Utilite

Technical Reference Manual

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Table 1 Document Revision Notes

Date	Description
August 2013	• First release

1 INTRODUCTION

1.1 About This Document

This document is part of a set of reference documents providing information necessary to operate and program Compulab Utilite.

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
Utilite Resources	http://utilite-computer.com/web/home

2 OVERVIEW

2.1 Highlights

The Utilite is a fully functional miniature computer based on the Freescale i.MX6 SoC – a multicore ARM Cortex-A9 CPU with a GPU3Dv4 and integrated multimedia acceleration engines.

The device enables versatile connectivity through a variety of peripheral interfaces – two Gigabit Ethernet ports, 802.11n WiFi, RS232, Bluetooth and high-speed USB.

High performance, low-power, rich I/O and miniature rugged design, position Utilite as an attractive solution for a wide range of applications – media player, IPTV, infotainment system, signage, gaming or small-footprint desktop replacement.

2.2 Specifications

Table 3 System

Feature	Specifications
CPU	Freescale i.MX6 single / dual / quad core Cortex-A9 MPCore, up to 1.2GHz
Memory	Up to 4GB DDR3-1066
Storage	mSATA SSD, up to 512GB
	Micro-SD SDXC, up to 128GB

Table 4 Display and Graphics

Feature	Specifications
GPU	Graphics Processing Unit supporting OpenGL ES 1.1 and 2.0, OpenVG 1.1 and OpenCL EP Video Processing Unit supporting multi-stream 1080p H.264, VC1, RV10, DivX HW decoding
Primary Display	HDMI 1.4 up to 1920 x 1200 @ 60Hz
Secondary Display	DVI-D up to 1920 x 1200 @ 60Hz

Table 5 Network

Feature	Specifications
LAN	Up to two 1000 BaseT Ethernet ports
WiFi	802.11b/g/n Wi-Fi, single antenna
Bluetooth	Bluetooth 3.0

Table 6 I/O

Feature	Specifications
Audio	Stereo line-out and stereo line-in, 3.5mm audio jacks
	5.1 channel input and output S/PDIF, data rates up to 24 bit, 96kHz, (electrical through 3.5mm audio jacks)
USB	Four USB 2.0 high-speed ports, standard A-type connectors, max current 1A per port
	USB OTG micro-USB connector
Serial	Two RS232 ports, ultra mini serial connectors. Programmable baud rate of up to 250 kbit/s

Table 7 Mechanical and Environmental

Supply Voltage	Unregulated 10 to 16 volt input
Power consumption	3W to 9W in full activity, depending on system configuration and load
Dimensions	135mm x 100mm x 21mm
Weight	
Operation temperature	0C – 45C

3 CORE SYSTEM COMPONENTS

3.1 i.MX6 SoC

3.1.1 Multi-core ARM Cortex-A9 CPU

The Freescale i.MX6 SoC is an implementation of the multi-core ARM Cortex™-A9 core, which operates at frequencies up to 1.2. i.MX6 provides a variety of interfaces and supports the following main features:

- Quad / Dual / Single Core ARM Cortex™-A9. Core configuration is symmetric, where each core includes:
  - 32 KByte L1 Instruction Cache
  - 32 KByte L1 Data Cache
  - Private Timer and Watchdog
  - Cortex-A9 NEON MPE (Media Processing Engine) Co-processor
- Level 2 Cache—Unified instruction and data (up to 1 MByte)
- General Interrupt Controller (GIC) with 128 interrupt support
- Global Timer
- Snoop Control Unit (SCU)
- NEON MPE coprocessor:
  - SIMD Media Processing Architecture
  - NEON register file with 32x64-bit general-purpose registers
  - NEON Integer execute pipeline (ALU, Shift, MAC)
  - NEON dual, single-precision floating point execute pipeline (FADD, FMUL)
  - NEON load/store and permute pipeline
- Integrated Power Management unit
  - Temperature Sensor for monitoring the die temperature
  - DVFS techniques for low power modes
  - Flexible clock gating control scheme
- Multimedia Hardware Accelerators

3.1.2 Video and Graphics subsystems

The Utilite video graphics subsystem consists of the following i.MX6 sub-blocks.

- VPU: A multi-standard high performance video codec engine supporting encode/decode operations.
- 3D GPU: Vivante GC2000 / GC880, compliant with OpenGL ES2.0, OpenGL ES1.1 and OpenVG 1.1.
- 2D GPU: Hardware acceleration of 2D graphics (Bit BLT and Stretch BLT). Based on the Vivante GC320 IP core.
- GPUVG: An OpenVG 1.1 Graphics Processing Unit providing hardware acceleration of vector graphics. Based on the Vivante GC355 IP core OpenGL ES 2.0

3.2 System Memory

3.2.1 DRAM

Utilite features up to a 4GB of DDR3. The DRAM interface operates with a 533 MHz clock.

3.2.2 SPI Flash

Utilite features 2MB of SPI NOR flash which functions as the primary bootable non-volatile memory device, used the boot-loader and configuration blocks storage.

3.3 System Storage

3.3.1 mSATA

Utilite features an internal mSATA socket supporting standard mSATA SSD devices of up-to 512GB. mSATA functionality is implemented with the Freescale i.MX6 integrated SATA controller and PHY. The following main features are supported:

- The SATA block fully complies with AHCI specification version 1.10 and partially complies with AHCI specification version 1.3 (FIS-based switching is currently not supported).
- SATA 1.5 Gb/s and SATA 3.0 Gb/s speed
- Power management features including automatic partial-to-slumber transition
- Hardware-assisted Native Command Queuing (NCQ) for up to 32 entries

NOTE: mSATA functionality is optional. Availability depends on Utilite model configuration.

3.3.2 Micro-SD

Utilite features micro-SD socket supporting SDXC cards of up-to 128GB.

3.4 Display Subsystem

3.4.1 HDMI

Utilite HDMI output is based on the HDMI transmitter & HDMI 3D Tx PHY integrated into the i.MX6 SoC. HDMI DDC is implemented with the i.MX6 I2C-2 interface. HDMI_DETECT signal is connected to the i.MX6 HDMI_HPD input. HDMI signals are routed to HDMI connector J1.

3.4.2 DVI

Utilite features a DVI transmitter that is based on the TFP410/SIL164 IC. DVI output signals are routed to HDMI connector J2 and only available without LVDS configuration. DVI transmitter is connected to the Utilite 24-bit parallel RGB interface.

DVI DDC is implemented with the i.MX6 I2C-1 interface.

NOTE: DVI functionality is optional. Availability depends on Utilite model configuration.

3.5 Audio Subsystem

3.5.1 Analog Audio

Utilite analog audio functionality is implemented with the Wolfson WM8731 audio codec interfaced with i.MX6 AUDMUX port 4. WM8731 supports the following features:

- Highly Efficient Headphone driver
- Audio performance ('A' weighted): ADC SNR – 90dB, DAC SNR – 100dB.
- Microphone input and electret bias with side tone mixer
- ADC and DAC sampling frequency: 8kHz – 96kHz.
- Selectable ADC high pass filter

Analog line output is routed to the audio jack P6. Analog line input is routed to the audio jack P7.

Table 8 Analog Audio Characteristics

Parameter	Test conditions		Min	Typ	Max	Unit
Headphone Output						
0-dB full-scale output voltage				1.0		Vrms
Maximum output power, PO	Rload = 32Ω			30		mW
	Rload = 16Ω			50		
Signal-to-noise ratio, A-weighted			90	97		dB
Total harmonic distortion	1kHz output, Rload = 32Ω	Pout = 10mW rms (-5dB)			0.1 50	% dB
		Pout = 20mW rms (-2dB)			1.0 40	% dB
Power supply rejection ratio	1 kHz, 100 mVp-p			50		dB
				45		
Programmable gain	1 kHz output		-73	0	6	dB
Programmable-gain step size	1 kHz			1		dB
Mute attenuation	1 kHz output, 0dB			80		dB
Line Input to ADC						
Input signal level (0 dB)				1.0		Vrms
Signal-to-noise ratio, A-weighted, 0-dB gain	Fsample = 48 kHz.		85	90		dB
	Fsample = 96 kHz.			90		
Dynamic range, A-weighted, −60-dB full-scale input			85	90		dB
Total harmonic distortion, −1-dB input, 0-dB gain				-80		dB
Power supply rejection ratio	1 kHz, 100 mVp-p			50		dB
	20Hz – 20kHz, 100mVpp			45		
ADC Channel Separation	1 kHz input tone			90		dB
Programmable-gain	1 kHz input tone, Rsource<50Ω		-34.5	0	+12	dB
Programmable-gain step size	Monotonic			1.5		dB
Mute attenuation	0dB, 1 kHz input tone			80		dB
Input resistance	12 dB input gain		10	15		kΩ
	0 dB input gain		20	30		
Input capacitance				10		pF

3.5.2 S/PDIF

Utilite features an S/PDIF interface implemented by means of the i.MX6 integrated S/PDIF transceiver.

The interface is compatible with the Tech 3250-E standard of the European Broadcasting Union, except clause 6.3.3 and the IEC60958-3 Ed2 for relevant topics.

The S/PDIF output signal is routed to audio jack P6 and the S/PDIF input signal is routed to audio jack P7.

For additional details, please refer to chapter 57 of the "i.MX6 Reference Manual".

3.6 USB Subsystem

3.6.1 USB 2.0 Host

Utilite high-speed USB interface is implemented with an on-board USB2.0 hub connected to the i.MX6 high-speed USB host port 1. The interface supports the following features:

- Supports USB 2.0 High Speed (480Mbps), Full Speed (12Mbps) and Low Speed (1.5Mbps) operation
- Complies with EHCI (high-speed host controller)

The four USB2 ports are routed to connectors P11, P12, P13 and P14.

3.6.2 USB 2.0 On-The-Go

USB 2.0 OTG interface is implemented with the i.MX6 USB 2.0 OTG controller and routed to connector P15. The interface provides the following features:

- Supports USB 2.0 High Speed (480Mbps), Full Speed (12Mbps) and Low Speed (1.5Mbps) operation in host mode
- Supports USB 2.0 High Speed (480 Mbps) and Full Speed (12 Mbps) operation in peripheral mode.
- Hardware support for OTG signaling, session request protocol, and host negotiation protocol
- Up to 8 bidirectional endpoints

3.7 Wireless Interfaces

Utilite features Wi-Fi 802.11b/g/n and Bluetooth 3.0 wireless connectivity, implemented with the AzureWave AW-NH387 WLAN+Bluetooth combo controller module. AW-NH387 is based on the Marvell 88W8787 chipset.

Wi-Fi and Bluetooth interfaces utilize a single 2.4GHz antenna that should be connected to the Utilite SMA connector ANT1.

NOTE: Wireless interfaces are optional. Availability depends on Utilite model configuration.

3.7.1 Wi-Fi

Utilite Wi-Fi interface supports the following main features:

- 802.11b: 1, 2, 5.5, 11Mbps
- 802.11g: 6, 9, 12, 18, 24, 36, 48, 54Mbps
- 802.11n up to 150Mbps
- WEP 64-bit and 128-bit encryption with H/W TKIP processing
- WPA/WPA2 (Wi-Fi Protected Access)
- AES-CCMP hardware implementation as part of 802.11i security standard

3.7.2 Bluetooth

Utilite Bluetooth interface supports the following main features:

- Bluetooth 2.1+EDR data rates of 1, 2 and 3 Mbps

3.8 Ethernet

Utilite features up to two Gigabits Ethernet ports.

3.8.1 Primary Ethernet Controller

Utilite incorporates a full-featured 10/100/1000 Ethernet interface, implemented with the i.MX6 integrated Ethernet MAC (ENET) coupled with the AR8033 RGMII Ethernet PHY from Atheros. The interface is routed to connector P3 and support the following features:

- 10/100/1000 BASE-T IEEE 802.3 compliant
- IEEE 802.3u compliant Auto-Negotiation
- Integrated IEEE 1588 time stamping module (inside the MAC)
- Automatic channel swap (ACS)
- Full- and Half-duplex
- Automatic MDI/MDIX crossover
- Automatic polarity correction
- Activity and speed indicator LEDs

3.8.2 Secondary Ethernet Controller

Secondary Gigabit Ethernet interface is implemented with the I211 Intel Gigabit Ethernet controller. The controller is connected to the PCIe interface of the i.MX6 SoC. The interface is routed to connector P10 and supports the following main features:

- MDI (copper) support for standard IEEE 802.3 Ethernet interface for 1000BASE-T, 100BASE-TX, and 10BASE-T applications (802.3, 802.3u, and 802.3ab)
- Half duplex at 10/100 Mb/s operation and full duplex operation at all supported speeds
- 10/100/1000 copper PHY
- 9.5KB Jumbo frames support
- Crossover Detection and Auto-Correction
- Activity and speed indicator LEDs
- Double VLAN
- IEEE 1588
- Activity and speed indicator LEDs

NOTE: Secondary Ethernet interface is optional. Availability depends on Utilite model configuration.

3.9 RS232

The Utilite features two RS232 ports. Both ports are implemented with MAX3243 transceiver.

RS232 ports support the following features:

- 16550 compatibility
- 16-byte FIFO for receiver and 16-byte FIFO for transmitter
- Programmable baud rate of up to 250 Kbps
- Configurable data format
- RS-232 bus-pin ESD protection exceeds ±15 kV using the Human-Body Model

RS232 ports are derived from UART-2 and UART-4 ports of the i.MX6 SoC, and are routed to ultra mini serial connectors P16 and P9 respectively.

4 SYSTEM LOGIC

4.1 Power Subsystem

4.1.1 Power Rails

Utilite is powered with a single 12V power supply.

Table 9 Power signals

Signal Name	Type	Description
+12V	P	Main power supply. Typical voltage – 12V.
GND	P	Common ground.

4.1.2 Power Modes

The Utilite supports three hardware power modes.

Table 10 Power modes

Power Mode	Description
ON	All internal power rails are enabled. Mode entered automatically when main power supply is connected.
LPM	TBD
OFF	All internal power rails except those required for the power management logic are switched off.

4.1.3 RTC Back-Up Battery

Utilite features an on-board 18mAh rechargeable coin cell lithium battery, which maintains the Utilite RTC whenever the main power supply is not present.

4.2 Firmware Boot Options

Utilite standard boot sequence provides the following boot options:

- Boot from the on-board SPI NOR flash – default boot device.
- Boot from an external SD card using the MMC-3 interface – alternative boot device.

The standard boot sequence is designed for normal system operation with the on-board SPI NOR flash as the boot media. If an SD card is present in the micro-SD socket P8, the system will attempt to boot from the card. This configuration is designed to perform recovery/upgrade of the firmware/boot-loader.

NOTE: The recovery-boot only affects boot-loader boot process. O/S and file-system boot configuration is determined by the boot-loader settings.

4.3 Real Time Clock

Utilite RTC is implemented with the EM Microelectronic EM3027 IC that provides clock and calendar information in BCD format. The EM3027 is connected to the I2C-1 port of the i.MX6 SoC. The on-board backup battery keeps the RTC running to maintain clock and time information whenever main Utilite power supply is not present.

For additional details, please refer to the EM3027 datasheet, available from http://www.emmicroelectronic.com/.

5 INTERFACES AND CONNECTORS

5.1 HDMI Connector (J1)

The primary HDMI display output is provided through the standard HDMI socket (J1).

For additional details, please refer to section 3.4.1 of this document.

Table 11 J1 connector pin-out

Pin	Signal Name	Pin	Signal Name
1	HDMI_TXD2+	11	GND
2	GND	12	HDMI_TXC-
3	HDMI_TXD2-	13	NC
4	HDMI_TXD1+	14	NC
5	GND	15	HDMI_DDC_SCL
6	HDMI_TXD1-	16	HDMI_DDC_SDA
7	HDMI_TXD0+	17	GND
8	GND	18	HDMI_5V
9	HDMI_TXD0-	19	HDMI_DETECT
10	HDMI_TXC+		

5.2 DVI Connector (J2)

The secondary DVI display output is provided through the standard HDMI socket (J2).

For additional details, please refer to section 3.4.2 of this document.

Table 12 J2 connector pin-out

Pin	Signal Name	Pin	Signal Name
1	DVI_TXD2+	11	GND
2	GND	12	DVI_TXC-
3	DVI_TXD2-	13	NC
4	DVI_TXD1+	14	NC
5	GND	15	DVI_DDC_SCL
6	DVI_TXD1-	16	DVI_DDC_SDA
7	DVI_TXD0+	17	GND
8	GND	18	DVI_5V
9	DVI_TXD0-	19	DVI_DETECT
10	DVI_TXC+		

5.3 DC Power Jack (J3)

DC power input connector.

Table 13 J3 connector pin-out

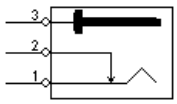
Pin	Signal Name	
1	GND	
2	GND	
3	VIN_12V	

Table 14 J3 connector data

Manufacturer	Mfg. P/N
Contact Technology	DC-022

The connector is compatible with the Utilite power supply unit available from CompuLab.

5.4 Micro-SD Socket (P8)

The micro-SD socket (P8) is connected directly to the i.MX6 SDIO-2 port.

Table 15 P8 connector pin-out

Pin	Signal Name	Pin	Signal Name
1	SDIO3_DAT2	5	SDIO3_CLK
2	SDIO3_DAT3	6	GND
3	SDIO3_CMD	7	SDIO3_DAT0
4	VDD_3V3	8	SDIO3_DAT1

5.5 RS232 connector (P9)

The primary Utilite RS232 port is routed to the front-panel ultra-mini serial connector P9. All signals are at RS232 levels.

Table 16 P9 connector pin-out

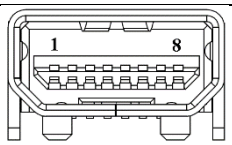
Pin	Signal Name	Pin	Signal Name	
1	RS232_TXD	5	GND	
2	NC	6	GND	
3	RS232_RXD	7	NC	
4	NC	8	GND	

Table 17 P9 connector data

Manufacturer	Mfg. P/N	Mating connector
Wieson	G3169-500001	Wieson, P/N: 4306-5000

The connector is compatible with the serial cable adapter (CompuLab P/N 199D10230) available from CompuLab.

5.6 RS232 connector (P16)

The secondary Utilite RS232 port is routed to the rear-panel ultra-mini serial connector P16. All signals are at RS232 levels.

Table 18 P16 connector pin-out

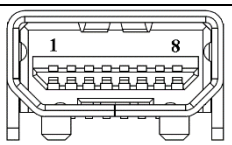
Pin	Signal Name	Pin	Signal Name	
1	RS232_TXD	5	NC	
2	RS232_RTS	6	NC	
3	RS232_RXD	7	NC	
4	RS232_CTS	8	GND	

Table 19 P16 connector data

Manufacturer	Mfg. P/N	Mating connector
Wieson	G3169-500001	Wieson, P/N: 4306-5000

The connector is compatible with the serial cable adapter (CompuLab P/N 199D10230) available from CompuLab.

5.7 Audio Jacks (P6, P7)

Utilite features two 3.5mm jacks. The analog audio signal pin-outs are compatible with standard 3-pole audio cables. The additional pins (S/PDIF input on P7 and S/PDIF output on P6) are accessible with the 3.5mm-to-RCA adapter cable (CompuLab P/N 199D10300) available from CompuLab.

Table 20 P6 connector pin-out

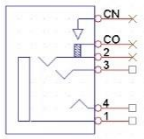
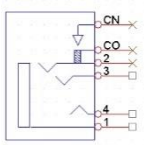
Pin	Signal Name	Jack pin-out	Mating plug
1	AUDIO_GND		
2	SPDIF_OUT		
3	AUDIO_OUT_R		
4	AUDIO_OUT_L		

Table 21 P7 connector pin-out

Pin	Signal Name	Jack pin-out	Mating plug
1	AUDIO_GND		
2	SPDIF_IN		
3	AUDIO_IN_R		
4	AUDIO_IN_L		

5.8 USB Host Connectors (P11, P12, P13, P14)

The Utilite external USB2.0 host ports are available through four standard type-A USB connectors (P11, P12, P13 and P14).

Table 22 P11 connector pin-out

Pin	Signal Name	Pin	Signal Name
1	VCC_USB_3	3	USBHUB_P3_DP
2	USBHUB_P3_DM	4	GND

Table 23 P12 connector pin-out

Pin	Signal Name	Pin	Signal Name
1	VCC_USB_1	3	USBHUB_P1_DP
2	USBHUB_P1_DM	4	GND

Table 24 P13 connector pin-out

Pin	Signal Name	Pin	Signal Name
1	VCC_USB_4	3	USBHUB_P4_DP
2	USBHUB_P4_DM	4	GND

Table 25 P14 connector pin-out

Pin	Signal Name	Pin	Signal Name
1	VCC_USB_2	3	USBHUB_P2_DP
2	USBHUB_P2_DM	4	GND

5.9 Primary Gigabit Ethernet Connector (P3)

Utilite primary Gigabit Ethernet port is routed to the standard RJ-45 connector P3.

Table 26 P7 connector pin-out

Pin	Signal Name	Pin	Signal Name
1	LAN_MDIP0	7	LAN_MDIP2
2	LAN_MDIN0	8	LAN_MDIN2
3	LAN_MDIP1	9	LAN_MDIP3
4	LAN_MDIN1	10	LAN_MDIN3
5	LAN_CT1		
6	LAN_CT2		

5.10 Secondary Gigabit Ethernet Connector (P10)

Utilite secondary Gigabit Ethernet port is routed to the standard RJ-45 connector P10.

Table 27 P10 connector pin-out

Pin	Signal Name	Pin	Signal Name
1	LAN_MDIP0	7	LAN_MDIP2
2	LAN_MDIN0	8	LAN_MDIN2
3	LAN_MDIP1	9	LAN_MDIP3
4	LAN_MDIN1	10	LAN_MDIN3
5	LAN_CT1		
6	LAN_CT2		

5.11 USB OTG Connector (P15)

The i.MX6 USB OTG port is routed to the micro-USB connector P15.

Table 28 P15 connector pin-out

Pin	Signal Name
1	VBUS_OTG
2	USB_DEV_DM
3	USB_DEV_DP
4	OTG_ID
5	GND

5.12 mSATA Socket (P4)

SATA signals are routed to mSATA socket P4. The mSATA socket is utilized for the Utilite internal SATA storage.

Table 29 P14 connector pin-out

Pin	Signal Name	Pin	Signal Name
1	GND	27	GND
2	3V3	28	NC
3	NC	29	GND
4	GND	30	VDD_5V
5	NC	31	SATA_TXN
6	NC	32	NC
7	NC	33	SATA_TXP
8	NC	34	GND
9	GND	35	GND
10	NC	36	NC
11	NC	37	GND
12	NC	38	NC
13	NC	39	3V3
14	NC	40	GND
15	GND	41	3V3
16	NC	42	NC
17	NC	43	NC
18	GND	44	NC
19	NC	45	NC
20	NC	46	NC
21	GND	47	NC
22	NC	48	NC
23	SATA_RXP	49	NC
24	3V3	50	GND
25	SATA_RXN	51	NC
26	GND	52	3V3

5.13 Power Button (SW1)

Utilite power button SW1 controls the system power state. The table below describes the button functions.

Table 30 Power button functions

User action	System state	System behavior
Short press	OFF	Power on.
Short press	ON	Notify the O/S of a shut-down request.
Long press (> 5sec)	ON	Shut down unconditionally.

For additional details, please refer to section 4.1.2 of this document.

5.14 Indicator LED (DS1)

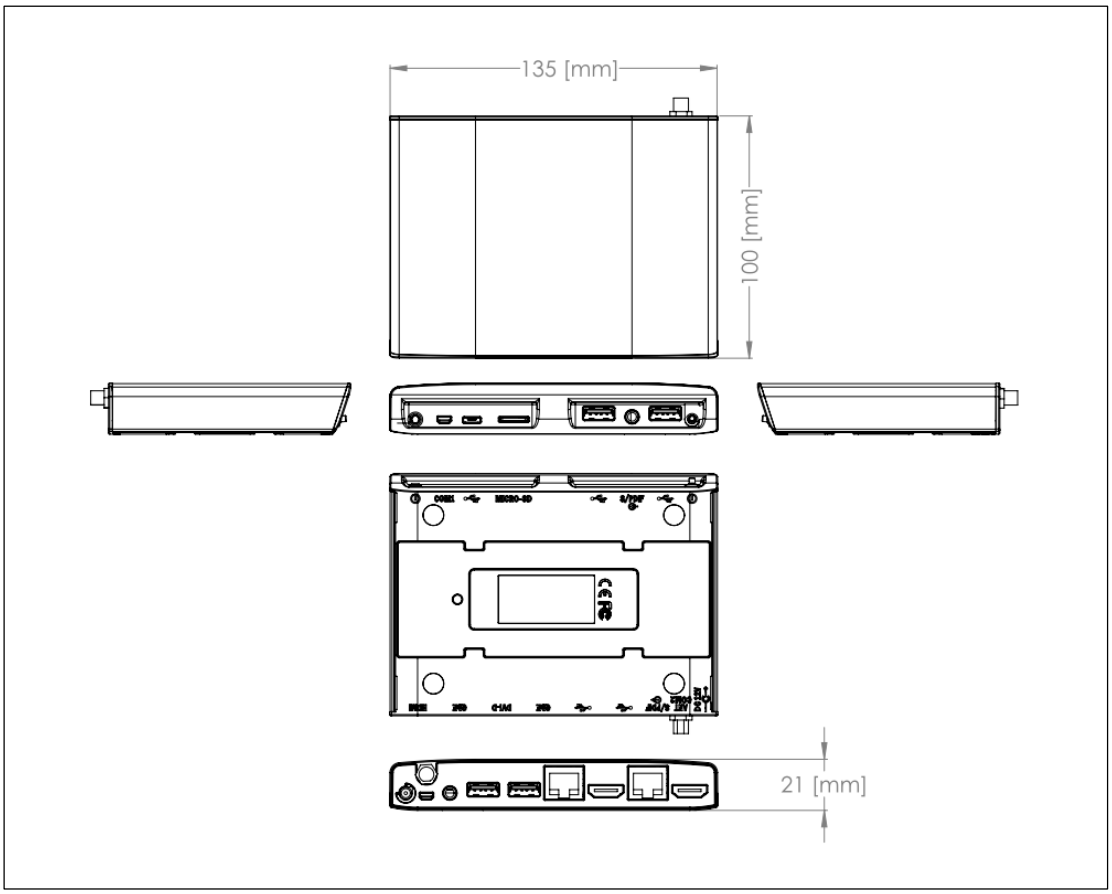
The table below describes Utilite indicator LED.

Table 31 DS1 Dual Color LED description

Power state	Color	
	Green	Orange
On	On	Off
Standby	On	On
Off	Off	On

6 MECHANICAL DRAWINGS

6.1 Dimensions



6.2 Connector Locations

Figure 1 - Front Panel

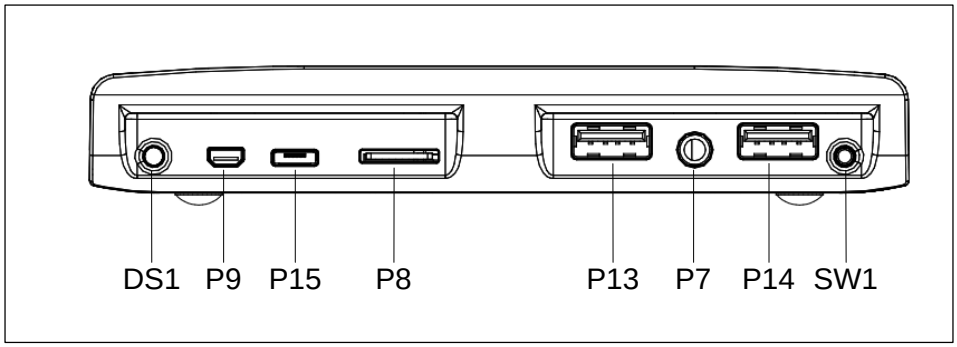
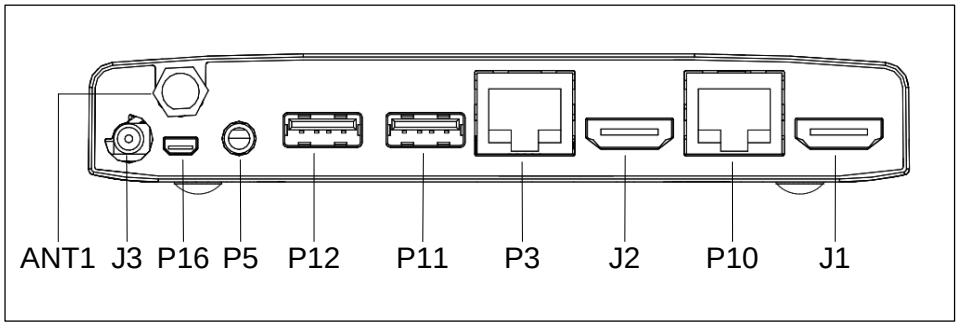


Figure 2 - Back Panel



7 OPERATIONAL CHARACTERISTICS

7.1 Absolute Maximum Ratings

Table 32 Absolute Maximum Ratings

Parameter	Min	Typ.	Max	Unit
Main power supply voltage	-0.3	12	16	V

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

7.2 Recommended Operating Conditions

Table 33 Recommended Operating Conditions

Parameter	Min	Typ.	Max	Unit
Main power supply voltage	10	12	16	V

7.3 DC Electrical Characteristics

Table 34 DC Electrical Characteristics

Parameter	Operating Conditions	Min	Typ	Max	Unit
3.3V Digital I/O					
V_{IH}		2.31		3.3	V
V_{IL}		0		0.99	V
V_{OH}		3.15			V
V_{OL}				0.15	V
RS232					
TX Voltage Swing		±5	±5.4		V
RX Voltage Swing			±25		V