

## 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 or Figure 2.
2. Connect:
  - DB-9 to PC COM 1 (with a pass-through cable).
  - RJ-11 to phone line or test box.
  - 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 or Figure 4.
2. Connect:
  - USB cable to PC
  - RJ-11 to phone line or test box
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. Jumper Settings

Check all jumper settings on the Si2493/57/34/15/04-EVB before applying power. The standard factory jumper settings for the FT package are shown in Figure 1; the FS package is shown in Figure 2. These settings configure the Si2493/57/34/15/04-EVB for RS-232 serial operation with autobaud. Any standard terminal program configured to communicate through a PC COM port can be used to communicate with the Si2493/57/34/15/04-EVB. The standard factory jumper settings for USB operation with the FT package are shown in Figure 3; the FS package is shown in Figure 4. The only difference between RS-232 and USB jumper settings is that JP5 must be installed to enable USB.

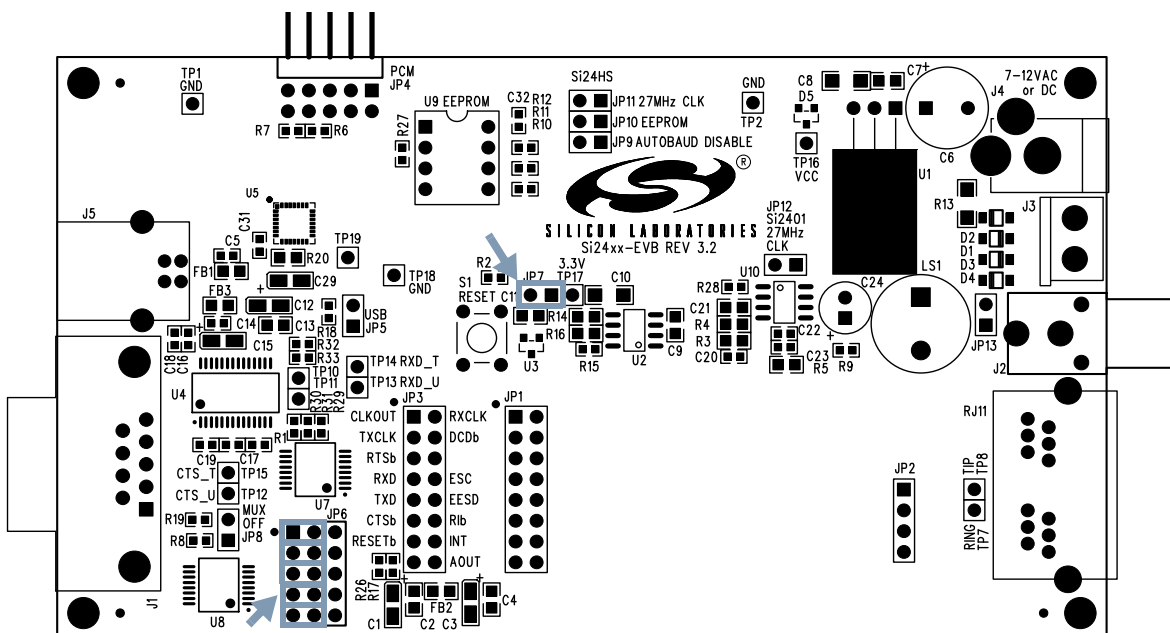
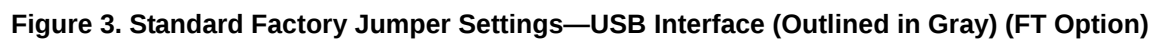


Figure 1. Standard Factory Jumper Settings—RS-232 Interface (Outlined in Gray) (FT Option)



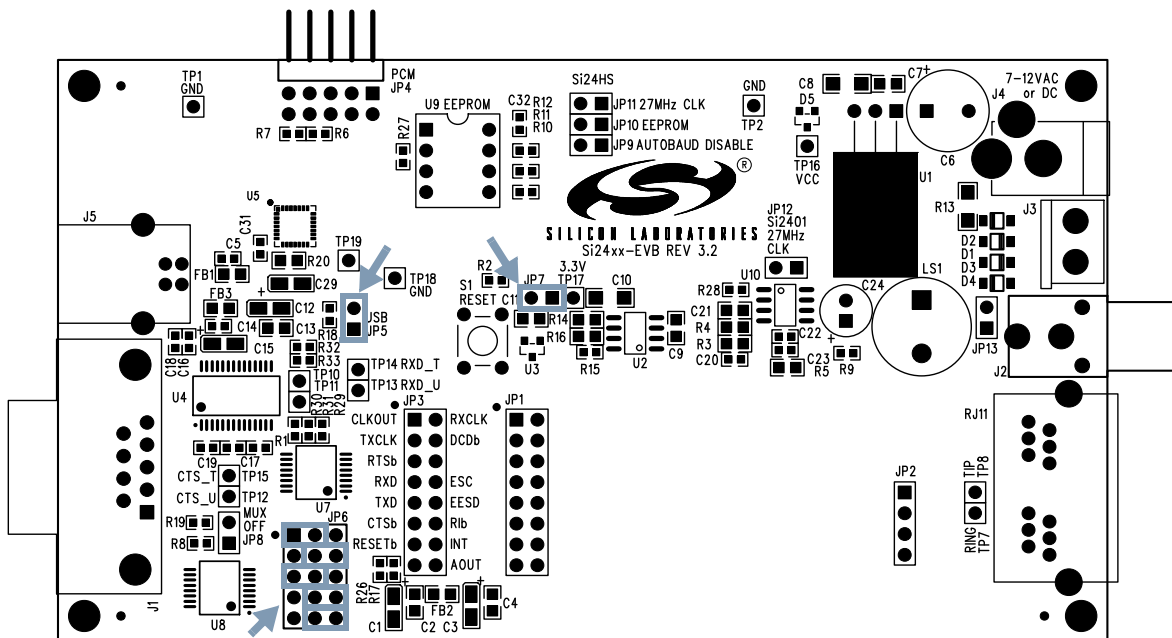


Figure 4. Standard Factory Jumper Settings—USB Interface (Outlined in Gray) (FS Option)

## 1.4. Power Requirements

The Si2493/57/34/15/04-EVB has an on-board diode bridge, filter capacitor, and voltage regulator (U1). 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 (J3), the 2 mm power jack (J4), 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 power is supplied through voltage regulator U2 by connecting JP7, pins 1 and 2. Daughter card current can be measured by connecting an ammeter between JP7, pins 1 and 2. Failure to connect pins 1 and 2 of JP7 through either a jumper or a low-impedance ammeter may result in damage to the Si2493/57/34/15/04-EVB.

## 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 JP9 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 5.

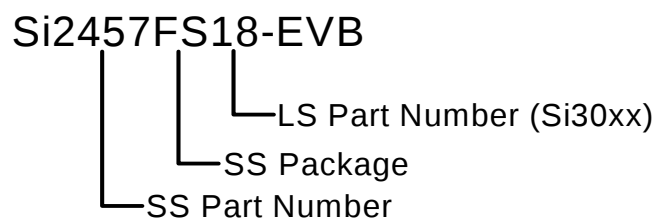


Figure 5. EVB Part Number Example

## 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, JP1 and JP2. JP1 is an 8x2 socket 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 JP1 (daughter card interface) are LVCMOS and TTL compatible. The Si2493/57/34/15/04 daughter card must be powered by 3.3 V. The motherboard is factory configured for 3.3 V with JP7. 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 J3 or J4 must be between 7.5 and 13.5 V dc or 7.5 and 13.5 V<sub>PEAK</sub> ac. The motherboard includes a diode bridge (D1–D4) 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. C6 serves as a filter cap for an ac input. The voltage regulator, U1, provides 5 V for the motherboard and the input for voltage regulator U2, 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 between pins 1 and 2 of JP7. The connection between JP7 pins 1 and 2 must be made at all times when power is applied to the evaluation board either through a jumper block or a low-impedance meter to avoid damage to the daughter card. 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, U3 (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. See

Figure 13 on page 17 and Figure 15 on page 19 for the reset circuit schematic.

## 2.1.3. 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  $\pm 10\%$  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. If S1 is used in conjunction with U3, 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 JP10 enables the optional EEPROM, U9. 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. Table 1 lists the interface controlled by each motherboard jumper. See Figure 14 on page 18 and Figure 24 on page 28.

**Table 1. Interface Selection Jumpers**

| Jumper | Function                            |
|--------|-------------------------------------|
| JP1    | Daughter Card Digital Connector.    |
| JP2    | Daughter Card Phone Line Connector. |
| JP3    | Direct Access Header.               |
| JP4    | PCM Interface.                      |
| JP5    | USB Enable (RS-232 Disable).        |
| JP6    | Options.                            |
| JP7    | 3.3 V Power for Daughter Card.      |
| JP8    | Disable both RS-232 and USB.        |
| JP9    | Autobaud disable.                   |
| JP10   | EEPROM enable.                      |
| JP11   | Enable 27 MHz Clock option.         |
| JP12   | Not used.                           |
| JP13   | On-board speaker enable.            |

## 2.1.7. RS-232 Interface

This operation mode uses the standard factory jumper settings illustrated in Figure 1 on page 2. 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 2.

## 2.1.8. USB Interface

The USB cable connects to J5 on the motherboard and provides both data and power. Installing a jumper on JP5 enables the USB interface and disables the RS-232 interface. The USB interface is provided by U5. A USB driver for this chip is available for most PC and MAC operating systems on the CD.

## 2.1.9. Direct Access Interface

The motherboard supplies power through J3, J4, or USB, power-on reset, and an RJ-11 jack for the modem. The direct access interface (JP3) is used to connect the motherboard to an embedded system. JP3 provides access to all Si2493/57/34/15/04 signals available on the daughter card. It is necessary to install a jumper on JP8 to disable both the RS-232 and USB interface and prevent signal contention. *Leave the jumper between JP7 pins 1 and 2.* Figures 6 and 7 illustrate the jumper settings required for the direct access mode using the motherboard.

## 2.1.10. PCM Interface (FT Only)

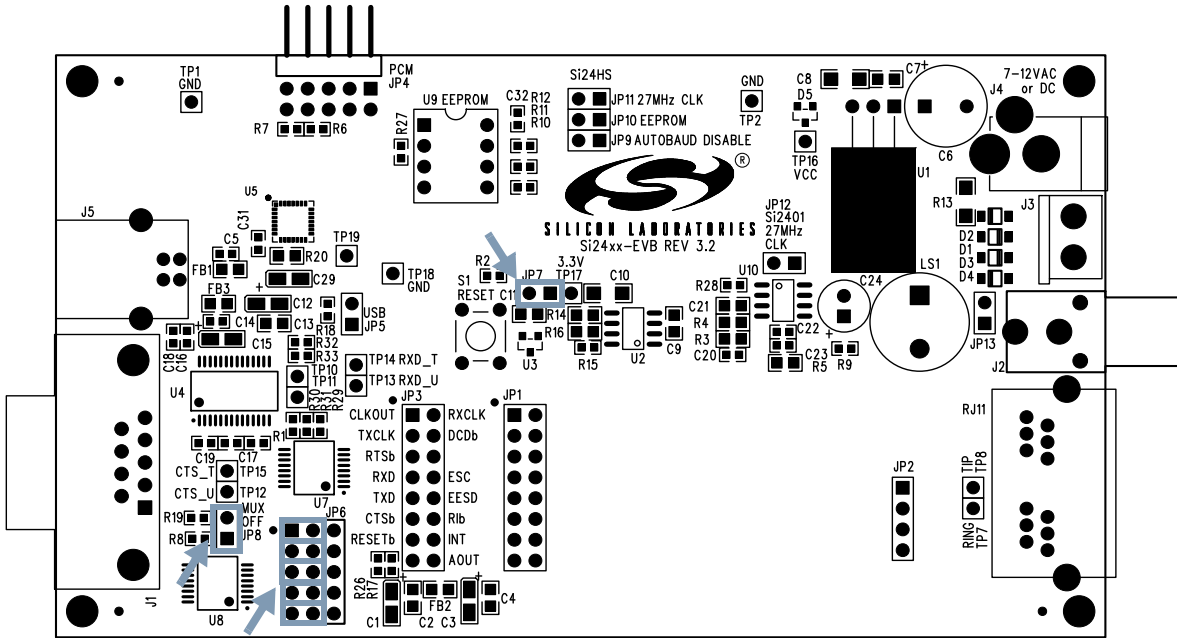
The Si2493/57/34/15/04 PCM interface is available on JP4. Table 3 lists the pin connections for JP4 designed to connect directly to the Si3000SSI-EVB JP6.

**Table 2. DB9 Pin Connections**

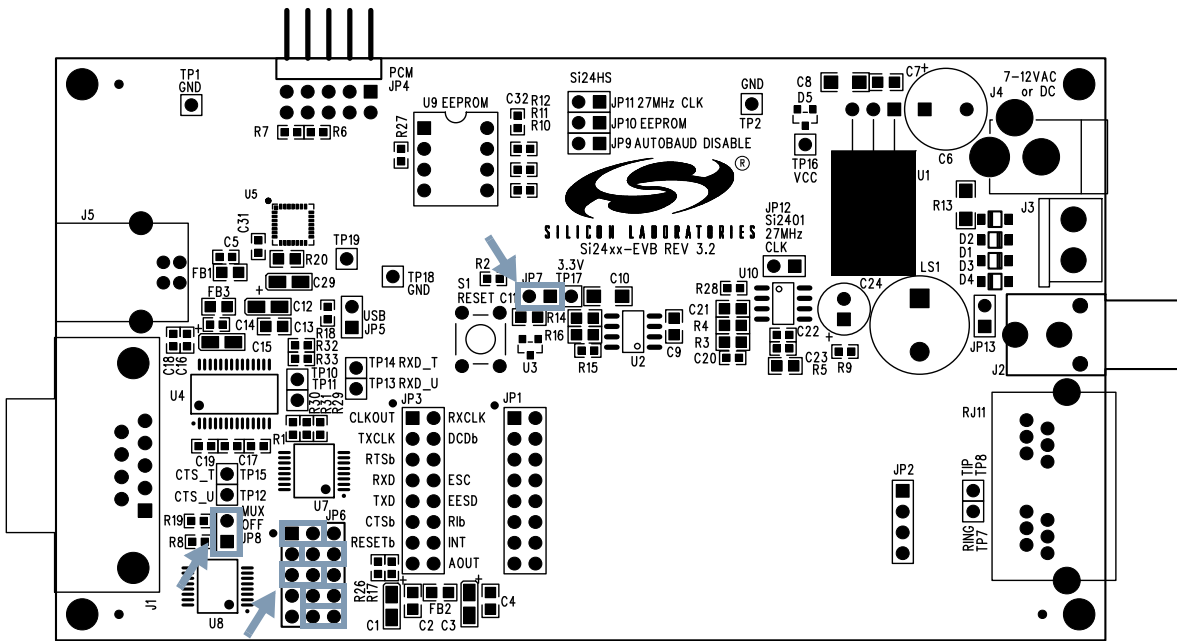
| J1 Name                          | J1 Symbol | J1 Pin | Si2493/57/34/15/04 Pin | Si2493/57/34/15/04 Name |
|----------------------------------|-----------|--------|------------------------|-------------------------|
| Carrier Detect                   | CD        | 1*     | See note               | 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               | INT/AOUT                |
| Ready to Send                    | RTS       | 7*     | See note               | RTS/RXCLK               |
| Clear to Send                    | CTS       | 8      | 11                     | CTS                     |
| Ring Indicator                   | RD        | 9*     | 17                     | RI                      |
| <b>*Note:</b> JP6 jumper option. |           |        |                        |                         |

**Table 3. JP 4 PCM Interface Pin Connections**

| JP 4 Pin | Board Signal | Si24xx Pin | Si24xx Signal |
|----------|--------------|------------|---------------|
| 1        | CLKOUT_H     | 3          | CLKOUT        |
| 2        | TXCLK_H      | 4          | FSYNC         |
| 3        | GND          | 6, 20      | GND           |
| 4        | GND          | 6, 20      | GND           |
| 5        | RXCLK_H      | 24         | SDO           |
| 6        | EESD_H       | 18         | SDI           |
| 7        | RESETb       | 12         | RESET*        |
| 8        | 3.3 V        | 5, 21      | VD3.3         |
| 9        | GND          | 6, 20      | GND           |
| 10       | VCC (+5 V)   |            |               |

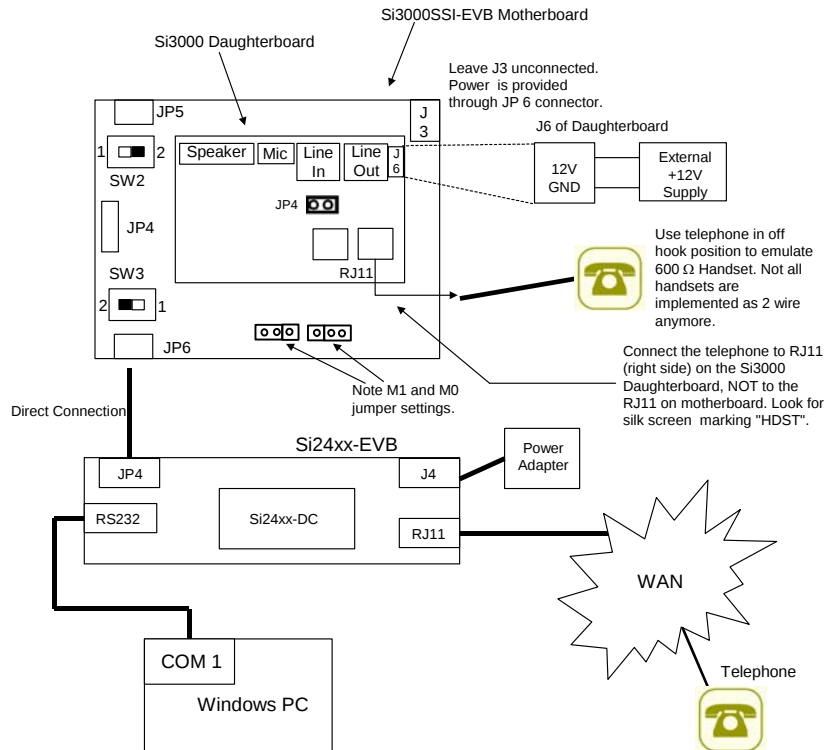


### Figure 6. Jumper Settings for Direct Access Interface (FT Option)



### Figure 7. Jumper Settings for Direct Access Interface (FS Option)

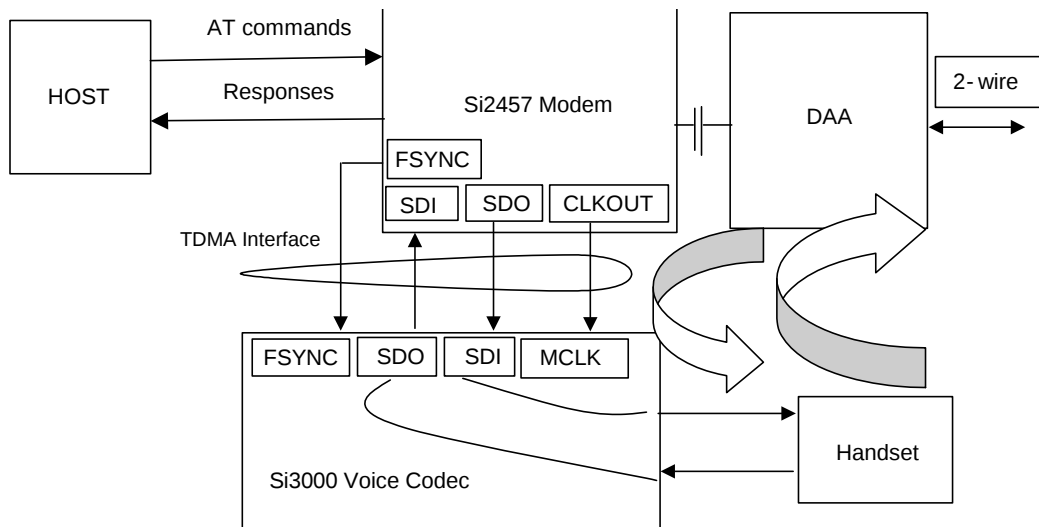
The block diagram in Figure 8 shows how the two evaluation boards are connected to demonstrate voice mode operation.



**Figure 8. Connection Block Diagram for Si3000SSI-EVB and Si24XXURT-EVB**

## 2.1.11. Voice Mode

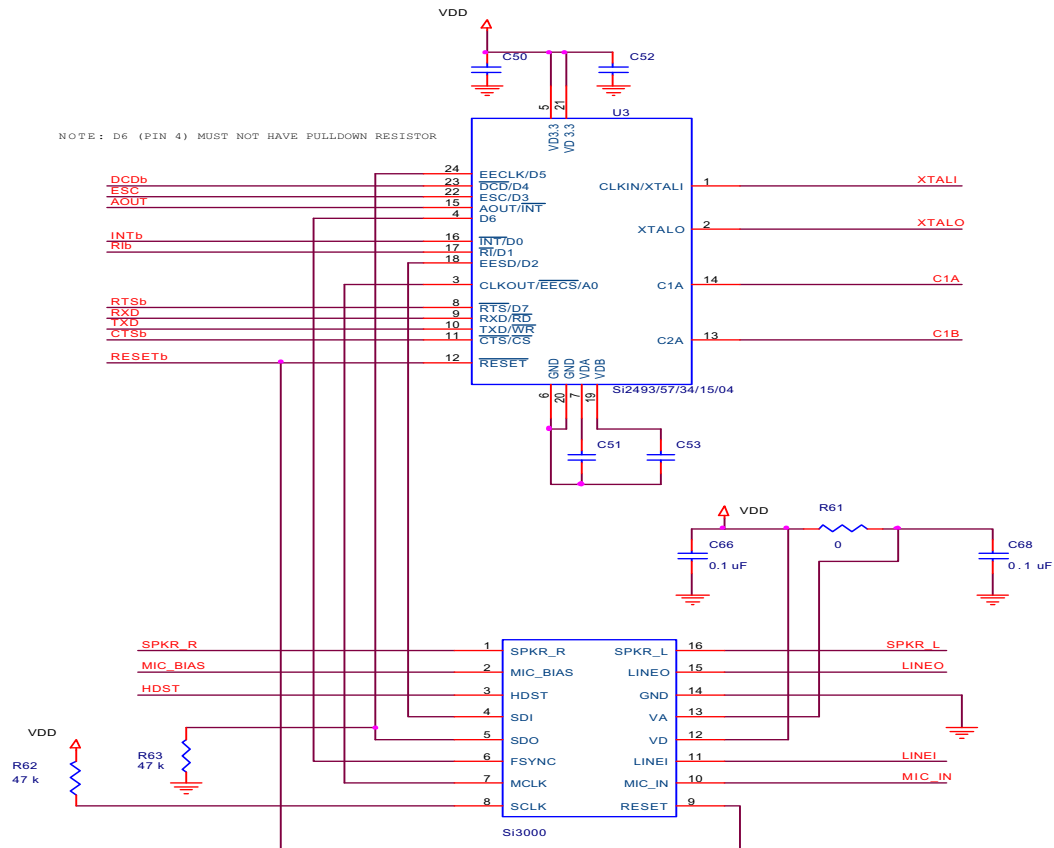
The Si3000 is used in conjunction with the Si2493/57/34/15/04 to transmit and receive 16-bit voice samples to and from telephone lines as shown in Figure 9.



**Figure 9. Voice Mode Block Diagram**

# Si2493/57/34/15/04

Figure 10 shows the actual circuit connection between the Si2493/57/34/15/04 and the Si3000.



**Figure 10. Circuit Connection between the Si2493/57/34/15/04 and the Si3000**

To use voice mode register U71 and data memory location 0x0059 must be properly configured.

Setting data memory 0x0059 = 0x0001 enables the Si24XX TDMA interface. When U71 is set to the value 0x0011 a 16-bit voice sample will be transmitted from the Si3000 through the Si2493/57/34/15/04 and DAA to the remote device. Likewise, an analog signal from the remote device will pass through the DAA where it is converted to a 16-bit voice sample, the Si24XX and finally the Si3000 where it is converted back to the analog receive signal.

In this example, the Si3000 has its digital TDMA interface configured as the Slave Serial Mode by adding a 50 kΩ pull-down resistor to SDO pin and a pull-up 50 kΩ resistor to SCLK pin. In this mode, the Si3000's MCLK is driven by the 2048 kHz clock from Si2493/57/34/15/04. The FSYNC has an 8 kHz pulse input. The bit clock is  $2048/8 = 256$  bits per frame sync. Refer to the Si3000 documentation for further details.

To send control information to the Si3000, the Si2493/57/34/15/04 modem chip provides a PCM control port 0x004B that allows the user to send control words across by using the AT memory write command. See Table 4. for details. Wait for the "OK" (approximately 300 ms after each command). When a connection is established, the "AT." command is used to generate the DTMF tone of a number; For example, AT.3<CR> will generate a number 3 DTMF tone without the need for an external DTMF generator. See "Voice Mode Example" for details.

**Table 4. Voice Commands**

| <b>AT Commands</b> | <b>Purposes</b>                                                                                               |
|--------------------|---------------------------------------------------------------------------------------------------------------|
| AT:U71,11          | Configure modem to send/receive data in linear mode to/from Si3000 interface                                  |
| AT*Y254:W0059,7785 | Enable Si2457 modem TDMA's interface by setting LSBit of memory 0x0059                                        |
| AT*Y254:W004B,011C | Write to Si3000 Control Reg1: Line Driver, Handset Driver, and Microphone Bias Normal Operations are enabled. |
| AT*Y254:W004B,0200 | Write to Si3000 Control Reg2: HPF enabled, PLL divided by 5, Digital Loopback Off                             |
| AT*Y254:W004B,0300 | Write to Si3000 Control Reg3: PLL Divider N1                                                                  |
| AT*Y254:W004B,0400 | Write to Si3000 Control Reg4: PLL Divider M1                                                                  |
| AT*Y254:W004B,055A | Write to Si3000 Control Reg5: Line-In, Mic-In, Handset-In, FIR are activated.                                 |
| AT*Y254:W004B,067F | Write to Si3000 Control Reg6: Line-Out, Handset-Out are activated.                                            |
| AT*Y254:W004B,075F | Write to Si3000 Control Reg7: SPKR_L, SPLR_R are activated.                                                   |
| ATH1               | Off-hook command for calling                                                                                  |
| AT.1               | Dial individual number 1                                                                                      |
| AT.0               | Dial individual number 0                                                                                      |
| AT.4               | Dial individual number 4 and wait for answer                                                                  |

## 2.2. Voice Mode Example

Perform the following steps:

1. Connect hardware as shown in Figure 8 on page 9. Note that the Si3000 Evaluation Board requires an external 12 V supply and derives 5 V power from the Si24xx-EVB. The Si24xx-EVB should be connected to the supplied power adapter or powered through USB.

2. Enter the following AT commands to initialize the modem:

|                           |                                        |
|---------------------------|----------------------------------------|
| ATZ                       | reset modem                            |
| ATE0                      | disable echo                           |
| AT:U0071,11               | enable voice routing firmware          |
| AT*Y254:W0059,7785        | enable Si3000 Hardware Interface       |
|                           | In actual application, this line       |
|                           | must be implemented as a read-modify-  |
|                           | write consisting of the following:     |
|                           | n = AT*Y254:Q0059                      |
|                           | n  = 1                                 |
|                           | AT*Y254:W0059,n                        |
| AT*Y254:W004B,011C        | Si3000 Reg 01 = 1C                     |
|                           | This applies power to SPKRx,HDST,LINE0 |
| AT*Y254:W004B,0545        | Si3000 Reg 05 = 45                     |
|                           | Enable HDST into ADC mixer             |
|                           | MIC input disabled                     |
|                           | LINEI input disabled                   |
| AT*Y254:W004B,065D        | Si3000 Reg 06 = 6D                     |
|                           | Activate HDST as output                |
|                           | Keep LINE0 muted                       |
| 0 db Receive Gain Setting |                                        |
| AT*Y254:W004B,075C        | Si3000 Reg 07 = 5C                     |
|                           | 0 dB Transmit Gain                     |
|                           | Keep SPKRx muted                       |

3. Type "ATDTnnn", where nnn represents the telephone number of the remote telephone.
4. The remote phone rings and should be picked up.
5. Also pick up the local phone connected to the Si3000 Evaluation Board.
6. At this point, a voice connection exists between the two telephones.
7. It is also possible to send a series of single digit DTMF tones to the remote phone using the "AT.N" command (dot character is in-between "AT" and "N", where N is a DTMF digit 0-9,A-F).

Example:

AT.1 sends DTMF digit 1, return to voice mode.

## 2.2.1. Audio Output

Audio output is provided from the Si2457/34/15 on the AOUT pin. 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 can be connected to an amplifier, such as the LM386 (the default stuffing option on the Si2457/34/15URT-EVB), for 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.

## 2.2.2. Amplifier (LM386)

The audio amplifier circuit consists of U10 (LM386), C20, R3, R4, C21, C22, C23, R5, C24, and an optional loudspeaker, LS1. The LM386 has an internally-set voltage gain of 20. R3 and R4 provide a voltage divider to reduce the AOUT signal to prevent overdriving the LM386. C20 provides dc blocking for the input signal and forms a high-pass filter with R3+R4 while R4 and C21 form a low-pass filter. These four components limit the bandwidth of the AOUT signal. C22 provides high-frequency power supply bypassing for the LM386 and should be connected to a hard ground and located very close to the amplifier's power supply and ground pins. C23 and R5 form a compensation circuit to prevent oscillation of the high current PNP transistor in the LM386 output stage on negative signal peaks. These oscillations can occur between 2–5 MHz and can pose a radiation compliance problem if C23 and R5 are omitted. C24 provides dc blocking for the output of the LM386, which is biased at approximately 2.5 V ( $V_{CC}/2$ ), and forms a high-pass filter with the impedance of the loudspeaker (LS1). The output from the LM386 amplifier circuit is available on the RCA jack, J2 (not installed). Install jumper JP13 to enable the on-board speaker, LS1.

## 2.3. Modem Module Operation

The Si2457/34/15URT-EVB daughter card is a complete modem solution perfectly suited for use in an embedded system.

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.

### 2.3.1. Reset Requirements

The Si2457/34/15 ISModem<sup>®</sup> daughter card must be properly reset at powerup. The reset pin (pin 8) of the Si2457/34/15 (JP1, 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.

### 2.3.2. Crystal Requirements

Clock accuracy and stability are important in modem applications. To ensure reliable communication between modems, the clock must remain within  $\pm 100$  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  $\pm 100$  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.

### 2.3.3. 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.

## 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.

"Si24xx2G-DC Rev. 1.0 IS0modem TM"

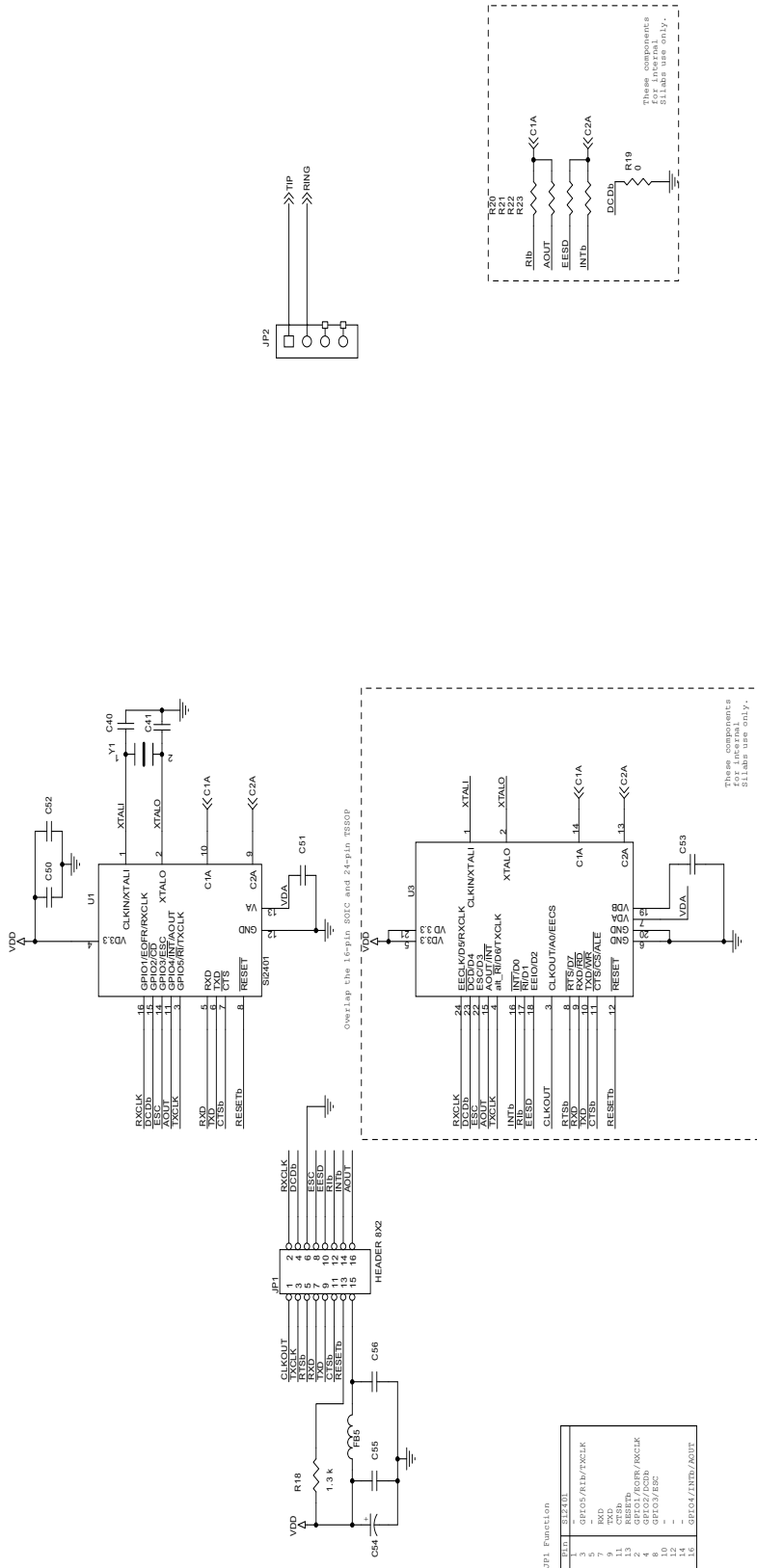


Figure 11. Si2493/57/34/15/04 Schematic

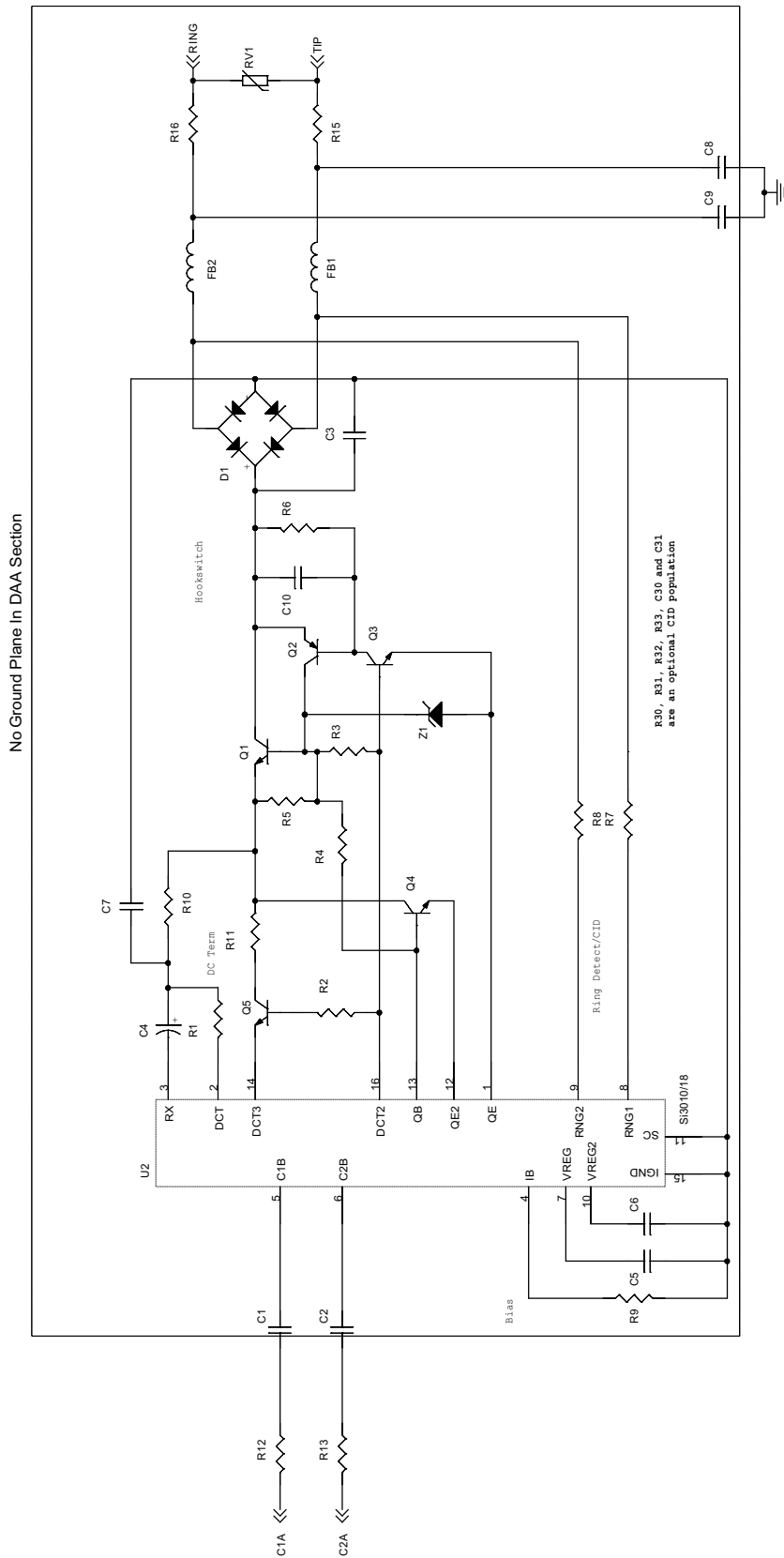


Figure 12. Si3018/10 DAA Schematic

## 4. Bill of Materials: Si24xx Daughter Card

| Item | Quantity | Reference       | Value        | Rating                | Tolerance | Foot Print                            | Dielectric         | Manufacturer Number | Manufacturer         |
|------|----------|-----------------|--------------|-----------------------|-----------|---------------------------------------|--------------------|---------------------|----------------------|
| 1    | 2        | C2,C1           | 33 pF        | Y2                    | ±20%      | 1808                                  | X7R                | GA342D1XGF330JY02L  | Murata               |
| 2    | 1        | C3              | 10 nF        | 250 V                 | ±20%      | 0805                                  | X7R                | C0805X7R251-103MNE  | Venkel               |
| 3    | 1        | C4              | 1.0 uF       | 50 V                  | ±20%      | Size A                                | Al<br>Electrolytic | NACE1R0M50V         | NIC Components       |
| 4    | 3        | C5,C6,C50       | 0.1 uF       | 16 V                  | ±20%      | 0603                                  | X7R                | C0603X7R160-104MNE  | Venkel               |
| 5    | 1        | C7              | 2.7 nF       | 50 V                  | ±20%      | 0603                                  | X7R                | C0603X7R500-272MNE  | Venkel               |
| 6    | 2        | C9,C8           | 680 pF       | Y3                    | ±10%      | 1808                                  | X7R                | GA342QR7GD681KW01L  | Murata               |
| 7    | 1        | C10             | 0.01 uF      | 16 V                  | ±20%      | 0603                                  | X7R                | C0603X7R160-103MNE  | Venkel               |
| 8    | 2        | C41,C40         | 33 pF        | 16 V                  | ±5%       | 0603                                  | NPO                | C0603NPO160-330JNE  | Venkel               |
| 9    | 1        | C51             | 0.22 uF      | 16 V                  | ±20%      | 0603                                  | X7R                | C0603X7R160-104MNE  | Venkel               |
| 10   | 1        | C54             | 1.0 uF       | 10 V                  | ±10%      | Case A                                | Tant               | TA010TTCM105-KAL    | Venkel               |
| 11   | 1        | D1              | HD04         | 400 V                 |           | Mini-DIP                              |                    | HD04-T              | Diodes, Inc.         |
| 12   | 2        | FB1,FB2,FB5     | Ferrite Bead |                       |           | 0603                                  |                    | BLM18AG601S         | MuRata               |
| 13   | 1        | JP1             | HEADER 8X2   |                       |           | 2x8 Surface Mount<br>Header, .1 space |                    | TSM-108-01-T-DV     | Samtec               |
| 14   | 1        | JP2             | 4X1 Header_0 |                       |           | CONN1X4-100-<br>SMT                   |                    | 68000-403           | Berg                 |
| 15   | 2        | Q3,Q1           | NPN          | 300 V                 |           | SOT-23                                |                    | MMBTA42LT1          | OnSemi               |
| 16   | 1        | Q2              | PNP          | 300 V                 |           | SOT-23                                |                    | MMBTA92LT1          | OnSemi               |
| 17   | 2        | Q4,Q5           | NPN          | 80 V                  |           | SOT-23                                |                    | MMBTA06LT1          | OnSemi               |
| 18   | 1        | RV1             | SiDactor     | 275 V                 | 100 A     | SOD 6                                 |                    | P3100SB             | Teccor               |
| 19   | 1        | R1              | 1.07 K       | 1/2 W                 | ±1%       | 1210                                  |                    | CR1210-2W-1071FT    | Venkel               |
| 20   | 1        | R2              | 150          | 1/16 W                | ±5%       | 0402                                  |                    | CR0402-16W-150JT    | Venkel               |
| 21   | 1        | R3              | 3.65 K       | 1/2 W                 | ±1%       | 1210                                  |                    | CR1210-2W-3651FT    | Venkel               |
| 22   | 1        | R4              | 2.49 K       | 1/2 W                 | ±1%       | 1210                                  |                    | CR1210-2W-2491FT    | Venkel               |
| 23   | 2        | R5,R6           | 100 K        | 1/16 W                | ±5%       | 0402                                  |                    | CR0402-16W-104JT    | Venkel               |
| 24   | 2        | R8,R7           | 20 M         | 1/8 W                 | ±5%       | 0805                                  |                    | CR0805-8W-206JT     | Venkel               |
| 25   | 1        | R9              | 1 M          | 1/16 W                | ±1%       | 0402                                  |                    | CR0402-16W-1004FT   | Venkel               |
| 26   | 1        | R10             | 536          | 1/4 W                 | ±1%       | 1206                                  |                    | CR1206-4W-5360FT    | Venkel               |
| 27   | 1        | R11             | 73.2         | 1/2 W                 | ±1%       | 1210                                  |                    | CR1210-2W-73R2FT    | Venkel               |
| 28   | 4        | R12,R13,R15,R16 | 0            | 1/16 W                | ±1%       | 0603                                  |                    | CR0603-16W-000F     | Venkel               |
| 29   | 1        | U3              | Si24xx       |                       |           | 24pin TSSOP                           |                    |                     | Silicon Laboratories |
| 30   | 1        | U2              | Si3018/10    |                       |           | 16pin SOIC                            |                    | Si3018/10-FS        | Silicon Laboratories |
| 31   | 1        | Y1              | 4.9152Mhz    | 20pF load,<br>150 ESR | 50 ppm    | ATS-SM                                |                    | 559-FOXSD049-20     | CTS Reeves           |
| 32   | 1        | Z1              | 43 V         | 1/2 W                 |           | SOD-123                               |                    | MMSZ43T1            | OnSemi               |

## Non-installed Components

|    |   |                     |         |        |      |            |     |                    |                      |
|----|---|---------------------|---------|--------|------|------------|-----|--------------------|----------------------|
| 33 | 2 | C31,C30             | 120pF   | 250 V  | ±10% | 0805       | X7R | C0805X7R251-121KNE | Venkel               |
| 34 | 2 | C55,C56             | 0.1 uF  | 10 V   | ±20% | C0603      | X7R | C0603C124K         | Kemet                |
| 35 | 1 | R18                 | 1.3 k   | 1/16 W | ±5%  | RC0603     |     | CR0603-16W-132JT   | Venkel               |
| 36 | 5 | R19,R20,R21,R22,R23 | 0       | 1/16W  | ±5%  | RC0603     |     | CR0603-16W-000J    | Venkel               |
| 37 | 2 | R32,R30             | 15M     | 1/8 W  | ±5%  | 0805       |     | CR0805-8W-156JT    | Venkel               |
| 38 | 2 | R33,R31             | 5.1M    | 1/8 W  | ±5%  | 0805       |     | CR0805-8W-515JT    | Venkel               |
| 39 | 1 | C52                 | 0.1 uF  | 16 V   | ±20% | 0603       | X7R | C0603X7R160-104MNE | Venkel               |
| 40 | 1 | C53                 | 0.22 uF | 16 V   | ±20% | 0603       | X7R | C0603X7R160-104MNE | Venkel               |
| 41 | 1 | U1                  | Si2401  |        |      | 16pin SOIC |     | Si2401-KS          | Silicon Laboratories |



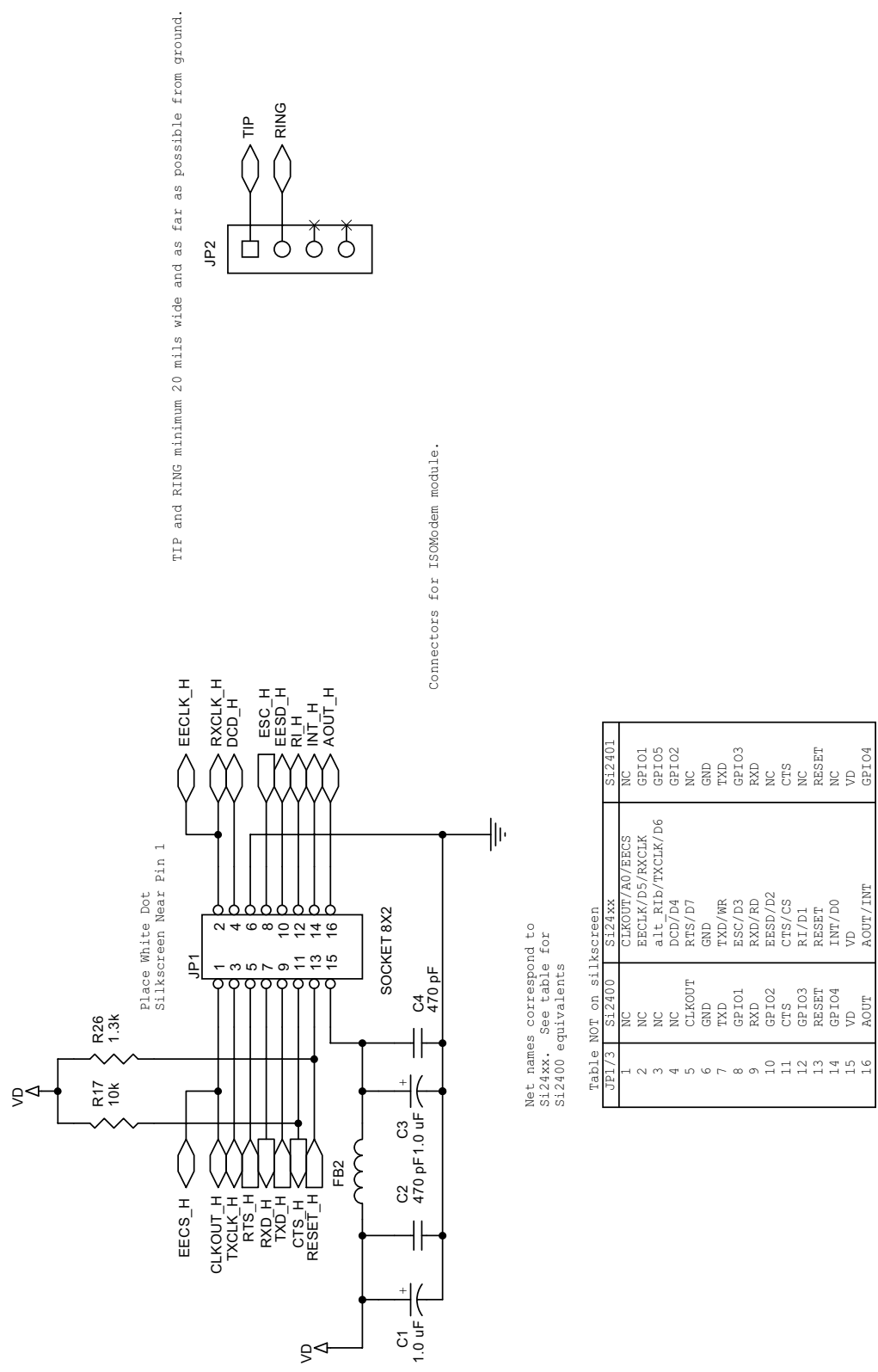
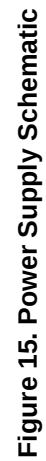


Figure 14. Daughter Card Interface Schematic



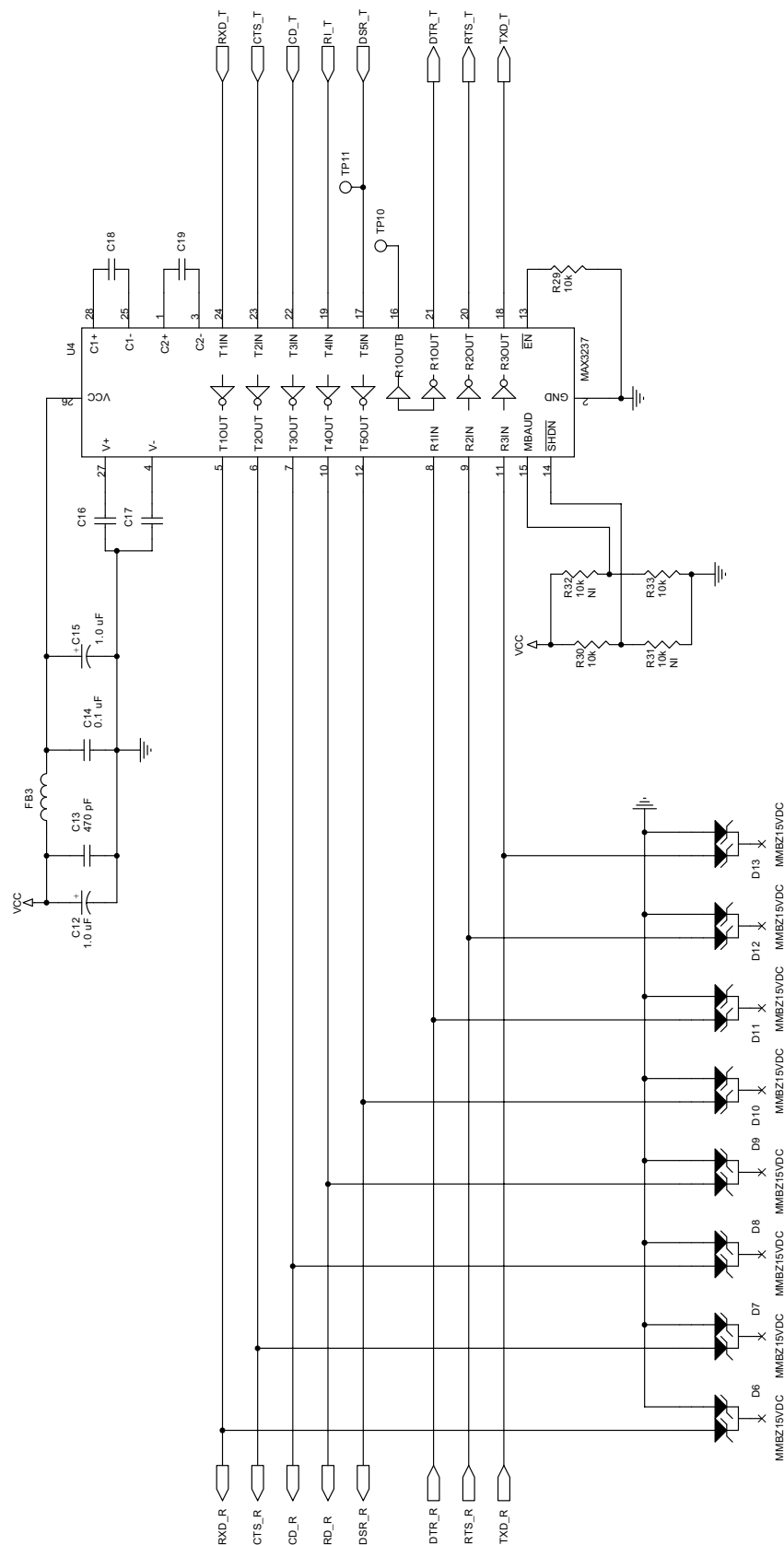


Figure 16. RS-232 Interface Schematic

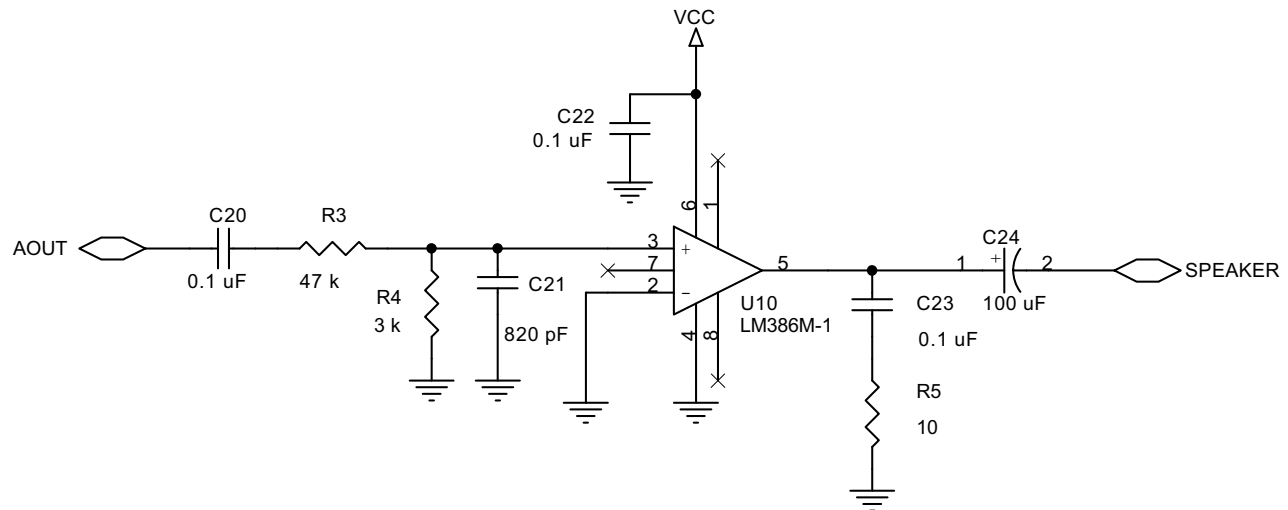


Figure 17. Audio Amplifier Schematic

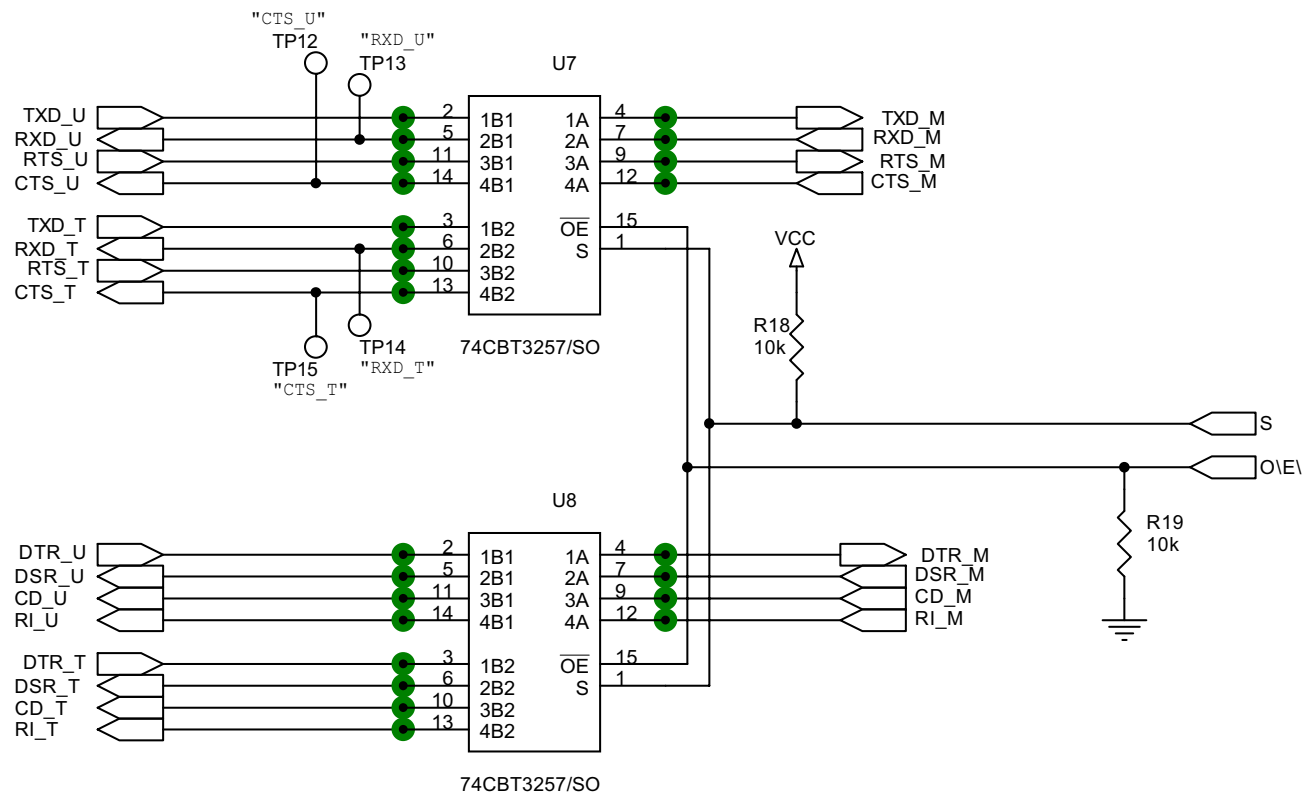
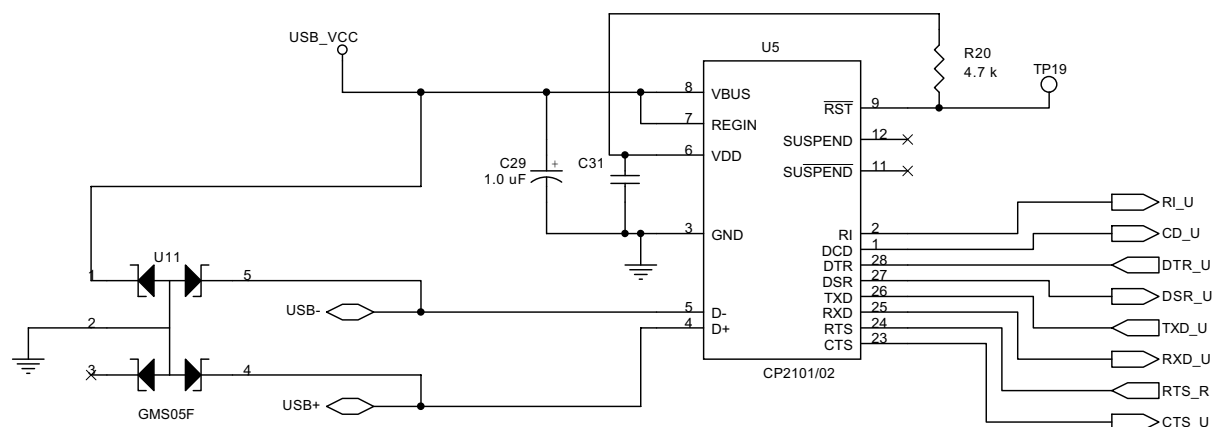


Figure 18. UART Mux Schematic



**Figure 19. USB Interface Schematic**

## 5. Bill of Materials: Si24xx Motherboard

| Item | Quantity | Reference                               | Value             | Rating | Tolerance | Foot Print       | Dielectric   | Manufacturer Number                    | Manufacturer          |
|------|----------|-----------------------------------------|-------------------|--------|-----------|------------------|--------------|----------------------------------------|-----------------------|
| 1    | 5        | C1,C3,C12,C15,C29                       | 1.0 uF            | 10 V   | ±10%      | 3216 EIAA        | Tant         | TA010TCM105-KAL                        | Venkel                |
| 2    | 4        | C2,C4,C11,C13                           | 470 pF            | 25V    | ±5%       | CC0805           | X7R          | C0805C471J5GACTU                       | TTI                   |
| 3    | 1        | C5                                      | 10 nF             | 16 V   | ±10%      | CC0603           | X7R          | C0603X7R160-103KNE                     | Venkel                |
| 4    | 1        | C6                                      | 470 uF            | 25 V   | ±20%      | C5X10MM-RAD      | Electrolytic | UVX1E471MPA                            | NIC Components        |
| 5    | 2        | C7,C9                                   | 0.1 uF            | 25 V   | ±10%      | CC0805           | X7R          | C0805X7R250-104KNE                     | Venkel                |
| 6    | 2        | C10,C8                                  | 10 uF             | 16V    | ±10%      | CC1206           | X7R          | C1206X7R100-106KNE                     | Venkel                |
| 7    | 10       | C14,C16,C17,C18,C19,C20,C22,C23,C31,C32 | 0.1 uF            | 16 V   | ±20%      | CC0603           | X7R          | C0603X7R160-104MNE                     | Venkel                |
| 8    | 1        | C21                                     | 820 pF            | 50 V   | ±5%       | CC0805           | NPO          | C0805COG500-821JNE                     | Venkel                |
| 9    | 1        | C24                                     | 100 uF            | 16 V   | ±10%      | C2.5X6.3MM-RAD   | Electrolytic | UVX1C101MEA1TD                         | Nichicon              |
| 10   | 4        | D1,D2,D3,D4                             | DIODE             | 30 V   | 0.5 A     | SOD123           |              | MBR0530T1                              | Motorola              |
| 11   | 1        | D5                                      | BAT54C            |        |           | SOT-23           |              | BAT54C                                 | Diodes Inc.           |
| 12   | 8        | D6,D7,D8,D9,D10,D11,D12,D13             | MMBZ15VDC         |        |           | SOT-23           |              | MMBZ15VDC                              | General Semiconductor |
| 13   | 3        | FB1,FB2,FB3                             | Ferrite Bead      |        |           | RC0805           |              | BLM21A601S                             | Murata                |
| 14   | 1        | JP1                                     | SOCKET 8X2        |        |           | CONN2X8          |              | SSW-108-01-T-D                         | Samtec                |
| 15   | 1        | JP2                                     | 4X1 Socket        |        |           | CONN4[6238]      |              | SSW-104-01-T-S                         | Samtec                |
| 16   | 1        | JP3                                     | HEADER 8X2        |        |           | CONN2X8          |              | 517-6121TN                             | Samtec                |
| 17   | 1        | JP4                                     | HEADER 5X2        |        |           | CONN2X5[6238]RA  |              | TSW-105-25-T-D-RA                      | Samtec                |
| 18   | 8        | JP5,JP7,JP8,JP9,JP10,JP11,JP12,JP13     | 2X1 Header        |        |           | CONN2[6040]      |              | 517-611TN                              | Berg                  |
| 19   | 1        | JP6                                     | 3x5 Header        |        |           | CONN3X5          |              |                                        |                       |
| 20   | 1        | J1                                      | DB9-RS232 1       |        |           | CONN9[6543]DBF   |              | K22-E9S-030                            | Kycon                 |
| 21   | 1        | J2                                      | RCA JACK          |        |           | CONN2[12090]JCA  |              | 16PJ097                                | Mouser                |
| 22   | 1        | J3                                      | Power Connector   |        |           | TB2[12065]TSA    |              | 506-5ULD02                             | Mouser                |
| 23   | 1        | J4                                      | 2.1 mm Power jack |        |           | CONN3[175120]PWR |              | ADC-002-1                              | Adam Tech             |
| 24   | 1        | J5                                      | USB Type B        |        |           | CONN-USB-B       |              | 897-30-004-90-000000                   | Mill-Max              |
| 25   | 1        | LS1                                     | Speaker           |        |           | HCM12A[9052]     |              | HCM1206A                               | JL World              |
| 26   | 1        | RJ11                                    | MTJG-2-64-2-2-1   |        |           | RJ11[6238]DUAL   |              | MTJG-2-64-2-2-1                        | Adam Tech             |
| 27   | 6        | R2,R6,R7,R9,R15,R27                     | 0                 | 1/10 W |           | RC0603           |              | CR0603-10W-000JT                       | Venkel                |
| 28   | 1        | R3                                      | 47 k              | 1/10 W | ±5%       | RC0805           |              | NRC10J473TR                            | NIC Components        |
| 29   | 1        | R4                                      | 3 k               | 1/10 W | ±5%       | RC0805           |              | NRC10J302TR                            | NIC Components        |
| 30   | 1        | R5                                      | 10                | 1/10 W | ±1%       | RC0805           |              | NRC10F10R0TR                           | NIC Components        |
| 31   | 2        | R26,R8                                  | 1.3k              | 1/16 W | ±5%       | RC0603           |              | CR0603-16W-132JT                       | Venkel                |
| 32   | 10       | R10,R11,R12,R17,R18,R19,R28,R29,R30,R33 | 10k               | 1/16 W | ±5%       | RC0603           |              | CR0603-16W-103JT                       | Venkel                |
| 33   | 1        | R13                                     | 1.6               | 1/8 W  | -0.05     | RC1206           |              | CR1206-8W-1R6JT                        | Venkel                |
| 34   | 1        | R14                                     | 196k              |        |           | RC0805           |              | MCHRIDEZHFX1963E                       | Classic Comp          |
| 35   | 1        | R16                                     | 110k              |        |           | RC0805           |              | CR21-114J-T                            | Classic Comp          |
| 36   | 1        | R20                                     | 4.7 k             | 1/10 W | ±5%       | RC0805           |              | NRC10J472TR                            | NIC Components        |
| 37   | 1        | S1                                      | SW<br>PUSHBUTTON  |        |           | SW4[6240]PB      |              | 101-0161                               | Mouser                |
| 38   | 3        | TP1,TP2,TP18                            | Black Test Point  |        |           | CONN1[6040]      |              | 151-203                                | Mouser                |
| 39   | 4        | TP3,TP4,TP5,TP6                         | Stand off         |        |           | MH-125           |              |                                        |                       |
| 40   | 8        | TP7,TP8,TP10,TP11,TP12,TP13,TP14,TP15   | Blue Test Point   |        |           | CONN1[6040]      |              | 151-205                                | Mouser                |
| 41   | 2        | TP16,TP17                               | Red Test Point    |        |           | CONN1[6040]      |              | 151-207                                | Mouser                |
| 42   | 1        | TP19                                    | Blue Test Point   |        |           | CONN1[6040]      |              | 151-207                                | Mouser                |
| 43   | 1        | U1                                      | 7805              |        |           | TO-220-LD        |              | uA7805CKC                              | Texas Instruments     |
| 44   | 1        | U2                                      | TPS77601DR        |        |           | SO8              |              | TPS77601DR                             | Texas Instruments     |
| 45   | 1        | U3                                      | DS1818            |        |           | SOT-23           |              | DS1818-10                              | Dallas Semiconductor  |
| 46   | 1        | U4                                      | MAX3237           |        |           | SOP65X780-28N    |              | MAX3237E (Sipex<br>SP3238E 2nd source) | Maxim                 |
| 47   | 1        | U5                                      | CP2101/02         |        |           | 28-pin MLP       |              | CP2101/02                              | Silicon Laboratories  |
| 48   | 2        | U8,U7                                   | 74CBT3257/SO      |        |           | SOP65X780-16N    |              | SN74CBT3257DBR                         | Texas Instruments     |
| 49   | 1        | U9                                      | PDIP Socket       |        |           | DIP8-SKT         |              | 210-93-308-41-001000                   | Mill-Max              |
| 50   | 1        | U10                                     | OP-AMP            |        |           | SO8              |              | LM386M-1                               | National Semi         |
| 51   | 1        | U11                                     | GMS05F            |        |           | SOT-23-5N        |              | GMS05F                                 | Vishay                |

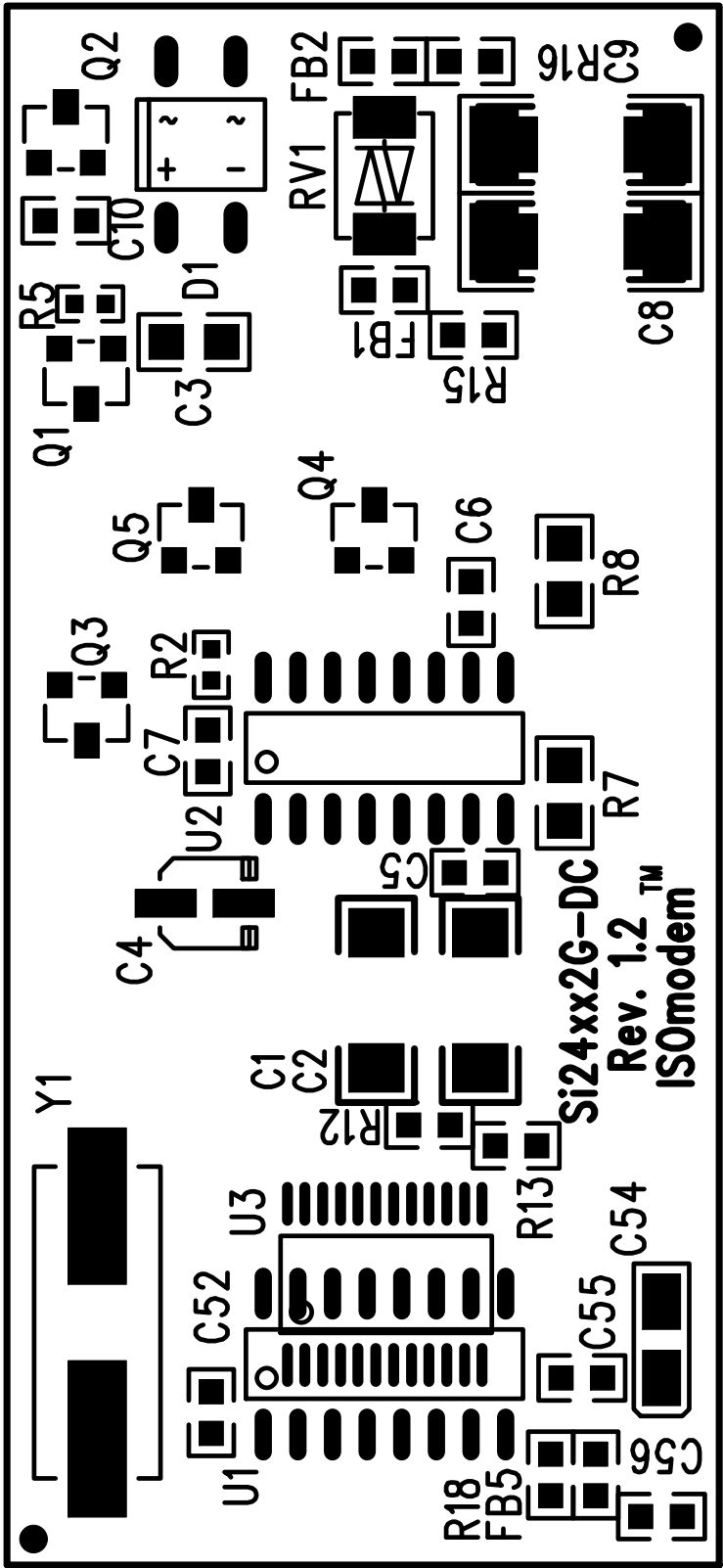


Figure 20. Daughter Card Component Side Silkscreen

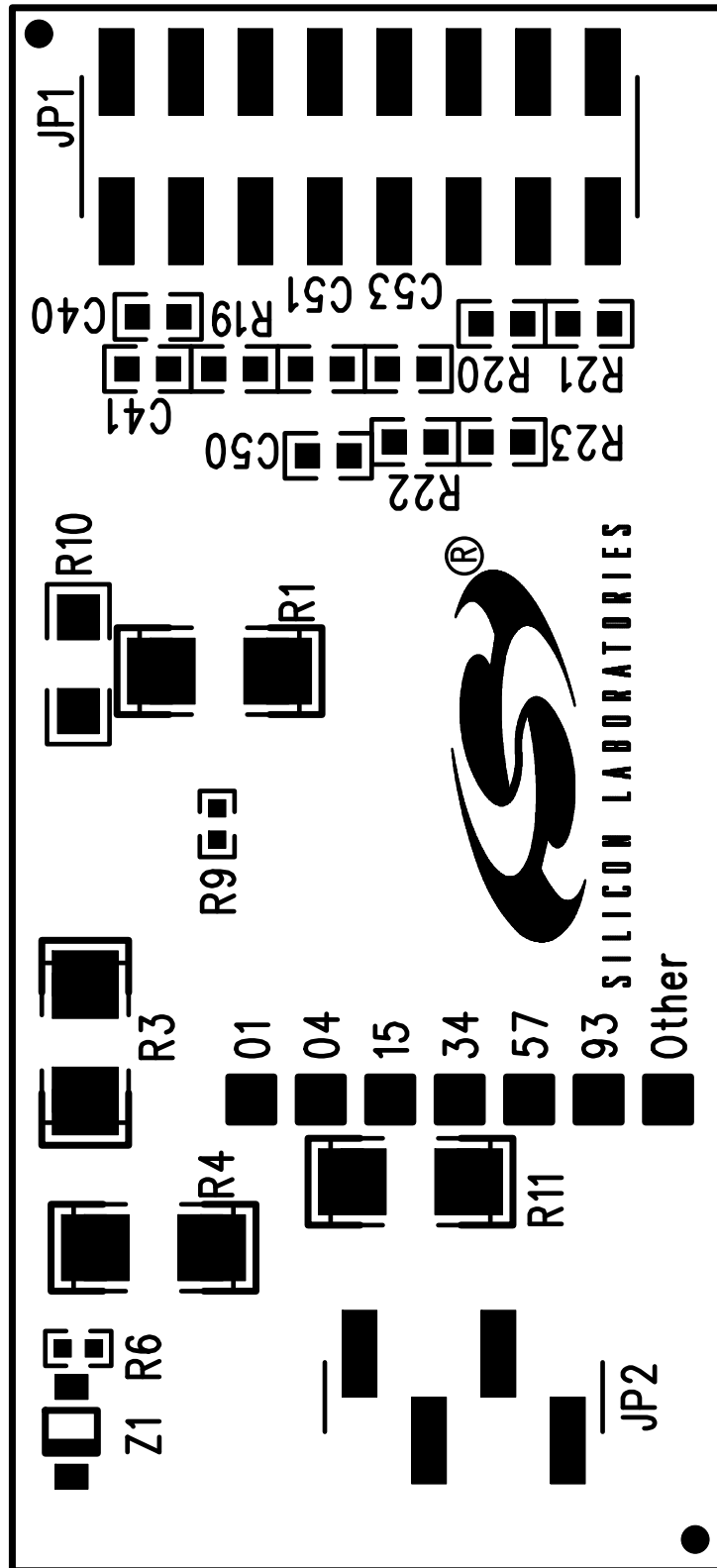


Figure 21. Daughter Card Solder Side Silkscreen

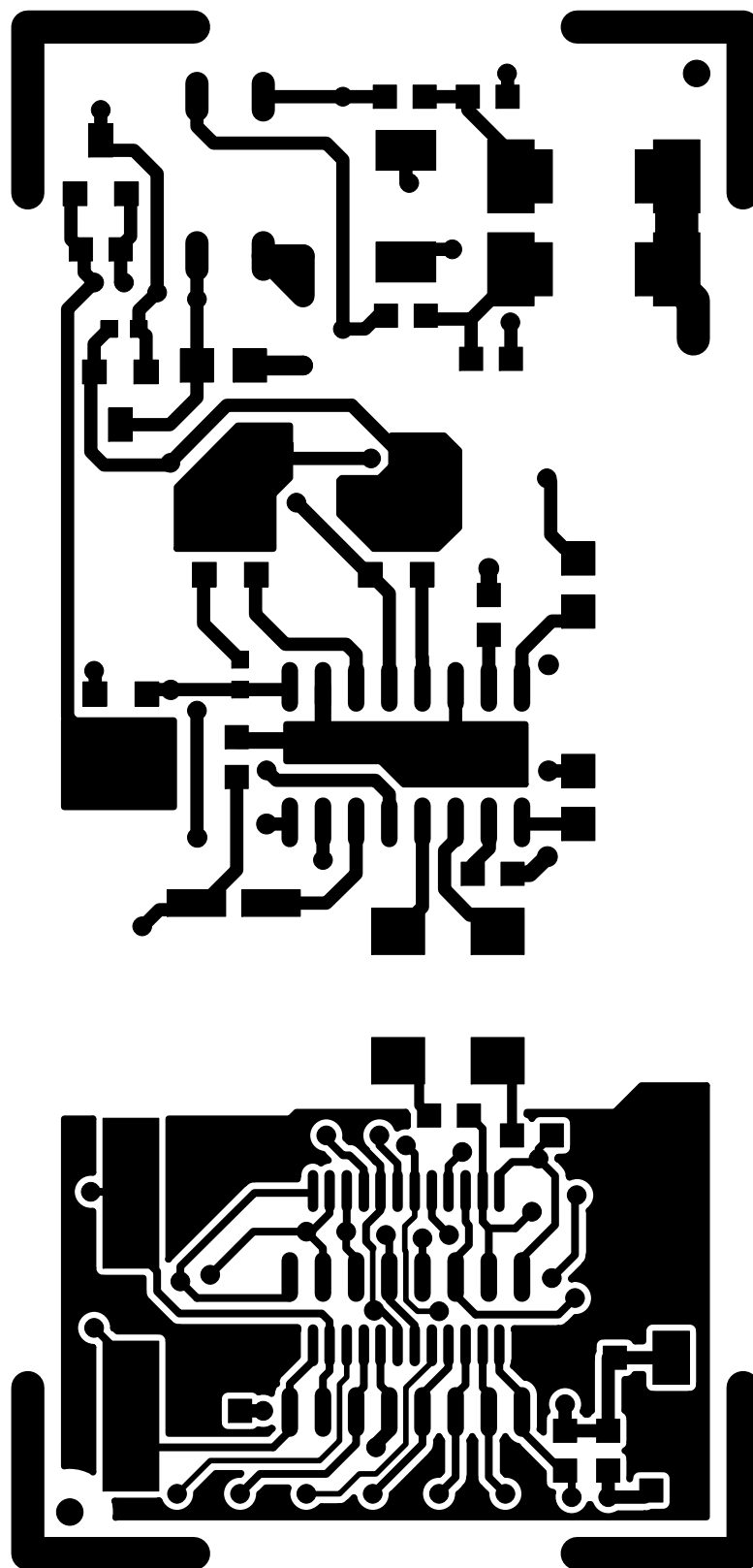


Figure 22. Daughter Card Component Side Layout

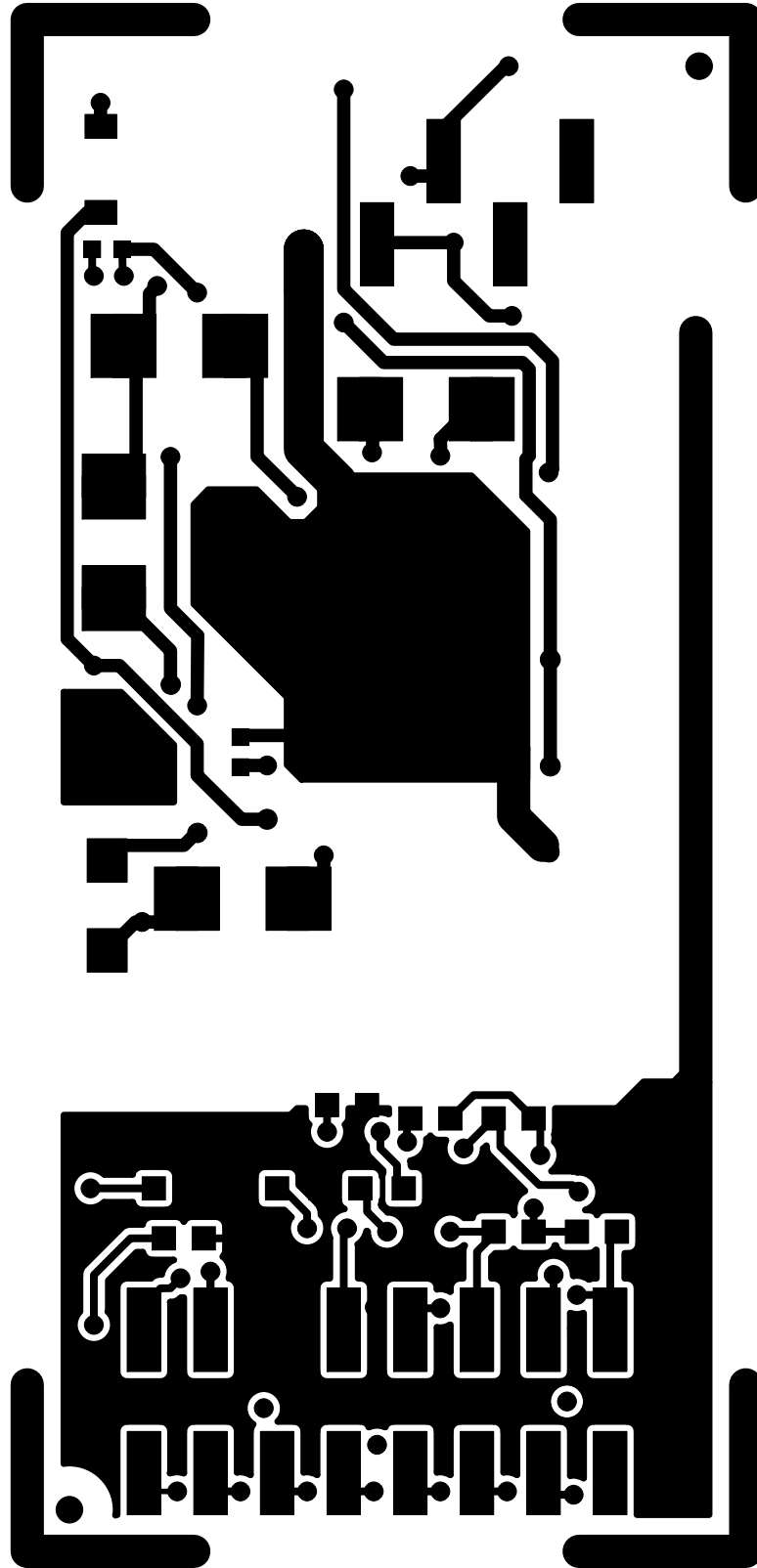


Figure 23. Daughter Card Solder Side Layout

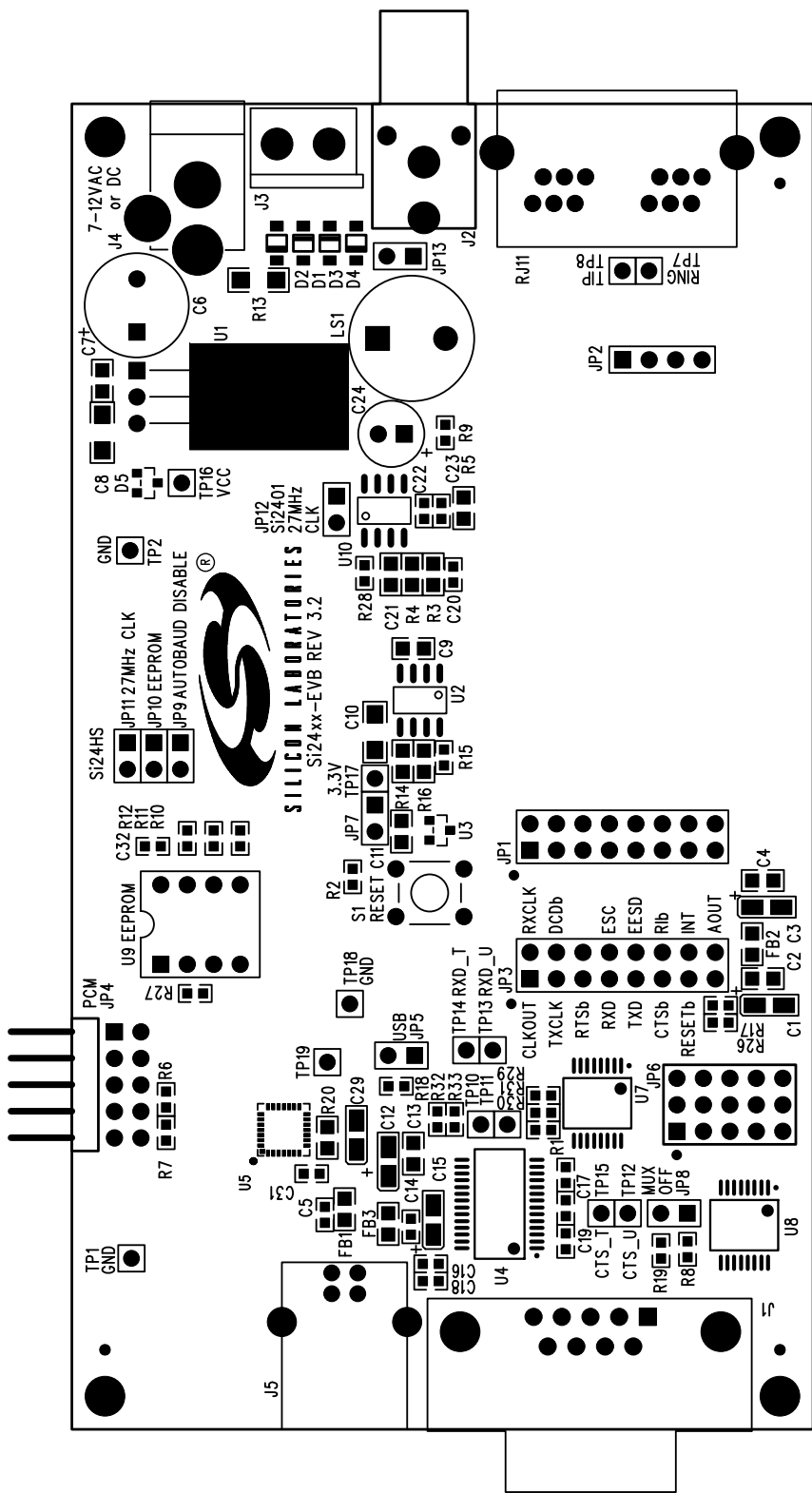


Figure 24. Motherboard Silkscreen

U11

D9 D7 D12 D10  
D11 D13 D6 D8

| Si2401      | Si24HS       | Si2400         | Function | RS-232 |
|-------------|--------------|----------------|----------|--------|
| GPIO2 or NC | DCD or EESD  | NC or GPIO2    | Info     | CD     |
| NC or GPIO5 | RI or TXCLK  | GPIO3 or NC    | Info     | RI     |
| GPIO3 or NC | ESC or X     | GPIO1 or GPIO3 | Ctrl     | DTR    |
| NC or GPIO1 | RTS or RXCLK | CLKOUT or NC   | Ctrl     | RTS    |
| NC or GPIO4 | INT or AOUT  | GPIO4 or AOUT  | Info     | DSR    |

JP6 recommended settings

Si2400: 2-3, 4-5, 8-9, 11-12, 13-14

Si24HS: 1-2, 4-5, 7-8, 10-11, 13-14

Si2401: 1-2, 5-6, 7-8, 11-12, 14-15

Si24HS alt: 1-2, 5-6, 7-8, 11-12, 14-15

Figure 25. Motherboard Silkscreen (Back Side)

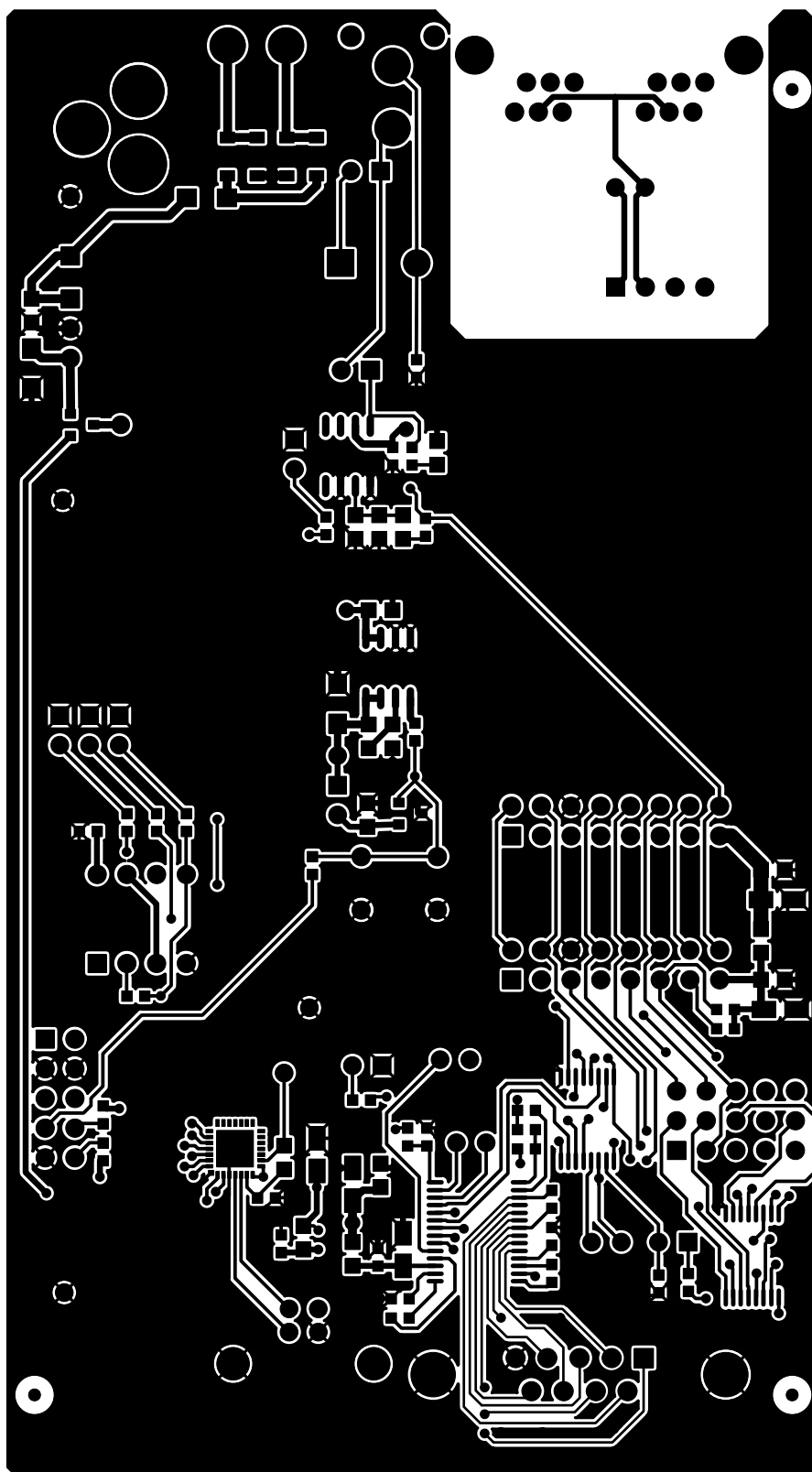


Figure 26. Motherboard Component Layout

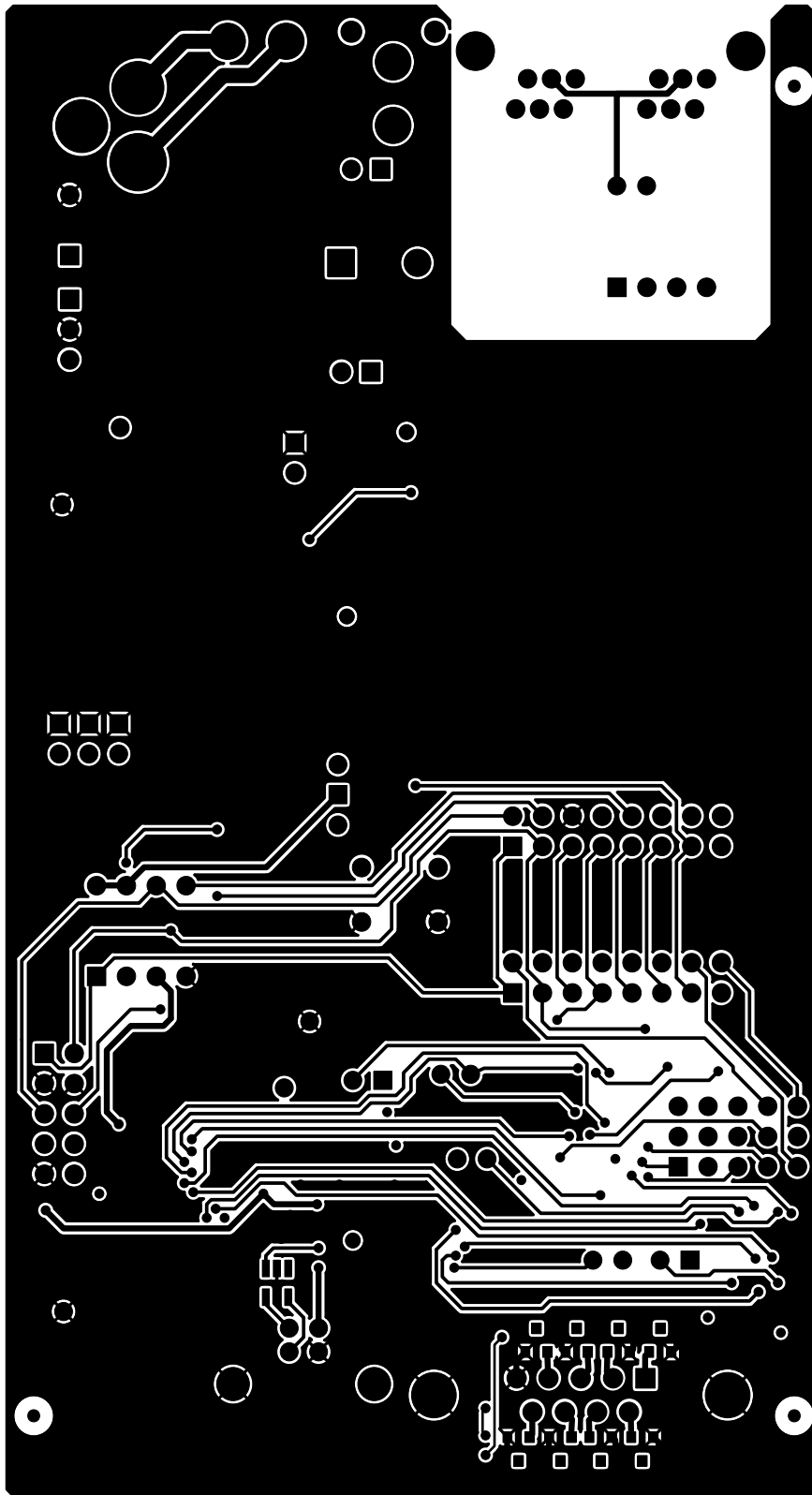


Figure 27. Motherboard Solder Side Layout

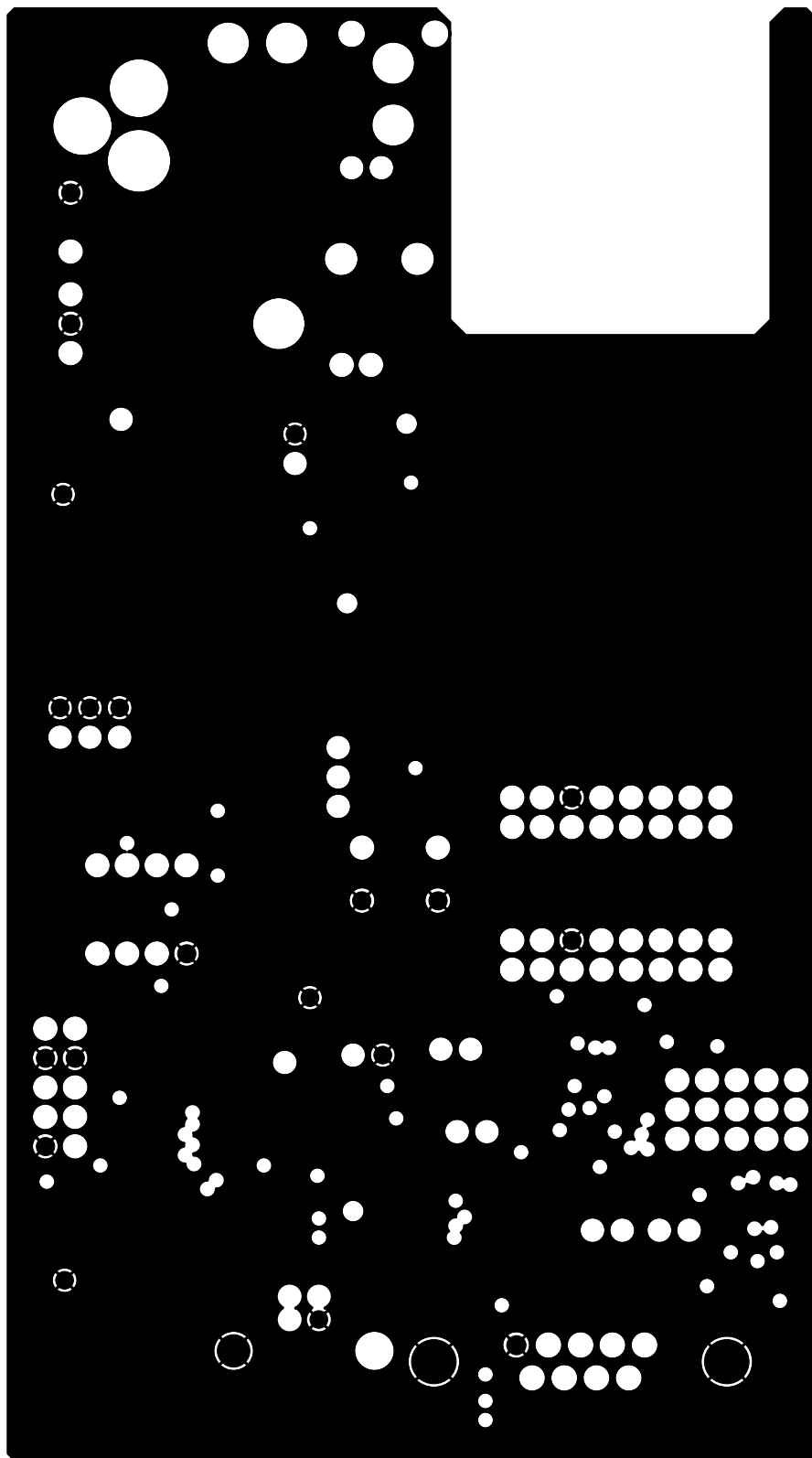


Figure 28. Motherboard Ground Plane Layout

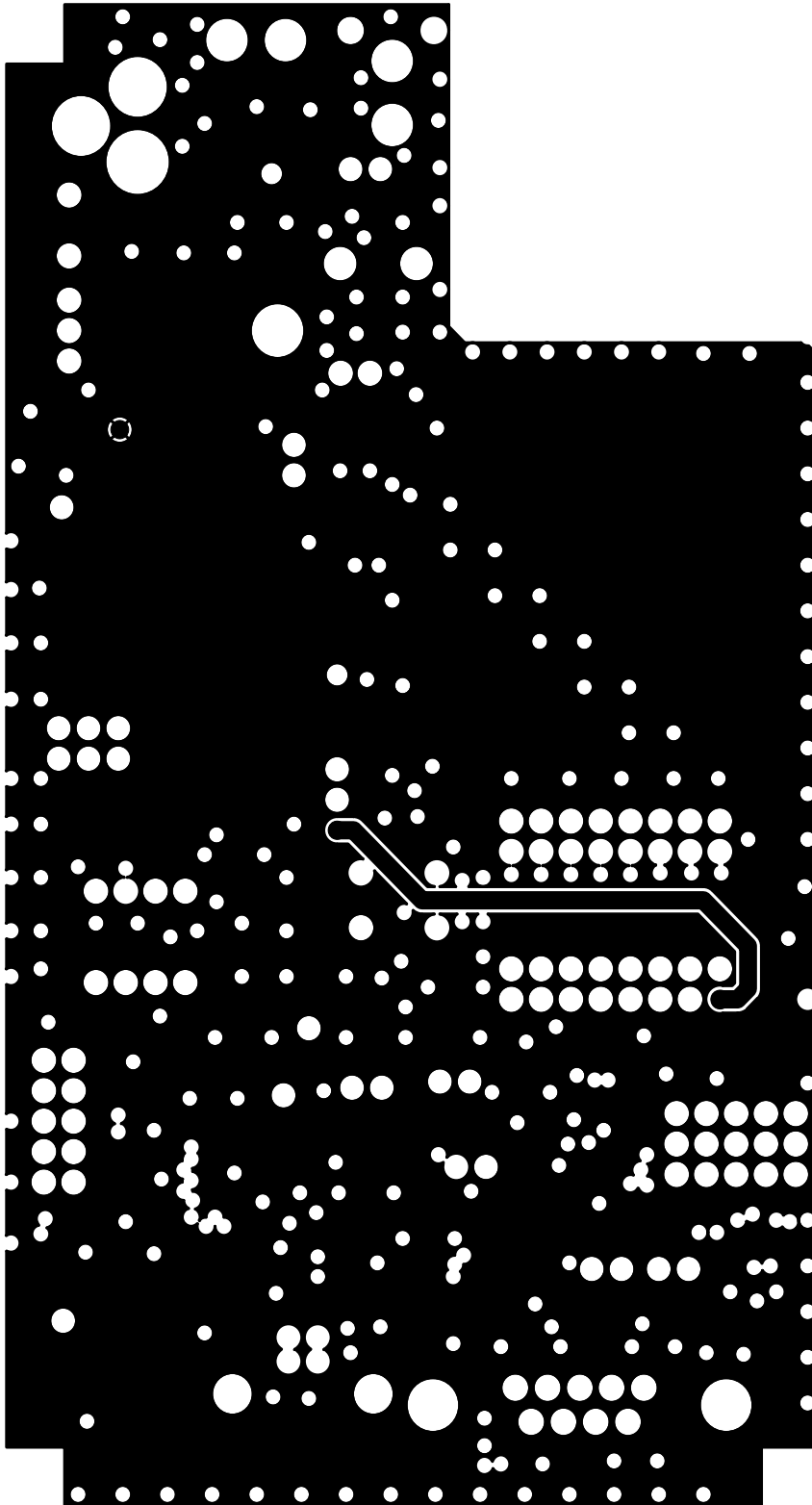


Figure 29. Motherboard Power Plane Layout

## 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

Please 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 21, “Daughter Card Solder Side Silkscreen,” on page 25
- Updated Figure 22, “Daughter Card Component Side Layout,” on page 26
- Updated Figure 23, “Daughter Card Solder Side Layout,” on page 27
- Updated “Bill of Materials: Si24xx Daughter Card”

### Revision 0.3 to Revision 0.4

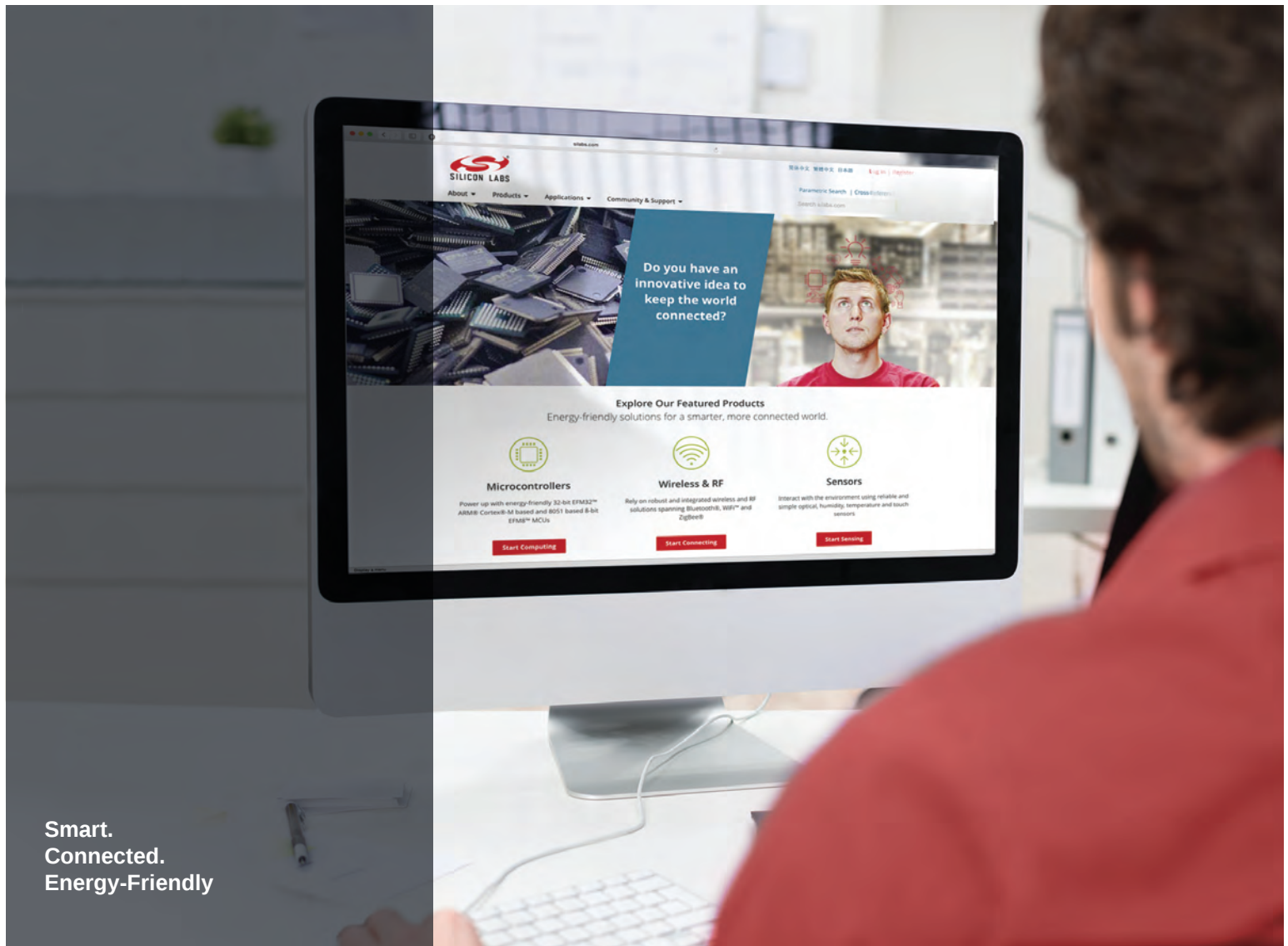
- Changed from Rev.1.0 to Rev.1.1 Daughter Card

### 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

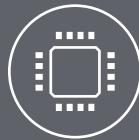


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