WP6420
Smart Low Side Power Switch

1.General Description

The WP6420 circuit use N channel lateral MOS as POWER FET embedded protection functions which consist of thermal-shutdown circuit, current limitation circuit, overload protection circuit and short circuit protection. When the circuit is short circuited, current limitation circuit is firstly triggered and a high current flow through POWER FET which led to high temperature of POWER FET. And then the thermal-shutdown circuit is triggered to shut down the circuit. So the current limitation circuit and thermal-shutdown circuit act as the short circuit protection role.

The WP6420 circuit features low on resistance, considerable load current. The input voltage can vary from 0V to 10V. The device is available in SOT-223 package.

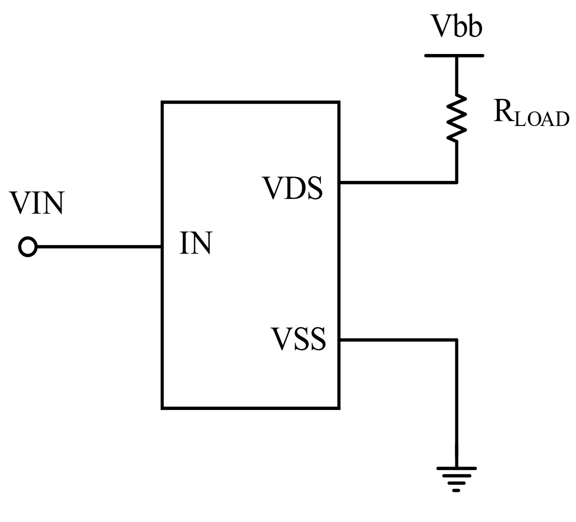
2. Features

- Logic Level Input
- Input Protection (ESD)
- Thermal shutdown with auto restart
- Overload protection
- Short circuit protection
- Overvoltage protection
- Current limitation
- Analog driving possible

3. Applications

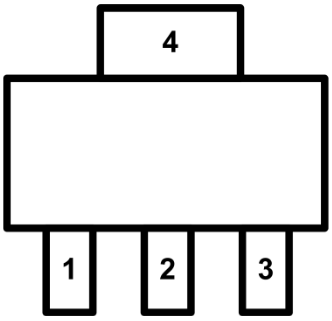
- All kinds of resistive, inductive and capacitive loads in switching or linear applications.
- µC compatible power switch for 12V DC applications
- Replaces electromechanical relays and discrete circuits

4. Typical Application



5. Pin Configuration

(Top View)



SOT223

6.Pin Description

PIN NUMBER	PIN NAME	I/O	PIN FUNCTION
1	IN	I	Input Voltage
2	OUT	O	Output Voltage (VD)
3	GND		Ground
4	OUT	O	Output Voltage (VD)

7. Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted)[1]

SYMBOL	PARAMETER	RATING	UNIT
V_{DS}	Drain source voltage	36	V
$V_{bb(SC)}$	Supply voltage for full short circuit protection[1]	36	V
V_{IN}	Continuous input voltage[2]	-0.2 ~ 10	V
I_{IN}	Continuous input current, -0.2V<V_{IN}< 14V	IIN <2	A
T_J	Operating temperature	-40 ~ 125	oC
T_{STG}	Storage temperature	-55 ~ 150	oC
P_{TOT}	Power dissipation[2], T_C = 85 °C	0.86	W
E_{AS}	Unclamped single pulse inductive energy[2]	128	V
ESD	Electrostatic discharge voltage (Human Body Model)	3	kV
R_{thJA}	Junction - ambient	125	ºC /W

Note1: When the $V_{bb(SC)}$ is higher than 24V (or V_{IN} is higher than 5V) and the load between V_{bb} and V_{DS} is shorted, device starting is forbidden.

Note2: Not tested in production，Specified by design.

8. Thermal Resistance

SYMBOL	PARAMETER	VALUE	UNIT
R_{thJA}	Junction - ambient	125	ºC /W

9. Electrical Characteristics

(T_A=25°C, unless otherwise noted)

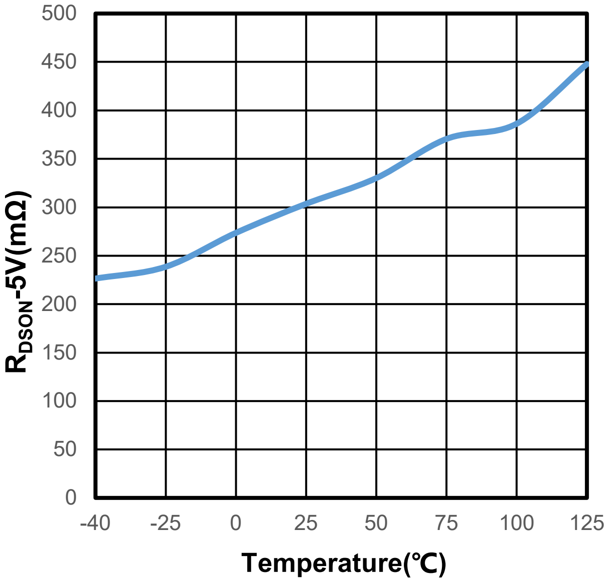
SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP.	MAX	UNIT
V_{DS}(AZ)	Drain source clamp voltage	ID=10mA		36		V
I_{DSS}	Off-state drain current	V_{bb}=32V, V_{IN}=0V, T_A=25ºC	0.1	0.13	0.4	µA
		V_{bb}=32V, V_{IN}=0V, T_A =150ºC		0.4		
IN(ON)	On state input current	V_{IN} =5 V		15	30	µA
		V_{IN} =10 V		48	80	
$V_{IN(th)}$	Input threshold Voltage	ID=0.3mA, TA=25 ºC	1.3	1.8	2.2	V
		ID=0.3mA, TA =150 ºC		1.3		
$R_{DS\ (on)}$	On-state resistance	V_{IN}=5 V, I_D=1.4 A, T_A =25ºC		300	360	mΩ
		V_{IN}=5 V, I_D=1.4 A, T_A =125ºC		500	540	
		V_{IN}=10 V, I_D=1.4 A, T_A =25ºC		250	286	
		V_{IN}=10 V, I_D=1.4A, T_A =125ºC		450	483	
$I_{D(Nor)}$	Nominal load current	V_{DS}=0.5, V_{IN}=10V, T_A<150ºC T_A =85ºC	1.4	1.62	2.0	A
$I_{D(LIM)}$	Current	V_{IN}=10V, V_{DS}=12V, (active if V_{DS}>2.5V)	4.4	4.5	7	A
Dynamic Characteristics						
t_{ON}	Turn-on time	V_{IN} to 90% I_D; R_L=4.7Ω,V_{IN}=0 to 10 V, V_{bb}=12 V, T_A =25ºC		20	60	µs
t_{OFF}	Turn-off time	V_{IN} to 90% I_D; R_L=4.7Ω, V_{IN}=0 to 10 V, V_{bb}=12 V, T_A =25ºC		45		µs
dV_{DS}/dt_{ON}	Slew rate on	70 to 50%V_{bb}; R_L=4.7Ω, V_{IN}=0 to 10 V, V_{bb}=12 V, T_A =25ºC		0.83	1.5	V/µs

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP.	MAX	UNIT
dV_{DS}/dt_{OFF}	Slew rate off	50 to 70% Vbb; R_L=4.7Ω, V_{IN}=10 to 0 V, V_{bb}=12 V, T_A =25ºC		0.57	1.5	V/μs
Protection Functions						
T_{SD}	Thermal shutdown threshold		140	150	160	ºC
$\triangle T_{SD}$	Thermal shutdown hysteresis		-	25		ºC
I_{IN} (Pro)	Input current protection mode T_J = 150 °C	T_A =150ºC		40		μA
E_{AS}	Unclamped single pulse inductive energy[3]	I_D = 1.4 A, T_A = 25 °C, V_{bb} = 12 V		128		mJ
Inverse Diode						
VSD	Inverse diode forward voltage[3]	I_F=7A, V_{IN}=0V		0.87		V

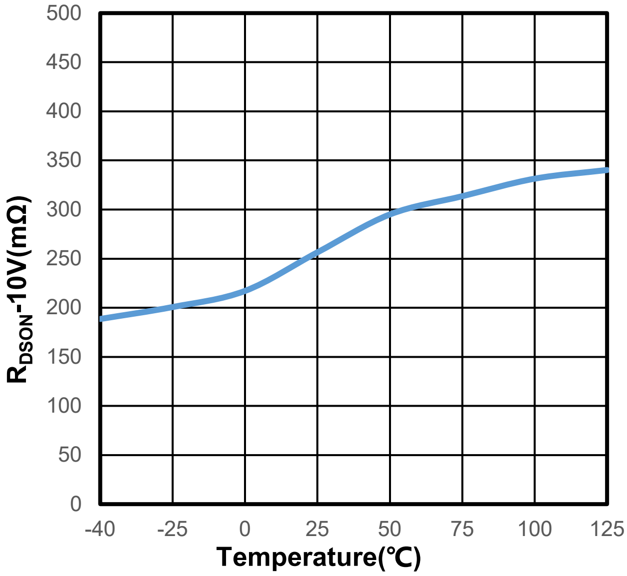
Note3: Not tested in production. Specified by design.

10. Typical Performance Characteristics

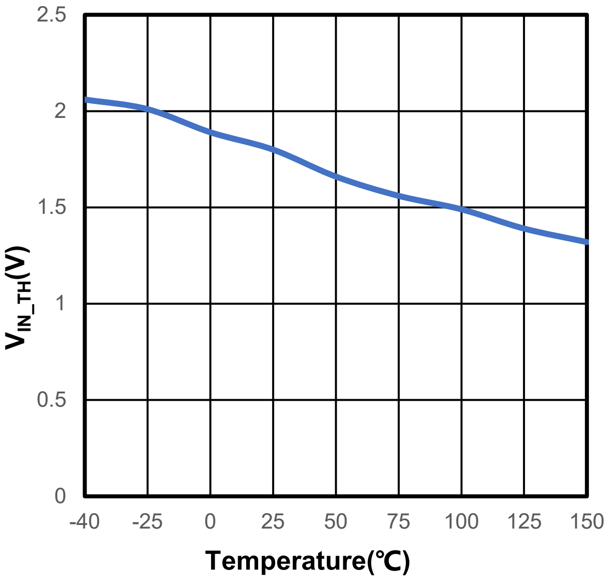
(T_A=25°C, unless otherwise noted)



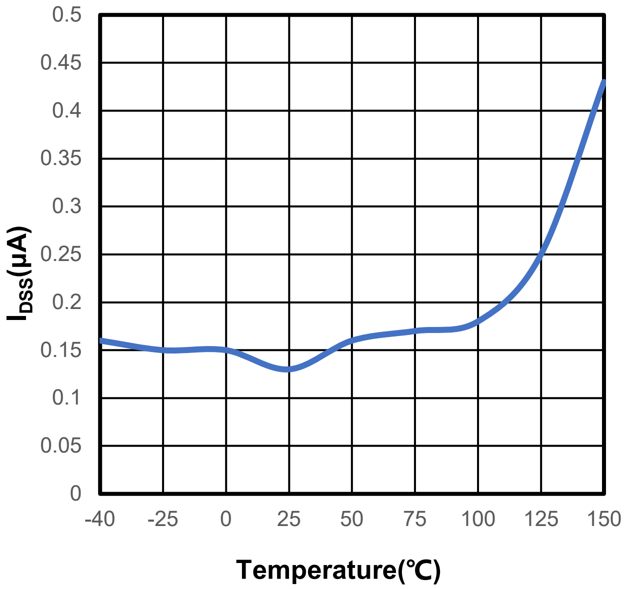
I_D= 1.4A; V_{IN}=5V
Switch On-Resistance vs. Temperature



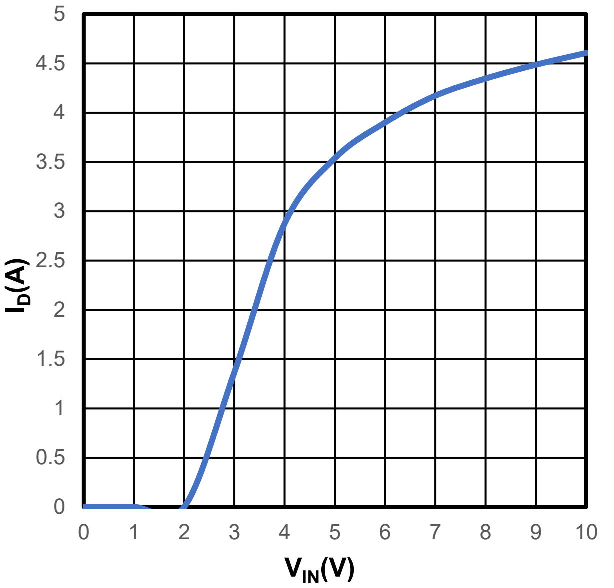
I_D= 1.4A; V_{IN}=10V
Switch On-Resistance vs. Temperature



I_D = 0.3 mA; V_{DS}= 12V
Input Threshold Voltage vs. Temperature

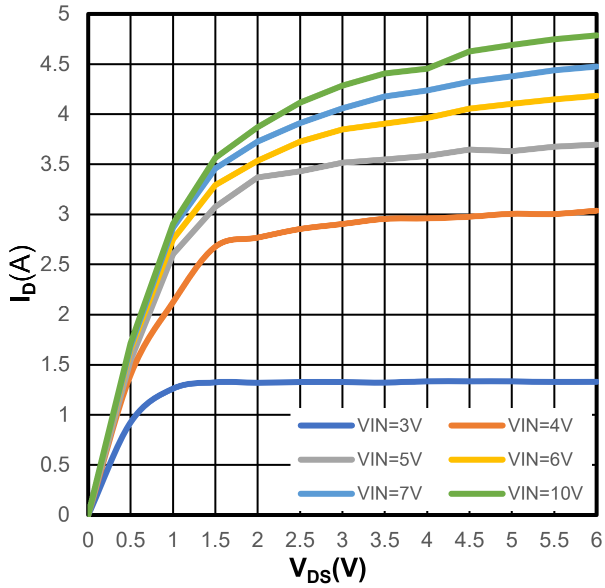


Off-state drain
Current I_{DSS} vs. Temperature



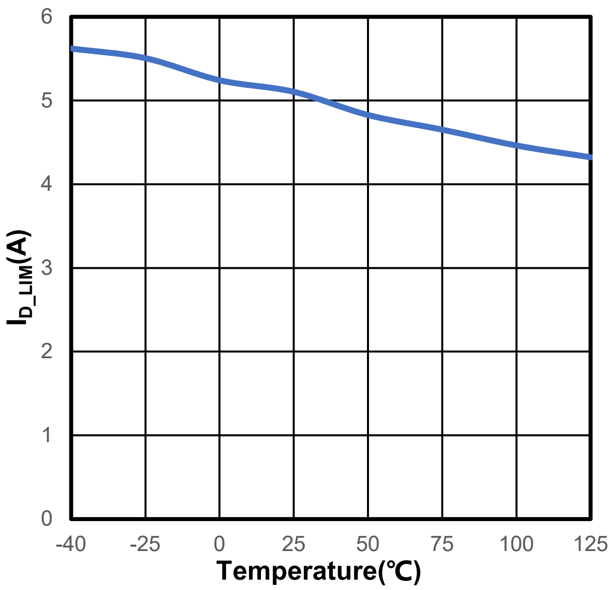
V_{DS}=12V; T_{J_START} =25°C

Transfer Characteristics



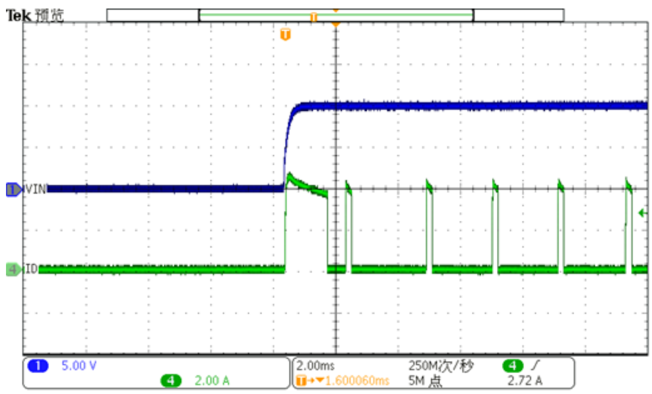
T_{J_START} =25°C

Output characteristics



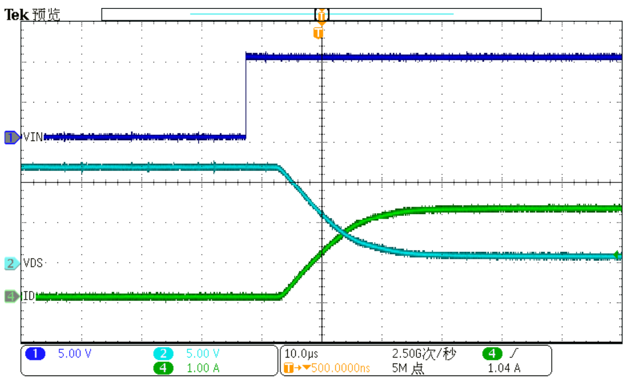
V_{DS}=12V; V_{IN}=10 V

Short Circuit Current vs. Temperature



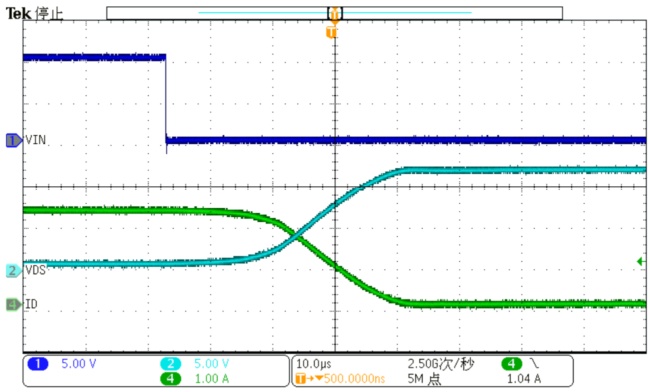
V_{DS}=12V; V_{IN}=0~10 V (Turn On)

Short circuit current $I_{D(LIM)}$



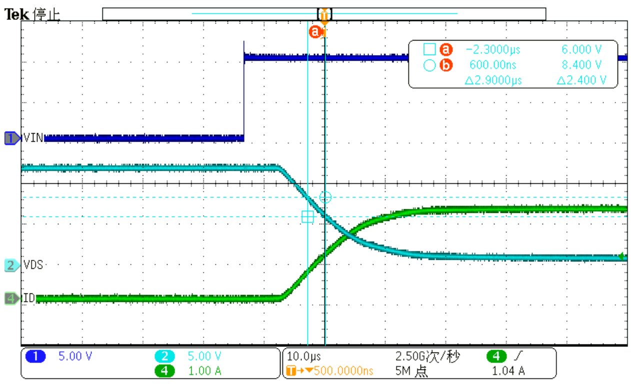
Turn-on time V_{IN} to 90% I_D (I_{OUT})

R_L=4.7Ω, V_{bb}=12V, V_{IN}=0 to 10V



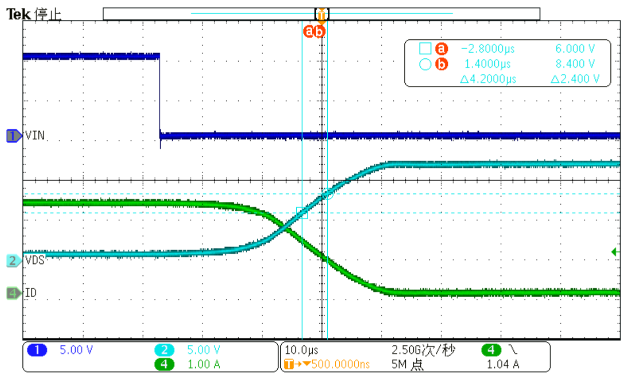
Turn-off time V_{IN} to 10% I_D (I_{OUT})

R_L=4.7Ω, V_{bb}=12V, V_{IN}=10 to 0V



Slew-rate on 70 to 50% V_{bb}

R_L=4.7Ω，V_{bb}=12V，V_{IN}=0 to 10V



Slew-rate off 50 to 70% V_{bb}

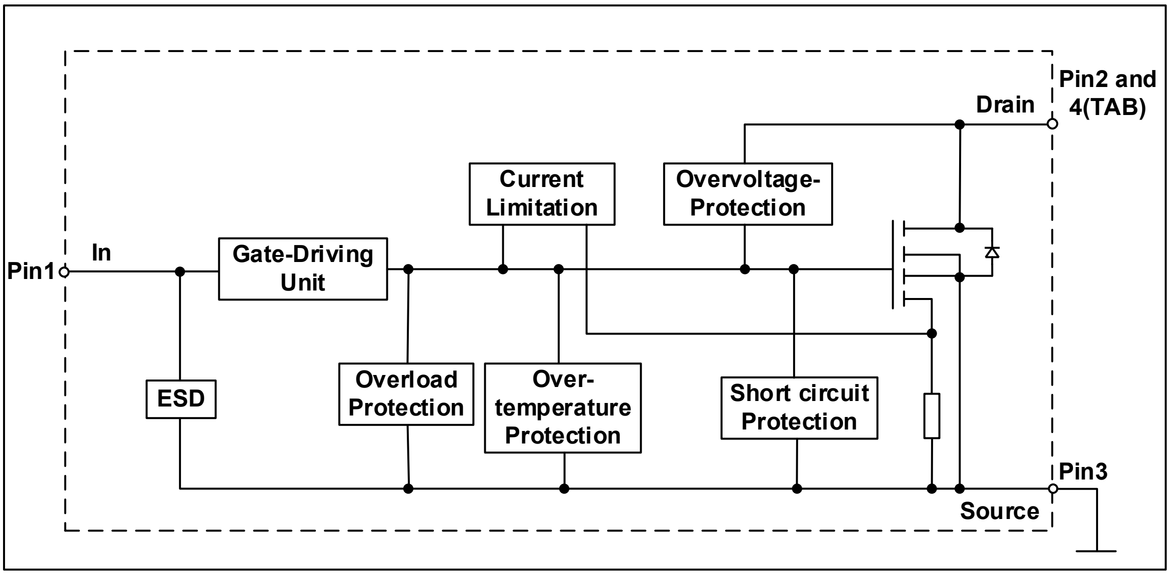
R_L=4.7Ω，V_{bb}=12V，V_{IN}=10 to 0V

11. Function Description

11.1 Overview

The WP6420 is an integrated power switch with a low RDS(ON) N-channel MOSFET, internal gate drive circuit, embedded protection functions.

11.2 Block Diagram



11.3 Feature Description

11.3.1 Over Current

A sense FET is employed to check for overcurrent conditions. When an overcurrent condition is detected, the device maintains a constant output current. WP6420 will limit the current until the overload condition is removed or the device begins to thermal cycle.

11.3.2 Thermal Protection

Thermal protection prevents damage to the IC when heavy-overload or short-circuit faults are present for extended periods of time. The WP6420 implements a thermal sensing to monitor the operating junction temperature of the power distribution switch. In an overcurrent or short-circuit condition, the junction temperature rises due to excessive power dissipation. Once the die temperature rises to approximately 150°C due to overcurrent conditions, the internal thermal sense circuitry turns the power switch off, thus preventing the power switch from damage. Hysteresis is built into the thermal sense circuit, and after the device has cooled approximately 20°C, the switch turns back on. The switch continues to cycle in this manner until the load fault or input power is removed.

12. Application and Implementation

12.1 Application Information

12.1.1 Power Dissipation and Junction Temperature

The low on-resistance on the N-channel MOSFET allows the small surface-mount packages to pass large currents. It is good design practice to check power dissipation and junction temperature for each application. Begin by determining the RDS (ON) of the N-channel MOSFET relative to the input voltage and operating temperature. Using the highest operating ambient temperature of interest and RDS (ON), the power dissipation per switch can be calculated by:

$$P_D = R_{DS\,(ON)} \times I^2$$

Finally, calculate the junction temperature:

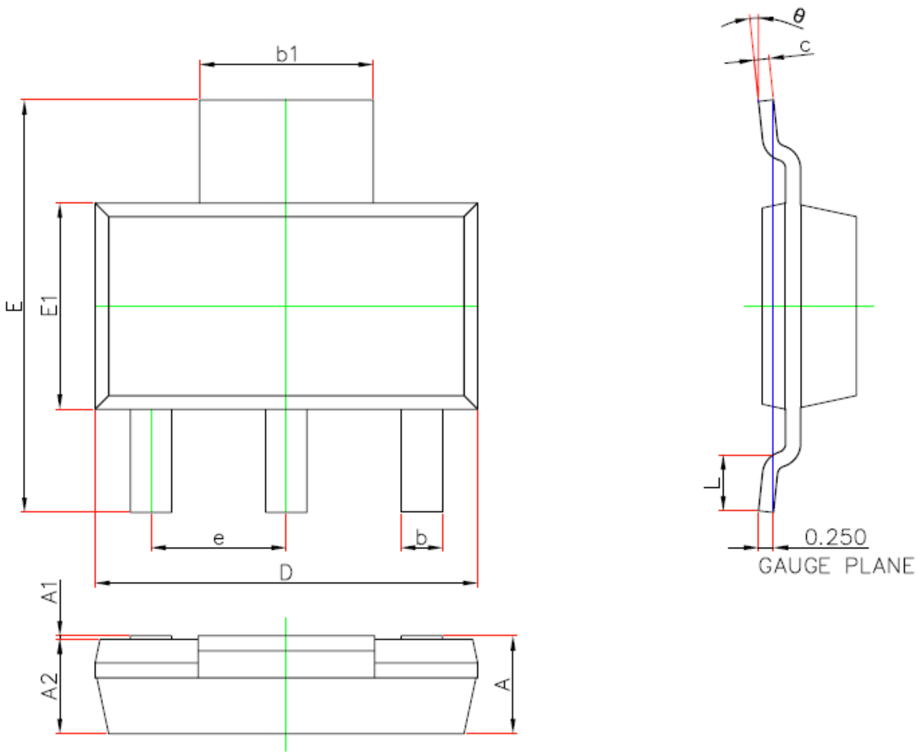
$$T_J = P_D \times R_{\theta JA} + T_A$$

Where:

T_A= Ambient temperature
$R_{\theta JA}$ = Thermal resistance
P_D = Total power dissipation

13. Package Information

SOT223



SYMBOL	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A			1.800
A1	0.02		0.100
A2	1.500	1.600	1.700
b	0.660	0.750	0.840
b1	2.900	3.000	3.100
c	0.230	0.290	0.350
D	6.300	6.500	6.700
E	6.700	7.000	7.300
E1	3.300	3.500	3.700
e	2.300(BSC)		
L	0.750		
θ	0°	5°	10°

14. Ordering Information

PART NUMBER	PACKAGE	PACKING QUANTITY	MARKING*
WP6420-A70R	SOT223	2.5k/Reel	6420 XXXX

* XXXX is variable.

STATEMENTS

WAY-ON provides data sheets based on the actual performance of the device, and users should verify actual device performance in their specific applications. The device characteristics and parameters in this data sheet can and do vary from application to application, and actual device performance may change over time. This information is intended for developers designing with WAY-ON products. Users are responsible for selecting the appropriate WAY-ON product for their application and for designing and verifying the application to ensure that your application meets the appropriate standards or other requirements, and users are responsible for all consequences. Specifications are subject to change without notice.

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