TMC8460-Eval

Evaluation Board for the TMC8460-BI EtherCAT Slave Controller with Enhanced Functionality

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The TMC8460-Eval is an evaluation board for the TMC8460-BI EtherCAT Slave Controller (ESC). It integrates into the evaluation board infrastructure by TRINAMIC but can also be used as a standalone evaluation platform.

Focus

- Evaluation of the TMC8460's extended control features (MFCIO, Multi-Function and Control IO Block)
- Control of extended features by MCU or EtherCAT
- EtherCAT state machine can be implemented in MCU or emulated (Device Emulation)

Features

- SPI interfaces between MCU and ESC (standard PDI + control interface for extra functions)
- SPI and GPIO interfaces to use in chained TRINAMIC driver evaluation boards
- ABN-Decoder inputs, 3 channel PWM and Step/Direction outputs available on extra header

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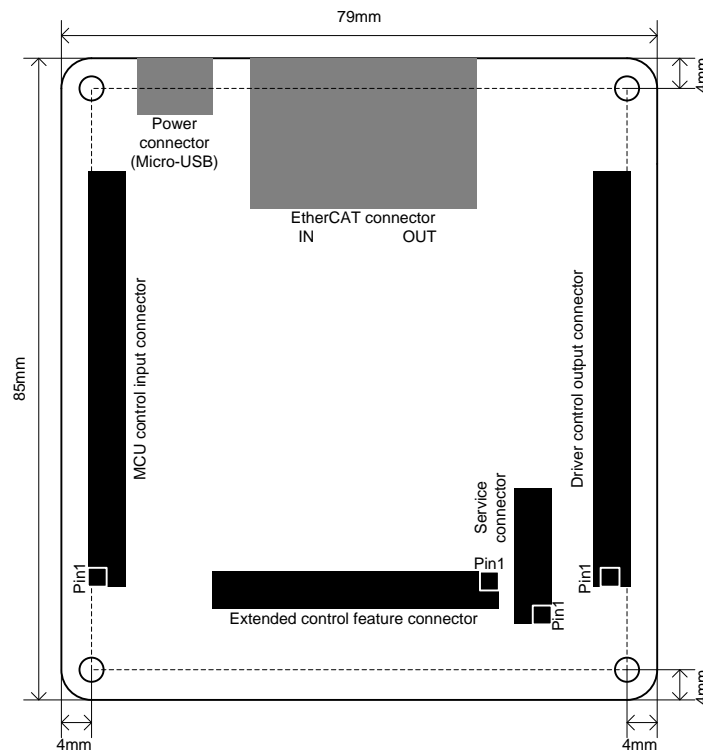
1   Board overview

Figure 1 - Dimensions and connector positions

1.1   Connectors

1.1.1   Power connector
The power connector on the board is a standard Micro-USB connector. No USB data connection is used.

1.1.2   EtherCAT connector
The EtherCAT connector is a two port RJ45 socket, the port closer to the USB port is the EtherCAT input for data coming from the master, the other port is the output to other EtherCAT slaves.

1.1.3   MCU control input connector
The MCU control input connector is a female 2x22pin header with 0.1"/2.54mm pitch. On this connector, access to the TMC8460's PDI and MFC control SPI busses is available. If the TMC8460 is not operated in device emulation mode, a MCU must be connected here, at least for control of the EtherCAT state machine.

Pin	Signal	Description	Pin	Signal	Description
1	VM	Motor supply voltage, directly connected to output connector	2	GND	Ground
3	GND	Ground	4	ID_CLK	Directly connected to output connector
5	+5V_USB	5V Supply voltage from USB	6	ID_CH0	Directly connected to output connector
7	ID_CH1	Directly connected	8	DIO0	Directly connected to

		to output connector			output connector
9	DIO1	Directly connected to output connector	10	PROM_CLK	I2C Clock to the ESC EEPROM
11	PROM_DATA	I2C Data to/from the ESC EEPROM	12	DIO4	Directly connected to output connector
13	DIO5	Directly connected to output connector	14	AIN0	Directly connected to output connector
15	AIN1	Directly connected to output connector	16	AIN2	Directly connected to output connector
17	DIO6	Directly connected to output connector	18	DIO7	Directly connected to output connector
19	EN_16MHZ_OUT	Enable signal for the 16MHz clock output	20	DIO9	Directly connected to output connector
21	DIO10	Directly connected to output connector	22	DIO11	Directly connected to output connector
23	MFC_nES_MCU	Low active emergency switch signal, controlled by MCU	24	MFC_CTRL_SPI_CSN	SPI chipselect (low active) for the MFCIO register access
25	MFCIO_IRQ	Interrupt signal from the MFCIO block	26	PDI_SPI_IRQ	Interrupt signal from the ESC
27	MFC_CTRL_SPI_SCK	SPI clock for the MFCIO register access	28	MFC_CTRL_SPI_MOSI	SPI data input for the MFCIO register access
29	MFC_CTRL_SPI_MISO	SPI data output for the MFCIO register access	30	PDI_SPI_CSN	SPI chipselect (low active) for the ESC PDI interface
31	PDI_SPI_SCK	SPI clock for the ESC PDI interface	32	PDI_SPI_MOSI	SPI data input for the ESC PDI interface
33	PDI_SPI_MISO	SPI data output for the ESC PDI interface	34	PDI_SOF	Start-Of-Frame signal from the ESC
35	PDI_EOF	End-Of-Frame signal from the ESC	36	PDI_WD_TRIGGER	Trigger pulse of the PDI watchdog of the ESC
37	PDI_WD_STATE	State of the PDI watchdog of the ESC	38	EEPROM_OK	Shows that the EEPROM was correctly loaded by the TMC8460
39	SYNC_OUT0	Distributed Clock Sync Signal 0	40	SYNC_OUT_1	Distributed Clock Sync Signal 1
41	nRST	Low active reset signal for the TMC8460	42	+5V_VM	5V, only connected to output connector
43	GND	Ground	44	GND	Ground

Table 1 - Signal list for MCU control input connector

Signals marked in light red are only connected between the MCU control input connector and the Driver control output connector.

1.1.4   Driver control output connector
The driver control output connector is a female 2x22pin header with 0.1"/2.54mm pitch. On this connector the MFCIO SPI bus and GPIOs are available as well as some GPIOs directly passed through from the MCU control input connector.

Pin	Signal	Description		Pin	Signal	Description
1	VM	Motor supply voltage, directly connected to input connector		2	GND	Ground
3	GND	Ground		4	ID_CLK	Directly connected to input connector
5	+5V_USB	5V Supply voltage from USB		6	ID_CH0	Directly connected to input connector
7	ID_CH1	Directly connected to input connector		8	DIO0	Directly connected to input connector
9	DIO1	Directly connected to input connector		10	n.c.	Not connected
11	n.c.	Not connected		12	DIO4	Directly connected to input connector
13	DIO5	Directly connected to input connector		14	AIN0	Directly connected to input connector
15	AIN1	Directly connected to input connector		16	AIN2	Directly connected to input connector
17	DIO6	Directly connected to input connector		18	DIO7	Directly connected to input connector
19	EN_16MHZ_OUT	Enable signal for 16MHz clock output of the TMC8460		20	DIO9	Directly connected to input connector
21	DIO10	Directly connected to input connector		22	DIO11	Directly connected to input connector
23	CLK_16MHZ_OUT	16MHz output of the TMC8460 as clock source for drivers		24	MFC_SPI_CSN1	Low active chip select of MFC SPI channel 1
25	MFC_SPI_CSN2	Low active chip select of MFC SPI channel 2		26	MFC_SPI_CSN3	Low active chip select of MFC SPI channel 3
27	MFC_SPI_SCK	MFC SPI master clock output		28	MFC_SPI_MISO	MFC SPI master data input
29	MFC_SPI_MOSI	MFC SPI master data output		30	MFC_SPI_CSN0	Low active chip select of MFC SPI channel 0
31	MFC_SPI_SCK	MFC SPI master clock output		32	MFC_SPI_MOSI	MFC SPI master data output
33	MFC_SPI_MISO	MFC SPI master data input		34	MFC_GPIO[0]	MFC GPIO Bit 0
35	MFC_GPIO[1]	MFC GPIO Bit 1		36	MFC_GPIO[2]	MFC GPIO Bit 2
37	MFC_GPIO[3]	MFC GPIO Bit 3		38	MFC_GPIO[4]	MFC GPIO Bit 4
39	MFC_GPIO[5]	MFC GPIO Bit 5		40	MFC_GPIO[6]	MFC GPIO Bit 6
41	MFC_GPIO[7]	MFC GPIO Bit 7		42	+5V_VM	5V, only connected to input connector
43	GND	Ground		44	GND	Ground

Table 2 - Signal list for Driver control output connector

Signals marked in light red are only connected between the MCU control input connector and the Driver control output connector.

1.1.5   Extended control feature connector
The extended control feature connector is a male 2x15pin header 0.1"/2.54mm pitch. On this header, some additional I/Os of the TMC8460 are available.

Pin	Signal	Description		Pin	Signal	Description
1	MFC_PWM_PULSE_START	Pulse at start of PWM cycle		2	GND	Ground

3	MFC_PWM_PULSE_CENTER	Pulse at center of PWM cycle		4	+3V3	3.3V supply
5	MFC_PWM_PULSE_A	Pulse at configurable point A in PWM cycle		6	MFC_PWM_LS_0	MFC PWM channel 0, low side
7	MFC_PWM_PULSE_B	Pulse at configurable point B in PWM cycle		8	MFC_PWM_HS_0	MFC PWM channel 0, high side
9	MFC_PWM_PULSE_A_B	Pulses at configurable points A&B in PWM cycle		10	MFC_PWM_LS_1	MFC PWM channel 1, low side
11	RESET_OUT	Reset output from TMC8460		12	MFC_PWM_HS_1	MFC PWM channel 1, high side
13	nRST_IN	Low active reset input for TMC8460		14	MFC_PWM_LS_2	MFC PWM channel 2, low side
15	GND	Ground		16	MFC_PWM_HS_2	MFC PWM channel 2, high side
17	MFC_nES_HEADER	Low active emergency switch signal, controlled by external hardware		18	MFC_SD_STP	MFC Step/Dir unit Step output
19	+3V3	3.3V supply		20	MFC_SD_DIR	MFC Step/Dir unit Direction output
21	MFC_ABN_A	MFC ABN decoder A-input		22	LATCH_IN0	Distributed Clock Latch Signal 0
23	MFC_ABN_B	MFC ABN decoder B-input		24	LATCH_IN1	Distributed Clock Latch Signal 1
25	MFC_ABN_N	MFC ABN decoder N-input		26	CLK_16MHZ_OUT	16MHz clock output
27	+5V_USB	5V Supply voltage from USB		28	GND	Ground
29	GND	Ground		30	CLK_25MHZ	25MHz clock output

Table 3 - Signal list for Extended control feature connector

1.1.6   Service connector
This connector is only for test purposes.
Pins 2 and 10 can be used as GND testpoints.
Pins 6 and 7 can be used as +3V3 testpoints.

1.2   I/O voltages
The I/O voltages on all connectors are 3.3V, which must not be exceeded.
The signals MFC_nES_HEADER, MFC_ABN_A, MFC_ABN_B and MFC_ABN_N have additional overvoltage protection, however it is not recommended to exceed 3.3V.

2   Configuration solder jumpers

Between the TMC8460-BI and the Extended control feature connector are four solder jumpers for configuration of certain features of the TMC8460.

2.1   nES Source

The jumper labelled **nES SOURCE** has the options **µC** and **EXT**. It is used to select the source of the Emergency Switch.

µC connects the nES Pin of the TMC8640 to MFC_nES_MCU on pin 23 of the MCU control input connector.

EXT connects the nES Pin of the TMC8640 to MFC_nES_HEADER on pin 17 of the Extended control feature connector.

2.2   PDI/MFC CTRL SPI bus sharing

The jumper labelled **PDI SPI** enables resource saving on the MCU side. If set to 1, the PDI SPI data and clock lines are also used for the MFC control SPI. The multiplexing is done via the nCS of both slaves.

	Jumper setting	
Signal	**0**	**1**
PDI_SPI_CSN	PDI_SPI_CSN	PDI_SPI_CSN
PDI_SPI_SCK	PDI_SPI_SCK	PDI_SPI_SCK and MFC_CTRL_SPI_SCK
PDI_SPI_MOSI	PDI_SPI_MOSI	PDI_SPI_MOSI and MFC_CTRL_SPI_MOSI
PDI_SPI_MISO	PDI_SPI_MISO	PDI_SPI_MISO when PDI_SPI_CSN = 0 MFC_CTRL_SPI_MISO when MFC_CTRL_SPI_CSN = 0
MFC_CTRL_SPI_CSN	MFC_CTRL_SPI_CSN	MFC_CTRL_SPI_CSN
MFC_CTRL_SPI_SCK	MFC_CTRL_SPI_SCK	Unused
MFC_CTRL_SPI_MOSI	MFC_CTRL_SPI_MOSI	Unused
MFC_CTRL_SPI_MISO	MFC_CTRL_SPI_MISO	Unused

Table 4 - Signal mapping for shared SPI bus

2.3   Device Emulation

The jumper labelled **PDI EMU** enables the ESC device emulation when set to 1. In this case a MCU is not necessary. The configuration in the EEPROM must match the configuration set on this jumper.

2.4   Reset out polarity

The jumper labelled **RESET OUT POL** determines the active polarity of the RESET_OUT signal available on the Extended control feature connector.

3   <u>Disclaimer</u>

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4   <u>Revision History</u>

Version	Date	Author	Description
V100	2015-JUL-24	SL	Initial Document

Table 5: Documentation Revisions