30W Synchronous Boost Converter with Load Disconnection Evaluation Board

FEATURES

- Load Disconnection Control with an External P-Channel MOSFET
- Wide 2.7V-14V Input Voltage Range
- Wide 4.5V-14.6V Output Voltage Range
- 13mΩ/11mΩ R_{dson} Internal Power MOSFETs
- Up to 12A Switch Current and Programmable Peak Current Limit
- Adjustable 200K-2.2MHz Switching Frequency:
- Selectable PFM or Forced PWM Mode
- Programmable Soft Start
- Output and Feedback Overvoltage Protection
- Thermal Shutdown Protection at 150°C
- DFN-20 3.5mmx4.5mm Package

APPLICATIONS

- Bluetooth Audio
- Power Banks
- POS System
- E-Cigarette
- USB Power Delivery
- E-Flash, E-Lamp

DESCRIPTION

The EV12A1-B-02A Evaluation Board is designed to demonstrate the capabilities of SCT12A1, a high efficiency fully integrated 30W synchronous boost converter with load disconnection feature. The device offers the gate control for an external P-channel MOSFET to disconnect load from boost converter output. This safety feature prevents the damage on load from input shooting through to output in shutdown or output hard short to ground conditions. The device also implements protection features including over-current protection, output and feedback over voltage protection and thermal shutdown. The SCT12A1 is available in a space-saving 20-pin DFN 3.5mmx4.5mm package.

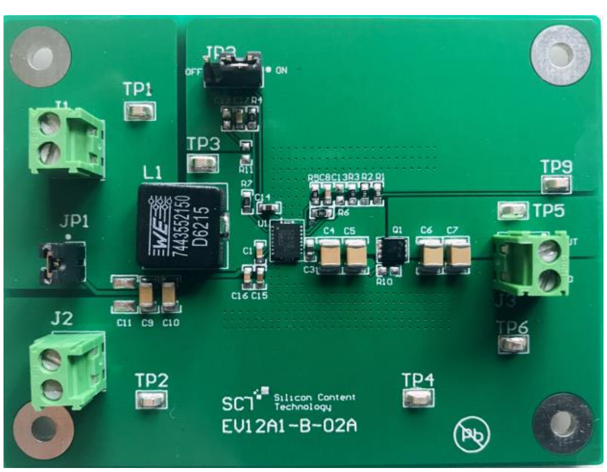
This user's guide describes the characteristics, operation and the use of the EV12A1-B-02A Evaluation Module including EVM specifications, recommended test setup, test result, schematic diagram, bill of materials, and the board layout.

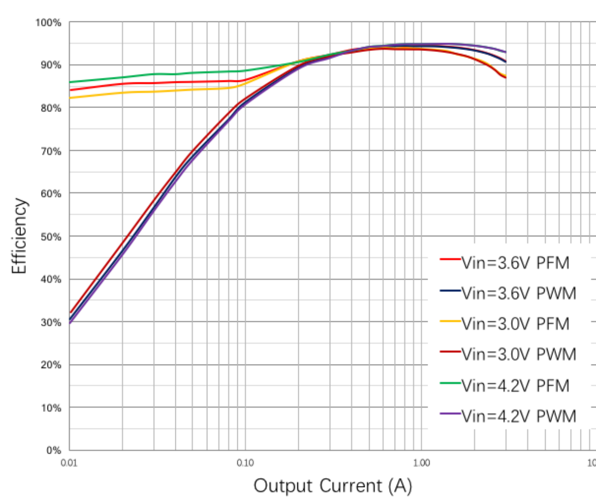
Board Number	IC Number
EV12A1-B-02A	SCT12A1

PERFORMANCE SUMMARY

Table 1. Performance — Specifications are at TA = 25°C

Parameter	Condition	Value
Input Voltage	DC up to 14V	2.7V-8.4V
Output Voltage	PWM or PFM	9V ± 2.5%
Output Current	Continuous DC current	3A
Frequency	Default	560KHz





QUICK START PROCESURE

Evaluation board EV12A1-B-02A is easy to set up to evaluate the performance of the SCT12A1. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

1. Place jumpers in the following positions:
   - JP1: ON Connect V_{IN} supply to V_{IN} pin of IC.
   - JP3: Enable. ON Connect EN pin to V_{CC} to enable IC. OFF Disable IC
   - Mode selection. There are two soldering points (See Figure 1) on bottom of EVM. Solder a wire to set PWM mode. Default open to select PFM
   - Load disconnection control is always enabled in this EVM with ENPGATEZ pin connecting to ground. PGATE controls P-MOSFET on and off as a power switch.
2. With power off, connect the input power supply to J1 V_{IN} connector and J2 GND connector. Turn on the power at the input. Make sure that the input voltage does not exceed 14V, and supports sufficient current limit.
3. Check the output voltage at J3. The output voltage should be 9V typical. Once the proper output voltage is established, adjust the load within the operating range and observe the output voltage regulation, output voltage ripple, efficiency and other parameters.
4. To use the enable function, apply a digital input to the EN pin of JP3.
5. The SCT12A1 provides a robust protection with an external P-channel MOSFET Q1 to disconnect the load from the converter output when the system shuts down or the output shorts to ground at fault condition. The feature can be verified on EV12A1-B-02A board. The output voltage is measured at 0V when the board is powered up and JP3 is on OFF. The system is protected when the output hard shorts at J3 or the board starts up at output hard-short at J3.

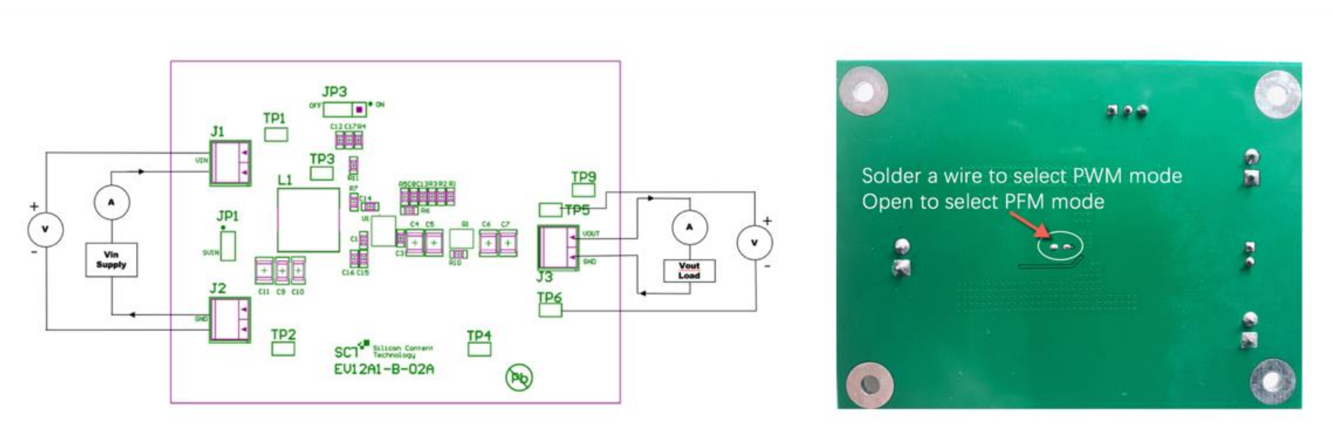


Figure 1. Proper Supply, Load and Measurement Equipment Setup

NOTE: When measuring the voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the input or output voltage ripple by touching the probe tip directly across relevant capacitor of VIN or VOUT. See Figure 2 for proper scope probe technique.

Figure 2. Measuring Voltage Ripple Across Terminals or Directly Across Ceramic Capacitor

SCHEMATIC DIAGRAM

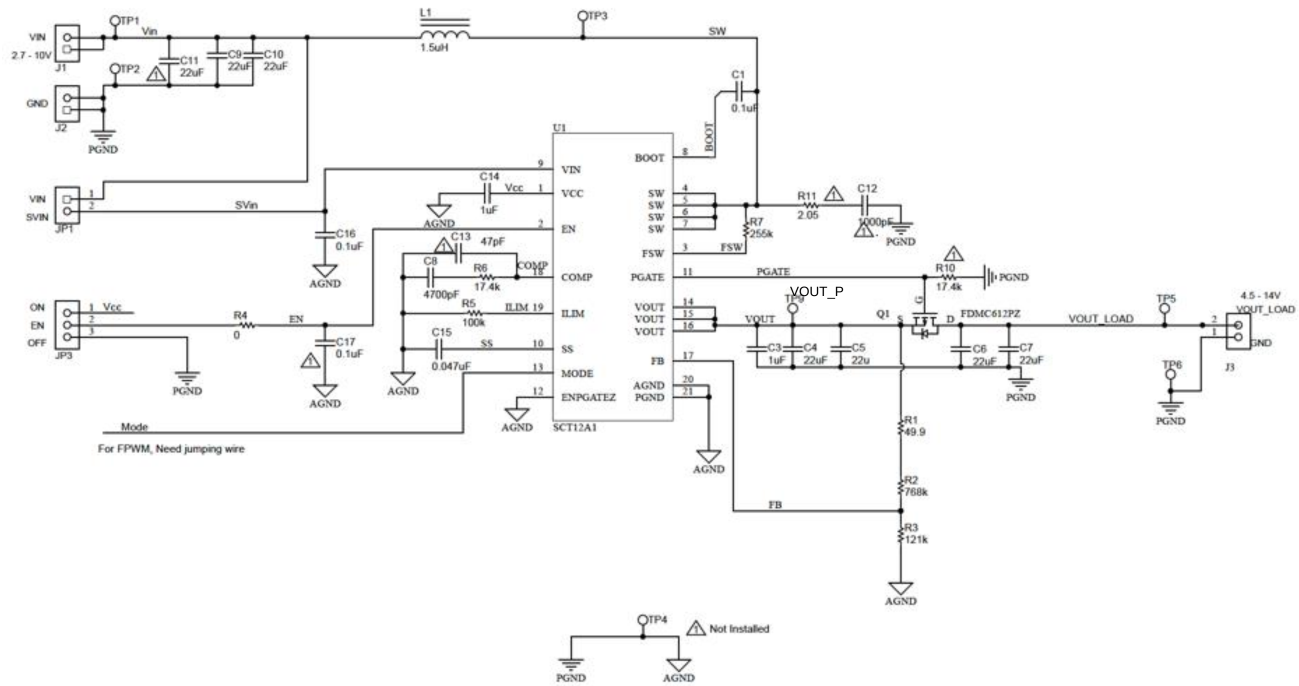


Figure 3. Evaluation Board Schematic

BILL OF MATERIALS

Table 2. Bills of Materials

Manufacture	Comment	Designator	Description	Quantity
Silicon Content Technology	SCT12A1	U1	SCT12A1, 30W Synchronous Boost Converter DFN-20L 3.5mmX4.5mm with thermal pad	1
Fairchild	FDMC612PZ	Q1	PMOS, -20V/-14A, 8.3mOhm	1
Wurth Elektronix	613 002 111 21	JP1	Header, 100mil, 2x1, Tin, TH	1
Wurth Elektronix	613 003 111 21	JP3	Header, 100mil, 3x1, Tin, TH	1
Wurth Elektronix	691 214 110 002S	J1, J2, J3	Terminal Block, 6A, 3.5mm Pitch, 2-Pos, TH	3
Wurth Elektronix	885 012 206 071	C1, C16, C17	CAP, CERM, 0.1 uF, 25 V, +/- 10%, X5R, 0603	3
Wurth Elektronix	885 012 206 063	C8	CAP, CERM, 4700 pF, 50 V, +/- 10%, X5R, 0603	1
Wurth Elektronix	C0603C105K8PACTU	C14	CAP, CERM, 1uF, 10V, +/-10%, X5R, 0603	1
Wurth Elektronix	885012109014	C4, C5, C6, C7	CAP, CERM, 22 uF, 25 V, +/- 10%, X5R, 1210	4
Wurth Elektronix	885012108018	C9, C10	CAP, CERM, 22uF, 16 V, +/- 10%, X5R, 1206	2
Wurth Elektronix	C0603C105K3PACTU	C3	CAP, CERM, 1 uF, 25 V, +/- 10%, X5R, 0603	1
Murata	GRM1885C1H470JA01D	C13	CAP, CERM, 47 pF, 50 V, +/- 5%, C0G/NP0, 0603	Not Installed
Murata	GRM188R71H102KA01D	C11	CAP, CERM, 22uF, 16 V, +/- 10%, X5R, 1206	Not Installed
Murata	GRM188R71H102KA01D	C12	CAP, CERM, 1000 pF, 50 V, +/- 10%, X7R, 0603	Not Installed
Murata	GRM188R71H473KA61D	C15	CAP, CERM, 0.047u, 50 V, +/- 10%, X7R, 0603	1
Wurth Elektronix	7443552150	L1	Inductor, Shielded Drum Core, WE-Perm, 1.5 uH, Rate current 14 A, DCR 0.0051 ohm, SMD	1
Vishay	CRCW0603768KFKEA	R2	RES, 768 k, 1%, 0.1 W, 0603	1
Vishay	CRCW0603255KFKEA	R7	RES, 255 k, 1%, 0.1 W, 0603	1
Vishay	CRCW0603121KFKEA	R3	RES, 121 k, 1%, 0.1 W, 0603	1
Vishay	CRCW0603100KFKEA	R5	RES, 100 k, 1%, 0.1 W, 0603	1
Vishay	CRCW060349R9FKEA	R1	RES, 49.9, 1%, 0.1 W, 0603	1
Vishay	CRCW060317K4FKEA	R6	RES, 17.4 k, 1%, 0.1 W, 0603	1
Vishay	CRCW060317K4FKEA	R10	RES, 17.4 k, 1%, 0.1 W, 0603	Not Installed
Vishay	CRCW06032R05FKEA	R11	RES, 2.05, 1%, 0.1 W, 0603	Not Installed
Vishay	CRCW06030000Z0EA	R4	RES, 0, 5%, 0.1 W, 0603	1
Keystone	5015	TP1~TP6, TP9	Test Point, Miniature, SMT	7
-	Not Populated	C12	Recommend not installed in application	Not Installed

PRINTED CIRCUIT BOARD LAYOUT

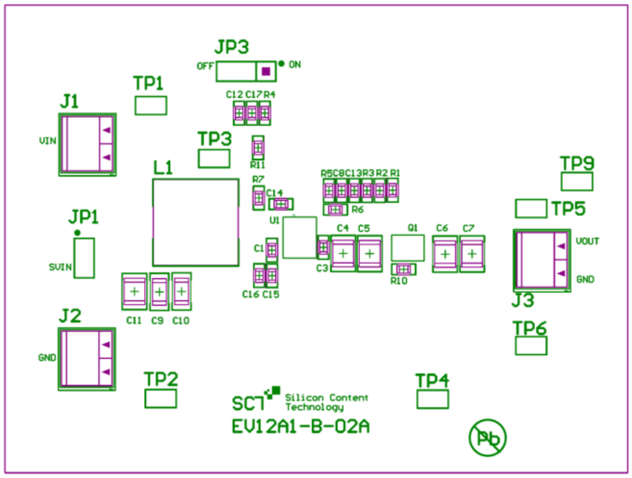


Figure 4. Top Silkscreen Layer

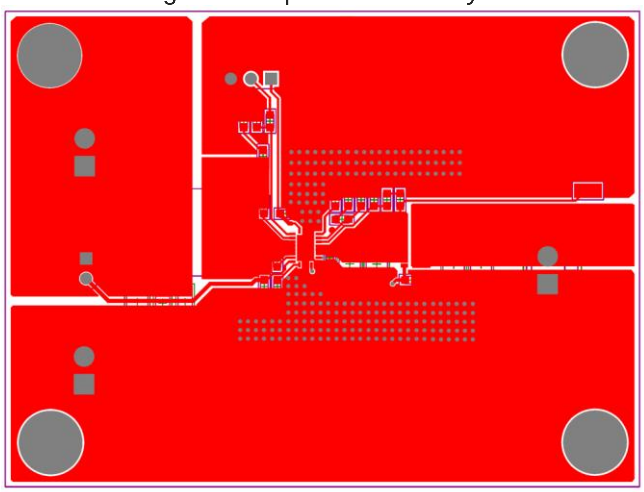


Figure 5. Top Layer

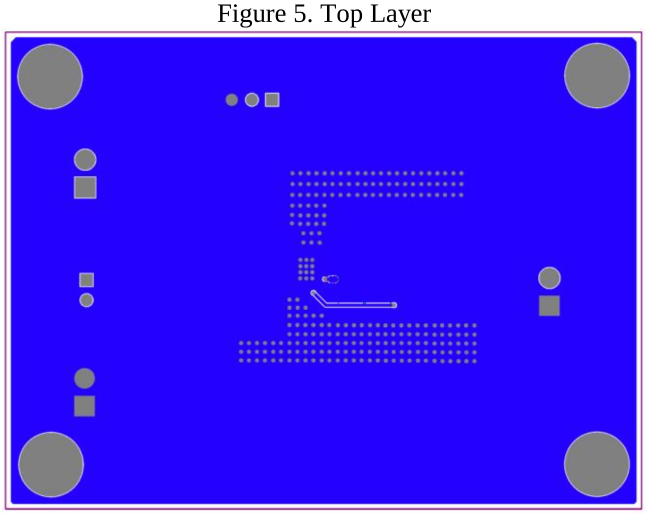


Figure 6: Bottom Layer

EVB TEST RESULTS

Vin=3.6V, Vout=9V, unless otherwise noted

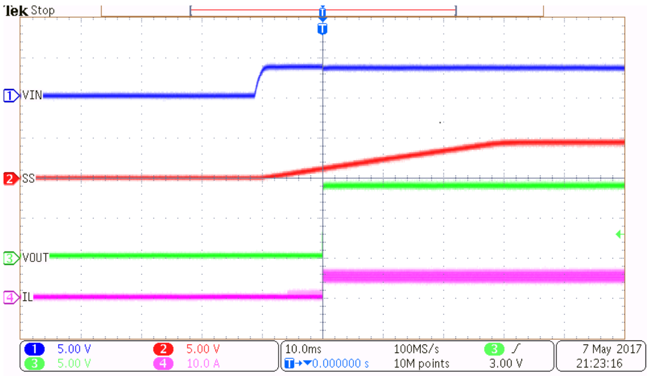


Figure 6. Power Up

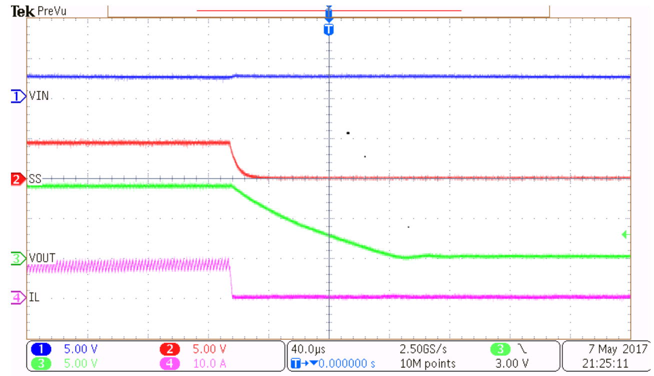


Figure 7. Power Down

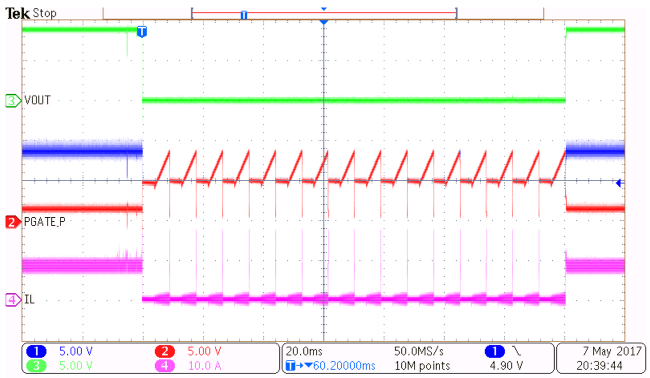


Figure 8. Output Hard-short and Recovery with 3A Load

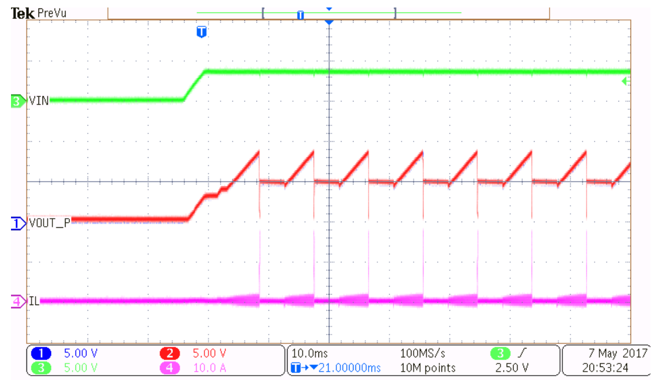


Figure 9. Startup at Output Hard-short

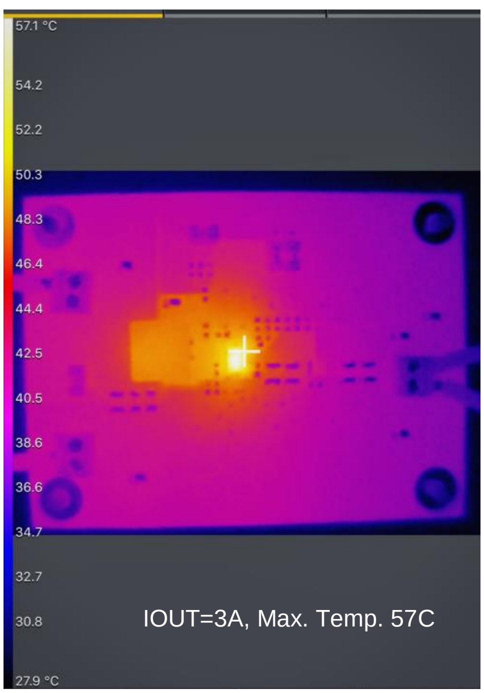


Figure 10. Infrared Thermal Image, Iout=2A

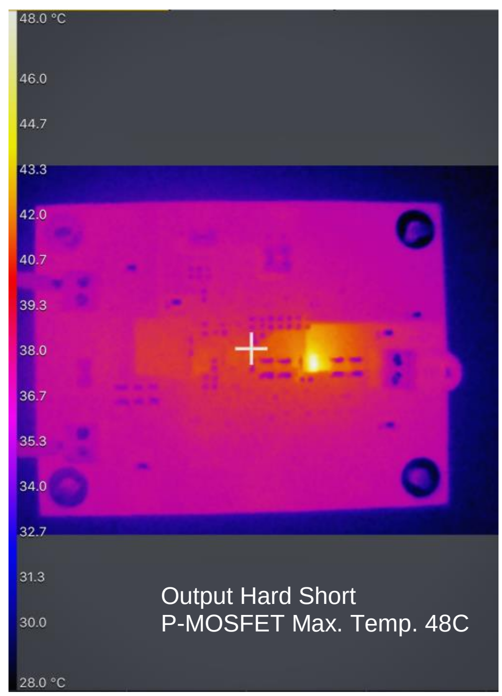


Figure 11. Infrared Thermal Image, Output Hard Short

OPTIONAL MODIFICATION

Switching Frequency

The resistor connected from FSW to SW R7 (Default 255KΩ) sets switching frequency of the converter. Use equation 1 to set a desired frequency.

$$R_{FREQ} = \frac{6*(\frac{1}{f_{SW}} - T_{DELAY}*\frac{V_{OUT}}{V_{IN}})}{C_{FREQ}} \quad (1)$$

where:

- f_{SW} is the desired switching frequency
- T_{DELAY} = 90 ns
- C_{FREQ} = 34 pF
- V_{IN} is the input voltage
- V_{OUT} is the output voltage

Table 3. R_{FSW} Value for Common Switching Frequencies (Vin=3.6V, Vout=9V, Room Temperature)

Fsw	R_{FSW} (R_7)
200 KHz	768 KΩ
350 KHz	422 KΩ
520 KHz	287 KΩ
730 KHz	196 KΩ
1000 KHz	130 KΩ
2000 KHz	48.7 KΩ

Peak Current Limit

The resistor R5 at ILIM pin sets default peak input current limit at 13A typical. Use equation 2 to set inductor peak current limit

$$I_{LIM} = \frac{12000}{R_{LIM}} \quad (2)$$

where:

- I_{LIM} is the peak current limit
- R_{LIM} is the resistance of ILIM pin to ground

Table 4. R_{LIM} Value for Inductor Peak Current (Vin=3.6V, Vout=9V, L=1.5uH, Room Temperature)

I_{LIM}	R_{LIM} (R_5)
12 A	100 KΩ
8 A	154 KΩ
6.3 A	200 KΩ
4.4 A	301 KΩ

Output Voltage

The output voltage is set by an external resistor divider R2 and R3 in typical application schematic. The value of R2 can be calculated by equation 3. A minimum current of typical 20uA flowing through feedback resistor divider gives good accuracy and noise covering.

$$R_2 = \frac{(V_{OUT} - V_{REF}) \times R_3}{V_{REF}} \quad (3)$$

where:

- V_{REF} is the feedback reference voltage, typical 1.2V

Table 5. Feedback Resistor R_3 R_4Value for Output Voltage (Room Temperature)

V_{OUT}	R_2	R_3
5 V	187 KΩ	59 KΩ
9 V	383 KΩ	59 KΩ
12.1 V	536 KΩ	59 KΩ

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Silicon Content Technology Co., Ltd.
#1 Floor 2 Building 15, Yard 33 Dijin Road, Haidian District, Beijing 100095
(86 10) 64779806 FAX: (86 10) 64779806 www.silicontent.com