# Stepnet™ Module

## Control Modes
- Indexer, Point-to-Point, PVT
- Camming, Gearing
- Position, Velocity (Servo Mode)
- Position (Microstepping)

## Command Interface
- CANopen/DeviceNet
- ASCII and discrete I/O
- Stepper commands
- PWM velocity/torque command
- Master encoder (Gearing/Camming)
- ±10V Position/Velocity/Torque command *

## Communications
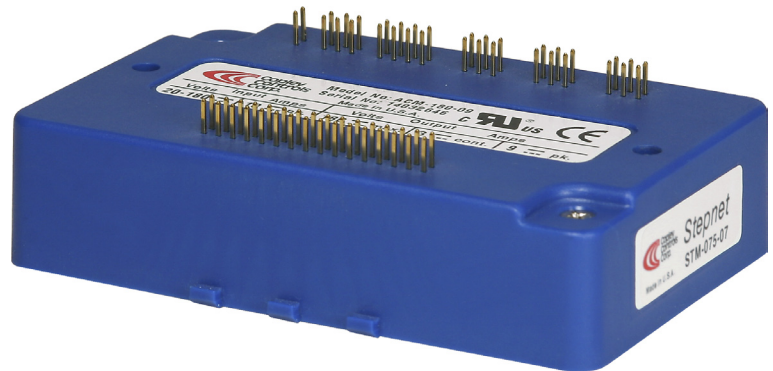- CANopen/DeviceNet
- RS-232

## Feedback
- Digital Quad A/B encoder

## I/O - Digital
- 12 inputs, 4 outputs

## Dimensions: mm [in]
- 102 x 69 x 25 [4.0 x 2.7 x 1.0]

| Model | Vdc | Ic | Ip |
|-------|-----|-----|-----|
| STM-075-07 | 20-75 | 5 | 7 |

## DESCRIPTION

*Stepnet* is a stepper motor drive that combines CANopen networking with 100% digital control of stepper motors. When used with Copley's *Accelnet*™ and *Xenus*™ digital servo drives it enables brushless, brush, and now stepper motors to be controlled over the same distributed network.

In addition to CANopen motion commands, *Stepnet* can operate as a stand-alone drive. Inputs can be incremental position commands from controllers in Step/Direction or CU/CD format, as well as A/B quadrature commands from a master-encoder. Step to motor position ratio is programmable for electronic gearing.

The RoHS version has a ±10V analog input for position/velocity/torque control. This enhances the ability of the driver to work with external motion controllers which can control steppers using *Stepnet* in servo-mode.

Set up is fast and simple using *CME 2*™ software operating under Windows® and communicating with *Stepnet* via an RS-232 link. CAN address selection is by digital inputs.

*Stepnet* 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 Mode, Interpolated Position Mode (PVT), and Homing Mode.

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 that of a single index or profile. The drive 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 combination of limit and home switches such that the drive moves the motor into a position that has an absolute reference to some part of the machine.

There are twelve logic inputs. Eleven are programmable as limit & home switches, stepper pulse inputs, A/B encoder, reset, or motor-temperature. Another dedicated input is for drive Enable. There are four programmable logic outputs for reporting a drive fault, or other status indications.

An Aux HV input is provided for "keep alive" power that preserves the drive data (e.g. current position) and CANopen operation if +HV has been removed as in an emergency-stop situation. This enables the control system to monitor drive status and to enable an orderly recovery without a full system reset, and "homing" of all axes.

Operation from transformer-isolated DC power supplies saves cost in multi-axis systems.

\* Available on RoHS version (see page 12)

# Stepnet™ Module

CANopen STEPPER MOTOR DRIVE
IN A PC-BOARD MOUNT PACKAGE

**RoHS**

## GENERAL SPECIFICATIONS

Test conditions: Load = 1mH per phase, ambient temperature = 25 °C. +HV = $HV_{max}$

| MODEL | STM-075-07 | |
|---|---|---|
| **OUTPUT CURRENT** | | |
| Peak Current | 7 (5) | Apeak (Arms, sinusoidal) |
| Peak time | 1 | s |
| Continuous current | 5 (3.5) | Apeak (Arms) |
| **INPUT POWER** | | |
| $HV_{min}$ to $HV_{max}$ | +20 to +75 | Vdc,transformer-isolated |
| Ipeak | 8 | Adc (1 sec) |
| Icont | 5.5 | Adc |
| Aux HV | +20 to +75 | Vdc |
| **PWM OUTPUTS** | | |
| Type | Dual MOSFET H-bridges, 15 kHz center-weighted PWM, space-vector modulation | |
| PWM ripple frequency | 30 kHz | |
| **BANDWIDTH** | | |
| Current loop, small signal | 2.5 kHz typical, bandwidth will vary with tuning & load inductance | |
| HV Compensation | Changes in HV do not affect bandwidth | |
| Current loop update rate | 15 kHz (66.7 µs) | |
| Position loop update rate | 3 kHz (333 µs) | |
| **COMMAND INPUTS** | | |
| CANopen bus | Position Mode commands | Homing, Profile, and Interpolated profile modes |
| Digital position reference | Step/Direction, CountUp/CountDown | Stepper command pulses (2 MHz maximum rate) |
| | Quad A/B Encoder | 2 Mline/sec, 8 Mcount/sec (after quadrature) |
| Analog ±10 Vdc | When operating in servo-mode with encoder feedback (RoHS version only) position/velocity/torque control, 5 kΩ differential input impedance | |
| **DIGITAL INPUTS (NOTE 1)** | | |
| Number | 12 | |
| Enable [IN1] | Dedicated input for drive enable, active level programmable, GP type with 33 µs RC | |
| GP [IN2,3,4,5] | General Purpose inputs with 33 µs (1 µs for [IN4]) RC filters, programmable functions, and active level select | |
| HS [IN6,7,8,9,10,11,12] | High-Speed Inputs with 100 ns RC filters, programmable functions, and active level select | |
| All inputs | 74HC14 Schmitt trigger operating from +5.0 V with RC filter on input, 10 kΩ pull-up to +5 Vdc RC time-constants assume active drive on inputs and do not include 10 kΩ pull-ups. | |
| Logic levels | Vin-LO < +1.35 Vdc, Vin-HI > +3.65 Vdc, Maximum input voltage = 0~5 Vdc for HS inputs, 0~24 Vdc for GP | |
| **DIGITAL OUTPUTS** | | |
| Number | 4 | |
| Type | Current-sinking MOSFET open-drain outputs with 1 kΩ pullup to +5 Vdc through diode, 300 mAdc sink max, +30 Vdc max. | |
| Functions | Programmable with *CME 2™* | |
| Active Level | Programmable to either HI (off, pull-up to +5 Vdc) or LO (on, current-sinking) when output is active | |
| **RS-232 COMMUNICATION PORT** | | |
| Signals | RxD, TxD, Gnd: DTE connections Full-duplex, serial communication port for drive setup and control, 9,600 to 115,200 Baud | |
| **CANOPEN COMMUNICATION PORT** | | |
| Signals | CANH, CANL, Gnd. 1 Mbit/sec maximum | |
| Protocol | CANopen Application Layer DS-301 V4.01 | |
| Device | DSP-402 Device Profile for Drives and Motion Control | |
| **MOTOR CONNECTIONS** | | |
| Motor A+,A-,B+,B- | Outputs to 2-phase stepper motor, bipolar drive connected | |
| Motemp | Motor temperature sensor or switch. Any input [IN2~IN12] can be programmed for this function | |
| Brake | Any digital output can be programmed for motor brake actuation External flyback diodes required if driving inductive loads | |
| **PROTECTIONS** | | |
| HV Overvoltage | > +91 Vdc | Drive outputs turn off until +HV is < overvoltage |
| HV Undervoltage | < +20 Vdc | Drive outputs turn off until +HV >= +20 Vdc |
| Drive over temperature | PC Board > 70 °C. | Drive latches OFF until drive is reset, or powered off-on |
| Short circuits | | Output to output, output to ground, internal PWM bridge faults |
| I²T Current limiting | | Programmable: continuous current, peak current, peak time |
| Latching / Non-Latching | | Programmable |

## NOTES

1. [IN1] is not programmable and always works as drive Enable. Other digital inputs are programmable.

# *Stepnet*™ *Module*

**AGENCY STANDARDS CONFORMANCE**

| | |
|---|---|
| EN 55011 : 1998 | CISPR 11 (1997) Edition 2/Amendment 2: |
| | Limits and Methods of Measurement of Radio Disturbance Characteristics of Industrial, Scientific, and Medical (ISM) Radio Frequency Equipment |
| EN 61000-6-1 : 2001 | Electromagnetic Compatibility |
| | Generic Immunity Requirements |

Following the provisions of EC Directive 89/336/EEC:

| | |
|---|---|
| EN 60204-1 : 1997 | Safety of Machinery - Electrical Equipment of Machines |

Following the provisions of EC Directive 98/37/EC:

| | |
|---|---|
| UL 508C : 1996 | UL Standard for Safety for Power Conversion Equipment |

## FEATURES

Stepnet is a DSP based drive for two-phase step motors that operates as a node on a CAN bus or as a stand-alone drive that takes step motor pulses to command motor position. It operates from line-isolated DC power supplies and mounts directly to PC boards that simplify internal machine wiring for multi-axis systems.

As a CAN node it operates under the CANOpen protocol DSP-402 for motion control devices. The functions supported include Profile Position Mode, Interpolated Position Mode, and Homing Mode. In Profile Position Mode a single PDO (Process Data Object) can command a position profile with programmable acceleration, deceleration, maximum speed, and target position. The acceleration can be trapezoidal or S-curve. Interpolated Position Mode works with multiple PDO's each of which specifies position, velocity, and time. For this reason this mode is sometimes called PVT (Position, Velocity, Time) mode. The drive uses a cubic-interpolation algorithm to connect the PVT points such that the motor satisfies the PVT parameters at each point while moving along a path that connects the points smoothly. In PVT mode long moves of complex shapes can be performed.

Multiple axes can be synchronized so that moves are coordinated. This emulates the functions normally performed by motion-controller cards or chips which can now be eliminated in many cases reducing cost and system complexity.

As a stand-alone drive it can take digital signals in Pulse/Direction or Count-Up/Count-Down format to control position or a ±10 Vdc analog signal can control torque, velocity, or position.

## RS-232 COMMUNICATION

*Stepnet* is configured via a three-wire, full-duplex RS-232 port that operates from 9,600 to 115,200 Baud. *CME 2*™ software provides a graphic user interface (GUI) to set up all of *Stepnet* features via a computer serial port. Once configured, *Stepnet* can be used in stand-alone mode, or as a networked drive on a CAN bus. The RS-232 signals are configured as DTE (Data Terminal Equipment) types. A single RS-232 port can communicate with multiple *Stepnet* drives by setting the CAN address of the drive connected to the computer to "0", making it a CAN bus master. Then, connect the CAN signals of the master to the other drives and set each of them to a non-zero, unique CAN address.
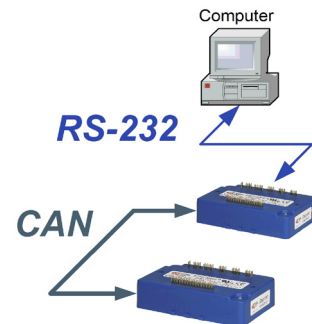


## CANOPEN COMMUNICATION

*Stepnet* uses the CAN physical layer signals CANH, CANL, and GND for connection, and CANopen protocol for communication.

Before connecting *Stepnet* to the CAN network, it must be assigned a CAN address. This is done via the RS-232 port, which is also used for general drive setup. The CAN address is a combination of an internal address stored in flash memory, and digital inputs which have been configured to act as CAN address bits. A maximum of 127 CAN devices are allowed on a CAN bus network, so this limits the input pins used for this purpose to a maximum of seven, leaving five inputs available for other purposes. If an address is stored in flash, then the address range controlled by digital inputs should never exceed a value that, when added to the flash address, produces a sum greater than 127. If the address is determined only by the flash memory value then it can be from 1 to 127.

Most installations will use less than the maximum number of CAN devices, in which case the number of inputs used for a CAN address can be less than seven, leaving more inputs available for other functions.

# Stepnet™ Module
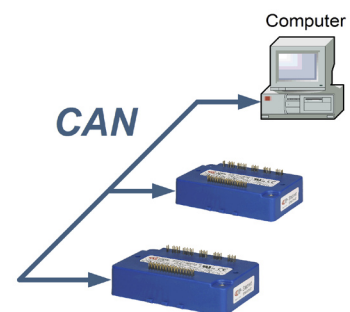
## DIGITAL INPUTS

There are twelve digital inputs to *Stepnet*, eleven of which can be programmed to a selection of functions. The Enable input which controls the on/off state of the PWM outputs is fixed to [IN1] as a safety measure so that a drive cannot be programmed in such a way that, once installed, it could not be shut down by the controller. The other inputs can be set to a selection of functions. Two types of RC filters are used: GP (General-purpose) and HS (High Speed). The input time-constants apply when driven by active sources (CMOS, TTL, etc). All inputs have 10 kΩ pull-up resistors to +5 Vdc.

Input functions such as Step/Direction, CountUp/CountDown, Quad A/B must be wired to inputs having the HS filters, and inputs with the GP filters can be used for general purpose logic functions, limit switches, and the motor temperature sensor.

Programmable functions of the I/O inputs include:

- CAN address
- Drive Reset
- Motion Abort
- PWM sync
- Step/Direction, or CU/CD stepper position pulses

- Positive Limit switch
- Negative Limit switch
- Home switch
- Motor temperature sensor input
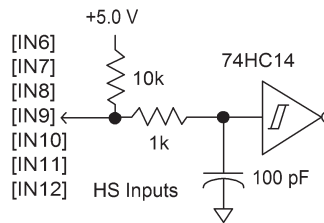- Quad A/B master encoder input for camming

In addition to the selection of functions, the active level for each input is individually programmable.

Drive reset takes place on transitions of the input and is programmable to 1/0 or 0/1. The motor temp sensor function will disable the drive if a switch in the motor opens or closes when the motor overheats.
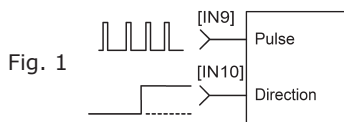
### GP INPUTS 1, 2, 3, 4, 5 +24 VDC MAX

+5.0V
[IN1]
[IN2]
[IN3]
[IN4] *
[IN5]
10k
10k
74HC14
3.3nF
* 100 pF
GP Inputs
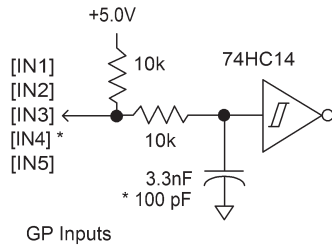
### HS INPUTS 6, 7, 8, 9, 10, 11, 12 +5 VDC MAX

+5.0 V
[IN6]
[IN7]
[IN8]
[IN9]
[IN10]
[IN11]
[IN12]
10k
1k
74HC14
100 pF
HS Inputs

## COMMAND INPUTS

As a network drive, the primary command input is the CANopen bus. But, *Stepnet* can also operate in  stand-alone mode, taking commands from a motion controller. These commands can control position when operating as a stepper drive. In servo-mode, digital PWM inputs can control velocity or torque and the ±10V analog input can control position, velocity, or torque. The figures below show the input types. Digital inputs are programmable for active-level selection. The pulses shown are normally-low, high-going, but can be programmed to be normally-high, low-going.
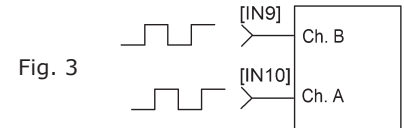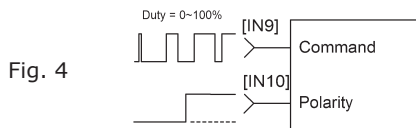
### PULSE-DIRECTION

Fig. 1
[IN9] Pulse
[IN10] Direction

### COUNT-UP / COUNT-DOWN

Fig. 2
[IN9] Count Up
[IN10] Count Down

### QUAD A/B ENCODER

Fig. 3
[IN9] Ch. B
[IN10] Ch. A

### COMMAND / POLARITY

Fig. 4
Duty = 0~100%
[IN9] Command
[IN10] Polarity

### COMMAND 50%

Fig. 5
Duty = 50% ±50%
[IN9] Command
<no connection> Not used

### ANALOG COMMAND

Fig. 6
Ref(+) 37.4k 5k
5.36k
Ref(-) 37.4k 5k
1.5V

# Stepnet™ Module
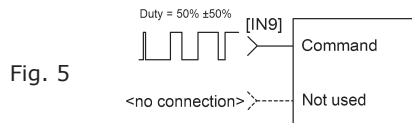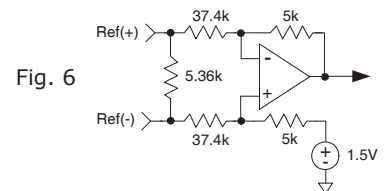
## DIGITAL OUTPUTS

Digital outputs [OUT1~4] are open-drain MOSFETs with 1 kΩ pull-up resistors in series with a diode to +5 Vdc. They can sink up to 100 mAdc from external loads operating from power supplies to +30 Vdc.

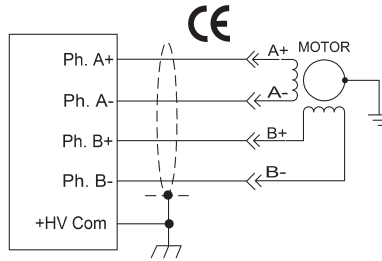The outputs are typically configured as drive fault and motor brake. Additional functions are programmable.

As an drive fault output, the active level is programmable to be HI or LO when a fault occurs. As a brake output, it is programmable to be either HI or LO to release a motor brake when the drive is enabled.

When driving inductive loads such as a relay, an external fly-back diode is required. A 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 kΩ resistor to +5 Vdc in the drive. This could turn the PLC input on, giving a false indication of the drive output state.
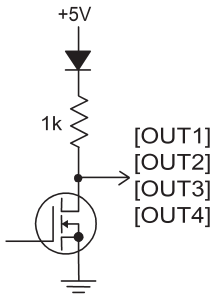
## MOTOR CONNECTIONS

There are four motor output terminals: A+, A-, B+, and B-. These outputs drive the two independent coils of a 2-phase step motor with windings configured for bipolar drive mode.
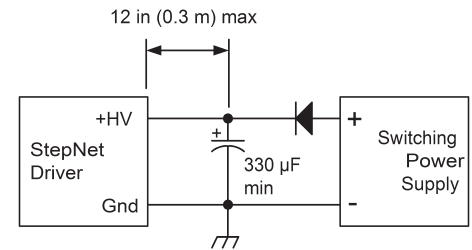


Ph. A+   A+  MOTOR
Ph. A-   A-
Ph. B+   B+
Ph. B-   B-
+HV Com

CE = Shielded cables required for CE compliance

## PWM SYNCHRONIZATION

Multiple drives can synchronize their PWM frequencies which can reduce the noise emission to nearby equipment. This is done by connecting the output of one drive the an input on the other drives in a group. When the output and inputs are programmed as PWM Sync, one drive becomes a PWM Sync master and the PWM Sync slaves then synchronize their PWM frequencies exactly to that of the master. This feature is particularly useful when mounting multiple *Stepnet* drives on a single PC board. Any output can be used as a PWM Sync master, and any high speed input can be used for a PWM Sync slave.



PWM Master
[OUT1~4]

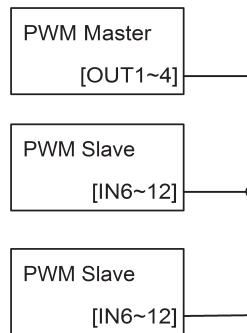PWM Slave
[IN6~12]

PWM Slave
[IN6~12]

## POWER SUPPLIES

Stepnet operates typically from transformer-isolated, unregulated DC power supplies. These should be sized such that the maximum output voltage under high-line and no-load conditions does not exceed the drives maximum voltage rating. Power supply rating depends on the power delivered to the load by the drive.

Operation from regulated switching power supplies is possible if a diode is placed between the power supply and drive to prevent regenerative energy from reaching the output of the supply. If this is done, there must be external capacitance between the diode and drive. The minimum value required is 330 µF per drive mounted no more than 12 inches from the drive.



12 in (0.3 m) max

+HV
StepNet Driver
Gnd

330 µF min

Switching Power Supply

## AUX HV (OPTIONAL)

CANopen communications with *Stepnet* can be maintained when +HV is turned off by using the Aux HV input. The voltage has the same range as +HV, and can be greater or less than +HV.

In operation, the Aux HV keeps the drive logic and control circuits active so it is always visible as a node on a CAN bus. The current-position data is maintained making 'homing' unnecessary after system power is re-enabled. If *Stepnet* is operating as a stand-alone drive, Aux HV is not necessary but can be useful if the controller is monitoring drive digital outputs.



+5V

1k   [OUT1]
     [OUT2]
     [OUT3]
     [OUT4]

CANopen STEPPER MOTOR DRIVE
IN A PC-BOARD MOUNT PACKAGE

*Stepnet*™ *Module*

Copley
Controls
Corp.

CE

RoHS

## TYPICAL DRIVE CONNECTIONS

Motion Controller

| | | |
|---|---|---|
| AmpEnable | 29 | Enable Input [IN1] GP |
| PosLim | 26 | Fwd Enable [IN2] GP |
| NegLim | 28 | Rev Enable [IN3] GP |
| | 2 | Signal Gnd |
| | 5 | Signal Gnd |
| | 11 | Fault Output [OUT1] |
| D/A  ±10 V   Note 3 | 10 | Ref(+) |
| | 9 | Ref(-) |
| | 27 | [IN4] GP |
| | 22 | [IN7] HS |
| | 21 | [IN8] HS |

| Signal Gnd | 15 |
| Signal Gnd | 16 |
| Signal Gnd | 23 |
| Signal Gnd | 24 |
| Signal Gnd | 31 |
| Signal Gnd | 32 |
| Motemp GP [IN5] | 30 |
| HS [IN11] | 18 | Ch. A |
| HS [IN12] | 17 | Ch. B |
| HS [IN6] | 25 | Ch. X |
| [OUT4] | 14 |
| [OUT3] | 13 |
| Brake [OUT2] | 12 |

TEMP SENSOR

External +5 Vdc

FEEDBACK ENCODER

+24V

BRAKE

J2

ENC Ch. A  CU  Step → 20 [IN9] HS
ENC Ch. B  CD  Direction → 19 [IN10] HS

| Motor B- | 2 | 1 | /B |
| | 4 | 3 | |
| Motor B+ | 10 | 9 | B |
| | 12 | 11 | |
| Motor A- | 18 | 17 | /A |
| | 20 | 19 | |
| Motor A+ | 26 | 25 | A |
| | 28 | 27 | |

STEP MOTOR

+24 V Optional: Used as keep-alive power when drive is operated as a CAN node

CANopen Bus Controller I/O

| CANH | 8 | CANH |
| CANL | 7 | CANL |
| Gnd | 6 | |

Aux HV Input  49

+24 V

Mount external capacitor <= 12" (30 cm) from drive

J1

Controller RS-232 I/O

| RxD | 4 | TxD |
| TxD | 3 | RxD |
| Gnd | 1 | |

| +HV Input | 45 | 43 | 41 |
| | 46 | 44 | 42 |
| +HV Com | 37 | 35 | 33 |
| | 38 | 36 | 34 |

Fuse
Cext
330 uF Minimum per drive
DC Power

NOTES

1. [IN1] always functions as Drive Enable with programmable active level
   [IN2]~[IN12] have programmable functions and active level

2. HS inputs [IN6,7,8,9,10,11,12] are for high-speed signals and have 100 ns RC filters.
   GP inputs [IN1,2,3, & 5] have 33 μs filters, [IN4] has a 1 μs filter.
   RC filter time constants apply when inputs are driven by active sources and do not include the 10 kΩ pull-up resistors.

3. The analog reference input is only available on RoHS versions of the drive.

# Stepnet™ Module

## DRIVE PC BOARD CONNECTORS

Pin 1
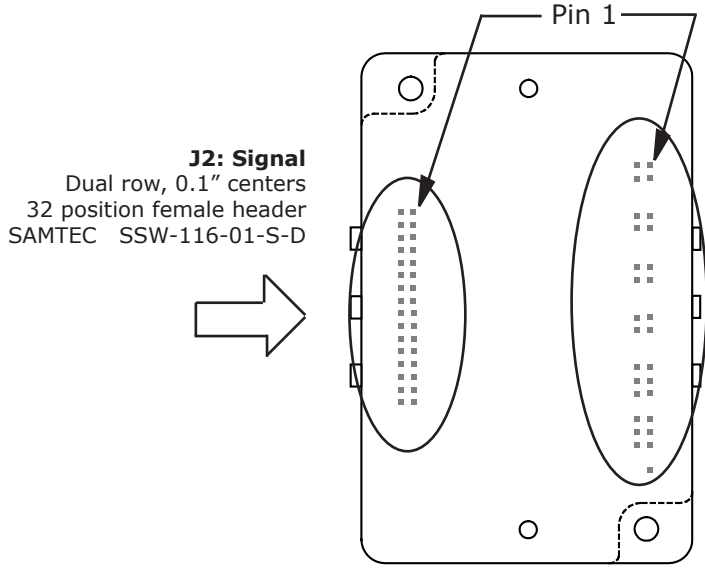
Drive viewed from above looking down on the PC board on which it is mounted.
Pins and housing shapes are shown in phantom view.

**J2: Signal**
Dual row, 0.1" centers
32 position female header
SAMTEC   SSW-116-01-S-D

**J1: +HV, Gnd, & Motor Outputs**
Dual row, 0.1" centers
50 position female header
SAMTEC SSW-125-01-S-D

| Signal | J2 Pin | | Signal |
|---|---|---|---|
| Signal Ground | 2 | 1 | Signal Ground |
| TS-232 TxD | 4 | 3 | RS-232 RxD |
| Signal Ground | 6 | 5 | Signal Ground |
| CANH | 8 | 7 | CANL |
| Analog Ref(+) | 10 | 9 | Analog Ref(-) |
| [OUT2] | 12 | 11 | [OUT1] |
| [OUT4] | 14 | 13 | [OUT3] |
| Signal Ground | 16 | 15 | Signal Ground |
| HS Input [IN11] | 18 | 17 | [IN12] HS Input |
| HS Input [IN9] | 20 | 19 | [IN10] HS Input |
| HS Input [IN7] | 22 | 21 | [IN8] HS Input |
| Signal Ground | 24 | 23 | Signal Ground |
| GP Input [IN2] | 26 | 25 | [IN6] HS Input |
| GP Input [IN3] | 28 | 27 | [IN4] GP Input |
| GP Input [IN5] | 30 | 29 | [IN1] Enable Input |
| Signal Ground | 32 | 31 | Signal Ground |

Note 2 (left side)    Note 2 (right side)

| Signal | J1 Pin | | Signal |
|---|---|---|---|
| Motor B- | 2 | 1 | Motor B- |
| | 4 | 3 | |
| No Connection | 6 | 5 | No Connection |
| | 8 | 7 | |
| Motor B+ | 10 | 9 | Motor B+ |
| | 12 | 11 | |
| No Connection | 14 | 13 | No Connection |
| | 16 | 15 | |
| Motor A- | 18 | 17 | Motor A- |
| | 20 | 19 | |
| No Connection | 22 | 21 | No Connection |
| | 24 | 23 | |
| Motor A+ | 26 | 25 | Motor A+ |
| | 28 | 27 | |
| No Connection | 30 | 29 | No Connection |
| | 32 | 31 | |
| Ground | 34 | 33 | Ground |
| | 36 | 35 | |
| | 38 | 37 | |
| No Connection | 40 | 39 | No Connection |
| +HV | 42 | 41 | +HV |
| | 44 | 43 | |
| | 46 | 45 | |
| No Connection | 48 | 47 | No Connection |
| | 50 | 49 | Aux HV |

## NOTES

1. Signals are grouped for current-sharing on the power connector. When laying out PC board artworks, all pins in groups having the same signal name must be connected.
2. The analog reference inputs are only available on RoHS versions of the drive.

## PC BOARD DESIGN

The peak voltage between adjacent etches on the PC board is equal to the +HV power. Peak input current is 8 Adc, continuous current is 5.5 Adc. A trace width of 0.175", plating thickness of 3 oz. copper, and spacing of 0.025" is adequate for Stepnet. As shown on p. 7, connections to J1 use multiple pins for current-sharing. PC board connections should connect these pins.

Printed circuit board layouts for *Stepnet* drives should follow some simple rules:

1. Install a low-ESR electrolytic capacitor not more than 12 inches from the drive. PWM drives produce ripple currents in their DC supply conductors. *Stepnet* drives do not use internal electrolytic capacitors as these can be easily supplied by the printed circuit board. In order to provide a good, low-impedance path for these currents a low-ESR capacitor should be mounted as close to the drive as possible. 330 µF is a minimum value, with a voltage rating appropriate to the drive model and power supply.

2. Connect J1 signals (A+,A-,B+,B- outputs, +HV, and +HV Common) in pin-groups for current-sharing. The signals on J1 are all high-current types. To carry these high currents (up to 7 Adc peak) the pins of J1 must be used in multiples to divide the current and keep the current carrying capacity of the connectors within specification. The diagram on page 6 shows the pin groups that must be interconnected to act as a single connection point for PC board traces.

3. Follow IPC-2221 rules for conductor thickness and width of J1 signals.

Minimum trace width, and copper plating thickness should follow industry-standards (IPC-2221). The width and plating depend on the maximum voltage, and maximum current of the drive. Power supply traces (+HV, +HV Common) should be routed close to each other to minimize the area of the loop enclosed by the drive DC power. Noise emission or effects on nearby circuitry are proportional to the area of this loop, so minimizing it is good layout practice.

Motor signals should also be routed close together. Output pairs (A & /A, B & /B) should be routed as closely as possible to form a balanced transmission path. Keeping these traces as closely placed as possible will again minimize noise radiation due to motor phase currents.
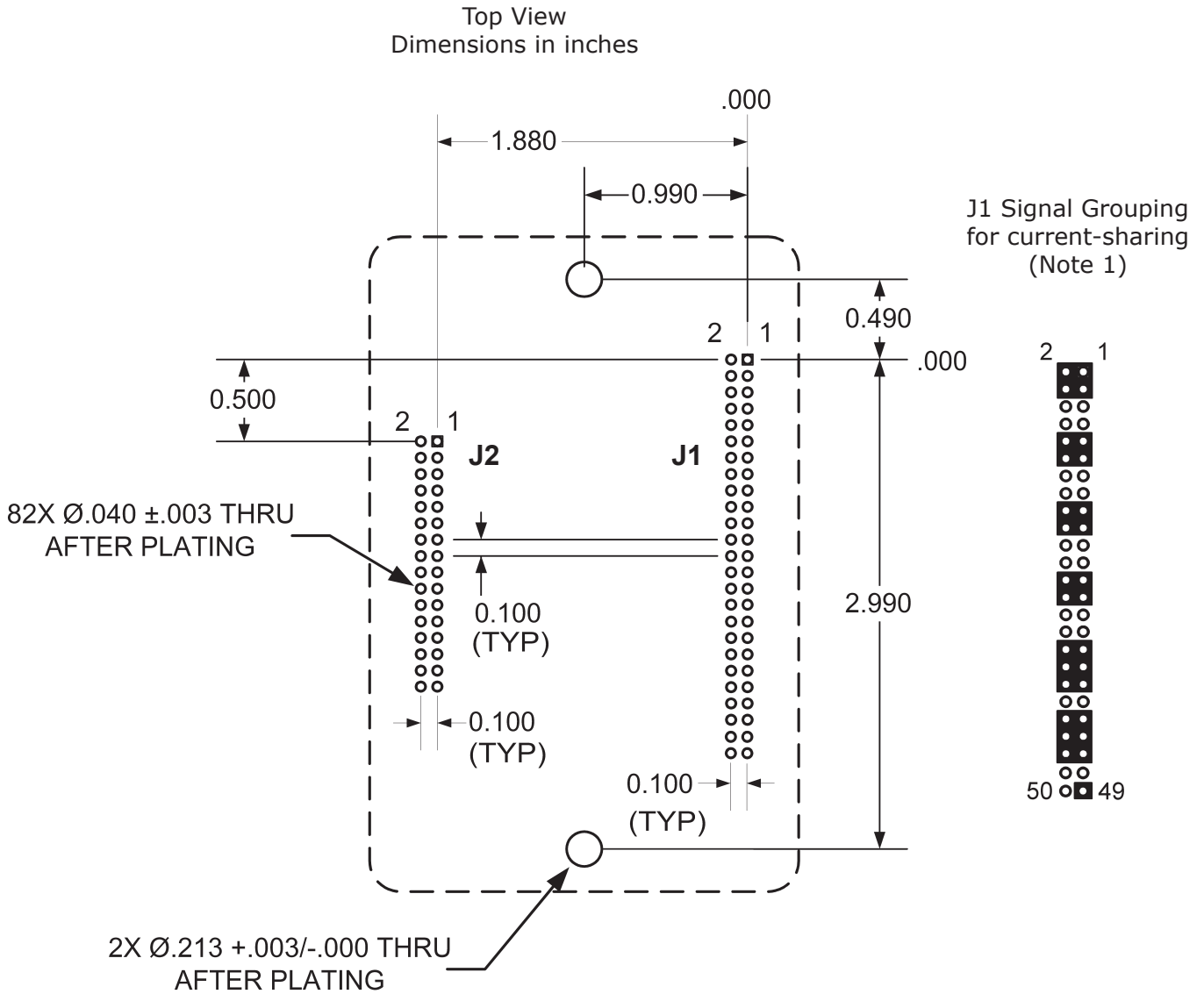
*Stepnet* circuit grounds are electrically common, and connect internally. However, the J1 signals carry high currents while the grounds on J2 (signal ground) carry low currents. So, J2 signals should be routed away from, and never parallel to the signals on J1.

The drive heatplate is electrically isolated from all drive circuits. For best noise-immunity it is recommended to connect the standoffs to frame ground and to use metal mounting screws to maintain continuity between heatplate and standoffs.

## MOUNTING AND COOLING

*Stepnet* mounts on PC boards using two, dual-row, 0.1" female headers. These permit easy installation and removal of the drive without soldering. Threaded standoffs should be swaged into the PC board provide positive retention of the drive and permit mounting in any orientation. Cooling configurations are: no heatsink, low-profile, and standard heatsinks.

**Stepnet Module**

## PC BOARD MOUNTING FOOTPRINT

Top View
Dimensions in inches



J1 Signal Grouping
for current-sharing
(Note 1)

.000

1.880

0.990

0.490

.000

0.500

2
1

J2

2
1

J1

82X Ø.040 ±.003 THRU
AFTER PLATING

0.100
(TYP)

0.100
(TYP)

2.990

0.100
(TYP)

2
1

50
49

2X Ø.213 +.003/-.000 THRU
AFTER PLATING

*Stepnet* Mounting Hardware:

| Qty | Description | Mfgr | Part Number | Remarks |
|---|---|---|---|---|
| 1 | Socket Strip | Samtec | SSW-116-01-S-D | J2 |
| 1 | Socket Strip | Samtec | SSW-125-01-S-D | J1 |
| 2 | Standoff 6-32 X 3/8" | PEM | KFE-632-12-ET | |

NOTES

1. J1 pins with the same signal name must be connected for current-sharing.
2. To determine copper width and thickness for J1 signals refer to specification IPC-2221. (Association Connecting Electronic Industries, http://www.ipc.org)
3. Standoffs should be connected to etches on PC board that connect to frame ground for maximum noise suppression and immunity.

# Stepnet™ Module

**RoHS**

## POWER DISSIPATION

The chart on this page shows the internal power dissipation for *Stepnet* under differing power supply and output current conditions. The output current is calculated from the motion profile, motor, and load conditions. The values on the chart represent the rms (root-mean-square) current that the drive would provide during operation. The +HV values are for the average DC voltage of the power supply.

When +HV and drive output current are known, the drive power dissipation can be found from the chart. The next step is to determine the temperature rise the drive will experience when it's installed. For example, if the ambient temperature in the enclosure is 40 °C, and the heatplate temperature is to be limited to 65 °C to avoid shutdown, the rise would be 25 °C *above ambient*.

Divide the temperature rise by the power dissipation will yield a result in units of °C/W. For a *Stepnet* operating at 75 Vdc and outputting 5 Arms, the dissipation would be about 6.6 W. This would give 25 °C/6.6W, or 3.8 °C/W as the maximum thermal resistance ($R_{th}$) of a heatsink.

From the illustrations on the opposite page, if it is desired to use the drive without fan cooling, the -HS heatsink option would work as it has an $R_{th}$ of 2.2 °C/W.

Driver Dissipation vs. Output Current & +HV for STM-075-07
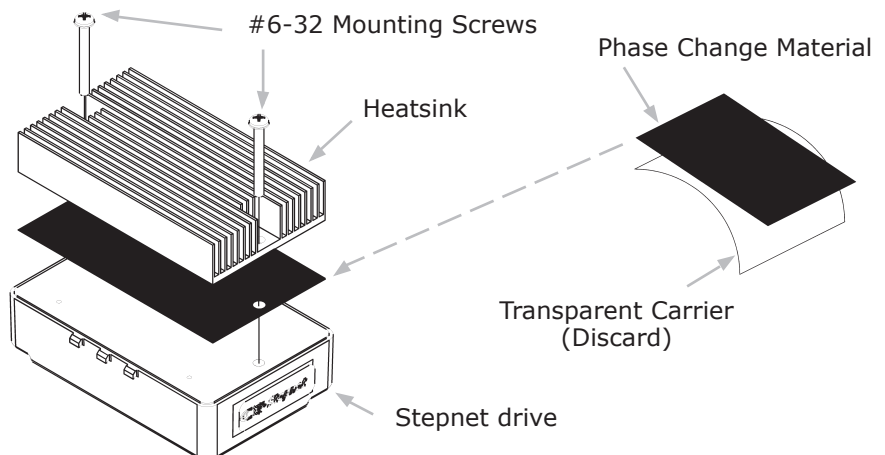
+HV (VDC)
75
45
25

6.6 W
5.4 W
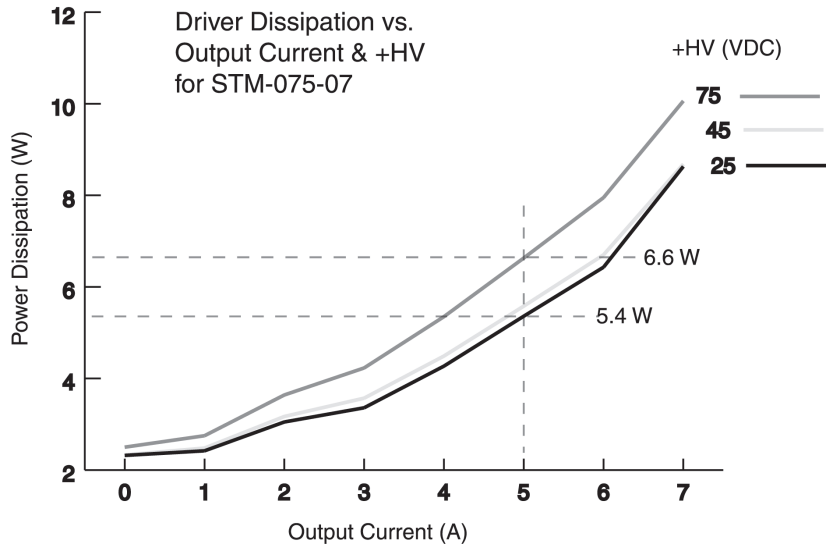
## HEATSINK INSTALLATION

If a heatsink is used it is mounted using the same type of screws used to mount the drive without a heatsink but slightly longer. 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 drive warms up. This forms an excellent thermal path from drive 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 *Stepnet* aluminum heatplate taking care to center the PSM holes over the holes in the drive body.
3. Mount the heatsink onto the PSM again taking care to see that the holes in the heatsink, PSM, and drive all line up.
4. Torque the #6-32 mounting screws to 8~10 lb-in (0.9~1.13 N·m).

#6-32 Mounting Screws

Phase Change Material

Heatsink

Transparent Carrier (Discard)

Stepnet drive

# Stepnet™ Module

## HEATSINK OPTIONS

Rth expresses the rise in temperature of the drive per Watt of internal power loss. The units of Rth are °C/W, where the °C represent the rise above ambient in degrees Celsius. The data below show thermal resistances under convection or forced-air conditions for the no-heatsink, HL, and HS heatsinks.
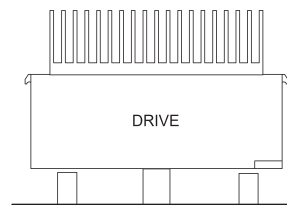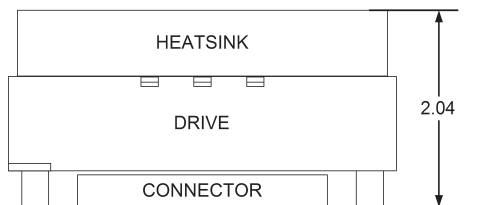
### NO HEATSINK
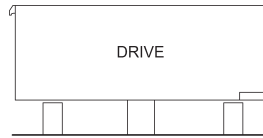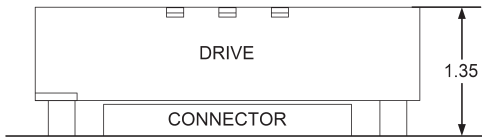


| NO HEATSINK | ºC/W |
|---|---|
| CONVECTION | 6.2 |
| FORCED AIR (300 LFM) | 2.1 |

### STANDARD HEATSINK (STM-HS)
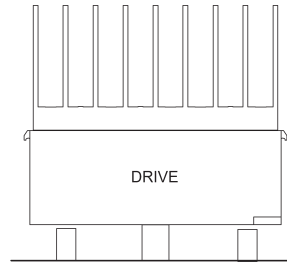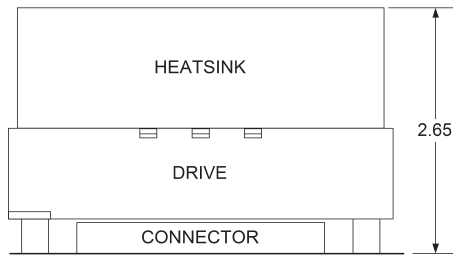


| STM-HS HEATSINK | ºC/W |
|---|---|
| CONVECTION | 2.2 |
| FORCED AIR (300 LFM) | 0.5 |

### LOW-PROFILE HEATSINK (STM-HL)



| STM-HL HEATSINK | ºC/W |
|---|---|
| CONVECTION | 4.0 |
| FORCED AIR (300 LFM) | 0.9 |

Dimensions in inches
using recommended connectors and standoffs (see page 9)

# Stepnet™ Module

## DIMENSIONS



0.282 [7.2]

3.480 [88.4]

1.31 [33.3]

2.62 [66.5]

2.79 [70.9]

4.05 [102.7]

2X    Ø.169 [Ø4.29]  HOLE
FOR NO. 6-32 [M3.5] SCREW

0.235 [6.0]

0.025 [0.6] SQ.

0.980 [24.9]
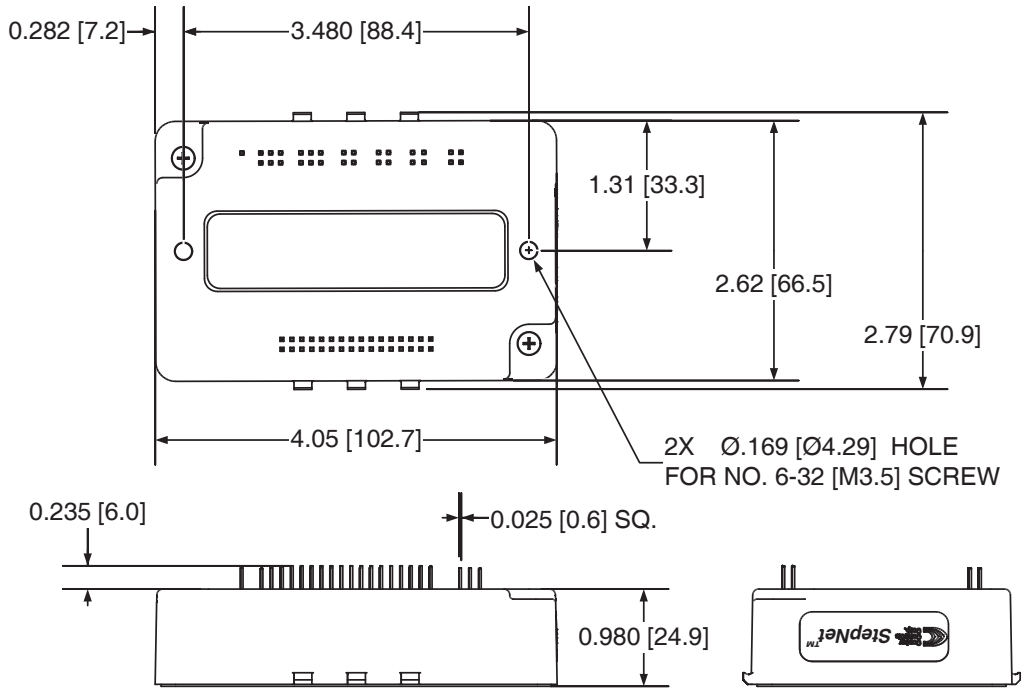
### NOTES

1. Dimensions shown in inches [mm].

## ORDERING GUIDE

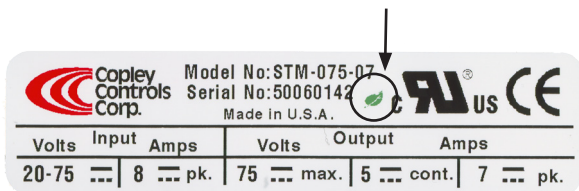| PART NUMBER | DESCRIPTION |
|---|---|
| STM-075-07 | *Stepnet* Stepper drive 5/7 Adc @ 75 Vdc |
| TDK-075-01 | *Stepnet* Development Kit |
| TDK-CK | *Stepnet* Development Kit Connector Kit |
| STM-HL | *Stepnet* Stepper Drive Low Profile Heatsink Kit |
| STM-HS | *Stepnet* Stepper Drive Standard Heatsink Kit |
| CME2 | *CME 2* Drive Configuration Software CD-ROM |
| SER-CK | Serial Cable Kit for Development Kit |

## ORDERING INSTRUCTIONS

Example: Order 1 STM-075-07 drive with
Standard Heatsink, Development Kit, and
Development Kit Connector Kit

| Qty | Item | Remarks |
|---|---|---|
| 1 | STM-075-07 | *Stepnet* drive |
| 1 | STM-HS | Standard Heatsink Kit |
| 1 | TDK-075-01 | *Stepnet* Development Kit |
| 1 | TDK-CK | Connector Kit for Development Kit |
| 1 | CME2 | *CME 2*™ CD |
| 1 | SER-CK | Serial Cable Kit |

### NOTES

1. Heatsink kits are ordered separately and assembled by the customer, not at the factory.

The RoHS version is identified by the green leaf symbol on the product identification tag. This model has the ±10V analog input for position/velocity/torque control.

Note: Specifications subject to change without notice

Rev 4.08_fr  01/11/2008

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