0="Linear Auto" 1="Linear Fxd" 2="Pump Fxd" 3="Fan Fxd" 4="Linear 2pc" 5="Vector"	40102		84
FUN 03	Start Mode	0="LS Lockout"	0="LS Lockout" 1="AutoStart" 2="LSL w/Fly" 3="Auto w/Fly"	40103		85
FUN 04	EMOP Config	0="TS no Mem"	0="TS no Mem" 1="TS Mem" 2="T/K Mem" 3="TS Stp" 4="TS Mem Stp" 5="T/K Mem Stp"	40104		86

Code	Parameter Name	Default	Range (Options)	Modbus	View Only	Page
FUN 05	DB Config	1="DB Internal"	0="No Dyn Brk" 1="DB Internal" 2="DB External" 3="Int-ARCTIC"	40105		87
FUN 06	DC Inj Cfg	0="DC at Stop"	0="DC at Stop" 1="DC at Start" 2="DC at Both" 3="DC on Freq"	40106		88
FUN 07	DC Inj Freq	0.0Hz	0.0 to 20.0 Hz	40107		88
FUN 08	DC Inj Time	0.2 sec	0.0 to 60.0 s	40108		89
FUN 09	DC Inj Lvl	50.00%	0.0 to 100.0 %	40109		89
FUN 10	Curr Lim Sel	0="Fixed Lvls"	0="Fixed Lvls" 1="Vin2" 2="Cin" 3="Vin2 Motor" 4="Cin Motor" 5="Vin2 F-Mtr" 6="Cin F-Motor"	40110		90
FUN 11	Curr Lim M/F	120%	5 to 200 %	40111		90
FUN 12	Curr Lim M\R	120%	5 to 200 %	40112		91
FUN 13	Curr Lim R/F	80%	5 to 200 %	40113		91
FUN 14	Curr Lim R\R	80%	5 to 200 %	40114		91
FUN 15	Curr Lim Frq	3.0Hz	0.0 to 400.0 Hz	40115		92
FUN 16	Ramp Time CL	1.0 sec	0.1 - 3200.0 sec	40116		92
FUN 17	Curr Lim Min	10%	0 - 50%	40117		92
FUN 18	Reg Time-Out	300%	100% to 1000%	40118		93
FUN 19	Skip Frq Bnd	0.2Hz	0.2 - 20.0Hz	40119		93
FUN 20	Skip Freq 1	0.0Hz	0.0 - 400.0 Hz	40120		94
FUN 21	Skip Freq 2	0.0Hz	0.0 - 400.0 Hz	40121		94
FUN 22	Skip Freq 3	0.0Hz	0.0 - 400.0 Hz	40122		94
FUN 23	Skip Freq 4	0.0Hz	0.0 - 400.0 Hz	40123		94
FUN 24	Fault LO #	0	0 to 8	40124		94
FUN 25	Auto Rst Tm	60.0 s	0 to 60.0 s	40125		94
FUN 26	Curr Level 1	0%	0 to 200 %	40126		95
FUN 27	Curr Level 2	0%	0 to 200 %	40127		95
FUN 28	Torque Lvl 1	0%	0 to 200 %	40128		95
FUN 29	Torque Lvl 2	0%	0 to 200 %	40129		95
FUN 30	Freq Level 1	0.0Hz	0.0 - 400.0 Hz	40130		95
FUN 31	Freq Level 2	0.0Hz	0.0 - 400.0 Hz	40131		95
FUN 32	Freq Level 3	0.0Hz	0.0 - 400.0 Hz	40132		95
FUN 33	Low Freq Thr	0.0Hz	0.0 - 400.0 Hz	40133		96
FUN 34	Timer 1 Type	0="On Delay"	0="On Delay" 1="Off Delay" 2="On/Off Delay"	40134		96
FUN 35	Timer 1 Time	1.0 s	0.0 to 320.0 s	40135		96
FUN 36	Timer 2 Type	0="On Delay"	0="On Delay" 1="Off Delay" 2="On/Off Delay"	40136		97

FUN 37	Timer 2 Time	1.0 s	0.0 to 320.0 s	40137		97
FUN 38	Status Field	0="Drive Load"	0="Drive Load" 1="Output Curr" 2="Out Volt" 3="Drive Temp" 4="% of FLA" 5="Out Power"	40138		97
FUN 39	Password	0	0 to 999	40139		98
FUN 40	Display Mode	0="Std Disply"	0="Std Disply" 1="Output Freq" 2="Stator Freq" 3="User Units" 4="RPM Units" 5="GPM Units" 6="FPM Units" 7="MPM Units" 8="PSI Units" 9="Degrees C" 10="Degrees F" 11="Time hrs" 12="Time min" 13="Time sec" 14="Fbk RPM" 15="Fbk PSI" 16="Fbk GPM" 17="Fbk User"	40140		98
FUN 41	Units Scale	18000	1 to 65535	40141		99
FUN 42	Units	"RPM-1"	Alpha-Numeric	40142		99

6.1.3 I/O Group

Code	Parameter Name	Default	Range (Options)	Modbus	View Only	Page
I/O 00	Jump Code					
I/O 01	Active Logic	1="Active High"	0="Active Low" 1="Active High"	40301		100
I/O 02	DI1 Config	1="Preset 1"	0="Not Assign" 1="Preset 1" 2="Preset 2" 3="Preset 3" 4="Coast Stop" 5="DC Inject" 6="DRV/Frq Set" 7="Alt Ramp" 8="Fault Reset" 9="EMOP+" 10="EMOP-" 11="PID Disable" 12="Cur Lim Dis" 13="SL Override" 14="FLY Dis" 15="CurLimIMax" 16="Jog Fwd" 17="Jog Rev" 18="NO MOL" 19="NC MOL" 20="Timer 1" 21="Timer 2" 22="Seq 1" 23="Seq 2" 24="Seq 3" 25="Seq Dwell" 26="Seq Advance"	40302		101
I/O 03	DI2 Config	2="Preset 2"		40303		
I/O 04	DI3 Config	3="Preset 3"		40304		
I/O 05	DI4 Config	6="DRV/Frq Set"		40305		
I/O 06	DI5 Config	8="Fault Reset"		40306		
I/O 07	MOL Config	18="NO MOL"		40307		

Code	Parameter Name	Default	Range (Options)	Modbus	View Only	Page
I/O 08	DO1 Config	4="Drv Ready"	0="Not Assign" 1="Drive Run" 2="Running Fwd" 3="Running Rev" 4="Drv Ready" 5="At Speed" 6="Drv Fault" 7="Drv NotFlt" 8="Kpd in Ctl" 9="Drv in Rem" 10="Jogging" 11="Curr Lvl 1" 12="Curr Lvl 2" 13="Trq Lvl 1" 14="Trq Lvl 2" 15="Frq Lvl 1" 16="Frq Lvl 2" 17="Frq Lvl 3" 18="Current Lim" 19="Loss Ref" 20="SL in Ctrl" 21="SL Override" 22="Zero Speed" 23="Frq Low Th" 24="PID High" 25="PID Low" 26="Timer 1" 27="Timer 2" 28="SeqOut-00" 29="SeqOut-01" 30="SeqOut-10" 31="SeqOut-11" 32="ARCTIC Mode"	40308		103
I/O 09	DO2 Config	5="At Speed"		40309		
I/O 10	R1 Config	6="Drv Fault"		40310		104
I/O 11	R2 Config	1="Drive Run"		40311		
I/O 12	Jog Speed	5.0 Hz	0.0 - 400.0 Hz	40312		105
I/O 13	Preset Spd 1	5.0 Hz	0.0 - 400.0 Hz	40313		106
I/O 14	Preset Spd 2	10.0 Hz	0.0 - 400.0 Hz	40314		
I/O 15	Preset Spd 3	20.0 Hz	0.0 - 400.0 Hz	40315		
I/O 16	Preset Spd 4	30.0 Hz	0.0 - 400.0 Hz	40316		
I/O 17	Preset Spd 5	40.0 Hz	0.0 - 400.0 Hz	40317		
I/O 18	Preset Spd 6	50.0 Hz	0.0 - 400.0 Hz	40318		
I/O 19	Vin1 Config	“0-10V”	0="0-10V" 1="0-10V Brk W" 2="0-10V I" 3="0-10V Bipol" 4="0-5V" 5="0-5V I" 6="0-20mA 250" 7="0-20mA 250I" 8="4-20mA 250" 9="4-20mA 250I" 10="PT 0-1kHz" 11="PT 0-10kHz" 12="PT 0-100kHz"	40319		107
I/O 20	Vin1 Span	100.00%	10.0 to 200.0%	40320		108
I/O 21	Vin1 Offset	0	0.0 to 100.0%	40321		108
I/O 22	Vin1 Filter	15 ms	1 to 1000 ms	40322		108
I/O 23	Cin Config	2="0-20mA 50"	0="4-20mA 50" 1="4-20mA 50I" 2="0-20mA 50" 3="0-20mA 50I"	40323		109
I/O 24	Cin Span	100.00%	10.0 to 200.0%	40324		109

Code	Parameter Name	Default	Range (Options)	Modbus	View Only	Page
I/O 25	Cin Offset	0	0.0 to 100.0%	40325		110
I/O 26	Cin Filter	15 ms	1 to 1000 ms	40326		110
I/O 27	Vin2 Config	0="0-10V"	0="0-10V" 1="0-10V Brk W" 2="0-10V l" 3="0-10V Bipol" 4="0-5V" 5="0-5V l"	40327		110
I/O 28	Vin2 Span	100.00%	10.0 to 200.0%	40328		111
I/O 29	Vin2 Offset	0	0.0 to 100.0%	40329		111
I/O 30	Vin2 Filter	15 ms	1 to 1000 ms	40330		112
I/O 31	Set k-Factor	0.0%	0.0%-100.0%	40331		112
I/O 32	Vmet Config	1="Out Freq"	0="Not Assign" 1="Out Freq" 2="Out Torque" 3="Out Volt" 4="Out Power" 5="Ref Freq" 6="PID Fback" 7="Bus Voltage" 8="Output Curr"	40332		112
I/O 33	Imet Config	2="Out Torque"		40333		
I/O 34	Vmet Span	100.0%	0.0 - 200.0%	40334		113
I/O 35	Imet Span	100.0%	0.0-200.0%	40335		113
I/O 36	Imet Offset	0.0%	0.0-90.0%	40336		114
I/O 37	Vin1 Status	Read-Only	0.00 to 100.00%	40337	X	114
I/O 38	Cin Status	Read-Only	0.00 to 100.00%	40338	X	114
I/O 39	Vin2 Status	Read-Only	0.00 to 100.00%	40339	X	115
I/O 40	Vmet Status	Read-Only	0.00 to 100.00%	40340	X	115
I/O 41	Imet Status	Read-Only	0.00 to 100.00%	40341	X	115
I/O 42	DOP Scaling	0="6FS"	0="6FS" 1="48FS"	40342		116
I/O 43	Speed Ratio	100.00%	0.0-200.0%	40343		116
I/O 44	Inputs	Read-Only	Bit 0 -> FWD DIBit 1 -> REV DIBit 2 -> R/J DIBit 3 -> DI1Bit 4 -> DI2Bit 5 -> DI3Bit 6 -> DI4Bit 7 -> DI5Bit 8 -> MOL DIBit 9 -> EN DI	40344	X	117
I/O 45	Outputs	Read-Only	Bit 0 -> R1 Relay Bit 1 -> R2 Relay Bit 2 -> DO1 Output Bit 3 -> DO2 Output	40345	X	117
I/O 46	Com Parity	0="RTU N81"	0="RTU N81" 1="RTU N82" 2="RTU E81" 3="RTU O81"	40346		118
I/O 47	Com Drop #	1	1-247	40347		118
I/O 48	Com Baudrate	1="9600"	0="4800" 1="9600" 2="19200" 3="38400" 4="57600"	40348		119
I/O 49	Com Timeout	0.0 sec	0.0 to 60.0 sec	40349		119
I/O 50	Infared Baud Rate	1="9600"	1="9600" 2="19200" 3="38400" 4="57600"	40350		120

6.1.4 AFN Group

Code	Parameter Name	Default	Range (Options)	Modbus	View Only	Page
AFN 00	Jump Code					
AFN 01	Nom Mtr Freq	Model Dependant	25.0 to 400.0 Hz	40501		120
AFN 02	Nom Mtr RPM	1750 rpm	1 to 24000 rpm	40502		121
AFN 03	Minimum Freq	0.0 Hz	0.0 to 400.0Hz	40503		121
AFN 04	Maximum Freq	60.0Hz	Minimum Freq to 400.0Hz	40504		121
AFN 05	Carrier Freq	3.0kHz	1.0 to 16.0kHz	40505		122
AFN 06	Slip Comp	0="No"	0="No" 1="Yes"	40506		122
AFN 07	V-Boost Conf	1.0%	0.0% to 50.0%	40507		123
AFN 08	Bst. Tpr Frq	60.0Hz	0.0Hz to Maximum Freq	40508		123
AFN 09	Bst. Tpr Vlt	100.0%	0.0 to 100.0 %	40509		124
AFN 10	Motor RS	Model Dependant	0.0 to 655.35 ohm	40510		
AFN 11	Auto-Tune	0="Not Active"	0="Not Active" 1="Motor RS"	40511		125
AFN 12	Power Factor	80.0%	0.50 to 1.00	40512		125
AFN 13	Fstator Filt	8 ms	1 to 100 ms	40513		126
AFN 14	Start Field	0="No"	0="No" 1="Yes"	40514		126
AFN 15	Filter Slip	100 ms	10 to 1000 ms	40515		127
AFN 16	ID Percent	Read-Only	-300.0 - 300.0%	40516	X	127
AFN 17	IQ Percent	Read-Only	-300.0 - 300.0%	40517	X	127
AFN 18	Catch Mode	0="Sweep Fwd"	0="Sweep Fwd" 1="Sweep Rev" 2="Sweep F/R"	40518		128
AFN 19	Run Prevent	0="Forward"	0="Allow F/R" 1="No Reverse" 2="No Forward"	40519		128
AFN 20	Stop Key	0="Coast"	0="Coast" 1="Ramp" 2="Disabled"	40520		129
AFN 21	Loc/Rem Key	1="Enabled"	0="Disabled" 1="Enabled"	40521		129
AFN 22	TOL Select	2="Std Ind 60s"	0="Std Ind Shp" 1="Std Ind 30s" 2="Std Ind 60s" 3="Std Ind 5mn" 4="In Duty Shp" 5="In Duty 30s" 6="In Duty 60s" 7="In Duty 5mn"	40522		130

Code	Parameter Name	Default	Range (Options)	Modbus	View Only	Page
AFN 23	Ramp Config	0="ART-DI"	0="ART-DI" 1="ART-F/R" 2="ART-Frq" 3="ART-Strt/RS" 4="S-Curve" 5="ART-DI CTS" 6="ART-F/R CTS" 7="ART-Frq CTS" 8="ART-Strt/CS 9="S-Curve CTS	40523		132
AFN 24	Accel Time 2	3.0 sec	0.1 to 3200.0 sec	40524		133
AFN 25	Decel Time 2	3.0 sec	0.1 to 3200.0 sec	40525		133
AFN 26	Rmp Rounding	25%	1-100%	40526		133
AFN 27	Rmp Sw. Freq	40.0Hz	0.0 to 400.0 Hz	40527		134
AFN 28	Single Phase	0="No" Model Dependant	0="No"1="Yes"	40528		134
AFN 29	Ref Fault	2="Fault"	0="Retain Spd" 1="Preset Lvl" 2="Fault"	40529		134
AFN 30	Lost Ref Frq	0.0Hz	0.0 to 400.0 Hz	40530		135
AFN 31	PID Config	0="No PID"	0="No PID" 1="Dir F-Fwd" 2="Rev F-Fwd" 3="Dir Full" 4="Rev Full"	40531		135
AFN 32	Feedback Cfg	0="Vin1"	0="Vin1" 1="Cin" 2="Vin2"	40532		136
AFN 33	PID P-Gain	0	0 to 2000	40533		136
AFN 34	PID I-Gain	0	0 to 10000	40534		137
AFN 35	PID D-Gain	0	0 to 1000	40535		137
AFN 36	PID FB Gain	1000	0 to 2000	40536		137
AFN 37	PID High Alm	0.00%	0.00 to 100.00 %	40537		138

Code	Parameter Name	Default	Range (Options)	Modbus	View Only	Page
AFN 38	PID Low Alm	0.00%	0.00 to 100.00 %	40538		138
AFN 39	PID Sleep	0="Disabled"	0="Disabled" 1="PID FBk <“ 2="PID FBk >" 3="PID Ref <“ 4="PID Ref >"	40539		138
AFN 40	Sleep Lvl	0.00%	0.00 to 100.00 %	40540		139
AFN 41	Wake-Up Lvl	0.00%	0.00 to 100.00 %	40541		139
AFN 42	Sleep Delay	0.0 sec	0.0 to 300.0 sec	40542		139
AFN 43	Wake-Up Dly	0.0 sec	0.0 to 300.0 sec	40543		140
AFN 44	PID Ref	Read-Only	0.00 to 100.00 %	40544		140
AFN 45	PID FB	Read-Only	0.00 to 100.00 %	40545		140
AFN 46	PID Error	Read-Only	0.00 to 100.00 %	40546		141
AFN 47	PID Output	Read-Only	0.00 to 100.00 %	40547		141
AFN 48	PID High Lim	100.00%	0.00 to 100.00 %	40548		141
AFN 49	PID Low Lim	0.00%	0.00 to 100.00 %	40549		142
AFN 50	PID Usr Unt	0="No"	0="No" 1="Yes"	40550		142
AFN 51	Software Rev	Read-Only	N/A	40551	X	142
AFN 52	Serial No 1	Read-Only	N/A	40552	X	143
AFN 53	Serial No 2	Read-Only	N/A	40553	X	143
AFN 54	Language	0="English"	0="English"	40554		143
AFN 55	Prog Number	0	Varies	40555		144
AFN 56	Par STO/RCL	0="Select…"	0="Select…" 1="Factory Rst" 2="Store Parm" 3="Load Param" 4="Swap Param"	40556		144
AFN 57	Power Fail Cfg	Retain Speed	0="Retain Speed" 1="Preset Lvl" 2="Fault" 3="3Cur" 4="4Cur" 5="5Cur"	40557		145
AFN 58	Ride-Thru En	w/ LVT	0="Disabled" 1="w/ LVT" 2="w/o LVT" 3="No UV Fault	40558		145
AFN 59	Cutoff Freq	0.0 Hz	0.0 to 5.0 Hz	40559		146
AFN 60	Stab. Gain	0	0 to 10	40560		146
AFN 61	Stab. Rate	5	1 to 1000	40561		146

6.1.5 APP Group

Code	Parameter Name	Default	Range (Options)	Modbus
APP 00	Jump Code			
APP 01	Seq Appl	0="Disabled"	0="Disabled" 1="1sec base" 2=".1sec base" 3=".01sec base"	40701
APP 02	Seq Cntl 1	00000000000	Bit 0-2 -> Speed Sel Bit 3 -> Accl Sel Bit 4-6 -> Event Length Bit 7-8 -> Dir Sel Bit 9-10 -> Output Sel	40702
APP 03	Seq Cntl 2	00000000000	Bit 0-2 -> Speed Sel Bit 3 -> Accl Sel Bit 4-6 -> Event Length Bit 7-8 -> Dir Sel Bit 9-10 -> Output Sel	40703
APP 04	Seq Cntl 3	00000000000	Bit 0-2 -> Speed Sel Bit 3 -> Accl Sel Bit 4-6 -> Event Length Bit 7-8 -> Dir Sel Bit 9-10 -> Output Sel	40704
APP 05	Seq Cntl 4	00000000000	Bit 0-2 -> Speed Sel Bit 3 -> Accl Sel Bit 4-6 -> Event Length Bit 7-8 -> Dir Sel Bit 9-10 -> Output Sel	40705
APP 06	Seq Cntl 5	00000000000	Bit 0-2 -> Speed Sel Bit 3 -> Accl Sel Bit 4-6 -> Event Length Bit 7-8 -> Dir Sel Bit 9-10 -> Output Sel	40706
APP 07	Seq Cntl 6	00000000000	Bit 0-2 -> Speed Sel Bit 3 -> Accl Sel Bit 4-6 -> Event Length Bit 7-8 -> Dir Sel Bit 9-10 -> Output Sel	40707
APP 08	Seq Cntl 7	00000000000	Bit 0-2 -> Speed Sel Bit 3 -> Accl Sel Bit 4-6 -> Event Length Bit 7-8 -> Dir Sel Bit 9-10 -> Output Sel	40708
APP 09	Seq Cntl 8	00000000000	Bit 0-2 -> Speed Sel Bit 3 -> Accl Sel Bit 4-6 -> Event Length Bit 7-8 -> Dir Sel Bit 9-10 -> Output Sel	40709
APP 10	Seq Cntl 9	00000000000	Bit 0-2 -> Speed Sel Bit 3 -> Accl Sel Bit 4-6 -> Event Length Bit 7-8 -> Dir Sel Bit 9-10 -> Output Sel	40710
APP 11	Seq Count 1	0	0-65535	40711
APP 12	Seq Count 2	0	0-65535	40712
APP 13	Seq Count 3	0	0-65535	40713
APP 14	Seq Count 4	0	0-65535	40714
APP 15	Seq Count 5	0	0-65535	40715
APP 16	Seq Count 6	0	0-65535	40716
APP 17	Seq Count 7	0	0-65535	40717
APP 18	Seq Count 8	0	0-65535	40718
APP 19	Seq Count 9	0	0-65535	40719

6.1.6 FLT Group

Code	Parameter Name	Default	Range (Options)	Details (or Differences)	Modbus	View Only	Page
FLT 01	Last Trip 1	Read-Only	Fault Codes of the Drive	Parameters saved in Fault History: Output Freq Drive Load Drive Status Drive Warn Output Voltage Output Current Drive Temp Run Time DC Bus Volt Adv Fault Code Cntl Brd Temp Out Power Power Time DI Status	40800	X	153
FLT 02	Last Trip 2	Read-Only	Fault Codes of the Drive		40820	X	
FLT 03	Last Trip 3	Read-Only	Fault Codes of the Drive		40840	X	
FLT 04	Last Trip 4	Read-Only	Fault Codes of the Drive		40860	X	
FLT 05	Last Trip 5	Read-Only	Fault Codes of the Drive		40880	X	

7 Parameter Descriptions

Parameter Descriptions

7.1 Parameter Descriptions

The detailed parameter descriptions in this chapter are organized in the same order as they appear on the LCD display.

Each parameter has a detailed description that is displayed with the following format.

Parameter Name	MMM__

LCD Display

```
MMM: Parameter
MI    Value
```

Description The description of the function.

See Also Cross references to related parameters or other chapters.

7.1.1 DRV Group

Jump to Parameter	DRV 00

LCD Display

```
DRV: Jump Code
00        11
```

Description By changing the value of this parameter and pressing [ENTER], you can jump directly to any parameter within the group.

Nom Mtr Amps	DRV 01

LCD Display

```
DRV:Nom Mtr Amps
01        x.xA
```

Description Model Dependent

Application Nominal Motor Amperage. This parameter configures the nominal motor current, and is obtained from the nameplate on the attached motor.

This parameter is used to set the motor overload. See AFN 22 (TOL Select) on page 130 .

⌘ **NOTE:** Incorrectly setting this parameter prevents proper operation of the drive.

Accel (Decel) Time 1 DRV 02, DRV 03

LCD Display:

DRV: Accel Time 1 02 5.0sec	DRV: Decel Time 1 03 5.0sec

Range 0.1 to 3200.0s **(Default 3.0s)**

Description

- Acceleration time sets the length of time to accelerate from 0Hz to the maximum frequency parameter AFN 04 (Maximum Freq) on page 121 for the primary ramp.

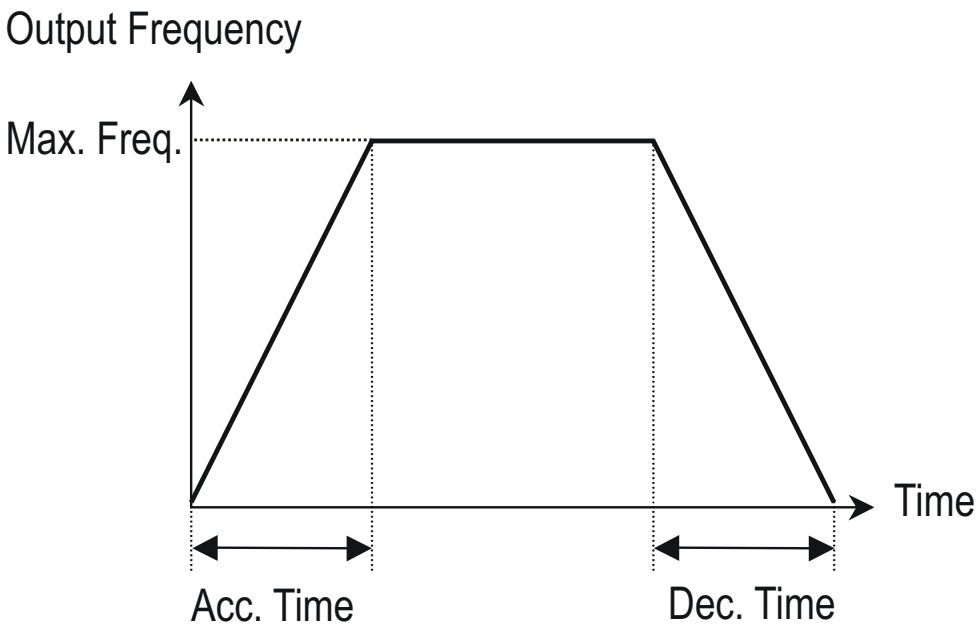
- Deceleration time sets the length of time to decelerate from the maximum frequency parameter AFN 04 (Maximum Freq) on page 121 to 0Hz from the primary ramp.

- For faster acceleration and/or deceleration, decrease the accel and/or decel time.

- For slower acceleration and/or deceleration, increase the accel and/or decel time.

⌘ **NOTE**: Accelerating too fast will cause an overcurrent to occur.
Decelerating too fast will cause an overvoltage to occur.

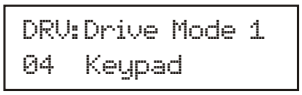
Figure 31: Accel/Decel Operation



⌘ **NOTE:** See also AFN 23 (Ramp Config) on page 132.

Drive Mode 1 DRV 04

LCD Display:



Range Keypad / Terminal-1 / Terminal-2 / Serial **(Default Keypad)**

Description

This parameter sets where the drive will receive its Start/Stop command.

Keypad: The **FWD/REV** keys on the display control the direction of the motor.

Terminal 1: Digital Inputs FWD and/or REV control the run command as well as the direction. Closing FWD will engage a forward run command. Closing REV will engage a reverse run command.

Terminal 2: Digital input FWD controls the run command with the REV input controlling direction. If reverse is not active or configured, the drive defaults to forward direction when a run command is indicated.

Serial: Start/Stop and direction is set via the communication link.

⌘ **NOTE:** The keypad stop button will always stop the drive regardless of this parameter's setting unless disabled through AFN 20 (Stop Key) on page 129.

Figure 32: Terminal 1 Operation

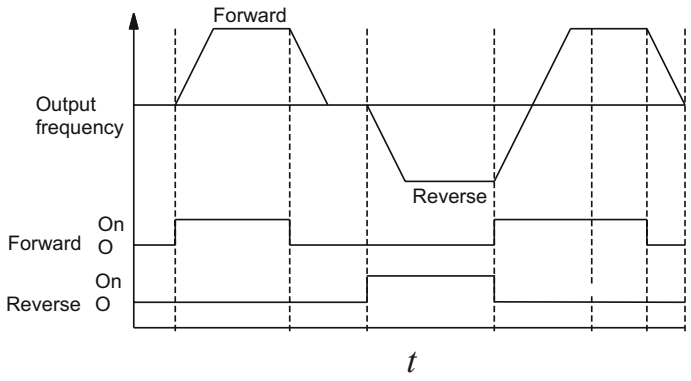
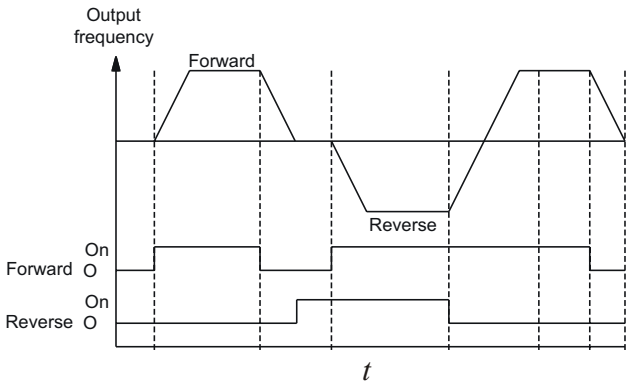
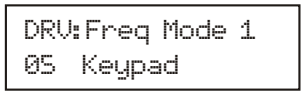


Figure 33: Terminal 2 Operation



Freq Mode 1 DRV 05

LCD Display



Default Keypad

Description Frequency Mode 1. This parameter selects the method of speed control for the drive.

Range

Keypad: Frequency Ref is input from the keypad.

Vin1: Frequency Ref is input from Analog Voltage Input 1.

Cin1: Frequency Ref is input from Analog Current Input.

Vin2: Frequency Ref is input from Analog Voltage Input 2.

Vin1 6FS: Frequency Ref is 1/6th of the frequency of a pulse train input at Vin1V.

Vin2 48FS: Frequency Ref is 1/48th of the frequency of a pulse train input at Vin1.

Vin1+Cin: Frequency Ref is the sum of Analog Inputs Vin1 and Cin.

Vin1+Vin2: Frequency Ref is the sum of Analog Inputs Vin1 and Vin2.

Vin1-Cin: Frequency Ref is the difference between Analog Inputs Vin1 and Cin.

Vin1+k*Cin: Frequency Ref is the sum of Vin1 and Cin times a programmable constant.

Vin1+k*Vin2: Frequency Ref is the sum of Vin1 and Vin2 times a programmable constant.

Max Input: Frequency Ref is the highest value of the three analog inputs Vin1, Vin2 and Cin.

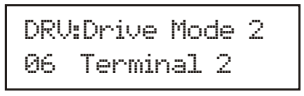
EMOP: Frequency Ref is set by the Motorized Pot function (see FUN 04, EMOP config on page 86).

Serial: Frequency Ref is set by Serial Communications.

⌘ **NOTE:** See parameter I/O 31 (Set K-Factor) on page 112 for programmable constant.

Drive Mode 2 DRV 06

LCD Display

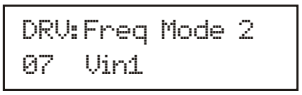


Description This parameter provides the user a second start source to be selected by a digital input. This is often used with a local/remote selector switch. To use this function, one of the digital inputs(I/O 02) must be set to Drv/Frq Set. When the input is closed, the second set of starting parameters is selected in DRV 06. When the input is open, the drive uses the starting parameters in DRV 04.

⌘ **NOTE**: See description for DRV 04 (Drive Mode 1) on page 78.

Freq Mode 2 DRV 07

LCD Display



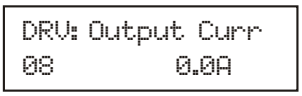
Description

This parameter provides the user a second frequency source to be selected by a digital input. This is often used with a local/remote selector switch. To use this function, one of the digital inputs must be set to Drv/Frq Set. When the input is closed, the second set of frequency parameters is selected in DRV 07. When the input is open, the drive uses the frequency parameters in DRV 05.

⌘ **NOTE:** See description for DRV 05 (Freq Mode 1) on page 79.

Output Current DRV 08

LCD Display

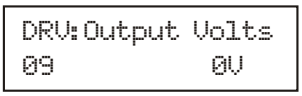


Description

The Output Current parameter displays the output current of the drive.

Output Voltage DRV 09

LCD Display

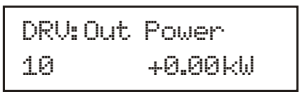


Description

The Output Voltage parameter displays the output voltage of the drive.

Output Power DRV 10

LCD Display

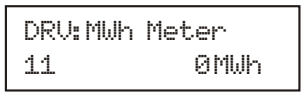


Description

This parameter displays power being output by the drive in terms of drive rating. The measurement is calculated by scaling the Load Torque value by the ratio of Volt-Amps to Rated Volt-Amps and adjusted by Output Frequency.)

MWh Meter DRV 11

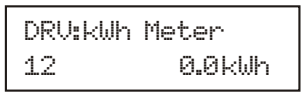
LCD Display



Description This display shows the drive's output power in MWh.

kWh Meter DRV 12

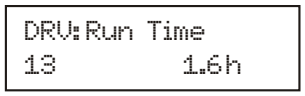
LCD Display



Description This display shows the drive's output power in KWh.

Run Time DRV 13

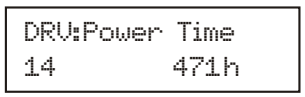
LCD Display



Description Total Run Time is a resettable timer for drive operation. To reset the timer, enter 10 in AFN 55 (Prog Number) on page 144.

Power Time DRV 14

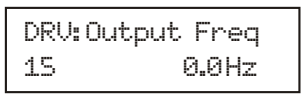
LCD Display



Description Power Time displays how long the drive has been powered up.

Output Freq DRV 15

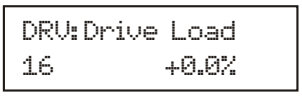
LCD Display



Description The Output Frequency parameter shows the frequency being applied to the motor connected to the drive.

Drive Load DRV 16

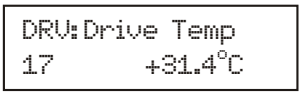
LCD Display



Description The drive load parameter shows the percentage torque of the drive when operating below the knee frequency. It displays Load Torque if the frequency is below nominal frequency and displays Power if aboveNominal Frequency. The output current is measured with the motor power factor applied to an accuracy of ±20%. The parameter value is positive when the motor is pulling a load ("motoring mode:) and negative when being pulled by a load ("regenerative mode").

Drive Temp DRV 17

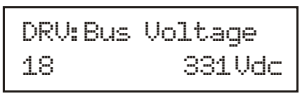
LCD Display



Description The Drive Temp parameter shows the actual temperature of the drive's heatsink.

DC Bus Voltage DRV 18

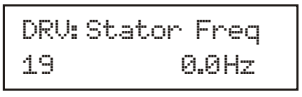
LCD Display



Description The DC Bus Voltage displays the voltage on the DC bus.

Stator Freq DRV 19

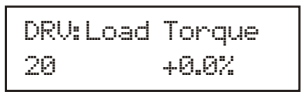
LCD Display



Description Stator Frequency displays the frequency the drive is applying to the motor stator.

Load Torque DRV 20

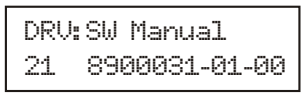
LCD Display



Description The Load Torque parameter displays the load torque of the drive.

SW Manual DRV 21

LCD Display

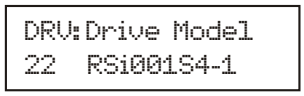


Description This is the document number for the applicable S4 User Guide.

⌘ **NOTE:** This is a view only parameter, it cannot be changed.

Drive Model DRV 22

LCD Display

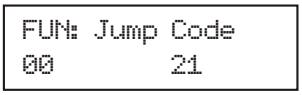


Description This parameter contains the RSi S4 model number in the format RSihhhS4v, where hhh is the horsepower rating of the drive and v represents the voltage code.
1 - single phase 120VAC
2 - three-phase 240VAC
4 - three-phase 460VAC
6 - three-phase 600VAC

7.1.2 FUN Group

Jump Code FUN 00

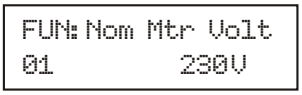
LCD Display



Description By changing the value of this parameter and pressing [ENTER], you can jump directly to any parameter within the group.

Nom Mtr Volt FUN 01

LCD Display



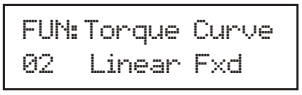
Range 100 – 690 Volts **(Default 230V)**

Description This parameter configures the voltage delivered to the motor terminals by the drive at the field weakening point (100% motor speed). The field weakening point is defined in AFN 01 (Nom Mtr Freq) on page 120.

⌘ **NOTE:** Incorrectly setting this parameter will affect motor torque and heating.

Torque Curve FUN 02

LCD Display



Range See below **(Default Linear Fxd)**

Description This parameter selects the control algorithms used by the RSi S4 drive. The V/Hz Characteristic Selection parameter determines the characteristic of the V/Hz curve and whether any boost will be applied at starting. The amount of boost may be automatically determined or set with parameters AFN 07 (V-Boost Conf on page 123). The following functions may be assigned to this parameter:

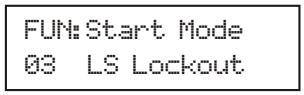
Parameter Value	Description
Linear Auto	V/Hz curve with auto-boost. This is typically used for constant torque applications; however, do not use it for multi-motor applications. The amount of boost applied varies from zero to the value of parameter AFN 07 (V-Boost Conf - on page 123) and is calculated by the drive based on the load.
Linear Fxd	V/Hz curve with the amount of boost fixed at the value set in parameter AFN 07 (V-Boost Conf on page 123). Curve designed for constant torque applications.

Pump Fxd	V/Hz curve with the amount of boost fixed at the value set in parameter AFN 07 (V-Boost Conf on page 123). Curve designed for pump applications
Fan Fxd	V/Hz curve with the amount of boost fixed at the value set in parameter AFN 07 (V-Boost Conf on page 123). Curve designed for fan applications.
Linear 2pc	Uses parameters AFN 08 (Bst. Trp Freq on page 123) and AFN 09 (Bst. Tpr Vlt). These parameters are used to define a midpoint through which the V/Hz curve passes so a custom curve may be created for special motor applications.
Vector	Activates the sensorless vector algorithm for high torque/low speed operation. A vector-duty motor should be used for this mode of operation. Vector mode does not use either of the boost parameters. ⌘ **NOTE:** See AFN 10, 11, 12, 13, 14 starting on page 125. ⌘ **NOTE:** When set to "Vector", the drive must first perform an autotune on the motor to calculate the motor RS. See page 168 for more information on autotuning.

⌘ **NOTE:** All vector control requires careful set up of motor parameters.

Start Mode FUN 03

LCD Display



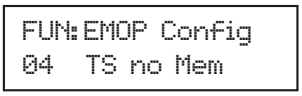
Range See below **(Default LS Lockout)**

Description This parameter allows you to select whether the drive will automatically start when line power is applied and a Run command is active from the terminal strip.

Parameter Value	Description
LS Lockout	Line Start Lock-Out. The drive will not automatically start when line power is applied and a Run command is active. Instead, the run command must be removed and a new Run command given.
Auto Start	The drive will automatically start when line power is applied and a Run command is active on the terminal strip.
LSL w/FLY	This setting has both LS Lockout and Catch on the Fly enabled at the same time. When restarting the drive, this command will try to "catch" the motor and match speed. ⌘ **NOTE:** See AFN 18 (Catch Mode on page 128).
Auto w/FLY	This setting has both Auto-Start and Catch on the Fly enabled at the same time. When restarting the drive, this command will try to "catch" the motor and match speed. ⌘ **NOTE:** See AFN 18 (Catch Mode on page 128).

EMOP Config FUN 04

LCD Display



Range See below **(Default TS no Mem)**

Description Electronic Motorized Operator Potentiometer. The RSi S4 drive supports a frequency reference control called EMOP. DRV 05 (Freq Mode 1 on page 79) or DRV 07 (Freq Mode 2) must be set to EMOP. EMOP allows the reference frequency to be adjusted incrementally using a pair of digital inputs (I/O 02-07) to activate this function. This is useful if you need fine-grained control of reference frequency but a traditional potentiometer is unacceptable (e.g., dirty or corrosive environments). To use a digital input, configure two digital inputs to function EMOP + Spd and EMOP - Spd.

The EMOP reference frequency may also be configured to stay at the most recent value or reset to zero speed when a stop command is received and/or if line power is lost. If configured to reset the reference speed, the drive reference frequency becomes the minimum frequency upon the next start

The following functions may be assigned to this parameter:

Parameter Value	Description
TS no Mem	Digital Inputs are used to change EMOP reference speed and the EMOP reference speed is lost when the drive is stopped or power cycles.
TS Mem	Digital inputs are used to change EMOP reference speed and the EMOP reference speed is not lost when the drive is stopped.
T/K Mem	Either Digital Inputs or the Keypad Arrows can be used to change EMOP reference speed and the EMOP reference speed is not lost when the drive is stopped or power cycles.
TS stp	Digital Inputs are used to change EMOP reference speed, the EMOP reference speed can be changed when the drive is stopped and the EMOP reference speed is lost when power cycles.
TS Mem stp	Digital Inputs are used to change EMOP reference speed, the EMOP reference speed can be changed when the drive is stopped and the EMOP reference speed is not lost when power cycles.
T/K Mem stp	Either Digital Inputs or the Keypad Arrows can be used to change EMOP reference speeds, the EMOP reference speed can be changed when the drive is stopped and the EMOP reference speed is not lost when the drive is stopped or power cycles.

DB Config FUN 05

LCD Display

Range See below **(Default DB Internal)**

Description Dynamic Braking configuration. The drive provides an internal dynamic brake resistor (DBR) to assist in stopping. If desired, an External Braking Resistor or Bus Control System may be connected to the B-/B+/DB/DB1 terminals on the power board.

The following functions may be assigned to this parameter:

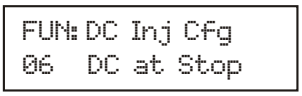
Parameter Value	Description
No Dyn Brk	The DB circuit is disabled.
DB Internal	The internal dynamic brake is enabled.
DB External	An external resistor is used for additional braking capacity.
Int-ARCTIC	- Dynamic braking becomes active if the drive temperature drops below -7 degrees C. ARCTIC Mode warning flashes on the keypad when the DB becomes active. The drive will be disabled and not allowed to run if the drive drops below -10 degrees C. The keypad will indicate a "Not Enabled" state at this point. The drive must meet the following criteria before operating again. - Drive temperature must be above -9 degrees C, and - Drive temperature must stay above -9 degrees C until a time period has elapsed. The time period is dependent on how far below -10 degrees C the drive was. Each degree below -10 degrees C adds another 4 minutes before restart. - The VFD can operate down to -15 with no wind loading in Artic Mode

⌘ **NOTE:** If an external DB resistor is used, it must be protected with a thermal monitor. The trip output must be interlocked with the VFD external fault input.

⌘ **NOTE:** See Dynamic Braking on page 38.

DC Inj Cfg FUN 06

LCD Display



Range See below **(Default DC at Stop)**

Description DC Injection Configuration. DC injection braking may be used to stop the motor quicker than normally possible by either a ramp-to stop or coast-to-stop. The RSi S4 drive allows DC braking to be initiated either when a digital input assigned to DC braking becomes active or when a specified frequency is reached, or when any of these occur.

When using a digital input for DC braking, one of the digital inputs must be configured for DC braking. The amount of braking force is set by parameter FUN-09 (DC Inj Lvl). The length of time that the braking force is applied is determined by the time that the selected digital input is active.

The second type of DC injection braking supported by the RSi S4 drive is where DC braking occurs below a specified frequency. With this type of DC injection braking, as the drive ramps down after a Stop command, DC braking begins when the frequency reaches the value specified in FUN 07 (DC Inj Freq). (If the frequency at the time of a Stop command is less than that of FUN 07 (DC Inj Freq), DC braking begins immediately). The braking continues for the time period specified by parameter FUN 08 (DC Inj Time). Once the time period elapses, the drive may be re-started.

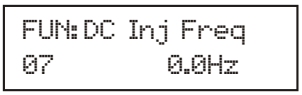
⌘ **NOTE:** If FUN 08 (DC Inj Time) is set to zero, braking is applied until the digital input " DC Inject" is de-activated. To re-start, the DC Inject Digital Input must be restored to its active condition and then the Run command re-issued.

The following functions may be assigned to this parameter:

Parameter Value	Description
DC at Stop	DC inject only on Stop
DC at Start	DC inject only on Start
DC at Both	DC inject only on both Start and Stop
DC on Freq	DC inject only on Stop below the set frequency

DC Inj Freq FUN 07

LCD Display



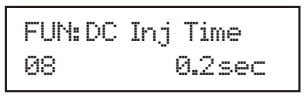
Range 0.00 to 25.00 Hz

Description DC Injection Frequency. If parameter FUN 06 (DC Inj Cfg) is set to DC on Freq, a frequency threshold is used for DC braking. This parameter sets the value of the frequency threshold. See parameter FUN 06 (DC Inj Cfg) for more information..

⌘ **NOTE:** See FUN 06 (DC Inj Cfg), FUN 07 (DC Inj Freq), FUN 08 (DC Inj Time) and FUN 09 (DC Inj Level) for further programming options.

DC Inj Time FUN 08

LCD Display



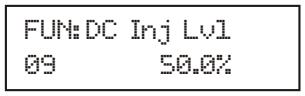
Range 0 - 5.0 seconds **(Default 0.2s)**

Description DC Injection Time. If FUN 06 is set to DC at Stop, or DC on Freq, direct current is applied to the motor. This parameter determines how long the direct current will be applied and how long DC is applied to Start if programmed accordingly.

This parameter works in tandem with FUN 06 (DC Inject Cfg) and the other parameters associated with DC Inject Config. That is, the time period configured by this parameter, DC Inject Time, determines how long DC injection braking will be active. When DC injection braking is controlled by a digital input, the braking continues for as long as the digital input is true, plus the time set by FUN 08 (DC Inject Time)..

DC Inj Level FUN 09

LCD Display

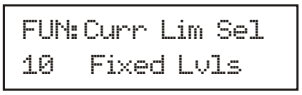


Range 0 - 100.0% **(Default 50.0%)**

Description DC Injection Level. This parameter configures the amount of DC current to be injected into the motor windings which act as a braking force. The amount of current is expressed as a percentage of nominal motor current. The braking force may be applied when starting or stopping.

Curr Limit Sel — FUN 10

LCD Display



Range See below **(Default Fixed Lvls)**

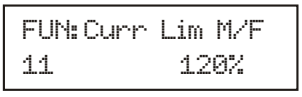
Description Current Limit Select. The S4 drive provides a Current Limit feature. With this feature enabled, the drive's frequency is automatically reduced when operating in motoring mode to keep the measured torque within limits. When operating in regenerative mode, the output frequency can be automatically increased for the same reason. In addition to the current limit parameters that activate the Current Limit mode, more current limit parameters are available to adjust the drive's response to the load demands.

The following functions may be assigned to this parameter:

Parameter Value	Description
Fixed Lvls	The fixed levels set in FUN 11 – FUN 14 determine the current limit in each of the four quadrants of operation.
Vin2	Vin2 analog input sets the current limit value, range 0–200%.
Cin	Cin analog input sets the current limit value, range 0–200%.
Vin2 Motor	Vin2 analog input sets the motoring current limit value, range 0–200%.
Cin Motor	Cin analog input sets the motoring current limit value, range 0–200%.
Vin2 F-Mtr	Vin2 analog inputs sets the FWD motoring current limit value, range 0–200%.
Cin F-Motor	Cin analog input sets the FWD motoring current limit value, range 0–200%.

Curr Lim M/F — FUN 11

LCD Display



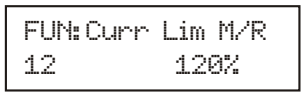
Range 5 - 200% **(Default 120%)**

Description Current limit motoring/forward. This parameter sets the current limiting point when the motor is driving the load in the Forward direction. The limit is expressed as a percentage of the current capacity of the drive.

⌘ **NOTE:** See FUN 10 (Curr Limit) for more programming options.

Curr Lim M/R FUN 12

LCD Display



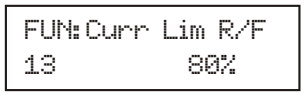
Range 5 - 200% **(Default 120%)**

Description Current limit motoring/reverse. This parameter sets the current limiting point when the motor is driving the load in the Reverse direction. The limit is expressed as a percentage of the current capacity of the drive.

⌘ **NOTE:** See FUN 10 (Curr Limit) on page 90 for more programming options.

Curr Lim R/F FUN 13

LCD Display

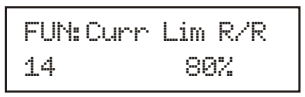


Range 5 - 200% **(Default 80%)**

Description Current limit regenerating/forward. This parameter sets the current limiting point when the load drives the motor (regenerative mode) in the Forward direction. The limit is expressed as a percentage of the current capacity of the drive.

Curr Lim R/R FUN 14

LCD Display

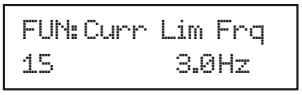


Range 5 - 200% **(Default 80%)**

Description Current limit regenerating/reverse. This parameter sets the current limiting point when the load drives the motor (regenerative mode) in the Reverse direction. The limit is expressed a percentage of the current capacity of the drive.

Curr Lim Freq — FUN 15

LCD Display



Range 0.00 to Max Frequency **(Default 3.0Hz)**

Description Current Limit Frequency. This parameter sets the frequency when the current limit becomes active. This value will also be the frequency point the drive will decelerate the motor to during Motoring Current.

Ramp Time CL — FUN 16

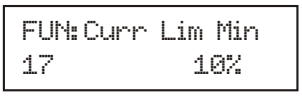
LCD Display

Range 0.1 - 3200 seconds **(Default 1.0s)**

Description Ramp Time in current limit. This parameter defines the ramp rate when the drive enters the current limit, and defines the ramping rate of the drive when in a current limiting mode. If the drive is in regenerative current limit, it is an acceleration time. If the drive is in motoring current limit, it is a deceleration time.

Curr Lim Min — FUN 17

LCD Display

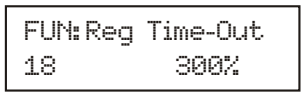


Range 0 - 50% **(Default 10%)**

Description Current Limit Minimum. This parameter sets the minimum amount of current limit when the current limit amount is determined by an analog input.

Reg Time-out FUN 18

LCD Display

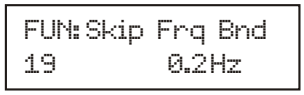


Range 0 - 300% **(Default 300%)**

Description Regenerative timeout. This parameter operates as a percentage of the longest ramp time. This time then defines the amount of time a deceleration to stop can take without causing a Regen Timeout fault. For example, if Decel Time 1 is 5.0 seconds, Decel Time 2 is 10.0 seconds, and Max Regen Ramp is 300%, a deceleration to stop that takes more than 30 seconds will cause a Regen Timeout fault in the drive.

Skip Frq Bnd FUN 19

LCD Display



Range 0.2 - 20.0Hz **(Default 0.2Hz)**

Description Skip Frequency band. The Skip Frequency function is used to prevent operation of the drive at a frequency that creates a resonant condition in the mechanical equipment associated with the motor.

Skip Frequencies are set in FUN 20-FUN 23. FUN 19 (Skip Freq Bnd) sets the width of the window of frequencies that will be skipped around the frequencies set in FUN 20-FUN 23.

When Skip Frequencies are used, the drive will accelerate or decelerate through a skip frequency, but will not stop accelerating or decelerating and maintaining speed within the skip frequency window.

Example If FUN 19 (Skip Frq Bnd) is set to 1.0 Hz, and FUN 20 (Skip Freq 1) is set to 20.0 Hz, the drive will skip from 19.0 to 21.0 Hz.

Skip Freq 1, 2, 3, 4 — FUN 20,21,22,23

LCD Display

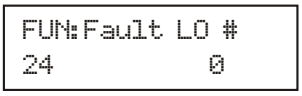
Range 0 to Max Frequency **(Default 0.0 Hz)**

Description These parameters set the mid points of the skip frequency windows.

⌘ **NOTE:** See FUN 19 (Skip Freq Bnd)

Fault LO # — FUN 24

LCD Display



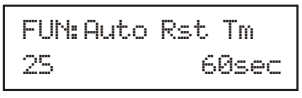
Range 0 to 10 **(Default 0)**

Description Fault Lockout Number. This parameter sets the number of faults that may occur before automatic resetting is disabled. Once the number set in this parameter is exceeded, a manual reset of the fault will be required. (A manual reset is accomplished by displaying the active fault display and then pressing the [STOP] key on the keypad or by using a digital input.)

⌘ **NOTE:** If the parameter is set to 0, no automatic fault resets will occur.

Auto Rst Tm — FUN 25

LCD Display



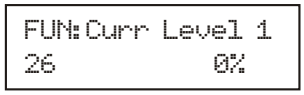
Range 0 - 60 seconds **(Default 60s)**

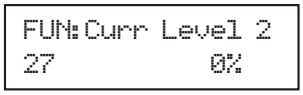
Description Auto Restart Time. When automatic resetting of certain types of faults is enabled by FUN 24 (Fault Lo #), this parameter specifies the time delay before the fault is reset.

⌘ **NOTE:** If this parameter (FUN 25) is set to 0, no automatic fault resets will occur.

Curr Level 1 & 2 — FUN 26, 27

LCD Display



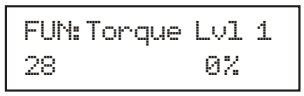


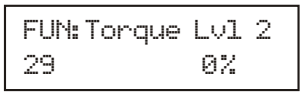
Range 0 to 200% **(Default 0%)**

Description Current Level parameter is a comparator between the nominal drive output current and the value entered into the Curr Level expressed in percent. When the nominal drive output current exceeds the set level, the associated digital output will be activated. The digital outputs are configured in I/O 08-I/O 11 on page 103.

Torque Lvl 1 & 2 — FUN 28, 29

LCD Display



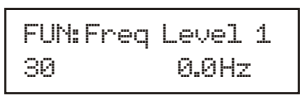


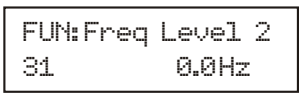
Range 0 to 200% **(Default 0%)**

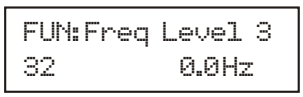
Description Torque Level parameter is a comparator between the nominal drive torque and the value entered into the Torque Lvl expressed in percent. When the nominal drive torque exceeds the set level, the associated digital output will be activated. The digital outputs are configured in I/O 08-I/O 11 on page 103.

Freq Lvl 1–3 — FUN 30,31,32

LCD Display







Range 0.00 to Max Freq **(Default 0.00 Hz)**

Description Frequency Level parameter is a comparator between the drive output frequency and the value entered into the Freq Lvl expressed in Hertz. When the drive output exceeds the set level, the associated digital output will be activated. The digital outputs are configured in I/O 08 – I/O 11 on page 103.

Low Freq Th — FUN 33

LCD Display

```
FUN:Low Freq Thr
33         0.0Hz
```

Range 0 to Max Freq **(Default 0.00 Hz)**

Description Low Frequency Threshold is a comparator between the drive output frequency and the value entered into the "Low Freq Thr" expressed in Hertz. When the drive output goes below the set level, the associated digital output will be activated. The digital outputs are configured in I/O 08-I/O 11.

Timer 1 Type — FUN 34

LCD Display

```
FUN:Timer 1 Type
34  On Delay
```

Range On Delay, Off Delay, On/Off Delay **(Default On Delay)**

Description The timer can be configured for On or Off Delay or for both On/Off Delay. The time value is set by FUN 35 (Timer 1 Time). If configured for both On/Off delay, the time value is the same for On and Off Delay. See I/O 01-I/O 06 and I/O 08-I/O 11 starting on page 100.

Timer 1 Time — FUN 35

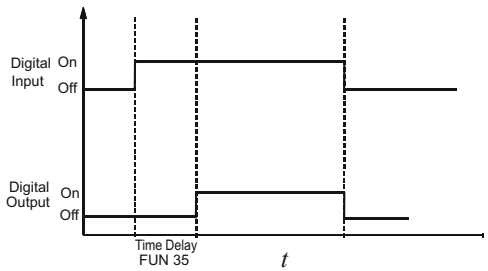
LCD Display

```
FUN:Timer 1 Time
35         1.0sec
```

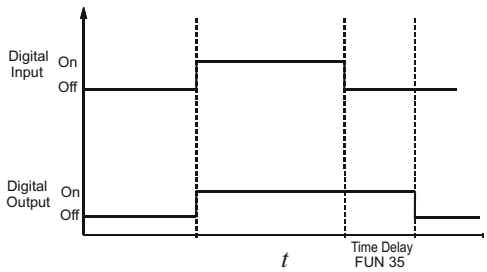
Range 0.00 to 320.00 seconds **(Default 1.0s)**

Description The Timer 1 Value is the threshold for the timer. Once the time value is reached, the output is turned on if an On Delay, or turned off if an Off Delay. See I/O 01-I/O 06 and I/O 08-I/O 11 starting on page 100.

On Delay

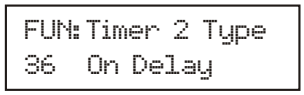


Off Delay



Timer 2 Type FUN 36

LCD Display

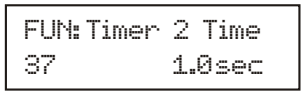


Range On Delay, Off Delay, On/Off Delay **(Default On Delay)**

Description The timer can be configured for On or Off Delay or for both On/Off Delay. The time value is set by FUN 37 (Timer 2 Time). If configured for both On/Off delay, the time value is the same for On and Off Delay. See I/O 01-I/O 06 and I/O 08-I/O 11 starting on page 100.

Timer 2 Time FUN 37

LCD Display

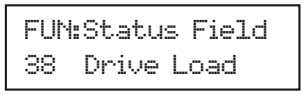


Range 0.00 to 320.00 seconds **(Default 1.0s)**

Description The Timer 2 Value is the threshold for the timer. Once the time value is reached, the output is turned on if an On Delay, or turned off if an Off Delay. See I/O 01-I/O 06 and I/O 08-I/O 11 starting on page 100.

Status Field FUN 38

LCD Display



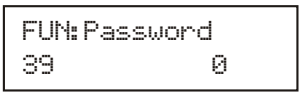
Range See below **(Default Drive Load)**

Description This parameter allows the configuration of additional parameter status field on the operate screen. The following fields can be configured.

Parameter Value	Description	Range Limit
Out Volt	Voltage being supplied to the motor	Rated Motor voltage
Output Curr	Current being supplied to the motor	200% of drive rating
Drive Load	Calculated percentage of drive rating	200% of drive rating
Out Power	Calculated power output of drive	250% of drive rating
% of FLA	Calculated percentage of drive rating	Percent of motor FLA
Drive Temp	Calculating of total drive tem rating	100% of unit temp rating

Password FUN 39

LCD Display



Range 0, 111–999

Description The Password allows the user to control access to the programmable functions of the inverter. The initial value of this parameter is 0, which signifies that no access code is necessary. Any number between 111 and 999 may be used for an access code, but is not necessary.

To enter an access code, re-program FUN 39 as you would any other parameter. After the new value is stored, you have 10 minutes of free access. If you remove power and then restore, it, you will need to enter the access code to change any program parameter. If you enter an incorrect access code, the drive displays **Wrong Code** and allows only viewing rights to the various parameters. Once the correct code is entered, you again have 10 minutes of free access unless power is removed and restored. To disable the access code requirement, set FUN 39 to "0".

Display Mode FUN 40

LCD Display

Range See below **(Default Std Display)**

Description Display Mode determines how the reference or output of the drive will be displayed to the operator.

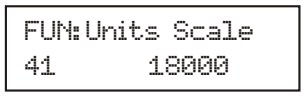
FUN 41 (Units Scale) and FUN 42 (Units) allow calibration of display to match actual process conditions.

Parameter Value	Description
Std Display	Standard commanded frequency
Output Freq	Output frequency actually sent to the motor
Stator Freq	Frequency of the stator
User Units	Custom units display based on values in FUN 41 and FUN 42
RPM Units	Custom speed display with RPM as units, must be scaled in FUN 41
GPM Units	Custom speed display with GPM as units, must be scaled in FUN 41
FPM Units	Custom speed display with FPM as units, must be scaled in FUN 41
MPM Units	Custom speed display with MPM as units, must be scaled in FUN 41
PSI Units	Custom speed display with PSI as units, must be scaled in FUN 41
Degrees C	Custom display with degrees C, must be scaled in FUN 41

Degrees F	Custom display with degrees F, must be scaled in FUN 41
Time hrs	Custom display time in hours of operation, must be scaled in FUN 41
Time min	Custom display time in minutes of operation, must be scaled in FUN 41
Time sec	Custom display time in seconds of operation, must be scaled in FUN 41
Fbk RPM	Display is scaled to read in RPM based on the PI feedback input to an analog input
Fbk PSI	Display is scaled to read in PSI based on the PI feedback input to an analog input
Fbk GPM	Display is scaled to read in GPM based on the PI feedback input to an analog input
Fbk User	Display is scaled to read in User units (FUN 40) based on the PI feedback input to an analog input

Units Scale FUN 41

LCD Display

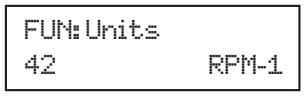


Range 1 to 65535 **(Default 18000)**

Description This parameter configures how the reference or output of the drive will be displayed to the operator. It selects the maximum scaling of the display when running at maximum frequency, AFN 04 (Maximum Freq).

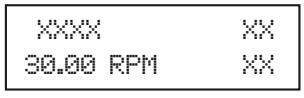
Units FUN 42

LCD Display



Description When user units are set in FUN 40, the alpha-numeric units can be assigned through FUN 42. The first three characters will be alpha-numeric characters of the units (i.e., RPM, FPS, etc.), the last character is the number of decimal places.

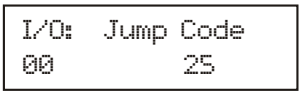
Example To program the display to read revolutions per minute (RPM), with two decimal places, set FUN 40 to "User", set FUN 41 to 3000 and set FUN 42 to RPM-2. The display will read as follows:



7.1.3 I/O Group

Jump Code	I/O 00

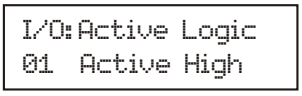
LCD Display



Description By changing the value of this parameter and pressing [ENTER], you can jump directly to any parameter within the group.

Active Logic	I/O 01

LCD Display



Range See below **(Default Active High)**

Description This parameter determines whether a high or a low input is regarded as active. A “high input” is input voltage between 10 and 24 VDC; a “low input” is voltage between 0 and 3 VDC. Any value in between is considered unspecified and is not supported.

Note that the EN (Enable) terminal on the TB4 terminal group is not affected by the setting of this parameter. A high input to the EN terminal is always regarded as active. Thus, if the input to the terminal goes low, the drive will not operate, even if pull-down logic is configured.

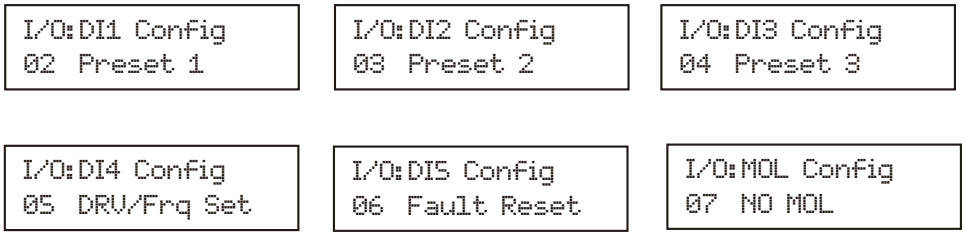
The following functions may be assigned to this parameter:

Parameter Value	Description
Active Low	Low input is true ("pull-down logic"); all digital inputs are referenced to Dcom.
Active High	High input is true ("pull-up logic"); all digital inputs are referenced to +24.

The digital inputs must be within the specified voltages or unintended operation may result, causing machinery and/or personal damage.

Multifunction Input Terminal DI1 - DI5 & MOL Configuration I/O 02 - I/O 07

LCD Display



Range See below

Factory Default

Code	LCD Display	Default	Setting
I/O 02	DI1 Config	Preset 1	See table below
I/O 03	DI2 Config	Preset 2	
I/O 04	DI3 Config	Preset 3	
I/O 05	DI4 Config	DRV/Frq Set	
I/O 06	DI5 Config	Fault Reset	
I/O 07	MOL Config	NO MOL	

Description Digital Inputs and Motor Overload configuration. The multi-function input terminals can be defined for many different applications.

⌘ **NOTE:** The MOL Input is configured by factory default as a normally open external motor overload. It can be used as an additional multi-function input by changing the value of parameter I/O 07.

Displayed Name	Function When Active	Parameter
Preset 1	Select reference to Preset Speed 1	I/O 13-18
Preset 2	Select reference to Preset Speed 2	I/O 13-18
Preset 3	Select reference to Preset Speed 3	I/O 13-18
Coast Stop	Drive will coast to stop. Will restart upon removal of input if run is active.	AFN 20
DC Inject	Begin DC Injection braking	FUN 06-09
DRV/Frq Set	Selects second DRV/Frq source. Used with local/remote switch.	DRV 06, 07
Alt Ramp	Active Alt ramp	AFN 24, AFN 25

Fault Reset	Remote fault reset	
EMOP+	Increase speed of electronic motorized pot	FUN 04
EMOP-	Decrease speed of electronic motorized pot	FUN 04
PID Disable	Disables PID function	AFN 31
Curr Lim Dis	Disables current limit mode	FUN 10
SL Override	Removes control of serial link	
FLY Dis	Disables "Catch-on-the-fly" mode	AFN 18
CurLimIMax	Sets current limit to maximum value	FUN 10-18
Jog FWD	Jog in Forward	I/O 12
Jog REV	Jog in Reverse	I/O 12
NO MOL	Normally Open motor overload	I/O 07
NC MOL	Normally Closed motor overload	I/O 07
Timer 1	Enable timer 1 function	FUN 34
Timer 2	Enable timer 2 function	FUN 36
Seq 1	Activate sequencer 1	APP Group
Seq 2	Activate sequencer 2	APP Group
Seq 3	Activate sequencer 3	APP Group
Seq Dwell	Sequencer dwell mode (pause)	APP Group
Seq Advance	Sequencer advance (skip)	APP Group
Not Assign	Input has no function	APP Group

⌘ **NOTE:** See also I/O 44 (Inputs) on page 117.

Digital Outputs (DO1 - DO2 Config) I/O 08, 09

LCD Display

Range See below **(Default DO1-Drv Ready; DO2-At Speed)**

Description These parameters configure what actions or states cause the digital outputs (terminal DQ1–DQ2) to become active.

⌘ **NOTE:** Only Active Low (pull-down) logic is available for the digital outputs.

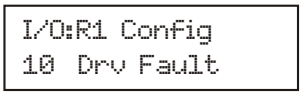
Displayed Name	DQ1-DQ2 Becomes Active When
Not Assign	Digital output is not used
Drive Run	Drive enters Run mode
Running Fwd	Drive is running in Forward
Running Rev	Drive is running in Reverse
Drv Ready	Drive is powered-up and ready
At Speed	Drive has reached reference speed
Drv Fault	Drive is in faulted state
Drv NotFlt	Drive is not in faulted state
Kpd in Ctl	The keypad is the control and reference source
Drv in Rem	The drive is in remote control
Jogging	Jogging operation begins
Curr Lvl 1	Value of parameter FUN 26 (Current Level 1) is exceeded
Curr Lvl 2	Value of parameter FUN 27 (Current Level 2) is exceeded
Trq Lvl 1	Value of parameter FUN 28 (Torque Level 1) is exceeded
Trq Lvl 2	Value of parameter FUN 29 (Torque Level 2) is exceeded
Frq Lvl 1	Value of parameter FUN 30 (Frequency Level 1) is exceeded
Frq Lvl 2	Value of parameter FUN 31 (Frequency Level 2) is exceeded
Frq Lvl 3	Value of parameter FUN 32 (Frequency Level 3) is exceeded
Current Lim	Current Limit mode is active
Loss Ref	Loss of 4 to 20mADC follower
SL in Ctrl	Serial Control in control, control bit SLC set
SL Override	Control by Serial Link being overridden
Zero Speed	The drive is in Run mode, but the speed reference is 0Hz

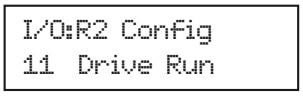
Frq Low Th	The drive frequency falls below the value set in FUN 33 (Low Freq Thr)
PID High	The PID output rises above the value in AFN 37 (PID High Alarm)
PID Low	The PID output falls below the value in AFN 38 (PID Low Alarm)
Timer 1	Output of Timer 1 activates (See FUN 34, 35)
Timer 2	Output of Timer 2 activates (See FUN 36, 37)
SEQOUT-00	Drive is in Sequence 00
SEQOUT-01	Drive is in Sequence 01
SEQOUT-10	Drive is in Sequence 10
SEQOUT-11	Drive is in Sequence 11
Arctic Mode	Drive is in Arctic Mode

⌘ **NOTE:** See also I/O 45 (Outputs) on page 117.

Relay Outputs (RO1 - RO2 Config) I/O 10, 11

LCD Display





Range See below **(Default RO1-Drv Fault; RO2-Drive Run)**

Description These parameters configure what actions or states cause output relay 1 and 2 (terminals RC ½, NC ½, NO ½) to become active. The functions that may be assigned to this parameter are the same as those that may be assigned to parameter I/O 08 and I/O 09.

Displayed Name	DQ1-DQ2 Becomes Active When
Not Assign	Digital output is not used
Drive Run	Drive enters Run mode
Running Fwd	Drive is running in Forward
Running Rev	Drive is running in Reverse
Drv Ready	Drive is powered-up and ready
At Speed	Drive has reached reference speed
Drv Fault	Drive is in faulted state
Drv NotFlt	Drive is not in faulted state
Kpd in Ctl	The keypad is the control and reference source
Drv in Rem	The drive is in remote control
Jogging	Jogging operation begins

Curr Lvl 1	Value of parameter FUN 26 (Current Level 1) is exceeded
Curr Lvl 2	Value of parameter FUN 27 (Current Level 2) is exceeded
Trq Lvl 1	Value of parameter FUN 28 (Torque Level 1) is exceeded
Trq Lvl 2	Value of parameter FUN 29 (Torque Level 2) is exceeded
Frq Lvl 1	Value of parameter FUN 30 (Frequency Level 1) is exceeded
Frq Lvl 2	Value of parameter FUN 31 (Frequency Level 2) is exceeded
Frq Lvl 3	Value of parameter FUN 32 (Frequency Level 3) is exceeded
Current Lim	Current Limit mode is active
Loss Ref	Loss of 4 to 20mADC follower
SL in Ctrl	Serial Control in control, control bit SLC set
SL Override	Control by Serial Link being overridden
Zero Speed	The drive is in Run mode, but the speed reference is 0Hz
Frq Low Th	The drive frequency falls below the value set in FUN 33 (Low Freq Thr)
PID High	The PID output rises above the value in AFN 37 (PID High Alarm)
PID Low	The PID output falls below the value in AFN 38 (PID Low Alarm)
Timer 1	Output of Timer 1 activates (See FUN 34, 35)
Timer 2	Output of Timer 2 activates (See FUN 36, 37)
SEQOUT-00	Drive is in Sequence 00
SEQOUT-01	Drive is in Sequence 01
SEQOUT-10	Drive is in Sequence 10
SEQOUT-11	Drive is in Sequence 11
Arctic Mode	Drive is in Arctic Mode

Jog Speed I/O 12

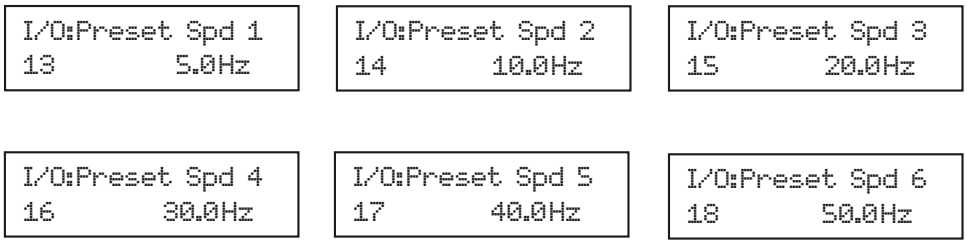
LCD Display

Range 0 to Max Freq **(Default 5.0 Hz)**

Description This parameter sets the speed; the drive will operate when a Jog command is given. A jog command can be via the keypad or via a digital input (R/J Terminal).

Preset Speed 1–6 I/O 13 - I/O 18

LCD Display



Factory Default 0.00 to Max Freq

Description These parameters set the eight preset speeds. The preset speed selection is made through a combination of digital inputs (or serial command bits, if serial control is used). Preset 1, Preset 2 and Preset 3 select the active preset speed, as shown in the table below.

Preset 1	Preset 2	Preset 3	Preset Selected
0	0	0	Reference Freq
1	0	0	Preset Spd 1
0	1	0	Preset Spd 2
1	1	0	Preset Spd 3
0	0	1	Preset Spd 4
1	0	1	Preset Spd 5
0	1	1	Preset Spd 6
1	1	1	Maximum Frequency

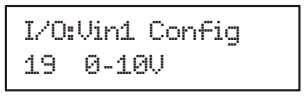
If Preset 1, Preset 2, or Preset 3 is not assigned to a digital input, it will always be read as 0. For example, if Preset 3 is not assigned to a digital input, you will only be able to select Preset 1 or Preset 2.

⌘ **NOTE:** Preset speed selection only works when the drive speed reference comes from the terminal strip (analog inputs) or (serial frequency) reference.

⌘ **NOTE:** For preset speed digital connections go to page 43.

Vin1 Config I/O 19

LCD Display



Range See below **(Default 0-10V)**

Description Vin1 Config, selects the type of signal for analog input Vin1. Vin1 can be voltage, current or pulse train input. This parameter also determines input range, impedance, and characteristics. Parameters I/O 21 (Vin1 Offset) and I/O 20 (Vin1 Span) may be used to customized the selected range. The following data values may be assigned to this parameter.

Parameter Value	Description
0 - 10V	0-10Vdc signal
0 - 10V Brk W	0-10Vdc signal with broken wire detection for speed pot operation
0 - 10V I	0-10Vdc signal inverted
0 - 10v Bipol	0-10Vdc signal 5Vdc is stop with 0Vdc Full Rev and 10Vdc Full FWD
0-5V	0-5Vdc signal
0-5V I	0-5Vdc signal inverted
0-20mA 250	0 to 20 mA current signal with 250 Ohm load
0-20mA 250I	0 to 20 mA current signal with 250 Ohm load inverted
4-20mA 250	4-20mA current signal with 250 Ohm load
4-20mA 250I	4-20mA current signal with 250 Ohm load inverted
PT 0-1kHz	0 to 1 KHz pulse train
PT 0-10kHz	0 to 10 KHz pulse train
PT 0-100kHz	0 to 100 KHz pulse train

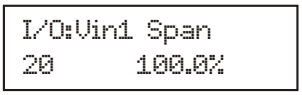
When the signal range is inverted, the minimum input produces the maximum output while the maximum input produces the minimum output.

⌘ **NOTE:** See also DRV 05 on page 79& I/O 20, 21, 22

⌘ **NOTE:** See "Description of Control Terminals" on page 41

Vin1 Span I/O 20

LCD Display

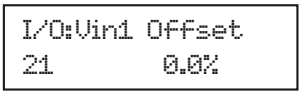


Range 0.0 to 200% **(Default 100%)**

Description This parameter is used to alter the range of the input being received at terminals (analog). For example, with a 0 to 10VDC input, setting this parameter to a value of 50% alters the range to 0 to 5VDC.

Vin1 Offset I/O 21

LCD Display

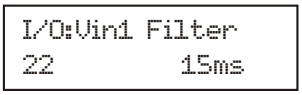


Range 0.0 to 100% **(Default 0.0%)**

Description This parameter is used to alter the starting value of the input being received at terminals Vin1 (analog input 1). For example, with a 0 to 10VDC input, setting this parameter to a value of 10% alters the range to 1 to 10VDC.

Vin1 Filter I/O 22

LCD Display:

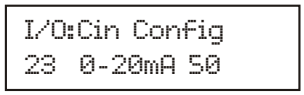


Range 1 - 1000 ms **(Default 15ms)**

Description This parameter sets the low-pass filter time for the analog input signal being received at (Vin1). Longer filter times better reduce noise disturbances, but may slow the signal response time.

Cin Config I/O 23

LCD Display



Range See below **(Default 0-20mA 50)**

Description Cin Config selects the type of signal for analog input Cin. Parameters I/O 25 (Cin Offset) and I/O 24 (Cin Span) may be used to customize the selected range.

The following data values may be assigned to this parameter.

Parameter Value	Description
4-20mA 50	4 to 20 mA current signal with 50 Ohm load
4-20mA 50I	4 to 20 mA current signal with 50 Ohm load inverted
0-20mA 50	0 to 20 mA current signal with 50 Ohm load
0-20mA 50I	0 to 20 mA current signal with 50 Ohm load inverted

When The signal range is inverted (that is, the minimum input corresponds to the maximum output, while the maximum input corresponds to the minimum output).

⌘ **NOTE:** See also DRV 05 on page 79.

⌘ **NOTE:** See "Description of Control Terminals" on page 41

Cin Span I/O 24

LCD Display

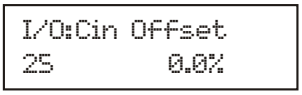
Range 0.0 to 200.0% **(Default 100%)**

Description This parameter is used to alter the range of the input being received at terminal (Cin). For example, with a 0-20mA DC input, setting this parameter to a value of 50% alters the range to 0 to 10mA DC.

⌘ **NOTE:** See also DRV 05 on page 79 & I/O 23, 25, 26

Cin Offset I/O 25

LCD Display



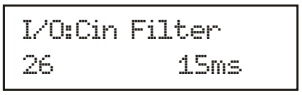
Range 0.0 to 100.0% **(Default 0.0%)**

Description Current Input offset. This parameter is used to alter the starting value of the input being received at terminal Cin. With Cin Config set to 4 to 20mA 50, and a 0-20mA input, setting this parameter to 40% alters the range to 8-20mA.

⌘ **NOTE :** See also I/O 23, 24, 25

Cin Filter I/O 26

LCD Display



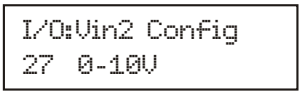
Range 1 to 1000 ms **(Default 15ms)**

Description Current Input filter time. This parameter sets the low-pass filter time for the analog input signal received at terminal Cin. Longer filter times better reduce noise disturbances, but may slow the signal response time.

⌘ **NOTE:** I/O 23, 24, 25

Vin2 Config I/O 27

LCD Display



Description This parameter selects the type of signal for analog input Vin2. I/O 29 (Vin2 Offset) and I/O 28 (Vin2 Span) may be used to customize the selected range. The following data values on page 111 may be assigned to this parameter.

⌘ **NOTE:** See "Description of Control Terminals" on page 41.

The following data values may be assigned to this parameter.

Parameter Value	Description
0 - 10V	0-10Vdc signal
0 - 10V Brk W	0-10Vdc signal with broken wire detection for speed pot operation
0 - 10V I	0-10Vdc signal inverted
0 - 10v Bipol	0-10Vdc signal 5Vdc is stop with 0Vdc Full Rev and 10Vdc Full FWD
0-5V	0-5Vdc signal
0-5V I	0-5Vdc signal inverted

⌘ **NOTE:** See also DRV 05 & I/O 28, 29, 30, 31

Vin2 Span I/O 28

LCD Display

```
I/O:Vin2 Span
28      100.0%
```

Range 0.0 to 200.0% **(Default 100.0%)**

Description Voltage Input 2 Span. This parameter is used to alter the range of the input being received at terminal Vin2. For example, with a 0 to 10VDC input, setting this parameter to a value of 50% alters the range to 0 to 5VDC.

⌘ **NOTE:** See also I/O 27, 29, 30, 31

Vin2 Offset I/O 29

LCD Display

```
I/O:Vin2 Offset
29        0.0%
```

Range 0.0 to 100.0% **(Default 0.0%)**

Description Voltage Input 2 Offset. This parameter is used to alter the starting value of the input being received at terminals Vin2. For example, with a 0 to 10VDC input, setting this parameter to a value of 10% alters the range to 1 to 10VDC.

⌘ **NOTE:** See also I/O 27, 28, 30, 31

Vin2 Filter — I/O 30

LCD Display

```
I/O:Vin2 Filter
30        15ms
```

Range 1 to 100ms **(Default 15ms)**

Description Voltage Input 2 Filter time. This parameter sets the low-pass filter time for the analog input signal being received at terminals Vin2. Longer filter times better reduce noise disturbances, but may slow the signal response time.

⌘ **NOTE:** See also I/O 27, 28, 29, 31

Set K-factor — I/O 31

LCD Display

```
I/O:Set k-Factor
31        0.0%
```

Description When parameters DRV 05 (Freq Mode 1) or DRV 07 (Freq Mode 2) are set to "Vin1 + k * Vin2", this parameter sets the value of k, which is the scale factor by which reference 2 is multiplied before being added to reference 1.

⌘ **NOTE:** See also I/O 27, 28, 29, 30

Vmet – Imet — I/O 32, 33

LCD Display

```
I/O:Vmet Config
32  Out Freq
```

```
I/O:Imet Config
33  Out Torque
```

Description Analog voltage output and Analog current output configure. These parameters configure what variable governs the analog outputs Vmet and Imet. Vmet is a 0 to 10VDC output, Imet is a 4 to 20mA output.

The following functions may be assigned to either of these parameters.

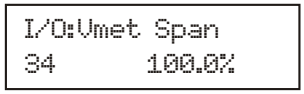
Displayed Name	Output is Governed by:
Not Assign	Output is not used
Out Freq (I/O 32 Default)	Percent speed of the attached motor
Out Torque (I/O 33 Default)	Estimated percentage of torque

Out Volt	Percentage of full voltage supplied to the motor (see FUN01)
Out Power	Percentage of calculated power
Ref Freq	Percentage of maximum frequency commanded (see AFN04)
PID Fback	Percentage of full scaled PID output (0-100%)
Bus Voltage	Percentage of DC bus level
Output Curr	Percentage of output current

⌘ **NOTE:** See also I/O 34, 35, 36, 40, 41

Vmet Span I/O 34

LCD Display



Range 0.0 to 200.0% **(Default 100.0%)**

Description These parameters are used to alter the range of the output at the Vmet analog output terminals. For example, for Vmet, setting this parameter to a value of 50% alters the range to 0 to 5VDC.

⌘ **NOTE:** See also I/O 32

Imet Span I/O 35

LCD Display

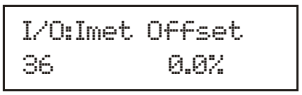
Range 0.0 to 200.0% **(Default 100.0%)**

Description These parameters are used to alter the range of the output at the Imet analog output terminals. For example, with a 4-20mA output, a value of 50%will alter the range to 4-12mA output.

⌘ **NOTE:** See also I/O 33, 36

Imet Offset I/O 36

LCD Display



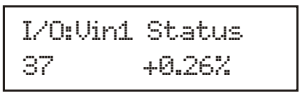
Range 0.0% to 100.0% **(Default 0.0%)**

Description Current analog output offset. These parameters adjust the low-end offset for the current analog output Imet. For example, if the value of this parameter was set to 50%, the range for the output would start at 10mA rather than 4mA.

⌘ **NOTE:** See also I/O 32, 35

Vin1 Status I/O 37

LCD Display



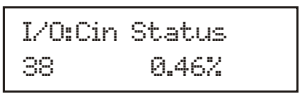
Range -100.0% to 100.0% **(view only)**

Description These parameters contains a value representing the measured input signal at the Vin terminal as a percentage of the maximum input signal. For example, if Vin was configured to range from 0 to 10VDC and the measured voltage was 2V, then this parameter would show 20% (2/10).

⌘ **NOTE:** See also I/O 32, 35

Cin1 Status I/O 38

LCD Display



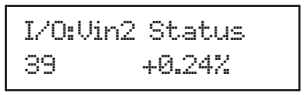
Range 0% to 100.0% **(view only)**

Description This parameter contains a value representing the measured input signal at the Cin terminal as a percentage of the maximum input signal. For example, if Cin was configured to range from 0 to 20mA and the measured current was 15mA, then this parameter would show a value of 75% (15/20).

⌘ **NOTE:** See also DRV 05, 07 on page 79.

Vin2 Status I/O 39

LCD Display



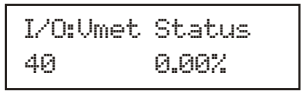
Range -100% to 100.0% **(view only)**

Description This parameter contains a value representing the measured input signal at the Vin 2 (input) terminal as a percentage of the maximum input signal. For example, if Vin 2 was configured to range from 0 to 10VDC and the measured voltage was 2V, then this parameter would show 20% (2/10).

⌘ **NOTE:** See also DRV 05, 07 on page 79.

Vmet Status I/O 40

LCD Display



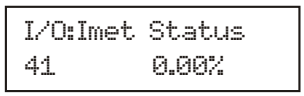
Range 0% to 100.0% **(view only)**

Description Voltage output status. This parameter contains a value representing the measured voltage at the Vmet (voltage output) terminal as a percentage of the maximum output voltage. For example, if this parameter showed 50%, then the voltage being output at A0 would be 5VDC (50% of 10VDC, the maximum value).

⌘ **NOTE:** See also I/O 33 on page 112.

Imet Status I/O 41

LCD Display



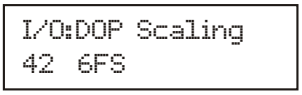
Range 0% to 100.0% **(view only)**

Description This parameter contains a value representing the measured current at the Imet (current output) terminal as a percentage of the maximum output current. For example, if this parameter showed 50%, then the current being output at Imet would be 12mA.

⌘ **NOTE:** See also I/O 33

DOP Scaling I/O 42

LCD Display



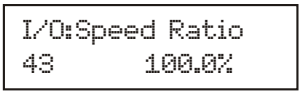
Range 6 or 48 times the output frequency (6FS or 48FS) **(Default 6FS)**

Description Pulse Train Output. This parameter selects the multiplier that is used to determine the output frequency at the DOP (Pulse Train Output) terminal. The pulse train is a 50% duty cycle signal and requires a pull-up resistor of approximately 4.7k Ohms.

⌘ **NOTE:** See also DRV 05, 07 on page 79 and "Description of Control Terminals" on page 41.

Speed Ratio I/O 43

LCD Display



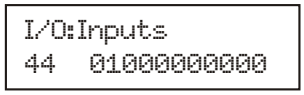
Range 0% to 200.0% of pulse train input at Vin1 **(Default 100.0%)**

Description This parameter configures the drive when using Vin1 as a Pulse Train Input. The drive will follow the Pulse Train at the percentage programmed.

⌘ **NOTE:** See also DRV 05, 07 on page 79 & I/O 42

Inputs I/O 44

LCD Display



Range 00000000000 to 11111111111

Description This eleven bit binary number indicates the status of the discrete inputs at the terminals. A one (1) indicates the input is true and a zero (0) indicates it is false.

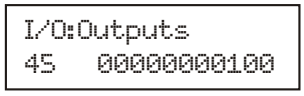
Bit	10	9	8	7	6	5	4	3	2	1	0
	N/A	EN	MOL	DI5	DI4	DI3	DI2	DI1	JOG	REV	FWD

Example 01000000001

Drive enable (EN) input is active, FWD input is active.

Outputs I/O 45

LCD Display



Range 00000000000 to 00000001111

Description This eleven bit binary number indicates the status of the discrete inputs as shown below. A one (1) indicates the input is true and a zero (0) indicates it is false.

Bit	10	9	8	7	6	5	4	3	2	1	0
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	DO2	DO1	R2	R1

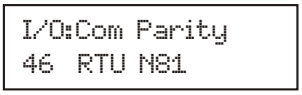
Example 00000000010

R2 is active.

⌘ **NOTE:** See also I/O 08 - I/O 09
I/O 10 - I/O 11 starting on page 103.

Com Parity I/O 46

LCD Display



Range See below **(Default RTU N81)**

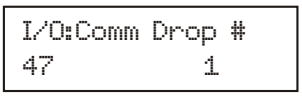
Description Communication parity. This parameter sets the parity and the number and stop bits recognized by the serial communication port. The parameter only affects the ModBus RTU and the ASCII Protocols, it has no effect if a different fieldbus is used.

Displayed Name:	Output is Governed by:
RTU N81	No parity, 8 data bis, 1 stop bit
RTU N82	No parity, 8 data bits, 2 stop bits
RTU E81	Even parity, 8 data bits, 1 stop bit
RTU 081	Odd parity, 8 data bits, 1 stop bit

⌘ **NOTE:** See also DRV 05, 07 on page 79.

Com Drop # I/O 47

LCD Display



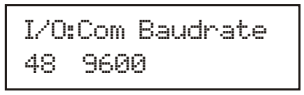
Range 1 to 247 **(Default 1)**

Description Communication drop number. This parameter sets the drop number of the serial communication port. Note that if a protocol other than ModBus is selected, you may change the drop number set in this parameter, but the change will not take effect until the power is cycled.

⌘ **NOTE:** Fieldbuses other than Modbus require option board.

Com Baudrate I/O 48

LCD Display



Range See below **(Default 9600)**

Description This parameter sets the baud rate for serial communication.

The following baud rates may be assigned:

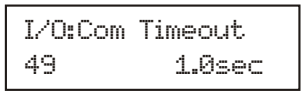
Displayed Name:	Baud Rate Assigned:
4800	4800 bps
9600	9600 bps **(Default)**
19200	19.2 K bps
38400	38.4 K bps
57600	57.6 K bps

⌘ **NOTE:** Only available for Modbus communication.

⌘ **NOTE:** The baud rate changes will not take effect until power is cycled if an option board is used for communication.

Com Timeout I/O 49

LCD Display



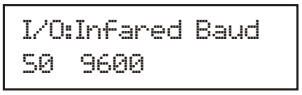
Range 0.0 to 60seconds **(Default 1.0s)**

Description This parameter configures a watchdog timer that will require a valid communication in the specified time period when the drive is in serial control. If the communication does not respond in the configured amount of time a fault code 25 will be generated.

⌘ **NOTE:** To disable the Com Loss faults, set to 0.

Infrared Baud Rate	I/O 50

LCD Display



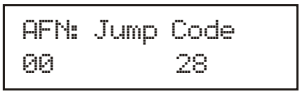
Range 9600 **(Default)**
19200
38400
57600

Description This parameter defines the baud rate of the infrared communications port.

7.1.4 AFN Group

Jump Code	AFN 00

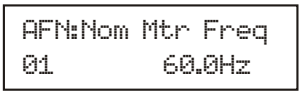
LCD Display



Description By changing the value of this parameter and pressing [ENTER], you can jump directly to any parameter within the group.

Nom Mtr Freq	AFN 01

LCD Display

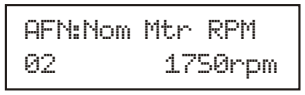


Range 25.00 to 400 Hz **(Default 60.0Hz)**

Description Nominal Motor Frequency. This parameter configures the nominal motor frequency or base frequency and is obtained from the nameplate on the attached motor.

Nom Mtr RPM AFN 02

LCD Display



Range 0 to 24000 RPM **(Default 1750)**

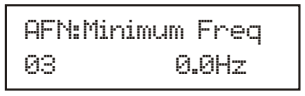
Description This parameter sets the nominal motor speed in revolutions per minute, and is obtained from the nameplate of the motor attached to the drive. It is important that this be entered accurately as it is used in sensorless vector control (SVC) calculations and in slip compensation.

For 50 Hz power systems, the default is 1450 RPM.

For 60 Hz power systems, the default is 1750 RPM.

Minimum Freq AFN 03

LCD Display

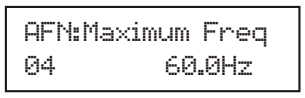


Range 0.00 to Max Freq **(Default 0.0Hz)**

Description This parameter sets the minimum frequency that may be output to the motor.

Maximum Freq AFN 04

LCD Display

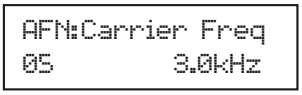


Range Minimum Freq to 320 Hz **(Default 60Hz)**

Description This parameter sets the maximum frequency that may be output to the motor. Note that the resolution is 1 Hz. Check with the motor manufacturer before exceeding the base speed of the motor.

Carrier Freq AFN 05

LCD Display



Range 0.6 to 16.0 kHz **(Default 3.0 kHz)**

Description This parameter configures the switching (or carrier) frequency for the drive. Lower frequencies produce better torque, but produce more audible noise from the motor. Higher switching frequencies produce less audible noise, but cause more heating in the drive and motor.

⌘ **NOTE:** This parameter is not adjustable during Run mode.

⌘ **NOTE:** See page 34 for information on motor lead lengths.

High carrier frequencies and long lead lengths can lead to premature motor and/or drive failure.

Slip Comp AFN 06

LCD Display

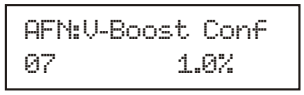
Range See below **(Default No)**

Description This parameter sets the amounts of slip compensation which may help maintain constant motor speed under changing load conditions.

Displayed Name	Automatic
No	Slip compensation is not utilized
Yes	The drive calculates how much slip compensation is needed depending on the load and motor speed

V-Boost Conf AFN 07

LCD Display



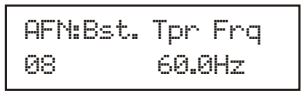
Range 0.00 to 50% **(Default 1.0%)**

Description Voltage boost configure. This parameter sets the amount of boost (expressed as a percentage of nominal motor voltage) to be applied at zero frequency. The amount configured then tapers linearly as frequency increases, reaching zero at the point specified by parameters AFN 08 (Bst Tpr Frq) and AFN 09 (Bst Tpr Vlt).

This parameter is used when FUN 02 (Torque Curve) is set to "Linear Fxd," "Pump Fxd," or "Fan Fxd."

Bst. Trp Frq AFN 08

LCD Display



Range 0.00 to Max Freq **(Default 60Hz)**

Description Boost Taper Frequency. This parameter works with the AFN 07 (V-Boost Conf) and AFN 09 (boost taper voltage) parameter. When voltage boost is applied at the start of the V/Hz curve, the amount of boost tapers linearly and reaches zero at the point established by the frequency set in this parameter and the voltage set in parameter AFN 09 (Bst. Tpr Vlt).

Bst. Tpr Vlt AFN 09

LCD Display

```
AFN:Bst. Tpr Vlt
09       100.0%
```

Range 0.00 to 100.00% **(Default 100.0%)**

Description Boost Taper Voltage. This parameter works with the AFN 07 (V-Boost Conf) parameters. When voltage boost is applied at the start of the V/Hz curve, the amount of boost tapers linearly and reaches zero at the point established by the voltage set in this parameter and the frequency set in parameter AFN 08 (Bst. Tpr Frq)

Application:

Figure 35: Terminal 1 Linear Operation

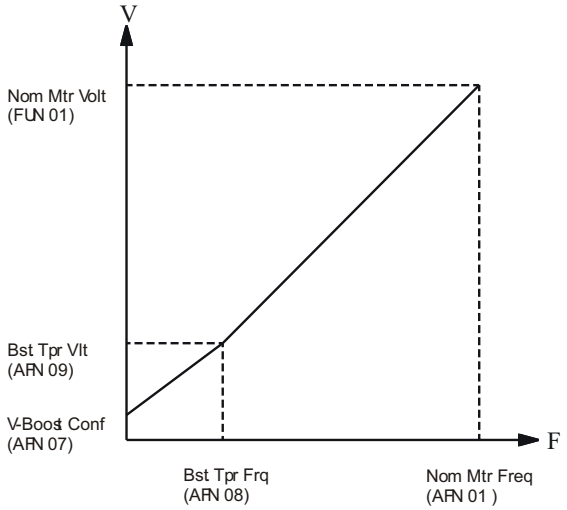
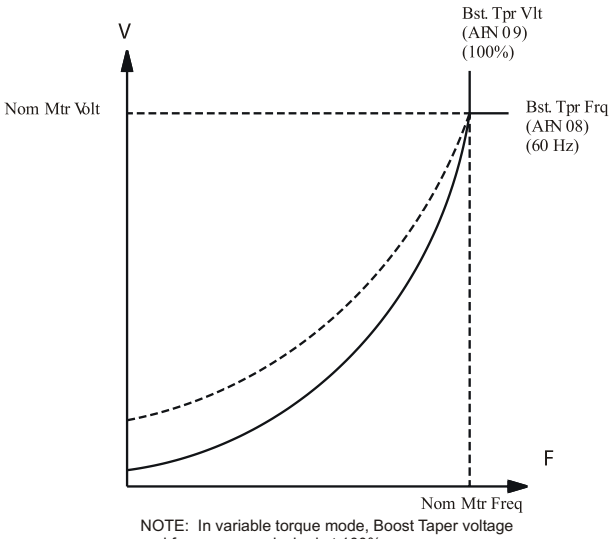


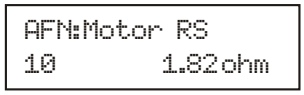
Figure 34: Terminal 2 Quadratic Operation



NOTE: In variable torque mode, Boost Taper voltage and frequency are locked at 100%

Motor RS AFN 10

LCD Display



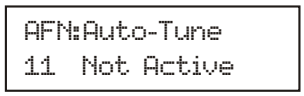
Range 0.0 to 655.35 ohm **(Default 1.82 ohm)**

Description Stator Resistance. This parameter allows direct entry of the Stator Resistance (Rs) of the motor for better vector performance. The motor manufacturer can provide this information.

⌘ **NOTE:** See also FUN02 - Vector on page 84.

Auto-tune AFN 11

LCD Display



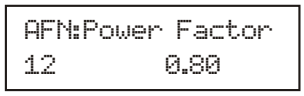
Range Not Active **(Default)**
Motor RS

Description When active the VFD automatically tunes the motor and acquires the motor RS value.

⌘ **NOTE:** See also FUN02 - vector on page 84.

Power Factor AFN 12

LCD Display



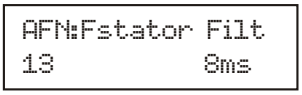
Range 0.50 to 1.00 **(Default 0.80)**

Description This parameter allows direct entry of the motor's power factor for better vector performance. The motor manufacturer can provide this information.

⌘ **NOTE:** See also FUN02 (Torque Curve) - "vector" on page 84.

Fstator Filt AFN 13

LCD Display



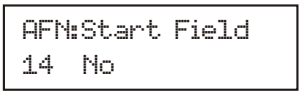
Range 1 to 100 ms **(Default 8ms)**

Description Stator Frequency Filter. This parameter filters the stator frequency applied to the motor, which can help tune the acceleration behavior of the motor. This is particularly helpful when using short ramps and operating the motor at a frequency above the Boost Taper Freq (AFN 08) value (field weakening area). Lower values allow dynamic currents to be produced, but with greater peaks. This could produce unstable states in the field weakening area. Low values for this parameter can cause overcurrent faults while accelerating to frequencies over the Knee Frequency. Higher values allow the drive to run more smoothly at frequencies over the Knee Frequency and protect the drive against overcurrent—often the case when using special motors or spindle drives.

⌘ **NOTE:** See also FUN02 on page 84.

Start Field AFN 14

LCD Display



Range
Yes
No **(Default)**

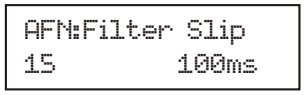
Description

Parameter Value	Description
No	The shaft will begin rotating after receiving a Start command, without delay. If the application has heavy load conditions or short ramp times, this setting can produce very large starting currents, to overcome the inertia of the system. This may produce nuisance trips when starting.
Yes	The shaft will begin rotating after receiving a Start command, with delay, the drive is building up the magnetic field in the motor. This allows the drive to start in vector mode with less starting current.

⌘ **NOTE:** See also FUN02 on page 84.

Filter Slip AFN 15

LCD Display



Range 10 to 1000 ms **(Default 100ms)**

Description This parameter filters the slip frequency applied to the motor, which can help improve the dynamic response of the drive. This parameter produces the following results based on the parameter value:

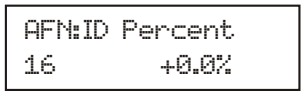
If the parameter is configured to 100 ms, the drive will produce stable conditions to a change in load, in most cases.

If the parameter is configured to less than 100 ms, the drive will be able to react quickly to a change in load, but may over-compensate its reaction to the load.

If the parameter is configured to greater than 100 ms, the drive will react very slowly to a change in load and will need a longer time to compensate for the difference between the setpoint and the actual frequency.

ID Percent AFN 16

LCD Display

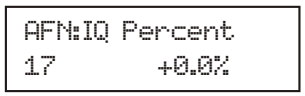


Range -300.0 to 300.0% **(view only)**

Description This parameter shows the Flux producing current (as a percentage of motor rated current) that is being applied to the motor.

IQ Percent AFN 17

LCD Display

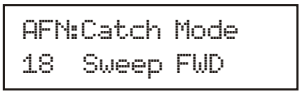


Range -300.0 to 300.0% **(view only)**

Description This parameter shows the Torque producing current (as a percentage of motor rated current) that is being applied to the motor.

Catch Mode AFN 18

LCD Display



Range See below **(Sweep Fwd)**

Description This parameter configures how the Catch Mode operates when selected in FUN 03 (Start Mode).

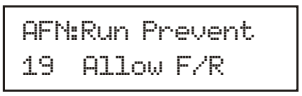
Parameter Value	Description
Sweep Fwd	Catch Mode algorithm sweeps through frequencies only in the forward direction while searching for the operating frequency.
Sweep Rev	Catch Mode algorithm sweeps through frequencies only in the reverse direction while searching for the operating frequency.
Sweep F/R	Catch Mode algorithm sweeps through frequencies in both directions while searching for the operating frequency. The direction that is chosen first depends on the direction of the command given to the drive. Note that this option is slower than the other two modes of operation.

⌘ **NOTE:** This feature is disabled if a digital input configured for "Fly Dis" is active. See I/O 01 through I/O 06 on page 100.

⌘ **NOTE:** See also FUN 03 on page 85.

Run Prevent AFN 19

LCD Display

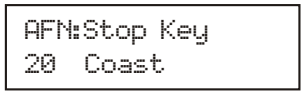


Range Allow F/R **(Default)**
No Reverse
No Forward

Description This function is to lock the direction of rotation. To lock the direction, select "No Reverse" or "No Forward".

Stop Key AFN 20

LCD Display



Range See below **(Coast)**

Description This parameter sets the type of stop that occurs when the drive is running under terminal strip control and the [STOP] key on the keypad is pressed.

The following function may be assigned to this parameter.

Displayed Name	Function of the STOP key
Disabled	The [STOP] key is disabled
Ramp	A ramp-to-stop is performed
Coast	A coast-to-stop

Loc/Rem Key AFN 21

LCD Display

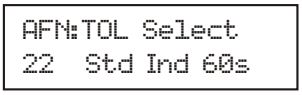
Range Enabled **(Default)**
Disabled

Description This parameter is used to enable or disable the function of the LOC/REM key on the keypad.

⌘ **NOTE:** See page 55 for more information on this parameter.

Timed Overload Select AFN 22

LCD Display



Range See below **(Default Std Ind 60s)**

Description

Two parameters in the S4 work together to configure how the motor timed overload operates: DRV 01 (Nom Mtr Amps) and AFN 22 (TOL Select).

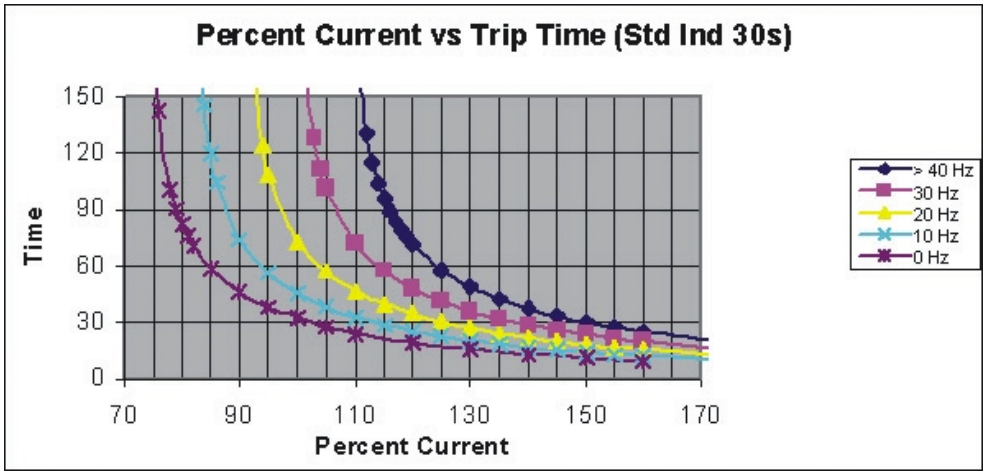
DRV 01 (Nom Mtr Amps) should be configured to the value on the nameplate of the motor. This value is used in calculating the percentage of load on the motor.

Set AFN 22 (TOL Select) to one of the following data values to configure the desired overload characteristic:

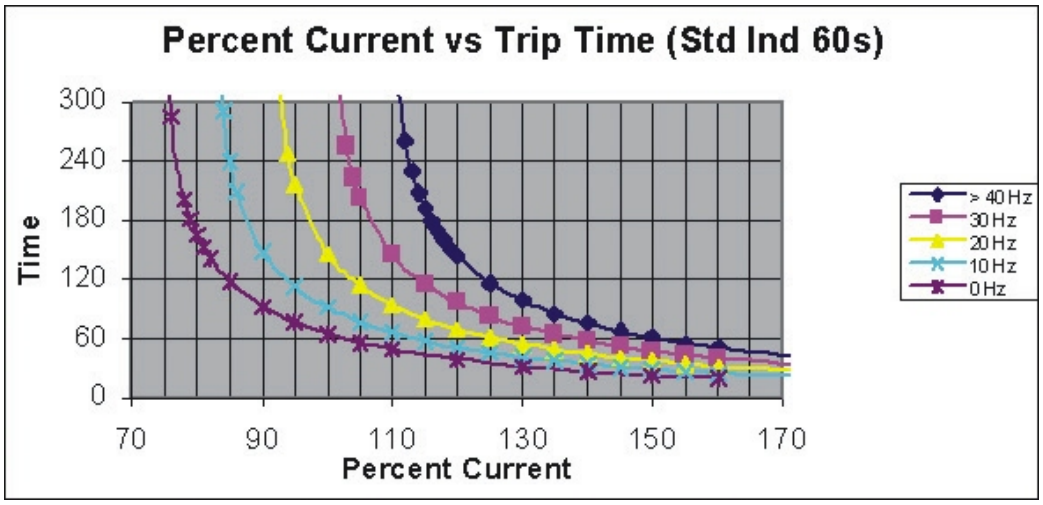
Options	Trip Time	Motor Type	Motor Class
Std Ind Shp (Shearpin)	0 sec	Standard Induction	N/A
Std Ind 30s	30 sec	Standard Induction	1
Std Ind 60s	60 sec	Standard Induction	2
Std Ind 5mn	300 sec	Standard Induction	10
In Duty Shp (Shearpin)	0 sec	Inverter Duty	N/A
In Duty 30s	30 sec	Inverter Duty	1
In Duty 60s	60 sec	Inverter Duty	2
In Duty 5mn	300 sec	Inverter Duty	10

AFN 22 (TOL Select) determines the graph of Trip (Fault) time vs. Percent Current that is used by the Motor TOL functionality. This protective feature is speed-dependent to handle standard induction motors whose cooling is limited by the shaft-mounted fan. Blower cooled motors and most inverter duty motors do not have this limitation.

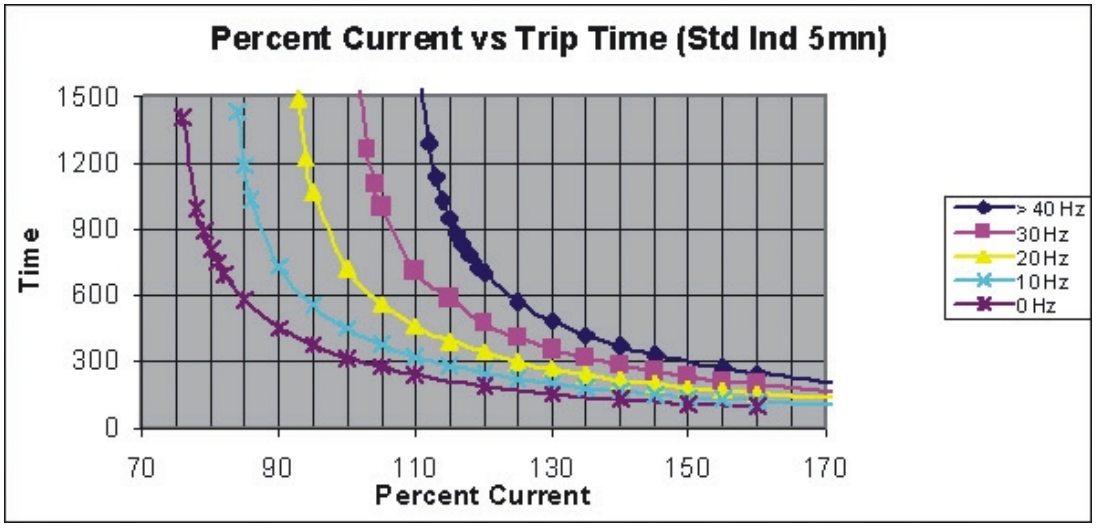
S4 Motor TOL Trip Time vs. Percent Current for 30s options



S4 Motor TOL Trip Time vs. Percent Current for 60s options



S4 Motor TOL Trip Time vs. Percent Current for 5 mn options



Ramp Config AFN 23

LCD Display

Range See below **(Default ART-DI)**

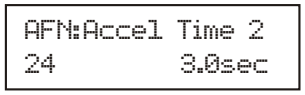
Description This parameter configures when the alternate ramps of the drive will be active and when either the drive ramps to stop or coasts to stop.

The following data values may be assigned to this parameter:

Parameter Value	Type of Ramp	Ramp Configured By
ART-DI	Ramp-to-Stop	DRV 02 and DRV 03
ART-F/R	Ramp-to-Stop	Running Forward: DRV 02 and DRV 03 Running Reverse: AFN 24 and AFN 25
ART-Frq	Ramp-to-Stop	If the output frequency is less than preset I/O 18 (Preset Spd 6), the active ramp is set by DRV 02 and DRV 03. If the output frequency is equal or greater than I/O 18 (Preset Spd 6), the active ramp is set by AFN 24 (Accel Time 2) and AFN 25 (Decel Time 2).
ART-Strt/RS	Ramp-to-Stop	A digital input is defined as the Alternate Ramp Selector. The digital input is then used to select between the ramp configured by DRV 02 (Accel Time 1) and DRV 03 (Decel Time 1) (digital input false or open) and the ramp configured by AFN 24 (Accel Time 2) and AFN 25 (Decel Time 2) (digital input true or closed).
S-Curve	Ramp-to-Stop	The drives uses DRV 02 (Accel Time 1) and DRV 03 (Decel Time 1) for total time and AFN 26 as the S Ramp Rounding value. The amount of rounding is the same for that start and stop of the ramp time.
ART-DI-CTS	Coast-to-Stop	Same as ART-DI but with Coast-to-Stop
ART-F/R CTS	Coast-to-Stop	Same as ART-F/R but with Coast-to-Stop
ART-Frq CTS	Coast-to-Stop	Same as ART-Frq but with Coast-to-Stop
ART-Str/CS	Coast-to-Stop	Same as ART-Strt but with Coast-to-Stop
S-Curve	Coast-to-Stop	Same as S-Curve with Coast-to-Stop

Accel Time 2 AFN 24

LCD Display

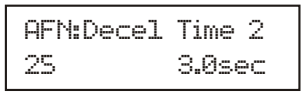


Range 0.1 to 3200.0 seconds **(Default 3.0s)**

Description This parameter sets the length of time to accelerate from 0 Hz to the maximum frequency for AFN 27.

Decel Time 2 AFN 25

LCD Display



Range 0.1 to 3200.0 seconds **(Default 3.0s)**

Description This parameter sets the length of time to decelerate from the maximum frequency parameter AFN 04 (Maximum Freq) to 0 Hz for Alternate Ramp 1.

Rmp Rounding AFN 26

LCD Display

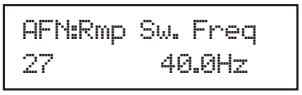
Range 1 to 100% **(Default 25%)**

Description Ramp Rounding. This parameter is used to define the amount of rounding or s-curve to the Accel and Decel ramps. The amount of rounding is split evenly between the beginning and end of the rap. A value of 1% would mean that the rounding of the ramp is near linear. A value of 50% would have 25% rounding at the start of the ramp and 25% at the end of the ramp.

Ramp Rounding is only active when S-Curve is selected in AFN 23 (Ramp Config).

Rmp Sw Freq AFN 27

LCD Display



Range 1 to 400.0 Hz **(Default 40.0Hz)**

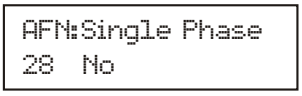
Description Ramp Switch Frequency. This parameter sets the threshold frequency that activates Accel 2 and Decel 2 ramp during acceleration and deceleration. Alternate ramp is invoked as long as the output frequency is greater than the defined value.

This parameter is only active when ART-FRQ or ART-FRQ CTS is selected in AFN 23 (Ramp Config).

Ramp Rounding is only active when S-Curve is selected in AFN 23 (Ramp Config).

Single Phase AFN 28

LCD Display



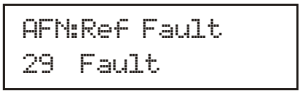
Range
Yes
No **(Default)**

Description Selecting Yes will allow the drive to function on single phase input power. If this parameter is set to No, the drive will fault on "Phase Loss" when single phase power is applied. The VFD may operate on single phase power and create three phase power, but should be derated by 50%. Consult factory for more information.

⌘ **NOTE:** See page 34 for more information on single phase.

Ref Fault AFN 29

LCD Display



Range See below **(Default Fault)**

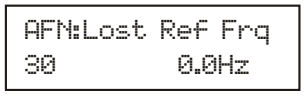
Description This parameter configures what action is taken, if any, when the drive loses the voltage input 1 (Vin1) signal when it is configured as the reference speed. Vin1 needs to be configured and wired for broken wire detection. See I/O 19 (Vin1 Configure).

The following functions may be assigned:

Displayed Name	Action taken when signal is lost
Retain Spd	The last known reference speed will remain in effect.
Preset Lvl	The drive will ramp to the frequency set by parameter AFN 30 (Lost Ref Freq)
Fault	A fault is generated and the drive stops.

Lost Ref Frq AFN 30

LCD Display

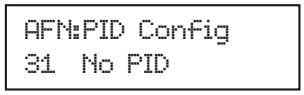


Range 0 to 400.0Hz **(Default 0.0Hz)**

Description Lost Reference Frequency. AFN 30 (Lost Ref Freq) sets the frequency level used when AFN 29 (Ref Fault) is set to Preset Lvl.

PID Config AFN 31

LCD Display



Range See below **(Default No PID)**

Description This parameter determines what means are used to enable PID control as well as the type of PID control that is enabled.

The following values may be assigned to this parameter:

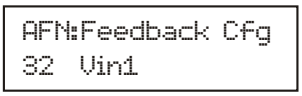
Parameter Value	Description
No PID	PID control is always inactive
Dir F-FWD	Direct action with feed-forward
Rev F-FWD	Reverse action with feed-forward
Dir Full	Direction action with full range
Rev Full	Reverse action with full range

If you select digital input to enable PID control, remember to configure the parameter that sets the function of the digital input or function key to enable PID control to complete the implementation.

See also I/O 01 through I/O 06 starting on page 101.

Feedback Cfg AFN 32

LCD Display



Range

Vin1 **(Default)**
Cin
Vin2

Description

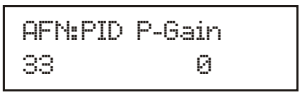
Feedback Configuration. This parameter configures the source of the feedback signal which may be either Vin1, Cin or Vin2.

The following sources may be assigned to this parameter:

Parameter Value	Description
Vin1	Sets Vin1 as the PID feedback signal
Cin	Sets Cin as the PID feedback signal
Vin2	Sets Vin2 as the PID feedback signal

PID P-gain AFN 33

LCD Display



Range

0 to 2000 **(Default 0)**

Description

PID Proportional gain. This parameter configures the short-term response of the drive to incremental change in the feedback signal. The range of this parameter is 0 to 1000 corresponding to 0.0% to 100.0% of the maximum frequency.

PID I-gain AFN 34

LCD Display

```
AFN:PID I-Gain
34          0
```

Range 0 to 10000 **(Default 0)**

Description PID Integral gain. This parameter sets the long-term response of the drive to a change in the feedback signal. (This is some times called “averaging time"). By setting this parameter appropriately, the drive may be calibrated to ignore short-term disturbances seen the in transducer signal (that may be considered either noise or insignificant) while still responding to longer-term effects reflected in the signal. The range of this parameter is 0 to 10000 with 0 being inactive and 10000 being the quickest response time.

PID D-gain AFN 35

LCD Display

```
AFN:PID D-Gain
35          0
```

Range 0 to 2000 **(Default 0)**

Description This parameter sets the gain of the drive’s response to changes in the feedback input. The range of this parameter is 0 to 2000 with 0 being inactive and 2000 being maximum derivative gain.

Changing the value of this parameter to a number greater than 0 may result in unstable operation. Since most applications only require integral feedback conditioning, not derivative feedback conditioning, adjustment of this parameter should only be performed by experienced personnel and with great care. Failure to observe this warning may result in injury or equipment damage.

PID FB-gain AFN 36

LCD Display

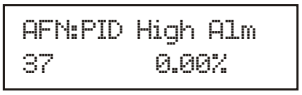
```
AFN:PID FB Gain
36       1000
```

Range 0 to 2000 **(Default 1000)**

Description PID Feedback gain. This parameter provides a scaling factor for the feedback signal. The range is 0 to 2000 corresponding to 0.0% to 200.0% of the maximum frequency.

PID High Alm AFN 37

LCD Display

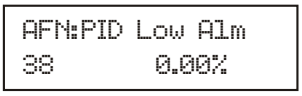


Range 0.00 to 100.00% **(Default 0.0%)**

Description PID high alarm. When PID output exceeds the value of this parameter (which is a percentage of the reference frequency), a digital output or relay may be configured to provide notification.

PID Low Alm AFN 38

LCD Display

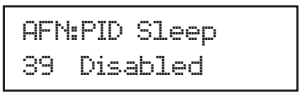


Range 0.00 to 100.00% **(Default 0.0%)**

Description PID low alarm. When PID output falls below the value of this parameter (which is a percentage of the reference frequency), a digital output or relay may be configured to provide notification.

PID Sleep AFN 39

LCD Display



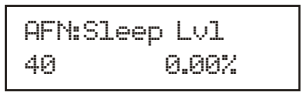
Range See below **(Default Disabled)**

Description The following values may be assigned to this parameter.

Parameter Value	Description
Disabled	Disables the Sleep Mode function
PID Fback <	Uses the feedback signal for Sleep Mode
PID Fback >	
PID Ref <	Uses the PID Ref for Sleep Mode
PID Ref >	

Sleep Lvl AFN 40

LCD Display



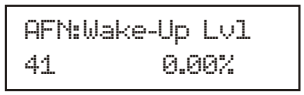
Range 0.00 to 100.00% **(Default 0.00%)**

Description Sleep Level. This parameter sets the sleep level. When the PID output command frequency drops below this level, the drive stops. The PID function remains active. When the command frequency goes above AFN 41, this drive will begin to run.

⌘ **NOTE:** See also AFN 39 (PID Sleep)

Wake-Up Lvl AFN 41

LCD Display



Range 0.00 to 100.00% **(Default 0.00%)**

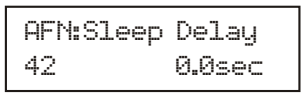
Description This parameter sets the wake-up level.

⌘ **NOTE:** See also AFN 39 (PID Sleep)

⌘ **NOTE:** See also AFN 40 (Sleep Lvl)

Sleep Delay AFN 42

LCD Display



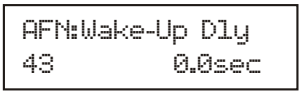
Range 0.00 to 300.0 seconds **(Default 0.0s)**

Description This parameter sets the sleep delay. When the drive output frequency falls below AFN 40, the drive waits for the time to expire before stopping.

⌘ **NOTE:** See also AFN 39 (PID Sleep)

Wake-Up Dly AFN 43

LCD Display



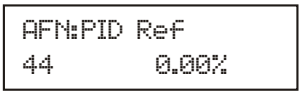
Range 0.00 to 300.0 seconds **(Default 0.0s)**

Description Wake up delay. This parameter sets the wake-up level. When the drive output rises above AFN 41, the drive waits for the time to expire before resuming output.

⌘ **NOTE:** See also AFN 39 (PID Sleep)

PID Ref AFN 44

LCD Display



Range 0.00 to 100.00% **(view only)**

Description PID reference. This parameter shows the set point for the PID control loop. The set point is expressed as a percentage of the maximum frequency. The value shown in this parameter can be used to determine whether the control path of the drive is configured correctly as well as whether the analog input is configured correctly with respect to span and offset.

PID FB AFN 45

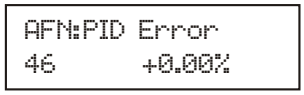
LCD Display

Range 0.00 to 100.00% **(view only)**

Description PID feedback. This parameter enables the set point for the feedback signal as a percentage of the maximum frequency. This parameter may be used to provide analog input scaling of the feedback signal. It can also be sent to either the Imet or Vmet analog output terminal if the analog output is configured to show the PID feedback signal.

PID Error AFN 46

LCD Display

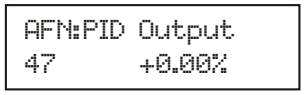


Range 0.00 to 100.00% **(view only)**

Description PID Error. This parameter shows the value of the error between AFN 45 (PID FB) and AFN 44 (PID Ref).

PID Output AFN 47

LCD Display

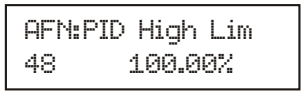


Range 0.00 to 100.00% **(view only)**

Description This parameter shows the value of the PID output, expressed as a percentage of maximum frequency.

PID High Lim AFN 48

LCD Display

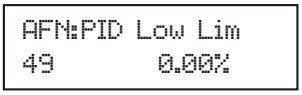


Range 0.00 to 100.00% **(Default 100.00%)**

Description PID high limit. This parameter sets the high limit of PID output. The range is 0.00 to 100.00% of the maximum frequency.

PID Low Lim AFN 49

LCD Display

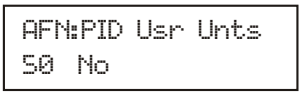


Range 0.00 to 100.00% **(Default 0.00%)**

Description PID low limit. This parameter sets the low limit of PID output. The range is 0.00 to 100.00% of the maximum frequency.

PID User Unt AFN 50

LCD Display

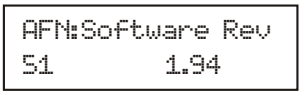


Range Yes
No **(Default)**

Description PID user unit. This parameter sets whether the drive will use units when in PID control. If set to Yes, the user units can be set in FUN 42 (Units). The actual values of the feedback signal and reference will then be displayed in AFN 44 (PID Ref) and AFN 45 (PID FB).

Software Rev AFN 51

LCD Display

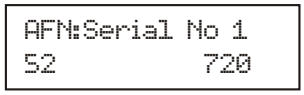


Range 0.00 to 99.99 **(Default 1.94)**

Description Software revision. This read-only parameter displays the software revision in use by the drive.

Serial No 1 AFN 52

LCD Display

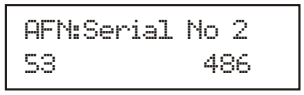


Range N/A **(view only)**

Description Serial number 1. This read-only parameter displays a date code indicating date of manufacturing for the drive.

Serial No 2 AFN 53

LCD Display

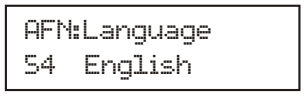


Range N/A **(view only)**

Description This read-only parameter contains a number that determines the number of the drive manufactured during the date indicated in AFN 52 (Serial No 1).

Language AFN 54

LCD Display

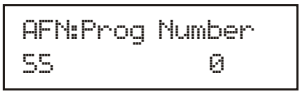


Range N/A **(view only)**

Description This read-only parameter displays the language used in the drive for programming purposes.

Prog Number AFN 55

LCD Display

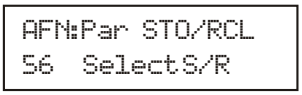


Range 0 to 9999 **(Default 0)**

Description Program number. Entering 10 in this parameter will reset the total run time meter in DRV 13 (Run Time) on page 81.

Par Sto/Rcl AFN 56

LCD Display



Range See below

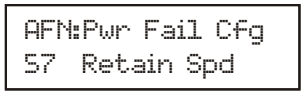
Description Parameter store/recall. This parameter allows the user to reset all parameters to factory defaults or store and recall custom parameter settings.

The following values may be assigned to this parameter:

Displayed Name	Function
Factory Rst	Resets all parameters to factory defaults
Store Parm	Stores current drive parameter settings in memory
Load Parm	Recalls stored parameters from memory
Swap Parm	Exchanges the active parameter settings and the stored parameter settings.

Power Fail Config AFN 57

LCD Display



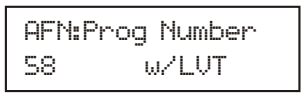
Range

Parameter Name	Description
Retain Speed	The last known reference speed will remain in effect.
Preset Level	The drive will ramp to the frequency set by parameter AFN 30 (Lost Ref Freq).
Fault	A fault is generated and the drive stops.
3Cur	
4Cur	
5Cur	

Description This parameter can be used to define how the drive responds to an undervoltage operation when parameter FUN 02 (Torque Curve) is set for "Vector" or "Linear Auto" mode.

Ride-Thru Enable AFN 58

LCD Display



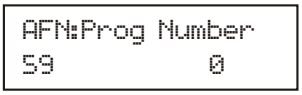
Range Disabled

Description This parameter allows the function to disable either (a) undervoltage ride-through or (b) continuous Line Voltage Tracking (LVT) that produces dynamic Undervoltage Ride-Thru Thresholds.

Parameter Setting	Description	Tracking	Ride-Thru mode	UV Fault
Disabled	- Under Voltage Ride-Thru state is disabled. Once the bus voltage system goes to the ready state, the drive will not stop. - Only mode that does not enter the ride-thru or ride-thru timeout bus monitoring states. - Disables both the Ride-Thru mode and Tracking.	Disable	Disable	Disable
w/ LVT	- The bus voltage system will adjust the voltage level (thresholds) based on the long term average of the bus voltage. - Only mode that uses the tracking system.	Enable	Enable	Enable
w/o LVT	- Disables the voltage tracking system. - The default levels define when the bus voltage system change to various states (Ride-Thru, ride-thre timeout, under voltage, etc)	Disable	Enable	Enable
No UV Fault	- Same as "w/o LVT" except if the bus recovers from the ride-thru timeout state then the under voltage fault is not generated. - The bus voltage system will reset and go back thru the startup sequence.	Disable	Enable	Disable

Cutoff Frequency AFN 59

LCD Display

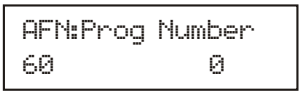


Range 0.0 – 5.0 Hz **(Default 0.0 Hz)**

Description This parameter sets the point where the drive no longer attempts to spin the motor. When the parameter is configured to a value of 0.0 Hz, the drive will operate with no Cut-off Frequency. If the function is enabled, the drive will be able to ramp up through the cut-off frequency range, as in normal operation. If the speed command falls below the cut-off frequency, the drive stops "gating" the outputs and coasts down to zero speed. The keypad display will indicate Zero Speed, and the Forward or Reverse LED will be lit depending on the command. When the frequency returns to a value greater than the cut-off frequency, the drive will ramp from 0.0 Hz to the reference frequency.

Stab. Gain AFN 60

LCD Display

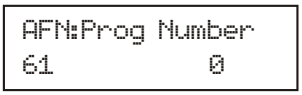


Range

Description

Stab. Rate AFN 61

LCD Display



Range

Description

7.1.5 APP Group

Seq Cntl 1 – 9	APP 02 – 10

These parameters each provide a 10-bit binary status display. See "Using the S4 Program Sequencer" on page 147.
The following bits are used with each of these parameters:
Bit 0-2 = Speed Sel
Bit 3 = Accl Sel
Bit 4-6 = Event Length
Bit 7-8 = Dir Sel
Bit 9-10 = Output Sel

Seq Count 1 – 9	APP 11 – 19

These parameters configure the time, number of pulses, or analog level of sequencer steps 1 through 9, respectively. See page 150 "Description of Seq Count Function" for more information regarding this group.

7.2 Using the S4 Program Sequencer

The S4 AC drive offers functionality that allows users to program up to nine independent operation states of the drive. This functionality is called the "program sequencer" because it allows the drive to sequence through the operation states programmed by the user. The S4 Program Sequencer can be used in applications that would normally require external intelligence, such as a simple programmable logic controller.

7.2.1 Enabling the S4 Program Sequencer

The S4 Program Sequencer can be enabled with parameter APP 01 (Seq Appl). This parameter configures sequencer. The time base may change depending on the timing loops used.

The following data values may be assigned to this parameter:

Options	Meaning
Disabled	The Sequencer mode of the S4 is not active.
1 sec base	The Sequencer mode of the S4 is active, and all timing for the sequencer will be on a 1-second base.
.1 sec base	The Sequencer mode of the S4 is active, and all timing for the sequencer will be on a 0.1-second base.
.01 sec base	The Sequencer mode of the S4 is active, and all timing for the sequencer will be on a 0.01-second base.

⌘ **NOTE:** The program sequencer can be activated and controlled from either the keypad or the terminal strip. It is not possible to control the sequencer through the serial link. See page 55 for information on "control modes".

7.2.2 Controlling the S4 Program Sequencer

The Program Sequencer can be activated and controlled from either the keypad or the terminal strip. It is NOT possible to control the sequencer through the serial link. The control method of the program sequencer is determined by parameters DRV 04 (Drive Mode 1) and DRV 05 (Freq Mode 1). Setting the input mode parameters also allows switching from Sequencer mode to normal keypad operation by way of the loc/rem button.

Keypad Control (Activation) of the S4 Program Sequencer

When activating or controlling the S4 Program Sequencer from the keypad, pressing "FWD" commands the drive to cycle through the programmed states of the sequencer one time only (one-shot operation). One-shot operation will run the sequencer until state 9 is reached, or until any state that is not changed from the default is reached.

Pressing the [LEFT] and [FWD] buttons simultaneously causes the programmed sequence to repeat until the [STOP] key is pressed (continuous operation). In continuous mode, the sequencer runs until state 9 or any state that is not changed from the default is reached; it then jumps back to state 1.

Terminal Control of the S4 Program Sequencer

When activating or controlling the S4 Program Sequencer from terminals, continuous and one-shot operation is determined by whether the drive is wired for 2-wire or 3-wire control. If the terminal is set up for 2-wire control, the sequencer operates in continuous mode (R/J terminal inactive). This will run the sequencer until the Forward command is removed. If the terminal is set up for 3-wire control, the sequencer runs one cycle when the FWD terminal is activated.

⌘ **NOTE:** The "REV" terminal has no function in sequencer mode.

S4 Sequencer Dwell Functionality

The S4 sequencer has the capability to dwell, or pause, in a state and disregard any command to advance to the next state. This can be done in two different ways, and both methods can be used at the same time.

If the sequencer is actively running and the [ENTER] key is pressed from the Operate screen of the S4 keypad, the sequencer will dwell in the current state(it will never advance to the next state). While the sequencer is dwelling, a warning of "Seq Dwell" will flash on the Operate screen. To leave the dwell state, press the [ENTER] key again from the Operate screen.

The sequencer Dwell mode can also be entered by programming a digital input to "Seq Dwell" The sequencer will then dwell in the current state, for as long as the digital input is active.

S4 Sequencer Advance Functionality

The sequencer has the ability to allow the user to advance to the next state without satisfying the conditions programmed to advance. To do this, program a digital input to "Seq Advance." When a digital input programmed to this option changes from inactive to active, a running sequencer will advance one state. This feature is useful when debugging a sequence with long time intervals.

7.2.3 Sequencer State Configuration Overview

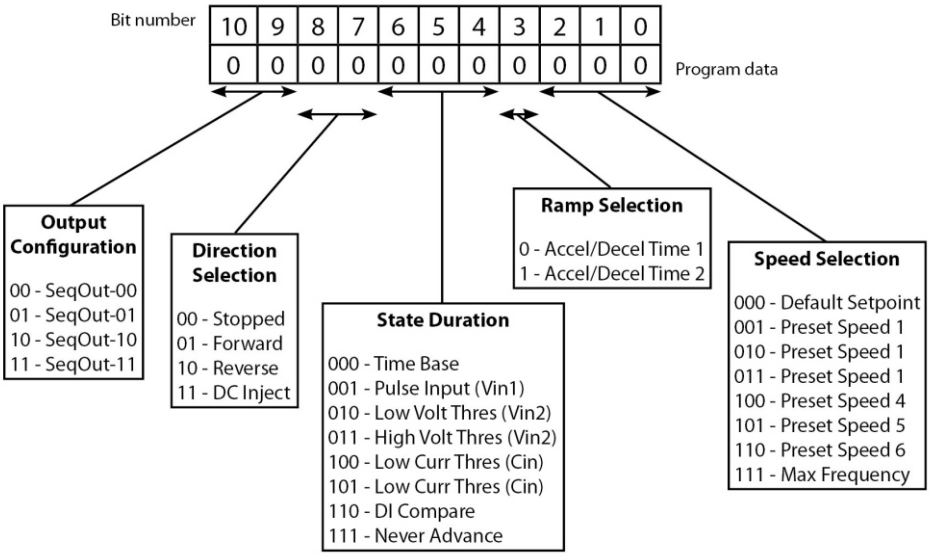
Each state of the program sequencer is defined by five characteristics:

- Direction in which the drive will operate
- Speed at which the drive will operate

- Ramp selection of the drive
- Output configuration (relays and digital outputs) of the drive
- How the sequencer advances to the next state

These five characteristics are configured by two parameters for each state. These parameters are named "Seq Cntl X" and Seq Count X," where X represents the state number of the sequencer (1-9). The "Seq Cntl X" parameter is a binary parameter that sets each of the five characteristics listed above. "Seq Count X" uses bits 4,5,6 and configures the threshold that the sequencer will use in determining when to advance to the next stage by the method programmed in the control parameter. The descriptions for "Seq Count X" is under the title "Description of Seq Count Function". The bit patterns of the "Seq Cntl X" parameters are shown below.

Seq Cntl Parameter: Bit Definition



S4 Sequencer Speed Selection (Bits 0, 1, 2)

The table below gives more information on the speed selection options available in the S4 sequencer by programming bits 0, 1 and 2 of each state's control parameter. The options include any Preset Speed, Max Frequency, or allowing the reference to be determined in the normal S4 control path.

Speed Selection Options

Binary Value	Definition (Resulting Speed)
000	Speed selection as in normal S4 operation, as defined by Operate Screen
001	Value of parameter Preset Speed 1 (I/O 13)
010	Value of parameter Preset Speed 2 (I/O 14)
011	Value of parameter Preset Speed 3 (I/O 15)
100	Value of parameter Preset Speed 4 (I/O 16)
101	Value of parameter Preset Speed 5 (I/O 17)
110	Value of parameter Preset Speed 6 (I/O 18)
111	Value of parameter Max Frequency (AFN 04)

S4 Sequencer Ramping Selection (Bit 3)

When the sequencer is active, the active ramp is no longer determined by parameter "Ramp Config". The user however, does have the choice of using the main ramps (Accel Time 1/Decel Time 1), or the alternate ramps (Accel Time 2/Decel Time 2) for each independent state. This is determined by bit 3 of the control parameter. If bit 3 is set to 1, then the alternate ramps are used (Accel Time 2/Decel Time 2).

Sequencer Output Configuration (Bits 9 and 10)

The S4 Program Sequencer allows digital outputs to be activated during states of the sequencer. This function could be used to activate other devices in a system or to signal to an operator when a part of the sequence is active. The user sets the digital output parameter with the option for that same binary value. For example, if a control state was output configured for a binary value of 11, then any digital output configured "SeqOut-11" would be activated during that time.

Sequencer Direction Selection (Bits 7 and 8)

The sequencer allows each state to be configured as running **Forward, Reverse, Stopped** or **DC Injected** by setting bits 7 and 8 of the control parameters.

Sequencer State Duration (Bits 4, 5 and 6)

Bits 4, 5, and 6 of each sequencer control parameter specify how that step will allow advancement to the next step. The options for advancement are **time, pulse input, voltage threshold, current threshold** or **digital input comparison.** After the advancement method is selected with these bits, the threshold of advancement is determined by the state's count parameter (see the next paragraph).

Sequencer State Advance Threshold (via Count Parameter)

The sequencer count parameters work in conjunction with the state duration configuration in the control parameter to determine when to advance to the next state. The function of this parameter is dependent on the state duration configuration as defined in the following table. The range of data programmed into this parameter can be from 0 to 65,535, and can represent time, pulse counts, analog voltage thresholds, analog current thresholds, or digital comparison values.

Bits 4, 5, 6 of Seq Cntl	Description of Seq Count Function (Bits 4, 5, 6)		
000	**Time Base -** The current sequencer state will last for a time interval equal to the number "Seq Count X" multiplied by the time base configured in the Seq Appl (APP 01) parameter.		
	Seq Appl Setting	**Time to Advance**	**Max Seq Time**
	1 sec Base	(1 sec) * (Seq Count X)	18.2 hours
	0.1 sec Base	(0.1 sec) * (Seq Count X)	1.82 hours
	0.01 sec Base	(0.01 sec) * (Seq Count X)	10.92 minutes
001	**Pulse Count -** The current sequencer state will last until the number of pulses programmed into "Seq Count X" is detected on terminal Vin1.		
010	**Low Analog Voltage Threshold -** The active sequencer state lasts until the voltage signal applied to terminal Vin2 is < a value programmed into "Seq Count X". The value programmed into "Seq Count X" should be the percentage of input after span and offset are applied (where 100.00% = 10000). **NOTE:**The % of analog input after span and offset can be read in parameter I/O39(Vin2 Stat)		
011	**High Analog Voltage Threshold -** The active sequencer state lasts until the voltage signal applied to terminal Vin2 is > a value programmed into "Seq Count X". The value programmed into "Seq Count X" should be the percentage of input after span and offset are applied (where 100.00% = 10000). **NOTE:**The % of analog input after span and offset can be read in parameter I/O39(Vin2 Stat)		

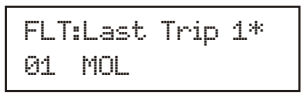
Chart to plot Program Sequencer settings

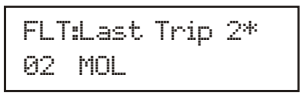
	Output Configuration		Direction Selection		State Duration			Ramp Select	Speed Selection		
Step											
1											
2											
3											
4											
5											
6											
7											
8											
9											

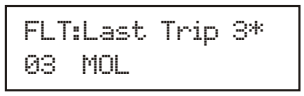
<table>
<tr><td>100</td><td>Low Analog Current Threshold - The active sequencer state lasts until the voltage signal applied to Cin terminals is < a value programmed into "Seq Count X". The value programmed into "Seq Count X" should be the percentage of input after span and offset are applied (where 100.00% = 10000).
NOTE:The % of analog input after span and offset can be read in parameter I/O39(Vin2 Stat)</td></tr>
<tr><td>101</td><td>High Analog Current Threshold - The active sequencer state lasts until the voltage signal applied to Cin Terminals is > a value programmed into "Seq Count X". The value programmed into "Seq Count X" should be the percentage of input after span and offset are applied (where 100.00% = 10000).
NOTE:The % of analog input after span and offset can be read in parameter I/O39(Vin2 Stat)</td></tr>
<tr><td>110</td><td>Digital Comparison - The active sequencer state lasts until the binary value of digital inputs configured to Seq1, Seq2 and Seq3 is equal to the value programmed into "Seq Count X".
NOTE: "DIx Configure" parameters must be set to "Seq1, Seq2, and Seq3".
<table>
<tr><th colspan="3">Digital Input Terminals</th><th rowspan="2">Description</th></tr>
<tr><th>Seq 1</th><th>Seq 2</th><th>Seq 3</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>No Input active</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Seq 1 active</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Seq 2 active</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Seq 1 & Seq 2 active</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Seq 3 active</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Seq 1 & Seq 3 active</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Seq 2 & Seq 3 active</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Seq 1, Seq 2, Seq 3 active</td></tr>
</table>
</td></tr>
<tr><td>111</td><td>The sequencer will never advance if this option is selected</td></tr>
</table>

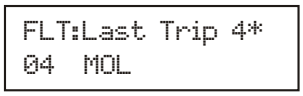
7.3 FLT Group

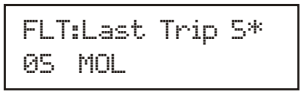
The FLT Group shows the last five faults:











The descriptions of all possible faults can be found in Chapter 8 on page 163: S4 Fault Codes.

Below is a list of values that show what the drives conditions were in when the fault occurred. Press [ENTER] on the keypad when the fault screen is being displayed (above displays) and scroll through the data. The following information is available:

FLT..A- Output Frequency

FLT..B- Drive Load

FLT..C- Drive Status

FLT..D- Drive Warn

FLT..E- Output Volts

FLT..F- Output Curr

FLT..G- Drive Temp

FLT..H- Run Time

FLT..I- Bus Voltage

FLT..J- Adv Flt Code

FLT..K- Ctl Brd Temp

FLT..L- Out Power

FLT..M- Power Time

FLT..N- Inputs

⌘ **NOTE:** Press [MENU] to go back to previous screen.

NOTES

8 Troubleshooting & Maintenance

FAULT REMEDY

8.1 Fault Remedy

Table 20: Fault Remedy

Protective Function	Cause	Remedy
Over Current Protection	1) Acceleration time is too short compared to the inertia of the load. 2) Inverter turns output on when the motor is still rotating. 3) Output short or ground fault has occurred. 4) Mechanical brake of the motor is operating too fast. 5) Components of the main circuit have overheated due to a faulty cooling fan or blocked cooling.	1) Increase Accel time. 2) Operate after motor has completely stopped. 3) Check output wiring. 4) Check mechanical brake operation. 5) Check cooling fan. **(CAUTION)** Operating VFD prior to correcting fault may damage the IGBTs.
Ground Fault Protection	1) Ground fault has occurred at the output wiring of VFD. 2) The insulation of the motor has been damaged.	1) Investigate the output wiring of VFD. 2) Exchange motor.
Over Voltage Protection	1) Deceleration time is too short compared to the inertia of load. 2) Regenerative load at the output. 3) Line voltage high.	1) Increase deceleration time 2) Install Dynamic braking / resistor option 3) Check line voltage
Current Limit Protection (Overload Protection)	1) Load is larger than the VFD rating. 2) Selected incorrect VFD capacity parameter. 3) Selected incorrect V/F pattern.	1) Increase capacity of motor and/or VFD 2) Select correct VFD capacity 3) Select correct V/F pattern
Fuse Damage	1) Damage due to repeated over current protection. 2) Damage due to instant deceleration when motor is at an excessive excitation status.	Exchange the fuse. **(CAUTION)** The IGBTs are often damaged when the Fuse Open Trip occurs and should be tested before returning the drive to service.
Heat Sink Overheat	1) Cooling fan damaged or a foreign substance is blocking fan. 2) Cooling system has faults. 3) Ambient temperature too high.	1) Exchange cooling fans and/or eliminate foreign substance. 2) Check for foreign substances in the heat sink. 3) Keep ambient temperature under 40C.
Electronic Thermal	1) Motor has overheated. 2) Load is larger than VFD rating. 3) TOL (AFN22) level set too low. 4) Incorrect VFD capacity selected. 5) Set incorrect V/F pattern. 6) Motor operated too long at low speeds.	1) Reduce load and/or running duty. 2) Increase VFD capacity. 3) Adjust TOL (AFN22) level to an appropriate level. 4) Select correct VFD capacity. 5) Select correct V/F pattern. 6) Install a cooling fan with a separate power supply.
External Fault	External fault has occurred.	Eliminate fault at circuit connected to external fault terminal or cause of external fault input.
Low Voltage Protection	1) Line voltage low. 2) Load larger than line capacity is connected to line (welding machine, motor with high starting current connected to the commercial line). 3) Faulty magnetic switch at the input side of the VFD.	1) Check line voltage. 2) Increase line capacity. 3) Exchange magnetic switch.

Fault Remedy

IGBT Short	1) Short has occurred between the upper and lower IGBT. 2) Short has occurred at the output of the VFD. 3) Acceleration/Deceleration time is too short compared to the inertia of the load.	1) Check IGBT. 2) Check output wiring of VFD. 3) Increase acceleration or deceleration time.
Inverter Overload	1) Load is larger than VFD rating. 2) Selected incorrect VFD capacity.	1) Increase motor and/or VFD capacity. 2) Select correct VFD capacity.
Magnetic	1) The magnetic contactor malfunctioned.	1) Replace the magnetic contactor.
Contactor Fail	1) The Control Power Transformer (CPT) fuse has opened.	1) Replace the CPT fuse.

TROUBLESHOOTING

8.2 Troubleshooting

Table 22: Troubleshooting

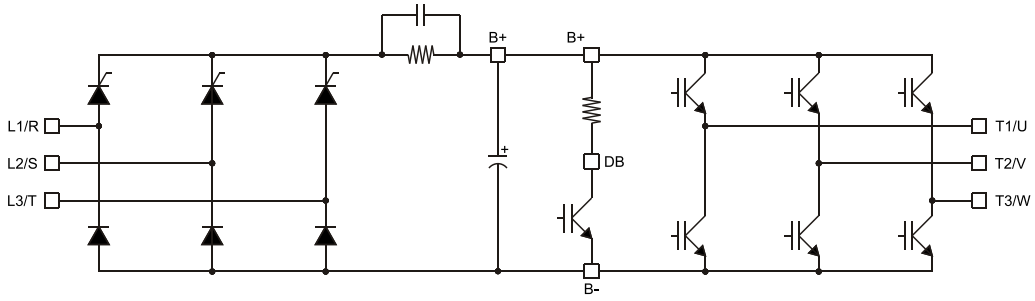
Condition	Check Point
The Motor Does Not Rotate	1) Main circuit inspection: Is the input (line) voltage normal? Is the motor connected correctly? 2) Input signal inspection: Check the operating signal input to the VFD. Check the forward and the reverse signal input simultaneously to the VFD. Check the command frequency signal input to the VFD. 3) Parameter setting inspection: Is the Run Prevention (AFN 19) function set? Is the Run/Stop Source () set correctly? Is the drive enable (EN) terminal input active? Is the command frequency set to 0? 4) Load inspection: Is the load too large or is the motor jammed? Is a mechanical or supplemental brake engaged? 5) Other: Is the alarm displayed on the keypad or is the Stop LED blinking?
The Motor Rotates in Opposite Directions	Is the phase sequence of the output terminal T1/U, T2/V, T3/W correct? Is the starting signal (forward/reverse) connected correctly?
The Difference Between the Rotating Speed and the Reference is Too Large	Is the frequency reference signal correct? (Check the level of the input signal) Are the following parameter settings correct? Minimum Frequency (AFN 03), Maximum Frequency (AFN 04), Analog Input Configuration (I/O 20-26) Is the input signal line influenced by external noise? (Use a shielded wire). Are there skip frequencies programmed?
The VFD Does Not Accelerate or Decelerate Smoothly	Is the acceleration/deceleration time is set too short a period of time? Is the load too large? Is the Torque Boost Configuration (AFN 07-11) set incorrectly?
The Motor Current is Too High?	Is the load too large? Is the Torque Boost Value (see above) too high?
The Rotating Speed Does Not Increase	Is the Maximum Frequency (AFN 04) value correct? Is the load too large?
The Rotating Speed Oscillates When the VFD is Operating.	1) Load inspection: Is the load oscillating? 2) Input signal inspection: Is the frequency reference signal oscillating? 3) Other: Is the wiring too long when the inverter is using V/F control? (Over 500m).

HOW TO CHECK POWER COMPONENTS

8.3 How to check Power Components

Before checking the power components, be sure to disconnect AC Input Supply and wait until the Main Electrolytic Capacitor (B+ - B-) discharges.

Figure 36: S4 Drive



- Diode Module Check

Check Module	Resistance to be Good
R,S,T - B+	50K ohms or more
R,S,T - B-	50K ohms or more

- DB (Dynamic Braking) IGBT

Check Module	Resistance to be Good
DB - B+	See Table 15 on page 39
DB - B-	50K ohms or more

- IGBT Module Check

Check Module	Resistance to be Good
U, V, W – B+	50K ohms or more
U, V, W – B-	50K ohms or more

⌘ **NOTE:** If the drive has been powered-off for more than two years, it is strongly recommended that the drive be sent back to the factory to recondition the electrolytic capacitors.

REPLACING FANS

8.4 Replacing Fans

The fans for the S4 drives are only on the Frame/Size 2 drives and up. Frames 0 and 1 do not have fans. The fans are located on the bottom of the drive and cool off the heatsinks. The fans should be clean from dust, dirt etc. because cooling off the heatsink is essential.

To replace fan, you must unfasten the screws in the four corners of the fan. Frame size 2 drives will have two different and smaller fans, and the frame size 3 drives will have one larger fan.

Frame 2 fans

Frame 3 drive fan

You must now disconnect the fans two wires (B, R) from the J1 terminals. Frame 2 will have a (B and R) connection at the J1 and J9 terminals. There is a grommet that the wires travel through to get to the J1, J9 terminals. This grommet must be loosened so the wires can get out. After installing new fans, this grommet must be tightened.

WARNING: DISCONNECT POWER TO DRIVE BEFORE REPLACING FANS

MAINTENANCE

8.5 Maintenance

Proper operation of the RSi S4 Series of drives can be influenced by temperature, humidity, and vibration. To avoid any possible uncertainty, the drive must be maintained properly by certified personnel.

PRECAUTIONS

8.6 Precautions

- Be sure to remove the drive power input while performing maintenance.
- Be sure to perform maintenance only after checking that the bus has discharged.
- The bus capacitors in the electronic circuit can still be charged even after the power is turned off.
- The correct output voltage can only be measured by using a rectifier voltage meter.
  Other voltage meters, including digital voltage meters, are likely to display incorrect values caused by the high frequency PWM output voltage of the drive.

ROUTINE INSPECTION

8.7 Routine Inspection

Be sure to check the following before operation:

- The conditions of the installation location
- The conditions of the drive cooling
- Abnormal vibration
- Abnormal heating

PERIODICAL INSPECTION

8.8 Periodical Inspection

- Are there any loose bolts, nuts or rust caused by surrounding conditions? If so, tighten or replace them.
- Are there any deposits inside the drive-cooling fan? If so, remove using compressed air.
- Are there any deposits on the drive's PCB (Printed Circuit Boards)? If so, remove using compressed air.
- Are there any abnormalities in the various connectors of the drive's PCB? If so, check the condition of the connector in question.
- Check the rotating condition of the cooling fan, the size and condition of the capacitors and the connections with the magnetic contactor. Replace them if there are any abnormalities.

DAILY AND PERIODIC INSPECTION ITEMS

8.9 Daily and Periodic Inspection Items

Table 23: Daily and Periodic Inspection Items

Inspection Location	Inspection Item	Inspection	Period			Inspection Method	Criterion	Measuring Instrument
			Daily	1 year	2 year			
All	Environment	Is there any dust? 1Is the ambient temperature and humidity adequate?	O			Refer to the precautions	Temperature: -10~+40 no freezing. Humidity: Under 90% no dew	Thermometer, Hygrometer, Recorder
	Equipment	Is there any abnormal oscillation or noise?	O			Use sight and hearing	No abnormality	
	Input Voltage	Is the input voltage of the main circuit normal?	O			Measure the voltage between the terminals L1/R, L2/S, L3/T		Digital Multi-Meter/Tester
Main Circuit	All	Megger check (between the main circuit and the ground) Are any fixed parts removed? Are there any traces of overheating at each component's cleaning?		O O O		None. Consult Factory Tighten the screws. Visual check.	No fault	
	Conductor / Wire	Is the conductor oxidized? Is the wire coating damaged?		O O		Visual check	No fault	
	Terminal	Is there any damage?		O		Visual check	No fault	
	IGBT Module/ Diode Module	Check the resistance between each of the terminals.			O	Undo the VFD connection and measure the resistance between R,S,T and U,V,W with a tester.	(Refer 'How to Check Power Components")	Digital Multi-Meter / Analog Tester
	Smoothing Capacitor	Is there any liquid coming out? Is the safety pin out, and is there any swelling? Measure the capacitance.	O O	O		Visual check. Measure with a capacitance-measuring device.	No fault Over 85% of the rated capacity	Capacitance Measuring Device
	Relay	Is there any chattering noise during operation? Is there any damage to the contact		O O		Auditory check. Visual check	No fault	
	Resistor	Is there any damage to the resistor insulation? Is the wiring in the resistor damaged (open)?		O O		Visual check. Disconnect one of the connections and measure with a tester.	No fault Error must be within 10% the displayed resistance	Digital MultiMeter / Analog Tester
Control Circuit Protective Circuit	Operation Check	Is there any unbalance between each phases of the output voltage? Nothing must be wrong with display circuit after executing the sequence protective operation		O O		Measure the voltage between the output terminals U, V and W. Short and open the VFD protective circuit output.	The voltage balance between the phases for 200V (800V) class is under 4V (8V).The fault circuit operates according to the sequence.	Digital Multi-Meter/ Rectifying Voltmeter
Cooling System	Cooling Fan	Is there any abnormal oscillation or noise? Is the connection area loose?	O	O		Turn OFF the power and turn the fan by hand. Tighten the connections.	Must rotate smoothly. No fault	
Display	Meter	Is the displayed value correct?	O	O		Check the meter reading at the exterior of the panel	Check the specified and management values.	Voltmeter / Ammeter etc.
Motor	All	Are there any abnormal vibrations or noise? Is there any unusual odor?	O O			Auditory, sensory, visual check. Check for overheat and damage.	No fault	
	Insulation Resistor	Megger check (between the output terminals and the ground terminal)			O	Disconnect motor from VFD and short motor leads together.	Over 5MO	500V class Megger

8.10 S4 Fault Codes

Table below shows the fault codes that may be displayed during S4 AC drive operation, along with suggestions for recovering from the fault condition.

When faults occur, you can access the status parameters that are saved along with the fault (Advanced Fault history). To view these parameters, which store the drive's status at the time of the fault, view Fault History, and select Last Fault. Press the Enter key while viewing the last fault, and then use the UP and DOWN arrow keys to scroll through the stored drive status parameters. Press the Menu key again to return to the programming mode fault parameter.

Code	Fault Display	Description	Adv. Fault Code	Explanation	Suggestions for Recovery
1	System	System fault	0, 1, 2	Internal microprocessor problem	Consult factory for repair or replacement
			3	Thermistor profile incorrect	Consult factory for repair or replacement
2	EE Checksum	Checksum error	0	Memory problem when reflashing the drive's memory	- Reset drive to factory settings - Consult factory
			1, 2, 3	Conflict in drive's memory	- Reset drive to factory settings - Consult factory
			4	Unable to write an EE parameter after a parameter has been changed through the keypad or SIO	- Reset drive to factory settings - Consult factory
			5	The drive is receiving EE parameter after a parameter has been changed through the keypad or SIO	Slow down the frequency of Modbus writes
3	Curr Calibr	Current calibration fault	0	Current calibration fault on phase T1/U	- Check the motor connections to the terminal strip of the drive and at the motor - Have motor checked - Consult factory for repair or replacement of drive
			1	Current calibration fault on phase T2/V	
			2	Current calibration fault on phase T3/W	
4	Power Supp	Power supply fault	0	5V supply is below 4Vdc for more than 100ms	- Increase resistance between REF and analog inputs - Check wiring to REF terminals - Consult factory
6	IOC Trip	Instantaneous overcurrent trip	0	Short circuit was detected on power-up	- Remove the short from the power wiring - Check for shorted motor - Consult factory
7	MOL	MOL contact fault	0	The MOL digital input was activated, depending on pull-up or pull-down logic configuration	Reset MOL contact or remove condition causing the MOL contact activation
8	Model ID	ID # out of range	0, 1, 2	Control board is not reading the drive ID properly	Consult factory for repair or replacement
10	Res Lockout	Restart lockout	0	The number of fault restarts is greater than the limit defined in FUN 24	Check the actual fault in the fault log and use the appropriate remedy

11	Ground	Ground fault	0	The drive has detected current imbalance between output phases. Imbalance determined to be current flow to ground	- Check for unbalanced current - Check for grounded motor leads or motor - Consult factory
12	Vac Imblnce	Input voltage imbalance	0	The drive has detected a single-phase condition or a voltage imbalance outside the drive's rating while running a load that could be damaging to the drive	- Check input voltage and current for imbalance, and correct
13	OverVoltage	Overvoltage condition	0	The drive has detected an overvoltage condition during a running condition	- Verify incoming line power is within specification. Add reactor or transformer to correct
			1, 3	The drive has detected an overvoltage condition during a running condition	- Verify incoming line power and check for regenerative load. Reduce Regen load or add dynamic braking resistors. Regen Current Limit may help - Consult factory
			2	The drive has detected an overvoltage condition on power-up	- Verify incoming line power is within specification. Add reactor or transformer to correct
15	Dyn Brake	Dynamic brake overload	0	The DB circuit is active on power-up (not auto-resettable)	- Check for failed braking transistor - Consult factory
			1	The DB circuit is being activated for too long, possibly causing the resistor to overheat or fail	- Reduce braking cycle or increase capacity. Activate current limit - Consult factory
			2	The DB circuit is overloaded because of too large a regenerative load	- Reduce braking cycle or increase capacity. Activate current limit - Consult factory
			3, 4, 5	The DB circuit is faulty on power-up (not auto-resettable)	
18	OverCurrent	Overcurrent condition	0	The drive sensed an overcurrent condition on power-up (not auto-resettable)	- Check for failed output power device or shorted motor
			1	The drive sensed an overcurrent condition during operation. The current has exceeded the safe operation point of power devices	- Reduce load on motor. - Verify that Motor FLA is programmed correctly - Check for mechanical binding and shock loading
19	Over Temp	Over temperature condition	0	The temperature of the heatsink exceeded a temperature limit	- Check that ambient temperature does not exceed drive's rating - Check for fan operation (assuming drive has fans installed)
			1	The temperature of the control board exceeded a temperature limit	- Check that ambient temperature does not exceed drive's rating - Check for fan operation (assuming drive has fans installed)
			2	The drive sensed the heatsink thermistor sensor is faulty or not connected properly	- Check thermistor connections or replace - Consult factory
			3	The drive sensed the control board thermistor sensor is faulty or not connected properly	Check thermistor connections or replace - Consult factory

20	Motor TOL	Motor timed overload trip	0	The drive detected an overload that exceeds the customer's defined overload setting	- Check load current demand - Verify Motor FLA is programmed to the correct value - Verify TOL characteristic is correct for the application
21	Low Temp	Low temperature	0	This fault occurs if the temperature of the heatsink falls below -10.0 degrees C	- Verify that ambient temperature is within the drive's specs - Increase the ambient temperature if necessary
22	Ref Loss	Speed reference loss	0	The drive detected the analog input was configured to fault if the input current went below the level specified by customer parameters	- Check physical connections for reference signal - Check that programming for 4-20 mA signal is correct - Verify that signal to the drive is correct
23	Brk Wire	Broken wire detection	0	The drive detected that the potentiometer circuit wiring opened and generated a fault	- Check wiring for loss of connection to control terminals - Check that a proper-value potentiometer is installed
24	Keypad Loss	Keypad loss	0	This fault occurs because of a problem with the keypad or a keypad connection. It occurs if the drive detects that it cannot read any key presses	- Check the connection from keypad to control board. Note that they keypad is not designed for remote mounting
			1	This fault occurs because of a problem with the keypad, a keypad connection, or the wrong keypad is being used. It occurs if the keypad ID for an S4 cannot be read	
			2	This fault occurs because of a problem with the keypad or a keypad connection. It occurs if the drive detects that it cannot write to the LCD	
25	Comm Loss	Communication loss	0	This fault occurs when the drive is in a serial link control path and the amount of time since the last Modbus comm. exceeds the time set in parameter **I/O 49**	- Check connections to the Modbus port. Adjust value of parameter **I/O 49** as needed
26	Regen Time	Regen timeout	0	This fault occurs if the drive takes more time to decelerate to a stop than is allowed. The timeout is determined by the longest deceleration ramp time (Decel 1 or Decel 2) plus the Regen Timeout parameter	- Reduce the amount of regenerative energy or increase the Regen timeout parameter
27	Pwr Bridge	Power bridge fault	0, 1, 2	The drive detected a failure in the output power devices	- Check for failed input power device
28	Drive TOL	Drive timed overload	0	The drive sensed an overload that exceeded the drive rating	- Check for stuck keypad and repair or replace - Consult factory
29	Stuck Key	Stuck key error	0	This fault occurs if a key press is detected upon power-up. This would occur because of a defective keypad or because someone was holding down a key when powering-up the drive	- Check for stuck keypad and repair or replace - Consult factory

30	Param Range	Parameter out of range	0	One of the customer parameters is out of range	- Check for a parameter value saved out of the standard range - Reset parameters to factory default - Consult factory
31	Pwr Wiring	Power wiring error	0	This fault flags a problem with the drive wiring	- Check that input power wiring is not connected to load power terminals - Consult factory
			1	This fault can occur if an IOC fault is detected during the power wiring test	
32	Low Voltage	Low voltage trip	0	This fault occurs if a power dip occurs when the drive is operating, and the drive is not able to ride through the power dip before shutting off outputs	- Verify that input line power is within the drive's specifications - Add a transformer or reduce demands to power feed - Consult factory
33	1Ph Overload	1Ph overload	0	If the user configures parameter **AFN 28** for single-phase operation, this fault occurs if the bus voltage ripple is outside the limit of the drive	- Check that input power demand does not exceed the drive's capacity for single-phase operation - Consult factory
34	RS Meas. Fail	Stator resistance measurement failed	0	If the drive cannot measure the stator resistance properly, this fault occurs	- Try the routine again and if the fault occurs twice, consult the factory
35	Fan Loss	Loss of fan control or operation	0	There is a problem with the heat sink fan	- Consult Factory
			1	There is a problem with the internal fan. This occurs only on Size 4 and 5 models. All other models display a fan error warning. Note that this is a lack of fan control, so the fan can be spinning and this fault will still occur. This can happen if the fan is on and should not be, or if the fan feedback signals are obstructed from getting to the control board.	

⌘ **NOTE:** Shaded faults are auto-resettable, except where noted.

9 Motor Characteristics

MOTOR CHARACTERISTICS

9.1 Motor Characteristics

Listed below are some variable speed AC motor control concepts with which the user of the RSi S4 Drive should become familiar with. Motor production methods may cause minor differences in the motor operation. The negative effects of these differences may be minimized by using the Autotune feature of the RSi S4.

9.1.1 Motor Autotuning

Autotuning is a function of the RSi S4 that automatically measures several parameters of the connected motor and places these readings in a stored table every time the VFD is started. The software uses the information in the table to help optimize the response of the VFD to application-specific load and operational requirements. The Autotuning function is enabled via , AFN 11 (Autotune) being set to "Motor RS". Once set, the "FWD" button must be pressed so the drive can measure the RS value of the motor. The drive applies a DC pulse for approx. 2 seconds to calculate the RS values. This new value will be kept in AFN 10 (Motor RS) until you re-autotune. You must re-autotune the drive if you switch motors and use the "Vector" in FUN 02 (Torque Curve)..

When FUN 02 (Torque Curve) is set to "Vector", the drive will execute a motor autotune. This means that the user must press "FWD" after switching to "Vector" so the motor can perform an autotune. After pressing "FWD" once to calculate the motor RS, the drive will be ready to run and will start up the second time you press "FWD".

The measured parameters include the rotor resistance, the stator resistance, the required excitation inductance, rotational inertia values, and inductive leakage values.

9.1.2 Pulse Width Modulation Operation

The RSi S4 drive uses a sinusoidal Pulse Width Modulation (PWM) control system. The output current waveform generated by the VFD approaches that of a perfect sine wave; however, the output voltage waveform is slightly distorted. For this reason, the motor may produce more heat, noise, and vibration when operated by a VFD, rather than other starting methods such as a soft starter.

9.1.3 Low Speed Operation

Operating a general-purpose motor at lower speeds may cause a decrease in the cooling ability of the motor. Reducing the torque requirement of the motor at lower speeds will decrease the generated heat at lower speeds.

When the motor is to be operated at low speeds (less than 50% of full speed) and at the rated torque continuously, an inverter-grade motor (designed for use in conjunction with a inverter) is recommended. When the VFD is used with an inverter grade motor, the overload (TOL Select - AFN22) of the VFD must be set to "inverter duty".

9.1.4 Overload Protection Adjustment

The RSi S4 drive software monitors the system current and determines when an overload condition occurs. The overload current level is a percentage of the rated system current. This function protects the motor from overload.

The default setting for the overload detection circuit is set to the maximum rated current of the VFD at the factory. This setting will have to be adjusted to match the rating of the motor with which the VFD is to be used. To change the overload reference level, refer to AFN 22 (Time OL) and I/O 07 (MOL Config).

9.1.5 Operation Above Base Frequency (50/60Hz)

A motor produces more noise and vibration when it is operated at frequencies above 60Hz. Also, when operating a motor above 60 Hz, the rated limit of the motor or its bearings may be exceeded; this may void the motor warranty.

Contact the motor manufacturer for additional information before operating the motor above 60 Hz.

9.1.6 Power Factor Correction

DO NOT connect power factor correction capacitors or surge absorbers to the output of the VFD. Doing so may cause damage to the VFD that is not covered under warranty.

If the VFD is used with a motor that is equipped with a capacitor for power factor correction, remove the capacitor from the motor.

Connecting either of these devices to the output of the VFD may cause the VFD to malfunction and trip, or the output may cause an over-current condition resulting in damage to the device or the VFD.

9.1.7 Light Load Conditions

When a motor is operated under a continuous light load (i.e., at a load of less than 50% of its rated capacity) or it VFDs a load which produces a very small amount of inertia, it may become unstable and produce abnormal vibration or trips because of an over-current condition. In such a case, the carrier frequency may be lowered to compensate for this condition, see AFN 05-06 (Carrier Frequency Configuration).

9.1.8 Motor Load Combinations

When the VFD is used in combination with one of the following motors or loads, it may result in unstable operation.

- A motor with a rated capacity that exceeds the motor capacity recommended for the VFD.
- An explosion-proof motor.

  When using the VFD with an explosion-proof motor or other special motor types, lower the carrier frequency to stabilize the operation. **DO NOT** set the carrier frequency below 2.2kHz if operating the system in the vector control mode.

- If the motor that is coupled to a load has a large backlash or a reciprocating load, use one of the following procedures to stabilize its operation.
  - Adjust the Ramp Shape settings,
  - Switch to the Constant Torque control mode.

⌘ **NOTE:** Consult motor manufacturer for operation on a VFD

9.1.9 Load Produced Negative Torque

When the VFD is combined with a load that produces negative torque, the over-voltage or over-current protective function of the display may cause the VFD to trip.

To minimize the effects of negative torque a dynamic braking system may be used. The dynamic braking system uses a braking resistor that must be suitably matched to the load.

The RSi S4 is equipped with a light-duty internal braking resistor which is sized appropriately for most applications. If you require constant braking torque or faster stop times, a larger external braking resistor may be required.

9.1.10 Motor Braking

The motor may continue to rotate and coast to a stop after being shut off due to the inertia of the load. If an immediate stop is required, a braking system should be used.

NOTES

10 Options

OPTIONS

10.1 Options

10.1.1 Standard Keypad Kits (for remote mounting)

The standard keypad is available for remote mounting use in your applications (maximum 2m or 6 feet).

VFD-RSI-S4-REMOTEKEYPAD – S4 Remote Keypad
VFD-2M-RE-CABLE-S4 – Ribbon Cable for S4

VFD-XFBPANKEYPADS0 – Blanking Plate for Size 0 and 2 VFD's
VFD-XFBPANKEYPADS1 – Blanking Plate for Size 1 VFD's
VFD-XFBPANKEYPADS3 – Blanking Plate for Size 3, 4 and 5 VFD's

10.1.2 IOC02 Protocol Converter

This product converts RS-232 protocol to RS-485 protocol.

10.1.3 Reflash Tool

The Reflash Tool allows you to upgrade the firmware of the RSi S4 Sensorless Vector Drive. This allows the latest features to be implemented in existing hardware. For more information on this capability, refer to the Benshaw document titled "Reflash Procedures for the RSi S4 Sensorless Vector Drive".

10.1.4 Dynamic Braking Units

To augment the braking capacity of the RSi S4 drive, consult factory.

10.1.5 Fins Out Kit

The Fins Out Kit allows you to mount the fins outside a host enclosure **(Only on Frame 3,4,5)**.

For Frames **0,1,2** Consult Factory.

11 Appendices

EU DECLARATION OF CONFORMITY

11.1 APPENDIX A: EU DECLARATION OF CONFORMITY

Product Category:	Motor Controller
Product Type:	(VFD) Variable Frequency Drives
Model Number:	RSi S4
Manufacturer's Name:	Benshaw, Inc.
Manufacturer's Address:	1659 East Sutter Road Glenshaw, PA 15116 United States of America

The before mentioned products comply with the following EU directives and Standards:

Low Voltage Directive:	EN50178 - Electronic equipment for use in power installations
Electromagnetic Compatibility:	EN61800-3 - Adjustable speed electrical power systems - Part 3: EMC product standard including specific test methods

The products referenced above are for the use of control of the speed of AC motors. For application information, consult the following document from Benshaw: Form 1346. The use in residential and commercial premises (Class B) requires an optional RSi LF series filter. Via internal mechanisms and Quality Control, it is verified that these products conform to the requirements of the Directive and applicable standards.

Glenshaw, PA USA - 1 September 2007

Neil Abrams
Quality Control
Manager

11.2 APPENDIX B: REMOTE COMMUNICATION

The RSi S4 drive provides a serial link to support remote communication. The serial link supports ASCII or RTU communication utilizing Modbus protocol. Modbus (I/O 45, 46, 47, 48 and 49) are supported by the RSi S4 drive.

The communication interface is RS-485, and allows up to 247 followers to be connected to one master (with repeaters when the number of drops exceeds 31). Please refer to the figure below for connection diagrams.

The figure below shows the pinout for the RJ45 connector on the bottom of the Terminal Strip Processor Card. An RJ45 male connector may be attached here to connect the RSi S4 drive to a ModBUS-485 Network. If the drive is the end of a cable, a 120 , 1/4 resistor may be required.

Figure 37: RJ45 Connector

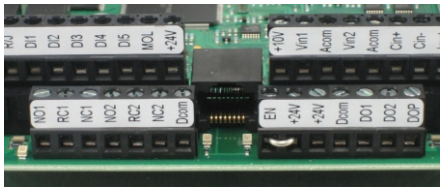
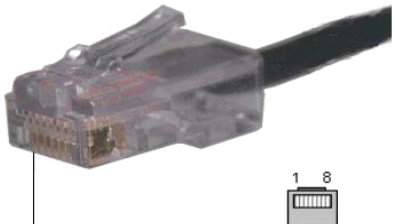


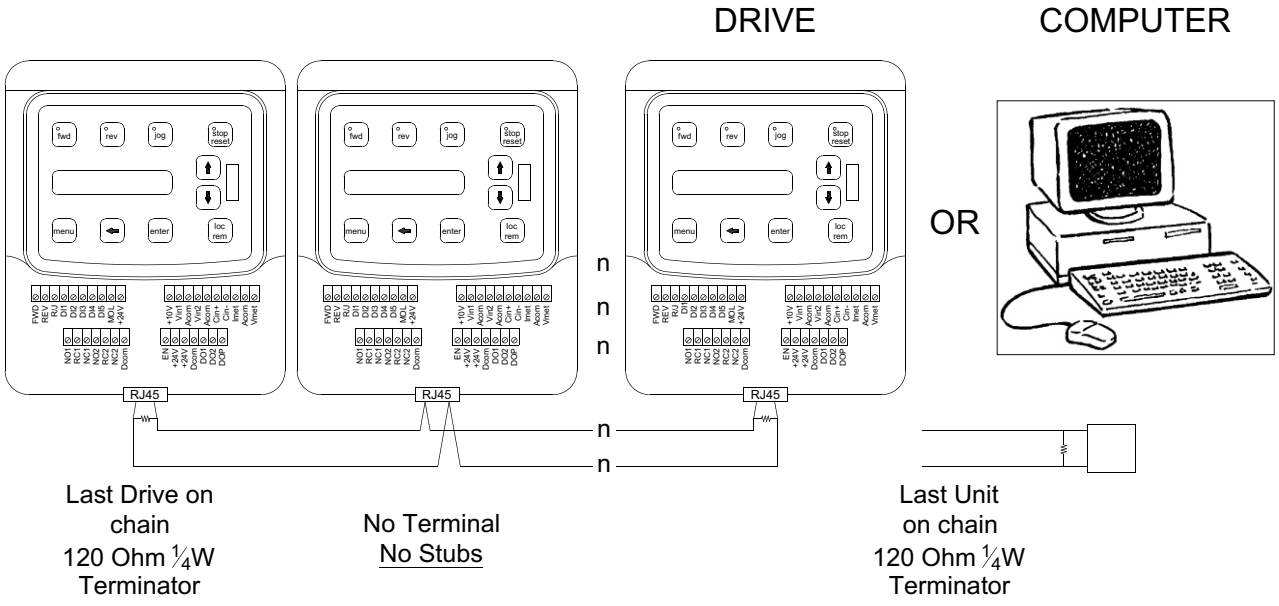
Figure 38: RS-485 pin connections

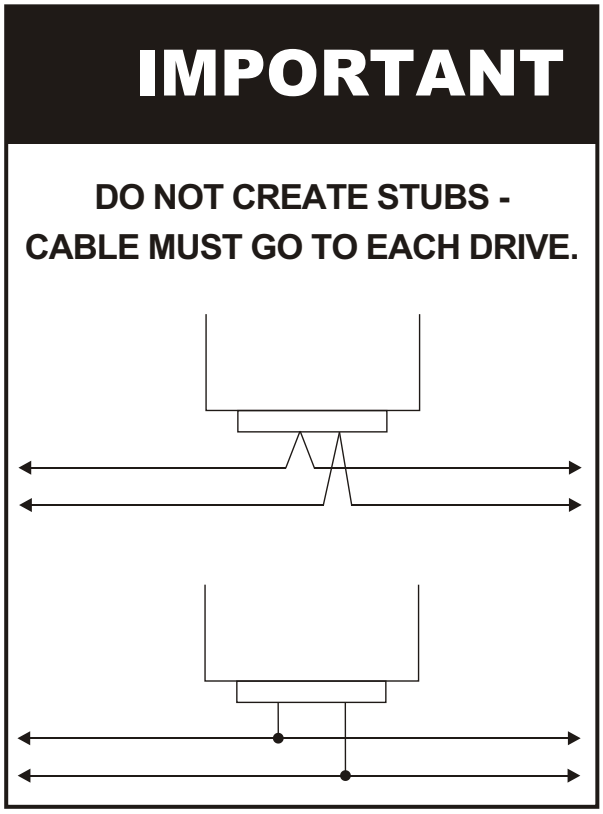
S4 RS-485 Connector (Modbus) Pin-out



Pin Number	Signal
1	+24 Vdc
2	NC
3	SIO+
4	NC
5	NC
6	SIO-
7	Ground
8	Ground

Figure 39: Connection Diagram for Remote Communication





11.2.1 Configuring of the Serial Link

The Advanced Function parameter group contains the parameters that govern the baud rate, watchdog timer, and protocol selection for the serial interface.

All addresses from 1 to 247 are allowed for RSi S4 drives. Address 0 is a broadcast address understood by all drives; however, no reply is returned for messages sent to this address.

11.2.2 Parameter Addresses

Each parameter is assigned a unique memory address to permit easy reading and configuration. Chapter 6 and 7 lists all RSi S4 parameters and the memory address assigned to each under the Modbus heading.

11.2.3 RSi S4 VFDs

RSi S4 VFDs can be controlled remotely via Modbus in the standard product, and via other fieldbusses with optional communications cards. The bits in Control Word 1 and Control Word 2 are used to control various aspects of the drive's operation, and the bits in Status Word 1 and Status Word 2 are used to communicate drive status back to the controlling computer.

Figure 40: Control Word 1 (ModBUS Address 40904)

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

Bit	Meaning	Bit	Meaning
15	*Reserved*	7	Preset Input 3 (PS3)
14	Ref Switch	6	Preset Input 2 (PS2)
13	CTS	5	Preset Input 1 (PS1)
12	DCI	4	FEXT2
11	Curr Lim	3	Reverse
10	Not Used	2	Forward
9	PI Enable	1	SLF (Ref)
8	Alt Ramp	0	SLC (Run)

Ext Ref Freq 1 & 2

These parameters provide access for changing the frequency reference over the serial link. Freq 2 is an alternate access for changing frequency.

Table 24: Control Word 1 Bit Description

Bit	Description
Bit 15	Reserved. This bit must be maintained at a logic '0' for proper drive operation.
Bit 14	Ref Switch
Bit 13	CTS
Bit 12	The drive will start injecting DC current into the motor when set to a 1, and will stop when this bit is cleared.
Bit 11	Curr Lim
Bit 10	Not Used
Bit 9	PI Enable
Bit 8	Ramp Select 00 - Main Ramp is selected. 01 - Alternate Ramp 1 is selected.
Bit 7-5	Preset Speed Selection. These bits work in the same manner as the PS1-3 digital inputs. Please refer to I/O 20-26 for more information about the preset speed selection.
Bit 4	FEXT2
Bit 3-2	Start/Stop (bit 3, 2) 00 - Stop 01 - Forward 10 - Reverse 11 - Forward (Forward has priority) **Note:** (Run/Stop Setting) must be set to "Serial" for these bits to have any effect.
Bit 1	Serial Speed Reference Select. If set to '0' the frequency speed reference comes from External Frequency Reference 1. If set to '1' the frequency speed reference comes from External Frequency Reference 2. Please refer to the end of this section for the description of these registers. **Note:** (Ref Source) and/or (Alt. Ref Src) must be set to "Serial" for this bit to have any effect.
Bit 0	Serial link Control (Run)

Status Word 1

Figure 41: Status Word 1 (ModBUS Address 40908)

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

Bit	Meaning	Bit	Meaning
15	*reserved*	7	*reserved*
14	Zero Speed	6	Decel
13	Jogging	5	Accel
12	DCI	4	FEXT2
11	Curr Lim	3	REV run
10	Remote	2	FWD run
9	SL Override	1	SLF (Ref)
8	Alt Ramp	0	SLC (Run)

11.2.4 Motor Operation from Serial Link

In order to allow the serial link to move the motor, the drive must be configured to accept start/stop control and/or frequency reference commands from the serial link. This is accomplished by setting DRV04 (Drive Mode 1) and/or DRV05(Frequency Mode 1) to "Serial". All other functions in the control words are available at all times.

11.2.5 Frequency Reference from Serial Link

In order to allow the serial link to set the frequency reference, the drive must be configured to accept the frequency reference from the serial link. This is accomplished by setting DRV05 (Freq Mode 1) or DRV07 to "Serial".

There are two serial frequency references available on the RSi-S4 drive. Freq Mode 1 is at the Modbus address 40005 and Freq Mode 2 is at 40007. Both of these registers accept a value from 0 to the max freq (see AFN04-Max Freq on page 121), times 100. Ex. writing a value of 4050 to one of these registers would command a reference frequency of 40.50Hz. The active serial frequency reference is controlled by bit 4 of Control Word. See the table "Control Word 1 Bit Descriptions" on page 177.

11.3 APPENDIX C: S4 Parameter Groups

11.3.1 DRV Group

Code	Parameter Name	Default	Range (Options)	Modbus	View Only	Page	User Setting
DRV 01	Nom Mtr Amps	Nominal for Drive	Model Dependant	40001		76	
DRV 02	Accel Time 1	5.0 sec	0.1 - 3200.0 sec	40002		77	
DRV 03	Decel Time 1	5.0 sec	0.1 - 3200.0 sec	40003		77	
DRV 04	Drive Mode 1	0="Keypad"	0="Keypad" 1="Terminal 1" 2="Terminal 2" 3="Serial"	40004		78	
DRV 05	Freq Mode 1	0="Keypad"	0="Keypad" 1="Vin1" 2="Cin" 3="Vin2" 4="Vin1 6FS" 5="Vin1 48FS" 6="Vin1+Cin" 7="Vin1+Vin2" 8="Vin1-Cin" 9="Vin1-Vin2" 10="Vin1+k*Cin" 11="Vin1+k*Vin2" 12="Max Input" 13="EMOP" 14="Serial"	40005		79	
DRV 06	Drive Mode 2	2="Terminal 2"	0="Keypad" 1="Terminal 1" 2="Terminal 2" 3="Serial"	40006		79	
DRV 07	Freq Mode 2	1="Vin1"	0="Keypad" 1="Vin1" 2="Cin" 3="Vin2" 4="Vin1 6FS" 5="Vin1 48FS" 6="Vin1+Cin" 7="Vin1+Vin2" 8="Vin1-Cin" 9="Vin1-Vin2" 10="Vin1+k*Cin" 11="Vin1+k*Vin2" 12="Max Input" 13="EMOP" 14="Serial"	40007		80	
DRV 08	Output Curr.	Read-Only	0.0 to 999.9 A	40008	X	80	
DRV 09	Output Volts	Read-Only	0 to 1000 V	40009	X	80	
DRV 10	Output Power	Read-Only	0.0 to 655.35 kW	40010	X	80	
DRV 11	MWh Meter	Read-Only	0 to 32767 MWh	40011	X	81	
DRV 12	kWh Meter	Read-Only	0.0 to 999.9 kWh	40012	X	81	
DRV 13	Run Time	Read-Only	0.0 to 6553.5 h	40013	X	81	
DRV 14	Power Time	Read-Only	0 to 65535 h	40014	X	81	
DRV 15	Output Freq	Read-Only	0.0-400.0 Hz	40015	X	81	
DRV 16	Drive Load	Read-Only	-250.0 to 250.0 %	40016	X	82	
DRV 17	Drive Temp	Read-Only	-20.0 to 125.0 Celcius	40017	X	82	
DRV 18	Bus Voltage	Read-Only	0 to 1000 Vdc	40018	X	82	

Code	Parameter Name	Default	Range (Options)	Modbus	View Only	Page	User Setting
DRV 19	Stator Freq	Read-Only	0.0 Hz	40019	X	82	
DRV 20	Load Torque	Read-Only	-250.0 to 250.0 %	40020	X	83	
DRV 21	SW Manual	Read-Only		40021	X	83	
DRV 22	Drive Model	Read-Only	1 - single phase 120VAC "RSi001S4-1" 2 - three phase 240VAC "RSi001S4-2" to "RSi030S4-2" 4 - three phase 460VAC "RSi001S4-4" to "RSi200S4-4" 6 - three phase 600VAC "RSi001S4-6" to "RSi200S4-6"	40022	X	83	

11.3.2 FUN Group

Code	Parameter Name	Default	Range (Options)	Modbus	View Only	Page	User Setting
FUN 00	Jump Code						
FUN 01	Nom Mtr Volt	Model Dependant	Model Dependant	40101		84	
FUN 02	Torque Curve	1="Linear Fxd"	0="Linear Auto" 1="Linear Fxd" 2="Pump Fxd" 3="Fan Fxd" 4="Linear 2pc" 5="Vector"	40102		84	
FUN 03	Start Mode	0="LS Lockout"	0="LS Lockout" 1="AutoStart" 2="LSL w/Fly" 3="Auto w/Fly"	40103		85	
FUN 04	EMOP Config	0="TS no Mem"	0="TS no Mem" 1="TS Mem" 2="T/K Mem" 3="TS Stp" 4="TS Mem Stp" 5="T/K Mem Stp"	40104		86	

Code	Parameter Name	Default	Range (Options)	Modbus	View Only	Page	User Setting
FUN 05	DB Config	1="DB Internal"	0="No Dyn Brk" 1="DB Internal" 2="DB External" 3="Int-ARCTIC"	40105		87	
FUN 06	DC Inj Cfg	0="DC at Stop"	0="DC at Stop" 1="DC at Start" 2="DC at Both" 3="DC on Freq"	40106		88	
FUN 07	DC Inj Freq	0.0Hz	0.0 to 20.0 Hz	40107		88	
FUN 08	DC Inj Time	0.2 sec	0.0 to 60.0 s	40108		89	
FUN 09	DC Inj Lvl	50.00%	0.0 to 100.0 %	40109		89	
FUN 10	Curr Lim Sel	0="Fixed Lvls"	0="Fixed Lvls" 1="Vin2" 2="Cin" 3="Vin2 Motor" 4="Cin Motor" 5="Vin2 F-Mtr" 6="Cin F-Motor"	40110		90	
FUN 11	Curr Lim M/F	120%	5 to 200 %	40111		90	
FUN 12	Curr Lim M\R	120%	5 to 200 %	40112		91	
FUN 13	Curr Lim R/F	80%	5 to 200 %	40113		91	
FUN 14	Curr Lim R\R	80%	5 to 200 %	40114		91	
FUN 15	Curr Lim Frq	3.0Hz	0.0 to 400.0 Hz	40115		92	
FUN 16	Ramp Time CL	1.0 sec	0.1 - 3200.0 sec	40116		92	
FUN 17	Curr Lim Min	10%	0 - 50%	40117		92	
FUN 18	Reg Time-Out	300%	100% to 1000%	40118		93	
FUN 19	Skip Frq Bnd	0.2Hz	0.2 - 20.0Hz	40119		93	
FUN 20	Skip Freq 1	0.0Hz	0.0 - 400.0 Hz	40120		94	
FUN 21	Skip Freq 2	0.0Hz	0.0 - 400.0 Hz	40121		94	
FUN 22	Skip Freq 3	0.0Hz	0.0 - 400.0 Hz	40122		94	
FUN 23	Skip Freq 4	0.0Hz	0.0 - 400.0 Hz	40123		94	
FUN 24	Fault LO #	0	0 to 8	40124		94	
FUN 25	Auto Rst Tm	60.0 s	0 to 60.0 s	40125		94	
FUN 26	Curr Level 1	0%	0 to 200 %	40126		95	
FUN 27	Curr Level 2	0%	0 to 200 %	40127		95	
FUN 28	Torque Lvl 1	0%	0 to 200 %	40128		95	
FUN 29	Torque Lvl 2	0%	0 to 200 %	40129		95	
FUN 30	Freq Level 1	0.0Hz	0.0 - 400.0 Hz	40130		95	
FUN 31	Freq Level 2	0.0Hz	0.0 - 400.0 Hz	40131		95	
FUN 32	Freq Level 3	0.0Hz	0.0 - 400.0 Hz	40132		95	
FUN 33	Low Freq Thr	0.0Hz	0.0 - 400.0 Hz	40133		96	
FUN 34	Timer 1 Type	0="On Delay"	0="On Delay" 1="Off Delay" 2="On/Off Delay"	40134		96	
FUN 35	Timer 1 Time	1.0 s	0.0 to 320.0 s	40135		96	
FUN 36	Timer 2 Type	0="On Delay"	0="On Delay" 1="Off Delay" 2="On/Off Delay"	40136		97	

FUN 37	Timer 2 Time	1.0 s	0.0 to 320.0 s	40137		97	
FUN 38	Status Field	0="Drive Load"	0="Drive Load" 1="Output Curr" 2="Out Volt" 3="Drive Temp" 4="% of FLA" 5="Out Power"	40138		97	
FUN 39	Password	0	0 to 999	40139		98	
FUN 40	Display Mode	0="Std Disply"	0="Std Disply" 1="Output Freq" 2="Stator Freq" 3="User Units" 4="RPM Units" 5="GPM Units" 6="FPM Units" 7="MPM Units" 8="PSI Units" 9="Degrees C" 10="Degrees F" 11="Time hrs" 12="Time min" 13="Time sec" 14="Fbk RPM" 15="Fbk PSI" 16="Fbk GPM" 17="Fbk User"	40140		98	
FUN 41	Units Scale	18000	1 to 65535	40141		99	
FUN 42	Units	"RPM-1"	Alpha-Numeric	40142		99	

11.3.3 I/O Group

Code	Parameter Name	Default	Range (Options)	Modbus	View Only	Page	User Setting
I/O 00	Jump Code						
I/O 01	Active Logic	1="Active High"	0="Active Low" 1="Active High"	40301		100	
I/O 02	DI1 Config	1="Preset 1"	0="Not Assign" 1="Preset 1" 2="Preset 2" 3="Preset 3" 4="Coast Stop" 5="DC Inject" 6="DRV/Frq Set" 7="Alt Ramp" 8="Fault Reset" 9="EMOP+" 10="EMOP-" 11="PID Disable" 12="Cur Lim Dis" 13="SL Override" 14="FLY Dis" 15="CurLimIMax" 16="Jog Fwd" 17="Jog Rev" 18="NO MOL" 19="NC MOL" 20="Timer 1" 21="Timer 2" 22="Seq 1" 23="Seq 2" 24="Seq 3" 25="Seq Dwell" 26="Seq Advance"	40302		101	
I/O 03	DI2 Config	2="Preset 2"		40303			
I/O 04	DI3 Config	3="Preset 3"		40304			
I/O 05	DI4 Config	6="DRV/Frq Set"		40305			
I/O 06	DI5 Config	8="Fault Reset"		40306			
I/O 07	MOL Config	18="NO MOL"		40307			

Code	Parameter Name	Default	Range (Options)	Modbus	View Only	Page	User Setting
I/O 08	DO1 Config	4="Drv Ready"	0="Not Assign" 1="Drive Run" 2="Running Fwd" 3="Running Rev" 4="Drv Ready" 5="At Speed" 6="Drv Fault" 7="Drv NotFlt" 8="Kpd in Ctl" 9="Drv in Rem" 10="Jogging" 11="Curr Lvl 1" 12="Curr Lvl 2" 13="Trq Lvl 1" 14="Trq Lvl 2" 15="Frq Lvl 1" 16="Frq Lvl 2" 17="Frq Lvl 3" 18="Current Lim" 19="Loss Ref" 20="SL in Ctrl" 21="SL Override" 22="Zero Speed" 23="Frq Low Th" 24="PID High" 25="PID Low" 26="Timer 1" 27="Timer 2" 28="SeqOut-00" 29="SeqOut-01" 30="SeqOut-10" 31="SeqOut-11" 32="ARCTIC Mode"	40308		103	
I/O 09	DO2 Config	5="At Speed"		40309			
I/O 10	R1 Config	6="Drv Fault"		40310		104	
I/O 11	R2 Config	1="Drive Run"		40311			
I/O 12	Jog Speed	5.0 Hz	0.0 - 400.0 Hz	40312		105	
I/O 13	Preset Spd 1	5.0 Hz	0.0 - 400.0 Hz	40313		106	
I/O 14	Preset Spd 2	10.0 Hz	0.0 - 400.0 Hz	40314			
I/O 15	Preset Spd 3	20.0 Hz	0.0 - 400.0 Hz	40315			
I/O 16	Preset Spd 4	30.0 Hz	0.0 - 400.0 Hz	40316			
I/O 17	Preset Spd 5	40.0 Hz	0.0 - 400.0 Hz	40317			
I/O 18	Preset Spd 6	50.0 Hz	0.0 - 400.0 Hz	40318			
I/O 19	Vin1 Config	“0-10V”	0="0-10V" 1="0-10V Brk W" 2="0-10V I" 3="0-10V Bipol" 4="0-5V" 5="0-5V I" 6="0-20mA 250" 7="0-20mA 250I" 8="4-20mA 250" 9="4-20mA 250I" 10="PT 0-1kHz" 11="PT 0-10kHz" 12="PT 0-100kHz"	40319		107	
I/O 20	Vin1 Span	100.00%	10.0 to 200.0%	40320		108	
I/O 21	Vin1 Offset	0	0.0 to 100.0%	40321		108	
I/O 22	Vin1 Filter	15 ms	1 to 1000 ms	40322		108	
I/O 23	Cin Config	2="0-20mA 50"	0="4-20mA 50" 1="4-20mA 50I" 2="0-20mA 50" 3="0-20mA 50I"	40323		109	
I/O 24	Cin Span	100.00%	10.0 to 200.0%	40324		109	

Code	Parameter Name	Default	Range (Options)	Modbus	View Only	Page	User Setting
I/O 25	Cin Offset	0	0.0 to 100.0%	40325		110	
I/O 26	Cin Filter	15 ms	1 to 1000 ms	40326		110	
I/O 27	Vin2 Config	0="0-10V"	0="0-10V" 1="0-10V Brk W" 2="0-10V I" 3="0-10V Bipol" 4="0-5V" 5="0-5V I"	40327		110	
I/O 28	Vin2 Span	100.00%	10.0 to 200.0%	40328		111	
I/O 29	Vin2 Offset	0	0.0 to 100.0%	40329		111	
I/O 30	Vin2 Filter	15 ms	1 to 1000 ms	40330		112	
I/O 31	Set k-Factor	0.0%	0.0%-100.0%	40331		112	
I/O 32	Vmet Config	1="Out Freq"	0="Not Assign" 1="Out Freq" 2="Out Torque" 3="Out Volt" 4="Out Power" 5="Ref Freq" 6="PID Fback" 7="Bus Voltage" 8="Output Curr"	40332		112	
I/O 33	Imet Config	2="Out Torque"		40333			
I/O 34	Vmet Span	100.0%	0.0 - 200.0%	40334		113	
I/O 35	Imet Span	100.0%	0.0-200.0%	40335		113	
I/O 36	Imet Offset	0.0%	0.0-90.0%	40336		114	
I/O 37	Vin1 Status	Read-Only	0.00 to 100.00%	40337	X	114	
I/O 38	Cin Status	Read-Only	0.00 to 100.00%	40338	X	114	
I/O 39	Vin2 Status	Read-Only	0.00 to 100.00%	40339	X	115	
I/O 40	Vmet Status	Read-Only	0.00 to 100.00%	40340	X	115	
I/O 41	Imet Status	Read-Only	0.00 to 100.00%	40341	X	115	
I/O 42	DOP Scaling	0="6FS"	0="6FS" 1="48FS"	40342		116	
I/O 43	Speed Ratio	100.00%	0.0-200.0%	40343		116	
I/O 44	Inputs	Read-Only	Bit 0 -> FWD DIBit 1 -> REV DIBit 2 -> R/J DIBit 3 -> DI1Bit 4 -> DI2Bit 5 -> DI3Bit 6 -> DI4Bit 7 -> DI5Bit 8 -> MOL DIBit 9 -> EN DI	40344	X	117	
I/O 45	Outputs	Read-Only	Bit 0 -> R1 Relay Bit 1 -> R2 Relay Bit 2 -> DO1 Output Bit 3 -> DO2 Output	40345	X	117	
I/O 46	Com Parity	0="RTU N81"	0="RTU N81" 1="RTU N82" 2="RTU E81" 3="RTU O81"	40346		118	
I/O 47	Com Drop #	1	1-247	40347		118	
I/O 48	Com Baudrate	1="9600"	0="4800" 1="9600" 2="19200" 3="38400" 4="57600"	40348		119	
I/O 49	Com Timeout	0.0 sec	0.0 to 60.0 sec	40349		119	
I/O 50	Infared Baud Rate	1="9600"	1="9600" 2="19200" 3="38400" 4="57600"	40350		120	

11.3.4 AFN Group

Code	Parameter Name	Default	Range (Options)	Modbus	View Only	Page	User Setting
AFN 00	Jump Code						
AFN 01	Nom Mtr Freq	Model Dependant	25.0 to 400.0 Hz	40501		120	
AFN 02	Nom Mtr RPM	1750 rpm	1 to 24000 rpm	40502		121	
AFN 03	Minimum Freq	0.0 Hz	0.0 to 400.0Hz	40503		121	
AFN 04	Maximum Freq	60.0Hz	Minimum Freq to 400.0Hz	40504		121	
AFN 05	Carrier Freq	3.0kHz	1.0 to 16.0kHz	40505		122	
AFN 06	Slip Comp	0="No"	0="No" 1="Yes"	40506		122	
AFN 07	V-Boost Conf	1.0%	0.0% to 50.0%	40507		123	
AFN 08	Bst. Tpr Frq	60.0Hz	0.0Hz to Maximum Freq	40508		123	
AFN 09	Bst. Tpr Vlt	100.0%	0.0 to 100.0 %	40509		124	
AFN 10	Motor RS	Model Dependant	0.0 to 655.35 ohm	40510		125	
AFN 11	Auto-Tune	0="Not Active"	0="Not Active" 1="Motor RS"	40511		125	
AFN 12	Power Factor	80.0%	0.50 to 1.00	40512		125	
AFN 13	Fstator Filt	8 ms	1 to 100 ms	40513		126	
AFN 14	Start Field	0="No"	0="No" 1="Yes"	40514		126	
AFN 15	Filter Slip	100 ms	10 to 1000 ms	40515		127	
AFN 16	ID Percent	Read-Only	-300.0 - 300.0%	40516	X	127	
AFN 17	IQ Percent	Read-Only	-300.0 - 300.0%	40517	X	127	
AFN 18	Catch Mode	0="Sweep Fwd"	0="Sweep Fwd" 1="Sweep Rev" 2="Sweep F\R"	40518		128	
AFN 19	Run Prevent	0="Forward"	0="Allow F\R" 1="No Reverse" 2="No Forward"	40519		128	
AFN 20	Stop Key	0="Coast"	0="Coast" 1="Ramp" 2="Disabled"	40520		129	
AFN 21	Loc/Rem Key	1="Enabled"	0="Disabled" 1="Enabled"	40521		129	
AFN 22	TOL Select	2="Std Ind 60s"	0="Std Ind Shp" 1="Std Ind 30s" 2="Std Ind 60s" 3="Std Ind 5mn" 4="In Duty Shp" 5="In Duty 30s" 6="In Duty 60s" 7="In Duty 5mn"	40522		130	

Code	Parameter Name	Default	Range (Options)	Modbus	View Only	Page	User Setting
AFN 23	Ramp Config	0="ART-DI"	0="ART-DI" 1="ART-F/R" 2="ART-Frq" 3="ART-Strt/RS" 4="S-Curve" 5="ART-DI CTS" 6="ART-F/R CTS" 7="ART-Frq CTS" 8="ART-Strt/CS 9="S-Curve CTS	40523		132	
AFN 24	Accel Time 2	3.0 sec	0.1 to 3200.0 sec	40524		133	
AFN 25	Decel Time 2	3.0 sec	0.1 to 3200.0 sec	40525		133	
AFN 26	Rmp Rounding	25%	1-100%	40526		133	
AFN 27	Rmp Sw. Freq	40.0Hz	0.0 to 400.0 Hz	40527		134	
AFN 28	Single Phase	0="No" Model Dependant	0="No"1="Yes"	40528		134	
AFN 29	Ref Fault	2="Fault"	0="Retain Spd" 1="Preset Lvl" 2="Fault"	40529		134	
AFN 30	Lost Ref Frq	0.0Hz	0.0 to 400.0 Hz	40530		135	
AFN 31	PID Config	0="No PID"	0="No PID" 1="Dir F-Fwd" 2="Rev F-Fwd" 3="Dir Full" 4="Rev Full"	40531		135	
AFN 32	Feedback Cfg	0="Vin1"	0="Vin1" 1="Cin" 2="Vin2"	40532		136	
AFN 33	PID P-Gain	0	0 to 2000	40533		136	
AFN 34	PID I-Gain	0	0 to 10000	40534		137	
AFN 35	PID D-Gain	0	0 to 1000	40535		137	
AFN 36	PID FB Gain	1000	0 to 2000	40536		137	
AFN 37	PID High Alm	0.00%	0.00 to 100.00 %	40537		138	

Code	Parameter Name	Default	Range (Options)	Modbus	View Only	Page	User Setting
AFN 38	PID Low Alm	0.00%	0.00 to 100.00 %	40538		138	
AFN 39	PID Sleep	0="Disabled"	0="Disabled" 1="PID FBk <“ 2="PID FBk >" 3="PID Ref <“ 4="PID Ref >"	40539		138	
AFN 40	Sleep Lvl	0.00%	0.00 to 100.00 %	40540		139	
AFN 41	Wake-Up Lvl	0.00%	0.00 to 100.00 %	40541		139	
AFN 42	Sleep Delay	0.0 sec	0.0 to 300.0 sec	40542		139	
AFN 43	Wake-Up Dly	0.0 sec	0.0 to 300.0 sec	40543		140	
AFN 44	PID Ref	Read-Only	0.00 to 100.00 %	40544	X	140	
AFN 45	PID FB	Read-Only	0.00 to 100.00 %	40545	X	140	
AFN 46	PID Error	Read-Only	0.00 to 100.00 %	40546	X	141	
AFN 47	PID Output	Read-Only	0.00 to 100.00 %	40547	X	141	
AFN 48	PID High Lim	100.00%	0.00 to 100.00 %	40548		141	
AFN 49	PID Low Lim	0.00%	0.00 to 100.00 %	40549		142	
AFN 50	PID Usr Unt	0="No"	0="No" 1="Yes"	40550		142	
AFN 51	Software Rev	Read-Only	N/A	40551	X	142	
AFN 52	Serial No 1	Read-Only	N/A	40552	X	143	
AFN 53	Serial No 2	Read-Only	N/A	40553	X	143	
AFN 54	Language	0="English"	0="English"	40554		143	
AFN 55	Prog Number	0	Varies	40555		144	
AFN 56	Par STO/RCL	0="Select…"	0="Select…" 1="Factory Rst" 2="Store Parm" 3="Load Param" 4="Swap Param"	40556		144	
AFN 57	Power Fail Cfg	Retain Speed	0="Retain Speed" 1="Preset Lvl" 2="Fault" 3="3Cur" 4="4Cur" 5="5Cur"	40557		145	
AFN 58	Ride-Thru En	w/ LVT	0="Disabled" 1="w/ LVT" 2="w/o LVT" 3="No UV Fault	40558		145	
AFN 59	Cutoff Freq	0.0 Hz	0.0 to 5.0 Hz	40559		146	
AFN 60	Stab. Gain	0	0 to 10	40560		146	
AFN 61	Stab. Rate	5	1 to 1000	40561		146	

11.3.5 APP Group

Code	Parameter Name	Default	Range (Options)	Modbus	User Setting
APP 00	Jump Code				
APP 01	Seq Appl	0="Disabled"	0="Disabled" 1="1sec base" 2=".1sec base" 3=".01sec base"	40701	
APP 02	Seq Cntl 1	00000000000	Bit 0-2 -> Speed Sel Bit 3 -> Accl Sel Bit 4-6 -> Event Length Bit 7-8 -> Dir Sel Bit 9-10 -> Output Sel	40702	
APP 03	Seq Cntl 2	00000000000	Bit 0-2 -> Speed Sel Bit 3 -> Accl Sel Bit 4-6 -> Event Length Bit 7-8 -> Dir Sel Bit 9-10 -> Output Sel	40703	
APP 04	Seq Cntl 3	00000000000	Bit 0-2 -> Speed Sel Bit 3 -> Accl Sel Bit 4-6 -> Event Length Bit 7-8 -> Dir Sel Bit 9-10 -> Output Sel	40704	
APP 05	Seq Cntl 4	00000000000	Bit 0-2 -> Speed Sel Bit 3 -> Accl Sel Bit 4-6 -> Event Length Bit 7-8 -> Dir Sel Bit 9-10 -> Output Sel	40705	
APP 06	Seq Cntl 5	00000000000	Bit 0-2 -> Speed Sel Bit 3 -> Accl Sel Bit 4-6 -> Event Length Bit 7-8 -> Dir Sel Bit 9-10 -> Output Sel	40706	
APP 07	Seq Cntl 6	00000000000	Bit 0-2 -> Speed Sel Bit 3 -> Accl Sel Bit 4-6 -> Event Length Bit 7-8 -> Dir Sel Bit 9-10 -> Output Sel	40707	
APP 08	Seq Cntl 7	00000000000	Bit 0-2 -> Speed Sel Bit 3 -> Accl Sel Bit 4-6 -> Event Length Bit 7-8 -> Dir Sel Bit 9-10 -> Output Sel	40708	
APP 09	Seq Cntl 8	00000000000	Bit 0-2 -> Speed Sel Bit 3 -> Accl Sel Bit 4-6 -> Event Length Bit 7-8 -> Dir Sel Bit 9-10 -> Output Sel	40709	
APP 10	Seq Cntl 9	00000000000	Bit 0-2 -> Speed Sel Bit 3 -> Accl Sel Bit 4-6 -> Event Length Bit 7-8 -> Dir Sel Bit 9-10 -> Output Sel	40710	
APP 11	Seq Count 1	0	0-65535	40711	
APP 12	Seq Count 2	0	0-65535	40712	
APP 13	Seq Count 3	0	0-65535	40713	
APP 14	Seq Count 4	0	0-65535	40714	
APP 15	Seq Count 5	0	0-65535	40715	
APP 16	Seq Count 6	0	0-65535	40716	
APP 17	Seq Count 7	0	0-65535	40717	
APP 18	Seq Count 8	0	0-65535	40718	
APP 19	Seq Count 9	0	0-65535	40719	

11.3.6 FLT Group

Code	Parameter Name	Default	Range (Options)	Details (or Differences)	Modbus	View Only	Page
FLT 01	Last Trip 1	Read-Only	Fault Codes of the Drive	Parameters saved in Fault History: Output Freq Drive Load Drive Status Drive Warn Output Voltage Output Current Drive Temp Run Time DC Bus Volt Adv Fault Code Cntl Brd Temp Out Power Power Time DI Status	40800	X	153
FLT 02	Last Trip 2	Read-Only	Fault Codes of the Drive		40820	X	
FLT 03	Last Trip 3	Read-Only	Fault Codes of the Drive		40840	X	
FLT 04	Last Trip 4	Read-Only	Fault Codes of the Drive		40860	X	
FLT 05	Last Trip 5	Read-Only	Fault Codes of the Drive		40880	X	

Revision History;

Revision	Date	ECO#	Description
01	Dec 5 / 2007	E1915	new sizes, ratings and correct errors

NOTES

BENSHAW PRODUCTS

Low Voltage Solid State Reduced Voltage Starters

- RC2/RC3 - SSRV Non or Separate Bypass + DC Braking
- RB2/RB3 - SSRV Integral Bypass + DC Braking
- RSM10 - SSRV + Reversing
- RSM11 - SSRV + DC Injection Braking + Reversing
- RSM10/12TS - SSRV Two Speed
- WRB - SSRV Wound Rotor
- SMRSM6 - SSRV Synchronous
- DCB3 - Solid State DC Injection Braking

Medium Voltage Solid State Reduced Voltage Starters

- 5kV - Induction or Synchronous to 10,000HP
- 7.2kV - Induction or Synchronous to 10,000HP
- 15kV - Induction or Synchronous to 60,000HP

Low Voltage - AC Drives

- Standard Drives to 1000HP
- Custom Industrial Packaged Drives
- HVAC Packaged Drives
- 18 Pulse/IEEE 519 Compliant Drives

RSC Series Contactors

- SPO/SPE/SPD Motor Protection Relays
- Enclosed Full Voltage, Wye Delta, Two Speed Part Winding and Reversing Starters

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