



40V, 3/5/8A Synchronous Step Down COT Regulator

February 2015

Rev. 1A

GENERAL DESCRIPTION

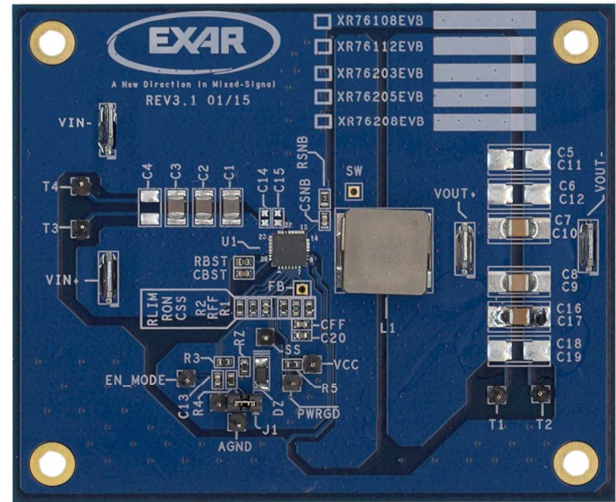
The XR76203, XR76205 and XR76208 are synchronous step-down regulators combining the controller, drivers, bootstrap diode and MOSFETs in a single package for point-of-load supplies. The XR76203, XR76205 and XR76208 have load current ratings of 3A, 5A and 8A respectively. A wide5V to 40V input voltage range allows for single supply operation from industry standard 24V ±10%, 18V-36V, and rectified 18VAC and 24VAC rails.

With a proprietary emulated current mode Constant On-Time (COT) control scheme, the XR76203, XR76205 and XR76208 provide extremely fast line and load transient response using ceramic output capacitors. They require no loop compensation, simplifying circuit implementation and reducing overall component count. The control loop also provides 0.07% load and 0.15% line regulation and maintains constant operating frequency. A selectable power saving mode allows the user to operate in discontinuous conduction mode (DCM) at light current loads thereby significantly increasing the converter efficiency.

A host of protection features, including over-current, over-temperature, short-circuit and UVLO, helps achieve safe operation under abnormal operating conditions.

The XR76203/5/8 are available in a RoHS-compliant, green/halogen-free space-saving QFN 5x5mm package.

EVALUATION BOARD MANUAL



FEATURES

- Controller, drivers, bootstrap diode, MOSFETs integrated in one package
• 3/5/8A Step Down Regulator
- Wide 5V to 40V Input Voltage Range
- ≥0.6V Adjustable Output Voltage
• Proprietary Constant On-Time Control
- No Loop Compensation Required
- Ceramic Output Cap. Stable operation
- Programmable 200ns-2µs On-Time
- Constant 400kHz-600kHz freq.
- Selectable CCM or CCM/DCM Operation
• 30-pin 5x5mm QFN package

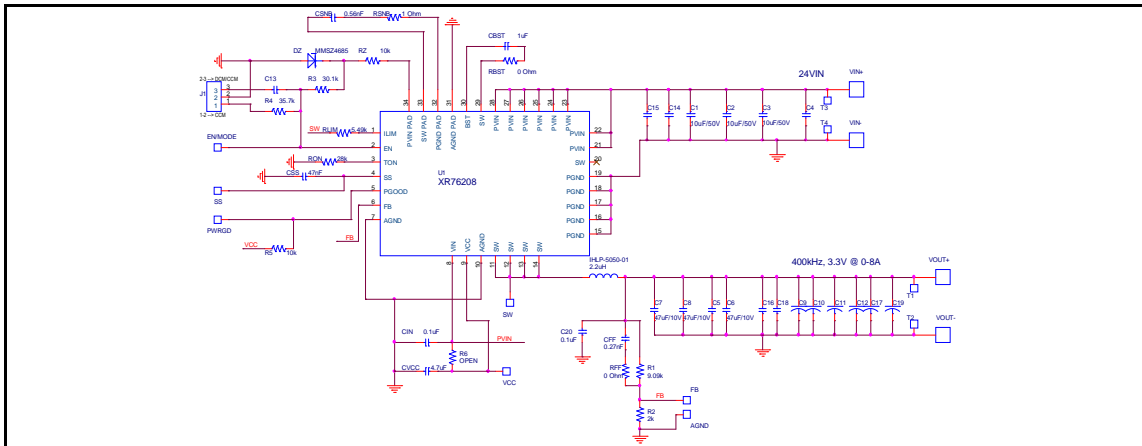


Fig. 1: XR76208 Evaluation Board Schematics



40V, 3/5/8A Synchronous Step Down COT Regulator

PIN ASSIGNMENT

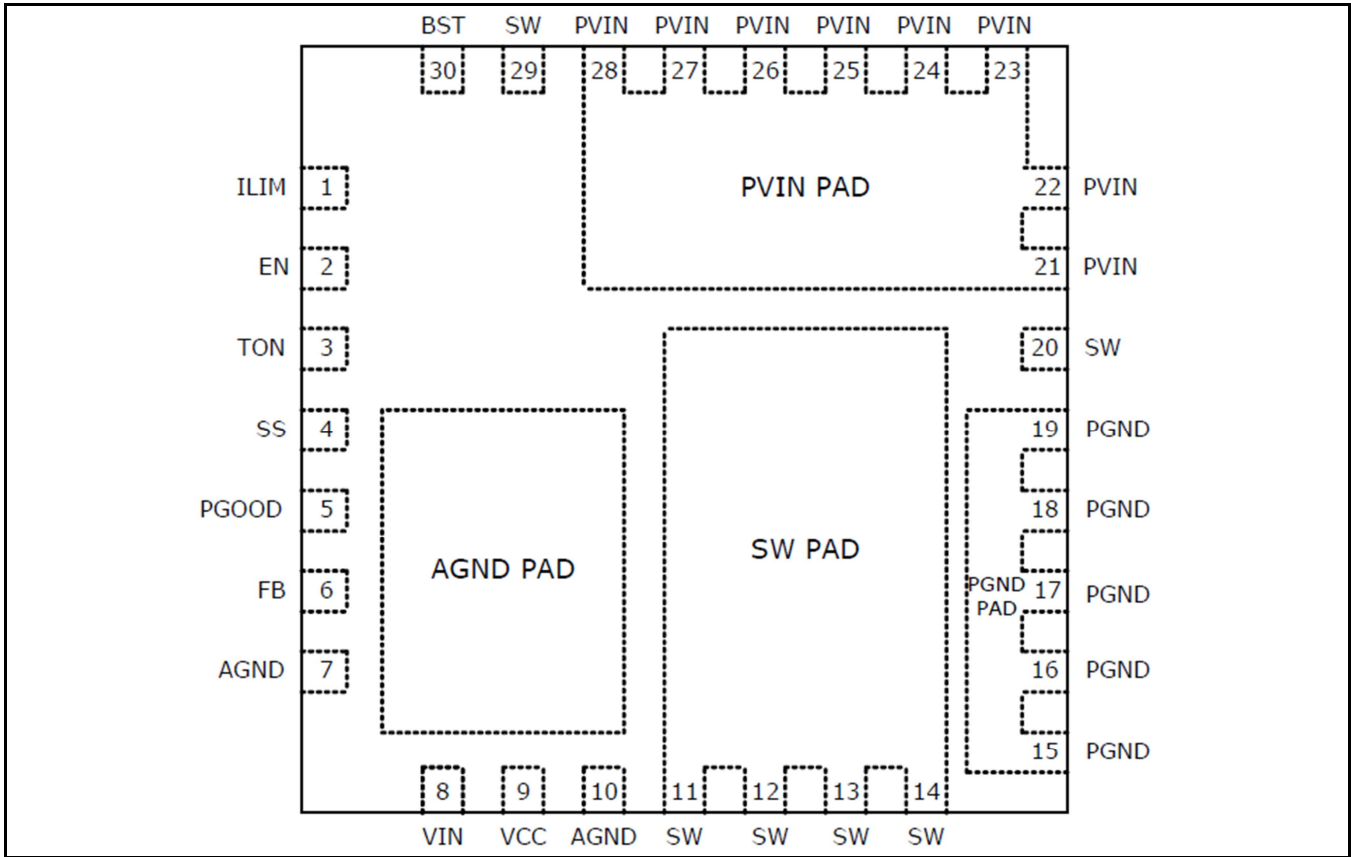


Fig. 2: XR76203/5/8 Pin Assignment

**40V, 3/5/8A Synchronous Step Down COT Regulator****PIN DESCRIPTION**

| Pin No. | Pin Name | Type | Description |
|-----------------------|----------|-------|---|
| 1 | ILIM | A | Over-current protection programming. Connect with a resistor to SW. |
| 2 | EN/MODE | I | Precision enable pin. Pulling this pin above 1.9V will turn the regulator on and it will operate in CCM. If the voltage is raised above 3.0V then the regulator will operate in DCM/CCM depending on load |
| 3 | TON | A | Constant on-time programming pin. Connect with a resistor to AGND. |
| 4 | SS | A | Soft-Start pin. Connect an external capacitor between SS and AGND to program the soft-start rate based on the 10uA internal source current. |
| 5 | PGOOD | O, OD | Power-good output. This open-drain output is pulled low when V _{OUT} is outside the regulation. |
| 6 | FB | A | Feedback input to feedback comparator. Connect with a set of resistors to V _{OUT} and AGND in order to program V _{OUT} . |
| 7, 10, AGND Pad | AGND | A | Signal ground for control circuitry. Connect AGND Pad with a short trace to pins 7 and 10. |
| 8 | VIN | A | Supply input for the regulator's LDO. Normally it is connected to PVIN. |
| 9 | VCC | A | The output of regulator's LDO. For operation using a 5V rail, VCC should be shorted to VIN. |
| 11-14, 20, 29, SW Pad | SW | PWR | Switch node. Drain of the low-side N-channel MOSFET. Source of the high-side MOSFET is wire-bonded to the SW Pad. Pins 20 and 29 are internally connected to SW pad. |
| 15-19, PGND Pad | PGND | PWR | Ground of the power stage. Should be connected to the system's power ground plane. Source of the low-side MOSFET is wire-bonded to PGND Pad. |
| 21-28, PVIN Pad | PVIN | PWR | Input voltage for power stage. Drain of the high-side N-channel MOSFET. |
| 30 | BST | A | High-side driver supply pin. Connect a bootstrap capacitor between BST and pin 29. |

Type: A = Analog, I = Input, O = Output, I/O = Input/Output, PWR = Power, OD = Open-Drain

ORDERING INFORMATION

Refer to XR76203/5/8 datasheet and/or www.exar.com for exact and up to date ordering information.

**40V, 3/5/8A Synchronous Step Down COT Regulator**

USING THE EVALUATION BOARD**POWERING UP**

Connect the VIN+/VIN- with short/thick leads to power supply. Use test pins T4 and T4 to monitor VIN+ and VIN- respectively. Connect VOUT+/VOUT- with short/thick leads to an electronic load. Use test pins T1 and T2 to monitor VOUT+ and VOUT- respectively. Apply 24V using the power supply. The XR76203/5/8EVB should power up and regulate the output at 3.3V. Input voltage range is from 5V to 40V. Maximum rated current for XR76203/5/8 is 3/5/8A respectively.

JUMPER J1

If the jumper is set to right side the regulator will operate in “forced CCM”.

If the Jumper is set to the left side the regulator will operate in DCM at light load.

PROGRAMMING THE OUTPUT VOLTAGE

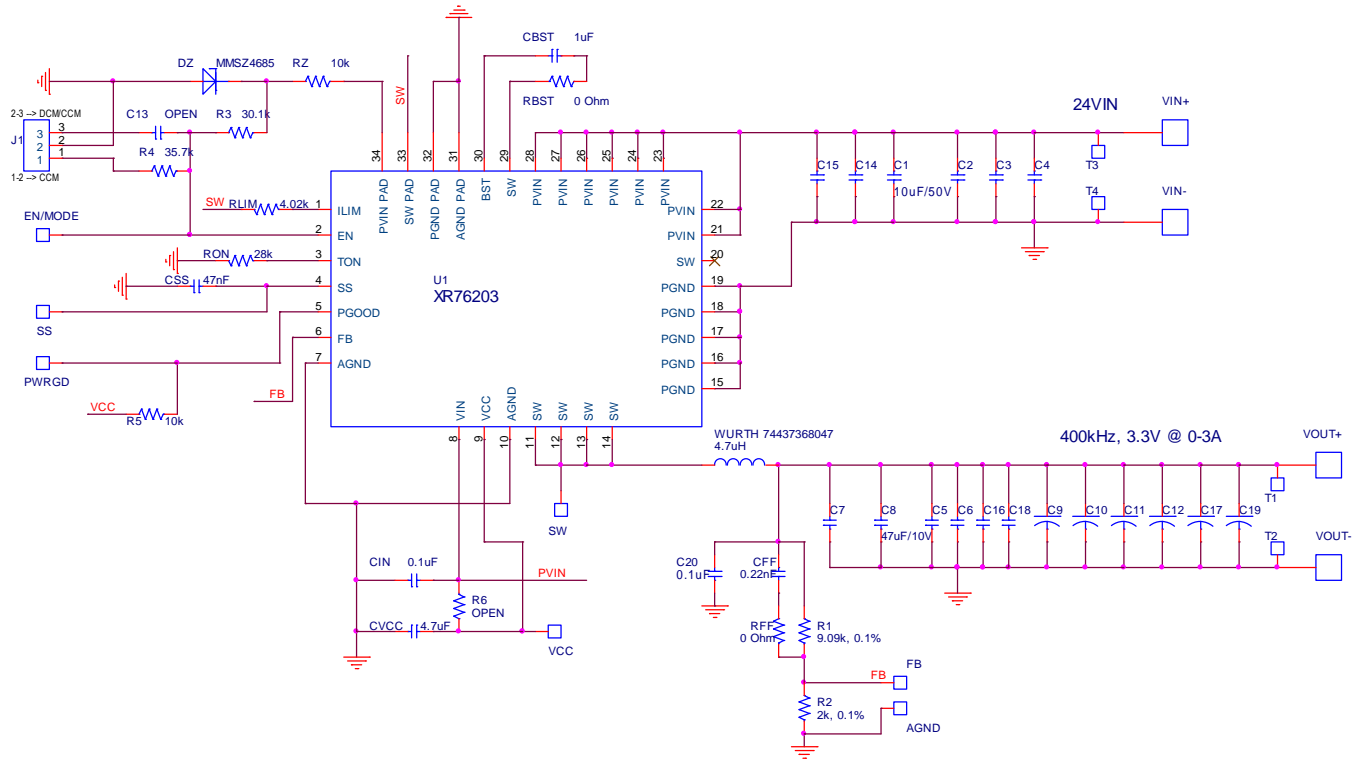
V_{OUT} can be programmed by changing R1 according to:

$$R1 = R2 \times \left(\frac{V_{OUT}}{0.6} - 1 \right)$$



40V, 3/5/8A Synchronous Step Down COT Regulator

XR76203 EVALUATION BOARD SCHEMATICS





40V, 3/5/8A Synchronous Step Down COT Regulator

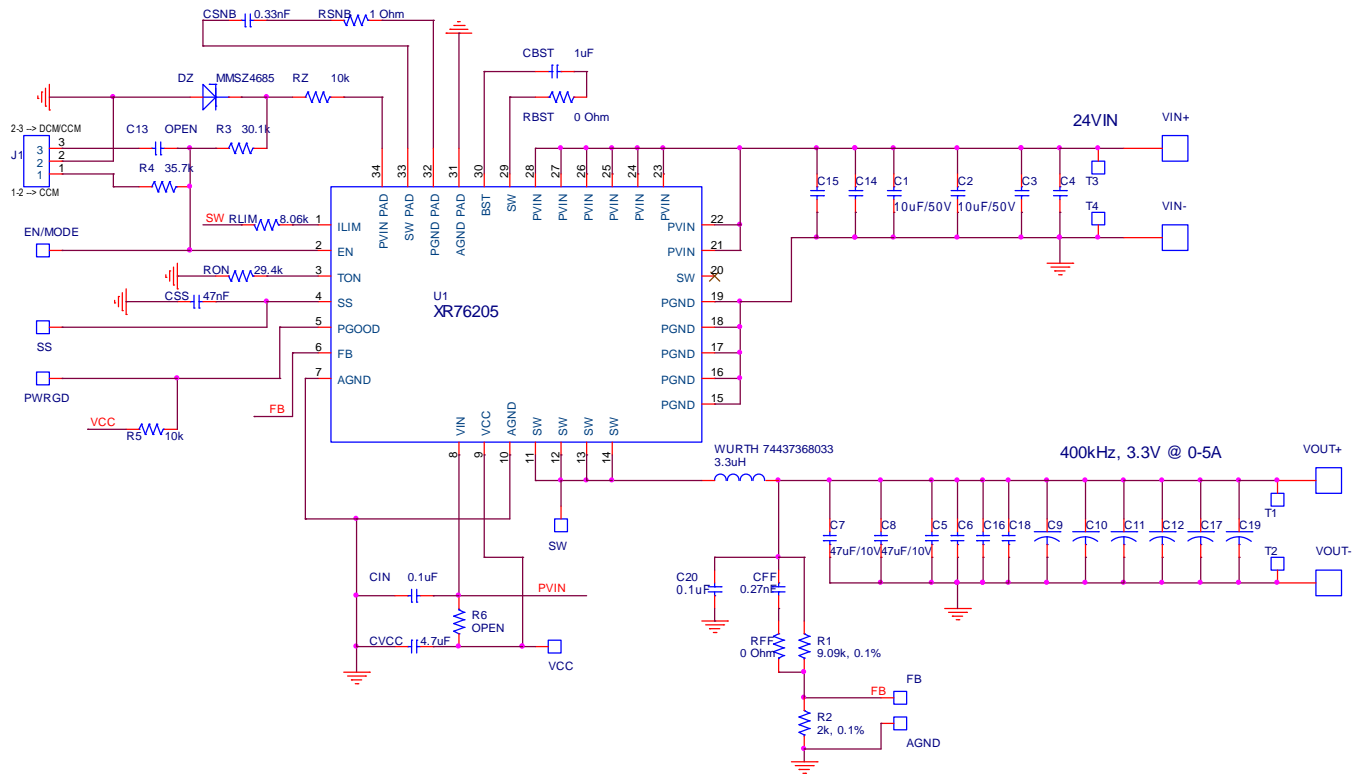
XR76203EVB BILL OF MATERIAL

| Reference Designator | Qty. | Manufacturer | Manufacturer Part Number | Size | Component |
|---|------|------------------|--------------------------|---------|---------------------------------------|
| PCB | 1 | Exar | XR76203 | | XR76203 Evaluation kit |
| U1 | 1 | Exar | XR76203 | | 40V, 3A COT Regulator |
| L1 | 1 | Würth Elektronik | 74437368047 | 11x10mm | Power Inductor 4.7uH, 7.0A, 15.0 mOhm |
| DZ | 1 | ON SEMI | MMSZ4685T1G | SOD-123 | Diode Zener 3.6V, 500MW, |
| C1 | 1 | MURATA | GRM32E71H106KA12L | 1210 | CERAMIC CAP. 10uF, 50V, X7R, 10% |
| C8 | 1 | MURATA | GRM32ER71A476KE15L | 1210 | CERAMIC CER, 47uF, 10V, X7R, 10% |
| CVCC | 1 | MURATA | GRM21BR71C475KA73L | 0805 | CERAMIC CAP , 4.7uF, 16V, X7R, 10% |
| CIN, C20 | 2 | MURATA | GRM188R71H104KA93D | 0603 | CERAMIC CAP., 0.1uF, 50V, X7R, 10% |
| CBST | 1 | MURATA | GRM188R71C105KA12D | 0603 | CERAMIC CAP., 1.0 uF, 16V, X7R, 10% |
| CFF | 1 | MURATA | GRM188R71H221KA01D | 0603 | CERAMIC CAP. , 220 pF, 50V, X7R, 10% |
| CSS | 1 | MURATA | GRM188R71H473KA61D | 0603 | CERAMIC CAP. 0.047uF, 50V,X7R,10% |
| R1 | 1 | PANASONIC | ERJ-3EKF9091V | 0603 | Resistor 9.09K Ohm, 1/10W,1%,SMD |
| R5,RZ | 2 | PANASONIC | ERJ-3EKF1002V | 0603 | Resistor 10.0K Ohm, 1/10W,1%,SMD |
| R3 | 1 | PANASONIC | ERJ-3EKF3012V | 0603 | Resistor 30.1K Ohm, 1/10W,1%,SMD |
| R4 | 1 | PANASONIC | ERJ-3EKF3572V | 0603 | Resistor 35.7K Ohm, 1/10W, 1%, SMD |
| RFF, RBST | 2 | PANASONIC | ERJ-3GEY0R00V | 0603 | Resistor 0.00 Ohm, Jumper, 1/10W, SMD |
| R2 | 1 | PANASONIC | ERA-3YEB202V | 0603 | Resistor 2.0K Ohm, 1/10W, 0.1%, SMD |
| RLIM | 1 | PANASONIC | ERJ-3EKF4021V | 0603 | Resistor 4.02K Ohm, 1/10W,1%,SMD |
| RON | 1 | PANASONIC | ERJ-3EKF2802V | 0603 | Resistor 28.0K Ohm, 1/10W,1%, SMD |
| J1 | 1 | Würth Elektronik | 61300311121 | | 3-PIN CONNECTOR |
| VIN+, VOUT+, VIN-, VOUT- T1,T2,T3,T4,SS,VCC,PWR GD, AGND, EN MODE | 4 | Würth Elektronik | 7471287 | | CONNECTOR BLADE TERMINAL |
| | 9 | Würth Elektronik | 61300111121 | | SINGLE Test Point Post |



40V, 3/5/8A Synchronous Step Down COT Regulator

XR76205 EVALUATION BOARD SCHEMATICS





40V, 3/5/8A Synchronous Step Down COT Regulator

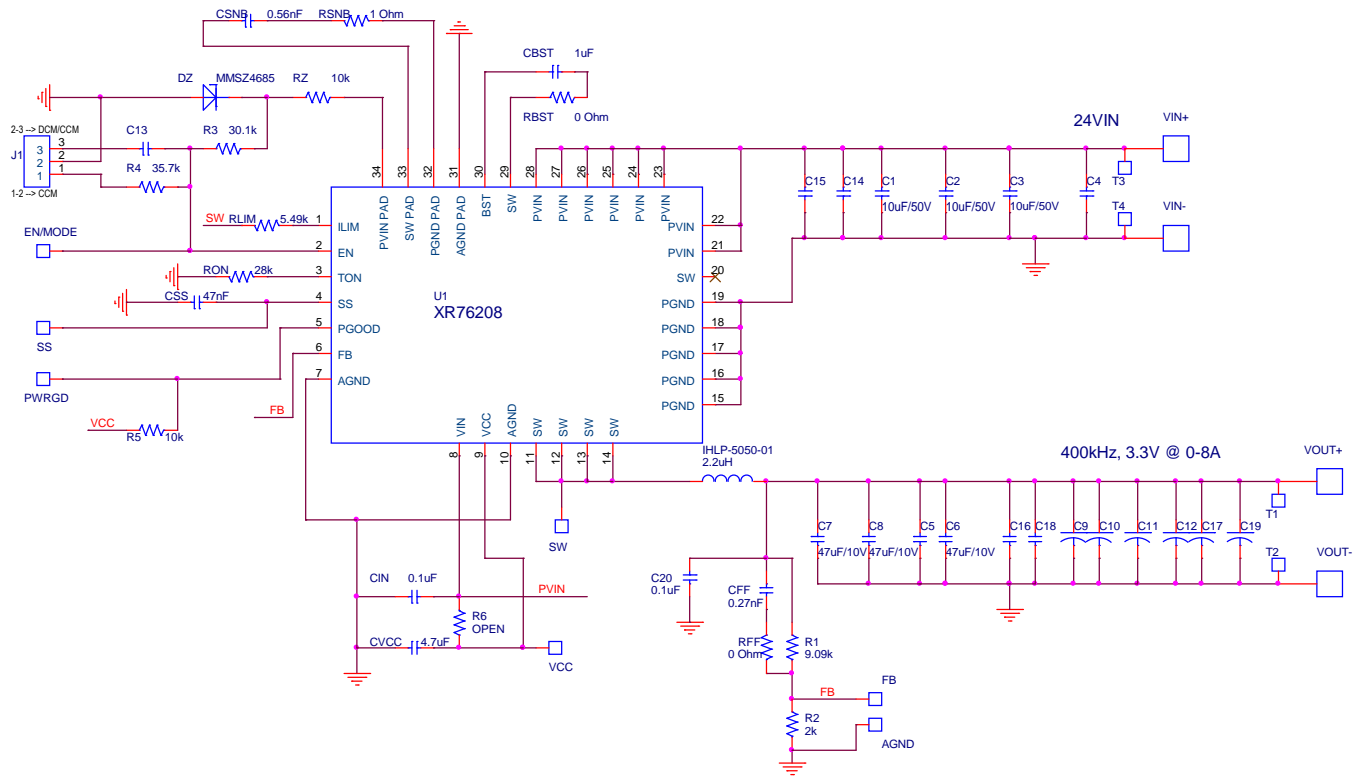
XR76205EV B BILL OF MATERIAL

| Reference Designator | Qty. | Manufacturer | Manufacturer Part Number | Size | Component |
|--|------|------------------|--------------------------|---------|---------------------------------------|
| PCB | 1 | Exar | XR76205 | | XR76205 Evaluation Kit |
| U1 | 1 | Exar | XR76205 | | 40V, 5A COT Regulator |
| L1 | 1 | Würth Elektronik | 74437368033 | 11x10mm | Power Inductor 3.3uH, 8.0A, 11.8mOhm |
| DZ | 1 | ON SEMI | MMSZ4685T1G | SOD-123 | Diode Zener 3.6V, 500MW, |
| C1, C2 | 2 | MURATA | GRM32E71H106KA12L | 1210 | CERAMIC CAP. 10uF, 50V, X7R, 10% |
| C7, C8 | 2 | MURATA | GRM32ER71A476KE15L | 1210 | CERAMIC CER, 47uF, 10V, X7R, 10% |
| CVCC | 1 | MURATA | GRM21BR71C475KA73L | 0805 | CERAMIC CAP , 4.7uF, 16V, X7R, 10% |
| CIN, C20 | 2 | MURATA | GRM188R71H104KA93D | 0603 | CERAMIC CAP., 0.1uF, 50V, X7R, 10% |
| CBST | 1 | MURATA | GRM188R71C105KA12D | 0603 | CERAMIC CAP., 1.0 Uf, 16V, X7R, 10% |
| CFF | 1 | MURATA | GRM188R71H271KA01D | 0603 | CERAMIC CAP. , 270 pF, 50V, X7R, 10% |
| CSNB | 1 | MURATA | GRM188R71H331KA01D | 0603 | CERAMIC CAP. 0.33 nF, 50V,X7R,10% |
| CSS | 1 | MURATA | GRM188R71H473KA61D | 0603 | CERAMIC CAP. 0.047uF, 50V,X7R,10% |
| R1 | 1 | PANASONIC | ERJ-3EKF9091V | 0603 | Resistor 9.09K Ohm, 1/10W,1%,SMD |
| R5,RZ | 2 | PANASONIC | ERJ-3EKF1002V | 0603 | Resistor 10.0K Ohm, 1/10W,1%,SMD |
| R3 | 1 | PANASONIC | ERJ-3EKF3012V | 0603 | Resistor 30.1K Ohm, 1/10W,1%,SMD |
| R4 | 1 | PANASONIC | ERJ-3EKF3572V | 0603 | Resistor 35.7K Ohm, 1/10W, 1%, SMD |
| RFF, RBST | 2 | PANASONIC | ERJ-3GEY0R00V | 0603 | Resistor 0.00 Ohm, Jumper, 1/10W, SMD |
| R2 | 1 | PANASONIC | ERA-3YEB202V | 0603 | Resistor 2.0K Ohm, 1/10W, 0.1%, SMD |
| RLIM | 1 | PANASONIC | ERJ-3EKF8061V | 0603 | Resistor 8.06K Ohm, 1/10W,1%,SMD |
| RON | 1 | PANASONIC | ERJ-3EKF2942V | 0603 | Resistor 29.4K Ohm, 1/10W,1%, SMD |
| RSNB | 1 | PANASONIC | ERJ-6RQF1R0V | 0805 | Resistor 1.0 Ohm,1/8W,1%,SMD |
| J1 | 1 | Würth Elektronik | 61300311121 | | 3-PIN CONNECTOR |
| VIN+, VOUT+, VIN-,VOUT- T1,T2,T3,T4,SS,VCC,PWR GD, AGND, EN_MODE | 4 | Würth Elektronik | 7471287 | | CONNECTOR BLADE TERMINAL |
| | 9 | Würth Elektronik | 61300111121 | | SINGLE Test Point Post |



40V, 3/5/8A Synchronous Step Down COT Regulator

XR76208 EVALUATION BOARD SCHEMATICS





40V, 3/5/8A Synchronous Step Down COT Regulator

XR76208EVB BILL OF MATERIAL

| Reference Designator | Qty. | Manufacturer | Manufacturer Part Number | Size | Component |
|---|------|------------------|--------------------------|-------------|--|
| PCB | 1 | Exar | XR76208 | | XR76208 Evaluation kit |
| U1 | 1 | Exar | XR76208 | | 40V, 8A COT Regulator |
| L1 | 1 | Vishay | IHLP5050FDER2R2M01 | 12.9x13.2mm | Inductor High Current 2.2uH, 22A, 4.2 mOhm |
| DZ | 1 | ON SEMI | MMSZ4685T1G | SOD-123 | Diode Zener 3.6V, 500MW, |
| C1, C2, C3 | 3 | MURATA | GRM32E71H106KA12L | 1210 | CERAMIC CAP. 10uF, 50V, X7R, 10% |
| C6,C7, C8 | 3 | MURATA | GRM32ER71A476KE15L | 1210 | CERAMIC CER, 47uF, 10V, X7R, 10% |
| CVCC | 1 | MURATA | GRM21BR71C475KA73L | 0805 | CERAMIC CAP , 4.7uF, 16V, X7R, 10% |
| CIN, C20 | 2 | MURATA | GRM188R71H104KA93D | 0603 | CERAMIC CAP., 0.1uF, 50V, X7R, 10% |
| CBST | 1 | MURATA | GRM188R71C105KA12D | 0603 | CERAMIC CAP., 1.0 Uf, 16V, X7R, 10% |
| CFF | 1 | MURATA | GRM188R71H271KA01D | 0603 | CERAMIC CAP. , 270 pF, 50V, X7R, 10% |
| CSNB | 1 | MURATA | GRM188R71H561KA01D | 0603 | CERAMIC CAP. 0.56 nF, 50V,X7R,10% |
| CSS | 1 | MURATA | GRM188R71H473KA61D | 0603 | CERAMIC CAP. 0.047uF, 50V,X7R,10% |
| R1 | 1 | PANASONIC | ERJ-3EKF9091V | 0603 | Resistor 9.09K Ohm, 1/10W,1%,SMD |
| R5,RZ | 2 | PANASONIC | ERJ-3EKF1002V | 0603 | Resistor 10.0K Ohm, 1/10W,1%,SMD |
| R3 | 1 | PANASONIC | ERJ-3EKF3012V | 0603 | Resistor 30.1K Ohm, 1/10W,1%,SMD |
| R4 | 1 | PANASONIC | ERJ-3EKF3572V | 0603 | Resistor 35.7K Ohm, 1/10W, 1%, SMD |
| RFF, RBST | 2 | PANASONIC | ERJ-3GEY0R00V | 0603 | Resistor 0.00 Ohm, Jumper, 1/10W, SMD |
| R2 | 1 | PANASONIC | ERA-3YEB202V | 0603 | Resistor 2.0K Ohm, 1/10W, 0.1%, SMD |
| RLIM | 1 | PANASONIC | ERJ-3EKF5491V | 0603 | Resistor 5.49K Ohm, 1/10W,1%, SMD |
| RON | 1 | PANASONIC | ERJ-3EKF2802V | 0603 | Resistor 28.0K Ohm, 1/10W,1%, SMD |
| RSNB | 1 | PANASONIC | ERJ-6RQF1R0V | 0805 | Resistor 1.0 Ohm,1/8W,1%,SMD |
| J1 | 1 | Würth Elektronik | 61300311121 | | 3-PIN CONNECTOR |
| VIN+, VOUT+, VIN-,VOUT-T1,T2,T3,T4,SS,VCC,PWR GD, AGND, EN MODE | 4 | Würth Elektronik | 7471287 | | CONNECTOR BLADE TERMINAL |
| | 9 | Würth Elektronik | 61300111121 | | SINGLE Test Point Post |



EVALUATION BOARD LAYOUT

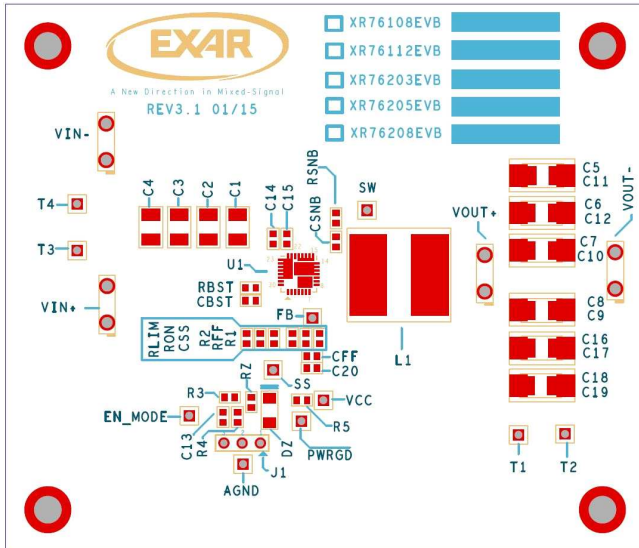


Fig. 3: Top components

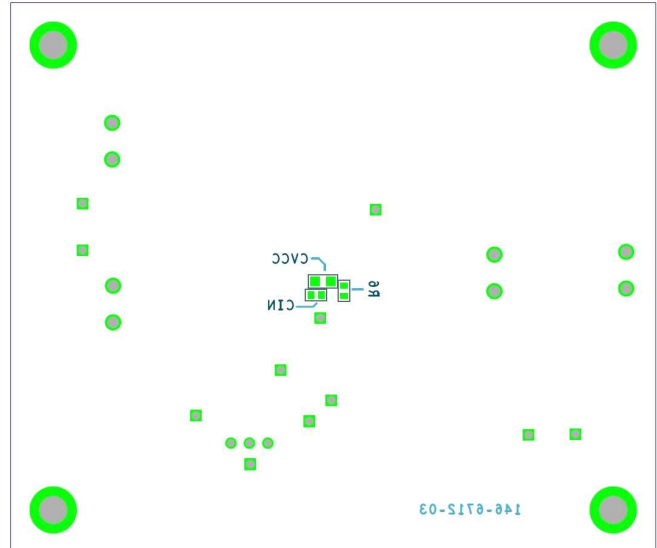


Fig. 4: Bottom components

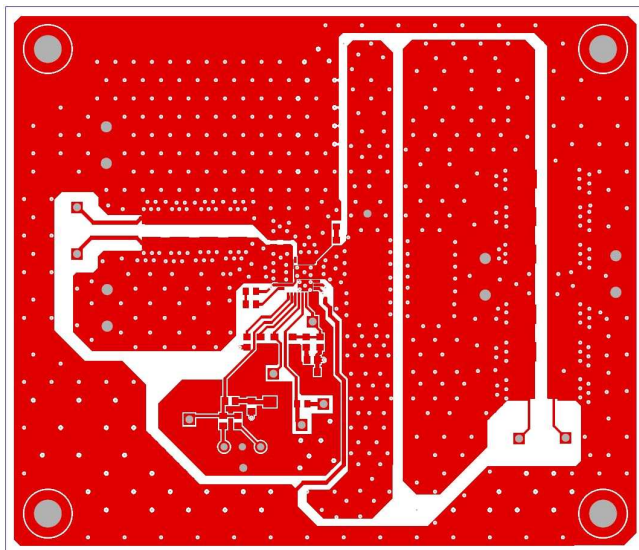


Fig. 5: Top

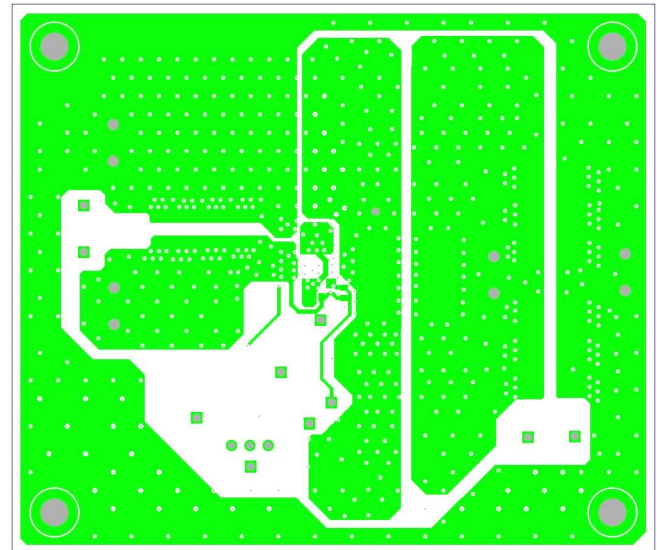


Fig. 6: Bottom



40V, 3/5/8A Synchronous Step Down COT Regulator

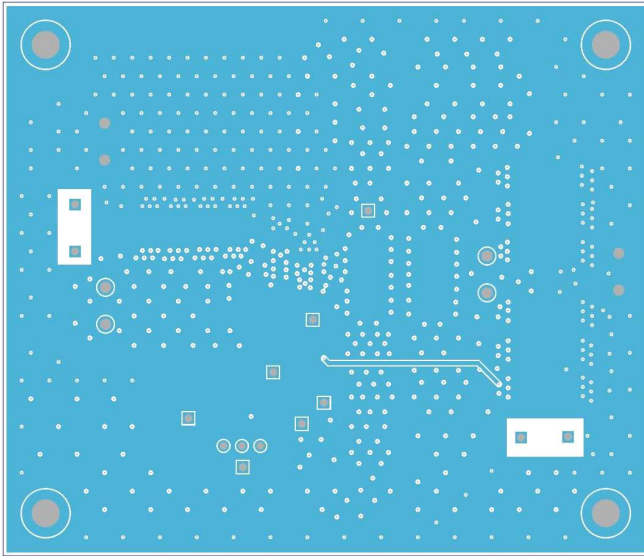


Fig. 7: Layer 2, GND 1

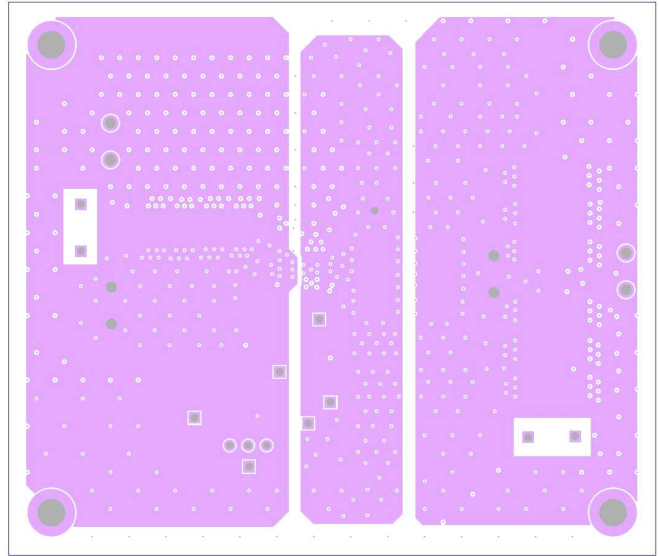


Fig. 8: Layer 3, VCC1

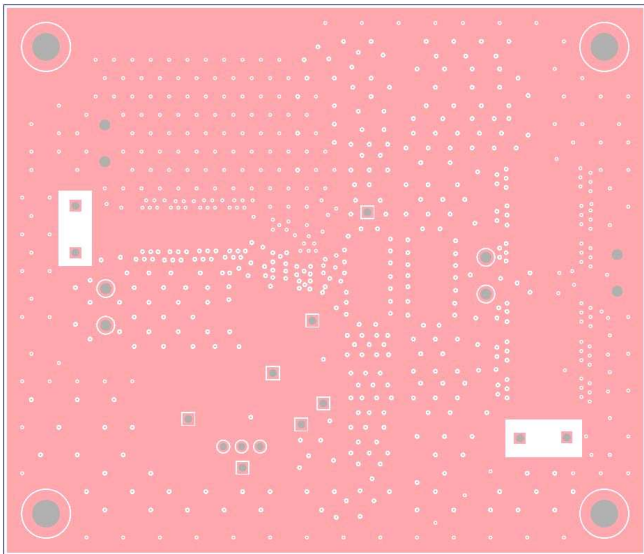


Fig. 9: Layer 4, GND 2

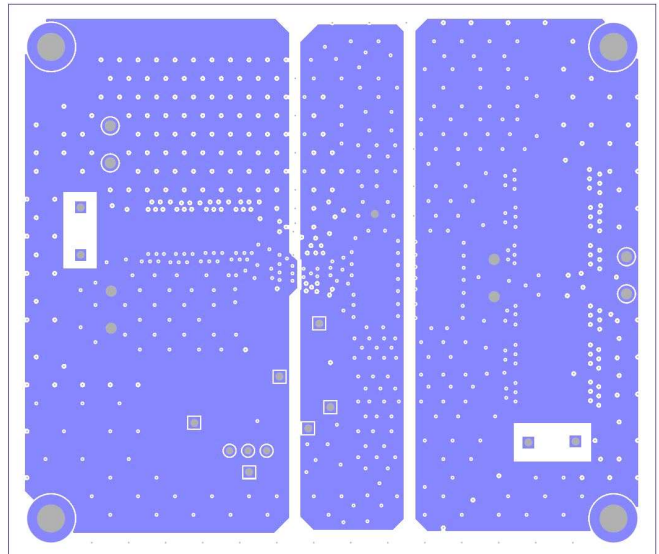


Fig. 10: Layer 5, VCC2