IoT Module

Design Specification

4117166
Rev 1
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Revision History

Revision number	Release date	Changes
1	June 2015	Creation (limited release)

Contents

List of Figures

List of Tables

1: Introduction

1.1 Overview

The IoT Module form factor represents an open hardware standard for sensors, network adapters, and other IoT technologies that can be "plugged" into host applications to provide new features and interfaces. As a family, IoT Modules share a standardized footprint and pinout, with several interfaces to support various IoT technologies.

1.2 Rationale for the IoT Module Form Factor

The IoT Module form factor is designed to be a cost-competitive solution for several current and emerging market demands for host applications, including:

- On-demand hardware applications—The same host application can be used for different market segments by including unique IoT Module solutions for each segment. For example, a Wi-Fi / Bluetooth solution for one segment and an environmental sensor for another segment.
- Electrical and feature compatibility across IoT technologies—Availability of several data interfaces allows support for various IoT solutions. For example, digital audio over PCM, application control and data transfer over USB, etc.
- Enables Configure/Built to Order
- Accommodates various PAN technologies, sensors, and other IoT applications

Using the IoT Module's modular design, all actors of the M2M value chain can benefit.

- Host applications can, without requiring redesign, inherit new features and interfaces for their products
- Technology specialists such as PAN, LPRF, Industrial Fieldbuses or sensors can bring their modules to market
- System integrators and end customers can easily combine host applications and IoT Modules to fit their specialized needs

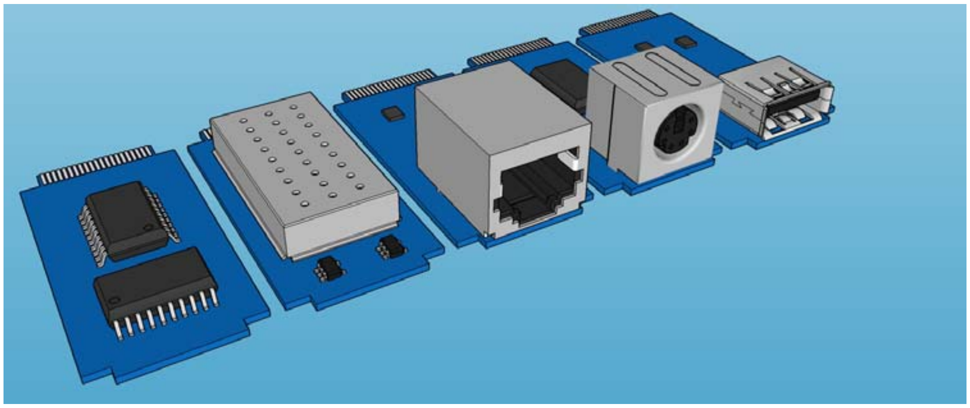

Figure 1-1: IoT Modules—Common footprint, variable designs

1.3 Specification Objective

This document defines a standard open-hardware pluggable module form factor specification. The specification describes supported interfaces and the mechanical design requirements (device-side and host-side) for building IoT Modules and integrating them into host applications.

1.4 Targeted Applications

The IoT Module form factor provides a common platform for OEMs to make a wide range of technologies available for use with IoT Module-compatible host applications. Some examples of technologies that could be implemented on IoT Modules include:

- PAN (Personal Area Network): WiFi, Bluetooth, Zigbee, etc.
- Common LAN/WAN: Ethernet, USB, Serial, etc.
- Low power and Low Power Long Range wireless technologies
- Industrial Fieldbuses: Modbus, Profibus, MPI, PPI
- Global Navigation Satellite Systems (GNSS)
- Specialized I/Os: Digital, Analog, Counting, PT1000, etc.
- Sensor networks
- Specialized sensors: Accelerometers, Temperature, Environment

1.5 IoT Module Characteristics

Key characteristics of the IoT Module specification include:

- Standard footprint
- Support for wide modules (up to 8 slots wide)
- Low-cost connectors
- Several available host interfaces:
  - ADC
  - GPIOs

- I2C
- I^2S
- PCM
- PPS Clock (Stratum 1)
- PWM
- SDIO
- SPI
- UART
- USB

1.6 Document Organization

- Technical Specifications—Environmental, EMC/ESD, and power specifications
- Interfaces Specification—Host interface details for all supported interfaces
- Mechanical / Form factor—Operational specifications, and hardware design (host and IoT Module) requirements
- Mounting methods—Mounting design details (host and IoT Module)
- Pinout—Connector pin details

2: Technical Specifications

2

2.1 Overview

This chapter describes environmental, EMC/ESD, and power specifications for IoT Modules.

2.2 Environmental Specifications

IoT Modules must satisfy the operational and non-operational environmental specifications defined in Table 2-1.

Table 2-1: Environmental Specifications

Parameter	Range	Operating Class
Ambient Operating Temperature	-30°C to +70°C	Class A—The host application and IoT Module remain fully functional across the specified temperature range, meeting the cellular performance requirements of ETSI or other appropriate wireless standards.
	-40°C to +85°C	Class B—The host application and IoT Module remain fully functional across the specified temperature range. Some cellular parameters may deviate from the performance requirements of ETSI or other appropriate wireless standards.
Ambient Storage Temperature	-40°C to +85°C	

2.3 Power Requirement

IoT Modules are powered by DC power provided by the host application via the pins (voltage rails) described in Table 2-2.

Table 2-2: Power Supply Pins

Pin	Name	Function	Specification	Notes
1	VCC_5V0	USB power supply/5V power supply	5.0V ± 10%, 500 mA	
11	VCC_1V8	1.8V power supply	1.8V ± 10%, 500 mA	
28	VCC_3V3	3.3V power supply	3.3V ± 10%, 500 mA	Each pin must be capable of 500 mA. IoT Modules may require up to 1 A total.
29	VCC_3V3	3.3V power supply	3.3V ± 10%, 500 mA	
Maximum combined power across all voltage rails (pins 1, 11, 28, 29)			3.3W	

2.3.1 Required Power-up Procedure

To prevent the possibility of latchup during the power-up sequence:

1. Host application must provide power rails (5V and 3.3V) first.
2. After power rails are provided, host application can provide I/O voltage (1.8V).

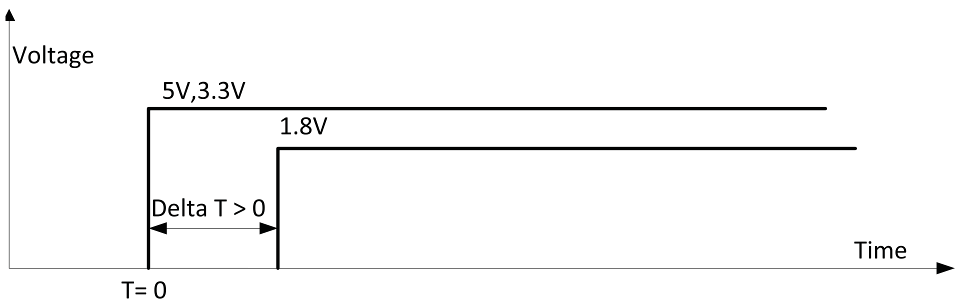

Figure 2-1: Power-up Sequence Timing

Note: Well-designed host applications will follow this procedure to make sure latchup will not occur. IoT Module developers may also include, if desired, latchup-resistant chips and/or a latchup protection technology (LPT) circuit to prevent latchup during the power-up sequence.

2.4 EMC and ESD Recommendations

When designing an IoT Module, make sure that potential EMC (Electromagnetic Compatibility) issues are considered, and appropriate ESD protection is incorporated in the design.

For example:

- Identify and mitigate possible spurious emissions radiated by the application to the host application's RF receiver in the receiver band.
- ESD protection is mandatory on the IoT Module on all externally-accessible signals, such as:
  - Serial link
  - USB
  - Antenna port
  - Ethernet
- Perform EMC/ESD tests on IoT Module board as soon as possible to detect potential issues
- Follow generic EMI mitigation philosophies
  - For high-speed buses, place decoupling capacitor close to IoT Module connector in case it is needed for signal speed reduction
  - Place bulk capacitors close to power rails. Ratings for these capacitors depend on the specific IoT Module design.

- Provide ESD protection ground strips underneath the IoT Module.
  Host applications should include ESD protection in the form of ground clips that engage with the IoT Module's ground protection strips.
  For details, see Mounting methods on page 37.
- If appropriate, place series resistors inline with high speed traces to drop speed and eliminate ringing effects. For example, place 33 Ω resistors inline on SDIO traces.

Table 2-3: ESD Specifications [1,2]

Category	Connection	Specification
Operational	Externally-accessible signals	IEC-61000-4-2 - Level (Electrostatic Discharge Immunity Test): • ± 15kV Contact • ± 6kV Air

1. ESD specifications are preliminary, subject to change.
2. ESD protection is highly recommended at the point where the UIM contacts are exposed, and for any other signals that would be subjected to ESD by the user.

3: Interfaces Specification

3

3.1 Overview

This chapter describes the interfaces supported by IoT Module form-factor devices and provides specific voltage, timing, and circuit recommendations for each interface.

3.2 IoT Module Platform Features

The IoT Module platform provides several interfaces for device control and data transfer:

- USB on page 19
- SDIO (Secure Digital Input/Output) Interface on page 20
- UART on page 20
- SPI Bus on page 21
- Reset Signal (n_RESET) on page 22
- ADC on page 22
- I2C Interface on page 22
- General Purpose Input/Output (GPIO) on page 23
- PWM on page 23
- n_CARD_DETECT on page 24
- Digital Audio on page 25
- Stratum Clock (PPS) on page 25

3.3 USB

The IoT Module supports one high-speed USB2.0 Interface that conforms to *[3] Universal Serial Bus Specification, Revision 2.0*. The interface may be used for application control and data transfer between the IoT Module and a host application.

Table 3-1: USB2.0 Interface Pins

Pin	Signal name	I/O[1]	Function	If unused	Voltage
1	VCC_5V0	I	USB power supply/5V power supply	No connect	
2	USB_D+	I/O	Differential data interface positive	No connect	
3	USB_D-	I/O	Differential data interface negative	No connect	

1. Direction with respect to IoT Module

3.4 SDIO (Secure Digital Input/Output) Interface

The IoT Module supports an SDIO interface that conforms to *[4] SD Specifications Part E1 SDIO Simplified Specification, Version 3.00*. The interface may be used for data communication between the IoT Module and a host application.

The IoT Module can incorporate an SDIO card or an embedded SDIO device, as identified in the EEPROM header (see EEPROM Header on page 30). The host application must identify the SDIO type and take appropriate steps to work with it (as described in the SDIO specification).

Table 3-2: SDIO Interface Pins

Pin	Signal name	I/O[1]	Function	If unused	Voltage
5	SDIO_CLK	I	SDIO clock	No connect	SDIO card: 2.7–3.6V Embedded SDIO device: 1.7–-1.95V or 2.7–3.6V See ([4] SD Specifications Part E1 SDIO Simplified Specification, Version 3.00 for details.
6	SDIO_CMD	I	Command/Response	No connect	
7	SDIO_DAT3/CD	I/O	Data 3/Card Detection	No connect	
8	SDIO_DAT2	I/O	Data 2	No connect	
9	SDIO_DAT1	I/O	Data 1	No connect	
10	SDIO_DAT0	I/O	Data 0	No connect	

1. Direction with respect to IoT Module

3.5 UART

The IoT Module supports a 4-wire UART interface. The interface may be used for data communication between the IoT Module and a host application.

Flow control is managed using the RTS/CTS signals, or using software XON/XOFF.

Table 3-3: UART Interface Pins

Pin	Signal name	I/O[1]	Function	If unused	Voltage
12	UART_TXD	O	UART Transmit Data	No connect	1.8V ± 10%
13	UART_RXD	I	UART Receive Data	No connect	
14	UART_CTS	I	UART Clear to Send	No connect	
15	UART_RTS	O	UART Ready to Send	No connect	

1. Direction with respect to IoT Module

3.6 SPI Bus

The IoT Module supports a 3/4/5-wire serial peripheral interface (SPI) that may be used for data communication between the IoT Module and a host application.

The following features are available on the SPI bus:

- Mode: Slave (Master mode is not supported)
- 3/4/5-wire interface

Note: Although the IoT Module supports 3, 4, and 5-wire implementations of the SPI bus, the module will only work if the host application supports the same architecture (number of signals, bus speed, data length) as the module.

Table 3-4: SPI Interface Pins

Pin	Signal name	I/O[1]	Function	If unused	Voltage
16	SPI_CLK	I	SPI serial clock	No connect	
17	SPI_MISO	O	SPI2 Master Input/ Slave Output (Data transfer from IoT Module to host application)	No connect	
18	SPI_MOSI	I	SPI Master Output/ Slave Input (Data transfer from host application to IoT Module)	No connect	1.8V ± 10%
19	SPI_SS/MRDY	I	SPI Slave Select	No connect	
26	SPI_SRDY (alternate function)	O	SPI Slave Ready	No connect	

1. Direction with respect to IoT Module

3.6.1 SPI Configuration

Table 3-5: SPI Configuration

Operation	Max Speed	SPI-Mode	Duplex	4-wire Type
Slave	Host application-dependent	0,1,2,3	Full	SCLK (SPI_CLK) MOSI (SPI_MOSI) MISO (SPI_MISO) SS (SPI1_SS/MRDY)

3.7 Reset Signal (n_RESET)

The IoT Module supports an interface that allows an external application to reset the device.

When the host application brings up the power rails for the IoT Module, n_RESET is pulled high.

To reset the IoT Module, the host must pulse n_RESET low.

Table 3-6: n_RESET Interface Pin

Pin	Signal name	I/O[1]	Function	If unused	Voltage
32	n_RESET	I	Active low reset from host application to IoT Module	No connect	1.8V ± 10%

1. Direction with respect to IoT Module

3.8 ADC

The IoT Module supports one general purpose Analog to Digital Converter (ADC) output.

The interface may be used for one-way (output) communication from the IoT Module to the host application. For example, ADC0 could be used as an indicator to the host application to notify when a specific analog event occurs (such as a sensor being triggered).

Table 3-7: ADC0 Interface Pin

Pin	Signal name	I/O[1]	Function	If unused	Voltage
20	ADC0	O	Analog to Digital Converter	No connect	1.8V ± 10%

1. Direction with respect to IoT Module

3.9 I^{2}C Interface

The IoT Module supports one I^{2}C (Inter-Integrated Circuit) interface. The interface may be used for data communication between the IoT Module and a host application.

The I^{2}C bus implemented on the IoT Module should support 100 kbps (standard mode) to be compatible with the widest variety of host applications. Higher speeds may also be implemented (for example, 400 kbps, 1 Mbps, etc.) but will only be attainable if also supported by the host application.

The I^{2}C interface has the following hardware requirements:

- Host application—All required pull-up resistors, including a weak pull-up for the I^{2}C bus, should be located on the host application, not on the IoT Module. Resistor values are host-dependent.

- IoT Module—A configuration EEPROM is required. For details, see n_CARD_DETECT on page 24 and EEPROM on page 30.

Table 3-8: I^{2}C Interface Pins

Pin	Signal name	I/O[1]	Function	If unused	Voltage
22	I2C_SDA	I/O	I^{2}C Data (Tx/Rx)	No connect	1.8V ± 10%
23	I2C_SCL	I	I^{2}C Clock	No connect	1.8V ± 10%

1. Direction with respect to IoT Module

3.10 General Purpose Input/Output (GPIO)

The IoT Module supports four GPIOs that may be used for data communication between the IoT Module and a host application.

Table 3-9: GPIO Pins

Pin	Signal name[1]	I/O[2]	Function	If unused	Voltage
24	GPIO_1	I/O	General purpose I/O	No connect	1.8V ± 10%
25	GPIO_2	I/O		No connect	1.8V ± 10%
26	GPIO_3	I/O		No connect	1.8V ± 10%
27	GPIO_4	I/O		No connect	1.8V ± 10%

1. Alternate functions available on these pins (pins 24–27: PWM; pin 26: SPI_SRDY)
2. Direction with respect to IoT Module

3.11 PWM

The IoT Module supports two signals for pulse width modulation (PWM), available as alternate functions for GPIO_1 and GPIO_2.

Table 3-10: PWM Pins

Pin	Signal name	I/O[1]	Function	If unused	Voltage
24	PWM1[2]	I	Pulse width modulation	No connect	1.8V ± 10%
25	PWM2[3]	I	Pulse width modulation	No connect	1.8V ± 10%
26	PWM3[4]	I	Pulse width modulation	No connect	1.8V ± 10%
27	PWM4[5]	I	Pulse width modulation	No connect	1.8V ± 10%

1. Direction with respect to IoT Module
2. Alternate function for GPIO_1
3. Alternate function for GPIO_2
4. Alternate function for GPIO_3
5. Alternate function for GPIO_4

Pulse width modulation involves modifying the frequency, duty cycle, and polarity of an output pulse, without CPU intervention, resulting in variation of the average value of the resulting waveform. Applications include driving DC motors and solenoids.

The PWM function output pulses are based on a set of parameters:

- Frequencies—Typically 1 Hz to 100 kHz
- Duty cycles—0–100%, with 0.01% resolution
- Polarity—Active-high or active-low

3.12 n_CARD_DETECT

The IoT Module provides a signal that is used by the host to detect when the IoT Module is inserted or removed from a slot on the host application.

Table 3-11: n_CARD_DETECT Pin

Pin	Signal name	I/O	Function	Voltage
31	n_CARD_DETECT	I/O	Host monitors the signal for a state change that indicates the module is inserted (active low), or removed (high)	1.8V ± 10%

Figure 4-5 on page 34 describes the process the host application uses to detect when IoT Modules are inserted or removed from slots on the host application.

All IoT Modules are assigned the same address (0x53) while they are inactive. When the host needs to work with a specific module, it accesses the appropriate slot and activates the module. When finished with a module, it is deactivated, and the host can then access another module if desired.

IoT Modules can be inserted before the host application boots, or while the host application is running. The host application monitors the slots on the application board waiting for state changes on the n_CARD_DETECT pins, which indicate that a module has been inserted or removed.

Note: IoT Modules that occupy more than one slot must use the n_CARD_DETECT pin in the first slot.

Note: n_CARD_DETECT must have a pull-up (≥47k) on the host. For details, see Recommended EEPROM Schematic on page 32 and Pull-up Resistors on page 36.

Table 3-12: n_CARD_DETECT States

State[1]	Logic state	Address pin A0 (level)	EEPROM address	Comments
Input	High	High	0x53	No IoT Module detected
Input	Low	High	0x53	IoT Module is inactive
Output	High	Low	0x52	IoT Module is active

1. Direction with respect to IoT Module

3.13 Digital Audio

The IoT Module supports a 4-wire digital audio interface that can be configured for either PCM (Pulse Code Modulation) or I^2S (Inter-IC Sound) audio.

Table 3-13: PCM/I^2S interface signals [1]

Pin	Signal name	I/O[2]	Function	If Unused
33	PCM_DIN	Output	PCM Data In The frame “data in” relies on the selected configuration mode.	Leave open
	I2S_IN		I2S Data In The frame “data in” relies on the selected configuration mode.	
34	PCM_DOUT	Input	PCM Data Out The frame “data out” relies on the selected configuration mode.	Leave open
	I2S_OUT		I2S Data Out The frame “data out” relies on the selected configuration mode.	
35	PCM_SYNC	Input	PCM Sync The frame synchronization signal delivers an 8 kHz frequency pulse that synchronizes the frame data in and the frame data out.	Leave open
	I2S_WS		I2S Word Select The word select clock indicates which channel is currently being transmitted (low cycle indicates left audio channel, high cycle indicates right audio channel).	
36	PCM_CLK	Input	PCM Clock The frame bit clock signal controls data transfer with the audio peripheral.	Leave open
	I2S_CLK		I2S Clock The frame bit clock signal controls data transfer with the audio peripheral.	

1. All values are preliminary and subject to change.
2. Direction with respect to IoT Module

3.14 Stratum Clock (PPS)

The IoT Module accepts a Stratum 1 clock input (PPS signal) from the host application. The host application should operate as a stratum 1 time source, connected to GPS (a stratum 0 source).

This signal can then be used to manage timing for sensor nodes (or other devices) that are attached to the IoT module.

Table 3-14: Clock interface pin descriptions

Pin	Signal name	I/O	I/O type	Description	If Unused
37	PPS	Input	1.8V	Stratum Clock 1 Pulse per second signal.	No connect

4: Mechanical / Form factor

4.1 Overview

This chapter describes mechanical specifications for the IoT Module and host devices.

4.2 Mechanical Dimensions

Figure 4-1 illustrates the space requirements between the IoT Module and a host application.

Thus, maximum component heights on the module's top and bottom face are:

- Top—TBD
- Bottom—2.5 mm (0.5 mm clearance required to host PCB)

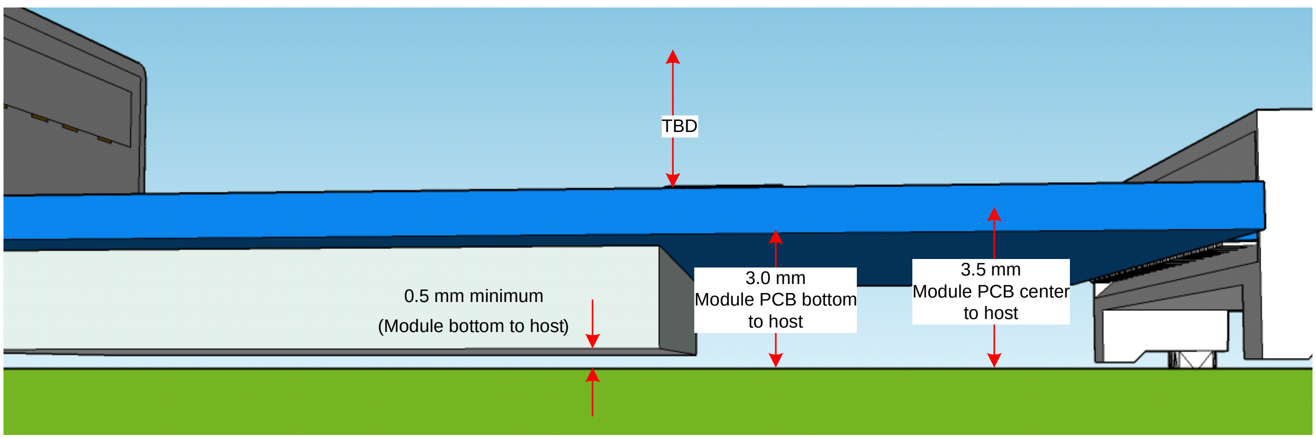

Figure 4-1: IoT Module Height Limits

IoT Modules may be designed to fit in 1–8 slots, depending on OEM design requirements. Figure 4-2 on page 28 and Figure 4-3 on page 29 describe the measurements for single-slot and double-slot IoT Modules respectively.

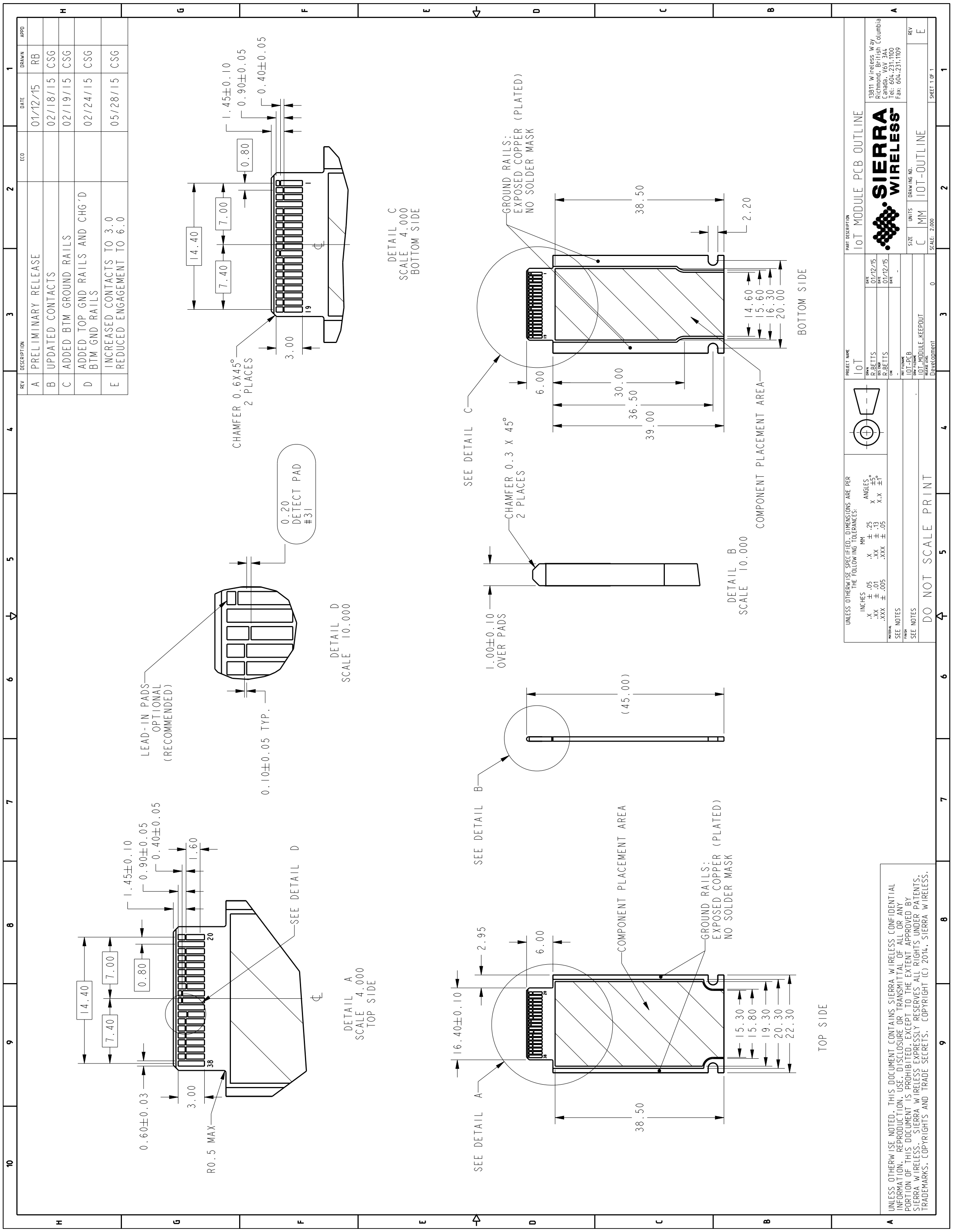

Figure 4-2: Single Slot Module Connector Details

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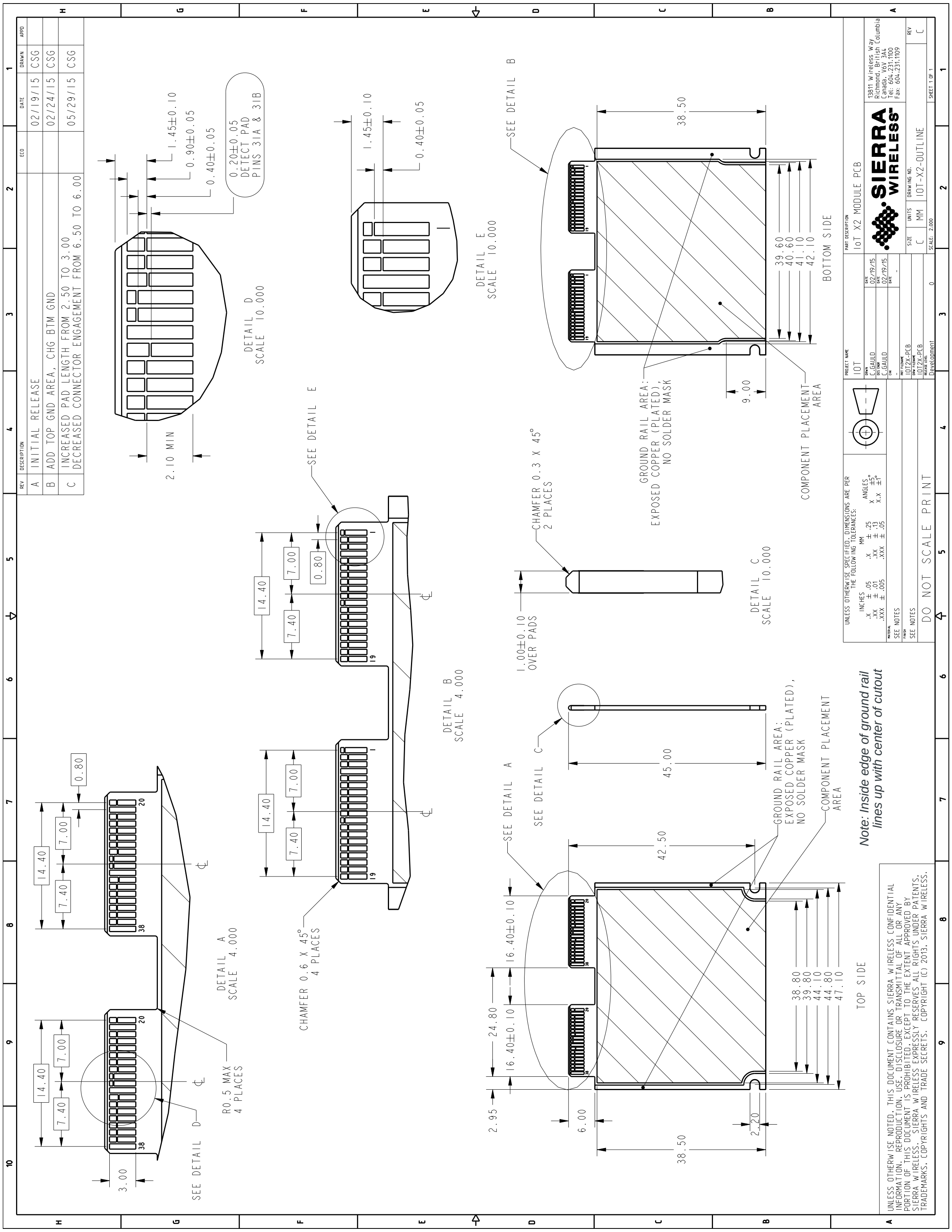

Figure 4-3: Double Slot Module Connector Details

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4.3 Module-side Requirements and Considerations

4.3.1 EEPROM

Each IoT Module is required to use an I2C EEPROM that meets the following specifications:

Table 4-1: EEPROM Requirements

Attribute	Requirement	Options / Restrictions
Model	24Cxx type 1.8V I2C EEPROM	Other model types are not supported (for example, 3.3V or 5V)
Addressing	16-bit only	• 8-bit and 24-bit addressing are not supported • Address when device is inactive: 0x52 • Address when device is active: 0x53
I2C mode support	100 kHz	OEM may also support higher speeds, which will only be usable if the host application also supports the higher speeds.
Memory paging	Not supported	Do not use paged type EEPROMs.
I2C clock stretching	Not supported	Do not use EEPROMs that perform I2C clock stretching
Write protect pin	Must be supported, and must protect the entire device memory	

EEPROMs satisfying these requirements are available from several vendors. One example is ON Semiconductor part # CAT24C32.

4.3.2 EEPROM Header

All IoT Modules must contain the following information in their EEPROMs.

Table 4-2: EEPROM Structure

Field	Address	Size (bytes)	Content
Header	0	2	0xAA, 0x55
Header Version	2	2	0x0001
Board Name	4	16	OEM-defined board description (in ASCII). Example: “IOT PAN module”

Table 4-2: EEPROM Structure (Continued)

Field	Address	Size (bytes)	Content
Serial Number	20	10	Serial number of the board. Format: YYMMDDnnnn • YY = 2 digit year of production • MM = 2 digit month of production • DD = 2 digit day of production • nnnn = incrementing board number
Number of slots	30	1	Board width • 1–8 • Note: 0 is reserved
Interfaces			
Slots used for I2C	31	1	• 0xNN bit mask of slots on which this interface is used • BitX = 0: Interface not used on slot X • BitX = 1: Interface used on slot X
Slots used for SPI	32	1	• 0xNN bit mask of slots on which this interface is used • BitX = 0: Interface not used on slot X • BitX = 1: Interface used on slot X
Slots used for UART	33	1	• 0xNN bit mask of slots on which this interface is used • BitX = 0: Interface not used on slot X • BitX = 1: Interface used on slot X
Slots used for GPIO	34	1	• 0xNN bit mask of slots on which this interface is used • BitX = 0: Interface not used on slot X • BitX = 1: Interface used on slot X
Slots used for SDIO	35	1	• 0xNN bit mask of slots on which this interface is used • BitX = 0: Interface not used on slot X • BitX = 1: Interface used on slot X
Slots used for PCM	36	1	• 0xNN bit mask of slots on which this interface is used • BitX = 0: Interface not used on slot X • BitX = 1: Interface used on slot X
Slots used for ADC	37	1	• 0xNN bit mask of slots on which this interface is used • BitX = 0: Interface not used on slot X • BitX = 1: Interface used on slot X
Power			
VCC_1V8	38	2	Current value in mA • 0 = Rail not used • Max value = 65534 (approx. 65A)

Table 4-2: EEPROM Structure (Continued)

Field	Address	Size (bytes)	Content
VCC_3V3	40	2	Current value in mA • 0 = Rail not used • Max value = 65534 (approx. 65A)
VCC_5V0	42	2	Current value in mA • 0 = Rail not used • Max value = 65534 (approx. 65A)
Additional fields			
SDIO type	44	1	SD device type • tbd = SDIO card • tbd = Embedded SDIO device

4.3.2.1 Recommended EEPROM Schematic

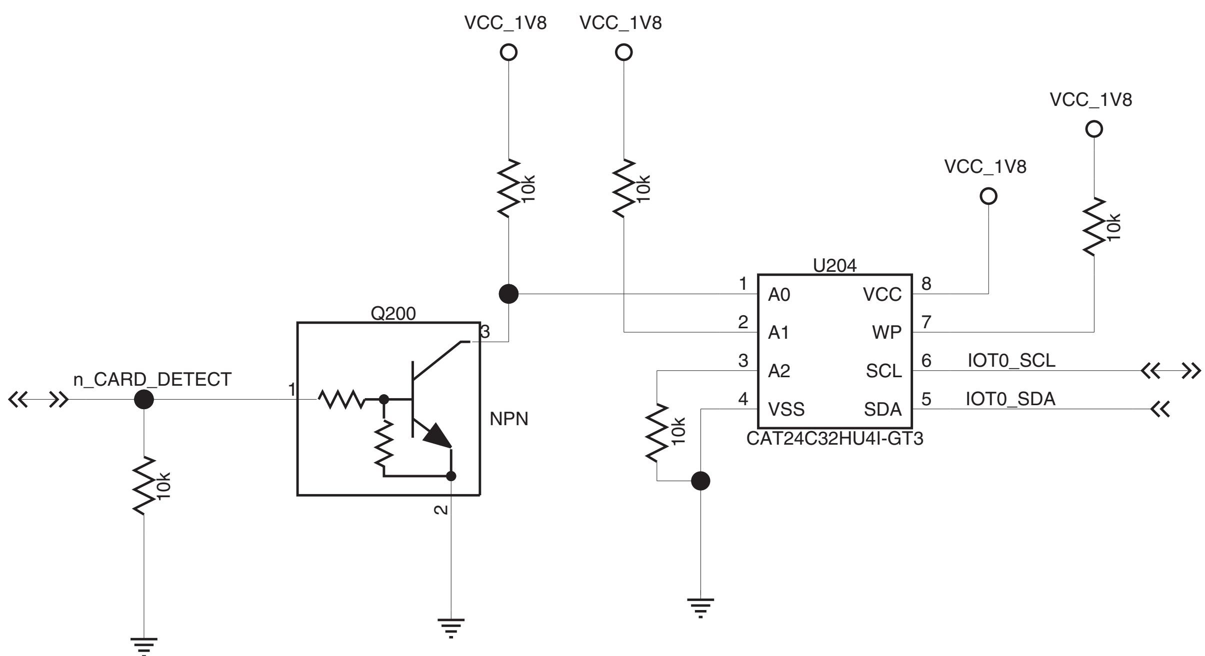

Figure 4-4: Schematic—Recommended EEPROM

Key EEPROM usage notes:

- Active device Address: 0x52
- Inactive Device Address: 0x53
- n_CARD_DETECT:
  - Tie to ground using a ≤10k pull-down resistor
  - Connect through the transistor to pin A0 on the EEPROM

4.4 Module Boot Process

When an IoT Module is detected, the host application reads the module's EEPROM header information (see EEPROM Header on page 30.) This includes the module's slot width (number of slots the module occupies), which the host needs to determine where each module is located. For example, if a 2-slot wide module is in slots 0–1, the host knows the next available slot is slot 2.

Figure 4-5 on page 34 illustrates the module boot process.

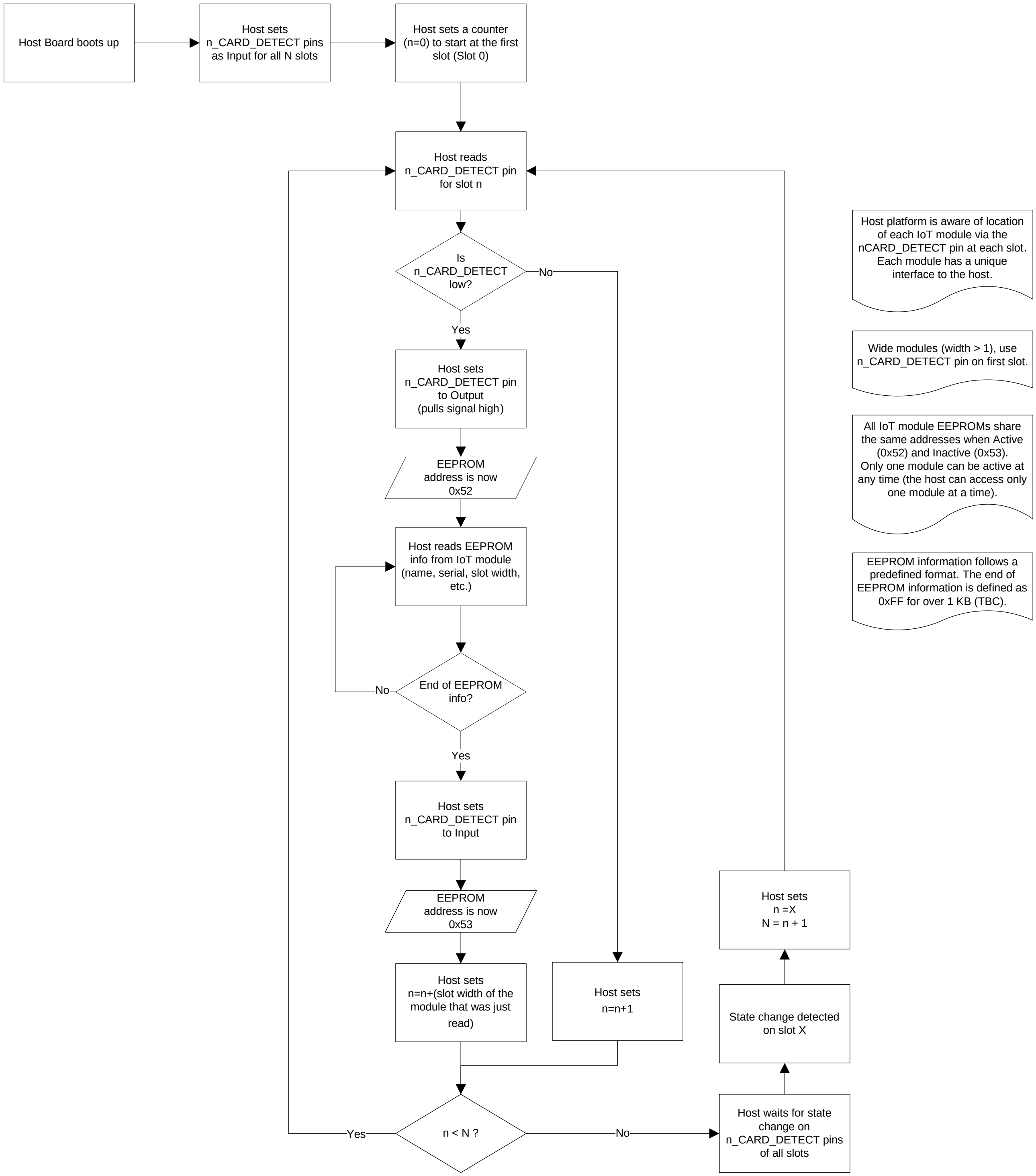

Figure 4-5: Host Process for IoT Module Detection

4.5 Host-side Requirements and Considerations

4.5.1 IoT Module Connector

IoT Modules connect to host applications via a QSFP+ connector mounted on the host application. This connector style was selected for ease of use, and wide commercial availability from multiple vendors.

The host application can be designed with as many connectors as desired—there is no prescribed limitation on the number of IoT Modules that a host application may support at one time.

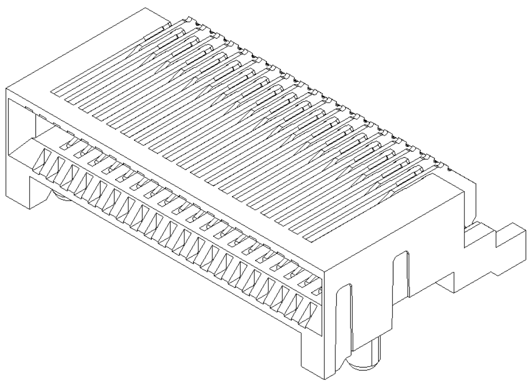

Figure 4-6: QSFP+ Connector

The QSFP+ connector standard is described in SFF-8436 Specification for QSFP+ 10 Gbs 4X Pluggable Transceiver (Standardized as EIA-964 at Rev 4.8 dated October 31, 2013)

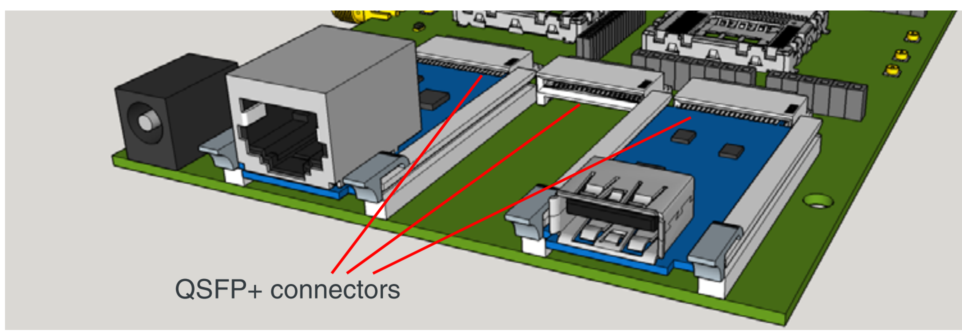

Figure 4-7: Installed QSFP+ Connectors

4.5.2 IoT Module Mounts

IoT Modules are mounted on host applications using one of three methods:

- Screwed into spacers
- Screwed into soldered standoffs
- Plugged in via rails

For details, see Mounting methods on page 37.

4.6 Pull-up Resistors

All required pull-up resistors (for example, for the I2C interface and n_CARD_DETECT) should be located on the host application, not on the IoT Module.

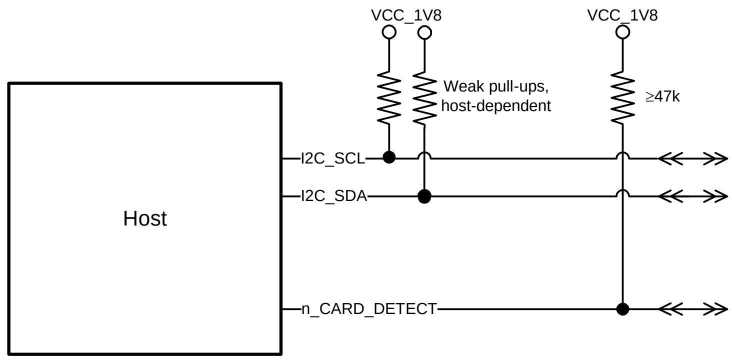

Figure 4-8: Host-side Pull-up Resistor Requirements

5: Mounting methods

5

5.1 Overview

This chapter describes methods and hardware specifications for mounting IoT Modules in Host applications.

IoT Module modules are designed to be mounted in host applications via three methods to meet customer requirements:

- Plug in via IoT Module rails. 3D-printing files are available at source.sierrawireless.com, and molded versions will be made available in future.
- Screwed into platform via spacers
- Screwed into platform via soldered standoffs

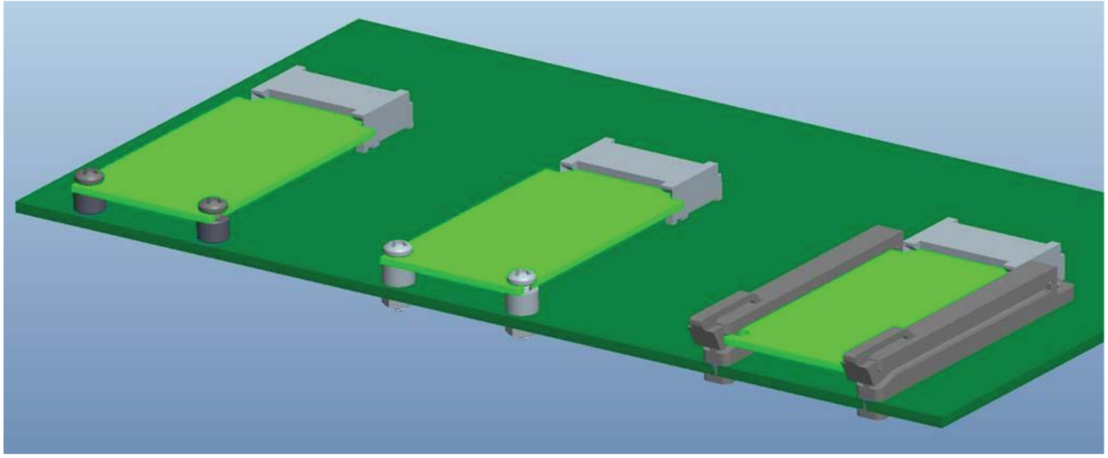

Figure 5-1: Module Mounting Methods

Figure 5-1, Module Mounting Methods, on page 37 and Figure 5-2, Host-side Mounting Types, on page 38 provide detailed specifications for the various mounting types.

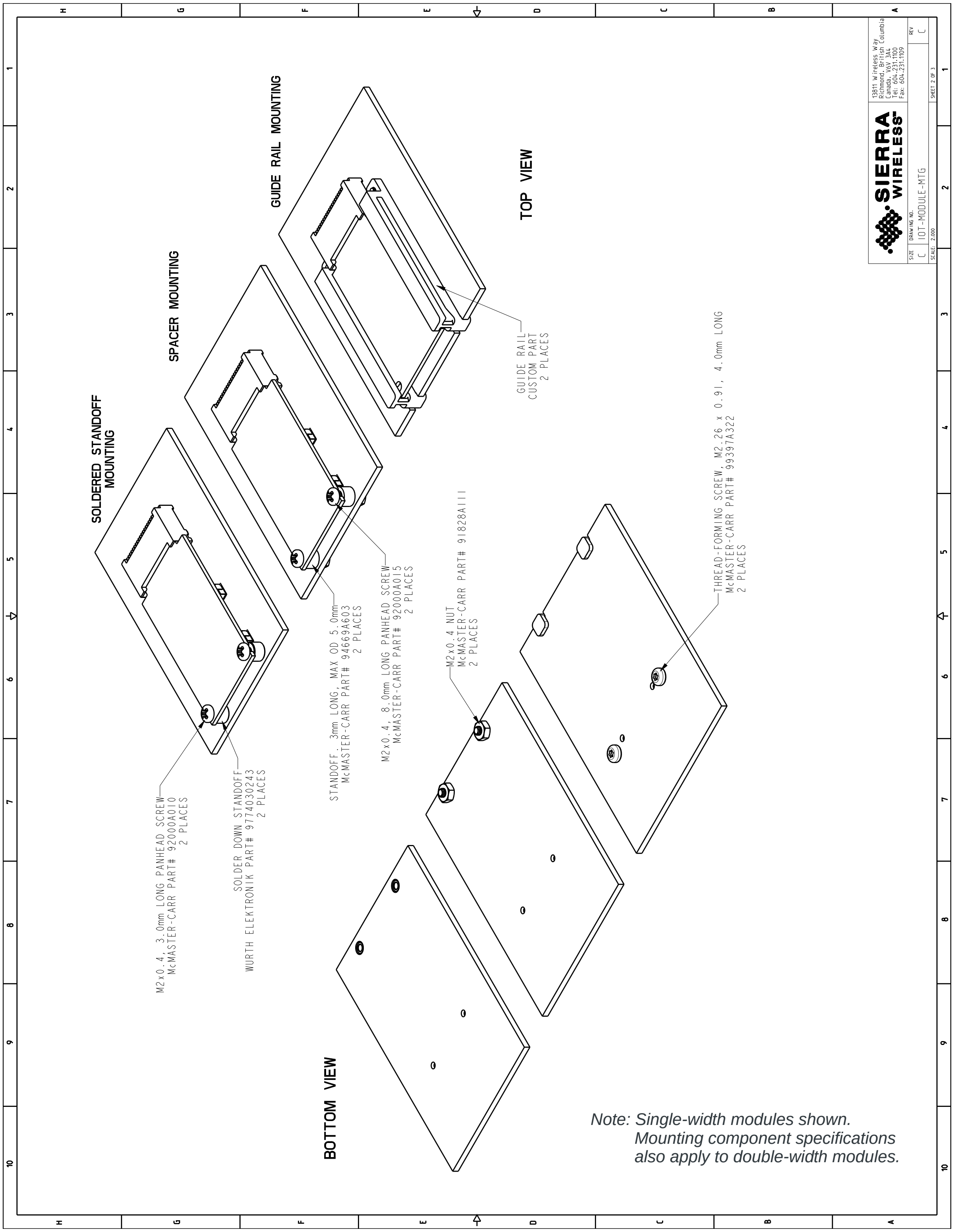

Figure 5-2: Host-side Mounting Types

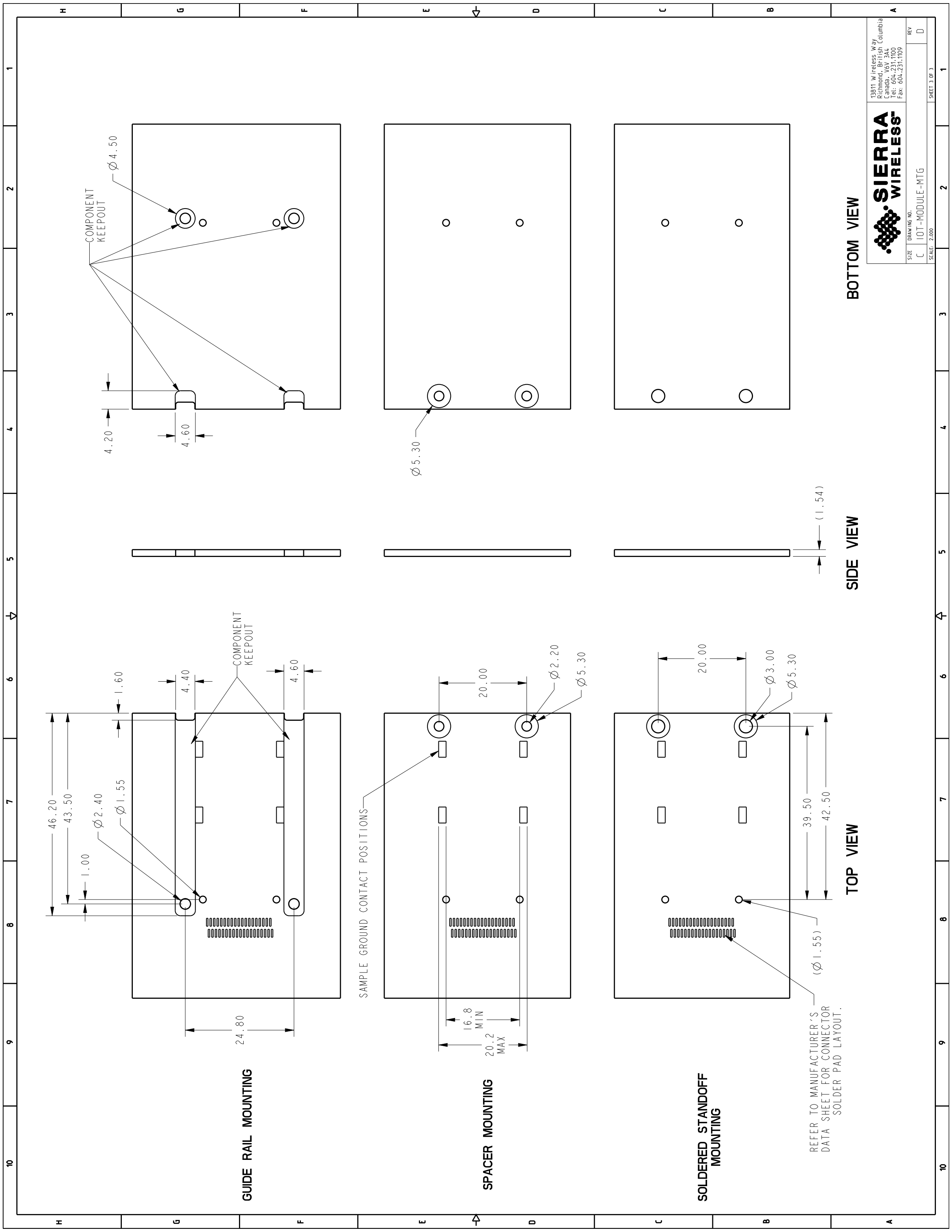

Figure 5-3: Module-side Mounting Details (Single-width Modules)

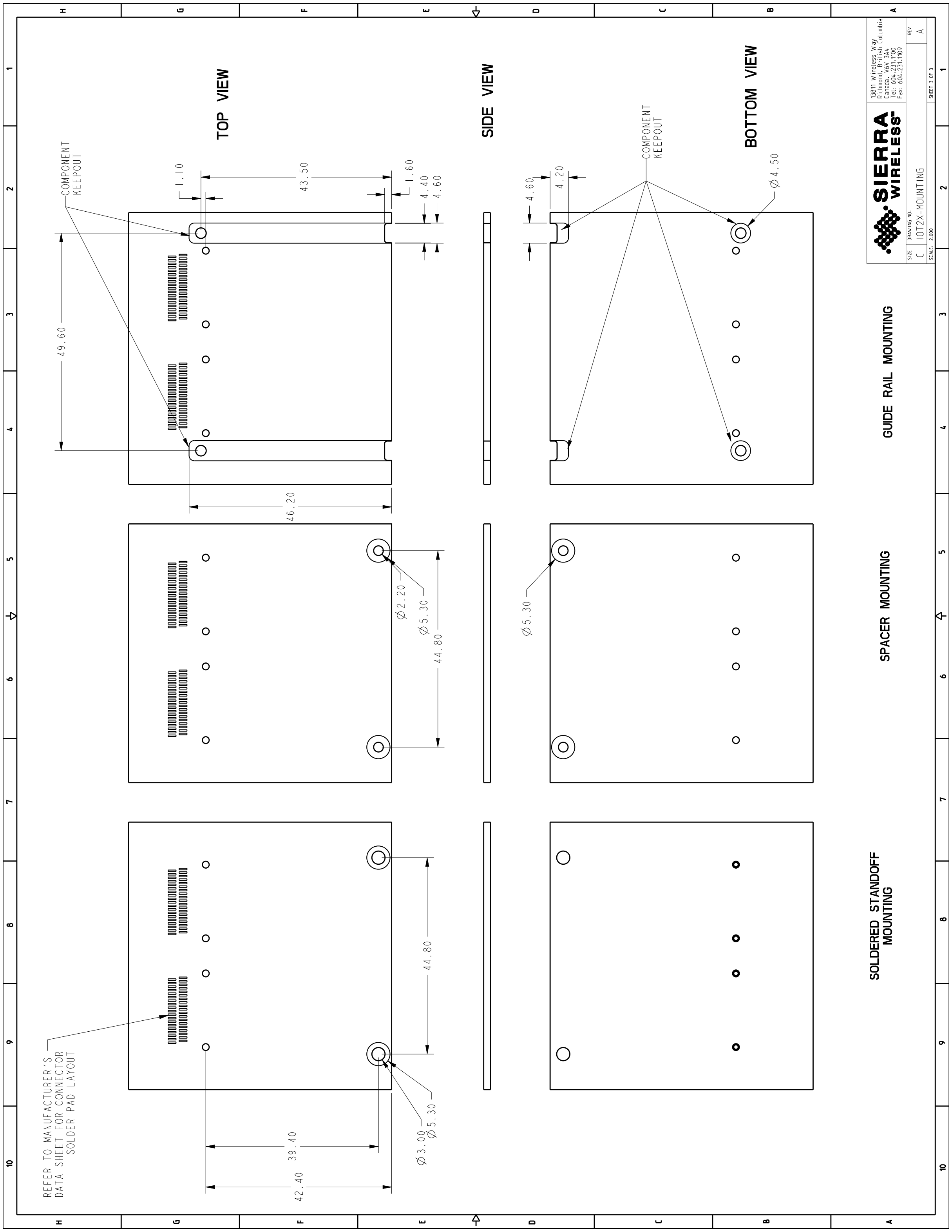

Figure 5-4: Module-side Mounting Details (Double-width Modules)

5.2 ESD Protection

IoT Module mounts on the host application require ground protection appropriate to the mounting method:

- Mounting screws—Either ground the mounting screws, or install grounding clips as described below.
- IoT Module rails—Install grounding clips as described below.

5.2.1 Grounding Clips

IoT Modules are designed with copper strips on their bottom side as shown in Figure 5-6 on page 43. A host application can use these strips for grounding by installing grounding clips as shown in Figure 5-5 on page 42. (ITT Cannon Universal Contact, 4mm, part #120220-0206, or equivalent)

When the module is connected to the host, the grounding clips are in contact with the module's copper strips, thus providing protection against ESD zap.

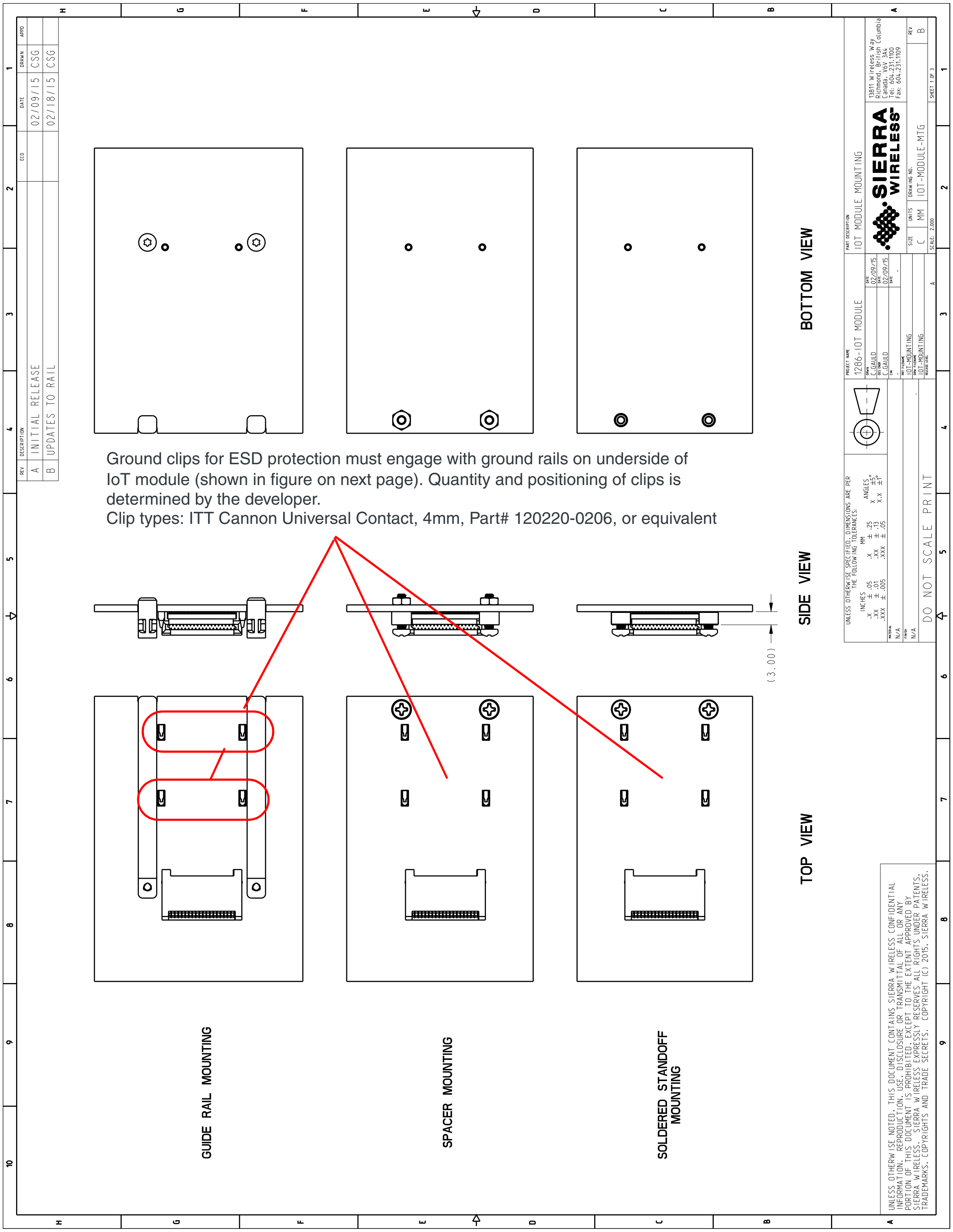

Figure 5-5: Host-side ESD Protection

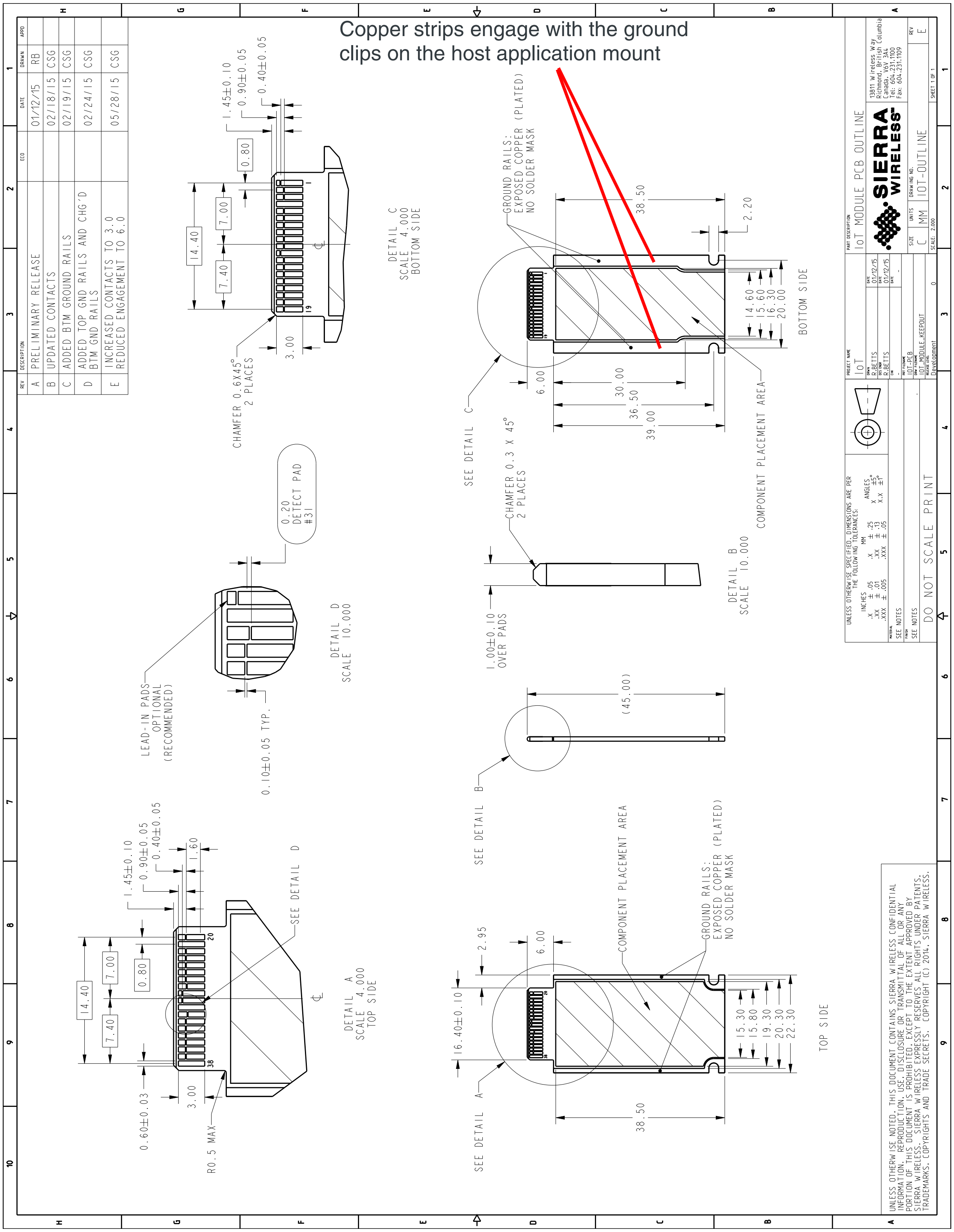

Figure 5-6: IoT Module ESD Protection

6: Pinout

6.1 Overview

The system interface of the IPM is through the gold-plated contacts on the end of the connector (19 on bottom, 19 on top).

6.2 Pin Configuration

Figure 6-1 illustrates the IoT Module's connector pin locations.

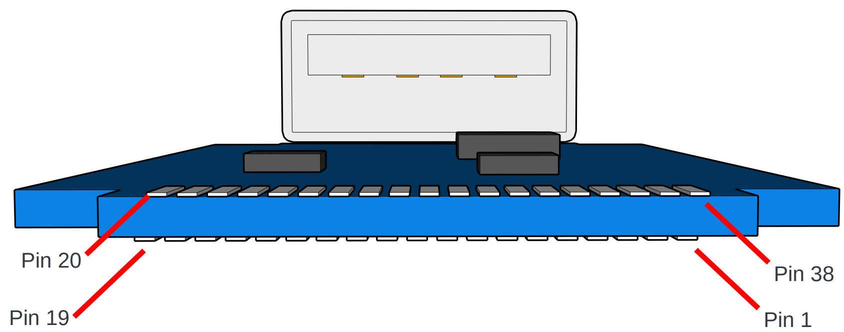

Figure 6-1: IoT Module Connector Pin Locations

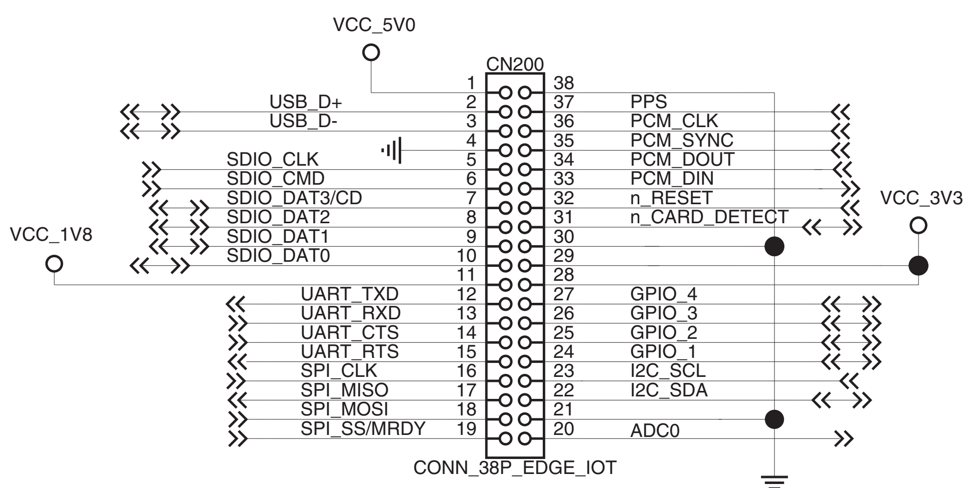

Figure 6-2: Edge Connector Schematic—Module View

6.3 Pin Definitions

Table 6-1 lists detailed information for the IoT Module's pin connector.

Table 6-1: Pin Definitions

Pin	Group	Signal name	Function	Voltage / Current	I/O[1]
Module bottom side					
1	Power	VCC_5V0	USB power supply / 5V power supply	5.0V, 500mA	I
2	USB	USB_D+	USB Data positive	See ([3] Universal Serial Bus Specification, Revision 2.0)	I/O
3	USB	USB_D-	USB Data negative		I/O
4	Power	GND	Ground		-
5	SDIO	SDIO_CLK	SDIO Clock	SDIO card: 2.7–3.6V Embedded SDIO device: 1.7–-1.95V or 2.7–3.6V See ([4] SD Specifications Part E1 SDIO Simplified Specification, Version 3.00 for details.	I
6	SDIO	SDIO_CMD	Command / Response		I
7	SDIO	SDIO_DAT3/CD	Data 3 / Card Detection		I/O
8	SDIO	SDIO_DAT2	Data 2		I/O
9	SDIO	SDIO_DAT1	Data 1		I/O
10	SDIO	SDIO_DAT0	Data 0		I/O
11	Voltage reference	VCC_1V8	GPIO voltage output	1.8V ±10%	I
12	UART	UART_TXD	UART Transmit data	1.8V ±10%	O
13	UART	UART_RXD	UART Receive data	1.8V ±10%	I
14	UART	UART_CTS	UART Clear to Send	1.8V ±10%	I
15	UART	UART_RTS	UART Ready to Send	1.8V ±10%	O
16	SPI	SPI_CLK	SPI clock	1.8V ±10%	I
17	SPI	SPI_MISO	SPI master RX data	1.8V ±10%	O
18	SPI	SPI_MOSI	SPI master TX data	1.8V ±10%	I
19	SPI	SPI_SS / MRDY	SPI Slave Select/ Master Ready	1.8V ±10%	I
Module top side					
20	Analog	ADC0	Analog to Digital Converter	1.8V max	O
21	Power	GND	Ground		-
22	I2C	I2C_SDA	I2C Tx/Rx data	1.8V ±10%	I/O
23	I2C	I2C_SCL	I2C Clock	1.8V ±10%	I

Table 6-1: Pin Definitions

Pin	Group	Signal name	Function	Voltage / Current	I/O[1]
24	GPIO	GPIO_1	General purpose I/O	1.8V ±10%	I/O
	PWM	PWM1	Pulse width modulation		I
25	GPIO	GPIO_2	General purpose I/O	1.8V ±10%	I/O
	PWM	PWM2	Pulse width modulation		I
26	GPIO	GPIO_3	General purpose I/O	1.8V ±10%	I/O
	PWM	PWM3	Pulse width modulation		I
	SPI	SPI_SRDY	SPI Slave Ready		O
27	GPIO	GPIO_4	General purpose I/O	1.8V ±10%	I/O
	PWM	PWM4	Pulse width modulation		I
28	Power	VCC_3V3	3.3V	3.3V ±10%, 500mA	I
29	Power	VCC_3V3	3.3V	3.3V ±10%, 500mA	I
30	Power	GND	Ground		-
31	DETECT	n_CARD_DETECT	Card detect: Active low detect	1.8V ±10%	I/O
32	Reset	n_RESET	Reset module	1.8V ±10%	I
33	PCM	PCM_DIN	PCM Data IN (Input to Host)	1.8V ±10%	O
	I2S	I2S_IN	I2S Data In (Input to Host)		O
34	PCM	PCM_DOUT	PCM Data OUT (Output from Host)	1.8V ±10%	I
	I2S	I2S_OUT	I2S Data Out (Output from Host)		I
35	PCM	PCM_SYNC	PCM Synchronization	1.8V ±10%	I
	I2S	I2S_WS	I2S Word Select		I
36	PCM	PCM_CLK	PCM Clock	1.8V ±10%	I
	I2S	I2S_CLK	I2S Clock		I
37	Clock	PPS	Stratum Clock 1	1.8V ±10%	I
38	Power	GND	Ground		-

1. Direction with respect to IoT Module

7: References

7

For more details, see the references listed below.

7.1 Web Site Support

Check the Sierra Wireless Developer Zone at source.sierrawireless.com for the latest documentation available for the IoT Module.

7.2 Reference Documents

[1] High-Speed Inter-Chip USB Electrical Specification, Version 1.0 (a supplement to the USB 2.0 specification)

[2] Legato.io for Legato API details

[3] Universal Serial Bus Specification, Revision 2.0

[4] SD Specifications Part E1 SDIO Simplified Specification, Version 3.00

[5] RS232 Interface Specification

[6] I^2C Specification

8: Abbreviations

Table 8-1: Acronyms and definitions

Acronym or term	Definition
3GPP	3rd Generation Partnership Project
ADC	Analog to Digital Converter
Bluetooth	Wireless protocol for data exchange over short distances
CLK	Clock
CPU	Central Processing Unit
CTS	Clear To Send
DC	Direct Current
DCD	Data Carrier Detect
EEPROM	Electrically Erasable Programmable Read-Only Memory
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharges
ETSI	European Telecommunications Standards Institute
GND	Ground
GNSS	Global Navigation Satellite Systems (GPS, GLONASS, BeiDou, and Galileo)
GPIO	General Purpose Input Output
Host	The device into which an IoT Module is inserted
Hz	Hertz = 1 cycle/second
I/O	Input/Output
I2C	Inter-Integrated Circuit
I^2S	Inter-IC Sound
IoT	Internet of Things
kHz	Kilohertz = 10e3 Hz
LAN	Local Area Network
LPRF	Low-Power RF
LPT	Latchup Protection Technology
M2M	Machine to Machine
MHz	Megahertz = 10e6 Hz
OEM	Original Equipment Manufacturer—a company that manufactures a product and sells it to a reseller.

Table 8-1: Acronyms and definitions (Continued)

Acronym or term	Definition
PAN	Personal Area Network
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
PPS	Pulse Per Second
PWM	Pulse Width Modulation
RTS	Request To Send
RX	Receive
SDIO	Secure Digital Input/Output
SPI	Serial Peripheral Interface
TBC	To Be Confirmed
TBD	To Be Determined
TX	Transmit
UART	Universal Asynchronous Receiver-Transmitter
USB	Universal Serial Bus
VCC	Supply voltage
WAN	Wide Area Network

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