I²C Control Boards for Large Screen Monitors

ETV/AN95004

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Application Note ETV/AN95004

Abstract

This report describes the printed circuit board lay out of the I²C micro controller board and the user interface board that can be used in large screen monitors.

Purchase of Philips I^2C components conveys a license under the I^2C patent to use the components in the I^2C system, provided the system conforms to the I^2C specifications defined by Philips.

APPLICATION NOTE

I²C Control Boards

ETV/AN95004

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Keywords

I²C Control
Micro Controller
User Interface
Display
Alignment
Mode Control

Date: 16th August, 1995

Pages: 23

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Summary

The I²C control and alignment of the large screen monitors is put on two separate printed circuit boards. This report describes both the I²C control board (with the 87C52 micro controller) and the user interface board (with push button keys and an LED display).

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1. INTRODUCTION.

This report describes the circuit of the latest version of the I²C micro controller circuit (consisting of two boards, the micro controller board and the push button and LED display board). Although these boards are universally suited for I²C applications, they have been adapted for use in the large screen HR-Monitor. For future use the board is assembled with several connectors that are not used at present. (auto mode selection and remote control).

2. I²C MICRO CONTROLLER BOARD.

All adjustable functions of the monitor can be controlled by I²C, except:

- SMPS output voltage
- Vg2 and focus voltages
- Horizontal linearity
- Vertical axis parabola
- Vertical axis tilt

The first two functions are not controlled by I²C for safety reasons and the last four for practical reasons.

Also for practical reasons it is possible to adjust the Earth magnetic field settings either via I²C control or with potentiometers. For practical reasons the manual setting for magnetic field sensitivity and biasing is suggested.

The micro controller board contains the following functions or parts:

- 87C52 micro controller
- PCF8598 E²PROM
- NE555 watchdog timer
- interface circuits for mode switching and μC status switching

The micro controller has the following functions

- I²C bus control
- Routines for the following I²C controlled IC's:

TDA8444N3	Octal DAC
TDA8432/33	Deflection processor
PCF8598	E²PROM
SAA1064	Quadruple 7 segment display driver
TDA4780	RGB-processor

- Routine for infra red remote control operation
- Routines for push button control
- Watchdog routine

The software is written by the Digital Control Group of PCALE.
The software has the following registration data:

- Project name: HDTVMON2.HEX
- Release number: V2.2
- ROM checksum: 3EDD

2.1 Remote Control.

Remote control can be done by connecting an RC5 compatible Infra Red module to connector K1 (e.g. module 3131 138 57101). The functions can be selected with the balance button(s) and the value of a certain function can be selected with the volume button(s).

Warning: *All functions can be modified via remote control. Original settings **will** be restored by pressing the green PP (personal preference) button. Making the changes permanent is only possible via the local push button panel with the "STORE" button.*

After switching off and back on, the set will start in the system (SY SX) where "STORE" was pushed last.

2.2 Push Button Control.

The I²C push button and LED display board (PR35322) is the user interface board.
All I²C IC's can be controlled via this panel. See paragraph 4 for detailed information.

2.3 Watchdog Timer.

Under normal conditions the I²C data is sent every few 100ms to the IC's. After a picture tube flash over or another electrostatic discharge the I²C data can be corrupted. Within a fraction of a second new data is sent and the picture will recover. If the micro controller program itself "crashes", the watchdog timer will reset the controller and normal operation will be continued. Every program cycle the micro controller resets the watchdog timer. If the program "crashes" the timer will not be reset by the controller and then the timer will reset the controller.

3. SELECTION POSSIBILITIES IN THE HR-MONITORS.

In the new monitor series a choice of components is offered. In the listing of the I²C control settings it is obvious that there is a choice between the use of the monolithic video processor TDA4780 series (or TDA4685/86) and the RGB processor TDA4882 with the TDA8444 digital to analog convertor. The used video processor is automatically detected by the micro controller.

There is also the possibility to add I²C controllable D/A convertors DAC2 and/or DAC3.
In the large screen HR monitor the presence of the Earth field compensation board[1] ensures that the second DAC is available. For optimal performance of the HR monitor the presence of this board is essential.

If the DAC's are not present the menu will not show functions 20-27 and 30-37 respectively.

TABLE 1 List of the used I²C Controlled IC's.

Device	Function	Slave Address
TDA8432M	Deflection controller	8C
TDA8444 (1)	Black level/White point adjustment	40
TDA8444 (2)	DAC-2 Earth field & EHT Compensation	42
TDA8444 (3)	DAC-3	44
TDA4780	RGB Processor	88
PCF8598	Non-volatile memory	A0 & A2
SAA1064	LED display driver	70

There can be up to five different monitor settings; SYS0 to SYS2 are used for the 31 - 33 kHz modes. And SYS3 and SYS4 are reserved for the 33 - 36 kHz mode.

4. USER INTERFACE BOARD.

All I²C functions can be controlled via this board. The left two digits of the 7 segment display will show the function number and the right two digits represent the value of that function. A complete list of display possibilities with their meaning and range is given below.

With the SY function five display modes can be selected. Each of these five modes has a complete set of functions for optimal performance. The last stored mode is recalled after power on.

ERROR CODES:	01	EEprom data error
	8C	TDA8432M does not acknowledge
	A0	EEprom does not acknowledge
	A2	EEprom does not acknowledge

When more then one error is detected, all errors are shown sequentially at a rate of 1 error per second.

This is the complete list of all error codes. The first time the set is powered up with an empty E²PROM, the micro controller will send the default values to the IC's and show "ER 01". The desired values can be entered one by one with the function and value select keys and then stored to the E²PROM by pressing "STORE". A faster method is a to make a copy with an external controller of another E²PROM from a monitor which is already adjusted. Then only minor changes are to be expected.

The Mode switches on the user interface board are not used with the latest software (HDTVMON1.HEX V2.2). The µController detects the IC's that are presently used in the monitor and adapts the functions as given in table 2, see also paragraph 3.

In Fig.1 the front view of the user interface board is shown. Since this board was originally designed to fit into a special cabinet, therefore the positioning of the push button keys for function and value may seem illogical. For this reason the correct position of the function and value displays and the push button keys is shown here.

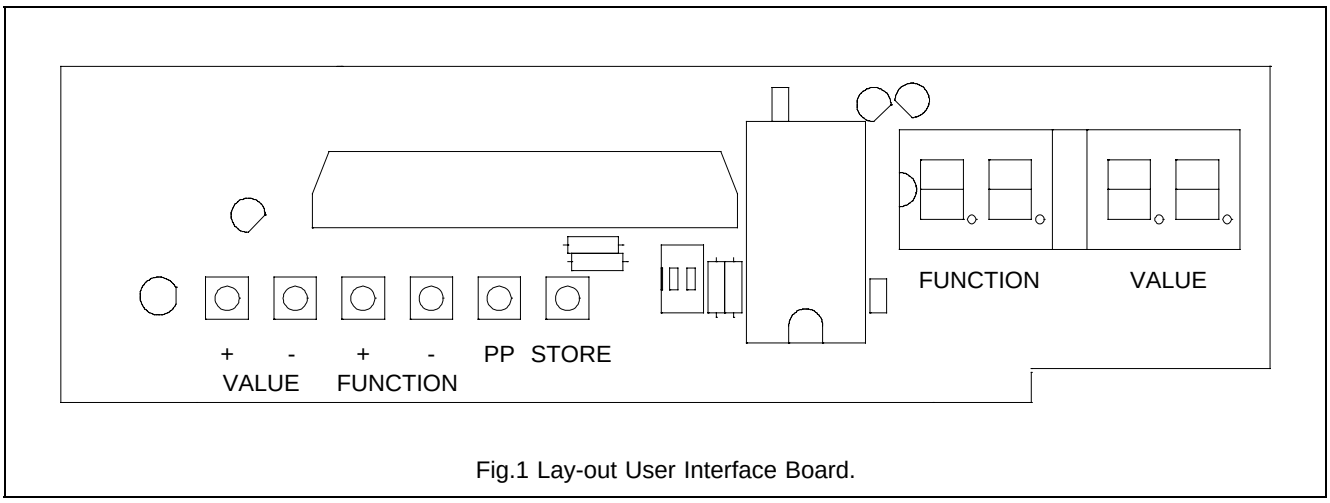

Fig.1 Lay-out User Interface Board.

The corresponding actions are given in table 2 paragraph 4.1. In this table the display setting and corresponding functions are given.

4.1 List of Parameter Settings for the HR Monitors.

TABLE 2 Parameter Settings for the New HR-Monitor Series.

Function	Display	min	max	default
System	SY	S0	S4	S0
TDA4780				
Brightness	BR	00	63	31
Contrast	CO	00	63	31
Saturation	SA	00	63	31
Hue	HU	00	63	31
Red ref	00	00	63	31
Green ref	01	00	63	31
Blue ref	02	00	63	31
Red gain	03	00	63	31
Green gain	04	00	63	31
Blue gain	05	00	63	31
Peak white limit	06	00	63	31
Gamma	07	00	63	31
NMEN	40	00	01	00
BREN	41	00	01	00
DELOF	42	00	01	01
SC5	43	00	01	00
FSON1	44	00	01	00
FSDIS1	45	00	01	00
FSON2	46	00	01	00
FSDIS2	47	00	01	00
BCOF	48	00	01	00
FSBL	49	00	01	00
MOD2	50	00	01	00
YHI	51	00	01	01
YEXH	52	00	01	01
ADBL	53	00	01	00
TCPL	54	00	01	00
BLST	56	00	01	00
HDTV	57	00	01	00
RELC	58	00	01	00
TEST	59	00	01	00
TDA4881/8444				
Brightness	BR	00	63	31
Contrast	CO	00	63	31
Red ref	00	00	63	31
Green ref	01	00	63	31
Blue ref	02	00	63	31
Green gain	03	00	63	31
Blue gain	04	00	63	31
SPARE DAC	05	00	63	31

Function	Display	min	max	Default
TDA8432M				
Hor. compensation	08	00	31	15
Vert. compensation	09	00	31	15
Hor. frequency	10	00	63	31
Hor. phase	11	00	63	31
Hor. amplitude	12	00	63	31
East/West parabola	13	00	63	31
East/West corner	14	00	63	31
Trapezoid	15	00	63	31
Vert. amplitude	16	00	63	31
Vert. linearity	17	00	63	31
Vert. S-correction	18	00	63	31
Vert. DC-shift	19	00	63	31
DAC2 TDA8444				
Horizontal tilt	20	00	63	31
N/S trapezoid	21	00	63	31
Earth field bias	22	00	63	31
Magn. sensitivity	23	00	63	31
EHT Compensation	24	00	63	31
DAC2-5	25	00	63	31
DAC2-6	26	00	63	31
Hsize PECOMA	27	00	63	31
DAC3 TDA8444				
DAC3-0	30	00	63	31
DAC3-1	31	00	63	31
DAC3-2	32	00	63	31
DAC3-3	33	00	63	31
DAC3-4	34	00	63	31
DAC3-5	35	00	63	31
DAC3-6	36	00	63	31
DAC3-7	37	00	63	31

5. SCHEMATIC DIAGRAMS AND PARTS LISTS.

In this chapter the circuit diagrams of the micro controller board and the user interface board are shown. In paragraph 5.2 a possible board lay out is given for the micro controller board.
In paragraph 5.5 the board lay out of the user interface board that is at present used in the HR monitors is given. From an ergonomic point of view the lay out of the user interface board is not logical. This board was especially designed to fit in an existing cabinet. It has not been adapted for other cabinets since.

5.1 Micro Controller Board Circuit Diagram.

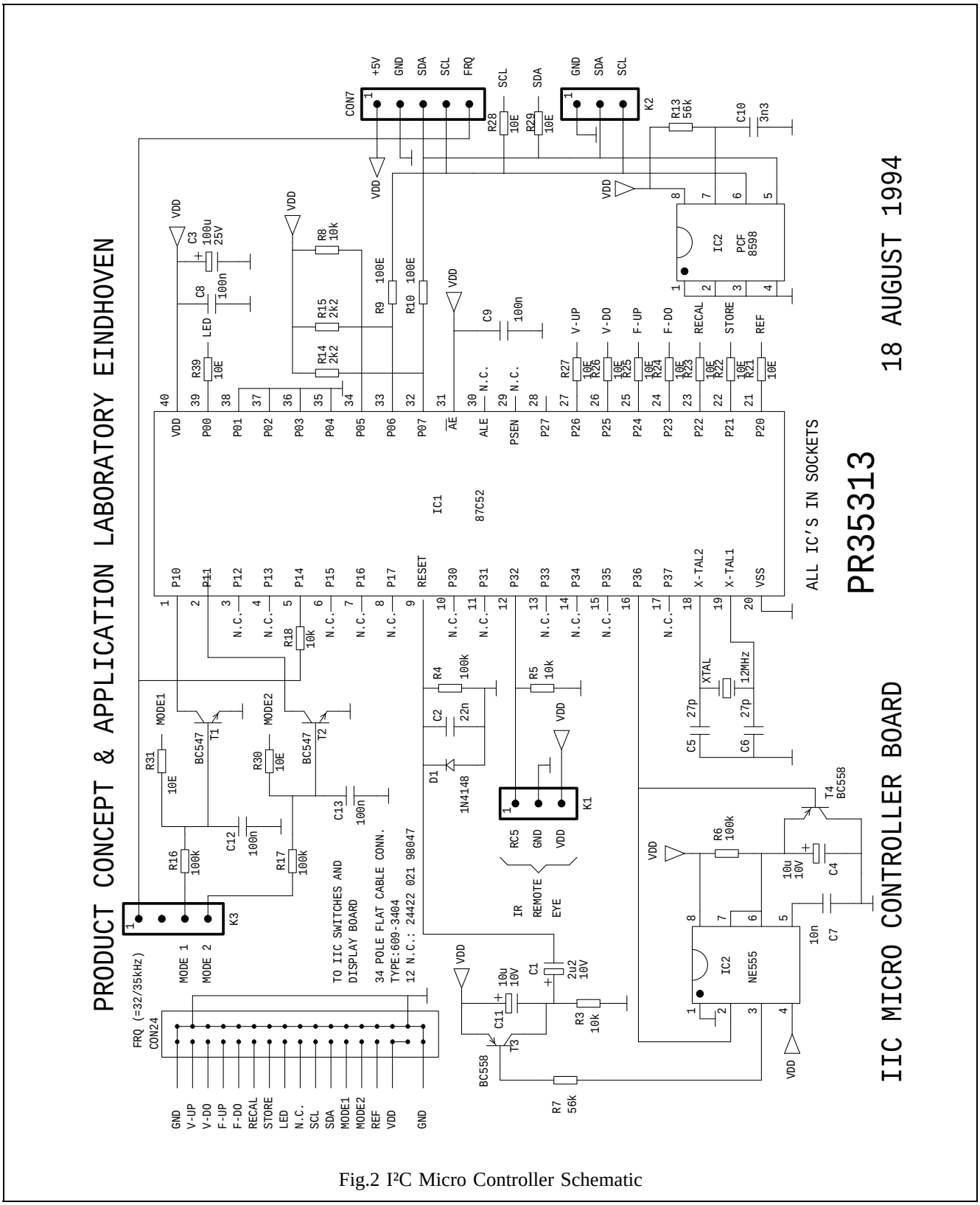

Fig.2 I²C Micro Controller Schematic

5.2 Micro Controller Board Lay-Out.

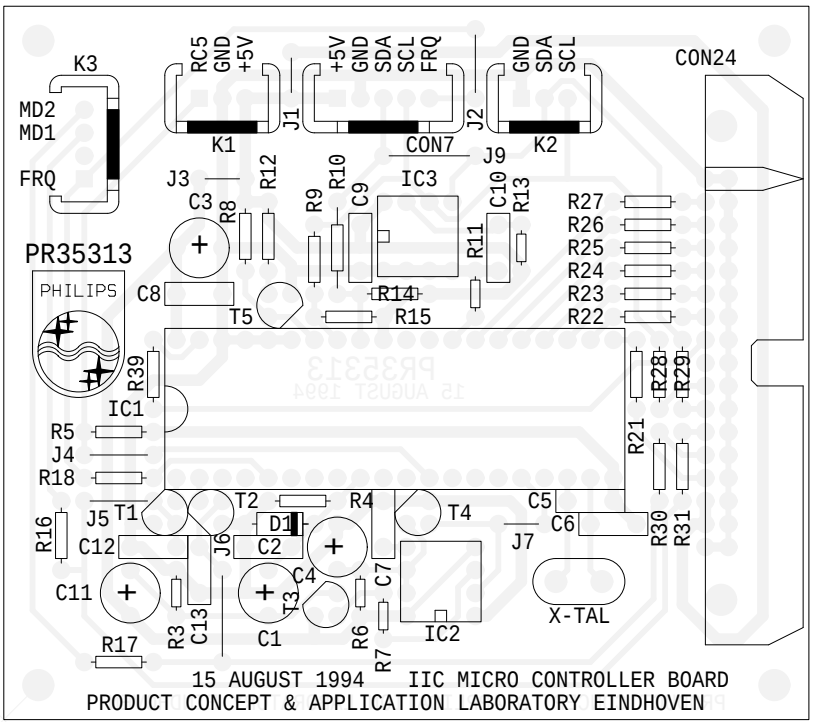

Fig.3 I²C Micro Controller Component Placement (Numbers)

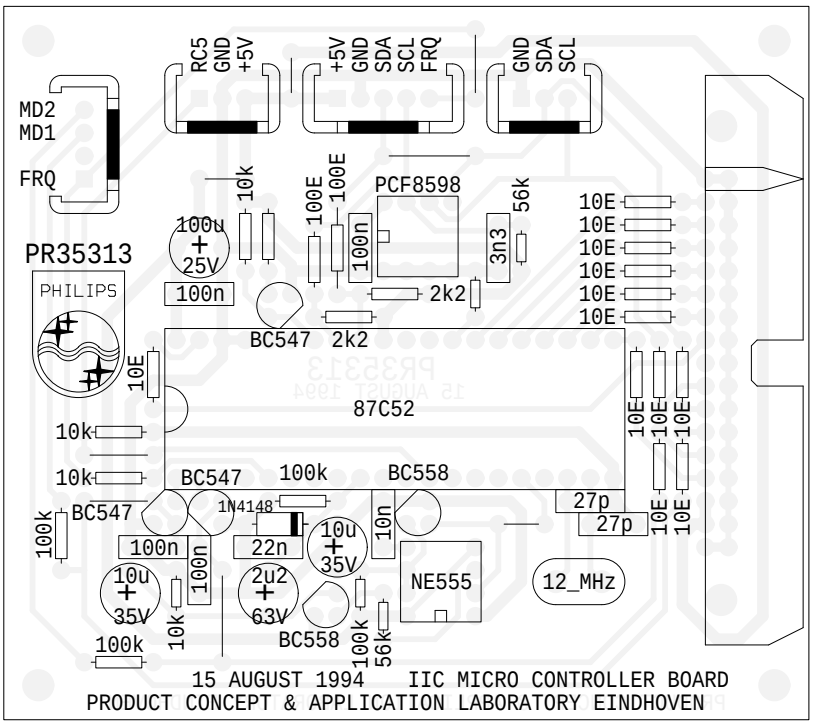

Fig.4 I²C Micro Controller Component Placement (Values)

5.3 Micro Controller Board Parts Lists.

P A R T S - L I S T
I²C MICRO CONTROLLER BOARD
PR35313

Ceramic capacitors

Component	Value	Type	12 n.c.	Number
C5 C6	27p	500V	2222-655-03273	2
C10	3n3	100V	2222-630-03332	1

Film capacitors

Component	Value	Type	12 n.c.	Number
C2	22n	100V	2222-370-21223	1
C7	10n	100V	2222-370-41103	1
C8 C9 C12 C13	100n	63V	2222-370-11104	4

Electrolytic capacitors

Component	Value	Type	12 n.c.	Number
C1	2u2 63V	63V	2222-037-58228	1
C3	100u 25V	25V	2222-037-90047	1
C4 C11	10u 35V	35V	2222-037-51109	2

Integrated circuits

Component	Value	Type	12 n.c.	Number
IC1	87C52	uController		1
IC2	NE555	Timer		1
IC3	PCF8598E	Non-volatile memory		1

Transistors

Component	Value	Type	12 n.c.	Number
T1 T2 T5	BC547	TO92	9331-976-10112	3
T3 T4	BC558	TO92	9331-977-30112	2

P A R T S - L I S T
I²C MICRO CONTROLLER BOARD
PR35313

Resistors

Component	Value	Type	12 n.c.	Number
R3 R5 R8 *R18*	10k	SFR16	2322-180-**103	4
R4 R6 R16 R17	100k	SFR16	2322-180-**104	4
R7 R13	56k	SFR16	2322-180-**563	2
R9 R10	100E	SFR16	2322-180-**101	2
R11 R12	do not place			
R14 R15	2k2	SFR16	2322-180-**222	2
R21 R22 R23 R24 R25 R26 R27 R28 R29 R30 R31 R39	10E	SFR16	2322-180-**109	12

Connectors

Component	Nr. of pins	Type	12 n.c.	Number
K1 K2	3	3 Pin Stocko connector		2
K3	4	4 Pin Stocko connector		1
CON7	5	5 Pin Stocko connector		1
CON24	34	34 Pins flat cable connector	2442-021-98047	1

Diodes

Component	Value	Type	12 n.c.	Number
D1	1N4148	SOD81	9330-839-90153	1

Miscellaneous

Component	Value	Type	12 n.c.	Number
J1 J3 J7		JUMPER2E		3
J2 J4 J5		JUMPER3E		3
J6 J9		JUMPER4E		2
X-TAL	12_MHz	XTAL		1
Screw	M2.5	10mm	2522 004 08139	2
Nut	M2.5		2522 401 64064	2
PCB	PC board PR35313			1

5.4 I²C User Interface Board Circuit Diagram.

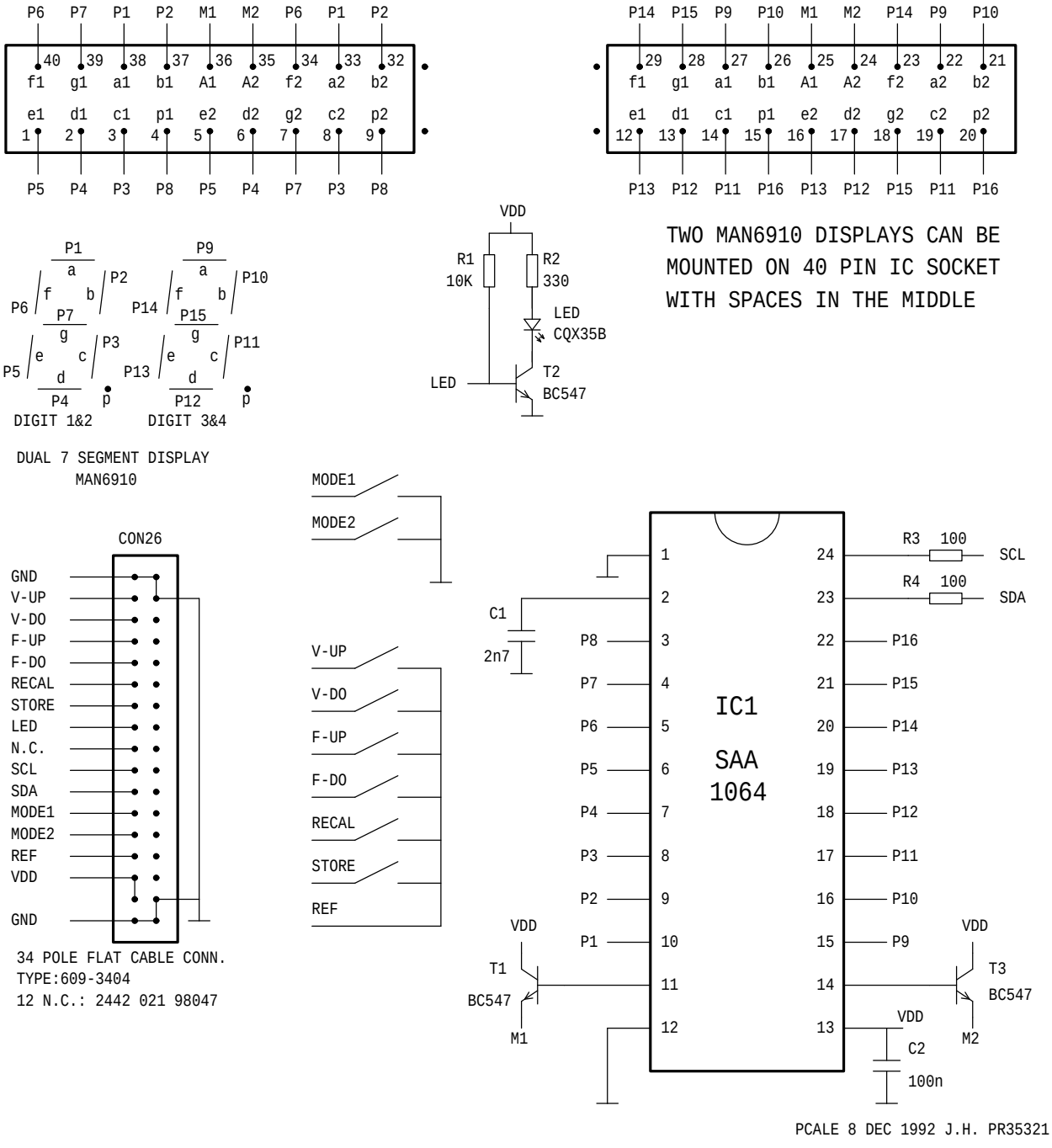

Fig.5 I²C User Interface Board Schematic

5.5 I²C User Interface Board Layout.

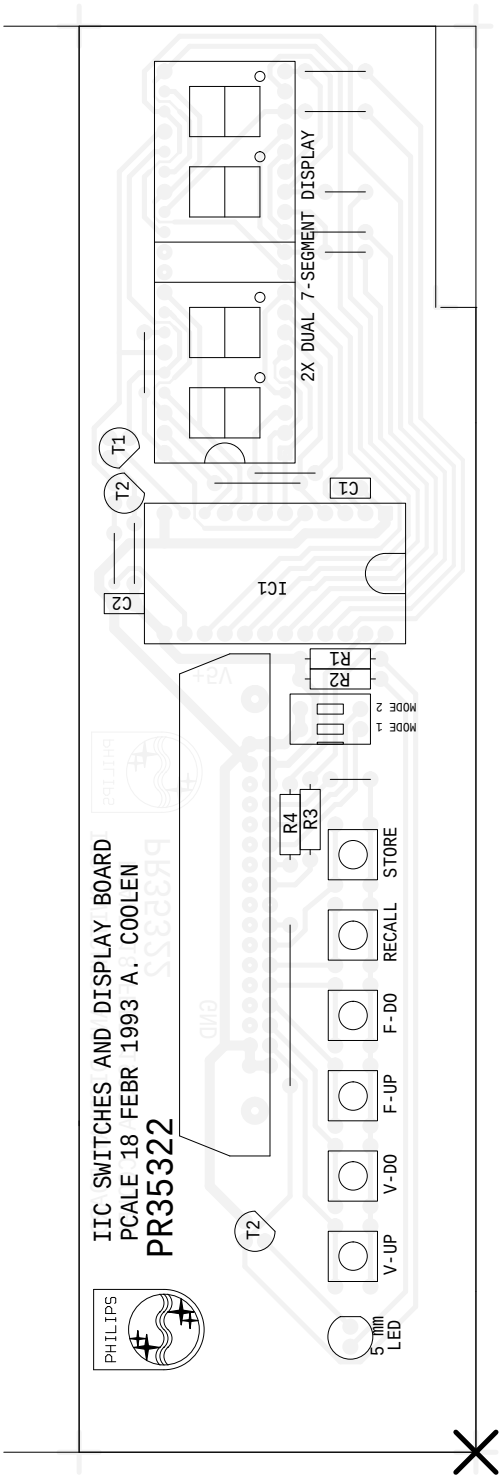

Fig.6 I²C User Interface Board Component Placement (Numbers)

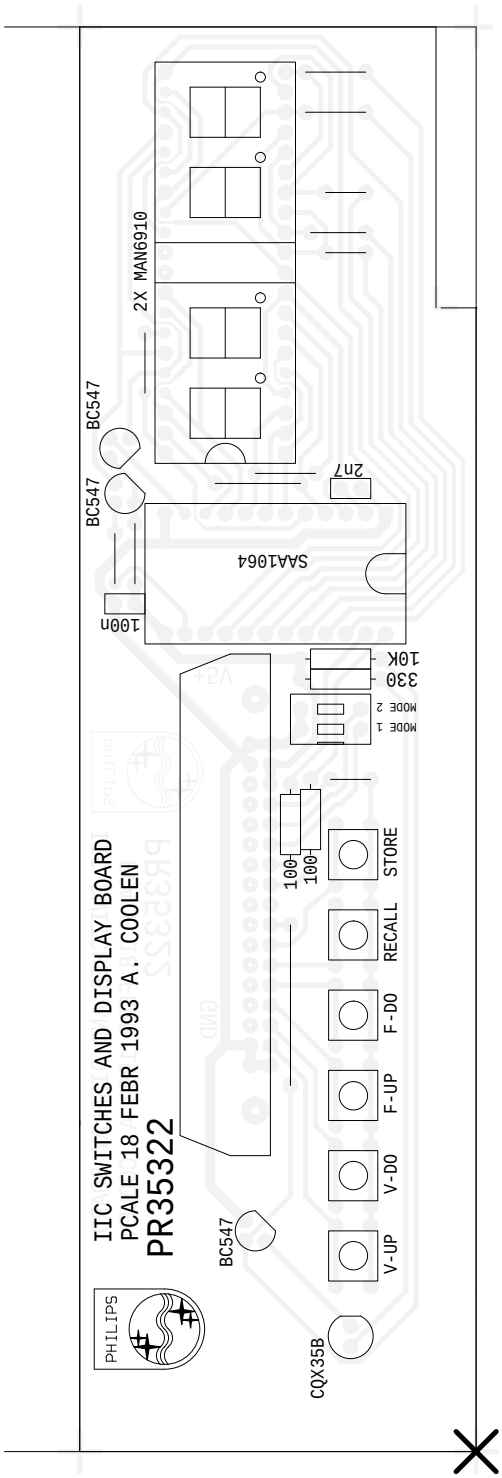

Fig.7 I²C User Interface Board Component Placement (Values)

5.6 I²C User Interface Board Parts Lists.

P A R T S - L I S T
I²C USER INTERFACE BOARD
PR35322

Resistors

Component	Value	Type	12nc	Number
R1	10k	SFR25H	2322 186 *3103	1
R2	330E	SFR25H	2322 186 *3331	1
R3 R4	100E	SFR25H	2322 186 *3101	2

Film capacitors

Component	Value	Voltage	12nc	Number
C2	100n	63V	2222-370-11104	1

Ceramic capacitors

Component	Value	Voltage	12nc	Number
C1	2n7	100V	2222 630 02272	1

Diodes

Component	Type	Remark	12nc	Number
LED	CQX35B			1

Transistors

Component	Type	Remark	12nc	Number
T1 T2 T3	BC547		9331 976 10112	3

Integrated circuits

Component	Type	Remark	12nc	Number
IC1	SAA1064	I²C display driver	9339 735 30112	1

P A R T S - L I S T
I²C USER INTERFACE BOARD
PR35322

Pin connectors

Component	Type	12nc	Number
CON26	34 pins Flat cable connector	2442 021 98047	1

Miscellaneous

Article	Description	12 n.c.	Number
PCB	PCALE Nr. PR35322		1
Mode 2 Mode 3	Turn-switch		2
Switch	Push-switch	5722 650 14003	6
Cover	Switch-cover	5722 650 13711	5
Dual 7-segment display	MAN6910		2
Screw	M2.5 x 10mm	2522 004 08139	2
Nut	M2.5	2522 401 64064	2

5.7 Total Parts List in Numerical Order for Boards PR35313 and PR35322.

A total overview of the components on PR35313 in numerical order.

Capacitors

C1	2u2 63V
C2	22n
C3	100u 25V
C4	10u 35V
C5	27p
C6	27p
C7	10n
C8	100n
C9	100n
C10	3n3
C11	10u 35V
C12	100n
C13	100n

Connectors

CON7	5 Pin Connector
CON24	34 Pole Flat Cable Connector 309-34-2
K1	3 Pin Connector
K2	3 Pin Connector
K3	4 Pin Connector

Resistors

R3	10k
R4	100k
R5	10k
R6	100k
R7	56k
R8	10k
R9	100E
R10	100E
R11	do not place
R12	do not place
R13	56k
R14	2k2
R15	2k2
R16	100k
R17	100k
R18	10k
R21	10E
R22	10E
R23	10E
R24	10E
R25	10E
R26	10E
R27	10E
R28	10E
R29	10E
R30	10E
R31	10E
R39	10E

Transistors

T1	BC547
T2	BC547
T3	BC558
T4	BC558
T5	BC547

Crystal

X-TAL	12_MHz

Integrated Circuits

IC1	87C52
IC2	NE555
IC3	PCF8598

Diodes

D1	1N4148

A total overview of the components on PR35322 in numerical order.

Resistors

R1	10k
R2	330E
R3	100E
R4	100E

Capacitors

C1	2n7
C2	100n

Diodes

LED	CQX35B

Transistors

T1	BC547
T2	BC547
T3	BC547

Integrated circuits

IC1	SAA1064

Connectors

CON26	34 Pole Flat Cable Connector 309-34-2

6. ACKNOWLEDGMENT.

This project was done with help of the following people:

A. Coolen	PC board layout, schematics and parts lists.
T. v.d. Weyst	Development I²C software and hardware.
F. v.d. Zanden	Mounting PC boards and demo board assembly.

7. REFERENCES.

1. ETV/AN95009 Earth Magnetic Field Compensation by J.J. Hekker