Freescale Semiconductor, Inc.
Application Note

Document Number: AN5233
Rev. 0, 12/2015

Isolator Board for In-Circuit Debugging & Programming tools of Freescale MCUs & MPUs

By: Prakash R Bhumireddy

Contents

1. Introduction

Galvanically Isolated Circuit Board (henceforth simply referred to as Isolator Board throughout this document) is meant to provide electrical isolation between a development tool and an application. The development tool (Host) is a hardware tool that is used to perform 'In-Circuit Debugging' and/or ‘Programming’ Freescale Microcontrollers (MCUs) & Microprocessors (MPUs). The term application (Target) in this document refers to an end customer product or a Freescale reference design/evaluation board that contains a Freescale MCU/MPU in its design. The Isolator Board can be used with following development tools.

- USB BDM Multilink
- USB Multilink Universal
- USB Multilink Universal FX
- Cyclone Pro
- Cyclone Max
- Cyclone for ARM® Devices

The Isolator Board is designed to support debugging & programming following MCUs & MPUs:

- 8-bit MCUs - S08, RS08, HC08
- 16-bit MCUs - HC12 (legacy), HCS12, S12X, S12Z (Magni-V Mixed Signal)
- 32-bit MCUs - Kinetis (all series), MPC5XXX
- Power QUICC I (MPC8XX)
- Digital Signal Controllers (DSCs) & Digital Signal Processors (DSPs)

2. Need for Galvanic Isolation

Electrical isolation for signals is essential when the development tools are not connected to the same ground as the application. It is also useful to protect the development tools from electrical spikes that often occur in some applications, such as motor control. With Galvanic Isolation, while the isolated circuits exchange signals, they do so without current flow between one another.

As shown in Figure 1, more than one conductive path between two circuits creates a ground-loop and multiple ground paths may lead to unintended equalization currents between these circuits. It is possible that these currents interfere with the intended functionality between these circuits and in worst case may damage one (or) both of these circuits permanently. The magnitude of these currents is proportional to the ground potential difference (GPD) between the two circuits.

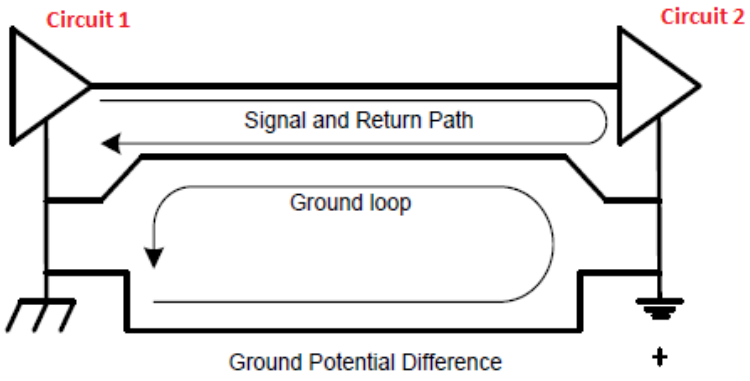


Figure 1. Ground Loop Example

A ground loop can be broken by:

- Disconnecting the grounds
- Common-mode chokes
- Frequency selective grounding
- Differential amplifiers
- Galvanic isolators

Only galvanic isolation provides protection for very large potential differences. Figure 2 shows how placing a galvanic isolator between the two circuits helps in preventing ground loop currents generated due to ground potential difference (GPD).

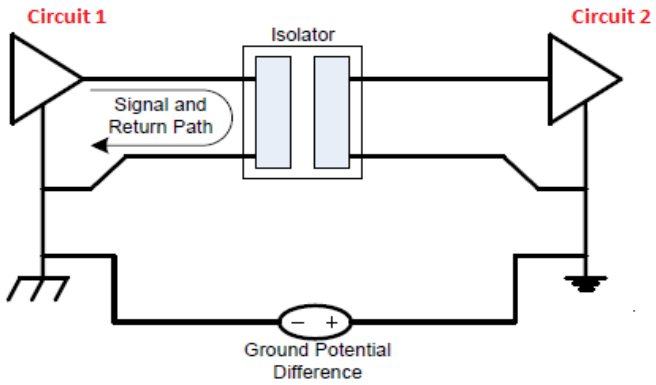


Figure 2. Breaking Ground Loop with Isolator Board

The Isolator Board is designed with high speed digital isolator integrated circuits (ICs) for isolating the signals between the development tool and the application as shown in Figure 3.

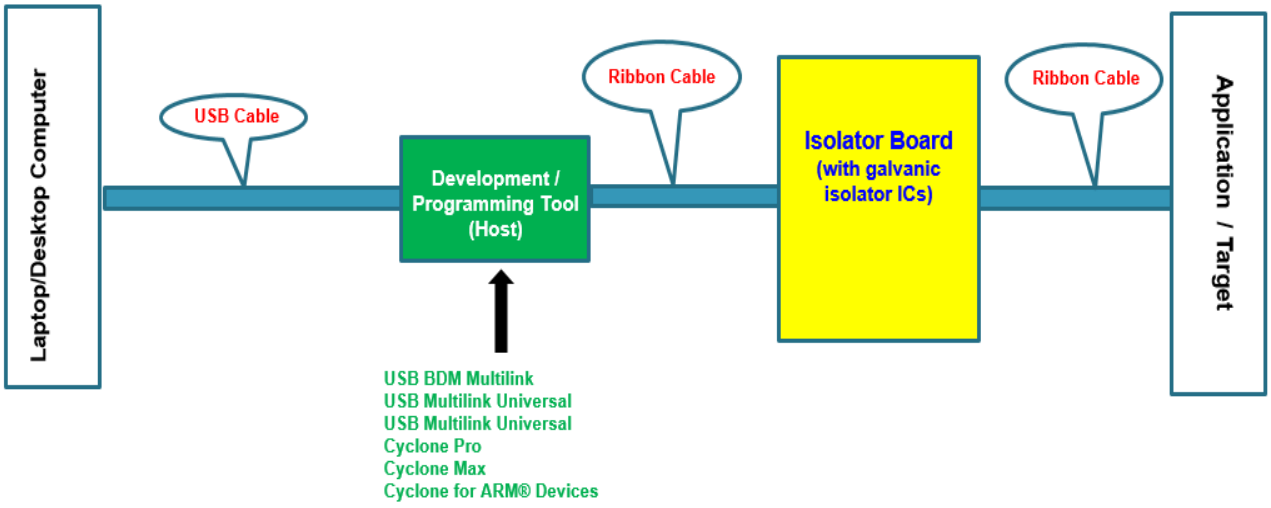


Figure 3. Isolator Board connected between Host and Target

3. Isolator Board Features

The Isolator Board has following features to support typical isolation requirements. Also see Figure 4 for details:

- Digital Isolators that can operate at high speed (1.7 mbps for bidirectional & 10 mbps for unidirectional signals).
- 2.5 kV (RMS) electrical isolation between host side and target side.
- Host side can be powered from USB port of Laptop/Desktop computer or by the development tool itself.
- Target side can be powered from on-board power supply (5 V or 3.3 V) or the target itself.
- Approximate power consumption: Host side ~ 60 mA & Target side ~ 60 mA (5 V operation).

- Push button switch to manually reset target MCU/MPU.
- 3 LEDs to indicate host side power, target side power and target RESET.
- Suitable header connectors (male type) on host side and target side for proper connectivity with development tool and the target.
- PCB cuts below digital isolator ICs to increase length of creepage path.

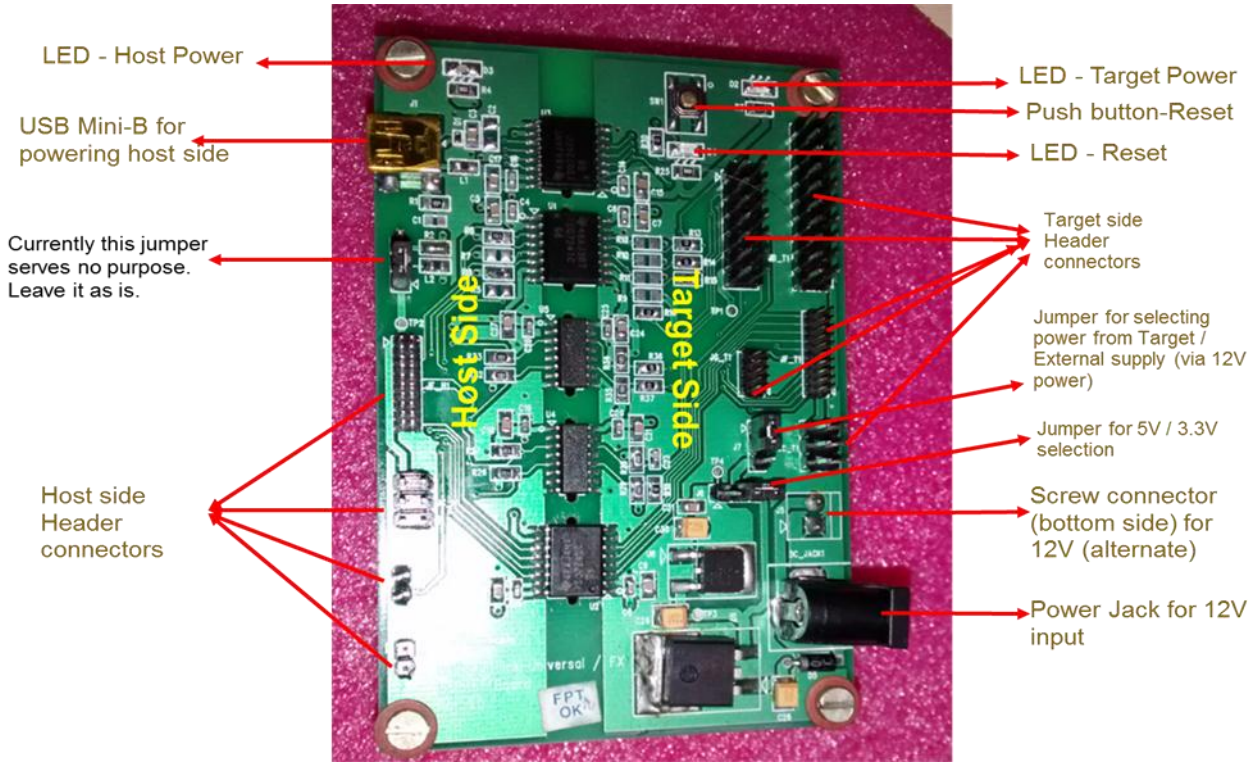


Figure 4. Isolator Board Top View

4. Basic Debugging/Programming Set-up

The basic debugging/programming set-up is shown in Figure 5. The Isolator Board is connected between the Host and the Target using flat ribbon cables. There are multiple header connectors provided on Host side and Target side of the Isolator Board for connecting it to the development tool and the target appropriately. For more details on header connectors refer section 6 and the schematic in Appendix B.

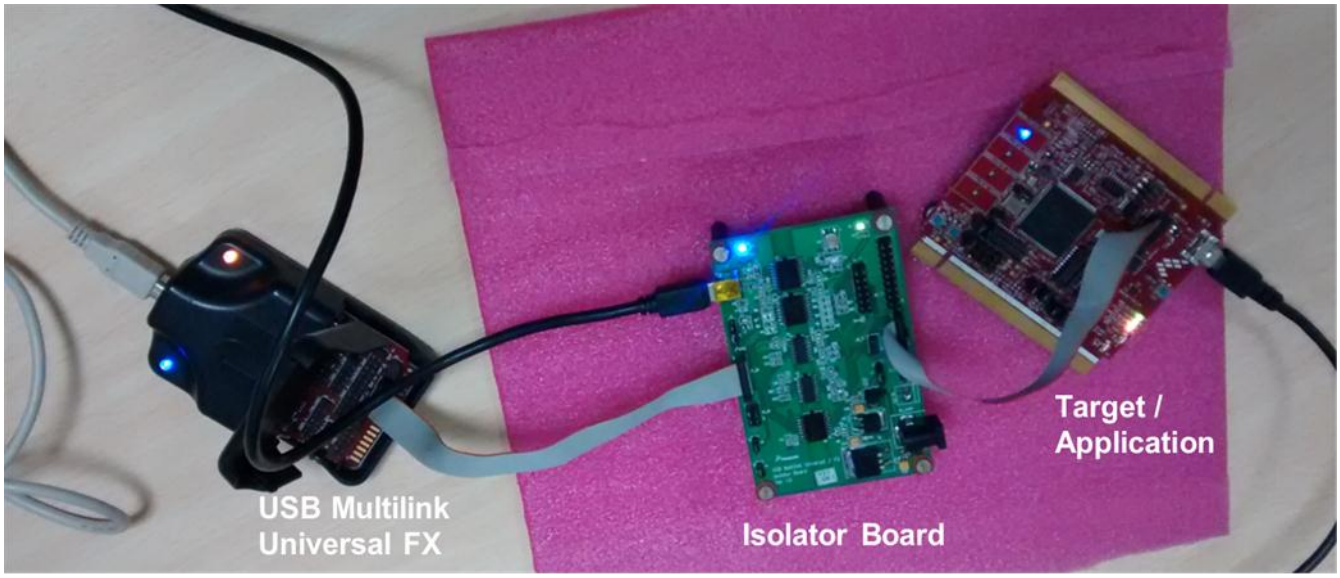


Figure 5. Basic Debugging/Programming Set-up with USB Multilink Universal FX

5. Power Options

Both Host side and Target side of the Isolator Board have to be powered separately. Host side can be powered either by USB port of the host computer or by the development tool itself. Target side can be powered either by the target/application itself or by providing external power. These are discussed in detail in Sections 5.1 & 5.2. As shown in Figure 6, blue LED on top left corner of the Isolator Board indicates host power and Green LED on top right corner indicates the target side power.

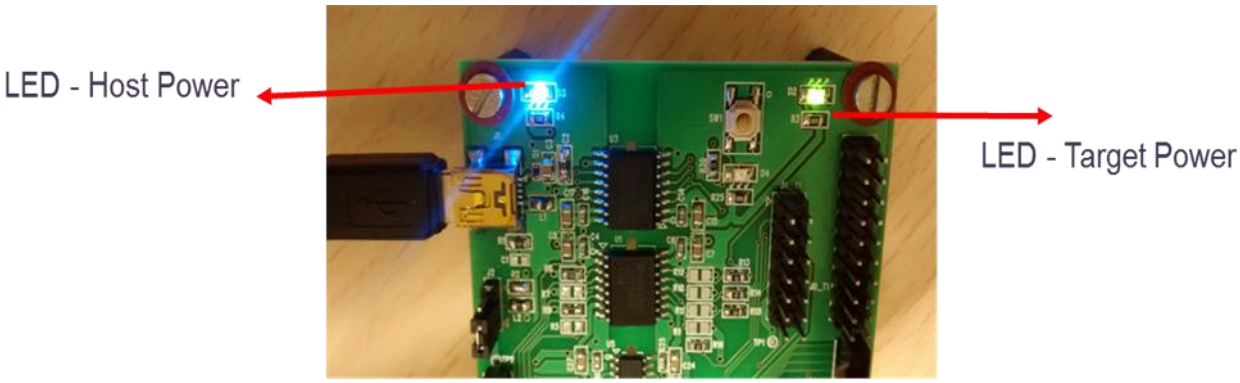


Figure 6. LEDs for Power Indication

5.1. Power Options – Host Side

Host side of the Isolator Board can be powered either by USB port of the host computer or by the development tool itself.

5.1.1. Power using USB port of host computer

Power (5 V) can be provided via USB Mini-B connector (J1) from the USB port of the host computer (Laptop/Desktop) to which the development tool is connected as shown in Figure 7. 'USB Type A Male to Mini B Male Cable' as shown in Figure 8 should be used for this purpose. Make sure blue color LED on the Isolator Board turns ON once board is powered via USB mini-B connector.

CAUTION

Avoid using USB port from a different computer or other device/instrument capable of providing USB power.

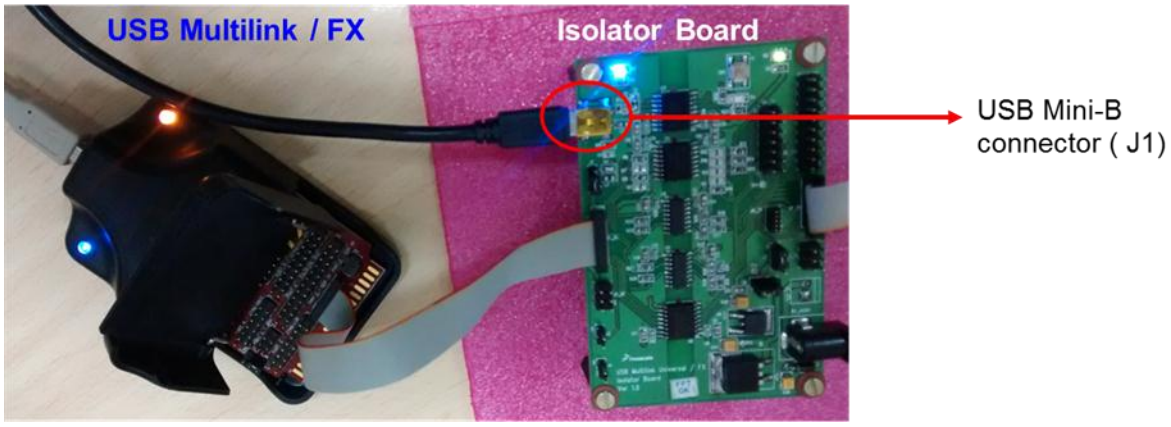


Figure 7. Powering Isolator Board using USB port

Figure 8. USB Type A Male to Mini B Male Cable

5.1.2. Power using the development tool

5.1.2.1. USB BDM Multilink Rev. C (Maroon Case)

Power (5 V) can be provided directly by the USB BDM Multilink (Figure 9). However, below are the steps to follow to obtain power from it.

- Open the Multilink case and remove the PCB.
- Solder a jumper wire between pins 3 and 16 on edge side connector J3 as shown in Figure 10.
- Connect a 6-wire flat ribbon cable between 6-pin header JC_H1 (Isolator Board) and 6-pin header J2 (USB BDM Multilink). Make sure the red strip on the ribbon cable aligns with the pin#1 (of 6-pin header) on both sides of the cable.

When the USB BDM Multilink is plugged into the USB port, the blue and the yellow LEDs on it illuminate. This is different than the non-isolated BDM multilink, where the yellow LED only illuminates when target power is applied. In addition, the blue LED on Isolator Board illuminates indicating host side of the board is powered.

Figure 9. USB BDM Multilink

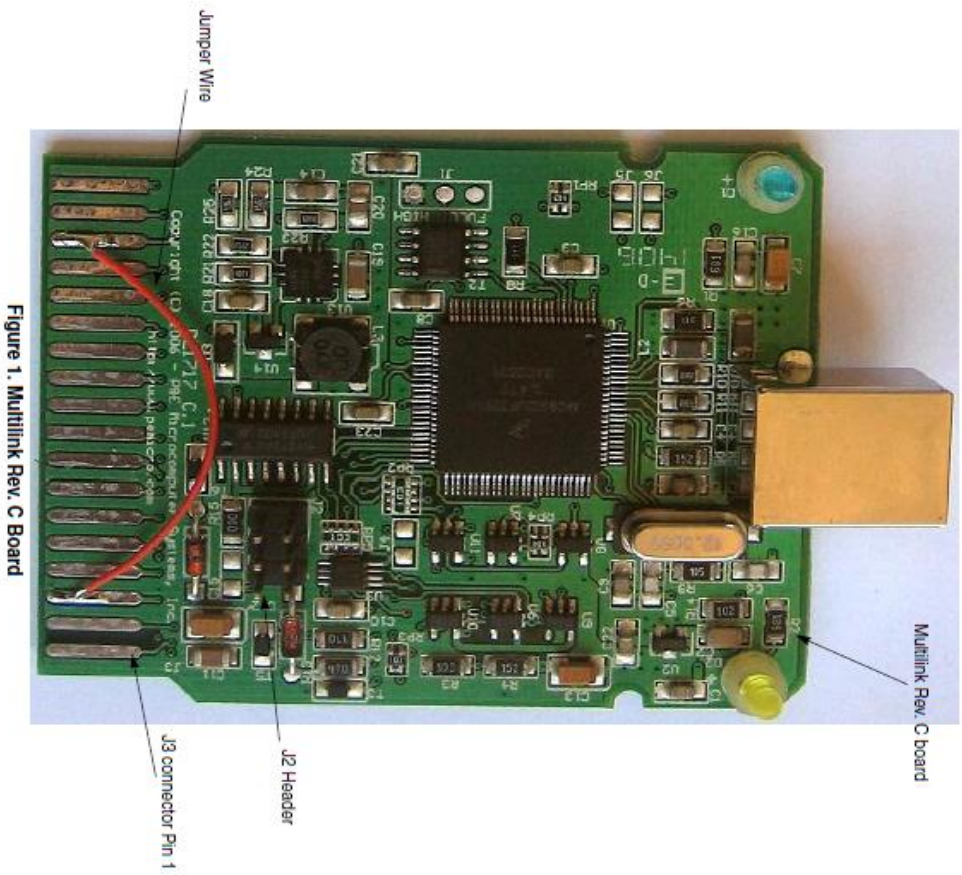


Figure 10. Jumper Cable on Edge Connector J3

5.1.2.2. USB Multilink Universal Rev. A (Green Case)

Power (5 V) can be provided directly by the USB Multilink Universal Rev. A (Figure 11). However, below are the steps to follow to obtain power from it.

- Open the Multilink case and remove the PCB.
- Solder a jumper wire between pins 3 and 16 on edge side connector as shown in the Figure 11.
- Use below options to connect a flat ribbon cable between USB Multilink Universal and the Isolator Board as below:
    - Connect a 6-wire flat ribbon cable between 6-pin header JC_H1 (Isolator Board) and 6-pin header JP1 (PORT C - BDM of USB Multilink Universal). This option should be used only for 8-bit and 16-bit MCUs mentioned in section 1. Make sure the red strip on the ribbon cable aligns with the pin#1 (of 6-pin header) on both sides of the cable.
    - Connect a 20-wire flat ribbon cable between 20-pin header JF_H1 (Isolator Board) and the 20-pin header JP5 (PORT F - MINI 20 of USB Multilink Universal). This option should be used for all other MCUs/MPUs (except 8-bit & 16-bit MCUs) mentioned in Section 1. Make sure the red strip on the ribbon cable aligns with the pin#1 (of 20-pin header) on both sides of the cable.

When the USB Multilink Universal is plugged into the USB port, the blue and the orange LEDs on it illuminate. This is different than the non-isolated USB Multilink Universal, where the orange LED illuminates only when target power is applied. In addition, the blue LED on Isolator Board illuminates indicating host side of the board is powered.

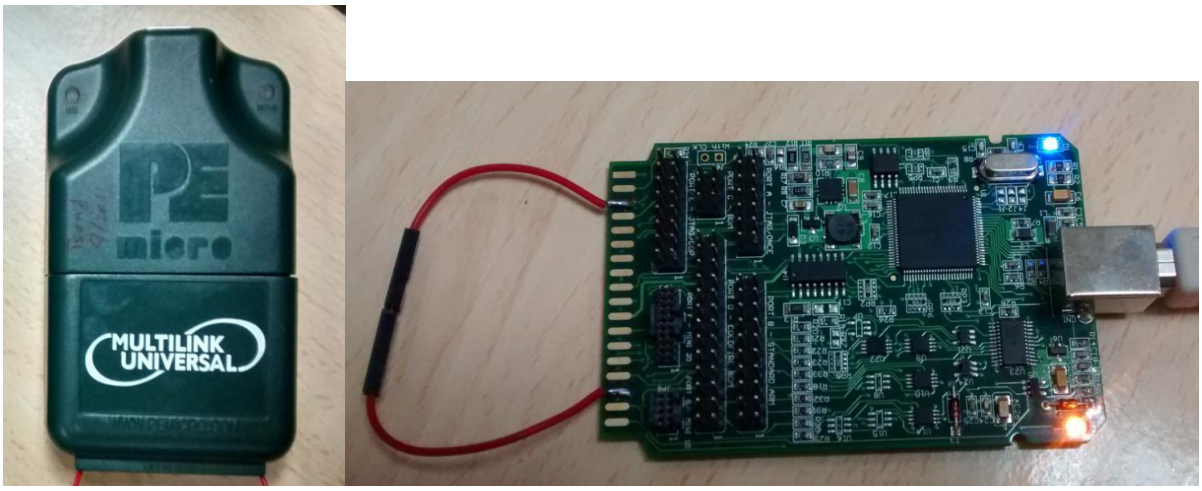


Figure 11. USB Multilink Universal Rev. A & Jumper Cable on Edge Connector

5.1.2.3. USB Multilink Universal Rev. C (Blue Case)

USB Multilink Universal Rev. C (Figure 12) does not have a provision to provide power to the Isolator Board by itself. Use USB power via USB mini-B connector (J1) as explained in Section 5.1.1 to provide power for host side of Isolator Board when USB Multilink Universal Rev. C is used.

Figure 12. USB Multilink Universal Rev. C

5.1.2.4. USB Multilink Universal FX Rev. A (Black Case)

Power (5 V) can be provided directly by the USB Multilink Universal FX Rev. A (Figure 13). However, below are the steps to follow to obtain power from it.

- Open the Multilink case
- Locate jumper J10 next to 6-pin header connector JP1, and shunt positions 1 & 2 to obtain 5 V power.

NOTE

3.3 V power can be obtained by shunting positions 2 & 3. This is not recommended.

- Use below options to connect a flat ribbon cable between USB Multilink Universal FX and the Isolator Board as below:
    - Connect a 6-wire flat ribbon cable between 6-pin header JC_H1 (Isolator Board) and the 6-pin header JP1 (PORT C - BDM of USB Multilink Universal FX). This option should be used only for 8-bit and 16-bit MCUs mentioned in section 1. Make sure the red strip on the ribbon cable aligns with the pin#1 (of 6-pin header) on both sides of the cable.
    - Connect a 20-wire flat ribbon cable between 20-pin header JF_H1 (Isolator Board) and the 20-pin header JP5 (PORT F - MINI 20 of USB Multilink Universal FX). This option should be used for all other MCUs/MPUs (except 8-bit & 16-bit MCUs) mentioned in section 1. Make sure the red strip on the ribbon cable aligns with the pin#1 (of 20-pin header) on both sides of the cable.

Figure 13. USB Multilink Universal FX Rev. A

As shown in Figure 14 (an example Code Warrior 10.6 window showing hardware or simulator connection), when using USB Multilink Universal FX, select the option “provide power to target”. You may choose similar option if you are using other Code Warrior versions. Forgetting to select this option will not enable USB Multilink Universal FX to provide power even if the jumper JP10 is properly chosen.

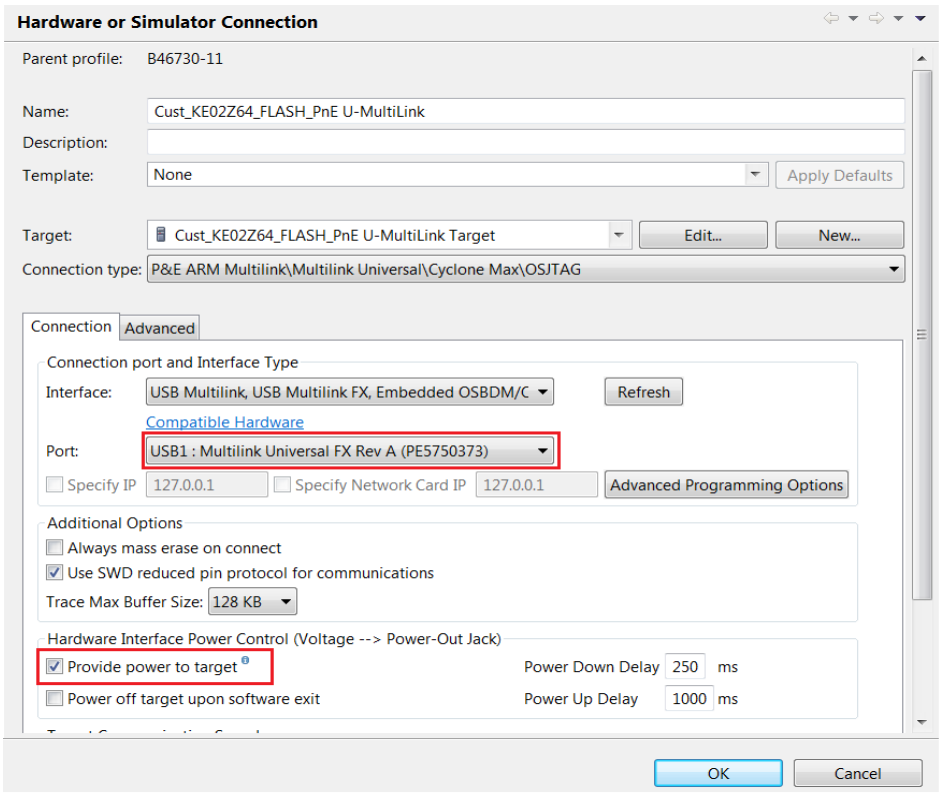


Figure 14. Power Option from USB Multilink Universal FX

When the USB Multilink Universal FX is plugged into the USB port, the blue LED illuminates immediately. However, orange LED illuminates only after debugging session/programming is initiated using the Code Warrior or other tool. In addition, the blue LED on Isolator Board illuminates indicating host side of the board is powered once power is enabled from USB Multilink Universal FX during debugging/programming.

5.1.2.5. Cyclone Pro (Rev. C)

Power (5 V) can be provided by Cyclone Pro to the host side of Isolator Board. Follow below steps:

- Follow jumper setting as shown in 0.
- Connect a 6-wire flat ribbon cable between 6-pin BDM (Figure 17 - Cyclone Pro) and 6-pin header JC_H1 (Isolator Board). Make sure the red strip on the ribbon cable aligns with the pin#1 (of 6-pin header) on both sides of the cable.
- The Cyclone PRO requires a regulated 6 V DC Center Positive power supply with 2.5/5.5mm female plug (Figure 16). Connect a regulated Cyclone Pro Power Supply (6 V) to this plug. The Cyclone PRO derives its power from the Power Jack located on the side of the unit and also provides power via pin#1 of 6-pin BDM connector.

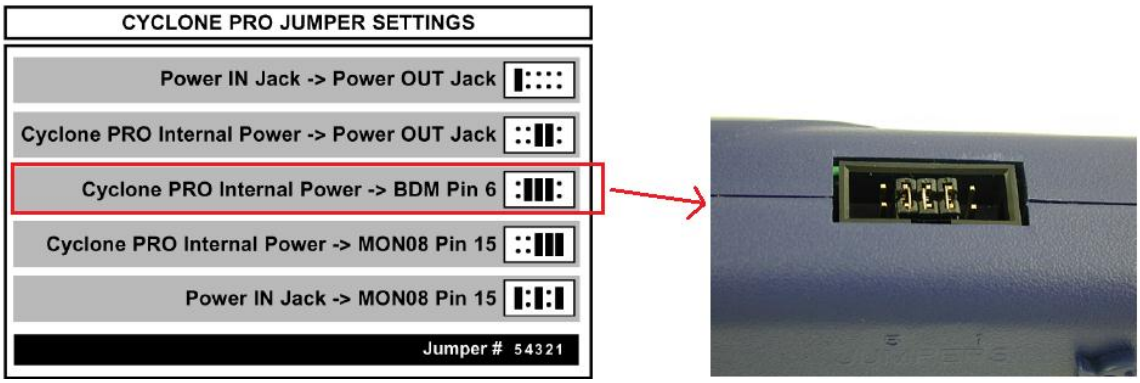


Figure 15. Jumper Setting for Host Side Power – Cyclone Pro

Figure 16. Power Jack for Connecting 6V DC Supply – Cyclone Pro

The blue LED on Isolator Board illuminates indicating host side of the board is powered.

NOTE

Only debugging/programming through 6-pin BDM connector of Cyclone Pro is supported with the Isolator Board. No debugging/programming using 16-Pin MON08 is supported.

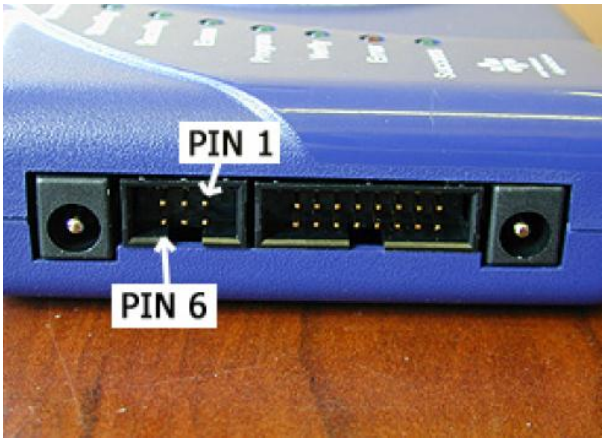


Figure 17. 6-Pin BDM Connector Pin Connections – Cyclone Pro

5.1.2.6. Cyclone Max

Cyclone Max does not have a provision to provide power to the Isolator Board by itself. Use USB power via USB mini-B connector (J1) as explained in section 5.1.1 to provide power for host side of Isolator Board when Cyclone Max is used.

NOTE

If Cyclone Max is used in Stand Alone Mode (not connected to host computer), use a 230V/110V AC to USB adapter (USB Charger) for providing power to host side of Isolator Board using USB Type A Male to Mini B Male Cable (Figure 8).

5.1.2.7. Cyclone for ARM® Devices

Power (5 V) can be provided by Cyclone for ARM® Devices to the host side of Isolator Board. Follow below steps:

- Follow jumper setting as shown in Figure 18.

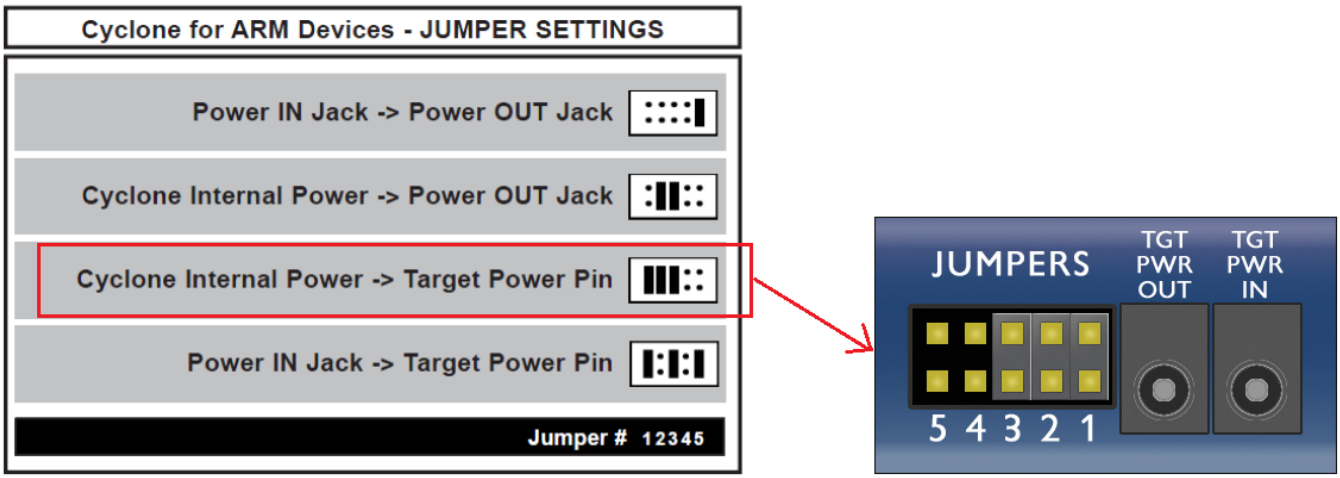


Figure 18. Jumper Setting for Host Side Power – Cyclone for ARM® Devices

- Connect a 20-wire flat ribbon cable between 20-pin keyed mini connector (Figure 19) of Cyclone for ARM® Devices and 20-pin header JF_H1 (of Isolator Board). Make sure the red strip on the ribbon cable aligns with the pin#1 (of 20-pin header) on both sides of the cable.

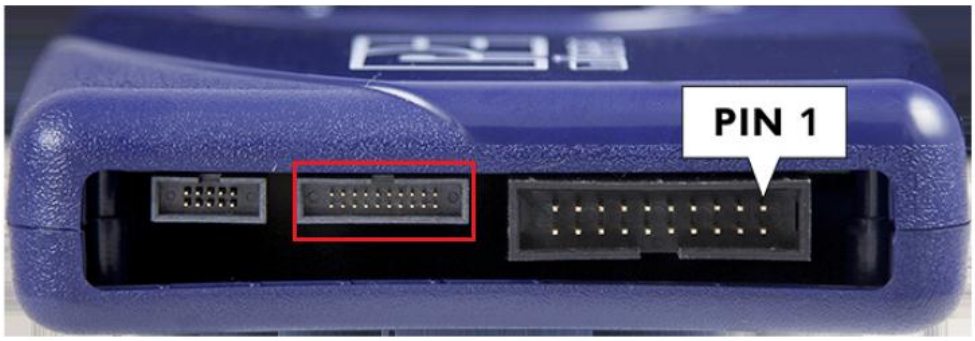


Figure 19. 20-pin keyed mini connector – Cyclone for ARM® Devices

- The Cyclone for ARM® Devices requires a regulated 6V DC Center Positive power supply with 2.5/5.5mm female plug (Figure 20). Connect a regulated Cyclone Pro Power Supply (6 V) to this plug. The Cyclone for ARM® Devices its power from the Power Jack located on the side of the unit and also provides power via pin#1 of 20-pin mini connector.

Figure 20. Power Jack for Connecting 6V DC Supply – Cyclone for ARM® Devices

5.2. Power Options - Target Side

Target side of the Isolator Board can be powered either by target itself or by providing external power.

5.2.1. Power from target

Power (5 V/3.3 V) can be provided to the target side of the Isolator Board simply by connecting appropriate flat ribbon cable between one of the header connectors (on target side of Isolator Board) and the debug/programming header connector of the target.

Make sure to verify below things:

- Target/Application is powered by its recommended power source
- Look out for jumper J7 on target side of Isolator Board and ‘remove’ any shunt if it exists between positions 2 & 3
- Do not connect any power source via DC_JACK1 or J5
- Connect a flat ribbon cable between Isolator Board and target as mentioned in Section 6.2.

The green LED on the Isolator Board illuminates to indicate that the target side is powered.

NOTE

It is estimated that the target side of Isolator Board draws current up to 60mA based on loading. It is also possible that most of the customer applications can source this additional current of 60 mA. If the customer's application (with it's on board 5V/3.3V power supply) cannot supply this additional current required by the Isolator Board, use power from external source as explained in Section 5.2.2.

5.2.2. Power from external source

Power (5V/3.3V) can be provided to the target side of the Isolator Board by connecting a 12 V DC power source via power jack DC_JACK1 or connector J5 (2 terminal screw type). The DC power source can be any one of the following:

- 230 V AC/110 V AC to 12 V DC adapter (use with DC_JACK1)
- 12 V battery (use with J5)

Make sure to verify below things:

- Target/Application is powered by its recommended power source
- Look out for jumper J7 and shunt positions 2 & 3
- Look out for jumper J6 and
    - Shunt positions 1 & 2 - for 3.3 V application
    - Shunt positions 2 & 3 - for 5 V application

The green LED on the Isolator Board illuminates to indicate that the target side is powered.

CAUTION

Be careful to choose correct voltage using jumper J6. This is most important as choosing 5 V on jumper J6 for a 3.3 V rated MCU/MPU on the application might damage the MCU/MPU and other 3.3 V rated components permanently.

NOTE

Target/application need not be powered by its recommended power source if the task is to only program/flash the MCU/MPU.

6. Using Header Connectors

6.1. Host Side

There are four header connectors (J3, J4, JC_H1, JF_H1) on host side of the Isolator Board as shown in Figure 21.

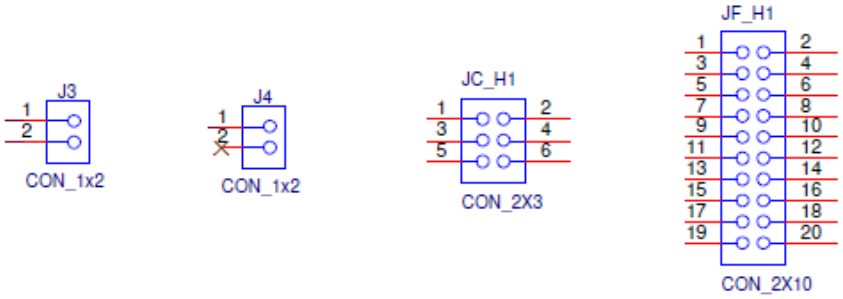


Figure 21. Host Side Header Connectors

Use these header connectors as below:

For USB BDM Multilink:

Connect a 6-wire flat ribbon cable between 6-pin header JC_H1 (Isolator Board) and 6-pin header J2 (USB BDM Multilink). This shall be used for S08 & S12X family of MCUs.

For USB Multilink Universal / USB Multilink Universal FX (use one of the two options below):

- Connect a 6-wire flat ribbon cable between 6-pin header JC_H1 (Isolator Board) and 6-pin header JP1 (PORT C - BDM of USB Multilink Universal). This shall be used for 8-bit and 16-bit microcontrollers as mentioned in Section 1.
- Connect a 20-wire flat ribbon cable between 20-pin header JF_H1 (Isolator Board) and 20-pin header JP5 (PORT F - MINI 20 of USB Multilink Universal). This option should be used for all other MCUs/MPUs (except 8-bit & 16-bit MCUs)

NOTE

J3 & J4 connectors (1x2) carry extra signals that may be required for some of MCUs/MPUs and shall be used along with JF_H1 connector. When needed, use a jumper wire from development tool to Isolator Board with proper correspondence. For example, RDY-B_H signal on J3 (pin#1) represents “active low RDY signal on Host side” and should be connected to pin#13 of 14-pin header connector JP3 (PORT A – JTAG/ONCE) on the USB Multilink Universal / USB Multilink Universal FX using a jumper wire.

For Cyclone Pro, Rev.C

Connect a 6-wire flat ribbon cable between 6-pin BDM (Cyclone Pro) and 6-pin header JC_H1 (Isolator Board). Make sure the red strip on the ribbon cable aligns with the pin#1 (of 6-pin header) on both sides of the cable.

For Cyclone Max

The Isolator Board is provided with Mini-20 type connector (JF_H1) on host side. However, Cyclone Max has a Standard 20-pin connector (Port - E) with signal mismatch. Follow below steps for proper connectivity.

- Purchase a Cyclone MAX JTAG / SWD Adapter from P&E Microcomputer Systems (Figure 22). Customers may design similar board on their own based on signal mapping between Standard 20-pin and Mini 20-pin header connectors. Refer Cyclone Max user manual for details. Mini-10 connector (J3 - Cyclone MAX JTAG / SWD Adapter) is not required for current design of Isolator Board and hence need not be considered.

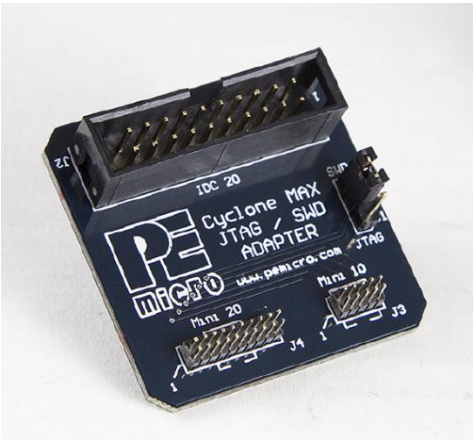


Figure 22. Cyclone MAX JTAG / SWD Adapter

- Connect a 20-wire flat ribbon cable between Standard 20-pin header (Port E - Cyclone Max) and Standard 20-pin header J2 (Cyclone MAX JTAG / SWD Adapter). Make sure the red strip on the ribbon cable aligns with the pin#1 (of 20-pin header) on both sides of the cable.
- Connect a 20-wire flat ribbon cable between Mini 20-pin header J4 (Cyclone MAX JTAG / SWD Adapter) and Mini 20-pin header JF_H1 (Isolator Board). Make sure the red strip on the ribbon cable aligns with the pin#1 (of 20-pin header) on both sides of the cable.
- Above two steps are sufficient for Kinetis MCUs. For Qorivva (MPC55xx/56xx), Power QUICC I (MPC8XX) and DSC Family of MCUs/MPUs, in addition to above two steps, connect a jumper cable between pin#14 of Port-B (Cyclone Max) and pin#2 of J3 (Isolator Board).

NOTE

Choose JTAG Mode / SWD mode as required. Refer Cyclone Max user manual for details.

For Cyclone for ARM® Devices

Connect a 20-wire flat ribbon cable between 20-Pin Keyed Mini Connector (0 - Cyclone for ARM® Devices) and Mini 20-pin header JF_H1 (Isolator Board). Make sure the red strip on the ribbon cable aligns with the pin#1 (of 20-pin header) on both sides of the cable.

NOTE

Choose JTAG Mode / SWD mode as required. Refer Cyclone for ARM® Devices user manual for details.

6.2. Target Side

There are five header connectors (JA_T1, JB_T1, JC_T1, JF_T1 & JG_T1) on Isolator Board target side as shown in Figure 23.

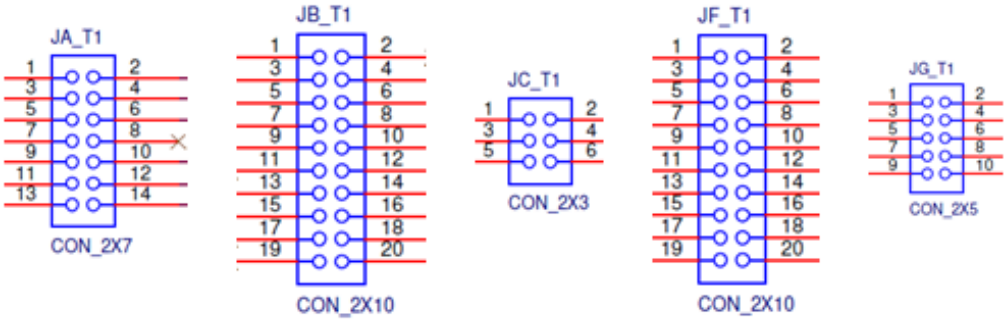


Figure 23. Target Side Header Connectors

- These connectors (on target side of Isolator Board) are equivalent to the header connectors found on development tools as shown in Table 1 and all signals on each connector match with respective connector on development tool. Only difference is that these signals are electrically isolated from the host side.

Table 1. Equivalent Connectors to Target Side Header Connectors

Connector on Isolator Board (Target Side)	Equivalent Connector of USB Universal Multilink/USB Universal Multilink FX	Equivalent Connector of USB BDM Multilink	Cyclone Pro	Cyclone Max	Cyclone for ARM® Devices
JA_T1 (2 X 7)	JP3 (PORT A - JTAG / ONCE)	J2 (BDM)	-	Port B	-
JB_T1 (2 X 10)	JP4 (PORT B - STANDARD ARM)	-	-	-	-
JC-T1 (2 X 3)	JP1 (PORT C - BDM)	-	6-Pin BDM Connector	-	-
JF_T1 (2 X 10)	JP5 (PORT F - MINI 20)	-	-	Mini-20 pin connector J4 of Cyclone MAX JTAG / SWD Adapter	20-Pin Keyed Mini Connector (JTAG/SWD)
JG_T1 (2 X 5)	JP6 (PORT G - MINI 10)	-	-	Mini-20 pin connector J4 of Cyclone MAX JTAG / SWD Adapter	10-Pin Keyed Mini Connector (JTAG/SWD)

- A flat ribbon cable shall be connected between one of these connectors (on Isolator Board) to ‘programming/debugging connector’ on the target/application.
- Refer schematic of the Isolator Board in Appendix B for more details.

7. Quick Set-up Instructions

Step 1: Connect the development tool (USB BDM Multilink, USB Multilink Universal or USB Multilink Universal FX) to laptop/desktop computer using USB cable (USB Type A Male to Mini B Male Cable).

Step 2: Connect USB cable (USB Type A Male to Mini B Male Cable) between laptop/desktop computer and USB mini-B connector (J1) on Isolator Board if 'host side' is powered as per Section 5.1.1. This cable is not required if power option is chosen as per Section 5.1.2.

Step 3: Connect a flat ribbon cable between development tool and the Isolator Board (host side) as per Section 6.1. Red strip of cable must align with pin#1 of header connectors on both sides.

Step 4: Connect a flat ribbon cable between the Isolator Board (target side) and the target/application as per Section 6.2. Red stripe of cable must align with pin#1 of header connectors on both sides.

NOTE

Pin#1 on header connectors (of Isolator Board) is marked with a small arrow as shown below:

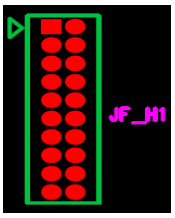


Figure 24. 20 pin header connector

Step 5: Select target voltage (5 V or 3.3 V) using jumper J6 and power options (external/from target) using jumper J7 as per Section 5.2.

Step 6: In case 'target side' of Isolator Board is to be powered by external power source, connect a suitable 12V DC power source to connector 'DC_JACK1' or 'J5' as per Section 5.2.2.

Step 7: Make sure Blue and Green LEDs on top left and top right corner of the Isolator Board illuminate and both LEDs on development tool glow.

Step 8: Start debugging!

NOTE

Isolator Board has maximum permissible speed of 1.7 MHz for bidirectional signals. Hence choose a BDM communication speed < 1.7 MHz (as shown in Figure 25, example using Code Warrior 10.6) when using longer ribbon cables (or) when using USB Multilink Universal FX.

For Cyclone Pro, Cyclone Max and Cyclone for ARM® Devices, choose communication speed < 1.7 MHz using proprietary software application from P&E Microcomputer Systems.

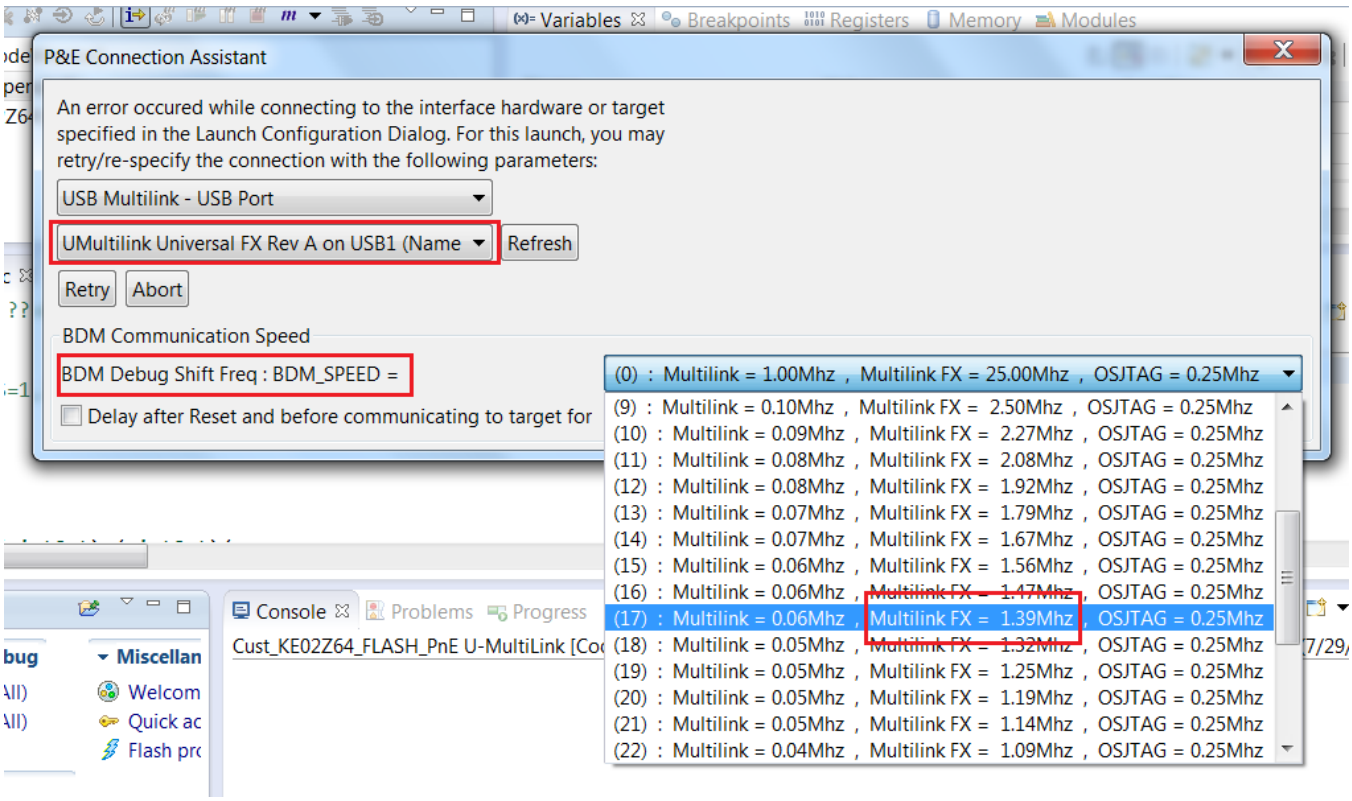


Figure 25. Communication Speed Setting

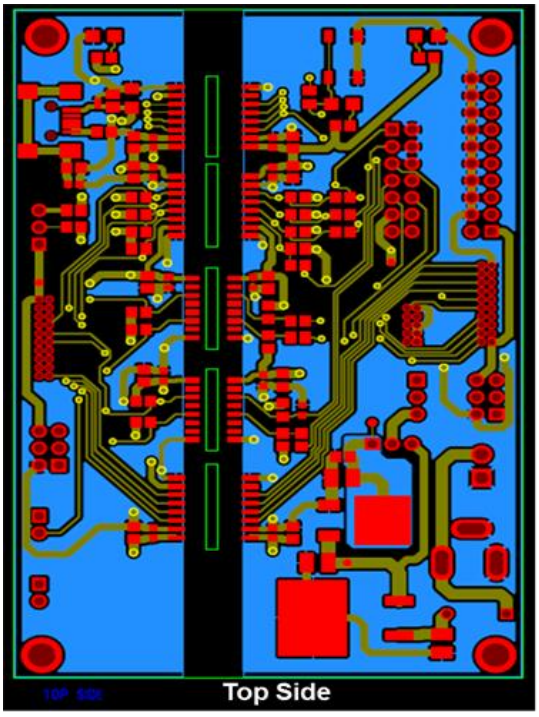
8. Last but not the least during Debugging/Programming

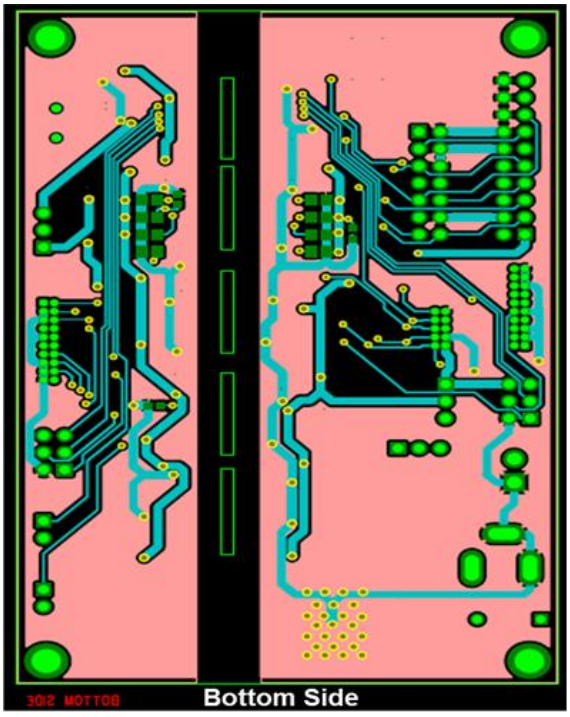
- Make sure IDEs (Code Warrior or other tools) are installed properly in your computer with all necessary USB drivers from P&E Microcomputer Systems.
- Check if the development tool is detectable correctly by the computer.
- Make sure target/application has no accidental short circuits across MCU/MPU supply (VDD & VSS).
- Provision for manually resetting MCU is provided via push button switch (SW1) on the top right hand side with associated red color LED (D4). Pushing the button resets the target MCU/MPU.
- Refer Isolator Board schematic in Appendix B for clarity.
- Use the complete debugging / programming set-up in Electrostatic Discharge (ESD) safe environment.
- And finally, clean the Isolator Board occasionally (near & below isolator ICs in the center) for effective isolation.

Appendix A. Top and Bottom view and PCB layout

Isolator Board Top & Bottom View:

PCB Layout





Appendix B. Schematics

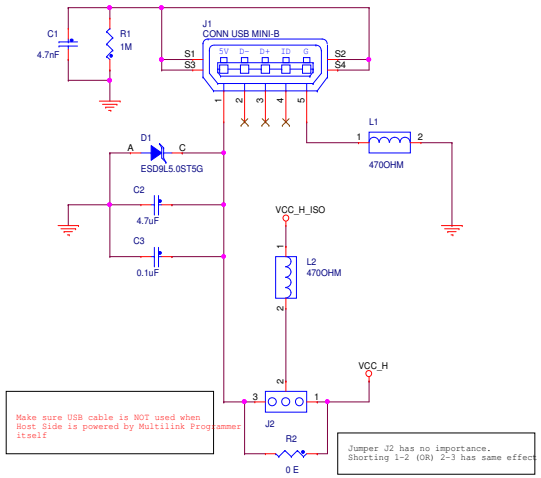
HOST SIDE CONNECTORS

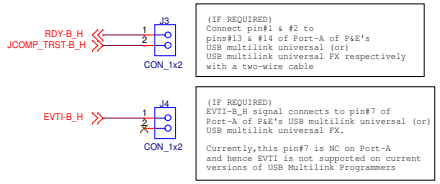
TARGET SIDE CONNECTORS

Do not attempt to use multiple header connectors & cables at once (either on HOST side or on TARGET side)

HOST SIDE

TARGET SIDE

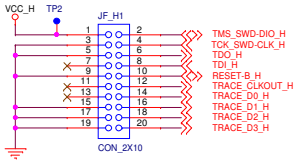




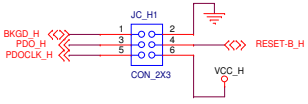
Every signal on this board ends with '_H' or '_T'
'_H' - represents a host side signal
'_T' - represents a target side signal
Few signals are combined to reduce the layout efforts they are separated by an underscore '_'
For example:
TMS_SWD-DIO_T : TMS (Jtag) & SWD-DIO (SWD protocol) are combined here.
For exact signal available at a particular port, refer to P&E USB Universal Multilink's datasheet.
Only one signal is present at a time.

-B indicates a 'Active Low' signal.
Example:
RESET-B_T

HOST POWER

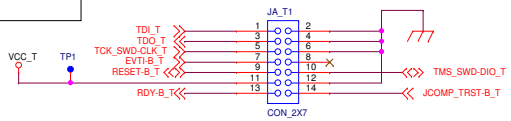


PORT F MINI-20

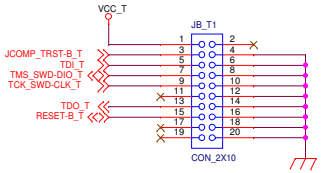


PORT C BDM

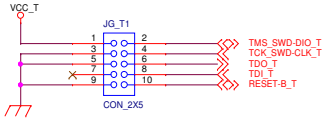
Note: To avoid improper connections, the "Red Stripe" of the ribbon cable should always be oriented towards Pin 1, on every connector as below:
1. On the Multilink header connector
2. On the target board's programming header connector
3. Isolator Board Host header connector
4. Isolator Board Target header connector



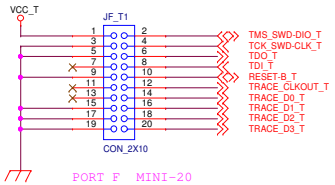
PORT A JTAG/ONCE



PORT B STANDARD ARM

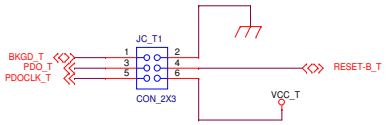


PORT G MINI-10



PORT F MINI-20

TARGET POWER



PORT C BDM

freescale semiconductor

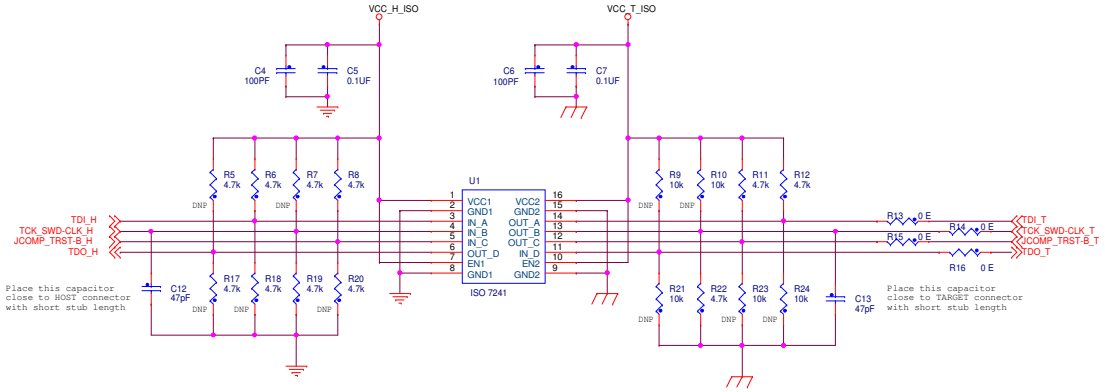
ICAP Classification: FCP: ___ FIUO: X PUBI: ___

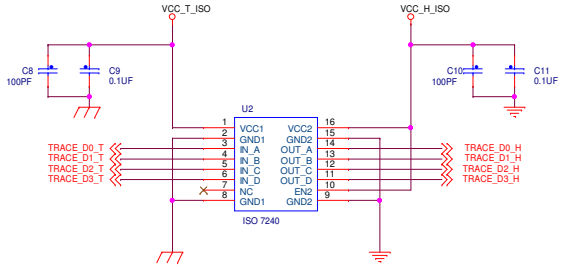
Drawing Title: **Isolator Board for FSL Programmers**

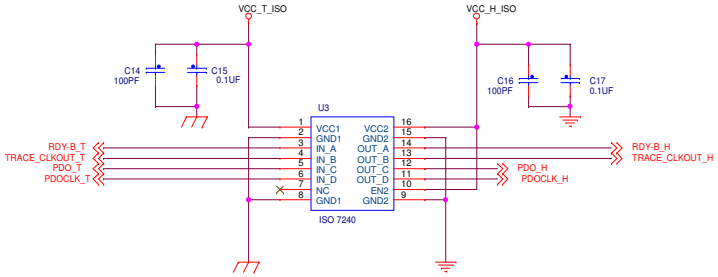
Page Title: **SCHEMATIC PAGE 1**

Size	Document Number	Rev
C	Designed by: Prakash R Bhumireddy (b46730@freescale.com)	1.0.
Date: Wednesday, July 08, 2015	Sheet 3 of 5	

freescale™







freescale

ICAP Classification: FCP: ___ FIUO: X PUBI: ___

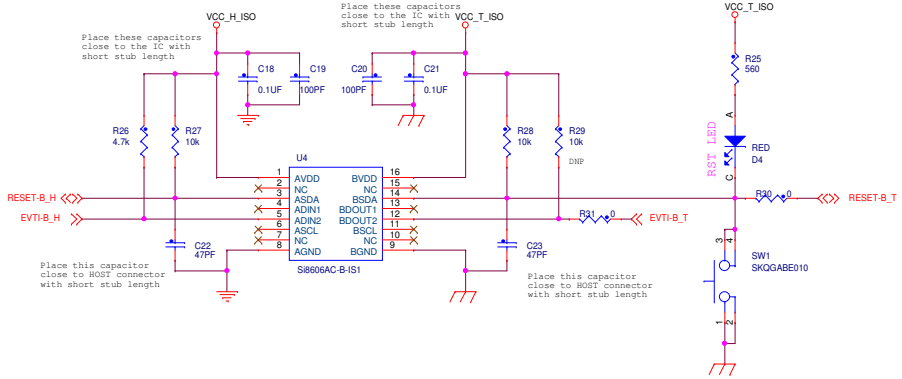
Drawing Title:

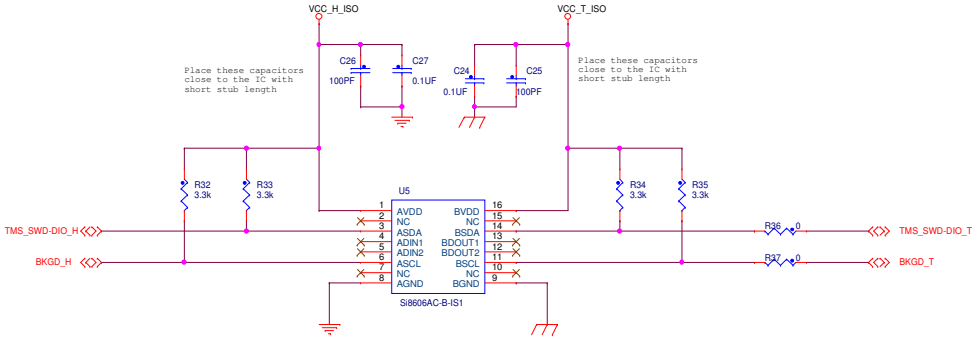
Isolator Board for FSL Programmers

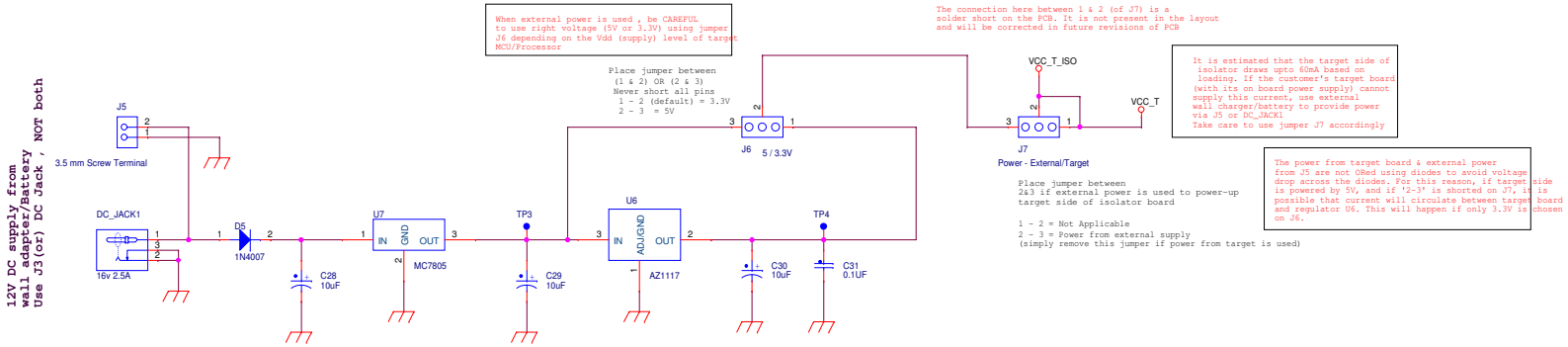
Page Title:

SCHEMATIC PAGE 2

Size	Document Number	Rev
C	Designed by: Prakash R Bhumireddy (b46730@freescale.com)	1.0.
Date: Wednesday, July 08, 2015	Sheet 4 of 5	







MH1 MH2 MH3 MH4

freescale

ICAP Classification: FCP: __ FIUO: X PUBI: __

Drawing Title:

Isolator Board for FSL Programmers

Page Title:

SCHEMATIC PAGE 3

Size	Document Number	Rev
C	Designed by: Prakash R Bhumireddy (b46730@freescale.com)	1.0.
Date: Wednesday, July 08, 2015	Sheet 5 of 5	

Appendix C. Bill of Materials

Item	Qty	Reference	Part	Part Description	Foot print
1	1	C1	4.7nF	Ceramic Capacitors SMT	0603
2	1	C2	4.7uF	Ceramic Capacitors SMT	1206
3	12	C3,C5,C7,C9,C11,C15,C17, C18,C21,C24,C27,C31	0.1UF	Ceramic Capacitors SMT	0805
4	10	C4,C6,C8,C10,C14,C16, C19,C20,C25,C26	100PF	Ceramic Capacitors SMT	0603
5	4	C12,C13,C22,C23	47PF	Ceramic Capacitors SMT	0603
6	3	C28,C29,C30	10uF	Tantulum Capacitors SMT	1210
7	1	DC_JACK1	16v 2.5A	Power Jack	CON_DC_JACK
8	1	D1	ESD9L5.0ST5G	ESD Diode	SOD−923
9	1	D2	GREEN	SMT LED	1206
10	1	D3	HSMR-C190	SMT LED	1206
11	1	D4	RED	SMT LED	1206
12	1	D5	1N4007	TH Diode	Through Hole (TH)
13	1	JA_T1	CON_2X7	Berg Strip Male Connector	0.100" pitch (2X7)
14	1	JG_T1	CON_2X5	Berg Strip Male Connector	(Mini) 0.050" pitch (2X5)
15	1	JB_T1	CON_2X10	Berg Strip Male Connector	0.100" pitch (2X10)
16	2	JF_T1,JF_H1	CON_2X10	Berg Strip Male Connector	(Mini) 0.050" pitch (2X10)
17	2	JC_T1,JC_H1	CON_2X3	Berg Strip Male Connector	0.100" pitch (2X3)
18	1	J1	CONN USB MINI-B	USB Mini Connector	USB Mini-B Select
19	1	J2	Multilink Power / USB port Power	Berg Strip Male Connector	0.100" pitch (1X3)
20	2	J3,J4	CON_1x2	Berg Strip Male Connector	0.100" pitch (1X2)
21	1	J5	3.5 mm Screw Terminal	2-pin power connector	CON_2P_3.5MM(MKDSN)
22	1	J6	5 / 3.3V	Berg Strip Male Connector	0.100" pitch (1X3)
23	1	J7	Power - External/Target	Berg Strip Male Connector	0.100" pitch (1X3)
24	2	L1,L2	470OHM	Ferrite Bead 470 ohm	0805
25	1	R1	1M	Resistor SMT	0805
26	9	R2,R13,R14,R15,R16,R30, R31,R36,R37	0 E	Resistor SMT	0805
27	1	R3	560	Resistor SMT	0805
28	1	R4	330	Resistor SMT	0805
29	12	R5,R6,R7,R8,R11,R12, R17,R18,R19,R20,R22,R26	4.7k	Resistor SMT	0805
30	8	R9,R10,R21,R23,R24,R27, R28,R29	10k	Resistor SMT	0805
31	1	R25	560	Resistor SMT	0805
33	4	R32,R33,R34,R35	3.3k	Resistor SMT	0805
34	1	SW1	SKQGABE010	Push button switch	Refer datasheet
36	1	U1	ISO7241CDWR	Standard Digital Isolator	SOIC 16 Wide Body

Item	Qty	Reference	Part	Part Description	Foot print
37	2	U2,U3	ISO7240CDWR	Standard Digital Isolator	SOIC 16 Wide Body
38	2	U4,U5	Si8606AC-B-IS1	I2C Digital Isolator	SOIC 16 Narrow Body
39	1	U6	AZ1117D-3.3TRE1	3.3V Fixed Regulator	TO252-2 (3)
40	1	U7	MC7805CD2TG	5V Fixed Regulator	TO-263-3 (D2PAK)

How to Reach Us:

Home Page:
freescale.com

Web Support:
freescale.com/support

Document Number: AN5233
Rev. 0
12/2015