



**THE DATASHEET OF
SI2404FS08-EVB**

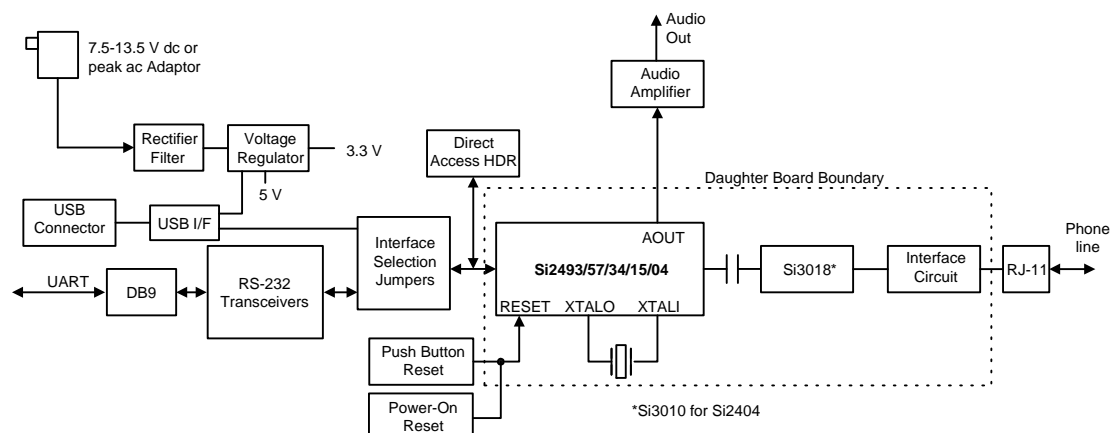


Evaluation Board Rev 5.0 for the Si2493/57/34/15/04 ISModem with UART and SPI Interfaces

Description

The global Si2493/57/34/15/04-EVB evaluation board Rev 5.0 provides the system designer an easy way of evaluating the Si2493/57/34/15/04 ISModem[®]. The Si2493/57/34/15/04-EVB consists of a motherboard with a power supply, an RS-232 and USB interface, other ease-of-use features, and a complete removable modem module on a daughter card. (A functional block diagram of the Si2493/57/34/15/04-EVB is shown below.) The Si2493/57/34/15/04 ISModem is a complete controller-based modem chipset with an integrated and programmable direct access arrangement (DAA) that meets global telephone line requirements. Available as a combination of one 16-pin small line-side device and one 24-pin or 16-pin system-side device, the Si2493/57/34/15/04 ISModem eliminates the need for a separate DSP data pump, modem controller, memories, codec, isolation transformer, relays, opto-isolators, and a 2- to 4-wire hybrid. The Si2493/57/34/15/04 is ideal for embedded modem applications due to its small board area, controller-based architecture, low power consumption, and global compliance. The Si2493/57/34/15/04-EVB provides an RJ-11 jack (for interfacing the Si2493/57/34/15/04-EVB to the phone line), and USB and RS232 serial ports for interfacing to a PC or data terminal. This allows the ISModem to operate as a serial modem for straightforward evaluation of the Si2493/57/34/15/04. To evaluate the Si2493/57/34/15/04 ISModem in an embedded system, the daughter card can be used independently of or with the motherboard.

Functional Block Diagram



A direct access header (J103) is available on the motherboard to bypass the RS-232 transceivers and connect the Si2493/57/34/15/04 ISModem directly to a target system.

An on-board rectifier, filter, and voltage regulator allow the power input to be 7.5–13 V ac or dc (either polarity) supplied through a screw terminal (J8) or a standard 2 mm power jack (J9). Alternatively, power can be supplied through the USB interface (whether the USB or RS232 interface is used). The evaluation board can drive an external speaker for call monitoring or the speaker mounted directly on the board. Please note that the PCM interface, parallel interface, and EEPROM are available on the 24-pin FT only. See "1.7.EVB Part Numbers" on page 8 for ISModem EVB options.

Features

The Si2493/57/34/15/04-EVB includes the following:

- Dual RJ-11 connection to phone line
- RS-232 and USB interface to PC
- Speaker for call monitoring
- Direct access to Si2493/57/34/15/04 for embedded application evaluation
- Easy power connection to common 7.5 V–13.5 V power supplies or USB port.
- 9 V ac adaptor
- Simple installation and operation
- EEPROM (24-pin FT only)
- RS232 lines status display on LEDs.

1. Si2493/57/34/15/04-EVB Setup and Evaluation

This section explains how to set up the Si2493/57/34/15/04-EVB for evaluation as an RS-232 or USB interface modem. Jumper settings, power connection, PC/terminal connections, and terminal program configuration settings are given. The initial modem setup after power is applied as well as a basic tutorial on modem operation are provided. Si2493/57/34/15/04-EVB configurations for evaluating additional features are discussed separately. See the Si2493/57/34/15 or Si2404 data sheets and “AN93: Si2493/57/34/15/04/04 Modem Designer’s Guide” for complete details.

1.1. Si2493/57/34/15/04-EVB Quick Start—RS-232 Interface

1. Set jumpers according to Figure 1, but change J6 to the arrangement shown in Figure 3 if an FS ISOModem package is used.
2. Connect:
 - DB-9 to PC COM 1 (with a pass-through cable).
 - RJ-11 to phone line or CO simulator.
 - 9 V ac adaptor (or USB cable).
3. Bring up:
 - Turn on power to modem.
 - Autobaud automatically adjusts modem DTE speed and protocol.
4. Type “AT” followed by a carriage return.
 - Should echo “AT” and then an “OK”.

1.2. Si2493/57/34/15/04-EVB Quick Start—USB Interface

1. Set jumpers according to Figure 3, but change J6 to the arrangement shown in Figure 3 if an FS ISOModem package is used.
2. Connect:
 - USB cable to PC
 - RJ-11 to phone line or CO simulator
3. Download USB driver for your operating system from the CD supplied with the evaluation board.
4. Install driver.
5. Bring up.
 - Reset the modem.
 - Autobaud automatically adjusts modem DTE speed and protocol.
6. Type “AT” followed by a carriage return.
 - Should echo “AT” and then an “OK”.

1.3. Motherboard and Daughter Card Configuration

The EVB consist of a motherboard that takes a plug in daughter card. The motherboard can be configured in a variety of ways that are explained below and are managed via jumpers. The daughter card contains both the modem system side and the isolated line interface (DAA).

The daughter card comes preconfigured and functional although the user may decide to change some operating options such as the type of crystal used with the modem chip or the type of control signals used, i.e. UART vs parallel. These features must be managed by changing strapping resistors soldered down to the daughter card and by changing parts associated with the crystal. These possible changes are explained below.

1.3.1. Motherboard Configuration

Check all the jumper setting on the S2493/57/34/15/04-EVB before applying power. The standard factory setting for the modem in a 24-pin FT package are shown in the figure below. This setup configures the modem for RS232 serial operation with autobaud enabled. Any standard terminal program configured to communicate through a PC com port can be used to communicate with the EVB.

Figure 1 shows the default motherboard setup for the FT package daughter card as well as the functions of connectors and jumpers.

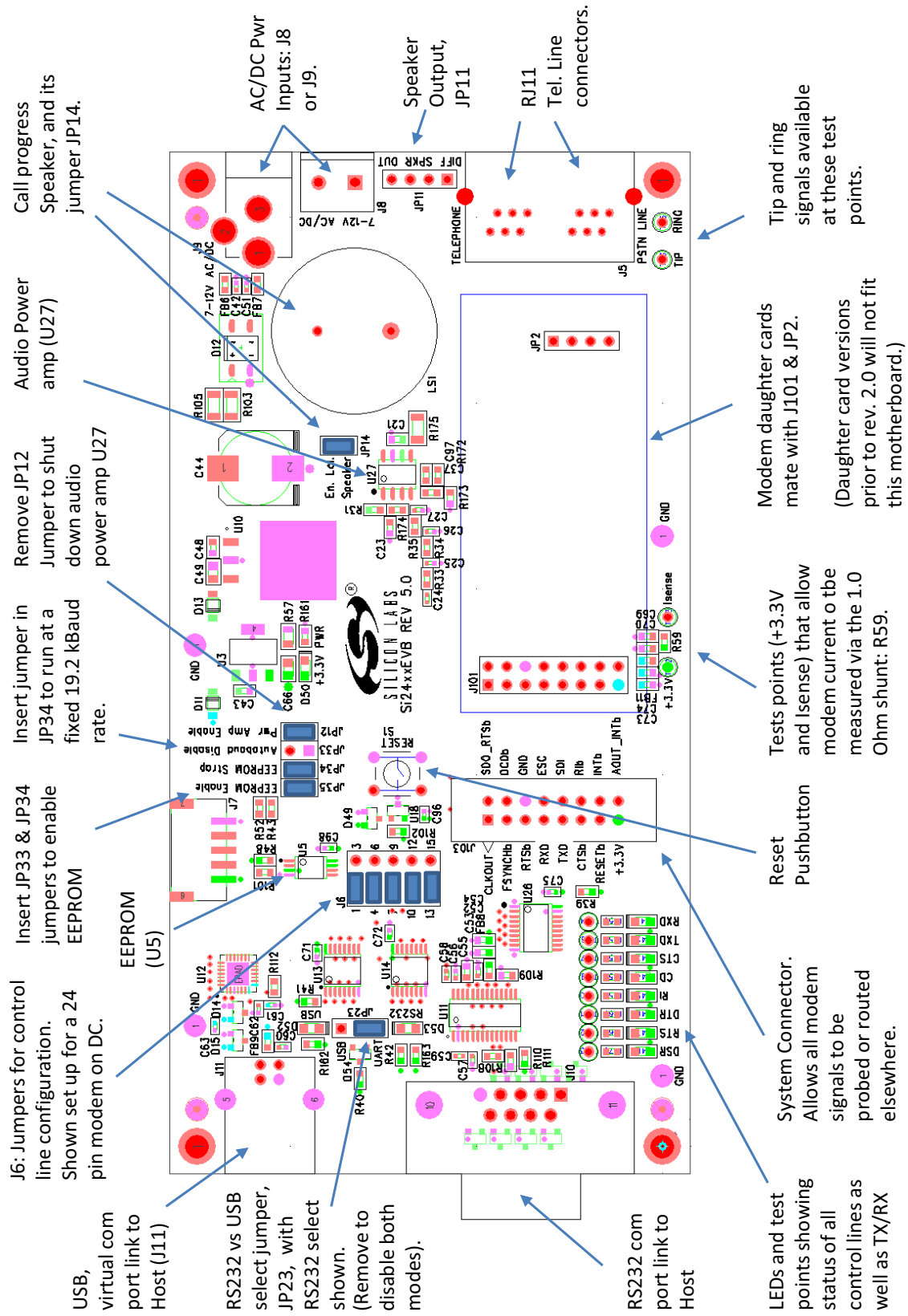


Figure 1. Default Motherboard Setup

Si2493/57/34/15/04

1.3.1.1. RS232 vs USB vs User Provided IO Selection

To change to USB operation simply move the RS232 selection jumper on JP23 to the USB position as marked on the PCB and shown in Figure 1. When the USB vs UART settings are changed the appropriate indicator LED will light up on the EVB.

If neither jumper is in place then neither serial port will be activated and the user must provide I/O signals via the pins on J103. This IO can be in ASYNCH SERIAL, SPI SERIAL and Parallel Bus mode.

1.3.1.2. Autobaud Control

Autobaud is enabled with no jumper at the JP34 position. When a jumper is in place, autobaud is disabled and the user must setup the host to run 19k2 baud in order to use the modem.

1.3.1.3. EEPROM Control

To enable the EEPROM (U5) both jumpers JP34 and JP35 must be in place and the modem reset.

JP35 physically connects the EEPROM chips select line to the modem and allows the EEPROM to function when addressed by the modem, while JP34 connects a strapping option to the correct modem pin which is sensed during reset and instructs the modem firmware to use the EEPROM.

1.3.1.4. Call Progress Configuration

The modem call establishment can be heard by enabling the call progress feature via software (see AN93) and Hardware. The hardware components include installing JP12 which enabled the audio power amplifier and installing JP14 to connect the on board speaker to the power amplifier output. If an offboard speaker is to be used then JP14 can be removed and the alternate speaker can be connected to pins 1 and 4 of JP11. Note the this audio output is 8Ω and differential so that neither output pin should be grounded.

1.3.1.5. Control Line Configuration

Table 1. Routing of Control Signals with Jumper Position on J6

| RS232 Signal | Si24xx 24-Pin | | Si24xx 16-Pin | | Si2401 | |
|--------------|---------------|-----------|---------------|-------|--------|----------|
| | Left | Right | Left | Right | Left | Right |
| DCD | DCD | SDI/EESD | DCD | NC | DCD | NC |
| RI | RI | FSYNCH | NC | RI | NC | RI |
| DTR | ESC | RI | ESC | NC | ESC | NC |
| RTS | RTS | SDO/EECLK | NC | RTS | NC | GPIO1 |
| DSR | INT | AOUT/INT | NC | INT | NC | AOUT/INT |

Various modem control lines can be rearranged depending on the user preferences and the specific modem chips used. This is done using JP6. The basic two JP6 configurations are shown in the following figures.

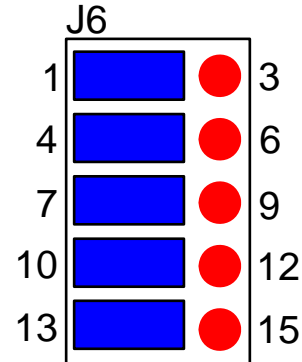


Figure 2. Default J6 Setup for 24-Pin Modem Chips

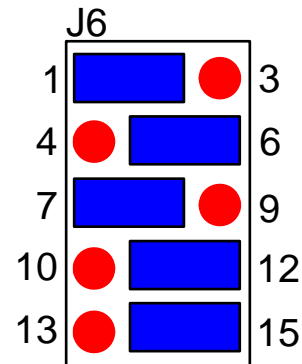


Figure 3. Default J6 Setup for 16-Pin Modem Chips

The specific details of what the jumpers connect are shown in Table 1, which is also found printed on the underside of the EVB.

1.3.2. Daughter Card Configuration

The daughter card comes configured with either a 24-pin FT or 16-pin FS system side part and either 32 kHz or 4.9152 MHz operation, and UART operation. The daughter card can also be setup to operate with a third clock frequency, an on board 27 MHz oscillator. To change between these options requires component changes on the daughter card.

The daughter card can also operate in three possible interface modes: parallel bus mode, in SPI mode as well as the default UART mode.

There are six small (0402) strapping resistors (R101 to R106) that are on the daughter card and are configured differently depending on the combination of chip package, clock frequency chosen, and interface mode. See Figures 5 and 6 for details.

The card and its options are shown in Figure 4, which shows the Modem Daughter card Rev 2.0 top and bottom views with the critical parts that may be changed to select another command mode (i.e. SPI) or an alternate crystal frequency, such as 4.9152 MHz.

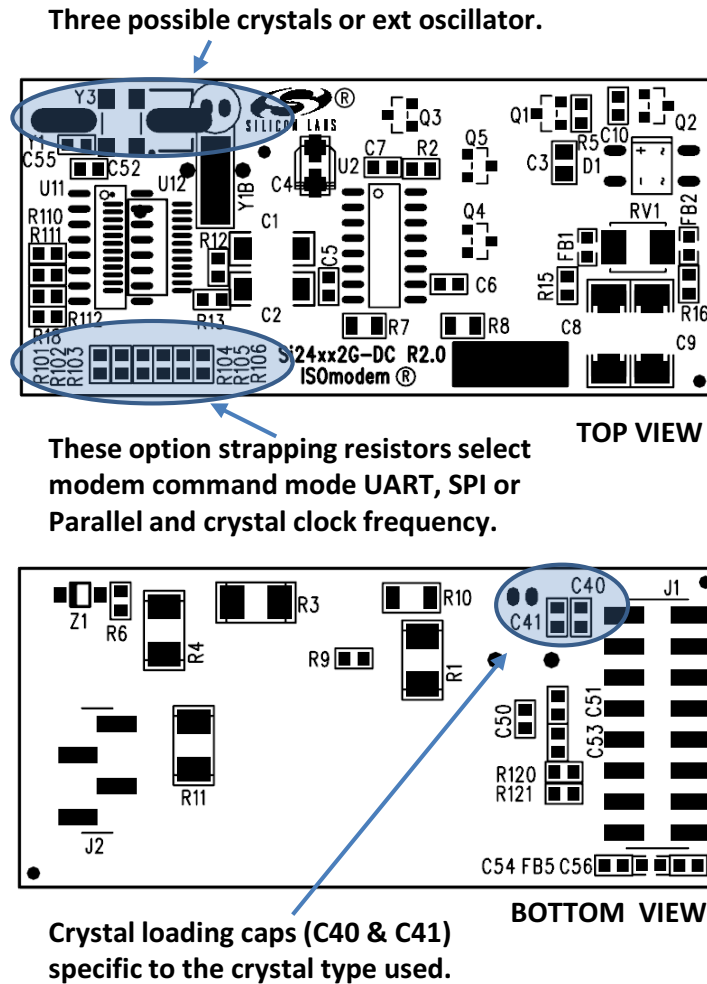


Figure 4. Modem Daughter Card Rev 2.0 Top and Bottom Views

| Pin7 | Pin11 | Pin3 | Pin15 | |
|------|-----------|-------------|-------|-----------------|
| CTSb | AOUT_INTb | FSYNCH (RI) | DCDb | |
| R101 | R102 | R103 | R106 | |
| No | No | No | No | UART 4.9152 MHz |
| No | No | No | Yes | UART 27 MHz |
| No | Yes | No | No | SPI 32 kHz |
| No | Yes | No | Yes | SPI 27 MHz |
| No | No | Yes | X | UART 32 kHz |
| No | Yes | Yes | X | SPI 4.9252 MHz |

Figure 5. R101–R106 Setup for Clock and Mode Configuration on the DC with the 16-Pin FS Package

| Pin11 | Pin15 | Pin16 | Pin17 | Pin23 | | |
|-------|-----------|-------|-------|-------|----------|------------|
| CTSb | AOUT_INTb | INTb | RIb | DCDb | | |
| R101 | R102 | R104 | R105 | R106 | | |
| No | No | Yes | No | Yes | SPI | 27 Mhz |
| No | No | Yes | Yes | X | SPI | 4.9152 MHz |
| No | No | Yes | No | No | SPI | 32.768 kHz |
| No | No | No | Yes | X | UART | 32.768 kHz |
| No | No | No | No | No | UART | 4.9152 MHz |
| No | No | No | No | Yes | UART | 27 Mhz |
| Yes | Yes | X | X | X | Parallel | 27 Mhz |
| No | Yes | X | X | X | Parallel | 4.9152 MHz |

Figure 6. R106 Setup for Clock and Mode Configuration on DC with 24-Pin FT Package

1.3.2.1. 32 kHz Setup

For 32 kHz, populate Y1 with the 32 kHz crystal shown in the BOM and use 18 pF capacitors for the C40/C41 values. Also remove Y3 and Y1b if present and strap R101 to R106 as shown in Figure 5.

The modem should then work as expected; no changes are needed on the motherboard

1.3.2.2. 4.9152 MHz

For 4.9152 MHz, populate Y1b with the 4.9152 MHz crystal shown in the BOM and use 33 pF capacitors for the C40 and C41 values. Also remove Y3 and Y1 if present and strap R101 to R106 as shown in Figures 5 or 6 above. The modem should then work as expected; no changes are needed on the motherboard

1.3.2.3. 27 MHz

For 27 MHz, populate Y3 with the small surface mount oscillator shown in the BOM and remove Y3 and Y1b if present. Also remove any capacitors at the C40 and C41 positions.

Strap R101 to R106 as shown in Figures 5 or 6 above.

The modem should then work as expected; no changes are needed on the motherboard

1.3.2.4. SPI Mode Setup

To change to SPI mode setup it is necessary to configure the R101 straps as shown in Figure 5 or Figure 6, according to the package and clock used. Then setup the daughter card with neither UART nor USB operation selected, i.e. with no jumper on JP23. The SPI signals can then be obtained on J103, the system connector and connected to the host. Signal usage is described in Table 2.

Table 2. Signal Usage

| SPI Function | JP23 Pin Number | Legacy Pin Function |
|--------------|-----------------|---------------------|
| SPI_CSb | 5 | RTSb |
| SPI_MISO | 7 | RXD |
| SPI_MOSI | 9 | TXD |
| SPI_SCLK | 11 | CTSb |

1.3.3. Parallel Bus Mode Setup

To change to parallel bus mode setup it is necessary to configure the R101 straps as shown in Figure 5 or Figure 6, according to the package and clock used. Then setup the daughter card with neither UART nor USB operation selected, i.e. with no jumper on JP23. The SPI signals can then be obtained on J103, the system connector and connected to the host. See the data sheet and schematic for signal and pin usage.

1.4. Power Requirements

The Si2493/57/34/15/04-EVB has an on-board diode bridge, filter capacitor, and voltage regulator (U10 and U18). Power can be supplied from any source capable of providing 7.5 V–13 V dc or 7.5 V–13 V peak ac and at least 100 mA. (Additional current may be required if a speaker is connected for monitoring call progress tones.) Power may be applied to the Si2493/57/34/15/04-EVB through the screw terminals (J8), the 2 mm power jack (J9), or the USB cable (even if the modem is configured for RS-232 operation). The onboard full-wave rectifier and filter ensure the correct polarity is applied to the Si2493/57/34/15/04-EVB. Daughter card current can be measured by connecting a DVM across R59, a 1 Ω resistor using the supplied test points on

either side.

1.5. Terminal and Line Connections

The Si2493/57/34/15/04 can be tested as a standard serial data modem by connecting the Si2493/57/34/15/04-EVB to a personal computer or other data terminal equipment (DTE), phone line, and power. Connect a PC serial port to the DB9 connector on the Si2493/57/34/15/04-EVB with a pass-through cable. The RS-232 transceivers on the EVB can communicate with the DTE at rates up to 1 Mbps. Any standard terminal program, such as HyperTerminal or ProComm, running on a PC communicates with the Si2493/57/34/15/04-EVB. The standard factory jumper configuration has autobaud enabled. Autobaud detects the DTE speed, data length, parity, and number of stop bits.

If JP33 is installed, autobaud is disabled. Configure the terminal emulation program to 19200 bps, eight data bits, no parity, one stop bit, and hardware (CTS) handshaking. Connect the RJ-11 jack on the Si2493/57/34/15/04-EVB to an analog phone line or telephone line simulator, such as a Teltone TLS 5.

1.6. Making Connections

With the terminal program properly configured and running, apply power to the Si2493/57/34/15/04-EVB. Type "AT<cr>", and the modem should return "OK" indicating the modem is working in the command mode and communicating with the terminal. If the "OK" response is not received, try resetting the modem by pressing the manual reset switch (S1); then, again type "AT<cr>." Next, type "ATI6<cr>." The modem should respond with "2493", "2457", "2434", "2415", or "2404" indicating the terminal is communicating with an Si2493, Si2457, Si2434, Si2415, or Si2404.

Type "ATS0=2<cr>" to configure the modem to answer on the second ring.

To take the modem off-hook, type "ATH1<cr>." The modem should go to the off-hook state, draw loop current, and respond with an "OK." Next, type "ATH<cr>" or "ATH0<cr>", and the modem should hang up (go on-hook) and stop drawing loop current.

To make a modem connection, type "ATDT(called modem phone number)<cr>." Once the connection is established, a "CONNECT" message appears indicating the two modems are in the data mode and communicating. Typing on one terminal should appear on the other terminal. To return to the command mode without interrupting the connection between the two modems, type "+++." Approximately two seconds later, "OK" appears. The modem is now in command mode and accepts "AT" commands. Type "ATH" (or "ATH0") to terminate the data connection, or type "ATO" to return to

the data mode. After the ATO command, the modem resumes the data connection and no longer accepts AT commands.

1.7. EVB Part Numbers

The ISModem evaluation boards are offered in multiple speeds and packaging options. The first four numbers indicate the system-side device. The next two letters indicate the system-side package (FS—Lead-free, 16-pin SOIC; FT—Lead-free, 24-pin TSSOP). The final two numbers indicate the line-side device. See Figure 7.

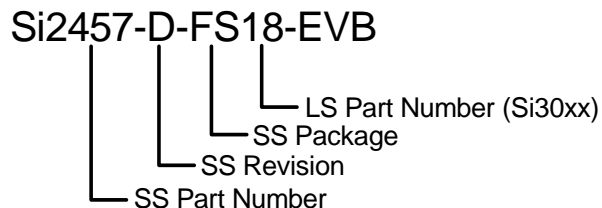


Figure 7. EVB Part Number Example

2. Si2493/57/34/15/04-EVB Functional Description

The Si2493/57/34/15/04-EVB is a multipurpose evaluation system. The modem daughter card illustrates the small size and few components required to implement an entire controller-based modem with global compatibility. The daughter card can be used independently of, or in conjunction with, the motherboard. The motherboard adds features that enhance the ease of evaluating the many capabilities of the Si2493/57/34/15/04 ISModem®.

2.1. Motherboard

The motherboard provides a convenient interface to the Si2493/57/34/15/04 DC (daughter card). The versatile power supply allows for a wide range of ac and dc voltages to power the board. RS-232 transceivers and a DB9 connector allow the Si2493/57/34/15/04-EVB to be easily connected to a PC or other terminal device. Jumper options allow direct access to the LVCMOS/TTL level serial inputs to the Si2493/57/34/15/04, bypassing the RS-232 transceivers or USB interface. This is particularly useful for directly connecting the Si2493/57/34/15/04 to embedded systems.

The Si24xxURT-EVB motherboard connects to the daughter card through two connectors, JP101 and JP2. JP101 is an 8x2 header providing connection to all Si2493/57/34/15/04 digital signals and regulated 3.3 V power for the Si2493/57/34/15/04. The Si2493/57/34/15/04 digital signals appearing at JP101 (daughter card interface) are LVCMOS and TTL compatible. JP2 is a 4x1 socket providing connection between the daughter

card and the RJ-11 phone jack.

2.1.1. Voltage Regulator/Power Supply

The input voltage to either J8 or J9 must be between 7.5 and 13.5 V dc or 7.5 and 13.5 V_{PEAK} ac. The motherboard includes a diode bridge (D12) to guard against a polarity reversal of the dc voltage or to rectify an ac voltage. The power source must be capable of continuously supplying at least 100 mA. C44 serves as a filter cap for an ac input. The voltage regulator, U10, provides 5 V for the motherboard and the input for voltage regulator U3, which outputs 3.3 V for use on the motherboard and to power the daughter card. Si24xxDC power consumption can be measured by placing a meter across R59. Power is supplied to U2 through D5 from the USB.

2.1.2. Reset Circuitry

The Si2493/57/34/15/04 requires a reset pulse to remain low for at least 5.0 ms after the power supply has stabilized during the powerup sequence or for at least 5.0 ms during a power-on reset. Most production Si2493/57/34/15/04 modem chipset applications require that RESET be controlled by the host processor. Certain Si2493/57/34/15/04 operation modes, including powerdown, require a hardware reset to recover.

The Si2493/57/34/15/04-EVB contains two reset options, an automatic power-on reset device, U18 (DS1818) (default), and a manual reset switch (S1) to permit resetting the chip without removing power. A reset, regardless of the mechanism, causes all modem settings to revert to factory default values.

2.1.3. Automatic Reset (DS1818)

The DS1818 is a small, low-cost device that monitors the voltage on V_D and an external reset pushbutton. If V_D drops below 3.0 V, the DS1818 provides a 220 ms active-low reset pulse. On powerup, the DS1818 also outputs an active low reset pulse for 220 ms after V_D reaches 90% of the nominal 3.3 V value. The DS1818 outputs a 220 ms reset pulse any time the power supply voltage exceeds the 3.3 V ±10% window.

2.1.4. Manual Reset

The manual reset switch (S1) performs a power-on reset. This resets the Si2493/57/34/15/04 to factory defaults without turning off power. Pressing S1 activates the reset monitor in the DS1818 and produces a 220 ms active low reset pulse.

2.1.5. EEPROM Enable (FT Only)

Connecting JP34 and JP35 enables the optional EEPROM, U5. See “AN93: Si2457/Si2434/Si2415/Si2404 Modem Designer’s Guide” for programming details.

2.1.6. Interface Selection

The serial interface of the Si2493/57/34/15/04-EVB can be connected to a computer, terminal, embedded system, or any other data terminal equipment (DTE) via a standard RS-232 interface, USB interface, or through a direct TTL serial interface.

The Si2493/57/34/15/04 can be tested as a standard data modem by connecting the Si2493/57/34/15/04-EVB to a personal computer or other DTE power supply and a phone line. A PC can communicate with the Si2493/57/34/15/04-EVB using a standard terminal program, such as HyperTerm or ProComm.

Jumper settings determine how the Si2493/57/34/15/04-EVB is connected to the DTE.

2.1.7. RS-232 Interface

This operation mode uses the standard factory jumper settings illustrated in Figure 1 on page 3. The Maxim MAX3237 transceiver interfaces directly with the TTL levels available at the serial interface of the Si2493/57/34/15/04 and, using internal charge pumps, makes these signals compatible with the RS-232 standard. The RS-232 transceiver on the Si2493/57/34/15/04-EVB can communicate at rates between 300 bps and 1 Mbps. This simplifies the connection to PCs and other data terminal equipment (DTE). The signals available on the Si2493/57/34/15/04-EVB serial interface (DB9 connector) are listed in Table 3.

2.1.8. USB Interface

The USB cable connects to J10 on the motherboard and provides both data and power. Installing a jumper on JP23 enables the USB interface and disables the RS-232 interface. The USB interface is provided by U12. A USB driver for this chip is available for most PC and MAC operating systems on the CD.

Si2493/57/34/15/04

2.1.9. Direct Access Interface

While the motherboard supplies power through J8, J9, or USB, power-on reset, and an RJ-11 jack for the modem, the direct access interface (J103) is used to connect the motherboard to an embedded system. J103 provides access to all Si2493/57/34/15/04 signals available on the daughter card.

It is necessary to remove the jumper on JP23 to disable both the RS-232 and USB interface and prevent signal contention.

2.1.10. PCM Interface (24-Pin FT Only)

The Si2493/57/34/15/04 PCM interface can be demonstrated using the voice motherboard, not with this EVB.

2.1.11. AOUT Call Progress Audio Output

Call progress audio output is provided by the Si2493/57/34/15/04 on the AOUT pin as a PWM signal. This signal allows the user to monitor call progress signals, such as dial tone, DTMF dialing, ring, busy signals, and modem negotiation. Control of this signal is provided by AT commands and register settings described in the introduction. The AOUT signal is connected to an on board amplifier, for a high-quality output. AOUT can also be connected to a summing amplifier or multiplexer in an embedded application as part of an integrated audio system.

2.1.11.1. AOUT Audio Processing

The AOUT signal discussed in this section leaves the Si2493/57/34/15/04 is processed (demodulated) by a high pass filter: (R133,134,135, and C24, C25, 26, C27). It is critically important to not put a dc load on the AOUT pin since the pin also acts as a modem feature control on reset and is internally weakly pulled up. Any unintentional dc load on AOUT prevents proper

operation of the modem. See “AN93: Si3457/34/15/04 Modem Designer’s Guide” for more details on the features controlled by pin strapping.

Since this PWM signal swings rail to rail and is simply filtered by a low pass filter to acquire the audio. It is important to keep the power supply to the modem free of noise in the audio spectrum.

2.1.11.2. The Audio Output Amplifier (LM4819)

The Power amplifier on the EVB is powered by a current limited 4.2 V supply. The current limit is implemented in the EVB because it is intended for HW/SW development and is not needed for a production design. This amplifier can drive an 8 Ω speaker with 200 mW of Call progress audio (i.e., ISModem's call progress dialing and negotiation tones).

The power amplifier itself is a low cost, rugged H bridge type device. There are several pin compatible designs from multiple vendors that can provide alternate price/power tradeoffs for this amplifier. This power amp can be shut down by removing jumper JP12. The signal at JP12 can also be tied to a control signal to allow the host to shut down the amplifier. The customer can change the values of R172 and R173 when integrating the EVB to his system, but should keep the RC formed by C37 and R173 at a 50 Hz or higher corner to avoid a power-on thump.

2.1.11.3. The Call Progress Speaker

The Call progress speaker, Regal RE-2308-NL is connected to the amplifier via a jumper, JP14. If another speaker is to be connected then it is necessary to remove JP14 and connect the external speaker to JP11, Pins 1 and 4. It is important to remember that the speaker signal is differential. Both the output pins are driven outputs and must not be grounded.

Table 3. DB9 Pin Connections

| J1 Name | J1 Symbol | J1 Pin | Si2493/57/34/15/04 Pin | Si2493/57/34/15/04 Name |
|---------------------|-----------|--------|------------------------|--------------------------------|
| Carrier Detect | CD | 1* | See note | $\overline{\text{DCD}}$ /EESD |
| Received Data | RXD | 2 | 9 | RXD |
| Transmit Data | TXD | 3 | 10 | TXD |
| Data Terminal Ready | DTR | 4* | See note | ESC/RI |
| Signal Ground | SG | 5 | 6 | GND |
| Data Set Ready | DSR | 6* | See note | $\overline{\text{INT}}$ /AOUT |
| Ready to Send | RTS | 7* | See note | $\overline{\text{RTS}}$ /RXCLK |
| Clear to Send | CTS | 8 | 11 | $\overline{\text{CTS}}$ |
| Ring Indicator | RD | 9* | 17 | $\overline{\text{RI}}$ |

*Note: JP6 jumper option.

2.2. Modem Daughter Card Operation

The Si2493/57/34/15/04URT-EVB daughter card is a complete modem solution perfectly suited for use in an embedded system. The daughtercard contains both the modem system-side chip and the isolated line interface (DAA).

The daughter card requires a 3.3 V supply capable of providing at least 35 mA and communicates with the system via LVCMOS/TTL-compatible digital signals on JP1. The RJ-11 jack (TIP and RING) is connected via JP2. Be sure to provide the proper power-on reset pulse to the daughter card if it is used in the stand-alone mode.

2.2.1. Reset Requirements

The Si2493/57/34/15/04 ISOmodem[®] daughter card must be properly reset at powerup. The reset pin (pin 8) of the Si2493/57/34/15/04 (JP103, J101 pin 13) must be held low for at least 5.0 ms after power is applied and stabilized to ensure the device is properly reset.

2.2.2. Crystal Requirements

Clock accuracy and stability are important in modem applications. To ensure reliable communication between modems, the clock must remain within ± 100 ppm of the design value over the life of the modem. The crystal selected for use in a modem application must have a frequency tolerance of less than ± 100 ppm for the combination of initial frequency tolerance, drift over the normal operating temperature range, and five year aging. Other considerations, such as production variations in PC board capacitance and the tolerance of loading capacitors, must also be taken into account.

2.2.3. Protection

The Si2493/57/34/15/04-EVB meets or exceeds all FCC and international PTT requirements and recommendations for high-voltage surge and isolation testing without any modification. The protection/isolation circuitry includes C1, C2, C8, C9, FB1, FB2, and RV1. The PCB layout is also a key “component” in the protection circuitry. The Si2493/57/34/15/04-EVB provides isolation to 3 kV. Contact Silicon Laboratories for information about designing to higher levels of isolation.

Si2493/57/34/15/04

3. Design

The following sections contain the schematics, bill of materials, and layout for the Si2493/57/34/15/04 including the daughter card and motherboard.

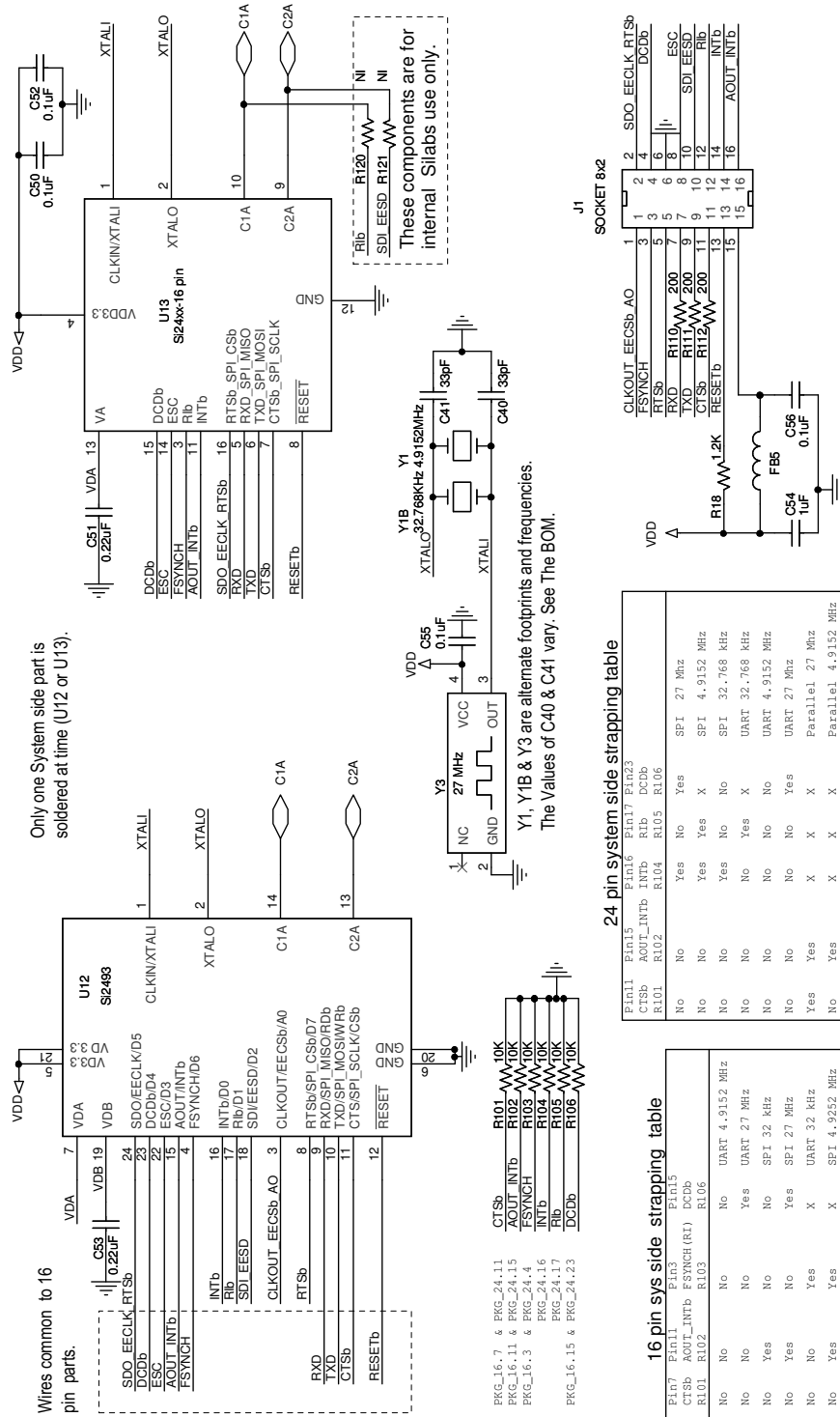


Figure 8. i2493/57/34/15/04 Schematic

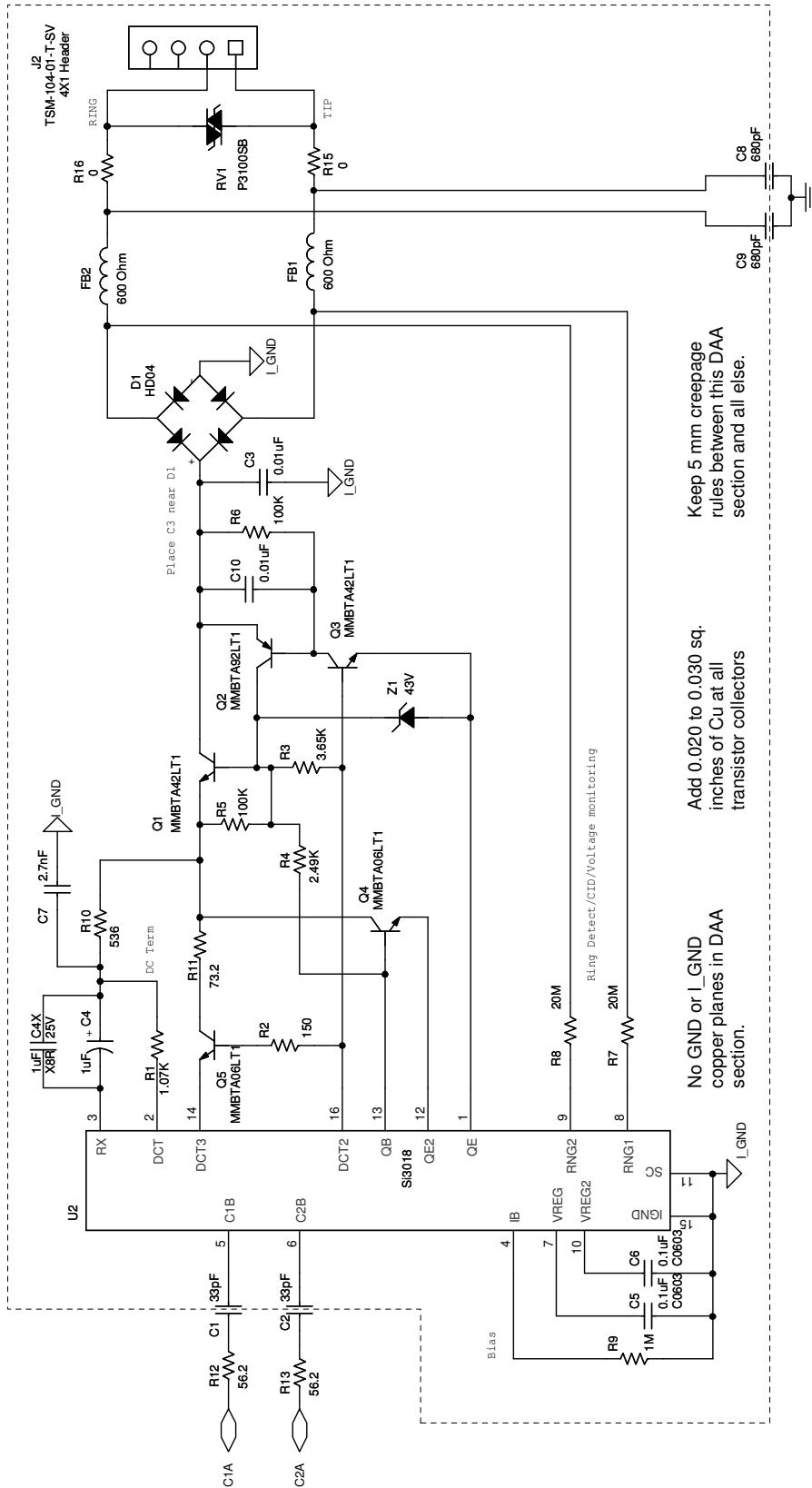


Figure 9. Si3018/10 DAA Schematic

4. Bill of Materials: Si24xx Daughter Card

Table 4. Si24xx Daughter Card Bill of Materials

| Item | Qty | Ref | Value | Rating | Voltage | Tol | Type | PCB Footprint | Mfr Part Number | Mfr |
|------|-----|------------------------------|--------------|--------|---------|------|-----------|------------------|--------------------|-------------|
| 1 | 2 | C1, C2 | 33 pF | Y2 | 250 V | ±10% | Y2 | C1808 | SCC1808X330K502T | Holy Stone |
| 2 | 1 | C3 | 0.01 µF | | 250 V | ±10% | X7R | C0805 | GRM21BR72E103KW03L | Murata |
| 3 | 1 | C4 | 1 µF | | 50 V | ±20% | Alum_Elec | C3.3X3.3MM | EEE1HS010SR | Panasonic |
| 4 | 2 | C5, C6 | 0.1 µF | | 16 V | ±20% | X7R | C0603 | C0603X7R160-104M | Venkel |
| 5 | 1 | C7 | 2.7 nF | | 50 V | ±20% | X7R | C0603 | C0603X7R500-272M | Venkel |
| 6 | 2 | C8, C9 | 680 pF | Y2 | 250 V | ±10% | Y2 | C1808 | SCC1808X681K502T | Holy Stone |
| 7 | 1 | C10 | 0.01 µF | | 16 V | ±20% | X7R | C0603 | C0603X7R160-103M | Venkel |
| 8 | 2 | C40, C41 | 18 pF | | 50 V | ±5% | COG | C0603 | C0603COG500-180J | Venkel |
| 9 | 3 | C50, C52, C56 | 0.1 µF | | 10 V | ±20% | X7R | C0603 | C0603X7R100-104M | Venkel |
| 10 | 2 | C51, C53 | 0.22 µF | | 6.3 V | ±10% | X5R | C0603 | C0603X7R6R3-224K | Venkel |
| 11 | 1 | C54 | 1 µF | | 25 V | ±10% | X5R | C0603 | C0603X5R250-105K | Venkel |
| 12 | 1 | D1 | HD04 | 0.8 A | 400 V | | BRIDGE | MiniDIP4 | HD04-T | Diodes Inc. |
| 13 | 3 | FB1, FB2, FB5 | 600 Ω | 200 mA | | | SMT | L0603 | BLM18AG601SN1 | Murata |
| 14 | 1 | J1 | SOCKET 8x2 | | | | SOCKET | SOCKETX8-100-SMT | SSW-108-22-G-D-VS | Samtec |
| 15 | 1 | J2 | 4X1 Header_0 | | | | | CONN1X4-100-SMT | TSM-104-01-T-SV | Berg |
| 16 | 2 | Q1 Q3 | MMBTA42LT1 | 200 mA | 300 V | | NPN | SOT23-BEC | MMBTA42LT1 | On Semi |
| 17 | 1 | Q2 | MMBTA92LT1 | 100 mA | 300 V | | PNP | SOT23-BEC | MMBTA92LT1 | On Semi |
| 18 | 2 | Q4 Q5 | MMBTA06LT1 | 500 mA | 80 V | | NPN | SOT23-BEC | MMBTA06LT1 | On Semi |
| 19 | 1 | RV1 | P3100SB | | 275 V | | Sidactor | DO-214AA-NP | P3100SBL | Littelfuse |
| 20 | 1 | R1 | 1.07 kΩ | 1/2 W | | ±1% | ThickFilm | R2010 | CR2010-2W-1071F | Venkel |
| 21 | 1 | R2 | 150 Ω | 1/16 W | | ±5% | ThickFilm | R0603 | CR0603-16W-151J | Venkel |
| 22 | 1 | R3 | 3.65 kΩ | 1/2 W | | ±1% | ThickFilm | R2010 | CR2010-2W-3651F | Venkel |
| 23 | 1 | R4 | 2.49 kΩ | 1/2 W | | ±1% | ThickFilm | R2010 | CR2010-2W-2491F | Venkel |
| 24 | 2 | R5, R6 | 100 kΩ | 1/16 W | | ±5% | ThickFilm | R0603 | CR0603-16W-104J | Venkel |
| 25 | 2 | R7, R8 | 20 MΩ | 1/8 W | | ±5% | ThickFilm | R0805 | CR0805-8W-206J | Venkel |
| 26 | 1 | R9 | 1 MΩ | 1/16 W | | ±1% | ThickFilm | R0603 | CR0603-16W-1004F | Venkel |
| 27 | 1 | R10 | 536 Ω | 1/4 W | | ±1% | ThickFilm | R1206 | CR1206-4W-5360F | Venkel |
| 28 | 1 | R11 | 73.2 Ω | 1/2 W | | ±1% | ThickFilm | R2010 | CR2010-2W-73R2F | Venkel |
| 29 | 2 | R12, R13 | 56.2 Ω | 1/16 W | | ±1% | ThickFilm | R0603 | CR0603-16W-56R2F | Venkel |
| 30 | 2 | R15, R16 | 0 Ω | 1 A | | | ThickFilm | R0603 | CR0603-16W-000 | Venkel |
| 31 | 2 | R120, R121 | 0 Ω | 1 A | | | ThickFilm | R0603 | CR0603-16W-000 | Venkel |
| 32 | 1 | R18 | 1.2 kΩ | 1/10 W | | ±5% | ThickFilm | R0603 | CR0603-10W-121J | Venkel |
| 33 | 4 | R101, R102, R103, R104, R106 | 10 kΩ | 1/10 W | | ±5% | ThickFilm | R0603 | CR0603-10W-103J | Venkel |

Table 4. Si24xx Daughter Card Bill of Materials (Continued)

| Item | Qty | Ref | Value | Rating | Voltage | Tol | Type | PCB Footprint | Mfr Part Number | Mfr |
|------|-----|------------------------|---------------|--------|---------|-----------|-----------|------------------|------------------|-------------------------|
| 34 | 1 | R105 | 1 k Ω | 1/10 W | | $\pm 5\%$ | ThickFilm | R0603 | CR0603-10W-102J | Venkel |
| 35 | 3 | R110, R111, R112 | 200 Ω | 1/10 W | | $\pm 5\%$ | ThickFilm | R0603 | CR0603-10W-2000J | Venkel |
| 36 | 1 | U2 | Si3018 | | 300 V | | LineSide | SO16N6.0P1.27 | Si3018-F-GS | SiLabs |
| 37 | 1 | U12 | Si24xx | | | | ISOMODEM | TSSOP24N6.4P0.65 | Si2493-E-FT | SiLabs |
| 38 | 1 | U13 | Si24xx-16 pin | | | | | 16pin SOIC | 2493 | Silicon Laboratories |
| 39 | 1 | Y1B (Y1, Y3) | 32.768 kHz | | | | | XTAL-3X8-LD | ECS-.327-12.5-8X | ECS International |
| 40 | 1 | Z1 | 43 V | 500 mW | 43 V | | Zener | SOD-123 | BZT52C43-7-F | Diodes Inc. |

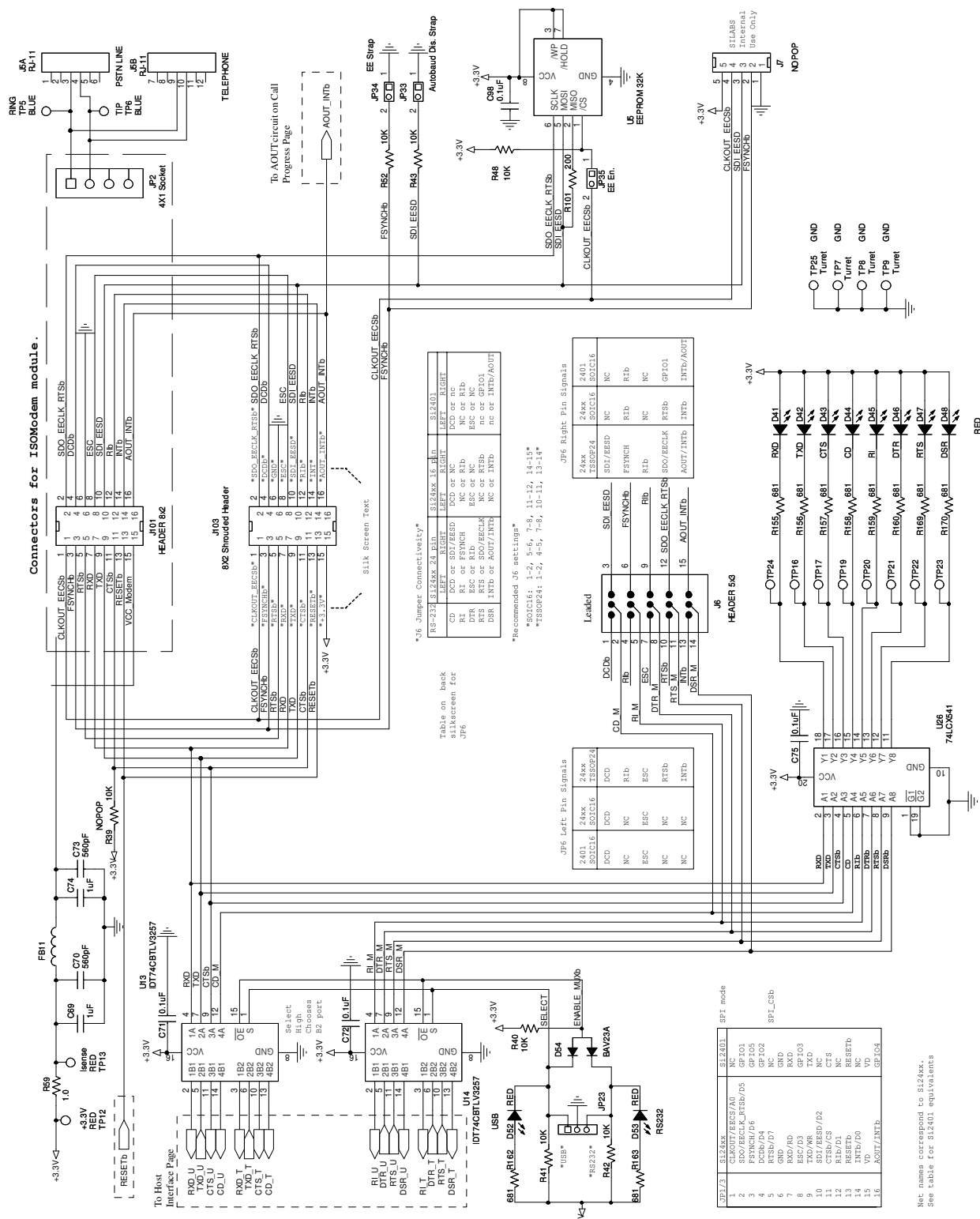


Figure 10. Motherboard Modem Interface Schematic

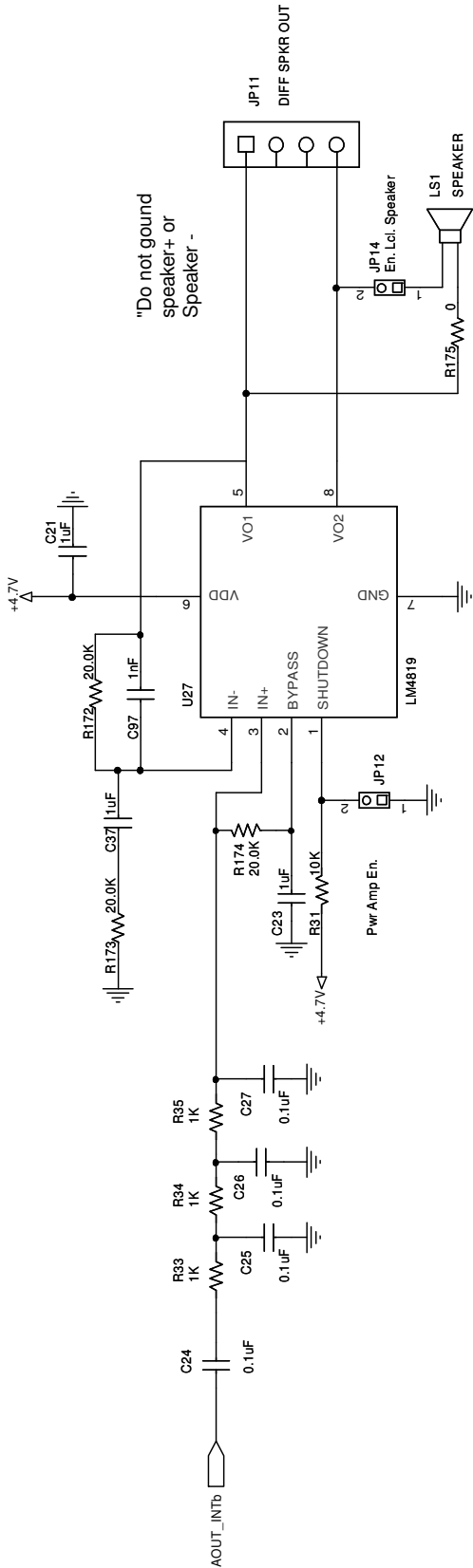


Figure 11. Audio Amplifier Schematic

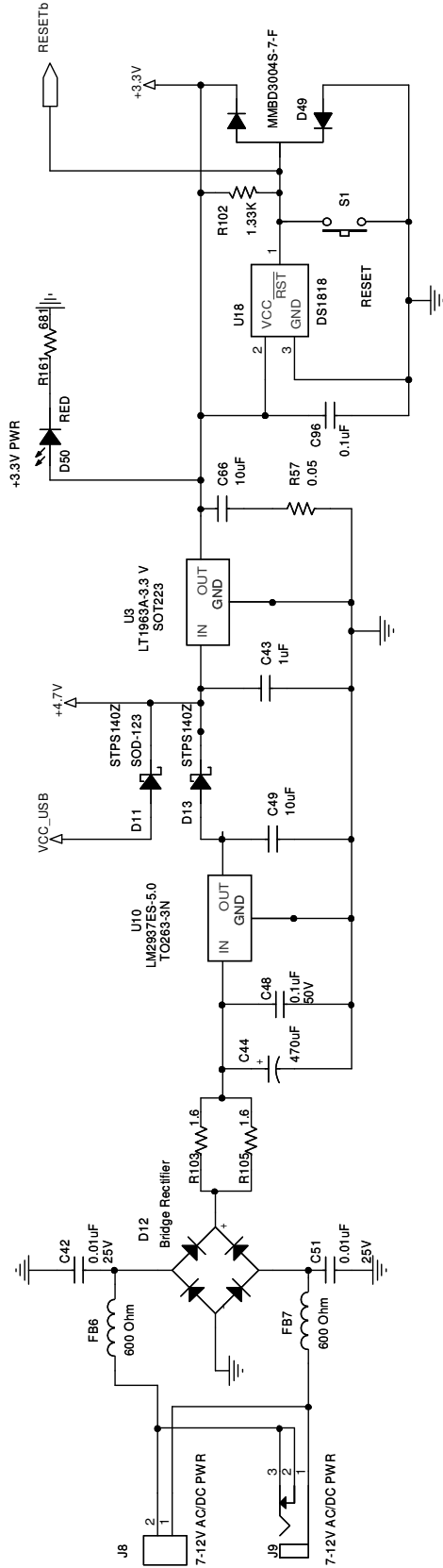


Figure 12. Power Supply Schematic

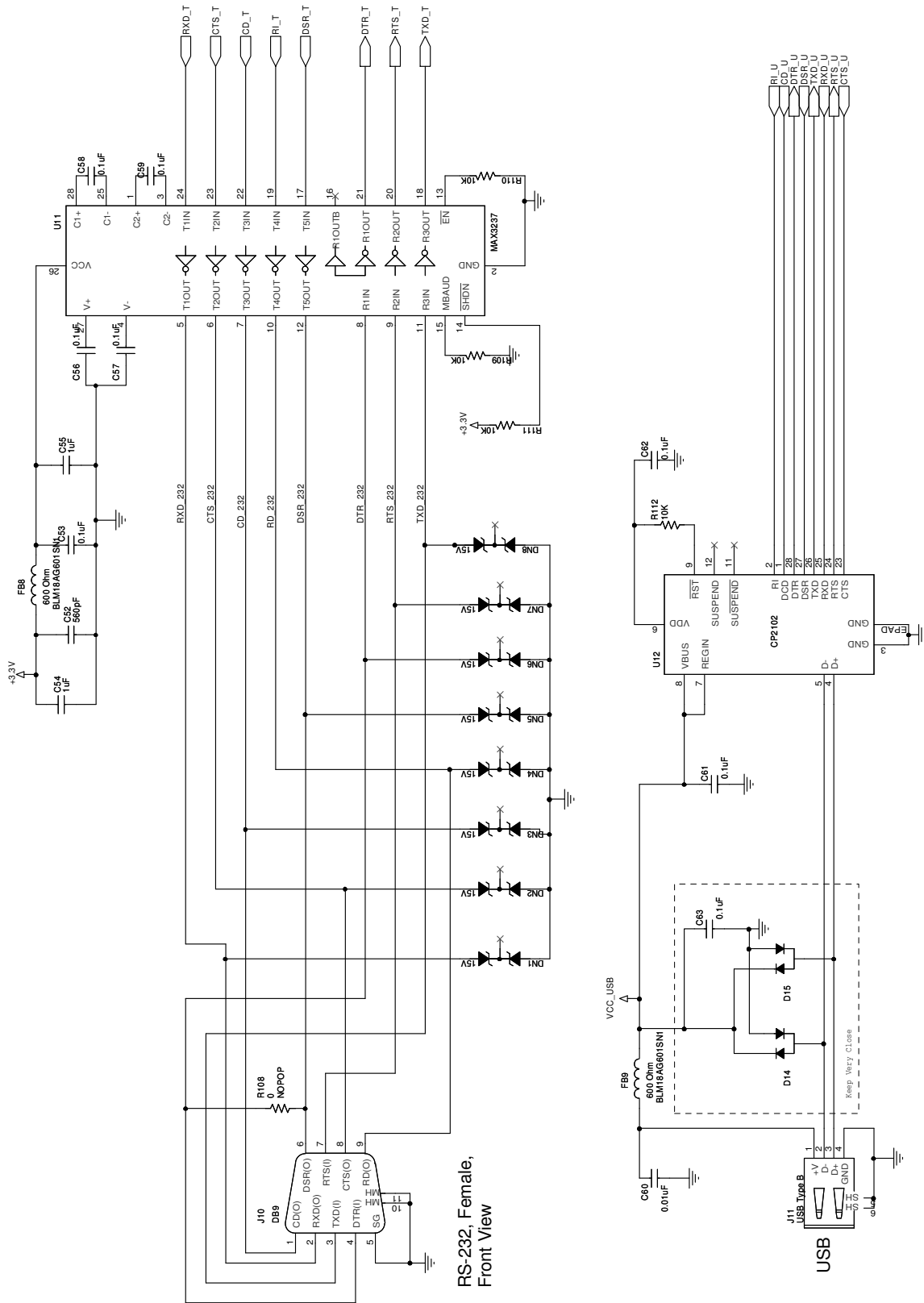


Figure 13. RS-232 Interface and USB Interface Schematic

5. Bill of Materials: Si24xx Motherboard

Table 5. Si24xx Motherboard Bill of Materials

| Item | Qty | Ref | Value | Rating | Voltage | Tol | Type | PCB Footprint | Mfr Part Number | Mfr |
|------|-----|---|------------------|--------|---------|-----------|---------------|---------------|--------------------|--------------------|
| 1 | 8 | C21, C23, C37, C43, C54, C55, C69, C74 | 1 μ F | | 10 V | \pm 10% | X7R | C0603 | C0603X7R100-105K | Venkel |
| 2 | 17 | C24, C25, C26, C27, C53, C56, C57, C58, C59, C61, C62, C63, C71, C72, C75, C96, C98 | 0.1 μ F | | 10 V | \pm 20% | X7R | C0402 | C0402X7R100-104M | Venkel |
| 3 | 3 | C42, C51, C60 | 0.01 μ F | | 25 V | \pm 10% | X7R | C0402 | C0402X7R250-103K | Venkel |
| 4 | 1 | C44 | 470 μ F | | 25 V | \pm 20% | Alum_Elec | C10.3X10.3MM | EMVE250ADA471MJA0G | United Chemicon |
| 5 | 1 | C48 | 0.1 μ F | | 50 V | \pm 10% | X7R | C0603 | C0603X7R500-104K | Venkel |
| 6 | 2 | C49, C66 | 10 μ F | | 16 V | \pm 10% | X5R | C0805 | C0805X5R160-106K | Venkel |
| 7 | 3 | C52, C70, C73 | 560 pF | | 16 V | \pm 10% | X7R | C0603 | C0603X7R160-561K | Venkel |
| 8 | 1 | C97 | 1 nF | | 100 V | \pm 10% | X7R | C0603 | C0603X7R101-102K | Venkel |
| 9 | 8 | DN1, DN2, DN3, DN4, DN5, DN6, DN7, DN8 | 15 V | 225 mW | 15 V | | Zener, Dual | SOT23-AAK | MMBZ15VDLT1G | On Semi |
| 10 | 2 | D11, D13 | STPS140Z | 1.0 A | 40 V | | Schottky | SOD-123 | STPS140Z | ST MICRO |
| 11 | 1 | D12 | Bridge Rectifier | 0.8 A | 100 V | | BRIDGE | MiniDIP4 | HD01-T | Diodes Inc. |
| 12 | 3 | D14, D15, D49 | MMBD300 4S-7-F | 225 mA | 300 V | | DUAL | SOT23-AKC | MMBD3004S-7-F | Diodes Inc. |
| 13 | 11 | D41, D42, D43, D44, D45, D46, D47, D48, D50, D52, D53 | RED | 25 mA | 1.9 V | | SMT, Chip LED | LED-HSMX-C170 | HSMC-C170 | Avago Technologies |
| 14 | 1 | D54 | BAV23A | 400 mA | 200 V | | DUAL | SOT23-KKA | BAV23A | Diodes Inc. |
| 15 | 5 | FB6, FB7, FB8, FB9, FB11 | 600 Ohm | 200 mA | | | SMT | L0603 | BLM18AG601SN1 | MuRata |
| 16 | 4 | HW1, HW2, HW3, HW4 | spacer | | | | | | 2397 | SPC Technology |
| 17 | 4 | HW5, HW6, HW7, HW8 | screw | | | | | | NSS-4-4-01 | Richco Plastic Co |

Table 5. Si24xx Motherboard Bill of Materials (Continued)

| Item | Qty | Ref | Value | Rating | Voltage | Tol | Type | PCB Footprint | Mfr Part Number | Mfr |
|------|-----|---|---------------------------|--------------|---------|-----------|-------------|--------------------|---------------------------------|--------------------|
| 18 | 1 | JP11 | HEADER 4X1 | | | | Header | CONN-1X4 | TSW-104-07-T-S | Samtec |
| 19 | 2 | JP12, JP14 | JUMPER | | | | Header | CONN-1X2 | TSW-102-07-T-S | Samtec |
| 20 | 1 | JP23 | HEADER 1x3 | | | | Header | CONN-1X3 | TSW-103-07-T-S | Samtec |
| 21 | 3 | JP33, JP34, JP35 | JUMPER | | | | Unshrouded | CONN-1X2 | 68000-402 | Berg |
| 22 | 1 | J5 | RJ-11 | | | | RJ-11 | RJ11-DUAL- MTJG | MTJG-2-64-2-2-1 | ADAM TECH |
| 23 | 1 | J6 | HEADER 5x3 | | | | Header | | TSW-105-07-S-T | Samtec |
| 24 | 1 | J8 | CONN TRBLK 2 | | | | TERM BLK | CONN-1X2-TB | 1729018 | PHOENIX CONTACT |
| 25 | 1 | J9 | Power Jack | 1 A | | | BARREL | CONN-3-PWR | ADC-002-1 | Adam Tech |
| 26 | 1 | J10 | DB9 | | | | D-SUB | CONN-9-DBF | D09S33E4GX00LF | FCI |
| 27 | 1 | J11 | USB Type B | | | | USB | CONN-USB-B | 292304-1 | Tyco |
| 28 | 1 | J101 | HEADER 8x2 | | | | Header | CONN2X8 | 16/80 pins of 9-146252-0- 08 | Tyco/AMP |
| 29 | 1 | J102 | Socket 1x4 | | | | Header | | SSW-104-01-T-S | Samtec |
| 30 | 1 | J103 | 8X2 Shrouded Header | | | | Shrouded | CONN2X8-4W | 5103309-3 | Tyco |
| 31 | 1 | LS1 | SPEAKER | 0.5 W Max | | | | RE-2308-NL | RE-2308-NL | Regal |
| 32 | 7 | R31, R40, R41, R42, R43, R52, R109, R110, R111, R112 | 10 k Ω | 1/10 W | | $\pm 1\%$ | ThickFilm | R0603 | CR0603-10W-1002F | Venkel |
| 33 | 3 | R33, R34, R35 | 1 k Ω | 1/16 W | | $\pm 1\%$ | ThickFilm | R0603 | CR0603-16W-1001F | Venkel |
| 34 | 1 | R48 | 100 k Ω | 1/10 W | | $\pm 1\%$ | ThickFilm | R0603 | CR0603-10W-1003F | Venkel |
| 35 | 1 | R57 | 0.05 Ω | 1/4 W | | $\pm 5\%$ | ThickFilm | R0805 | LCR0805-R050J | Venkel |
| 36 | 1 | R59 | 1 Ω | 1/10 W | | $\pm 1\%$ | ThickFilm | R0603 | CR0603-10W-1R00F | Venkel |
| 37 | 1 | R101 | 200 Ω | 1/10 W | | $\pm 5\%$ | ThickFilm | R0603 | CR0603-10W-2000J | Venkel |
| 38 | 1 | R102 | 1.33 k Ω | 1/10 W | | $\pm 1\%$ | ThickFilm | R0603 | CR0603-10W-1331F | Venkel |
| 39 | 2 | R103, R105 | 1.6 Ω | 1/4 W | | $\pm 5\%$ | ThickFilm | R1206 | CR1206-8W-1R6J | Venkel |
| 40 | 11 | R155, R156, R157, R158, R159, R160, R161, R162, R163, R169, R170 | 681 Ω | 1/10 W | | $\pm 1\%$ | ThickFilm | R0603 | CR0603-10W-6810F | Venkel |

Table 5. Si24xx Motherboard Bill of Materials (Continued)

| Item | Qty | Ref | Value | Rating | Voltage | Tol | Type | PCB Footprint | Mfr Part Number | Mfr |
|-------------------------------|-----|--|-----------------|-----------|---------|-----|-----------|-----------------------|-------------------------|-------------------------|
| 41 | 3 | R172, R173, R174 | 20.0 kΩ | 1/16 W | | ±1% | ThickFilm | R0603 | CR0603-16W-2002F | Venkel |
| 42 | 1 | R175 | 0 | 2 A | | | ThickFilm | R1206 | CR1206-4W-000 | Venkel |
| 43 | 1 | S1 | SW PUSH-BUTTON | 50 mA | 12 Vdc | | Tactile | SW4N6.5X4.5-PB | 101-0161-EV | Mountain Switch |
| 44 | 10 | TP5, TP6, TP16, TP17, TP19, TP20, TP21, TP22, TP23, TP24 | BLUE | | | | Loop | TESTPOINT | 151-205-RC | Kobiconn |
| 45 | 4 | TP7, TP8, TP9, TP25 | Turret | | | | Turret | TP[12594] | 2551-2-00-44-00-00-07-0 | Mill-Max |
| 46 | 1 | TP11 | RED | | | | Loop | TESTPOINT | 151-207-RC | Kobiconn |
| 47 | 1 | U3 | LT1963A-3.3 V | 1.5 A max | | | LDO | SOT223 | LT1963AEST-3.3#PBF | Linear Technologies |
| 48 | 1 | U5 | EEPROM 32K | | | | Serial | TSSOP8N6.4P0.65 | 25LC320A-I/ST | Microchip Technology |
| 49 | 1 | U10 | 5 | 0.5 A max | | | LDO | TO263-3N | LM2937ES-5.0 | National Semiconductors |
| 50 | 1 | U11 | MAX3237 | | 5.5 V | | RS232 | TSSOP | MAX3237EIPWR | TI |
| 51 | 1 | U12 | CP2102 | | | | MCU | QFN28N5X5P0.5 | CP2102-GM | SiLabs |
| 52 | 2 | U13, U14 | IDT74CBT LV3257 | | | | | TSSOP-16 | IDT74CBTLV3257 | IDT |
| 53 | 1 | U18 | DS1818 | | 3.3 V | 10% | | SOT-23 | DS1818-10 | Dallas Semiconductor |
| 54 | 1 | U26 | 74LCX541 | | | | Buffer | TSSOP20N6.4P0.65 | 74LCX541MTC | Fairchild |
| 55 | 1 | U27 | LM4819 | 350 mW | | | | SO8N6.0P1.27 | LM4819M | National Semiconductor |
| Unpopulated Components | | | | | | | | | | |
| 56 | 1 | J7 | 2MM, RT ANG | | | | SHROUDED | CONN1X5-S5B-PH-SM4-TB | S5B-PH-SM4-TB | JST |
| 1 | 1 | R39 | 10 kΩ | 1/10 W | | ±1% | ThickFilm | R0603 | CR0603-10W-1002F | Venkel |
| 1 | 1 | R108 | 0 | 1 A | | | ThickFilm | R0603 | CR0603-16W-000 | Venkel |

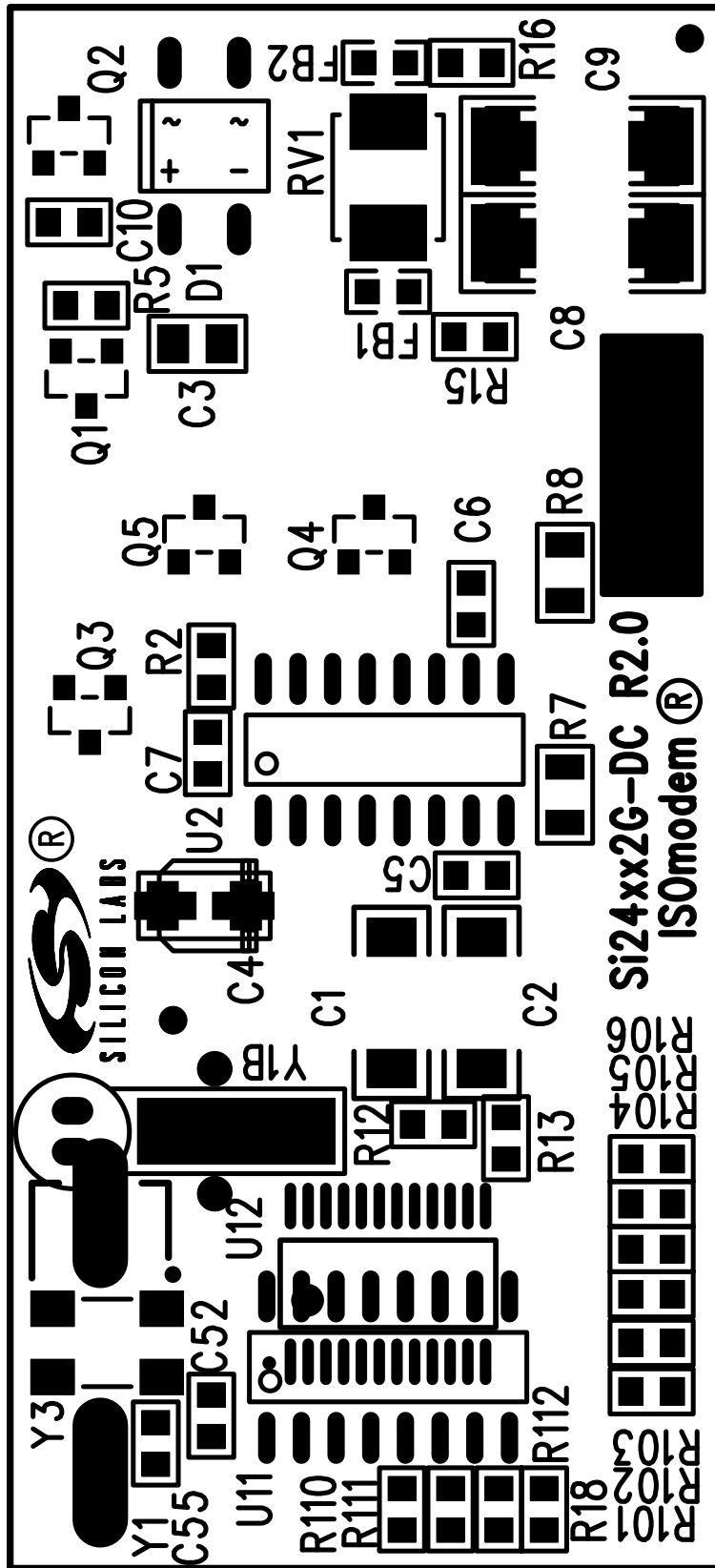


Figure 14. Daughter Card Primary Side Silkscreen

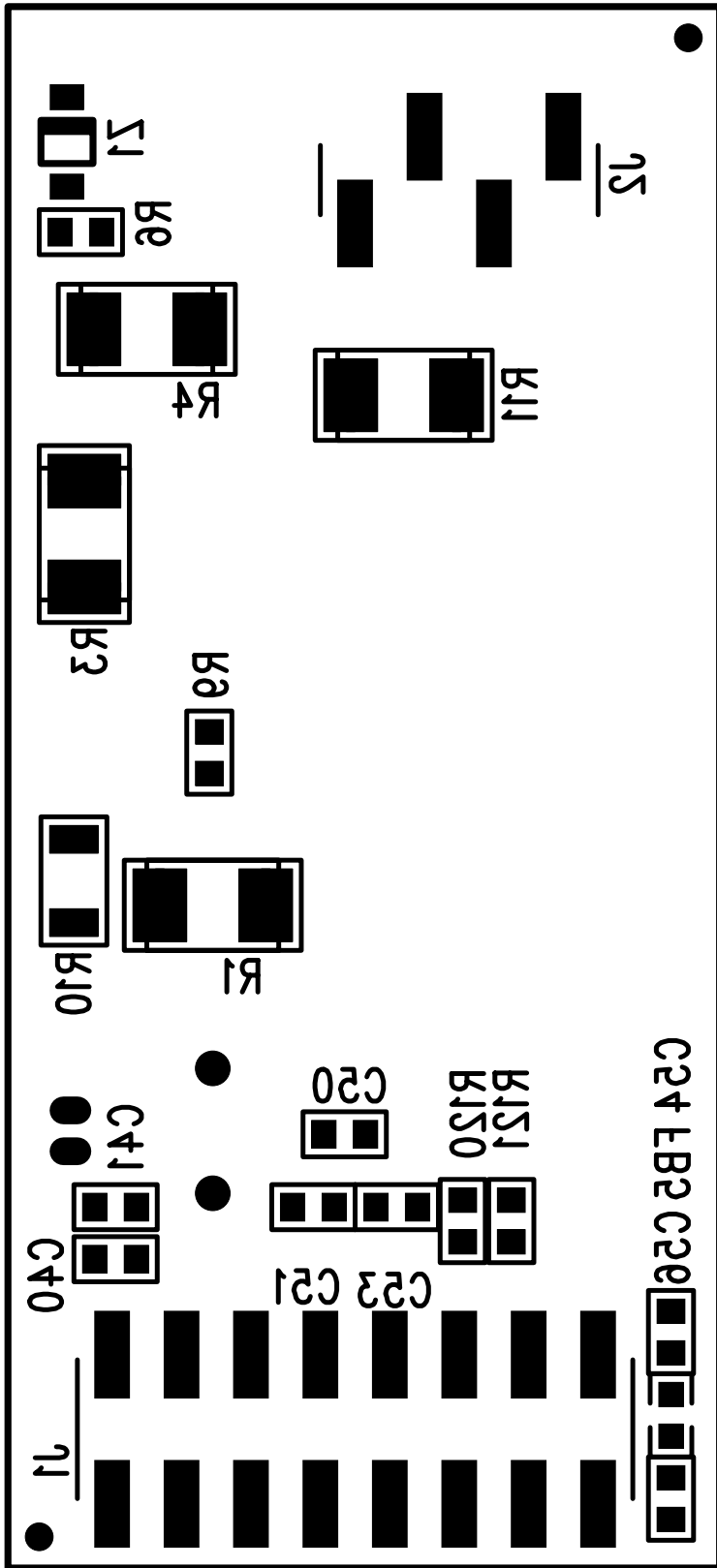


Figure 15. Daughter Card Secondary Side Silkscreen

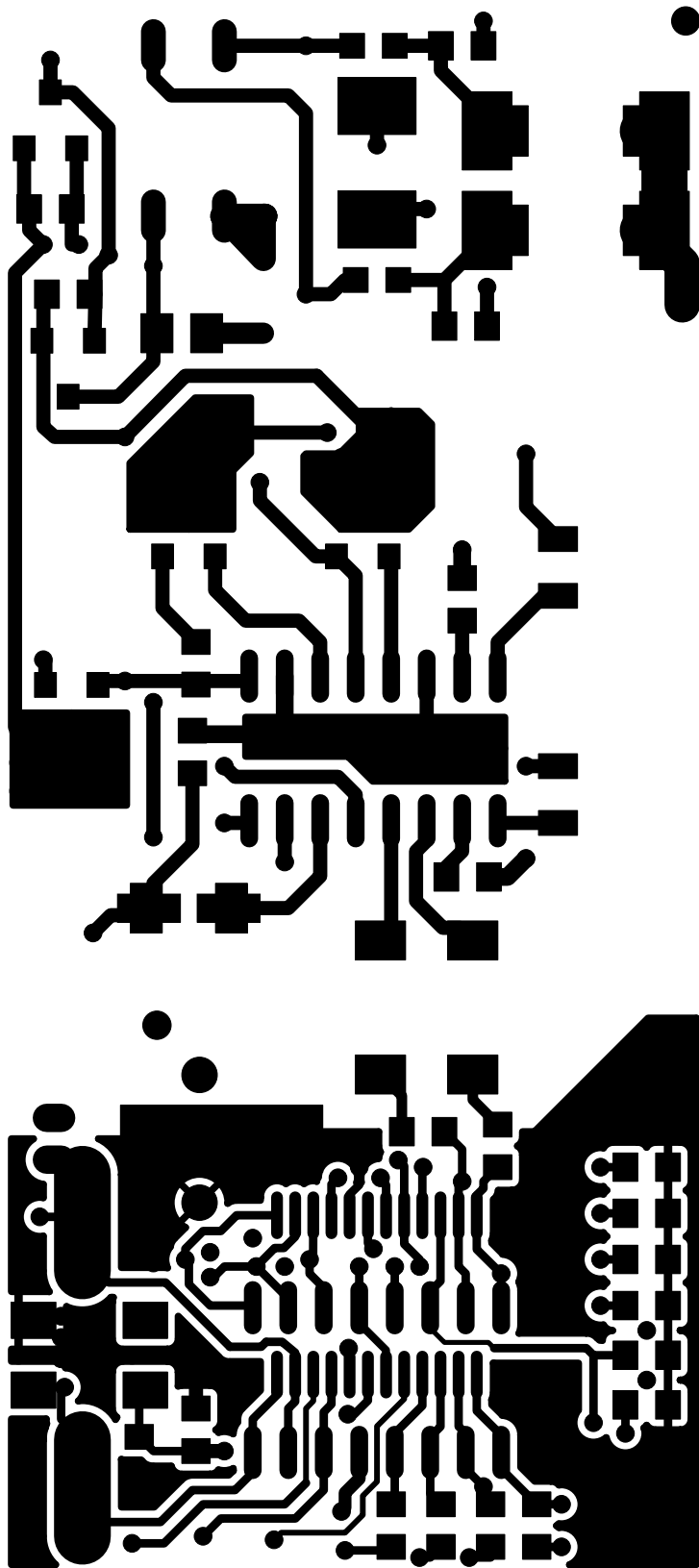


Figure 16. Daughter Card Primary Side Layout

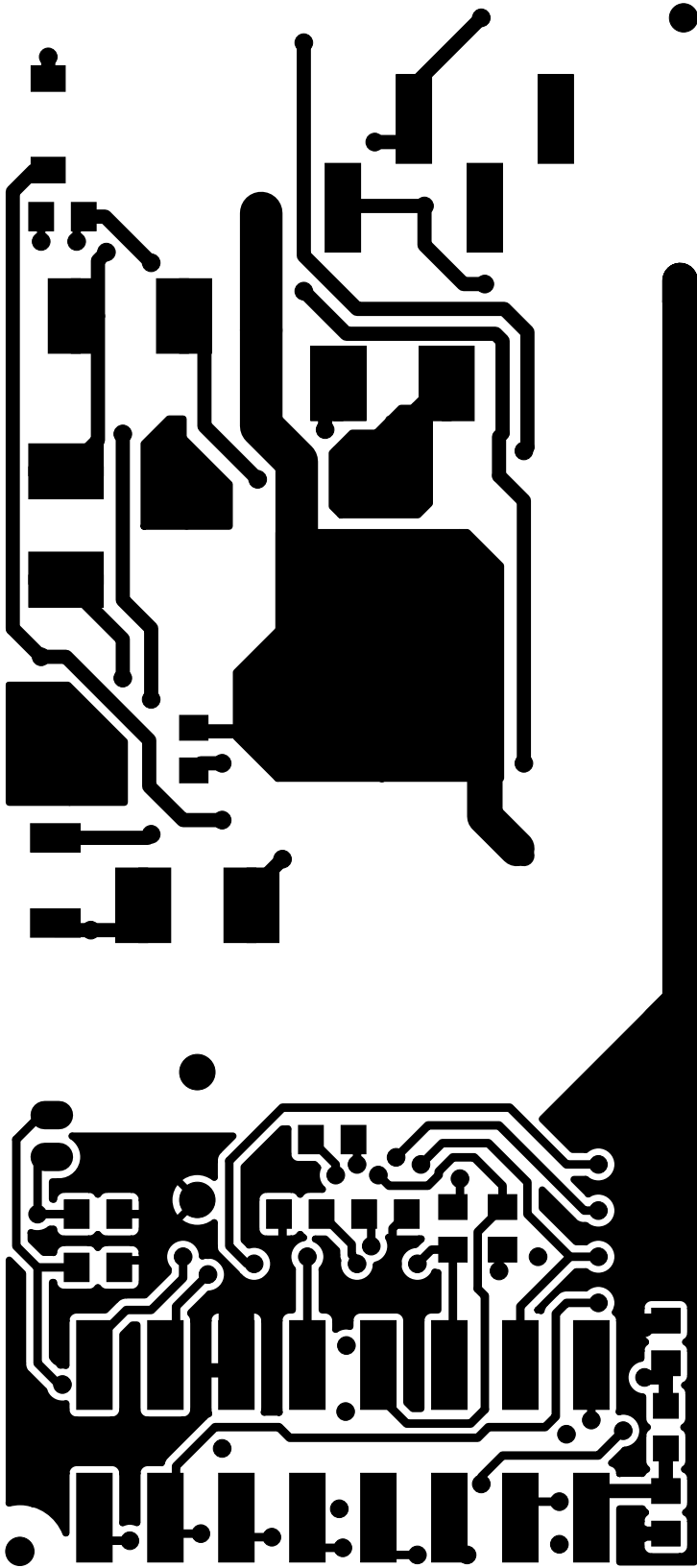


Figure 17. Daughter Card Secondary Side Layout

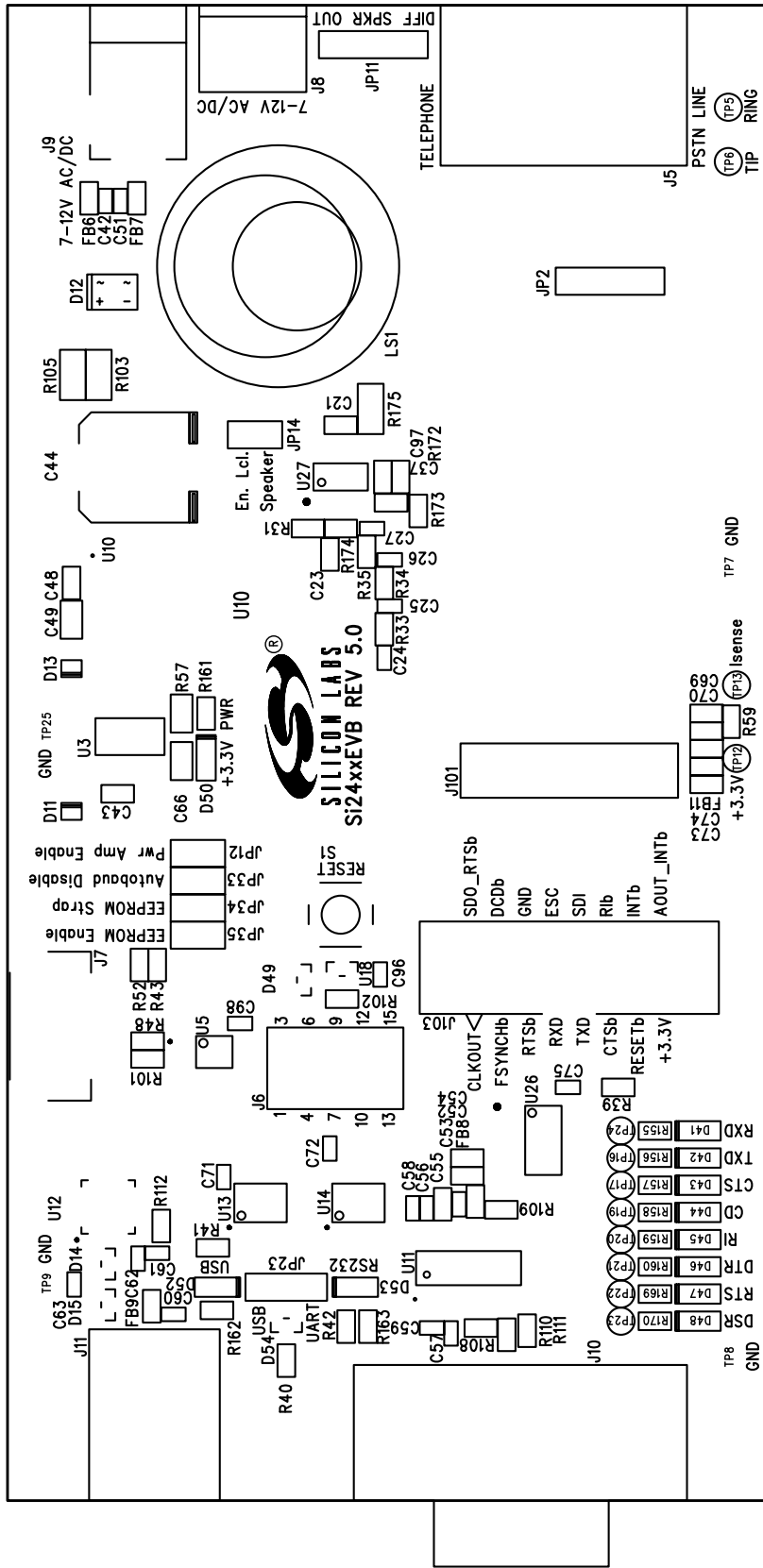


Figure 18. Motherboard Primary Side Silkscreen

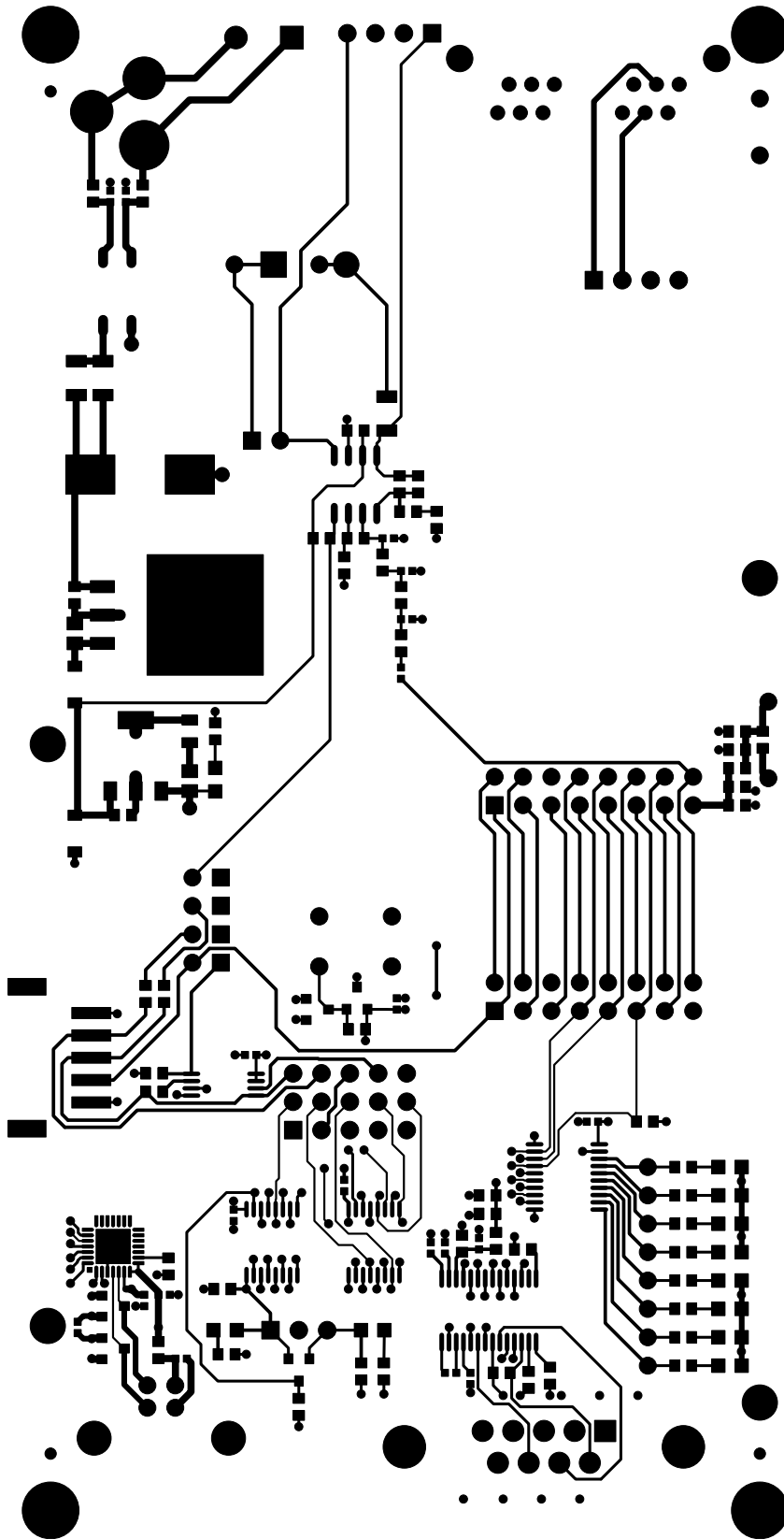


Figure 20. Motherboard Primary Side Layout

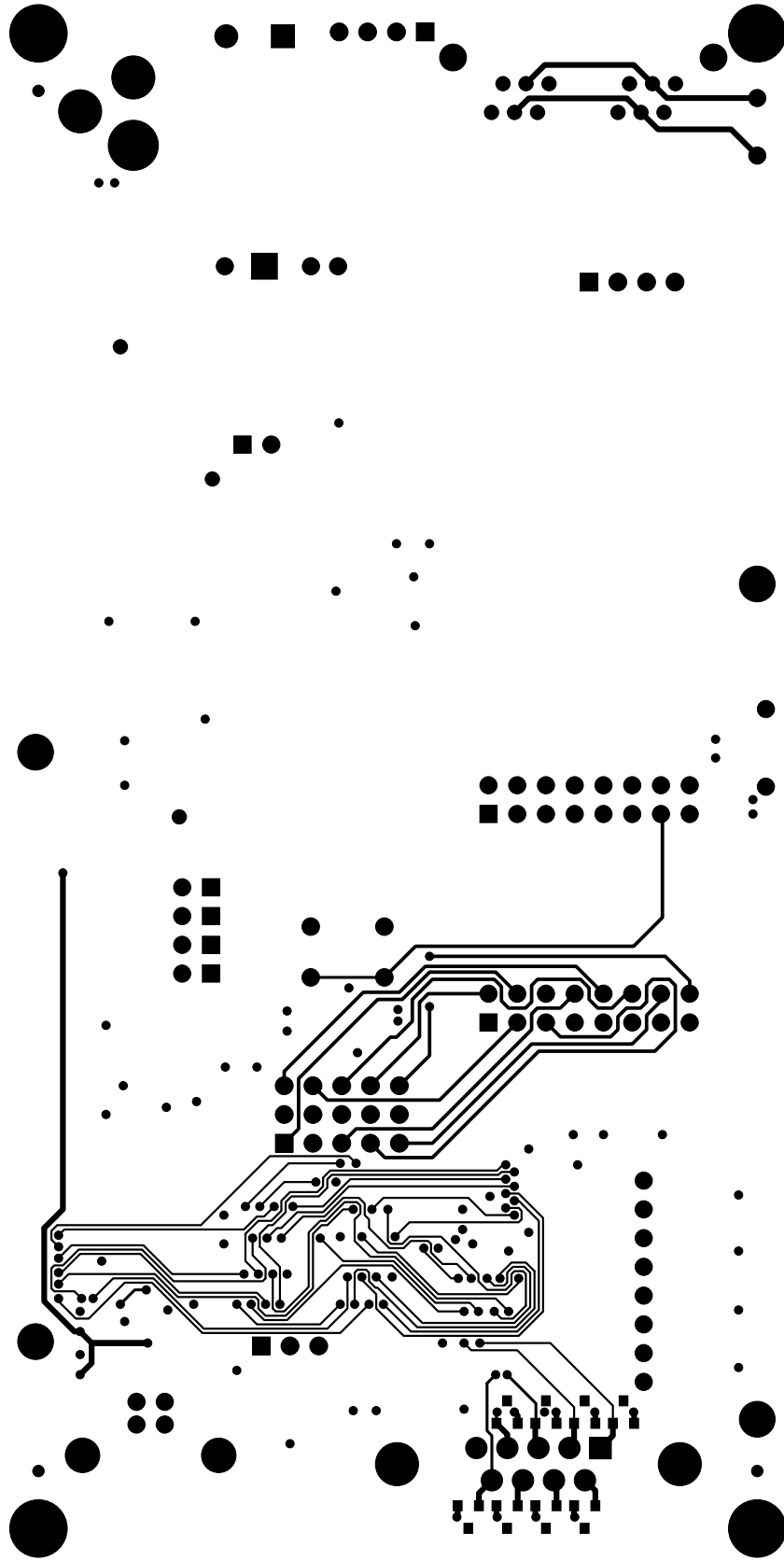


Figure 21. Motherboard Secondary Side Layout

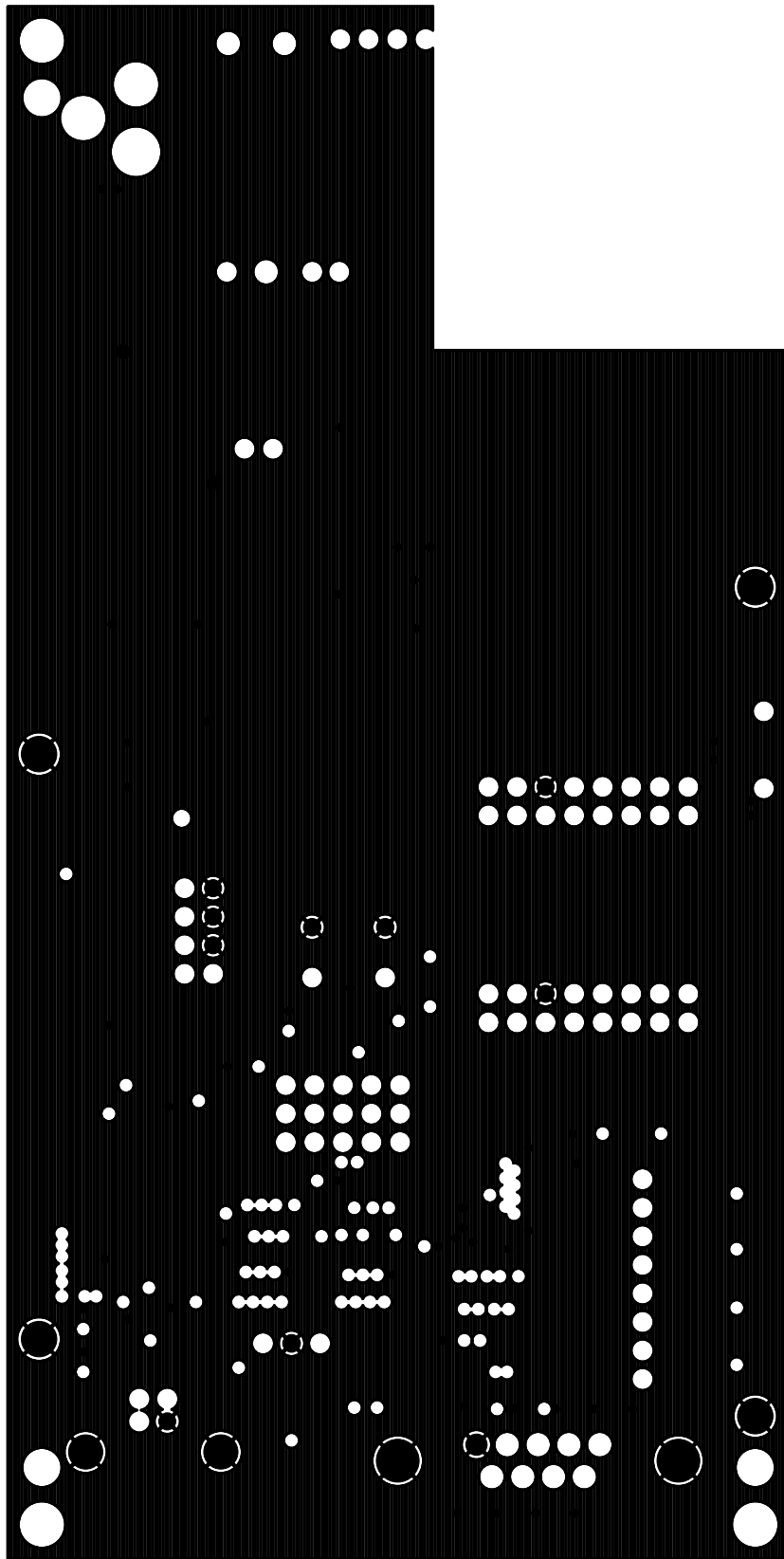


Figure 22. Motherboard Ground Plane Layout

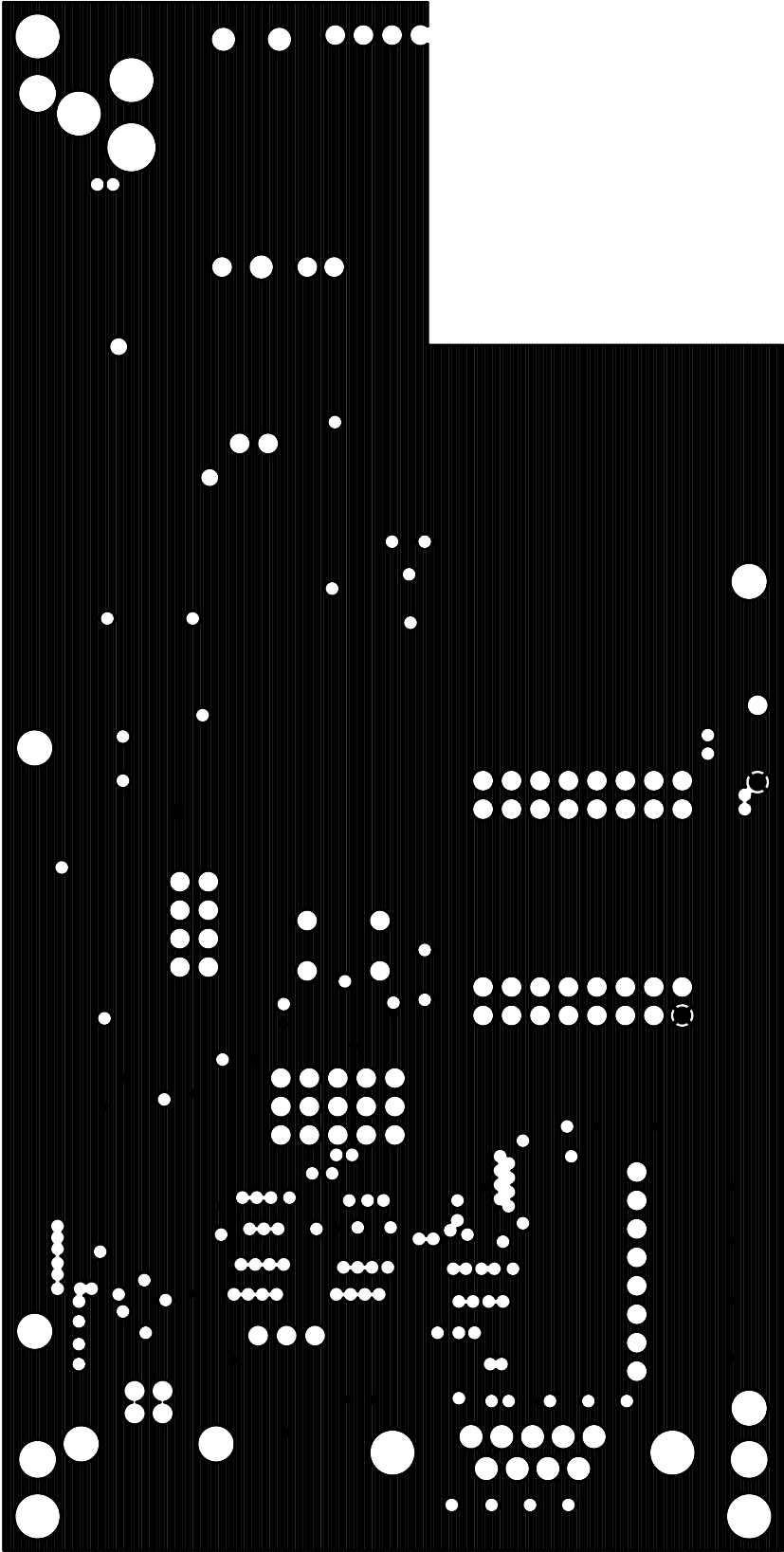


Figure 23. Motherboard Power Plane Layout

6. Complete Design Package on CD (See Sales Representative for Details)

Silicon Laboratories can provide a complete design package of the Si2493/57/34/15/04-EVB including the following:

- OrCad Schematics
- Gerber Files
- BOM
- Documentation

Contact your local sales representative or Silicon Laboratories headquarters sales for ordering information.

DOCUMENT CHANGE LIST

Revision 0.2 to Revision 0.3

- Updated Figure 15, “Daughter Card Secondary Side Silkscreen,” on page 24.
- Updated Figure 16, “Daughter Card Primary Side Layout,” on page 25.
- Updated Figure 17, “Daughter Card Secondary Side Layout,” on page 26.
- Updated “Bill of Materials: Si24xx Daughter Card” .

Revision 0.3 to Revision 0.4

- Changed from Rev.1.0 to Rev.1.1 Daughter Card.

Revision 0.4 to Revision 0.5

- Changed from Rev.3.1 to Rev.3.2 Motherboard.

Revision 0.5 to Revision 0.6

- Changed from Rev.1.1 to Rev.1.2 Daughter Card.
- Added FS (SOIC) Package Option.

Revision 0.6 to Revision 0.7

- Changed R1.2 to 2.0 daughtercard.
- Changed R32 to 5.0 motherboard.
- Changed power amplifier chip and speakers.
- Removed connector to SSI BUS.
- Changed regulator and power on reset circuit.
- Changed various jumper locations.

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