EtherCAT/Net expansion modules for MAC motors. MAC00-EC4 and - EI4

JVL is one of the leading companies in the field of integrated servo and stepper motors. For their medium power and new high power MAC motor's, i.e. from 400 W to 3000 W, yet another expansion module has been added: The EtherCAT and the EtherNet/IP control module.

Beginning with BlueTooth and WLAN, JVL decided that established communications protocols in their expansion modules must be provided from well-known companies. This way, JVL can concentrate their efforts into the key area of developing leading integrated servo and stepper technology.

In the case of EtherCAT, the netX 50 series communication processor from Hilscher has been selected. One of the big advantages of this choice is that the expansion module hardware is the same no matter which Ethernet protocol is implemented thus minimizing the development time of e.g. EtherNet/IP, Profinet, Modbus TCP, Powerlink or Sercos III. Even future Ethernet protocols are supported as Hilscher develops drivers for them.

EtherCAT, or Ethernet for Control Automation Technology, was originally developed by Beckhoff, but is now an open standard under EtherCAT Technology Group (ETG), which consist of key user companies from various industries and leading automation suppliers and it's purpose is to further develop and promote the EtherCAT technology. EtherCAT is the fastest growing industrial Ethernet bus and is leading in Europe. Since it is based on an open protocol, inexpensive hardware (see below) and so far has an unmatched performance it is likely to become the European leader within industrial Ethernet busses.

The EtherCAT technology overcomes the system limitations of other Ethernet solutions: The Ethernet packet is no longer received, then interpreted and copied as process data at every connection. Instead, the Ethernet frame is processed on the fly: The newly developed FMMU (fieldbus memory management unit) in each slave node reads the data addressed to it, while the telegram is forwarded to the next device. Similarly, input data is inserted while the telegram passes through. The telegrams are only delayed by a few nanoseconds.

On the master side, very inexpensive, commercially available standard network interface cards (NIC) or any on-board Ethernet controller can be used as hardware interface. The common feature of these interfaces is data transfer to the PC via DMA (direct memory access), i.e. no CPU capacity is taken up for the network access.

EtherCAT reaches new dimensions in network performance. Thanks to FMMU in the slave nodes and DMA access to the network card in the master, the complete protocol processing takes place within hardware and is thus independent of the run-time of protocol stacks, CPU performance or software implementation. The update time for 1,000 distributed I/Os is only 30 µs. Up to 1,486 bytes of process data can be exchanged with a single Ethernet frame - this is equivalent to almost 12,000 digital inputs and outputs. The transfer of this data quantity only takes 300 µs.

The communication with 100 servo axes only takes 100 µs. During this time, all axes are provided with set values and control data and report their actual position and status. The distributed clock technique enables the axes to be synchronized with a deviation of significantly less than 1 microsecond.

The central PC becomes smaller and more cost effective because additional slots are not needed for interface cards since the onboard Ethernet port can be used. With increasing miniaturisation of the PC-components, the physical size of Industrial PCs is increasingly determined by the number of required slots. One Ethernet interface is sufficient for the complete communication with the periphery.

Regarding topology EtherCAT supports almost any topology: Line, tree or star.
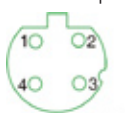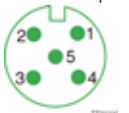
Read more about EtherCAT at Ethercat. org.
JVL's EtherCAT module enables high speed real time Ethernet communication directly to the drives:
• 100 Mbit/s communications speed

• Response times in the sub-millisecond range
• 2 ports on the module offer Daisy-chaining possibility
• User friendly LED indicators
• Tough M12 connectors for industrial environment
• Option for 4 digital inputs, 2 digital outputs and 2 analogue inputs

	EtherCAT	Ethernet/IP	PROFINET IO	SERCOS III	Modbus TCP	Powerlink
Hardware	**MAC00-EC4**	MAC00-EI4	MAC00-EP4	MAC00-ES4	MAC00-ES4	MAC00-EL4
Avaliable	Yes Q4 2010	Yes Q4 2010	Planned Q4 2011	Planned Q4 2011	Planned Q4 2011	Planned
Serial	CANopen	DeviceNet	Profibus	Sercos I/Sercos II	Modbus-RTU	CANopen
Company	Beckhoff	Rockwell	Siemens	Bosch Rexroth		B&R
Protocol	EtherCAT EtherCAT/UDP	TCP/IP, UDP/IP	Real time protocol (RT)		TCP/IP	
Minimum cycle time	<50 µS	1-2 mS	1 mS	250 µS		<100 µS
Address Range	65535	65535/ unlimited	65535/ unlimited	65535	256	65535
Max. Baudrate	EtherNet 100Mbit/s	EtherNet 100Mbit/s	EtherNet 100Mbit/s	EtherNet 100Mbit/s	EtherNet 100Mbit/s	EtherNet 100Mbit/s
Network topology	Line, Ring	Switches routers wireless	Switches routers wireless	Line, Ring	Switches routers wireless	Line, Ring
Standards	IEC61158, IEC/PAS 62407, IEC61784-3, ISO15745-4	IEC 61158/ IEC61784/ ODVA EtherNet/IP standard	IEC 61158/ IEC61784	IEC 61491 merged into IEC61158	IEC 61158 and IEC61784	IEC 61158, EPSG (Ether-Net Powerlink standardiza-tion Group)

Motor Connector Description

|		Connector	1	2	3	4	5	6	7	8
Up link to master	EtherNet	M12 Male 4pin	TX0_P	RX0_P	TX0_N	RX0_N				
	Cable Color code		Brown/ White	Blue/ White	Brown	Blue				
Down link to other slave	EtherNet	M12 Male 4pin	TX1_P	RX1_P	TX1_N	RX1_N				
	Cable Color code		Brown/ White	Blue/ White	Brown	Blue				
PWR (Power supply)	EtherNet	M12 Male 5pin	P+ (12-48VDC)	P+ (12-48VDC)	P- (GND)	CV control voltage	P- (GND)			
	Cable Color code		Brown	White	Blue	Black	Grey			
I/O	EtherNet	M12 Female 8 pin	OUT1 or A2+	Tx (RS232)	Rx (RS232)	GND (RS232)	AIN1	IN1 or B2-	IO-GND or B2+	OUT+ or A2-
	Cable Color code		White	Brown	Green	Yellow	Grey	Pink	Blue	Red
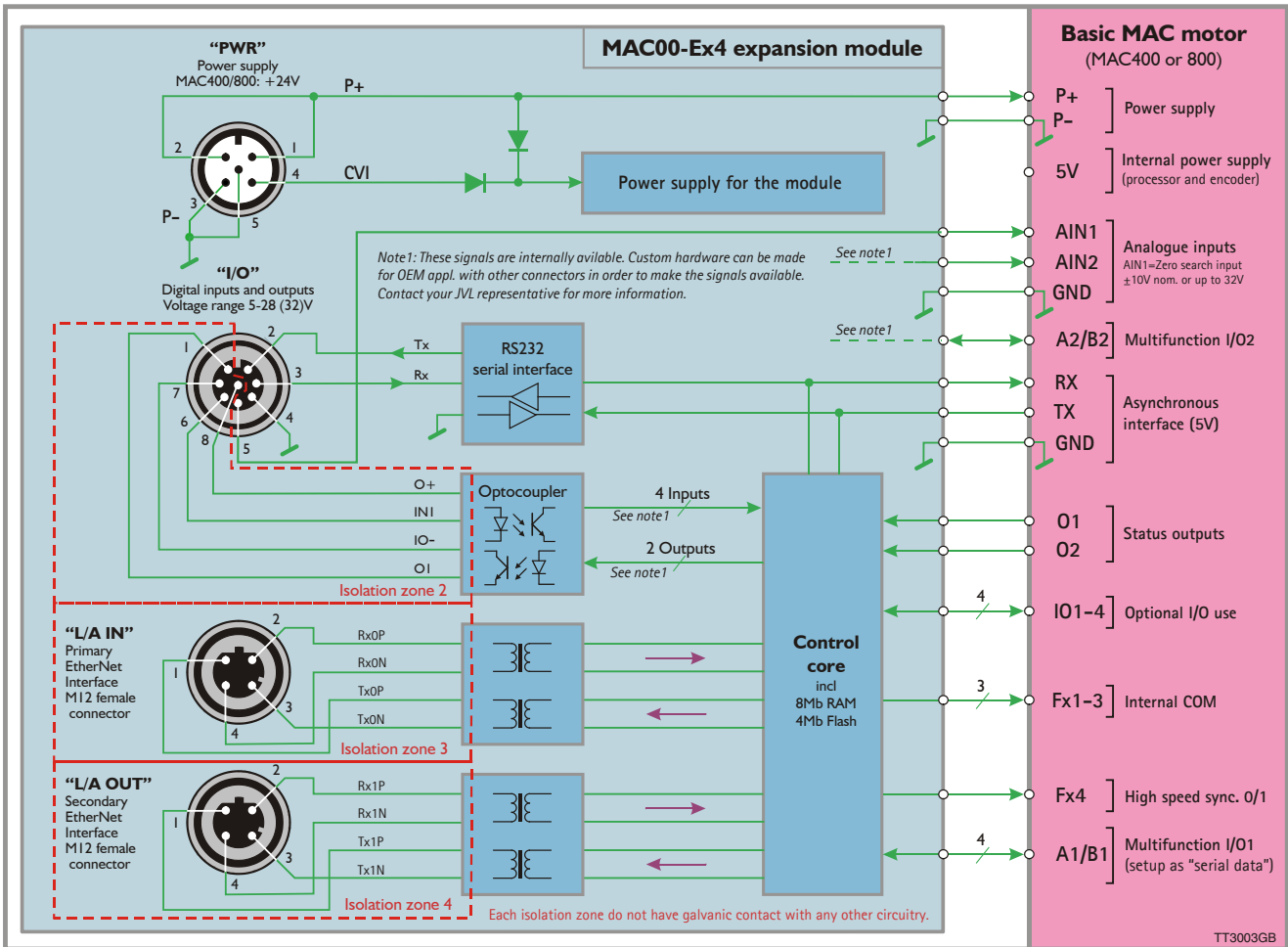
Block diagram of MAC00-Ex4 with MAC motor

Easy start with sample code for Beckhoff TWINCAT

At no additional cost can a program example for Beckhoff TWINCat software be downloaded from www.jvl.dk. Function blocks are fully documented so they can be readily adapted for use with other PLC types.
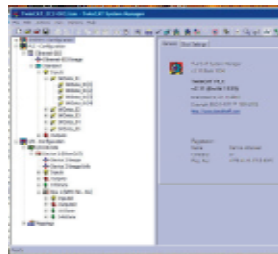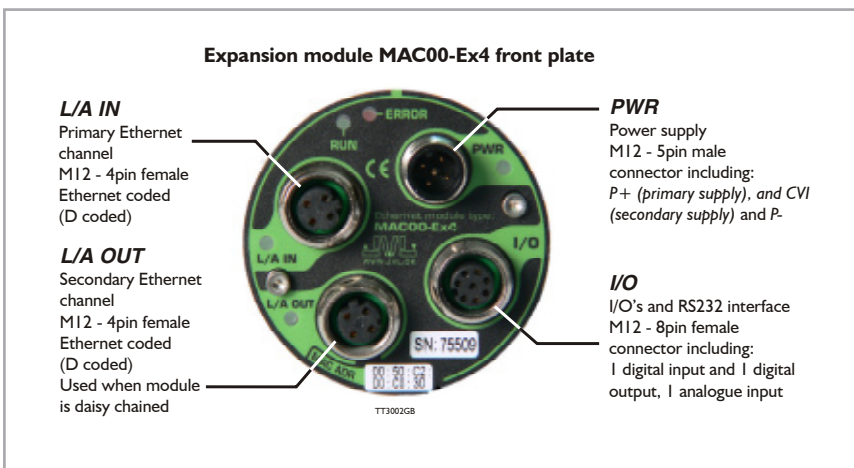

Easy installation with M12 connector

JVL MACmotor expansion EtherNet module uses a standard M12 connector with 4 and 8 pin, and optional 12 pin. To ease installation there is one EtherNet connector for Input and one for Output.

I/O possibilities

The expansion board is equipped with 2 inputs and 1 outputs, all galvanically isolated. Because of the limited number of pins in the M12 connector only some of the I/O´s are available in the connector. With an optional modul MAC00-FC41 are used a 12 pin where IN1-4, AIN1, AIN2, O1, O2, RS422, IO-IO+ are available.

Contact JVL if other configurations are required. For OEM use, a solution with customer specified connector with all I/O´s supported can be delivered.
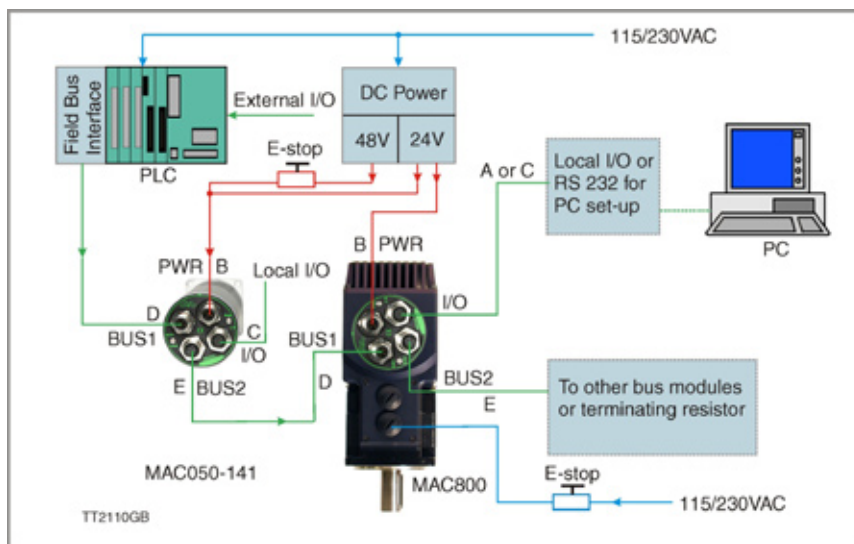
Expansion module MAC00-Ex4 front plate

L/A IN
Primary Ethernet channel
M12 - 4pin female
Ethernet coded
(D coded)

L/A OUT
Secondary Ethernet channel
M12 - 4pin female
Ethernet coded
(D coded)
Used when module is daisy chained

PWR
Power supply
M12 - 5pin male connector including:
P+ (primary supply), and CVI (secondary supply) and P-

I/O
I/O's and RS232 interface
M12 - 8pin female connector including:
1 digital input and 1 digital output, 1 analogue input

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Cables and accessories

Cable and accessory	Description M12 IP67 (Standard cable with shield)	Connector	Type code	Picture
A	RS232 programming cable	I/O	RS232-M12-1-5-8	
B	Power cable	PWR	WI1000-M12F5VxxN	
C	IO cable	I/O	WI1000-M12F8VxxN	
D,E	BUS cable. D-Code. 4 pin	BUS1	WI1004-M12M4SxxR	
F	Protection cap for M12 male	BUS1/BUS2	WI1000-M12MCAP1	
G	Protection cap for M12 female	BUS2 or I/O	WI1000-M12FCAP1	
H	Connector 5 pin female straight solder terminals	PWR	WI1008-M12F5SSC	
I	Connector 4 pin Male straight presslock, D-Code	BUS1/BUS2	WI1048-M12M4TRI	
J	EtherNet cable with RJ45 and M12 4 pin D-Code	BUS1	WI1046-M12M4S05NRJ45	

xx indicates cable length 05 or 20 meters (flying leads)

Two MAC motors in a network

Protection

The Module is supplied with M12 connectors (IP67) with watertight connection for use in industrial environments. Modules with other types of connector can be developed to suit customer requirements.

Technical specifications

Absolute maximum rating

Description	Min	Typ	Max	Absolute Max	Unit
CV Current@ 24VDC*		150	250		mA
Voltage O+	10		30	32	VDC
Voltage P+	12		48	50	VDC
Control Voltage CV	12		48	50	VDC
Input	4,5		28	32	VDC
Input Impedance		5.6			kOhms
Input current @24V		4.3			mA
Analoque input **	−10		10	32	VDC
Output	0		30	32	VDC
Output current			25		mA

* Only expansion module. Remember to add the current for the basic motor
** Resolution 11bit+sign for MAC800/MAC400 and 9bit+sign for MAC050-MAC141