20A, 17V, ACOT® High-Efficiency Synchronous Step-Down Converter Evaluation Board

General Description

This user guide contains information for the RTQ2820AGQWF DC-DC converter. Also included are the performance specifications, the schematic, and the list of materials for the RTQ2820AGQWF.

Table of Contents

Performance Specification Summary

A summary of the RTQ2820AGQWF Evaluation Board performance specification is provided in Table 1. The ambient temperature is 25°C.

Table 1. RTQ2820AGQWF Evaluation Board Performance Specification Summary

Specification	Test Conditions	Min	Typ	Max	Unit
Input Voltage Range		3.5	12	17	V
Output Current		0	--	20	A
Default Output Voltage		--	1.2	--	V
Operation Frequency		--	800	--	kHz
Output Ripple Voltage	I_{OUT} = 20A	--	10	--	mVp-p
Line Regulation	I_{OUT} = 10A, V_{IN} = 3.5V to 17V	--	±0.5	--	%
Load Regulation	V_{IN} = 12V, I_{OUT} = 0.001A to 20A	--	±0.5	--	%
Load Transient Response	I_{OUT} = 10mA to 20A	--	±5	--	%
Maximum Efficiency	V_{IN} = 12V, V_{OUT} = 1.2V, I_{OUT} = 20A	--	85.8	--	%

Power-up Procedure

Suggestion Required Equipments

- RTQ2820AGQWF Evaluation Board
- DC power supply capable of at least 17V and 7A
- Electronic load capable of 20A
- Function Generator
- Oscilloscope

Quick Start Procedures

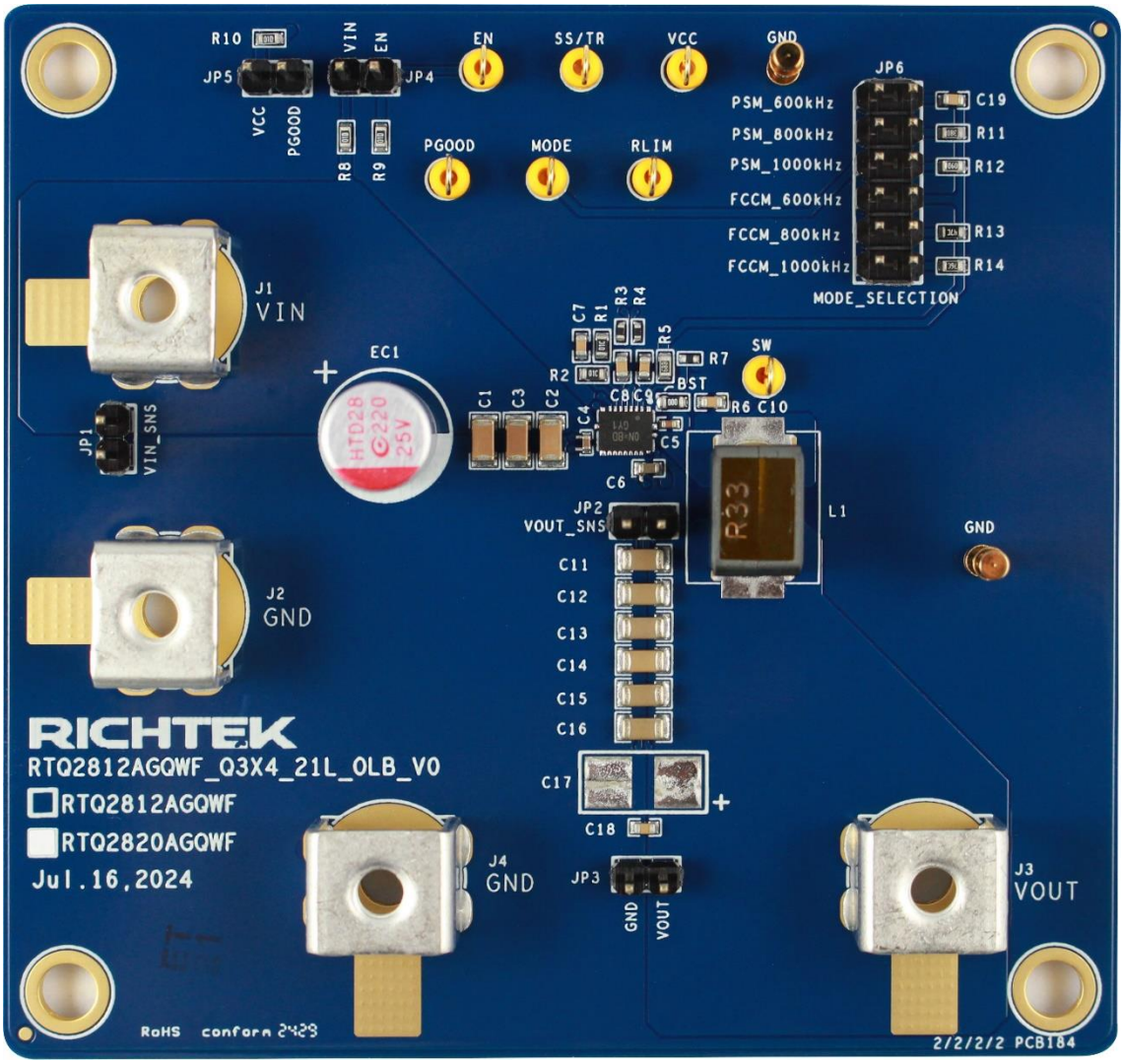
The Evaluation Board is fully assembled and tested. Follow the steps below to verify board operation. Do not turn on supplies until all connections are made. When measuring the output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the output voltage ripple by touching the probe tip and ground ring directly across the last output capacitor.

Proper measurement equipment setup and follow the procedure below.

1) With power off, connect the input power supply to the VIN and GND pins.
2) With power off, connect the electronic load between the VOUT and nearest GND pins.
3) Turn on the power supply at the input. Make sure that the input voltage does not exceeds 17V on the Evaluation Board.
4) Check for the proper output voltage using a voltmeter.
5) Once the proper output voltage is established, adjust the load within the operating ranges and observe the output voltage regulation, ripple voltage, efficiency, and other performance.

Detailed Description of Hardware

Headers Description and Placement



Carefully inspect all the components used in the EVB according to the following Bill of Materials table, and then make sure all the components are undamaged and correctly installed. If there is any missing or damaged component, which may occur during transportation, please contact our distributors or e-mail us at evb_service@richtek.com.

Test Points

The EVB is provided with the test points and pin names listed in the table below.

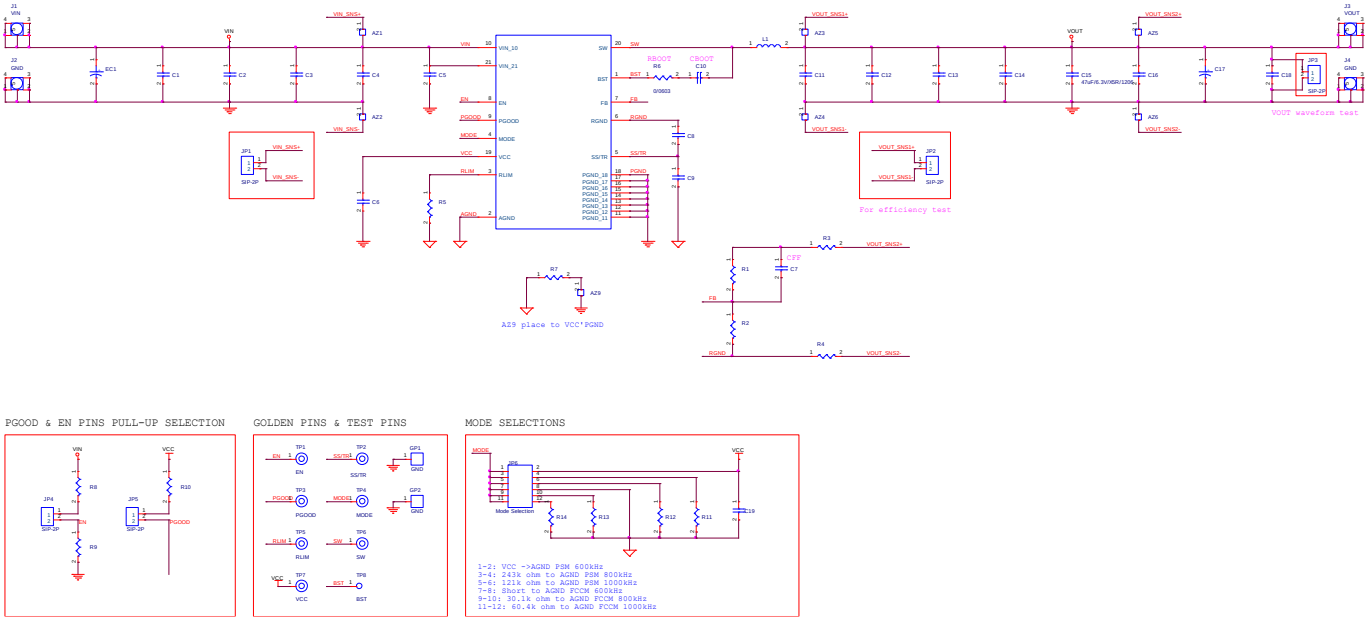
Test Point/ Pin Name	Function
J1	VIN input voltage connector
J2	PGND connection for input
J3	VOUT output voltage connector
J4	PGND connection for output
JP1	VIN voltage sensing for efficiency test points
JP2	VOUT voltage sensing for efficiency test points
JP3	VOUT voltage measuring for waveform test points
JP4	Connects EN to VIN to enable the device.
JP5	Connects PGOOD to VCC through a 100kΩ.
JP6	Mode selection
EN	EN test point
SS/TR	Can be used to monitor the reference voltage.
VCC	VCC test point
PGOOD	PGOOD output test point
MODE	Mode selection test point
RLIM	Can be used to monitor the voltage level of the valley current limit.
SW	Switch node test point

Bill of Materials

V_{IN} = 12V, V_{OUT} = 1.2V, I_{OUT} = 20A, f_{SW} = 800kHz						
Reference	Count	Part Number	Value	Description	Package	Manufacturer
U1	1	RTQ2820AGQWF	--	Step-Down Converter	WQFN-21TL 3x4 (FC)	RICHTEK
L1	1	VLBU1007090T-R33L	0.33µH	Inductor, Isat = 39A, 180µΩ	--	TDK
C1, C2, C3	3	GRM31CR71E106KA12L	10µF	Capacitor, Ceramic, 25V, X7R	1206	MURATA
C4, C5	2	GRM155C81E105KE11D	1µF	Capacitor, Ceramic, 25V, X6S	0402	MURATA
C6	1	GRM188R60J105KA01D	1µF	Capacitor, Ceramic, 6.3V, X5R	0603	MURATA
C7	1	GRM188R71H471KA01D	470pF	Capacitor, Ceramic, 50V, X7R	0603	MURATA
C8, C10, C18, C19	4	GRM188R71H104KA93D	0.1µF	Capacitor, Ceramic, 50V, X7R	0603	MURATA
C9	1	GRM188R71H223KA01D	22nF	Capacitor, Ceramic, 50V, X7R	0603	MURATA
C11, C12, C13, C14, C15, C16	6	GRM31CR60J476ME19	47µF	Capacitor, Ceramic, 6.3V, X5R	1206	MURATA
EC1	1	250ARHA221M08A2	220µF	Capacitor, Solid, 25V, 105°C	--	APAQ
R1, R2	2	WR06X1002FTL	10k	Resistor, Chip, 1/10W, 1%	0603	WALSIN
R3, R4, R7	3	WR04X000 PTL	0	Resistor, Chip, 1/10W, 1%	0402	WALSIN
R5	1	WR06X4991FTL	4.99k	Resistor, Chip, 1/10W, 1%	0603	WALSIN
R6	1	WR06X000 PTL	0	Resistor, Chip, 1/10W, 1%	0603	WALSIN
R8, R9, R10	3	WR06X1003FTL	100k	Resistor, Chip, 1/10W, 1%	0603	WALSIN
R11	1	WR06X2433FTL	243k	Resistor, Chip, 1/10W, 1%	0603	WALSIN
R12	1	RTT031213FTP	121k	Resistor, Chip, 1/10W, 1%	0603	RALEC
R13	1	RTT033012FTP	30.1k	Resistor, Chip, 1/10W, 1%	0603	RALEC
R14	1	CR0603F60K4P05Z	60.4k	Resistor, Chip, 1/10W, 1%	0603	EVER OHMS

Typical Applications

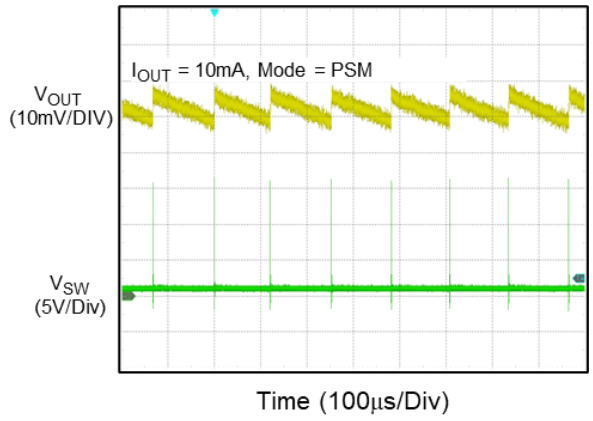
EVB Schematic Diagram



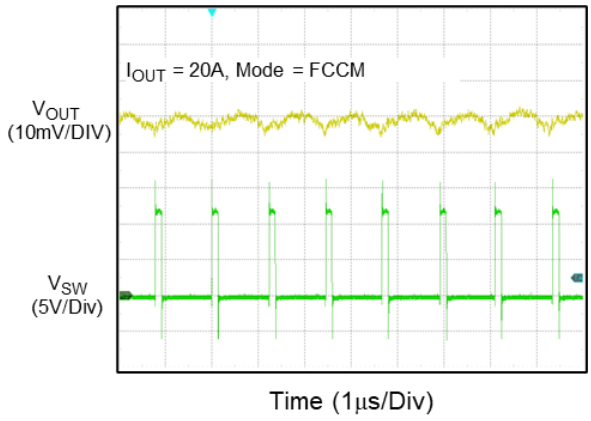
1. The capacitance values of the input and output capacitors will influence the input and output voltage ripple.
2. MLCC capacitors have degrading capacitance at DC bias voltage, and especially smaller size MLCC capacitors will have much lower capacitance.

Measure Result

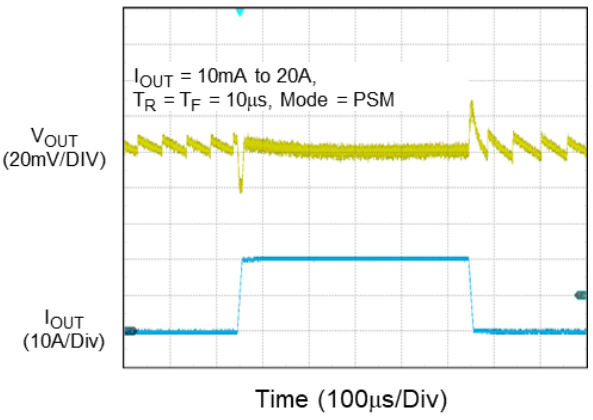
Output Ripple Measurement



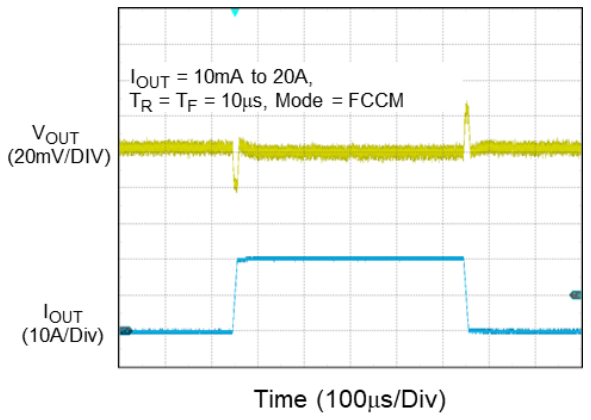
Output Ripple Measurement



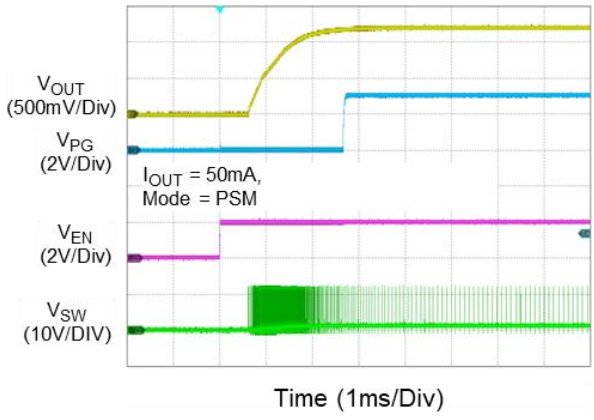
Load Transient Response



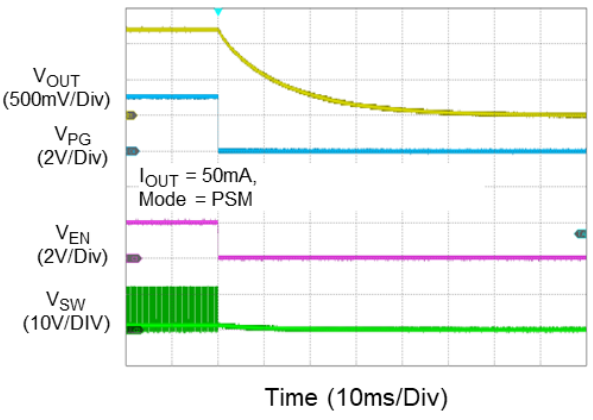
Load Transient Response



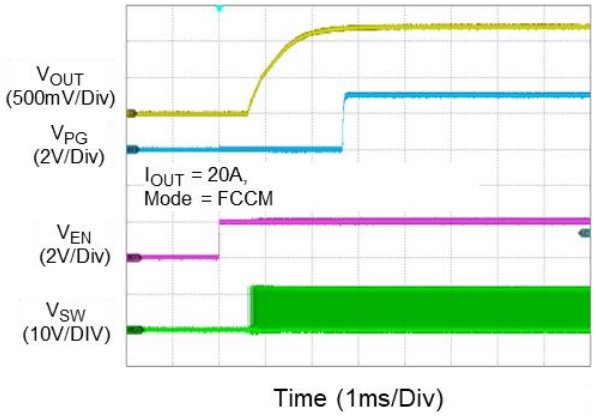
Power On from EN



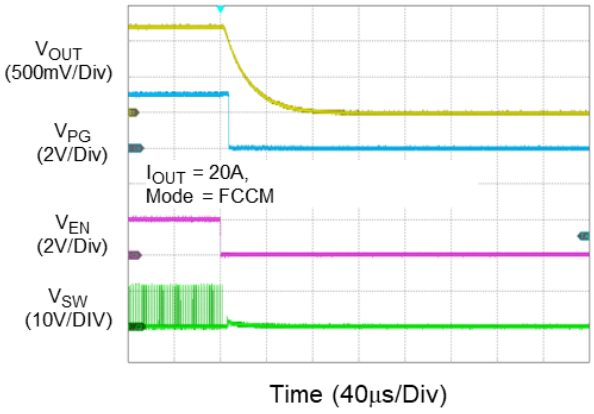
Power Off from EN



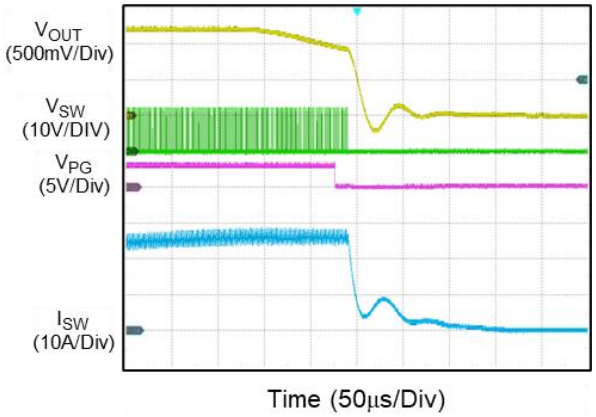
Power On from EN



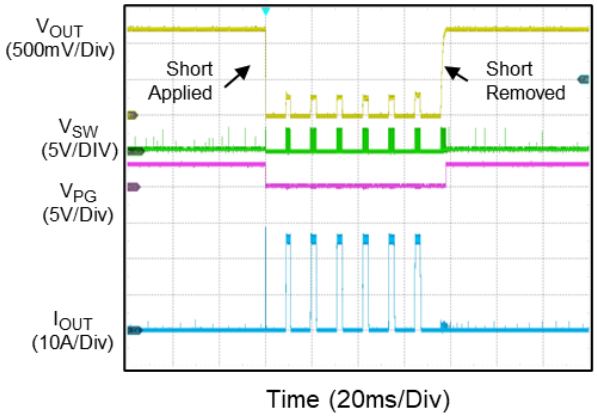
Power Off from EN



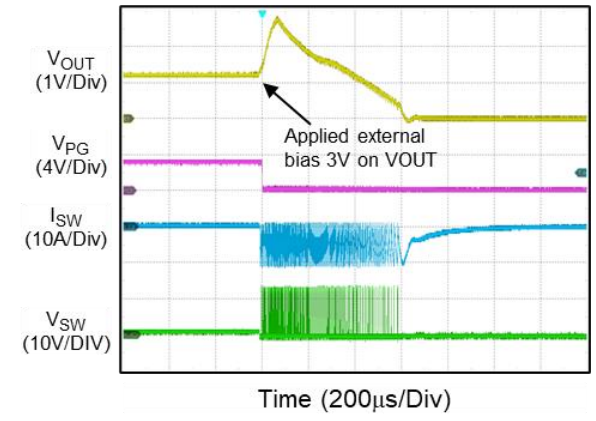
Overcurrent Protection



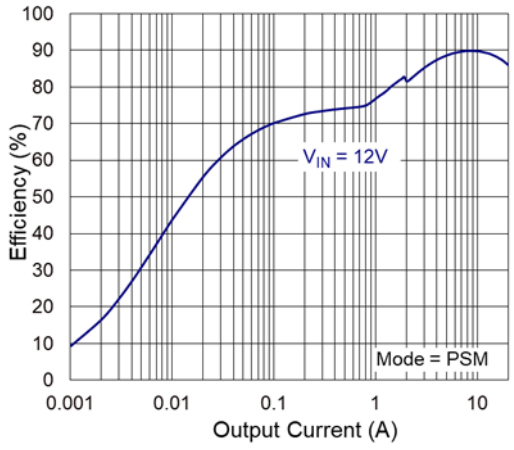
Short-Circuit Protection and Recovery



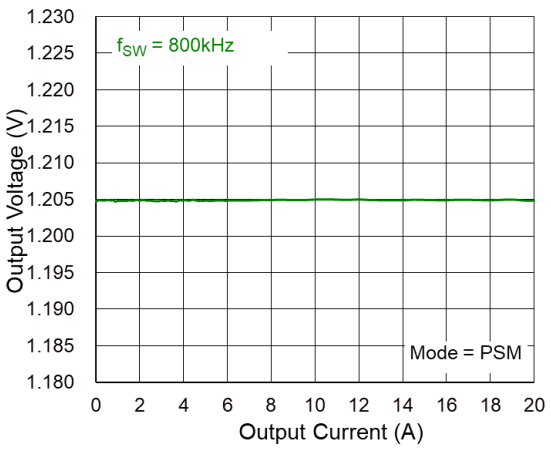
Overvoltage Protection



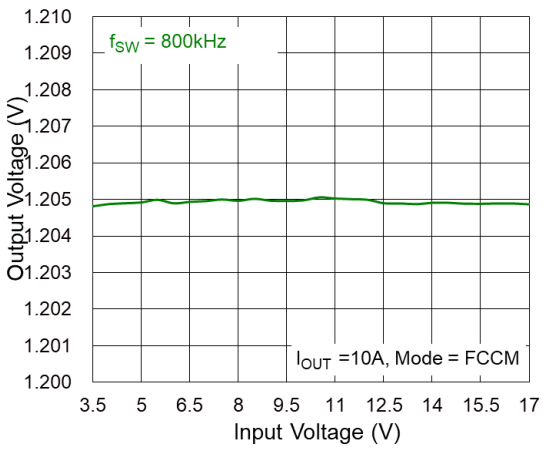
Efficiency vs. Output Current



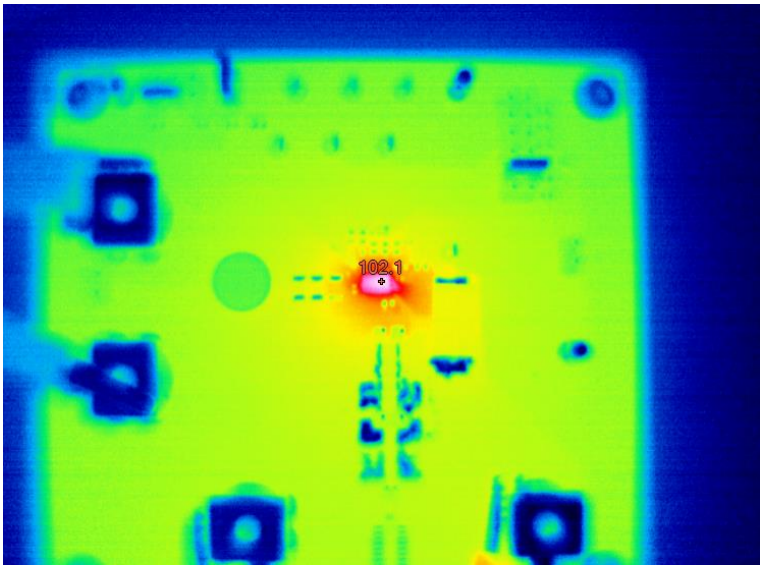
Output Voltage vs. Output Current



Output Voltage vs. Input Voltage



Thermal Image at V_{IN} = 12V, V_{OUT} = 1.2V, I_{OUT} = 20A



Note: Care must be taken to avoid a long ground lead on the oscilloscope probe when measuring the input or output voltage ripple. Measure the output voltage ripple by touching the probe tip directly across the output capacitor.

Evaluation Board Layout

Figures 1 to 4 show the RTQ2820AGQWF Evaluation Board layout. This board size is 85mm x 80mm and is constructed on a four-layer PCB, with outer layers of 2 oz. Cu and inner layers with 2 oz. Cu.

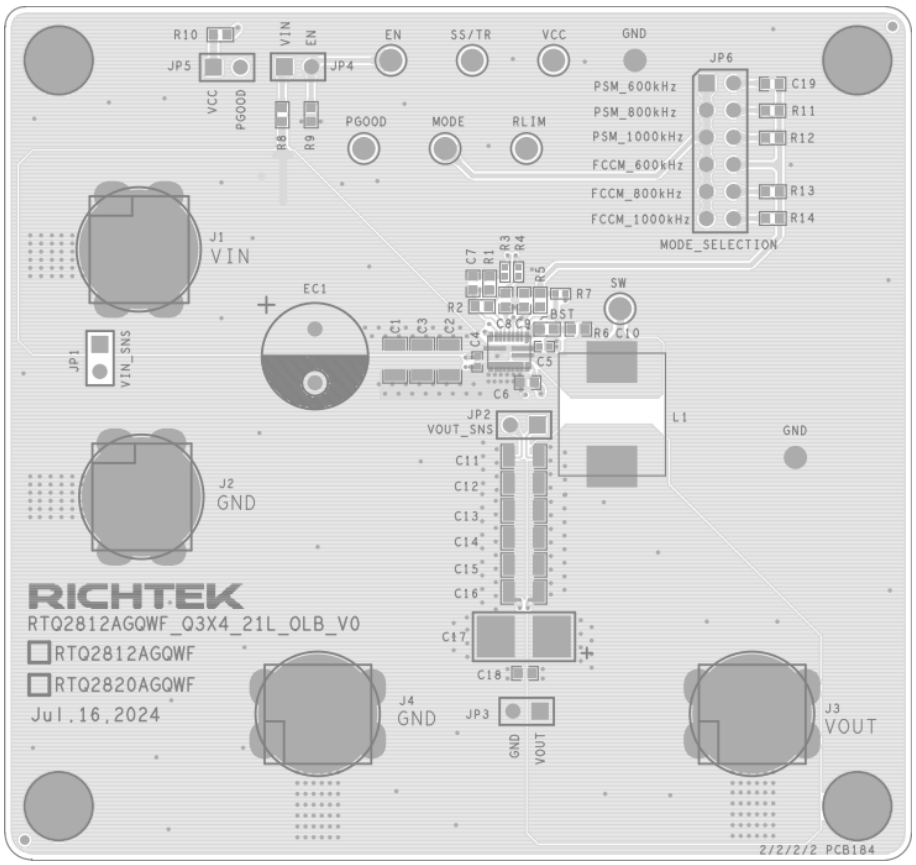


Figure 1. Top View (1st layer)

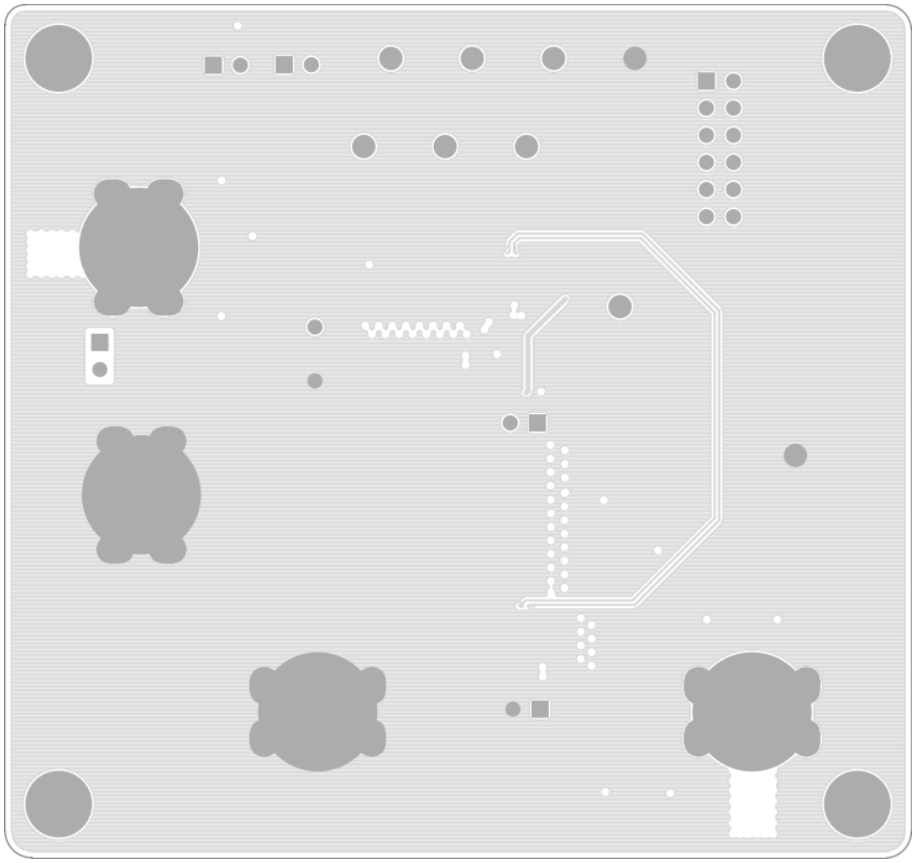


Figure 2. PCB Layout—Inner Side (2nd Layer)

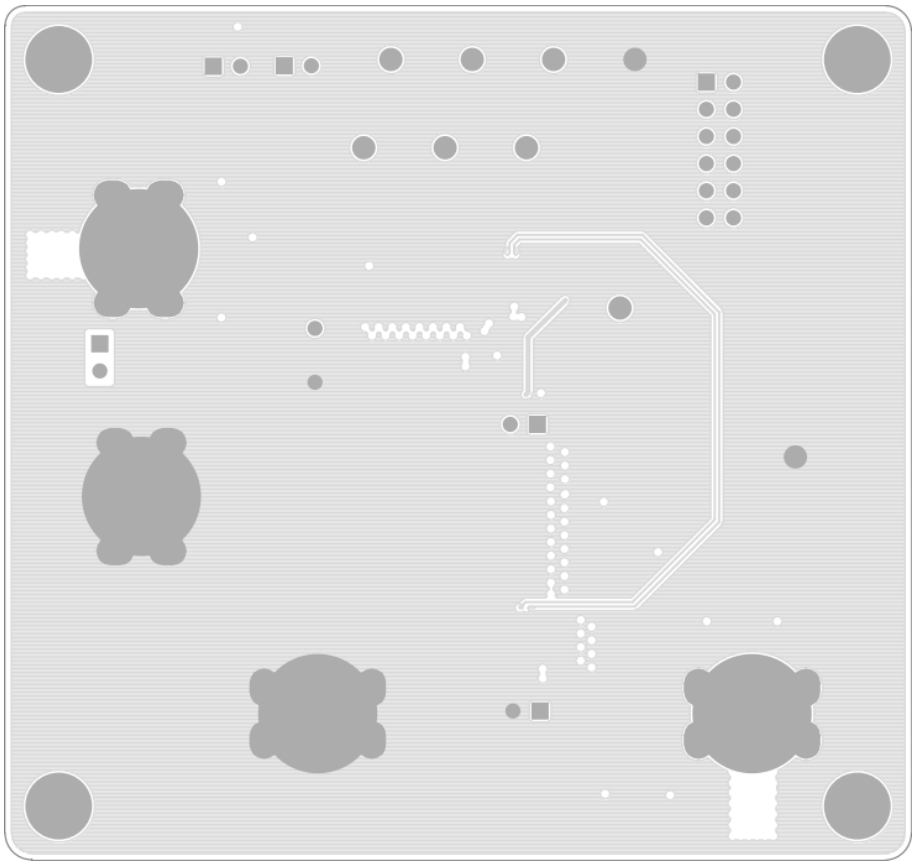


Figure 3. PCB Layout—Inner Side (3rd Layer)

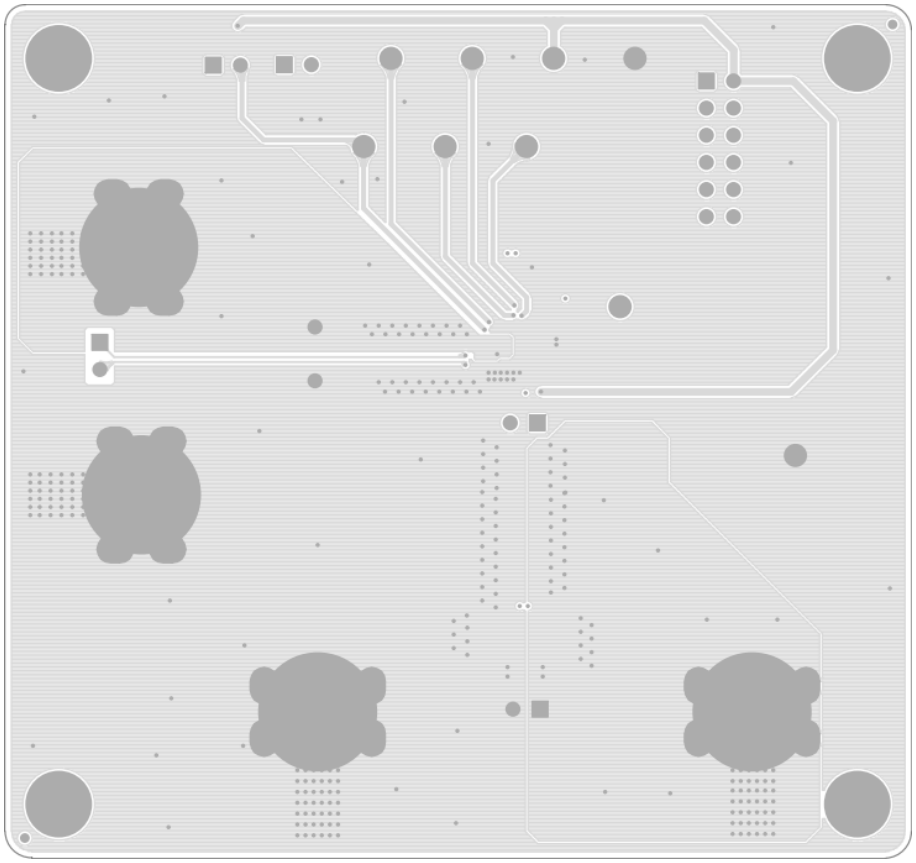


Figure 4. Bottom View (4th Layer)

More Information

For more information, please find the related datasheet or application notes from Richtek website http://www.richtek.com.

Important Notice for Richtek Evaluation Board