



# ConnectCard™

i.MX28

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Hardware Reference Manual

## Revision history—90002181

Revision	Date	Description
H	November, 2013	Corrected errors in pinout table.
J	May, 2014	Updated DC power output section to clarify purpose of 3.3V line, correct pinout for i.MX287 processor, apply new style and cover page.
K	July, 2015	Edited pins 26 and 31 in standard 18-bit color pinout table.
L	June, 2017	Updated branding and added statements for RED compliance.
M	July, 2018	Add battery supply voltage note for wireless variants.

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# Chapter 1: ConnectCard for i.MX28 features and functionality

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## Introduction

The ConnectCard™ for i.MX28 is a cost-effective, small-footprint wireless embedded module solution that is designed for connected devices in healthcare and other markets.

The module is based on the NXP® i.MX28 processor family with a high-performance ARM 9 core, multimedia options, and a complete set of peripherals.

Combined with a Qualcomm-Atheros 802.11 and Bluetooth module featuring data rates up to 150 Mbps the ConnectCard for i.MX28 is capable of communicating with a vast number of peripheral devices over many different networks.

The module combines the fast integration, reliability and design flexibility of an off-the-shelf System-on Module (SOM) with complete out-of-the-box software development support for platforms such as Digi® Embedded Linux® and Timesys® LinuxLink®.

Complete and cost-efficient Digi Jump Start Kits™ enable professional embedded product development with reduced design risk and time-to-market.

## i.MX28 features and functionality

The ConnectCard for i.MX28 module is based on the i.MX28 processor series from NXP. This processor offers a high number of interfaces. Most of these interfaces are multiplexed and are not available simultaneously. Not all features are available on all variations of the module. More in-depth information can be found in the *i.MX28 Applications Processor Reference Manual* at [www.nxp.com](http://www.nxp.com). The i.MX28 processor uses an ARM 926 core with on-chip RISC (Reduced Instruction Set Computer).

The ConnectCard for i.MX28 module has the following i.MX28 features:

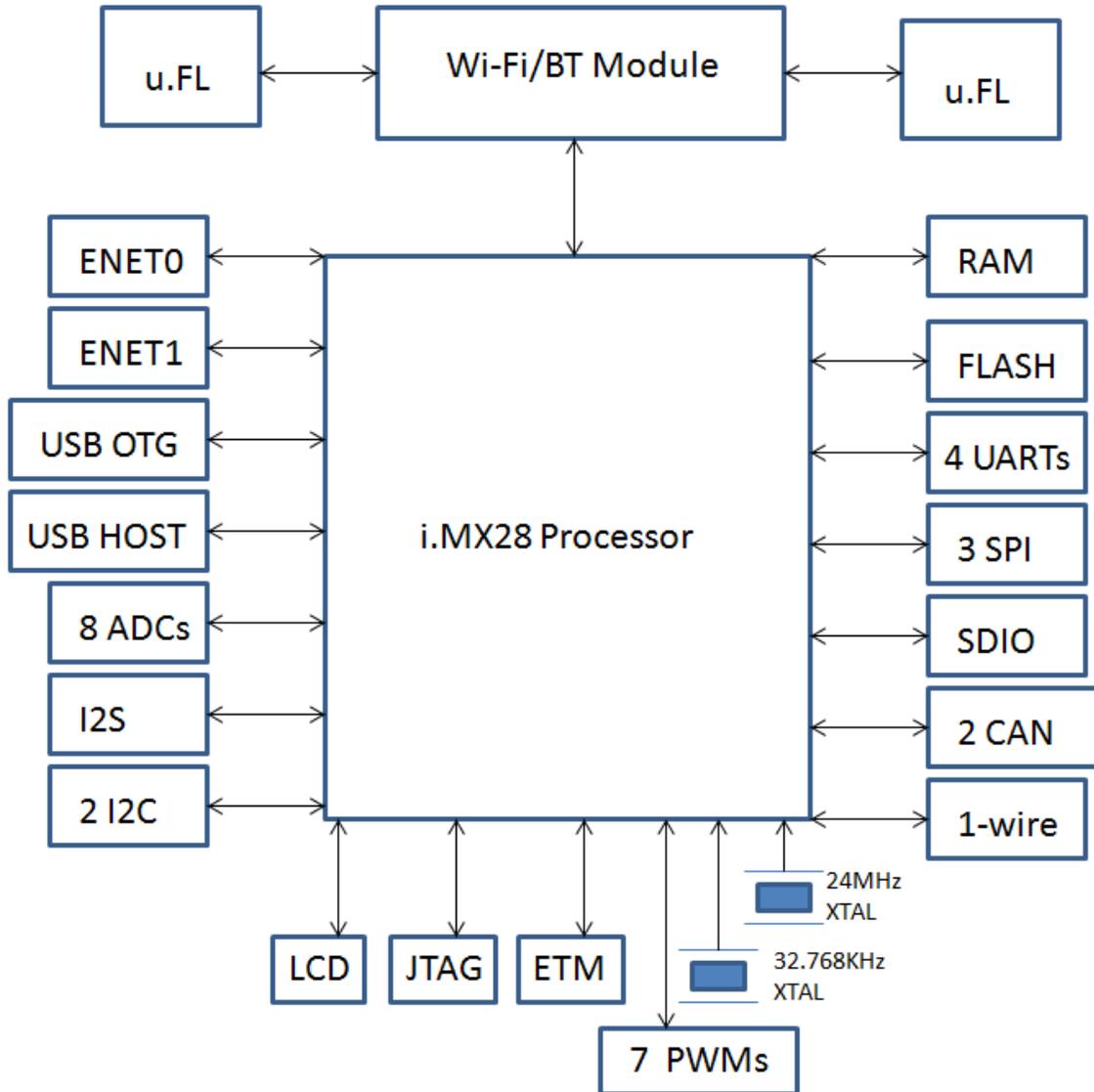
- LRADC (Low Resolution ADC)
- HSADC (High Speed ADC)
- GPIO (General Purpose Input Output)
- SD/SDIO/MMC (Secure Digital/ Secure Digital Input Output/ Multi-Media Card)
- UART (Universal Asynchronous Receiver/Transmitter)
- DUART (Debug Universal Asynchronous Receiver/Transmitter)
- SPI (Serial Peripheral Interface)
- I2C (Inter-Integrated Circuit)
- CAN (Controller Area Network)
- USB OTG (Universal Serial Bus On-the-Go)
- USB Host (Universal Serial Bus)
- ENET (Ethernet)
- SAIF (Serial Audio Interface)
- PWM (Pulse Width Modulator)
- LCD (Liquid Crystal Display)
- ETM (Embedded Trace Macrocell)
- JTAG (Joint Test Action Group)
- 802.11 abgn and Bluetooth
- Flash memory

- DDR2 memory
- One-Wire interface
- Power supply options - battery and DC

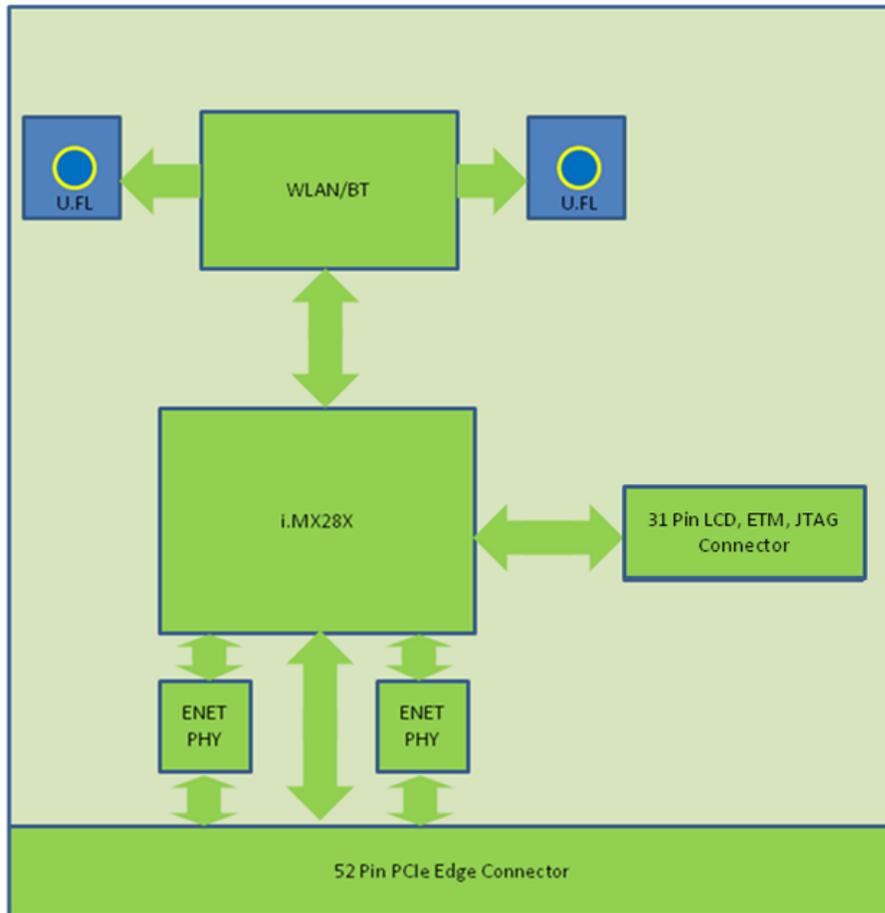
## Block diagram

The following figures show the block diagram of the NXP i.MX285 CPU and the block diagram of the ConnectCard for i.MX28 module.

### CPU - NXP i.MX28X



### ConnectCard for i.MX28

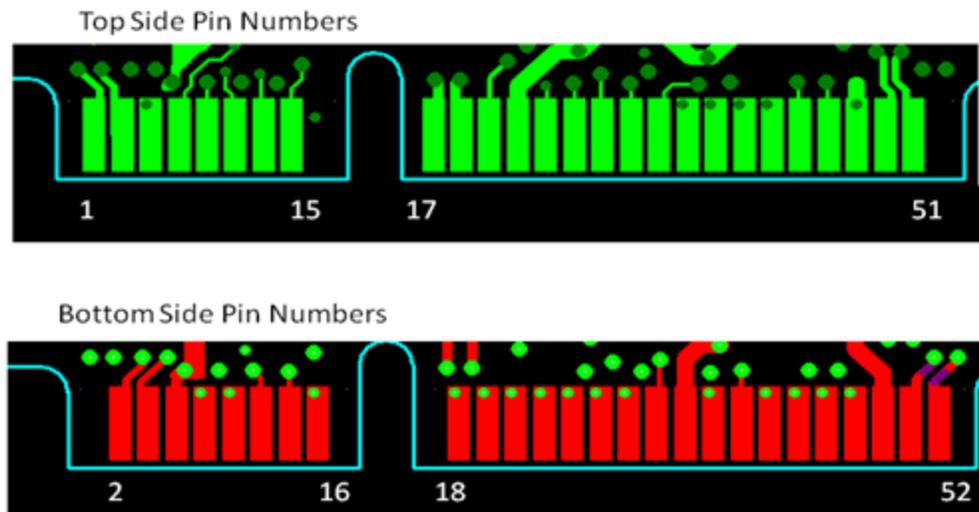


## Module pinout

The module has two connectors: The 52-pin PCIe edge connector, and the 31-pin LCD connector.

### 52-pin PCIe edge connector

The top side of the module has the shield, and the bottom side of the module has the i.MX28X. Pin numbering is shown below:



### Pinout

Pin	Pin name	Available on i.MX287	Available on i.MX280	Mux 0	Mux 1	Mux 2	Mux 3
1	ENET0_TX+	X	X				
3	ENET0_TX-	X	X				
5	GND	X	X				
7	AUART4_CTS	X	X	SAIF0_MCLK	PWM_3	AUART4_CTS	GPIO3_20
		X		SSP3_SS0	AUART4_CTS	ENET1_1588_EVENT1_IN	GPIO2_27
9	**AUART4_RTS	X	X	SAIF0_LRCLK	PWM4	AUART4_RST	GPIO3_21
		X		SSP3_CMD	AUART4_RX	ENET1_1588_EVENT0_IN	GPIO2_25

Pin	Pin name	Available on i.MX287	Available on i.MX280	Mux 0	Mux 1	Mux 2	Mux 3
11	**AUART4_RX	X	X	SAIF0_BITCLK	PWM_5	AUART4_RX	GPIO3_22
		X		SSP3_D0	AUART4_RTS	ENET1_1588_EVENT1_OUT	GPIO2_26
13	AUART4_TX	X	X	SAIF0_SDAT0	PWM_6	AUART4_TX	GPIO3_23
		X		SSP3_SCK	AUART4_TX	ENET1_1588_EVENT0_OUT	GPIO2_24
15	Pswitch	X	X				
GAP							
17	USB0_DM	X	X				
19	USB0_DP	X	X				
21	USB0_ID	X	X	PWM_2	USB0_ID	USB1_OVERCURRENT	GPIO3_18
23	Battery	X	X				
25	HSADC0	X	X	HSADC0			
27	CAN0_RX	X		GPMI_READY3	CAN0_RX	HSADC_TRIGGER	GPIO0_23
29	CAN0_TX	X		GPMI_READY2	CAN0_TX	ENET0_TX_ER	GPIO0_22
31	SSP1_SS	X		SSP1_D3	SSP2_D7	ENET0_1588_EVENT3_IN	GPIO2_15
		X	X	LRADC0			
33	SSP1_MOSI	X		SSP1_CMD	SSP2_D2	ENET0_1588_EVENT2_IN	GPIO2_13
		X	X	LRADC1			
35	SSP1_MISO	X		SSP1_D0	SSP2_D6	ENET0_1588_EVENT3_OUT	GPIO2_14
		X	X	LRADC2			
37	SSP1_SCK	X		SSP1_SCK	SSP2_D1	ENET0_1588_EVENT2_OUT	GPIO2_12
		X	X	LRADC3			

Pin	Pin name	Available on i.MX287	Available on i.MX280	Mux 0	Mux 1	Mux 2	Mux 3
39	AUART1_CTS	X		AUART1_CTS	USB0_OVERCURRENT	TIMROT_ROTARYA	GPIO3_6
		X	X	LRADC4			
41	AUART1_RTS	X		AUART1_RTS	USB0_ID	TIMROT_ROTARYB	GPIO3_7
		X	X	LRADC5			
43	AUART1_TX	X	X	AUART1_TX	SSP3_CARD_DETECT	PWM1	GPIO3_5
45	AUART1_RX	X	X	AUART1_RX	SSP2_CARD_DETECT	PWM0	GPIO3_4
47	GND	X	X				
49	ENET1_TX+	X					
51	ENET1_TX-	X					
2	ENET0_RX+	X	X				
4	ENET0_RX-	X	X				
6	VDD_5V	X	X				
8	I2C1_SCL	X	X	PWM0	I2C1_SCL	DUART_RX	GPIO3_16
10	I2C1_SDA	X	X	PWM1	I2C1_SDA	DUART_TX	GPIO3_17
12	DUART_RX	X	X	I2C0_SCL	TIMROT_ROTARYA	DUART_RX	GPIO3_24
14	DUART_TX	X	X	I2C0_SDA	TIMROT_ROTARYB	DUART_TX	GPIO3_25
16	RESET	X	X				
GAP							
18	SSP0_CMD	X	X	SSP0_CMD			GPIO2_8
20	SSP0_DATA0	X	X	SSP0_DATA0			GPIO2_0

Pin	Pin name	Available on i.MX287	Available on i.MX280	Mux 0	Mux 1	Mux 2	Mux 3
22	SSP0_DATA1	X	X	SSP0_DATA1			GPIO2_1
		X		AUART3_CTS	CAN1_TX	ENET0_1588_EVENT1_OUT	GPIO3_14
24	SSP0_DATA2	X	X	SSP0_DATA2			GPIO2_2
		X		AUART3_RTS	CAN1_RX	ENET0_1588_EVENT1_IN	GPIO3_15
26	SSP0_DATA3	X	X	SSP0_DATA3			GPIO2_3
28	SSP0_SCLK	X	X	SSP0_SCK			GPIO2_10
30	SSP0_CARD_DETECT	X	X	SSP0_CARD_DETECT			GPIO2_9
32	LRADC6 /	X	X	LRADC6			
		X		LCD_VSYNC	SAIF1_DATA0		GPIO_1_28
34	i.MX28 3.3V Output	X	X				
36	AUART2_CTS	X		AUART2_CTS	I2C1_SCL	SAIF1_BITCLK	GPIO3_10
	One-Wire	X	X				
38	AUART2_RTS	X		AUART2_RTS	I2C1_SDA	SAIF1_LRCLK	GPIO3_11
40	AUART2_RX	X		AUART2_RX	SSP3_D1	SSP3_D4	GPIO3_8
42	AUART2_TX	X		AUART2_TX	SSP3_D2	SSP3_D5	GPIO3_9
44	CAN1_RX	X		GPMI_CE3N	CAN1_RX	SAIF1_MCLK	GPIO0_19
		X		AUART3_RX	CAN0_TX	ENET0_1588_EVENT0_OUT	GPIO3_12

Pin	Pin name	Available on i.MX287	Available on i.MX280	Mux 0	Mux 1	Mux 2	Mux 3
46	CAN1_TX	X		GPMI_CE2N	CAN1_TX	ENET0_RX_ER	GPIO0_18
		X		AUART3_TX	CAN0_RX	ENET0_1588_EVENT0_IN	GPIO3_13
48	VDD_5V	X	X				
50	ENET1_RX+	X					
	USB1_DM		X	USB1_DM			
52	ENET1_RX-	X					
	USB1_DP		X	USB1_DP			

## Pinout for pins 50 and 52

	Pin name	Available on 2-ENET Variants	Available on 1-ENET Variants	Mux 0	Mux 1	Mux 2	Mux 3
50	ENET1_RX+	X					
	USB1_DM		X	USB1_DM			
52	ENET1_RX-	X					
	USB1_DP		X	USB1_DP			

### Notice:

For product applications in a harsh environments (extreme temperature cycling and/or high vibration locations), Digi strongly recommends applying a thin layer of dielectric grease (using a cotton swab or equivalent) on the top and bottom of the module edge connector and to the inside of the mating connector to prevent unexpected failures in production environments.

Digi recommends the use for Dow Corning® #4 Electrical Insulating Compound (Dielectric Grease). A local distributor can be located via the link below:

<http://www.dowcorning.com/applications/search/distributor/default.aspx>

Apply a thin layer of dielectric grease to the top and bottom of the PCIe edge connector prior to inserting the ConnectCard for i.MX28 module into the PCIe connector.

The microprocessor used on this module, like all CMOS devices, can be driven into a latch-up condition if any I/O pin is driven outside of its associated power rail. Care must be taken to:

- Never drive an I/O pin beyond its positive rail or below ground.
- Never drive an I/O pin from an external power source during the power-on or reset sequences.
- Never hot-swap the module or interrupt its ground connection to external circuitry.

Latch-up is a condition that can cause excessive current draw and result in excessive heating of the microprocessor or its power supplies. This excessive heating can permanently damage the microprocessor and/or its supporting components.

## Available features

Standard variants are available with either the i.MX280 or i.MX287. Not all features are available on all variants. For custom variants see your Digi International sales person.

### Available features for i.MX280 and i.MX287

Function	i.MX280	i.MX287
LCD Interface	-	Yes
Touch Screen	-	Yes
Ethernet	x1	x2
L2 Switch	-	Yes
CAN	-	x2
12-bit ADC	x7	x7
12-bit ADC	x7	x7
USB 2.0	OTG HS with HS PHY x1	OTG HS with HS PHY x1
	HS Host with HS PHY x1	HS Host with HS PHY x1
SDIO	x1	x1
SPI	x2	x3
Application UART	x2	x4
Debug UART	x1	x1
PWM	x8	x8
S/PDIF Tx	-	Yes
Security	Yes	Yes

### Thermal considerations

Heat dissipation of the i.MX28 processor is highly dependent on the selected clock speed and the peripherals it is supporting. NXP specifies the maximum allowed junction temperature of the processor to be limited to 105C, which translates to the following processor case temperatures:

Processor speed	Max ambient temperature without thermal pad	Max case temperature
454 MHz	59 C	84 C
360 MHz	68 C	88 C
261 MHz	69 C	88 C
64 MHz	99 C	102 C

At high clock rates, the i.MX28 pulls more current. The ConnectCard for i.MX28 has been built to function up to 65C at full clock speed without a thermal pad attached (not included in the development kit) between the processor and the development board, and has been checked up to 75C with the thermal pad attached. There is a large ground area left open on the development board under the module to accommodate the thermal pad. Bergquist makes thermal pad material in various thicknesses. The CCI.MX28 has been characterized using a combination of 2500S20 and 2000S40 pads from Bergquist. Consult the NXP data sheet for the i.MX28 for thermal requirements.

When developing designs using the ConnectCard for i.MX28, ensure that the application does not exceed the rating maximums above. Case temperature can be measured using an external probe on the center of the i.MX28 processor package, and the junction temperature can be monitored in software through an on-die temperature sensor provided in the i.MX processor.

Because of the limitation above, active and/or passive thermal management may be required (thermal pad, airflow, clocking, and so on) like the Bergquist 2500S20 and 2000S40 thermal pads.

For more information on thermal consideration with the i.MX28 processor see the NXP i.MX28 data sheet.

### **31-pin LCD, JTAG, and ETM connector**

The module uses a 31-pin ZIF connector for the LCD, JTAG and ETM connections. These pins can also be used for GPIO functions. A list of possible connectors is shown below. Note that the list is not all inclusive:

Manufacturer	Part number
FCI	SFV31R-1STE1HLF
FCI	SFV31R-1STE1LF
TYCO ELECTRONICS	3-1734839-1

The standard connection is 18-bit color, and the CC-WMX-PF58-TK-JT comes with this option.

### **Standard 18-bit color pinout**

Pin	Pin name	i.MX28	Mux 0	Mux 1	Mux 2	Mux 3
1	LCD_DOTCLK	N1	LCD_DOTCLK	SAIF1_MCLK	ETM_TCLK	GPIO1_30
2	LCD_VSYNC	M6	LCD_RESET	LCD_VSYNC	LCD_RESET / LCD_VSYNC	GPIO3_30
3	LCD_HSYNC	M1	LCD_HSYNC	SAIF1_SDATA1	EMT_TCTL	GPIO1_29
4	LCD_ENABLE	N5	LCD_ENABLE	LCD_ENABLE		GPIO1_31
5	LCD_WR_RWN / ETM_TCLK	K1	LCD_WR_RWN	LCD_HSYNC	ETM_TCLK	GPIO1_25

Pin	Pin name	i.MX28	Mux 0	Mux 1	Mux 2	Mux 3
6	LCD_D17	R3	LCD_D17		ETM_DA6	GPIO1_17
7	LCD_D16	T3	LCD_D16		ETM_DA7	GPIO1_16
8	LCD_D15 / ETM_DA15	U3	LCD_D15		ETM_DA15	GPIO1_15
9	LCD_D14 / ETM_DA14	U2	LCD_D14		ETM_DA14	GPIO1_14
10	LCD_D13 / ETM_DA13	T2	LCD_D13		ETM_DA13	GPIO1_13
11	LCD_D12 / ETM_DA12	T1	LCD_D12		ETM_DA12	GPIO1_12
12	LCD_D11 / ETM_DA11	R2	LCD_D11		ETM_DA11	GPIO1_11
13	LCD_D10 / ETM_DA10	R1	LCD_D10		ETM_DA10	GPIO1_10
14	LCD_D09 / ETM_DA9	P3	LCD_D09	ETM_DA4	ETM_DA9	GPIO1_9
15	LCD_D08 / ETM_DA8	P2	LCD_D08	ETM_DA3	ETM_DA8	GPIO1_8
16	LCD_D07 / ETM_DA7	P1	LCD_D07		ETM_DA7	GPIO1_7
17	LCD_D06 / ETM_DA6	N2	LCD_D06		ETM_DA6	GPIO1-6
18	LCD_D05 / ETM_DA5	M3	LCD_D05		ETM_DA5	GPIO1_5
19	LCD_D04 / ETM_DA4	M2	LCD_D04	ETM_DA9	ETM_DA4	GPIO1_4
20	LCD_D03 / ETM_DA3	L3	LCD_D03	ETM_DA8	ETM_DA3	GPIO1_3
21	LCD_D02 / ETM_DA2	L2	LCD_D02		ETM_DA2	GPIO1_2
22	LCD_D01 / ETM_DA1	K3	LCD_D01		ETM_DA1	GPIO1_1
23	LCD_D00 / ETM_DA0	K2	LCD_D00		ETM_DA0	GPIO1_0

Pin	Pin name	i.MX28	Mux 0	Mux 1	Mux 2	Mux 3
24	ETM_TCTL	P4	LCD_RD_E	LCD_VSYNC	ETM_TCTL	GPIO1_24
25	LCD_CS / Touch_Interrupt	P5	LCD_CS			GPIO1_27
26	JTAG_TRST#	D14				
27	JTAG_TMS	D12				
28	JTAG_TDO	E13				
29	JTAG_TDI	E12				
30	JTAG_TCK	E11				
31	JTAG-RTCK	E14	JTAG_RTCK			GP104_20 (default)

Provisions have been made on the module for 24-bit color without the JTAG connections.

### **24-bit color pinout (without JTAG)**

Pin	Pin name	i.MX28 pin	Mux 0	Mux 1	Mux 2
1	LCD_DOTCLK	N1	LCD_DOTCLK	SAIF1_MCLK	ETM_TCLK
2	LCD_VSYNC	M6	LCD_RESET	LCD_VSYNC	
3	LCD_HSYNC	M1	LCD_HSYNC	SAIF1_SDATA1	ETM_TCTL
4	LCD_ENABLE	N5	LCD_ENABLE		
5	LCD_WR_RWN / ETM_TCLK	K1	LCD_WR_RWN	LCD_HSYNC	ETM_TCLK
6	LCD_D17	R3	LCD_D17		ETM_DA6
7	LCD_D16	T3	LCD_D16		ETM_DA7
8	LCD_D15 / ETM_DA15	U3	LCD_D15		ETM_DA15
9	LCD_D14 / ETM_DA14	U2	LCD_D14		ETM_DA14
10	LCD_D13 / ETM_DA13	T2	LCD_D13		ETM_DA13

Pin	Pin name	i.MX28 pin	Mux 0	Mux 1	Mux 2
11	LCD_D12 / ETM_DA12	T1	LCD_D12		ETM_DA12
12	LCD_D11 / ETM_DA11	R2	LCD_D11		ETM_DA11
13	LCD_D10 / ETM_DA10	R1	LCD_D10		ETM_DA10
14	LCD_D09 / ETM_DA9	P3	LCD_D09	ETM_DA4	ETM_DA9
15	LCD_D08 / ETM_DA8	P2	LCD_D08	ETM_DA3	ETM_DA8
16	LCD_D07 / ETM_DA7	P1	LCD_D07		ETM_DA7
17	LCD_D06 / ETM_DA6	N2	LCD_D06		ETM_DA6
18	LCD_D05 / ETM_DA5	M3	LCD_D05		ETM_DA5
19	LCD_D04 / ETM_DA4	M2	LCD_D04	ETM_DA9	ETM_DA4
20	LCD_D03 / ETM_DA3	L3	LCD_D03	ETM_DA8	ETM_DA3
21	LCD_D02 / ETM_DA2	L2	LCD_D02		ETM_DA2
22	LCD_D01 / ETM_DA1	K3	LCD_D01		ETM_DA1
23	LCD_D00 / ETM_DA0	K2	LCD_D00		ETM_DA0
24	ETM_TCTL	P4	LCD_RD_E	LCD_VSYNC	ETM_TCTL
25	LCD_CS / touch_interrupt	P5	LCD_CS	LCD_ENABLE	
26	LCD_D18	U4	LCD_D18		ETM_DA18
27	LCD_D19	T4	LCD_D19		ETM_DA19
28	LCD_D20	R4	LCD_D20	ENET1_1588_EVENT2_OUT	ETM_DA3
29	LCD_D21	U5	LCD_D21	ENET1_1588_EVENT2_IN	ETM_DA2
30	LCD_D22	T5	LCD_D22	ENET1_1588_EVENT3_OUT	ETM_DA1
31	LCD_D23	R5	LCD_D23	ENET1_1588_EVENT3_IN	ETM_DA0

### Module operation

Not all functions are available at the same time or on all module variants. The configuration of the resources depends on the system requirements, and some planning may be required to set up the available interfaces in a particular application.

## **DC power**

The ConnectCard for i.MX28 has 5V and battery inputs:

The 5V supply has a maximum of 5.25V and a minimum operating voltage of 4.75V. This supply is assumed to come from a regulated supply with about 1A of current capability. The development board supply can generate up to 1.5A.

The battery voltage must be between 3.4 and 4.242V. If both 5V and battery supplies are connected, the module will automatically use the 5V supply.

In addition, there is a +3.3V line coming out of the module that goes high when the processor starts up. This signal is intended for applications that need to sync with the processor start.

## **System boot**

The ConnectCard for i.MX28 boot process begins at Power On Reset when the hardware reset logic forces the ARM core to begin execution starting from the on-chip boot ROM. Boot ROM code uses the state of the internal register `BOOT_MODE[1:0]` as well as the state of various eFUSES and/or GPIO settings to determine the boot flow behavior of the module.

The following boot modes are supported:

- Boot from FLASH
- Boot from SD Card
- Boot from USB
- Boot from JTAG

Each mode is selected by applying the proper bit pattern to `LCD_D00`, `LCD_D01`, `LCD_D02`, `LCD_D03`, and `LCD_D04`. The default boot mode is FLASH. No internal eFUSES have been set. For more information on boot modes, please refer to the NXP documentation.

## **Audio System**

The audio system is using an SAIF interface configured as I2S.

## **LCD System**

The LCD is available through a 31-pin ZIF connector on the top side of the module (see variants for availability). The development kit uses a cable from NICOMATIC (part number 050P331K0076-406406). The default LCD setting is for 18-bit color, and the development board is set up for this setting as well. A special 24-bit color option is available (not supported in current variant list) but will disconnect the JTAG functionality. Touch screen functionality is supported by connecting LRADC2-5. There are multiple SPI ports available to communicate with an SPI touch screen controller (the development board uses SSP1). PWM0,1,3,4,5 and 6 are available to use for backlight control (the development board uses PWM0).

## **GPIO**

Any of the module's digital pins can be set as a GPIO. There are three available states for any GPIO—low, high, and high-impedance. Each of the GPIO pins is capable of functioning either at 1.8 or 3.3V or an interrupt/trigger pin. Each individual GPIO can be dynamically programmed at any time as low, high, or high-impedance (for input, three-state, or open-drain applications). They can also be controlled by one of the three selectable i.MX28 peripheral module interfaces. The state of any GPIO pin can be read at any time regardless of its configuration. Analog pins may not be set as GPIO. The following functions cannot be used for GPIO functions:

- Ethernet
- USB
- LRADC (although muxed functions can be used)
- HSADC
- 1-wire (technically it could be by controlling the I2C line)
- JTAG
- PSWITCH
- RESET
- DC connections (5V, battery, and GND)

## Interfaces

### 1-wire

The ConnectCard for i.MX28 provides a 1-wire interface to communicate with 1-wire devices such as EEPROMs, secure memory and sensors. The required protocol for accessing the generic 1-wire device is defined by Maxim. The Maxim DS2482-100 interface is used for 1-wire communication. The 1-wire interface uses a strong 3.3V pull-up.

### ADCs and Touch Screen

The ConnectCard for i.MX28 provides both Low-Resolution ADC's (LRADC) and a High-Speed ADC (HSADC). In either case, the ADC's have 12 bit resolution and an absolute accuracy of 1.3%.

LRADC's can operate with up to 3.3V inputs, with an absolute accuracy of 1.3%. In addition to ADC functions, LRADC 2-6 can also be used for touch screen control (2-5 are used on the development board for touch screen control). There are 16 ADC channels available, the channel assignments are shown in the table below:

ADC channel number	Assignment
0-6	LRADC0-6 measures the voltage on the seven application-dependent LRADC pins. LRADC2-6 can be used for 4/5-wire touch screen control. LRADC6 can be used for a wiper of 5-wire touch screen controller and external temperature sensing, but they cannot be enabled at the same time in hardware configuration.
7	Dedicated to measuring the battery voltage.
8, 9	Dedicated to measuring the internal die temperature.
10	Dedicated to measuring the internal 3.3V rail, and for calibrating the voltage levels measured on the auxiliary channels.
11	Reserved input for analog testing.
12	Dedicated to measuring the internal 1.8V rail.
13	Dedicated to measuring the internal 1.5V rail.

ADC channel number	Assignment
14	Dedicated to measuring the band gap reference voltage and can be used to calibrate out a portion of the LRADC measurement error. In most cases the band gap reference error dominates the total LRADC error, and this calibration is not helpful.
15	Dedicated to measuring the 5V supply to detect possible issues with the 5V rail dropping.

**Note** Back-driving the LRADC signals can lead to processor malfunctions and excess current draw. This leakage current may impact the lifespan of the RTC battery if not properly isolated.

The HSADC is capable of measuring up to 2Msps, and can be used in conjunction with the PWM's to generate signals for external devices like a linear image scanner sensor. The HSADC can be triggered to start the conversion of an analog source in three modes:

- Trigger by software
- Trigger signal generated by the PWM block
- Trigger by an input pin from an external source

## CAN

The ConnectCard for i.MX28 includes two FlexCAN2 controllers which are compatible with the CAN 2.0B protocol specification. The CAN Protocol Interface (CPI) manages the serial communication on the CAN bus, requesting RAM access for receiving and transmitting message frames, validating received messages and performing error handling. The Message Buffer Management (MBM) handles Message Buffer selection for reception and transmission, taking care of arbitration and ID matching algorithms. The CAN bus can operate up to 1Mbps.

The FlexCAN2 controllers require additional hardware. An example of this circuitry can be found on the development board.

## Ethernet (ENET1)

The ConnectCard for i.MX28 provides up to two 10/100 Mbps Ethernet connections (see variants table for number of Ethernet connections). The MAC and PHY are on the module, and the Magnetics and Jack need to be provided external to the module. The connections from the module are differential pairs for the TX and RX ports. Variants with one Ethernet include two USB ports.

## USB

The ConnectCard for i.MX28 includes up to two high-speed Universal Serial Bus (USB) version 2.0 controllers and integrated USB Transceiver Macrocell Interface (UTMI) PHYs. The i.MX28 device interface can be attached to USB 2.0 hosts and hubs running in the USB 2.0 high-speed mode at 480 Mbps. It can be attached to USB 2.0 full-speed interfaces at 12 Mbps. Note that a dual-device configuration is not supported. The USB controllers and integrated PHYs support high-speed host modes for peer-to-peer file interchange. The USB controller can also be configured as a high-speed host.

Each USB is a dynamically configured port that can support up to seven RX and seven TX endpoints besides EP0, each of which may be configured for bulk, interrupt, or isochronous transfers.

USB0 is a high speed, OTG-capable universal serial bus. The ConnectCard for i.MX28 can operate as a host controller that can support eight endpoints: one control, one bulk-out, one bulk-in, and five

flexible endpoints. Further, it can negotiate with another OTG system to be either the host or the device in a peer connection.

Note that USB1 is a host-only USB port.

Variants with two USB ports have only one Ethernet port, as noted in the Ethernet section above.

## **I<sup>2</sup>C**

The ConnectCard for i.MX28 contains two 2-wire SMB/I<sup>2</sup>C bus interfaces. Each interface can act as a slave or a master on the SMB. The I<sup>2</sup>C interfaces are multiplexed with the DUART, and I<sup>2</sup>C0 is used for the DUART on the development board, and no termination resistors are on the module for this interface. I<sup>2</sup>C1 is used to run the 1-wire interface, and 2.2K ohm termination resistors are located on the module. The supply voltage of these resistors is 3.3V.

The I<sup>2</sup>C bus is a standard 2-wire serial interface for connecting the ConnectCard for i.MX28 to peripheral devices or host controllers. The I<sup>2</sup>C bus operates at a standard speed of up to 100Kbps and a fast speed of up to 400Kbps. The ConnectCard for i.MX28 can act as either master or slave on the I<sup>2</sup>C bus. This module is also capable of supporting multi-master configurations. The device address of the 1-wire bridge is 00, and cannot be used by other I<sup>2</sup>C devices connected to the I<sup>2</sup>C1 bus.

## **SAIF (Audio)**

The ConnectCard for i.MX28 includes a serial audio interface (SAIF) configured as an I2S interface. It is capable of transmitting and receiving in 16 or 24-bit audio, by connecting to an audio codec. A possible example circuit is shown in the development board schematics.

## **AUARTs and DUART**

Up to four application UARTs (AUART), and one debug (console) DUART are available on the ConnectCard for i.MX28 module. The AUARTs are capable of running up to 3.25 Mbps, while the DUART is capable of speeds up to 115Kbps. Variants using the i.MX287 include flow control on all application UARTs.

Through the DUART the CPU reads and writes data and control/status information through the APBX interface. The DUART does the serial to parallel conversions on data received from a peripheral device and the parallel to serial conversion on data transmitted to the peripheral device. The buffer size for the DUART is 32 bytes. Flow control is not included for the debug UART.

## **Pulse Width Modulator (PWM)**

The ConnectCard for i.MX28 module provides access to PWM0 through PWM6. The PWMs can be used in place of GPIO pins to control such things as LED brightness, HSADC, and LCD backlight control. Independent output control of each phase allows 0, 1, or high-impedance to be independently selected for the active and inactive phases. Individual outputs can be run in lock step with guaranteed non-overlapping portions for differential drive applications.

## **Synchronous Serial Ports (SPI, and SD)**

The three available Synchronous Serial Ports on the ConnectCard for i.MX28 module can support SPI master and slave modes with up to 52MHz speeds. In addition SSP0 is capable of SD card functions including booting.

## **Real Time Clock (RTC)**

The real-time clock (RTC) and alarm share a one-second pulse time domain. The watchdog reset and millisecond counter run on a one-millisecond time domain. The RTC, alarm, and persistent bits use persistent storage and reside in a special power domain (crystal domain) that remains powered up even when the rest of the chip is in its powered-down state.

The ConnectCard for i.MX28 development board does not include a backup battery, so the RTC will not be maintained through power cycles.

### Liquid Crystal Display (LCD)

Some versions of the ConnectCard for i.MX28 includes an LCD connector that is separate from the edge connector. Smart LCDs are available in a range of sizes and capabilities, from simple text-only displays to WVGA, 16/18/24 bpp color TFT panels. This device supports displays that support moving pictures and require the RGB interface mode (called DOTCLK interface in this document).

### Wi-Fi and Bluetooth

The ConnectCard for i.MX28 is available with an Qualcomm-Atheros 802.11 a b g n and BT4.0 interfaces. Wi-Fi data rates up to 150 Mbps (5 GHz n-mode) are possible. For variants without BT a diversity antenna (using the 2 u.FL ports) is utilized for the 2.4 GHz band. For variants with BT a single u.FL antenna connection for both bands is used.

The module is built with coexistence in mind and handles the BT coexistence internally. Cellular coexistence filtering is onboard to aid in designing systems susceptible to cellular interference and so on.

A mini access point mode is available in the Wi-Fi with up to 5 clients. This mode is limited to non DFS channels. The channels available are shown below:

- US and Canada - 2.4 GHz band, 5.8, 5.15-5.25 GHz only
- EU - 2.4 GHz band only
- Japan - 2.4 GHz band only

### Embedded Trace Macrocell

The ConnectCard for i.MX28 includes a stand-alone ARM CoreSight Embedded Trace Macrocell, ETM9CSSingle, which provides an instruction trace and a data trace for the ARM9 microprocessor. This function is available on the same connector as the LCD, and many of the pins are shared with the LCD controller. This feature is disabled by default. To enable Embedded Trace Macrocell, you need to use external hardware to set LCD\_D05 to high during reset (refer to the i.MX28 boot mode configuration).

### Reset

The reset pin on the module is low asserted. A low pulse will reset the module. There is an internal pull up resistor to 3.3V, so no external pull up resistor is needed.

### Recovery and Power

Use the power pin to turn the ConnectCard for i.MX28 module on when only the battery supply is connected. To do so, connect about 1V to the pin for 100ms.

The power pin can also be used to place the module in recovery mode. To do so, place the 3.3V on the pin for more than 5 seconds. You can then use the sb\_loader to boot the part through the USB OTG (USB0) interface.

### NAND FLASH

The ConnectCard for i.MX28 module includes either 128MB or 256MB of NAND FLASH from the Micron Technologies MT29F series. These chips operate from 1.8V.

### DDR2 RAM

The DDR2 RAM on the ConnectCard for i.MX28 module is either 128MB or 256MB from the Micron Technologies MT47 series.

## Chapter 2: About the development board

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## Introduction

The development board for the ConnectCard for i.MX28 is set up to allow testing of the interfaces on the module. These various interfaces are selected by switches, and not all interfaces are available at the same time.

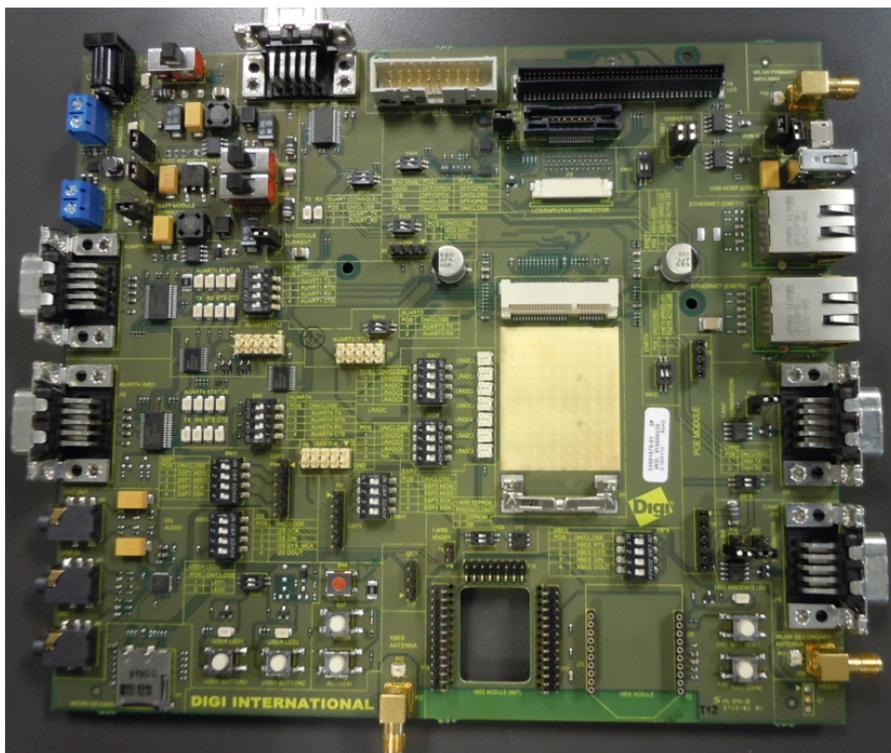
In addition to the switches there are jumpers, pushbutton switches, potentiometers, header connectors, and various connectors to handle the interfaces. All the required circuitry for the interfaces is included on the development board.

## What's on the development board?

- Locking barrel power supply port for 12V wall adapter
- Power switch
- Connectors for Digi 802.3af Power Over Ethernet module (sold separately)
- 5V regulated power supply
- 4.2V regulated power supply (battery simulator)
- 3.3V regulated power supply to run the dev board and XBee modules
- Screw terminal blocks for 5V, 4.2V external supplies
- 2 X Ethernet connections
- 2 X UART 232 SUB-D 9-pin connectors
- 1 X DUART 232 SUB-D 9-pin connector
- 2 X UART with TTL levels
- 2 X CAN bus with termination resistors selection and SUB-D 9-pin connections
- 1 X USB OTG connector
- 1 X USB host connector
- 1 X micro SD card holder
- HSADC header
- LRADC header and potentiometers
- SPI and I2C headers
- One Wire header and EEPROM
- Audio interface
- 18-bit color LCD interface
- Boot mode selection jumpers
- ETM header
- JTAG header
- XBee through-hole and SMT sockets
- User buttons and LEDs
- Power and reset buttons

- GPIO header
- 3 X u.FL to RPSMA connectors (2 for the CCI.MX28 module and 1 for XBee antennas)

## The development board



Since some interfaces share a common pin on the ConnectCard for i.MX28 module, and may be used for multiple interfaces on the development board, conflicts between interfaces are possible. Tables are included to show which interfaces share resources. Tables in this section show the position of switches and jumpers. For switches ON/CLOSE indicates the switch is set to the on position connecting the two sides of the switch, conversely OFF/OPEN indicates the switch is in the off position disconnecting the two sides of the switch. For Jumpers SHORT indicates the jumper is installed across the two posts, and OPEN indicates the jumper is not installed. The functions are shown in rows. To set up a function follow the instructions on the row for that function. If the table has nothing in the box, there is no conflict with that switch or jumper.

### Header pinouts

The pinout for the interface headers are shown below.

SSP1 (P85) & SSP3 (P87)	
PIN	FUNCTION
1	VCC_3V3
2	MOSI
3	MISO

SSP1 (P85) & SSP3 (P87)	
4	SCK
5	SSN
6	GND

LRADC (0-6) (P8)		AUART2 (P2)		AUART3 (P3)	
PIN	FUNCTION	PIN	FUNCTION	PIN	FUNCTION
1	LRADC0	1	NC	1	NC
2	LRADC1	2	NC	2	NC
3	LRADC2	3	RX	3	RX
4	LRADC3	4	NC	4	NC
5	LRADC4	5	TX	5	TX
6	LRADC5	6	NC	6	NC
7	LRADC6	7	NC	7	NC
8	NC	8	NC	8	NC
9	GND	9	GND	9	GND
10	3.3VDC	10	3.3VDC	10	3.3VDC

LRADC (0-6) (P8)		AUART2 (P2)		AUART3 (P3)	
PIN	FUNCTION	PIN	FUNCTION	PIN	FUNCTION
1	LRADC0	1	NC	1	NC
2	LRADC1	2	NC	2	NC
3	LRADC2	3	RX	3	RX
4	LRADC3	4	NC	4	NC
5	LRADC4	5	TX	5	TX
6	LRADC5	6	NC	6	NC
7	LRADC6	7	NC	7	NC
8	NC	8	NC	8	NC
9	GND	9	GND	9	GND
10	3.3VDC	10	3.3VDC	10	3.3VDC

JTAG (P34)		ETM (J4)			
PIN	FUNCTION	PIN	FUNCTION	PIN	FUNCTION
1	3.3VDC	1	NC	2	NC
2	3.3VDC	3	NC	4	NC
3	TRST	5	GND	6	TCLK
4	GND	7	DBGREQ	8	DBGACK
5	TDI	9	NC	10	EXTTRIG
6	GND	11	NC	12	VTREF
7	TMS	13	NC	14	VSUPPLY
8	GND	15	NC	16	DA7
9	TCK	17	NC	18	DA6
10	GND	19	NC	20	DA5
11	RTCK	21	NC	22	DA4
12	GND	23	DA15	24	DA3
13	TD0	25	DA14	26	DA2
14	GND	27	DA13	28	DA1
15	RESET	29	DA12	30	GND
16	GND	31	DA11	32	GND
17	NC	33	DA10	34	VTREF
18	GND	35	DA9	36	TCTL
19	Pull Down	37	DA8	38	DA0
20	GND	39	GND	40	GND
		41	GND	42	GND
		43	GND		

LCD (P4)			
PIN	FUNCTION	PIN	FUNCTION
1	D16	2	D17
3	D12	4	D13
5	D14	6	D15
7	D16	8	D17
9	NC	10	NC

LCD (P4)			
11	NC	12	NC
13	GND	14	GND
15	D10	16	D11
17	D06	18	D07
19	D08	20	D09
21	D10	22	D11
23	NC	24	NC
25	NC	26	NC
27	GND	28	GND
29	D04	30	D05
31	D00	32	D01
33	D02	34	D03
35	D04	36	D05
37	NC	38	NC
39	NC	40	NC
41	GND	42	GND
43	ENABLE	44	DOTCLK
45	PWM0	46	GND
47	VSYNC	48	HSYNC
49	NC	50	NC
51	NC	52	NC
53	NC	54	NC
55	GND	56	GND
57	SSP1_MOSI	58	SSP1_SCK
59	AUART1_CTS	60	AUART1_RTS
61	I2C1_SDA	62	I2C1_SCL
63	SSP1_SSN	64	SSP1_SCK
65	SSP1_MOSI	66	SSP1_MISO
67	NC	68	Touch jumper
69	NC	70	NC

LCD (P4)			
71	TOUCH_INTERRUPT	72	GND
73	3.3VDC	74	3.3VDC
75	WALL_12V	76	WALL_12V
77	WALL_12V	78	WALL_12V
79	NC	80	NC

## Development board setup

### Power supplies

The development board includes two 5V, one 4.2V, and one 3.3V regulators. One 5V regulator is set up to power the module from the 9VDC to 30VDC wall adaptor, the other 5V regulator is a buck boost regulator to power the USBs. The 4.2V regulator is set up to power the module through the BATT port. The 3.3V regulator powers both the development board and the XBee if so equipped. The development board has an ON/OFF switch, SW1. The power switch SW1 can switch both 9V-30VDC input power supply and 12VDC coming out of the optional PoE module (Digi P/N DG-ACC-POE). However, if a power plug is present on the DC power jack, PoE is disabled.

The 5V and BATT module supplies can also come from an external jack. For the 5V external jack the voltage range is 4.75VDC to 5.25VDC. For the external BATT supply the allowable range is 3.4VDC to 4.2VDC. The module will not auto boot from the BATT supply, but will from the 5V supply. If operating from only the BATT supply the POWER BUTTON will need to be pressed to turn the module on.

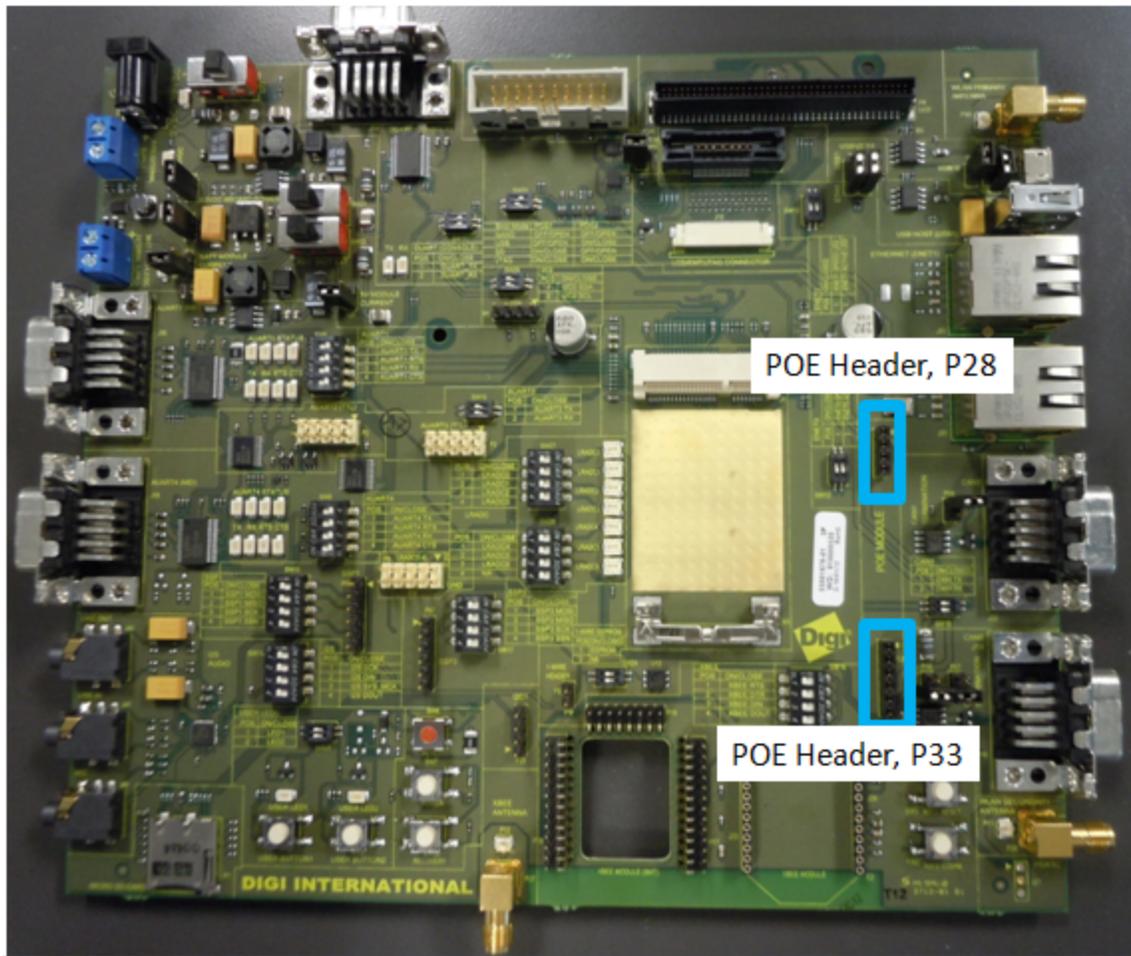
The 3.3V board supply and XBee supply along with the 5V USB supply are powered from either the 5V or BATT module supplies, with the 5V supply being the primary and the BATT supply being the secondary supply.

The module can be connected to both the 5V and BATT supply at the same time. When connected to both supplies the module will draw its power from the 5V supply, as will the board, USB, and XBee.

### Power over Ethernet (PoE) - IEEE802.3af

PoE is only available through ENET0 on the development board.

If the wall plug is connected PoE is disabled.



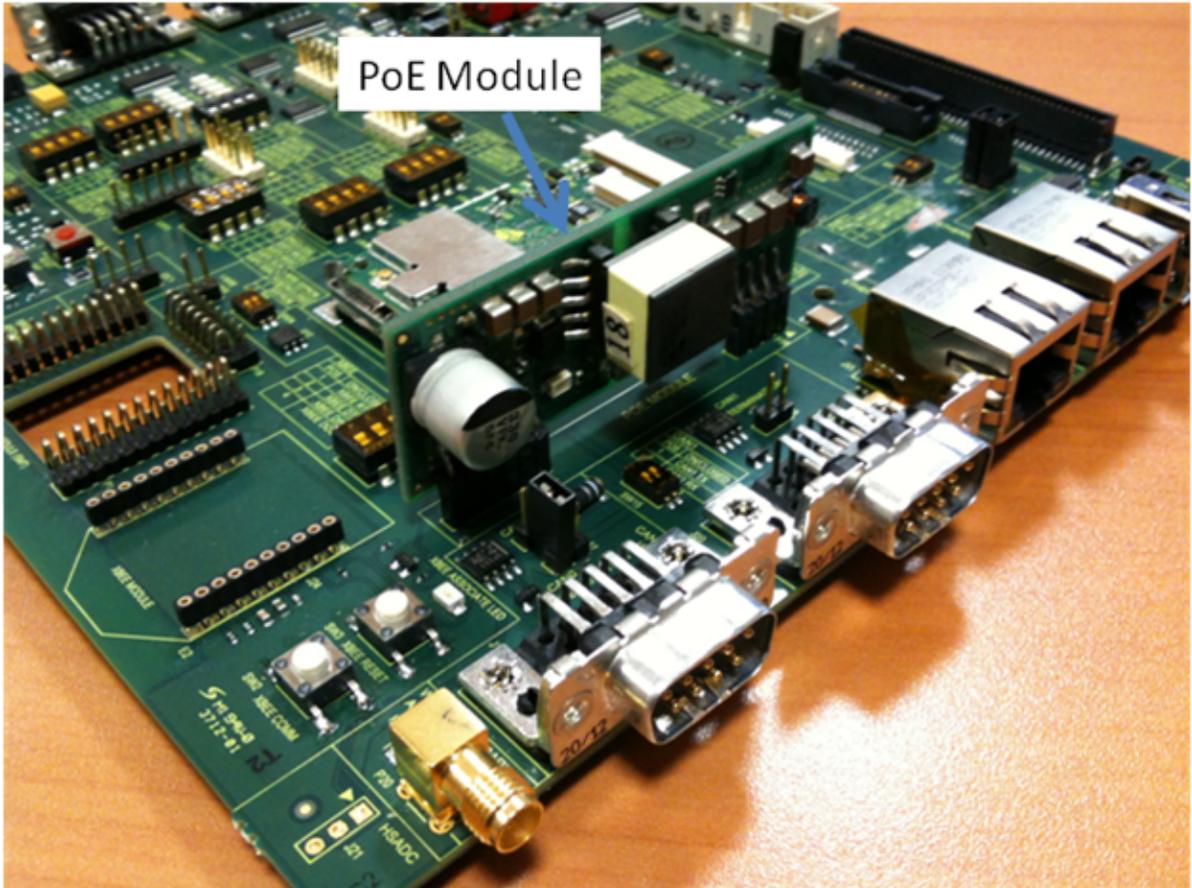
The development board provides two PoE module connectors, P28 and P33, to plug a Digi PoE module (DG-ACC-POE). The PoE module is an optional accessory item that can be plugged on the development board through the two connectors.

- P28, input connector: provides access to the PoE signals from the Ethernet connector
- P33, output connector: provides the output power supply from the PoE module

### The PoE module

Plug in the PoE module at a right angle to the development board, as shown in the picture below.

**Note** The PoE module is part of the optional Digi 802.3af application kit (sold separately, Digi P/N DG-ACC-POE).



### PoE connector (power in), P28

The table below provides the pinout of the PoE input connector:

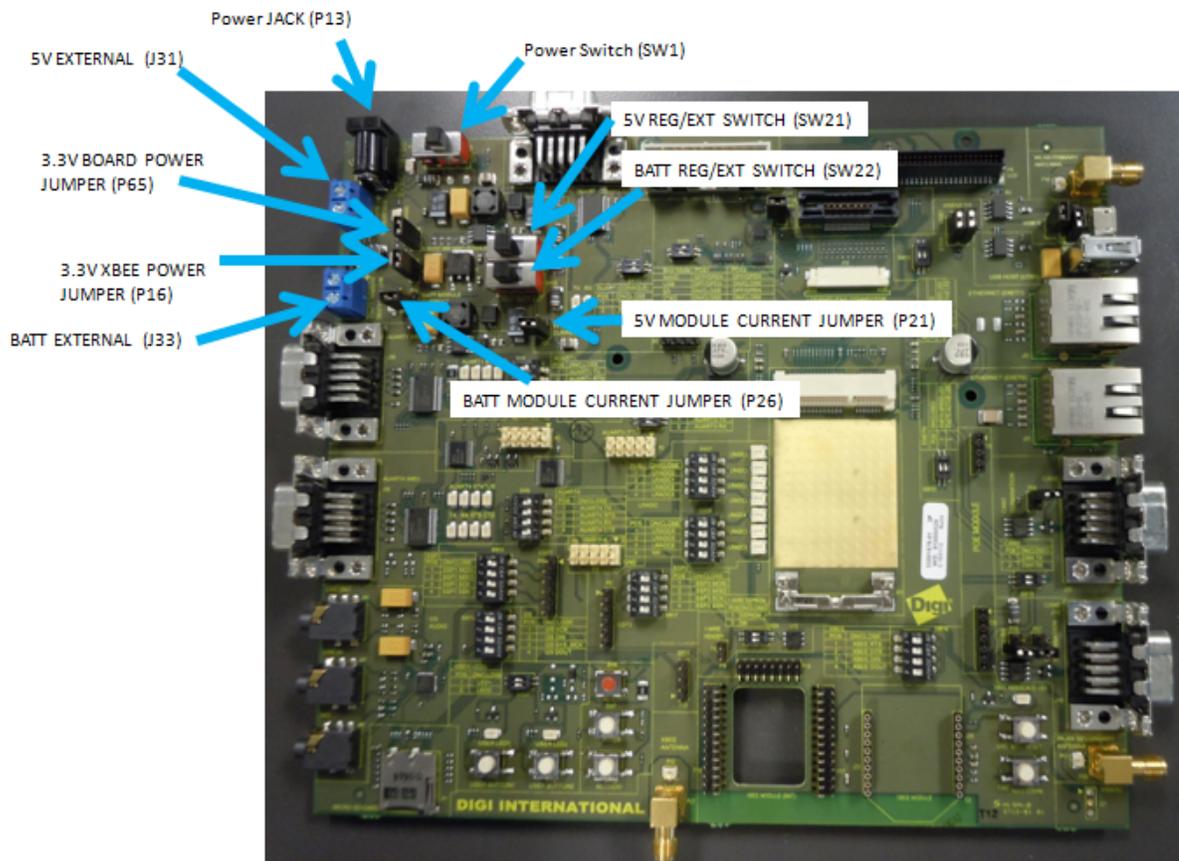
Pin	Signal
1	Poe_TX_CT
2	Poe_RX_CT
3	Poe_RJ45_4/5
4	Poe_RJ45_7/8

**PoE connector (power out), P33**

The table below provides the pinout of the PoE output connector:

Pin	Signal
1	+12V_PoE
2	+12V_PoE
3	GND
4	GND
5	Poe_GND
6	Poe_GND

## Connector, switch, and jumper locations



### Power functions and settings

#### 9-30VDHC, P13 set

Function	J31	J33	SW1	SW21	SW22	P65	P16	P26	P21
5V regulator, no XBee	NC	NC	ON	REG	EXT	SHORT	OPEN	OPEN	SHORT
5V regulator, with XBee	NC	NC	ON	REG	EXT	SHORT	SHORT	OPEN	SHORT
Battery regulator, no XBee	NC	NC	ON	EXT	REG	SHORT	OPEN	SHORT	OPEN
Battery regulator, with XBee	NC	NC	ON	EXT	REG	SHORT	SHORT	SHORT	OPEN

**4.2V and 5V external terminal blocks, P13 open**

Function	J31	J33	SW1	SW21	SW22	P65	P16	P26	P21
External 5 V, no XBee	4.75- 5.25 VDC	NC	OFF	EXT	EXT	SHORT	OPEN	OPEN	SHORT
External 5 V, with XBee	4.75- 5.25 VDC	NC	OFF	EXT	EXT	SHORT	SHORT	OPEN	SHORT
External battery no XBee	NC	3.4- 4.2 VDC	ON	EXT	EXT	SHORT	OPEN	SHORT	OPEN
External battery with XBee	NC	3.4- 4.2 VDC	ON	EXT	EXT	SHORT	SHORT	SHORT	OPEN

5V and BATT supplies can be connected at the same time, however 5V will be selected by the CCI.MX28 in this case.

The term REG refers to connection to the onboard regulator, and the term EXT refers to connection to an external supply using the screw terminals. To use the internal regulator function move the switch (SW21 or SW22) to the REG setting, and the opposite setting (EXT) to connect the module to an external supply.

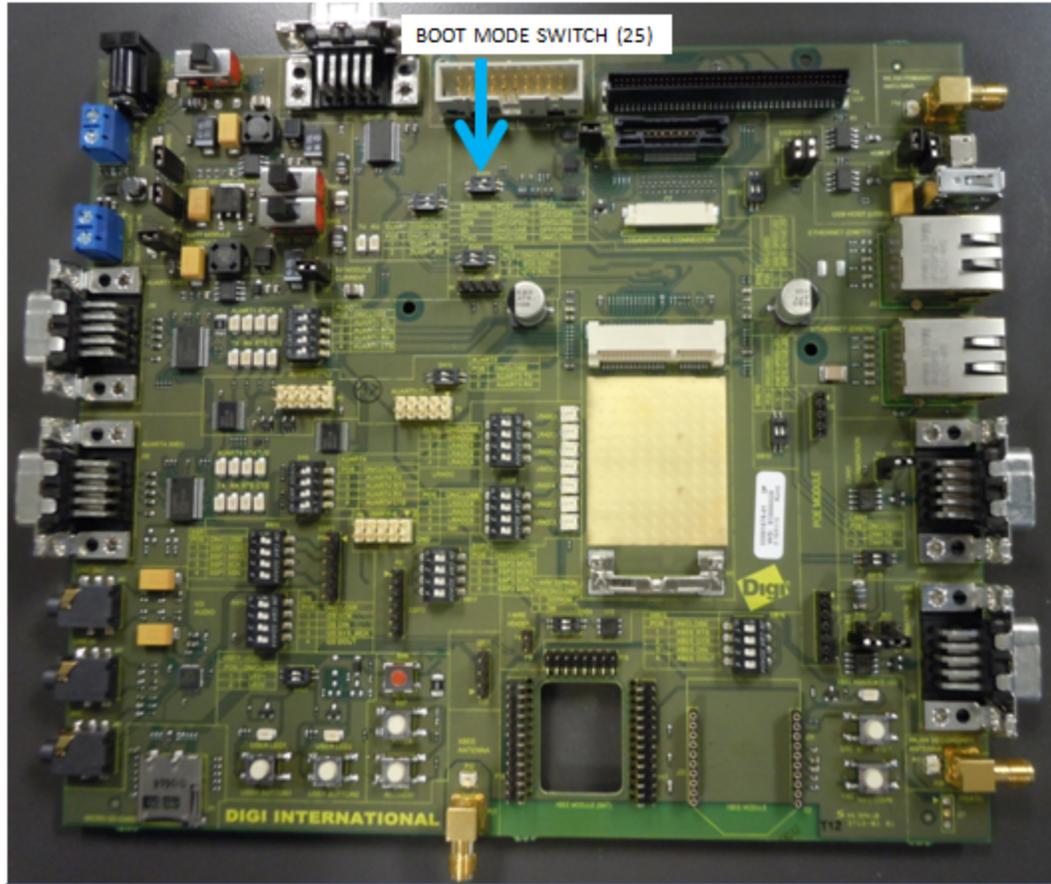
**Boot mode**

The Boot mode of the ConnectCard for i.MX28 is set using SW25. Setting the boot mode requires the 31 connector FFC cable, as five of the LCD lines are used to set the boot mode. On board logic sets up the boot mode in accordance with the NXP requirements.

Some LCDs can drive these lines to undesired states. The development board includes circuitry to prevent the LCD from corrupting the boot mode.

If your final design does not include the video cable, you may still boot from USB using the recovery button. This is explained in Chapter 3.

## Switch location



### Function and settings

Boot Mode	SW25 P1	SW25 P2
NAND FLASH	OFF/OPEN	OFF/OPEN
USB	OFF/OPEN	ON/CLOSE
SD	ON/CLOSE	OFF/OPEN
JTAG	ON/CLOSE	ON/CLOSE

### Development board button functions

The development board has seven buttons with different functions.

#### ***XBEE Reset button and XBEE Comm button***

These two buttons are for an XBee module. For the XBee button function, consult the documentation for your XBee module.

**User Button1 and User Button2**

The two user buttons are connected to the ConnectCard for i.MX28 modules as GPIOs to UART2\_RTS (module pin 38) and SD\_CARDDETECT (module pin 30). User buttons provide a high (3.3V) level until pressed, then a low (GND) level is sent.

**CCi.MX28 Reset button**

This button resets the module and is red in color. Pressing this button will cause the module to reboot.

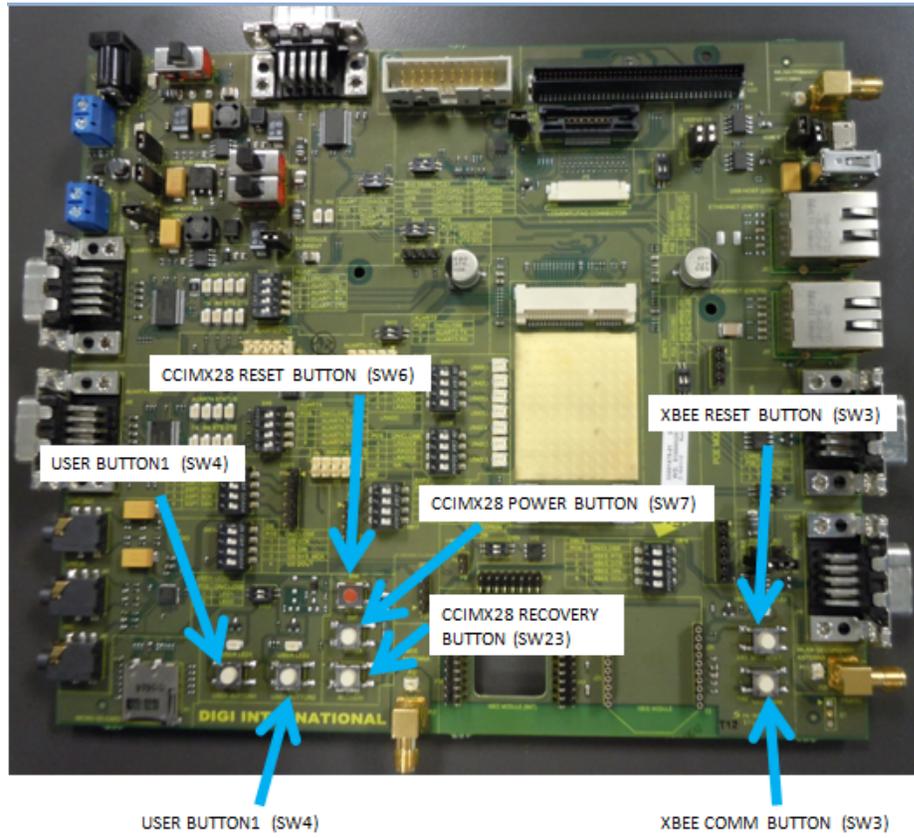
**CCi.MX28 Power button**

This button is used to turn the module on when it is operating from the BATT power supply. The module will not auto-boot from the battery supply, but will from the 5V supply.

**CCi.MX28 Recovery button**

This button is used to put the module in recovery mode. In this mode, the SB\_LOADER program can be used to boot the module through the USB OTG (USB0) port.

## Button locations

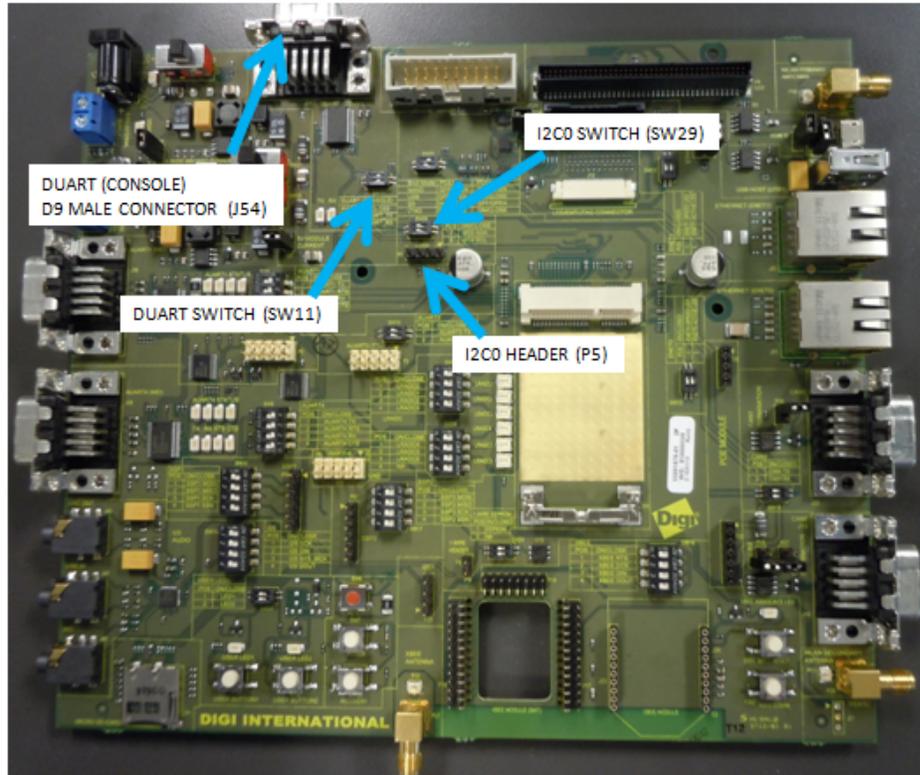


## DUART (Console) and I2C0

The normal mode of sending commands and receiving information from the module about those commands is through the DUART. The DUART is multiplexed with I2C0, and switches are provided to select the function desired.

The DUART status can be seen in the DUART LEDs located close to SW11.

### Connector and switch locations



### Functions and settings

Function	SW11 P1	SW11 P2	SW29 P1	SW29 P2
DUART_TX	ON/CLOSE	ON/CLOSE	OFF/OPEN	OFF/OPEN
DUART_RX	ON/CLOSE	ON/CLOSE	OFF/OPEN	OFF/OPEN
I2C0_SDA	OFF/OPEN	OFF/OPEN	ON/CLOSE	ON/CLOSE
I1C0_SCL	OFF/OPEN	OFF/OPEN	ON/CLOSE	ON/CLOSE

## **AUART1, ENET0, LRADC4, LRADC5, and User LEDs**

### **AUART1**

You can operate AUART1 with or without flow control, and each of the functions are connected separately to the D9 connector through switch SW8. The status of AUART 1 can be seen in the AUART1 LEDs located next to SW8.

### **ENET0**

ETHERNET (ENET0) is wired directly to the module and no switching is required. The LEDs for ENET0 are operated by GPIOs and are available through switch SW12.

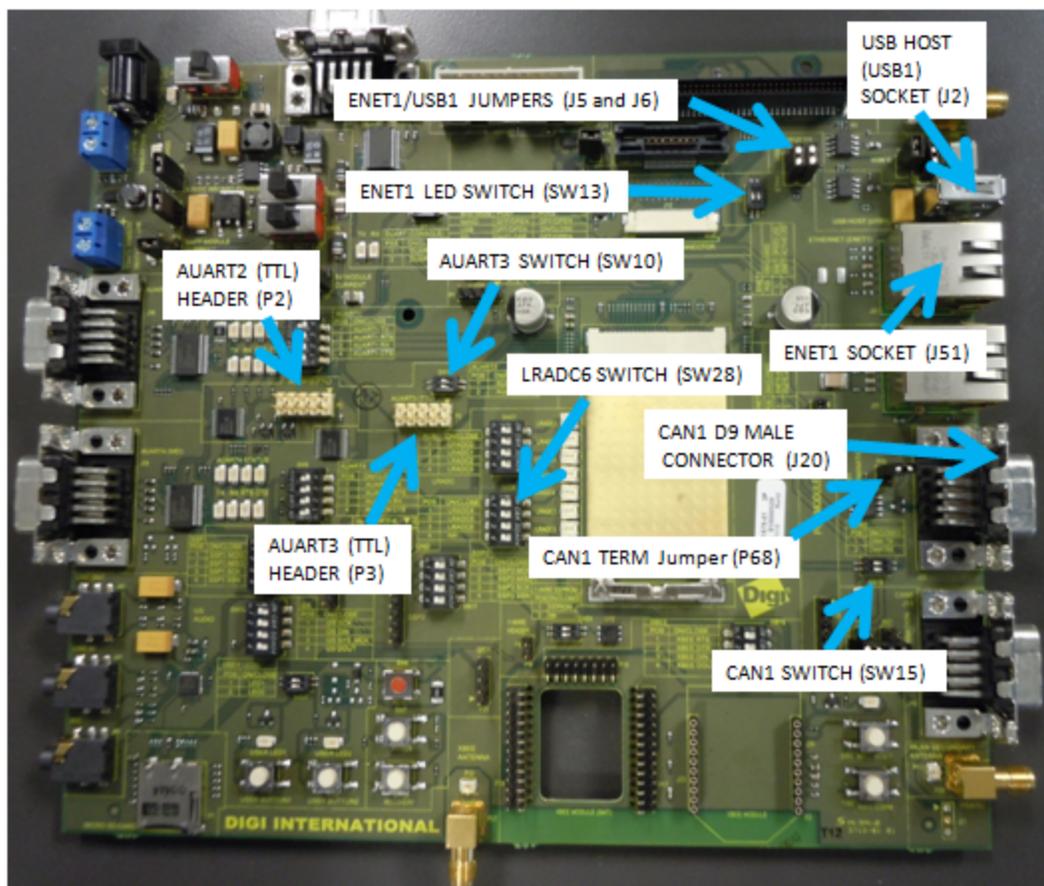
### **LRADC4 & LRADC5**

LRADC4 and LRADC5 are connected to separate potentiometers through switch SW28 and SW20. When you are not using the potentiometer, it is best to leave the switch in the OFF/OPEN condition to avoid allowing the potentiometer voltage to affect the other signals on the line. All the LRADCs (0-6) are also available through the LRADC header.

### **User LEDs**

USER\_LED1 and USER\_LED2 are connected to PWM1, and PWM0 respectively. The LEDs will turn on with a low and off with a high.

**Connector, switch, and jumper locations**



Variants with ENET1 do not have USB1 and variants with USB1 do not have ENET1.

**Function and settings**

Function	SW8 P1	SW8 P2	SW8 P3	SW8 P4	SW12 P1	SW12 P2	SW20 P1	SW20 P2	SW28 P1	SW28 P2
AUART1_TX	ON/CLOSE						OFF/OPEN			
AUART1_RTS		ON/CLOSE				OFF/OPEN				OFF/OPEN
AUART1_RX			ON/CLOSE					OFF/OPEN		
AUART1_CTS				ON/CLOSE	OFF/OPEN				OFF/OPEN	

Function	SW8 P1	SW8 P2	SW8 P3	SW8 P4	SW12 P1	SW12 P2	SW20 P1	SW20 P2	SW28 P1	SW28 P2
ENET0_SPEE D_LED				OFF/O PEN	ON/CL OSE				OFF/O PEN	
ENET0_ACTIV E_LED		OFF/O PEN				ON/CL OSE				OFF/O PEN
LRADC4 POT				OFF/O PEN	OFF/O PEN				ON/CL OSE	
LRADC5 POT		OFF/O PEN				OFF/O PEN				ON/CL OSE
USER_LED1	OFF/O PEN						ON/CL OSE			
USER_LED2			OFF/O PEN					ON/CL OSE		

## **AUART4, SSP3, I2S (Audio), LRADC6, and XBee**

### **AUART4**

AUART4 can be operated with or without the flow control, and each of the functions are connected separately to the D9 connector through switch SW9. The status of AUART4 can be seen in the AUART4 LEDs located next to SW9.

### **SSP3**

SSP3 is connected to its header (P87) through switch SW17.

### **I2S (Audio)**

I2S (AUDIO) connections are made through switch SW14. The CODEC also uses I2C1. The LRCLK is multiplexed with AUART4\_CTS.

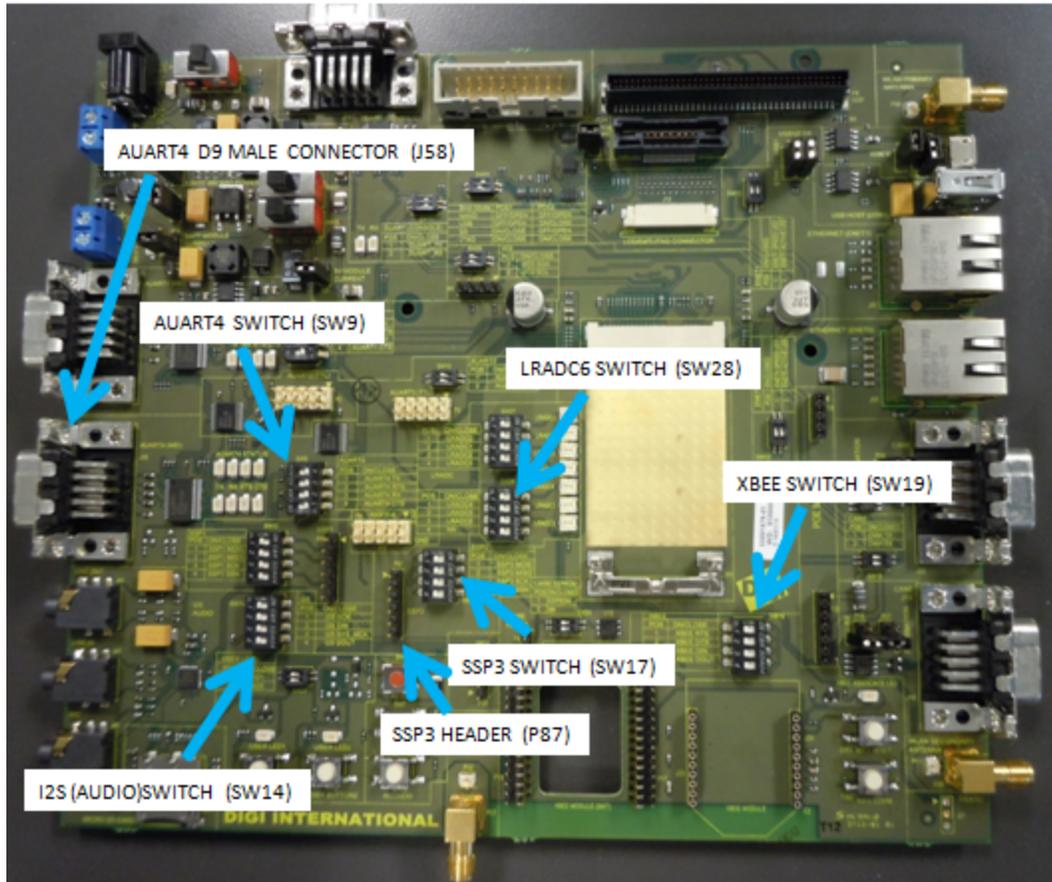
### **LRADC6**

LRADC6 is connected to its potentiometer through switch SW28 POS3. When you are not using the potentiometer, it is best to leave the switch in the OFF/OPEN condition to avoid having the potentiometer voltage affecting the other signals on the line. All the LRADCs (0-6) are also available through the LRADC header.

### **XBee**

XBee connections are made through switch SW19. AUART4 is used to communicate with the XBee module.

**Connector and switch locations**



**Function and settings table - AUART4**

Function	AUART4_TX	AUART4_RTS	AUART4_RX	AUART4_CTS
SW9 / P1	ON/CLOSE			
SW9 / P2		ON/CLOSE		
SW9 / P3			ON/CLOSE	
SW9 / P4				
SW14 / P1				
SW14 / P2				OFF/OPEN
SW17 / P1		OFF/OPEN		
SW17 / P2			OFF/OPEN	
SW17 / P3	OFF/OPEN			

Function	AUART4_TX	AUART4_RTS	AUART4_RX	AUART4_CTS
SW17 / P4				OFF/OPEN
SW19 / P1				OFF/OPEN
SW19 / P2			OFF/OPEN	
SW19 / P3	OFF/OPEN			
SW19 / P4			OFF/OPEN	
SW28 / P3				

### Function and settings table - SSP3

Function	SSP3_MOSI	SSP3_MISO	SSP3_SCK	SSP3_SS0
SW9 / P1			OFF/OPEN	
SW9 / P2	OFF/OPEN			
SW9 / P3		OFF/OPEN		
SW9 / P4				OFF/OPEN
SW14 / P1				
SW14 / P2				OFF/OPEN
SW17 / P1	ON/CLOSE			
SW17 / P2		ON/CLOSE		
SW17 / P3			ON/CLOSE	
SW17 / P4				ON/CLOSE
SW19 / P1				OFF/OPEN
SW19 / P2	OFF/OPEN			
SW19 / P3			OFF/OPEN	
SW19 / P4		OFF/OPEN		
SW28 / P3				

### Function and settings table - I2S

Function	I2S_SAIF1_DATA0	I2S_SAIF0_MCLK	I2S_SAIF0_DATA0	I2S_SAIF0_BITCLK
SW9 / P1			OFF/OPEN	
SW9 / P2				
SW9 / P3				OFF/OPEN

Function	I2S_SAIF1_DATA0	I2S_SAIF0_MCLK	I2S_SAIF0_DATA0	I2S_SAIF0_BITCLK
SW9 / P4		OFF/OPEN		
SW14 / P1	ON/CLOSE			
SW14 / P2		ON/CLOSE		
SW17 / P1				
SW17 / P2				OFF/OPEN
SW17 / P3			OFF/OPEN	
SW17 / P4		OFF/OPEN		
SW19 / P1		OFF/OPEN		
SW19 / P2				
SW19 / P3			OFF/OPEN	
SW19 / P4				OFF/OPEN
SW28 / P3	OFF/OPEN			

---

**Note** I2S (Audio) also uses I2C1.

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### **Function and settings table - XBee**

Function	XBEE_RTS	XBEE_DTR	XBEE DIN	XBEE DOUT
SW9 / P1			OFF/OPEN	
SW9 / P2		OFF/OPEN		
SW9 / P3				OFF/OPEN
SW9 / P4	OFF/OPEN			
SW14 / P1				
SW14 / P2	OFF/OPEN			
SW17 / P1		OFF/OPEN		
SW17 / P2				OFF/OPEN
SW17 / P3			OFF/OPEN	
SW17 / P4	OFF/OPEN			
SW19 / P1	ON/CLOSE			
SW19 / P2		ON/CLOSE		
SW19 / P3			ON/CLOSE	

Function	XBEE_RTS	XBEE_DTR	XBEE DIN	XBEE DOUT
SW19 / P4				ON/CLOSE
SW28 / P3				

**Function and settings table - LRADC6**

Function	LRADC6
SW9 / P1	
SW9 / P2	
SW9 / P3	
SW9 / P4	
SW14 / P1	OFF/OPEN
SW14 / P2	
SW17 / P1	
SW17 / P2	
SW17 / P3	
SW17 / P4	
SW19 / P1	
SW19 / P2	
SW19 / P3	
SW19 / P4	
SW28 / P3	ON/CLOSE

## **AUART2, AUART3, CAN1, Ethernet, and USB host**

### ***AUART2 (TTL)***

This header needs no switches to operate. The flow control for AUART2 is not connected to the header (P2).

### ***AUART3 (TTL)***

This header is connected to header P3 through switch SW10.

### ***CAN1***

The CAN1 header is connected to D9 Header J20 through Switch SW15. A termination resistor is also available on the development board and is connected through jumper P68.

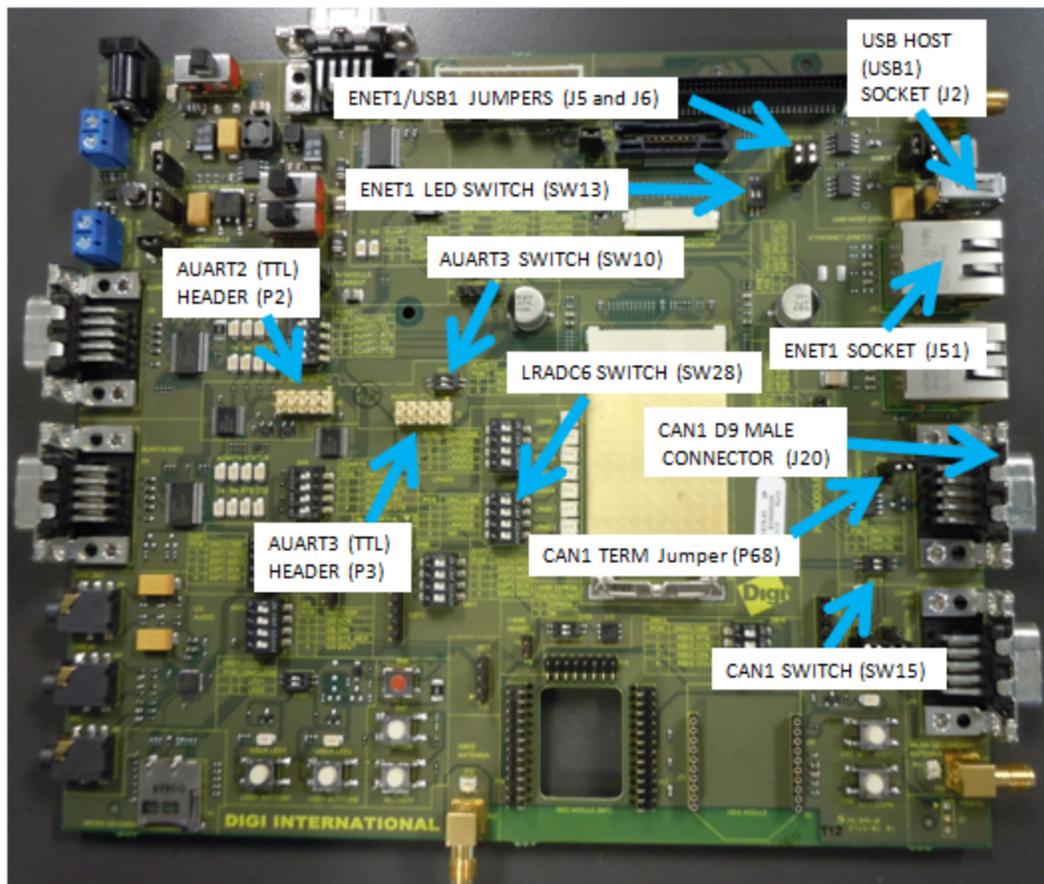
### ***Ethernet (ENET1)***

The ConnectCard for i.MX28 provides up to two 10/100 Mbps Ethernet connections (see variants table for number of Ethernet connections). The MAC and PHY are on the module, and the Magnetics and Jack need to be provided external to the module. The connections from the module are differential pairs for the TX and RX ports. Variants with one Ethernet include two USB ports.

### ***USB HOST (USB1)***

For modules without ENET1, USB1 is available and is connected to the USB socket J2 using jumpers J5 and J6.

**Connector, switch, and jumper locations**



Variants with ENET1 do not have USB1 and variants with USB1 do not have ENET1.

**Function and settings table - AUART3**

Function	AUART3_RX	AUART3_TX
SW10 / P1	ON/CLOSE	
SW10 / P2		ON/CLOSE
SW13 / P1		OFF/OPEN
SW13 / P2	OFF/OPEN	
SW15 / P1	OFF/OPEN	
SW15 / P2		OFF/OPEN
P68		
J5 / ETH1		

Function	AUART3_RX	AUART3_TX
J5 / USB1		
J6 / ETH1		
J6 / USB1		

### **Function and settings table - CAN1**

Function	CAN1_RX	CAN1_TX	CAN1_TERMINATION
SW10 / P1	OFF/OPEN		
SW10 / P2		OFF/OPEN	
SW13 / P1		OFF/OPEN	
SW13 / P2	OFF/OPEN		
SW15 / P1	ON/CLOSE		
SW15 / P2		ON/CLOSE	
P68			SHORT
J5 / ETH1			
J5 / USB1			
J6 / ETH1			
J6 / USB1			

### **Function and settings table - ENET1**

Function	ENET1_SPEED_LED	ENET1_ACTIVE_LED	ENET1_RX+	ENET1_RX-
SW10 / P1	OFF/OPEN			
SW10 / P2		OFF/OPEN		
SW13 / P1	ON/CLOSE			
SW13 / P2		ON/CLOSE		
SW15 / P1	OFF/OPEN			
SW15 / P2		OFF/OPEN		
P68				
J5 / ETH1			SHORT	
J5 / USB1			OPEN	
J6 / ETH1				SHORT
J6 / USB1				OPEN

**Function and settings table - USB1**

Function	USB1_DM	USB1_DP
SW10 / P1		
SW10 / P2		
SW13 / P1		
SW13 / P2		
SW15 / P1		
SW15 / P2		
P68		
J5 / ETH1	OPEN	
J5 / USB1	SHORT	
J6 / ETH1		OPEN
J6 / USB1		SHORT

AUART2 has no switches to set. If the CAN1 Termination is not needed, P68 can be left OPEN.

## SD CARD, SSP1, LRADC0, LRADC1, LRADC2, and LRADC3

### SD CARD

The SD CARD socket P1 requires no switches to operate.

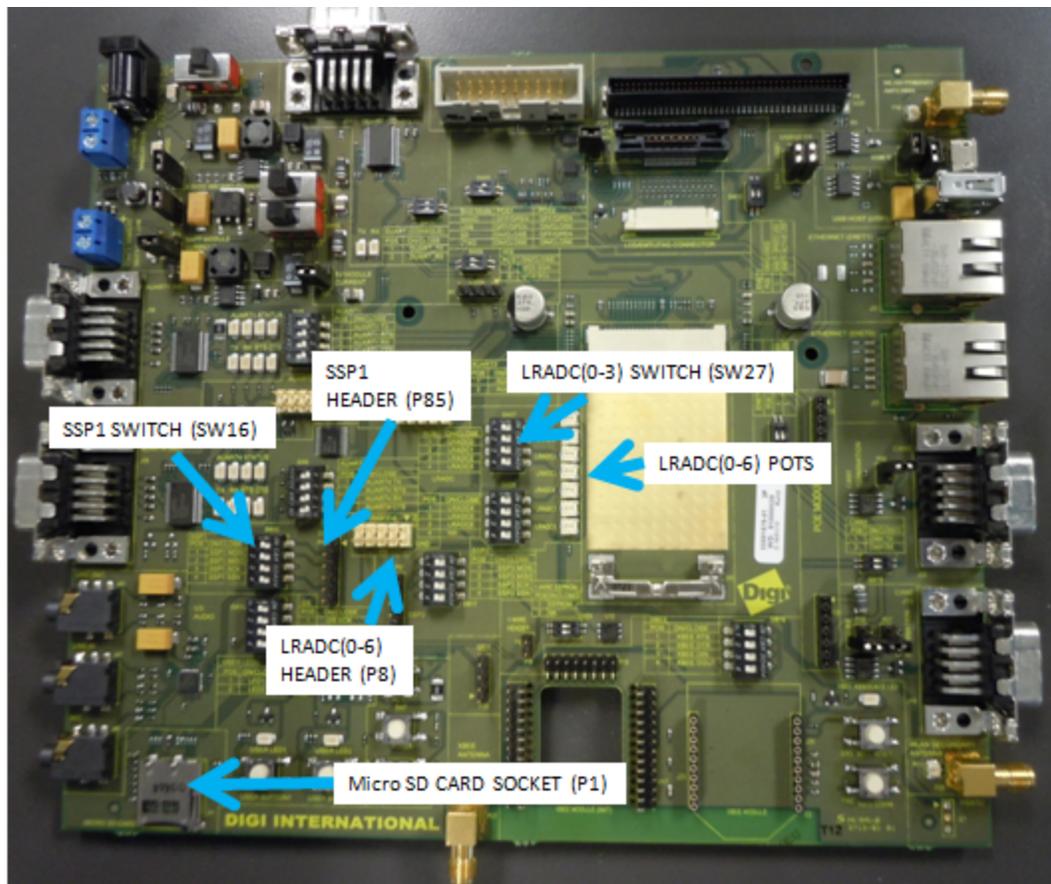
### SSP1

SSP1 or SPI1 is connected to header P85 through switch SW16.

### LRADC0, LRADC1, LRADC2 and LRADC3

LRADC0, LRADC1, LRADC2 and LRADC3 are connected to their associated potentiometers through switch SW27. These functions are also available on Header P8.

### Connector, switch, and jumper locations



### Function and settings table - SSP1

Function	SSP1_MOSI	SSP1_MISO	SSP1_SCK	SSP1_SSN
SW16 / P1	ON/CLOSE			

Function	SSP1_MOSI	SSP1_MISO	SSP1_SCK	SSP1_SSN
SW16 / P2		ON/CLOSE		
SW16 / P3			ON/CLOSE	
SW16 / P4				ON/CLOSE
SW27 / P1				OFF/OPEN
SW27 / P2	OFF/OPEN			
SW27 / P3		OFF/OPEN		
SW27 / P4			OFF/OPEN	

**Function and settings table - LRADC0-3**

Function	LRADC0 POT	LRADC1 POT	LRADC2 POT	LRADC3 POT
SW16 / P1				
SW16 / P2		OFF/OPEN		
SW16 / P3			OFF/OPEN	
SW16 / P4	OFF/OPEN			OFF/OPEN
SW27 / P1	ON/CLOSE			
SW27 / P2		ON/CLOSE		
SW27 / P3			ON/CLOSE	
SW27 / P4				ON/CLOSE

## CAN0, HSADC, and 1-wire

### CAN0

CAN0\_RX is connected to D9 header J19 through jumper P38. No switch is needed for CAN0\_TX. The termination resistor is available on jumper P67.

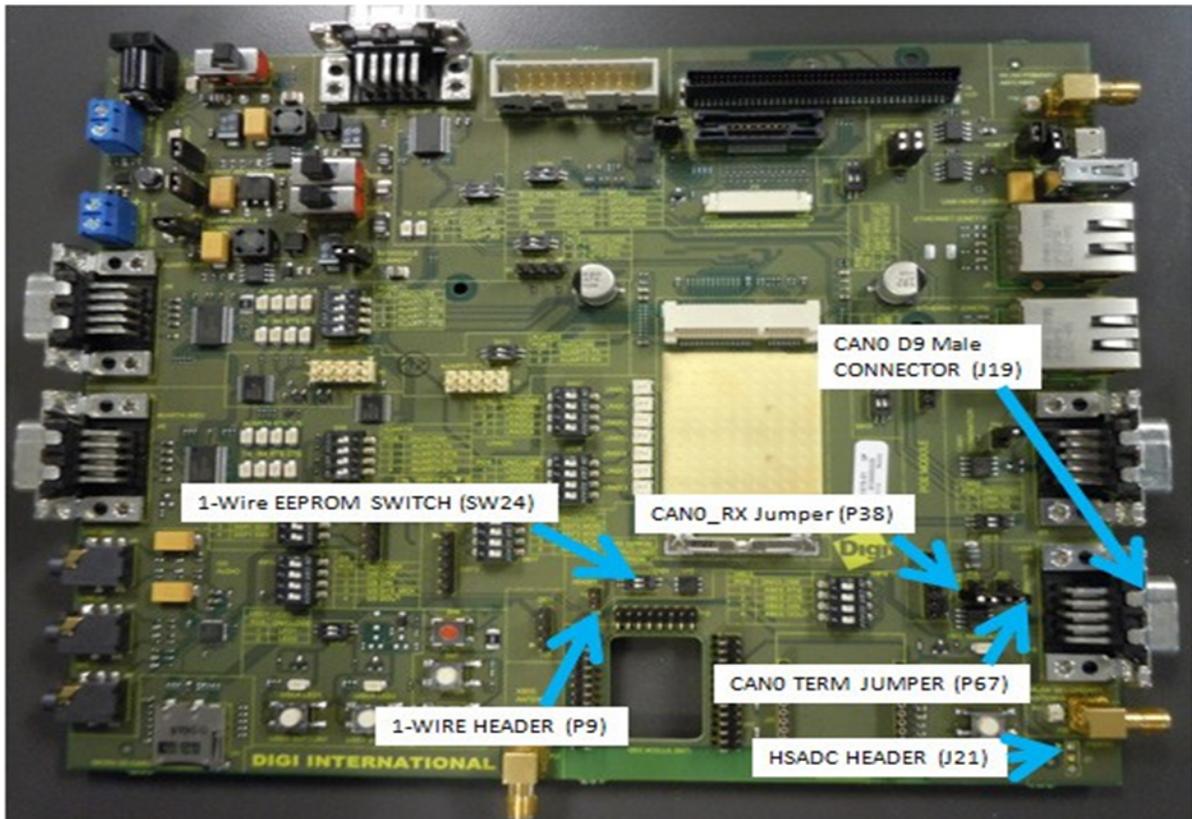
### HSADC

The HSADC header (J21) is not populated on the development board.

### 1-wire

The ConnectCard for i.MX28 provides a 1-wire interface to communicate with 1-wire devices such as EEPROMs, secure memory and sensors. The required protocol for accessing the generic 1-wire device is defined by Maxim. The Maxim DS2482-100 interface is used for 1-wire communication. The 1-wire interface uses a strong 3.3V pull-up.

### Connector, switch, and jumper locations



**Function and settings table**

Function	1-WIRE EEPROM	CAN0_RX	CAN0_TERMINATION	HS ADC_TRIGGER
SW24 / P1	ON/CLOSE			
P38		ON/CLOSE		OFF/OPEN
P67			ON/CLOSE	

- 1-wire header has no switches
- CAN0\_TX has no switches
- HSADC0 header is not populated
- SW24 P2 is not connected

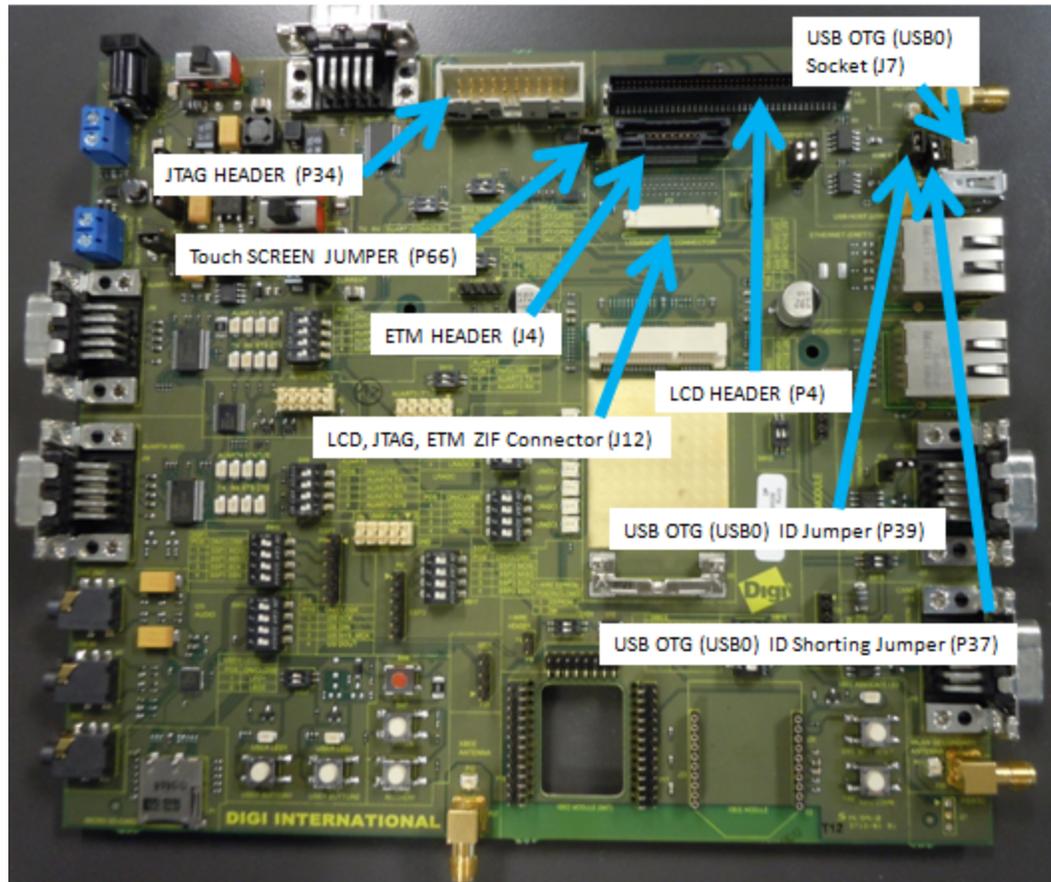
## LCD, ETM, JTAG, USB OTG (USB0)

The locations of the LCD, ETM, JTAG and USB OTG (USB0) are shown below.

The USB OTG (USB0) can be operated with or without the OTG functionality. The USB0\_ID line is connected to the socket (J7) through jumper P39. A short to GND of the USB0\_ID line is available on jumper P37.

To operate the LCD, ETM and JTAG the 31-pin LCD cable must be connected from the development board to the module.

### Connector and jumper locations



### Functions and settings

- LCD has no switches. To operate the touch screen OPEN P66.
- JTAG has no switches.
- ETM has no switches.
- LCD JTAG ETM ZIF connector is for the FFC 31-pin cable connecting these interfaces to the CCI.MX28.

## Chapter 3: Regulatory information

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## Agency certifications

### United States FCC

#### FCC Class B statement

#### Radio Frequency Interface (RFI) (FCC 15.105)

This device has been tested and found to comply with the limits for Class B digital devices pursuant to Part 15 Subpart B, of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential environment. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try and correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna. Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

#### Labeling Requirements (FCC 15.19)

This device complies with Part 15 of FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

If the FCC ID is not visible when installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module FCC ID.

#### Modifications (FCC 15.21)

Changes or modifications to this equipment not expressly approved by Digi may void the user's authority to operate this equipment.

The ConnectCard for i.MX28 Module complies with Part 15 of the FCC rules and regulations. Compliance with the labeling requirements, FCC notices and antenna usage guidelines is required.

To fulfill FCC Certification, the OEM must comply with the following regulations:

- The system integrator must ensure that the text on back side of the module is placed on the outside of the final product.
- ConnectCard for i.MX28 RF Module may only be used with antennas that have been tested and approved for use with this module (refer to [Approved antennas for the ConnectCard for i.MX28 Wi-Fi modules](#)).

## OEM labeling requirements



**WARNING!** The Original Equipment Manufacturer (OEM) must ensure that FCC labeling requirements are met. This includes a clearly visible label on the outside of the final product enclosure that displays the contents shown in the figure below.

Required FCC Label for OEM products containing the ConnectCard for i.MX28 RF Module:

Contains FCC ID: MCQ-CCIMX28

The enclosed device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (i.) this device may not cause harmful interference and (ii.) this device must accept any interference received, including interference that may cause undesired operation.

## FCC notices

**IMPORTANT:** The ConnectCard for i.MX28 RF module has been certified by the FCC for use with other products without any further certification (as per FCC section 2.1091). Modifications not expressly approved by Digi could void the user's authority to operate the equipment.

**IMPORTANT:** OEMs must test final product to comply with unintentional radiators (FCC section 15.107 & 15.109) before declaring compliance of their final product to Part 15 of the FCC rules.

**IMPORTANT:** The ConnectCard for i.MX28 RF module has been certified for remote and base radio applications. If the module will be used for portable applications, the device must undergo SAR testing. This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Re-orient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect equipment and receiver to outlets on different circuits.
- Consult the dealer or an experienced radio/TV technician for help.

## FCC-approved antennas

The ConnectCard for i.MX28 can be installed utilizing antennas and cables constructed with non-standard connectors (RPSMA, RPTNC, and so on).

The modules are FCC approved for fixed base station and mobile applications for the channels indicated in the tables below. If the antenna is mounted at least 20cm (8 in.) from nearby persons, the application is considered a mobile application. Antennas not listed in the table must be tested to comply with FCC Section 15.203 (Unique Antenna Connectors) and Section 15.247 (Emissions).

**ConnectCard for i.MX28:** ConnectCard for i.MX28 RF Modules have been tested and approved for use with all the antennas listed in the tables below. (Cable-loss is required when using gain antennas as shown below.)

The antennas in the tables below have been approved for use with this module. Digi does not carry all of these antenna variants. Contact Digi Sales for available antennas.

## Approved antennas for the ConnectCard for i.MX28 Wi-Fi modules

Part number	Type (description)	Peak gain	Application	Supplier
A24-HASM-450	Dipole (articulated RPSMA, 2.4 GHz antenna)	1.8 dBi	Fixed/Mobile	Digi International
DG-ANT-50DP-AG	Dipole (articulated RPSMA, 2.4 GHz and 5 GHz antenna)	5 dBi	Fixed/Mobile	Digi International
PC.11.07.0100A	The Stripe Omni-directional antenna	3 dBi @ 2.4 GHz 4.5 dBi @ 5 GHz	Fixed/Mobile	Taoglas (www.taoglas.com)
	Dipole	2.6 dBi @ 2.4 GHz 5 dBi @ 5 GHz	Fixed/Mobile	Taoglas (www.taoglas.com)

\* If using the RF module in a portable application (for example - if the module is used in a handheld device and the antenna is less than 20cm from the human body when the device is in operation): The integrator is responsible for passing additional SAR (Specific Absorption Rate) testing based on FCC rules 2.1091 and FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, OET Bulletin and Supplement C. The testing results will be submitted to the FCC for approval prior to selling the integrated unit. The required SAR testing measures emissions from the module and how they affect the person.

### RF Exposure



**WARNING!** To satisfy FCC RF exposure requirements for mobile transmitting devices, a separation distance of 20 cm or more should be maintained between the antenna of this device and persons during device operation. To ensure compliance, operations at closer than this distance are not recommended. The antenna used for this transmitter must not be co-located in conjunction with any other antenna or transmitter.

The preceding statement must be included as a CAUTION statement in OEM product manuals in order to alert users of FCC RF Exposure compliance.

## Europe

The ConnectCard for i.MX28 Module has been certified for use in several European countries. For a complete list, refer to [www.digi.com](http://www.digi.com).

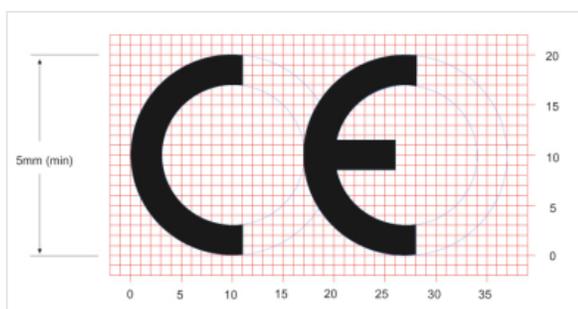
If the ConnectCard for i.MX28 RF Modules are incorporated into a product, the manufacturer must ensure compliance of the final product with articles 3.1a and 3.1b of the RE Directive (Radio Equipment Directive). A Declaration of Conformity must be issued for each of these standards and kept on file as described in the RE Directive (Radio Equipment Directive).

Furthermore, the manufacturer must maintain a copy of the ConnectCard for i.MX28 Hardware Reference manual documentation and ensure the final product does not exceed the specified power ratings, antenna specifications, and/or installation requirements as specified in the user manual. If any of these specifications are exceeded in the final product, a submission must be made to a notified body for compliance testing to all required standards.

### OEM Labeling Requirements

The CE marking must be affixed to a visible location on the OEM product.

#### CE Labeling Requirements



The CE mark shall consist of the initials "CE" taking the following form:

- If the CE marking is reduced or enlarged, the proportions given in the above graduated drawing must be respected.
- The CE marking must have a height of at least 5mm except where this is not possible on account of the nature of the apparatus.
- The CE marking must be affixed visibly, legibly, and indelibly.

### Declaration of Conformity (DoC) statement

Digi has issued Declarations of Conformity for the ConnectCard for i.MX28 concerning emissions, EMC, and safety. For more information, see <http://www.digi.com/resources/certifications>.

#### Important note

Digi customers assume full responsibility for learning and meeting the required guidelines for each country in their distribution market. Refer to the radio regulatory agency in the desired countries of operation for more information.

### Approved antennas

The same antennas have been approved for Europe as stated in the FCC table for use with the ConnectCard for i.MX28 Module.

## Canada (IC)

This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la class B prescrites dans le Règlement sur le brouillage radioélectrique édicté par le ministère des Communications du Canada.

### Labeling requirements

Labeling requirements for Industry Canada are similar to those of the FCC. A clearly visible label on the outside of the final product enclosure must display the following text:

**Contains Model ConnectCard for i.MX28 Radio, IC: 1846A-CCi.MX28**

The integrator is responsible for its product to comply with IC ICES-003 & FCC Part 15, Sub. B - Unintentional Radiators. ICES-003 is the same as FCC Part 15 Sub. B and Industry Canada accepts FCC test report or CISPR 22 test report for compliance with ICES-003.

### Transmitters with detachable antennas

This radio transmitter (IC: 1846A-CCi.MX28) has been approved by Industry Canada to operate with the antenna types listed in the [Approved antennas for the ConnectCard for i.MX28 Wi-Fi modules](#) table with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

*Le présent émetteur radio (IC: 1846A-CCi.MX28) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.*

### Detachable antenna

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

*Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.*

## Australia (C-Tick)

These modules comply with requirements to be used in end products in Australia. All products with EMC and radio communications must have a registered C-Tick mark. Registration to use the compliance mark will only be accepted from Australian manufacturers or importers, or their agents, in Australia.

In order to have a C-Tick mark on an end product, a company must comply with a or b below.

- a. Have a company presence in Australia.
- b. Have a company/distributor/agent in Australia that will sponsor the importing of the end product.

Contact Digi for questions related to locating a contact in Australia.

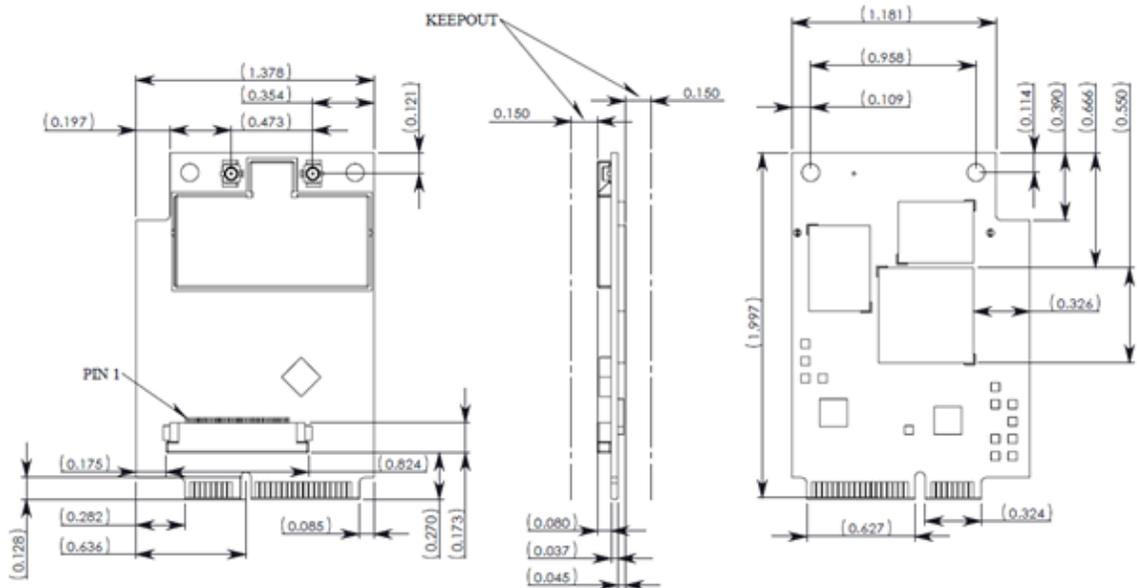
## Appendix A: Module specifications

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## Mechanical specifications

### Dimensional drawing



## Environmental specifications

- Operating temperature: -40°C to +85°C\*
- Storage temperature: -40°C to +125°C

\*Operating temperatures above 65°C may require additional thermal management considerations as part of the module integration. See [Thermal considerations](#) for details.

## Network interface

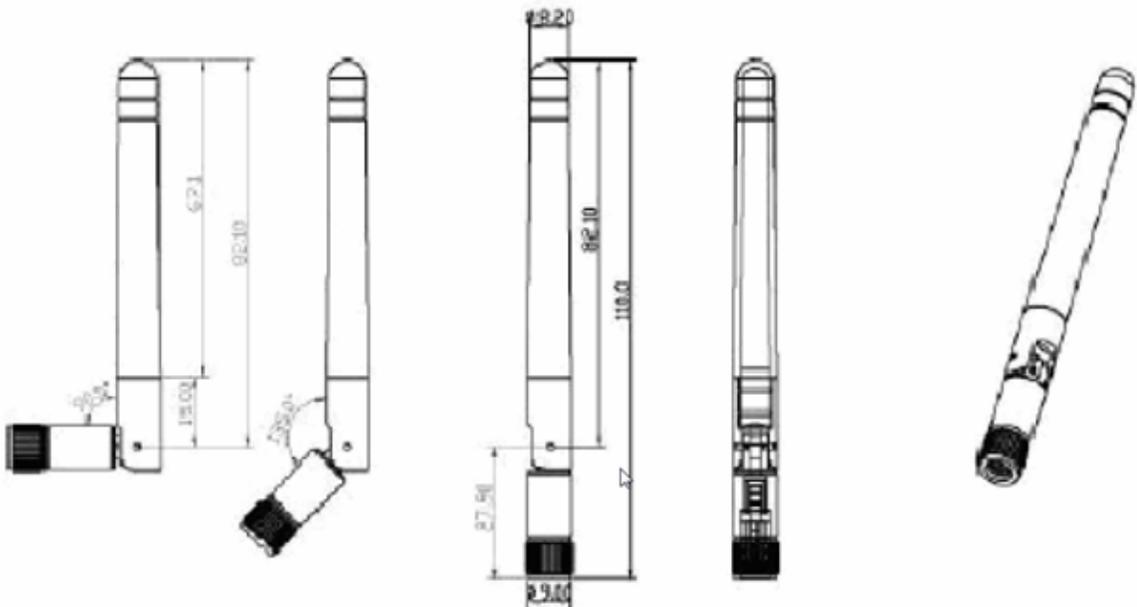
### Digi part number A24-HASM-450

#### Antenna attributes

Specification	Attribute
Frequency range	2.4 - 2.5 GHz
Gain	1.8 dBi
VSWR	2.0 max
Connector	Reverse male SMA (RP-SMA)
Impedance	50 W
Temperature	RP-SMA
Gain	-20°C to +80°C
Return loss	-9.5dB
Weight	27g
Dimensions	10.6 x 87.4 mm

#### Dimensions

**Note** Dimensions are provided for reference purposes only. The actual antenna may vary.



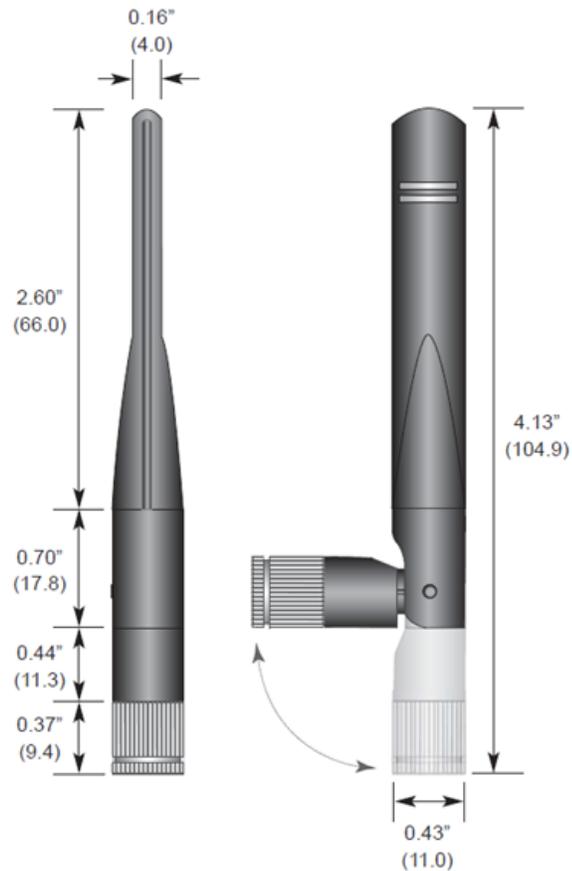
## Digi part number 29000146

### Antenna attributes

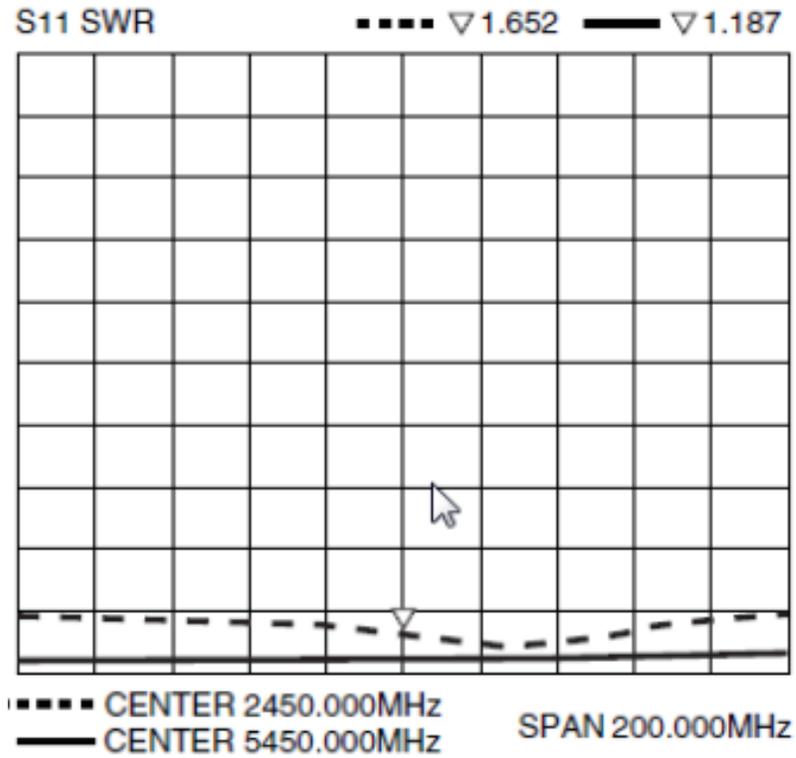
Specification	Attribute
Frequency range	2.4 - 2.5 GHz, 5.15 - 5.825 GHz
Gain	5 dBi max
VSWR	1.9 typical
Connector	Reverse male SMA (RP-SMA)
Impedance	50 W
Temperature rating	-20°C to +80° C
Dimensions	104.9 x 11 mm

### Dimensions

**Note** Dimensions are provided for reference purposes only. The actual antenna may vary.



**VSWR chart**



Typical VSWR

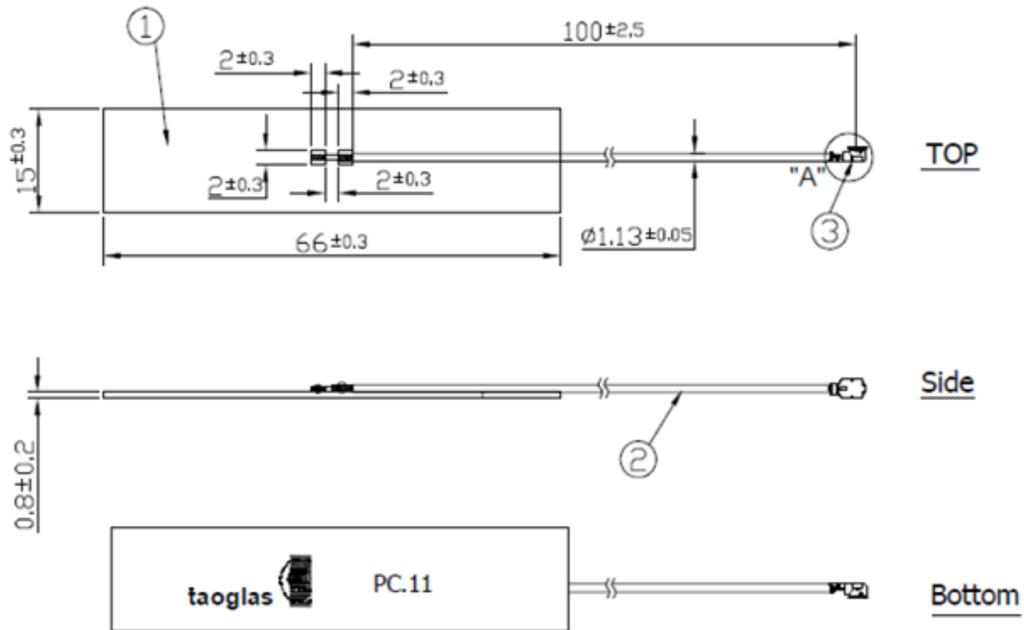
**Taoglas PC.11.07.0100A**

**Antenna attributes**

Specification	2.4 GHz attribute	5 GHz attribute
Frequency range	2.4 - 2.5 GHz	4.9 - 5.9 GHz
Peak gain	3 dBi	4.5 dBi
Average gain (on plastic)	-0.6 dBi	-0.d5 dBi
VSWR	1.5	
Connector	u.FL	
Impedance	50 W	
Temperature	-40° C to +85° C	
Dimensions	66 x 15 mm (excluding cable)	

**Dimensions**

**Note** Dimensions are provided for reference purposes only. The actual antenna may vary.

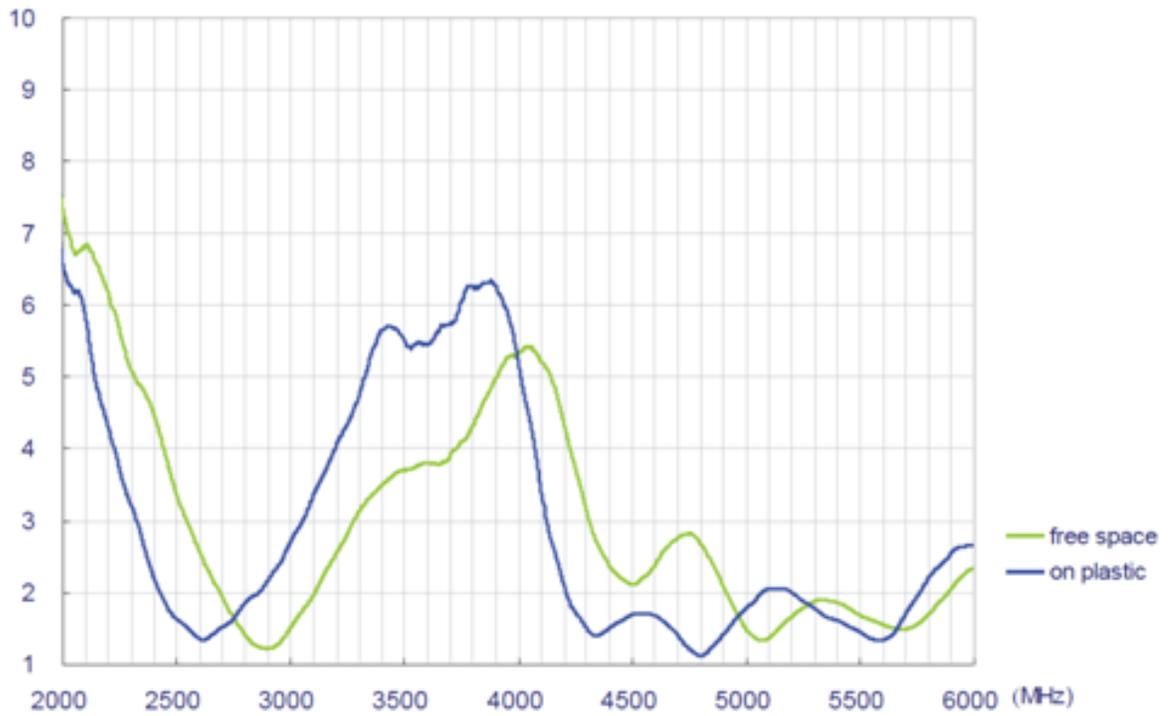


**Taoglas FXP.830.07.0100C**

**Antenna attributes**

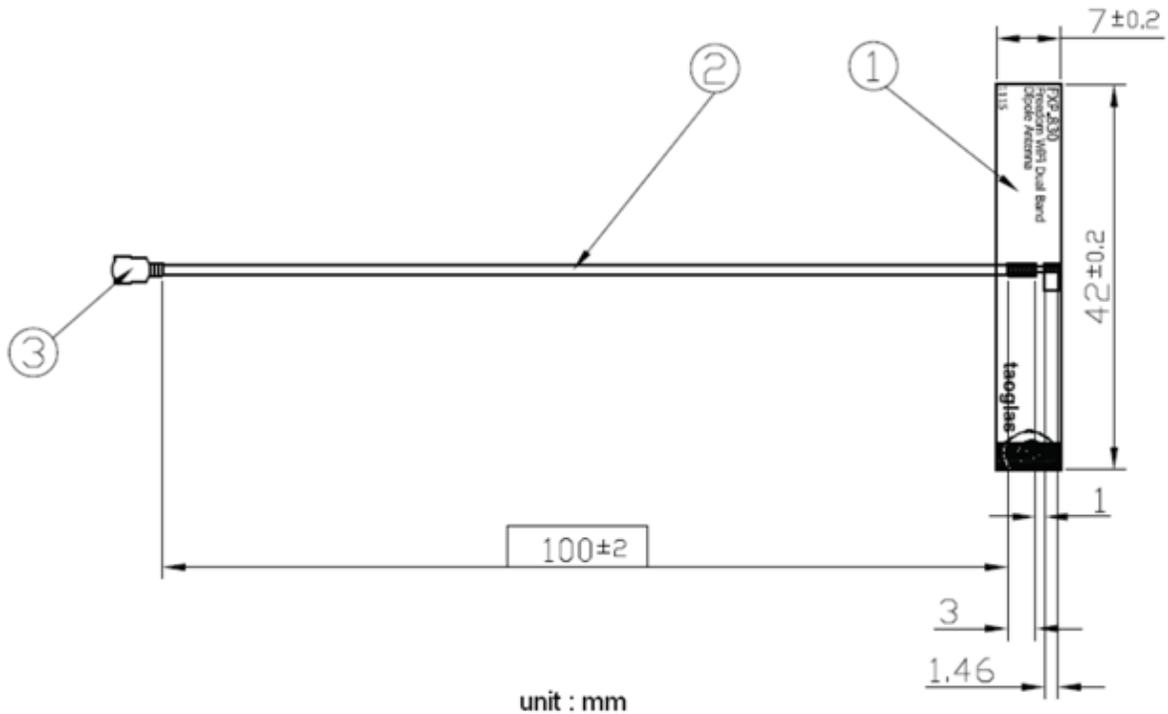
Specification	2.4 GHz attribute	5 GHz attribute
Frequency range	2.4 - 2.5 GHz	4.9 - 5.9 GHz
Peak gain (free space)	1.8 dBi	3.6 dBi
Peak gain (on plastic)	2.6 dBi	5.0 dBi
Average gain (free space)	-3.0 dBi	-0.6 dBi
Average gain (on plastic)	-3.0 dBi	-0.7 dBi
VSWR (free space, on plastic)	See chart below	
Connector	u.FL	
Impedance	50 W	
Temperature	-40° C to +85° C	
Dimensions	42 x 7 mm (excluding cable)	

**VSWR chart**



### Dimensions

**Note** Dimensions are provided for reference purposes only. The actual antenna may vary.



### Ethernet 1

- Standard: IEEE802.3
- Physical layer: 10/10Base
- Data rate: 10/100 Mbps

### Ethernet 2

- Standard: IEEE802.3
- Physical layer: 10/10Base
- Data rate: 10/100 Mbps

### WLAN

#### Standard

- IEEE 802.11a/b/g/n standards
- HT20, and HT40 IEEE 802.11n

**Frequency band**

- 2.40 - 2.50 GHz ( low band )
- 5.18 - 5.825 GHz ( high band )

**Data rates**

- 802.11b: 1, 2, 5.5, 11 Mbps
- 802.11a/g: 6, 9, 12, 18, 24, 35, 48, 54 Mbps
- 802.11n HT20 FGI: 6.5, 13, 19.5, 26, 39, 52, 58.5, 65 Mbps
- 802.11n HT20 HGI: 7.2, 14.4, 21.7, 29.9, 43.3, 57.8, 65, 72.2 Mbps
- 802.11n HT40 FGI (5 GHz only): 13.5, 27, 40.5, 54, 81, 108, 121.5, 135 Mbps
- 802.11n HT40 HGI (5 GHz only): 15, 30, 45, 60, 90, 120, 135, 150 Mbps

**Modulation**

Mode	Data rate	Modulation	Mode	Data rate	Modulation	Mode	Data rate	Modulation
802.11b	1	DBPSK	802.11g	6	BPSK	802.11a	6	BPSK
	2	DQPSK		9	BPSK		9	BPSK
	5.5	CCK		12	QPSK		12	QPSK
	11	CCK		18	QPSK		18	QPSK
				24	16-QAM		24	16-QAM
				35	16-QAM		35	16-QAM
				48	64-QAM		48	64-QAM
				054	64-QAM		54	64-QAM

Mode	MCS	Modulation	Data rate			
			HT20 (2.4 GHz and 5 GHz)		HT40 (5 GHz only)	
802.11n			FGI	HGI	FGI	HGI
	MCS0	BPSK	6.5	7.2	13.5	15
	MCS1	QPSK	13	14.4	27	30
	MCS2	QPSK	19.5	21.7	40.5	45
	MCS3	16-QAM	26	29.9	54	60
	MCS4	16-QAM	39	43.3	81	90
	MCS5	64-QAM	52	57.8	108	120
	MCS6	64-QAM	58.5	65	121.5	135
	MCS7	64-QAM	65	72.2	135	150

### Security

- Cisco CCXv4 ASD
- WAPI (for China)
- WPS
- WEP
- WPA
- WPA2

### Frequency bands

#### US, Canada

- 2.412 to 2.462 GHz; 11 channels
- 5.180 to 5.320 GHz; 8 channels
- 5.500 to 5.700 GHz, 8 channels (excludes 5.600 to 5.650 GHz)
- 5.745 to 5.825 GHz; 5 channels

#### Europe

- 2.412 to 2.472 GHz; 13 channels
- 5.180 to 5.320 GHz; 8 channels
- 5.500 to 5.700 GHz, 8 channels (excludes 5.600 to 5.640 GHz)

#### Australia, New Zealand

- 2.412 to 2.462 GHz; 11 channels
- 5.180 to 5.320 GHz; 8 channels
- 5.745 to 5.825 GHz; 5 channels

**Japan**

- 2.412 to 2.472 GHz; 13 channels
- 5.180 to 5.320 GHz; 8 channels
- 5.500 to 5.700 GHz; 11 channels

**AD HOC mode channels**

- 2.4 GHz band - channels 10 and 11
- 5 GHz band US, Australia, New Zealand - channels 36, 40, 44, 45, 149, 157, 161, and 165.  
channels 36, 40, 44, and 45 are for indoor use only
- 5 GHz band Europe and Japan - per 802.11d

**5 GHz HT 20 and HT40 channels available**

Channel number	Frequency	Mode	Secondary channel allowed
36	5180 (MHz)	HT40	PLUS
38	5190 (MHz)	HT20	
40	5200 (MHz)	HT40	MINUS
44	5220 (MHz)	HT40	PLUS
46	5230 (MHz)	HT20	
48	5240 (MHz)	HT40	MINUS
52	5260 (MHz)	HT40	PLUS
54	5270 (MHz)	HT20	
56	5280 (MHz)	HT40	MINUS
60	5300 (MHz)	HT40	PLUS
62	5310 (MHz)	HT20	
64	5320 (MHz)	HT40	MINUS
100	5500 (MHz)	HT40	PLUS
102	5510 (MHz)	HT20	
104	5520 (MHz)	HT40	MINUS
108	5540 (MHz)	HT40	PLUS
110	5550 (MHz)	HT20	
112	5560 (MHz)	HT40	MINUS
116	5580 (MHz)	HT40	PLUS

Channel number	Frequency	Mode	Secondary channel allowed
118	5590 (MHz)	HT20	
120	5600 (MHz)	HT40	MINUS
124	5620 (MHz)	HT40	PLUS
126	5630 (MHz)	HT20	
128	5640 (MHz)	HT40	MINUS
132	5660 (MHz)	HT40	PLUS
134	5670 (MHz)	HT20	
136	5680 (MHz)	HT40	MINUS
140	5700 (MHz)	HT20	
149	5745 (MHz)	HT40	PLUS
151	5755 (MHz)	HT20	
153	5765 (MHz)	HT40	MINUS
157	5785 (MHz)	HT40	PLUS
159	5795 (MHz)	HT20	
161	5805 (MHz)	HT40	MINUS
165	5825 (MHz)	HT20	

## Receive sensitivity

Network Type	Sensitivity
802.11 b	-88 dBm
802.11 g	-88 dBm
802.11 n (2.4 GHz)	-89 dBm
802.11 a	-90 dBm
802.11 n (5 GHz, 20 MHz bandwidth)	-90 dBm
802.11 n (5 GHz, 40 MHz bandwidth)	-86 dBm

## Transmit power

Network Type	Transmit Power
802.11 b	10.5 dBm

Network Type	Transmit Power
802.11 g/n	11 dBm
802.11 a/n	13 dBm

## Electrical characteristics

### Absolute maximum ratings

Parameter	Min	Max	Unit
VDD_5V	-0.3	5.25	V
Battery	-0.3	4.242	V
Pswitch	-0.3	battery/2	V
USB DP and DN	-0.3	3.63	V
GPIO	-0.3	3.6	V
Ethernet TX +/- and RX +/-	-0.5	4	V

Note that other interfaces not specifically mentioned are the same as GPIOs.

### Voltage supplies

Parameter	Min	Typ	Max	Unit
5 V supply	4.75	5	5.25	V
Battery supply	3.4		4.2	V

**Note** On wireless variants, the minimum battery supply voltage to ensure proper system behavior is 3.8 V.

### Supply current

Settings	Supply Current
Wi-Fi 2.4 GHz transmit, CPU 545 MHz, 50%, UART active	475 mA
Wi-Fi 5 GHz transmit, CPU 545 MHz, 50%, UART active	600 mA
Wi-Fi 5 GHz receive CPU Idle (auto slow)	300 mA

Settings	Supply Current
Wi-Fi 2.4 GHz receive CPU Idle (auto slow)	325 mA

## GPIO DC parameters

Parameter	Min	Max	Unit
Input voltage high (DC)	2	3.3	V
Input voltage low (DC)	-	0.8	V
Output voltage high (DC)	2.64	-	V
Output voltage low (DC)	-	0.4	V
Output source current (DC) gpio, gpio_f and gpio_nobs			
4 mA setting	3.8	6.8	mA
8 mA setting	7.6	13.6	mA
12 mA setting	12.1	24.5	mA
Output sink current (DC) gpio, gpio_f, and gpio_nobs			
4 mA setting	4	8.1	mA
8 mA setting	8.1	16.4	mA
12 mA setting	12.1	24.5	mA
Output source current (DC) gpio_clk			
8 mA setting	7.6	13.6	mA
12 mA setting	15.2	27.2	mA
Output sink current (DC) gpio_clk			
8 mA setting	8.1	15.4	mA
12 mA setting	16.2	30.6	mA
10k pull-up resistance	8	12	kOhm
47k pull-up resistance	39	56	kOhm

See the NXP i.MX28 data sheet and manual for full details.

## Agency approvals

Specification	ConnectCard for i.MX28
United States (FCC Part 15.247)	FCC ID: MCQ-CCIMX28
Industry Canada (IC) variants without Bluetooth	IC: 1846A-CCIMX28
Industry Canada (IC) variants with Bluetooth	IC: 1846A-CCIMX28B
Europe (DC)	ETSI
Australia	N30375
New Zealand	R-NZ Z1123
Japan variants without Bluetooth	R210-101065
Japan variants with Bluetooth	R210-101066
UR	UL-UR mark
VCCI	Pending

# Appendix B: ConnectCard for i.MX28 module dimensions

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## Mini PCI Express Connector design recommendations

The ConnectCard for i.MX28 module is mounted on the Development Board via a mini PCI Express connector and a corresponding locking latch connector. These are offered by manufacturers as a matched set, although in some cases different manufacturer's parts may be interchangeable. The table below lists the recommended parts for the mini PCI Express connector and the locking latch connector used for the development board.

### Interface board connector-related parts

Connector part	Manufacturer	Part number
Mini PCI Express connector	Pinrex	984-63-052202
	Homologation impact	999002
	Foxcon International	AS0B221-S68Q-7H
	Foxcon International	AS0B226-S68N-7F
Latch connector	Foxcon International	AS0B226-S68K-7F

Other manufacturers such as Molex offer similar connectors and latches, but these can have different mechanical structures and PCB footprints than the interface board. The following table lists a pair of matched Molex parts that might be used.

### Molex connector-related parts

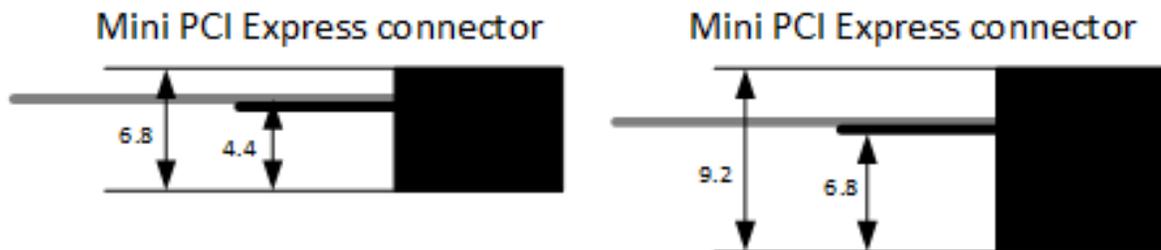
Connector part	Molex part number
Mini PCI Express connector	67910-0002
Latch connector	48099-4000

The ConnectCard for i.MX28 may also be mounted with stand-offs rather than a latch connector. This is the type of mounting recommended for the ConnectCard for i.MX28 to maximize both the vibration resistance and the ground connections via the stand-offs between the ConnectCard for i.MX28 and the board it is mounted on. The height of the standoffs will depend on the mini PCI Express Connector selected. The following table provides some examples.

### Stand-off heights based on Mini PCI Express Connectors

Mini PCI Express connector height	Stand-off height	Remarks
6.8 mm	4.4 mm	Used on development board
9.2 mm	6.8 mm	Also available

The heights of the mini PCI Express connector and the associated standoffs for the two examples in the [Stand-off heights based on Mini PCI Express Connectors](#) table are shown in millimeters below.



The SMT connectors are ideal in a development environment, where the latch connector facilitates swapping ConnectCard for i.MX28 modules as development progresses. The absence of holes also maximizes trace routing flexibility on the printed circuit board. The standoff option offers better vibration resistance and grounding once you are ready to deploy your application based on the ConnectCard for i.MX28.

## **Maximum power and frequency specifications**

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### **MAX POWER 17.5mW**

Frequencies:

13 overlapping channels each 22MHz wide and spaced at 5MHz. Centered at 2.412 to 2.472MHz

### **MAX POWER 62.4mW**

Frequencies:

165 overlapping channels each 22 or 40MHz wide and spaced at 5MHz. Centered at 5180 to 5825MHz