

iCEman65 Evaluation Kit User Guide



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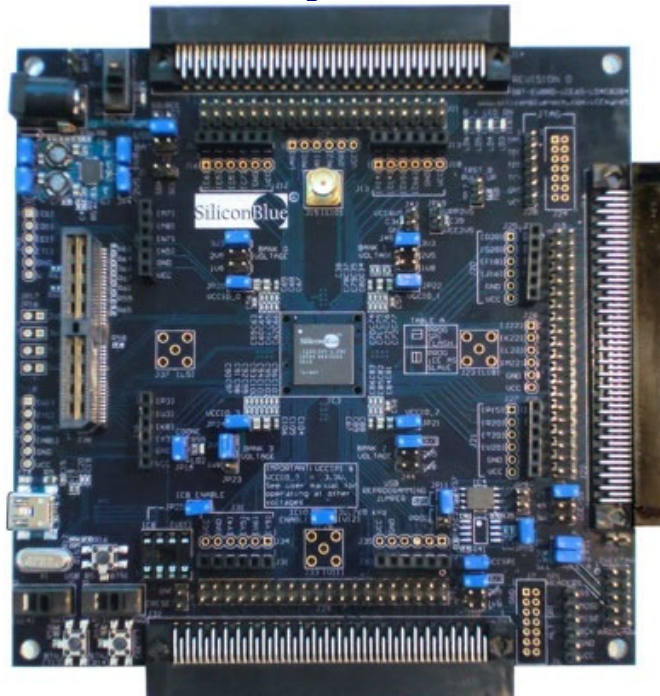
Preliminary

- Evaluation and development platform for SiliconBlue Technologies iCE65 ultra low-power programmable logic family.
 - ◆ iCE65L04V
 - 3,520 logic cells
 - Approximately 200,000 system gates
 - Equivalent to about 2,700 macrocells
 - 80Kbits of RAM
 - ◆ 284-ball chip-scale BGA package
 - 176 programmable I/O pins
 - Four I/O banks, each with a selectable I/O voltage
- Extensive I/O expansion
 - ◆ Three 100-pin Hirose FX2 connectors
 - ◆ Three 40-pin ribbon cable connectors
 - ◆ Eight 6-pin peripheral module PMOD connectors
 - ◆ An 80-pin high-speed Samtec connector
 - ◆ Available, affordable, off-the-shelf accessory boards
- Selectable I/O bank voltages
 - ◆ Choose 3.3V, 2.5V, or 1.8V
 - ◆ Isolation jumper for accurate power measurement
- Multiple clock inputs
 - ◆ 32.768 kHz oscillator on board
 - ◆ Socketed 32.0 MHz half-size oscillator
 - ◆ SMA-style clock input/output
 - ◆ Three additional unpopulated SMA clock inputs
- SPI configuration interface
 - ◆ 8Mbit SPI serial Flash PROM; store up to four independent configuration images
 - ◆ iCE65 slave SPI download interface
- USB 2.0 programming/debugging support
 - ◆ Power board from USB host
 - ◆ Program SPI serial Flash
 - ◆ Program iCE65 device as SPI slave
 - ◆ Parallel application interface to iCE65 device

Overview

The iCEman65 evaluation board, pictured in [Figure 1](#), is designed as an applications development and evaluation platform for the SiliconBlue Technologies ultra low-power iCE65 programmable logic family. The iCE65 evaluation board provides for extensive I/O expansion and voltage flexibility. Very few of the iCE65 programmable I/O pins are dedicated to specific functions.

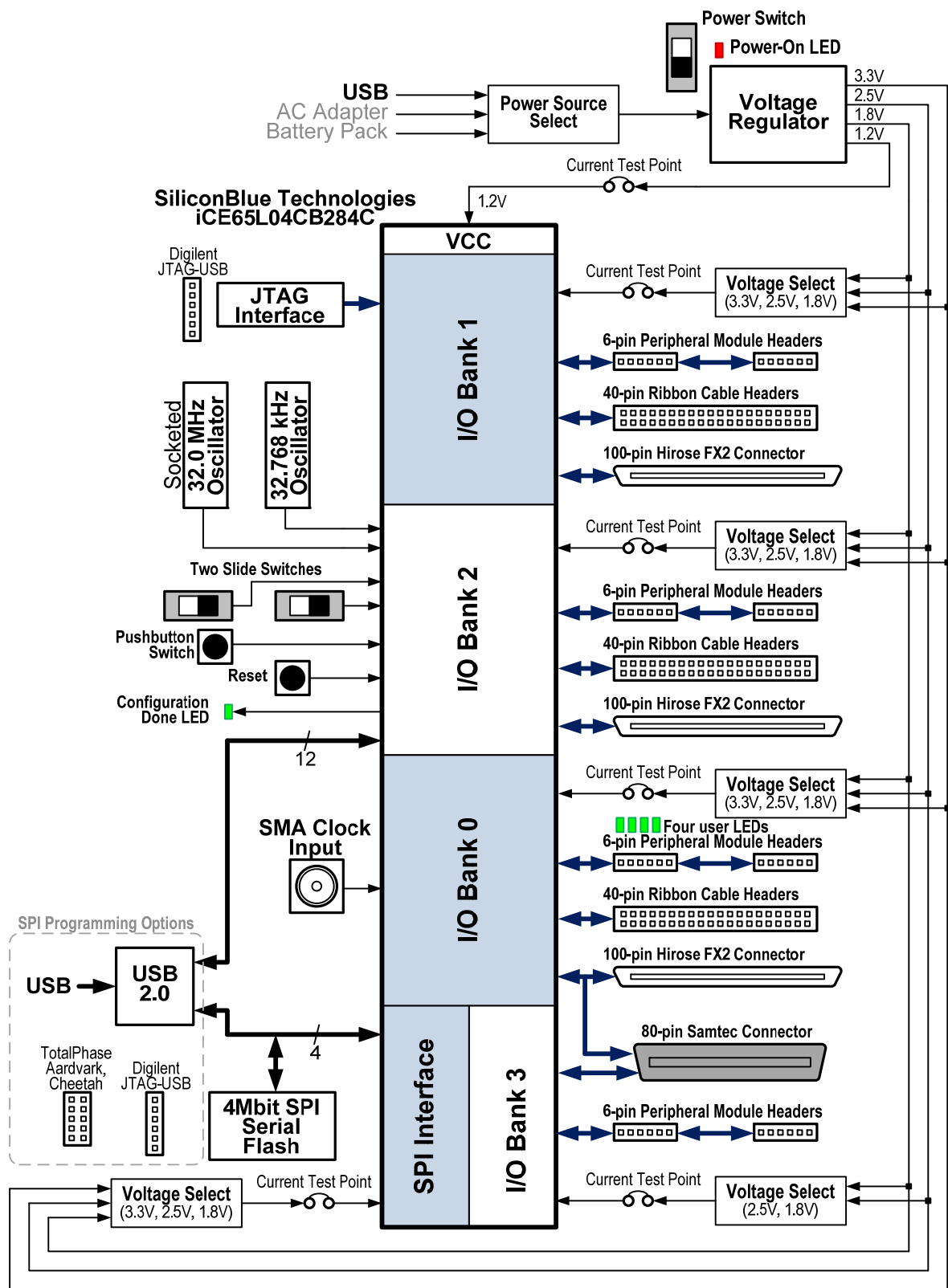
Figure 1: SiliconBlue Technologies iCEman65 Evaluation Kit Board



Block Diagram

Figure 2 provides a block diagram of the iCEman65 board, outlining major board components and interfaces. In the electronic version of this document, click on a feature to jump to the relevant section in the document.

Figure 2: iCEman65 Board Block Diagram



Switches and Buttons

By design, the iCEman65 board dedicates very few PIO pins to switches, pushbuttons, and LEDs. However, there are a few available on the board. Add other I/O functions with [Compatible, Third-Party Peripheral Module \(PMOD\) Boards](#) or other expansion boards.

Switches

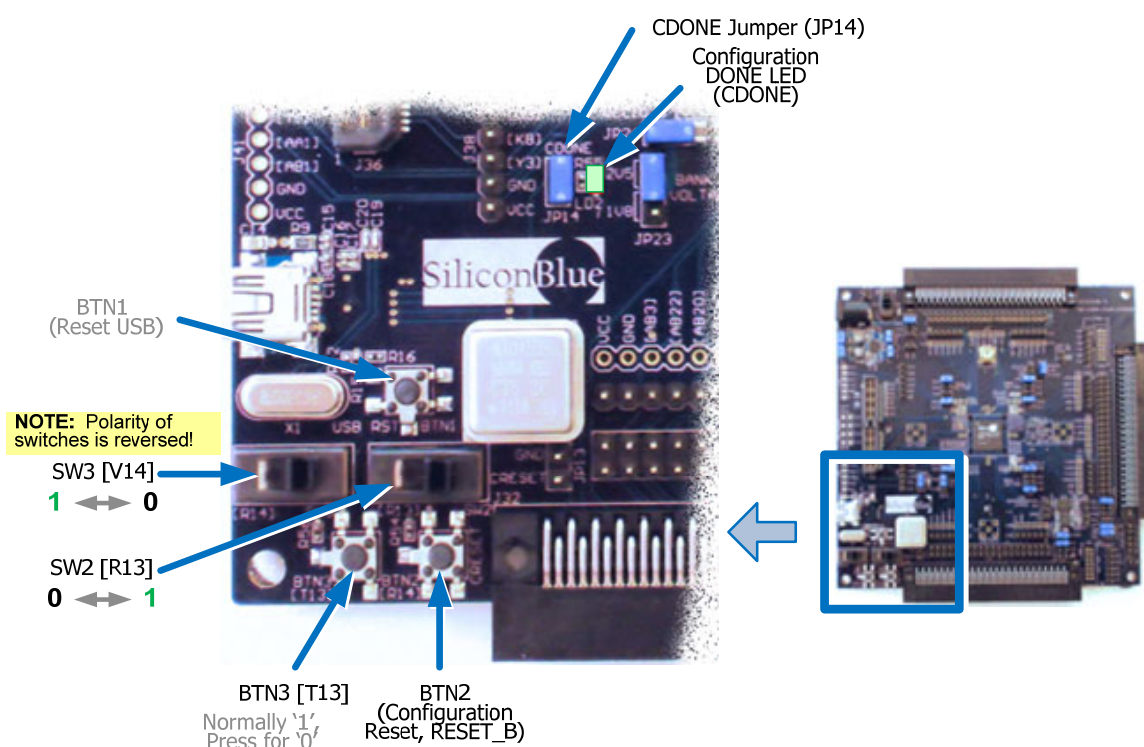
Power Supply Switch (SW1)

Slide switch SW1, shown in [Figure 12](#) located in the upper left corner, enables the LP3906 regulator on the board. When power is applied, the red LED (LD1) next to the switch lights up.

User Switches (SW2, SW3)

Slide switches SW2 and SW3 are located in the lower left corner of the board, as shown in [Figure 3](#). These switches are typically input signals for an iCE65 application. However, if the ColdBoot feature is enabled in the iCE65 configuration image, then these switches select which of the four possible configuration images is loaded during power on or after pressing and releasing the configuration reset, CRESET_B, pushbutton (BTN2).

Figure 3: Switches, Pushbuttons, and LEDs



After configuration, regardless if the ColdBoot feature is enabled or not, these switches are available as general-purpose control inputs to the iCE65 application. Optionally use these pins select one of four possible WarmBoot configuration images. See the iCE65 data sheet for additional information using ColdBoot and WarmBoot.

Note that the direction of the two switches is reversed. **The silkscreen marking on the board is incorrect.**

Table 1: Slide Switches SW2 and SW3

Switch	CB284 Ball	ColdBoot Function	WarmBoot Function	General-Purpose Function
SW2	R13	CBSEL0	Connect to port S0 on the SB_WARMBOOT primitive. Can also connect to other logic.	Connect to any logic function.
SW3	V14	CBSEL1	Connect to port S1 on the SB_WARMBOOT primitive. Can also connect to other logic.	Connect to any logic function.

Pushbuttons

USB Controller Reset (BTN1)

The BNT1 pushbutton is located near the USB connector along the left edge, near the oscillator socket and switches, as pictured in [Figure 3](#). When pressed, the BTN1 pushbutton resets the USB interface controller, which is located on the back-side of the board. If the iCEman65 board is connected to a computer via a USB cable, pressing this button also disconnects the board as a USB peripheral.

Configuration Reset, CRESET_B (BTN2)

The BTN2 pushbutton is located in the lower left corner of the board, below the slide switches, adjacent to the Hirose FX2 connector, as pictured in [Figure 3](#). The BTN2 pushbutton connects directly to the iCE65's active-Low configuration reset input, CRESET_B. Press this pushbutton switch at any time to reset the iCE65 device and force it to restart its configuration process. When jumper JP13 is installed (see [Figure 15](#)), then the CRESET_B pin is held in reset (Low) until the jumper is removed.

User Pushbutton (BTN3)

The BTN3 pushbutton is located in the lower left corner of the board, below the slide switches, closest to the corner, as pictured in [Figure 3](#). Pushbutton BTN3 is primarily a general-purpose user input to the iCE65 device as shown in [Table 2](#). However, BTN3 is also useful to demonstrate or evaluate the WarmBoot configuration operation.

BTN3 is normally High, or logic '1.' Press BTN3 to force the associated input Low, or to logic '0.'

Table 2: Pushbutton Switch BTN3

Switch	CB284 Ball	WarmBoot Function	General-Purpose Function
BTN3	T13	Connect to the BOOT port on the SB_WARMBOOT primitive. Press and release to cause a WarmBoot configuration operation.	Normally High. Press to force ball T13 Low.

LEDs

Power-On LED (LD1)

When power is applied to the board, LED LD1 lights up, indicating that the board is powered. This LED is located immediately adjacent to the power switch, as shown in [Figure 12](#).

Configuration DONE LED (LD2)

When the iCE65 device is properly configured, the LD2 LED lights, although jumper JP14 must also be installed. The LED may light only dimly as the CDONE pin output current is purposely low to conserve power. See [Figure 3](#).

Four User LEDs (Revision D Board or Later)

Revision D or later iCEman65 boards also include four user LEDs, located in the upper right corner of the board as shown in [Figure 4](#). These LEDs light only when the associated PIO pin drives Low. There is no additional I/O current when these pins are unused or when the pins drive High.

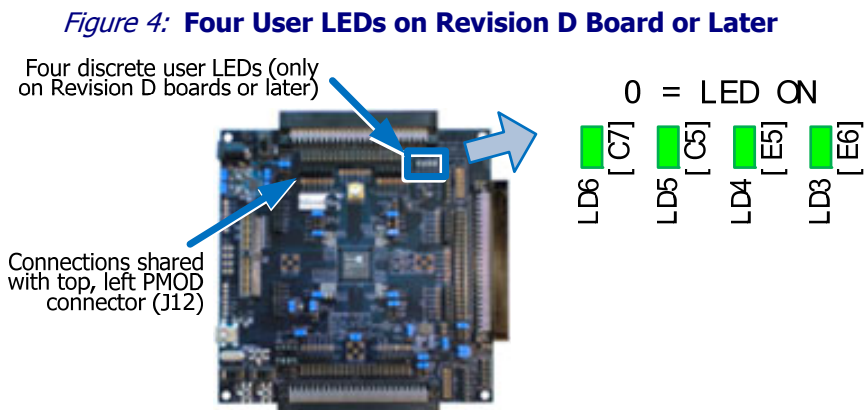


Table 3 lists the iCE65 ball numbers associated with each LED. Additionally, these LED connections are shared with the Top Left (J12) PMOD connector.

Table 3: User LEDs (Revision D or Later)

LED	Schematic Name	Shared Connection	CB284 Ball
LD6 (left-most)	B0-PM-A4	J12.4	[C7]
LD5	B0-PM-A3	J12.3	[C5]
LD4	B0-PM-A2	J12.2	[E5]
LD3 (right-most)	B0-PM-A1	J12.1	[E6]

These LEDs connect to the VCCIO_0 power rail and are brightest when operated at 3.3V, less so at lower voltages.

Clock Sources

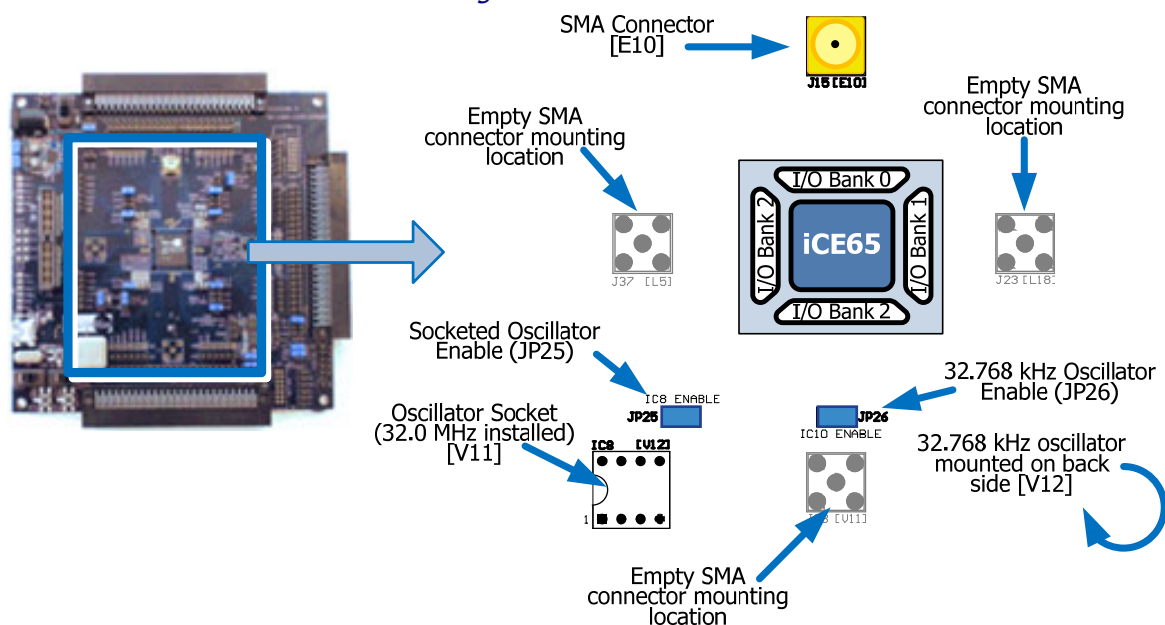
The iCE65 board has three default clock sources, as listed in Table 4 and depicted in Figure 5.

- 32.768 kHz Oscillator
- Socket Oscillator (IC8)
- SMA Clock Input/Output

Table 4: Default Clock Sources and Pin Connections

Clock Source	iCE65 Ball	Clock Source Supply	Enable Control	Comment
32.768 kHz Oscillator	V12	VCCIO_2	JP26	Connects to global buffer GBIN5
32.0 MHz Oscillator (socketed)	V11	VCCIO_2	JP25	Connects to global buffer GBIN4
SMA connector	E1	VCCIO_0	None	As an input, optionally connects to global buffer GBIN0. iCE65 device can also provide an output on this connector

Figure 5: Clock Sources



32.768 kHz Oscillator

To demonstrate low-frequency operation, the iCE65 evaluation board includes a 32.768 kHz oscillator, sometimes also called a 32K oscillator. This oscillator is enabled when jumper JP26 is installed, as shown in [Figure 5](#). The Rev. A board, produced in small volumes, does not have jumper JP26.

The oscillator is physically mounted on the back side of the board. The oscillator is designed for 3.3V operation, so be sure that I/O Bank 2 is configured for 3.3V operation using jumper J44, shown in [Figure 13](#).

To generate a 1 second period, divide the 32.768 kHz oscillator output using a 15-bit binary counter. The output from bit Q15 generates a one second clock with a 50% duty cycle.

Socket Oscillator (IC8)

By default, the iCEman65 board includes a 32.0 MHz oscillator, which is installed in socket IC8 as shown in [Figure 6](#). When installed, the oscillator is enabled when jumper JP25 is installed. When jumper JP25 is removed, then the oscillator is disabled.

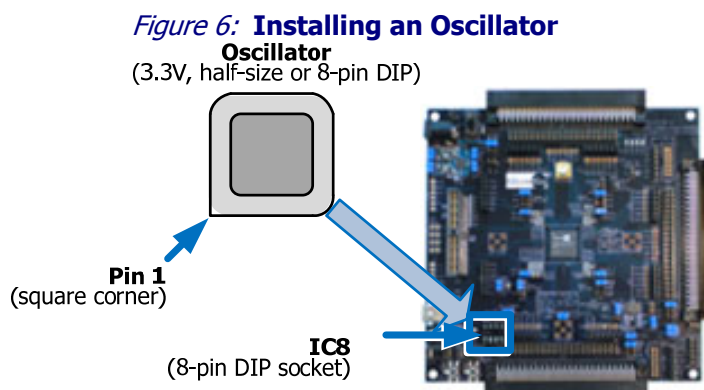
The oscillator is designed for 3.3V operation, so be sure that I/O Bank 2 is configured for 3.3V operation using jumper J44, shown in [Figure 13](#).

Using a Different Oscillator

To change to another frequency, simply remove the 32.0 MHz oscillator from the IC8 socket and replace it with a different, 3.3V oscillator packaged in either a half-size oscillator can or an 8-pin DIP package.

Installing an Oscillator

Insert the half-size oscillator into the 8-pin DIP socket labeled IC8. Be sure to align pin 1, the square corner of the oscillator, as shown in [Figure 6](#). All other corners are rounded.



SMA Clock Input/Output

When shipped, the iCEman65 board has one SMA connector, as shown in [Figure 5](#). Use this connector to supply a clock frequency from an external frequency generator. Optionally, supply an internally generated signal to the connector for easy external measurement with an oscilloscope or logic analyzer.

The SMA connector attaches to I/O Bank 0, so be sure that the I/O Bank 0 voltage is compatible with the external clock source using jumper J45, shown in [Figure 13](#).

Optional SMA Clock Inputs

As shown in [Figure 5](#), the iCEman65 board has empty mounting locations for up to three additional SMA connectors. Each is associated with a specific I/O bank and global buffer. If using these SMA connectors, be sure that the I/O Bank voltage is compatible with the external clock source by adjusting the appropriate jumper shown in [Figure 13](#).

Table 5: Unpopulated SMA Connectors

Unpopulated SMA Connections	I/O Bank	iCE65 Ball	Bank Power Supply	Comment
J23	1	L18	VCCIO_1	Connects to global buffer GBIN2
J33	2	V11	VCCIO_2	Must remove or disable the clock oscillator in socket IC8 before using J33; they share the same iCE65 package ball. Connects to global buffer GBIN4
J37	3	L5	VCCIO_3	Connects to global buffer GBIN6

Clock Connections To/From Hirose FX2 Connectors

Each of the [Hirose FX2 I/O Expansion Connectors](#) has up to three possible clock connections. [Table 6](#) lists the specific iCE65 package balls associated with these clock connections.

- One connection is from the SMA clock connector associated with the I/O bank. This connection drives a global buffer input on the iCE65 device and the attached peripheral expansion board.
- On one connection, the iCE65 device drives a clock signal to the attached peripheral expansion board.
- On one connection, the peripheral expansion board drives a clock signal to the iCE65 device using a global buffer input.

Table 6: Clock Connections to/from Hirose FX2 Connectors

I/O Bank (edge)	Connection Type	Schematic Name	CB284 Ball
Bank 0 (top)	SMA $\leftrightarrow$ iCE65, FX2	B0-CLKSMA	[E10]
	iCE65 $\leftrightarrow$ FX2		
	iCE65 $\rightarrow$ FX2	B0-CLK2PRL	[C13]
Bank 1 (right)	iCE65 $\leftarrow$ FX2	B0-PRL2CLK	[E11]
	SMA $\leftrightarrow$ iCE65, FX2	B1-CLKSMA	[L18]
	iCE65 $\leftrightarrow$ FX2		
Bank 2 (bottom)	iCE65 $\rightarrow$ FX2	B1-CLK2PRL	Not available
	iCE65 $\leftarrow$ FX2	B1-PRL2CLK	[K18]
	SMA $\leftrightarrow$ iCE65, FX2	B2-CLKOSC	[V11]
Bank 2 (bottom)	iCE65 $\leftrightarrow$ FX2		
	iCE65 $\rightarrow$ FX2	B2-CLK32K	[V12]
Bank 2 (bottom)	iCE65 $\leftarrow$ FX2	B2-PRL2CLK	Not available

Hirose FX2 I/O Expansion Connectors

The iCEman65 board has three 100-pin Hirose FX2 expansion connectors, located at the top, right, and bottom edges of the board. Each connector provides up to 43 total I/O connections to the iCE65 device; three connections are intended for clock connections while the other 40 connections are available for general-purpose I/O. The three connections intended for clocks can also be used for general-purpose I/O if appropriate.

The footprints for the three connectors are designed to be mostly interchangeable, although the three connectors are not identical.

Each connector is associated with a specific I/O bank on the iCE65 device. The associated I/O voltage (VCCIO) is controlled by the I/O bank voltage selection jumper (see [Table 32](#)). The +5V connection is the voltage supplied by the Source Select jumper (J3), which is +5V DC when powering the board from the +5V DC wall adapter input or from the USB 2.0 connector. If powering the board from a battery, then the voltage is the same as the battery pack voltage. The +5V DC connection is provided to generate any special voltages required on the peripheral expansion board.

Mating Connectors and Cables

The iCEman65 board has three, Hirose FX2, 100-pin FX2-100P-1.27DS(71) headers. These connectors mate to any of the Hirose receptacles and sockets listed in [Table 7](#). Also see [Table 11](#) for commercially-available expansion boards that plug into the Hirose FX2 connectors on the iCEman65 board.

- **Hirose FX2 Series Connector Data Sheet**
http://www.hirose.co.jp/cataloge_hp/e57220088.pdf

Table 7: Mating Connectors for 100-pin Hirose FX2 Connectors

Connector Type	Hirose Part Number(s)	Online Ordering Part Number/Link
PCB, Right-angle, through-hole	FX2-100S-1.27DS FX2-100S-1.27DS(71)	Digilent FX2SOCKET www.digilentinc.com/Products/Detail.cfm?Prod=FX2SOCKET&Nav1=Products&Nav2=Cables
		Trenz Electronics Hirose FX2 Receptacle shop.trenz-electronic.de/catalog/product_info.php?cPath=1_47&products_id=136
		Digi-Key H10644-ND search.digikey.com/scripts/DkSearch/dksus.dll?Detail?name=H10644-ND
		Digi-Key H4316-ND search.digikey.com/scripts/DkSearch/dksus.dll?Detail?name=H4316-ND
PCB, Straight-type, through-hole	FX2C-100S-1.27DS FX2C-100S-1.27DS(71)	Digi-Key H10599-ND search.digikey.com/scripts/DkSearch/dksus.dll?Detail?name=H10599-ND
PCB, Straight-type, surface-mount (SMT)	FX2-100S-1.27SV FX2-100S-1.27SV(71)	Digi-Key H4324-ND search.digikey.com/scripts/DkSearch/dksus.dll?Detail?name=H4324-ND
		Digi-Key H10536-ND search.digikey.com/scripts/DkSearch/dksus.dll?Detail?name=H10536-ND
Cable Connector Assembly	FX2BA-100SA-1.27R FX2BA-100SA-1.27R(71)	Digi-Key H4355-ND search.digikey.com/scripts/DkSearch/dksus.dll?Detail?name=H4355-ND

I/O Bank 0 (Top)*Table 8: Header J14 FX2 Pinout (I/O Bank 0)*

Shared	Schematic Name	CB284 Ball	A	B	CB284 Ball	Schematic Name	Shared
	VCCIO_0	VCCIO_0	1	1	SHIELD		
	VCCIO_0	VCCIO_0	2	2	GND	GND	
	JTAG-TMS		3	3		TDO-CBL	
	JTSEL-0		4	4		JTAG-CLK	
	TDO-FX2-0		5	5	GND	GND	
J11.1	B0-IO00	[C3]	6	6	GND	GND	
J11.2	B0-IO01	[E7]	7	7	GND	GND	
J11.3	B0-IO02	[C4]	8	8	GND	GND	
J11.4	B0-IO03	[A5]	9	9	GND	GND	
J11.5	B0-IO04	[C6]	10	10	GND	GND	
J11.6	B0-IO05	[A6]	11	11	GND	GND	
J11.7	B0-IO06	[A7]	12	12	GND	GND	
J11.8	B0-IO07	[G9]	13	13	GND	GND	
J11.9	B0-IO08	[C11]	14	14	GND	GND	
J11.10	B0-IO09	[G11]	15	15	GND	GND	
J11.13	B0-IO10	[H9]	16	16	GND	GND	
J11.14	B0-IO11	[C9]	17	17	GND	GND	
J11.15	B0-IO12	[E8]	18	18	GND	GND	
J11.16	B0-IO13	[H10]	19	19	GND	GND	
J11.17	B0-IO14	[C10]	20	20	GND	GND	
J11.18	B0-IO15	[E9]	21	21	GND	GND	
J11.19	B0-IO16	[G10]	22	22	GND	GND	
J11.20	B0-IO17	[G8]	23	23	GND	GND	
J11.21	B0-IO18	[G15]	24	24	GND	GND	
J11.22	B0-IO19	[G14]	25	25	GND	GND	
J11.23	B0-IO20	[H11]	26	26	GND	GND	
J11.24	B0-IO21	[G16]	27	27	GND	GND	
J11.25	B0-IO22	[G12]	28	28	GND	GND	
J11.26	B0-IO23	[E14]	29	29	GND	GND	
J11.27	B0-IO24	[G13]	30	30	GND	GND	
J11.28	B0-IO25	[A17]	31	31	GND	GND	
J11.31	B0-IO26	[A18]	32	32	GND	GND	
J11.32	B0-IO27	[E15]	33	33	GND	GND	
J11.33	B0-IO28	[A15]	34	34	GND	GND	
J11.34	B0-IO29	[A16]	35	35	GND	GND	
J11.35	B0-IO30	[H13]	36	36	GND	GND	
J11.36	B0-IO31	[H12]	37	37	GND	GND	
J11.37	B0-IO32	[H15]	38	38	GND	GND	
J11.38	B0-IO33	[E16]	39	39	GND	GND	
J11.39	B0-IO34	[C18]	40	40	GND	GND	
J11.40	B0-IO35	[C17]	41	41	GND	GND	
J13.1	B0-IO36	[H14]	42	42	GND	GND	
J13.2	B0-IO37	[C14]	43	43	GND	GND	
J13.3	B0-IO38	[C15]	44	44	GND	GND	
J13.4	B0-IO39	[C16]	45	45	GND	GND	
	GND	GND	46	46	[E11]	B0-PRL2CLK	
SMA J15	B0-CLKSMA	[E10]	47	47	GND	GND	
	GND	GND	48	48	[C13]	B0-CLK2PRL	
	VCC5V0	+5V DC	49	49	+5V DC	VCC5V0	
	VCC5V0	+5V DC	50	50	SHIELD		

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I/O Bank 1 (Right)

Table 9: Header J22 FX2 Pinout (I/O Bank 1)

Shared	Schematic Name	CB284 Ball	A	B	CB284 Ball	Schematic Name	Shared
	VCCIO_1	VCCIO_1	1	1	SHIELD		
	VCCIO_1	VCCIO_1	2	2	GND	GND	
	JTAG-TMS		3	3		TDO-FX2-2	
	JTSEL-1		4	4		JTAG-CLK	
	TDO-FX2-1		5	5	GND	GND	
J19.1	B1-IO00	[C20]	6	6	GND	GND	
J19.2	B1-IO01	[E20]	7	7	GND	GND	
J19.3	B1-IO02	[G18]	8	8	GND	GND	
J19.4, J20.1	B1-IO03	[D20]	9	9	GND	GND	
J19.5, J20.2	B1-IO04	[G20]	10	10	GND	GND	
J19.6, J20.3	B1-IO05	[F18]	11	11	GND	GND	
J19.7, J20.4	B1-IO06	[J16]	12	12	GND	GND	
J19.8	B1-IO07	[F20]	13	13	GND	GND	
J19.9	B1-IO08	[G22]	14	14	GND	GND	
J19.10	B1-IO09	[H20]	15	15	GND	GND	
J19.13	B1-IO10	[H16]	16	16	GND	GND	
J19.14	B1-IO11	[L16]	17	17	GND	GND	
J19.15	B1-IO12	[K20]	18	18	GND	GND	
J19.16	B1-IO13	[J15]	19	19	GND	GND	
J19.17	B1-IO14	[J18]	20	20	GND	GND	
J19.18	B1-IO15	[H18]	21	21	GND	GND	
J19.19	B1-IO16	[K15]	22	22	GND	GND	
J19.20	B1-IO17	[K16]	23	23	GND	GND	
J19.21	B1-IO18	[M20]	24	24	GND	GND	
J19.22	B1-IO19	[L15]	25	25	GND	GND	
J19.23	B1-IO20	[M16]	26	26	GND	GND	
J19.24	B1-IO21	[N15]	27	27	GND	GND	
J19.25	B1-IO22	[M15]	28	28	GND	GND	
J22.A47, J23	B1-CLKSMA	[L18]	29	29	GND	GND	
J22.B46	B1-PRL2CLK	[K18]	30	30	GND	GND	
J19.26	B1-IO23	[N22]	31	31	GND	GND	
J19.27	B1-IO24	[N16]	32	32	GND	GND	
J19.28	B1-IO25	[P22]	33	33	GND	GND	
J19.31	B1-IO26	[R22]	34	34	GND	GND	
J19.32	B1-IO27	[T22]	35	35	GND	GND	
J19.33	B1-IO28	[P20]	36	36	GND	GND	
J19.34	B1-IO29	[P16]	37	37	GND	GND	
J19.35	B1-IO30	[U20]	38	38	GND	GND	
J19.36	B1-IO31	[R18]	39	39	GND	GND	
J19.37	B1-IO32	[P18]	40	40	GND	GND	
J19.38, J21.1	B1-IO33	[P15]	41	41	GND	GND	
J19.39, J21.2	B1-IO34	[R20]	42	42	GND	GND	
J19.40, J21.3	B1-IO35	[T20]	43	43	GND	GND	
J21.4	B1-IO36	[V20]	44	44	GND	GND	
	B1-IO37	[W20]	45	45	GND	GND	
	GND	GND	46	46	[K18]	B1-PRL2CLK	J22.A30
J22.A29, J23	B1-CLKSMA	[L18]	47	47	GND	GND	
	GND	GND	48	48	—	N.C.	
	VCC5V0	+5V DC	49	49	+5V DC	VCC5V0	
	VCC5V0	+5V DC	50	50	SHIELD		

I/O Bank 2 (Bottom)*Table 10: Header J32 FX2 Pinout (I/O Bank 2)*

Shared	Schematic Name	CB284 Ball	A	B	CB284 Ball	Schematic Name	Shared
	VCCIO_2	VCCIO_2	1	1	SHIELD		
	VCCIO_2	VCCIO_2	2	2	GND	GND	
	JTAG-TMS		3	3		TDO-ICE	
	JTSEL-2		4	4		JTAG-CLK	
	TDO-FX2-2		5	5	GND	GND	
J29.1	B2-IO00	[Y6]	6	6	GND	GND	
J29.2	B2-IO01	[V8]	7	7	GND	GND	
J29.3	B2-IO02	[Y7]	8	8	GND	GND	
J29.4, J30.1	B2-IO03	[Y20]	9	9	GND	GND	
J29.5, J30.2	B2-IO04	[Y18]	10	10	GND	GND	
J29.6, J30.3	B2-IO05	[Y19]	11	11	GND	GND	
J29.7, J30.4	B2-IO06	[Y17]	12	12	GND	GND	
J29.8	B2-IO07	[AB15]	13	13	GND	GND	
J29.9	B2-IO08	[AB14]	14	14	GND	GND	
J29.10	B2-IO09	[AB13]	15	15	GND	GND	
J29.13	B2-IO10	[AB12]	16	16	GND	GND	
J29.14	B2-IO11	[V13]	17	17	GND	GND	
J29.15	B2-IO12	[Y15]	18	18	GND	GND	
J29.16	B2-IO13	[T12]	19	19	GND	GND	
J29.17	B2-IO14	[Y13]	20	20	GND	GND	
J29.18	B2-IO15	[R12]	21	21	GND	GND	
J29.19	B2-IO16	[R9]	22	22	GND	GND	
J29.20	B2-IO17	[Y14]	23	23	GND	GND	
J29.21	B2-IO18	[V9]	24	24	GND	GND	
J29.22	B2-IO19	[R11]	25	25	GND	GND	
J29.23	B2-IO20	[Y10]	26	26	GND	GND	
J29.24	B2-IO21	[R10]	27	27	GND	GND	
J29.25	B2-IO22	[T10]	28	28	GND	GND	
J29.26	B2-IO23	[T11]	29	29	GND	GND	
J29.27	B2-IO24	[R8]	30	30	GND	GND	
J29.28	B2-IO25	[T8]	31	31	GND	GND	
J29.31	B2-IO26	[AB11]	32	32	GND	GND	
J29.32	B2-IO27	[AB10]	33	33	GND	GND	
J29.33	B2-IO28	[T7]	34	34	GND	GND	
J29.34	B2-IO29	[AB9]	35	35	GND	GND	
J29.35	B2-IO30	[AB8]	36	36	GND	GND	
J29.36	B2-IO31	[AB7]	37	37	GND	GND	
J29.37	B2-IO32	[AB6]	38	38	GND	GND	
J29.38	B2-IO33	[V7]	39	39	GND	GND	
J29.39	B2-IO34	[T13]	40	40	GND	GND	
J29.40, J31.1	B2-IO35	[Y9]	41	41	GND	GND	
J31.2	B2-IO36	[V6]	42	42	GND	GND	
J31.3	B2-IO37	[Y5]	43	43	GND	GND	
J31.4	B2-IO38	[Y4]	44	44	GND	GND	
	B2-IO39	[AB2]	45	45	GND	GND	
	GND	GND	46	46	—	N.C.	
IC8, J33	B2-CLKOSC	[V11]	47	47	GND	GND	
	GND	GND	48	48	[V12]	B2-CLK32K	32.768 kHz
	VCC5V0	+5V DC	49	49	+5V DC	VCC5V0	
	VCC5V0	+5V DC	50	50	SHIELD		

iCEman65 Evaluation Kit User Guide

Compatible Third-Party Boards

Table 11 lists the available third-party expansion boards that plug into any one of the Hirose FX2 connectors on the iCEman65 board.



These products have not yet been verified to work with the iCEman65 board.

SiliconBlue Technologies makes no warranty or guarantee of compatibility for these third-party products.

Table 11: Available Hirose FX Expansion Boards

Board	Description, Link to More Information
	Wire-Wrap Prototyping Board www.digilentinc.com/Products/Detail.cfm?Prod=FX2WW&Nav1=Products&Nav2=Accessory
	Breadboard Prototyping Board www.digilentinc.com/Products/Detail.cfm?Prod=FX2BB&Nav1=Products&Nav2=Accessory
	Video Decoder Board www.digilentinc.com/Products/Detail.cfm?Prod=VDEC1&Nav1=Products&Nav2=Accessory

40-pin Ribbon Cable Headers

The iCEman65 board has three 40-pin ribbon cable headers, located on the top, right, and bottom edges of the board. As shown in Table 12, each header has an independent voltage supply, controlled by a jumper selection.

Table 12: 40-pin Ribbon Cable Headers

Header Location	Header Designator	I/O Bank/ Voltage Source	Voltage Control	Pinout References
Top Edge	J11	I/O Bank 0 (VCCIO_0)	Jumper J43	Figure 7 Table 13
Right Edge	J19	I/O Bank 1 (VCCIO_1)	Jumper J45	Figure 8 Table 14
Bottom Edge	J29	I/O Bank 2 (VCCIO_2)	Jumper J44	Figure 9 Table 15

I/O Bank 0 (Top)

Figure 7 shows the ball connections for the iCE65 PIO pins that connect to the top-edge 40-pin header, J11. There are 36 PIO pins from I/O Bank 0 connected to the J11 header.

The header carries both +5V supply voltages and the VCCIO_0 supply, controlled by jumper header J43.

Figure 7: Top 40-pin Header (J11) and BG284 Ball Connections

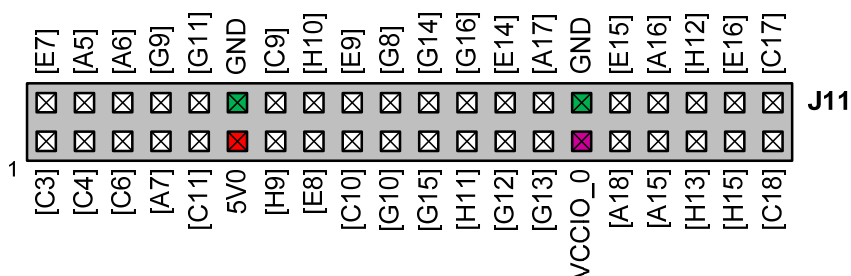


Table 13 provides a listing of the header connections.

Table 13: Header J11 Pinout

Shared	Schematic Name	CB284 Ball	Header J11		CB284 Ball	Schematic Name	Shared
J14.A6	B0-IO00	[C3]	1	2	[E7]	B0-IO01	J14.A7
J14.A8	B0-IO02	[C4]	3	4	[A5]	B0-IO03	J14.A9
J14.A10	B0-IO04	[C6]	5	6	[A6]	B0-IO05	J14.A11
J14.A12	B0-IO06	[A7]	7	8	[G9]	B0-IO07	J14.A13
J14.A14	B0-IO08	[C11]	9	10	[G11]	B0-IO09	J14.A15
	VCC5V0	+5V DC	11	12	GND	GND	
J14.A16	B0-IO10	[H9]	13	14	[C9]	B0-IO11	J14.A17
J14.A18	B0-IO12	[E8]	15	16	[H10]	B0-IO13	J14.A19
J14.A20	B0-IO14	[C10]	17	18	[E9]	B0-IO15	J14.A21
J14.A22	B0-IO16	[G11]	19	20	[G8]	B0-IO17	J14.A23
J14.A24	B0-IO18	[G15]	21	22	[G14]	B0-IO19	J14.A25
J14.A26	B0-IO20	[H11]	23	24	[G16]	B0-IO21	J14.A27
J14.A28	B0-IO22	[G12]	25	26	[E14]	B0-IO23	J14.A29
J14.A30	B0-IO24	[G13]	27	28	[A17]	B0-IO25	J14.A31
	VCCIO_0	VCCIO_0	29	30	GND	GND	
J14.A32	B0-IO26	[A18]	31	32	[E15]	B0-IO27	J14.A33
J14.A34	B0-IO28	[A15]	33	34	[A16]	B0-IO29	J14.A35
J14.A36	B0-IO30	[H13]	35	36	[H12]	B0-IO31	J14.A37
J14.A38	B0-IO32	[H15]	37	38	[E16]	B0-IO33	J14.A39
J14.A40	B0-IO34	[C18]	39	40	[C17]	B0-IO35	J14.A41

I/O Bank 1 (Right)

Figure 8 shows the ball connections for the iCE65 PIO pins that connect to the right-edge 40-pin header, J19. There are 36 PIO pins from I/O Bank 1 connected to the J19 header.

The header carries both +5V supply voltages and the VCCIO_1 supply, controlled by jumper header J45.

Figure 8: Top 40-pin Header (J19) and BG284 Ball Connections

J19	
1	
[C20]	[E20]
[G18]	[D20]
[G20]	[F18]
[J16]	[F20]
[G22]	[H20]
5V0	GND
[H16]	[L16]
[K20]	[J15]
[J18]	[H18]
[K15]	[K16]
[M20]	[L15]
[M16]	[N15]
[M15]	[N22]
[N16]	[P22]
VCCIO_1	GND
[R22]	[T22]
[P20]	[P16]
[U20]	[R18]
[P18]	[P15]
[R20]	[T20]

Table 14 provides a listing of the header connections.

Table 14: Header J19 Pinout

Shared	Schematic Name	CB284 Ball	Header J19		CB284 Ball	Schematic Name	Shared
J22.A6	B1-IO00	[C20]	1	2	[E20]	B1-IO01	J22.A7
J22.A8	B1-IO02	[G18]	3	4	[D20]	B1-IO03	J22.A9
J22.A10	B1-IO04	[G20]	5	6	[F18]	B1-IO05	J22.A11
J22.A12	B1-IO06	[J16]	7	8	[F20]	B1-IO07	J22.A13
J22.A14	B1-IO08	[G22]	9	10	[H20]	B1-IO09	J22.A15
	VCC5V0	+5V DC	11	12	GND	GND	
J22.A16	B1-IO10	[H16]	13	14	[L16]	B1-IO11	J22.A17
J22.A18	B1-IO12	[K20]	15	16	[J15]	B1-IO13	J22.A19
J22.A20	B1-IO14	[J18]	17	18	[H18]	B1-IO15	J22.A21
J22.A22	B1-IO16	[K15]	19	20	[K16]	B1-IO17	J22.A23
J22.A24	B1-IO18	[M20]	21	22	[L15]	B1-IO19	J22.A25
J22.A26	B1-IO20	[M16]	23	24	[N15]	B1-IO21	J22.A27
J22.A28	B1-IO22	[M15]	25	26	[N22]	B1-IO23	J22.A31
J22.A32	B1-IO24	[N16]	27	28	[P22]	B1-IO25	J22.A33
	VCCIO_1	VCCIO_1	29	30	GND	GND	
J22.A34	B1-IO26	[R22]	31	32	[T22]	B1-IO27	J22.A35
J22.A36	B1-IO28	[P20]	33	34	[P16]	B1-IO29	J22.A37
J22.A38	B1-IO30	[U20]	35	36	[R18]	B1-IO31	J22.A39
J22.A40	B1-IO32	[P18]	37	38	[P15]	B1-IO33	J22.A41, J21.1
J22.A42, J21.2	B1-IO34	[R20]	39	40	[T20]	B1-IO35	J22.A43, J21.3

I/O Bank 2 (Bottom)

Figure 9 shows the ball connections for the iCE65 PIO pins that connect to the bottom-edge 40-pin header, J29. There are 36 PIO pins from I/O Bank 2 connected to the J29 header.

The header carries both +5V supply voltages and the VCCIO_2 supply, controlled by jumper header J44.

Figure 9: Top 40-pin Header (J29) and BG284 Ball Connections

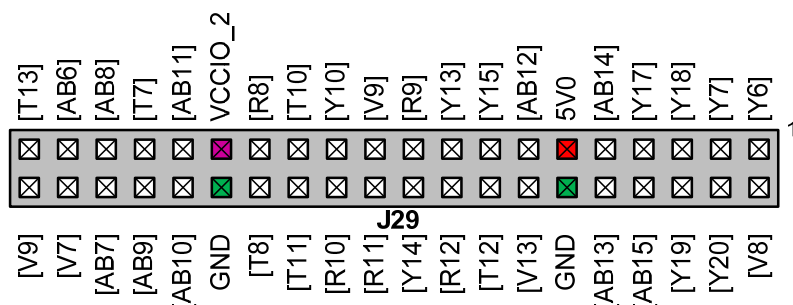


Table 15 provides a listing of the header connections.

Table 15: Header J29 Pinout

Shared	Schematic Name	CB284 Ball	Header J29		CB284 Ball	Schematic Name	Shared
J32.A6	B2-IO00	[Y6]	1	2	[V8]	B2-IO01	J32.A7
J32.A8	B2-IO02	[Y7]	3	4	[Y20]	B2-IO03	J30.1, J32.A9
J30.2, J32.A10	B2-IO04	[Y18]	5	6	[Y19]	B2-IO05	J30.3, J32.A11
J30.4, J32.A12,	B2-IO06	[Y17]	7	8	[AB15]	B2-IO07	J32.A13
J32.A14	B2-IO08	[AB14]	9	10	[AB13]	B2-IO09	J32.A15
	VCC5V0	+5V DC	11	12	GND	GND	
J32.A16	B2-IO10	[AB12]	13	14	[V13]	B2-IO11	J32.A17
J32.A18	B2-IO12	[Y15]	15	16	[T12]	B2-IO13	J32.A19
J32.A20	B2-IO14	[Y13]	17	18	[R12]	B2-IO15	J32.A21
J32.A22	B2-IO16	[R9]	19	20	[Y14]	B2-IO17	J32.A23
J32.A24	B2-IO18	[V9]	21	22	[R11]	B2-IO19	J32.A25
J32.A26	B2-IO20	[Y10]	23	24	[R10]	B2-IO21	J32.A27
J32.A28	B2-IO22	[T10]	25	26	[T11]	B2-IO23	J32.A29
J32.A30	B2-IO24	[R8]	27	28	[T8]	B2-IO25	J32.A31
	VCCIO_2	VCCIO_2	29	30	GND	GND	
J32.A32	B2-IO26	[AB11]	31	32	[AB10]	B2-IO27	J32.A33
J32.A34	B2-IO28	[T7]	33	34	[AB9]	B2-IO29	J32.A35
J32.A36	B2-IO30	[AB8]	35	36	[AB7]	B2-IO31	J32.A37
J32.A38	B2-IO32	[AB6]	37	38	[V7]	B2-IO33	J32.A39
J32.A40	B2-IO34	[T13]	39	40	[Y9]	B2-IO35	J31.1, J32.A41

Compatible Cabling

- 2x20 Ribbon Cable, 0.1" Spacing
- IDE Hard Disk Drive (HDD) Cable

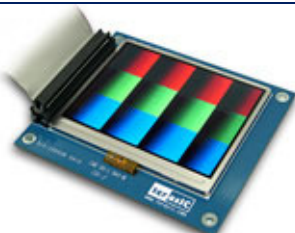
Compatible Third-Party Boards

The 40-pin header is designed to work with the following third-party products. These products require that the iCEman65 board be powered by an external AC adapter or from USB. The products listed in Table 16 connect to the iCEman65 board using a 40-wire ribbon cable included with the kits.

These products have not yet been verified to work with the iCEman65 board.

SiliconBlue Technologies makes no warranty or guarantee of compatibility for these third-party products.

Table 16: Available Expansion Boards for 40-Pin Header

Board	Description, Link to More Information
	1.3 Megapixel Digital Camera Module www.terasic.com.tw/cgi-bin/page/archive.pl?Language=English&CategoryNo=39&No=50
	3.6-inch Digital Panel Kit www.terasic.com.tw/cgi-bin/page/archive.pl?Language=English&CategoryNo=39&No=78
	4.3-inch Ultra-High Resolution LCD Touch Panel Kit www.terasic.com.tw/cgi-bin/page/archive.pl?Language=English&CategoryNo=39&No=213

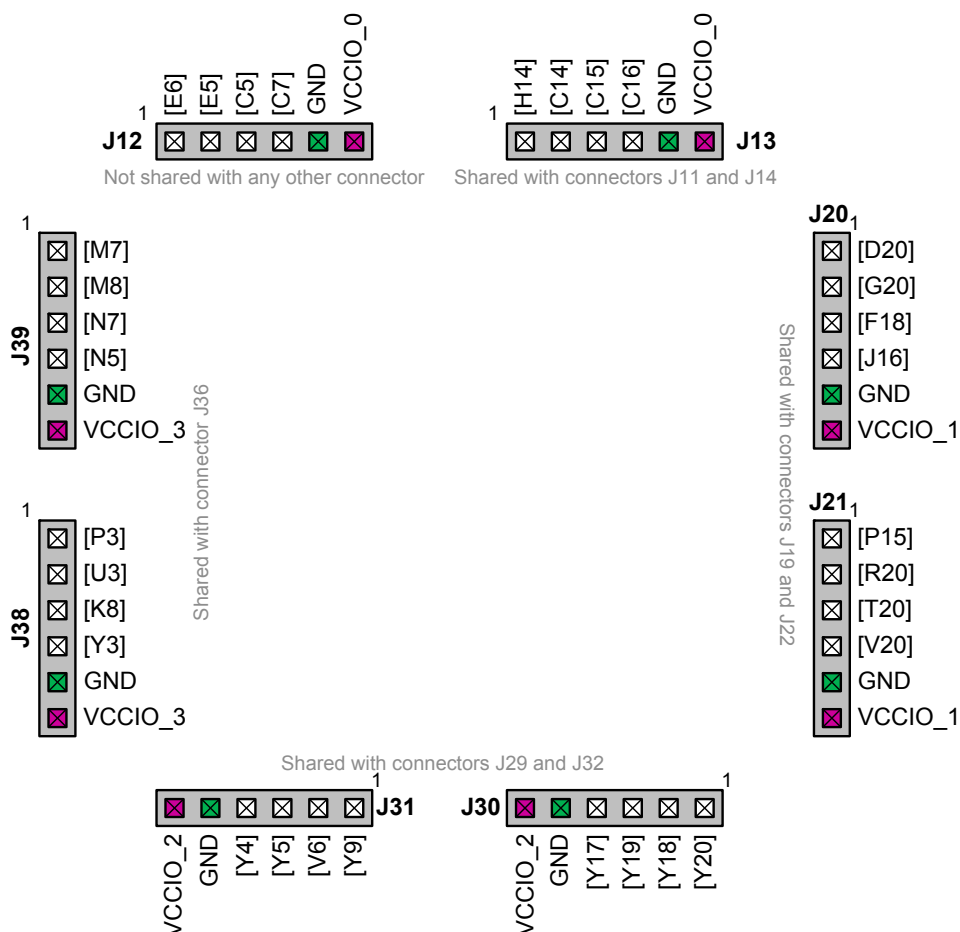
Peripheral Module (PMOD) Connectors

The iCE65 evaluation board includes eight 6-pin Peripheral Module (PMOD) connectors, as shown in Figure 10 and listed in Table 17. By default, each of the four I/O banks has two PMOD connectors. Both PMOD connectors within a bank are controlled by a common voltage selection jumper. Many of the PMOD connectors share signals with the other expansion connectors in the same I/O bank.

Table 17: 6-pin Peripheral Module Headers

Header Location	Header Designator	I/O Bank/ Voltage Source	Voltage Selection	Pinout References	
Top Edge	J12	I/O Bank 0 (VCCIO_0)	Jumper J43	Figure 10	Table 18
	J13				Table 19
Right Edge	J20	I/O Bank 1 (VCCIO_1)	Jumper J45	Figure 10	Table 20
	J21				Table 21
Bottom Edge	J30	I/O Bank 2 (VCCIO_2)	Jumper J44	Figure 10	Table 22
	J31				Table 23
Left Edge	J38	I/O Bank 3 (VCCIO_3)	Jumper JP23	Figure 10	Table 24
	J39				Table 25

Figure 10: Digilent Peripheral Module (PMOD) Location and BG284 Ball Connections



I/O Bank 0 (Top)

Top Left (J12)

The J12 PMOD connector has shared connections with the [Four User LEDs \(Revision D Board or Later\)](#). The associated LED will light whenever a J12 PMOD connection, shown in [Table 18](#), is driven Low.

Table 18: Top-Left PMOD Header (J12)

Pin	CB284 Ball	Schematic Name	Shared Connections/Notes
1	[E6]	B0-PM-A1	Active-Low LED LD3 (only on Rev. D or later boards), J36.61
2	[E5]	B0-PM-A2	Active-Low LED LD4 (only on Rev. D or later boards), J36.57
3	[C5]	B0-PM-A3	Active-Low LED LD5 (only on Rev. D or later boards), J36.53
4	[C7]	B0-PM-A4	Active-Low LED LD6 (only on Rev. D or later boards), J36.49
GND	GND	GND	—
VCC	VCCIO_0	VCCIO_0	Voltage selected using jumper J43

Top Right (J13)

Table 19: Top-Right PMOD Header (J13)

Pin	CB284 Ball	Schematic Name	Shared Connections/Notes
1	[H14]	B0-IO36	J14J22.A42
2	[C14]	B0-IO37	J14.A43
3	[C15]	B0-IO38	J14.A44
4	[C16]	B0-IO39	J14.A45
GND	GND	GND	—
VCC	VCCIO_0	VCCIO_0	Voltage selected using jumper J43

I/O Bank 1 (Right)

Right Top (J20)

Table 20: Right-Top PMOD Header (J20)

Pin	CB284 Ball	Schematic Name	Shared Connections/Notes
1	[D20]	B1-IO03	J19.4, J22.A9
2	[G20]	B1-IO04	J19.5, J22.A10
3	[F18]	B1-IO05	J19.6, J22.A11
4	[J16]	B1-IO06	J19.7, J22.A12
GND	GND	GND	—
VCC	VCCIO_1	VCCIO_1	Voltage selected using jumper J45

Right Bottom (J21)

Table 21: Right-Bottom PMOD Header (J21)

Pin	CB284 Ball	Schematic Name	Shared Connections/Notes
1	[P15]	B1-IO33	J19.38, J22.A41
2	[R20]	B1-IO34	J19.39, J22.A42
3	[T20]	B1-IO35	J19.40, J22.A43
4	[V20]	B1-IO36	J22.A44
GND	GND	GND	—
VCC	VCCIO_1	VCCIO_1	Voltage selected using jumper J45

I/O Bank 2 (Bottom)**Bottom Left (J31)***Table 22: Bottom-Left PMOD Header (J31)*

Pin	CB284 Ball	Schematic Name	Shared Connections/Notes
1	[Y9]	B2-IO35	Pin 1 on right. J29.40 , J32.A41
2	[V6]	B2-IO36	J32.A42
3	[Y5]	B2-IO37	J32.A43
4	[Y4]	B2-IO38	J32.A44
GND	GND	GND	—
VCC	VCCIO_1	VCCIO_2	Voltage selected using jumper J44

Bottom Right (J30)*Table 23: Bottom-Right PMOD Header (J30)*

Pin	CB284 Ball	Schematic Name	Shared Connections/Notes
1	[Y20]	B2-IO03	Pin 1 on right. J29.4 , J32.A9
2	[Y18]	B2-IO04	J29.5 , J32.A10
3	[Y19]	B2-IO05	J29.6 , J32.A11
4	[Y19]	B2-IO06	J29.7 , J32.A12
GND	GND	GND	—
VCC	VCCIO_1	VCCIO_2	Voltage selected using jumper J44

I/O Bank 3 (Left)**Right Top (J39)***Table 24: Right-Top PMOD Header (J39)*

Pin	CB284 Ball	Schematic Name	Shared Connections/Notes
1	[M7]	B3-DP20_N	J36.80
2	[M8]	B3-DP20_P	J36.78
3	[N7]	B3-DP21_N	J36.76
4	[N5]	B3-DP21_P	J36.74
GND	GND	GND	—
VCC	VCCIO_3	VCCIO_3	Voltage selected using jumper JP23

Right Bottom (J38)*Table 25: Right-Bottom PMOD Header (J38)*

Pin	CB284 Ball	Schematic Name	Shared Connections/Notes
1	[P3]	B3-IO07	J36.10
2	[U3]	B3-IO06	J36.8
3	[K8]	B3-IO02	J36.6
4	[Y3]	B3-IO03	J36.4
GND	GND	GND	—
VCC	VCCIO_3	VCCIO_3	Voltage selected using jumper JP23

Additional PMOD Connectors for iCE65L08 and iCE65L16 devices

The iCEman65 board is designed to potentially support all iCE65 components available in the CB132 or CB284 chip-scale ball-grid array packages. Nearly all PIO pins on an iCE65L04 device are connected on the board. However, the iCE65L08 and iCE65L16 offer additional PIO pins in the CB284 package.

Consequently, the iCEman65 board has additional, unpopulated PMOD connections designated J16, J17, J18, J25, J26, J27, J34, J35, J40 and J41. These connections are only available when an iCE65L08CB284 or iCE65L16CB284 device is mounted on the board.

Compatible, Third-Party Peripheral Module (PMOD) Boards

Table 26 lists the available third-party expansion boards that plug into one of the Peripheral Module (PMOD) connectors on the iCEman65 board. PMOD modules are available for a variety of functions. Also see the list of [Other Useful Peripheral Module Accessories](#).

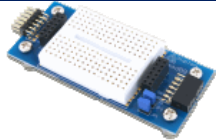
- | | |
|---|------------------------------------|
| ■ Prototyping/Breadboarding | ■ Memory |
| ■ Displays | ■ Sensors |
| ■ Inputs, Switches, Pushbuttons | ■ Audio |
| ■ Serial Interfaces | ■ Connectors |
| ■ Analog/Digital, Digital/Analog Conversion | ■ Motor Control/High-Drive Outputs |

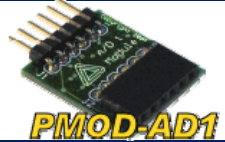


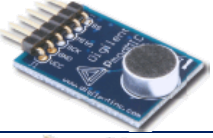
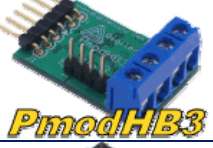
These products have not yet been verified to work with the iCEman65 board.

SiliconBlue Technologies makes no warranty or guarantee of compatibility for these third-party products.

Table 26: Available Third-Party Peripheral Module (PMOD) Boards

Board	Description, Link to More Information
Prototyping/Breadboarding	
	PMOD Breadboard Prototyping Board www.digilentinc.com/Products/Detail.cfm?Prod=PMOD-BB&Nav1=Products&Nav2=Peripheral Uses a 2x6-pin header. Recommend 6-pin headers and a 2x6-pin splitter cable .
Displays	
	Four Discrete LEDs www.digilentinc.com/Data/Products/PMOD-LED/pmod-led-rm.pdf Verified for compatibility.
	Dual Seven-Segment LED Module www.digilentinc.com/Products/Detail.cfm?Prod=PMOD-SSD&Nav1=Products&Nav2=Peripheral NOTE: Requires two PMOD connections on the iCEman65 board Verified for compatibility. Recommend 6-pin headers and two 6-pin extension cables .
	16x2 Character LCD Display www.digilentinc.com/Products/Detail.cfm?Prod=PMOD-CLS&Nav1=Products&Nav2=Peripheral NOTE: Requires two PMOD connections on the iCEman65 board Recommend 6-pin headers and two 6-pin extension cables .
Inputs, Switches, Pushbuttons	
	Four Debounced Pushbutton Switches www.digilentinc.com/Products/Detail.cfm?Prod=PMOD-BTN&Nav1=Products&Nav2=Peripheral

Board	Description, Link to More Information
 PMOD-SWITCH	Four Slide Switches www.digilentinc.com/Products/Detail.cfm?Prod=PMOD-SWITCH&Nav1=Products&Nav2=Peripheral
 PmodENC	Rotary Shaft Encoder and Pushbutton Module www.digilentinc.com/Products/Detail.cfm?Prod=PMOD-ENC&Nav1=Products&Nav2=Peripheral
 PMOD-DIN1	Debounced Digital Inputs with Input Protection www.digilentinc.com/Data/Products/PMOD-DIN1/pmod-din1-rm.pdf
Serial Interfaces	
 PmodPS2	PS/2-Style Mouse/Keyboard Interface www.digilentinc.com/Products/Detail.cfm?Prod=PMOD-PS2&Nav1=Products&Nav2=Peripheral
 PmodRS232	RS-232 Serial Port Interface www.digilentinc.com/Products/Detail.cfm?Prod=PMOD-RS232&Nav1=Products&Nav2=Peripheral
Analog/Digital, Digital/Analog Conversion	
 PMOD-AD1	Two-Channel, 12-bit Analog-to-Digital Converter (ADC) www.digilentinc.com/Products/Detail.cfm?Prod=PMOD-AD1&Nav1=Products&Nav2=Peripheral
 PMOD-DA1	Four-Channel, Digital-to-Analog Converter (DAC) www.digilentinc.com/Products/Detail.cfm?Prod=PMOD-DA1&Nav1=Products&Nav2=Peripheral
 PMOD DA2	Four-Channel, 12-bit Digital-to-Analog Converter (DAC) www.digilentinc.com/Products/Detail.cfm?Prod=PMOD-DA2&Nav1=Products&Nav2=Peripheral
Memory	
	PMOD Secure Digital (SD) Media Card Interface www.digilentinc.com/Products/Detail.cfm?Prod=PMOD-SD&Nav1=Products&Nav2=Peripheral Uses a 2x6-pin header. Recommend 6-pin headers and a 2x6-pin splitter cable.
 PMOD SF	16 Mbit SPI Serial Flash PROM (M25P16) www.digilentinc.com/Products/Detail.cfm?Prod=PMOD-SF&Nav1=Products&Nav2=Peripheral NOTE: This PROM is compatible with the 8 Mbit SPI Serial Flash PROM already on the iCEman 65 board.

Sensors	
 PmodLS1	Infrared Light Detector Module www.digilentinc.com/Products/Detail.cfm?Prod=PMOD-LS1&Nav1=Products&Nav2=Peripheral
 PmodTMP	Temperature/Thermostat Module www.digilentinc.com/Products/Detail.cfm?Prod=PMOD-TMP&Nav1=Products&Nav2=Peripheral
Audio	
	Microphone Module www.digilentinc.com/Products/Detail.cfm?Prod=PMOD-MIC&Nav1=Products&Nav2=Peripheral
 PmodAMP1	Speaker/Headphone Amplifier Module www.digilentinc.com/Products/Detail.cfm?Prod=PMOD-AMP1&Nav1=Products&Nav2=Peripheral
Connectors	
 PMOD-CON1	Screw Terminal Connectors www.digilentinc.com/Data/Products/PMOD-CON1/pmod-con1-rm.pdf
 PMOD-CON2	BNC Connectors www.digilentinc.com/Data/Products/PMOD-CON2/pmod-con2-rm.pdf
 PmodCON4	RCA Audio Jack Connectors www.digilentinc.com/Products/Detail.cfm?Prod=PMOD-CON4&Nav1=Products&Nav2=Peripheral
Motor Control/High-Drive Outputs	
 PMOD-CON3	Servo Motor Connectors www.digilentinc.com/Products/Detail.cfm?Prod=PMOD-CON3&Nav1=Products&Nav2=Peripheral
 PmodHB3	H-Bridge Module for Small/Medium-Size DC Motors www.digilentinc.com/Products/Detail.cfm?Prod=PMOD-HB3&Nav1=Products&Nav2=Peripheral
 PMOD-OC1	Open-Collector Output Module (Transistor Drivers) www.digilentinc.com/Data/Products/PMOD-OC1/pmod-oc1-rm.pdf
 PmodOD1	Open-Drain Output Module (Power FETs) www.digilentinc.com/Products/Detail.cfm?Prod=PMOD-OD1&Nav1=Products&Nav2=Peripheral

Other Useful Peripheral Module Accessories

Table 27 lists some other useful accessories when developing applications with Peripheral Modules. Some of the Peripheral Modules described in Table 26 require these additional accessories to connect to the iCEman65 board.

Table 27: Other Useful Peripheral Module Accessories

Picture	Description, Link to More Information
	6Pin-Header: Six Pin Header and Gender Changer www.digilentinc.com/Products/Catalog.cfm?Nav1=Products&Nav2=Cables&Cat=Cable Useful to connect to a Peripheral Module via a 6-pin or 2x6-pin splitter cable.
	6pinCable: Six Pin Extension Cable www.digilentinc.com/Products/Catalog.cfm?Nav1=Products&Nav2=Cables&Cat=Cable
	2X6SPLIT: 2x6 Header to Two 1x6 Header Splitter Cable www.digilentinc.com/Products/Catalog.cfm?Nav1=Products&Nav2=Cables&Cat=Cable

Samtec Connector (I/O Bank 3)

The left edge of the board includes a 2x40-connection, high-speed Samtec QTE-040-04-L-D-A header (J36). Portions of the header connect to PIO pins from I/O Bank 3. Other portions connect to PIO pins from I/O Bank 0, shaded in light blue in [Table 28](#).

Table 28: Header J36 Samtec Pinout (I/O Bank 3, I/O Bank 0)

Shared	Schematic Name	CB284 Ball	Header J36		CB284 Ball	Schematic Name	Shared
	B3-VREF	[M1]	2	1	[V3]	B3-IO01	
J38.4	B3-IO03	[Y3]	4	3	[W3]	B3-IO00	
J38.3	B3-IO02	[K8]	6	5	GND	GND	
J38.2	B3-IO06	[U3]	8	7	[L8]	B3-IO05	
J38.1	B3-IO07	[P3]	10	9	[L7]	B3-IO04	
	B3-IO08	[N3]	12	11	GND	GND	
	B3-IO09	[L1]	14	13	[J8]	B3-IO11	
J40.4	N.C., B3-8XTRA-0	[T1]	16	15	[H8]	B3-IO10	
	B3-IO12	[K1]	18	17	GND	GND	
	N.C.	—	20	19	[H7]	B3-IO15	
	JP15 (VCC5V0)	—	22	21	[G7]	B3-IO14	
	B3-IO13	[J1]	24	23	GND	GND	
	JP16 (VCC3V3)	—	26	25	[J5]	B3-IO17	
	N.C.	—	28	27	[H5]	B3-IO16	
	B3-IO20	[H1]	30	29	GND	GND	
	JP17 (VCC2V5)	—	32	31	[G5]	B3-IO23	
	JP18 (VCC1V8)	—	34	33	[F5]	B3-IO22	
	B3-IO21	[K7]	36	35	GND	GND	
	N.C.	—	38	37	[H3]	B3-IO25	
	VCCIO_0 thru R	—	40	39	[G3]	B3-IO24	
	B3-IO27	[F3]	42	41	[A12]	N.C., B0-PM-Y4	J17.4
	B3-IO26	[E3]	44	43	[A11]	N.C., B0-PM-Y3	J17.3
	GND	GND	46	45	[A10]	N.C., B0-PM-Y2	J17.2
	B3-DP22_P	[P8]	48	47	[A9]	N.C., B0-PM-Y1	J17.1
	B3-DP22_N	[P7]	50	49	[C7]	B0-PM-A4	J12.4
	GND	GND	52	51	[A4]	N.C., B0-PM-X4	J16.4
	B3-CLK-SMA_P	[L5]	54	53	[C5]	B0-PM-A3	J12.3
	B3-CLK-SMA_N	[L3]	56	55	[A3]	N.C., B0-PM-X3	J16.3
	GND	GND	58	57	[E5]	B0-PM-A2	J12.2
	B3-PRL2CLK_P	[M3]	60	59	[A2]	N.C., B0-PM-X2	J16.2
	B3-PRL2CLK_N	[M5]	62	61	[E6]	B0-PM-A1	J12.1
	GND	GND	64	63	[A1]	N.C., B0-PM-X1	J16.1
	B3-DP24_P	[V5]	66	65	[C6]	B0-IO04	
	B3-DP24_N	[U5]	68	67	[A6]	B0-IO05	
	B3-DP23_P	[T5]	70	69	[C4]	B0-IO02	
	B3-DP23_N	[R5]	72	71	[A5]	B0-IO03	
J39.4	B3-DP21_P	[N5]	74	73	[C3]	B0-IO00	
J39.3	B3-DP21_N	[N7]	76	75	[E7]	B0-IO01	
J39.2	B3-DP20_P	[M8]	78	77	[C13]	B0-CLK2PRL	
J39.1	B3-DP20_N	[M7]	80	79	[E11]	B0-PRL2CLK	

Power Connections to J36 Header

The iCE65's VCCIO_3 power rail does not connect to the Samtec connector, which differs from the connectors in the other I/O banks. However, four different voltage rails optionally connect to the header and optionally power any attached daughter modules. Each power connector has an associated jumper to connect or disconnect the power rail to the header as shown in [Table 29](#). Multiple power rails can simultaneously connect to the header although only jumper JP16 is installed by default.

Table 29: Samtec Connector (J36) Power Connections

Power Rail	Jumper	Header Connection	Description
5 V	JP15	22	Source selected by jumper J3. Only 5V if AC wall adapter or USB selected. Same as 5V0 connection elsewhere on the board.
3.3 V	JP16	26	The 3.3V output from the LP3906 regulator. The same as the 3V3 connection elsewhere on the board.
2.5 V	JP17	32	The 2.5V output from the LP3906 regulator. The same as the 2V5 connection elsewhere on the board.
1.8 V	JP18	34	The 1.8V output from the LP3906 regulator. The same as the 2V5 connection elsewhere on the board.

Mating Connectors and Cables

Additional information will appear in future revisions of this document.

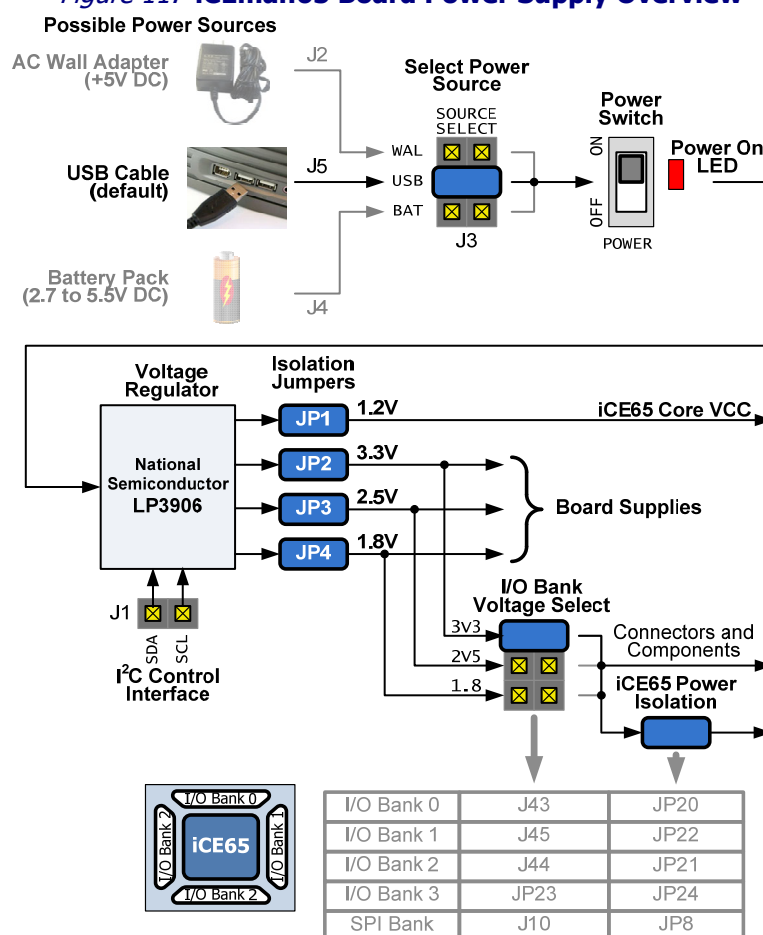
Power Supply Design Overview

Figure 11 depicts the power supply design for the iCEman65 board. There are three possible [Board Power Sources](#), although generally the board is powered from the USB cable connected to a USB port on a PC or powered USB hub.

The J3 jumper selects between the three possible power sources, as described in [Table 30](#). The select power source is then controlled by the power switch, SW1. If the board is connected to a power supply, then the red LED next to the switch lights up when the switch is turned ON.

When the power switch is ON, the selected power source then drives a [National Semiconductor LP3906](#) four-output regulator. The regulator provides 1.2V for the iCE65's core voltage and 3.3V, 2.5V, and 1.8V to the [I/O Bank Supply Voltage Controls](#).

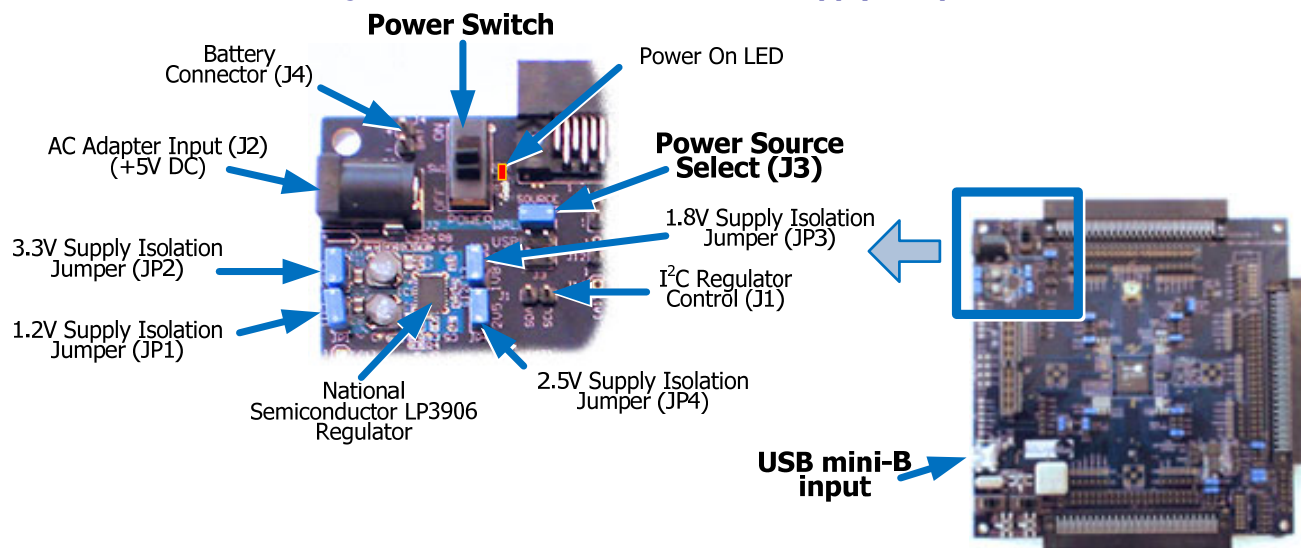
Figure 11: iCEman65 Board Power Supply Overview



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The LP3906 regulator also includes an I²C control interface. Consequently, an external controller can adjust the regulator voltage outputs. Any adjustments are only active while power is supplied to the board. When the power supply is removed, the regulator returns to the default output voltage levels. Consult the [LP3906 data sheet](#) for additional information.

Figure 12: iCEman65 Board Power Supply Jumpers



Board Power Sources

By default, the iCE65 board operates directly from the power supplied from a USB port. Just connect the included USB cable between the mini-B connector on the board and a powered port on your computer or USB hub.

However, the board physically supports three possible power sources, offering additional flexibility.

1. USB 2.0 Connector
2. +5V DC Wall Power Adapter
3. External Battery Pack

Select the desired power source using jumper J3, located in the upper left corner of the board, near the power switch and LED.

The selected power source is controlled by the SW1 power switch. The LD1 LED lights when power is applied to the board.

Table 30: Power Input Sources, Jumper J3 Settings

Power Source	Jumper J3 Setting	Cabling Requirements
+5V DC from AC Wall Adapter	SOURCE SELECT WAL ☐ ☒ USB ☒ ☒ BAT ☒ ☒ J3	Requires a +5V DC adapter (not included), connected to the barrel plug (J2).
USB Connector (DEFAULT)	SOURCE SELECT WAL ☒ ☒ USB ☐ ☒ BAT ☒ ☒ J3	Connect the included mini-USB cable to a powered USB port on a computer or to a powered USB hub.
External Battery Pack	SOURCE SELECT WAL ☒ ☒ USB ☒ ☒ BAT ☐ ☒ J3	Connect a battery pack (not included) to jumper header J4.

USB 2.0 Connector

The USB 2.0 cable supplied with the kit typically supplies power to the iCE65 board. The total power to the board may be limited by the USB host controller to approximately 2.5 W (5V @ 500 mA), which is more than sufficient for most stand-alone iCE65 applications. If you add you multiple add-on boards or modules, then the [+5V DC Wall Power Adapter](#) may prove a better power option.

To power the board from the USB connector, attach a cable between a host with a powered USB port and the board's mini-USB connector. Also, set jumper J3 to the "USB" setting, as shown in [Table 30](#).

+5V DC Wall Power Adapter

For additional power capacity, connect the iCE65 board directly to AC wall power using a +5V DC wall adapter. Set jumper J3 to the "WAL" setting, as shown in [Table 30](#).

The +5V DC input is the best choice for applications that use any of the Hirose FX2 connectors, the 40-pin ribbon cable connectors, or the Samtec connector because the attached peripheral boards may require additional power.

An AC adapter is not included with the iCEman65 kit. However, one is available for purchase as listed in [Table 31](#). The switching power supply directly supports North American, Japanese, and Taiwanese AC outlets. The optional adapter kit is available for European countries and the United Kingdom.

Table 31: AC Wall Power Adapters

Picture	Description, Link to More Information
	SWPS: Switching Power Supply www.digilentinc.com/Products/Catalog.cfm?Nav1=Products&Nav2=Components&Cat=Component
	PLUGADAPTER: European/UK Wall Plug Adapter www.digilentinc.com/Products/Catalog.cfm?Nav1=Products&Nav2=Components&Cat=Component

External Battery Pack

The iCE65 board is optionally powered by a battery pack. Connect the batter pack to the plated-through holes associated with the J4 connector, located in the upper left corner of the board.

A single Li-ion cell has a nominal voltage of 3.6V and can be connected directly to the J4 header. However, there is no recharging mechanism provided on the board.

If using NiCd, NiMH, or alkaline batteries, use a pack with three or four cells connected in series, which provides a nominal voltage of 3.6V or 4.8V.

If using a battery pack, set jumper J3 to the "BAT" setting, as shown in [Table 30](#).

I/O Bank Supply Voltage Controls

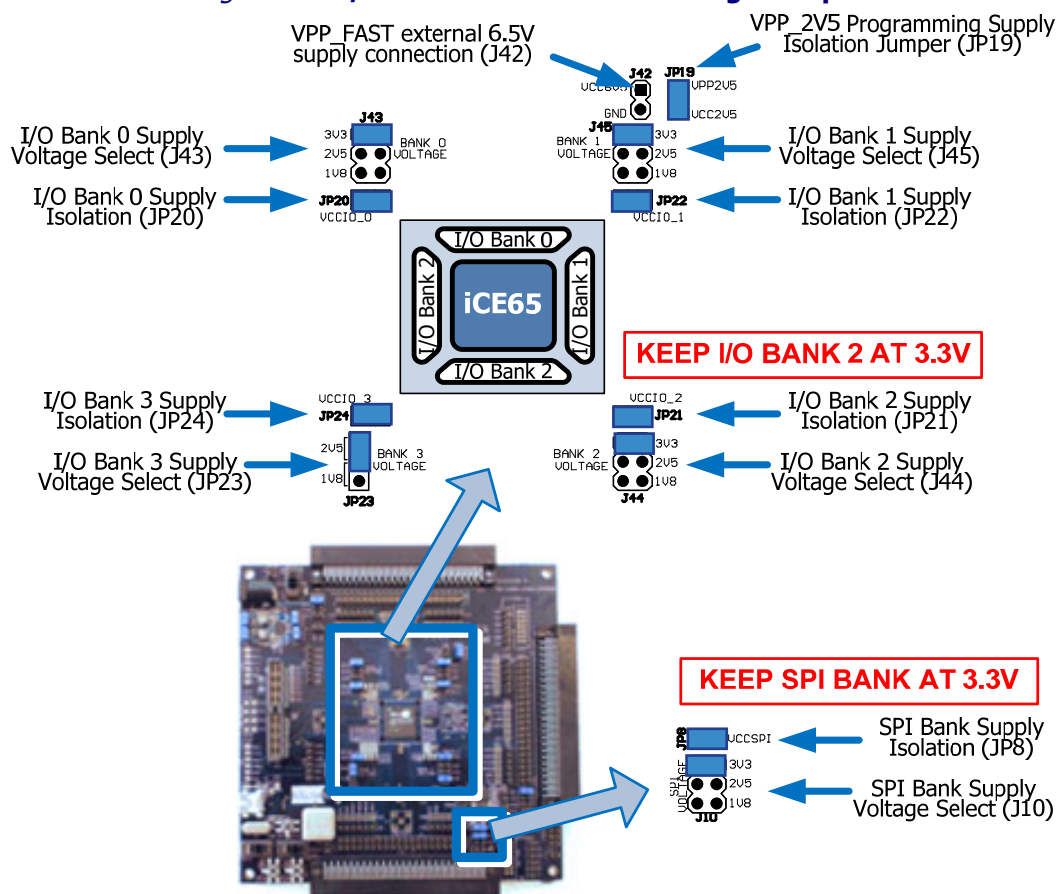
As shown in Table 32, each of the four iCE65 I/O banks and the SPI configuration interface bank supports a range of I/O standards and voltages.

Table 32: I/O Bank Voltage Settings

I/O Bank	Controlling Jumper Header	Available Options
I/O Bank 0 (top)	J43	3.3V, 2.5V, 1.8V
I/O Bank 1 (right)	J45	3.3V, 2.5V, 1.8V
I/O Bank 2 (bottom)	J44	Normally set to 3.3V (2.5V or 1.8V options are available by modifying the board)
I/O Bank 3 (left)	JP23	2.5V, 1.8V
SPI	J10	Normally set to 3.3V (2.5V or 1.8V options for future use)

Figure 13 indicates the location and default setting for each of the voltage select jumpers.

Figure 13: I/O Bank and SPI Bank Voltage Jumpers



Power Measurement/Voltage Isolation

Each voltage input to the iCE65 device has an isolation jumper. This jumper provides two possible functions.

1. Remove a specific jumper to isolate the supply rail and provide power from an external source.
2. Remove a specific jumper to measure the current flowing to the specific voltage rail.

Voltage Rail	Nominal Voltage	Upstream Voltage Source	Isolation Jumper	Reference Figure
Primary input supply	5.0V	Selectable, controlled by jumper J3	J3	Figure 12
VCC1V2: iCE65 core voltage	1.2V	LP3906 output SW1	JP1	Figure 12
VCC3V3: 3.3V supply	3.3V	LP3906 output SW2	JP2	Figure 12
VCC2V5: 2.5V supply	2.5V	LP3906 output LDO1	JP3	Figure 12
VCC1V8: 1.8V supply	1.8V	LP3906 output LDO2	JP3	Figure 12
VCCIO_0: I/O Bank 0 supply	Selectable	Controlled by jumper J43	JP20	Figure 13
VCCIO_1: I/O Bank 1 supply	Selectable	Controlled by jumper J45	JP22	Figure 13
VCCIO_2: I/O Bank 2 supply	3.3V (Selectable)	Controlled by jumper J44	JP21	Figure 13
VCCIO_3: I/O Bank 3 supply	Selectable	Controlled by jumper JP23	JP24	Figure 13
VCCSPI: SPI Bank supply	3.3V (Selectable)	Controlled by jumper J10	JP8	Figure 13
VPP2V5: NVCM programming voltage	2.5V	LP3906 output LDO1	JP19	Figure 13
VPP6V5: Fast NVCM programming voltage	6.5V	External voltage source	J42	Figure 13

SPI Configuration Interface

The iCEman65 board uses a 'V'-series part, meaning that the device does not physically have internal programmable Nonvolatile Configuration Memory (NVCM). The iCE65L04 device on the board optionally configures itself from an attached SPI Flash PROM or is downloaded like a processor peripheral using an SPI-like interface.

[Figure 14](#) shows the various options available on the SPI interface.

SPI Serial Flash

All iCEman65 boards have a 25-series SPI serial Flash PROM to hold one or more iCE65 configuration images. Revision A and B boards also include a 45-series SPI serial Flash PROM for additional compatibility testing. By default, however, all instructions use the 25-series SPI Flash PROM.

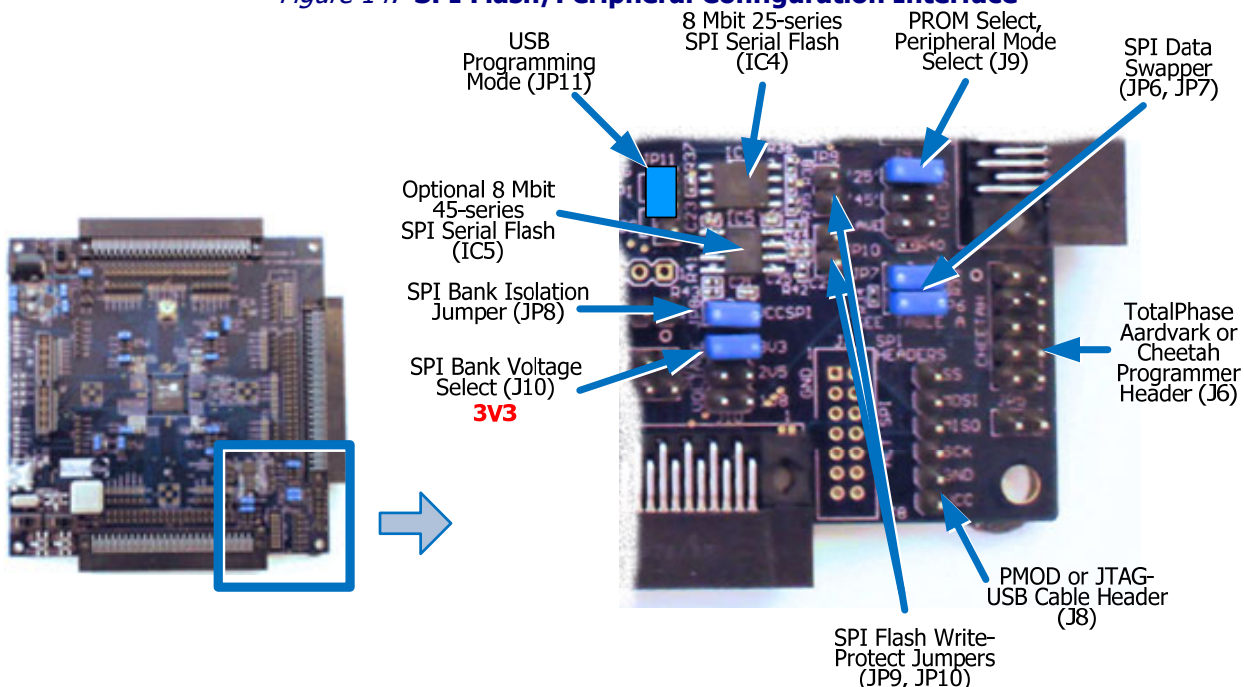
Default Options

As pictured in [Figure 14](#), the following are the default jumper settings required to program and configure from the 25-series SPI serial Flash PROM.

- The USB programmer must target the SPI serial Flash. Set jumper JP11 to the "SPI" setting.
- The 25-series SPI serial Flash PROM is the default memory. Set jumper J9 to the "25" setting.
- The 25-series SPI serial Flash PROM operates from a 3.3V supply. Install the SPI bank isolation jumper (JP8) and set the SPI bank voltage to 3.3V by setting jumper J10 to "3V3."
- To program the 25-serial PROM, ensure that the associated write-protect jumper, JP9, is removed.
- Set the SPI data swapper jumpers, JP6 and JP7, to the settings shown in [Figure 14](#).

Selecting a Configuration PROM

Figure 14: SPI Flash/Peripheral Configuration Interface



Supply Voltage

Although the SPI interface can operate at different voltages, set jumper J10 to 3.3V. The SPI serial PROM mounted on the board is a 3.3V device.

SPI Serial Flash

Each SPI serial PROM location has two associated jumpers, pictured in Figure 14.

Enable Jumpers

Header block J9 controls which SPI PROM, if any, is enabled, as described in Table 33. The selection controls the location of the iCE65 configuration image. Only one jumper is allowed.

Table 33: Jumper J9 Settings: Configuration Source Select

J9 Jumper Setting	Function
'25'	When inserted, the 8Mbit M25P80 25-series SPI serial PROM is the configuration source for the iCE65 component.
'45'	This setting is only useful if an AT45DB081D or similar PROM is mounted in location IC5. If inserted, the 45-series SPI serial PROM is the configuration source for the iCE65 component.
SLAVE	If inserted, then the iCE65 component is configured by an external processor or controller using an SPI-like serial interface.

Write-Protect Jumpers

Both SPI PROMs have an associated write-protect jumper, as described in [Table 34](#). Installing the associated jumper prevents the PROM from being erased, programmed, or overwritten. The jumper must be removed to program the associated PROM.

Table 34: SPI PROM Write-Protect Jumpers

Jumper	Function
JP9	Normally empty. When inserted, protects the 8Mbit M25P80 25-series SPI serial PROM against any erase, programming, or write operations. This jumper must be removed in order to program the PROM.
JP10	Normally inserted. When inserted, protects the 45-series SPI serial PROM, if mounted in location IC5, against any erase, programming, or write operations. This jumper must be removed in order to program the PROM.

SPI Flash Programming

The iCEman65 board supports three different programming options, as listed below. The most popular option is the on-board USB programmer.

- [On-Board USB Programmer](#)
- [TotalPhase Cheetah/Aardvark Programmer](#)
- [Digilent USB-JTAG Programmer](#)

On-Board USB Programmer

The iCEman65 board provides an on-board USB programmer, based on a USB-based microcontroller. The USB interface is powered by the attached computer's USB interface, independent from the board's power source.

Software Requirements

The on-board USB programmer requires the following Windows/DOS-based programming software. Refer to the [Adept Programming Software and ICEUTIL.EXE Installation Guide](#) for installation instructions.

- **Adept USB Programming Software**
www.siliconbluetech.com/iCEman65/downloads/Adept.msi
 This software installs the various device drivers required for the on-board USB programmer.
- **ICEUTIL.EXE Command-Line Utility**
www.siliconbluetech.com/iCEman65/downloads/iceutil.exe
 After installing the Adept USB software, use this command-line utility to program the SPI Flash PROM on the iCEman65 board.
- **Adept Programming Software and ICEUTIL.EXE Installation Guide**
www.siliconbluetech.com/iCEman65/AdeptICEUTILInstallation.pdf

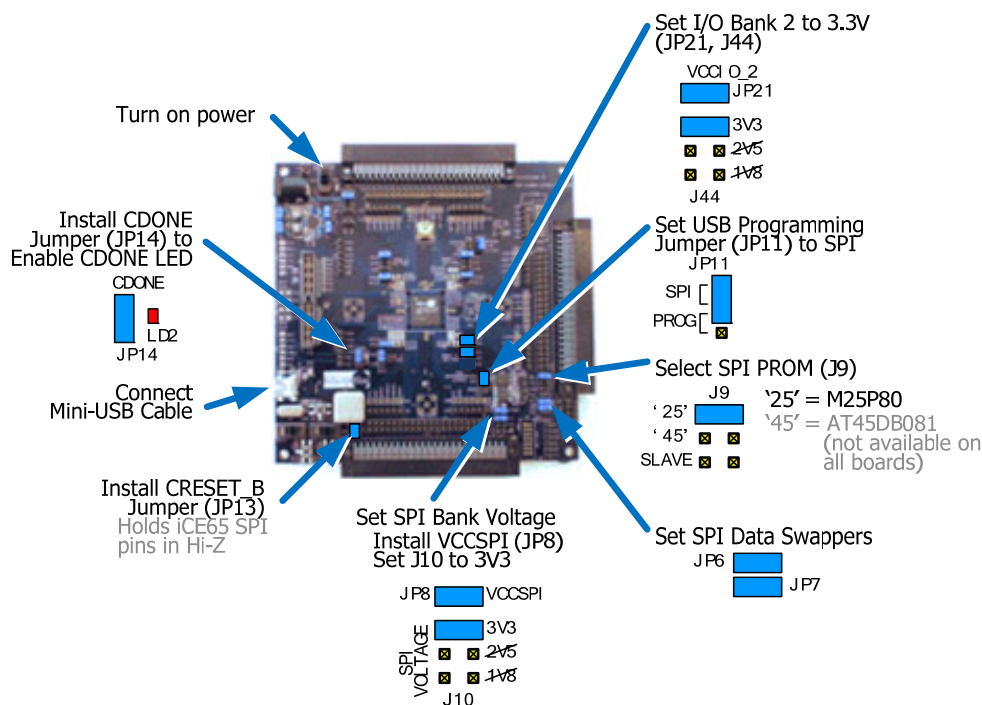
Board Setup/Jumper Settings

To use the on-board USB programmer, configure the iCEman65 board as shown in [Figure 15](#).

- Connect the included mini-USB cable to the min-USB connector on the iCEman65 board. Connect the opposite end of the cable to a computer or a powered USB hub.
- Insert a jumper on JP13 to force the iCE65 CRESET_B pin Low. This holds the iCE65 SPI interface in high-impedance (Hi-Z), allowing the USB controller or external programmer full access to the SPI Flash PROM.
- Ensure that the SPI bank is set for 3.3V operation. Install jumper JP8 and set jumper J10 to 3V3.
- Set the SPI data swapper, JP6 and JP7, as shown in [Figure 15](#) and also shown in Table A on the board. The jumpers must be in the horizontal setting.
- Ensure that the USB Programming Jumper, JP11, is set to SPI.
- Ensure that I/O Bank 2 is set to 3.3V. Install jumper JP21 and set jumper J44 to 3V3.

- Ensure that the CDONE LED is enabled. Install jumper JP14.
- Turn on the board power.

Figure 15: Onboard USB Programmer Jumper Settings



Example ICEUTIL.EXE Commands

The following examples demonstrate how to check the PROM ID code and to program the PROM using either the raw hexadecimal bitstream or the Intel-compatible hexadecimal bitstream generated by the SiliconBlue iCE-CUBE development system.

The development system writes the bitstream files to the `../<project_name>_Impl/sbt/outputs/bitmap` sub-directory, where `<project_name>` is the iCE-CUBE project name. The name of the hexadecimal file is described in Figure 16, based on the project name.

Figure 16: Bitstream File Name by Type

Hexadecimal Bitstream Type	File Name
Raw	<code><project_name>_bitmap.hex</code>
Intel-Compatible	<code><project_name>_bitmap_int.hex</code>

Display Available Options

```
iceutil -help
```

Check PROM ID Code

```
iceutil -d iCEman65 -m m25p80 -id
```

Program ST Micro/Numonyx M25P80 PROM Using Raw Hex Bitstream

```
iceutil -d iCEman65 -m m25p80 -fh -w <project_name>_bitmap.hex -v
```

Program ST Micro/Numonyx M25P80 PROM Using Intel Hex Bitstream

```
iceutil -d iCEman65 -m m25p80 -fi -w <project_name>_bitmap_int.hex -v
```

Post-Programming Operations

After successfully programming the SPI Flash PROM, simply remove the CRESET_B jumper (JP13). This releases the iCE65 device from reset. The iCE65 part will automatically load from the programmed SPI Flash PROM and the CDONE LED lights indicating successful configuration.

TotalPhase Cheetah/Aardvark Programmer

The iCEman65 board supports two different USB-based SPI memory programmers from TotalPhase, Inc (www.totalphase.com). Both programmers support a variety of industry-standard SPI serial PROMs. These programmers are NOT included with the iCEman65 evaluation kit. They are third-party products sold and supported by TotalPhase, Inc.

- **Cheetah SPI Host Adapter**
www.totalphase.com/products/cheetah_spi/
- **Aardvark I2C/SPI Host Adapter**
www.totalphase.com/products/aardvark_i2cspi/

Software Requirements

The TotalPhase SPI programmers come complete with an installation CD-ROM and provide drivers and software for both the Windows and Linux OS environments.

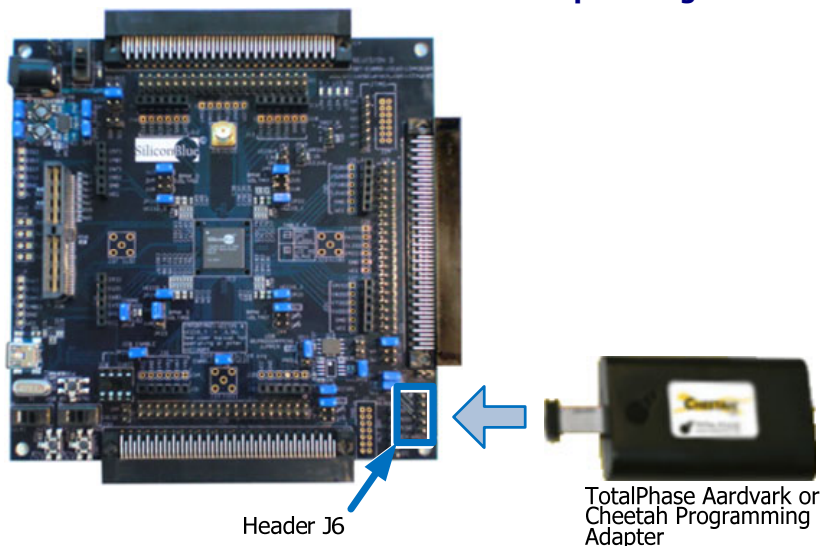
- **TotalPhase USB Drivers**
www.totalphase.com/download/zip/tp-usb-drivers.zip
- **TotalPhase Flash Center Software**
www.totalphase.com/products/flash_center/

Board Setup/Jumper Settings

In general, the board setup when using the TotalPhase programmers is similar to that for the Onboard USB programmer, shown in Figure 15. However, the iCEman65 board does not require a direct USB connection. The iCEman65 board can be powered by any of the possible sources.

Plug the Aardvark or Cheetah programmer header onto the J6 header, located in the lower right corner of the board, as shown in Figure 17. The header on the iCEman65 board is not keyed. The red-colored line on the adapter cable is pin 1, and should be at the top, as shown in the figure. Plug the Aardvark or Cheetah adapter into the USB port on your computer.

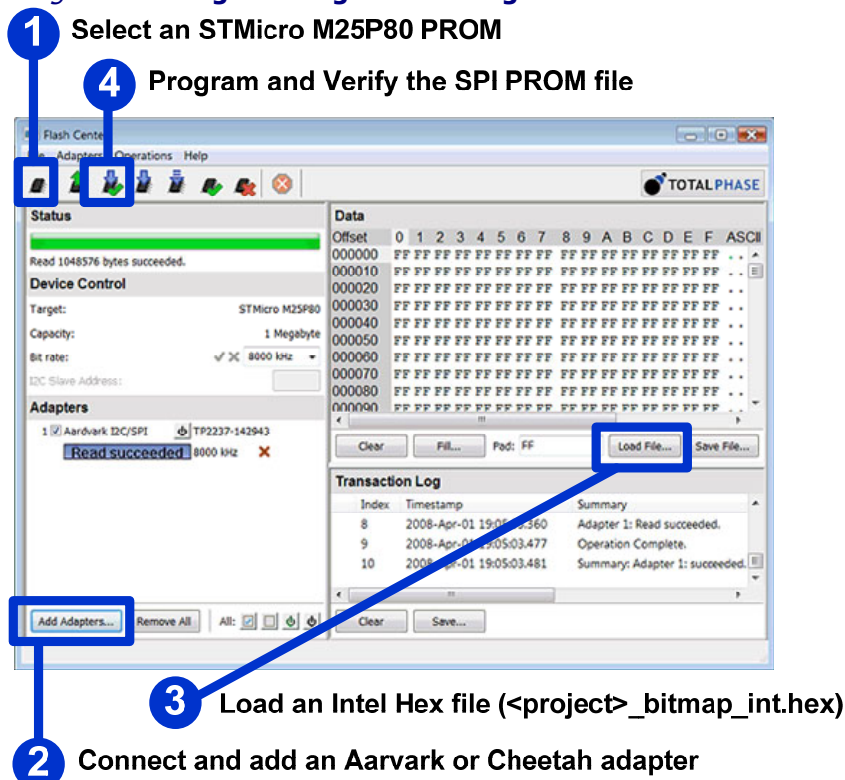
Figure 17: TotalPhase Aardvark or Cheetah Adapter Plugs into Header J6



Programming the PROM Using Flash Center

As shown in Figure 18, programming the STMicro SPI serial Flash PROM on the iCEman65 board is a relatively simple four-step process.

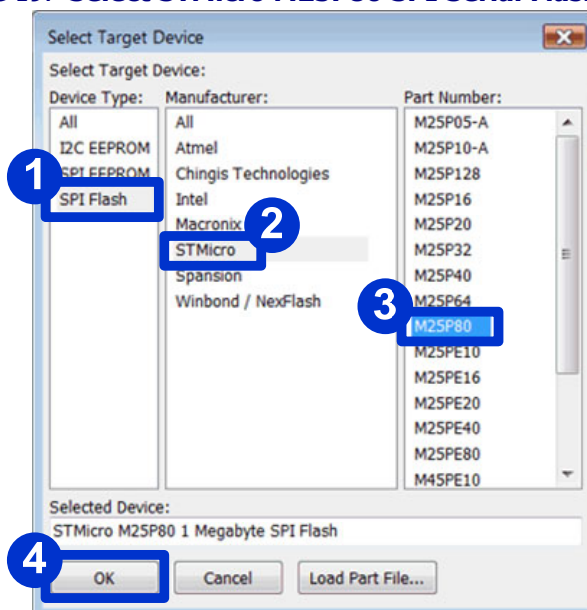
Figure 18: Programming PROM using TotalPhase Flash Center



After invoking the Flash Center software ...

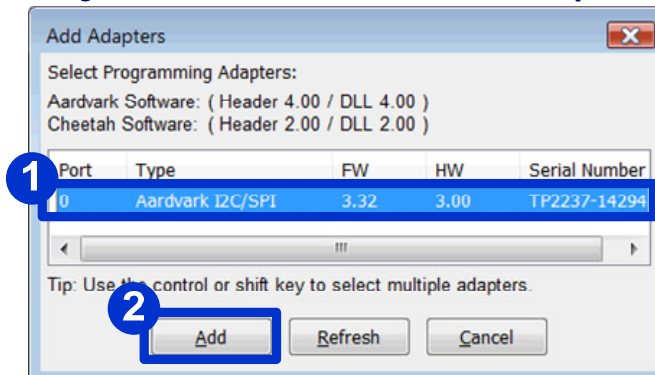
1. **Select the STMicro M25P80 SPI serial Flash PROM.** Click the Select Target icon in the toolbar. Then select the STMicro M25P80 SPI serial Flash PROM, as shown in Figure 19. Depending on your version of Flash Center, this device may be listed under the manufacturer name Numonyx, which is the joint venture between the Intel and STMicro Flash memory divisions.

Figure 19: Select STMicro M25P80 SPI Serial Flash PROM



2. **Add a TotalPhase Aardvark or Cheetah adapter.** Connect the USB-based TotalPhase Aardvark or Cheetah programmers to your computer. Click **Add Adapters**, as shown in Figure 18. Select and add the adapter, as shown in Figure 20.

Figure 20: Add Aardvark or Cheetah Adapter



3. **Load the Intel Hex version of the iCE65 configuration bitmap.** By default, the Intel Hex file will be named <project>_int_bitmap.hex. The SiliconBlue iCECUBE development system generates the bitmap files in the ../<project_name>_Impl/sbt/outputs/bitmap sub-directory, where <project_name> is the iCEcube project name.

Click **Load File** as shown in Figure 18. The contents of the selected file appear in the Data buffer display.

4. Program and Verify the SPI PROM file, as shown in Figure 18. The Flash Center software erases the PROM sectors as required, programs the contents loaded in the Data buffer, and then verifies the contents.

Remove CRESET_B Jumper (JP13)

After programming the SPI serial Flash PROM, remove jumper JP13 and store it on the board, typically on jumper JP10. Jumper JP10 is the write-project for the 45-series SPI PROM.

After jumper JP13 is removed, the iCE65 device loads the new configuration data from the SPI PROM. The CDONE LED, LD2 shown in Figure 3, dimly lights up indicating that the iCE65 device is configured correctly.

Digilent USB-JTAG Programmer

The iCEman65 board also supports the Digilent JTAG-USB cable using the ICEUTIL programming utility. The JTAG-USB cable potentially provides a possible low-cost programming solution for stand-alone iCE65 applications.

■ Digilent JTAG-USB Cable

www.digilentinc.com/Products/Detail.cfm?Prod=JTAG-USB&Nav1=Products&Nav2=Cables

Plug the cable directly into SPI header J8, located in the bottom-right corner of the board. Table 35 illustrates how the JTAG-USB cable connects to the J8 header.

Table 35: SPI Header J8 Supports Digilent JTAG-USB Cable

SPI Header J8	JTAG-USB Cable	Function
SS	TMS	SPI PROM slave select.
MOSI	TDI	SPI Master Output, Slave Input
MISO	TDO	SPI Master Input, Slave Output
SCK	TCK	SPI clock
GND	GND	Ground
VCC	VDD	Voltage controlled by jumpers JP8 and J10, shown in Figure 13.

The only difference when using the ICEUTIL programming utility is the target device name (-d <device_name>). The device name for the iCEman65 USB programmer is iCEman65. However, the JTAG-USB cable has a different device name. Use the Adept USB Administrator software to determine the name of the cable. For example, if USB Administrator reports the name as "DCabUSB", then use this value as the device name with the ICEUTIL utility as "-d DCabusb".

The board setup and programming is similar to using the iCEman65 On-Board USB Programmer.

Measuring Power

The iCEman65 board is specifically designed to easily measure power on the iCE65 device.

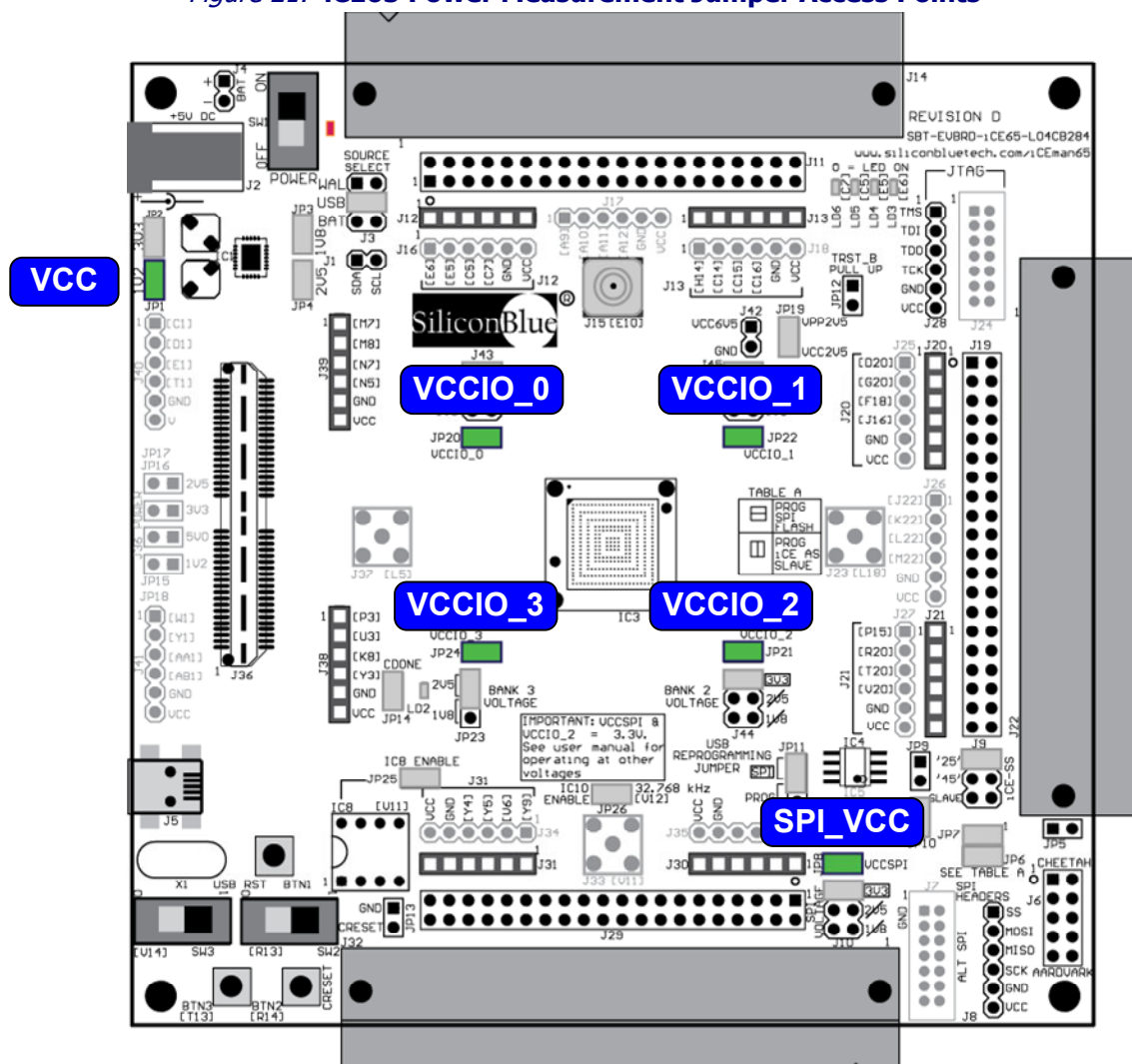
Test Access Points

Each iCE65 voltage rail has a two-pin header access point, as listed in Table 36 and indicated in Figure 21.

Table 36: iCE65 Power Measurement Test Points

Voltage Input	iCE65 Power Rail	Jumper Test Point
VCC	iCE65 Core Logic	JP1
VCCIO_0	I/O Bank 0 (Top)	JP20
VCCIO_1	I/O Bank 1 (Top)	JP22
VCCIO_2	I/O Bank 2 (Bottom)	JP21
VCCIO_3	I/O Bank 3 (Left)	JP24
SPI_VCC	SPI Bank	JP8

Figure 21: iCE65 Power Measurement Jumper Access Points



Power Testing Methods

There are a variety of methods to measure power on the iCEman65 board as described below.

Easy Method using a Multimeter

The iCEman65 evaluation kit includes a small, red and black, two-pin MTE connector, shown in [Figure 22](#). The cable provides an easy connection between the iCEman65 board and your high-accuracy multimeter. Use a meter with a minimum of 10,000 counts; 50,000 counts or more is recommended for better accuracy.

Figure 22: Included Power Test Cable



To take a quick measurement, follow these steps.

1. Turn off power to the iCEman65 board.
2. Remove the jumper associated with the voltage rail to be measured. Refer to [Table 36](#) and [Figure 21](#) to locate the correct jumper.
3. Insert the power test cable shown in [Figure 22](#) over the empty jumper location.
4. Connect the available power cable leads to your multimeter using the multimeter's alligator or test clips.
5. Configure the multimeter to measure current using its highest mA or Amp range. This setting typically has the lowest voltage drop internally within the meter.
6. Reapply power to the iCEman65 board and configure the iCE65 device if necessary.
7. Observe the power reading on the multimeter. At low clock rates, which result in lower iCE65 power, switch the meter to a lower amperage setting for better accuracy reading the low current levels. However, this also may increase the resistance across the meter leads. Using too low of a meter setting causes a large voltage drop within the meter, violating the minimum input voltage specification to the iCE65 device.
8. The value measured by the multimeter is a current. Convert the measurement to power using [Equation 1](#). The voltage is the operating voltage, the voltage across the jumper. This value can be accurately measured with a second multimeter to show the voltage drop across the first. However, just measuring the initial voltage, before taking any current readings, usually provides acceptable accuracy and the voltage drop across the meter is generally small.

Equation 1

$$\text{Power} = \text{Current} \times \text{Voltage}$$

Although this method is easy, here are a few caveats and pointers.

- **Always start at the highest current setting for your meter. Using too small a setting may damage your meter!** After determining the maximum current range for your measurement, then you can safely use the appropriate lower current setting.
- The voltage drop across the meter leads may violate the minimum supply voltage specification for the iCE65 device. To determine the voltage drop, use a second multimeter to measure either the voltage across the first meter's leads during a test or the resistance between the first meter's leads.
- Using the highest current measurement setting typically results in the lowest voltage drop.

Using High-Precision, Small-Value Resistors

For more-accurate, time-sensitive measurements, place a low-value resistor across the jumper test point. According to Ohm's Law, the current passing through the resistor produces a voltage drop. Measure the voltage differential across the resistor during expected operation. Convert the measurement to power using [Equation 2](#). The voltage is the measured voltage across the resistor; the resistance is the value of the resistor.

Equation 2

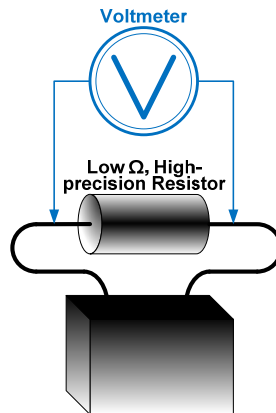
$$\text{Power} = \frac{(\text{Voltage})^2}{\text{Resistance}}$$

The following are a few guidelines on selecting a resistor.

- Use a high-precision resistor.
- The resistor must handle the power dissipated under the anticipated test conditions.
- Too small a resistor value may result in too small a voltage difference across the resistor to measure with your test equipment.
- Too large a resistor value may result in too large of a voltage difference across the resistor. Too large a voltage drop might violate the minimum voltage specifications for the iCE65 device.

Figure 23 shows an example header block designed to fit over one of the jump locations. Measure the voltage drop across the low-value resistor, either with a voltmeter or with data acquisition equipment.

Figure 23: Resistor Header Block



This method is recommended for taking power measurements over time.

Board Revision and Serial Number

Identifying the Board Revision

The board revision appears on the top-side of the board, in the upper right corner. To date, three different versions have been produced.

Revision D

This is the current production version of the board.

Revision B

This version was a small-volume engineering run. It did not include the four user LEDs. This version added USB programming options, and a socketing option for the iCE65 device. Only 15 units were assembled.

Revision A

This version was a small-volume pilot production. It did not include the four user LEDs and the USB programming option was not yet available. Only three units were assembled.

Serial Number

Each iCEman board has a unique serial number affixed to the bottom side of the board.

Quick Board Test

The following procedure provides a quick and simple board test. This is the same design that is pre-programmed on the board when it is shipped from the factory and described in the [Getting Started](#) booklet included with the board.

Set Jumpers

Start by setting the jumpers to their default locations shown in [Figure 25](#).

Install Oscillator

Install the 32.0 MHz oscillator in location IC8, as described in “[Installing an Oscillator](#)” on page 6. The precise oscillator frequency does not matter, although the oscillator should be in the 5 to 40 MHz range for this simple test.

Insert PMOD-LED Module

The board ships with a small, 6-pin LED peripheral module. Connect this module to the top-edge, left-most PMOD socket, J12 (see [Figure 10](#) on page 17). Note the location of the power and ground connections. The LEDs on the module face toward the SiliconBlue logo. Even if the module is installed backwards, no damage occurs.

Program SPI Flash

Using the USB cable, program the SPI serial PROM with the following configuration image. See “On-Board USB Programmer” on page 31 for more information on setting up the programming interface.

■ Test Configuration Image File

www.siliconbluetech.com/iCEman65/downloads/icetest_bitmap.hex

Use the ICEUTIL software to program the SPI serial PROM.

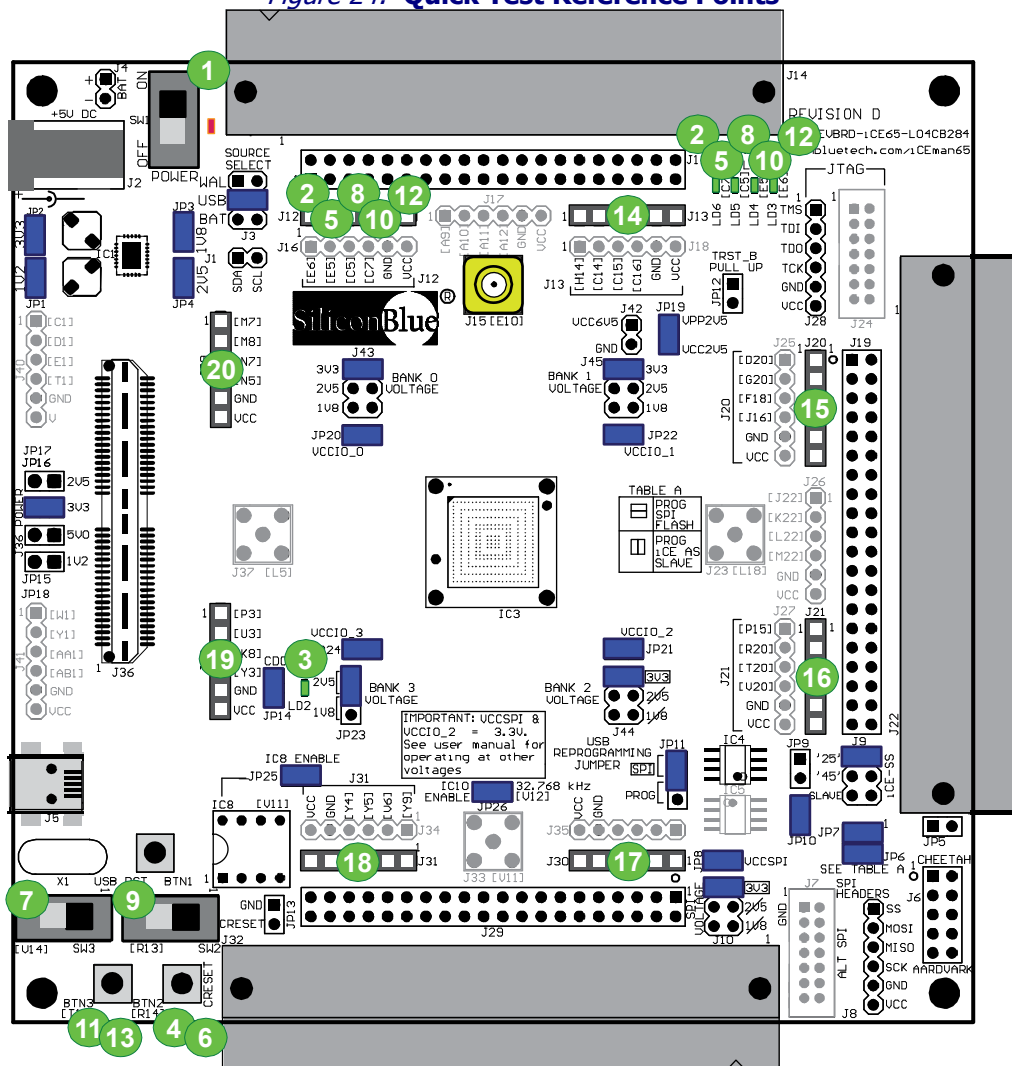
```
iceutil -d iCEman65 -m m25p80 -fh -w icetest_bitmap.hex -v
```

When programming is complete, remove the jumper on JP13, which holds the iCE65 CRESET_B pin Low during programming.

Test Procedure and Observations

To test the board, perform the following steps and observations. See [Figure 24](#) for the associated test reference points.

Figure 24: Quick Test Reference Points



0. Start the test with no power applied to the board; power switch SW1 is turned off.
1. Apply power to the board by switching SW1 to the ON position. The adjacent LED, LD1, should light.
2. Observe that the LEDs on the board and on the LED peripheral module blink in a directional pattern.
3. Check that the CDONE LED, LD2, is lit although it may dim.
4. Press and hold pushbutton BTN2, which asserts the iCE65's CRESET_B signal.
5. Observe that the LEDs are static because the iCE65 is held in the reset state. The LEDs on the peripheral module are lit, pulled High by the iCE65's internal pull-up resistors. The green LEDs on the board may be off or dimly lit.
6. Release BTN2. The LEDs again blink.
7. Change slide switch SW3. Left or right does not matter.
8. Observe that the LEDs change direction.
9. Change slide switch SW2. Left or right does not matter.
10. Observe that the LEDs change direction.
11. Press and hold BTN3.
12. Observe that the green LEDs are static and fully lit. The peripheral module LEDs are static and not lit.
13. Release BT3 and the LEDs again blink.
14. Remove the LED peripheral module and connect it to the top-edge, right-most header, J13. The LEDs face toward the iCE65 component. The LEDs toggle as before. The top-edge and right-edge PMOD connectors in this test design are controlled by the 32.768 kHz oscillator on the back of the board.
15. Remove the LED peripheral module and connect it to the right-edge, top-most header, J20. The LEDs face toward the iCE65 component. The LEDs toggle as before.
16. Remove the LED peripheral module and connect it to the right-edge, bottom-most header, J21. The LEDs face toward the iCE65 component. The LEDs toggle as before.
17. Remove the LED peripheral module and connect it to the bottom-edge, right-most header, J30. The LEDs face toward the iCE65 component. The LEDs toggle as before. The bottom-edge and left-edge PMOD connectors in this test design are controlled by the 32.0 MHz oscillator mounted in socket IC8.
18. Remove the LED peripheral module and connect it to the bottom-edge, left-most header, J31. The LEDs face toward the iCE65 component. The LEDs toggle as before.
19. Remove the LED peripheral module and connect it to the left-edge, bottom-most header, J38. The LEDs face **away** the iCE65 component, toward the Samtec connector. The LEDs toggle as before.
20. Remove the LED peripheral module and connect it to the left-edge, top-most header, J39. The LEDs face **away** the iCE65 component, toward the Samtec connector. The LEDs toggle as before.

Functions Tested

While this test does not comprehensively test the board, here is a list of items and functions exercised by this simple application.

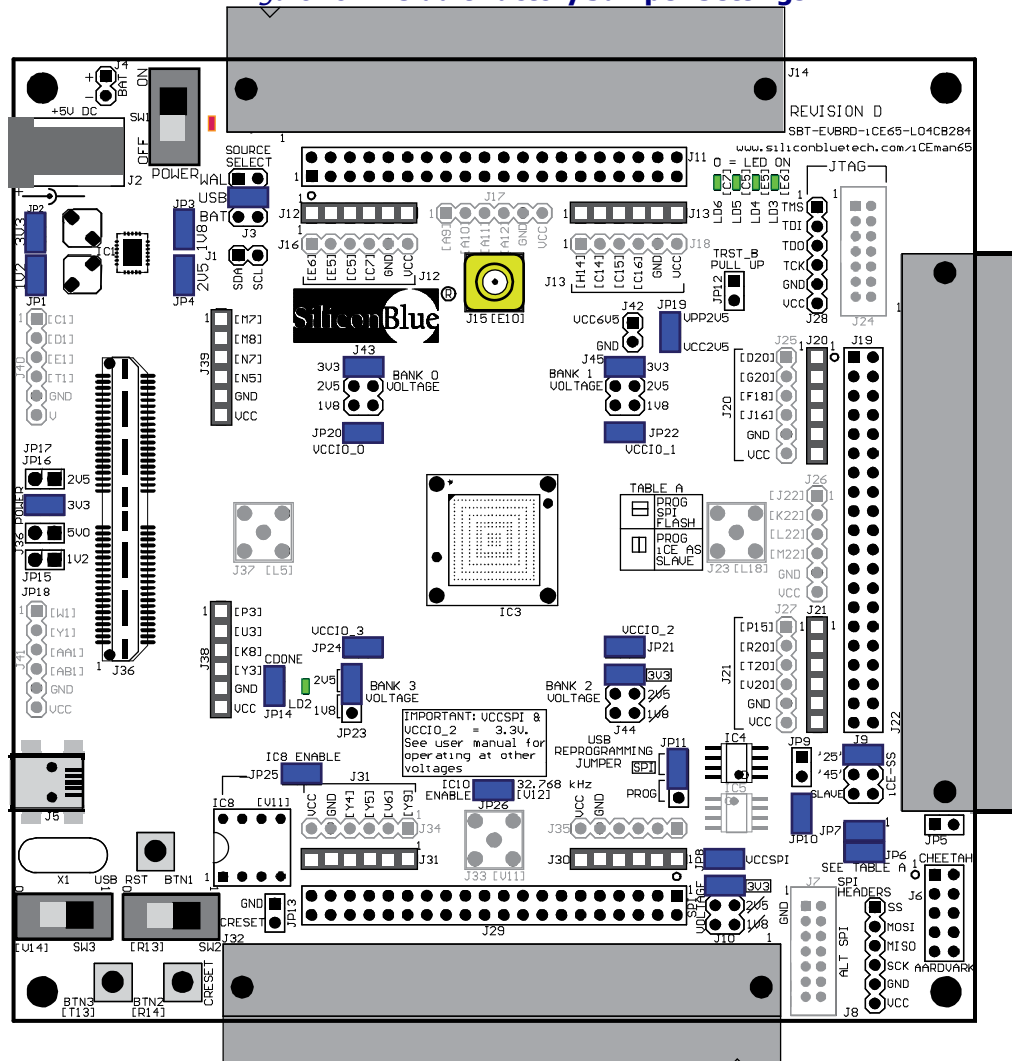
- iCE65L04 device for basic functionality
- M25P80 SPI configuration memory
- USB interface and programming interface
- Power switch SW1 and LED, LD1
- LP3906 regulator
- The CDONE LED, LD2
- Four discrete LEDs (Rev. D boards and later), LD3 through LD6
- Slide switches SW2 and SW3
- Pushbutton switches BTN2 (CRESET_B) and BTN3

- 32.768 kHz oscillator
- IC8 oscillator socket and installed oscillator
- PMOD-LED module
- All eight PMOD sockets and connections

Factory Jumper Settings/Component Location, Top-Side

Figure 25 shows the default factory jumper settings and the location of major components on the board. All resistor and capacitor locations are removed for clarity. See Figure 26 for complete top-side silkscreen markings.

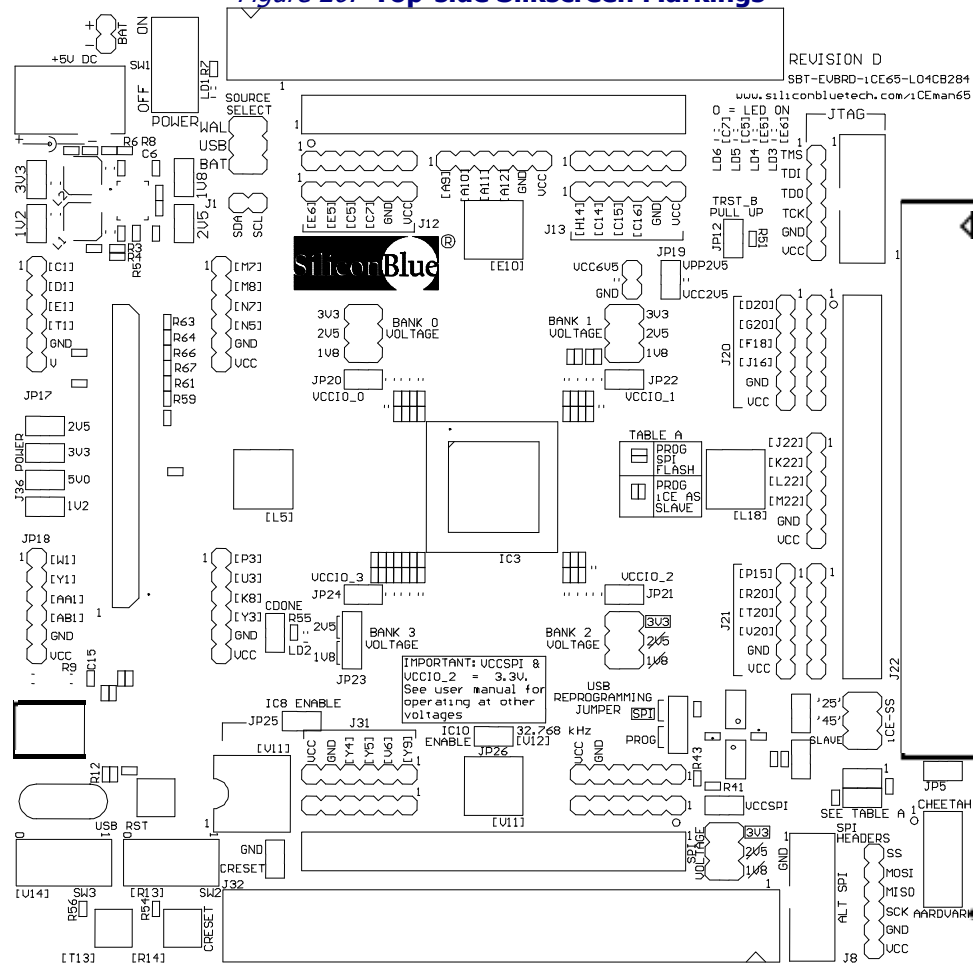
Figure 25: Default Factory Jumper Settings



Top-side Silkscreen Markings

Figure 26 shows the top-side silkscreen markings, including reference designators for all components mounted on the top side of the board.

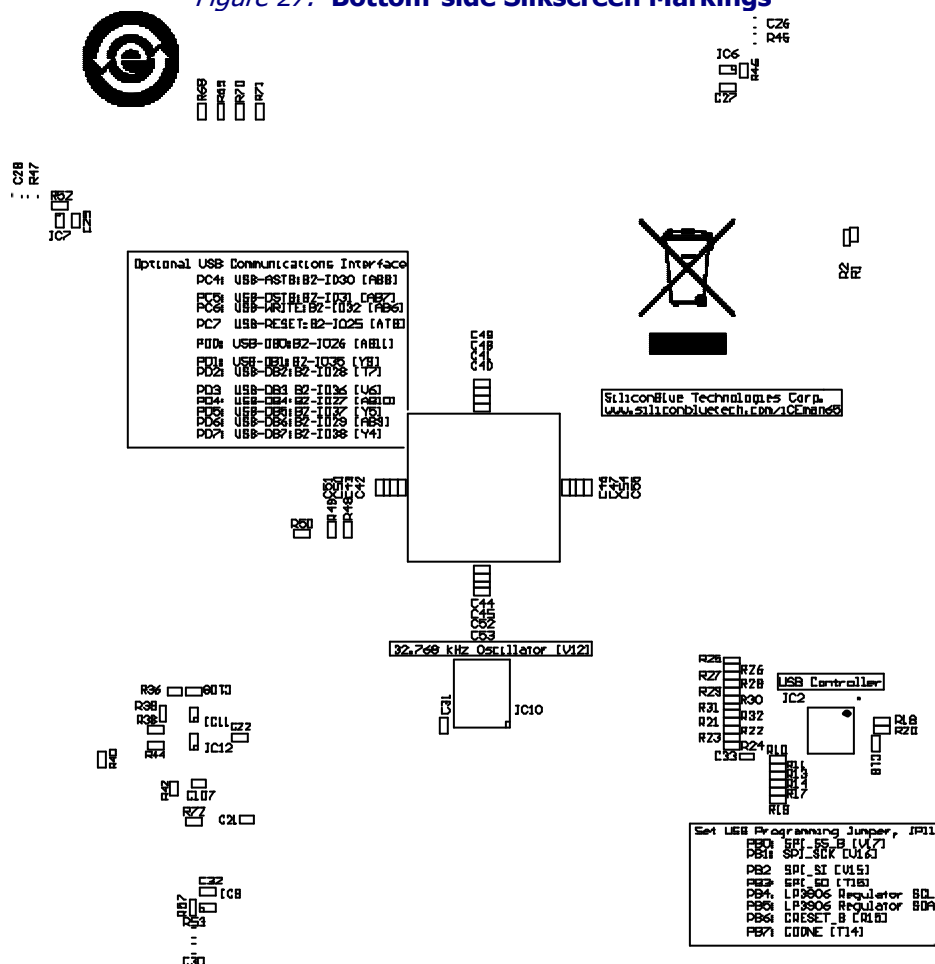
Figure 26: Top-side Silkscreen Markings



Bottom-side Silkscreen Markings

Figure 27 shows the top-side silkscreen markings, including reference designators for all components mounted on the bottom side of the board.

Figure 27: Bottom-side Silkscreen Markings



PCB Layout

The printed circuit board (PCB) layout files (Gerber files) are available for download from the SiliconBlue iCEman65 web page. The following diagrams provide some general guidelines on component placement and routing.

Caveats

The iCEman65 board is significantly more complex than a typical real-world iCE65 application. The iCE65 board provides for flexible voltage assignment, multiple configuration programming interfaces, and separate power islands for simpler power testing. Typically, none of these constraints exist in a typical, real-world, single-purpose application.

Although the iCEman65 board uses eight PCB layers, again primarily due to additional flexibility, a typical application requires just 4 to 6 PCB layers, depending on the package used and the general complexity of the application.

Gerber Files

A complete set of Gerber files are available for download from the SiliconBlue iCEman65 web page. [Table 37](#) describes the various PCB layout layers, including links to a reference figures within this document.

■ iCEman65 Gerber Files Download

www.siliconbluetech.com/iCEman65/index.html#Gerber

Table 37: Printed Circuit Board (PCB) Layer Stack Up

Layer	Layer Name	Reference Figure	Gerber File Extension	Copper Thickness	Dielectric Height to Next Layer
1	Top Signal Layer	Figure 28	(.GTL)	0.7 mil	3 mil
2	Top Signal Layer	Figure 29	(.GP1)	1.417 mil	6 mil
3	Top Inner Signal Layer	Figure 30	(.G1)	1.417 mil	7 mil
4	Top Power Plane	Figure 31	(.G2)	1.417 mil	20 mil
5	Bottom Power Plane	Figure 32	(.G3)	1.417 mil	7 mil
6	Bottom Inner Signal Layer	Figure 33	(.G4)	1.417 mil	6 mil
7	Bottom Ground Plane	Figure 34	(.GP2)	1.417 mil	3 mil
8	Bottom Signal Layer	Figure 35	(.GBL)	0.7 mil	N/A

The Gerber files should be compatible with most PCB layout packages. If you do not already have a PCB package, you can view the electronic files directly using the free **PentaLogix ViewMate Gerber Viewer** for Windows, available for download from the following link. Register to download the free software.

■ Free PentaLogix ViewMate Gerber Viewer

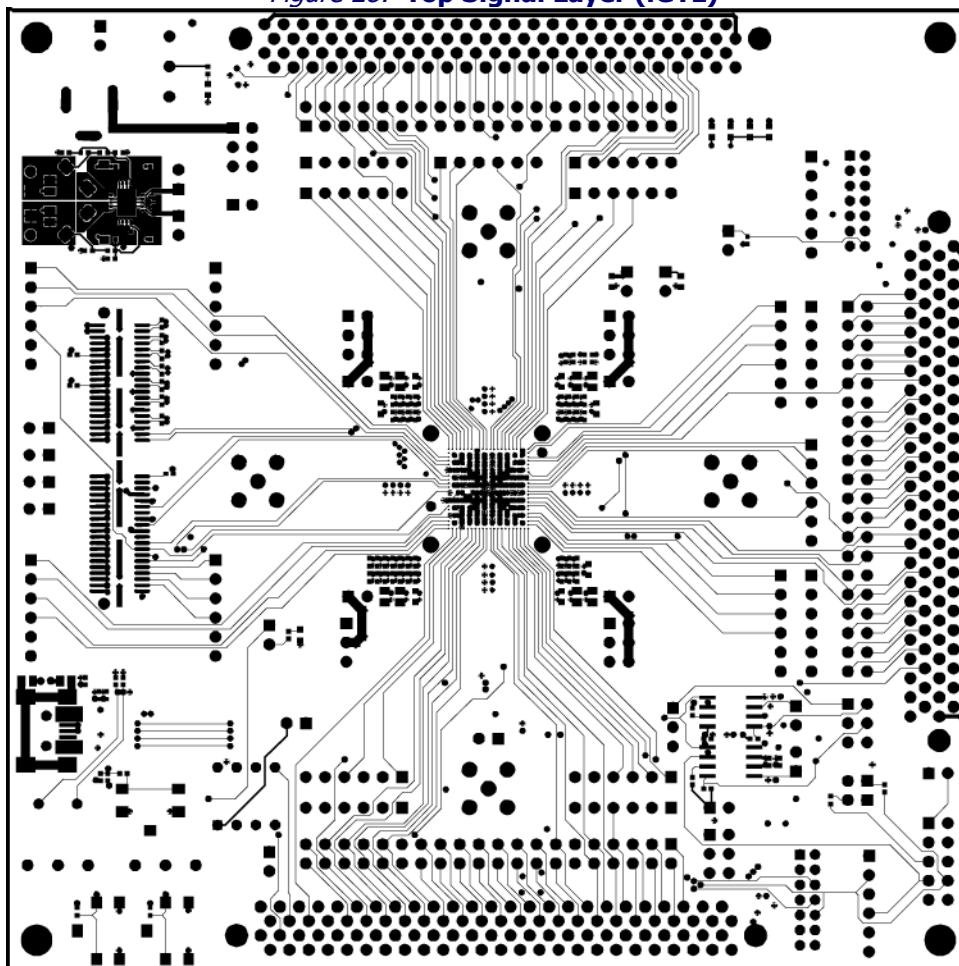
www.pentalogix.com/Products/ViewMate/register.cfm

After downloading the Gerber files and downloading and installing the ViewMate software, follow these steps to view the files.

1. Invoke the ViewMate software.
 - Click the Windows **Start** button
 - Locate and click **ViewMate**
2. Import the Gerber files
 - Click **File → Import → Gerber**
 - Browse to the directory where the Gerber files were extracted from the download archive
 - Select all the Gerber files in the directory
 - Click **Import**

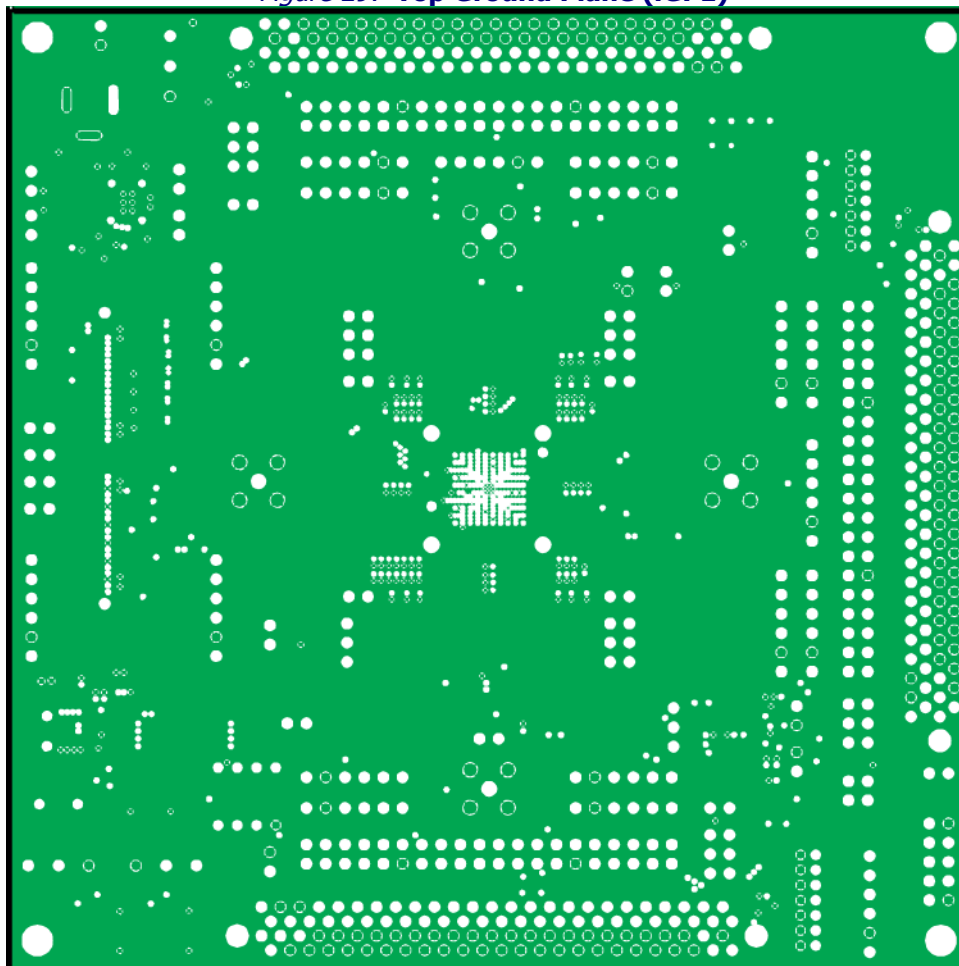
Top Signal Layer

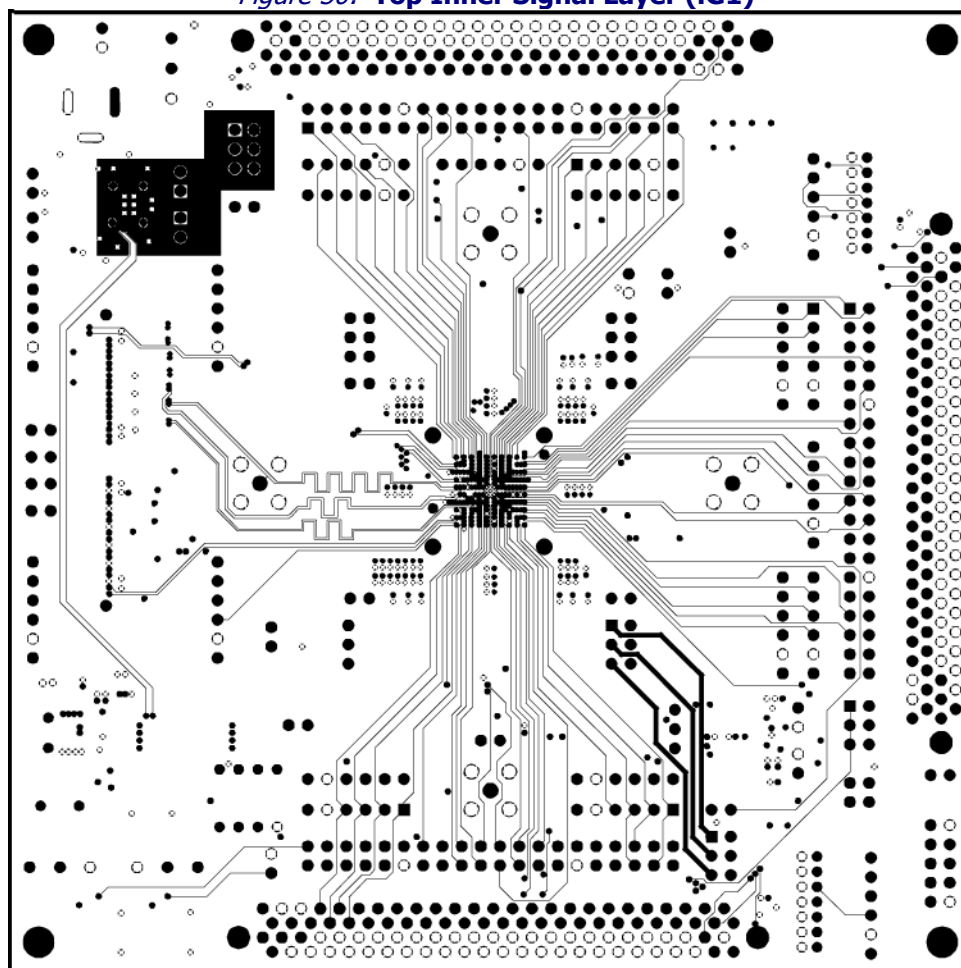
Figure 28: Top Signal Layer (.GTL)



Top Ground Plane

Figure 29: Top Ground Plane (.GP1)

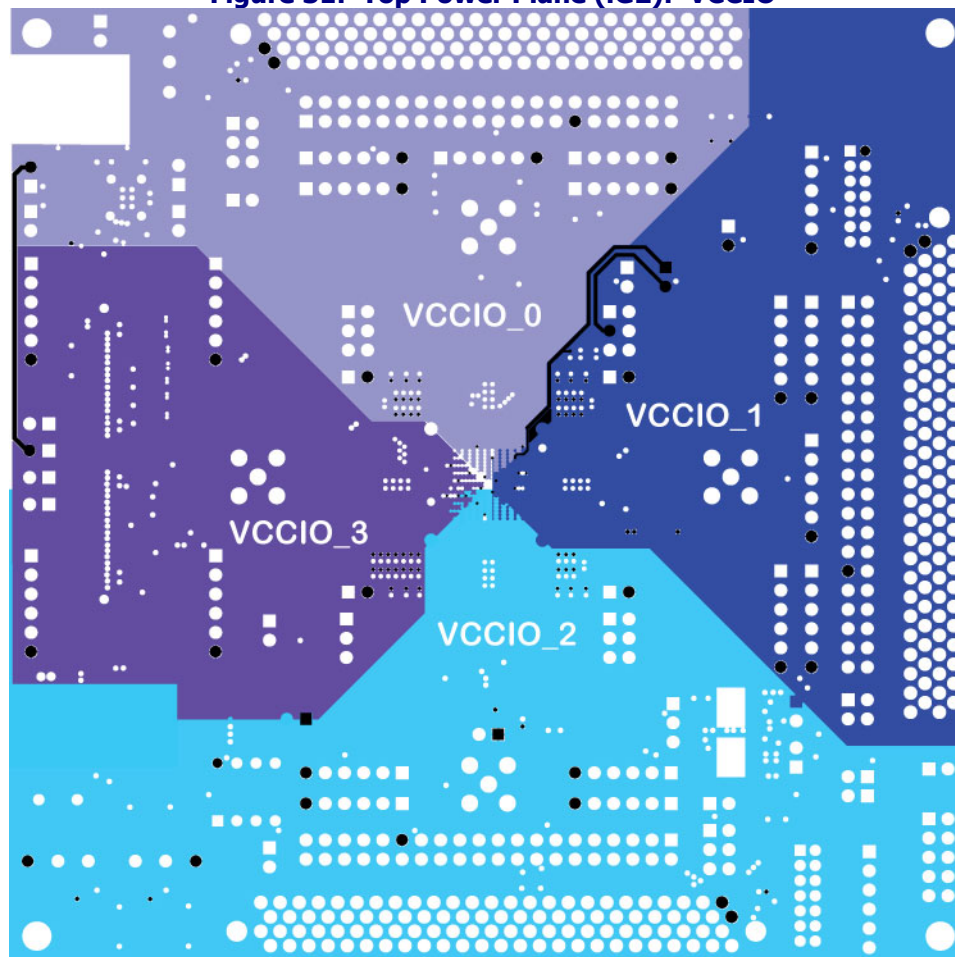


Top Inner Signal Layer*Figure 30: Top Inner Signal Layer (.G1)*

Top Power Plane

As shown in Figure 31, the top power plane is split into four primary voltage islands, one for each of the four iCE65 I/O banks.

Figure 31: Top Power Plane (.G2): VCCIO

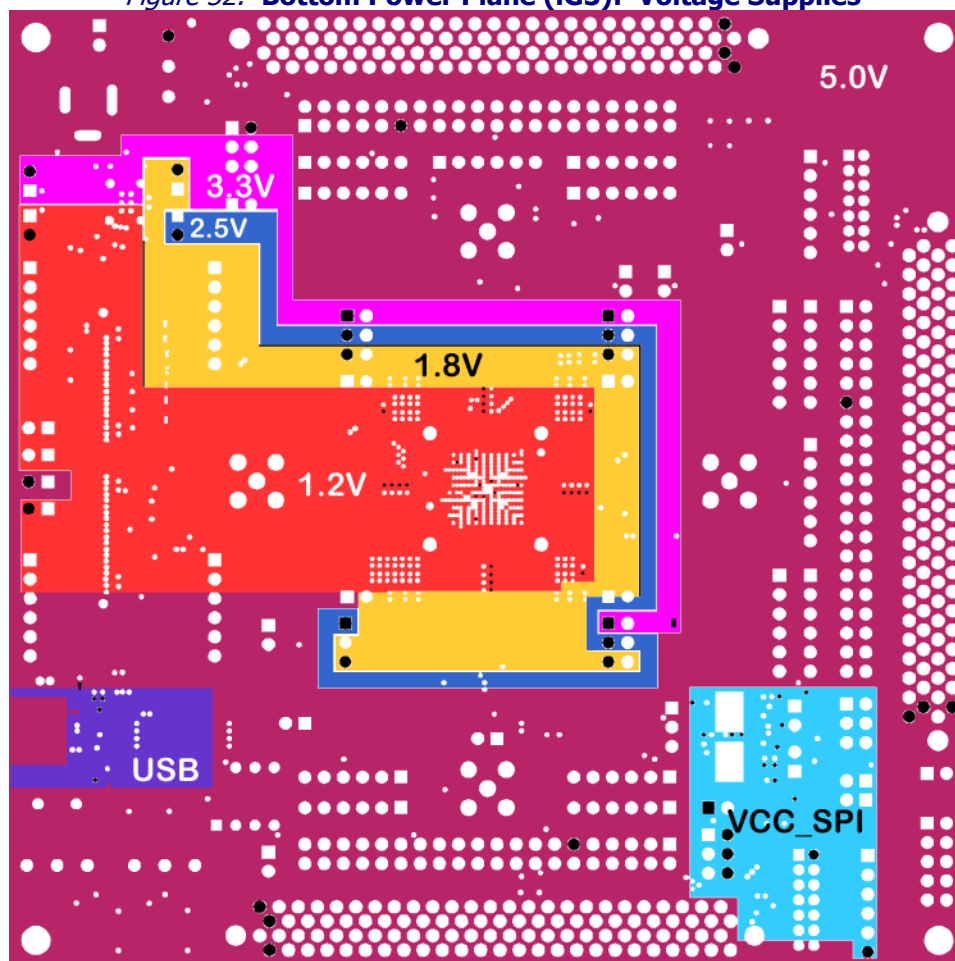


Bottom Power Plane

As shown in Figure 32, the bottom power plane is split into multiple power islands.

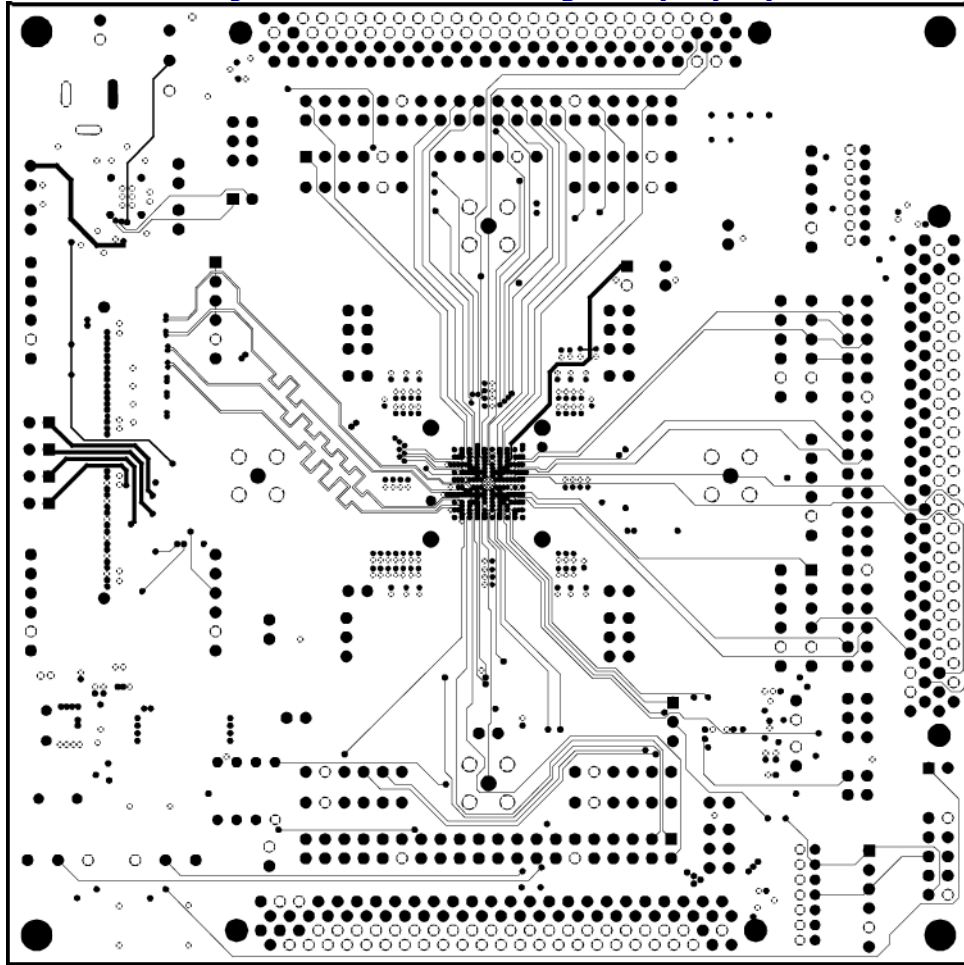
- A 5.0V island feeds the regulator and the some of the I/O expansion connectors.
- A USB island that powers the Atmel USB controller and optionally supplies power to the board.
- A 1.2V island that supplies power to the iCE65 core logic.
- The iCE65 SPI configuration interface and SPI serial PROM(s) have their own power island.
- Separate islands for each of the three primary I/O supply voltage options.
 - ◆ 3.3V
 - ◆ 2.5V
 - ◆ 1.8V

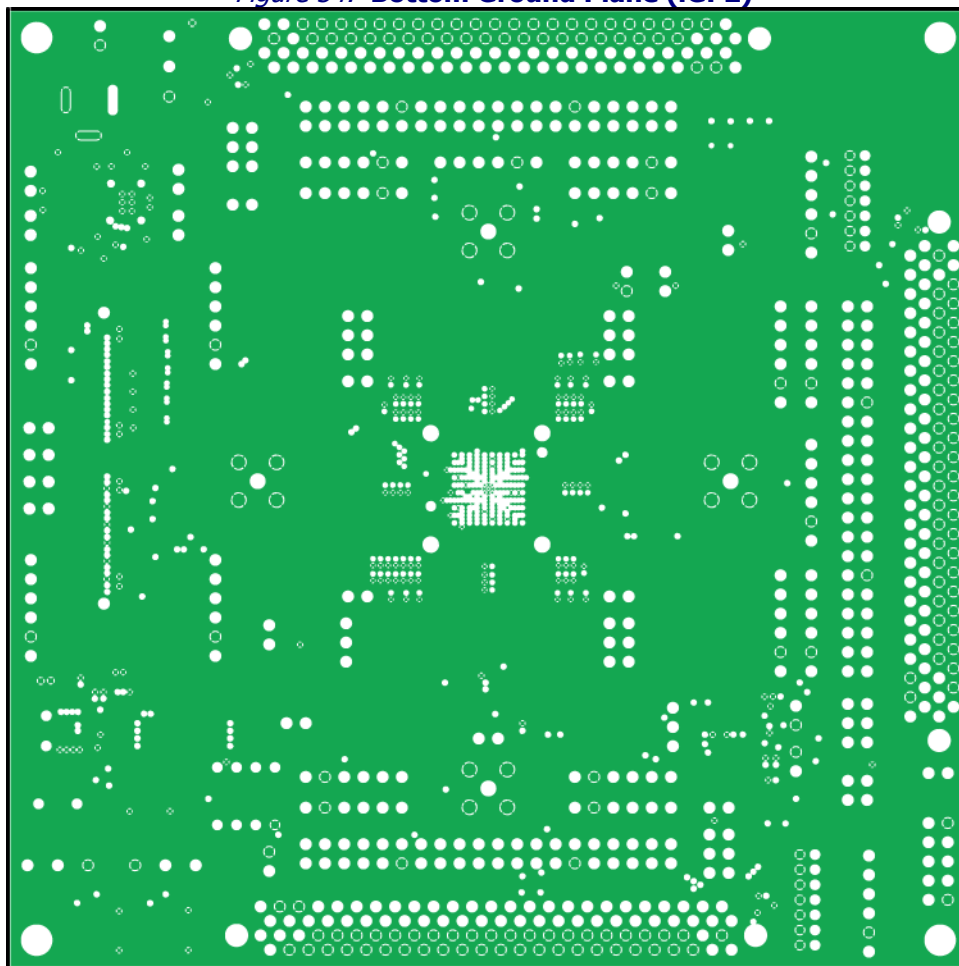
Figure 32: Bottom Power Plane (.G3): Voltage Supplies



Bottom Inner Signal Layer

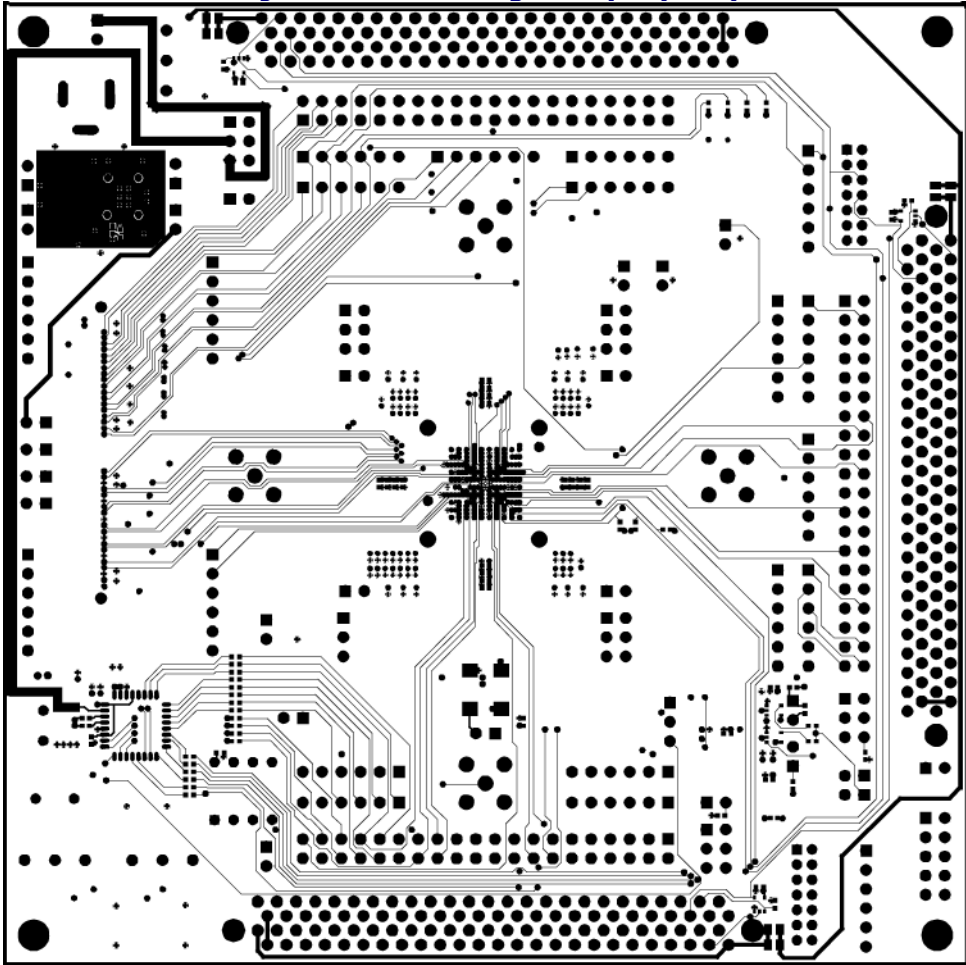
Figure 33: Bottom Inner Signal Layer (.G4)



Bottom Ground Plane*Figure 34: Bottom Ground Plane (.GP2)*

Bottom Signal Layer

Figure 35: Bottom Signal Layer (.GBL)



Reduction of Hazardous Substances (RoHS)

The iCEman65 board is designed for RoHS compliance.

More Information

For more information, visit the SiliconBlue iCEman65 web page at the following location.

- iCEman65 Web Page
www.siliconbluetech.com/iCEman65

Revision History

Version	Date	Description
1.0	31-MAY-2008	Initial release.