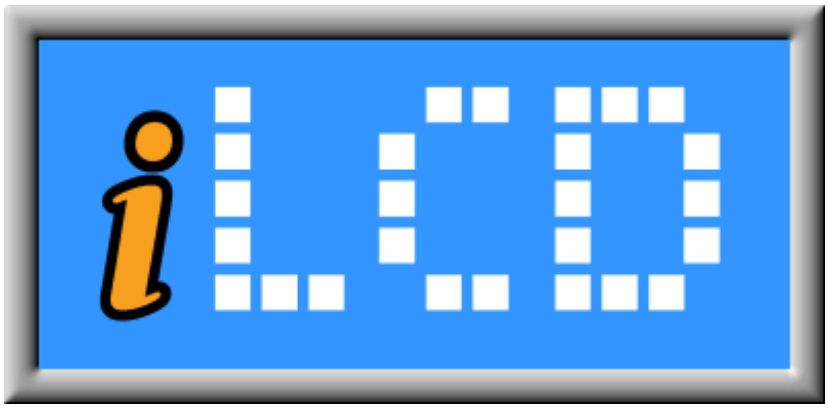

Next Generation Intelligent LCD Panels

DPP-A2412 and DPP-AT2412 Specification
DPP-A3224 and DPP-AT3224 Specification
DPP-AP3224 and DPP-ATP3224 Specification

Version 1.1
Document Date: May 5, 2007

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General Description

The iLCD modules are intelligent LCD panels with a fast 32-bit iLCD controller allowing 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, I^2C or SPI port or via USB.

Numbering System

Example:

DP	P	-	ATP3224	Z	5	5	5	1	1	-	B	F	H
1	2	3	4	5	6	7	8	9	10	11	12	13	14

Description:

No.	Description	Explanation	
1	Brand	demmel products	
2	Product	P = iLCD Panel	
3	Separator		
4	Format	A2412 = 240 x 128 dots AT2412 = 240 x 128 dots /w touch A2412 = 240 x 128 dots AT2412 = 240 x 128 dots /w touch	A3224 = 320 x 240 dots AT3224 = 320 x 240 dots /w touch AP3224 = 320 x 240 dots, PDA size ATP3224 = 320 x 240 dots, PDA size, /w touch
5	Display Type	B = Chip on board /w pin headers	Z = Chip on board /w FCC connector
6	iLCD Controller	6 = DPC2060	
7	Control ports [1])	0 = 5 Volt serial + I^2C 1 = RS-232 port	2 = USB port 4 = RS-422/RS-485 port
8	I/O Ports [1])	0 = No I/O ports 1 = General purpose I/O	2 = ATX power outputs 4 = Relay outputs
9	Options [1])	0 = No options 1 = Keyboard inputs	
10	Power Supply [1])	0 = Jumper only 1 = Floppy disk power supply	2 = Built in regulator
11	Separator [2])		
12	LCD manufacturer [2])	B = Bolymin	E = EDT
13	LCD Color [2])	G = STN/gray Y = STN/yellow green	B = STN/blue F = FSTN
14	Backlight type/color [2])	L = LED array/yellow green H = LED edge/white R = LED array/red G = LED edge/yellow-green	D = LED edge/blue E = EL/white B = EL/blue C = CCFL/white

Note:
1. The resulting number is calculated by adding the options' numbers.
2. These positions are omitted when the numbering system is used for iLCD controller boards.

Features

Display Specific Data

Item	DPP-A2412xxxxxx-BFH	DPP-AT2412xxxxxx-BFH	DPP-A(P)3224xxxxxx-BFH	DPP-AT(P)3224xxxxxx-BFH
LCD Controller	T6963C		S1D13305 / RA8835	
Display Format	Transflective and positive type graphic LCD 240 × 128 dot-matrix		Transflective and positive type graphic LCD 320 × 240 dot-matrix	
Touch Panel	No	Yes	No	Yes
Display Mode	Black/White Mode FSTN LCD			
Backlight	White LED			
Viewing Direction	6 O'clock			

Electrical Specific Data

Item	All models without touch panel (depending on installed options)	All models with touch panel (depending on installed options)
Connectivity	USB 2.0 / RS-232 / RS-232 5 Volt / RS-422 / RS-485 / I^2C / SPI	
I/O Ports	4 general purpose ports (10 bit ADC 0..3.3 Volt or digital input or LED output), LED outputs, keyboard with max. 128 keys, 2 relays outputs with 100 mA, real time clock	2 general purpose ports (10 bit ADC 0..3.3 Volt or digital input or LED output), LED outputs, keyboard with max. 128 keys, 2 relays outputs with 100 mA, real time clock, touch panel interface

Mechanical Specification

Item	Specification			Unit
	DPP-Ax2412xxxxxx-BFH	DPP-Ax3224xxxxxx-BFH	DPP-AxP3224xxxxxx-BFH	
Module Dimension	144 x 104	165 x 109	105 x 85	mm
View Area	114 x 64	122 x 92	81.8 x 62.0	mm
Dot Size	0.43 x 0.43	0.34 x 0.34	0.225 x 0.225	mm
Dot Pitch	0.45 x 0.45	0.36 x 0.36	0.24 x 0.24	mm

Maximum Ratings

Item	Symbol	Minimum	Maximum	Unit
Supply Voltage	V_{CC}	-0.3	5.5	V
Supply Voltage Unregulated [1])	V_{UNREG}	-50.0	12.0	V
Input Voltage	V_{IN}	-0.3	3.3	V
Operating Temperature	T_{OPR}	-20	70	°C
Storage Temperature	T_{STR}	-30	80	°C
Humidity			90	%RH

Note:
1. Only available when the built in regulator option is installed. The maximum input voltage depends also on the maximum current drawn by the iLCD module (limited by the maximum power dissipation of the built in regulator).

Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage	V_{CC}	-	4.75	5.0	5.25	V
Supply Voltage Unregulated [1])	V_{UNREG}	-	6.0	-	12.0	V
Input Voltage H Level [2])	V_{IH}	-	2.0	-	5.0	V
Input voltage L Level [2])	V_{IL}	-	0.0	-	0.8	V
Input Voltage Analog Inputs	V_{IAL}		0.0		3.3	V
Max. output current (push/pull port outputs)	I_{OUT}				±4	mA
Max. output current (pull down port outputs)					-4	mA
RS-232 Input Voltage Operating Range					±30	V
RS-232 Input Threshold Low	V_{IRL}	V_{CC} = 5V	0.8	1.3		V
RS-232 Input Threshold High	V_{IRH}	V_{CC} = 5V		1.8	2.4	V
RS-232 Input Hysteresis	V_{IRH}	V_{CC} = 5V	0.2	0.5	1	V
RS-485/RS-422 Driver Differential V_{OUT}	V_{OD2}	R_{LOAD} = 50 Ω	2	3		V
RS-485/RS-422 Receiver Differential Threshold Voltage	V_{TH}	-7V ≤ V_{CM} ≤ 12V	-0.2		0.2	V
Current Consumption	I_{DD}	No ports active, B/L off		t.b.d. [3]) [4]) 110 135		mA
B/L LED Current Consumption	I_{LED}	V_{CC} = 5V		t.b.d [4]) 65 150		mA

Note:
1. Only available when the built in regulator option is installed. The maximum input voltage depends also on the maximum current drawn by the iLCD module (limited by the maximum power dissipation of the built in regulator which is 500 mW).
2. For digital inputs only, except GP0 to GP3 pins.
3. Expected to be reduced with future firmware versions.
4. 1st value is for DPP-Ax2412xxxxxx-BFH, 2nd for DPP-AxP3224xxxxxx-BFH, 3rd for DPP-Ax3224xxxxxx-BFH

Module Function Description

General Information about Port Pins

Must 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:

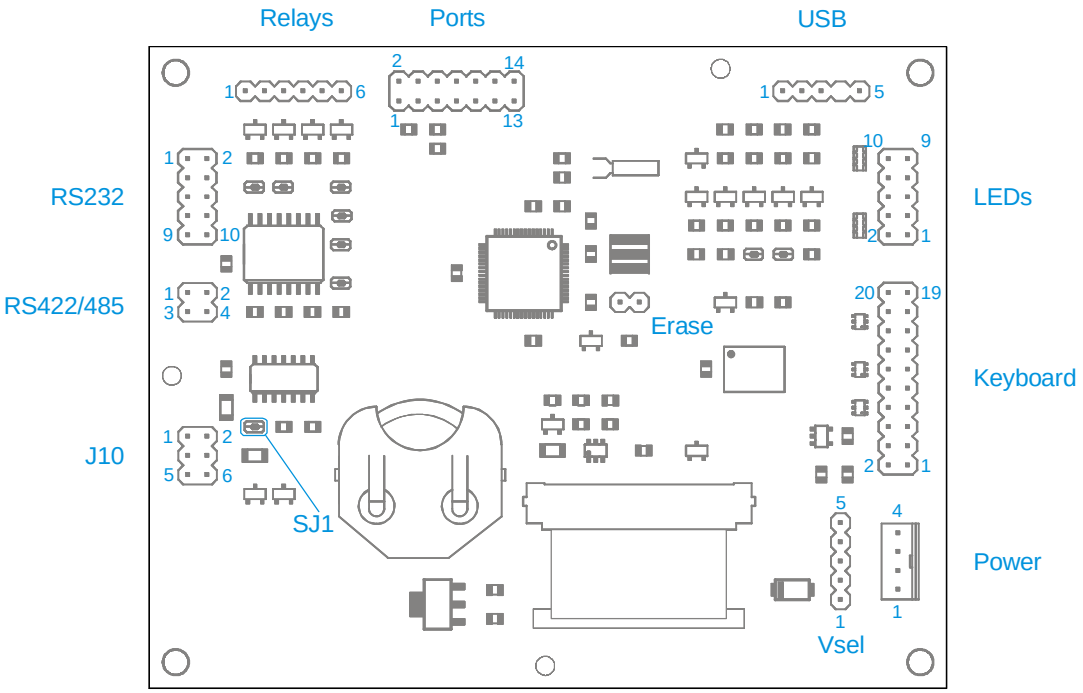
The serial port pins RX1 and TX1 on the "General Port Connector" are normally used for serial communication via 5 volt RS232. If you disable using the 2nd serial port, the function list for RX1 and TX1 changes and these pins can be used as inputs, outputs or keyboard column ports.

As the DPC2060 iLCD controller works with a power supply of 3.3 volts (a voltage-regulator for this voltage is on-board allowing the board to work with single 5 volt supply), push/pull outputs have a voltage swing of 0 … 3.3 volt. Pull down outputs and digital inputs are 5 volt tolerant (with some exceptions, see the comments below) allowing to work with 5 volt systems as well.

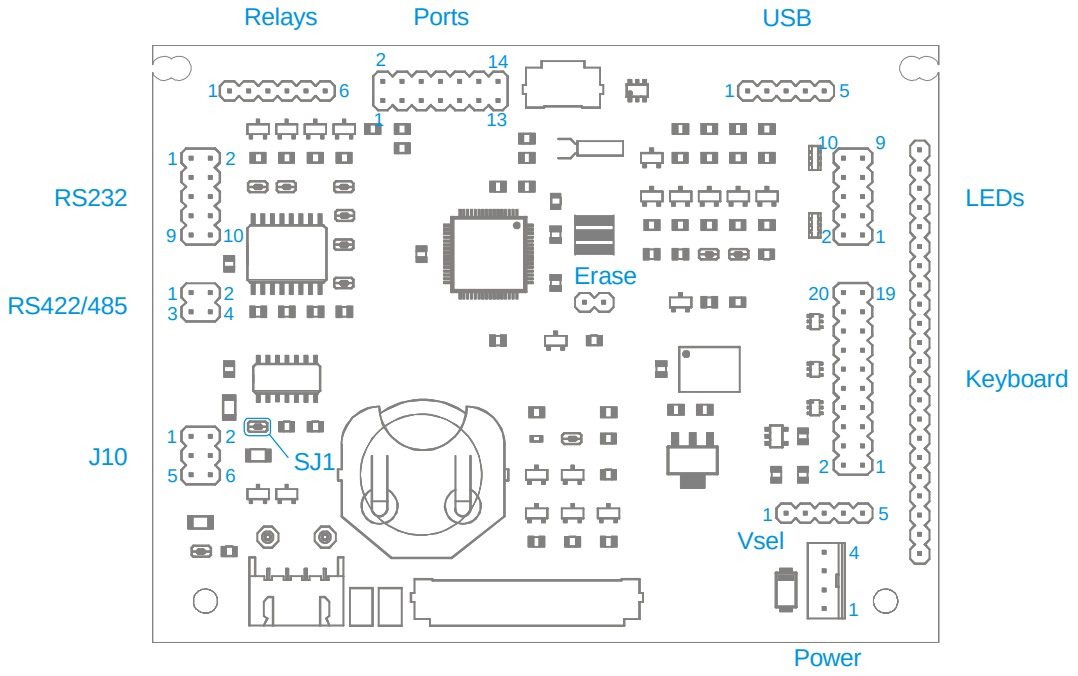
Connectors and Jumpers

This section describes and illustrates the connectors and jumpers of the iLCD modules.

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



DPP-AxP3224 series connector and jumper locations



DPP-Ax3224 and DPP-Ax2412 series connector and jumper locations

Power Supply Connector (Power)

This connector applies the 5 Volt 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 ½" floppy disk drive, and has the same pinning.

Pin	Description
1	V_{UNREG} Unregulated power supply 6 … 12 Volt (save against reverse polarity) [1])
2	Ground
3	Ground
4	V_{CC} (+5 Volt)

Note:
1. Only connected when the built in regulator option is installed.

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 [1])
4	5	Enables the power supply connector's pin 1 (V_{UNREG}) [1])

Note:
1. Only connected when the built in regulator option is installed.

Serial Port Connector (RS232)

This connector allows the driving application or PC to send and receive data from and to the iLCD module via standard RS232 signals. A cable can be made by simply using a straight flat cable connection between a 10 pin flat cable connector to a 9 pin female Sub-D (10th wire of the flat cable removed at the Sub-D side). The pinning will match the standard layout of a PC's serial port then.

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

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 second RS232 port (3.3 Volt signals only, no standard RS232 signal level of ± 9 Volt), the I2C and SPI port, and some other signals described below. Please note that "Direction" is valid only when the primary function is enabled. Ports defined as inputs are 5 Volt tolerant.

Pin #	Pin Name	Direc-tion	Primary Function Description
1	+5V	-	+5 Volt
2	SDA [1)2)]	In/Out	I²C Data
3	RX1 [3)]	Out	RX2 - data sent from the iLCD module to the controlling application / PC
4	SCL [1)2)]	In/Out	I²C Clock
5	TX1 [3)]	In	TX2 - data sent from the controlling application / PC to the iLCD module
6	ALERT [1)2)4)]	Out	I²C Alert – signals data available to the application (e.g. a keystroke)
7	CTS [5)]	Out	iLCD's output for hardware flow control – see iLCD's command description
8	PROG	-	Used for production programming – DO NOT USE THIS PIN
9	RESET [6)]	In/Out	/RESET – Pulling this pin low resets the iLCD module
10	SCK [3)]	In	Clock input for SPI
11	GND	-	Ground
12	MISO [3)]	In	Master In / Slave Out for SPI
13	VBATT	-	Power supply for the on-board real time clock when then main power supply is not available. Internally connected with the on-board battery.
14	MOSI	Out	Master Out / Slave In for SPI

Notes:
1. This pin can be used as a input, a pull down output or keyboard column output when the primary function is not enabled.
2. This pin is pulled high via a 3k3 resistor on the iLCD board to match the I²C specification.
3. This pin can be used as a input, a push/pull or pull down output or a keyboard column output when the primary function is not enabled.

4. When using SPI, this pin must be used as SSEL for selecting the SPI via attaching a low signal. The ALERT function can be assigned to any other pin according to note [1]) or note [3]).
5. The 3.3 Volt CTS output connected to this pin is connected to the CTS port driver of primary RS232 port internally as well. The iLCD's hardware flow control pin CTS is common for both RS232 ports.
6. The board's internal power up reset signal can be seen on this pin as well.

RS422/RS485 Data Connector (RS422/RS485)

This connector enables you to connect the second RS232 port via RS422 or RS485. The 5 Volt RS232 port and the RS422/RS485 port cannot be active at the same time. RS422 and RS485 do not use hardware flow control. Please read the iLCD's command description about when it is not necessary to use hardware flow control.

Please note that running RS422 (4-wire bus) can have the RS422 transmitter enabled continuously by soldering the solder jumper SJ1. When running RS485 (2-wire bus) or requiring the RS422 transmitter enabled only when data are sent, the ALERT pin must be assigned to the TXON push/pull output function with normal polarity via the setup software. Running SPI is not possible in this case, as SPI requires the ALERT pin set to the SSEL function.

When the iLCD module shall be controlled via RS485, RX+ must be connected with TX+ and RX- must be connected with TX-.

Pin	Direc-tion	Description
1	In	TX- - data sent from the controlling application to the iLCD module
2	In	TX+ - data sent from the controlling application to the iLCD module
3	Out	RX- - data sent from the iLCD module to the controlling application
4	Out	RX+ - data sent from the iLCD module to the controlling application

Please note that using RS422 or RS485 requires setting the jumpers as shown below.

RS422/RS485 Configuration Connector (J10)

Pin	Pin	Description
1	2	A jumper must be set between pin 1 and 2 to enable RS422 or RS485. When using the 5 volt mode for the secondary RS232 port, the jumper must be removed.
3	4	Set a jumper between pin 3 and 4 to use the on-board terminating 100E resistor for RX+ / RX-
4	5	Set a jumper between pin 3 and 4 to use the on-board terminating 100E resistor for TX+ / TX-

USB Connector (USB)

This connector enables you to connect iLCD's USB port to a USB port on a PC. The board can be supplied via the USB connector as well.

Pin	Direc-tion	Description
1	In/Out	USB+
2	-	Ground
3	In/Out	USB-
4	-	Pin does not exist. Used as a polarization key.
5	-	Vcc +5 Volt

General Purpose I/O Connector (LEDs)

Depending on the settings in the iLCD's setup software the I/O can be a digital input, a push/pull or pull-down output, a keyboard column output, a digital or an ADC input. Please use the setup software for setting the appropriate configuration.

Please note that when driving a LED the maximum output current of 4 mA for port pins must not be exceeded. Depending on the voltage a LED is connected to, a serial resistor with appropriate value must be used to limit the current to 4 mA.

Pin #	Pin Name	Direc-tion	Primary Function Description
1	+5V	-	+5 Volt
2	IO4 [2] [3] (KBC6)	In/Out	General digital input/output
3	IO5 [2] [3] (KBC6)	In/Out	General digital input/output
4	GP0 [1] [4] [5]	In/Out	General purpose analog input Analog In #0, digital input or output
5	IO6 [2] [3] (KBC8)	In/Out	General digital input/output
6	GP1 [1] [4] [5]	In/Out	General purpose analog input Analog In #1, digital input or output
7	IO7 [2] [3] (KBC7)	In/Out	General digital input/output
8	GP2 [1] [6]	In/Out	General purpose analog input Analog In #2, digital input or output
9	GND	-	Ground
10	GP3 [6] [6]	In/Out	General purpose analog input Analog In #3, digital input or output

Notes:

1. 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 3.3 volts, even if it is used as a digital input or a pull-down output.
2. This pin can be used as a digital input, a push/pull or pull down output or a keyboard column output.
3. This pin is connected via a serial resistor of 220 Ohm with the pin marked with ().
4. This pin must be left open when a touch screen is connected to the iLCD panel. If the touch screen is not available this pin can be used after unsoldering a jumper on the board only. Please contact demmel products for details.
5. This pin is connected via a R/C combination of 220 Ohm / 10 nF to the iLCD controller to avoid noise.
6. This pin is connected via a serial resistor of 220 Ohm to the iLCD controller.

Keyboard Connector (Keyboard)

The iLCD module supports up to 128 keys connected in a matrix with up to 16 columns and 8 rows. The scan code / key code sent by the iLCD module is to be set via the setup software for any of the 128 keys. Please note, that the keyboard connector has pins for up to 9 columns only, if you need the full 16 columns you can use some additional pins from the Ports or LEDs connector not in use for other I/Os. All columns need to be assigned via the setup software accordingly, the actual row/column scan code depends on the assignment of the column port, not on the physical port name. This means, you even can swap columns logically or use a part of the keyboard column pins for your keyboard only and use the other pins as digital inputs or outputs pins instead.

Pin #	Pin Name	Primary Function Description
1	KBR0	Keyboard row 0
2	KBR1	Keyboard row 1
3	KBR2	Keyboard row 2
4	KBR3	Keyboard row 3
5	KBR4	Keyboard row 4
6	KBR5	Keyboard row 5
7	KBR6	Keyboard row 6
8	KBR7	Keyboard row 7
9	KBC0 [1])	Keyboard column 0
10	KBC1 [1])	Keyboard column 1
11	KBC2 [1])	Keyboard column 2
12	KBC3 [1])	Keyboard column 3
13	KBC4 [1])	Keyboard column 4
14	KBC5 [1])	Keyboard column 5
15	KBC6 [1]) [2]) (IO4)	Keyboard column 6
16	KBC7 [1]) [2]) (IO7)	Keyboard column 7
17	KBC8 [1])[2]) (IO5)	Keyboard column 8
18	RESET [3])	/RESET – Pulling this pin low resets the iLCD module
19	VCC [4])	Board-internal Vcc voltage of 3.3 volt
20	GND	Ground

Notes:
1. This pin can be used as a input, a push/pull or pull down output when the primary function is not enabled.
2. This pin is connected via a serial resistor of 220 Ohm with the pin marked with ().
3. The board's internal power up reset signal can be seen on this pin as well. This pin is connected with the RESET pin of the Ports connector internally.
4. When using this pin to source an external circuit, the maximum current of 10 mA must not be exceeded.

Relays Connector (Relays)

The two relays, which may be connected to the iLCD board, can be supplied using up to 24 Volts. 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 as well.

Pin	Direc-tion	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	-	+5 Volt

Relay 0 can be used to drive a speaker or buzzer or a pulse-width modulated signal with frequencies between 1 Hz and 1 MHz alternatively. Please note, that the on-board pull-down switching transistor will be too slow to switch frequencies above 100 kHz approximately, such high frequencies of up to 1 MHz are rather intended to be used without switching transistor (not applicable for this board).

Relay 1 can be used to generate a pulse-width modulated output voltage with a frequency fixed to 1 kHz as well.

Please have a look to the extra document "iLCD Commands" to learn more about how to control the relay outputs in PWM mode.

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.

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

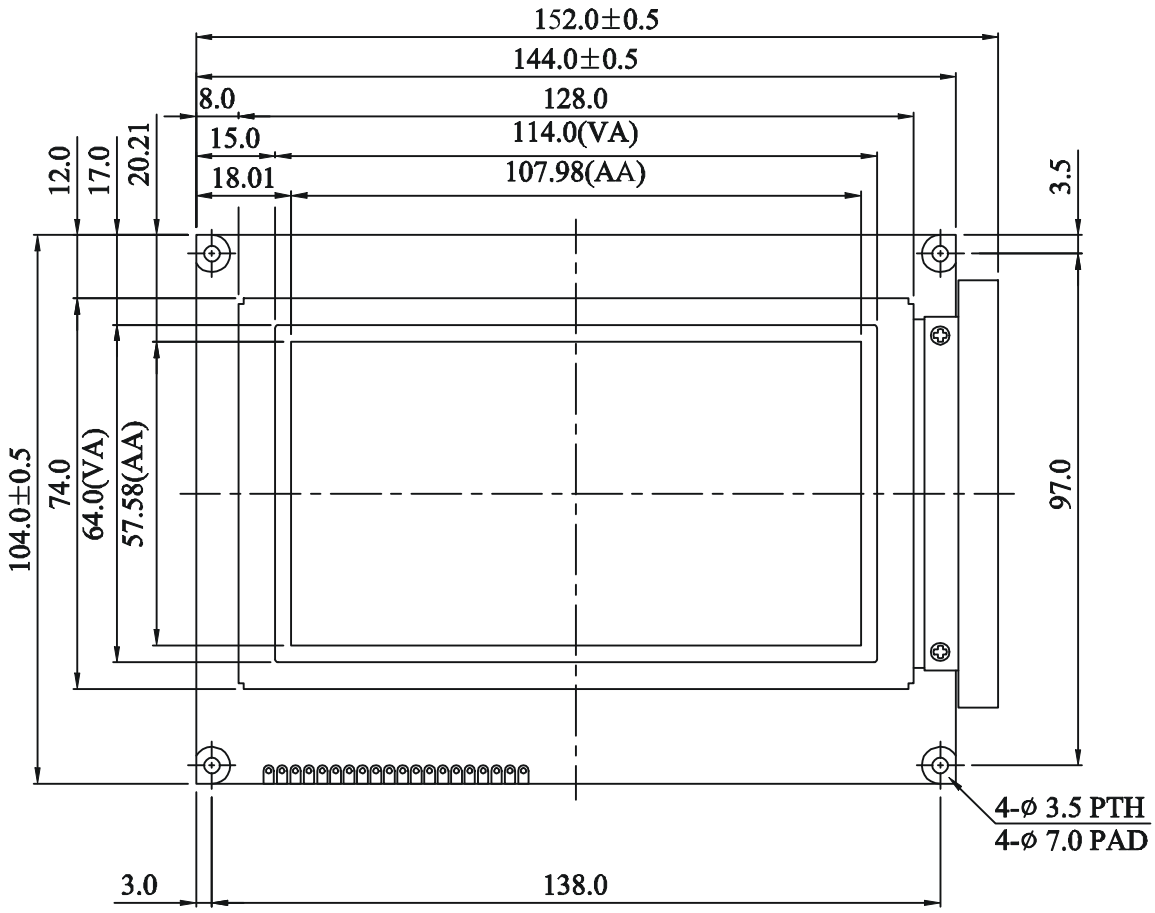
If you intend to use I²C, SPI and/or the real-time cock, and your iLCD controller has a firmware version not supporting this functionality yet, please update your firmware via the setup software.

Command Set

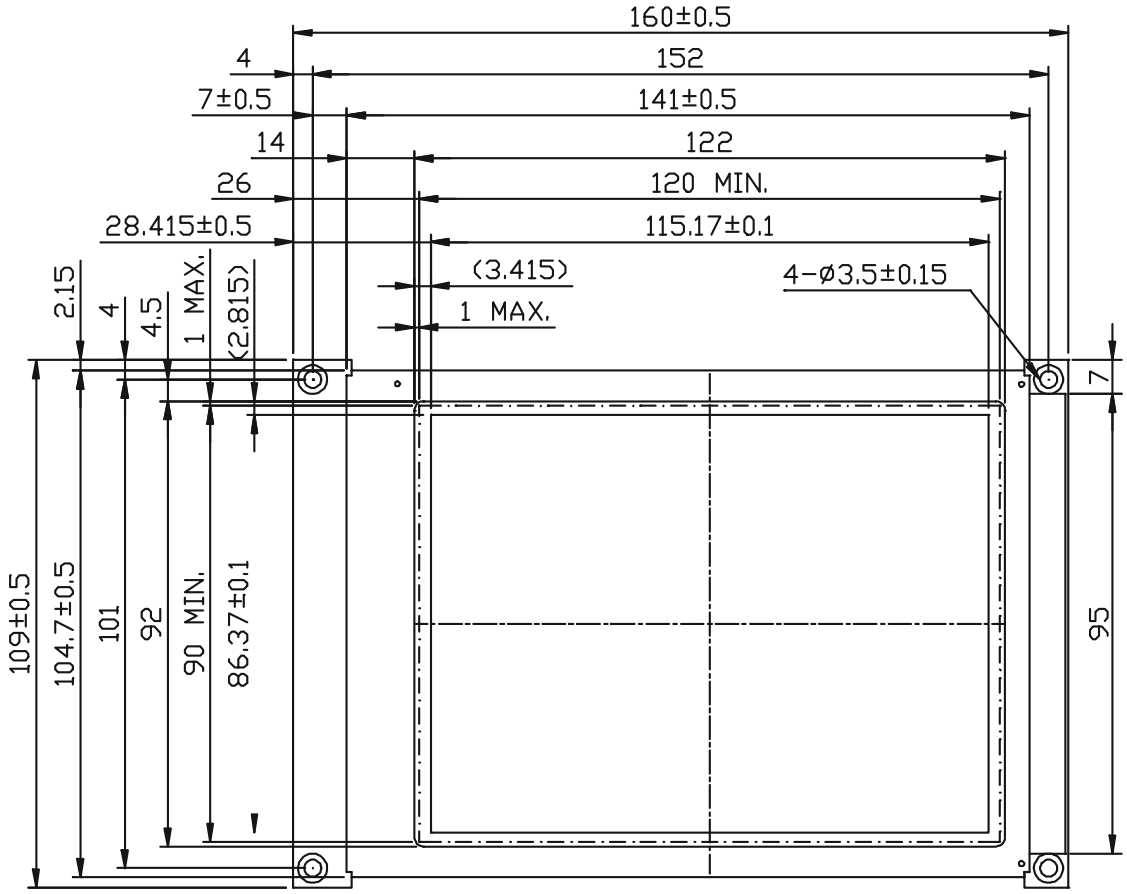
Please see the extra document "iLCD Commands" describing the common command set available for all iLCD modules.

Outline Dimensions

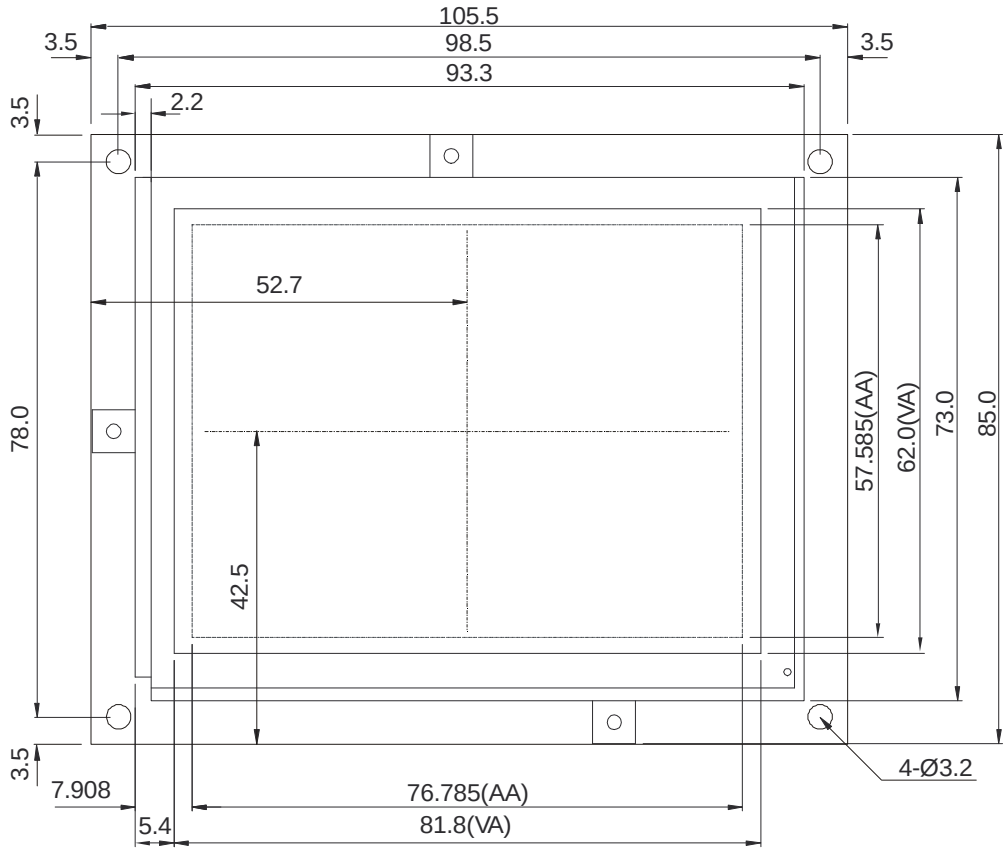
DPP-Ax2412xxxxx-xxx Series



DPP-Ax3224xxxxxx-xxx Series



DPP-AxP3224xxxxxx-xxx Series



Revision History

Date	Rev. #	Revision Details
May 05, 2007	1.1	Added information for DPP-Ax3224xxxxxx-xxx and DPP-Ax2412xxxxx-xxx Series
January 09, 2006	1.0	First Issue

If you find any errors in this document, please contact demmel products at support@demmel.com