# SOMDIMM-LPC1788

# **Users Manual**

# For use with Touch Screen LCD Kit

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## 1. Introduction

The SOMDIMM-LPC1788 provides a quick and easy solution for implementing a Cortex-M3 based design by providing the basic functions necessary for a product on an easy to use SOMDIMM. The SOMDIMM uses an industry standard 200 pin SO-DIMM interface. These sockets are utilized by virtually every laptop on the market.

This SOMDIMM is compatible with FDI's Family of Touch Screen LCD Kits but can also be used for custom platform development or customer applications.

# 2. LPC1788 SOMDIMM Block Diagram



Figure 1 – LPC1788 SOMDIMM Block Diagram

# 3. Functional Description

SOMDIMM-LPC1788

- LPC1788 Cortex-M3 based Microprocessor
- 2Mx32 SDRAM (8Mega-bytes) optional up to 32Mx32
- 1KB I2C-Serial EEPROM with Access Protection
- 10/100 Ethernet PHY
- Micro SD Card Socket for up to 2Giga-bytes storage (SDHC is not supported)
- Mini JTAG
- ISP Connector for use with USP-ICP-LPC2K
- Power-on Reset Generator

## 4. ESD Warning

The DK-TS-KIT shipped in a protective anti-static package. The kit must not be subjected to high electrostatic potentials. Damage may occur to the boards that will not be covered under warranty. General practice for working with static sensitive devices should be followed when working with the DK-TS-KIT.

## 5. <u>Requirements</u>

The SOMDIMM-LPC1788 requires a carrier board with a 200-pin SO-DIMM socket. The socket should have the key at the 1.8V location (the SOMDIMM-LPC1788 doesn't require 1.8V). The CARRIER Board from Future Designs provides this socket and should be utilized to develop your application for initial verification.

Example SO-DIMM Socket Manufacturer and Part Number: TYCO 1473005-4

Please refer to section 10 for the pin out details of the SOMDIMM Edge Finger.

### 6. SOMDIMM-LPC1788 Power Requirements

The following power requirements were measured at room temperature at 120MHz operating clock rate:

Voltage	Booted at the uEZ Demo Screen	Observed Max
3.3 V	200mA	208mA

# 7. Setting up the Hardware

The following are step by step instructions for setting up the hardware.

- 1) Make sure you have a SOMDIMM-LPC1788 board plugged into the CARRIER board at J1.
- 2) Verify the LCD Interface ribbon cable connects the CARRIER board to the LCD CARRIER (J7) board.
- 3) With the power off, plug the 5V center-positive Power Supply into 5V (P5) of the CARRIER board.
- 4) Connect an RJ-45 Ethernet cable to the ETHERNET (J5) interface of the CARRIER board.
- 5) Plug in a female-to-female DB9 serial cable (not included in the DK-TS-KIT) between PC and RS232 (P4)
- 6) Insert a flash media drive with the demonstration files (included) into USB HOST (P1).
- 7) If available, plug in a Mini-USB cable to USB DEVICE (P6).
- 8) If available, plug in a CAN DB9 cable into CAN (P3).
- 9) Turn on the power. The title screen should appear and a short tune is played. The main menu will appear.
- 10) After connecting all of the above, your configuration should look as follows:



## 8. Demonstration Software Main Menu

The Demonstration Software has the following options:

• Slideshow

Loads up to nine slides from the flash drive and allows the user to scroll up and down through the material. Slide back to the load screen to return to the main menu. See **Setting up a Slideshow** for details on how to customize.

• Draw

A very simple art program is provided. Use the touch screen to draw lines in the box to the right. Click on **Color** to rotate through a list of color choices. **Save** stores the graphic image as the file IMAGE.RAW on the USB Flash drive. **Load** recalls the saved graphic image from the USB Flash drive.

Console

Presents an output screen showing what a remote user sees when Telnetting into the console. On a Windows PC, configure the PC as explained in **PC to Demonstration Network Configuration**, then open a CMD window and type "telnet 192.168.10.20" to connect to the DK-TS-KIT. Type "dir" to show the contents of the Flash drive that is plugged into the DK-TS-KIT. Type "quit" to disconnect.

• Time & Temperature

Displays the current time and date from the external Real Time Clock (RTC) and the temperature from the LM75 temperature sensor on the CARRIER board.

• Accelerometer

Demonstrates the accelerometer by moving a simulated ball across the screen as the CARRIER board is tilted along the X and Y axis.

• Settings

Displays the submenu screen.

• Calibrate

Calibrates the Touch Screen and stores the new calibration information in the EEPROM on the SOMDIMM.

• Functional Test

Provides a step by step test of all basic features of the DK-TS-KIT. Requires additional hardware to test all features. See **Functional Test Software** section for more details.

• FCT Loopback

Puts the unit into a mode that will communicate with another DK-TS-KIT running the **Functional Test**. See **Functional Test Software** section for more details.

# 9. PC to Demonstration Network Configuration

In order to communicate via Ethernet to the DK-TS-KIT, the PC's network configuration will need to be changed. The simplest method is to give the PC another IP number and add the PC to another subnet. If using Windows XP, follow these instructions. Other operating systems should have similar operations.

Start by going to the **Control Panel** and select **Network Connections**. Then double click the **Local Area Connection** (or similarly named) and click **Properties**. The following dialog should appear. Scroll down to "Internet Protocol (TCP/IP)", select, and then click **Properties**.

📙 Local Area Connection Properties 🛛 🔋 🗙
General Advanced
Connect using:
Broadcom NetXtreme 57xx Gigabit C
This connection uses the following items:
Pile and Printer Sharing for Microsoft Networks      QoS Packet Scheduler      Themet Protocol (TCP/IP)
wide area network protocol that provides communication across diverse interconnected networks.
<ul> <li>✓ Show icon in notification area when connected</li> <li>✓ Notify me when this connection has limited or no connectivity</li> </ul>
OK Cancel

On the next screen, the computer needs to be set to a static IP number. Enter the current IP address, subnet mask, default gateway, and DNS servers (enter the command "ipconfig /all" at a CMD window to get this information). Then click **Advanced** and then click **Add...** and enter the following information and then click **Add**. Click **OK**. Click **OK**.

TCP/IP Address	<u>? ×</u>
<u>I</u> P address:	192 . 168 . 10 . 1
<u>S</u> ubnet mask:	255 . 255 . 255 . 0
	Add Cancel

Open another CMD window and type the command "ping 192.168.10.20" and should output the following:



Open a browser and go to http://192.168.10.20 and watch the output. It should appear as follows:

Arrow Page Hits = 9       Task       State Priority       Stack       #       *       Page +       >*       Page +       >*       Page +       *       *       *       Page +       * <th< th=""><th>🙋 http://192.168.3</th><th>10.20/index</th><th>.html - Windo</th><th>ws Internet</th><th>Explorer</th><th></th><th>_ 🗆 🗙</th></th<>	🙋 http://192.168.3	10.20/index	.html - Windo	ws Internet	Explorer		_ 🗆 🗙
Page Hits = 9       Task       State Priority       Stack       #         WebSvr       R       3       150       5         TS_Mon       R       3       154       6         IDLE       R       0       89       2         PWM_Audio       B       3       150       8         WiF       B       3       100       3         ETH_INT       B       3       279       7         Main       B       3       210       4	🕒 🗸 🔁 h	ttp://192.168	8.10.20 💌 🍫	X Yahoo	! Search		<b>P</b>
Task         State         Priority         Stack         #           WebSvr         R         3         150         5           TS_Mon         R         3         154         6           IDLE         R         0         89         2           FWM_Audio         B         3         150         8           lwIP         B         3         413         0           Heart         B         3         100         3           ETH_INT         B         3         279         7           Main         B         3         210         4	🚖 🎄 🏾 🏉 http:	//192.168.10	.20/ind	🟠 - 🖾	- 🖶 -	<mark>€}</mark> <u>P</u> age ▼	»
WebSvr       R       3       150       5         TS_Mon       R       3       154       6         IDLE       R       0       89       2         FWM_Audio       B       3       150       8         IwTF       B       3       413       0         Heart       B       3       100       3         ETH_INT       B       3       279       7         Main       B       3       824       1         GenHID       S       3       210       4	Page Hits = 9						<u> </u>
TS_Mon R 3 154 6 IDLE R 0 89 2 FWM_Audio B 3 150 8 IwTF B 3 413 0 Heart B 3 100 3 ETH_INT B 3 279 7 Main B 3 824 1 GenHID S 3 210 4	Task	State	Priority	Stack	#		
TS_Mon R 3 154 6 IDLE R 0 89 2 FWM_Audio B 3 150 8 IwTF B 3 413 0 Heart B 3 100 3 ETH_INT B 3 279 7 Main B 3 824 1 GenHID S 3 210 4	********	*******	****	****	******	***	
IDLE R 0 89 2 PWM Audio B 3 150 8 1wIF B 3 413 0 Heart B 3 100 3 ETH_INT B 3 279 7 Main B 3 824 1 GenHID S 3 210 4	WebSvr	R	3	150	5		
FWM_Audio         B         3         150         8           lwIP         B         3         413         0           Heart         B         3         100         3           ETH_INT         B         3         279         7           Main         B         3         824         1           GenHID         S         3         210         4	TS Mon	R	3	154	6		
1wIP     B     3     413     0       Heart     B     3     100     3       ETH_INT     B     3     279     7       Main     B     3     824     1       GenHID     S     3     210     4	IDLE	R	0	89	2		
Heart B 3 100 3 ETH_INT B 3 279 7 Main B 3 824 1 GenHID S 3 210 4	PWM Audio		В	3	150	8	
ETH_INT B 3 279 7 Main B 3 824 1 GenHID S 3 210 4	lwIP	в	3	413	0		
Main B 3 824 1 GenHID S 3 210 4	Heart	В	3	100	3		
GenHID S 3 210 4	ETH INT	в	3	279	7		
	Main	в	3	824	1		
	GenHID	S	3	210	4		
							<b>T</b>
🖌 🔜 Internet 🔍 100% 🗸	Di			😜 Interne	t	10	0% - //

States are: R = Running, B = Blocked, S = Suspended, D = Deleted

NOTE: Blocked means the task is waiting for an event and has a timeout specified, Suspended means it also waiting but has no timeout.

The Stack value is the stack watermark representing the lowest amount of stack left in 32-bit words. For example, in your screenshot, the WebSvr task has always had 150\*4 = 600 bytes (or more) available in its stack.

# is the task control block number in FreeRTOS. In short, it is the unique number for an active task.

# 10. <u>Setting up a Slideshow</u>

The Slideshow demonstration loads and scrolls between images provided on a USB Flash drive. Images must be in 24 bit uncompressed Targa (.TGA) format. Adobe Photoshop and many other graphics programs can save images in this format.

When using DK-TS-KIT's with a VGA LCD (e.g. DK-57VTS-LPC1788), the images must be 640x480 in size and use the file names VSLIDE01.TGA, VSLIDE02.TGA, VSLIDE03.TGA, etc. For best results, always use caps in the filename. There is a limit of 8 slides in a VGA slideshow.

## 11. Board Layout

The following figures illustrate the layout of the various components of the DK-TS-KIT. They are for reference only and are subject to change.



Figure 2 – SOMDIMM-LPC1788 Top Side



# 12. DK-TS-KIT System Functional Block Diagram

The DK-TS-KIT Block Diagram is illustrated below. (5.7" VGA shown)



Figure 4 – DK-TS-KIT System Block Diagram

# 13. I/O Connector Descriptions

### JTAG Connector – J3

The SOMDIMM-LPC1788 uses a new, reduced size JTAG connector based on a 2mm Header. This smaller connector provides 100% of the functionality of the standard 20-pin JTAG connector, but utilizes 70% less board space. The connector is a standard part available from most major vendors.

Pin Number	Description
1	3.3V
2	TRSTn
3	TDI
4	TMS
5	ТСК
6	RTCK
7	TDO
8	Reset
9	Ground
10	5.0V

For users that may have existing JTAG debuggers, an adapter may be fabricated using the following wiring diagram: (part numbers for the connectors are included from both the manufacturer and Digi-key)



Figure 5 – Mini JTAG Adapter Wiring Diagram

The DK-57xTS-LPCxxxx that ship with the SEGGER J-Link Lite now include the FDI JLink Adapter board to convert the standard JTAG connector to the SOMDIMM mini JTAG connector.



Figure 6 – FDI JTAG Adapter Board

#### MicroSD Connector – J2

The SOMDIMM-LPC1788 utilizes a MicroSD Socket for flexible mass storage capability. MicroSD Flash Cards are utilized by almost every cell phone on the market and are very cost effective, providing as much as 2GB of user-changeable memory storage. Adapter cards are available (and are usually included with the MicroSD) to facilitate installation of the MicroSD card into a standard SD reader. At this time, the SOMDIMM-LPC1788 µEZ<sup>®</sup> software does not support SDHC MicroSD Cards.

Pin Number	Description	
1	NC	
2	Micro SD Chip Select	
3	Micro SD MOSI	
4	3.3V	
5	Micro SD SCLK	
6	Ground	
7	Micro SD MISO	
8	NC	

#### **ISP Connector – J5**

The SOMDIMM-LPC1788 includes an ISP programming header that is designed to be utilized with the USB-ICP-LPC2K programmer from Future Designs. This connector is a 1.5mm JST Male, shrouded connector. The JST Part Number is: SM06B-SHLS-TF. The pin out shown below is a direct, 1:1 connection to the USB-ICP-LPC2K programmer available from Future Designs, Digi-Key or Mouser. This ISP programmer may also be included in some, but not all, DK-TS-KITS.

Pin Number	Description
1	3.3V
2	Reset Input
3	ISP Entry
4	Ground
5	RXD
6	TXD

## 14. On Board Functions

#### **Ethernet PHY – U8**

The SOMDIMM-LPC1788 provides an Ethernet PHY from Micrel, KSZ8041NL. The KSZ8041NL is a single chip solution for a 100BASE-TX/10BASE-T physical layer transceiver. It has support for media independent interface (MII), reduced MII (RMII), and HP MDI/MDI-X auto crossover. This allows for any standard Ethernet cable to be used, even a crossover cable. The KSZ8041NL is fully compliant to IEEE 802.3u with support for auto-negotiation and manual selection of 10/100Mbps speed as well as full and half-duplex modes.

For detailed information, please refer to the specific data sheet for this device available from the manufacturer.

#### MicroSD – J2

The SOMDIMM-LPC1788 provides a MicroSD interface for access to a removable Flash memory. Micro Secure Digital cards are one of the lowest prices per capacity memory cards available. They allow the LPC1788 to have access to a much larger amount of Flash memory in a very small form factor. When using

a MicroSD card it can be accessed via the SPIO bus of the LPC1788. At this time, SDHC MicroSD Cards are not supported by the  $\mu$ EZ<sup>®</sup> software.

#### **Reset Generator – U3**

The SOMDIMM-LPC1788 utilizes a TPS3801 power-on reset supervisor and voltage monitor. The TPS3801 includes an external reset input that is connected to the reset button on the CARRIER Board.

For detailed information, please refer to the specific data sheet for this device available from the manufacturer.

#### Serial EEPROM – U2

The SOMDIMM-LPC1788 includes a serial EEPROM, NXP PCA24S08. This device provides 1K-Byte of serial electrically erasable and programmable Read-only memory (EEPROM). Data is received and transmitted via the serial I2C bus. Access permissions limiting reads or writes can be set via the I2C-bus to isolate blocks of memory from improper access.

#### PCA24S08 Device I2C Bus 2 Address = 0xA8

For detailed information, please refer to the specific data sheet for this device available from the manufacturer.

#### **Internal Real Time Clock**

The SOMDIMM-LPC1788's LPC1788 includes an Internal Real Time Clock. The LPC1788s Internal RTC, at room temperature, draws less than  $1\mu$ A of current in standby. The internal RTC features 20 bytes of battery-backed storage, a dedicated 32kHz low power oscillator, and a dedicated battery power supply pin.

For detailed information, please refer to the specific data sheet for this device available from the manufacturer.

# 15. <u>200-pin SOMDIMM Connector Details – J4</u>

PinSOMDIMM Signal NameApplication DetailsI/OSOMDIMM Connect1EFH_TXPEthernet Transmit Positive0Output from KS28041 Ethernet PHY2ETH_TXNEthernet Transmit Negative0Input to KS28041 Ethernet PHY3ETH_TXNEthernet Transmit Negative0Input to KS28041 Ethernet PHY4ETH_TKNEthernet Receive Negative1Input to KS28041 Ethernet PHY53V3A3.3V AnalogPAnalog 3.3V Output from KS280416GNDGroundPAnalog 3.3V Output from KS280417ETH_LED0Ethernet LED00Ethernet LED1 output from KS280418ETH_LED1Ethernet LED10Ethernet LED1 output from KS280419VBAT_INVdd Battery InputPVdd for battery backup of internal R10ALARMAlarm Signal From Micro0111RESET_INReset Input from POR0Reset output from POR circuit13NCNot connectedU114NCNot connectedU115NCNot connectedU16NCNot connectedU119NCNot connectedU119NCNot connectedU120NCNot connectedU121VDAVdd Analog1ADC Ground22NREFReference Voltage1ADC Ground23VSSAVss Analog<	t
2       ETH_RXP       Ethernet Transmit Negative       1       Output from KSZ8041 Ethernet PHY         3       ETH_TXN       Ethernet Transmit Negative       0       Input to KSZ8041 Ethernet PHY         4       ETH_RXN       Ethernet Receive Negative       1       Input to KSZ8041 Ethernet PHY         5       3V3A       3.3V Analog       P       Analog 3.3V Output from PHY Circuit         6       GND       Ground       P       Ethernet LED0       0       Ethernet LED1 output from KSZ8041         9       VBAT_IN       Vdd Battery Input       P       Vdd for battery backup of internal R         10       ALARM       Alarm Signal From Micro       0       Ethernet LED1 output from KSZ801         12       RESET_IN       Reset Input       I       Reset input to POR IC TPS3801         12       RESET_OUT       Reset Output from POR       0       Reset output from POR circuit         13       NC       Not connected       U       1         14       NC       Not connected       U       1         17       NC       Not connected       U       1         19       NC       Not connected       U       1         19       NC       Not connected       U	
3       ETH_TXN       Ethernet Transmit Negative       0       Input to KSZ8041 Ethernet PHY         4       ETH_RXN       Ethernet Receive Negative       1       Input to KSZ8041 Ethernet PHY         5       3/3/A       3/3/Analog       P       Analog 3.3V Output from PHY Circuit         6       GND       Ground       P       Analog 3.3V Output from PHY Circuit         7       ETH_LED0       Ethernet LED1       0       Ethernet LED1 output from KS28041         8       ETH_LED1       Ethernet LED1       0       Ethernet LED1 output from KS28041         9       VBAT_IN       Vdd Battery Input       P       Vdd for battery backup of internal R         10       ALARM       Alarm Signal From Micro       0       0         11       RESET_IN       Reset Input       I       Reset input to POR IC TPS3801         12       RESET_OUT       Reset output from POR       0       Reset output from POR circuit         13       NC       Not connected       U       1         14       NC       Not connected       U       1         15       NC       Not connected       U       1         16       NC       Not connected       U       1         17	
4       ETH_RXN       Ethernet Receive Negative       I       Input to KSZ8041 Ethernet PHY         5       3V3A       3.3V Analog       P       Analog 3.3V Output from PHY Circuit         6       GND       Ground       P       Analog 3.3V Output from PHY Circuit         7       ETH_LED0       Ethernet LED0       O       Ethernet LED1 output from KSZ8041         8       ETH_LED1       Ethernet LED1       O       Ethernet LED1 output from KSZ8041         9       VBAT_IN       Vdd Battery Input       P       Vdd for battery backup of internal R         10       ALARM       Alarm Signal From Micro       O       Ethernet LED0       Reset input from POR IC TPS3801         12       RESET_OUT       Reset Output from POR       O       Reset output from POR circuit       I         13       NC       Not connected       U       Internet Connected       U       Internet Connected       U         16       NC       Not connected       U       Internet Connected       U       Internet Connected       Internet Connected       Internet Connected       Internet Connected       Internet Connected Connected       Internet Connected Conneconected Connected Coneconec	
5       3V3A       3.3V Analog       P       Analog 3.3V Output from PHY Circuit         6       GND       Ground       P         7       ETH_LEDO       Ethernet LED0       O       Ethernet LED1 output from KSZ8041         8       ETH_LED1       Ethernet LED1       O       Ethernet LED1 output from KSZ8041         9       VBAT_IN       Vdd Battery Input       P       Vdd for battery backup of internal R         10       ALARM       Alarm Signal From Micro       O       Ithernet LED1       O         11       RESET_IN       Reset Input       I       Reset output from POR CO       Reset output from POR circuit         13       NC       Not connected       U       U       144         14       NC       Not connected       U       17         15       NC       Not connected       U       17         19       NC       Not connected       U       12         20       NC       Not connected       U       12         21       VDDA       Vdd Analog       I       ADC Power Supply         22       VREF       Reference Voltage       I       ADC Ground         23       VSSA       VsS Analog       I	
6     GND     Ground     P       7     ETH_LED0     Ethernet LED0     O     Ethernet LED0 output from KS28041       8     ETH_LED1     Ethernet LED1     O     Ethernet LED1 output from KS28041       9     VBAT_IN     Vdd Battery Input     P     Vdd for battery backup of internal R       10     ALARM     Alarm Signal From Micro     O     Iterating to POR IC TPS3801       11     RESET_IN     Reset Input     I     Reset output from POR ic resident of the POR ic residen	
7ETH_LED0Ethernet LED00Ethernet LED0 output from KS280419VBAT_INVdd Battery InputPVdd for battery backup of internal R10ALARMAlarm Signal From Micro011RESET_INReset InputIReset input to POR IC TPS380112RESET_OUTReset Output from POR0Reset output from POR circuit13NCNot connectedU14NCNot connectedU15NCNot connectedU16NCNot connectedU19NCNot connectedU19NCNot connectedU20NCNot connectedU21VDDAVdd AnalogI22VREFReference VoltageI23VSSAVss AnalogI24GNDGroundP25GPI025_LCDPWRLCD Power EnableO26GPI025_LCDPWRLCD Power EnableO27GPI025_LCDPWRLCD ClockO28GPI025_LCDPWRLCD ClockO29GORonected to LPC1788 Port 2 bit 329GPI025_LCDPWRLCD Data Bit 4O20Connected to LPC1788 Port 2 bit 321GPI03_LCDVD4LCD Data Bit 5O23GPI03_LCDVD5LCD Data Bit 7O24GPI03_LCDVD4LCD Data Bit 7O25GPI03_LCDVD5LCD Data Bit 7O26GPI03_LCDVD6 <td></td>	
8       ETH_LED1       Ethernet LED1       0       Ethernet LED1 output from KSZ8041         9       VBAT_IN       Vdd Battery Input       P       Vdd for battery backup of internal R         10       ALARM       Alarm Signal From Micro       0       0         11       RESET_IN       Reset Input       1       Reset input to POR IC TPS3801         12       RESET_OUT       Reset Output from POR       0       Reset output from POR circuit         13       NC       Not connected       U       1         14       NC       Not connected       U       1         15       NC       Not connected       U       1         16       NC       Not connected       U       1         19       NC       Not connected       U       1         20       NC       Not connected       U       1         21       VDDA       Vdd Analog       1       ADC Power Supply         22       VREF       Reference Voltage       1       ADC Ground         24       GND       Ground       P       2       Gelo25_LCDPWR       LCD Power Enable       0       Connected to LPC1788 Port 2 bit 0         26       GPIO25_LCDPWR <t< td=""><td></td></t<>	
9       VBAT_IN       Vdd Battery Input       P       Vdd for battery backup of internal R         10       ALARM       Alarm Signal From Micro       O         11       RESET_IN       Reset Input       I       Reset input to POR IC TPS3801         12       RESET_OUT       Reset Output from POR       O       Reset output from POR circuit         13       NC       Not connected       U       U         14       NC       Not connected       U       U         15       NC       Not connected       U       U         16       NC       Not connected       U       U         18       NC       Not connected       U       U         19       NC       Not connected       U       U         20       NC       Not connected       U       U         21       VDDA       Vdd Analog       I       ADC Power Supply         22       VREF       Reference Voltage       I       ADC Ground         24       GND       Ground       P       E       GPIO25_LCDPWR       LCD Dower Enable       O       Connected to LPC1788 Port 2 bit 0         26       GPIO25_LCDEWR       LCD Dower Enable       O       Con	
10ALARMAlarm Signal From Micro011RESET_INReset InputIReset input to POR IC TPS380112RESET_OUTReset Output from POR0Reset output from POR circuit13NCNot connectedUU14NCNot connectedU15NCNot connectedU16NCNot connectedU17NCNot connectedU18NCNot connectedU19NCNot connectedU20NCNot connectedU21VDDAVdd AnalogI22VREFReference VoltageI23VSSAVss AnalogI24GNDGroundP25GPI025_LCDPWRLCD Power EnableOConnected to LPC1788 Port 2 bit 026GPI026_LCDLELCD Latch EnableOConnected to LPC1788 Port 2 bit 127GPI029_LCDCLKLCD ClockOConnected to LPC1788 Port 2 bit 328GPI029_LCDENABOConnected to LPC1788 Port 2 bit 329GPI031_LCDVD4LCD Data Bit 4OConnected to LPC1788 Port 2 bit 631GPI031_LCDVD5LCD Data Bit 7OConnected to LPC1788 Port 2 bit 634GPI034_LCDVD7LCD Data Bit 7OConnected to LPC1788 Port 2 bit 735GPI035GPI00UConnected to LPC1788 Port 2 bit 10	TC
11RESET_INReset InputIReset input to POR IC TPS380112RESET_OUTReset Output from POROReset output from POR circuit13NCNot connectedU14NCNot connectedU15NCNot connectedU16NCNot connectedU17NCNot connectedU18NCNot connectedU20NCNot connectedU21VDDAVdd AnalogI22VREFReference VoltageI23VSSAVss AnalogI24GNDGroundP25GPI025_LCDPWRLCD Power EnableO26GPI026_LCDLELCD Latch EnableOConnected to LPC1788 Port 2 bit 026GPI026_LCDLKLCD ClockOConnected to LPC1788 Port 2 bit 127GPI027_LCDCLKLCD ClockOConnected to LPC1788 Port 2 bit 329GPI030_LCDLPOConnected to LPC1788 Port 2 bit 331GPI031_LCDVD4LCD Data Bit 4OConnected to LPC1788 Port 2 bit 533GPI033_LCDVD6LCD Data Bit 7OConnected to LPC1788 Port 2 bit 735GPI035GPI0UConnected to LPC1788 Port 2 bit 10	
12RESET_OUTReset Output from POROReset output from POR circuit13NCNot connectedU14NCNot connectedU15NCNot connectedU16NCNot connectedU17NCNot connectedU18NCNot connectedU19NCNot connectedU20NCNot connectedU21VDDAVdd AnalogI22VREFReference VoltageI23VSSAVss AnalogI24GNDGroundP25GPI025_LCDPWRLCD Power EnableO26GPI025_LCDPWRLCD Power EnableO27GPI027_LCDCLKLCD ClockO28GPI030_LCDFPOConnected to LPC1788 Port 2 bit 129GPI029_LCDENABOConnected to LPC1788 Port 2 bit 331GPI031_LCDVD4LCD Data Bit 4OConnected to LPC1788 Port 2 bit 430GPI031_LCDVD5LCD Data Bit 6OConnected to LPC1788 Port 2 bit 531GPI033_LCDVD6LCD Data Bit 6OConnected to LPC1788 Port 2 bit 633GPI034_LCDVD7LCD Data Bit 7OConnected to LPC1788 Port 2 bit 735GPI035GPI0UConnected to LPC1788 Port 2 bit 7	
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28         GPI028_LCDFP         O         Connected to LPC1788 Port 2 bit 3           29         GPI029_LCDENAB         O         Connected to LPC1788 Port 2 bit 4           30         GPI030_LCDLP         O         Connected to LPC1788 Port 2 bit 5           31         GPI031_LCDVD4         LCD Data Bit 4         O         Connected to LPC1788 Port 2 bit 6           32         GPI032_LCDVD5         LCD Data Bit 5         O         Connected to LPC1788 Port 2 bit 7           33         GPI033_LCDVD6         LCD Data Bit 6         O         Connected to LPC1788 Port 2 bit 8           34         GPI034_LCDVD7         LCD Data Bit 7         O         Connected to LPC1788 Port 2 bit 9           35         GPI035         GPI0         U         Connected to LPC1788 Port 2 bit 10	
29GPI029_LCDENAB0Connected to LPC1788 Port 2 bit 430GPI030_LCDLP0Connected to LPC1788 Port 2 bit 531GPI031_LCDVD4LCD Data Bit 40Connected to LPC1788 Port 2 bit 632GPI032_LCDVD5LCD Data Bit 50Connected to LPC1788 Port 2 bit 733GPI033_LCDVD6LCD Data Bit 60Connected to LPC1788 Port 2 bit 834GPI034_LCDVD7LCD Data Bit 70Connected to LPC1788 Port 2 bit 935GPI035GPI0UConnected to LPC1788 Port 2 bit 10	
30         GPI030_LCDLP         0         Connected to LPC1788 Port 2 bit 5           31         GPI031_LCDVD4         LCD Data Bit 4         0         Connected to LPC1788 Port 2 bit 6           32         GPI032_LCDVD5         LCD Data Bit 5         0         Connected to LPC1788 Port 2 bit 7           33         GPI033_LCDVD6         LCD Data Bit 6         0         Connected to LPC1788 Port 2 bit 8           34         GPI034_LCDVD7         LCD Data Bit 7         0         Connected to LPC1788 Port 2 bit 9           35         GPI035         GPI0         U         Connected to LPC1788 Port 2 bit 10	
31         GPI031_LCDVD4         LCD Data Bit 4         0         Connected to LPC1788 Port 2 bit 6           32         GPI032_LCDVD5         LCD Data Bit 5         0         Connected to LPC1788 Port 2 bit 7           33         GPI033_LCDVD6         LCD Data Bit 6         0         Connected to LPC1788 Port 2 bit 8           34         GPI034_LCDVD7         LCD Data Bit 7         0         Connected to LPC1788 Port 2 bit 9           35         GPI035         GPI0         U         Connected to LPC1788 Port 2 bit 10	
32         GPI032_LCDVD5         LCD Data Bit 5         O         Connected to LPC1788 Port 2 bit 7           33         GPI033_LCDVD6         LCD Data Bit 6         O         Connected to LPC1788 Port 2 bit 8           34         GPI034_LCDVD7         LCD Data Bit 7         O         Connected to LPC1788 Port 2 bit 9           35         GPI035         GPIO         U         Connected to LPC1788 Port 2 bit 10	
33         GPIO33_LCDVD6         LCD Data Bit 6         O         Connected to LPC1788 Port 2 bit 8           34         GPIO34_LCDVD7         LCD Data Bit 7         O         Connected to LPC1788 Port 2 bit 9           35         GPIO35         GPIO         U         Connected to LPC1788 Port 2 bit 10	
34         GPIO34_LCDVD7         LCD Data Bit 7         O         Connected to LPC1788 Port 2 bit 9           35         GPIO35         GPIO         U         Connected to LPC1788 Port 2 bit 10	
35         GPI035         GPI0         U         Connected to LPC1788 Port 2 bit 10	
36         GPIO36         U         Connected to LPC1788 Port 2 bit 11	
37 3.3V 3.3V Power P	
38 GND Ground P	
39         3.3V         3.3V Power         P	
40 GND Ground P	
41         USBH_DP         USB Host Data Positive         B         Connected to LPC1788 USB Port A D	+
42         USBD_DP         USB Device Data Postive         B         Connected to LPC1788 USB Port B D	+
43 USBH_DM USB Host Data Negative B Connected to LPC1788 USB Port A D	-
44     USBD_DM     USB Device Data Negative     B     Connected to LPC1788 USB Port B Device Data Negative	-
45         GPIO45_LCDVD18         LCD Data Bit 18         O         Connected to LPC1788 Port 2 bit 12	
46GPIO46_LCDVD19LCD Data Bit 19OConnected to LPC1788 Port 2 bit 13	
47     GPI047_RD     GPI0 / CAN Receive Data     I     Connected to LPC1788 Port 0 bit 0	
48 GPI048_TD GPI0 / CAN Transmit Data O Connected to LPC1788 Port 0 bit 1	
49 GPIO49 GPIO B Connected to LPC1788 Port 0 bit 2	
50     GPIO50     GPIO     B     Connected to LPC1788 Port 0 bit 3	
51 GPI051 I2SRX CLK GPI0 / I2S Receive Clock O Connected to LPC1788 Port 0 bit 4	
51     61/05letting_ont     61/07/letting_ont       52     GPI052_I2SRX_WS     GPI0 / I2S Receive Write Sel     0     Connected to LPC1788 Port 0 bit 5	
52     61105_1834(100)     61107185 Receive Data     6     6       53     GPI053_12SRX_SDA     GPI0 / 12S Receive Data     I     Connected to LPC1788 Port 0 bit 6	
54     GPIO54     IST CLK     GPIO / IST reasmit Clock     O     Connected to LPC1788 Port 0 bit 7	
54     GHO54_1251X_2ELK     GHO7125 Transmit Crock     O     Connected to L C1788 Fort 0 bit 7       55     GPI055_12STX_WS     GPI0 / 125 Transmit Write Sel     O     Connected to LPC1788 Port 0 bit 8	
55GPIO56_12STX_SDAGPIO / 12S Transmit DataBConnected to LPC1788 Port 0 bit 9	
50GPIO50_1251X_SDAGPIO7125 Halishit DataDConnected to LPC1788 Port 0 bit 357GPIO57_TXDGPIO / Serial Transmit DataOConnected to LPC1788 Port 0 bit 10	
57     GPIO5     GPIO7 Serial Prairie Managine Data     0     Connected to LPC1788 Port 0 bit 10       58     GPIO58 RXD     GPIO / Serial Receive Data     I     Connected to LPC1788 Port 0 bit 11	
59     GPI059_USBH_PWRD     GPI0 / USB Host Power Detect     I     Connected to LPC1788 Port 0 bit 12       60     GPI060_USBD_UBLED     GPI0 / USB Device Up LED     O     Connected to LPC1788 Port 0 bit 13	
60     GPIO60_USBD_UPLED     GPIO / USB Device Up LED     O     Connected to LPC1788 Port 0 bit 13	
61     GPIO61_USBD_CON     GPIO / USB Device Connect     O     Connected to LPC1788 Port 0 bit 14       62     GPIO62_SGY     GPIO / USB Device Connect     O     Connected to LPC1788 Port 0 bit 14	
62 GPI062_SCK GPI0 / SPI Clock O Connected to LPC1788 Port 0 bit 15	
63         GPIO63         GPIO         O         Connected to LPC1788 Port 0 bit 16           61         63/64 </td <td></td>	
64         GPIO64_MISO         GPIO / SPI MISO         I         Connected to LPC1788 Port 0 bit 17	(used for EEPROM CS)
65     GPIO65_MOSI     GPIO / SPI MOSI     O     Connected to LPC1788 Port 0 bit 18	(used for EEPROM CS)

66	GPIO66 ESDA	GPIO / External I2C SDA	В	Connected to LPC1788 Port 0 bit 19
67	GPIO67 ESCL	GPIO / External I2C SDA	B I	Connected to LPC1788 Port 0 bit 19
68	GPIO68 USBH OVC	GPIO / USB Host Over Current	1	Connected to LPC1788 Port 0 bit 20
69	GPIO69 TPIRQ	GPIO / Touch IC IRQ Input	1	Connected to LPC1788 Port 0 bit 22
70	GPIO70 AD0.0	GPIO / ADO Bit 0	1	Connected to LPC1788 Port 0 bit 23
70	GPIO71 AD0.1	GPIO / AD0 Bit 1	1	Connected to LPC1788 Port 0 bit 24
72	GPIO72 AD0.2	GPIO / AD0 Bit 2	1	Connected to LPC1788 Port 0 bit 25
73	GPIO73 AD0.3	GPIO / ADO Bit 3	i	Connected to LPC1788 Port 0 bit 26
74	GPIO74 SDA	GPIO / User IO I2C Bus SDA	В	Connected to LPC1788 Port 0 bit 27
75	GPIO75 SCL	GPIO / User IO I2C Bus SCL	0	Connected to LPC1788 Port 0 bit 28
76	GND	Ground	Р	
77	GND	Ground	Р	
78	GPIO78 ACC IRQ	GPIO / Accelerometer IRQ	1	Connected to LPC1788 Port 1 bit 2
79	 GPIO79	GPIO	U	Connected to LPC1788 Port 1 bit 3
80	GPIO80 RTC IRQ	GPIO / RTC IRQ Input	1	Connected to LPC1788 Port 1 bit 5
81	GPIO81	Not connected	U	Connected to LPC1788 Port 1 bit 6
82	GPIO82	Not connected	U	Connected to LPC1788 Port 1 bit 7
83	GPIO83	Not connected	U	Connected to LPC1788 Port 1 bit 11
84	GPIO84	Not connected	U	Connected to LPC1788 Port 1 bit 12
85	GPIO85	Not connected	U	Connected to LPC1788 Port 1 bit 13
86	GPIO86_LED_BR	GPIO / LED Backlight Bright	0	Connected to LPC1788 Port 1 bit 18
87	GPIO87_USBH_PPWR	GPIO / USB Host Power Ctl	0	Connected to LPC1788 Port 1 bit 19
88	GPIO88_LCDVD10	LCD Data Bit 10	0	Connected to LPC1788 Port 1 bit 20
89	GPIO89_LCDVD11	LCD Data Bit 11	0	Connected to LPC1788 Port 1 bit 21
90	 GPIO90_LCDVD12	LCD Data Bit 12	0	Connected to LPC1788 Port 1 bit 22
91	 GPIO91_LCDVD13	LCD Data Bit 13	0	Connected to LPC1788 Port 1 bit 23
92	 GPIO92_LCDVD14	LCD Data Bit 14	0	Connected to LPC1788 Port 1 bit 24
93	GPIO93_LCDVD15	LCD Data Bit 15	0	Connected to LPC1788 Port 1 bit 25
94	GPIO94_LCDVD20	LCD Data Bit 16	0	Connected to LPC1788 Port 1 bit 26
95	GPIO95_LCDVD21	LCD Data Bit 17	0	Connected to LPC1788 Port 1 bit 27
96	GPIO96_LCDVD22	LCD Data Bit 22	0	Connected to LPC1788 Port 1 bit 28
97	GPIO97_LCDVD23	LCD Data Bit 23	0	Connected to LPC1788 Port 1 bit 29
98	GPIO98_USBD_VBUS	USB Device VBus Sense Input	I	Connected to LPC1788 Port 1 bit 30
99	GPIO99_AD0.5	GPIO or AD0.5	I	Connected to LPC1788 Port 1 bit 31
100	NC	Not connected	В	Unused
101	GND	Ground	Р	
102	GND	Ground	Р	
103	NC	Not connected	U	Unused
104	NC	Not connected	U	Unused
105	NC	Not connected	U	Unused
106	NC	Not connected	U	Unused
107	NC	Not connected	U	Unused
108	NC	Not connected	U	Unused
109	NC	Not connected	U	Unused
110	NC	Not connected	U	Unused
111	NC	Not connected	U	Unused
112	NC	Not connected	U	Unused
113	5V0	5.0V Power	P	
114	5V0	5.0V Power	Р	Unused
115 116	NC GRI0116	Not connected GPIO	UB	Unused
116	GPIO116	GPIO	В	Connected to LPC1788 Port 2 bit 14 Connected to LPC1788 Port 2 bit 15
/		1 517 157		CONNECTED TO FLET A DO FOLL & DIL TO
	GPIO117		-	Connected to LPC1788 Port 2 hit 19
118	GPIO118	GPIO	В	Connected to LPC1788 Port 2 bit 19
118 119	GPIO118 GPIO119	GPIO GPIO	B B	Connected to LPC1788 Port 2 bit 21
118 119 120	GPIO118 GPIO119 GPIO120	GPIO GPIO GPIO	B B B	Connected to LPC1788 Port 2 bit 21 Connected to LPC1788 Port 2 bit 22
118 119 120 121	GPI0118 GPI0119 GPI0120 GPI0121	GPIO GPIO GPIO GPIO	B B B B	Connected to LPC1788 Port 2 bit 21 Connected to LPC1788 Port 2 bit 22 Connected to LPC1788 Port 2 bit 23
118 119 120 121 122	GPI0118 GPI0119 GPI0120 GPI0121 GPI0122	GPIO GPIO GPIO GPIO GPIO	B B B B B B	Connected to LPC1788 Port 2 bit 21 Connected to LPC1788 Port 2 bit 22 Connected to LPC1788 Port 2 bit 23 Connected to LPC1788 Port 2 bit 25
118 119 120 121 122 123	GPI0118 GPI0119 GPI0120 GPI0121 GPI0122 GPI0123_SPKR	GPIO           GPIO           GPIO           GPIO           GPIO           GPIO           GPIO           GPIO	B B B B B O	Connected to LPC1788 Port 2 bit 21 Connected to LPC1788 Port 2 bit 22 Connected to LPC1788 Port 2 bit 23 Connected to LPC1788 Port 2 bit 25 Connected to LPC1788 Port 2 bit 26
118 119 120 121 122 123 124	GPI0118 GPI0119 GPI0120 GPI0121 GPI0122 GPI0123_SPKR GPI0124	GPIO	B B B B O B B	Connected to LPC1788 Port 2 bit 21 Connected to LPC1788 Port 2 bit 22 Connected to LPC1788 Port 2 bit 23 Connected to LPC1788 Port 2 bit 25
118 119 120 121 122 123 124 125	GPI0118 GPI0119 GPI0120 GPI0121 GPI0122 GPI0123_SPKR GPI0124 NC	GPIO         GPIO         GPIO         GPIO         GPIO         GPIO         GPIO         GPIO         Motion         GPIO         SPIO         GPIO         GPIO         SPIO         SPIO         SPIO         Not connected	B B B B O B U	Connected to LPC1788 Port 2 bit 21 Connected to LPC1788 Port 2 bit 22 Connected to LPC1788 Port 2 bit 23 Connected to LPC1788 Port 2 bit 25 Connected to LPC1788 Port 2 bit 26
118 119 120 121 122 123 124 125 126	GPI0118           GPI0119           GPI0120           GPI0121           GPI0122           GPI0123_SPKR           GPI0124           NC           NC	GPIO         GPIO         GPIO         GPIO         GPIO         GPIO         GPIO         GPIO         Mot connected         Not connected	B B B B O B U U U	Connected to LPC1788 Port 2 bit 21 Connected to LPC1788 Port 2 bit 22 Connected to LPC1788 Port 2 bit 23 Connected to LPC1788 Port 2 bit 25 Connected to LPC1788 Port 2 bit 26 Connected to LPC1788 Port 2 bit 27
118 119 120 121 122 123 124 125 126 127	GPI0118           GPI0119           GPI0120           GPI0121           GPI0122           GPI0123_SPKR           GPI0124           NC           NC           GPI0127_LCDVD2	GPIO         GPIO         GPIO         GPIO         GPIO         GPIO         GPIO         Mot connected         Not connected         LCD Data Bit 2	B B B B O B U U U O	Connected to LPC1788 Port 2 bit 21 Connected to LPC1788 Port 2 bit 22 Connected to LPC1788 Port 2 bit 23 Connected to LPC1788 Port 2 bit 25 Connected to LPC1788 Port 2 bit 26 Connected to LPC1788 Port 2 bit 27 Connected to LPC1788 Port 4 bit 28
118           119           120           121           122           123           124           125           126           127           128	GPI0118           GPI0119           GPI0120           GPI0121           GPI0122           GPI0123_SPKR           GPI0124           NC           NC           GPI0127_LCDVD2           GPI0128_LCDVD3	GPIO         GPIO         GPIO         GPIO         GPIO         GPIO         GPIO         Mot connected         Not connected         LCD Data Bit 2         LCD Data Bit 3	B B B B O B U U U	Connected to LPC1788 Port 2 bit 21 Connected to LPC1788 Port 2 bit 22 Connected to LPC1788 Port 2 bit 23 Connected to LPC1788 Port 2 bit 25 Connected to LPC1788 Port 2 bit 26 Connected to LPC1788 Port 2 bit 27
118           119           120           121           122           123           124           125           126           127           128           129	GPI0118           GPI0119           GPI0120           GPI0121           GPI0122	GPIO         GPIO         GPIO         GPIO         GPIO         GPIO         GPIO         Mot connected         Not connected         LCD Data Bit 2         LCD Data Bit 3         Ground	B           B           B           B           O           U           O           O           O           P	Connected to LPC1788 Port 2 bit 21 Connected to LPC1788 Port 2 bit 22 Connected to LPC1788 Port 2 bit 23 Connected to LPC1788 Port 2 bit 25 Connected to LPC1788 Port 2 bit 26 Connected to LPC1788 Port 2 bit 27 Connected to LPC1788 Port 4 bit 28
118           119           120           121           122           123           124           125           126           127           128           129           130	GPI0118           GPI0119           GPI0120           GPI0121           GPI0122           GPI0123_SPKR           GPI0124           NC           NC           GPI0127_LCDVD2           GPI0128_LCDVD3           GND	GPIO         GPIO         GPIO         GPIO         GPIO         GPIO         GPIO         Mot connected         Not connected         LCD Data Bit 2         LCD Data Bit 3         Ground         Ground	B           B           B           B           U           U           O           O           P           P	Connected to LPC1788 Port 2 bit 21 Connected to LPC1788 Port 2 bit 22 Connected to LPC1788 Port 2 bit 23 Connected to LPC1788 Port 2 bit 25 Connected to LPC1788 Port 2 bit 26 Connected to LPC1788 Port 2 bit 27 Connected to LPC1788 Port 2 bit 27 Connected to LPC1788 Port 4 bit 28 Connected to LPC1788 Port 4 bit 29
118           119           120           121           122           123           124           125           126           127           128           129	GPI0118           GPI0119           GPI0120           GPI0121           GPI0122	GPIO         GPIO         GPIO         GPIO         GPIO         GPIO         GPIO         Not connected         LCD Data Bit 2         LCD Data Bit 3         Ground         Ground         Not connected	B           B           B           B           O           U           O           O           O           P	Connected to LPC1788 Port 2 bit 21 Connected to LPC1788 Port 2 bit 22 Connected to LPC1788 Port 2 bit 23 Connected to LPC1788 Port 2 bit 25 Connected to LPC1788 Port 2 bit 26 Connected to LPC1788 Port 2 bit 27 Connected to LPC1788 Port 4 bit 28 Connected to LPC1788 Port 4 bit 29 Unused
118           119           120           121           122           123           124           125           126           127           128           129           130	GPI0118           GPI0119           GPI0120           GPI0121           GPI0122	GPIO         GPIO         GPIO         GPIO         GPIO         GPIO         GPIO         Mot connected         Not connected         LCD Data Bit 2         LCD Data Bit 3         Ground         Ground	B           B           B           B           U           U           O           O           P           P           U	Connected to LPC1788 Port 2 bit 21 Connected to LPC1788 Port 2 bit 22 Connected to LPC1788 Port 2 bit 23 Connected to LPC1788 Port 2 bit 25 Connected to LPC1788 Port 2 bit 26 Connected to LPC1788 Port 2 bit 27 Connected to LPC1788 Port 2 bit 27 Connected to LPC1788 Port 4 bit 28 Connected to LPC1788 Port 4 bit 29
118           119           120           121           122           123           124           125           126           127           128           129           130           131	GPI0118           GPI0119           GPI0120           GPI0121           GPI0122	GPIO         GPIO         GPIO         GPIO         GPIO         GPIO         GPIO         Not connected         LCD Data Bit 2         LCD Data Bit 3         Ground         Ground         Not connected         Not connected	B           B           B           B           U           U           O           O           P           P           U           U	Connected to LPC1788 Port 2 bit 21 Connected to LPC1788 Port 2 bit 22 Connected to LPC1788 Port 2 bit 23 Connected to LPC1788 Port 2 bit 25 Connected to LPC1788 Port 2 bit 26 Connected to LPC1788 Port 2 bit 27 Connected to LPC1788 Port 4 bit 28 Connected to LPC1788 Port 4 bit 29 Unused Unused

135     NC     Not connected     U     Unused       137     NC     Not connected     U     Unused       138     NC     Not connected     U     Unused       139     NC     Not connected     U     Unused       140     NC     Not connected     U     Unused       141     NC     Not connected     U     Unused       142     NC     Not connected     U     Unused       143     NC     Not connected     U     Unused       144     NC     Not connected     U     Unused       145     NC     Not connected     U     Unused       146     NC     Not connected     U     Unused       147     NC     Not connected     U     Unused       148     NC     Not connected     U     Unused       149     NC     Not connected     U     Unused       150     NC     Not connected     U     Unused       151     NC     Not connected     U     Unused       152     NC     Not connected     U     Unused       153     NC     Not connected     U     Unused       154     NC     Not connected <th></th>	
137         NC         Not connected         U         Unused           138         NC         Not connected         U         Unused           140         NC         Not connected         U         Unused           141         NC         Not connected         U         Unused           142         NC         Not connected         U         Unused           144         NC         Not connected         U         Unused           144         NC         Not connected         U         Unused           144         NC         Not connected         U         Unused           145         NC         Not connected         U         Unused           146         NC         Not connected         U         Unused           147         NC         Not connected         U         Unused           148         NC         Not connected         U         Unused           150         NC         Not connected         U         Unused           151         NC         Not connected         U         Unused           153         NC         Not connected         U         Unused           154	
138     NC     Not connected     U     Unused       140     NC     Not connected     U     Unused       141     NC     Not connected     U     Unused       142     NC     Not connected     U     Unused       143     NC     Not connected     U     Unused       144     NC     Not connected     U     Unused       145     NC     Not connected     U     Unused       146     NC     Not connected     U     Unused       147     NC     Not connected     U     Unused       148     NC     Not connected     U     Unused       150     NC     Not connected     U     Unused       151     NC     Not connected     U     Unused       152     NC     Not connected     U     Unused       153     NC     Not connected     U     Unused       154     NC     Not connected     U     Unused       155     NC     Not connected     U     Unused       156     NC     Not connected     U     Unused       157     NC     Not connected     U     Unused       158     NC     Not connected <td></td>	
139     NC     Not connected     U     Unused       140     NC     Not connected     U     Unused       141     NC     Not connected     U     Unused       142     NC     Not connected     U     Unused       143     NC     Not connected     U     Unused       144     NC     Not connected     U     Unused       144     NC     Not connected     U     Unused       146     NC     Not connected     U     Unused       147     NC     Not connected     U     Unused       148     NC     Not connected     U     Unused       149     NC     Not connected     U     Unused       150     NC     Not connected     U     Unused       151     NC     Not connected     U     Unused       152     NC     Not connected     U     Unused       154     NC     Not connected     U     Unused       155     NC     Not connected     U     Unused       156     NC     Not connected     U     Unused       157     NC     Not connected     U     Unused       158     NC     Not connected <td></td>	
140         NC         Not connected         U         Unused           141         NC         Not connected         U         Unused           142         NC         Not connected         U         Unused           144         NC         Not connected         U         Unused           144         NC         Not connected         U         Unused           145         NC         Not connected         U         Unused           146         NC         Not connected         U         Unused           147         NC         Not connected         U         Unused           148         NC         Not connected         U         Unused           150         NC         Not connected         U         Unused           151         NC         Not connected         U         Unused           152         NC         Not connected         U         Unused           154         NC         Not connected         U         Unused           155         NC         Not connected         U         Unused           156         NC         Not connected         U         Unused           157	
141     NC     Not connected     U     Unused       142     NC     Not connected     U     Unused       144     NC     Not connected     U     Unused       144     NC     Not connected     U     Unused       145     NC     Not connected     U     Unused       146     NC     Not connected     U     Unused       147     NC     Not connected     U     Unused       148     NC     Not connected     U     Unused       149     NC     Not connected     U     Unused       150     NC     Not connected     U     Unused       151     NC     Not connected     U     Unused       153     NC     Not connected     U     Unused       154     NC     Not connected     U     Unused       155     NC     Not connected     U     Unused       156     NC     Not connected     U     Unused       157     NC     Not connected     U     Unused       158     NC     Not connected     U     Unused       159     NC     Not connected     U     Unused       160     NC     Not connected <td></td>	
142     NC     Not connected     U     Unused       144     NC     Not connected     U     Unused       145     NC     Not connected     U     Unused       146     NC     Not connected     U     Unused       147     NC     Not connected     U     Unused       148     NC     Not connected     U     Unused       149     NC     Not connected     U     Unused       150     NC     Not connected     U     Unused       151     NC     Not connected     U     Unused       152     NC     Not connected     U     Unused       153     NC     Not connected     U     Unused       154     NC     Not connected     U     Unused       155     NC     Not connected     U     Unused       156     NC     Not connected     U     Unused       157     NC     Not connected     U     Unused       158     NC     Not connected     U     Unused       159     NC     Not connected     U     Unused       160     NC     Not connected     U     Unused       161     NC     Not connected <td></td>	
141     NC     Not connected     U     Unused       144     NC     Not connected     U     Unused       145     NC     Not connected     U     Unused       146     NC     Not connected     U     Unused       147     NC     Not connected     U     Unused       148     NC     Not connected     U     Unused       148     NC     Not connected     U     Unused       150     NC     Not connected     U     Unused       151     NC     Not connected     U     Unused       152     NC     Not connected     U     Unused       153     NC     Not connected     U     Unused       154     NC     Not connected     U     Unused       155     NC     Not connected     U     Unused       156     NC     Not connected     U     Unused       157     NC     Not connected     U     Unused       158     NC     Not connected     U     Unused       159     NC     Not connected     U     Unused       150     NC     Not connected     U     Unused       154     NC     Not connected <td></td>	
143     NC     Not connected     U     Unused       144     NC     Not connected     U     Unused       145     NC     Not connected     U     Unused       146     NC     Not connected     U     Unused       147     NC     Not connected     U     Unused       148     NC     Not connected     U     Unused       148     NC     Not connected     U     Unused       150     NC     Not connected     U     Unused       151     NC     Not connected     U     Unused       152     NC     Not connected     U     Unused       153     NC     Not connected     U     Unused       154     NC     Not connected     U     Unused       155     NC     Not connected     U     Unused       156     NC     Not connected     U     Unused       157     NC     Not connected     U     Unused       158     NC     Not connected     U     Unused       159     NC     Not connected     U     Unused       150     NC     Not connected     U     Unused       160     NC     Not connected <td></td>	
144     NC     Not connected     U     Unused       145     NC     Not connected     U     Unused       146     NC     Not connected     U     Unused       147     NC     Not connected     U     Unused       148     NC     Not connected     U     Unused       149     NC     Not connected     U     Unused       150     NC     Not connected     U     Unused       151     NC     Not connected     U     Unused       152     NC     Not connected     U     Unused       153     NC     Not connected     U     Unused       154     NC     Not connected     U     Unused       155     NC     Not connected     U     Unused       156     NC     Not connected     U     Unused       157     NC     Not connected     U     Unused       158     NC     Not connected     U     Unused       159     NC     Not connected     U     Unused       160     NC     Not connected     U     Unused       161     NC     Not connected     U     Unused       162     NC     Not connected <td></td>	
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147     NC     Not connected     U     Unused       148     NC     Not connected     U     Unused       150     NC     Not connected     U     Unused       151     NC     Not connected     U     Unused       152     NC     Not connected     U     Unused       153     NC     Not connected     U     Unused       154     NC     Not connected     U     Unused       155     NC     Not connected     U     Unused       156     NC     Not connected     U     Unused       157     NC     Not connected     U     Unused       158     NC     Not connected     U     Unused       159     NC     Not connected     U     Unused       159     NC     Not connected     U     Unused       160     NC     Not connected     U     Unused       161     NC     Not connected     U     Unused       162     NC     Not connected     U     Unused       163     GND     Ground     P       164     GND     Ground     P       165     NC     Not connected     U     Unused	
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192     Ne     Not connected     U     Unused       193     NC     Not connected     U     Unused	
193     NC     Not connected     0     Onused       194     NC     Not connected     U     Unused	
196 NC Not connected U Unused	-
197 NC Not connected U Unused	
198     NC     Not connected     U     Unused	
199 3.3V 3.3V Power P	
200 GND Ground P	

# 16. SOMDIMM Installation

The SOMDIMM-LPC1788 should be inserted into the DIMM Socket as shown below and then locked into place by pushing down to the Carrier Board. Ensure the SOMDIMM is inserted completely into the socket prior to locking. The socket utilized on the CARRIER Board is rated for a minimum of 25 insertions.



**Figure 7 – SOMDIMM Insertion** 

## 17. SOMDIMM Socket Details

The SOMDIMM-LPC1788 is designed to be used with a standard 200-pin DDR2 SO-DIMM Socket connector. An example connector part is as follows: Mfg: Tyco (AMP), Part Number: 1473005-5.

# 18. Mechanical Details



Figure 8 – SOMDIMM-LPC1788 Mechanical Details

## 19. Software

**μEZ**<sup>®</sup> takes its name from the Muses of Greek mythology. A Muse was a goddess who inspired the creation process for the arts and sciences. Like its ancient Greek namesake, the **μEZ**<sup>®</sup> platform inspires rapid development by supplying customers with an extensive library of open source software, drivers, and processor support - all under a common framework. **μEZ**<sup>®</sup> development works on the premise of "design once, reuse many times". This provides an open source standard for embedded developers to build upon and support. **μEZ**<sup>®</sup> allows companies to focus on innovation and on their own value-added applications while minimizing development time and maximizing software reuse.

The diagram below shows a typical embedded application stack. **µEZ**<sup>®</sup> has three primary categories of components that help simplify embedded application development:

- 1. Operating System Abstraction Layer (µEZ® OSAL)
- 2. Sub-system drivers (µEZ® TCP/IP, µEZ® USB, µEZ® Driver)
- 3. Hardware Abstraction Layer (µEZ® HAL)



The selection of an RTOS can be one of the most daunting aspects of an embedded system development. With **µEZ**<sup>®</sup> the primary features of common multi-tasking operating systems are abstracted, thus easing the transition to an open source or low-cost RTOS. The **µEZ**<sup>®</sup> OSAL provides applications access to the following features in an OS-independent fashion:

- Pre-emptive multitasking
- Stack overflow detection
- Unlimited number of tasks

- Queues
- Semaphores (binary, counting, mutex)

The **µEZ**<sup>®</sup> sub-system drivers utilize the OSAL functions to provide protected access to the processor peripherals. The sub-system driver API functions are typically protocol layer interfaces (TCP/IP, USB, etc) designed as high-level access routines such as open, close, read, write, etc. where possible.

The HAL functions provide single-threaded unprotected access to the processor peripherals. Customers can use the **µEZ**<sup>®</sup> HAL routines provided by FDI or they can write their own. The HAL routines provide for RTOS/**µEZ**<sup>®</sup> independence and allow portability within a family of processors.

**µEZ**<sup>®</sup> is ideally suited for Embedded Systems with standard features such as:

- Processor and Platform BSPs (Board Support Packages)
- Real Time Operating System (RTOS)
- Memory Management
- NAND/NOR Flash
- SDRAM and DDR Memory
- TCP/IP stack
- USB Device/Host Libraries
- Mass Storage Devices
- LCD Displays with Touch Screen
- Input / Output Devices

# 20. Configuring Keil µVision4 for J-Link Flashing

- 1) Plug in the J-Link device into the PC and install any drivers as directed.
- 2) Plug in the J-Link's JTAG connector to the SOMDIMM board at J3 with the JTAG adapter.
- 3) From the Menu Bar select Flash then Configure Flash Tools.
- 4) Under Use Target Driver for Flash Programming select the CortexM/R J-LINK/J-Trace

Options for Target 'Flash'
Device   Target   Output   Listing   User   C/C++   Asm   Linker   Debug   Utilities
Configure Flash Menu Command
Use Target Driver for Flash Programming
Cortex-M/R J-LINK/J-Trace Settings VDpdate Target before Debugging
Init File:
C Use External Tool for Flash Programming
Command:
Arguments:
E Run Independent
OK Cancel Defaults Help

5) Click the Debug tab then click the radial button Use and select the CortexM/R J-LINK/J-Trace in the drop down menu

Device   Target   Output   Listing   User   C/C++   Asm	Linker Debug Utilities		
C Use <u>S</u> imulator <u>Settings</u> ☐ Limit Speed to Real-Time	© Use: Cortex-M/R J-LINK/J-Trace ▼ Settings		
Load Application at Startup     Initialization File:      Edit	Load Application at Startup Initialization File:     Edit		
Restore Debug Session Settings Breakpoints Watch Windows & Performance Analyzer Memory Display	Restore Debug Session Settings Breakpoints   Toolbox Watch Windows Memory Display		
CPU DLL: Parameter: SARMCM3.DLL -MPU	Driver DLL: Parameter: SARMCM3.DLL MPU		
Dialog DLL: Parameter: DARMP1.DLL pLPC1768	Dialog DLL: Parameter: TARMP1.DLL -pLPC1768		

- 6) Click setting then Select the Flash Download tab
- 7) Click Add and the LPC17xx IAP 512KB Flash

Cortex JLink/JTrace Target Dr	iver Setup			
Debug Trace Flash Download				
Download Function C Erase Full Chip E Erase Sectors D onot Erase	<ul> <li>✓ Program</li> <li>✓ Verify</li> <li>✓ Reset and Run</li> </ul>	RAM for A	Algorithm 0x10000000 Size: 0x0800	
Programming Algorithm				- I
Description LPC17xx IAP 512kB Flash	Device Type On-chip Flash	Device Size 512k	Address Range	
		Start:	Size:	
	Add	Remove		
	OK	Cance	el	Help

8) Close the dialogs, compile the project then press Ctrl + F5 to start debugging

# 21. Functional Test Software

The functional test software tests all the features of the DK-TS-KIT. Additional hardware is required to test all the features, but these additional tests can be bypassed if the necessary hardware is not available.

## **Configuring the Functional Test setup**

Another DK-TS-KIT is required for complete functional testing. By connecting to another kit's serial and CAN port, the functional test can receive automatic responses for specific queries. The DK-TS-KIT only needs a version of firmware that has the FCT Loopback program. This document will refer to this second unit as the "loopback unit".

Start with a CARRIER board that is already connected as described above, but disconnect the PC to serial connection. Connect a null modem cable between the CARRIER RS232 port (P4) and the loopback unit's RS232 port (also P4). NOTE: A gender change may be required. Then connect a DB9 cable between the CARRIER CAN port (P3) and loopback unit's CAN port (also P3). Power will be provided to the loopback unit from the CARRIER CAN port. When the unit boots up, select **Settings** and then **FCT Loopback**. You are now ready to do the functional test.

### **Running Functional Test**

From the Main Menu, select Settings and then **Functional Test** to start the test. To abort the functional test, PRESS and HOLD the **Cancel** button. If the current test cannot be performed, press **Skip** to go to the next test. Most tests will run automatically and will report a green "Pass" or red "Fail" output. Some tests will require user input in the form of a question and a **Yes** or **No** response. If a test fails, the functional test will pause to show the error – press **OK** to continue.

The following tests are performed:

- SDRAM Memory is sized and a basic test is performed to confirm read/write access.
- LCD Colors Red, Green, and Blue are displayed in smooth bands to ensure the LCD lines are correct.
- External RTC The CARRIER board has an external NXP I2C PCF8563 Real Time Clock that is set to 1/1/2009, 8:00:00 and then sampled for 3 seconds to verify that it is operational.
- Internal RTC The LPC1788 has an internal RTC that is programmed to 1/1/2009, 8:00:00 and then sampled for 3 seconds to verify that it is operational.
- EEPROM The EEPROM is tested for communication and integrity.
- Temperature Sensor The CARRIER board has an external LM75A that is tested to be in a range of 20-30 C.
- Serial Port A serial command is sent to the loopback unit and a response detected.
- CAN Port An 8 byte message is sent via CAN to the loopback unit and a response detected.
- Micro SDCard A FAT formatted Micro SDCard that is inserted into the SOMDIMM-LPC1788 J2 slot is read to verify that the file TESTSDC.TXT is correct. (SDHC not supported)
- USB Host A FAT formatted USB Flash drive inserted into the CARRIER board P1 slot is read to verify that the file TESTUSB.TXT is correct.
- Accelerometer The on board accelerometer detects when the CARRIER board is rotated 90 degrees back (LCD facing towards the back and upside down) and then rotated forward 90 degrees (LCD facing forward and right side up).
- LEDs and Buttons All four LEDs (LED1 to LED4) on the CARRIER board are lit by pressing the push button switches SW1 to SW4.

- USB Device The CARRIER board is plugged into a PC via its USB Device port (P6) and acts as a keyboard. Pressing the Caps Lock key twice on the PC will continue the functional test.
- Speaker Tunes are played and the User is asked to verify that they are heard.
- Ethernet Waits for a web page hit at <a href="http://192.168.10.20/">http://192.168.10.20/</a>

A final report of PASS or FAIL is displayed along with a list of any Skipped and Failed items.

# 22. <u>Schematics</u>

Please see the website at:

http://www.teamfdi.com/SOMDIMM-LPC1788

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