36-V Input, 1-A Synchronous Step-Down Voltage Regulator

Features

- Wide Supply Voltage: 4.5 V to 36 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 (TPP361060/2)
  - 1 MHz (TPP361064/5)
  - 2.2 MHz (TPP361061/3)
- Low 2-μA Shutdown, 70-μA Quiescent Current
- Internal Light Load Power-Save Mode for High Efficiency at Light Load (TPP361060/1/4)
- Forced-PWM Mode for Low Output Ripple (TPP361062/3/5)
- 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

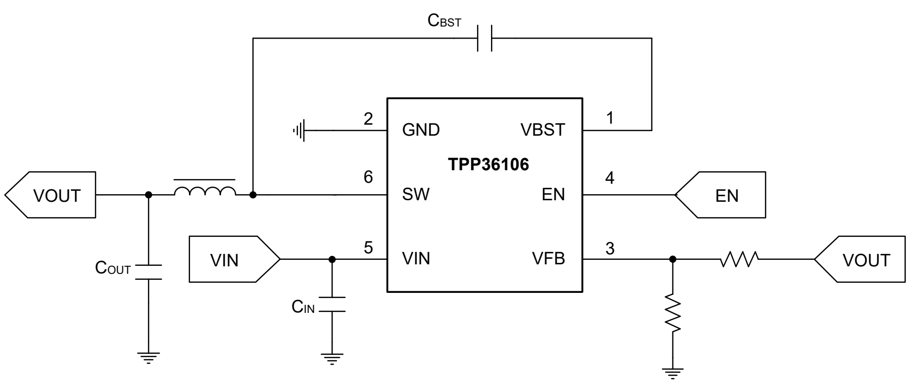
The TPP36106x series is a simple, easy-to-use, 1-A output, synchronous, step-down, and switch-mode converter with internal power MOSFETs.

The TPP36106x integrates low-$R_{DS(ON)}$ power transistors in the TSOT23-6 package with internal soft-start, compensation, and protection features. The TPP36106x offers a very compact solution to achieve 1-A continuous output current over a wide input supply range, with excellent load and line regulation.

The TPP36106x has different versions of switching frequency at 500-kHz, 1-MHz, and 2.2-MHz, and also supports light load PSM mode to save quiescent current and forced-PWM mode to maintain 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



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Product Family Table

Orderable Part Number	Frequency	Low Output Current Mode
TPP361060-T6TR	500 kHz	Pulse-Skip Mode
TPP361061-T6TR	2.2 MHz	Pulse-Skip Mode
TPP361062-T6TR	500 kHz	Forced PWM Mode
TPP361063-T6TR	2.2 MHz	Forced PWM Mode
TPP361064-T6TR	1 MHz	Pulse-Skip Mode
TPP361065-T6TR	1 MHz	Forced PWM Mode

Revision History

Date	Revision	Notes
2023-02-13	Rev A.0	Initial release
2023-05-12	Rev A.1	Updated electrical table, description, and typical applications.
2024-04-01	Rev A.2	Updated recommended operating conditions and maximum duty cycle.
2024-08-28	Rev A.3	Updated family table.

Pin Configuration and Functions

TPP36106
TSOT23-6
Top View

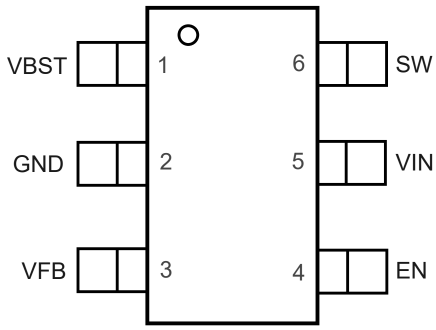


Table 1. Pin Functions: TPP36106

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

Specifications

Absolute Maximum Ratings (1)

Symbol	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	5.5	V
FB	Feedback Voltage	−0.3	5.5	V
EN	Enable Input	−0.3	42	V
T_J	Maximum Junction Temperature		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

Symbol	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	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 Input Voltage Range	0	5.5	V
SW	SW 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 conditions: 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	1.17	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		116.2		mΩ
f_{SW}	Switching Frequency	TPP361060/2	390	500	590	kHz
		TPP361061/3	1.76	2.2	2.64	MHz
		TPP361064/5	0.8	1	1.2	MHz
D_{MAX}	Maximum duty cycle			93		%
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	1.2	1.5	1.8	A
I_{Limit_LS}	Low-side Current Limit	Inductor valley current	0.9	1.2	1.5	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			40		%
$V_{FB\_UVP\_falling}$	FB Hiccup Protection Falling Ratio			33		%
$V_{FB\_OVP\_rising}$	FB Over-Voltage Protection Rising Ratio			108		%

Parameter		Conditions	Min	Typ	Max	Unit
$V_{FB\_OVP\_falling}$	FB Over-Voltage Protection Falling Ratio			107		%
t_{HIC_wait}	Hiccup Protection Wait Time			128		Cycles
$t_{HIC\_restart}$	Hiccup Protection Restart Time			60		ms
Thermal Shut-Down						
T_{SD}	Thermal Shut-Down Temperature			160		°C
T_{SD_hys}	Thermal Hysteresis			10		°C

(1) Guaranteed by design.

Typical Performance Characteristics

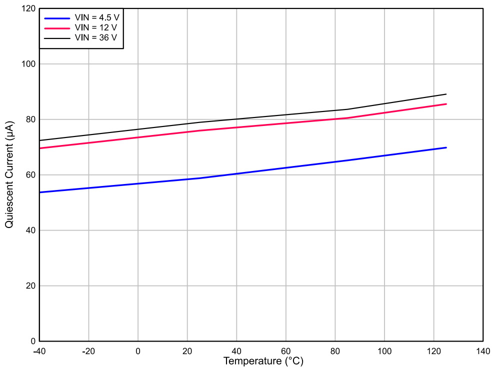


Figure 1. Quiescent Current vs. Supply Voltage

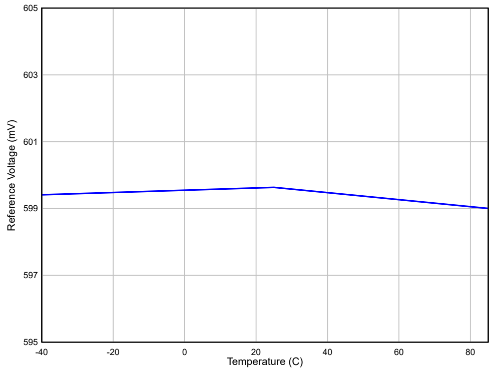


Figure 2. Reference Voltage vs. Temperature

V_{IN} = 12 V

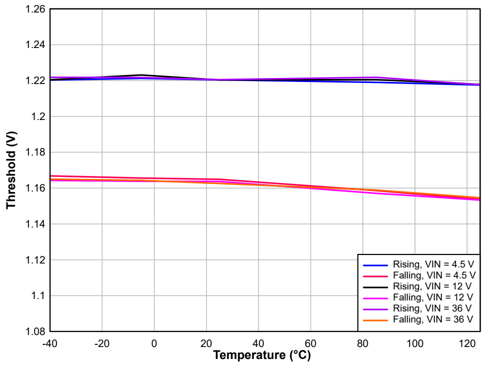


Figure 3. EN Threshold vs. Junction Temperature

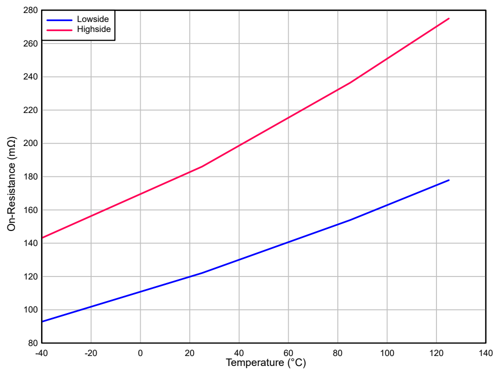


Figure 4. On-Resistance vs Temperature

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

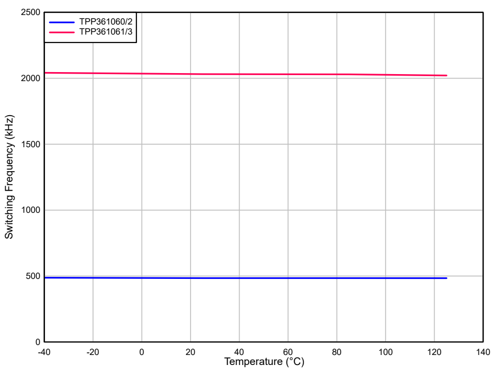


Figure 5. Switching Frequency vs. Temperature

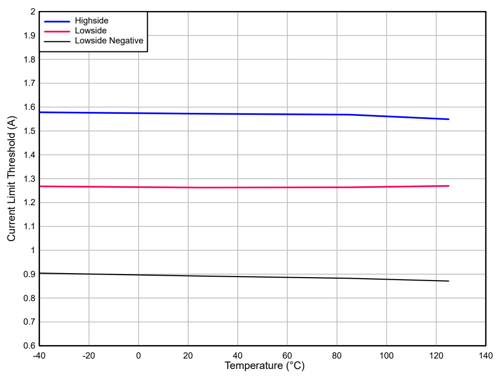


Figure 6. Current Limit vs. Temperature

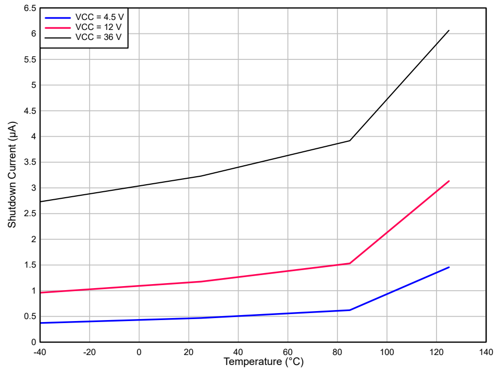


Figure 7. Shutdown Current vs Junction Temperature

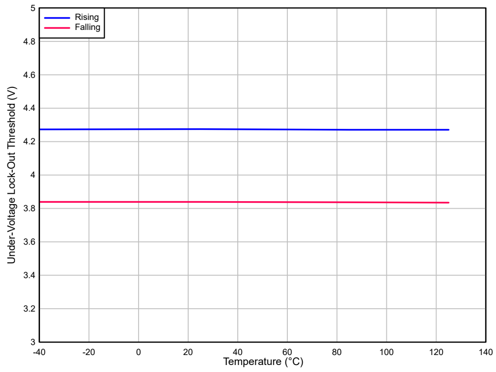


Figure 8. UVLO Threshold vs Temperature

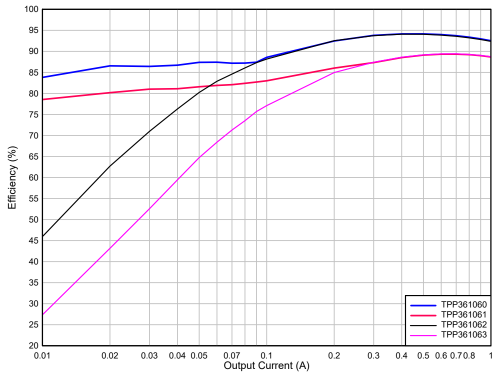


Figure 9. Efficiency vs. Output Current

V_{IN} = 12 V, V_{OUT} = 5 V, L = 2.2 µH

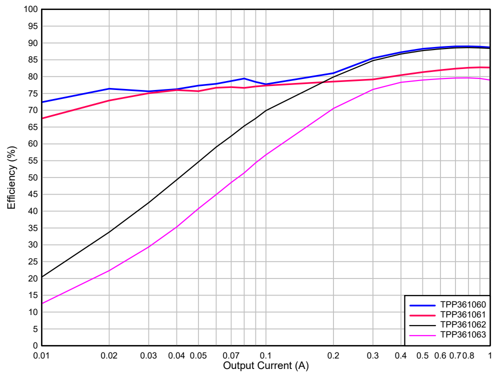


Figure 10. Efficiency vs. Output Current

V_{IN} = 36 V, V_{OUT} = 5 V, L = 2.2 µH

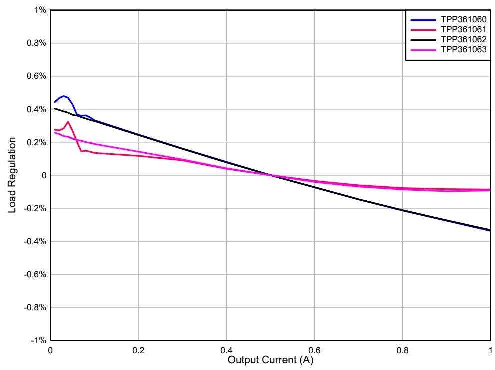


Figure 11. Load Regulation

V_{OUT} = 5 V

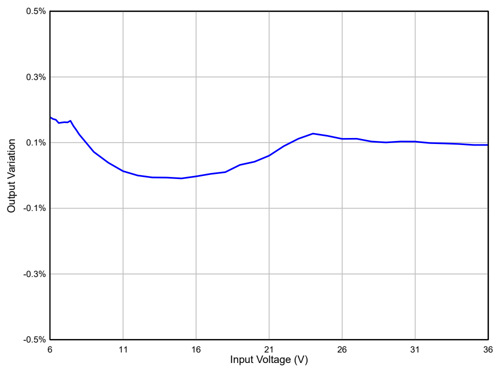


Figure 12. Line Regulation

V_{OUT} = 5 V

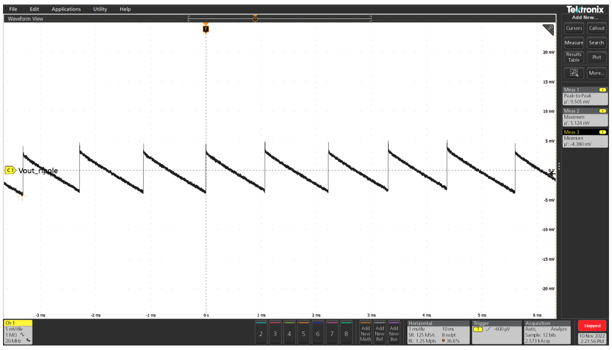


Figure 13. Pulse Skip Mode Output Voltage Ripple

CH1: V_{OUT} Ripple

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

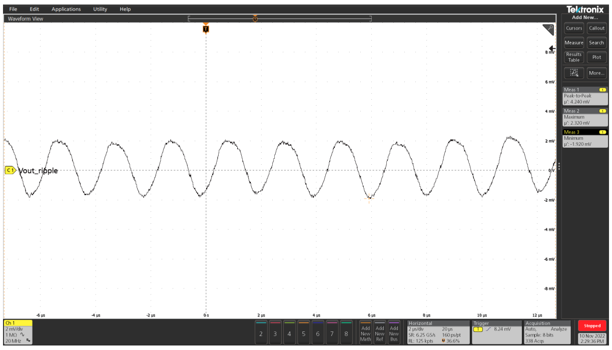


Figure 14. Pulse Skip Mode Output Voltage Ripple

CH1: V_{OUT} Ripple

V_{IN} = 12 V, V_{OUT} = 5 V, I_{OUT} = 100 mA

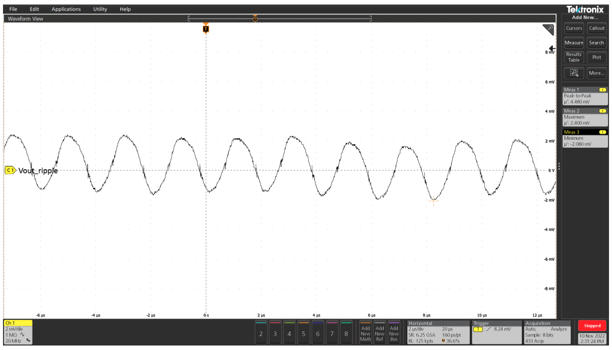


Figure 15. Output Voltage Ripple

CH1: V_{OUT} Ripple

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

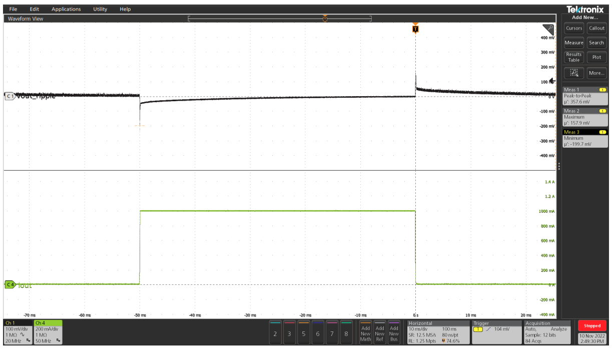


Figure 16. Load Transient

CH1: V_{OUT} Ripple, CH4: Load Current

V_{IN} = 12 V, V_{OUT} = 5 V, I_{OUT} = 0 A to 1 A to 0A

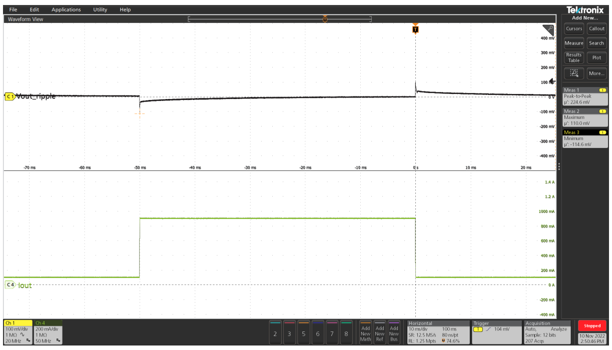


Figure 17. Load Transient

CH1: V_{OUT} Ripple, CH4: Load Current

V_{IN} = 12 V, V_{OUT} = 5 V, I_{OUT} = 0.1 A to 0.9 A to 0.1A

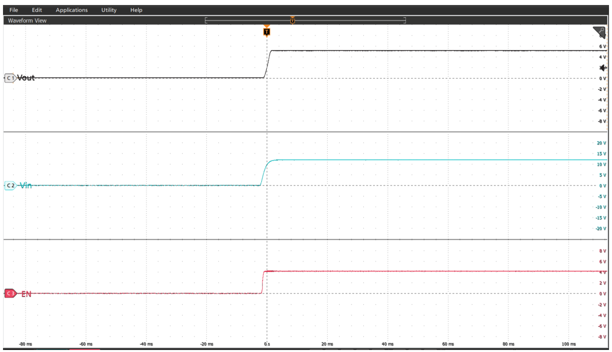


Figure 18. Start-Up by VIN

CH1: V_{OUT}, CH2: V_{IN}, CH3: V_{EN}

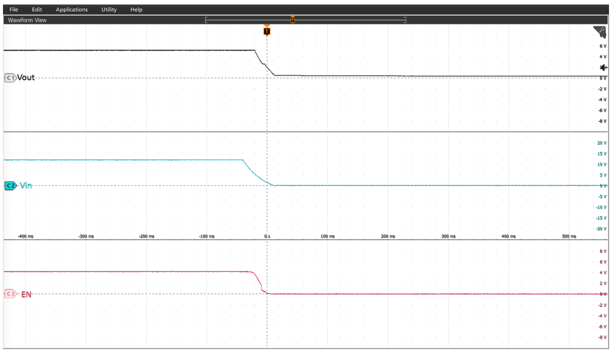


Figure 19. Power-Down by VIN

CH1: V_{OUT}, CH2: V_{IN}, CH3: V_{EN}

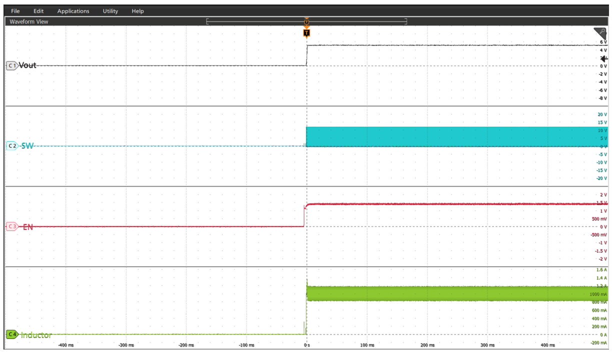


Figure 20. Start-Up by EN

CH1: V_{OUT}, CH2: SW, CH3: V_{EN} , CH4: I_L

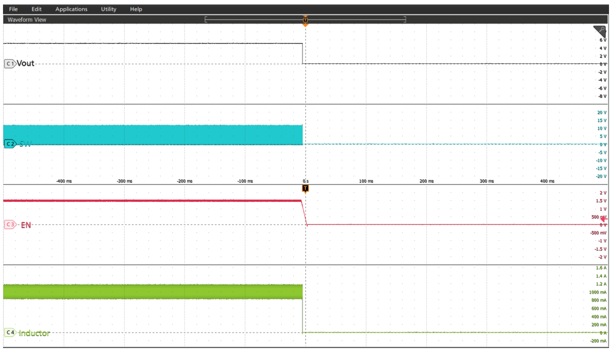


Figure 21. Power-Down by EN

CH1: V_{OUT}, CH2: SW, CH3: V_{EN}, CH4: I_L

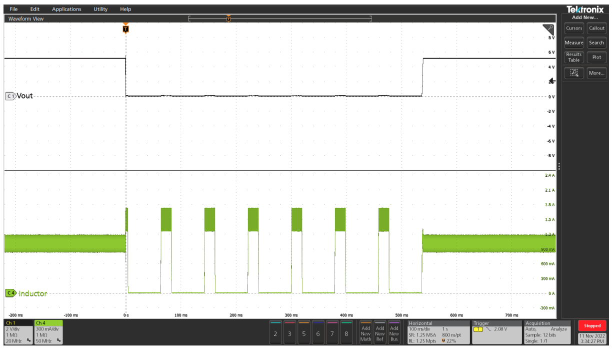


Figure 22. Hiccup Protection

CH1: V_{OUT}, CH4: I_L

Detailed Description

Overview

The TPP36106x is a 1-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
TPP361060-T6TR	500 kHz	Pulse-Skip Mode
TPP361061-T6TR	2.2 MHz	Pulse-Skip Mode
TPP361062-T6TR	500 kHz	Forced-PWM Mode
TPP361063-T6TR	2.2 MHz	Forced-PWM Mode
TPP361064-T6TR	1 MHz	Pulse-Skip Mode
TPP361065-T6TR	1 MHz	Forced-PWM Mode

Functional Block Diagram

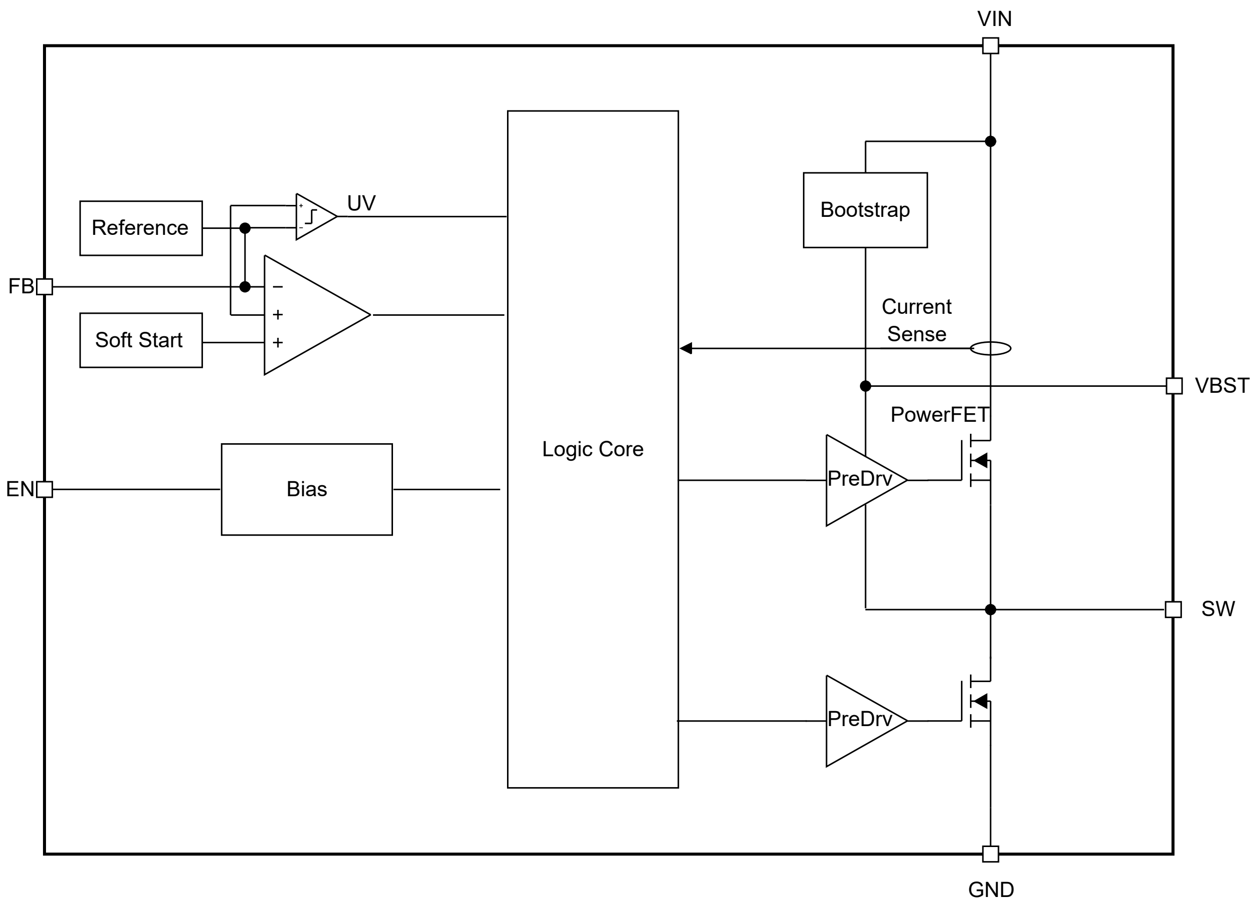


Figure 23. Functional Block Diagram

Feature Description

Current Mode Control

The TPP36106x 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

The TPP36106x supports both 500-kHz (TPP361060/TPP361062), 1-MHz (TPP361064/5), and 2.2-MHz switching frequency(TPP361061/TPP361063). 500-kHz has better efficiency due to less switching loss, 2.2-MHz supports high-frequency inductors with small form factor and 1-MHz is a good balance in between. 3PEAK recommends evaluating thermal performance in 1-MHz and 2.2-MHz scenarios, especially at high-temperature conditions.

Pulse-Skip Mode

To improve light-load efficiency, the TPP361060/1/4 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 the same. With a light load, the decay of voltage takes a longer time and lowers the switching frequency accordingly.

Forced-PWM Mode

The TPP361062/3/5 has Forced-PWM mode to support low-noise applications. When the inductor ripple valley current reaches zero, the device will automatically enter 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}.

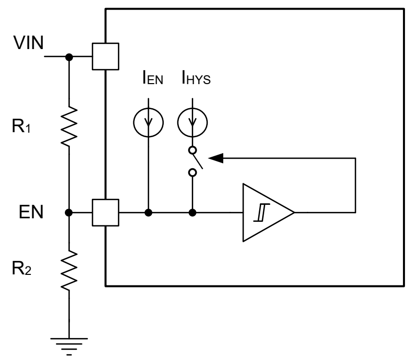


Figure 24. EN Block Diagram

The EN threshold can be set via the equations below:

$$R_1 = \frac{V_{ENL}\left(V_{IN\_START} - V_{ENH}\right) - V_{ENH}\left(V_{IN\_STOP} - V_{ENL}\right)}{V_{ENH} \cdot I_{ENH} - V_{ENL} \cdot I_{ENL}} \quad (1)$$

$$R_2 = \frac{V_{ENH}}{I_{ENL} + \frac{V_{IN\_START} - V_{ENH}}{R_1}} \quad (2)$$

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 internal reference ramps above the FB voltage.

Over Current Protection

The device has a cycle-by-cycle current limit. During the OFF state, once the over current is detected at the 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 a negative current and can block reverse current when the reverse inductor current is higher than the threshold.

Output Undervoltage Hiccup Protection

When the device output voltage falls below the hiccup voltage threshold, the device gets into 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 from 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 across 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, industrial pinout, step-down voltage regulator, also known as a buck regulator, the TPP36106x usually converts a higher input voltage to the desired output voltage set by the VFB resistor divider. The maximum output current is 1 A. The below section depicts a simplified design flow of circuitry for the TPP36106x.

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.

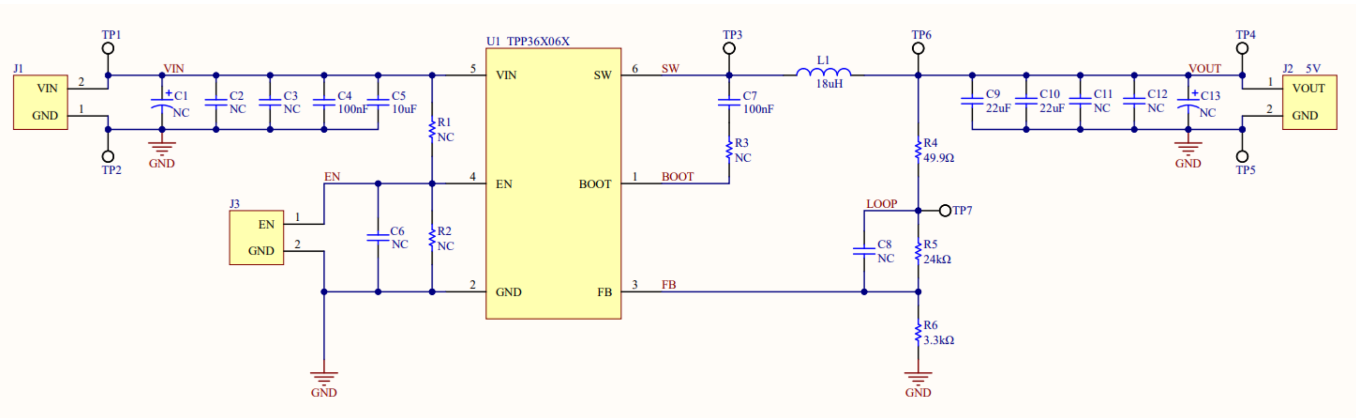


Figure 25. Typical Application Circuit

The following steps provide how to design a buck solution for the TPP361060 based on the above.

1. To establish the desired output voltage (VOUT), employ Equation 3 and proceed with the selection of the resistor divider (R_{HS}/R_{LS}).

$$R_{HS} = R_{LS} \cdot \left(\frac{V_{OUT}}{0.6} - 1\right) \tag{3}$$

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

$$I_{RIPPLE} = \frac{V_{OUT} \cdot (V_{IN\_MAX} - V_{OUT})}{V_{IN\_MAX} \cdot L_O \cdot f_{SW}} \tag{4}$$

$$L_{O\_MIN} = \frac{V_{OUT} \cdot (V_{IN\_MAX} - V_{OUT})}{V_{IN\_MAX} \cdot f_{SW} \cdot I_{OUT} \cdot r} \tag{5}$$

$$I_{LO\_RMS} = \sqrt{I_{OUT}^2 + \frac{I_{RIPPLE}^2}{12}} \tag{6}$$

$$I_{LO\_PEAK} = I_{OUT} + \frac{I_{RIPPLE}}{2} \tag{7}$$

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 0.2-0.5 is chosen when utilizing low ESR output capacitors. For the TPP361060 with an f_{SW} of 500kHz, we recommend selecting an inductor with I_{OUT} = 1A and r =0.5, regardless of the operating conditions.
For example, when V_{IN_MAX}= 36 V and V_{OUT} = 5 V, the minimum value of the output inductor $I_{(LO\_MIN)}$ is calculated to be approximately 17.2 uH. In this case, a standard inductor with a rating of 18μH, a saturation current of 2.05 A, and a rated current of 1.5 A would be suitable.

3. Choose the Output Capacitor (C_{OUT})
   For the selection of the output capacitor (C_{OUT}), the minimum value (C_{O_MIN}) is determined by employing equations below.

$$C_{O\_MIN} \geq \frac{2\Delta I_{OUT}}{f_{SW} \cdot \Delta V_{OUT}} \tag{8}$$

$$C_{O\_MIN} \geq L_O \cdot \frac{I_{Oi}^2 - I_{Of}^2}{V_f^2 - V_i^2} \tag{9}$$

$$\Delta I_{OUT} = I_{Oi} - I_{Of} \tag{10}$$

$$C_{O\_MIN} \geq \frac{I_{RIPPLE}}{8 f_{SW} \cdot V_{O\_RIPPLE}} \tag{11}$$

$$R_{ESR} \leq \frac{V_{O\_RIPPLE}}{I_{RIPPLE}} \tag{12}$$

$$I_{CO\_RMS} \geq \frac{V_{OUT} \times \left(V_{IN\_MAX} - V_{OUT}\right)}{\sqrt{12} \cdot V_{IN\_MAX} \cdot L_O \cdot f_{SW}} \tag{13}$$

   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} = 5 V, ΔI_{OUT} = 0.75 A - 0.25 A = 0.5 A, V_{O_RIPPLE} < 25 mV, and ΔV_{OUT} < 100 mV. In this case, a minimum output capacitance of approximately 20 μF with an ESR of less than 53 mΩ is calculated. Therefore, with capacitance derating in consideration, 2 * 22 μF ceramic capacitors rated at 25 V with an ESR of 5 mΩ will be used.
4. Choosing the Bootstrap Capacitor (C_{BST})
   To ensure proper operation of the TPP36106x device, a 0.1 μF 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 10 V or higher.
5. Choosing the Input Capacitor (C_{IN})
   To ensure proper operation of the TPP36106x device, it is necessary to connect a 10 μF 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 50 V or higher. Additionally, it is common to include a 0.1 μF, 50 V decoupling ceramic capacitor as an input capacitor.

Component Selection

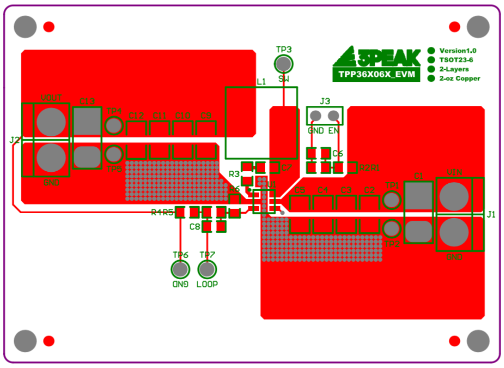
	EVM: V_{OUT} = 5 V					
RefDes	**Value**	**Description**	**Package**	**MFR**	**Part No.**	**Qty**
U1		Buck Converter, 36 V, 1 A, 500 kHz, PFM	TSOT23-6	3PEAK	TPP361060-T6TR	1
C1	NC					0
C2	NC					0
C3	NC					0
C4	100nF	Capacitor, 100 nF, 50 V DC, X7R, ±10%	0805	YAGEO	CC0805KRX7R9BB104	1
R1	NC					0
C5	10uF	Capacitor, 10 uF, 50 V DC, X7R, ±15%	1210	muRata	GXM32ER71H106KA10L	1
R2	NC					0
C6	NC					0
C7	100nF	Capacitor, 100 nF, 50 V DC, X7R, ±10%	0805	YAGEO	CC0805KRX7R9BB104	0
R3	0R	Resistor, 0 Ω, 5%, 0.1W	0603	Panasonic	ERJ-3GEY0R00V	1
L1	18uH	18 uH, 5 ARat, 3.8 ASat, 34.4 mohm	10×4×10mm	Wurth	7447798181	1
C8	NC					0
C9	22uF	Capacitor, 22 uF, 25 V DC, X7R, ±15%	1210	muRata	GRM32ER71E226ME15L	1
C10	22uF	Capacitor, 22 uF, 25 V DC, X7R, ±15%	1210	muRata	GRM32ER71E226ME15L	1
C11	NC					0
C12	NC					0
C13	NC					0
R4	49.9Ω	Resistor, 49.9 Ω, ±1%, 0.1 W	0603	Viking	ARG03FTC49R9	1
R5	24K	Resistor, 24 K, ±1%, 0.1 W	0603	Viking	ARG03FTC2402	1
R6	3.3K	Resistor, 3.3 K, ±1%, 0.1 W	0603	Viking	ARG03FTC3301	1

Layout

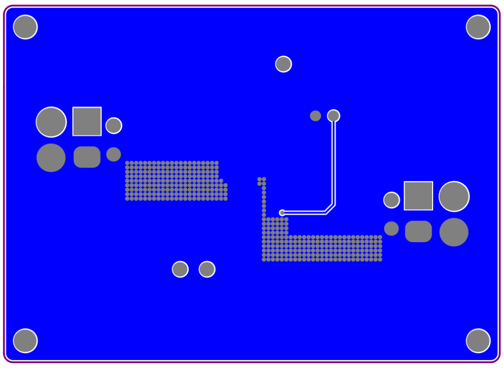
Layout Guideline

- 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.

Layout Recommendations

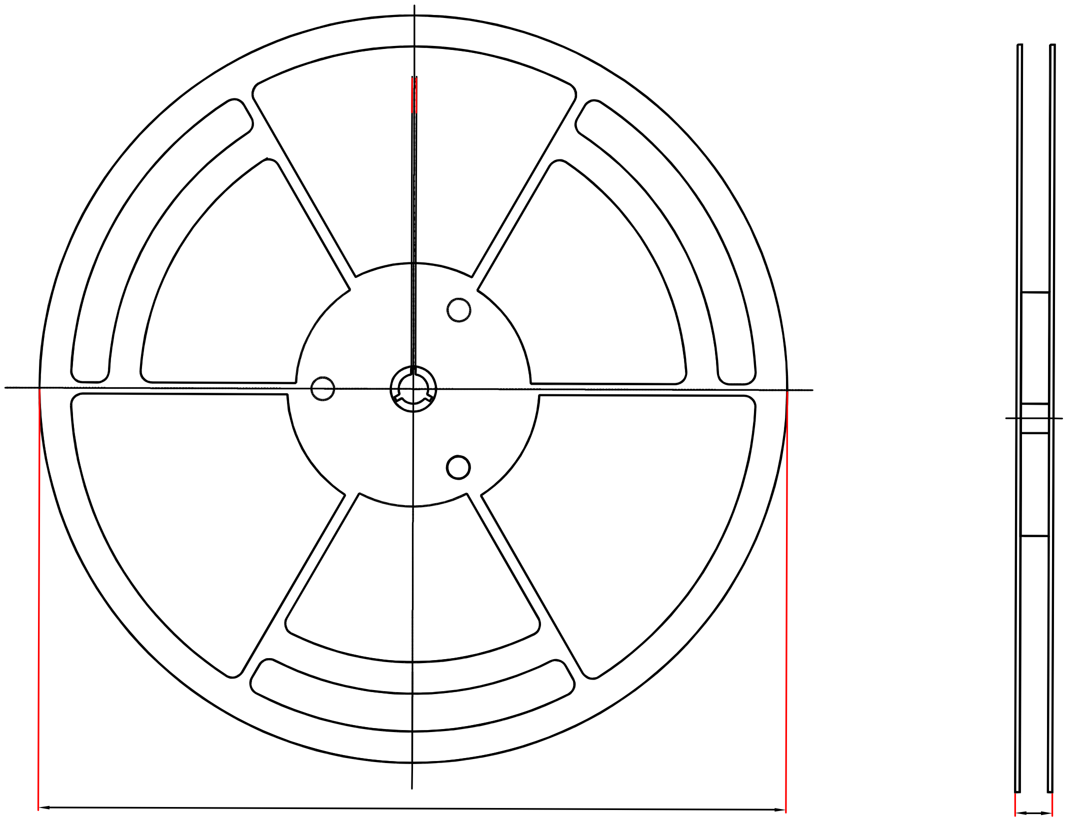


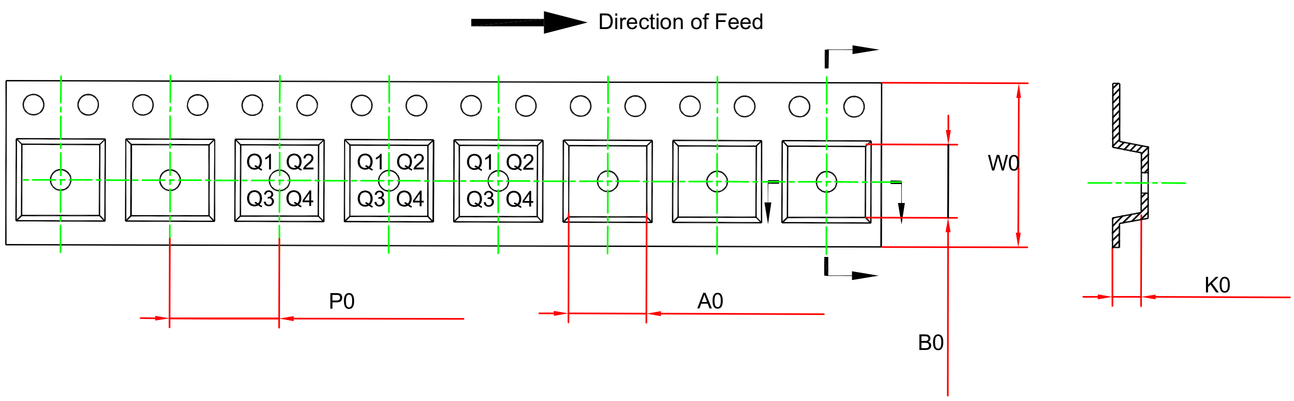
Top Layer



Bottom Layer

Tape and Reel Information





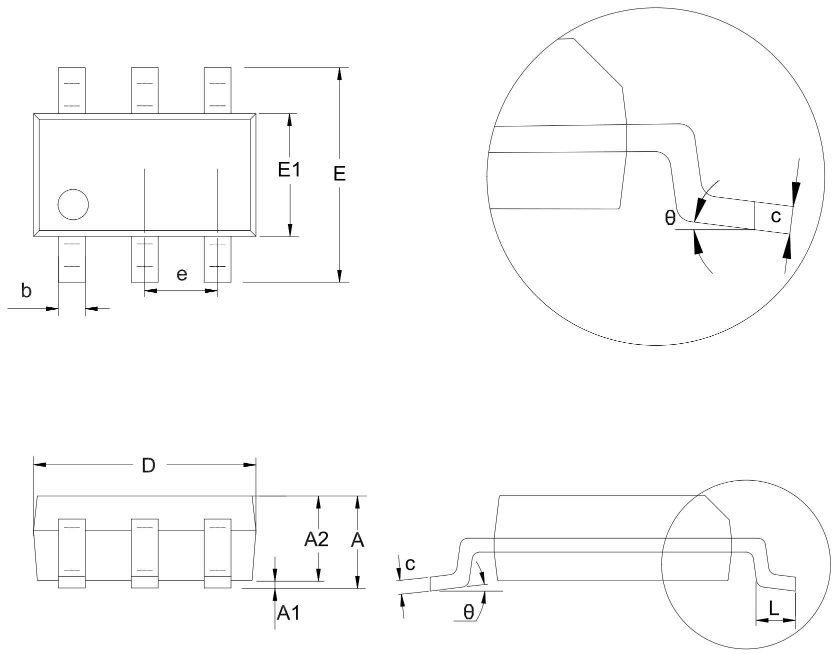
Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPP361060-T6TR	TSOT23-6	178	12.3	3.2	3.05	1.1	4.0	8.0	Q3
TPP361061-T6TR	TSOT23-6	178	12.3	3.2	3.05	1.1	4.0	8.0	Q3

Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPP361062-T6TR	TSOT23-6	178	12.3	3.2	3.05	1.1	4.0	8.0	Q3
TPP361063-T6TR	TSOT23-6	178	12.3	3.2	3.2	1.1	4.0	8.0	Q3
TPP361064-T6TR	TSOT23-6	178	12.3	3.2	3.05	1.1	4.0	8.0	Q3
TPP361065-T6TR	TSOT23-6	178	12.3	3.2	3.05	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
TPP361060-T6TR	−40 to 125°C	TSOT23-6	610	MSL1	Tape and Reel, 3000	Green
TPP361061-T6TR	−40 to 125°C	TSOT23-6	611	MSL1	Tape and Reel, 3000	Green
TPP361062-T6TR	−40 to 125°C	TSOT23-6	612	MSL1	Tape and Reel, 3000	Green
TPP361063-T6TR	−40 to 125°C	TSOT23-6	613	MSL1	Tape and Reel, 3000	Green
TPP361064-T6TR	−40 to 125°C	TSOT23-6	614	MSL1	Tape and Reel, 3000	Green
TPP361065-T6TR	−40 to 125°C	TSOT23-6	615	MSL1	Tape and Reel, 3000	Green

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

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