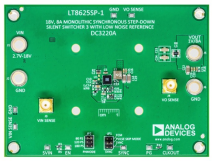
ANALOG DEVICES LT8625SP-1 Synchronous Step-Down Silent Switcher



ANALOG DEVICES LT8625SP-1 Synchronous Step Down Silent Switcher User Manual

Contents

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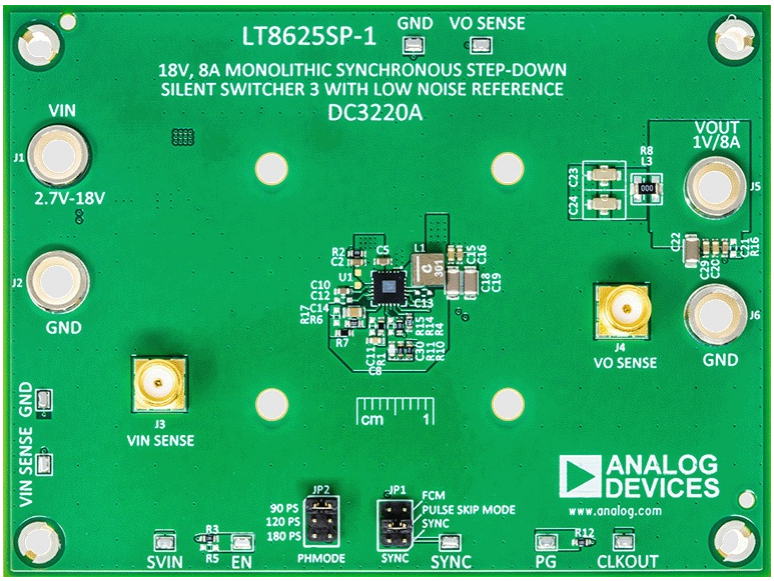


Product Specifications:

- **Model**: LT8625SP-1
- **Input Voltage Range:** 2.7V to 18V
- **Output Voltage:** Default 1V
- **Switching Frequency:** Programmable from 300kHz to 4MHz
- **Maximum Output Current:** 8A
- **Efficiency:** Up to 77.2%

Product Usage Instructions

Setting the Switching Frequency:
The LT8625SP-1 switching frequency can be programmed via an oscillator resistor or external clock over a range of 300kHz to 4MHz. The default frequency on demo circuit 3220A is 2MHz.

Operating Modes:
By default, the SYNC pin is grounded for low ripple pulse skip mode operation. To synchronize to an external clock, move JP1 toSYNC and connect the external clock to the SYNC terminal. Forced continuous mode (FCM) can be selected by adjusting JP1 shunt.

EMI Performance:
The demo board includes an EMI filter for improved performance. Refer to Figure 3 for Radiated EMI Performance results.

Noise Reduction:
The regulator features ultralow noise over a wide frequency range. See Figure 4 for Noise Spectral Density information.

Quick Start Procedure:

1. Refer to Figure 5 for equipment setup.
2. Avoid long ground leads when measuring voltage ripple.
3. Measure output voltage ripple across the output capacitor directly.
4. Input voltage ripple and remote output voltage ripple can be measured through SMA connectors.

5. Output voltage ripple at capacitor C22 can be measured through the VO_SENSE SMA connector (refer to Figure 6).

DESCRIPTION

Demonstration circuit 3220A is an 18V, 8A synchronous step-down Silent Switcher® 3 with ultralow noise, high efficiency and power density featuring the LT®8625SP-1. The input voltage range of DC3220A is 2.7V to 18V. The default demo board setting is 1V at 8A maximum DC output current. The LT8625SP-1 is a compact, ultralow noise, ultralow emission, high efficiency and high speed synchronous monolithic step-down switching regulator. The uniquely designed combination of the ultralow noise reference and the third-generation Silent Switcher architecture enables the LT8625SP-1 to achieve both high efficiency and excellent wideband noise performance. A minimum on-time of 15ns allows high VIN to low VOUT conversion at high frequencies. The LT8625SP-1 switching frequency can be programmed either via oscillator resistor or external clock over a 300kHz to 4MHz range. The default frequency of demo circuit 3220A is 2MHz. The SYNC pin on the demo board is grounded by default for low ripple pulse skip mode operation. To synchronize to an external clock, move JP1 to SYNC and apply the external clock to the SYNC terminal. Forced continuous mode (FCM) can be selected by moving JP1 shunt. Figure 1 shows the efficiency of the circuit at 5V input and 12V input in forced continuous mode operation (input from VIN terminal). Figure 2 shows the LT8625SP-1 temperature rising on DC3220A demo board under 6A and 8A load conditions. The demo board has an EMI filter installed. The EMI performance of the board is shown on Figure 3. The red line in Radiated EMI Performance is the CISPR32 Class B limit. In addition to the excellent EMI performance, the regulator also features ultralow noise over a wide frequency range, as is shown in Figure 4. The LT8625SP-1 data sheet gives a complete description of the part including operation and application information. The data sheet must be read in conjunction with this demo manual for demo circuit 3220A. The LT8625SP-1 is assembled in a 4mm × 4mm LQFN package with exposed pads and exposed die for low thermal resistance. The layout recommendations for low EMI operation and maximum thermal performance are available in the datasheet section Low EMI PCB Layout and Thermal Considerations. Design files for this circuit board are available.

PERFORMANCE SUMMARY

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range VIN		2.7		18	V
Output Voltage		0.992	1	1.008	V
Default Switching Frequency		1.93	2	2.07	MHz
Maximum Output Current	Derating is Necessary for Certain VIN and Thermal Conditions	8			A
Efficiency	VIN = 12V, fSW = 2MHz, VOUT = 1V at IOUT = 8A	77.2			%

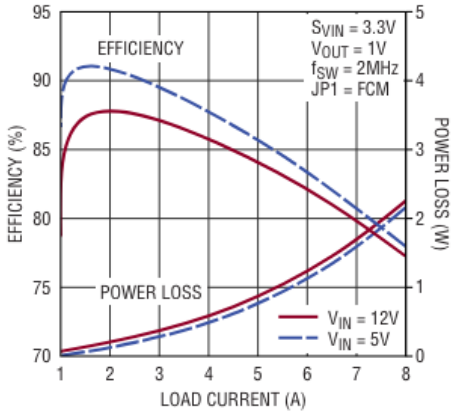


Figure 1. LT8625SP-1 Demo Circuit DC3220A Efficiency vs Load Current

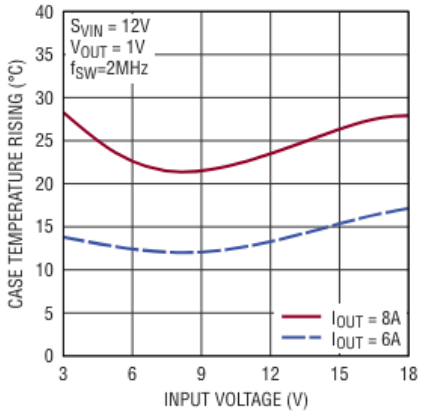


Figure 2. Temperature Rising vs V_{IN}

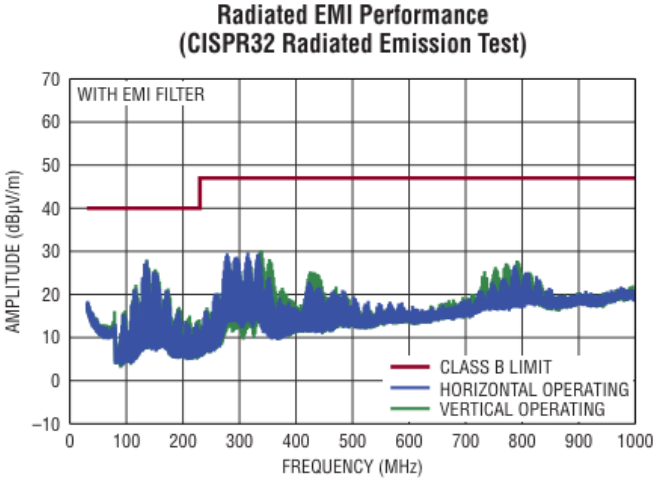


Figure 3. LT8625SP-1 Demo Circuit DC3220A EMI Performance (12V Input to 1V Output at 3A, f_{SW} = 2MHz)

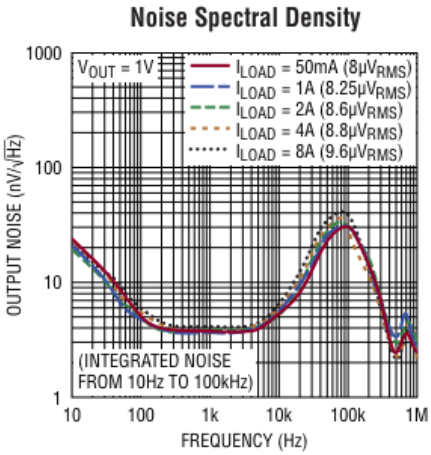


Figure 4. LT8625SP-1 Demo Circuit DC3220A Noise Spectral Density (12V Input to 1V Output, f_{SW} = 2MHz)

QUICK START PROCEDURE

Demonstration circuit 3220A is easy to set up to evaluate the performance of LT8625SP-1. Please refer to Figure 5 for proper equipment setup and follow the test procedures below:
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 output voltage ripple by touching the probe tip directly across the output capacitor. For input voltage ripple and the remote output voltage ripple, they can also be measured through the SMA connectors via VIN_SENSE and VO_SENSE. Figure 6 shows the output voltage ripple measured at the output capacitor C22 through the VO_SENSE SMA connector.

1. Place JP1 on FCM position.
2. With power off, connect the input power supply to VIN (J1) and GND (J2).
3. With power off, connect the load from VOUT (J5) to GND (J6).
4. Connect the DMM between the input test points: VIN_SENSE (E1) and SENSE_GND (E2) to monitor the input voltage. Connect DMM between VO_SENSE (E4) and SENSE_GND (E7) to monitor the output voltage
5. Turn on the power supply at the input.
6. Check for the proper output voltage (VOUT = 1V).
7. Once the input and output voltages are properly established, adjust the load current within the operating range of 0A to 8A max. Observe the output voltage regulation, output voltage ripples, switching node waveform, load transient response and other parameters.

8. An external clock can be added to the SYNC terminal when the SYNC function is used (JP1 on the SYNC position). The RT resistor (R4) should be chosen to set the LT8625SP-1 switching frequency at least 20% below the lowest SYNC frequency.

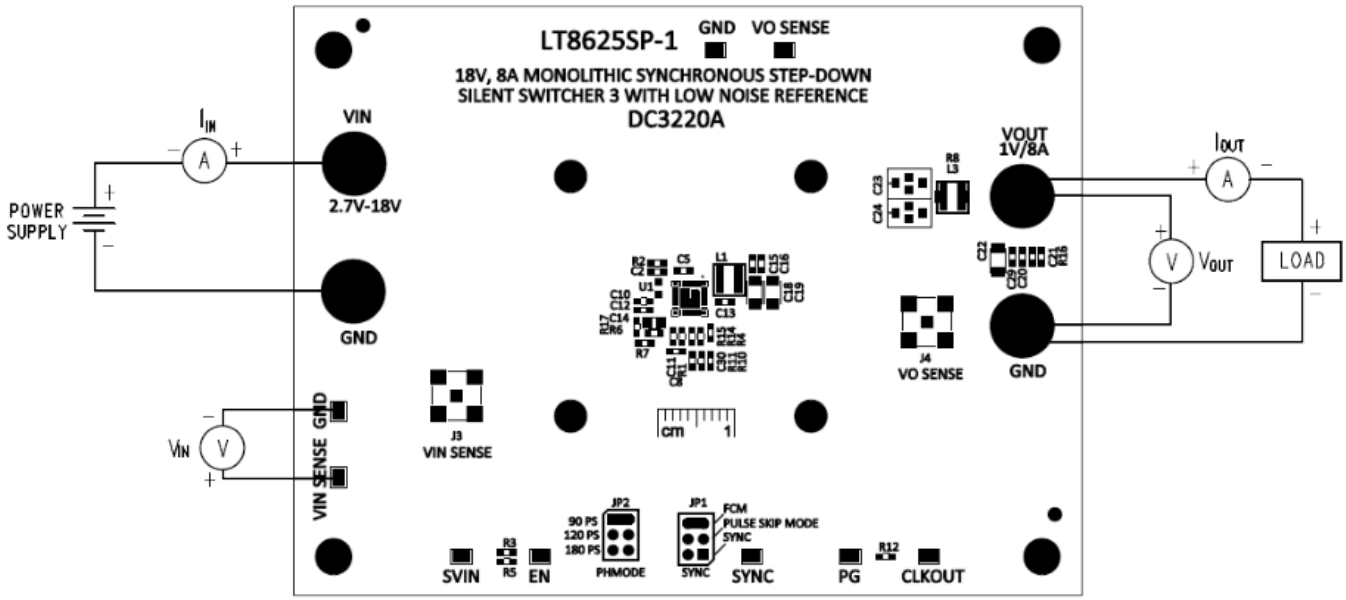


Figure 5. Proper Measurement Equipment Setup

TYPICAL PERFORMANCE CHARACTERISTICS

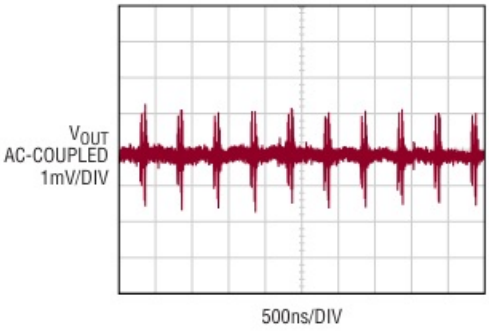


Figure 6. LT8625SP-1 Demo Circuit DC3220A Output Voltage Ripple Measured through J4 (12V Input, I_{OUT} = 8A, 200MHz BW)

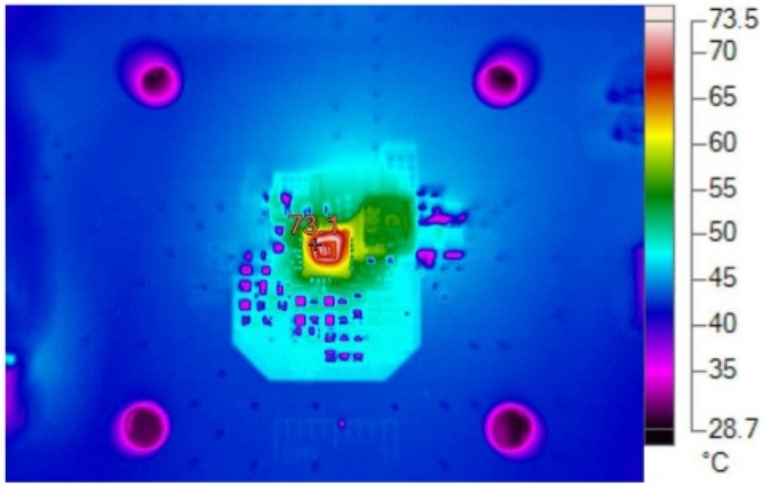


Figure 7. Thermal Performance at V_{IN} = 12V, f_{SW} = 2MHz, V_{OUT} = 1V, I_{LOAD} = 8A, T_A = 25°C

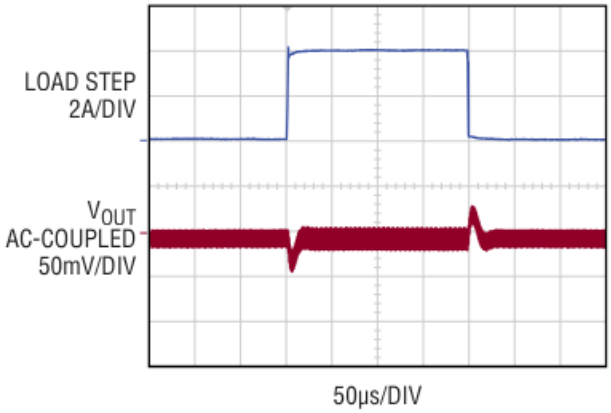


Figure 8. Transient Responses with Load Steps 0A to 4A to 0A at dI/dt = 4A/µs

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER

Required Circuit Components

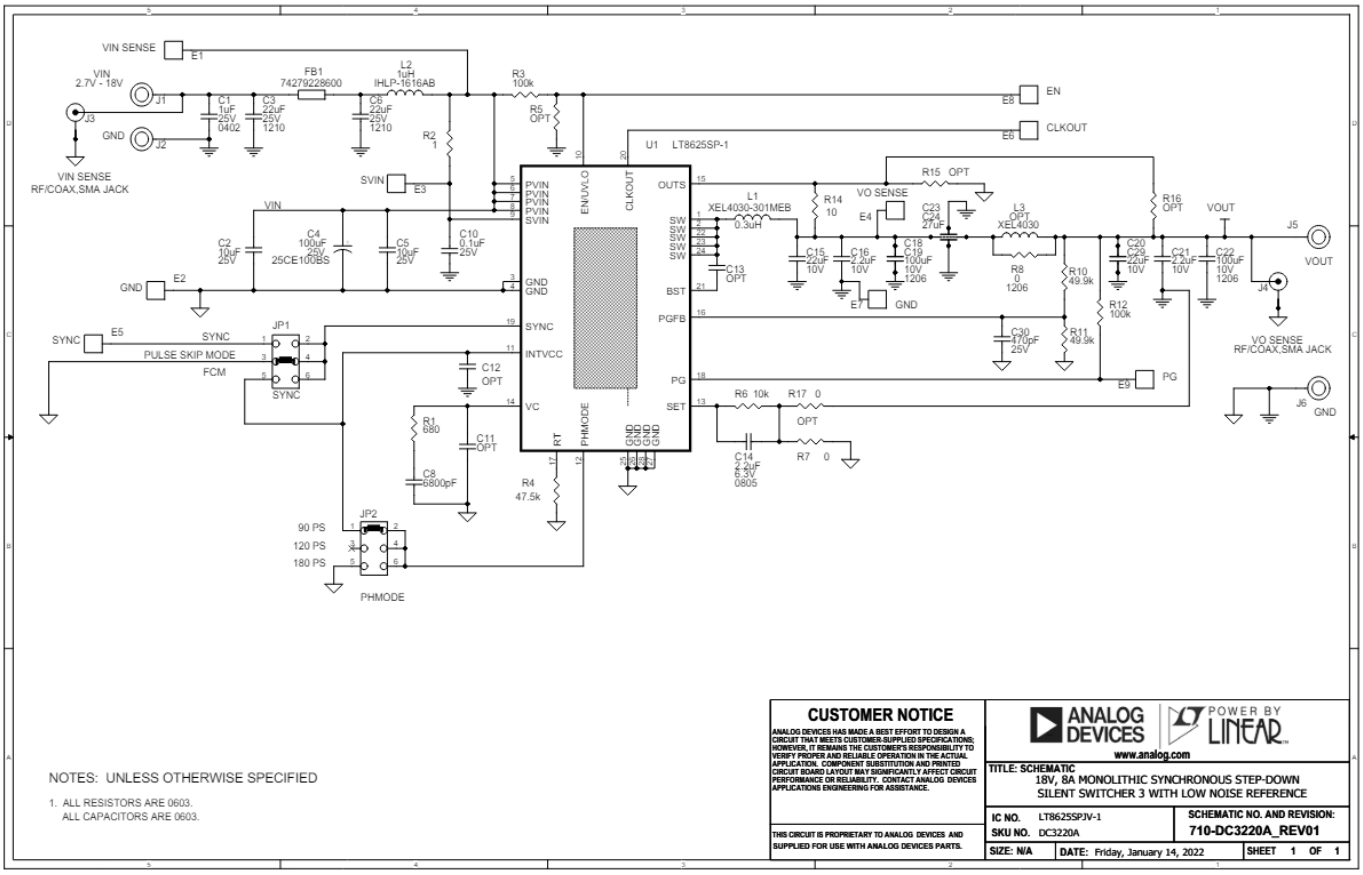
1	1	C1	CAP., 1µF, X5R, 25V, 10%, 0402, AEC-Q200	MURATA, GRT155R61E105KE01D

2	2	C2, C5	CAP., 10µF, X5R, 25V, 20%, 0603	MURATA, GRM188R61E106MA73D NIC, NMC0603X5R106M25TRPF SAMSUNG, CL10A106MA8NRNC TDK, C1608X5R1E106M080AC
3	2	C3, C6	CAP., 22µF, X7R, 25V, 10%, 1210	AVX, 12103C226KAT2A KEMET, C1210C226K3RACTU MURATA, GRM32ER71E226KE15L SAMSUNG, CL32B226KAJNNNE
4	1	C4	CAP., 100µF, ALUM ELECT, 25V, 20%, 6.3 mm × 7.7mm, CE-BS SERIES	SUN ELECTRONIC INDUSTRIES CORP, 25CE100BS
5	1	C8	CAP., 6800pF, X7R, 25V, 10%, 0603	YAGEO, CC0603KRX7R8BB682 AVX, 06033C682KAT2A MURATA, GRM188R71E682KA01D WURTH ELEKTRONIK, 885012206064
6	1	C10	CAP., 0.1µF, X7R, 25V, 10%, 0603, AEC-Q200	MURATA, GCM188R71E104KA57D TDK, CGA3E2X7R1E104K080AA
7	0	C11, C12, C13	CAP., OPTION, 0603	
8	1	C14	CAP., 2.2µF, X7R, 25V, 10%, 0805, AEC-Q200	TAIYO YUDEN, TMK212B7225KGHT
9	3	C15, C20, C29	CAP., 22µF, X5R, 10V, 20%, 0603	AVX, 0603ZD226MAT2A MURATA, GRM188R61A226ME15D SAMSUNG, CL10A226MP8NUNE
10	2	C16, C21	CAP., 2.2µF, X7R, 10V, 10%, 0603	MURATA, GRM188R71A225KE15D TDK, C1608X7R1A225K080AC AVX, 0603ZC225KAT2A YAGEO, CC0603KRX7R6BB225
11	3	C18, C19, C22	CAP., 100µF, X5R, 10V, 20%, 1206	TDK, C3216X5R1A107M160AC
12	2	C23, C24	CAP., 27µF, FEED THRU, 6.3V, 20%, 1206, 3-TERM, 5mΩ DCR, 6A	MURATA, NFM31PC276B0J3L
13	1	C30	CAP., 470pF, C0G, 25V, 10%, 0603	AVX, 06033A471KAT2A KEMET, C0603C471K3GACTU
14	9	E1, E2, E3, E4, E5, E6, E7, E8, E9	TEST POINT, 0805, 2mm × 1.25mm × 1.45 mm, PROBE PAD, FOIL, VERT, SMT, NATURAL	TE CONNECTIVITY, 1625854-2 TE CONNECTIVITY, RCT-0C
15	1	FB1	IND., 60Ω AT 100MHz, PWR, FERRITE BEAD, 25%, 5100mA, 15mΩ, 0603	WURTH ELEKTRONIK, 74279228600

16	4	J1, J2, J5, J6	CONN., BANANA JACK, FEMALE, THT, NON-INSULATED, SWAGE, 0.218″	KEYSTONE, 575-4
17	2	J3, J4	CONN., RF/COAX, SMA JACK, FEMALE, 1 PORT, VERT, ST, SMT, 50Ω, Au	MOLEX, 0732511350 MOLEX, 73251-1350 MOLEX, 732511350
18	2	JP1, JP2	CONN., HDR, MALE, 2×3, 2mm, VERT, ST, THT	WURTH ELEKTRONIK, 62000621121
19	1	L1	IND., 0.3µH, PWR, SHIELDED, 20%, 18.9A, 3.1mΩ, 4.3mm × 4.3mm, XEL4030, AEC-Q200	COILCRAFT, XEL4030-301MEB COILCRAFT, XEL4030-301MEC
20	1	L2	IND., 1µH, PWR, SHIELDED, 20%, 4A, 52.5mΩ, 1616AB, IHLP-01 SERIES	VISHAY, IHLP1616ABER1R0M01
21	0	L3	IND., 0.47µH, PWR, SHIELDED, 20%, 15.6A, 4.6mΩ, 4.3mm × 4.3mm, XEL4030, AEC-Q200	COILCRAFT, XEL4030-471MEB COILCRAFT, XEL4030-471MEC
22	1	LB1	LABEL SPEC, DEMO BOARD SERIAL NUMBER	BRADY, THT-96-717-10
23	4	MP1, MP2, MP3, MP4	STANDOFF, NYLON, SNAP-ON, 0.375″	KEYSTONE, 8832

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
24	1	PCB1	PCB, DC3220A	ADI APPROVED SUPPLIER, 600-DC3220A
25	1	R1	RES., 680Ω, 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3EKF6800V VISHAY, CRCW0603680RFKEA
26	1	R2	RES., 1Ω, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F1R00TRF VISHAY, CRCW06031R00FKEA
27	2	R3, R12	RES., 100k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW0603100KFKEA NIC, NRC06F1003TRF PANASONIC, ERJ3EKF1003V VISHAY, RCA0603100KFKEAHP
28	1	R4	RES., 47.5k, 1%, 1/10W, 0603	VISHAY, CRCW060347K5FKEA YAGEO, RC0603FR-0747K5L
29	0	R5, R15, R16	RES., OPTION, 0603	
30	1	R6	RES., 10k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW060310K0FKEA KOA SPEER, RK73H1JTTD1002F PANASONIC, ERJ3EKF1002V
31	2	R7, R14	RES., 0Ω, 1/10W, 0603, AEC-Q200	VISHAY, CRCW06030000Z0EA VISHAY, CRCW06030000Z0EB NIC, NRC06ZOTRF
32	1	R8	RES., 0Ω, 1/4W, 1206, AEC-Q200	VISHAY, CRCW12060000Z0EA PANASONIC, ERJ8GEY0R00V NIC, NRC12ZOTRF
33	2	R10, R11	RES., 49.9k, 1%, 1/10W, 0603	NIC, NRC06F4992TRF VISHAY, CRCW060349K9FKEA YAGEO, RC0603FR-0749K9L
34	1	STNCL1	TOOL, STENCIL, DC3220A	ADI APPROVED SUPPLIER, 830-DC3220A
35	1	U1	IC, STEP-DOWN SILENT SWITCHER 3, LQFN-24	ANALOG DEVICES, LT8625SP-1#PBF ANALOG DEVICES, LT8625SP-1#TRPBF
36	2	XJP1, XJP2	CONN., SHUNT, FEMALE, 2-POS, 2mm	WURTH ELEKTRONIK, 60800213421

SCHEMATIC DIAGRAM



REVISION HISTORY

REV	DATE	DESCRIPTION	PAGE NUMBER
A	5/24	Initial release	—

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FAQ

Q: How do I change the switching frequency on the demo board?
A: The switching frequency can be adjusted by either changing the oscillator resistor or using an external clock input.

Q: What is the default output voltage of the LT8625SP-1?
A: The default output voltage is 1V.

Q: How can I measure the output voltage ripple?
A: To measure output voltage ripple, touch the oscilloscope probe directly across the output capacitor.

Documents / Resources

	**ANALOG DEVICES LT8625SP-1 Synchronous Step Down Silent Switcher** [pdf] User Manual LT8625SP-1 Synchronous Step Down Silent Switcher, LT8625SP-1, Synchronous Step Down Silent Switcher, Step Down Silent Switcher, Silent Switcher, Switcher

References

- **User Manual**