HM9711A

90mΩ，2A Current Limited USB Power Switch

General Description

The HM9711A are current limited P-channel MOSFET power switch designed for high-side load switching applications. This switch operates with inputs ranging from 2.5V to 5.5V, making it ideal for both 3.3V and 5V systems. An integrated current-limiting circuit protects the input supply against large currents which may cause the supply to fall out of regulation. The HM9711A is also protected from thermal overload which limits power dissipation and junction temperatures. Current limit threshold is fixed internally. The quiescent supply current in active mode is only 25μA. In shutdown mode, the supply current decreases to less than 1μA.

The HM9711A is available in Pb-free packages and is specified over the -40°C to +85°C ambient temperature range.

Features

- Input Voltage Range: 2.5V to 5.5V
- Fixed Current Limit
- Reverse Current Blocking
- Short-Circuit Response: 350ns
- Very Low Quiescent Current: 25μA (Typ)
- 1μA Max Shutdown Supply Current
- Under-Voltage Lockout
- Thermal Shutdown
- 4kV ESD Rating
- SOT23-5 Packages
- Ambient Temperature Range: -40°C to +85°C

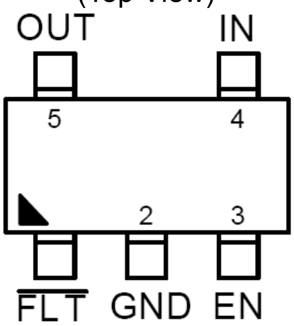
Applications

- Laptop/Desktop Computers and NetBooks
- 3G Wireless Cards
- Smart Phones and PDAs
- LCD TVs and Monitors
- Set-Top-Boxes
- MP3/MP4
- Printers
- Portable Game Players
- Portable Media Players and MIDs
- USB Keyboards
- USB Hard Disk Drives
- USB Memory Drives
- USB Hubs

Pin Configuration

HM9711A

SOT23-5
(Top View)



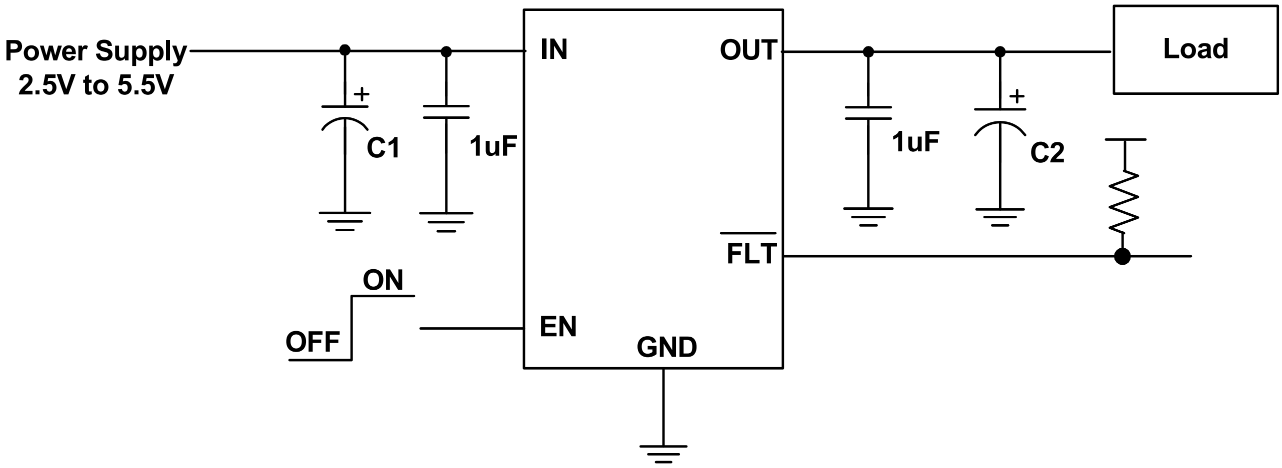
Ordering Information

PART NUMBER	TEMPERATURE RANGE	MAXIMUM CURRENT	PACKAGE	TAPE&REEL
HM9711A	-40°C to 85°C	2.1A	SOT23-5	-T

Available Options of the H&M Semi USB Power Switches

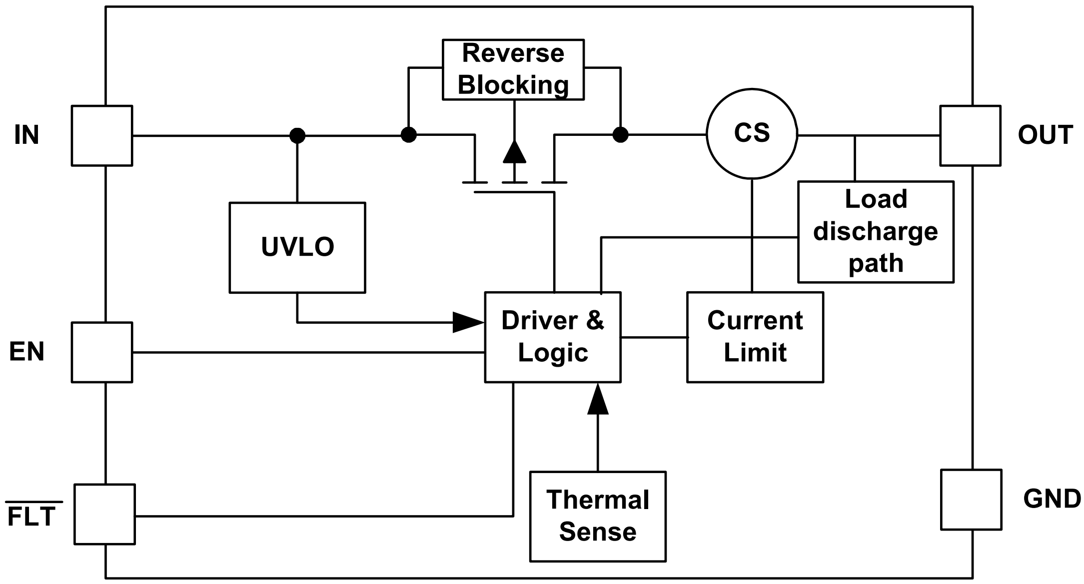
PART NUMBER	CH	ENABLE	$R_{ds(ON)}$	Current Limit	MAX I_{OUT} (DC)	P2P COMPATIBLE	PACKAGES
HM9711A	**1**	**Active High**	**90mΩ**	**2.5A**	**2.1A**	**RT9711A**	**SOT23-5**

Typical Application Diagram



Note: Tantalum or Aluminum Electrolytic capacitors (C1 and C2) may be required for USB applications.

Function Block Diagram



Pin Description

Pin No.	Pin Name	Pin Function
5	OUT	Power output.
2	GND	Ground Pin
3	EN	Enable input
4	IN	Power supply input
1	/FLT	Overcurrent and over-temperature fault reporting signal output, active low with 4.5ms blanking time for overcurrent conditions and 0ms blanking for over-temperature conditions.

■ Absolute Maximum Rating

Parameter	Rating	Unit
IN, EN, /FLT Voltage	-0.3 to 6	V
OUT Voltage	-0.3 to V_{IN} + 0.3	V
OUT Current	Internal Limited	A
Power Dissipation	300	mW
Package Thermal Resistance(θ_{JA})	250	°C/W
Operating Junction Temperature	-40 to 125	°C
Storage Temperature	-55 to 150	°C
Lead Temperature (Soldering, 10 sec)	300	°C

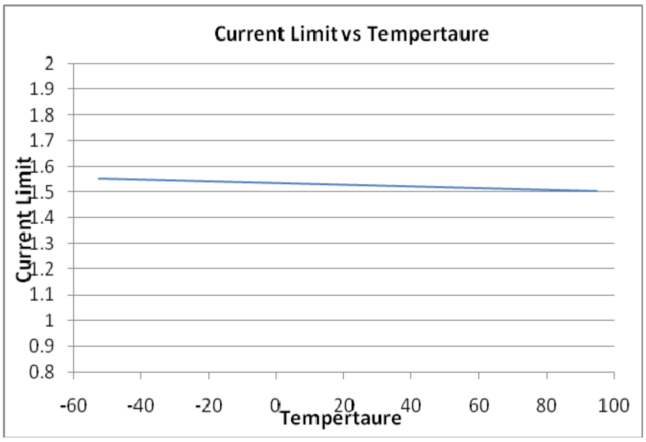
■ Electrical Characteristics

(V_{IN} = +5.0V, T_A = -40°C to 85°C, typical values at T_A=25°C, unless otherwise stated)

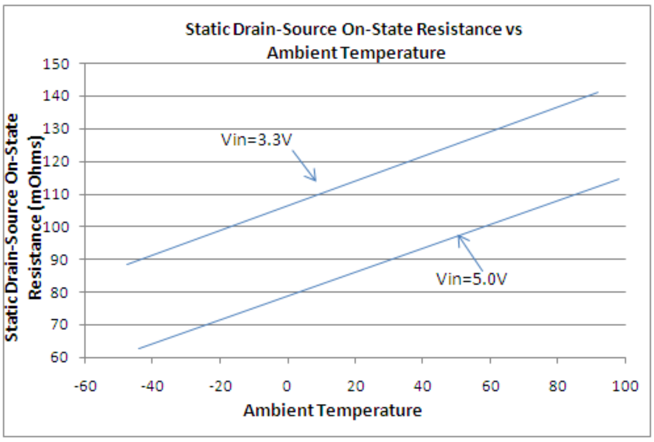
Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
V_{IN}	Input Voltage Range		2.7		5.5	V
V_{UVLO}	Input UVLO		1.8		2.5	V
I_{SHDN}	Input Shutdown Quiescent Current	Disabled, V_{EN}=0V, OUT floating or shorted to ground		0.1	1	μA
I_Q	Input Quiescent Current /Channel	Enabled, V_{EN}=V_{IN}, I_{OUT}= 0		25	40	μA
$R_{DS(ON)}$	Switch on-resistance	V_{IN}=5V, I_{OUT}=1.5A		90	110	mΩ
I_{LMT}	Current Limit	V_{IN}=5V, V_{OUT}=4.5V	2.0	2.5	3.2	A
V_{IL}	EN Input Logic Low Voltage				0.8	V
V_{IH}	EN Input Logic High Voltage		2.0			V
I_{SINK}	EN Input leakage	V_{EN} = 5V		0.01	1	μA
$T_{D(ON)}$	Output Turn-on Delay Time	V_{IN} =5V, C_L=1uF, R_{load}=10Ω		10		μs
T_R	Output Turn-on Rise Time	V_{IN} =5V, C_L=1uF, R_{load}=10Ω		800		μs
$T_{D(OFF)}$	Output Turn-off Delay Time	V_{IN} =5V, C_L=1uF, R_{load}=10Ω		60		μs
T_F	Output Turn-off Fall Time	V_{IN} =5V, C_L=1uF, R_{load}=10Ω		20	200	μs
T_{FLT_BLANK}	FLT Blanking Time			4		ms
V_{FLT_Lo}	FLT Logic Low Voltage	$I_{FLT(SINK)}$ =1mA			0.4	V
I_{FLT}	FLT Leakage Current	V_{FLT} = 5V, Enabeld, No Fault Conditions		0.1	1	μA
$R_{dischrg}$	Output discharge FET Rdson	V_{IN} = 5V, EN=0V, VOUT=5V		100	200	Ω
T_{SHDN}	Thermal shutdown threshold	V_{IN} = 5V		135		°C
T_{HYS}	Thermal shutdown hysteresis	V_{IN} = 5V		15		°C

■ Typical Performance Characteristics

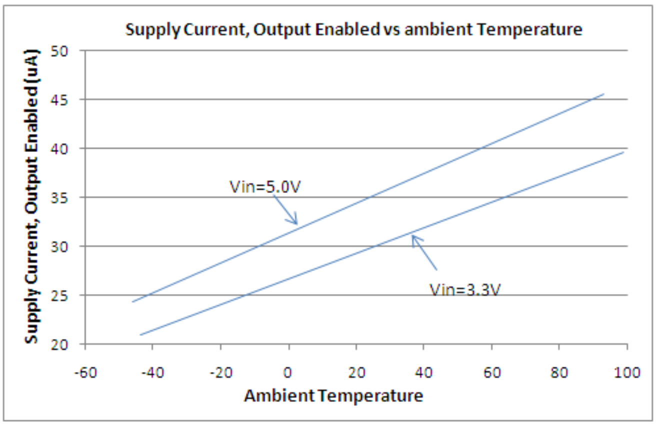
Current Limit VS Temperature



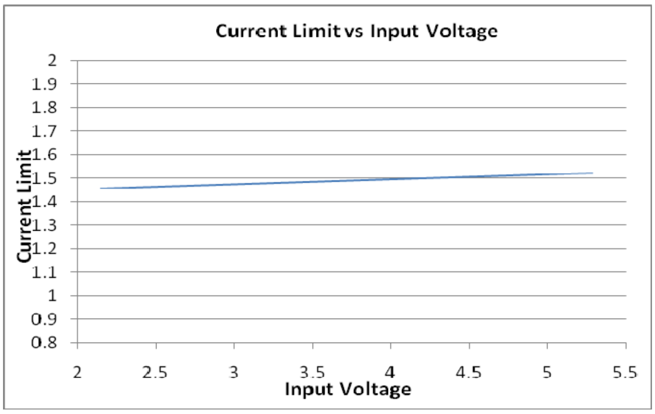
RDS(on) VS Temperature



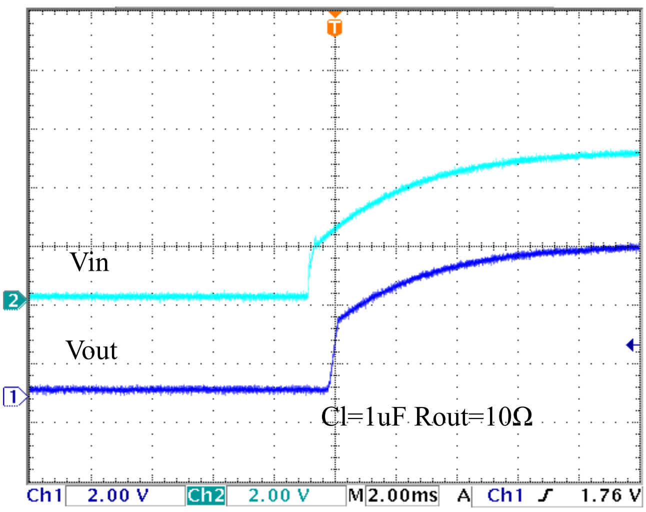
Supply Current VS Temperature



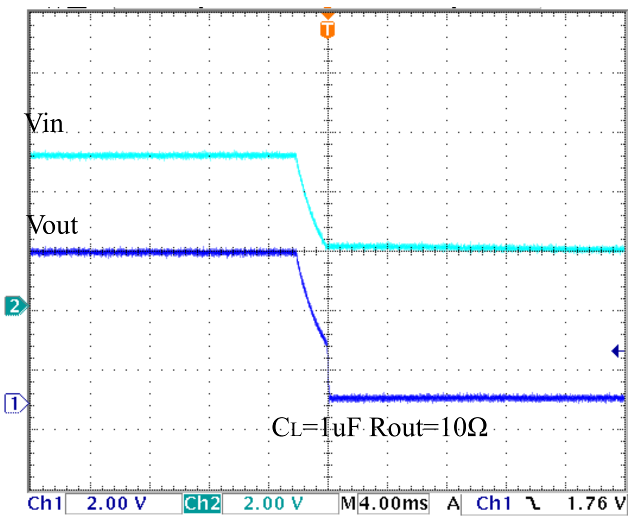
Current Limit VS Input Voltage



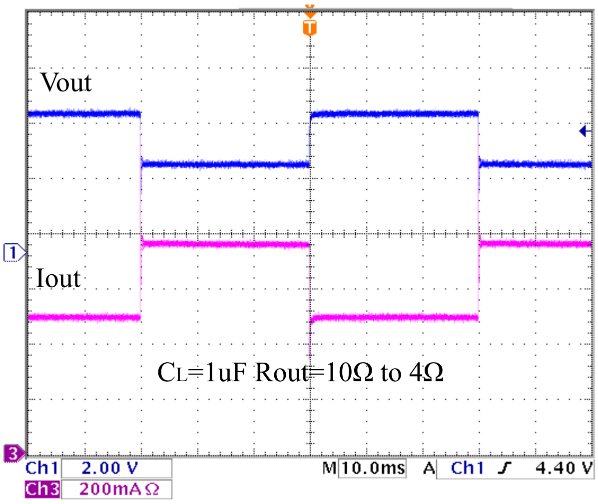
UVLO at Rising



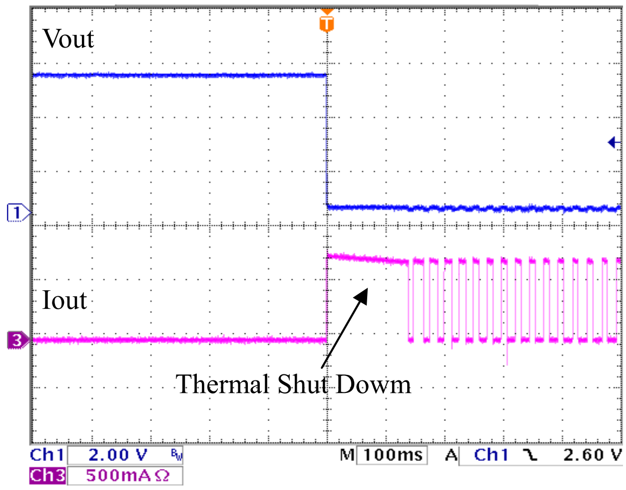
UVLO at Falling



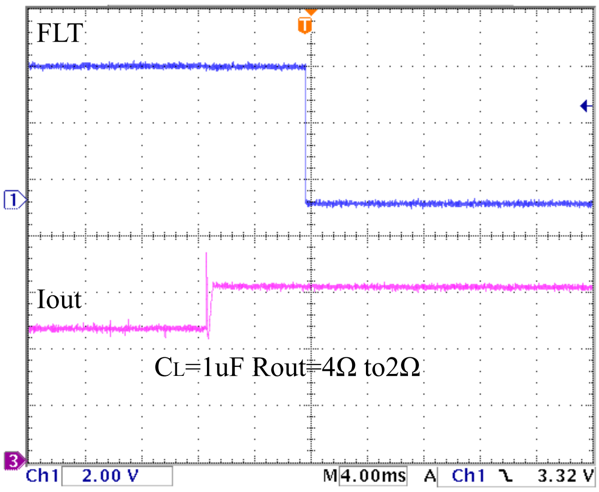
Over Load Response VS Vout



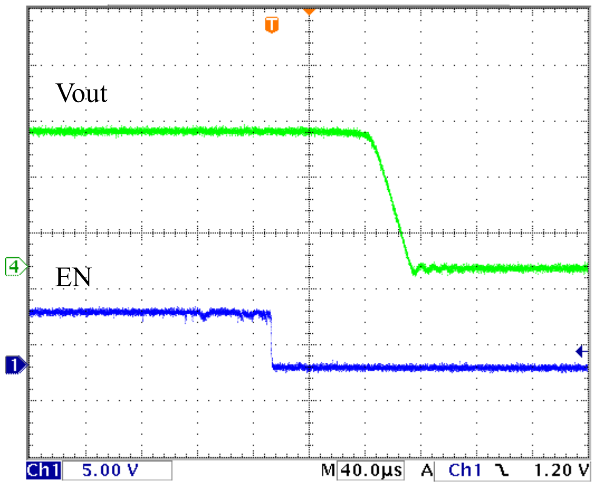
Short Circuit Response and Thermal Shut Down



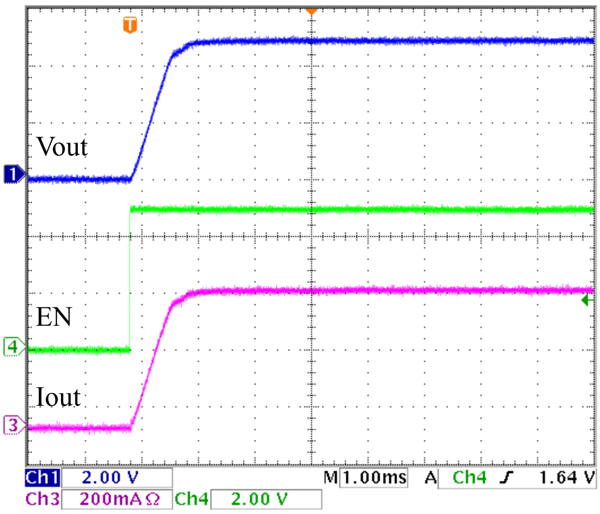
Over Load Response VS FLT



Turnoff Delay and Fall time



Turnon Delay and Output Response



Operation

HM9711A is an integrated power switch with a low Rdson P-channel MOSFET, internal gate rive circuit, programmable current limiting, and thermal protection. When the device is active, if there is no load, the device only consumes 25uA supply current, which makes the device suitable for battery powered applications.

Power Supply Considerations

A 0.01-μF to 0.1-μF ceramic bypass capacitor between IN and GND, close to the device, is recommended.
Placing a high-value electrolytic capacitor on the output pin(s) is recommended when the output load is heavy. This precaution reduces power-supply transients that may cause ringing on the input and minimize the input voltage droops. Additionally, bypassing the output with a 0.01-μF to 0.1-μF ceramic capacitor improves the immunity of the device to short-circuit transients.

Power Dissipation and Junction Temperature

The low on-resistance on the P-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 $R_{DS(ON)}$ of the P-channel MOSFET relative to the input voltage and operating temperature. Using the highest operating ambient temperature of interest and $R_{DS(ON)}$, 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

Compare the calculated junction temperature with the maximum junction temperature which is 125°C. If they are within degrees, either the maximum load current needs to be reduced or another package option will be required.

FLT Output

The FAULT Flag (FLT) is provided to alert the system if a HM9711A load is not receiving sufficient voltage to operate properly. If current limiting circuit is active for more than approximately 4ms, the FAULT Flag is pulled to ground through an approximately 100Ω resistor. The filtering of voltage or current transients of less than 4ms prevents capacitive loads connected to the HM9711A output from activating the FAULT Flag when they are initially attached. However, if the device is entering over-temperature conditions, the FLT will be pulled low without delay or deglitch. Pull-up resistance of 1kΩ to 100kΩ on FLT pin is recommended. Since FLT is an open drain terminal, it may be pulled up to any unrelated voltage less than the maximum operating voltage of 5.5V, allowing for level shifting between circuits.

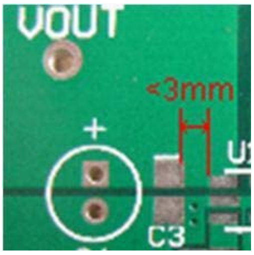
Thermal Protection

Thermal protection prevents damage to the IC when heavy-overload or short-circuit faults are present for extended periods of time. The HM9711A 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 135°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 15°C, the switch turns back on. The switch continues to cycle in this manner until the load fault or input power is removed.

PCB Layout Guide

PCB layout is very important to achieve stable operation. It is highly recommended to duplicate EVB layout for optimum performance. If change is necessary, please follow these guidelines for reference.

1) Keep the path of current short and minimize the loop area formed by Input and output capacitor.
2) Output capacitor and IC must be on the same side, The distance of outpin and output capacitor <3mm is recommended.



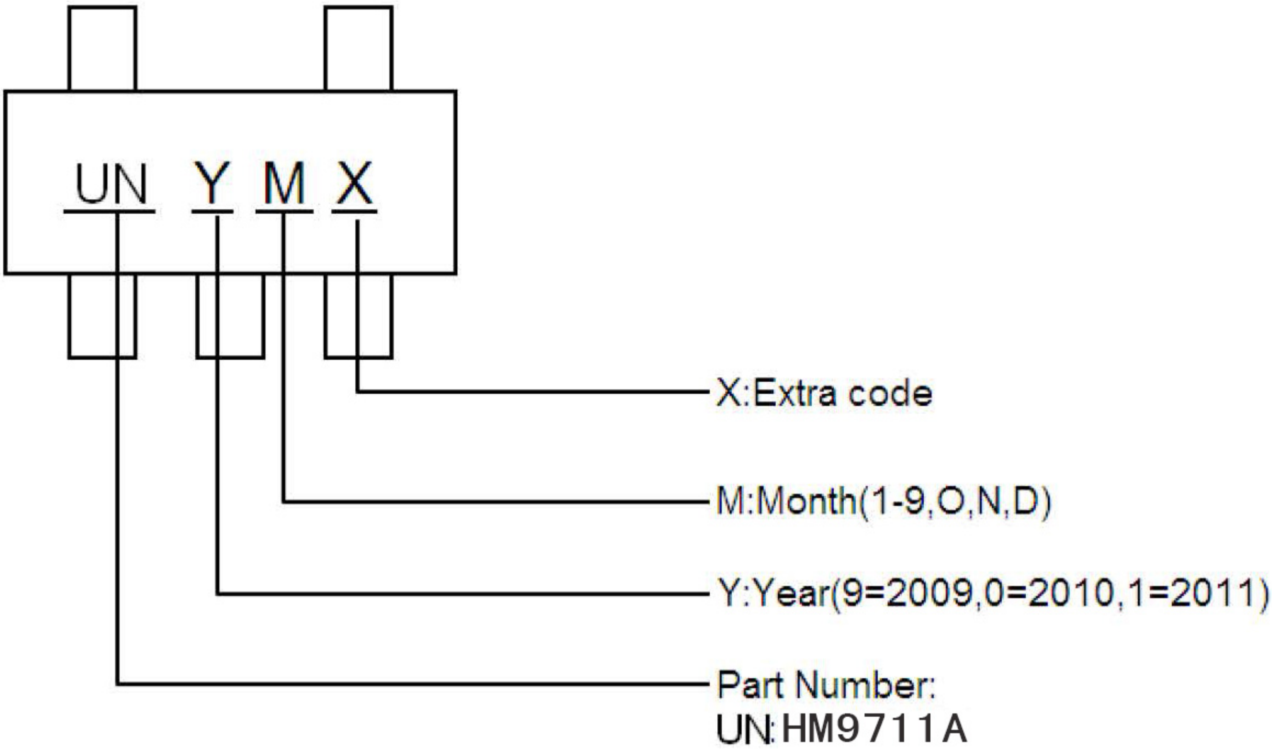
3) Bypass ceramic capacitors are suggested to be put close to the Vin Pin.

4) Connect IN, OUT, and especially GND respectively to a large copper area to cool the chip to improve thermal performance and long-term reliability.

5) A 2-layer PCB layout is recommended.

Marking Information

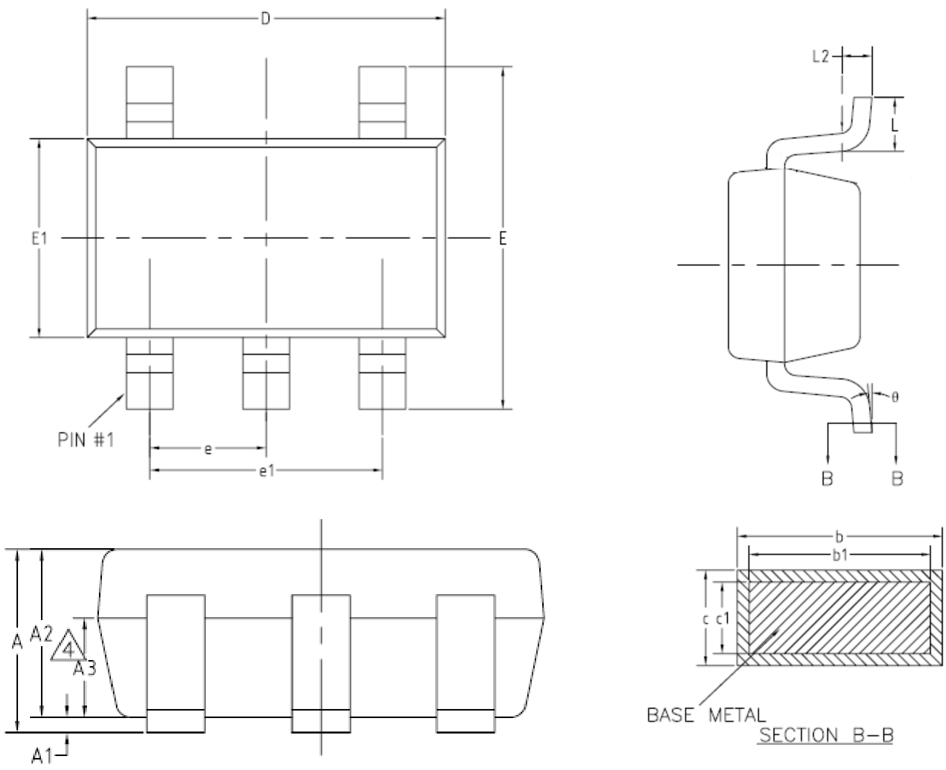
SOT23-5



**For More detailed marking information, contact our sales representative directly or through a H&M Semi distributor located in your area.

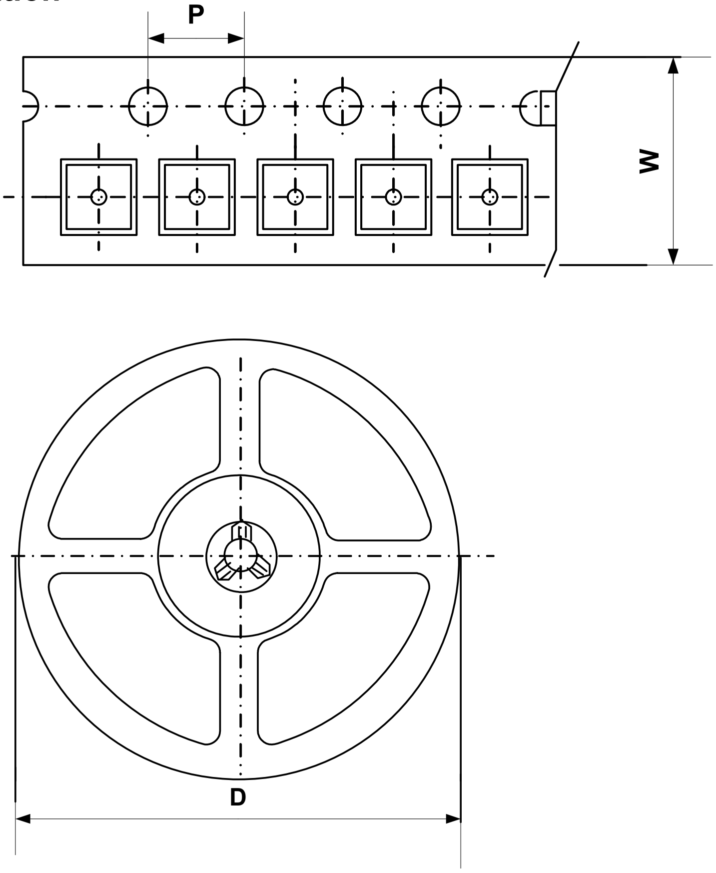
■ Package Information

SOT23-5



SYMBOL	MILLMETER			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	--	--	1.35	--	--	0.0531
A1	0.04	--	0.15	0.0016	--	0.0059
A2	1.00	1.10	1.20	0.0394	0.0433	0.0472
A3	0.55	0.65	0.75	0.0217	0.0256	0.0295
b	0.34	--	0.43	0.0134	--	0.0169
b1	0.33	0.35	0.38	0.0130	0.0138	0.0150
c	0.15	--	0.21	0.0059	--	0.0083
c1	0.14	0.15	0.16	0.0055	0.0059	0.0063
D	2.72	2.92	3.12	0.1071	0.1150	0.1228
E	2.60	2.80	3.00	0.1024	0.1102	0.1181
E1	1.40	1.60	1.80	0.0118	0.0157	0.0197
e	0.95 BSC			0.0374 BSC		
e1	1.90 BSC			0.0748 BSC		
L	0.3	--	0.6	0.0118	--	0.0236
L2	0.25 BSC			0.0098 BSC		
θ	0	--	8°	0	--	8°

■ Packing Information



Package Type	Carrier Width (W)	Pitch (P)	Reel Size(D)	Packing Minimum
SOT23-5	8.0±0.1 mm	4.0±0.1 mm	180±1 mm	3000pcs

Note: Carrier Tape Dimension, Reel Size and Packing Minimum