LTC2874
Quad IO-Link Master Hot Swap Controller and PHY

DESCRIPTION

Demonstration circuit 1880A showcases the LTC®2874, a quad Hot Swap™ controller and PHY suitable for IO-Link® master and other applications. DC1880A operates from an external supply V_{DD} and utilizes the DC590 USB serial controller board to communicate with the LTC2874 using SPI protocol.

Design files for this circuit board are available at http://www.linear.com/demo/DC1880A

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C, V_{DD} = 24V, and V_L = 3.3V.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{DD}	Input Supply Range	24VMODE = 0 24VMODE = 1	8 20		30 30	V V
ΔV_{ACL}	L+ Analog Current Limit Voltage	$\Delta V_{ACL} = V_{SENSE}^+ - V_{SENSE}^-$ V_{L+} = 0V, FLDBK_MODE = 1 $V_{L+} = V_{DD} - 1V$ Start-Up, 2XPTC Enabled, V_{L+} > 18V	 9.2 42	 16.7 50 100	 24.2 58	 mV mV mV
ΔV_{GATE}	External N-Channel Gate Drive ($V_{GATE} - V_{L+}$)	I_{GATE} = –1µA V_{DD} = 17V to 30V V_{DD} = 8V	 10 4.5	 13	 15 15	V V V
V_{RQH}, V_{RQL}	CQ Residual Voltage	Output High, I_{CQ} = –100mA Output Low, I_{CQ} = 100mA		1.2 1.1	1.6 1.5	V V
I_{QPKH}, I_{QPKL}	Wake-Up Request (WURQ) Current		±500	±700		mA
I_{QH}, I_{QL}	CQ Current Limit		±110	±160	±230	mA
f_{DTR}	Maximum Data Transfer Rate	f_{DTR} = 4nF SLEW = 0 SLEW = 1	 38.4 230.4			 kb/s kb/s
t_{WU}	WURQ Pulse Duration		75	80	85	µs
	SCK Frequency	50% Duty Cycle			20	MHz

QUICK START PROCEDURE

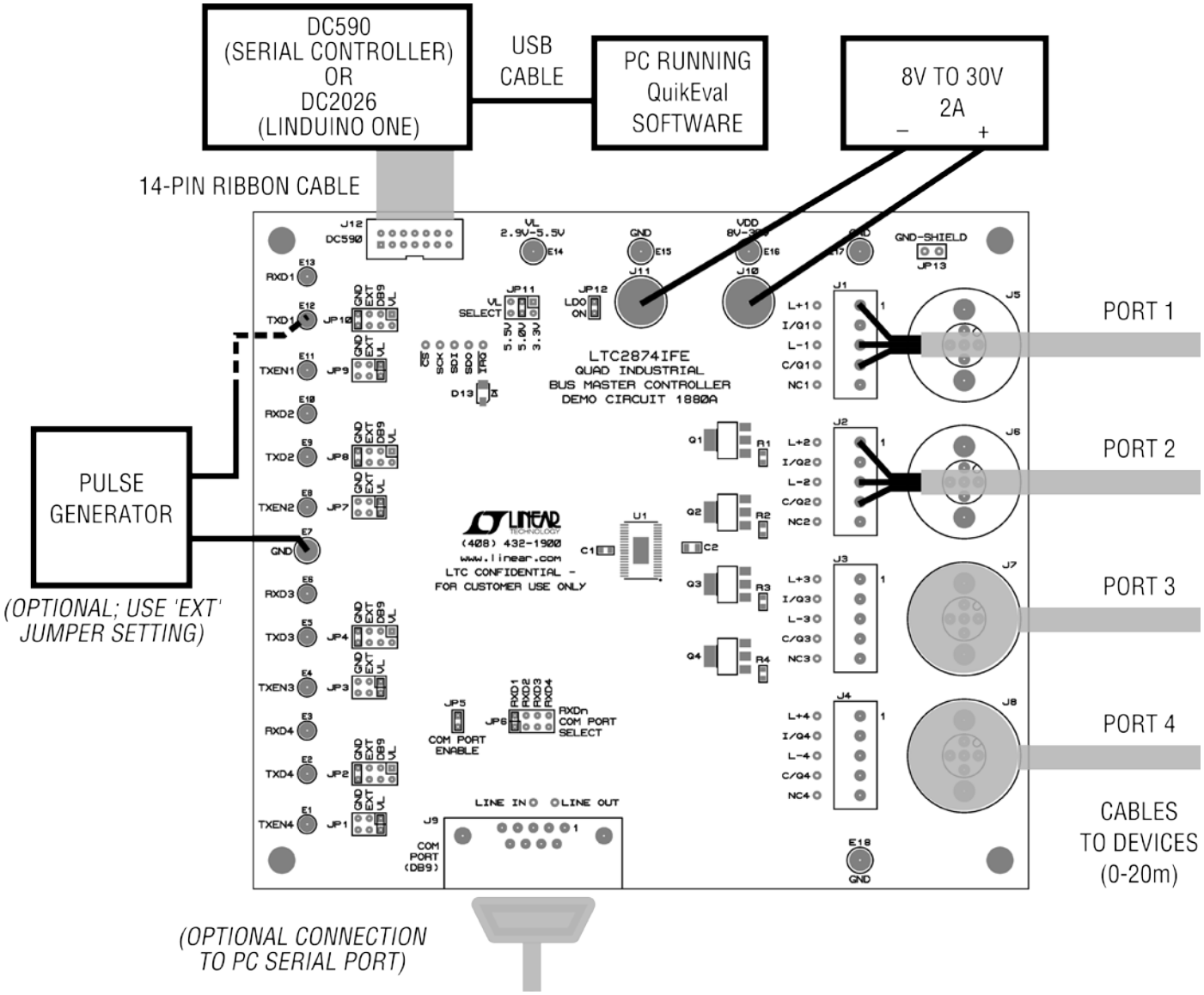


Figure 1. Proper Setup

QUICK START PROCEDURE

DC1880A is a 6-layer demonstration board. An LDO is included to optionally derive the V_L logic supply from the V_{DD} input supply. An LED lights up when the $\overline{IRQ}$ pin signals interrupt requests.

1. Install, or update as needed, Linear Technology's QuikEval™ evaluation software on the PC. See Using the LTC2874 Software section for more information.
2. Connect the DC590 board to the PC with a standard USB A/B cable.
3. Connect the DC1880A board to the DC590 board using the 14-conductor ribbon cable supplied with the DC590 board.
4. Choose the source for the VL logic supply—the DC590, the LDO on the DC1880A, or either if both are set to the same voltage:
   a. Set the DC1880A LDO jumpers (JP11 and JP12) and DC590 VCCIO jumper (JP6) to one of the combinations listed in Table 1. Default jumper positions set both boards to 5V.
   b. When using a Linduino™ One instead of a DC590 board, set the DC1880A LDO to 5V (JP11 = 5.0V) or disable it (JP12 = OPEN).
5. Before connecting the input power supply to the DC1880A board, verify the voltage is below 40V (normally between 8V and 30V) and that the supply is turned off.
6. Connect the power supply between V_{DD} and GND on the DC1880A board as shown in Figure 1.
7. Connect line interface cables (up to 20m long) to either the screw-terminal blocks (J1-J4) or the IO-Link connectors (J5-J8).
8. Turn on the 24V power supply and verify that the $\overline{IRQ}$ LED on the DC1880A board is lit. (The LTC2874 is signalling that one or more of its supplies had been low.)
9. Launch the GUI software. Refer to the Using the LTC2874 Software section for more information on how to control the LTC2874 using the GUI.
10. Clear the $\overline{IRQ}$ condition by clearing any Supply Event bits that are set. On the Events tab, simply click on any lamps that are lit.
11. Refer to the Additional Information section and the data sheet for operating details.

ADDITIONAL INFORMATION

VL Logic Supply

Table 1 lists several ways to supply power to the VL pin. Methods 1a/b/c are recommended for most purposes.

Table 1. Recommended Options for Powering the VL Supply

METHOD	DC590 JP6	DC1880A JP12	DC1880A JP11	SOURCE FOR VL POWER
1a	5V*	ON*	5V*	LDO or DC590
1b	3.3V	ON*	3.3V	LDO or DC590
1c	OPEN (2.7V)	ON*	OPEN (2.9V)	LDO or DC590
2	EXT	ON*	X**	LDO
3	EXT	OPEN	X**	DC1880A VL TURRET
4	5V* or 3.3V	OPEN	X**	DC590

* (Default)
** Including OPEN (2.9V)

L+ Power Supply Outputs

Enable the L+ power supply outputs by setting their respective EN_L+ register bits high.

CQ Line Driver Outputs

Enable the CQ line drivers either by input pin (using the TXEN turrets and/or jumpers JP1/3/7/9) or via the SPI interface (by setting DRVEN register bits high). See Table 2.

Table 2. CQ Driver Mode Configuration

JP1/3/7/9 SETTING	TXEN TURRET	DRVEN BIT	CQ DRIVER MODE
GND	X	0	OFF
VL	X	X	ON
X	X	1	ON
EXT	L/H	0	OFF/ON

Control the output CQ states using the TXD turrets and/or jumpers JP2/4/8/10. See Table 3.

Table 3. CQ Driver Output Level Configuration

JP2/4/8/10 SETTING	TXD TURRET	DRVEN BIT	CQ DRIVER MODE*	CQ LEVEL
GND	X	X	OFF	L
GND/VL	X	X	ON	H/L
EXT	L/H	X	ON	H/L
DB9	X	H/L**	ON	H/L

* From Table 2
** RS232 transceiver U2 inverts

Alternatively, operate the CQ drivers solely via the SPI interface by tying TXD low and controlling the DRVEN register bits. This method is suitable for SIO mode and switching at or below COM2 data rates (38.4kb/s).

TVS Protection

The CQ and L+ pins are protected by 36V TVS diodes for cable-driving applications.

Serial Port

A DB9 connector enables CQ data to be sent (for one or more ports) and received (for one port) using PC software such as a serial terminal program. Jumper JP5 enables the required RS-232 transceiver.

Select the desired combination of drivers by setting one or more of JP2/4/8/10 to the DB9 position. Select one CQ receiver using JP6.

L+ Isolation

If L+ isolation is not needed, Schottky diodes D1-D4 may be replaced with 0Ω resistors.

Interrupts

The LTC2874 includes an open-drain interrupt line for signaling the host controller when it needs service. This signal is accessible on the DC1880A board at the $\overline{IRQ}$ test point. An LED is also included for convenience.

ADDITIONAL INFORMATION

Jumpers

JP1/3/7/9: Port 4/3/2/1 CQ Driver Enables. See Table 2. Default position VL.

JP2/4/8/10: Port 4/3/2/1 Data Input to CQ Driver. See Table 3. Default position GND.

JP6: RXDn COM Port Select. Determines which receiver output (RXD1/2/3/4, if any) is connected to the serial port. Default position RXD1.

JP5: COM PORT Enable. Connects RS232 transceiver U2 to VL logic supply. Default position ON.

JP11: VL Select. Programs LDO voltage to 2.9V (OPEN), 3.3V, 5V, or 5.5V. Default position 5V.

JP12: LDO On. Enables LDO which derives VL logic supply from V_{DD} supply voltage input. Default position ON.

JP13: GND Shield. Shorts shields of J5-8 to GND. Default position OPEN.

USING THE DC1880A SOFTWARE

Introduction

Linear Technology's QuikEval software provides a quick and easy way to evaluate most aspects of LTC2874 operation. It operates a SPI interface that reads or writes from the 14 onboard registers via a DC590 serial controller.

Install QuikEval BEFORE connecting the DC1880A to the USB port of the PC. Download and run the installation program from http://www.linear.com/software and follow the onscreen instructions. The LTC2874 GUI will launch automatically when the PC begins communicating with the DC1880A via the serial controller. Thereafter, start the GUI by running QuikEval from:

C:\Program Files\LTC\QuikEval\quikeval.exe

If the QuikEval software was installed previously, update it to the latest version using Tools > Update Program.

The LTC2874 GUI is composed of a main window having three tabs, and a Register Map window. The Ports tab (Figure 2) contains controls and monitors that are unique to each individual port. The Timers and Globals tab (Figure 3) contains controls and monitors that are common to all ports. The Events tab (Figure 4) provides access to event monitoring registers. The Register Map window (Figure 5) provides access to all register bits via an alternate format.

The LTC2874 GUI begins communicating with the DC1880A automatically. Once running, it continuously polls the LTC2874 registers to monitor status.

Connect/Disconnect Button

The Disconnect button disables the SPI interface and most of the GUI. The Connect button restarts SPI polling and activates the complete GUI.

Reset Button

This button issues a SPI Reset command, returning all registers to default values.

Events Tab

This tab contains lamps that map to Event Register bits. A lamp that is on indicates that the corresponding bit in the LTC2874 Event Register has been set. Clicking on a lamp will clear the Event bit if the condition no longer persists. Event Register behavior is sticky, meaning each lamp stays on until cleared.

The check boxes control which events will cause $\overline{IRQ}$ to signal.

Register Map

This window presents all register bits in an alternate format. Change register values directly by clicking on individual bits, using arrow widgets, or by entering numeric values.

Changed bits appear yellow until either committed to the LTC2874 by pressing the Write and Update button, or cleared by pressing the Discard Unwritten Changes button.

The Save Current Values button saves the LTC2874 register values to a text file. The Load Saved Values button loads the register values from one such file into the Register Map window. (Write and Update will then configure LTC2874 accordingly.)

Running QuikEval GUI Using Linduino One

The QuikEval GUI software for DC1880A may be operated using a Linduino One (DC2026) with the DC590 emulator sketch in place of the DC590. When using this USB-isolated Arduino-compatible demonstration board, set the DC1880A LDO to 5V (JP11=5.0V) or disable it (JP12=OPEN).

USING THE DC1880A SOFTWARE

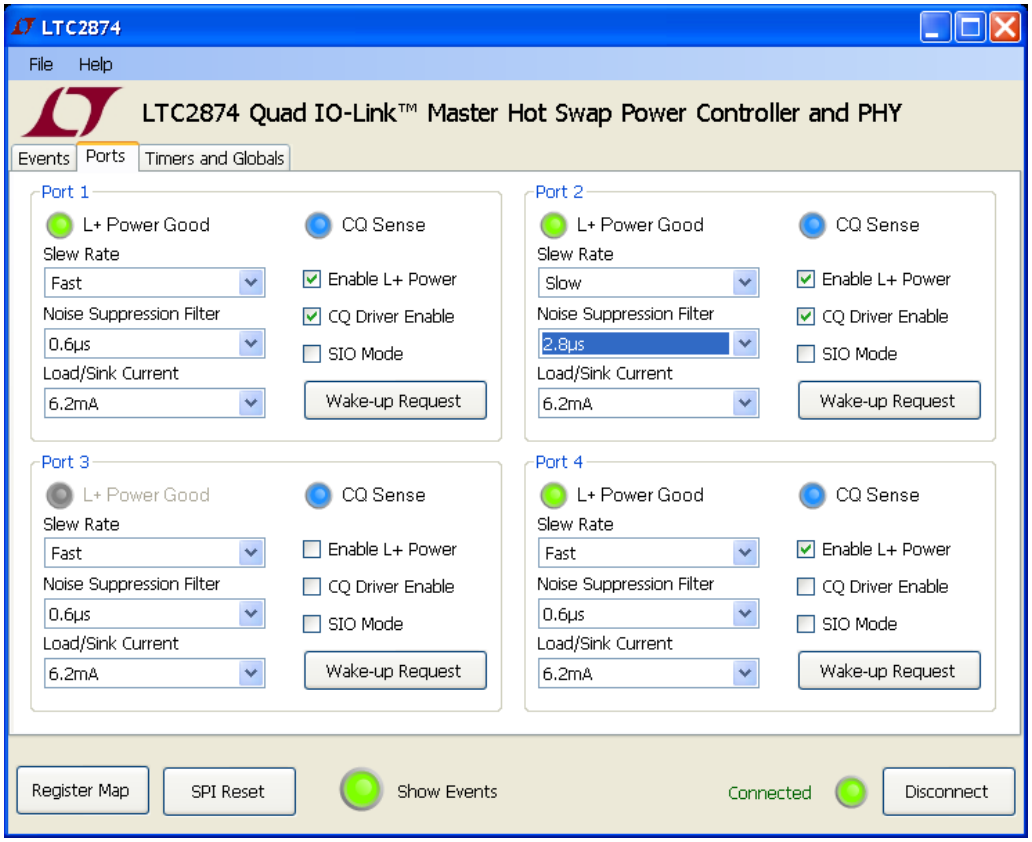


Figure 2. Main Window, Ports Tab

USING THE DC1880A SOFTWARE

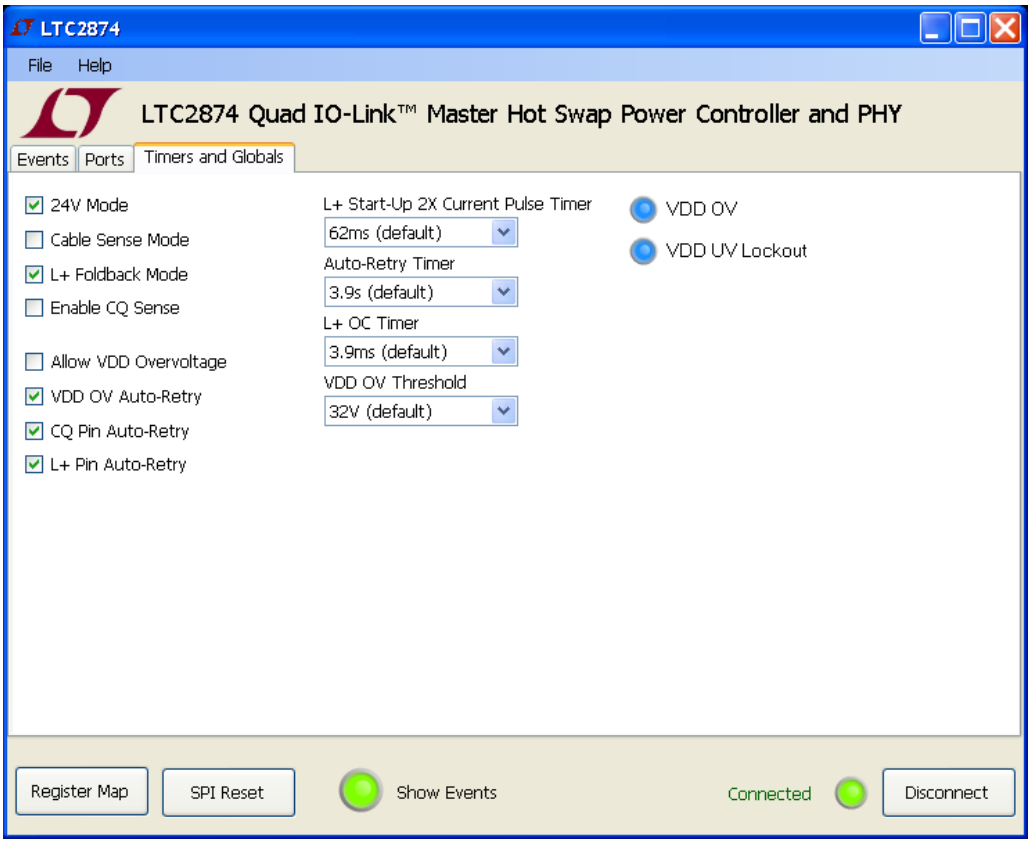


Figure 3. Main Window, Timers and Globals Tab

USING THE DC1880A SOFTWARE

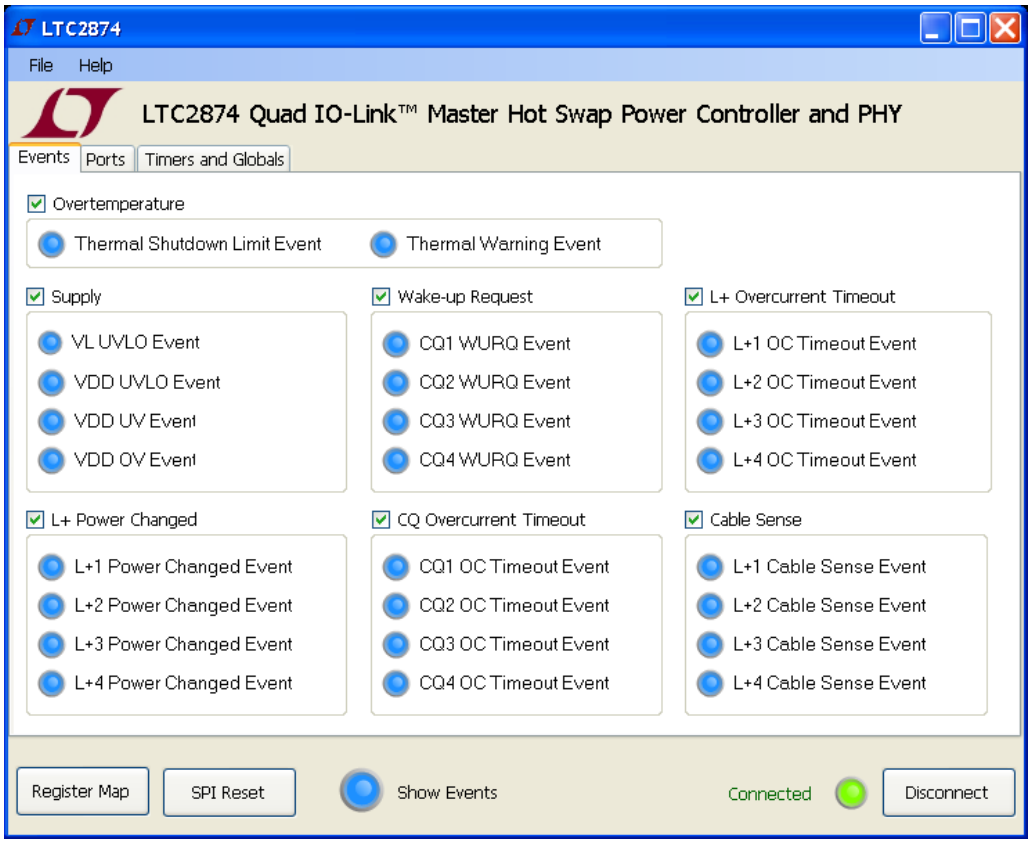


Figure 4. Main Window, Events Tab

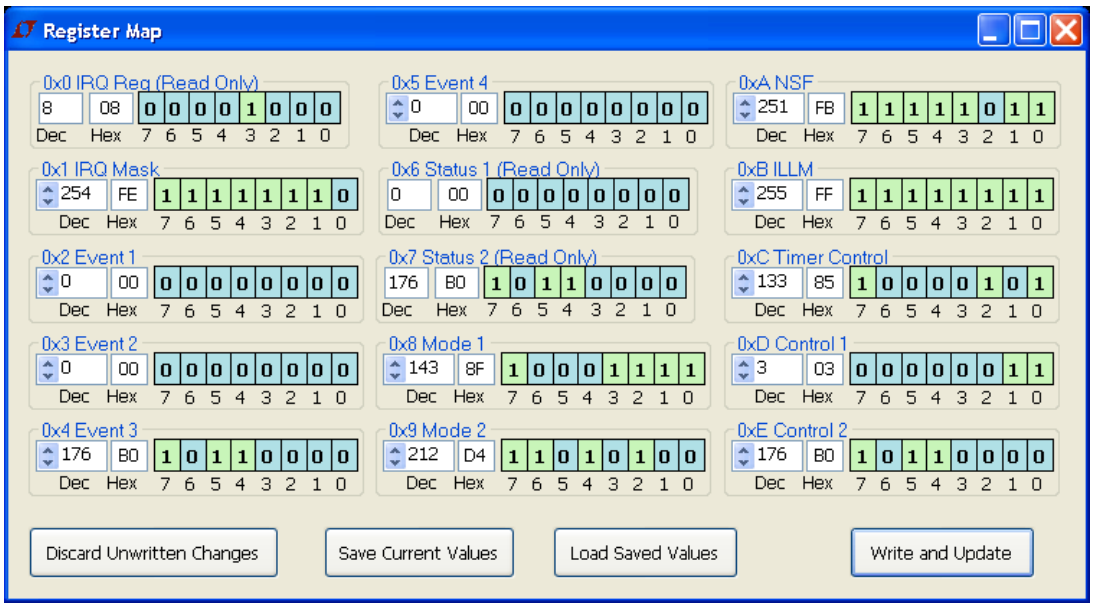


Figure 5. Register Map Window

TROUBLESHOOTING GUIDE

1. **Problem:** LTC2874 program doesn't download and install automatically.

   Solution: Get the latest QuikEval software either by updating QuikEval from its pull-down menu (Tools > Update Program), or by installing the latest version directly from: www.linear.com/software.

2. **Problem:** DC590 controller board not detected. (Error 1)

   Solution: Connect to PC using USB A/B cable.

3. **Problem:** LTC2874 not detected. (Error 2)

   Solution: Ensure that the DC590 ribbon cable is connected and that VL power is applied. See Table 1.

4. **Problem:** Unsuccessful communication with the LTC2874. (Error 5)

   Solution: Check DC590 ribbon and USB connections. Usually, this error indicates that one was disconnected while the program was running.

5. **Problem:** Invalid value read from the LTC2874. (Error 6)

   Solution: Ensure VL supply power is applied correctly. Referring to Table 1, check LDO jumper on the DC1880A and JP6 on the DC590.

6. **Problem:** GUI is gray-colored and inactive.

   Solution: Press Connect button.

PARTS LIST

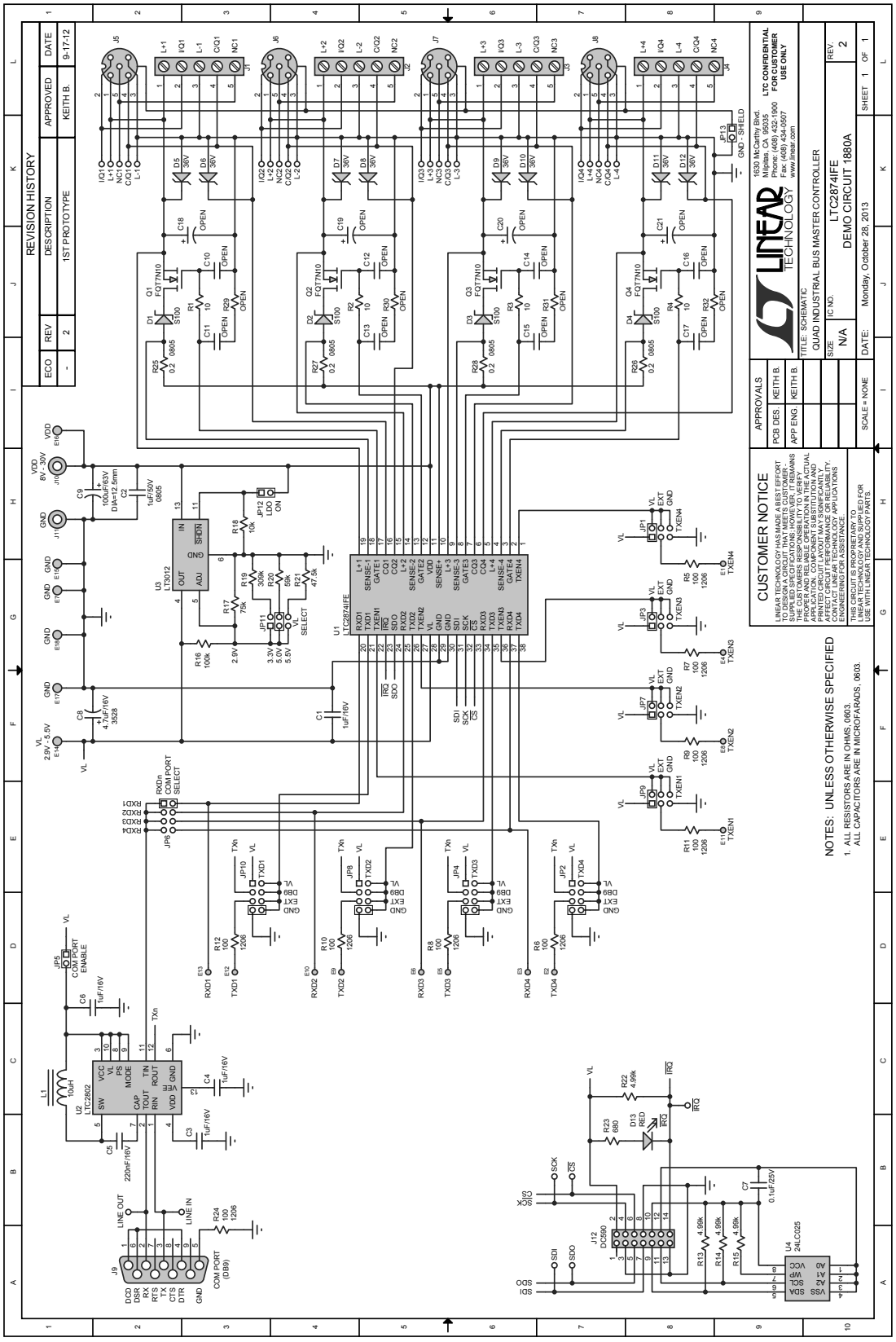
ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	C1	CAP, 1µF 20%, 16V, X7R, 0603	TDK, C1608X7R1C105M
2	1	C2	CAP, 1µF 10%, 50V, X7R, 0805	MURATA, GRM21BR71H105KA12L
3	1	C9	CAP, ALUMINUM, 100µF, 20%, 63V	UCC, EMZA630ADA101MJA0G
4	8	D5-12*	DIODE, TVS, 36V, SMA	STM, SM6T36A
5	4	Q1-4	TRANSISTOR, NFET, SOT-223	FAIRCHILD, FQT7N10TF
6	4	R1-4	RES, 10Ω,1%, 0603	AAC, CR16-10R0FM
7	4	R25-28	RES, 0.2Ω, 1%, 0805	SUSUMO, RL1220S-R20-F
8	1	U1	IC, QUAD IO-LINK MASTER HOT SWAP CONTROLLER AND PHY	LINEAR TECH, LTC2874IFE
Additional Demo Board Circuit Components				
1	3	C3,C4,C6	CAP, 1µF, 20%, 16V X7R, 0603	TDK, C1608X7R1C105M
2	1	C5	CAP, 0.22µF, 10%, 16V X7R, 0603	TDK, C1608X7R1C224K
3	1	C7	CAP, 0.1µF, 10%, 25V X7R, 0603	TDK, C1608X7R1E104K
4	1	C8	CAP, TANTALUM, 4.7µF, 20%, 7343 50V	AVX, TAJD475K050R
5	0	C10-21	OPTIONAL	
6	4	D1-4**	DIODE, SCHOTTKY, 1A, 100V	FAIRCHILD, S100
7	1	D13	LED, RED	PANASONIC, LN1251C
8	1	L1	INDUCTOR, 10µH, 0.5Ω, 0.3A, 0806	TAIYO-YUDEN, CBC2016T100M
9	9	R5-12, R24	RES, 100, 5%, 1206	AAC, CR18-101JM
10	1	R22	RES, 4.99k, 1%, 0603	AAC, CR16-4991FM
11	3	R13-15	RES, 4.99k, 1%, 0603	AAC, CR16-4991FM
12	1	R16	RES, 100k, 1%, 0603	AAC, CR16-1003FM
13	1	R17	RES, 75k, 1%, 0603	VISHAY, CRCW060375K0FKEA
14	1	R18	RES, 10k, 1%, 0603	AAC, CR16-1002FM
15	1	R19	RES, 309k, 1%, 0603	VISHAY, CRCW0603309KFKEA
16	1	R20	RES, 59k, 1%, 0603	AAC, CR16-5902FM
17	1	R21	RES, 47.5k, 1%, 0603	AAC, CR16-4752FM
18	1	R23	RES, 680, 1%, 0603	AAC, CR16-681FM
19	0	R29-32	OPTIONAL	
20	1	U2	IC, RS232 TRANSCEIVER	LINEAR TECH, LTC2802CDE
21	1	U3	IC, LDO	LINEAR TECH, LT3012EFE
22	1	U4	IC, SERIAL EEPROM 2k	MICROCHIP, 24LC025-I/ST
Hardware for Demo Board Only				
1	12	E1-6, E8-13	TURRET	MILL-MAX, 2308-2-00-80-00-00-07-0
2	6	E7, E14-18	TURRET	MILL-MAX, 2501-2-00-80-00-00-07-0
3	4	J1-4	TERMINAL BLOCK, 5 POSITION, 3.5mm, HEADER	WÜRTH, 691321100005
4	4	J1-4	TERMINAL BLOCK, 5 POSITION, 3.5mm, PLUG	WÜRTH, 691361100005
5	1	J5	JACK, M12, 5 POSITION, FEMALE, STRAIGHT	BINDER, 09-3442-500-05
6	0	J6-8	OPTIONAL	
7	1	J9	CONNECTOR, DSUB, 9 PIN FEMALE	SIGNATRON, DR-E9SB-NJ-001

* TVS diodes are recommended for cable-driving applications.
** Substitute 0Ω resistors if diodes not desired.

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
8	2	J10-11	JACK, BANANA	KEYSTONE, 575-4
9	1	J12	HEADER, 2×7 2mm	MOLEX, 87831-1420
10	5	JP1, JP3, JP7, JP9, JP11	HEADER, 2×3 2mm	SAMTEC, TMM-103-02-L-D
11	5	JP2, JP4, JP6, JP8, JP10	HEADER, 2×4 2mm	SAMTEC, TMM-104-02-L-D
12	2	JP5, JP12	HEADER, 1×2 2mm	SAMTEC, TMM-102-02-L-S
13	12	JP1-12	SHUNT, 2mm	SAMTEC, 2SN-BK-G
14	1	JP13	HEADER, 1×2 0.1"	SAMTEC, TSW-101-07-G-D
15	1	JP13	SHUNT, 0.1"	SAMTEC, SNT-100-BK-G
16	4		STANDOFF, SNAP-ON	KEYSTONE, 8833

SCHEMATIC DIAGRAM



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This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact a LTC application engineer.

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