

# LTC3630AEMSE/LTC3630EMSE

## High Efficiency High Voltage 500mA Synchronous Step-Down Converter

### DESCRIPTION

Demonstration circuit 2105A is a 500mA output DC/DC power supply. There are two versions: DC2105A-A is a board featuring [LTC®3630A](#), with 4V to 76V input range; DC2105A-B is a board featuring LTC3630, with 4V to 65V input range. The LTC3630A/LTC3630 operates in a high efficiency Burst Mode® operation and includes internal high and low side switches. The board provides jumper selected output voltages of 1.8V, 3.3V, 5V and an option for additional voltages. LTC3630A/LTC3630 has internal soft-start and a provision for increasing soft-start time.

Included on the board is an ON/OFF jumper that can also be configured as a precision undervoltage lockout. Additional PC pads are included for programming current limit to optimize efficiency and for reducing output voltage

ripple and reducing component size. A terminal (FBO) is available to allow multiple boards to be paralleled for increasing output current.

Output voltage between 800mV and  $V_{IN}$  can be programmed using optional resistors, although higher voltage output capacitors will be required.

The LTC3630A/LTC3630 data sheet gives a complete description of the operation and application information. The data sheet must be read in conjunction with this demo manual.

**Design files for this circuit board are available at <http://www.linear.com/demo/DC2105A>**

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### PERFORMANCE SUMMARY

Specifications are at  $T_A = 25^\circ\text{C}$

| PARAMETER                         | CONDITION                                      | VALUE               |
|-----------------------------------|------------------------------------------------|---------------------|
| Input Voltage Range for DC2105A-A | LTC3630A                                       | 4V to 76V           |
| Input Voltage Range for DC2105A-B | LTC3630                                        | 4V to 65V           |
| 1.8V Output                       | $V_{IN} = 20\text{V}$ , $V_{OUT}$ Load = 100mA | 1.8V $\pm 2\%$      |
| 3.3V Output                       | $V_{IN} = 20\text{V}$ , $V_{OUT}$ Load = 100mA | 3.3V $\pm 2\%$      |
| 5V Output                         | $V_{IN} = 20\text{V}$ , $V_{OUT}$ Load = 100mA | 5V $\pm 2\%$        |
| Maximum Output Current            | $V_{IN} = 20\text{V}$ , $V_{OUT} = 5\text{V}$  | 500mA               |
| Typical Output Voltage Ripple     | $V_{IN} = 20\text{V}$ , $V_{OUT} = 5\text{V}$  | 75mV <sub>p-p</sub> |

## QUICK START PROCEDURE

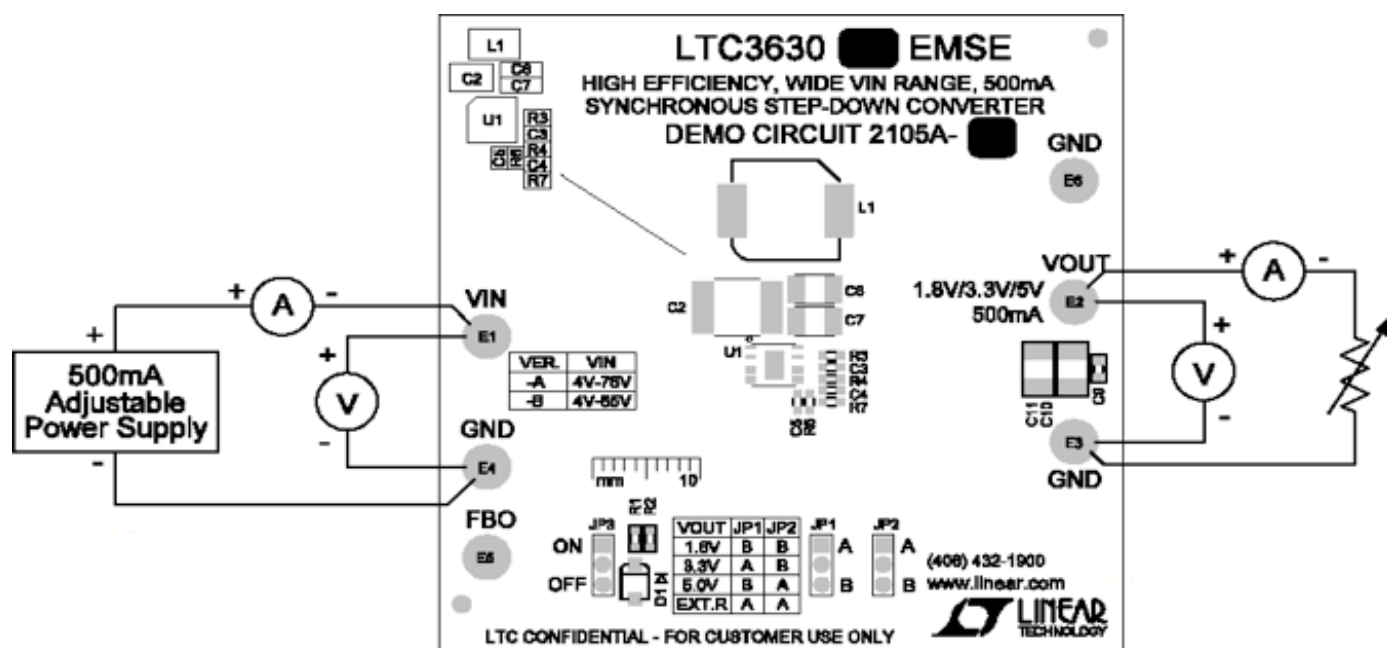
This DC2105A can be evaluated using the setup shown in Figure 1.

1. Connect the DVMs to the input and output. Select 5V setting using jumper JP1 (lower position) and JP2 (upper position), select ON position for JP3.
2. With input power supply set for 0V, connect the supply to  $V_{IN}$  and GND terminals using short (less than 10 inches) leads, preferably twisted leads. Connect a suitable load to  $V_{OUT}$  and GND terminals.
3. Slowly increase the input power supply to 10V. Observe output voltage and verify that it meets the specifications in the Performance Summary. Measure output voltage with and without the load.
4. Move jumpers JP1 and JP2 to the other two fixed voltage settings and verify that each output voltage meets the values as shown in the Performance Summary.

5. Once the proper output voltages are established, adjust the load and input voltage within the operating range and observe the output voltage regulation, ripple voltage and other parameters.

### NOTES:

1. **IMPORTANT: 60V or higher voltage can result in an electric shock if care is not taken. Also, hot plugging the circuit to a power supply that has more than 40V present at its output can produce a high voltage transient exceeding the absolute maximum input voltage which can damage the LTC3630A/LTC3630.**
2. 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 3 for proper scope probe technique.



**NOTE:** A 10 $\mu$ F, 100V electrolytic capacitor is necessary when evaluating circuit with input voltages greater than 40V, using long input wires and hot plugging circuit into a powered input supply. See Figure 2.

Figure 1. Proper Measurement Equipment Setup

## QUICK START PROCEDURE

### Circuit Options

Detailed information is contained in the data sheet.

**Optional Output Voltage:** Additional output voltages can be programmed by selecting proper resistors for the R6 and R7 feedback network. C5 is a feed-forward capacitor to optimize transient response and increase stability. JP1 and JP2 must be in the lower position if R6 and R7 are used. The 10V rated output capacitors must be replaced with suitable voltage ratings.

**ISET Components:** C3, R3 and R4 are used to provide a number of features and circuit enhancements such as, output current limit, input current limit, optimizing output ripple voltage reduction and efficiency improvement. R4 sets maximum output current, see Figure 2 in the

LTC3630A/LTC3630 data sheet, leave open for maximum load current. R3 and R4 can be used to set input current limit. C3 is used to reduce output voltage ripple and optimize efficiency. See data sheet for details.

**RUN Pin Components:** The converter is enabled when the RUN pin voltage exceeds 1.21V and is disabled when dropping below 0.7V. Moving JP3 to the ON position allows an internal current to pull the RUN pin up to 5V. R1 and R2 are used to program input undervoltage lockout. Select suitable resistors to divide the input voltage down to the precision threshold voltage levels that enable and disable the converter. Note that the maximum voltage on the RUN pin is 6V, therefore a nominal 5V Zener diode (D1) is required to limit the RUN pin voltage when high input voltages are used.

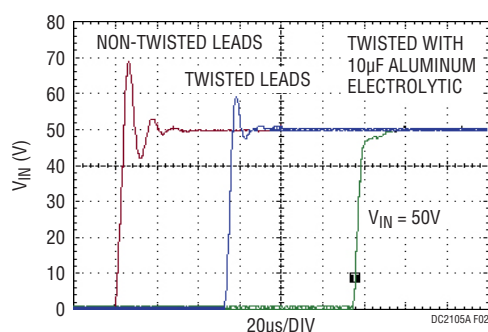


Figure 2. Hot Plugging Input Voltage Transient Using 12" Leads

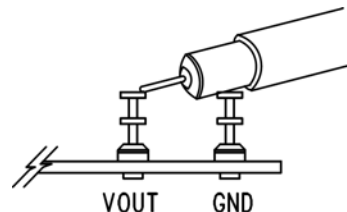
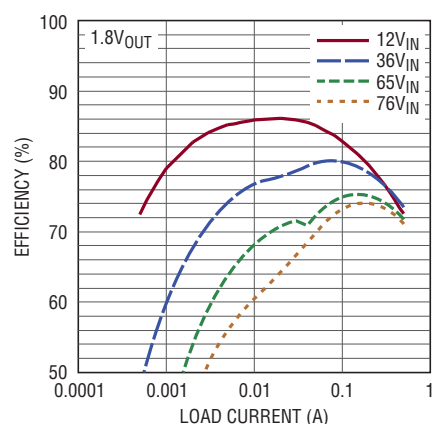
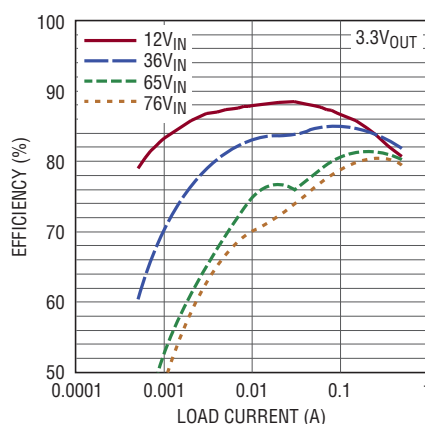


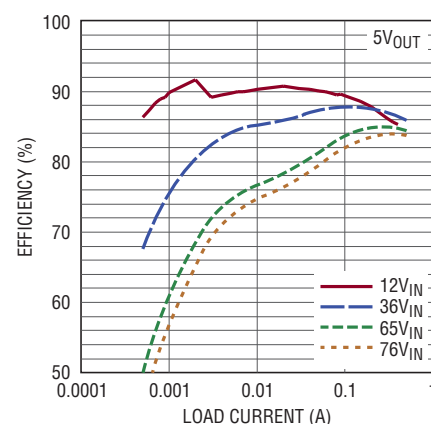
Figure 3. Measuring Input or Output Voltage Ripple



DC2105A F04a



DC2105A F04b



DC2105A F04c

Figure 4. Efficiency vs Load Current Curves

# DEMO MANUAL DC2105A

## PARTS LIST

### DC2105A-A

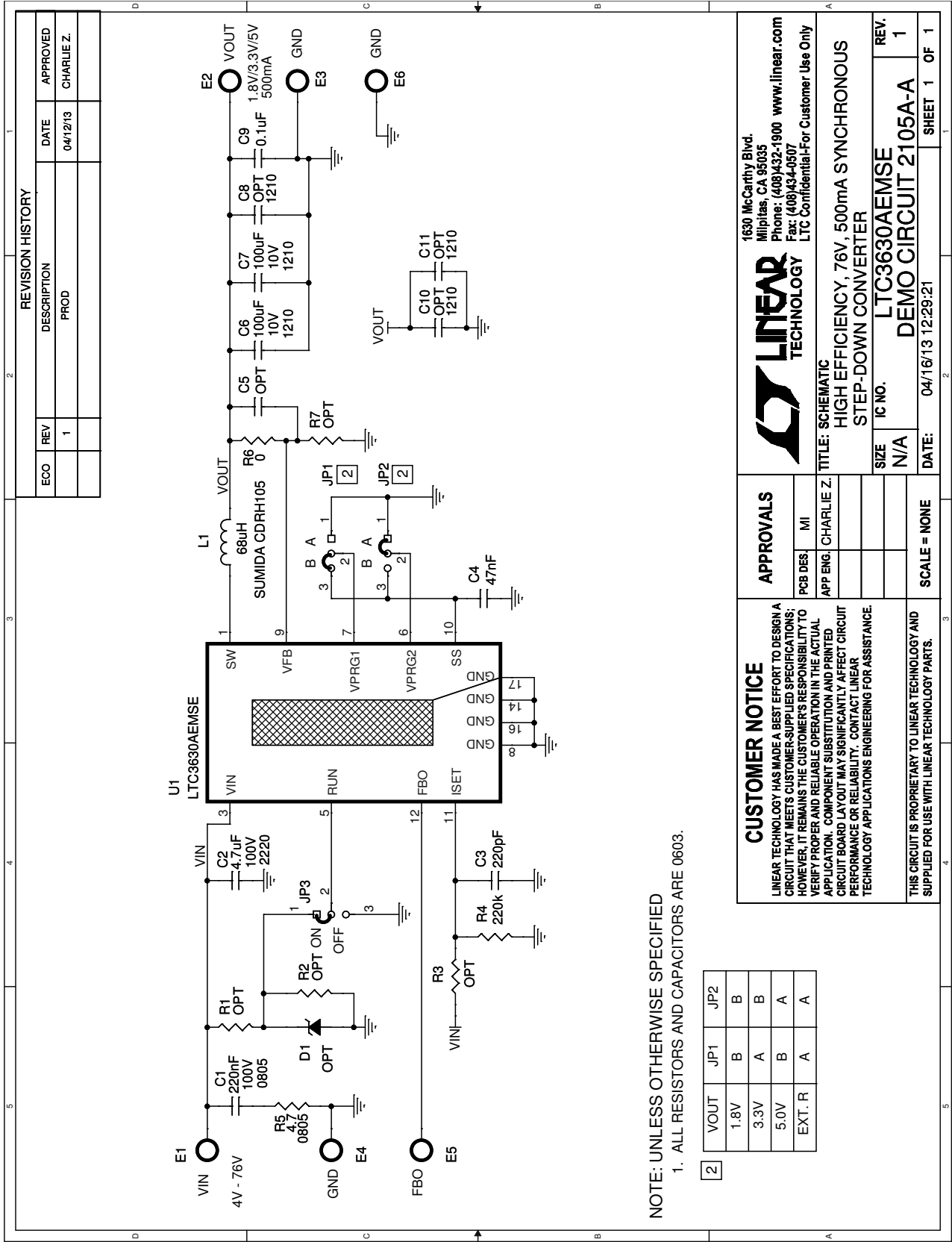
| ITEM                                            | QTY | REFERENCE              | PART DESCRIPTION                    | MANUFACTURER/PART NUMBER         |
|-------------------------------------------------|-----|------------------------|-------------------------------------|----------------------------------|
| <b>Required Circuit Components</b>              |     |                        |                                     |                                  |
| 1                                               | 1   | C1                     | CAP, 0805 220nF 10% 100V X7R        | MURATA GRM21AR72A224KAC5L        |
| 2                                               | 1   | C2                     | CAP, 2220 4.7 $\mu$ F 20% 100V X7R  | TDK C5750X7R2A475M               |
| 3                                               | 1   | C3                     | CAP, 0603 220pF 10% 50V X7R         | AVX 06035C221KAT2A               |
| 4                                               | 1   | C4                     | CAP, 0603 47nF 10% 25V X7R          | AVX 06033C473KAT                 |
| 5                                               | 2   | C6, C7                 | CAP, 1210 100 $\mu$ F 20% 10V X5R   | TAIYO YUDEN LMK325ABJ107MM-T     |
| 6                                               | 1   | C9                     | CAP, 0603 0.1 $\mu$ F 10% 25V X7R   | AVX 06033C104KAT2A               |
| 7                                               | 1   | L1                     | IND, 68 $\mu$ H                     | SUMIDA CDRH105RNP-680N           |
| 8                                               | 1   | R4                     | RES, 0603 220k $\Omega$ 5% 1/10W    | VISHAY CRCW0603220KJNEA          |
| 9                                               | 1   | R5                     | RES, 0805 4.7 $\Omega$ 5% 1/8W      | VISHAY CRCW08054R70JNEA          |
| 10                                              | 1   | R6                     | RES, 0603 0 $\Omega$ JUMPER         | VISHAY CRCW06030000Z0EA          |
| 11                                              | 1   | U1                     | IC, SYNCHRONOUS STEP-DOWN CONVERTER | LINEAR TECH. LTC3630AEMSE        |
| <b>Additional Demo Board Circuit Components</b> |     |                        |                                     |                                  |
| 1                                               | 0   | C5                     | CAP, 0603 OPTION                    | OPTION                           |
| 2                                               | 0   | C8, C10, C11           | CAP, 1210 OPTION                    | OPTION                           |
| 3                                               | 0   | D1                     | DIODE, OPTION                       | OPTION                           |
| 4                                               | 0   | R1, R2, R3, R7         | RES, 0603 OPTION                    | OPTION                           |
| <b>Hardware</b>                                 |     |                        |                                     |                                  |
| 1                                               | 6   | E1, E2, E3, E4, E5, E6 | TURRET                              | MILL MAX 2501-2-00-80-00-00-07-0 |
| 2                                               | 3   | JP1, JP2, JP3          | HEADER, 3 PIN, 2mm                  | SAMTEC TMM-103-02-L-S            |
| 3                                               | 3   | JP1, JP2, JP3          | SHUNT, 2mm                          | SAMTEC 2SN-BK-G                  |

## PARTS LIST

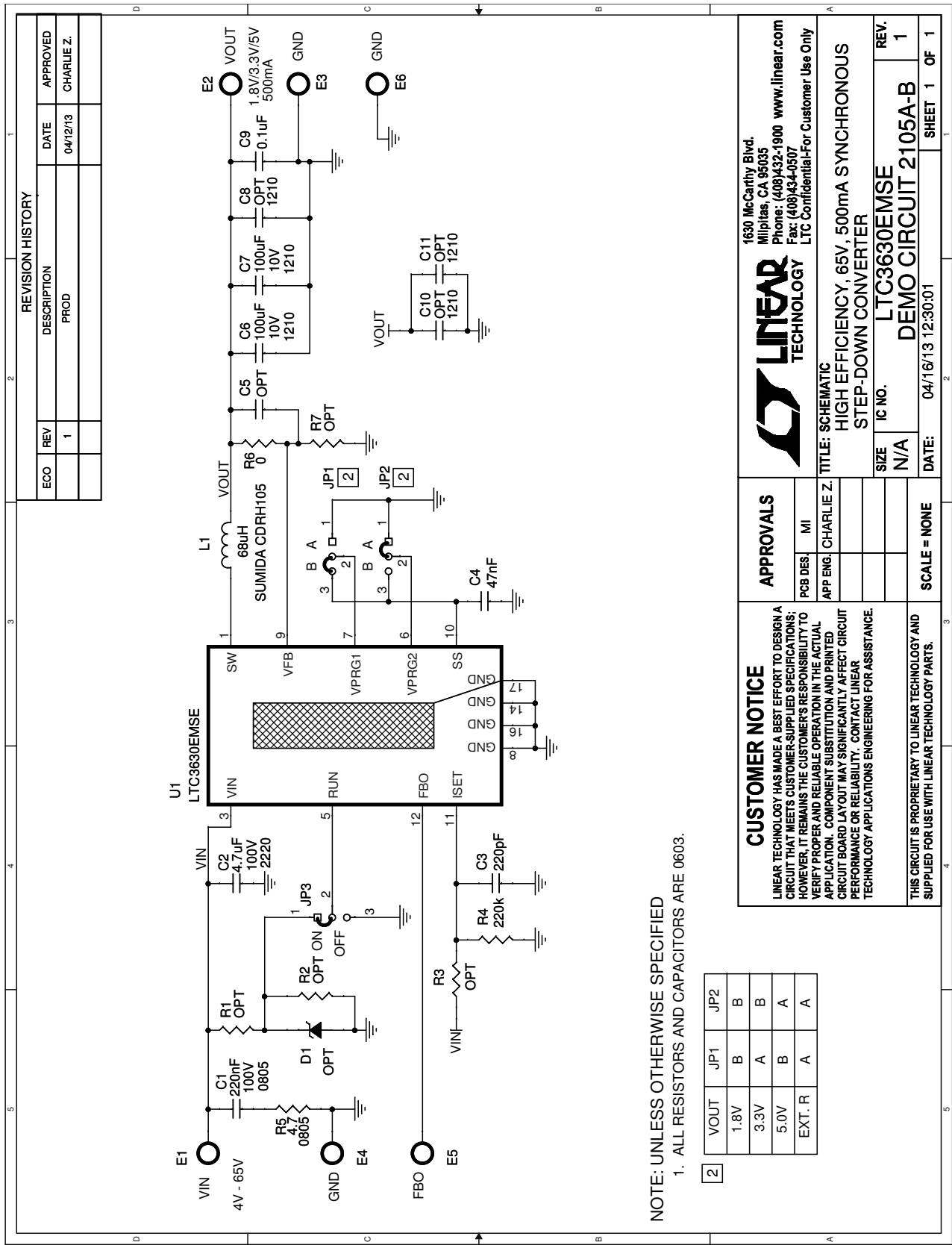
### DC2105A-B

| ITEM                                            | QTY | REFERENCE              | PART DESCRIPTION                    | MANUFACTURER/PART NUMBER         |
|-------------------------------------------------|-----|------------------------|-------------------------------------|----------------------------------|
| <b>Required Circuit Components</b>              |     |                        |                                     |                                  |
| 1                                               | 1   | C1                     | CAP, 0805 220nF 10% 100V X7R        | MURATA GRM21AR72A224KAC5L        |
| 2                                               | 1   | C2                     | CAP, 2220 4.7μF 20% 100V X7R        | TDK C5750X7R2A475M               |
| 3                                               | 1   | C3                     | CAP, 0603 220pF 10% 50V X7R         | AVX 06035C221KAT2A               |
| 4                                               | 1   | C4                     | CAP, 0603 47nF 10% 25V X7R          | AVX 06033C473KAT                 |
| 5                                               | 2   | C6, C7                 | CAP, 1210 100μF 20% 10V X5R         | TAIYO YUDEN LMK325ABJ107MM-T     |
| 6                                               | 1   | C9                     | CAP, 0603 0.1μF 10% 25V X7R         | AVX 06033C104KAT2A               |
| 7                                               | 1   | L1                     | IND, 68μH                           | SUMIDA CDRH105RNP-680N           |
| 8                                               | 1   | R4                     | RES, 0603 220kΩ 5% 1/10W            | VISHAY CRCW0603220KJNEA          |
| 9                                               | 1   | R5                     | RES, 0805 4.7Ω 5% 1/8W              | VISHAY CRCW08054R70JNEA          |
| 10                                              | 1   | R6                     | RES, 0603 0Ω JUMPER                 | VISHAY CRCW06030000Z0EA          |
| 11                                              | 1   | U1                     | IC, SYNCHRONOUS STEP-DOWN CONVERTER | LINEAR TECH. LTC3630EMSE         |
| <b>Additional Demo Board Circuit Components</b> |     |                        |                                     |                                  |
| 1                                               | 0   | C5                     | CAP, 0603 OPTION                    | OPTION                           |
| 2                                               | 0   | C8, C10, C11           | CAP, 1210 OPTION                    | OPTION                           |
| 3                                               | 0   | D1                     | DIODE, OPTION                       | OPTION                           |
| 4                                               | 0   | R1, R2, R3, R7         | RES, 0603 OPTION                    | OPTION                           |
| <b>Hardware</b>                                 |     |                        |                                     |                                  |
| 1                                               | 6   | E1, E2, E3, E4, E5, E6 | TURRET                              | MILL MAX 2501-2-00-80-00-00-07-0 |
| 2                                               | 3   | JP1, JP2, JP3          | HEADER, 3 PIN, 2mm                  | SAMTEC TMM-103-02-L-S            |
| 3                                               | 3   | JP1, JP2, JP3          | SHUNT, 2mm                          | SAMTEC 2SN-BK-G                  |

SCHEMATIC DIAGRAM



# SCHEMATIC DIAGRAM



# DEMO MANUAL DC2105A

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