19-3832; Rev 0; 9/05

MAX5945 Evaluation Kit/Evaluation System

Evaluate: MAX5945

General Description

The MAX5945 evaluation kit (EV kit) is a fully assembled and tested surface-mount circuit board featuring an Ethernet four-port network power controller circuit for -48V supply rail systems. The MAX5945 IEEE 802.3af-compliant network power controller is available in a 36-pin SSOP package. The circuit includes four n-channel power MOSFETs used to form the main power-sourcing equipment (PSE) circuit on the EV kit. The MAX5945 is used in power-over-ethernet (POE) applications requiring DC power over four Ethernet network ports. The EV kit provides optical isolation for the I²C-compliant 3-wire interface. The isolated interface connects to a PC parallel port (LPT) through a MAXSMBus interface board. The EV kit can easily be reconfigured for interfacing to a user's stand-alone microcontroller for isolated or nonisolated operation.

The MAX5945 EV kit requires a -32V to -60V power supply (-48V supply rail) capable of supplying 2A or more to the EV kit for powering the power device (PD) through the four 10/100 base-TX Ethernet network ports. The EV kit demonstrates PD discovery, classification, current-limit control and other functions of an IEEE 802.3af-compliant PSE. The user must also supply two separate 3.3V power supplies capable of supplying 100mA for the EV kit's digital logic and 3.3V (V_{CC}) optically isolated 3-wire interface. The MAXSMBus interface board requires a dedicated 9V power supply capable of supplying 250mA. The +9V power supply is not required for nonisolated operation.

The MAX5945 controls the -48V DC power to each of the four Ethernet network ports by controlling each port's power MOSFET and sensing current through the respective port's current-sense resistor. The current is fed to a 10/100 base-TX Voice-over-IP (VoIP) magnetic module at each Ethernet network output port. The MAX5945 EV kit provides a separate independent power channel for each of the four Ethernet network output ports.

The EV kit demonstrates the full functionality of the MAX5945 for each power channel such as configurable operational modes, PD detection, PD classification, overcurrent protection, current foldback, under/overvoltage protection, and AC disconnect monitoring. All of these features are configurable on the EV kit and additional test points for voltage probing and current measurements have been provided.

Windows is a registered trademark of Microsoft Corp.

The MAX5945 EV kit software is Windows® 95/98/2000-compatible and provides a user-friendly interface to demonstrate the features of the MAX5945 while providing access to each register at the bit level. The program is menu-driven and offers a graphic interface with control buttons. The program also includes a macro engine to allow automated evaluation and testing of the MAX5945 at the system level. The program's macro output files can be automatically saved.

Order the MAX5945EVSYS for a complete PC-based evaluation of the MAX5945. Order the MAX5945EVKIT if you already have a MAXSMBus interface board or do not require PC-based evaluation of the MAX5945.

Features

- **IEEE 802.3af-Compliant Power-Sourcing Equipment (PSE) Circuit**
- **Input Voltages**
  - **-32V to -60V Providing 2A (-48V Power Circuit, 350mA/Port)**
  - **+3.3V Providing 100mA (Digital Logic Power)**
  - **V_{CC} (+3.3V) Provides 100mA (Optical Interface)**
  - **+9V Provides 250mA (SMBus LPT Interface Board)**
- **Ethernet Network Ports**
  - **Four RJ-45 10/100 Base-TX Ethernet Network Input Ports**
  - **Four RJ-45 10/100 Base-TX Ethernet Network Output Power-Over-Ethernet Ports**
- **Demonstrates Four Separate Independent Power Switch Controllers**
- **Provides PD Detection and Classification**
- **Configurable DC/AC Load Removal Detection and Disconnect Monitoring**
- **Configurable Current Sensing**
- **Convenient Voltage and Current Test Points**
- **Four Output-Port LED Status Indicators**
- **Optically Isolated 3-Wire I²C-Compliant PC Interface**
- **Reconfigurable for Stand-Alone Operation or with External Microcontroller**
- **Windows 95/98/2000-Compatible Software**
- **Fully Assembled and Tested**

Ordering Information

PART	TEMP RANGE	IC PACKAGE	SMBus INTERFACE TYPE
MAX5945EVKIT	0°C to +70°C	36 SSOP	Not included
MAX5945EVSYS	0°C to +70°C	36 SSOP	MAXSMBus

Note: *The MAX5945EV kit software is provided with the MAX5945EVKIT. However, the MAXSMBUS interface board is required to interface the EV kit to the computer when using the software.*

For pricing, delivery, and ordering information, please contact Maxim/Dallas Direct! at 1-888-629-4642, or visit Maxim's website at www.maxim-ic.com.

MAX5945EVSYS (MAX5945 EV System) Component List

PART	QTY	DESCRIPTION
MAX5945EVKIT	1	MAX5945 evaluation kit
MAXSMBus	1	SMBus interface board

Component List

DESIGNATION	QTY	DESCRIPTION
C1	1	220µF ±20%, 100V electrolytic capacitor (18mm x 16.5mm) Panasonic EEVFK2A221M
C2, C3	2	1.0µF ±10%, 6.3V X5R ceramic capacitors (0603) Taiyo Yuden JMK107BJ105KA
C4	1	10µF ±20%, 6.3V X5R ceramic capacitor (1206) Taiyo Yuden JMK316BJ106ML
C5, C8, C13, C15	4	0.47µF ±10%, 100V X7R ceramic capacitors (1210) Vishay VJ1210Y474KXBAB
C6	1	1.0µF ±20%, 100V X7R ceramic capacitor (1210) TDK C3225X7R2A105M
C7, C9, C16, C23, C30, C31, C33–C36, C38, C39	12	0.1µF ±10%, 16V X5R ceramic capacitors (0603) Taiyo Yuden EMK107BJ104KA
C10, C11, C12, C17	0	Not installed ceramic capacitors (0805) 3300pF ±10%, 50V X7R ceramic capacitors Murata GRM219R71H333K recommended
C14	1	4.7µF ±10%, 6.3V X5R ceramic capacitor (0805) Taiyo Yuden JMK212BJ475KG
C18, C26–C29, C47–C52, C54–C63	21	0.1µF ±10%, 100V X7R ceramic capacitors (0805) TDK C2012X7R2A104K
C19, C20, C21, C22, C24, C25	6	1000pF ±10%, 250VAC X7R UL ceramic capacitors (2010) Murata GA352QR7GF102K
C32	1	3.3µF ±10%, 10V X5R ceramic capacitor (0805) Taiyo Yuden LMK212BJ335KG
D1–D4	4	1A, 200V rectifier diodes (SMA) Central Semiconductor CMR1-02M or Diodes Incorporated S1B
D5–D8	4	250mA, 75V high-speed switching diodes (SOT23) Central Semiconductor CMPMD4448
D9–D12	4	56.7V, 600W transient voltage suppressors (SMB) Diodes Incorporated SMBJ51A
D13–D16	4	Green-leaded LEDs (T 1-3/4) Panasonic LN31GPHL
D17–D20	4	5.6V, 500mW ±5% low-noise zener diodes (SOD-123) Central Semiconductor CMHZ4626
J1	1	2 x 10 right-angle female receptacle
J2	1	6-pin header
J3–J10	8	RJ-45 black through-hole connectors, 8P-8C
JU1–JU8	8	3-pin headers
JU9	1	2 x 5-pin header
JU11–JU14	4	2 x 3-pin headers
JU15–JU30	16	2-pin headers
N1–N4	4	100V, 3.7A n-channel MOSFETs (SOT-223) Fairchild FDT3612
N5–N8	4	100V, 0.17A n-channel MOSFETs (SOT23) Fairchild BSS123

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
R1–R4	4	0.500Ω ±1% resistors (1206) IRC LR1206-01-R500-F
R5, R8, R56, R71	4	180Ω ±5% resistors (0603)
R6, R7, R9, R29, R30, R53, R54, R77	8	3kΩ ±5% resistors (0603)
R10–R22, R26, R28, R31, R34, R35, R62, R63, R65, R66, R67	23	1kΩ ±5% resistors (0603)
R23	1	51Ω ±5% resistor (0805)
R24, R27, R32, R64	4	10Ω ±5% resistors (0603)
R25, R33, R36, R57	0	Not installed resistors (0603) 2kΩ ±5% recommended
R37–R52	16	75Ω ±5% resistors (0805)
R55	1	0.56Ω ±5% resistor (0603)
R58–R61	4	5.1kΩ ±5% resistors (0603)
R68	1	0Ω ±5% resistor (0805)
R69, R70	2	40.2kΩ ±1% resistors (0603)
R72	0	Not installed resistor (1206) 0Ω ±5% resistor recommended
R73–R76	4	301kΩ ±1% resistors (0603)
R78, R80	2	10kΩ ±1% resistors (0603)
R79, R91	2	100Ω ±1% resistors (0603)
R81	1	32.4kΩ ±1% resistor (0603)
R82, R86	2	20kΩ ±1% resistors (0603)
R83	1	46.4kΩ ±1% resistor (0603)
R84	1	226kΩ ±1% resistor (0603)
R85	1	200kΩ ±1% resistor (0603)
R87–R90	4	2.2MΩ ±5% resistor (0805)
S1–S5	5	Micro miniature pushbutton switches
T1, T2	2	10/100BASE-TX voice-over-IP magnetic modules Pulse Engineering H2005A

DESIGNATION	QTY	DESCRIPTION
U1-Socket	1	36-pin IC socket
U1	1	MAX5945EAX (36-pin SSOP)
U2	1	SPDT analog switch (6-pin SC70) Maxim MAX4599EXT-T
U3	1	Dual-output op amp (8-pin SOT23) Maxim LMX358AKA
U4	1	Dual universal switched-capacitor filter (16-pin QSOP) Maxim MAX7491EEE
U5	1	3V EconOscillator™/divider (8-pin µSOP) Dallas Semiconductor/Maxim DS1077LU-40
U6	1	2.048V voltage reference (3-pin SOT23) MAX6106EUR
U7, U8	2	High-speed, 10Mbps logic gate optocouplers (8-pin surface- mount lead bend) Fairchild Semiconductor HCPL-2630S
U9	1	TinyLogic UHS dual buffer with Schmitt trigger inputs (SC70-6) Fairchild NC7WZ17P6X
OSC_INPUT	1	BNC connector
TP3	1	PC test point red
GND	4	PC test points black
VDIG, DGND, VEE, GND	4	Uninsulated banana jacks
—	15	Shunts (JU1–JU8, JU15–JU22)
—	5	Rubber bumpers
—	1	MAX5945 PC board
—	1	Software disk (CD-ROM) “MAX5945 Evaluation Kit”

EconOscillator is a trademark of Dallas Semiconductor.

Component Suppliers

SUPPLIER	PHONE	FAX	WEBSITE
Central Semiconductor	631-435-1110	631-435-1824	www.centralsemi.com
Diodes Incorperated	805-446-4800	805-446-4850	www.diodes.com
Fairchild	888-522-5372	—	www.fairchildsemi.com
IRC	361-992-7900	361-992-3377	www.irctt.com
Murata	770-436-1300	770-436-3030	www.murata.com
Panasonic	714-373-7366	714-737-7323	www.panasonic.com
Pulse Engineering	858-674-8100	858-674-8262	www.pulseeng.com
Taiyo Yuden	800-348-2496	847-925-0899	www.t-yuden.com
TDK	847-803-6100	847-390-4405	www.component.tdk.com
Vishay	—	—	www.vishay.com

Note: *Indicate that you are using the MAX5945 when contacting these component suppliers.*

Quick Start

The MAX5945 EV kit is fully assembled and tested. Follow these steps to verify board operation. **Do not turn on the power supplies until all connections are completed.**

Required Equipment:

- One -32V to -60V, 2A-capable DC power supply
- Two separate +3.3V, 100mA-capable DC power supplies
- One +9V, 250mA-capable DC power supply
- Maxim MAX5945 EV kit and MAXSMBus interface board
- Windows 95/98/2000 computer with a spare parallel (printer) port
- 25-pin I/O extension cable, straight-through, male-to-female cable
- One voltmeter for confirming output voltages

Hardware Connections

1) Connect the MAXSMBus interface board to the MAX5945 EV kit's interface connector J1.
2) Verify that a shunt is installed on pins 2 and 3 of jumpers JU1 (A0, low), JU2 (A1, low), JU3 (A2, low), and JU4 (A4, low) to set the MAX5945 I^2C-compliant slave address to 0x40 hexadecimal.
3) Verify that a shunt is installed on pins 2 and 3 of jumpers JU5 (signal mode).
4) Verify that a shunt is installed on pins 1 and 2 of jumpers JU6 (automatic mode) and JU8 (on-board 100Hz oscillator running).
5) Verify that a shunt is installed on pins 2 and 3 of jumper JU7 (OSC_IN, 100Hz oscillator).
6) Verify that no shunt is installed on jumpers JU15–JU18 (AC disconnect).
7) Verify that shunts are installed on jumpers JU19–JU22 (RC filter).
8) Connect one of the +3.3V DC power supplies to the metal VDIG banana jack or PC board pad and the supply ground to the metal DGND banana jack or PC board pad.
9) Connect the -32V to -60V DC power supply to the metal VEE banana jack and the supply ground to the metal GND banana jack.
10) Connect the second +3.3V DC power supply to the optically isolated VCC pad and the supply ground to the OPTO_GND pad.

Note: The GND is more positive than the VEE jacks.

11) Connect the +9V DC power supply to the MAXSMBus interface board's POS9 pad and the supply ground to the GND pad on the MAXSMBus Interface board.
12) Connect a PD to the desired Ethernet network output port's RJ-45 connector on the MAX5945 EV kit as listed below:

- PORT1_OUT at J7
- PORT2_OUT at J8
- PORT3_OUT at J9
- PORT4_OUT at J10

This step is optional if network connectivity is not required.

13) Connect the MAX5945 EV kit's network input LAN port to the corresponding PD LAN connection as listed below:

- PORT1_IN at J3
- PORT2_IN at J4
- PORT3_IN at J5
- PORT4_IN at J6

14) Connect the computer's parallel port to the MAXSMBus interface board. Use the straight-through 25-pin female-to-male cable. The EV kit software uses a loopback connection to confirm that the correct port is selected.

15) Install the MAX5945 evaluation software on your computer by running the INSTALL.EXE program on the CD-ROM disk. The program files are copied and icons are created for them in the Windows Start Menu. Restart the computer when prompted. For Windows 2000, you may need administrator privileges.

16) Turn on all four power supplies.

17) Start the MAX5945 program by opening its icon in the Start Menu.

18) Observe as the program automatically detects the parallel port connected to the MAXSMBus, starts the main program, and then automatically detects the I²C-compliant address configured for the MAX5945.

19) Load and run the Power_on.smb macro program from the File|Open|Run Macro menu. The script automatically runs after selecting open.

20) All four network port green status LEDs should light.

21) Four other example macros allow quick testing of the manual mode, auto mode, semiauto mode, and with DC and/or AC load disconnect detection. These macros are:

- test#1_manual_mode.smb
- test#2_auto_mode_dc.smb
- test#3_auto_mode_dc.smb
- test#4_semiauto_mode.smb

Please read the embedded comments in each macro for detailed descriptions using a plain text editor.

22) Pressing pushbutton switches S1 through S4 shuts down PORT1_OUT through PORT4_OUT's respective DC power.

23) Test points TP3 (U1 V_{EE} pin) and GND test points are provided throughout the PC board to observe desired signals with an oscilloscope or voltage meter.

24) Header J2 is provided to monitor the $\overline{SHDN}$ pin signals. These signals are not isolated and are referenced to the DGND. **DGND and GND are shorted by a PC board trace between the pads of resistor R72.**

25) Pressing the RESET pushbutton turns off power to all ports and returns the MAX5945 IC to the power-up condition.

Note: An uninstall program is included with the software. Click on the UNINSTALL icon to remove the EV kit software from the hard drive.

Detailed Description of Hardware

The MAX5945 EV kit features a 10/100 base-TX Ethernet four-port network power controller circuit for -48V supply rail systems. The EV kit's PSE circuit uses the IEEE 802.3af-compliant MAX5945 network power controller, four n-channel power MOSFETs in SOT-223 surface-mount packages, four surface-mount current-sensing resistors and two 10/100 base-TX VoIP magnetic modules to form the basic portion of a PSE circuit. The MAX5945 EV kit has been designed as an IEEE 802.3af-compliant PSE and demonstrates all the required functions such as PD discovery, classification, current-limit control of a connected PD at each Ethernet output port, and DC/AC disconnect detection. The EV kit also has a separate on-board, 100Hz sine-wave oscillator circuit for the AC disconnect detection features. An IBM-compatible PC is used to communicate with the slave MAX5945 over an I²C-compliant 3-wire interface, optically coupled logic, and a 2-wire to parallel port (LPT) MAXSMBus interface board.

The MAX5945 EV kit PSE circuit requires a -32V to -60V power supply (-48V supply rail) capable of supplying 2A to the EV kit's GND and VEE steel banana jacks or PC board pads. Two separate +3.3V power supplies capable of supplying 100mA are also required for the MAX5945 digital logic (VDIG, DGND) and optically isolated I²C-compliant 3-wire interface. **Note that DGND and GND are shorted by a PC board trace between the pads of resistor R72.**

The MAX5945 controls the -48V DC power to each of the four 10/100 base-TX Ethernet network output ports by regulating the respective port's n-channel power

MOSFET and sensing current through the respective port's current-sense resistor. The current is fed to a 10/100 base-TX VoIP magnetic module connected to the respective Ethernet network output port's RJ-45 jack. An IEEE 802.3af-compliant PD connects to the respective Ethernet network output port on the EV kit. The PD can be located up to 350ft from the EV kit when connected with Category 5 Ethernet cable. The MAX5945 EV kit provides separate and independent power control for each of the four Ethernet network output ports. The 10/100 base-TX VoIP magnetic module is decoupled to the EV kit's chassis ground by system chassis capacitors C19–C22, C24, and C25. The EV kit's isolated chassis ground (Chassis_GND) PC board pad connects to the network system ground.

The MAX5945 EV kit features configurable operational modes, PD detection, PD classification, overcurrent protection, current foldback, under/overvoltage protection, DC and AC disconnect monitoring. The overcurrent protection can be programmed through software and/or changing current-sense resistors R1–R4 for the desired output port. Each of the four modes of operation (auto, semi, manual, shutdown) can be evaluated after configuring jumper JU6 and configuring the appropriate MAX5945 register (see Table 3). PD detection diodes D1–D4 can be bypassed to reduce power dissipation when AC disconnect monitoring is not required, using jumpers JU15–JU18. Each port's AC detection circuit resistor-capacitor diode (RCD) network can be reconfigured with a jumper also. See Tables 4, 8, and 9 for various AC detection-disconnect and oscillator configurations. Each port features a 600W bidirectional overvoltage transient suppressor diode (D9–D12) and decoupling capacitor (C26–C29) for transient protection at the port.

Test points and jumpers have been provided for voltage probing and current measurements of each channel's power circuit. Additionally, a 6-pin 0.100in center header is also provided for monitoring the $\overline{SHDN1}$, $\overline{SHDN2}$, $\overline{SHDN3}$, $\overline{SHDN4}$, and $\overline{RESET}$ signals routed to the MAX5945 pins from the respective switch (S1–S5). **When using the header signals, caution should be exercised since the DGND and GND are shorted by resistor R72's PC board shorting trace.** Green LEDs near each port's RJ-45 output jack indicate when the respective port power is turned on.

A 100Hz oscillator circuit that meets the IEEE 802.3af PSE power interface (PI) parameters for AC disconnect detection is provided by the MAX5945 EV kit. Five ICs make up the 100Hz oscillator circuit, which consists of U5, a programmable Dallas Semiconductor 40MHz EconOscillator/divider squarewave oscillator and a MAX7491 dual universal switched-capacitor filter, U4. Voltage reference source U6 (MAX6106) provides 2.048V for the circuit and level shifts the sine wave's output. The MAX4599, an SPDT analog switch, and U3, an LMX358 dual-output op amp, provides support functions for the oscillator circuit. An external sine-wave oscillator meeting the IEEE 802.3af PSE PI parameters can be connected to the EV kit's BNC connector (OSC_INPUT) after reconfiguring jumper JU7. The EV kit's 100Hz oscillator circuit can be shut down using jumper JU8 if an external oscillator is used or AC disconnect detection is not required.

The EV kit provides the required optical isolation for the I²C-compliant 3-wire interface so the MAX5945 can operate as a slave device. The optically isolated interface connects to a PC parallel port through a MAXSMBus interface board. The MAXSMBus interface board requires a dedicated 9V power supply capable of supplying 250mA. The EV kit's I²C-compliant 2-wire or 3-wire interface can be reconfigured for interfacing to a stand-alone microcontroller for isolated (2-wire) or nonisolated (3-wire) serial operation. Additionally, for stand-alone microcontroller operation, the MAXSMBus interface board and 9V power supply are not required.

The optical isolation consists of optocoupler U7, which provides galvanic isolation for the serial interface clock line (SCL) and serial interface input data line signals. Optocoupler U8 provides galvanic isolation for the serial output and data line (SDAOUT) and $\overline{INT}$ signals. The SCL and SDAOUT signals' 3-wire serial interface are combined on the isolated 2-wire side prior to feeding logic buffer U9. The SCL_IN, SDA, $\overline{INT}$_OUT, OPTO_GND and VCC PC board pads are used for a 2-wire isolated stand-alone operation. For nonisolated stand-alone 3-wire operation, jumper JU9 must be reconfigured and then the SCL, SDAIN, SDAOUT, $\overline{INT}$, DGND, and VDIG PC board pads must be connected to the microcontroller circuit. Note that VDIG is at +3.3V, which is required by the EV kit. The OPTO_GND and GND, DGND planes are isolated by the optical couplers. **However, when using the EV kit in a nonisolated configuration, caution should be exercised since DGND and GND are shorted by resistor R72's PC board shorting trace.**

The MAX5945 slave address is configured by four jumpers (JU1–JU4) and can be configured from 0x40 through 0x5F hexadecimal serial address. Global address 0x60 is accepted by the MAX5945 regardless of the jumper settings. Refer to Table 1 and the *Address Inputs* section in the MAX5945 data sheet for more information on setting the MAX5945 slave address.

Table 1. MAX5945 Slave Address Selection

JU4 (BIT A3) SHUNT	JU3 (BIT A2) SHUNT	JU2 (BIT A1) SHUNT	JU1 (BIT A0) SHUNT	MAX5945 SLAVE ADDRESS	READ/WRITE
2-3	2-3	2-3	2-3	0x40	Read
				0x41	Write
2-3	2-3	2-3	1-2	0x42	Read
				0x43	Write
2-3	2-3	1-2	2-3	0x44	Read
				0x45	Write
2-3	2-3	1-2	1-2	0x46	Read
				0x47	Write
2-3	1-2	2-3	2-3	0x48	Read
				0x49	Write
2-3	1-2	2-3	1-2	0x4A	Read
				0x4B	Write
2-3	1-2	1-2	2-3	0x4C	Read
				0x4D	Write
2-3	1-2	1-2	1-2	0X4E	Read
				0x4F	Write
1-2	2-3	2-3	2-3	0x50	Read
				0x51	Write
1-2	2-3	2-3	1-2	0x52	Read
				0x53	Write
1-2	2-3	1-2	2-3	0x54	Read
				0x55	Write
1-2	2-3	1-2	1-2	0x56	Read
				0x57	Write
1-2	1-2	2-3	2-3	0x58	Read
				0x59	Write
1-2	1-2	2-3	1-2	0x5A	Read
				0x5B	Write
1-2	1-2	1-2	2-3	0x5C	Read
				0x5D	Write
1-2	1-2	1-2	1-2	0X5E	Read
				0x5F	Write
X	X	X	X	0x60*	Read
				0x61*	Write

X = Don't care.

**Global address calls.*

Jumper Selection

The MAX5945 EV kit features several jumpers to reconfigure the EV kit for various PSE configurations and PD requirements. Additionally, jumpers and PC board pads are provided for connecting an external microcontroller.

MAX5945 I²C-Compatible 2-Wire or 3-Wire Slave Address Selection

The MAX5945 EV kit features several 3-pin jumpers (JU1–JU4) to set the slave address of the MAX5945 least significant bits (LSB) of the slave address on the I²C-compatible 2-wire or 3-wire interface. The three most significant bits are set by the MAX5945 to 010. The EV kit's software automatically sets the LSB for the proper read/write command. Table 1 lists the jumper addressing options.

Midspan/Signal-Mode Selection

The MAX5945 EV kit features a 3-pin jumper (JU5) to set the MAX5945 in midspan or signal mode. Table 2 lists the jumper options for the two modes used to detect a valid PD connected to the PSE respective Ethernet network output port. Refer to the MAX5945 data sheet for more information on the modes.

Table 2. Jumper JU5 Functions

SHUNT LOCATION	MIDSPAN PIN	MAX5945 MODE
1 and 2	Connected to VDIG through resistor R14	Midspan mode
2 and 3	Connected to DGND through resistor R14	Signal mode

Operational Modes (Automatic, Shutdown)

The MAX5945 EV kit features a 3-pin jumper JU6 to set the MAX5945's initial startup operational mode. After startup, data sent to the mode register (0x12) reconfigure the operational mode of the MAX5945. Table 3 lists the jumper options.

Table 3. Initial Startup Operational Mode

JU6 SHUNT LOCATION	AUTO PIN	MODE REGISTER (0x12) STATUS BITS	OPERATION MODE
1 and 2	Connected to VDIG through resistor R15	10xff	Automatic
2 and 3	Connected to DGND through resistor R14	0x00	Shutdown

AC Disconnect Monitoring Oscillator Input

The MAX5945 EV kit features a 3-pin jumper (JU7) to configure the MAX5945's oscillator input at the OSC_IN pin. The oscillator is used for AC disconnect monitoring of the PD. Table 4 lists the jumper options for the three oscillator configurations available on the EV kit.

Table 4. Jumper JU7 Functions

SHUNT LOCATION	MAX5945 OSC_IN PIN	EV KIT MODE
1 and 2	Connected to the OSC_INPUT BNC connector	AC disconnect detection using external 100Hz oscillator
2 and 3	Connected to EV kit's on-board 100Hz oscillator	AC disconnect detection using EV kit on-board 100Hz oscillator

100Hz Oscillator Shutdown

The MAX5945 EV kit features a jumper to set the EV kit's on-board 100Hz oscillator modes of operation. Table 5 lists the selectable jumper options to configure the 100Hz oscillator.

Table 5. Jumper JU8 Functions

SHUNT LOCATION	U4, $\overline{\text{SHDN}}$ PIN	100Hz OSCILLATOR MODE
1 and 2	Connected to VDIG_F	Running
2 and 3*	Connected to GND	Shutdown

**See the Bypassing AC Disconnect and the DGND-to-GND Connection (Resistor R72) section.*

Stand-Alone Microcontroller Interface (Isolated/Nonisolated)

The MAX5945 EV kit features PC board pads and a jumper to interface directly with a microcontroller. The 2 x 5-pin jumper JU9 has shorting connections on the bottom layer that must be cut open to disable the optical coupler interface for nonisolated evaluation. The jumper shorting connections must be in place for evaluating an isolated stand-alone microcontroller interface. Table 6 lists the selectable jumper options.

MAX5945 PORT DET_, OUT_, GATE_, and SENSE_ Pins Signal Measurements

The MAX5945 EV kit features jumpers to facilitate current and voltage measuring at each port's respective DET_, OUT_, GATE_, and SENSE_ pins on the MAX5945 IC. Several 2 x 3-pin and 2-pin jumpers are used to obtain the desired measurement for each port. Jumpers JU11 and JU23 are provided for port 1, jumpers JU12 and JU24 are provided for port 2, jumpers JU13 and JU25 are provided for port 3, and jumpers JU14 and JU26 are provided for port 4. The jumper pins are shorted by a PC board trace on the bottom layer of the EV kit by default for normal operation. The shorts can be cut open for measurements. See Figure 3, the controller circuit schematic for a specific ports jumper.

AC Disconnect Operation (Rectifier Diodes D1–D4)

The MAX5945 EV kit features jumpers JU15–JU18 to bypass each port's respective AC disconnect rectifier diode (D1–D4), thus reducing diode power dissipation when AC disconnect is not required. Jumpers JU15–JU18 are used to bypass the respective port's rectifier diode. Table 7 lists the selectable jumper options for each port.

Table 6. Jumper JU9 and Microcontroller PC Board Pads Function

JU9 PIN NUMBER SHORT LOCATION	ISOLATION MODE	MAX5945 EV KIT PC PAD TO MICROCONTROLLER CONNECTION
1 and 2 Shorted*	Isolated	VCC PC pad connects to microcontroller +3.3V power supply.
3 and 4 Shorted*	Isolated	SCL_IN PC pad connects to microcontroller serial clock line.
5 and 6 Shorted*	Isolated	SDA PC pad connects to microcontroller bidirectional serial data line.
7 and 8 Shorted*	Isolated	SDA PC pad connects to microcontroller bidirectional serial data line.
9 and 10 Shorted*	Isolated	INT_OUT PC pad connects to microcontroller interrupt pin.
—	Isolated	OPTO_GND PC pad connects to microcontroller power-supply ground.
1 and 2 Cut Open	Nonisolated	VDIG PC pad supplies power to the microcontroller from VDIG voltage.
3 and 4 Cut Open	Nonisolated	SCL PC pad connects to microcontroller serial clock line.
5 and 6 Cut Open	Nonisolated	SDAIN PC pad connects to microcontroller bidirectional serial data line.
7 and 8 Cut Open	Nonisolated	SDAOUT PC pad connects to microcontroller bidirectional serial data line.
9 and 10 Cut Open	Nonisolated	INT PC pad connects to microcontroller interrupt pin.
—	Nonisolated	DGND PC pad connects to microcontroller power-supply ground.

**Default set by PC board trace.*

Table 7. AC Disconnect Jumper Functions

PORT	JUMPER	SHUNT POSITION	AC DISCONNECT RECTIFIER DIODE
Port 1	JU15	Open	AC disconnect diode D1 active, AC disconnect function can be used.
		Installed*	AC disconnect diode D1 bypassed, no AC disconnect function.
Port 2	JU16	Open	AC disconnect diode D2 active, AC disconnect function can be used.
		Installed*	AC disconnect diode D2 bypassed, no AC disconnect function.
Port 3	JU17	Open	AC disconnect diode D3 active, AC disconnect function can be used.
		Installed*	AC disconnect diode D3 bypassed, no AC disconnect function.
Port 4	JU18	Open	AC disconnect diode D4 active, AC disconnect function can be used.
		Installed*	AC disconnect diode D4 bypassed, no AC disconnect function.

**See the Bypassing AC Disconnect and the DGND-to-GND Connection (Resistor R72) section.*

Table 8. AC Detection RC Jumper Functions

PORT	JUMPER	SHUNT POSITION	AC DETECTION RC NETWORK
Port 1	JU19	Open*	RC network R22/C5 bypassed.
		Installed	RC network R22/C5 active, AC disconnect function can be used.
Port 2	JU20	Open*	RC network R26/C8 bypassed.
		Installed	RC network R26/C8 active, AC disconnect function can be used.
Port 3	JU21	Open*	RC network R34/C13 bypassed.
		Installed	RC network R34/C13 active, AC disconnect function can be used.
Port 4	JU22	Open*	RC network R35/C15 bypassed.
		Installed	RC network R35/C15 active, AC disconnect function can be used.

**See the Bypassing AC Disconnect and the DGND-to-GND Connection (Resistor R72) section.*

Table 9. -48V Port Power Interface Jumper Functions

PORT	JUMPER	PC BOARD TRACE SHORT	EV KIT OPERATION
Port 1	JU27	Shorting trace intact	Normal operation.
		Cut open	-48V_1 power available at pin 1* only.
Port 2	JU28	Shorting trace intact	Normal operation.
		Cut open	-48V_2 power available at pin 1* only.
Port 3	JU29	Shorting trace intact	Normal operation.
		Cut open	-48V_3 power available at pin 1* only.
Port 4	JU30	Shorting trace intact	Normal operation.
		Cut open	-48V_4 power available at pin 1* only.

**The pin closest to U1 is pin1.*

AC Detection RC Network

The MAX5945 EV kit features jumpers JU19–JU22 to bypass the AC detection RC network when AC load disconnect detection is not needed. The inclusion of this RC network does not affect other circuit parameters. Table 8 lists the selectable jumper options to reconfigure each port's AC detection network. See Table 7 above for bypassing the respective port's AC disconnect diode.

-48V Port Power Interface or Voltage Measurement

The MAX5945 EV kit includes jumpers JU27–JU30 to disconnect each port's -48V power independently for connection to an external network interface circuit. Additionally, the respective jumper's pins can be utilized to measure the voltage or current for the respective port. Table 9 lists the specific jumper for each port. Each jumper is shorted on the bottom layer of the PC board.

Table 10. Switch and Header J2 pin signals

SWITCH	SIGNAL	HEADER J2 PIN
S1	$\overline{SHDN1}$	1
S2	$\overline{SHDN2}$	2
S3	$\overline{SHDN3}$	3
S4	$\overline{SHDN4}$	4
S5	RESET	5
None	DGND	6

$\overline{SHDN}$ and $\overline{RESET}$ Signals

The MAX5945 EV kit features four pushbutton switches (S1, S2, S3, S4) to independently shut down each channel's respective power circuit. A reset pushbutton (S5) is also provided to reset the MAX5945.

Header J2 (6-pin 0.100in center header) is available for monitoring the $\overline{SHDN1}$, $\overline{SHDN2}$, $\overline{SHDN3}$, $\overline{SHDN4}$, and $\overline{RESET}$ signals routed to the MAX5945 pins. Digital ground is provided at the header on pin 6. See Table 10, which lists the specific switch and header pin signals that can be interfaced with a ribbon cable or test leads. **These signals are not isolated and are referenced to DGND on the EV kit**.

Bypassing AC Disconnect and the DGND-to-GND Connection (Resistor R72)

The AC disconnect detection function requires that the EV kit's DGND be connected directly to the GND. If the AC disconnect detection function is not required, the PC board trace shorting DGND-to-GND at resistor R72 pads can be cut open. Cutting open the PC board shorting trace at resistor R72 allows DGND to be referenced to a voltage potential anywhere from V_{EE} to (V_{EE} + 60V). **Additionally, when the PC board trace at R72 is cut open, the appropriate AC detection jumper tables must be set and the OSC_IN pin on the MAX5945 must be floating by removing jumper JU7. See Tables 4, 7, and 8 for the appropriate jumper settings to bypass the AC detection function.** Refer to the *AC Disconnect Monitoring Oscillator Input* section in the MAX5945 data sheet for additional information. If the AC disconnect detection function is required again, install a 0Ω ±5% 1206 case size surface-mount resistor at R72 pads and set the appropriate jumpers.

Detailed Description of Software

(Words in bold are user-selectable features in the software).

Software Startup

A mouse or the tab key is used to navigate various items on the Main Window. Upon starting the program, the MAX5945 EV kit software starts in the **Auto Read** state. The software automatically detects the **Slave Address** and begins reading the contents of each register in the MAX5945. The register's contents are placed on the appropriate line of the **Register Read** tables in binary and hexadecimal format. If data changes between the next register read, the updated register hexadecimal data is displayed in red and blinks four times. The blink rate can be changed in the **ViewlRed Hex Data Blink Rate** menu. The left status bar at the bottom of the main window provides the MAXSMBus interface board status. The center status bar provides the current EV kit and macro engine status.

Autoread/Run Macro State Controls

When the **Auto Read** checkbox is checked, the program continuously updates the main window registers and is operating in the autoread state. In the autoread state, data can be written to the MAX5945 by entering or selecting the desired data in the **Register Address** and **Hexadecimal** or **Binary Data** combo boxes. Selecting the **Write Byte** button writes the combo box data to the MAX5945. To perform an immediate register read, enter, or choose the desired **Register Address,** and choose the **Read Byte** button. Hexadecimal or binary data may be entered into the **Hexadecimal** or **Binary Data** combo boxes and then the alternate combo box displays the corresponding number in the respective number base.

If the **Auto Read** check box is unchecked, the program's main window displays register data from the last read. To obtain current data, a **Read Byte** must be performed after selecting the appropriate register address from the **Register Address** combo box. The autoread state does not read the clear on read (COR) registers.

A macro can be run after loading the file from the **FilelOpen Macro** menu. The opened macro is displayed in the upper half of the **Macro** edit box and has an smb file extension. Selecting the **Run** button runs the macro to completion and displays the output in the **Macro Script Output** edit box field. Each edit box can be sized relative to the other half using the splitter bar above the **Script Output** text. Selecting the **Single Step** button instead of the **Run** button causes the macro to execute a single line with each activation of the **Single Step** button. The **Reset** button is used to reset the macro script engine and clear the **Macro Script Output** edit box field. A macro can be run regardless of the **Auto Read** checkbox status. A macro can be run immediately after opening by using the **FilelOpen/Run Macro** menu, selecting the desired macro to run, and clicking on the **Open** button. Selecting the **Cancel** button exits this feature.

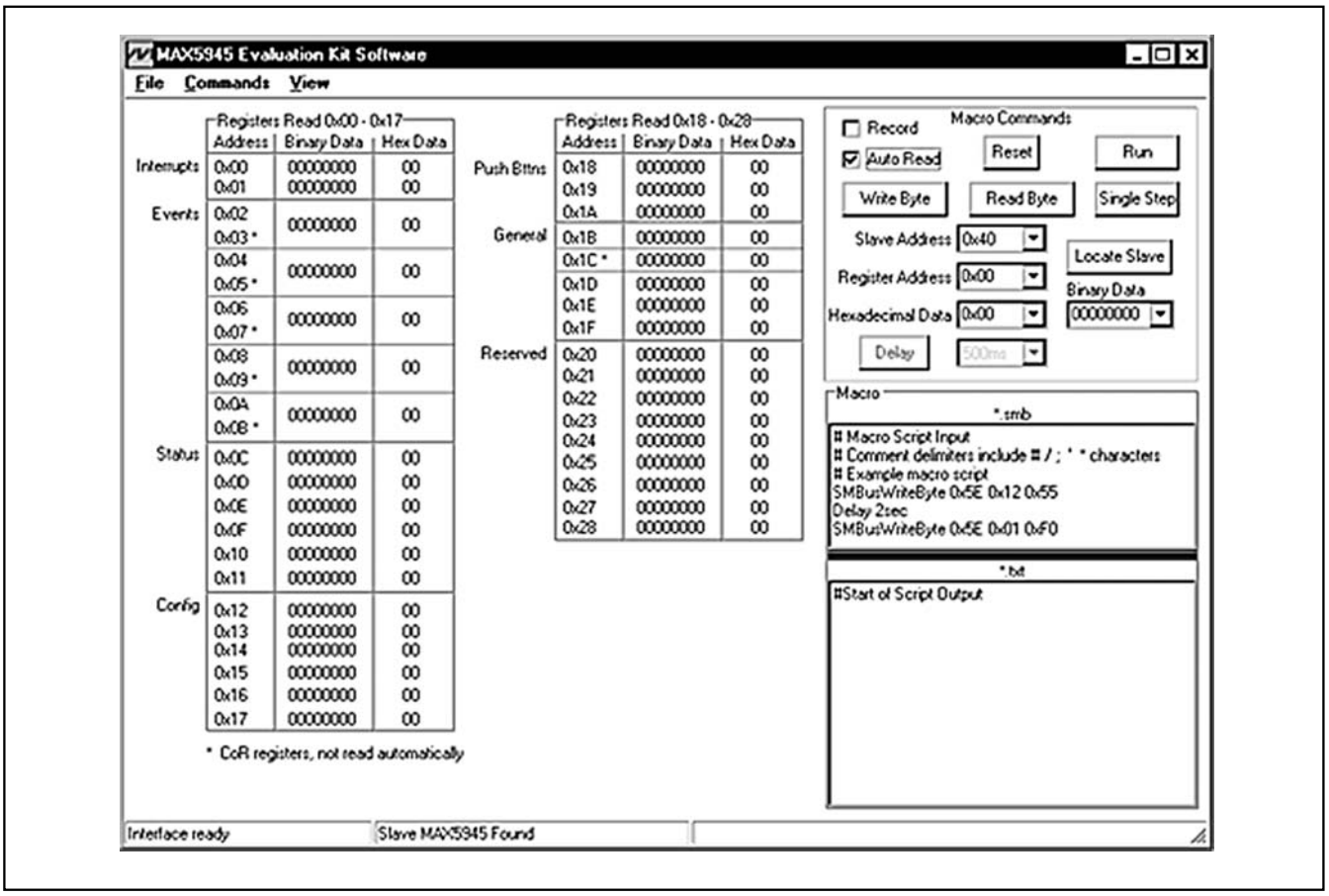


Figure 1. The MAX5945 Evaluation Software's Main Window for Controlling the Software State, Configuring the MAX5945 Registers Using the Macro Engine and Displaying All the Registers In Binary and Hexadecimal Format

The **Locate Slave** button is used to search for a MAX5945 located on the I²C-compliant 2-wire serial interface whose address has been changed while the software was running. The valid MAX5945 slave address range is 0x40 through 0x5F. The MAX5945 does respond to global address 0x60, although the EV kit hardware cannot be set to this specific address.

Record Macro State Controls

When the **Record** checkbox is checked, the program automatically enters the record macro state and disables certain buttons and menus. Choosing the **Commands|Clear Script Input** menu clears any script presently in the **Macro** script input edit box field. Comment lines in a macro script begin with a # / ; ' * character. A line of script is entered by choosing the appropriate **Slave Address**, **Register Address** and entering the desired **Hexadecimal Data** or **Binary Data** in the combo boxes. Then selecting the **Write Byte** or **Read Byte** button enters the script into the **Macro** input edit box field. For time delays in a macro, choose the desired delay time from the combo box on the right side of the **Delay** button and then select the **Delay** button. The macro must be saved before exiting the record macro state, using the **File|Save Macro** menu. The macro file must have an smb file extension name.

To edit a previously saved macro, open the macro using the **File|Open Macro** menu and make the desired edits. The modified file must be saved prior to exiting the record macro state. Uncheck the **Record** checkbox to exit the record macro state. Additionally, a macro can be created or edited using a plain text editor in "Text Mode." The file must be saved with an smb extension.

Pulldown Menus and Saving Data

Most of the main window's available functions and a few more can be evaluated by using the **pulldown menu**.

General-Purpose 2-Wire Interface Utility

There are two methods for communicating with the MAX5945: through the Main Window Display or through the general-purpose Two-Wire Interface Diagnostics Utility using the **ViewInterface** menu. The utility configures the I²C-compliant 2-wire interface parameters such as Start and Stop bits, Acknowledgements, and clock timing. The two-wire Interface screen allows you to send general-purpose I²C-compliant 2-wire commands using the SMBus-**WriteByte**/**ReadByte** and **WriteWord**/**ReadWord** commands. For more information on the differences between the I²C-compliant 2-wire interface and an SMBus interface, read the application note, "*Comparing the I²C Bus to the SMBus*" at www.maxim-ic.com. When using the Two-Wire Utility, the Main Window display no longer keeps track of changes sent to hardware. The EV kit can be reinitialized to the startup screen settings by resetting the MAX5945 using Reset pushbutton S5.

The **Hunt for active devices** button scans the entire two-wire address space, reporting each address that is acknowledged. The **SMBusWriteByte** transmits the device address, command, and one byte of data. The **SMBusReadByte** transmits the device address, a command and then retransmits the device address and reads one byte of data. The **SMBusWriteWord** and **SMBusReadWord** operate the same, except two bytes of data are used.

Troubleshooting

Problem: Cannot find MAX5945 EV kit parallel port connection.

Ensure that the I/O extension cable is connected to a parallel port, and not a SCSI or other type of port. If a local printer driver is installed, temporarily disable it. The software will not work if the program icon is dragged onto the Windows desktop; instead, install the software into a subdirectory, such as C:\MAX5945.

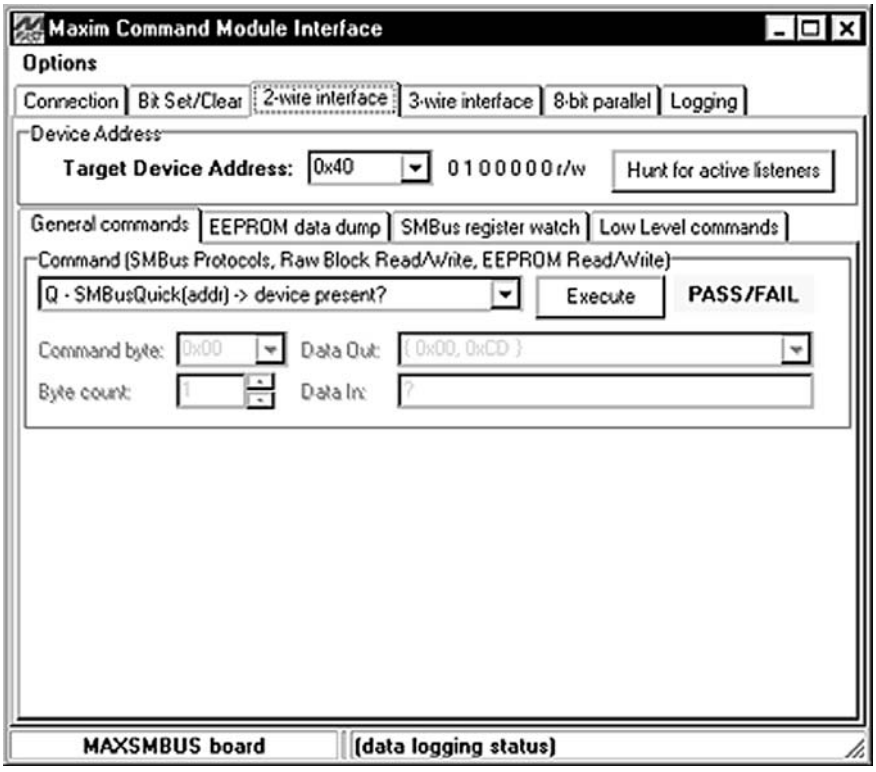


Figure 2. The 2-Wire Interface Window Provides Direct, Low-Level Access to the MAX5945 through the I²C-Compliant 2-Wire Interface

MAX5945 Evaluation Kit/Evaluation System

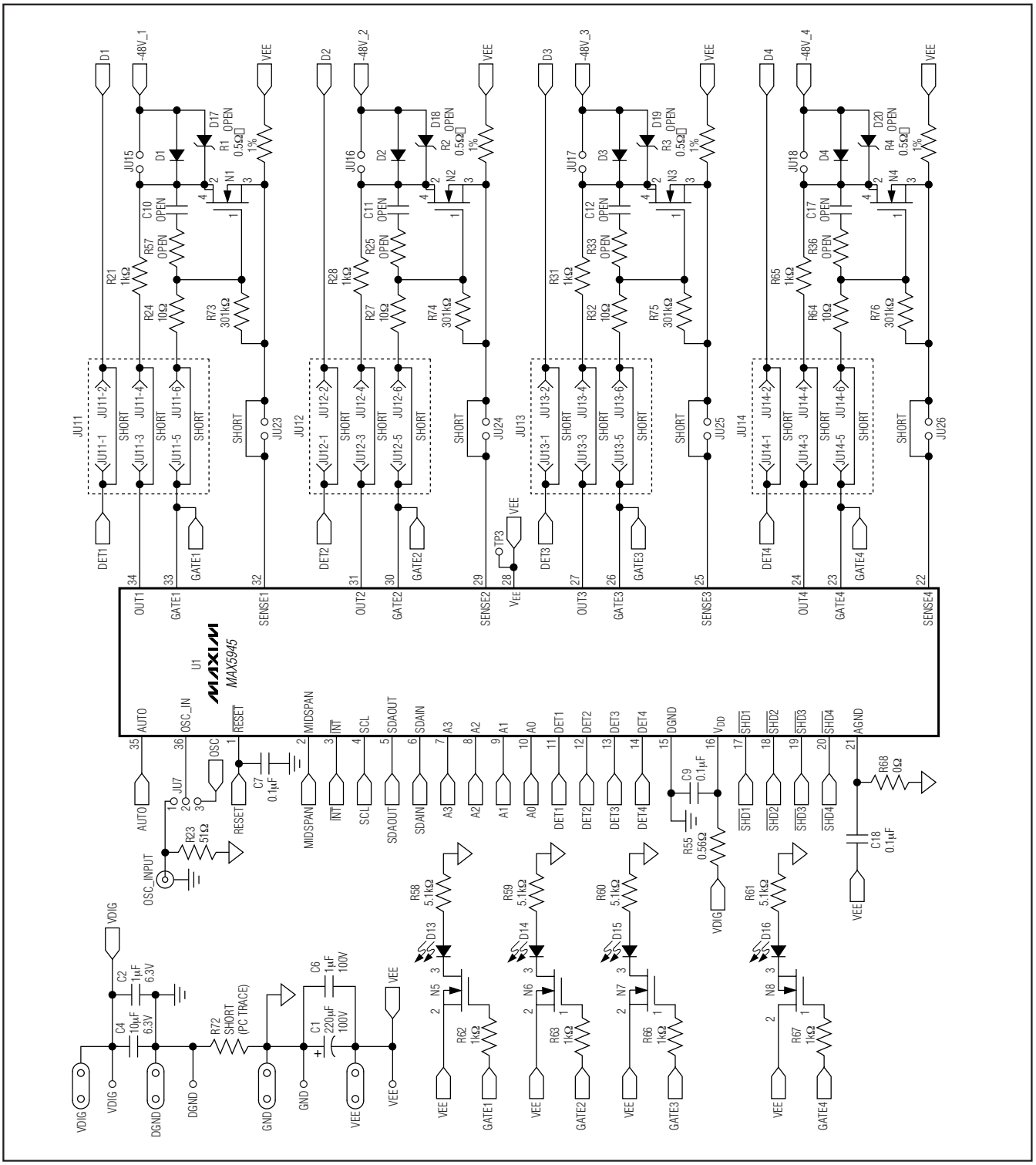


Figure 3. MAX5945 EV Kit Schematic (Controller Circuit)

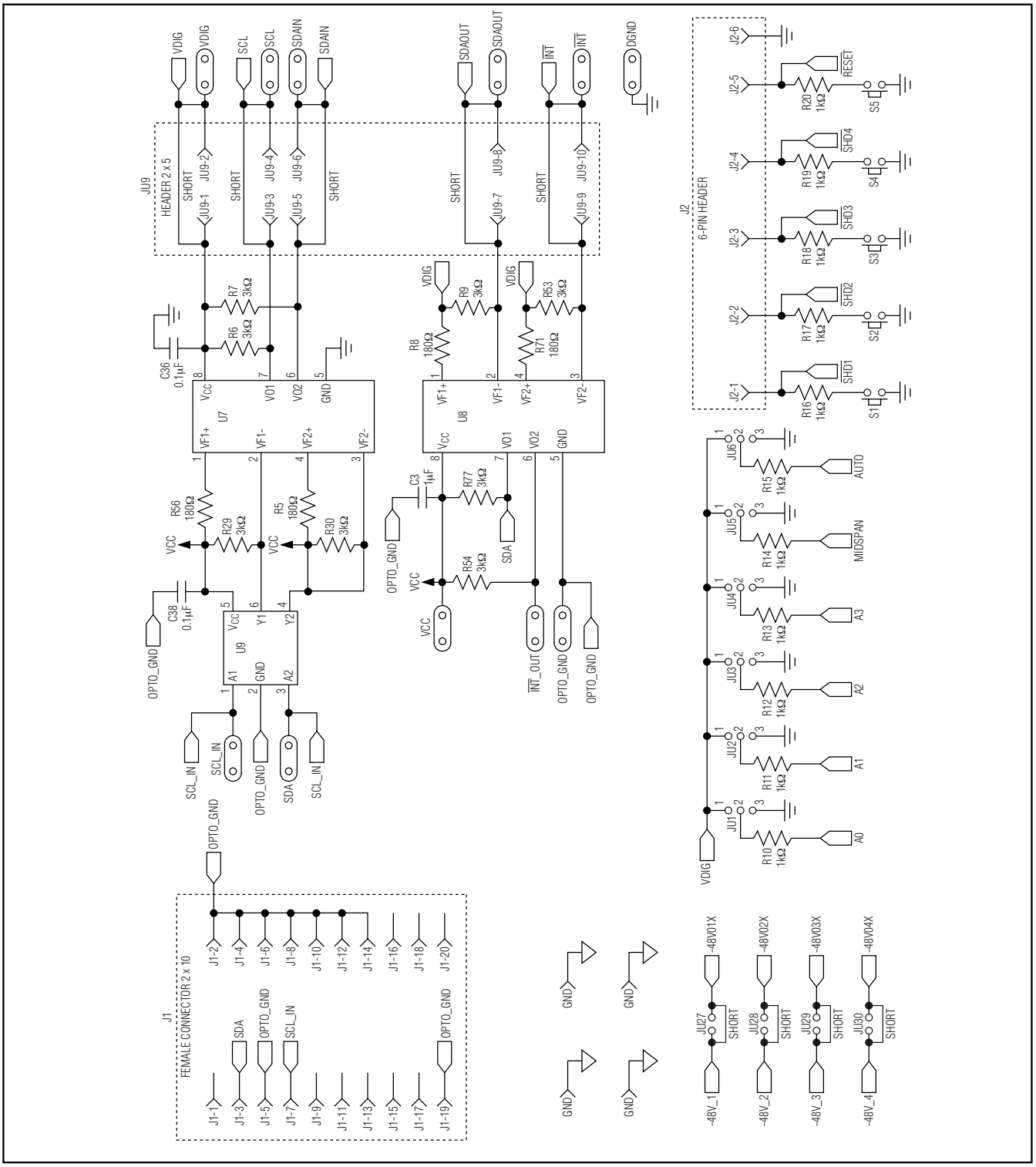


Figure 4. MAX5945 EV Kit Schematic (Optical Coupler Circuit)

MAX5945 Evaluation Kit/Evaluation System

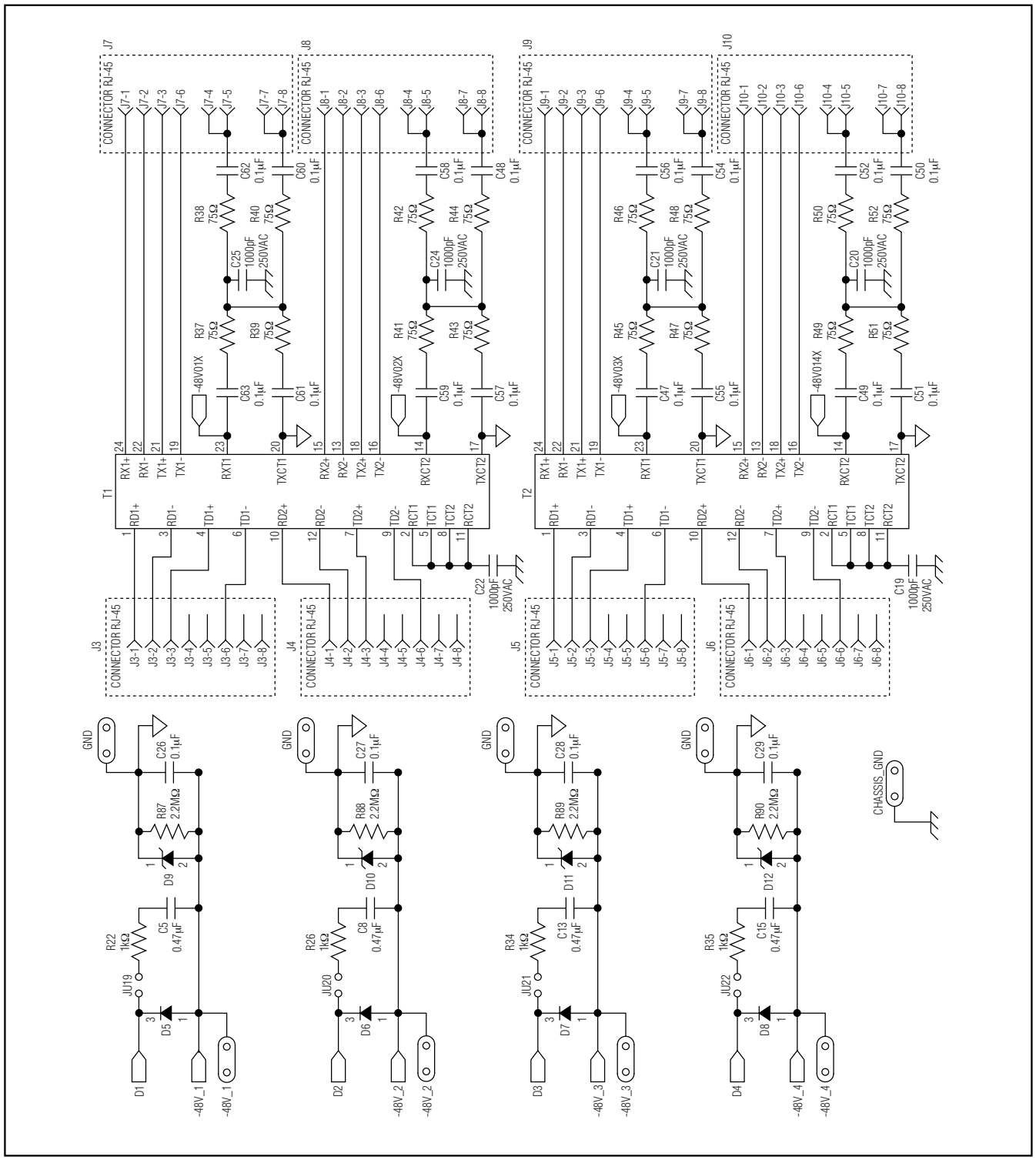


Figure 5. MAX5945 EV Kit Schematic (Network Interface)

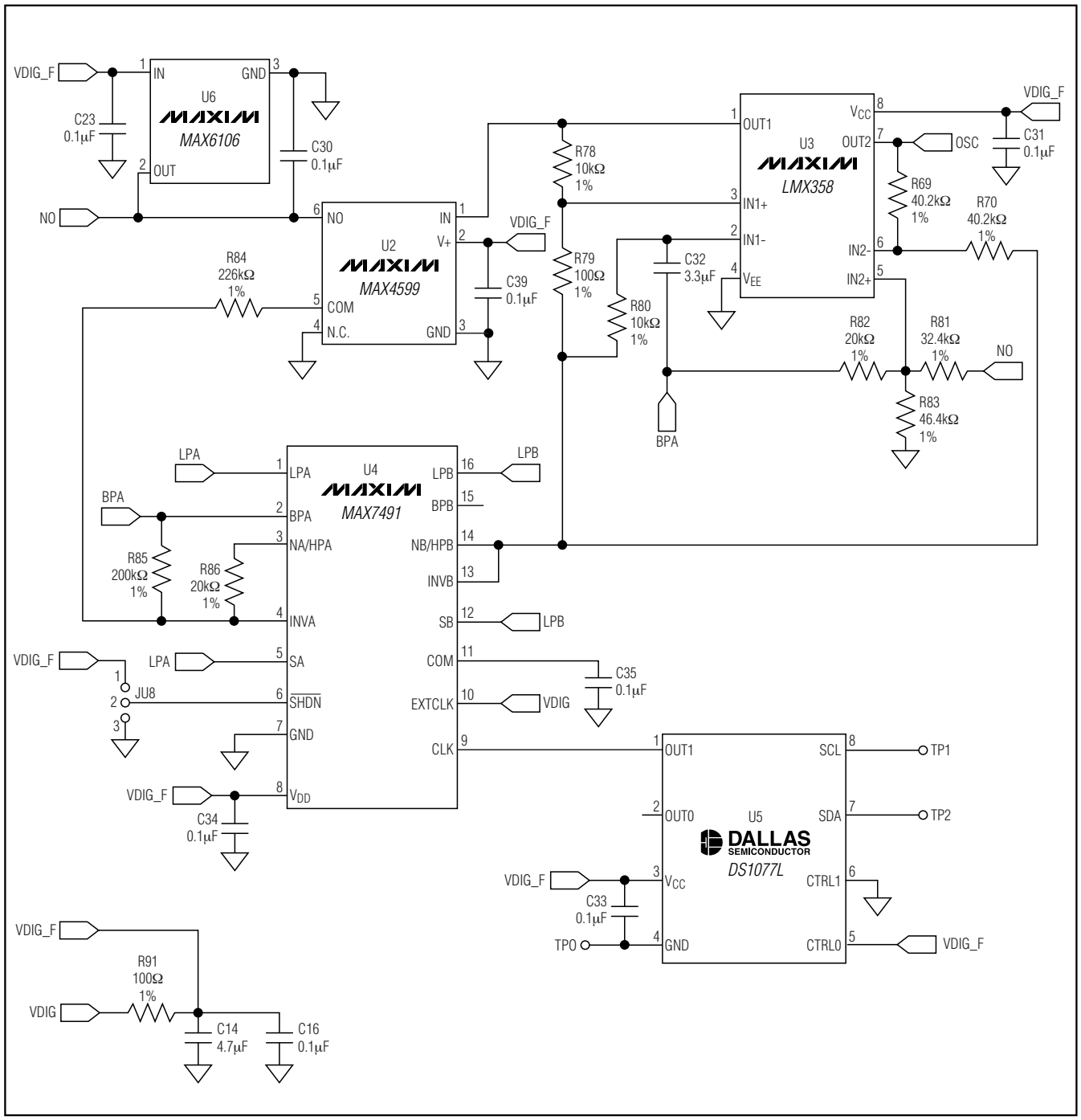


Figure 6. MAX5945 EV Kit Schematic (100Hz Oscillator Circuit)

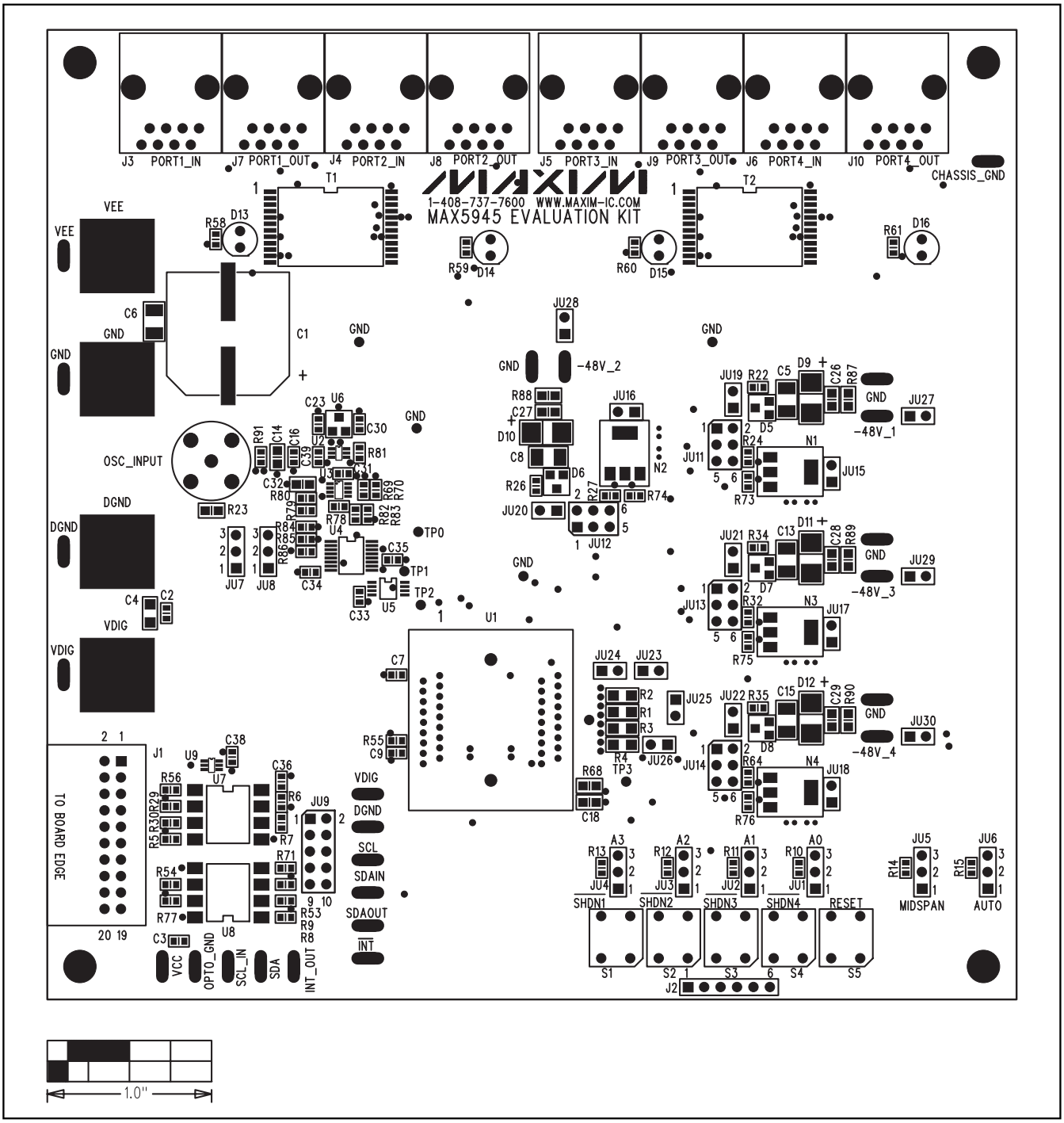


Figure 7. MAX5945 EV Kit Component Placement Guide—Component Side

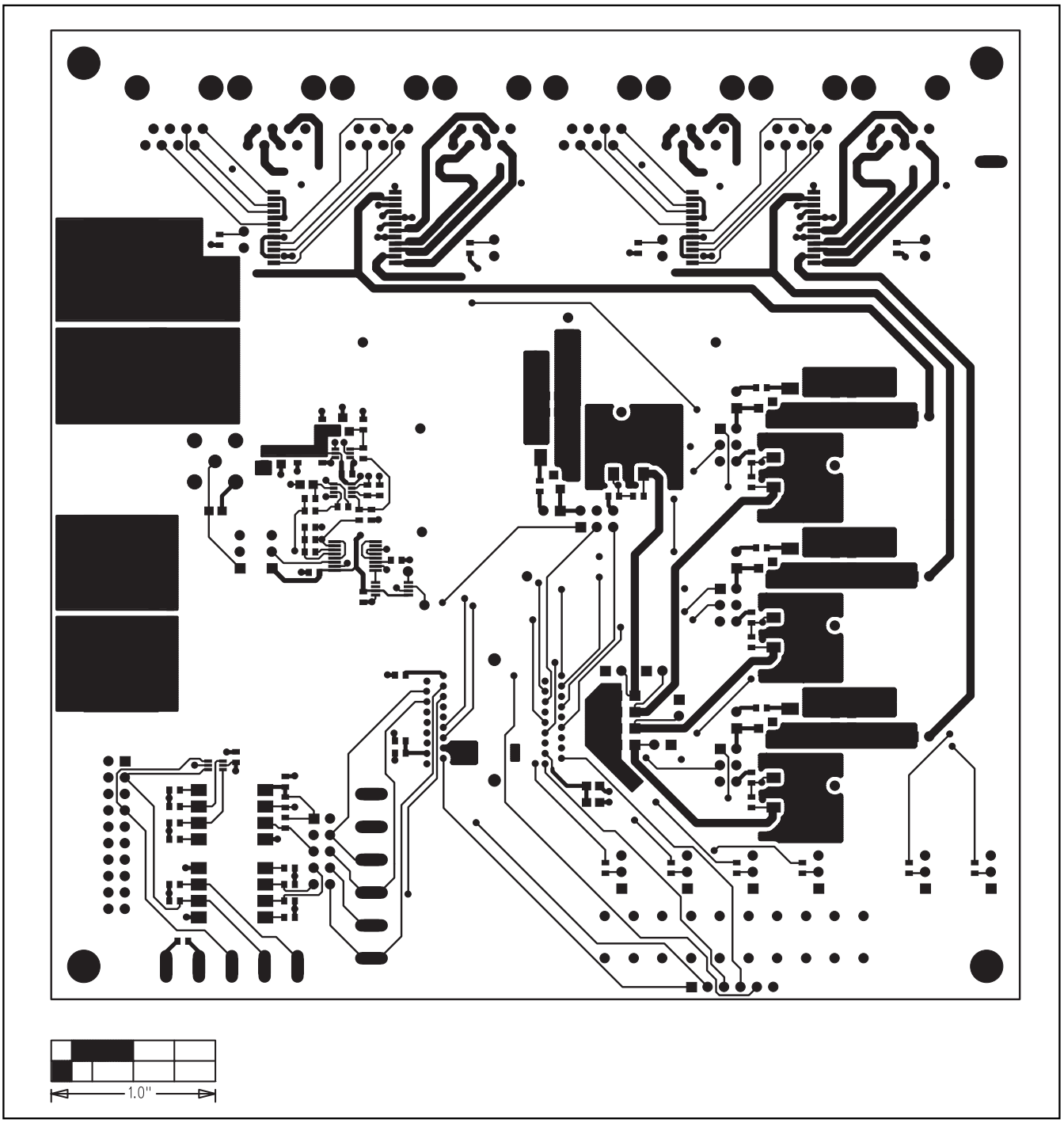


Figure 8. MAX5945 EV Kit PC Board Layout—Component Side

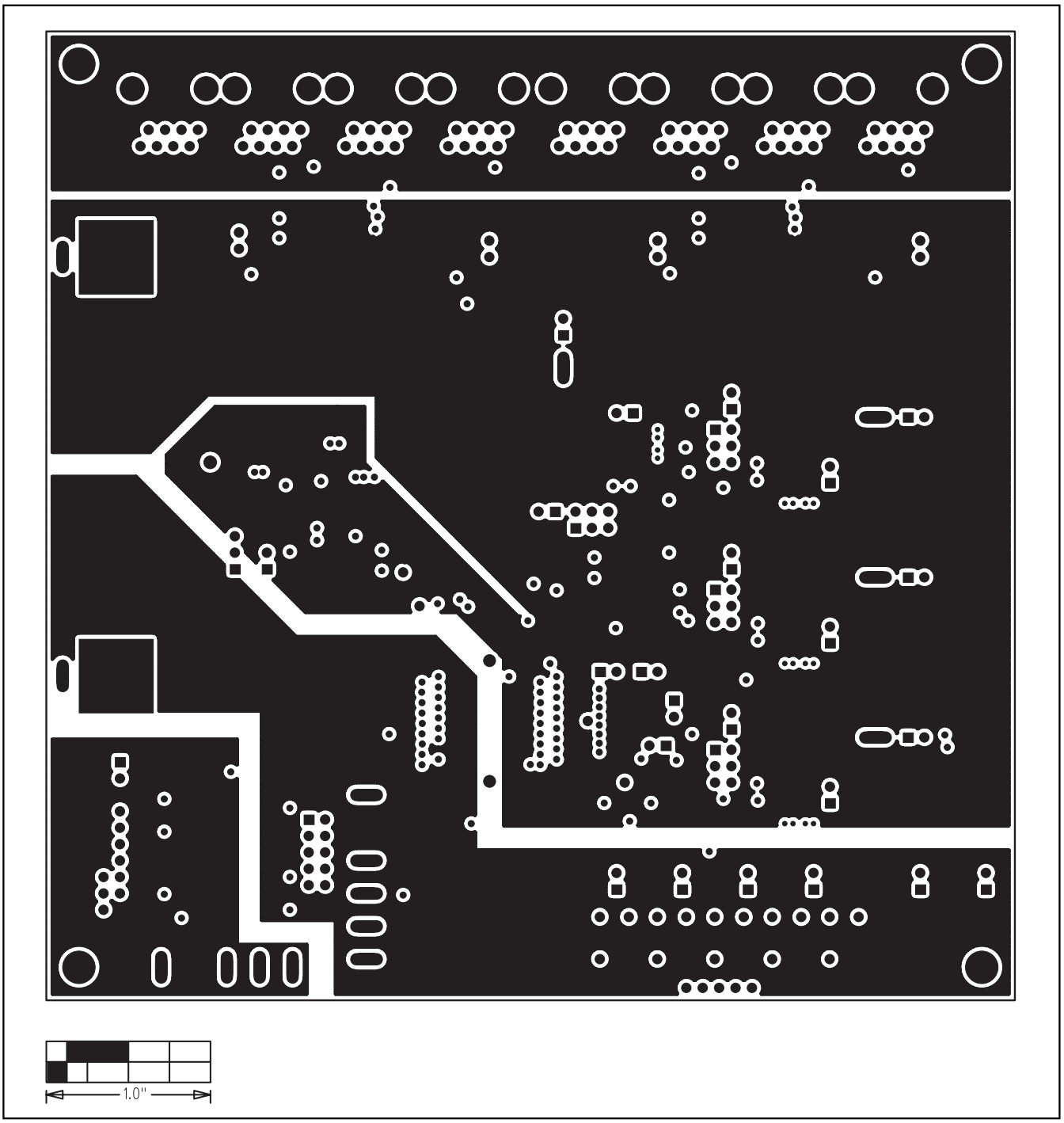


Figure 9. MAX5945 EV Kit PC Board Layout—GND Layer 2

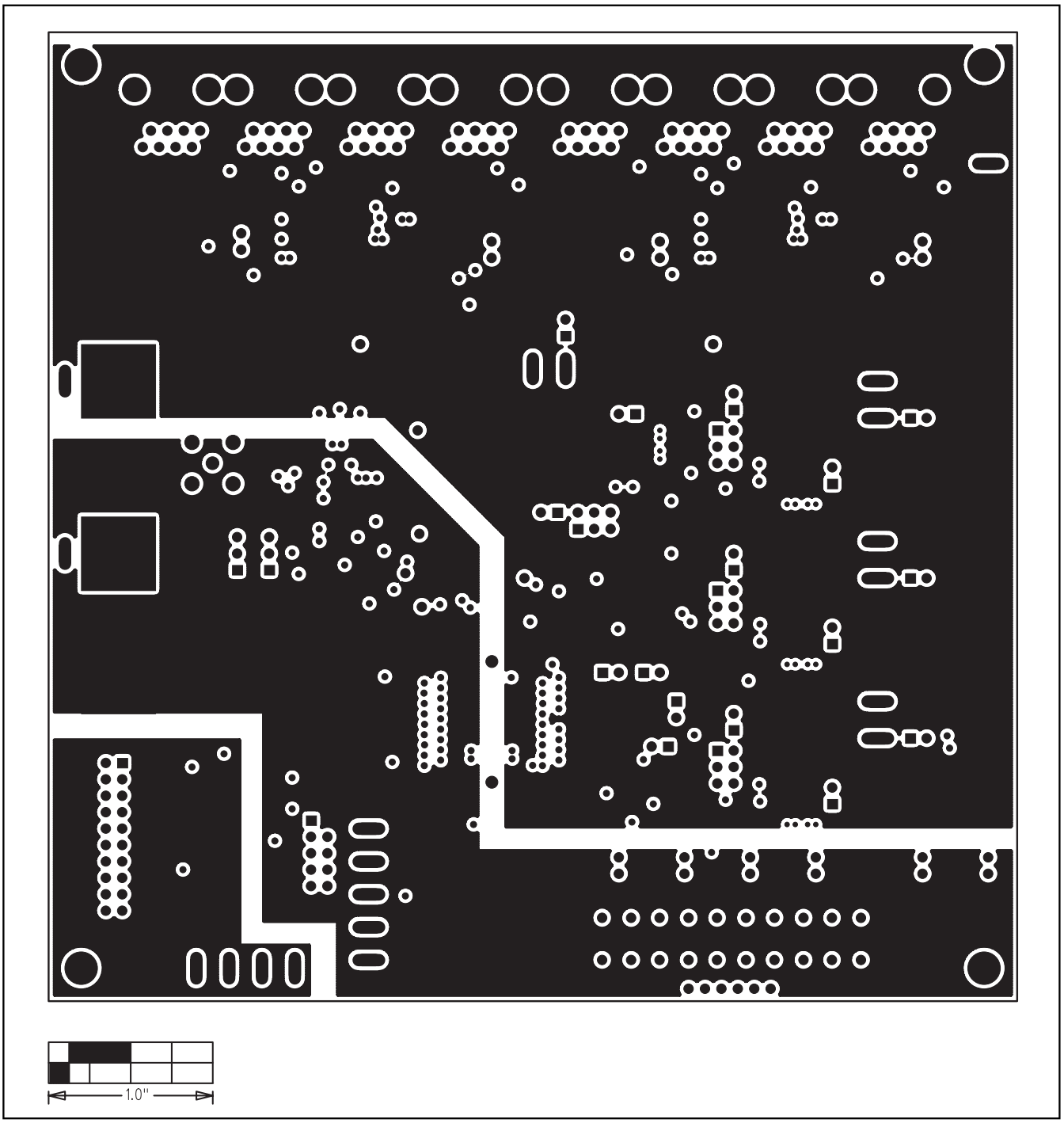


Figure 10. MAX5945 EV Kit PC Board Layout—V_{CC} Layer 3

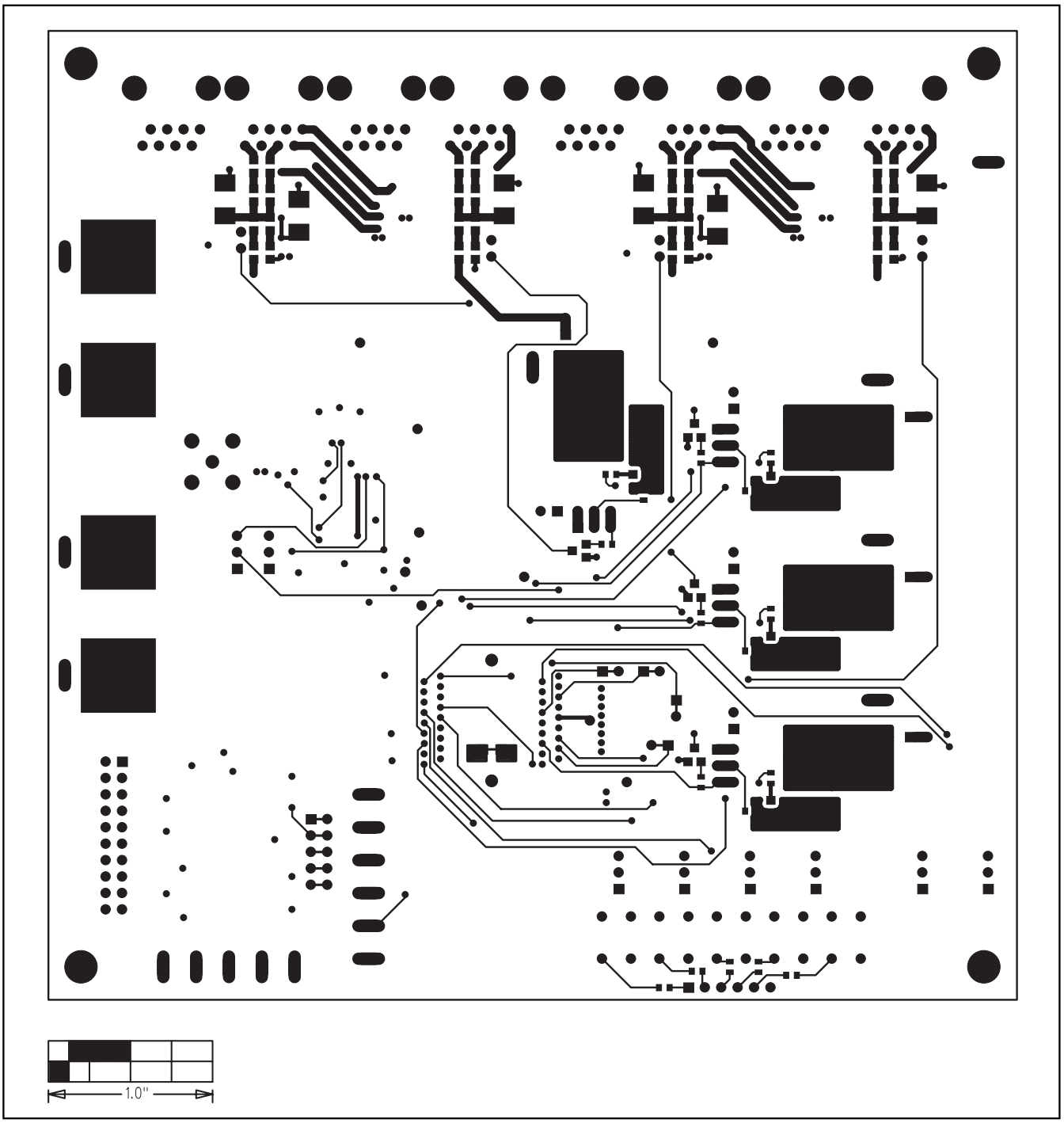


Figure 11. MAX5945 EV Kit PC Board Layout—Solder Side

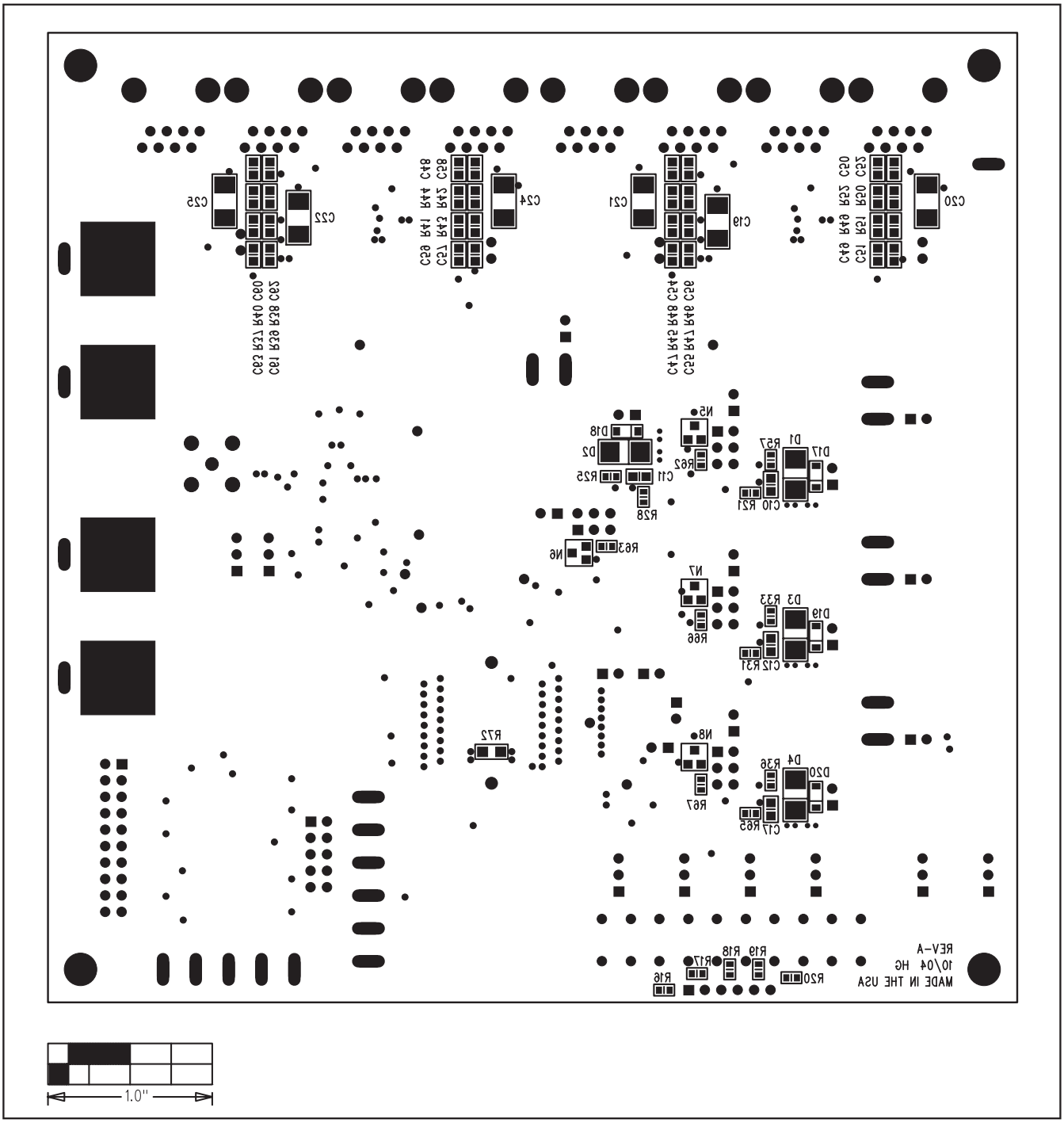


Figure 12. MAX5945 EV Kit Component Placement Guide—Solder Side

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