Description and instruction for:

PIC_C2_1

PIC-Mastercontroller for MCS-control

Characteristics:

- *Contolling processor PIC16F877*
- *MCS-control for INPUT-, address-, function- and OUTPUT-bus*
- *Connection for ExternI/O; 17 bit implemented as SUB-D-25m; opto decouples*
- *RS232*
- *Read in of a 16-fold keyboard*
- *Control of a LCD-Display*
- *Eightfold DIP-switch*
- *Connection for second level MCS system*

STAND: 13.12.2009

ING.-BÜRO R.FINK / Entwicklung von Hard- und Software
93170 Bernhardswald www.IB-Fink.de Tel.: 09407/90640

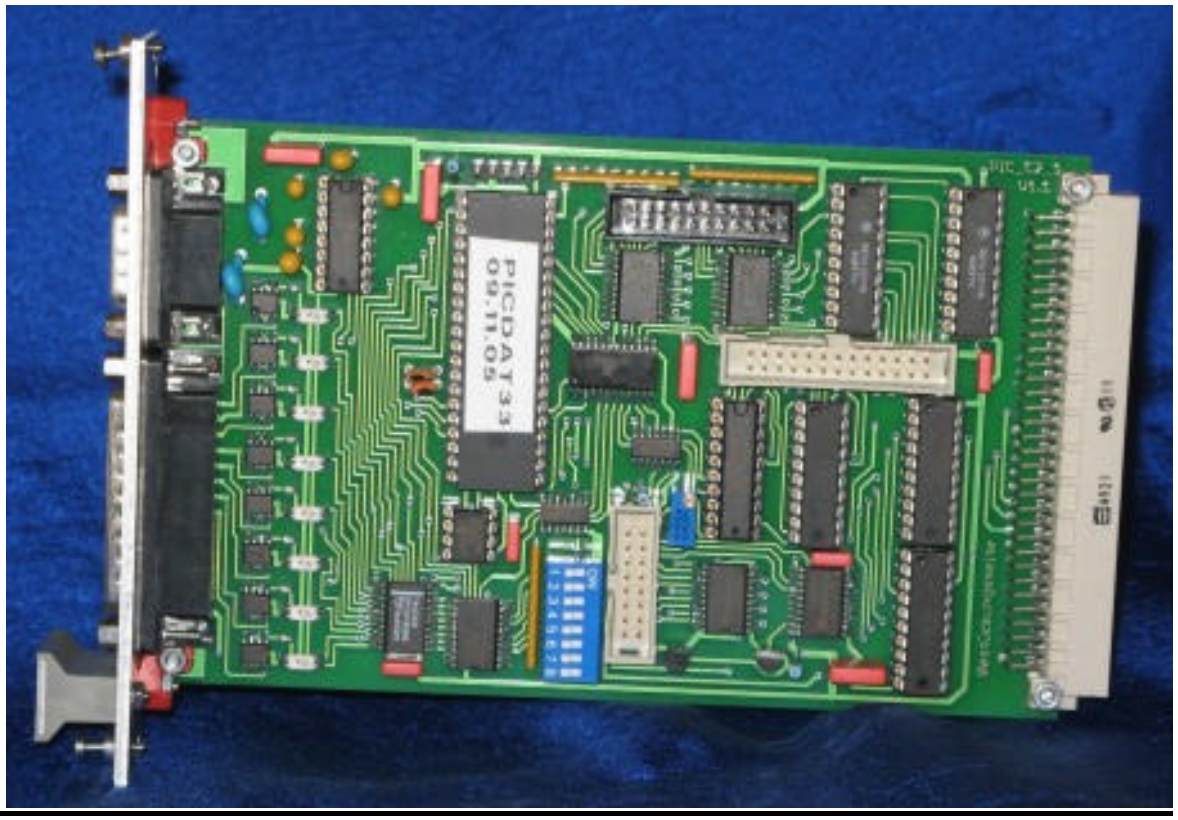
1. Function and application type:

The board ` PIC_C2_1 ' is a double side Europe card and can be used as master controller in the MCS system. A self-sufficient operation, for which an operating voltage is only needed by 5V, is just as possible.

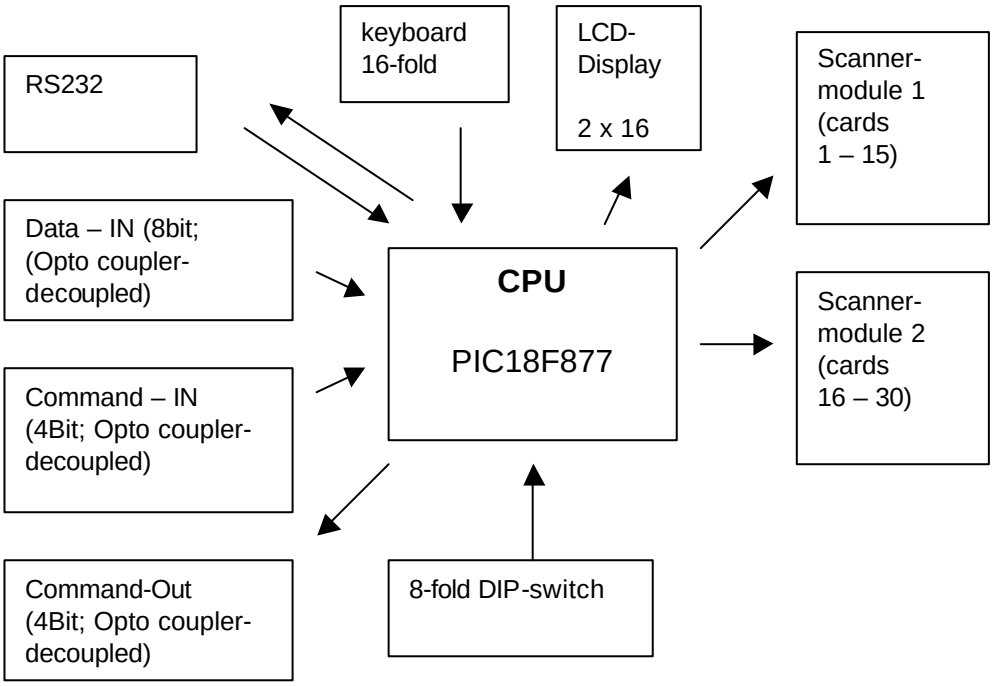
As One chip processor a PIC16C74, a higher performance PIC16F877 or a pin-compatible version can be used. The I/O bits of the processor are used on the board rigidly for input and output. These are in the further process of the description the so-called ` processor buses '.

At the port ` B ' is attached a 4 bits BCD decoder. With its 15 exits thus can be activated 15 different drivers-, bus- or latchfunctions, which ensure that the desired signals are connected through by and/or to the port ` B ' or ` C '.

By the particularly implemented connections of port B6/B7, Reset, GND and VCC on a 5 pole pin row can be loaded or debugged a software during the current operation with the microchip-development-board "ICD".



2. In principle existing function groups of the PIC_C2_1:



3. Power supply:

The board ` PIC_C2_1 ' needs only a supply voltage of +5V. The necessary current depends primarily of the turned on components (e.g.: LCD announcement;...) .
The necessary power depends on primarily of the turned on components (e.g.: LCD display;...). As basis need approx. 200mA can be set.

The supply of supply voltage is made by the 64pol. band:

Voltage:	*Pin of the 64pol. ac*
+5V (VCC)	1ac
GND (VDD)	32ac

4.1. Function groups, which can be served by the PIC:

Group:	*Connection:*	*Description / remark:*
RS232	SUB-D-9pole male (front);	
External input	SUB-D-25pole male (front);	12 inputs ; 5 outputs ; opto decoupled
16-fold keyboard	20pole connector plug;	the 16 keyboard signals are pulled on 5V and thus low active
LCD-Display	16pole connector plug	Brightness attitude of the display over trimmers on the board. Pin connections for LED lighting already available (by software adjustably).
8f-DIP switch	On the board	` ON ' is read in the PIC as ` 0 '
MCS-OUTPUT	64pol. ac-band (CON1)	8-bit data output for the MCS system
MCS-INPUT	64pol. ac-band (CON1)	8-bit data input of the MCS system
MCS-address- and function bus	64pol. ac-band (CON1)	4 bit output for card selecting (addressing) in the MCS system. 4 bit output for function selecting on the chosen map

Since activating the function groups is made by bus drivers or Latch components, is to be counted on an appropriate response time of the PIC's or the mentioned module.
As guide it is considered that, when using a cristal of 3,686MHz and thus a cycle time of approx. 1us, all input signals should fit to 50us at least. The shifting on the MCS bus depends on the structure of the software and lasts maximally 250us (recommendation to the software production).

4.2. Responding and connecting through the function groups by codes at the port `B':

At the port A and E of the PIC processor 8-bit signals are read in. The poer D serves in principle for the outgo of 8-bit data. With some functions are notall 8 bits needed, they do´nt have any effects on the remaining behavior of the board.

Code (Dez./ HEX):	*Function group / function:*	*Remark, kind of components; bits:*
1 / 01H		
2 / 02H	CS_Command_Out; I/O: Out	The five opto couplers for the output of the I/O interface (25pol. SUB D) are set
3 / 03H	CS_Command_In; I/O: In	The five opto couplers for the input of the I/O interface (25pol. SUB D; Command signals) are queried
4 / 04H	CS_Data_In; I/O: In	The 8 opto couplers for the entrance of the I/O interface (25pol.SUB-D; Data signals) are queried
5 / 05H	CS_DIP8	The switching status of the eightfold DIP switch is queried. Note: LOW active
6 / 06H	CS_LCD1; LCD-Data	The data record for the LCD display is spent
7 / 07H	CS_MCS_Out1	The Out data bus for the MCS bus (regular bus wiring) is set
8 / 08H	CS_LCD1; LCD-Command	Die Steuersignale für die LCD-Anzeige werden gesetzt
9 / 09H	CS_MCS_Out2	The Out data bus for the MCS bus (additional bus wiring) is set over a 26 pol. connector plug
10 / 0AH	CS_MCS_Adr2	The address and function bus for the MCS_Bus (additional bus wiring) are set over the 26 pol. connector plug
11 / 0BH	CS_MCS_Adr1	The address and function bus for the MCS_Bus (regular bus wiring) are set over the 26 pol. connector plug
12 / 0CH	CS_MCS_In1	The lying close data of the MCS_Bus (regular bus wiring) are read in over the 26 pol. connector plug
13 / 0DH	CS_MCS_In2	The lying close data of the MCS_Bus (additional bus wiring) are read in over the 26 pol. connector plug
14 / 0EH	CS_Tast2; keyboard numbers	By the keyboard the keys with numbers of 1 – 9 are read in bit by bit (not decoded); Low active
15 / 0FH	CS_Tast1; keyboard special function	By the keyboard the keys with special functions and/or control characters are read in bit by bit (not decoded); Low active

5. Pin configuration of the connectors/ connector plugs etc.:

5.1. RS232

SUB-D-9m: Pin	*Function:*
2	TX
3	RX
5	GND

5.2. External input / I/O: X 1

At this 25pol.SUB-D (male) the input and output signals are spent and/or read in on external I/O cards.
The inputs are high active between a voltage of 3V and 24V.
At the outputs opto couplers are connected through. Accordingly a protective circuit is to be planned here.

SUB-D-25m: Pin	*Function:*
1	Data-In / BIT 0
2	Data-In / BIT 1
3	Data-In / BIT 2
4	Data-In / BIT 3
5	Data-In / BIT 4
6	Data-In / BIT 5
7	Data-In / BIT 6
8	Data-In / BIT 7
9	Command-In / BIT 0
10	Command-In / BIT 6
11	Command-In / BIT 4
12	Command-In / BIT 2
13	GND: Command-In
14	Command-Out / BIT 0
15	Command-Out / BIT 0
16	Command-Out / BIT 0
17	Command-Out / BIT 0
18	Command-Out / BIT 0
19	GND: Command-Out
20	GND: Command-Out
21	N.C.
22	N.C.
23	GND: Data-In
24	GND: Data-In
25	GND: Data-In

5.3. Keyboard:

Pin-connector plug:	*Function/key:*	*Selecting port B:*	*Bit and/or HEX-result:*
1	GND		
2	GND		
3	0	CS_Tast2 = 0EH	Bit 1
4	# = S	"	Bit 0
5	9	"	Bit 3
6	* = C	"	Bit 2
7	7	"	Bit 5
8	8	"	Bit 6
9	5	"	Bit 7
10	6	"	Bit 4
11	1	CS_Tast2 = 0FH	Bit 0
12	4	"	Bit 1
13	3	"	Bit 2
14	2	"	Bit 3
15	Left = L	"	Bit 4
16	Down = D	"	Bit 5
17	Right = R	"	Bit 6
18	Reserve1		
19	Up = U	"	Bit 7
20	Reserve2		

5.4. LCD-Display:

connector plug 16pol.: Pin	*Function:*	*Description*
1	VSS	GND
2	VDD	+5V (Display)
3	VEE	contrast / Poti
4	RS	Register Select (H=data; L=command)
5	R/W	Read /Write (L=Write; H=Read)
6	E	Enable (Assumption with falling flank)
7	D0	Data line / command bit 0
8	D1	Data line / command bit 1
9	D2	Data line / command bit 2
10	D3	Data line / command bit 3
11	D4	Data line / command bit 4
12	D5	Data line / command bit 5
13	D6	Data line / command bit 6
14	D7	Data line / command bit 7
15	VDD	+5V for LED background lighting
16	VSS	GND for LED background lighting

5.5. DIP-switch:

The set switching positions 1 to 8 correspond to the associated bit values in the read in byte and are inverted at the port (low active).

5.6. Connection to the MCS system over 64pol. connecting strip (regular bus coupling):

Connecting strip: 64pol. Pin	*Function:*	*Description*
7c	MCS-INPUTBUS D0	
7a	MCS-INPUTBUS D1	
6c	MCS-INPUTBUS D2	
6a	MCS-INPUTBUS D3	
5c	MCS-INPUTBUS D4	
5a	MCS-INPUTBUS D5	
4c	MCS-INPUTBUS D6	
4a	MCS-INPUTBUS D7	
21a	MCS-ADRESSBUS D0	
21c	MCS-ADRESSBUS D1	
22a	MCS-ADRESSBUS D2	
22c	MCS-ADRESSBUS D3	
23a	MCS-FUNKTIONSBUS D0	
23c	MCS-FUNKTIONSBUS D1	
24a	MCS-FUNKTIONSBUS D2	
24c	MCS-FUNKTIONSBUS D3	
25a	MCS-OUTPUTBUS D0	
25c	MCS-OUTPUTBUS D1	
26a	MCS-OUTPUTBUS D2	
26c	MCS-OUTPUTBUS D3	
28c	MCS-OUTPUTBUS D4	
28a	MCS-OUTPUTBUS D5	
27c	MCS-OUTPUTBUS D6	
27a	MCS-OUTPUTBUS D7	

5.7. Connection to the additional MCS system over 26pol. connector plug:

26pol. connector plug Pin	*Function:*	Connection to the separate MCS bus; Connecting strip 64pol. Pin; Description:
1	MCS-INPUTBUS B6	
2	MCS-INPUTBUS B7	
3	MCS-INPUTBUS B4	
4	MCS-INPUTBUS B5	
5	MCS-INPUTBUS B2	
6	MCS-INPUTBUS B3	
7	MCS-INPUTBUS B0	
8	MCS-INPUTBUS B1	
9	MCS-ADRESSBUS B1	
10	MCS-ADRESSBUS B0	
11	MCS-ADRESSBUS B3	
12	MCS-ADRESSBUS B2	
13	MCS-FUNKTIONSBUS B1	
14	MCS-FUNKTIONSBUS B0	
15	MCS-FUNKTIONSBUS B3	
16	MCS-FUNKTIONSBUS B2	
17	MCS-OUTPUTBUS	
18	MCS-OUTPUTBUS	
19	MCS-OUTPUTBUS	
20	MCS-OUTPUTBUS	
21	MCS-OUTPUTBUS	
22	MCS-OUTPUTBUS	
23	MCS-OUTPUTBUS	
24	MCS-OUTPUTBUS	
25	GND	
26	GND	

6. Changes to previous versions of the board:

Actually no changes/ modifications

7. Partlist:

Partlist

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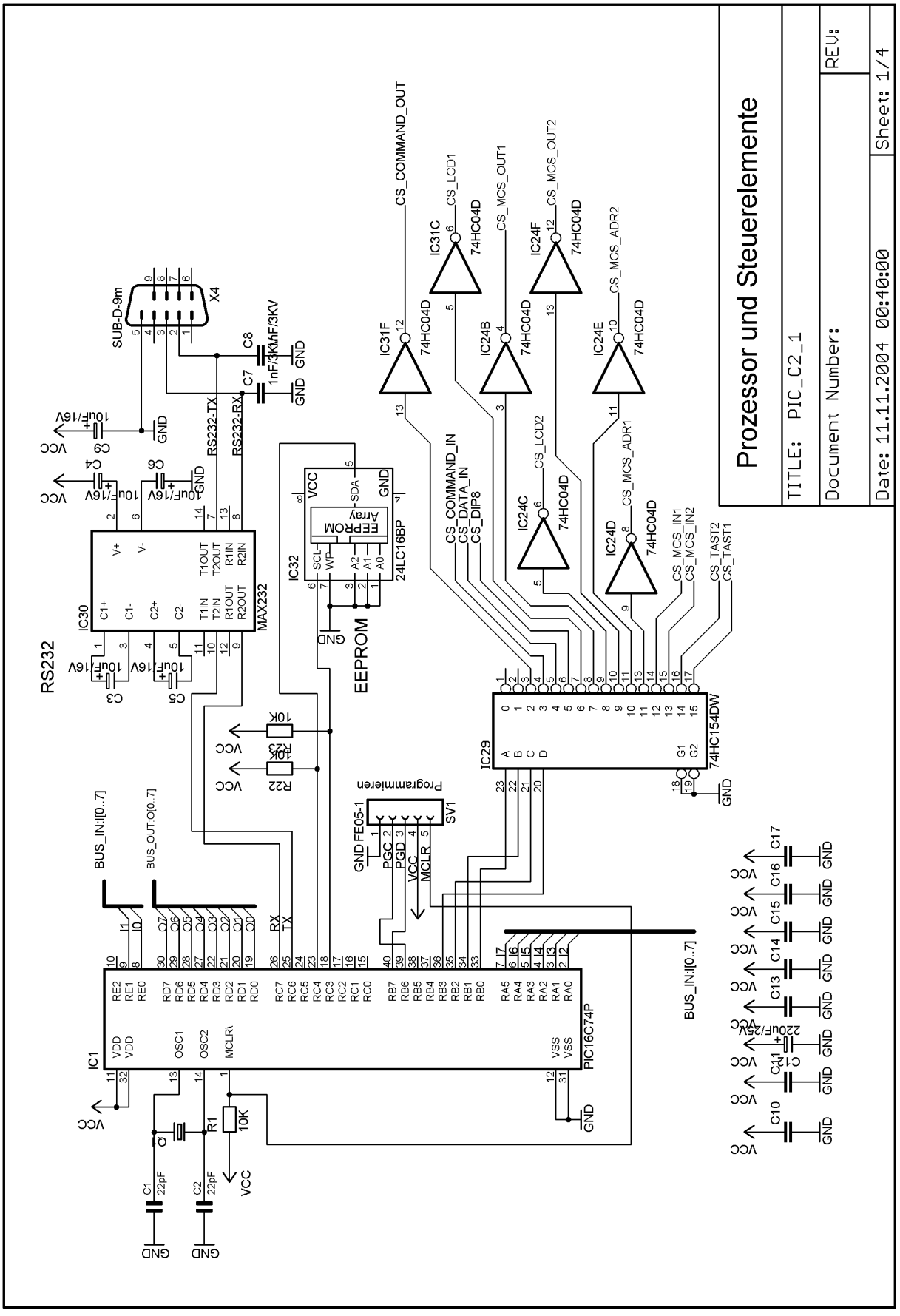
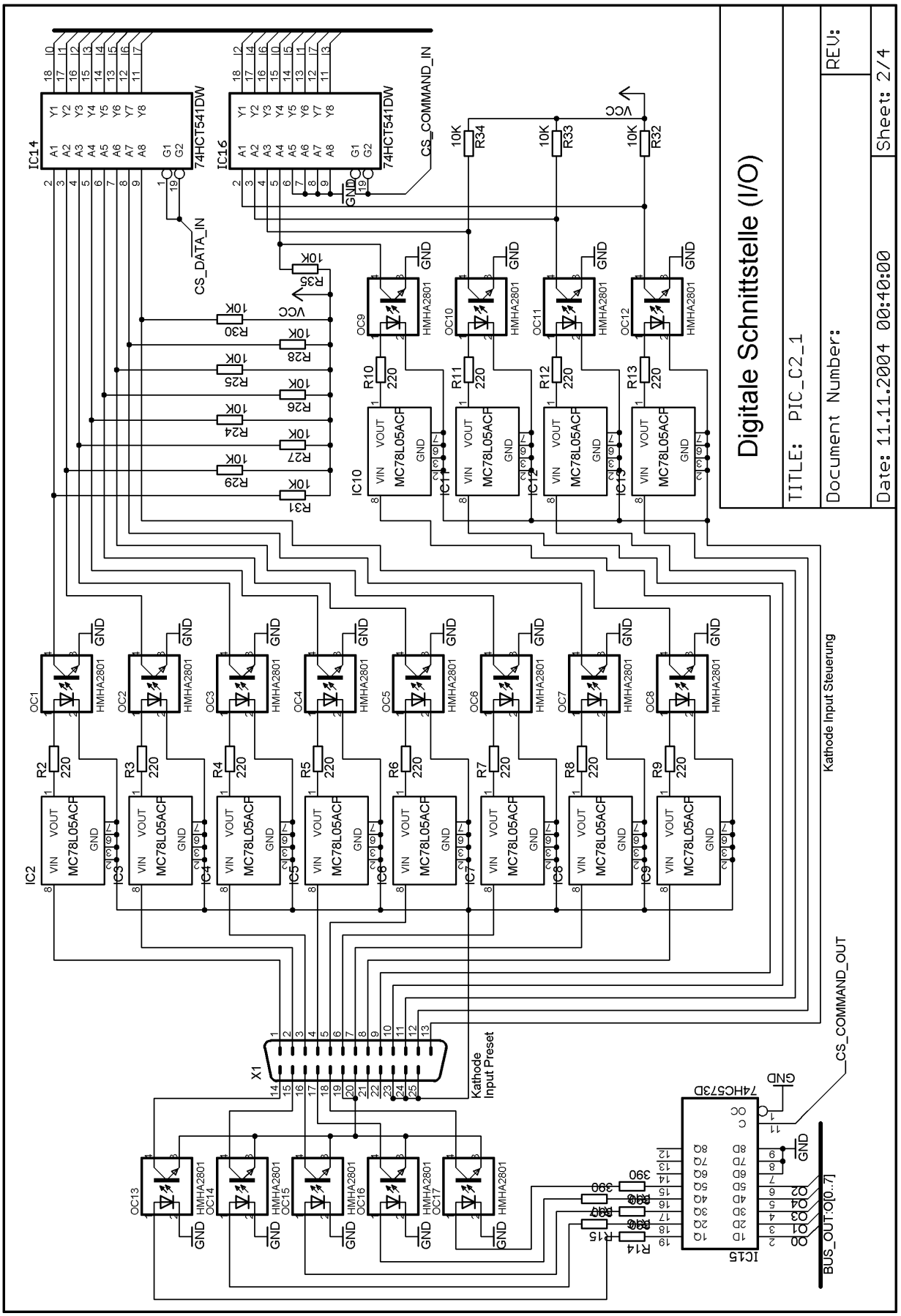
Part	Value	Device	Package	Library	Sheet
C1	22pF	C5B2,5	C5B2,5	CAP	1
C2	22pF	C5B2,5	C5B2,5	CAP	1
C3	10uF/16V	ELC-2,5L	ES-2,5L	DISCRETE	1
C4	10uF/16V	ELC-2,5L	ES-2,5L	DISCRETE	1
C5	10uF/16V	ELC-2,5L	ES-2,5L	DISCRETE	1
C6	10uF/16V	ELC-2,5L	ES-2,5L	DISCRETE	1
C7	1nF/3KV	C7.5/3	C7.5B3	capacitor-wima	1
C8	1nF/3KV	C7.5/3	C7.5B3	capacitor-wima	1
C9	10uF/16V	ELC-2,5L	ES-2,5L	DISCRETE	1
C10		C7.5/3	C7.5B3	capacitor-wima	1
C11		C7.5/3	C7.5B3	capacitor-wima	1
C12	220uF/25V	ELC-5	ES-5	DISCRETE	1
C13		C7.5/3	C7.5B3	capacitor-wima	1
C14		C7.5/3	C7.5B3	capacitor-wima	1
C15		C5/3	C5B3	capacitor-wima	1
C16		C5/3	C5B3	capacitor-wima	1
C17		C5/3	C5B3	capacitor-wima	1
IC1	PIC16C74P	PIC16C74P	DIL40	microchip	1
IC2	MC78L05ACP	78L05SMD	SO08	linear	2
IC3	MC78L05ACP	78L05SMD	SO08	linear	2
IC4	MC78L05ACP	78L05SMD	SO08	linear	2
IC5	MC78L05ACP	78L05SMD	SO08	linear	2
IC6	MC78L05ACP	78L05SMD	SO08	linear	2
IC7	MC78L05ACP	78L05SMD	SO08	linear	2
IC8	MC78L05ACP	78L05SMD	SO08	linear	2
IC9	MC78L05ACP	78L05SMD	SO08	linear	2
IC10	MC78L05ACP	78L05SMD	SO08	linear	2
IC11	MC78L05ACP	78L05SMD	SO08	linear	2
IC12	MC78L05ACP	78L05SMD	SO08	linear	2
IC13	MC78L05ACP	78L05SMD	SO08	linear	2
IC14	74HCT541DW	74HCT541DW	SO20W	74xx-eu	2
IC15	74HC573D	74HC573D	SO20W	74xx-eu	2
IC16	74HCT541DW	74HCT541DW	SO20W	74xx-eu	2
IC17	74LS244	74AC244N	DIL20	74xx-eu	3
IC18	74LS373	74AC373N	DIL20	74xx-eu	3
IC19	74LS373	74AC373N	DIL20	74xx-eu	3
IC20	74LS244	74HCT244N	DIL20	74xx-eu	3
IC21	74AC541DW	74AC541DW	SO20W	74xx-eu	4
IC22	74LS373	74AC373N	DIL20	74xx-eu	3
IC23	74LS373	74AC373N	DIL20	74xx-eu	3
IC24	74HC04D	74AC04D	SO14	74xx-eu	1
IC25	74AC541DW	74AC541DW	SO20W	74xx-eu	4
IC26	74AC541DW	74AC541DW	SO20W	74xx-eu	4
IC27	74HC573D	74HC573D	SO20W	74xx-eu	4
IC28	74HC573D	74HC573D	SO20W	74xx-eu	4
IC29	74HC154DW	74HC154DW	SO24W	74xx-eu	1
IC30	MAX232	MAX232	DIL16	maxim	1
IC31	74HC04D	74AC04D	SO14	74xx-eu	1
IC32	24LC16BP	24LC16BP	DIL8	microchip	1

OC1	HMHA2801	SFH6206SO4	SO4	OPTOCPL	2
OC2	HMHA2801	SFH6206SO4	SO4	OPTOCPL	2
OC3	HMHA2801	SFH6206SO4	SO4	OPTOCPL	2
OC4	HMHA2801	SFH6206SO4	SO4	OPTOCPL	2
OC5	HMHA2801	SFH6206SO4	SO4	OPTOCPL	2
OC6	HMHA2801	SFH6206SO4	SO4	OPTOCPL	2
OC7	HMHA2801	SFH6206SO4	SO4	OPTOCPL	2
OC8	HMHA2801	SFH6206SO4	SO4	OPTOCPL	2
OC9	HMHA2801	SFH6206SO4	SO4	OPTOCPL	2
OC10	HMHA2801	SFH6206SO4	SO4	OPTOCPL	2
OC11	HMHA2801	SFH6206SO4	SO4	OPTOCPL	2
OC12	HMHA2801	SFH6206SO4	SO4	OPTOCPL	2
OC13	HMHA2801	SFH6206SO4	SO4	OPTOCPL	2
OC14	HMHA2801	SFH6206SO4	SO4	OPTOCPL	2
OC15	HMHA2801	SFH6206SO4	SO4	OPTOCPL	2
OC16	HMHA2801	SFH6206SO4	SO4	OPTOCPL	2
OC17	HMHA2801	SFH6206SO4	SO4	OPTOCPL	2
Q1		CRYTALHC49U-V	HC49U-V	crystal	1
Q2	BC337-40	BC337-40	TO92	transistor-npn	4
Q3	BC337-40	BC337-40	TO92	transistor-npn	4
R1	10K	RESEU-S2,5	RS-2,5	DISCRETE	1
R2	220	R-EU_R0603	R0603	rcl	2
R3	220	R-EU_R0603	R0603	rcl	2
R4	220	R-EU_R0603	R0603	rcl	2
R5	220	R-EU_R0603	R0603	rcl	2
R6	220	R-EU_R0603	R0603	rcl	2
R7	220	R-EU_R0603	R0603	rcl	2
R8	220	R-EU_R0603	R0603	rcl	2
R9	220	R-EU_R0603	R0603	rcl	2
R10	220	R-EU_R0603	R0603	rcl	2
R11	220	R-EU_R0603	R0603	rcl	2
R12	220	R-EU_R0603	R0603	rcl	2
R13	220	R-EU_R0603	R0603	rcl	2
R14	390	R-EU_R0603	R0603	rcl	2
R15	390	R-EU_R0603	R0603	rcl	2
R16	390	R-EU_R0603	R0603	rcl	2
R17	390	R-EU_R0603	R0603	rcl	2
R18	390	R-EU_R0603	R0603	rcl	2
R19	2.7K	RESEU-S2,5	RS-2,5	DISCRETE	4
R20	4.7K	RESEU-S2,5	RS-2,5	DISCRETE	4
R21	15K	TRIM_EU-S64Y	S64Y	pot	4
R22	10K	RESEU-10	R-10	DISCRETE	1
R23	10K	RESEU-10	R-10	DISCRETE	1
R24	10K	R-EU_R0603	R0603	rcl	2
R25	10K	R-EU_R0603	R0603	rcl	2
R26	10K	R-EU_R0603	R0603	rcl	2
R27	10K	R-EU_R0603	R0603	rcl	2
R28	10K	R-EU_R0603	R0603	rcl	2
R29	10K	R-EU_R0603	R0603	rcl	2
R30	10K	R-EU_R0603	R0603	rcl	2
R31	10K	R-EU_R0603	R0603	rcl	2
R32	10K	R-EU_R0603	R0603	rcl	2
R33	10K	R-EU_R0603	R0603	rcl	2
R34	10K	R-EU_R0603	R0603	rcl	2
R35	10K	R-EU_R0603	R0603	rcl	2
RN1	8x10K	RN08	RN-9	DISCRETE	4
RN2	8x10K	RN08	RN-9	DISCRETE	4
RN3	8x10K	RN08	RN-9	DISCRETE	4
S1		DIP08S	DIP08S	switch-dil	4

SV1	FE05-1	FE05-1	FE05-1	CON-LSTA	1
SV2		ML26	ML26	con-ml	3
SV3		ML20	ML20	con-ml	4
SV4		ML16	ML16	con-ml	4
X1		M25HP	M25HP	con-subd	2
X3	MAC64L	MAC64L	MAC64L	con-vg	3
X4	SUB-D-9m	M09HP	M09HP	con-subd	1

8. Connection diagram:

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IC16
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CS_COMMAND_IN
VCC
GND
10K
R34
10K
R33
10K
R32
R35
10K
R30
10K
R28
10K
R25
10K
R26
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R24
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R27
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R31
10K
IC10
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OC9
OC10
OC11
OC12
HMHA2801
R10
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R12
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IC2
OC1
OC2
OC3
OC4
OC5
OC6
OC7
OC8
R2
R3
R4
R5
R6
R7
R8
R9
Kathode Input Steuerung
X1
Kathode
Input Preset
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IC15
OC13
OC14
OC15
OC16
OC17
390
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R15
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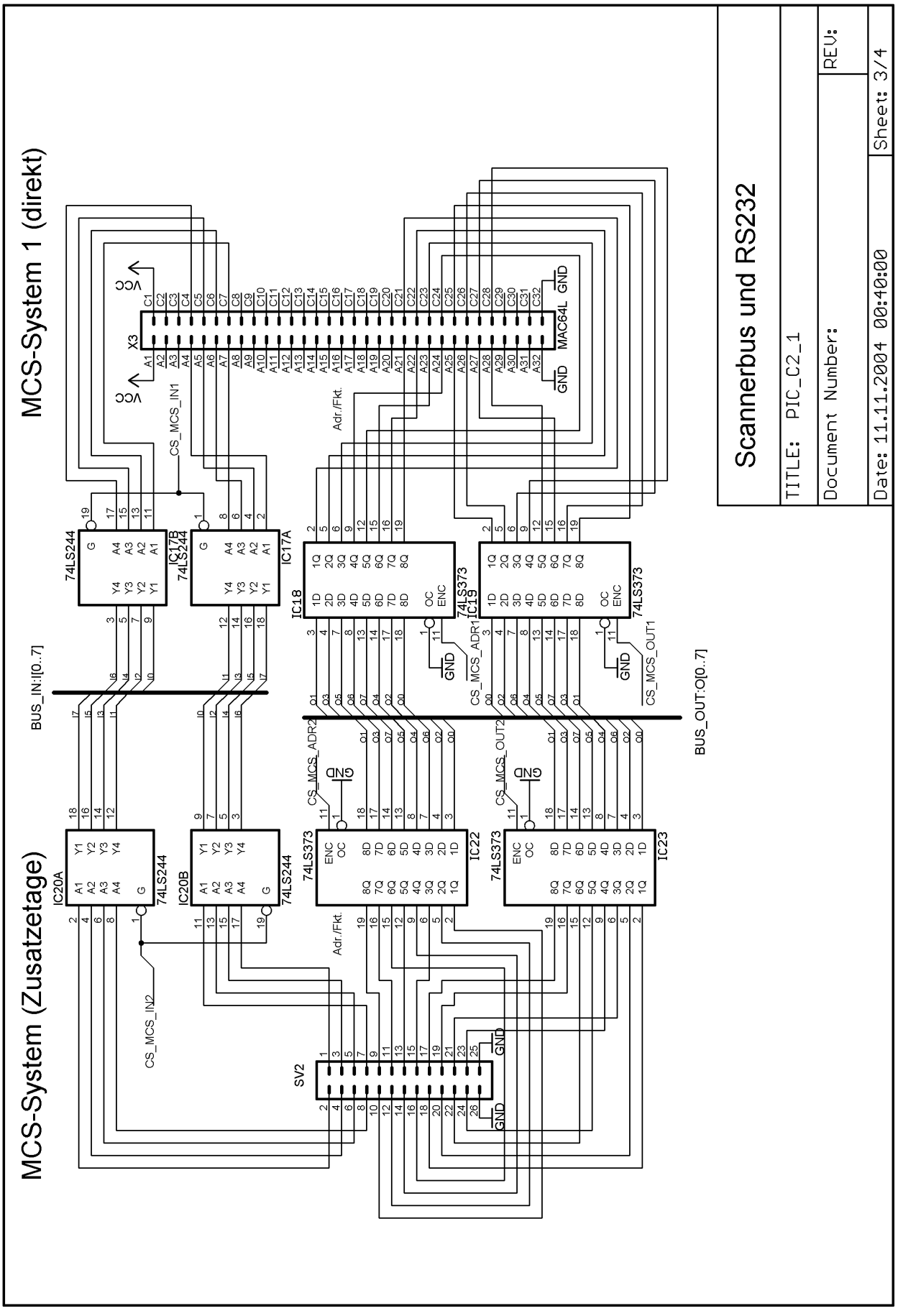
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MCS-System (Zusatzetage)
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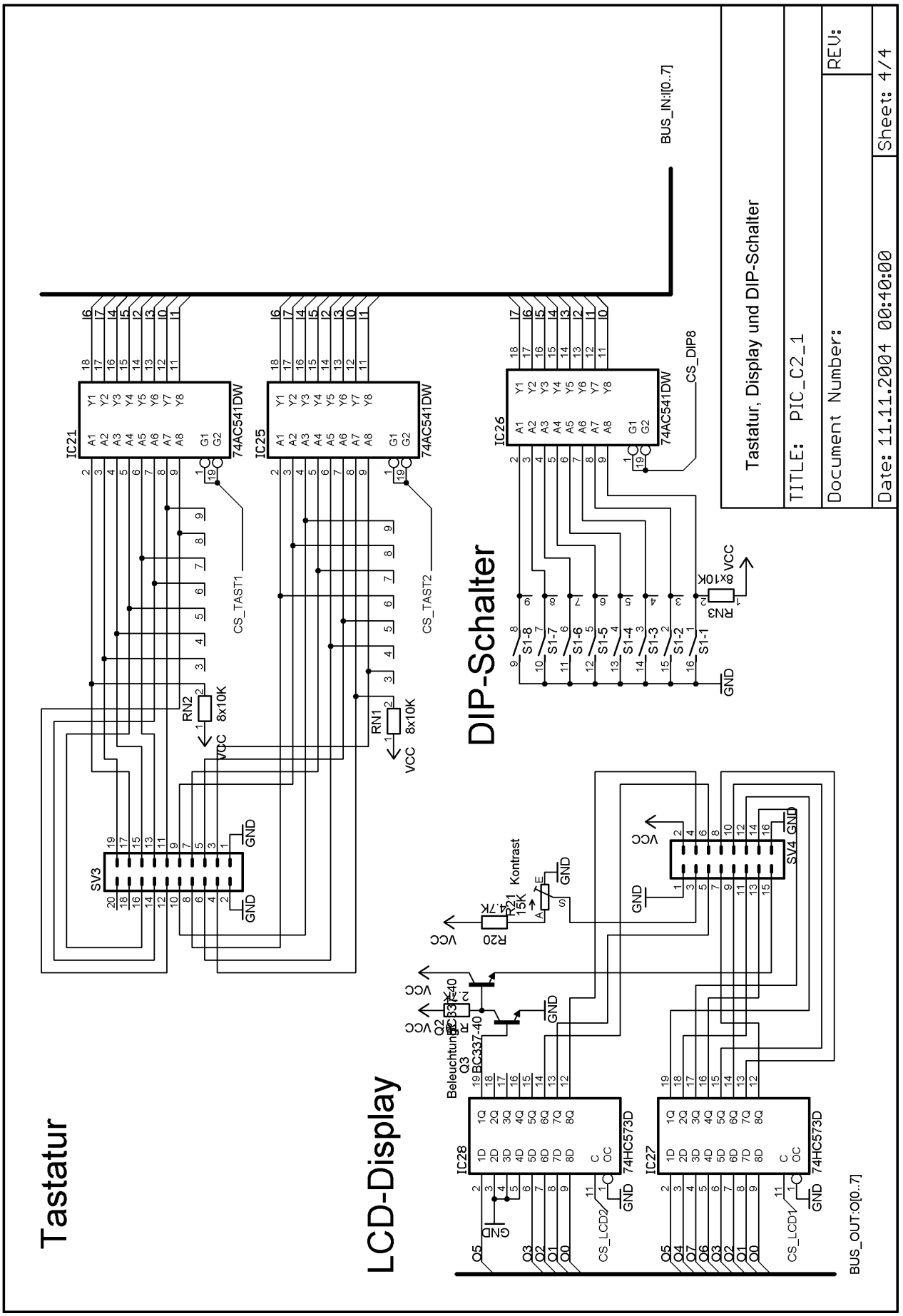
CS_MCS_IN2
CS_MCS_ADR1
CS_MCS_ADR2
CS_MCS_OUT1
CS_MCS_OUT2
Adr./Fkt.
74LS244
74LS373
MAC64L
IC17A
IC17B
IC18
IC19
IC20A
IC20B
IC22
IC23
SV2
X3
VCC
GND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DIP-Schalter
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IC25
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IC27
IC28
74AC541DW
74HC573D
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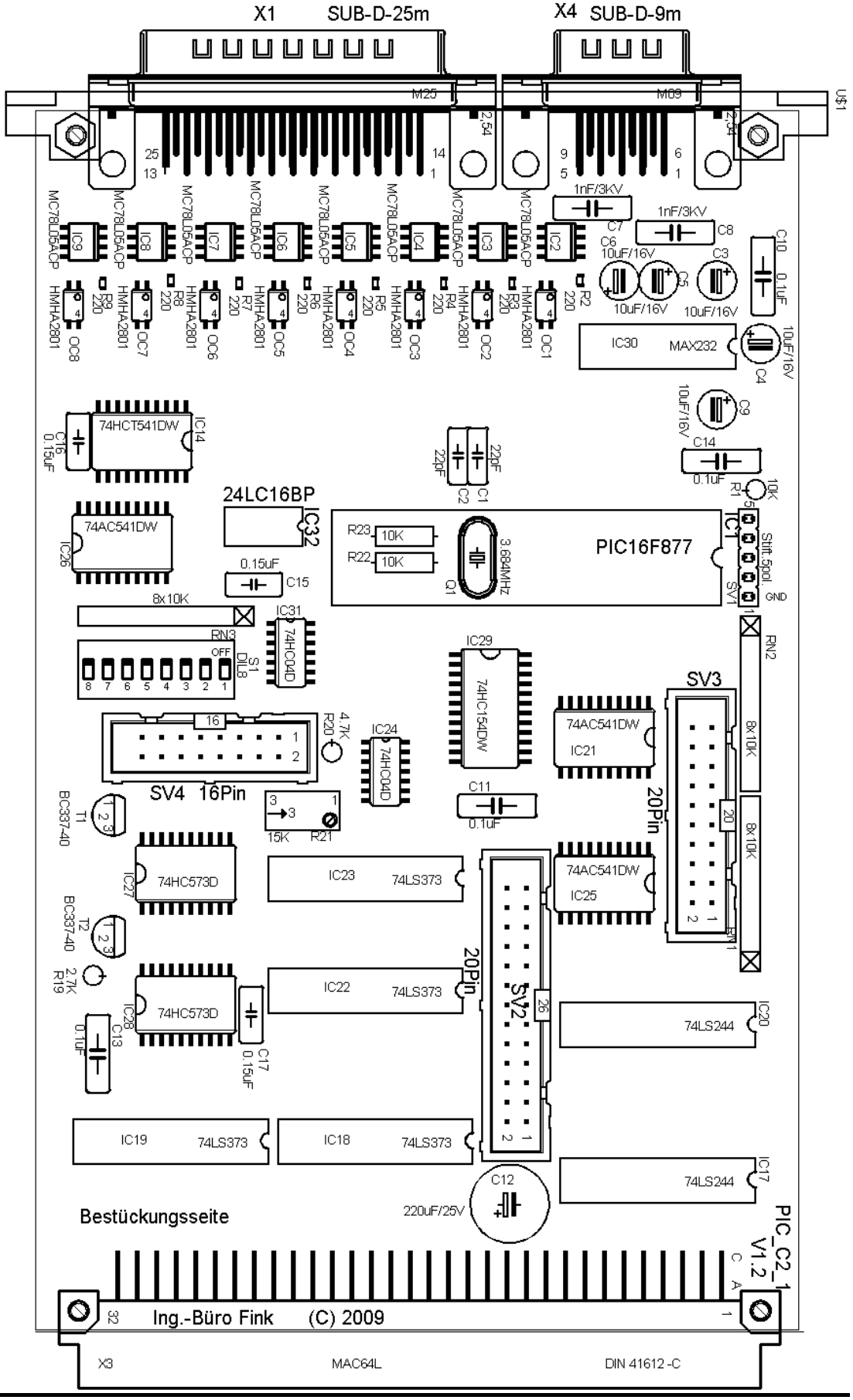
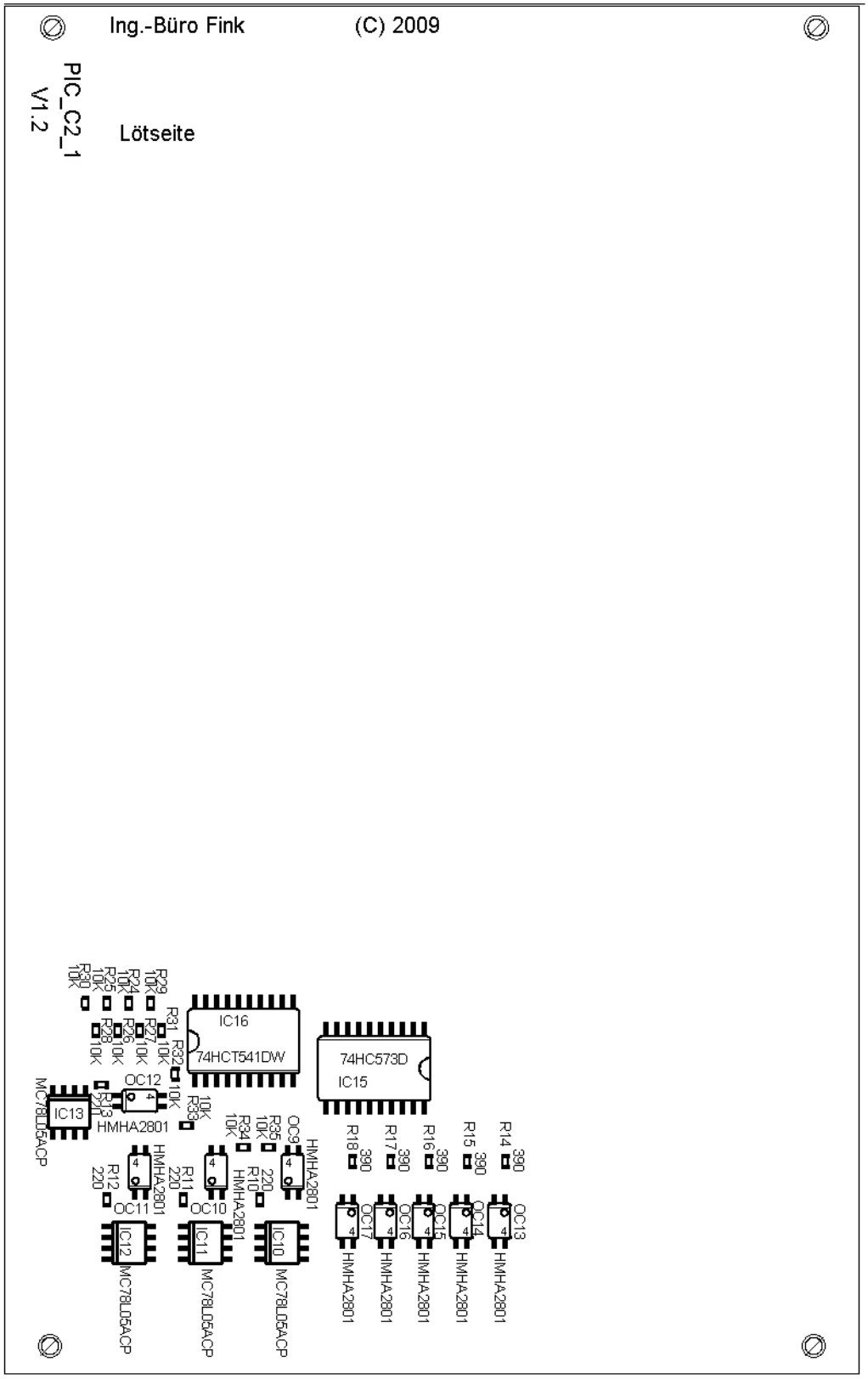
CS_TAST2
CS_DIP8
CS_LCD1
CS_LCD2
RN1
RN2
RN3
8x10K
VCC
GND
SV3
SV4
Kontrast
R20
4,7K
R21
15K
Beleuchtung
Q2
Q3
BC337-40
S1-1
S1-2
S1-3
S1-4
S1-5
S1-6
S1-7
S1-8

9. Bill of material:

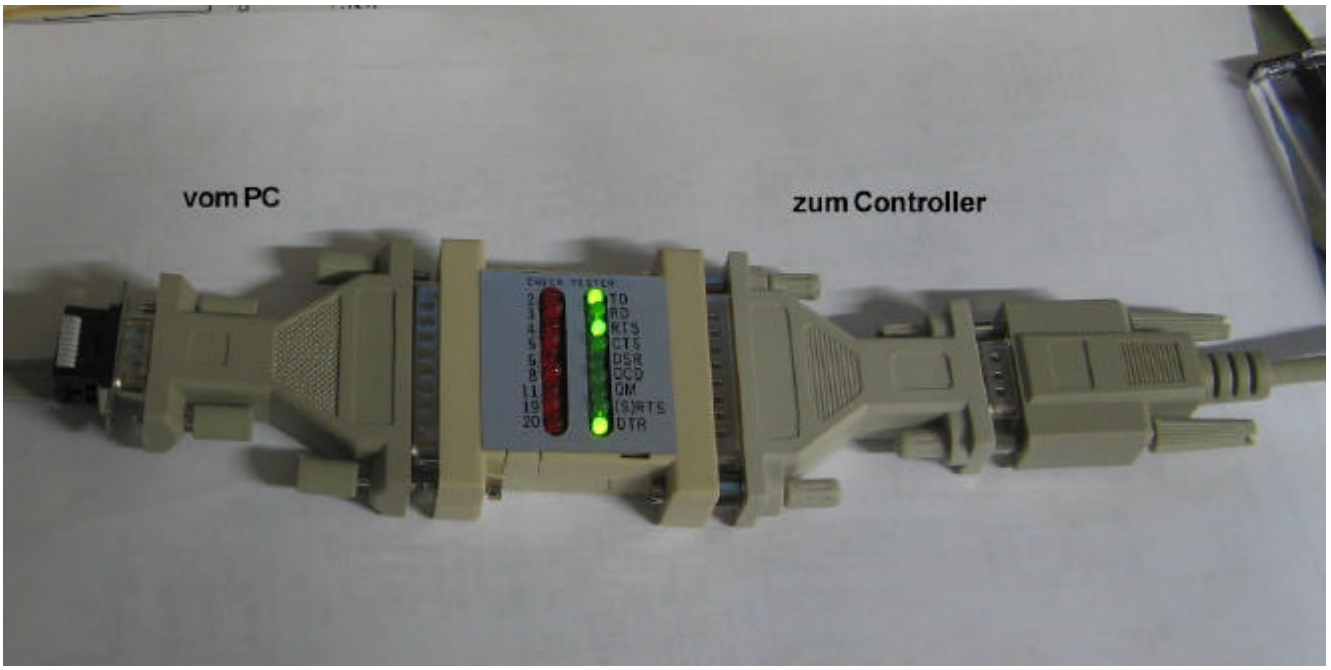



Ing.-Büro Fink
(C) 2009
PIC_C2_1
V1.2
Lötseite
IC16
74HCT541DW
74HC573D
IC15
IC13
MC78L05ACP
IC12
IC11
IC10
HMHA2801
OC9
OC10
OC11
OC12
OC13
OC14
OC15
OC16
OC17
R10
R11
R12
R14
R15
R16
R17
R18
R24
R25
R26
R27
R28
R29
R30
R31
R32
R33
R34
R35
10K
220
390

10. Check Communication RS232:

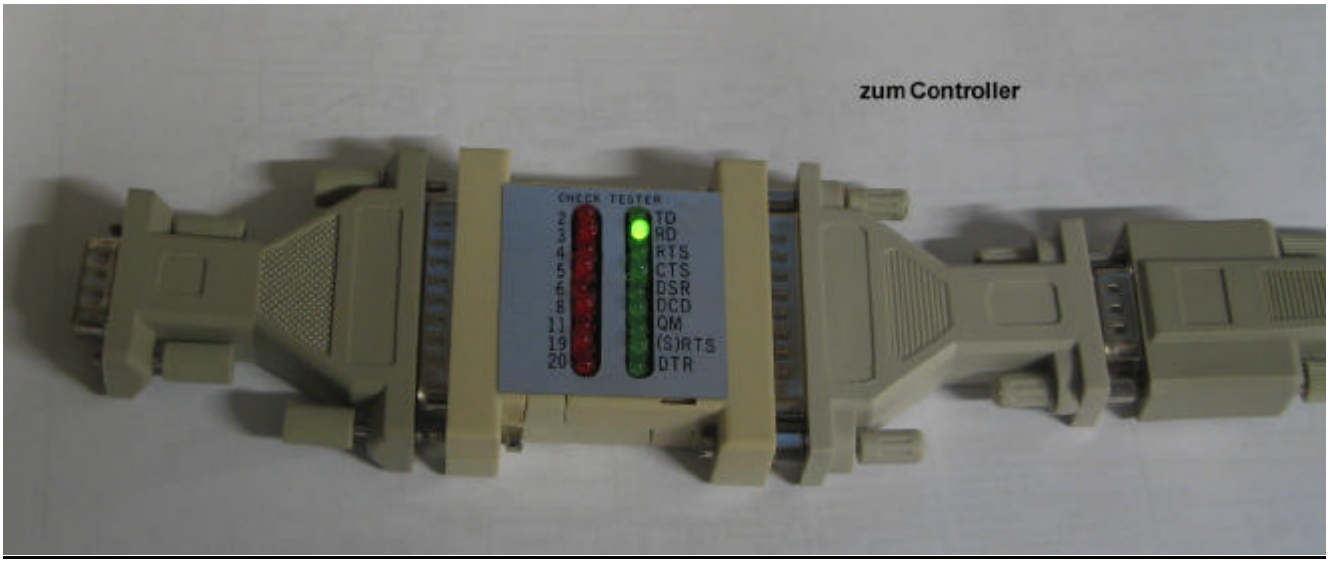
If some problems with the communication between PC and the Controller, try this one:

10.1. Connect the PC to a serial texter:



The serial communication in the softwaretool (MCS-Tools) must not be activated. On the serial tester are only this LEDs emitting: the three green LEDs "TD", "RTS" and "DTR".

10.2. Connect the Controller to the serial tester:



When the controller get's power, the green LED "RD" is emitting.

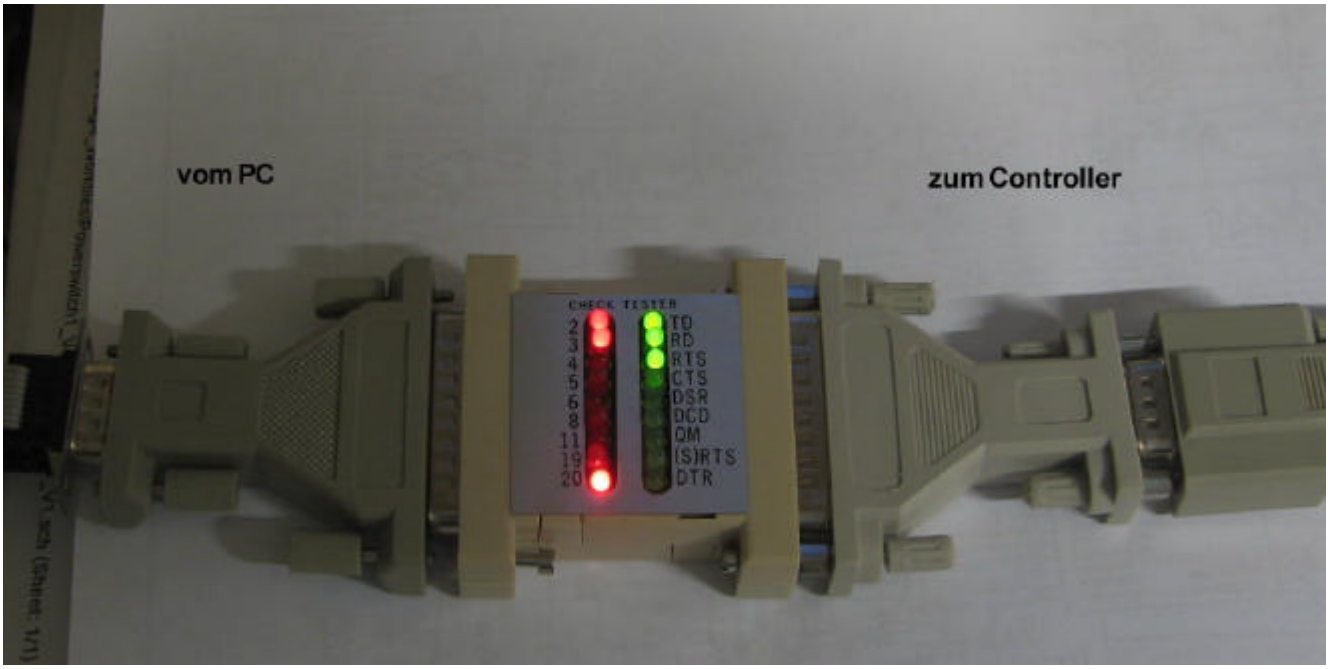
10.3. Connect PC an Controller together to the serial tester:

On the PC is with the tool (MCS-Tool-Programm) already not aktivated. The controller has power. Four green LEDs "TD", "RD", "RTS" and "DTR" are emitting.

10.4. PC and controller are connected. Activate the program "MCS-Tools":

When activating the serial connection in the program "MCS-Tools", the red LED "DTR" must be emitting and the grenn LED "DTR" must lapsed.

10.5. Active Datas between PC and controller:



Select in the program "MCS-Tools" the segment test. Continously are Datas between PC and controller transmitted. In case the red LEDs from "TD" and "RD" are emitting.