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Email & Skype: info@chipsmall.com Web: www.chipsmall.com
Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

Cerebot 32MX7™ Board Reference Manual

Revision: October 20, 2011

Note: This document applies to REV C of the board.

www.digilentinc.com

1300 Henley Court | Pullman, WA 99163

(509) 334 6306 Voice and Fax

Overview

The Cerebot 32MX7 board is a useful tool for embedded control and network communications projects for both students and hobbyists.

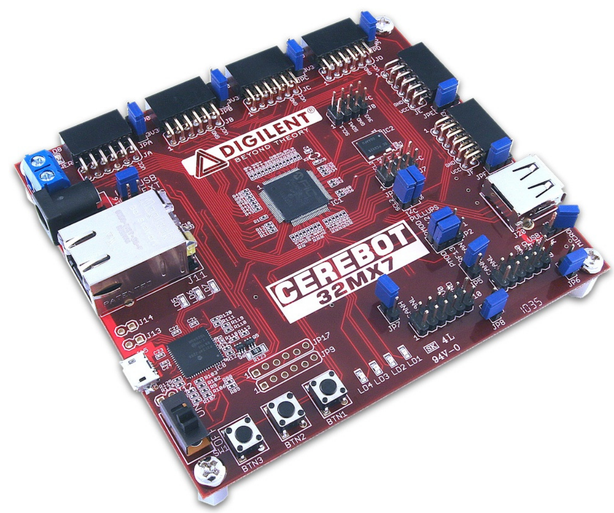
Its versatile design and programmable microcontroller lets you access numerous peripheral devices and program the board for multiple uses. The board has many I/O connectors and power supply options. It's network and communications features include 10/100 Ethernet interface, Full Speed USB 2.0 OTG interface, dual CAN network interfaces, dual I2C buses, up to three UART ports and up to three SPI ports.

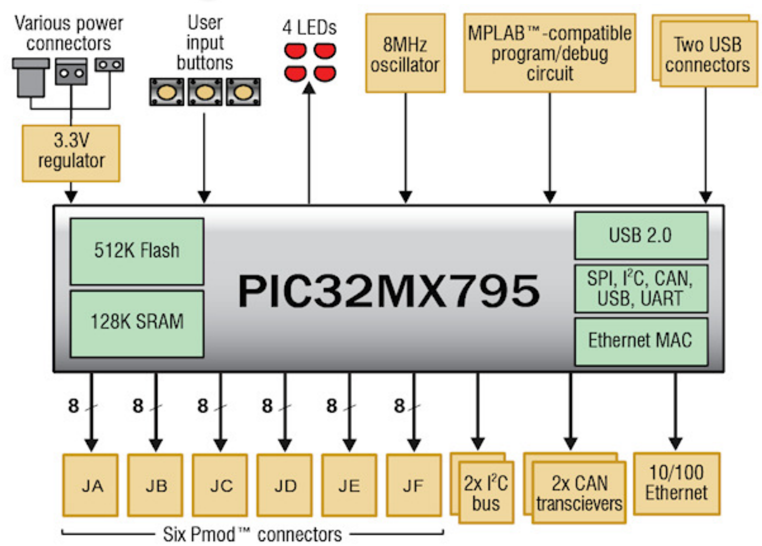
The Cerebot 32MX7 works with the Microchip MPLAB development environment and provides built in programming and debugging support within MPLAB.

The Cerebot 32MX7 provides a number of connections for peripheral devices. It has six connectors for attaching Digilent Pmod™ peripheral modules. Digilent Pmod peripheral modules include H-bridges, analog-to-digital and digital-to-analog converters, a speaker amplifier, switches, buttons, LEDs, as well as converters for easy connection to RS232, screw terminals, BNC jacks, servo motors, and more.

Features include:

- a PIC32MX795F512L microcontroller
- support for programming and debugging within the Microchip MPLAB development environment
- six Pmod connectors for Digilent peripheral module boards
- 10/100 Ethernet
- USB 2.0 Device, Host, and OTG support
- two CAN network interfaces
- three push buttons
- four LEDs
- multiple power supply options, including USB powered
- ESD protection and short circuit protection for all I/O pins.





Cerebot 32MX7 Circuit Diagram

Features of the PIC32MX795F512L include:

- 512KB internal program flash memory
- 128KB internal SRAM memory
- USB 2.0 compliant full-speed On-The-Go (OTG) controller with dedicated DMA channel
- 10/100 Ethernet controller
- two CAN network controllers
- up to four serial peripheral interfaces (SPI)
- up to six UART serial interfaces
- up to four I2C serial interfaces
- five 16-bit timer/counters
- five timer capture inputs
- five compare/PWM outputs
- sixteen 10-bit analog inputs
- two analog comparators

For more information on the PIC32MX795F512L microcontroller, refer to the PIC32MX5XX/6XX/7XX Family Data Sheet and the PIC32 Family Reference Manual available at www.microchip.com.

Functional Description

The Cerebot 32MX7 is designed for embedded control and network communications applications as well as general microprocessor experimentation. Firmware suitable for many applications can be downloaded to the Cerebot 32MX7's programmable PIC32 microcontroller.

The board has a number of input/output connection options, and is specially designed to work with the Digilent line of Pmod peripheral modules with various input and output functions. For more information, see www.digilentinc.com. In addition to the Pmod connectors, the board provides three push buttons and four LEDs for user i/o, as well as providing connections for two I2C busses. A serial EEPROM is provided on one of the I2C busses.

The Cerebot 32MX7 can be used with the Microchip MPLAB development environment. In-system-programming and debug of firmware running on the PIC32MX795 microcontroller is supported using an on-board program/debug circuit licensed from Microchip.

The Cerebot 32MX7 features a flexible power supply system with a number of options for powering the board as well as powering peripheral devices connected to the board. It can be USB powered via either the debug USB port or the USB device port, or it can be powered from an external power supply or batteries.

Programming and In-System Debugging Using the MPLAB® IDE

The Cerebot 32MX7 board is intended to be used with the Microchip MPLAB® IDE for firmware development, programming and in-system debugging using a circuit licensed from Microchip. MPLAB version 8.63 or later is required for use of the on-board program/debug circuit. The licensed debugger is accessed via USB, using connector J15. This connector is a micro-USB connector on the lower left side of the board, near the power switch. The provided USB cable should be connected from J15 to a USB port on the development PC for access to the board.

When creating a new project, use the `Configure.Select Device` menu to specify the PIC32 device in use. Ensure that the device is set to PIC32MX795F512L.

To use the on-board program/debug circuit it must be selected as the debugger or programmer within the MPLAB IDE. Use the `Debugger.Select Tool` menu, or the `Programmer.Select Tool` menu, and select "Licensed Debugger" as the programmer or debugger.

The in-system programming/debugging interface uses two pins on the PIC32 microcontroller. The PIC32 devices support two alternate pin pairs for this interface: PGC1/PGD1 or PGC2/PGD2. PIC32 devices use PGC2/PGD2 by default. Due to conflicting uses of the microcontroller pins, the Cerebot

32MX7 is designed to use PGC1/PGD1. Because of this, it is necessary to select the use of PGC1/PGD1 for the debugging interface. This is done using configuration variables set using the `#pragma config` statement. The following statement must be used to configure the microcontroller for use with the on-board licensed debugger circuit:

```
#pragma config ICESEL = ICS_PGx1
```

The MPLAB IDE may report an error indicating that the device is not configured for debugging until a program containing this statement has been programmed into the board.

Board Power Supply

Switch SW1, in the lower left corner of the board is the power switch. Place this switch in the ON position to turn on board power and in the OFF position to turn off board power.

There are three power options for main power to the board: USB powered from the debug USB connector, USB powered from the USB device connector, or external, non-USB powered. Jumper block J16, (above the Ethernet connector, J11) is used to select the main power source. To select USB powered from the debug connector, place the shorting block in the DBG position. To select USB power from the USB device connector, place the shorting block in the USB position. This option is used when the board is being used to implement a bus powered USB device. To power the board from an external power supply, place the shorting block in the EXT position. The board comes from the factor jumpered for USB power from the debug USB connector.

When powering the board from an external power supply, there are two power supply connectors that can be used: J17 and J18.

The barrel connector, J17, is used to power the board from a "wall wart" style power supply. This type of power supply is available from many sources. Digilent has an optional power supply available, the 5V Switching Power Supply, that can be used with connector J17. Connector J17 is a 2.5mm x 5.5mm coaxial connector wired with the center terminal as the positive voltage.

Connector J18 is a screw terminal connector for an alternative power supply connection for use with battery packs, bench supplies or other power sources where use of a hard wired power supply is desirable.

The Cerebot 32MX7 is rated for external power from 3.6 to 5.5 volts DC. Using a voltage outside this range will damage the board and connected devices. For most purposes, when using external power, a regulated 5V supply should be used. When operating the board from an external supply with a voltage less than 5V, some features of the board won't work correctly.

When the Cerebot 32MX7 is operating as a USB host, an external power supply connected to either J17 or J18 must be used to power the board. In addition to powering the logic on the Cerebot 32MX7 board, this supply provides the USB bus voltage supplied to any connected USB device and must be a regulated 5V with at least 500mA current capability to meet the USB specifications.

The CAN bus operates at 5V, and therefore the transceivers for the two CAN interfaces require 5V to operate correctly and within the CAN specification. When using the CAN network interfaces, the board should be operated from a 5V supply if using an external power supply.

Connectors J17, and J18 are wired in parallel and connect to the "External Power" position (center position) on the Power Select jumper block J16. A shorting block should be placed on the "EXT" position of J16 when using this option for board power. Only one of the external power connectors should be used at a time. If multiple power supplies are connected simultaneously, damage to the board or the power supplies may occur.

The power supply selected by the shorting block on J16 will appear on the input power supply bus, labeled VIN in the schematic. This voltage is regulated to 3.3V to power the debug circuit by IC11, a Microchip MCP1801 Low Dropout voltage regulator. This regulator is turned on and the debug circuit is powered whenever the power switch is in the on position.

The USB specification requires that USB devices not draw more than 100mA of current until they have enumerated on the USB bus and informed the host that they want to consume more current. To meet this specification, the debug circuit turns on main board power by driving the PWR_ON signal high after successfully enumerating on the USB bus. The bus labeled on the schematic as VCC5V0 is switched on when this occurs. The VCC5V0 bus powers the input to the main board voltage regulator, the input voltage to the USB bus voltage load switch used when using the board as a USB host, the power supply voltage for the CAN transceivers, and the 5V0 side of the power select jumpers for the Pmod connectors. The voltage on the VCC5V0 bus will be 5V when the board is being operated from USB power or an external regulated 5V supply. If a different external supply voltage is used, that voltage will appear on the VCC5V0 bus.

Note: The signal labeled DBG5V0 on the schematic comes from the debug USB connector. If the debug USB connector is not connected to a live USB port, this voltage will not be present and the debug circuit is not involved in turning on board power. In this case, the board power is turned on when the power switch is placed in the ON position.

The PIC32 microcontroller and on-board I/O devices operate at a supply voltage of 3.3V provided by the VCC3V3 bus. The regulated voltage on this bus is provided by a Microchip MCP1726 Low Dropout voltage regulator, IC10. This regulator is capable of providing a maximum of 1A of current. The PIC32 microcontroller will use approximately 85mA when running at 80MHz. The SMSC LAN8720 Ethernet PHY consumes approximately 45mA when operating at 100Mbps. The Microchip MCP2551 CAN transceivers can draw up to 75mA each when operating the CAN busses. The other circuitry on the board will draw 10-20 mA. The remaining current is available to provide power to attached Pmods and I^2C devices. The voltage regulator is on the bottom of the board, approximately under the "3" in the Cerebot 32MX7 logo, and will get warm when the amount of current being used is close to its limit.

The Cerebot 32MX7 can provide power to any peripheral modules attached to the Pmod connectors, JA-JF, and to I^2C devices powered from the I^2C daisy chain connectors, J7 and J8. Each Pmod connector provides power pins that can be powered from either the switched main power bus, VCC5V0, or regulated voltage, VCC3V3, by setting the voltage jumper block to the desired position. The I^2C power connectors only provide the regulated voltage, VCC3V3.

USB Interface

The PIC32MX795 microcontroller contains a USB 2.0 Compliant, Full Speed Device and On-The-Go (OTG) controller. This controller provides the following features:

- USB full speed host and device support
- Low speed host support
- USB OTG support
- Endpoint buffering anywhere in system RAM
- Integrated DMA to access system RAM and Flash memory.

The USB controller uses a phased lock loop, PLL, to generate the necessary USB clock frequency from the external primary oscillator input frequency. By default, this PLL is disabled. In order to use the USB controller, it is necessary to enable the USB PLL, and set the input divider to the correct value to generate a valid USB clock. The input to the USB PLL must be 4Mhz. The Cerebot 32MX7 provides an 8Mhz clock to the PIC32 microcontroller, so a USB PLL input divider value of 2 must be used. These parameters are set in the PIC32 microcontroller configuration registers using the `#pragma config` statement. The following statements must be used to configure the PIC32 microcontroller for use of the USB controller:

```
#pragma config UPLLEN = ON
#pragma config UPLLIDIV = DIV_2
```

When operating as a USB device, the Cerebot 32MX7 can be used as a self powered device or as a bus powered device. To operate as a self powered device, an external power supply should be connected to one of the external power connectors (J17 or J18) and a shorting block placed on the center, “EXT” position of J16. The external power supply must be a regulated 5V supply. To operate as a bus powered device, the shorting block should be placed in the USB Device position, “USB”, on J16.

Connector J19, on the bottom of the board in the lower right corner is the Device/OTG connector. This is a standard USB micro-AB connector. Connect a cable with a micro-A plug (optionally available from Digilent) from this connector to an available USB port on a PC or USB hub for device operation.

When operating as a USB host, the Cerebot 32MX7 must be externally powered. Connect a regulated 5V power supply to one of the external power connectors (J17, or J18) and ensure that the shorting block is in the center, “EXT” position of J16. The power supply used must be a regulated 5V supply. The Cerebot 32MX7 board provides power to the attached USB device when operating as a host, and the USB specification requires the use of a 5V power supply. NOTE: Providing a voltage greater than 5V can damage the Cerebot 32MX7 board and/or the USB device being used.

Jumper JP10 is used to route power to the host connector being used. Place the shorting block in the “A” position when using the standard USB type A (host) Connector, J20. Place the shorting block in the “MICRO” position for use with the USB micro-AB (OTG) connector, J19.

When operating as a USB host, the PIC32MX795 microcontroller controls application of power to the connected device via the VBUSON control pin (labeled P32_VBUSON in the schematic). Bus power is applied to the device by driving the VBUSON pin high. Power is removed from the device by driving the VBUSON pin low. The VBUSON pin is accessed via bit 3 of the U1OTGCON register.

The VBUSON pin drives the enable input of a TPS2051B Current-Limited Power Distribution Switch to control the application of USB power to the host connector. This switch has over-current detection capability and provides an over-current fault indication by pulling the signal P32_USBOC low. The over-current output pin can be monitored via the INT1/RE8 pin on the PIC32MX795 microcontroller. Details about the operation of the TPS2051B can be obtained from the data sheet available at the Texas Instruments web site.

There are reference designs available on the Microchip web site demonstrating both device and host operation of PIC32 microcontrollers. These reference designs are suitable to use for developing USB firmware for the Cerebot 32MX7 board.

Ethernet Interface

The Cerebot 32MX7 provides the ability to interface with 10Mbps or 100Mbps Ethernet networks. The PIC32MX795 microcontroller contains a 10/100 Ethernet Medium Access Controller (MAC). External to the microcontroller, the Cerebot 32MX7 board provides an SMSC LAN8720 Ethernet Physical Layer Transceiver (PHY). Together, the MAC and PHY in combination with an appropriate coupling transformer and RJ45 jack provide a standard 10/100 Ethernet interface.

The RJ45 connector J11, provides the physical connection to an Ethernet network using a standard Ethernet cable.

All devices on an Ethernet network must have a unique address. This address is used to direct packets on the network to a specific device and to identify the device that originated a packet. An Ethernet MAC uses a 48-bit address value, commonly called the “MAC Address”. These address values are globally unique to ensure that no two devices on a network can have conflicting addresses. MAC addresses are assigned by the IEEE. The address to use with the Cerebot 32MX7 is printed on a sticker attached to the bottom of the board. The address is a twelve digit hexadecimal number of the form: 00183Exxxxxx, where xxxxxx represents six hexadecimal digits. This value is used to initialize the Ethernet Controller MAC Station Address registers in the Ethernet controller of the PIC32MX795 microcontroller.

In order to connect to and operate with an Ethernet network, the PIC32 microcontroller must be running network protocol stack firmware. Normally, the TCP/IP (Transmission Control Protocol/Internet Protocol) network protocol is used and “TCP/IP Stack” software must be used. The Microchip Applications Library, available for download from the Microchip web site provides full protocol stack support compatible with the PIC32MX795 MAC and the LAN8720 PHY. Microchip also provides numerous example programs illustrating the use of their network protocol stack for various applications.

When not using the Microchip network protocol stack, refer to the manufacturer documentation for the PIC32MX795 and LAN8720, plus network protocol documentation, for operation of the Ethernet interface.

The PIC32MX795 microcontroller provides two alternate sets of pins that can be used to connect the MAC to the external PHY. It also provides two alternate standard MAC/PHY interface signaling conventions. The Cerebot 32MX7 is designed to use the standard (not the alternate) pins, and to use the RMII (not the MII) interface signaling convention. These options are selected using the configuration variables in the PIC32 microcontroller and are specified using the `#pragma config` statement. To enable the Ethernet controller in the correct configuration, the following statements must appear in the main program module:

```
#pragma config FETHIO=ON
#pragma config FMIIEN=OFF
```

The LAN8720 PHY has a reset signal, labeled NRST in the schematic, that can be used to reset the PHY. This signal is connected to the INT2/RE9 pin on the PIC32 microcontroller. The NRST signal is active low. Configure the microcontroller pin as an output and drive it low to reset the PHY, or drive it high to allow the PHY to come out of reset and begin operation. The NRST signal is pulled low on the board, so that the PHY is held in reset by default. To allow the PHY to operate, this pin must be driven high. This reset operation is not part of the Microchip network protocol stack, and so driving NRST high must be done before initializing the Microchip network stack.

CAN Interfaces

The Controller Area Network (CAN) standard is a control networking standard originally developed for use in automobile systems, but has since become a standard used in various industrial control and building automation networking applications as well.

The PIC32MX795 microcontroller contains two independent CAN network controllers. These CAN controllers in combination with two Microchip MCP2551 CAN transceivers allow the Cerebot 32MX7 board to operate on up to two independent CAN networks. Refer to the PIC32MX7XX data sheet and the PIC32 Family Reference Manual, plus CAN network documentation for information on operation of the CAN controllers and CAN networking in general.

The PIC32MX795 microcontroller provides two sets of pins that can be used to connect the CAN controllers to the external transceivers. The Cerebot 32MX7 is designed to use the alternate (not the standard) pins. This selection is made using the configuration variables in the microcontroller, set using a `#pragma config` statement. To select the use of the alternate interface pins, the following statement must appear in the main program module:

```
#pragma config FCANIO=OFF
```

The pins on the PIC32MX795 microcontroller used by signals for the CAN1 controller to connect to its transceiver are shared with two of the signals for UART3A and SPI port 3A. Jumpers JP1 and JP2 are used to select the use of these two signals. Place JP1 and JP2 in the CAN position for use of the CAN1 network interface. Place JP1 and JP2 in the PMOD position for use of these signals for UART or SPI operation. These signals connect to pins 1 & 4 of Pmod connector JF. When JP1 and JP2 are in the CAN position, Pins 1 & 4 of Pmod connector JF are not useable.

There is no standard connector for use with CAN networks. The Cerebot 32MX7 board provides two 2x6 pin header connectors for access to the CAN signals. Connector J9 provides access to the signals for the CAN1 network controller, and connector J10 provides access to the signals for CAN2. Refer to the schematic for the Cerebot 32MX7 board for information on the connectors and signals. Digilent 6-pin or 2x6 to dual 6-pin cables can be used to daisy chain Digilent boards together in a CAN network. A Digilent 6-Pin cable in combination with a Digilent PmodCON1 Screw Terminal Connector module can be used to connect the Cerebot 32MX7 board to other network wiring configurations.

The CAN network standard requires that the network nodes at each end of a network provide 120 ohm termination. The Cerebot 32MX7 provides the termination resistors and jumpers to enable/disable the termination resistors depending on the location of the board in the network. Jumper JP5 is used to enable/disable the termination resistor for the CAN1 network connector, and JP7 is used to enable/disable the termination resistor for CAN2. Install a shorting block on the jumper pins to enable the termination resistor, or remove the shorting block to disable the termination resistor.

I^{2}C™ Interfaces

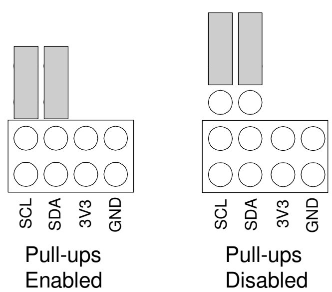
The Inter-Integrated Circuit (I^{2}C™) Interface provides a medium speed (100K or 400K bps) synchronous serial communications bus. The I^{2}C interface provides master and slave operation using either 7 bit or 10 bit device addressing. Each device is given a unique address, and the protocol provides the ability to address packets to a specific device or to broadcast packets to all devices on the bus. Refer to the Microchip PIC32MX7XX Data Sheet and the PIC32 Family Reference Manual for detailed information on configuring and using the I^{2}C interface.

The PIC32MX795 microcontroller provides for up to five independent I^{2}C interfaces. The Cerebot 32MX7 is designed to provide dedicated access to two of these interfaces I2C #1 and I2C #2. There are two sets of connectors on the board for access to the two I^{2}C ports. Connector J8 provides access to I2C #1 while connector J7 provides access to I2C #2.

Each I^{2}C connector provides two positions for connecting to the I^{2}C signals, power and ground. By using two-wire or four-wire MTE cables (available separately from Digilent) a daisy chain of multiple Cerebot 32MX7 boards or other I^{2}C-capable boards can be created.

The I^{2}C bus is an open-collector bus. Devices on the bus actively drive the signals low. The high state on the I^{2}C signals is achieved by pull-up resistors when no device is driving the lines low. One device on the I^{2}C bus must provide the pull-up resistors. On the Cerebot 32MX7, I2C #1 has permanently connected pull-up resistors. I2C #2 provides selectable pull-up resistors that can be enabled or disabled via jumper blocks on the 'pull-up' positions on connector J2. The pull-ups are enabled by installing shorting blocks and are disabled by removing the shorting blocks. The shorting blocks are placed so that they line up with the SCL and SDA labels on the board. Only one device on the bus should have the pull-ups enabled.

The pull-up resistors on I2C #2 on the Cerebot 32MX7 board are actually implemented using current mirrors rather than simple resistors. These current mirrors source approximately 1.7mA. The use of current mirrors provides faster rise times on the I2C signals and provides the ability to drive longer cable runs reliably than would be the case with simple pull-up resistors.



Jumper Settings for I²C Pull-Up Resistors

On-Board I2C Peripheral Device

The Cerebot 32MX7 provides one on-board I²C peripheral device, a Microchip 24LC256 serial EEPROM. This device is connected to I2C #1. The 24LC256 is a 256Kbit (32Kbyte) serial EEPROM device to provide non-volatile memory storage. The device address for the 24LC256 is 1010000 (0x50).

Refer to the Microchip data sheet for detailed information on the operation of this device.

Pmod Connectors

The Cerebot 32MX7 has six Pmod connectors for connecting Digilent Pmod peripheral modules. Digilent Pmods are a line of small peripheral modules that provide various kind of I/O interfaces. The Pmod line includes such things as button, switch and LED modules, connector modules, LCD displays, high current output drivers, and many others.

There are two styles of Pmod connector: six-pin and twelve-pin. Both connectors use standard pin headers with 100mil spaced pins. The six-pin connectors have the pins in a 1x6 configuration, while the twelve-pin connectors use a 2x6 configuration. The six-pin connectors provide four I/O signals, ground and a switchable power connection. The twelve-pin connectors provide eight I/O signals, two power and two ground pins. The twelve-pin connectors have the signals arranged so that one twelve-pin connector is equivalent to two of the six-pin connectors. The power connection is switchable between the regulated 3.3V main board supply and the unregulated input supply.

Digilent Pmod peripheral modules can either be plugged directly into the connectors on the Cerebot 32MX7 or attached via cables. Digilent has a variety of Pmod interconnect cables available.

See the "Connector and Jumper Block Pinout Tables" section below for more information about connecting peripheral modules and other devices to the Cerebot 32MX7. These tables indicate the mapping between pins on the PIC32MX795 microcontroller and the pins on the various connectors.

User I/O Devices

The Cerebot 32MX7 board provides three push button switches for user input and four LEDs for output. The buttons, BTN1 and BTN2 are connected to I/O pins RG6, RG7 and RD13 respectively. To read the buttons, bits 6 and 7 of PORTG and/or bit 13 of PORTD must be set as inputs by setting the corresponding bits in the TRISG and/or TRISD register and then reading the PORTG and/or PORTD register. When a button is pressed, the corresponding bit will be high ('1').

The four LEDs are connected to bits 12-15 of PORTG. LED 1 is connected to bit 12, LED 2 is connected to bit 13, and so on. To use the LEDs, set the desired bits as outputs by clearing the corresponding bits in the TRISG register and set the bits to the desired value in the PORTG register. Setting a bit to 1 will illuminate the LED and setting the bit to 0 will turn it off.

CPU Clock Source

The PIC32 microcontroller supports numerous clock source options for the main processor operating clock. The Cerebot 32MX7 board is designed to support either a silicon resonator from Discera, IC2, for use with the EC oscillator option, or an external crystal for use with the XT oscillator option. Standard production boards will have an 8Mhz Discera silicon resonator loaded and the EC oscillator option should be used. If IC2 is not loaded, an 8Mhz crystal will be loaded for X1 (on the bottom of the board) and the XT oscillator option should be used. Oscillator options are selected via the configuration settings specified using the #pragma config statement. Use `#pragma config POSCMOD=EC` to select the EC option and `#pragma config POSCMOD=XT` to select the XT option.

Using the internal system clock phase-locked loop (PLL), it is possible to select numerous multiples or divisions of the 8Mhz oscillator to produce CPU operating frequencies up to 80Mhz. The clock circuit PLL provides an input divider, multiplier, and output divider. The external clock frequency (8Mhz) is first divided by the input divider value selected. This is multiplied by the selected multiplier value and then finally divided by the selected output divider. The result is the system clock, SYSCLK, frequency. The SYSCLK frequency is used by the CPU, DMA controller, interrupt controller and pre-fetch cache.

The operating frequency is selected using the PIC32MX795 configuration variables. These are set using the `#pragma config` statement. Use `#pragma config FPLLIDIV` to set the input divider, `#pragma config FPLLMUL` to set the multiplication factor and `#pragma config FPLLODIV` to set the output divider. Refer to the PIC32MX5XX/6XX/7XX Family Data Sheet and the PIC32MX Family Reference Manual, Section 6. Oscillators for information on how to choose the correct values, as not all combinations of multiplication and division factors will work.

In addition to configuring the SYSCLK frequency, the peripheral bus clock, PBCLK, frequency is also configurable. The peripheral bus clock is used for most peripheral devices, and in particular is the clock used by the timers, and serial controllers (UART, SPI, I2C). The PBLCK frequency is a division of the SYSCLK frequency selected using `#pragma config FPBDIV`. The PBCLK divider can be set to divide by 1, 2, 4, or 8.

The following example will set up the Cerebot 32MX7 for operation with a SYSCLK frequency of 80Mhz and a PBCLK frequency of 10Mhz:

```
#pragma config FNOSC = PRIPLL
#pragma config POSCMOD = EC
#pragma config FPLLIDIV = DIV_2
#pragma config FPLLMUL = MUL_20
#pragma config FPLLODIV = DIV_1
#pragma config FPBDIV = DIV_8
```

Appendix A: Example of Configuration Values

The following example illustrates setting the configuration values in the PIC32 microcontroller on the Cerebot 32MX7. The microcontroller configuration should be done in a single source file in the project, and is typically done in the 'main' project source file. This example sets all configuration values to valid values for the Cerebot 32MX7 board. It sets the system clock for processor operation at 80Mhz, and the peripheral bus at 10Mhz.

```
/* ------------------------------------------------------------ */
/*                PIC32 Configuration Settings                  */
/* ------------------------------------------------------------ */

/* Oscillator Settings
*/
#pragma config FNOSC     = PRIPLL    // Oscillator selection
#pragma config POSCMOD   = EC        // Primary oscillator mode
#pragma config FPLLIDIV  = DIV_2     // PLL input divider
#pragma config FPLLMUL   = MUL_20    // PLL multiplier
#pragma config FPLLODIV  = DIV_1     // PLL output divider
#pragma config FPBDIV    = DIV_8     // Peripheral bus clock divider
#pragma config FSOSCEN   = OFF       // Secondary oscillator enable

/* Clock control settings
*/
#pragma config IESO      = OFF       // Internal/external clock switchover
#pragma config FCKSM     = CSDCMD    // Clock switching (CSx)/Clock monitor (CMx)
#pragma config OSCIOFNC  = OFF       // Clock output on OSCO pin enable

/* USB Settings
*/
#pragma config UPLLEN    = ON        // USB PLL enable
#pragma config UPLLIDIV  = DIV_2     // USB PLL input divider
#pragma config FVBUSONIO = OFF       // VBUS pin control
#pragma config FUSBIDIO  = OFF       // USBID pin control

/* Other Peripheral Device settings
*/
#pragma config FWDTEN    = OFF       // Watchdog timer enable
#pragma config WDTPS     = PS1024    // Watchdog timer post-scaler
#pragma config FSRSSEL   = PRIORITY_7 // SRS interrupt priority
#pragma config FCANIO    = OFF       // Standard/alternate CAN pin select
#pragma config FETHIO    = ON        // Standard/alternate ETH pin select
#pragma config FMIIEN    = OFF       // MII/RMII select (OFF=RMII)

/* Code Protection settings
*/
#pragma config CP        = OFF       // Code protection
#pragma config BWP       = OFF       // Boot flash write protect
#pragma config PWP       = OFF       // Program flash write protect

/* Debug settings
*/
#pragma config ICESEL    = ICS_PGx1  // ICE pin selection
```

Appendix B: Connector and Jumper Block Pinout Tables

MCU Port Bit to Pmod Connector Pin

MCU Port Bit	Signal	Connector Pin	Notes
RA00	TMS/RA0	JF-07	
RA01	TCK/RA1	JF-08	
RA02	SCL2/RA2	N/A	I2C Bus #2, not shared with Pmod connector
RA03	SDA2/RA3	N/A	I2C Bus #2, not shared with Pmod connector
RA04	TDI/RA4	JF-09	
RA05	TDO/RA5	JF-10	
RA06	TRCLK/RA6	JE-07	
RA07	TRD3/RA7	JE-08	
RA09	Vref-/CVref-/AERXD2/PMA7/RA9	JE-09	
RA10	Vref+/CVref+/AERXD3/PMA6/RA10	JE-10	
RA14	AETXCLK/SCL1/INT3/RA14	N/A	I2C Bus #1, not shared with Pmod connector
RA15	AETXEN/SDA1/INT4/RA15	N/A	I2C Bus #1, not shared with Pmod connector
RB00	PGED1/AN0/CN2/RB0	N/A	Used by debug circuit, PGC
RB01	PGEC1/AN1/CN3/RB1	N/A	Used by debug circuit, PGD
RB02	AN2/C2IN-/CN4/RB2	JA-01	
RB03	AN3/C2IN+/CN5/RB3	JA-02	
RB04	AN4/C1IN-/CN6/RB4	JA-03	
RB05	AN5/C1IN+/VBUSON/CN7/RB5	N/A	USB VBUSON
RB06	PGEC2/AN6/OCFA/RB6	JA-04	
RB07	PGED2/AN7/RB7	JA-07	
RB08	AN8/C1OUT/RB8	JA-08	
RB09	AN9/C2OUT/RB9	JA-09	
RB10	CVrefout/PMA13/AN10/RB10	JA-10	
RB11	AN11/ERXERR/AETXERR/PMA12/RB11	N/A	Ethernet PHY
RB12	AN12/ERXD0/AECRS/PMA11/RB12	N/A	Ethernet PHY
RB13	AN13/ERXD1/AECOL/PMA10/RB13	N/A	Ethernet PHY
RB14	AN14/ERXD2/AETXD3/PMALH/PMA1/RB14	JC-10	
RB15	AN15/…/OCFB/PMALL/PMA0/CN12/RB15	JC-07	
RC01	T2CK/RC1	JC-01	
RC02	T3CK/AC2TX/RC2	N/A	CAN2 Transceiver
RC03	T4CK/AC2RX/RC3	N/A	CAN2 Transceiver
RC04	T5CK/SDI1/RC4	JD-03	
RC12	OSC1/CLKI/RC12	N/A	Primary Oscillator Crystal
RC13	SOSCI/CN1/RC13	N/A	Secondary Oscillator Crystal
RC14	SOSCO/T1CK/CN0/RC14	N/A	Secondary Oscillator Crystal
RC15	OSC2/CLKO/RC15	N/A	Primary Oscillator Crystal
RD00	SDO1/OC1/INT0/RD0	JD-02	
RD01	OC2/RD1	JD-07	
RD02	OC3/RD2	JD-08	
RD03	OC4/RD3	JD-09	
RD04	OC5/PMWR/CN13/RD4	JC-09	
RD05	PMRD/CN14/RD5	JC-08	
RD06	ETXEN/PMD14/CN15/RD6	N/A	Ethernet PHY
RD07	ETXCLK/PMD15/CN16/RD7	JC-04	
RD08	RTCC/EMDIO/AEMDIO/IC1/RD8	N/A	Ethernet PHY

RD09	SS1/IC2/RD9	JD-01	
RD10	SCK1/IC3/PMCS2/PMA15/RD10	JD-04	
RD11	EMDC/AEMDC/IC4/PMCS1/PMA14/RD11	N/A	Ethernet PHY
RD12	ETXD2/IC5/PMD12/RD12	JD-10	
RD13	ETXD3/PMD13/CN19/RD13	N/A	BTN3
RD14	AETXD0/SS1A/U1BRX/U1ACTS/CN20/RD14	JE-01	
RD15	AETXD1/SCK1A/U1BTX/U1ARTS/CN21/RD15	JE-04	
RE00	PMD0/RE0	JB-01	
RE01	PMD1/RE1	JB-02	
RE02	PMD2/RE2	JB-03	
RE03	PMD3/RE3	JB-04	
RE04	PMD4/RE4	JB-07	
RE05	PMD5/RE5	JB-08	
RE06	PMD6/RE6	JB-09	
RE07	PMD7/RE7	JB-10	
RE08	AERXD0/INT1/RE8	N/A	USB Overcurrent detect
RE09	AERXD1/INT2/RE9	N/A	Ethernet PHY Reset
RF00	C1RX/ETXD1/PMD11/RF0	N/A	Ethernet PHY
RF01	C1TX/ETXD0/PMD10/RF1	N/A	Ethernet PHY
RF02	SDA1A/SDI1A/U1ARX/RF2	JE-03	
RF03	USBID/RF3	N/A	USBID (USB-4)
RF04	SDA3A/SDI3A/U3ARX/PMA9/CN17/RF4	JF-03	
RF05	SCL3A/SDO3A/U3ATX/PMA8/CN18/RF5	JF-02	
RF08	SCL1A/SDO1A/U1ATX/RF8	JE-02	
RF12	AC1RX/SS3A/U3BRX/U3ACTS/RF12	JF-01	shared with CAN1 Transceiver (JP-1)
RF13	AC1TX/SCK3A/U3BTX/U3ARTS/RF13	JF-04	shared with CAN1 Transceiver (JP-2)
RG00	C2RX/PMD8/RG0	JC-02	
RG01	C2TX/ETXERR/PMD9/RG1	JC-03	
RG02	D+/RG2	N/A	D+ (USB-3)
RG03	D-/RG3	N/A	D- (USB-2)
RG06	ECOL/SCK2A/U2BTX/U2ARTS/PMA5/CN8/RG6	N/A	BTN1
RG07	ECRS/SDA2A/SDI2A/U2ARX/PMA4/CN9/RG7	N/A	BTN2
RG08	…/SCL2A/SDO2A/U2ATX/PMA3/CN10/RG8	N/A	Ethernet PHY
RG09	…/SS2A/U2BRX/U2ACTS/PMA2/CN11/RG9	N/A	Ethernet PHY
RG12	TRD1/RG12	N/A	LED1
RG13	TRD0/RG13	N/A	LED2
RG14	TRD2/RG14	N/A	LED3
RG15	AERXERR/RG15	N/A	LED4

Pmod Connector Pin to MCU Port bit

Connector Pin	Signal	MCU Port Bit	Notes
JA-01	AN2/C2IN-/CN4/RB2	RB02	
JA-02	AN3/C2IN+/CN5/RB3	RB03	
JA-03	AN4/C1IN-/CN6/RB4	RB04	
JA-04	PGEC2/AN6/OCFA/RB6	RB06	
JA-07	PGED2/AN7/RB7	RB07	
JA-08	AN8/C1OUT/RB8	RB08	
JA-09	AN9/C2OUT/RB9	RB09	
JA-10	CVrefout/PMA13/AN10/RB10	RB10	
JB-01	PMD0/RE0	RE00	
JB-02	PMD1/RE1	RE01	
JB-03	PMD2/RE2	RE02	
JB-04	PMD3/RE3	RE03	
JB-07	PMD4/RE4	RE04	
JB-08	PMD5/RE5	RE05	
JB-09	PMD6/RE6	RE06	
JB-10	PMD7/RE7	RE07	
JC-01	T2CK/RC1	RC01	
JC-02	C2RX/PMD8/RG0	RG00	
JC-03	C2TX/ETXERR/PMD9/RG1	RG01	
JC-04	ETXCLK/PMD15/CN16/RD7	RD07	
JC-07	AN15/…/OCFB/PMALL/PMA0/CN12/RB15	RB15	
JC-08	PMRD/CN14/RD5	RD05	
JC-09	OC5/PMWR/CN13/RD4	RD04	
JC-10	AN14/ERXD2/AETXD3/PMALH/PMA1/RB14	RB14	
JD-01	SS1/IC2/RD9	RD09	
JD-02	SDO1/OC1/INT0/RD0	RD00	
JD-03	T5CK/SDI1/RC4	RC04	
JD-04	SCK1/IC3/PMCS2/PMA15/RD10	RD10	
JD-07	OC2/RD1	RD01	
JD-08	OC3/RD2	RD02	
JD-09	OC4/RD3	RD03	
JD-10	ETXD2/IC5/PMD12/RD12	RD12	
JE-01	AETXD0/SS1A/U1BRX/U1ACTS/CN20/RD14	RD14	
JE-02	SCL1A/SDO1A/U1ATX/RF8	RF08	
JE-03	SDA1A/SDI1A/U1ARX/RF2	RF02	
JE-04	AETXD1/SCK1A/U1BTX/U1ARTS/CN21/RD15	RD15	
JE-07	TRCLK/RA6	RA06	
JE-08	TRD3/RA7	RA07	
JE-09	Vref-/CVref-/AERXD2/PMA7/RA9	RA09	
JE-10	Vref+/CVref+/AERXD3/PMA6/RA10	RA10	
JF-01	AC1RX/SS3A/U3BRX/U3ACTS/RF12	RF12	shared with CAN1 Transceiver (JP-1)
JF-02	SCL3A/SDO3A/U3ATX/PMA8/CN18/RF5	RF05	
JF-03	SDA3A/SDI3A/U3ARX/PMA9/CN17/RF4	RF04	
JF-04	AC1TX/SCK3A/U3BTX/U3ARTS/RF13	RF13	shared with CAN1 Transceiver (JP-2)
JF-07	TMS/RA0	RA00	
JF-08	TCK/RA1	RA01	

JF-09	TDI/RA4	RA04	
JF-10	TDO/RA5	RA05	
N/A	SCL2/RA2	RA02	I2C bus #2, not shared with Pmod connector
N/A	SDA2/RA3	RA03	I2C bus #2, not shared with Pmod connector
N/A	AETXCLK/SCL1/INT3/RA14	RA14	I2C Bus #1, not shared with Pmod connector
N/A	AETXEN/SDA1/INT4/RA15	RA15	I2C Bus #1, not shared with Pmod connector
N/A	PGED1/AN0/CN2/RB0	RB00	Used by debug circuit, PGC
N/A	PGEC1/AN1/CN3/RB1	RB01	Used by debug circuit, PGD
N/A	AN5/C1IN+/VBUSON/CN7/RB5	RB05	USB VBUSON
N/A	AN11/ERXERR/AETXERR/PMA12/RB11	RB11	Ethernet PHY
N/A	AN12/ERXD0/AECRS/PMA11/RB12	RB12	Ethernet PHY
N/A	AN13/ERXD1/AECOL/PMA10/RB13	RB13	Ethernet PHY
N/A	OSC1/CLKI/RC12	RC12	Primary Oscillator Crystal
N/A	SOSCI/CN1/RC13	RC13	Secondary Oscillator Crystal
N/A	SOSCO/T1CK/CN0/RC14	RC14	Secondary Oscillator Crystal
N/A	OSC2/CLKO/RC15	RC15	Primary Oscillator Crystal
N/A	ETXEN/PMD14/CN15/RD6	RD06	Ethernet PHY
N/A	RTCC/EMDIO/AEMDIO/IC1/RD8	RD08	Ethernet PHY
N/A	EMDC/AEMDC/IC4/PMCS1/PMA14/RD11	RD11	Ethernet PHY
N/A	ETXD3/PMD13/CN19/RD13	RD13	BTN3
N/A	AERXD0/INT1/RE8	RE08	USB Overcurrent detect
N/A	AERXD1/INT2/RE9	RE09	Ethernet PHY Reset
N/A	C1RX/ETXD1/PMD11/RF0	RF00	Ethernet PHY
N/A	C1TX/ETXD0/PMD10/RF1	RF01	Ethernet PHY
N/A	USBID/RF3	RF03	USBID (USB-4)
N/A	D+/RG2	RG02	D+ (USB-3)
N/A	D-/RG3	RG03	D- (USB-2)
N/A	ECOL/SCK2A/U2BTX/U2ARTS/PMA5/CN8/RG6	RG06	BTN1
N/A	ECRS/SDA2A/SDI2A/U2ARX/PMA4/CN9/RG7	RG07	BTN2
N/A	…/SCL2A/SDO2A/U2ATX/PMA3/CN10/RG8	RG08	Ethernet PHY
N/A	…/SS2A/U2BRX/U2ACTS/PMA2/CN11/RG9	RG09	Ethernet PHY
N/A	TRD1/RG12	RG12	LED1
N/A	TRD0/RG13	RG13	LED2
N/A	TRD2/RG14	RG14	LED3
N/A	AERXERR/RG15	RG15	LED4

MCU Pin to Pmod Connector Pin

MCU Port Bit	MCU Pin	Signal	Connector Pin	Notes
RG15	1	AERXERR/RG15	N/A	LED4
RE05	3	PMD5/RE5	JB-08	
RE06	4	PMD6/RE6	JB-09	
RE07	5	PMD7/RE7	JB-10	
RC01	6	T2CK/RC1	JC-01	
RC02	7	T3CK/AC2TX/RC2	N/A	CAN2 Transceiver
RC03	8	T4CK/AC2RX/RC3	N/A	CAN2 Transceiver
RC04	9	T5CK/SDI1/RC4	JD-03	
RG06	10	ECOL/SCK2A/U2BTX/U2ARTS/PMA5/CN8/RG6	N/A	BTN1
RG07	11	ECRS/SDA2A/SDI2A/U2ARX/PMA4/CN9/RG7	N/A	BTN2
RG08	12	…/SCL2A/SDO2A/U2ATX/PMA3/CN10/RG8	N/A	Ethernet PHY
RG09	14	…/SS2A/U2BRX/U2ACTS/PMA2/CN11/RG9	N/A	Ethernet PHY
RA00	17	TMS/RA0	JF-07	
RE08	18	AERXD0/INT1/RE8	N/A	USB Overcurrent detect
RE09	19	AERXD1/INT2/RE9	N/A	Ethernet PHY Reset
RB05	20	AN5/C1IN+/VBUSON/CN7/RB5	N/A	USB VBUSON
RB04	21	AN4/C1IN-/CN6/RB4	JA-03	
RB03	22	AN3/C2IN+/CN5/RB3	JA-02	
RB02	23	AN2/C2IN-/CN4/RB2	JA-01	
RB01	24	PGEC1/AN1/CN3/RB1	N/A	Used by debug circuit, PGD
RB00	25	PGED1/AN0/CN2/RB0	N/A	Used by debug circuit, PGC
RB06	26	PGEC2/AN6/OCFA/RB6	JA-04	
RB07	27	PGED2/AN7/RB7	JA-07	
RA09	28	Vref-/CVref-/AERXD2/PMA7/RA9	JE-09	
RA10	29	Vref+/CVref+/AERXD3/PMA6/RA10	JE-10	
RB08	32	AN8/C1OUT/RB8	JA-08	
RB09	33	AN9/C2OUT/RB9	JA-09	
RB10	34	CVrefout/PMA13/AN10/RB10	JA-10	
RB11	35	AN11/ERXERR/AETXERR/PMA12/RB11	N/A	Ethernet PHY
RA01	38	TCK/RA1	JF-08	
RF13	39	AC1TX/SCK3A/U3BTX/U3ARTS/RF13	JF-04	shared with CAN1 Transceiver (JP-2)
RF12	40	AC1RX/SS3A/U3BRX/U3ACTS/RF12	JF-01	shared with CAN1 Transceiver (JP-1)
RB12	41	AN12/ERXD0/AECRS/PMA11/RB12	N/A	Ethernet PHY
RB13	42	AN13/ERXD1/AECOL/PMA10/RB13	N/A	Ethernet PHY
RB14	43	AN14/ERXD2/AETXD3/PMALH/PMA1/RB14	JC-10	
RB15	44	AN15/…/OCFB/PMALL/PMA0/CN12/RB15	JC-07	
RD14	47	AETXD0/SS1A/U1BRX/U1ACTS/CN20/RD14	JE-01	
RD15	48	AETXD1/SCK1A/U1BTX/U1ARTS/CN21/RD15	JE-04	
RF04	49	SDA3A/SDI3A/U3ARX/PMA9/CN17/RF4	JF-03	
RF05	50	SCL3A/SDO3A/U3ATX/PMA8/CN18/RF5	JF-02	
RF03	51	USBID/RF3	N/A	USBID (USB-4)
RF02	52	SDA1A/SDI1A/U1ARX/RF2	JE-03	
RF08	53	SCL1A/SDO1A/U1ATX/RF8	JE-02	
RG03	56	D-/RG3	N/A	D- (USB-2)
RG02	57	D+/RG2	N/A	D+ (USB-3)
RA02	58	SCL2/RA2	N/A	I2C Bus #2, not shared with Pmod connector

RA03	59	SDA2/RA3	N/A	I2C Bus #2, not shared with Pmod connector
RA04	60	TDI/RA4	JF-09	
RA05	61	TDO/RA5	JF-10	
RC12	63	OSC1/CLKI/RC12	N/A	Primary Oscillator Crystal
RC15	64	OSC2/CLKO/RC15	N/A	Primary Oscillator Crystal
RA14	66	AETXCLK/SCL1/INT3/RA14	N/A	I2C Bus #1, not shared with Pmod connector
RA15	67	AETXEN/SDA1/INT4/RA15	N/A	I2C Bus #1, not shared with Pmod connector
RD08	68	RTCC/EMDIO/AEMDIO/IC1/RD8	N/A	Ethernet PHY
RD09	69	SS1/IC2/RD9	JD-01	
RD10	70	SCK1/IC3/PMCS2/PMA15/RD10	JD-04	
RD11	71	EMDC/AEMDC/IC4/PMCS1/PMA14/RD11	N/A	Ethernet PHY
RD00	72	SDO1/OC1/INT0/RD0	JD-02	
RC13	73	SOSCI/CN1/RC13	N/A	Secondary Oscillator Crystal
RC14	74	SOSCO/T1CK/CN0/RC14	N/A	Secondary Oscillator Crystal
RD01	76	OC2/RD1	JD-07	
RD02	77	OC3/RD2	JD-08	
RD03	78	OC4/RD3	JD-09	
RD12	79	ETXD2/IC5/PMD12/RD12	JD-10	
RD13	80	ETXD3/PMD13/CN19/RD13	N/A	BTN3
RD04	81	OC5/PMWR/CN13/RD4	JC-09	
RD05	82	PMRD/CN14/RD5	JC-08	
RD06	83	ETXEN/PMD14/CN15/RD6	N/A	Ethernet PHY
RD07	84	ETXCLK/PMD15/CN16/RD7	JC-04	
RF00	87	C1RX/ETXD1/PMD11/RF0	N/A	Ethernet PHY
RF01	88	C1TX/ETXD0/PMD10/RF1	N/A	Ethernet PHY
RG01	89	C2TX/ETXERR/PMD9/RG1	JC-02	
RG00	90	C2RX/PMD8/RG0	JC-03	
RA06	91	TRCLK/RA6	JE-07	
RA07	92	TRD3/RA7	JE-08	
RE00	93	PMD0/RE0	JB-01	
RE01	94	PMD1/RE1	JB-02	
RG14	95	TRD2/RG14	N/A	LED3
RG12	96	TRD1/RG12	N/A	LED1
RG13	97	TRD0/RG13	N/A	LED2
RE02	98	PMD2/RE2	JB-03	
RE03	99	PMD3/RE3	JB-04	
RE04	100	PMD4/RE4	JB-07	

Appendix C: Connector Descriptions and Jumper Settings

Label	Function
J7	**I2C port #2 daisy chain connector** This connector provides access to the I2C signals, power and ground for I2C port #2.
J8	**I2C port #1 daisy chain connector** This connector provides access to the I2C signals, power and ground for I2C port #1.
J9	**CAN #1 Connector** This connector is used to access the signals for CAN #1.
J10	**CAN #2 Connector** This connector is used to access the signals for CAN #2.
J11	**Ethernet Connector** This connector provides access to the 10/100 Ethernet port.
J12-J14	**Do Not Use**.
J15	**Debug USB Connector** This connector is used to connect the on-board programming and debug circuit to the PC for use with the MPLAB IDE.
J16	**Power supply source select** This jumper is used to select the source of main board power. Place a shorting block in the upper, “USB” position to have the board powered from the USB device connector, J19. Place a shorting block in the center, “EXT” position to have the board powered from one of the external power connectors, J17 or J18. Place a shorting block in the lower, “DBG” position to have the board powered from the debug USB connector, J15.
J17	**External Power Connector** This is a 2.5mm x 5.5mm, center positive, coax power connector used to provide external power to the board. The optional Digilent 5V Switching Power Supply is connected here.
J18	**External Power Connector** This is a screw terminal connector used to provide external power to the board. Be sure to observe proper polarity (marked near the connector) when providing power via this connector, or damage to the board and/or connected devices may result.
J19	**USB Device / OTG Connector** This is a USB micro-AB connector. It is used when using the PIC32MX795 microcontroller to implement a USB device or OTG Host/Device.

J20	**USB Host Connector** This is a standard sized USB type A connector. This connector is used to connect USB devices to the board when using the PIC32MX795 microcontroller to implement an embedded USB host.
JP1 & JP2	**CAN or Pmod Select** These jumpers select microcontroller signals RF12 and RF13 for use with CAN #1 or Pmod connector JF. Place these jumpers in the CAN position to use CAN #1. Place the jumpers in the PMOD position to use then with Pmod connector JF.
JP3 & JP4	**Pull-up enable for I2C port #2** These two jumpers are used to enable/disable the pull-up resistors on I2C port #2. Insert shorting blocks on these two jumpers to enable the pull-up resistors. Remove the shorting blocks to disable the pull-up resistors. Only a single device on the I2C bus should have the pull-up resistors enabled.
JP5	**CAN #1 Termination** This jumper is used to enable/disable the 120 ohm termination resistor for CAN #1. Insert the shorting block to enable the termination resistor, remove it to disable the termination resistor.
JP6	**CAN #1 5V0 Enable** This jumper is used to enable/disable providing 5V to the CAN #1 connector. Insert the shorting block to connect the board 5V0 supply to pins 9 & 10 of CAN #1 connector. Remove the shorting block to disconnect the 5V0 supply.
JP7	**CAN #2 Termination** This jumper is used to enable/disable the 120 ohm termination resistor for CAN #2. Insert the shorting block to enable the termination resistor, remove it to disable the termination resistor.
JP8	**CAN #1 5V0 Enable** This jumper is used to enable/disable providing 5V to the CAN #1 connector. Insert the shorting block to connect the board 5V0 supply to pins 9 & 10 of CAN #1 connector. Remove the shorting block to disconnect the 5V0 supply.
JP9	**Do Not Use**
JP10	**USB host power select** This jumper is used to select which host connector is powered when host power is enabled. Place the shorting block in the “MICRO” position to supply power to the USB micro-AB OTG Connector, J19. Place the shorting block in the “A” position to supply power to the USB type A Host Connector, J20.
JP17	**Do Not Use**
JA-JF	**Pmod Connectors** These connectors provide access to the I/O pins on the PIC32MX795 microcontroller. Digilent Pmod peripheral modules can be attached to these connectors.
JPA –	**Pmod header power select**

JPF	Any of the Pmod connectors can provide either regulated or unregulated power. To use regulated power, place the jumper block over the center pin and the pin marked 3V3. To use unregulated power, place the jumper block over the center pin and the pin marked 5V0.