

# LT3845A: High Voltage Synchronous Buck Controller with Programmable Frequency and Sync

## DESCRIPTION

Demonstration Circuit 1619A is a 100kHz to 500kHz programmable frequency, high voltage, current mode DC/DC step-down converter featuring the LT<sup>®</sup>3845A. The operating frequency can be synchronized up to 600kHz. This demo board is designed for 12V up to 10A (120W) output from a 16V to 60V input. A soft-start feature controls the output voltage slew rate at start-up, reducing current surges and voltage overshoots. The modes of operation (Burst Mode<sup>®</sup>, discontinuous current mode and continuous current mode) are jumper selectable. Both Burst Mode operation and discontinuous current mode increase the efficiency at light loads. Continuous current mode will maintain a constant switching frequency regardless of the load current.

An optional boost bias circuit is provided on the bottom side of the board for back-driving the LT3845A internal regulator from the output voltage. Customers may want to use this optional circuit with modified applications that have relatively high input voltages and low (~3.3V)

output voltages. In such applications, this optional circuit can increase the overall efficiency by reducing the power loss in the LT3845A. The demonstration board has the option of doubling the number of switching MOSFETs to facilitate higher output current. This board is suitable for a wide range of industrial control systems and telecom power supplies.

The LT3845A data sheet gives a complete description of the part, operation and application information. The data sheet must be read in conjunction with this quick start guide for demo circuit 1619A.

Note: It is best to ground the SYNC pin if the SYNC function is not being used.

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

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## PERFORMANCE SUMMARY (T<sub>A</sub> = 25°C)

| PARAMETER FOR BUCK REGULATOR               | CONDITION                                                            | VALUE                             |
|--------------------------------------------|----------------------------------------------------------------------|-----------------------------------|
| Minimum Input Voltage                      |                                                                      | 16V                               |
| Maximum Input Voltage                      |                                                                      | 60V                               |
| Output Voltage, V <sub>OUT</sub>           |                                                                      | 12V ±2%                           |
| Maximum Output Current                     | V <sub>IN</sub> < 28V<br>V <sub>IN</sub> ≥ 28V                       | 7.5A to 10A (See Figure 5)<br>10A |
| Typical Switching Frequency                | R9 = 49.9k                                                           | 300kHz                            |
| External Clock Synchronous Frequency Range | R9 = 49.9k                                                           | 325kHz to 600kHz                  |
| Efficiency                                 | V <sub>IN</sub> = 48V, V <sub>OUT</sub> = 12V, I <sub>OUT</sub> = 8A | 94% (See Figure 3)                |

## QUICK START PROCEDURE

Demonstration circuit 1619A is easy to set up to evaluate the performance of the LT3845A. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

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 directly across the VIN or VOUT capacitors by soldering leads on the appropriate capacitor. See Figure 2 for proper scope probe technique. An oscilloscope probe can be directly connected to VIN or VOUT using a banana jack to BNC adapters.

1. Place JP1 in the RUN position.
2. Place JP2 in the desired operating mode: burst, pulse-skipping or continuous.
3. With power off, connect the input power supply to VIN and GND.

4. Turn on the power at the input and adjust the input voltage until the LT3845A turns on.

Note: Make sure that the input voltage does not exceed 60V.

5. Check for the proper output voltage.

Note: If output does not come up, make sure the load is not set too high. Reduce the load and repeat steps 4 and 5.

6. Once the proper output voltage is established, adjust the input voltage and load within the operating range and observe the output voltage regulation, ripple voltage, efficiency and other parameters.
7. An external clock can be added to the SYNC pin when the SYNC function is used. See the Oscillator SYNC section in the data sheet for details.

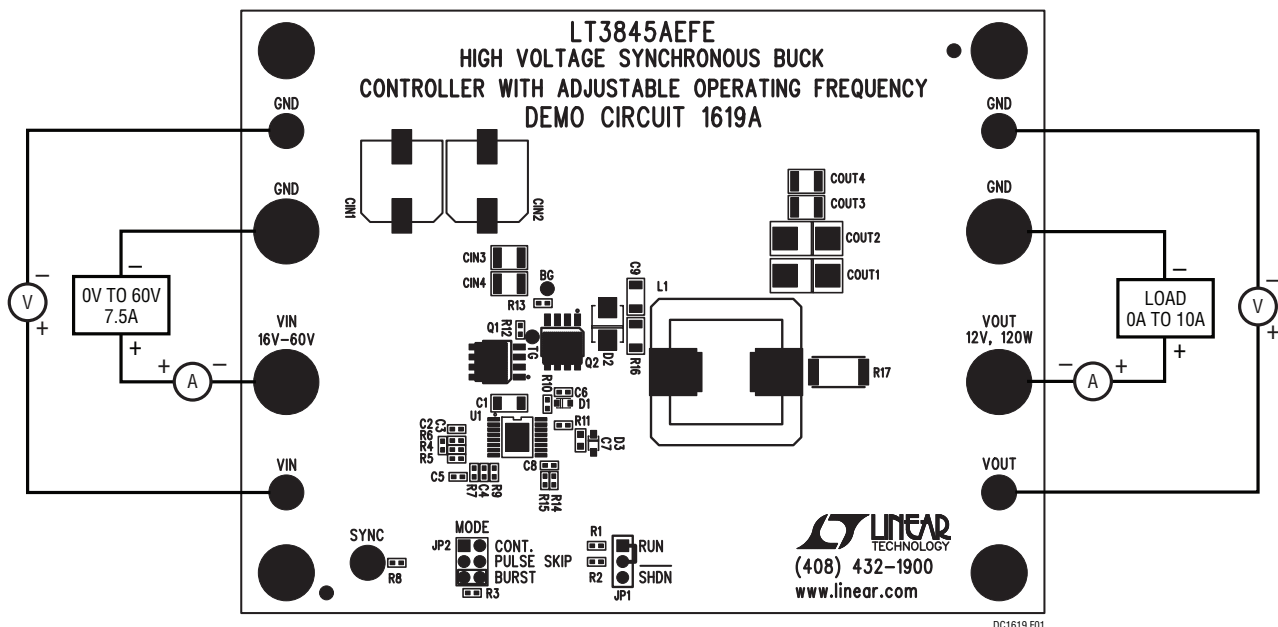


Figure 1. Proper Measurement Equipment Setup

## QUICK START PROCEDURE

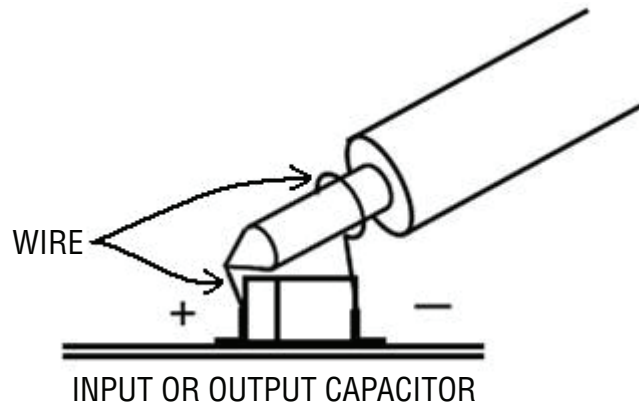


Figure 2. Measuring Input or Output Ripple

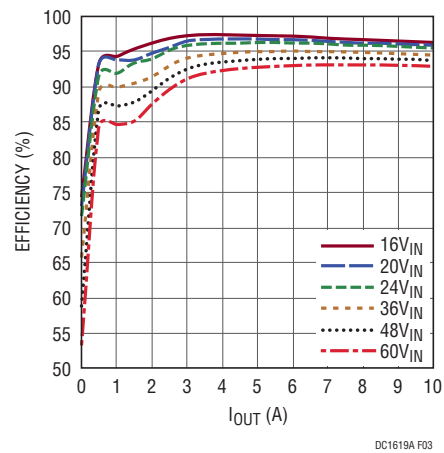


Figure 3. DC1619A Burst Mode Efficiency

QUICK START PROCEDURE

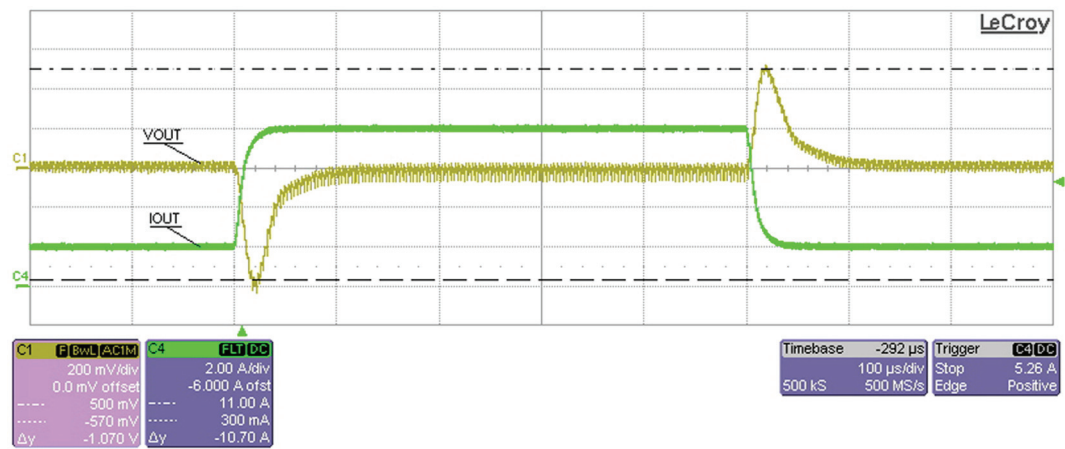


Figure 4. DC1619A 2A to 8A Load Transient

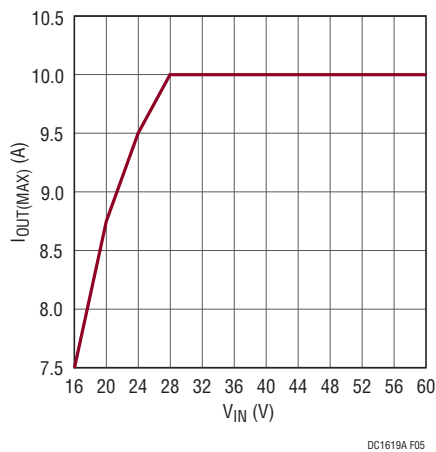


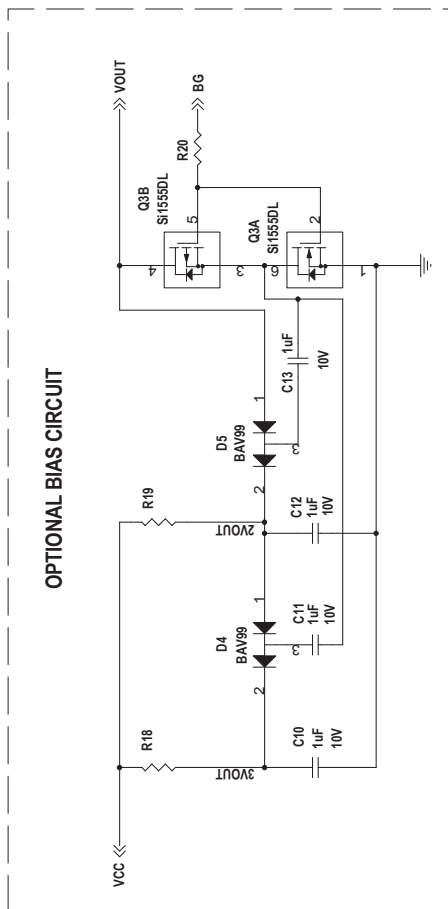
Figure 5. DC1619A Output Current Derating Graph

## PARTS LIST

| ITEM                                            | QTY | REFERENCE                   | PART DESCRIPTION                            | MANUFACTURER/PART NUMBER          |
|-------------------------------------------------|-----|-----------------------------|---------------------------------------------|-----------------------------------|
| <b>Required Circuit Components</b>              |     |                             |                                             |                                   |
| 1                                               | 2   | CIN1, CIN2                  | CAP, SMT Aluminum, 33 $\mu$ F, 63V          | SUNCON, 63HVH33M                  |
| 2                                               | 2   | CIN3, CIN4                  | CAP, X7R, 2.2 $\mu$ F, 100V, 10%, 1210      | MURATA, GRM32ER72A225KA35L        |
| 3                                               | 1   | COUT1                       | CAP, POSCAP, 68 $\mu$ F, 16V, 20%,          | SANYO, 16TQC68M                   |
| 4                                               | 1   | COUT3                       | CAP, X5R, 22 $\mu$ F, 16V, 10%, 1210        | TAIYO, EMK325BJ226KM-T            |
| 5                                               | 1   | C1                          | CAP, X5R, 0.47 $\mu$ F, 100V, 10%, 1206     | TDK, C3216X5R2A474KAT             |
| 6                                               | 2   | C2, C5                      | CAP, X7R, 1500pF, 50V, 10%, 0402            | AVX, 04025C152KAT                 |
| 7                                               | 1   | C4                          | CAP, C0G, 100pF, 50V, 10%, 0402             | TDK, C1005COG1H101J               |
| 8                                               | 1   | C6                          | CAP, X5R, 0.1 $\mu$ F, 16V, 10%, 0402       | AVX, 0402YD104KAT                 |
| 9                                               | 1   | C7                          | CAP, X5R, 1 $\mu$ F, 16V, 10%, 0603         | TDK, C1608X5R1C105K               |
| 10                                              | 1   | C9                          | CAP, C0G, 220pF, 100V, 10%, 1206            | VISHAY, VJ1206A221XB              |
| 11                                              | 1   | D1                          | HIGH VOLTAGE SWITCHING DIODE, SOD-523       | PHILLIPS, BAS521                  |
| 12                                              | 1   | D2                          | SMT SCHOTTKY BARRIER RECTIFIER, SMB         | DIODES INC, B160-13-F             |
| 13                                              | 1   | D3                          | HIGH VOLTAGE SWITCHING DIODE, SOD-323       | DIODES INC, 1N4148WS-7-F          |
| 14                                              | 1   | L1                          | INDUCTOR, 10 $\mu$ H                        | WURTH ELEKTRONIC, 74435561100     |
| 15                                              | 2   | Q1, Q2                      | N-MOSFET, 80V                               | INFINEON, BSC123N08NS3            |
| 16                                              | 1   | R1                          | RES., CHIP, 1M, 1/16W, 1%, 0402             | VISHAY, CRCW04021M00FKED          |
| 17                                              | 1   | R2                          | RES., CHIP, 97.6k, 1/16W, 1%, 0402          | VISHAY, CRW040297K6FKED           |
| 18                                              | 1   | R4                          | RES., CHIP, 143k, 1/16W, 1%, 0402           | VISHAY, CRCW0402143KFKED          |
| 19                                              | 1   | R5                          | RES., CHIP, 16.2k, 1/16W, 1%, 0402          | VISHAY, CRCW040216K2FKED          |
| 20                                              | 1   | R7                          | RES., CHIP, 20k, 1/16W, 1%, 0402            | VISHAY, CRCW040220K0FKED          |
| 21                                              | 1   | R9                          | RES., CHIP, 49.9k, 1/16W, 1%, 0402          | VISHAY, CRCW040249K9FKED          |
| 22                                              | 1   | R10                         | RES., CHIP, 4.99 $\Omega$ , 1/16W, 1%, 0402 | VISHAY, CRCW04024R99FKED          |
| 23                                              | 1   | R16                         | RES., CHIP, 6.65 $\Omega$ , 1/4W, 1%, 1206  | VISHAY, CRCW12066R65FKED          |
| 24                                              | 1   | R17                         | RES., CHIP, 0.007 $\Omega$ , 1W, 1%, 2512   | VISHAY, WSL25127L000FEA           |
| 25                                              | 1   | U1                          | I.C, LT3845AEFE#PBF, TSSOP (4.4MM) 16-PIN   | LINEAR TECH., LT3845AEFE#PBF      |
| <b>Additional Demo Board Circuit Components</b> |     |                             |                                             |                                   |
| 1                                               | 0   | COUT2 (OPT)                 | CAP, POSCAP, 68 $\mu$ F, 16V, 20%,          | SANYO, 16TQC68M                   |
| 2                                               | 0   | COUT4 (OPT)                 | CAP, X5R, 22 $\mu$ F, 16V, 10%, 1210        | AVX, 1210YD226KAT                 |
| 3                                               | 0   | C3, C8, C10-C13 (OPT)       | CAP, 0402                                   |                                   |
| 4                                               | 0   | D4, D5 (OPT)                | DUAL SMT SWITCHING DIODE, SOT-23            | DIODES INC, BAV99-7-F             |
| 5                                               | 1   | R3                          | RES., CHIP, 5.1M, 1/16W, 5%, 0402           | PANASONIC, ERJ2GEJ515X            |
| 6                                               | 5   | R11-R15                     | RES., CHIP, 0 $\Omega$ , 1/16W, 0402        | VISHAY, CRCW04020000Z0ED          |
| 7                                               | 1   | R8                          | RES., CHIP, 100k, 1/16W, 1%, 0402           | VISHAY, CRCW0402100KFKED          |
| 8                                               | 0   | Q4, Q5 (OPT)                | N-MOSFET, 80V                               | INFINEON, BSC123N08NS3            |
| 9                                               | 0   | Q3 (OPT)                    | COMPLIMENTARY MOSFET PAIR, SC-70            | VISHAY, Si1555DL-T1-E3            |
| 10                                              | 0   | R6, R18-R22 (OPT)           | RES., 0402                                  |                                   |
| <b>Hardware For Demo Board Only</b>             |     |                             |                                             |                                   |
| 1                                               | 4   | J1-J4                       | JACK, BANANA                                | KEYSTONE, 575-4                   |
| 2                                               | 5   | E1-E5                       | TESTPOINT, TURRET, 0.095"                   | MILL-MAX, 2501-2-00-80-00-00-07-0 |
| 3                                               | 1   | JP1                         | JMP, 3-PIN 1 ROW 0.079CC                    | SAMTEC, TMM-103-02-L-S            |
| 4                                               | 1   | JP2                         | 2MM DOUBLE ROW HEADER 2x3                   | SAMTEC, TMM-103-02-L-D            |
| 5                                               | 2   | JP1(1 and 2), JP2 (5 and 6) | SHUNT, 0.079" CENTER                        | SAMTEC, 2SN-BK-G                  |
| 6                                               | 4   | STAND-OFF                   | STAND-OFF, NYLON 0.50" tall                 | KEYSTONE, 8833(SNAP ON)           |

## SCHEMATIC DIAGRAM





USE OPTIONAL BIAS CIRCUIT TO BACKFEED VCC WHEN VOUT IS BETWEEN 9V AND 9V AND VCC POWER DISSIPATION EXCEEDS 250mW.  
REFER TO THE LT3845AEFE DATASHEET FOR MORE DETAILS.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           |          |  |                                                                                                                                        |  |  |  |          |    |          |          |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |  |  |      |        |      |     |           |   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|----------|--|----------------------------------------------------------------------------------------------------------------------------------------|--|--|--|----------|----|----------|----------|--|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|------|--------|------|-----|-----------|---|
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| PCB DES.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | NC        | MARTY M. |  |                                                                                                                                        |  |  |  |          |    |          |          |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |  |  |      |        |      |     |           |   |
| APP ENG.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |          |  |                                                                                                                                        |  |  |  |          |    |          |          |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |  |  |      |        |      |     |           |   |
| SIZE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | IC NO.    | REV.     |  |                                                                                                                                        |  |  |  |          |    |          |          |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |  |  |      |        |      |     |           |   |
| N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | LT3845AEF | 2        |  |                                                                                                                                        |  |  |  |          |    |          |          |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |  |  |      |        |      |     |           |   |

# DEMO MANUAL DC1619A

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dc1619af



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