

# **SBC-IOT-iMX8**

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Reference Guide



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**Table 1 Document Revision Notes**

Date	Description
May 2020	<ul style="list-style-type: none"><li>• First release</li></ul>
July 2020	<ul style="list-style-type: none"><li>• Added P41 pin-out table in section 5.8</li><li>• Added connector pin numbering in sections 5.3 and 5.9</li></ul>
August 2020	<ul style="list-style-type: none"><li>• Added industrial I/O add-on sections 3.10 and 5.10</li></ul>
September 2020	<ul style="list-style-type: none"><li>• Fixed LED GPIO number in section 5.11</li></ul>
February 2021	<ul style="list-style-type: none"><li>• Removed legacy section</li></ul>

# 1 INTRODUCTION

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## 1.1 About This Document

This document is part of a set of documents providing information necessary to operate and program Compulab SBC-IOT-iMX8.

## 1.2 Related Documents

For additional information not covered in this manual, please refer to the documents listed in Table 2.

**Table 2 Related Documents**

Document	Location
SBC-IOT-iMX8 design resources	<a href="https://www.compulab.com/products/sbcs/sbc-iot-imx8-nxp-i-mx8m-mini-internet-of-things-single-board-computer/#devres">https://www.compulab.com/products/sbcs/sbc-iot-imx8-nxp-i-mx8m-mini-internet-of-things-single-board-computer/#devres</a>

## 2 OVERVIEW

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### 2.1 Highlights

- NXP i.MX8M Mini CPU, quad-core Cortex-A53
- Up-to 4GB RAM and 128GB eMMC
- LTE modem, WiFi 802.11ax, Bluetooth 5.1
- 2x Ethernet, 3x USB2, RS485 / RS232, CAN-FD
- Custom I/O expansion boards
- Designed for reliability and 24/7 operation
- Wide temperature range of -40C to 80C
- 5 year warranty and 15 year availability
- Wide input voltage range of 8V to 36V
- Debian Linux and Yocto Project

## 2.2 Specifications

**Table 3 CPU, RAM and Storage**

Feature	Specifications
CPU	NXP i.MX8M Mini, quad-core ARM Cortex-A53, 1.8GHz
Real-Time Co-processor	ARM Cortex-M4
RAM	1GB – 4GB, LPDDR4
Primary Storage	4GB - 64GB eMMC flash, soldered on-board
Secondary Storage	16GB - 64GB eMMC flash, optional module

**Table 4 Network**

Feature	Specifications
LAN	1x 1000Mbps Ethernet port, RJ45 connector
	1x 100Mbps Ethernet port, RJ45 connector
WiFi	802.11ax WiFi interface Intel WiFi 6 AX200 module
Bluetooth	Bluetooth 5.1 BLE Intel WiFi 6 AX200 module
Cellular	4G/LTE CAT1 cellular module, Simcom SIM7600G * via mini-PCIe socket
	On-board micro-SIM card socket
GNSS	GPS / GLONASS Implemented with Simcom SIM7600G module

**Table 5 I/O and System**

Feature	Specifications
PCI Express	mini-PCIe socket, full-size * mutually exclusive with WiFi/BT module
USB	3x USB2.0 ports, type-A connectors
Debug	1x serial console via UART-to-USB bridge, micro-USB connector
Serial	1x RS485 (2-wire) / RS232 port, terminal-block
Interface add-on	Up-to 2x CAN-FD   RS485   RS232 ports Isolated, terminal-block connector * implemented with add-on board
Digital I/O add-on	4x digital outputs + 4x digital inputs Compliant with EN 61131-2, isolated, terminal-block connector * implemented with add-on board
Expansion Connector	Expansion connector for add-on boards 2x SPI, 2x UART, I2C, 12x GPIO
Security	Secure boot, implemented with i.MX8M Mini HAB module
RTC	Real time clock operated from on-board coin-cell battery



**Table 6 Electrical, Mechanical and Environmental**

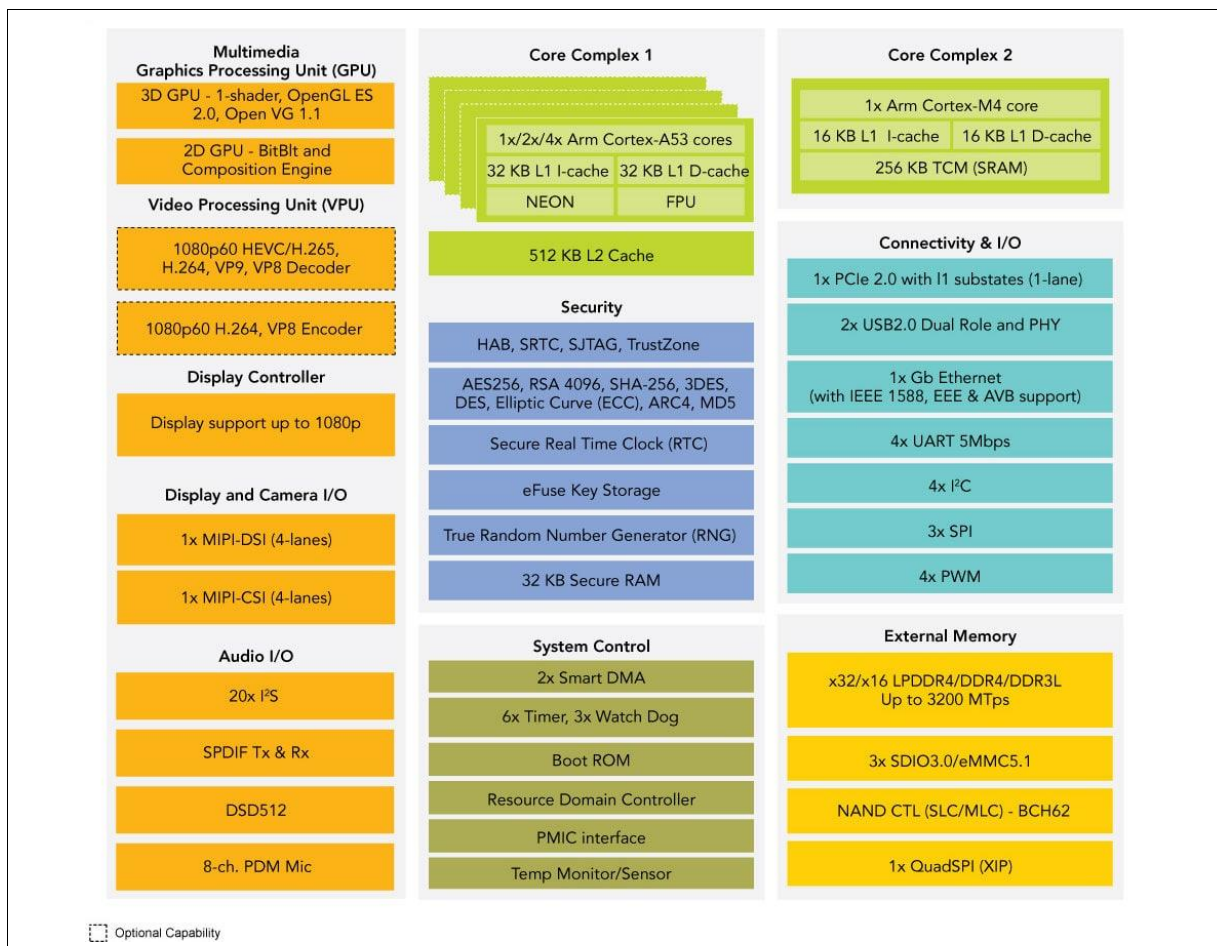
Supply Voltage	Unregulated 8V to 36V
Power Consumption	2W - 7W, depending on system load and configuration
Dimensions	104 x 80 x 23 mm
Weight	150 grams
MTTF	> 200,000 hours
Operation temperature	Commercial: 0° to 60° C Extended: -20° to 60° C Industrial: -40° to 80° C

### 3 CORE SYSTEM COMPONENTS

#### 3.1 NXP i.MX8M Mini SoC

The NXP i.MX8M Mini family of processors features advanced implementation of a quad ARM® Cortex®-A53 core, which operates at speeds of up to 1.8 GHz. A general purpose Cortex®-M4 core processor enables low-power processing.

**Figure 1 i.MX8M Mini Block Diagram**



#### 3.2 System Memory

##### 3.2.1 DRAM

SBC-IOT-iMX8 is available with up-to 4GB of on-board LPDDR4 memory.

##### 3.2.2 Primary Storage

SBC-IOT-iMX8 features up-to 64GB of soldered on-board eMMC memory for storing the boot-loader and operating system (kernel and root filesystem). The remaining eMMC space can be used to store general purpose (user) data.

### 3.2.3 Secondary Storage

SBC-IOT-iMX8 features an optional eMMC module which allows to expand the system non-volatile memory for storing additional data, back-up of the primary storage or installation of a secondary operating system. The eMMC module is installed in socket P14.

### 3.3 WiFi and Bluetooth

SBC-IOT-iMX8 can be optionally assembled with the Intel WiFi 6 AX200 module providing 2x2 WiFi 802.11ax and Bluetooth 5.1 interfaces.

AX200 module is assembled in mini-PCIe socket #1 (P6).

### 3.4 Cellular and GPS

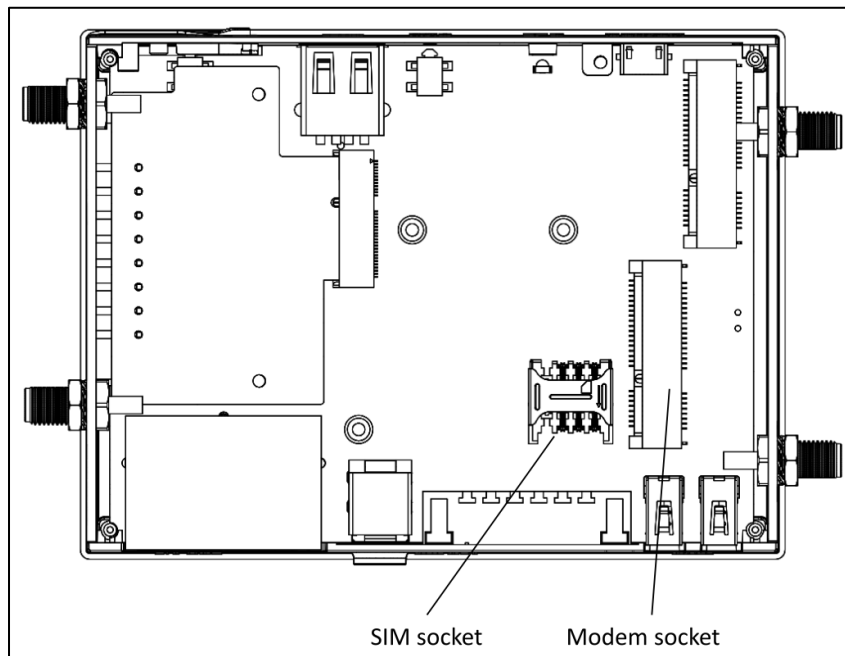
SBC-IOT-iMX8 cellular interface is implemented with a mini-PCIe modem module and a micro-SIM socket. In order to setup SBC-IOT-iMX8 for cellular functionality install an active SIM card into micro-SIM socket P12. The cellular module should be installed into mini-PCIe socket P8.

The cellular modem module also implements GNSS / GPS.

CompuLab supplies SBC-IOT-iMX8 with the following cellular modem options:

- 4G/LTE CAT1 module, Simcom SIM7600G (global bands)

**Figure 2 service bay - cellular modem**



### 3.5 Ethernet

SBC-IOT-iMX8 incorporates two Ethernet ports:

- ETH1 - primary 1000Mbps port implemented with i.MX8M Mini MAC and Atheros AR8033 PHY
- ETH2 – secondary 100Mbps port implemented with Microchip LAN9514 controller

The Ethernet ports are available on dual RJ45 connector P46.

### 3.6 USB 2.0

SBC-IOT-iMX8 features three external USB2.0 host ports. The ports are routed to USB connectors P3, P4 and J4. Front panel USB port (J4) is implemented directly with the i.MX8M Mini native USB interface. Back panel ports (P3, P4) are implemented with the on-board USB hub.

### 3.7 RS485 / RS232

SBC-IOT-iMX8 features a user configurable RS485 / RS232 port implemented with the SP330 transceiver connected to NXP i.MX8M Mini UART port. Port signals are routed to terminal block connector P7.

### 3.8 Serial Debug Console

SBC-IOT-IMX8 features a serial debug console via UART-to-USB bridge over micro USB connector P5. CP2104 UART-to-USB bridge is interfaced with i.MX8M Mini UART port. CP2104 USB signals are routed to micro USB connector located on the front panel.

### 3.9 I/O Expansion interface

SBC-IOT-iMX8 expansion interface is available on M.2 Key-E socket P41. The expansion connector allows to integrate custom I/O add-on boards into SBC-IOT-iMX8. The expansion connector features a set of embedded interfaces such as I2C, SPI, UART and GPIOs. All the interfaces are derived directly from the i.MX8M Mini SoC.

### 3.10 Industrial I/O add-on

IOT-GATE-iMX8 can be optionally assembled with the industrial I/O add-on board installed into the I/O expansion socket. The industrial I/O add-on features up-to three separate I/O modules which allow to implement different combinations of isolated CAN, RS485, RS232, digital outputs and inputs. The following table shows the supported I/O combinations and ordering codes.

**Table 7 Industrial I/O add-on – supported combinations**

	Function	Ordering Code
I/O module A	RS232 (rx/tx)	FARS2
	RS485 (2-wire)	FARS4
	CAN-FD	FACAN
I/O module B	RS232 (rx/tx)	FBR2
	RS485 (2-wire)	FBR4
	CAN-FD	FBCAN
I/O module C	4x DI + 4x DO	FCDIO

Combination examples:

- For 2x RS485 the ordering code will be IOTG-IMX8-...-FARS4-FBR4-...

- For RS485 + CAN + 4xDI+4xDO ordering code will be IOTG-IMX8-...-FARS4-FBCAN-FCDIO-...

For connector details please refer to section 5.9

### 3.10.1 RS485

RS485 function is implemented with MAX13488 transceiver interfaced with i.MX8M-Mini UART port. Key characteristics:

- 2-wire, half-duplex
- Galvanic isolation from main unit and other I/O modules
- Programmable baud rate of up-to 4Mbps
- Software controlled 120ohm termination resistor

### 3.10.2 CAN-FD

CAN function is implemented with MCP2518FD controller interfaced with i.MX8M-Mini SPI port.

- Supports both CAN 2.0B and CAN FD modes
- Galvanic isolation from main unit and other I/O modules
- Data rate of up to 8Mbps

### 3.10.3 RS232

RS232 function is implemented with MAX3221 (or compatible) transceiver interfaced with i.MX8M-Mini UART port. Key characteristics:

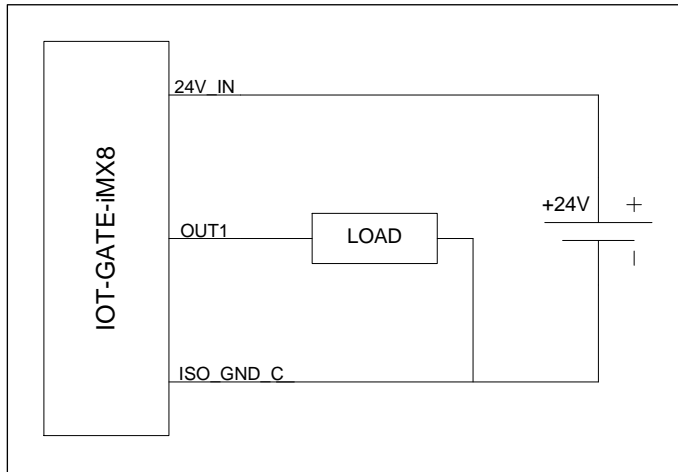
- RX/TX only
- Galvanic isolation from main unit and other I/O modules
- Programmable baud rate of up-to 250kbps

### 3.10.4 Digital inputs and outputs

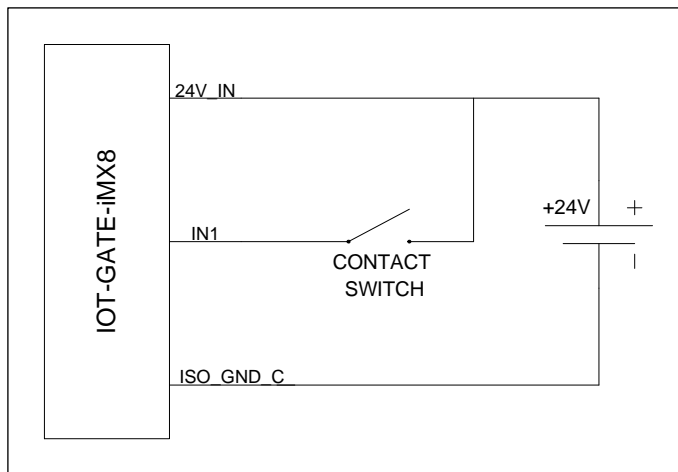
Four digital inputs are implemented with the CLT3-4B digital termination in accordance with EN 61131-2. Four digital outputs are implemented with the VNI4140K solid state relay in accordance with EN 61131-2. Key characteristics:

- External supply voltage up-to 24V
- Galvanic isolation from main unit and other I/O modules
- Digital outputs maximal output current – 0.5A per channel

**Figure 3 Digital output – typical wiring example**



**Figure 4 Digital input – typical wiring example**



## 4 SYSTEM LOGIC

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### 4.1 Power Subsystem

#### 4.1.1 Power Rails

SBC-IOT-iMX8 is powered with a single power rail with input voltage range of 8V to 36V.

#### 4.1.2 Power Modes

SBC-IOT-iMX8 supports two hardware power modes.

**Table 8 Power modes**

Power Mode	Description
ON	All internal power rails are enabled. Mode entered automatically when main power supply is connected.
OFF	i.MX8M Mini core power rails are off, most of the peripherals power rails are off.

#### 4.1.3 RTC Back-Up Battery

SBC-IOT-iMX8 features a 120mAh coin cell lithium battery, which maintains the on-board RTC whenever the main power supply is not present.

### 4.2 Real Time Clock

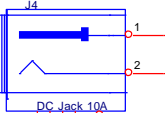
The SBC-IOT-iMX8 RTC is implemented with the AM1805 real time clock (RTC). The RTC is connected to the i.MX8M SoC using I2C2 interface at address 0xD2/D3. SBC-IOT-iMX8 backup battery keeps the RTC running to maintain clock and time information whenever the main power supply is not present.

## 5 INTERFACES AND CONNECTORS

### 5.1 DC Power Jack (J1)

DC power input connector.

**Table 9 J1 connector pin-out**

Pin	Signal Name	
1	DC IN	
2	GND	

**Table 10 J1 connector data**

Manufacturer	Mfg. P/N
Contact Technology	DC-081HS(-2.5)

The connector is compatible with the SBC-IOT-iMX8 power supply unit available from CompuLab.

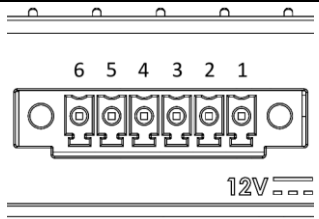
### 5.2 USB Host Connectors (J4, P3, P4)

The SBC-IOT-iMX8 external USB2.0 host ports are available through three standard type-A USB connectors (J4, P3, P4). For additional details, please refer to section 3.6 of this document.

### 5.3 RS485 / RS232 Connector (P7)

SBC-IOT-iMX8 features configurable RS485 / RS232 interface routed to terminal block P7. RS485 / RS232 operation mode is controlled in software. For additional details please refer to SBC-IOT-iMX8 Linux documentation.

**Table 11 P7 connector pin-out**

Pin	RS485 mode	RS232 mode	Pin numbering
1	RS485_NEG	RS232_TXD	
2	RS485_POS	RS232_RTS	
3	GND	GND	
4	NC	RS232_CTS	
5	NC	RS232_RXD	
6	GND	GND	

### 5.4 Serial Debug Console (P5)

The SBC-IOT-iMX8 serial debug console interface is routed to micro USB connector P5. For more information, please refer to section 3.8 of this documents.

### 5.5 RJ45 Dual Ethernet Connector (P46)

The SBC-IOT-iMX8 two Ethernet ports are routed to dual RJ45 connector P46. For additional details, please refer to section 3.5 of this document.

### 5.6 uSIM socket (P12)

The uSIM socket (P12) is connected to mini-PCIe socket P8.



## 5.7 Mini-PCIe Sockets (P6, P8)

SBC-IOT-iMX8 features two mini-PCIe sockets (P6, P8) which implement different interfaces and are intended to different functions.

- Mini-PCIe socket #1 is mainly intended for WiFi modules that require PCIe interface
- Mini-PCIe socket #2 is mainly intended for cellular modems and LORA modules

**Table 12 mini-PCIe socket interfaces**

Interface	mini-PCIe socket #1 (P6)	mini-PCIe socket #2 (P8)
PCIe	Yes	No
USB	Yes	Yes
SIM	No	Yes

**NOTE: Mini-PCIe socket #2 (P8) does not feature PCIe interface.**

## 5.8 I/O Expansion Connector

SBC-IOT-iMX8 I/O expansion connector P41 allows to connect add-on boards to SBC-IOT-iMX8.

Some of the P41 signal are derived from i.MX8M Mini multifunctional pins. The following table outlines the connector pin-out and available pin functions.

**NOTE: Multifunctional pin function selection is controlled in software.**

**NOTE: Each multifunctional pin can be used for a single function at a time.**

**NOTE: Only one pin can be used for each function (in case a function is available on more than one carrier board interface pin).**

**Table 13 P41 connector pin-out**

Pin	Signal name	Description
1	GND	SBC-IOT-iMX8 common ground
2	VCC_3V3	SBC-IOT-iMX8 3.3V power rail
3	EXT_HUSB_DP3	Optional USB port positive data signal. Multiplexed with back-panel connector P4
4	VCC_3V3	SBC-IOT-iMX8 3.3V power rail
5	EXT_HUSB_DN3	Optional USB port negative data signal. Multiplexed with back-panel connector P4.
6	RESERVED	Reserved for future use. Must be left unconnected
7	GND	SBC-IOT-iMX8 common ground
8	RESERVED	Reserved for future use. Must be left unconnected
9	JTAG_NTRST	Processor JTAG interface. Test reset signal.
10	RESERVED	Reserved for future use. Must be left unconnected.
11	JTAG_TMS	Processor JTAG interface. Test mode select signal.
12	VCC_SOM	SBC-IOT-iMX8 3.7V power rail
13	JTAG_TDO	Processor JTAG interface. Test data out signal.
14	VCC_SOM	SBC-IOT-iMX8 3.7V power rail
15	JTAG_TDI	Processor JTAG interface. Test data in signal.

16	RESERVED	Reserved for future use. Must be left unconnected.
17	JTAG_TCK	Processor JTAG interface. Test clock signal.
18	RESERVED	Reserved for future use. Must be left unconnected.
19	JTAG_MOD	Processor JTAG interface. JTAG mode signal.
20	RESERVED	Reserved for future use. Must be left unconnected.
21	VCC_5V	SBC-IOT-iMX8 5V power rail
22	RESERVED	Reserved for future use. Must be left unconnected.
23	VCC_5V	SBC-IOT-iMX8 5V power rail
32	RESERVED	Reserved for future use. Must be left unconnected.
33	QSPIA_DATA3	Multifunctional signal. Available functions: QSPIA_DATA3, GPIO3_IO[9]
34	RESERVED	Reserved for future use. Must be left unconnected.
35	QSPIA_DATA2	Multifunctional signal. Available functions: QSPI_A_DATA2, GPIO3_IO[8]
36	ECSPI2_MISO/UART4_CTS	Multifunctional signal. Available functions: ECSPI2_MISO, UART4_CTS, GPIO5_IO[12]
37	QSPIA_DATA1	Multifunctional signal. Available functions: QSPI_A_DATA1, GPIO3_IO[7]
38	ECSPI2_SS0/UART4_RTS	Multifunctional signal. Available functions: ECSPI2_SS0, UART4_RTS, GPIO5_IO[13]
39	QSPIA_DATA0	Multifunctional signal. Available functions: QSPI_A_DATA0, GPIO3_IO[6]
40	ECSPI2_SCLK/UART4_RX	Multifunctional signal. Available functions: ECSPI2_SCLK, UART4_RXD, GPIO5_IO[10]
41	QSPIA_NSS0	Multifunctional signal. Available functions: QSPI_A_SS0_B, GPIO3_IO[1]
42	ECSPI2_MOSI/UART4_TX	Multifunctional signal. Available functions: ECSPI2_MOSI, UART4_TXD, GPIO5_IO[11]
43	QSPIA_SCLK	Multifunctional signal. Available functions: QSPI_A_SCLK, GPIO3_IO[0]
44	VCC_SOM	SBC-IOT-iMX8 3.7V power rail
45	GND	SBC-IOT-iMX8 common ground
46	VCC_SOM	SBC-IOT-iMX8 3.7V power rail
47	DSI_DN3	MIPI-DSI, data diff-pair #3 negative
48	I2C4_SCL_CM	Multifunctional signal. Available functions: I2C4_SCL, PWM2_OUT, GPIO5_IO[20]
49	DSI_DP3	MIPI-DSI, data diff-pair #3 positive
50	I2C4_SDA_CM	Multifunctional signal. Available functions: I2C4_SDA, PWM1_OUT, GPIO5_IO[21]
51	GND	SBC-IOT-iMX8 common ground
52	SAI3_TXC	Multifunctional signal. Available functions: GPT1_COMPARE2, UART2_TXD, GPIO5_IO[0]
53	DSI_DN2	MIPI-DSI, data diff-pair #2 negative
54	SAI3_TXFS	Multifunctional signal. Available functions: GPT1_CAPTURE2, UART2_RXD, GPIO4_IO[31]
55	DSI_DP2	MIPI-DSI, data diff-pair #2 positive
56	UART4_TXD	Multifunctional signal. Available functions: UART4_TXD, UART2_RTS, GPIO5_IO[29]
57	GND	SBC-IOT-iMX8 common ground
58	UART2_RXD/ECSPI3_MISO	Multifunctional signal. Available functions: UART2_RXD, ECSPI3_MISO, GPIO5_IO[24]
59	DSI_DN1	MIPI-DSI, data diff-pair #1 negative
60	UART2_TXD/ECSPI3_SS0	Multifunctional signal. Available functions: UART2_TXD, ECSPI3_SS0, GPIO5_IO[25]
61	DSI_DP1	MIPI-DSI, data diff-pair #1 positive
62	RESERVED	Reserved for future use. Must be left unconnected.

63	GND	SBC-IOT-iMX8 common ground
64	RESERVED	Reserved for future use. Must be left unconnected.
65	DSI_DN0	MIPI-DSI, data diff-pair #0 negative
66	UART4_RXD	Multifunctional signal. Available functions: UART4_RXD, UART2_CTS, GPIO5_IO[28]
67	DSI_DP0	MIPI-DSI, data diff-pair #0 positive
68	ECSPI3_SCLK	Multifunctional signal. Available functions: ECSPI3_SCLK, GPIO5_IO[22]
69	GND	SBC-IOT-iMX8 common ground
70	ECSPI3_MOSI	Multifunctional signal. Available functions: ECSPI3_MOSI, GPIO5_IO[23]
71	DSI_CKN	MIPI-DSI, clock diff-pair negative
72	EXT_PWRBTNn	SBC-IOT-iMX8 ON/OFF signal
73	DSI_CKP	MIPI-DSI, clock diff-pair positive
74	EXT_RESETn	SBC-IOT-iMX8 cold reset signal
75	GND	SBC-IOT-iMX8 common ground

**Table 14 P41 connector data**

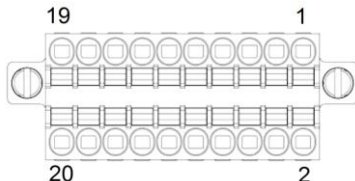
Type	Manufacturer	Mfg. P/N
M.2, E key, H 4.2mm	Lotes	APCI0076-P001A

## 5.9 Industrial I/O add-on board

**Table 15 Industrial I/O add-on connector pin-out**

I/O module	Pin	Singal
A	1	RS232_TXD / RS485_POS / CAN_H
	2	ISO_GND_A
	3	RS232_RXD / RS485_NEG / CAN_L
	4	NC
	5	NC
B	6	NC
	7	RS232_TXD / RS485_POS / CAN_H
	8	ISO_GND_B
	9	RS232_RXD / RS485_NEG / CAN_L
	10	NC
C	11	OUT0
	12	OUT2
	13	OUT1
	14	OUT3
	15	IN0
	16	IN2
	17	IN1
	18	IN3
	19	24V_IN
	20	ISO_GND_C

**Table 16 Industrial I/O add-on connector data**

Connector type	Pin numbering
20-pin dual-row plug with push-in spring connections Locking: screw flange Pitch: 2.54 mm Wire cross section: AWG 20 – AWG 30	

## 5.10 Indicator LEDs

The tables below describes SBC-IOT-iMX8 indicator LEDs.

**Table 17 Power LED (DS1)**

Main power connected	LED state
Yes	On
No	Off

**Table 18 User LED (DS4)**

General purpose LED (DS4) is controlled by SoC GPIOs GP3\_IO19 and GP3\_IO25.

GP3_IO19 state	GP3_IO25 state	LED state
Low	Low	Off
Low	High	Green
High	Low	Yellow
High	High	Orange

## 6 MECHANICAL DRAWINGS

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SBC-IOT-iMX8 3D model is available for download at:

<https://www.compulab.com/products/sbcs/sbc-iot-imx8-nxp-i-mx8m-mini-internet-of-things-single-board-computer/#devres>

## 7 OPERATIONAL CHARACTERISTICS

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### 7.1 Absolute Maximum Ratings

**Table 19 Absolute Maximum Ratings**

Parameter	Min	Max	Unit
Main power supply voltage	-0.3	40	V

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**NOTE:** Stress beyond Absolute Maximum Ratings may cause permanent damage to the device.

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### 7.2 Recommended Operating Conditions

**Table 20 Recommended Operating Conditions**

Parameter	Min	Typ.	Max	Unit
Main power supply voltage	8	12	36	V