General Description

The MAX34451 evaluation kit (EV kit) provides the hardware and software graphical-user interface (GUI) necessary to evaluate the MAX34451 PMBus™ 16-channel V/I monitor and 12-channel sequencer/marginer. The EV kit includes a MAX34451 installed as well as four power supplies that can be sequenced, monitored, and margined by the device.

EV Kit Contents

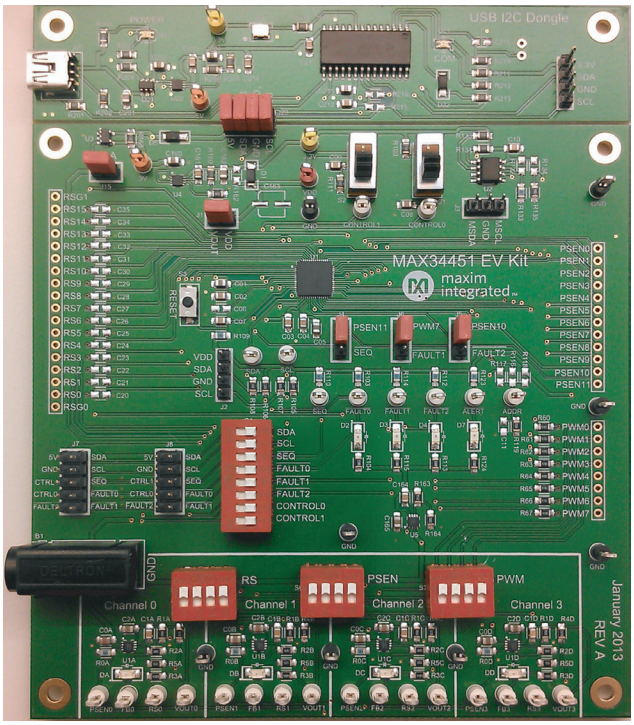
- Assembled Circuit Board Including MAX34451
- Mini USB Cable

Ordering Information ***appears at end of data sheet.***

Features

- Easy Evaluation of the MAX34451
- Four Power-Supply Channels
- One Current-Sense Amplifier
- EV Kit Hardware is USB Powered (USB Cable Included)
- USB HID interface
- Windows XP®- and Windows® 7-Compatible Software
- RoHS Compliant
- Proven PCB Layout
- Fully Assembled and Tested

MAX34451 EV Kit Photo



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PMBus is a trademark of SMIF, Inc.

maxim integrated™

Component List

DESIGNATION	QTY	DESCRIPTION
B1	1	Black banana jack (GND)
C01, C05, C211	3	1µF, X7R ceramic capacitors (0805)
C02, C03, C07–C10, C212	7	0.1µF, X7R ceramic capacitors (0805)
C06, C11, C20–C35, C215	0	Do not populate, ceramic capacitors (0805)
C0A–C0D, C2A–C2D, C160, C162, C165, C201, C202, C204	14	10µF, X5R ceramic capacitors (0805)
C163	0	Do not populate, 470µF aluminum capacitor
C1A–C1D, C04, C60–C67, C161, C164, C203, C214	17	0.01µF, X7R ceramic capacitors (0805)
C213	1	220nF, X7R ceramic capacitor (0805)
D1, D5, D22	3	Schottky diodes
D2–D4, D7	4	Red LEDs (1206)
D20, D21	2	Red/green dual LEDs
DA–DD	4	Green LEDs (1206)
J1, J15	2	2-pin headers, 2.54mm pitch
J2, J22	2	4-pin headers, 2.54mm pitch
J3–J6	4	3-pin headers, 2.54mm pitch
J7, J8	2	10-pin (2 x 5) headers, 2.54mm pitch
J9–J14, J21	0	Do not populate, headers
J20	1	5-pin female Mini-USB
J23	1	8-pin (2 x 4) header, 2.54mm pitch
R0–R17, R36, R37, R102, R107, R108, R119, R201, R202, R214	27	0Ω ±1% resistors (0805)
R0A–R0D, R80–R91, R101, R103, R109, R110, R112, R114, R123, R133, R135, R204	26	100kΩ ±1% resistors (0805)
R1A–R1D	4	8.66kΩ ±1% resistors (0805)
R2A–R2D	4	3.09kΩ ±1% resistors (0805)
R3A–R3D	4	49.9Ω ±1% resistors (0805)
R4A–R4D	4	267Ω ±1% resistors (0805)
R5A–R5D	4	1kΩ ±1% resistors (0805)
R20–R35, R40–R51, R116–R118, R132, R134, R162, R215, R216	0	Do not populate, resistors (0805)
R60–R67, R100, R130, R131, R210	12	4.7kΩ ±1% resistors (0805)
R68–R75 R111, R161, R164, R207	12	10kΩ ±1% resistors (0805)
R104, R113, R115, R124, R211, R212	6	330Ω ±1% resistors (0805)
R105, R106, R213	3	2.2kΩ ±1% resistors (0805)
R160, R163, R206	3	45.3kΩ ±1% resistors (0805)
R165	1	0.1Ω ±1% resistor (0805)
R203, R205	2	560Ω ±1% resistors (0805)
S1, S2	2	SPDT slide switches
S3	1	Single-pole pushbutton switch
S4	1	8-pole DIP switch
S5–S7	3	4-pole DIP switches
TP15, TP17–TP25, TP27–TP42	26	White test points
TP2–TP6, TP9–TP11	8	Black test points
TP1	1	Red test point
TP7, TP44	2	Orange test points
TP8, TP43	2	Yellow test points
U1	1	PMBus 16-channel V/I monitor and 12-channel sequencer/ marginer (56 TQFN-EP*) Maxim MAX34451ETN+
U1A–U1D, U4, U5, U22	7	500mA LDO regulators (8 TDFN-EP*) Maxim MAX8902BATA+
U2	1	Digital temperature sensor (8 SO,150mil) Maxim DS75LVS+
U3	1	25V/V precision current-sense amplifier (SOT23) Maxim MAX9938TEUK+

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
U20	1	Microcontroller (28 SO) Microchip PIC18LF2550-I/SO
U21	1	50mA to 600mA current-limit switch (6 SOT23) Maxim MAX4995AAUT+

**EP = Exposed pad.*

DESIGNATION	QTY	DESCRIPTION
X1	1	48MHz, 3.3V oscillator (SMD) AVX KC3225A48.0000C30E00
—	9	Jumpers/shunts
—	1	Mini-USB cable
—	1	PCB: MAX34451 EV Kit

MAX34451 EV Kit Files

FILE	DESCRIPTION
MAX34451EVKitSoftwareInstall.EXE	Application program

Note: *The .EXE file is downloaded as a .ZIP file.*

Quick Start

Required Equipment

- MAX34451 EV kit hardware
- Windows XP or Windows 7 PC
- USB port
- Mini-USB cable (included)

Note: In the following sections, software-related items are identified by **bolding**. Text in bold refers to items directly from the install or EV kit software. Text in **bold and underlined** refers to items from the Windows operating system.

Procedure

The EV kit is fully assembled and tested. Follow the steps below to verify board operation:

1) Ensure that jumpers/shunts on J23 and J1 are installed. **Note:** The GND planes of the USB I²C dongle and the EV kit are not connected. The GND jumper on J23 must be connected for proper communication.
2) Ensure that the 4-pole DIP switches RS (S5), PSEN (S6), and PWM (S7) are in the on position.
3) Set the EV kit hardware on a nonconductive surface to ensure that nothing on the PCB gets shorted together.
4) Prior to starting the GUI, connect the EV kit hardware to a PC using the supplied Mini-USB cable, or equivalent. The power LED (D20) should be green and the com LED (D21) should be red and slowly flash orange.
5) Windows should automatically begin installing the necessary device driver. The USB interface of the EV kit hardware is configured as an HID device and therefore does not require a unique/custom device driver. Once the driver installation is complete, a Windows message appears near the **System Icon** menu, indicating that the hardware is ready to use. Do not attempt to run the GUI prior to this message. If you do, you must close the application and restart it once the driver installation is complete. On some versions of Windows, administrator privileges may be required to install the USB device.
6) Once the device driver installation is complete, visit **www.maximintegrated.com/evkitsoftware** to download the latest version of the EV kit software, MAX34451EVKitSoftwareInstall.ZIP. Save the EV kit software to a temporary folder.
7) Open the .ZIP file and double-click the .EXE file to run the installer. A message box stating: **The publisher could not be verified. Are you sure you want to run this software?** may appear. If so, click **Yes**.
8) The installer GUI appears. Click **Next** and then **Install**. Once complete, click **Close**.
9) Go to **Start | All Programs**. Look for the **MAX34451EVKitSoftware** folder and click on the MAX34451EVKitSoftware.EXE inside the folder.
10) When the GUI appears, the text to the left of the Maxim logo should display **EV Kit Hardware Connected**. The com LED (D21) on the EV kit board should turn green.

Detailed Description of Software

Software Startup

If the MAX34451 EV kit is connected when the software is opened, the software first initializes the hardware to communicate. The software then searches for all slave addresses on the I²C bus and connects to the first valid slave address. The GUI displays **EV Kit Hardware Connected** to the left of the Maxim logo. If the EV kit is not connected on software startup, then the GUI populates with default EV kit values. Once the EV kit is connected, the GUI executes the sequence above.

Menu and Status Bar

The **File** menu item contains **Save**, **Load**, and **Exit** options. To save the current GUI configuration, click **Save Project As**. This saves the device name, pin names, and the RAM CRC to an XML file and saves PMBus configurations to a HEX file. If a device is connected, this reads and saves data directly from the device; otherwise, it saves the configuration that is currently displayed on the GUI. The STORE_DEAULT_ALL (11h) command is appended to the end of the HEX file so that the configuration is saved to the main flash when the HEX file is loaded. **Load Project** updates the GUI with the XML file, writes the HEX file to the device, performs a STORE_DEFAULT_ALL (11h), and then reads current values from the device. The RAM CRC and main flash CRC are then read and compared to the CRC saved in the XML file. If a device is not connected, the HEX file is written to a virtual device. The HEX file only contains data for the PMBus commands that are stored in flash. **Create Report** saves a CSV file that contains all the configuration tables.

The **Connection** menu item allows the user to connect to a desired device. **Find Slave Addresses** searches for all slave addresses connected to the I^2C bus. To select a device, click **Device1 Slave Address** and all the slave addresses found are shown and are selectable. Slave addresses 18h and 34h are not selectable to prevent communicating with the alert response address and factory-programmed address. If multiple devices are connected, then the number of devices to read/write is selected with the **Number of Devices** option.

The **Auto Polling** menu item allows the user to set the automatic polling rate. Select the delay between reads by choosing **300ms**, **600ms**, **800ms**, **1000ms**, **1500ms**, or **2000ms**. Press the **Auto Polling On** button in the status bar to start the polling. Each poll reads the **Power Status** (STATUS_WORD 79h), **Fault Status** (STATUS_WORD 79h), and the polled values for the **Data Log Graph** tab. The **Status** and **Margining** tabs are only polled if the tab is currently selected. If multiple devices are being polled, then selected polling rate options can be disabled to account for the longer time it takes to read all devices. To stop polling, press the **Auto Polling Off** button on the status bar. Polling automatically stops if items in the **File** menu or **Connection** menu are selected. Polling also stops if any buttons that involve action with the NV fault log or flash are pressed.

The **GUI Lock** menu item allows the user to safely browse a configuration by preventing all controls from writing to registers. The **Clear Faults** button in the status bar sends the CLEAR_FAULTS (03h) command to clear any faults or warnings. To turn the power supplies on or off, select the **Power On/Power Off** button, which writes a value to the OPERATION (01h) command. The supplies power on with margining off and power off based on the **Power Down Action** drop-down list on the **Sequencing** tab.

Status Log

The status log below the tabs displays all the actions that the GUI performs. Whenever a PMBus command is read or written, the action is confirmed by the log. To save the log, press the **Save Log** button and the text in the box is saved to a .TXT file. The log can also be cleared by pressing the **Clear Log** button.

Sequencing Tab

The **Sequencing** tab sheet (Figure 1) includes all the sequence configuration and delays. All values on the tab are read when the tab is selected. The **On/Off Config** group box controls write to the ON_OFF_CONFIG (02h) command to set when the power supplies sequence on or off. The power supplies can be turned on with bias, with the CONTROL0/CONTROL1 pin, or with the OPERATION (01h) command by selecting the option on the **Turn Power Supplies ON** drop-down list. To change the CONTROL0/CONTROL1 pin's polarity, select the **Active Low** or **Active High** radio buttons. The channels can be powered down simultaneously or with a TOFF delay by selecting the option in the **Power Down Action** drop-down list. To edit the sequencing table, the **Output Select** on the **PSEN/GPO** tab must be set to **Power Supply Enable (PSEN)** and the **Input Select** on the **Monitoring** tab must be set to **Sequence + Voltage Monitor**. The **Sequence On Select**, **PG/GPI Select**, and **SEQ Match** columns read/write to MFR_SEQ_CONFIG (E8h). The **PG/GPI Select** columns can only be edited if the **Sequence On Select** for that channel is set to one of the **PG/GPI combo** options. To edit the **SEQ Match** column the **Sequence On Select** for that channel must be set to one the of **SEQ Pin Match** options. The sequencing delays can be set by writing values to **TON Delay** (TON_DELAY 60h), **TON Max** (TON_MAX_FAULT_LIMIT 62h), **TON Seq Max** (MFR_TON_SEQ_MAX E6h), and **TOFF Delay** (TOFF_DELAY 64h). Each channel responds to the FAULT pins selected in the **FAULT Pin Response** columns that read/write to MFR_FAULT_RESPONSE (D9h).

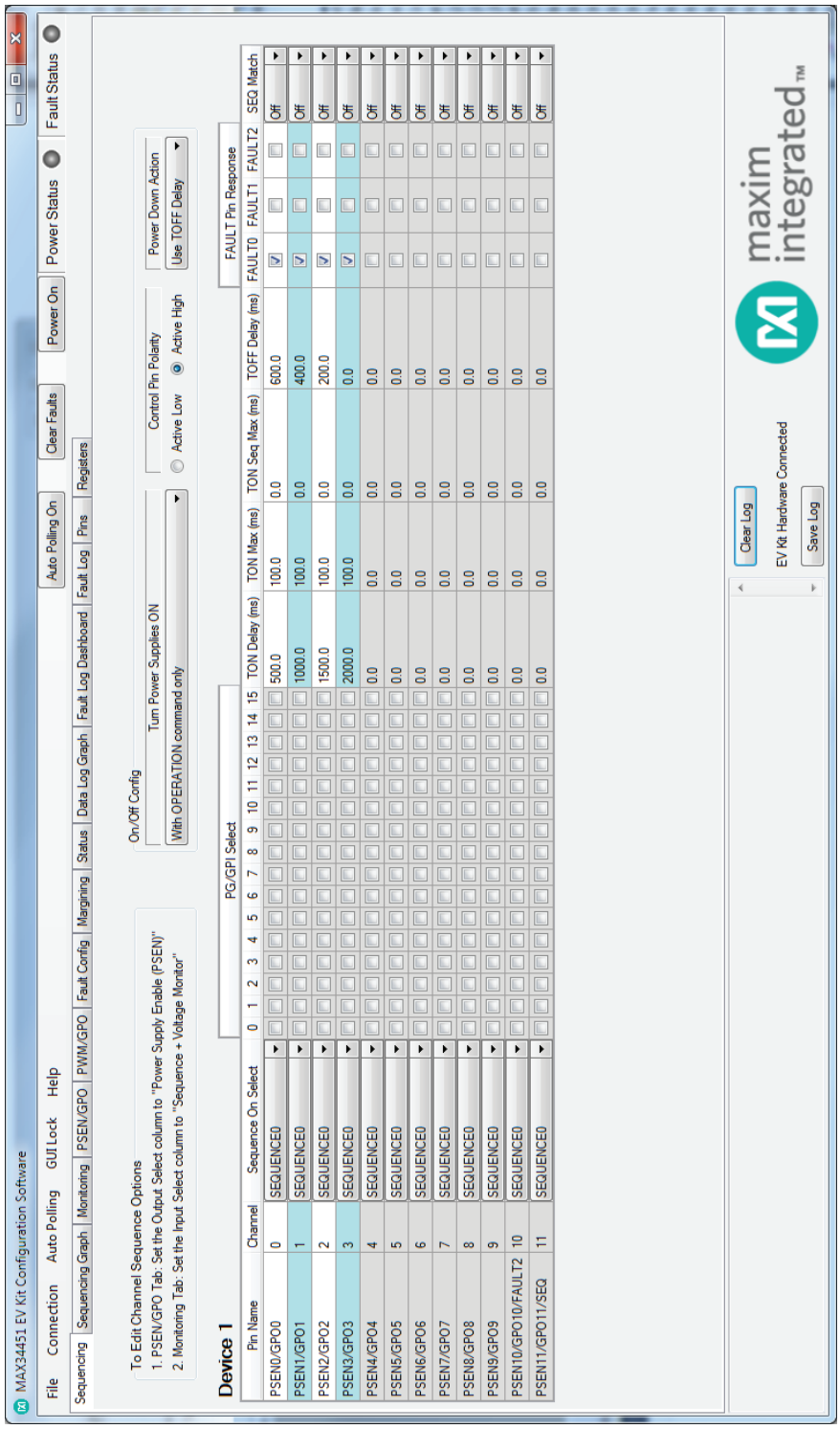


Figure 1. MAX34451 EV Kit GUI (Sequencing Tab)

Sequencing Graph Tab

The **Sequencing Graph** tab sheet (Figure 2) displays the timing diagrams for all the sequencing channels. To edit a channel's sequencing timing, the **Output Select** on the **PSEN/GPO** tab must be set to **Power Supply Enable (PSEN)** and the **Input Select** on the **Monitoring** tab must be set to **Sequence + Voltage Monitor**. When the **Power Up** radio button is selected, the **TON Delay** (TON_DELAY 60h) and **TON Max** (TON_MAX_FAULT_LIMIT 62h) values are displayed on the graph. To change **TON Delay**, click and drag the green vertical bar; to change **TON Max**, click and drag the red vertical bar. If **TON Max** is set to 0ms, then this limit is and the red bar are disabled. To set a precise time with the graph, click and hold the green or red vertical bar for a zoomed-in timeline. If a channel is set up to generate a SEQ on the **Monitoring** tab, a yellow GEN tag is displayed to show which sequence is generated. The **Sequence On Select** column is read from the **Sequencing** tab. If this column is set to a SEQ pin match option, a SEQ yellow tag appears at the time location displayed in the **Event Tag** column. If there is a GEN tag that matches the SEQ tag, the SEQ tag is lined up with the GEN tag to have the same time. If there is not a GEN tag that matches the SEQ tag, the tag can be moved to a location where the user expects this signal to occur by dragging the yellow tag or editing the value in the **Event Tag** column. If the **Sequence On Select** is set to a PG/GPI combo option, the **PG/GPI Select** columns on the **Sequencing** tab are read to see which channel combination triggers the sequence. If any of these checked channels are set to GPI in the **Input Select** column on the **Monitoring** tab, a yellow GPI tag appears at the time location in the **Event Tag** column, which can be edited. If the checked channels are not set to GPI, a PG yellow tag appears. This PG tag is placed at the last TON Delay to occur in the checked channels. The **Power Down** graph displays the **TOFF Delay** (TOFF_DELAY 64h) and can be changed by clicking and dragging the green vertical bar. To view more of the time in the diagram, click and drag the timeline at the bottom, or use the zooming controls in the upper right-hand corner. To change the order of the channels, press the **Sort By Time** button or the **Sort By Device** button for multiple devices. When in Sort By Device mode, the channels can be reordered by clicking and dragging the gripper box in the upper left-hand corner of the channel row. The sequencing graph also has the ability to detect circular dependance errors.

Monitoring Tab

The **Monitoring** tab sheet (Figure 3) displays the fault/warn limit settings for each channel and for each temperature sensor. To read the settings, click on the **Monitoring** tab and all the values are automatically read. To write to a value, click on the corresponding cell, type in a valid value, and either click another cell or press Enter on the keyboard. In the **VOLTAGE and CURRENT** table, the **Input Select** and **SEQ Generate** columns write to MFR_CHANNEL_CONFIG (E4h). Some columns might be grayed out depending on what is selected in the **Input Select** column. The **Nominal** and **V Ratio** columns are calculated based on a nominal ADC level of 1.8V to set the VOUT_SCALE_MONITOR (2Ah). The resistive **V Ratio** is found by dividing 1.8V by the **Nominal** value. The **C Gain** column writes to IOUT_CAL_GAIN (38h) to set the ratio of the voltage at the ADC input to the sensed current. The fault/warn limits can be set by entering the voltage/current level or the percent of the nominal in the **UV Fault** (VOUT_UV_FAULT_LIMIT 44h), **UV Warn** (VOUT_UV_WARN_LIMIT 43h), **OV Warn** (VOUT_OV_WARN_LIMIT 42h), **OV Fault** (VOUT_OV_FAULT_LIMIT 40h), **PG On** (POWER_GOOD_ON 5Eh), **PG Off** (POWER_GOOD_OFF 5Fh), **OC Warn** (IOUT_OC_WARN_LIMIT 46h), or **OC Fault** (IOUT_OC_FAULT_LIMIT 4Ah) columns. In the **TEMPERATURE** table, the sensors can be enable/disabled in the **Enable** column, which writes to a bit in MFR_TEMP_SENSOR_CONFIG F0h). The OT warn/fault limits can be set by entering a value in the **OT Warn** (OT_WARN_LIMIT 51h) or **OT Fault** (OT_FAULT_LIMIT 4Fh) columns. The ADC and averaging settings can be adjusted with the **ADC Conversion Time**, **ADC Averaging**, or **IOUT Averaging** drop-down lists, which all write to MFR_MODE (D1h).

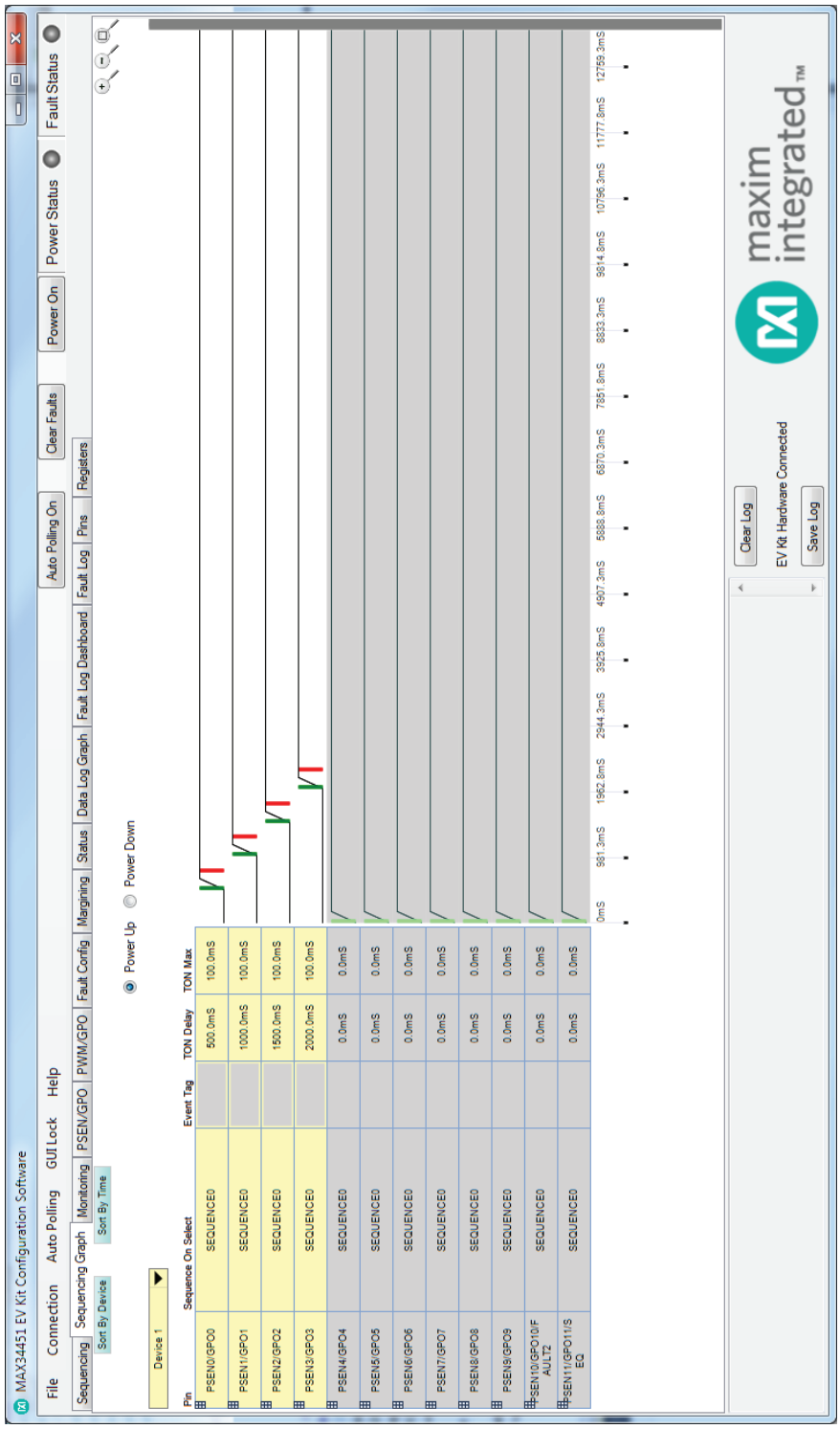
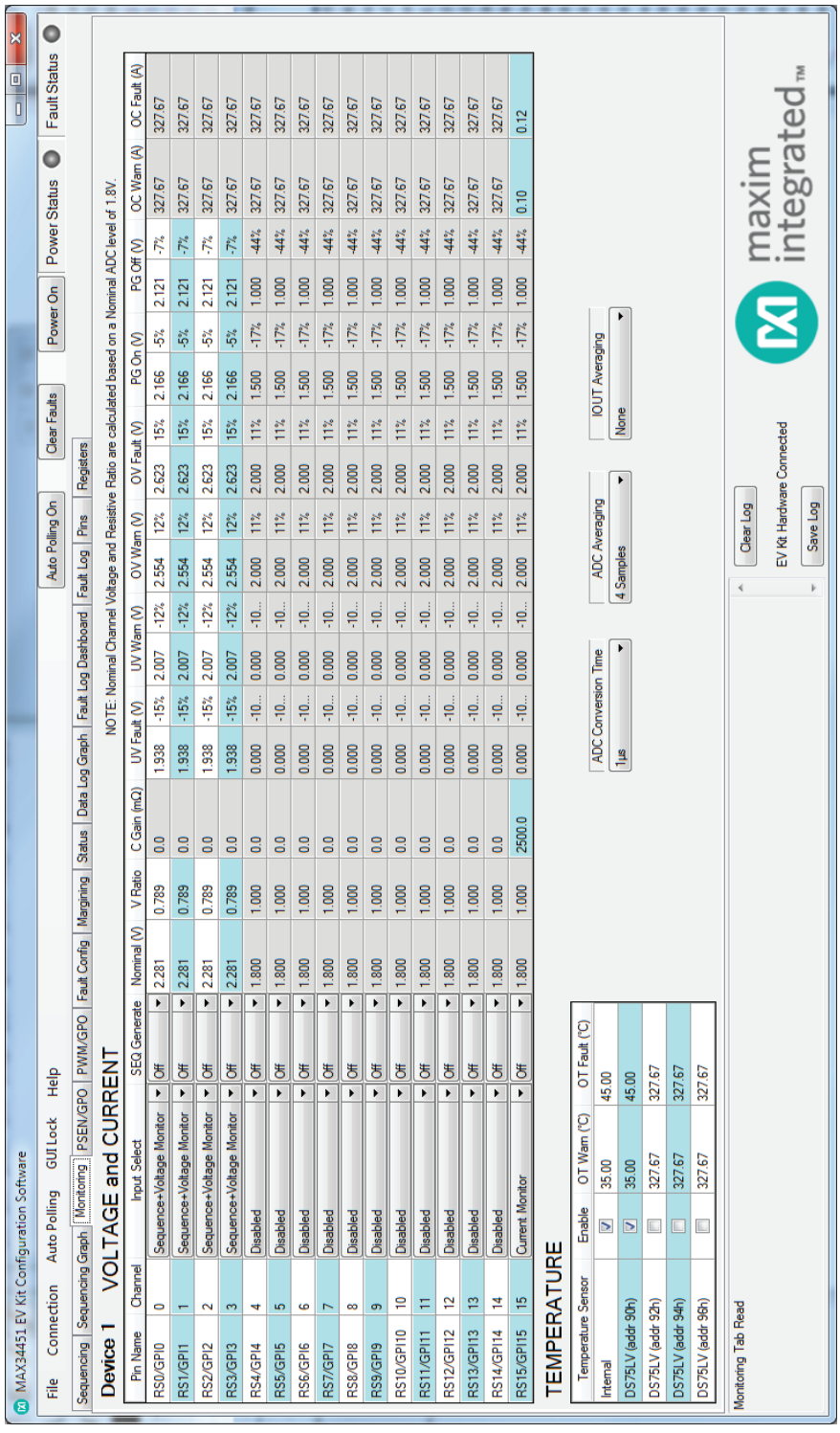


Figure 2. MAX34451 EV Kit GUI (Sequencing Graph Tab)



Pin Name	Channel	Input Select	SEQ Generate	Nominal (V)	V Ratio	C Gain (mΩ)	UV Fault (V)		UV Warn (V)		OV Warn (V)		OV Fault (V)		PG On (V)		PG Off (V)		OC Warn (A)	OC Fault (A)
RS0/GPI0	0	Sequence+Voltage Monitor	Off	2.281	0.789	0.0	1.938	-15%	2.007	-12%	2.554	12%	2.623	15%	2.166	-5%	2.121	-7%	327.67	327.67
RS1/GPI1	1	Sequence+Voltage Monitor	Off	2.281	0.789	0.0	1.938	-15%	2.007	-12%	2.554	12%	2.623	15%	2.166	-5%	2.121	-7%	327.67	327.67
RS2/GPI2	2	Sequence+Voltage Monitor	Off	2.281	0.789	0.0	1.938	-15%	2.007	-12%	2.554	12%	2.623	15%	2.166	-5%	2.121	-7%	327.67	327.67
RS3/GPI3	3	Sequence+Voltage Monitor	Off	2.281	0.789	0.0	1.938	-15%	2.007	-12%	2.554	12%	2.623	15%	2.166	-5%	2.121	-7%	327.67	327.67
RS4/GPI4	4	Disabled	Off	1.800	1.000	0.0	0.000	-10...	0.000	-10...	2.000	11%	2.000	11%	1.500	-17%	1.000	-44%	327.67	327.67
RS5/GPI5	5	Disabled	Off	1.800	1.000	0.0	0.000	-10...	0.000	-10...	2.000	11%	2.000	11%	1.500	-17%	1.000	-44%	327.67	327.67
RS6/GPI6	6	Disabled	Off	1.800	1.000	0.0	0.000	-10...	0.000	-10...	2.000	11%	2.000	11%	1.500	-17%	1.000	-44%	327.67	327.67
RS7/GPI7	7	Disabled	Off	1.800	1.000	0.0	0.000	-10...	0.000	-10...	2.000	11%	2.000	11%	1.500	-17%	1.000	-44%	327.67	327.67
RS8/GPI8	8	Disabled	Off	1.800	1.000	0.0	0.000	-10...	0.000	-10...	2.000	11%	2.000	11%	1.500	-17%	1.000	-44%	327.67	327.67
RS9/GPI9	9	Disabled	Off	1.800	1.000	0.0	0.000	-10...	0.000	-10...	2.000	11%	2.000	11%	1.500	-17%	1.000	-44%	327.67	327.67
RS10/GPI10	10	Disabled	Off	1.800	1.000	0.0	0.000	-10...	0.000	-10...	2.000	11%	2.000	11%	1.500	-17%	1.000	-44%	327.67	327.67
RS11/GPI11	11	Disabled	Off	1.800	1.000	0.0	0.000	-10...	0.000	-10...	2.000	11%	2.000	11%	1.500	-17%	1.000	-44%	327.67	327.67
RS12/GPI12	12	Disabled	Off	1.800	1.000	0.0	0.000	-10...	0.000	-10...	2.000	11%	2.000	11%	1.500	-17%	1.000	-44%	327.67	327.67
RS13/GPI13	13	Disabled	Off	1.800	1.000	0.0	0.000	-10...	0.000	-10...	2.000	11%	2.000	11%	1.500	-17%	1.000	-44%	327.67	327.67
RS14/GPI14	14	Disabled	Off	1.800	1.000	0.0	0.000	-10...	0.000	-10...	2.000	11%	2.000	11%	1.500	-17%	1.000	-44%	327.67	327.67
RS15/GPI15	15	Current Monitor	Off	1.800	1.000	2500.0	0.000	-10...	0.000	-10...	2.000	11%	2.000	11%	1.500	-17%	1.000	-44%	0.10	0.12

Temperature Sensor	Enable	OT Warn (°C)	OT Fault (°C)
Internal	☑	35.00	45.00
DS75LV (addr 90h)	☑	35.00	45.00
DS75LV (addr 92h)	☐	327.67	327.67
DS75LV (addr 94h)	☐	327.67	327.67
DS75LV (addr 98h)	☐	327.67	327.67

Figure 3. MAX34451 EV Kit GUI (Monitoring Tab)

PSEN/GPO Tab

The **PSEN/GPO** tab sheet (Figure 4) sets the function of the PSENn pins. The **Output Select**, **PG/GPI or Alarm Channel Select**, and **PSEN/GPO Output Type** columns write to bits in the MFR_PSEN_CONFIG (D2h) command. **Output Select** sets the function of the PSENn pin and the **PSEN/GPO Output Type** column sets the output logic of the pin. For PSEN10 and PSEN11, the **Output Select** column has an extra option to configure PSEN10 as $\overline{\text{FAULT2}}$ and PSEN11 as $\overline{\text{SEQ}}$. If either of these options are selected, jumpers J5 or J4 on the EV kit board should be moved to the corresponding position. The **PG/GPI or Alarm Channel Select**, **TON Delay** (TON_DELAY 60h) and **TOFF Delay** (TOFF_DELAY 64h) columns can only be edited when the **Output Select** is set to **PG/GPI Combination** or **ALARM**.

PWM/GPO Tab

The **PWM/GPO** tab sheet (Figure 5) sets the function of the PWMn pins. All the columns in the PWM table write to the MFR_PWM_CONFIG (E7h) command. The **Output Select** column sets the function of the PWMn pin and the **PWM/GPO Output Type** sets the output logic of the pin. For PWM7, the **Output Select** column has an extra option to configure it as $\overline{\text{FAULT1}}$. If this option is selected, jumper J6 on the EV kit board should be moved to the $\overline{\text{FAULT1}}$ position. The **PG/GPI or Alarm Channel Select**, **ON Delay**, and **OFF Delay** columns can only be edited when the **Output Select** is set to **PG/GPI Combination** or **ALARM**.

Fault Config Tab

The **Fault Config** tab sheet (Figure 6) contains all the fault configuration settings. The **Fault Retry** time sets the value in MFR_FAULT_RETRY (DAh). The fault configuration table writes to a channel's MFR_FAULT_RESPONSE (D9h). To edit a channel's configuration, the **Input Select** on the **Monitoring** tab must be set to monitor voltage or current. To edit the **FAULT Pin Assertion** or **FAULT Pin Response** columns, set the **Global** column to **Global**.

Margining Tab

The **Margining** tab sheet (Figure 7) includes the margin configurations, margin fault status, a PWM calculator, and a DAC calculator for the DS4424. All values on the tab are read when the tab is selected. To edit a channel's margin options, the **Output Select** on the **PSEN/GPO** tab must be set to **Power Supply Enable (PSEN)** and the **Input Select** on the **Monitoring** tab must be set to **Sequence + Voltage Monitor**. For channels 0–7, the **Output Select** on the **PWM/GPO** tab must also be set to **PWM Operation**. The **Margin** column turns the margin on/off by writing to the OPERATION (01h) command. To force all the channels to the same margin, select the state in the **Margin All Control** drop-down list. The **Slope**, **Open Loop**, **PWM Level**, and **DAC Value** configure the PWMn outputs and the external DS4424 by writing bits in the MFR_MARGIN_CONFIG (DFh) command. The margining limits can be set by entering the voltage level or the percent of the nominal in the **Margin Low** (VOUT_MARGIN_LOW 26h) and **Margin High** (VOUT_MARGIN_HIGH 25h) columns. When the margining is turned on, the margin fault status is shown in the **Status** column read from STATUS_MFR_SPECIFIC (80h). The **Polled** column displays the channel voltage read from READ_VOUT (8Bh). To read the **Status** and **Polled** values, press the **Read Status and Vout** button or turn on polling with the **Auto Polling On** button. The margin faults can be cleared by pressing the **Clear Faults** button in the status bar.

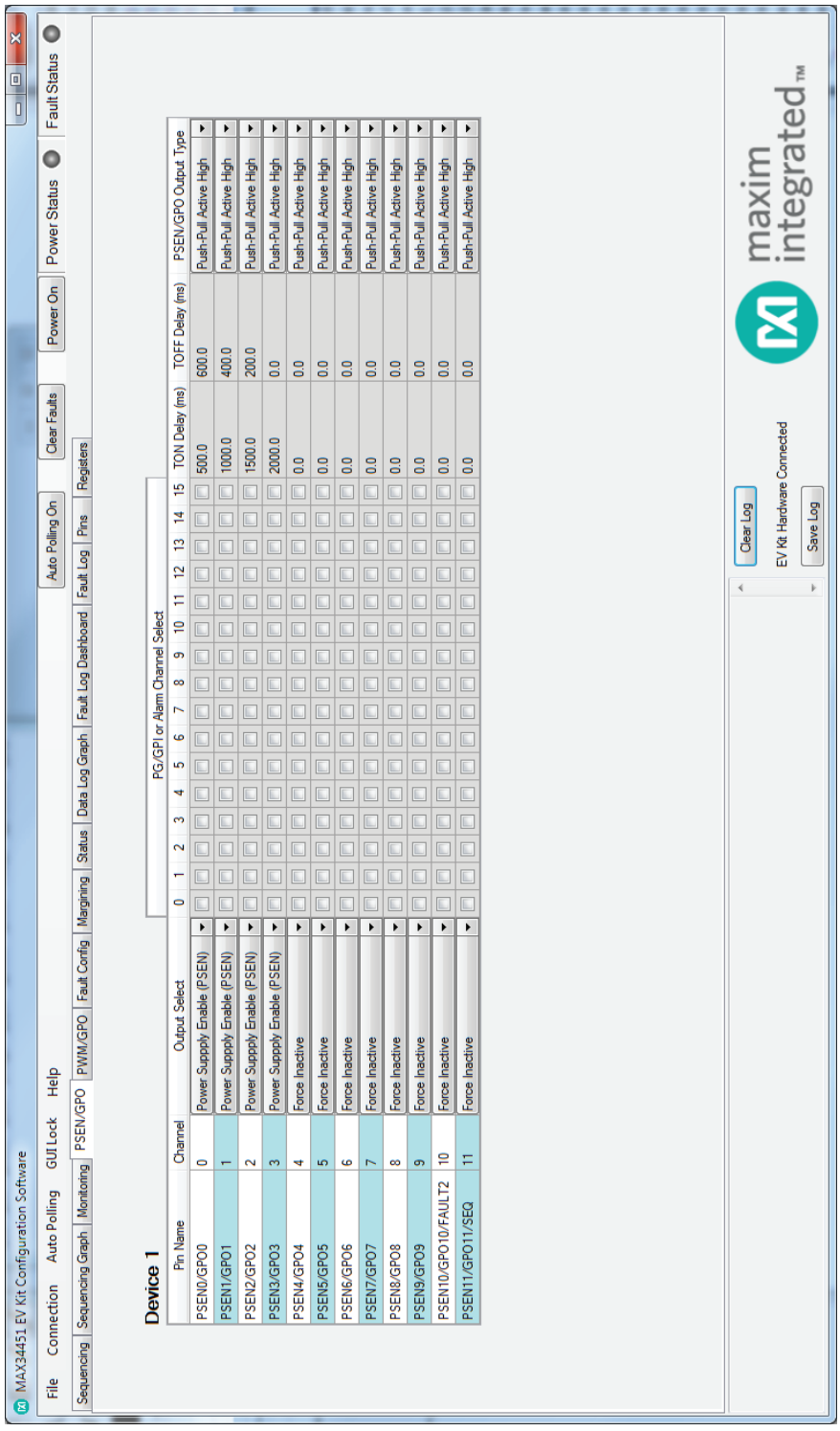


Figure 4. MAX34451 EV Kit GUI (PSEN/GPO Tab)

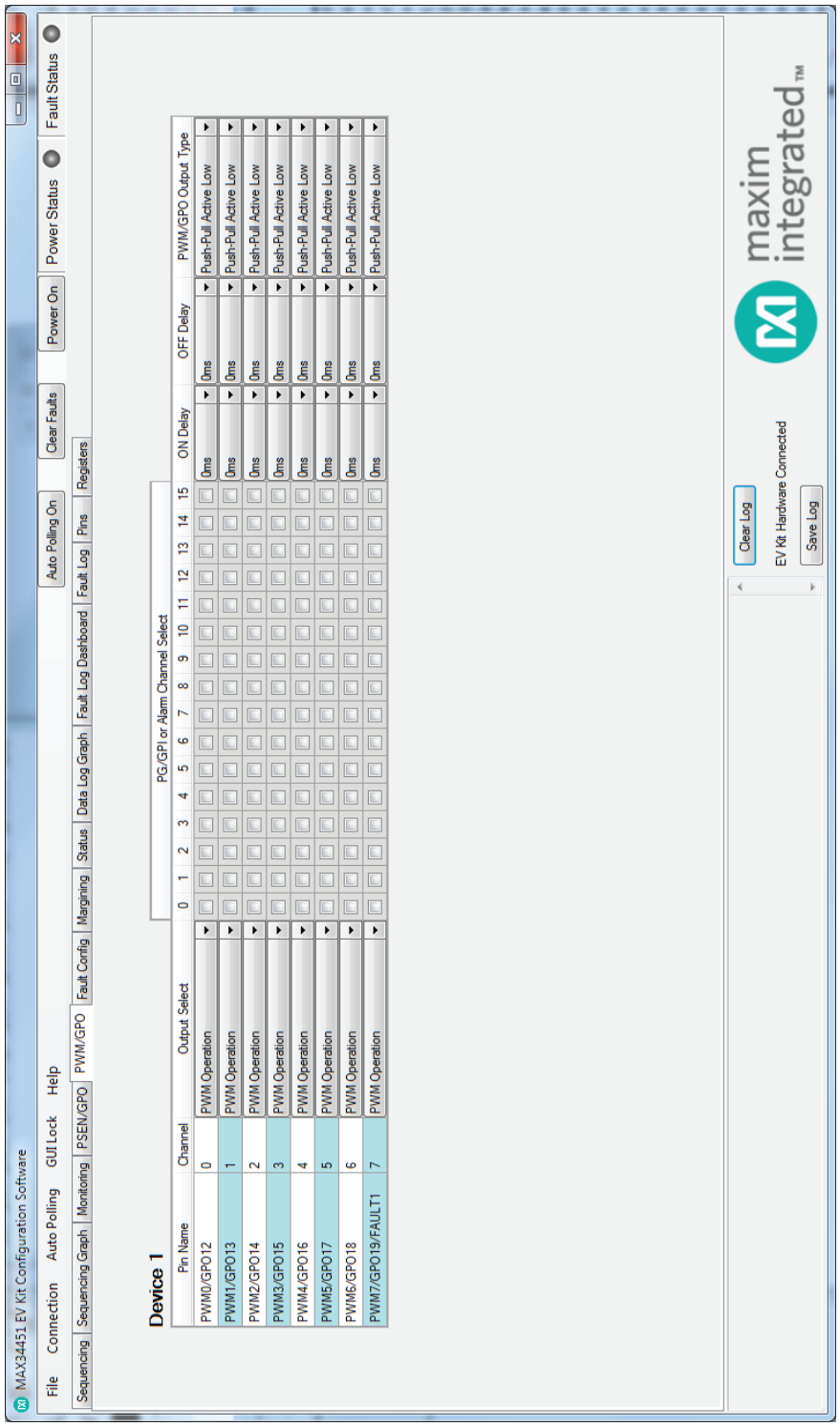


Figure 5. MAX34451 EV Kit GUI (PWM/GPO Tab)

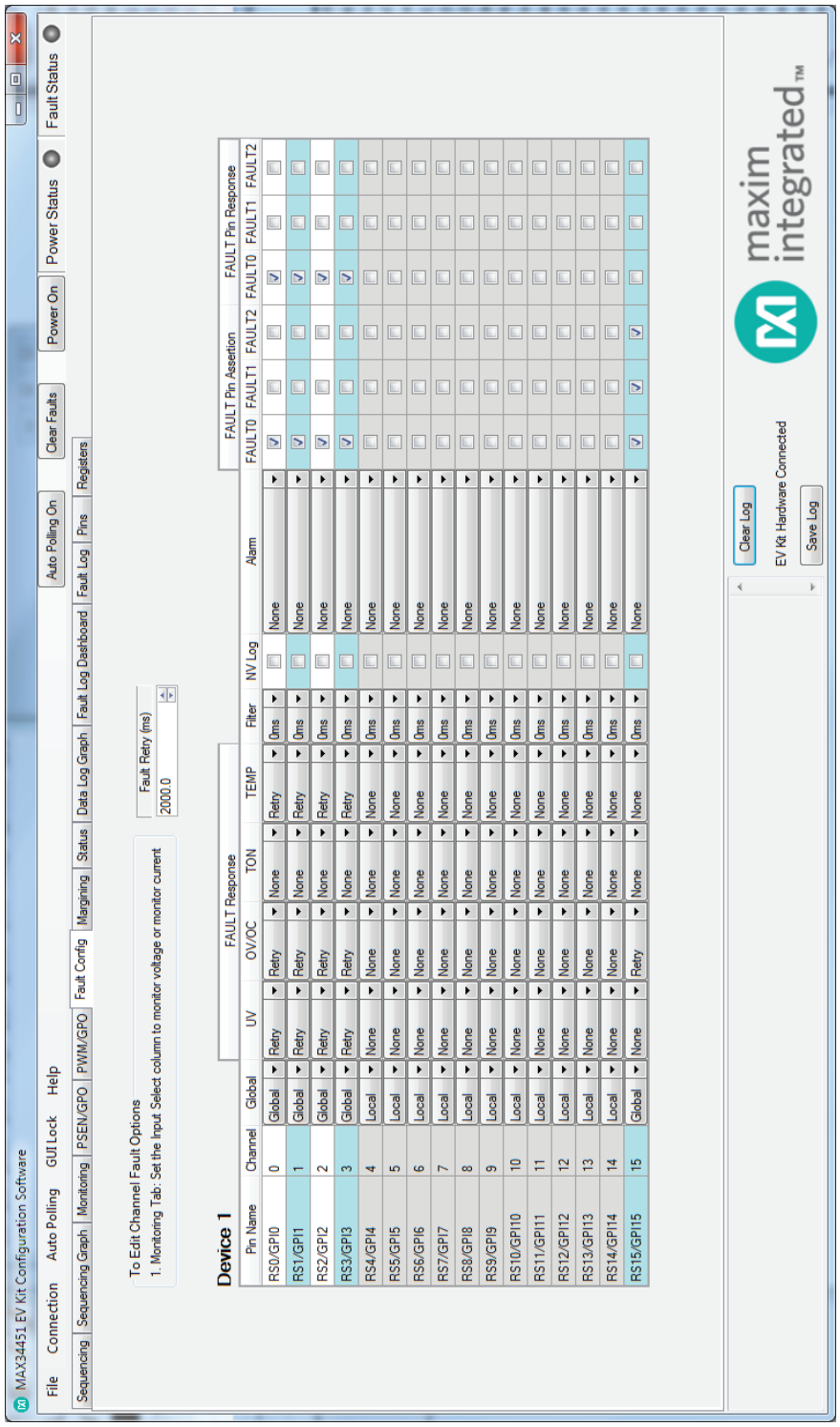


Figure 6. MAX34451 EV Kit GUI (Fault Config Tab)

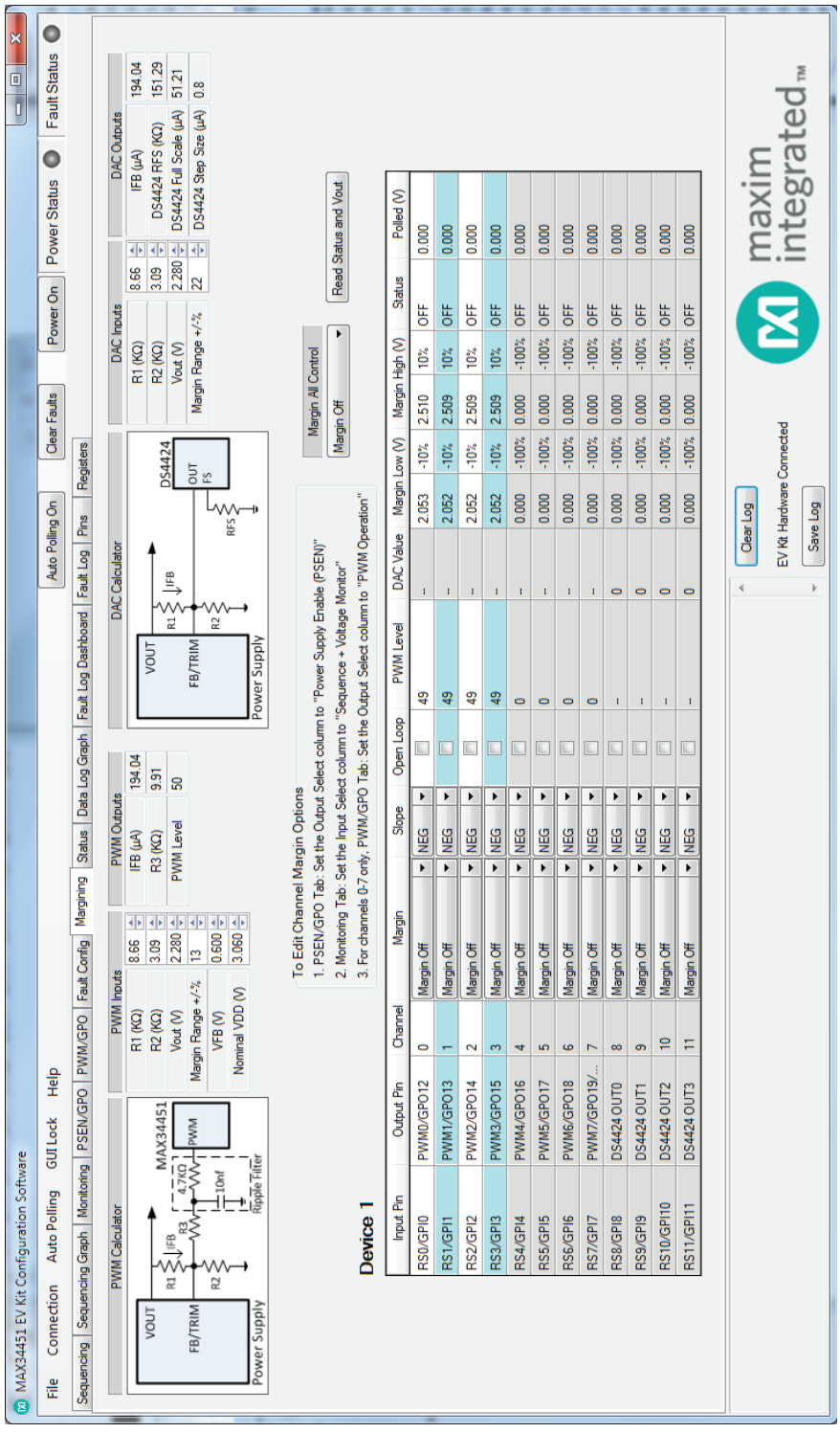


Figure 7. MAX34451 EV Kit GUI (Margining Tab)

The **PWM Calculator** is used to find the series resistance (R3) and PWM level. The equations used to calculate the outputs are given in Table 1.

The **DAC Calculator** is used to find the DS4424 external resistor (R_{FS}), which determines the full-scale and step-size current for the DAC. If R_{FS} is calculated to be outside its limits (40kΩ < R_{FS} < 160kΩ), then the resistor is forced to the edge of the limit and the **DS4424 RFS** edit box turns red. The equations used to calculate the outputs are given in Table 2.

Status Tab

The **Status** tab sheet (Figure 8) displays all the faults, warning, and device ID information. To read all the output values, faults, and warnings, press the **Read Device 1 Status** button or turn on polling with the **Auto Polling On** button. The fault and warning bits are read from STATUS_VOUT (7Ah), STATUS_IOUT (7Bh), STATUS_MFR_SPECIFIC (80h), and STATUS_TEMPERATURE (7Dh). The **Polled** values are read from READ_VOUT (8Bh), READ_IOUT (8Ch), and READ_TEMPERATURE (8Dh). Each color indicator turns green if the status is good, red if there is a fault, or yellow to indicate a warning. The **Polled** value might not reflect the fault or warning because some bits are latches and have to be cleared. To clear the faults and warnings, press the **Clear Faults** button in the status bar to send the CLEAR_FAULTS (03h) command. The **Time Count** displays the 32-bit counter read from the MFR_TIME_COUNT (DDh) command. The **ID COMMANDS** table displays all the ID information of the device. Press the **Read ID** button to read all the commands in the table.

Data Log Graph Tab

The **Data Log Graph** tab sheet (Figure 9) plots the polled values in a graph and keeps track of the minimum and maximum values for each channel voltage or current and each temperature sensor. To read the polled values, press the **Data Log Read** button. Each data log reads every channel's voltage (READ_VOUT 8Bh) or current (READ_IOUT 8Ch) and every temperature sensor (READ_TEMPERATURE 8Dh). The software finds the minimum and maximum values over multiple reads. To plot the value being read, press the **Auto Polling On** button and the **Poll Count** displays the number of reads that have been tracked in the data log. When the polled count reaches 10,000, the graph deletes the oldest polled values and adds a new polled value. The min/max values are still based on all the poll-count values, but the graph only displays the latest 10,000 polled values. To reset the **Poll Count** and all the min/max values, select **Data Log Reset**. To turn off data logging during polling, check the **Data Log Off** checkbox. The **Select Data** drop-down list is used to select the voltage, current, or temperature data to display on the graph and in the **MIN/MAX Data** table. To save all the data graphed to a CSV file, press the **Save Data Log** button.

Fault Log Dashboard Tab

The **Fault Log Dashboard** tab sheet (Figure 10) displays all 15 NV fault logs in table format. When the tab is selected, the **Overwrite** and **Fault Log Depth** are read. When the fault log is full, the **Enable Overwrite** can be checked to automatically overwrite previous logs. The fault log depth can be adjusted with the **Fault Log Depth** drop-down list. The **Enable Overwrite** and **Fault Log Depth** are read from bits in MFR_NV_LOG_CONFIG (D8h). To read all 15 fault logs, press the **Read All Fault Logs** button. This command takes at least 10s to complete. For each channel within a fault log, the **VOLTAGE/CURRENT** table shows the fault/warning status, minimum value, maximum value, and the last three black box readings. The **TEMPERATURE** table shows the OT fault status, the peak value, and the last temperature reading. To clear or force the fault log, press the **Clear NV Fault Log** or **Force NV Fault Log** buttons, respectively. These buttons write to a bit in MFR_NV_LOG_CONFIG (D8h). The **Dump Logs to File** button saves all the fault log tables in a CSV file.

Table 1. PWM Calculator

OUTPUT EQUATIONS
$I_{FB} = (V_{OUT})/(R1 + R2)$
$R3 = (V_{FB} - 0.3)/(I_{FB}$ x Margining Range x 120%)
PWM Level = 256 x (V_{FB}/V_{DD})

Table 2. DAC Calculator

OUTPUT EQUATIONS
$I_{FB} = (V_{OUT})/(R1 + R2)$
DS4424 $R_{FS} = (7.75)/(I_{FB}$ x Margining Range x 120%)
DS4424 full scale = (0.976 x 127)/(16 x R_{FS})
DS4424 step size = Full scale/64

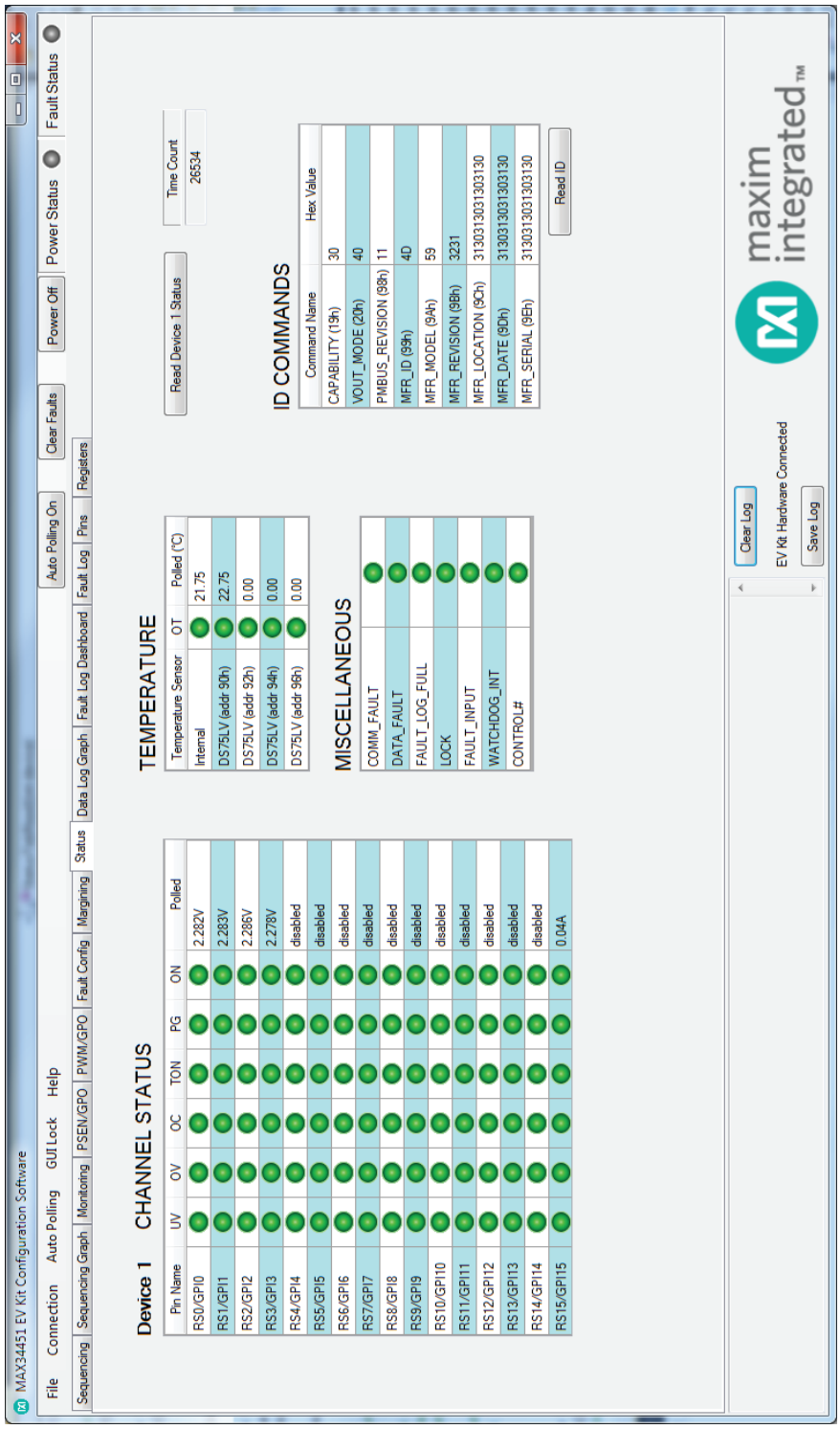


Figure 8. MAX34451 EV Kit GUI (Status Tab)



Figure 9. MAX34451 EV Kit GUI (Data Log Graph Tab)

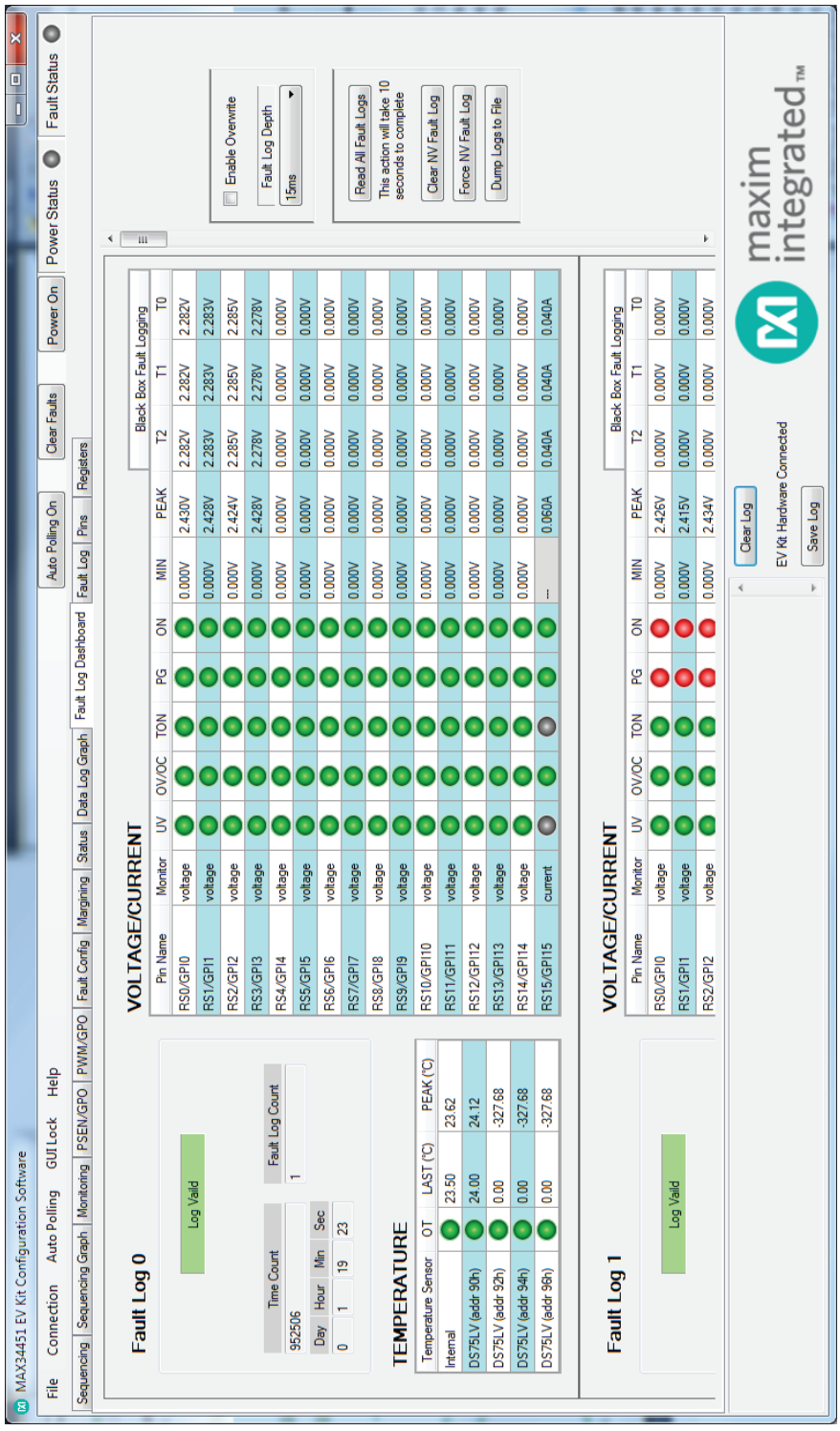


Figure 10. MAX34451 EV Kit GUI (Fault Log Dashboard Tab)

Fault Log Tab

The **Fault Log** tab sheet (Figure 11) displays a single log in the NV fault log. To read the fault log, press the **Read NV Fault Log** button and all 255 bytes from MFR_NV_FAULT_LOG (DCh) are displayed in the table. The fault log number is displayed above the **Read NV Fault Log** button. To save the current fault log displayed in the table, press the **Dump to a File** button and the table is saved as a CSV file.

Pins Tab

The **Pins** tab sheet (Figure 12) shows all the pin names, pin numbers, and pin descriptions. The **Pin Name** and **Description** columns can be edited to specify how the pin is configured. The pin names listed in the **Pin Name** column are copied to the **Pin Name** columns on the other tabs and are saved in the XML file when a project is saved.

Registers Tab

The **Registers** tab sheet (Figure 13) displays all the PMBus commands and their current data. To read the registers, select a page in the top drop-down list and all the PMBus commands valid for that page are automatically read. The commands not valid for that page are grayed out. Press the **Read All** button to read the registers again. To write to a command, enter the hex value in the cell and click another cell or press Enter on the keyboard. The CRC of all three memory arrays in the device can be read by pressing the **Read CRC of All Memory Arrays** button, which reads/writes to the MFR_CRC (FEh) command. The current register configuration can be saved to main flash by pressing the **Save To Main Flash** button, which sends the STORE_DEFAULT_ALL (11h) command. The configuration can also be saved to BACKUP flash by pressing the **Save To Back Up Flash** button, which reads/writes to the MFR_STORE_ALL (EEh) command. To return the device to the configuration in MAIN flash, press the **Restore From Main Flash** button, which sends the RESTORE_DEFAULT_ALL (12h) command. The device can also be returned to the configuration stored in BACKUP flash by pressing the **Restore From Back Up Flash** button to read/write to the MFR_RESTORE_ALL (EFh) command. To reset the device, press the **Soft Reset** button to write to a bit in MFR_MODE (D1h). The **Command Description** shows the bitmap for selected PMBus commands. Select the command in the drop-down list and the table below shows a description of each bit for that command.

Multiple Devices

The GUI has the ability to display data for up to four devices. If multiple slave addresses are detected, the **Number of Devices** option in the **Connection** menu allows the user to choose how many devices to display. To choose the order of devices, select the appropriate slave address in the **DeviceX Slave Address** options. Most tabs have separate tables and controls for each device. The **Fault Log Dashboard**, **Fault Log**, and **Register** tabs all have a drop-down list to select the device to read/write if the number of devices is greater than one.

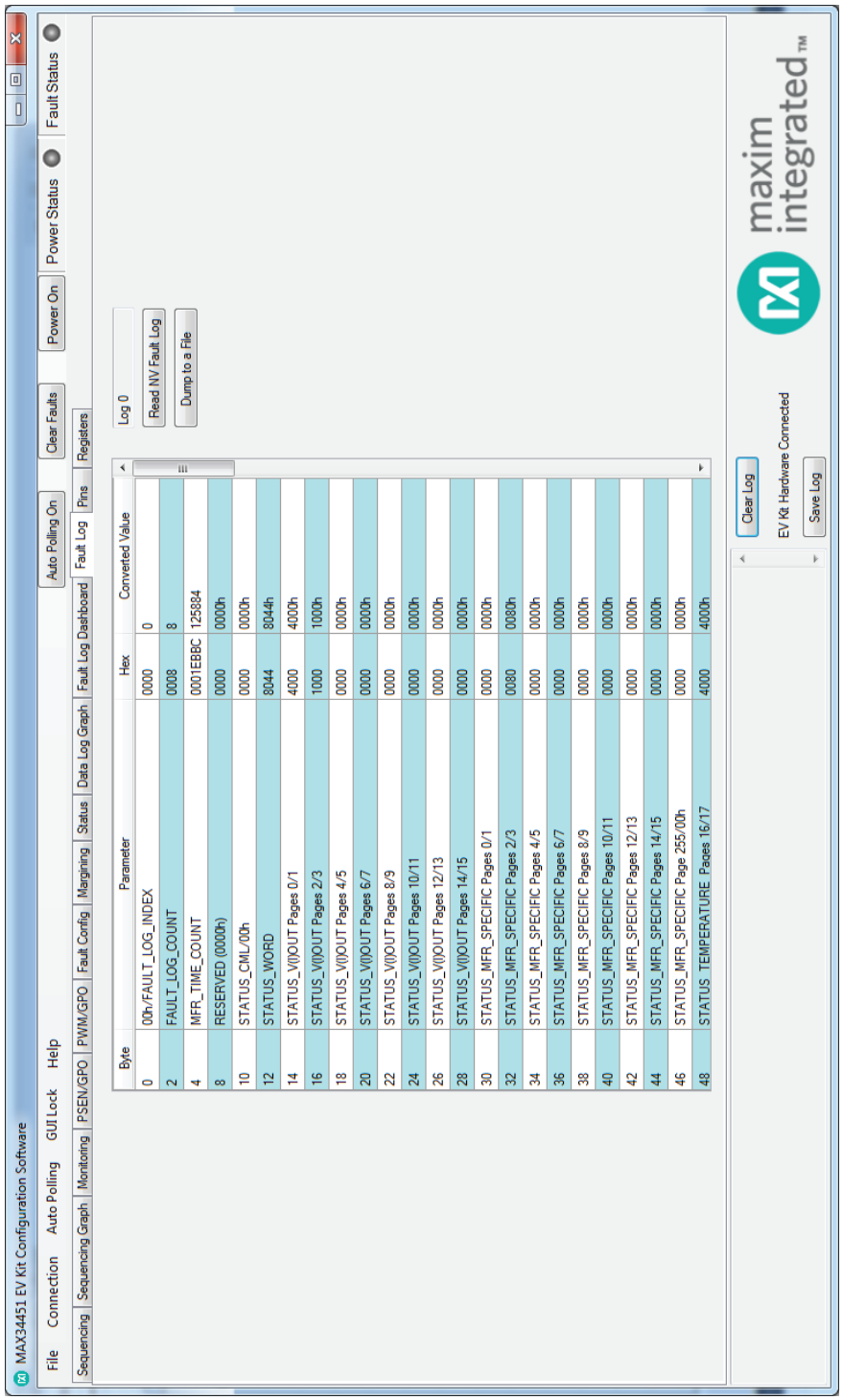


Figure 11. MAX34451 EV Kit GUI (Fault Log Tab)

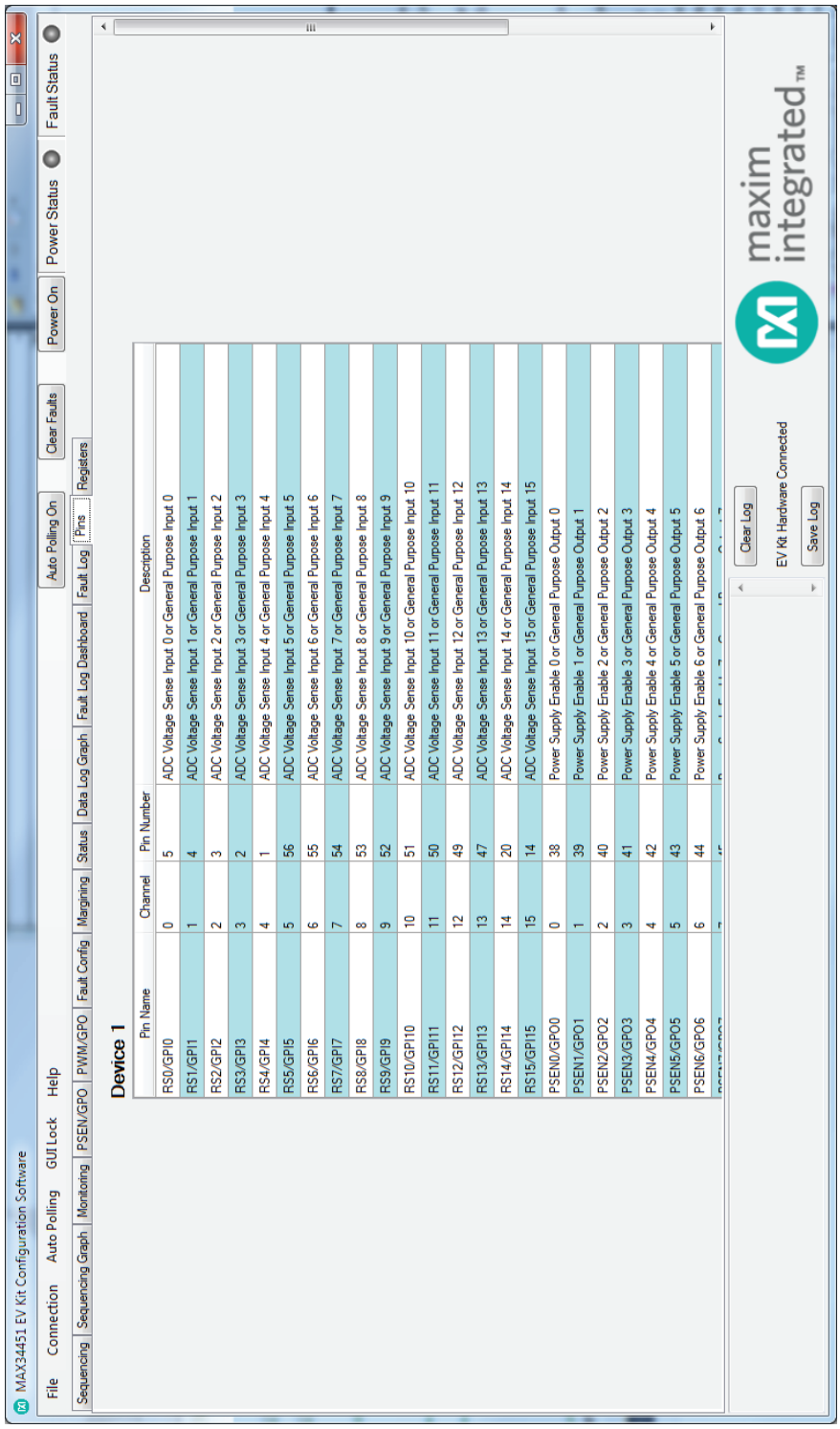


Figure 12. MAX34451 EV Kit GUI (Pins Tab)

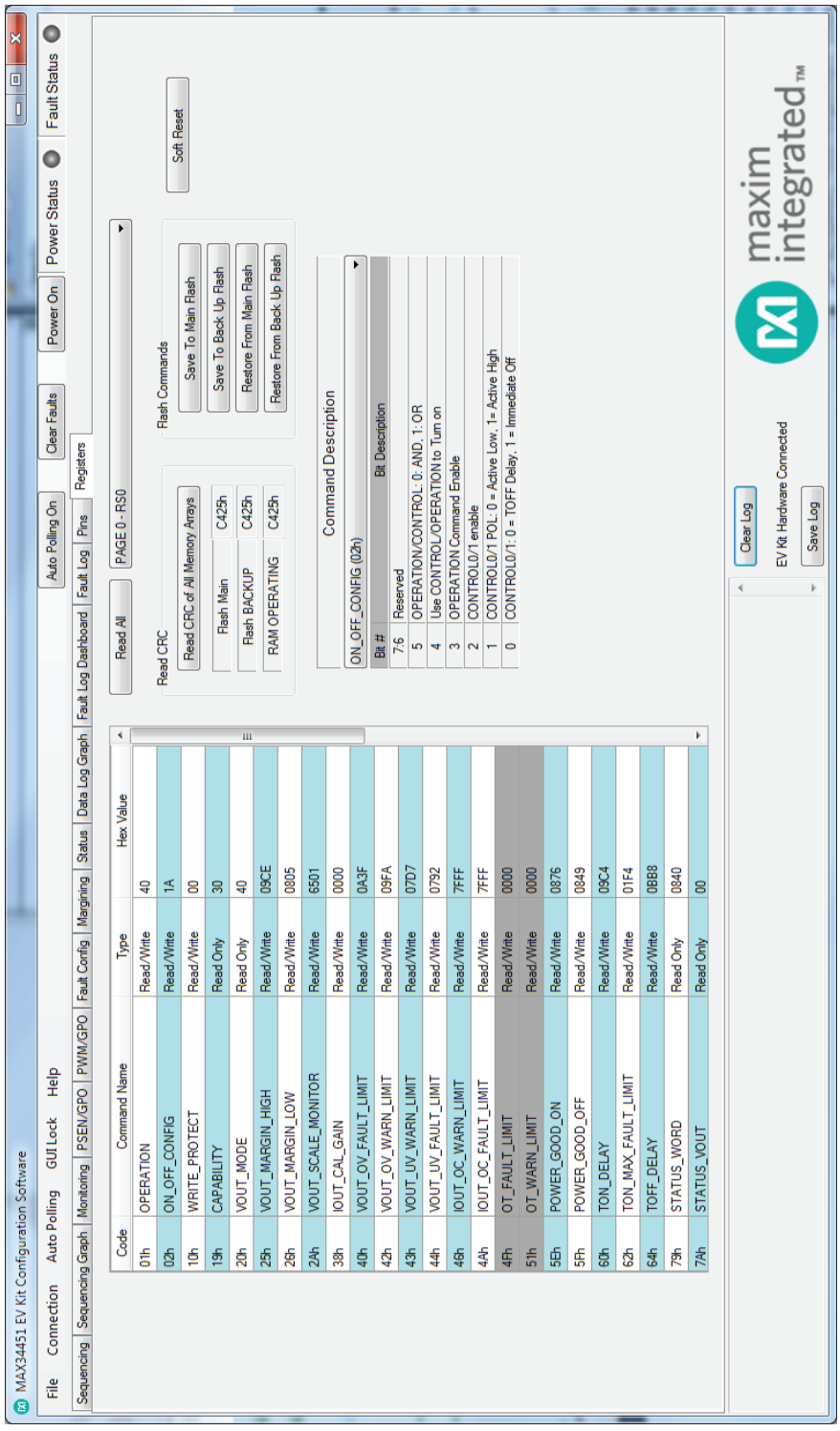


Figure 13. MAX34451 EV Kit GUI (Registers Tab)

Detailed Description of Hardware

User-Supplied I²C Interface

To communicate with the MAX34451 with a user-supplied I²C interface, first remove J23 jumpers to disconnect the USB I²C dongle. If the dongle is no longer desired, it can be separated from the EV kit by snapping the PCB at the scored line. Connect test points SDA, SCL, GND, and 5V to the off-board I²C interface. The I²C interface should operate at 3.3V.

User-Supplied Power Supplies

To disconnect the on-board power supplies, turn off 4-pole DIP switches RS (S5), PSEN (S6), and PWM (S7). The power supplies' GND should be connected to the banana jack (GND). Connect the desired PSENn pins to the enable pin on the power supply, and the RSn pins to a voltage-divider on the output of the power supply. The voltage-divider is only required if the output voltage is greater than 1.8V. For PWM margining, the PWMn outputs can be connected to the feedback of the power supply for channels 0–7. Resistors R68–R75 should be adjusted to match the power-supply feedback circuitry. Refer to the MAX34451 IC data sheet for details or use the PWM calculator to determine the proper values.

User-Supplied DS75LV

To use an off-board digital temperature sensor, connect MSDA, MSCL, and GND on J3 to the DS75LV. The slave address for the user-supplied DS75LV should be 92h, 94h, or 96h. The on-board DS75LV has slave address 90h.

Current-Sense Amplifier

The EV kit comes with an on-board 25V/V current-sense amplifier (U3) to demonstrate how the device can monitor current. The output of the amplifier is connected to RS15 and can be removed by removing the jumper on J15.

Multiple Device System

To chain multiple MAX34451 EV kits together as one system, follow the steps below. **Note:** Do not chain more than four EV kits together.

1) Remove power to all EV kits.
2) On one EV kit, populate the four jumpers on J23. For all other boards, remove the four jumpers on J23.
3) For all EV kits, switch the SDA and SCL signals on the 8-pole DIP switch (S4) to on.
4) If using the other signals on the 8-pole DIP, then switch those signals to on; otherwise, turn the switches off. **Note:** To connect the $\overline{SEQ}$, $\overline{FAULT1}$, or $\overline{FAULT2}$ signals, jumpers J4, J6, or J5 must also be set to $\overline{SEQ}$, $\overline{FAULT1}$, or $\overline{FAULT2}$, respectively.
5) Connect the EV kit signals together using ribbon-cable connectors on J7 or J8. To power and communicate to another EV kit, ensure that 5V, GND, SDA, and SCL are all connected on J7 or J8. All other signals are optional.
6) Connect the EV kit with the four jumpers on J23 to a PC using the USB cable.

Table 3. Description of LEDs

LED	COLOR	DESCRIPTION
D2	Red	$\overline{\text{FAULT0}}$: A fault has occurred.
D3	Red	$\overline{\text{FAULT1}}$: A fault has occurred.
D4	Red	$\overline{\text{FAULT2}}$: A fault has occurred.
D7	Red	$\overline{\text{ALERT}}$: A fault or warning has occurred.
DA	Green	VOUT0: Channel 0 is on.
DB	Green	VOUT1: Channel 1 is on.
DC	Green	VOUT2: Channel 2 is on.
DD	Green	VOUT3: Channel 3 is on.
D20 (Power)	Red	USB Power Fault: A fault occurred due to overvoltage limit, current limit, or thermal limit.
	Green	USB Power: USB power supply is on.
D21(Com)	Red	Communication: After the software has initialized the hardware, the LED flashes red when an I²C command is received.
	Green	Initialized: Hardware has been initialized by software.

Table 4. Description of Switches

SWITCH	SWITCH POSITION	DESCRIPTION
S1	On*	CONTROL0: Pulls the CONTROL0 pin high.
S2	On*	CONTROL1: Pulls the CONTROL1 pin high.
S3	Pressed	Reset: Pulls the $\overline{\text{RST}}$ pin low to reset the device.
S4	On*	Multiple Devices: Connects all the multiple device signals to headers J7 and J8.
S5	On*	RS0–RS3: Connects RSn of the device to the output of the power-supply channel.
S6	On*	PSEN0–PSEN3: Connects PSENn of the device to the enable pin of the power-supply channel.
S7	On*	PWM0–PWM3: Connects PWMn of the device to the feedback of the power-supply channel.

**Default position.*

Table 5. Description of Jumpers

JUMPER	JUMPER POSITION	DESCRIPTION
J1	VDD-VDUT	Connects VDD to VDUT (U1).
J4	PSEN11*	Connects the PSEN11/GPO11/$\overline{\text{SEQ}}$ pin to the PSEN header.
	$\overline{\text{SEQ}}$	Connects the PSEN11/GPO11/$\overline{\text{SEQ}}$ pin to a pullup resistor and $\overline{\text{SEQ}}$ test point.
J5	PSEN10*	Connects the PSEN10/GPO10/$\overline{\text{FAULT2}}$ pin to the PSEN header.
	$\overline{\text{FAULT2}}$	Connects the PSEN10/GPO10/$\overline{\text{FAULT2}}$ pin to a pullup resistor, LED, and $\overline{\text{FAULT2}}$ test point.
J6	PWM7*	Connects the PWM7/GPO19/$\overline{\text{FAULT1}}$ pin to the PWM header.
	$\overline{\text{FAULT1}}$	Connects the PWM7/GPO19/$\overline{\text{FAULT1}}$ pin to a pullup resistor, LED, and $\overline{\text{FAULT1}}$ test point.
J15	CSA	Connects the current sense amplifier (U3) output to RS15.
J23	5V-5V	Supplies 5V from the USB I²C dongle to the EV kit board.
	SDA-SDA	Connects SDA from the USB I²C dongle to the U1 device SDA.
	GND-GND	Connects GND from the USB I²C dongle to the EV kit board GND.
	SCL-SCL	Connects SCL from the USB I²C dongle to the U1 device SCL.

**Default position.*

Troubleshooting

All efforts have been made to ensure that each kit works on the first try, right out of the box. In the rare occasion that a problem is suspected, see Table 6 to help troubleshoot the issue.

Table 6. Troubleshooting

SYMPTOM	CHECK	SOLUTION
GUI says hardware not found.	Is the LED labeled D20 red?	If yes, then the electronic fuse is in a fault state. Inspect for electrical shorts on the PCB and make sure that the PCB is not sitting on a conductive surface.
	Does the LED labeled D21 turn green when the GUI is running?	If not, then exit the GUI and try running it again. If D20 still does not turn green, then exit the GUI and try connecting the USB cable to a different USB port on the PC and wait for a Windows message that states the hardware is ready to use. Run the GUI again.
	Are any of the LEDs illuminated?	If not, then the PCB may not be getting power from the USB. Try a different USB cable or a different USB port.
No slave address found and read/writes fail	Jumper J1	Make sure jumper J1 is installed to power the U1 device.
	Jumper J23	Make sure four jumpers on J23 are installed.
Channels do not turn on	Is there a **CONTROL#** fault on the **Status** tab of the GUI?	If the ON_OFF_CONFIG command is set as turn-on power supplies with the CONTROL0/CONTROL1 pin, then make sure S1 and S2 are in on position.
	Is the ALERT LED on and all channel LEDs off?	If so, make sure switch PSEN (S6) is in the on position to connect the PSENs of U1 device to channel power supplies.
	Is the ALERT LED on and at least one channel LED on?	If so, make sure switch RS (S5) is in the on position to connect the power-supply outputs to the U1 device.
Margining is not working, voltage is not changing	S7	Make sure the PWM (S7) switch is in the on position to connect the PWMs of the U1 device to the FB of channels 0–3.
Chaining multiple EV kits together using J7 and J8 does not seem to work	S4	Make sure that all the switches on the 8-pole DIP switch (S4) are in the on position.
The $\overline{\text{FAULT1}}$ LED does not turn on.	J6	If the channel is configured to assert the $\overline{\text{FAULT1}}$ pin, make sure the **Output Select** for PWM7 on the **PWM/GPO** tab is set to **FAULT1**. On the EV kit, make sure the J6 jumper is set to $\overline{\text{FAULT1}}$.
The $\overline{\text{FAULT2}}$ LED does not turn on.	J5	If the channel is configured to assert the $\overline{\text{FAULT2}}$ pin, make sure the **Output Select** for PSEN10 on the **PSEN/GPO** tab is set to **FAULT2**. On the EV kit, make sure the J5 jumper is set to $\overline{\text{FAULT2}}$.
The $\overline{\text{SEQ}}$ input/output signal is not working	J4	If the channel is configured to generate or match a $\overline{\text{SEQ}}$ signal, make sure the **Output Select** for PSEN11 on the **PSEN/GPO** tab is set to **SEQ**. On the EV kit, make sure the J4 jumper is set to $\overline{\text{SEQ}}$.
The current monitored on RS15 does not work	J15	Make sure the jumper on J15 is populated to connect the output of the current-sense amplifier to RS15.

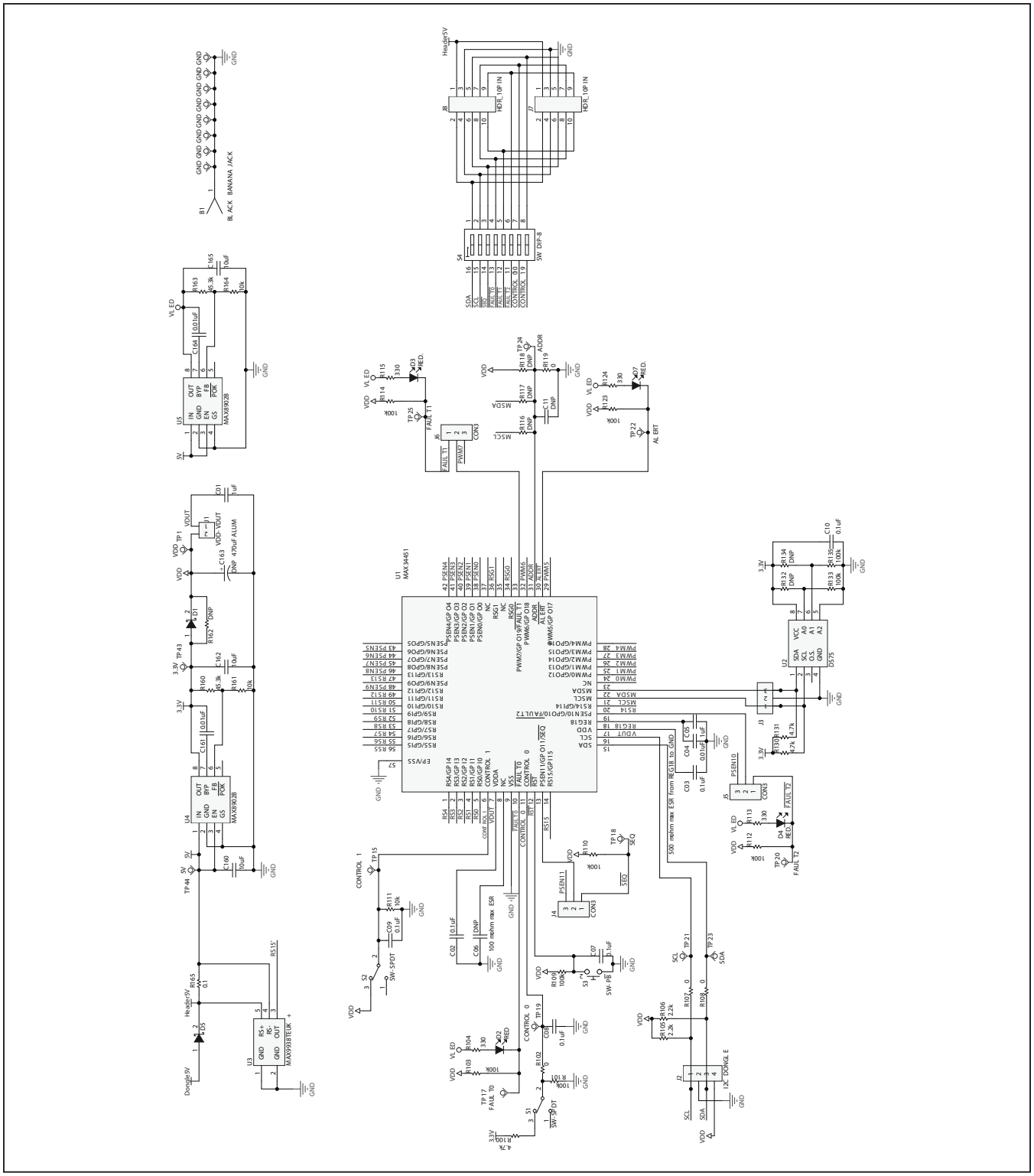


Figure 14a. MAX34451 EV Kit Schematic (Sheet 1 of 3)

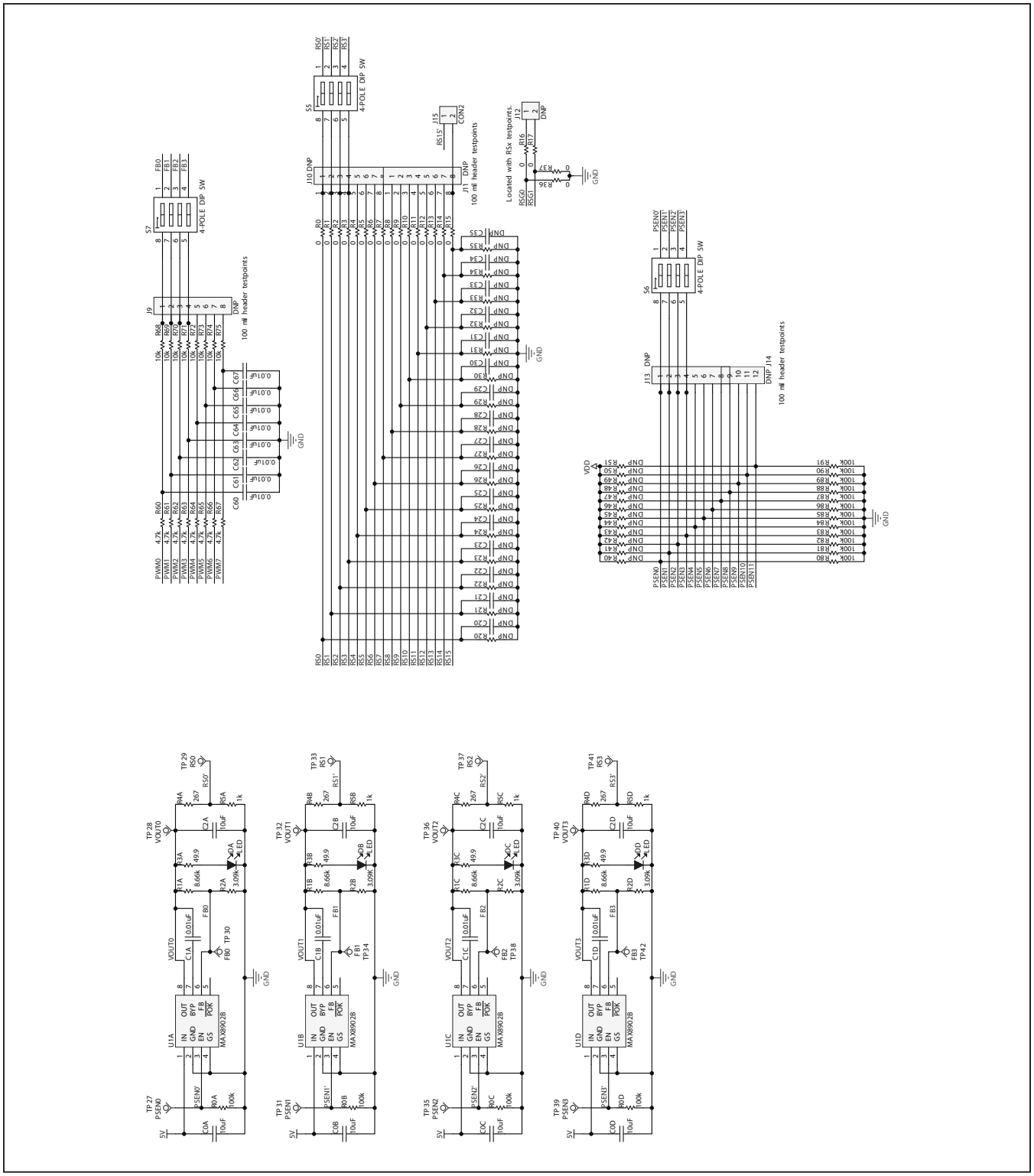


Figure 14b. MAX34451 EV Kit Schematic (Sheet 2 of 3)

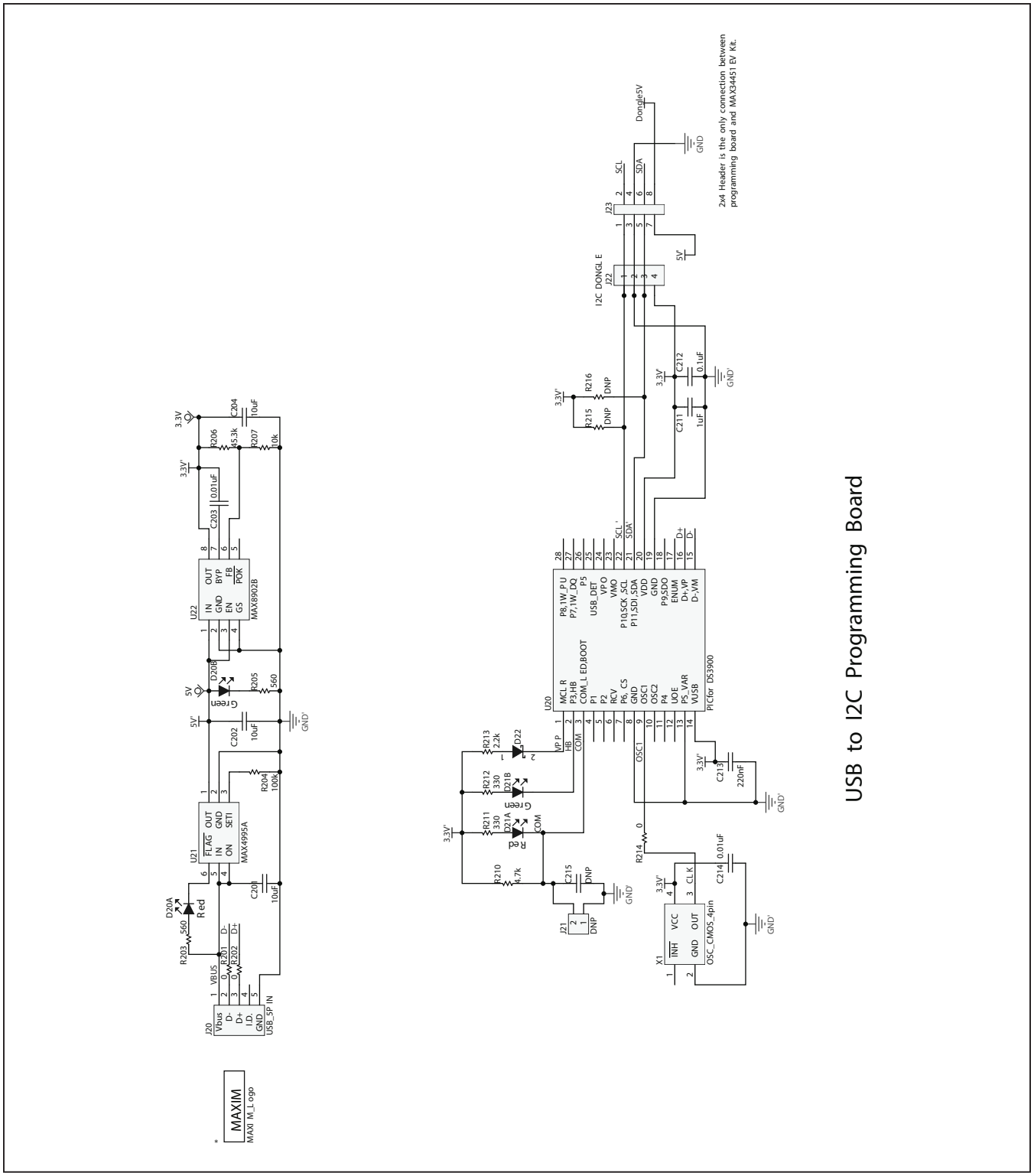


Figure 14c. MAX34451 EV Kit Schematic (Sheet 3 of 3)

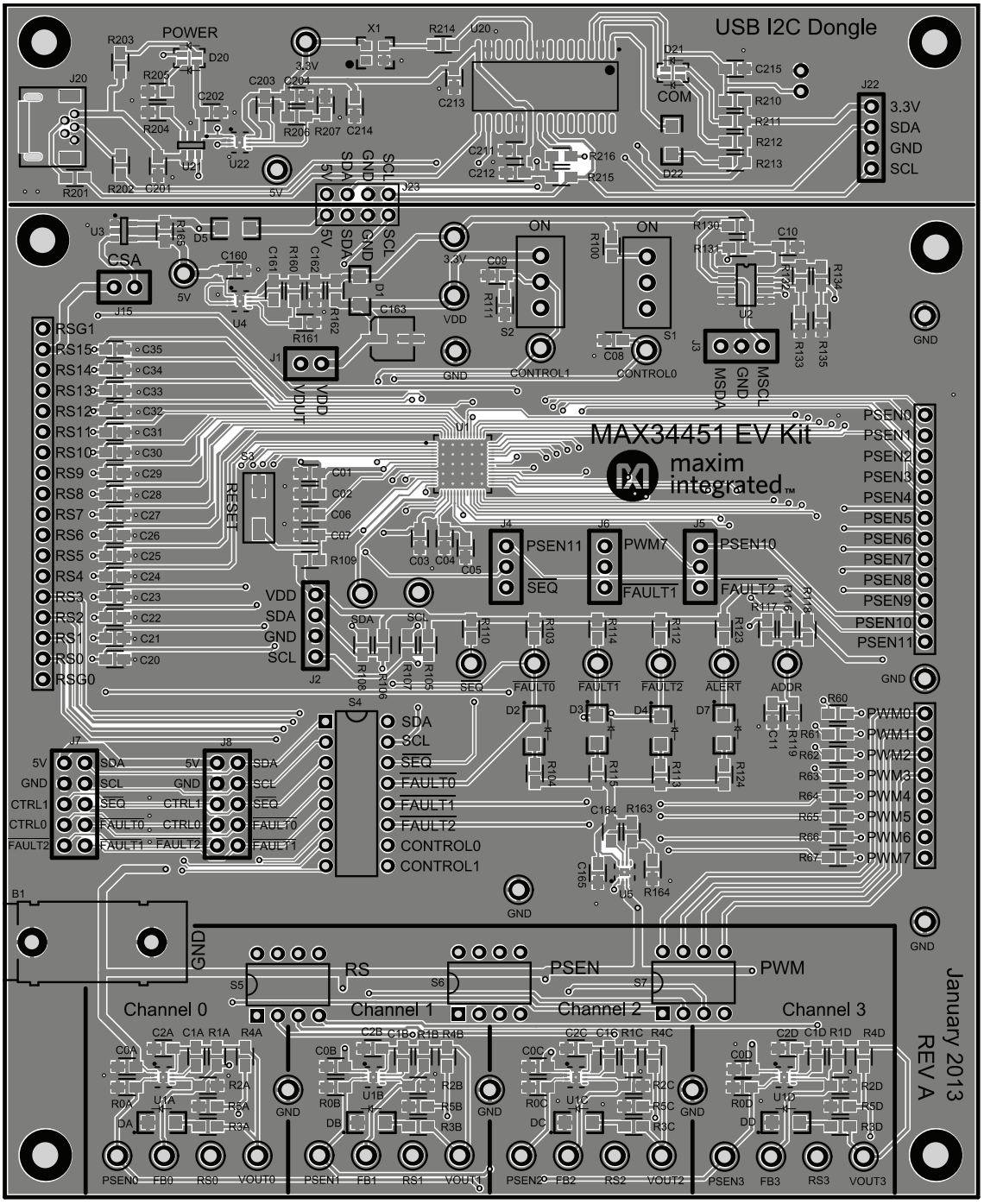


Figure 15. MAX34451 EV Kit PCB Layout—Top Layer

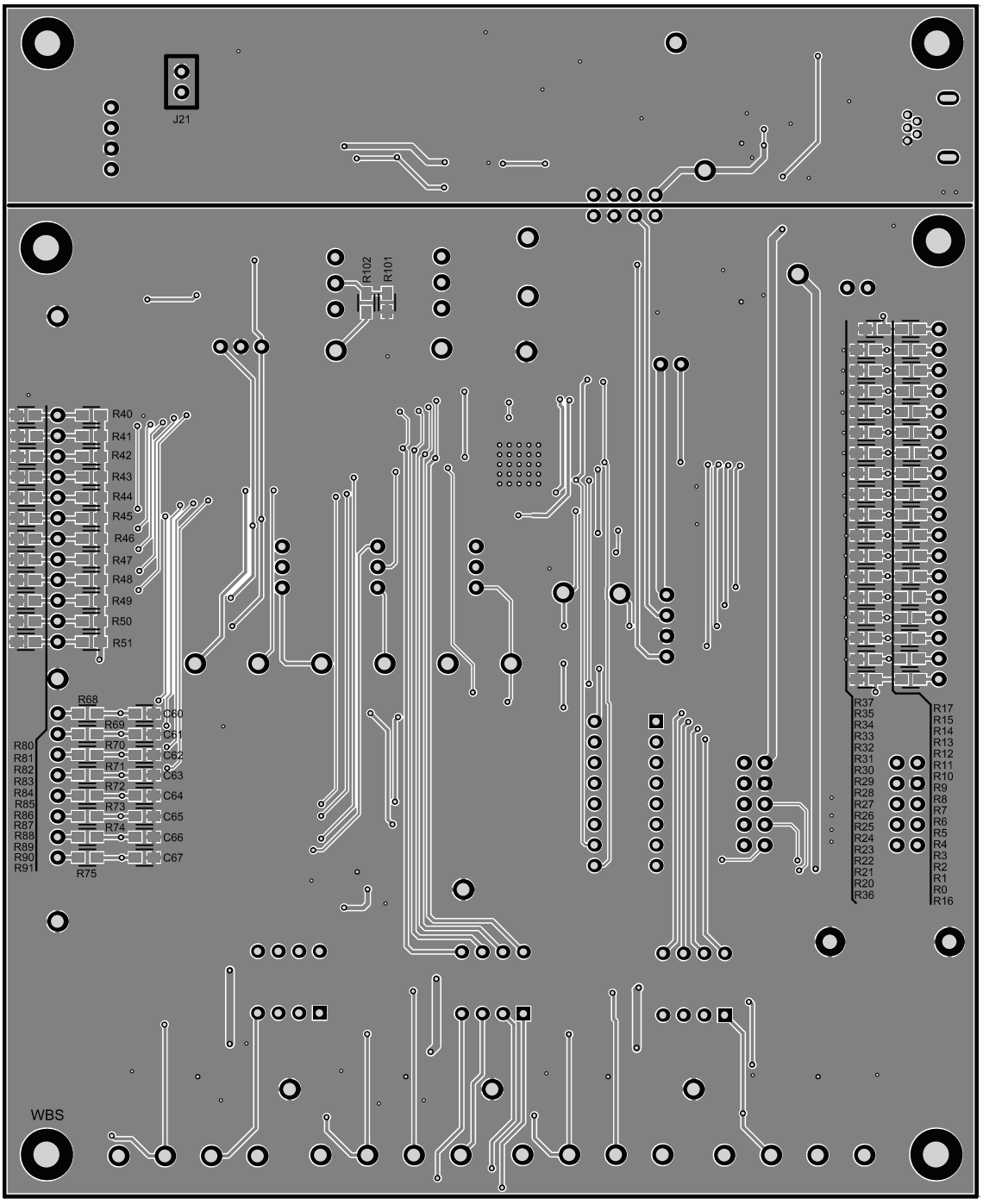


Figure 16. MAX34451 EV Kit PCB Layout—Bottom Layer

Ordering Information

PART	TYPE
MAX34451EVKIT#	EV Kit

#Denotes an RoHS-compliant device that may include lead(Pb), which is exempt under the RoHS requirements

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	5/13	Initial release	—

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim Integrated's website at www.maximintegrated.com.

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