36-V Input, 2-A Synchronous Step-Down Voltage Regulator

Features

- Wide Supply Voltage: 4.5 V to 36 V
- Absolute Maximum Voltage: 42 V
- Internal Power FET: 180 mΩ and 90 mΩ
- 0.6-V Reference Voltage with 2% Accuracy
- High-Efficiency Synchronous-Mode Operation
- Fixed Switching Frequency
  - 500 kHz (TPP362080/2)
  - 1 MHz (TPP362084/5)
  - 2.2 MHz (TPP362081/3)
- Low 2-μA Shutdown, 70-μA Quiescent Current
- Internal Light Load Power-Save Mode for High Efficiency at Light Load (TPP362080/1/4)
- Forced-PWM Mode for Low-Output Ripple (TPP362082/3/5)
- Internal 2-ms Soft-Start Timer
- Internal Loop Compensation
- Over-Current Protection with Hiccup Mode
- Output over Voltage Protection
- Thermal Shutdown
- Small Outline Package TSOT23-6
- −40°C to 125°C Operation Ambient Temperature Range

Applications

- 12-V, 24-V Distributed Power Supply
- Industrial Applications
- General Purpose

Description

The TPP36208x series is a simple, easy-to-use, 2-A output, synchronous, step-down, and switch-mode converter with internal power MOSFETs.

The TPP36208x series integrates low-$R_{DS(ON)}$ power transistors in the TSOT23-6 package with internal soft-start, compensation, and protection features. The TPP36208x offers a very compact solution to achieve a 2-A continuous output current over a wide input supply range, with excellent load and line regulation.

The TPP36208x series has different versions of switching frequencies at 500-kHz, 1-MHz and 2.2-MHz, and also supports light load PSM to save quiescent current and forced-PWM mode to maintain the fixed switching frequency.

The device is available in the 6-pin TSOT23-6 package with the support of a wide operation ambient temperature range from −40 °C to 125 °C.

Typical Application Circuit

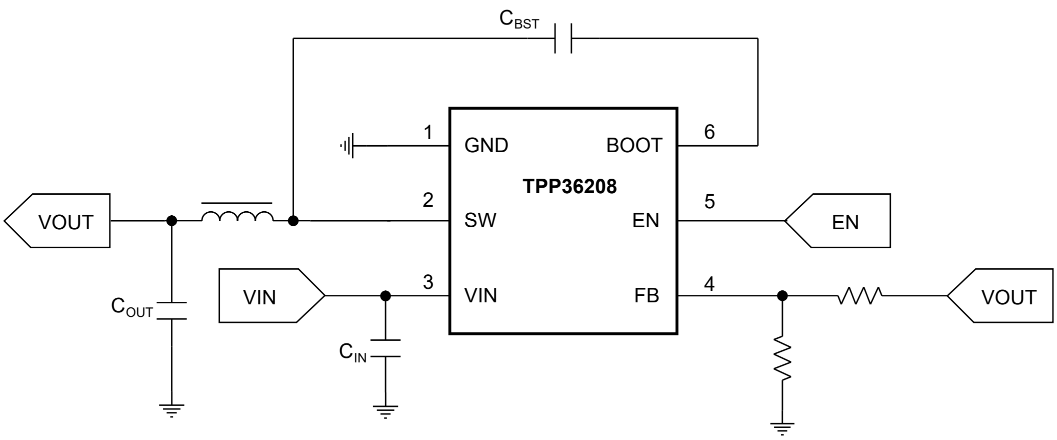


Table of Contents

Revision History

Date	Revision	Notes
2022-03-15	Rev A.0	Initial release.
2022-07-11	Rev A.1	Minor correction. Updated description of EN pin function to internally weak pulled up.
2022-07-31	Rev A.2	Updated order information, automotive grade devices, electrical table rising/ falling timing and block diagrams.
2022-12-28	Rev A.3	Updated information in Typical Performance Characteristics.
2023-02-17	Rev A.4	Updated electrical characteristics on VIL,max, VIH,min
2023-05-12	Rev A.5	Updated 1-MHz version part number, TPP362084/5, updated EN voltage recommended voltage and current, detailed description and typical applications.

Pin Configuration and Functions

TPP36208
TSOT23-6 Package
Top View

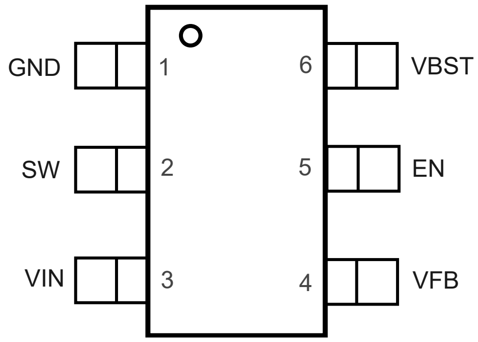


Table 1. Pin Functions: TPP36208x

Pin	Name	I/O	Description
1	GND	G	Ground pin. Power and controller circuit ground. Use star connection to GND pin with good contact.
2	SW	O	Switching node pin. Voltage switching between high-side FET and low-side FET.
3	VIN	P	Supply input pin. Connect decoupling 2 × 10-μF and 1 × 0.1-μF capacitors between VIN and GND pins.
4	VFB	I	Voltage feedback pin. Connect to output voltage with a feedback resistor divider.
5	EN	I	Enable input. Active high. Internal weak pull-up.
6	VBST	O	High-side MOSFET gate supply pin. Connect 0.1-μF between VBST and SW pins.

Specifications

Absolute Maximum Ratings (1)

Parameter		Min	Max	Unit
V_{IN}	Supply Voltage	−0.3	42	V
SW	Switching Node Voltage	−0.3	V_{IN} + 0.3	V
	Switching Node Voltage (50 ns)	−3	42	V
	Switching Node Voltage (20 ns)	−5	42	V
VBST-SW	Bootstrap Voltage	−0.3	6	V
FB	Feedback Voltage	−0.3	6	V
EN	Enable Input	−0.3	42	V
T_J	Maximum Junction Temperature	−40	150	°C
T_A	Operating Temperature Range	−40	125	°C
T_{STG}	Storage Temperature Range	−65	150	°C
T_L	Lead Temperature (Soldering 10 sec)		260	°C

(1) 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.
(2) The inputs are protected by ESD protection diodes to each power supply. If the input extends more than 300 mV beyond the power supply, the input current should be limited to less than 10 mA.
(3) A heat sink may be required to keep the junction temperature below the absolute maximum. This depends on the power supply voltage and how many amplifiers are shorted. Thermal resistance varies with the amount of PC board metal connected to the package. The specified values are for short traces connected to the leads.

ESD, Electrostatic Discharge Protection

Parameter		Condition	Minimum Level	Unit
HBM	Human Body Model ESD	ANSI/ESDA/JEDEC JS-001 (1)	2	kV
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002 (2)	1.5	kV

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

Recommended Operating Conditions

Parameter		Min	Typ	Max	Unit
VIN	Supply Input Voltage Range	4.5		36	V
EN	EN Input Voltage Range	0		36	V
FB	FB Input Voltage Range	0		5.5	V
BOOT – SW	BOOT Voltage Range	0		5.5	V
SW	FB Input Voltage Range	0		VIN	V
T_J	Operating Junction Temperature	–40		150	°C

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
TSOT23-6	100	67	°C/W

Electrical Characteristics

All test condition is at V_{IN} = 12 V, T_A = −40°C to +125°C, unless otherwise noted.

Parameter		Conditions	Min	Typ	Max	Unit
Power Supply						
V_{IN}	Supply Voltage Range		4.5		36	V
I_Q	Operating Supply Current	Non-switching, EN = 5 V, V_{FB} = 1 V		70		μA
I_{QSD}	Shut Down Supply Current	EN = GND		2		μA
V_{UVLO_rising}	UVLO Rising Threshold		3.9	4.3	4.5	V
$V_{UVLO\_falling}$	UVLO Falling Threshold		3.7	3.9	4.1	V
Enable						
V_{ENH}	EN Input Rising Threshold		1.15	1.28	1.35	V
V_{ENL}	EN Input Falling Threshold		1	1.15	1.2	V
I_{EN_L}	EN current, EN = L(1)	V_{EN} = 0.9 V	0.65	1.04	1.5	μA
I_{EN_H}	EN current, EN = H	V_{EN} = 1.5 V	3.6	4.3	5.2	μA
I_{EN_HYS}	EN hysteresis current	V_{EN} = 1.5 V		3.3		μA
Feedback and Power Stage						
V_{FB}	V_{FB} Feedback Voltage		588	600	612	mV
$R_{ds(on)\_HSD}$	High-side FET On-Resistance	I_{SW} = 1 A		180		mΩ
$R_{ds(on)\_LSD}$	Low-side FET On-Resistance	I_{SW} = 1 A		90		mΩ
f_{SW}	Switching Frequency	TPP362080/2	390	500	590	kHz
		TPP362081/3	1.76	2.2	2.64	MHz
		TPP362084/5	0.8	1	1.2	MHz
t_{ss}	Soft-Start Time			2		ms
t_{ss_done}	Soft start transition time		14	18	24	ms
I_{skip}	Pulse-Skip Mode Peak Inductor Current Threshold	V_{IN} = 12 V, V_{OUT} = 5 V, L = 15 μH		300		mA
Current Limit						
I_{Limit_HS}	High-side Current Limit	Inductor peak current	2.5	3.2	3.9	A
I_{Limit_LS}	Low-side Current Limit	Inductor valley current		2.5		A
$I_{Limit\_LS\_neg}$	Negative Low-side Current Limit			0.9		A
Diagnostics and Protection						
$V_{FB\_UVP\_rising}$	FB Hiccup Protection Rising Ratio			33		%
$V_{FB\_UVP\_falling}$	FB Hiccup Protection Falling Ratio			40		%
$V_{FB\_OVP\_rising}$	FB Over-Voltage Protection Rising Ratio			108		%
$V_{FB\_OVP\_falling}$	FB Over-Voltage Protection Falling Ratio			107		%

Parameter		Conditions	Min	Typ	Max	Unit
t_{HIC_wait}	Hiccup Protection Wait Time			128		Cycles
$t_{HIC\_restart}$	Hiccup Protection Restart Time			60		ms
Thermal Shutdown						
T_{SD}	Thermal Shut Down Temperature			160		°C
T_{SD_hys}	Thermal Hysteresis			10		°C

1. Guranteed by design

Typical Performance Characteristics

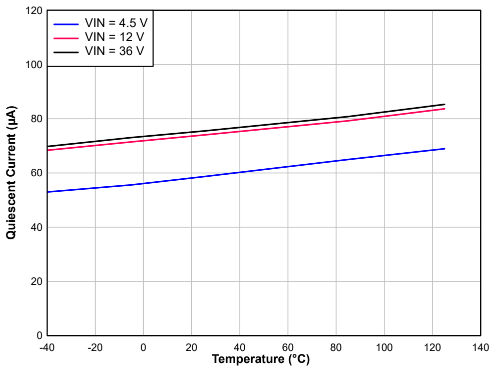


Figure 1. Quiescent Current vs. Supply Voltage

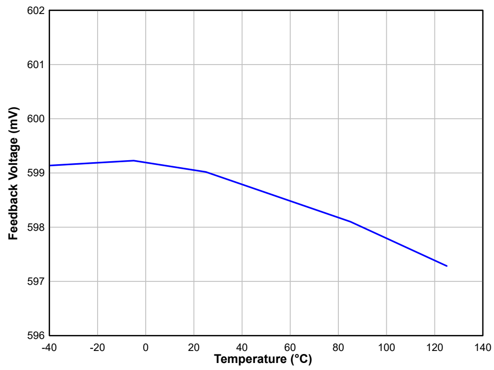


Figure 2. Reference Voltage vs. Temperature

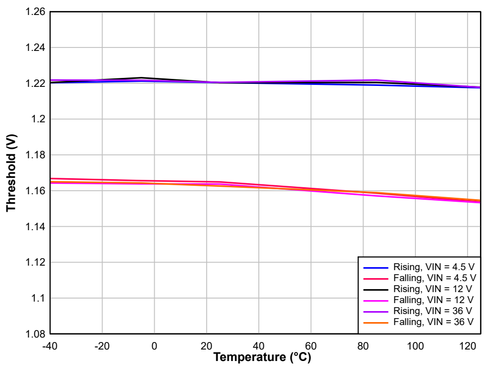


Figure 3. EN Threshold vs. Junction Temperature

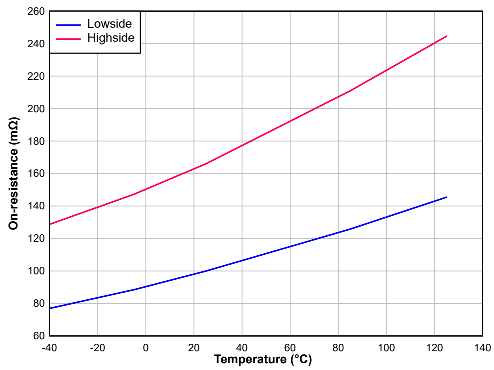


Figure 4. On-Resistance vs. Temperature

V_{IN} = 12 V, I_{OUT} = 0.5 A

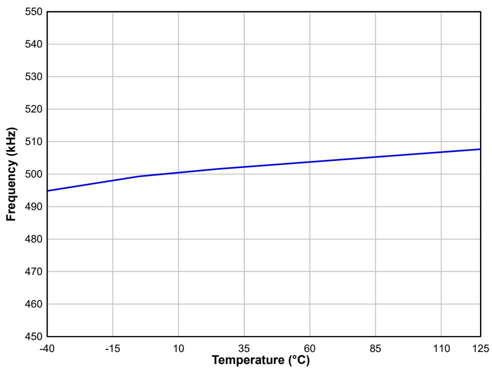


Figure 5. Switching Frequency vs. Temperature

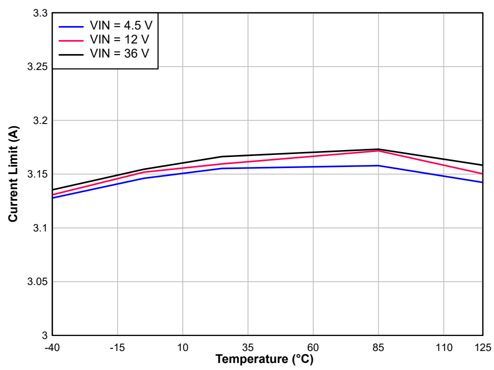


Figure 6. Current Limit vs. Temperature

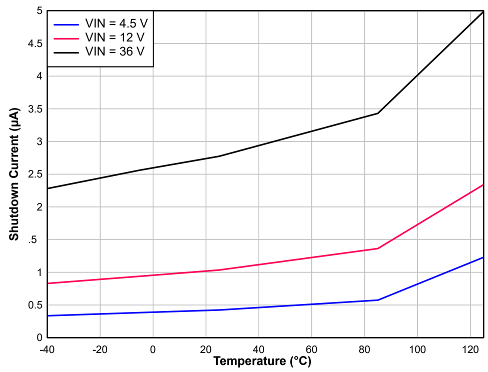


Figure 7. Shutdown Current vs. Junction Temperature

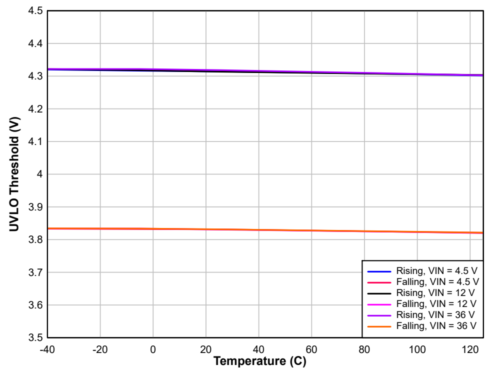


Figure 8. UVLO Threshold vs. Temperature

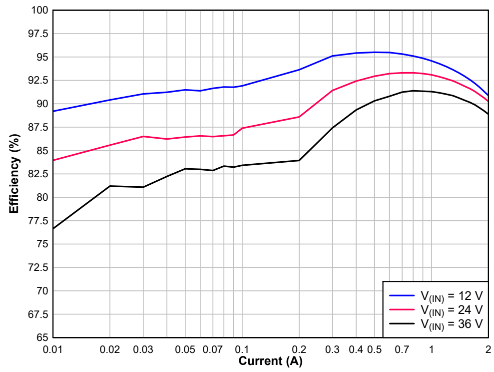


Figure 9. Efficiency vs. Output Current

V_{OUT}= 5 V, L = 2.2 µH, 500kHz, TPP362080 with Pulse Skip Mode

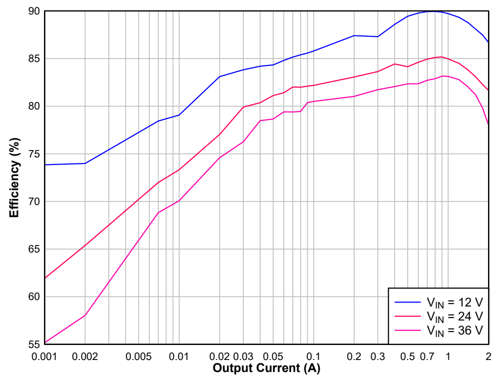


Figure 10. Efficiency vs. Output Current

V_{OUT}= 5 V, L = 2.2 µH, 2.2MHz, TPP362081 with Pulse Skip Mode

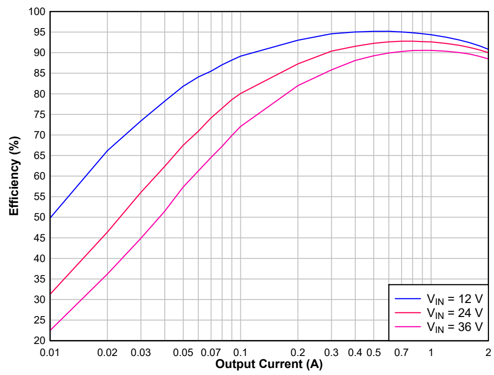


Figure 11. Efficiency vs. Output Current

V_{OUT}= 5 V, L = 2.2 µH, 500kHz, TPP362082 with Forced-PWM Mode

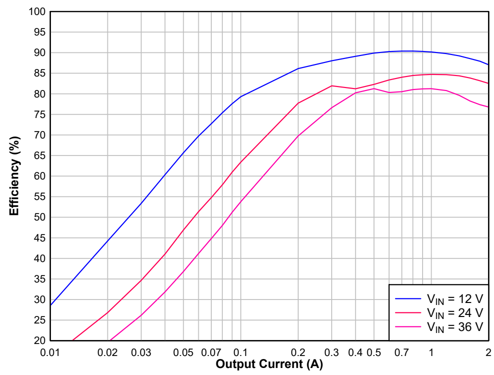


Figure 12. Efficiency vs. Output Current

V_{OUT}= 5 V, L = 2.2 µH, 2.2MHz, TPP362083 with Forced-PWM Mode

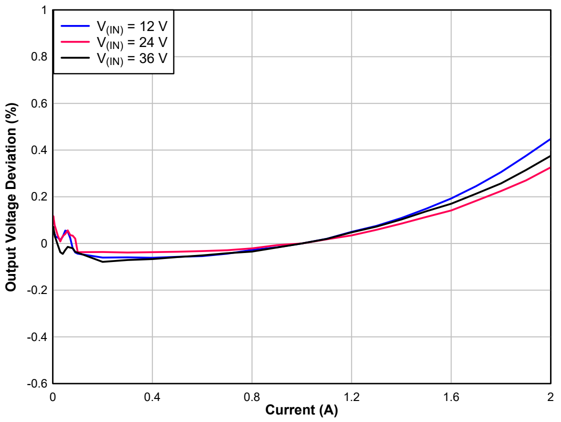


Figure 13. Load Regulation

V_{OUT} = 5 V

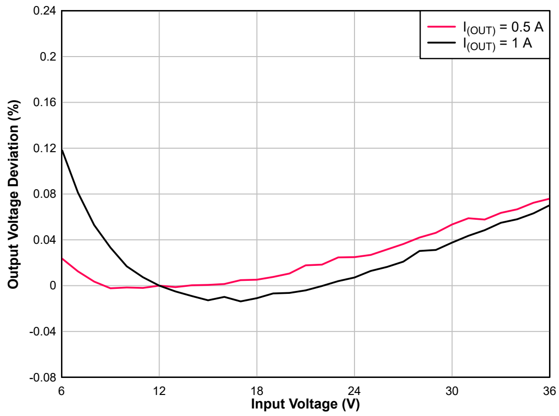


Figure 14. Line Regulation

V_{OUT}= 5 V

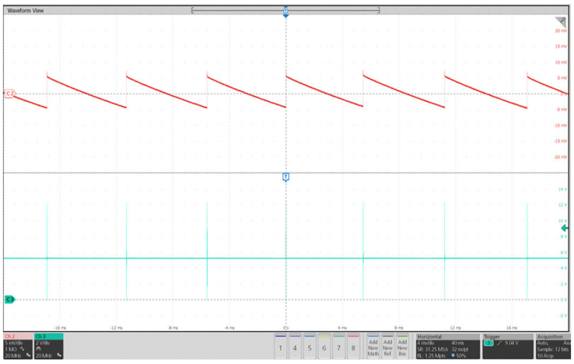


Figure 15. Pulse Skip Mode Output Voltage Ripple

CH2: SW, CH3: V_{OUT} Ripple

V_{IN} = 12 V, V_{OUT} = 5 V, I_L = 0 A

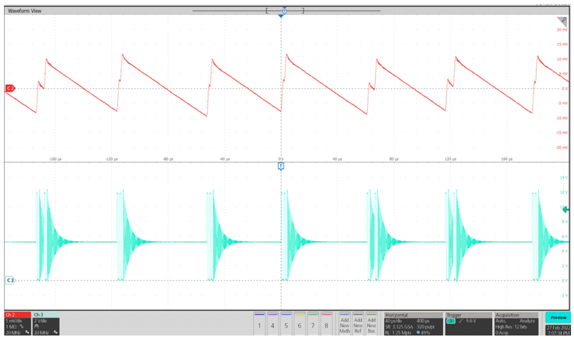


Figure 16. Pulse Skip Mode Output Voltage Ripple

CH2: V_{OUT} Ripple, CH3: SW

V_{IN} = 12 V, V_{OUT} = 5 V, I_L = 10 mA

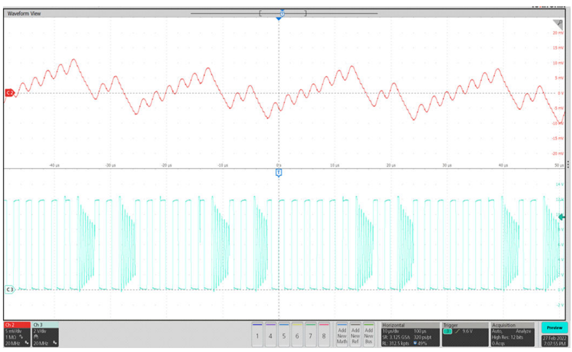


Figure 17. Pulse Skip Mode Output Voltage Ripple

CH2: V_{OUT} , CH3: SW

V_{IN} = 12 V, V_{OUT} = 5 V, I_L = 0.1 A

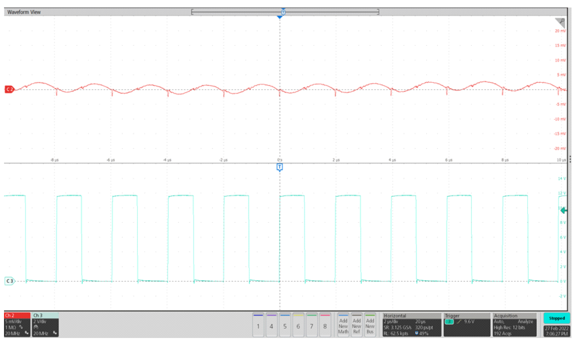


Figure 18. Output Voltage Ripple

CH2: V_{OUT} , CH3: SW

V_{IN} = 12 V, V_{OUT} = 5 V, I_L = 1 A

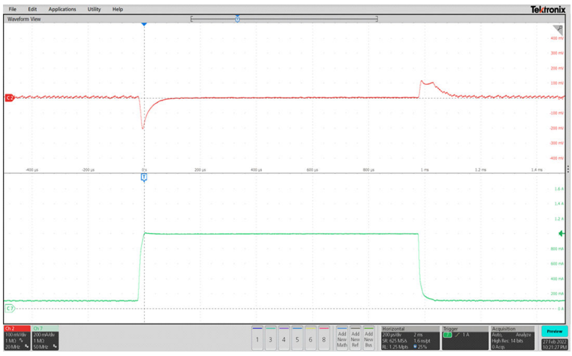


Figure 19. Load Transient

CH2: V_{OUT} , CH4: Load Current
V_{IN} = 12 V, V_{OUT} = 5 V, I_L = 0.1 A to 1 A

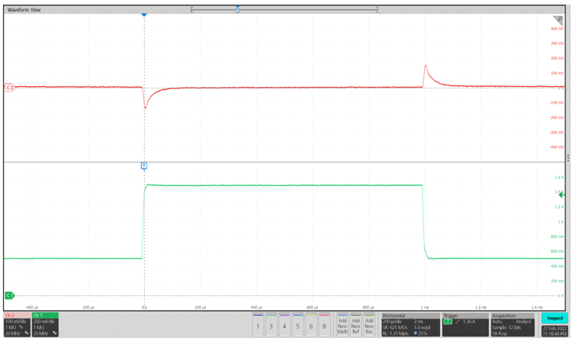


Figure 20. Load Transient

CH2: V_{OUT} , CH4: Load Current
V_{IN} = 12 V, V_{OUT} = 5 V, I_L = 0.5 A to 1.5 A

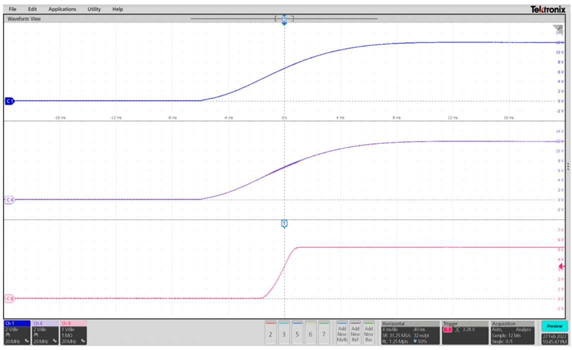


Figure 21. Start Up by VIN

CH1: V_{IN} , CH4: EN, CH8: V_{OUT}

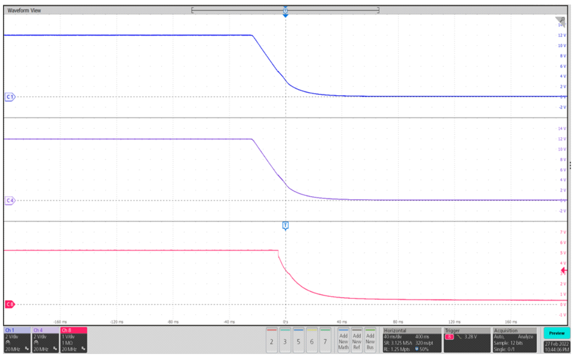


Figure 22. Power-Down by VIN

CH1: V_{IN} , CH4: EN, CH8: V_{OUT}

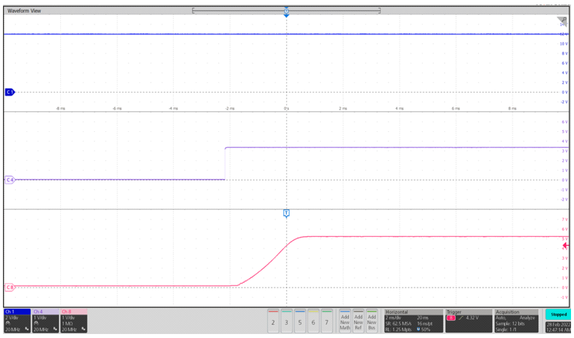


Figure 23. Start Up by EN

CH1: V_{IN} , CH4: EN, CH8: V_{OUT}

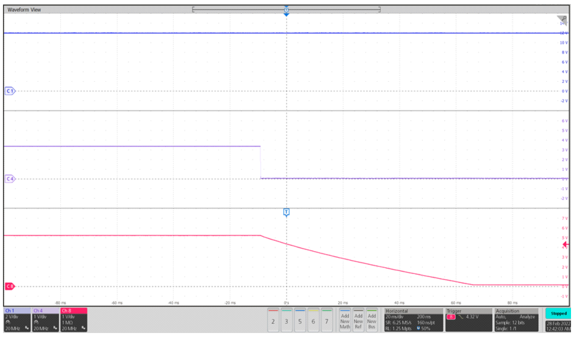


Figure 24. Power-Down by EN

CH1: V_{IN} , CH4: EN, CH8: V_{OUT}

Detailed Description

Overview

The TPP36208x is a 2-A synchronous step-down converter. The current mode control topology provides a fast transient response and supports low ESR output capacitors, such as specialty polymer capacitors and multi-layer ceramic capacitors, without extra compensation circuitry.

Device	Frequency	Low Output Current Mode
TPP362080-T6TR	500 kHz	Pulse-Skip Mode
TPP362081-T6TR	2.2 MHz	Pulse-Skip Mode
TPP362082-T6TR	500 kHz	Forced-PWM Mode
TPP362083-T6TR	2.2 MHz	Forced-PWM Mode
TPP362084-T6TR	1 MHz	Pulse-Skip Mode
TPP362085-T6TR	1 MHz	Forced-PWM Mode

Functional Block Diagram

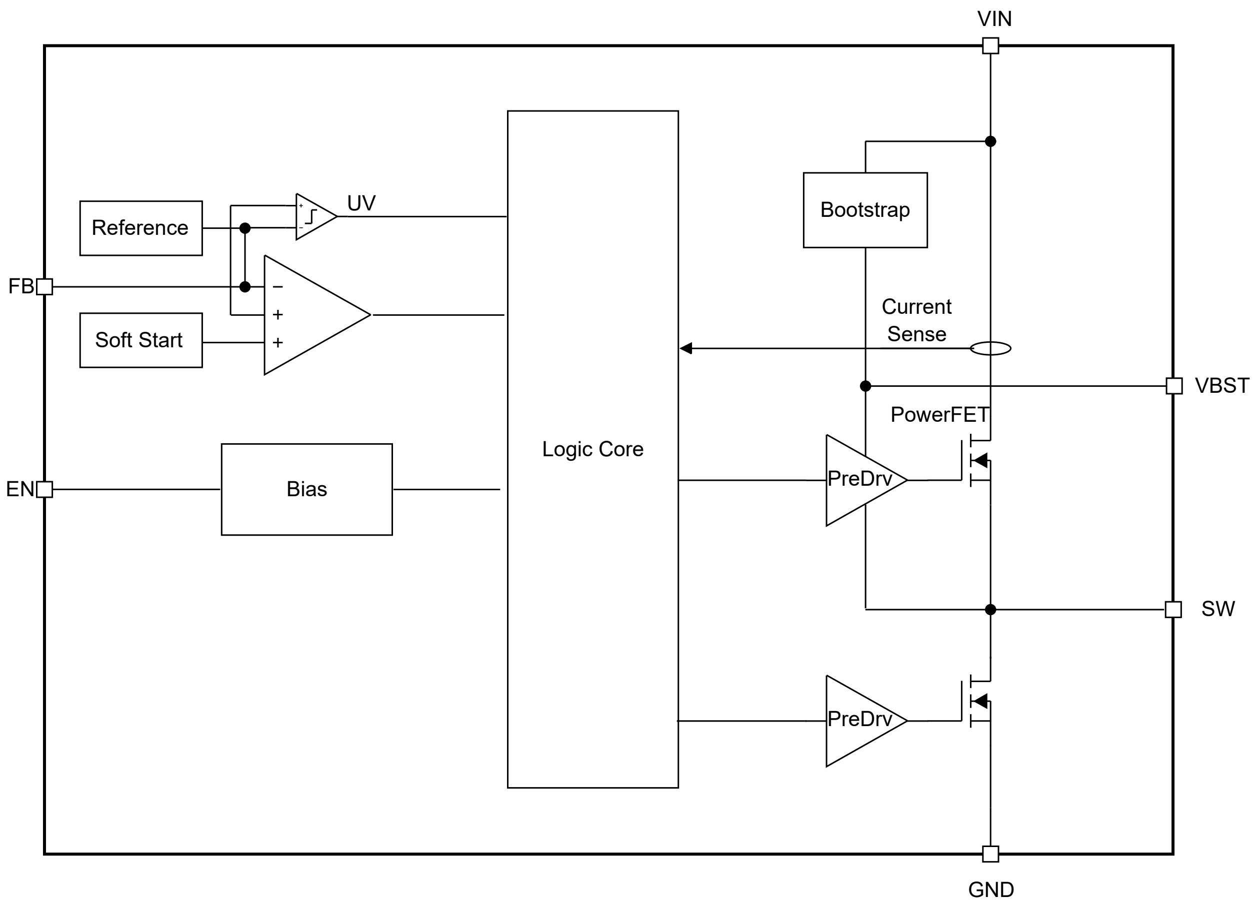


Figure 25. Functional Block Diagram

Feature Description

Current Mode Control

The TPP36208x uses the current mode control topology. The current mode topology supports fixed frequency operation thus optimizing ripple performance. With integrated low $R_{ds(on)}$, the device can achieve high efficiency in a small physical footprint.

Switching Frequency

TPP36208x supports both 500-kHz(TPP362080/TPP362082), 1-MHz (TPP362085/6) and 2.2-MHz switching frequency(TPP362081/TPP362083). 500-kHz has better efficiency due to less switching loss, 2.2-MHz supports high frequency inductor with small form factor and 1-MHz is a good balance in between. 3PEAK recommends to evaluate thermal performance in 1-MHz and 2.2-MHz scenarios especially at high temperature conditions.

Pulse-Skip Mode

To improve light-load efficiency, the TPP362080/1/4 will automatically enter improved light-load mode when the inductor ripple valley current reaches zero. The controller keeps the on-time of the high-side switch unchanged. With a light load, the decay of voltage takes a longer time and lowers the switching frequency accordingly.

Forced-PWM Mode

The TPP362082/3/5 has forced-PWM mode to support low-noise applications. When the inductor ripple valley current reaches zero, the device will automatically enter the forced-PWM mode with a fixed switching frequency. In this mode, the negative current limit of low-side FET is enabled.

Enable Input

The device EN has two current sources to pull EN up high. $I_{EN}$and I_{HYS}. When EN is low, the $I_{EN}$is enabled as I_{EN_L}. When EN rises above the threshold and turns hysteresis current I_{EN_SYS}on, the total current is I_{EN_H}

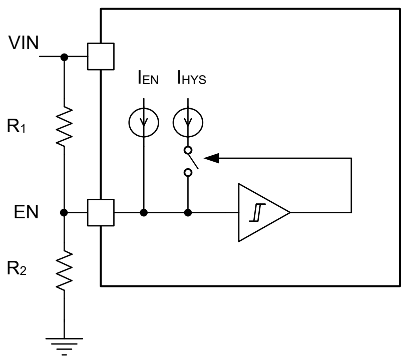


Figure 26. EN Block Diagram

The EN threshold can be set via below equations

(1)

$$R_1 = \frac{V_{ENL}\left(V_{IN\_START} - V_{ENH}\right) - V_{ENH}\left(V_{IN\_STOP} - V_{ENL}\right)}{V_{ENH} \cdot I_{ENH} - V_{ENL} \cdot I_{ENL}}$$

$$R_2 = \frac{V_{ENH}}{I_{ENL} + \frac{V_{IN\_START} - V_{ENH}}{R_1}}$$

Soft-Start with Pre-Biased Capability

Once EN becomes high, the device ramps up its internal reference voltage with a fixed 2-ms rise time. When the output capacitor is pre-charged, the soft-start ramp will only enable output switching after the internal reference ramps above the FB voltage.

Over Current Protection

The device has a cycle-by-cycle current limit. During the OFF state, once overcurrent is detected at ripple current valley by measuring the low-side FET current, the device keeps the low-side FET OFF until the current falls below the over-current protection (OCP) threshold. The device has negative current and can block reverse current when reverse inductor current is higher than threshold.

Output Undervoltage Hiccup Protection

When the device output voltage falls below the hiccup voltage threshold, the device turns into the hiccup mode by turning off the device and restarts after the hiccup timer (typically 60 ms) expires.

To support large output capacitance as large as 1 mF, the device has an extended soft start transition timer. Upon power up, the device gets into soft-start and prevents the device into output under voltage hiccup protection mode until soft start transition time $t_{ss_done}$is over.

Undervoltage Lockout (UVLO) Protection

Once the input voltage falls below the UVLO threshold, the device is shut off. Once the device recovers above the UVLO threshold, the device returns to normal operation.

Over-Temperature Shutdown

Once the junction temperature rises above the internal over-temperature shutdown threshold, the device shuts off and recovers when the temperature falls below the threshold with hysteresis.

Application and Implementation

> Note
>
> Information in the following application sections is not part of the 3PEAK's component specification and 3PEAK does not warrant its accuracy or completeness. 3PEAK's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

Application Information

As an easy-to-use step-down voltage regulator, also known as a buck regulator, the TPP36208x usually coverts a higher input voltage to the desired output voltage set by the VFB resistor divider. The maximum output current is 2 A. The below section depicts a simplified design flow of circuitry for the TPP36208x.

Typical Application

In most 12-V systems, lower voltage rail such as 5 V/3.3 V is a typical need for microcontrollers, I/Os, and other low voltage components. The below application lists the typical schematic for a 5-V buck regulator.

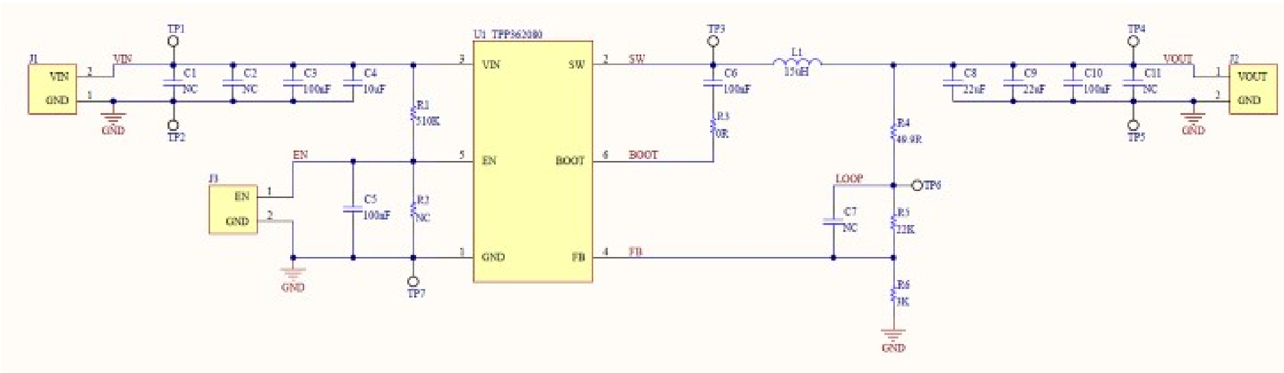


Figure 27. Typical Application Circuit

The following steps provide how to design a buck solution of TPP362080 based on the above

1.To establish the desired output voltage (VOUT), employ equation [1] and proceed with the selection of the resistor divider (R_{HS}/R_{LS}).

$$R_{HS} = R_{LS} \cdot \left(\frac{V_{OUT}}{0.6} - 1\right) \tag{2}$$

2.For the selection of the output inductor (LO), determine the minimum value (LO_MIN) by applying equations below

$$I_{RIPPLE} = \frac{V_{OUT} \cdot (V_{IN\_MAX} - V_{OUT})}{V_{IN\_MAX} \cdot L_O \cdot f_{SW}} \tag{3}$$

$$L_{O\_MIN} = \frac{V_{OUT} \cdot (V_{IN\_MAX} - V_{OUT})}{V_{IN\_MAX} \cdot f_{SW} \cdot I_{OUT} \cdot r} \tag{4}$$

$$I_{LO\_RMS} = \sqrt{I_{OUT}^2 + \frac{I_{RIPPLE}^2}{12}} \tag{5}$$

$$I_{LO\_PEAK} = I_{OUT} + \frac{I_{RIPPLE}}{2} \tag{6}$$

Where V_{IN_MAX} represents the maximum input voltage, r denotes the ratio between the inductor ripple current (I_{RIPPLE}) and the maximum output current (I_{OUT}), I_{LO_RMS} signifies the RMS inductor current, and I_{LO_PEAK} represents the peak inductor current. Typically, a value of 0.3 is chosen when utilizing low ESR output capacitors. For the TPP362080 with an f_{SW} of 500kHz, we recommend selecting an inductor with I_{OUT}= 2A and r=0.3, regardless of the operating conditions.

For example, when V_{IN_MAX}= 36V and V_{OUT}= 5V, the minimum value of the output inductor $I_{(LO_MIN)}$is calculated to be approximately 14.3uH. In this case, a standard inductor with a rating of 15μH, a saturation current of 4.1A, and a rated current of 3.5A would be suitable.

3.Choose the Output Capacitor (C_{OUT})

For the selection of the output capacitor (C_{OUT}), determine the minimum value (C_{O_MIN}) by employing equations below.

$$C_{O\_MIN} \geq \frac{2\Delta I_{OUT}}{f_{SW} \cdot \Delta V_{OUT}} \quad (7)$$

$$C_{O\_MIN} \geq L_O \cdot \frac{I_{Oi}^2 - I_{Of}^2}{V_f^2 - V_i^2} \quad (8)$$

$$\Delta I_{OUT} = I_{Oi} - I_{Of} \quad (9)$$

$$C_{O\_MIN} \geq \frac{I_{RIPPLE}}{8f_{SW} \cdot V_{O\_RIPPLE}} \quad (10)$$

$$R_{ESR} \leq \frac{V_{O\_RIPPLE}}{I_{RIPPLE}} \quad (11)$$

$$I_{CO\_RMS} \geq \frac{V_{OUT} \times \left(V_{IN\_MAX} - V_{OUT}\right)}{\sqrt{12} \cdot V_{IN\_MAX} \cdot L_O \cdot f_{SW}} \quad (12)$$

Where ΔI_{OUT} represents the change in output current, I_{Oi} signifies the heavy load output current, and I_{Of} represents the light load output current during load transient. ΔV_{OUT} denotes the allowable change in output voltage, while Vi represents the initial output voltage and V_f represents the maximum allowable output voltage during the transient from light load to heavy load. V_{O_RIPPLE} represents the maximum allowable value of output voltage ripple under maximum output current conditions. R_{ESR} indicates the equivalent series resistance of the output capacitor, and I_{CO_RMS} represents the RMS current of the output capacitor.

As an example, let's consider V_{OUT}= 5V, ΔI_{OUT}= 1.5A - 0.5A = 1A, V_{O_RIPPLE}< 50mV, and ΔV_{OUT}< 250mV. In this case, a minimum output capacitance of approximately 26μF with an ESR of less than 35mΩ is calculated. Therefore, with capacitance derating in consideration, 2 * 22μF ceramic capacitors rated at 25V with an ESR of 5mΩ will be used.

4.Choosing the Bootstrap Capacitor (C_{BST})

To ensure proper operation of the TPP362080 device, a 0.1μF ceramic capacitor should be connected between the BOOT and SW pins. It is recommended to use a ceramic capacitor with X5R or superior grade dielectric and a voltage rating of 10V or higher.

5.Choosing the Input Capacitor (C_{IN})

To ensure proper operation of the TPP362080 device, it is necessary to connect a 10μF capacitor between the VIN and GND pins with a short PCB trace. It is recommended to use a ceramic capacitor with X5R or superior grade dielectric and a voltage rating of 50V or higher. Additionally, it is common to include a 0.1μF, 50V decoupling ceramic capacitor as an input capacitor.

Component Selection

	EVM: F_{sw}= 500 kHz, MODE = Pulse-Skip, I_{OUT}= 2 A, t_{SS}= 2 ms, V_{OUT}= 5 V					
Designator	**Value**	**Quantity**	**Part No.**	**Package**	**Manufacturer**	**Description**
U1	TPP362080	Buck Converter,	TSOT23-6	3PEAK	TPP362080-T6TR	1

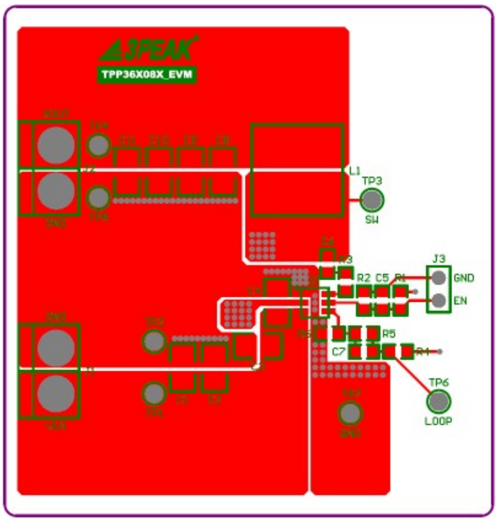
	EVM: F_{sw}= 500 kHz, MODE = Pulse-Skip, I_{OUT}= 2 A, t_{SS}= 2 ms, V_{OUT}= 5 V					
Designator	Value	Quantity	Part No.	Package	Manufacturer	Description
		36V, 1A, 500kHz, PFM				
C1	NC	0				
C2	NC	0				
C3	100 nF	1	GGD21BR71H104KA02	0805	muRata	Capacitor, 100 nF, 50VDC, X7R, ±15%
C4	10 µF	1	GCM32EC71H106MA03L	1210	muRata	Capacitor, 10 µF, 50VDC, X7S, ±22%
R1	510 K	1	ARG03FTC5103	0603	Viking	Resistor, 510 K, ±1%, 0.1 W
C5	NC	0				
R2	100 K	1	ARG03FTC1003	0603	Viking	Resistor, 100 K, ±1%, 0.1 W
C6	100 nF	1	GRM188R71C104KA01D	0603	muRata	Capacitor, 100 nF, 16VDC, X7R, ±15%
C7	NC	0				
R3	0 R	1	ERJ-3GEY0R00V	0603	Panasonic	Resistor, 0 Ω, 5%, 0.1 W
L1	15 µH	1	7447714150	10mm × 5mm × 10mm	Wurth Elektronik eiSos	Inductor, 15 µH, 3.5 A, 36ohm, ±20%
C8	22 µF	1	GRM32ER71E226ME15L	1210	muRata	Capacitor, 22 µF, 25VDC, X7R, ±15%
C9	22 µF	1	GRM32ER71E226ME15L	1210	muRata	Capacitor, 22 µF, 25VDC, X7R, ±15%
C10	100 nF	1	GGD21BR71H104KA02	0805	muRata	Capacitor, 100 nF, 50VDC, X7R, ±15%
C11	NC	0				
R4	49.9 R	1	ARG03FTC49R9	0603	Viking	Resistor, 49.9 Ω, ±1%, 0.1 W
R5	22 K	1	ARG03FTC2202	0603	Viking	Resistor, 22 K, ±1%, 0.1 W
R6	3 K	1	ARG03FTC3001	0603	Viking	Resistor, 3 K, ±1%, 0.1 W

Layout

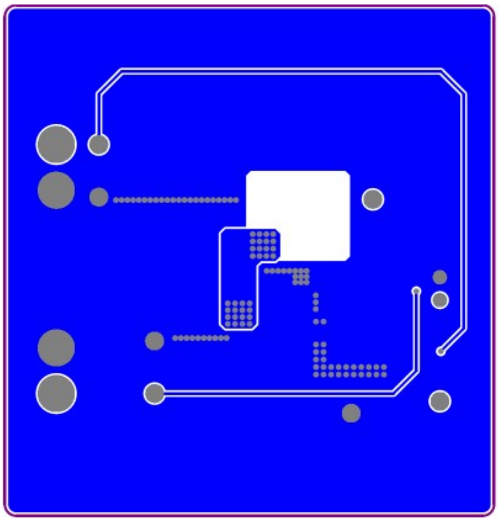
Layout Guideline

- Both input capacitors and output capacitors must be placed to the device pins as close as possible.
- It is recommended to bypass the input pin to ground with a 0.1-μF bypass capacitor.
- It is recommended to use wide and thick copper to minimize I×R drop and heat dissipation.
- Exposed pad must be connected to the PCB ground plane directly, the copper area must be as large as possible.

Layout Recommendations

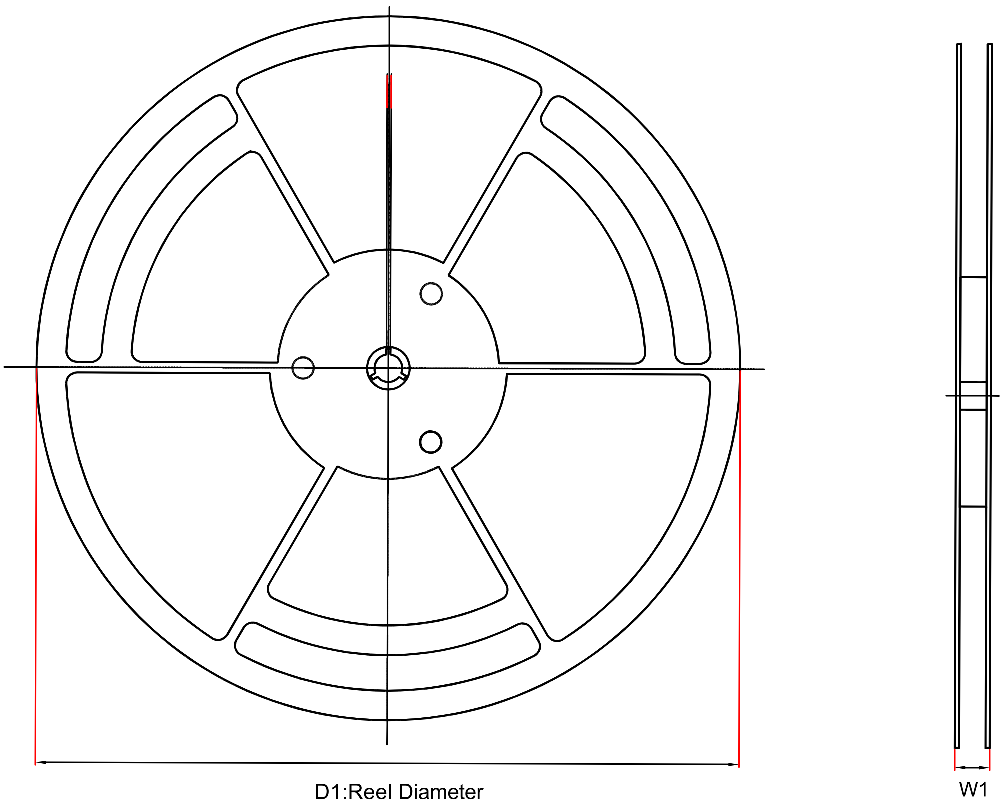


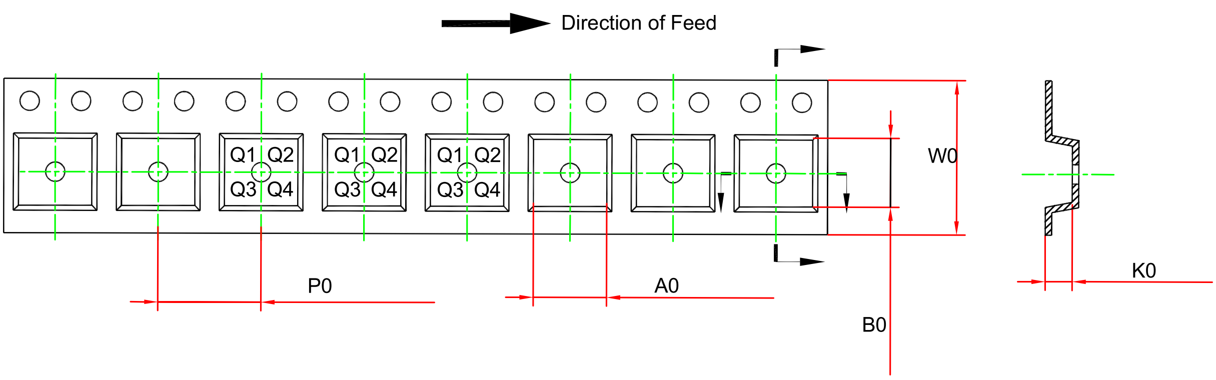
Top Layer



Bottom Layer

Tape and Reel Information





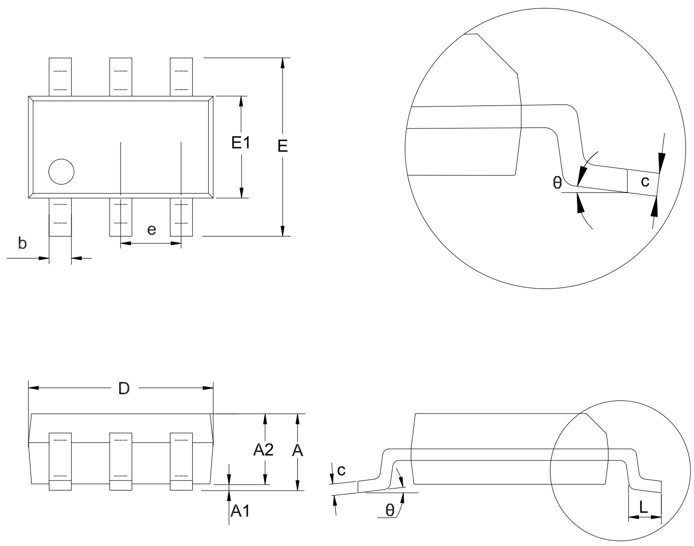
Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPP362080-T6TR	TSOT23-6	180.0	12.3	3.2	3.2	1.1	4.0	8.0	Q3
TPP362081-T6TR	TSOT23-6	180.0	12.3	3.2	3.2	1.1	4.0	8.0	Q3
TPP362082-T6TR	TSOT23-6	180.0	12.3	3.2	3.2	1.1	4.0	8.0	Q3

Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPP362083-T6TR	TSOT23-6	180.0	12.3	3.2	3.2	1.1	4.0	8.0	Q3
TPP362084-T6TR	TSOT23-6	180.0	12.3	3.2	3.2	1.1	4.0	8.0	Q3
TPP362085-T6TR	TSOT23-6	180.0	12.3	3.2	3.2	1.1	4.0	8.0	Q3

Package Outline Dimensions

TSOT23-6

Package Outline Dimensions T6T(TSOT23-6-A)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.700	0.950	0.028	0.037
A1	0.000	0.150	0.000	0.006
A2	0.650	0.850	0.026	0.033
b	0.360	0.500	0.014	0.020
c	0.130	0.230	0.005	0.009
D	2.820	3.050	0.111	0.120
E	2.600	3.000	0.102	0.118
E1	1.500	1.700	0.059	0.067
e	0.950 BSC		0.037 BSC	
L	0.300	0.600	0.012	0.024
θ	0	8°	0	8°

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPP362080-T6TR	−40 to 125°C	TSOT23-6	320	MSL3	Tape and Reel, 3000	Green
TPP362081-T6TR	−40 to 125°C	TSOT23-6	321	MSL3	Tape and Reel, 3000	Green
TPP362082-T6TR	−40 to 125°C	TSOT23-6	322	MSL3	Tape and Reel, 3000	Green
TPP362083-T6TR	−40 to 125°C	TSOT23-6	323	MSL3	Tape and Reel, 3000	Green
TPP362084-T6TR	−40 to 125°C	TSOT23-6	324	MSL3	Tape and Reel, 3000	Green
TPP362085-T6TR	−40 to 125°C	TSOT23-6	325	MSL3	Tape and Reel, 3000	Green

Green: 3PEAK defines "Green" to mean RoHS compatible and free of halogen substances.

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