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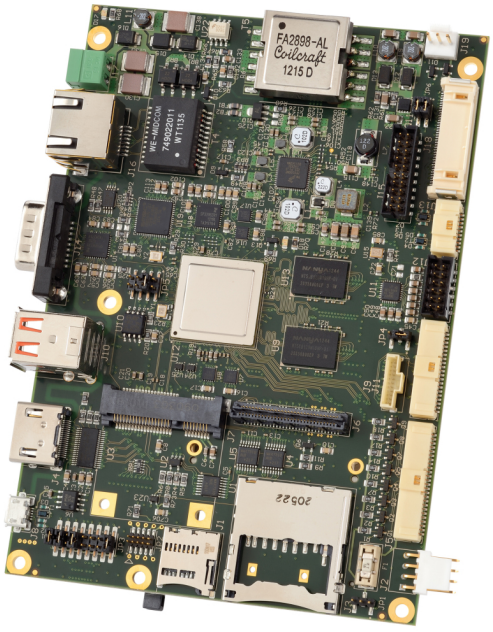
WinSystems®

The Embedded Systems Authority

SBC35-C398

Single-Core ARM® Industrial Computer with NXP's i.MX 6 Processor

Product Manual



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1. Introduction

This manual provides configuration and usage information for the SBC35-C398. 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 for other accessories (including cable drawings and pinouts) that can be used with your SBC35-C398.

2. Functionality

The WinSystems SBC35-C398 Single Board Computer (SBC) enables customers to use the full capabilities of the NXP i.MX6 CPU, which WinSystems has integrated into a compact, rugged, industrial form factor. This design features the following:

- **High-Performance Computer:** With Single, Dual, or Quad core ARM Cortex A9 options, the SBC35-C398 product family provides a performance, scalable, multi-core platform.
- **Multiple Displays with video acceleration:** Supporting from two to four active displays, Camera, MIPI capture and display, and power efficient accelerators for 2D, 3D, HD Video, and multimedia applications.
- **Robust I/O Platform:** Each system supports the full range of available integrated I/O, including Storage, Networking, GPIO, COM, CAN, I^2C, SPI, WDT, RTC, and MiniPCIe expansion.
- **Reliable in extreme environments:** WinSystems specifically designed the SBC35-C398 family for the rugged and wide operating range required of modern Industry. Passive Cooling operation from -40 °C to +85 °C and a wide power input range of +10 V DC to +50 V DC.

NOTE WinSystems can provide custom configurations for Original Equipment Manufacturer (OEM) clients. Please contact an Application Engineer through technical support for details (see the “Introduction” on page 1 for details).

3. Features

The different models of SBC35-C398 provide the following features:

Product Number	SBC35-C398Q-2-0	SBC35-C398DL-2-0	SBC35-C398S-1-0
Processor	NXP i.MX 6Q	NXP i.MX 6DL	NXP i.MX 6S
Cores	4x ARM Cortex A9	2x ARM Cortex A9	ARM Cortex A9
Frequency	800MHz	800MHz	800MHz
Cache	32KB/32KB L1, 1MB L2	32KB/32KB L1, 512KB L2	32KB/32KB L1, 512KB L2
Memory	2GB 64bit DDR3	2GB 64bit DDR3	1GB 32bit DDR3
Embedded SRAM	256KB	128KB	128KB
Hardware Display Accelerators	NEON Media Processor Engine	NEON Media Processor Engine	NEON Media Processor Engine
3D Graphics Core	Open GL ES 3.0, Open CL	Open GL ES 3.0	Open GL ES 3.0
2D Graphics Core	Dual BitBlt	BitBlt	BitBlt
Vector Graphics Core	OpenVG 1.1	-	-
Video Interfaces	Up to Four Active Displays	Up to Two Active Displays	Up to Two Active Displays
HDMI 1.4 Type A	HD1080p60	HD1080p30	HD1080p30
LVDS Interface	2x (2048x1536) or 2x (1280x720)	2x (1366x768)	2x (1366x768)
MIPI/DSI	Capture + Display	-	-
MIPI	Display Port + Camera Input	-	-
Camera Interface	CMOS 8 bit	CMOS 8 bit	-
Ethernet*	1 Gbps	1 Gbps	1 Gbps
	Wake on LAN (WOL) IEEE 1588	Wake on LAN (WOL) IEEE 1588	Wake on LAN (WOL) IEEE 1588
Serial			
RS 232/422/485	2x up to 1 Mbps	1x up to 1 Mbps	1x up to 1 Mbps
RS 422/485	3x up to 5 Mbps	-	-
CAN Ports	Two	Two	-
USB Ports with Over Current Protection	6x USB 2.0 + On The Go	6x USB 2.0 + On The Go	6x USB 2.0 + On The Go
Audio Interfaces	HDMI + Line In/Out, Mic, Head	HDMI + Line In/Out, Mic, Head	HDMI
General Purpose I/O	24 Lines Tolerant to 30V	24 Lines Tolerant to 30V	24 Lines Tolerant to 30V
Mass Storage	CFast + SD/SDIO + MicroSD	SD/SDIO + MicroSD	SD/SDIO + MicroSD
Expansion Bus Connectors			
Mini PCIe	One Half Size	One Half Size	-
IO60	I2C, SPI, TTL & PWM	I2C, SPI, TTL & PWM	I2C, SPI, TTL & PWM
Operating Temperature	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C
Timers	Three	Three	Three
Real Time Clock	Secure RTC	Secure RTC	Secure RTC
Battery	Optional External	Optional External	Optional External
Watchdog Timer	Programmable + TrustZone	Programmable + TrustZone	Programmable + TrustZone
Electrical			
PoE PD	IEEE802.3at (Up to 25W)	IEEE802.3at (Up to 25W)	IEEE802.3at (Up to 25W)
Aux. Input	10–50VDC	10–50VDC	10–50VDC
Mechanical			
Dimensions	4 x 5.75 in (102 x 146 mm)	4 x 5.75 in (102 x 146 mm)	4 x 5.75 in (102 x 146 mm)
Weight	5.0 oz (142.2 gm)	4.8 oz (136.1 gm)	4.2 oz (113.4 gm)
PC Board Thickness	0.078"	0.078"	0.078"

* The theoretical maximum performance of 1 Gbps ENET is limited to 470 Mbps (total for Tx and Rx). The actual measured performance in an optimized environment is up to 400 Mbps. Per NXP IMX6DQCE Rev. 2, 5/2013/ERR004512/ "ENET: 1 Gb Ethernet MAC (ENET) system limitation."

4. Before You Begin

Review the warnings in this section and the best practice recommendations (see “Best Practices” on page 42) when using and handling the WinSystems SBC35-C398. Adherence to these recommendations provides an optimal user experience and prevents damage. Read through this document and become familiar with the SBC35-C398 before proceeding.



FAILING TO COMPLY WITH THESE BEST PRACTICES MAY DAMAGE THE SBC35-C398 AND VOID YOUR WARRANTY.

4.1 Warnings

Only qualified personnel should configure and install the SBC35-C398. While observing the 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.



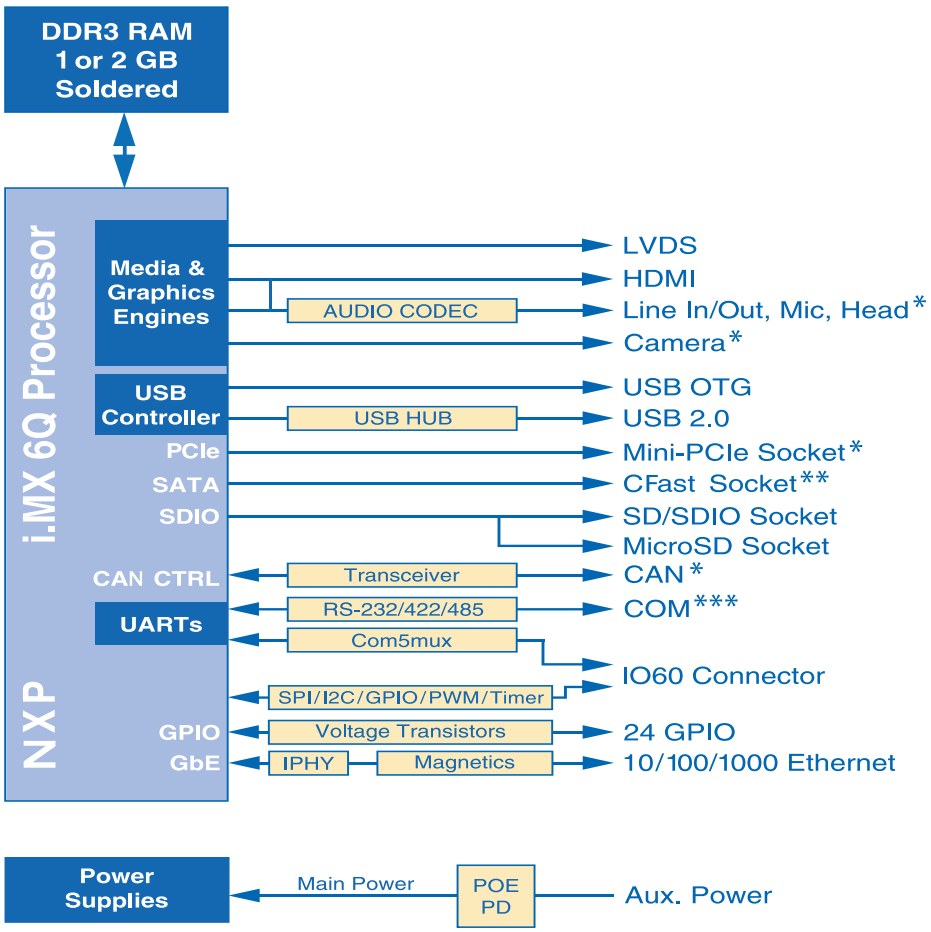
Before supplying voltage to pin 49 of J5, remove any jumper installed on JP1. Damage to the board may occur if you apply a voltage to pin 49 of J1 while a jumper is installed on JP1.

5. General Operation

5.1 System Block Diagrams

The SBC35-C398 is a single-board computer (SBC). It is a full-featured embedded system with a variety of on-board I/O options. The following figure is a simplified system block of the SBC35-C398:

Figure 5–2: Simplified Block Diagram



* Not available on SBC35-C398S (SBC35-C398DL and SBC35-C398Q only)

** Model SBC35-C398Q only

*** Available COM numbers are model specific. Refer to your model's Serial interface specifications for details.

6. Specifications

The SBC35-C398 adheres to the following specifications and requirements:

SBC35-C398 Specifications

Electrical	
V_{CC} or Power	+10 V DC to + 50 V DC or Power over Ethernet (PoE IEEE802.3) at up to 25W
MTBF	16.25 years
Models / Processor	**SBC35-C398S:** NXP i.MX 6S, Single core ARM Cortex A9, 800MHz, 32KB/32KB L1, 512KB L2 (Cache), 1GB 32-bit DDR3 (Soldered), 128KB (Embedded) **SBC35-C398DL:** NXP i.MX 6DL, Dual core ARM Cortex A9, 800MHz, 32 KB/32 KB L1, 512 KB L2 (Cache), 2 GB 64-bit DDR3 (Soldered), 128KB (Embedded) **SBC35-C398Q:** NXP i.MX 6Q, Quad core ARM Cortex A9, 800MHz, 32 KB/32 KB L1, 1 MB L2 (Cache), 2 GB 64-bit DDR3 (Soldered), 256 KB (Embedded)
Mechanical	
Dimensions	4 x 5.75 in (102 x 146 mm)
Weight	SBC35-C398Q-2-0 (Quad): 5.0 oz (142.2 gm) SBC35-C398DL-2-0 (Dual Lite): 4.8 oz (136.1 gm) SBC35-C398S-1-0 (Solo): 4.2 oz (113.4 gm)
PCB thickness	0.078 inch (1.98 mm)
Environmental	
Temperature	-40 °C and +85 °C (-40 °F and +185 °F)
Humidity (RH)	5% to 95% non-condensing
Mechanical Shock Testing	MIL-STD-202G, Method 213B, Condition A 50g half-sine, 11 ms duration per axis, 3 axis
Random Vibration Testing	MIL-STD-202G, Method 214A, Condition D .1g/Hz (11.95g rms), 20 minutes per axis, 3 axis
RoHS Compliant	Yes
Operating Systems	
Runs Linux and other compatible operating systems.	

7. Setup

7.1 Power Setup



Use Proper Power Connections (Voltage)—When verifying the voltage, measure it at the power connector on the SBC35-C398. Measuring it at the power supply does not account for voltage drop through the wire and connectors.
Power the SBC35-C398 using Power over Ethernet (J16 RJ45, PoE IEEE802.3) or Auxiliary Input (J17, +10 V DC to + 50 V DC). Verify the power connections. Incorrect voltages can cause catastrophic damage.

Power can be provided to the SBC35-C398 through either of two inputs:

1. +10 V DC to +50 V DC power supply connected to the green power connector at J17.
2. IEEE 802.3 at compliant Power over Ethernet (PoE).

See “Power up” on page 7 for additional information.

7.2 Serial Console Setup

A serial cable connected to the SBC and a secondary system with a terminal emulator program is required to view the serial console output of the SBC35-C398 SBC and to configure the SBC through the U-Boot boot loader interface. The default serial port settings are:

- Baud rate = 115200
- Data width = 8 bits
- Parity = None
- Stop = 1 bit
- Flow Control = Off

See “Console” on page 11 for additional information.

7.3 Keyboard and Mouse

Connect a keyboard and mouse to the SBC35-C398 through the USB connectors.

7.4 Audio and Video Display Setup

The SBC35-C398 can provide three separate video outputs, one HDMI and two LVDS. See “Video Output” on page 11 for additional information.

An audio cable bundle is available from WinSystems for the SBC35-C398Q board (P/N CBL-AUDIO2-202-12D). It attaches to **J12** and brings the analog audio signals out to

1/8” phone jacks. The signals available on the cable are Line Out, Headphone, Line In, and Microphone In. In addition to the analog audio outputs & inputs, the SBC35-C398Q also supports digital audio on the HDMI video connector. Plugging this connector into a device with HDMI audio capability allows the board to play audio through the device.

7.5 Startup

As shipped from the factory, the SBC35-C398Q uses the **JP5** jumpers to signal the i.MX6 ARM processor which device loads the initial boot application. The default device is on-board SPI-NOR flash, but boot-up can be loaded from the SD card or the microSD card if desired.

U-Boot is the default boot loader installed on the SBC35-C398. U-Boot has been ported to the board, and all of the board’s boot peripherals are available for use from within U-Boot. The boot loader uses environment variables to specify configuration of the board during startup; the variables also specify the operating system boot device, and any variables that pass on to the operating system during startup. As shipped from the factory, U-Boot environment variables are stored in a partition of the SPI-NOR flash.

7.6 Power up

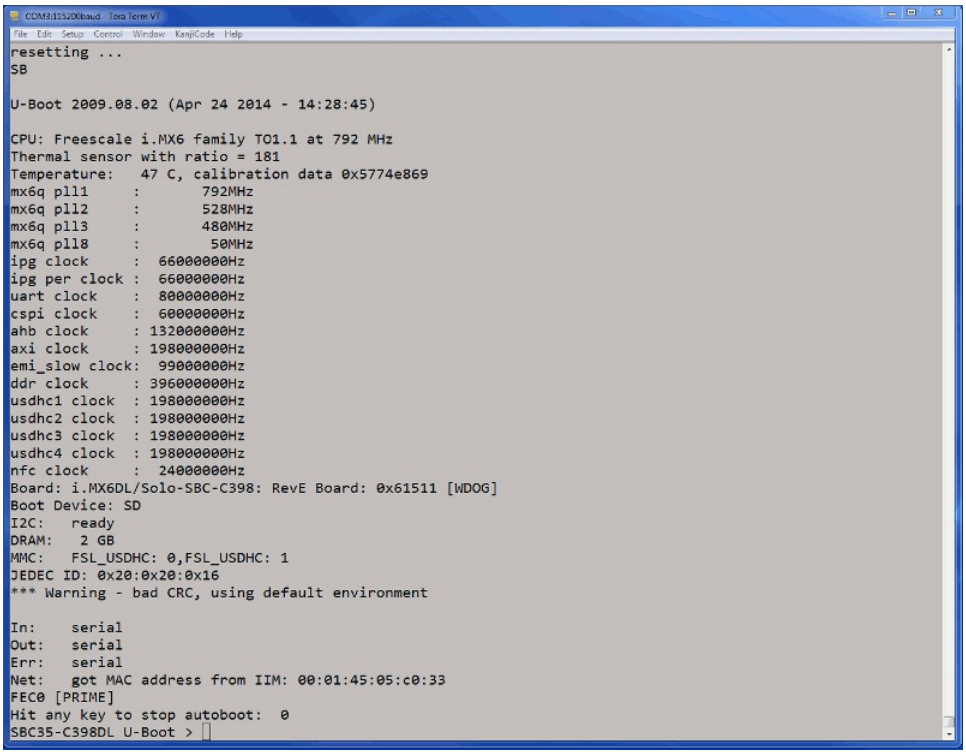
Once the SBC35-C398 powers up, the boot loader starts. U-Boot pauses for three seconds to allow for aborting the OS boot. If you do not abort the OS boot during the three-second window, the system loads the WinSystems Linaro distribution of Linux. The U-Boot OS abort period is programmable - it can be changed by aborting an OS boot and changing the bootdelay parameters. Please remember to save the changes to the SPI-NOR flash device after modifying the parameters. If you abort the U-Boot OS boot by pressing any key during the three-second pause, the U-Boot command prompt displays as shown in the screen snapshot on the next page.

NOTE The open source U-Boot project is hosted at http://www.denx.de/wiki/U-Boot. Extensive U-Boot documentation is available for download from this site.

The image depicted in the figure titled “U-Boot Screen During Startup” on page 36 shows the U-Boot startup screen and OS boot countdown boot screen from an SBC35-C398 Dual Core or Single Core board.

NOTE The **“*** Warning - bad CRC…”** message is an indicator that U-Boot is using the built-in environment variables and not a local copy from SPI-NOR flash. If a variable were added or modified and the environment saved with the U-Boot **saveenv** command, this message would not be present.

U-Boot Screen During Startup



7.7 U-Boot Commands

U-Boot supports commands that are executable from the U-Boot command prompt. This manual focuses on commands used to display and change the boot configuration.

NOTE Use single quotes for argument strings that require spaces and environment variables, as depicted in the following examples:

Example	Command string
Single quote requirement for argument strings with spaces.	`setenv bootcmd 'run bootcmd_mmc'` `setenv ipaddr '192.16.1.104'`
Single quote requirement for environment variables.	`setenv bootdelay '10'`
Alternate single quote requirement for environment variables.	`setenv fastboot_dev 'mmc1'`

The U-Boot commands, formats, and functions table provides U-Boot commands to display and change the boot configuration, an example of syntax in context, and command definitions.

U-Boot commands, Formats, and Functions.

Command	Example Format in Context	Command Definition
printenv	printenv	Prints a list with all variables in the environment and their values, plus some statistics about the current usage and the total size of the memory available for the environment
setenv	setenv <variable name> <variable settings>	Used to define the value of environment variables, and if no argument is given (used alone), it displays all environment valuables.
saveenv	saveenv	This command saves environment variables to persistent storage; saving is required after making changes to any variable; without doing so, changes are lost when the system is reset
destroyenv	destroyenv	Erases entire contents of the U-Boot environment and restores variables to default values; it will not save the default environment to persistent storage, such as with saveenv
help *or* ?	help *or* ?	Lists all of the available U-Boot commands, and when used with an argument, such as "help run" it will list all the run commands under the help environment variable
reset	reset	Resets the system and restarts the boot process
run	run <executable>	Executes (Runs) the selected executable
boot	boot = run bootcmd	Executes default boot command

7.8 U-Boot Environment Variables

U-Boot parameters configure the SBC35-C398 during OS boot. Many should remain unchanged, but others can be modified to reflect a board's hardware specific configuration. Each U-Boot variable is stored as a character array (a string) in the board's memory. As shipped from the factory, the U-Boot parameters are stored in the same SPI flash device as U-Boot. When used in U-Boot commands, parameter names are replaced with the contents of the string associated with the variable. If you enter the U-Boot command 'printenv' on the U-Boot command line, all of the parameters will be printed followed by their string contents.

The use of an environment variable is indicated to U-Boot by surrounding the variable name with the U-Boot variable '${' and '}'. For example, to use the environment variable 'serverip' in a U-Boot command, it must be specified as follows:

```
${serverip}
```

The environment variables depicted below are the defaults for the SBC35-C398Q (Quad Core).

NOTE Since the environment variables depicted below are not part of a command line (they are a screen printout of global environment variables), there are no single line quotes required; it is merely a list.

```
bootdelay=3
baudrate=115200
ipaddr=192.168.1.103
serverip=192.168.1.101
netmask=255.255.255.0
loadaddr=0x10800000
rd_loadaddr=0x11000000
netdev=eth0
ethprime=FEC0
kernel=uImage
cpu_count=maxcpus=4
video1=video=mxcfb0:dev=hdmi,1280x720M@60,if=RGB24 video2=video=mxcfb1:dev=ldb,1024x600M@60,if=RGB666
video3=video=mxcfb2:off
bootargs=console=ttymxc0,115200n8 ${video1} ${video2} ${video3}
bootargs_mmc=setenv bootargs ${bootargs} root=/dev/mmcblk0p2 rootwait rw ip=none '${cpu_count} bootcmd_mmc=run
bootargs_mmc; fatload ${mmc_bootdevice} ${loadaddr} ${kernel}; bootm ${loadaddr} bootcmd=run bootcmd_mmc
mmc_bootdevice=mmc 1:1
stdin=serial
stdout=serial
stderr=serial
ethact=FEC0
```

Environment variables may be composed of other variables. All of the text in a U-Boot environment variable preceded by a '$' and enclosed between the braces '{' and '}' are themselves environment variables. When U-Boot encounters this markup notation during variable processing, it replaces the markup characters and variable name with the variable's string contents. In the list above, the environment variable 'bootargs' is comprised of the following string:

```
console=ttymxc0,115200n8 ${video1} ${video2} ${video3}
```

When used internally by U-Boot, ${video1} is expanded to become:

```
video=mxcfb0:dev=hdmi,1280x720M@60,if=RGB24
```

${video2} will be expanded to become:

```
video=mxcfb1:dev=ldb,1024x600M@60,if=RGB666
```

and ${video3} will expand to become:

```
video=mxcfb2: off
```

The complete expansion of the environment variable 'bootargs' will become:

```
console=ttymxc0,115200n8
video=mxcfb0:dev=hdmi,1280x720M@60,if=RGB24
video=mxcfb1:dev=ldb,1024x600M@60,if=RGB666 video=mxcfb2: off
```

By using U-Boot's variable expansion capability, complex U-Boot environment strings can be assembled from simple strings. The following sections illustrate important U-Boot devices and their environment variables.

7.8.1 Console

The console argument (`console=ttymxc0,115200n8`) selects the serial device and protocol for the console output. This variable should not be changed if a console is desired, and it can be deleted if no console is used.

7.8.2 Video Output

There are three video outputs on the SBC35-C398; one HDMI and two LVDS (Flat Panel). The two LVDS sources also provide back light support. The desired video sources and resolutions must be configured using U-Boot environment variables. The default settings enable the HDMI port with a resolution of 1280x720; the default settings also enable a single LVDS port with resolution of 1024x600.

Setting the primary display mode:

To set the primary display to HDMI with 1080P60 mode, and the secondary display on LVDS with XGA mode enter the following:

```
video=mxcfb0:dev=hdmi, 1920x1080M@60,if=RGB24
   video=mxcfb1:dev=ldb,LDB-XGA,if=RGB666
```

To set the primary display to LVDS with XGA mode, and the secondary display on HDMI with 1080P60 mode, enter the following:

```
video=mxcfb0:dev=ldb,LDB-XGA,if=RGB666
   video=mxcfb1:dev=hdmi,1920x1080M@60,if=RGB24
```

7.8.3 Specifying Active Cores

The SBC35-C398Q utilizes the NXP i.MX6Q processor, which has four ARM processor cores. By default, all four cores are active. You can specify the maximum number of cores with the environment variable '`cpu_count`'.

Normally, Linux will use all available CPU cores. Changing this variable can make kernel and device driver debugging easier to accomplish. To change the number of CPU cores in use, enter the following series of commands from the U-Boot command line, substituting the number of CPUs for ***X***:

```
setenv cpu_count 'maxcpus=X'
saveenv
```

7.8.4 Boot Command and Boot Device

As shipped from the factory, the board is set to boot the Operating System (OS) image from an SD card. By changing certain U-Boot environment variables, the board can be directed to boot the OS image from a microSD card, an attached SATA/CFast device, or over the Ethernet. On startup, U-Boot will look in the environment for a variable named '`bootcmd`'. Typically, '`bootcmd`' directs U-Boot to execute commands contained in another environment variable. For instance, the default '`bootcmd`', which is

'run bootcmd_mmc', simply directs U-Boot to execute, as a command, the contents of environment variable 'bootcmd_mmc', which are reflected in the following table.

Executing Boot Command Environment Variable

Command	Format in Context	Function
bootcmd	run bootcmd_mmc	On startup, U-Boot will look in the environment for a variable named 'bootcmd'. For instance, the default 'bootcmd', which is 'run bootcmd_mmc', simply directs U-Boot to execute, as a command, the contents of environment variable 'bootcmd_mmc'.The contents of 'bootcmd_mmc' are: run 'bootargs_mmc'; Fatload {mmc_bootdevice} ${loadaddre}${kernel}; bootm ${loadadr} The contents of environmental variable bootargs_mmc are: Setenv bootargs ${bootargs} root=/dev/mmcblk0p2 'rootwait' 'rw' 'ip=none' This command causes UBoot to set bootargs to be the same value as the environment variable bootargs; it then specifies the root device. Further definitions of variables are as follows: 'rootwait' – tells U-Boot to wiat for the mount of the root file system to complete 'rw' – specifies that the file system is to be mounted 'ip=none' – directs U-Boot not to initialize the Ethernet device

Parameters referenced in the prior table expand so the variable is replaced by the value specified in the environment. The following are options of each.

${kernel} *becomes* 'uImage '

${loadaddr} *becomes* '0x10800000'

${mmc_bootdevice} *becomes* 'mmc 1:1'

When all are completed and the variables expanded, the above commands instruct U-Boot to execute a FAT file system copy from device 'mmc 1:1' of the 'uImage' file. The file will be copied to RAM address '01080000', and then execution will begin at address '01080000'.

To use the microSD card instead of the SD card as the OS image source device, modify the environment variable 'mmc_bootdevice' so that its value becomes 'mmc 0:1' instead of 'mmc 1:1'.

To boot from a CFast/SATA device attached to the SBC35-C398 board's SATA interface, modify bootcmd so that its value becomes 'run bootcmd_sata'. Changes to variable 'bootcmd_sata' and 'bootargs_sata' may also be required to boot from the desired partition of a SATA/CFast device.

It is also possible to use U-Boot to boot the kernel 'uImage' file from a network server using the TFTP protocol. This is convenient for rapid kernel debug/testing kernel configuration. It is also a great way to speed up the debug process for kernel device drivers. However this requires knowledge of the TFTP server's file system, and the correct U-Boot configuration will vary from development environment to development environment. You must install and configure a TFTP server, and copy the 'uImage' file

into the file system so that the TFTP server is configured for use. Contact your WinSystems Applications Engineer for additional information on configuring U-Boot.

7.8.5 Root File System

The root file system arguments (`root=/dev/mmcblk0p2 'rootwait rw'`) specify the device and partition where the Linux file system resides. For each device, this will be the second partition that contains a Linux ext3 file system.

7.8.6 U-Boot Delay

This is the amount of time after power-up during which you can press a key to abort the OS boot; if the OS boot is aborted, the U-Boot command prompt will appear and the various U-Boot commands can be executed. This delay can be changed by modifying the environment variable '`bootdelay`'. The default value is three (3 seconds). To change the value to 10 seconds enter:

```
setenv bootdelay '10'
```

8. Configuration

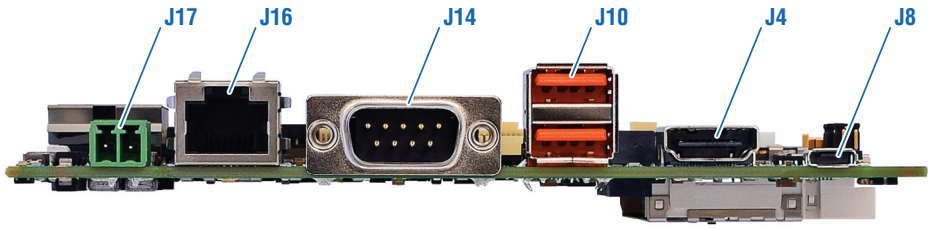
This section describes the SBC35-C398 components and configuration.

8.1 Component Layout

The SBC35-C398 provides components on the edge, top, and bottom of the board.

8.1.1 Edge Connections

Edge connections provide common external connections.

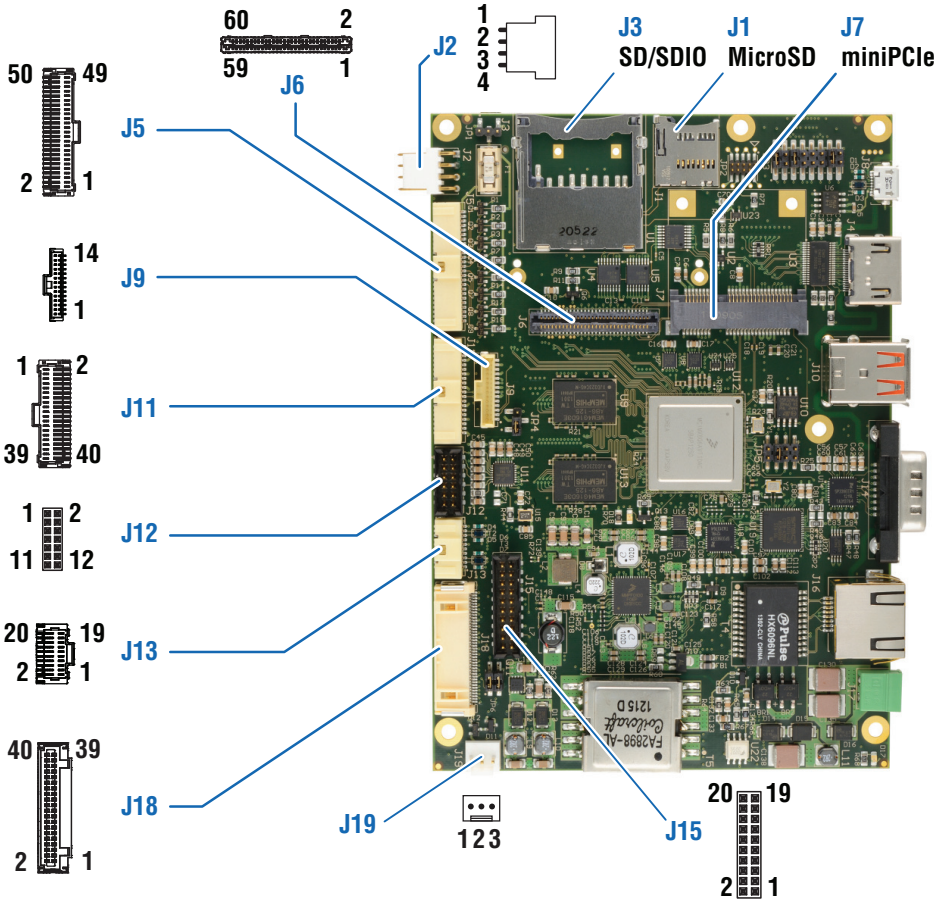


Edge Connections

Item	Description	Reference
J4	HDMI	page 20
J8	Micro USB (USB OTG)	page 24
J10	USB 2.0	page 26
J14	COM 1	page 29
J16	Ethernet Port	page 31
J17	Power Connector	page 31

8.1.2 Top View Connections

The connectors in this view connect the SBC35-C398 to peripherals. Refer to “Edge Connections” on page 14 and “Bottom View Connections” on page 16 for other connections.

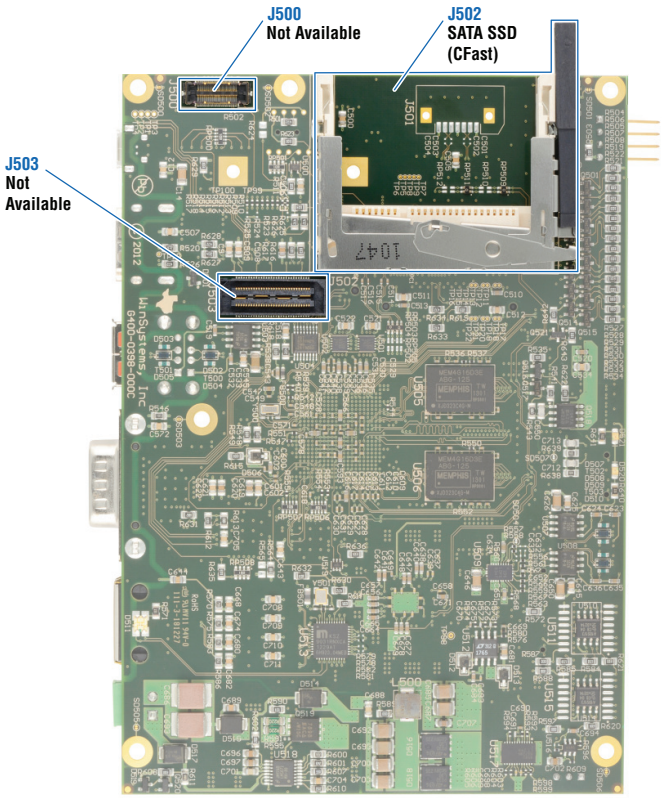


Top View Connections

Item	Description	Reference
J1	Micro SD	page 18
J2	Power Controls	page 19
J3	SD/SDIO	page 19
J5	GPIO	page 20
J6	IO60 Expansion Bus	page 22
J7	MiniPCIe (SBC35-C398DL and SBC35-C398Q Only)	page 23
J9	Backlight Power	page 25
J11	LVDS	page 27
J12	Analog Audio	page 28
J13	Four USB Ports (SBC35-C398DL and SBC35-C398Q Only)	page 28
J15	Controller Area Network (CAN) BUS Connector (SBC35-C398DL and SBC35-C398Q Only)	page 30
J18	COM 2, 3, 4, & 5 (SBC35-C398Q Only)	page 32
J19	External Battery Connection	page 35

8.1.3 Bottom View Connections

The connectors in this view connect the SBC35-C398 to peripherals. Refer to “Edge Connections” on page 14 and “Top View Connections” on page 15 for other connections.

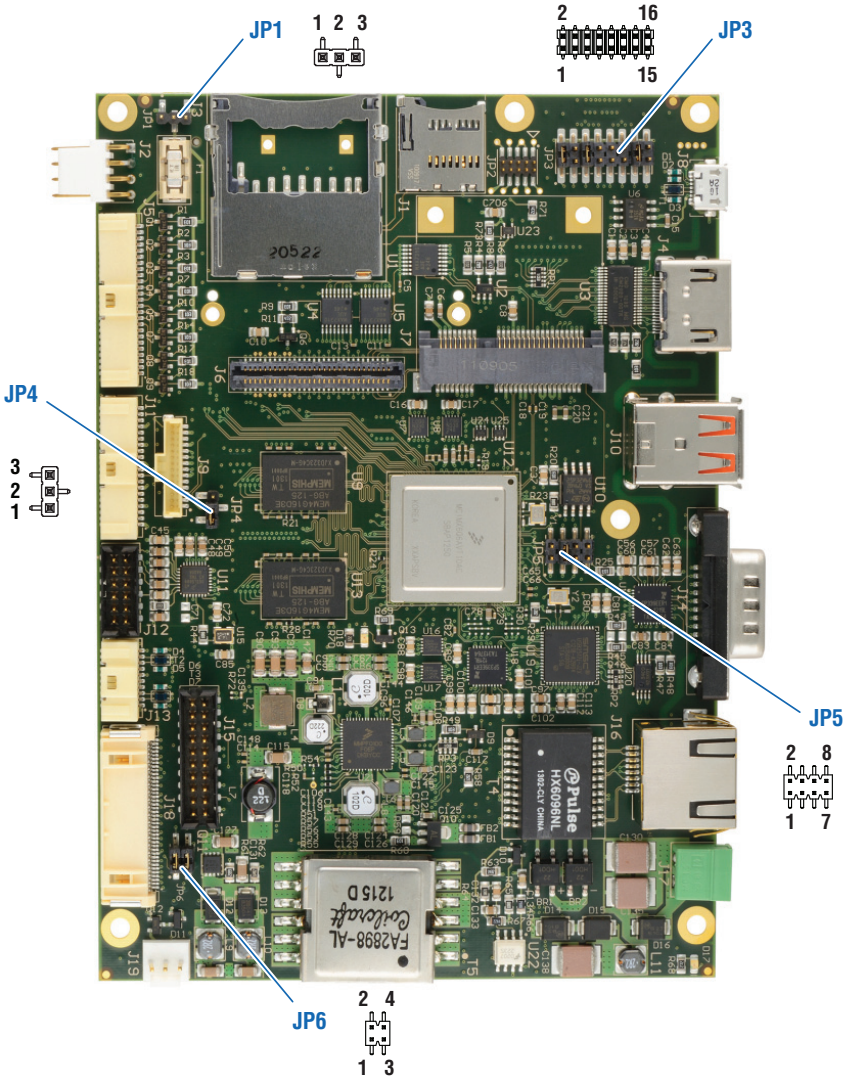


Bottom View Connections

Item	Description	Reference
J500	Not Available	Not Available
J502	SATA SSD (CFast)(SBC35-C398Q Only)	page 36
J503	Not Available	Not Available

8.1.4 Jumpers

Jumpers configure the settings for the SBC35-C398.



Item	Description	Reference
JP1	Digital I/O Power Jumper	page 37
JP3	Boot Configuration Jumper	page 38
JP4	Panel Power Jumper	page 39
JP5	Boot Mode Jumper	page 40
JP6	CAN Termination Jumper Block	page 40

8.2 Watchdog Timer

The SBC35-C398 features the watchdog timer built into the i.MX6. This advanced watchdog timer can be used to guard against software lockups (Programmable + TrustZone).

8.3 Secure Real-time Clock/Calendar

A secure real-time clock is used as the 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 connected to J19 for the real-time clock to retain time and date during a power down. See “External Battery Connection (J19)” on page 35.

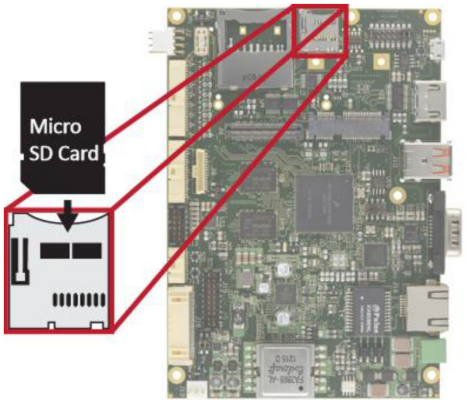
8.4 Power

The SBC35-C398 draws power through the J17 connector (see “Power Connector (J17)” on page 31). Alternately, power can be supplied by PoE (see “Ethernet Port (J16)” on page 31).

8.5 Connectors

8.5.1 Micro SD (J1)

Orient the micro SD card as depicted in the following illustration. The card should be positioned so that the beveled edge is on the right front.





Do not insert or remove the Micro SD card while the SBC35-C398 is powered up or in the process of powering up or down. This could corrupt the file system on the removable media. Always power down the board completely, then remove or insert media.

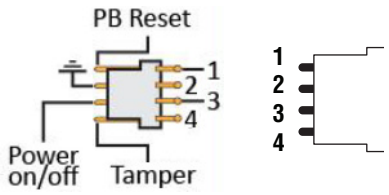
Additional Information

This micro SD card connector is a Molex 47352-1001.

8.5.2 Power Controls (J2)

J2 provides inputs for Pushbutton (PB) Reset, Power ON/OFF, and Tamper detection. The Power On/Off and Tamper circuits (pins 3 and 4, respectively) connect directly to the i.MX6 processor. PB Reset connects to the Master Reset input of a voltage supervisor and reset control circuit.

Layout and Pin Reference:



Pin	Name
1	PB Reset
2	Ground
3	Power On/Off
4	Tamper

Additional Information

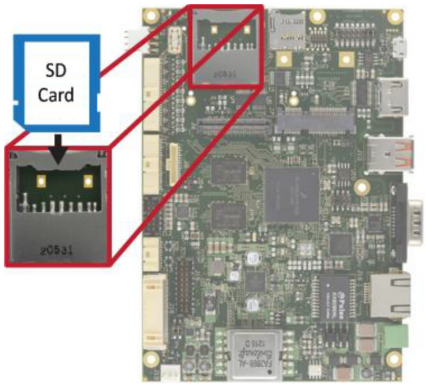
This power connection is a Molex 22-12-2044.

Matching connector: Molex 22-01-2045

Mating Crimp Connector: Molex 08-55-0110/Molex 08-55-0111

8.5.3 SD/SDIO (J3)

Make sure the SD/SDIO card is oriented properly, as depicted in the following illustration. The card should be positioned so that the beveled edge is on the right front.





Do not insert or remove the SD/SDIO card while the SBC35-C398 is powered up or in the process of powering up or down. This could corrupt the file system on the removable media. Always power down the board completely, then remove or insert media.

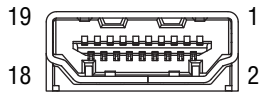
Additional Information

This connection is a Molex G650-0009-0K0.

8.5.4 HDMI (J4)

The High Definition Multimedia Interface (HDMI) provides crisp, clear audio and video.

Layout and Pin Reference:



Pin	Name	Pin	Name
1	D2+	2	D1_Shield
3	D2-	4	D1+
5	D1-_Shield	6	D1-
7	D0+	8	D0_Shield
9	D0-	10	CK+
11	CK_Shield	12	CK-
13	CEC	14	HEC
15	I2C_CLK	16	I2C _DAT
17	GND	18	+5V
19	HOT_PLUG_DET		

Additional Information

This connector is a Molex 47151-10010.

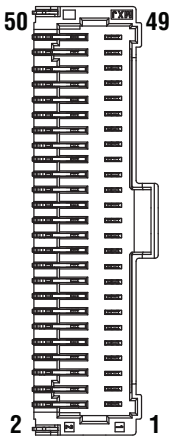
8.5.5 GPIO (J5)

The SBC35-C398 supports 24 lines of digital input/output (DIO). All signals are 30 V tolerant.



Before supplying voltage to pin 49 of J5, remove any jumper installed on JP1. Damage to the board may occur if you apply a voltage to pin 49 of J1 while a jumper is installed on JP1.

Layout and Pin Reference:



Pin	Name	Pin	Name
1	DIO[0]	2	GND
3	DIO[1]	4	GND
5	DIO[2]	6	GND
7	DIO[3]	8	GND
9	DIO[4]	10	GND
11	DIO[5]	12	GND
13	DIO[6]	14	GND
15	DIO[7]	16	GND
17	DIO[8]	18	GND
19	DIO[9]	20	GND
21	DIO[10]	22	GND
23	DIO[11]	24	GND
25	DIO[12]	26	GND
27	DIO[13]	28	GND
29	DIO[14]	30	GND
31	DIO[15]	32	GND
33	DIO[16]	34	GND
35	DIO[17]	36	GND
37	DIO[18]	38	GND
39	DIO[19]	40	GND
41	DIO[20]	42	GND
43	DIO[21]	44	GND
45	DIO[22]	46	GND
47	DIO[23]	48	GND
49	Power*	50	GND

* Power sourced to pin49 from the SBC is configured using JP1:

JP1: 1-2 = 3.3 V

JP1: 2-3 = 5 V

Remove jumper from JP1 if applying external power source to pin 49. See “Digital I/O Power Jumper (JP1)” on page 37.

Additional Information

The I/O is terminated at a Molex 501571-5007, 2x25, 1mm pitch (Pico-Clasp™) right angle locking header connector (WS G650-2050-7HB).

Matching connector: The mate is the Molex 501189-5010 housing with Molex 501193-2000 crimp pins.

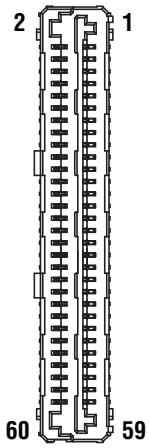
WinSystems cables simplify connections to the board:

- CBL-DIO24-000-14: Pico-Clasp to unterminated
- CBL-DIO24-001-12: Pico-Clasp to Pico-Clasp
- CBL-DIO24-002-12: Pico-Clasp to 2x25, 0.1" pitch housing

8.5.6 IO60 Expansion Bus (J6)

IO60 includes I^{2}C, SPI, (1) TTL Serial Port, (8) GPIO and (1) PWM line. IO60 provides developers with easy access to these popular buses so they can add special functionality to a system. Go to www.winsystems.com for predefined expansion options and the IO60 design guide or contact an Application Engineer through technical support (see “Introduction” on page 1 for details).

Layout and Pin Reference:



Pin	Name	Pin	Name
1	+5 V (VCC5)	2	+5 V (VCC5)
3	+5 V (VCC5)	4	+5 V (VCC5)
5	TX	6	RX
7	RTS	8	CTS
9	GND	10	UART_MUX_CTL
11	SPI_CLK	12	SPI_MISO
13	SPI_CS0	14	SPI_MOSI
15	SPI_CS1	16	SPI_CS2
17	SPI_CS3	18	SPI_RDY
19	GND	20	GND
21	SMB/I²C_SCLK	22	SMB/I²C_SCLK
23	GND	24	GND
25	PWM0	26	EPIT
27	GND	28	GND
29	POR	30	GPIO_0
31	GPIO_1	32	GPIO_2
33	GPIO_3	34	GPIO_4
35	GPIO_5	36	GPIO_6
37	GPIO_7	38	GPIO_8
39	GND	40	GND
41	RSVD	42	RSVD
43	RSVD	44	RSVD
45	GND	46	GND
47	RSVD	48	RSVD
49	RSVD	50	RSVD
51	GND	52	GND
53	RSVD	54	RSVD
55	RSVD	56	RSVD
57	+3.3 V (VCC3)	58	+3.3 V (VCC3)
59	+3.3 V (VCC3)	60	+3.3 V (VCC3)

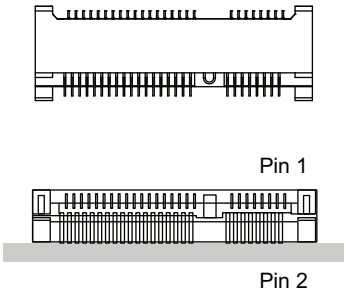
Additional Information

This connection is a Samtec LSEM-130-06.0-L-DV-A-N-K-TR.

8.5.7 MiniPCIe (J7)

The SBC35-C398Q and SBC35-C398DL (not available on the SBC35-C398S) provide a half-length mini-PCIe socket to support a variety of peripherals available in this format.

Layout and Pin Reference:



Pin	Name	Pin	Name
1	Mechanical Key	2	Mechanical Key
3	NC	4	GND
5	NC	6	1.5V
7	CLKREQ#	8	NC
9	GND	10	NC
11	REFCLK-	12	NC
13	REFCLK+	14	NC
15	GND	16	NC
17	NC	18	GND
19	NC	20	W_DISABLE#
21	GND	22	PERST#
23	PERn0	24	+3.3Vaux
25	PERp0	26	GND
27	GND	28	+1.5V
29	GND	30	SMB_CLK
31	PERn0	32	SMB_DATA
33	PERp0	34	GND
35	GND	36	NC
37	GND	38	NC
39	+3.3Vaux	40	GND
41		42	
43	GND	44	LED_WLAN#
45	NC	46	LED_WPAN#
47	NC	48	1.5V
49	NC	50	GND
51	mSATA DET	52	+3.3Vaux

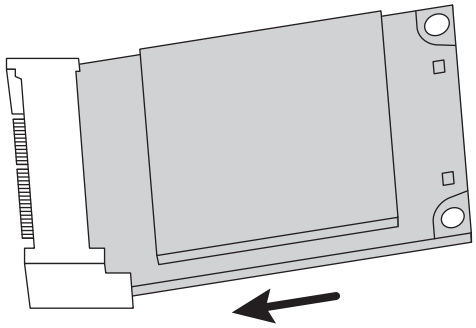
Shaded cells indicate Mechanical Key or other no pin/no connection.

Additional Information

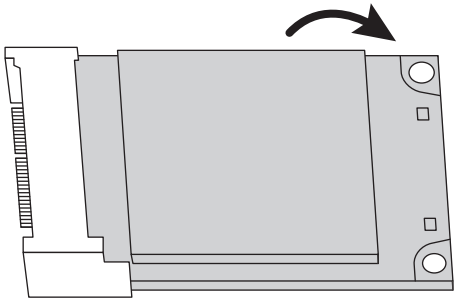
This connection is a Molex 0679105700.

To install a miniPCIe into J7:

1. Insert the miniPCIe.



2. Push the free end of the card toward the circuit board and then secure it with two (2 mm) screws (WinSystems P/N: G527-0000-400).



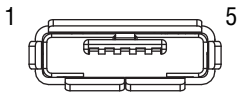
8.5.8 Micro USB (USB OTG) (J8)

The USB on-the-go (OTG) connector enables the SBC35-C398 to be connected to a USB host (such as a desktop PC), allowing the SBC35-C398 to appear as a USB flash drive, digital audio device, camera, etc. The USB OTG port can also be used as a debug interface to the SBC35-C398 when it runs certain operating systems such as Android.

Host or Client

If the cable assembly that is plugged into J8 grounds pin four (4), the SBC35-C398 is the host. If the cable assembly plugged into J8 does not ground pin four (4), the SBC35-C398 is the client.

Layout and Pin Reference:



Pin	Function
1	USB_OTG_VCC5
2	USB_OTG_CON_D-
3	USB_OTG_CON_D+
4	USB_OTG_ID_SENSE
5	GND

Additional Information

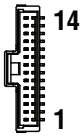
This connection is a Molex 47589-0001.

Mating Connector: Molex Cable Assembly 68784-0001

8.5.9 Backlight Power (J9)

J9 supplies power for up to two backlights.

Layout and Pin Reference:

	Backlight Control 0		Backlight Control 1	
	Pin	Name	Pin	Name
	1	+5 V DC	8	+5 V DC
	2	Enable (Low)	9	Enable (LOW)
	3	Enable (High)	10	Enable (High)
	4	GND	11	GND
	5	+12 V DC	12	+12 V DC
	6	GND	13	GND
	7	PWM	14	PWM

Additional Information

This connection is a Molex/501331-1407.

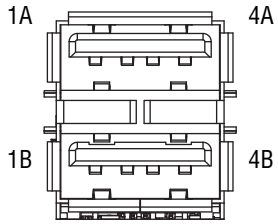
Mating Connector: Molex 501330-1400

Mating Crimp Connector: Molex 501334-0000

8.5.10 USB 2.0 (J10)

J10 provides two USB ports (USB port 5 and USB port 6).

Layout and Pin Reference:



Port	Pin	Function
USB Port 5 (upper)	1A	USB_PWR5
	2A	USB_D-5
	3A	USB_D+5
	4A	GND
USB Port 6 (lower)	1B	USB_PWR6
	2B	USB_D-6
	3B	USB_D+6
	4B	GND

Additional Information

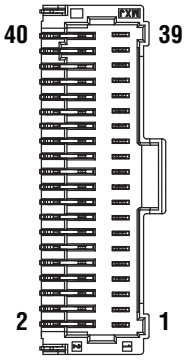
This connection is a Samtec USBR-A-D-S-W-TH.

Mating Connector: Standard USB 2.0 Connector.

8.5.11 LVDS (J11)

The Low Voltage Differential Interface (LVDS) interface works in conjunction with Panel Power at JP4 and Backlight Power at J9 to provide flat panel display video.

Layout and Pin Reference:



LVDS	Pin	Name	Pin	Name
LVDS 0	1	SWVDD	2	GND
	3	D0-	4	D0+
	5	D1-	6	D1+
	7	SWVDD	8	GND
	9	D2-	10	D2+
	11	D3-	12	D3+
	13	SWVDD	14	GND
	15	CLK-	16	CLK+
	17	DDC_CLK	18	GND
	19	DDC_DATA	20	GND
LVDS 1	21	SWVDD	22	GND
	23	D0-	24	D0+
	25	D1-	26	D1+
	27	SWVDD	28	GND
	39	D2-	30	D2+
	31	D3-	32	D3+
	33	SWVDD	34	GND
	35	CLK-	36	CLK+
	37	NC	38	GND
	39	NC	40	GND

Additional Information

This connector is a Molex 501571-4007.

Mating Connector: Molex 501189-4010

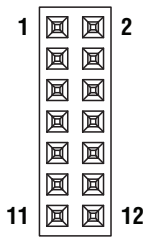
Mating Crimp Connector: Molex 501193-3000

WinSystems cables simplify connections to the board:

- CBL-LVDS24-000-14: Video – (LVDS) Unterminated, 14”
- CBL-LVDSB-009-12: Video – (LVDS) Dual – Ampire AM800480R3TMQWA1H, 12”
- CBL-LVDSB-012-18: Video – (LVDS) Single – Ampire AM800480R3TMQWA1H, 18”

8.5.12 Analog Audio (J12)

Layout and Pin Reference:



Pin	Name	Pin	Name
1	OUT_R	2	LINE_R
3	OUT_L	4	LINE_L
5	ADGND	6	ADGND
7	HEADPHONE_R	8	MIC_IN
9	HEADPHONE_L	10	ADGND
11	HEADPHONE_GND	12	ADGND

Additional Information

This connection is a Molex 087832-1206.

Mating Connector: Molex 51110-1250

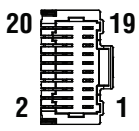
Crimp Connector: Molex 50394-8051

Cable Assembly WinSystems: CBL-AUDIO2-202-12D

8.5.13 Four USB Ports (J13)

The SBC35-C398Q and SBC35-C398DL (not available on the SBC35-C398S) provide four USB ports. Cable Assembly CBL-USB4-002-12 can be attached to the 20 pin connector at J13 to provide four USB 2.0 ports (with ADP-IO-USB-001).

Layout and Pin Reference:



Pin	Function	Pin	Function
1	USB1_PWR	2	USB2_PWR
3	USB1_D-	4	USB2_D-
5	USB1_D+	6	USB2_D+
7	GND	8	GND
9	GND	10	GND
11	GND	12	GND
13	USB3_PWR	14	USB4_PWR
15	USB3_D-	16	USB4_D-
17	USB3_D+	18	USB4_D+
19	GND	20	GND

Additional Information

This connection is a Molex 501571-2007.

Cable Assembly: WinSystems CBL-USB4-002-12

Termination Adapter: WinSystems ADP-IO-USB-002

8.5.14 COM 1 (J14)

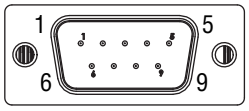
COM1 uses the advanced EXAR SP339E multi-protocol transceiver and supports Loopback, RS-232, RS-485 half-duplex), and RS-422 (full-duplex). RS-232 can transmit and receive data up to 1 Mbps, while the RS-422/485 ports support data transmission speeds up to 5 Mbps. The SP339E transceiver includes programmable line termination for the RS-422/485, loopback mode, and slew rate.

A termination resister may be necessary for accurate RS-485/422 communication, but must be removed when the lines are used for RS-232.

WinSystems provides scripts that configure selected modes for each UART with the example operating systems. The settings used by the scripts to configure different communication protocols are shown in the table below.

	M0	M1	SLEW*	Termination**
Loopback	0	0	0	0
RS232	1	0	0	0
RS485 (half duplex)	0	1	0	1
RS485 (full duplex)/RS422	1	1	0	1
*SLEW = VCC enables 250 kbps slew limiting **TERM = VCC enables 120 Ω (ohm) differential termination to the receive inputs				

Layout and Pin Reference:



Pin	RS-232	RS-422	RS-485
1	DCD	-	-
2	RX	TX+	TX/RX+
3	TX	RX+	-
4	DTR	-	-
5	GND	-	-
6	DSR	TX-	TX/RX-
7	RTS	RX-	-
8	CTS	-	-
9	RI	-	-

Additional Information

This connection is a Norcomp 190-009-163R001.

Mating Connector: Norcomp 9T190-009-263R001

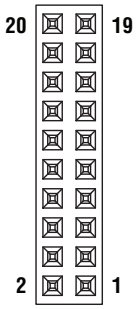
8.5.15 Controller Area Network (CAN) BUS Connector (J15)

The SBC35-C398Q and SBC35-C398DL (not available on the SBC35-C398S) provide access to two FlexCAN channels through J15. The module is a full implementation of the CAN protocol specification, which supports both standard and extended message frames.

The FLEXCAN module has four functional modes: Normal Mode (User and Supervisor), Freeze Mode, Listen-Only Mode and Loop-Back Mode. There are also two low power modes: Disable Mode and Stop Mode.

For more information on FLEXCAN, see chapter 26 of the NXP (formerly Freescale) i.MX 6Dual_6Quad Reference Manual at http://www.nxp.com/files/32bit/doc/ref_manual/IMX6DQRM.pdf.

Layout and Pin Reference:



Pin	Function	Pin	Function
1	VCC5	2	GND
3	CAN1L	4	CAN1H
5	GND	6	N/C
7	N/C	8	VCC5
9	N/C	10	N/C
11	VCC5	12	GND
13	CAN2L	14	CAN2H
15	GND	16	N/C
17	N/C	18	VCC5
19	N/C	20	N/C

Additional Information

This connection is a Molex 87832-2020.

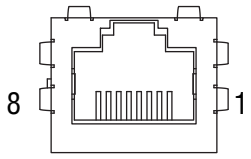
Mating Connector: Molex 51110-2050

Crimp Terminal: Molex 50394-8051

8.5.16 Ethernet Port (J16)

J16 is a Gigabit (10/100/1000) Ethernet port that complies with the Precision Time Protocol standard IEEE-1588. The SBC35-C398 is a POE PD (powered device).

Layout and Pin Reference:

	Pin	Function	Description
	1	BI_D1+	Bi-Directional Data +
	2	BI_D1-	Bi-Directional Data -
	3	BI_D2+	Bi-Directional Data +
	4	BI_D3+	Bi-Directional Data +
	5	BI_D3-	Bi-Directional Data -
	6	BI_D2-	Bi-Directional Data -
	7	BI_D4+	Bi-Directional Data +
	8	BI_D4-	Bi-Directional Data -

Additional Information

This connection is a Amphenol RJCSE538001.

Mating Connector: Amphenol RJ45

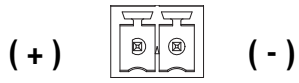
8.5.17 Power Connector (J17)

Use this connection to supply power to the SBC35-C398. The SBC35-C398 can operate from a +10 V DC to +50 V DC (+/- 5%) power source.



Warning
Do not reverse the positive and negative terminals when you connect power to the unit. This will void the warranty and damage the board.

Layout and Pin Reference:



Pin	Name	Notes
1	+ Positive	Power Input: +10 V DC to +50 V DC
2	- Negative	

Additional Information

This connection is a Phoenix 1803277.

Matching connector: Phoenix 1803578

8.5.18 COM 2, 3, 4, & 5 (J18)

The SBC35-C398Q (not available on the SBC35-C398S and SBC35-C398DL) provides a COM Interface at J18. COM 2 uses the EXAR SP339E multi-protocol transceiver and supports RS-232, RS-422, and RS-485 modes. RS-232 can transmit and receive data up to 1 Mbps, while RS-422/485 modes are capable of data transmission speeds up to 5 Mbps. The SP339E transceiver includes programmable line termination for the RS-422/485, loopback mode, and slew rate.

COMS 3, 4, & 5 use Linear Tech LTC2854 RS-422/485 transceivers with programmable 120 ohm termination. All three COM ports are capable of transmitting and receiving data up to 5 Mbps.

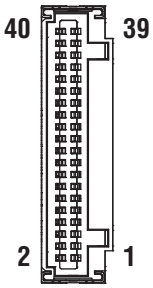
COM5 is multiplexed with the IO60 UART signals. If a module with UART support is plugged into the IO60 connector, the COM5 UART signals will be routed to the IO60 expansion bus, not J18.

Linear Tech Transceiver (COMS 3, 4, & 5) table

	Rx485EN	RX422EN	HD3_TE	FD3_TE
RS485 W/Term	0	1	1	0
RS485 W/O Term	0	1	0	0
RS422 W/RCVR Term	1	0	0	1
RS422 W/O RCVR Term	1	0	0	0

WinSystems provides scripts that configure selected modes for each UART with the example operating systems. The settings used by the scripts to configure different communication protocols are shown in the Linear Tech Transceiver (COMS 3, 4, & 5) table. A termination resister may be necessary for accurate RS-485/422 communication, but must be removed when the lines are used for RS-232.

Layout and Pin Reference:

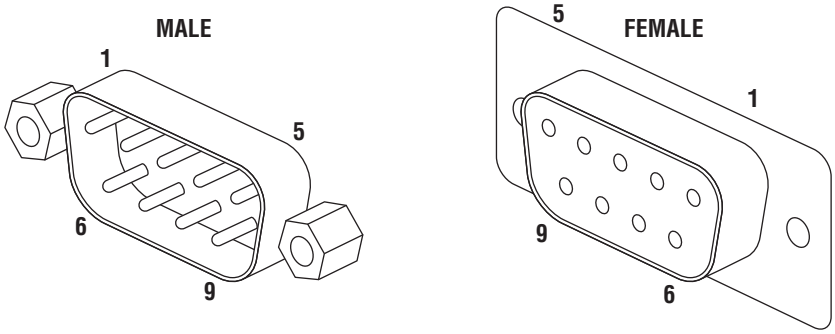


Pin	Name	Interface			Pin	Name	Interface		
		RS-232	RS-422	RS-485			RS-232	RS-422	RS-485
1	COM2	-	-	-	21	COM4	-	-	-
2	COM2	-	TX-	TX/RX-	22	COM4	-	TX-	TX/RX-
3	COM2	RX	TX+	TX/RX+	23	COM4	-	TX+	TX/RX+
4	COM2	RTS	RX-	-	24	COM4	-	RX-	-
5	COM2	TX	RX+	-	25	COM4	-	RX+	-
6	COM2	CTS	-	-	26	COM4	-	-	-
7	COM2	-	-	-	27	COM4	-	-	-
8	COM2	-	-	-	28	COM4	-	-	-
9	COM2	GND	GND	GND	29	COM4	-	GND	GND
10	COM2	GND	GND	GND	30	COM4	-	GND	GND
11	COM3	-	-	-	31	COM5	-	-	-
12	COM3	-	TX-	TX/RX-	32	COM5	-	TX-	TX/RX-
13	COM3	-	TX+	TX/RX+	33	COM5	-	TX+	TX/RX+
14	COM3	-	RX-	-	34	COM5	-	RX-	-
15	COM3	-	RX+	-	35	COM5	-	RX+	-
16	COM3	-	-	-	36	COM5	-	-	-
17	COM3	-	-	-	37	COM5	-	-	-
18	COM3	-	-	-	38	COM5	-	-	-
19	COM3	-	GND	GND	39	COM5	-	GND	GND
20	COM3	-	GND	GND	40	COM5	-	GND	GND

DB9 Pinout using CBL-SER4-002-12

Pin	Interface		
	RS-232	RS-422	RS-485
1	-	-	-
2	RX	TX+	TX/RX+
3	TX	RX+	
4	-	-	-
5	GND	GND	GND
6	-	TX-	TX/RX-
7	RTS	RX-	-
8	CTS	-	-
9	-	-	-

DB-9 Male and Female



Additional Information

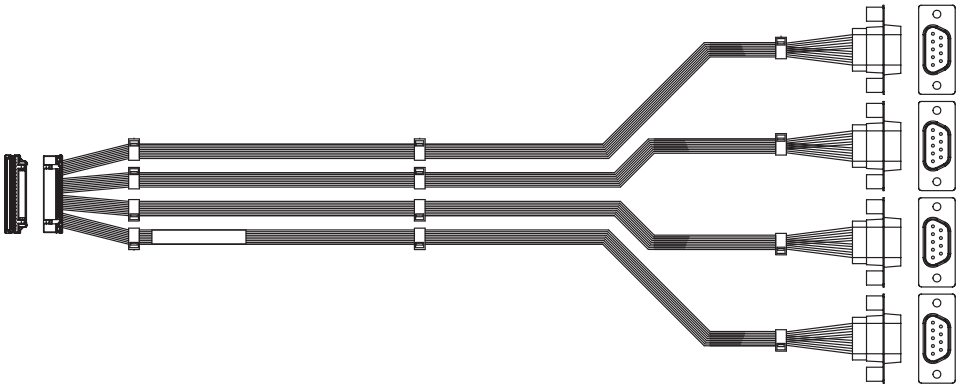
This connection is a Molex 502046-4070.

Mating Connector: Molex 9T503110-4000

Crimp Terminal: Molex 501930-1100

WinSystems cables simplify connections to the board:

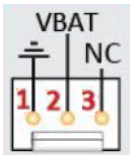
- CBL-SER4-000-14: Duo-Clasp to unterminated
- CBL-SER4-001-12: Duo-Clasp to Duo-Clasp
- CBL-SER4-002-12: Duo-Clasp to 4xDB9 (shown)



8.5.19 External Battery Connection (J19)

When connected to one of the External Batteries provided in the table below, J19 supplies standby power for the secure real-time clock. External Batteries are available from WinSystems.

Layout and Pin Reference:



Pin	Name
1	Ground
2	V_{BAT}
3	No connection

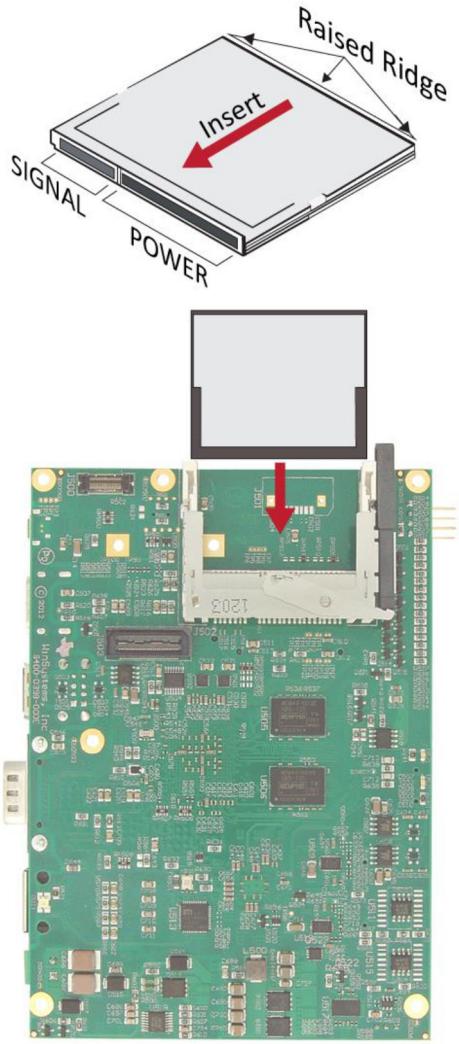
Additional Information

This connection is described in the following table.

Description	MFR Part Number	WinSystems Part Number
PCB Connector	Molex 22-11-2032	-
Mating Connector	Molex 22-01-2035	-
Battery with Connector 3.6 V DC, 2700 mAh	-	BAT-LTC-E-36-27-1
Battery with Connector 3.6 V DC, 1650 mAh	-	BAT-LTC-E-36-16-1

8.5.20 SATA SSD (CFast) (J502)

The SBC35-C398 supports CFast high performance storage at J502, which is located on the bottom of the board. The SATA compatible data card consists of 24 pins. The raised ridge along the back top of the card is useful for making sure the card is oriented properly.



NOTE The CFast connector can be depopulated to support a SATA connection.

Pin Reference (Signal):

Pin	CFast	Description
S1	GND	Signal Ground
S2	A+	Differential Signal A+
S3	A-	Differential Signal A-
S4	GND	Ground
S5	B-	Differential Signal B-
S6	B+	Differential Signal B+
S7	GND	Ground

Pin Reference (Power):

Pin	CFast	Description
P1	CDI	Card Detect In P15 PGND Device Ground
P2	GND	Device Ground P16 PGND Device Ground
P3	NC	Not Connected P17 CDO Card Detect Out
P4	NC	Not Connected
P5	NC	Not Connected
P6	NC	Not Connected
P7	GND	Device Ground
P8	LED1	LED Output
P9	LED2	LED Output
P10	IO1 Reserved	Input/Output
P11	IO2 Reserved	Input/Output
P12	IO4 Reserved	Input/Output
P13	PWR 3.3V	Device Power
P14	PWR 3.3V	Device Power
P15	PGND	Device Ground
P16	PGND	Device Ground
P17	CDO	Card Detect Out

Additional Information

This connection is a Molex 0679105700.

8.6 Jumpers

Jumper Part Number SAMTEC 2SN-BK-G applies to all jumpers. These are available in a ten piece kit from WinSystems (Part# KIT-JMP-G-200).

8.6.1 Digital I/O Power Jumper (JP1)

Purpose: The jumper configuration at JP1 allows you to provide power for supporting additional I/O devices at J5. See “GPIO (J5)” on page 20.



Before supplying voltage to pin 49 of J5, remove any jumper installed on JP1. Damage to the board may occur if you apply a voltage to pin 49 of J1 while a jumper is installed on JP1.

Jumper Pin Reference:



Jumpered Pins	Name
1-2	+3.3 V to pin 49 of J5 (default)
2-3	+5 V to pin 49 of J5
No jumper installed	0 V DSV to J5. With no jumper installed, up to +30 V external power source can be used.

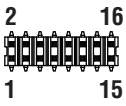
Additional Information

Jumper Kit: KIT-JMP-G-200

8.6.2 Boot Configuration Jumper (JP3)

Purpose: Jumper JP3 controls SBC35-C398 Boot Configuration. Reference the NXP (formerly Freescale) manual for more in depth information on boot configurations. See http://www.nxp.com/files/32bit/doc/ref_manual/IMX6DQRM.pdf.

Jumper Pin Reference:



Option	Jumper Configuration							
Jumper Block PINS	**1-2**	**3-4**	**5-6**	**7-8**	**9-10**	**11-12**	**13-14**	**15-16**
SATA (CFAST/HARD DRIVE)	0	1	0	X	X	X	X	1
SERIAL ROM (SPI-NOR)	0	1	1	0	X	X	X	X
SD/MicroSD Options								
- Normal Boot	1	0	0	*	*	*	*	*
- Fast Boot	1	0	1	*	*	*	*	*
- Bus/High Speed 25 MB/s (SDR25)	1	0	*	0	0	*	*	*
- Bus/Normal Speed 12.5MB/s (SDR12)	1	0	*	0	1	*	*	*
- Bus - UHS-I 50MB/s (SDR50)	1	0	*	1	0	*	*	*
- Bus - UHS-I 104MB/s (SDR104)	1	0	*	1	1	*	*	*
- Bus Width - 1-Bit with 1 Delay Cell	1	0	*	*	*	0	0	*
- Bus Width - 4-Bit with 1 Delay Cell	1	0	*	*	*	0	1	*
- Bus Width - 1-Bit with 2 Delay Cell	1	0	*	*	*	1	0	*
- Bus Width - 4-Bit with 2 Delay Cell	1	0	*	*	*	1	1	*
- Port Select - J1 - uSD	1	0	*	*	*	*	*	0
- Port Select - J3 - SD	1	0	*	*	*	*	*	1

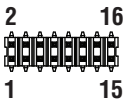
Legend:

1 – Jumper Installed

0 – Jumper Removed

X – Does not matter

* – Options



Option	Jumper Configuration							
MMC Options								
- Normal Boot	1	1	0	*	*	*	*	*
- Fast Boot	1	1	1	*	*	*	*	*
- Bus - High Speed Mode	1	1	*	0	X	*	*	*
- Bus - Normal Speed Mode	1	1	*	1	X	*	*	*
- Bus Width - 1-Bit	1	1	*	*	*	0	0	*
- Bus Width - 4-Bit	1	1	*	*	*	0	1	*
- Bus Width - Reserved	1	1	*	*	*	1	0	*
- Bus Width - 4-Bit DDR (MMC 4.4)	1	1	*	*	*	1	1	*
- Port Select - J1 - uSD	1	1	*	*	*	*	*	0
- Port Select - J3 - SD	1	1	*	*	*	*	*	1

Legend:

1 – Jumper Installed

0 – Jumper Removed

X – Does not matter

* – Options

Additional Information

This connection is a Samtec TMM-108-01-L-D-SM-P.
Jumper Kit: KIT-JMP-G-200

8.6.3 Panel Power Jumper (JP4)

Purpose: JP4 provides 3.3 V DC (Default) or 5 V DC for panel power to connector J11.

Jumper Pin Reference:



Jumpered Pins	Name
1-2	+3.3 V DC (J11)(default)
2-3	+5 V DC (J11)(default)

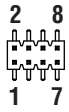
Additional Information

Jumper Kit: KIT-JMP-G-200

8.6.4 Boot Mode Jumper (JP5)

Purpose: JP5 selects the boot mode for the SBC35-C398. The default JP5 set for Internal Boot mode (jumper installed on Pins 3-4).

Jumper Pin Reference:



Description	Boot Mode	Jumper Pins
Boot from fuses	0 0	No Jumpers
Serial downloader (USB OTG)	1 0	1 – 2
Internal boot	0 1	3 – 4
Reserved	1 1	1 – 2, 3 – 4

Additional Information

This connection is a Samtec TMM-104-01-G-D-SM-P-TR.

Jumper Kit: KIT-JMP-G-200

8.6.5 CAN Termination Jumper Block (JP6)

Purpose: For high speed Controller Area Network (CAN), both ends of the pair of signal wires (CANH and CANL) must be terminated. JP6 allows the user to add 120 Ω (ohm) differential termination to the signal pairs when necessary. If you place multiple devices along the cable, only devices on the ends of the cable need termination resistors.

Jumper Pin Reference:



Pin	Function
1	CAN1L
2	CANH (120 Ohm Termination)
3	CAN2L
4	CANH (120 Ohm Termination)

Additional Information

Jumper Kit: KIT-JMP-G-200

9. Cables and Accessories

WinSystems cables and batteries simplify connection to the SBC35-C398. The following table lists available items.

Item	Part Number	Connection	Description
Cables	CBL-DIO24-000-14	See “GPIO (J5)” on page 20	Pico-Clasp to unterminated
	CBL-DIO24-001-12		Pico-Clasp to Pico-Clasp
	CBL-DIO24-002-12		Pico-Clasp to 2x25, 0.1“ pitch housing
	CBL-LVDS24-000-14	See “LVDS (J11)” on page 27	Video – (LVDS) Unterminated, 14”
	CBL-LVDSB-009-12		Video – (LVDS) Dual – Ampire AM800480R3TMQWA1H, 12”
	CBL-LVDSB-012-18		Video – (LVDS) Single – Ampire AM800480R3TMQWA1H, 18”
	CBL-AUDIO2-202-12D	See “Analog Audio (J12)” on page 28	Cable Assembly WinSystems
	CBL-USB4-002-12	See “Four USB Ports (J13)” on page 28	USB Cable Assembly WinSystems
	CBL-SER4-000-14	See “COM 2, 3, 4, & 5 (J18)” on page 32	Duo-Clasp to unterminated
	CBL-SER4-001-12		Duo-Clasp to Duo-Clasp
	CBL-SER4-002-12		Duo-Clasp to 4xDB9
Batteries	3.6 V DC, 2700 mAh	See “External Battery Connection (J19)” on page 35	BAT-LTC-E-36-27-1
	3.6 V DC, 1650 mAh		BAT-LTC-E-36-16-1
Screws	G527-0000-400	See “MiniPCIe (J7)” on page 23	2 mm
Jumpers	KIT-JMP-G-200	See “Jumpers” on page 37 See “Boot Configuration Jumper (JP3)” on page 38	Jumper Kit (10 jumpers)
Standoffs	KIT-PCM-STANDOFF-4	See “Mounting and Protecting the SBC35-C398” on page 43	Four piece Nylon Hex PC/104 Standoff Kit
	KIT-PCM-STANDOFF-B-4		Four piece Brass Hex PC/104 Standoff Kit

10. Software Drivers

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

Appendix A. Best Practices

This section outlines the best practices for operating the SBC35-C398 in a safe and effective manner that does not damage the board. Please read this section carefully.



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

Power Supply Budget

Evaluate your power supply budget. It is usually good practice to budget twice the typical power requirement for all of your devices.

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 will not regulate properly and can cause damage to the SBC35-C398.



Use Proper Power Connections (Voltage)—When verifying the voltage, measure it at the power connector on the SBC35-C398. Measuring it at the power supply does not account for voltage drop through the wire and connectors.
Power the SBC35-C398 using Power over Ethernet (J16 RJ45, PoE IEEE802.3) or Auxiliary Input (J17, +10 V DC to + 50 V DC). Verify the power connections. Incorrect voltages can cause catastrophic damage.

Power Harness

Minimize the length of the power harness. This will reduce the amount of voltage drop between the power supply and the SBC35-C398.

Gauge Wire

Use the largest gauge wire available for your application and connector. Most connector manufacturers have a maximum gauge wire they recommend for their pins.

Contact Points

For maximum reliability, WinSystems' boards typically use connectors with gold finish contacts. 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 uses a design similar to Molex's or Trifurcon's design that provides 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—The power supply should always be off before it is connected to the I/O Module. Do not hot-plug the SBC35-C398 on a host platform that is already powered.

I/O Connections OFF—I/O Connections should also be off 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 SBC35-C398

The SBC35-C398 must be mounted properly to avoid damage. The following standoff kits are available and recommended for use with the SBC35-C398:

- KIT-PCM-STANDOFF-4: Four piece Nylon Hex PC/104 Standoff Kit
- KIT-PCM-STANDOFF-B-4: Four piece Brass Hex PC/104 Standoff Kit

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

Placing the SBC35-C398 on Mounting Standoffs—Be careful when placing the SBC35-C398 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-C398—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 and are connected 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 will 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 will provide the support that 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 tightly, and the force needed to plug or unplug them could cause the embedded computer module to flex.

Avoid Cutting the SBC35-C398—Never use star washers or any fastening hardware that will cut into the SBC35-C398.

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.

Conformal Coating

Applying conformal coating to a WinSystems product will not in itself void the product warranty, if it is properly removed prior to return. Coating may change thermal characteristics and impedes our ability to test, diagnose, and repair products. Any coated product sent to WinSystems for repair will be returned at customer expense and no service will be performed.

Operations/Product Manuals

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

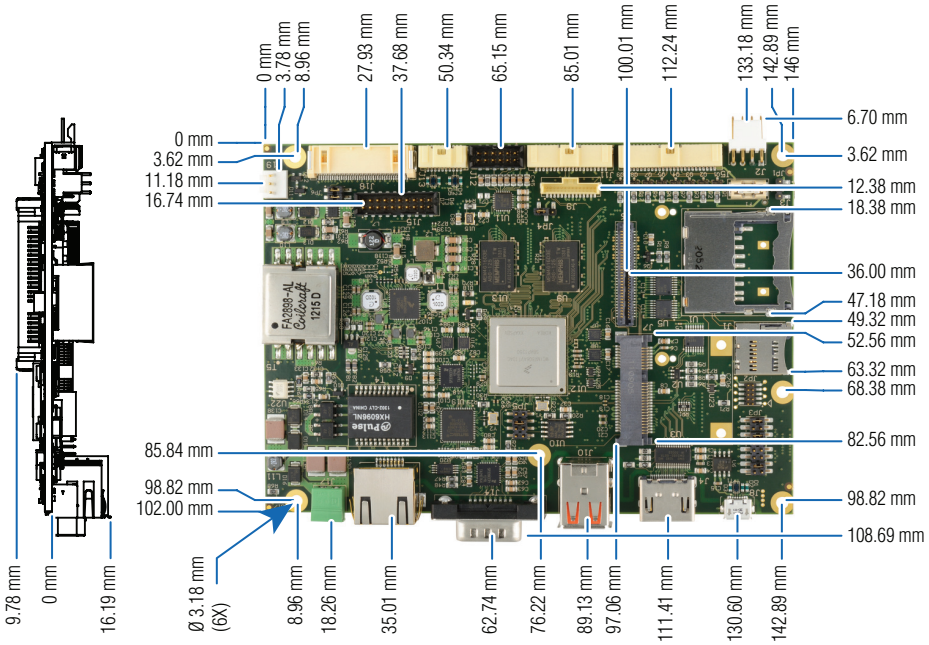
Periodic Updates—Operations/Product manuals are updated often. Periodically check the WinSystems website (http://www.winsystems.com) for revisions.

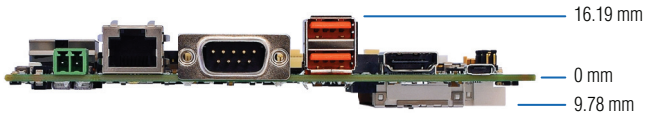
Check Pinouts—Always check the pinout and connector locations in the manual before plugging in a cable. Many I/O modules will have identical headers for different functions and plugging a cable into the wrong header can have disastrous results.

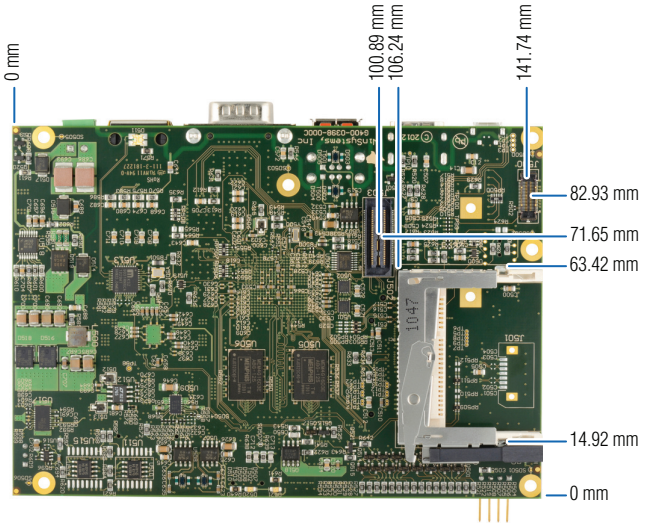
Contact an Applications Engineer—If a diagram or chart in a manual does not seem to match your board, or if you have additional questions, contact a WinSystems Applications Engineer at: +1-817-274-7553.

Appendix B. Mechanical Drawing

SBC35-C398 Dimensions







Appendix C. Warranty Information

WinSystems warrants that for a period of two (2) years from the date of shipment, any Products and Software purchased or licensed hereunder which have been developed or manufactured by WinSystems shall be free of any defects and shall perform substantially in accordance with WinSystems' specifications therefor. With respect to any Products or Software purchased or licensed hereunder which have been developed or manufactured by others, WinSystems shall transfer and assign to Customer any warranty of such manufacturer or developer held by WinSystems, provided that the warranty, if any, may be assigned. The sole obligation of WinSystems for any breach of warranty contained herein shall be, at its option, either (i) to repair or replace at its expense any materially defective Products or Software, or (ii) to take back such Products and Software and refund the Customer the purchase price and any license fees paid for the same. Customer shall pay all freight, duty, broker's fees, insurance, charges and other fees and charges for the return of any Products or Software to WinSystems under this warranty. WinSystems shall pay freight and insurance charges for any repaired or replaced Products or Software thereafter delivered to Customer within the United States. All fees and costs for shipment outside of the United States shall be paid by Customer. The foregoing warranty shall not apply to any Products or Software which have been subject to abuse, misuse, vandalism, accident, alteration, neglect, unauthorized repair or improper installation.

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There are no understandings, agreements or representations, express or implied, other than those set forth herein. This Order embodies the entire agreement between the parties and may be waived, amended or supplemented only by a written instrument executed jointly by WinSystems and Customer as evidenced only by the signature of duly authorized officers of each party. The foregoing terms and conditions of any order which may be issued by Customer for the purchase of Products or licensing of Software hereunder.

In the event this Order is placed in the hands of an attorney or collection agency by WinSystems to collect any sums due hereunder to WinSystems, Customer shall pay all reasonable attorney's fees, expenses, collection and court costs incurred by WinSystems.

THIS AGREEMENT SHALL BE GOVERNED AND CONSTRUED UNDER THE TEXAS UNIFORM COMMERCIAL CODE AND THE APPLICABLE LAWS OF THE STATE OF TEXAS. THE PARTIES ACKNOWLEDGE THAT ANY ACTION BROUGHT HEREUNDER SHALL ONLY BE BROUGHT IN A COURT OF COMPETENT JURISDICTION IN TARRANT COUNTY, TEXAS.

Warranty Service

1. To obtain service under this warranty, obtain a return authorization number. In the United States, contact the WinSystems Service Center for a return authorization number. Outside the United States, contact your local sales agent for a return authorization number.
2. You must send the product postage prepaid and insured. You must enclose the products in an anti-static bag to protect from damage by static electricity. WinSystems is not responsible for damage to the product due to static electricity.

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