LT8653S
Dual Channel 2A, 42V, Synchronous Step-Down Silent Switcher with 6.2µA Quiescent Current

DESCRIPTION

Demonstration circuit 2535A is a 42V, dual channel, 2A synchronous step-down regulator featuring the LT®8653S. The LT8653S is a compact, high efficiency, high speed synchronous monolithic step-down switching regulator which features the second generation Silent Switcher® technology that minimizes EMI and reduces PCB layout sensitivity. The demo board is designed for two outputs: 5V and 3.3V from a 5.5V to 42V input. Each output can source up to 2A continuous current at the same time. The wide input range allows a variety of input sources, such as automotive batteries and industrial supplies. The integrated power switches and other necessary circuitry reduce the external component count and simplify design. Selectable spread spectrum mode of operation can further improve EMI/EMC performance. Ultralow quiescent current in Burst Mode® operation achieves high efficiency at very light loads.

The DC2535A demo board is 3" by 3" in size and has four layers with 2oz copper on the outer layers and 1oz copper on the inner layers. The DC2535A operates at 2MHz switching frequency by default to minimize solution size. The LT8653S is assembled in a small thermally enhanced 4mm × 3mm LQFN package. The IC temperature rises about 50°C when both channels operate at full load, 2A each, with the default switching frequency of 2MHz.

The jumper JP2 on the demo board determines the configuration of the SYNC pin of the LT8653S. By default, the SYNC pin on the demo board is grounded for low ripple Burst Mode operation. Moving JP2 to FCM W/SSM enables the spread spectrum mode of operation by tying the SYNC pin to VCC pin. To synchronize to an external clock, move JP2 to FCM W/O SSM OR SYNC position and apply the external clock on the SYNC turret.

The jumpers JP3 and JP4 on the demo board determine the configuration of the output voltage select bit pins D0 and D1. On the DC2535A, the D0 and D1 pins are by default floating. This combination connects internal feedback resistor divider between the FB1/FB2 pins and the error amplifier which means that FB1 and FB2 pins are regulated to 5V and 3.3V respectively. On the DC2535A, FB1/FB2 pins are by default connected through 0Ω resistors to the output nodes. Refer to the LT8653S data sheet for more information on the D0 and D1 pin settings.

The demo board has an EMI filter installed. The EMI performance of the demo board (with EMI filter) is shown in Figure 1 and Figure 2. The black lines in Figure 2 are CISPR 25 class 5 limits. To achieve EMI/EMC performance as shown in Figure 2, the input EMI filter is required and the input voltage should be applied at VEMI terminal.

The LT8653S data sheet gives a complete description of the part, operation and application information. The data sheet must be read in conjunction with this manual for demo circuit 2535A.

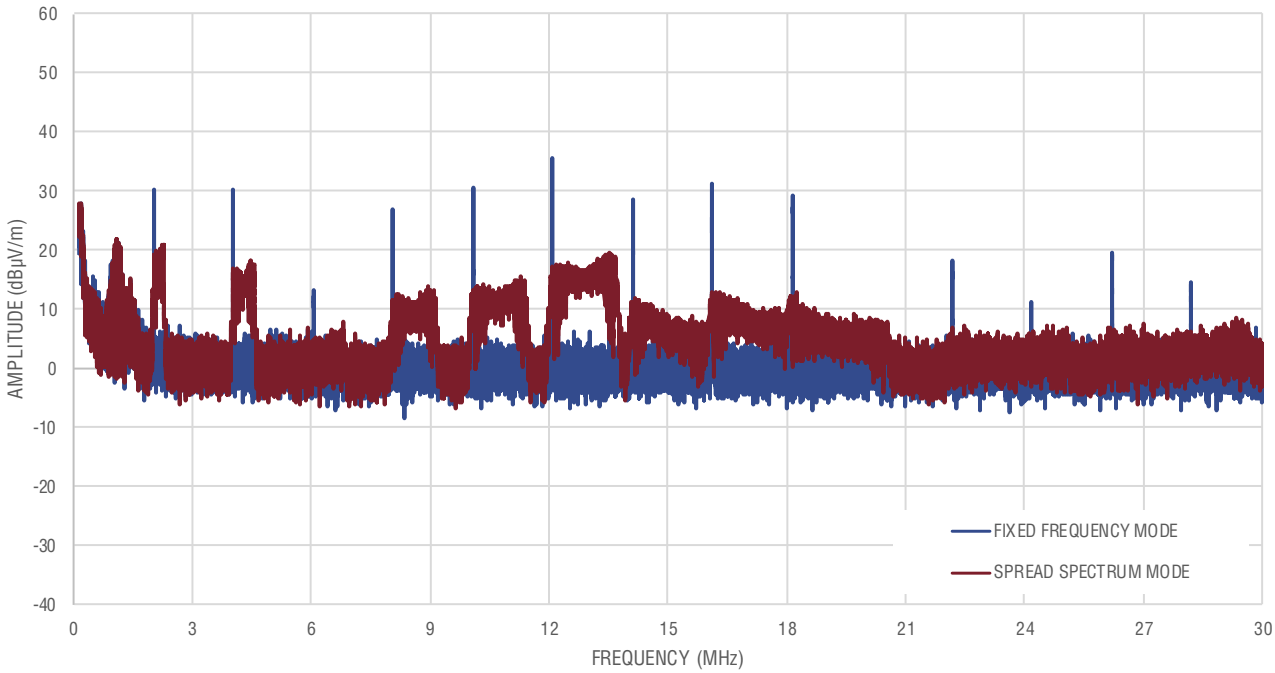
Design files for this circuit board are available.

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

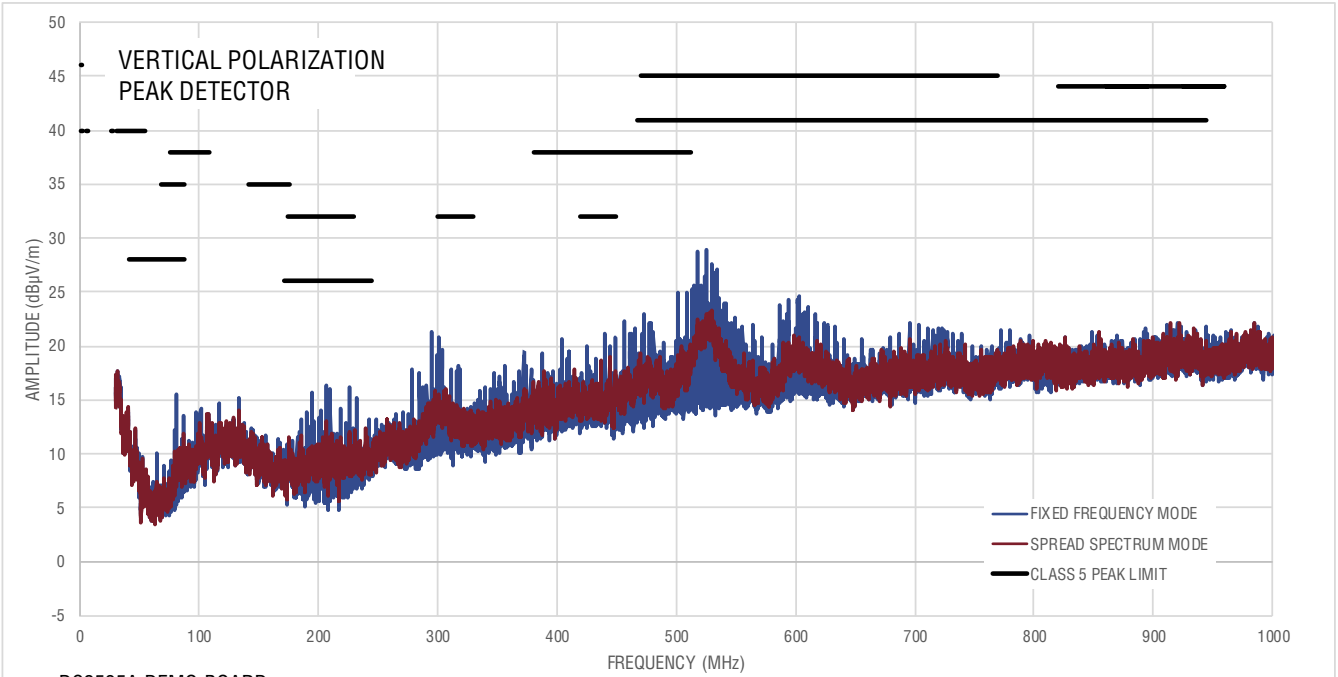
SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN}	Input Supply Range		5.5		42	V
V_{OUT1}	Output1 Voltage		4.8	5	5.2	V
I_{OUT1}	Maximum Output1 Current		2			A
V_{OUT2}	Output2 Voltage		3.168	3.3	3.432	V
I_{OUT2}	Maximum Output2 Current		2			A
f_{SW}	Switching Frequency		1.85	2	2.15	MHz
EFE	Efficiency at DC	V_{IN} = 12V, I_{OUT1} = 1A, I_{OUT2} = 1A		93.1		%

TYPICAL PERFORMANCE CHARACTERISTICS



DC2535A DEMO BOARD
(WITH EMI FILTER INSTALLED)
14V INPUT TO 5V OUTPUT1 AT 2A AND 3.3V OUTPUT2 AT 2A, f_{SW} = 2MHz

Figure 1. Conducted EMI Performance



DC2535A DEMO BOARD
(WITH EMI FILTER INSTALLED)
14V INPUT TO 5V OUTPUT1 AT 2A AND 3.3V OUTPUT2 AT 2A, f_{SW} = 2MHz

Figure 2. Radiated EMI Performance (CISPR 25 Radiated Emission Test with Class 5 Peak Limits)

QUICK START PROCEDURE

Demonstration circuit 2535A is easy to set up to evaluate the performance of the LT8653S. Refer to Figure 3 for proper measurement equipment setup and follow the procedure below:

NOTE: When measuring the input or output voltage ripple, care must be taken to avoid long ground lead on the oscilloscope probe. Measure the output voltage ripple by touching the probe tip directly across the VOUT and GND terminals. See Figure 4 for the proper measurement technique.

1. Check that JP3 and JP4 are placed on the FLOAT position.
2. Check that JP2 are placed on BURST position.
3. With power off, connect the input power supply to VEMI and GND. If the EMI/EMC performance is not important, connect the input power supply to VIN and GND.
4. With power off, connect the loads from VOUT1 to GND, and VOUT2 to GND.
5. Turn on the power at the input.

   NOTE: make sure that the input voltage never exceeds 42V.
6. Check for proper output voltages: V_{OUT1} = 5V, V_{OUT2} = 3.3V.

   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 voltages are established, adjust the load within the operating ranges and observe the output voltage regulation, ripple voltage, efficiency and other parameters.
8. An external clock can be added to the SYNC terminal when SYNC function is used (JP2 on the FCM W/O SSM OR SYNC position). Please make sure that R12 resistor should be chosen to set the LT8653S switching frequency equal to or below the lowest synchronization frequency. JP2 can also set the LT8653S in spread spectrum mode (JP2 on the FCM W/SSM position).

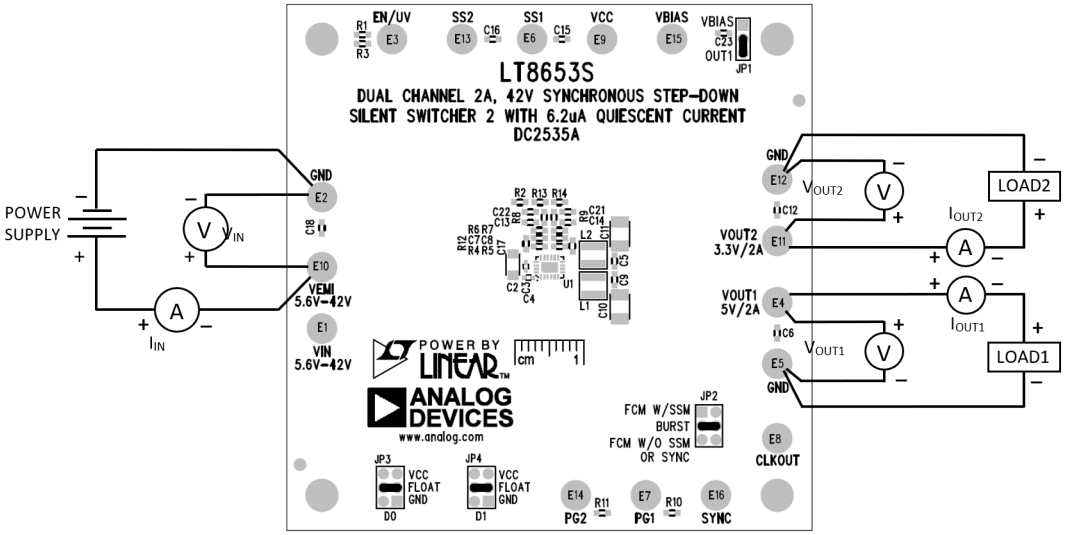


Figure 3. Proper Measurement Equipment Setup

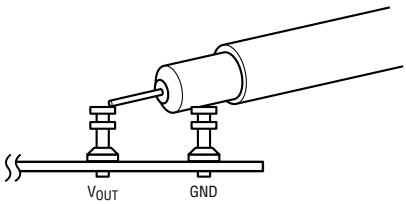
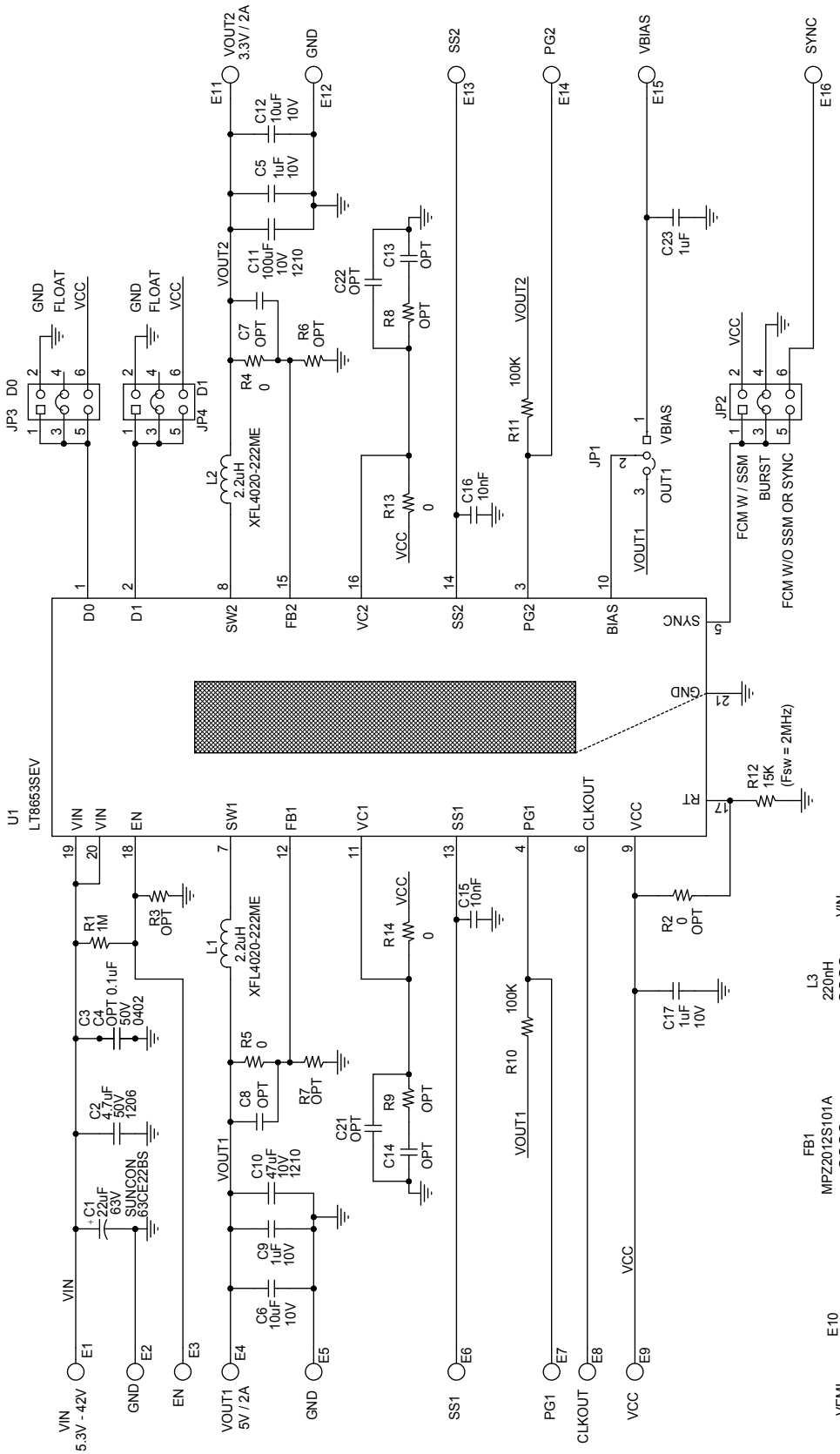


Figure 4. Measure Output Ripple

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	C2	CAP., 4.7µF, X7R, 50V, 10%, 1206	MURATA, GRM31CR71H475KA12L
2	4	C5, C9, C17, C23	CAP., 1µF, X7R, 10V, 10%, 0603	MURATA, GRM188R71A105KA61D
3	2	C6, C12	CAP., 10µF, X5R, 10V, 10%, 0603	TDK, C1608X5R1A106K080AC
4	1	C10	CAP., 47µF, X5R, 10V, 10%, 1210	MURATA, GRM32ER61A476KE20K
5	1	C11	CAP., 100µF, X5R, 10V, 20%, 1210	MURATA, GRM32ER61A107ME20L
6	2	C15, C16	CAP., 10nF, X7R, 25V, 10%, 0603	MURATA, GRM188R71E103KA01D
7	2	L1, L2	INDUCTOR, 2.2µH, XFL4020	COILCRAFT, XFL4020-222ME
8	1	R1	RES., 1M, 1/10W, 1%, 0603	VISHAY, CRCW06031M00FKEA
9	4	R4, R5, R13, R14	RES., 0Ω, 1/10W, 0603	VISHAY, CRCW06030000Z0EA
10	2	R10, R11	RES., 100k, 1/10W, 1%, 0603	VISHAY, CRCW0603100KFKEA
11	1	R12	RES., 15k, 1/10W, 1%, 0603	VISHAY, CRCW060315K0FKEA
12	1	U1	I.C., STEP-DOWN SWITCHER, LQFN	ANALOG DEVICES, LT8653SEV#PBF
Additional Demo Board Circuit Components				
1	1	C1	CAP., ALUM, 22µF, 63V, 20%	SUN ELECT., 63CE22BS
2	0	C7, C8	CAP., OPTION, 0603	
3	2	C3, C4 (OPT)	CAP., 0.1µF, X7R, 50V, 10%, 0402	MURATA, GRM155R71H104KE14J
4	0	C13, C14, C21, C22 (OPT)	CAP., OPTION, 0603	
5	3	C18, C25, C26	CAP., 1µF, X5R, 50V, 10% 0603	MURATA, GRM188R61H105KAALD
6	2	C19, C20	CAP., 10µF, X7R, 50V, 10% 1210	MURATA, GRM32ER71H106KA12L
7	1	FB1	CHIP BEAD, 0805	TDK, MPZ2012S101A
8	1	L3	INDUCTOR, 220nH	VISHAY, IHLP1616ABERR22M01
9	1	R2	RES., 0Ω, 1/10W, 0603	VISHAY, CRCW06030000Z0EA
10	0	R3, R6, R7, R8, R9 (OPT)	RES, OPTION, 0603	
Hardware: For Demo Board Only				
1	16	E1-E16	TESTPOINT, TURRET, 0.094"	MILL-MAX, 2501-2-00-80-00-00-07-0
2	1	JP1	HEADER 3 PIN 0.079 SINGLE ROW	WURTH ELEKTRONIK, 62000311121
3	3	JP2, JP3, JP4	HEADER 3 PIN 0.079 DOUBLE ROW	WURTH ELEKTRONIK, 62000621121
4	4	xJP1, xJP2, xJP3, xJP4	SHUNT, 0.079" CENTER	WURTH ELEKTRONIK, 60800213421
5	4	MH1-MH4	STAND-OFF, NYLON, 9.5mm	WURTH ELEKTRONIK, 702933000

SCHEMATIC DIAGRAM



NOTE: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS ARE 0603.
   ALL CAPACITORS ARE 0603.

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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