

Programmable Hex Voltage Supervisor Featuring the LTC2936 with EEPROM

DESCRIPTION

The DC1605B is a demonstration system that showcases the LTC[®]2936, a 6-channel I²C/SMBus voltage supervisor with EEPROM. The LTC2936 simultaneously monitors up to six power supply voltages and detects undervoltage and overvoltage conditions. In addition the LTC2936 monitors two GPI pins and is able to drive three GPIO pins to indicate OV, UV, system reset, system alert, or other control signal.

The DC1605B is a single circuit board that contains the LTC2936 and support circuitry to provide the ability to demonstrate features and capabilities of the LTC2936 without the need for external power supplies. The DC1605B demo board provides an accurate voltage supervision of six channels and offers over/undervoltage thresholds in various ranges and increments that are digitally programmable.

This demonstration system is supported by the LTpowerPlay™ graphical user interface (GUI) which enables complete control of all the features of the device. Together, the LTpowerPlay software and DC1605B hardware system create a powerful development environment for designing and testing configuration settings of the LTC2936. These settings can be stored in the device's internal EEPROM or in a file. This file can later be used to order pre-programmed devices or to program devices in a production environment. The software displays all of the configuration settings and real time measurements from the system supervisor and peripheral ICs. Telemetry allows easy access and decoding of the fault log created by the LTC2936. The board comes pre-programmed with the EEPROM values appropriate for the six power supply rails on the DC1605B. Just plug and play!

The LTC2936 chip is mounted on the topside of the board with support ADC and DAC circuitry on the back.

The ADC provides voltage readings for all six voltage supervisor inputs on the LTC2936 and also reads the GPI and GPIO voltages. The DAC drives six programmable voltages that are used to emulate the user's system rails. The extra support circuitry allows the user to evaluate

the LTC2936 quickly and without the need for external voltmeters or power supplies.

The DC1605B demo board can be powered by an external power supply, such as a 12VDC supply. Communication with the software is provided through the DC1613 USB-to-I²C/SMBus/PMBus Controller. The following is a checklist of items which can be obtained from the LTC website or LTC Field Sales.

- USB-to-I²C/SMBus/PMBus Controller (DC1613)
- LTpowerPlay Software

DC1605B Features

- Supervise Six Power Supplies
- Powered from USB Dongle, Power Jack, or V_{IN}
- I²C Adjustable OV/UV Trip Points
- Guaranteed Threshold Accuracy: ±1%
- I²C/SMBus Serial Interface
- Internal EEPROM
- Six Comparator Outputs
- 256 Programmable Thresholds per Channel
- Up to Three Range Settings per Channel
- Two General Purpose Inputs
- Three General Purpose Inputs/Outputs
- Programmable Output Delays
- Autonomous Operation without Additional Software
- Supported by LTpowerPlay GUI
- LTC2936 Available in 24-Lead QFN and SSOP Packages

Design files for this circuit board are available at
<http://www.linear.com/demo/DC1605B>

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PERFORMANCE SUMMARY Specifications are valid over the full operating temperature range.

Common Characteristics

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Input Voltage Range	V_{PWR}	3.4		13.9	V
	$V_{PWR} = V_{DD33}$	3.2		3.4	V
V1 to V6 Threshold Accuracy				±1.0	%
V1 to V6 Monitoring Range	Precision Range	0.2		1.2	V
	Low Range	0.5		3.0	V
	Medium Range	1.0		5.8	V

Table 1. Default Thresholds and GPIO Mappings

	$V_{n_THR_LO}$	$V_{n_THR_HI}$	GPIO1	GPIO2	GPIO3	CMP
	Default Thresholds		\overline{OV}	\overline{ALERT}	\overline{UV}	
V1	3.2	3.4	Comp_Hi	Comp_Hi	Comp_Lo	Comp_Lo
V2	2.4V	2.6V	Comp_Hi	Comp_Hi	Comp_Lo	Comp_Lo
V3	1.7V	1.9V	Comp_Hi	Comp_Hi	Comp_Lo	Comp_Lo
V4	1.4V	1.6V	Comp_Hi	Comp_Hi	Comp_Lo	Comp_Lo
V5	1.1V	1.3V	Comp_Hi	Comp_Hi	Comp_Lo	Comp_Lo
V6	0.95V	1.05V	Comp_Hi	Comp_Hi	Comp_Lo	Comp_Lo

Table 2. Default GPI Settings

	MANUAL RESET	MARGIN	UVDISABLE	AUX COMP
GPI1	✓			
GPI2		✓		

GLOSSARY OF TERMS

The following list contains terms used throughout the document.

AUXC – Auxiliary Comparator. A GPI pin may be programmed to this function and map behavior to a GPIO pin. Nominal $V_{TH} = 0.5V$.

EEPROM – Non-volatile memory (NVM) storage used to retain data after power is removed.

Margin – Term used typically in board level testing that increases/decreases the output voltage to look for sensitivity/marginality problems.

MARG – Ignore margining (OV and UV) when active (low). A GPI pin may be programmed to this function and map behavior to a GPIO pin. Nominal $V_{TH} = 1.0V$.

\overline{MR} – Manual Reset, Active Low. A GPI pin may be programmed to this function and map behavior to a GPIO pin, and optionally clear the fault history. Nominal $V_{TH} = 1.0V$.

NVM – Non-volatile memory, see EEPROM.

OV – Overvoltage, the result of a voltage comparison that a pin voltage is above a programmable threshold voltage.

Rail – The final output voltage that the LTC2936 supervises.

Supervise – The act of quickly responding (compared to a fault setting) to a voltage condition that is compared to pre-programmed values.

UV – Undervoltage, the result of a voltage comparison that a pin voltage is below a programmable threshold voltage.

UVDIS – UV Disable. Ignore UVs when the pin is low. A GPI pin may be programmed to this function and map behavior to a GPIO pin. Nominal $V_{TH} = 1.0V$.

THEORY OF OPERATION

GENERAL DESCRIPTION

The LTC2936 is a hex voltage supervisor which detects an overvoltage or undervoltage and signals the system of a fault condition. The chip has a dedicated power supply pin, V_{PWR} , and has an internal 3.3V regulator. The chip may be powered either by powering V_{PWR} with the on-board 5V supply, with an external 3.4V to 13.9V supply, or with an external 3.3V supply by tying V_{PWR} and V_{DD33} pins together.

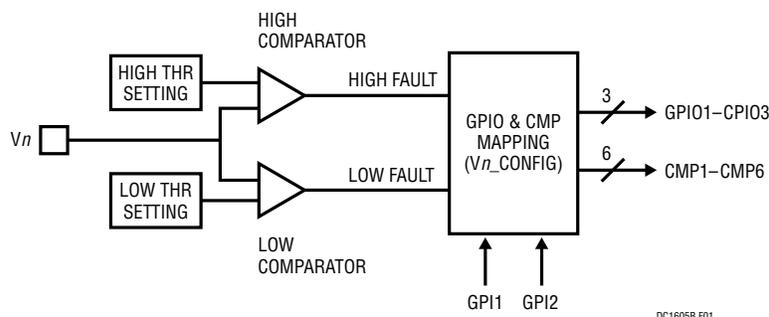
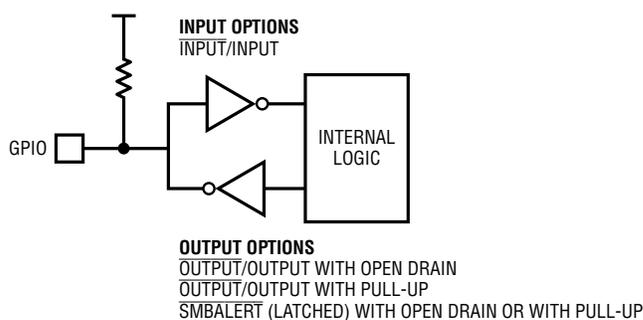
THE CHIP

The LTC2936 integrates six voltage supervisors with associated comparator outputs, two GPIs, and three GPIOs. The V1-V6 supervisors are comprised of OV/UV window comparators that can be programmed to map the detection of a fault to one or more GPIO pin.

In LTpowerPlay, the user programs each voltage supervisor's range, polarity, mapping, and high and low threshold voltages.

Each channel's high/low comparators may be mapped to any GPIO pin, and any comparator may be mapped to multiple GPIO pins. Typically the high comparator is used for the overvoltage condition and the low comparator is used for the undervoltage condition. The high comparator is not dedicated as the OV detection nor is the low comparator dedicated for UV detection. For example, both comparators may be configured as OV with the Vn_THR_HI set to indicate an OV Fault and the Vn_THR_LO set for an OV Warning.

V1	
V1_CONFIG	(0xA99C) Medium Range, HI is OV (M...
Comparator Range	
range	<input type="radio"/> (2'b 00) High Range (2.5 to 15V) <input checked="" type="radio"/> (2'b 01) Medium Range (1 to 6V)
High Comparator Configuration	
high_comp_polarity	<input type="radio"/> (1'b 0) HI comp is UV <input checked="" type="radio"/> (1'b 1) HI comp is OV
high_comp_map	<input checked="" type="checkbox"/> HI comp -> GPIO1 <input checked="" type="checkbox"/> HI comp -> GPIO2 <input type="checkbox"/> HI comp -> GPIO3
Low Comparator Configuration	
low_comp_polarity	<input checked="" type="radio"/> (1'b 0) LO Comp is UV <input type="radio"/> (1'b 1) LO Comp is OV
low_comp_map	<input type="checkbox"/> LO comp -> GPIO1 <input type="checkbox"/> LO comp -> GPIO2 <input checked="" type="checkbox"/> LO comp -> GPIO3
V1_THR	(0xE6B4) Hi=5,50V, Low=4,50V
High Comparator	
HighThresholdVoltage	5,5
Low Comparator	
LowThresholdVoltage	4,5
Threshold Resolution	
Threshold LSB size	20mV/LSB (depends on Range in VX...



DC1605B F01

Figure 1. Simplified Block Diagram of Voltage Supervisor Input

THEORY OF OPERATION

One LTC2637 (DAC) =



The multichannel DAC emulates a 6-channel programmable power supply that is used to place “rail” voltages at levels that replicate the user’s system rails. This avoids the need for the user to wire actual supply rails to the demo board, however the board was designed to allow this use case. The DAC output range is 0V to 4V. This is sufficient for demo purposes. Simply place the V1-V6 jumpers to “INT” for internal DAC use, and ensure the LTC2936 is powered by setting JP9 appropriately.

POWERING THE BOARD

The DC1605B board can be powered from the DC1613 USB’s 5V power or from a wall-powered 12V supply (jack). The LTC2936 hex supervisor can be powered in a number of different ways. The chip itself is powered from the on-board 5V supply or an external supply. There is a table silk-screened onto the board as a reminder. If the USB power or jack power is present, the +5V LED will illuminate. The LTC2936 can then be powered by setting the jumper to “INT.” Alternatively set the jumper to “EXT” to connect an external power supply voltage to the V_{PWR} turret. With JP9 set to “EXT,” apply an external 3.3V supply. If the jumper is removed, apply an external voltage in the range 3.4V to 13.9V. The board comes pre-configured with jumpers JP1-JP6 set to the INTERNAL position which allows the on-board 5V LDO regulator to power all circuits.

NOTE: Turrets V1-V6 are tied directly to the LTC2936 independent of the jumper settings.

The DC1605B uses a multiplexed ADC that is used to provide voltage readback values. The telemetry plot in the GUI is similar to a multichannel oscilloscope which is capable of displaying any parameter that is displayed in the telemetry window. Due to the nature of a multiplexed ADC converter, it has an associated ADC loop time. The total ADC loop time is ~400ms for a given channel. You

may notice some lag in the update rate of the displayed voltages.

SELECTING A DEVICE ADDRESS

The DC1605B has jumpers (JP7, JP8) labeled ASEL0 and ASEL1 which allow the user to select one of nine I²C addresses. See Table 3.

Table 3. Address Selection of LTC2936

I ² C ADDRESS (7-BIT)	ASEL1 POSITION	ASEL0 POSITION	DEFAULT
0x50	L	L	•
0x51	L	Z	
0x52	L	H	
0x53	Z	L	
0x54	Z	Z	
0x55	Z	H	
0x58	H	L	
0x59	H	Z	
0x5A	H	H	

Regardless of the jumper setting, the part will always respond to the I²C global 7-bit addresses 0x0C and 0x73.

STATUS_WORD REGISTER

The STATUS_WORD register is a read-only register that provides a summary of fault status on all six HI and LO comparator outputs, and are determined by the comparator threshold/configuration settings and V_n voltages. Faults may be disabled by setting GPI pins to MARG or UVDIS.

RESTORING RAM AND GUI FROM LTC2936

To restore the operating memory (RAM) from the LTC2936 EEPROM contents, click the “R” NVM-to-RAM icon in the toolbar. To read the RAM registers into the GUI, click the “R” RAM-to-PC icon in the toolbar.

DC1605B LEDs

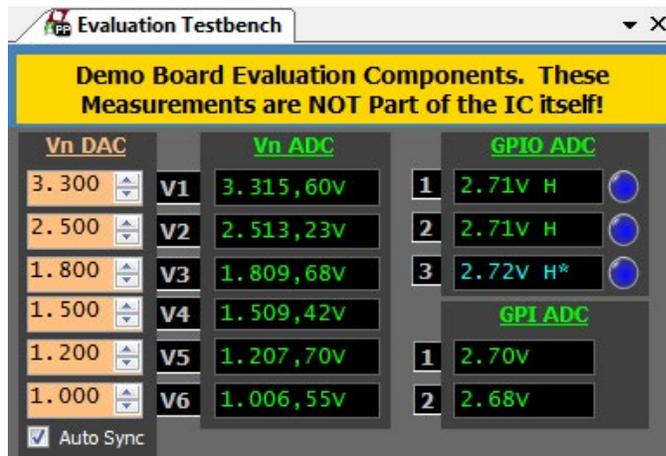
The DC1605B board has two green LEDs. When USB power (DC1613 Controller) or external power (6V to 14V jack) is applied, the +5V green LED will illuminate. The +5V supply provides power to the support circuitry, not necessarily to the LTC2936. Jumper JP9 determines how the LTC2936

THEORY OF OPERATION

is powered. The default setting of jumper JP9 is set to internal 5V and the 3.3V OUT LED will illuminate, indicating the LTC2936 is powered. If this LED is not illuminated, the LTC2936 is not in a functioning state, the I²C bus will not communicate with the GUI, and the LTC2936 will be grayed out in the system tree.

DC1605B ToolWindow and GUI Indicators

The ToolWindow displays the ADC readings on the left and DAC voltage settings on the right. The blue/red indicators next to the GPIs and GPIOs display the state (H vs. L) and voltage reading from the ADC (LT2499). Blue indicates a logic high and red indicates a logic low. The ToolWindow is automatically populated when LTpowerPlay detects the DC1605B demo board when it starts. Note that when you save a project, the DAC settings are saved in the project file.



LTpowerPlay GUI SOFTWARE

LTpowerPlay is a powerful Windows-based development environment that supports Linear Technology power system management ICs with EEPROM, including the LTC2936 6-channel voltage supervisor. The software supports a variety of different tasks. You can use LTpowerPlay to evaluate Linear Technology ICs by connecting to a demo board system. LTpowerPlay can also be used in an offline mode (with no hardware present) in order to build a multi-chip configuration file that can be saved and re-loaded at a later time. LTpowerPlay provides unprecedented system level diagnostic and debug features. It becomes a valuable diagnostic tool during board bring-up to program or tweak the power management scheme in

a system or to diagnose power issues when bringing up rails. LTpowerPlay utilizes the DC1613 I²C/SMBus/PMBus controller to communicate with one of many potential targets, including the DC1605B demo system or a customer board. The software also provides an automatic update feature to keep the software current with the latest set of device drivers and documentation. The LTpowerPlay software can be downloaded from:

<http://www.linear.com/ltpowerplay>

To access technical support documents for LTC power system management products visit “Help, View Online Help” on the LTpowerPlay menu.

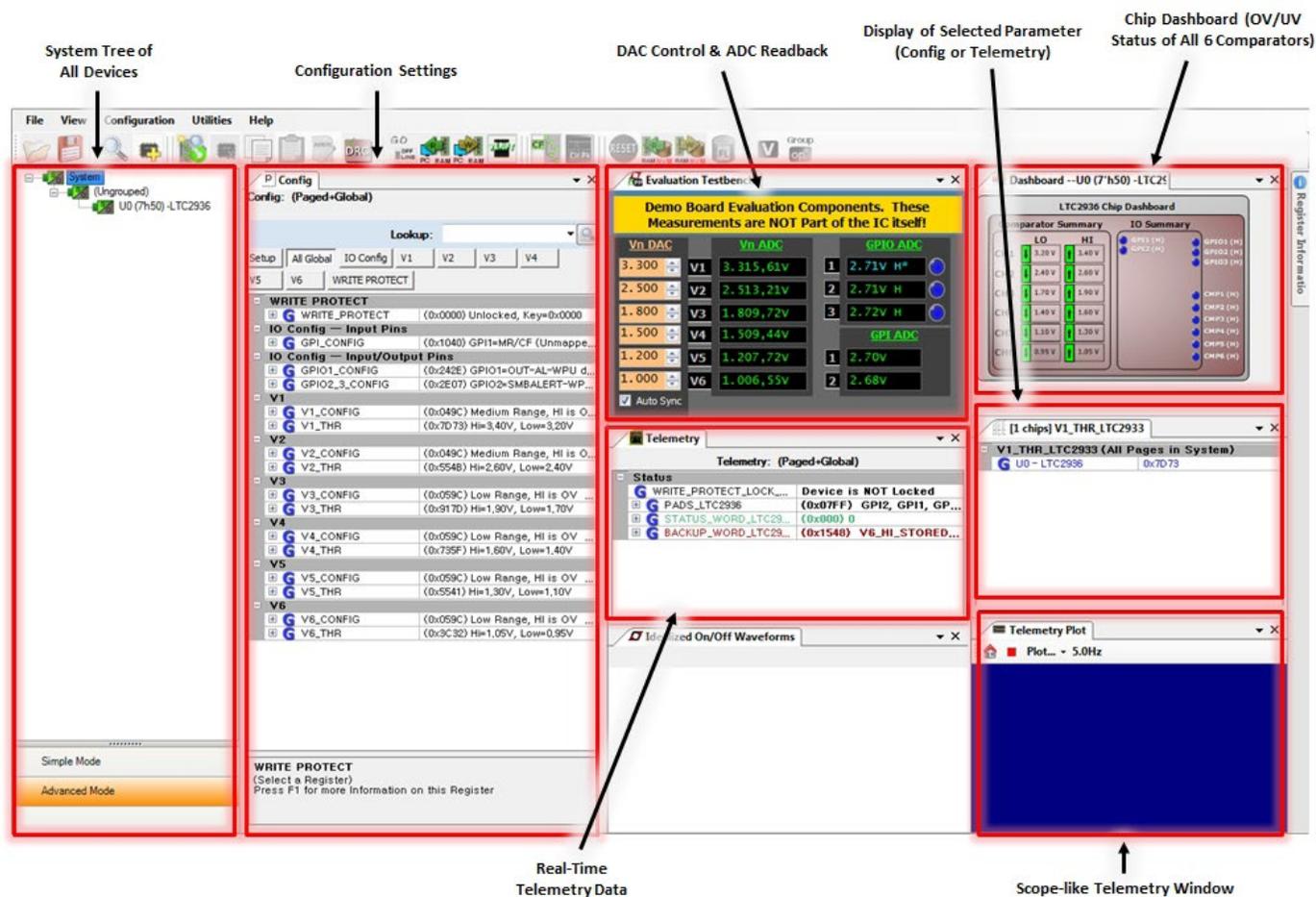


Figure 3. Screenshot of the LTpowerPlay GUI

DEMO MANUAL DC1605B

QUICK START PROCEDURE

The following procedure describes how to set up a DC1605B demo system.

1. Download and install the LTpowerPlay GUI: www.linear.com/ltpowerplay
2. Remove the board from the ESD protective bag and place it on a level surface. Connect the DC1613 I²C/SMBus/PMBus controller to the DC1605B board using the 12-pin ribbon cable.
3. Plug the USB-to-I²C/SMBus/PMBus Controller into a USB port on your PC. The board should power up with +5V and +3.3V_{OUT} LEDs illuminated green. The GPIO and CMP LEDs will illuminate blue.

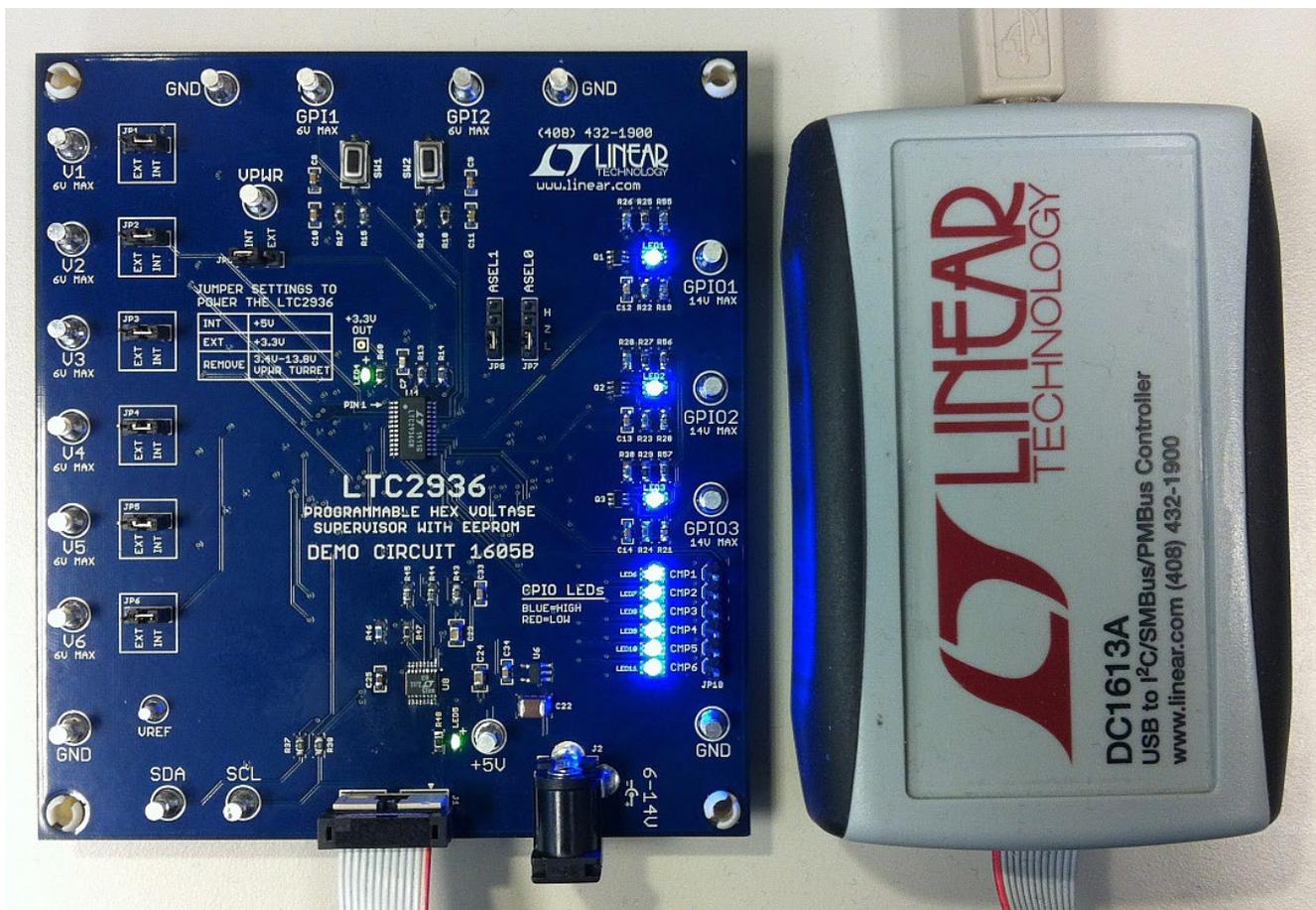


Figure 4. Connecting DC1605B Board and the DC1613 USB to I²C/SMBus/PMBus Controller

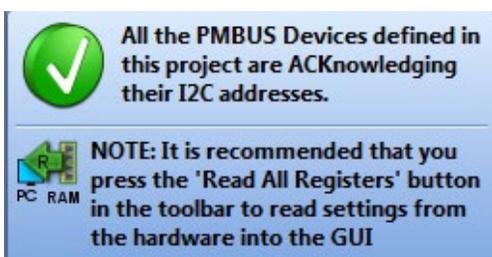
QUICK START PROCEDURE

4. Launch the LTpowerPlay GUI.

- a. The GUI automatically identifies the DC1605B and builds a system tree for each I²C device. The system tree on the left hand side will look like this:



- b. A green message box will be displayed momentarily in the lower left hand corner confirming that the DC1605B is communicating. The board at this point is fully operational.

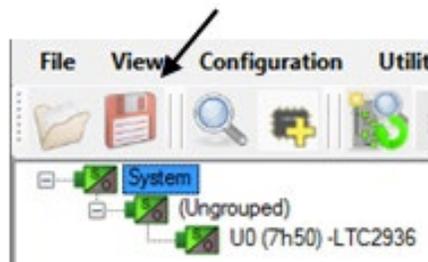


5. Load the Demo Configuration.

In the upper left hand corner of the GUI, select File > Initialize DC1605B Demo > Demo Config (or Factory Defaults). This will load the configuration settings into the working RAM of the LTC2936, set the DAC outputs, clear the status registers, and store the settings into NVM (EEPROM). The 'Demo Config' file is the starting point for the use cases. The 'Factory Defaults' file sets the V_n thresholds that accommodate the initial powerup state of the DAC outputs (2.048V).

SAVING A CONFIGURATION

You can make changes to the LTC2936 register values and DAC settings. Save the demo board configuration to a (*.proj) file by clicking the "Save" icon. This creates a backup file. Name it whatever you like. Note that the DAC settings are saved in the project file.



QUICK START VIDEO

There is a Quick Start Video that covers the basic features of the LTC2936 chip and DC1605B demo board. The video can be accessed via LTpowerPlay by navigating to the Help menu > DC1605B Content.

LOADING A DC1605B CONFIGURATION (*.proj) FILE WITH THE GUI

1. In the upper left hand corner of the GUI, File > Open > browse to your *.proj file. This will load the file into the GUI.
2. Click on the "Go Online" icon, then click on the "PC → RAM" icon to write all registers. This loads the configuration into the working RAM of the LTC2936. The DAC settings are stored and retrieved from the .proj file.
3. To store the configuration to NVM (EEPROM), click on the "RAM → NVM" icon

DEMO BOARD USE CASES

USE CASE #1

A common configuration for the LTC2936 dedicates the V1 pin to the highest supply in the system and uses V2-V6 to monitor other voltages. The V1 pin provides power to the chip and also is used to detect an OV or UV on the V1 pin. For simplicity, the USB controller (DC1613) powers the board and the LTC2936 is powered via the V1 pin with the jumper set to INT 5V.

Each of the high comparator fault outputs is mapped to GPIO1, indicating an active-low OV fault. Each of the low comparator fault outputs are mapped to GPIO3, indicating an active-low UV fault. These OV and UV conditions are indicated in multiple places—LEDs next to the GPIO turrets and also in the GUI. The GPIO2 pin has been mapped as an active-low latched OV indicator. The latched ALERT is cleared by pressing the GPI1 pushbutton. The GPIO pins have a red-blue LED which is red when low and blue when high.

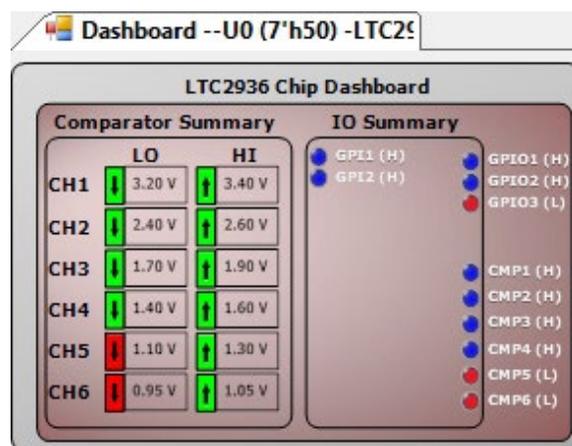
The two GPI inputs are used to detect a manual reset (MR) and margin disable (MARG) and activated when the pushbutton switches are depressed.

- GPIO1 → OV fault
- GPIO2 → ALERT (latched)
- GPIO3 → UV fault
- GPI1 → MR (manual reset)
- GPI2 → MARG (ignore OV/UV when margining)

Let's margin V5 and V6 low by typing a value of 1V and 0.9V into the respective DAC control boxes. You may also move the DAC output by clicking the up/down arrows on the individual DAC box or by double-clicking the DAC value and entering a new value in the box. V5 and V6 will report a UV, turning the LED on GPIO3 red. The dashboard in the GUI indicates the V5 and V6 voltages are below the LO thresholds of 0.95V and 1.1V. Also notice in the Telemetry window a STATUS_WORD register, expand it. This register is a live indicator of LO or HI fault conditions. Note the state of LO_FAULT bits when the margin low button is selected. We can demonstrate the effect of the GPI2 pushbutton at this point. The GPI2 pin has been programmed to function as MARG, enabling the LTC2936 to ignore all UV condi-

Vn DAC		Vn ADC
3.300	V1	3.315,60V
2.500	V2	2.513,23V
1.800	V3	1.809,68V
1.500	V4	1.509,42V
1.200	V5	1.207,70V
1.000	V6	1.006,55V

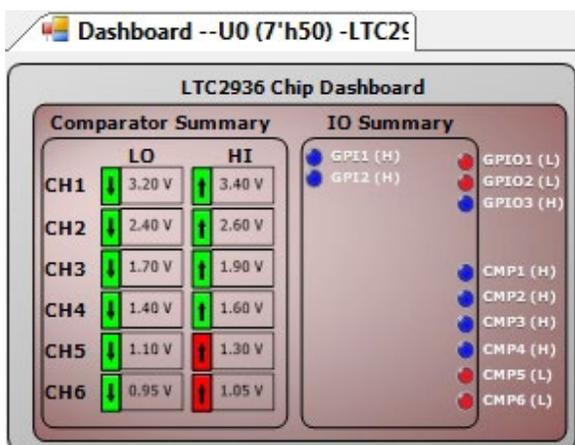
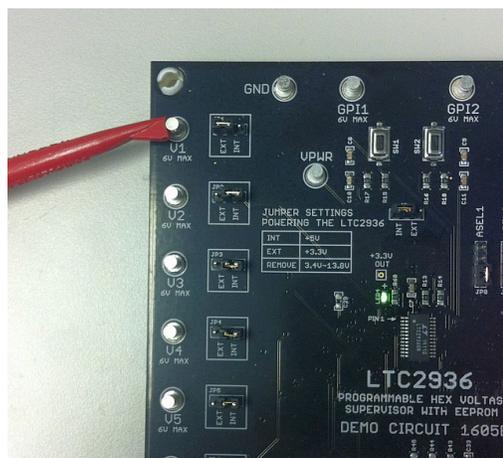
tions. Notice that when the pushbutton is depressed, GPIO3 returns high (blue). This is useful when the system does not want to be informed of a UV condition during margin low testing. Moving the DAC voltages back to 1.2V and 1V returns GPIO3 to a high state (blue), indicating there is no UV condition.



Status	
WRITE_PROTECT_LOCK_S...	Device is NOT Locked
STATUS_WORD_LTC2933	(0xA00) V6_LO_FAULT
V6_HI_FAULT	<input type="checkbox"/> 0x0
V6_LO_FAULT	<input checked="" type="checkbox"/> 0x1
V5_HI_FAULT	<input type="checkbox"/> 0x0
V5_LO_FAULT	<input checked="" type="checkbox"/> 0x1
V4_HI_FAULT	<input type="checkbox"/> 0x0
V4_LO_FAULT	<input type="checkbox"/> 0x0
V3_HI_FAULT	<input type="checkbox"/> 0x0
V3_LO_FAULT	<input type="checkbox"/> 0x0
V2_HI_FAULT	<input type="checkbox"/> 0x0
V2_LO_FAULT	<input type="checkbox"/> 0x0

DEMO BOARD USE CASES

Let's margin V5 and V6 high by typing a value of 1.4V and 1.1V into the respective DAC control boxes. V5 and V6 will report an OV in the GUI and on the demo board. Both GPIO1 and GPIO2 LEDs will turn red and the dashboard indicates an OV condition and a latched ALERT. Note the state of HI_FAULT bits in the STATUS_WORD register. When the GPI2 button is pushed, the GPIO1 (OV) LED is returned to blue and the STATUS_WORD reflects the MARG pin as well, clearing the HI_FAULT bits. We can now change the DACs back to 1.2V and 1.0V. The OV condition is no longer present, however ALERT (GPIO2) remains latched low. Since the GPI1 pin is defined as a Manual Reset, pressing this button clears the latched ALERT, turning GPIO2 LED blue which indicates a de-asserted high state.



USE CASE #2

The DC1605B demo board can be configured to supervise external supply voltages. Inputs V1-V6 may be used for this purpose. Simply move the jumper from INT to EXT which disconnects the backside DAC, allowing an external voltage to be applied to the LTC2936. Please ensure the maximum ratings on the turrets are not exceeded, most of which are 6V.

Apply an external supply voltage to the turret. A sensor or other moderate source impedance voltage may be supervised on the V_n inputs. A battery voltage may be supervised since the LTC2936 supply current is $< 700\mu\text{A}$.

For example, a +5V external supply may be connected to turret V1. Notice the GPIO1 and GPIO2 LEDs turn red, indicating OV and ALERT are asserted low. The V2 thresholds need to be changed. Enter 5.5V and 4.5V for the HI and LO threshold settings. The GPIO1 will return high and the LED will change to blue but the GPIO2 remains low (red) since it indicates a latched ALERT. Press the MR pushbutton on GPI1 to release GPIO2 back high (LED blue).

V1_THR	(0xE6B4) Hi=5.50V, Low=4.50V
High Comparator	
Vn_THR_HI	5.5
Low Comparator	
Vn_THR_LO	4.5
Threshold Resolution	
Threshold LSB size	20mV/LSB (depends on Rang...

The GPI inputs may also be used to monitor external voltages. These pins can be configured as an auxiliary pins (AUXC). In this mode, the GPI pin voltage is compared to an internal 0.5V reference. Typically an external voltage divider is provided to obtain the appropriate trip point for the external voltage. The GPI comparators can be mapped to one of the GPIOs to alert the system of an overvoltage or undervoltage condition.

DEMO BOARD USE CASES

USE CASE #3

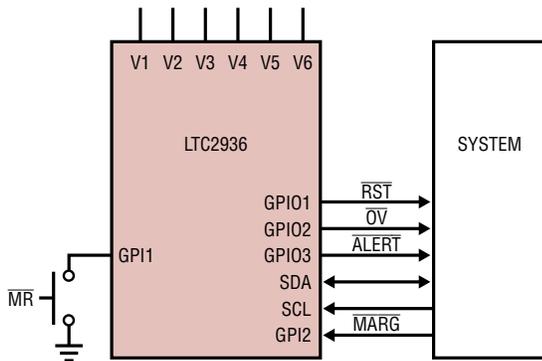
Another common configuration is one that uses a GPIO pin to drive a system reset. The LTC2936 data sheet shows this feature throughout. The other two GPIOs are configured as previously shown, OV and ALERT. Additionally a manual reset pushbutton (GPI1) asserts the system reset.

GPI01 → RST (system reset)

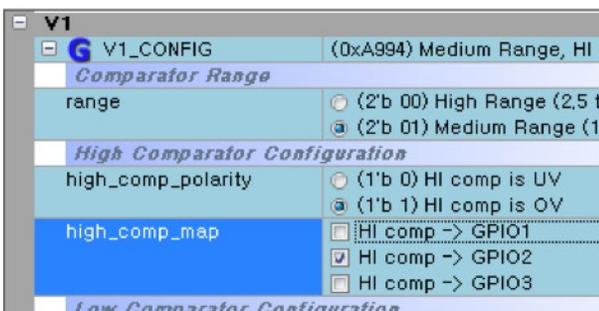
GPI02 → OV

GPI03 → ALERT

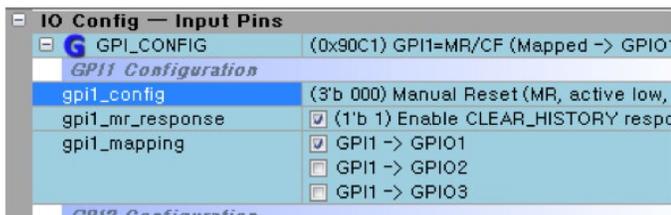
GPI1 → MR pushbutton



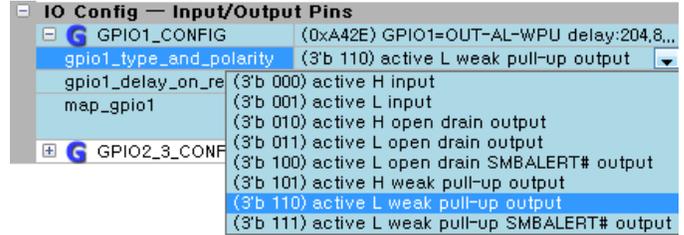
1. To program GPIO1 to system reset function, first uncheck the hi_comp mapping of all V1-V6 channels to GPIO1.



2. Configure GPI1 as a Manual Reset. Map GPI1 to GPIO1.



3. Configure GPIO1 as active-low with weak pull-up. To update the changes made in steps 1-3, click the Write All Registers (PC → RAM) icon.

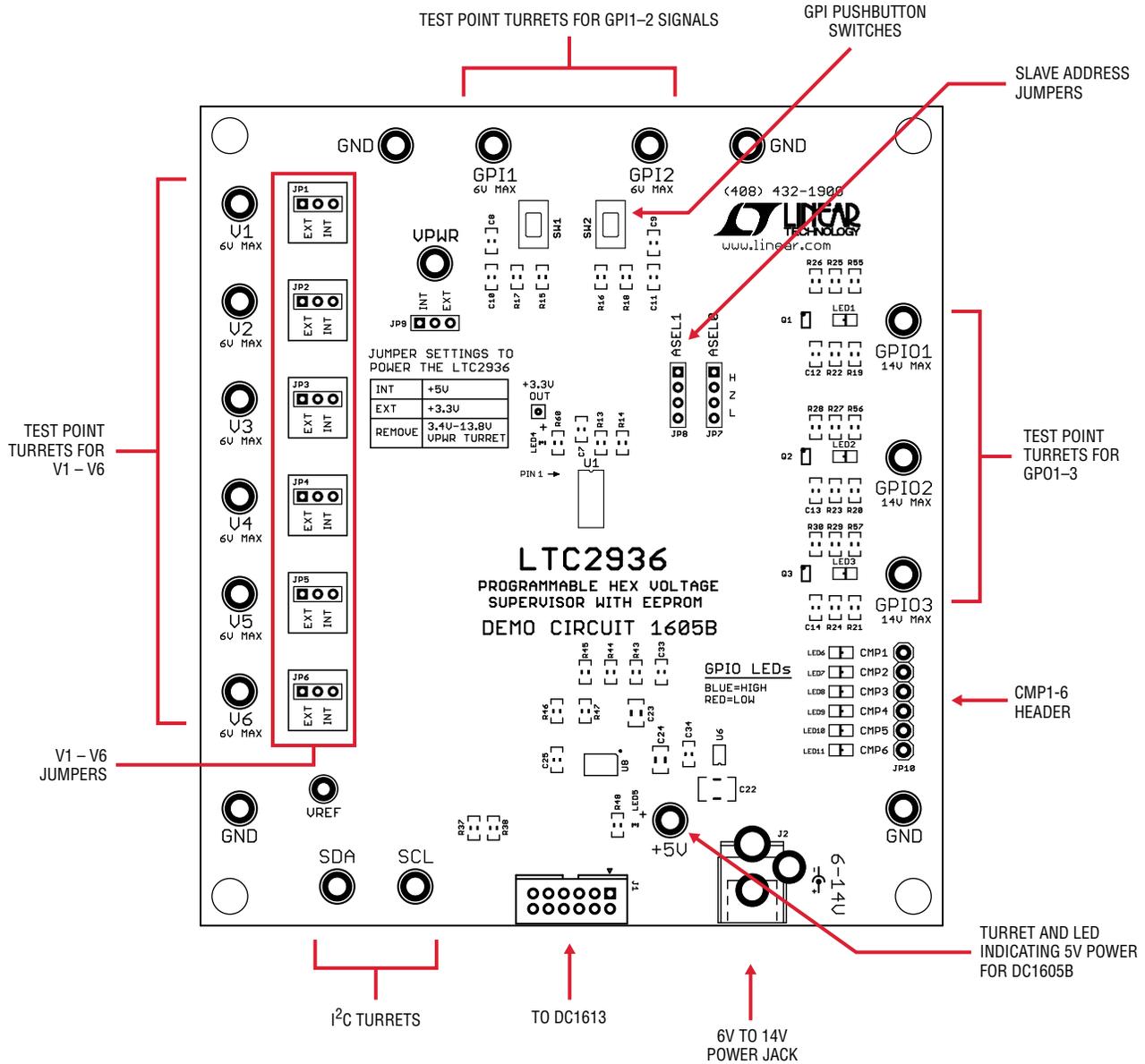


4. You can optionally extend the low time of the system reset by changing the delay-on-release setting to ensure a clean release of reset. This provides a time-based debounce of the switch.

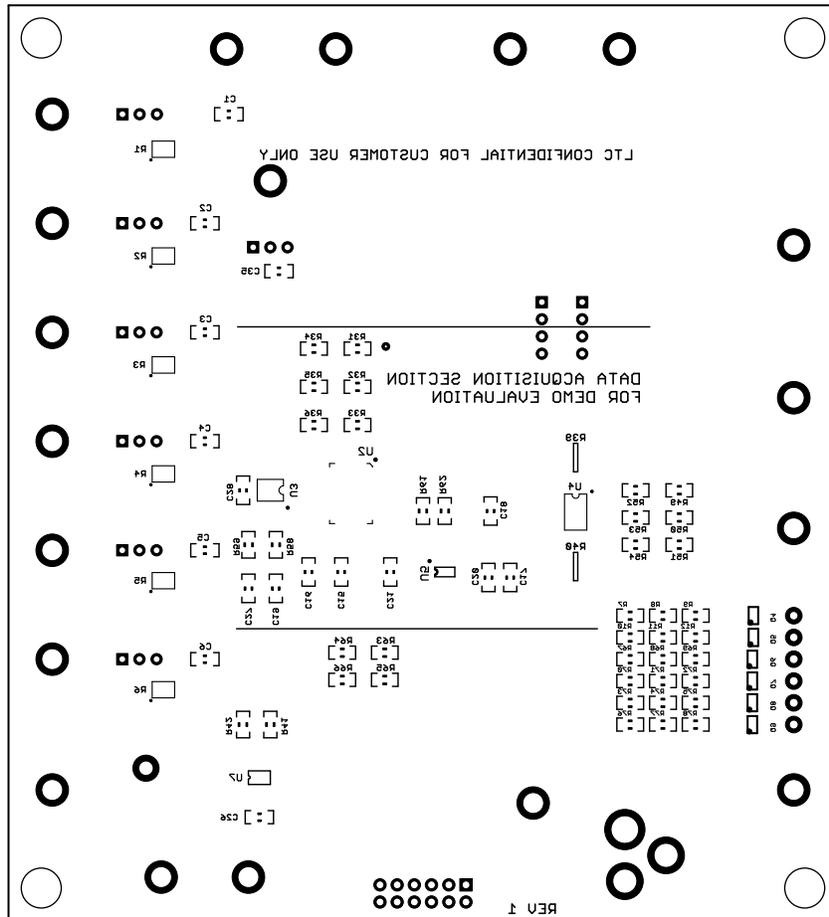


When configured in this way, GPIO1 provides a system reset for the host processor and GPI1 can drive a system reset (GPIO1) with a push of a button. You may set the GPIO1 delay-on-release time to 410 ms to experience the extended reset firsthand. The UV condition indicator remains on GPIO3. The OV condition is indicated as a latched ALERT on GPIO2. When GPI1 pushbutton is pressed, a system reset is asserted on GPIO1 and the ALERT is released if the OV condition is removed.

DC1605B DETAILS – TOP



DC1605B DETAILS – BOTTOM

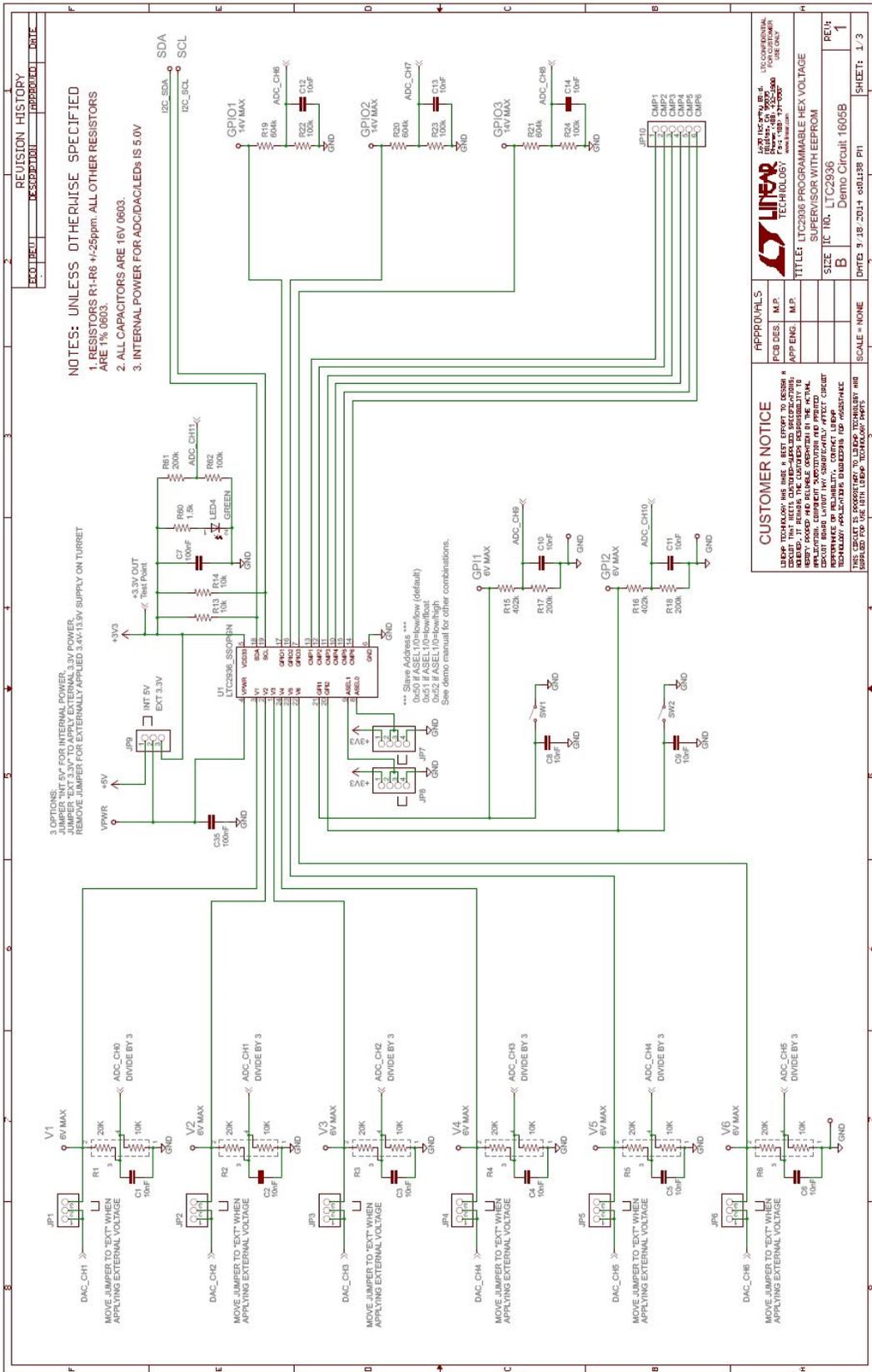


DEMO MANUAL DC1605B

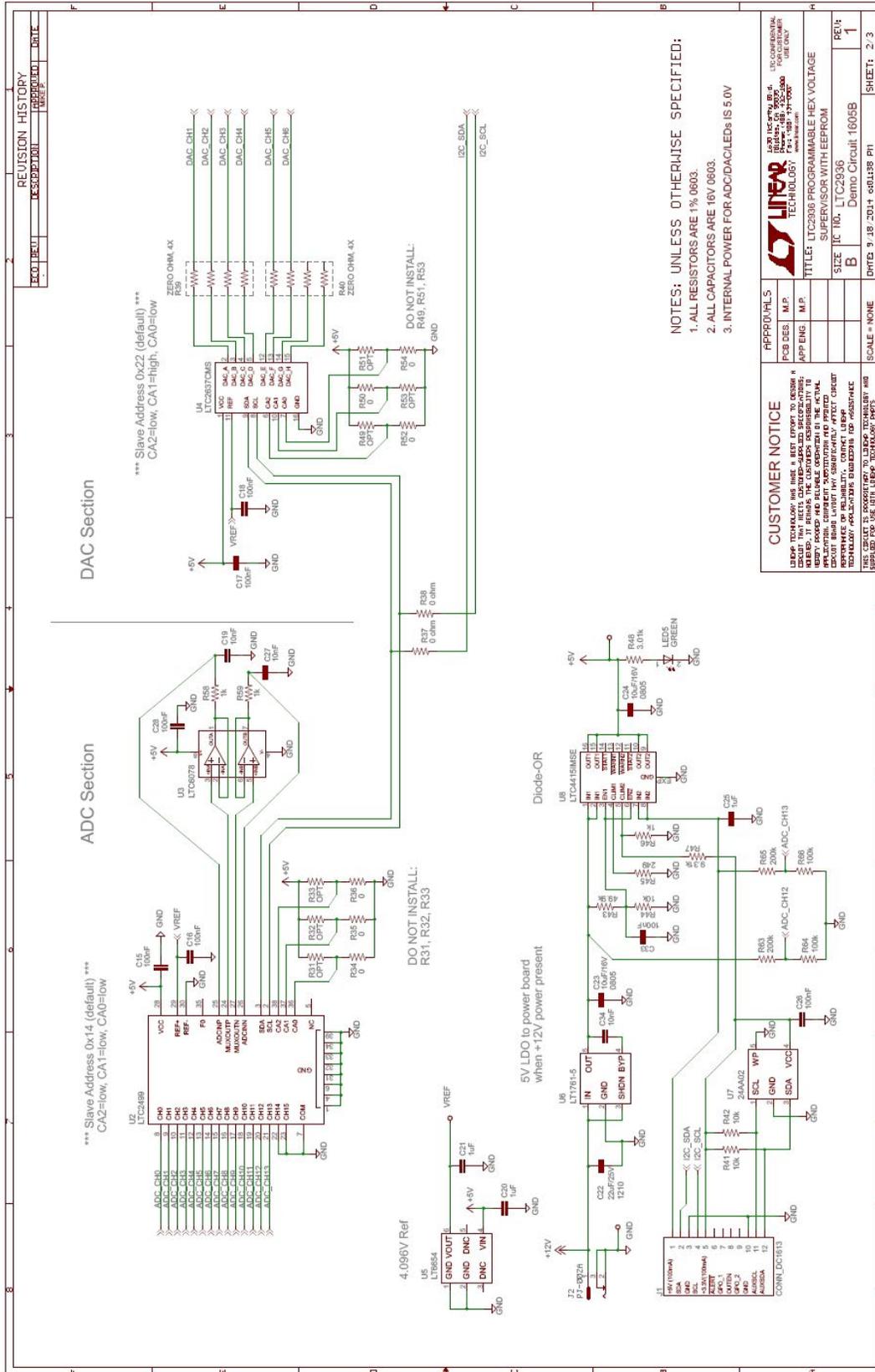
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	U1	IC PROG HEX VOLT SUPERVISOR EEPROM SSOP-24	LINEAR: LTC2936CGN#PBF
Additional Demo Board Circuit Components				
2	16	C1, C2, C3, C4, C5, C6, C8, C9, C10, C11, C12, C13, C14, C19, C27, C34	CAP CER 10nF 25V 10% X7R 0603	MURATA: GRM188R71E103KA01D
3	8	C7, C15, C16, C17, C18, C26, C28, C33	CAP CER 100nF 16V 10% X7R 0603	MURATA: GRM188R71C104KA01D
4	3	C20, C21, C25	CAP CER 1µF 16V 10% X7R 0603	MURATA: GRM188R71C105KA12D
5	1	C22	CAP CER 22µF 25V 10% X5R 1210	MURATA: GRM32ER61E226KE15L
6	2	C23, C24	CAP CER 10µF 16V 10% X5R 0805	MURATA: GRM21BR61C106KE15L
7	3	LED1-LED3, LED6-LED11	LED-DUAL-COLOR BLUE-RED SS SMD	KINGBRIGHT: APHB1608QBDSURKC
8	2	LED4, LED5	LED GREEN SS TYPE BRIGHT SMD	PANASONIC-SSG: LNJ326W83RA
9	9	Q1-Q9	DUAL N-CHANNEL FET2N7002DWA	DIODES INC.: 2N7002DWA-7
10	6	R1-R6	RES ARRAY 10k/20k 0.1W 0.1% 25ppm 0606 SMD	VISHAY: ACASN1002S2002AT
11	10	R7, R10, R25, R27, R48, R67, R70, R73, R76	RES 3k 0.1W 5% 0603 SMD	VISHAY: CRCW06033K00JNEA
12	12	R8, R11, R26, R28, R30, R46, R58, R59, R68, R71, R74, R77	RES 1k 0.1W 5% 0603 SMD	VISHAY: CRCW06031K00JNEA
13	14	R9, R12, R13, R14, R41, R42, R44, R55, R56, R57, R69, R72, R75, R78	RES 10k 0.1W 1% 0603 SMD	VISHAY: CRCW060310K0FKEA
14	2	R15, R16	RES 402k 0.1W 1% 0603 SMD	VISHAY: CRCW0603402KFKEA
15	5	R17, R18, R61, R63, R65	RES 200k 0.1W 1% 0603 SMD	VISHAY: CRCW0603200KFKEA
16	3	R19, R20, R21	RES 604k 0.1W 1% 0603 SMD	VISHAY: CRCW0603604KFKEA
17	6	R22, R23, R24, R62, R64, R66	RES 100k 0.1W 1% 0603 SMD	VISHAY: CRCW0603100KFKEA
18	0	R31, R32, R33, R49, R51, R53 (OPTIONAL)	RES 0Ω 0.1W 1% 0603 SMD	
19	8	R34, R35, R36, R37, R38, R50, R52, R54	RES 0Ω 0.1W 1% 0603 SMD	VISHAY: CRCW060366K5FKEA
20	2	R39, R40	0Ω RESISTOR ARRAY, 4 RES, 1206	PANASONIC: EXB-38VR000V
21	1	R43	RES 49.9k 0.1W 1% 0603 SMD	VISHAY: CRCW060349K9FKEA
22	1	R45	RES 249 Ω 0.1W 1% 0603 SMD	VISHAY: CRCW0603249RFKEA
23	1	R47	RES 9.31k 0.1W 1% 0603 SMD	VISHAY: CRCW06039K31FKEA
24	1	R60	RES 1.50k 0.1W 1% 0603 SMD	VISHAY: CRCW06031K50JNEA
25	1	U2	IC ADC 24-BIT DELTA SIGMA 16-CH WITH I ² C	LINEAR: LTC2499CUHF#PBF
26	1	U3	IC OP AMP DUAL MICROPOWER	LINEAR: LTC6078CMS8
27	1	U4	IC DAC 12-BIT OCTAL WITH I ² C	LINEAR: LTC2637CMS-HMX12
28	1	U5	IC VREF SERIES PRECISION REFERENCE	LINEAR: LT6654AMPS6-4.096
29	1	U6	FIXED 5V 100mA MICROPOWER LDO	LINEAR: LT1761ES5-5#PBF
30	1	U7	2K-BIT I ² C SERIAL EEPROM	MICROCHIP: 24AA02T-I/OT
31	1	U8	DUAL 4A IDEAL DIODES WITH ADJ CURR LMT	LINEAR: LTC4415IMSE#PBF
Hardware: For Demo Board Only				
32	1	J1	CONN HEADER 12POS 2mm STR DL PCB	FCI: 98414-G06-12ULF
33	1	J2	CONN PWR JACK 2.1mm x 5.5mm HIGH CUR	CUI INC.: PJ-002AH
34	6	JP1-JP6, JP9	2mm PIN HEADER 1x3	SULLINS: NRPN031PAEN-RC
35	1	JP7, JP8	2mm PIN HEADER 1x4	SULLINS: NRPN041PAEN-RC
36	1	JP10	0.100" PIN HEADER 1x6	SULLINS: PRPC006SAAN-RC
37	4	MH1-MH4	SPACER STACKING #4 SCREW NYLON	KEYSTONE: 8831
38	2	SW1, SW2	BLK SWITCH TACTILE SPST-NO 0.05A 12V	C&K: PTS635SL25SMTR LFS
39	19	TP1-TP19	TERM SOLDER TURRET .219"H .109"L	MILL MAX:: 2501-2-00-80-00-00-07-0
40	1	TP20	TERM SOLDER TURRET .156"H .084"L	MILL MAX: 2308-2-00-80-00-00-07-0

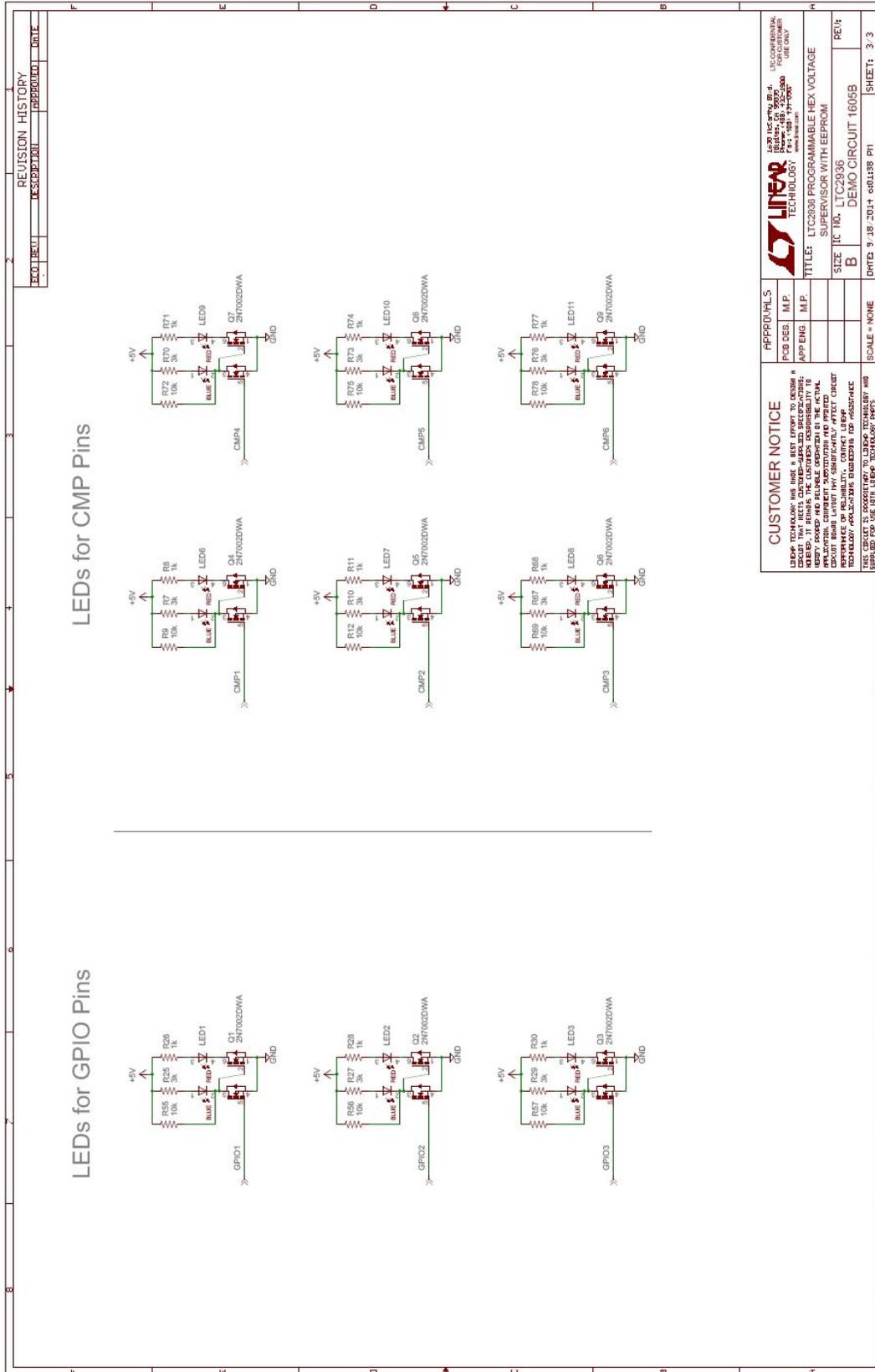
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SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM



REV	DESCRIPTION	DATE
1	REVISION HISTORY	

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<p>LINEAR TECHNOLOGY</p> <p>100 N. RIVER ST., WILMINGTON, MA 01890 TEL: 508-651-2200 FAX: 508-651-2201 WWW.LINEAR.COM</p>		<p>LTC2936 PROGRAMMABLE HEX VOLTAGE SUPERVISOR WITH EEPROM</p> <p>SIZE TIC NO. LTC2936</p> <p>REV: B</p> <p>DATE: 9 JUN 2014 08:11:38 PM</p> <p>SHEET: 3 / 3</p>



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DEMO MANUAL DC1605B

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