

LTC4155EUF D Dual Input Power Manager/3.5A Li-Ion Battery Charger with I²C Control and USB OTG

DESCRIPTION

Demonstration Circuit 1674A-A is dual input power manager/3.5A Li-Ion battery charger with I²C control and USB On-The-Go (OTG).

The dual input multiplexer, overvoltage protection (OVP) and reverse voltage protection (RVP) is implemented with external N-channel MOSFETs.

An on board buck regulator generates the V_{OUT} voltage from the active input voltage. This voltage is regulated to minimize the dissipation in the battery charger. The minimum voltage of the V_{OUT} regulator is 3.5V to provide an instant-on function when the battery is fully discharged.

Most functions on the LTC[®]4155EUF D are controlled via the I²C serial interface. The LTC4155EUF D also provides extensive status information via the I²C serial interface.

Please refer to the LTC4155EUF D data sheet for details about the I²C serial interface, control and status registers, and the electrical and timing specifications.

The LTC4155EUF D does modify several of its own control registers to reflect the current operating conditions.

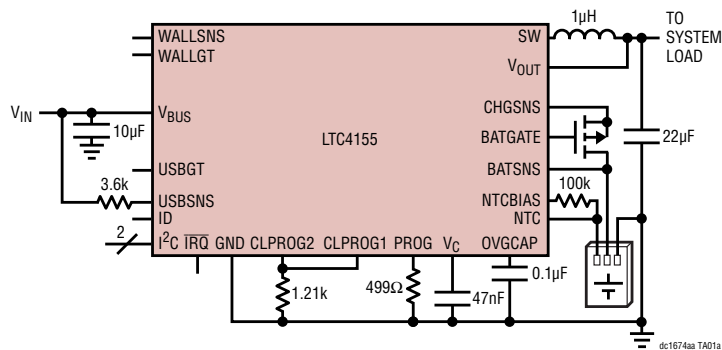
Design files for this circuit board are available at <http://www.linear.com/demo/DC1674A-A>

LT, LT, LTC, LTM, μModule, Linear Technology and the Linear logo are registered trademarks and QuikEval is a trademark of Linear Technology Corporation. All other trademarks are the property of their respective owners.

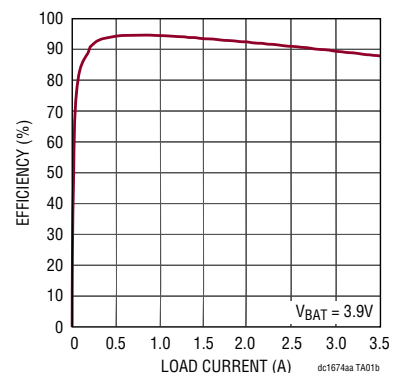
PERFORMANCE SUMMARY (T_A = 25°C)

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V _{WALL}	WALL Input Voltage Range		4.35	5	5.5	V
I _{WALL}	Input Current from WALL Input	4.35V < V _{WALL} < 6V	0	0.1	3	A
V _{USB}	USB Input Voltage Range		4.35	5	5.5	V
I _{USB}	Input Current from USB Input	4.35V < V _{USB} < 6V	0	0.1	3	A
V _{OUT}	Voltage on the V _{OUT} Pin	0A < I _{VOUT} ≤ 4A, 2.7V < V _{BAT} ≤ 4.2V	3.4	4	4.6	V
I _{VOUT}	Output Current from V _{OUT}	Total Load Current Including Battery Charger			4.5	A
V _{BAT}	Voltage on the BAT Pin		2.7	3.6	4.2	V
I _{BAT}	BAT Pin Source or Sink Current		-4		3	A
V _{WALL.USB}	Input Voltage Range, Non-Operating				27	V

I²C Controlled High Power Battery Charger/USB Power Manager



Switching Regulator Efficiency



DEMO MANUAL DC1674A-A

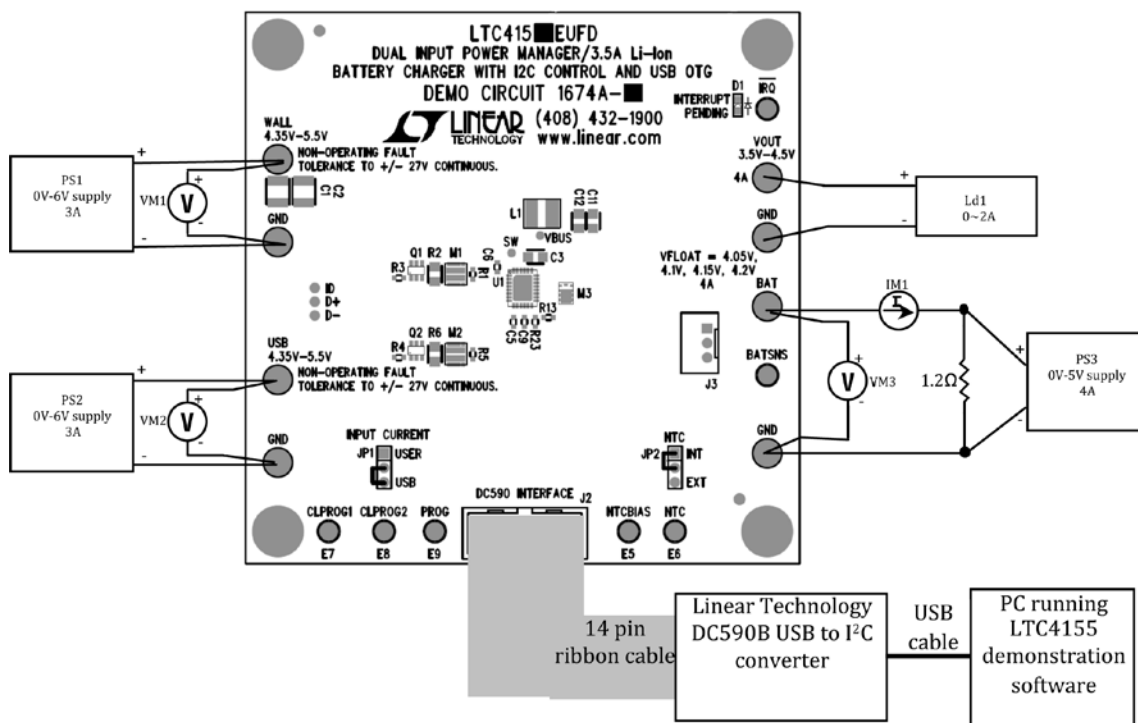
QUICK START PROCEDURE

DC1674A-A working input voltage range is 4.35V to 5.5V on both the WALL and USB input. The DC1674A-A will tolerate non-operating overvoltage inputs up to 27V. DC1674A-A utilizes the DC590B, USB to I²C interface board, to control the LTC4155EUF and to read back the contents of the command and status registers.

The DC1674A-A is easy to set up to evaluate the performance of the LTC4155EUF. Refer to Figure 1 and Figure 2

for proper measurement equipment setup and follow the evaluation procedure below using the DC590B board.

NOTE. When measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the input or output voltage ripple by touching the probe tip directly across the V_{IN} or V_{OUT} and GND terminals. See Figure 2 for proper scope probe technique.



Note: All connections from equipment should be Kelvin connected directly to the Board PINS which they are connected to on this diagram and any input, or output, leads should be twisted pair

Figure 1. Proper Measurement Equipment Setup

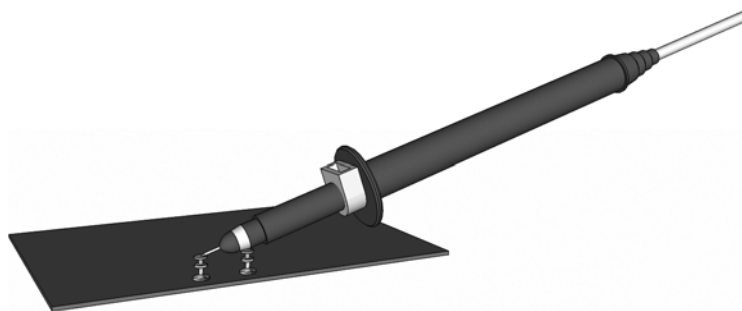


Figure 2. Measuring Input or Output Ripple

QUICK START PROCEDURE

1. Ensure that JP1 and JP2 are in their default positions, as shown in Figure 1. Set PS3 to 3.6V and turn on. The DV_{CC} voltage level may be selected on the DC590B. This is done by setting the V_{CCIO} jumper, JP6, on the DC590B board to one of the following settings: 3.3V, 5V, removed for 2.7V or set to external if an external supply is desired to be used. Please set DV_{CC} to 3.3V.
2. Start the Linear Technology QuickEval™ program. Download and install the latest version of the QuikEval program from the following weblink: <http://www.linear.com/designtools/software/>. This program should automatically detect the presence of the LTC4155EUFd demo board (DC1674A-A) and activate the appropriate GUI, as seen in Figure 3.
3. Set PS1 to 5V, and turn on. The “WALL Input Power Available” and “External Power Available” indicators on the GUI should turn green. The current on PS1 should indicate approximately 80mA.
4. Set “WALL I_{LIM} ” to 3000mA. To compensate for the sense resistance of IM1, adjust PS3 such that VM3 reads 3.6V. PS1 should now read approximately 2A, and IM1 should read approximately 2.4A.
5. Set PS2 to 5V, and turn on. The only change should be the “USB Input Power Available” indicator should turn green.
6. Set the “USB I_{LIM} ” to 3000mA, and select the USB Input radio button in the “Input Power Priority” frame. PS1 should now read 0A, PS2 should read approximately 2A, and IM1 should be unchanged at 2.4A.
7. Set LD1 to 1A, and turn on. PS2 should now read approximately 3A, and IM1 should be unchanged.
8. Set “ $I_{CHARGE\%}$ ” to 50%. PS2 should now read approximately 2A, and IM1 should be 1.2A.
9. Turn off and disconnect PS1, VM1, and PS2.
10. Select the “Force OTG Boost On” radio button. VM2 should now read approximately 5V.

USING THE LTC4155EUFd SOFTWARE

Introduction

The DC1674A-A GUI provides control of most aspects of operation of the LTC4155EUFd. The DC1674A-A GUI continuously reads back the LTC4155EUFd registers and updates the displayed status accordingly. The DC1674A-A GUI also provides a means to change the value of the CLPROGx and PROG resistors, as well as the β of the NTC device. The user is responsible for ensuring that these values match the values on the physical Demo Board. The DC1674A-A GUI will remember these values from session to session, and they can be reset to the default values at any time.

The DC1674A-A GUI is composed of three forms, the LTC4155 form (Figure 3) that is brought up by the QuickEval program, the Manage Current Limit Resistors form (Figure 4), that is brought up by pressing the “Change Resistors” button on the LTC4155 form, and the Manage β Value form (Figure 5) that is brought up by pressing the “Change β ” button on the LTC4155 form.

Any changes made in the Manage Current Limit Resistors or Manage β Value forms will be reflected on the main form as soon as “Apply” is pressed. All changes made in these two forms will be remembered from session to session. The values can be set to default at any time.

View LTC4155EUFd Product Page

This button opens your default internet browser, and searches the Linear Technology Corporation web site for information on the LTC4155EUFd when an internet connection is available.

WALL and USB I_{LIM} Sections

These sections allow control over the WALL and USB input current limit.

These sections should default to 100mA at power-up, when the USB/USER (JP1) is in the “USB” position. They

QUICK START PROCEDURE

should both default to the 1000mA value at the top of the frame, at power-up, with the USB/USER (JP1) in the “USER” position.

If the USB input power becomes unavailable, the USB I_{LIM} section will return to 100mA.

$I_{CHARGE\%}$ Section

This section controls the battery charging current as a percent of maximum. The maximum is shown at the top of the frame, and is calculated from the displayed PROG resistor value.

C/x Set

Select the End of Charging condition. This selects the current, as a percent of the maximum that indicates end of charging. Optionally, charging may also be terminated at the C/x current threshold by selecting the “8hr or C/x” timer mode.

Timer

This selects the timeout for the charging timer. When the end of charging condition is reached, the charger is not turned off, but the timer is started, and when it times out, the charger is turned off. The exception is “8hr or C/x” mode, where whichever 8hrs or C/x, occurs first will terminate charging.

V_{FLOAT}

This selects the desired battery float voltage, and defaults to 4.05V.

Input Power Priority

By default, the WALL input has priority on the input power multiplexer. The priority can be reassigned to USB input by selecting the appropriate radio button.

OTG Boost Automatic Enable

Selects whether or not the ID pin of the USB connector enables USB On-The-Go (OTG) operation. It may be desirable to control USB OTG directly, without the need to set the USB connector ID pin voltage level below V_{ID_OTG} . To control USB OTG directly, check the “Force OTG Boost On” box. Automatic enable has no effect on ID pin status indication.

Battery Conditioner Disabled

The Battery Conditioner function may be turned on and off with this button. The battery conditioner is only active when enabled, and the NTC is reporting a battery temperature of 60°C or higher.

Disable Input UVCL

As the active input voltage (USB or WALL) drops below 4.3V, the LTC4155EUFD will lower the input current limit to attempt to prevent the input voltage from drooping lower. This is a useful feature in the input supply voltage is not very stiff, or if there is significant impedance between the input supply and the LTC4155EUFD. If this function is not desired, check the “Disable Input UVCL” box.

Interrupts

The LTC4155EUFD can monitor a variety of conditions, which it reports over the I²C buss. By selecting the check boxes in the Interrupt section, the LTC4155EUFD can also issue interrupts whenever one of these conditions changes. The presence of an interrupt is indicated by the indicator changing to red and displaying “Interrupt Pending.” The interrupt can be cleared by pressing the “Clear Interrupt” button. Changing the interrupt mask also clears all pending interrupts.

QUICK START PROCEDURE

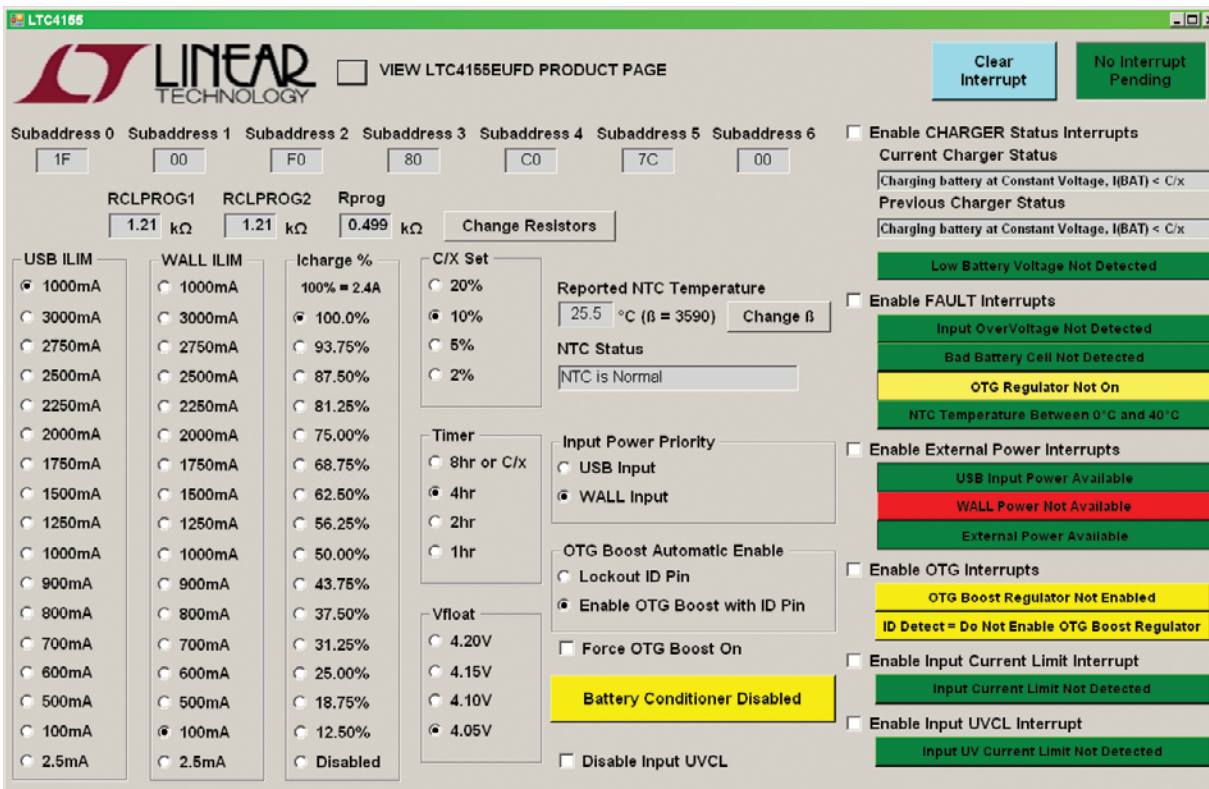


Figure 3. LTC4155 Main Form

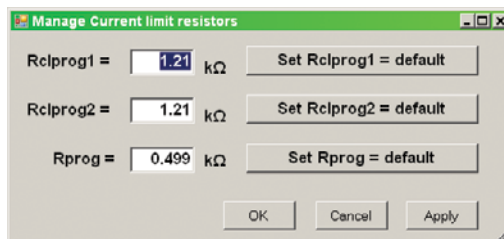


Figure 4. Manage Current Limit Resistors Form

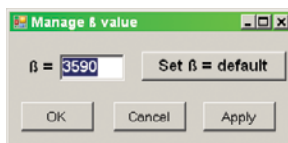


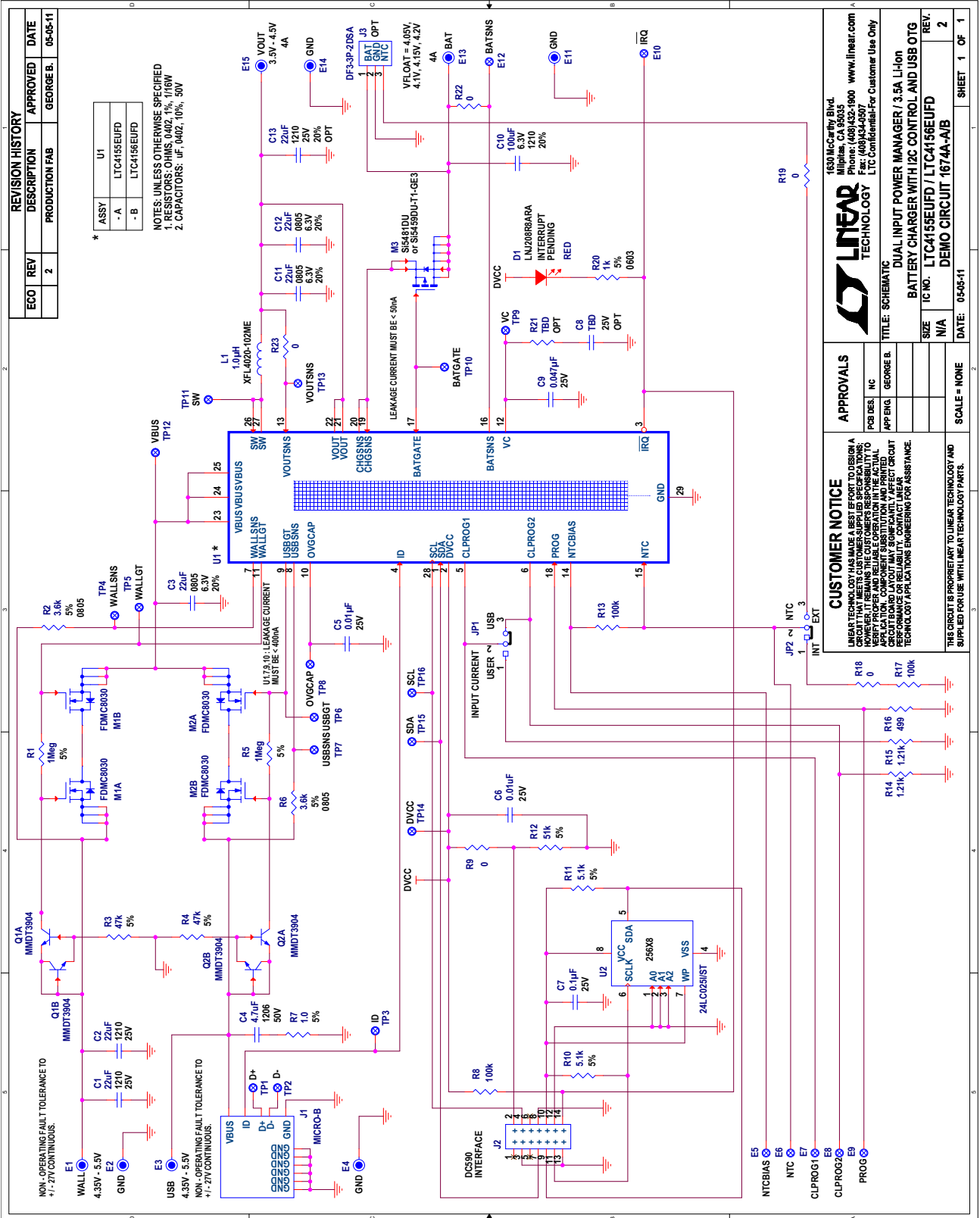
Figure 5. Manage β Value Form

DEMO MANUAL DC1674A-A

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	2	C1, C2	CAP, CHIP, X5R, 22 μ F, \pm 10%, 25V, 1210	MURATA, GRM32ER61E226KE15L
2	3	C3, C11, C12	CAP, CHIP, X5R, 22 μ F, \pm 20%, 6.3V, 0805	TAIYO-YUDEN, JMK212BJ226MG
3	1	C5	CAP, CHIP, X7R, 0.01 μ F, \pm 10%, 25V, 0402	TDK, C1005X7R1E103K
4	1	C9	CAP, CHIP, X7R, 0.047 μ F, \pm 10%, 25V, 0402	TDK, C1005X7R1E473K
5	1	C10	CAP, CHIP, X5R, 100 μ F, \pm 20%, 6.3V, 1210	MURATA, GRM32ER60J107ME20L
6	1	L1	IND, SMT, 1.0 μ H, 10.8m Ω , \pm 20%, 4.0mm \times 4mm	COILCRAFT, XFL4020-102ME
7	2	M1-M2	MOSFET, 40V, 25m Ω , 12A, POWER33	FAIRCHILD, FDMC8030
8	0	M3	MOSFET, -20V, 22m Ω , 12A, POWER PAK CHIPFET SINGLE	VISHAY, Si5481DU-T1-GE3
9	1	M3	MOSFET, -20V, 52m Ω , 8A, POWER PAK CHIPFET SINGLE	VISHAY, Si5459DU-T1-GE3
10	1	Q1, Q2	DUAL NPN, SOT363	DIODES/ZETEX, MMDT3904-7-F
11	2	R1, R5	RES, CHIP, 1M Ω , \pm 5%, 1/16W, 0402	VISHAY, CRCW04021M00JNED
12	2	R2, R6	RES, CHIP, 3.6k Ω , \pm 5%, 1/8W, 0805	VISHAY, CRCW08053K60JNED
13	2	R3, R4	RES, CHIP, 47k Ω , \pm 5%, 1/16W, 0402	VISHAY, CRCW040247K0JNED
14	2	R13, R17	RES, CHIP, 100k Ω , \pm 1%, 1/16W, 0402	VISHAY, CRCW0402100KFED
15	2	R14, R15	RES, CHIP, 1.21k Ω , \pm 1%, 1/16W, 0402	VISHAY, CRCW04021K21FKED
16	1	R16	RES, CHIP, 499 Ω , \pm 1%, 1/16W, 0402	VISHAY, CRCW0402499RFKED
17	4	R18, R19, R22, R23	RES, CHIP, 0 Ω JUMPER, 1/16W, 0402	VISHAY, CRCW04020000Z0ED
18	1	U1 (ASSEMBLY- A) U1 (ASSEMBLY- B)	DUAL INPUT POWER MANAGER/3.5A LI-ION BATTERY CHARGER WITH I ² C CONTROL AND USB OTG	LINEAR TECH., LTC4155EUFDF/LTC4156EUFDF
Additional Demo Board Circuit Components				
1	1	C4	CAP, CHIP, X7R, 4.7 μ F, \pm 10%, 50V, 1206	MURATA, GRM31CR71H475KA12L
2	1	C6	CAP, CHIP, X7R, 0.01 μ F, \pm 10%, 25V, 0402	TDK, C1005X7R1E103K
3	1	C7	CAP, CHIP, X5R, 0.1 μ F, \pm 10%, 25V, 0402	TDK, C1005X5R1E104K
4	0	C8-OPT	CAP, CHIP, TBD, 0402	USER DEFINED
5	0	C13-OPT	CAP, CHIP, X5R, 22 μ F, \pm 10%, 25V, 1210	MURATA, GRM32ER61E226KE15L
6	1	D1	LED, RED, 0603	PANASONIC, LNJ208R8ARA
7	1	R7	RES, CHIP, 1.0 Ω , \pm 5%, 1/16W, 0402	VISHAY, CRCW04021R00JNED
8	1	R8	RES, CHIP, 100k Ω , \pm 1%, 1/16W, 0402	VISHAY, CRCW0402100KFED
9	1	R9	RES, CHIP, 0 Ω JUMPER, 1/16W, 0402	VISHAY, CRCW04020000Z0ED
10	2	R10, R11	RES, CHIP, 5.1k Ω , \pm 5%, 1/16W, 0402	VISHAY, CRCW04025K10JNED
11	1	R12	RES, CHIP, 51k Ω , \pm 5%, 1/16W, 0402	VISHAY, CRCW040251K0JNED
12	1	R20	RES, CHIP, 1k Ω , \pm 5%, 1/10W, 0603	VISHAY, CRCW06031K00JNED
13	0	R21-OPT	RES, CHIP, TBD, 0402	USER DEFINED
14	1	U2	I ² C EEPROM	MICROCHIP, 24LC025-I/ST
Hardware for Demo Board Only				
1	8	E1, E2, E3, E4, E11, E13, E14, E15	TURRET, 0.09 DIA	MILL-MAX, 2501-2-00-80-00-00-07-0
2	7	E5, E6, E7, E8, E9, E10, E12	TURRET, 0.061 DIA	MILL-MAX, 2308-2-00-80-00-00-07-0
3	1	J1	CONN, USB MICRO-B	TYCO, 1981568-1
4	1	J2	HEADER, 2 \times 7-PIN, 0.079CC	MOLEX, 87831-1420
5	0	J3-OPT	CONN, BATTERY	HIROSE, DF3-3P-2DSA
6	2	JP1, JP2	HEADER, 3-PIN 1 ROW .079CC	SAMTEC, TMM-103-02-L-S
7	2	JP1, JP2	SHUNT, 2mm	SAMTEC, 2SN-KB-G
8	4		STAND-OFF, NYLON, 0.375" TALL (SNAP ON)	KEYSTONE, 8832 (SNAP ON)
9	1		FAB, PRINTED CIRCUIT BOARD	DEMO CIRCUIT 1674A
10	2		STENCIL – TOP & BOTTOM	DC1674A-2

SCHEMATIC DIAGRAM



DEMO MANUAL DC1674A-A

DEMONSTRATION BOARD IMPORTANT NOTICE

Linear Technology Corporation (LTC) provides the enclosed product(s) under the following **AS IS** conditions:

This demonstration board (DEMO BOARD) kit being sold or provided by Linear Technology is intended for use for **ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY** and is not provided by LTC for commercial use. As such, the DEMO BOARD herein may not be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including but not limited to product safety measures typically found in finished commercial goods. As a prototype, this product does not fall within the scope of the European Union directive on electromagnetic compatibility and therefore may or may not meet the technical requirements of the directive, or other regulations.

If this evaluation kit does not meet the specifications recited in the DEMO BOARD manual the kit may be returned within 30 days from the date of delivery for a full refund. **THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY THE SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THIS INDEMNITY, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.**

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user releases LTC from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge. Also be aware that the products herein may not be regulatory compliant or agency certified (FCC, UL, CE, etc.).

No License is granted under any patent right or other intellectual property whatsoever. **LTC assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or any other intellectual property rights of any kind.**

LTC currently services a variety of customers for products around the world, and therefore this transaction **is not exclusive**.

Please read the DEMO BOARD manual prior to handling the product. Persons handling this product must have electronics training and observe good laboratory practice standards. **Common sense is encouraged.**

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

Mailing Address:

Linear Technology
1630 McCarthy Blvd.
Milpitas, CA 95035

Copyright © 2004, Linear Technology Corporation