S200 Position Node with CANOpen/ DeviceNet

Installation Manual
M-SS-S2-11
Revision J June 25 2007

Keep all product manuals as a product component during the life span of the servo amplifier.
Pass all product manuals to future users/owners of the servo amplifier.

NOTICE:

1.) This S200 Option requires the use of special user interface software called S200 OC Tools. This software can be installed using the included CD ROM. This device will ***not*** communicate with the standard S200 Tools software.

2.) Common Problems

a.) If all dip switches are set to ON (Toggled to the right), the unit enters a perpetual rest state and does not communicate. **Change dip switch settings**.

b.) When selecting a non-SFD motor, be certain to enter the 'motor poles' data.

c.) Always remember to Save the configuration to Non-volatile memory.

d.) Remember that COLDSTART is required before using the drive after changing I/O configuration.

DANAHER MOTION

Helping you build a better machine faster.

Record of Revisions

Date	***Issue***	***Description***
2/1/07	D	Revised Input definitions
2/19/07	E	Major rewrite
4/4/07	F	Added Modbus information
5/21/07	G	Made clarifications in Modbus Section
6/13/07	H	Added Page Numbers, modified encoder input circuit
6/25/07	J	Corrected J12 pin-out information

NOTICE:

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Safety Symbols

WARNING

Warnings alert users to potential physical danger or harm. Failure to follow warning notices could result in personal injury or death.

CAUTION

Cautions direct attention to general precautions which, if not followed, could result in personal injury and/or equipment damage.

NOTE

Notes highlight information critical to your understanding or use of the product.

Safety

WARNING

READ these instructions before connecting power. Damage can result from MISWIRING at the power terminals.

DANGEROUS voltages are present on power input and motor output terminals.

Only qualified personnel are permitted to transport, assemble, commission, and maintain this equipment. Properly qualified personnel are persons who are familiar with the transport, assembly, installation, commissioning and operation of motors, and who have the appropriate qualifications for their jobs.

Read all available documentation before assembling and using. Incorrect handling of products described in this manual can result in injury and damage to people and/or machinery. Strictly adhere to the technical information regarding installation requirements.

- Keep all covers and cabinet doors shut during operation.
- Be aware that during operation, the product has electrically charged components and hot surfaces. Control and power cables can carry a high voltage, even when the motor is not rotating.
- Never disconnect or connect the product while the power source is energized.
- After removing the power source from the equipment, wait at least 5 minutes before touching or disconnecting sections of the equipment that normally carry electrical charges (e.g., capacitors, contacts, screw connections). To be safe, measure the electrical contact points to each other and to electrical safety earth with a meter before touching the equipment.

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1 PRODUCT OVERVIEW

The S200 Position Node with CANOpen/DeviceNet™ brings greater flexibility to the S200 drive platform by adding profile generation and field bus capabilities. It also brings added I/O, Digital Oscilloscope emulation, and the ability to use incremental encoder with commutation tracks (ComCoder) for motor feedback.

The S200 Position Node brushless position node servo drives with CANOpen push high performance servo technology into lower power applications than was previously possible without having to compromise on reliability or package size. Couple a S200 position node drive with an AKM servo motor for a complete servo control solution designed to excel in applications such as semiconductor fabrication, electronic assembly, packaging, medical, and woodworking equipment.

The S200 position node servo drives with CANOpen communication are the first all digital industrial drives with a velocity loop bandwidth up to 800 Hz offering unmatched system throughput and simplified tuning. High resolution (24 bit) feedback and high performance 3-5 kHz current loop bandwidth provide smooth motion and rapid start and stop action to optimize machine performance. Smart feedback and industry leading high bandwidth deliver fast and accurate commissioning by eliminating the need for servo loop tuning in most applications.
A separate "keep alive" power input allows rapid recovery from emergency stop conditions. Optically isolated inputs/outputs, positive locking connectors and full fault protection promise long machine life and immunity to accidental damage. A single motor power/feedback cable simplifies connectivity. All connectors and LED status indicators are easily accessible from the front of the drive.

1.1 *HIGHLIGHTS*

- ✓ DC or AC input voltage:
- ✓ DC type: 20 V ... 90 V
  AC type: 110 V ... 240 V, 1Ø or 3Ø, 50/60 Hz
- ✓ Highest performance all digital servo in the industry
- ✓ Operation and Setup via a PC using the S200 OC Tools setup software
- ✓ Easy set up and tuning with Smart Feedback Device
- ✓ Optimized performance with AKM motors
- ✓ Rugged optically isolated I/O
- ✓ UL508C recognition, CE (EN50178, EN61800-3)
- ✓ Very compact footprint
- ✓ Full fault protection
- ✓ Velocity, Position, and Electronic Gearing control standard
- ✓ Indexing - 180 unique motion tasks can be defined and initiated via the serial port or discrete inputs
- ✓ Relative, Absolute, Simple Registration, and Home motion tasks can be easily setup and executed
- ✓ Individual motion tasks can be linked with each other
- ✓ Digital Oscilloscope Functions for improved tuning
- ✓ Built-in CANOpen / DeviceNet Communication bus

- ✓ Flash memory allows for quick and easy firmware updates via the serial interface
- ✓ Incremental Encoder Input port allows ComCoder motor feedback for position loop control.

1.2 *INCREASED MACHINE THROUGHPUT & LONGER LIFE*

- ✓ Servo system performance is synonymous with machine throughput. The S200 POSITION NODE family takes servo performance to new heights.
- ✓ Industry-leading current loop bandwidth up to 5 kHz and velocity loop bandwidth up to 800 Hz means machine throughput can be increased by as much as 2 to 3 times.
- ✓ Robust design including full fault protection, locking connectors and optical isolation promise greater machine “up-time”.
- ✓ Smooth motion, a benefit of sinusoidal current control and high resolution (24 bit) feedback minimizes harsh torque disturbances that can cut short the life of mechanical components.
- ✓ Both the AC and the DC input drives are equipped with separate control power input to speed recovery from “E-Stop” conditions.
- ✓ CANOpen Field Bus or DeviceNet communications

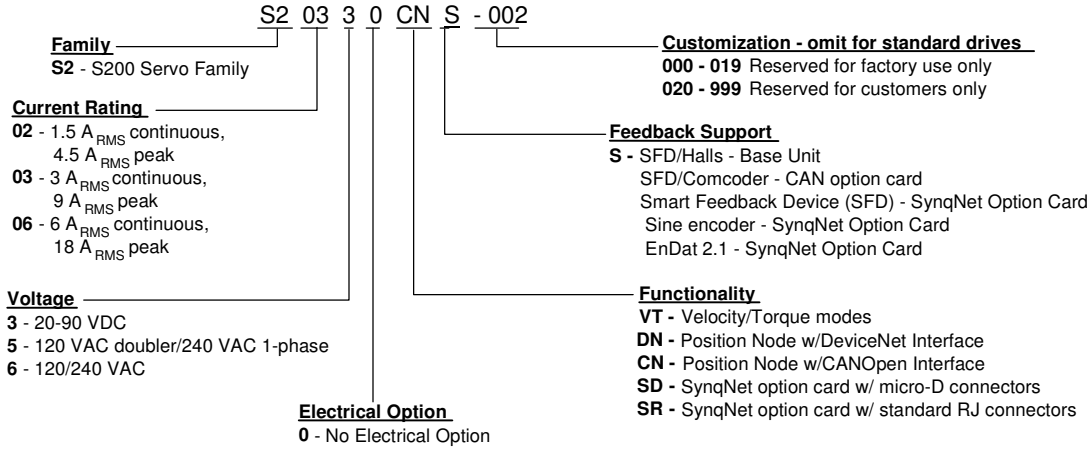
1.3 *REDUCED ENGINEERING & SUPPORT TIME*

- ✓ Simplified tuning, friendly Graphical User Interface and shared components with Stepper products.
- ✓ Windows-based Graphical User Interface models the tree format found in Explorer so learning is quick and easy.
- ✓ Digital Oscilloscope emulator for easier setup.
- ✓ Easy to debug with full fault diagnostics reduce engineering support time.
- ✓ Field bus connectivity.

1.4 *CE- / UL- CONFORMITY*

- ✓ The S200 position node with CANOpen meets all relevant standards:
- ✓ EMC Directive 89/336/EWG, standard used ENG61800-3
- ✓ Low Voltage Directive 73/23/EWG, standard used 50178
- ✓ UL / cUL 508C recognized

1.5 *MODEL NUMBER SCHEME*



1.5.1 Valid Drive Model Numbers

DC Input Power Drive Models

S20330-VTS: 90 V_{DC}, 3/9 A_{RMS} Base Unit
S20630-VTS: 90 V_{DC}, 6,18 A_{RMS} Base Unit
S20330-CNS: 90 V_{DC}, 3/9 A_{RMS} Base Unit, CAN/Indexer option card
S20630-CNS: 90 V_{DC}, 6/18 A_{RMS} Base Unit, CAN/Indexer option card
S20330-SRS: 90 V_{DC}, 3/9 A_{RMS} Base Unit, SynqNet option card with RJ-45 connectors
S20630-SRS: 90 V_{DC}, 6/18 A_{RMS} Base Unit, SynqNet option card with RJ-45 connectors
S20330-CNS: 90 V_{DC}, 3/9 A_{RMS} Base Unit, SynqNet with Micro-D connectors
S20630-SDS: 90 V_{DC}, 6/18 A_{RMS} Base Unit, SynqNet with Micro-D connectors

AC Input Power Drive Models

S20250-CNS: 120V_{AC} doubler/240V_{AC}, 1 phase, 1.5/4.5 A_{RMS} Base Unit, Profile Node with CanOpen
S20250-DNS: 120V_{AC} doubler/240V_{AC}, 1 phase, 1.5/4.5 A_{RMS} Base Unit, Profile Node with DeviceNet
S20260-CNS: 120/240 V_{AC}, 1/3-phase, 1.5/4.5 A_{RMS} Base Unit, Profile Node with CanOpen
S20260-DNS: 120/240 V_{AC}, 1/3-phase, 1.5/4.5 A_{RMS} Base Unit, Profile Node with DeviceNet

S20350-CNS: 120V_{AC} doubler/240V_{AC}, 1 phase, 3/9 A_{RMS} Base Unit, Profile Node with CanOpen
S20350-DNS: 120V_{AC} doubler/240V_{AC}, 1 phase, 3/9 A_{RMS} Base Unit, Profile Node with DeviceNet
S20360-CNS: 120/240 V_{AC}, 1/3-phase, 3/9 A_{RMS} Base Unit, Profile Node with CanOpen
S20360-DNS: 120/240 V_{AC}, 1/3-phase, 3/9 A_{RMS} Base Unit, Profile Node with DeviceNet

S20650-VTS: 120V_{AC} doubler/240V_{AC}, 1/3-phase 6/18 A_{RMS} Base Unit
S20650-SRS: 120V_{AC} doubler/240V_{AC}, 6/18 A_{RMS} Base Unit, SynqNet option card with RJ-45 connectors
S20650-SDS: 120V_{AC} doubler/240V_{AC}, 6/18 A_{RMS} Base Unit, SynqNet with Micro-D connectors
S20650-CNS: 120V_{AC} doubler/240V_{AC}, 6/18 A_{RMS} Base Unit, Profile Node with CanOpen
S20650-DNS: 120V_{AC} doubler/240V_{AC}, 6/18 A_{RMS} Base Unit, Profile Node with DeviceNet
S20660-VTS: 120/240 V_{AC}, 1/3-phase 6/18 A_{RMS} Base Unit
S20660-SRS: 120/240 V_{AC}, 1/3-phase 6/18 A_{RMS} Base Unit, SynqNet option card with RJ-45 connectors
S20660-SDS: 120/240 V_{AC}, 1/3-phase 6/18 A_{RMS} Base Unit, SynqNet with Micro-D connectors
S20660-CNS: 120/240 V_{AC}, 1/3-phase 6/18 A_{RMS} Base Unit, Profile Node with CanOpen
S20660-DNS: 120/240 V_{AC}, 1/3-phase 6/18 A_{RMS} Base Unit, Profile Node with DeviceNet

1.6 *SPECIFICATIONS*

NOTE

Unless otherwise specified, the specifications are worse case limits and apply over the specified operating ambient temperature and over the specified operating line voltage.

1.6.1 Drive Family Power

	AC Input			DC Input	
	S20260	**S20360**	**S20660**	**S20330**	**S20630**
Peak Output Current (A_{RMS})[1]					
(0 to 40°C) Ambient (A_{RMS})	4.5	9.0	18.0	9.0	18.0
Minimum Peak Current Time					
(Starting from 0 amps) seconds	3.0	3.0	3.0	3.0	3.0
Continuous Output Current (A_{RMS})[2]					
0 to 30°C ambient (A_{RMS})	2.3	4.5	9.0	4.5	7.5
40° C ambient (A_{RMS})	1.5	3.0	6.0	3.0	6.0
50° C ambient (A_{RMS})	1.0	2.0	4.0	2.0	4.0
Peak Output Power					
240 VAC (VA), 3 phase	1500	3000	6000	-	-
120 VAC (VA), 1 phase	750	1500	2400	-	-
75 VDC (VA)	-	-	-	750	1500
Drive Continuous Output Power					
240 VAC, 3 Phase (watts)	600	1100	2000	-	-
240 VAC, 1 Phase (watts)	500	900	1500	-	-
120 VAC, 1 Phase (watts)	250	450	-	-	-
75 VDC (watts)	-	-	-	250	500
Continuous Motor Shaft Power at 3000 RPM (Nominal Bus – 10%)					
0 to 30°C ambient (watts)	300	750	1500	180	315
40° C ambient (watts)	200	500	1000	125	250
RMS Line Current at Continuous Output Power					
240 VAC 3 Phase (A_{RMS})	2.7	5.0	9.0	-	-
240 VAC 1 Phase (A_{RMS})	3.4	6.5	12.0[4]	-	-
120 VAC 1 Phase (A_{RMS})	3.4	6.5	12.0[4]	-	-
+BUS Current – 75 VDC at Continuous Output Power[3]					
Average (A_{DC})	-	-	-	3.0	6.7
Instantaneous Peak (A_{PEAK})	-	-	-	12.7	25.5
Power Dissipation at 40° C P_{CONT} (watts)	17	29	60	8	12
Shunt Regulator					
Peak Power kW (500 ms)	4.4 at 36Ω	6.4 at 25Ω	10 at 15Ω	-	-
Cont. Power watts	440 at 36Ω	640 at 25Ω	1000 at 15Ω	-	-
Maximum Regen Duty Cycle (%)	10 at 36Ω	10 at 25Ω	10 at 15Ω	-	-
Regen Value (Ω)	25 – 50	25 – 50	12 – 50	-	-
Bus Capacitance Energy Absorption (joules)					
340 VDC Nominal BUS	15.5	15.5	20	-	-
75 VDC BUS with 4,000 µf (5 volt increase to 80 VDC)	-	-	-	1.5	1.5
Output Current Ripple Freq f_S (kHz)	20	20	20	31.2	31.2
Minimum Motor Inductance l-l (mH)	5	2.5	1.25	-	-
At 75 VDC	-	-	-	0.4	0.2

[1] *Peak Output Current listed is for sine mode. In six-step mode, the peak output currents are scaled to give the same output torque as in sine mode with a pure sinusoidal Back EMF motor.*

*To convert A_{RMS} to A(0-pk), multiply A_{RMS} * 1.414.*

[2] *For Operation above Above 40° C ambient: Derate linearly to 67% at 50° C .*

At higher ambient temperatures (above 30° C) the S20360 drive needs to be mounted on a thermally conductive surface to limit the heatsink temperature to less than 75° C.

[3] *Single phase operation of the S20660 requires derating of continuous output power to avoid excessive AC line front-end currents.*

[4] *See Appendix – Cables for voltage loss vs cable length.*

	AC Input			DC Input	
	S20260	**S20360**	**S20660**	**S20330**	**S20630**
Maximum Motor Inductance l-l (mH)	300	150	75	30	15
Maximum Motor Power Cable Length[4]					
18 AWG cable (m)	50	50		50	25
14 AWG Cable (m)	50	50	50	50	50

1.6.2 AC Input Drives - Control and Power

AC Control Power Supply	
Input Voltage Range (RMS)	85 VAC to 265 VAC single phase 47 to 63 Hz 120 VDC to 375 VDC
Ride Through Time for AC Line Drop	85 VAC 60 Hz > 0.78 60 Hz cycles 120 VAC 60 Hz > 3.3 60 Hz cycles 240 VAC 60 Hz >18.5 60 Hz cycles

AC Motor Power Supply	
Input Voltage Range (RMS) VAC	90 to 265
Phases	1 or 3
Transformer Suggested KVA	2 to 3
Maximum AC Line KVA[1]	100

[1] *Maximum AC Line is specified to limit the mains surges to the drive.*

AC Bus Voltage and Faults	
240 VAC Input Nominal Bus Voltage	320 VDC
120 VAC Input Nominal Bus Voltage	155 VDC
BUS Undervoltage Fault	Factory Default is None
BUS Overvoltge (BusOV) Fault	407 VDC $\pm$ 5%
BUS Regen Voltage	= 0.974*BusOV = 397 VDC Nominal

AC Inrush Current & Fusing	
Worse Case Inrush Peak Current at 240 VAC	140 A 0-p
Inrush pulse width	1.5 ms

Recommended Fusing Line Inputs	**S20260**	**S20360**	**S20660**
Type – 250 VAC Time Delay Fuse			
240 VAC 3 Phase (A_{RMS})	Bussmann MDA-5	Bussmann MDA-8	Bussmann MDA-15
240 VAC 1 Phase (A_{RMS})	Bussmann MDA-5	Bussmann MDA-10	Bussmann MDA-10
120 VAC 1 Phase (A_{RMS})	Bussmann MDA-5	Bussmann MDA-10	

AC Control Inrush Current & Fusing	
Worse case Inrush Peak Current at 240 VAC	10 A 0-p
Inrush pulse width	1.60 ms
Fusing – Control Inputs	Bussmann MDA – 1/2

AC Power on Delay	
Control Power Applied to Drive Operational	1.25 seconds

1.6.3 DC Input Drives - Control and Power

DC Control Power	
Control Voltage Range (VDC) (J1-1 to J1-2)	+10 to +90
Control Input power (watts)[1]	2 to 8

[1] *(20 watt min supply recommended) Refer to the DC Power Supply Section for detailed application information and requirements.*

DC BUS Voltage and Faults	
+BUS Voltage Range (VDC) (J1-3 to J1-2)	+20 to +90
+BUS Undervoltage Fault	+17 VDC nominal
+BUS Overvoltage Fault	+91 VDC nominal

DC Power On Delay	
Control Power Applied to Drive Operational	1.5 seconds

Motor Current Control	
Motor Phase Current Waveform (In Sine or six-step mode output torque = Motor K_T*Drive I_{FB})	Pure sinusoidal or six-step, depending on feedback device
Motor Shaft Torque (Ignoring motor magnetic saturation)	
Peak (hot motor winding) Multiply K_T by 1.06 for cold motor winding (AKM or PMA motors).	K_T (N-m/A_{RMS})*Drive Ipeak (A_{RMS})
Instantaneous	K_T (N-m/A_{RMS})*IFB (A_{RMS})

Current Loop Bandwidth	
Maximum Bandwidth	
AC Input Drive (kHz)	3
DC Input Drive (kHz)	5
Recommended Bandwidth	
AC Input Drive (kHz)	2
DC Input Drive (kHz)	3
SFD Auto Set (kHz) AC & DC	2
Bandwidth Variation For Fixed Motor L (*% regulated independent of bus voltage)*	± 2.5
Update Period (µs)	0.8
Recommended Max Motor Electrical Frequency (Hz)	
AC Input Drive (Hz)	600
DC Input Drive (Hz)	900

Offset Current		
Drive	**Typical**	**Worst Case Over Temp**
S20260	0.2% / 12 mA	1.0% / 64 mA
S20360	0.2% / 25 mA	0.5% / 64 mA
S20330	0.2% / 25 mA	0.5% / 64 mA
S20630	0.2% / 50 mA	0.5% / 128 mA

1.6.4 Velocity Loop

Maximum Stable Bandwidth (Hz with SFD)	800
Update Period (µs)	0.8
Range (rpm)	0 to 18,300
Command Resolution	< 0.001 rpm analog 0.558 rpm serial

Velocity Loop Compensation	
KVP Range (Depends on Ipeak)	0.00044 to 0.106 (Ipeak)(1/rad/sec)
KVP Resolution (%)	10
KVI Range (Hz)	0 to > 22
KVI Resolution (%)	10
ARF0[1] Range (Hz)	24.3 to > 46627
ARF1[1] Range (Hz)	24.3 to > 46627

[1] ***Values for ARF0, ARF1; from 3012 to 24873 Hz cannot be set.***

1.6.5 Mechanical

	S200 DC INPUT DRIVES		**S200 AC INPUT DRIVES**		
	S20630-VT S20330-VT	**S20630-XX S20330-XX**	**S20660-XX**	**S20360-VT S20260-VT**	**S20360-XX S20360-XX**
Drive Dimensions					
Drive Height (A)	152.4 mm 6.00 in	152.4 mm 6.00 in	175.0 mm 6.9 in	175.0 mm 6.90 in	175.0 mm 6.90 in
Drive Width (B)	28.7 mm 1.13 in	48.3 mm 1.90 in	64.0 mm 2.52 in	54.8 mm 2.16 in	54.8 mm 2.16 in
Drive Depth[1] (C)	100.8 mm 3.97 in	100.8 mm 3.97 in	131.6 mm 5.18 in	131.6 mm 5.18 in	131.6 mm 5.18 in
Mounting Hardware	M4 or #8	M4 or #8	M4 or #8	M4 or #8	M4 or #8
Drive Weight	0.40 kg 0.88 lb	0.5 kg 1.10 lb	0.82 kg 1.80 lb 1.97 with option card	0.77 kg 1.69 lb	0.85 kg 1.86 lb

[1] *Depth measurement is for drive only. Add approximately 50.8 mm (2 in) to depth given in the table to accommodate mating connectors and wire bend radius.*

1.6.6 I/O Specifications

Analog command is not allowed in this product. Digital Velocity and Motion Task position loop control is the only possibilities.

Analog Output (DacMon)	
DACMON1, DACMON 2 (J4 14,15)	
Maximum Range (volts)	0.5 – 4.5
Full Scale Tolerance (%)	
Typical (Worse Case)	+/- 1 (± 5)
Linearity (% Full Scale)	<0.1
Monotonic to	< 2^{-16} Full Scale
Offset (mV)	< 100
Offset Drift (µV/°C typ.)	250

Quadrature Input	
Quadrature Input CHA (J12-12, 13 CH B J12-14,15)	
Type	RS-422/RS-485
Input Voltage	See Appendix C: Open Collector, TTL, Differential Compatible
Input Termination	See Appendix C
Maximum Line Frequency	625 kHz (corresponds to 2.5 MHz quadrature pulse rate)

General Purpose Digital Inputs	
DINP1-4, DINP6-9 (J4 2-4 and J12 2-5)	
Input Voltage Referenced to DINPCOM (J4-5)	± (4.0 - 30.0) volts
Input Current	0.65 - 6.7 mA
Response Time	1.0 ms
DINP5/DINP10 (HSINP - J4-10 & 11, J12 8 & 9)	
Input Voltage	3.0 – 6.0 volts
Input Current	9.0 – 24.0 mA

General Purpose Outputs	
DOUT1, DOUT2 (J4-6,7 and J4-8,9)	
Maximum Output Voltage	- 0.30 to 30.0 volts
Clamp Voltage	33 volt ± 6%
Maximum Output Current	50 mA
On voltage	1.0 volts at 10 mA 1.2 volts at 50 mA
Response Time	1.0 ms

Quadrature Outputs	
Quadrature Output (CHA- J4-19, 20 CH B- J4-21,22 CHZ- J4-17,18)	
Type	RS-422/RS-485
Output Voltage	5.0 V Differential Output - Unloaded
Hysteresis	1/2 Quadrature Count corresponding to 1/8 Encoder Line Count

1.6.7 Environmental

Operating Temperature (° C) – Full Rating	0 to 40
Operating Temperature (° C) – Derated Linearly Derate Continuous Current to 67% of 40° C Rating	40 – 50
Pollution Degree	2
Storage Temperature (° C)	-20 to 70
Humidity (% non-condensing)	10 to 90
Altitude	<1500 m (5000 feet)

1.6.8 Smart Feedback Device (SFD)

Resolution/Rev (arc min)	24 bits = 0.0013
Repeatability (arc min RMS)	< ± 2^{-19} Rev = ± 0.04
Noise	
No Filtering (arc min RMS)	< 2^{-17} Rev RMS = 0.16
150 Hz Single Pole Filtered (arc min RMS)	< 2^{-18} Rev RMS = 0.08
10 Hz Single Pole Filtered (arc min RMS)	< 2^{-19} Rev RMS = 0.02
DC Offset Temperature Drift	< 2^{-18} Rev/° C = 0.08 arc min/° C
Absolute Accuracy	
AKM1 (arc min)	± $2^{-10.3}$ Rev = ±17
AKM2 or 3, 4 (arc min)	± $2^{-11.1}$ Rev = ±10
Communications Update Period (µs)	51.2

1.6.9 Emulated Encoder Output Signals

Available Resolutions (PPR)		
Binary	128, 512, 1024, 2048, 4096, 8192, 16384, 32768	
Decimal	125, 500, 1000, 2000, 2500, 5000, 10000, 20000	
Maximum Output Line Frequency (MHz)		2.5
Max Recommended Speed at 32768 PPR (rpm)		2200
Max Recommended Speed at 16384 PPR (rpm)		4600
Max Recommended Speed at 4096 PPR (rpm)		18300
Marker Pulse Width		~ 1 Quadrature Pulse

1.6.10 Current Loop

- 3 dB Bandwidth (Hz)	> 2000
- 45° Phase Lag (Hz)	> 1000

1.6.11 General

Max Tracking Rate (rpm)	> 48600
Max Recommended Rate (rpm)	25000
Max Tracking Acceleration (rpm/sec)	> $16x10^6$
Maximum Feedback Cable Length	50 m (164 ft)

2 GETTING STARTED

2.1 *UNPACKING AND INSPECTING*

Open the box and remove all the contents. Check to ensure there is no visible damage to any of the equipment.

CAUTION

Use proper procedures when handling electronic components to avoid damage to equipment.

CAUTION

Remove all packing material and equipment from the shipping container. Be aware that some connector kits and other equipment pieces may be quite small and can be accidentally discarded. Do not dispose of shipping materials until the packing list has been checked.

NOTE

Upon receipt of the equipment, inspect components to ensure that no damage has occurred in shipment. If damage is detected, notify the carrier immediately. Check all shipping material for connector kits, documentation, diskettes, CD-ROM, or other small pieces of equipment.

2.2 *MOUNTING*

The S200 drives are designed for operation in a cabinet using the following installation instructions:

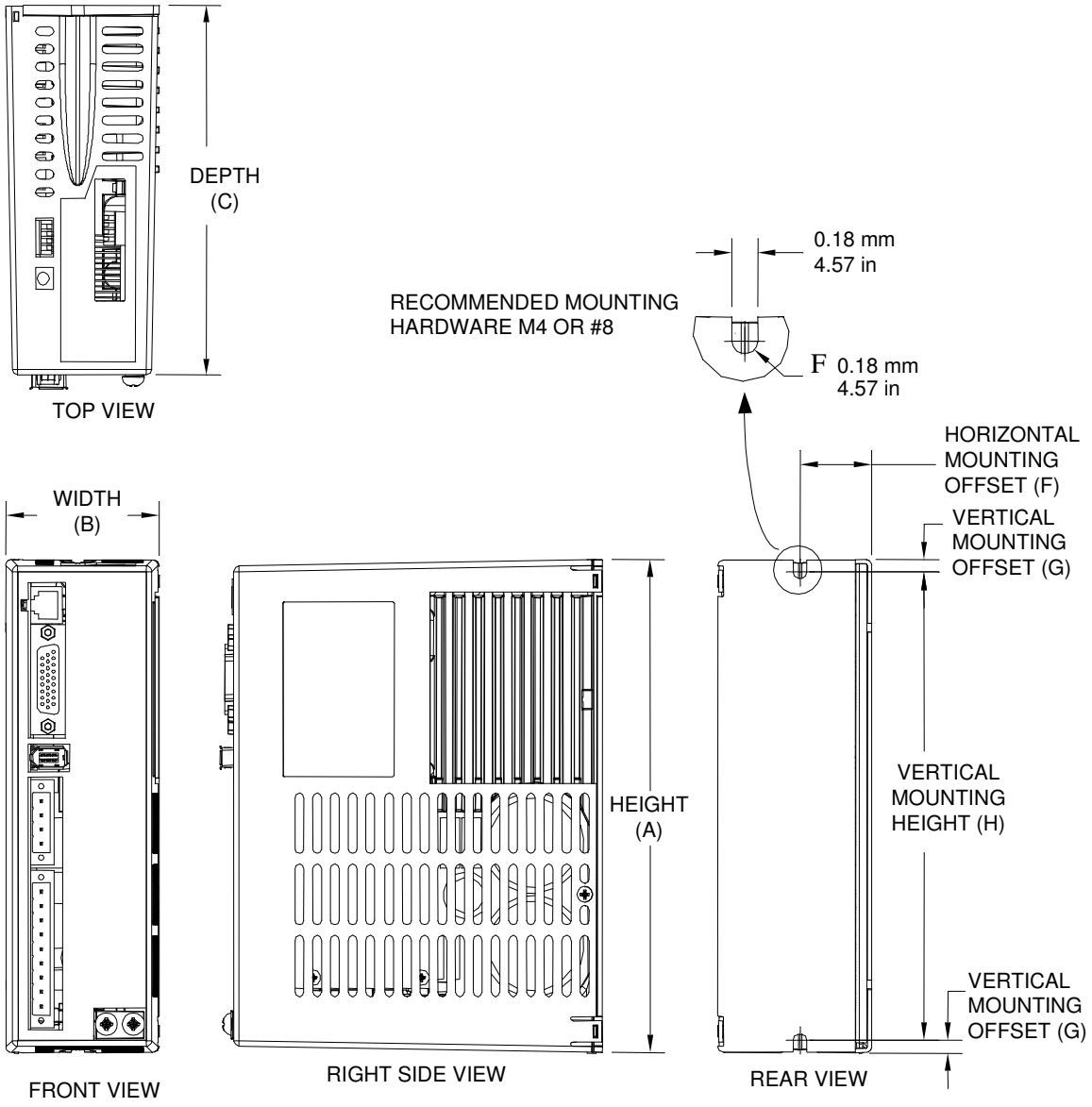
- Mount the drives vertically inside a cabinet on a flat, solid, electrically conductive, mounting surface connected to PE (protective earth ground) and capable of supporting the weight of the unit.
- Provide a good connection to PE. Remove the paint on the mounting surface over an area extending at least 12 mm (0.5 in) from the mounting bolts to achieve good electrical connection over a large area between the drive and grounded mounting surface.
- Insure the environment within the cabinet meets the requirements listed in the environmental specifications table.

2.2.1 Dimensions

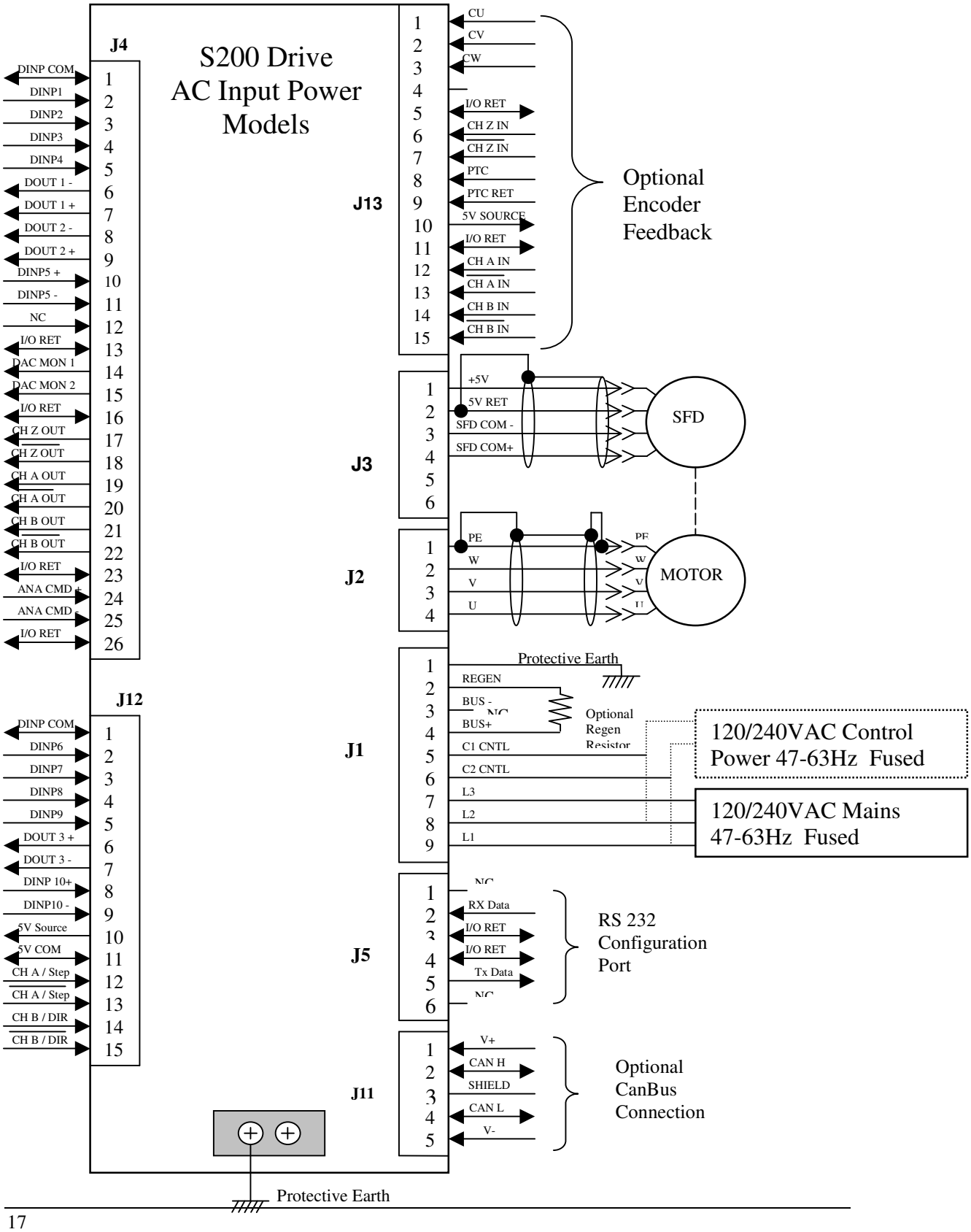
	S200 DC INPUT DRIVES	S200 AC INPUT DRIVES	
	S20630 S20330	**S20660**	**S20360 S20260**
Drive Dimensions			
Drive Height (A)	152.4 mm 6.00 in	175.0 mm 6.90 in	175.0 mm 6.90 in
Drive Width (B)	48.3 mm 1.90 in	64.0 mm 2.52 in	54.8 mm 2.16 in
Drive Depth[1] (C)	100.8 mm 3.97 in	131.6 mm 5.18 in	131.6 mm 5.18 in
Clearance Requirements			
Top and Bottom (D)	12.7 mm 0.50 in	25.4 mm 1.0 in	25.4 mm 1.0 in
Side to Side (E)	12.7 mm 0.50 in	25.4 mm 1.0 in	25.4 mm 1.0 in
Mounting Dimensions			
Horizontal Mounting Offset (F)	24.6 mm 0.97 in	25.6 mm 1.01 in	25.6 mm 1.01 in
Vertical Mounting Offset (G)	4.1 mm 0.16 in	4.3 mm 0.17 in	4.3 mm 0.17 in
Vertical Mounting Height (H)	144.3 mm 5.68 in	169.5 mm 6.67 in	169.5 mm 6.67 in
Drive to Drive Mounting (J)	60.96 mm 2.40 in	87.3 mm 3.16 in	80.3 mm 3.16 in
Mounting Hardware	M4 or #8	M4 or #8	M4 or #8
Drive Weight	0.5 kg 1.10 lb	0.5 kg 1.10 lb	0.85 kg 1.86 lb

[1] Depth measurement is for drive only. Add approximately 50.8 mm (2 in) to depth given in the table to accommodate mating connectors and wire bend radius.

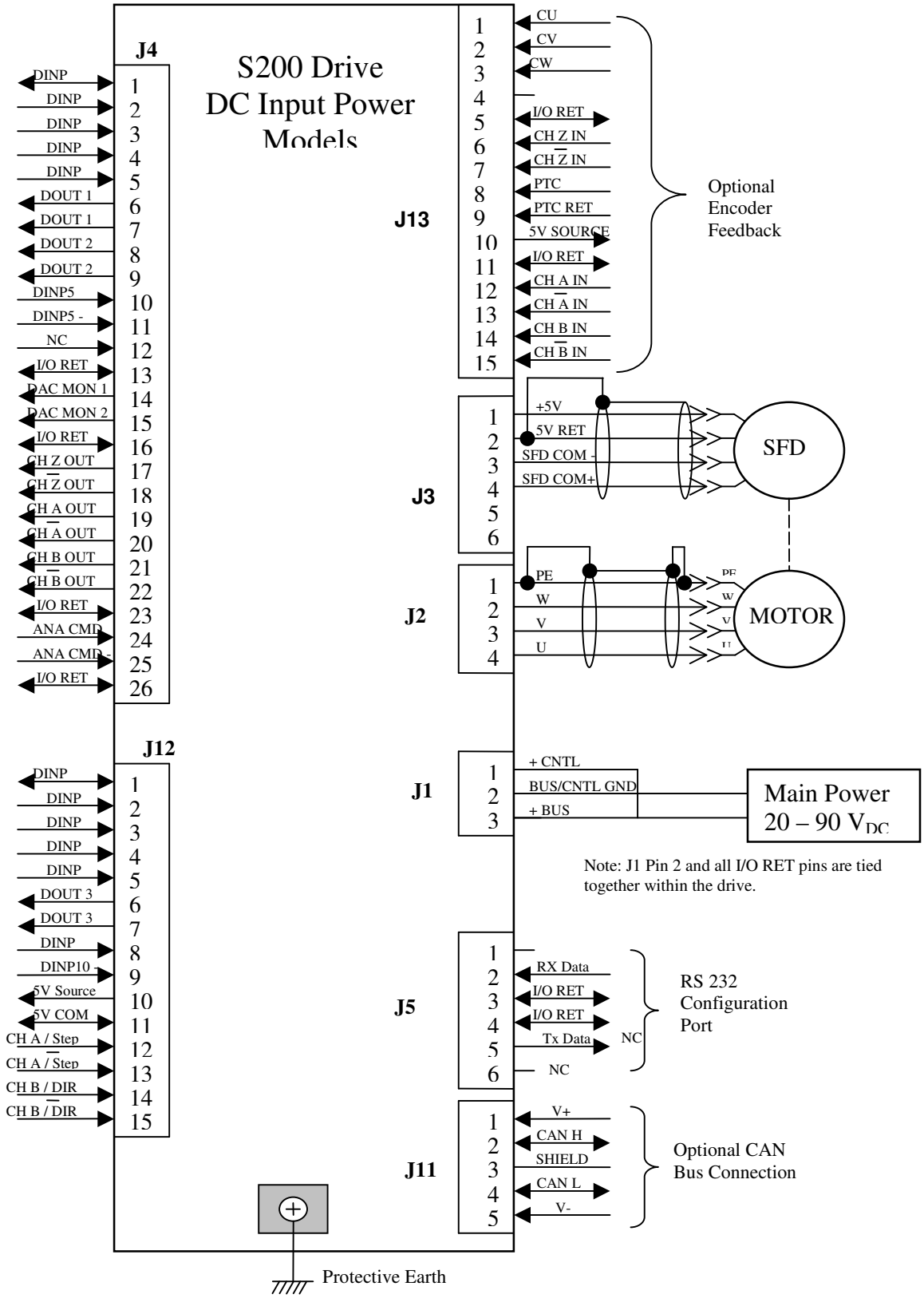
2.2.2 Mounting Outline



2.3 S200 POSITION NODE AC DRIVE WIRING DIAGRAM



2.4 *S200 POSITION NODE DC DRIVE WIRING DIAGRAM*



2.5 CONNECTORS

2.5.1 J1 – AC Input Power Models Drive Power

The S200 AC input drives are capable of direct line operation. All units are fully isolated and do not require external isolation transformers. The inrush current on the connection to the line is internally limited to a safe level for the drive. There are no voltage selection or ranging switches required to operate within the specified voltage input ranges.

The S200 series drives are functionally compatible with all standard forms of three phase AC lines:

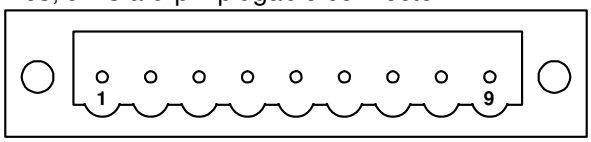
- Grounded neutral WYE
- Open-Delta Grounded Leg
- TEE

NOTE

It is the customer's responsibility to supply appropriate fuses or circuit breakers in the J1 AC drive power lines to comply with local electrical codes.

The control input power required is between 5 and 10 watts. The AC motor input power depends on output power and losses in the power stage.

On AC input drives, J1 is a 9-pin plugable connector.



(J1 Connector view from front of drive).

Pin	Description
J1-1	PE (Protective Earth) – Must be tied back to central earth bar.
J1-2	REGEN - Model S20660 uses a 26 Ω resistor. For all other models, the chosen resistor must be rated for the appropriate peak power (400 V ^2 / x Ω). For example, 25 to 50 Ω for the S20260 and 20360 drives or 15 to 50 Ω for the S20630 and S20330.
J1-3	-BUS DC – Internal DC Bus negative connection (Not normally used)
J1-4	+BUS – Internal DC Bus Positive Connection (Regen Resitor Termination Point)

J1-5	C2 CTRL VAC – Logic control Power
J1-6	C1 CTRL VAC – Logic Control Power
J1-7	L3 240 VAC – Main Line
J1-8	L2 240/120 VAC – Main Line
J1-9	L1 240/120 VAC – Main Line

J1 Mating Connector Information

Screw Terminal Connector:
12 – 24 AWG Wire Range, Phoenix MSTB2,5/9-STF-5,08-BK
OR Spring Cage Clamp Connector
12 – 24 AWG Wire Range, Phoenix FKC 2,5/9-SFT-5,08-BK
OR Crimp Connector
14-20 AWG Wire Range, Phoenix MSTBC 2,5/9-STZF-5,08-BK
Crimp Contact: 14-16 AWG Wire Range, Phoenix MSTBC-MT 1,5-2,5
Crimp Contact: 18-20 AWG Wire Range, Phoenix MSTBC-MT 0,5-1,0

Refer to www.phoenixcon.com.


CAUTION

To avoid damage to the connector and drive, NEVER plug or unplug J1 with power applied.

J1-1 PE Protective Earth

Protective Earth: This chassis ground point **must be connected to Protective Earth ground.** The connection at the Protective Earth ground end **must be hard wired** (do not use a plugable connection). A ground fault detector (RCD) cannot be depended on for safety.

J1-2 REGEN

Connection for an optional regeneration power resistor to absorb regenerated energy from the motor. Models S20260, S20360 use 36 Ω. Use a Wire wound resistor with 1500 V_{RMS} isolation between terminals and case. Many applications do not require a regen resistor. If over-voltage faults occur during motor deceleration, connect the proper ohm 50 to 300 watt power resistor from this terminal to terminal J1-4 (+BUS). The power rating of the regen resistor depends on the amount of regenerated energy that needs to be dissipated.


WARNING

The Regen input is not short circuit protected. The Regen Resistance MUST be within specified ranges to prevent damage to the drive. For example, between 25 to 50 Ω for the S20260, S20360 drives or 15 to 50 Ω for the S20660.


NOTE

For safety, either mount the external resistor on a grounded panel or wire it to a grounded connection. The terminals of the resistor MUST NOT be grounded.


WARNING

Wait 5 minutes after power is removed for the bus cap voltage to decay to a safe level before touching the regen resistor or wiring. Monitor the voltage on the bus caps with a voltmeter from +BUS (J1-4) to -BUS (J1-3).

J1-3 -BUS

The -BUS terminal is usually left open during normal operation. In special multi-axis applications drive buses can be wired in parallel to allow returned energy from one motor to power another and limit high regen powers.

J1-4 +BUS

The +BUS terminal is used with the J1-2, REGEN, terminal to add a regen resistor to the drive to absorb regenerated energy.

NOTE

After powering down the drive, monitor the BUS voltage by connecting a meter from J1-4 (+BUS) to J1-3 (-BUS) to verify the internal BUS capacitors have discharged prior to working on the drive.

J1-5, J1-6
C2 CTRL VAC
C1 CTRL VAC

These terminals connect 120/240 VAC power to the drive's control voltage power supply.

Input Voltage Range (RMS)	85 VAC to 265 VAC single phase 47 to 63 Hz 120 VDC to 375 VDC
Inrush Peak Current	10 A 0-p with 240 VAC Input
Inrush pulse width	1.60 ms
Fusing	Bussmann MDA – ½

NOTE

For maximum ride through capability a 240 VAC input is recommended.

J1-7, J1-8, J1-9
L3 240 VAC
L2 240/120 VAC
L1 240/120 VAC

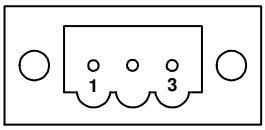
These terminals connect 120/240 VAC power to the drive's output power stage BUS.
For single phase operation 120/240 use inputs J1-8, L2, and J1-9, L1.

Input Voltage Range	90 to 265 VAC		
Phases	1 or 3		
Transformer	2 to 3 KVA – recommended KVA if transformer is required		
Maximum AC Line	100 KVA[1]		
Inrush Peak Current	140 A 0-p with 240 VAC input		
Inrush pulse width	1.5 ms		
Fusing	**S20260**	**S20360**	**S20660**
240 VAC 3 Phase	Bussmann MDA-5	Bussmann MDA-8	Bussmann MDA-15
240 VAC 1 Phase	Bussmann MDA-5	Bussmann MDA-10	Bussmann MDA-10
120 VAC 1 Phase	Bussmann MDA-5	Bussmann MDA-10	Bussmann MDA-10

[1] ***Maximum AC Line is specified to limit the mains surges to the drive.***

2.5.2 J1 – DC Input Power Models Drive Power Connector

The S200 DC input drives should be powered from power supplies with reinforced isolation.
On DC input drives, J1 is a 3 pin plugable connector.



(J1 Connector view from front of drive).

Pin	Description
J1-1	+CTRL
J1-2	BUS/CTRL GND
J1-3	+BUS

CAUTION

To avoid damage to the connector and drive, NEVER plug or unplug J1 with power applied.

Mating Connector Information

Screw Terminal Connector
12 – 24 AWG Wire Range, Phoenix MSTB2,5/3-STF-5,08-BK
OR Spring Cage Clamp Connector
12 – 24 AWG Wire Range, Phoenix FKC 2,5/3-SFT-5,08-BK
OR Crimp Connector
Crimp Shell: 14-20 AWG Wire Range, Phoenix MSTBC 2,5/3-STZF-5,08-BK
Crimp Contact: 14-16 AWG Wire Range, Phoenix MSTBC-MT 1,5-2,5
Crimp Contact: 18-20 AWG Wire Range, Phoenix MSTBC-MT 0,5-1,0

Refer to www.phoenixcon.com.

J1-1
+CTRL

Control power input. The DC drive accepts +10 to +90 VDC on this input referenced to J1-2. An isolated regulated or isolated unregulated power supply can be used. This input can be connected to +Bus input, J1-3, and powered by the same supply as +Bus.
The control power supply should be rated for 20 watts. While the power drain typically is 2 W to 8 W, a 20 W supply ensures reliable starting of the drive.

J1-2
BUS/CTRL GND

Power return for the control and BUS power supplies. The BUS/CTRL GND is connected to I/O RTN internally in the drive.

J1-3
+BUS

Main power input to the drive. The DC drive accepts +20 to +90 VDC on this input referenced to J1-2. An isolated regulated or isolated unregulated power supply can be used. The +Bus power drain with +Bus voltage at 75 VDC is in the range shown below. It varies according to the application and motor.

	S20330 (3 Amp)	S20630 (6 AMP)
+Bus Continuous Power	250 watt	500 watt
+Bus Peak Power	750 watt	1,500 watt

NOTE

Refer to the DC Power Supply Requirements section for detailed requirements selecting a compatible power supply.

PE
Screw Connection

Protective Earth connection point. This chassis ground point **must be connected to Protective Earth ground.** The connection at the Protective Earth ground end **must be hard wired** (do not use a pluggable connection).

2.5.3 DC Input Power Model Power Supply Requirements

Bus Voltage (J1-3 to J1-2)	+ 20 VDC to + 90 VDC	
BUS Supply Current	**48 VDC BUS**	**75 VDC BUS**
S20330 Continuous Peak (3 sec)	3.3 ADC at 160 W 10 ADC at 480 W	3.3 ADC at 250 W 10 ADC at 750 W
S20630 Continuous Peak (3 sec)	6.7 ADC at 320 W 20 ADC at 960 W	6.7 ADC at 500 W 20 ADC at 3,000 W
BUS Output Capacitance (min)	**48 VDC BUS**	**75 VDC BUS**
S20330	4,000 µf, 63 V	2,000 µf, 100 V
S20630	8,000 µf, 63 V	4,000 µf, 100 V

Bus Supply Characteristics

The BUS Supply should have the following characteristics:

- Must provide safety isolation from the power line
- Can be regulated or unregulated
- Bus Supply Return is connected to the Control Supply Return and I/O RTN in the drive

Typical BUS Supply:

- Unregulated, Isolating, step down transformer with secondary rectified into capacitive filter
- BUS Supply Return is connected to earth ground

Wiring from BUS Supply to Drive

10 ft maximum
16 AWG (minimum)
Twisted pair
Daisy chaining of multiple drive OK
No contactor or switching in the BUS wiring

Control Voltage (J1-1 to J1-2)

+ 10 VDC to +90 VDC

Control Supply Type

Isolating
Unregulated or Regulated
Common GND with bus supply and I/O RTN
20 watt supply or 1 amp short circuit

Control Supply Wiring

Wire control (J1-1) to bus (J1-3)
or
Wire control (J1-1) to separate supply to preserve status and fault information. (+ 10 VDC to + 30 VDC supply can be shared by Control and I/O)

Control Supply Current	20 to 110 mA at 75 VDC 60 to 330 mA at 24 VDC 125 to 660 mA at 12 VDC
Bus Voltage	Bus voltage outside the operating range (20 to 90 V) causes an under-voltage or over-voltage fault. Under-voltage and over-voltage faults self clear when the fault condition clears.

NOTE

Do Not allow the Bus Voltage to exceed + 90 VDC. This causes damage to the drive.

Target design center voltage for unregulated supply is + 70 to + 75 VDC. This provides 15 to 20 VDC margin for line tolerance, transformer regulation, and regen pump up. Design center voltage for a regulated supply can be up to + 80 VDC.

2.5.4 Control Voltage

The control voltage range for normal operation is + 10 VDC to + 90 VDC. The control voltage can either be wired to the bus voltage so one supply can power the drive, or from a separate supply. Separately powering the control from the bus allows the bus to be powered down for safety while drive status and fault information remain available. A single + 10 VDC to + 30 VDC supply can be shared by Control and I/O.

NOTE

Do Not allow the Control Voltage to exceed + 90 VDC as it can damage the drive.

2.5.5 Grounding

Provide safety isolation with the external bus and control supplies from the power line.

NOTE

The drive cannot be powered from an electrically Hot supply as it does not contain an isolation barrier.

The Ctrl and Bus voltages and non-opto coupled I/O grounds (I/O RTN) are tied together inside the drive. The Ctrl and Bus power supplies share a ground pin (Bus/Ctrl Gnd). Join and connect to the negative terminals of the Ctrl and Bus power supplies. The I/O RTNs are normally connected to the signal ground of the system. (Some of the I/O is opto coupled and have separate returns. Thoroughly review this document for details.)

Earth the power supply negative terminal somewhere in the cabinet. Also earth the chassis. In normal operation, there should be no significant voltage between earth and the Bus/Ctrl Gnd and I/O RTNs.

NOTE

The maximum voltage allowed between Bus/Ctrl Gnd and chassis is 100 VDC.

2.5.6 Bus Capacitance

There is a minimum requirement on the output capacitance of the bus power supply for the DC input S200. This capacitor is needed to absorb energy during motor deceleration and motor disable and to help provide energy during motor acceleration. For multiple S200 drives operated from one supply the recommendation is to increase the capacitance according to the number of drives. For example, for four 6 A / 18 A_{RMS} DC S200 drives powered from one 75 VDC supply the recommended minimum bus output capacitance of the supply is 4 x 4,000 µf = 16,000 µf. Bus capacitor voltage rating should be 100 V. Bus capacitor type is aluminum electrolytic.

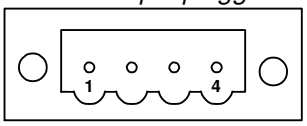
2.5.7 Bus Switching and Fusing

Do not put E-Stop switches or contactors between the drive bus pin (J1-3) and the power supply bus capacitor. There is a risk of damage to the drive if the bus is disconnected from the power supply capacitor when the drive is enabled. The motor does not need to be rotating to regenerate energy. The motor windings store magnetic energy that regenerates back to the supply when the drive is disabled.
E-stop switches can safely be located in series with the primary winding of a step down transformer. If individual axis E-Stop switches are required, connect a local (unswitched) capacitor (1,000 µf, 100 V) across the drive bus terminals (J1-3 to J1-2).
If the buses of individual drives are to be fused, select the fuse type and rating for high margin.

S20630 (6 amp)	S20330 (3 amp)
15 A, Slo-Blo (Bussmann MDA-15)	7 A, Slo-Blo (Bussmann MDA-7)

2.6 *J2 – MOTOR POWER CONNECTOR*

J2 is a 4 pin pluggable connector.



(J2 Connector view from front of drive).

Pin	Description
J2-1	PE (Chassis Ground) on S200 AC Input Drives BUS/CTRL GND on S200 DC Input Drives
J2-2	Motor Phase W
J2-3	Motor Phase V
J2-4	Motor Phase U

Mating Connector Information
Screw Terminal Connector: 12 – 24 AWG Wire Range, Phoenix MSTB2,5/4-STF-5,08-BK
OR
Spring Cage Clamp Connector: 12 – 24 AWG Wire Range, Phoenix FKC 2,5/4-SFT-5,08-BK
OR
Crimp Connector
Crimp Shell: 14-20 AWG Wire Range, Phoenix MSTBC 2,5/4-STZF-5,08-BK
Crimp Contact: 14-16 AWG Wire Range, Phoenix MSTBC-MT 1,5-2,5
Crimp Contact: 18-20 AWG Wire Range, Phoenix MSTBC-MT 0,5-1,0
Refer to www.phoenixcon.com

J2-1 PE Motor Case Ground On S200 AC Input Drives this point is connected to Chassis Ground.

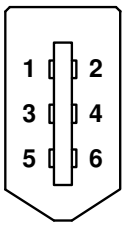
J2-2, 3, 4 Motor Phases These three terminals provide the 3-phase power output to the motor.

NOTE

Observe motor polarity, connect phase U on the drive to phase U on the motor, etc.
For nonstandard motor drive combinations consult the factory for proper phase orientation.

2.7 J3 – FEEDBACK CONNECTOR

J3 is a 6-pin plugable IEEE 1394 style connector for the feedback device. Although this connector mechanically accepts standard IEEE 1394 cables, it is electrically **not** an IEEE 1394 interface. The base drive accepts either SFD (Smart Feedback Device) or Hall inputs.



(J3 Connector view from front of drive)

Pins	Description
J3-1	SFD +5 V (200 mA)
J3-2	SFD +5 RTN
J3-3	SFD COM-
J3-4	SFD COM+/CU
J3-5	NC/CV
J3-6	NC/CW
Shell	Shield Connection

Mating Connector Information

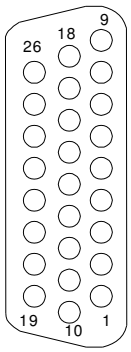
IEEE1394, Firewire type, 2.0 mm plug set
22 AWG Max., Molex 55100-0600

Refer to www.molex.com for assembly instructions.

J3 –1 **SFD +5 V**	This terminal provides a 5 VDC output to power the feedback device. For example, motor equipped with SFD, Halls or commutation encoder. The load current should not exceed 200 mA.
J3-2 **SFD +5 RTN**	This terminal is the return connection for the 5 VDC supply. An inner feedback cable shield can be connected to this point. Outer shields should connect to the shell which is PE.
J3-3 **SFD COM-**	SFD serial communications port when using the SFD feedback device. No connection when using Hall feedback.
J3-4 **SFD COM+** / **CU**	SFD serial communications port when using the SFD feedback device. CU (Commutation Phase U) input when using open collector Hall feedback. This input has a 2.21 kΩ pull-up resistor to 3.3 volts.
J3-5 **NC** / **CV**	No connection when using the SFD feedback device. CV (Commutation Phase V) input when using open collector Hall feedback. This input has a 2.21 kΩ pull-up resistor to 3.3 volts.
J3-6 **NC** / **CW**	No connection when using the SFD feedback device. CW (Commutation Phase W) input when using open collector Hall feedback. This input has a 2.21 kΩ pull-up resistor to 3.3 volts.
Shell	Outer shield connection (wired to PE in the drive).

2.8 *J4 – COMMAND I/O CONNECTOR*

J4 is a 26-Position High Density D subminiature female connector.



(J4 Connector view from front of drive.)

Pin	Description	Pin	Description
J4-1	DINP COM	J4-14	DAC MON1
J4-2	DINP1 (Enable)	J4-15	DAC MON2
J4-3	DINP2	J4-16	I/O RTN
J4-4	DINP3	J4-17	Encoder Output Channel Z
J4-5	DIP4 (MSINP1)	J4-18	Encoder Output Channel $\overline{Z}$
J4-6	DOUT1-	J4-19	Channel A Encoder Output
J4-7	DOUT1+ (Fault)	J4-20	Channel $\overline{A}$ Encoder Output
J4-8	DOUT2-	J4-21	Channel B Encoder Output
J4-9	DOUT2+ ($\overline{RUN}$)	J4-22	Channel $\overline{B}$ Encoder Output
J4-10	DINP 5+ (HSINP1+)	J4-23	I/O RTN
J4-11	DIP5 – (HSINP1-)	J4-24	Analog Command Input +
J4-12	SFD BAT+	J4-25	Analog Command Input -
J4-13	I/O RTN	J4-26	I/O RTN

Mating Connector Information

26-Pin Male High Density D-Sub with Back shell Kit
24 AWG Max., NorComp 180-026-102-001 – D-Sub Connector
NorComp 978-015-010-03-1 – Back shell Kit

Refer to www.norcomp.net.

2.8.1 Base Drive Unit General Purpose Inputs

General Purpose Inputs DINP1-3 J4-2, 3, 4

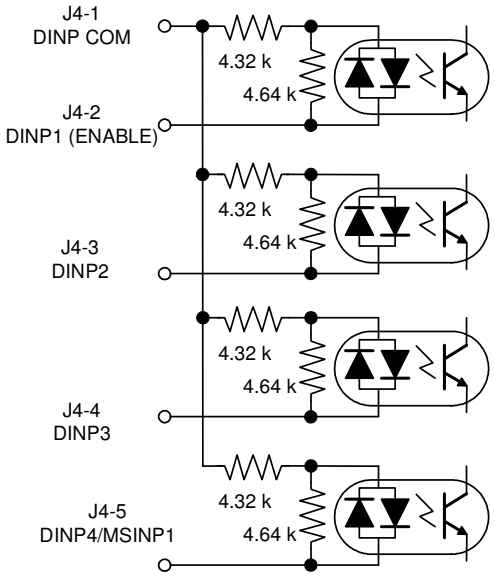
The general purpose inputs are a bank of four inputs that share a common terminal, DINP COM, on J4-1. The inputs operate over a wide input voltage range of ± 4.0 to ± 30 volts.

DINP4 J4-5

General purpose inputs are compatible with either sourcing or sinking currents to provide maximum flexibility for interfacing to field wiring.

Common Input Terminal J4-1

Common Rail for Inputs 1 through 4. Common can be tied to positive supply or negative supply, depending on the application need.



Input current is a function of the input voltage and listed in the following table.

Input Voltage (±)	Input Current (±)
4.0 volts	0.65 mA
5.0 volts	0.95 mA
12 volts	2.5 mA
24 volts	5.3 mA
30 volts	6.7 mA

The response time for DINP1, DINP2 and DINP3 is less than 1 ms. MSINP1 has a response time of less than 100 µs.

NOTE

For fastest response to an input, configure the drive to respond when the input opto isolator is turned on (current starts flowing in the photo diode).

The list below describes the factory defaults for each of the inputs. A logic input is active when current is flowing through the photo diode. Inactive inputs are open circuited.

Default Input Functions

DINP1 (ENABLE) — **Input 1**: This input enables the drive. When input 1 is activated (current flowing in the photo diode), the drive is enabled. This input must be actively driven to enable the drive. An open circuited input disables the drive.

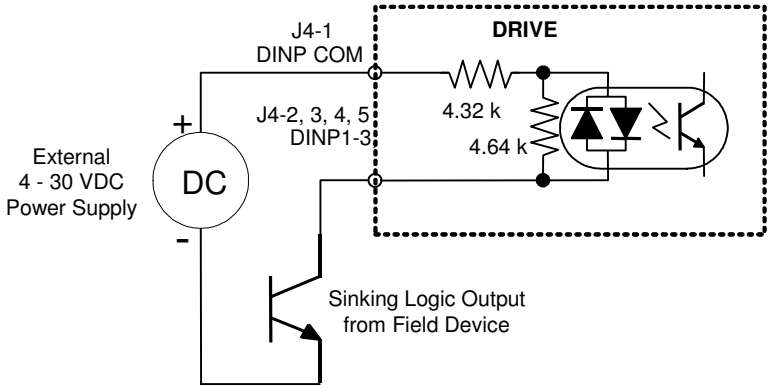
DINP2 — **Input 2**: General purpose input default assigned to Home Switch.

DINP3 — **Input 3**: General purpose input default assigned to Start Move BCD.

DINP4 — **Input 4**: General purpose input default assigned to Move Select Bit. One of two inputs that can be assigned as end-travel limit switch inputs.

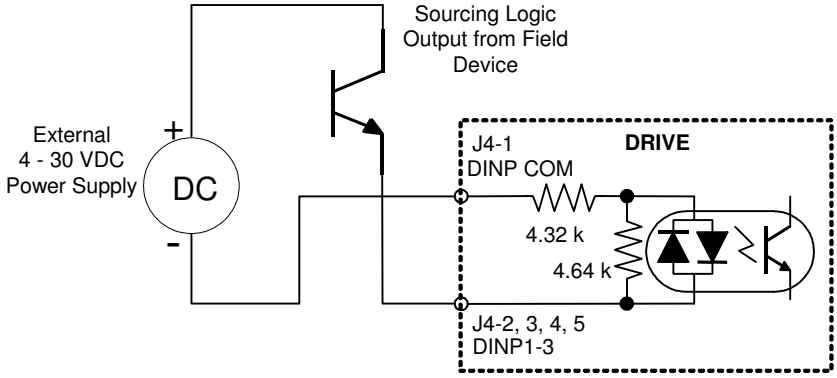
Sinking Logic

For compatibility with sinking outputs, the DINP COM terminal is connected to the positive terminal of a power source (4.0 to 30 VDC). The input (DINP1-3) is connected to the sinking logic output of the field device as shown.



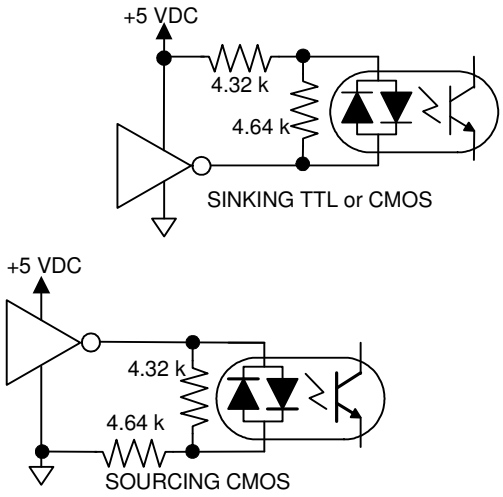
Sourcing Logic

For compatibility with sourcing outputs, the DINP COM terminal is connected to the negative terminal of the power source (4.0 to 30 VDC). The input (DINP1-3) is connected to the sourcing logic output on the field device as shown.



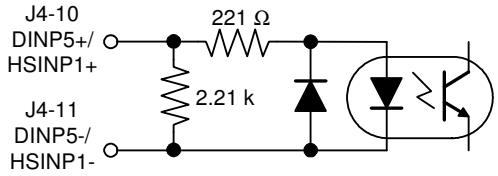
TTL and CMOS Drivers

The following are examples of driving with TTL or CMOS output device



DINP5 (and10)
J4-10, 11

General Purpose input default assigned as 'No Function'. One of two inputs that can be assigned as end-travel limit switch inputs. Tie pin 10 or 11 to common rail for normal operation.



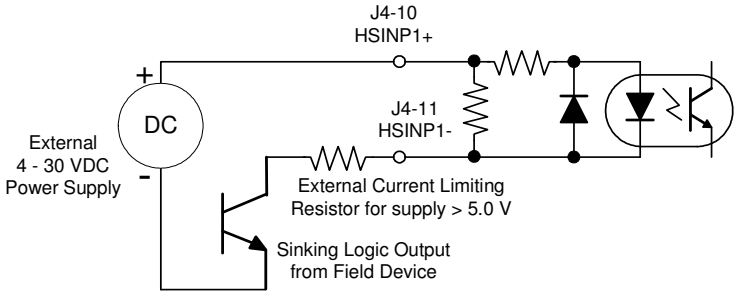
The high speed input works directly with 5 volt input, 3.0 to 6.0 volt range, without the use of a current limiting resistor. To operate the input with voltages higher than 5 volts, an external current limiting resistor is required in series with the input.

The input current should be in the range of 9 to 24 mA for proper operation. The following table lists the recommend current limiting resistors for supply voltages greater than 5 volts.

SUPPLY VOLTAGE	CURRENT LIMITING RESISTOR
5 Volts	None
12 Volts	360 Ohm ¼ Watt
24 Volts	1000 Ohm ¼ Watt

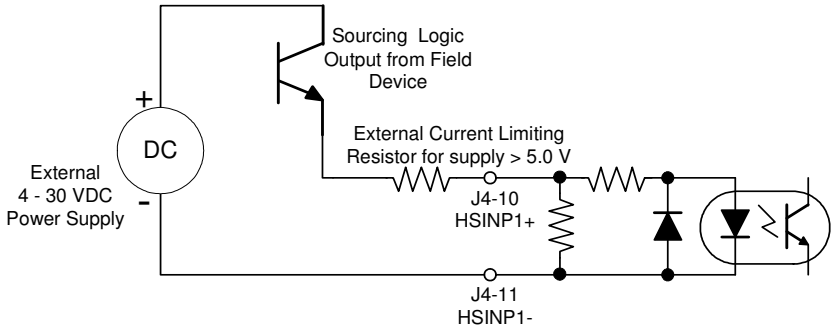
Sinking Load

For single ended operation, both terminals of the high speed input are available on J4 allowing the input to be connected to either sinking or sourcing logic. The following shows the connections to drive the high-speed input from sinking logic.



Sourcing Load

The following shows the connections to drive the high speed input from sourcing logic. The power supply can be the same power source used to provide power for the general purpose inputs.



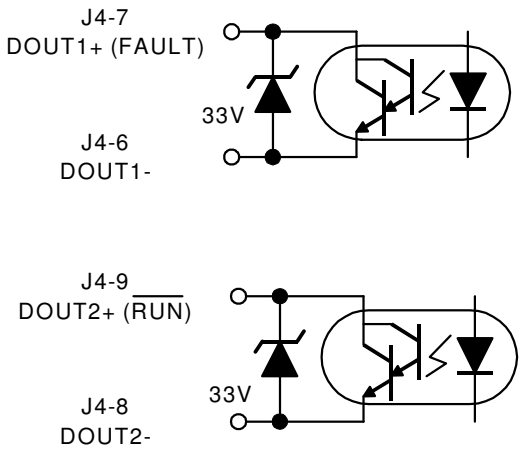
2.8.2 Base Drive Unit Outputs

General Purpose Outputs

DOUT1 and DOUT2 are optically isolated outputs that provide information about the state of the drive. The outputs are Darlington phototransistors with a 33 volt zener diode wired in parallel to clamp voltage transients.

J4-6,7
DOUT1
FAULT

J4-8,9
DOUT2
$\overline{\text{RUN}}$



The following table lists the maximum output rating.

Maximum Voltage	30 VDC
Maximum Current	50 mA
V_{ON}	1.0 V at 10 mA
	1.2 V at 50 mA
I_{OFF}	5 µA
Response time	1 ms
Clamp voltage	33 V (nominal)

CAUTION

The outputs are not short circuit protected. Configure the application to ensure the maximum current is not exceeded.

The list below describes the factory defaults for each of the outputs.

DOUT1 (FAULT)

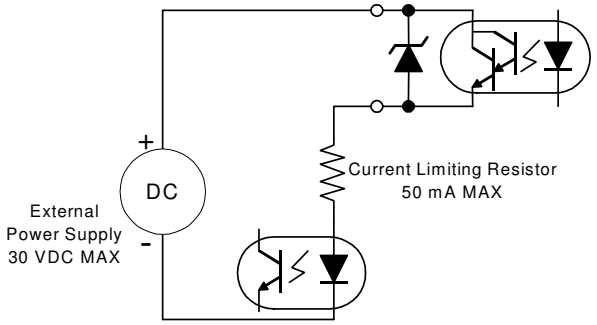
Output 1: This output provides the FAULT state of the drive. When the drive is powered and not faulted, the output transistor is turned on. When the drive is faulted or not powered, the output transistor is turned off.

DOUT2 ($\overline{\text{RUN}}$)

Output 2: This output provides the RUN state of the drive. When the drive is powered, not faulted and enabled, the output transistor is turned on. When the drive is faulted, not enabled or not powered the output transistor is turned off. This output indicates when the drive is capable of running the motor.

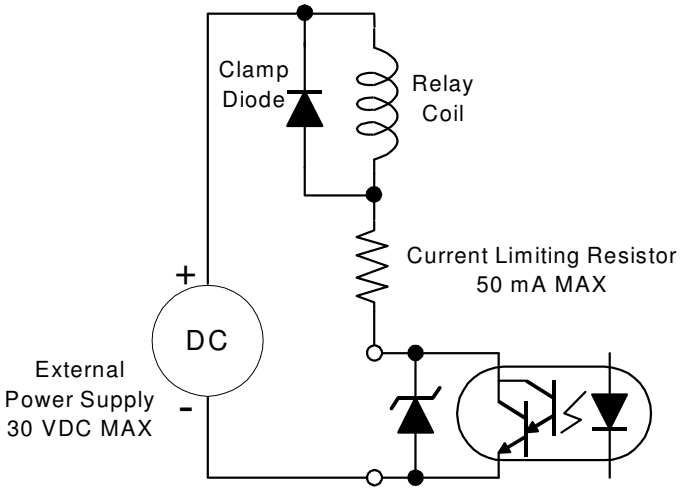
Both the collector and emitter of the phototransistor are on J4, providing the capability to drive either sinking or sourcing loads.

Sinking Load



An opto isolator is being driven in this example. The current through the output needs to be limited to 50 mA or less, which is accomplished by selecting an appropriate current limiting resistor. The voltage of the external power source needs to be 30 VDC or less and can be the same source used to provide power to the inputs.

Sourcing Load



In this example, a relay coil is being driven. The current through the coil needs to be limited to 50 mA or less, which is accomplished by selecting an appropriate value of current limiting resistor.

The voltage of the external power source needs to be 30 VDC or less and can be the same source used to provide power to the inputs. A clamp diode must be added across the coil to clamp the voltage during turn-off.

2.8.3 SFD BAT+


NOTE

SFD BAT is not implemented.

2.8.4 DAC Monitors

J4-14
DAC MON1
J4-15
DAC MON2

The DAC Monitors are general-purpose analog monitor points. The output range is 0.5 to 4.5 volts with a source impedance of 2.9 kΩ, which limits the short circuit to I/O RTN to 2 mA.

Each DAC Monitor can be mapped by software to one of a number of internal variables.

J4-13, 16, 23, 26
I/O RTN

I/O RTN is the ground reference for the DAC MON, Analog Command, Encoder output/inputs, and SFD BAT+. These pins are electrically shorted together inside the drive.


NOTE

Connect one of the I/O RTN pins to an earth ground point in the cabinet reserved for single point grounding of all returns (drives and supplies) to control common mode voltage.

2.8.5 Encoder Outputs

J4-19
CH A OUT/IN

Channels A and B are RS-485 compliant differential outputs.

J4-20
CH A OUT

Channels A and B provide position signals generated from the feedback device that emulate a quadrature encoder.

J4-21
CH B OUT

J4-22
CH B OUT

The outputs are buffered by 5.0 volt 75LBC170 type RS-422 compatible line drivers. Recommended load current is ±20 mA, which corresponds to a line-to-line load resistance of 100 Ω. These outputs are short circuit proof to I/O RTN.

Outputs

The resolution of the Encoder Outputs (number of pulses per motor revolution), is set by S1 (rotary switch), as follows:

S1 Position	*Encoder Pulses/Revolution*
0	User settable[1] (factory default = 500)
1	512
2	1000
3	1024
4	2000
5	2048
6	4096
7	5000
8	8192
9	10000

[1] ***User settable non-volatile PPR via the serial port is more flexible with the following PPR:***
128, 512, 1024, 2048, 4096, 8192, 16384, 32768,
125, 500, 1000, 2000, 2500, 5000, 10000, 20000

The maximum output line frequency is 2.5 MHz. Limit line frequency to below 1.25 MHz, which corresponds to quadrature count frequency below 5 MHz, for robust operation.

NOTE

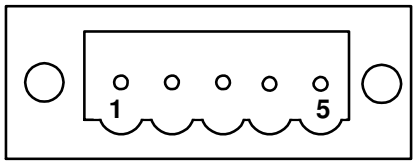
The emulated encoder output is only available when using a high resolution feedback device such as the SFD feedback to the base unit or Encoder feedback to the option card. The emulated encoder outputs have no signals when there is only base unit 6-step feedback.

J4-17, 18
CH Z OUT
CH Z OUT

The CH Z output is only available when using SFD Feedback. These two terminals function as a differential, TTL marker pulse. The output pulse occurs once per motor shaft revolution, starting at feedback device position = 0. Its width is one line width or two quadrature encoder widths.

2.8.6 J11

J11 is a five-pin plugable connector to the CAN physical layer and is compliant with CANOpen and the DeviceNet specification (less color code requirements).



Pin	Description	DeviceNet Color
J11-1	V-	Black
J11-2	CAN_L	Blue
J11-3	Shield	Bare
J11-4	CAN_H	White
J11-5	V+	Red

J11-1 V- Return on power supply to CAN physical layer

J11-2 CAN_L Low level CAN transmission signal

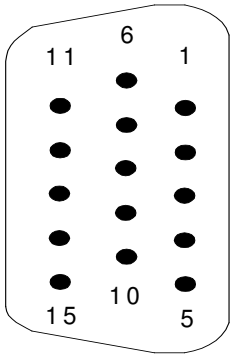
J11-3 Shield Shield connection point. Tied to chassis ground through 1MΩ resistor in parallel with 0.01 μF capacitor

J11-4 CAN_H High level CAN transmission signal

J11-5 V+ Power supply input for CAN physical layer. Rated 11-26 volts dc. Typically draws 30mA

2.8.7 J12

J12, Option Card General Purpose I/O is a 15-Position High Density D subminiature male connector.



Pin	Description	Pin	Description
J12-1	DINP COM	J12-9	DINP10 +
J12-2	DINP6	J12-10	+5VDC
J12-3	DINP7	J12-11	I/O RTN
J12-4	DINP8	J12-12	CMD CH A+
J12-5	DINP9	J12-13	CMD CH A-
J12-6	OUT3 -	J12-14	CMD CH B+
J12-7	OUT3 +	J12-15	CMD CH B-
J12-8	DINP10 -		

General Purpose Inputs DINP 6-9 J12-2, 3, 4, 5 Common Input Terminal J12-1

The general purpose inputs are a bank of four inputs that share a common terminal, DINP COM, on J12-1. The inputs operate over a wide input voltage range of ± 4.0 to ± 30 volts. General purpose inputs are compatible with either sourcing or sinking currents to provide maximum flexibility for interfacing to field wiring.

OUT3 J12-6,7

This output pair provides a general purpose output configurable by software to perform one of a variety of functions.

DINP 10: High Speed Input J12-8, 9

General Purpose Input with uncommitted opto isolator design. Same as DINP 5 on Base Unit. Can be tied to common rail (may require a resistor – see DINP 5 on page 35.

J12 –10 +5 VDC

This terminal provides a 5 VDC output to power an external command encoder, if necessary. The load current should not exceed 200 mA.

J12-11 I/O RTN

This terminal is the return connection for the 5 VDC supply. An inner feedback cable shield can be connected to this point. Outer shields should connect to the shell which is PE.

Shell	Outer shield connection (wired to PE in the drive).
J12-12 ***CMD CH A+*** ***J12-13*** ***CMD CH A-*** ***J12-14*** ***CMD CH B+*** ***J12-15*** ***CMD CH B-***	Channel A and B inputs can be configured to receive position commands in 1 of 4 modes. The command channels can be placed in quadrature, step and direction, up/down, or hold modes. Either differential or single ended inputs can be received. The drive defaults to differential quadrature mode. In quadrature mode A leads B is a negative count, which corresponds to CCW direction looking into the motor shaft. In step and direction mode, channel B positive commands positive direction. The step on channel A is counted on the rising edge. In up/down mode, channel A is counted up on the rising edge and channel B is decremented on the falling edge. The maximum line frequency is 2 MHz, the maximum quadrature count frequency is 8 MHz, and the minimum pulse width is 250 ns. Please see Section 3 for more information regarding the use of the A and B input channels.

2.8.8 J13

J13 Provides the option to bring a ComCoder feedback into the S200 drive.

Pin	Description	Pin	Description
J13-1	CU	J13-9	PTC RTN
J13-2	CV	J13-10	+5VDC
J13-3	CW	J13-11	I/O RTN
J13-4	NO CONNECT	J13-12	ENC CH A+
J13-5	I/O RTN	J13-13	ENC CH A-
J13-6	ENC CH Z+	J13-14	ENC CH B+
J13-7	ENC CH Z-	J13-15	ENC CH B-
J13-8	PTC		

J13-1
CU
CU (Commutation Phase U) input when using open collector Hall feedback. This input has a 2.21 kΩ pull-up resistor to 3.3 volts.

J13-2
CV
CV (Commutation Phase V) input when using open collector Hall feedback. This input has a 2.21 kΩ pull-up resistor to 3.3 volts.

J13-3
CW
CW (Commutation Phase W) input when using open collector Hall feedback. This input has a 2.21 kΩ pull-up resistor to 3.3 volts.

J13-4
NC
No connect

J13-5
I/O RTN
This terminal is the return connection for the 5 VDC supply. I/O return is internally connected to PTC return. An inner feedback cable shield can be connected to this point. Outer shields should connect to the shell which is PE.

J13-6
CH Z +
J13-7
CH Z -
The CH Z differential input. The minimum pulse width is 250 ns.

J13-8
PTC
The PTC input has a trip point at 2200 Ω.
If a PTC is not used, PTC must be wired to PTC return.
PTC return is internally connected to I/O return

J13-9
PTC RTN

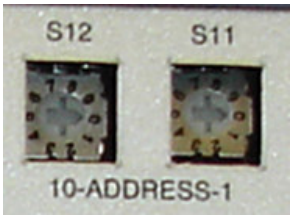
J13 –10
+5 VDC
This terminal provides a 5 VDC output to power an external command encoder, if necessary. The load current should not exceed 200 mA.

J13-11
I/O RTN
This terminal is the return connection for the 5 VDC supply. I/O return is internally connected to PTC return. An inner feedback cable shield can be connected to this point. Outer shields should connect to the shell, which is PE.

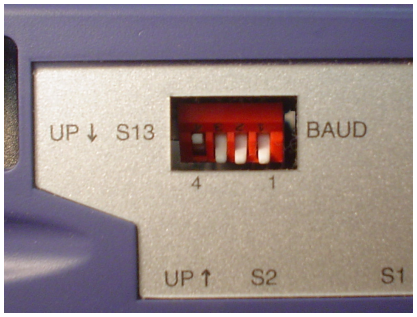
Shell
Outer shield connection (wired to PE in the drive).

J13-12 ***CMD CH A+***	Channel A and B inputs that can be configured to receive differential, quadrature feedback.
J13-13 ***CMD CH A-***	Channel A leads B is a negative count, which corresponds to CCW direction looking into the motor shaft.
J13-14 ***CMD CH B+***	The maximum line frequency is 2 MHz, the maximum quadrature count frequency is 8 MHz, and the minimum pulse width is 250 ns.
J13-15 ***CMD CH B-***	

2.8.9 Switch Settings



Address Switch S11 & S12 set the MAC ID. The two rotary decimal switches are used to set the CAN address from 00 to 99.



Baud Rate Switch S13 sets the baud rate. The 4-position piano style dip switch located at the top of the drive uses switches 1 & 2 to set the baud rate. Switches 3 and 4 are reserved. The reference of Up is indicated on the label at S13.

S13-1	S13-2	S13-3	S13-4	BAUD RATE SETTING (1000 BITS PER SECOND)
Down	Down	Reserved	Reserved	125 kbps
Up	Down	Reserved	Reserved	250 kbps
Down	Up	Reserved	Reserved	500 kbps
Up	Up	Reserved	Reserved	1 Mbps

2.8.10 LED2

Bicolor LED2. The module/network status LED

LED STATE	DRIVE STATE	INDICATION
OFF	Off-line	Drive not on line
Solid RED	Failed	Critical failure on drive or Communication failure (bus off) Drive may need to be replaced.
Solid Green	Connected and not faulted	Drive is on-line and is connected and drive is in normal operation and not faulted.
Blinking RED	Faulted	Drive should be power cycled. The drive has faulted or a time out has occurred.
Blinking Green	Not connected and not faulted	Drive is operational and not faulted. Drive is on-line but not connected.

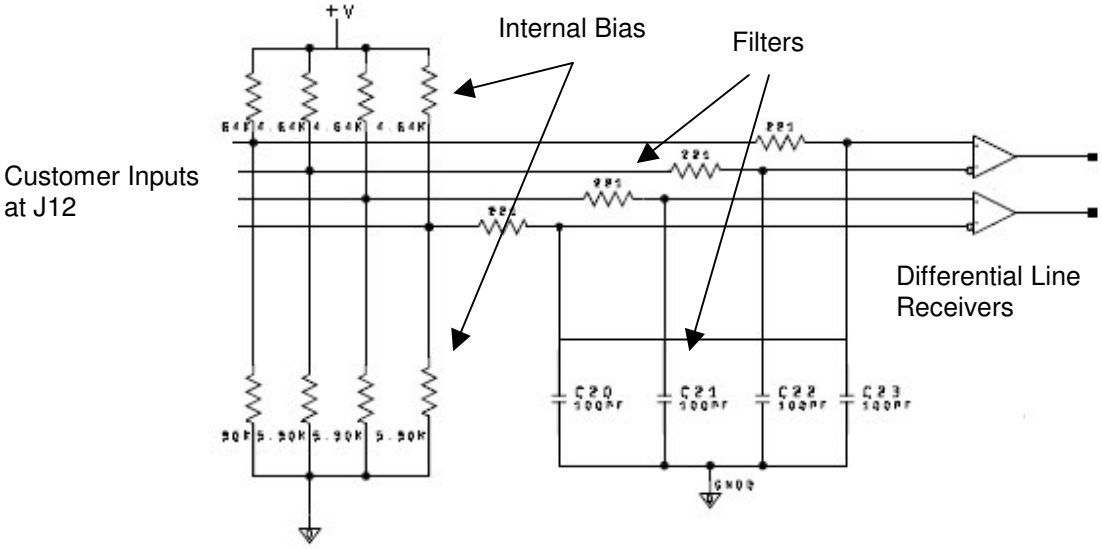
3 OPERATIONAL NOTES

The S200 Position Node product is simple and intuitive to setup and use. Chapter 5 is designed to help the user step through the User Interface Software, S200 OC TOOLS, explaining much of the operation and setup. Chapter 4 is designed to provide some insight on the application setup for the product and to discuss some details about the product operation.

3.1 *ENCODER INPUT CHANNELS*

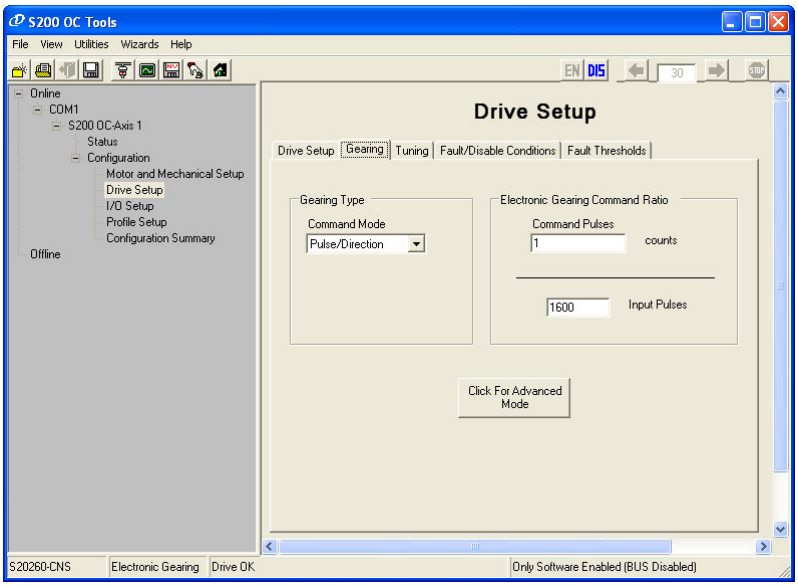
The S200 CNS Option has the ability to accept pulsed position command input. The digital command can be set to come from an incremental encoder (gearing), step and direction controller (pulse and direction), or count up/down. The inputs for these modes come in the encoder input connections on J12 pins 12-15.

The internal circuitry of these 4 inputs is shown in the following diagram. The circuits are designed to facilitate a wide range of compatible driver configurations. They may be tied to differential line drives (as with normal incremental encoders), Open Collector Outputs (some pulse and direction controllers), or TTL drivers (wide applications). Driving circuits should be wired accordingly and must have the DC Commons of the drive and controller tied together. Failure to tie the DC commons together can cause operation that is difficult to predict.



3.2 PULSE (STEP) AND DIRECTION

When using pulse and direction the pulses for command come in on the A channel and the direction on the B channel. The data in Section 3.1 will facilitate the electrical interface design. Select the 'Mode of Operation (Drive Setup Menu) to 'Electronic Gearing. Set the 'Command Mode' (Gearing menu) to 'Pulse and Direction. And finally, set the pulses per revolution as the 'Electronic Gearing Command Ration as revs / pulses. In the below diagram the system is set up for 1600 pulses per motor revolution.



If no Digital Input is assigned to begin the gearing then the motor will follow pulses a soon as the drive is enabled. A Digital Input can be assigned to start the gearing With or Without correction. If one of these is selected then the input is edge-triggered, meaning that it must go from off-to-on while the drive is ready and enabled. (More on With and Without Correction in Section 3.3).

3.3 DIGITAL INPUT NOTES

Inputs selected for absolute or relative move must be turned on and maintained on for the duration of the move. Motion will terminate if the input assertion goes off during the move.
Only inputs 2 and 3 can be assigned as Registration Move Inputs.

Only Inputs 4 and 5 can be assigned as Direction Limit Inputs.

Using Input 5: Input 5 (DINP5 / HSINP) is an uncommitted high speed opto isolator available at J4 pins 10 and 11. Simply tie pin 10 to the common rail (Pin 1) if the common rail is tied to the positive supply an switch pin 11. Reverse 10 and 11 if the common rail ties to the negative of the supply. Digital input 5 is rated for 3 to 6 volt operation. If the application requires higher voltage than simply make the tie to the I/O common rail with a series dropping resistor.

Gearing With and Without Correction: Used for Electronic gear modes to lock or unlock to / from the master signal. These inputs are edge triggered and must see an off-to-on transition while the drive is ready and enabled for motion in order to get motor motion. Selecting Gearing Without Correction causes the motor to ramp to commanded speed from the master and lock on once the speed is reached. Gearing With Correction causes the motor to ramp to match the master speed and overshoots, if required, to catch up to the exact position of the master at the time that the input was toggled.

Jog Move: This capability exists in both Electronic Gearing and Motion Task modes. Selecting a Digital Input as a Jog Move pops up an associated velocity box. Multiple inputs can be programmed for multiple jog velocities. The sign of the velocity is used to control the direction of the jog.

Fault Reset: The fault reset cannot reset all faults. Please refer to Section 4 for further information about which faults can be reset.

Registration: Simple registration moves can be performed with the S200 Position Node product. The basic concept needs explanation. Registration is required, for example, when a plastic web is being fed into cutter knives from a roll of pre-printed product. For any number of reasons the printing will not be separated by reliable and repeatable distances. The variation must be compensated for. The printed material will have a registration mark once-per-product and the machine will have a detector device capable of detecting this mark. The S200 is set up with a indexing (Relative Move) motion task whose feed length is slightly more than the maximum length ever required to feed one product length into the cutters. Another motion tasking move is defined Registration Move (with ether latch) with a short distance and triggered by the registration mark detector. The machine is ready to operate as follows: The larger Relative Move is executed, the detector triggers the Registration Move DURING the Relative Move, the motor comes to rest the distance defined by the Registration Move motion task AFTER the detector fired. If the detector never trigger the motion comes to stop as defined by the Relative Move distance. The Registration Move distance should be at least enough to cover the deceleration distance. Again, only inputs 2 and 3 can be assigned as Registration Move Inputs.

Relative Move: Relative moves are indexes. Relative Move (w/o Memory) simply moves the distance expected by the distance stated in the motion task. Relative Move (W/ Memory) moves the distance expected in the motion task PLUS and distance remaining from the prior move that was terminated due to the input assertion going away.

3.4 *RAMP CONTROL*

The GUI Revision 1.XX presents no option for acceleration / deceleration control for gearing or jogs. Acceleration control is still possible by using the variable editor to modify the variables ACCR and DECR for independent acceleration and deceleration control, respectively.

*** Always be sure that the ACC and DEC variables are set to maximum values

when using Motion Tasking or Electronic Gearing Modes. Because values of ACC and DEC are velocity loop parameters low values will appear to cause instability and severe overshoot when the product is in a position loop control mode.

3.5 *HOMING*

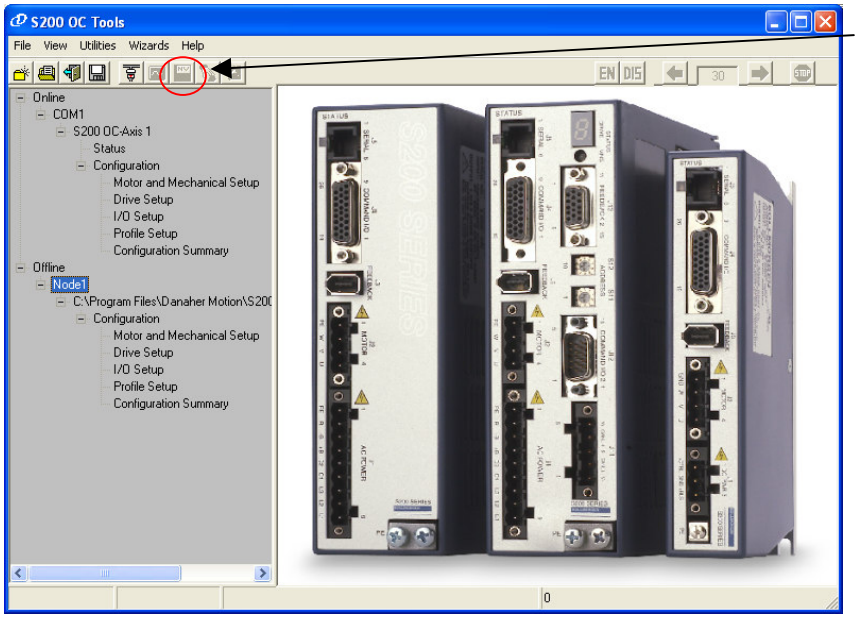
Homing is always required. If the application does not require homing then simply go into the Profile Setup / Homing tab and select 'Set Current Position as Home Position' and 'Auto Home Move Upon Enabling the Drive'.

3.6 *SAVING DRIVE SETTINGS*

It is highly recommended that the properly configured drive have its settings archived on external media for future reconfiguration. Once the drive is operating properly the data can be uploaded to the host computer. S200 OC TOOLS User Interface software is used to accomplish this. The drive must be 'selected' on the 'folder-side' of S200 OC Tools software. Then simply click the file menus; File / Save (or Save As), name the file as desired, and direct the file to the desired directory. The file will default with a '.CNS' extension.

3.7 CONFIGURING DRIVE FROM EXISTING FILE

It is often desirable to configure a drive exactly like another one. This is often the case when reproducing a machine design or changing out a drive on an existing machine. The configuration of the drive is saved as described in section above. S200 OC TOOLS User Interface Software is used to configure the connected drive. The file must first be loaded into S200 OC TOOLS by using the file menus 'File / Open'. Locate and select the desired configuration file. It will be loaded into S200 OC TOOLS 'folder- side' as though there was a second drive talking to the software. The tree structure will show the file as 'Offline' and normally as Node1. The full filename, with path, will be under Node 1. Select this filename with a single click of the left mouse button. The file can be sent to the connected drive by a right-click of the mouse button and selecting 'Download offline Configuration to an Online drive. Save the configuration to Non Volatile memory.



configuration to Non-Volatile Memory.

Right-Click on Node 1 and select Download Off Line Configuration to On Line Drive.

3.8 *UPGRADING FIRMWARE PROCEDURE*

Firmware can be downloaded to the drive using the S200 OC TOOLS User Interface Software. The firmware to download must be accessible by the computer via local media (hard drive, floppy, CDROM, memory stick, etc.). The proper procedure for upgrading firmware is as follows:

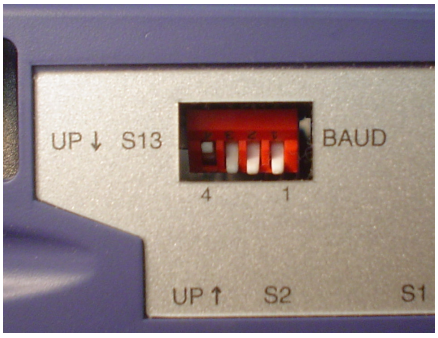
1.) Archive drive settings as described in Saving Drive Settings, above.
2.) Execute the following firmware upgrade procedure.
3.) Clear memory by 'Utilities / Reset Variables to Factory Default'
4.) Restore the drive settings using the procedure describes above for 'Configuring Drive from Existing File

The drive must be selected on the 'folder-side' of the S200 OC TOOLS window. From the menu bar, select 'Utilities / Download new firmware to drive'. The drive must be disabled. If the drive is enabled the software will ask you to disable it. A 'file locator' box will pop up allowing you to locate the desired firmware file to load to the drive. Drive firmware has the extension of '.BIN'.

NOTE

A file name that includes the letters 'CAN' (ie: S200_CAN_V1_10_00.BIN) supports CANOpen field bus communication for –CNS product. A filename that contains the letters 'DeviceNet' (ie: S200_DeviceNet_V1_10_00.BIN) supports DeviceNet filed bus communications for –DNS product.

Open the desired file. S200 OC TOOLS will direct you to 'set' DIP Switch S13-4 (located on the top of the product) to a position at the top of the product. Set this switch. The photo to the right shows S13-4 in the proper position to load firmware.



NOTE

Some Versions of S200 OC TOOLS mistakenly refer to switch S13 as S3.

A progress window will come up to indicate the firmware load is taking place. Upon completion S200 OC TOOLS will put up a status box asking you to turn S13 back to it's original (UP) position and cycle power on the drive BEFORE clicking the 'OK' box. S200 OC TOOLS will then begin to operate normally with a data refresh.

4 FAULTS AND ERRORS

The S200 Position Node product has internal fault and error monitoring systems. Constructed of a base-unit drive and a position controller board the product actually has two monitoring systems and three annunciation systems. The Base Unit is the drive-portion of the product and is an S200 Series AC Motor Drive with a single green status LED that signals status of the base unit. The position controller card has a seven segment status display used to indicate faults. Finally, the CAN bus firmware has access to a separate MNS bi-color LED to signal bus status. This section provides information about these 3 status indicators, the faults they represent, the conditions that can cause the faults, and how to recover from the faults.

Faults can occur with primary detection by the drive base-unit. These faults are called 'b-faults'. ('b' Is for Base Unit'). Faults that are primarily detected by the position controller card are called 'F-faults' ('F' for fault') or 'o-faults' (letter O). Base unit errors are detected by the position controller card and become F20 faults be definition. The position controller card annunciates these with an 'F20' in the seven segment display followed by the 'b-code' (base unit) fault.

The user interface software, S200 OC Tools, displays drive status information on the Status Menu real-time. The status block will indicate both a Position Card Fault and the Base-unit fault, if applicable.

4.1 *CAN BUS STATUS INDICATOR*

The CAN bus status indicator's function is largely guided by the rules and definitions of the CAN bus interface standards. Different software can provide different functions. Details about this status indicator are located in the appropriate reference manuals for the can bus interface. If the CAN bus portion of this product is not used (not connected) then a word about this LED is justified here. S200 Position Node products with the –CNS suffix will normally have this indicator a solid green with no CAN Bus connected and the drive enabled but will flash green at approximately once per second if the drive is disabled. S200 products with the –DNS suffix will normally have this LED a solid red with no CAN Bus connected.

4.2 *NORMAL INDICATOR OPERATION*

The remaining two indicators are easy to understand in normal operation. The green status LED on the Base Unit will flash at a constant (2 times per second) rate if the drive is disabled and there is no base-unit fault condition. The green status LED will remain illuminated if the drive is enabled and there is no base-unit fault condition. At anytime a base-unit fault condition exists this LED will flash a code. The code is signaled by a 2 second LED off-time followed by a series of flashes. Counting the number of flashes indicates the numerical fault code.

The 7-segment display is under control of the position loop controller. The decimal point is always on and has no meaning. The display will flash a series of numbers on power-up indicating the drive model number. The display then goes into normal operation. Power-up indicator may flash b-s-2-0-3-6 indicating that the base unit drive model is 'S2036(0 implied)' model. Under normal operation the 7-segment display simply displays a 'd' for disabled without faults or an 'E' for enabled without faults. Anytime that a fault condition is detected by the position controller card the display is likely to flash a code sequence.

4.3 CLEARING FAULT CONDITIONS

There may be several ways to clear any given fault. The tables located below will provide more information directed at explaining the recovery method for a particular fault. There are a couple of guidelines that should be noted. To clear a fault the condition that caused the fault must no longer exist. (i.e.: short circuit of motor leads has be cleared). All faults can be reset with a power cycle of the logic control power. All faults can be cleared by the GUI executing a Coldstart procedure. The product can be configured to have an input serve a 'Clear Fault' input. The Clear Fault input is limited as to what faults it can actually reset. Details of the Clear Fault input are listed in the below tables.

4.4 CONDITIONAL SETTINGS

It is possible that the actions of some 'less fatal' fault conditions have conditional settings configurable within the User Interface Software. The following tables do not explain conditional occurrences rather only the default actions.

4.5 S200 POSITION CONTROLLER FAULTS

Table 4.1 lists the S200 Position Controller faults, the action that the drive will take upon sensing the fault condition, and the fault recovery methods allowed. Some of these faults can have multiple source reasons.

Display Error Code	Description of Fault	Drive Action	Reset Method
F01 – F07	Reserved		
F08	Over speed motor runs away, speed is too high	Drive disable with Fault	Clear Fault input, Disable/Enable, Coldstart, GUI 'Drive Reset' Button, or Cycle Power
F09 – F14	Reserved		
F15	I^2t maximum value exceeded (Note: The base unit can report an I2T fault as well.)	Drive disable with Fault	Clear Fault input, Disable/Enable, Coldstart, GUI 'Drive Reset' Button, or Cycle Power
F16 – F19	Reserved		
F20	Option Card / Base Unit error	See 'b-faults'	See 'b-faults'
F21 – F23	Reserved		
F24	Warning is displayed as fault. (Advanced note: WMASK determines which warning will cause F24.)	Drive disabled with fault	Clear Fault input, Disable/Enable, Coldstart, GUI 'Drive Reset' Button, or Cycle Power
F25	Reserved		
F26	Limit switch error on homing move	No Motion	Clear Fault input, Disable/Enable, Coldstart, GUI

Display Error Code	Description of Fault	Drive Action	Reset Method
			'Drive Reset' Button, or Cycle Power
F27 - F31	Reserved		
F32	System software not responding correctly This is internally called System-Panic. It's set when a severe error occurs during system startup.	Drive disabled with Fault	Power Cycle Required. Drive should be reconfigured.
o01	Motor over temp (PTC) when using incremental encoder feedback option.	Drive disable with Fault	Clear Fault input, Disable/Enable, Coldstart, GUI 'Drive Reset' Button, or Cycle Power
o02 – o30	Reserved		
o31	New Firmware detected. This is a reminder that the user area of the drive memory could be corrupt and should be reset by reloading variables to the drive.	Drive disable with Fault	Power Cycle, Reset Drive to Default Parameters followed by Coldstart.
o32	*User memory checksum error.*	Drive disable with Fault	Drive must be 'Reset to Factory Default or have a previously saved setup down loaded to it, followed by Colstart.

Table 4.1: Position Controller Fault List

4.6 *EXTENDED FAULT INFORMATION*

As stated in the above section the Position Controller fault may come from different sources. A Status word can be viewed using the GUI Utilities/Edit Variables On Line feature. The below table gives the meaning of each bit in the Status word.

Fault Code	Status Bit	Extended fault	Definition
16	1	SFD UART parity error	The SFD UART received a parity error.
SFD UART Error	2	SFD UART overrun error	The SFD UART received a second transfer without reading the first
	3	SFD UART framing error	SFD UART stop bit was not the correct polarity.
17	4	SFD Frame timeout	Indicates that more then 89.6 uSecs has elapsed since last frame was received
SFD Comm Error	5	SFD transfer incomplete	Indicates that a transfer started but did not complete in 18.4 microseconds

	6	SFD CRC error(s)	In SFD Span mode, this indicates that there was more then one CRC error over 256 transfers. If not in SFD Span mode, any CRC error will fault
	7	SFD Motor Data timeout	SFD configuration did not complete within 49.2 milliseconds.
3 Drive Over/Under	8	Drive over temperature	The drive has an over temperature fault
	9	Drive under temperature	The drive has an under temperature fault
9 Motor l-l or l-n Short	10	Drive short circuit	One or both the current sensor A/D has been in positive current saturation for longer then 10 microseconds
	11	Drive output over current	Drive over current
18 Option Card Watch Dog	12	Option card read timeout	OC response time out
	13	Option card watchdog time out	OC Watchdog timer timed out
19 PosErr Too Large	14	Step size overflow	Size of revs per step greater than 255 revs per step.
	15	PosErr overflow	Position loop position error greater then +/-128 revs.
20 OC Fault	16	Option Card Feedback Fault	Fault with the option card encoder feedback

Table 4.2: Extended Status Word Fault Code Information

4.7 S200 BASE UNIT FAULTS (B-FAULTS)

As previously stated the base unit Status LED will flash a code if the drive is in a faulted condition. The following table explains the fault code.

Flash Count	Status	Resulting Drive Action	Reset Method
1	No Fault drive disabled	Normal Operation	
2	Motor Over Temp sensor has tripped	Drive Disabled with fault	Clear Fault input, Disable/Enable, Coldstart, GUI 'Drive Reset' Button, or Cycle Power
3	Drive Over/Under Temp	Drive Disabled with fault	Clear Fault input, Disable/Enable, Coldstart, GUI 'Drive Reset' Button, or Cycle Power
4	Drive I*t Too High; Exceeded RMS ratings of the drive.	Drive Disabled with fault	Clear Fault input, Disable/Enable, Coldstart, GUI 'Drive Reset' Button, or Cycle Power
5	Motor I*I*t Too High; Exceeded RMS ratings of the motor.	Drive Disabled with fault	Clear Fault input, Disable/Enable, Coldstart, GUI 'Drive Reset' Button, or Cycle Power
6	Reserved		
7	Bus Over Voltage; Mains high-line or excessive regeneration.	Drive Disabled with fault	Clear Fault input, Disable/Enable, Coldstart, GUI 'Drive Reset' Button, or Cycle Power
8	Bus Under Voltage	Drive Disabled with fault	Clear Fault input, Disable/Enable, Coldstart, GUI 'Drive Reset' Button, or Cycle Power
9	Motor l-l or l-n Short	Drive Disabled with fault	Clear Fault input, Disable/Enable, Coldstart, GUI 'Drive Reset' Button, or Cycle Power
10	Output Over Current	Drive Disabled with fault	Clear Fault input, Disable/Enable, Coldstart, GUI 'Drive Reset' Button, or Cycle Power
11	Hall Fault	Drive Disabled with fault	Clear Fault input, Disable/Enable, Coldstart, GUI 'Drive Reset' Button, or Cycle Power
12	**SFD Configuration Error**	Drive Disabled with fault	Clear Fault input, Disable/Enable, Coldstart, GUI 'Drive Reset' Button, or Cycle Power
13	SFD Short	Drive Disabled with fault	Clear Fault input, Disable/Enable, Coldstart, GUI 'Drive Reset' Button, or Cycle Power
14	**SFD Motor Data Error**	Drive Disabled with fault	Clear Fault input, Disable/Enable, Coldstart, GUI 'Drive Reset' Button, or Cycle Power
15	SFD Sensor Failure	Drive Disabled with fault	Clear Fault input, Disable/Enable, Coldstart, GUI 'Drive Reset' Button, or Cycle Power
16	SFD UART Error	Drive Disabled with fault	Clear Fault input, Disable/Enable, Coldstart, GUI 'Drive Reset' Button, or Cycle Power
17	SFD Comm Error	Drive Disabled with fault	Clear Fault input, Disable/Enable, Coldstart, GUI 'Drive Reset' Button, or Cycle Power
18	Option Card Watch Dog Time out	Drive Disabled with fault	Clear Fault input, Disable/Enable, Coldstart, GUI 'Drive Reset' Button, or Cycle Power
19	PosErr Too Large	Drive Disabled with fault	Clear Fault input, Disable/Enable, Coldstart, GUI 'Drive Reset' Button, or Cycle Power
20			

Table 4.3: Base Unit Fault Table

4.8 *SYSTEM WARNINGS*

Warnings are like faults in that they can terminate motion. In most cases they will not cause the drive to disable. Warnings can be reset using Clear Fault input or GUI Drive Reset input.

Warning Code	Description
N01	Reserved
N02	Reserved
N03	Position Error Warning
N04	Watchdog Limit Reached
N05	Reserved
N06	Software Limit Switch 1 Active
N07	Software Limit Switch 2 Active
N08	Invalid Motion Task Has Been Initiated
N09	Home Reference Point Not Set
n10	Positive Hardware Limit Switch Activated
n11	Negative Hardware Limit Switch Activated
n12	Reserved
n13	Reserved
n14	Reserved
n15	Invalid Velocity Current Table Entry Error (INXMODE=35)
n16…n31	Reserved
n32	Current Drive Firmware Version is a Beta Release

Table 4.4: Warning Codes

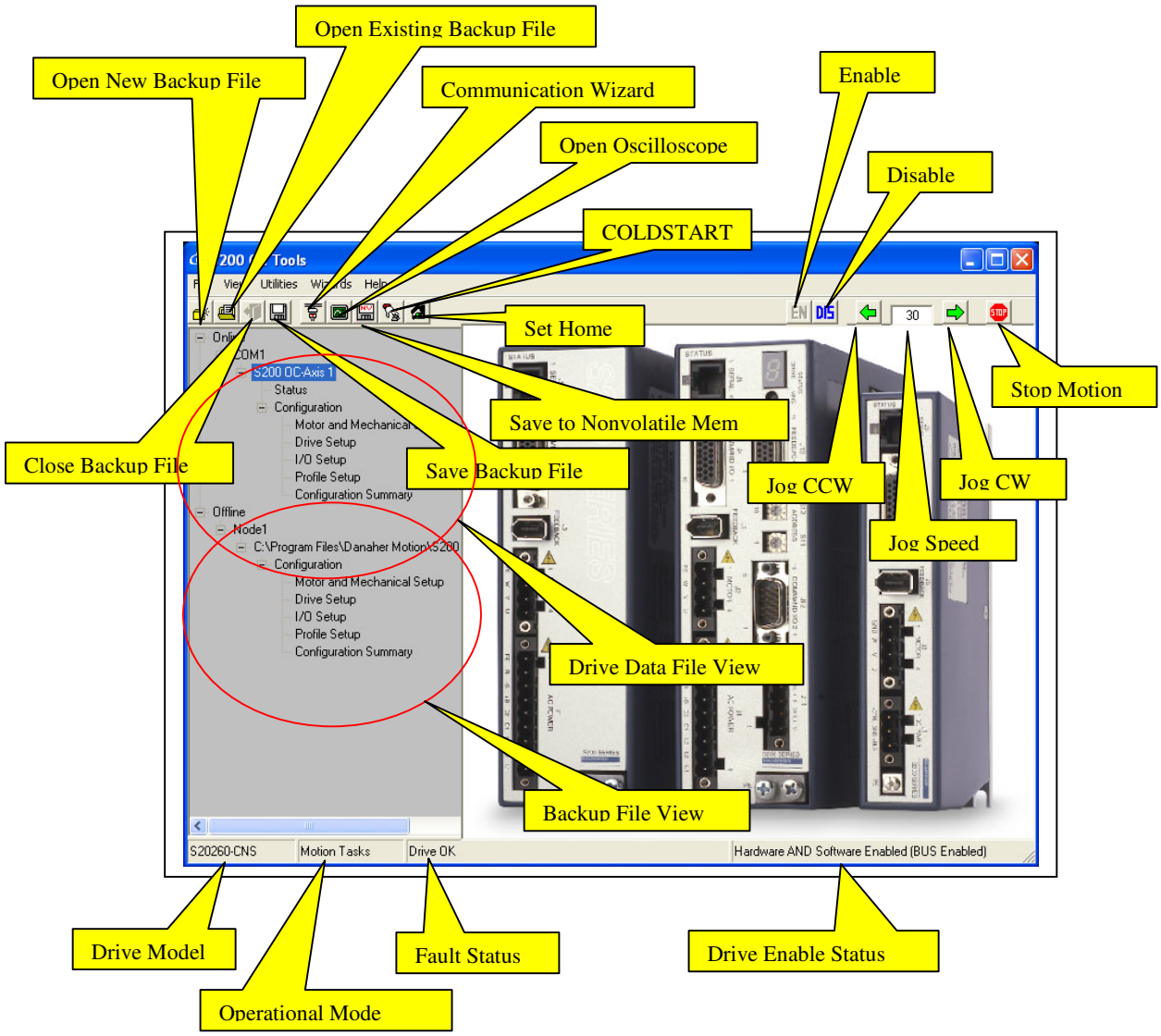
5 SETUP SOFTWARE

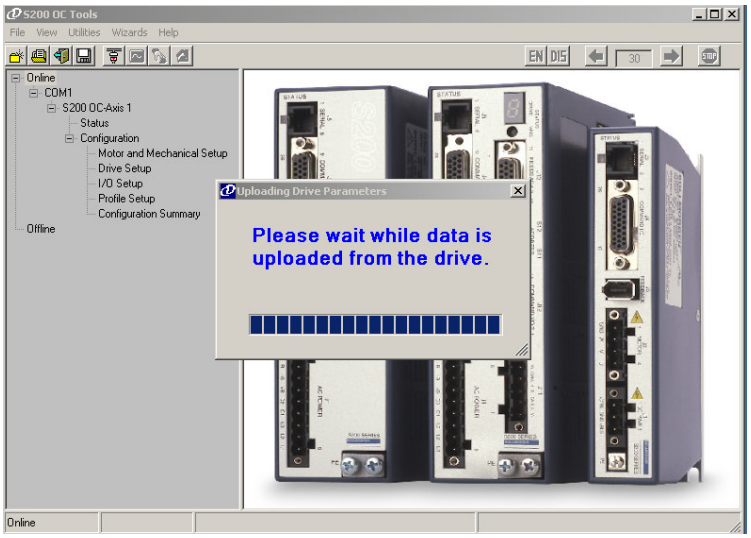
The User Interface software package is called S200 OC TOOLS. Begin by installing the **S200OCTools** software. Follow the prompts. Once the software is installed, connect the computer's RS232 port to the wired and powered drive and motor. Double-click on the S200OCTools icon to open the software. The software, when opened for the first time, will automatically invoke a startup wizard that will take the user through a guided setup tour meant to bring attention to some of the basic setup requirements. The wizard can be defeated by checking the 'Do not show this wizard again' box. It can be invoked anytime using the 'Utilities / Full Setup Configuration Utility' menu bar. While there are many options this section of the manual will guide the reader through some basic setup parameters. After going through this section the software should be easy to understand and the drive ready to run. The user should be comfortable enough to proceed without further guidance.

NOTE

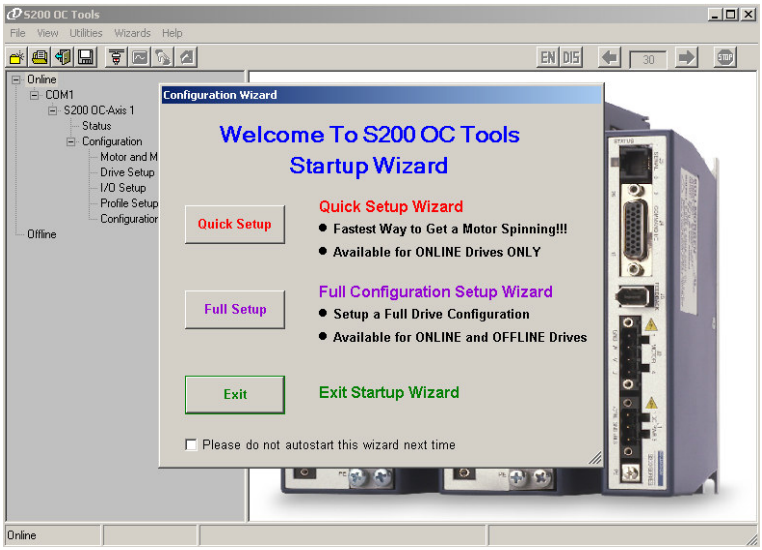
It is important to understand that any change made to the drive is not saved in non-volatile memory until the NVSAVE function is executed ether through the Utilities Menu or the NV save button

The left-side of the screen is the 'Folder-side'. The folder side shows what drives is connected and any open backup files. Some until the drive is selected by clicking on the appropriate folder.

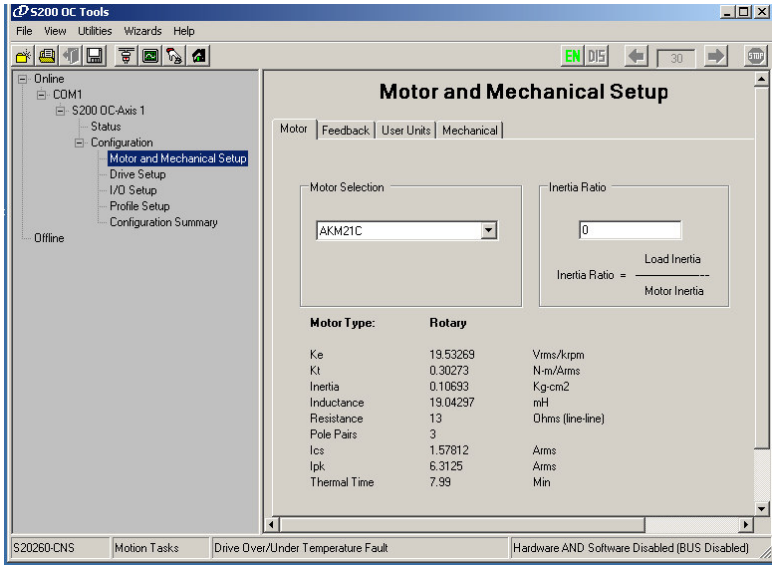

Open Existing Backup File
Open New Backup File
Communication Wizard
Enable
Open Oscilloscope
Disable
COLDSTART
Set Home
Stop Motion
Save to Nonvolatile Mem
Close Backup File
Save Backup File
Jog CCW
Jog CW
Jog Speed
Drive Data File View
Backup File View
Drive Model
Fault Status
Drive Enable Status
Operational Mode



Once invoked, S200 OC TOOLS will need to retrieve the data from the drive. If no drive is connected S200 OCTOOLS cannot be navigated unless you open an existing drive back up file to work offline.

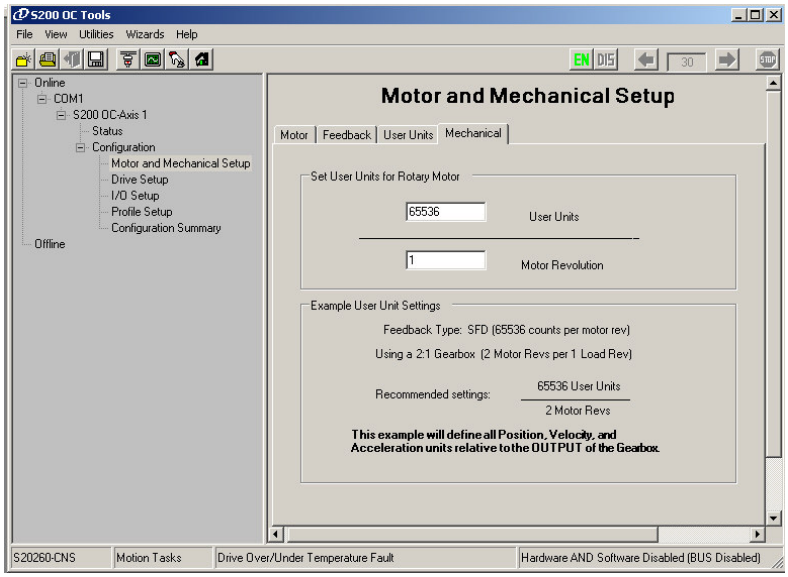


Once the data upload is complete, the wizard screen will appear. (Or can be invoked using 'Utilities / Full Setup Configuration Utility' The wizard will guide you through the necessarily steps to complete the drive configuration.

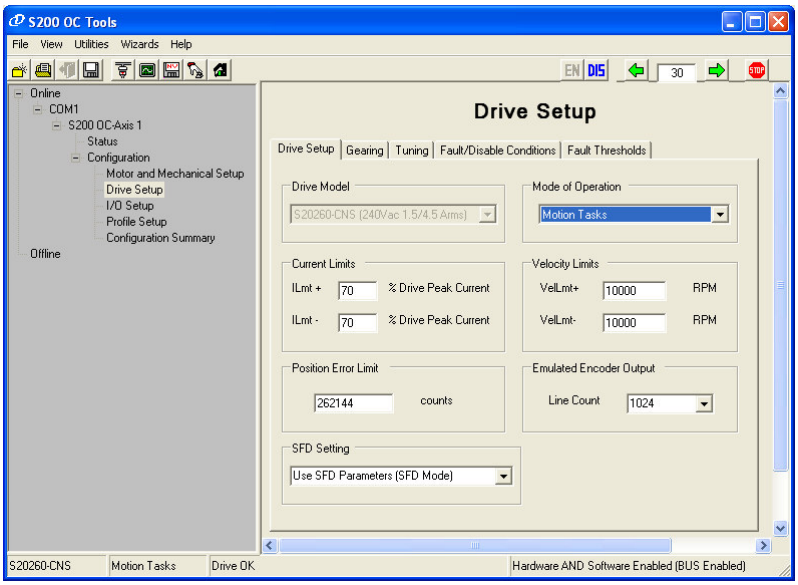


The first step is to confirm that the drive is configured for the motor being used. This information is automatically gathered from a system using an 'SFD-Equipped' AKM-Series motor.

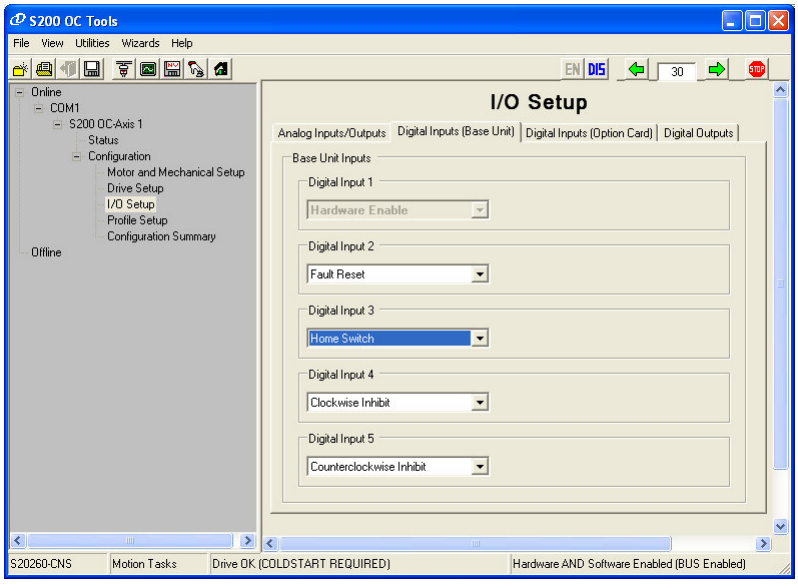
This system is using an AKM21C motor with SFD. Enter the load-to-motor inertia ratio. You can set the Inertia Ratio or select a different motor.



The user can elect to set the drive up to use customized position units. Set the desired mechanical user units by clicking on the Mechanical tab. Specify how many units per motor revolution. Here we have the drive set up for 65536 counts per motor revolution.

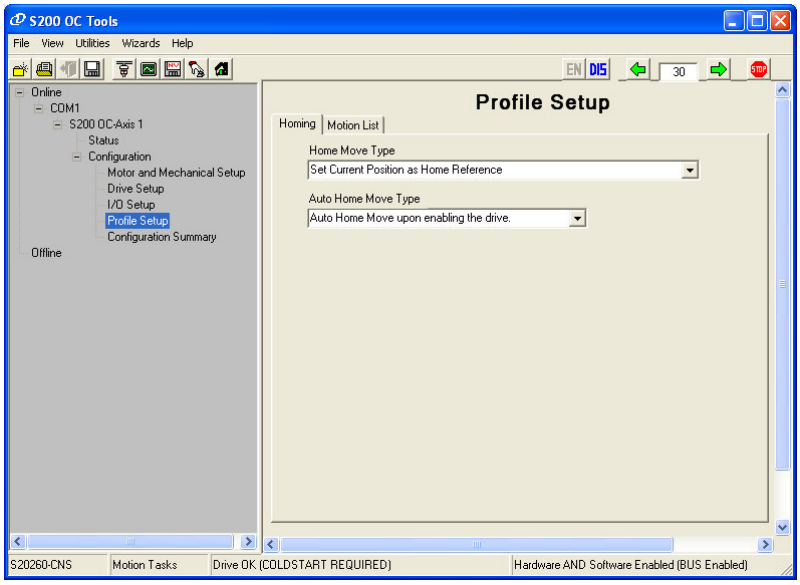


The Drive Setup tab is where the drive's mode of operation is set for Digital Velocity, Electronic Gearing or Motion tasks. This example has selected Motion Tasks that will allow indexing and absolute positioning. Additional boxes and tabs for gearing, tuning, faults, and thresholds and other system limits should be explored.
See Chapter 7 for more details on Digital Velocity Mode.



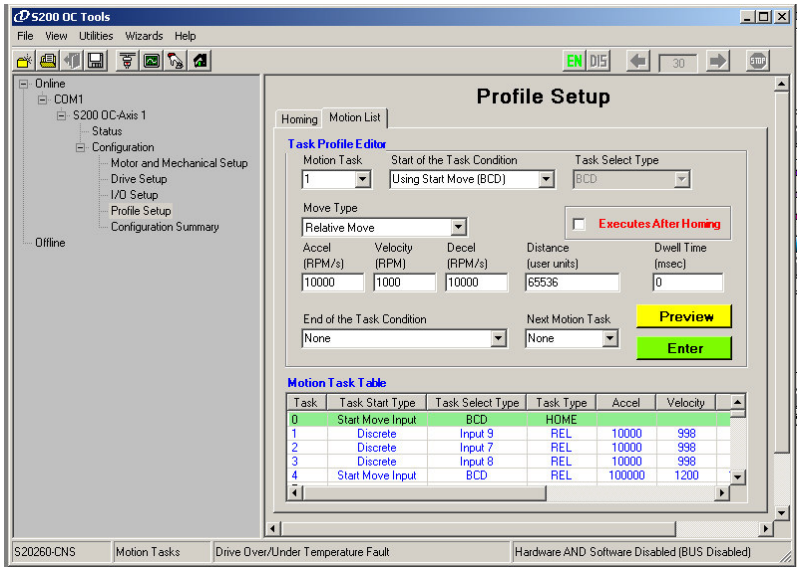
The I/O Setup tabs provide an easy and convenient way to link inputs and outputs to execute moves and report status. Not all inputs can serve all functions. Pull down the menus and browse around. Set up inputs for both the base unit and the option card functions.

Note: When inputs are changed a ColdStart is required.



The Profile Setup menu allows you to set homing and motion tasks. This screen shows a handy method to set home when the system doesn't really need to have a home reference. Homing always has to be done. Shown above is a method to home without ever having to know that you homed. You can not change motion task 0. It follows then that executing a BCD code of 0 executes a homing routine.

For systems requiring homing to a switch there are options to simply find the switch and stop or to find the switch, stop, and move back to home.



Set up motion tasks as required. Motion task 0 will always be a homing routine. The task number is the binary code if BCD select is used. See section 4 about more information on inputs and move types.

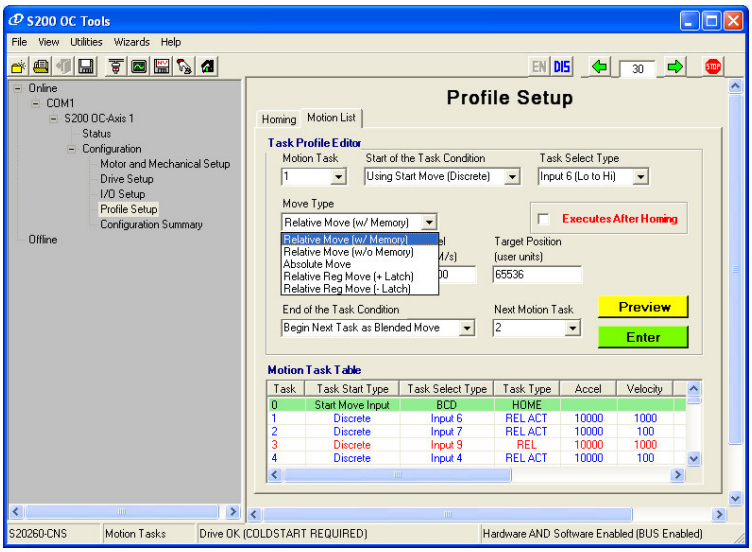
End of Task condition can be a blended move. A
Blended move concatenates two moves together without having to go to zero speed to begin the second move. The actual index distance will be the sum of the blended move distances. Distance move is based on actual motor position, not commanded motor position.

Next Motion Task can set the motion task that will be blended to the present move (if blended move is selected) or can be used to automatically start another move without the need for an additional input signal; the 'next motion task' will be executed upon completion of the present move. A 'Next Motion Task' of 'none' places a '0' in the table but does not mean to execute a home (motion task 0); it is interpreted as 'do nothing'. An In-Position output will not come on until all moves are complete.

A Dwell Time can be added which occurs at the end of the move. The dwell time's purpose is to add a delay to moves linked with Next Motion Task (not blended moves). If there is no Next Motion Task then the dwell timer performs no function.

The check box 'Executes after home' is simply a means of making an equivalent function of 'Next Motion Task' after 'Homing' available. (There is no other way to do that since you can not directly edit Motion Task 0).

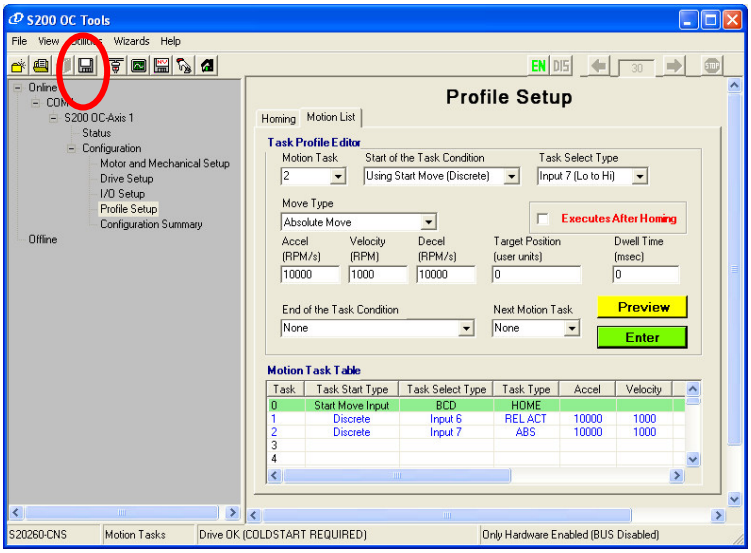
Coldstart is a process whereby the firmware generates custom internal code (compiles) for extremely fast execution. It is good practice to hit the Coldstart button after changing motion tasks and I/O assignments. Without it you may get results that indicate that your changes did not take affect.



Move types include: Relative move with Memory: When indexing (relative moves) an early termination of prior moves is remembered. Choosing this Move Type calculates the next move distance as the sum of the entered move distance PLUS the distance that did not get made in earlier moves due to early termination of the index.

Relative Move Without Memory: When indexing (relative moves) this input cause the index distance in the associated motion task to be executed. There is no reference to earlier lost motion.
Absolute Move: Moves to an absolute position relative to the home location.
Relative Registration Moves: Explained in Chapter 4

.

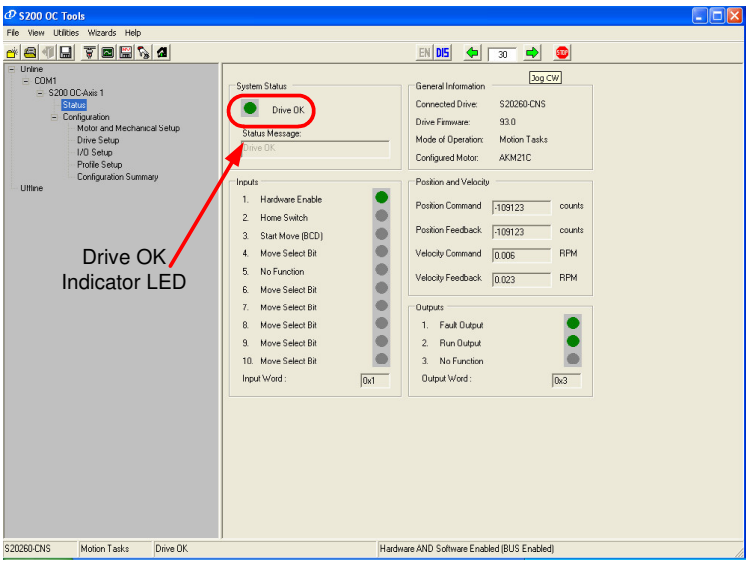


For demonstration purposes; the system shown on the left will index one motor turn (User Units are set to 65536 counts per rev) each time input 6 is turned on. Input 7 will cause the motor to turn back to its original locations.

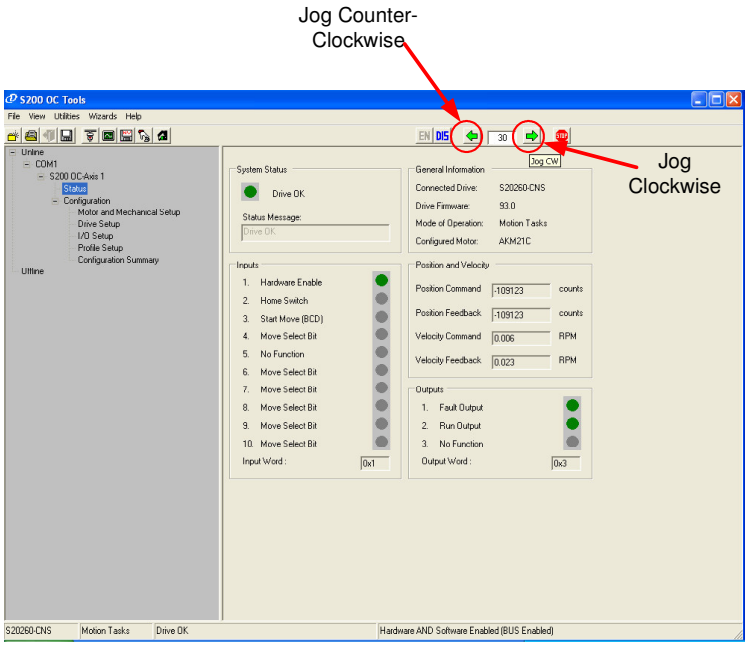
Always remember to hit the Save to Non-volatile memory to save your configuration. (Button circled in Red).

6 SYSTEM TOOLS

6.1 *STATUS SCREEN*



The Status screen can be helpful to understand system operation. Drive Status should read 'OK'. If not then a meaningful fault code will be shown. General information about drive size and firmware version is shown. Energizing a drive input causes the green 'Virtual LED' to illuminate. If an output is on then it's Virtual LED will illuminate.
Position and velocity information can be monitored.

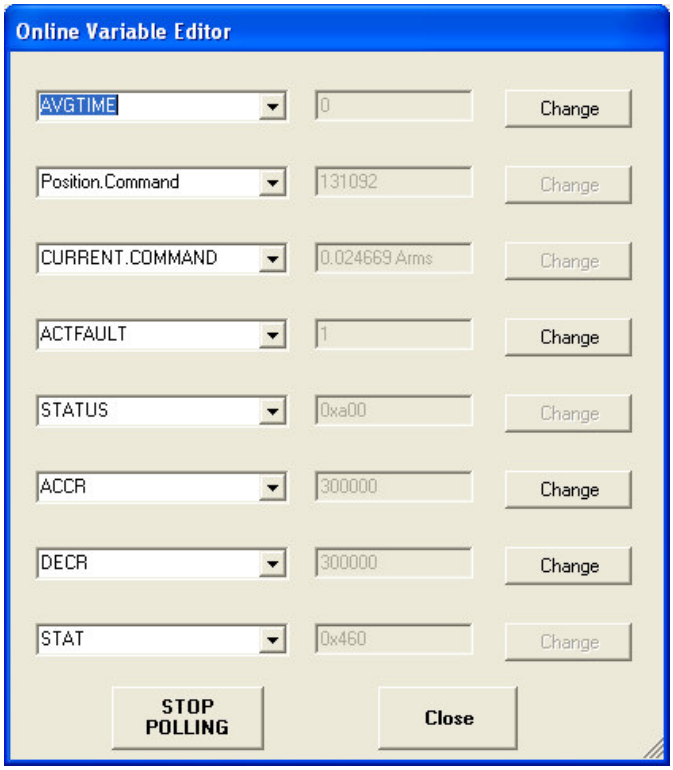


If the system is safe to accept motion then the motor can be jogged from the status screen.

6.2 COMMUNICATION WIZARD

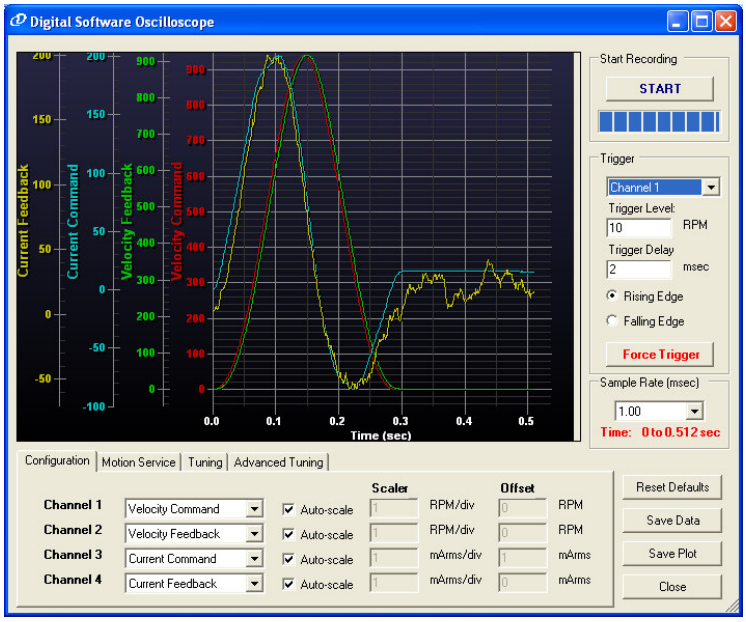
A communications wizard can be found under the Utilities menu. This allows you to select the RS232 communications port for the computer being used and allows a simple test of communications. Baud rate is always 38.4k Baud. Other port parameters are automatically set by S200 OC TOOLS.

6.3 VARIABLE EDITOR



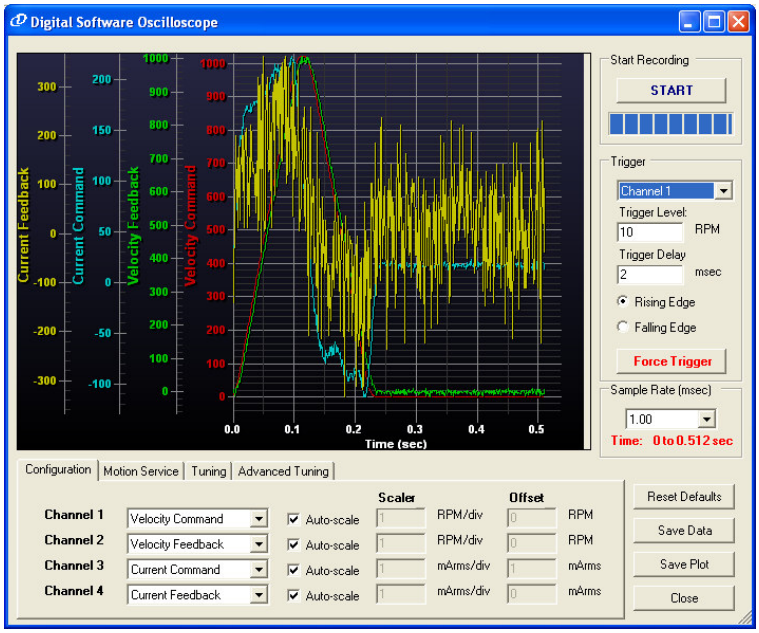
Although the variables available in the S200 Position Node product are not well documented there may be a reason that a user wants to view or change them. The Utilities/Edit Variables On-Line tool brings up this box which can be used to monitor or modify up to 8 variables at a time.

6.4 *DIGITAL OSCILLOSCOPE*



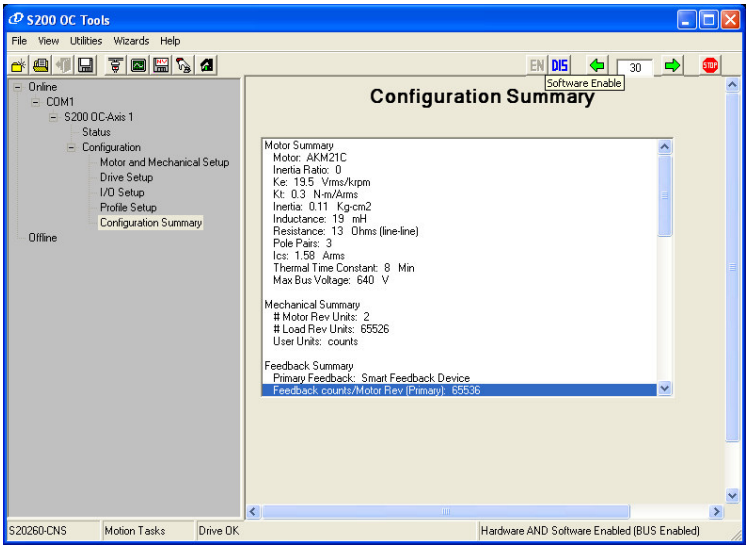
Up to 4 channels of data can be recorded simultaneously. Set the channels for the desired data, the sample rate for an appropriate buffer size, and a trigger level suitable for the capture. Press Start. The scope data plots will be presented after the trigger occurs. It is important to note that each plot has an independent vertical axis scalar.

A variable called AVGTIME can be changed using the above-mentioned variable editor. AVGTIME will allow averaging of data to make it more presentable form. The plot to the left has AVGTIME set to 64.



The plot to the left has AVGTIME set to 0. The effect of having AVGTIME set to a value is smoothing but setting AVGTIME to a large number can sometimes prevent the data from showing proper detail and relationship – as any low pass filter would. AVGTIME is the number of reads summed in the average calculation.

6.5 CONFIGURATION SUMMARY SCREEN



The configuration Summary screen allows the user to see all the drive settings in one location without having to navigate through each possible GUI menu.

7 SERIAL COMMUNICATIONS AND MODBUS RTU

7.1 GENERAL INFORMATION

The serial communications port on the S200 Position Node product uses an RS232 physical layer and communicates using a protocol known as Modbus RTU. The Modbus protocol implementation of the S200 -CNS/ -DNS options is based on the on the documents:

- MODBUS over Serial Line V1.0
- MODBUS Application Protocol Specification V1.1

Details of the protocol itself are not covered in this document. Both aforementioned documents can be obtained at www.modbus.org.

This documents assumes that the user is knowledgeable about the information contained in those documents and has some level of knowledge about serial communications, in general. It is not the intent of this document to provide that basic information.

Section 7.6 will reiterate this but the Modbus strategy is kept simple: always 2-16 bit word transfers (Defined by most interfaces as the 'swapped mode') using either integer or floating point data types. The tables at the end of this section identify the data types for each variable.

7.2 ABBREVIATIONS

Abbreviation	Description
UA	Unit Address The unit address of the option card configured through the rotary switches; S11 and S12.
FC	ModBus Function Code (Defined by standard)
CRC	16bit Cyclic Redundancy Check Value

7.3 RS232 SERIAL PORT CONFIGURATION

- Baud rate: 38400
- Data bit: 8
- Stop bit: 1
- Parity: Odd

7.4 EXCEPTION MESSAGES

The Modbus protocol defines exceptions (error identification methods). The S200 implements exceptions according to the requirements and defines additional exception codes. The following table lists all proprietary codes.

Exception Code	Description
10	Invalid Quantity
11	Invalid register address
12	Invalid package number
13	Command is in execution
14	Unknown command ID
15	Command requires disabled drive
16	Invalid Motion Task number
17	Next Motion Task number is invalid
18	Enable Drive rejected
19	Writing data to FLASH failed
20	Parameter is not of type String
21	Scope: Internal error
22	Scope: Invalid Signal Name
23	Scope: Invalid Signal Size
24	Scope: Invalid record data
25	Step: Invalid Step length
26	Step: Velocity 1 for Step is out of range
27	Step: Velocity 2 for Step is out of range
28	Step: Velocity Mode is required
29	Memory Allocation Error
30	Internal error
31	Scope: No lookup table available

Exception Code	Description
32	Scope: Wrong lookup number
33	String length is invalid

7.5 COMMUNICATION STRATEGY

The S200 Position Node product has a lot of functionality. Decisions must be made as to how much of this should be implemented at the customer's end of the communication network. There may be some limitations. Most limitations can be overcome. Limitations include;

1.) The S200 Position Node communications is based on RS232 physical layer. This is to say that multidrop communications is not directly supported by the S200 Position Node hardware. This can be overcome with external RS485-to-RS232 converters.

2.) Changing the function of an discrete input on the S200 Position Node (Inx) requires a Coldstart function. A Coldstart function can be a little complex on the Modbus scheme as it requires a Manufacture-Specific Function Code and a status-check loop. It may be better to define the input functions in the GUI and associated drive setup configuration file and leave it static.

3.) Certain functions require Manufacturer-Specific Function Codes to execute. This is normally not a problem unless you have a pre-manufactured terminal that has limited communications configuration capability that can not easily support manufacture-specific function codes. For example; Modifications to Motion Task table requires a customized Function Code.

4.) Setup of motor parameters over Modbus is not supported. Please use the GUI software and/or configuration backup files for setting these parameters.

5.) Variables regarding the digital inputs can be misleading. In documentation and wiring diagrams we label the inputs DINP1 through DINP 10. In the Modbus protocol we call these Enable through IN9. Enable relates to DINP1, IN1 related to DINP2, IN2 relates to DINP3, etc.

6.) When using third-party Modbus software such as Modbus Poll the data types may have to be set to Long Inverse or Float Inverse to make the data easily readable.

7.6 MODBUS FUNCTIONS

To simplify the communications the S200 Position Node is set up with almost all data defined as 32bit values comprised of two 16-bit registers. The data type of any one of these register sets can be defined as Long, Text, or Float data types. With a few exceptions, all communications to the S200 Position Node card will be *Read Holding Registers* (FC=03) or *Write Multiple Registers* (FC = 16).
The register address of each parameter is aligned to an even register address values. Variable address in the GUI software is set up as 32-bit address space and is called the PDID (using variable browser utility). The Modbus registers, being 16 bit address space, are addressed at 2 * PDID value. Please see address table at the end of this chapter.
The first register (even address) is the high word of the 32 bit value, the second register (odd address) the low word.

Important: Although data transfer should be done using FC 16 (Write Multiple Registers, quantity 2) the Position Node does support write of a single register:

1. To synchronize the write access when using single register access both registers of a parameter need to be written to starting with the high word (even address). If the low word is accessed first, an error exception occurs.
2. The firmware supports only a block read/write access of up to 2 registers. Both registers must belong to the same parameter.

Each parameter has a set of attributes like minimum value, maximum value, default value, read only, data type, etc., which can be uploaded from the option card. See tables at the end of this section for details.

7.6.1 Reading Variables

To read a variable use the Modbus Function 'Read Holding Registers'. As found in the Modbus documents the serial communication model for a variable read is presented as follows:

UA=x x	FC = 3	Address (16bit)	Number of registers (16bit)	CRC

Where:
UA is the unit address of the drive as set by rotary switches S11 and S12.
FC is the Read Multiple Holding Register Function Code (03).
Address is the variable register address (even number).
Number of registers to read should be set to 2.

As defined by Modbus, the S200 Position Node product will respond with the value set in those registers:

UA=xx	FC=3	data length	data	CRC

Where:
UA is the unit address echoed back.
FC is the function code echoed back (03)
Data length will be 2 (Data count)
Data will be the 32 bit value of the variable read. Variable type may be Long or Float.

7.6.2 Writing Variables

To write variables use the Modbus Function 'Write Multiple Registers'. As found in the Modbus documents the serial communications model for a variable write is presented as follows:

UA	FC = 16	Address(16bit)	Register count (16bit)	Length	Data	CRC

Where:
UA is the unit address of the drive as set by rotary switches S11 and S12.
FC is the Write Multiple Registers function code (16 decimal = 0x10)
Register Count - Data length will be 2 (Data count)
Data will be the 32 bit value of the variable read. Variable type may be Long or Float

As defined by Modbus, the S200 Position Node product will respond with the value set in those registers:

UA	FC = 16	Address(16bit)	Number of Registers(16bit)	CRC

Where:
UA is the unit address echoed back.
FC is the function code echoed back (16d / 0x10).
Address is the address of the registers written echoed back.
Number of registers (written) echoed back - will be 2 (Data count)

7.6.3 Example: Read the ACC parameter

The following example on how to read the value of the ACC registers is presented. The guidelines in the example are as follows:

- Unit address is 2 (S11 = 2, S12 = 0)
- The actual value of ACC in the drive is 10,000 decimal / 0x2710
- From the table, the address of ACC is 2 and the data type is long.
- As defined in above text, all variables are 32 bit constructed with 2 contiguous 16 bit registers.

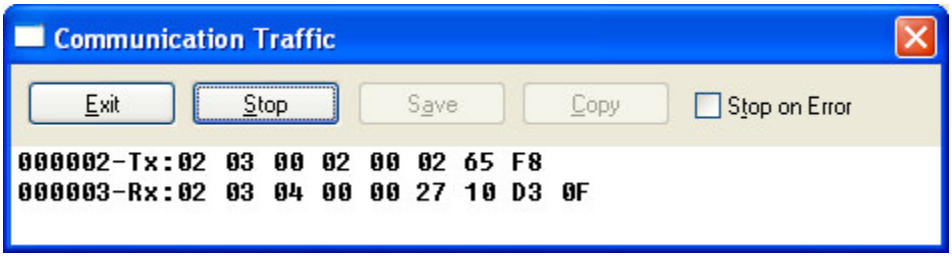
Transmit the request to read the value of ACC:

0x02	0x03	0x00	0x02	0x00	0x02	CRC low	CRC hi

Response from the S200 Position Node:

0x02	0x03	0x04	0x00	0x00	0x27	0x10	CRC low	CRC hi

An actual communications monitor report for this communication transaction looks like the following:



7.6.4 Example: Write the ACC parameter

Assume we wish to change the value of ACC to 20,000 in the above example:

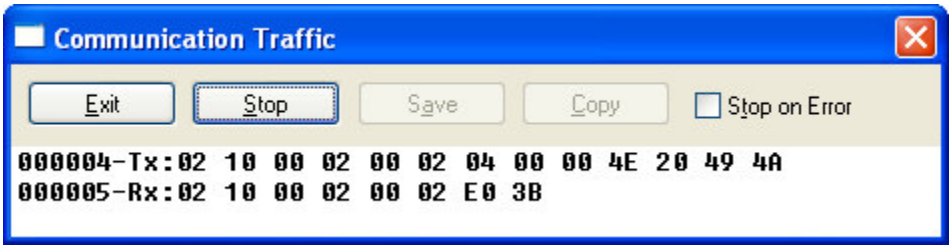
Transmit the request to write:

0x02	0x10	0x00	0x02	0x00	0x02	0x04	0x00	0x00	0x4E	0x20	CRC low	CRC high

Response from the S200 Position Node:

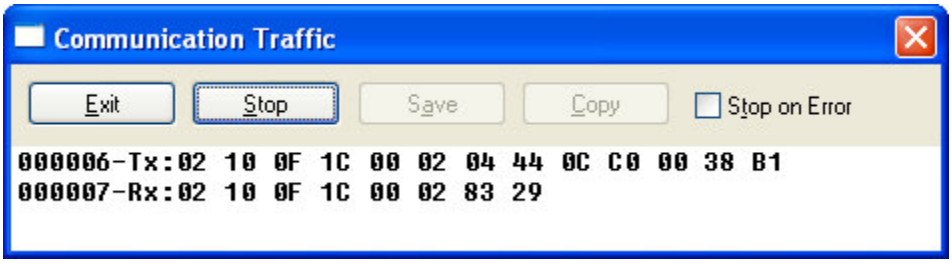
0x02	0x10	0x00	0x02	0x00	0x02	CRC low	CRC high

An actual communications monitor report for this communication transaction looks like the following:



7.6.5 Example: Change Speeds in Digital Velocity Mode

The S200 Position Node can be set up to operate in Digital Velocity Mode. Velocity is controlled by the 'J' parameter = PDID 1934 = Modbus Address 3868. The following communication traffic window changes the speed to 563 RPM:



Note that this data traffic representation is sending the speed, 563, as a floating point data type.

7.7 MANUFACTURER SPECIFIC FUNCTION CODES

7.7.1 Command functions

Modbus allows a block of function codes to be assigned by the manufacturer. The S200 Position Node product has chosen to implement the following function codes.

7.7.2 Command Execution: FC 65

The following model is the general form of the commands. Function Code 65 and the command ID request triggers the execution of a command function (see table below). Transmit the command to the S200 Position Node:

UA=xx	FC=65	command id	CRC

Response Received from the S200 Position Node:

UA=xx	FC=65	command id	CRC

The defined commands are:

Command	Id
Save Parameters Non-volatile memory	1
Restore Parameters from Non-Volatile Memory	2
Set all parameter to factory default settings	3
Enable Drive	12
Disable Drive	13
Coldstart Drive (Reset)	14
Reset Faults and Warnings	15

7.7.3 Command execution status

Used to determine the status of a formerly transmitted command execution request, i.e. the command save parameters non-volatile takes some time to be performed. This request allows to check if the command is finished.

UA	FC=67	CRC

UA	FC=67	Status(16bit)	CRC

Status	Id
Idle (read to execute command)	0
Busy (command execution in progress)	1
Success	2
Failed (last command execution failed)	3

7.7.4 Drive Status

This command requests a predefined list of status variables to be sent in one message block. Each variable can be requested separately through 'Read Register'. Hence status information is likely to be requested very often, this command saves communication overhead.

UA	FC = 65	Command Id = 7	CRC

UA	FC = 65	Command Id = 7	Length(16bit)	Variables	CRC

The response message contains the following variables. Each variable is a 32bit integer.

Variable Name	Description
PFB	Position Feedback

Variable Name	Description
POS	Position Command
V	Velocity Feedback
VCMD	Velocity Command
ICMD	Torque Command
STATUS	Software Status Word
STAT	Second Software Status Word
Panic	Panic Flags word
errCode	Error Code Flags
INPUT	State of digital inputs
OUTPUT	State of digital outputs
buErrCode	Base Unit Error Code Flags
ocErrCode	Option Card Error Code Flags
Warning	Warning Flags

7.7.5 Set Motion Task

UA	FC = 65	Id = 8	Block Length(16bit)	MotionTaskStructure	CRC

Motion Task Structure:

```
typedef struct  {
  unsigned short  nr;          //! motion task number
  sInt64  targetPosition;      //!< O_P
  int  velocity;               //!< O_V
  int  V_soll;                 //!< command/max velocity in counts
  int  accel;                  //!< O_ACC
  int  decel;                  //!< O_DEC
  unsigned int  controlWord;   //!< O_C
  int  res1;                   //!< reserved
  short  tabNumber;            //!< O_TAB
  short  res4;                 //!< reserved
  unsigned short  nextTask;    //!< O_FN
  unsigned short  delay;       //!< O_FT
} PACKED tsMotionTask;
```

UA	FC = 65	CID = 8	CRC

Clear Motion Task

UA	FC = 65	Id = 10	Motion Task Number (16bit)	CRC

UA	FC = 65	Id = 10	Minimum Wait Time (16bit)	CRC

The Minimum Wait Time is the time the master must wait at least before sending the next request. Motion Tasks are stored in the program FLASH. During write access the FLASH cannot be accessed and communication is down until the FLASH is back into normal operation.

7.7.6 Clear All Motion Tasks

UA	FC = 65	Id = 11	CRC

UA	FC = 65	Id = 10	Minimum Wait Time (16bit)	CRC

The Minimum Wait Time is the time the master must wait at least before sending the next request. Motion Tasks are stored in the program FLASH. During write access the FLASH cannot be accessed for program execution and communication is down until the FLASH is back into normal operation.

7.8 MODBUS ADDRESS AND FUNCTION TABLES

The following tables contain the required data for implementing Modbus commands. The advanced user may determine that functions other than these will show up in the GUI Variable browser. The functions listed here are the only functions supported by the Modbus communication.

PDID Index	Modbus Address	Name	Data Type	Rights	Default Value	Min Value	Max Value	Units	Comments
1	2	ACC	Long	R/W	300000	1	12000000	RPM/S	Velocity Loop Acceleration Limits
2	4	ACCR	Long	R/W	300000	1	12000000	RPM/S	Jog and Homing Acceleration Limits
3	6	ACTFAULT	Long	R/W	1	0	1	See List	What to do upon fault
4	8	ACTIVE	Long	RO	-1	0	0	On/Off	Returns 1 if drive active, else 0
6	12	AENA	Long	R/W	1	0	1	On/Off	Software Auto Enable: 1 Normal, 0 Disable at power up
34	68	DEC	Long	R/W	300000	1	12000000	RPM/S	Velocity Loop Deceleration Limit
36	72	DECR	Long	R/W	300000	1	12000000	RPM/S	Jog and Homing Deceleration Limits
37	74	DECSTOP	Long	R/W	300000	1	12000000	RPM/S	Priority Stop Deceleration Rate (See Vel0)
41	82	DIPEAK	Float	RO	0	4294968	4294968	Amps	Returns Drive's Peak Current (RMS) Rating
44	88	DREF	Long	R/W	0	0	34	CW/CCW	Set Homing Direction
45	90	DRVSTAT	Long	RO	0	-1	-1	Bit Coded	Return Drive Status Bit Word
50	100	ENCIN	Long	R/W	1024	16	32767	LPR	Encoder Resolution for Encoder Feedback Systems
62	124	GEARI	Long	R/W	1024	-2.15E+09	2.147E+09	Counts	Gearing mode: Sets GEARI pulses within GEARO motor turns
63	126	GEARMODE	Long	R/W	0	0	9	See List	Sets Electronic Gearing Mode
64	128	GEARO	Long	R/W	1	0	2.147E+09	Counts	Gearing mode: Sets GEARI pulses within GEARO motor turns
88	176	I	Float	RO	0	4294968	4294968	Amps	Returns actual motor current
97	194	IN1	Long	RO	0	0	0	On/Off	Returns the state of DINP2
98	196	***IN1MODE***	Long	R/W				List	Sets the function of DINP2
100	200	IN2	Long	RO	0	0	0	On/Off	Returns the state of DINP3
101	202	***IN2MODE***	Long	R/W	17	0	90	List	Sets function of DINP3
103	206	IN3	Long	RO	0	0	0	On/Off	Returns the state of DINP4
104	208	***IN3MODE***	Long	R/W	9	0	90	List	Sets function of DINP4
106	212	IN4	Long	RO	0	0	0	On/Off	Returns the state of DINP5
107	214	***IN4MODE***	Long	R/W	0	0	90	List	Sets function of DINP5
109	218	INPOS	Long	RO	0	0	0	On/Off	Returns the state of the IN Position bit of the Status Register
110	220	IPEAK	Float	R/W	2.25	0	4.5	Amps	Allows the user to lower the peak application current
122	244	LATCH2P32	Long	RO	0	-1	-1	Counts	Returns Positive edge latch position

PDID Index	Modbus Address	Name	Data Type	Rights	Default Value	Min Value	Max Value	Units	Comments
123	246	LATCH2N32	Long	RO	0	-1	-1	Counts	Returns Negative Edge Latch Position
140	280	VLIM	Long	R/W	10000	0	10000	RPM	Defines the maximum application velocity
141	282	MH	Long	WO	0	-128	127	Start	Move to home
145	290	MJOG	Long	WO	0	-128	127	Start	Jog at VJOG speed and ACCR / DECR Ramps
163	326	MSPEED	Long	R/W	10000	0	16000	RPM	Motor's rated speed
174	348	O1	Long	RO	0	0	1	On/Off	Returns the state of DOUT1
177	354	O2	Long	RO	0	0	1	On/Off	Returns the state of DOUT2
180	360	OPMODE	Long	R/W	8	0	8	List	Sets the drive's mode of operation
197	394	PE	Long	RO	0	-1	-1	Counts	Returns the position error
198	396	PEINPOS	Long	R/W	4000	0	2.147E+09	Counts	Sets the allowable window condition for the In Window for Pos flag, status bit, In Pos Output
199	398	PEMAX	Long	R/W	262144	-2.15E+09	2.147E+09	Counts	Sets the maximum allowable position error
200	400	PFB	Long	RO	-1	-1	-1	Counts	Returns the Position Feedback value
201	402	PFB0	Long	RO	-1	-1	-1	Counts	Returns the position counter of the external encoder
202	404	PGEARI	Long	R/W	65536	1	2.147E+09	NA	Numerator (with PGEARO) used in setting user position and velocity units
203	406	PGEARO	Long	R/W	1	1	32768	NA	Denominator (with PGEARI) used in setting user position and velocity units
210	420	PRD	Long	RO	0	-1	-1	Counts	Returns the inter-revolution feedback position
215	430	PV	Long	RO	0	-1	-1	RPM	Returns the actual velocity as seen by the position control loop
216	432	PVMAX	Long	R/W	10000	0	10000	RPM	Sets the maximum velocity allowed in a motion task
221	442	READY	Long	RO	0	0	0	On/Off	Returns the state of the software enable bit
228	456	REMOTE	Long	RO	0	0	0	On/Off	Returns the state of the hardware enable input, DINP1
234	468	S	Long	WO	0	-128	127	Start	Stop: Decel at DECSTOP and disable drive
240	480	SETREF	Long	WO	0	-128	127	Start	Set present position as home
251	502	STAT	Long	RO	0	0	4.295E+09	Bits	Returns a compressed 16-Bit status word
253	506	STATUS	Long	RO	0	0	4.295E+09	Bits	Returns full status word
254	508	STOP	Long	WO	0	-128	127	Start	Force velocity to 0

PDID Index	Modbus Address	Name	Data Type	Rights	Default Value	Min Value	Max Value	Units	Comments
263	526	ARHPD	Float	R/W	0	0	10	NA	High-pass damping of the velocity loop filter (BQMODE)
264	528	ARHPF	Float	R/W	1000	80	4000	Hz	High-pass frequency of the velocity loop filter (BQMODE)
266	532	ARLPD	Float	R/W	0	0	10	NA	Low-pass damping of the velocity loop filter (BQMODE)
267	534	ARLPF	Float	R/W	160	0	1000	Hz	Low-pass frequency of the velocity loop filter (BQMODE)
279	558	UVLTMODE	Long	R/W	0	0	1	On/Off	1' Turns on under-voltage monitoring
280	560	V	Float	RO	0	4294968	4294968	RPM	Returns the actual motor velocity
282	564	VBUS	Long	RO	0	-1	-1	Volts	Returns the DC Bus voltage value
289	578	VJOG	Float	R/W	60	-10000	10000	RPM	Jog command while in Motion Tasking or Gearing Modes
295	590	VOSPD	Float	R/W	3600	0	12000	RPM	Sets the Over Speed Fault detection threshold
296	592	VREF	Float	R/W	60	0	10000	RPM	Defines velocity for home to reference
304	608	INPT0	Long	R/W	10	0	32000	Milliseconds	Defines the minimum removal time of the 'In Pos' output
322	644	MOVE	Long	R/W	0	0	300	Task Number	Execute the motion task number of the argument.
340	680	PTARGET	Long	RO	0	-1	-1	Counts	Returns the last target position resulted from Motion Task
358	716	BQMODE	Long	R/W	1	0	4	List	BiQuad Filter Mode
466	932	NREFMT	Long	R/W	0	0	511	Task Number	Defines which motion task to automatically execute immediately following a homing
470	940	GEARFILT	Long	R/W	4	0	8	List	Sets low pass filter frequency on gearing input
471	942	AUTOHOME	Long	R/W	0	0	2	On/Off	Enables Auto Homing
501	1002	IN5	Long	RO	0	0	1	On/Off	Returns the state of DINP6
502	1004	***IN5MODE***	Long	R/W	9	0	90	List	Sets function of DINP6
504	1008	IN6	Long	RO	0	0	1	On/Off	Returns the state of DINP7
505	1010	***IN6MODE***	Long	R/W	9	0	90	List	Sets function of DINP7
507	1014	IN7	Long	RO	0	0	1	On/Off	Returns the state of DINP8
508	1016	***IN7MODE***	Long	R/W	9	0	90	List	Sets function of DINP8
510	1020	IN8	Long	RO	0	0	1	On/Off	Returns the state of DINP9

PDID Index	Modbus Address	Name	Data Type	Rights	Default Value	Min Value	Max Value	Units	Comments
511	1022	***IN8MODE***	Long	R/W	9	0	90	List	Sets function of DINP9
513	1026	IN9	Long	RO	0	0	1	On/Off	Returns the state of DINP10
514	1028	***IN9MODE***	Long	R/W	9	0	90	List	Sets function of DINP10
549	1098	O3	Long	R/W	0	0	1	On/Off	Returns the state of DOUT3 or if O3MODE=0 can turn on or off DOUT3
550	1100	O3MODE	Long	R/W	0	0	100	List	Sets the function of DOUT3
551	1102	O3TRIG	Long	R/W	0	-2.15E+09	2.147E+09		Sets trigger level associated with O3MODE
1008	2016	Motor.Name	String	R/W				ASCII	Motor Name String
1009	2018	KVP	Float	R/W	0.014	0.001	110.769	A/(rad/s)	Velocity Loop Proportional gain
1010	2020	KVI	Float	R/W	100	0	3000	Hz	Velocity Loop Integrator Rate
1011	2022	ILmtPlus	Long	R/W	50	0	100	%	Positive Current Limit
1012	2024	ILmtMinus	Long	R/W	50	0	100	%	Negative Current Limit
1013	2026	BU.Error.code	Long	RO	0	0	4.295E+09	List	Base Unit Error Code
1014	2028	OC.Error.code	Long	RO	0	0	4.295E+09	List	Position Node fault code
1015	2030	Warning.Code	Long	RO	0	0	4.295E+09	List	Position Node Warning Code
1017	2034	DPoles	Long	R/W	10	2	254	Pole-pairs	Motor's pole pair
1025	2050	KPP	Float	R/W	16	0	300	(rad/s)/rad	Position Loop Proportional gain
1026	2052	KVFF	Long	R/W	100	0	1000	%	Position Loop Velocity Feed forward tuning parameter
1027	2054	KTFF	Long	R/W	1	0	1000	%	Position Loop Acceleration Feed Forward tuning parameter
1028	2056	AVGTIME	Long	R/W	0	0	4.295E+09	Reads	Sets the number of reads used to average data over for presentation to the user.
1404	2808	Digital.Inputs	Long	RO	0	0	4.295E+09	Bit Coded	Returns DINP2-DINP10 in one word weighted 2^INx
1453	2906	Motor.Lqll	Float	R/W	0	0	255	Henry	Motor Q-Axis inductance
1454	2908	Motor.Ldll	Float	R/W	0	0	255	Henry	Motor D-Axis Inductance
1455	2910	Motor.KVPAuto	Float	R/W	0	0	255	Arms/rad/sec	
1456	2912	Motor.MIpeak	Float	R/W	0	0	255	Arms	Motor's Peak Rated Current
1457	2914	Motor.MIcont	Float	R/W	0	0	255	Arms	Motor's continuous rated current
1458	2916	Motor.MTF0	Float	R/W	0	0	255	Hz	
1502	3004	Error.code			0	-2.15E+09	2.147E+09		
1620	3240	EncOut(BU)	Long	R/W	3	0	15	List	Sets Encoder Output Resolution
1642	3284	HSTemp(BU)	Float	RO	0	0	0	Degrees C	Returns the temperature of the drive heat sink

PDID Index	Modbus Address	Name	Data Type	Rights	Default Value	Min Value	Max Value	Units	Comments
1934	3868	J	Float	R/W	0	-3.40E+38	3.40E+38	RPM	Sets (or returns set value) for Digital Velocity Mode Velocity

APPENDIX A - CABLES

LONG CABLES

The DC resistance of long motor power cables steals some of the available voltage when motor current is high. The principal effect of this is some reduction in peak motor power so acceleration and deceleration times can be longer. The cable resistance has no significant effect on lower speed torque or top speed. For most applications, the loss of performance is small with cables up to the maximum cable length specification. Do not operate a DC input S200 with long cables at the lower end of the bus voltage range because too much of the available voltage is stolen by the cable resistance. For AC input S200s, the DC resistance of the motor power cable is rarely an issue because the voltage drop across the resistance is usually a small fraction of the available nominal bus voltage.

For DC S200 applications with long cables and demanding dynamics, the 14 AWG cable is preferred over the 18 AWG cable. Cable voltage drop vs cable length is shown in the table below.

Cable Voltage Drop vs Length

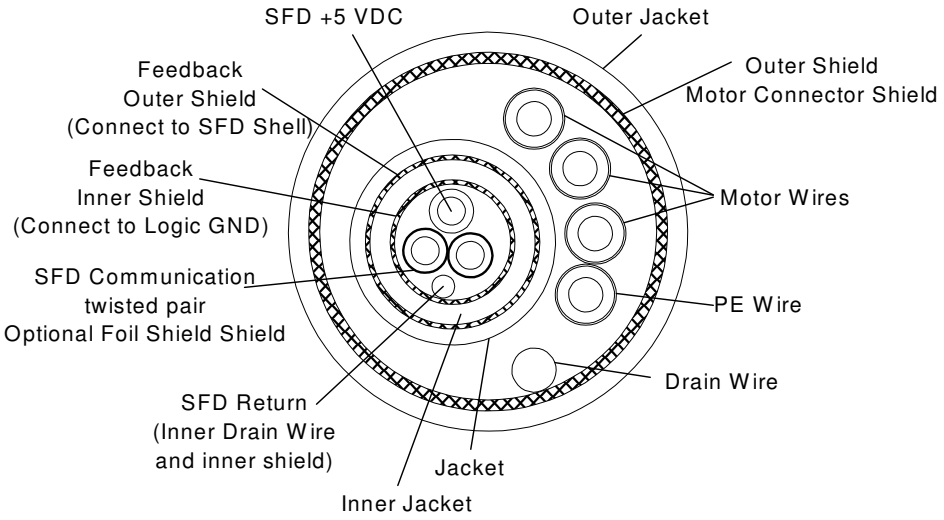
Cable Length (meter)	2 x Rphase (ohm)	V line-line peak at 0.866 x 18 A_{RMS} 18 AWG cable	V_{LOSS} in cable as a percent of 75 V bus	
			18 cable	14 cable
3	0.126	2.77	3.7 %	1.5 %
10	0.413	9.09	12.1 %	4.8 %
25	1.03	22.7	30.3 %	12.0 %
50	(50 m not recommended with 6/18 A_{RMS})		N/A	24.0 %

CUSTOM COMPOSITE CABLES

A composite cable has both feedback and power wires in one cable. One of the critical requirements for a composite cable is to provide a high degree of isolation between the power and feedback wires. For 240 VAC-connected drives, the power wires can have up to 400 $V_{peak-peak}$ fast switching PWM waveforms that can couple to the feedback wiring, causing communication errors between the Drive and the Smart Feedback Device (SFD).

Danaher Motion has developed and sells a composite cable that has very good isolation between the power and feedback sections. It is strongly recommended that this raw cable be used for custom composite cable designs. Contact your Danaher Motion sales representative for additional information. If this cable does not meet your specifications, the following are some guidelines for custom composite cable development. ***Due to the complexity of modeling and understanding cable coupling, a new composite cable needs to be prototyped and tested to have confidence that it will be reliable.***

1) **Composite cable should have double concentric feedback shields – one shield within another.**
The raw composite cable that has been tested and is known to work well with the S200 has the following structure: *double, concentric shields* around the feedback wires plus an outer shield around the whole cable (see diagram below). This type of raw cable is strongly recommended. Testing shows double, concentric, shielding is ten times better than single shielding at reducing coupling from the power wires to the feedback data wires.



Composite Cable Cross-Section

There can be substantial capacitance between the power wires and adjacent feedback shield in a composite cable. Some of the PWM ampere level spikes tend to return in this adjacent shield. In effect, the power stage voltage and current *drive* the feedback shield nearest to the power wires. In a single-shielded feedback cable this *driven* shield is also around the feedback data wires, so some coupling can occur. With double, concentric feedback shields, the *driven* shield is the outer of the two feedback shields, and interposed between the *driven* shield and feedback data wires is the inner feedback shield. Typically, the inner feedback shield is isolated from the connector shells and connected to the return for the power supply powering the feedback device.

NOTE

A raw cable with two pairs of twisted, shielded feedback sections inside a composite cable is electrically the same as single feedback shielding. There may physically be two feedback shields in such a cable, but these shields are not concentric. There is only one shield between the power wires and feedback wires, where with double, concentric feedback shields, there are two.

2) **SFD +5 and Gnd Resistance Spec**

To insure that the SFD + 5 voltage at the SFD inside the motor is within specification, the voltage drop total in the SFD + 5 V wire and SFD + 5 V RTN wire must not be greater than 0.5 V at 150 mA. For this reason, a cable requirement is that the total resistance of the feedback SFD + 5 V wire plus SFD + 5 V RTN wire must be < 3.33 Ω (at 20° C). In practice, this means that for long cables, the AWG wire gage needs to be considered.

NOTE

The inner shield of the a double, concentric feedback cable, when isolated from the terminating connector shells, can also function as a conductor to carry some or all of the SFD + 5 V RTN current. This is useful to keep the total SFD + 5 and RTN resistance within specification on long cables without having large diameters.

3) Feedback Characteristic Impedance

Danaher Motion's S200 feedback cables are designed to have a feedback data pair differential impedance of 81 Ω (at 1 MHz). Impedances in the range of 50 to 100 Ω, while not tested, will likely work properly with the S200.

Purchase a Danaher Motion-built composite feedback cable, review its construction, and test its performance. There are many ways to connect the multiple shields of a composite cable. A good way to understand how the Danaher Motion composite cable is built is to buy a short Danaher Motion S200 composite cable, open it up, and see how the shields at both the motor and drive end are connected.

APPENDIX B - REGULATORY INFORMATION

B.1 CONFORMANCE REQUIREMENTS

The equipment described herein has been developed, produced, tested and documented in accordance with the corresponding standards. During use conforming with requirements, the equipment is not dangerous for people or equipment. Use conforming with requirements means that the safety recommendations and warnings detailed in this manual are complied with and that the applicable regulations for safety (machine directives, etc.) and noise suppression (EMC Directives) are observed while operating the drive. At the end of its lifetime, dispose of or recycle the drive according to the regulations applicable at that time.

B.2 CE APPROVAL

The CE initials confirm that the S200 drives satisfy all requirements of CE Directives. However, the equipment is not ready to operate without additional installations (cable, motor, etc.). Thus, all necessary tests and measurements had to be made on a typical installation. The test installation with all peripheral devices, as well as the test results and measurements are recorded in detail in documentation that is available from the manufacturer on request.

B.3 CE EMC COMPLIANCE

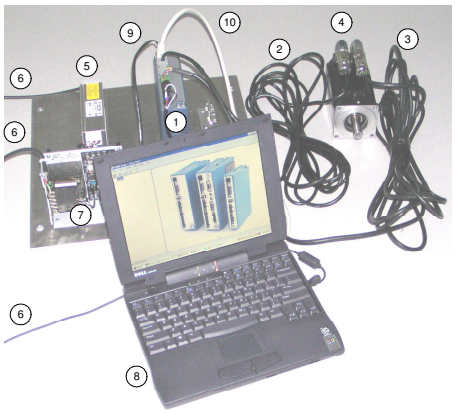
If the connection method on your machine is different from the ones pictured in this manual, or in the event of use of components other than those specified, adherence to CE interference limit values cannot be guaranteed.

NOTE

The machine builder should incorporate good EMC installation and wiring practices in the machine design. Some machine designs require more EMC consideration than others. For example, a multi-axis machine generates more noise than a single-axis machine. Therefore, multi-axis machines may require additional noise reduction techniques, such as a metal enclosure or clamping of cables shields to an RF ground.

B.3.1. CE Test Setup

AC MODELS S2XX6X-VTS

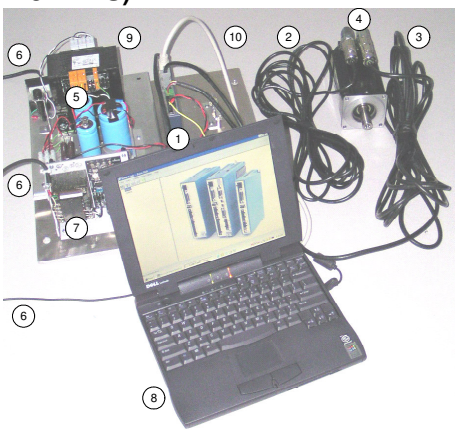


1) **S200 AC DRIVE:** S20360-VTS
2) **MOTOR FEEDBACK CABLE:** CF-DA0111N-05-0 (CF-DA0111N-50-0 for conducted emissions)
3) **MOTOR POWER CABLE:** CP-102AAAN-05-0 (CP-102AAAN-50-0 for conducted emissions)
4) **MOTOR:** KOLLMORGEN AKM43K-ANCNC-00
5) **LINE FILTER:** MTE RF30006-4 (see * below)
6) CORDS FOR AC MAINS CONNECTION
7) 5V POWER SUPPLY FOR ENABLE OPTO
8) PERSONAL COMPUTER
9) SERIAL CABLE (for setup and diagnostics)
10) SHIELDED I/O CABLE WITH DSUB SHELL GROUNDED AT EACH END

* (cable between filter and drive shielded with shield tied to PE with a 360 degree termination at each end of the cable)

B.3.2 CE Test Setup

(DC MODELS S2XX3X-VTS)



1) **S200 DC DRIVE:** S20630-VTS
2) **MOTOR FEEDBACK CABLE:** CF-DA0111N-05-0 (CF-DA0111N-50-0 for conducted emissions)
3) **MOTOR POWER CABLE:** CP-102AAAN-05-0 (CP-102AAAN-50-0 for conducted emissions)
4) **MOTOR:** KOLLMORGEN AKM43K-ANCNC-00
5) SAFETY ISOLATED DC BUS POWER SUPPLY
6) CORDS FOR AC MAINS CONNECTION
7) 5V POWER SUPPLY FOR ENABLE OPTO
8) PERSONAL COMPUTER
9) SERIAL CABLE (for setup and diagnostics)
10) SHIELDED I/O CABLE WITH DSUB SHELL GROUNDED AT EACH END

B.4 Declaration of Conformity

In our Declaration of Conformity, we affirm our compliance with Directive 73/23/EEC (Low voltage Directive) and with Directive 89/336/EEC (EMC Directive).
For the S20260-VTS, S20360-VTS, S20330-VTS, and S20630-VTS, EMC testing was done according to EN61800-3:1997 with the incorporation of amendment A11:2000 (Emission limits according to chapter 6.3.1 of that regulation, First environment / restricted distribution).
During assembly of our product in a machine, startup (that is, normal operation) is prohibited until the end-product complies with Directive 89/392/EEC (Machine Directive) and directive 89/336/EEC (EMC Directive).
The machine manufacturer must prove that the complete system conforms with all relevant European Directives.
Drive conformance to specified standards is certified by the Declaration of Conformity in this manual.

CE Declaration of Conformity

This is to certify that: Kollmorgen Industrial Drives
201 Rock Rd
Radford, VA 24141

Declares that the product(s):

Designation DIGITAL SERVO DRIVE

Type S20260-DNS, S20360-DNS, S20330-DNS, S20630-DNS, S20250-DNS, S20350- DNS, S20260-CNS, S20360-CNS, S20330-CNS, S20630-CNS, S20250-CNS, and S20350-CNS

comply with the following relevant regulations:

CE Guideline 72/23/EEC Low Voltage Directive

Applied harmonized standards: EN 50178: 1998

CE Guideline 89/336/EEC EMC Directive

Applied harmonized standards: EN 61800-3:1997

Manufacturer's Contact: Peter Deneault, Compliance Engineer
Danaher Motion GPS North America
Pacific Scientific

Issued By: Steve McClellan, Engineering Services Director
Danaher Motion GPS North America
Kollmorgen Industrial Drives

Place, Date: Radford, VA, USA 03/15/2005

Legally binding

Signature 

B.5 INSTALLATION AND COMMISSIONING

Installation and wiring of the drive must be completed only by qualified personnel having a basic knowledge of electronics, installation of electronic and mechanical components, and all applicable wiring regulations.
Only qualified personnel having broad knowledge of electronics and motion control technology are to commission the machine utilizing the drives.
This manual should be read in its entirety. This appendix contains important regulatory information not necessarily covered in earlier chapters. The material in this section should be taken into consideration to ensure compliance with applicable regulatory requirements. This section alone does not contain all the information needed to install and operate an S200 drive. General information on installation and wiring are explained in detail in previous sections.

B.6 SAFETY REQUIREMENTS

As the user or person applying this unit, you are responsible for determining the suitability of this product for the application. In no event will Danaher Motion be responsible or liable for indirect or consequential damage resulting from the misuse of this product.
Read this manual completely to effectively and safely operate the S200.

B.7 EUROPEAN COMPLIANCE

In Germany, these include:

- DIN VDE 0100 (instructions for setting up power installations with rated voltages below 1000 V).
- DIN - EN 60204 - Part 1, (VDE 0113, part 1) instructions relative to electric equipment in machines for industrial use.
- DIN EN 50178, (VDE 0160) instructions relative to electronic equipment for use in power installations.

B.8 LOW VOLTAGE DIRECTIVE AND EN50178

To ensure compliance with the Low Voltage Directive and EN50178, following these requirements:

- Electronic drives contain electrostatic sensitive devices, that can be damaged when handled improperly. Qualified personnel must follow ESD protection measures. For example: wear grounded heel and wrist straps when contacting drive.
- The climatic conditions shall be in accordance with EN 50178 climatic class: Type B, temperature and relative humidity: Class 3K3.
- The drives shall be installed in an environment of Pollution Degree 2 or better.
- The S200 drives are not considered portable and are to be mounted in the intended manner in a motor/control cabinet having adequate strength and thickness with acceptable spacings for the end product classification accessible by qualified personnel only. The enclosure/cabinet shall meet at least the requirements of Protective Type IP2X according to 5.1 of EN 60529. If the top surface of the enclosure/cabinet is easily accessible it shall meet at least the requirements of the Protective Type IP4X.
- Care shall be taken to ensure that the larger device or enclosure that accommodates the built-in device provides protection against direct contact.
- The S200 drives may be erected in closed electrical operating areas if a protection against direct contact is available or assigned for by means of obstacles and/or a distance according to IEC 364-4-412.3 and IEC 364-4-412.4.
- Follow IEC 536-2 and IEC 1140 for installation protection against electric shock.
- Installation shall be performed in accordance with local electric codes, local accident prevention rules, EN 50178 and EN 61800-3.
- Never connect or disconnect any drive connectors or terminals while the power is switched on.
- Due to high leakage current, permanently install this drive (hard wired or fixed type). The PE connection shall be made by two separate protective conductors satisfying the requirements for protective conductors as given in 543 of HD 384.5.54 S1 between the earth ground and the PE terminal(s) on the drive, or by a protective conductor having a cross section of at least 10 mm^2 Cu. The S200 drives are designed to Protective Class I.

- The discharge time for the bus capacitors may be as long as 5 minutes. After disconnecting the drive from the ac mains be sure to wait 5 minutes before removing the drive's cover and exposing live parts.
- The finished installation shall comply with the requirements of the IEC 364-4-41 series of standards.
- The cables and leads (except the protective conductors) used in the erection of the S200 in an installation which are accessible for contact without opening or removing a barrier or are laid on extraneous conductive parts shall have double or reinforced insulation between the core and the surface or shall be surrounded by a metal screen having a satisfactory current-carrying capacity in the event of a short-circuit between the core and the screen.
- When installing the S200 into its operating location, it shall be ensured that any existing protective separation according to 5.2.18 of EN50178 is maintained throughout the entire length of the circuit in question. In installations the compliance for of the measures for protective separation shall be checked by visual inspection.
- Refer to Sections 1 and 4 of this manual for external fusing information.
- Motor cable shield must be connected to protective earth.
- During periods of extreme regeneration or excessively high input voltage the temperature of the regen resistor may exceed 70 °C.
- When using an external regen resistor, if regen cabling is accessible during normal machine operation, regen resistor cable should be rated at 450 VDC and shielded with shield connected to PE.
- Consult the factory before using this product on a circuit protected by a residual-current-operated protective device (RCD).
- All covers shall be closed during operation.
- The S200 drives should be used within their specified ratings.

B.9 UL AND cUL CONFORMANCE

The S200 drives are UL and cUL Recognized to UL 508C under UL File number E137798. Consider the following points to ensure that final installation meets UL requirements:

- The drive should be used within its specified ratings.
- The drive should be mounted in the intended manner in an enclosure having adequate strength and thickness with acceptable spacings for the end product classification.
- The spacings from the exposed live-metal parts to the enclosure wall should be in accordance with the requirements for the overall equipment.
- These drives shall be used in a pollution degree 2 environment in order to comply with the spacing requirements of UL 840 and UL 508C.
- The UL temperature tests were done with a metal heat plate with overall dimensions, 6 in x 12 in x 1/8 in. The machine builder is responsible for ensuring adequate heat sinking capability in the final installation.
- The thermal protective device(s) provided integral to the motor drives were not evaluated by UL.
- The terminals are suitable for factory wiring only.
- These motor drives have not been evaluated to provide solid-state overload or over speed protection.
- The DC models were evaluated by UL for use with an isolated power supply rated no more than 150 V open circuit secondary voltage and 10 kVA secondary power. This combination shall be maintained to satisfy UL requirements.

B.10 ADDITIONAL SAFETY PRECAUTIONS

Motor Case Grounding

Insure that the motor's case is connected to PE ground. The fourth wire in the motor cable connecting J2,1 to the motor case accomplishes this.

CAUTION

If the motor is not properly grounded, dangerous voltages can be present on the motor case due to capacitive coupling between the motor windings and case.

Requirements for Safe Operation of the Drive

It is the machine builder's responsibility to insure that the complete machine complies with the Machine Directive (EN60204).

The following requirements relate directly to the servo controller:

1. **Emergency Stop**

CAUTION

If personal injury can result from motor motion, the user must provide an external hardwired emergency stop circuit outside the drive. This circuit must simultaneously remove power from the drive's motor power terminal J2-2, J2-3, and J2-4 and disable the drive (by open circuiting the connection to J4 pin 2).

NOTE

The motor will coast under this condition with no braking torque.

CAUTION

If braking torque is required to quickly stop the motor, a dynamic brake can be added that loads the motor's windings resistively. The motor should not be loaded until the servo drive is disabled. **The holding brake, optional on Danaher Motion motors, is not intended to stop a spinning motor.** ***It is designed to prevent a stopped motor from rotating due to an applied torque.***

2. **Avoid Unexpected Motion**


CAUTION

Always remove power from J1 and wait 5 minutes before working on the machine or working anywhere where injury can occur due to machine motion.

3. **Avoid Electrical Shock**
   - ***Never power the servo drive with the cover removed or with anything attached to circuitry inside the cover.***
   - ***If the drive must be removed from the cabinet, wait at least five minutes after turning off power before removing any cables from the drive or removing the drive from the mounting panel.***


CAUTION

- ***Never connect or disconnect any wiring to the drive while power is applied. Always power down and wait five minutes before connecting or disconnecting any wires to the terminals.***

4. **Avoid Burns**


CAUTION

The temperature of the drive's heat sink and housing as well as an external regen resistor may exceed 60° C. Therefore, there is a danger of severe burns if these regions are touched.

5. **Prevent Damage to the Drive**

Follow these guidelines to prevent damage to the servo drive during operation:
- Never plug or unplug connectors with power applied.
- Never connect or disconnect any wires to terminals with power applied.
- If the drive indicates a fault condition, find the cause of the fault and fix it prior to resetting the fault or power-cycling the drive.

B.9 EMC COMPLIANCE WITH EN61800-3

Use in a Domestic Environment


WARNING

The products covered in this manual are of the restricted sales distribution class according to IEC 61800-3. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.


CAUTION

Because applications differ, it is impossible for the drive manufacturer to guarantee machine EMC compliance. In some applications, it may be necessary for the machine builder to incorporate more EMC mitigation techniques than Danaher Motion had to use in the EMC test setups.

General Suggestions to Improve Machine EMC Performance

- Use Danaher Motion cables – Danaher Motion cables have been designed with EMC considerations in mind. Because subtle differences in cable construction can cause dramatic changes in EMC performance use of Danaher Motion's Kollmorgen motor power and feedback cables is recommended.
- When joining or splicing sections of cable, be sure to maintain the integrity of the cable shield along the entire length of the finished cable.
- Separate cables according to type - AC Mains input, motor power and signal cables should be separated from each other by at least 100 mm (4 in) to avoid cross coupling between them. If cables of different types have to cross, they should do so at a 90° angle.
- Route wiring close to machine frame - It is a good practice to run wires along the machine frame (local ground) whenever practical, this couples some high frequency noise/signals that could otherwise be troublesome directly to the local ground.

- Remove paint from all drive, filter, and cable clamp mounting locations.
- Add clamp-on ferrites to cables – Adding clamp-on ferrites to noisy cables can reduce emissions by absorbing RF energy before it is radiated.
- Use the appropriate line filter – A line filter is required for CE applications, more information on line filter selection can be found in D.10
- Add a balun to the motor power cable – adding a balun in series with the U, V and W phases of the motor power cable can attenuate both conducted and radiated emissions.
- Ensure that cables shields have a good RF ground – more information on this can be found in D.10.

B.10 AC MAINS CONDUCTED EMISSIONS

Line Filter

To meet the CE-conducted EMC requirements, an external line filter (in series with the AC mains) is necessary. It is the responsibility of the machine builder to choose filter(s) appropriate for the application. Danaher Motion is willing to assist in this choice. Often, the decision is made to filter the machine as a whole instead of filtering the individual drives.

Mount the line filter as close as possible to the point where incoming power enters the machine/cabinet. Locate the drive(s) as close as possible to the line filter. To provide maximum high frequency filtering, remove any paint from between the filter, the drive and the conductive surface, ground plane to which they are bonded. For maximum benefit, separate input wiring to the line filter and output wiring from the line filter from each other.

During CE testing, three (3) line filters were qualified for use with 50 m motor and feedback cables to represent worse-case, conducted emissions compliance. The following filters were used:

Corcom 6EQ1 (single phase)
Corcom 36FCD10 (three phase)
MTE RF30006-4 (three phase)

Information on these and other filters can be found at:

Corcom, Inc.	**MTE Corporation**
USA 1-800-468-2023 ***or*** 847-680-7400	USA 1-800-455-4MTE
Germany 49-89-857920	International 1-262-253-8200
http://www.cor.com	http://www.mtecorp.com

NOTE

For complete instructions on wiring an AC version S200 drive refer to *Error! Reference source not found.****, of this manual.***

For complete instructions on wiring a DC version S200 drive refer to *Error! Reference source not found.****, of this manual.***

Motor Power Cable Filtering

In typical applications, the S200 drives do not require additional filtering in the motor leads. Machines with many drives and long motor power cables may require an external balun in series with the power motor power cable to reduce the machine's conducted emissions. Additional information can be found in Pacific Scientific Application Notes 106 (*Reducing Motor Drive Line Noise*) and 107 (*Reducing Motor Drive Radiated Emissions*).

NOTE

Balun part number is 104-090003-01.

Current Rating	60 A sine wave pk (42 A_{RMS}) 5 sec
	20 A sine wave pk (14 A_{RMS}) cont
Inductance	340 µh nominal
Energy Rating	7,200 µJ nominal
Resistance	0.021 Ω nominal
Gap	10 mil

Ground Cable Shields

The Motor Power (J2), Feedback (J3), Command I/O (J4), and Serial Port (J5) cables must be shielded and the shields should be connected to PE. The safety PE connection can be made through connector pin or shell.

CAUTION

All cables used with the S200 drives should be shielded with the shields connected to PE. Dangerous voltages, resulting from cable capacitance, exist on some cable shields if the shields are not connected to PE ground.

Avoid Cross talk

CAUTION

To avoid the risk of cross talk, keep the motor and feedback cables away from sensitive signal cables (i.e., telephone and intercommunication lines). Shield all cables used with the S200 drives with the shields connected to PE.

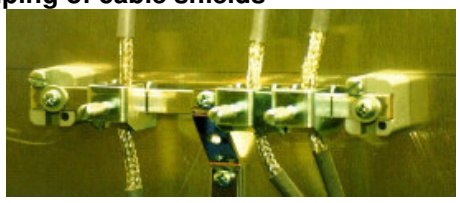
EMC testing was performed using a single drive with standard wiring. When a machine incorporates several drives or is designed for use in an environment requiring very low emissions, additional steps may be necessary to reduce the overall machine emissions and/or susceptibility. High frequency grounding of cable shields may help reduce radiated and conducted emissions as well as protect against susceptibility to external and self-generated noise.

High Frequency Grounding of Cable Shields

- When a cable with a separate inner foil shield and outer braided shield is used, EMC performance may be improved by connecting the foil shield to the PE location on the connector and removing about 10 mm (0.5 in) of the outer cable jacket close to the drive [within 0.6 m (2 ft) of the drive] to expose the braided shield and clamping the outer braided shield to the ground plane with a 360°-type clamp.
- If a ground plane is available at the motor end of these cables, similar use of a conductive clamp at that end to connect the shield to the ground plane may help as well. Clamping the cable shields to PE typically reduces the level of emissions and increases the level of immunity to interference.

NOTE

Example of 360° clamping of cable shields



B.11 REGEN RESISTOR

Regen Wiring (AC drives)

For complete instructions pertaining to an external regen resistor with an AC input drive, refer to the System Wiring Diagrams. In addition to the information in that section, users installing drives for use in a CE installation should use an appropriately-grounded, shielded regen cable to reduce overall system emissions.

Accessible Regen Cables

CAUTION

When using an external regen resistor, if regen cabling is accessible during normal machine operation, the cable should be a shielded cable rated at 450 VDC with the shield connected to PE.

High Frequency Grounding of Regen Cable Shield

NOTE

When using a regen resistor in a CE installation, the cable should be appropriately rated and have a braided shield connected to PE for safety, and clamped to the ground plane with a 360° clamp for EMC purposes

B.12 ADDITIONAL EMC INFORMATION SOURCES

Additional information on EMC performance and noise reduction techniques can be found on the Danaher Motion website (www.DanaherMotion.com):

Kollmorgen Application Note *EMI Noise Checklist*
Pacific Scientific Application Note 106 - *Reducing Motor Drive Line Noise*
Pacific Scientific Application Note 107 - *Reducing Motor Drive Radiated Emissions*

SALES AND SERVICE

Danaher Motion is committed to quality customer service. Our products are available world-wide through an extensive authorized distributor network. To serve in the most effective way, please contact your local sales representative for assistance. If you are unaware of your local sales representative, please contact us.

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