

Next Generation Intelligent LCD Panels

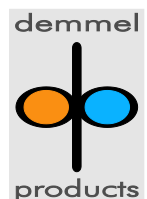
DPP-CTx3224 Series Specification

Version 1.4

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General Description

The iLCD modules are intelligent LCD panels which allow the user to carry out all graphic and font needs via an easy and comfortable way without having to deal with pixel addressing, low level functions or hardware details. Controlling the screen contents is done either via a serial port, I²C port, SPI port or via USB.

Features

Display Specific Data

Item	DPP-CTP3224-x	DPP-CT3224-x
Screen Size	3.5 inch	5.7 inch
Display Resolution	320 x RGB x 240 dots	
Dot Pitch	0.073 (H) x 0.219 (V) mm	0.12 (H) x 0.36 (V) mm
Active Area	70.08 (H) x 52.56 (V) mm	115.2(H) x 86.4(V) mm
Display Mode	Normally white/Transmissive	
Pixel Arrangement	RGB-Strip	
Display Color	16.7 M (Display) / 64k (Controller)	262 k (Display) / 64k (Controller)
Backlight 1)	White LED, typical lifetime 50.000 hours	White LED, typical lifetime 20.000 hours
Brightness typ.	220 cd/m ²	300 cd/m ²
Contrast ratio typ.	300	400
Viewing Direction	6 O'clock	
Touch Screen	4-wire resistive	

Note:

- Brightness decreased to be 50% of the initial value. Life time; mean time before failure at normal temperature(25°C) and normal humidity(60%)

Electrical Specific Data

Item	DPP-CTx3224	DPP-CTx3224-1
Connectivity	2 x RS-232 5V / I ² C / SPI	USB 2.0 / 1 x RS-232 5V / I ² C / SPI
I/O Ports	4 general purpose ports (10 bit ADC 0..Vcc or digital input or output), control for 2 relays outputs, keyboard with up to 128 keys, miscellaneous I/O ports	
Real-Time Clock	No	Yes
Flash Memory	2 MByte for fonts, graphics, macros and text templates	
RAM	No	1 MByte RAM for screen saving

Mechanical Specification

Item	DPP-CTP3224-x	DPP-CT3224-x	Unit
Module Dimension (without mounting ears)	76.9 x 63.9	126.0 x 101.55	mm
Module Dimension (inclusive mounting ears)	89.0 x 63.9	142.0 x 101.55	mm
Total Module Thickness	9.0	12.0	mm

Maximum Ratings

Item	Symbol	Minimum	Maximum	Unit
Supply Voltage	V_{CC}	-0.3	5.5	V
Input Voltage	V_{IN}	-0.3	3.3	V
Operating Temperature ¹⁾	T_{OPR}	-20	70	°C
Storage Temperature	T_{STR}	-20	80	°C
Humidity ²⁾		10	90	%RH

Note:

1. Lifetime of backlight LEDs will be decreased for temperatures $\geq 50^{\circ}\text{C}$
2. Temp. $\leq 60^{\circ}\text{C}$, 90% RH MAX.
Temp. $\geq 60^{\circ}\text{C}$, absolute humidity shall be less than 90% RH at 60°C

Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage	V_{CC}	-	4.75	5.0	5.25	V
Input Voltage H Level ¹⁾²⁾	V_{IH}	-	2.4	-	3.3	V
Input voltage L Level ¹⁾	V_{IL}	-	0.0	-	0.8	V
Output current ³⁾	I_{OUT}				3.5	mA
Current Consumption	I_{DD}	No ports active, B/L off		120 130 ⁴⁾		mA
B/L LED Current Consumption	I_{LED}	$V_{CC} = 5\text{V}$		100 395 ⁴⁾		mA

Note:

1. For digital inputs only
2. Digital inputs are 5-volt tolerant
3. For digital outputs
4. First value for DPP-CTP3224-x, second value for DPP-CT3224-x

Module Function Description

Important Information about the USB and the Serial Port

The DPP-CTx3224-1 contains a USB to serial bridge internally connected to the iLCD controller's serial port RX0/TX0. The drivers for this USB to serial bridge should be installed before the USB port is connected, the installation of these drivers is offered when the setups software is started the first time.

The USB port shows up as a virtual COM port in your Windows device manager (CP2102 USB bridge), you can modify the COM port name there. This COM port (e.g. COM4) has to be used for communicating with the iLCD panel (do not use "USB port" but "Serial port" in the "Preferences" section of your iLCD setup software) and defaults to 115200 Baud. If this virtual COM port does not show up in the "Serial port" combo-box in the "Preferences" section of the setup software, it's name has to be entered manually to enable the communication with the iLCD panel via the USB's virtual COM port.

Setting different baud rates than 115200 Baud can be done via the "Set Baud Rate" command (see the extra document "iLCD Commands") for serial port 0 until the next power up or reboot of the iLCD panel. The baud rate has to be set in the "Preferences" section of your iLCD setup accordingly. Changing the communication speed between the on board USB bridge and the iLCD controller's serial port permanently can be done in the "Setup" section via "Edit->Setup Data..." on the "Hardware" tab for "Baud Rate 0". After downloading this new setup data via the USB port to the iLCD panel, the baud rate of the setup software is changed automatically according to the new setting, a message box appears.

The free second serial port's (RX1/TX1) baud rate can be set in the same way, this port can be even completely disabled. In case of any misconfiguration possibly further disabling the communication via the USB bridge and/or the serial port, the evaluation board's "Erase" jumper can be set during power up (pulling the RX1 port low) to completely erase the flash user data. The default value of 115200 Baud on both serial ports (second serial port enabled) is reset then, the user data has to be re-written via the setup software then.

General Information about Port Pins

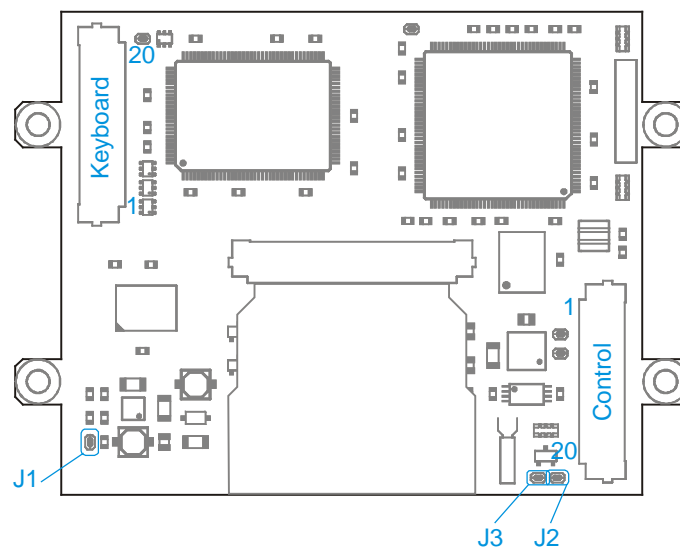
Most port pins can be used as outputs (push/pull or pull down only outputs), as keyboard column outputs or as digital inputs besides of their primary function. The assignment of these port pins must be done once via the setup software under "Edit->Setup Data..." on the hardware tab by pressing the "Pin Assignments..." button. The names of the pins described below refer to the primary function only, the notes show the alternative functionality.

Example:

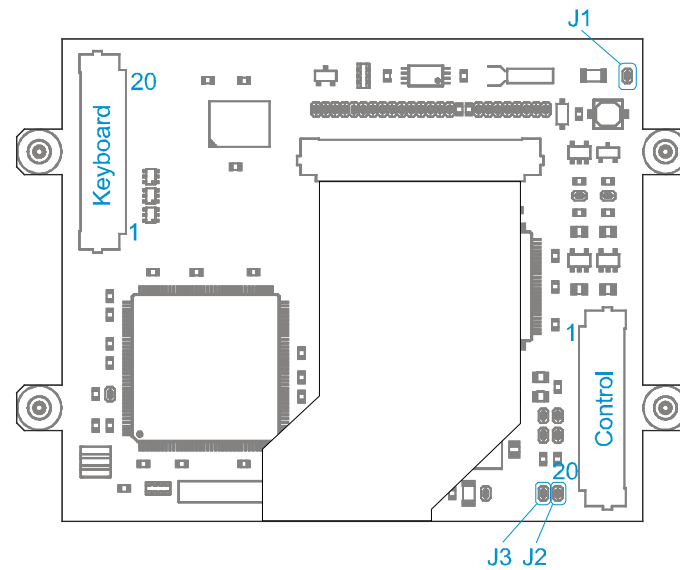
The serial port pins RX1 and TX1 on the "General Port Connector" are normally used for serial communication via 5V RS232. If you disable using the 2nd serial port, the function list for RX1 and TX1 changes and these pins can be used as inputs, outputs or keyboard column ports.

As the DPC3020 iLCD controller works with a power supply of 3.3V (a voltage-regulator for this voltage is on-board allowing the board to work with single 5V supply), push/pull outputs have a voltage swing of 0V ... 3.3V. Pull down outputs and digital inputs are 5 volt tolerant (with some exceptions, see the comments below) allowing to work with 5V systems as well.

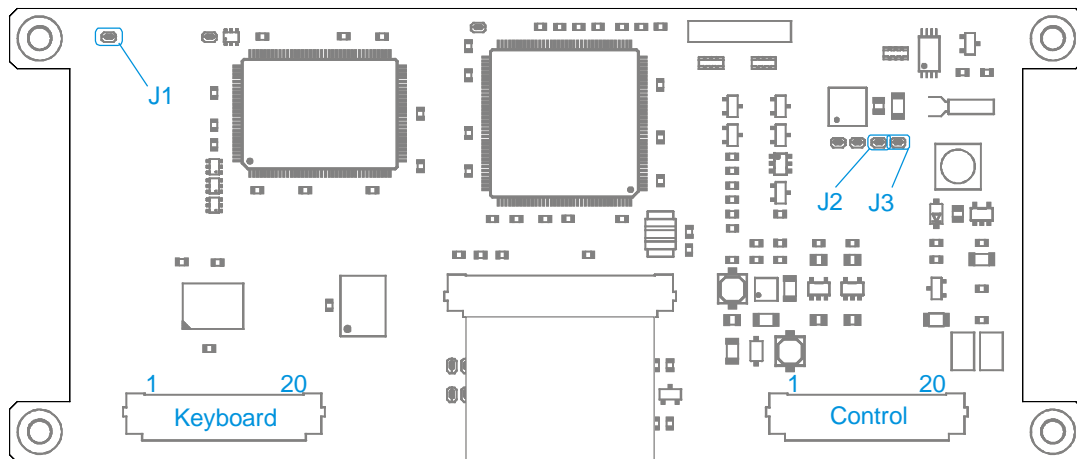
Pin Descriptions



DPP-CTP3224-x connections (view from P.C.B. side)



New layout DPP-CTP3224-x connections (view from P.C.B. side)



DPP-CT3224-x connections (view from P.C.B. side)

Control Port (Control)

Connection to the control port is made via an 20-pin FFC/FPC cable with 1.0 mm pitch. The FFC/FPC connector on the board is an top-contact model.

Please note that the pin names of the serial port connections are seen from the driving PC / application side, that means a pin with name TX is in fact the output of the PC and an input of the iLCD panel. "Direction" is valid only when the primary function is enabled.

Pin #	Pin Name	Direction	Primary Function Description
1	VCC	-	5V power supply
2 ¹⁾	USB-	In/Out	USB-, can be directly connected to pin 2 of a USB-Jack B
3 ¹⁾	USB+	In/Out	USB+, can be directly connected to pin 3 of a USB-Jack B
2 ²⁾	TX	In	Serial port 0, transmit line from PC, receive input of iLCD controller
3 ²⁾	RX	Out	Serial port 0, receive line to PC, transmit output of iLCD controller.
4	GND	-	Ground pin
5	TX1 ³⁾	In	Serial port 1, transmit line from PC, receive input of iLCD controller. Can be used for RS-422/RS-485 in conjunction with ALERT pin

6	RX1 ³⁾⁸⁾	Out	Serial port 1, receive line to PC, transmit output of iLCD controller. Can be used for RS-422/RS-485 in conjunction with ALERT pin
7	CTS	Out	Output to avoid input buffer overflow, connect to RS232 driver's CTS of the PC. Common for both serial ports.
8	SDA ⁴⁾⁷⁾	In/Out	I ² C data pin. Note, that there is no pull up resistor on the iLCD panel, so an external resistor may be necessary depending on the I ² C bus structure.
9	SCL ⁴⁾⁷⁾	In/Out	I ² C clock pin. Note, that there is no pull up resistor on the iLCD panel, so an external resistor may be necessary depending on the I ² C bus structure.
10	ALERT ³⁾	Out	Output pin to indicate I ² C data availability (= low) to the I ² C master. When using the RS422/RS485 mode on the second serial port, pin goes low during data transmit.
11	SCK ³⁾	In	Clock for SPI
12	MISO ³⁾	Out	Serial output line for SPI
13	MOSI ³⁾	In	Serial input line for SPI
14	SSEL ³⁾⁶⁾	In/Out	Must be tied to GND when using SPI
15	RELO	Out	Relay output 0 / PWM0 output
16	REL1	Out	Relay output 1 / PWM1 output
17	GPO ⁵⁾	In/Out	General purpose I/O pin 0. Use serial resistor when driving a LED.
18	GP1 ⁵⁾	In/Out	General purpose I/O pin 1. Use serial resistor when driving a LED.
19	I/O5 ³⁾⁹⁾ RESET	In/Out In/Out	Digital I/O pin /RESET – Pulling this pin low resets the iLCD module
20	Vbatt	-	Backup input voltage for real-time clock, should be between 2.5V and 3.3 V

Note:

1. For DPP-CTP3224-1, see "Important Information about the USB and the Serial Port"
2. For DPP-CTP3224, see "Important Information about the USB and the Serial Port"
3. This pin can be used as a digital input, a push/pull or pull down output or a keyboard column output when the primary function is not enabled.
4. This pin can be used as a digital input, a pull down output or keyboard column output when the primary function is not enabled.
5. This pin can be used as a digital input, an analog input, a push/pull or pull down output or a keyboard column output. The voltage on this pin is not allowed to exceed 3.3V, even if it is used as a digital input or a pull-down output.
6. When using SPI, this pin must be used as SSEL for selecting the SPI via attaching a low signal.
7. When using the I²C port, this pin must be terminated with a resistor (usually 3k3) to 3.3V or 5V when the iLCD panel is the last device on the I²C bus. Please note, that the evaluation board has this pull-up resistor populated on the board.
8. When pulling low this pin via a 1k resistor during power-up, the flash memory's user data is erased.
9. The functionality of this pin depends on the setting of Jumper J2 and J3. When configured as /RESET pin, the board's internal power up reset signal can be seen on this pin as well.

WARNING! Reversed power supply connections (Vcc and Gnd) made to the iLCD module or invalid power supply voltage greater than 5.5V will cause module damage.

Keyboard Port (Keyboard)

Connection to the keyboard port is made via an 20-pin FFC/FPC cable with 1.0 mm pitch. The FFC/FPC connector on the board is an top-contact model.

Pin #	Pin Name	Direction	Primary Function Description
1	KBR0	In	Keyboard row 0
2	KBR1	In	Keyboard row 1
3	KBR2	In	Keyboard row 2
4	KBR3	In	Keyboard row 3
5	KBR4	In	Keyboard row 4
6	KBR5	In	Keyboard row 5
7	KBR6	In	Keyboard row 6
8	KBR7	In	Keyboard row 7
9	KBC0 ¹⁾	Out	Keyboard column 0, optionally I/O pin
10	KBC1 ¹⁾	Out	Keyboard column 1, optionally I/O pin
11	KBC2 ¹⁾	Out	Keyboard column 2, optionally I/O pin
12	KBC3 ¹⁾	Out	Keyboard column 3, optionally I/O pin
13	KBC4 ¹⁾	Out	Keyboard column 4, optionally I/O pin
14	KBC5 ¹⁾	Out	Keyboard column 5, optionally I/O pin
15	KBC6 ¹⁾	Out	Keyboard column 6, optionally I/O pin
16	KBC7 ¹⁾	Out	Keyboard column 7, optionally I/O pin
17	KBC8 ¹⁾	Out	Keyboard column 8, optionally I/O pin
18	GP2 ²⁾	In/Out	General purpose I/O pin 0. Use serial resistor when driving a LED.
19	GP3 ²⁾	In/Out	General purpose I/O pin 1. Use serial resistor when driving a LED.
20	I/O6 ¹⁾	In/Out	Digital I/O pin

Note:

1. This pin can be used as a digital input, a push/pull or pull down output or a keyboard column output when the primary function is not enabled.
2. This pin can be used as a digital input, an analog input, a push/pull or pull down output or a keyboard column output. The voltage on this pin is not allowed to exceed 3.3V, even if it is used as a digital input or a pull-down output.

Jumper J1 (J1)

If jumper 1 is set (= soldered) the frame ground of the display and the through-hole of the 4 mounting holes is connected to GND, otherwise the frame ground is not connected.

Jumper J2 and J3 (J1 and J2)

If jumper 2 is set (= soldered) and jumper 3 is open, pin 19 of the control port is connected to I/O5.
If jumper 2 is open and jumper 3 is set (= soldered), pin 19 of the control port is connected to RESET.

Please note, that the default configuration has jumper 2 set and jumper 3 open. Former versions of the DPP-CTP3224-x board do not have jumpers J2 and J3, pin 19 of the control board is connected to I/O5 always on this version.

Restrictions on Using I²C, SPI and the Real-Time Clock

Please note, that using the I²C and SPI communication port and the real-time clock is not available for firmware versions < Version 1.20

If you intend to use I²C, SPI and/or the real-time clock, and your iLCD controller has a firmware version not supporting this functionality yet, please update your firmware via the setup software.

Contrast and Gamma Value Setting

Please be informed that the new layout of the DPP-CTP3224-x does not need to set the contrast and the gamma value anymore, as these values are set to the optimum values by the TFT panel producer. So setting the contrast and the gamma value via software on this new model does not have any effect, the iLCD setup software does not even offer to modify these values. Your application may issue the "Get Fixed LCD Contrast/Gamma" command to know if your iLCD panel needs to have set the contrast and gamma values. Command Set

Please see the extra document "iLCD Commands" describing the common command set available for all iLCD modules.

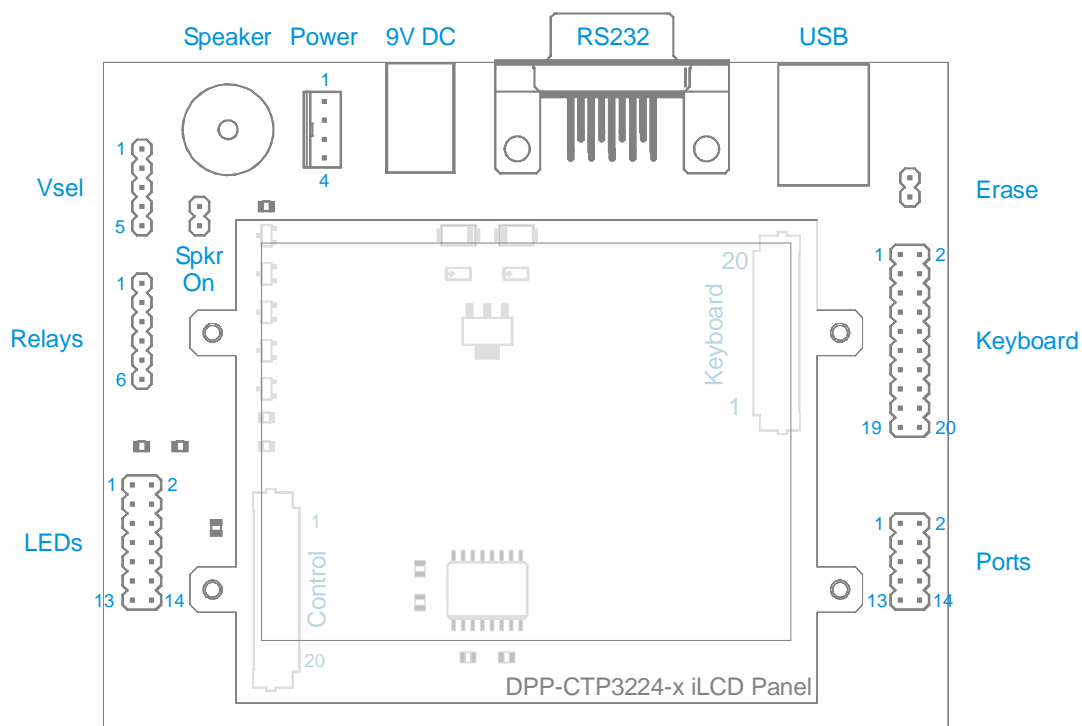
Evaluation Board

To make it easier to use and program the DPP-CTP3224-x panel, an evaluation board has been designed. The DPP-CTP3224-x connecting to the evaluation board via two FFC cables contains the following parts:

- RS-232 Sub-D 9-pin connector + RS-232 driver IC
- USB Jack (type B)
- Power supply jack + 5V regulator
- Speaker
- Terminal pins for relays, keyboard, ports and LEDs + interface electronic

Connectors and Jumpers

This section describes and illustrates the connectors and jumpers of the evaluation board for the DPP-CTP3224-x iLCD panel.



DPP-CTP3224-x evaluation board connector and jumper locations

Power Supply Connector (Power)

This connector applies the 5V power supply to the iLCD module if there is no USB port connected to the module. The connector used for this connection is the same as the power supply connector for a 3 1/2" floppy disk drive, and has the same pinning.

Pin	Description
1	V _{UNREG} Unregulated power supply 6V ... 12V (save against reverse polarity)
2	Ground
3	Ground
4	V _{CC} (+5V)

AC/DC Power Adapter Connector (9V DC)

This connector can be used as an alternative to the Power Supply Connector when the iLCD module is not powered via the USB port. An unregulated power supply with 9V to 12V DC can be connected to the jack, the middle contact must be connected to the positive voltage. This input is save against reverse polarity.

Power Supply Configuration Connector (Vsel)

Only one jumper is allowed to be set to select the power source for the iLCD module as follows:

Jumper Location		Description
Pin	Pin	
1	2	Enables the power supply connector's pin 4 (V _{CC})
2	3	Enables supplying the iLCD module via the USB port
3	4	Enables supplying the iLCD module via the USB port
4	5	Enables the power supply connector's pin 1 (V _{UNREG}) and/or the power jack

Serial Port Connector (RS232)

This 9-pin Sub-D female connector allows the driving application or PC to send and receive data from and to the iLCD module via standard RS232 signals. The pinning matches the standard layout of a PC's serial port.

The pins are connected with the iLCD's secondary serial port, please see the note "Important Information about the USB and the Serial Port"

Pin On Sub-D	Direction	Description
1	-	Not connected
6	-	Not connected
2	Out	RX - data sent from the iLCD module to the controlling application / PC
7	In	RTS – not in use, but connected to the iLCD's RS232 driver
3	In	TX – data sent from the controlling application / PC to the iLCD module
8 ¹⁾	Out	CTS – iLCD's output for hardware flow control
4	-	Not connected
9	-	Not connected
5	-	Signal ground

Note:

1. See iLCD's command description about why you should connect this pin and when it is not necessary to use hardware flow control.

General Port Connector (Ports)

This connector enables you to connect the primary serial port of an DPP-CTP3224 iLCD panel (5V signals only, no standard RS232 signal level of $\pm 9V$), the I²C, and some other signals described below. "Direction" is valid only when the primary function is enabled.

Pin #	Pin Name	Direction	Primary Function Description
1	VCC	-	5V power supply
2	SDA ⁴⁾	In/Out	I ² C data pin. Note, that there is no pull-up resistor on the iLCD panel itself, but the evaluation board contains a 3k3 pull-up resistor.
3	RX ¹⁾	Out	Serial port 0, receive line to PC, transmit output of iLCD controller.
4	SCL ⁴⁾	In/Out	I ² C clock pin. Note, that there is no pull-up resistor on the iLCD panel itself, but the evaluation board contains a 3k3 pull-up resistor.
5	TX ¹⁾	In	Serial port 0, transmit line from PC, receive input of iLCD controller
6	ALERT ³⁾	Out	Output pin to indicate I ² C data availability (= low) to the I ² C master. When using the RS422/RS485 mode on the second serial port, pin goes low during data transmit.
7	CTS ²⁾	Out	Output to avoid input buffer overflow, connect to CTS of the PC. Common for both serial ports.
8	SSEL ³⁾⁵⁾	In/Out	Must be tied to GND when using SPI
9	I/O5 ³⁾⁶⁾ RESET	In/Out In/Out	Digital I/O pin /RESET – Pulling this pin low resets the iLCD module
10	SCK ³⁾	In	Clock for SPI
11	GND	-	Ground pin
12	MISO ³⁾	Out	Serial output line for SPI
13	Vbatt	-	Backup input voltage for real-time clock, should be between 2.5V and 3.3V
14	MOSI ³⁾	In	Serial input line for SPI

Note:

1. This pin should not be connected when a DPP-CTP3224-1 is used, as this panel has the primary serial port to the on-board USB bridge and USB+ and USB- are connected to these pins then.
2. The 5V CTS output connected to this pin is connected to the CTS port driver of primary RS232 port internally. This means that the iLCD's hardware flow control pin CTS is common for both RS232 ports.
3. This pin can be used as a digital input, a push/pull or pull down output or a keyboard column output when the primary function is not enabled.
4. This pin can be used as a digital input, a pull down output or keyboard column output when the primary function is not enabled.
5. When using SPI, this pin must be used as SSEL for selecting the SPI via attaching a low signal.
6. The functionality of this pin depends on the setting of Jumper J2 and J3 on the DPP-CTx3224-x board. When configured as /RESET pin, the board's internal power up reset signal can be seen on this pin as well.

USB Connector (USB)

This connector enables you to connect iLCD's USB port to a USB port on a PC via a standard USB cable.

Pin	Direction	Description
1	-	Vcc +5V
2	In/Out	USB-
3	In/Out	USB+
4	-	Ground

General Purpose I/O Connector (LEDs)

Depending on the settings in the iLCD's setup software the I/O ports can be a digital input, a push/pull or a pull-down output or an ADC input.

Pin	Name	Direction	Description
1	VCC	-	5V power supply
2	I/O5 ¹⁾³⁾ RESET	In/Out In/Out	Digital I/O pin /RESET – Pulling this pin low resets the iLCD module
3	I/O6 ¹⁾	In/Out	Digital I/O pin
4	GP0 ²⁾	In/Out	General purpose I/O pin 0. Use serial resistor when driving a LED.
5	N/C	-	Not connected
6	GP1 ²⁾	In/Out	General purpose I/O pin 1. Use serial resistor when driving a LED.
7	N/C	-	Not connected
8	GP2 ²⁾	In/Out	General purpose I/O pin 0. Use serial resistor when driving a LED.
9	N/C	-	Not connected
10	GP3 ²⁾	In/Out	General purpose I/O pin 1. Use serial resistor when driving a LED.

Note:

1. This pin can be used as a digital input, a push/pull or pull down output or a keyboard column output.
2. This pin can be used as a digital input, an analog input, a push/pull or pull down output or a keyboard column output. The voltage on this pin is not allowed to exceed 3.3V, even if it is used as a digital input or a pull-down output.
3. The functionality of this pin depends on the setting of Jumper J2 and J3 on the DPP-CTx3224-x board. When configured as /RESET pin, the board's internal power up reset signal can be seen on this pin as well.

Keyboard Connector (Keyboard)

Pin	Name	Direction	Description
1	KBR0	In	Keyboard row 0
2	KBR1	In	Keyboard row 1
3	KBR2	In	Keyboard row 2
4	KBR3	In	Keyboard row 3
5	KBR4	In	Keyboard row 4
6	KBR5	In	Keyboard row 5
7	KBR6	In	Keyboard row 6
8	KBR7	In	Keyboard row 7
9	KBC0 ¹⁾	Out	Keyboard column 0, optionally I/O pin
10	KBC1 ¹⁾	Out	Keyboard column 1, optionally I/O pin
11	KBC2 ¹⁾	Out	Keyboard column 2, optionally I/O pin
12	KBC3 ¹⁾	Out	Keyboard column 3, optionally I/O pin
13	KBC4 ¹⁾	Out	Keyboard column 4, optionally I/O pin
14	KBC5 ¹⁾	Out	Keyboard column 5, optionally I/O pin
15	KBC6 ¹⁾	Out	Keyboard column 6, optionally I/O pin
16	KBC7 ¹⁾	Out	Keyboard column 7, optionally I/O pin
17	KBC8 ¹⁾	Out	Keyboard column 8, optionally I/O pin
18	I/O5 ¹⁾²⁾ RESET	In/Out In/Out	Digital I/O pin /RESET – Pulling this pin low resets the iLCD module
18	I/O5 ¹⁾	In/Out	Digital I/O pin
19	I/O6 ¹⁾	In/Out	Digital I/O pin
20	GND	-	Ground pin

Note:

1. This pin can be used as a digital input, a push/pull or pull down output or a keyboard column output when the primary function is not enabled.
2. The functionality of this pin depends on the setting of Jumper J2 and J3 on the DPP-CTx3224-x board. When configured as /RESET pin, the board's internal power up reset signal can be seen on this pin as well.

Relays Connector (Relays)

The two relays, which may be connected to the iLCD board, can be supplied using up to 24V. The iLCD module contains a diode for any of the two relays outputs to protect the switching transistor against reverse voltage. To enable the diodes to protect the transistors, the relay supply voltages must be connected to the board too.

Pin	Direction	Description
1	-	Relay 1 positive supply voltage
2	Out	Relay 1 output (minus pin of relay)
3	-	Ground
4	Out	Relay 0 output (minus pin of relay)
5	-	Relay 0 positive supply voltage
6	-	Vcc +5V

Relay 0 can also be used to drive a speaker or buzzer and relay 1 can be used to generate a pulse-width modulated output voltage. Please have a look to the extra document "iLCD Commands" to learn more about how to control these output ports in this case.

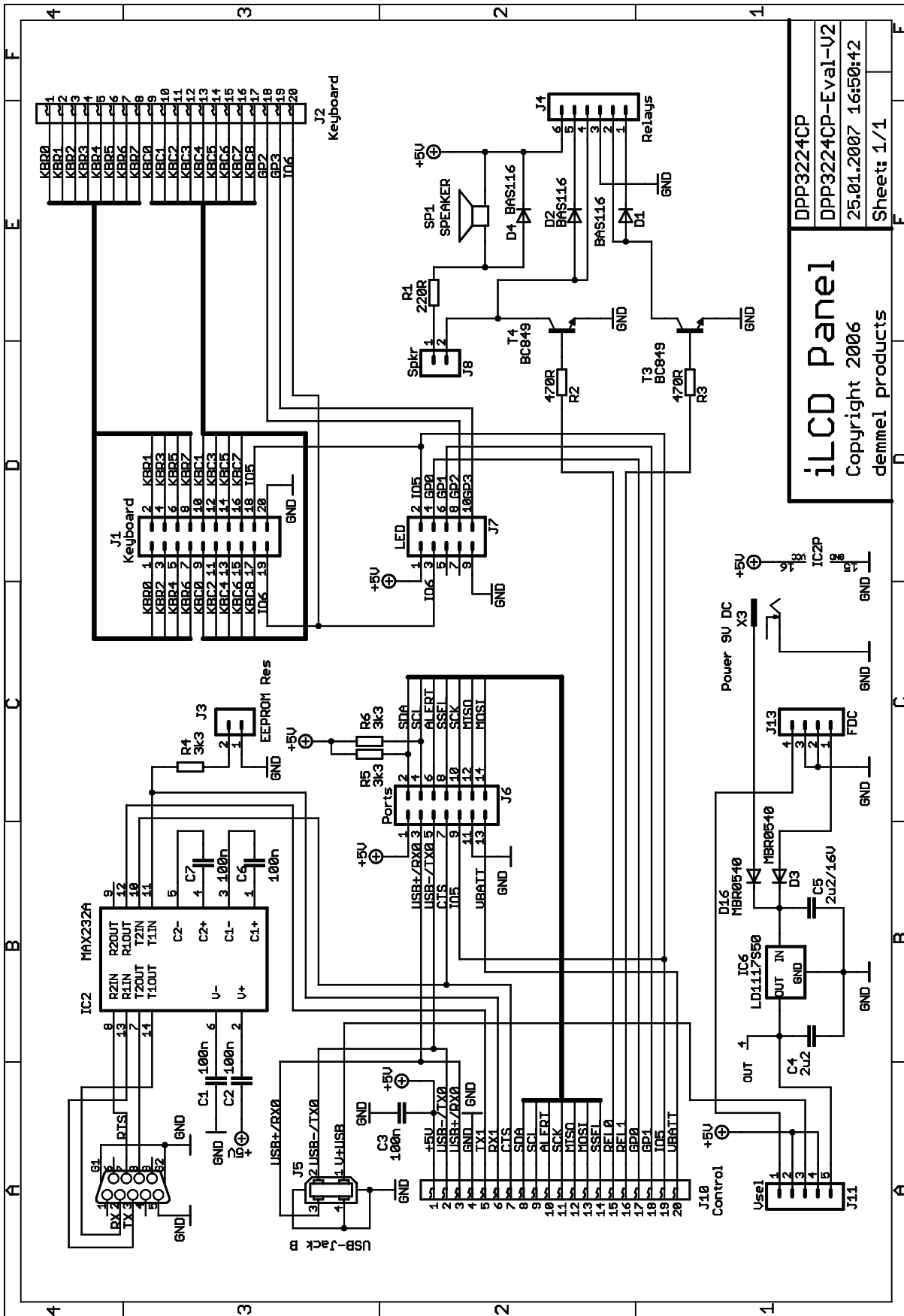
Speaker-On Jumper (Spkr On)

When a jumper is connected to this connector, the Relay 0 output is connected to the evaluation board's speaker via a resistor.

Erase Jumper (Erase)

When a jumper is connected to this connector, the iLCD module erases all user data from the Flash memory at boot time. A corresponding message is shown on the LCD. Please remove the jumper after startup to avoid consecutive erasing of Flash contents at the next startup.

Schematic Evaluation Board

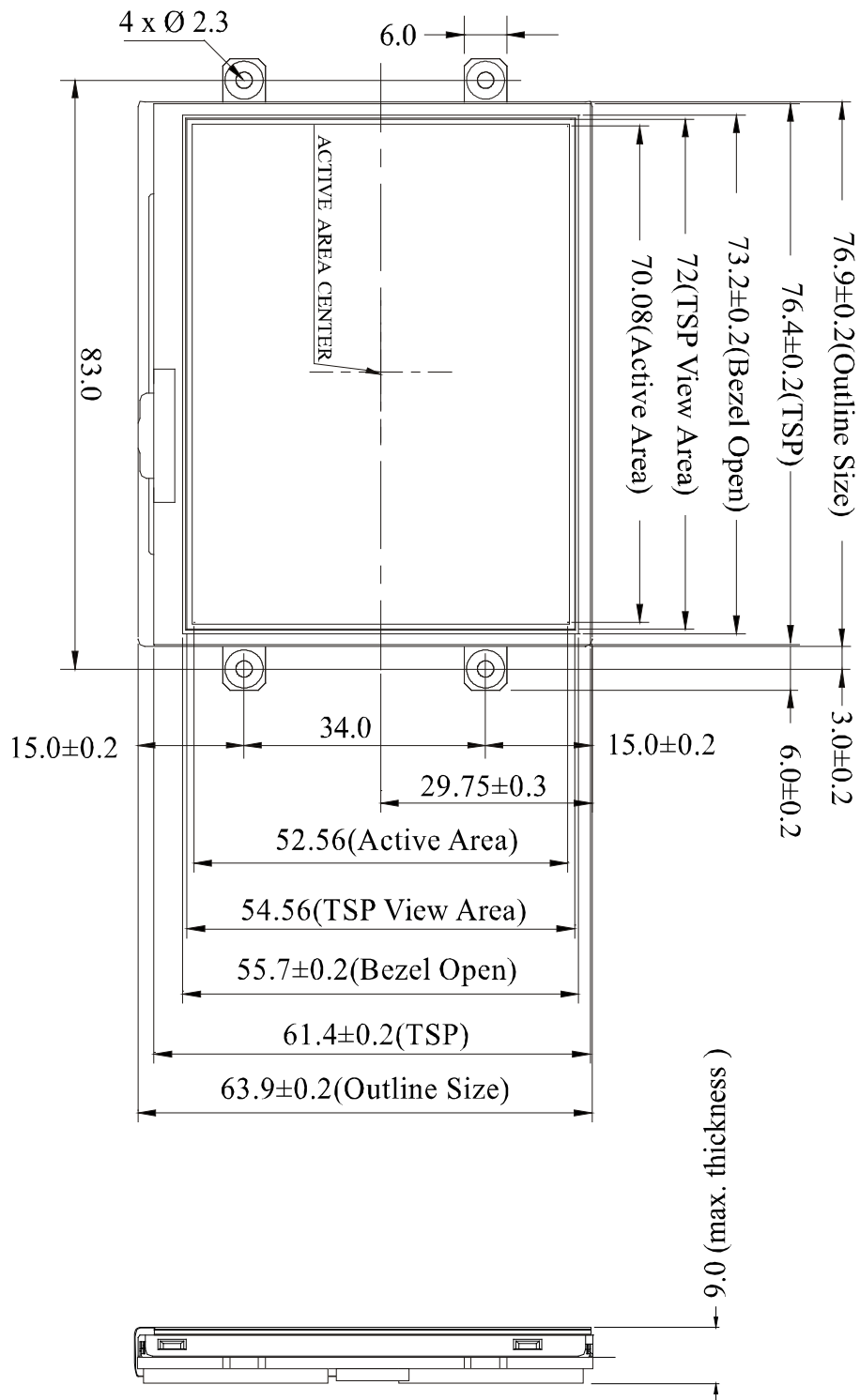


iLCD Panel
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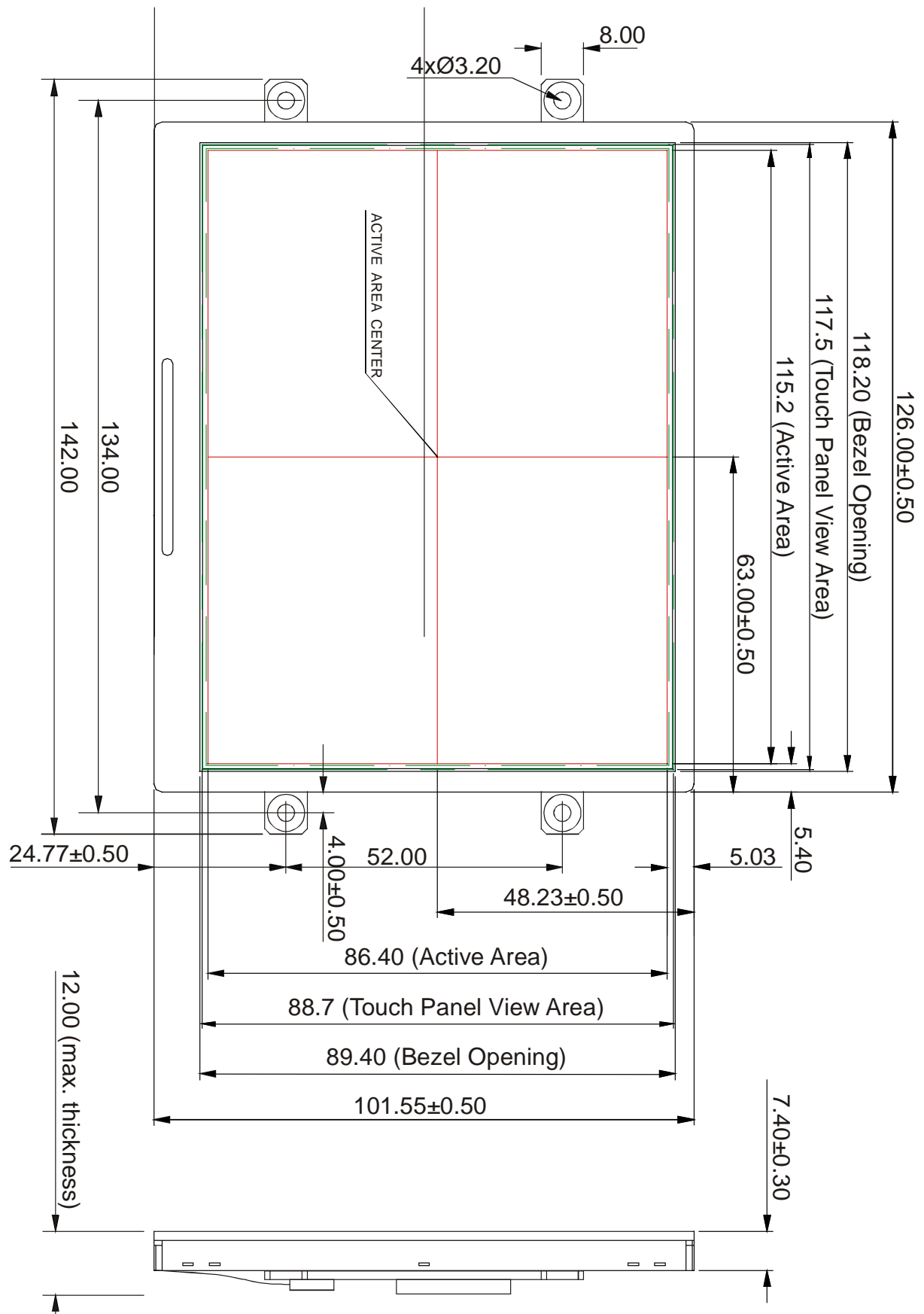
DPP3224CP
 DPP3224CP-Eval-V2
 25.01.2007 16:50:42
 Sheet: 1/1

Outline Dimensions

DPP-CTP3224-x



DPP-CT3224-x



Revision History

Date	Rev. #	Revision Details
June 2, 2008	1.4	Added new layout image for DPP-CTP3224-x Added chapter "Contrast and Gamma Value Setting"
September 17, 2007	1.31	Added contrast and brightness values
April 03, 2007	1.3	Added information about DPP-CT3224-x iLCD panel
January 21, 2007	1.2	Added information about ports
December 26, 2006	1.1	Added evaluation board documentation
December 19, 2006	1.0	First Issue

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