# LTM4705
# $20V_{IN}$, Dual 5A Step-Down DC/DC µModule Regulator

## DESCRIPTION

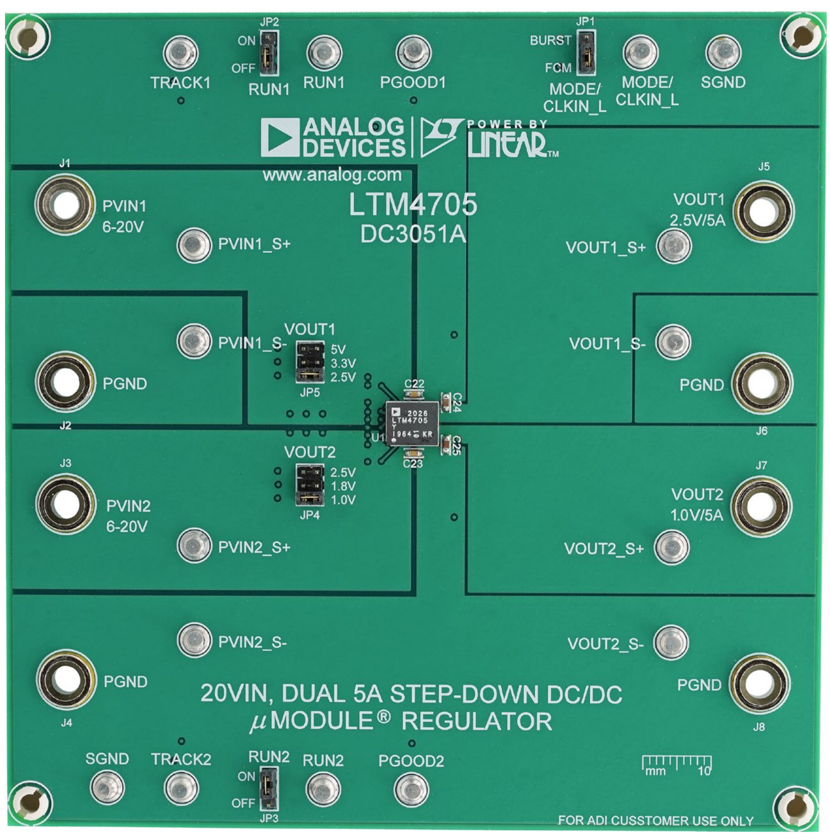
Demonstration circuit 3051A features the LTM®4705, a high efficiency dual 5A or single 10A µModule® DC/DC regulator in a compact and low profile 6.25mm × 7.5mm × 3.22mm BGA package. The LTM4705 can take 3.1V to 20V input and generate 0.6V to 5.5V output (step-down only). The DC3051A demo board is designed to take $6V_{IN}$ to $20V_{IN}$ to dual 5A jumper selectable outputs. The board operates by default at a fixed 1MHz and can be synchronized from 1MHz to 3MHz via the MODE/SYNC pin. With its high switching frequency and current mode architecture, a fast transient response to line and load changes is possible without sacrificing stability. The DC3051A can be used in forced continuous mode or pulse-skipping mode for low noise, or in Burst Mode® operation for high efficiency at light loads. Please see the LTM4705 data sheet for more detailed information.

It is recommended to read the data sheet for the LTM4705 prior to making any changes to the DC3051A.

**Design files for this circuit board are available.**



## BOARD PHOTO



## PERFORMANCE SUMMARY Specifications are at $T_A$ = 25°C

| PARAMETER | CONDITIONS/NOTES | MIN | TYP | MAX | VALUE |
|---|---|---|---|---|---|
| Input Voltage Range | | 6 | | 20 | V |
| Output Voltage, $V_{OUT}$ | $V_{IN}$ = 6V – 20V, $I_{OUT}$ = 0A to 5A | | $V_{OUT1}$ = 2.5<br>$V_{OUT2}$ = 1 | | V<br>V |
| Maximum Output Current, $I_{OUT}$ | $V_{IN}$ = 6V – 20V | | 5 | | A |
| Typical Efficiency | $V_{IN}$ = 12V, $V_{OUT1}$ = 2.5V, $I_{OUT}$ = 5A<br>$V_{IN}$ = 12V, $V_{OUT2}$ = 1.0V, $I_{OUT}$ = 5A | | 89.5<br>79 | | %<br>% |
| Peak Efficiency | $V_{IN}$ = 12V, $V_{OUT1}$ = 2.5V<br>$V_{IN}$ = 12V, $V_{OUT2}$ = 1.0V | | 92<br>84.5 | | %<br>% |
| Default Switching Frequency | | | 1 | | MHz |

## QUICK START PROCEDURE

Demonstration circuit 3051A provides an easy way to evaluate the performance of the LTM4705. Please refer to Figure 1 for test setup connections and follow the procedure below.

1. With power off, connect the input power supply to $V_{IN}$ (6V to 20V) and GND (input return).
2. Connect the output loads between $V_{OUT}$ and GND (Initial load: no load). Refer to Figure 1.
3. Connect the DVMs to the input and output.
4. Check the default jumper position: JP2 (RUN1): OFF; JP3 (RUN2): OFF.
5. Turn on the input power supply and adjust voltage to 6V to 20V;

   NOTE: Make sure that the input voltage does not exceed 22V.
6. Change the following jumpers' position: JP2: ON; JP3: ON.
7. Check for the proper output voltages from VOUT_S+ to VOUT_S– turrets.
8. Once the proper output voltage is established, adjust the loads within the operating range and measure the efficiency, output ripple voltage and other parameters.
9. After completing all tests, adjust the load to 0A, power off the input power supply.

NOTES:

1. 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.
2. If the 5V output option is selected, it is recommended to have a minimum $V_{IN}$ of 6.5V to meet the minimum off-time requirement. Refer to the LTM4705 data sheet for more information.
3. The two $V_{OUT}$ rails can be paralleled through some modification and adding some jumper resistors. See the schematic for details.

# QUICK START PROCEDURE

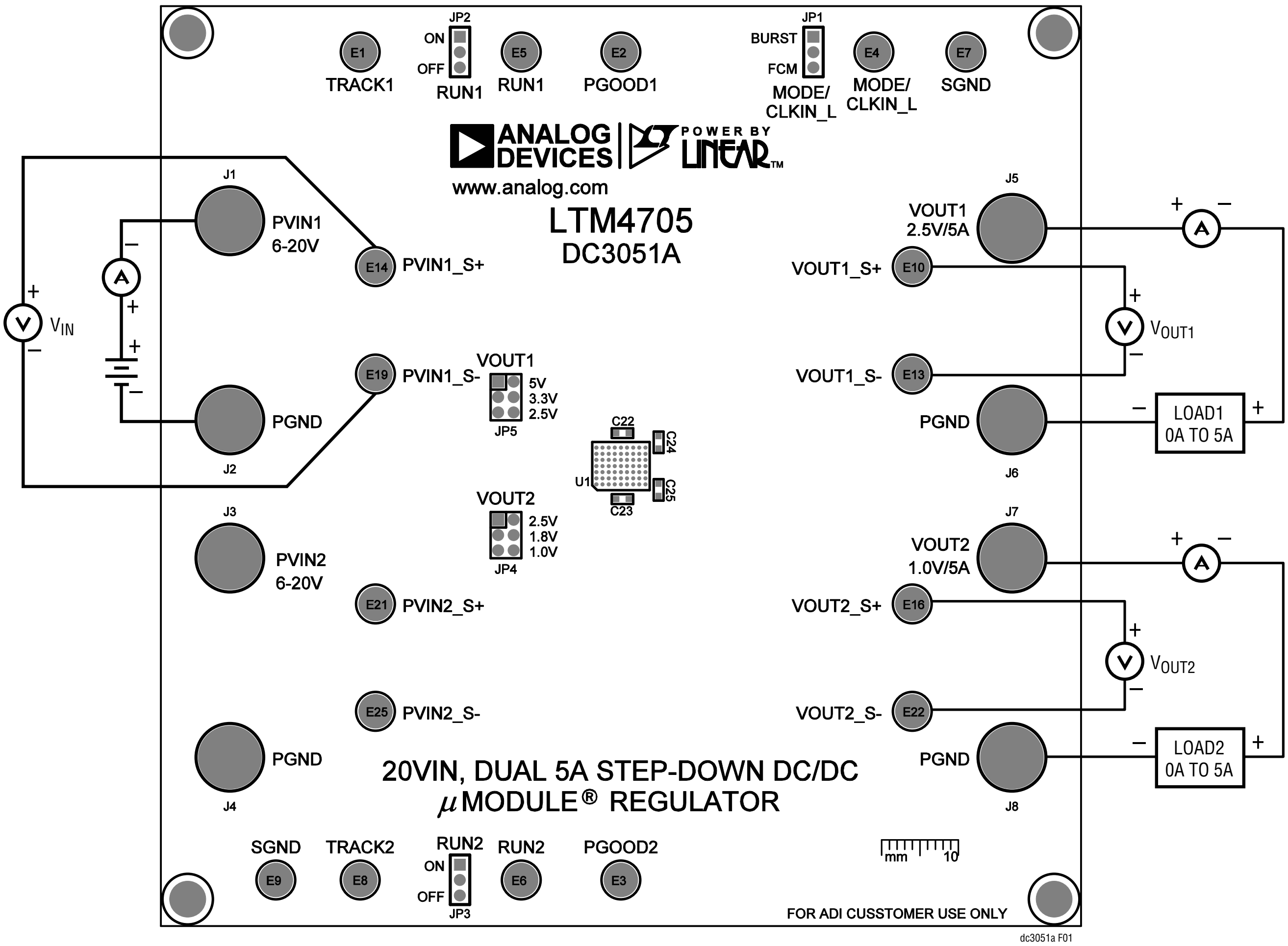



**Figure 1. Proper Measurement Equipment Setup**

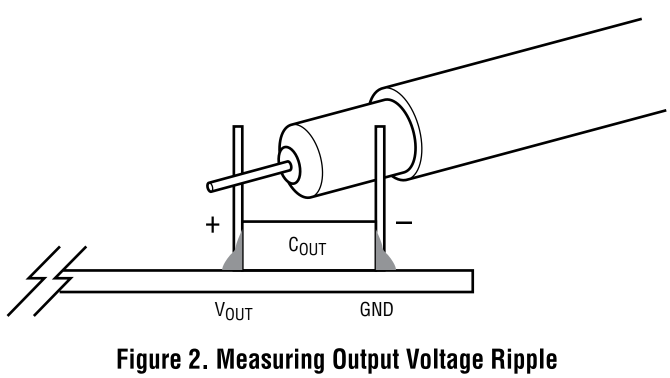



**Figure 2. Measuring Output Voltage Ripple**

## TYPICAL TEST RESULTS

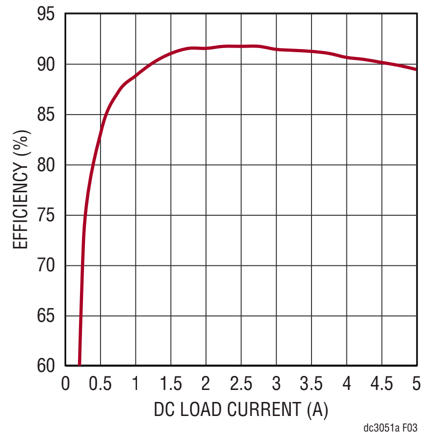



Figure 3. Efficiency vs Load Current at $V_{IN}$ = 12V, $V_{OUT1}$ = 2.5V, $f_{SW}$ = 1MHz, FCM Mode

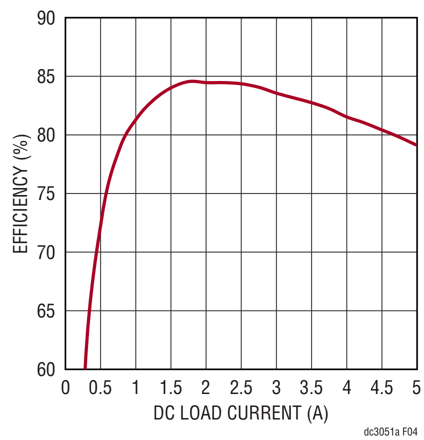



Figure 4. Efficiency vs Load Current at $V_{IN}$ = 12V, $V_{OUT2}$ = 1.0V, $f_{SW}$ = 1MHz, FCM Mode

## TYPICAL TEST RESULTS

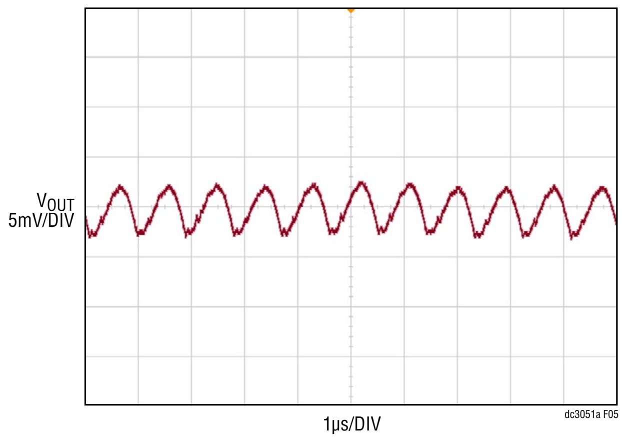



**Figure 5. Output Voltage Ripple at $V_{IN}$ = 12V, $V_{OUT1}$ = 2.5V, $I_{OUT1}$ = 5A, $f_{SW}$ = 1MHz**

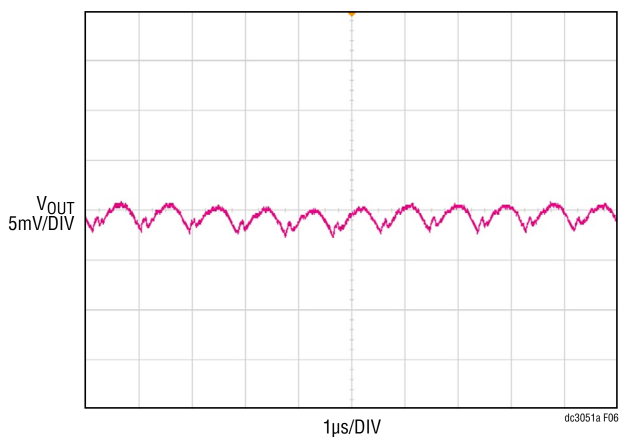



**Figure 6. Output Voltage Ripple at $V_{IN}$ = 12V, $V_{OUT2}$ = 1.0V, $I_{OUT2}$ = 5A, $f_{SW}$ = 1MHz**

## TYPICAL TEST RESULTS

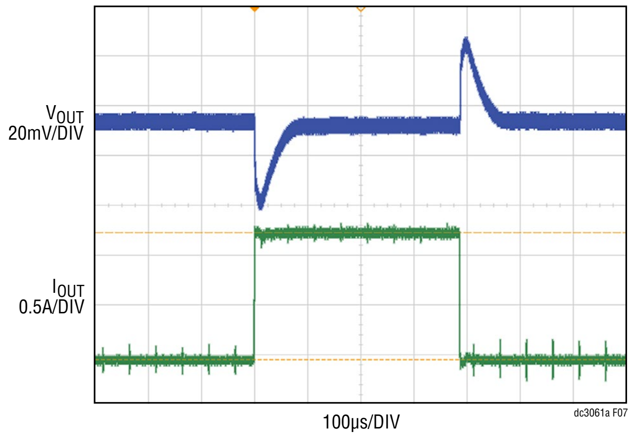



**Figure 7. Load Step at $V_{IN}$ = 12V, $V_{OUT1}$ = 2.5V, $f_{SW}$ = 1MHz**

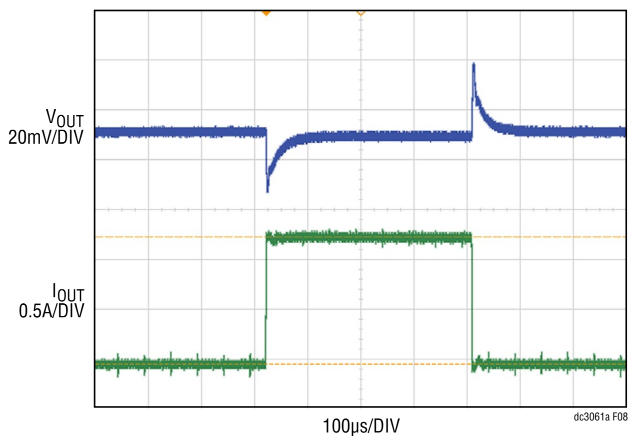



**Figure 8. Load Step at $V_{IN}$ = 12V, $V_{OUT2}$ = 1.0V, $f_{SW}$ = 1MHz**

## TYPICAL TEST RESULTS

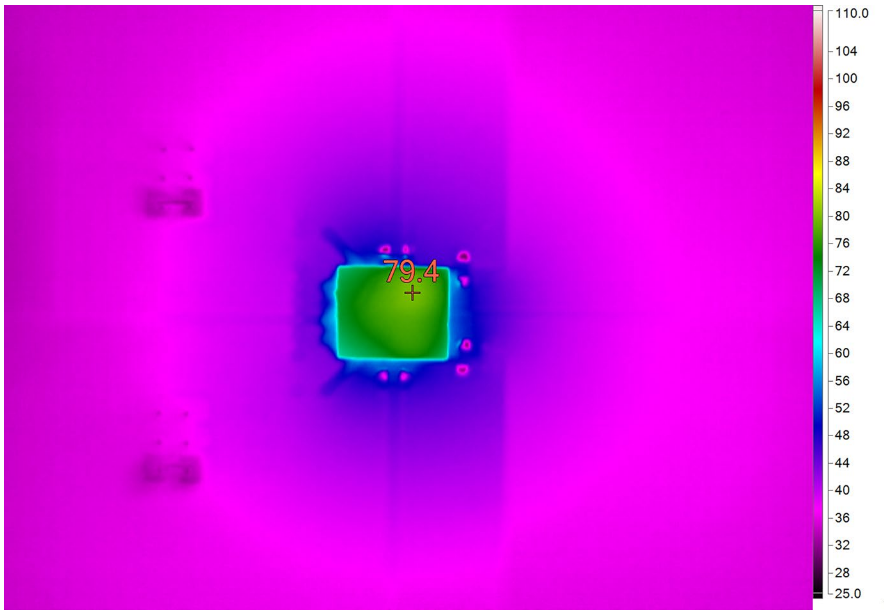
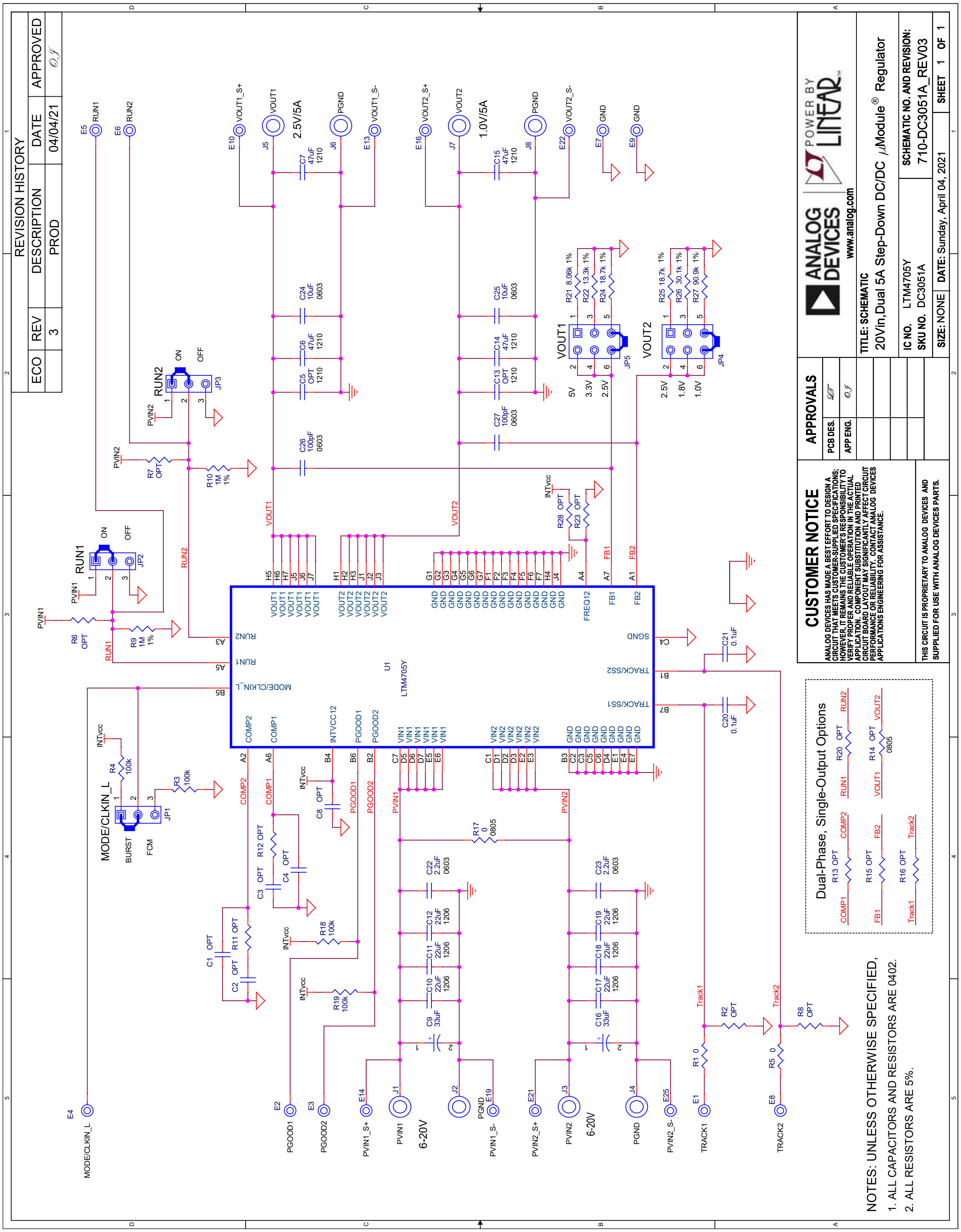



**Figure 9. Thermal Performance at $V_{IN}$ = 12V, $V_{OUT1}$ = 2.5V, $V_{OUT2}$ = 1.0V, $I_{OUT1}$ = 5A, $I_{OUT2}$ = 5A, $T_A$ = 23°C, No Forced Airflow**

## PARTS LIST

| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER/PART NUMBER |
|---|---|---|---|---|
| **Required Circuit Components** | | | | |
| 1 | 4 | C6, C7, C14, C15 | CAP., 47µF, X7R, 10V, 20%, 1210 | MURATA, GRM32ER71A476ME15L |
| 2 | 2 | C9, C16 | CAP., 33µF, ALUM. ELECT., 50V, 20%, 6.3mm × 7.7mm | SUN ELECTRONIC INDUSTRIES CORP., 50CE33FS |
| 3 | 6 | C10-C12, C17-C19 | CAP., 22µF, X5R, 35V, 20%, 1206 | TDK, C3216X5R1V226M160AC |
| 4 | 2 | C20, C21 | CAP., 0.1µF, X7R, 25V, 10%, 0402, AEC-Q200 | MURATA, GCM155R71E104KE02D |
| 5 | 2 | C22, C23 | CAP., 2.2µF, X5R, 35V, 10%, 0603 | MURATA, GRM188R6YA225KA12D |
| 6 | 2 | C24, C25 | CAP., 10µF, X5R, 10V, 10%, 0603 | AVX, 0603ZD106KAT2A |
| 7 | 2 | C26, C27 | CAP., 100pF, X7R, 50V, 10%, 0603 | AVX, 06035C101KAT2A |
| 8 | 2 | R3, R4 | RES., 100k, 5%, 1/16W, 0402, AEC-Q200 | ROHM, MCR01MZPJ104 |
| 9 | 2 | R9, R10 | RES., 1M, 1%, 1/16W, 0402, AEC-Q200 | STACKPOLE ELECTRONICS, INC., RMCF0402FT1M00 |
| 10 | 2 | R18, R19 | RES., 100k, 5%, 1/16W, 0402, AEC-Q200 | NIC, NRC04J104TRF |
| 11 | 1 | R21 | RES., 8.06k, 1%, 1/16W, 0402, AEC-Q200 | NIC, NRC04F8061TRF |
| 12 | 1 | R22 | RES., 13.3k, 1%, 1/16W, 0402, AEC-Q200 | VISHAY, CRCWs040213K3FKED |
| 13 | 2 | R24, R25 | RES., 18.7k, 1%, 1/16W, 0402, AEC-Q200 | VISHAY, CRCW040218K7FKED |
| 14 | 1 | R26 | RES., 30.1k, 1%, 1/16W, 0402, AEC-Q200 | NIC, NRC04F3012TRF |
| 15 | 1 | R27 | RES., 90.9k, 1%, 1/16W, 0402, AEC-Q200 | NIC, NRC04F9092TRF |
| 16 | 1 | U1 | IC, $20V_{IN}$, DUAL 5A STEP-DOWN, 63-LGA | ANALOG DEVICES, LTM4705Y#PBF |
| **Additional Demo Board Circuit Components** | | | | |
| 1 | 0 | C1C4, C8 | CAP., OPTION, 0402 | |
| 2 | 0 | C5, C13 | CAP., OPTION, 1210 | |
| 3 | 2 | R1, R5 | RES., 0Ω, 1/10W, 0402, AEC-Q200 | PANASONIC, ERJ2GE0R00X |
| 4 | 0 | R2, R6, R8, R11, R13, R15, R16, R20, R23, R28 | RES., OPTION, 0402 | |
| 5 | 0 | R14 | RES., OPTION, 0805 | |
| 6 | 1 | R17 | RES., 0Ω, JUMPER, 0805 | VISHAY, WSL080500000ZEA9 |
| **Hardware: For Demo Board Only** | | | | |
| 1 | 17 | E1E10, E13, E14, E16, E19, E21, E22, E25 | TEST POINT, TURRET, 0.094" MTG. HOLE, PCB 0.062" THK | MILL-MAX, 2501-2-00-80-00-00-07-0 |
| 2 | 8 | J1-J8 | CONN., BANANA JACK, FEMALE, THT, NON-INSULATED, SWAGE, 0.218" | KEYSTONE, 575-4 |
| 3 | 3 | JP1-JP3 | CONN., HDR, MALE, 1 × 3, 2mm, VERT, ST, THT, NO SUBS. ALLOWED | WURTH ELEKTRONIK, 62000311121 |
| 4 | 2 | JP4, JP5 | CONN., HDR, MALE, 2 × 3, 2mm, VERT, ST, THT | SULLINS CONNECTOR SOLUTIONS, NRPN032PAEN-RC |
| 5 | 4 | MP1-MP4 | STANDOFF, NYLON, SNAP-ON, 0.375" | KEYSTONE, 8832 |
| 6 | 3 | XJP1-XJP3 | CONN., SHUNT, FEMALE, 2-POS, 2mm | WURTH ELEKTRONIK, 60800213421 |
| 7 | 2 | XJP4, XJP5 | CONN., SHUNT, FEMALE, 2-POS., 2.54mm | WURTH ELEKTRONIK, 60900213421 |

# SCHEMATIC DIAGRAM




Rev. 0

**ESD Caution**

**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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