# XR76108 and XR76112

PowerBlox™

8A and 12A Synchronous Step Down COT Regulator

## General Description

The XR76108 and XR76112 are synchronous step-down regulators combining the controller, drivers, bootstrap diode and MOSFETs in a single package for point-of-load supplies. The XR76108 has a load current rating of 8A and the XR76112 has a load current rating of 12A. A wide 5V to 22V input voltage range allows for single supply operation from industry standard 5V, 12V and 19.6V rails.

With a proprietary emulated current mode Constant On-Time (COT) control scheme, the XR76108 and XR76112 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 0.25% load and 0.1% line regulation and maintains constant operating frequency. A selectable power saving mode, allows the user to operate in discontinuous 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, help achieve safe operation under abnormal operating conditions.

The XR76108/12 are available in a RoHS-compliant, green/halogen-free space-saving QFN 5x5mm package.

## FEATURES

- 8A and 12A Capable Step Down Regulators
  - 4.5V to 5.5V Low $V_{IN}$ Operation
  - 5V to 22V Wide Single Input Voltage
  - ≥0.6V Adjustable Output Voltage
- Controller, drivers, bootstrap diode and MOSFETs integrated in one package
- Proprietary Constant On-Time Control
  - No Loop Compensation Required
  - Ceramic Output Cap. Stable operation
  - Programmable 200ns-2µs On-Time
  - Quasi Constant 200kHz-800kHz Freq.
  - Selectable CCM or CCM/DCM Operation
- Precision Enable and Power-Good Flag
- Programmable Soft-start
- 5x5mm 30-pin QFN Package

## APPLICATIONS

- Distributed Power Architecture
- Point-of-Load Converters
- Power Supply Modules
- FPGA, DSP, and Processor Supplies
- Base Stations, Switches/Routers, and Servers

## Typical Application

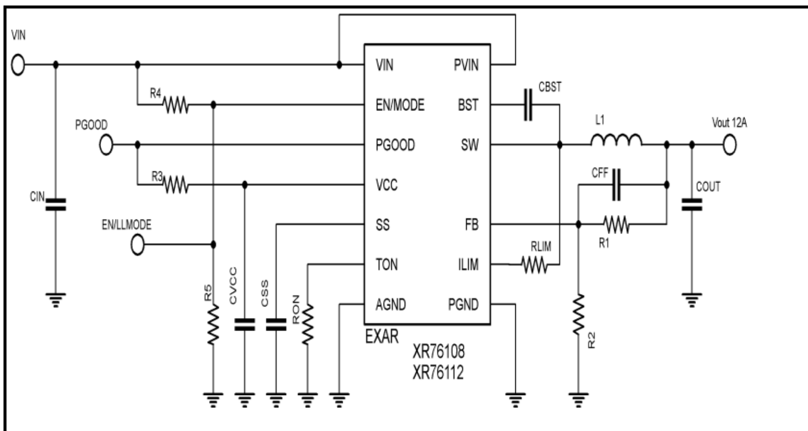



Figure 1: XR76108/12 Application Diagram

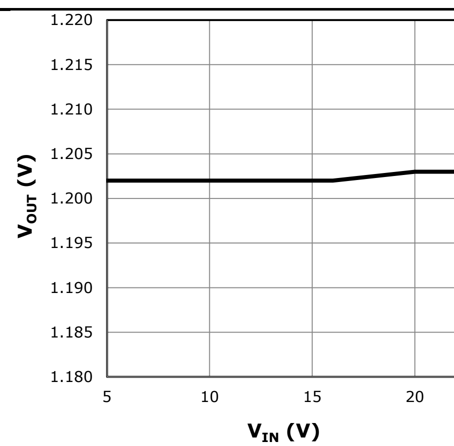



Figure 2: XR76112 Line Regulation

## Absolute Maximum Ratings

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications below is not implied. Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

$PV_{IN}$, $V_{IN}$ ........ -0.3V to 25V
$V_{CC}$ ........ -0.3V to 6.0V
BST ........ -0.3V to 31V[1]
BST-SW ........ -0.3V to 6V
SW, $I_{LIM}$ ........ -1V to 25V[1,2]
All other pins ........ -0.3V to $V_{CC}$+0.3V
Storage Temperature ........ -65°C to 150°C
Junction Temperature ........ 150°C
Power Dissipation ........ Internally Limited
Lead Temperature (Soldering, 10 sec) ........ 300°C
ESD Rating (HBM - Human Body Model) ........ 2kV

## Operating Ratings

$PV_{IN}$ ........ 3V to 22V
$V_{IN}$ ........ 4.5V to 22V
$V_{CC}$ ........ 4.5V to 5.5V
SW, $I_{LIM}$ ........ -1V to 22V[2]
PGOOD, $V_{CC}$, $T_{ON}$, SS, EN ........ -0.3V to 5.5V
Switching Frequency ........ 200kHz-800kHz[3]
Junction Temperature Range ($T_J$) ........ -40°C to 125°C
XR76108 Package Power Dissipation max at 25°C ........ 3.8W
XR76112 Package Power Dissipation max at 25°C ........ 4.1W
XR76108 JEDEC51 Package Thermal Resistance $\theta_{JA}$ ........ 26°C/W
XR76112 JEDEC51 Package Thermal Resistance $\theta_{JA}$ ........ 24°C/W

Note 1: No external voltage applied
Note 2: SW pin's DC range is -1V, transient is -5V for less than 50ns
Note 3: Recommended

## Ordering Information

| Part Number | Temperature Range | Marking | Package | Packing Quantity | Note 1 |
|---|---|---|---|---|---|
| XR76108EL-F | -40°C≤$T_J$≤+125°C | 76108E YYWW XXXXXX | 5x5mm QFN | Bulk | RoHS Compliant Halogen Free |
| XR76108ELMTR-F | | | | 250/Tape & Reel | |
| XR76108ELTR-F | | | | 3K/Tape & Reel | |
| XR76112EL-F | | 76112E YYWW XXXXXX | | Bulk | |
| XR76112ELMTR-F | | | | 250/Tape & Reel | |
| XR76112ELTR-F | | | | 3K/Tape & Reel | |
| XR76108EVB | | XR76108 Evaluation Board | | | |
| XR76112EVB | | XR76112 Evaluation Board | | | |

"YY" = Year – "WW" = Work Week – "XXXXXX" = Lot Number; when applicable.

## Electrical Characteristics

Specifications are for Operating Junction Temperature of $T_J$ = 25°C only; limits applying over the full Operating Junction Temperature range are denoted by a "•". Typical values represent the most likely parametric norm at $T_J$ = 25°C, and are provided for reference purposes only. Unless otherwise indicated, $V_{IN}$=12V

| Parameter | Min. | Typ. | Max. | Units | | Conditions |
|---|---|---|---|---|---|---|
| **Power Supply Characteristics** | | | | | | |
| $V_{IN}$, Input Voltage Range | 5 | 12 | 22 | V | • | $V_{CC}$ regulating |
| | 4.5 | 5.0 | 5.5 | | | $V_{CC}$ tied to $V_{IN}$ |
| $I_{VIN}$, $V_{IN}$ supply current | | 0.7 | 1.3 | mA | • | Not switching, $V_{IN}$=12V, $V_{FB}$=0.7V |
| $I_{VCC}$, $V_{CC}$ Quiescent current | | 0.7 | 1.3 | mA | • | Not switching, $V_{CC}$=$V_{IN}$=5V, $V_{FB}$=0.7V |
| $I_{VIN}$, $V_{IN}$ supply current (XR76112) | | 8 | | mA | | f=300kHz, $R_{ON}$=107k, $V_{FB}$=0.58V |
| $I_{VIN}$, $V_{IN}$ supply current (XR76108) | | 6 | | mA | | f=300kHz, $R_{ON}$=107k, $V_{FB}$=0.58V |
| $I_{OFF}$, Shutdown current | | 0.5 | | µA | | Enable=0V, $V_{IN}$=12V, $V_{IN}$=$PV_{IN}$ |
| **Enable and Under-Voltage Lock-Out UVLO** | | | | | | |
| $V_{IH\_EN}$, EN Pin Rising Threshold | 1.8 | 1.9 | 2.0 | V | • | |

| Parameter | Min. | Typ. | Max. | Units | | Conditions |
|---|---|---|---|---|---|---|
| $V_{EN\_HYS}$, EN Pin Hysteresis | | 50 | | mV | | |
| $V_{IH\_EN}$, EN Pin Rising Threshold for DCM/CCM operation | 2.8 | 3.0 | 3.1 | V | • | |
| $V_{EN\_HYS}$, EN Pin Hysteresis | | 100 | | mV | | |
| $V_{CC}$ UVLO start threshold, rising edge | 4.00 | 4.25 | 4.50 | V | • | |
| $V_{CC}$ UVLO Hysteresis | | 200 | | mV | | |
| **Reference voltage** | | | | | | |
| $V_{REF}$, Reference voltage | 0.597 | 0.600 | 0.603 | V | | $V_{IN}$=5V-22V → $V_{CC}$ regulating |
| | 0.596 | 0.600 | 0.604 | V | | $V_{IN}$=4.5V-5.5V → $V_{CC}$ tied to $V_{IN}$ |
| | 0.594 | 0.600 | 0.606 | V | • | $V_{IN}$=5V-22V → $V_{CC}$ regulating,<br>$V_{IN}$=4.5V-5.5V → $V_{CC}$ tied to $V_{IN}$ |
| DC load regulation | | ±0.25 | | % | | CCM operation, closed loop, applies to any $C_{OUT}$ |
| DC Line regulation | | ±0.1 | | % | | |
| **Parameter** | **Min.** | **Typ.** | **Max.** | **Units** | | **Conditions** |
| **Programmable Constant On-Time** | | | | | | |
| On-Time 1 | 1.66 | 1.95 | 2.24 | µs | • | $R_{ON}$=140kΩ, $V_{IN}$=22V |
| f corresponding to On-Time 1 | 243 | 280 | 329 | kHz | | $V_{IN}$=22V, $V_{OUT}$=12V |
| Minimum Programmable On-Time | | 109 | | ns | | $R_{ON}$=6.98kΩ, $V_{IN}$=22V |
| On-Time 2 | 162 | 202 | 226 | ns | • | $R_{ON}$=6.98kΩ, $V_{IN}$=12V |
| f corresponding to On-Time 2 | 1217 | 1361 | 1698 | kHz | | $V_{OUT}$=3.3V |
| f corresponding to On-Time 2 | 369 | 413 | 514 | kHz | | $V_{OUT}$=1.0V |
| On-Time 3 | 352 | 422 | 492 | ns | • | $R_{ON}$=16.2kΩ, $V_{IN}$=12V |
| Minimum Off-Time | | 250 | 350 | ns | • | |
| **Diode Emulation Mode** | | | | | | |
| Zero crossing threshold | | -2 | | mV | | DC value measured during test |
| **Soft-Start** | | | | | | |
| SS Charge current | -14 | -10 | -6 | µA | • | |
| SS Discharge current | 1 | 3 | | mA | • | Fault present |
| **$V_{CC}$ Linear Regulator** | | | | | | |
| $V_{CC}$ Output Voltage | 4.8 | 5.0 | 5.2 | V | • | $V_{IN}$=6V to 22V, $I_{load}$=0 to 30mA |
| | 4.51 | 4.7 | | V | • | $V_{IN}$=5V, $I_{load}$=0 to 20mA |
| Dropout Voltage | 100 | 300 | 490 | mV | • | $I_{VCC}$=30mA |
| **Power Good Output** | | | | | | |
| Power Good Threshold | -10 | -7.5 | -5 | % | | |
| Power Good Hysteresis | | 2 | 4 | % | | |
| Power Good Sink Current | 1 | 15 | | mA | | |
| **Protection: OCP, OTP, Short-Circuit** | | | | | | |
| Hiccup timeout | | 110 | | ms | | |
| $I_{LIM}$ pin source current | 45 | 50 | 55 | µA | | |
| $I_{LIM}$ current temperature coefficient | | 0.4 | | %/°C | | |
| $I_{LIM}$ comparator offset | -8 | 0 | +8 | mV | • | |
| Current limit blanking | | 100 | | ns | | |
| Thermal shutdown threshold | | 150 | | °C | | Rising temperature |
| Thermal Hysteresis | | 15 | | °C | | |
| Feedback pin short-circuit threshold | 50 | 60 | 70 | % | • | Percent of $V_{REF}$, short circuit is active After PGOOD is up |
| **XR76108 Output Power Stage** | | | | | | |
| High-side MOSFET $R_{DSON}$ | | 21 | 28 | mΩ | | $V_{GS}$=4.5V, $I_{DS}$=2A |
| Low-side MOSFET $R_{DSON}$ | | 7 | 10 | mΩ | | $V_{GS}$=4.5V, $I_{DS}$=2A |

| Parameter | Min. | Typ. | Max. | Units | | Conditions |
|---|---|---|---|---|---|---|
| Maximum Output Current | 8 | | | A | • | |
| **XR76112 Output Power Stage** | | | | | | |
| High-side MOSFET $R_{DSON}$ | | 11 | 15.5 | mΩ | | $V_{GS}$=4.5V, $I_{DS}$=2A |
| Low-side MOSFET $R_{DSON}$ | | 5 | 9 | mΩ | | $V_{GS}$=4.5V, $I_{DS}$=2A |
| Maximum Output Current | 12 | | | A | • | |

## Block Diagram

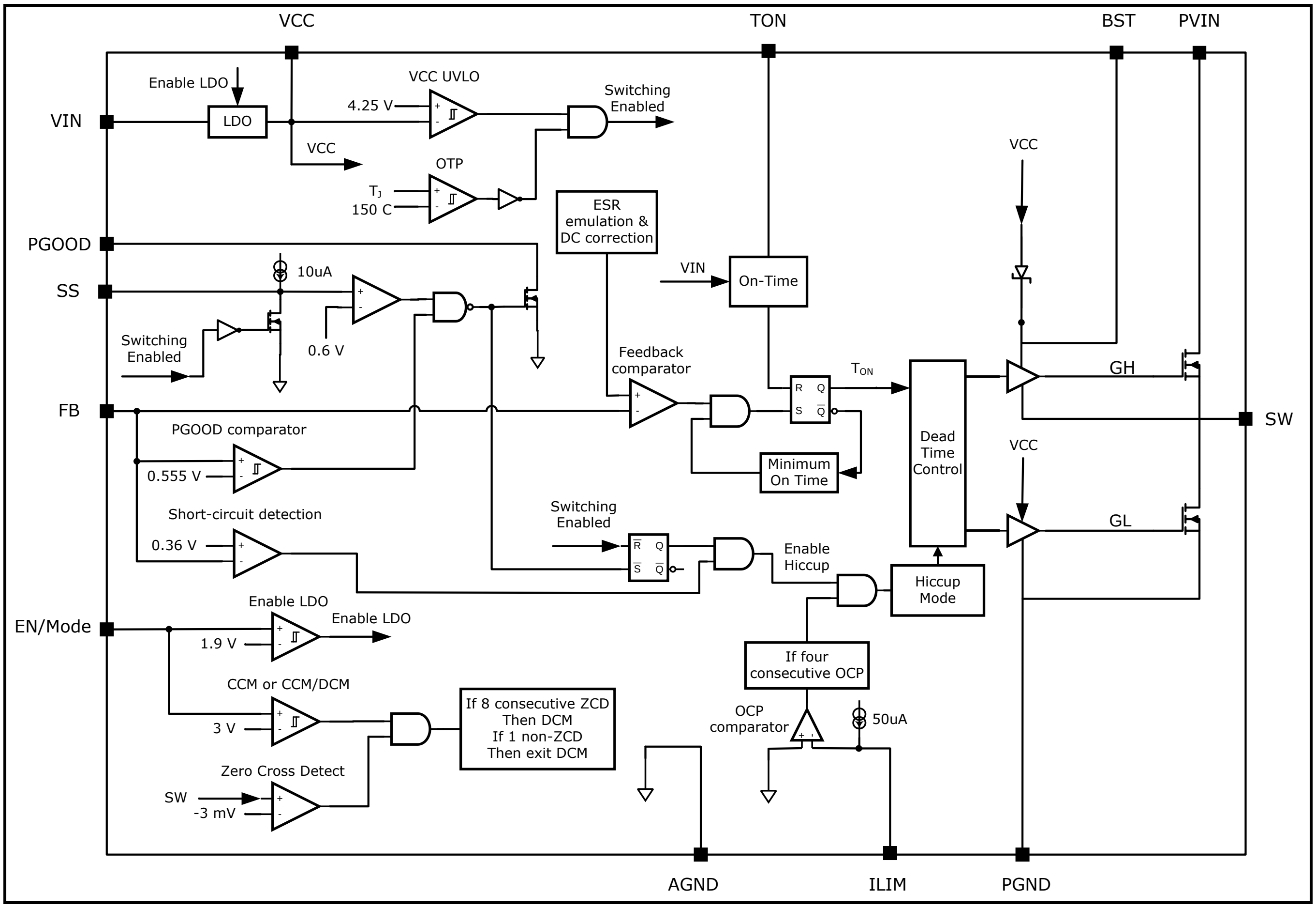



Figure 3: XR76108/12 Block Diagram

## Pin Assignment

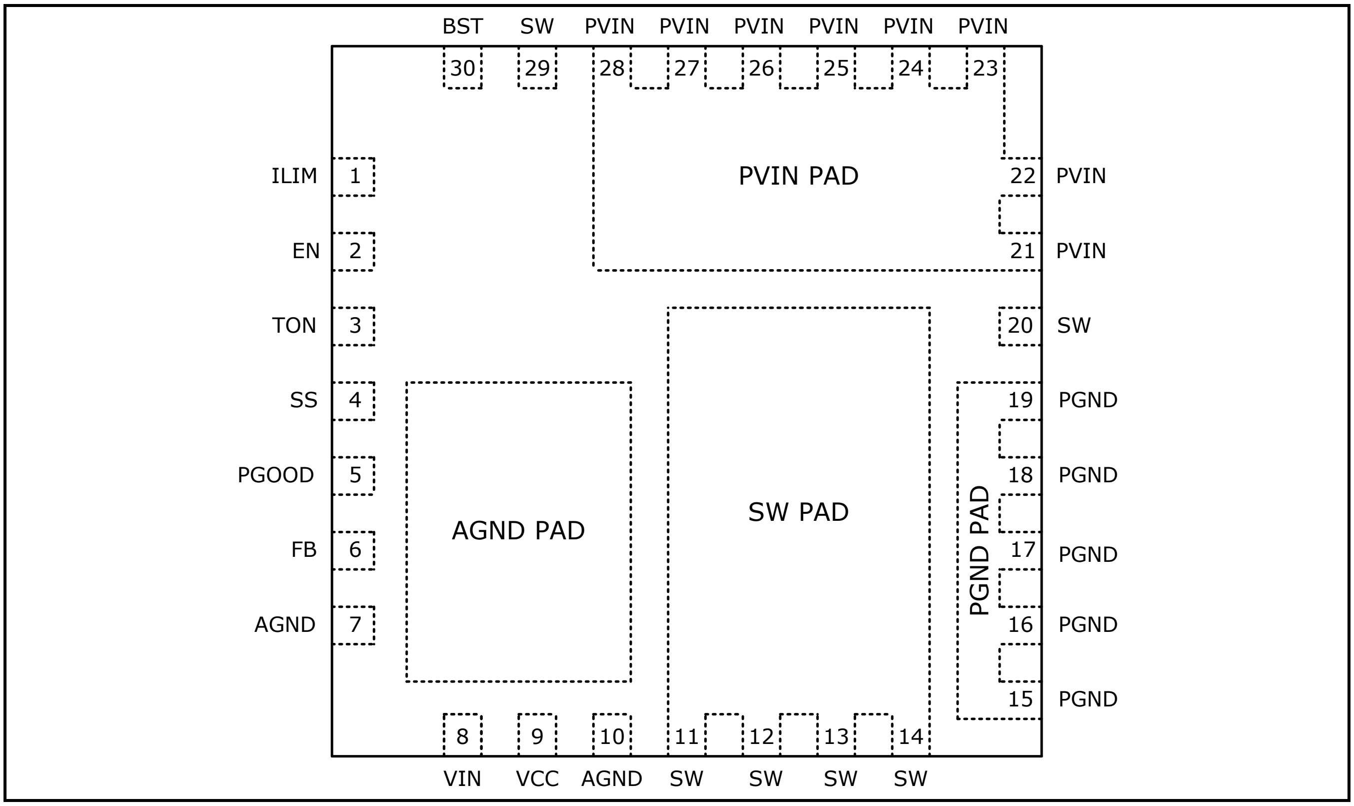



Figure 4: XR76108/12 Pin Assignment

## Pin Description

| Name | Pin Number | Description |
|---|---|---|
| ILIM | 1 | Over-current protection programming. Connect with a resistor to SW. |
| EN/MODE | 2 | 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. |
| TON | 3 | Constant on-time programming pin. Connect with a resistor to AGND. |
| SS | 4 | Soft-Start pin. Connect an external capacitor between SS and AGND to program the soft-start rate based on the 10uA internal source current. |
| PGOOD | 5 | Power-good output. This open-drain output is pulled low when $V_{OUT}$ is outside the regulation. |
| FB | 6 | Feedback input to feedback comparator. Connect with a set of resistors to VOUT and AGND in order to program $V_{OUT}$. |
| AGND | 7, 10, AGND Pad | Signal ground for control circuitry. Connect AGND Pad with a short trace to pins 7 and 10. |
| VIN | 8 | Supply input for the regulator's LDO. Normally it is connected to PVIN. |
| VCC | 9 | The output of regulator's LDO. For operation using a 5V rail, VCC should be shorted to VIN. |
| SW | 11-14, 20, 29, SW Pad | Switch node. Drain of the low-side N-channel MOSFET. Source of the high-side MOSFET is wire-bonded to the SW Pad. |
| PGND | 15-19, PGND Pad | 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. |
| PVIN | 21-28, PVIN Pad | Input voltage for power stage. Drain of the high-side N-channel MOSFET. |
| BST | 30 | High-side driver supply pin. Connect a 0.1uF bootstrap capacitor between BST and SW. |

## Typical Performance Characteristics

All data taken at $V_{IN}$=12V, $V_{OUT}$=1.2V, f=600kHz, $T_A$=25°C, No Air flow, Forced CCM, unless otherwise specified. Schematic and BOM from Applications Circuit section of this datasheet.

### REGULATION

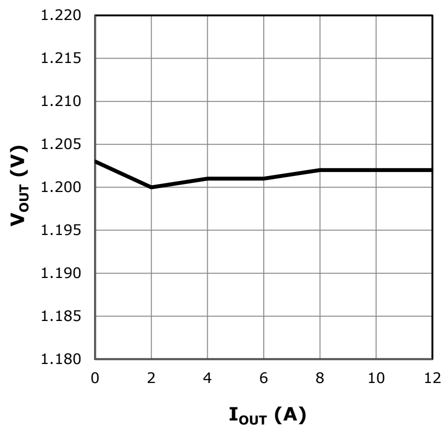



Figure 5: XR76112 Load regulation, $V_{IN}$=12V

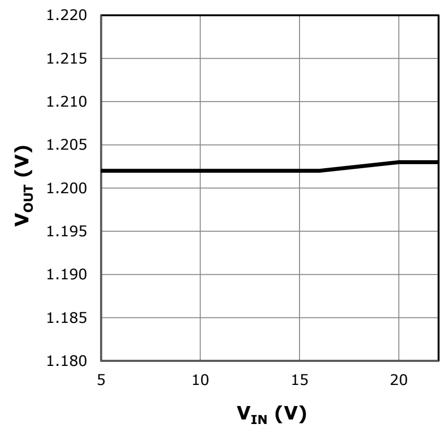



Figure 6: XR76112 Line regulation, $I_{OUT}$=12A

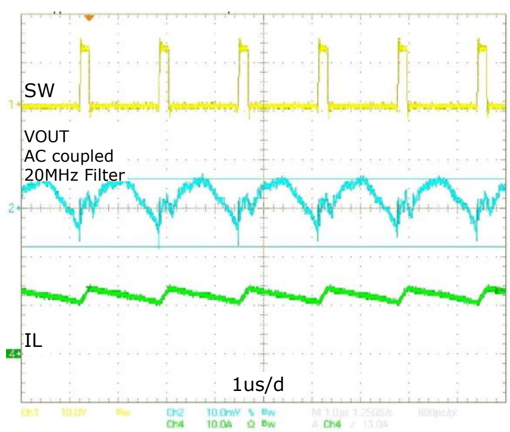



Figure 7: XR76112 $V_{OUT}$ ripple is 14mV at 12A

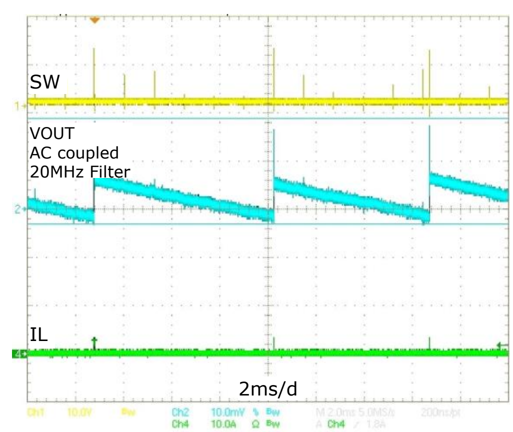



Figure 8: XR76112 $V_{OUT}$ ripple is 22mV at 0A, DCM

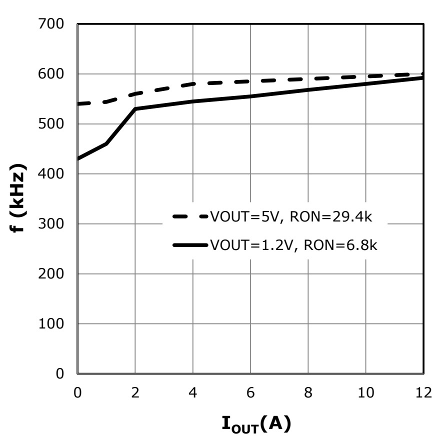



Figure 9: XR76112 Frequency vs. $I_{OUT}$, Forced CCM

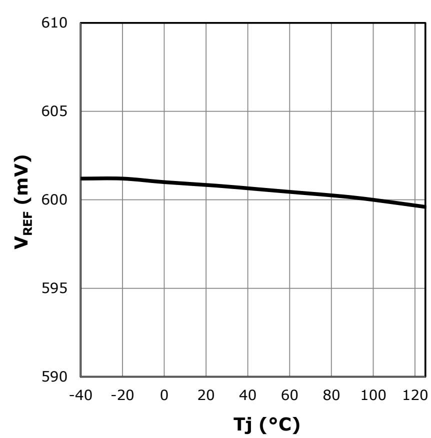



Figure 10: $V_{REF}$ vs. temperature

## Typical Performance Characteristics

All data taken at $V_{IN}$=12V, $V_{OUT}$=1.2V, f=600kHz, $T_A$=25°C, No Air flow, Forced CCM, unless otherwise specified. Schematic and BOM from Applications Circuit section of this datasheet.

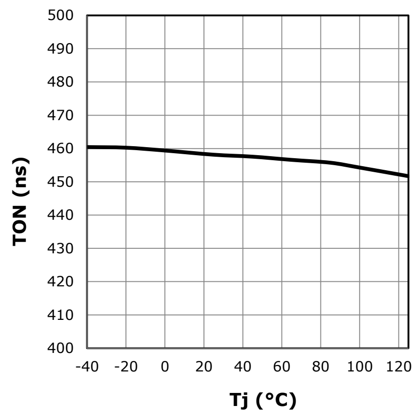



Figure 11: On-Time vs. temperature

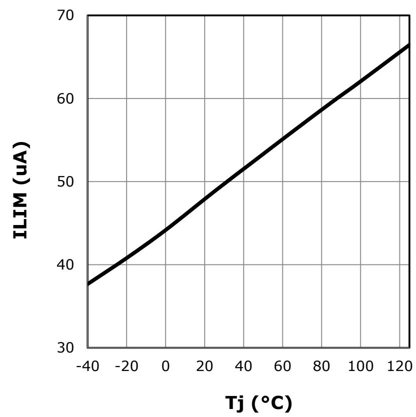



Figure 12: $I_{LIM}$ vs. temperature

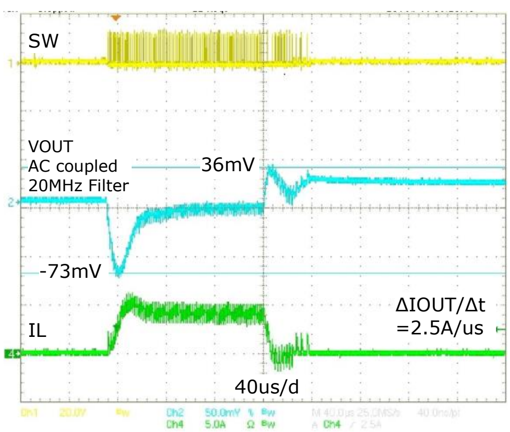



Figure 13: XR76108 load step, DCM/CCM, 0A-4A-0A

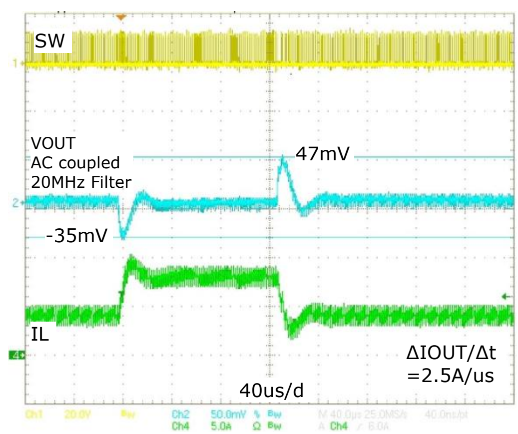



Figure 14: XR76108 load step, Forced CCM, 4A-8-4A

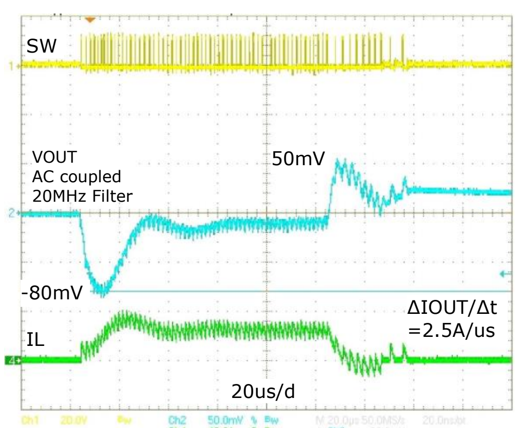



Figure 15: XR76112 load step, DCM/CCM, 0A-6A-0A

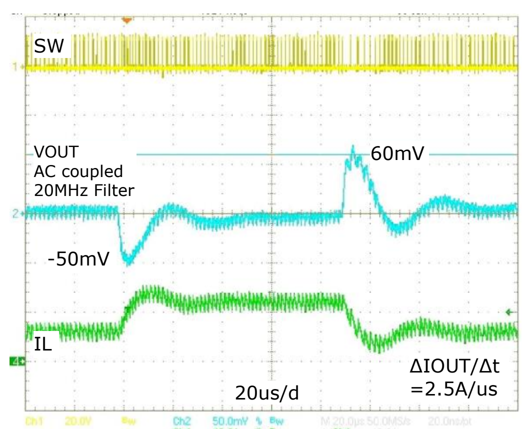



Figure 16: XR76112 load step, Forced CCM, 6A-12A-6A

## Powerup

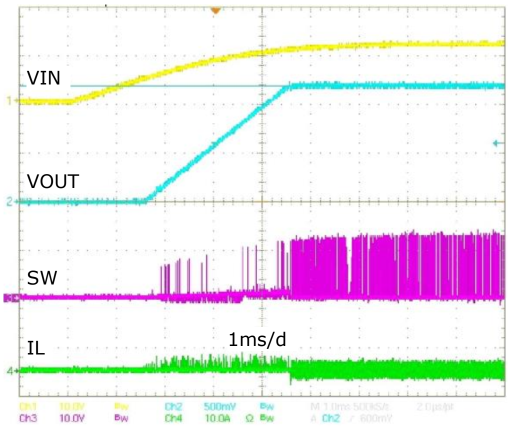



Figure 17: XR76112 Powerup, Forced CCM, $I_{OUT}$=0A

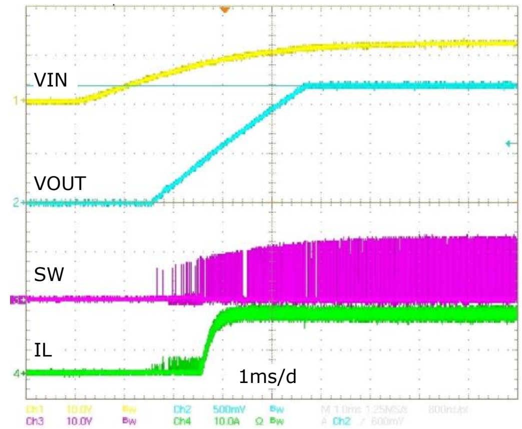



Figure 18: XR76112 Powerup, Forced CCM, $I_{OUT}$=12A

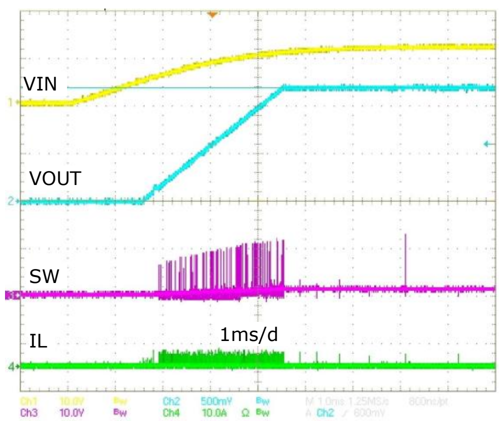



Figure 19: XR76112 Powerup, DCM/CCM, $I_{OUT}$=0A

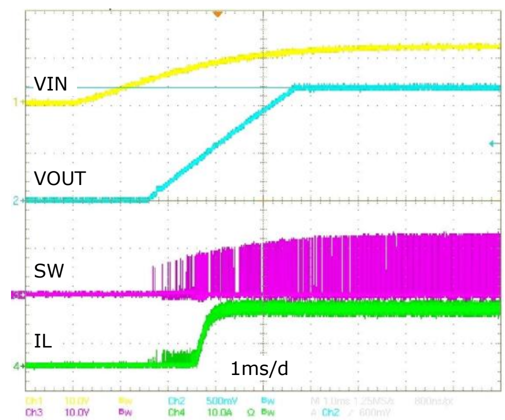



Figure 20: XR76112 Powerup, DCM/CCM, $I_{OUT}$=12A

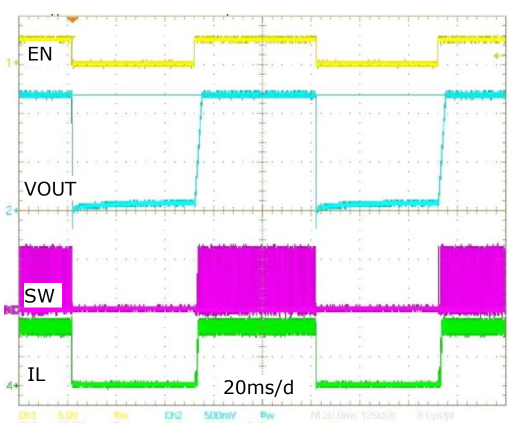



Figure 21: XR76112 Enable turn on/turn off, 1.2$V_{OUT}$, 12A

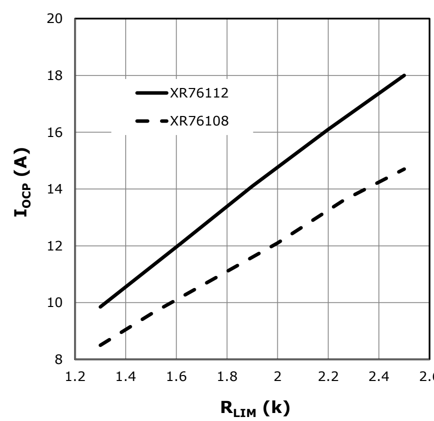



Figure 22: Typical $I_{OCP}$ versus $R_{LIM}$

## Efficiency – XR76108/ XR76112

$T_{AMBIENT}$=25°C, No Air flow, Inductor losses are included.

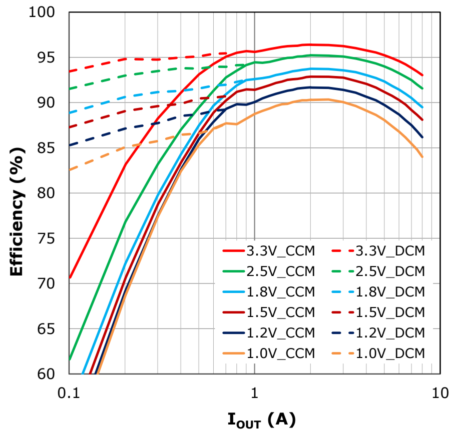



Figure 23: XR76108, 5$V_{IN}$, 600kHz, 1uH

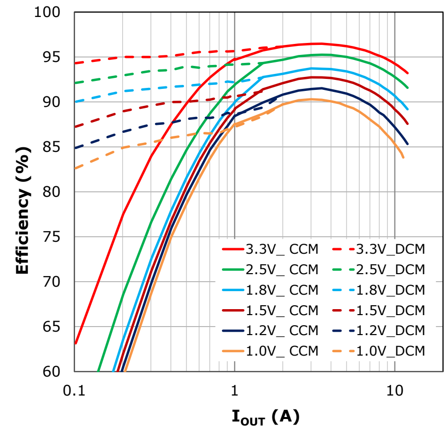



Figure 24: XR76112, 5$V_{IN}$, 600kHz, 0.56uH

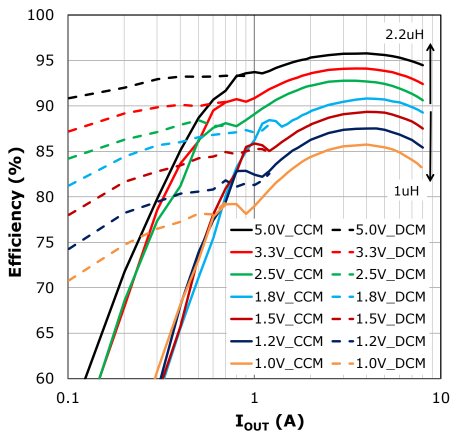



Figure 25: XR76108, 12$V_{IN}$, 600kHz

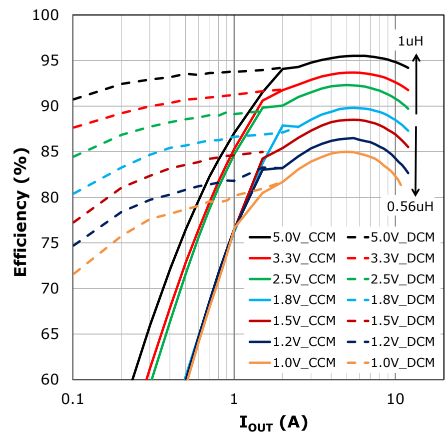



Figure 26: XR76112, 12$V_{IN}$, 600kHz

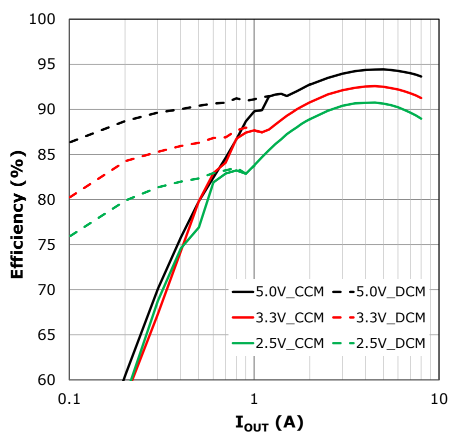



Figure 27: XR76108, 22$V_{IN}$, 400kHz, 3.3uH

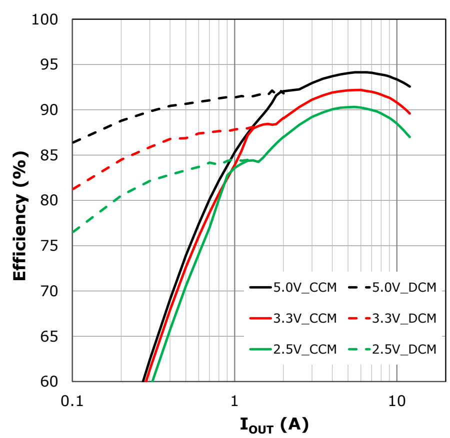



Figure 28: XR76112, 22$V_{IN}$, 400kHz, 2.2uH

## Thermal Characteristics

No Air flow, f=600kHz

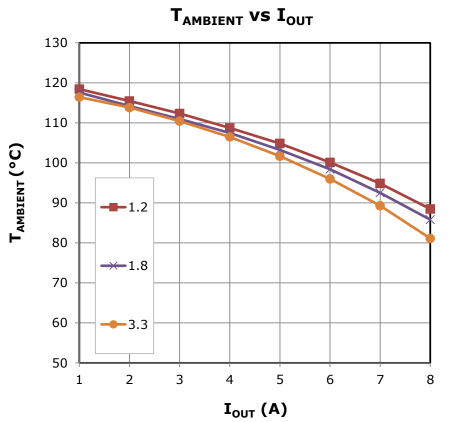



Figure 29: XR76108 Package Thermal Derating, 12VIN

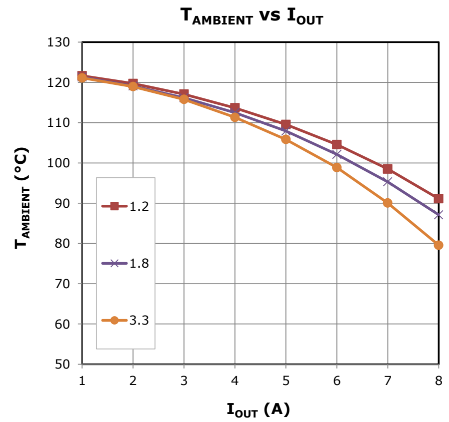



Figure 30: XR76108 Package Thermal Derating, 5VIN

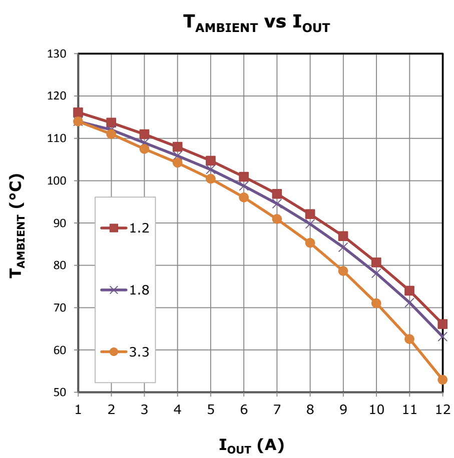



Figure 31: XR76112 Package Thermal Derating, $12V_{IN}$

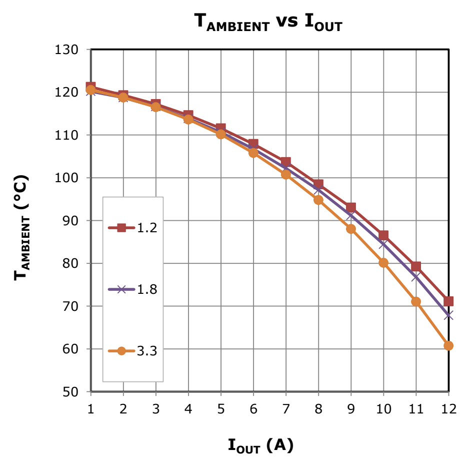



Figure 32: XR76112 Package Thermal Derating, $5V_{IN}$

## Detailed Operation

The XR76108/12 uses a synchronous step-down proprietary emulated current-mode Constant On-Time (COT) control scheme. The on-time, which is programmed via $R_{ON}$, is inversely proportional to $V_{IN}$ and maintains a nearly constant frequency. The emulated current-mode control allows the use of ceramic output capacitors.

Each switching cycle begins with the high-side (switching) FET turning on for a preprogrammed time. At the end of the on-time, the high-side FET is turned off and the low-side (synchronous) FET is turned on for a preset minimum time (250ns nominal). This parameter is termed the Minimum Off-Time. After the minimum off-time the voltage at the feedback pin FB is compared to an internal voltage ramp at the feedback comparator. When VFB drops below the ramp voltage, the high-side FET is turned on and the cycle repeats. This voltage ramp constitutes an emulated current ramp and allows for the use of ceramic capacitors, in addition to other capacitor types, for output filtering.

## Enable/Mode

The EN/MODE pin accepts a tri-level signal that is used to control channel turn-on and turn-off. It also selects between two modes of operation: 'Forced CCM' and 'DCM/CCM'. If EN is pulled below 1.9V the regulator shuts down. A voltage between 1.9V and 3V selects the Forced CCM mode, which will run the converter in continuous conduction for all load currents. A voltage higher than 3V selects the DCM/CCM mode, which will run the converter in discontinuous conduction mode at light loads. DCM/CCM, which is based on diode emulation, is described below.

## Diode Emulation Mode (DCM/CCM)

Diode Emulation Mode is designed to increase the converter efficiency at light loads. Light-load efficiency is increased by preventing negative inductor current. This is achieved by monitoring the inductor current valley (bottom) via SW and turning off the synchronous FET as inductor current $I_L$ approaches zero. $I_L$ is monitored indirectly by monitoring $V_{SW}$ during the synchronous FET conduction period (i.e., $V_{SW}=I_L \times R_{DSON}$). If $V_{SW}$ does not drop to -2mV the converter operates in continuous conduction mode as shown in Figure 33. If $V_{SW}$ equals -2mV then a zero-crossing is detected (Figure 34). Eight consecutive zero-crossings activate the diode emulation mode. Then, on every subsequent switching cycle, GL is turned off when $V_{SW}$ reaches -2mV (Figure 35). If $I_{OUT}$ decreases further, discontinuous conduction ensues (Figure 36). The constant on-time delivers a fixed energy at the start of each switching cycle. The synchronous FET is turned off when $V_{SW}$ drops to -2mV. Any remaining inductor energy is discharged through the FET's body diode. Now, because $I_{OUT}$ is low, it takes longer for $V_{OUT}$ to drop below regulation and trigger a new switching cycle. Hence switching frequency f decreases. This increases the efficiency at light loads.

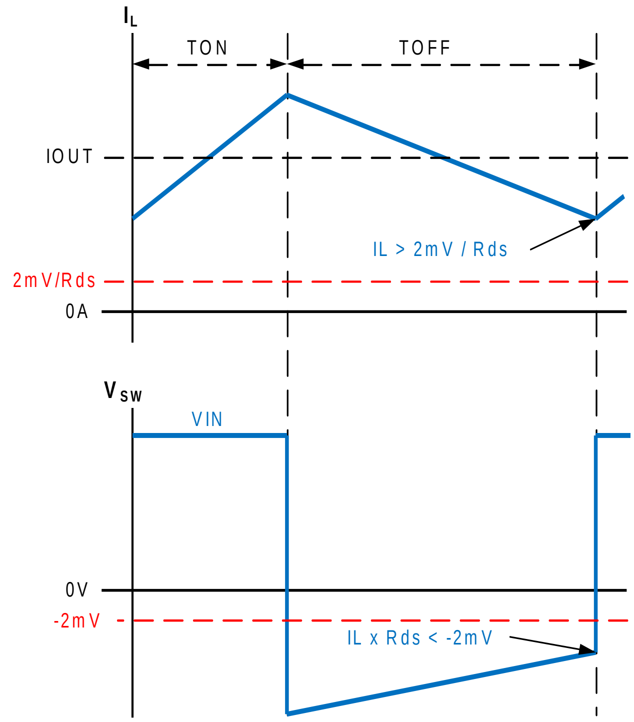



Figure 33: Continuous conduction during diode emulation

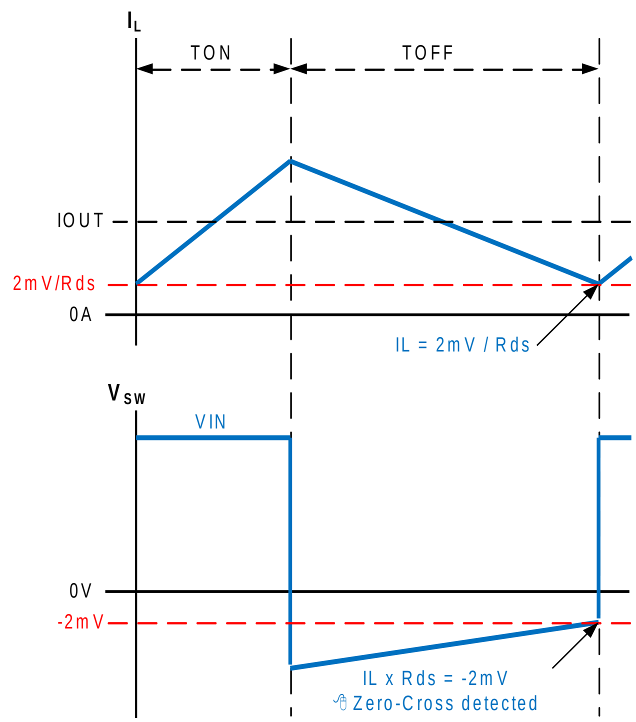



Figure 34: Zero-Crossing detection

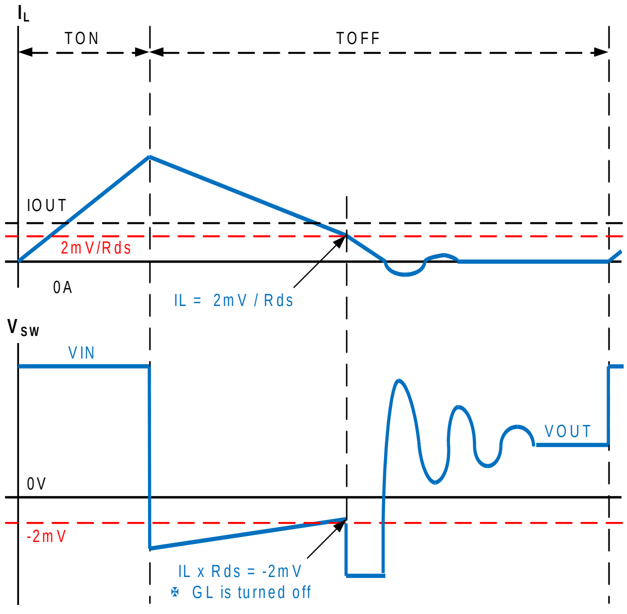



Figure 35: Discontinuous conduction during diode emulation

## Programming the On-Time

The on-time $T_{ON}$ is programmed via resistor $R_{ON}$ according to following equation:

$$T_{ON} = \frac{(3.4 \times 10^{-10}) \times R_{ON}}{V_{IN}}$$

The required $T_{ON}$ for a given application is calculated from:

$$T_{ON} = \frac{V_{OUT}}{V_{IN} \times f}$$

Therefore, $R_{ON}$ can be selected based on the output voltage and desired switching frequency as follows:

$$R_{ON} = \frac{V_{OUT}}{(3.4 \times 10^{-10}) \times f}$$

Note that switching frequency f will increase somewhat, as a function of increasing load current and increasing losses (see Figure 9).

Figure 36 suggests resistance values for common output voltages and switching frequencies.

| $V_{OUT}$ [V] | $R_{ON}$ [Ω] at 300kHz | $R_{ON}$ [Ω] at 400kHz | $R_{ON}$ [Ω] at 500kHz | $R_{ON}$ [Ω] at 600kHz | $R_{ON}$ [Ω] at 800kHz |
|---|---|---|---|---|---|
| **3.3** | 32,353 | 24,265 | 19,412 | 16,176 | 12,132 |
| **2.5** | 24,510 | 18,382 | 14,706 | 12,255 | 9,191 |
| **1.8** | 17,647 | 13,235 | 10,588 | 8,824 | 6,618 |
| **1.5** | 14,706 | 11,029 | 8,824 | 7,353 | 5,515 |
| **1.2** | 11,765 | 8,824 | 7,059 | 5,882 | 4,412 |
| **1.0** | 9,804 | 7,353 | 5,882 | 4,902 | 3,676 |

Figure 36: $R_{ON}$ resistances for common output voltages and frequencies

## Over-Current Protection (OCP)

If the load current exceeds the programmed over-current $I_{OCP}$ for four consecutive switching cycles, then the regulator enters the hiccup mode of operation. In hiccup mode the MOSFET gates are turned off for 110ms (hiccup timeout). Following the hiccup timeout a soft-start is attempted. If OCP persists, hiccup timeout will repeat. The regulator will remain in hiccup mode until load current is reduced below the programmed $I_{OCP}$. In order to program over-current protection use the following equation:

$$R_{ILIM} = \frac{(I_{OCP} \times R_{DSON}) + 8mV}{I_{LIM}}$$

where:

$R_{LIM}$ is resistor value for programming $I_{OCP}$

$I_{OCP}$ is the over-current value to be programmed

$R_{DSON}$=10mΩ(XR76108)

$R_{DSON}$=9mΩ(XR76112)

8mV is the OCP comparator offset

$I_{LIM}$ is the internal current that generates the necessary OCP comparator threshold (use 45µA)

Note that $I_{LIM}$ has a positive temperature coefficient of 0.4%/°C. This is meant to roughly match and compensate for positive temperature coefficient of the synchronous FET.

The above equation is for worst-case analysis and safeguards against premature OCP. Actual value of $I_{OCP}$, for a given $R_{LIM}$, will be higher than that predicted by the above equation. Typical $I_{OCP}$ versus $R_{LIM}$ is shown in Figure 22.

## Short-Circuit Protection (SCP)

If the output voltage drops below 60% of its programmed value, the regulator will enter hiccup mode. Hiccup mode will persist until the short-circuit is removed. The SCP circuit becomes active after PGOOD asserts high.

## Over-Temperature Protection (OTP)

OTP triggers at a nominal controller temperature of 150°C. The gates of the switching FET and the synchronous FET are turned off. When die temperature cools down to 135°C, soft-start is initiated and operation resumes.

## Programming the Output Voltage

Use an external voltage divider as shown in Figure 1 to program the output voltage $V_{OUT}$.

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

The recommended value for R2 is 2kΩ.

## Programming the Softstart

Place a capacitor $C_{SS}$ between the SS and GND pins to program the soft-start. In order to program a soft-start time of $T_{SS}$, calculate the required capacitance $C_{SS}$ from the following equation:

$$C_{SS} = T_{SS} \times \frac{10uA}{0.6V}$$

## Feed-Forward Capacitor CFF

A feed-forward capacitor $C_{FF}$ is required. $C_{FF}$ provides a low-impedance/high-frequency path for the output voltage ripple to be transmitted to FB. It also results in improved load transient response. Calculate $C_{FF}$ from:

$$C_{FF} = \frac{L \times Istep}{\frac{V_{OUT}}{V_{IN}} \times (V_{IN} - V_{OUT}) \times R1}$$

Where $I_{step}$ is load step

If necessary the value of $C_{FF}$ may be adjusted in order to yield a critically damped transient load response.

## Feed-Forward Resistor RFF

In order to prevent switching noise from coupling to the feedback pin, it may be necessary to place a resistor $R_{FF}$ in series with $C_{FF}$. Calculate RFF from:

$$R_{FF} = \frac{10ns}{C_{FF}}$$

In the case of XR76108 $R_{FF}$ is not necessary.

## Thermal Design

Proper thermal design is critical in controlling device temperatures and in achieving robust designs. There are a number of factors that affect the thermal performance. One key factor is the temperature rise of the devices in the package, which is a function of the thermal resistances of the devices inside the package and the power being dissipated.

The thermal resistances of the XR76108/12 are specified in the “Operating Ratings” section of this datasheet. The JEDEC θJA thermal resistance provided is based on tests that comply with the JESD51-2A “Integrated Circuit Thermal Test Method Environmental Conditions – Natural Convection” standard. JESD51-xx are a group of standards whose intent is to provide comparative data based on a standard test condition which includes a defined board construction. Since the actual board design in the final application will be different from the board defined in the standard, the thermal resistances in the final design may be different from those shown.

The package thermal derating curves for the XR76108 are shown in Figures 29 and 30. These correspond to input voltage of 12V and 5V respectively. The package thermal derating curves for the XR76112 are shown in Figures 31 and 32.

## Applications Circuit

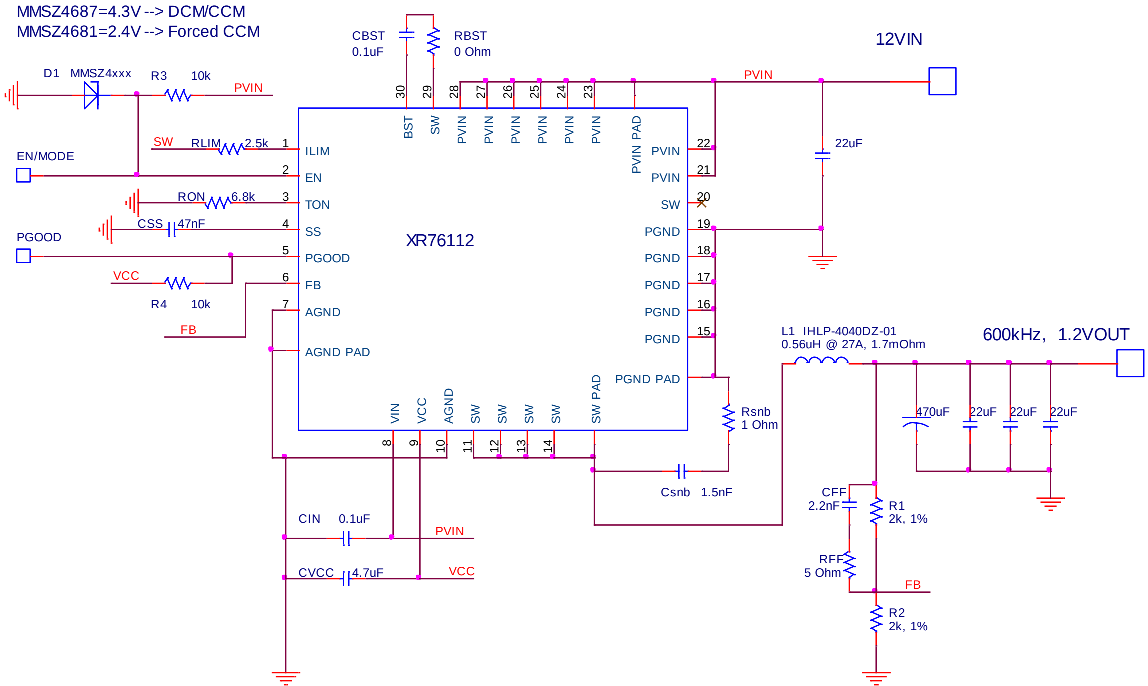



Figure 37: XR76112 Application circuit schematic

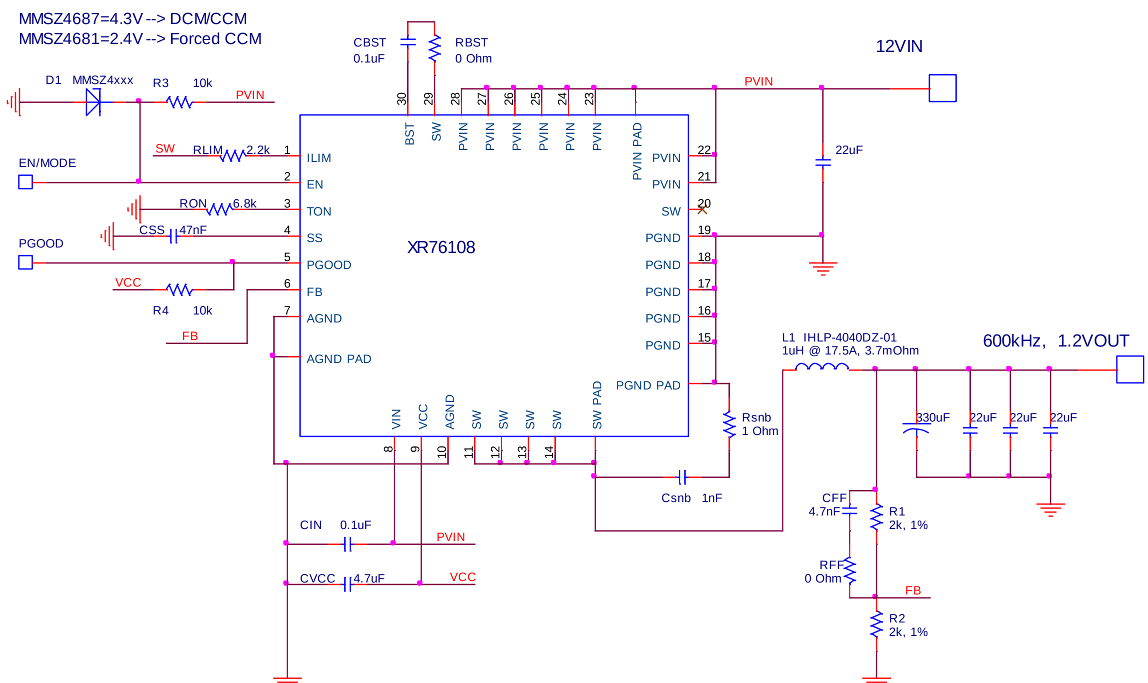
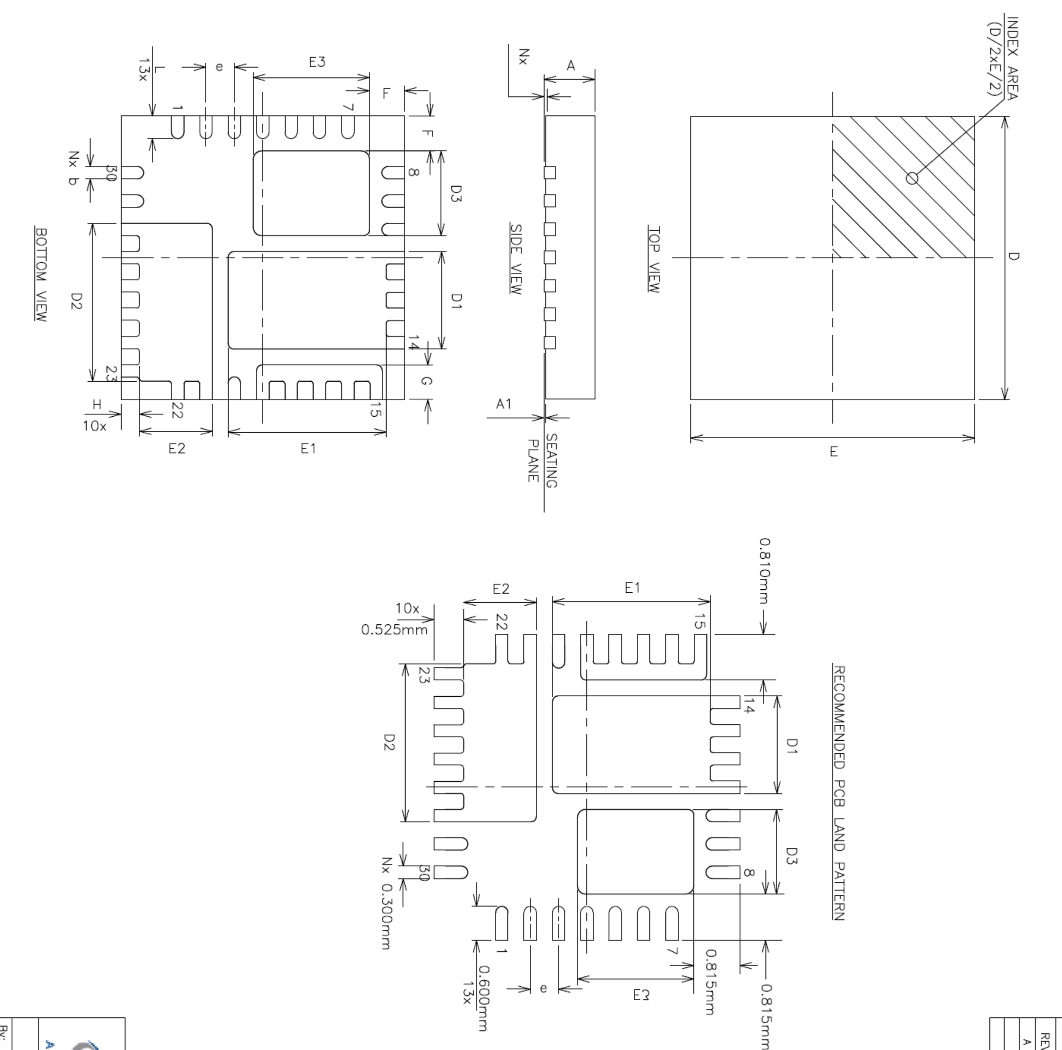



Figure 37: XR76108 Application circuit schematic

## Package Specification




| REVISION HISTORY | | | |
|---|---|---|---|
| REV | DISCRIPTION | DATE | APP'D |
| A | DRAWING ORIGINATION | 11/6/13 | AD |

| 30LD 5x5mm QFN 0.50 PITCH | | | | | | |
|---|---|---|---|---|---|---|
| SYMBOLS | DIMENSIONS IN MM (Control Unit) | | | DIMENSIONS IN INCH (Reference Unit) | | |
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 0.800 | 0.900 | 1.000 | 0.031 | 0.035 | 0.039 |
| A1 | 0.000 | 0.020 | 0.050 | 0.000 | 0.001 | 0.002 |
| b | 0.180 | 0.250 | 0.300 | 0.007 | 0.010 | 0.012 |
| D | 5.000 BSC | | | 0.200 BSC | | |
| E | 5.000 BSC | | | 0.200 BSC | | |
| e | 0.500 BSC | | | 0.020 BSC | | |
| F | 0.615 REF | | | 0.024 REF | | |
| G | 0.610 REF | | | 0.024 REF | | |
| H | 0.325 REF | | | 0.013 REF | | |
| D1 | 1.570 | 1.720 | 1.820 | 0.062 | 0.068 | 0.072 |
| E1 | 2.635 | 2.785 | 2.885 | 0.104 | 0.110 | 0.113 |
| D2 | 2.635 | 2.785 | 2.885 | 0.104 | 0.110 | 0.113 |
| E2 | 1.135 | 1.285 | 1.385 | 0.045 | 0.050 | 0.054 |
| D3 | 1.345 | 1.495 | 1.595 | 0.053 | 0.059 | 0.063 |
| E3 | 1.903 | 2.053 | 2.153 | 0.075 | 0.081 | 0.085 |
| L | 0.300 | 0.400 | 0.500 | 0.012 | 0.016 | 0.020 |
| N | 30 | | | 30 | | |

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30LD 5x5mm QFN PACKAGE OUTLINE

| | | | |
|---|---|---|---|
| Packaging Approval: | | Drawing No: | POD-00000018 |
| By: AD | Date: 11/12/13 | Revision: A | Sheet: 1 OF 1 |

## Revision History

| Revision | Date | Description |
|---|---|---|
| 1A | March 2014 | Initial release: ECN 1413-13 03-26-14 |
| | | |
| | | |

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**Exar Technical Documentation:** http://www.exar.com/TechDoc/

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