

DESCRIPTION

Demonstration circuit 1804A is a 12V output, high efficiency synchronous PolyPhase® buck converter featuring the LTC3890EUH. This demo board operates over a wide input voltage range of 16V to 60V, and is capable of delivering up to 25A of output current. The output voltage can go as high as 24V with certain modifications.

The DC1804A supports three operation modes: fixed frequency pulse-width modulation, pulse skipping and Burst Mode® operation. Fixed frequency mode of operation maximizes the output current, reduces output voltage ripple and yields a low noise switching spectrum. Burst Mode operation employs a variable frequency switching algorithm that minimizes the no-load input quiescent current and improves efficiency at light loads.

The DC1804A consumes less than 50 μ A of quiescent current during shutdown and draws less than 1mA during no-load conditions in Burst Mode operation. In addition, this demo board has a standard operating frequency of 150kHz, but can be adjusted to frequencies as high as 900kHz.

The DC1804 is a dual phase step-down converter that can be easily transformed to a 4- or 6-phase system by combining two or three DC1804A boards. The LTC3890EUH data sheet gives a complete description of this part, its operation and application information, and must be read in conjunction with this DC1804A quick start guide.

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

LT, LT, LTC, LTM, Linear Technology, Burst Mode, PolyPhase and the Linear logo are registered trademarks of Linear Technology Corporation. All other trademarks are the property of their respective owners.

PERFORMANCE SUMMARY

| PARAMETER | CONDITIONS | VALUE |
|--------------------------------------|---|----------------------|
| Minimum Input Voltage | | 16V |
| Maximum Input Voltage | | 60V |
| Output Voltage V_{OUT} Regulation | V_{IN} : 16V to 55V | 12V \pm 2% |
| Maximum Continuous Output Current | | 25A |
| Preset Operating Frequency | R7 = 30.1k | 150kHz |
| External Clock Sync. Frequency Range | | 75kHz to 850kHz |
| Efficiency | V_{IN} = 36V, V_{OUT} = 12V, I_{OUT} = 12A. See Figure 3 Efficiency Curves for Complete Operating Range | 97% |
| Typical Output Ripple V_{OUT} | V_{IN} = 36V, I_{OUT} = 12A (20MHz BW) | <35mV _{P-P} |
| Quiescent Current at Shutdown | V_{IN} : 16V to 55V | <50 μ A |
| Input Current at No-Load | V_{IN} : 16V to 55V | <1mA |

QUICK START PROCEDURE

Demonstration circuit 1804A is easy to set up to evaluate the performance of the LTC3890. For proper measurement equipment configuration, set up the circuit according to the diagram in Figure 1. Before proceeding to test, insert the shunt into the JP1 (RUN) off position, which connects the RUN pin to ground (GND), and thus, shuts down the circuit.

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 the proper scope probe technique.

1. With the DC1804 set up according to the proper measurement and equipment in Figure 1, apply 20V at V_{IN} . Measure V_{OUT} ; it should read 0V. If desired, one can measure the shutdown supply current at this point. The supply current will be approximately 50 μ A, or less, in shutdown.

2. Turn on the circuit by inserting the shunt in header JP1 (RUN) into the on position. The output voltage should be regulating. Measure V_{OUT} ; it should measure 12V \pm 2%. **Do not apply more than the rated maximum voltage of 60V to the board or the part may be damaged.**
3. Vary the converter load, which should not exceed 25A. Note: all four input and output terminals V_{IN} , V_{OUT} and two GND equipped with two 'banana jacks', two wires can be used for each terminal to reduce copper losses and heat dissipation in the interconnection lines.
4. Vary the input voltage from 16V to 55V; the V_{OUT} should measure 12V \pm 2%.
5. Set output current to zero, move jumper JP2 (MODE) into the Burst Mode position and measure V_{OUT} ; it should register 12V \pm 2%.
6. Set output current to zero and move jumper JP2 (MODE) into the PLS SKIP position and measure V_{OUT} ; it should register 12V \pm 2%.

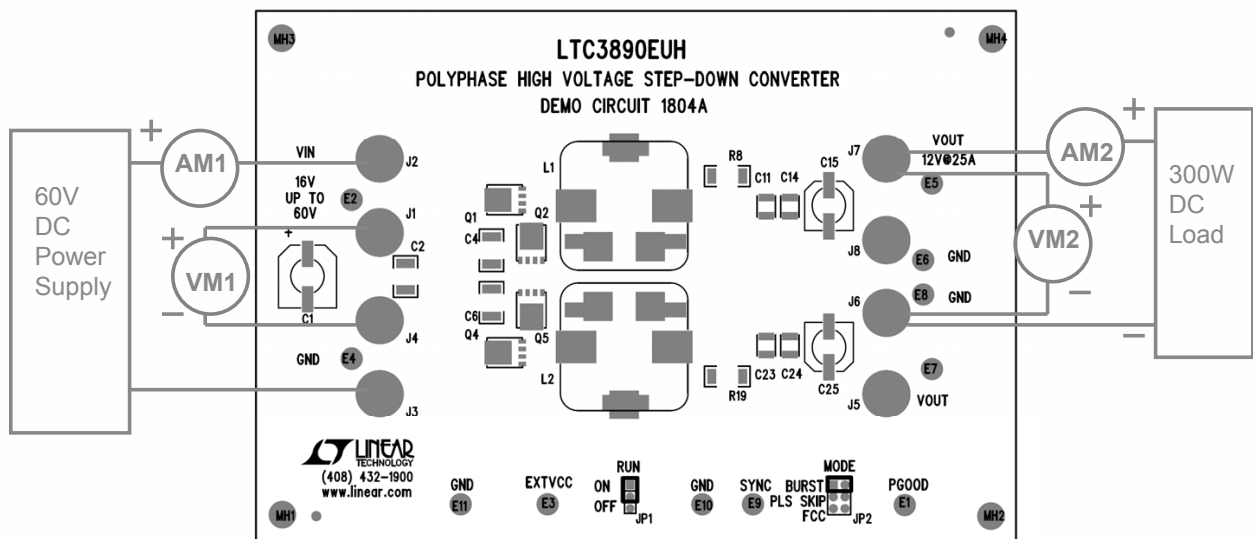


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

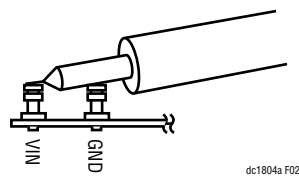


Figure 2. Measuring Input or Output Ripple

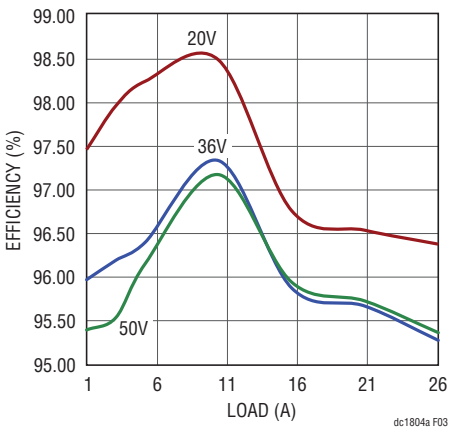


Figure 3. Efficiency vs Load

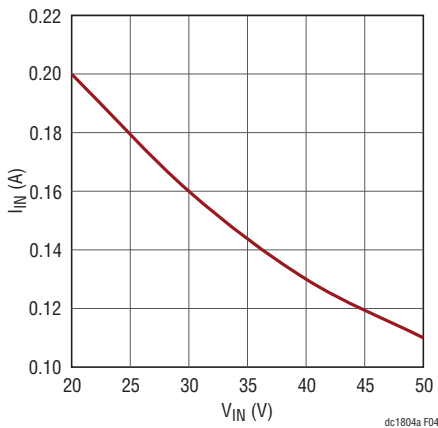


Figure 4. Input Current at No-Load vs Input Voltage

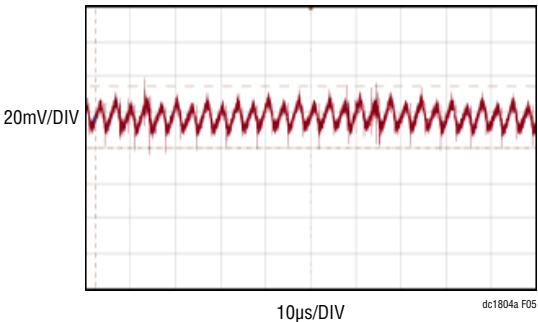


Figure 5. Output Noise, $V_{IN} = 36V$, $I_O = 12A$

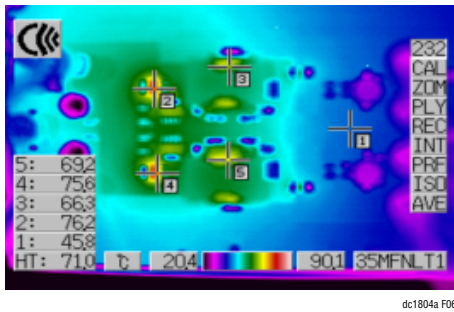


Figure 6. Thermal Map, $V_{IN} = 20V$, $I_O = 25A$, No Forced Air

DEMO MANUAL DC1804A

PARTS LIST

| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER/PART NUMBER |
|---|-----|---------------------------------|--------------------------------------|---|
| Required Circuit Components | | | | |
| 1 | 1 | C1 | Cap., Alum., 100µF, 63V, 10%, | Sun Elect., 63CE100BS |
| 2 | 6 | C2, C3, C4, C5, C6, C7 | Cap., X7R, 2.2µF, 100V 10%, 1812 | TDK, C4532X7R2A225K |
| 3 | 2 | C8, C26 | Cap., NPO, 2.2pF, 50V, 0603, ±0.25pF | AVX, 06035A2R2CAT |
| 4 | 1 | C9 | Cap., X7S, 1µF, 100V, 10%, 0805 | TDK, C2012X7S2A105K330 |
| 5 | 4 | C11, C14, C23, C24 | Cap., X5R, 10µF, 50V, 1210, 20% | Taiyo Yuden, UMK325BJ106MM-T |
| 6 | 3 | C12, C16, C21 | Cap., X7R, 0.1µF, 50V 10%, 0603 | TDK, C1608X7R1H104K |
| 7 | 2 | C15, C25 | Cap., Sanyo, 150µF, 16V, 20% | Sanyo, 16TSVPC150 |
| 8 | 1 | C17 | Cap., X7R, 4.7nF, 100V, 10%, 0603 | AVX, 06031C472KAT |
| 9 | 2 | C18, C19 | Cap., NPO, 47pF, 25V, 10%, 0603 | AVX, 06033A470KAT2A |
| 10 | 2 | C20 | Cap., X7R, 4.7µF, 10V, 10%, 0603 | Taiyo Yuden, LMK107BJ475KA-T |
| 11 | 1 | C22 | Cap., NPO, 10pF, 25V, 10%, 0603 | AVX, 06033A100KAT2A |
| 12 | 1 | C27 | Cap., X5R, 1µF, 25V, 10%, 0603 | AVX, 06033D105KAT2A |
| 13 | 2 | D1, D2 | Diode, Schottky, DFLS1100, PDI-123 | Diodes, Inc., DFLS1100 |
| 14 | 2 | L1, L2 | Ind., 10µH, SMD | Würth, 7443631000 |
| 15 | 2 | Q1, Q4 | Renesas, N-Channel Power MOSFET | Renesas, RJK0651DPB |
| 16 | 2 | Q2, Q5 | Renesas, N-Channel MOSFET | Renesas, RJK0653DPB |
| 17 | 1 | R1 | Res., 2.2, 1%, 1/10W, 0603 | Vishay, CRCW06032R20FNEA |
| 18 | 2 | R4, R22 | Res., 100, 1%, 1/10W, 0603 | Vishay, CRCW0603100RFKEA |
| 19 | 6 | R2, R10, R14, R15, R24, R27 | Res., 0Ω, 1/10W, 0603 | Vishay, CRCW06030000Z0EA |
| 20 | 1 | R6 | Res., 1M, 5%, 0805 | Vishay, CRCW08051M00JNED |
| 21 | 1 | R7 | Res., 30.1k, 1%, 1/10W, 0603 | Vishay, CRCW060330K1FKEA |
| 22 | 2 | R8, R19 | Res., 0.003Ω, 1%, 1/2W, 2010 | Vishay, WSL20103L000FEA |
| 23 | 1 | R9 | Res., 57.6k, 1%, 1/10W, 0603 | Vishay, CRCW060357K6FKEA |
| 24 | 2 | R12, R18 | Res., 0Ω, 1/10W, 0805 | Vishay, CRCW08050000Z0EA |
| 25 | 1 | R13 | Res., 9.76k, 1%, 1/10W, 0603 | Vishay, CRCW060315K0FKEA |
| 26 | 1 | R16 | Res., 499k, 1%, 1/10W, 0603 | Vishay, CRCW0603499KFKEA |
| 27 | 1 | R20 | Res., 35.7k, 1%, 1/10W, 0603 | Vishay, CRCW060335K7FKEA |
| 28 | 2 | R21, R29 | Res., 100k, 1%, 1/10W, 0603 | Vishay, CRCW0603100KFKEA |
| 29 | 1 | R28 | Res., 1k, 1%, 1/10W, 0603 | Vishay, CRCW06031K00FKEA |
| 30 | 1 | U1 | I.C., LTC3890EUH, QFN-32-UH | Linear Technology Corporation, LTC3890EUH |
| Additional Demo Board Circuit Components | | | | |
| 1 | 0 | R3, R5, C10, C13, R25, R26, C28 | Opt. | 0603 Package |
| 2 | 0 | Q3, Q6, Q7, Q8 | Opt | LFPK Package |
| Hardware | | | | |
| 1 | 11 | E1 to E11 | Testpoint, Turret, 0.094" | Mill-Max, 2501-2-00-80-00-00-07-0 |
| 2 | 2 | JP1, JP2 | JMP, 3-Pin, 1 Row, 0.079" | Samtec, TMM-103-02-L-S |
| 3 | 2 | XJP1, XJP2 | Shunt, 0.079" Center | Samtec, 2SN-BK-G |
| 4 | 7 | J1 to J8 | Connector, Banana Jack | Keystone, 575-4 |
| 5 | 4 | Mtgs at Four Corners | Standoff, Nylon, 0.5, 1/2" | Keystone, 8833 (Snap-On) |



DEMO MANUAL DC1804A

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

dc1804Af