LTM4626
$20V_{IN}$, 12A Step-Down µModule Regulator

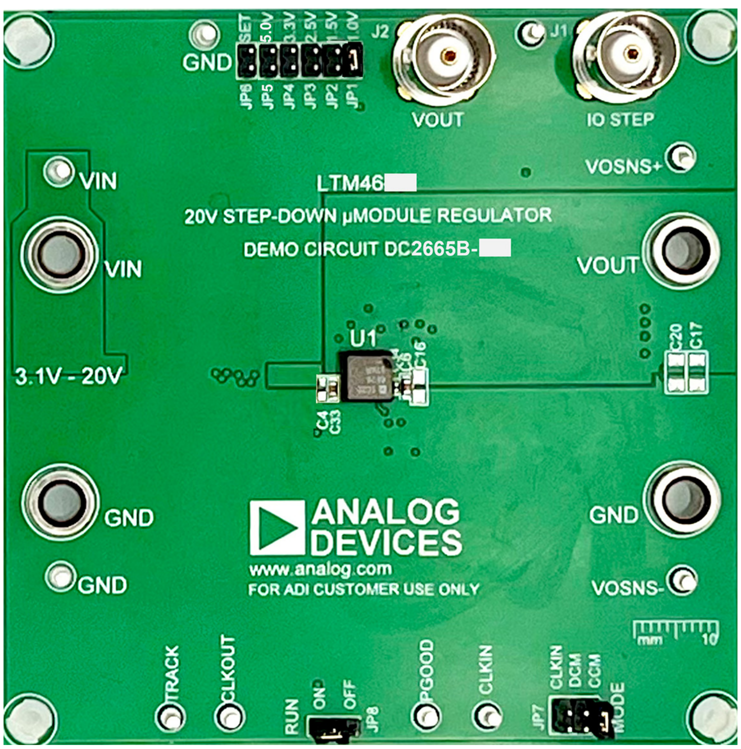
DESCRIPTION

Demonstration circuit 2665B-A features the LTM®4626 µModule® regulator, a high performance, high efficiency step-down regulator. The LTM4626 is a complete DC/DC point-of-load regulator in a thermally enhanced 6.25mm × 6.25mm × 3.87mm BGA package. The LTM4626 has an operating input voltage range of 3.1V to 20V and provides an output current up to 12A. The output voltage is programmable from 0.6V to 5.5V and can be remotely sensed. The stacked inductor design improves thermal dissipation and significantly reduces the package area. Output voltage tracking is available through the TRACK/SS pin for supply rail sequencing. External clock synchronization is available through the SYNC/MODE pin. For high efficiency at low load currents, select discontinuous current mode (DCM) operation using the MODE jumper (JP7) in less noise sensitive applications. Refer to the LTM4626 data sheet in conjunction with this demo manual for working on or modifying the DC2665B-A.

Design files for this circuit board are available.

BOARD PHOTO

Part marking is either ink mark or laser mark



PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range		3.1		20	V
Output Voltage, V_{OUT}	Jumper Selection on JP1 Jumper Selection on JP2 Jumper Selection on JP3 Jumper Selection on JP4 Jumper Selection on JP5	0.98 1.47 2.45 3.23 4.9	1.0 1.5 2.5 3.3 5.0	1.02 1.53 2.55 3.37 5.1	V V V V V
Maximum Continuous Output Current	Derating Is Necessary for Certain Operating Conditions (See Data Sheet for Details)		12		A
Default Operating Frequency			600		kHz
Efficiency	V_{IN} = 12V, V_{OUT} = 1V, I_{OUT} = 12A		85		%

QUICK START PROCEDURE

Demonstration circuit 2665B-A is an easy way to evaluate the performance of the LTM4626EY. Refer to Figure 1 for test setup connections and use the following procedure.

1. With power off, place the jumpers in the following positions:

JP8	JP7	JP1 TO JP6
RUN	MODE	V_{OUT} Select
ON	CCM	1V

2. Before connecting the input supply, load, and meters, preset the input voltage supply between 3.1V and 20V. Preset the load current to 0A.
3. With the power off, connect the load, input voltage supply, and meters as shown in Figure 1.
4. Turn on the input power supply. The output voltage meters for each phase display the ±1.2% programmed output voltage .
5. Once the proper output voltage is established, adjust the load current in the 0A to 12A range and observe the load regulation, efficiency, and other parameters. Measure the output voltage ripple across the furthest output cap with a BNC cable and oscilloscope from J2.
6. Place the MODE pin jumper (JP7) in the DCM position to observe increased light load efficiency.
7. For optional load transient testing, an onboard transient circuit is provided to measure transient response. Place a positive pulse signal between the IO_STEP_CLK (E10) pin and GND pin. The pulse amplitude sets the load step current amplitude. Keep the pulse width short (<1ms) and the pulse duty cycle low (<15%) to limit the thermal stress on the load transient circuit. Monitor the load step with a BNC connected to J1 (5mV/A).

QUICK START PROCEDURE

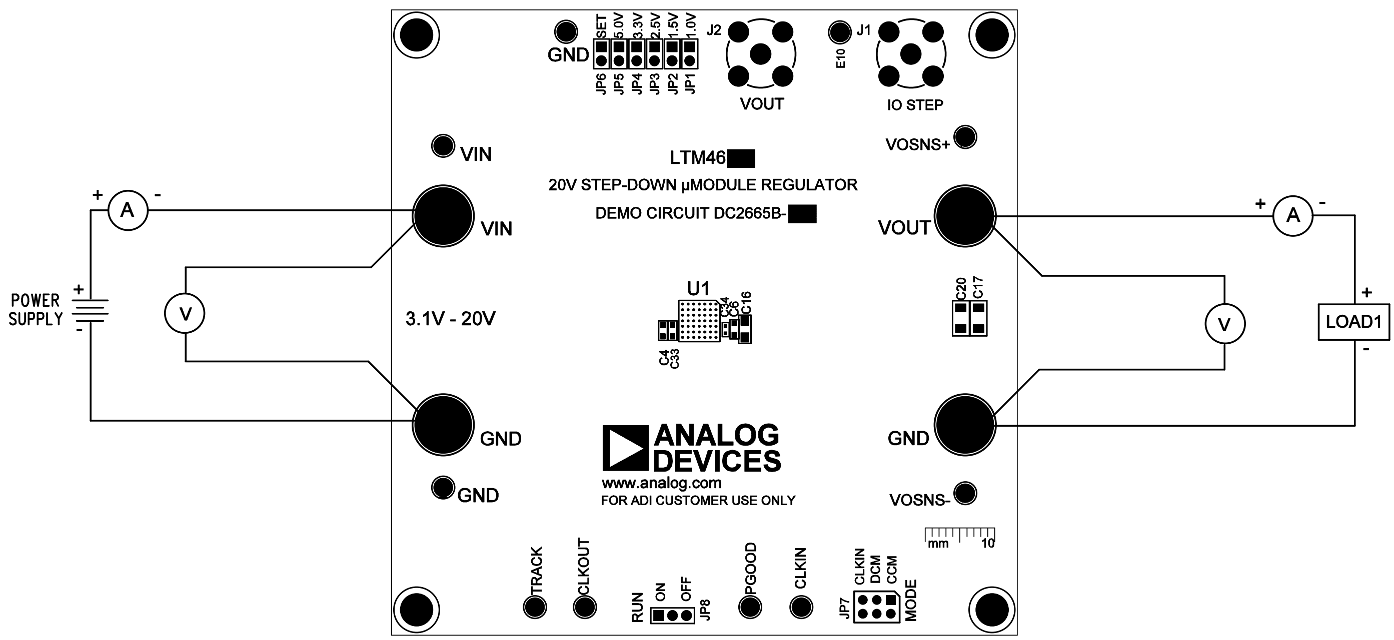


Figure 1. Test Setup of DC2665B-A

NOTES:

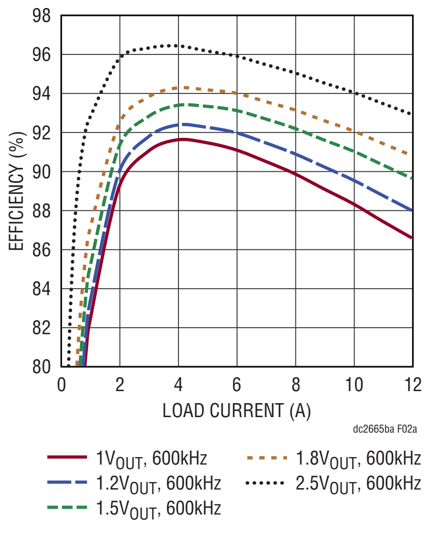
1. To achieve the minimum output ripple voltage, optimize the operation frequency at different input and output voltages. Suggested operation frequencies at different voltages are shown in Table 1. Adjust the operation frequency by changing the value of R_{fSET} (R5). Refer to the LTM4626 data sheet for a detailed calculation of R_{fSET} (R5).

Table 1. Suggested Operation Frequencies

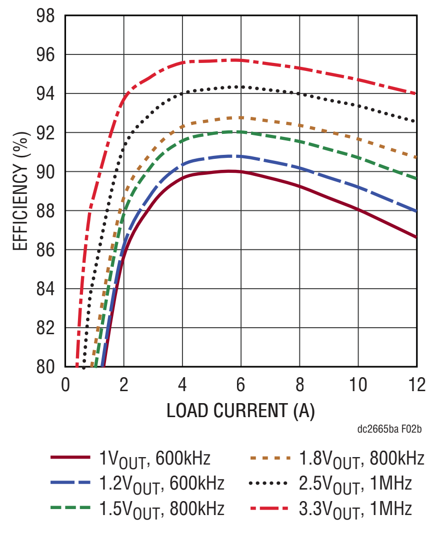
	$3.3V_{IN}$					$5V_{IN}$						$12V_{IN}$						
V_{OUT} (V)	1	1.2	1.5	1.8	2.5	1	1.2	1.5	1.8	2.5	3.3	1	1.2	1.5	1.8	2.5	3.3	5
f_{SW} (kHz)	600	600	600	600	600	600	600	800	800	1000	1000	600	800	800	1000	1500	1500	2000

2. For applications that require small output voltage ripple, add shunt-through three-terminal capacitors on the output at C41 and C42.

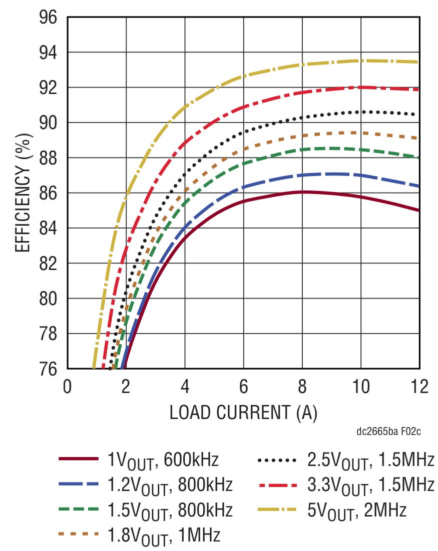
QUICK START PROCEDURE



(a) $3.3V_{IN}$

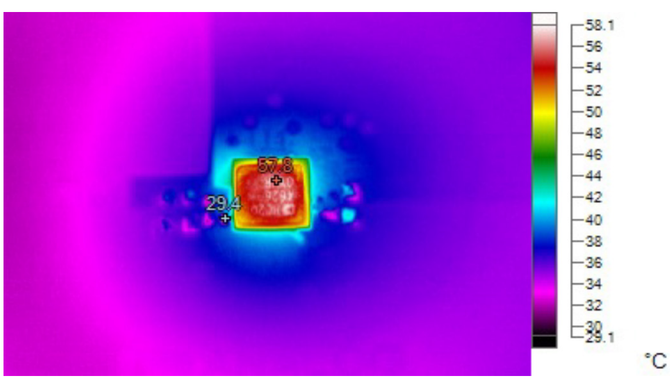


(b) $5V_{IN}$

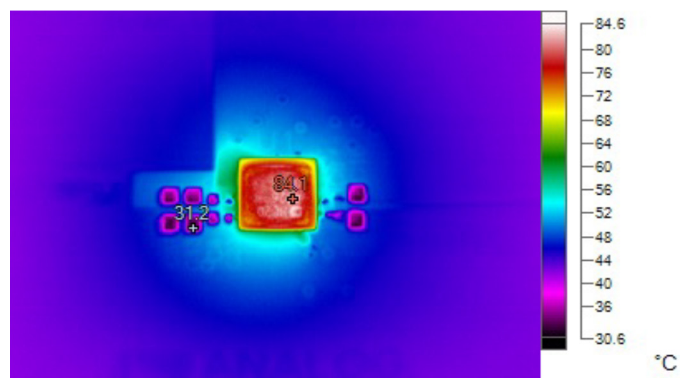


(c) $12V_{IN}$

Figure 2. Measured Supply, CCM Efficiency vs Load Current



(a) $1V_{OUT}$, 600kHz

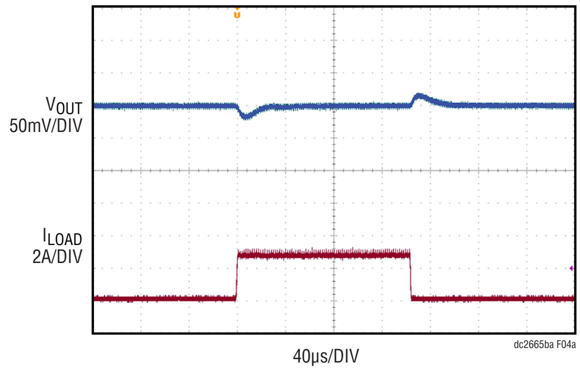


(b) $5V_{OUT}$, 2MHz

Figure 3. Measured Thermal Capture at $12V_{IN}$, I_{OUT} = 12A at 25°C Ambient with No Airflow

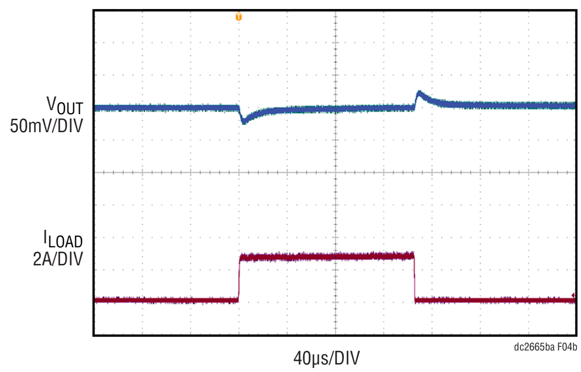
Rev. 0

QUICK START PROCEDURE



$V_{OUT(PK-PK)}$ = 42mV

(a) 1V_{OUT}

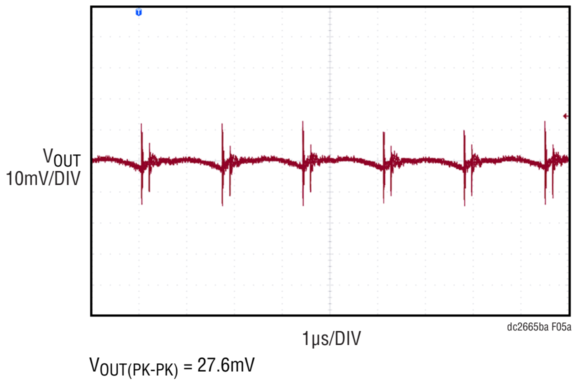


$V_{OUT(PK-PK)}$ = 52mV

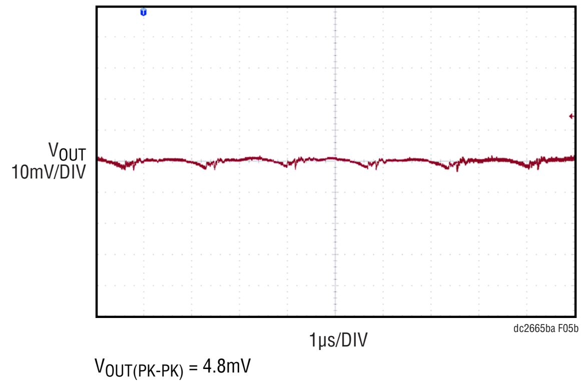
(b) 5V_{OUT}

Figure 4. Load Transient (6A to 9A) Response Waveform at 12V_{IN}

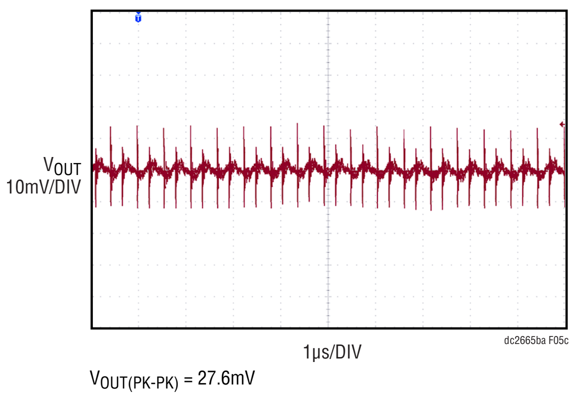
QUICK START PROCEDURE



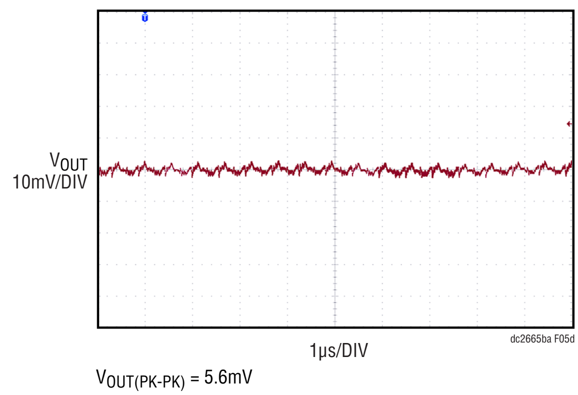
(a) 1V_{OUT}, 600kHz, Full Bandwidth (500MHz)



(b) 1V_{OUT}, 600kHz, 20MHz Bandwidth



(c) 5V_{OUT}, 2MHz, Full Bandwidth (500MHz)



(d) 5V_{OUT}, 2MHz, 20MHz Bandwidth

Figure 5. Tested V_{OUT} AC Ripple at $12V_{IN}$, I_{OUT} = 12A, V_{OUT} Ripple Is Tested Across C12

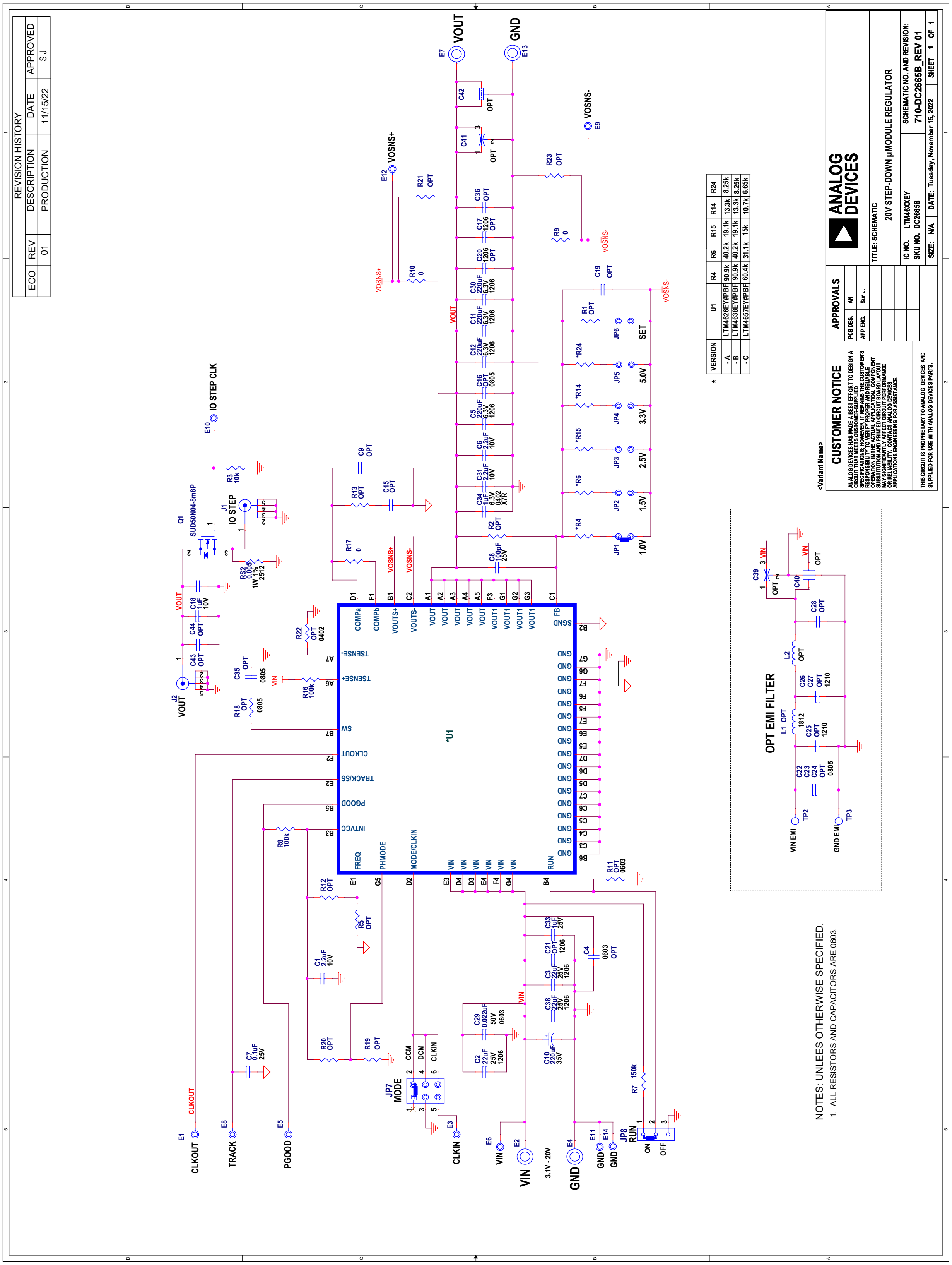
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	3	C1, C6, C31	CAP., 2.2µF, X7R, 10V, 20%, 0603	TDK, C1608X7R1A225M080AC
2	3	C2, C3, C38	CAP., 22µF, X5R, 25V, 10%, 1206	AVX, 12063D226KAT2A
3	1	C33	CAP., 1µF, X7R, 25V, 10%, 0603	TDK, C1608X7R1E105K080AB
4	4	C5, C11, C12, C30	CAP., 220µF, X5R, 6.3V, 20%, 1206	MURATA, GRM31CR60J227ME11L
5	1	C7	CAP., 0.1µF, X7R, 25V, 10%, 0603	AVX, 06033C104KAT2A
6	1	C8	CAP., 100pF, X7R, 25V, 5%, 0603	AVX, 06033C101JAT2A
7	1	C10	CAP., 220µF, ALUM HYB, 35V, 20%	SUN ELECTRONIC, 35HVH220M

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
8	1	C18	CAP., 1µF, X7R, 10V, 20%, 0603	AVX, 0603ZC105MAT2A
9	1	C29	CAP., 0.022µF, X7R, 50V, 10%, 0603	KEMET, C0603C223K5RAC7867
10	1	C34	CAP., 1µF, X7R, 6.3V, 10%, 0402	MURATA, GRM155R70J105KA12D
11	1	R3	RES., 10k, 1%, 1/10W, 0603	VISHAY, CRCW060310K0FKEAC
12	1	R4	RES., 90.9k, 0.5%, 1/10W, 0603	SUSUMU, RG1608P-9092-D-T5
13	1	R6	RES., 40.2k, 0.5%, 1/10W, 0603	SUSUMU, RG1608P-4022-D-T5
14	1	R14	RES., 13.3k, 0.5%, 1/10W, 0603	SUSUMU, RG1608P-1332-D-T5
15	1	R15	RES., 19.1k, 0.5%, 1/10W, 0603	SUSUMU, RG1608P-1912-D-T5
16	1	R24	RES., 8.25k, 0.5% 1/10W 0603	SUSUMU, RG1608P-8251-D-T5
17	2	R8, R16	RES., 100k, 1%, 1/10W, 0603	STACKPOLE ELECTRONICS, RMCF0603FG100K
18	2	R9, R10	RES., 0Ω, 5%, 1/16W, 0402	ROHM, SFR01MZPJ000
19	1	R17	RES., 0Ω, 1/10W, JUMPER, 0603	YAGEO, RC0603FR-070RL
20	1	R7	RES., 150k, 5%, 1/10W, 0603	YAGEO, RC0603JR-07150KL
21	1	Q1	XSTR, MOSFET, N-CH, 40V, TO-252 (DPAK)	VISHAY, SUD50N04-8M8P-4GE3
22	1	RS2	RES., SENSE, 0.005Ω, 1%, 1W, 2512	VISHAY, WSL25125L000FEA
23	1	U1	IC, 20V, 12A STEP-DOWN µModule REG.	ANALOG DEVICES, INC. LTM4626EY#PBF
Additional Demo Board Circuit Components				
24	0	C4, C9, C15, C36, C19, C43, C44	CAP., OPTION, 0603	OPTION
25	0	C13, C16, C22-C24, C37	CAP., OPTION, 0805	OPTION
26	0	C21, C20, C17	CAP., OPTION, 1206	OPTION
27	0	C25-C28	CAP., OPTION, 1210	OPTION
28	0	C39	CAP., OPTION, 0805, 3 PC PAD	MURATA, NFM21PC104R1E3D
29	0	C40	CAP., OPTION, 1206, 3 PC Pad	TDK, YFF31HC2A104MT000N
30	0	C41	CAP., OPTION, 0603, 3 PC PAD	MURATA, NFM18CC223R1C3D
31	0	C42	CAP., OPTION, 1206, 3 PC PAD	MURATA, NFM31PC276B0J3L
32	0	R18	RES., OPTION, 0805	OPTION
33	0	C35	CAP., OPTION, 0805	OPTION
34	0	R21-R23	RES., OPTION, 0402	OPTION
35	0	R1, R2, R5, R11-R13, R19, R20	RES., OPTION, 0603	OPTION
36	0	L1	IND., OPTION, 1812	OPTION
37	0	L2	IND., OPTION, 4mm × 4mm, AEX-Q200	COILCRAFT, XEL4020-800MEC
Hardware: For Demo Board Only				
38	10	E1, E3, E5, E6, E8-E12, E14	TESTPOINT, TURRET 0.064"	MILL-MAX, 2308-2-00-80-00-00-07-0
39	4	E2, E4, E7, E13	JACK, BANANA	KEYSTONE, 575-4
40	2	J1, J2	CONN, BNC, 5 PINS	AMPHENOL RF, 112404
41	5	JP1-JP6	HEADER, 1×2, 2mm	SULLINS, NRPN021PAEN-RC
42	1	JP7	HEADER, 2×3, 2mm	SULLINS, NRPN032PAEN-RC
43	1	JP8	HEADER, 1×3, 2mm	SAMTEC, TMM-103-02-L-S
44	4	MP1-MP4	STAND-OFF, NYLON 0.5"	KEYSTONE, 8833(SNAP ON)
45	3	XJP1, XJP7, XJP8	SHUNT, 2mm	SAMTEC, 2SN-BK-G

SCHEMATIC DIAGRAM



REVISION HISTORY

DEMO BOARD REV	DEMO MANUAL REV	DATE	DESCRIPTION	PAGE NUMBER
DC2665A-A	0	02/19	Initial Release.	—
DC2665B-A	0	12/22	DC2665B-A replaces DC2665A-A for low HF V_{OUT} ripple.	—

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.