LT3753
Active Clamp Forward Converter

DESCRIPTION

Demonstration circuit 2306A is an active clamp forward converter featuring the LT®3753.

This circuit was designed to demonstrate the high level of performance and efficiency that can be attained with the LT3753. It operates at 100kHz and produces a regulated 54V, 1.5A output from a wide input voltage range of 10V to 54V, making it suitable for telecom, industrial, and other applications. The output voltage of this circuit is jumper selectable between 54V and 48V.

The DC2306 circuit features soft-start which prevents output voltage overshoot during startup or when recovering from overload condition.

The DC2306 also has precise overcurrent protection circuit that allows for continuous operation under short circuit conditions. The low power dissipation under short circuit conditions insures high reliability even during short circuits.

Please refer to LT3753 data sheet for design details and applications information.

Design files for this circuit board are available at http://www.linear.com/demo/DC2306A

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN}	Input Supply Range		10		54	V
V_{OUT}	Output Voltage		53	54	55	V
I_{OUT}	Maximum Output Current, Continuous		1.5			A
f_{SW}	Switching (Clock) Frequency			100		kHz
$V_{OUT\ P-P}$	Output Ripple	V_{IN} = 12V, I_{OUT} = 1.5A (20MHz BW)		40		mV_{P-P}
I_{REG}	Output Regulation	Line and Load (10V_{IN} to 54V_{IN}, 0A to 1.5A_{OUT})		±0.1		%
P_{OUT}/P_{IN}	Efficiency (See Figure 2)	V_{IN} =12V, I_{OUT} = 1.5A		93		%

QUICK START PROCEDURE

Demonstration circuit 2306A is easy to set up to evaluate the performance of the LT3753. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

NOTE: When measuring the output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the output voltage ripple by touching the probe tip and ground ring directly across the last output capacitor as shown in Figure 1.

1. Set an input power supply that is capable of 10V to 54V to 10V. Then turn off the supply.
2. With power off, connect the supply to the input terminals $+V_{IN}$ and $-V_{IN}$.
   a. Input voltages lower than 10V can keep the converter from turning on due to the undervoltage lockout feature of the LT3753.
   b. If efficiency measurements are desired, an ammeter capable of measuring 9Adc can be put in series with the input supply in order to measure the DC2306A's input current.
   c. A voltmeter with a capability of measuring at least 54V can be placed across the input terminals in order to get an accurate input voltage measurement.
3. Turn on the power at the input.

   NOTE: Make sure that the input voltage does not exceed 100V.
4. Check for the proper output voltage of 54V. Turn off the power at the input.
5. Once the proper output voltages are established, connect a variable load capable of sinking 1.5A at 54V to the output terminals $+V_{OUT}$ and $-V_{OUT}$. Set the current for 0A.
   a. If efficiency measurements are desired, an ammeter that is capable of handling 1.5Adc can be put in series with the output load in order to measure the DC2306A's output current.
   b. A voltmeter can be placed across the output terminals in order to get an accurate output voltage measurement.
6. Turn on the power at the input.

   NOTE: If there is no output, temporarily disconnect the load to make sure that the load is not set too high.
7. Once the proper output voltage is again established, adjust the load within the operating range and observe the output voltage regulation, ripple voltage, efficiency and other desired parameters.

QUICK START PROCEDURE

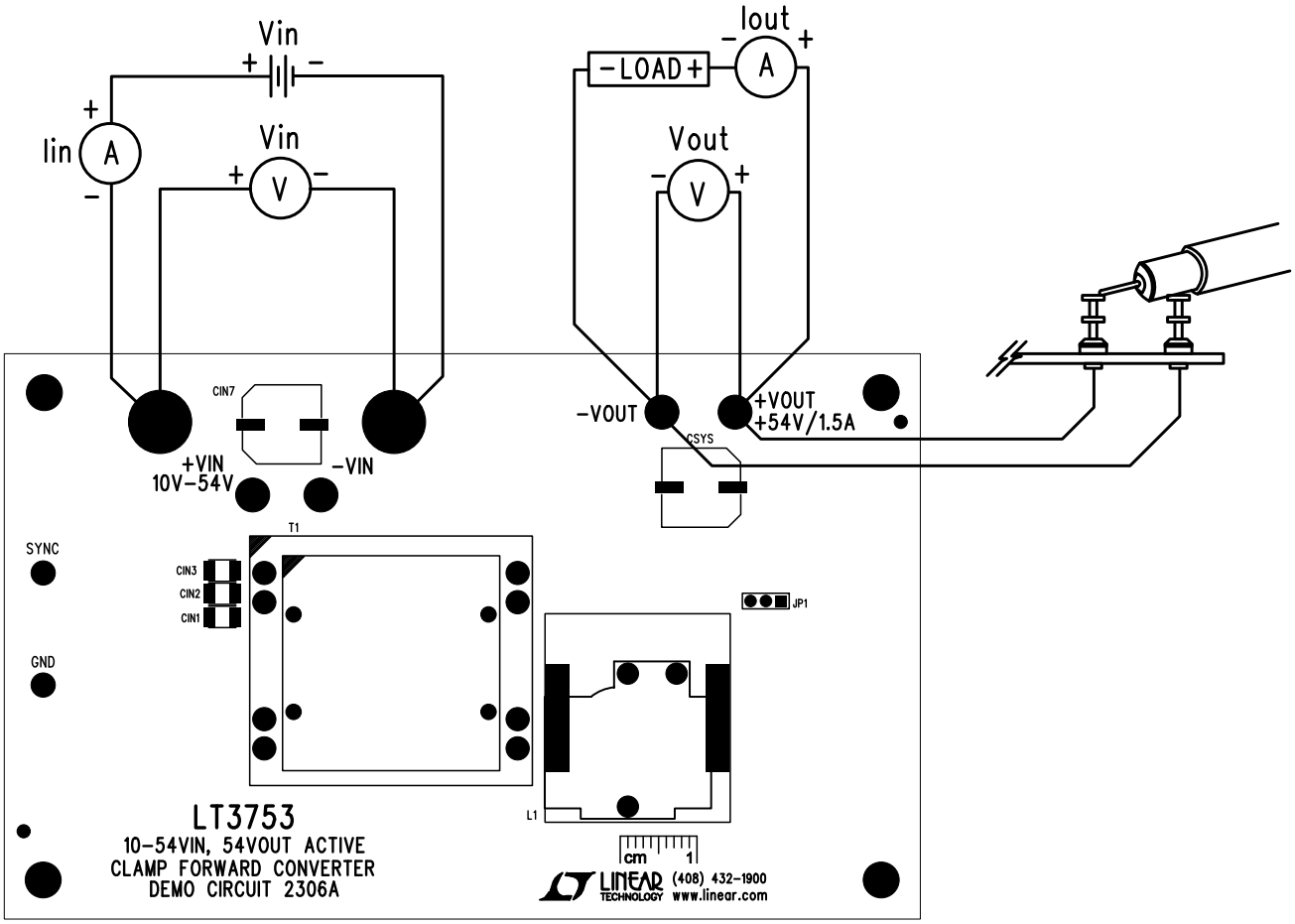


Figure 1. Proper Measurement Equipment Setup

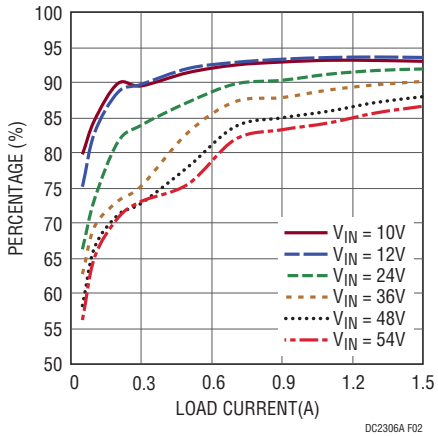


Figure 2. Efficiency vs Load Current

QUICK START PROCEDURE

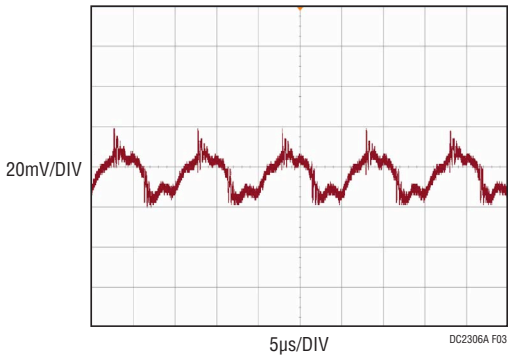


Figure 3. Output Ripple at $12V_{IN}$ and $1.5A_{OUT}$ (20MHz BW)

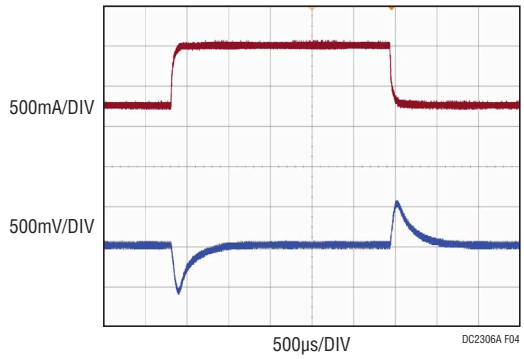


Figure 4. Transient Response Waveform at $12V_{IN}$ and $0.75A_{OUT}$ to $1.5A_{OUT}$

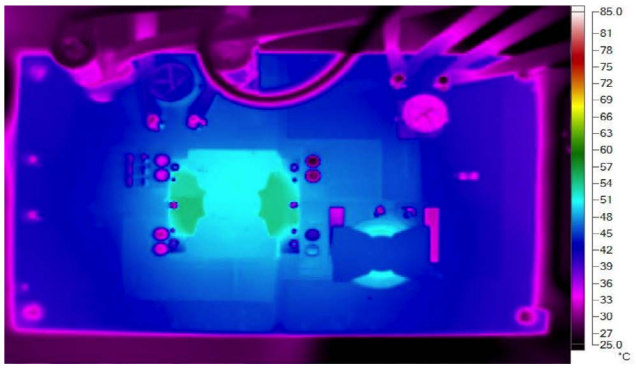


Figure 5. Thermal Map, Front Side at $12V_{IN}$ and $1.5A_{OUT}$ (T_A = 25°C)

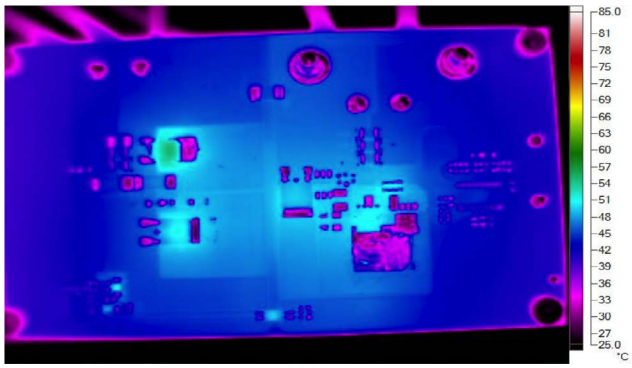


Figure 6. Thermal Map, Backside at $12V_{IN}$ and $1.5A_{OUT}$ (T_A = 25°C)

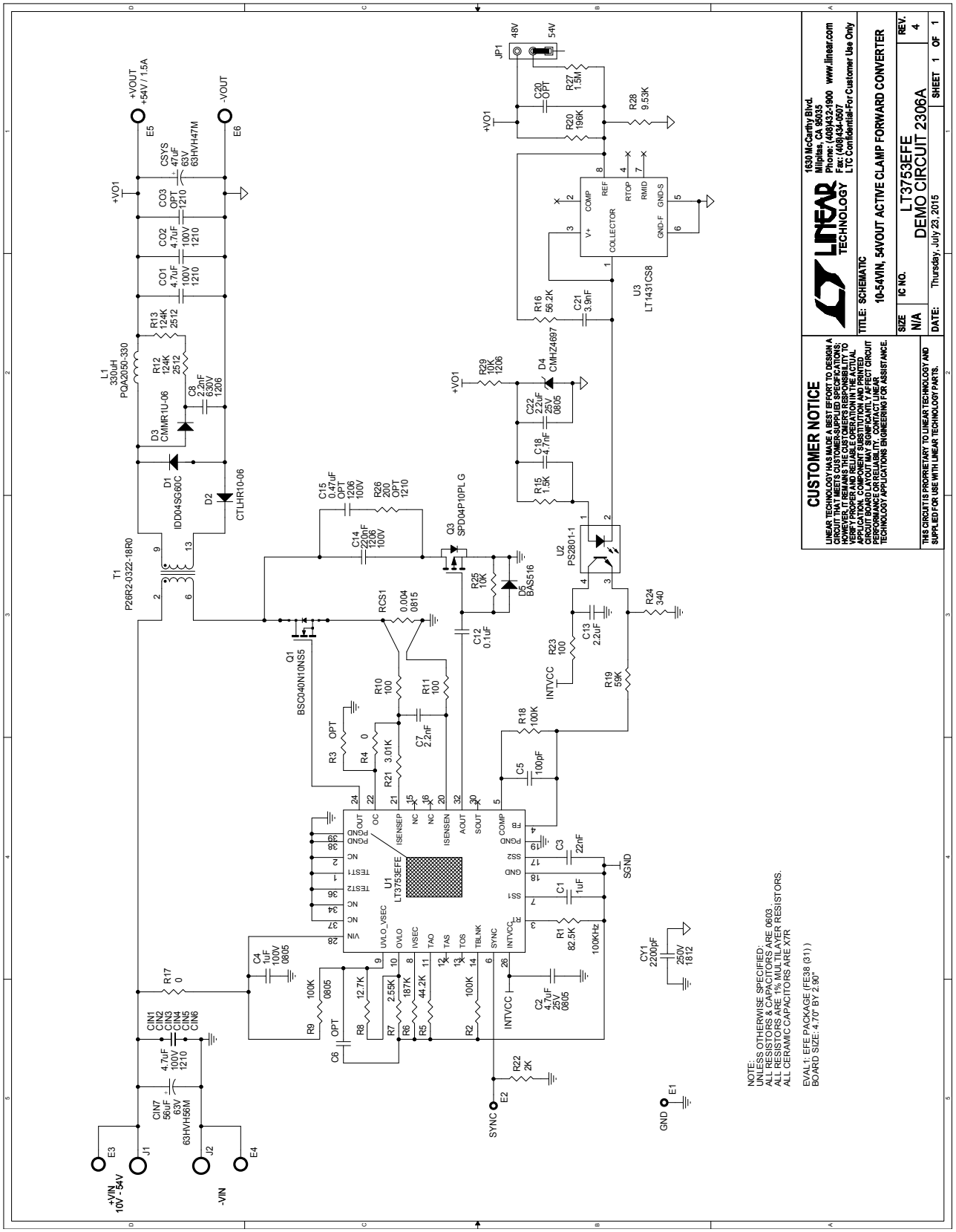
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	8	CIN1-CIN6, CO1, CO2	CAP., X7S, 4.7µF, 100V, 10%, 1210	TDK, CGA6M3X7S2A475K
2	1	CIN7	CAP., ALUM, 56µF, 63V	SUN ELEC., 63HVH56M
3	1	CSYS	CAP., ALUM, 47µF, 63V	SUN ELEC., 63HVH47M
4	1	CY1	CAP., X7R, 2200pF, 250V, 10%, 1812	MURATA, GA343QR7GD222KW01L
5	1	C1	CAP., X7R, 1µF, 25V, 10%, 0603	MURATA, GRM188R71E105KA12D
6	1	C2	CAP., X7R, 4.7µF, 25V, 10%, 0805	MURATA, GRM21BR61E475KA12L
7	1	C3	CAP., X7R, 22nF, 25V, 10%, 0603	MURATA, GRM188R71E223KA01D
8	1	C4	CAP., X7S, 1µF, 100V, 10%, 0805	TDK, C2012X7S2A105K
9	1	C5	CAP., X7R, 100pF, 50V, 10%, 0603	AVX, 06035C101KAT2A
10	1	C7	CAP., X7R, 2200pF, 50V, 10%, 0603	MURATA, GRM188R71H222KA01D
11	1	C8	CAP., U2J, 2200pF, 630V, 10%, 1206	MURATA, GRM31A7U2J222JW31D
12	1	C12	CAP., X7R, 0.1µF, 50V, 10%, 0603	MURATA, GRM188R71H104KA93D
13	1	C13	CAP., X5R, 2.2µF, 25V, 10%, 0603	TDK, C1608X5R1E225K080AB
14	1	C14	CAP., X7R, 0.22µF, 100V, 10%, 1206	TDK, C3216X7R2A224K115AA
15	1	C18	CAP., C0G, 4.7nF, 50V, 5%, 0603	MURATA, GRM1885C1H472JA01D
16	1	C21	CAP., NP0, 3900pF, 50V, 10%, 0603	MURATA, GRM1885C1H392JA01D
17	1	C22	CAP., X7R, 2.2pF, 50V, 10%, 0805	MURATA, GRM21BR71E225KA73L
18	1	D1	DIODE,SiC SCHOTTKY, DIODE, 600V, 4A, DPAK	INFINEON, IDD04SG60C
19	1	D2	DIODE, 600V, 10A, TLM364	CENTRAL SEMI., CTLHR10-06
20	1	D3	DIODE, 600V, 1A, SOD123F	CENTRAL SEMI., CMMR1U-06
21	1	D4	DIODE, ZENER, 10V, SOD-123	CENTRAL SEMI., CMHZ4697
22	1	D5	DIODE, HIGH-SPEED DIODE, SOD-523	NXP/PHILLIPS SEMI., BAS516
23	1	L1	INDUCTOR, 330µH	CHAMPS, PQA2050-330
24	1	Q1	MOSFET, N-CH, 100V, PG-TDSON-8	INFINEON, BSC040N10NS5
25	1	Q3	MOSFET, P-CH, 100V, 4.2A, DPAK	INFINEON, SPD04P10PL G
26	1	RCS1	RES., CHIP, 0.004Ω, 1W, 1%, 0815	SUSUMU, RL3720WT-R004-F
27	1	R1	RES., CHIP, 82.5k, 0.1W, 1%, 0603	VISHAY, CRCW060382K5FKEA
28	1	R2	RES., CHIP, 100k, 0.1W, 1%, 0603	VISHAY, CRCW0603100KFKEA
29	2	R4, R17	RES., CHIP, 0Ω, 0.1W, 1%, 0603	VISHAY, CRCW06030000Z0EA
30	1	R5	RES., CHIP, 44.2k, 0.1W, 1%, 0603	VISHAY, CRCW060344K2FKEA
31	1	R6	RES., CHIP, 187k, 0.1W, 1%, 0603	VISHAY, CRCW0603187KFKEA
32	1	R7	RES., CHIP, 2.55k, 0.1W, 1%, 0603	VISHAY, CRCW06032K55FKEA
33	1	R8	RES., CHIP, 12.7k, 0.1W, 1%, 0603	VISHAY, CRCW060312K7FKEA
34	1	R9	RES., CHIP, 100k, 1/8W, 1%, 0805	VISHAY, CRCW0805100KFKEA
35	3	R10, R11, R23	RES., CHIP, 100Ω, 0.1W, 1%, 0603	VISHAY, CRCW0603100RFKEA
36	2	R12, R13	RES., CHIP, 124k, 1W, 1%, 2512	VISHAY, CRCW2512124KFKEG
37	1	R15	RES., CHIP, 1.5k, 0.1W, 5%, 0603	VISHAY, CRCW06031K50JNEA
38	1	R16	RES., CHIP, 56.2k, 0.1W, 1%, 0603	VISHAY, CRCW060356K2FKEA
39	1	R18	RES., CHIP, 100k, 0.1W, 5%, 0603	VISHAY, CRCW0603100KJNEA
40	1	R19	RES., CHIP, 59k, 0.1W, 1%, 0603	VISHAY, CRCW060359K0FKEA
41	1	R20	RES., CHIP, 196k, 0.1W, 1%, 0603	VISHAY, CRCW0603196KFKEA

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
42	1	R21	RES., CHIP, 3.01k, 0.1W, 1%, 0603	VISHAY, CRCW06033K01FKEA
43	1	R22	RES., CHIP, 2k, 0.1W, 1%, 0603	VISHAY, CRCW06032K00FKEA
44	1	R24	RES., CHIP, 340Ω, 0.1W, 1%, 0603	VISHAY, CRCW0603340RFKEA
45	1	R25	RES., CHIP, 10k, 0.1W, 1%, 0603	VISHAY, CRCW060310K0FKEA
46	1	R27	RES., CHIP, 1.5M, 0.1W, 1%, 0603	VISHAY, CRCW06031M50FKEA
47	1	R28	RES., CHIP, 9.53k, 0.1W, 1%, 0603	VISHAY, CRCW06039K53FKEA
48	1	R29	RES., CHIP, 10k, 0.25W, 1%, 1206	VISHAY, CRCW120610K0FKEA
49	1	T1	TRANSFORMER	CHAMPS, P26R2-0322-18R0
50	1	U1	I.C., LT3753EFE#TRPBF, TSSOP-38(31)	LINEAR TECH., LT3753EFE#TRPBF
51	1	U2	I.C., PS2801C-1-P-A	NEC, PS2801C-1-P-A
52	1	U3	I.C. LT1431CS8, SO8	LINEAR TECH., LT1431CS8#TRPBF
Additional Demo Board Circuit Components				
1	0	CO3 (OPT)	CAP., 1210	
2	0	C6 (OPT)	CAP., 0603	
3	0	C15 (OPT)	CAP., X7R, 0.47µF, 100V, 10%, 1206	
4	0	C20 (OPT)	CAP., 0603	
5	0	R3 (OPT)	RES., 0603	
6	0	R26 (OPT)	RES., CHIP, 200, 1/2W, 1%, 1210	
Hardware: For Demo Board Only				
1	2	E1, E2	TESTPOINT, TURRET, .061" PBF	MILL-MAX, 2308-2-00-80-00-00-07-0
2	4	E3-E6	TESTPOINT, TURRET, .094" PBF	MILL-MAX, 2501-2-00-80-00-00-07-0
3	2	J1, J2	BANANA JACK	KEYSTONE, 575-4
4	1	JP1	CONN., HEADER, 1×3, 2mm	WURTH ELEKTRONIK, 620 003 111 21
5	1	XJP1	SHUNT, 2mm	WURTH ELEKTRONIK, 608 002 134 21
6	4	MH1-MH4	STAND-OFF, NYLON 0.25"	KEYSTONE, 8831(SNAP ON)
7	1		FAB, PRINTED CIRCUIT BOARD	DEMO CIRCUIT 2306A
8	2		STENCIL (TOP & BOTTOM)	STENCIL DC2306A

SCHEMATIC DIAGRAM



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