

LTC2604

Quad 16-Bit Rail-to-Rail DAC with SPI Interface

DESCRIPTION

Demonstration circuit 809 features the **LTC®2604** Quad 16-Bit DAC. This device establishes a new board-density benchmark for 16-bit DACs and advances performance standards for output drive, crosstalk and load regulation in single supply, voltage-output multiple DACs.

DC809 has many features for evaluating the performance of the LTC2604. Onboard 5V, 4.096V, and 2.5V precision references are provided. The LTC2604 features separate reference inputs for each DAC, and any of the onboard references can be used for any of the reference inputs.

Another feature of this board is the onboard LTC2428 20-bit ADC for monitoring DAC output voltage. The 16ppm total error of this device is adequate for taking meaningful measurements of various LTC2604 parameters.

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

LT, LT, LTC, LTM, 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 Specifications are at T_A = 25°C

PARAMETER	CONDITION	VALUE
Resolution		16 Bits
Monotonicity	V _{CC} = 5V, V _{REF} = 4.096V	16 Bits
Differential Nonlinearity	V _{CC} = 5V, V _{REF} = 4.096V	±1LSB
Integral Nonlinearity	V _{CC} = 5V, V _{REF} = 4.096V	±12LSB Typical
Load Regulation	V _{CC} = V _{REF} = 5V, Mid-Scale I _{OUT} = ±15mA	2LSB/mA Max
DC Crosstalk	Due to Load Current Change on Any Other Channel	3.5µV/mA

QUICK START PROCEDURE

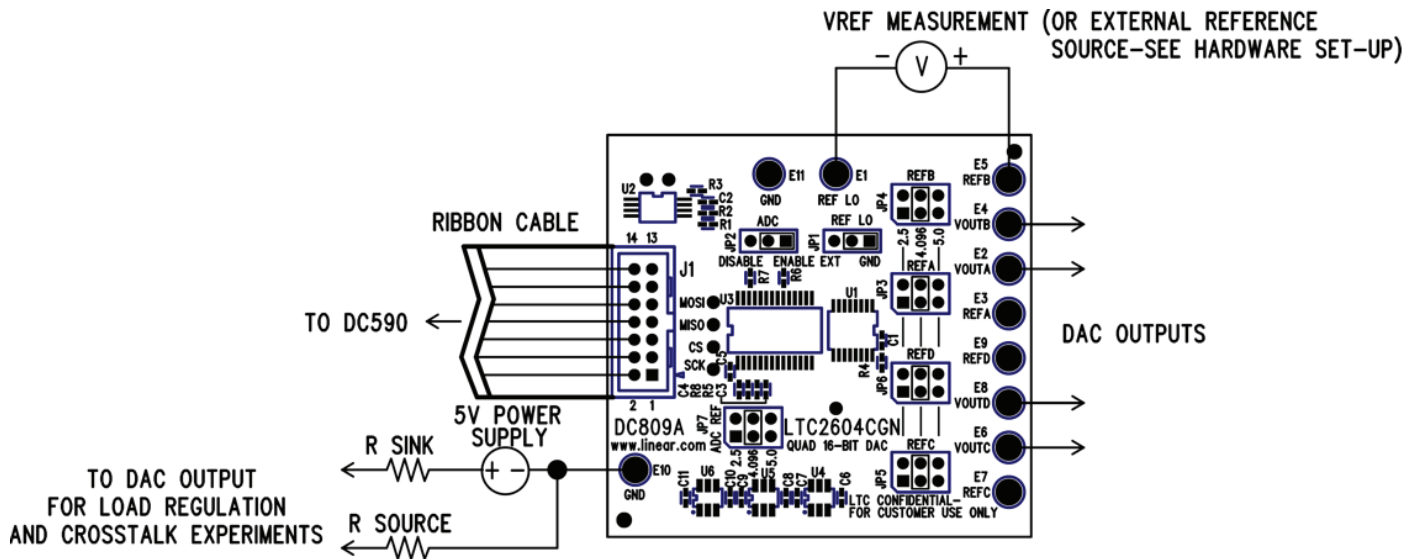


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

Connect DC809A to a DC590 USB serial controller using the supplied 14-conductor ribbon cable. Connect DC590 to a host PC with a standard USB A/B cable. Run the evaluation software supplied with DC590 or download it from www.linear.com/software. The correct control panel

will be loaded automatically. Click the COLLECT button to begin outputting codes to the DACs and reading back the resulting output voltage for each DAC.

Complete software documentation is available from the Help menu item, as features may be added periodically.

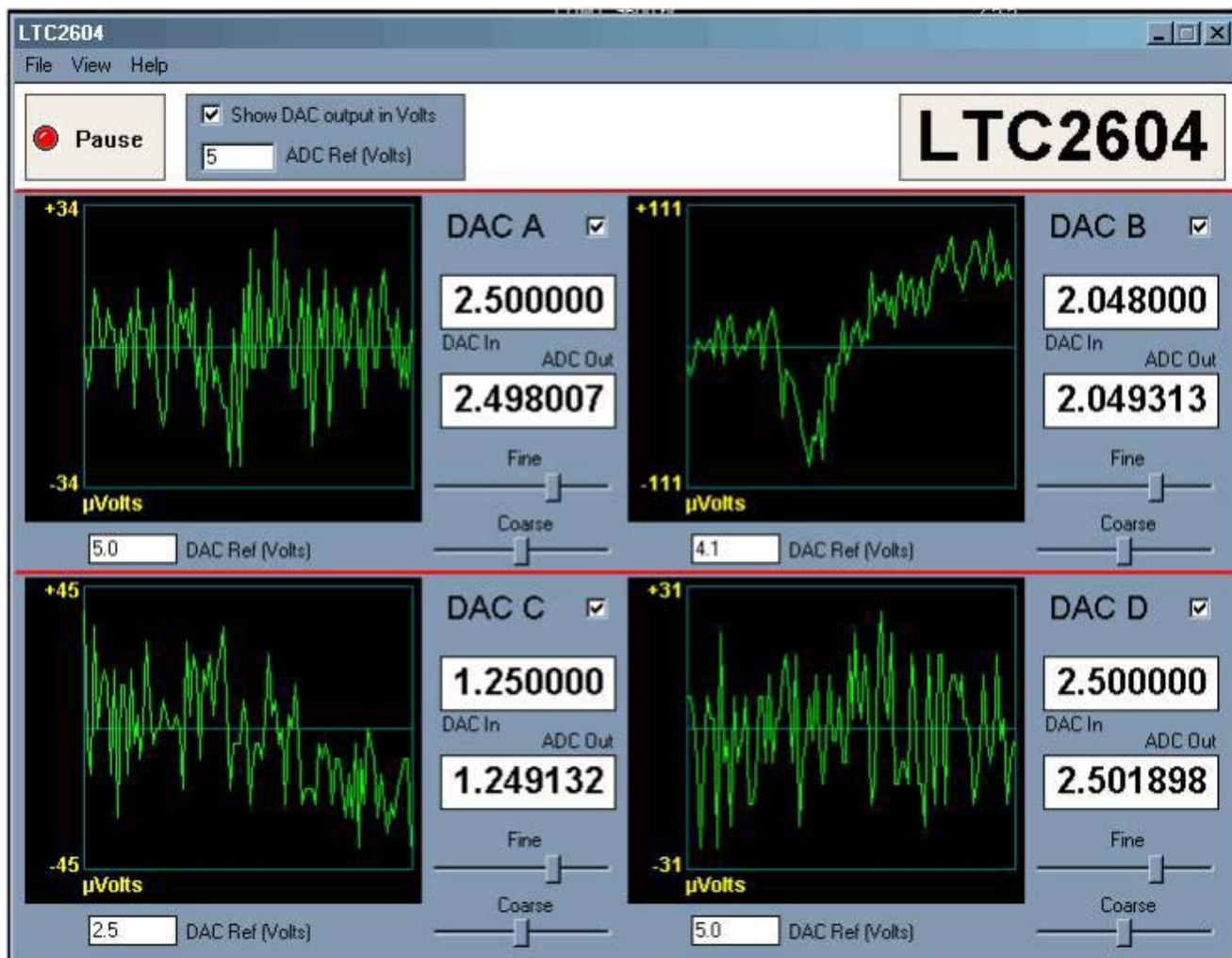


Figure 2. DC809A QuikEval™ Screen Shot

HARDWARE SETUP

Jumpers

JP1 – REFLO Selection. Either tied to ground or supplied externally to the REFLO turret post.

JP2 – ADC Disable. Set to ON for normal operation, with the onboard ADC enabled. For very sensitive noise measurements, the ADC may be disabled. The software will then display a positive full-scale reading.

JP7 – V_{REF} Select for ADC. This selects which onboard reference is used for the LTC2428 ADC. If all DAC references are set to the same voltage, set the ADC reference to the same voltage. If different DAC reference voltages are used, set the ADC reference to the highest DAC reference voltage.

JP3, JP4, JP5, JP6 – Select reference for DAC A, B, C, and D, respectively. Onboard references are 2.5V, 4.096V, and 5.0V. Remove jumper entirely to apply an external reference.

Analog Connections

DAC Outputs – The four DAC outputs from the LTC2604 are brought out to turrets labeled DAC A through DAC D. These may be connected to external instruments or other circuitry.

DAC outputs are not in alphabetical order on the circuit board.

DAC References – The REFA, REFB, REFC, and REFD turrets are connected directly to the reference terminals of the LTC2604. When one of the onboard references is being used, the reference voltage may be monitored at this point. An external reference may also be applied to this turret after removing the associated reference selection jumper.

REFLO – This is connected to the LTC2604 REFLO pin and can be used to raise the zero-code output of all of the DACs above ground potential. This is normally set to ground, but may be raised up to 1V above ground. Refer to the LTC2604 data sheet for details.

Ground Connections

Grounding – Separate power and signal grounds are provided. Any large currents drawn from the DAC outputs should be returned to the power ground turret closest to Pin 1 on the 14-pin header. Signal ground is connected to the exposed ground planes at the top and bottom edges of the board, and to the two turrets labeled “GND.” Use signal ground as the reference point for measurements and connections to external circuits.

EXPERIMENTS

The following experiments are intended to demonstrate some of the outstanding features of the LTC2604. All can be performed using the onboard LTC2428 to monitor the DAC output voltage. The indicated output voltage will typically agree with an HP3458A voltmeter to 5 digits. If a DAC will be sinking or sourcing a significant current, then the output voltage should be measured as close to the DAC as possible.

Most of the data sheet specifications use a 4.096 volt reference, so this is the preferred reference to use for these experiments. Using the 5V reference has the limitation that V_{CC} may be slightly lower than V_{REF} , which may affect the full-scale error.

Using an external power supply is highly recommended for these experiments, especially those that draw significant current. Refer to the DC590 quick start guide for details.

Resolution

The onboard LTC2428 ADC has an input resolution of $6\mu\text{V}$. This will easily resolve a 1LSB ($76\mu\text{V}$ for $V_{REF} = 5\text{V}$, $62.5\mu\text{V}$ for $V_{REF} = 4.096\text{V}$) change in the LTC2604 output. Set one of the DAC channels to a voltage close to mid-scale. Select the FINE slider on the control panel with the mouse and use the right and left arrow keys to step the output by single LSBs. The change should be clearly visible in the output graph. (It may be necessary to wait for the graph to clear if a large step has just occurred. This can be sped up by disabling all other DAC channels in the software by unchecking them.)

Integral Nonlinearity

A rough measurement of INL can be taken using the onboard ADC. Measure one of the LTC2604 outputs at code 256 and 65,535 and calculate the slope and intercept using a spreadsheet. Next, take several readings at intermediate points. The readings should not deviate from the calculated line by more than 64LSBs, and they will typically be within 12LSBs.

Load Regulation/DC Output Impedance

Set one of the outputs to mid-scale (code 32768) source or sink 15mA from this output by pulling it to power ground or V_{CC} with an appropriate value resistor. The voltage change should be less than 2.25mV, corresponding to an output impedance of 0.15Ω . Output impedance is typically less than 0.030Ω . (Measure DAC voltage at the output pin if using a voltmeter.)

Zero Scale Error

Set one of the DACs to code 0. The measured output should be less than 9mV and will typically be less than 1mV.

Offset Error

Set one of the DACs to code 256. The output voltage should be within 1mV of the correct value, or $V_{REF} \cdot 256/65535$.

Gain Error

Set one of the DACs to code 65,535. The output voltage should be within 0.7% of V_{REF} , and will typically be within 0.2%.

DC Crosstalk

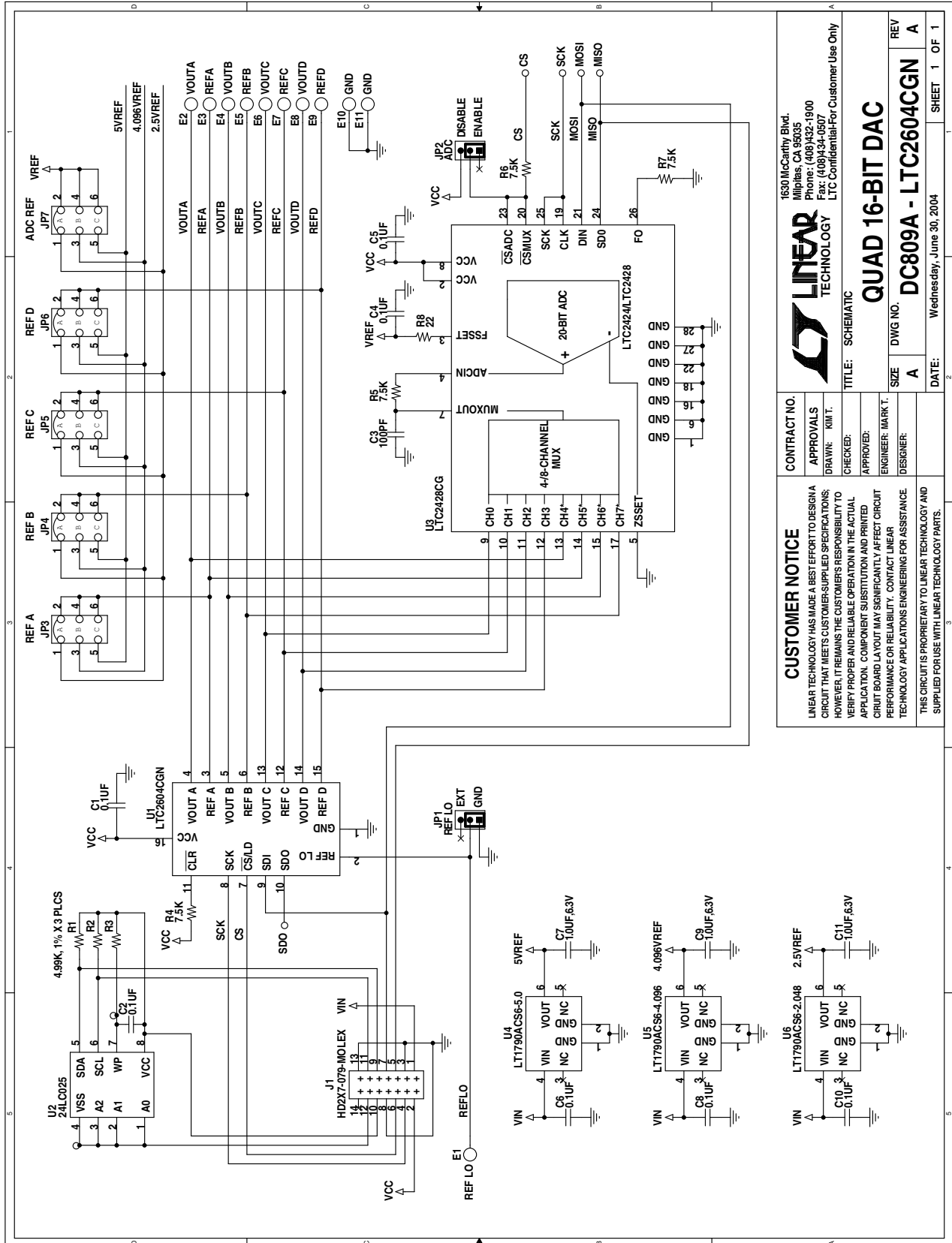
Set all DACs to mid-scale. Connect a 250Ω resistor from one output to V_{CC} or Power Ground (to sink or source 10mA, respectively, when the 5V reference is being used.) A given output should not change by more than $3.5\mu\text{V}$ per milliamp of output current in all other DACs combined.

DEMO MANUAL DC809A

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
1	7	C1, C2, C4, C5, C6, C8, C10	CAP., X7R, 0.1 μ F 16V,0402	TDK, C1005X7R1C104M
2	1	C3	CAP., NPO, 100pF 50V,0402	AVX, 04025A101MAT
3	3	C7, C9, C11	CAP., X5R, 1.0 μ F 6.3V,0402	TDK, C1005X5R0J105M
4	11	E1-E11	TESTPOINT, TURRET, 0.064"	MILL-MAX, 2308-2
5	2	JP1, JP2	JMP, 3 PIN 1 ROW 0.079CC	COMM-CON, 2802S-03-G1
6	5	JP3, JP4, JP5, JP6, JP7	HEADER, 2 \times 3 PIN, 0.079CC	COMM CON, 2202S-06G2
7	7	ON JP1-JP7 PIN 1 AND 2	SHUNT, .079" CENTER	COMM-CON CCIJ2MM-138G
8	1	J1	HEADER, 2 \times 7 PIN, 0.079CC	MOLEX, 87331-1420
9	3	R1, R2, R3	RES., CHIP, 4.99k, 1%,0402	AAC, CR05-4991FM
10	4	R4, R5, R6, R7	RES., CHIP, 7.5k, 5%,0402	AAC, CR05-752JM
11	1	R8	RES., CHIP, 22, 5%,0402	AAC, CR05-220JM
12	1	U1	I.C., LTC2604CGN,SSOP16GN	LINEAR TECH., LTC2604CGN
13	1	U2	I.C., 24LC025, TSSOP8	MICROCHIP, 24LC025
14	1	U3	I.C., LTC2428CG,SSOP28G	LINEAR TECH., LTC2428CG
15	1	U4	I.C., LT1790ACS6-5,SOT23-6	LINEAR TECH., LT1790ACS6-5
16	1	U5	I.C., LT1790ACS6-4.096,SOT23-6	LINEAR TECH., LT1790ACS6-4.096
17	1	U6	I.C., LT1790ACS6-2.5,SOT23-6	LINEAR TECH., LT1790ACS6-2.5

SCHEMATIC DIAGRAM



LINEAR TECHNOLOGY
 1630 McCarthy Blvd.
 Milpitas, CA 95035
 Phone: (408)432-1900
 Fax: (408)434-0507
 LTC Confidential-For Customer Use Only

QUAD 16-BIT DAC
DC809A - LTC2604CGN

CONTRACT NO. _____
 APPROVALS _____
 DRAWN: KMT
 CHECKED: _____
 APPROVED: _____
 ENGINEER: MARK T.
 DESIGNER: _____

TITLE: SCHEMATIC

SIZE: A
 DWG NO. DC809A - LTC2604CGN
 DATE: Wednesday, June 30, 2004

REV A
 SHEET 1 OF 1

CUSTOMER NOTICE
 LINEAR TECHNOLOGY HAS MADE A BEST EFFORT TO DESIGN A CIRCUIT THAT MEETS CUSTOMER-SUPPLIED SPECIFICATIONS; HOWEVER, IT REMAINS THE CUSTOMER'S RESPONSIBILITY TO VERIFY PROPER AND RELIABLE OPERATION IN THE ACTUAL APPLICATION. COMPONENT SUBSTITUTION AND PRINTED CIRCUIT BOARD LAYOUT MAY SIGNIFICANTLY AFFECT CIRCUIT PERFORMANCE OR RELIABILITY. CONTACT LINEAR TECHNOLOGY APPLICATIONS ENGINEERING FOR ASSISTANCE.
 THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.



Information furnished by Linear Technology Corporation is believed to be accurate and reliable. However, no responsibility is assumed for its use. Linear Technology Corporation makes no representation that the interconnection of its circuits as described herein will not infringe on existing patent rights.

DEMO MANUAL DC809A

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

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: ocean@oceanchips.ru

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А