

# LTC4120EUD

## Wireless Power Receiver and 400mA Buck Battery Charger

### DESCRIPTION

Demonstration circuit 2181 is an **LTC®4120EUD** demonstration board. The DC2181 is used with the DC1968A wireless power transmitter or the PowerByProxi ProxiPoint transmitter (both available separately). Either can deliver 2W to the DC2181, with up to 10mm spacing between the transmitter and the receive coil. The basic transmitter doesn't support foreign metal object detection. Transmitters available separately. See last page for details.

#### FEATURED PART

|           |                                |
|-----------|--------------------------------|
| DC2181A-A | LTC4120EUD-4.2 (Fixed Output)  |
| DC2181A-B | LTC4120EUD (Adjustable Output) |

Design files for this circuit board are available at <http://www.linear.com/demo/DC2181A>

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

### PERFORMANCE SUMMARY

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

| SYMBOL          | PARAMETER                                | CONDITIONS                                                           | MIN  | TYP | MAX  | UNITS |
|-----------------|------------------------------------------|----------------------------------------------------------------------|------|-----|------|-------|
| HVIN            | DC1968A High Voltage Input Voltage Range | IHVIN $\leq$ 500mA at HVIN = 8V                                      | 8    |     | 38   | V     |
| V <sub>CC</sub> | DC1968A V <sub>CC</sub> Input Range      | IV <sub>CC</sub> = 0 ~ 700mA                                         | 4.75 |     | 5.25 | V     |
| V(BAT)          | DC2181A BAT Pin Voltage                  | R9 = 1.40M $\Omega$ , R10 = 1.05M $\Omega$                           | 2.5  |     | 4.25 | V     |
| I(BAT)          | DC2181A BAT Pin Current                  | V(BAT) = 3.7V, DC1967A(R5) = 3.01k $\Omega$ , All Bar Graph LEDs on. | 370  | 380 | 390  | mA    |

### BOARD PHOTO

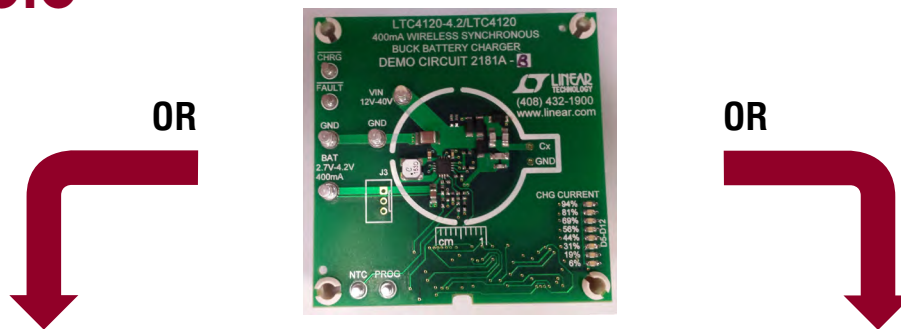


Figure 1. DC2181 Wireless Power Receiver Demo Board

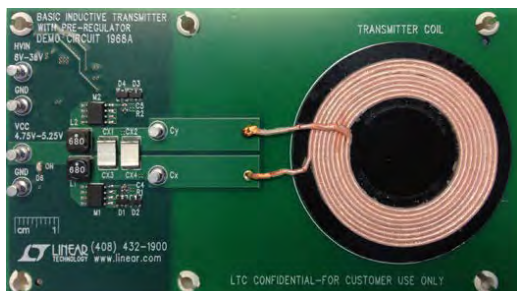


Figure 2. DC1968A Wireless Power Basic Transmitter Demo Board

NOTE: These boards are not included with DC2181 and must be ordered separately. See last page for details.



Figure 3. PowerByProxi ProxiPoint Transmitter

dc2181afb

### ASSEMBLY TEST PROCEDURE

For the proper measurement equipment setup and jumper settings refer to Figure 6a, if you are using the DC1968A wireless power basic transmitter, or Figure 5a, if you are using the PowerByProxi ProxiPoint transmitter. Please follow the checkout procedure, below, to familiarize yourself with the DC2181 demo board.

**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  $V_{CC}$  or  $V_{IN}$  and GND terminals. See Figure 4 for proper scope probe technique.

1. Connect power to the transmitter. For the DC1968A basic transmitter set PS1 to 5V, and turn on. For the PowerByProxi ProxiPoint transmitter, plug in the power supply that came with the transmitter.
2. Set PS2 to 3.6V, and turn the supply on. PS2 is the battery emulator *battery* voltage. The purpose of the  $3.6\Omega$  is to make PS2 into a bipolar supply. Most power supplies can only source current not sink current, bipolar supplies can do both. A bipolar supply is necessary for a battery emulator, as it must absorb the current coming from the charger. By placing a  $3.6\Omega$  resistor in parallel with a normal supply, the supply can absorb up to 1A, at 3.6V.

3. Place the DC2181A receive board on the transmitter as shown in Figure 5c, if you are using the PowerByProxi ProxiPoint transmitter. Or as shown in Figure 6c, if using the DC1968A. Note: for the ProxiPoint transmitter, the LED the ProxiPoint transmitter should change from green to solid red. If the LED turns blinking red, please remove the DC2181A board, wait until the LED turns green, and once again place the DC2181 on the transmitter. If the ProxiPoint transmitter LED does not change to solid red on the second try, please contact your FAE.
4. The green bar graph LEDs on the DC2181 demo board should light. Observe AM1, there is an additional 10mA flowing from the BAT into the bar graph LEDs. Please ensure that VM1 measures less than 4V. If not lower PS2 until it does.

The bar graph LEDs indicate the percent of programmed charge current flowing into the battery. They do so by monitoring the PROG voltage. PROG will be 1V, at full programmed charge current.

If you lower the battery emulator voltage, by lowering PS2, until VM1 reads approximately 2.9V, you will see the bar graph drop to 10%. This is the trickle current, which is set to 10% of the programmed charge current.

5. Test is complete.

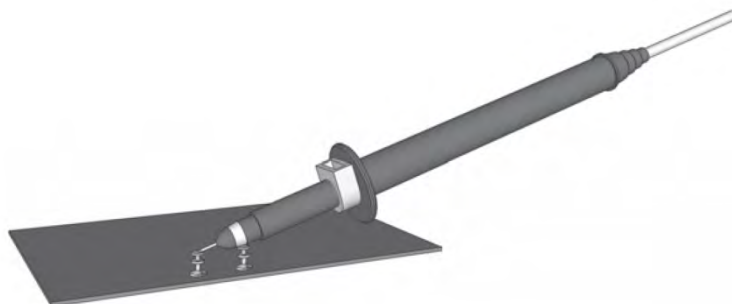


Figure 4. Proper Measurement Technique for Measuring Ripple

### ASSEMBLY TEST PROCEDURE

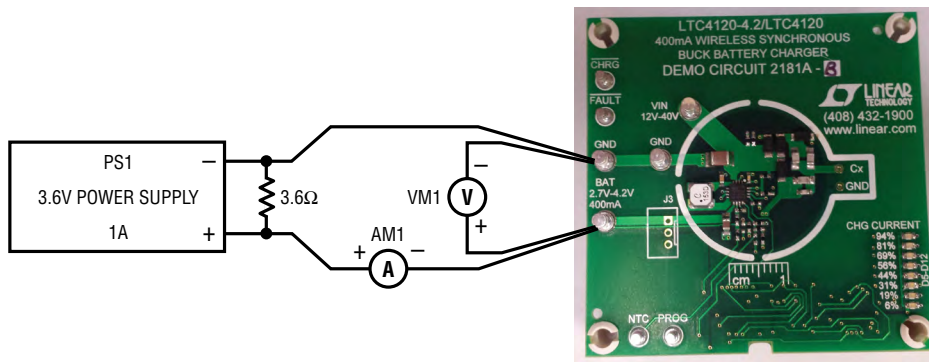


Figure 5a. DC2181A-A/B Wireless Power Demo Board Connection



Figure 5b. PowerByProxi's ProxiPoint Transmitter



Figure 5c. DC2181A-A/B Wireless Power Demo Board Mounted on PowerByProxi's ProxiPoint Transmitter

Note: All connections from equipment should be Kelvin connected directly to the board pins which they are connected on this diagram and any input or output leads should be twisted pair.

# DEMO MANUAL

## DC2181A-A/B

### ASSEMBLY TEST PROCEDURE

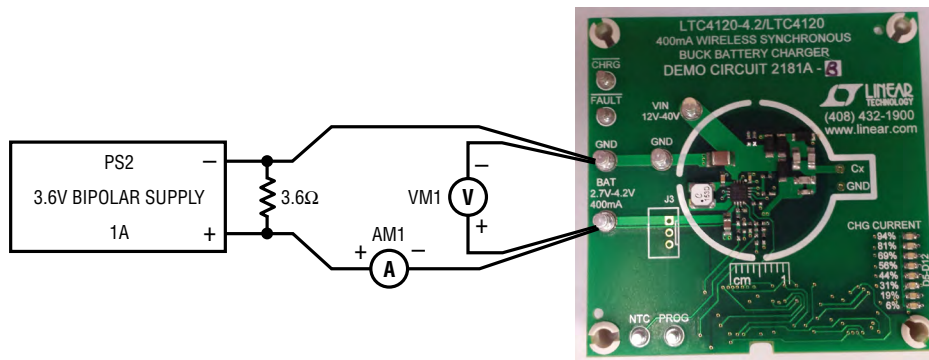


Figure 6a. DC2181A-A/B Wireless Power Demo Board Connection

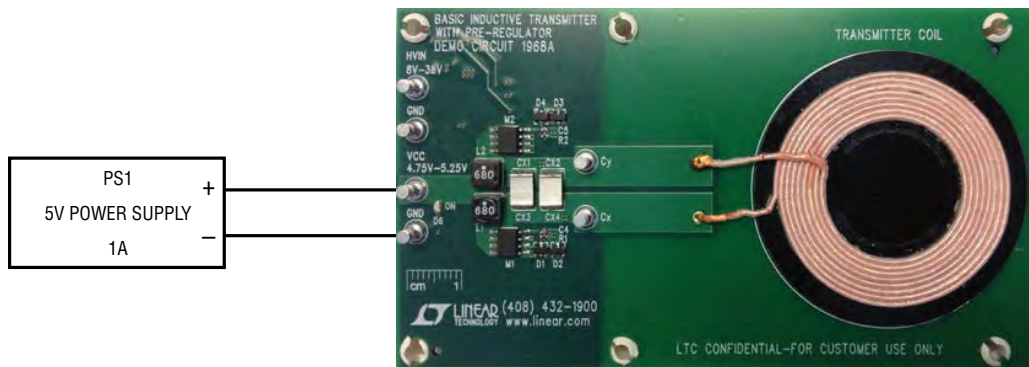


Figure 6b. DC1968A Wireless Power Basic Transmitter Connection

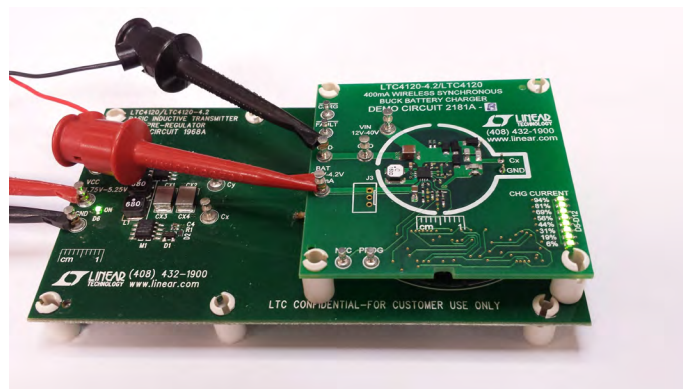


Figure 6c. DC2181A-A/B Wireless Power Demo Board Mounted on DC1968A Wireless Power Basic Transmitter

Note: All connections from equipment should be Kelvin connected directly to the board pins which they are connected on this diagram and any input or output leads should be twisted pair.

## THEORY OF OPERATION

The DC2181A demo board demonstrates operation of a double tuned magnetically coupled resonant power transfer circuit. The DC2181A demo Board must be used in conjunction with either the DC1968A wireless power basic transmitter or the PowerByProxi ProxiPoint transmitter.

For theory of operation of the PowerByProxi ProxiPoint transmitter, please refer to the ProxiPoint documentation.

### DC1968A – Basic Transmitter

The DC1968A basic transmitter is used to transmit wireless power and is used in conjunction with the DC2181A wireless power receiver board featuring the LTC4120.

The DC1968A is configured as a current fed astable multi-vibrator, with oscillation frequency set by a resonant tank. The DC1968A basic transmitter is set to 130kHz operation and the DC1967A LTC4120 demonstration board resonant frequency is 127kHz with DHC enabled and 140kHz with DHC disabled. For the DC1968A basic transmitter the resonant components are the 2X 0.15μF PPE film capacitors (Cx1 and Cx2) and the 5.0μH (Lx) transmit coil (see Schematic: Basic Inductive Transmitter with Pre-Regulator). This gives a resonant frequency of 129.95kHz. The tolerance on the transmit coil and resonant capacitors is ±2%, or 2.6kHz. Inductors L1 and L2 are used to make the resonant structure current fed.

The current fed topology makes the peak-to-peak voltage on the resonant tank equal to  $2\pi V_{CC}$ .  $V_{CC}$  is 5V, so the peak-to-peak tank voltage is 31.5V, see Figure 7.

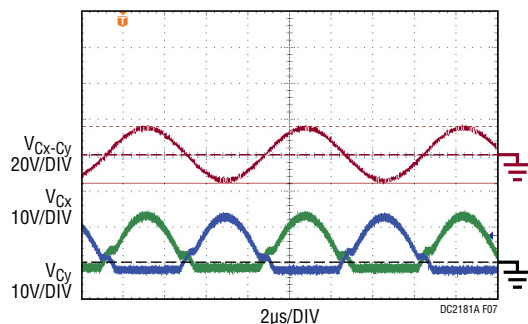


Figure 7. DC1968A Basic Transmitter

The blue and green traces are the drains of the transmitter MOSFETs M1 and M2 (see Schematic: Basic Inductive Transmitter with Pre-Regulator), respectively. The red trace is the difference ( $V_{CX} - V_{CY}$ ) of those two nodes, and shows that the resonant tank is producing a sine wave. The peak-to-peak voltage of  $2\pi V_{CC} = 31.5V$ , results from the current fed topology. This in turn determines the breakdown of the MOSFETs and diodes D2 and D3. To increase transmit power by raising  $V_{CC}$ , you must also change M1, M2, D2 and D3, to reflect the higher voltages on the  $C_X$  and  $C_Y$  nodes.

The magnitude of the magnetic field is directly proportional to the current in the transmit coil. For a resonant system this current is Q times the input current. So the higher the Q the larger the magnetic field. Therefore the transmit coil is constructed with Litz wire, and the resonant capacitors are very low dissipation PPS film capacitors. This leads to a Q of approximately 10 at 130kHz, and a circulating current of approximately 6A<sub>P-P</sub>, at full load.

### DC2181 – Wireless Power Receiver Board Featuring the LTC4120

The DC2181 LTC4120 wireless power receiver IC implements dynamic harmonization control (DHC), which tunes or detunes the receive circuit to receive more or less power as needed. The primary receive tank is composed of AE1, and C2S, although it must be noted that C2S is AC grounded through C5, the LTC4120 decoupling capacitor, to be in parallel with AE1. C2S also serves to tap power off the resonant circuit and send it to the LTC4120, (see Schematic: 400mA Wireless Synchronous Buck Battery Charger).



### THEORY OF OPERATION

The waveforms in Figure 8 were captured at a transmit-to-receive gap of 8mm. The blue trace is the waveform at the  $C_X$  pin of the receiver board (see Schematic: 400mA Wireless Synchronous Buck Battery Charger), and the red trace is the charge current into the battery. Although the transmit waveform is a sine wave, the series-parallel connection of the secondary resonant circuit does not yield a sine wave, and this waveform is correct. The charge current into the battery has an average of  $\approx 400\text{mA}$ , for a delivered power of  $1.5\text{W}$  ( $V_{\text{BAT}} = 3.7\text{V}$ ). However,  $10\text{mA}$  has been diverted to the charge LEDs, for a net battery charge current of  $390\text{mA}$ . The ripple on the charge current is synchronous to the transmit waveform.

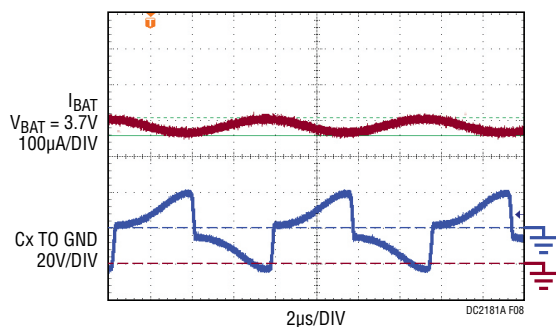


Figure 8. DC2181A Receiver Board

### DHC

When  $V_{\text{IN}}$  is above  $14\text{V}$ , the DHC pin is open and C2P doesn't enhance the energy transfer; this is the detuned state, and the resonant frequency of the receive tank is  $142\text{kHz}$ . When  $V_{\text{IN}}$  falls below  $14\text{V}$ , the DHC pin is grounded putting C2P in parallel with both C2S and AE1 thus changing the resonant frequency to  $127.4\text{kHz}$ . When the receiver is tuned at  $127.4\text{kHz}$  and drawing significant power, the transmit frequency is pulled down to  $127\text{kHz}$ . So, at full power the system is now a double-tuned resonant circuit. Figure 10 shows approximate power transfer vs distance between transmitter and receiver. Note the minimum clearance. The minimum is needed to avoid exceeding the maximum input voltage.

### Summary

The LTC4120 wireless power receiver IC adjusts the receiver resonant frequency to keep the system from transferring too much power when the coupling is high between transmit and receive coils. The LTC4120 wireless power receiver IC increases power transfer when power transfer is insufficient. This is accomplished by switching capacitors into the resonant circuit using the DHC pin. This gives a much wider operating transmit distance.

Figure 9 shows  $V_{\text{IN}}$  to the LTC4120 and the battery charge current. The blue trace is the charge current into the battery, and the red trace is the voltage at  $V_{\text{IN}}$  on the receiver board.  $V_{\text{IN}}$  is about  $25\text{V}$ , while the LTC4120 delivers  $1.5\text{W}$  at a distance of  $8\text{mm}$ , to the battery. There is negligible transmit frequency ripple on  $V_{\text{IN}}$ , and the voltage is well above the  $14\text{V}$  DHC voltage. This indicates that the input rectifiers are operating in peak detect mode, and that DHC is inactive.

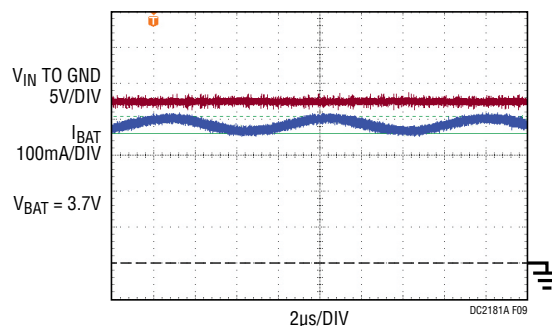


Figure 9. DC2181A Receiver

## THEORY OF OPERATION

### AE1, the Receive Antenna

One of the main differences between the DC1967A and the DC2181 demo boards, is that the wireless power receive antenna is separate for the DC2181 demo board.

Several antennas were tested, with the criteria of passing 2.5W at 8mm spacing. The following table lists the antennas that passed successfully:

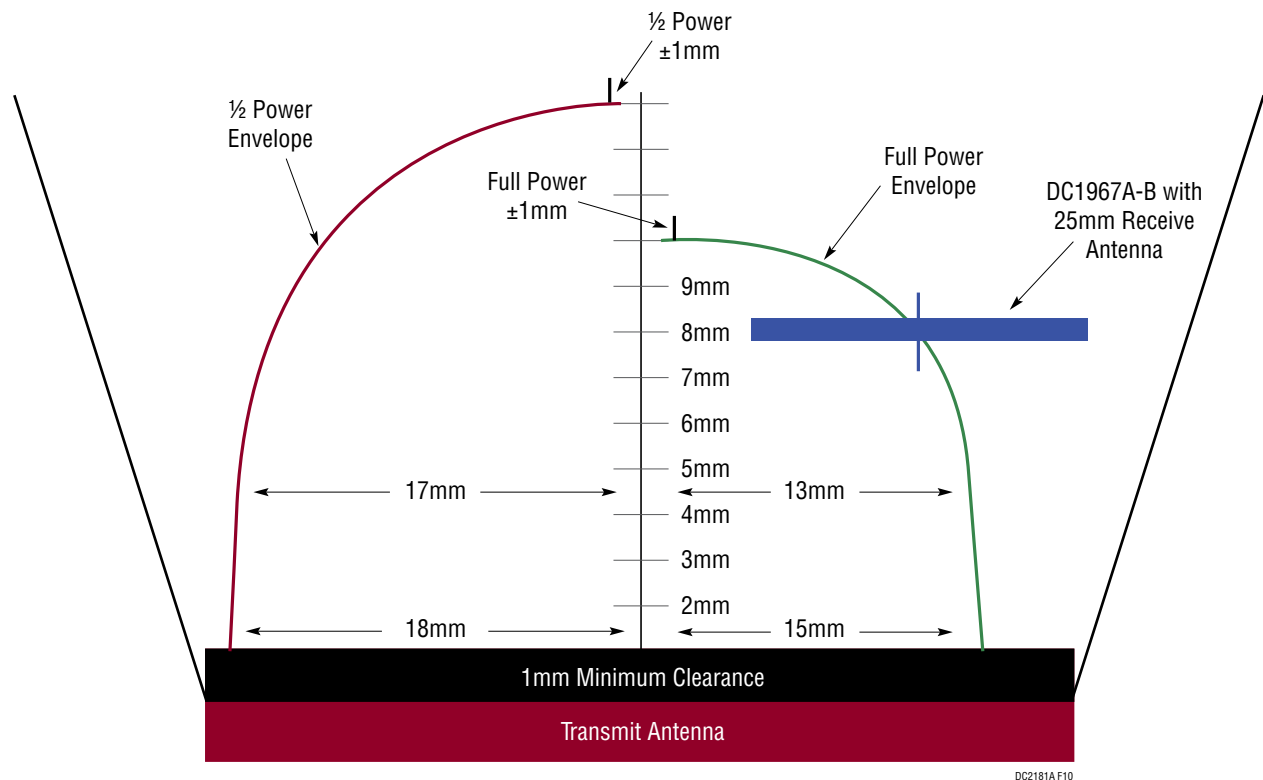
| MANUFACTURER           | CONSTRUCTION          | MFG PART NUMBER   |
|------------------------|-----------------------|-------------------|
| TDK                    | Ferrite on PCB        | B67410-A0223-X195 |
| Inter-Technical        | Ferrite on PCB        | L41200R01         |
| <b>Inter-Technical</b> | <b>Ferrite on PCB</b> | <b>L41200R02*</b> |
| Inter-Technical        | Litz on Ferrite       | L41200R03         |
| Inter-Technical        | Litz on Ferrite       | L41200R04         |
| Inter-Technical        | Ferrite on PCB        | L41200R05         |
| TDK                    | Wire on Ferrite       | WR282830-37M8-LR4 |
| Würth                  | Wire on Ferrite       | 760308101303      |

\*AE1 wireless power receive antenna shipped with DC2181

The manufacturers can be contacted at:

|                 |                                                                                                                                     |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Inter-Technical | <a href="http://www.inter-technical.com">www.inter-technical.com</a> , search for LTC4120                                           |
| TDK             | <a href="http://www.tdk.components.com">www.tdk.components.com</a>                                                                  |
| Würth           | <a href="http://katalog.we-online.de/pbs/datasheet/760308101303.pdf">http://katalog.we-online.de/pbs/datasheet/760308101303.pdf</a> |

AE1 is physically mounted with double sided tape, as well as the electrical connection pins. Removing AE1 is likely to damage the ferrite on the backside of the antenna. Only remove AE1 when you have a suitable replacement at hand.



DC2181A F10

Figure 10. Power Transfer vs Axial Distance and Misalignment

# DEMO MANUAL

## DC2181A-A/B

### PARTS LIST

| ITEM                                            | QTY | REFERENCE                         | PART DESCRIPTION                                                         | MANUFACTURER/PART NUMBER       |
|-------------------------------------------------|-----|-----------------------------------|--------------------------------------------------------------------------|--------------------------------|
| <b>DC2181A General Bill of Materials</b>        |     |                                   |                                                                          |                                |
| <b>DC2181A Required Circuit Components</b>      |     |                                   |                                                                          |                                |
| 1                                               | 1   | AE1                               | RECEIVE ANTENNA                                                          | INTER-TECHNICAL, L41200R02     |
| 2                                               | 2   | C2S1, C2P1                        | CAP, CHIP, COG, 0.0047 $\mu$ F, $\pm$ 5%, 50V, 0805                      | MURATA, GRM2165C1H472JA01D     |
| 3                                               | 1   | C2P2                              | CAP, CHIP, COG, 0.0018 $\mu$ F, $\pm$ 5%, 50V, 0603                      | KEMET, C0603C182J5GAC7533      |
| 4                                               | 1   | C2S2                              | CAP, CHIP, COG, 0.022 $\mu$ F, $\pm$ 5%, 50V, 0805                       | MURATA, GRM21B5C1H223JA01L     |
| 5                                               | 1   | C1                                | CAP, CHIP, X5R, 10 $\mu$ F, $\pm$ 20%, 16V, 0805                         | TDK, C2012X5R1C106K            |
| 6                                               | 1   | C2                                | CAP, CHIP, X5R, 47 $\mu$ F, $\pm$ 10%, 16V, 1210                         | MURATA, GRM32ER61C476KE15L     |
| 7                                               | 1   | C3                                | CAP, CHIP, X7R, 0.01 $\mu$ F, $\pm$ 10%, 50V, 0603                       | TDK, C1608X7R1H103K            |
| 8                                               | 1   | C4                                | CAP, CHIP, X5R, 2.2 $\mu$ F, $\pm$ 20%, 6.3V, 0402                       | MURATA, GRM155R60J225ME15D     |
| 9                                               | 1   | C5                                | CAP, CHIP, X7S, 10 $\mu$ F, $\pm$ 20%, 50V, 1210                         | TDK, C3225X7S1H106M            |
| 10                                              | 3   | D1, D2, D3                        | DIODE, SCHOTTKY, 40V, 2A, PowerDI123                                     | DIODES, DFLS240L-7             |
| 11                                              | 1   | L1                                | IND, SMT, 15 $\mu$ H, 260m $\Omega$ , $\pm$ 20%, 0.86A, 4mm $\times$ 4mm | COILCRAFT, LPS4018-153ML       |
| 12                                              | 1   | R1                                | RES, CHIP, 1.40M, $\pm$ 1%, 1/16W, 0402                                  | VISHAY, CRCW04021M40FKED       |
| 13                                              | 1   | R2                                | RES, CHIP, 412k $\Omega$ , $\pm$ 1%, 1/16W, 0402                         | VISHAY, CRCW0402412KFKED       |
| 14                                              | 2   | R3, R7                            | RES, CHIP, 10k $\Omega$ , $\pm$ 1%, 1/16W, 0402                          | VISHAY, CRCW040210K0FKED       |
| 15                                              | 1   | R5                                | RES, CHIP, 3.01k $\Omega$ , $\pm$ 1%, 1/16W, 0402                        | VISHAY, CRCW04023K01FKED       |
| 16                                              | 1   | R36                               | RES, CHIP, 0 $\Omega$ JUMPER, 1/16W, 0402                                | VISHAY, CRCW04020000Z0ED       |
| <b>Additional Demo Board Circuit Components</b> |     |                                   |                                                                          |                                |
| 1                                               | 3   | C6, C8, C9                        | CAP, CHIP, X7R, 0.01 $\mu$ F, $\pm$ 10%, 25V, 0402                       | TDK, C1005X7R1E103K            |
| 2                                               | 2   | C7, C10                           | CAP, CHIP, X5R, 1 $\mu$ F, $\pm$ 10%, 16V, 0402                          | TDK, C1005X5R1C105K            |
| 3                                               | 1   | D4                                | DIODE, ZENER, 39V, $\pm$ 5%, 1W, PowerDI123                              | DIODES, DFLZ39                 |
| 4                                               | 8   | D5, D6, D7, D8, D9, D10, D11, D12 | DIODE, LED, GREEN, 0603                                                  | LITE-ON, LTST-C193KGKT-5A      |
| 5                                               | 1   | R4                                | RES, CHIP, 2k $\Omega$ , $\pm$ 5%, 1/16W, 0402                           | VISHAY, CRCW04022K00JNED       |
| 6                                               | 2   | R11, R12                          | RES, CHIP, 100k $\Omega$ , $\pm$ 5%, 1/16W, 0402                         | VISHAY, CRCW0402100KJNED       |
| 7                                               | 1   | R13                               | RES, CHIP, 10k $\Omega$ , $\pm$ 5%, 1/16W, 0402                          | VISHAY, CRCW040210K0JNED       |
| 8                                               | 2   | R14, R35                          | RES, CHIP, 432 $\Omega$ , $\pm$ 1%, 1/16W, 0402                          | VISHAY, CRCW0402432RFKED       |
| 9                                               | 2   | R15, R33                          | RES, CHIP, 22.6k $\Omega$ , $\pm$ 1%, 1/16W, 0402                        | VISHAY, CRCW040222K6FKED       |
| 10                                              | 1   | R16                               | RES, CHIP, 34.8k $\Omega$ , $\pm$ 1%, 1/16W, 0402                        | VISHAY, CRCW040234K8FKED       |
| 11                                              | 7   | R17, R18, R19, R20, R21, R22, R23 | RES, CHIP, 100k $\Omega$ , $\pm$ 1%, 1/16W, 0402                         | VISHAY, CRCW0402100KFKED       |
| 12                                              | 1   | R24                               | RES, CHIP, 49.9k $\Omega$ , $\pm$ 1%, 1/16W, 0402                        | VISHAY, CRCW040249K9FKED       |
| 13                                              | 8   | R25 TO R32                        | RES, CHIP, 1k $\Omega$ , $\pm$ 5%, 1/16W, 0402                           | VISHAY, CRCW04021K00JNED       |
| 14                                              | 1   | R34                               | RES, CHIP, 787k $\Omega$ , $\pm$ 1%, 1/16W, 0402                         | VISHAY, CRCW0402787KFKED       |
| 15                                              | 2   | R6, R38                           | RES, CHIP, 0 $\Omega$ JUMPER, 1/16W, 0402                                | VISHAY, CRCW04020000Z0ED       |
| 16                                              | 0   | R8-OPT, R37-OPT                   | RES, CHIP, 0 $\Omega$ JUMPER, 1/16W, 0402                                | VISHAY, CRCW04020000Z0ED       |
| 17                                              | 2   | U2, U3                            | ULTRALOW POWER QUAD COMPARATORS WITH REFERENCE, 5mm $\times$ 4mm DFN16   | LINEAR TECHNOLOGY, LTC1445CDHD |



### PARTS LIST

| ITEM                                 | QTY     | REFERENCE          | PART DESCRIPTION                                                            | MANUFACTURER/PART NUMBER          |
|--------------------------------------|---------|--------------------|-----------------------------------------------------------------------------|-----------------------------------|
| <b>Hardware: For Demo Board Only</b> |         |                    |                                                                             |                                   |
| 1                                    | 4       | E3, E4, E7, E8     | TURRET, 0.091"                                                              | MILL-MAX, 2501-2-00-80-00-00-07-0 |
| 2                                    | 4       | E1, E2, E5, E6     | TURRET, 0.061"                                                              | MILL-MAX, 2308-2-00-80-00-00-07-0 |
| 3                                    | 2       | J1, J2             | HEADER, 1PIN, 0.020" × 0.020"                                               | SAMTEC, TMM-101-02-L-S            |
| 4                                    | 0       | J3-OPT             | CONN, 3 PIN POLARIZED                                                       | HIROSE, DF3-3P-2DSA               |
| 5                                    | 2       | BP1, BP2, BP3, BP4 | CLEAR 0.200" × 0.440" BUMPER                                                | KEYSTONE, 785-C                   |
| 6                                    | 0.00058 |                    | 3M, 0.5IN WIDE, 1/16IN THICK, DOUBLE SIDED FOAM TAPE, 0.75IN × 0.50IN PIECE | 3M, 4466                          |
| 7                                    | 4       |                    | STAND-OFF, NYLON, 0.375"                                                    | KEYSTONE, 8832                    |

| ITEM                                         | QTY | REFERENCE | PART DESCRIPTION                                                 | MANUFACTURER/PART NUMBER          |
|----------------------------------------------|-----|-----------|------------------------------------------------------------------|-----------------------------------|
| <b>DC2181A-A Required Circuit Components</b> |     |           |                                                                  |                                   |
| 1                                            | 0   | R9        | NO LOAD. SMD 0402                                                |                                   |
| 2                                            | 1   | R10       | RES, CHIP, 0Ω JUMPER, 1/16W, 0402                                | VISHAY, CRCW04020000Z0ED          |
| 3                                            | 1   | U1        | 400mA WIRELESS SYNCHRONOUS BUCK BATTERY CHARGER, 3mm × 3mm QFN16 | LINEAR TECHNOLOGY, LTC4120EUD-4.2 |

| ITEM                                         | QTY | REFERENCE | PART DESCRIPTION                                                 | MANUFACTURER/PART NUMBER      |
|----------------------------------------------|-----|-----------|------------------------------------------------------------------|-------------------------------|
| <b>DC2181A-B Required Circuit Components</b> |     |           |                                                                  |                               |
| 1                                            | 1   | R9        | RES, CHIP, 1.40M, ±1%, 1/16W, 0402                               | VISHAY, CRCW04021M40FKED      |
| 2                                            | 1   | R10       | RES, CHIP, 1.05M, ±1%, 1/16W, 0402                               | VISHAY, CRCW04021M05FKED      |
| 3                                            | 1   | U1        | 400mA WIRELESS SYNCHRONOUS BUCK BATTERY CHARGER, 3mm × 3mm QFN16 | LINEAR TECHNOLOGY, LTC4120EUD |

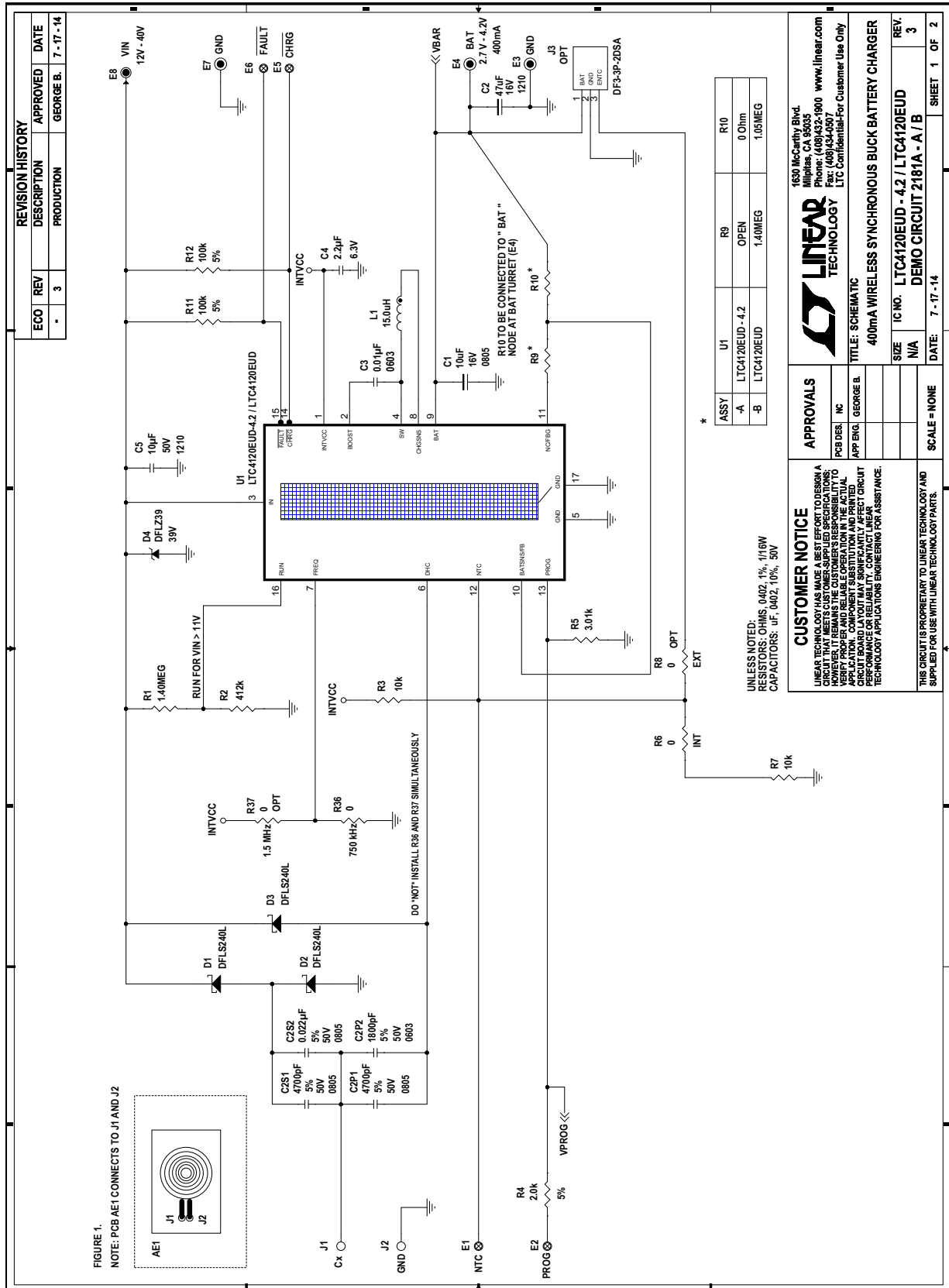
# DEMO MANUAL

## DC2181A-A/B

### PARTS LIST

| ITEM                                            | QTY | REFERENCE        | PART DESCRIPTION                                                                                | MANUFACTURER/PART NUMBER          |
|-------------------------------------------------|-----|------------------|-------------------------------------------------------------------------------------------------|-----------------------------------|
| <b>DC1968A Bill of Materials</b>                |     |                  |                                                                                                 |                                   |
| <b>DC1968A Required Circuit Components</b>      |     |                  |                                                                                                 |                                   |
| 1                                               | 1   | CX1, CX2         | CAP, CHIP, PPS, 0.15 $\mu$ F, $\pm$ 2%, 50V, 6mm $\times$ 4.1mm                                 | PANASONIC, ECHU1H154GX9           |
| 2                                               | 2   | C4, C5           | CAP, CHIP, X7R, 0.01 $\mu$ F, $\pm$ 10%, 50V, 0402                                              | MURATA, GRM155R71H103KA88D        |
| 3                                               | 1   | C6               | CAP, CHIP, X7R, 4.7 $\mu$ F, $\pm$ 10%, 50V, 0402                                               | MURATA, GRM31CR71H475KA12L        |
| 4                                               | 1   | C7               | CAP, CHIP, X5R, 0.068 $\mu$ F, $\pm$ 10%, 50V, 0603                                             | MURATA, GRM188R71H683K            |
| 5                                               | 1   | C8               | CAP, CHIP, C0G, 330pF, $\pm$ 5%, 50V, 0402                                                      | TDK, C1005COG1H331J               |
| 6                                               | 1   | C9               | CAP, CHIP, X7R, 0.47 $\mu$ F, $\pm$ 10%, 25V, 0603                                              | MURATA, GRM188R71E474K            |
| 7                                               | 1   | C10              | CAP, CHIP, X5R, 22 $\mu$ F, $\pm$ 20%, 6.3V, 0805                                               | TAIYO-YUDEN, JMK212BJ226MG        |
| 8                                               | 2   | D1, D4           | DIODE, ZENER, 16V, 350mV, SOT23                                                                 | DIODES, BZX84C16                  |
| 9                                               | 2   | D2, D3           | DIODE, SCHOTTKY, 40V, 1A, 2DSN                                                                  | ON SEMICONDUCTOR, NSR10F40NXT5G   |
| 10                                              | 1   | D5               | DIODE, SCHOTTKY, 40V, 2A, PowerDI123                                                            | DIODES, DFLS240L                  |
| 11                                              | 2   | L1, L2           | IND, SMT, 68 $\mu$ H, 0.41A, 0.40 $\Omega$ , $\pm$ 20%, 5mm $\times$ 5mm                        | TDK, VLCF5028T-680MR40-2          |
| 12                                              | 1   | L3               | IND, SMT, 4.7 $\mu$ H, 1.6A, 0.125 $\Omega$ , $\pm$ 20%, 4mm $\times$ 4mm                       | COILCRAFT, LPS4018-472M           |
| 13                                              | 1   | Lx               | TRANSMIT COIL                                                                                   | TDK, WT-505060-8K2-LT             |
| 14                                              | 2   | M1, M2           | MOSFET, SMT, N-CHANNEL, 60V, 11m $\Omega$ , S08                                                 | VISHAY, Si4108DY-T1-GE3           |
| 15                                              | 1   | M3               | MOSFET, SMT, P-CHANNEL, -12V, 32m $\Omega$ , SOT23                                              | VISHAY, Si2333DS                  |
| 16                                              | 1   | M4               | MOSFET, SMT, N-CHANNEL, 60V, 7.5 $\Omega$ , 115mA, SOT23                                        | ON SEMI, 2N7002L                  |
| 17                                              | 2   | R1, R2           | RES, CHIP, 100 $\Omega$ , $\pm$ 5%, 1/16W, 0402                                                 | VISHAY, CRCW0402100RJNED          |
| 18                                              | 2   | R3, R8           | RES, CHIP, 150k $\Omega$ , $\pm$ 5%, 1/16W, 0402                                                | VISHAY, CRCW0402150JNED           |
| 19                                              | 1   | R4               | RES, CHIP, 40.2k $\Omega$ , $\pm$ 1%, 1/16W, 0402                                               | VISHAY, CRCW040240K2FKED          |
| 20                                              | 1   | R5               | RES, CHIP, 20k $\Omega$ , $\pm$ 1%, 1/16W, 0402                                                 | VISHAY, CRCW040220K0FKED          |
| 21                                              | 2   | R6, R10          | RES, CHIP, 100k $\Omega$ , $\pm$ 1%, 1/16W, 0402                                                | VISHAY, CRCW0402100KFKED          |
| 22                                              | 1   | R7               | RES, CHIP, 536k $\Omega$ , $\pm$ 1%, 1/16W, 0402                                                | VISHAY, CRCW0402536KFKED          |
| 23                                              | 1   | U1               | LT3480EDD, PMIC 38V, 2A, 2.4MHz STEP-DOWN SWITCHING REGULATOR WITH 70 $\mu$ A QUIESCENT CURRENT | LINEAR TECHNOLOGY, LT3480EDD      |
| <b>Additional Demo Board Circuit Components</b> |     |                  |                                                                                                 |                                   |
| 1                                               | 0   | CX3-OPT, CX4-OPT | CAP, PPS, 0.15 $\mu$ F, 2.5%, 63VAC, MKS02                                                      | WIMA, MKS0D031500D00JSSD          |
| 2                                               | 1   | D6               | LED, GREEN, 0603                                                                                | LITE-ON, LTST-C190KGKT            |
| 3                                               | 1   | R9               | RES, CHIP, 1k $\Omega$ , $\pm$ 5%, 1/16W, 0402                                                  | VISHAY, CRCW04021K00JNED          |
| <b>Hardware: For Demo Board Only</b>            |     |                  |                                                                                                 |                                   |
| 1                                               | 6   | E1 TO E6         | TURRET, 0.09 DIA                                                                                | MILL-MAX, 2501-2-00-80-00-00-07-0 |
| 2                                               | 4   |                  | STAND-OFF, NYLON, 0.375"                                                                        | KEYSTONE, 8832                    |

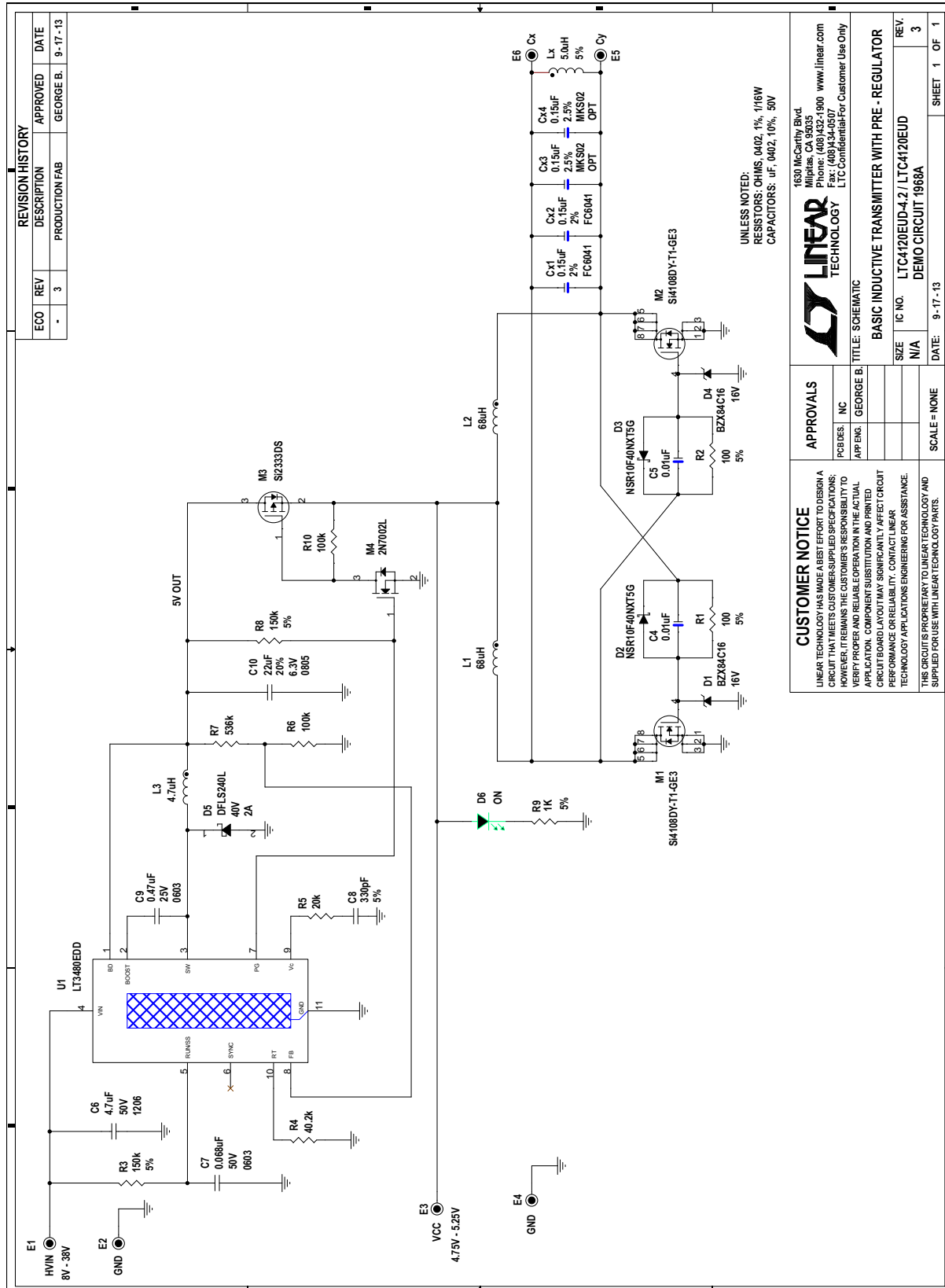
### SCHEMATIC DIAGRAM



## SCHEMATIC DIAGRAM



### SCHEMATIC DIAGRAM



dc2181afb



# DEMO MANUAL

## DC2181A-A/B

---

The DC1968A Basic Wireless Transmitter is available from Linear Technology as part of the DC1969A-B Wireless Power Kit. To obtain the DC1968A Basic Wireless Transmitter, please order the DC1969A-B kit.

The ProxiPoint Transmitters are available from PowerByProxi: [www.powerbyproxi.com/evaluation-kits/proxi-point/](http://www.powerbyproxi.com/evaluation-kits/proxi-point/)

### 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

dc2181afb