REVISIONS		
NO	VERSION	APPROVED
1	1.0	2000-09-18

Data Sheet

MMI200-PC/104

Encoder Interface Board

EnDat

(Bi-directional interface for absolute encoders according to the specification of DR. J. HEIDENHAIN GmbH)

SSI

(Unidirectional interface for absolute encoders)

square wave incremental signals

(TTL-interface for incremental encoders with a 32 bit encoder counter)

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MAZeT GmbH Sales
Göschwitzer Straße 32
07745 JENA / GERMANY
Phone: +49 3641 2809-0
Fax: +49 3641 2809-12
E-Mail: sales@MAZeT.de
Url: http://www.MAZeT.de

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1 General description

The MIP200-PC/104 board comprises two measurement channels for data acquisition. It is used as an interface board for EnDat, SSI or incremental encoders.

A timer is available in all operational modes (i.e. EnDat, SSI, incremental). The timer can be used to generate a hardware strobe for equidistant data sampling by defining the break interval. The system is clocked at 33.00 MHz, for EnDat mode preferably at 24.00 MHz.*)

The power supply for the encoders (5/12 V, Ground) is supplied on sockets D-SUB9 / D-SUB15.**) The maximum available current is 300 mA.

Figure 1 shows the MIP200-PC/104 board's block diagram connected to an EnDat encoder on channel X1 and to an incremental encoder on channel X2.

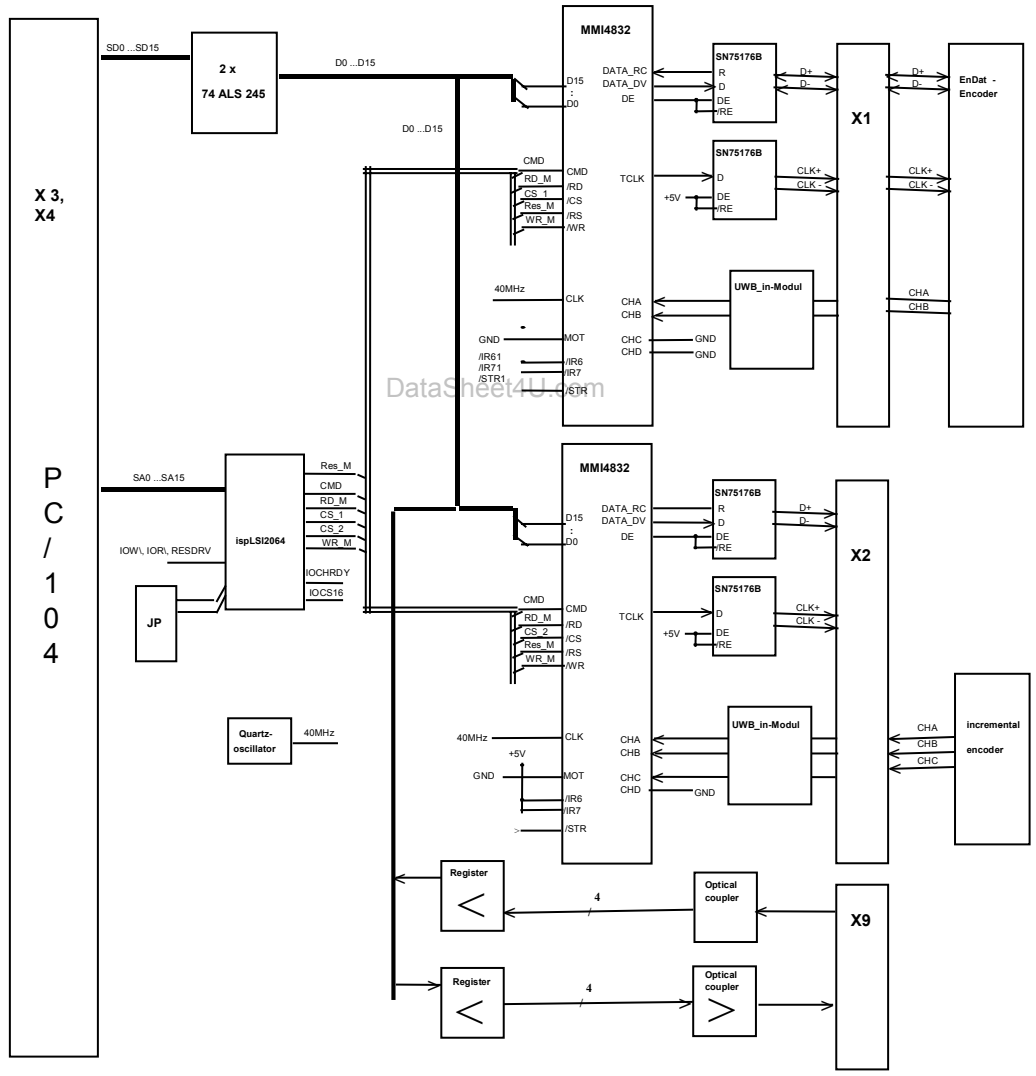


Figure 1: Block diagram MMI200-PC/104

*) Default configuration 33 MHz

**) Default configuration 5V power supply for encoder

2 ISA Interface

The board supports only 16 bit accesses (to even addresses).

Board addresses

The board address setting is done by switches S1.1 .. S1.3 according to Table 1.

S1.3	S1.2	S1.1	Base address
off	off	off	30x
off	off	ON	31x
off	ON	ON	33x
ON	off	off	34x
ON	off	ON	35x
ON	ON	off	36x

Table 1: Board address

Register addresses

The available addressable registers are divided into on-board registers and measurement interface circuit MMI4832 registers. On-board registers are interrupt enable register, command register, optical coupler register. They are directly accessible by reading from or writing to the appropriate address. MMI4832 registers are hidden, meaning that they can be accessed by first writing the address and then reading or writing the actual data.

Offset address	Function
0x0 (read/write)	Data access MMI4832 (measurement interface IC) channel 1
0x2 (write only)	Address selection MMI4832 (measurement interface IC) channel 1
0x4 (read/write)	Data access MMI4832 (measurement interface IC) channel 2
0x6 (write only)	On-board Interrupt enable register
0x8 (write only)	Software reset
0xA (write only)	Address selection MMI4832 (measurement interface IC) channel 1
0xC (write only)	On-board command register (analog interpolator, optical coupler outputs)
0xC (read only)	Optical coupler input register
others	reserved

Table 2: Offset addresses

3 Register description

3.1 On-board command register

This register holds the settings of the analog interpolation coefficient and the control of four optical coupler outputs.

analog interpolation coefficient				optical coupler outputs			
D(7)	D(6)	D(5)	D(4)	D(3) O_OPTO4	D(2) O_OPTO3	D(1) O_OPTO2	D(0) O_OPTO1

The (optional) MIP200's interpolation coefficient is set and modified by bits D(7) to D(4). According to Table 3 every channel has its own interpolation coefficient. Refer to chap. 4 for a detailed description of the optical coupler signals.

analog interpolation coefficient	D(7) channel 2	D(6) channel 2	D(5) channel 1	D(4) channel 1
5	0	0	0	0
10	0	1	0	1
25	1	0	1	0
50	1	1	1	1

Table 3: Selecting the interpolation coefficient of MIP200

3.2 Optical coupler input register

This register holds the current status of the two coupler inputs I_OPTO5 and I_OPTO6. The other coupler inputs can be polled via the MMI4832 internal status register.

	D(3)	D(2)
---	O_OPTO6	O_OPTO5

3.3 On-board interrupt enable register

Two interrupt levels can be selected by writing this register (1=enable, 0=disable) as a board interrupt. Valid interrupts are IRQ10 and 11.

D(2)	D(1)	D(0)
---	IRQ11	IRQ10

3.4 MMI4832 registers

Internal MMI4832 registers are accessed by first writing the register address to the offset address 0x2 (channel 1) or 0xA (channel 2). After that only the internal register can be read or written to via the offset address 0x0 (channel 1) or 0x4 (channel 2).
Table 4 contains the bit mapping of MMI4832's internal address register.

D7	D6	D5	D4	D3	D2	D1	D0
---	M16	AINC	address A4	address A3	address A2	address A1	address A0

Table 4: Internal address register

M16 = 1 16 bit accesses (this board only supports 16 bit accesses)
AINC = 1 Autoincrement addressing mode. The base address of an internal register is written to A(4:2). The access is repeated n times, where n is the number of words.

A(4:2)	**/WR-, /RD-access**	**Register**	**Write 16 bit port**	**Read 16 bit port**
0	1 2	Transmit register	*Write Transmit register* Write D(0:15) Write D(16:31) 2	*Read Transmit register* Read D(0:15) Read D(16:31) 2
1	1 2 3	Receive register	*Latching the value of the Serial-Parallel converters into the Receive register* --- --- 1	*Read Receive register, Strobe-RG* Read D(0:15) Read D(16:31) Read D(32:47) 1 - 3 **
2	-- -		---	---
3	1 2	Reference / Offset register	*Write Ref./Offset register* Write D(0:15) Write D(16:31) 2	*Read Receive register + Offset* Read D(0:15) Read D(16:31) 2
4	1 2	Control register	*Write control register* Write D(0:15) Write D(16:31) 2	*Read control register* Read D(0:15) Read D(16:31) 2
5	1	Status register	*Software strobe* --- 1	*Read Status register with reset* Read D(0:7) 1
6	1	Interrupt mask register	*Write Interrupt mask register* Write D(0:7) 1	*Read Interrupt mask register* Read D(0:7) 1
7	1	Timer register	*Write Timer register* Write D(0:15) 1	*Read Status register without reset* Read D(0:7) 1

Table 5: Parallel port mode "Intel": autoincrement (MOT = "0", AINC = "1")

** *The number of necessary accesses is determined by the data width set in control register (bits 24:29)*

4 Optical coupler

The board contains 10 optical coupler (2x HCPL0601 for STR1, STR2 and 2x 4 PC3Q66Q) to electrically separate signal levels of external devices. The optical coupler can be controlled via registers, i.e. settings can be written to and the status read from via register access. Four optical couplers (outputs, write only) can drive external signals. The other six couplers can receive control signals of external devices (e.g. programmable logic controllers). A "1" in the on-board command register results in closing the circuit O_OPTOx with x = 1..4. The coupler inputs are high-active.

4.1 Optical coupler inputs

The six inputs at the X9 connector are wired to the optical coupler via a serial resistor of approx. 3 kΩ. Both strobe inputs STR1 and STR2 (pins 9, 10) have a common ground (GND1 – pin 11). The inputs IR71, IR72, I_OPTO5 and I_OPTO6 have a common ground, too (GDN2 – pin 17). A 24 V, 7 mA signal is required to drive the inputs. The maximum rate at inputs STR1, STR2 should not exceed 10 MHz. The maximum rate at the other input amounts is 100 kHz.

A special HW configuration is supplied when 5 V input signal voltage is required. Figure 2 shows the optical coupler input circuit.

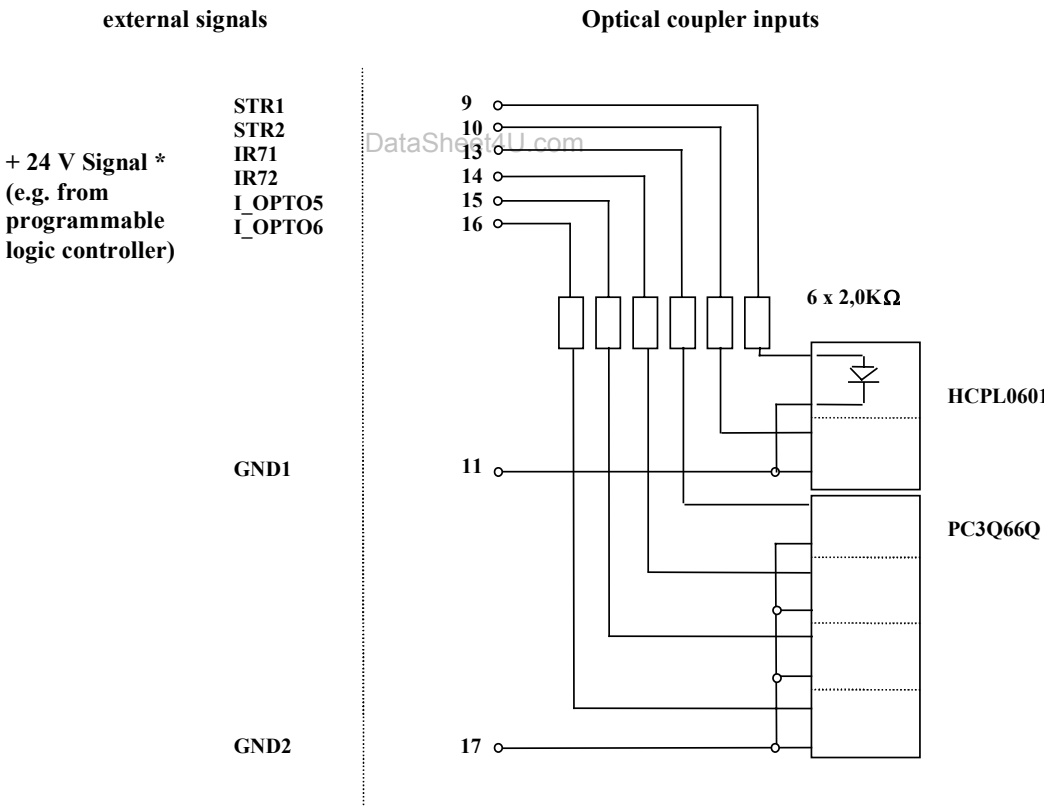


Figure 2: Optical coupler input circuit

4.2 Optical coupler outputs

The four outputs have a common ground GND3 (pin 25) and a common power supply Vcc3 (pin 24). The GND3 has to be connected to 0V = ground, the Vcc3 to 24 V. The coupler outputs O_OPTOx with x=1..4 (pins 19..22) deliver 24 V that can be used directly to control machines. The maximum output rate is 5 kHz.

Figure 3 shows the optical coupler output circuit.

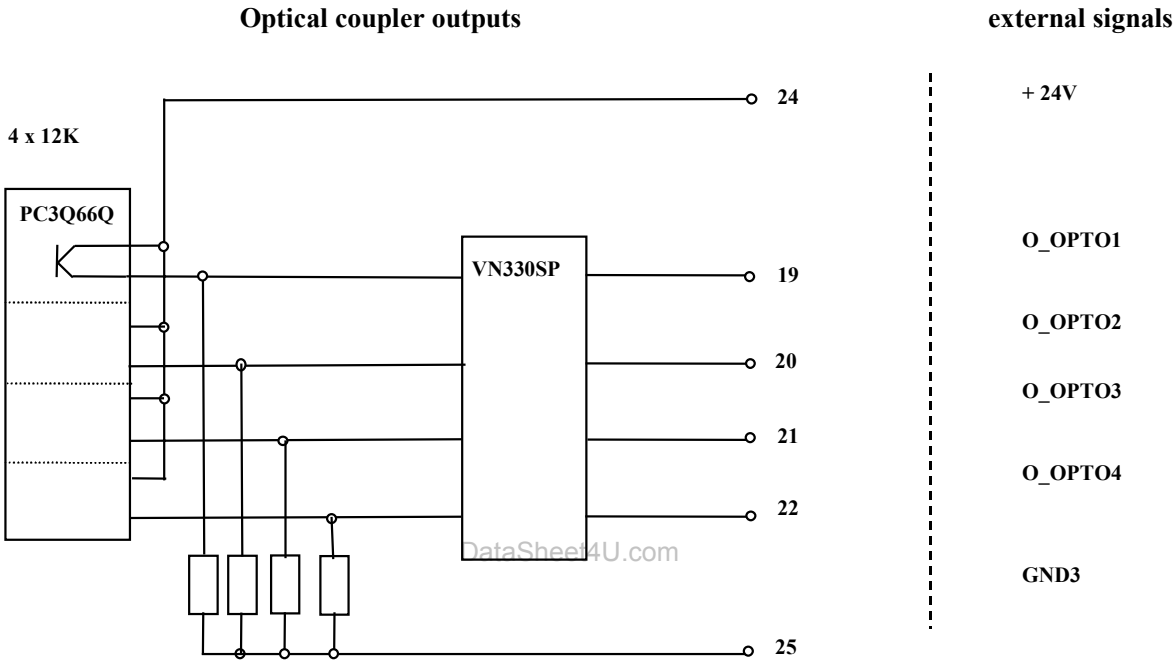


Figure 3: Optical coupler output circuit

5 Measurement system interface

D-SUB9 or D-SUB15 sockets are alternatively available to interface to a measurement system. They are wired by a ribbon cable to the 16-pin connectors placed on the board. Signal assignments are described in Table 6.

D-SUB15 socket	D-SUB9 socket	16-pin connector X1/2	signal name
1	6	2	A + (incremental signals)
2	2	3	GND
3	8	6	B + (incremental signals)
4	7	4	+ 5 V
5	---	10	Data +
6	---	---	inner shield
7	5	9	C – (Ref)
8	---	12	Clock
9	1	1	A – (incremental signals)
10	---	15, 16	GND
11	3	5	B – (incremental signals)
12	---	14	+ 5 V
13	---	11	Data -
14	9	8	C + (Ref)
15	---	13	/Clock

Table 6: Measurement system pin assignment

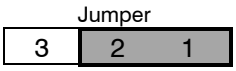
The connector X9 supports additional signals as described in Table 7.

Pin Number	26 pin connector **X9**		
1	/NULL1	External reset channel 1	pull-up
2	/NULL2	External reset channel 2	pull-up
3	CHD1	2nd Reference impulse channel 1	pull-up
4	CHD2	2nd Reference impulse channel 2	pull-up
5	/IR61	Free input for interrupt request channel 1	pull-up
6	/IR62	Free Input for interrupt request channel 2	pull-up
7	Vcc0	Vcc0 – Output voltage (for pin 1-6)	5 V
8	GND	GND	GND (board)
9	STR1	Optical coupler Input 1 (External Strobe channel 1)	
10	STR2	Optical coupler Input 2 (External Strobe channel 2)	
11	GND1	Ground1 - Input for Optical coupler Input(1-2)	---
12	---	---	---
13	IR71	Optical coupler Input 3 for Interrupt request channel 1	
14	IR72	Optical coupler Input 4 for Interrupt request channel 2	
15	I_OPTO5	Optical coupler Input 5	

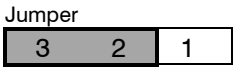
Pin Number	26 pin connector **X9**		
16	I_OPTO6	Optical coupler Input 6	
17	GND2	Ground2 - Input for Optical coupler Input(3-6)	
18	---	---	
19	O_OPTO1	Optical coupler Output 1	
20	O_OPTO2	Optical coupler Output 2	
21	O_OPTO3	Optical coupler Output 3	
22	O_OPTO4	Optical coupler Output 4	
23	---		
24	Vcc3	Vcc3 – Input for Optical coupler Output(1-4)	24V
25	GND3	Ground3 for Optical coupler Output(1-4)	
26	GND	Ground (board)	GND (board)

Table 7: Pin assignment of connector X9

The setting for the power supply voltage is done by a jumper on X11.

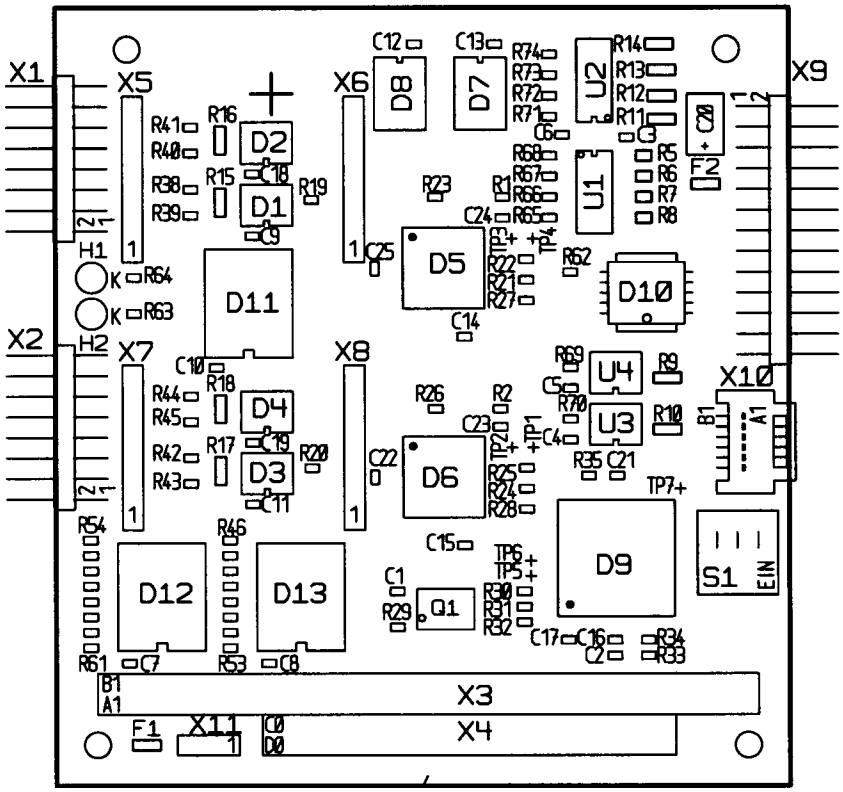


5 V



12 V

6 Board design mechanics



7 Electrical specifications

7.1 Absolute Maximum ratings

Characteristics	Symbol	min.	max.	Unit	Remarks
DC supply voltage			7 [1]	V	
Operating temperature	T_a	0	70 [2]	°C	
Storage temperature	T_{stg}	-55	125	°C	

Table 8: Absolute maximum ratings

1 The maximum supply voltage is not allowed for continuous operation
2 Guaranteed value, tolerances to higher values possible

7.2 Recommended operating conditions

Characteristics (Nominal value: Ucc=5V)	Symbol	min.	max.	Unit	Remarks
DC supply voltage	V_{DD}	4,75	5,25	V	
Operating temperature	T_{amb}	0	70	°C	

Table 9: Recommended operating conditions

7.3 Electrical characteristics

Characteristics (Nominal value: Ucc=5V)	Symbol	min.	typ	max.	Unit	Bemerkung
System clock frequency	fclk	---	33	---	MHz	preferable for incremental systems
	fclk	---	24	---	MHz	preferable for EnDat
Supply current		---	---	400	mA	
Input voltage Optical coupler inputs	V I_OPTO	10	24	30	V	i(typ)= 7 mA
Input current Optical coupler inputs	I I_OPTO	4	7	---	mA	V I_OPTO = 24V
Rising time (STR1, STR2)	ta I_OPTO	---	---	300	ns	V I_OPTO = 24V, i(typ)= 10 mA
Rising time (IR71,IR72,I_OPTO5,I_OPTO 6)	ta I_OPTO	---	---	30	µs	V I_OPTO = 24V, i(typ)= 10 mA
Output voltage Optical coupler outputs	V O_OPTOX	10	24	30	V	i(typ)= 30 mA
Output current Optical coupler outputs	I O_OPTOX	---	30	100	mA	V O_OPTO = 24V
Rising time	ta O_OPTOX	---	---	100	µs	V I_OPTO = 24V

Table 10: Electrical characteristics

Absolute ratings:
It will lead to irreversible damage of the board when exceeded.

Recommended operating conditions:
Under these conditions the functions described in this manual are fulfilled.

Characteristics:
The described features are guaranteed on operating conditions of the board.

Reference: - Data sheet MMI4832 (DB-99-031, V1.3)

For more information please contact:

MAZeT GmbH
Sales office:
Dr. Winfried Mahler
Göschwitzer Straße 32
07745 JENA
GERMANY
Phone: +49 3641 2809-0
Fax: +49 3641 2809-12
E-Mail: mahler@MAZeT.de
Url: http://www.MAZeT.de