# XR76203 / XR76205 / XR76208

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

## 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 wide 5V 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.

### FEATURES

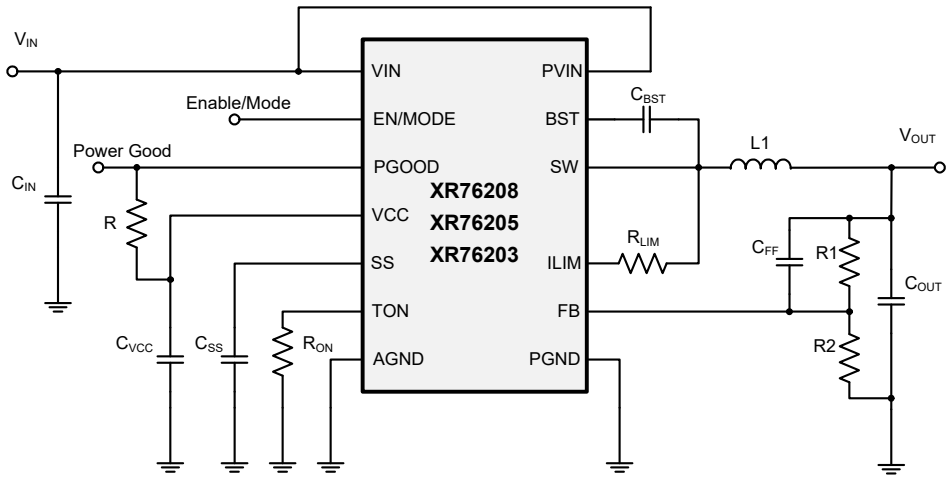
- Controller, drivers, bootstrap diode and MOSFETs integrated in one package
- 3A, 5A and 8A Step Down Regulators
  - Wide 5V to 40V Input Voltage Range
  - ≥0.6V Adjustable Output Voltage
- Proprietary Constant On-Time Control
  - No Loop Compensation Required
  - Stable Ceramic Output Capacitor Operation
  - Programmable 200ns to 2µs On-Time
  - Constant 100kHz to 800kHz Frequency
- Selectable CCM or CCM/DCM
  - CCM/DCM for high efficiency at light-load
  - CCM for constant frequency at light-load
- Programmable Hiccup Current Limit with Thermal Compensation
- Precision Enable and Power Good flag
- Programmable Soft-start
- 30-pin 5x5mm QFN package

### APPLICATIONS

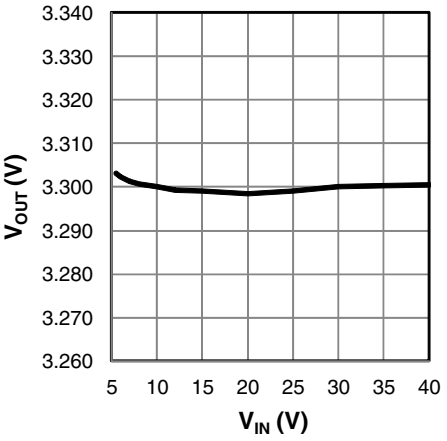
- Distributed Power Architecture
- Point-of-Load Converters
- Power Supply Modules
- FPGA, DSP, and Processor Supplies
- Base Stations, Switches/Routers, and Servers

Ordering Information – back page

## Typical Application




Line Regulation



## Absolute Maximum Ratings

Stresses beyond the limits listed below 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 43V

$V_{CC}$.....-0.3V to 6.0V

BST.....-0.3V to 48V(1)

BST-SW.....-0.3V to 6V

SW, ILIM.....-1V to 43V(1, 2)

ALL other pins.....-0.3V to VCC+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 Conditions

$PV_{IN}$.....5V to 40V

$V_{IN}$.....5V to 40V

SW, ILIM.....-1V to 40V(1)

PGOOD, $V_{CC}$, $T_{ON}$, SS, EN, FB.....-0.3V to 5.5V

Switching Frequency.....100kHz to 800kHz(3)

Junction Temperature Range.....-40°C to +125°C

XR76203 JEDEC51 Package Thermal Resistance, $\theta_{JA}$.....28°C/W

XR76205 JEDEC51 Package Thermal Resistance, $\theta_{JA}$.....26°C/W

XR76208 JEDEC51 Package Thermal Resistance, $\theta_{JA}$.....25°C/W

XR76203 Package Power Dissipation at 25°C.....3.6W

XR76205 Package Power Dissipation at 25°C.....3.8W

XR76208 Package Power Dissipation at 25°C.....4.0W

Note 1: No external voltage applied.

Note 2: SW pin's minimum DC range is -1V, transient is -5V for less than 50ns.

Note 3: Recommended frequency

## Electrical Characteristics

Unless otherwise noted: $T_J$= 25°C, $V_{IN}$=24V, BST=$V_{CC}$, SW=AGND=PGND=0V, $C_{VCC}$=4.7uF. Limits applying over the full operating temperature range are denoted by a "•"

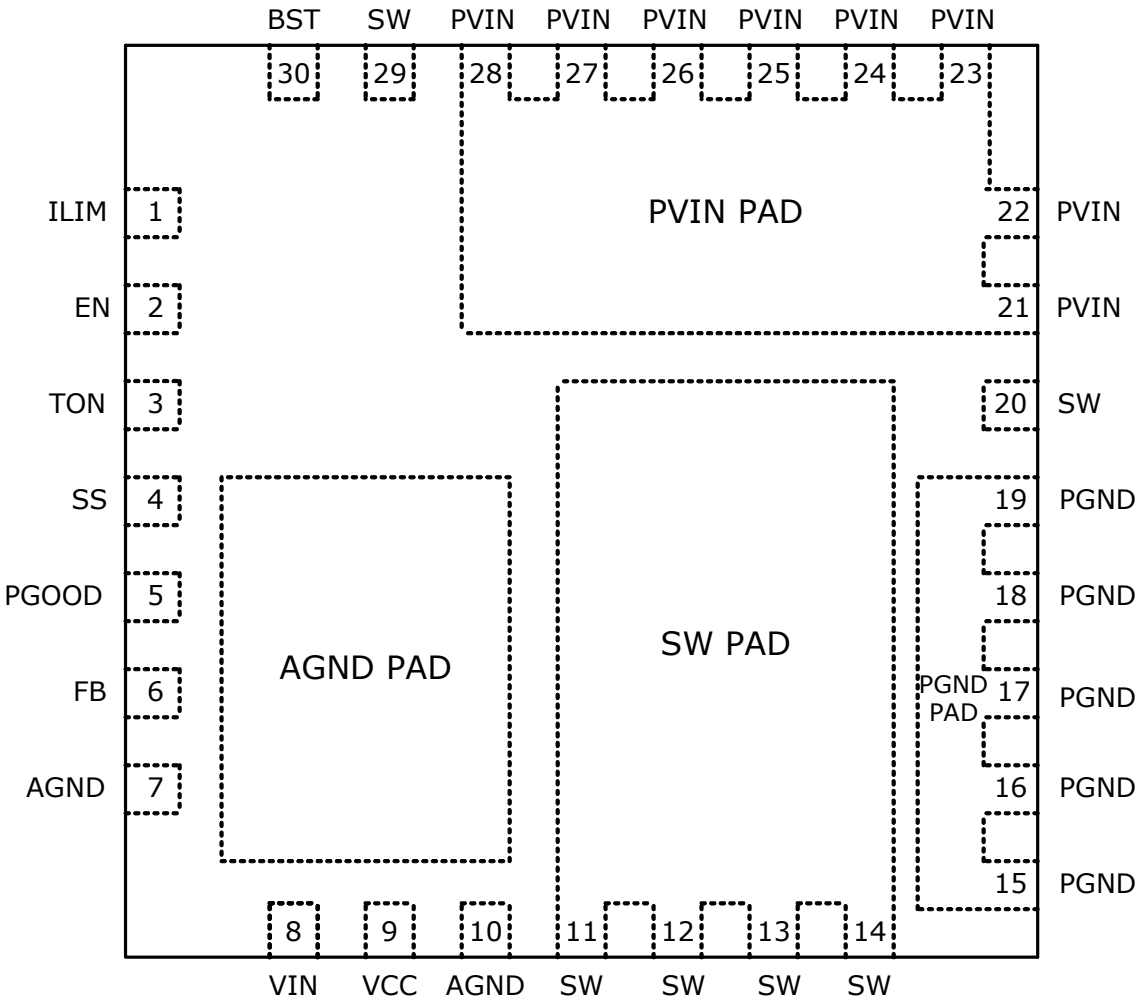
| Symbol | Parameter | Conditions | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| Power Supply Characteristics | | | | | | | |
| $V_{IN}$ | Input Voltage Range | VCC regulating | • | 5.5 | | 40 | V |
| $I_{VIN}$ | VIN Input Supply Current | Not switching, $V_{IN}$ = 24V, $V_{FB}$ = 0.7V | • | | 0.7 | 2 | mA |
| $I_{VIN}$ | VIN Input Supply Current (XR76203) | f=300kHz, $R_{ON}$=215k, VFB=0.58V | | | 12 | | mA |
| $I_{VIN}$ | VIN Input Supply Current (XR76205) | f=300kHz, $R_{ON}$=215k, VFB=0.58V | | | 15 | | mA |
| $I_{VIN}$ | VIN Input Supply Current (XR76208) | f=300kHz, $R_{ON}$=215k, VFB=0.58V | | | 19 | | mA |
| $I_{OFF}$ | Shutdown Current | Enable = 0V, $V_{IN}$ = 12V | | | 1 | | µA |
| Enable and Under-Voltage Lock-Out UVLO | | | | | | | |
| $V_{IH_EN_1}$ | EN Pin Rising Threshold | | • | 1.8 | 1.9 | 2.0 | V |
| $V_{EN_H_1}$ | EN Pin Hysteresis | | | | 70 | | mV |
| $V_{IH_EN_2}$ | EN Pin Rising Threshold for DCM/ CCM operation | | • | 2.8 | 3.0 | 3.1 | V |
| $V_{EN_H_2}$ | EN Pin Hysteresis | | | | 100 | | mV |

| Symbol | Parameter | Conditions | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| | VCC UVLO Start Threshold, Rising Edge | | • | 4.00 | 4.25 | 4.40 | V |
| | VCC UVLO Hysteresis | | | | 230 | | mV |
| Reference Voltage | | | | | | | |
| $V_{REF}$ | Reference Voltage | $V_{IN}$ = 5.5V to 40V, VCC regulating | | 0.596 | 0.600 | 0.604 | V |
| | | $V_{IN}$ = 5.5V to 40V, VCC regulating | • | 0.594 | 0.600 | 0.606 | V |
| | DC Line Regulation | CCM, closed loop, $V_{IN}$=5.5V-40V, applies to any $C_{OUT}$ | | | ±0.33 | | % |
| | DC Load Regulation | CCM, closed loop, applies to any $C_{OUT}$ | | | ±0.39 | | % |
| Programmable Constant On-Time | | | | | | | |
| $T_{ON1}$ | On-Time 1 | $R_{ON}$ = 237k, $V_{IN}$ = 40V | • | 1570 | 1840 | 2120 | ns |
| | f Corresponding to On-Time 1 | $V_{OUT}$= 24V, $V_{IN}$ = 40V, $R_{ON}$ = 237k | • | 283 | 326 | 382 | kHz |
| $T_{ON(MIN)}$ | Minimum Programmable On-Time | $R_{ON}$ = 14k, $V_{IN}$ = 40V | | | 120 | | ns |
| $T_{ON2}$ | On-Time 2 | $R_{ON}$ = 14k, $V_{IN}$ = 24V | • | 174 | 205 | 236 | ns |
| $T_{ON3}$ | On-Time 3 | $R_{ON}$ = 35.7k, $V_{IN}$ = 24V | • | 407 | 479 | 550 | ns |
| | f Corresponding to On-Time 3 | $V_{OUT}$ = 3.3V, $V_{IN}$ = 24V, $R_{ON}$ = 35.7k | • | 250 | 287 | 338 | kHz |
| | f Corresponding to On-Time 3 | $V_{OUT}$ = 5.0V, $V_{IN}$ = 24V, $R_{ON}$ = 35.7k | • | 379 | 435 | 512 | kHz |
| | Minimum Off-Time | | • | | 250 | 350 | ns |
| Diode Emulation Mode | | | | | | | |
| | Zero Crossing Threshold | DC value measured during test | | | -2 | | mV |
| Soft-start | | | | | | | |
| | SS Charge Current | | • | -14 | -10 | -6 | µA |
| | SS Discharge Current | Fault present | • | 1 | | | mA |
| VCC Linear Regulator | | | | | | | |
| | VCC Output Voltage | $V_{IN}$ = 6V to 40V, $I_{LOAD}$ = 0 to 30mA | • | 4.8 | 5.0 | 5.2 | V |
| | | $V_{IN}$ = 5V, $I_{LOAD}$ = 0 to 20mA | • | 4.51 | 4.7 | | V |
| Power Good Output | | | | | | | |
| | Power Good Threshold | | | -10 | -6.9 | -5 | % |
| | Power Good Hysteresis | | | | 1.6 | 4 | % |
| | Power Good Sink Current | | | 1 | | | mA |
| Protection: OCP, OTP, Short-Circuit | | | | | | | |
| | Hiccup Timeout | | | | 110 | | ms |
| | ILIM Pin Source Current | | | 45 | 50 | 55 | µA |
| | ILIM Current Temperature Coefficient | | | | 0.4 | | %/°C |
| | OCP Comparator Offset | | • | -8 | 0 | +8 | mV |

| Symbol | Parameter | Conditions | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| | Current Limit Blanking | GL rising>1V | | | 100 | | ns |
| | Thermal Shutdown Threshold[1] | Rising temperature | | | 150 | | °C |
| | Thermal Hysteresis[1] | | | | 15 | | °C |
| | VSCTH Feedback Pin Short-Circuit Threshold | Percent of $V_{REF}$, short circuit is active after PGOOD is asserted | • | 50 | 60 | 70 | % |
| XRP76203 Output Power Stage | | | | | | | |
| $R_{DSON}$ | High-Side MOSFET $R_{DSON}$ | $I_{DS}$ = 1A | | | 115 | 160 | mΩ |
| | Low-Side MOSFET $R_{DSON}$ | | | | 40 | 59 | mΩ |
| $I_{OUT}$ | Maximum Output Current | | • | 3A | | | A |
| XRP76205 Output Power Stage | | | | | | | |
| $R_{DSON}$ | High-Side MOSFET $R_{DSON}$ | $I_{DS}$ = 2A | | | 42 | 59 | mΩ |
| | Low-Side MOSFET $R_{DSON}$ | | | | 40 | 59 | mΩ |
| $I_{OUT}$ | Maximum Output Current | | • | 5A | | | A |
| XRP76208 Output Power Stage | | | | | | | |
| $R_{DSON}$ | High-Side MOSFET $R_{DSON}$ | $I_{DS}$ = 2A | | | 42 | 59 | mΩ |
| | Low-Side MOSFET $R_{DSON}$ | | | | 16.2 | 21.5 | mΩ |
| $I_{OUT}$ | Maximum Output Current | | • | 8A | | | A |

Note 1: Guaranteed by design

## Pin Configuration, Top View

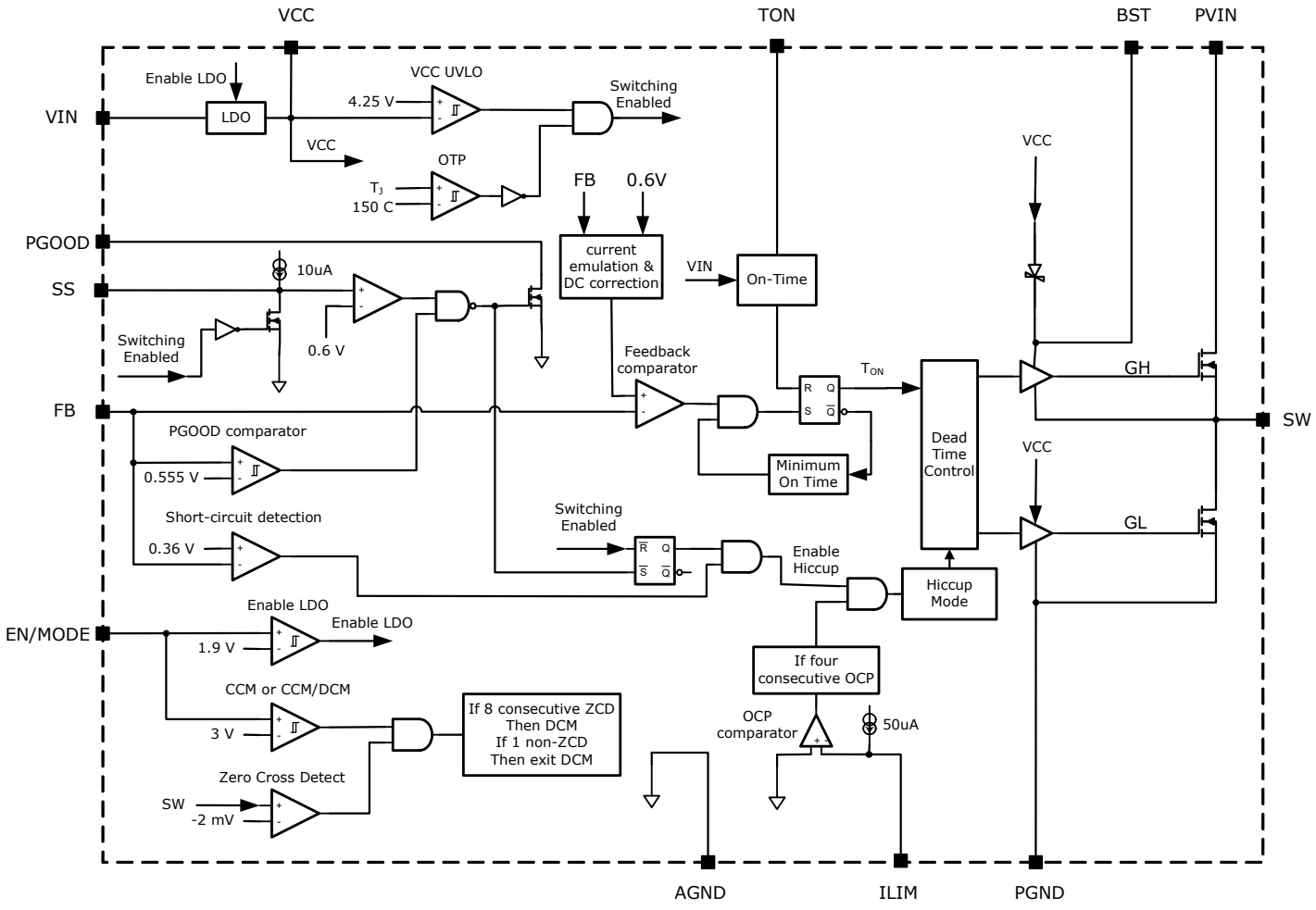


## Pin Assignments

| 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 VOUT 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

## Functional Block Diagram



## Typical Performance Characteristics

Unless otherwise noted: $V_{IN}$ = 24V, $V_{OUT}$=3.3V, $I_{OUT}$=8A, f=400kHz, $T_A$ = 25°C. Schematic from the application information section.

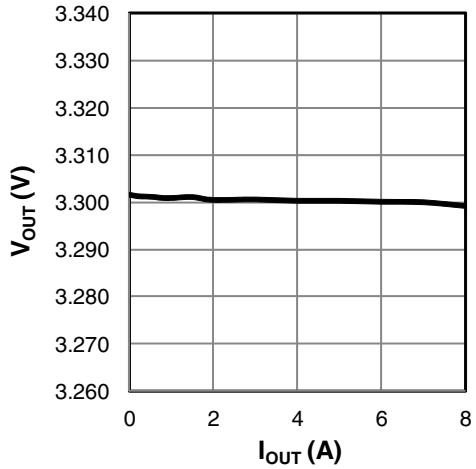



**Figure 1: Load Regulation**

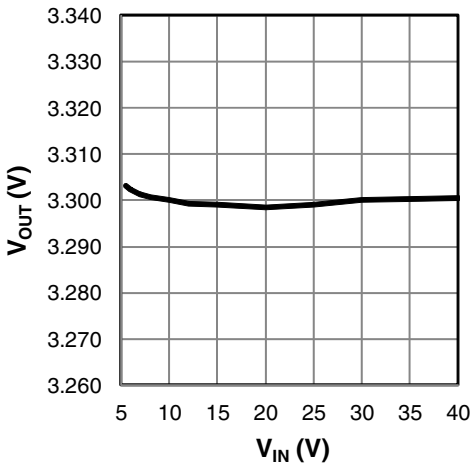



**Figure 2: Line regulation**

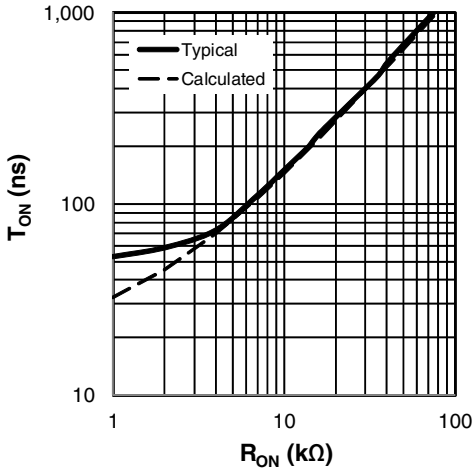



**Figure 3: $T_{ON}$ versus $R_{ON}$**

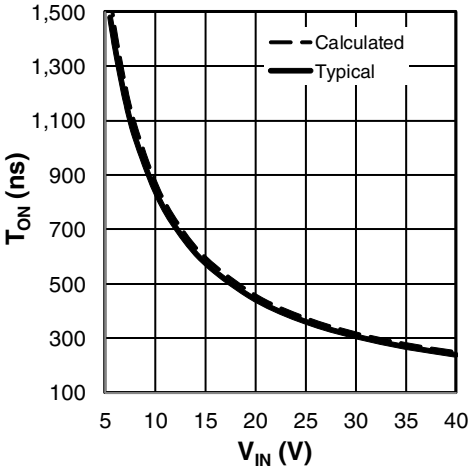



**Figure 4: $T_{ON}$ versus $V_{IN}$, $R_{ON}$=27.4k**

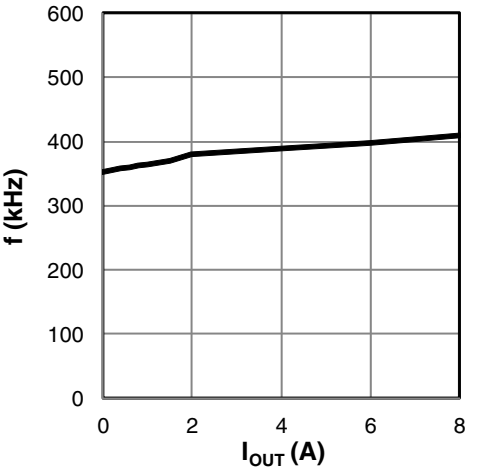



**Figure 5: frequency versus $I_{OUT}$**

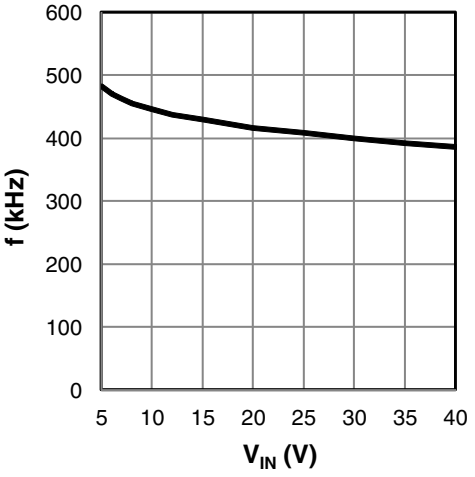



**Figure 6: frequency versus $V_{IN}$**

## Typical Performance Characteristics

Unless otherwise noted: $V_{IN}$ = 24V, $V_{OUT}$=3.3V, $I_{OUT}$=8A, f=400kHz, $T_A$ = 25°C. Schematic from the application information section.

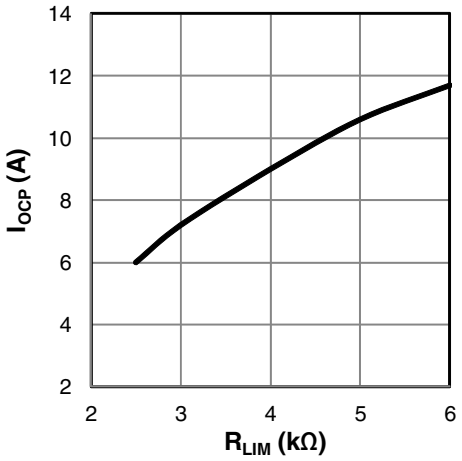



**Figure 7: XR76208 $I_{OCP}$ versus $R_{LIM}$**

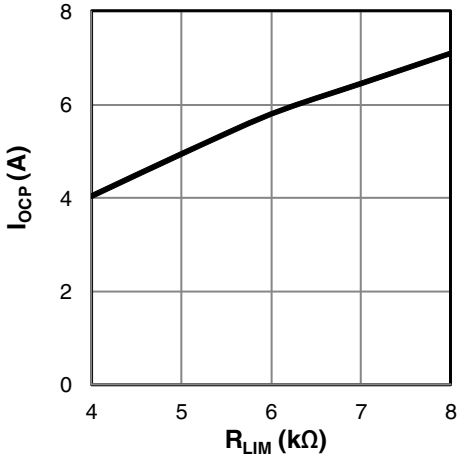



**Figure 8: XR76205 $I_{OCP}$ versus $R_{LIM}$**

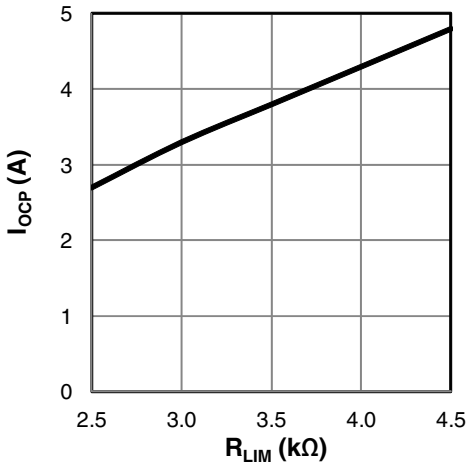



**Figure 9: XR76203 $I_{OCP}$ versus $R_{LIM}$**

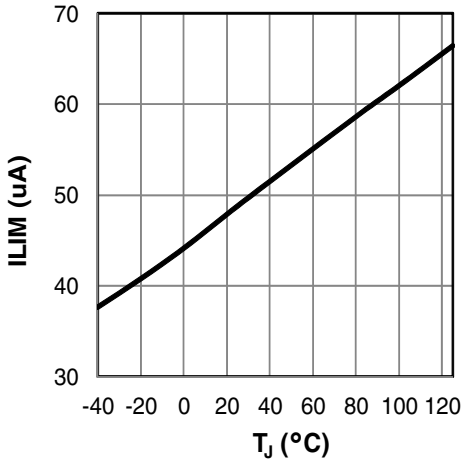



**Figure 10: $I_{LIM}$ versus temperature**

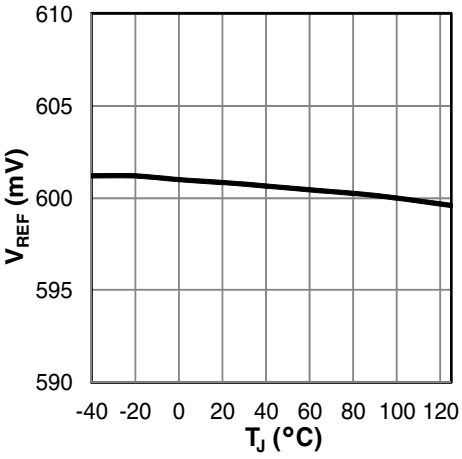



**Figure 11: $V_{REF}$ versus temperature**

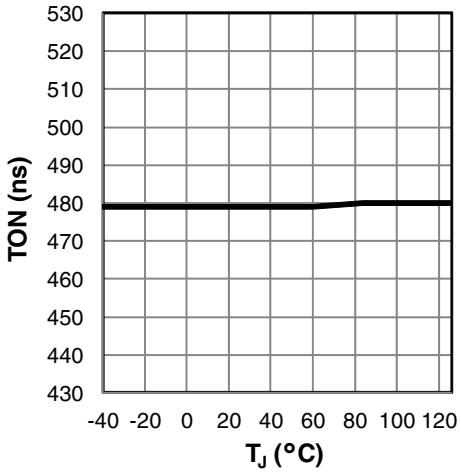



**Figure 12: $T_{ON}$ versus temperature, $R_{ON}$=35.7kΩ**

## Typical Performance Characteristics

Unless otherwise noted: $V_{IN}$ = 24V, $V_{OUT}$=3.3V, $I_{OUT}$=8A, f=400kHz, $T_A$ = 25°C. Schematic from the application information section.

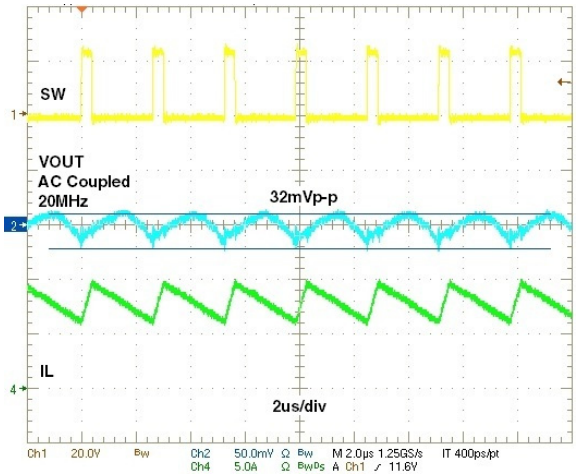



**Figure 13: Steady state, $I_{OUT}$=8A**

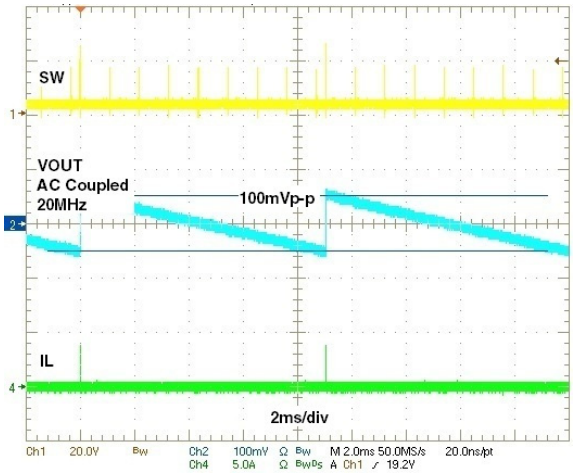



**Figure 14: Steady state, DCM, $I_{OUT}$=0A**

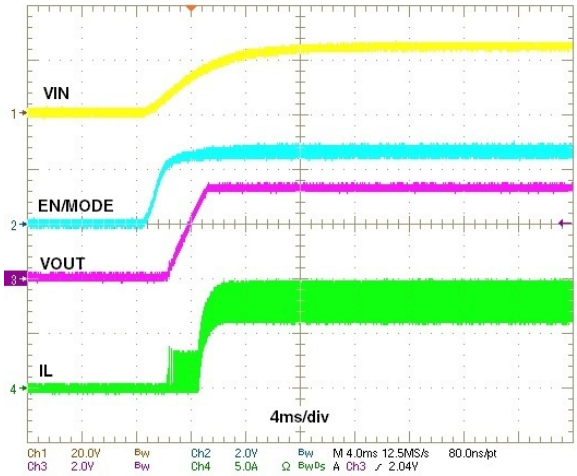



**Figure 15: Power up, Forced CCM**

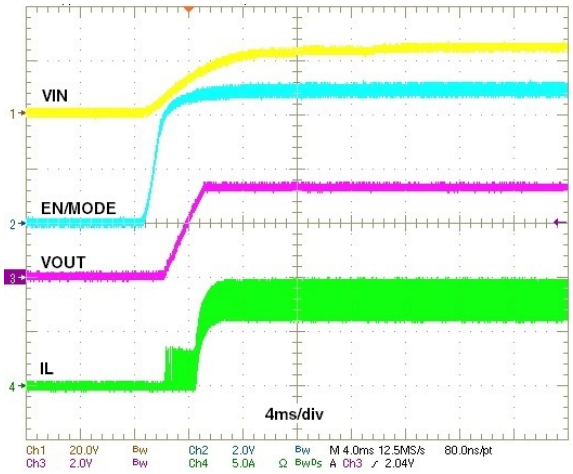



**Figure 16: Power up, DCM/CCM**

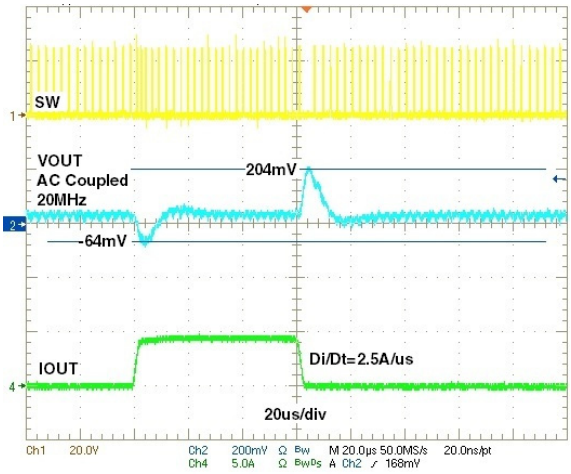



**Figure 17: Load step, Forced CCM, 0A-4A-0A**

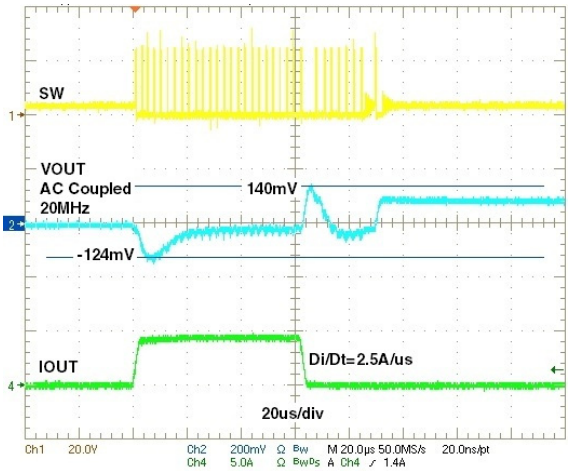



**Figure 18: Load step, DCM/CCM, 0A-4A-0A**

## Efficiency

Unless otherwise noted: $T_{AMBIENT}$ = 25°C, No Air flow, f=400kHz, Inductor losses are included, Schematic from the application information section.

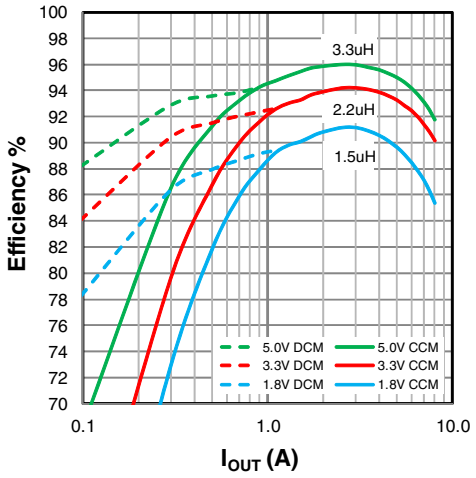



**Figure 19: XR76208 efficiency, $V_{IN}$=12V**

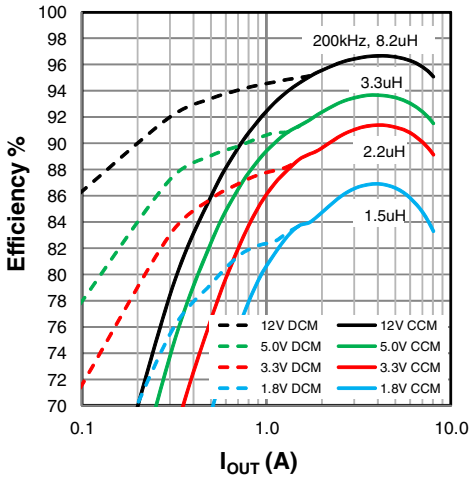



**Figure 20: XR76208 efficiency, $V_{IN}$=24V**

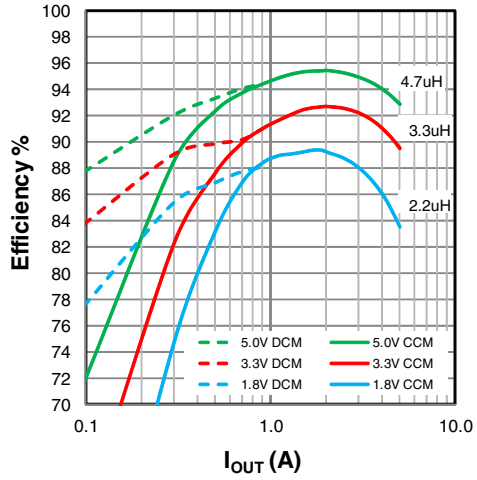



**Figure 21: XR76205 efficiency, $V_{IN}$=12V**

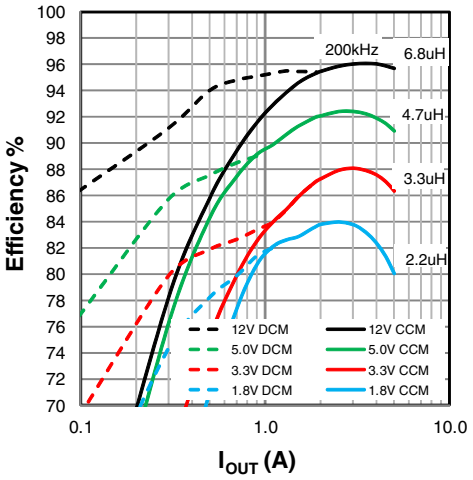



**Figure 22: XR76205 efficiency, $V_{IN}$=24V**

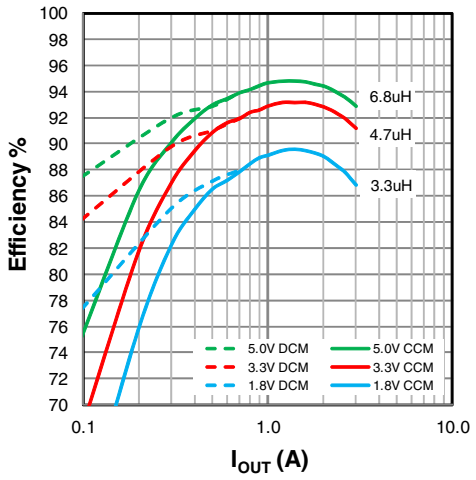



**Figure 23: XR76203 efficiency, $V_{IN}$=12V**

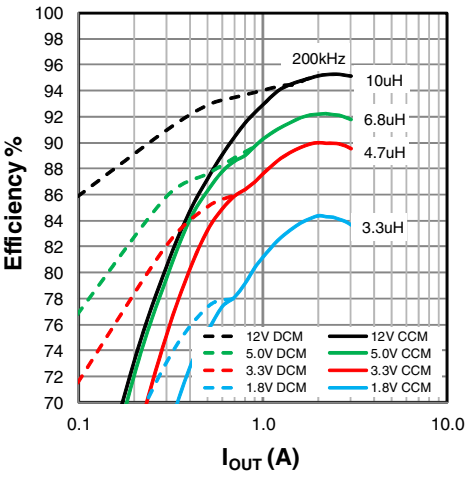



**Figure 24: XR76203 efficiency, $V_{IN}$=24V**

## Thermal Derating

Unless otherwise noted: No Air flow, f=400kHz, Schematic from the application information section.

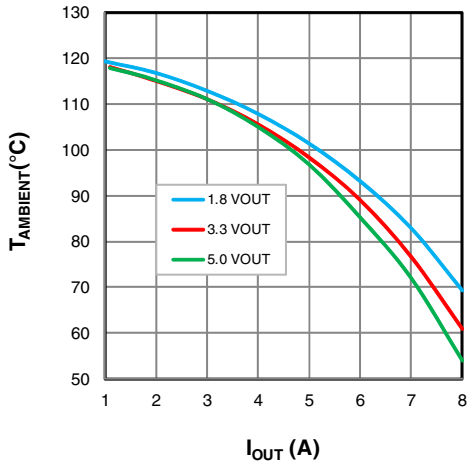



**Figure 25: XR76208, $V_{IN}$=12V**

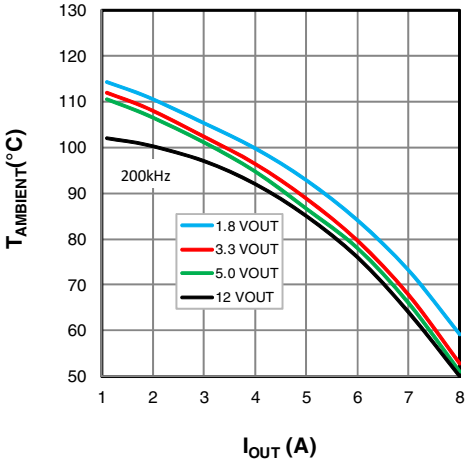



**Figure 26: XR76208, $V_{IN}$=24V**

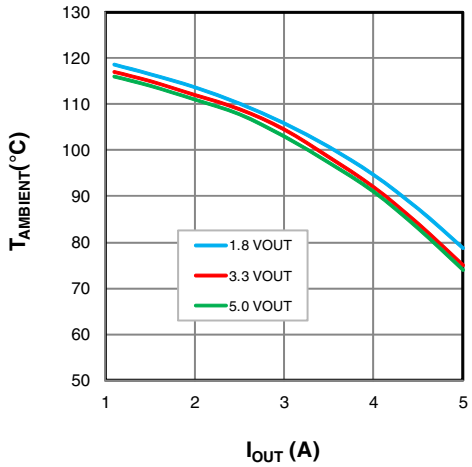



**Figure 27: XR76205, $V_{IN}$=12V**

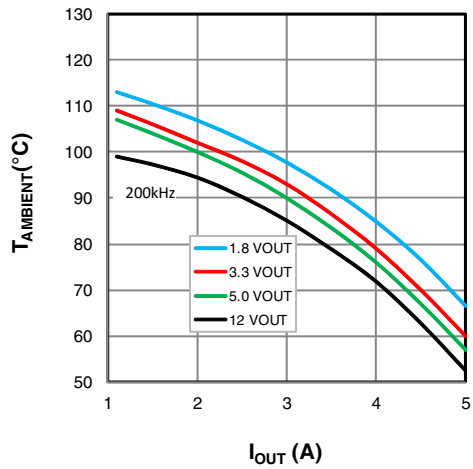



**Figure 28: XR76205, $V_{IN}$=24V**

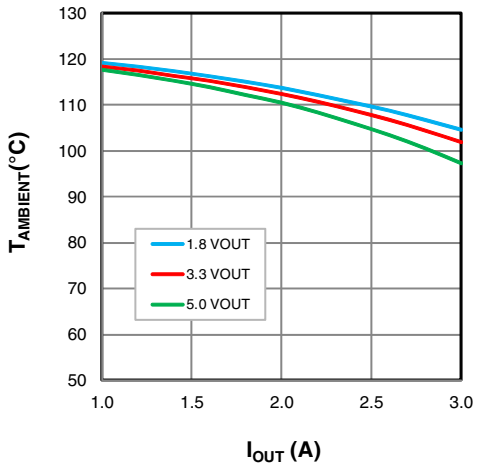



**Figure 29: XR76203, $V_{IN}$=12V**

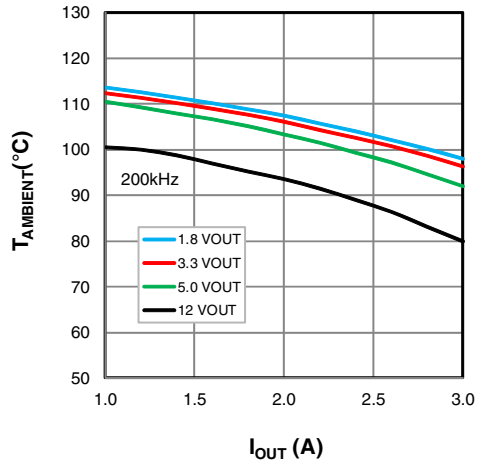



**Figure 30: XR76203, $V_{IN}$=24V**

## Functional Description

XR76203, XR76205 and XR76208 are synchronous step-down proprietary emulated current-mode Constant On-Time (COT) regulators. 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 is stable with ceramic output capacitors.

Each switching cycle begins with GH signal turning on the high-side (control) FET 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 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 $V_{FB}$ 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 makes possible the use of ceramic capacitors, in addition to other capacitor types, for output filtering.

### Enable/Mode Input (EN/MODE)

EN/MODE pin accepts a tri-level signal that is used to control turn on/off. It also selects between two modes of operation: 'Forced CCM' and 'DCM/CCM'. If EN is pulled below 1.8V, the Regulator shuts down. A voltage between 2.0V and 2.8V selects the Forced CCM mode which will run the Regulator in continuous conduction at all times. A voltage higher than 3.1V selects the DCM/CCM mode which will run the Regulator in discontinuous conduction at light loads.

### Selecting the Forced CCM Mode

In order to set the Regulator to operate in Forced CCM, a voltage between 2.0V and 2.8V must be applied to EN/MODE. This can be achieved with an external control signal that meets the above voltage requirement. Where an external control is not available, the EN/MODE can be derived from $V_{IN}$. If $V_{IN}$ is well regulated, use a resistor divider and set the voltage to 2.5V. If $V_{IN}$ varies over a wide range, the circuit shown in Figure 31 can be used to generate the required voltage. Note that at $V_{IN}$ of 5.5V and 40V the nominal Zener voltage is 4.0V and 5.0V respectively. Therefore for $V_{IN}$ in the range of 5.5V to 40V, the circuit shown in Figure 31 will generate $V_{EN}$ required for Forced CCM.

### Selecting the DCM/CCM Mode

In order to set the Regulator operation to DCM/CCM, a voltage between 3.1V and 5.5V must be applied to EN/MODE pin. If an external control signal is available, it can be directly connected to EN/MODE. In applications where an external control is not available, EN/MODE input can be derived from $V_{IN}$. If $V_{IN}$ is well regulated, use a resistor divider and set the voltage to 4V. If $V_{IN}$ varies over a wide range, the circuit shown in Figure 32 can be used to generate the required voltage.

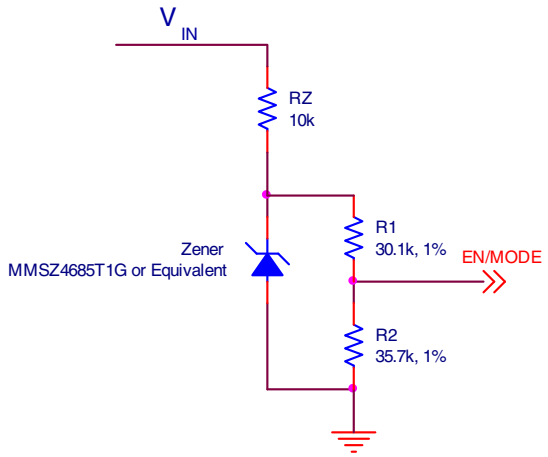



**Figure 31: Selecting Forced CCM by deriving EN/MODE from $V_{IN}$**

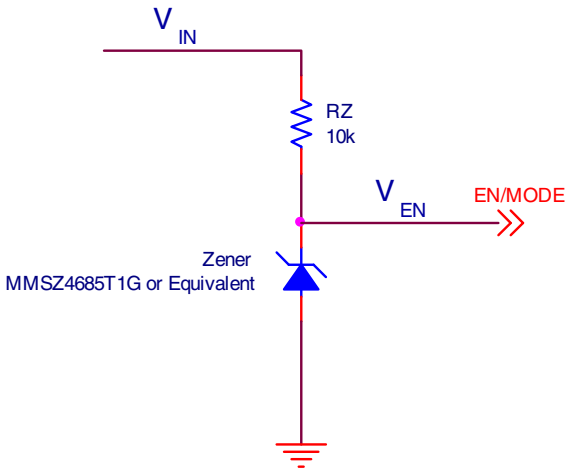



**Figure 32: Selecting DCM/CCM by deriving EN/MODE from $V_{IN}$**

## Programming the On-Time

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

$$R_{ON} = \frac{V_{IN} \times [T_{ON} - (25 \times 10^{-9})]}{3.05 \times 10^{-10}}$$

where $T_{ON}$ is calculated from:

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

where:

f is the desired switching frequency at nominal $I_{OUT}$

Eff is the Regulator efficiency corresponding to nominal $I_{OUT}$ shown in Figures 19-24

Substituting for $T_{ON}$ in the first equation we get:

$$R_{ON} = \frac{\left(\frac{V_{OUT}}{f \times Eff}\right) - [(25 \times 10^{-9}) \times V_{IN}]}{3.05 \times 10^{-10}}$$

## Over-Current Protection (OCP)

If load current exceeds the programmed over-current, $I_{OCP}$, for four consecutive switching cycles, the Module enters hiccup mode of operation. In hiccup, 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 Module will remain in hiccup mode until load current is reduced below the programmed $I_{OCP}$ . In order to program the over-current protection, use the following equation:

$$RLIM = \frac{(I_{OCP} \times RDS) + 8mV}{ILIM}$$

Where:

RLIM is resistor value for programming $I_{OCP}$

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

RDS is the MOSFET rated On Resistance; XR76208=21.5mΩ, XR76205=59mΩ, XR76203=59mΩ

8mV is the OCP comparator maximum offset

ILIM is the internal current that generates the necessary OCP comparator threshold (use 45µA).

Note that ILIM has a positive temperature coefficient of 0.4%/°C (Figure 10). This is meant to roughly match and compensate for positive temperature coefficient of the synchronous FET. Graph of typical $I_{OCP}$ versus RLIM is shown in Figure 7-9. Maximum allowable RLIM for XR76205 is 8.06kΩ.

## Short-Circuit Protection (SCP)

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

## Over-Temperature (OTP)

OTP triggers at a nominal die temperature of 150°C. The gate of switching FET and 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 the Application Circuit to program the output voltage $V_{OUT}$.

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

where R2 has a nominal value of 2kΩ.

## Programming the Soft-start

Place a capacitor CSS between the SS and AGND pins to program the soft-start. In order to program a soft-start time of TSS, calculate the required capacitance CSS from the following equation:

$$CSS = TSS \times \left(\frac{10\mu A}{0.6V}\right)$$

### Feed-Forward Capacitor ($C_{FF}$)

A feed-forward capacitor ($C_{FF}$) may be necessary depending on the Equivalent Series Resistance (ESR) of $C_{OUT}$. If only ceramic output capacitors are used for $C_{OUT}$ then a $C_{FF}$ is necessary. Calculate $C_{FF}$ from:

$$C_{FF} = \frac{1}{2 \times \pi \times R1 \times 7 \times f_{LC}}$$

where:

R1 is the resistor that $C_{FF}$ is placed in parallel with

$f_{LC}$ is the frequency of output filter double-pole

$f_{LC}$ frequency must be less than 11kHz when using ceramic $C_{OUT}$. If necessary, increase L and/or $C_{OUT}$ in order to meet this constraint.

When using capacitors with higher ESR, such as PANASONIC TPE series, a $C_{FF}$ is not required provided following conditions are met:

1. The frequency of output filter LC double-pole $f_{LC}$ should be less than 11kHz.

2. The frequency of ESR Zero $f_{Zero,ESR}$ should be at least five times larger than $f_{LC}$.

Note that if $f_{Zero,ESR}$ is less than $5xf_{LC}$, then it is recommended to set the $f_{LC}$ at less than 2kHz. CFF is still not required.

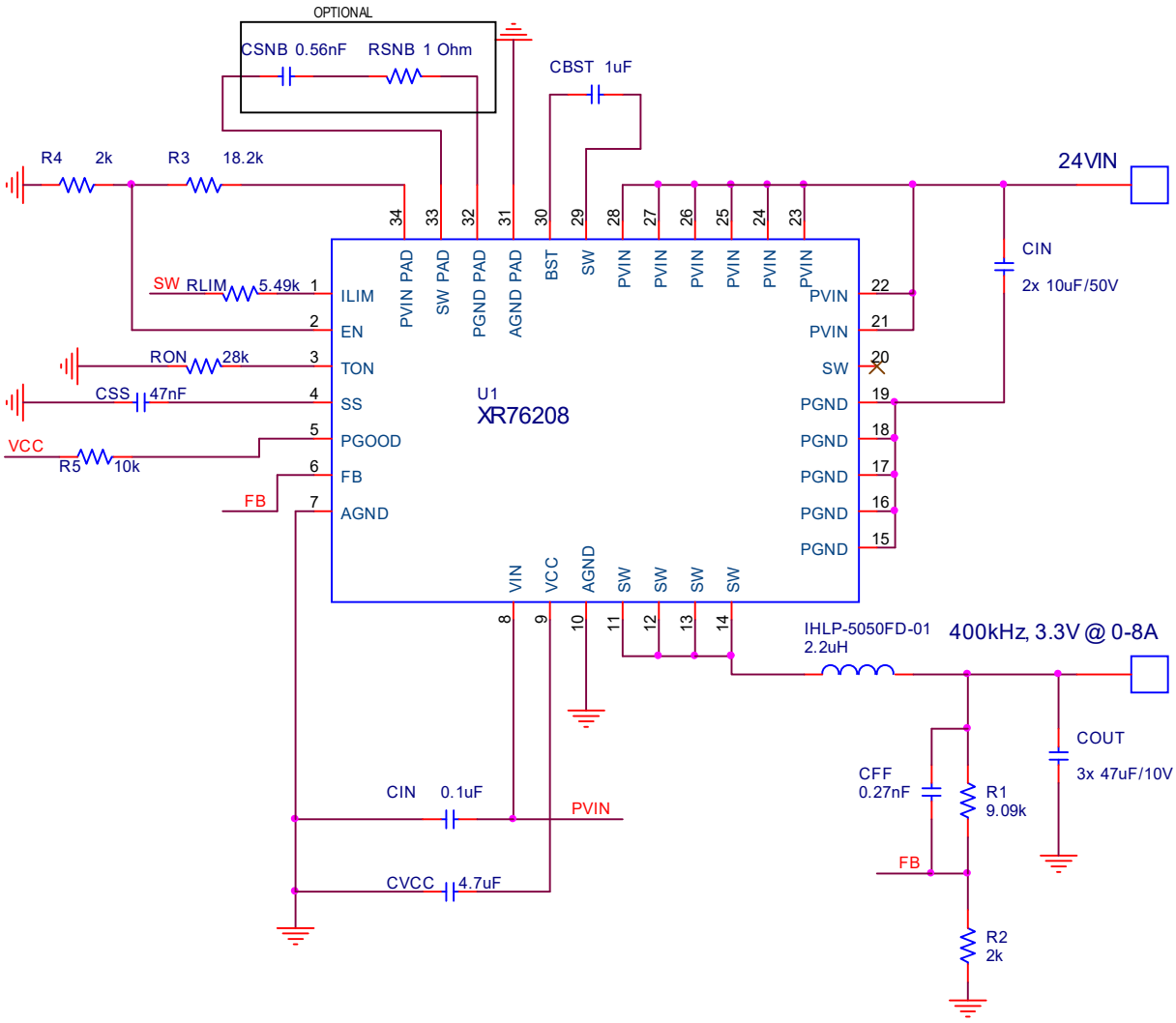
### Maximum Allowable Voltage Ripple at FB pin

Note that the steady-state voltage ripple at feedback pin FB ($V_{FB,RIPPLE}$) must not exceed 50mV in order for the Regulator to function correctly. If $V_{FB,RIPPLE}$ is larger than 50mV then $C_{OUT}$ should be increased as necessary in order to keep the $V_{FB,RIPPLE}$ below 50mV.

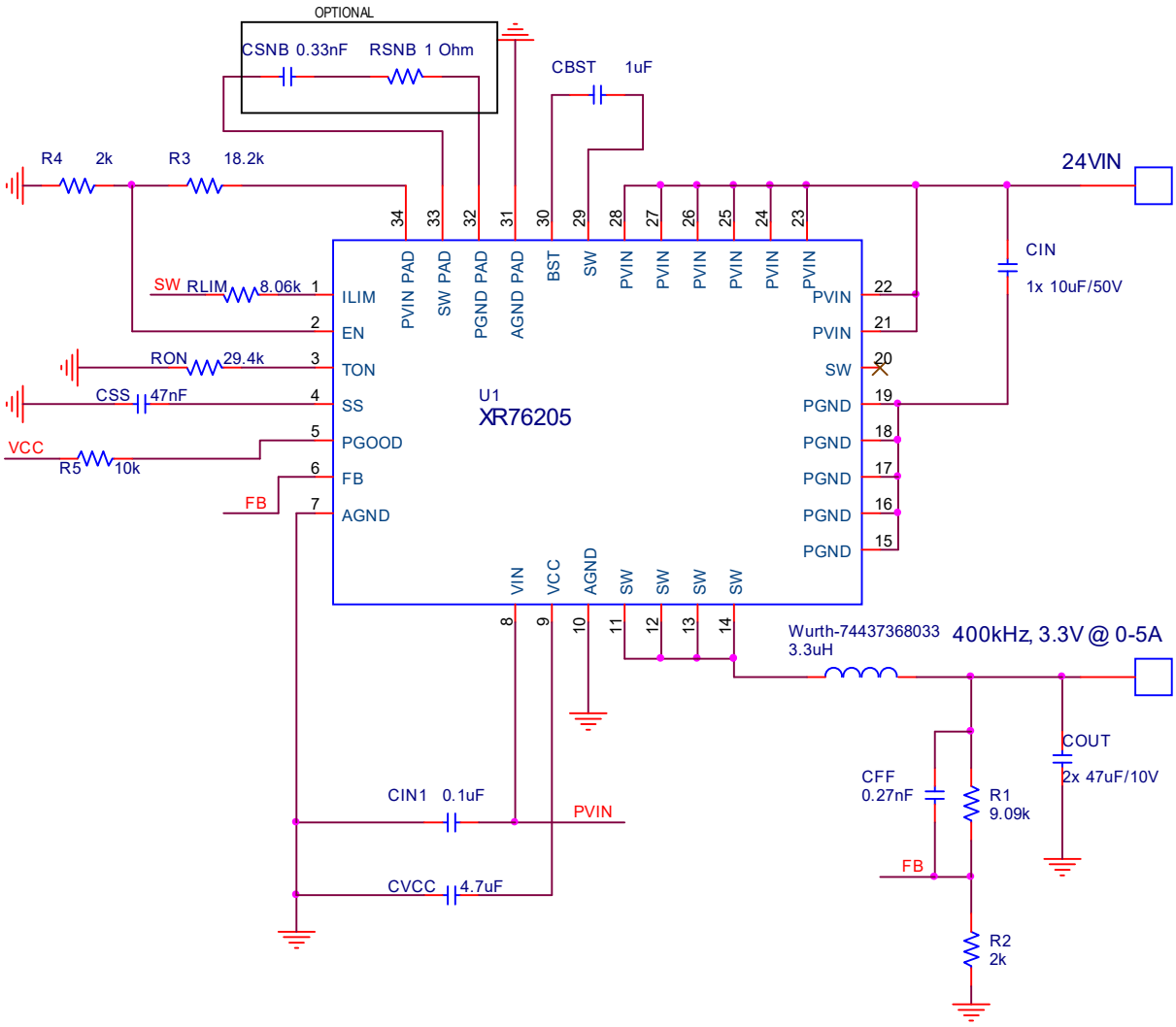
### Feed-Forward Resistor ($R_{FF}$)

Poor PCB layout can cause FET switching noise at the output and may couple to the FB pin via $C_{FF}$. Excessive noise at FB will cause poor load regulation. To solve this problem place a resistor $R_{FF}$ in series with $C_{FF}$. $R_{FF}$ value up to 2% of R1 is acceptable.

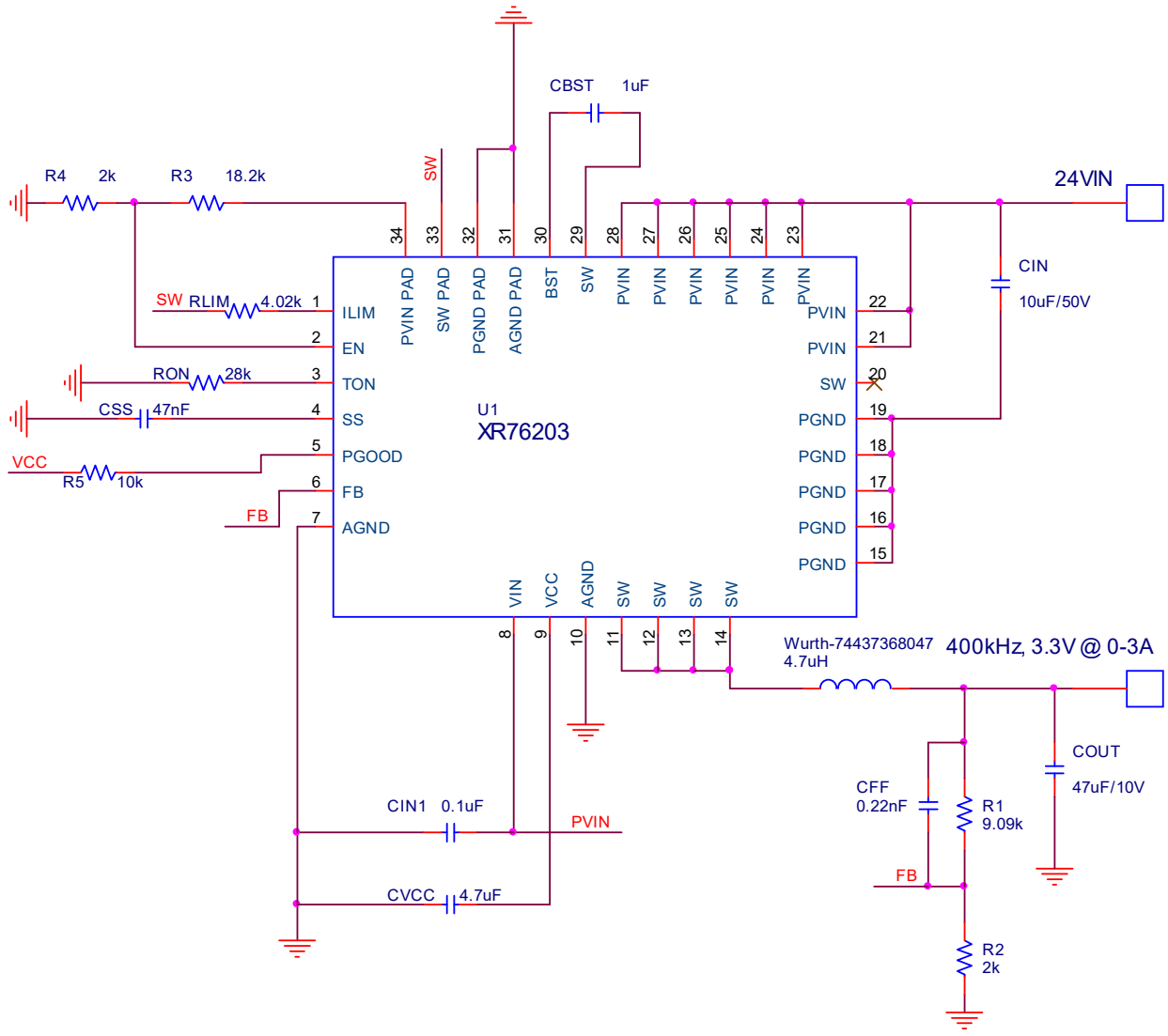
## Application Circuit, XR76208



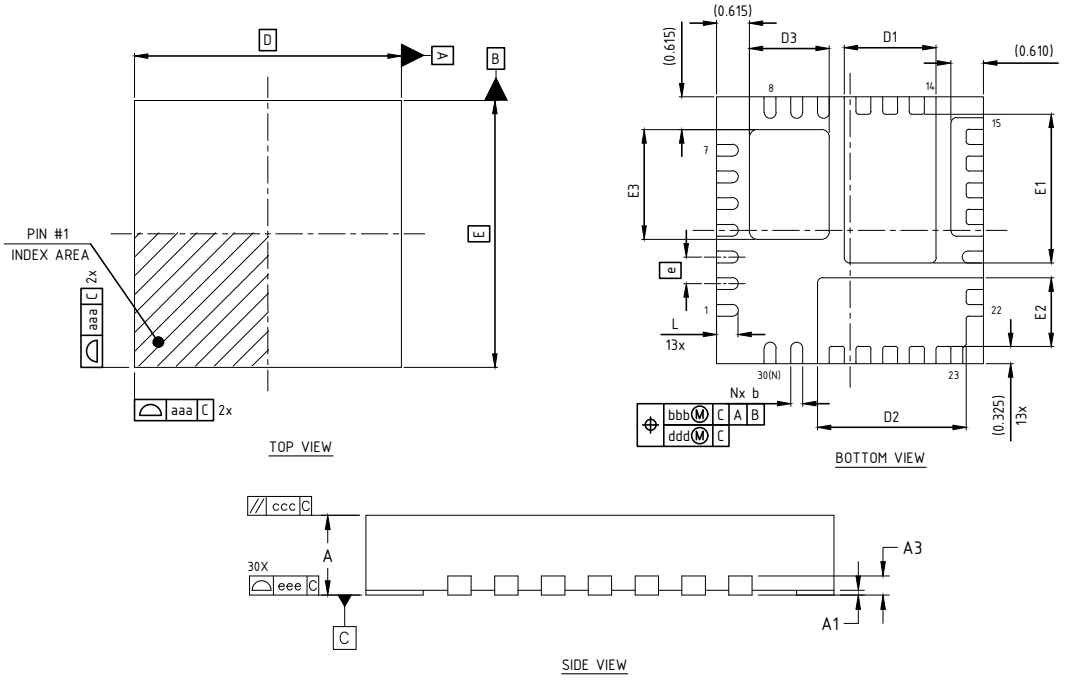
## Application Circuit, XR76205



## Application Circuit, XR76203



## Mechanical Dimensions




| Dimension Table | | | |
|---|---|---|---|
| Thickness / Symbol | MINIMUM | NOMINAL | MAXIMUM |
| A | 0.80 | 0.90 | 1.00 |
| A1 | 0.00 | 0.02 | 0.05 |
| A3 | | 0.20 Ref. | |
| b | 0.18 | 0.25 | 0.30 |
| D | | 5.00 BSC | |
| E | | 5.00 BSC | |
| e | | 0.50 BSC | |
| D1 | 1.570 | 1.720 | 1.820 |
| E1 | 2.635 | 2.785 | 2.885 |
| D2 | 2.635 | 2.785 | 2.885 |
| E2 | 1.135 | 1.285 | 1.385 |
| D3 | 1.345 | 1.495 | 1.595 |
| E3 | 1.903 | 2.053 | 2.153 |
| L | 0.30 | 0.40 | 0.50 |
| aaa | | 0.05 | |
| bbb | | 0.10 | |
| ccc | | 0.10 | |
| ddd | | 0.05 | |
| eee | | 0.08 | |
| N | | 30 | |

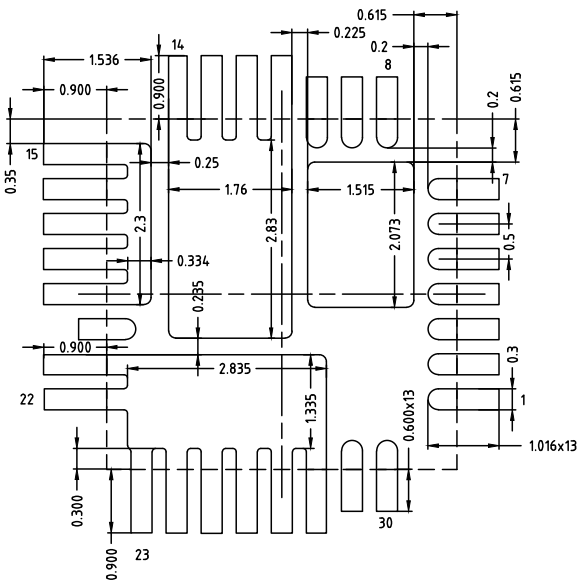
TERMINAL DETAIL

NOTE : ALL DIMENSIONS ARE IN MILLIMETERS, ANGLES ARE IN DEGREES.

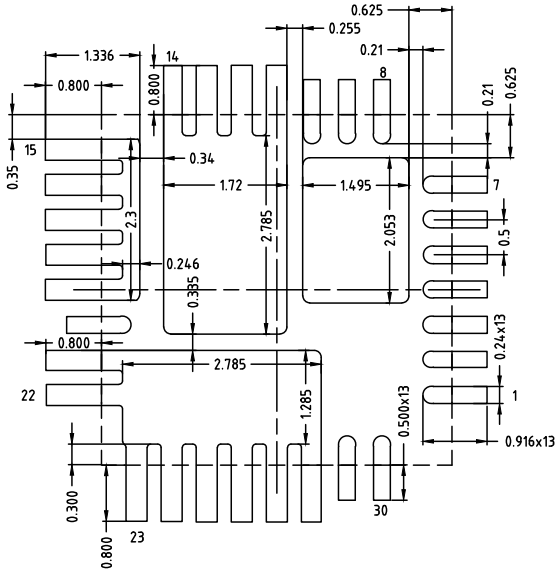
Drawing No.: POD-00000018

Revision: B

## Recommended Land Pattern and Stencil




TYPICAL RECOMMENDED LAND PATTERN




TYPICAL RECOMMENDED STENCIL

NOTE : ALL DIMENSIONS ARE IN MILLIMETERS, ANGLES ARE IN DEGREES.

Drawing No.: POD-00000018

Revision: B

## Ordering Information[1]

| Part Number | Operating Temperature Range | Lead-Free | Package | Packaging Method |
|---|---|---|---|---|
| XR76208EL-F | -40°C ≤ $T_J$ ≤ +125°C | Yes[2] | 5x5mm QFN | Tray |
| XR76208ELTR-F | | | | Tape and Reel |
| XR76208EVB | XR76208 Evaluation Board | | | |
| XR76205EL-F | -40°C ≤ $T_J$ ≤ +125°C | Yes[2] | 5x5mm QFN | Tray |
| XR76205ELTR-F | | | | Tape and Reel |
| XR76205EVB | XR76205 Evaluation Board | | | |
| XR76203EL-F | -40°C ≤ $T_J$ ≤ +125°C | Yes[2] | 5x5mm QFN | Tray |
| XR76203ELTR-F | | | | Tape and Reel |
| XR76203EVB | XR76203 Evaluation Board | | | |

NOTES:
1. Refer to www.exar.com/XR76203, www.exar.com/XR76205, www.exar.com/XR76208 for most up-to-date Ordering Information.
2. Visit www.exar.com for additional information on Environmental Rating.

## Revision History

| Revision | Date | Description |
|---|---|---|
| 1A | February 2015 | Initial release |
| 1B | June 2018 | Update to MaxLinear logo. Update format and Ordering Information table. |
| 1C | July 2018 | Add land pattern and stencil. Update Ordering Information table. |

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