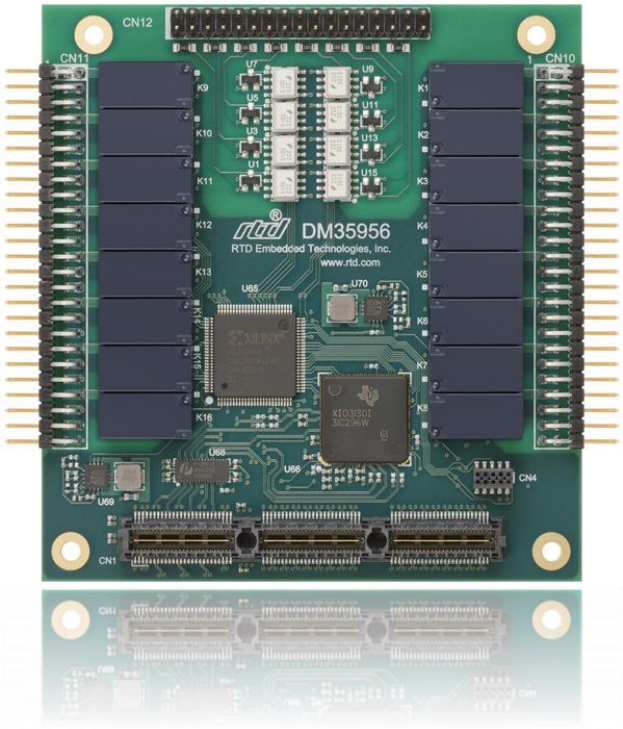
DM35956HR

PCIe/104 16-Channel Mechanical Relay Output with 16 Opto-isolated Inputs

User's Manual

BDM-610010050 Rev. C



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Revision History

Rev A	Initial Release
Rev B	Corrected some typographical errors. Added ASPM note. Changed to 0 based numbering.
Rev C	Added MTBF. Added wire size specifications for terminal block. Corrected title of Table 5 and 6. Corrected maximum and minimum input voltage specification for opto-isolated inputs.

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1 Introduction

1.1 Product Overview

The DM35956HR provides Opto-Isolated Digital Inputs and Outputs to interface with a variety of devices. The Inputs allow for a broad range of input voltages, and are compatible with 5V systems and 120V systems. The high-current Outputs allow for driving LEDs, relays, and solenoids. The PCIe interface provides compatibility with the latest generation of CPUs, and the PCIe lane repopulation allows for virtually limitless system expansion.

1.2 Board Features

- PC/104 form factor
- PCIe/104 stackable bus structure
  - PCIe/104 Universal Connector
  - PCI Express (PCIe) x1 Upstream Interface to CPU
  - Uses a PCIe x1 link
  - Repopulates the PCIe bus
- Broad input voltage range
- High-current outputs
- -40 to +85°C Operation
- Isolated Input
  - 16 Opto-Isolated digital Inputs
  - Maximum Input Voltage:
    - Standard Version: $15V_{DC}$
    - 24V Version: $30V_{DC}$
  - Reverse-polarity protection
  - 2500 $V_{AC(RMS)}$ Isolation
  - Custom settings available
- Relay Outputs
  - 16 power relays with Form C contacts
  - 60 VA switching capacity
  - Switching current
    - 2 A at 30 VDC
    - 0.5 A at 125 VAC
    - 0.25 A at 250 VAC
  - Max switching voltage 220 VDC / 250 VAC
  - Operate and release time 4 milliseconds
  - 1000 Vrms isolation
  - Expected life
    - Mechanical (at 180 cpm) 100,000,000 operations
    - Electrical at 2 A, 30 VDC resistive 500,000 operations

1.3 Ordering Information

The DM35956HR is available with the following options:

Table 1: Ordering Options

Part Number	Description
DM35956HR-H	PCIe/104 64-Channel High Density Isolated Digital I/O Module with Headers
DM35956HR-24V-H	PCIe/104 64-Channel High Density Isolated Digital I/O Module with Headers for 24V systems
DM35956HR-S	PCIe/104 64-Channel High Density Isolated Digital I/O Module with Screw Terminals
DM35956HR-24V-S	PCIe/104 64-Channel High Density Isolated Digital I/O Module with Screw Terminals for 24V systems
IDAN-DM35956HR-D	PCIe/104 64-Channel High Density Isolated Digital I/O Module in IDAN enclosure
IDAN-DM35956HR-24V-D	PCIe/104 64-Channel High Density Isolated Digital I/O Module in IDAN enclosure for 24V systems

The Intelligent Data Acquisition Node (IDAN™) building block can be used in just about any combination with other IDAN building blocks to create a simple but rugged 104™ stack. This module can also be incorporated in a custom-built RTD HiDAN™ or HiDANplus High Reliability Intelligent Data Acquisition Node. Contact RTD sales for more information on our high reliability systems.

1.4 Contact Information

1.4.1 Sales Support

For sales inquiries, you can contact RTD Embedded Technologies sales via the following methods:

Phone: 1-814-234-8087 Monday through Friday, 8:00am to 5:00pm (EST).
E-Mail: sales@rtd.com

1.4.2 Technical Support

If you are having problems with you system, please try the steps in the Troubleshooting section of this manual on page 15.

For help with this product, or any other product made by RTD, you can contact RTD Embedded Technologies technical support via the following methods:

Phone: 1-814-234-8087 Monday through Friday, 8:00am to 5:00pm (EST).
E-Mail: techsupport@rtd.com

2 Specifications

2.1 Operating Conditions

Table 2: Operating Conditions

Symbol	Parameter	Test Condition	Min	Max	Unit
V_{cc5}	5V Supply Voltage		4.75	5.25	V
V_{cc3}	3.3V Supply Voltage		n/a	n/a	V
V_{cc12}	12V Supply Voltage		n/a	n/a	V
V_{cc-12}	-12V Supply Voltage		n/a	n/a	V
T_a	Operating Temperature		-40	+85	C
T_s	Storage Temperature		-55	+125	C
RH	Relative Humidity	Non-Condensing	0	90%	%
MTBF	Mean Time Before Failure	Telcordia Issue 2 30°C, Ground benign, controlled		565,477	Hours

2.2 Electrical Characteristics

Table 3: Electrical Characteristics

Symbol	Parameter	Test Condition	Min	Max	Unit
P	Power Consumption	V_{cc5} = 5.0V		3.75	W
I_{cc5}	5V Input Supply Current	Active		750	mA
		PCIe Bus			
	Differential Output Voltage		0.8	1.2	V
	DC Differential TX Impedance		95.2	116.9	Ω
	Differential Input Voltage		0.175	3.3	V
	DC Differential RX Impedance		92.7	115.8	Ω
	Electrical Idle Detect Threshold		61	173	mV
		Isolated Inputs			
	Input Voltage	Standard Version 24V	-15 -30	15 30	V_{DC}
	Turn-On Threshold Voltage	Standard Version 24V	1.0 1.0	2.4 4.5	V_{DC}
	Turn-On Threshold Current			500	µA
	Isolation Voltage			2500	$V_{AC(RMS)}$
		Relay Outputs			
	Nominal switching capacity	30 V_{DC}, resistive load 125V_{AC}, resistive load		2.0 0.5	A
	Switching Power			60	W
	Switching Voltage			220 250	V_{DC} V_{AC}
	Breakdown Voltage (initial)	Between open contacts		1000	V_{RMS}
		Between contact and coil		2000	V_{RMS}
	Set time	20°C, nominal supply voltage Excluding contact bounce		4	ms
	Release time	20°C, nominal supply voltage Excluding contact bounce		4	ms
	Expected life	Mechanical, 180 cpm Electrical, 20 cpm 2A @ 30V resistive 1A @ 30V resistive 0.5A @ 125V_{AC} resistive	1 x 10^8 1 x 10^5 5 x 10^5 1 x 10^5		Cycles
	Operating Speed			20	Cpm
	Terminal Block Wire Size	-S version	26	20	AWG

3 Board Connection

NOTE: It may be necessary to disable PCIe Active State Power Management (ASPM) in the BIOS setup utility for correct operation. This is typically in the "Advanced/PCI Express/Port #" menu. Contact your CPU vendor for details.

3.1 Board Handling Precautions

To prevent damage due to Electrostatic Discharge (ESD), keep your board in its antistatic bag until you are ready to install it into your system. When removing it from the bag, hold the board at the edges, and do not touch the components or connectors. Handle the board in an antistatic environment, and use a grounded workbench for testing and handling of your hardware.

3.2 Physical Characteristics

- Weight: Approximately 0.20 lbs. (90 g)
- Dimensions: 90.17 mm L x 95.89 mm W (3.550 in L x 3.775 in W)
- Stand-off Height: 0.600 inches (15.240 mm)

3.3 Connectors and Jumpers

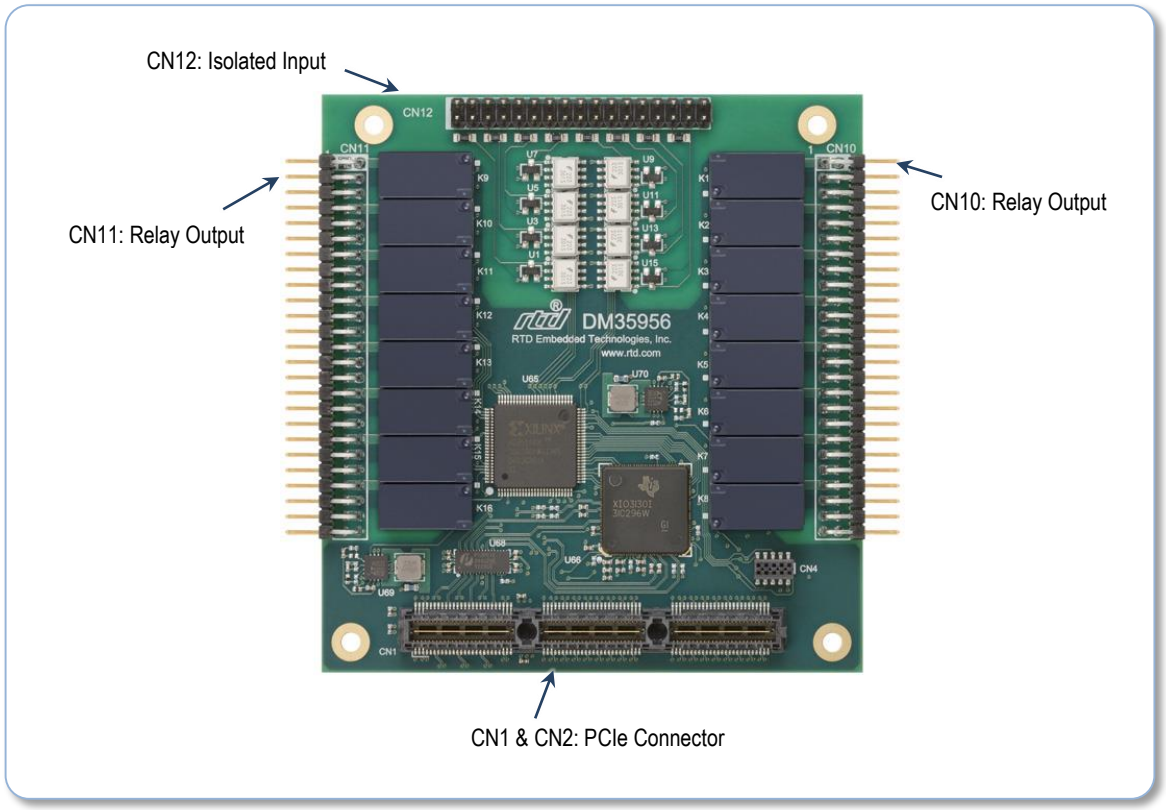

Figure 1: Board Connections

3.3.1 EXTERNAL I/O CONNECTORS

CN12: Isolated Input

The Isolated Inputs are on CN12. The pin assignments are shown in the Table below. The Figure below shows the input circuit.

Table 4: CN12 Isolated Input

Pin Name	#	#	Pin Name
IN0-	2	1	IN0+
IN1-	4	3	IN1+
IN2-	6	5	IN2+
IN3-	8	7	IN3+
IN4-	10	9	IN4+
IN5-	12	11	IN5+
IN6-	14	13	IN6+
IN7-	16	15	IN7+
IN8-	18	17	IN8+
IN9-	20	19	IN9+
IN10-	22	21	IN10+
IN11-	24	23	IN11+
IN12-	26	25	IN12+
IN13-	28	27	IN13+
IN14-	30	29	IN14+
IN15-	32	31	IN15+
n.c.	34	33	n.c.

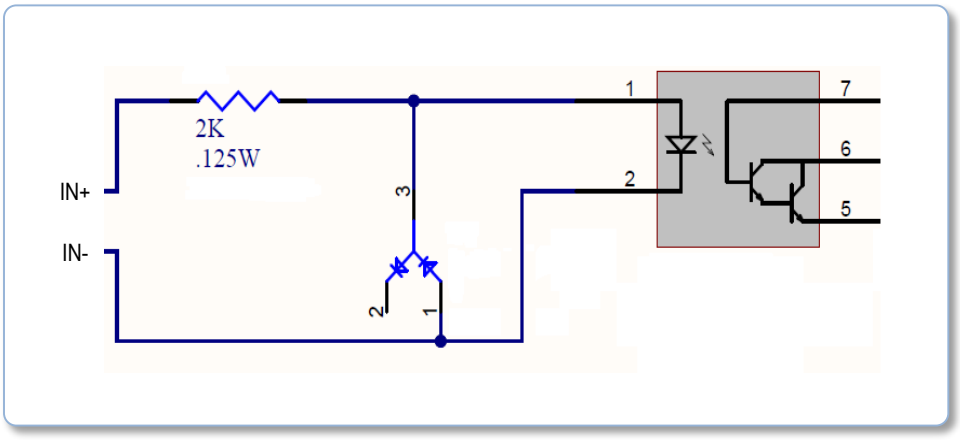

Figure 2: Isolated Input Circuit

CN10 and CN11: Relay Output with Headers (-H)

The Relay Outputs are on CN10 and CN11. The pin assignments are shown in the Table below. Each contact on the relay is attached to two pins on the connector. Only one connection is required to be used.

Table 5: CN10 Relay Output

Pin Name	#	#	Pin Name
RELAY0_NO	2	1	RELAY0_NO
RELAY0_C	4	3	RELAY0_C
RELAY0_NC	6	5	RELAY0_NC
RELAY1_NO	8	7	RELAY1_NO
RELAY1_C	10	9	RELAY1_C
RELAY1_NC	12	11	RELAY1_NC
RELAY2_NO	14	13	RELAY2_NO
RELAY2_C	16	15	RELAY2_C
RELAY2_NC	18	17	RELAY2_NC
RELAY3_NO	20	19	RELAY3_NO
RELAY3_C	22	21	RELAY3_C
RELAY3_NC	24	23	RELAY3_NC
RELAY4_NO	26	25	RELAY4_NO
RELAY4_C	28	27	RELAY4_C
RELAY4_NC	30	29	RELAY4_NC
RELAY5_NO	32	31	RELAY5_NO
RELAY5_C	34	33	RELAY5_C
RELAY5_NC	36	35	RELAY5_NC
RELAY6_NO	38	37	RELAY6_NO
RELAY6_C	40	39	RELAY6_C
RELAY6_NC	42	41	RELAY6_NC
RELAY7_NO	44	43	RELAY7_NO
RELAY7_C	46	45	RELAY7_C
RELAY7_NC	48	47	RELAY7_NC
n.c.	50	49	n.c.

Table 6: CN11 Relay Output

Pin Name	#	#	Pin Name
RELAY8_NO	2	1	RELAY8_NO
RELAY8_C	4	3	RELAY8_C
RELAY8_NC	6	5	RELAY8_NC
RELAY9_NO	8	7	RELAY9_NO
RELAY9_C	10	9	RELAY9_C
RELAY9_NC	12	11	RELAY9_NC
RELAY10_NO	14	13	RELAY10_NO
RELAY10_C	16	15	RELAY10_C
RELAY10_NC	18	17	RELAY10_NC
RELAY11_NO	20	19	RELAY11_NO
RELAY11_C	22	21	RELAY11_C
RELAY11_NC	24	23	RELAY11_NC
RELAY12_NO	26	25	RELAY12_NO
RELAY12_C	28	27	RELAY12_C
RELAY12_NC	30	29	RELAY12_NC
RELAY13_NO	32	31	RELAY13_NO
RELAY13_C	34	33	RELAY13_C
RELAY13_NC	36	35	RELAY13_NC
RELAY14_NO	38	37	RELAY14_NO
RELAY14_C	40	39	RELAY14_C
RELAY14_NC	42	41	RELAY14_NC
RELAY15_NO	44	43	RELAY15_NO
RELAY15_C	46	45	RELAY15_C
RELAY15_NC	48	47	RELAY15_NC
n.c.	50	49	n.c.

CN10 and CN11: Relay Output with Screw Terminals (-S)

The Relay Outputs are on CN10 and CN11. The pin assignments are shown in the Table below.

Table 7: CN10 Relay Output

#	Pin Name
1	RELAY0_NO
2	RELAY0_C
3	RELAY0_NC
4	RELAY1_NO
5	RELAY1_C
6	RELAY1_NC
7	RELAY2_NO
8	RELAY2_C
9	RELAY2_NC
10	RELAY3_NO
11	RELAY3_C
12	RELAY3_NC
13	RELAY4_NO
14	RELAY4_C
15	RELAY4_NC
16	RELAY5_NO
17	RELAY5_C
18	RELAY5_NC
19	RELAY6_NO
20	RELAY6_C
21	RELAY6_NC
22	RELAY7_NO
23	RELAY7_C
24	RELAY7_NC
25	n.c.

Table 8: CN11 Relay Output

#	Pin Name
1	RELAY8_NO
2	RELAY8_C
3	RELAY8_NC
4	RELAY9_NO
5	RELAY9_C
6	RELAY9_NC
7	RELAY10_NO
8	RELAY10_C
9	RELAY10_NC
10	RELAY11_NO
11	RELAY11_C
12	RELAY11_NC
13	RELAY12_NO
14	RELAY12_C
15	RELAY12_NC
16	RELAY13_NO
17	RELAY13_C
18	RELAY13_NC
19	RELAY14_NO
20	RELAY14_C
21	RELAY14_NC
22	RELAY15_NO
23	RELAY15_C
24	RELAY15_NC
25	n.c.

3.3.2 BUS CONNECTORS

CN1 (Top) & CN2 (Bottom): PCIe Connector

The PCIe connector is the connection to the system CPU. The position and pin assignments are compliant with the *PCI/104-Express Specification*. (See PC/104 Specifications on page 20)

The DM35956HR is a "Universal" board, and can connect to either a Type 1 or Type 2 PCIe/104 connector.

3.4 Steps for Installing

NOTE: It may be necessary to disable PCIe Active State Power Management (ASPM) in the BIOS setup utility for correct operation. This is typically in the "Advanced/PCI Express/Port #" menu. Contact your CPU vendor for details.

1. Always work at an ESD protected workstation, and wear a grounded wrist-strap.
2. Turn off power to the PC/104 system or stack.
3. Select and install stand-offs to properly position the module on the stack.
4. Remove the module from its anti-static bag.
5. Check that pins of the bus connector are properly positioned.
6. Check the stacking order; make sure all of the busses used by the peripheral cards are connected to the cpuModule.
7. Hold the module by its edges and orient it so the bus connector pins line up with the matching connector on the stack.
8. Gently and evenly press the module onto the PC/104 stack.
9. If any boards are to be stacked above this module, install them.
10. Attach any necessary cables to the PC/104 stack.
11. Re-connect the power cord and apply power to the stack.
12. Boot the system and verify that all of the hardware is working properly.

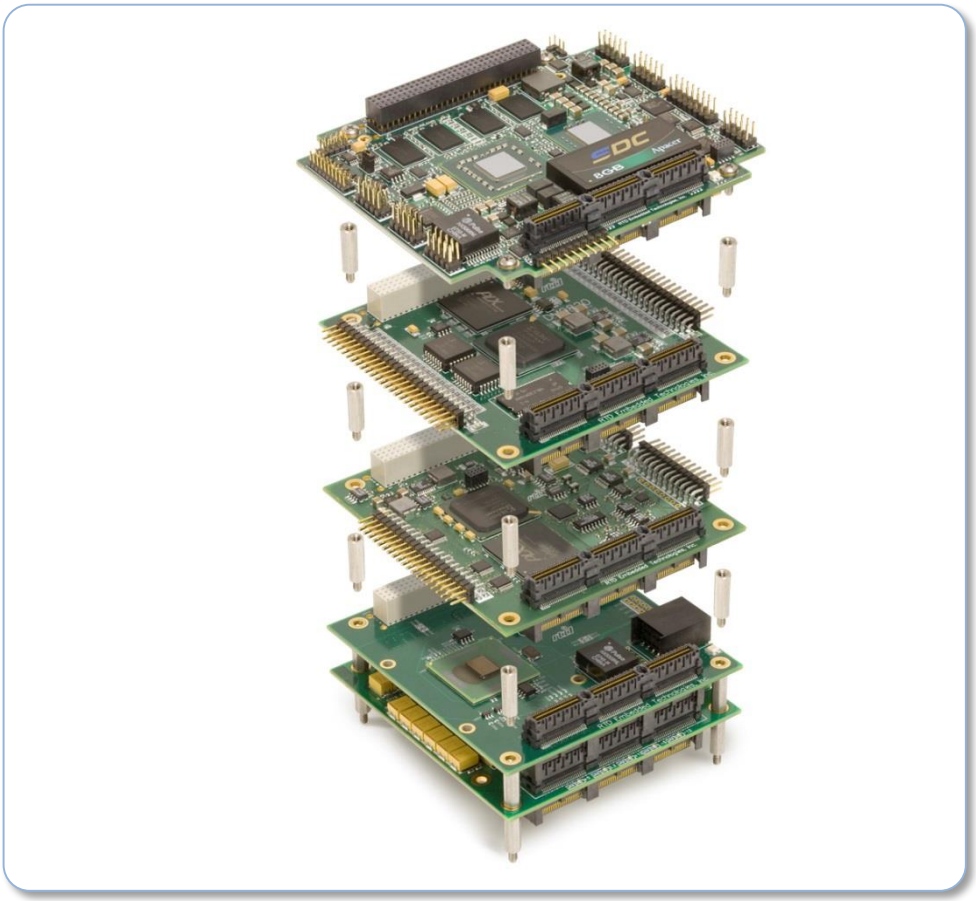

Figure 3: Example 104™ Stack

4 Functional Description

4.1 Block Diagram

The Figure below shows the functional block diagram of the DM35956HR. The various parts of the block diagram are discussed in the following sections.

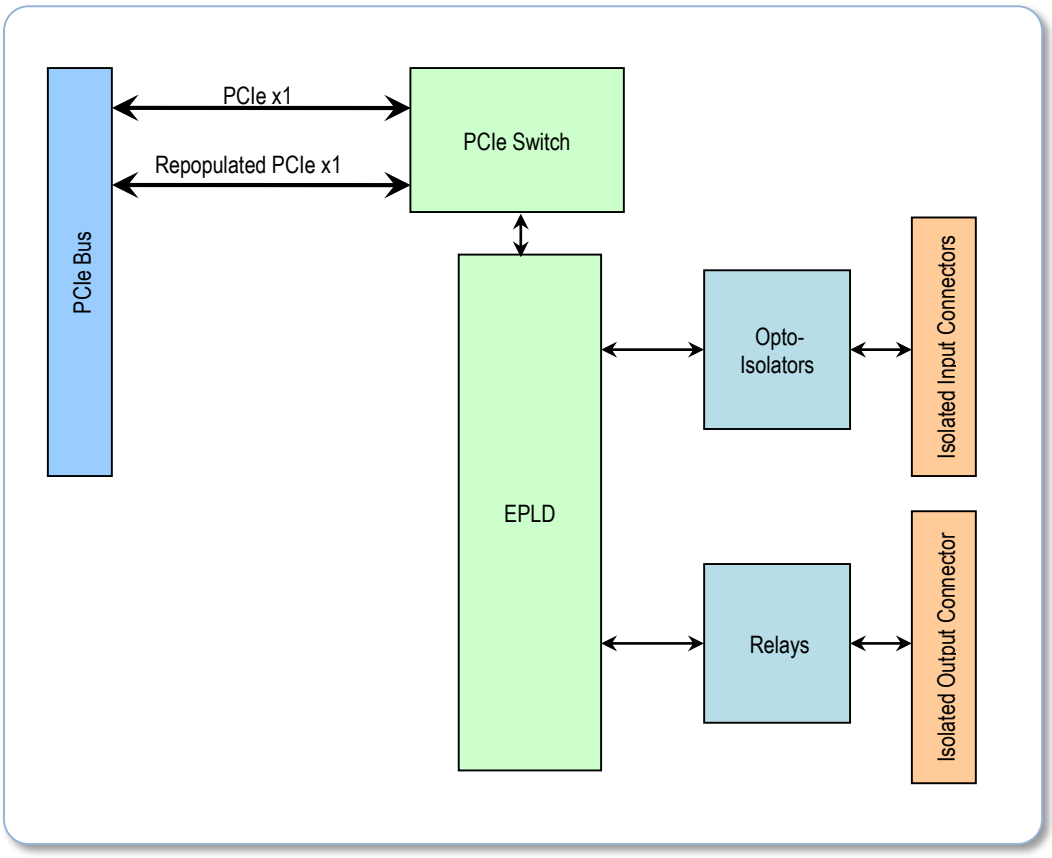

Figure 4: DM35956HR Block Diagram

4.2 PCIe Switch

The PCI Express Switch provides the bus interface to the DM35956HR. The switch includes GPIO that are accessible from its Configuration Space, which is configured as a generic bus. This is a low speed interface that does not provide support for interrupts or DMA.

The PCIe Switch also provides lane repopulation. One lane is used as the uplink to the CPU. On the opposite side of the board it is replaced by a lane from the switch. This allows a virtually limitless number of boards to be added to the system.

4.3 EPLD

The EPLD provides glue logic between the PCIe interface and the on-board functions.

4.4 Relays and Opto-Isolators

The relays and opto-isolators provide the isolation and input/output circuit for the digital I/O.

5 Register Address Space

The bus interface is provided through the GPIO of the PCIe Switch. The GPIO are configured as a generic bus, and the board registers are accessed through an index and data register. The following sections describe the steps needed to access the board registers.

NOTE: It may be necessary to disable PCIe Active State Power Management (ASPM) in the BIOS setup utility for correct operation. This is typically in the "Advanced/PCI Express/Port #" menu. Contact your CPU vendor for details.

5.1 Identifying the Board

The DM35956HR shows up in standard PCI Configuration space as a set of PCI to PCI Bridges. It can be positively identified as shown in the Table below.

Table 9: Identifying the DM35956HR

Configuration Space Offset	Register Description	Value
0x00	Vendor ID	0x104C
0x02	Device ID	0x8232
0x84	Subsystem Vendor ID	0x1435
0x86	Subsystem ID	0x5956

5.2 Index and Data Registers

Table 10: Index and Data Registers

Configuration Space Offset	0x03	0x02	0x01	0x00
0xBC	GPIOAB_CTRL			
0xC0	GPIOCD_CTRL			
0xC4	SELECT		INDEX_DATA	

5.2.1 GPIOAB_CTRL (READ/WRITE)

This register is used to set the direction for the GPIO port. The values to write to it are:

0x12491249 for a Write operation
0x00000000 for a Read operation

5.2.2 GPIOCD_CTRL (READ/WRITE)

This register is used to set the direction for the GPIO port. The values to write to it are:

0x01491249 for a Write operation
0x01480000 for a Read operation

5.2.3 SELECT (READ/WRITE)

This register is used to select between the Index and Data register. All undefined bits may be written with a 0.

B2: DATA
0 = Accessing Index register
1 = Accessing Data register
B1:WR_STRB
Writes take effect on 0 to 1 transition

B0: OE#

0 = Output of EPLD is enabled (for reads)
1 = Output of EPLD is disabled (for writes)

5.2.4 INDEX_DATA (READ/WRITE)

This register is used to access the Index or Data register.

NOTE: The SELECT and INDEX_DATA register may be accessed using a single 32-bit operation.

5.3 Accessing the Board Registers

5.3.1 READING FROM A BOARD REGISTER

To read one of the Board Registers, use the following steps:

1. Read the GPIOAB_CTRL, GPIOCD_CTRL, SELECT and INDEX_DATA registers and store them so they can be restored.
2. Save the Index Register
    a. Set GPIOAB_CTRL and GPIOCD_CTRL to their Read values.
    b. Set SELECT such that DATA=0, WR_STRB=0, and OE#=0
    c. Read INDEX_DATA and store it as the Old Index.
3. Set the Index Register
    a. Set SELECT such that DATA=0, WR_STRB=0, and OE#=1 and set INDEX_DATA to the desired Index.
    b. Set GPIOAB_CTRL and GPIOCD_CTRL to their Write values.
    c. Set SELECT such that DATA=0, WR_STRB=1, and OE#=1. (May also set INDEX_DATA to the desired Index again).
4. Read the Data Register
    a. Set GPIOAB_CTRL and GPIOCD_CTRL to their Read values.
    b. Set SELECT such that DATA=1, WR_STRB=0, and OE#=0
    c. Read INDEX_DATA as the desired Data.
5. Restore the Index Register
    a. Set SELECT such that DATA=0, WR_STRB=0, and OE#=1 and set INDEX_DATA to the Old Index.
    b. Set GPIOAB_CTRL and GPIOCD_CTRL to their Write values.
    c. Set SELECT such that DATA=0, WR_STRB=1, and OE#=1. (May also set INDEX_DATA to the Old Index again).
6. Restore Other Registers
    a. Restore GPIOAB_CTRL
    b. Restore GPIOCD_CTRL bit-wise or'ed with the Read Value (to make sure the SELECT pins are always output)
    c. Restore SELECT and INDEX_DATA with the WR_STRB bit cleared (to make sure a write isn't duplicated)

NOTE: If multi-thread safe operation is not required, steps 1, 2, 5, and 6 can be eliminated.

5.3.2 WRITING TO A BOARD REGISTER

To write to one of the Board Registers, use the following steps:

1. Read the GPIOAB_CTRL, GPIOCD_CTRL, SELECT and INDEX_DATA registers and store them so they can be restored.
2. Save the Index Register
    a. Set GPIOAB_CTRL and GPIOCD_CTRL to their Read values.
    b. Set SELECT such that DATA=0, WR_STRB=0, and OE#=0
    c. Read INDEX_DATA and store it as the Old Index.
3. Set the Index Register
    a. Set SELECT such that DATA=0, WR_STRB=0, and OE#=1 and set INDEX_DATA to the desired Index.
    b. Set GPIOAB_CTRL and GPIOCD_CTRL to their Write values.
    c. Set SELECT such that DATA=0, WR_STRB=1, and OE#=1. (May also set INDEX_DATA to the desired Index again).
4. Set the Data Register
    a. Set SELECT such that DATA=1, WR_STRB=0, and OE#=1 and set INDEX_DATA to the desired Data.
    b. Set GPIOAB_CTRL and GPIOCD_CTRL to their Write values. (Already set by Step 3 above)
    c. Set SELECT such that DATA=1, WR_STRB=1, and OE#=1. (May also set INDEX_DATA to the desired Data again).
5. Restore the Index Register
    a. Set SELECT such that DATA=0, WR_STRB=0, and OE#=1 and set INDEX_DATA to the Old Index.
    b. Set GPIOAB_CTRL and GPIOCD_CTRL to their Write values. (Already set by Step 3 above)
    c. Set SELECT such that DATA=0, WR_STRB=1, and OE#=1. (May also set INDEX_DATA to the Old Index again).
6. Restore Other Registers
    a. Restore GPIOAB_CTRL
    b. Restore GPIOCD_CTRL bit-wise or'ed with the Read Value (to make sure the SELECT pins are always output)
    c. Restore SELECT and INDEX_DATA with the WR_STRB bit cleared (to make sure a write isn't duplicated)

NOTE: If multi-thread safe operation is not required, steps 1, 2, 5, and 6 can be eliminated.

5.4 Board Registers

Table 11: Board Registers

Index	Data (16-bit)
0x00	BUILD_NUM_LS
0x01	BUILD_NUM_MS
0x02	Reserved
0x03	Reserved
0x04	OPTO_IN
0x05	Reserved
0x06	Reserved
0x07	RELAY_CTRL

5.4.1 BUILD_NUM_LS, BUILD_NUM_MS (READ-ONLY)

These two registers contain the build number of the EPLD. It can be used to track revisions of the EPLD. BUILD_NUM_LS is the least-significant word, and BUILD_NUM_MS is the most significant word.

5.4.2 OPTO_IN (READ-ONLY)

This register provides access to IN1 through IN16. Bit 0 corresponds to IN0, and Bit 15 corresponds to IN15. For each bit, a '0' indicates that a voltage is applied to the input, and a value of '1' indicates that there is no voltage on the input.

5.4.3 RELAY_CTRL (READ/WRITE)

This register sets the values of the Outputs. Bit 0 corresponds to RELAY0, and Bit 15 corresponds to RELAY15. For each bit, a '0' causes the "normally closed" contact to be closed, and a value of '1' causes the "normally open" contact to be closed.

6 Troubleshooting

NOTE: It may be necessary to disable PCIe Active State Power Management (ASPM) in the BIOS setup utility for correct operation. This is typically in the "Advanced/PCI Express/Port #" menu. Contact your CPU vendor for details.

If you are having problems with your system, please try the following initial steps:

- **Simplify the System** – Remove modules one at a time from your system to see if there is a specific module that is causing a problem. Perform you troubleshooting with the least number of modules in the system possible.

- **Swap Components** – Try replacing parts in the system one at a time with similar parts to determine if a part is faulty or if a type of part is configured incorrectly.

If problems persist, or you have questions about configuring this product, contact RTD Embedded Technologies via the following methods:

Phone: +1-814-234-8087
E-Mail: techsupport@rtd.com

Be sure to check the RTD web site (http://www.rtd.com) frequently for product updates, including newer versions of the board manual and application software.

7 Additional Information

7.1 PC/104 Specifications

A copy of the latest PC/104 specifications can be found on the webpage for the PC/104 Embedded Consortium:

www.pc104.org

7.2 PCI and PCI Express Specification

A copy of the latest PCI and PCI Express specifications can be found on the webpage for the PCI Special Interest Group:

www.pcisig.com

8 Limited Warranty

RTD Embedded Technologies, Inc. warrants the hardware and software products it manufactures and produces to be free from defects in materials and workmanship for one year following the date of shipment from RTD Embedded Technologies, Inc. This warranty is limited to the original purchaser of product and is not transferable.

During the one year warranty period, RTD Embedded Technologies will repair or replace, at its option, any defective products or parts at no additional charge, provided that the product is returned, shipping prepaid, to RTD Embedded Technologies. All replaced parts and products become the property of RTD Embedded Technologies. Before returning any product for repair, customers are required to contact the factory for a Return Material Authorization (RMA) number.

This limited warranty does not extend to any products which have been damaged as a result of accident, misuse, abuse (such as: use of incorrect input voltages, improper or insufficient ventilation, failure to follow the operating instructions that are provided by RTD Embedded Technologies, “acts of God” or other contingencies beyond the control of RTD Embedded Technologies), or as a result of service or modification by anyone other than RTD Embedded Technologies. Except as expressly set forth above, no other warranties are expressed or implied, including, but not limited to, any implied warranties of merchantability and fitness for a particular purpose, and RTD Embedded Technologies expressly disclaims all warranties not stated herein. All implied warranties, including implied warranties for merchantability and fitness for a particular purpose, are limited to the duration of this warranty. In the event the product is not free from defects as warranted above, the purchaser's sole remedy shall be repair or replacement as provided above. Under no circumstances will RTD Embedded Technologies be liable to the purchaser or any user for any damages, including any incidental or consequential damages, expenses, lost profits, lost savings, or other damages arising out of the use or inability to use the product.

Some states do not allow the exclusion or limitation of incidental or consequential damages for consumer products, and some states do not allow limitations on how long an implied warranty lasts, so the above limitations or exclusions may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

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