User Guide for

FEBFAN23SV04T_LVA

Evaluation Board

High-Efficiency Synchronous Buck Converter for DDR Termination

Featured Product: FAN23SV04T

Direct questions or comments about this evaluation board to: "Worldwide Direct Support"

Fairchild Semiconductor.com

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This user guide supports the evaluation board for the FAN23SV04T integrated synchronous buck regulators for Double Date Rate (DDR) tracking applications. It should be used in conjunction with the FAN23SV04T datasheet. Please visit Fairchild's website at www.fairchildsemi.com.

1. Introduction

This evaluation board highlights the FAN23SV04T integrated synchronous buck regulators for DDR-tracking applications, and combines Fairchild's constant on-time control architecture with an integrated MOSFETs to supply high-efficiency Point of Load (POL) solutions.

1.1. Typical Applications

- Servers
- NVDC Notebooks
- Telecommunications
- Game Consoles
- Storage

1.2. Features

- V_{DDQ} Input Functions as Reference Input
- Internal Resistive Divider Programs V_{OUT} =0.5 V_{DDQ}
- Configurable Enable Function
- On-board Transient Generator with Adjustable Load Current Slew Rate
- Internal Regulator; Requires No External Bias Supply
- Test Points for Probing Critical Waveforms, Efficiency Measurements

2. Evaluation Board Specifications

Table 1. Evaluation Board Specifications

Description	Symbol	Value	Comments
Input Voltage	PVIN	7-15 V	
V_{DDQ} Input	VDDQ	0-3 V	
Output Voltage	V_{OUT}	0.6 V	
Switching Frequency	f_{SW}	500 kHz	
Output Load Current	I_{OUT}	0-4 A	
Output Current Limit		120%	Maximum load current
PCB Size		7 cm X 7 cm	
PCB Layer		4 Layers	
PCB Thickness		1.6 mm	
PCB Copper Thickness		1 oz-1 oz-1 oz-1 oz	

3. Schematics

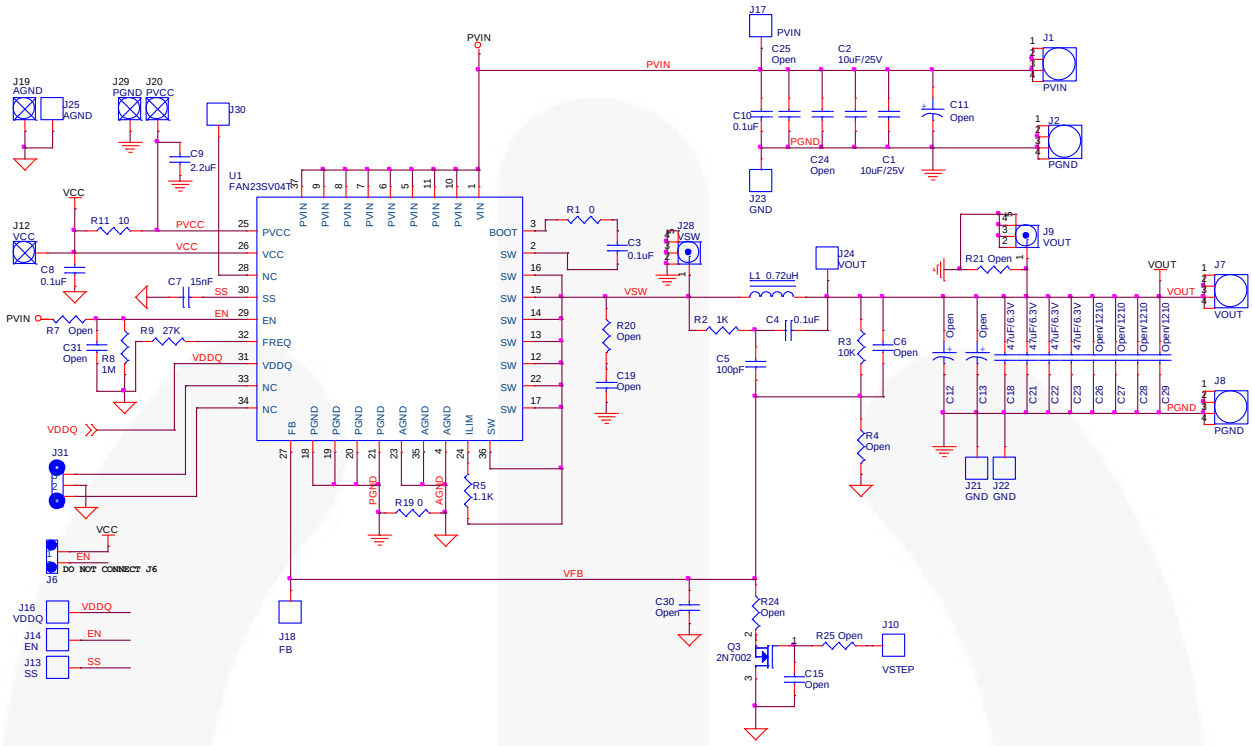

Figure 1. Evaluation Board Regulator Schematic

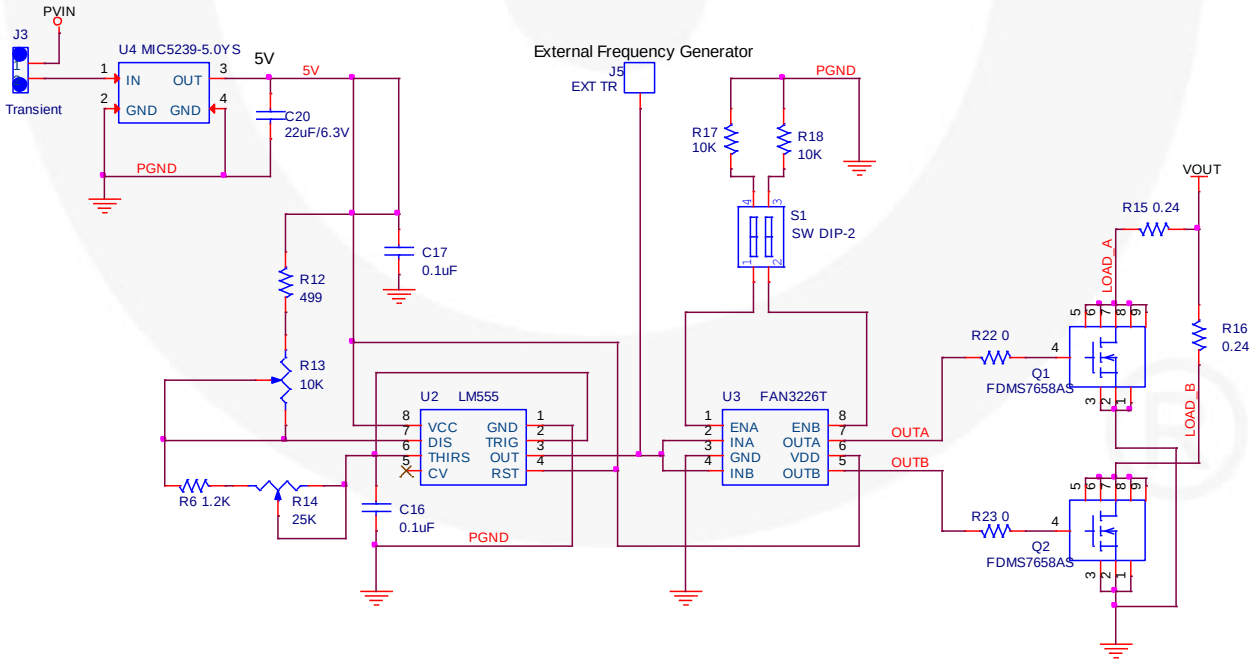

Figure 2. Evaluation Board Transient Generator Schematic

4. Test Setup

4.1. Test Equipment

- 0-15 V / 5 A power supply for input voltage
- Oscilloscope to view waveforms
- 0-5 V / 0.1 A power supply for optional external enable signal

4.2. Test Setup

- Adjust V_{IN} power supply, V_{DDQ} supply, and external EN supply to 0 V.
- Connect V_{IN} supply to PVIN (J1) and GND (J2).
- Connect V_{DDQ} supply to VDDQ (J16) and AGND (J19).
- Connect external enable source to EN (J14) and AGND (J25).
- Optional filter can be installed to filter V_{DDQ} track input source local to evaluation board if needed. With filter installed, V_{DDQ} voltage at (J16) is half (½) the voltage of the V_{DDQ} supply.

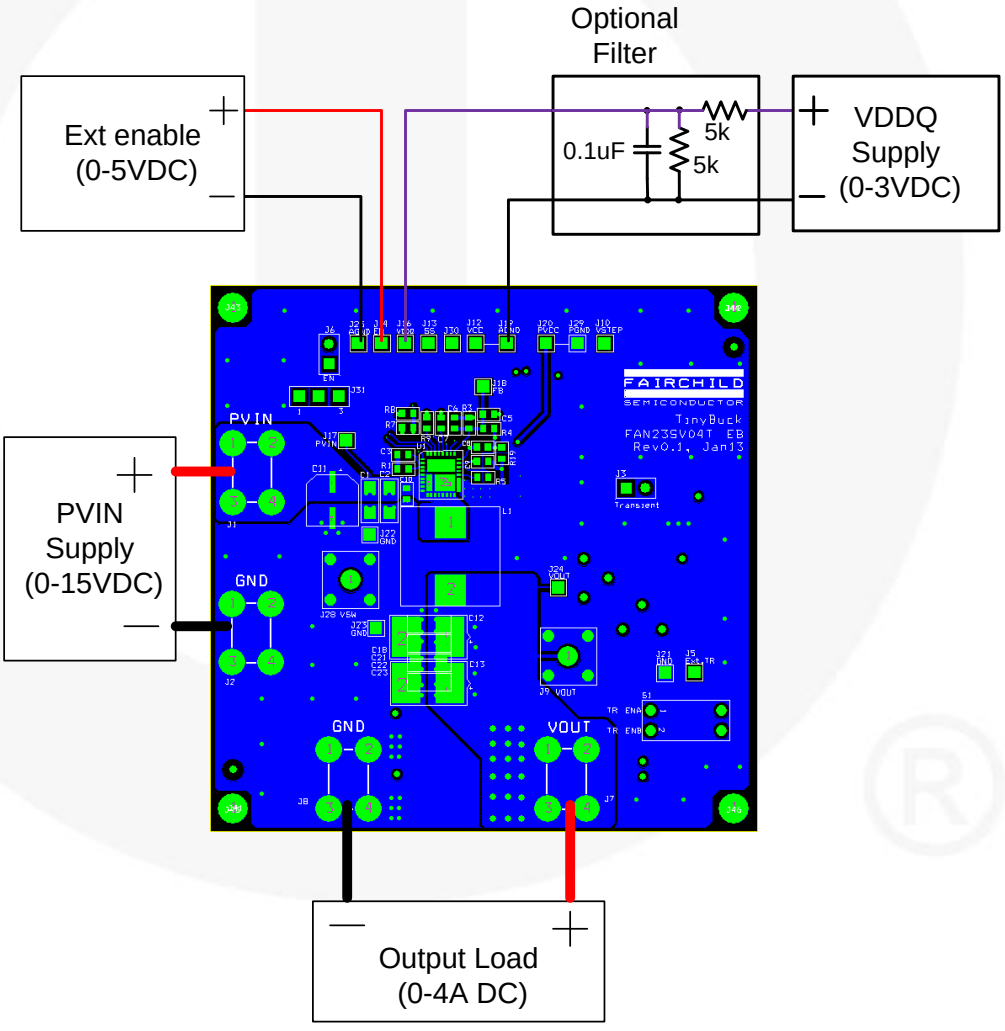

Figure 3. Test Setup for FAN23SV04T Tracking Application

5. Configuration

5.1. V_{DDQ} Input

Figure 3 shows an optional filter on the V_{DDQ} (tracking) input. This filter is not required for operation, but is useful to filter the V_{DDQ} supply voltage input, which is used to develop the reference for the output voltage. This can help reduce frequency jitter.

5.2. Enable Selection

The FAN23SV04T evaluation board can be enabled using an external enable logic signal as shown in Figure 3. R8 can be populated with 1 MΩ to hold EN LOW by default.

5.3. On board transient generator

Transient generator circuitry, shown in Figure 2, is included on the bottom of the board to facilitate testing of extremely fast transient loads, with the following usage guidelines:

- A shorting jumper installed in J3 enables the transient generator.
- Open J3 to conduct efficiency testing.
- R13 and R14 adjust the frequency and duty cycle of the 555 timer.
- J5 can be used to monitor transient frequency and to trigger oscilloscope.
- Switch S1 enables turn-on of load switch Q1, Q2, or both simultaneously.
- Load applied with Q1 ON is equal to V_{OUT}/R15; with Q2 ON is equal to V_{OUT}/R16.
- Use low duty cycle to minimize power dissipation on PCB.
- R22/R23 can be increased in value to reduce load current slew rate.

6. Test Procedure

6.1. Measurement Procedure

1. Set up equipment and board as shown in Figure 3.
2. For efficiency testing, open J3 (disable transient generator).
3. Adjust load to sink 0 A.
4. Monitor V_{IN} on J17(+) and J23(-) as voltage is increased from 0 V to 12 V.
5. Adjust the external enable signal to 3.3 V to enable converter operation.
6. Adjust the V_{DDQ} signal from 0 to 1.5 V, monitoring on the VDDQ pin.
7. Monitor PVCC on J20(+) and J19(-) as voltage is increased from 0 to 5 V.
8. Monitor V_{OUT} on J24(+) and J23(-).
9. With I_{OUT} from 0 to maximum I_{OUT}; V_{OUT} should remain in regulation.
10. To disable the converter, adjust external enable signal to 0 V.
11. After converter is disabled, reduce PVIN to 0 V.

6.2. List of Test Points and Connections

Test Points	Name	Description
J1	PVIN	VIN connection (+)
J2	GND	VIN connection (-)
J3	Transient	Connects PVIN to power transient generator
J5	Ext TR	External Transient Generator Frequency Monitor
J6	EN	Connects EN to VCC for auto-enable with non-SV parts
J7	VOUT	V_{OUT} connection (+)
J8	GND	V_{OUT} connection (-)
J9	VOUT	V_{OUT} scope jack
J10	VSTEP	Input to optional V_{OUT} step circuit
J12	VCC	Monitor VCC voltage
J13	SS	SS(Soft-Start) pin 30
J14	EN	Enable input to controller
J16	VDDQ	VDDQ Track input
J17	PVIN	Input voltage (+)
J18	FB	Feedback pin 27
J19	AGND	
J20	PVCC	PVCC supply input (+)
J21	GND	
J22	GND	Input voltage (-)
J23	GND	V_{OUT} monitor (-)
J24	VOUT	V_{OUT} monitor (+)
J25	AGND	AGND reference for EN input
J28	VSW	Switch node scope jack
J29	PGND	PVCC supply input (-)
J30		No connect
J31		No connect

7. Performance Data and Characteristic Curves

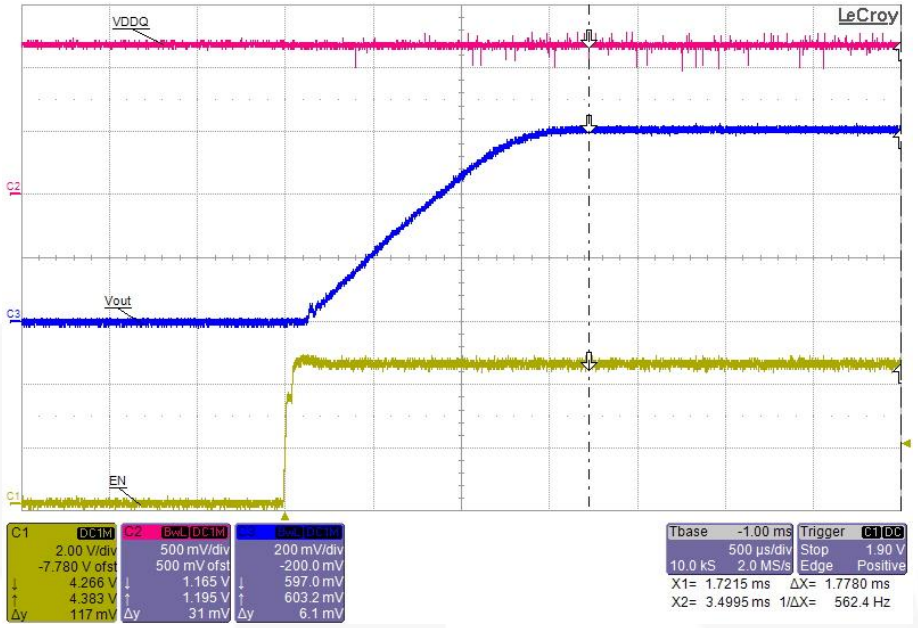

Figure 4. Typical Startup Waveforms with V_{DDQ} before EN Applied

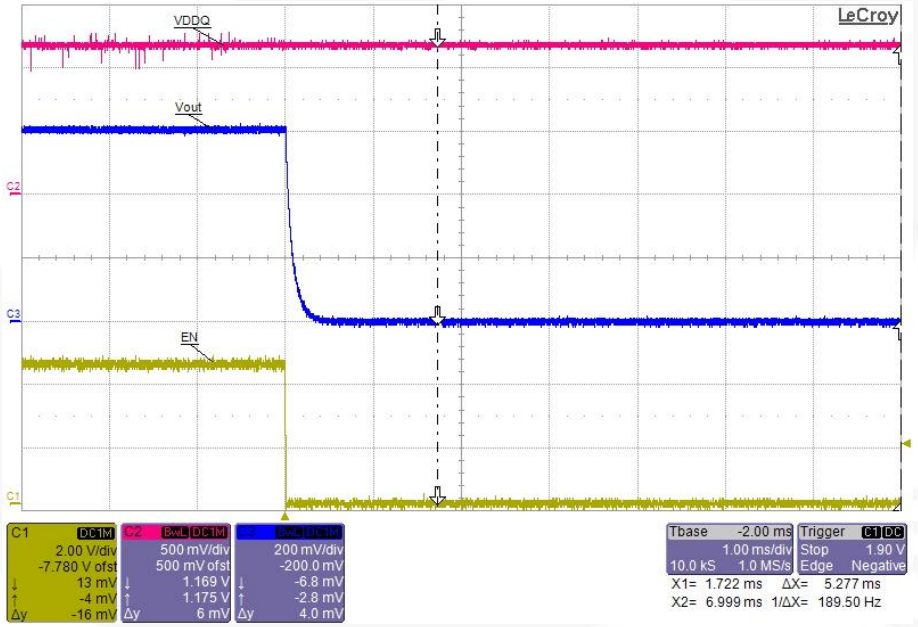

Figure 5. Typical Shutdown Using EN

8. Printed Circuit Board

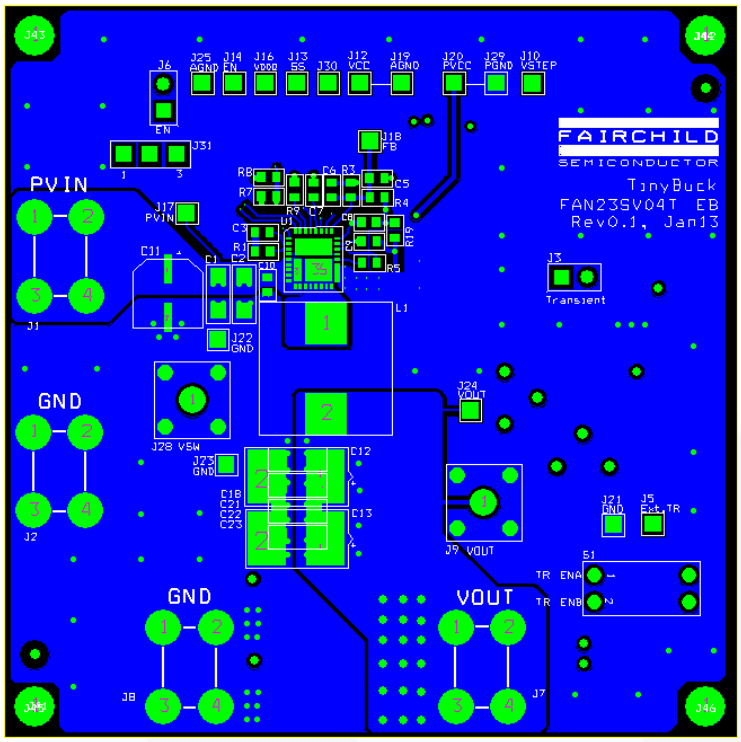

Figure 6. Top Side

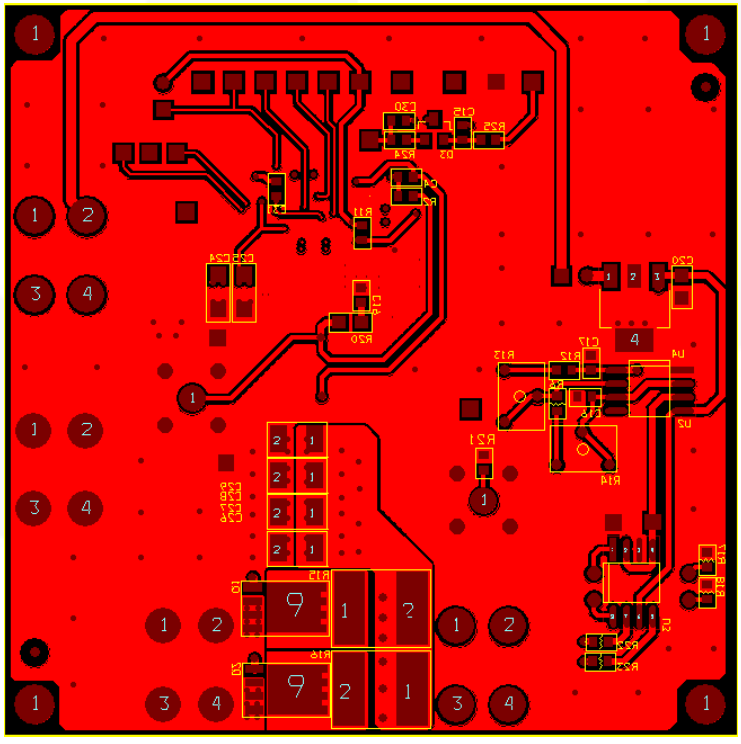

Figure 7. Bottom Side

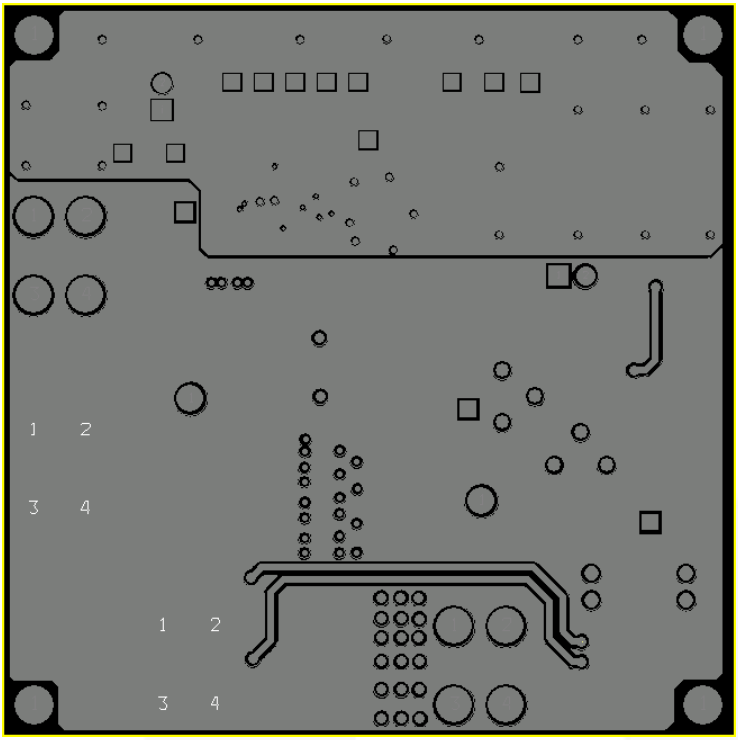

Figure 8. Inner Layer 1

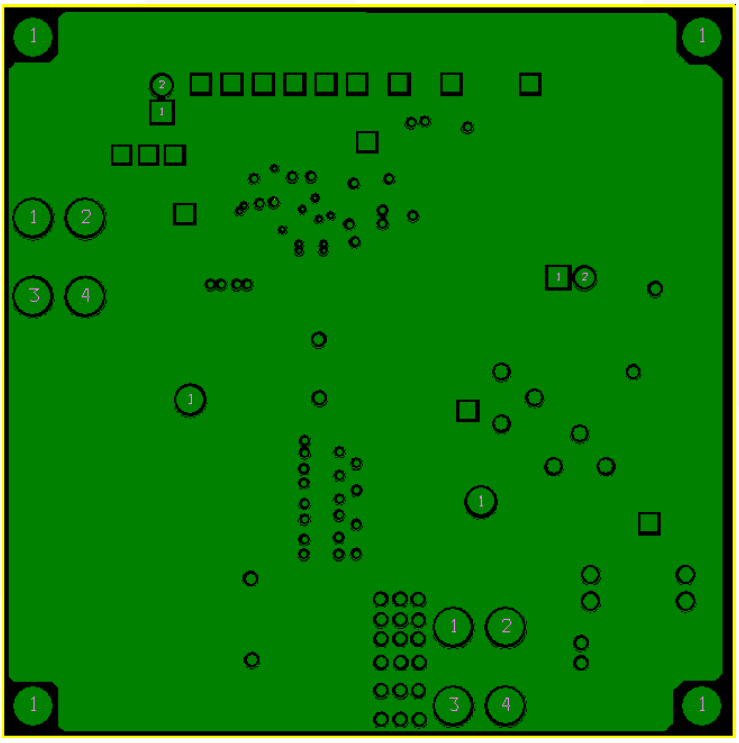

Figure 9. Inner Layer 2

9. Bill of Materials

Reference	Value	Description	Manufacturer PN	Manufacturer	Case	Qty
C1	10 µF	Capacitor, SMD, Ceramic, X7R, 25 V	TMK316B7106KL-TD	Taiyo Yuden	1206	1
C2	10 µF	Capacitor, SMD, Ceramic, X7R, 25 V	TMK316B7106KL-TD	Taiyo Yuden	1206	1
C3	0.1 µF	Capacitor, SMD, Ceramic, X7R, 25 V	C1608X7R1E104K	TDK	0603	1
C4	0.1 µF	Capacitor, SMD, Ceramic, X7R, 25 V	C1608X7R1E104K	TDK	0603	1
C5	100 pF	Capacitor, SMD, Ceramic, NPO, 50 V	C1608COG1H101J	TDK	0603	1
C7	0.015 µF	Capacitor, SMD, Ceramic, X7R, 25 V	C1608X7R1E153K	TDK	0603	1
C8	0.1 µF	Capacitor, SMD, Ceramic, X7R, 25 V	C1608X7R1E104K	TDK	0603	1
C9	2.2 µF	Capacitor, SMD, Ceramic, X5R, 25 V	C1608X5R1E225M	TDK	0603	1
C10	0.1 µF	Capacitor, SMD, Ceramic, X7R, 25 V	C1608X7R1E104K	TDK	0603	1
C18	47 µF	Capacitor, SMD, Ceramic, 6.3 V	C3216X5R0J476M	TDK	1206	1
C21	47 µF	Capacitor, SMD, Ceramic, 6.3 V	C3216X5R0J476M	TDK	1206	1
C22	47 µF	Capacitor, SMD, Ceramic, 6.3 V	C3216X5R0J476M	TDK	1206	1
C23	47µF	Capacitor, SMD, Ceramic, 6.3 V	C3216X5R0J476M	TDK	1206	1
R1	0 Ω	RES, SMD, 1/10W			0603	1
R2	1 kΩ	RES, SMD, 1/10W			0603	1
R3	10 kΩ	RES, SMD, 1/10W			0603	1
R5	1.1 kΩ	RES, SMD, 1/10W			0603	1
R8	1 MΩ	RES, SMD, 1/10W			0603	1
R9	27 kΩ	RES, SMD, 1/10W			0603	1
R11	10 Ω	RES, SMD, 1/10W			0603	1
R19	0 Ω	RES, SMD, 1/10W			0603	1
L1	720 nH	Inductor, Power	744325072	Wurth		1
U1	FAN23SV04T	TinyBuck 4 A COT Integrated Regulator	FAN23SV04T	Fairchild	MLP 5.5x5	1
J1-J2, J7-J8		Terminal, 15 A, Screw, Vertical, PC Mount	8191	Keystone		4
J10,J12-14, J16-25, J29		Testpin, Gold, 40 mil	3103-2-00-21-00-00-08-0 (DS10P11)	Mill-Max (Young Jin)		15
PCB		PCB, FAN23SV04T EB Rev 0.1, Jan 13				1

Continued on the following page…

Reference	Value	Description	Manufacturer PN	Manufacturer	Case	Qty
Transient Generator						
C16	0.1 µF	Capacitor, SMD, Ceramic, 25 V, X7R	C1608X7R1E104K	TDK	0603	1
C17	0.1 µF	Capacitor, SMD, Ceramic, 25 V, X7R	C1608X7R1E104K	TDK	0603	1
C20	22 µF	Capacitor, SMD, Ceramic, 10 V, X5R	LMK212BJ226MG-T	TAIYO YUDEN	0805	1
R6	1.2 kΩ	Resistor, SMD, 1/10W	ERJ-3EKF1201V	Panasonic	0603	1
R12	499 Ω	Resistor, SMD, 1/10W	ERJ-3EKF4990V	Panasonic	0603	1
R13	10 kΩ	Pot, 0.25W	3266W-1-103LF	Bourns		1
R14	25 kΩ	Pot, 0.25W	3266W-1-253LF	Bourns		1
R15-R16	0.24 Ω	Resistor, SMD, 1W	ERJ-1TRQFR24U	Panasonic	2512	2
R17-R18	10 kΩ	Resistor, SMD, 1/10W	ERJ-3EKF1002V	Panasonic	0603	2
R22-R23	0	Resistor, SMD, 1/10W	ERJ-3GEY0R00V	Panasonic	0603	2
U2	LM555	Timer	LM555CM	Fairchild	SO8	1
U3	FAN3226T	Driver	FAN3226TM	Fairchild	SO8	1
U4	MIC5239	LDO	MIC5239-5.0YS	Micrel	SOT-223	1
J3		Generic 2-Pin SIP .100 Centers				1
J5		Testpin, Gold, 40 mil	3103-2-00-21-00-00-08-0	Mill-Max		1
Q1-Q2	FDMS7658AS	MOSFET	FDMS7658AS	Fairchild	MLP5x6	1
S1	209-2MS	Switch DIP Top Slide Flush 6-POS	209-2MS	CTS	DIP4	1
Q1-Q2	FDMS7658AS	MOSFET	FDMS7658AS	Fairchild	MLP5x6	2

10. Revision History

Rev.	Date	Description
0.0.1	November 2012	Initial draft of FAN23SV04T
0.0.2	March 2013	Updated with changes of FAN23SV04T EB Rev0.1
0.0.3	May 2013	Added PCB structure. Updated schematic & BOM
1.0.0	June 2013	Added EVB# on page.1 & Release