

## Control Modes

- Indexer, Point-to-Point, PVT
- Camming, Gearing, Position, Velocity, Torque

## Command Interface

- Stepper commands  
*Single-ended or Differential selectable*
- CANopen, DeviceNet
- ASCII and discrete I/O
- $\pm 10V$  position/velocity/torque command
- PWM velocity/torque command
- Master encoder (Gearing/Camming)

## Communications

- CANopen/DeviceNet
- RS232

## Accessories

- External regen resistors
- External edge filter

## Feedback

- Digital Quad A/B encoder
- Secondary encoder / emulated encoder out
- Analog sin/cos encoder
- Digital Halls

## I/O - Digital

- 12 inputs, 4 outputs

## Dimensions

- 191 x 140 x 64 mm (7.5 x 5.5 x 2.5 in)



Model	Vac	Ic	Ip
800-1513	100-240	12	36
800-1519	100-240	6	18

## DESCRIPTION

800-1513/1519 combines CANopen networking with 100% digital control of brushless or brush motors in an off-line powered package that can operate from single or three-phase mains. This model has stepper signal inputs that are programmable as either single-ended or differential.

800-1513/1519 operates as a Motion Control Device under the DSP-402 protocol of the CANopen DS-301 V4.01 (EN 50325-4) application layer. DSP-402 modes supported include: Profile Position, Profile Velocity, Profile Torque, Interpolated Position Mode (PVT), and Homing.

Amplifier commissioning is fast and simple using CME 2™ software operating under Windows® communicating with 800-1513/1519 via CAN or an RS-232 link. CAN address selection is by a 16-position rotary switch on the front panel. If there are more than fifteen devices on a CAN bus, the additional address bits needed can come from programmable inputs, or can be set in flash memory. Profile Position Mode does a complete motion index on command with S-curve acceleration & deceleration, top speed, and distance programmable. In PVT mode, the controller sends out a sequence of points each of which is an increment of a larger, more complex move than a single index or profile. The amplifier then uses cubic polynomial interpolation to "connect the dots" such that the motor reaches each point (Position) at the specified velocity (Velocity) at the prescribed time (Time). Homing mode is configurable to work with a variety of limit, index, and home switches such that the amplifier moves the motor into a position that

has an absolute reference to some part of the machine.

Nine logic inputs are programmable as limit or home switches, step-per/encoder pulse inputs, reset, digital torque or velocity reference, or motor-temperature. A tenth input is dedicated to the amplifier Enable function. Three programmable logic outputs are for reporting an amplifier fault or other status indications. A fourth optically-isolated output can drive a motor brake from the external +24 Vdc power supply or can be programmed as a logic output.

In addition to CANopen motion commands, 800-1513/1519 can operate as a stand-alone amplifier. Current and velocity modes accept  $\pm 10$  Vdc analog, digital 50% PWM or PWM/polarity inputs. In position mode inputs can be incremental position commands from step-motor controllers in Pulse/Direction or CW/CCW format, as well as A/B quadrature commands from a master-encoder. Pulse to position ratio is programmable for electronic gearing.

Power output of the amplifier varies with the input power which can range from 100 to 240 Vac, and from 47 to 63 Hz. Either single or three phase mains can be used giving 800-1513/1519 the ability to work in the widest possible range of industrial settings. Signal and control circuits are isolated from the high-voltage power supply and inverter stage that connect to the mains. A +24 Vdc input powers control circuits for keep-alive operation permitting the amplifier power stage to be completely powered down without losing position information, or communications with the control system.

**GENERAL SPECIFICATIONS**

Test conditions: Wye connected load: 2 mH line-line. Ambient temperature = 25 °C. Power input = 230 Vac, 60 Hz, 1 Ø

MODEL	800-1519	800-1513	
<b>OUTPUT CURRENT</b>			
Peak Current	18 (12.73)	36 (25.5)	Adc (Arms, sinusoidal)
Peak time	1	1	s
Continuous current (Note 1)	6 (4.25)	12 (8.5)	Adc (Arms, sinusoidal)
<b>INPUT POWER</b>			
Mains voltage, phase, frequency	100~240		Vac, ±10%, 1 Ø or 3 Ø, 47~63 Hz
Mains current	20		Arms
+24 Vdc Control power	+20 to +32 Vdc, 500 mA max		<i>Required for operation</i>
<b>DIGITAL CONTROL</b>			
Digital Control Loops	Current, velocity, position. 100% digital loop control		
Sampling rate (time)	Current loop: 15 kHz ( 67 µs ), Velocity & position loops: 3 kHz ( 333 µs )		
Bus voltage compensation	Changes in bus or mains voltage do not affect bandwidth		
Minimum load inductance	200 µH line-line		
<b>REFERENCE INPUTS</b> (Note: Digital input functions are programmable)			
<i>Stand-alone mode</i>			
Digital position reference	Pulse/Direction, CW/CCW	Stepper commands (2 MHz maximum rate) programmable as single-ended or differential	
Analog torque & velocity reference	±10 Vdc, 12 bit resolution	Dedicated differential analog input	
Input impedance	66 kΩ	Between Re f(+), Ref(-)	
Digital torque & velocity reference	PWM , Polarity	Quad A/B Encoder 2 M line/sec, 8 Mcount/sec (after quadrature)	
	PWM 50%	PWM = 0% - 100%, Polarity = 1/0	
	PWM frequency range	PWM = 50% ±50%, no polarity signal required	
	PWM minimum pulse width	1 kHz minimum, 100 kHz maximum	
<i>As CAN node</i>		220 ns	
CANopen bus	Position & Velocity Mode commands	Homing, Profile, and Interpolated profile modes	
<b>DIGITAL INPUTS</b>			
Number	10		
Inputs 1~6, 11, 12	74HC14 Schmitt trigger operating from 5.0 Vdc with RC filter on input, 10 kΩ to +5 Vdc or ground (selectable)		
Logic levels	Vin-LO < 1.35 Vdc, Vin-HI >3.65 Vdc		
Pull-up, pull-down control	Inputs are divided into three groups with selectable connection of input pull-up/down resistor to +5 Vdc or ground for each group: [IN1,2,3], [IN4,5], [IN6,7,8,9,10,11,12]		
Enable [IN1]	1 dedicated input with 330 µs RC filter for amplifier enable. Active level programmable, +24 Vdc max		
GP [IN2,3,4,5,11,12]	6 General Purpose inputs with 330 µs RC filter, programmable functions, and active level select, +24 Vdc max		
HS [IN6,9,10]	5 High-Speed Inputs inputs with 100 ns RC filter, programmable functions, and active level select, +12 Vdc max		
HS [IN 7,8,9,10]	Programmable single-ended or differential high-speed inputs (see p. 4~5). [IN7,8] not available in single-ended mode		
<b>DIGITAL OUTPUTS (NOTE 2)</b>			
Number	4		
[OUT1], [OUT2], [OUT3]	Current-sinking MOSFET with 1kΩ pullup to +5 Vdc through diode		
Current rating	1 Adc max, +40 Vdc max. Functions programmable		
	External flyback diode required if driving inductive loads		
Brake [OUT4]	Opto-isolated, current-sinking with flyback diode to +24 Vdc, 1 Adc		
<b>QUADRATURE ENCODER OUTPUTS</b>			
Maximum frequency	18 M-counts, post-quadrature (4.5 M-lines/sec)		
Encoder feedback models			
Operation	Motor encoder signals are buffered and appear on J7		
Signals	A, /A, B, /B, X, /X		
Driver	26LS31 differential line driver		
<b>RS-232 PORT</b>			
Signals	Rx/D, Tx/D, Gnd in 6-position, 4-contact RJ-11 style modular connector		
Mode	Full-duplex, serial communication port for amplifier setup and control, 9,600 to 115,200 baud		
Protocol	Binary and ASCII formats		
<b>CAN PORTS</b>			
Signals	CANH, CANL, Gnd in 8-position RJ-45 style modular connector, wired as per CAN Cia DR-303-1, V1.1		
Format	CAN V2.0b physical layer for high-speed connections compliant		
Data	CANopen Device Profile DSP-402		
Address selection	16 position rotary switch on front panel with 3 additional address bits available as digital inputs or programmable to flash memory (7-bit addressing, 128 devices per CAN network)		
<b>STATUS INDICATORS</b>			
Amp Status	Bicolor LED, amplifier status indicated by color, and blinking or non-blinking condition		
CAN Status	Bicolor LED, status of CAN bus indicated by color and blink codes to CAN Indicator Specification 303-3		
<b>REGENERATION</b>			
Cut-In Voltage	+HV > 390 Vdc	Regen output is on, (optional external) regen resistor is dissipating energy	
Drop-Out Voltage	+HV < 380 Vdc	Regen output is off, (optional external) regen resistor not dissipating energy	
Tolerance	±2 Vdc	For either Cut-In or Drop-Out voltage	
Hysteresis	10 ±0.5 Vdc	Differential between Cut-In & Drop-Out voltage	

**NOTES:**

1. Heatsinking and/or forced-air cooling is required for continuous output power rating
2. Brake[OUT4] is programmable as motor brake, or as general purpose digital output
3. With "red dot" models (see p. 18) encoder +5 Vdc output current is increased to 400 mA

**GENERAL SPECIFICATIONS (CONTINUED)**
**PROTECTIONS**

HV Overvoltage	+HV > 400 Vdc	Amplifier PWM outputs turn off until +HV is less than overvoltage
HV Undervoltage	+HV < 60 Vdc	Amplifier PWM outputs turn off until +HV is greater than undervoltage
Amplifier over temperature	IGBT > 80 °C ±3 °C	Amplifier PWM outputs turn off until IGBT temperature is below threshold
Short circuits	Output to output, output to ground, internal PWM bridge faults	
I <sup>2</sup> T Current limiting	Programmable: continuous current, peak current, peak time	
Motor over temperature	Amplifier shuts down when motor over-temperature switch changes to high-resistance state, or opens	
Feedback power loss	Fault occurs if feedback +5 Vdc output is < 85% of nominal value	

**MECHANICAL & ENVIRONMENTAL**

Size	7.55 in (191,8 mm) X 5.57 in (141,5 mm) X 2.57 in (65,3 mm)
Weight	3.0 lb (1.36 kg) for amplifier without heatsink (see page 23 for heatsink details)
Ambient temperature	0 to +45 °C operating, -40 to +85 °C storage
Humidity	0% to 95%, non-condensing
Contaminants	Pollution degree 2
Environment	IEC68-2: 1990
Cooling	Heat sink and/or forced air cooling required for continuous power output

**FEEDBACK SPECIFICATIONS**
**DIGITAL ENCODER**

Type	Quadrature, differential line driver outputs
Signals	A, /A, B, /B, (X, /X, index signals optional)
Frequency	5 MHz line frequency, 20 MHz quadrature count frequency

**ANALOG ENCODER**

Type	Sin/cos, differential line driver outputs, 0.5 V <sub>peak-peak</sub> (1.0 V <sub>peak-peak</sub> differential) centered about 2.5 Vdc typical. Common-mode voltage 0.25 to 3.75 Vdc
Signals	Sin(+), sin(-), cos(+), cos(-)
Frequency	230 kHz maximum line (cycle) frequency
Interpolation	10 bits/cycle (1024 counts/cycle)

**DIGITAL HALLS**

Type	Digital, single-ended, 120° electrical phase difference
Signals	U, V, W
Frequency	Consult factory for speeds >10,000 RPM

**ENCODER POWER SUPPLY**

Power Supply	+5 Vdc @ 250 mA to power encoders & Halls (Note 3)
Protection	Current-limited to 750 mA @ 1 Vdc if overloaded Encoder power developed from +24 Vdc so position information is not lost when AC mains power is removed

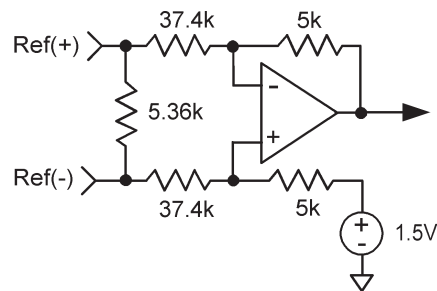
**MOTOR CONNECTIONS**

Phase U, V, W	PWM outputs to 3-phase ungrounded Wye or delta connected brushless motors
Hall U, V, W	Hall signals
Digital Encoder A, /A, B, /B, (X, /X)	
Analog Encoder	Sin(+), sin(-), cos(+), cos(-)
Hall & encoder power	+5 Vdc @ 250 mA maximum (Note 3)
Motemp [IN5]	Motor overtemperature sensor input. Active level programmable. 10 kΩ to +5 Vdc or ground Disables amplifier when motor over-temperature condition occurs Same input circuit as GP digital inputs
Signal ground	Return for encoder, Halls, and temperature sensor
Brake [OUT4]	Current-sinking motor brake driver
+24 Vdc	From amplifier +24 Vdc power supply to power motor brake
Frame ground	For motor cable shield

## COMMAND INPUTS (STAND-ALONE OPERATION)

### ANALOG COMMAND INPUT

A single  $\pm 10$  Vdc differential input takes inputs from controllers that use PID or similar compensators, and output a current command to the amplifier. Amplifier output current, velocity, or position vs. reference input voltage is programmable.



### DIGITAL COMMAND INPUTS

Current, velocity, and position modes are supported using digital signals in either differential or single-ended format. Controllers that output differential signals should be able to drive 121 ohm terminating resistors across the command inputs. Single-ended output controllers should have active outputs. When inputs are configured for single-ended operation, inputs [IN7] and [IN8] are not available. In differential operation these inputs become the (-) inputs for the command signals. The table below shows the functions of the inputs in single-ended and differential configurations for the various operating modes.

#### Current/velocity mode

In PWM 0~100% operation, the PWM signal controls the magnitude and the DIR input controls polarity. By default, when the PWM input is either grounded or open the amplifier output drops to zero. This is a safety measure so that if the control connector

J7 was to be removed, or a wire break, then the output would not go to maximum. Using CME 2 this feature can be altered so that ground or open inputs command 0 or 100% of amplifier output. In PWM 50% operation only one signal is used to control magnitude and polarity. When the PWM signal is at 50%, the amplifier output is zero. Thereafter the outputs become increasingly negative as the duty cycle moves toward 0%, and increasingly positive as it moves toward 100%.

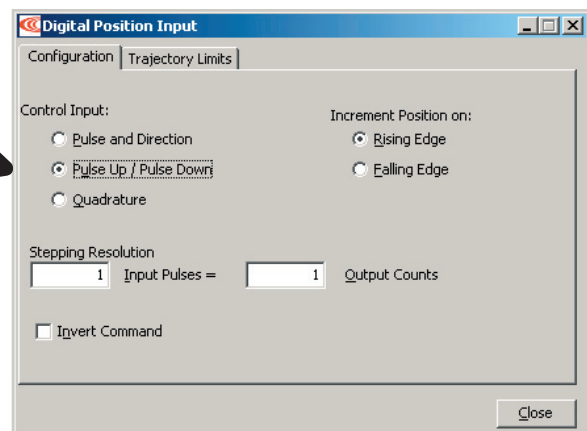
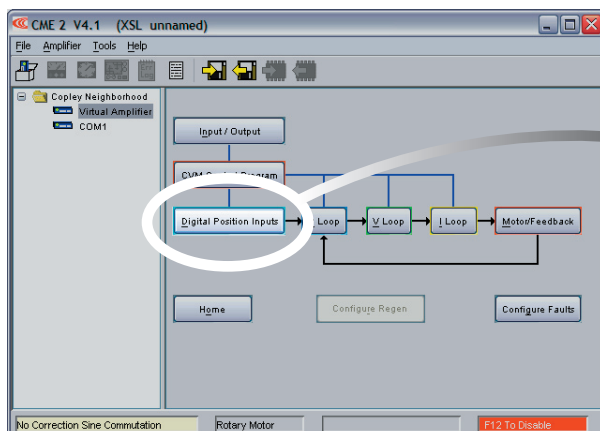
#### Position mode

Position control inputs can be in stepper or quad A/B encoder format. Stepper signals are called CW/CCW (clockwise/counter-clockwise), CU/CD (count-up/count-down), or Pulse/Dir (pulse/direction). Quad A/B encoder signals enable the amplifier to operate as a slave to a master encoder.

INPUT	SINGLE	DIFFERENTIAL	POSITION MODE			CURRENT / VELOCITY MODE	
[IN9]	IN	IN(+)	CW (CU)	PULSE	QUAD A	PWM 0~100%	PWM 50%
[IN7]	N.C.	IN(-)					
[IN10]	IN	IN(+)	CCW (CD)	DIR	QUAD B	DIR	N.C.
[IN8]	N.C.	IN(-)					

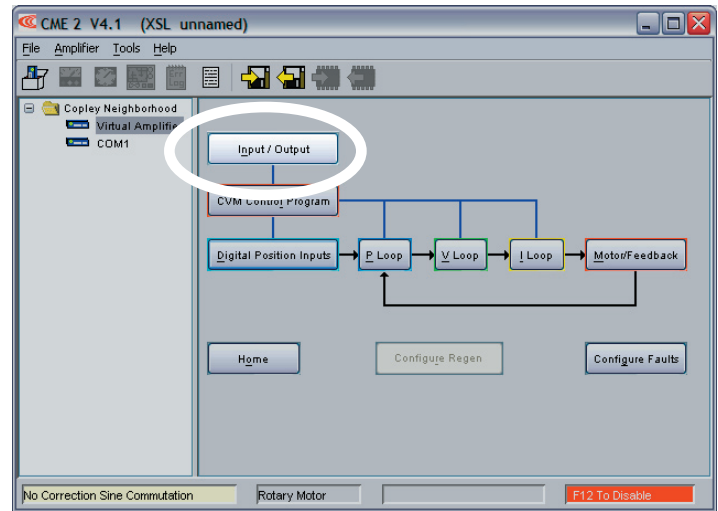
Note: N.C. = No Connection

The position modes in the chart above are selected in CME 2 using the screen shown below



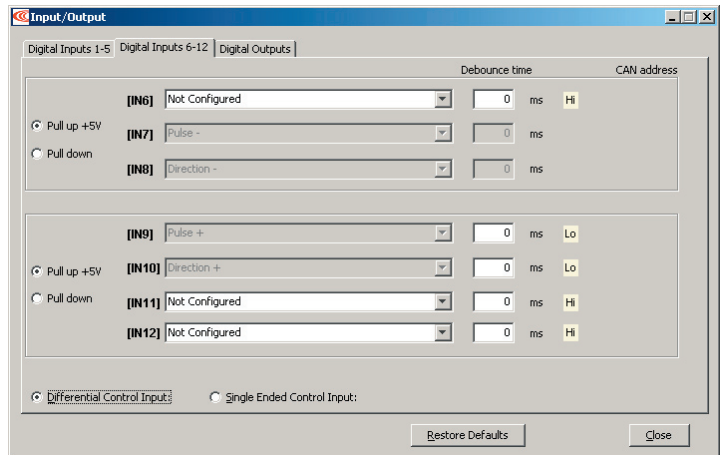
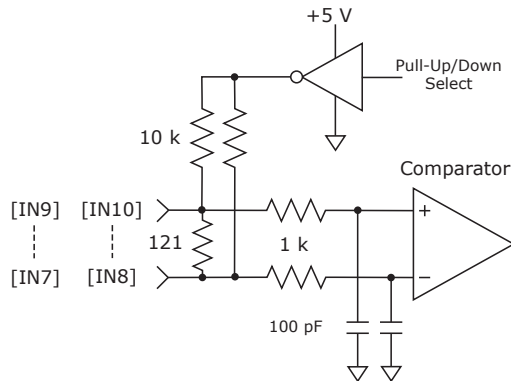
### SINGLE-ENDED OR DIFFERENTIAL TYPE INPUT SELECTION

From the CME 2 main page, click on the Input / Output box to bring up the screens shown below. It is on these screens that the choice of single-ended or differential is made, as well as the pull-up or pull-down choice. The input circuit configurations are shown for these modes, too.



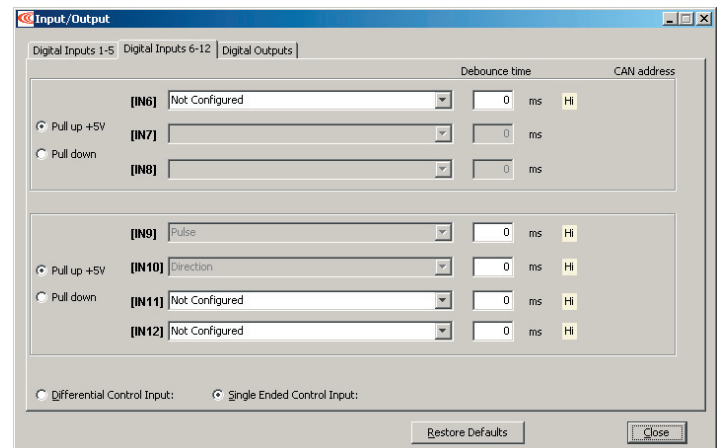
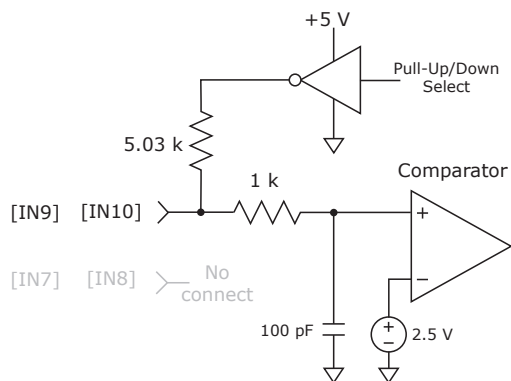
### DIFFERENTIAL INPUTS

With the Differential Control Inputs item selected [IN9] and [IN10] become the (+) side of the inputs and [IN7] and [IN8] become the (-) side. Pull-up and pull-down selections are still active but have no effect as the inputs use the difference between (+) and (-) and this is zero if the inputs are open and are both at ground or +5V.



### SINGLE-ENDED INPUTS

With Single Ended Control Inputs selected, [IN9] and [IN10] remain the active inputs but [IN7] and [IN8] are disabled.





## DIGITAL INPUTS

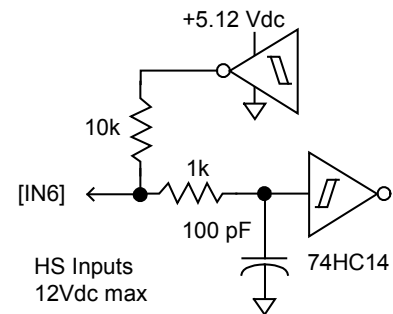
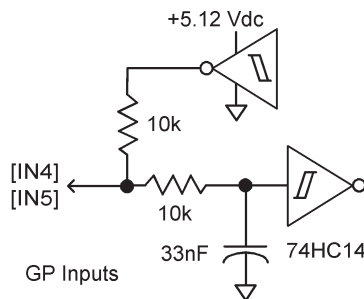
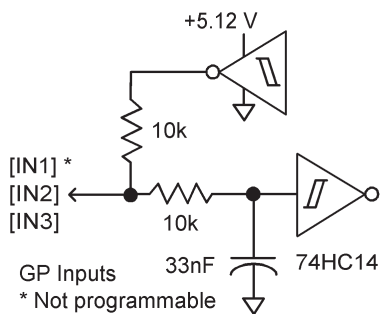
800-1513/1519 has ten digital inputs, nine of which have programmable functions. Input [IN1] is not programmable and is dedicated to the amplifier Enable function. This is done to prevent accidental programming of the input in such a way that the controller could not shut it down.

Two types of RC filters are used: GP (general purpose) and HS (high speed). Input functions such as Pulse/Dir, CW/CCW, Quad A/B are wired to inputs having the HS filters, and inputs with the GP filters are used for general purpose logic functions, limit switches, and the motor temperature sensor. Programmable functions of the digital inputs are:

- Positive Limit switch
- Home switch
- Quad A/B master encoder
- CAN address bits
- Reference input attenuation select (zero or divide by eight)
- Negative Limit switch
- Amplifier Reset
- Stepper commands
- Motor over-temperature

In addition to the active level and function for each programmable input, the input resistors are programmable in four groups to either pull up to +5 Vdc, or down to ground. Grounded inputs with HI active levels interface to PLC's that have PNP outputs that source current from +24 Vdc sources. Inputs pulled up to +5 Vdc work with open-collector, or NPN drivers that sink current to ground.

## DIGITAL INPUT CIRCUITS

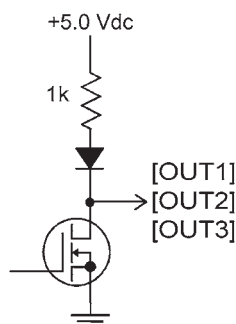


## DIGITAL OUTPUTS

The digital outputs are open-drain MOSFETs with 1 k $\Omega$  pull-up resistors in series with a diode to +5 Vdc. They can sink up to 1 Adc from external loads operating from power supplies to +30 Vdc.

The output functions are programmable. The active state of the outputs is programmable to be on or off.

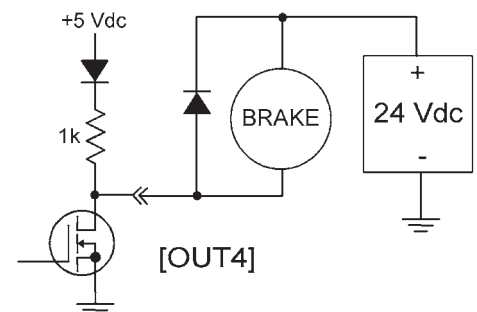
When driving inductive loads such as a relay, an external fly-back diode is required. The internal diode in the output is for driving PLC inputs that are opto-isolated and connected to +24 Vdc. The diode prevents conduction from +24 Vdc through the 1 k $\Omega$  resistor to +5 Vdc in the amplifier. This could turn the PLC input on, giving a false indication of the amplifier output state.



## BRAKE OUTPUT [OUT4]

This output is an open-drain MOSFET with an internal flyback diode connected to the +24 Vdc input. It can sink up to 1A from a motor brake connected to the +24 Vdc supply.

The operation of the brake is programmable with CME 2™. It can also be programmed as a general-purpose digital output.

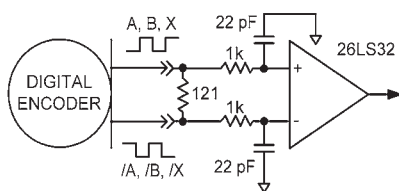


## FEEDBACK : ENCODER VERSIONS

### DIGITAL ENCODERS

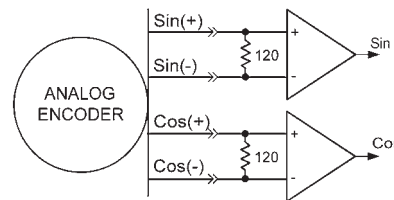
The motor encoder interface is a differential line-receiver with R-C filtering on the inputs. The circuit is shown below. Encoders with differential outputs are required because they are less susceptible to noise that can be degrade single-ended outputs. Encoder cables should use twisted-pairs for each signal pair: A & /A, B & /B, Index & /Index. An overall shield should be used, and for longer cables, shields for individual pairs may be necessary to guarantee signal integrity.

The encoder signals are made available to the controller via the signal connector J7, where they are re-transmitted by differential line-drivers. This eliminates split cables that would have to route the motor encoder signals to both amplifier and controller, as well as providing a good signal quality termination of the encoder signals at the amplifier.

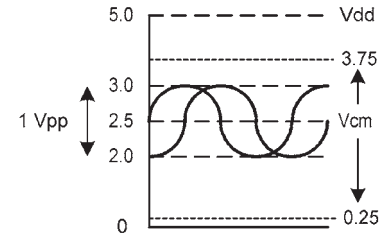


### ANALOG ENCODERS

800-1513/1519 supports analog encoder signals for position feedback. The Sin and Cos inputs are differential with 121  $\Omega$  terminating resistors and accept 1.0 Vp-p signals in the A/B format used by encoders with analog outputs such as Heidenhain, Stegman, and



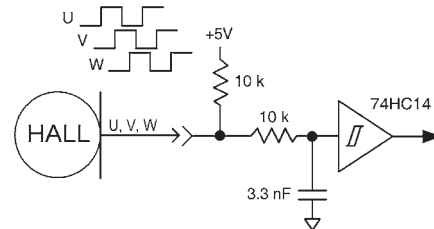
Sin/Cos Encoder Signals



Vdd = Encoder supply voltage  
Vcm = Common-Mode Voltage

### DIGITAL HALL SIGNALS

Use of these signals is optional. 800-1513/1519 is capable of auto-phasing using encoder signals and motor movement on power-up. Hall signals are single-ended signals that provide absolute feedback within one electrical cycle of the motor. There are three of them (U, V, & W) and they may be sourced by magnetic sensors in the motor, or by encoders that have Hall tracks as part of the encoder disc. They typically operate at much lower frequencies than the motor encoder signals, and in 800-1513/1519 they are used for commutation-initialization after startup, and for checking the motor phasing after the amplifier has switched to sinusoidal commutation.



### TRI-MODE ENCODER PORT

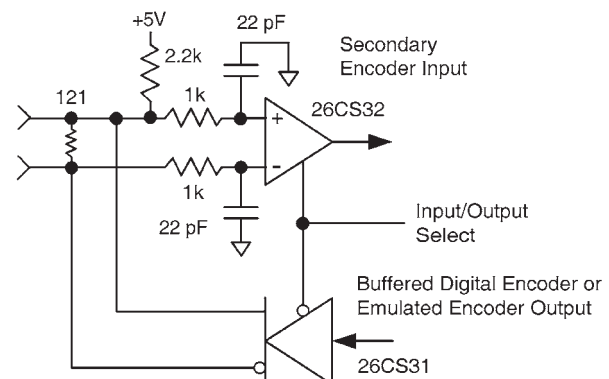
This port consists of three differential input/output channels with functions programmable.

For dual-loop position-mode operation that employs a primary encoder on the motor, and a secondary encoder on the load, the port works as an input receiving the secondary encoder's quad A/B/X signals.

For stand-alone operation with an external motion controller, the signals from the digital encoder on the motor are buffered and made available at the control signal connector for transmission to the controller. This eliminates split-wired motor cables with dual connectors that take the encoder signals to both amplifier and controller.

When used with ServoTube motors, or other motors using analog encoders with sin/cos signal format, the amplifier interpolates the sin/cos signals to a resolution that is programmable. The incremental changes in position are then converted to digital quad A/B/X format for use by the external motion controller.

### FUNCTIONAL DIAGRAM OF ONE CHANNEL



## COMMUNICATIONS

### CME 2™ SOFTWARE

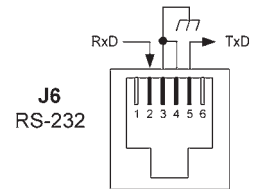
Amplifier setup is fast and easy using *CME 2™* software. All of the operations needed to configure the amplifier are accessible through this powerful and intuitive program. Auto-phasing of brushless motor Hall sensors and phase eliminates “wire and try”. Connections are made once and *CME 2™* does the rest thereafter. Encoder wire swapping to establish the direction of positive motion is eliminated.

Motor data can be saved as .ccm files. Amplifier data is saved as .ccx files that contain all amplifier settings plus motor data. This eases system management as files can be cross-referenced to amplifiers. Once an amplifier configuration has been completed systems can be replicated easily with the same setup and performance.

### RS-232 COMMUNICATION

*800-1513/1519* is configured via a three-wire, full-duplex RS-232 port that operates from 9,600 to 115,200 Baud. *CME 2™* software communicates with the amplifier over this link for commissioning and adjustments.

When operating as a stand-alone amplifier that takes command inputs from an external controller, *CME 2™* is used for configuration. When operated as a CAN node, *CME 2™* can be used for programming before and after installation in a CAN network. *800-1513/1519* can also be controlled via *CME 2™* while it is in place as a CAN node. During this process, amplifier operation as a CAN node is suspended. When adjustments are complete, *CME 2™* relinquishes control of the amplifier and returns it to the CAN node state.



### CANopen NETWORKING

Based on the CAN V2.0b physical layer, a robust, two-wire communication bus originally designed for automotive use where low-cost and noise-immunity are essential, CANopen adds support for motion-control devices and command synchronization. The result is a highly effective combination of data-rate and low cost for multi-axis motion control systems. Device synchronization enables multiple axes to coordinate moves as if they were driven from a single control card.

### CANopen COMMUNICATION

*800-1513/1519* uses the CAN physical layer signals CANH, CANL, and GND for connection, and CANopen protocol for communication.

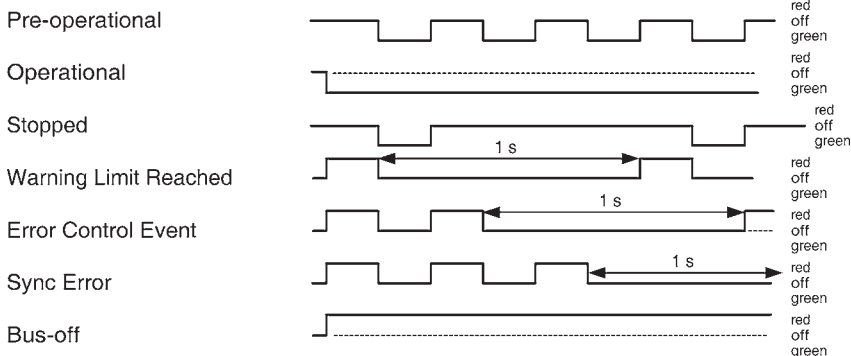
Before installing the amplifier in a CAN system, it must be assigned a CAN address. A maximum of 127 CAN nodes are allowed on a single CAN bus. The rotary switch on the front panel controls the four lower bits of the seven-bit CAN address. When the number of nodes on a bus is less than sixteen, the CAN address can be set using only the switch.

For installations with sixteen or more CAN nodes on a network *CME 2™* can be used to configure *800-1513/1519* to use the rotary switch, or combinations of digital inputs and programmed offset in flash memory to configure the amplifier with a higher CAN node address.

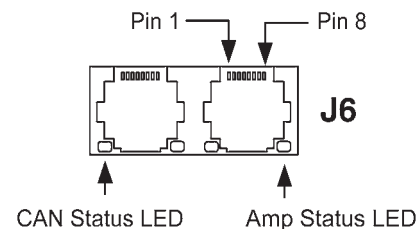
### CAN status LED

#### AMPLIFIER STATE

#### LED ON-OFF CONDITION



Note: Red & green led on-times do not overlap.  
LED color may be red, green, off, or flashing of either color.



#### Amplifier Fault conditions:

- Over or under-voltage
- Motor over-temperature
- Encoder +5 Vdc fault
- Short-circuits from output to output
- Short-circuits from output to ground
- Internal short circuits
- Driver over-temperature

Faults are programmable to be either transient or latching

### AMP status LED

A single bi-color LED gives the state of the driver by changing color, and either blinking or remaining solid. The possible color and blink combinations are:

- *Green/Solid*: Driver OK and enabled. Will run in response to reference inputs or CANopen commands.
- *Green/Slow-Blinking*: Driver OK but NOT-enabled. Will run when enabled.
- *Green/Fast-Blinking*: Positive or Negative limit switch active. Driver will only move in direction not inhibited by limit switch.
- *Red/Solid*: Transient fault condition. Driver will resume operation when fault is removed.
- *Red/Blinking*: Latching fault. Operation will not resume until amp is Reset



## AMPLIFIER POWER SOURCES

An external +24 Vdc power supply is required, and powers an internal DC/DC converter that supplies all the control voltages for amplifier operation. Use of an external supply enables CAN communication with the amplifier when the mains power has been removed.

Power distribution in 800-1513/1519 is divided into three sections: +24 Vdc, signal, and high-voltage. Each is isolated from the other and all are isolated from the chassis.

## EXTERNAL +24 Vdc

The primary side of the DC/DC converter operates directly from the external +24 Vdc supply and is isolated from other amplifier power sections. The Brake output [OUT4] operates in this section and is referenced to the +24 Vdc return (0V). It sinks current from an external load connected to the external +24 Vdc power source.

## INTERNAL SIGNAL POWER

The signal power section supplies power for the DSP controller as well as logic inputs and outputs. Motor feedback signals such as Halls, encoder, and temperature sensor operate from this power source. All signal circuits are referenced to signal ground. This ground should connect to the control system circuit ground or common so that amplifier and controller inputs and output voltage levels work properly with each other.

## MAINS POWER

Mains power drives the high-voltage section. It is rectified and capacitor-filtered to produce +HV which the PWM stage converts into voltages that drive either three phase brushless, or DC brush motors. An internal solid-state switch together with an external power resistor provides dissipation during regeneration when the mechanical energy of the motor is converted back into electrical energy that must be dissipated before it charges the internal capacitors to an overvoltage condition. All the circuits in this section are "hot", that is, they connect directly to the mains and must be considered high-voltages and a shock hazard requiring proper insulation techniques during installation.

## GROUNDING

A grounding system has three primary functions: safety, voltage-reference, and shielding. As a safety measure, the primary ground at J1-3 will carry fault-currents from the mains in the case of an internal failure or short-circuit of electronic components. Wiring to this is typically done with the green conductor with yellow stripe using the same gauge wire as that used for the mains. The pin on the amplifier at J1-3 is longer than the other pins on J1 giving it a first-make, last-break action so that the amplifier chassis is never ungrounded when the mains power is connected. This wire is a 'bonding' conductor that should connect to an earthed ground

point and must not pass through any circuit interrupting devices. All of the other circuits on J1, J2, and J3 are mains-connected and must never be grounded. The ground terminals at J1-3, J2-1, and J3-1 all connect to the amplifier chassis and are isolated from all amplifier internal circuits.

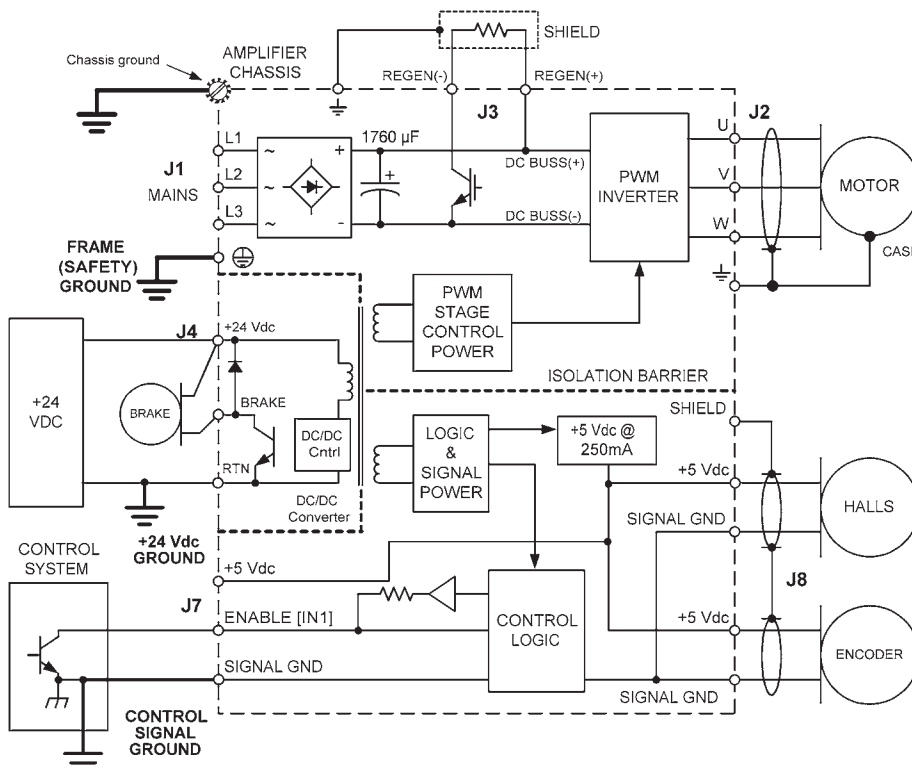
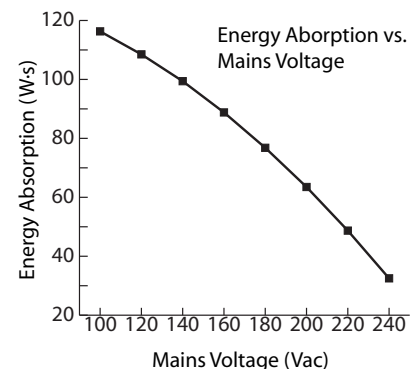
Signal grounding references the amplifier control circuits to those of the control system. These controls circuits typically have their own earth connection at some point. To eliminate ground-loops it is recommended that the amplifier signal ground be connected to the control system circuit ground. When this is done the amplifier signal voltages will be referenced to the same 0 V level as the circuits in the control system. Small currents flow between controller and amplifier when inputs and outputs interact. The signal ground is the path for these currents to return to their power sources in both controller and amplifier.

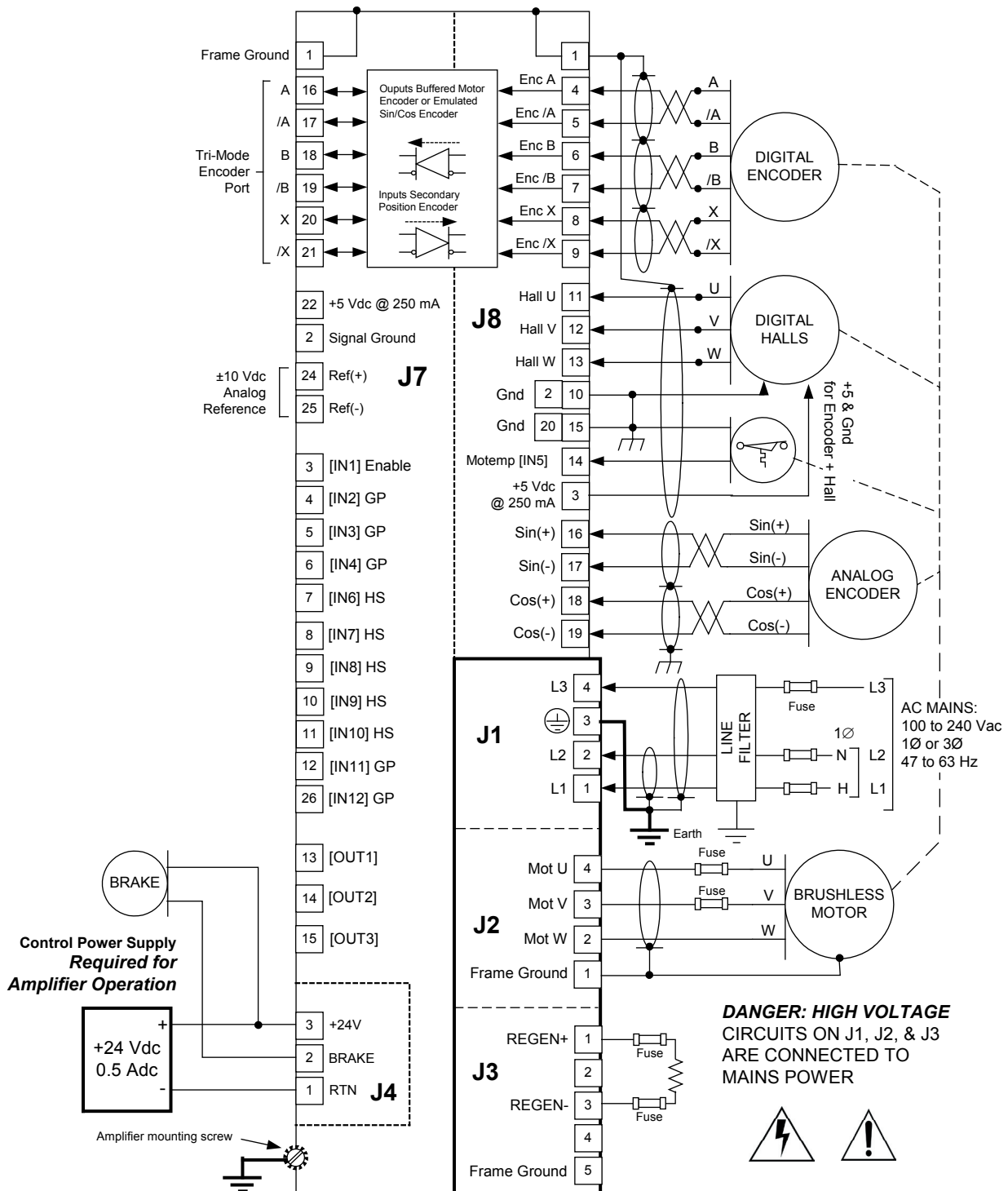
Shields on cables reduce emissions from the amplifier for CE compliance and protect internal circuits from interference due to external sources of electrical noise. Because of their smaller wire gauge, these should not be used as part of a safety-ground system. Motor cases can be safety-grounded either at the motor, by earthing the frame, or by a grounding conductor in the motor cable that connects to J2-1. This cable should be of the same gauge as the other motor phase cables.

For CE compliance and operator safety, the amplifier should be earthed by using external tooth lockwashers under the mounting screws. These will make contact with the aluminum chassis through the anodized finish to connect the chassis to the equipment frame ground.

## REGENERATION

The chart below shows the energy absorption in W-s for a 800-1513/1519 amplifier operating at some typical mains voltages. When the load mechanical energy is greater than these values an external resistor is available as an accessory.





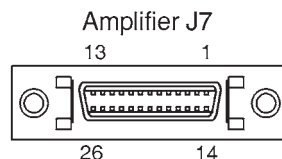
**Notes:**

1. The total output current from the +5 Vdc supply to J7-22 and J8-3 cannot exceed 250 mAdc.

## ACCESSORY CABLE CONNECTIONS

### SIGNAL CABLE ( XSL-CC-10 )

Plug assembly: Molex 52316-2611  
 Boot cover: Molex 52370-2610  
 Molded connector mates with amplifier J7 and has flying-lead terminations with colors shown in chart below.

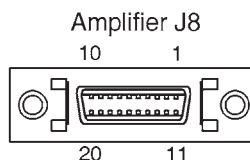


Note: Wires are solid-color with a stripe of an alternate color.  
 E.g. "Black / Orange" is a black wire with an orange stripe.

Signal	Pin	Color (Body / Stripe)	Pair		Color (Body / Stripe)	Pin	Signal
Shield	1	White / Tan	1a	8a	White / Violet	14	[OUT2]
Signal Ground	2	Tan / White	1b	8b	Violet / White	15	[OUT3]
Enable [IN1]	3	White / Brown	2a	9a	White / Gray	16	Tri-Mode Encoder A
GP Input [IN2]	4	Brown / White	2b	9b	Gray / White	17	Tri-Mode Encoder /A
GP Input [IN3]	5	White / Pink	3a	10a	Tan / Brown	18	Tri-Mode Encoder B
GP Input [IN4]	6	Pink / White	3b	10b	Brown / Tan	19	Tri-Mode Encoder /B
HS Input [IN6]	7	White / Orange	4a	11a	Tan / Pink	20	Tri-Mode Encoder X
HS Input [IN7]	8	Orange / White	4b	11b	Pink / Tan	21	Tri-Mode Encoder /X
HS Input [IN8]	9	White / Yellow	5a	12a	Tan / Orange	22	+5 Vdc @ 250 mA
HS Input [IN9]	10	Yellow / White	5b	12b	Orange / Tan	23	Signal Ground
HS Input [IN10]	11	White / Green	6a	13a	Tan / Yellow	24	Analog Ref In(+)
GP Input [IN11]	12	Green / White	6b	13b	Yellow / Tan	25	Analog Ref In(-)
[OUT1]	13	White / Blue	7a	7b	Blue / White	26	[IN12] GP Input

### FEEDBACK CABLE ( XSL-FC-10 )

Plug assembly: Molex 52316-2011  
 Boot cover: Molex 52370-2010  
 Molded connector mates with amplifier J8 and has flying-lead terminations with colors shown in chart below.



Signal	Pin	Color (Body / Stripe)	Pair		Color (Body / Stripe)	Pin	Signal
Frame Ground	1	White / Tan	1a	1b	Tan / White	11	Digital Hall U
Signal Ground	2	White / Brown	2a	7a	White / Blue	12	Digital Hall V
+5 Vdc @ 250 mA	3	Brown / White	2b	7b	Blue / White	13	Digital Hall W
Encodert A Input	4	White / Pink	3a	8a	White / Violet	14	[IN5] Temp Sensor
Encodert /A Input	5	Pink / White	3b	8b	Violet / White	15	Signal Ground
Encoder B Input	6	White / Orange	4a	9a	White / Gray	16	Encoder Sin(+) Input
Encodert /B Input	7	Orange / White	4b	9b	Gray / White	17	Encoder Sin(-) Input
Encoder X Input	8	White / Yellow	5a	10a	Tan / Brown	18	Encoder Cos(+) Input
Encoder /X Input	9	Yellow / White	5b	10b	Brown / Tan	19	Encoder Cos(-) Input
Signal Ground	10	White / Green	6a	6b	Green / White	20	Signal Ground



**WARNING: CONNECTIONS WITHIN DASHED OUTLINE  
ARE CONNECTED DIRECTLY TO MAINS POWER!**



### J1 Cable Connector:

Wago 721-204/026-045  
Euro-style 7,5 mm pluggable female terminal block  
with preceding ground receptacle

Cable: AWG 12, 600 V recommended  
for XSL-230-36 and XSL-230-40 models,  
AWG 14, 600V for XSL-230-18  
Shielded cable required for CE compliance

### J1 Mains Connections

Signal	Pin
Mains Input L3	4
Protective Ground	3
Mains Input L2	2
Mains Input L1	1

### J2 Cable Connector:

Wago 721-104/026-047  
Euro-style 5,0 mm pluggable female terminal block

Cable: AWG 12, 600 V recommended  
for XSL-230-36 and XSL-230-40 models,  
AWG 14, 600V for XSL-230-18  
Shielded cable required for CE compliance

### J2 Motor Outputs

Signal	Pin
Motor Phase U	4
Motor Phase V	3
Motor Phase W	2
Cable Shield	1

### J3 Cable Connector:

Wago 721-605/000-043  
Euro-style 5,0 mm pluggable male terminal block

Cable: AWG 12, 600 V recommended  
for XSL-230-36 and XSL-230-40 models,  
AWG 14, 600V for XSL-230-18  
Shielded cable required for CE compliance

### J3 Regen Resistor

Signal	Pin
Regen Resistor	1
No Connection	2
Regen Resistor	3
No Connection	4
Cable Shield	5

### Wire Insertion/Extraction Tool:

Used on J1, J2, & J3  
Wago 231-131

**NOTE: AN EXTERNAL  
+24 Vdc POWER SUPPLY  
IS REQUIRED FOR OPERATION**

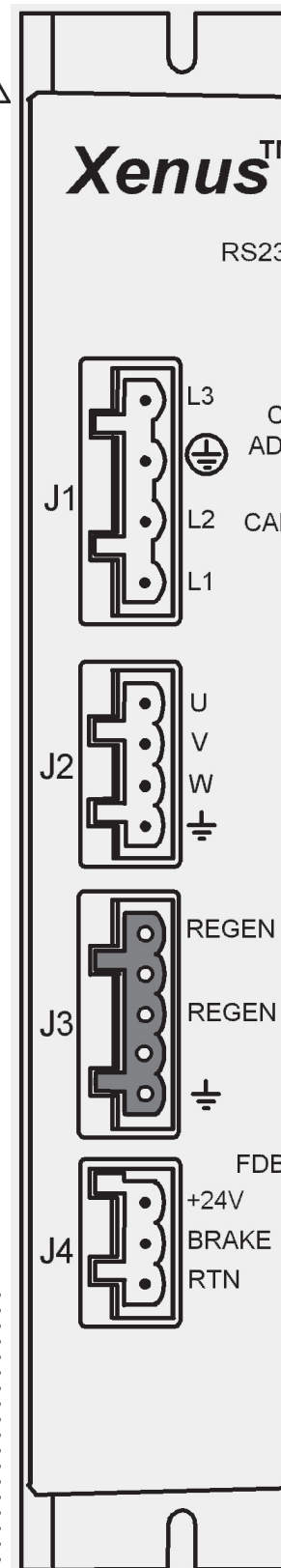
### J4 Cable Connector:

Wago 721-103/026-047  
Euro-style 5,0 mm  
pluggable terminal block

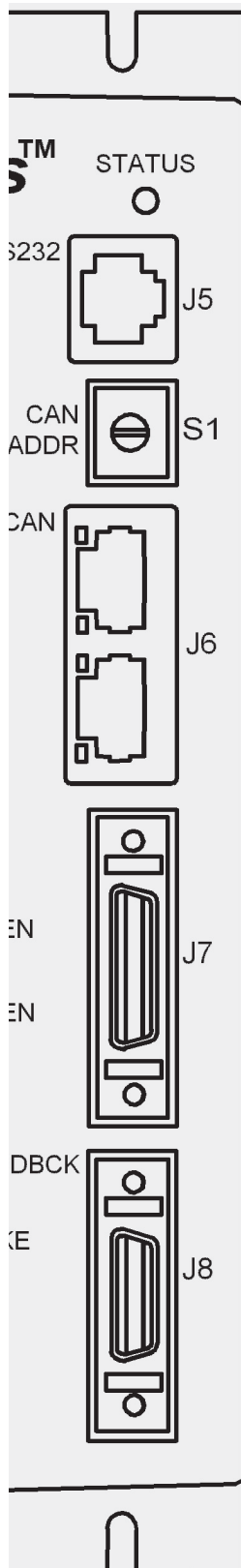
### J4 +24 VDC & Brake

Signal	Pin
+24 Vdc Control Power	3
Brake Output [OUT4]	2
0V (+24 Vdc Return)	1

..... ISOLATED CIRCUIT .....



## J5 RS-232



Pin	Signal
6	No connect
5	TxD Output
4	Ground
3	Ground
2	RxD Input
1	No connect

### J5 Cable Connector:

RJ-11 style, male, 6 position

Cable: 6-conductor modular type

### Notes:

1. CAN circuits are opto-isolated from amplifier circuits.
2. CAN\_GND connects to amplifier Signal Ground.
3. CAN\_SHLD and CAN\_V+ are wired-thru on both J6 connectors and have no connection to amplifier.

## J7 Control Signals

Signal	Pin		Signal
Frame Ground	1	14	[OUT2]
Signal Ground	2	15	[OUT3]
Enable [IN1]	3	16	Tri-Mode Encoder A
GP Input [IN2]	4	17	Tri-Mode Encoder /A
GP Input [IN3]	5	18	Tri-Mode Encoder B
GP Input [IN4]	6	19	Tri-Mode Encoder /B
HS Input [IN6]	7	20	Tri-Mode Encoder X
HS Input [IN7]	8	21	Tri-Mode Encoder /X
HS Input [IN8]	9	22	+5 Vdc @ 250 mA
HS Input [IN9]	10	23	Signal Ground
HS Input [IN10]	11	24	Ref(+) Input
GP Input [IN11]	12	25	Ref(-) Input
[OUT1]	13	26	[IN12] GP Input

## ISOLATED CIRCUIT

### J6 CAN Bus

Pin	Signal
1	CAN_H
2	CAN_L
3	CAN_GND
4	No connection
5	No connection
6	(CAN_SHLD)
7	CAN_GND
8	(CAN_V+)

### J6 Cable Connector:

RJ-45 style, male, 8 position

Cable: 8-conductor modular type

## J8 Motor Feedback

Signal	Pin		Signal
Frame Ground	1	11	Digital Hall U
Signal Ground	2	12	Digital Hall V
+5 Vdc @ 250 mA	3	13	Digital Hall W
Encoder A Input	4	14	[IN5] Temp Sensor
Encoder /A Input	5	15	Signal Ground
Encoder B Input	6	16	Encoder Sin(+) Input
Encoder /B Input	7	17	Encoder Sin(-) Input
Encoder X Input	8	18	Encoder Cos(+) Input
Encoder /X Input	9	19	Encoder Cos(-) Input
Signal Ground	10	20	Signal Ground

### J7 Cable Connector:

3M: 10126-3000VE connector

3M: 10326-52F0-008 backshell

26 position male, 1.27 mm pitch

Cable: 26 conductor, shielded

Note: Molded cable assemblies are available for J7 & J8. See Accessories p. 18

### J8 Cable Connector:

3M: 10120-3000VE connector

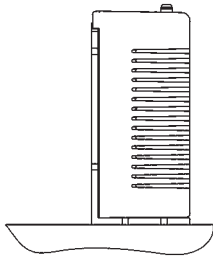
3M: 10320-52F0-008 backshell

20 position male, 1.27 mm pitch

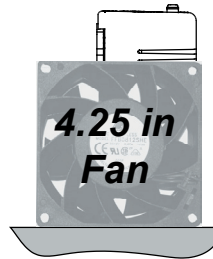
Cable: 20 conductor, shielded



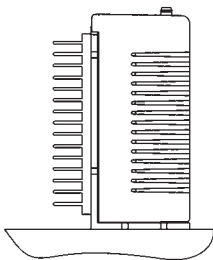
## HEATSINK & FAN CONFIGURATIONS



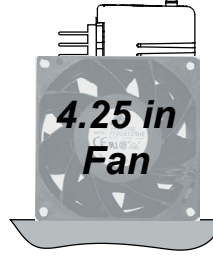
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NO FAN**



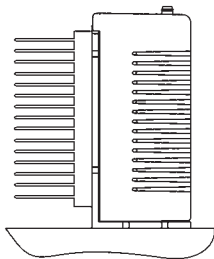
**NO HEATSINK  
WITH FAN**



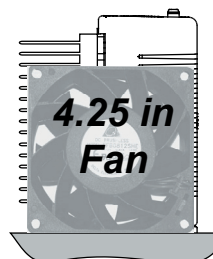
**LOW-PROFILE  
HEATSINK  
NO FAN**



**LOW PROFILE HEATSINK  
WITH FAN**



**STANDARD HEAT-  
SINK  
NO FAN**



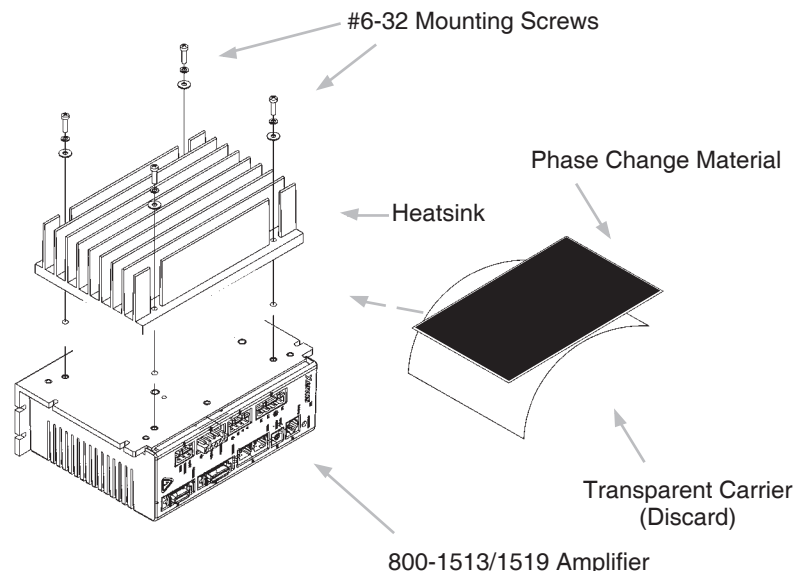
**STANDARD HEATSINK  
WITH FAN**

## HEATSINK MOUNTING

Phase change material (PSM) is used in place of thermal grease. This material comes in sheet form and changes from solid to liquid form as the amplifier warms up. This forms an excellent thermal path from amplifier heatplate to heatsink for optimum heat transfer.

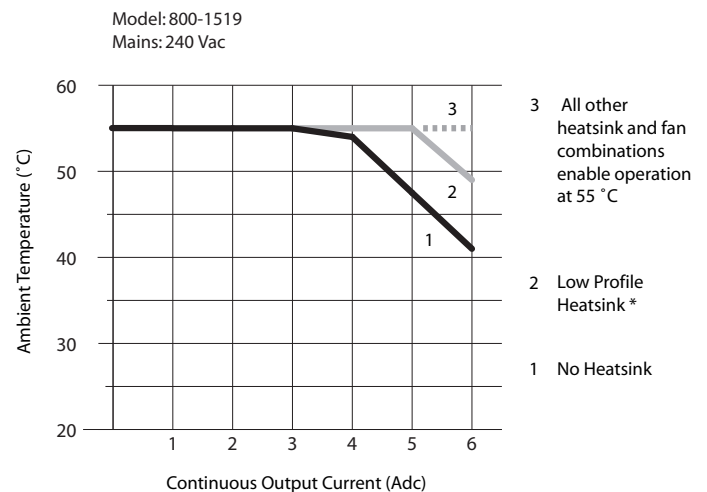
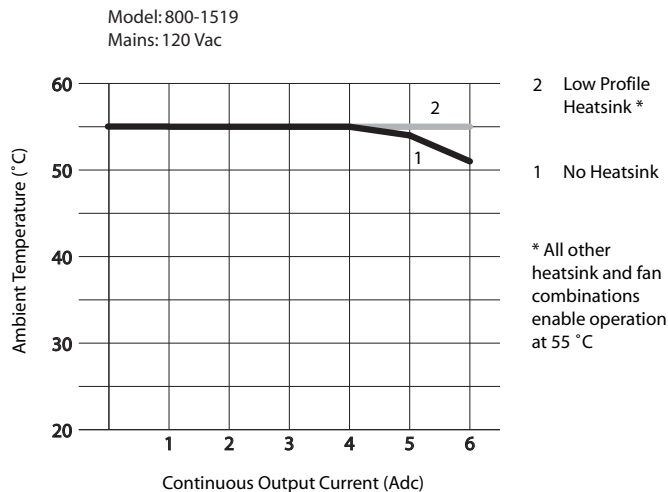
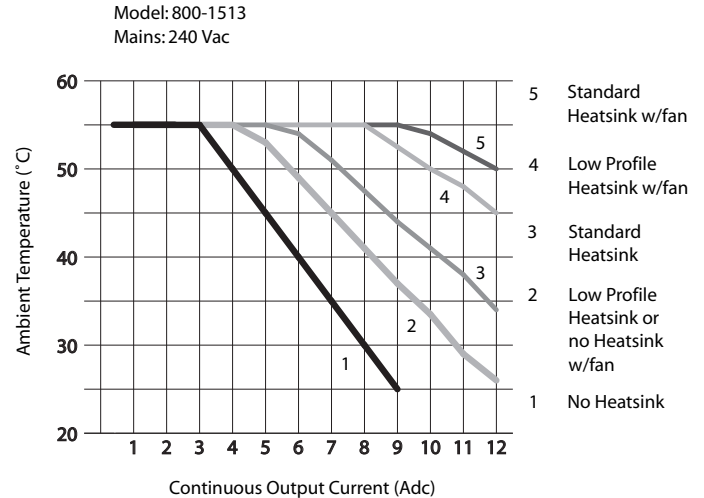
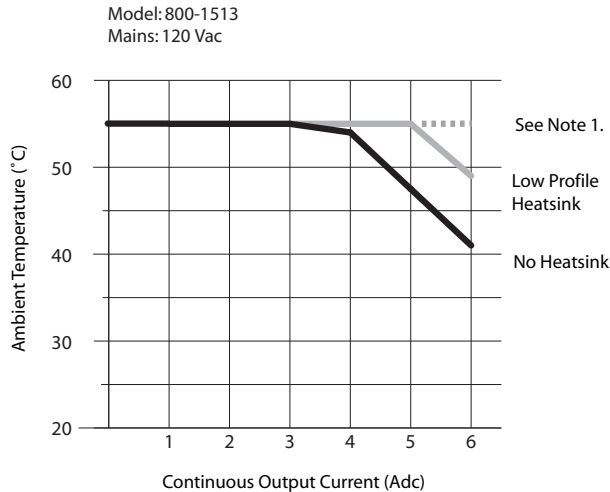
## STEPS TO INSTALL

1. Remove the PSM (Phase Change Material) from the clear plastic carrier.
2. Place the PSM on the amplifier taking care to center the PSM holes over the heatsink mounting holes.
3. Mount the heatsink onto the amplifier taking care to see that the holes in the heatsink, PSM, and amplifier all line up.
4. Torque the #6-32 mounting screws to 8~10 lb-in (0.9~1.13 N·m).



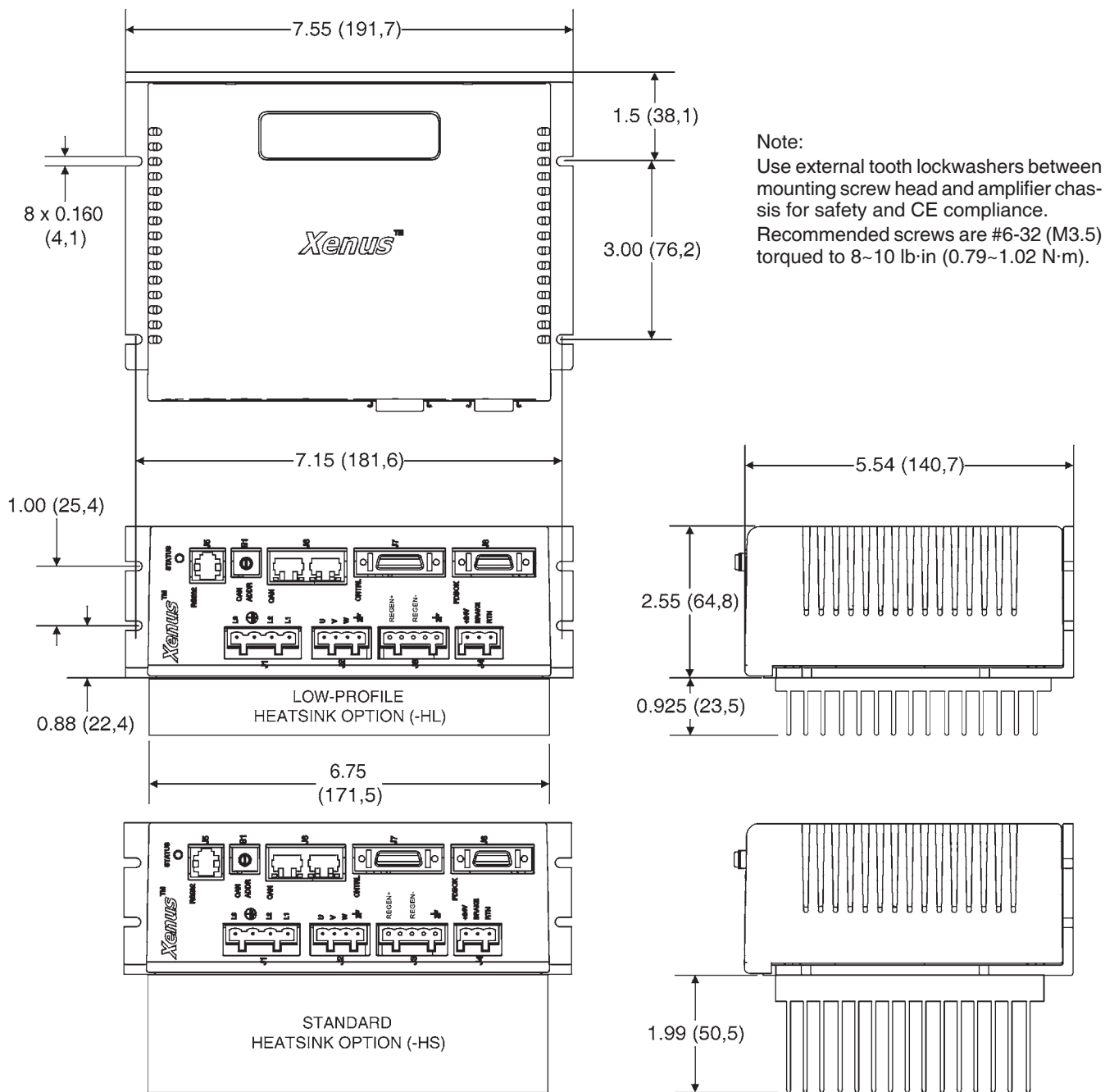
## MAXIMUM OPERATING TEMPERATURE VS HEATSINK TYPE & AIR CIRCULATION

The charts below show that maximum ambient temperature vs. continuous output current for the 800-1513/1519 models. The cooling options are no heatsink, standard heatsink, and low-profile heatsink. For each of these the amplifier can be operated with convection or forced-air cooling.



## DIMENSIONS

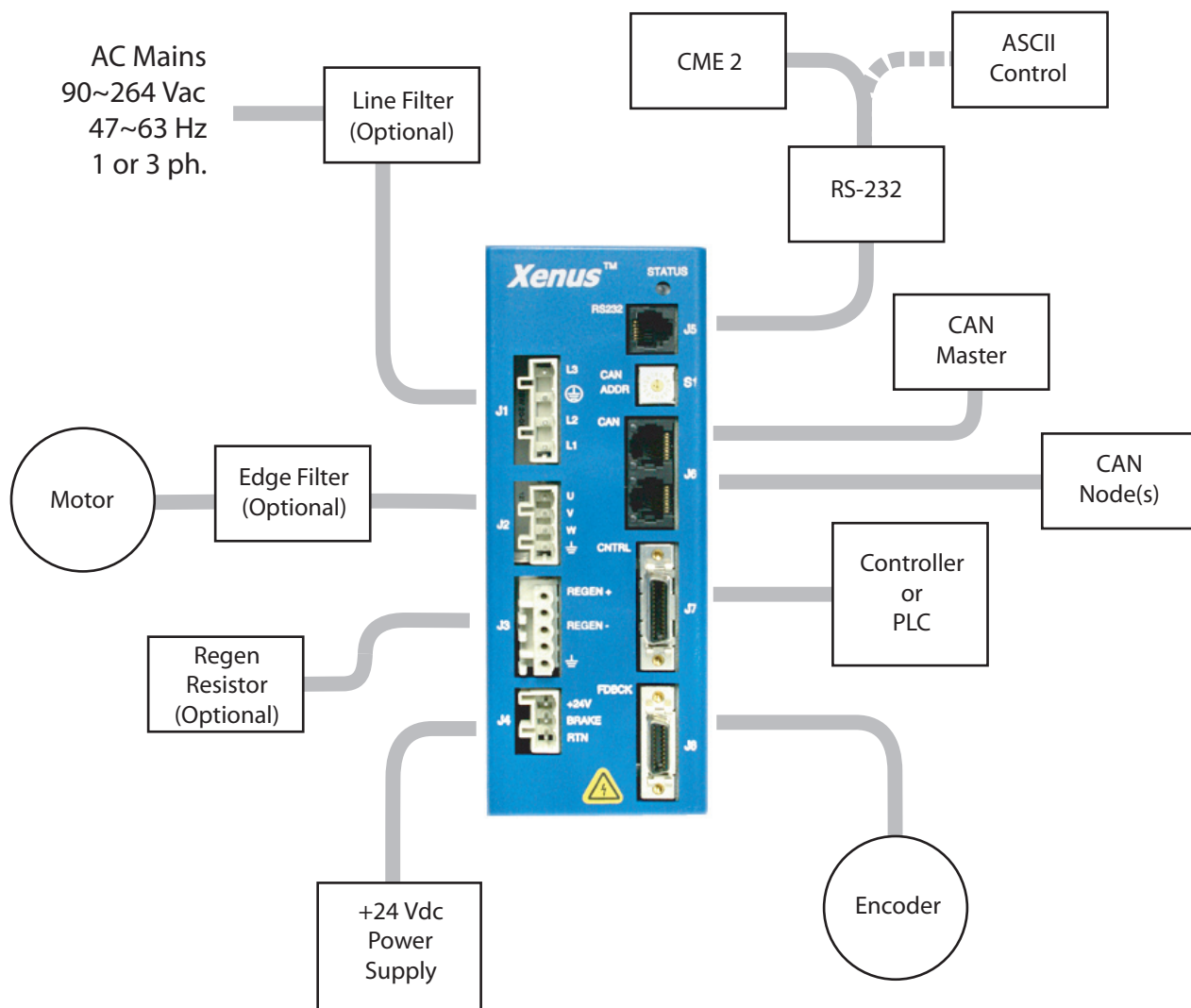
Inches (mm)





Weights:

Amplifier: 3.0 lb (1.36 kg)  
Low-profile Heatsink: 1.31 lb (0.59 kg)  
Standard Heatsink: 1.84 lb (0.83 kg)

## INSTALLATION



## NEW FEATURES

		Model No: 800-1519			
Copley Controls Corp.		Serial No: 02057242		Made in U.S.A.	
Volts	Input	Amps	Volts	Output	Amps
85-264 ~	20 ~	373 max.	6 cont.	18 pk.	

Amplifier models manufactured after March, 2005 have enhanced features and can be identified by the red square on the label. The new features are:

- Indexing
- ASCII communications
- Multi-mode encoder port
  - Emulated encoder outputs from ServoTube motors
  - Buffered digital encoder outputs
  - Secondary encoder input
- Encoder +5 V output increased to 400 mA (was 250)

## ORDERING GUIDE

PART NUMBER	DESCRIPTION
800-1513	Servoamplifier 12/36 A
800-1519	Servoamplifier 6/18 A

Example: Order one 800-1513 amplifier,  
12/36 A with solder-cup connector kit, *CME 2™* CD, and  
a serial cable kit:

Qty	Item	Remarks
1	800-1513	800-1513 servoamplifier
1	XSL-CK	Connector Kit
1	CME 2	CME 2™ CD
1	SER-CK	Serial Cable Kit

## ACCESSORIES

	QTY	REF	DESCRIPTION	MANUFACTURER PART NO.
<b>XSL-CK</b> Connector Kit with Solder-Cup Connectors for J7 & J8	1	J1	Plug, 4 position, 7.5 mm, female	Wago: 721-204 / 026-045
	1	J2	Plug, 4 position, 5.0 mm, female	Wago: 721-104 / 026-047
	1	J3	Plug, 5 position, 5.0 mm, male	Wago: 721-605 / 000-043
	1	J4	Plug, 3 position, 5.0 mm, female	Wago: 721-103 / 026-047
	4	J1-4	Tool, wire insertion & extraction ( for J1-4 )	Wago: 231-131
	1	J7	Connector, 26 position, solder-cup	3M: 10126-3000VE
	1		Back shell, for 26 pin connector	3M: 10326-52F0-008
	1	J8	Connector, 20 position, solder-cup	3M: 10120-3000VE
	1		Back shell, for 20 position connector	3M: 10320-52F0-008
<b>XSL-CA</b> Connector Kit with Molded Cables for J7 & J8	1	J1	Plug, 4 position, 7.5 mm, female	Wago: 721-204 / 026-045
	1	J2	Plug, 4 position, 5.0 mm, female	Wago: 721-104 / 026-047
	1	J3	Plug, 5 position, 5.0 mm, male	Wago: 721-605 / 000-043
	1	J4	Plug, 3 position, 5.0 mm, female	Wago: 721-103 / 026-047
	4	J1-4	Tool, wire insertion & extraction ( for J1-4 )	Wago: 231-131
	1	J7	Cable assembly, control, 10 ft (3 m)	Molex 52316-2611, plug assy, Molex 52370-2610, boot cover
	1	J8	Cable assembly, feedback, 10 ft (3 m)	Molex 52316-2011, plug assy, Molex 52370-2010, boot cover
<b>CME2</b>		J5	CME 2™ Drive Configuration Software (CD-ROM)	
<b>SER-CK</b>			RS-232 Serial Cable Kit	
<b>XSL-CC-10</b>		J7	Cable + molded connector, control, 10 ft (3 m)	Molex 52316-2611, plug assy, Molex 52370-2610, boot cover
<b>XSL-FC-10</b>		J8	Cable + molded connector, feedback, 10 ft (3 m)	Molex 52316-2011, plug assy, Molex 52370-2010, boot cover

### Connectors & software for CANopen operation

<b>XSL-NK</b> CANopen Connector Kit	1	J6	Sub-D 9-position female to RJ-45 adapter	
	1		CAN bus terminator	
	1		CAN bus Network Cable, 10 ft (3 m)	Kristamicro: 60-662BY
<b>XSL-CV</b>			Sub-D 9-position female to RJ-45 adapter	
<b>XSL-NC-10</b>			CAN bus Network Cable, 10 ft (3 m)	Kristamicro: 60-662BY
<b>XSL-NC-01</b>			CAN bus Network Cable, 1 ft (0.3 m)	Kristamicro: 60-660BY
<b>XSL-NT</b>			CAN bus Network Terminator	
<b>CMO</b>	1		CD with CMO software	
<b>CML</b>	1		CD with CML software (note: license fee required)	

### Heatsink kits for field installation (optional)

<b>XSL-HL</b> Heatsink Kit Low Profile	1		Heatsink, low profile	
	1		Heatsink thermal material	
	4		Heatsink hardware	
<b>XSL-HS</b> Heatsink Kit Standard	1		Heatsink, standard	
	1		Heatsink thermal material	
	4		Heatsink hardware	

### Regeneration resistors (optional)

XSL-RA-01	Regen Resistor Assembly (for 800-1519 )
XSL-RA-02	Regen Resistor Assembly (for 800-1513)
Edge Filter	
XSL-FA-01	Edge Filter for Amplifier Outputs