Hypertherm®

Mitsubishi EtherCAT® Drives Supported by EDGE® Connect CNCs

Application Note

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Hypertherm, Inc.
Etna Road, P.O. Box 5010
Hanover, NH 03755 USA
603-643-3441 Tel (Main Office)
603-643-5352 Fax (All Departments)
info@hypertherm.com (Main Office Email)
800-643-9878 Tel (Technical Service)
technical.service@hypertherm.com (Technical Service Email)
800-737-2978 Tel (Customer Service)
customer.service@hypertherm.com (Customer Service Email)
866-643-7711 Tel (Return Materials Authorization)
877-371-2876 Fax (Return Materials Authorization)
return.materials@hypertherm.com (RMA email)

Hypertherm México, S.A. de C.V.
Avenida Toluca No. 444, Anexo 1,
Colonia Olivar de los Padres
Delegación Álvaro Obregón
México, D.F. C.P. 01780
52 55 5681 8109 Tel
52 55 5683 2127 Fax
Soporte.Tecnico@hypertherm.com (Technical Service Email)

Hypertherm Plasmatechnik GmbH
Sophie-Scholl-Platz 5
63452 Hanau
Germany
00 800 33 24 97 37 Tel
00 800 49 73 73 29 Fax
31 (0) 165 596900 Tel (Technical Service)
00 800 4973 7843 Tel (Technical Service)
technicalservice.emea@hypertherm.com (Technical Service Email)

Hypertherm (Singapore) Pte Ltd.
82 Genting Lane
Media Centre
Annexe Block #A01-01
Singapore 349567, Republic of Singapore
65 6841 2489 Tel
65 6841 2490 Fax
Marketing.asia@hypertherm.com (Marketing Email)
TechSupportAPAC@hypertherm.com (Technical Service Email)

Hypertherm Japan Ltd.
Level 9, Edobori Center Building
2-1-1 Edobori, Nishi-ku
Osaka 550-0002 Japan
81 6 6225 1183 Tel
81 6 6225 1184 Fax
HTJapan.info@hypertherm.com (Main Office Email)
TechSupportAPAC@hypertherm.com (Technical Service Email)

Hypertherm Europe B.V.
Vaartveld 9, 4704 SE
Roosendaal, Nederland
31 165 596907 Tel
31 165 596901 Fax
31 165 596908 Tel (Marketing)
31 (0) 165 596900 Tel (Technical Service)
00 800 4973 7843 Tel (Technical Service)
technicalservice.emea@hypertherm.com
(Technical Service Email)

Hypertherm (Shanghai) Trading Co., Ltd.
B301, 495 ShangZhong Road
Shanghai, 200231
PR China
86-21-80231122 Tel
86-21-80231120 Fax
86-21-80231128 Tel (Technical Service)
techsupport.china@hypertherm.com
(Technical Service Email)

South America & Central America: Hypertherm Brasil Ltda.
Rua Bras Cubas, 231 – Jardim Maia
Guarulhos, SP – Brasil
CEP 07115-030
55 11 2409 2636 Tel
tecnico.sa@hypertherm.com (Technical Service Email)

Hypertherm Korea Branch
#3904. APEC-ro 17. Heaundae-gu. Busan.
Korea 48060
82 (0)51 747 0358 Tel
82 (0)51 701 0358 Fax
Marketing.korea@hypertherm.com (Marketing Email)
TechSupportAPAC@hypertherm.com
(Technical Service Email)

Hypertherm Pty Limited
GPO Box 4836
Sydney NSW 2001, Australia
61 (0) 437 606 995 Tel
61 7 3219 9010 Fax
au.sales@Hypertherm.com (Main Office Email)
TechSupportAPAC@hypertherm.com
(Technical Service Email)

Hypertherm (India) Thermal Cutting Pvt. Ltd
A-18 / B-1 Extension,
Mohan Co-Operative Industrial Estate,
Mathura Road, New Delhi 110044, India
91-11-40521201/ 2/ 3 Tel
91-11 40521204 Fax
HTIndia.info@hypertherm.com (Main Office Email)
TechSupportAPAC@hypertherm.com
(Technical Service Email)

One of Hypertherm's long-standing core values is a focus on minimizing our impact on the environment. Doing so is critical to our, and our customers', success. We are always striving to become better environmental stewards; it is a process we care deeply about.

Introduction

The following information is provided to Hypertherm channel partners for reference only, to help you select and configure an EtherCAT drive that is supported by EDGE Connect/T/TC CNCs.

> **NOTE:** Work in partnership with your drive manufacturer to select and configure the drives for your cutting system. Refer to your drive manufacturer's drive documentation for technical information about the drives. Make sure to follow the guidelines and instructions provided by the drive manufacturer.

When possible, the following information is provided to support integration of the drives with the cutting system and the CNC.

- Drive model supported
- Firmware revision supported
- Example drive amplifier file
- Setup and parameter notes

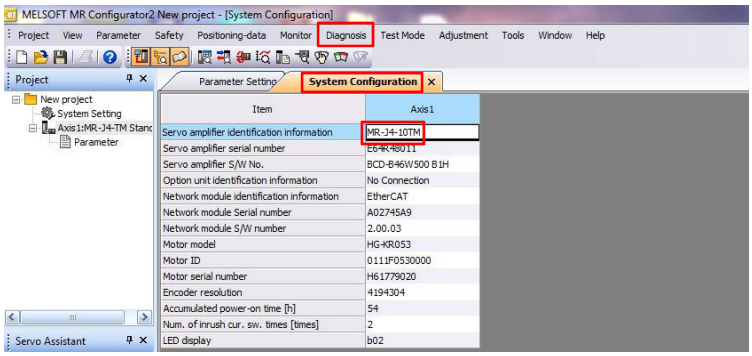
Setup files and parameters provided by Hypertherm can be used for the initial machine setup. We expect these files and parameters to be modified by the installer for the specific cutting system configuration and desired performance.

Supported Mitsubishi drives

Series	Model	Firmware	Notes
MR-J4	All MR-J4 models	Amplifier: BCD-B46W500 B1H EtherCAT module: 1.10.01	• J3 motors ONLY • P06 (electronic gear numerator) is not supported • No I/O is supported on the drive amplifier. An I/O module on the EtherCAT network is required.
MR-J4	All MR-J4 models	Amplifier: BCD-B46W500 B1H EtherCAT module: 2.00.03	• J4 and J3 motors • P06 (electronic gear numerator) is supported • No I/O is supported on the drive amplifier. An I/O module on the EtherCAT network is required.

NOTE:

- Mixing different brands of drives in one system is not supported.
- All drives must support and be configured for a 1 ms update rate.
- For a list of supported I/O modules, see the *EtherCAT Drives and I/O Modules Supported by EDGE® Connect/T/TC CNCs* Application Note (809660).
- J4 amplifiers with 1.xx firmware must use J3 motors with 18-bit encoder feedback devices.
- J4 amplifiers with 2.xx firmware can use J3 or J4 motors.
- J4 amplifiers with 2.xx firmware now supports P06 (electronic gear numerator). See Electronic gear numerator for more information.
- For proper operation you must set PA01(**STY) = 1001. See Operation mode for more information.
- For proper operation you must disable the slave watchdog in Hypertherm EtherCAT Studio. See Disable the Slave Watchdog for more information.
- To check a drive's firmware version, use the Mitsubishi MR Configurator drive software. select System Configuration under the Diagnosis menu.



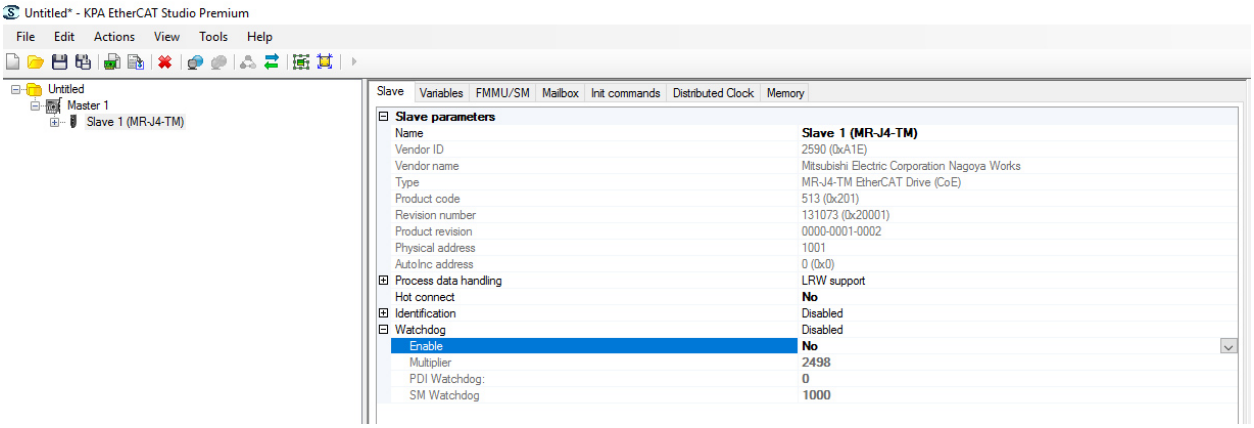
Disable the Slave Watchdog

When using Mitsubishi drives you must disable the Slave Watchdog feature.

> **NOTE:** If you do not disable the Slave Watch Dog you will experience Hypertherm Studio errors such as PDI WDOG or AL Status register 0x002e and unreliable phase up when trying to create Phoenix.xml.

To Disable the Watchdog, follow these steps;

- In Hypertherm studio, select the MRJ4-TM Slave (Mitsubishi drive)
- Click the Slave tab
- Click + on Watchdog
- Use the pulldown arrow on Enable and select No
- Repeat this for all Mitsubishi drives on the network
- Configure the network by following the instructions in the *EDGE Connect Installation and Setup Manual* (809340). It is available in the Hypertherm Document Library at www.hypertherm.com/docs.



Setup and parameters

From a high level, the process of setting up your drives is as follows.

1. Make sure that the correct firmware is installed. If an update is needed, contact the drive manufacturer. Hypertherm is not currently providing firmware updates.
2. Set up the drive parameters per the drive manufacturer's instructions.
3. Make sure the drives are communicating on the network.

In addition to this application note, also refer to the following sections of the *EDGE® Connect Installation and Setup Manual* (809340).

- Section 3: *Machine stop strategies and table hardware*, for information about:
  - How the CNC enables and disables the drives, and stops motion
  - Drive enable signals
  - Drive Enable output and Drive Disabled input
  - Overtravel limits
  - Safety circuit
- Section 5: *Machine Axes*, for information about:
  - Axis orientation and positive motion
  - Axis assignment and setup
- Section 7: *I/O – Inputs and Outputs*, for information about:
  - How Phoenix® assigns I/O
  - Digital I/O and assignment
  - Analog I/O and assignment

NOTE:

- Make sure you can remove power, including control (logic) power, from all drives. Refer to your drive manufacturer's drive documentation for more information.
- All drives must be set up as linear axes.

Parameters in Drive using MR Configurator

Electronic gear numerator

NOTE: Phoenix does not support the EU numbering format of using decimal points (periods) as numerical separators. Using decimal points as numerical separators will result in incorrect settings. Example:
Correct - 200,000.00 = Two hundred thousand
Incorrect - 200.000,00 = Two hundred

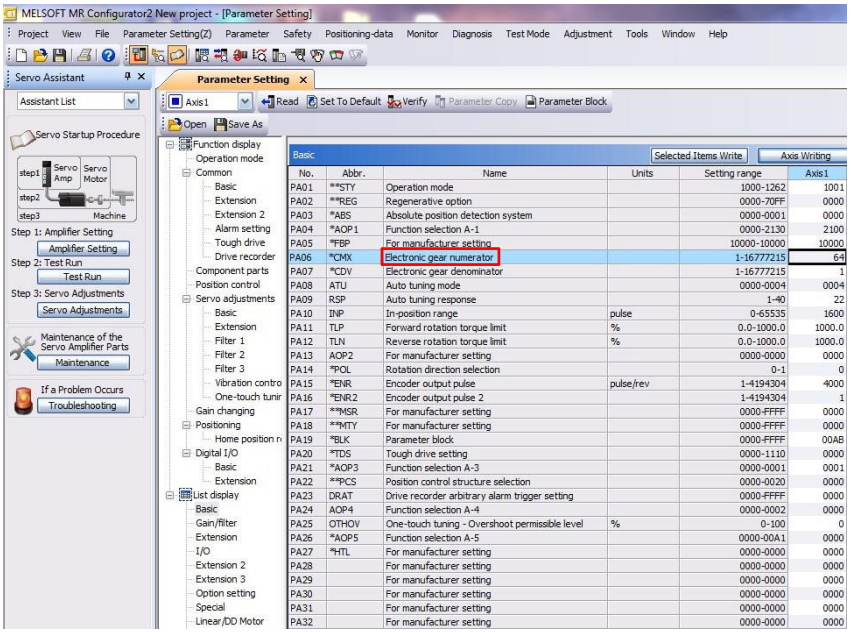
In the MR-Configurator2 software, use the parameter editor to set the Parameter Electronic Gear Numerator PA06 to allow the motor to reach maximum RPM. Then write the parameters to the drive. For the parameters to take effect the drive power must be cycled.

When using EtherCAT the MR drives with J4 (HF-Series motors) encoder resolution is set to 22 bits for all encoders (22 bits = 4,194,304 counts/revolution).

Refer to Maximum machine speed per minute to calculate your desired PA06 (electronic gear numerator).

For example, if you change the PA06 value to 16, this will divide the 4,194,304 counts/revolution by 16 to give 262,144 counts/rev over the EtherCAT network.

PA06 Parameter Value



Operation mode

- Under Basic Parameters, configure the drive for cyclic synchronous mode:

  PA01(**STY) Operation mode = 1001

Supported encoder counts

For the example below, the encoder counts per revolution are 262.144 – metric (262,144 – English) over the ECAT network.

Encoder counts per mm (inch)

Linear axis example – metric:

In this example the linear axis has the following machine characteristics.

- **Gear box ratio:** 5:1
- **Lead screw pitch:** 150 mm/revolution

Use these values with the following formula to calculate encoder counts per mm, as shown.

$$\frac{262.144 \text{ encoder counts}}{1 \text{ motor revolution}} \times \frac{5 \text{ motor revolutions}}{1 \text{ pinion revolution}} \times \frac{1 \text{ pinion revolution}}{150 \text{ mm (pitch)}} = 8.738{,}13 \text{ encoder counts per mm}$$

Linear axis example – English:

In this example the linear axis has the following machine characteristics.

- **Gear box ratio:** 5:1
- **Lead screw pitch:** 5.91 in./revolution

Use these values with the following formula to calculate encoder counts per inch, as shown.

$$\frac{262{,}144 \text{ encoder counts}}{1 \text{ motor revolution}} \times \frac{5 \text{ motor revolutions}}{1 \text{ pinion revolution}} \times \frac{1 \text{ pinion revolution}}{5.91 \text{ in. (pitch)}} = 221{,}780.03 \text{ encoder counts per inch}$$

Maximum machine speed per minute

There is a limit to the maximum encoder feedback on the EDGE Connect. The CNC's maximum encoder input rate is 32.767 counts per millisecond – metric (32,767 counts per millisecond – English). The drive's encoder scaling parameter needs to be adjusted so that the CNC's maximum encoder input rate is not exceeded at the table's designed maximum speed. (Refer to *Maximum machine speed per minute* below for more information.)

Use the calculated encoder counts from the example on the previous page with the following formula to calculate the maximum machine speed.

Metric example:

$$\frac{\text{32.767 (max. encoder counts per ms)} \times \text{60.000 (ms per minute)}}{\text{8.738,13 encoder counts per mm}} = \text{224.993,22 mmpm Maximum machine speed}$$

English example:

$$\frac{\text{32,767 (max. encoder counts per ms)} \times \text{60,000 (ms per minute)}}{\text{221,780.03 encoder counts per inch}} = \text{8,864.73 ipm Maximum machine speed}$$