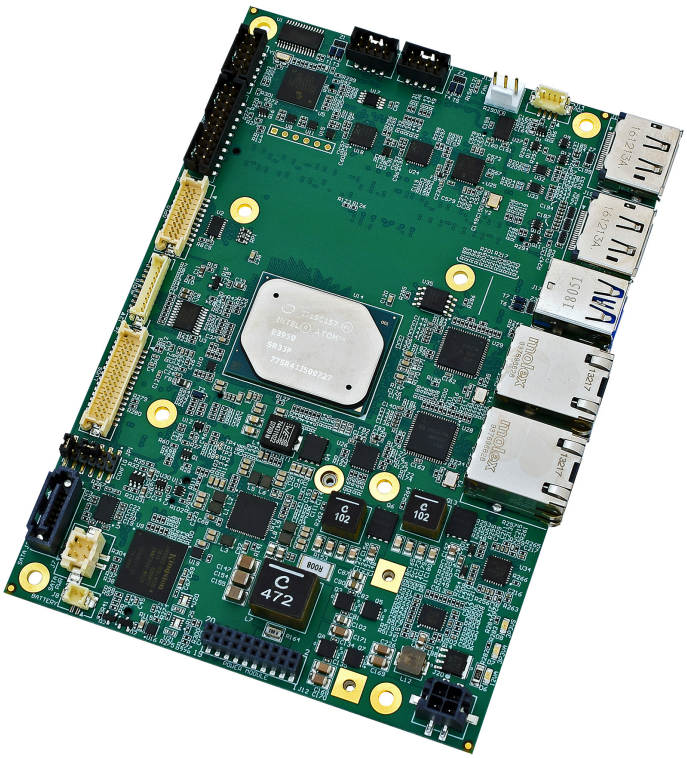
WINSYSTEMS®

SBC35-427

Industrial Single Board Computer with Intel® Atom™ E3900 processor, Dual Ethernet, Multi-Display, and Expansion

Product Manual



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Revision History

Document Version	Last Updated Date	Brief Description of Change
v1.0	8/9/2019	Initial release
v1.1	5/11/2020	Added “Single Channel” to LVDS description, mechanical shock and vibration testing data, and battery part number in section 9
v1.2	5/2020	Added maximum power usage, maximum input power ratings, and input wire/cable flammability rating
v1.3	8/25/2020	Added compliance safety data under specification table
v1.31	9/9/2021	Updated compliance section and added FCC and CE certifications.
v1.4	7/29/2025	Updated Conformal Coating, added Warranty link, updated all links

Copyright and Trademarks

Trademark Acknowledgments

Table of Contents

1. Before You Begin

Review the warnings in this section and the best practice recommendations (see “Best Practices” on page 34) when using and handling the WINSYSTEMS SBC35-427 board. Following these recommendations provides an optimal user experience and prevents damage. Read through this document and become familiar with the SBC35-427 before proceeding.

APPLYING CONFORMAL COATING AFTER PURCHASE WILL VOID YOUR WARRANTY. FAILING TO COMPLY WITH THESE BEST PRACTICES MAY DAMAGE THE PRODUCT AND VOID YOUR WARRANTY.

1.1 Warnings

Only qualified personnel should configure and install the SBC35-427. While observing best practices, pay particular attention to the following:.

Avoid Electrostatic Discharge (ESD)
Only handle the circuit board and other bare electronics when electrostatic discharge (ESD) protection is in place. Having a wrist strap and a fully grounded workstation is the minimum ESD protection required before the ESD seal on the product bag is broken.

2. Introduction

This manual provides configuration and usage information for the SBC35-427. If you still have questions, contact Technical Support at (817) 274-7553, Monday through Friday, between 8 AM and 5 PM Central Standard Time (CST).

Refer to the WINSYSTEMS website at https://www.winsystems.com/ for other accessories (including cable drawings and pinouts) that can be used with your SBC35-427.

3. Functionality

The WINSYSTEMS’ SBC35-427 is a small form factor single board computer (SBC) featuring the latest generation Intel Apollo Lake-I SOC processor. Its small size, low power, rugged design, and extended operational temperature make it a great fit for rugged embedded systems in the industrial control, transportation, energy, and industrial IoT markets.

The WINSYSTEMS’ SBC35-427 SBC features a dual or quad-core processor and up to 8 GB of socketed SODIMM DDR3L ECC SDRAM. The SBC includes an mSATA socket and optional soldered down eMMC device for solid state

storage of operating systems and applications. Additionally, the board supports an external SATA device.

The board has expansion capabilities via a M.2 Socket 1 with E key, Mini PCIe socket (with mSATA support), and WINSYSTEMS Modular IO80 interface.

4. Features

The SBC35-427 provides the following features.

Single Board Computer

- Multi-core Intel Atom E3900 processors
  - X5 E3930 dual core, up to 1.8 GHz (base frequency 1.3 GHz)
  - X5 E3940 quad core, up to 1.8 GHz (base frequency 1.6 GHz)
  - X7 E3950 quad core, up to 2.0 GHz (base frequency 1.6 GHz)

Operating Systems (compatibility)

- Windows 10 x64, IoT Core, and Professional
- Linux x64
- Most x86 operating systems

Memory

- Up to 8 GB ECC DDR3L SODIMM (socketed)

BIOS

- AMI UEFI-compliant BIOS in SPI flash device

Video Interfaces (supports three simultaneous displays)

- 2x DisplayPort (version 1.2)
  - 4096 x 2160 at 60 Hz
- Single-channel, low-voltage differential signaling (LVDS)
  - 18 and 24 bpp color panel support
  - Supports up to 1440 x 1080 or 1600 x 900 at 60 Hz resolution

Ethernet

- 2x Intel 10/100/1000 Mbps controllers using Intel i210
- Wake-on-LAN support, both channels

Storage

- SATA 6Gb/s port
- mSATA SSD support (Mini PCIe card)

- eMMC solid state disk

Data Acquisition

- 8x GPIO bidirectional lines
- 2x analog to digital (ADC) lines

Bus Expansion

- WINSYSTEMS Modular IO80
  - 2x PCIe x1 Gen 2 (one PCIe x1 lane is software switchable to 1x USB 3.1 Gen 1 port)
  - 2x USB 2.0
  - 1x I2C
  - 1x SPI
  - 4x GPIO
  - 1x LPC
  - HD stereo audio
- M.2 Socket 1, with E key, type 2230
- Mini PCIe card (mPCIe, USB, mSATA)

Serial Interface

- 2x RS232/422/485 serial ports

USB

- 2x USB 3.1 Gen 1 ports
- 9x USB 2.0 ports
  - 4x USB 2.0 available on USB header
  - 2x USB 2.0 on WINSYSTEMS Modular IO80
  - 1x USB 2.0 on M.2
  - 1x USB 2.0 on Mini PCIe card
  - 1x USB 2.0 on Touch Controller

Power

- Supports a wide range DC input power: 10 V to 50 V
- External battery connector, operates with no battery connected
- +5 V and +12 V SATA power

Industrial Operating Temperature

- -40 to +85°C (-40 to +185°F)[1]

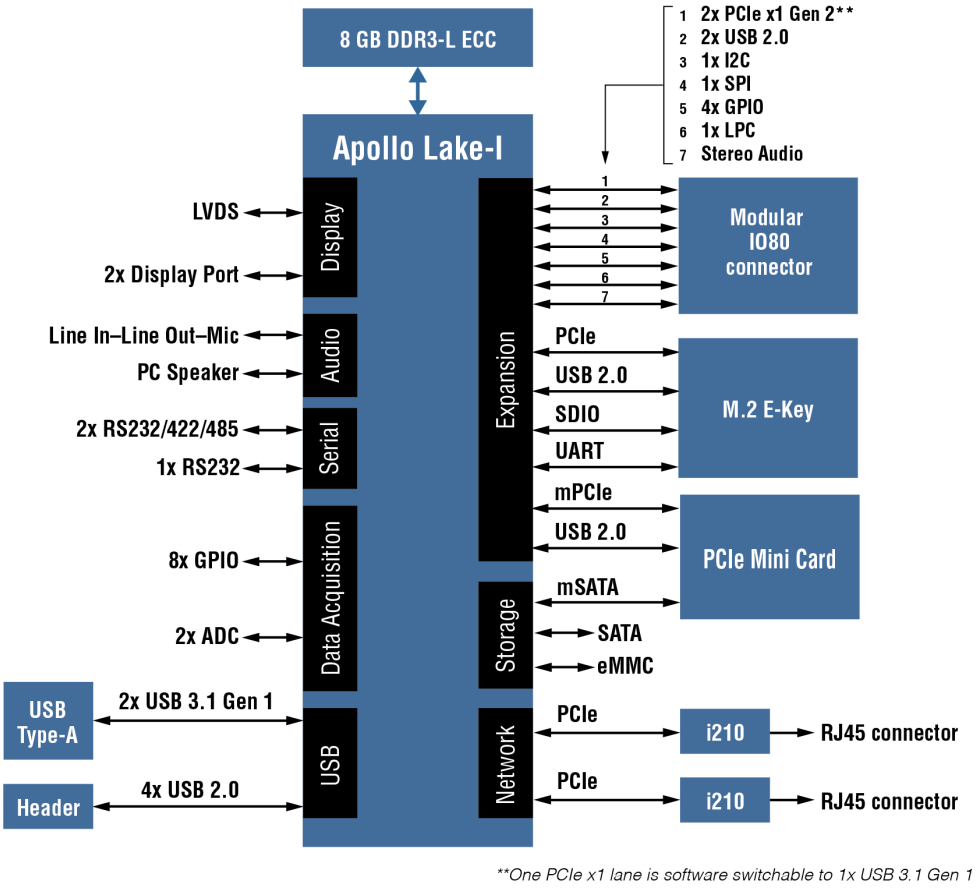
1. Requires airflow and high temperature grade DRAM.

Additional Features

- Hardware security - Trusted Platform Module (TPM) enabled
- Watchdog timer adjustable from 1 second to 255 minute reset
- RoHS compliant
- Backlight power supported
- Custom splash screen on startup
- Intel low-power Gen9 graphics engine
- Intel security engine

5. General Operation

5.1 System Block Diagram



***One PCIe x1 lane is software switchable to 1x USB 3.1 Gen 1*

The SBC35-427 provides three independent video displays (two DisplayPort and one LVDS video), dual Ethernet, two USB 3.1 Gen 1 ports, four USB 2.0 ports, eight general purpose I/O (GPIO) lines, two channels

analog-to-digital converter (ADC), stereo audio, and a Trusted Platform Module (TPM 2.0)

Solid state storage options include an mSATA socket and optional soldered down eMMC device for operating systems and applications.

Additionally, the board supports an external SATA device. Expansion options are provided through the M.2 socket 1 with E key, Mini PCIe socket (with mSATA support) and WINSYSTEMS modular IO80 interface.

The SBC35-427 board supports up to 8 GB of socketed SODIMM DDR3L Error Correcting Code (ECC) SDRAM.

6. Specifications

The SBC35-427 adheres to the following specifications and requirements.

Feature	Specification
Electrical	
V_{CC}	Supports a wide range DC input power: 10 V to 50 V
Models	SBC35-427-**3950-32-1** **3950** = CPU (E3930, E3940, E3950) **32** = EMMC (0, 32, 64, 128) future (256, 512) **1** = Thermal option (0 = none, 1 = spreader only, 2 = spreader+heatsink, 3 = spreader+heatsink+fan)
Processor	E3930 x5 dual core up to 1.8 GHz E3940 x5 quad core up to 1.8 GHz E3950 x7 quad core up to 2.0 GHz
Maximum power usage	30 W
Mechanical	
Dimensions	5.75 in x 4.00 in (146 mm x 102 mm) (3.5” SBC)
Weight	4.2 oz. (120 g), without heat sink
PCB thickness	0.078 in. (1.98 mm)
Environmental	
Temperature	-40 to +85°C (-40 to +185°F)[a]
Humidity (RH)	5% to 95% non-condensing
Mechanical shock testing	IEC 60068-2-27 40 g half-sine, 6 ms, 18 shocks
Random vibration testing	Vibration specification IEC 60068-2-64 7 g rms for all X, Y, and Z directions; 3 hours
Mean time between failure (MTBF) [b]	MTBF (hours) 171370.5013 MTBF (years) 19.56284262
RoHS compliant	Yes
Operating Systems	
Runs 64-bit Windows, Linux, and other x86-64-compatible operating systems.	

a. Requires airflow and high temperature grade DRAM.
b. A MTBF measurement is based on a statistical sample and is not intended to predict any one specific unit's reliability; thus MTBF is not, and should not be construed as, a warranty measurement.

7. Compliance and Safety

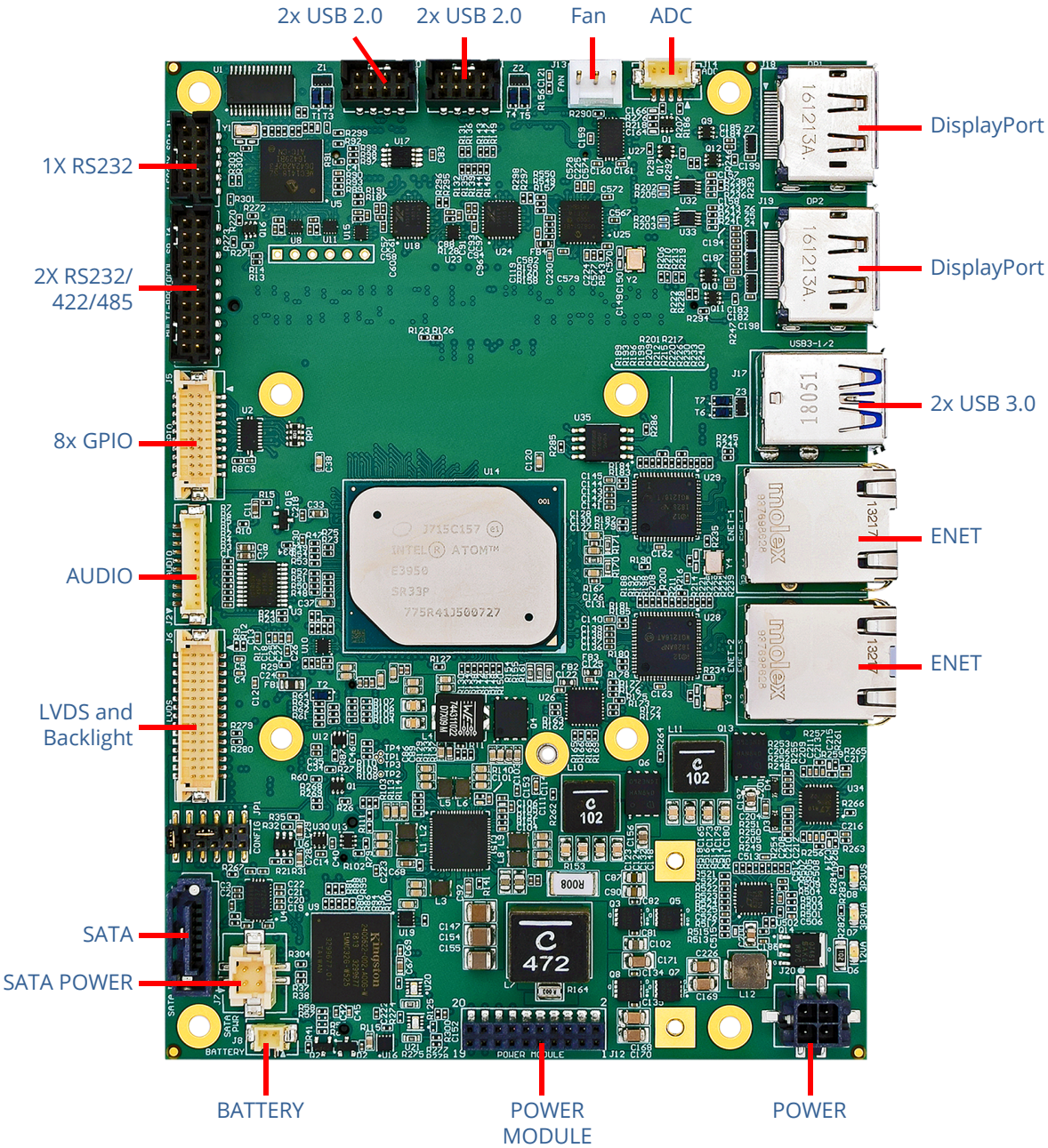
WINSYSTEMS, INC.
SBC35-427
Conforms To UL STD 62368-1
Certified To CSA STD C22.2 # 62368-1

8. Configuration

This section describes the SBC35-427 components and configuration.

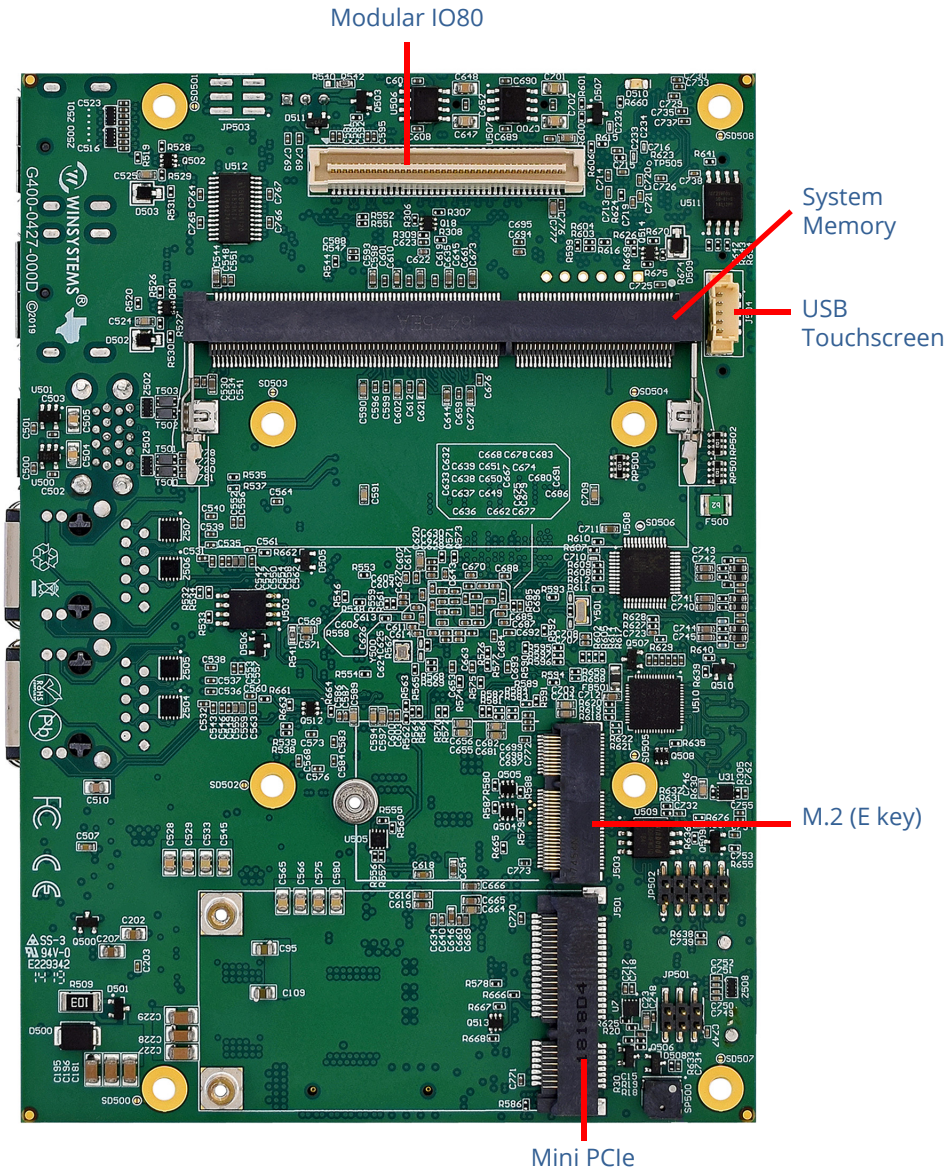
8.1 Component Layout

8.1.1 Top View



Item	Description	Reference
J1	Legacy RS232 Header	page 20
J2	HD Audio Header	page 20
J3	SATA 6Gb/s Port	page 23
J4	Serial Ports (RS232/422/485) Header	page 21
J5	GPIO General-Purpose Input/Output Header	page 24
J6	LVDS Data and Backlight Header	page 18
J7	SATA Power Header	page 17
J8	External Battery Header	page 16
J10/J11	USB 2.0 Port 2x Headers	page 22
J12	Power Module Header	page 16
J13	External Fan Header	page 17
J14	Analog Inputs (Analog to Digital) Header	page 24
J15/J16	Ethernet (LAN) RJ45	page 23
J17	USB 3.1 Gen 1 Ports	page 23
J18/J19	DisplayPort	page 19
J20	Input Power Header	page 15
JP1	Board Configuration Jumpers	page 27

8.1.2 Bottom View



Item	Description	Reference
J500	System Memory	page 23
J501	Mini PCIe (with mSATA Support)	page 27
J502	WINSYSTEMS Modular IO80	page 26
J503	M.2 Socket 1, with E key	page 27
J504	USB Touchscreen Header	page 19

8.2 Watchdog Timer (WDT)

8.2.1 WDT Register Usage

The Watchdog Timer (WDT) implemented in the SBC35-427 board's embedded controller (EC) can be used to reset the system if a lock-up prevents a software task from periodically resetting the watchdog timer. The WDT is controlled through a set of virtual registers that are exposed to Apollo Lake applications by the EC on the SBC35-427 board. The WDT can be programmed to count in either seconds or minutes; it has a minimum granularity of 1 second, and a maximum granularity of 255 minutes.

8.3 Real-time Clock/Calendar

A real-time clock is used as the AT-compatible clock/calendar. It supports a number of features including periodic and alarm interrupt capabilities. In addition to the time and date-keeping functions, the system configuration is kept in CMOS RAM contained within the clock section. A battery must be enabled for the real-time clock to retain time and date during a power down.

WINSYSTEMS has software available for manipulating the CMOS RTC from a high-level application.

8.4 System Management Software

The system management software for the SBC35-427 board consists of a set of library functions and example applications that demonstrate the functionality of the system management software. The software is available for both Windows 10 and Ubuntu Linux.

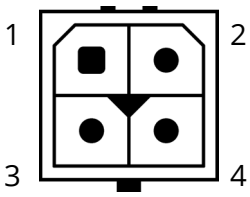
The system management software is custom software designed to use the built-in functionality of the SBC35-427 board's embedded controller (MicroChip MEC1418) to perform system management tasks such as reporting of board voltages (3.3 V, 5 V, 12 V, V_{ddq}, V_{core}, V_{bat}, and the pair of user ADC inputs), the control of the system fan, reporting of the ambient temperature and setting of temperature sensor thresholds. Additional functionality allows applications to determine the version of the EC firmware, report the boot image used when the system started, and allow the EC to update its own firmware image. The EC contains a pair of identical images for redundancy and rolls over to a correct image if the first image is compromised.

8.5 Connectors

8.5.1 J20 - Input Power Header

Use this connection to supply power to the SBC35-427. This computer supports a wide range DC input power from 10 V to 50 V.

Layout and Pin Reference



Pin	Name	Pin	Name
1	Voltage In (VIN)	2	Voltage In (VIN)
3	Ground (GND)	4	Ground (GND)

Connector

- Molex Micro-Fit 3.0 vertical header

  Part Number: 43045-0418

Matching Connector

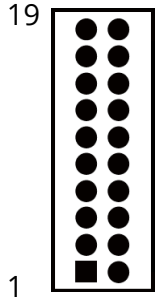
- Molex Micro-Fit 3.0 receptacle housing

  Part Number: 43025-0400

8.5.2 J12 - Power Module Header

This connection accepts WINSYSTEMS power modules providing additional power options such as PoE PD, and UPS backup. Contact a WINSYSTEMS Applications Engineer at +1-817-274-7553.

Layout and Pin Reference

Diagram	Pin	Name	Pin	Name
	1	VIN	2	GND
	3	VIN	4	GND
	5	VIN	6	GND
	7	VIN	8	GND
	9	VIN	10	GND
	11	VIN	12	GND
	13	V12_RUN	14	PM_GPIO0
	15	I2C_PM_SCL	16	PM_GPIO1
	17	I2C_PM_SDA	18	PMU_RSTBTN_N
	19	ALL_SYS_PWRGD	20	PM_PWRBTN_N

Connector

- Samtec SQW series 2.00 mm rugged sockets

  Part Number: SQW-110-01-F-D-VS-A-K-TR

Matching Connector

- Samtec TW series 2.00 mm flex stack

  Part Number: TW-10-03-F-D-280-SM-A

8.5.3 J8 - External Battery Header

An external battery connected to the SBC35-427 provides standby power for the real-time clock.

Layout and Pin Reference

Pin	Name
	
1	VBAT
2	GND

Connector

- Hirose DF13 series 1.25 mm 2-pin

  Part Number: DF13C-2P-1.25V (51)

Matching Connector

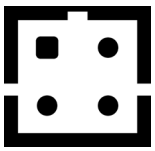
- Hirose DF13C 1.25 mm 2-pin

  Part Number: DF13C-2S-1.25C

8.5.4 J7 - SATA Power Header

Power is supplied to the SATA device via the connector at **J7**.

Layout and Pin Reference

Pin	Name	Pin	Name
1 			
1	+12 V SB	2	+5 V SB
3	GND	4	GND

Connector

- Hirose DF11 series 2.00 mm dual-row 4-pin

  Part Number: DF11C-4DP-2V(57)

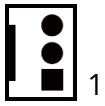
Matching Connector

- Hirose DF11 series 2.00 mm crimping socket 4-pin

  Part Number: DF11-4S-2C

8.5.5 J13 - External Fan Header

Layout and Pin Reference

Pin	Name
 1	
1	TACH_EC
2	+12 VDC
3	GND

Connector

- Hirose DF13 series 1.25 mm 3-pin

  Part Number: DF13C-3P-1.25V (51)

Matching Connector

- Hirose DF13C 1.25 mm 3-pin

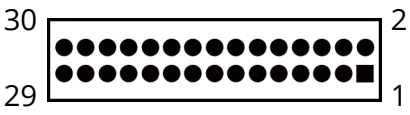
  Part Number: DF13C-2S-1.25C

8.5.6 J6 - LVDS Data and Backlight Header

The SBC35-427 supports single channel LVDS flat panel displays with resolutions up to 1440 x 1080 or 1600 x 900 at 24 bpp.

The LVDS output signals are odd bus, differential signals to the LVDS receiver. Each LVDS **P** output makes a differential pair with LVDS **N**.

Layout and Pin Reference

Pin	Name	Description	Pin	Name	Description
					
1	LVDSAO_P	Channel A - Positive LVDS Output	2	LVDSBO_P	Channel B - Positive LVDS Output
3	LVDSAO_N	Channel A - Negative LVDS Output	4	LVDSBO_N	Channel B - Negative LVDS Output
5	GND	Ground	6	GND	Ground
7	LVDSCO_P	Channel C - Positive LVDS Output	8	LVDSDO_P	Channel D - Positive LVDS Output
9	LVDSCO_N	Channel C - Negative LVDS Output	10	LVDSDO_N	Channel D - Negative LVDS Output
11	GND	Ground	12	GND	Ground
13	LVDSCKO_P	Positive LVDS Clock Output	14	DDC_SCL	Open-drain DDC Data I/O
15	LVDSCKO_N	Negative LVDS Clock Output	16	DDC_SDA	Open-drain DDC Clock I/O
17	GND	Ground	18	GND	Ground
19	I2C_TC_SCL	I2C Touch Control Clock	20	VCC_LVDS	+3.3 VDC
21	I2C_TC_SDA	I2C Touch Control Data	22	VCC_LVDS	+3.3 VDC
23	GND	Ground	24	GND	Ground
25	BKLTPWM	Backlight PWM brightness control	26	BKLT_PWR	Backlight Power (+5 VDC or +12 VDC)
27	BKLT_EN	Backlight Enable	28	BKLT_PWR	Backlight Power (+5 VDC or +12 VDC)
29	SEL68	Select 8/6-bit	30	BKLT_PWR	Backlight Power (+5 VDC or +12 VDC)

Connector

- Hirose DF13 Series 1.25 mm double row 30-pin

  Part Number: DF13EA-30DP-1.25V(51)

Matching Connectors

- Hirose DF13C 1.25 mm double row 30-pin

  Part Number: DF13-30DS-1.25C

8.5.7 J504 - USB Touchscreen Header

J504 provides plug-and-play support for a USB touchscreen. Aside from a simpler and faster interface, it also provides power within the USB cable, eliminating the need for a separate, dedicated cable to power the touchscreen.

Layout and Pin Reference

Pin	Name
	
1	GND
2	+5 V SB
3	DATA+
4	DATA-
5	GND

Connector

- Molex 1.25 mm PicoBlade

  Part Number: 53398-0571

Matching Connector

- Molex 1.25 mm PicoBlade housing

  Part Number: 51021-0500

8.5.8 J18/J19 - DisplayPort

Layout and Pin Reference

Standard full-size 20-pin DisplayPort (Version 1.2)

Connector

- Molex 47272 series DisplayPort receptacle

Matching Connector

- Standard DisplayPort compliant cable

8.5.9 SP500 - Speaker

An on-board speaker, SP500, is available for sound generation. The BIOS activates the speaker to beep during POST failure. Each error has its own unique beep code. Refer to *BIOS Status and Errors* in the supplemental BIOS Manual located under documentation on the WINSYSTEMS SBC35-427 webpage.

8.5.10 J2 - HD Audio Header

The HD audio header supports sample rates ranging from 44.1 to 192 kHz. The left and right front audio channels provide concurrent independent stereo sound output (multiple streaming).

Layout and Pin Reference

Pin	Name
	
1	HDA GND
2	MIC L
3	MIC R
4	HDA GND
5	LINE L
6	LINE R
7	HDA GND
8	FRONT L
9	FRONT R
10	HDA GND

Connector

- Hirose DF13 series 1.25 mm 10-pin

  Part Number: DF13C-10P-1.25V (51)

Matching Connector

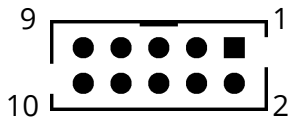
- Hirose DF13C 1.25 mm 10-pin

  Part Number: DF13C-10S-1.25C

8.5.11 J1 - Legacy RS232 Header

The legacy RS232 header provides port IO addresses defined in the original PC specification. The legacy UART allows software originally designed for older PCs to function on the SBC35-427.

Layout and Pin Reference

Diagram	Pin	Name	Pin	Name
	1	DCD	2	DSR
	3	RXD	4	RTS
	5	TXD	6	CTS
	7	DTR	8	RI
	9	GND	10	NC

Connector

- Molex Milli-Grid header, shrouded with locking window

  Part Number: 87832-1006

Matching Connectors

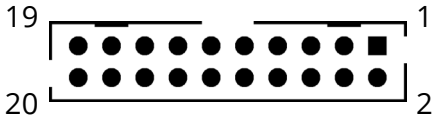
- Molex Milli-Grid receptacles (with locking ramp)

  Part Number: 51110-1060

Warning
Do not use receptacle with center polarization key.

8.5.12 J4 - Serial Ports (RS232/422/485) Header

Layout and Pin Reference

Pin	Name	Pin	Name
			
1	NC	2	NC
3	RXD1/ RX+	4	RTS1/ TX+/ TXRX+
5	TXD1/ TX-/ TXRX-	6	CTS1/ RX-
7	NC	8	NC
9	GND	10	NC
11	NC	12	NC
13	RXD2/ RX+	14	RTS2/ TX+/ TXRX+
15	TXD2/ TX-/ TXRX-	16	CTS2/ RX-
17	NC	18	NC
19	GND	20	NC

Connector

- Molex Milli-Grid header, shrouded with center polarization slot and locking windows

  Part Number: 87832-2020

Matching Connectors

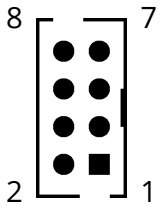
- Molex Milli-Grid receptacles with center polarization key and locking ramps

  Part Number: 51110-2051

8.5.13 J10/J11 - USB 2.0 Port 2x Headers

J10 and **J11** provide four USB 2.0 ports supplying 500 mA minimum continuous current per channel.

Layout and Pin Reference

Pin	Name	Pin	Name
			
1	USB1 VCC	2	USB2 VCC
3	DATA1-	4	DATA2-
5	DATA1+	6	DATA2+
7	GND	8	GND

Connector

- Molex Milli-Grid header, shrouded with locking window

  Part Number: 87832-0806

Matching Connectors

- Molex Milli-Grid receptacles (with locking ramp)

  Part Number: 51110-0860

Warning
Do not use receptacle with center polarization key.

8.5.14 J17 - USB 3.1 Gen 1 Ports

J17 provides two USB 3.1 Gen 1 Type A ports. These ports supply 1A minimum continuous current per channel and 5 Gbps transfer speeds.

Connector

- Dual-port stacked standard USB 3.1 Gen 1 Type A

Matching Connector

- Standard USB 3.1 Gen 1 cables and devices

8.5.15 J3 - Serial ATA 6Gbps Connector

J3 provides a serial ATA 6 Gbps 7-pin connector for interfacing with hard disk drives and solid state disk drives.

Connectors

- Standard 7-pin serial ATA connector

Matching Connector

- Standard serial ATA 6 Gbps signal cables

8.5.16 J500 - System Memory

Connector **J500** is a DDR3L, 204-pin, SODIMM socket, accommodating a maximum of 8 GB error-correcting code (ECC) RAM.

Warning
Do not install non-ECC RAM in this SODIMM socket.

8.5.17 J15/J16 - Ethernet (LAN) RJ45

Two Intel I210 Gigabit Ethernet controllers provide standard IEEE 1588 and 802.1AS protocol timestamping. Each Ethernet interface includes 10/100/1000 Mbps multispeed, full, and half-duplex operation.

Connector

- Gigabit single-port RJ45 connector with integrated magnetics and LEDs

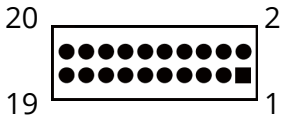
Matching Connector

- Standard Gigabit Ethernet cables with RJ45 connectors

8.5.18 J5 - GPIO General-Purpose Input/Output Header

The SBC35-427 supplies eight 5 V-tolerant GPIO lines with rising/falling edge event sense interrupt generation.

Layout and Pin Reference

Pin	Name	Pin	Name
			
1	GPIO_0	2	GND
3	GPIO_1	4	GND
5	GPIO_2	6	GND
7	GPIO_3	8	GND
9	GPIO_4	10	GND
11	GPIO_5	12	GND
13	GPIO_6	14	GND
15	GPIO_7	16	GND
17	+5 V	18	GND
19	+5 V	20	GND

Connector

- Hirose DF13 series 1.25 mm double row 30-pin

  Part Number: DF13EA-20DP-1.25V(51)

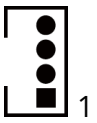
Cables

- Hirose DF13C 1.25 mm double row 20-pin

  Part Number: DF13-20DS-1.25C

8.5.19 J14 - Analog Inputs (Analog to Digital) Header

Layout and Pin Reference

Pin	Name
	
1	ADC_CH0
2	GND
3	ADC_CH1
4	GND

Connector

- Hirose DF13 series 1.25 mm 4-pin

  Part Number: DF13C-4P-1.25V (51)

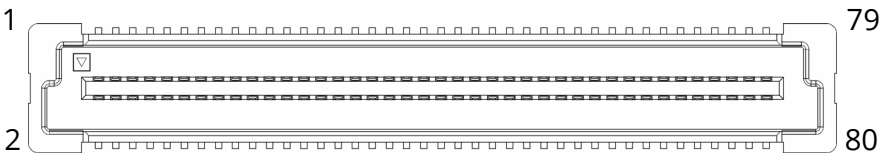
Matching Connector

- Hirose DF13C 1.25 mm 4-pin

  Part Number: DF13C-4S-1.25C

8.5.20 J502 - WINSYSTEMS Modular IO80

Layout and Pin Reference



Pin	Name	Pin	Name		Pin	Name	Pin	Name
1	PCIE4_TX+	2	USB3_TX+		41	GND	42	GND
3	PCIE4_TX-	4	USB3_TX-		43	RESERVED	44	LPC_CLK (3.3 V)
5	GND	6	GND		45	RESERVED	46	LPC_FRAME (3.3 V)
7	PCIE4_RX+	8	USB3_RX+		47	GND	48	LPC_AD3 (3.3 V)
9	PCIE4_RX-	10	USB3_RX-		49	RESERVED	50	LPC_AD2 (3.3 V)
11	GND	12	GND		51	RESERVED	52	LPC_AD1 (3.3 V)
13	PCIE5_TX+	14	USB2_D0+		53	GND	54	LPC_AD0 (3.3 V)
15	PCIE5_TX-	16	USB2_D0-		55	RESERVED	56	BUF_PLTRST_N (3.3 V)
17	GND	18	GND		57	RESERVED	58	LPC_SERIRQ (3.3 V)
19	PCIE5_RX+	20	USB2_D1+		59	GND	60	GND
21	PCIE5_RX-	22	USB2_D1-		61	ISH_GPIO[11] (1.8 V)	62	I2C1_SCL (1.8 V)
23	GND	24	GND		63	ISH_GPIO[12] (1.8 V)	64	I2C1_SDA (1.8 V)
25	PCIE_REFCLK+	26	USB_OC#		65	ISH_GPIO[13] (1.8 V)	66	ISH_GPIO[10] (1.8 V)
27	PCIE_REFCLK-	28	USB_OC#		67	GND	68	GND
29	GND	30	GND		69	LINE_OUT_L	70	HDA_GND
31	RESERVED	32	SPI1_CLK (1.8 V)		71	LINE_OUT_R	72	HDA_GND
33	RESERVED	34	SPI1_MOSI (1.8 V)		73	BUF_PLTRST_N (3.3 V)	74	PCIE_WAKE_N (3.3 V)
35	GND	36	SPI1_MISO (1.8 V)		75	ALL_SYS_PWRGD (3.3 V)	76	PMU_SLP_S3 (3.3 V)
37	RESERVED	38	SPI1_CS0 (1.8 V)		77	12VA	78	V5A
39	RESERVED	40	SPI1_CS1 (1.8 V)		79	12VA	80	V5A

Connector

- Amphenol BergStak Mezzanine connector 0.8 mm 80-pin

  Part Number: 61083-082602LF

Matching Connector

- Amphenol BergStak receptacle 0.8 mm 80-pin

  Part Number: 61082-081400LF

8.5.21 J503 - M.2 Socket 1, with E key

The M.2 expansion socket typically provides support for E key, type 2230 form factor WiFi and Bluetooth modules.

This connector supports PCIe Gen2 x1, SDIO, USB 2.0, UART, and I2C interfaces.

8.5.22 J501 - Mini PCIe (with mSATA Support)

The SBC35-427 Mini PCIe socket supports a variety of peripherals as available in this format. Though the sockets support other devices, they are most often used to add mSATA SSD, wireless Ethernet cards from Broadcom, Foxconn (Atheros), or others. This Mini PCIe socket supports SATA, PCIe, and USB.

8.6 Jumpers

8.6.1 JP1 - Board Configuration Jumpers

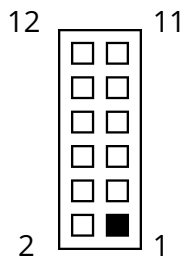
Jumpering pins 1-2 enable you to reset the BIOS CMOS settings to factory defaults. The BIOS reads this pin during system boot and forces the settings to reset if the pin is at ground.

To reset the BIOS CMOS parameters:

1. Remove power from the board.
2. Place a jumper across 1-2.
3. Apply power to the board, and let it boot into the BIOS.
4. Power off the board, and remove the jumper at 1-2.

Jumpering pins 3-4 configures LVDS output as 8-bit. Removing the jumper configures the output as 6-bit.

Layout and Pin Reference

Diagram	Selection	Jumper Positions
	Backlight Power = 12 V	11-12 (Default)
	Backlight Power = 5 V	9-11
	Backlight Enable = Active Low	7-8
	Backlight Enable = Active High	5-7 (Default)
	LVDS 6-bit/ 8-bit Select	3-4 (Default)
	Load BIOS Defaults	1-2

8.7 LED Indicators

LED Reference

LED	Description	Color
D6	+12 VDC	Red
D7	+3.3 VDC	Yellow
D8	+3.3 VSB	Green
D510	EC_LED	Green
ETH1_LED1	LINK1000=GREEN, LINK100=YELLOW	Green/yellow
ETH1_LED2	LINK=SOLID, ACTIVITY=BLINKING	Green
ETH2_LED2	LINK1000=GREEN, LINK100=YELLOW	Green/yellow
ETH2_LED1	LINK=SOLID, ACTIVITY=BLINKING	Green

If the EC_LED is toggling, the chip is in full on running state. If the EC_LED is not toggling, then the chip has entered the programmed sleep state.

9. BIOS Functionality

The SBC35-427 BIOS settings and option descriptions can be found in our supplemental SBC35-427 BIOS Manual.

9.1 Software Description

This section provides details on the AMI BIOS components to be used in the implementation of the SBC35-427 BIOS firmware.

9.1.1 Software Design Specification: UEFI Operating System Support

The BIOS supports the booting of the following UEFI compliant operating systems:

- Windows 10 x64, IoT Core, and Professional
- Linux x64
- Most x86 operating systems

9.1.2 Software Design Specification: Legacy Operating System Support

The BIOS supports the booting of the following legacy OS capabilities:

- MS-DOS 6
- Compatibility support module (CSM)
- Legacy boot support
- Legacy option ROM support

9.1.3 Software Design Specification: Boot Device Configuration

The BIOS supports booting an OS from the following devices:

- USB mass storage device
- Serial ATA (SATA) device
- Network boot - PXE
- eMMC
- M.2 mass storage device

9.1.4 Software Design Specification: BIOS Update Mechanisms

The BIOS supports the following update mechanisms:

- BIOS update with UEFI shell
- Software utilities
- Flash recovery via USB mass storage device
- Flash recovery via eMMC device
- Embedded controller (EC) firmware update with UEFI shell

9.1.5 Software Design Requirements: BIOS Components

The BIOS includes the following components:

- **Advanced Host Controller Interface (AHCI) support:** Provides SATA host controller functionality.
- **Display switching in setup:** Implements display switching using the UEFI GOP driver under the SETUP environment.
- **Boot order:** Generates the default boot order on the platform's first boot.
- **Boot/resume from S4 device:** Allows the platform to boot from the last S4 hibernated device, disregarding the current boot priority.
- **Cryptographic support:** Provides cryptographic related libraries, PPI, and UEFI protocols for security modules (secure FW update, secure boot, etc.)
- **Source level support:** Provides source level debug functionality for the BIOS project.
- **Fastboot:** Provides optimization of the boot time.
- **Fixed boot order:** Provides infrastructure that allows custom handling of available boot options to meet specific customer needs. Custom boot behavior may include different requests, such as always boot from specific device, default support of various kinds of grouping of boot devices.

- **Generic error logging:** Provides support for logging POST and runtime errors to the GPNV area.
- **Keyboard controller emulation** for USB keyboard/mouse.
- **Physical memory testing:** Supports testing of physical memory present in the system.
- RTC registration and ability to handle wakeup from S5 sleep state.
- **Secure boot support:** Provides support and functionality to conform with UEFI 2.3.1 secure boot requirements and includes the following components:
  - Extended functionality of EFI NVRAM driver with support for authenticated EFI variables.
  - EFI image authentication module that installs EFI security architecture protocol with image authentication and image execution policy.
  - Secure boot variable (PK, KEK, db, and dbx) provisioning.
- Support for the booting to the built in UEFI shell.

9.2 BIOS Update with UEFI Shell

9.2.1 Scope

The Unified Extensible Firmware Interface (EFI or UEFI for short) is a new model for the interface between operating systems and firmware. It provides a standard environment for booting an operating system and running pre-boot applications.

An optional feature of a UEFI implementation is the ability to boot the system to a built-in shell. The UEFI shell provides a command prompt and a rich set of commands that extend and enhance the capability of the UEFI BIOS.

This section describes the process for updating the SBC35-427 BIOS firmware image using the built-in UEFI shell.

9.2.2 Process

1. Insert a USB flash drive containing the BIOS update program into a USB socket on the SBC35-427 platform.
2. Turn on the SBC35-427 and press the **ESC** or **DEL** key during the boot process, which starts the BIOS setup utility.
3. In the BIOS setup utility, use the cursor keys to highlight the **Save & Exit** menu option.
4. Use the cursor keys to select **UEFI: Built-In EFI Shell** from the list of boot devices displayed under the **Boot Override** section.

5. Press **Enter**.

   The SBC35-427 executes the built-in UEFI shell, and displays a list of attached storage devices. The USB flash drive shows up in the list; depending on other boot devices attached, it may be listed as **fs0**, **fs1**, etc.

6. From the UEFI shell command prompt, enter the following command where `N` is the number of the fs device representing the USB flash drive:

   ```
   fsN:
   ```

   Example: `fs1:`

   The shell prompt changes to indicate that device fsN is now the active storage device, for example, `fs1:`

7. Execute the following command:

   ```
   ls
   ```

   The output of the `ls` command is similar to the display listing available with the Linux or MS-DOS list directory command. If the correct storage device was selected in step 6 above, the `ls` command should show the BIOS update program in the directory listing obtained with the ls command.

8. Assuming the BIOS update program is named `Update.efi`, enter the following command at the shell command prompt:

   ```
   Update.efi
   ```

   The BIOS update program begins executing.

9. When the update program completes, power cycle the platform to force the new BIOS image to load and execute.

10. Verify that the BIOS update was successful by comparing the displayed BIOS version with the version specified in the BIOS update notification.

9.3 Embedded Controller (EC) Update with UEFI Shell

9.3.1 Scope

The Unified Extensible Firmware Interface (EFI or UEFI for short) is a new model for the interface between operating systems and firmware. It provides a standard environment for booting an operating system and running pre-boot applications.

An optional feature of a UEFI implementation is the ability to boot the system to a built-in shell. The UEFI shell provides a command prompt and a rich set of commands that extend and enhance the capability of the UEFI BIOS.

This section describes the process for updating the SBC35-427 Embedded Controller (EC) image using the built-in UEFI shell.

9.3.2 Process

1. Insert a USB flash drive containing the EC update program into a USB socket on the SBC35-427 platform.
2. Turn on the SBC35-427 and press the **ESC** or **DEL** key during the boot process, which starts the BIOS setup utility.
3. In the BIOS setup utility, use the cursor keys to highlight the **Save & Exit** menu option.
4. Use the cursor keys to select **UEFI: Built-In EFI Shell** from the list of boot devices displayed under the **Boot Override** section.
5. Press **Enter**.

   The SBC35-427 executes the built-in UEFI shell, and displays a list of attached storage devices. The USB flash drive shows up in the list; depending on other boot devices attached, it may be listed as **fs0**, **fs1**, etc.

6. From the UEFI shell command prompt, enter the following command where `N` is the number of the fs device representing the USB flash drive:

   ```
   fsN:
   ```

   Example: `fs1:`

   The shell prompt changes to indicate that device fsN is now the active storage device, for example, `fs1:`

7. Execute the following command:

   ```
   ls
   ```

   The output of the `ls` command is similar to the display listing available with the Linux or MS-DOS list directory command. If the correct storage device was selected in step 6 above, the `ls` command should show the EC update program in the directory listing obtained with the ls command.

8. Assuming the EC update program is named `Update.efi`, enter the following command at the shell command prompt:

   ```
   Update.efi
   ```

   The EC update program begins executing.

9. When the update program completes, power cycle the platform to force the new EC image to load and execute.
10. Verify that the EC update was successful by comparing the displayed EC version in the BIOS with the version specified in the EC update notification.

10. Accessories and Cables

WINSYSTEMS cables and batteries simplify connection to the SBC35-427. The following table lists available items.

Go to https://www.winsystems.com/ for more information on WINSYSTEMS cables and batteries.

Item	Part Number	Connection	Description
Cable	CBL-PWR-125-20A	J20 - Input power header on page 15	Molex Micro-Fit 3.0 receptacle housing
Cable	CBL-PWR-124-12A	J7 - SATA power header on page 17	Hirose DF11 series 2.00 mm crimping socket 4-pin
Cable	CBL-LVDSB-021-20A	J6 - LVDS data and backlight header on page 18	Hirose DF13C 1.25 mm double row 30-pin
Cable	CBL-USB1-202-12B	J504 - USB touchscreen header on page 19	Molex 1.25 mm PicoBlade housing
Cable	CBL-AUDIO-001-20A	J2 - HD audio header on page 20	Hirose DF13C 1.25 mm 10-pin
Cable	CBL-SER1-202-12A	J1 - Legacy RS232 header on page 20	Molex Milli-Grid receptacles
Cable	CBL-SER2-202-12A	J4 - Serial ports (RS232/422/485) header on page 21	Molex Milli-Grid receptacles
Cable	CBL-USB2-006-12A	J10/J11 - USB 2.0 port 2x header on page 22	Molex Milli-Grid receptacles
Cable	CBL-DIO8-101-12A	J5 - GPIO General-Purpose Input/ Output Header on page 24	Hirose DF13C 1.25 mm double row 20-pin
Cable	CBL-ADC-001-12A	J14 - Analog Inputs (Analog to Digital) Header on page 24	Hirose DF13C 1.25 mm 4-pin
Battery	BAT-LPC-BR2330	J8 - External Battery Header on page 16	Hirose DF13C 1.25 mm 2-pin

Standoff kits are available and recommended for use with the SBC35-427. The following table lists the items contained in each kit.

Kit	Component	Description	Qty
KIT-PCM-STANDOFF-4 4 pc. nylon hex PC/104 standoff kit	Standoff	Nylon 0.25” hex, 0.600” long male/female 4-40	4
	Hex nut	Hex nylon 4-40	4
	Screw	Phillips-pan head (PPH) 4-40 x 1/4” stainless steel	4
KIT-PCM-STANDOFF-B-4 4 pc. brass hex PC/104 standoff kit	Standoff	Brass 5 mm hex, 0.600” long male/female 4-40	4
	Hex nut	4-40 x 0.095 thick, nickel finish	4
	Screw	Phillips-pan head (PPH) 4-40 x 1/4” stainless steel	4

11. Software Drivers

Go to https://www.winsystems.com/ for information on available software drivers.

Appendix A. Best Practices

The following paragraphs outline the best practices for operating the SBC35-427 in a safe, effective manner, that does not damage the board. Read this section carefully.

Power Supply

Avoid Electrostatic Discharge (ESD)
Only handle the circuit board and other bare electronics when electrostatic discharge (ESD) protection is in place. Having a wrist strap and a fully grounded workstation is the minimum ESD protection required before the ESD seal on the product bag is broken.

Power Supply Budget

Evaluate your power supply budget. Recommended maximum power supply input rating for the SBC35-427 is 95 W.

Zero-load Power Supply

Use a zero-load power supply whenever possible. A zero-load power supply does not require a minimum power load to regulate. If a zero-load power supply is not appropriate for your application, then verify that the single board computer's typical load is not lower than the power supply's minimum load. If the single board computer does not draw enough power to meet the power supply's minimum load, then the power supply does not regulate properly and can cause damage to the SBC35-427.

Use Proper Power Connections (Voltage)
When verifying the voltage, measure it at the power connector on the SBC35-427. Measuring it at the power supply does not account for voltage drop through the wire and connectors.

The SBC35-427 requires 10 V to 50 V to operate. Verify the power connections. Incorrect voltages can cause catastrophic damage.

The SBC35-427 has a single power connector at J20. A single 10 V to 50 V DC input and ground is required to power the board.

Power Harness

Minimize the length of the power harness. This reduces the amount of voltage drop between the power supply and the SBC35-427. Recommended DC power input wires/cable with a flammability rating of VW-1 or better.

Gauge Wire

Use the largest gauge wire that you can. Most connector manufacturers have a maximum gauge wire they recommend for their pins.

Contact Points

WINSYSTEMS boards mostly use connectors with gold finish contacts. Gold finish contacts are used exclusively on high-speed connections. Power and lower speed peripheral connectors may use a tin finish as an alternative contact surface. It is critical that the contact material in the mating connectors is matched properly (gold to gold and tin to tin). Contact areas made with dissimilar metals can cause oxidation/corrosion, resulting in unreliable connections.

Pin Contacts

Often the pin contacts used in cabling are not given enough attention. The ideal choice for a pin contact would include a design similar to Molex or Trifurcon designs, which provide three distinct points to maximize the contact area and improve connection integrity in high shock and vibration applications.

Power Down

Make sure that power has been removed from the system before making or breaking any connections.

Power Supply OFF—Always turn off the power supply before connecting to the I/O Module. Do not hot-plug the SBC35-427 on a host platform that is already powered.

I/O Connections OFF—Turn off all I/O connections before connecting them to the embedded computer modules or any I/O cards. Connecting hot signals can cause damage whether the embedded system is powered or not.

Mounting and Protecting the I/O Module

To avoid damage, mount the SBC35-427 properly. Standoff kits are available and recommended for use with the SBC35-427. See the table on page 33 for the items contained in each kit.

Placing the SBC35-427 on mounting standoffs—Be careful when placing the SBC35-427 on the mounting standoffs. Sliding the board around until the standoffs are visible from the top can cause component damage on the bottom of the board.

Do not bend or flex the SBC35-427—Bending or flexing can cause irreparable damage. Embedded computer modules are especially sensitive to flexing or bending around ball grid array (BGA) devices. BGA devices are extremely rigid by design, and flexing or bending the embedded computer module can cause the BGA to tear away from the printed circuit board.

Mounting holes—The mounting holes are plated on the top, bottom, and through the barrel of the hole. Solder dots SD501–SD508 can be soldered together to connect the mounting holes to the embedded computer module's ground plane. Traces are often routed in the inner layers right below, above, or around the mounting holes.

- Never use a drill or any other tool in an attempt to make the holes larger.
- Never use screws with oversized heads. The head could come in contact with nearby components causing a short or physical damage.
- Never use self-tapping screws; they compromise the walls of the mounting hole.
- Never use oversized screws that cut into the walls of the mounting holes.
- Always use all of the mounting holes. By using all of the mounting holes, you provide the support the embedded computer module needs to prevent bending or flexing.

Plug or unplug connectors only on fully mounted boards—Never plug or unplug connectors on a board that is not fully mounted. Many of the connectors fit rather tightly and the force needed to plug or unplug them could cause the embedded computer module to be flexed.

Avoid cutting the SBC35-427—Never use star washers or any fastening hardware that cut into the SBC35-427.

Avoid over-tightening of mounting hardware—Causing the area around the mounting holes to compress could damage interlayer traces around the mounting holes.

Use appropriate tools—Always use tools that are appropriate for working with small hardware. Large tools can damage components around the mounting holes.

Avoid conductive surfaces—Never allow the embedded computer module to be placed on a conductive surface. Many embedded systems use a battery to back up the clock-calendar and CMOS memory. A conductive surface such as a metal bench can short the battery causing premature failure.

Adding WINSYSTEMS Modular IO80 Boards

Be careful when adding Modular IO80 boards to the SBC35-427—Never allow the power to be turned on when a Modular IO80 board has been improperly plugged onto the SBC35-427.

Conformal Coating

AConformal coating by any source other than WINSYSTEMS voids the product warranty and will not be accepted for repair by WINSYSTEMS. If such a product is sent to WINSYSTEMS for repair, it will be returned at customer expense and no service will be performed. A WINSYSTEMS product conformally coated by WINSYSTEMS will be subject to regular WINSYSTEMS warranty terms and conditions.

Operations/Product Manuals

Every single board computer has an Operations manual or Product manual.

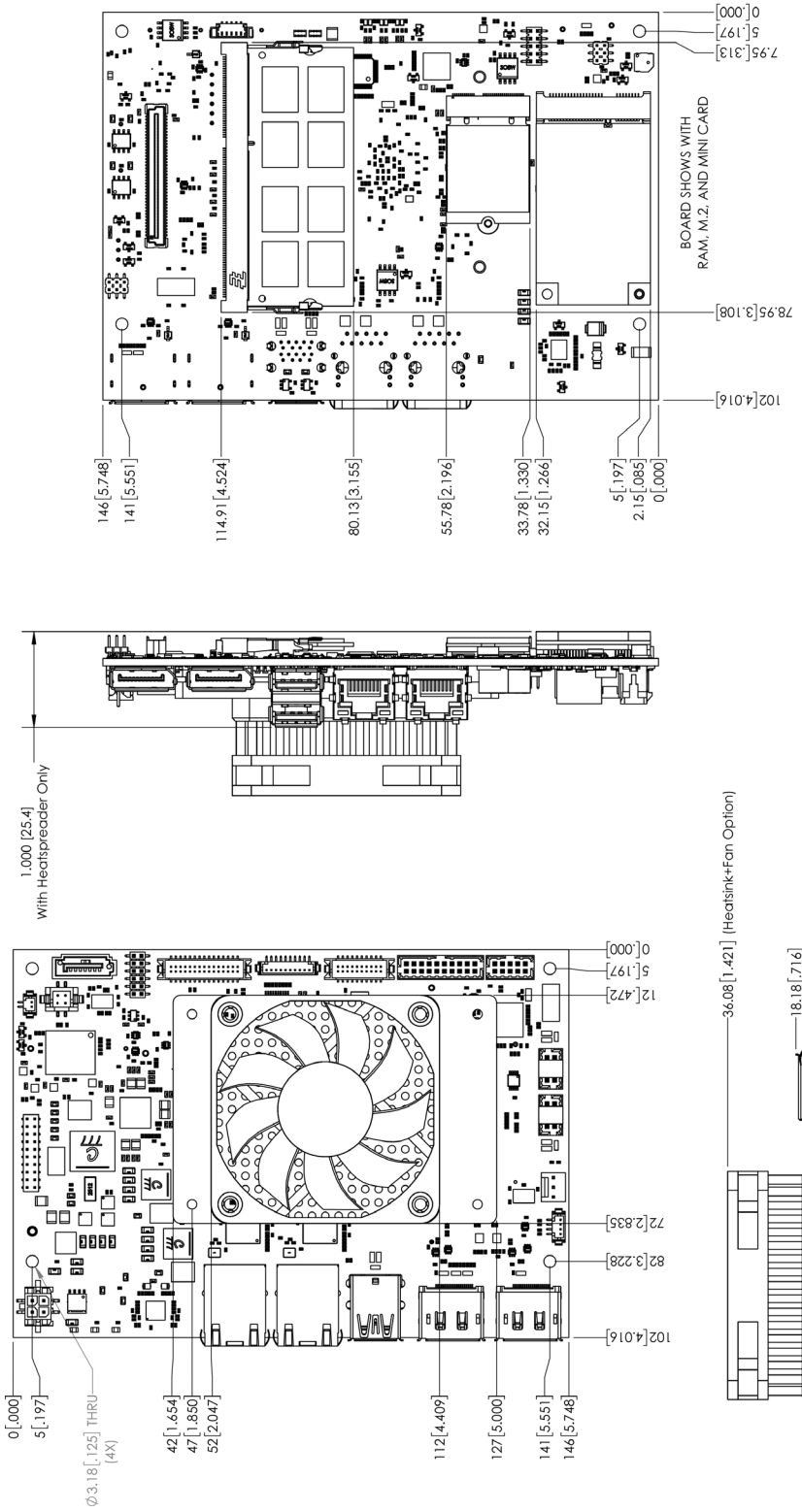
Periodic updates—Operations/product manuals are updated often. Periodically check the WINSYSTEMS website (https://www.winsystems.com) for revisions.

Check pinouts—Always check the pinout and connector locations in the manual before plugging in a cable. Many I/O modules have identical headers for different functions and plugging a cable into the wrong header can have disastrous results.

Contact an Applications Engineer—If a diagram or chart in a manual does not seem to match your board, or if you have additional questions, contact a WINSYSTEMS Applications Engineer at +1-817-274-7553.

Appendix B. Mechanical Drawings

SBC35-427 Mechanical Drawing



Appendix C. Warranty Information

Full warranty information can be found at https://winsystems.com/company-policies/warranty/.