Low-Voltage Supervisory Circuits with Power-Fail Detector

Features

- Precision Low-Voltage Monitoring and Power-Fail Detector
- 200-ms (typical) Reset Timeout
- Manual Reset Input
- Independent Watchdog Timer
- Reset Output Stage
- Push-pull Active-low Output (TPV706)
- Low Power Consumption: 4-μA
- Guaranteed Reset Output Valid to VCC = 1 V
- Power Supply Glitch Immunity
- Temperature Range: −40°C to 125°C
- SOP8 Package

Applications

- Microprocessor Systems
- Computers
- Controllers
- Intelligent Instruments
- Portable Equipment

Description

The TPV706 is a supervisory circuit to monitor power supply voltage levels and provides a power-on reset signal.

A watchdog monitor is provided, which is activated if the watchdog input doesn't toggle within 1.6 sec.

A reset signal can be asserted by an external manual reset input.

In addition, there is a power-fail detector with a 1.25-V threshold, which can be used to monitor an additional power supply.

The reset periods are fixed at 200-ms (typical). The TPV706 is available in an 8-pin SOP package and typically consumes only 4-μA, which is suitable for low-power and portable applications.

Typical Application Circuit

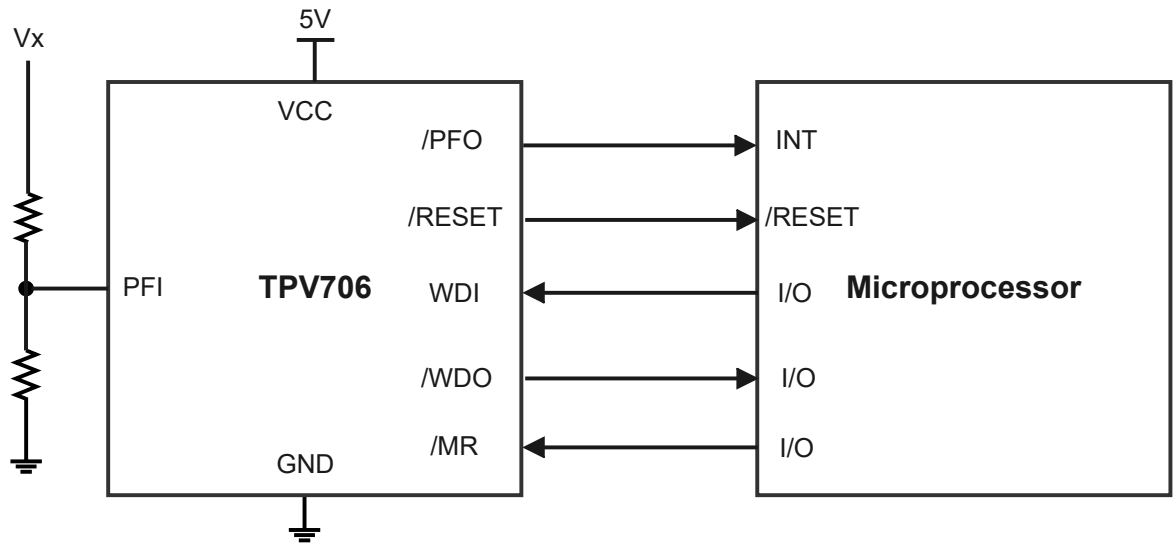


Table of Contents

Product Family Table

Order Number	Threshold Voltage (V_{TH})	Package Marking	Package
TPV706VL1-SR (1)	1.58	V6V	SOP8
TPV706WL1-SR (1)	1.67	V6W	SOP8
TPV706YL1-SR (1)	2.19	V6Y	SOP8
TPV706ZL1-SR (1)	2.32	V6Z	SOP8
TPV706RL1-SR	2.63	V6R	SOP8
TPV706SL1-SR	2.93	V6S	SOP8
TPV706TL1-SR	3.08	V6T	SOP8
TPV706ML1-SR	4.38	V6M	SOP8
TPV706LL1-SR	4.63	V6L	SOP8

(1) For future products, contact the 3PEAK factory for more information and samples.

Revision History

Date	Revision	Notes
2019-01-01	Rev.A.1	Initial version.
2019-05-28	Rev.A.2	Added WDI pulse interval spec.
2022-06-25	Rev.A.3	Updated note for MR input pulse width, update to latest datasheet format and add WDI to /WDO time information.
2022-08-29	Rev.A.4	Added WDI pulse interval spec.
2023-08-15	Rev.A.5	Added package tape and reel information, and updated datasheet format.
2024-07-09	Rev.A.6	Corrected typo in order information, corrected typo in typical application circuit.

Pin Configuration and Functions

TPV706
SOP8 Package
Top View

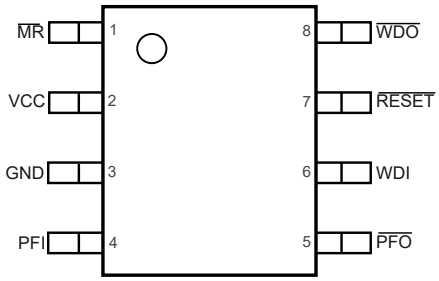


Table 1. Pin Functions: TPV706

Pin		I/O	Description
No.	Name		
1	$\overline{MR}$	I	Manual Reset Input. $\overline{MR}$ low asserts $\overline{RESET}$ pin. It features an internal pull-up current.
2	VCC	P	Power supply voltage being monitored.
3	GND	G	Ground. This pin should be connected to ground reference.
4	PFI	I	Power fail input. When PFI is less than 1.25-V, $\overline{PFO}$ goes low. If unused, connect PFI to GND.
5	$\overline{PFO}$	O	Power fail output. It goes low when PFI is less than 1.25-V, otherwise stays high.
6	WDI	I	Watchdog Input. Generates a reset if the voltage on the pin remains low or high for the duration of the watchdog timeout. The timer is cleared if a logic transition occurs on this pin or if a reset is generated. Floating WDI disables the watchdog function.
7	$\overline{RESET}$	O	Active-Low Reset Push-Pull Output Stage. Asserted whenever VCC is below the reset threshold or by a low signal on the $\overline{MR}$ input. It remains low for 200-ms after VCC goes above the reset threshold or $\overline{MR}$ goes from low to high. A watchdog timeout does not trigger $\overline{RESET}$.
8	$\overline{WDO}$	O	Watchdog Output. Pulls low if WDI remains low or high for the duration of the watchdog timeout, and does not go high again until the watchdog is cleared. Whenever VCC is below the reset threshold, $\overline{WDO}$ stays low. As soon as VCC rises above the reset threshold, $\overline{WDO}$ goes high with no delay.

Specifications

Absolute Maximum Ratings

Parameter		Min	Max	Unit
V_{CC}	Power Supply	−0.3	6	V
	Output Current		20	mA
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) This data was taken with the JEDEC low effective thermal conductivity test board.
(3) This data was taken with the JEDEC standard multilayer test boards.

ESD, Electrostatic Discharge Protection

Parameter		Condition	Minimum Level	Unit
HBM	Human Body Model ESD	ANSI/ESDA/JEDEC JS-001 (1)	4	kV
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002 (2)	2	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.

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
SOP8	143	60	°C/W

Electrical Characteristics

All test conditions: V_{CC} = 1.53 V to 5.5 V, T_A = −40°C to 125°C, unless otherwise noted.

Parameter		Conditions	Min	Typ	Max	Unit
Supply Voltage and Current						
V_{CC}	Operating Supply Voltage		1		5.5	V
I_{CC}	Supply Current	WDI and MR unconnected (VCC = 1.8 V)		4	15	μA
		WDI and MR unconnected (VCC = 5 V)		6	20	μA
V_{TH}	Reset Threshold Voltage	TPV706V	1.51	1.58	1.63	V
		TPV706W	1.62	1.67	1.71	V
		TPV706Y	2.12	2.19	2.25	V
		TPV706Z	2.25	2.32	2.38	V
		TPV706R	2.55	2.63	2.70	V
		TPV706S	2.82	2.93	3.00	V
		TPV706T	3.00	3.08	3.15	V
		TPV706M	4.25	4.38	4.5	V
		TPV706L	4.5	4.63	4.75	V
	Reset Threshold Temperature Coefficient			80		ppm/°C
V_{HYS}	Reset Threshold Hysteresis			$2 \times \frac{V_{TH}}{1000}$		mV
t_{RD}	V_{CC} to Reset Delay			20		μs
t_{RP}	Reset Timeout Period		140	200	280	ms
V_{OL}	Reset Output Voltage Low (Push-Pull)	V_{CC} ≥ 1 V, I_{SINK} = 50 μA			0.3	V
		I_{SINK} = 1.2 mA @ Vcc ≥ 2 V			0.4	V
V_{OH}	Reset Output Voltage High (Push-Pull)	I_{SOURCE} = 800 μA, @ V_{CC}≥ 5 V	0.7 × V_{CC}			V
$\overline{MR}$ Pin						
V_{IL_MR}	$\overline{MR}$ Input Threshold V_{IL}				0.3 × V_{CC}	V
V_{IH_MR}	$\overline{MR}$ Input Threshold V_{IH}		0.7 × V_{CC}			V
t_{PW_MR}	$\overline{MR}$ Input Pulse Width (1)		6			μs
t_{GR_MR}	$\overline{MR}$ Glitch Rejection			100		ns
t_{d_MR}	$\overline{MR}$ to Reset Delay			1	6	μs
I_{MR_V0}	$\overline{MR}$ Pull-up Current	V_{CC} = 3V		80		μA
t_{WD}	Watchdog Timeout Period		1	1.6	2.4	sec

Parameter		Conditions	Min	Typ	Max	Unit
t_{PW_WD}	WDI Pulse Width 50 ns		50			ns
Parameter		**Conditions**	**Min**	**Typ**	**Max**	**Unit**
V_{IL_WDI}	WDI input threshold V_{IL}				0.3 × V_{CC}	V
V_{IH_WDI}	WDI input threshold V_{IH}		0.7 × V_{CC}			V
I_{WDI}	WDI input current	V_{WDI} = V_{CC}		20		μA
		V_{WDI} = 0		-15		μA
V_{OL_WDO}	$\overline{WDO}$ V_{OL}	I_{SINK} = 1.2 mA @ V_{CC} ≥ 5 V			0.4	V
V_{OH_WDO}	$\overline{WDO}$ V_{OH}	I_{SOURCE} = 800 μA @ Vcc≥ 5 V	0.7 x V_{CC}			V
PFI and $\overline{PFO}$						
V_{TH_PFI}	Power fail input threshold	PFI falling	1.18	1.25	1.32	V
V_{OL_PFO}	$\overline{PFO}$ V_{OL}	I_{SINK} = 1.6 mA @ V_{CC} ≥ 5 V			0.4	V
V_{OH_PFO}	$\overline{PFO}$ V_{OH}	I_{SOURCE} = 800 μA @ V_{CC} ≥ 5 V	0.7 x V_{CC}			V

(1) MR pulse width given by customer in application should be longer than minimum value of MR input pulse width requirement.

Typical Performance Characteristics

All test conditions: V_{CC} = 5 V, T_A = + 25°C, unless otherwise noted.

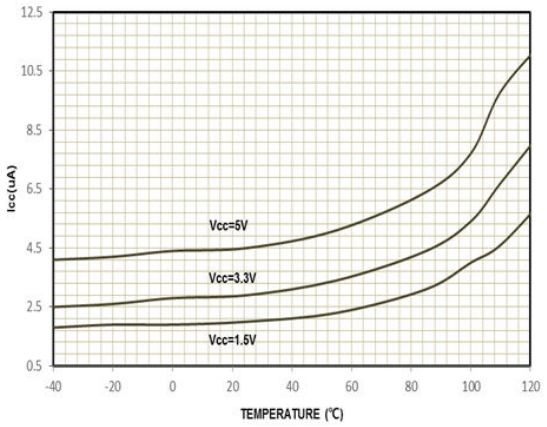


Figure 1. Supply Current vs Temperature

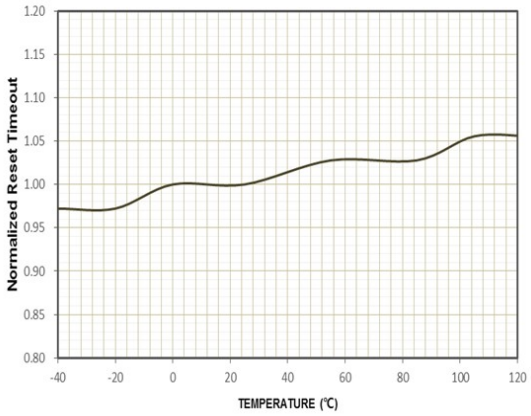


Figure 2. Normalized RESET Timeout Period vs. Temperature

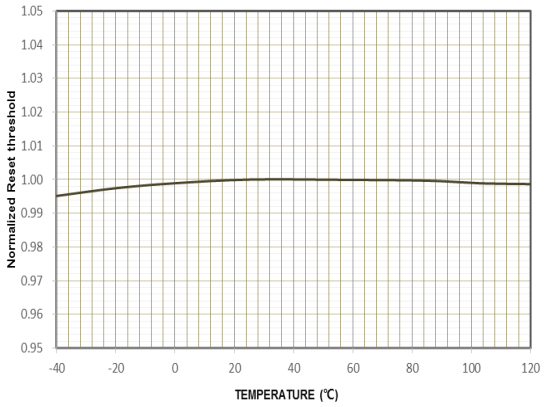


Figure 3. Normalized RESET Threshold vs Temperature

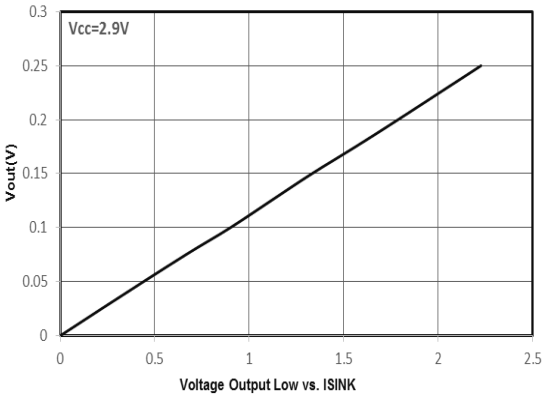


Figure 4. Voltage Output Low vs ISINK

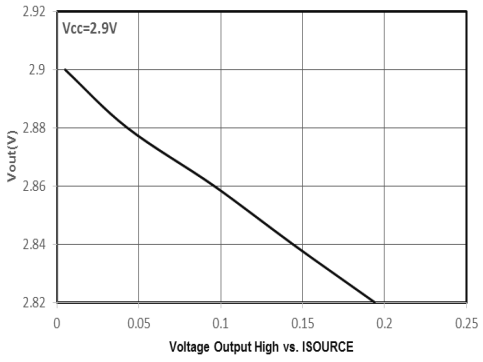


Figure 5. Voltage Output Low vs. ISOURCE

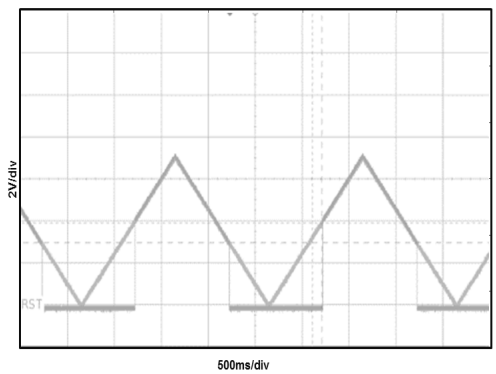


Figure 6. Reset Output Voltage vs. Supply Voltage

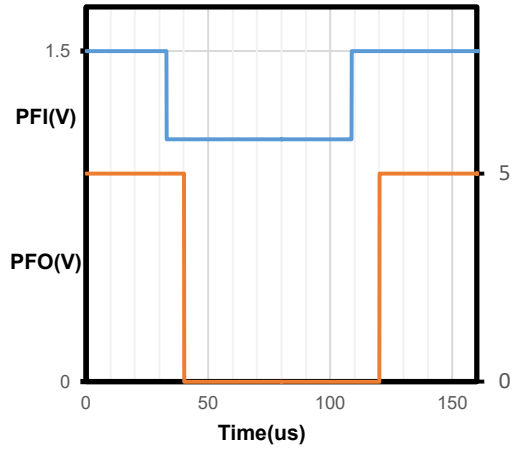


Figure 7. PFI vs. PFO

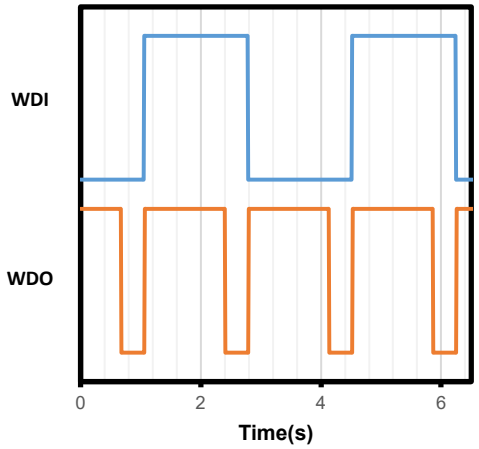


Figure 8. WDI vs. WDO

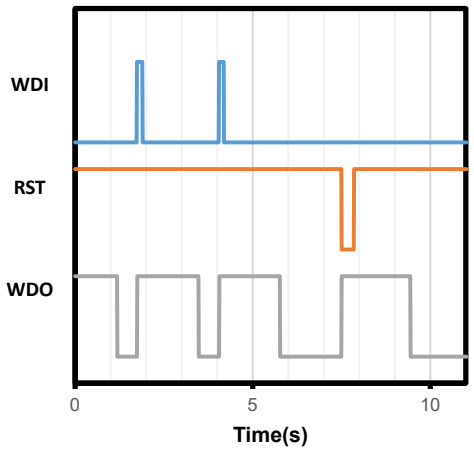


Figure 9. WDI vs. RST and WDO

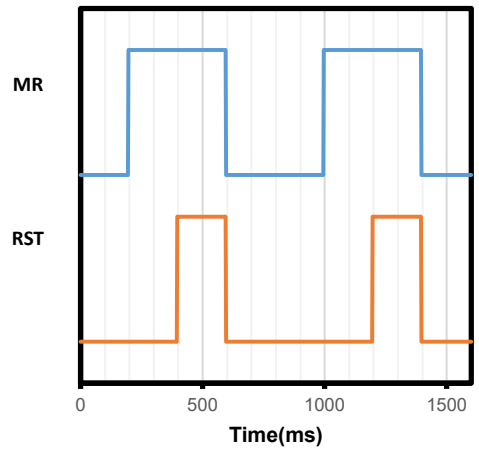


Figure 10. MR vs. RST

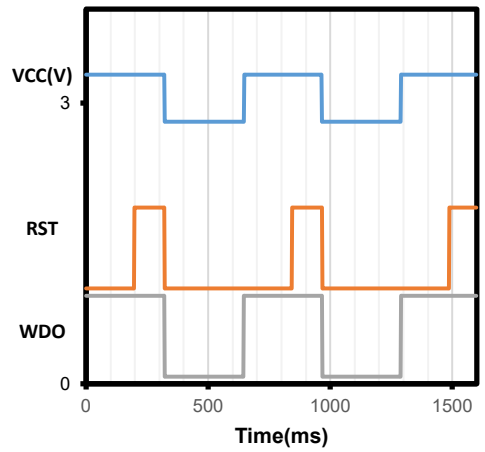


Figure 11. Vcc vs. RST and WDO

Detailed Description

Overview

The TPV706 provides supply voltage supervision, watchdog function, manual reset function, as well as a 1.25-V power-fail comparator.

Functional Block Diagram

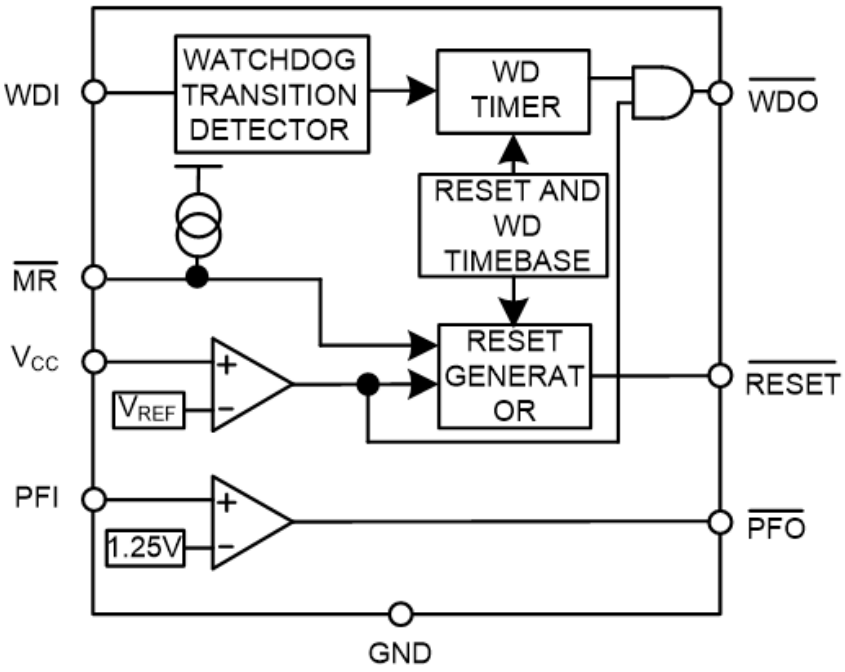


Figure 12. Functional Block Diagram

Feature Description

RESET Output

The TPV706 features an active-low push-pull output. The reset signal is guaranteed to be logic low for V_{CC} down to 1-V. The reset output is asserted when V_{CC} is below the reset threshold (V_{TH}), or when MR is driven low. Reset remains asserted for the duration of the reset active timeout period (t_{RP}) after V_{CC} rises above the reset threshold, or after MR transitions from low to high. Figure 13 shows the reset (active low) outputs.

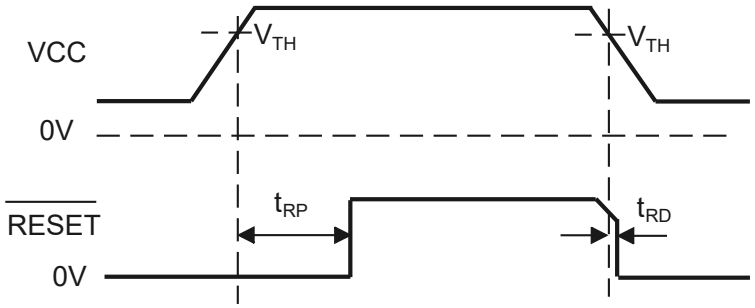


Figure 13. Reset Timing Diagram

Manual RESET Input

The TPV706 features a manual reset input ($\overline{MR}$), which, when driven low, asserts the reset output. When $\overline{MR}$ transitions from low to high, reset remains asserted for the duration of the reset active timeout period before de-asserting.

The $\overline{MR}$ input has an internal pull-up current so that the input is always high when unconnected. Noise immunity is provided on the $\overline{MR}$ input, and the fast and negative-going transients are ignored. A 0.1-μF capacitor between $\overline{MR}$ and ground provides additional noise immunity.

Watchdog Input

The TPV706 features a watchdog timer, which monitors microprocessor activity. A timer circuit is cleared with every low-to-high or high-to-low logic transition on the watchdog input pin ($\overline{WDI}$). If the timer counts through the preset watchdog timeout period (t_{WD}), the watchdog output ($\overline{WDO}$) goes low, a low to high or high to low transition on the $\overline{WDI}$ pin clears the watchdog timer. The delay time from $\overline{WDI}$ toggling to $\overline{WDO}$ going high is within 35-ms. The microprocessor is required to toggle the $\overline{WDI}$ pin to avoid being reset. Whenever VCC is below the reset threshold, $\overline{WDO}$ stays low. As soon as VCC rises above the reset threshold, $\overline{WDO}$ goes high with no delay. Figure 14 shows the watchdog timing.

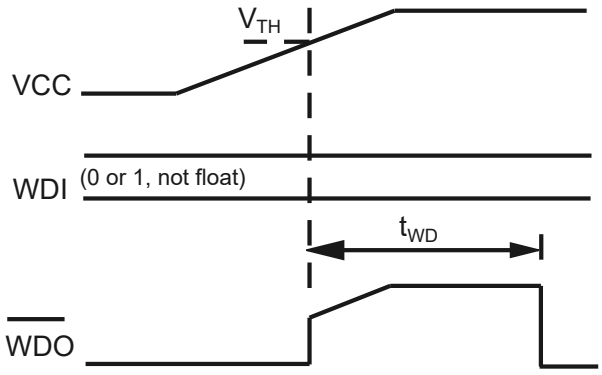


Figure 14. Watchdog Timing

Power-Fail Detector

The power-fail detector is a 1.25-V comparator, which can monitor an external power supply through a resistive divider. When the voltage on the PFI is lower than 1.25-V, the comparator output goes low, indicating a power fail, which can be used as an early warning of the power fail.

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

Figure 15 shows the typical application circuit of TPV706. Microprocessor activity is monitored using WDI. When the WDI remains low or high for the duration of the watchdog timeout, the WDO will trigger a manual reset to MCU. The MCU can drive the $\overline{MR}$ from high to low and trigger the $\overline{RESET}$.

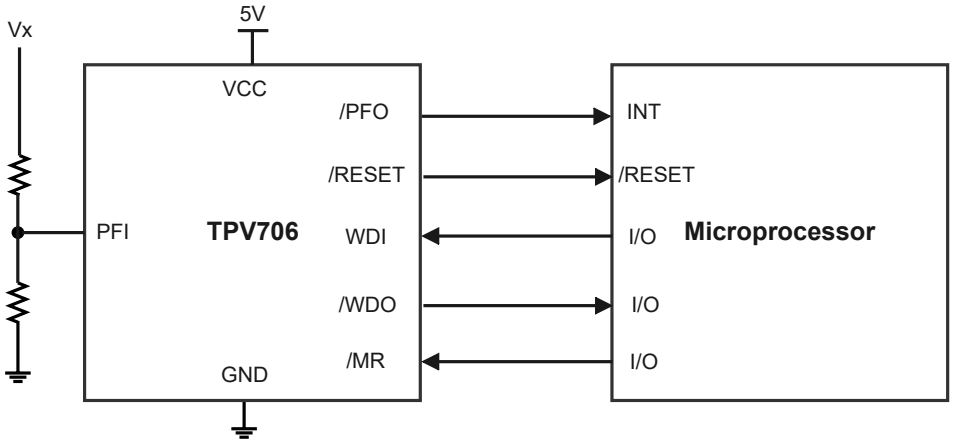
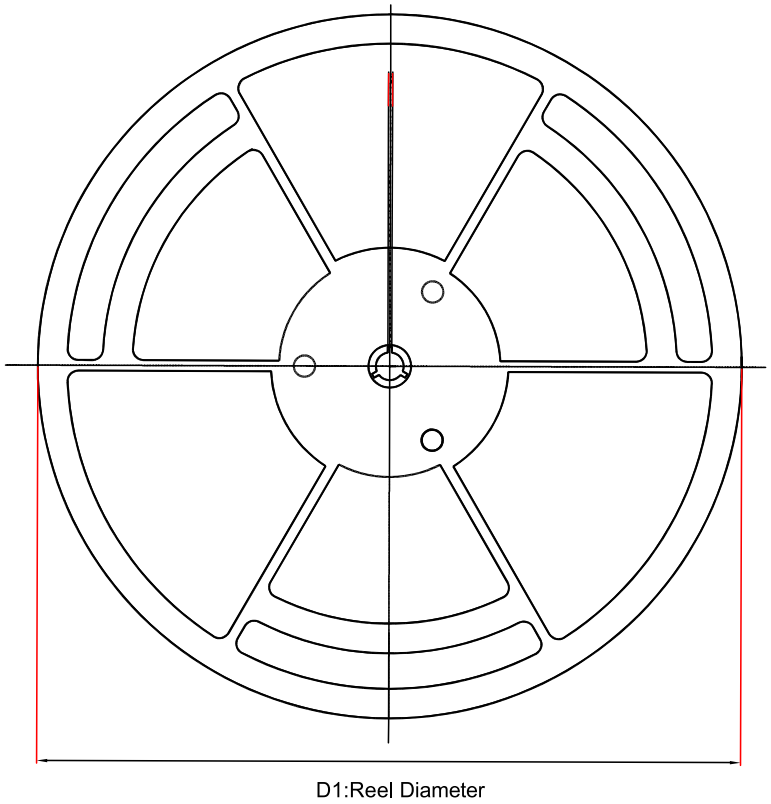
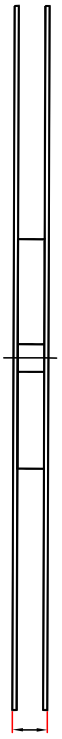
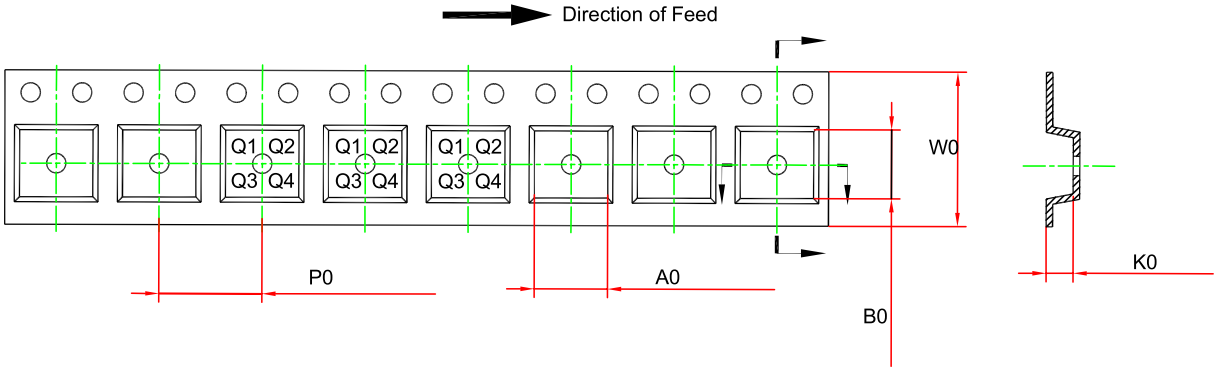


Figure 15. TPV706 Typical Application Circuit

Tape and Reel Information





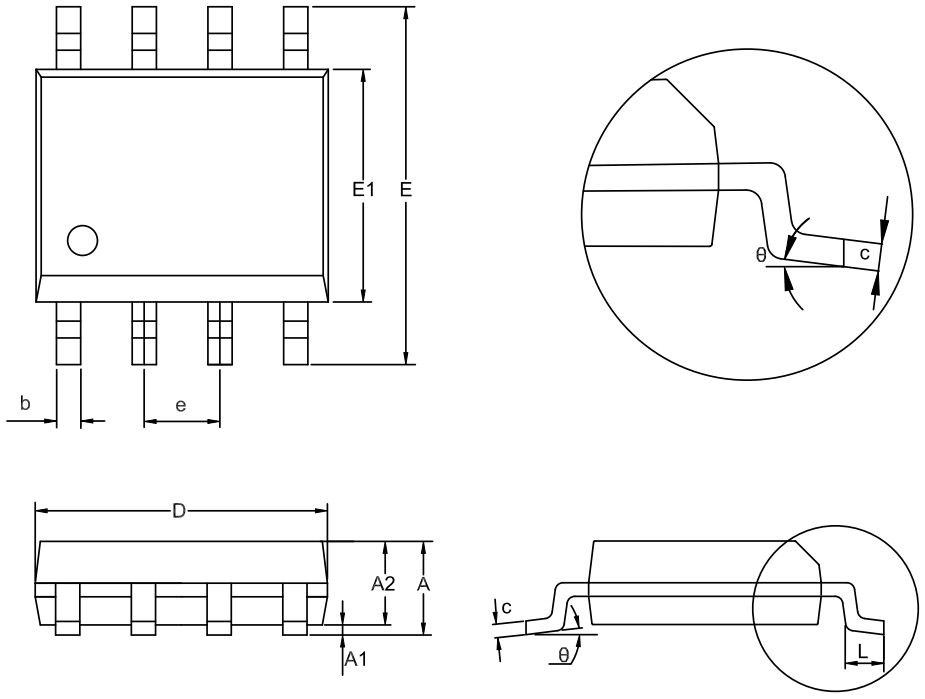


Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPV706xx-SR	SOP8	330	17.6	6.5	5.4	2	8	12	Q1

Package Outline Dimensions

SOP8

Package Outline Dimensions SO1(SOP-8-A)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.050	0.250	0.002	0.010
A2	1.250	1.550	0.049	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.201
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050 BSC	
L	0.400	1.000	0.016	0.039
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
TPV706VL1-SR (1)	−40 to 125°C	SOP8	V6V	1	Tape and Reel, 4000	Green
TPV706WL1-SR (1)	−40 to 125°C	SOP8	V6W	1	Tape and Reel, 4000	Green
TPV706YL1-SR (1)	−40 to 125°C	SOP8	V6Y	1	Tape and Reel, 4000	Green
TPV706ZL1-SR (1)	−40 to 125°C	SOP8	V6Z	1	Tape and Reel, 4000	Green
TPV706RL1-SR	−40 to 125°C	SOP8	V6R	1	Tape and Reel, 4000	Green
TPV706SL1-SR	−40 to 125°C	SOP8	V6S	1	Tape and Reel, 4000	Green
TPV706TL1-SR	−40 to 125°C	SOP8	V6T	1	Tape and Reel, 4000	Green
TPV706ML1-SR	−40 to 125°C	SOP8	V6M	1	Tape and Reel, 4000	Green
TPV706LL1-SR	−40 to 125°C	SOP8	V6L	1	Tape and Reel, 4000	Green

(1) For future products, contact the 3PEAK factory for more information and samples.

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

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