

PAMS Technical Documentation

RAE-2 Series PDA Phone

Chapter 4

UIF Module BS2

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Introduction

This document describes the RAE-2 UI module BS2. The module comprises PDA LCD display and function keys and all CMT UI electronics except the audio components.

Technical Summary

The following sections of circuitry are included in the BS2 UI module:

- External components of BC2 CMT LCD module
- External components of PDA LCD display
- Backlighting circuit of CMT LCD display and keyboard
- PDA display backlighting circuit
- PDA function keyboard and CMT keyboard switch matrices including key dome sheets (3 pcs)
- RF coaxial cable connector and antenna clip

Other parts covered in this document:

- BC2 CMT LCD module
- PDA LCD display
- PDA LCD display EL backlighting panel
- CMT LCD display and keyboard EL backlighting panel

Technical Specifications

DC Characteristics

Pin / Conn.	Line Symbol	Parameter	Minimum	Typical / Nominal	Maximum	Unit	Notes
1/X700	VPDA	Filtered battery voltage from PDA	3.0	3.6	4.1	V	
				0		mA	PDA and CMT LCD backlights OFF
			13		30	mA	PDA LCD backlight ON
			7		15	mA	CMT LCD backlight ON
3/X700	VBB	Regulated baseband voltage	2.7	2.8	2.85	V	
					300	μA	
42/X700	V17_i4	PDA LCD intermediate bias voltage	1.3	1.5	1.7	V	1/13xV17_OUT Throughout the whole temperature range
			1.4	1.5	1.6	V	At +20°C
43/X700	V17_i3	PDA LCD intermediate bias voltage	2.6	3.0	3.3	V	2/13xV17_OUT Throughout the whole temperature range
			2.9	3.0	3.2	V	At +20°C
44/X700	V17_i2	PDA LCD intermediate bias voltage	13.5	16.4	18.6	V	11/13xV17_OUT Throughout the whole temperature range
			15.4	16.4	17.4	V	At +20°C
45/X700	V17_i1	PDA LCD intermediate bias voltage	14.7	17.9	20.3	V	12/13xV17_OUT Throughout the whole temperature range
			16.8	17.9	19.0	V	At +20°C
47/X700	V17_OUT	PDA LCD bias voltage	16.0	19.4	22.0	V	Throughout the whole temperature range
			18.2	19.4	20.6	V	At +20°C

Pin / Conn.	Line Symbol	Parameter	Minimum	Typical / Nominal	Maximum	Unit	Notes
49/X700	V28_1	PDA LCD logic supply voltage	2.7	2.8	2.85	V	
				0.3	2.0	mA	
5,7,9,31,34,36,38,41,46,51/X700	GND			0		V	

AC Characteristics

Pin / Conn.	Parameter	Minimum	Typical / Nominal	Maximum	Unit	Notes
6,7/N700	Frequency	152	158	165	Hz	Differential measurement between the pins, NOT between pin and ground
	Peak-to-peak voltage	155	164	175	V	
	RMS voltage	58	63	70	V	
6,7/N730	Frequency	148	156	168	Hz	Differential measurement between the pins, NOT between pin and ground
	Peak-to-peak voltage	160	164	170	V	
	RMS voltage	61	65	70	V	
X790, X791	Transmitter frequency	890		915	MHz	
	Receiver frequency	935		960	MHz	

Interface to BS1 PDA Module

Pin	I/O	Line Symbol	Parameter	Minimum	Typical / Nominal	Maximum	Unit	Notes	
1		VPDA	Filtered battery voltage from PDA	3.0	3.6	4.1	V		
					0		mA		PDA and CMT backlights OFF
				13		30	mA		PDA LCD backlight ON
				7		15	mA		CMT LCD backlight ON
2	O	PWRKEYx	Power on key	0		0.3xVBB	V	Low, Power key pressed High	
3		VBB	Regulated baseband voltage	2.7	2.8	2.85	V		
						300	μA		

Pin	I/O	Line Symbol	Parameter	Minimum	Typical / Nominal	Maximum	Unit	Notes
4	I	LCDRSTx	CMT LCD driver reset	0 0.7xVBB		0.3xVBB VBB	V	Low, Reset active High, Reset inactive
5		GND			0		V	
6	I	GENSDIO	CMT LCD driver serial data	0 0.7xVBB		0.3xVBB VBB	V	Low High
				0		4.0	MHz	
7		GND			0		V	
8	I	GENSCLK	CMT LCD driver bus clock	0 0.7xVBB		0.3xVBB VBB	V	Low High
				0	3.2	4.0	MHz	
9		GND			0		V	
10	I	LCDSCx	CMT LCD driver chip select	0 0.7xVBB		0.3xVBB VBB	V	Low, Chip selected High, Chip unselected
11	I	LCDCD	CMT LCD driver command/data selection	0 0.7xVBB		0.3xVBB VBB	V	Low, Command High, Data
12	I	APP_COL0	PDA function keyboard column 0	0 0.7xVSY S		0.3xVSY S VSY S	V	Low High
13	I	APP_COL1	PDA function keyboard column 1	0 0.7xVSY S		0.3xVSY S VSY S	V	Low High
14	I	APP_COL2	PDA function keyboard column 2	0 0.7xVSY S		0.3xVSY S VSY S	V	Low High
15	I	APP_COL3	PDA function keyboard column 3	0 0.7xVSY S		0.3xVSY S VSY S	V	Low High
16	O	APP_ROW0	PDA function keyboard row 0	0 0.7xVSY S		0.3xVSY S VSY S	V	Low High
17	O	APP_ROW1	PDA function keyboard row 1	0 0.7xVSY S		0.3xVSY S VSY S	V	Low High
18	I	COL0	CMT Keyboard column 0	0 0.7xVBB		0.3xVBB VBB	V	Low High
19	I	COL1	CMT Keyboard column 1	0 0.7xVBB		0.3xVBB VBB	V	Low High

Pin	I/O	Line Symbol	Parameter	Minimum	Typical / Nominal	Maximum	Unit	Notes
20	I	COL2	CMT Keyboard column 2	0 0.7xVBB		0.3xVBB VBB	V	Low High
21	I	COL3	CMT Keyboard column 3	0 0.7xVBB		0.3xVBB VBB	V	Low High
22	I	COL4	CMT keyboard column 4	0 0.7xVBB		0.3xVBB VBB	V	Low High
23	O	ROW0	CMT keyboard row 0	0 0.7xVBB		0.3xVBB VBB	V	Low High
24	O	ROW1	CMT keyboard row 1	0 0.7xVBB		0.3xVBB VBB	V	Low High
25	O	ROW2	CMT keyboard row 2	0 0.7xVBB		0.3xVBB VBB	V	Low High
26	O	ROW3	CMT keyboard row 3	0 0.7xVBB		0.3xVBB VBB	V	Low High
27	I	CMT_BL_ON	CMT LCD and keyboard backlight enable	0 0.7xVBB		0.3xVBB VBB	V	Low, backlight OFF High, backlight ON
28	I	PDA_BL_ON	PDA LCD backlight enable	0 0.7xVSS		0.3xVSS VSS	V	Low, backlight OFF High, backlight ON
29	I	LCDD3	PDA LCD data, leftmost pixel	0 0.8xVSS		0.2xVSS VSS	V	Low High
30	I	LCDD2	PDA LCD data	0 0.8xVSS		0.2xVSS VSS	V	Low High
31		GND			0		V	
32	I	LCDD1	PDA LCD data	0 0.8xVSS		0.2xVSS VSS	V	Low High
33	I	LCDD0	PDA LCD data, rightmost pixel	0 0.8xVSS		0.2xVSS VSS	V	Low High
34		GND			0		V	
35	I	SCK	PDA LCD bus clock	0 0.8xVSS		0.2xVSS VSS	V	Low High
				0	2.3	3.2	MHz	
36		GND	GND		0		V	

Pin	I/O	Line Symbol	Parameter	Minimum	Typical / Nominal	Maximum	Unit	Notes
37	I	LC	PDA LCD line pulse	0		0.2xVSY	V	Low
				0.8xVSY		S	VSYS	High
				0	13.6	20	kHz	
				870			ns	Pulse 'high' time
38		GND		0			V	
39	I	M	PDA LCD AC modulation	0		0.2xVSY	V	Low
				0.8xVSY		S	VSYS	High
				0	1		kHz	
40	I	FRM	PDA LCD frame pulse	0		0.2xVSY	V	Low
				0.8xVSY		S	VSYS	High
				0	67	100	Hz	
				75			μs	Pulse 'high' time
41		GND		0			V	
42		V17_i4	PDA LCD intermediate bias voltage	1.3	1.5	1.7	V	1/13xV17_OUT Throughout the whole temperature range
				1.4	1.5	1.6	V	At +20°C
43		V17_i3	PDA LCD intermediate bias voltage	2.6	3.0	3.3	V	2/13xV17_OUT Throughout the whole temperature range
				2.9	3.0	3.2	V	At +20°C
44		V17_i2	PDA LCD intermediate bias voltage	14.4	16.4	18.3	V	11/13xV17_OUT Throughout the whole temperature range
				16.1	16.8	17.4	V	At +20°C
45		V17_i1	PDA LCD intermediate bias voltage	15.8	17.9	19.9	V	12/13xV17_OUT Throughout the whole temperature range
				17.5	18.3	19.0	V	At +20°C
46		GND		0			V	
47		V17_OUT	PDA LCD bias voltage	17.1	19.8	21.6	V	Throughout the whole temperature range
				19.0	19.8	20.6	V	At +20°C

Pin	I/O	Line Symbol	Parameter	Minimum	Typical / Nominal	Maximum	Unit	Notes
48	I	LCD_ON	PDA LCD enable	0 0.8xV _{SY} S		0.2xV _{SY} S V _{SY}	V	Low High
49		V28_1	PDA LCD logic supply voltage	2.7	2.8	2.85	V	
					0.3	2.0	mA	
50	O	LCD_TEMP	PDA LCD temperature	0.2	0.9	2.5	V	Voltage range throughout the whole temperature range
				0.88	0.90	0.91	V	At +25°C
51		GND			0		V	

Note: V_{SY} is PDA system voltage used in BS1 module, min. 2.75 V, typ. 2.80 V, max. 2.85 V.

Interface to BS8 CMT Module

Conn.	Parameter	Minimum	Typical / Nominal	Maximum	Unit / Notes	Notes
X790, X791	Impedance		50		Ω	
	Transmitter frequency	890		915	MHz	
	Receiver frequency	935		960	MHz	
	Max. output power		2W (33 dBm)			

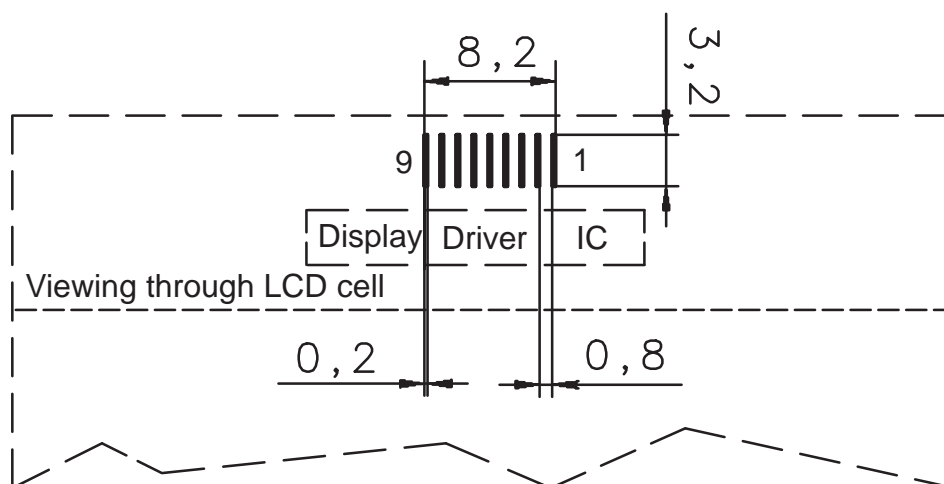
Interface to BC2 LCD Module

Pin	Line Symbol	Parameter	Minimum	Typical	Maximum	Unit	Notes
1	VBB	Supply voltage	2.7	2.8	2.85	V	
					300	μA	
2	GENSCLK	Serial clock input	0	3.2	4.0	MHz	
			0		0.3xV _{BB}	V	Low
			0.7xV _{BB}		V _{BB}	V	High
3	GENSDIO	Serial data input	0		0.3xV _{BB}		Low
			0.7xV _{BB}		V _{BB}		High
4	LCDCD	Control/display data flag input	0		0.3xV _{BB}		Low, Control
			0.7xV _{BB}		V _{BB}		High, Data
5	LCDCSx	Chip select input	0		0.3xV _{BB}		Low, Chip selected
			0.7xV _{BB}		V _{BB}		High, Chip unselected

Pin	Line Symbol	Parameter	Minimum	Typical	Maximum	Unit	Notes
6	OSC*	External clock for LCD	30.4	32.0	33.6	kHz	Connected to VBB on UI
7	GND	Ground		0		V	
8	VOUT	DC/DC voltage converter output		6.8	9		
9	LCDRSTx	Reset	0		0.3xVBB		Low, Reset Active
			0.7xVBB		VBB		High, Reset Inactive

* External oscillator is not used in BS2.

Connection layout diagram of interface to BC2 module



Interface to PDA LCD Display

Table 1. Interface to PDA LCD display, connector X730.

Pin	Line Symbol	Parameter	Minimum	Typical / Nominal	Maximum	Unit	Notes
1 2	V17_OUT	PDA LCD bias voltage	16.0	19.4	22.0	V	Throughout the whole temperature range
			18.2	19.4	20.6	V	At +20°C
3	V17_i1	PDA LCD intermediate bias voltage	14.7	17.9	20.3	V	12/13xV17_OUT Throughout the whole temperature range
			16.8	17.9	19.0	V	At +20°C

Table 1. Interface to PDA LCD display, connector X730. (continued)

Pin	Line Symbol	Parameter	Minimum	Typical / Nominal	Maximum	Unit	Notes
4	V17_i2	PDA LCD intermediate bias voltage	13.5	16.4	18.6	V	11/13xV17_OUT Throughout the whole temperature range
			15.4	16.4	17.4	V	At +20°C
5	V17_i3	PDA LCD intermediate bias voltage	2.6	3.0	3.3	V	2/13xV17_OUT Throughout the whole temperature range
			2.9	3.0	3.2	V	At +20°C
6	V17_i4	PDA LCD intermediate bias voltage	1.3	1.5	1.7	V	1/13xV17_OUT Throughout the whole temperature range
			1.4	1.5	1.6	V	At +20°C
7	GND			0		V	
8	GND			0		V	
9	V28_1		2.7	2.8	2.85	V	PDA LCD logic supply voltage
10	FRM	PDA LCD frame pulse	0		0.2xVSY	V	Low
			0.8xVSY		S		High
				70	100	Hz	
				75		µs	Pulse 'high' time
11	SCK	PDA LCD bus clock	0		0.2xVSY	V	Low
			0.8xVSY		S		High
				0	2.3	3.2	MHz
12	M	PDA LCD AC modulation	0		0.2xVSY	V	Low
			0.8xVSY		S		High
				0	2.5	3.4	kHz
13	LC	PDA LCD line pulse	0		0.2xVSY	V	Low
			0.8xVSY		S		High
				0	32	44.5	kHz
				870		ns	Pulse 'high' time

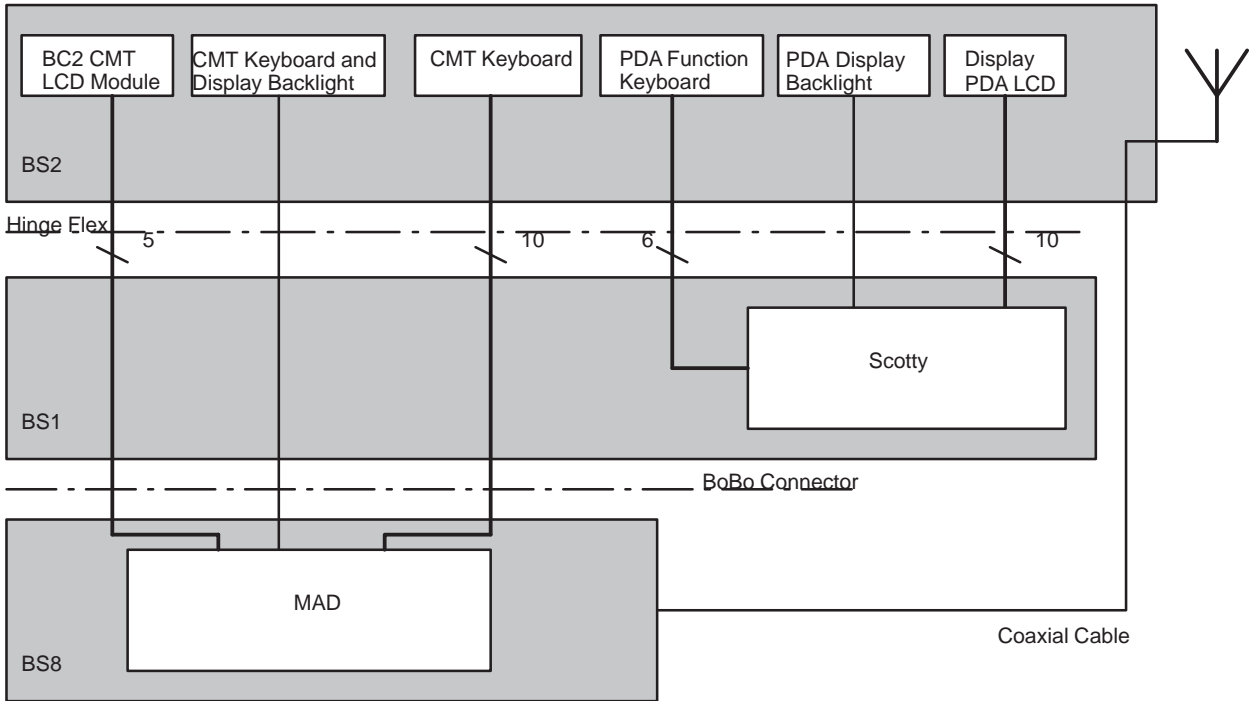
Table 1. Interface to PDA LCD display, connector X730. (continued)

Pin	Line Symbol	Parameter	Minimum	Typical / Nominal	Maximum	Unit	Notes
14	LCD_ON	PDA LCD enable	0 0.8xV _{SY} S		0.2xV _{SY} S V _{SY}	V	Low, Display OFF High, Display ON
15	LCDD3	PDA LCD data, leftmost pixel	0 0.8xV _{SY} S		0.2xV _{SY} S V _{SY}	V	Low High
16	LCDD2	PDA LCD data	0 0.8xV _{SY} S		0.2xV _{SY} S V _{SY}	V	Low High
17	LCDD1	PDA LCD data	0 0.8xV _{SY} S		0.2xV _{SY} S V _{SY}	V	Low High
18	LCDD0	PDA LCD data, rightmost pixel	0 0.8xV _{SY} S		0.2xV _{SY} S V _{SY}	V	Low High

Note: V_{SY} is PDA system voltage used in BS1 module, min. 2.75 V, typ. 2.80 V, max. 2.85 V.

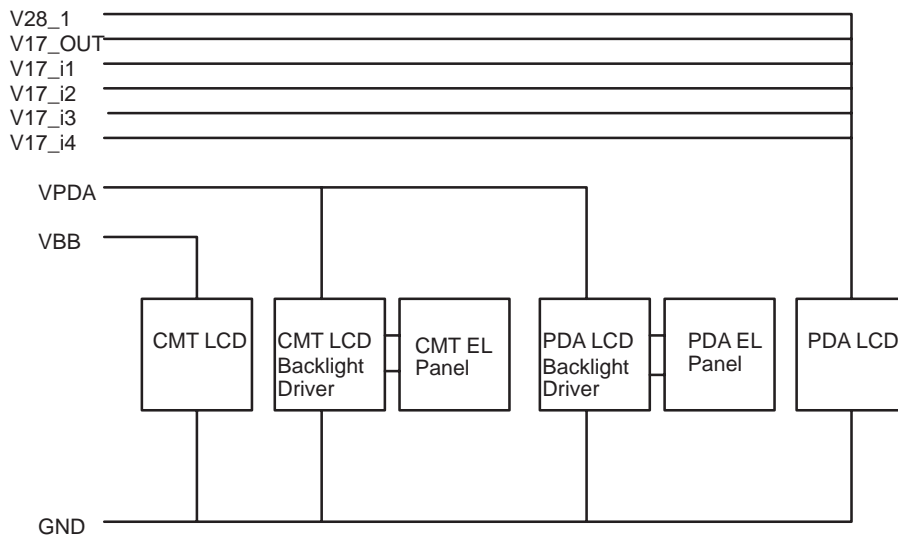
Signal number 1 is marked with a triangle in the connector X730.

Interconnection Diagram



Functional Description

Power Distribution Diagram



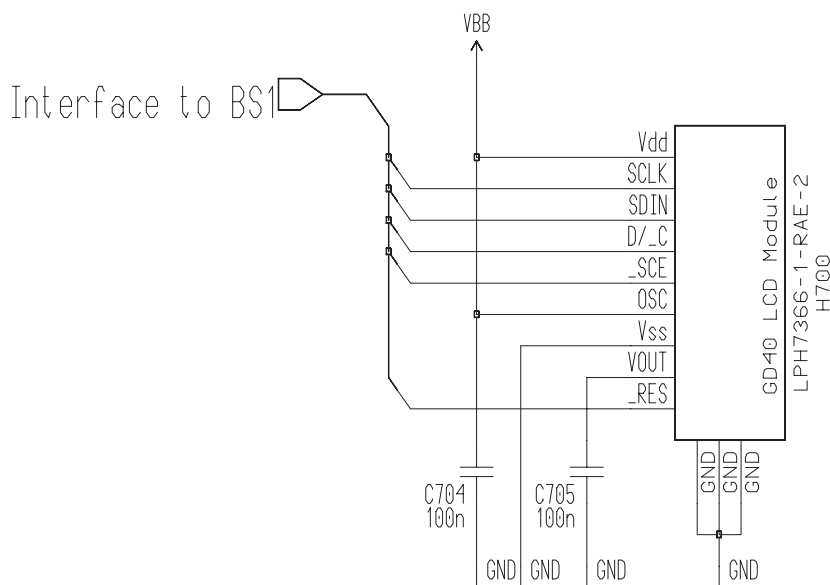
CMT LCD Display Circuit

The display circuit includes the LCD module BC2 and two capacitors. The LCD module uses COG (Chip On Glass) technology. The connection method for chip on the glass is ACF, Adhesive Conductive Film. The LCD module is electrically connected to UI board with gold wired elastomer. Two external capacitors are placed on UI PCB.

The display driver includes hw-reset, voltage tripler or quadrupler which depends on temperature, temperature compensating circuit and low power control. The driver includes a 84x48 RAM memory which is used for storing display data. The driver does not include character generator ROM. One bit in RAM is mapped directly to one pixel on display.

Main characteristics of the CMT LCD display:

- Display resolution: 84 x 48
- Viewing area: 34.96 x 23.50 mm
- Dot size: 0.31 x 0.37 mm
- Dot pitch: 0.345 x 0.405 mm
- Display type: Transflective black and white FSTN



Backlighting Circuit of CMT LCD And Keyboard

An electroluminescent (EL) panel is used for CMT LCD and keyboard backlighting. Electrically it can be considered as a capacitor. An inverter circuit is used to generate the high voltage AC to drive the EL panel. The inverter can be divided into two sections: power converter section and lamp driver section.

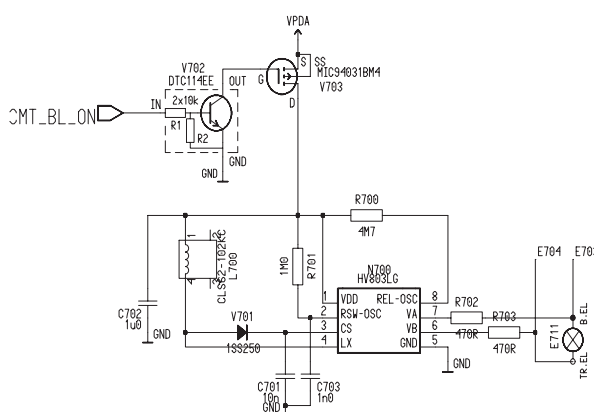
The power converter section employs a switch-mode converter to generate a voltage of maximum 90V. This voltage is connected to the EL panel through the lamp driver section, which changes the polarity of the output pins at a frequency that is set by one external resistor. Since the switch-mode converter's output is regulated to 90 volts at maximum, it is possible to achieve almost constant illuminance from the EL panel throughout the battery voltage range.

Connection between the EL panel and the PCB is a simple pressure contact. The frame of the CMT display module has two springs that press the EL panel against the pads on the PCB.

NOTE: The EL driver output voltage between pins 6 and 7 is over 150 V peak-to-peak. When making measurements, be sure that measuring equipment like oscilloscope, probe etc. have high enough voltage rating. There is no risk of getting a harmful or fatal electric shock due to low current driving capability of the inverter.

Table 2. CMT display illuminance measured with Tektronics J17 on the surface of the display lense.

Parameter	Minimum	Typical / Nominal	Maximum	Unit	Notes
Display illuminance	1.5		2.1	cd/m ²	Throughout the VPDA voltage range
	1.6	1.8	2.0	cd/m ²	VPDA = 3.5 V



PDA LCD Backlighting Circuit

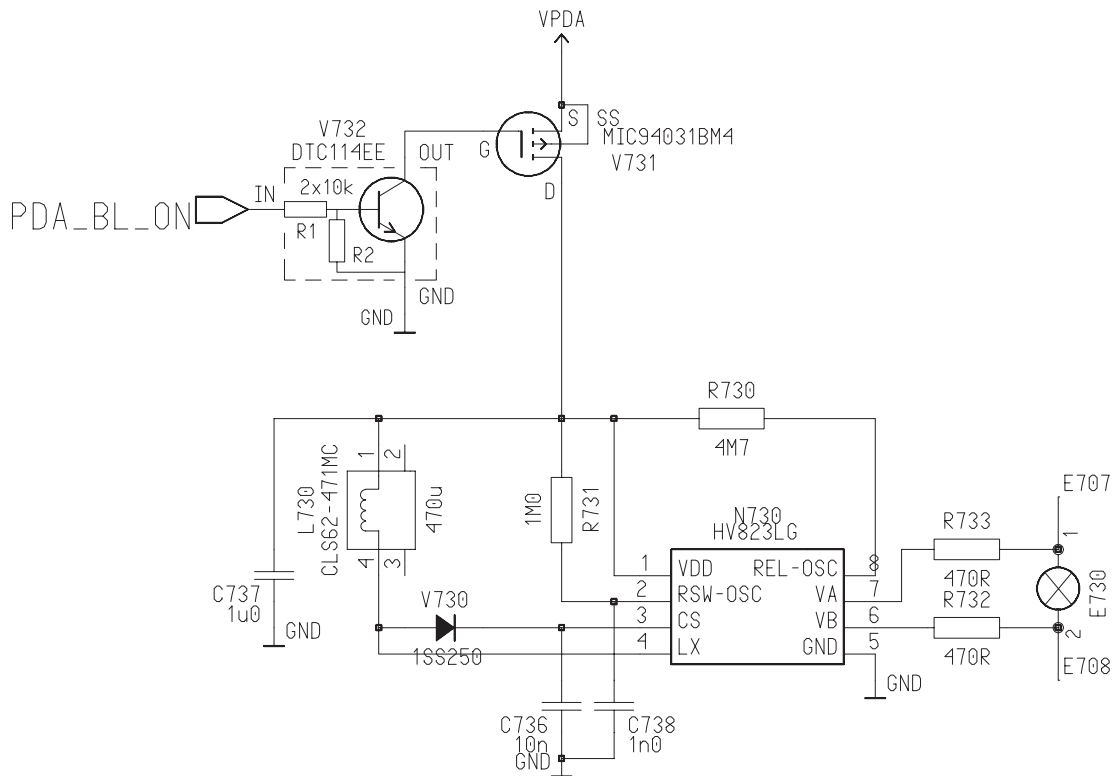
Electroluminescent (EL) panel is used for PDA LCD backlighting. The circuit is similar to the CMT keyboard and the display backlighting circuit, only some component values are different.

PDA display frame presses the EL panel contacts against the pads on PCB.

NOTE: The EL driver output voltage between pins 6 and 7 is over 150 V peak-to-peak. When making measurements, be sure that measuring equipment like oscilloscope, probe etc. have high enough voltage rating. There is no risk of getting a harmful or fatal electric shock due to low current driving capability of the inverter.

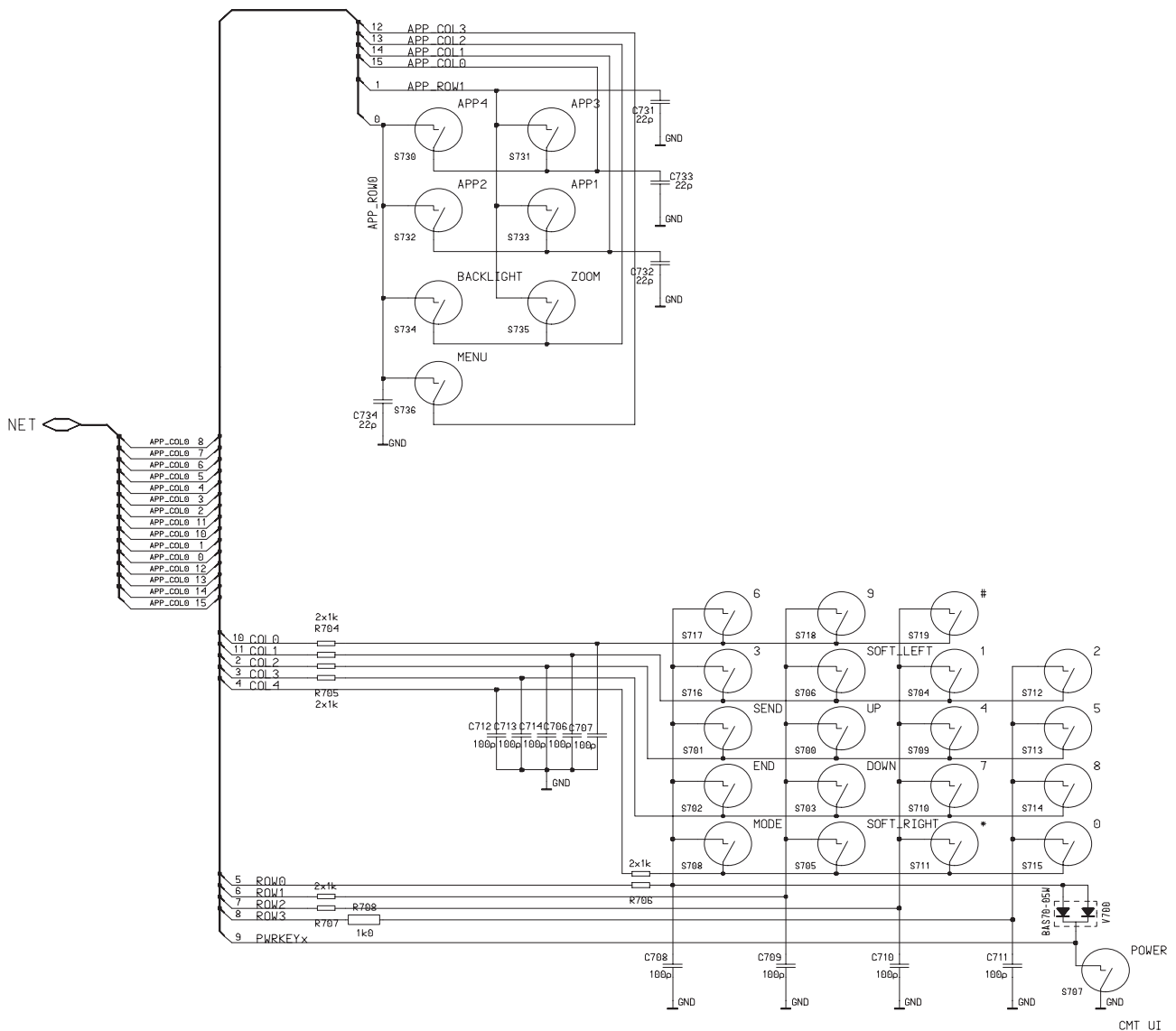
Table 3. PDA display illuminance measured with Tektronics J17 on the surface of the display.

Parameter	Minimum	Typical / Nominal	Maximum	Unit	Notes
Display illuminance	1.0		2.0	cd/m ²	Throughout the VPDA voltage range
	1.2	1.5	1.8	cd/m ²	VPDA = 3.5 V



PDA Function Keyboard And CMT Keyboard Circuit

There are 5 columns and 4 rows in the CMT keyboard matrix and 2 rows and 4 columns in the PDA function keyboard matrix. The power key is connected to the CMT row 0 through a diode, that prevents the POWER-KEYx line from being pulled down when the other keys are scanned. A normal keyboard scanning is used to read both matrices.



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