

# ISL88736EVAL1Z Evaluation Board Setup Procedure

## Introduction

The ISL88736 is a highly integrated battery charger controller for Li-ion/Li-ion polymer batteries with SMBus interface. It controls charge voltage, charge current and input current limiting. It is capable of operating in boost mode to draw power from the battery and boost it to adapter voltage when system loads exceed the adapter current limit. The evaluation board includes a USB to SMBus interface to allow users to control the ISL88736 from a Personal Computer.

## Features

- Boost mode to support Intel “Turbo Mode”
- Overvoltage, overcurrent and over-temp protection
- 0.5% battery voltage accuracy
- 4% adapter current limit accuracy
- 3% charge current accuracy
- SMBus 2-wire serial interface
- Charge current limited by SMBus DAC OR analog voltage at the CCLIM pin
- Turbo-boost discharge current limit
- Monitor outputs
  - Adapter current (3% accuracy)
  - Adapter overcurrent ALERT#. Threshold set by resistor divider
  - AC-adapter detection

- 8A maximum battery charger current
- 11A maximum adapter current limit
- +8V to +22V adapter voltage range
- Source Select FET control

## What’s Inside

This Evaluation Board Kit contains the following materials:

- Qty (1) ISL88736EVAL1Z Evaluation Board
- Qty (1) USB cable

## What is Needed

The following materials are recommended to perform testing:

- One AC adapter or one adjustable 25V/6A DC power supply
- Two adjustable electronic loads with constant current mode and constant voltage mode
- One volt meter
- One 500MHz four-channel oscilloscope with voltage and current probes
- A Personal Computer (PC) with ISL88736 control software and drivers (software is available from the Intersil web site)

See the connection diagram in Figure 1.

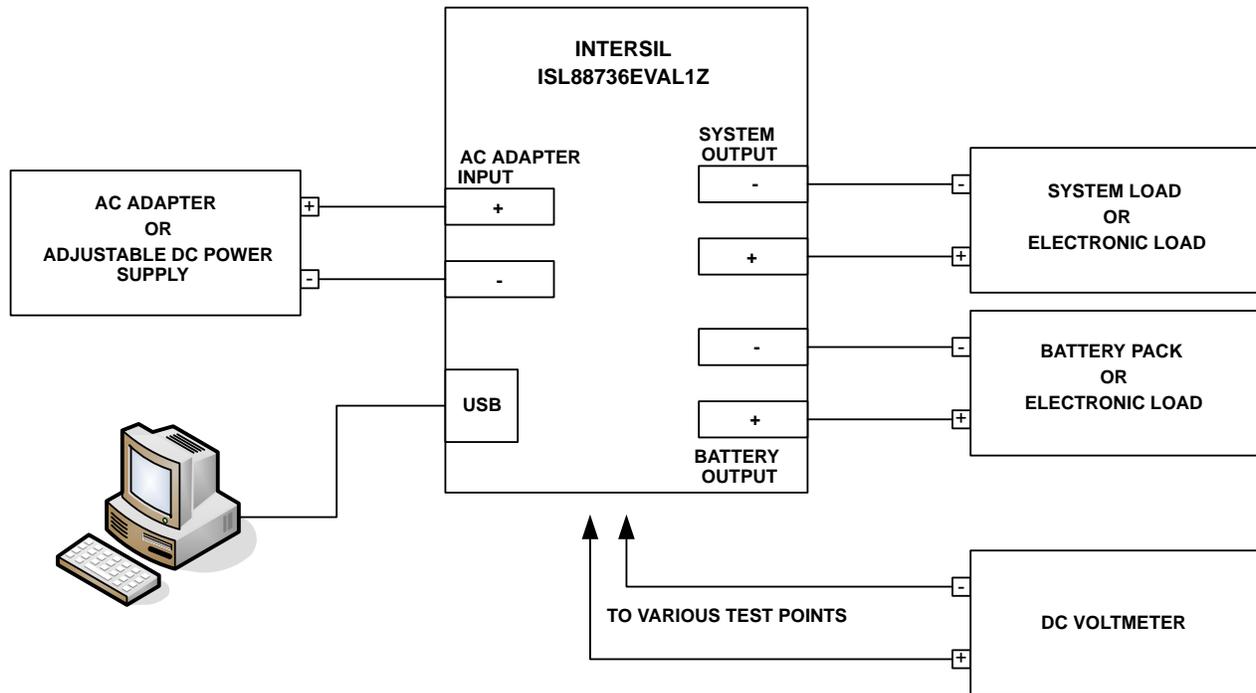


FIGURE 1. ISL88736EVAL1Z HARDWARE CONNECTION DIAGRAM

# Application Note 1841

## Download, Extract and Install the Software

The required ISL88736 CONTROL software is available for download from [www.Intersil.com](http://www.Intersil.com).

## Software Installation

Both the ISL88736 control program and the National Instruments run time engine are installed from the “ISL88736 Installer” folder. Navigate to the folder and double click the “AutoRun.exe” file. You should see the window as shown in Figure 2.

Click on the “Install ISL88736 Control Software” to run the Installation Wizard.

You should now see a window as shown in Figure 3. You will be asked to agree to 2 End User License agreements.

In most PCs the National Instruments Runtime Engine will be installed automatically after the ISL88736 control software. You should see the window as shown in Figure 4.

Follow the instructions to install the Runtime Engine. If it does not run automatically, click “Install National Instruments Runtime Engine” on the ISL88736 Control Software Installation Menu (see Figure 2). After installation, click on the Close Menu button.



FIGURE 2. ISL88736EVAL1Z CONTROL SOFTWARE INSTALLATION MENU

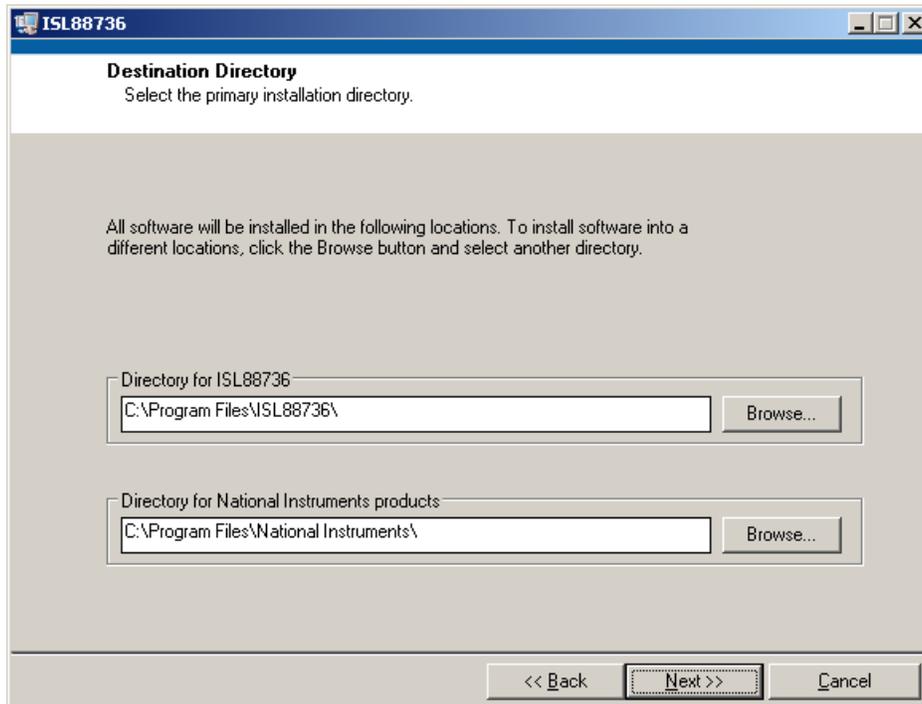


FIGURE 3. ISL88736 CONTROL SOFTWARE INSTALLATION WIZARD

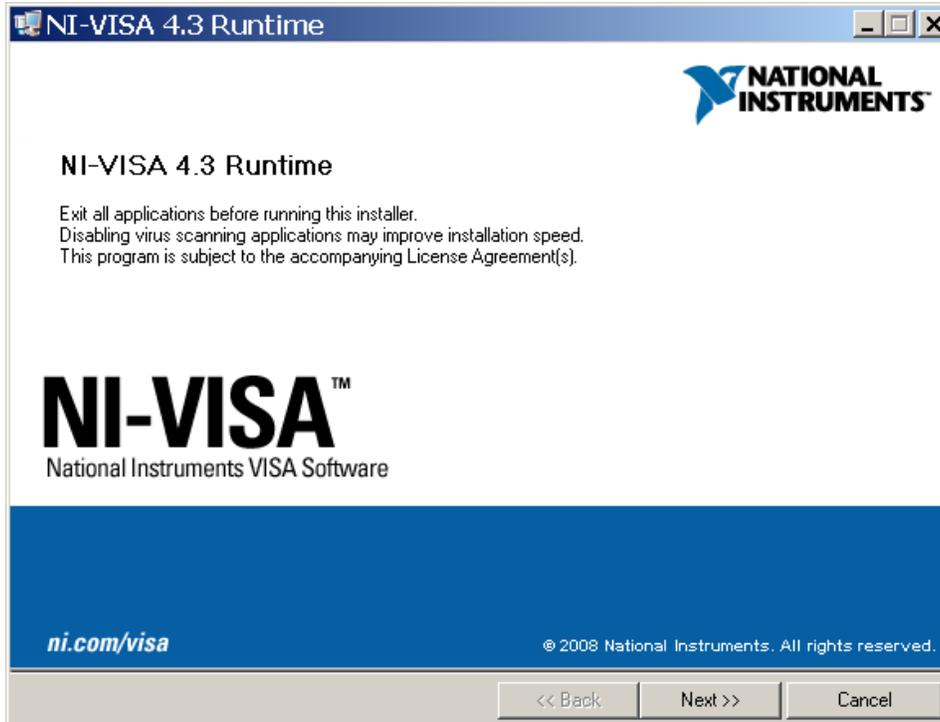


FIGURE 4. NATIONAL INSTRUMENTS RUNTIME ENGINE INSTALLATION WIZARD

## Driver Installation

Connect the ISL88736EVAL1Z to the USB port of your PC.

Note: The SMBus part of the ISL88736 and the USB-SMBus interface are powered by the 5V from the USB port on the PC. It is not necessary to have other power supplies connected to the evaluation board to read or write to the ISL88736.

When WINDOWS detects new hardware, the new hardware wizard should appear. Direct it to look for the driver information file in the "ISL88736 Installer" folder (extracted from the downloaded file). In some systems, it may be necessary to specify the driver information file (USB-I2C\_WDM\_XP\_vista\_W7.inf).

## Run the ISL88736 Application Software

ISL88736 control software should now appear in your Start/All Programs list. Click on it to run the application.

The following icon will appear if the USB cable is not connected.



Click OK after attaching the cable.

Figure 5 shows a screen shot of the ISL88736 control software user interface for DAC controls.

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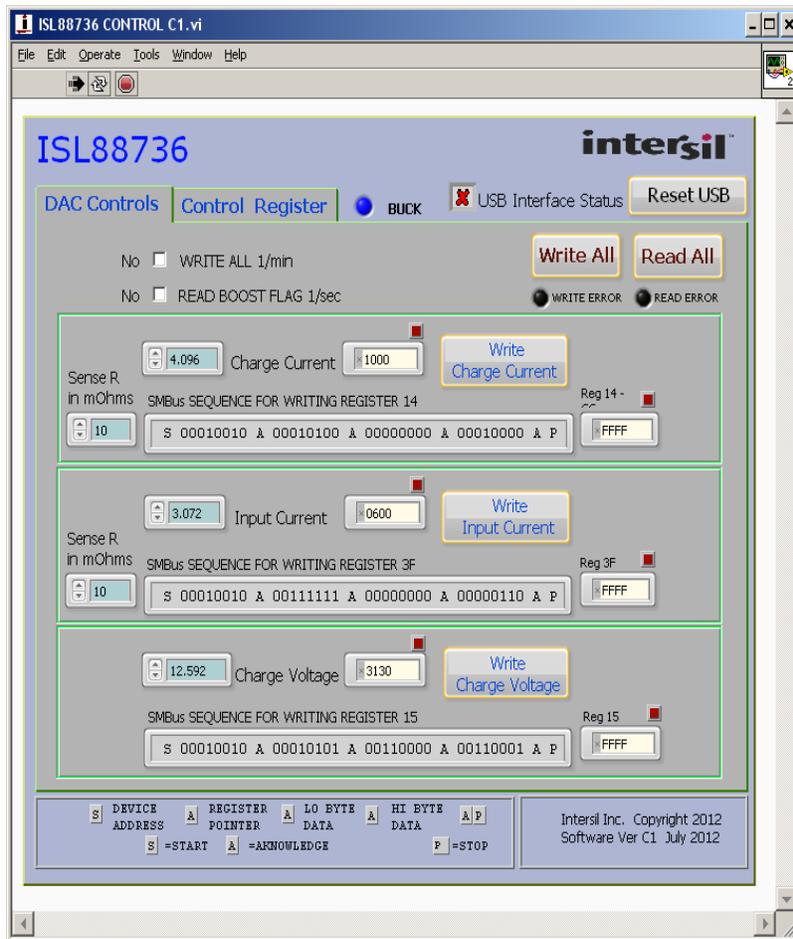
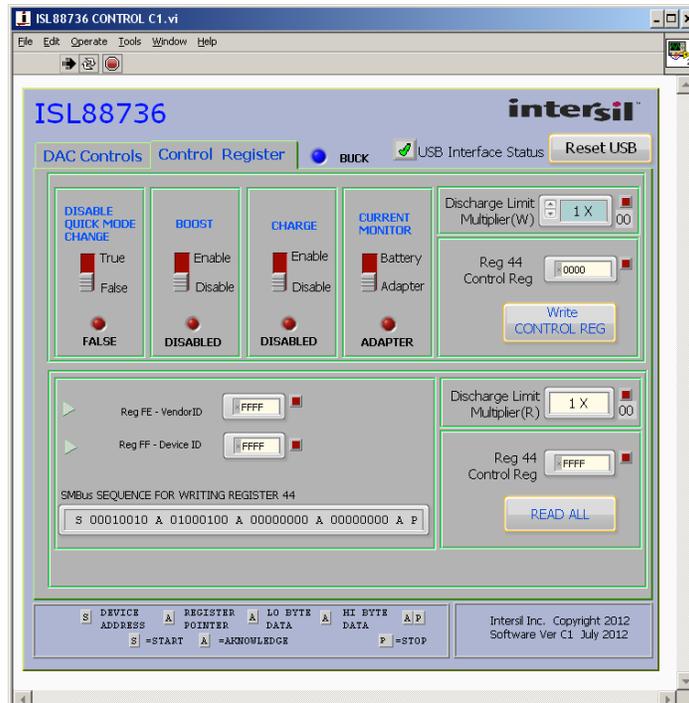


FIGURE 5. THE ISL88736 DAC CONTROLS GUI, CLICK ON THE RESET

The the red X is replaced by a green check mark in the GUI. This shows that the USB link is communicating.



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The Control Register GUI will appear as shown in Figure 6.

Figure 6 shows a screen shot of the ISL88736 control software user interface for control bits. Click on the control BITS tab at the top of the window to see these controls.

## Connect the EVAL Board to Power and Loads

Connect the evaluation board to power and loads as shown in Figure 1. Input power will appear on the SYSTEM OUTPUT terminals. No voltage or current is available at the BATTERY OUTPUT until the charger is ENABLED.

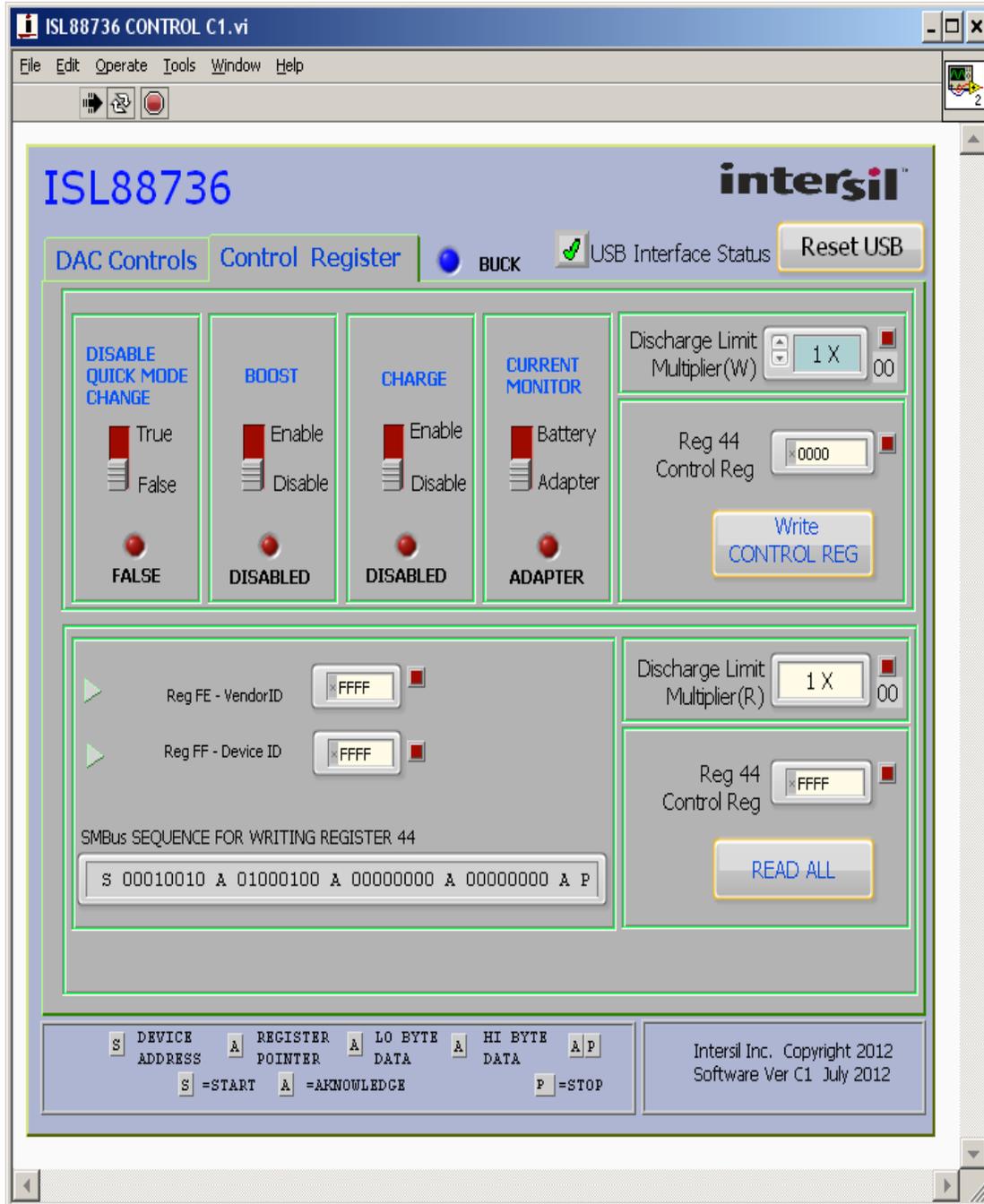


FIGURE 6. CONTROL REGISTER

# Application Note 1841

## Enable the Output

When power is applied to the ISL88736, the Charge Current and Charge Voltage Registers are 0x0000, the CHARGE ENABLE and BOOST ENABLE bits are zero. The output is disabled. The output is enabled by writing valid, non-zero values to these 2 registers and writing a logic 1 to the CHARGE ENABLE bit. Boost is enabled by writing a logic 1 to the BOOST ENABLE bit. See the ISL88736 datasheet for valid values.

The ISL88736 is also disabled if the ACIN pin is below 3.2V. An Input voltage >13.1V will pull ACIN above 3.2V. The minimum input voltage can be adjusted on the evaluation board by changing R<sub>6</sub> or R<sub>7</sub> (see Figure 13).

## Description of the User Interface Controls and Display Information



Clicking the “Write All” button will write the indicated SMBus sequences to Registers 14, 15, 44 and 3F in the ISL88736.

Clicking on the “Read All” button will read all 4 registers in the ISL88736 and display the results in the grey indicators below the “Read All” button.



If the device and the interface are operating normally, the VendorID (reg FE) and the DeviceID (reg FF) will display as follows:



If the VendorID (reg FE) and DeviceID (reg FF) remain FFFF it indicates a communication problem.

If the USB Interface Status has a red X, it indicates a problem with the USB communication.

Clicking on the “RESET INTERFACE” button may correct the problem. If not, try closing the software, remove power and USB connections from the evaluation board, then reconnect and restart.

Note the register contents in the user interface are updated ONLY when the “Read All” button is clicked.

The “Write Charge Current” button sends only the charge current command to the ISL88736. Other registers are unchanged.



The small blue window next to “Charge Current” accepts inputs in Amps, and converts them to the hexadecimal (hex) value to be written to the ISL88736 in the white window.



The hex value depends on the value entered in Sense R.



The value in the white window will be forced to the nearest valid number that can be produced by the DAC in the ISL88736. That is, after entering 4 and hitting the enter key, the display will change to 3.968. After entering 4.1 and hitting the enter key, the display will change to 4.096. The value can be incremented and decremented with the up/down arrows at the left of the window.

The Sense R inputs are used to calculate the hexadecimal (hex) values and the SMBus sequences for the Charge Current limit and Input Current limit entered in the blue boxes. The evaluation board is built with 10mΩ sense resistors. If you change them to another value, enter the new value to get correct calculations.

After entering a number in the blue box, hitting the enter key or clicking on another area will enter the value and the resulting hex value and the SMBus sequence will be calculated and displayed.



S = the Start condition, A = the Acknowledge, P = the Stop condition.

Note: The LO byte is sent first. The HI byte is sent second.

When writing 0x41A0, 0xA0 is written first and 0x41 is sent second.

**Important Note: The SMBus commands are NOT sent until one of the WRITE buttons is clicked (i.e., Write All or Write Charge Current).**

The “Write Charge Voltage” button writes only the Charge Voltage register. Other registers are unchanged.

The small white window accepts Charge Voltage (in Volts) and calculates the hexadecimal value and the SMBus sequence to write to the ISL88736. The SMBus command is sent when the “Write Charge Voltage” or “Write All” button is clicked. See Figure 8.

The “Write Input Current” button writes only the Input Current register. Other registers are unchanged. The small white window accepts Input Current Limit in Amps and calculates the hex value and the SMBus sequence to be written to the ISL88736. The Sense R input is used to calculate the hex value and the SMBus sequence. The SMBus command is sent when the “Write Input Current” or “Write All” button is clicked. See Figure 7.

# Application Note 1841



FIGURE 7. WRITE INPUT CURRENT BLOCK



FIGURE 8. WRITE CHARGE VOLTAGE BLOCK

## Safety Time-out

The ISL88736 will shut down unless it receives Charge Voltage or Charge Current commands every 175s. This is a safety feature that prevents overcharging batteries if bus master has stopped functioning. The control software includes the function to write the Charge Current register every 60 seconds, which can be enabled or disabled as shown in Figure 9. The software can also read the BOOST FLAG every 1 second with the switch in Figure 9 in the ON position.

## ENABLE CHARGE and BOOST

The 4 toggle switches in Figure 10 control what is written to the control register when the WRITE ALL or WRITE CONTROL REG buttons are clicked. The Current Monitor switch chooses Adapter Current or Battery Current.



FIGURE 9. ENABLE WRITING CHARGE CURRENT REGISTER EVERY 60 SECONDS or READ THE BOOST FLAG EVERY 1 SECOND



FIGURE 10. SELECT CURRENT MONITOR, ENABLE/ DISABLE CHARGE, BOOST, AND QUICK MODE CHANGE

## Set the Discharge Limit Multiplier

Click on the up/down arrows to the left of the blue Discharge Limit Multiplier(W) area of the control to get a list of choices for the multiplier. Click on the desired multiplier in the list and click on WRITE CONTROL reg to send the SMBus command.



FIGURE 11. DISCHARGE LIMIT MULTIPLIER CONTROL INPUT

## Read Back from the CONTROL Register

Click on the READ ALL button to refresh the display in the window in Figure 12.



FIGURE 12. READ BACK FROM THE CONTROL REGISTER 44

## Interface Troubleshooting

When the evaluation board is connected to the PC by a USB cable and the software is able to communicate with the evaluation board, it puts a check mark in the USB Interface Status.



If there is a red X, it indicates a problem with communication between the PC and the micro controller on the evaluation board. Check and correct the connection of the USB cable to your PC and the evaluation board. Click on the "RESET INTERFACE" button.

If you still get a red X, Close and restart the ISL88736 control software.

If you still get a red X, Open the Device Manager (Control Panel/System/Device Manager) with the ISL88736 evaluation board connected to your USB port. You should see a device named "NI-VISA USB Device". If it is not in the list of devices, the driver may not be correctly installed. Run the New Hardware wizard.

If you still get a red X, contact your Intersil Field Application Engineer for assistance

# ISL88736EVAL1Z Schematics

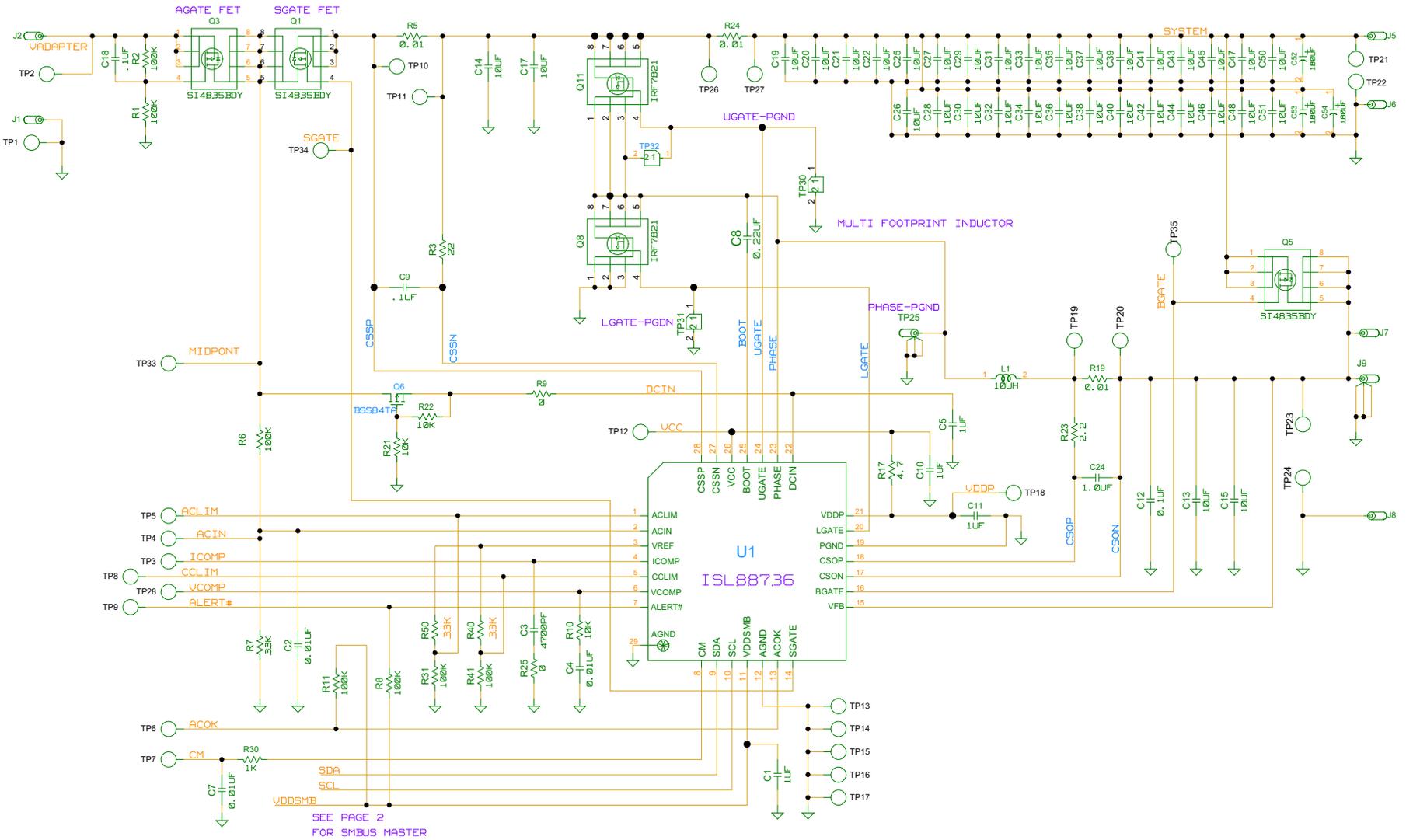


FIGURE 13. ISL88736EVAL1Z SCHEMATIC

# ISL88736EVAL1Z Schematics (Continued)

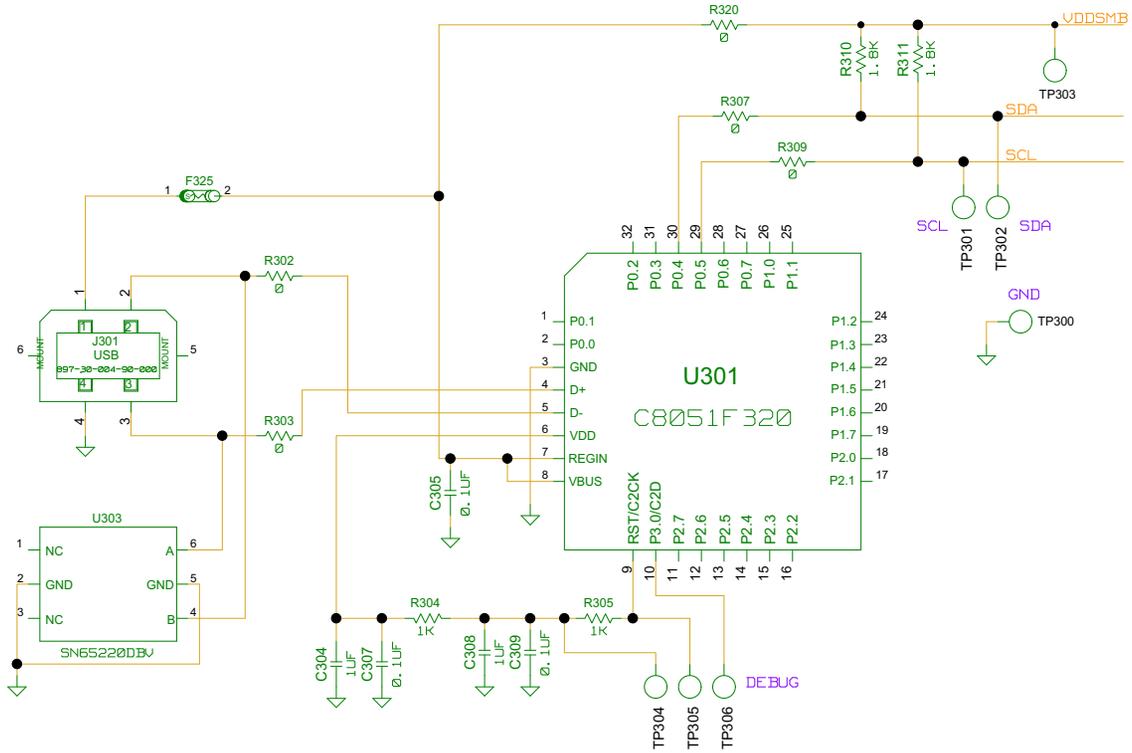


FIGURE 14. ISL88736EVAL1Z SCHEMATIC (USB - SMBUS INTERFACE)

# ISL88736EVAL1Z REV A Bill of Materials

PART NUMBER	REF DES	QTY	VALUE	TOL.	VOLTAGE	PWR	JEDEC TYPE	MANUFACTURER	DESCRIPTION
H1045-00105-6R3V10	C1, C10, C11, C304, C308	5	1 $\mu$ F	10%	6.3V		CAP_0603	GENERIC	Multilayer Cap
H1045-00104-50V10-T	C12	1	0.1 $\mu$ F	20%	50V		SM0603	TDK	MULTILAYER CAP
H1065-00106-25V10-T	C13-C15, C17, C19-C22, C25-C48, C50, C51	34	10 $\mu$ F	10%	25V		CAP_1206		
H1045-00103-25V10	C2, C4, C7	3	0.01 $\mu$ F	10%	25V		CAP_0603	GENERIC	Multilayer Cap
H1044-00105-10V10-T	C24	1	1.0 $\mu$ F	10%	10V		CAP_0402		
H1045-00472-50V5-T	C3	1	4700PF	5%	50V		CAP_0603		
H1045-00104-16V10	C305, C307, C309	3	0.1 $\mu$ F	10%	16V		SM0603	GENERIC	Multilayer Cap
H1046-00105-25V10	C5	1	1 $\mu$ F	10%	25V		SM0805	GENERIC	Multilayer Cap
25SVPF180M	C52-C54	3	180 $\mu$ F	20%	25V		CASE_E12_SVPC	SANYO-OS-CON	SVPF Series E12 Size SMD Cap
H1045-00224-25V20	C8	1	0.22 $\mu$ F	20%	25V		SM0603	GENERIC	Multilayer Cap
H1045-00104-25V10-T	C9, C18	2	0.1 $\mu$ F	10%	25V		CAP_0603		
MICROSMD050F-2-T	F325	1				0.5A	FU_MICROSMD050F	RAYCHEM-TYCO	PolySwitch SM Resettable Fuse
111-0703-001	J1, J6, J8	3					111-0703-001	JOHNSON-COMP	Binding Post Black
111-0702-001	J2, J5, J7	3					111-0702-001	JOHNSON-COMP	Binding Post Red
897-43-004-90-000	J301	1					USB_897-43-004-90-000	MIL-MAX	Type B Receptacle USB Connector
131-4353-00	J9, TP25 (DNP J9)	1					TEK131-4353-00	TEKTRONIX	Scope Probe Test Point PCB Mount
IHLP-5050CE-ER-100-M-01	L1	1	10 $\mu$ H	20%		14A	VISHAY_IHLP-5050CE	VISHAY	LOW PROFILE HIGH CURRENT INDUCTOR (RoHS COMPLIANT)
SI4835DDY-T1-E3	Q1, Q3, Q5	3			30V	8.7A	SOIC8	VISHAY	30V -8.7A P-Channel MOSFET
BSS84TA-T	Q6	1			50V		SOT23	FAIRCHILD	P-Channel Enhancement Mode Field Effect Transistor
IRF7821PBF	Q8, Q11	2	9.1m $\Omega$		30V		SOIC8_150_50	IR	30V 13.6A N-Channel HEXFET Power MOSFET (Pb-FREE)
H2511-01003-1/10W1-T	R1, R2, R6, R8, R11, R31, R41	7	100k	1%		1/10W	SM0603	GENERIC	Thick Film Chip Resistor
H2511-01002-1/10W1-T	R10, R21, R22	3	10k	1%		1/10W	RES_0603	GENERIC	Thick Film Chip Resistor
H2511-004R7-1/10W1	R17	1	4.7	1%		1/10W	SM0603	GENERIC	Thick Film Chip Resistor
H2511-002R2-1/10W1-T	R23	1	2.2	1%		1/10W	RES_0603		
H2511-00220-1/10W1-T	R3	1	22	1%		1/10W	RES_0603		
H2511-01001-1/10W1-T	R30, R304, R305	3	1k	1%		1/10W	SM0603	GENERIC	Thick Film Chip Resistor

# ISL88736EVAL1Z REV A Bill of Materials (Continued)

PART NUMBER	REF DES	QTY	VALUE	TOL.	VOLTAGE	PWR	JEDEC TYPE	MANUFACTURER	DESCRIPTION
H2511-01801-1/10W1	R310, R311	2	1.8k	1%		1/10W	RES_0603	GENERIC	Thick Film Chip Resistor
WSL2512R0100FEA-T	R5, R19, R24	3	0.01	1%		1W	RES_2512	VISHAY	POWER METAL STRIP RESISTOR
H2511-03302-1/10W1-T	R7, R40, R50	3	33k	1%		1/10W	RES_0603	GENERIC	Thick Film Chip Resistor
H2511-00R00-1/10W-T	R9, R25, R302, R303, R307, R309, R320	7	0			1/10W	SM0603	GENERIC	Thick Film Chip Resistor
5006	TP1, TP11, TP13-TP17, TP20, TP22, TP24, TP27, TP300	12					CTP500X_REVA	KEYSTONE	Compact Black Test Point .100 Pad .063 Thole
5007	TP10, TP19, TP301-TP306	8					CTP500X_REVA	KEYSTONE	Compact White Test Point .100 Pad .063 Thole
5005	TP2, TP12, TP18, TP21, TP23, TP26	6					CTP500X_REVA	KEYSTONE	Compact Red Test Point .100 Pad .063 Thole
67996-272HLF-2X2	TP30, TP31	2					CONN2	SAMTEC	2 Pin Header 2.54mm (.100) Pitch
5009	TP3-TP9, TP28	8					CTP500X_REVA	KEYSTONE	Compact Yellow Test Point .100 Pad .063 Thole
ISL88736HRTZ	U1	1					QFN28_157X157_157_EP	INTERSIL	SMBus LEVEL 2 BATTERY CHARGER with BOOST MODE(Pb-FREE)
C8051F320-GQ/PROG-REV.02	U301	1					32LQFP_80	SILICON LABRATORIES	General Purpose Micro Controllers
SN65220DBVR-T	U303	1					SOT23-6	TI	SINGLE USB Port Transient Suppressors



ISL88736EVAL1Z Evaluation Board Layout (Continued)

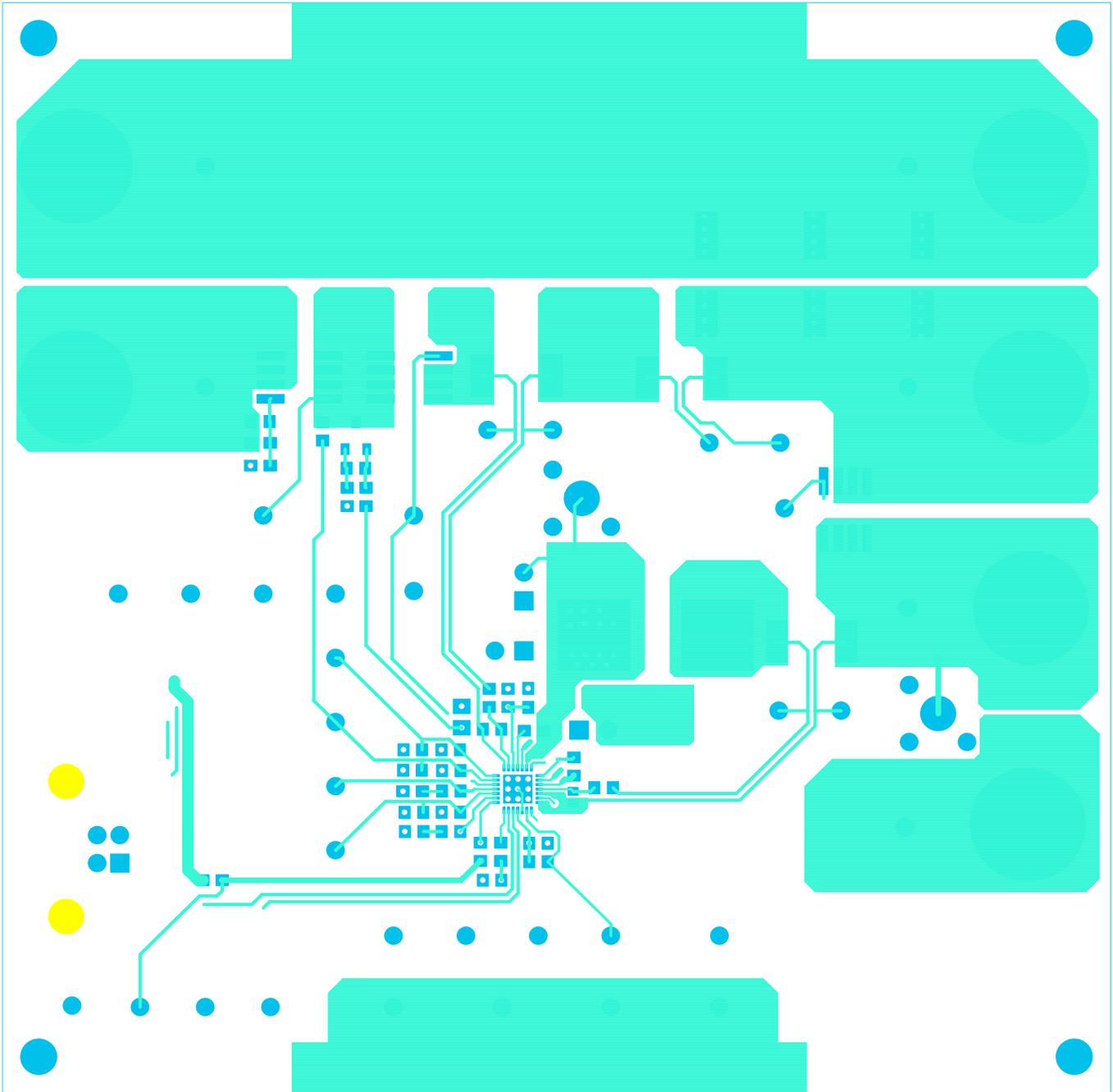


FIGURE 16. TOP COPPER

**ISL88736EVAL1Z Evaluation Board Layout** (Continued)

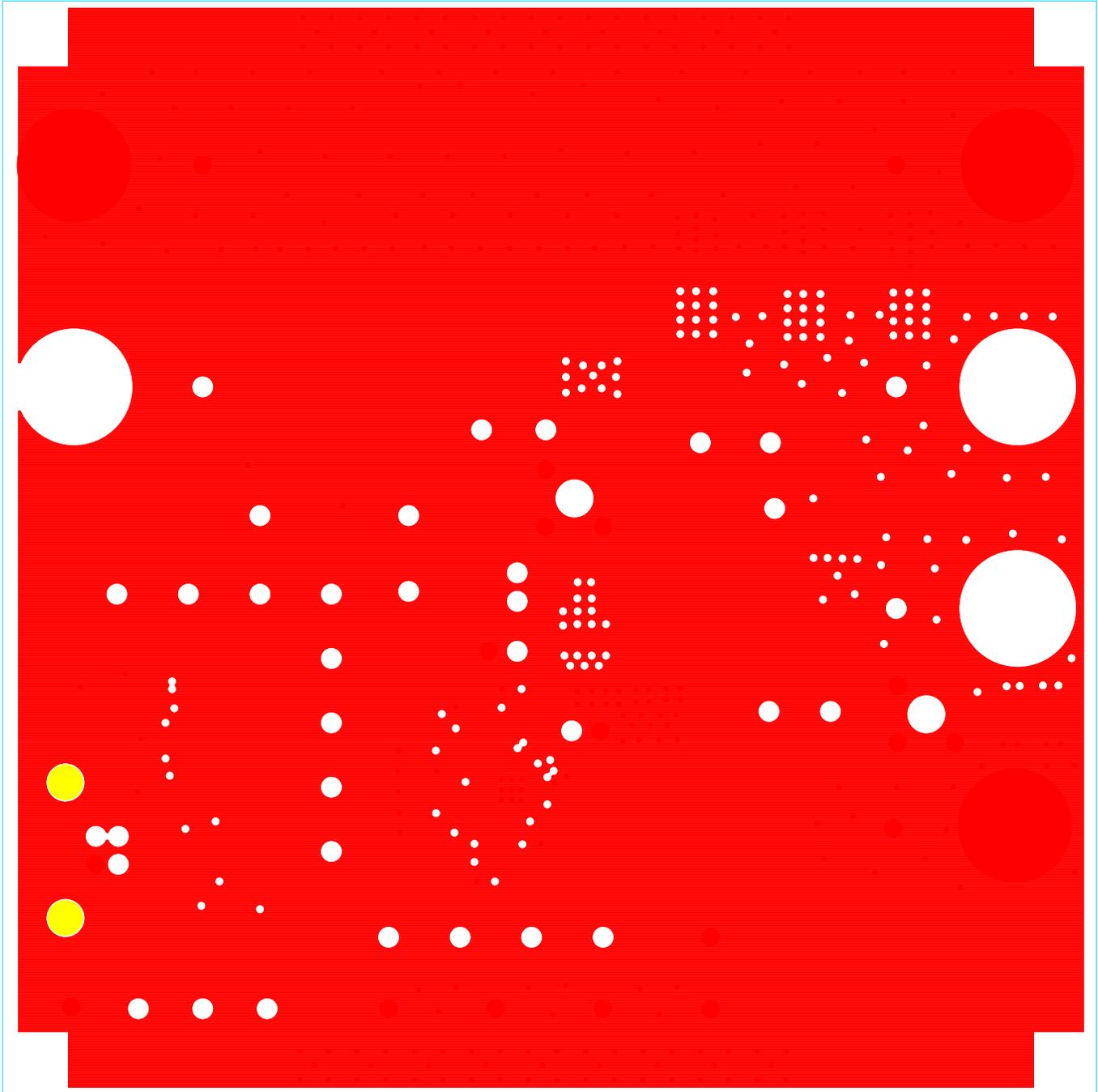


FIGURE 17. LAYER 2 (GROUNDS) (TOP VIEW)

**ISL88736EVAL1Z Evaluation Board Layout** (Continued)

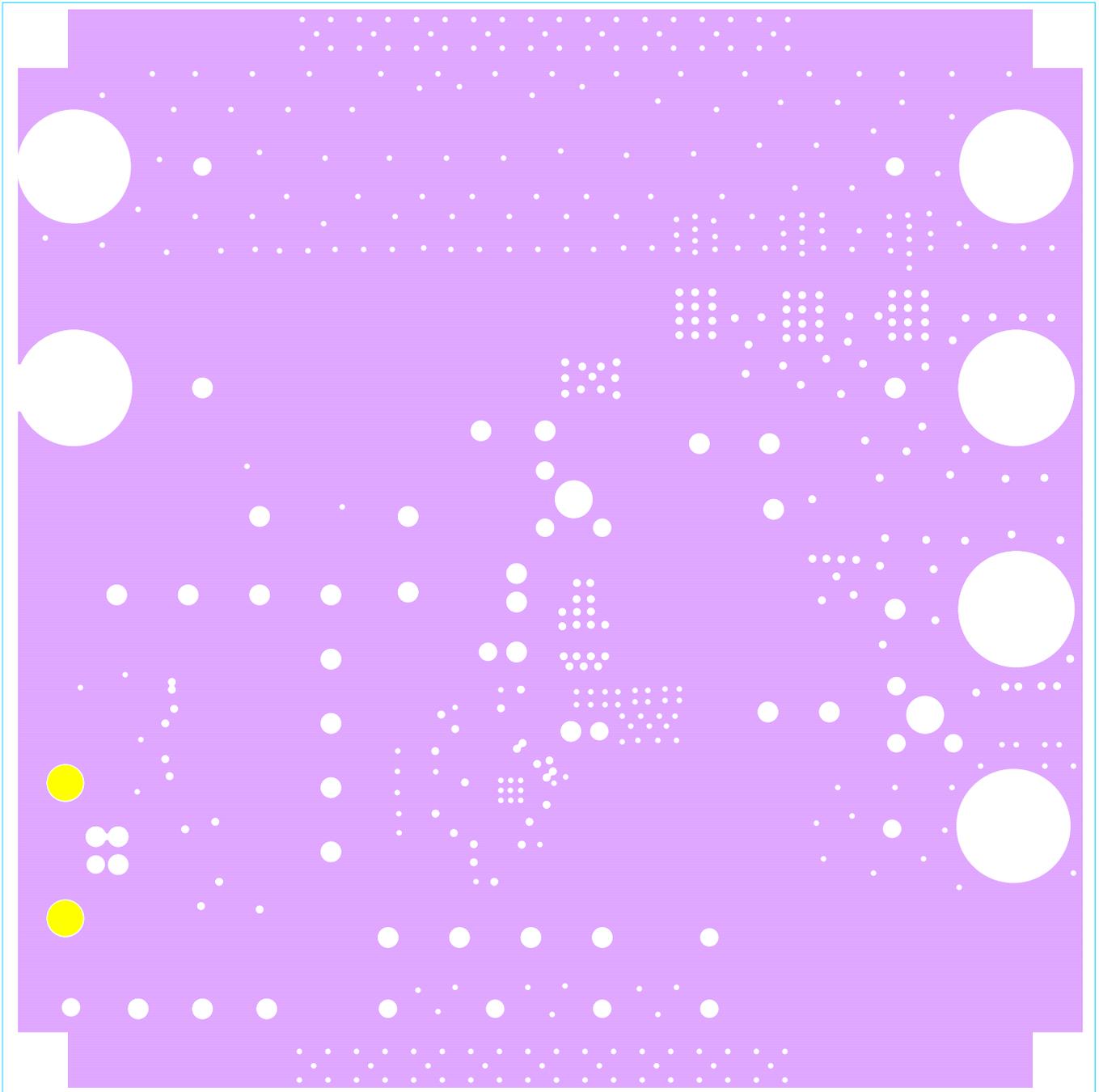


FIGURE 18. LAYER 3 (GROUNDS) (TOP VIEW)

ISL88736EVAL1Z Evaluation Board Layout (Continued)

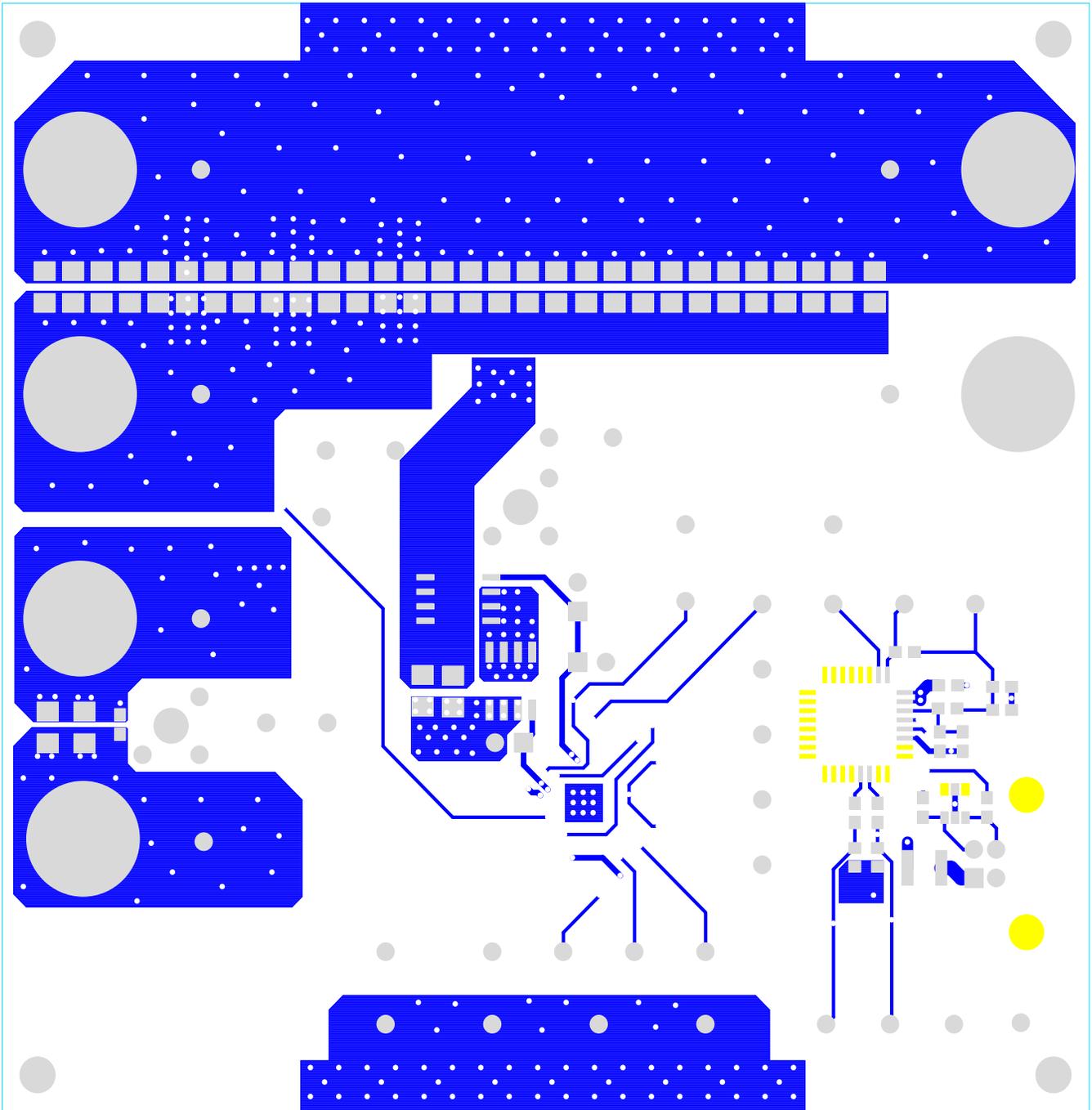


FIGURE 19. BOTTOM COPPER (BOTTOM VIEW)

ISL88736EVAL1Z Evaluation Board Layout (Continued)

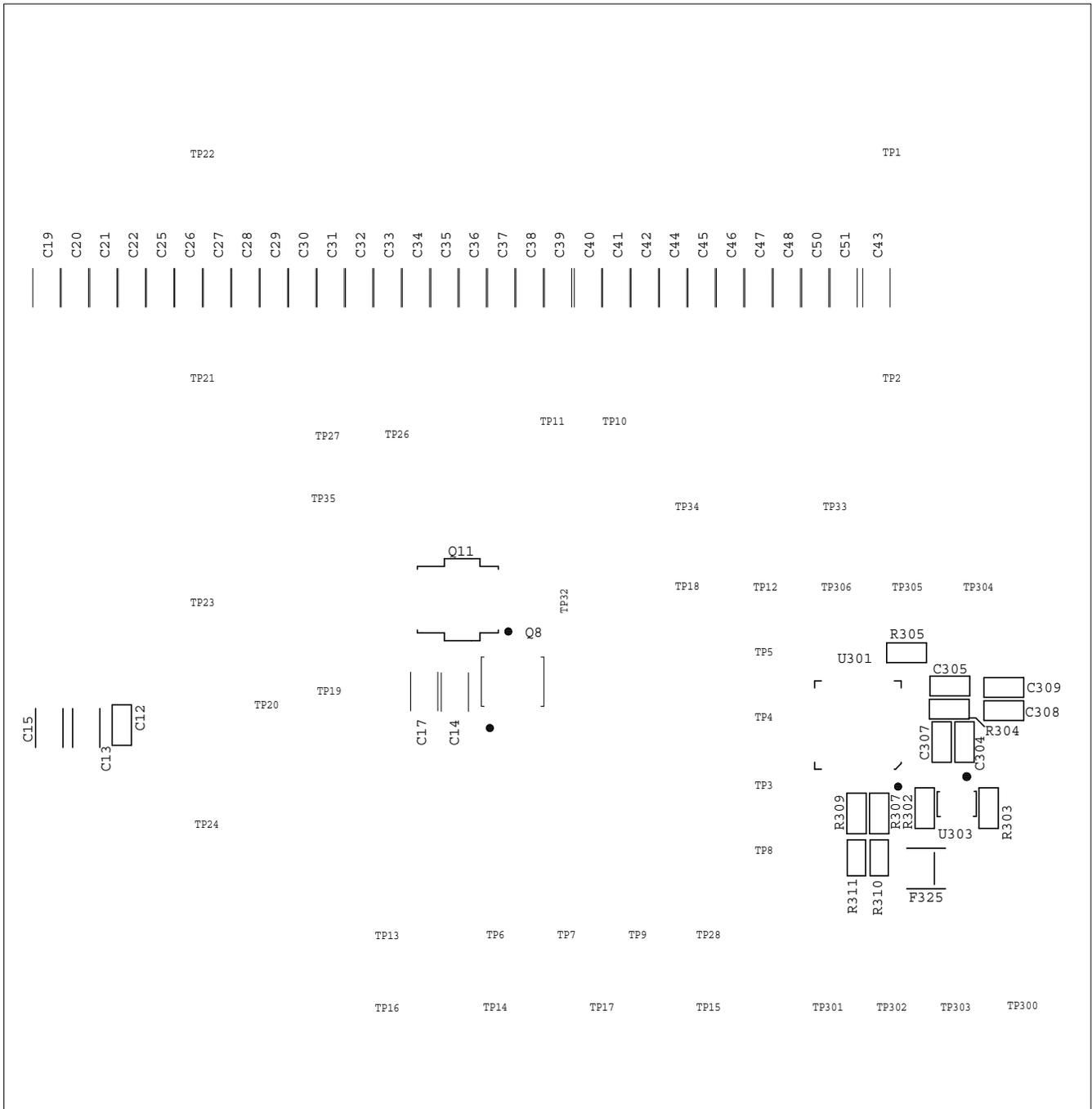


FIGURE 20. BOTTOM SILK SCREEN (BOTTOM VIEW)

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