# LTC3875EUJ
# High Efficient, Single Output Synchronous Buck Converter with Very Low DCR Inductor

## DESCRIPTION

Demonstration circuit 2055A is a high efficiency, high density, 4-phase synchronous buck converter with a 4.5V to 14V input voltage range. It can supply up to 120A of load current with a 1.0V output. This demo board has two each LTC®3875EUJ feature-rich dual-phase synchronous current mode buck controllers with very low DCR current sensing capability, on-chip drivers and remote output voltage sensing. This board is set up with 0.32mΩ DCR output inductors. The temperature compensation function can guarantee accurate current limit over a wide temperature range with DCR sensing.

The LTC3875 is suitable for inputs from 4.5V to 38V and outputs up to 3.5V. It can provide a high efficiency, high power density and versatile power solution for telecom and datacom systems, industrial, medical instruments, and DC power distribution. The LTC3875 is available in a 40-lead 6mm × 6mm QFN package.

To shut down the converter, set the RUN pin voltage below 1.0V (SW1 and SW2: both OFF). Use JP1 jumper to select Burst Mode® operation, pulse-skipping mode or forced continuous mode operation at light load. The switching frequency is pre-set at about 400kHz, and it can be easily modified from 250kHz to 720kHz. An onboard dynamic circuit is also available for a load transient test. Please see LTC3875 data sheet for more detailed information.

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



## PERFORMANCE SUMMARY

**Specifications are at $T_A$ = 25°C**

| PARAMETER | CONDITION | VALUE |
|---|---|---|
| Input Voltage Range | | 4.5V to 14V |
| Output Voltage, $V_{OUT}$ | $V_{IN}$ = 4.5 to 14V, $I_{OUT}$ = 0A to 120A | 1.0V ±2% |
| Maximum Output Current, $I_{OUT}$ | $V_{IN}$ = 4.5 to 14V, $V_{OUT}$ = 1.0V | 120A |
| Typical Efficiency, $V_{OUT}$ | $V_{IN}$ = 12V, $V_{OUT}$ = 1.0 V, $I_{OUT}$ = 120A | 87.1%, See Figure 3 |
| Typical Switching Frequency | | 400kHz |

## QUICK START PROCEDURE

Demonstration circuit 2055A is easy to set up to evaluate the performance of the LTC3875EUJ. Refer to Figure 1 for the proper measurement equipment setup and follow the procedure below:

1. With power off, connect the input power supply to VIN (4.5V-14V) and GND (input return).
2. Connect the 1.0V output load between VOUT1 and GND (Initial load: no load).
3. Connect the DVMs to the input and outputs. Set default jumper position:
4. Turn on the input power supply and check for the proper output voltages. $V_{OUT1}$ should be 1.0V ±2%.
5. Once the proper output voltages are established, adjust the loads within the operating range and observe the output voltage regulation, ripple voltage and other parameters.

Note: When measuring the output or input voltage ripple, do not use the long ground lead on the oscilloscope probe. See Figure 2 for the proper scope probe technique. Short, stiff leads need to be soldered to the (+) and (–) terminals of an output capacitor. The probe's ground ring needs to touch the (–) lead and the probe tip needs to touch the (+) lead.

| *JP1* | *JP2* | *JP3* | *JP4* | *JP5* | *JP6* | *SW1* | *SW2* |
|---|---|---|---|---|---|---|---|
| **MODE** | **PHASMD1** | **ENTMPB1** | **ENTMPB1** | **BIAS** | **PHASMD1** | **RUN1** | **RUN2** |
| CCM | 90° | OFF | OFF | OFF | 90° | ON | ON |

## QUICK START PROCEDURE

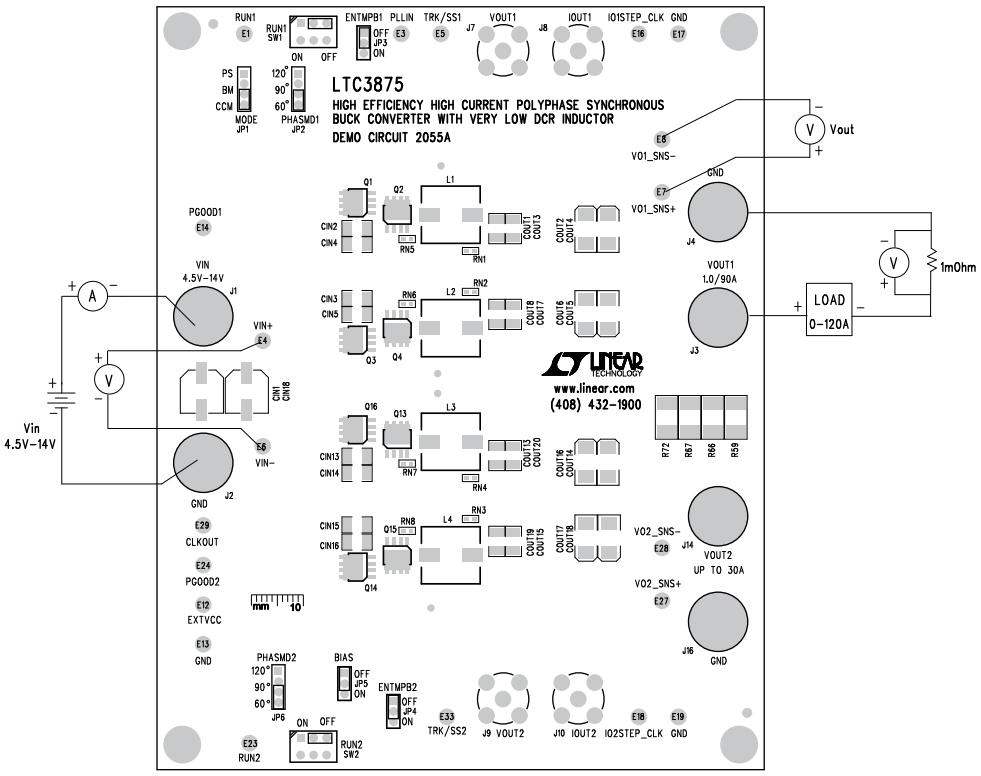


**Figure 1. Proper Measurement Equipment Setup**

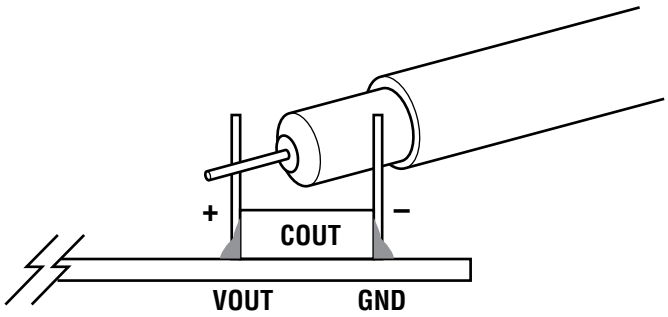


**Figure 2. Measuring Output Voltage Ripple**

## QUICK START PROCEDURE

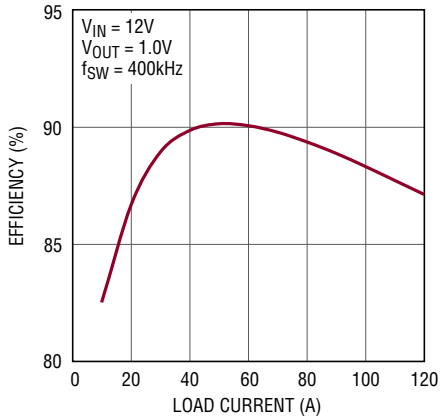


**Figure 3. Efficiency vs Load Current**

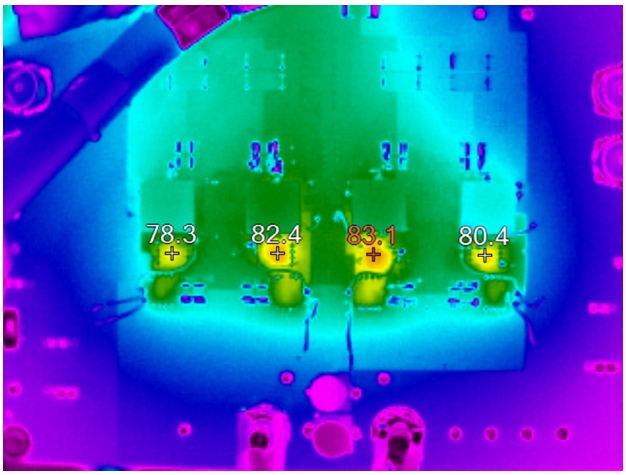


**Figure 4. Thermal Performance at $V_{IN}$ = 12V, $V_{OUT}$ = 1.0V, $I_{OUT}$ = 120A, 200LFM Forced Air Flow**

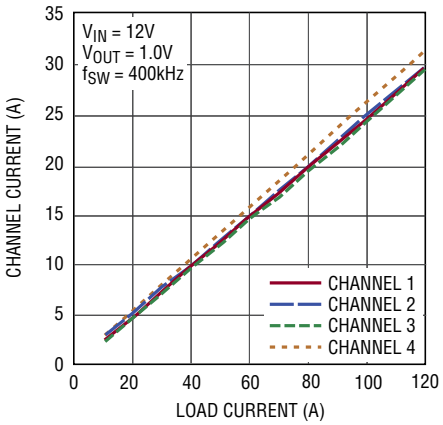


**Figure 5. Current Sharing vs Load Current**

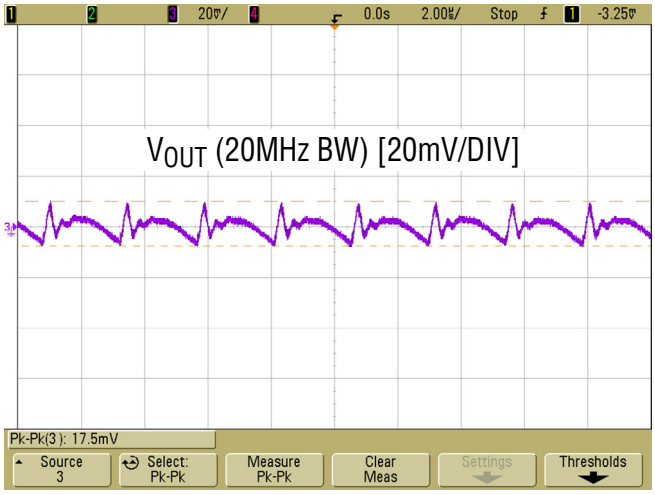


**Figure 6. Output Voltage Ripple at $V_{IN}$ = 12V, $V_{OUT}$ = 1.0V, $I_{OUT}$ = 120A, $f_{SW}$ = 400kHz**

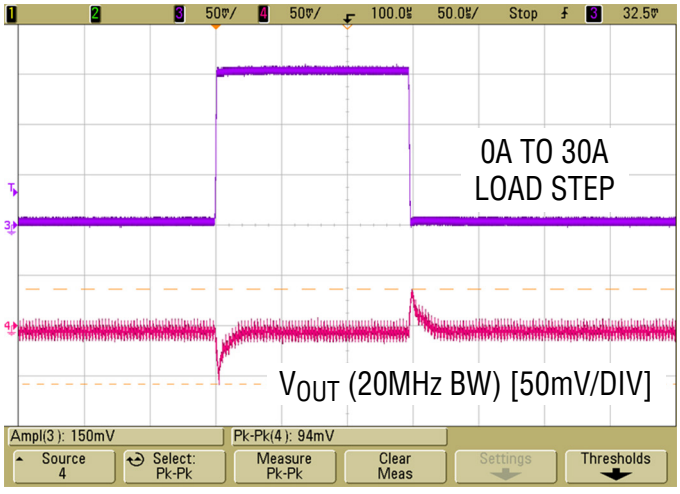


**Figure 7. Transient Performance at $V_{IN}$ = 12V, $V_{OUT}$ = 1.0V, $I_{OUT}$ = 0A to 30A, $f_{SW}$ = 400kHz**

## PARTS LIST

| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER/PART NUMBER |
|---|---|---|---|---|
| **Required Circuit Components** | | | | |
| 1 | 2 | CIN1, CIN18 | CAP., OS-CON, 270µF, 16V, 20%, E12 | SANYO, 16SVPC270M |
| 2 | 12 | COUT1, COUT3, COUT7, COUT8, COUT13, COUT15, COUT19, COUT20, C29, C30, C33, C34 | CAP., X5R, 100µF, 6.3V, 20%,1210 | AVX 12106D107MAT2A |
| 3 | 12 | COUT2, COUT4-COUT6, COUT9-COUT12, COUT14, COUT16-COUT18 | CAP., OS-CON, 330µF, 2.5V, 20%, 7343 | SANYO, 2R5TPE330M9 |
| 4 | 4 | L1, L2, L3, L4 | IND, 0.25µH | WURTH ELECT.,744301025 |
| 5 | 4 | Q1, Q3, Q14, Q16 | OPTIMOS POWER-TRANSISTOR, PG-TDSON-8 25V | INFINEON, BSC050NE2LS |
| 6 | 4 | Q2, Q4, Q13, Q15 | OPTIMOS POWER-TRANSISTOR, PG-TDSON-8 25V | INFINEON, BSC010NE2LSI |
| 7 | 2 | U1, U3 | IC, LTC3875IUJ, QFN 6mm × 6mm | LINEAR TECH., LTC3875IUJ#PBF |
| 8 | 1 | U2 | IC, LT1763CDE, DFN 4mm × 3mm | LINEAR TECH., LT1763CDE-SD |
| **Additional Demo Board Circuit Components** | | | | |
| 9 | 10 | CIN2-CIN5, CIN13-CIN16, C27, C28 | CAP., X5R, 10µF,16V, 10%, 1210 | AVX 1210YD106KAT2A |
| 10 | 0 | C1, C5, C6, CIN6-CIN12, CIN17, C23, C24, C26, C37, C48, C49, C54, C55, C58, C59, C63 | CAP., OPTIONAL | |
| 11 | 5 | C2, C7, C18, C38, C42, C43 | CAP., X5R, 0.1µF, 16V, 10%, 0603 | AVX 0603YD104KAT2A |
| 12 | 8 | C3, C4, C16, C19, C44, C46, C52, C62 | CAP., X5R, 220nF, 25V, 10%, 0603 | AVX 06033D224KAT2A |
| 13 | 1 | C8 | CAP., X7R, 4.7nF, 25V, 10%, 0603 | AVX 06033C472KAT2A |
| 14 | 2 | C9, C57 | CAP., NPO, 220pF, 25V, 10%, 0603 | AVX 06033A221KAT2A |
| 15 | 3 | C13, C22, C56 | CAP., X5R, 1µF, 25V, 10%, 0603 | AVX 06033D105KAT2A |
| 16 | 2 | C14, C60 | CAP., X5R, 4.7µF, 16V, 10%, 0805 | TDK C2012X5R1E475K |
| 17 | 4 | C31,C32,C35,C36 | CAP., X5R, 0.22µF, 16V, 10%, 0805 | AVX 0805YC224KAT2A |
| 18 | 4 | D1, D2, D3, D4 | DIODE, SCHOTTKY, SOD-323 | CENTRAL CMDSH-3TR |
| 19 | 0 | Q5, Q6, Q9-Q12, Q17, Q18 | OPTIONAL | |
| 20 | 2 | Q7, Q8 | MOSFET SPEED SRS 30V 30A LFPAK | RENESAS RJK0305DPB |
| 21 | 2 | R1, R14 | RES., CHIP, 20k, 1%, 0603 | NIC NRC06F2002TRF |
| 22 | 0 | R2, R3, R5-R8, R22, R27, R31, R33, R38, R39, R41, R42, R47, R63, R65, R68, R69, RN1-RN8, R73, R74, R75, R76, R79, R83, R84, R88, R89, R90, R91, R92, R93, R94, R96, R97 | RES., OPTIONAL | |
| 23 | 12 | R4, R17, R23, R46, R48, R51, R53, R54, R60, R61, R64, R82 | RES., CHIP, 0Ω, 0603 | NIC NRC06Z0TRF |
| 24 | 4 | R59, R66, R67, R72 | RES., CHIP, 0Ω, 2512 | VISHAY CRCW25120000Z0ZG |
| 25 | 2 | R9, R80 | RES., CHIP, 3.01k, 1%, 0603 | NIC NRC06F3011TRF |
| 26 | 2 | R10, R81 | RES., CHIP, 1k, 1%, 0603 | NIC NRC06F1001TRF |
| 27 | 4 | R11, R34, R77, R86 | RES., CHIP, 3.57k, 1%, 0603 | NIC NRC06F3571TRF |
| 28 | 4 | R12, R35, R70, R85 | RES., CHIP, 715Ω, 1%, 0603 | VISHAY CRCW0603715RFKEA |
| 29 | 1 | R13 | RES., CHIP, 13.3k, 1%, 0603 | VISHAY CRCW060313K3FKEA |
| 30 | 8 | R37, R40, R49, R52, R55, R57, R78, R101 | RES., CHIP, 10k, 1%, 0603 | NIC NRC06F1002TRF |
| 31 | 1 | R15 | RES., CHIP, 2k, 1%, 0603 | NIC NRC06F2001TRF |
| 32 | 2 | R16, R20 | RES., CHIP, 10Ω, 1%, 0603 | NIC NRC06F10R0TRF |
| 33 | 2 | R18, R62 | RES., CHIP, 2.2Ω, 1%, 0603 | NIC NRC06F2R20TRF |

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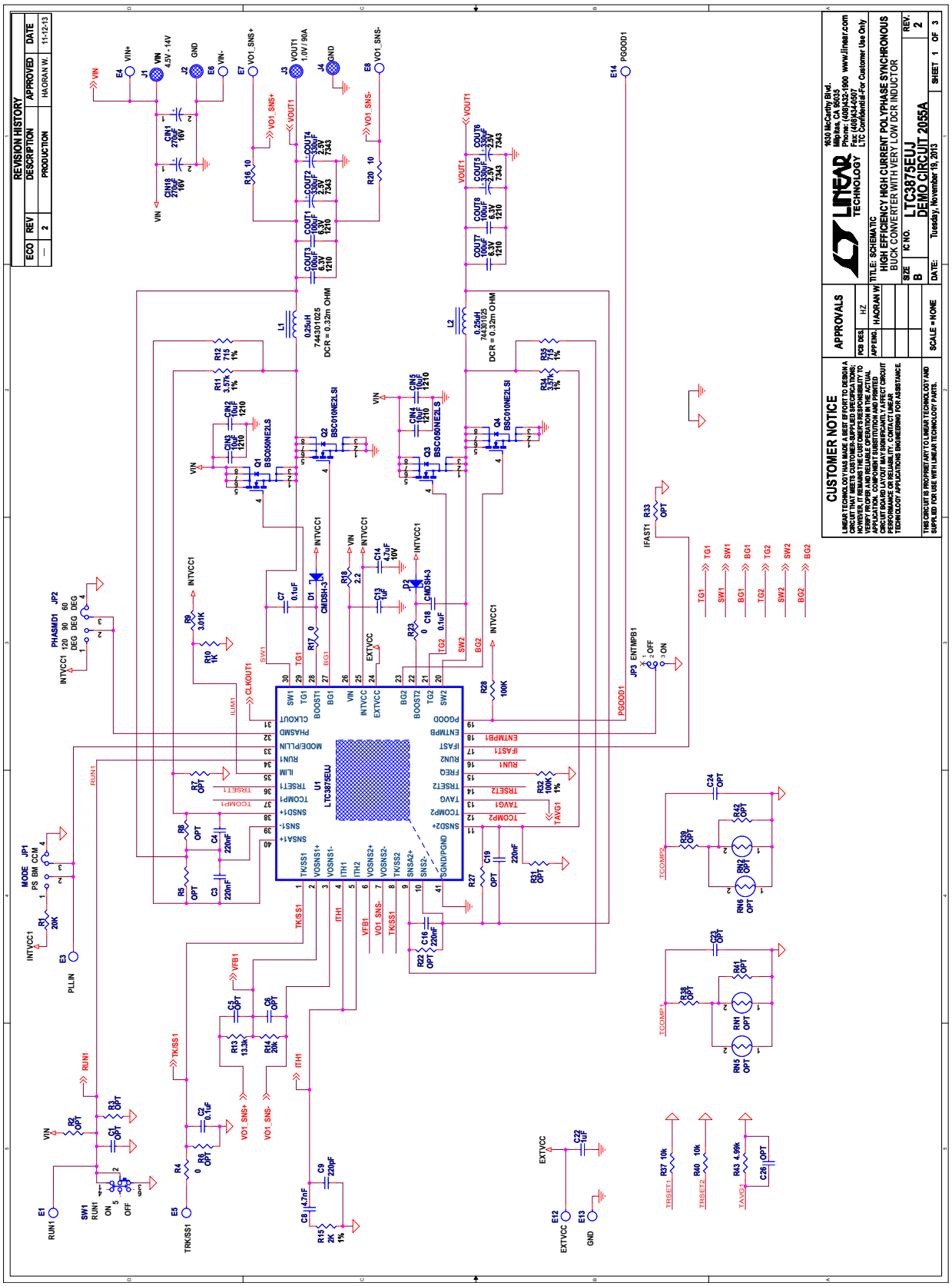
| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER/PART NUMBER |
|---|---|---|---|---|
| 34 | 4 | R28, R32, R87, R99 | RES., CHIP, 100k, 1%, 0603 | NIC NRC06F1003TRF |
| 35 | 2 | R43, R44 | RES., CHIP, 4.99k, 1%, 0603 | NIC NRC06F4K99TRF |
| 36 | 1 | R50 | RES., CHIP, 34.8k, 1%, 0603 | VISHAY CRCW060334K8FKEA |
| 37 | 2 | R56, R58 | RES., CHIP, 0.005Ω, 1%, 2512 | VISHAY WSL25125L000FEA |
| **Hardware-For Demo Board Only** | | | | |
| 38 | 19 | E1, E3-E8, E12-E14, E16-E19, E23, E24, E27-E29, E33 | TESTPOINT, TURRET, 0.062" | MILL-MAX, 2308-2-00-80-00-00-07-0 |
| 39 | 6 | J1, J2, J3, J4, J14, J16 | STUD, TESTPIN | PEM KFH-032-10 |
| 40 | 12 | J1-J4, J14, J16 (X2) | NUT, BRASS 10-32 | ANY #10-32 |
| 41 | 6 | J1-J4, J14, J16 | RING, LUG #10 | KEYSTONE, 8205, #10 |
| 42 | 6 | J1-J4, J14, J16 | WASHER, TIN PLATED BRASS | ANY #10 |
| 43 | 3 | JP1, JP2, JP6 | 2MM SINGLE ROW HEADER, 4-PIN | SAMTEC, TMM-104-02-L-S |
| 44 | 3 | JP3-JP5 | HEADER 3-PIN 0.079 SINGLE ROW | SAMTEC, TMM103-02-L-S |
| 45 | 6 | JP1-JP6 | SHUNT | SAMTEC, 2SN-BK-G |
| 46 | 2 | SW1, SW2 | CONNECTOR, SUB MINIATURE SLIDE SWITCHES | C&K.,JS202011CQN |
| 47 | 4 | J7, J8, J9, J10 | CONN, BNC, 5PINS | CONNEX, 112404 |

# SCHEMATIC DIAGRAM



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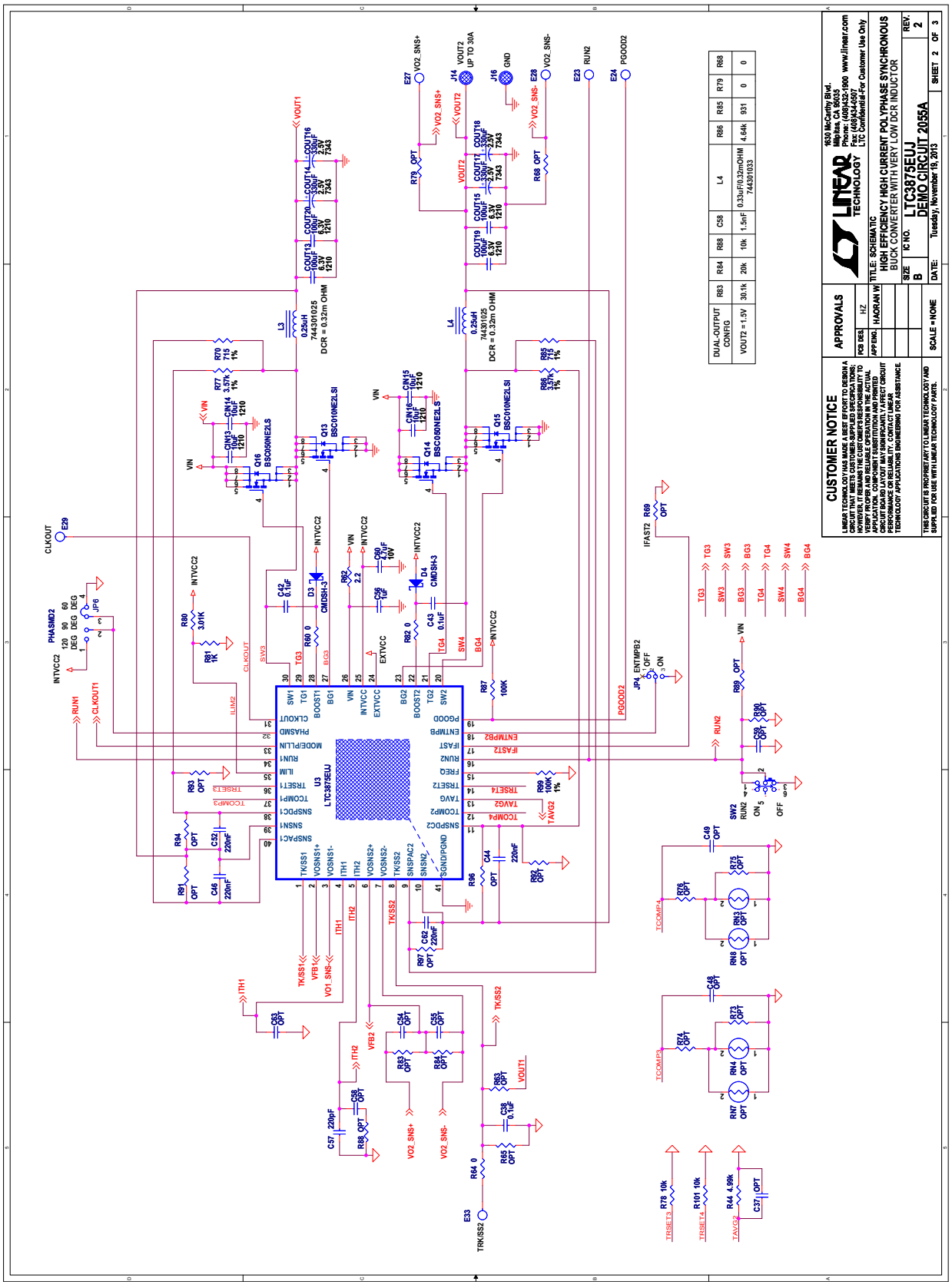

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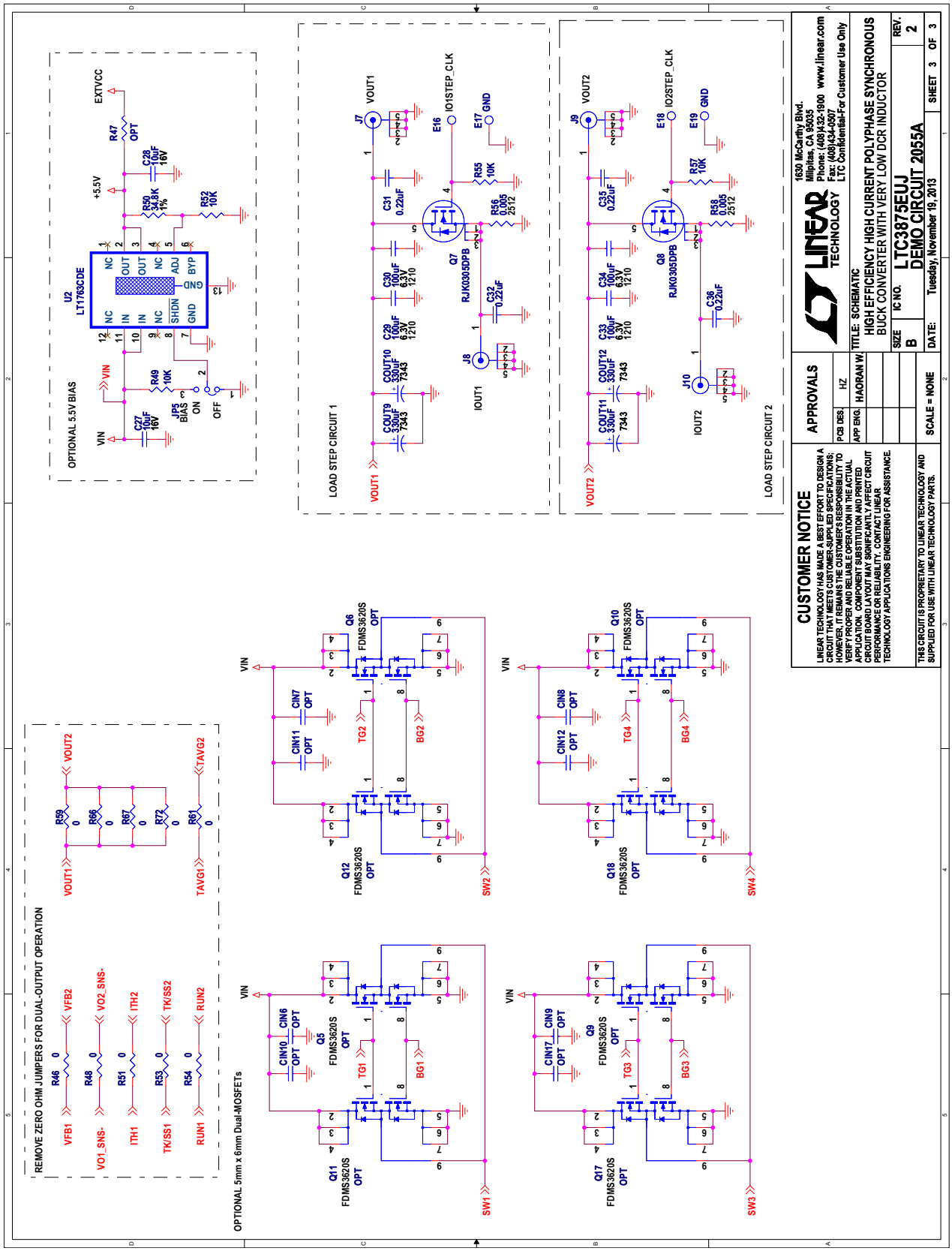

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