EtherCAT VFD Quick Start Guide





Version 1.00

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For more information, please visit the product web page:

www.vitalsystem.com/ec01



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Update Firmware and Software

VFD Support on Vital Systems EtherCAT motion controllers requires the following minimum versions:

- Firmware: 5.84
- Plugin: 2.50.75
- <u>EC-Link: v1.6.0</u>

Any existing EC-Link projects must be remade and any ESI files must be reimported. This can be done by first clicking the trash symbol to remove the ESI file, then once again importing the ESI file:

Mitsubishi Electric FR-E800-E 1_01.x	Mitsubishi Electric Corpora	00000A1E	교
Omron R88D-1SN04H-ECT.xml	OMRON Corporation	0000083	莭
			_
Import ESI		Delete A	II

It is recommended you create a backup of your ECLink project before remaking it so you have a reference to go back to and avoid losing your old settings.



Configuring Project

In the following example my network has an Omron drive and a Mitsubishi VFD. This guide will demonstrate how to configure the Mitsubishi VFD. The steps may vary if using a different VFD.

When setting up your VFD for the first time, we recommend starting with just the VFD on the network by itself. Once it is working, you can add more drives.

Note that it is highly recommended your VFDs be located at the end of your EtherCAT network.

After updating to the latest firmware, plugin, and EC-Link version, and reimporting all your ESI files, we can begin configuring your project. For the VFD RxPDOs, select one with ControlWord and Target Velocity. For the TxPDOs, select one with Statusword and Actual Velocity.

HCON Isc-Master PDO SDO Object Map Settings R880-1500-E Rx-PDO Copy PDO Description PDO ID Description Index SubIndex Bits Controlword 0x6040 0 16 33rd Receive PDO Mapping 0x1620 It arget velocity 0x6042 0 16 Tx-PDO Description PDO ID Description Index SubIndex Bits 16 Ist Transmit PDO Mapping 0x1620 Statusword 0x6041 0 16 Ist Transmit PDO Mapping 0x1a20 Statusword 0x6041 0 16 Viet Viet Contexes Inte Vietocity 0x6044 0 16	State: ECAT Unplugged ESI	Aew Project	PROJECT Copen Reset Sa Project Project Project	ave As roject	CONTROLLER Download Project Connect Device	Browse Network	? Help	MISCELL	ANEOUS
Tx-PDO Copy PDO Description PDO ID 1st Transmit PDO Mapping 0x1a00 33rd Transmit PDO Mapping 0x1a20 Velocity demand 0x6041 0x6044 0 16 0x6044 Actual Velocity 0x6044 16 0x6044	HICON EC-Master R88D-1SN04H-ECT 200V/400W ServoE FR-E800-E	R	D SDO C x-PDO Description 1st Receive PDO Mapp 33rd Receive PDO Map	PDO ID ping 0x1600 oping 0x1620	Settings Descrip Controlword vl target velocit	+ Copy ption V	PDO Index 0x6040 0x6042	SubIndex 0 0	Bits 16 16
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	Systems inc		Description 1st Transmit PDO Map 33rd Transmit PDO Ma	PDO ID ping 0x1a00 pping 0x1a20	Descrij Statusword vl velocity dema Actual Velocity	nd	Index 0x6041 0x6043 0x6044	SubIndex 0 0 0	Bits 16 16 16 16

There are a few caveats specific to the Mitsubishi VFD to note here:

- It does not have Actual Velocity in its TxPDOs by default. We will have to add this manually by editing the PDO 0x1a20. I will demonstrate this in the below section.
- PDOs 0x1600 and 0x1a00 are fixed and cannot be edited. Any additions and edits you would like to make must use either 0x1620 or 0x1a20.



Right click the PDO we want to edit, and select Edit:

Tx-	PDO			
		Description	PDO ID	
	1st Trans	smit PDO Mapping	0x1a00	Status
-	33rd Tra	pemit PDO Mapping	0x1a20	vl velo
		Edit		Actual
		Reset		

Usually common objects such as Actual Velocity will be easily available and added in the top right box. In the case of this VFD however, we must manually add the object. Select New in the bottom right.

smit PDO Maj	pping			Add 💵	ESI OR	ojects	9	
				Description		Index	SubIndex	Bits
Fixed:			1	Statusword		0x6041	0	16
Index	Sublades	Rite		Index:Pr.1330,Sub:Pr.	1394(Low	0x5FFF	1	32
0x6041	0	16		vl velocity demand		0x6043	0	16
0x6043	0	16						
				Add	llsor (hiects	0	F
				Description		Index	SubIndex	Bits
		_						
		_						
	Fixed: Index 0x6041 0x6043	Fixed: SubIndex Ox6041 0 Ox6043 0	smit PDO Mapping	Fixed: Index SubIndex Bits 0x6041 0 16 0x6043 0 16	Fixed: Index SubIndex Bits Description 0x6041 0 16 0x6043 0 16	Fixed: Index SubIndex Bits 0x6041 0 16 0x6043 0 16	Fixed: Index SubIndex Bits Ox6041 0 16 Ox6043 0 16	Fixed: Index SubIndex SubI

Fill the box with the following information and select Save:

Cu	ustom User Object
Name:	Actual Velocity
Index: 0x	6044
SubIndex:	0
Ritl on	16
bitten:	10
Save Ob	ject Discard

Note that the information entered here may vary from slave to slave. For Example, the Actual Velocity object for the Omron slave I have on my network uses Index 0x606c and is 32 bits. You will need to check your VFD's documentation for this information if it is not in the Available Objects list.

Then select actual velocity and press Add, and then Save:

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Name: 33rd Transmi	it PDO Map	oping			Add ESI	Objects	8	
					Description	Index	SubIndex	Bits
PDO ID: 0x1a20	Fixed:				Statusword	0x6041	0	16
Description	Index	SubIndex	Bits	1	Index:Pr.1330,Sub:Pr.1394(Low 0x5FFF	1	32
Statusword	0x6041	0	16		vl velocity demand	0x6043	0	16
vl velocity demand	0x6043	0	16					
					Add Use	r Object:	5 🔞	+ N
					Add Use	r Object:	S 🕜	+ N Bits
					Add Use Description Actual Velocity	r Objects Index 0x6044	5 ? SubIndex 0	N Bits 16
					Add Use Description Actual Velocity	r Objects Index 0x6044	Subindex	H N Bits 16

Now the Actual Velocity PDO has been successfully added:

State: ECAT Unplugged es	sı SI Ies	Aew Project	PROJECT Open R Project Pro	eset Save As oject Project	Dpload Project	CONT Downloa Project	d Connect Device	Browse Network	? Help	MISCELL	ANEOUS
HICON EC-Master (1) R88D-15N04H-ECT 200V/400W S (1) FR-E800-E	Servo[R	x-PDO De 1st Receive 33rd Receive	Object scription PDO Mapping e PDO Mapping	PDO ID 0x1600 0x1620	Settings Corr vit	Descrip ntrolword arget velocity	tion	PDO Index 0x6040 0x6042	Subindex 0 0	Bits 16 16
Visit Vital Systems Inc	υr	T	x-PDO De 1st Transmit 33rd Transm	scription PDO Mapping nit PDO Mapping	PDO ID 0x1a00 0x1a20	Sta vi v Act	Descrip tusword velocity demai ual Velocity	+ Copy ition nd	PDO Index 0x6041 0x6043 0x6044	SubIndex 0 0 0	Bits 16 16 16



We do not need to configure any SDOs for this VFD, so that tab will be skipped. On the Object Map tab, we will want to assign the objects to their function. Auto Select should correctly do the mapping for you, but if not you can manually set them through the dropdowns.

Ostate: ECAT Unplugged	ESI		PF	OJECT			CONTRO	DLLER			MISCELLAN	EOUS
VI.6.0	ESI Files	New Project	Open Project	Reset Project	Save As Project	Dipload Project	U Download Project	Connect Device	Browse Network	() Help		
HiCON Ec-Master	100W ServoE	PDC		SDO	Object N	lap	Settings					
FR-E800-E							Rx-	PDO				Auto Select
			Ĩ		Description		Index	SubIndex	Bits	Object Type		
				Controlword			0x6040	0	16	Controlword ~		
				vl target velo	ocity		0x6042	0	16	Target Velocity		
							Tx-	PDO				
					Description		Index	SubIndex	Bits	Object Type		
				Statusword			0x6041	0	16	Status Word		
				vl velocity de	emand		0x6043	0	16	Default v		
				Actual Veloci	ity		0x6044	0	16	Actual Velocity		
System	s inc											
Visit Vital Systems Ir												



There are a few more configuration settings available on the Settings tab. These are used as workarounds for slaves with unique requirements. In most cases these can be ignored, but in the case of our Mitsubishi VFD I will need to select the DC Override – ForceNoDC. The Mitsubishi drive will incorrectly be flagged as using a distributed clock and be unable to arm if we do not choose this setting.

O State: ECAT Unplugged	ESI		PRO	JECT			CONTRO	DLLER			MISCELLANEOUS
VI.6.0	ESI Files	New Project	Open Project	Reset Project	Save As Project	Dpload Project	U Download Project	Connect Device	Browse Network	? Help	
HiCON Ec-Master R88D-1SN04H-ECT 200V/4	100W ServoE	PD	0	SDO	Object Ma	ар	Settings	<u> </u>			
FR-2800-2		(Force SI	l Config fro	m EEPROM						
			DC Overrid	e Forcel	NoDC	~					
XATA system	s inc										
Visit Vital Systems	s inc ≌										

Now our project is configured and we can Connect and Download to our EtherCAT Master. If the steps have been followed correctly, the status indicator in the top left of EtherCAT should switch from:

Init->PreOp->SafeOp->Operational

This concludes the necessary steps in EC-Link.



Mach4 Configuration

In the System Tab of the HiCON plugin, there will now be two different options for ECAT Spindle Type:

- ECAT RPM The VFD will transmit the selected RPM directly to the VFD. No further configuration on this tab is needed. This mode is used by the Mitsubishi VFD.
- ECAT Counts The VFD expects its velocity in terms of Counts/Second. Selecting this option will enable the Motor Counts/Rev text box below, where you will need to specify the counts per/rev for your EtherCAT VFD. For example, this is the mode the Omron Drive's Velocity Mode requires, and it uses 20000 counts/Rev.

```
HiCON Config
```

System	MPG	Motor[0]	Motor[1]	Motor[2]	Motor[3]	Motor[4]	Мо			
Com	munica	tion – – S	pindle —							
Seria	l Numbe	r	Spindle Typ	e	Feedback	Source				
0			ECAT RPM	- ×	Encoder	\sim				
Max (1 - 5	Buffer Le 5000 milli	evel isec)	Spindle Ch 0	annel V	Feedback 1	Channel ~				
125	F		Analog Spi (10 - 200%)	ndle Scale	Feedback Counts/Rev					
(2 - 2	ng Frequ 250Hz)*	ency	100		1500					
80			Motor Cour 20000	nts/Rev	RPM Sam 50	pling(ms)				
E	J DI	14	F			A				

You will also need to set the Feedback Source as Encoder. Otherwise you will not get Actual Velocity back from the drive to the Mach4 UI.



We will also need to set one of the motor tabs as an EtherCAT VFD, and select the appropriate EtherCAT Drive. EtherCAT VFDs require more internal processing than a traditional VFD, so are piggybacking off of the pre-existing axis system in the HiCON plugin. Note that any motors set as VFD will not count towards your Activated Motor count (an ECO1 with 4 activated motors can use 4 drives and any number of VFDs.)

Here in this example, we are assigning VFD to HiCON Motor 6 and then make sure Motor 6 is also enabled in Mach Control (and make sure it is not mapped to any axis in mach, see below for more detail)

						This mo in mach	otor must n control	be enable	ed	
HiCON	l Config									_
System	MPG	Motor[0]	Motor[1]	Motor[2]	Motor[3]	Motor[4]	Motor[5]	Motor[6]	Motor[7]	Mo
Cont	rol Outp	ut	Fee	dback				PID Filt	ter	
Type Ethe Ether [2]Fl	rCAT VFD CAT Drive R-E800-E	Index 0	Sou Un Ma:	rce defined < Following 00	Frror Mot	ix (Gain 1 old Counts	Enab P 0 I 0 D 0	le PID	Offs 0 Vel. 0 Low
Save C	onfig U	pdate HiCC	٥N	X	T syste	A ems i	L	Dead Bar 0 Backla Value (m 0.00000	nd sh nm, inch) 0000	Ma» 0 Sp

One quirk is that the Feedback from the ECAT VFD will be in terms of velocity; either RPM or Counts/Sec. You will need to set the Max Following Error sufficiently high that the Max Following Error will not be hit when the Targeted RPM jumps instantly when commanded. This should be at least twice as the Max Velocity, but may also just be an arbitrarily high number to avoid this.

One final thing to do is confirm that the selected motor is enabled in the Mach4 Motor tab (configuration here is unnecessary, it simply must be enabled) and should **NOT** be mapped in the Axis Mapping tab. This is essentially a dummy axis and shouldn't be under Mach's control.





Control Configuration Mach4Mill:0

Defaults	General	Plu	gins Motors		Aux. Position	is <mark> Axis Map</mark>	oing	Homing/S	
	Ena		Master		Slave 1	Slave 2	Sla	Slave 3	
X (0)) 🖌		Mot	or0					
Y (1)) 🔀								
Z (2)) 🔀								
A (3) 🔀			Moto	or 6 is no	t mappe	d to		
B (4) 🐰		any A		vis here				
C (5)) 🔀			uny /	Mis fiere.				
OB1 (6) 🐰								
OB2 (7) 🐰								

Configuration Complete

Now the Configuration in both ECLink and Mach4 has been complete. Enable Mach4, set the RPM with the S command, and enable the spindle with M3. The VFD should properly enable and move at the selected speed.