ezLINX iCoupler Isolated Interface Development Environment

FEATURES
Plug and play system evaluation
Easy evaluation of 8 isolated physical layer communication standards
Open source hardware
Open source software
iCoupler and isoPower technology
ADSP-BF548 Blackfin processor running uClinux
Sample PC application
Sample embedded uClinux application
64 MB RAM
32 MB flash
Extender connector for additional functionality

APPLICATIONS
Isolated interfaces

EVALUATION KIT CONTENTS
EZLINX-IIIDE-EBZ
Power supply
ezLINX software DVD
USB A to mini USB B cable

GENERAL DESCRIPTION
The ezLINX™ iCoupler® isolated interface development environment provides developers with a cost-effective, plug and play method for evaluating eight digitally isolated physical layer communication standards (USB, RS-422, RS-485, RS-232, CAN, SPI, I2C, and LVDS). The Blackfin® ADSP-BF548 processor runs the uClinux® operating system and allows for easy customization through the open source hardware and software platform. Development time is significantly reduced for embedded designers and system architects who are designing and evaluating isolated communication standards. The interfaces on ezLINX use Analog Devices, Inc., isolated transceivers with integrated iCoupler and isoPower® digital isolator technology.

The hardware of the ezLINX iCoupler isolated interface development environment contains the ADSP-BF548 Blackfin processor with 64 MB of RAM and 32 MB of flash memory. The isolated physical layer communication standards are implemented using Analog Devices isolated transceivers with integrated iCoupler and isoPower technology. Devices used to implement these isolated physical layer communication standards include the following:

- Isolated USB using the ADuM3160
- Isolated CAN using the ADM3053 signal and power isolated CAN transceiver
- Isolated RS-485 and RS-422 using the ADM2587E signal and power isolated RS-485/R-422 transceiver
- Isolated RS-232 using the ADM3252E signal and power isolated RS-232 transceiver
- Isolated I2C using the ADuM1250 and ADuM5000
- Isolated SPI using the ADuM3401, ADuM3402, and ADuM5000
- Isolated LVDS using the ADuM3442, ADuM5000, ADN4663, and ADN4664

This evaluation board contains multiple parts with isoPower technology, which uses high frequency switching elements to transfer power through the transformer. Special care must be taken during PCB layout to meet emissions standards. See the AN-0971 Application Note, Recommendations for Control of Radiated Emissions with isoPower Devices, for board layout recommendations. The ezLINX PCB layout has not been verified to pass radiated emissions specifications.
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REVISION HISTORY

8/12—Revision 0: Initial Version
SYSTEM ARCHITECTURE

The system architecture block diagram of the ezLINX hardware is shown in Figure 2. An extender connector, Hirose FX8-120P-SV(91), is added for additional functionality. The Ethernet option is not fitted on the standard ezLINX hardware.

Figure 2. ezLINX Hardware Block Diagram
The isolated CAN port is implemented using the ADM3053 signal and power isolated CAN transceiver. The ADM3053 connects to CAN0 of the ADSP-BF548 and is capable of functioning at data rates of up to 1 Mbit/sec. Figure 3 shows a circuit diagram of the implementation of the ADM3053 on the ezLINX hardware.

The CAN node can be configured using Jumpers JP17 and JP18. When both Jumpers JP17 and JP18 are fitted, the CAN node is split terminated with 120 Ω and a common-mode capacitor of 47 nF. If termination is not required, remove JP17 and JP18. Table 4 shows the jumper configurations for all the interfaces on ezLINX.

The 5 V supply is connected to the VCC pin (Pin 8) to power the isoPower isolated power supply of the ADM3053. This generates an isolated 5 V on the VISOOUT pin (Pin 12) of the ADM3053 and must be connected to the VISOIN pin (Pin 19). The 3.3 V supply is connected to the VIO pin (Pin 6) to power the iCoupler signal isolation of the ADM3053. This is to ensure compatibility with the 3.3 V logic of the Blackfin ADSP-BF548. The Rs pin (Pin 18) is connected through a 0 Ω resistor to CAN_ISO_GND to deactivate slew rate limiting.

A 4-pin screw terminal connector, J8, is used for easy access to the CANH (Pin 1 of J8), CANL (Pin 3 of J8), and CAN_ISO_GND (Pin 2 and Pin 4 of J8) signals.

The AN-1123 Application Note, Controller Area Network (CAN) Implementation Guide, provides more information about implementing CAN nodes.

The ADM3053 contains isoPower technology that uses high frequency switching elements to transfer power through the transformer. Special care must be taken during printed circuit board (PCB) layout to meet emissions standards. Refer to the AN-0971 Application Note, Recommendations for Control of Radiated Emissions with isoPower Devices, for details on board layout considerations.
**ISOLATED RS-485 AND RS-422**

The isolated RS-485 and RS-422 port is implemented using the ADM2587E signal and power isolated CAN transceiver. The ADM2587E connects to UART2 of the ADSP-BF548 and is capable of functioning at data rates of up to 500 kbit/sec. Figure 4 shows a circuit diagram of the implementation of the ADM2587E on the ezLINX hardware.

The RS-485/RS-422 node can be configured using Jumpers JP3, JP4, JP19, and JP40. To configure the node as a half-duplex RS-485 node, connect JP3, JP4, and JP40. When JP3 and JP4 are fitted, A to Y are connected and B to Z are connected. When JP3 and JP4 are removed, the node is configured as a full-duplex RS-422 node. When JP19 is fitted, the A and B pins are terminated with 120 Ω. If termination is not required, remove JP19. When JP40 is connected, a pull-up resistor of 10 kΩ is connected to the RxD pin (Pin 4) of the ADM2587E. Table 4 shows jumper configurations for all the interfaces on ezLINX.

The 3.3 V supply is connected to the VCC pins (Pin 2 and Pin 8) to power the isoPower isolated power supply and the iCoupler signal isolation of the ADM2587E. This generates an isolated 3.3 V on the VISOOUT pin (Pin 12) of the ADM2587E, which is connected to the VISOIN pin (Pin 19).

A 6-pin screw terminal connector, J7, is used for easy access to the A (Pin 2 of J7), B (Pin 3 of J7), Z (Pin 4 of J7), Y (Pin 5 of J7), and RS-485_ISO_GND (Pin 1 and Pin 6 of J7) signals.


The ADM2587E contains isoPower technology that uses high frequency switching elements to transfer power through the transformer. Special care must be taken during PCB layout to meet emissions standards. Refer to the AN-0971 Application Note, *Recommendations for Control of Radiated Emissions with isoPower Devices*, for details on board layout considerations.

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**Figure 4. ADM2587E Isolated RS-485 and RS-422 Implementation**
ISOLATED USB

The isolated USB port is implemented using the ADuM3160 full speed USB isolator. The ADuM3160 connects to the integrated PHY of the ADSP-BF548's USB controller and is capable of functioning at data rates of up to 12 Mbit/sec. Figure 5 shows a circuit diagram of the implementation of the ADuM3160 on the ezLINX hardware.

The VBUS1 pin (Pin 1) and VDD1 pin (Pin 3) of the ADuM3160 are powered from the 5 V VBUS line of the USB mini connector and can only be connected to a USB master. The VBUS2 pin (Pin 16) and VDD2 pin (Pin 14) are powered from the 3.3 V generated by the ezLINX power supply.

Figure 5. ADuM3160 Isolated USB Implementation
**ISOLATED RS-232**

The isolated RS-232 port is implemented using the ADM3252E signal and power isolated RS-232 transceiver. The ADM3252E connects to UART3 of the ADSP-BF548 and is capable of functioning at data rates of up to 460 kbit/sec. Figure 6 shows a circuit diagram of the implementation of the ADM3252E on the ezLINX hardware.

When the JP2 jumper is fitted, it implements a loopback of the isolated RS-232 transmitter output (Pin TOUT1) to the receiver input (Pin RIN1).

The VCC pins (Pin A2, Pin B1, and Pin B2) of the ADM3252E are powered with 3.3 V and generate an isolated 3.3 V on the VISO pins (Pin A10, Pin B10, and Pin C10) using Analog Devices isoPower technology.

A 3-pin screw terminal connector, J6, is used for easy access to the TOUT2 (Pin 2 of J6), RIN2 (Pin 3 of J6), and RS232_ISO_GND (Pin 1 of J6) signals.

The ADM3252E contains isoPower technology that uses high frequency switching elements to transfer power through the transformer. Special care must be taken during PCB layout to meet emissions standards. Refer to the AN-0971 Application Note, Recommendations for Control of Radiated Emissions with isoPower Devices, for details on board layout considerations.

**Figure 6. ADM3252E Isolated RS-232 Implementation**
**ISOLATED I^C**

The isolated I^C port is implemented using the **ADuM1250** I^C isolator and the **ADuM5000** isoPower isolated dc-to-dc converter. The **ADuM1250** connects to TWI1 of the **ADSP-BF548** and is capable of functioning at a maximum frequency of 1 MHz. Figure 7 shows a circuit diagram of the implementation of the **ADuM1250** and **ADuM5000** on the ezLINX hardware.

The V^DDI_1 pin (Pin 1) of the **ADuM1250** and the V^DDI_1 pins (Pin 1 and Pin 7) of the **ADuM5000** are powered by 3.3 V. The **ADuM5000** generates an isolated 3.3 V, which is used to supply power to the V^DDO_1 pin (Pin 8) of the **ADuM1250**.

A 3-pin screw terminal connector, J22, is used for easy access to the SDA (Pin 1 of J22), SCL (Pin 2 of J22), and I2C_ISO_GND (Pin 3 of J22) signals.

The **ADuM5000** contains isoPower technology that uses high frequency switching elements to transfer power through the transformer. Special care must be taken during PCB layout to meet emissions standards. See the **AN-0971 Application Note, Recommendations for Control of Radiated Emissions with isoPower Devices**, for board layout recommendations.

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**Figure 7. ADuM1250 and ADuM5000 Isolated I^C Implementation**
**ISOLATED SPI**

Two isolated SPI ports are implemented using the ADuM3401, the ADuM3402 iCoupler signal isolators, and the ADuM5000 isoPower isolated dc-to-dc converter. The isolated SPI0 implementation on the ezLINX hardware uses the ADuM3401. The ADuM3401 connects to SPI0 of the Blackfin ADSP-BF548 and is used to isolate the SCLK, MISO, SEL1, and MOSI lines. The ADuM3402 is used for isolating the SPI slave select lines. Figure 8 shows a circuit diagram of the implementation of isolated SPI1 using the ADuM3401, ADuM3402, and ADuM5000 on the ezLINX hardware.

The isolated SPI2 implementation on the ezLINX hardware uses the ADuM3401. The ADuM3401 connects to SPI2 of the ADSP-BF548 and is used to isolate the SCLK, MISO, SEL1, and MOSI lines. The ADuM3402 is used for isolating the SPI slave select lines. Figure 9 shows a circuit diagram of the implementation of the isolated SPI2 using the ADuM3401, ADuM3402, and ADuM5000 on the ezLINX hardware.

The VDD1 pin (Pin 1) of the ADuM3401 and ADuM3402 and the VDD1 pins (Pin 1 and Pin 7) of the ADuM5000 are powered by 3.3 V. The ADuM5000 generates an isolated 3.3 V, which is used to supply power to the VDD0 pin (Pin 16) of the ADuM3401 and ADuM3402.

Two 7-pin screw terminal connectors, J10 and J25, are used for easy access to the SPISCK (Pin 1 of J10 and J25), SPIMOSI (Pin 2 of J10 and J25), SPISEL1/SPISS (Pin 3 of J10 and J25), SPIMISO (Pin 4 of J10 and J25), SPISEL2 (Pin 5 of J10 and J25), SPISEL3 (Pin 6 of J10 and J25), and SPI_ISO_GND (Pin 7 of J10 and J25) signals.


### Table 1. Isolated SPI0 Connections

<table>
<thead>
<tr>
<th>Jumper</th>
<th>SPI0 Master</th>
<th>SPI0 Slave</th>
</tr>
</thead>
<tbody>
<tr>
<td>JP5</td>
<td>Connect</td>
<td>Open</td>
</tr>
<tr>
<td>JP6</td>
<td>Open</td>
<td>Connect</td>
</tr>
<tr>
<td>JP7</td>
<td>Connect</td>
<td>Open</td>
</tr>
<tr>
<td>JP8</td>
<td>Open</td>
<td>Connect</td>
</tr>
<tr>
<td>JP9</td>
<td>Connect</td>
<td>Open</td>
</tr>
<tr>
<td>JP10</td>
<td>Open</td>
<td>Connect</td>
</tr>
<tr>
<td>JP11</td>
<td>Connect</td>
<td>Open</td>
</tr>
<tr>
<td>JP12</td>
<td>Open</td>
<td>Connect</td>
</tr>
<tr>
<td>JP13</td>
<td>Connect</td>
<td>Open</td>
</tr>
<tr>
<td>JP14</td>
<td>Open</td>
<td>Connect</td>
</tr>
<tr>
<td>JP15</td>
<td>Connect</td>
<td>Open</td>
</tr>
<tr>
<td>JP16</td>
<td>Open</td>
<td>Connect</td>
</tr>
<tr>
<td>JP20</td>
<td>Open</td>
<td>Connect</td>
</tr>
<tr>
<td>JP21</td>
<td>Connect</td>
<td>Open</td>
</tr>
<tr>
<td>JP36</td>
<td>Connect</td>
<td>Open</td>
</tr>
<tr>
<td>JP37</td>
<td>Open</td>
<td>Connect</td>
</tr>
</tbody>
</table>


### Table 2. Isolated SPI2 Connections

<table>
<thead>
<tr>
<th>Jumper</th>
<th>SPI2 Master</th>
<th>SPI2 Slave</th>
</tr>
</thead>
<tbody>
<tr>
<td>JP22</td>
<td>Connect</td>
<td>Open</td>
</tr>
<tr>
<td>JP23</td>
<td>Open</td>
<td>Connect</td>
</tr>
<tr>
<td>JP24</td>
<td>Connect</td>
<td>Open</td>
</tr>
<tr>
<td>JP25</td>
<td>Open</td>
<td>Connect</td>
</tr>
<tr>
<td>JP26</td>
<td>Connect</td>
<td>Open</td>
</tr>
<tr>
<td>JP27</td>
<td>Open</td>
<td>Connect</td>
</tr>
<tr>
<td>JP28</td>
<td>Connect</td>
<td>Open</td>
</tr>
<tr>
<td>JP29</td>
<td>Open</td>
<td>Connect</td>
</tr>
<tr>
<td>JP30</td>
<td>Connect</td>
<td>Open</td>
</tr>
<tr>
<td>JP31</td>
<td>Open</td>
<td>Connect</td>
</tr>
<tr>
<td>JP32</td>
<td>Connect</td>
<td>Open</td>
</tr>
<tr>
<td>JP33</td>
<td>Open</td>
<td>Connect</td>
</tr>
<tr>
<td>JP34</td>
<td>Open</td>
<td>Connect</td>
</tr>
<tr>
<td>JP35</td>
<td>Connect</td>
<td>Open</td>
</tr>
<tr>
<td>JP36</td>
<td>Connect</td>
<td>Open</td>
</tr>
<tr>
<td>JP37</td>
<td>Open</td>
<td>Connect</td>
</tr>
</tbody>
</table>

The ADuM5000 contains isoPower technology that uses high frequency switching elements to transfer power through the transformer. Special care must be taken during PCB layout to meet emissions standards. See the AN-0971 Application Note, Recommendations for Control of Radiated Emissions with isoPower Devices, for board layout recommendations.

**Warnings**

**JP20 and JP21**

JP20 and JP21 should never both be connected because doing so will create a short circuit between 3.3 V and GND.

**JP34 and JP35**

JP34 and JP35 should never both be connected because doing so will create a short circuit between 3.3 V and GND.
Figure 8. ADuM3401, ADuM3402, ADuM5000 Isolated SPI Implementation
Figure 9. ADuM3401, ADuM3402, ADuM5000 Isolated SPI2 Implementation
ISOLATED LVDS

The isolated LVDS port is implemented using the ADuM3442 iCoupler signal isolator, the ADN4664 dual LVDS receiver, the ADN4663 dual LVDS transmitter, and the ADuM5000 isoPower isolated dc-to-dc converter. The ADuM3442 is connected to SPORT2 of the ADSP-BF548. Figure 10 shows a circuit diagram of the implementation of the isolated LVDS using the ADuM3442, ADN4663, ADN4664, and ADuM5000 on the ezLINX hardware.

The VDD1 pin (Pin 1) of the ADuM3442 and the VDD1 pin (Pin 1 and Pin 7) of the ADuM5000 are powered by 3.3 V. The ADuM5000 generates an isolated 3.3 V, which is used to supply power to the VDD2 pin (Pin 16) of the ADuM3442, the VCC pin (Pin 1) of the ADN4663, and the VCC pin (Pin 8) of the ADN4664.

A 32-pin header connector is used for easy access to the isolated LVDS signals.

The ADuM5000 contains isoPower technology that uses high frequency switching elements to transfer power through the transformer. Special care must be taken during PCB layout to meet emissions standards. See the AN-0971 Application Note, Recommendations for Control of Radiated Emissions with isoPower Devices, for board layout recommendations.
Figure 10. ADuM3442, ADN4663, ADN4664, and ADuM5000 Isolated LVDS Implementation
POWER INPUT
An ac-to-dc desktop power supply is used to supply 7.5 V input to the J1 barrel connector on the ezLINX hardware. This supply connects to the UNREG_IN node of the circuit through a protection circuit as shown in Figure 11.

3.3 V POWER SUPPLY
The ADP1864 constant frequency, current-mode, step-down dc-to-dc controller is used with an external P-channel MOSFET to generate the regulated 3.3 V power supply for the ezLINX hardware. The circuit implementation of the 3.3 V power supply is shown in Figure 12.
1.2 V, 2.5 V, AND 5 V POWER SUPPLIES

A P-channel MOSFET is used to regulate the 3.3 V input to 1.2 V (see Figure 13). The ADP1706 linear regulator is used to regulate the 3.3 V input to 2.5 V (see Figure 14). The ADP3335 low dropout regulator is used to regulate the UNREG_IN input to 5 V (see Figure 15).
EXTENDER CONNECTOR

The Hirose FX8-120P-SV(91) extender connector is used for daughter board connections. This allows additional functionality to be added to the ezLINX hardware. Figure 16 shows the circuit implementation of the J23 and J26 extender connectors. Connector J26 is a 3-pin header connector that allows the CAN1 signals of the ADSP-BF548 to be routed to an external daughter board.

Figure 16. Extender Connector Using Hirose FX8-120P-SV(91)
RS-232 CONSOLE

The RS-232 console connector is used for accessing the console of the uClinux kernel running on the ADSP-BF548 processor. It uses the ADM3202 RS-232 line driver and receiver to connect to UART1 of the ADSP-BF548. The RS-232 signals connect to a DB-9 connector, J4. A circuit implementation of the RS-232 console is shown in Figure 17.

The RS-232 console is used to directly access the uClinux kernel running on the ADSP-BF548. When the console is connected to a RS-232 port on the PC, the kernel can be accessed through a terminal program.

Figure 17. RS-232 Console Implementation
LEDs

There are 10 LEDs on the ezLINX evaluation board. The red LED6 illuminates to indicate when the reset button is being pressed. The orange LED10 illuminates to indicate when the isolated USB port is connected to a USB port on the PC. The green LED7 illuminates to indicate when the board is powered.

The orange LED1 illuminates to indicate when the uClinux kernel and application finishes booting up.

Table 4 describes the functionality and connections of the LEDs for the ADSP-BF548 and other circuitry.

Table 3.

<table>
<thead>
<tr>
<th>LED</th>
<th>ADSP-BF548 Port</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED1</td>
<td>PD6</td>
<td>Illuminates when the uClinux kernel and application finishes booting up.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>This LED can also be used as a general-purpose indicator that can be turned on and off through software.</td>
</tr>
<tr>
<td>LED2</td>
<td>PD7</td>
<td>General-purpose indicator that can be turned on and off through software.</td>
</tr>
<tr>
<td>LED3</td>
<td>PD8</td>
<td>General-purpose indicator that can be turned on and off through software.</td>
</tr>
<tr>
<td>LED4</td>
<td>PD9</td>
<td>General-purpose indicator that can be turned on and off through software.</td>
</tr>
<tr>
<td>LED5</td>
<td>PD10</td>
<td>General-purpose indicator that can be turned on and off through software.</td>
</tr>
<tr>
<td>LED6</td>
<td>PD11</td>
<td>General-purpose indicator that can be turned on and off through software.</td>
</tr>
<tr>
<td>LED7</td>
<td>Not Applicable</td>
<td>Illuminates when the 3.3 V power supply is available.</td>
</tr>
<tr>
<td>LED8</td>
<td>Not Applicable</td>
<td>Illuminates when the reset button is pressed.</td>
</tr>
<tr>
<td>LED10</td>
<td>Not Applicable</td>
<td>Illuminates when the VBUS voltage from the USB host is connected.</td>
</tr>
</tbody>
</table>
### JUMPER CONFIGURATIONS

**Table 4.**

<table>
<thead>
<tr>
<th>Interface</th>
<th>Configuration</th>
<th>Jumpers Fitted</th>
<th>Jumpers Open</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Full-duplex configuration</td>
<td>Not applicable</td>
<td>JP3, JP4, JP40</td>
</tr>
<tr>
<td></td>
<td>120 Ω termination</td>
<td>JP19</td>
<td>Not applicable</td>
</tr>
<tr>
<td>RS-232</td>
<td>Loopback TOUT to RIN</td>
<td>JP2</td>
<td>Not applicable</td>
</tr>
<tr>
<td>CAN</td>
<td>Split terminate the bus with 120 Ω and a common-mode 47 nF capacitor</td>
<td>JP17, JP18</td>
<td>Not applicable</td>
</tr>
<tr>
<td></td>
<td>No termination</td>
<td>Not applicable</td>
<td>JP17, JP18</td>
</tr>
</tbody>
</table>

1 Warning: JP20 and JP21 should never both be connected because doing so will create a short circuit between 3.3 V and GND.
2 Warning: JP34 and JP35 should never both be connected because doing so will create a short circuit between 3.3 V and GND.
NOTES

I2C refers to a communications protocol originally developed by Philips Semiconductors (now NXP Semiconductors).

ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high-energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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