DESCRIPTION

Demonstration circuit DC1409 is DC/DC boost converter featuring the LTC3788 constant frequency current mode boost controller. The DC1409A operates over 5V to 24V input and provides 8A to 10A of output current at 12V output. Also, the DC1409A provides a second 24V output capable of delivering 3A to 5A. The 300kHz constant frequency operation results in small and efficient circuit. The converter provides high output voltage accuracy (typically ±3%) over wide load range with no minimum load requirement.

The demonstration circuit can be easily modified to generate different output voltages. Also, the two outputs can be connected together to generate single output with two phase operation. Please consult LTC factory for details.

The DC1409 has small circuit footprint. It is a high performance and cost effective solution for Telecom, Automotive and Power Over Ethernet applications.

Design files for this circuit board are available. Call the LTC factory.

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Table 1. Performance Summary

PARAMETER	CONDITION	VALUE
Minimum Input Voltage DC1409A-A	I_{OUT1} = 0A to 3A, I_{OUT2} = 0A to 8A	5V
Maximum Input Voltage	I_{OUT1} = 0A to 5A, I_{OUT2} = 0A to 10A	24V
V_{OUT1}	V_{IN} = 5V to 24V, I_{OUT1} = 3A	24V ±3%
V_{OUT2}	V_{IN} = 5V to 12V, I_{OUT2} = 8A	12V ±3% (see text)
Typical Output Ripple V_{OUT1}	V_{IN} = 6V, I_{OUT} = 3A	200mV_{P-P}
V_{OUT2}	V_{IN} = 12V, I_{OUT} = 8A	200mV_{P-P}
Nominal Switching Frequency		350kHz

QUICK START PROCEDURE

Demonstration circuit DC1409 is easy to set up to evaluate the performance of the LTC3788. For proper measurement equipment setup refer to Figure 1 and follow the procedure below:

NOTE: When measuring the input or output voltage ripple, care must be taken to minimize the length of oscilloscope probe ground lead. Measure the input or output voltage ripple by connecting the

probe tip directly across the VIN or VOUT and GND terminals as shown in Figure 2.

1. With power off, connect the input power supply to Vin and GND.

2. Check the Vcc Bias voltage-setting jumper JP5. Move it into Vin position if required.

3. Turn the input power source on and slowly increase the input voltage. Be careful not to exceed 24V.

    NOTE: Make sure that the input voltage Vin does not exceed 24V. If higher operating voltage is required, power components with higher voltage ratings should be used.

4. Set the input voltage to 6V and check for the proper output voltage of 12V and 24V.

If there is no output, temporarily disconnect the load to make sure that the load is not set too high.

5. Once the proper output voltage is established, adjust the load and observe the output voltage regulation, ripple voltage, efficiency and other parameters.
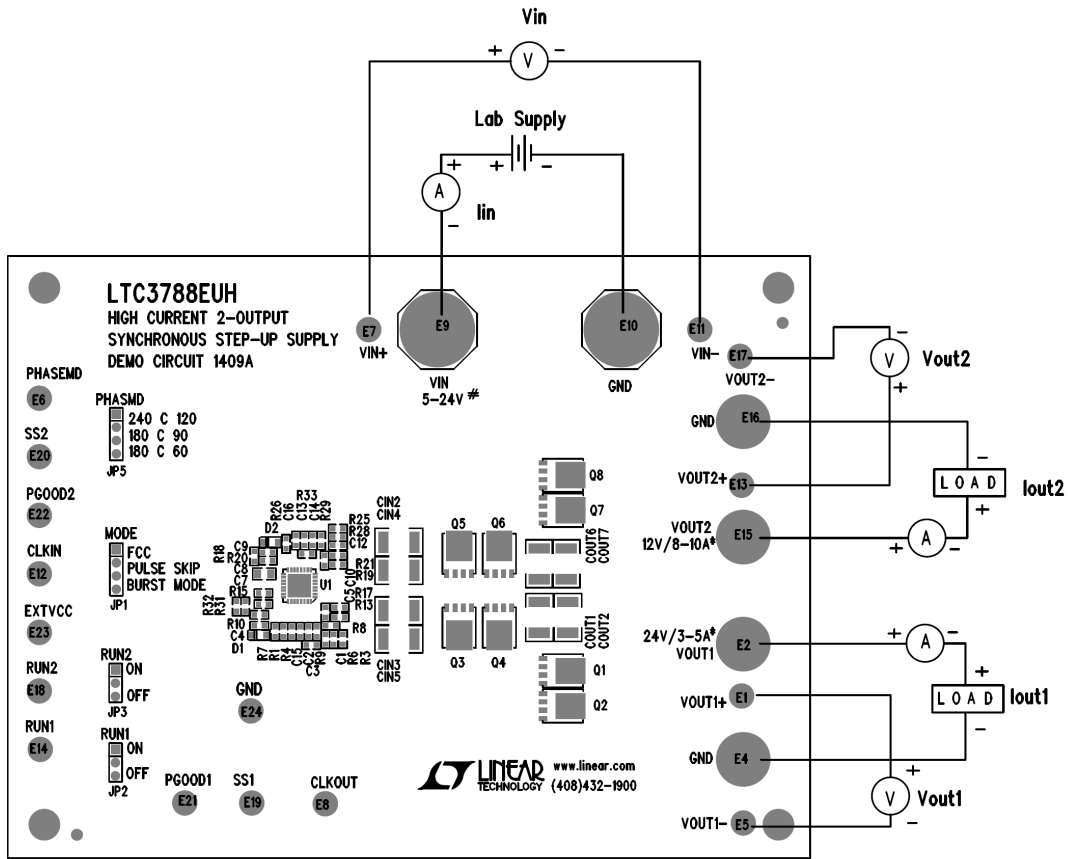
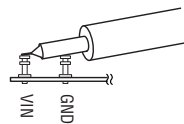**Figure 1. Proper Measurement Equipment Setup**

Figure 2. Measuring Input or Output Ripple

CHANGING THE OUTPUT VOLTAGE

To set the output voltage lower than 12V or 24V, change the bottom voltage divider resistors connected to LTC3788 FB pin (see the schematic on page 6).

To get higher than 12V and 24V output voltages MOSFETs and capacitors with higher voltage ratings may be required. Please contact LTC factory for details.

Note that the output voltage will start following the input voltage when input voltage is greater than the voltage set by the voltage divider. In this mode (wire mode) the output rectifier MOSFET is turned continuously ON. The only losses in this mode are due to the current sense resistors, inductor and output MOSFET DC resistance.

CONVERTER EFFICIENCY AND OUTPUT CURRENT

The DC1409 output current capability depends on the input voltage and proper cooling. Typical performance of DC1409A is shown in Figure 3. As can be seen from Figure 3, the output current capability depends on the input voltage. Also, when input voltage is equal or higher than the output voltge setting (wire mode) the efficiency is very high (99%) since the converter is not really running and the output MOSFET is shorting Vin to Vout (blue trace in Figure 3).
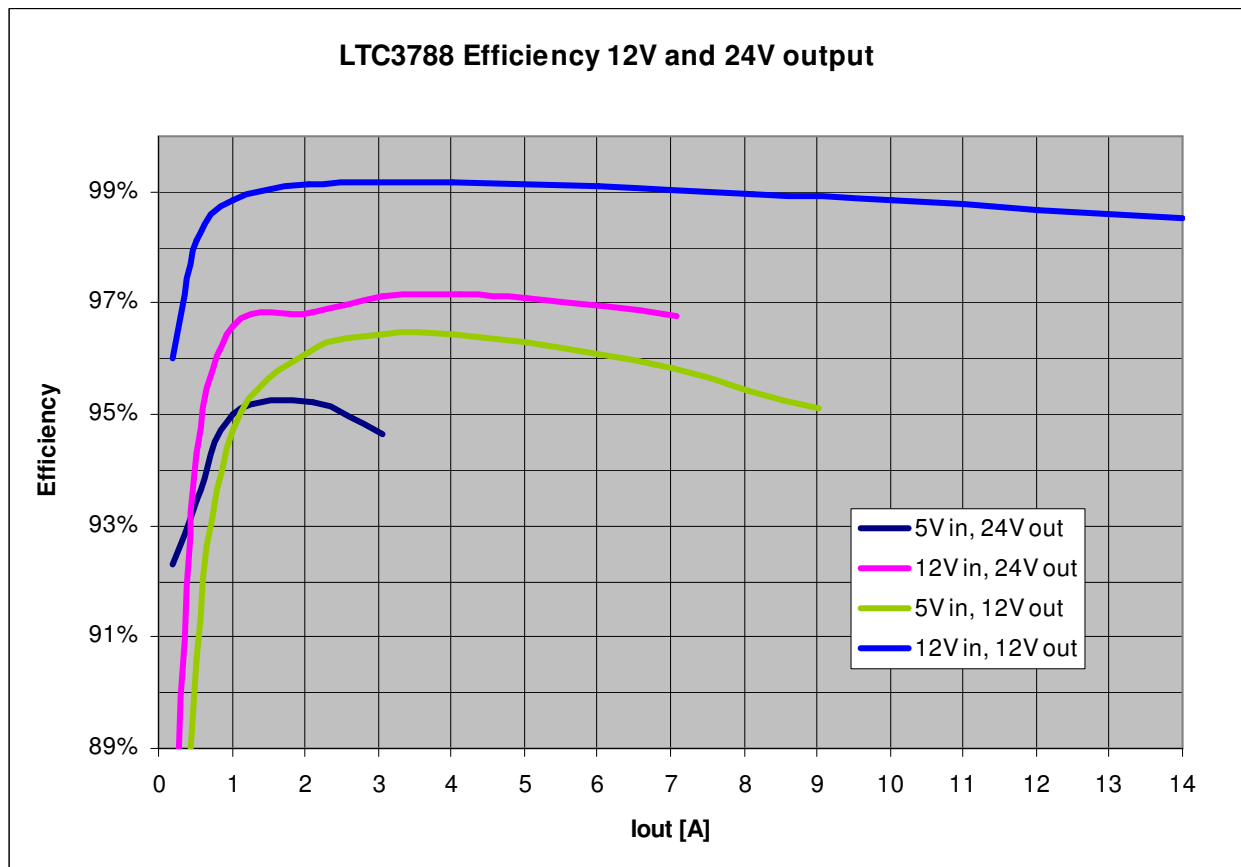

Figure 3. DC1409A Efficiency

OUTPUT LOAD STEP RESPONSE

The load step response of DC1409A is very good even though relatively small amount of output capacitance is present at the output. If higher load steps need to be handled more output capacitance can be added in order to keep the voltage transients at the desired level. The load step transients are shown in Figure 5 and Figure 6. Also, note that load step response even from 0% load is excellent thanks to synchronous rectification.
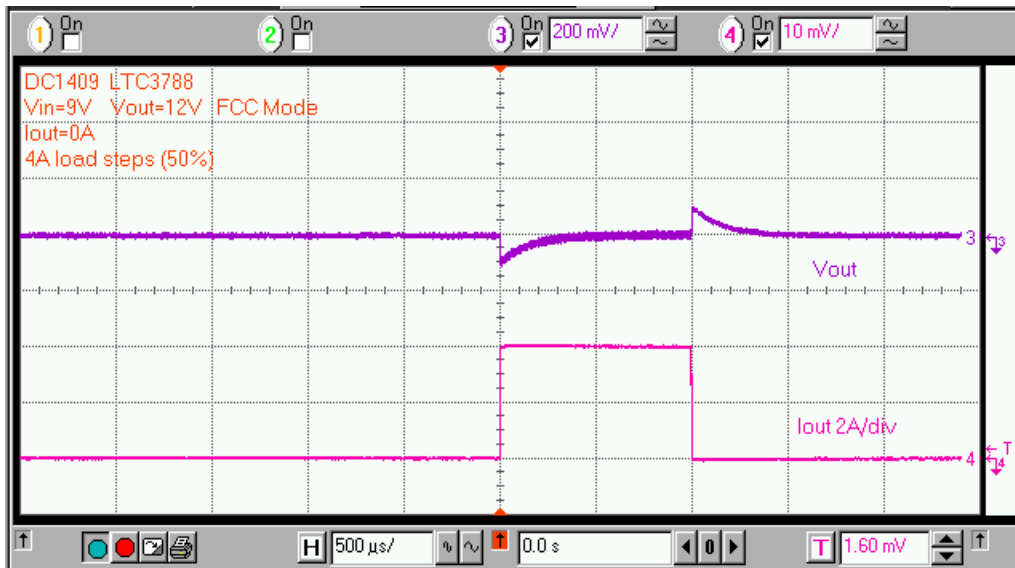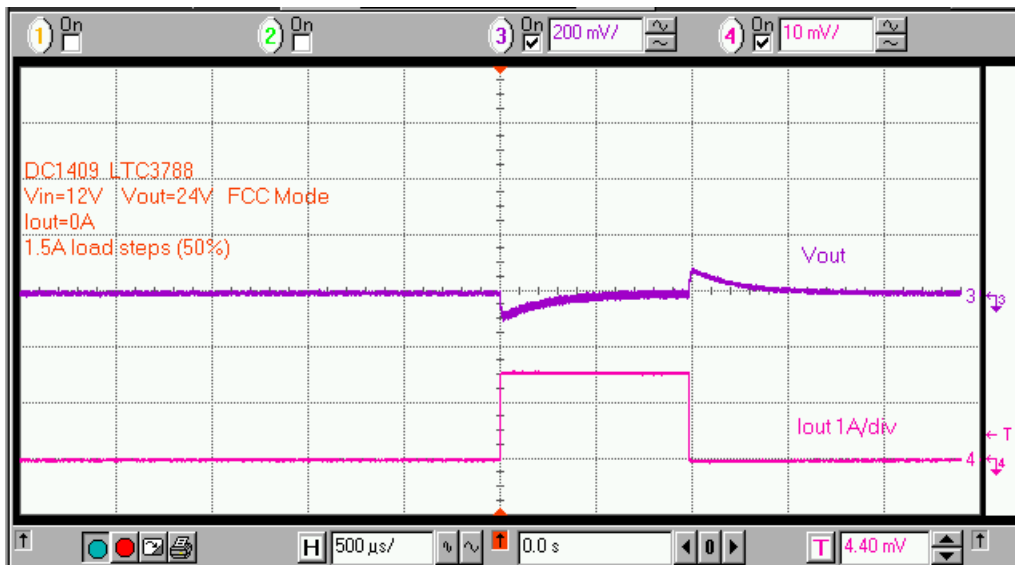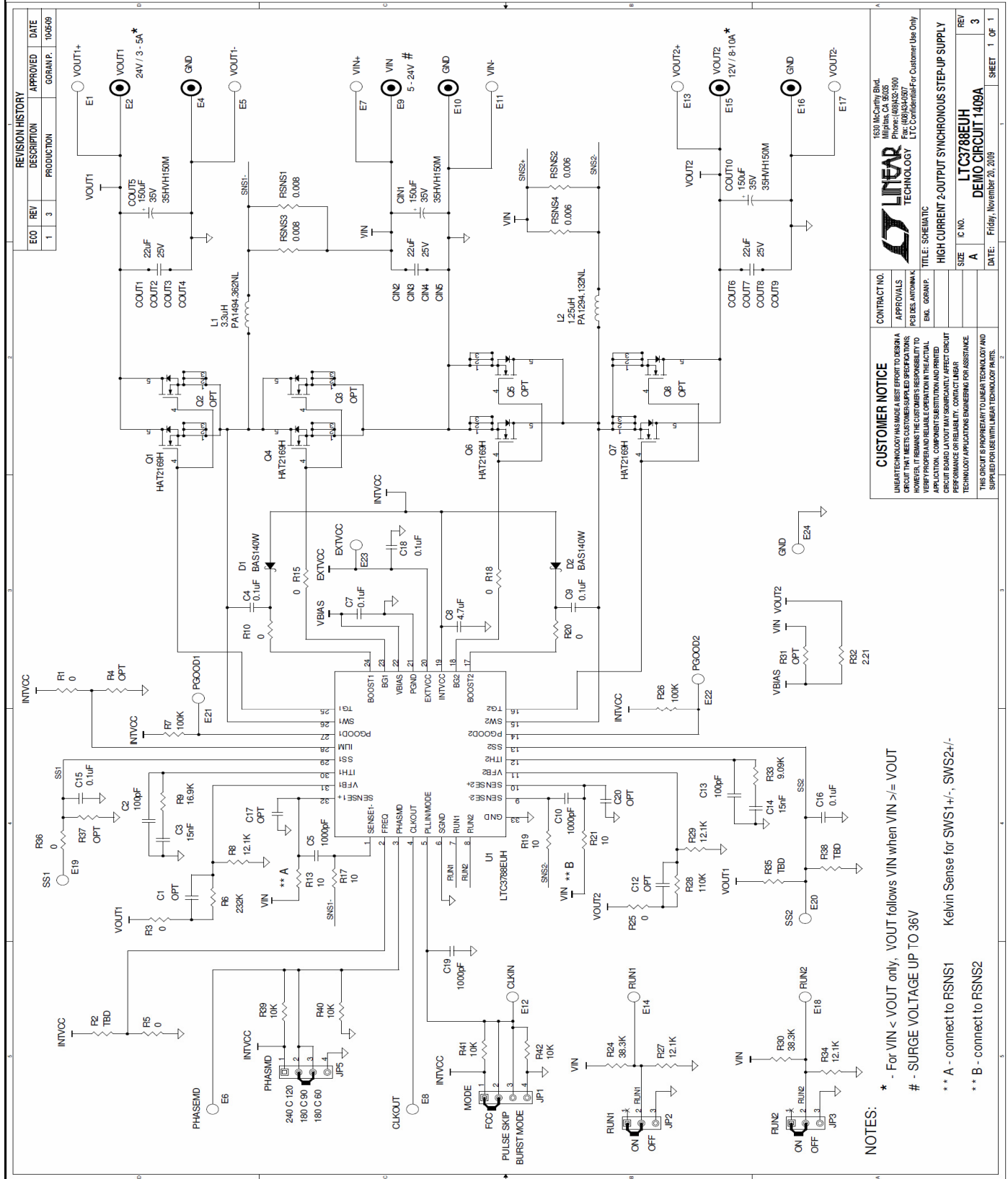

Figure 5. 12V Output load step response

Figure 6. 24V Output load step response

REVISION HISTORY

ECO	REV	DESCRIPTION	APPROVED	DATE
1	3	PRODUCTION	GORAN P.	10/05/09

VOUT1+ E1
VOUT1 E2 24V / 3 - 5A *
GND E4
VOUT1- E5

VIN+ E7
VIN E9 5 - 24V #
GND E10
VIN- E11

VOUT2+ E13
VOUT2 E15 12V / 8 -10A *
GND E16
VOUT2- E17

VOUT1
COUT5 150µF 35V 35HVH150M
COUT1 COUT2 COUT3 COUT4 22µF 25V
SNS1-
RSNS1 0.008
RSNS3 0.008
VIN
CIN1 150µF 35V 35HVH150M
CIN2 CIN3 CIN4 CIN5 22µF 25V
SNS2+
RSNS2 0.006
RSNS4 0.006
SNS2-
VIN
VOUT2
COUT10 150µF 35V 35HVH150M
COUT6 COUT7 COUT8 COUT9 22µF 25V

L1 3.3µH PA1494.362NL
L2 1.25µH PA1294.132NL

Q1 HAT2169H Q2 OPT Q4 HAT2169H Q3 OPT
Q6 HAT2169H Q5 OPT Q7 HAT2169H Q8 OPT

D1 BAS140W D2 BAS140W
C4 0.1µF C9 0.1µF
R10 0 R20 0
R15 0 R18 0
C18 0.1µF C8 4.7µF
C7 0.1µF
INTVCC EXTVCC VBIAS
E23

GND E24
VIN VOUT2
R31 OPT R32 2.21
VBIAS

R1 0 R4 OPT INTVCC PGOOD1 E21
R7 100K INTVCC

SS1
R36 0 R37 OPT C15 0.1µF C2 100pF R9 16.9K C17 OPT C5 1000pF
E19 C3 15nF R8 12.1K R13 10 R17 10
C1 OPT R6 232K VIN SNS1-
VOUT1 R3 0
**A **B

PGOOD2 E22
R26 100K INTVCC

R19 10 SNS2- VIN VOUT2
R21 10
C10 1000pF C20 OPT C13 100pF R33 9.09K
C12 OPT R29 12.1K C14 15nF C16 0.1µF
R28 110K VOUT1 R35 TBD R38 TBD
R25 0 SS2 E20

U1 LTC3788EUH

INTVCC P2 TBD R5 0
PHASEMD E6
PHASEMD 240 C 120 180 C 90 180 C 60
INTVCC R39 10K R40 10K
CLKOUT E8
C19 1000pF
CLKIN E12
INTVCC R41 10K R42 10K
MODE JP1 JP5
PULSE SKIP BURST MODE FCC

RUN1 E14
VIN R24 38.3K R27 12.1K
RUN1 JP2 ON OFF

RUN2 E18
VIN R30 38.3K R34 12.1K
RUN2 JP3 ON OFF

NOTES:

* - For VIN < VOUT only, VOUT follows VIN when VIN >/= VOUT
# - SURGE VOLTAGE UP TO 36V
** A - connect to RSNS1
** B - connect to RSNS2
Kelvin Sense for SWS1+/-, SWS2-/-

CONTRACT NO.
APPROVALS
PCB DES. ANTONINA K.
ENG. GORAN P.
TITLE: SCHEMATIC
HIGH CURRENT 2-OUTPUT SYNCHRONOUS STEP-UP SUPPLY

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IC NO. LTC3788EUH
DEMO CIRCUIT 1409A
SIZE A
REV 3
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SHEET 1 OF 1