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## Debug Header Specification

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### NOTICE TO CUSTOMERS

All documentation becomes dated, and this manual is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so some actual dialogs and/or tool descriptions may differ from those in this document. Please refer to our web site ([www.microchip.com](http://www.microchip.com)) to obtain the latest documentation available.

Documents are identified with a “DS” number. This number is located on the bottom of each page, in front of the page number. The numbering convention for the DS number is “DSXXXXXA”, where “XXXXX” is the document number and “A” is the revision level of the document.

For the most up-to-date information on development tools, see the MPLAB® IDE online Help. Select the Help menu, and then Topics to open a list of available online Help files.

This chapter contains the following:

- Why Do I Need A Header To Debug?
- Debug Details
- Programming Details
- General Header Setup
- Calibration Bits
- Performance Issues
- Related Debug Tools
- Customer Support

# Debug Header Specification

## WHY DO I NEED A HEADER TO DEBUG?

Some PIC® microcontrollers, particularly low pin count devices (with 20 pins or less), generally must use a header for debugging. This is done to free up I/O lines for your application and to make production parts more affordable. Optional headers are also available for high pin count devices (with 64 pins or higher).

Debugging requires a two-line connection (plus VDD, VSS and VPP) to communicate with the device. In a high pin count device, losing a few I/O lines is generally not a problem for most designs. But in a low pin count device, it can be a critical problem. Imagine having to do an 8-pin design where there are only 5 I/Os, having used up 2 I/Os just for debugging!

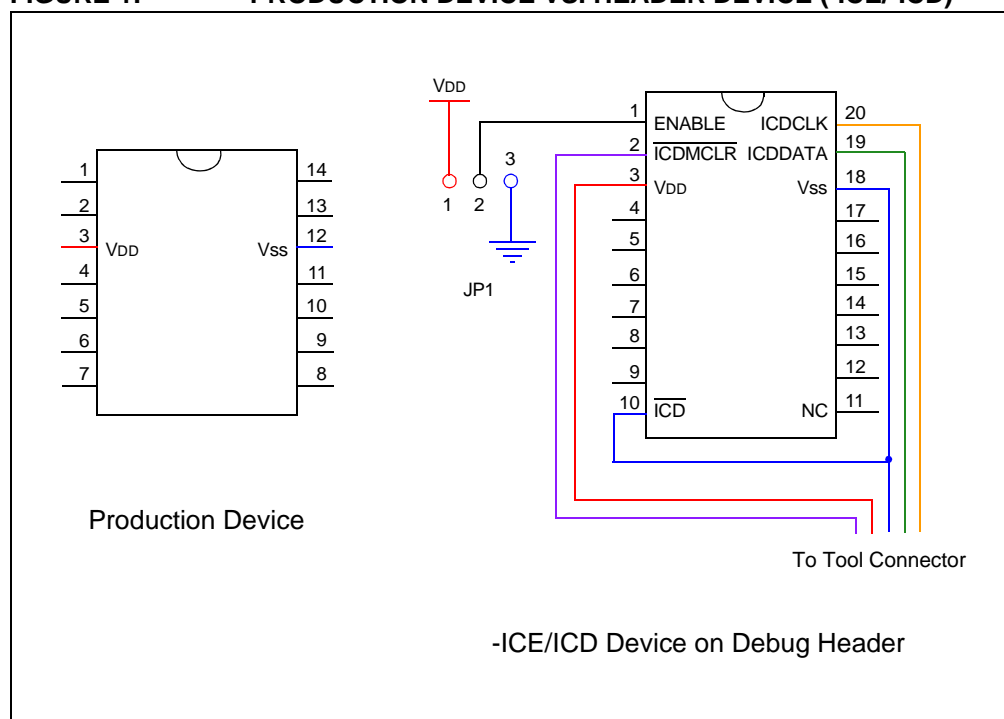
Headers are also used to save you money. In high pin count devices, adding debugging to the silicon can generally be done at little or no cost since the silicon is already fairly large. However, low pin count devices are low cost specifically because they use very little silicon. So, adding debugging circuitry on-board these parts would add significant cost since it would raise the amount of silicon used by a considerable percentage. The header places the cost for debugging up front and frees your production parts from the extra cost of an unused debug module.

Microchip also makes optional debug modules, usually for high pin count devices. The module is optional because you can still do basic debugging without a header, but if you use one, you get back I/O lines, and may also gain additional debugging features. Only certain devices can use an optional header, see the device page on our website for details.

Microchip lists what header must be ordered to work with your device, if one is required. Simply consult the device page on our website, or our other ordering guides.

Note that in all cases, devices can be programmed “in circuit” (called ICSP™) with very few exceptions. Even devices without an internal debug feature can still be programmed by connecting the programming/debugging tool to the in-circuit programming lines. These devices simply cannot perform debugging without a header.

**FIGURE 1: PRODUCTION DEVICE VS. HEADER DEVICE (-ICE/-ICD)**

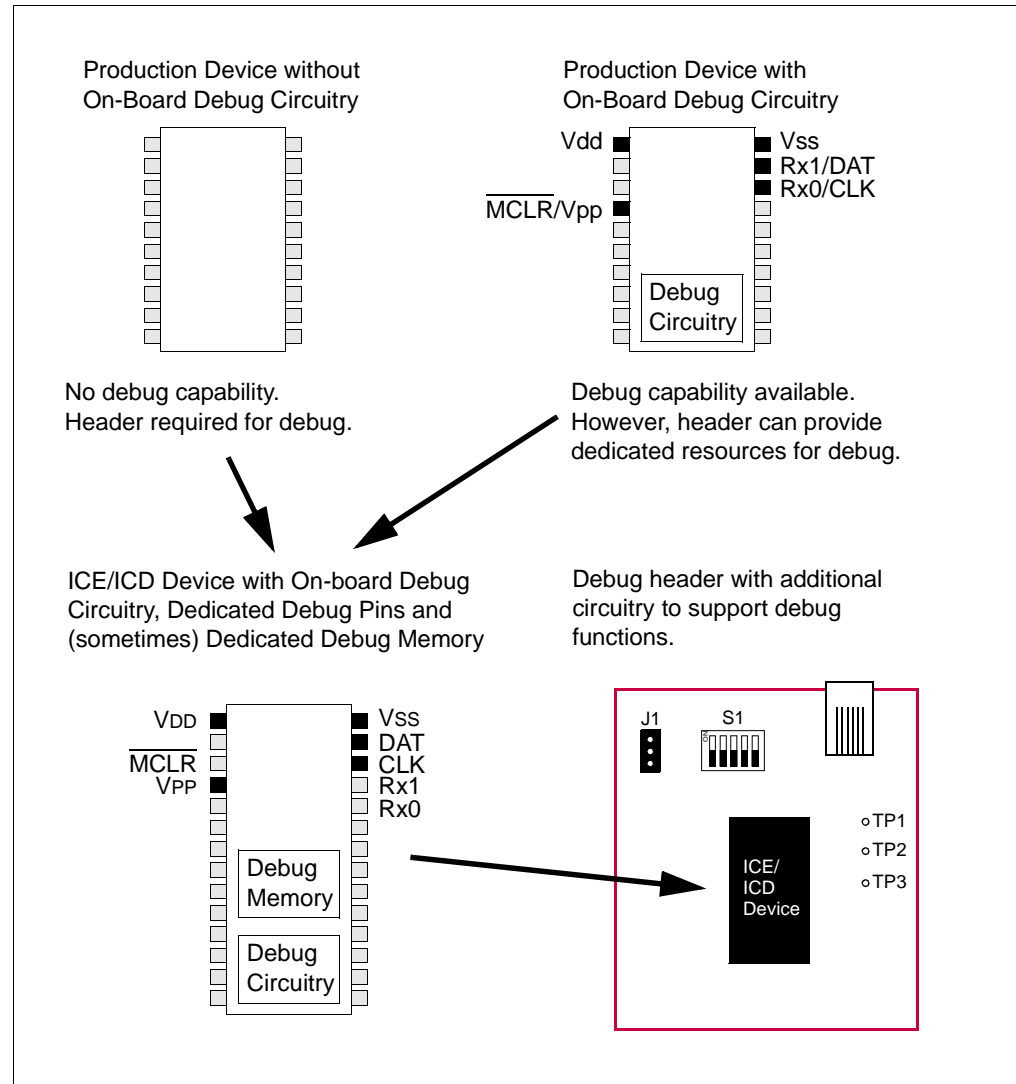


## DEBUG DETAILS

Next generation in-circuit emulators (such as the MPLAB® REAL ICE™ in-circuit emulator) and in-circuit debuggers work with devices that have on-chip debug circuitry. Sometimes the actual production device will have this circuitry and sometimes a special version of this device is required or available for code debugging. This special version of the chip, with the suffix -ICD or -ICE, is mounted on a debug header (Figure 2).

**Note:** ICE/ICD devices are only used on the header; they are not sold separately.

**FIGURE 2: DEBUG OPTIONS**



In general, ICE devices are designed for next-generation in-circuit emulator use and ICD devices are designed for in-circuit debugger use. However, ICE devices may be used with an in-circuit debugger and ICD devices may be used with a next-generation in-circuit emulator, but will provide only basic ICD functionality.

To determine what device resources must be dedicated to debugging for either a device with on-board debug capability or the special ICE/ICD device, see the “Resources used by ...” section of the in-circuit emulator or in-circuit debugger online Help file.

# Debug Header Specification

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## PROGRAMMING DETAILS

The debug header is designed to be used with the in-circuit emulator or the in-circuit debugger selected as a debugger, not a programmer, in MPLAB IDE. Any programming of the ICE/ICD device on the header is for debug purposes and includes the debug executive. See your related debug tool documentation for details on using it as a debugger.

To program production (non-ICE/ICD) devices with your debug tool, use the Universal Programming Module (AC162049) or design a modular interface connector on the target. See the appropriate specification for connections. For the most up-to-date device programming specifications, see the Microchip website ([www.microchip.com](http://www.microchip.com)).

Also, production devices may be programmed with the following tools:

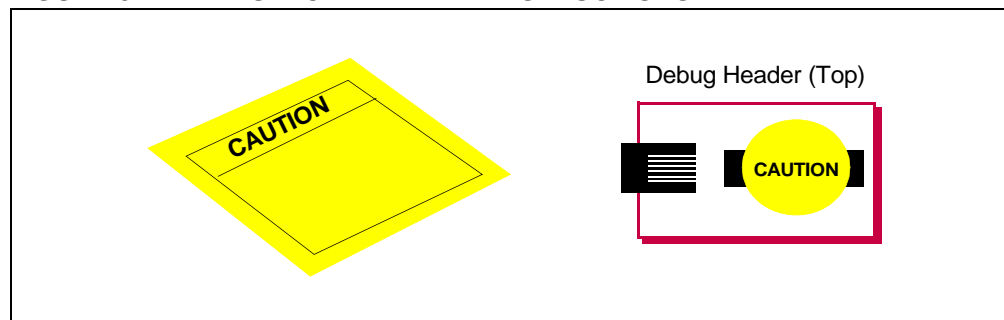
- MPLAB PM3 device programmer
- PICSTART® Plus development programmer
- PICKit™ 1, 2 or 3 development programmer
- MPLAB ICD 3 in-circuit debugger (select as a programmer)
- MPLAB REAL ICE in-circuit emulator (select as a programmer)

## GENERAL HEADER SETUP

To set up your header, do the following:

1. Check the debug header for any stickers and the header box for any paper inserts that may specify special operating instructions (Figure 3). Follow these instructions before doing anything else.

**FIGURE 3: SPECIAL HEADER INSTRUCTIONS**

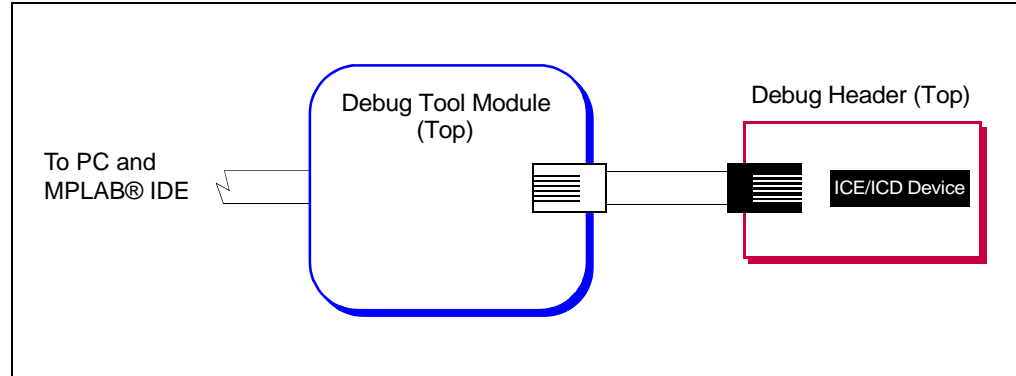


2. Set any jumpers or switches on the header to determine device functionality or selection as specified for that header. See the sections "Optional Debug Headers" or "Required Debug Headers" for information on how to set up individual headers.
3. Connect the header to your desired debug tool by consulting the tool documentation for connection options. An example connection is shown in Figure 4.

The special ICE/ICD device is mounted on the top of a header and its signals are routed to the emulator or debugger connector. These special device versions are labeled with the appropriate suffix (i.e., either *Device-ICE* or *Device-ICD*).

# Debug Header Specification

**FIGURE 4: CONNECT HEADER TO DEBUG TOOL**

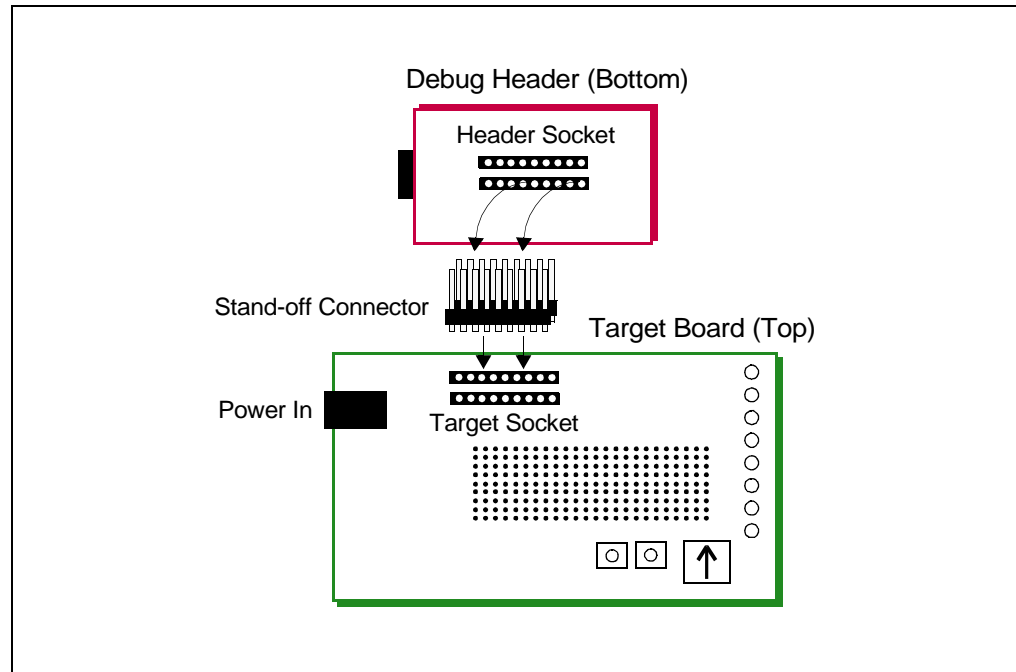


4. Connect the header to the target board. On the bottom of the header is a socket that is used to connect to the target board. The header may be connected to the target board as follows:
  - a) PDIP header socket to PDIP target socket with a stand-off (male-to-male) connector
  - b) Header socket to plug on the target board
  - c) Header socket to target socket with a transition socket (see the “*Transition Socket Specification*”, DS51194)

An example connection is shown in Figure 5.

The header socket will have the same pin count as your selected device. The ICE/ICD device on the top of the header usually has a larger pin count because it has additional pins that are dedicated to debug.

**FIGURE 5: CONNECT HEADER TO TARGET**



5. If using a debug tool that can power the target, power that tool now.
6. Power the target, if needed.

# Debug Header Specification

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## CALIBRATION BITS

The calibration bits for the band gap and internal oscillator are always preserved to their factory settings.

## PERFORMANCE ISSUES

The PIC<sup>®</sup> MCU devices do not support partial program memory erase; therefore, users may experience slower performance than with other devices.

Also, see either the in-circuit emulator or the in-circuit debugger Help file for information on specific device limitations that may affect performance.

## RELATED DEBUG TOOLS

The following tools support the use of headers:

- MPLAB REAL ICE In-Circuit Emulator
- MPLAB ICD 2 or 3 In-Circuit Debugger
- PICkit 2 or 3 Debug Express

See the Microchip website (<http://www.microchip.com>) for the latest documentation.

## CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

Customers should contact their distributor, representative or field application engineer (FAE) for support. Local sales offices are also available to help customers.

Technical support is available through the web site at: <http://support.microchip.com>.

Documentation errors or comments may be sent to [docerrors@microchip.com](mailto:docerrors@microchip.com).

## Required Debug Headers

### INTRODUCTION

Some devices have no built-in debug circuitry. Therefore, special ICE/ICD versions of these devices are required for debug tool operation.

Currently available debug headers and their associated ICE/ICD devices are shown below, sorted by supported device.

**TABLE 1: REQUIRED DEBUG HEADERS BY DEVICE**

| Device                   | Pin Count | Header Part Number       | ICE/ICD Device Used | VDD Max |
|--------------------------|-----------|--------------------------|---------------------|---------|
| PIC10F200/2/4/6          | 8/14      | <a href="#">AC162059</a> | PIC16F505-ICD       | 5.5V    |
| PIC10F220/2              | 8/14      | <a href="#">AC162070</a> | PIC16F506-ICD       | 5.5V    |
| PIC10F320/322            | 6/8       | <a href="#">AC244045</a> | PIC10F320-ICE       | 5.5V    |
| PIC10LF320/322           | 6/8       | <a href="#">AC244045</a> | PIC10F320-ICE       | 3.6V    |
| PIC12F508/509            | 8/14      | <a href="#">AC162059</a> | PIC16F505-ICD       | 5.5V    |
| PIC12F510                | 8/14      | <a href="#">AC162070</a> | PIC16F506-ICD       | 5.5V    |
| PIC12F519                | 8/14      | <a href="#">AC162096</a> | PIC16F526-ICD       | 5.5V    |
| PIC12F609/HV609          | 28        | <a href="#">AC162083</a> | PIC16F616-ICD       | 5.5V    |
| PIC12F615/HV615          | 28        | <a href="#">AC162083</a> | PIC16F616-ICD       | 5.5V    |
| PIC12F617                | 28        | <a href="#">AC162083</a> | PIC16F616-ICD       | 5.5V    |
| PIC12F629                | 8         | <a href="#">AC162050</a> | PIC12F675-ICD       | 5.5V    |
| PIC12F635                | 14        | <a href="#">AC162057</a> | PIC16F636-ICD       | 5.5V    |
| PIC12F675                | 8         | <a href="#">AC162050</a> | PIC12F675-ICD       | 5.5V    |
| PIC12F683                | 8         | <a href="#">AC162058</a> | PIC12F683-ICD       | 5.5V    |
| PIC16F505                | 8/14      | <a href="#">AC162059</a> | PIC16F505-ICD       | 5.5V    |
| PIC16F506                | 8/14      | <a href="#">AC162070</a> | PIC16F506-ICD       | 5.5V    |
| PIC16F526                | 8/14      | <a href="#">AC162096</a> | PIC16F526-ICD       | 5.5V    |
| PIC16F610/HV610          | 14/16     | <a href="#">AC162083</a> | PIC16F616-ICD       | 5.5V    |
| PIC16F616/HV616          | 14/16     | <a href="#">AC162083</a> | PIC16F616-ICD       | 5.5V    |
| PIC16F627A/628A          | 18        | <a href="#">AC162053</a> | PIC16F648A-ICD      | 5.5V    |
| PIC16F630                | 14        | <a href="#">AC162052</a> | PIC16F676-ICD       | 5.5V    |
| PIC16F631                | 20        | <a href="#">AC162061</a> | PIC16F690-ICD       | 5.5V    |
| PIC16F636                | 14        | <a href="#">AC162057</a> | PIC16F636-ICD       | 5.5V    |
| PIC16F639 <sup>(1)</sup> | 20        | <a href="#">AC162066</a> | PIC16F636-ICD       | 5.5V    |
| PIC16F648A               | 18        | <a href="#">AC162053</a> | PIC16F648A-ICD      | 5.5V    |
| PIC16F676                | 14        | <a href="#">AC162052</a> | PIC16F676-ICD       | 5.5V    |
| PIC16F677                | 20        | <a href="#">AC162061</a> | PIC16F690-ICD       | 5.5V    |
| PIC16F684                | 14        | <a href="#">AC162055</a> | PIC16F684-ICD       | 5.5V    |

# Required Debug Headers

TABLE 1: REQUIRED DEBUG HEADERS BY DEVICE (CON'T)

| Device                         | Pin Count | Header Part Number       | ICE/ICD Device Used              | VDD Max                      |
|--------------------------------|-----------|--------------------------|----------------------------------|------------------------------|
| PIC16F685/687                  | 20        | <a href="#">AC162061</a> | PIC16F690-ICD                    | 5.5V                         |
| PIC16F688                      | 14        | <a href="#">AC162056</a> | PIC16F688-ICD                    | 5.5V                         |
| PIC16F689/690                  | 20        | <a href="#">AC162061</a> | PIC16F690-ICD                    | 5.5V                         |
| PIC16F716                      | 18        | <a href="#">AC162054</a> | PIC16F716-ICD                    | 5.5V                         |
| PIC16F785/HV785                | 20        | <a href="#">AC162060</a> | PIC16F785-ICD                    | 5.5V                         |
| PIC18F13K50<br>PIC18F14K50     | 20        | <a href="#">AC244023</a> | PIC18F14K50-ICE                  | 5.5V                         |
| PIC18LF13K50<br>PIC18LF14K50   | 20        | <a href="#">AC244024</a> | PIC18LF14K50-ICE                 | 3.6V<br>2.75V <sup>(2)</sup> |
| PIC24F04KA200<br>PIC24F04KA201 | 14<br>20  | <a href="#">AC244028</a> | PIC24F16KA102-ICE <sup>(3)</sup> | 3.6V                         |

**Note 1:** Dual die

**Note 2:** VDDCORE Max

**Note 3:** Header optional for other devices

## AC162050, AC162058

### Header Identification

The header AC number is used for ordering the header. However, this number is not on the debug header, as the board is often used for multiple headers by inserting different ICE/ICD devices. To identify these debug headers, use the following information.

| Header   | ICE/ICD Device | Board Assembly Number |
|----------|----------------|-----------------------|
| AC162050 | PIC12F675-ICD  | 02-01662              |
| AC162058 | PIC12F683-ICD  |                       |

### Header Setup and Operation

For these headers, device peripherals need to be selected by setting jumper J1 to the appropriate position. For AC162050, this will have the effect of selecting the device.

| Header   | Jumper J1 | Function     | Device Selected |
|----------|-----------|--------------|-----------------|
| AC162050 | 2-3       | A/D Disabled | PIC12F629       |
|          | 1-2       | A/D Enabled  | PIC12F675       |
| AC162058 | 1-2       | A/D Enabled  | PIC12F683       |

### Header Limitations

See the “Limitations” section in your debug tool online Help file for details.

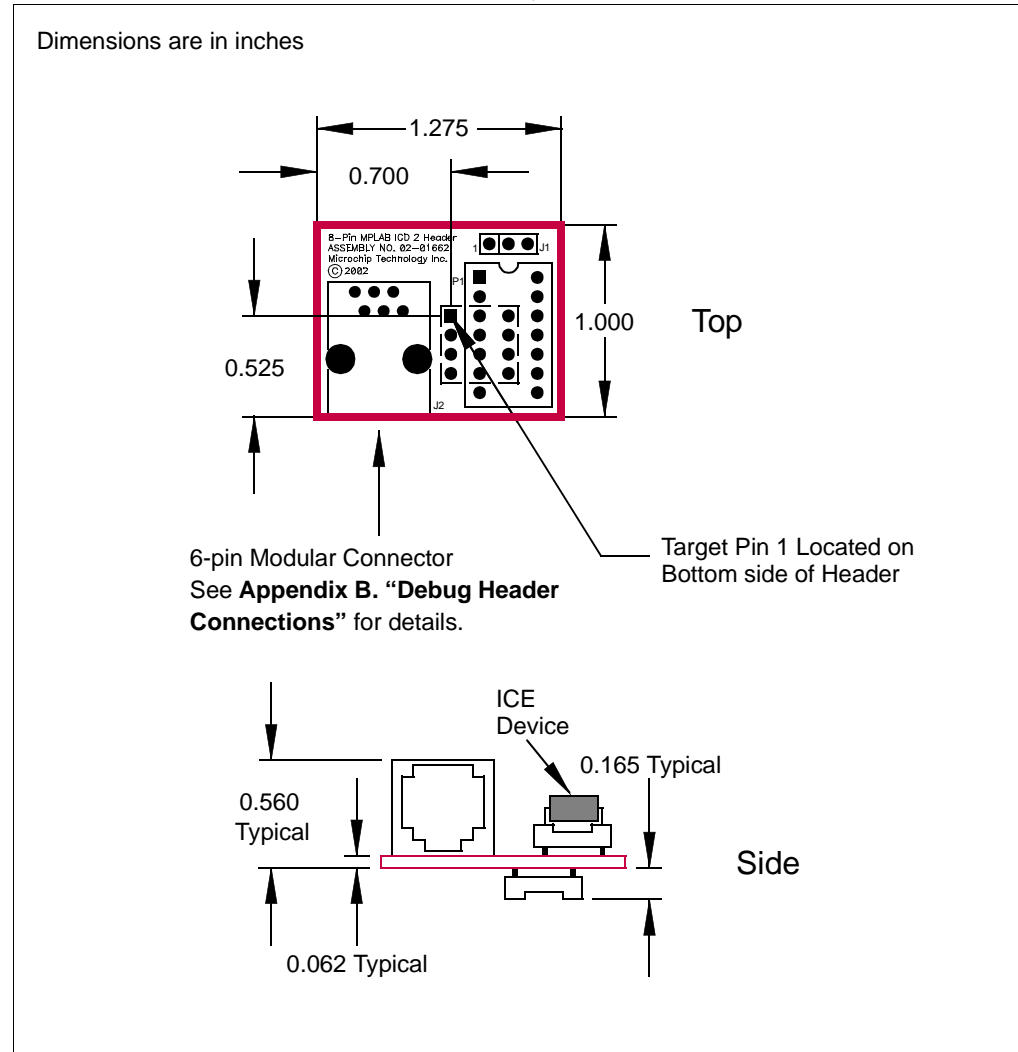
### Header Dimensions

The figure below lists the dimensions for the debug header. Dimensions are design values in inches.

If the length and/or width of the debug header is too large a footprint for the target board, consider using stand-offs, transition sockets or other extenders in the header connection socket to raise the header above the target.



**FIGURE 1: DIMENSIONS – AC162050, AC162058**



# Required Debug Headers

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## AC162052, AC162055, AC162056, AC162057

### Header Identification

The header AC number is used for ordering the header. However, this number is not on the debug header, as the board is often used for multiple headers by inserting different ICE/ICD devices. To identify these debug headers, use the following information.

| Header   | ICE/ICD Device | Board Assembly Number |
|----------|----------------|-----------------------|
| AC162052 | PIC16F676-ICD  | 02-01686              |
| AC162055 | PIC16F684-ICD  |                       |
| AC162056 | PIC16F688-ICD  |                       |
| AC162057 | PIC16F636-ICD  |                       |

### Header Setup and Operation

For these headers, device peripherals need to be selected by setting jumper J1 to the appropriate position. For AC162052 and AC162057, this will have the effect of selecting the device.

| Header   | Jumper J1  | Function                     | Device Selected |
|----------|------------|------------------------------|-----------------|
| AC162052 | 2-3        | A/D Disabled                 | PIC16F630       |
|          | 1-2        | A/D Enabled                  | PIC16F676       |
| AC162055 | Don't care | N/A                          | PIC16F684       |
| AC162056 | Don't care | N/A                          | PIC16F688       |
| AC162057 | 2-3        | PORTC, Comparator 2 Disabled | PIC12F635       |
|          | 1-2        | PORTC, Comparator 2 Enabled  | PIC16F636       |

### Header Limitations

See the "Limitations" section in your debug tool online Help file for details.

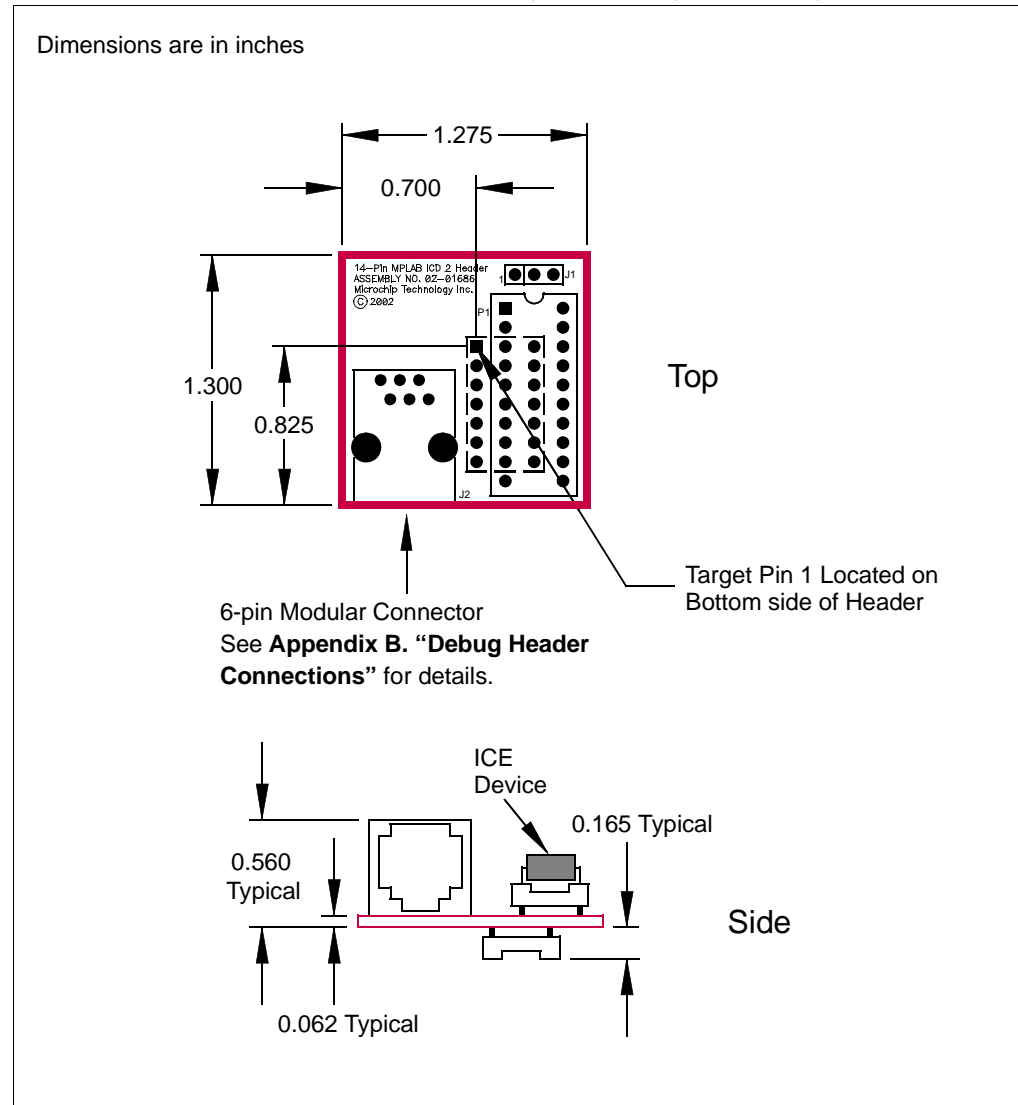
# Required Debug Headers

## Header Dimensions

The figure below lists the dimensions for the debug header. Dimensions are design values in inches.

If the length and/or width of the debug header is too large a footprint for the target board, consider using stand-offs, transition sockets or other extenders in the header connection socket to raise the header above the target.

**FIGURE 2: DIMENSIONS – AC162052, AC162055, AC162056, AC162057**



# Required Debug Headers

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## AC162053, AC162054

### Header Identification

The header AC number is used for ordering the header. However, this number is not on the debug header, as the board is often used for multiple headers by inserting different ICE/ICD devices. To identify these debug headers, use the following information.

| Header   | ICE/ICD Device | Board Assembly Number |
|----------|----------------|-----------------------|
| AC162053 | PIC16F648A-ICD | 02-01695              |
| AC162054 | PIC16F716-ICD  |                       |

### Header Setup and Operation – AC162053

For this headers, there are no jumpers/switches. The device with the most program memory is always selected.

If PIC16F627A or PIC16F628A devices are selected for development in MPLAB IDE, the warning “Invalid target device ID” may be received in the build window and as a dialog. The reason is the PIC16F648A-ICD device supports PIC16F648A, PIC16F627A and PIC16F628A, but only reports the device ID for the PIC16F648A.

Ignore this warning or disable it under the **Warnings** tab on the ICD Programming dialog.

### Header Setup and Operation – AC162054

This header supports one device (PIC16F716) so there are no jumpers or switches.

### Header Limitations

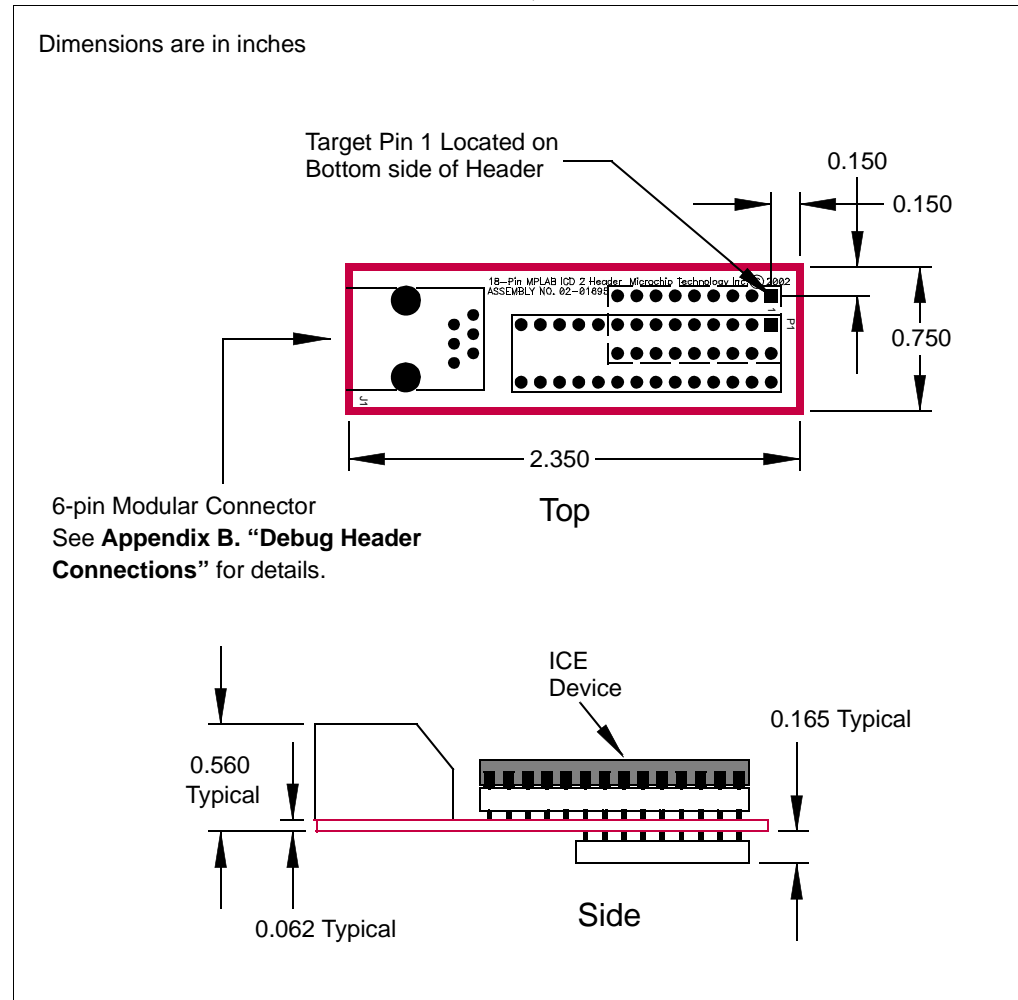
See the “Limitations” section in your debug tool online Help file for details.

## Header Dimensions

The figure below lists the dimensions for the debug header. Dimensions are design values in inches.

If the length and/or width of the debug header is too large a footprint for the target board, consider using stand-offs, transition sockets or other extenders in the header connection socket to raise the header above the target.

**FIGURE 3: DIMENSIONS – AC162053, AC162054**



# Required Debug Headers

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## AC162059, AC162070, AC162096

### Header Identification

The header AC number is used for ordering the header. However, this number is not on the debug header, as the board is often used for multiple headers by inserting different ICE/ICD devices. To identify these debug headers, use the following information.

| Header   | ICE/ICD Device | Board Assembly Number |
|----------|----------------|-----------------------|
| AC162059 | PIC16F505-ICD  | 02-01803              |
| AC162070 | PIC16F506-ICD  |                       |
| AC162096 | PIC16F526-ICD  |                       |

### Header Setup and Operation

The ICD devices on these headers are specifically designed to select a device without the use of additional jumpers or switches.

These headers support 8 and 14-pin devices (see Figure 4.) For the AC162059 and AC162070, there is an 8-pin and a 14-pin connector. For the AC162096, there is only a 14-pin connector. (The 8-pin connector is not populated.) Use the 14-pin connector for 8-pin devices, but make sure device pin 1 is placed at the 14-pin connector pin 1.

### Header Limitations

See the “Limitations” section in your debug tool online Help file for details.

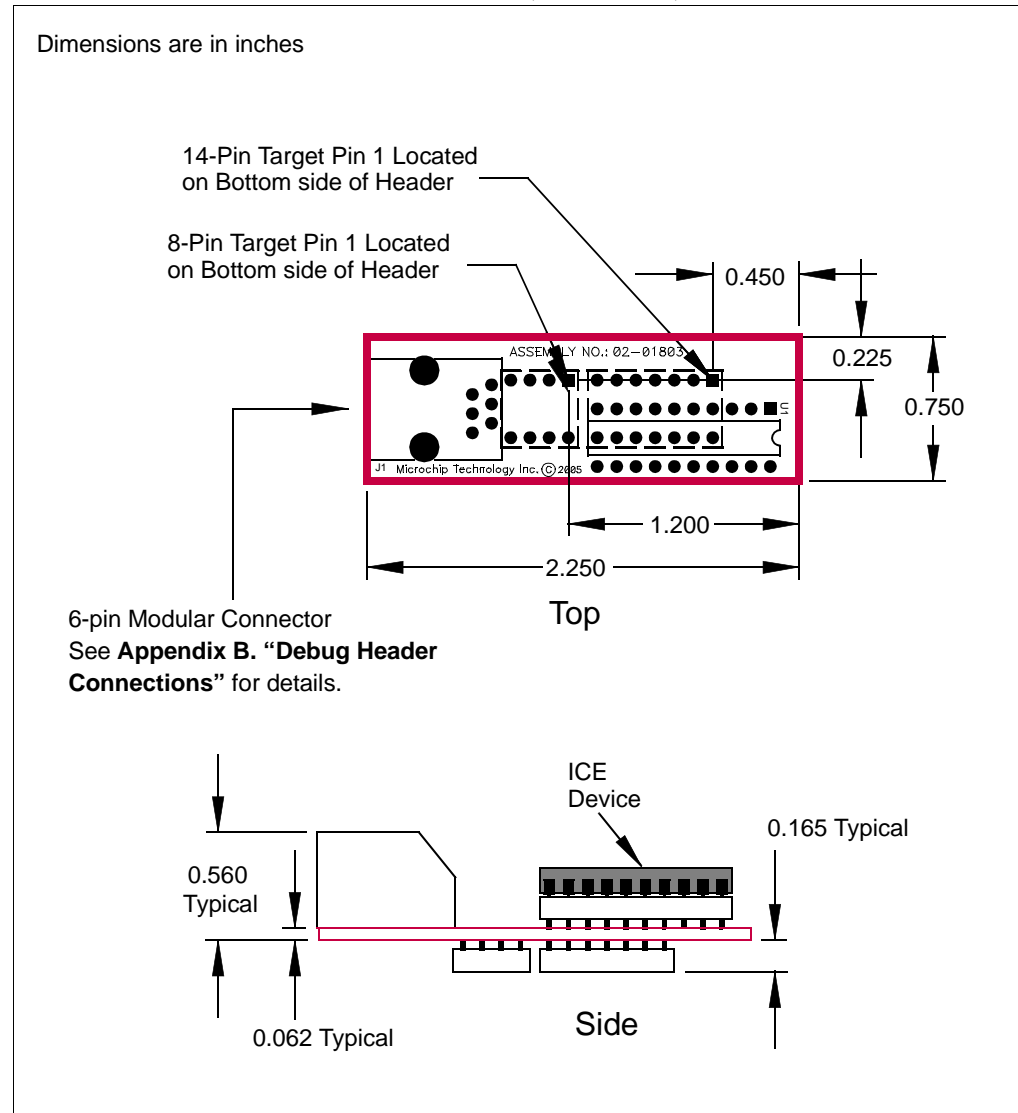
# Required Debug Headers

## Header Dimensions

The figure below lists the dimensions for the debug header. Dimensions are design values in inches.

If the length and/or width of the debug header is too large a footprint for the target board, consider using stand-offs, transition sockets or other extenders in the header connection socket to raise the header above the target.

**FIGURE 4: DIMENSIONS – AC162059, AC162070, AC162096**



# Required Debug Headers

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## AC162060

### Header Identification

The header AC number is used for ordering the header. However, this number is not on the debug header, as the board is often used for multiple headers by inserting different ICE/ICD devices. To identify this debug header, use the following information.

| Header   | ICE/ICD Device | Board Assembly Number |
|----------|----------------|-----------------------|
| AC162060 | PIC16F785-ICD  | 02-01820              |

### Header Setup and Operation

For the PIC16F785 20-pin header, you will need to connect the jumper J2 to enable the shunt regulator.

| Device     | Device Type | Jumper J2 | Function                |
|------------|-------------|-----------|-------------------------|
| PIC16F785  | F           | 1-2       | Disable shunt regulator |
| PIC16HV785 | HV          | 2-3       | Enable shunt regulator  |

### Header Limitations

See the "Limitations" section in your debug tool online Help file for details.

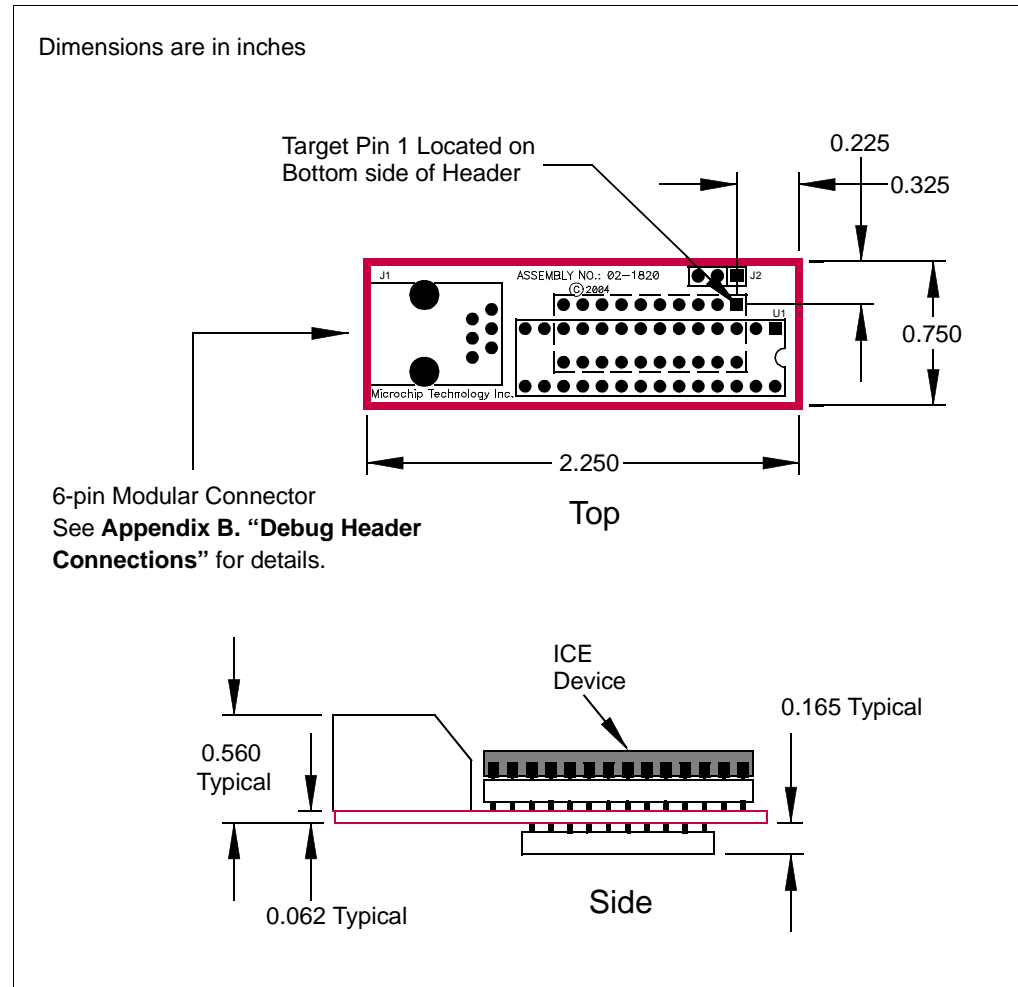


## Header Dimensions

The figure below lists the dimensions for the debug header. Dimensions are design values in inches.

If the length and/or width of the debug header is too large a footprint for the target board, consider using stand-offs, transition sockets or other extenders in the header connection socket to raise the header above the target.

**FIGURE 5: DIMENSIONS – AC162060**



# Required Debug Headers

## AC162061

### Header Identification

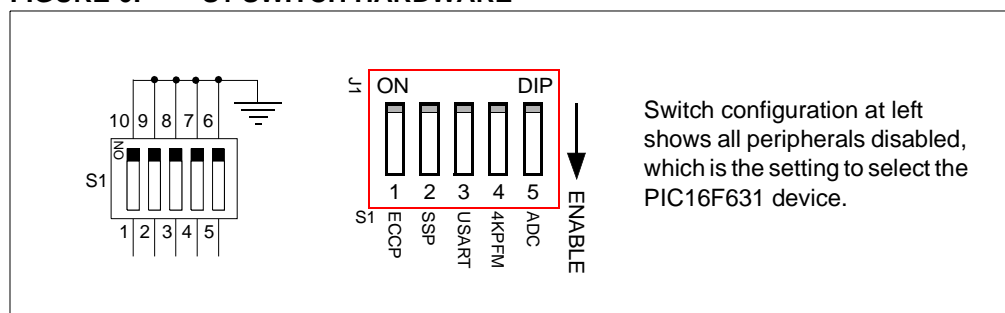
The header AC number is used for ordering the header. However, this number is not on the debug header, as the board is often used for multiple headers by inserting different ICE/ICD devices. To identify this debug header, use the following information.

| Header   | ICE/ICD Device | Board Assembly Number |
|----------|----------------|-----------------------|
| AC162061 | PIC16F690-ICD  | 02-01835              |

### Header Setup and Operation

For the PIC16F690 20-pin header, you will need to set the S1 switches (Figure 6) to enable peripherals and choose devices (Table 2).

**FIGURE 6: S1 SWITCH HARDWARE**



**TABLE 2: S1 SWITCH DEVICE SELECTION**

| Device    | Switches  |          |            |             |          |
|-----------|-----------|----------|------------|-------------|----------|
|           | 1<br>ECCP | 2<br>SSP | 3<br>USART | 4<br>4k PFM | 5<br>ADC |
| PIC16F631 | 0         | 0        | 0          | 0*          | 0        |
| PIC16F677 | 0         | 1        | 0          | 0**         | 1        |
| PIC16F685 | 1         | 0        | 0          | 1           | 1        |
| PIC16F687 | 0         | 1        | 1          | 0**         | 1        |
| PIC16F689 | 0         | 1        | 1          | 1           | 1        |
| PIC16F690 | 1         | 1        | 1          | 1           | 1        |

**Legend:** 1 = Enabled 0 = Disabled \* = 1k PFM \*\* = 2k PFM

### Header Limitations

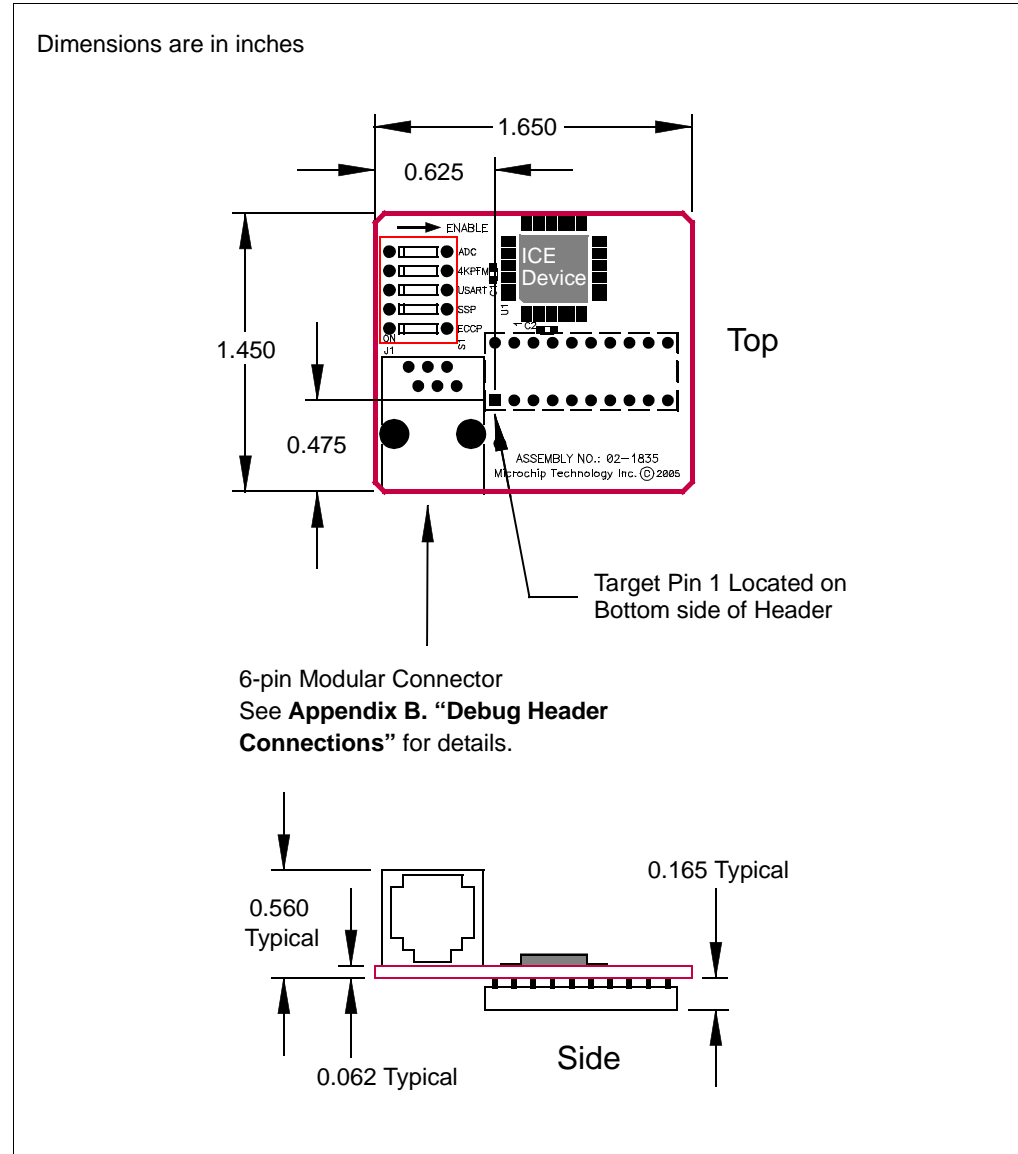
See the “Limitations” section in your debug tool online Help file for details.

## Header Dimensions

The figure below lists the dimensions for the debug header. Dimensions are design values in inches.

If the length and/or width of the debug header is too large a footprint for the target board, consider using stand-offs, transition sockets or other extenders in the header connection socket to raise the header above the target.

**FIGURE 7: DIMENSIONS – AC162061**



# Required Debug Headers

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## AC162066

### Header Identification

The header AC number is used for ordering the header. However, this number is not on the debug header, as the board is often used for multiple headers by inserting different ICE/ICD devices. To identify this debug header, use the following information.

| Header   | ICE/ICD Device | Board Assembly Number |
|----------|----------------|-----------------------|
| AC162066 | PIC16F636-ICD  | 02-01832              |

### Header Setup and Operation

For the PIC16F639 20-pin header, you will need to connect the jumper J3 as specified below.

| Tool  | Jumper J3 | Function                         |
|---|-----------|----------------------------------|
| ®   | 1-2       | Run/program as production device |
| In-circuit debuggers,<br>next generation in-circuit emulators | 2-3       | Run/program as ICD device        |

### Header Limitations

See the “Limitations” section in your debug tool online Help file for details.

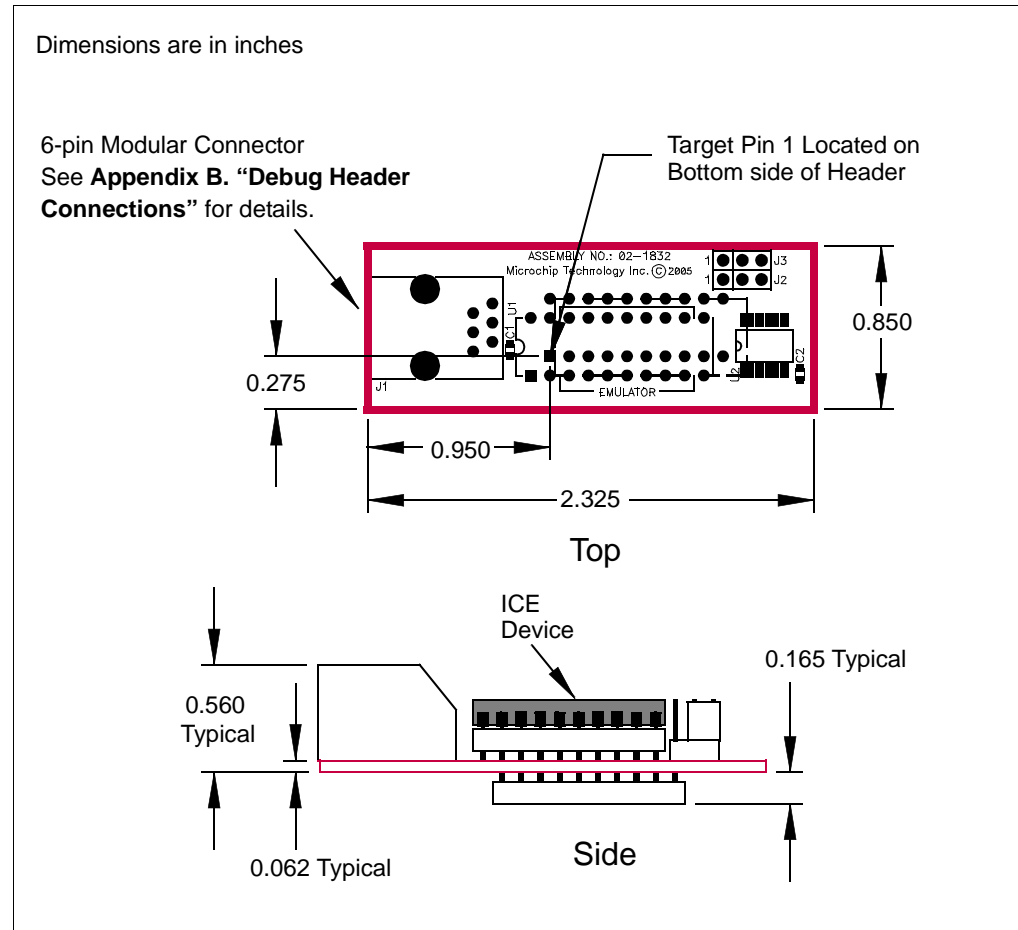
# Required Debug Headers

## Header Dimensions

The figure below lists the dimensions for the debug header. Dimensions are design values in inches.

If the length and/or width of the debug header is too large a footprint for the target board, consider using stand-offs, transition sockets or other extenders in the header connection socket to raise the header above the target.

**FIGURE 8: DIMENSIONS – AC162066**



# Required Debug Headers


## AC162083

### Header Identification

The header AC number is used for ordering the header. However, this number is not on the debug header, as the board is often used for multiple headers by inserting different ICE/ICD devices. To identify this debug header, use the following information.

| Header   | ICE/ICD Device | Board Assembly Number |
|----------|----------------|-----------------------|
| AC162083 | PIC16F616-ICD  | 02-01976              |

### Header Setup and Operation

| CAUTION   |  |
|---|--|
|  | <p>Incorrect rotary switch (Figure 9) settings may irreparably damage the header. Ensure rotary switch settings are correct (Table 3) before powering or connecting the header. Do not change the rotary switch setting while the header is powered or connected to a debug tool. Do not power shunt regulator (HV) devices from the debug tool.</p> |

Test points are available on this header to check the following: Ground (TP1), VDD (TP2), ICD Clock (TP3), ICD Data (TP4) and ICD MCLR/VPP (TP5).

**TABLE 3: ROTARY SWITCH SETTINGS**

| Switch Position | Device      | Switch Position | Device     |
|-----------------|-------------|-----------------|------------|
| 0               | PIC12HV609  | 8               | PIC12F609  |
| 1               | PIC12HV615  | 9               | PIC12F615  |
| 2               | Reserved HV | A               | PIC12F617  |
| 3               | PIC16HV610  | B               | PIC16F610  |
| 4               | PIC16HV616  | C               | PIC16F616  |
| 5               | Reserved HV | D               | Reserved F |
| 6               | Reserved HV | E               | Reserved F |
| 7               | Reserved HV | F               | Reserved F |

Also see the AC162083 Insert (DS51693).

### POTENTIAL ISSUES

#### HV device selected instead of F device

If you inadvertently select a shunt regulator (HV) device and attempt to use it in a target board designed for a non-shunt regulator (F) device, the shunt may draw excessive current due to the lack of current-limiting circuitry on the target board and damage the device mounted on the header.

#### F device selected instead of HV device

If you inadvertently select a non-shunt regulator (F) device and attempt to use it in a target board designed for a shunt regulator (HV) device, the device may draw excessive current due to the higher voltage used on a target board designed for HV devices and damage the device mounted on the header.

#### HV devices cannot be powered from debug tool

Do not select in MPLAB IDE to power the target (debug header) from the debug tool (if it supports powering the target) when using shunt regulator (HV) devices since this will also cause the shunt to draw excessive current.

# Required Debug Headers

## DETERMINING DAMAGE

A damaged header will cause MPLAB IDE to report a device ID of 0. However, there are other issues that can cause the device ID to report as 0. Please consult your debug tool documentation on troubleshooting to identify the problem. If you believe you have a damaged header, please contact Microchip technical support at <http://support.microchip.com>.

## Header Limitations

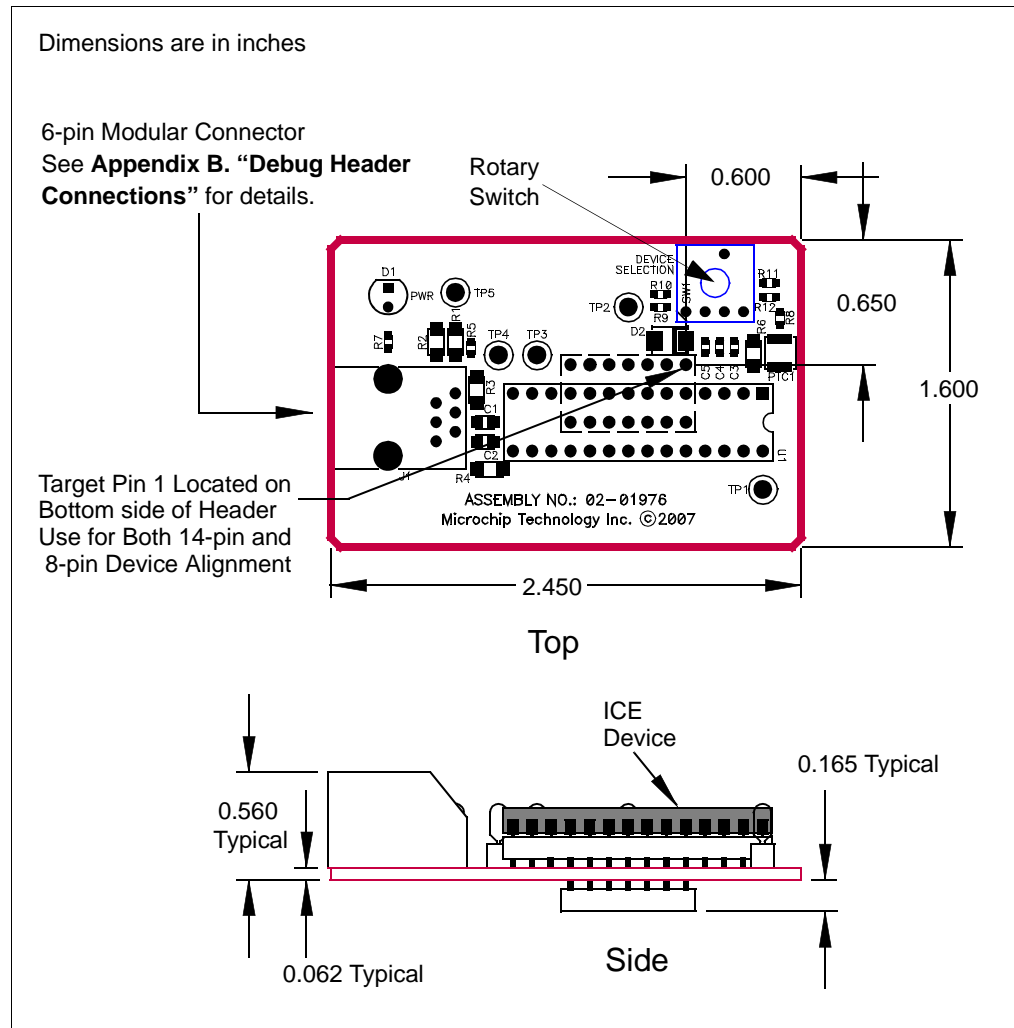
See the "Limitations" section in your debug tool online Help file for details.

## Header Dimensions

The figure below lists the dimensions for the debug header. Dimensions are design values in inches.

If the length and/or width of the debug header is too large a footprint for the target board, consider using stand-offs, transition sockets or other extenders in the header connection socket to raise the header above the target.

**FIGURE 9: DIMENSIONS – AC162083**



# Required Debug Headers

## AC244023, AC244024

### Header Identification

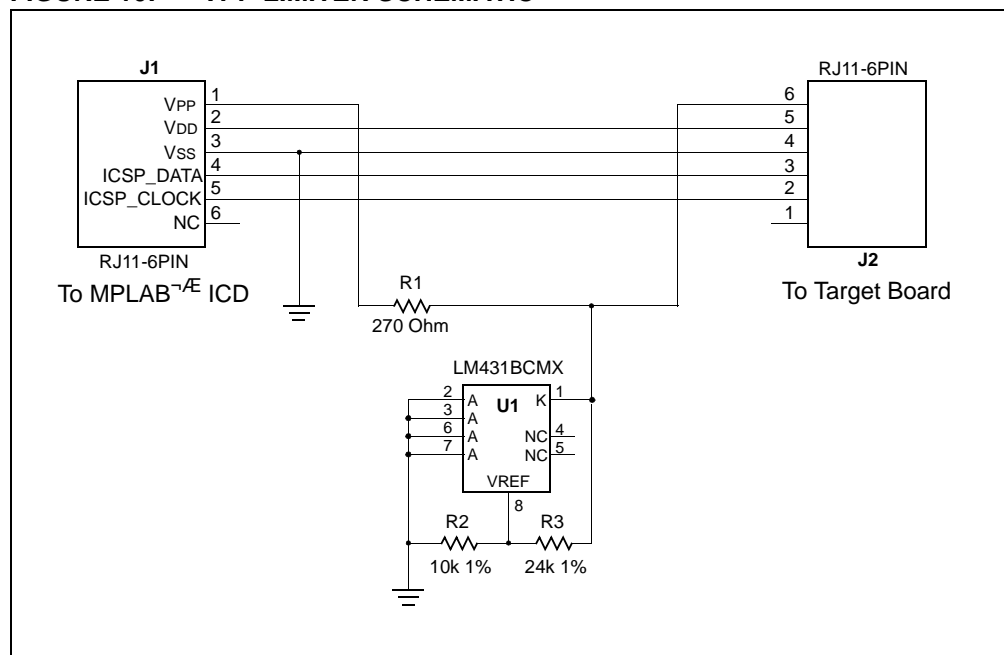
The header AC number is used for ordering the header. However, this number is not on the debug header, as the board is often used for multiple headers by inserting different ICE/ICD devices. To identify these debug headers, use the following information.

| Header   | ICE/ICD Device   | Board Assembly Number |
|----------|------------------|-----------------------|
| AC244023 | PIC18F14K50-ICE  | 02-02031              |
| AC244024 | PIC18LF14K50-ICE |                       |

### Header Setup and Operation

When the MPLAB ICD 2 is used with this header, you must use the Vpp Limiter (AC164112).

**FIGURE 10: VPP LIMITER SCHEMATIC**



### Header Limitations

See the "Limitations" section in your debug tool online Help file for details.

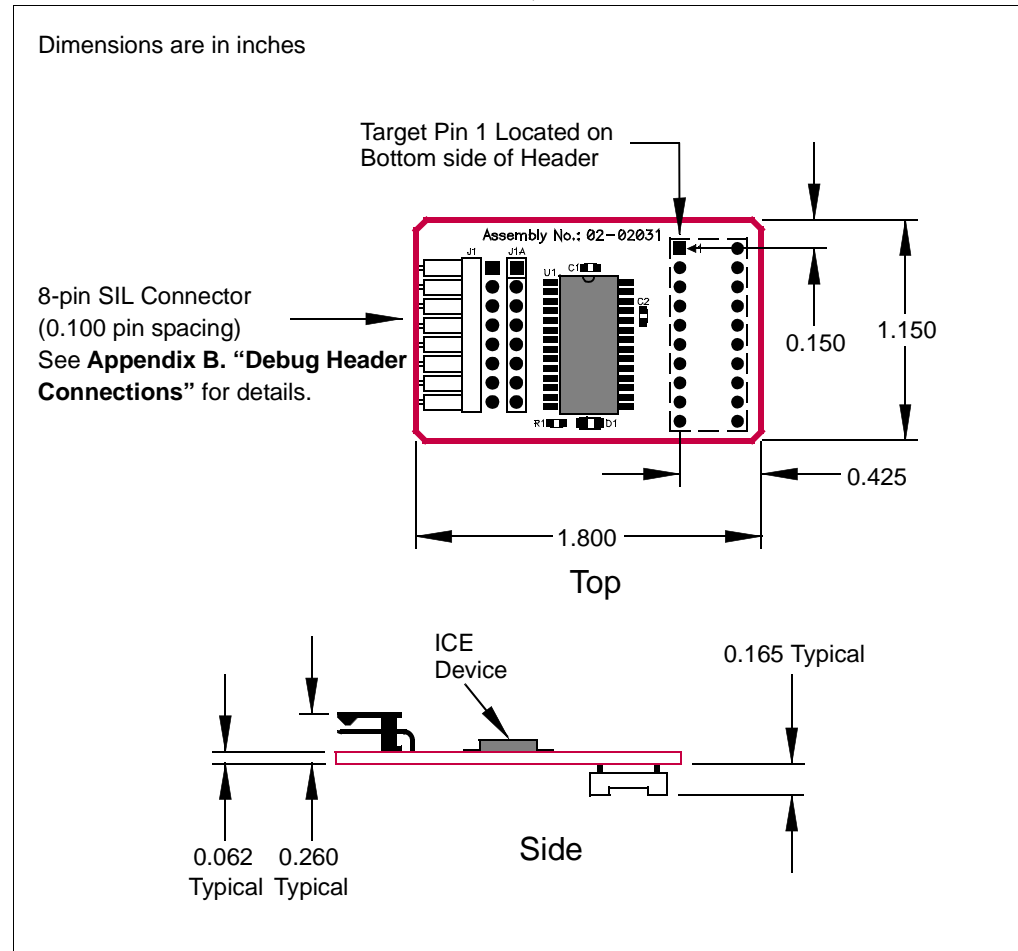


## Header Dimensions

The figure below lists the dimensions for the debug header. Dimensions are design values in inches.

If the length and/or width of the debug header is too large a footprint for the target board, consider using stand-offs, transition sockets or other extenders in the header connection socket to raise the header above the target.

**FIGURE 11: DIMENSIONS – AC244023, AC224024**



# Required Debug Headers

---

## AC244028

### Header Identification

The header AC number is used for ordering the header. However, this number is not on the debug header, as the board is often used for multiple headers by inserting different ICE/ICD devices. To identify this debug header, use the following information.

| Header   | ICE/ICD Device    | Board Assembly Number |
|----------|-------------------|-----------------------|
| AC244028 | PIC24F16KA102-ICE | 02-02107              |

### Header Setup and Operation

For this header, you will need to set up jumper J2 and J3.

| Jumper | Setting | Function                               |
|--------|---------|--|
| J2     | Open    | Disable weak ICE/MCLR pull-up resistor |
|        | Short   | Enable weak ICE/MCLR pull-up resistor  |
| J3     | Open    | Disable power LED indicator            |
|        | Short   | Enable power LED indicator             |

### Header Limitations

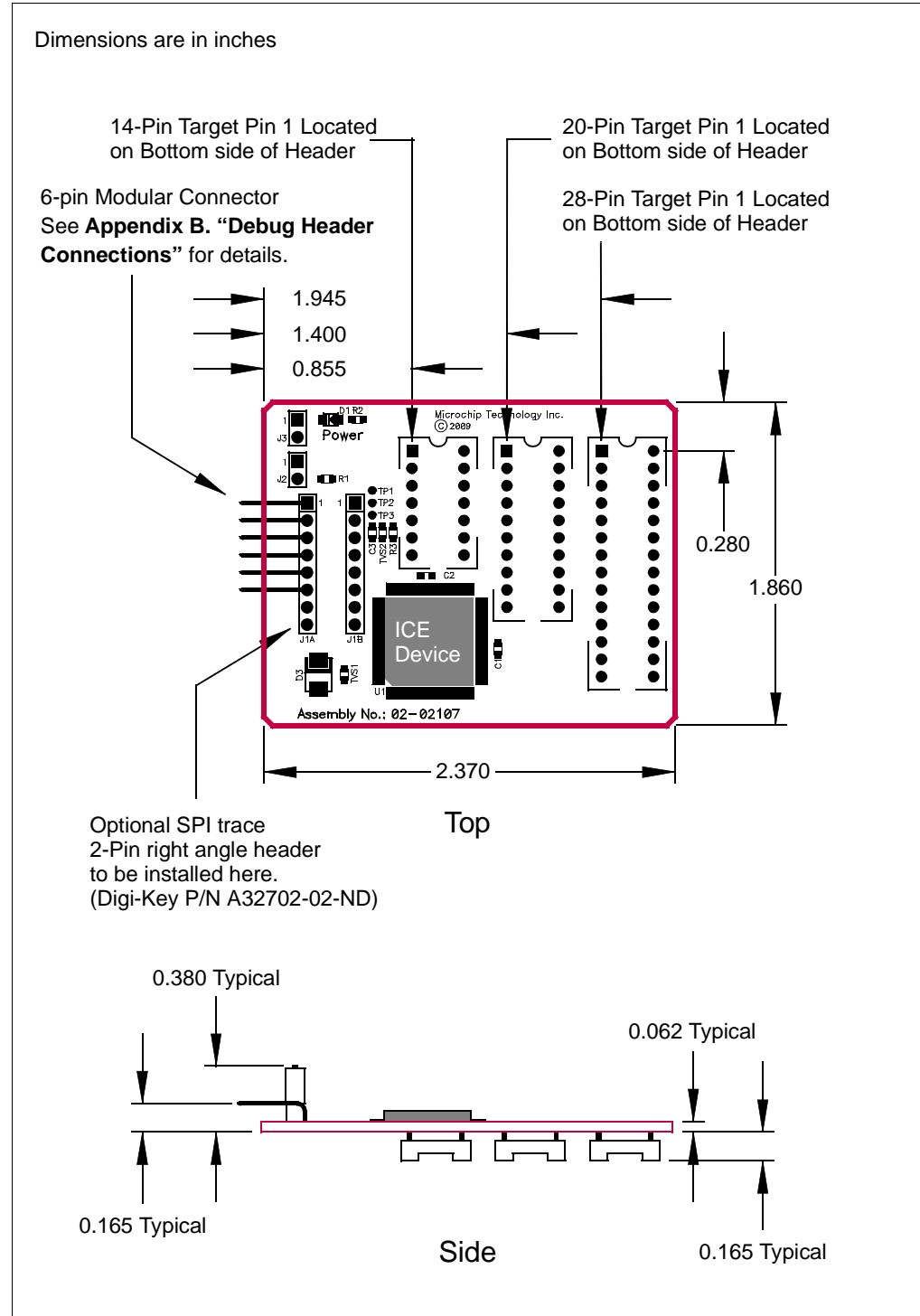
See the “Limitations” section in your debug tool online Help file for details.

## Header Dimensions

The figure below lists the dimensions for the debug header. Dimensions are design values in inches.

If the length and/or width of the debug header is too large a footprint for the target board, consider using stand-offs, transition sockets or other extenders in the header connection socket to raise the header above the target.

**FIGURE 12: DIMENSIONS - AC244028**



# Required Debug Headers

---

## AC244045

### Header Identification

The header AC number is used for ordering the header. However, this number is not on the debug header, as the board is often used for multiple headers by inserting different ICE/ICD devices. To identify this debug header, use the following information.

| Header   | ICE/ICD Device | Board Assembly Number |
|----------|----------------|-----------------------|
| AC244045 | PIC10F320-ICE  | 02-02255              |

Because the ICE chip is based on the PIC10F320 device, the ICE device memory will be greater than the actual chip for the PIC10F322 device.

### Header Limitations

See the "Limitations" section in your debug tool online Help file for details.

If the length and/or width of the debug header is too large a footprint for the target board, consider using stand-offs, transition sockets or other extenders in the header connection socket to raise the header above the target.

Dimensions are in inches

Target Pin 1 Located on Bottom side of Header

0.300

0.350

1.150

0.540

1.800

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U1

J1A

J1B

J2

LF

D1

F

TVS1

C1

R1

Assembly No.: 02-02255

6-pin Modular Connector  
See **Appendix B. "Debug Header Connections"** for details.

0.410 Typical

ICE Device

0.062 Typical

0.165 Typical

0.165 Typical

# Required Debug Headers

---

NOTES:

## Optional Debug Headers

### INTRODUCTION

Devices that have built-in debug circuitry do not require a header to use debug tools. However, some pins and memory must be used to support the debug function. Special ICE/ICD versions offering additional pins, memory and emulator functions can be used to provide superior emulating/debugging capabilities.

Currently available debug headers and their associated ICE/ICD devices are shown below by supported device.

**TABLE 1: OPTIONAL DEBUG HEADERS BY DEVICE**

| Device   | Pin Count                                 | Header Part Number       | ICE/ICD Device Used | V <sub>DD</sub> Max |
|--|---|--------------------------|---------------------|---------------------|
| PIC16F722<br>PIC16F723<br>PIC16F724<br>PIC16F726<br>PIC16F727                    | 28<br>28<br>40/44<br>28<br>40/44          | <a href="#">AC244026</a> | PIC16F727-ICE       | 5.5V                |
| PIC16LF722<br>PIC16LF723<br>PIC16LF724<br>PIC16LF726<br>PIC16LF727               | 28<br>28<br>40/44<br>28<br>40/44          | <a href="#">AC244027</a> | PIC16LF727-ICE      | 3.6V                |
| PIC16F1826<br>PIC16F1827<br>PIC16F1847   | 18/20/<br>28                              | <a href="#">AC244046</a> | PIC16F1847-ICE      | 3.6V                |
| PIC12F1822<br>PIC12F1840<br>PIC16F1823<br>PIC16F1824<br>PIC16F1825<br>PIC16F1829 | 8/14/<br>20                               | <a href="#">AC244043</a> | PIC16F1829-ICE      | 5.5V                |
| PIC16LF1826<br>PIC16LF1827<br>PIC16LF1847  | 18/20/<br>28                              | <a href="#">AC244047</a> | PIC16LF1847-ICE     | 3.6V                |
| PIC12F1822<br>PIC12F1840<br>PIC16F1823<br>PIC16F1824<br>PIC16F1825<br>PIC16F1829 | 8/14/<br>20                               | <a href="#">AC244044</a> | PIC16LF1829-ICE     | 3.6V                |
| PIC16F1933<br>PIC16F1934<br>PIC16F1936<br>PIC16F1937<br>PIC16F1938<br>PIC16F1939 | 28<br>40/44<br>28<br>40/44<br>28<br>40/44 | <a href="#">AC244035</a> | PIC16F1939-ICE      | 5.5V                |

# Optional Debug Headers

**TABLE 1: OPTIONAL DEBUG HEADERS BY DEVICE (CON'T)**

| Device   | Pin Count                                 | Header Part Number       | ICE/ICD Device Used | V <sub>DD</sub> Max          |
|--|---|--------------------------|---------------------|------------------------------|
| PIC16LF1933<br>PIC16LF1934<br>PIC16LF1936<br>PIC16LF1937<br>PIC16LF1938<br>PIC16LF1939                               | 28<br>40/44<br>28<br>40/44<br>28<br>40/44 | <a href="#">AC244036</a> | PIC16LF1939-ICE     | 3.6V<br>2.75V <sup>(2)</sup> |
| PIC18F1230/1330  | 28  | <a href="#">AC162078</a> | PIC18F1330-ICD      | 5.5V                         |
| PIC18F13K22<br>PIC18F14K22   | 20  | <a href="#">AC244033</a> | PIC18F14K22-ICE     | 5.5V                         |
| PIC18LF13K22<br>PIC18LF14K22   | 20  | <a href="#">AC244034</a> | PIC18LF14K22-ICE    | 3.6V<br>2.75V <sup>(1)</sup> |
| PIC18F24J10<br>PIC18F25J10   | 28  | <a href="#">AC162067</a> | PIC18F45J10-ICE     | 3.6V                         |
| PIC18LF24J10<br>PIC18LF25J10   |   |                          |                     | 3.6V<br>2.75V <sup>(1)</sup> |
| PIC18F44J10<br>PIC18F45J10   | 40  |                          |                     | 3.6V                         |
| PIC18LF44J10<br>PIC18LF45J10   |   |                          |                     | 3.6V<br>2.75V <sup>(1)</sup> |
| PIC18F44J10<br>PIC18F45J10   | 44  | <a href="#">AC162074</a> | PIC18F45J10-ICE     | 3.6V                         |
| PIC18LF44J10<br>PIC18LF45J10   |   |                          |                     | 3.6V<br>2.75V <sup>(1)</sup> |
| PIC18F63J11<br>PIC18F63J90<br>PIC18F64J11<br>PIC18F64J16<br>PIC18F64J90<br>PIC18F64J95<br>PIC18F65J11<br>PIC18F65J90 | 64  | <a href="#">AC162079</a> | PIC18F85J90-ICE     | 3.6V                         |
| PIC18F83J11<br>PIC18F83J90<br>PIC18F84J11<br>PIC18F84J16<br>PIC18F84J90<br>PIC18F84J95<br>PIC18F85J11<br>PIC18F85J90 | 80  |                          |                     |                              |
| PIC18F65J10<br>PIC18F65J15<br>PIC18F66J10<br>PIC18F66J15<br>PIC18F67J10  | 64  | <a href="#">AC162062</a> | PIC18F87J10-ICE     | 3.6V                         |
| PIC18F85J10<br>PIC18F85J15<br>PIC18F86J10<br>PIC18F86J15<br>PIC18F87J10  | 80  |                          |                     |                              |



**TABLE 1: OPTIONAL DEBUG HEADERS BY DEVICE (CON'T)**

| Device  | Pin Count                  | Header Part Number   | ICE/ICD Device Used              | V <sub>DD</sub> Max |
|---|----------------------------|--|----------------------------------|---------------------|
| PIC18F65J16<br>PIC18F66J11<br>PIC18F66J16<br>PIC18F67J11                | 64                         | <a href="#">AC162091</a>                                   | PIC18F87J11-ICE                  | 3.6V                |
| PIC18F85J16<br>PIC18F86J11<br>PIC18F86J16<br>PIC18F87J11                | 80                         |  |                                  |                     |
| PIC18F65J50<br>PIC18F65J55<br>PIC18F66J50<br>PIC18F66J55<br>PIC18F67J50 | 64                         | <a href="#">AC162087</a>                                   | PIC18F87J50-ICE                  | 3.6V                |
| PIC18F85J50<br>PIC18F85J55<br>PIC18F86J50<br>PIC18F86J55<br>PIC18F87J50 | 80                         |  |                                  |                     |
| PIC18F66J60<br>PIC18F66J65<br>PIC18F67J60                               | 64                         | <a href="#">AC162064</a>                                   | PIC18F97J60-ICE                  | 3.6V                |
| PIC18F86J60<br>PIC18F86J65<br>PIC18F87J60                               | 80                         |  |                                  |                     |
| PIC18F96J60<br>PIC18F96J65<br>PIC18F97J60                               | 100                        |  |                                  |                     |
| PIC24F08KA101<br>PIC24F08KA102<br>PIC24F16KA101<br>PIC24F16KA102        | 20<br>20/28<br>20<br>20/28 | <a href="#">AC244028</a>                                   | PIC24F16KA102-ICE <sup>(2)</sup> | 3.6V                |
| PIC24FJ16GA002<br>PIC24FJ32GA002<br>PIC24FJ48GA002<br>PIC24FJ64GA002    | 28                         | <a href="#">AC162088</a>                                   | PIC24FJ64GA004-ICE               | 3.6V                |
| PIC24FJ16GA004<br>PIC24FJ32GA004<br>PIC24FJ48GA004<br>PIC24FJ64GA004    | 44                         | <a href="#">AC162094</a>                                   |                                  |                     |
| PIC24FJ64GA006<br>PIC24FJ64GA008<br>PIC24FJ64GA010                      | 64<br>80<br>100            | <a href="#">AC162065</a><br>or<br><a href="#">AC244022</a> | PIC24FJ128GA010-ICE              | 3.6V                |
| PIC24FJ96GA006<br>PIC24FJ96GA008<br>PIC24FJ96GA010                      | 64<br>80<br>100            |  |                                  |                     |
| PIC24FJ128GA006<br>PIC24FJ128GA008<br>PIC24FJ128GA010                   | 64<br>80<br>100            |  |                                  |                     |

**Note 1:** V<sub>DDCORE</sub> Max

**Note 2:** Header required for other devices.

# Optional Debug Headers

## AC162062, AC162079, AC162087, AC162091

### Header Identification

The header AC number is used for ordering the header. However, this number is not on the debug header, as the board is often used for multiple headers by inserting different ICE/ICD devices. To identify these debug headers, use the following information.

| Header   | ICE/ICD Device  | Board Assembly Number |
|----------|-----------------|-----------------------|
| AC162062 | PIC18F87J10-ICE | 02-01830              |
| AC162079 | PIC18F85J90-ICE |                       |
| AC162087 | PIC18F87J50-ICE |                       |
| AC162091 | PIC18F87J11-ICE |                       |

### Header Setup and Operation – AC162062

For this header, there are no jumpers/switches. MPLAB IDE will use its selected device to choose the correct device to emulate.

Test points are available on this header to check the following: VDD, VDDCORE and ground.

**CAUTION**

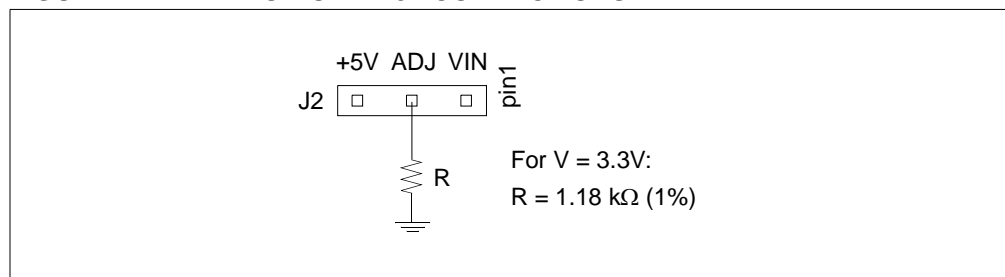


**This header cannot be plugged directly into the PICDEM™ HPC Explorer Board!**  
Device damage will result.

The PICDEM™ HPC Explorer Board is 5V, whereas the ICD device on the header is 3.6V max. Therefore, modification to the demo board is necessary before the header can be used.

1. Switch S3 should be set to ICE.
2. Jumper J2 must be connected as shown in Figure 1 to modify the operating voltage. See demo board documentation for more information.

**FIGURE 1: DEMO BOARD J2 CONNECTIONS**



### Header Setup and Operation – AC162079, AC162087, AC162091

For these headers, there are no jumpers/switches. MPLAB IDE will use its selected device to choose the correct device to emulate.

Test points are available on this header to check the following: VDD, VDDCORE and ground.

### Header Limitations

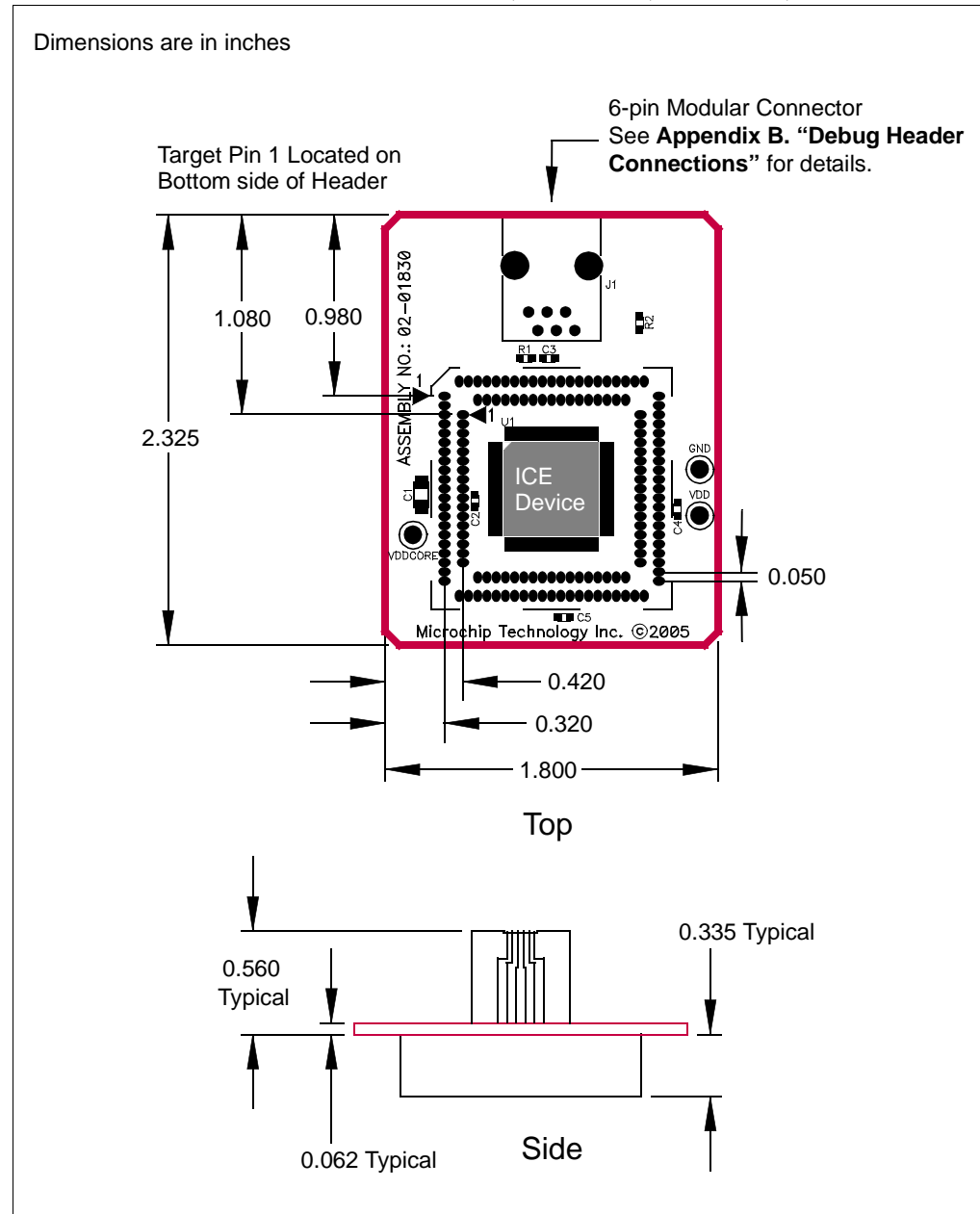
See the “Limitations” section in your debug tool online Help file for details.

## Header Dimensions

The figure below lists the dimensions for the debug header. Dimensions are design values in inches.

If the length and/or width of the debug header is too large a footprint for the target board, consider using stand-offs, transition sockets or other extenders in the header connection socket to raise the header above the target.

**FIGURE 2: DIMENSIONS – AC162062, AC162079, AC162087, AC162091**



# Optional Debug Headers

---

## AC162064

### Header Identification

The header AC number is used for ordering the header. However, this number is not on the debug header, as the board is often used for multiple headers by inserting different ICE/ICD devices. To identify this debug header, use the following information.

| Header   | ICE/ICD Device  | Board Assembly Number |
|----------|-----------------|-----------------------|
| AC162064 | PIC18F97J60-ICE | 02-01853              |

### Header Setup and Operation

For this header, there are no jumpers/switches. MPLAB IDE will use its selected device to choose the correct device to emulate.

Test points are available on this header to check the following: VDD, VDDCORE and ground.

### Header Limitations

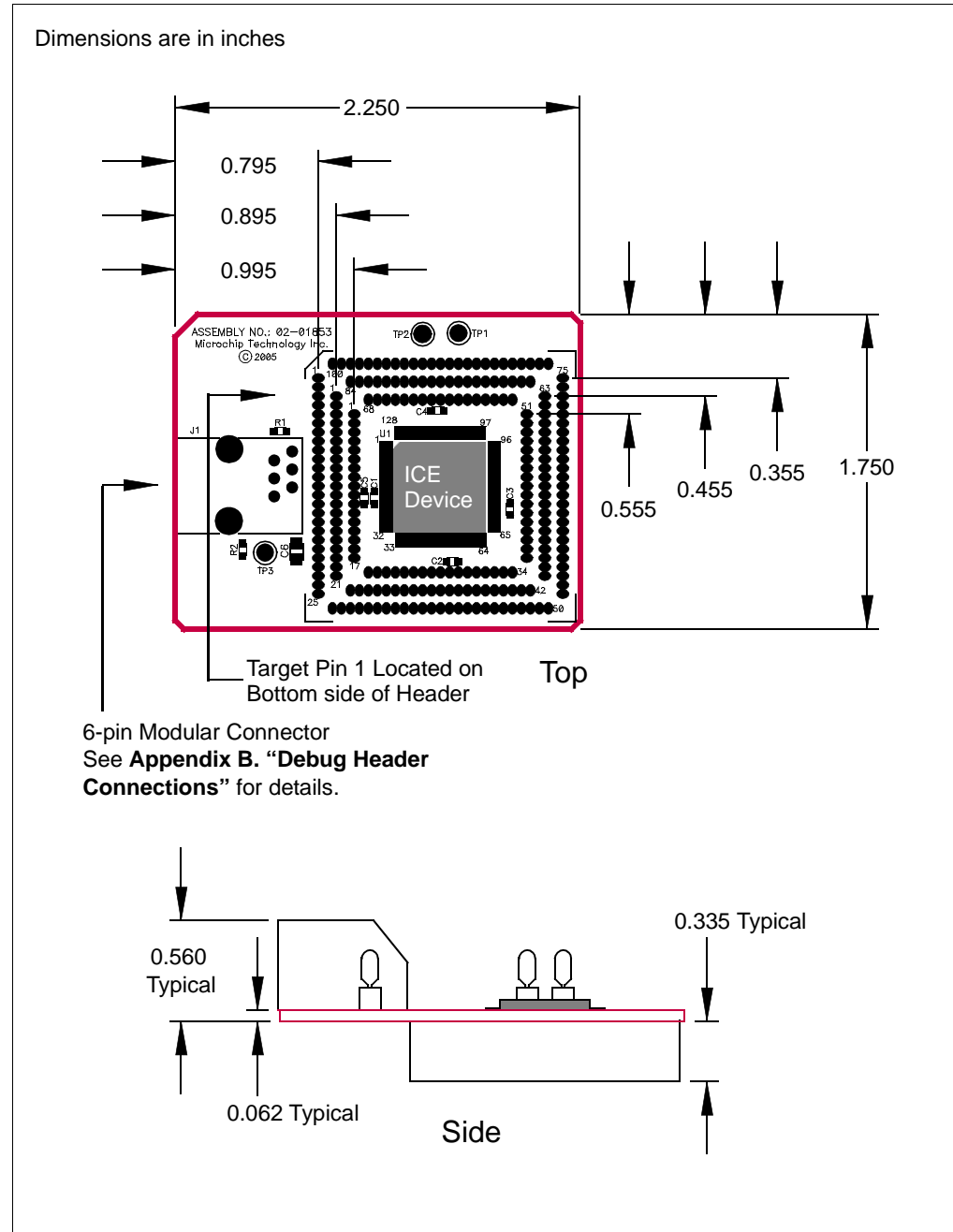
See the “Limitations” section in your debug tool online Help file for details.

### Header Dimensions

The figure below lists the dimensions for the debug header. Dimensions are design values in inches.

If the length and/or width of the debug header is too large a footprint for the target board, consider using stand-offs, transition sockets or other extenders in the header connection socket to raise the header above the target.

**FIGURE 3: DIMENSIONS – AC162064**



# Optional Debug Headers

---

## AC162065, AC244022

### Header Identification

The header AC number is used for ordering the header. However, this number is not on the debug header, as the board is often used for multiple headers by inserting different ICE/ICD devices. To identify these debug headers, use the following information.

| Header   | ICE/ICD Device      | Board Assembly Number |
|----------|---------------------|-----------------------|
| AC162065 | PIC24FJ128GA010-ICE | 02-01856              |
| AC244022 |                     | 02-01985              |

### Header Setup and Operation

For this header, there are no jumpers/switches. MPLAB IDE will use its selected device to choose the correct device to emulate.

Test points are available on this header to check the following: VDD, VDDCORE and ground.

### Header Limitations

See the “Limitations” section in your debug tool online Help file for details.

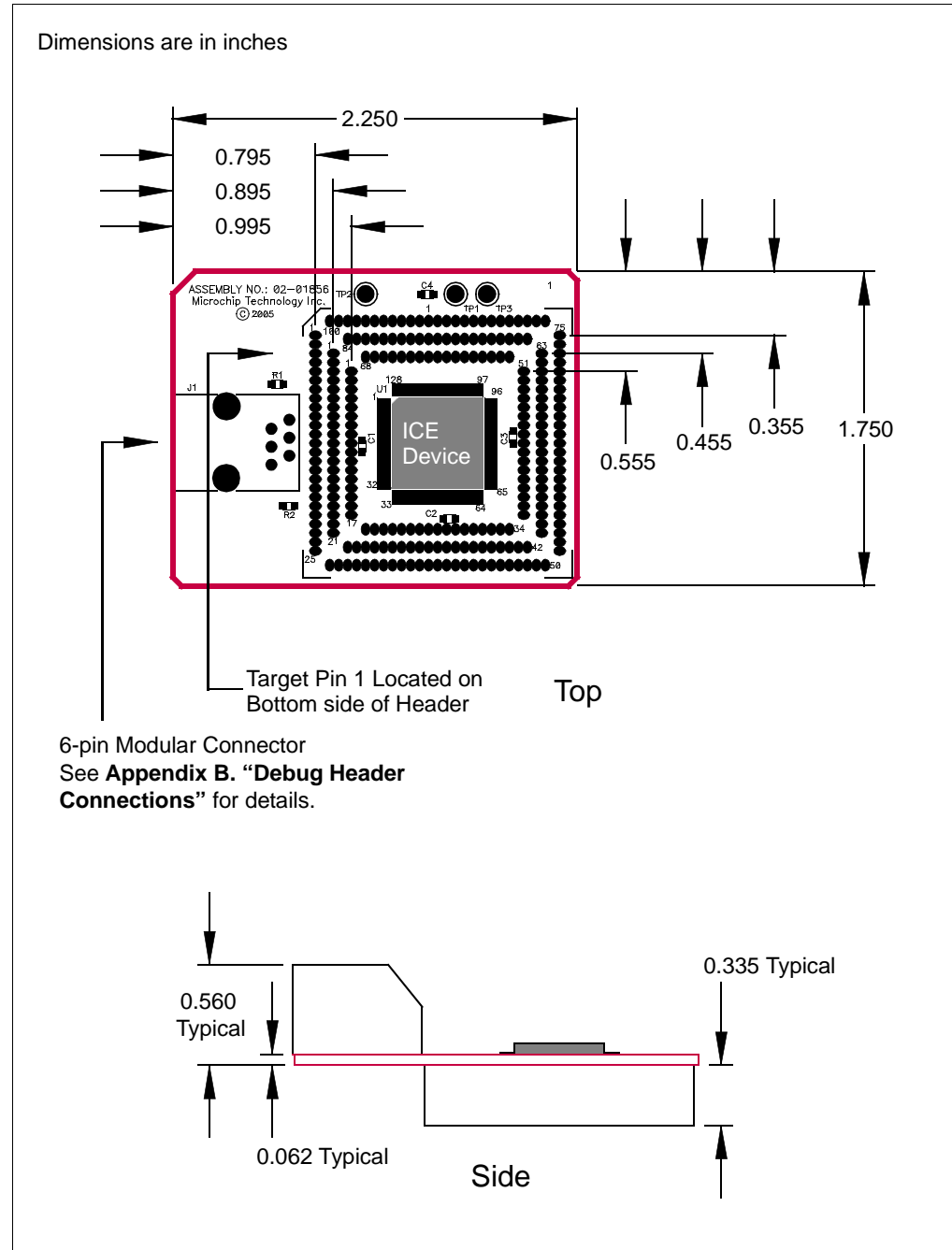
### Header Dimensions

The figures below lists the dimensions for the debug headers. Dimensions are design values in inches.

For this device family, header AC162065 will be sold until depleted. Then only header AC244022 will remain as a Performance Pak.

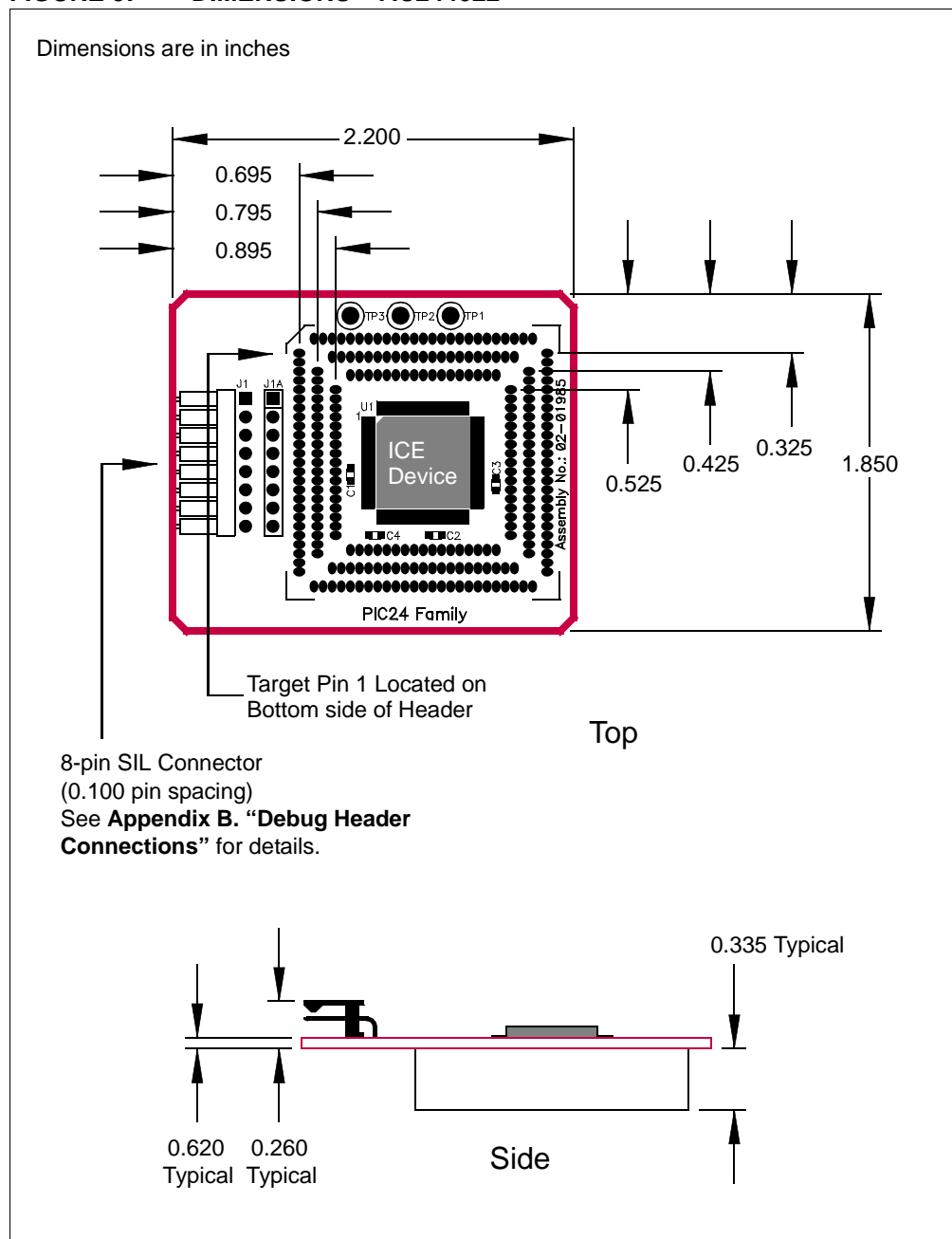
If the length and/or width of the debug header is too large a footprint for the target board, consider using stand-offs, transition sockets or other extenders in the header connection socket to raise the header above the target.

**FIGURE 4: DIMENSIONS – AC162065**



# Optional Debug Headers

FIGURE 5: DIMENSIONS – AC244022





## AC162067, AC162074

### Header Identification

The header AC number is used for ordering the header. However, this number is not on the debug header, as the board is often used for multiple headers by inserting different ICE/ICD devices. To identify these debug headers, use the following information.

| Header   | ICE/ICD Device  | Board Assembly Number |
|----------|-----------------|-----------------------|
| AC162067 | PIC18F45J10-ICE | 02-01854              |
| AC162074 |                 | 02-01929              |

### Header Setup and Operation

For these headers, you will need to connect jumpers J2 and J3 to select between the LF and F versions of devices.

| Device       | Device Type | Jumper J2 | Jumper J3 | Function                   |
|--------------|-------------|-----------|-----------|----------------------------|
| PIC18LFXXJ10 | LF          | 1-2       | 1-2       | Disable voltage regulator* |
| PIC18FXXJ10  | F           | 2-3       | 2-3       | Enable voltage regulator   |

\* VDDCORE must be supplied externally.

### Header Limitations

See the “Limitations” section in your debug tool online Help file for details.

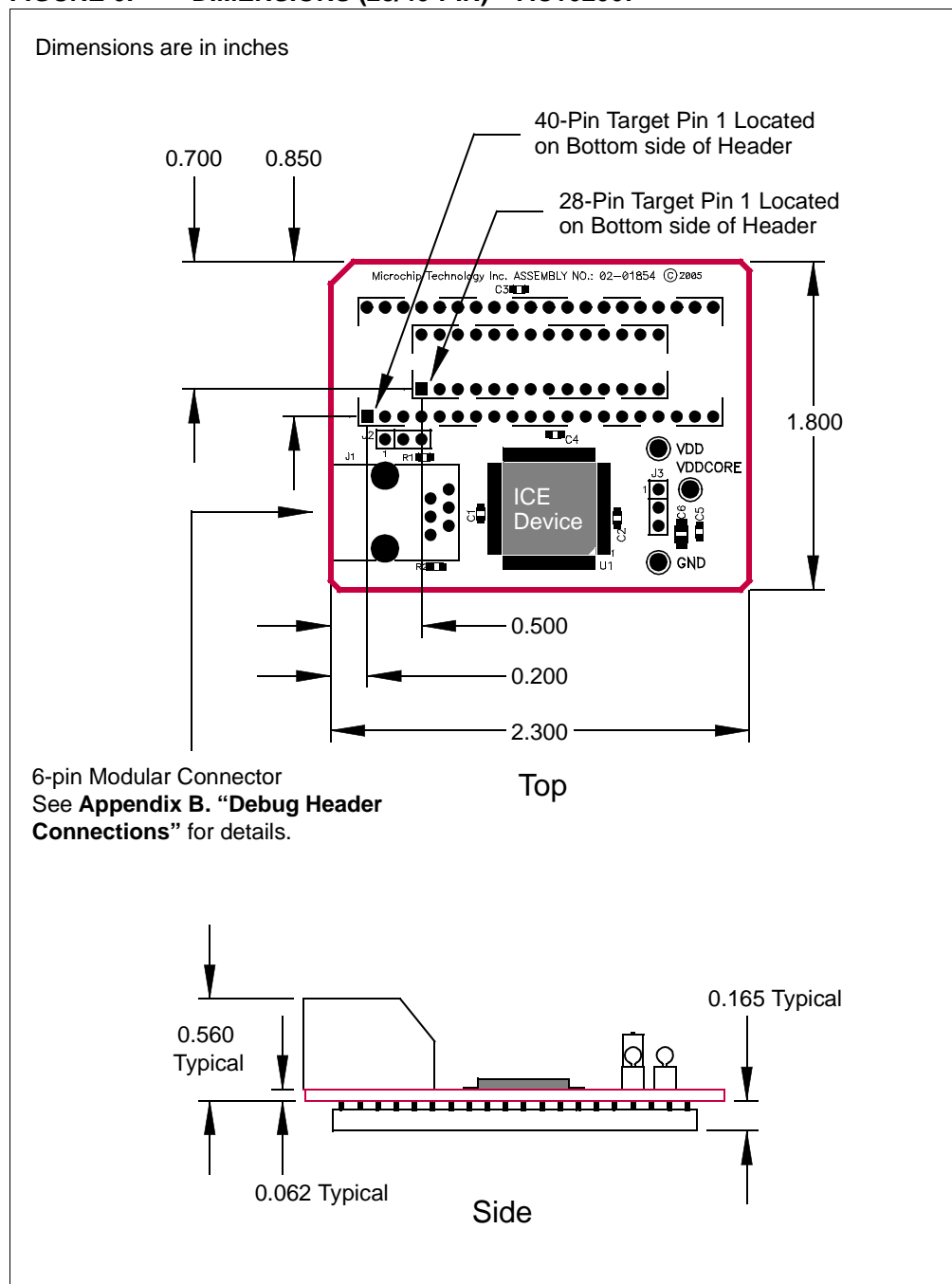
### Header Dimensions

The figures below lists the dimensions for the debug headers. Dimensions are design values in inches.

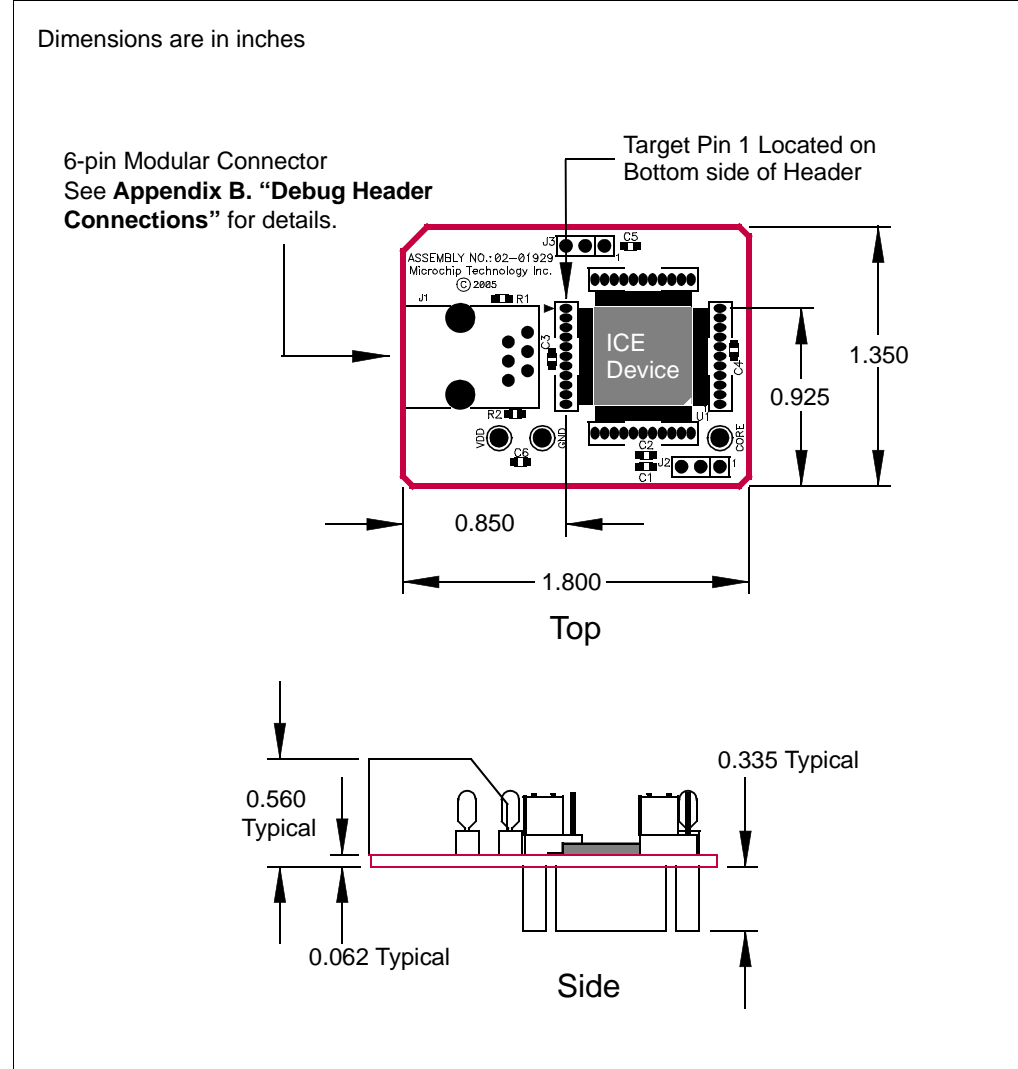
If the length and/or width of the debug header is too large a footprint for the target board, consider using stand-offs, transition sockets or other extenders in the header connection socket to raise the header above the target.

# Optional Debug Headers

**FIGURE 6: DIMENSIONS (28/40-PIN) – AC162067**



**FIGURE 7: DIMENSIONS (44-PIN) – AC162074**



# Optional Debug Headers

---

## AC162078

### Header Identification

The header AC number is used for ordering the header. However, this number is not on the debug header, as the board is often used for multiple headers by inserting different ICE/ICD devices. To identify this debug header, use the following information.

| Header   | ICE/ICD Device | Board Assembly Number |
|----------|----------------|-----------------------|
| AC162078 | PIC18F1330-ICD | 02-01896              |

### Header Setup and Operation

This debug header can be used with the following targets:

1. Customer target board for PIC18F1230/1330 devices. The target board should have an 18-pin DIP socket to connect to the 18-pin DIP socket on the debug header.
2. PICDEM MC motor control demo board. Use the 28-pin DIP socket on both boards to mount the debug header on to the PICDEM MC board.
3. PICDEM MC LV motor control demo board. Use the 28-pin DIP socket on both boards to mount the debug header on to the PICDEM MC LV board.

The following sections detail the configuration of the jumpers on the debug header for use with the above mentioned boards.

#### CUSTOMER TARGET BOARD

The default configuration is to remove all jumpers.

S1 is not populated and should not be used.

After the debug header is set up, do the following:

1. Connect the header to the target board.
2. Power the target board. You should see the red LED on the debug header turn on.
3. Connect the debug tool to the debug header.
4. Use MPLAB IDE and the debug tool to develop your application.

#### PICDEM MC/MC LV MOTOR CONTROL DEMO BOARDS

To run a BLDC motor on the PICDEM MC board or PICDEM MC LV board using the supplied firmware, use the following jumper setup:

| Jumper | Jumper Setting | Jumper | Jumper Setting |
|--------|----------------|--------|----------------|
| J1     | 2-3            | JP1    | Open           |
| J2     | 2-3            |        |                |
| J3     | 2-3            | JP2    | Open           |
| J5     | 2-3            |        |                |
| J6     | 1-2            | JP3    | Open           |
| J7     | 1-2            |        |                |

S1 is not populated and should not be used.

After the debug header is set up, do the following:

1. Connect the header to the PICDEM MC/MC LV target board.
2. Power the target board. You should see the red LED on the debug header turn on.
3. Connect the debug tool to the debug header.
4. Program the part with the demo code.
5. Run the program.
6. Press and release switch S2 on the target board to toggle the direction of the motor's rotation.
7. Press and release switch S1 on the target board to toggle between running and stopping the motor.
8. If the motor stops while reversing from a high speed, there could be an overcurrent condition detected by the system. Reset the system to run the program again.

## Header Limitations

See the "Limitations" section in your debug tool online Help file for details.

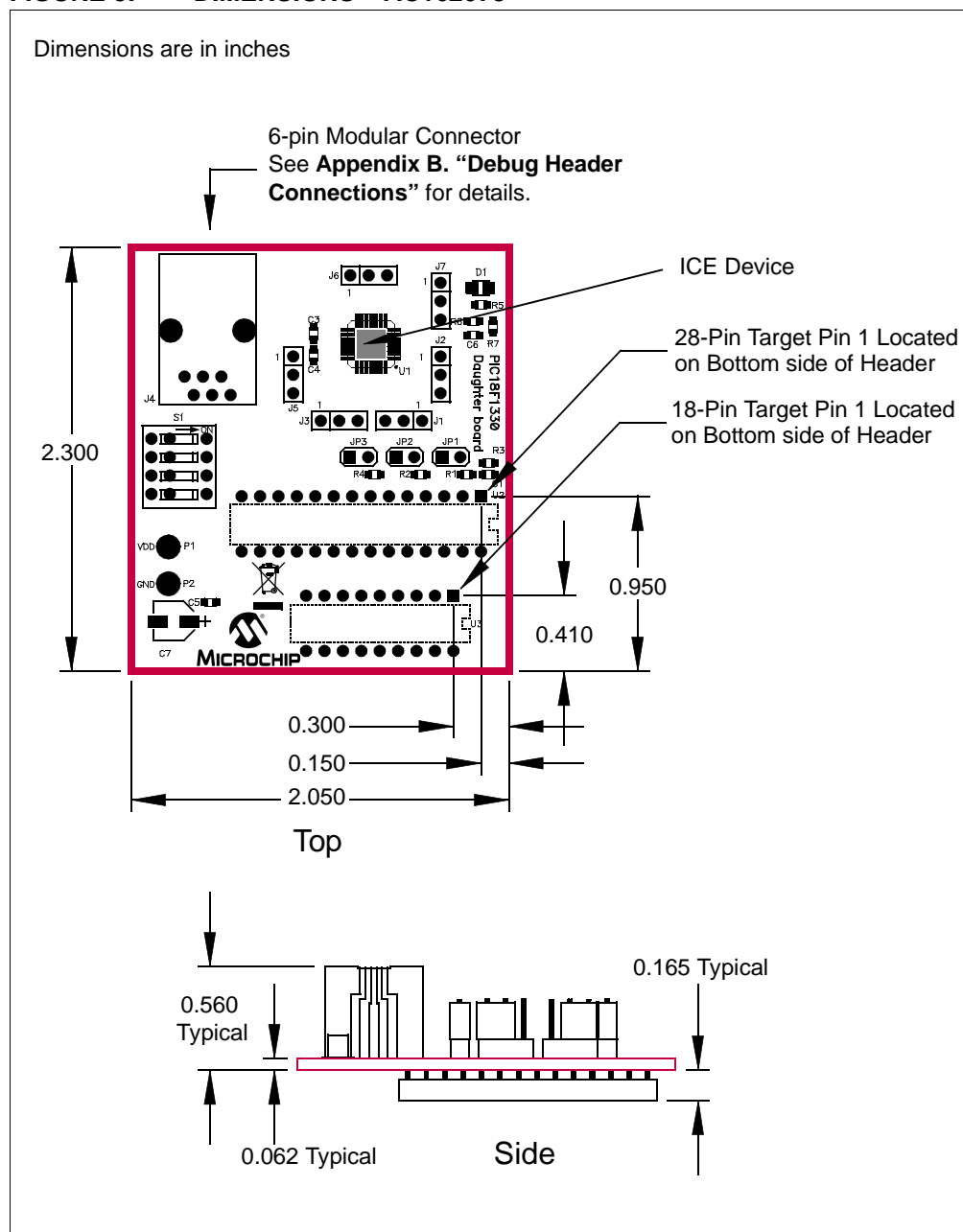
# Optional Debug Headers

## Header Dimensions

The figure below lists the dimensions for the debug header. Dimensions are design values in inches.

If the length and/or width of the debug header is too large a footprint for the target board, consider using stand-offs, transition sockets or other extenders in the header connection socket to raise the header above the target.

**FIGURE 8: DIMENSIONS – AC162078**



## AC162088, AC162094

### Header Identification

The header AC number is used for ordering the header. However, this number is not on the debug header, as the board is often used for multiple headers by inserting different ICE/ICD devices. To identify this debug header, use the following information.

| Header   | ICE/ICD Device     | Board Assembly Number |
|----------|--------------------|-----------------------|
| AC162088 | PIC24FJ64GA004-ICE | 02-01979              |
| AC162094 |                    | 02-01982              |

### Header Setup and Operation

Both 28-pin and 44-pin device headers have jumpers related to the enabling or disabling of the on-chip 2.5 volt voltage regulator. Please see the section entitled “On-Chip Voltage Regulator” in the “*dsPIC33F Family Reference Manual*” (DS70165) for more details.

| Jumper J2     | Function                     |
|---------------|------------------------------|
| 1-2           | Disable voltage regulator    |
| 2-3           | Enable voltage regulator     |
| No connection | DISVREG controlled by target |

Test points are available on this header to check the following:

| Test Point | Color | Signal | Test Point | Color  | Signal  |
|------------|-------|--------|------------|--------|---------|
| TP1        | Black | Ground | TP5        | White  | DISVREG |
| TP2        | Red   | VDD    | TP6        | White  | PGC     |
| TP3        | Black | AVss   | TP7        | White  | PGD     |
| TP4        | Red   | AVDD   | TP8        | Yellow | ICRST   |

### Header Limitations

See the “Limitations” section in your debug tool online Help file for details.

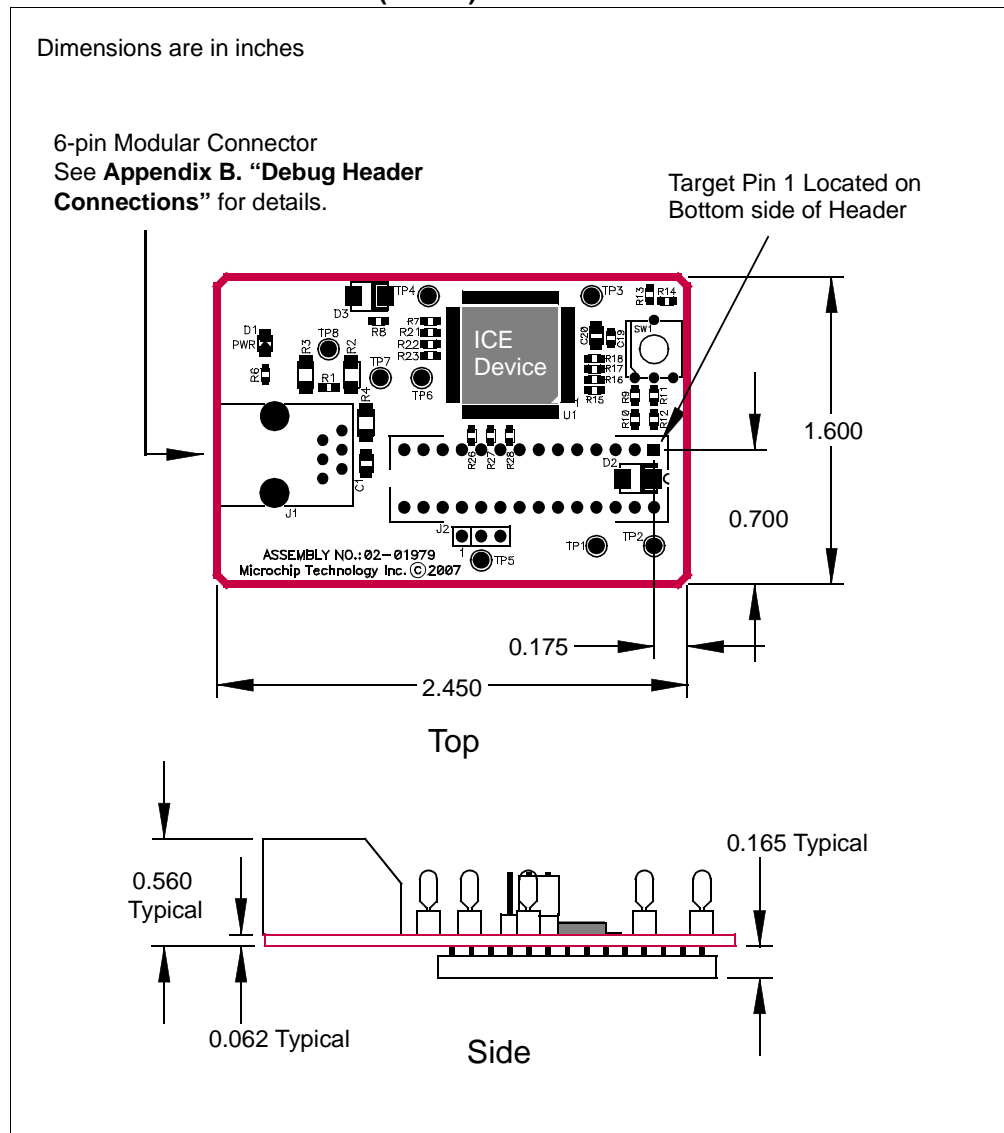
### Header Dimensions

The figures below list the dimensions for the debug headers. Dimensions are design values in inches.

If the length and/or width of the debug header is too large a footprint for the target board, consider using stand-offs, transition sockets or other extenders in the header connection socket to raise the header above the target.

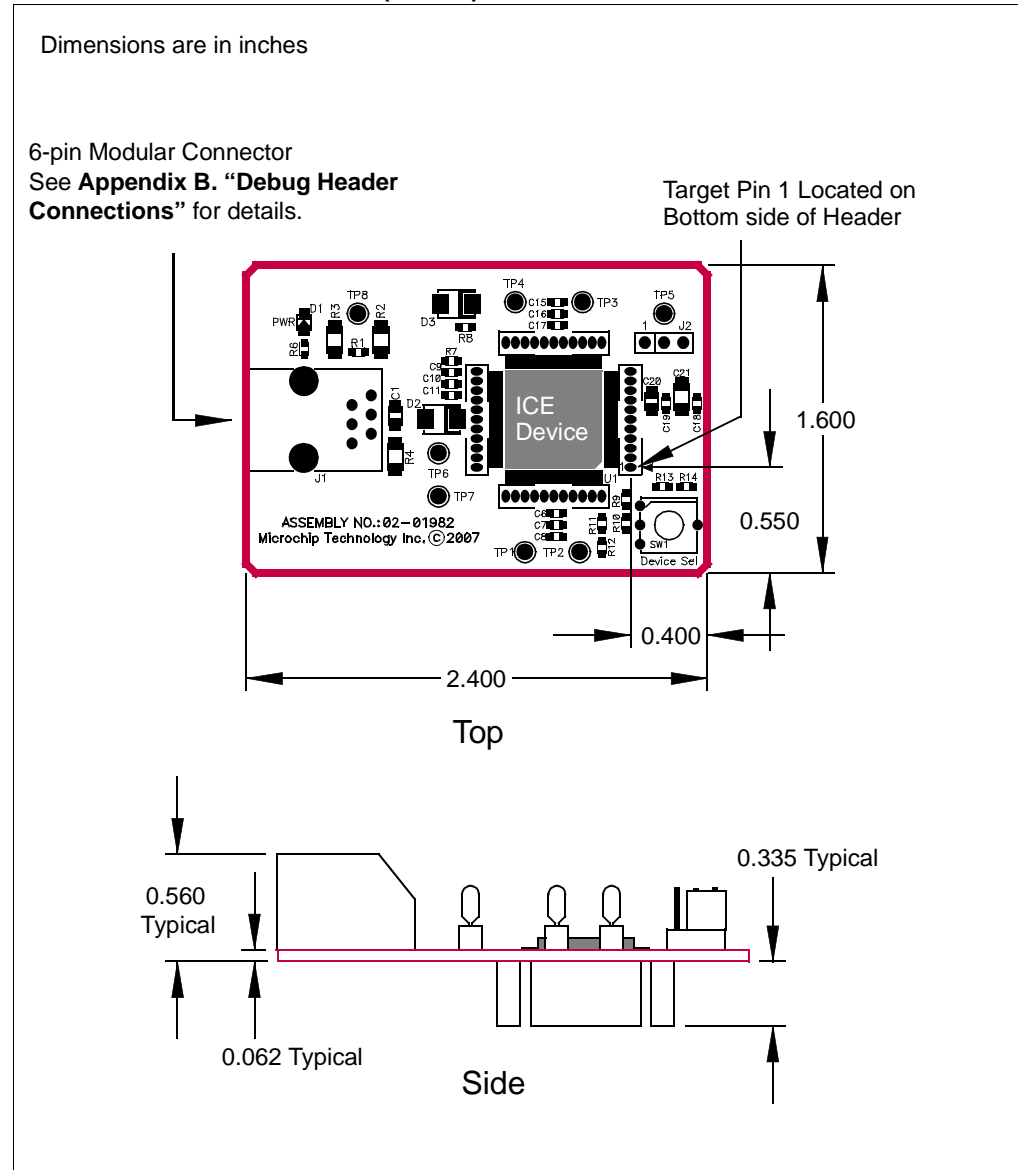
# Optional Debug Headers

FIGURE 9: DIMENSIONS (28 PIN) – AC162088





**FIGURE 10: DIMENSIONS (44 PIN) – AC162094**



# Optional Debug Headers

## AC244026, AC244027

### Header Identification

The header AC number is used for ordering the header. However, this number is not on the debug header, as the board is often used for multiple headers by inserting different ICE/ICD devices. To identify this debug header, use the following information.

| Header   | ICE/ICD Device | Board Assembly Number |
|----------|----------------|-----------------------|
| AC244026 | PIC16F727-ICE  | 02-02105              |
| AC244027 | PIC16LF727-ICE |                       |

### Header Setup and Operation - AC244026

This Processor Extension Pak provides extra debugging capability not available on PIC16F727 production devices:

- 3 Address / Data breakpoints (1 Address only breakpoint on production devices)
- Data capture (Real Time Data Streaming)
- No user Flash resources needed for debugging
- No user RAM resources needed for debugging
- No user pins required

This header has jumpers available for MCLR pull-up and power LED control.

| Jumper | Setting | Function  |
|--------|---------|---|
| J2     | Open    | Disable weak ICE $\overline{\text{MCLR}}$ pull-up resistor.   |
|        | Short   | Enable weak ICE $\overline{\text{MCLR}}$ pull-up resistor. This option keeps the target program running even after the tool has been disconnected from the header, i.e., the pin will not float high. |
| J3     | Open    | Disable power LED indicator. This option saves power.   |
|        | Short   | Enable power LED indicator.   |

Additionally, this header has jumpers related to the LDO voltage regulator. Depending on the device pin used for this function, you would use either J4 (RA0), J5 (RA5) or J6 (RA6) for Vcap selection. For details on the voltage regulator, see the *PIC16F72X/PIC16LF72X Data Sheet* (DS41341).

| Jumper        | Setting | Function  |
|---------------|---------|---|
| J4, J5, or J6 | Open    | Use only target capacitance for Vcap. This is the standard configuration.   |
|               | Short   | Use both on-board and target capacitance for Vcap. This option is to provide extra margin for the voltage regulator stability/regulation in cases where there is a long lead length between the emulation header Vcap pin and the target Vcap pin. (As examples, when using long-pin DIP transition sockets or certain QFN transition sockets.) |

# Optional Debug Headers

Test points are available on this header to check the following:

| Test Point | Signal                         | Test Point | Signal | Pin | Jumper |
|------------|--------------------------------|------------|--------|-----|--------|
| TP1        | Vss                            | TP6        | Vcap   | RA0 | J4     |
| TP2        | VDD                            | TP7        | Vcap   | RA5 | J5     |
| TP3        | $\overline{\text{ICD}}$ Enable | TP8        | Vcap   | RA6 | J6     |
| TP4        | VDD                            |            |        |     |        |
| TP5        | Vss                            |            |        |     |        |

## Header Setup and Operation - AC244027

This Processor Extension Pak provides extra debugging capability not available on PIC16LF727 production devices:

- 3 Address / Data breakpoints (1 Address only breakpoint on production devices)
- Data capture (Real Time Data Streaming)
- No user Flash resources needed for debugging
- No user RAM resources needed for debugging
- No user pins required

This header has jumpers available for MCLR pull-up and power LED control.

| Jumper | Setting | Function  |
|--------|---------|---|
| J2     | Open    | Disable weak ICE $\overline{\text{MCLR}}$ pull-up resistor.   |
|        | Short   | Enable weak ICE $\overline{\text{MCLR}}$ pull-up resistor. This option keeps the target program running even after the tool has been disconnected from the header, i.e., the pin will not float high. |
| J3     | Open    | Disable power LED indicator. This option saves power.   |
|        | Short   | Enable power LED indicator.   |

Test points are available on this header to check the following:

| Test Point | Signal                         | Test Point | Signal |
|------------|--------------------------------|------------|--------|
| TP1        | Vss                            | TP4        | VDD    |
| TP2        | VDD                            | TP5        | Vss    |
| TP3        | $\overline{\text{ICD}}$ Enable |            |        |

## Header Limitations

See the “Limitations” section in your debug tool online Help file for details.

## Header Dimensions

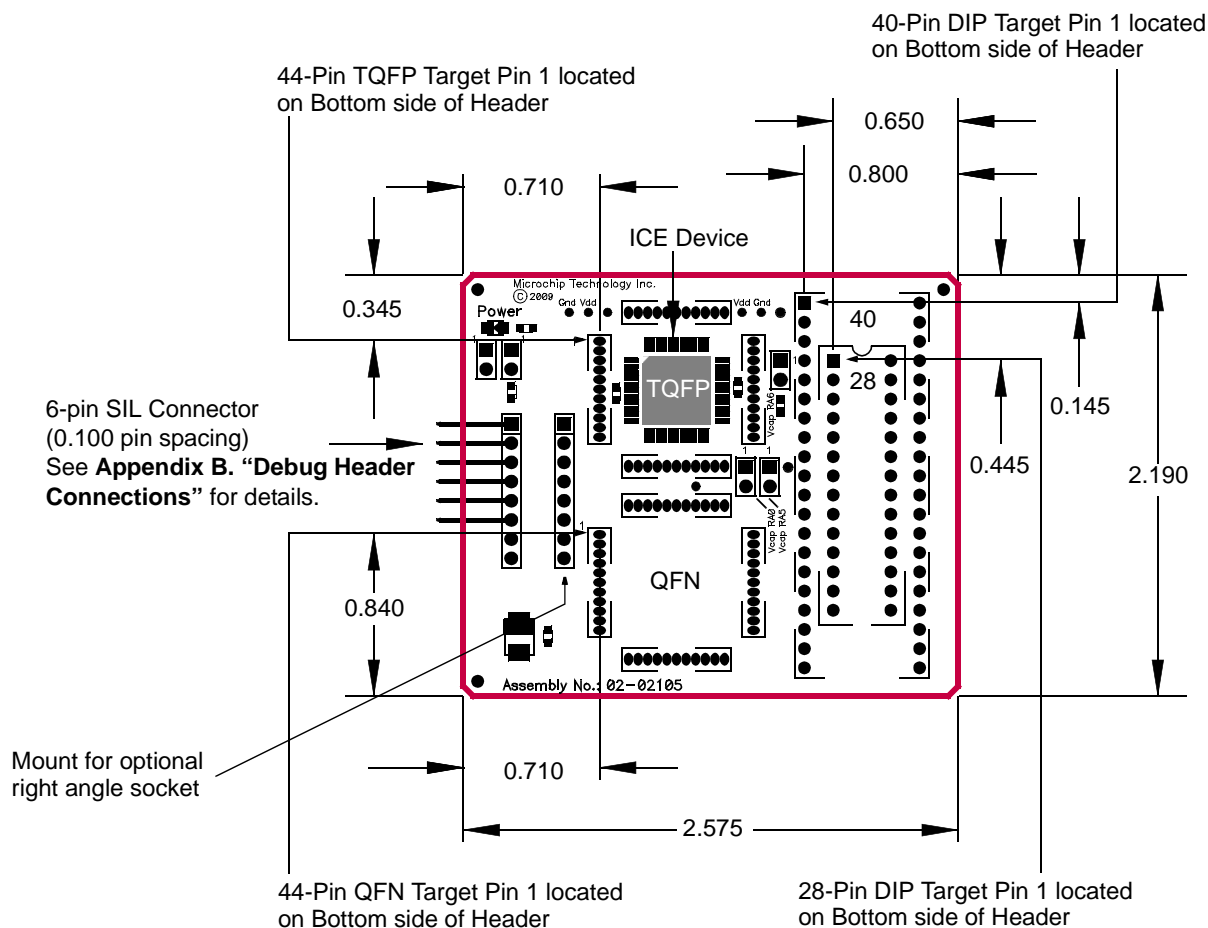
The figures below list the dimensions for the debug headers. Dimensions are design values in inches.

If the length and/or width of the debug header is too large a footprint for the target board, consider using stand-offs, transition sockets or other extenders in the header connection socket to raise the header above the target.

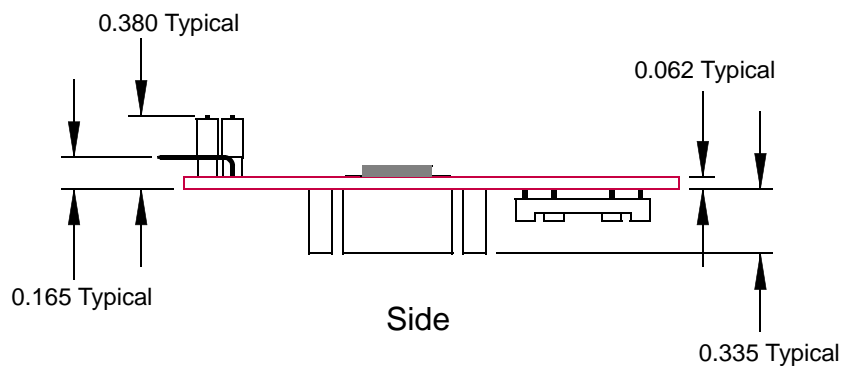
# Optional Debug Headers

**FIGURE 11: DIMENSIONS – AC244026, AC244027**

Dimensions are in inches



Top



Side

## AC244033, AC244034

### Header Identification

The header AC number is used for ordering the header. However, this number is not on the debug header, as the board is often used for multiple headers by inserting different ICE/ICD devices. To identify this debug header, use the following information.

| Header   | ICE/ICD Device   | Board Assembly Number |
|----------|------------------|-----------------------|
| AC244033 | PIC18F14K22-ICE  | 02-02031              |
| AC244034 | PIC18LF14K22-ICE |                       |

### Header Setup and Operation

For this header, there are no jumpers/switches. MPLAB IDE will use its selected device to choose the correct device to emulate.

### Header Limitations

See the “Limitations” section in your debug tool online Help file for details.

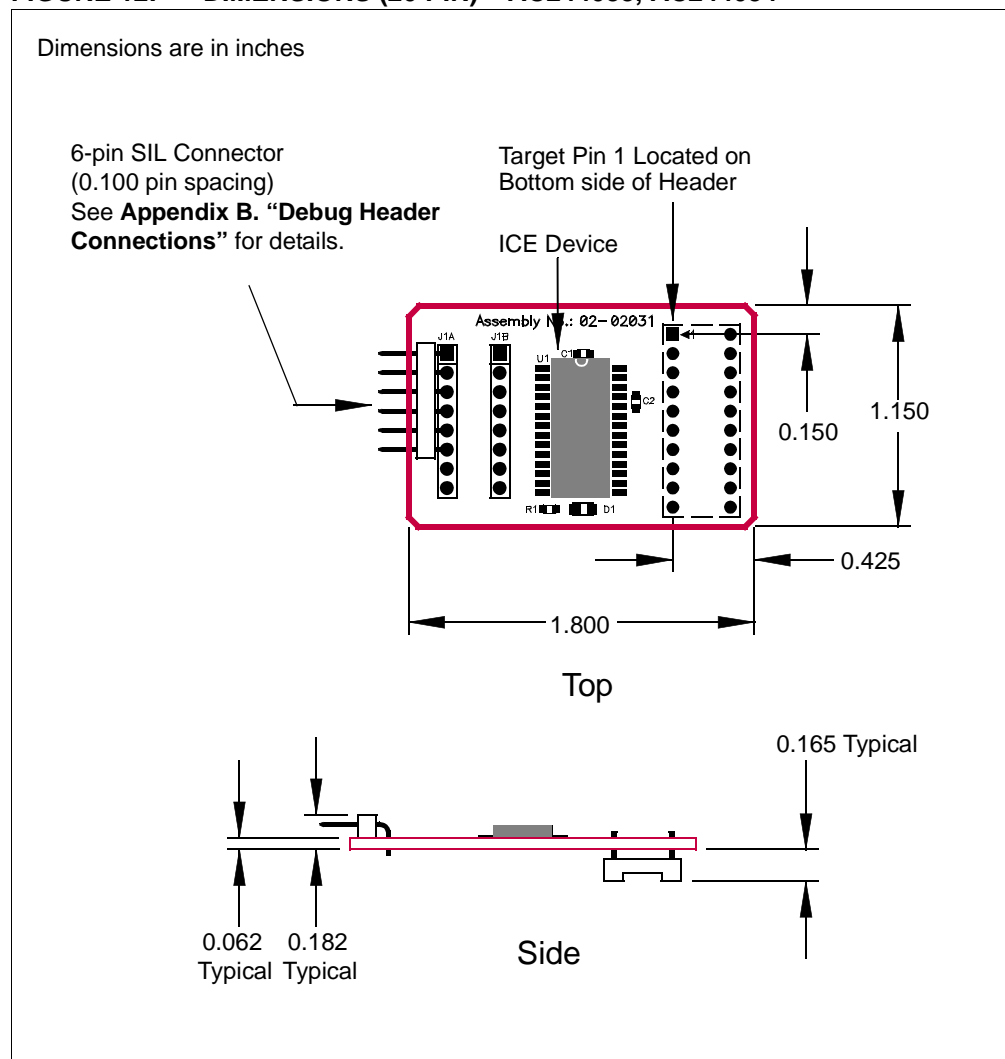
### Header Dimensions

The figures below list the dimensions for the debug headers. Dimensions are design values in inches.

If the length and/or width of the debug header is too large a footprint for the target board, consider using stand-offs, transition sockets or other extenders in the header connection socket to raise the header above the target.

# Optional Debug Headers

FIGURE 12: DIMENSIONS (20 PIN) – AC244033, AC244034



## AC244035, AC244036

### Header Identification

The header AC number is used for ordering the header. However, this number is not on the debug header, as the board is often used for multiple headers by inserting different ICE/ICD devices. To identify this debug header, use the following information.

| Header   | ICE/ICD Device  | Board Assembly Number |
|----------|-----------------|-----------------------|
| AC244035 | PIC16F1939-ICE  | 02-02105              |
| AC244036 | PIC16LF1939-ICE |                       |

### Header Setup and Operation

For this header, you will need to set up the jumpers below.

| Jumper | Setting | Function   |
|--------|---------|--|
| J2     | Open    | Disable weak ICE/MCLR pull-up resistor                         |
|        | Short   | Enable weak ICE/MCLR pull-up resistor                          |
| J3     | Open    | Disable power LED indicator                                    |
|        | Short   | Enable power LED indicator                                     |
| J4     | Open    | Use only target capacitance for VCAP (on RA0 pin)              |
|        | Short   | Use both on-board and target capacitance for VCAP (on RA0 pin) |
| J5     | Open    | Use only target capacitance for VCAP (on RA5 pin)              |
|        | Short   | Use both on-board and target capacitance for VCAP (on RA5 pin) |
| J6     | Open    | Use only target capacitance for VCAP (on RA6 pin)              |
|        | Short   | Use both on-board and target capacitance for VCAP (on RA6 pin) |

### Header Limitations

See the “Limitations” section in your debug tool online Help file for details.

---

The figure below lists the dimensions for the debug header. Dimensions are design values in inches.



## AC244043, AC244044

### Header Identification

The header AC number is used for ordering the header. However, this number is not on the debug header, as the board is often used for multiple headers by inserting different ICE/ICD devices. To identify this debug header, use the following information.

| Header   | ICE/ICD Device  | Board Assembly Number |
|----------|-----------------|-----------------------|
| AC244043 | PIC16F1829-ICE  | 02-02208              |
| AC244044 | PIC16LF1829-ICE |                       |

### Header Setup and Operation

For this header, there are no jumpers/switches. MPLAB IDE will use its selected device to choose the correct device to emulate.

### Header Limitations

See the "Limitations" section in your debug tool online Help file for details.

# Optional Debug Headers

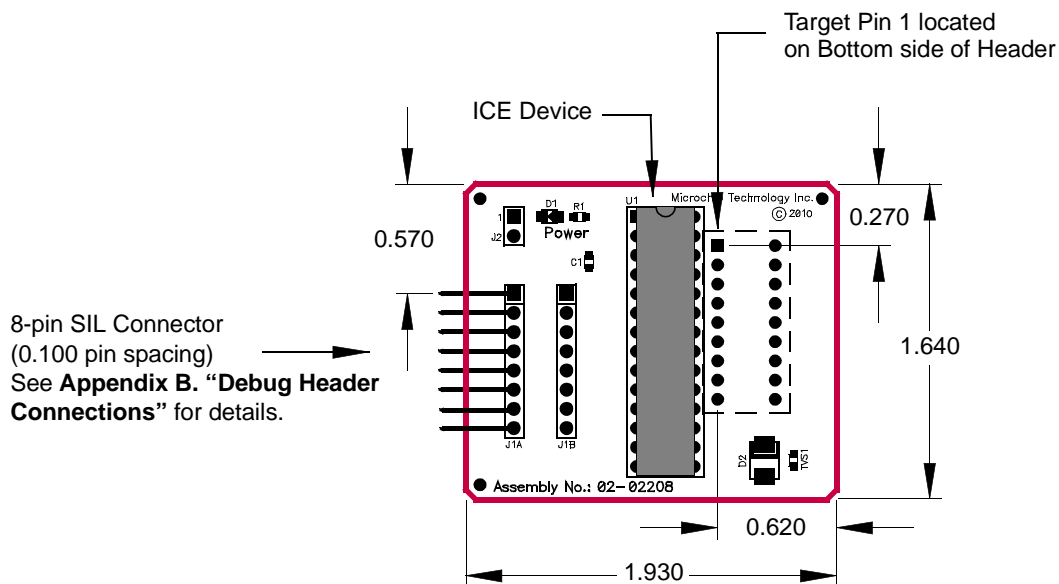
## Header Dimensions

The figure below lists the dimensions for the debug header. Dimensions are design values in inches.

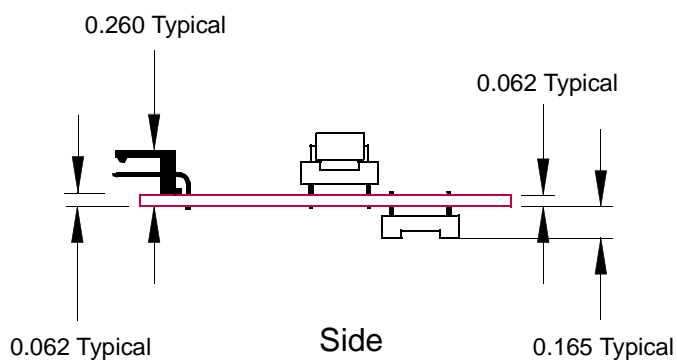
If the length and/or width of the debug header is too large a footprint for the target board, consider using stand-offs, transition sockets or other extenders in the header connection socket to raise the header above the target.

**FIGURE 14: DIMENSIONS - AC244043, AC244044**

Dimensions are in inches



Top



## AC244046, AC244047

### Header Identification

The header AC number is used for ordering the header. However, this number is not on the debug header, as the board is often used for multiple headers by inserting different ICE/ICD devices. To identify this debug header, use the following information.

| Header   | ICE/ICD Device  | Board Assembly Number |
|----------|-----------------|-----------------------|
| AC244046 | PIC16F1847-ICE  | 02-02258              |
| AC244047 | PIC16LF1847-ICE |                       |

### Header Setup and Operation

For this header, there are no jumpers/switches. MPLAB IDE will use its selected device to choose the correct device to emulate.

### Header Limitations

See the "Limitations" section in your debug tool online Help file for details.

# Optional Debug Headers

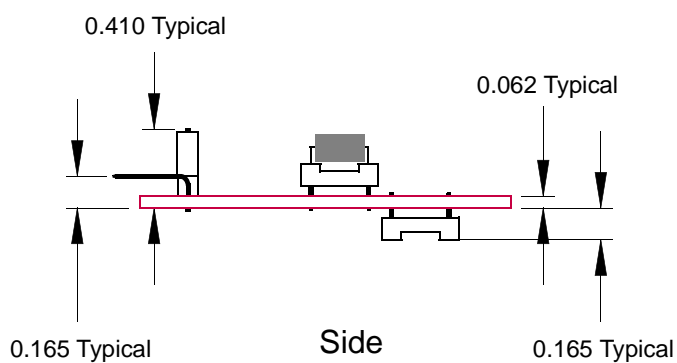
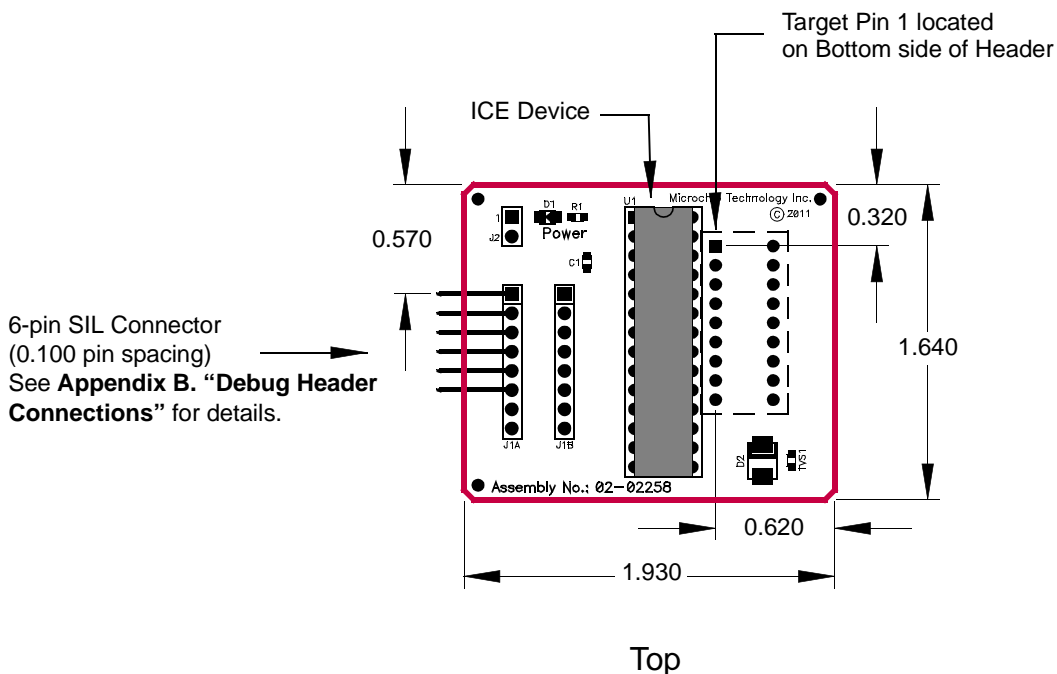
## Header Dimensions

The figure below lists the dimensions for the debug header. Dimensions are design values in inches.

If the length and/or width of the debug header is too large a footprint for the target board, consider using stand-offs, transition sockets or other extenders in the header connection socket to raise the header above the target.

**FIGURE 15: DIMENSIONS - AC244046, AC244047**

Dimensions are in inches



## Appendix A. Debug Header Target Footprints

### INTRODUCTION

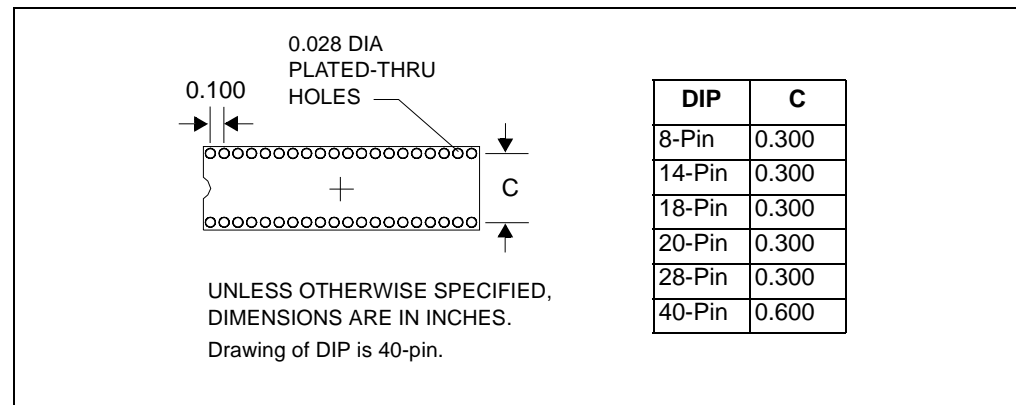
To connect a debug header directly to a target board (without the use of a transition socket) the following information will be helpful.

- DIP Device Footprints
- TQFP/PLCC Device Footprints

### DIP DEVICE FOOTPRINTS

DIP device adapter footprints shown will accept adapter plugs like Samtec series APA plugs. These plugs can be soldered in place during development/emulation and eliminate the need for any other sockets.

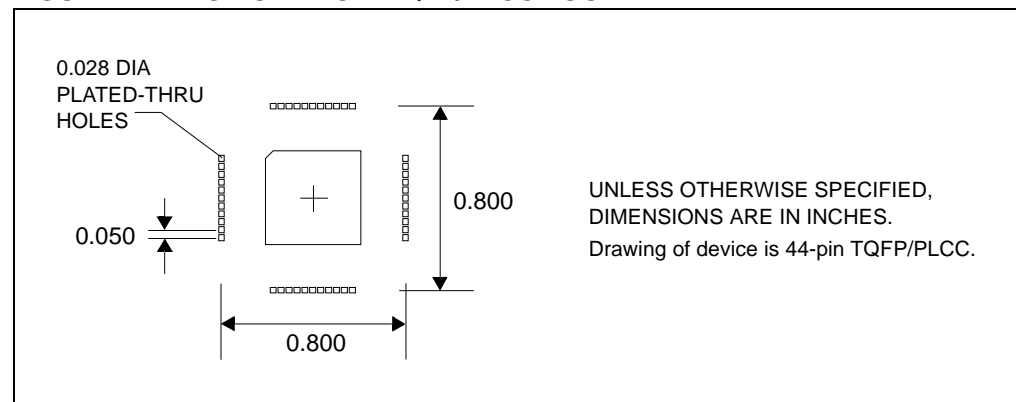
**FIGURE 16: DIP FOOTPRINT**



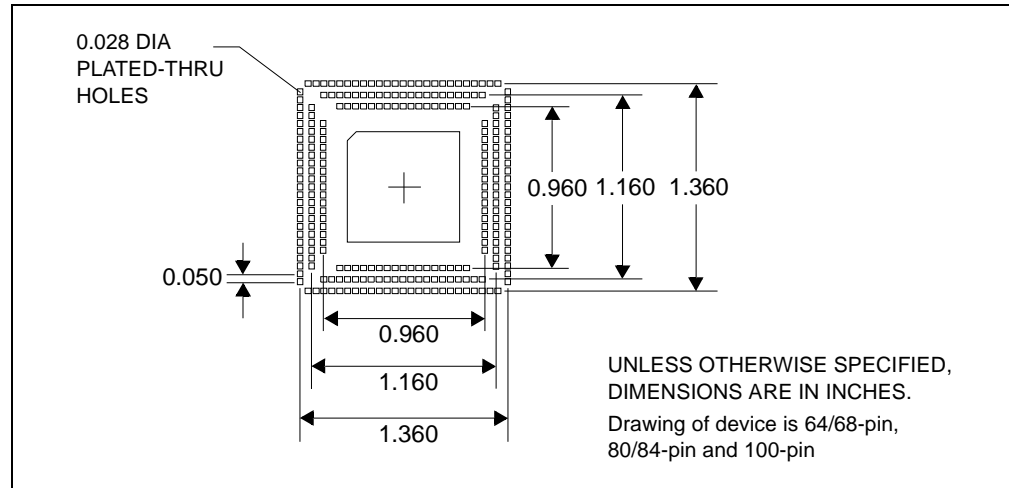
### TQFP/PLCC DEVICE FOOTPRINTS

TQFP/PLCC device adapter footprints shown will accept board stackers like Samtec series DWM 0.050 Pitch Stackers. These stackers can be soldered in place during development/emulation and eliminate the need for any other sockets.

**FIGURE 17: SINGLE-ROW TQFP/PLCC FOOTPRINT**



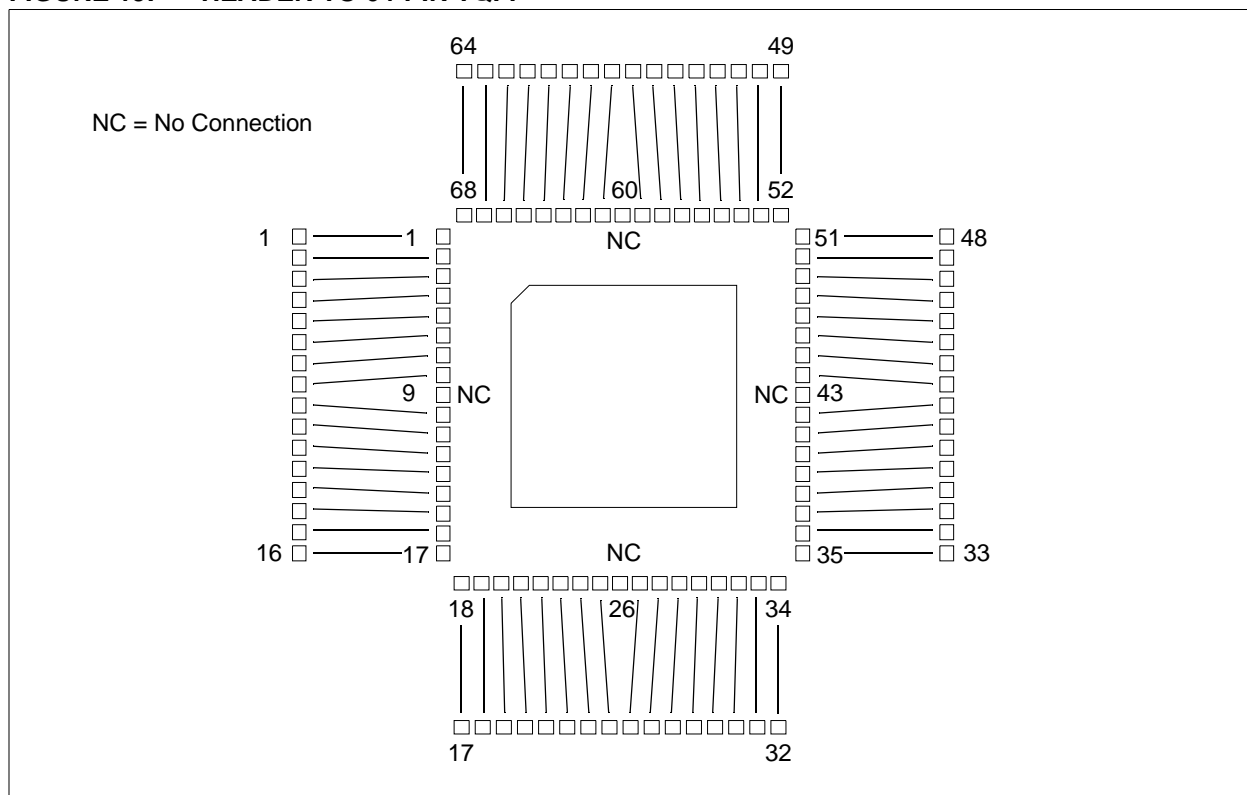
**FIGURE 18: DOUBLE AND TRIPLE-ROW TQFP/PLCC FOOTPRINT**



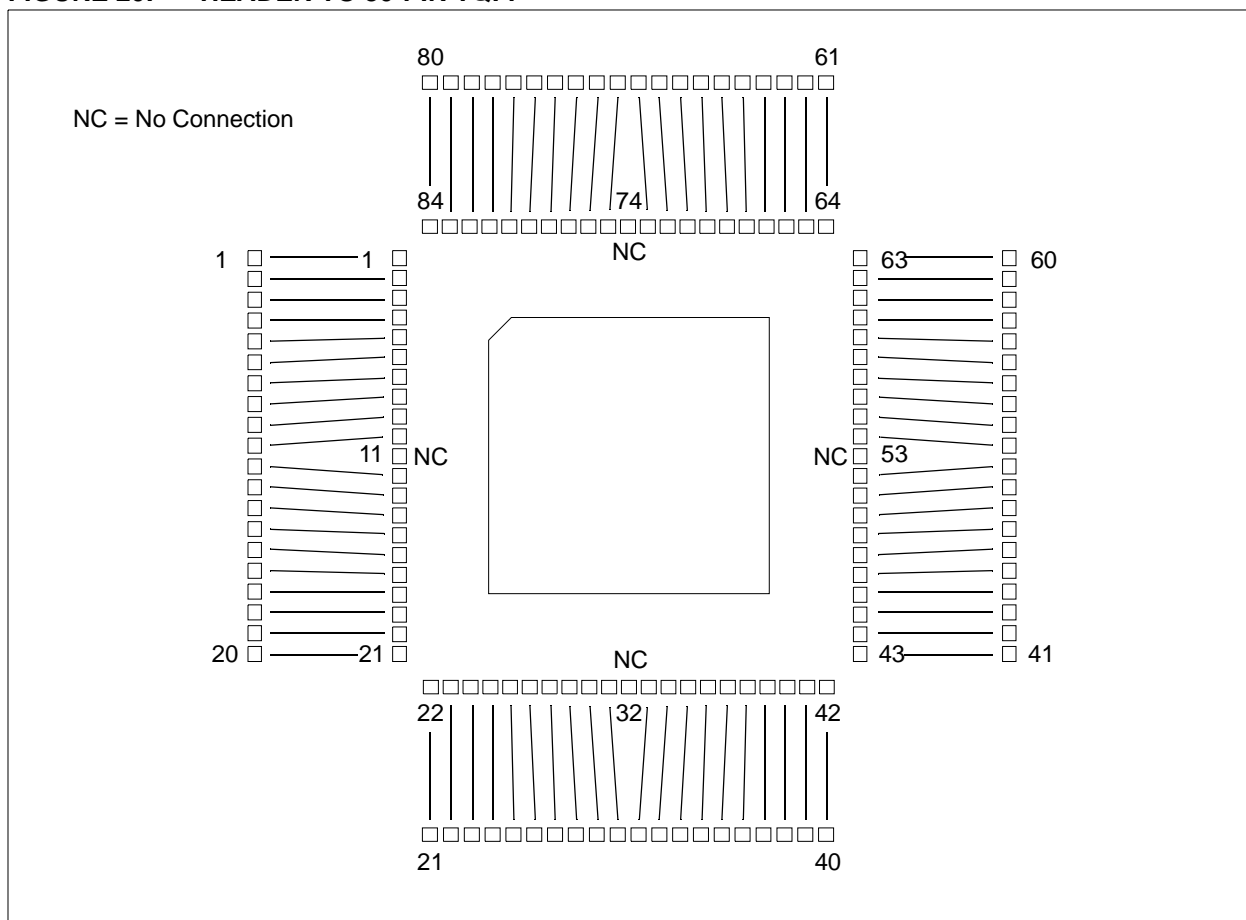
Header pin-out matches the PLCC package. PLCC will map to TQFP as follows:

- Header to 44-pin TQFP – one-to-one mapping.
- Header to 64-pin TQFP – see Figure 19 for mapping.
- Header to 80-pin TQFP – see Figure 20 for mapping.
- Header to 100-pin TQFP – one-to-one mapping.

**FIGURE 19: HEADER TO 64-PIN TQFP**



**FIGURE 20: HEADER TO 80-PIN TQFP**



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**NOTES:**



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## Appendix B. Debug Header Connections

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### INTRODUCTION

The different types of debug header connectors are shown here, as well as information on connecting development tools to the header.

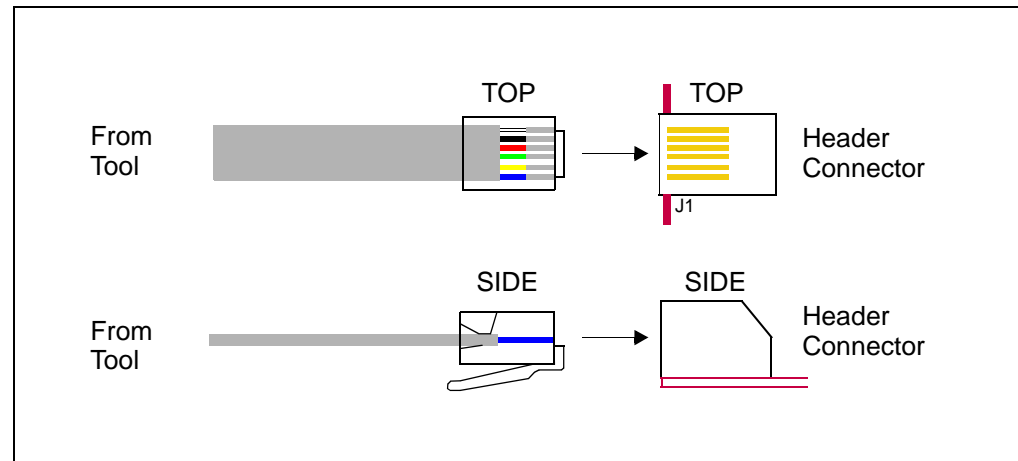
- 6-Pin Modular Connector
- 8-Pin SIL Connector
- 6-Pin SIL Connector
- SIL Optional Connection
- Modular-to-SIL Adapter
- Ordering Information

### 6-PIN MODULAR CONNECTOR

Debug headers with 6-pin modular (RJ-11/ICSP) connectors can connect directly with the following tools:

- MPLAB REAL ICE in-circuit emulator (Standard Driver Board)
- MPLAB ICD 2 or 3

**FIGURE 1: MODULAR CONNECTION**



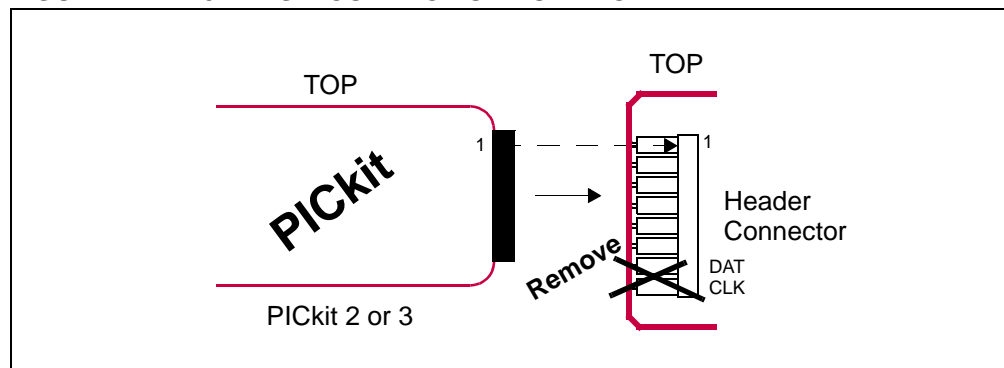
## 8-PIN SIL CONNECTOR

Debug headers with 8-pin SIL (Single In-Line) connectors are compatible with the tools listed below.

### PICKit 2 or 3 Programmer/Debug Express

The 6-pin socket of the PICKit 2 or PICKit 3 may be connected to the 8 header pins by removing the two DAT and CLK pins. However, this may compromise future use of these pins/functions with other tools.

**FIGURE 2: 8-PIN SIL CONNECTION TO A PICKIT**



### MPLAB ICD 2 or 3 In-Circuit Debugger

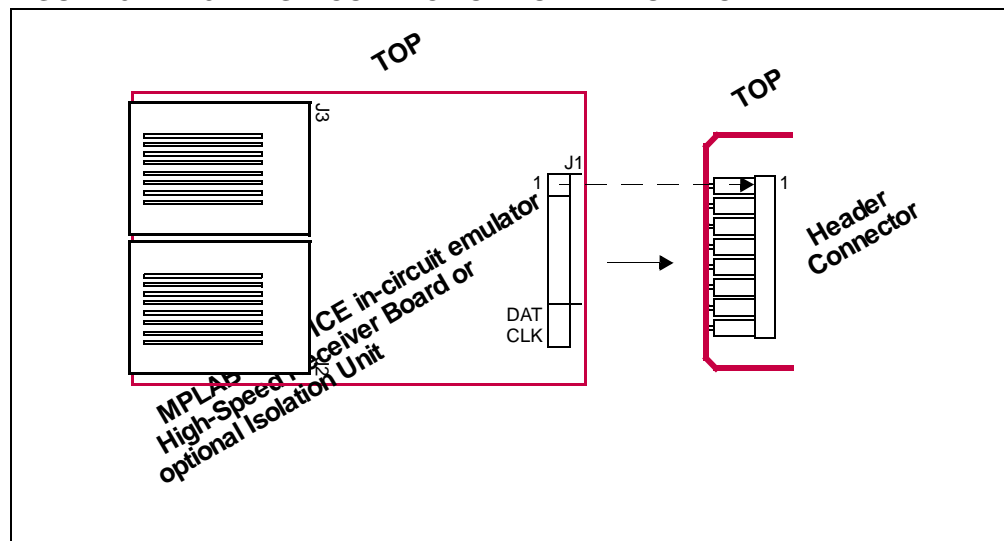
The 6-pin modular cable attached to the MPLAB ICD 2 or MPLAB ICD 3 may be connected to the 8 header pins through the Modular-to-SIL Adapter.

### MPLAB REAL ICE In-Circuit Emulator

The 6-pin modular cable attached to the Standard Driver Board may be connected to the 8 header pins through the Modular-to-SIL Adapter. No SPI trace is available with this connection because of the loss of the DAT and CLK pins.

The 8-pin socket of the High Speed Driver Board or optional Isolation Unit may be directly connected to the 8 header pins. Be sure to line up pin 1 on the board with pin 1 on the header.

**FIGURE 3: 8-PIN SIL CONNECTION TO AN EMULATOR**



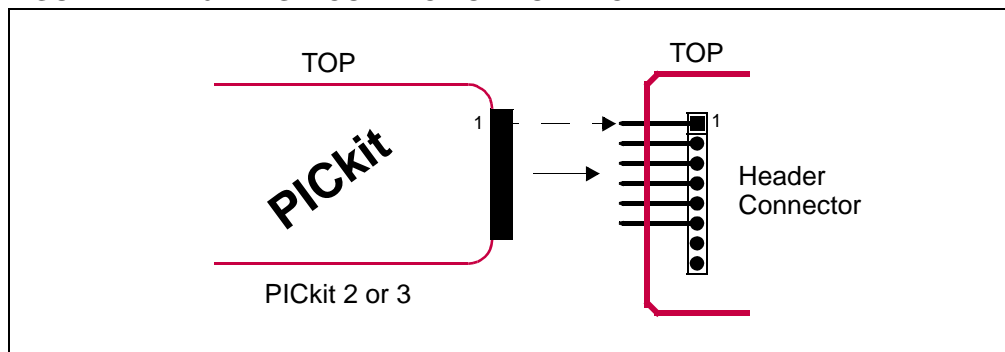
## 6-PIN SIL CONNECTOR

Debug headers with 6-pin SIL (Single In-Line) connectors are compatible with the tools listed below.

### PICkit 2 or 3 Programmer/Debug Express

The 6-pin socket of the PICkit 2 or PICkit 3 may be directly connected to the 6 header pins. Be sure to line up pin 1 on PICkit with pin 1 on header.

**FIGURE 4: 6-PIN SIL CONNECTION TO A PICKIT**



### MPLAB ICD 2 or 3 In-Circuit Debugger

The 6-pin modular cable attached to the MPLAB ICD 2 or MPLAB ICD 3 may be connected to the 6 header pins through the Modular-to-SIL Adapter.

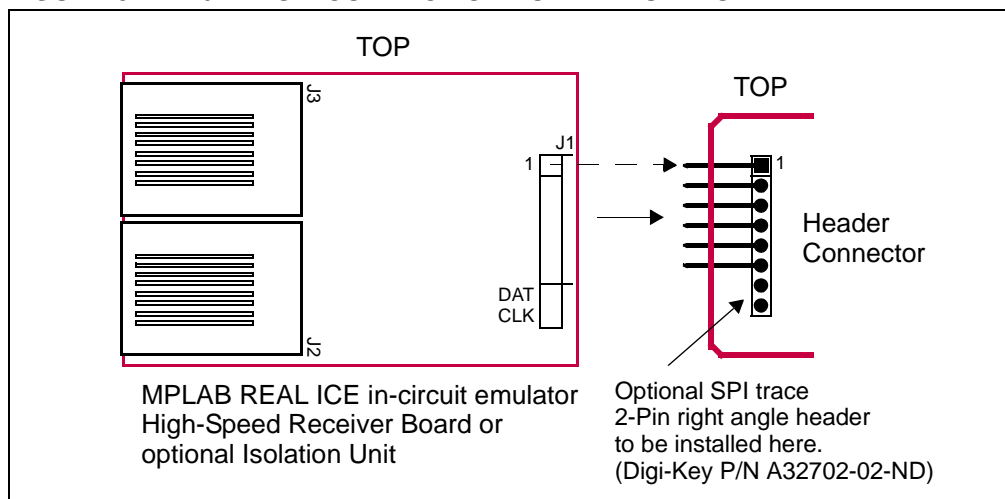
### MPLAB REAL ICE In-Circuit Emulator

The 6-pin modular cable attached to the Standard Driver Board may be connected to the 6 header pins through the Modular-to-SIL Adapter. No SPI trace is available with this connection because of the loss of the DAT and CLK pins.

The 8-pin socket of the High Speed Driver Board or optional Isolation Unit may be directly connected to the 6 header pins. Be sure to line up pin 1 on the board with pin 1 on the header.

**Note:** No SPI trace is possible in this case because of the loss of DAT and CLK pins. However, if the device supports SPI, two additional header pins can be attached to add this functionality.

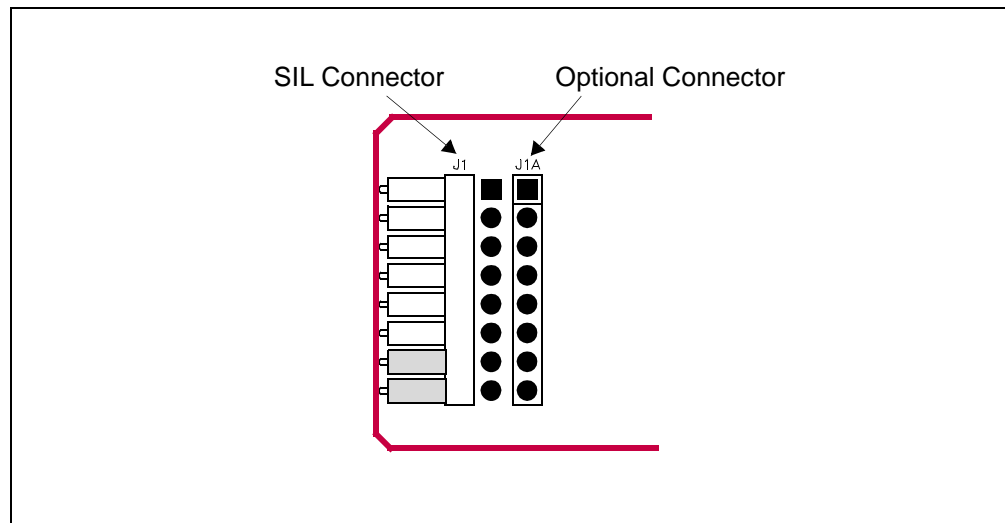
**FIGURE 5: 6-PIN SIL CONNECTION TO AN EMULATOR**



## SIL OPTIONAL CONNECTION

Debug headers with 6- and 8-pin SIL connectors have an additional unpopulated connector available for customer use. This connector has the same pinout as the SIL connector. Solder wires to access individual pins or attach an entire vertical connector.

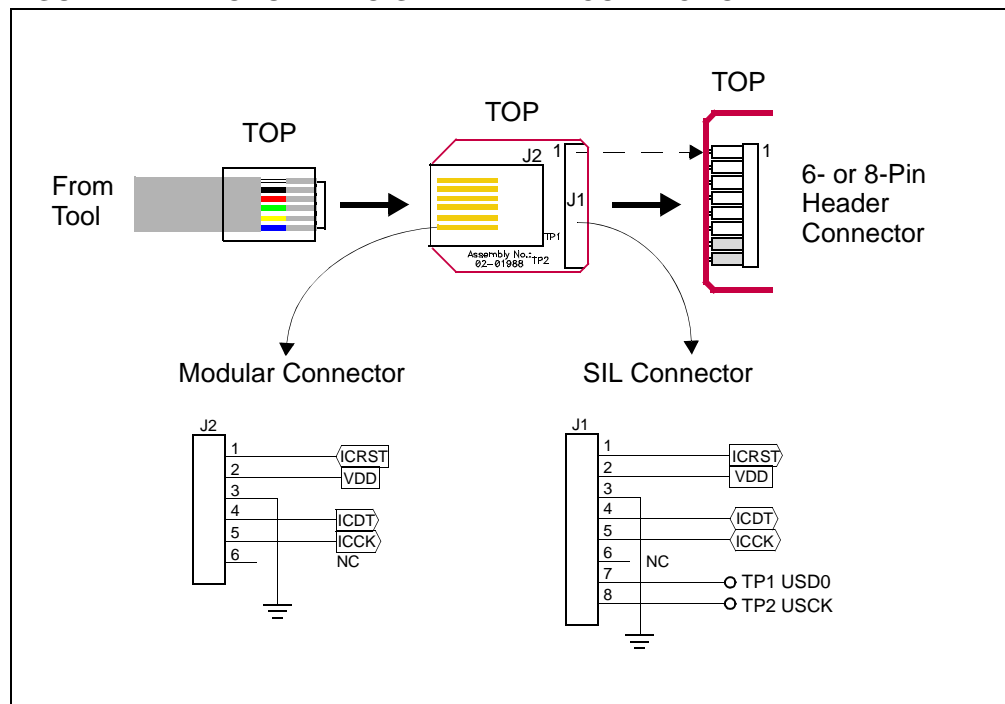
**FIGURE 6: SIL OPTIONAL CONNECTION**



## MODULAR-TO-SIL ADAPTER

To adapt a 6-pin modular connector to an 8-pin SIL (Single In-Line) connector, you can use this adapter. You can also use this adapter for a 6-pin modular connector to an 6-pin SIL connector. In either case, **line up pin 1 of J1 with pin 1** of the 6- or 8-pin header connector.

**FIGURE 7: MODULAR-TO-SIL ADAPTER CONNECTION**



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## ORDERING INFORMATION

To order the development tools and other hardware shown here, please refer to the table below.

**TABLE B-1: MICROCHIP HARDWARE ORDERING NUMBERS**

| Hardware  | Order #  |
|---|----------|
| MPLAB REAL ICE in-circuit emulator (Standard Communication)                     | DV244005 |
| MPLAB REAL ICE in-circuit emulator (High-Speed Communication) - Performance Pak | AC244002 |
| MPLAB REAL ICE Isolation Unit (works with High-Speed Communication)             | AC244005 |
| MPLAB ICD 2   | DV164005 |
| MPLAB ICD 3   | DV164035 |
| PICkit 2 Debug Express  | DV164121 |
| PICkit 3 Debug Express  | DV164131 |
| Modular-to-SIL Adapter  | AC164110 |

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**NOTES:**

## APPENDIX C: REVISION HISTORY

### C.1 Revision N (February 2006)

- Added Appendix A: Revision History
- Updated document to reflect support of additional tools
- Additional minor corrections throughout document text

### C.2 Revision P (September 2007)

- Updated document to reflect support of additional tools
- Additional minor corrections throughout document text

### C.3 Revision Q (December 2008)

- Added limitations to header setup sections as needed.
- Changed “ICD Headers” and “ICE Headers” to “Required Headers” and “Optional Headers” and move sections as necessary.
- Rearranged sections to organize by header (AC) number.

### C.4 Revision R (April 2009)

- Added board dimensions
- Removed header pinouts
- Added board identification info
- Added “why use a header” section
- Added footprint appendix
- Changed MPLAB ICD 2 and MPLAB ICD 3 references to generic debug tool
- Added MPLAB REAL ICE in-circuit emulator and MPLAB ICD 3 as programmers

### C.5 Revision S (July 2010)

- Added AC244028
- Added Header Connections chapter
- Added AC244033, AC244034
- Moved limitations to common Limitations file and added small section referencing Help files
- Added PIC12F617 to AC162083

### C.6 Revision T (February 2012)

- Added AC244043 and AC244044 and associated devices
- Removed Header Setup and Operation for AC244045

# Header Board Specification

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