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SEMICONDUCTOR

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MNCP380HSN05AAT1G

Product specification

GENERAL DESCRIPTION

The MNCP380HSN05AAT1G is a cost-effective, low voltage,single P-MOSFET load switch,optimized for self-powered and bus-powered Universal Serial Bus (USB) applications. This switch operates with inputs ranging from 2.4V to 5.5V, making it ideal for both 3V and 5V systems. The switch's low $R_{DS(ON)}$, 80mΩ ,meets USB voltage drop requirements.

The MNCP380HSN05AAT1G is also protected from thermal overload which limits power dissipation and junction temperatures.Current limit threshold is programmed with a resistor from SET to ground.

The quiescent supply current is typically 15μA at switch on state. At switch off state the supply current decreases to less than 1μA.The MNCP380HSN05AAT1G is available in SOT23-5 package.

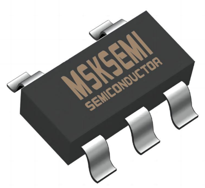
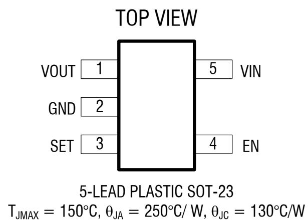
Features

- Compliant to USB Specifications
- Integrated 80mΩ Power MOSFET
- Low Supply Current
  15μA Typical at Switch On State
  1μA Typical at Switch Off State
- Wide Input Voltage Range:2.4V to 5.5V
- Fast Transient Response:<2μs
- Reverse Current Flow Blocking
- Thermal Shutdown Protection
- Hot Plug-In Application (Soft-Start)
- Available in a 5-Pin SOT23-5 Package

Applications

- USB Bus/Self Powered Hubs
- USB Peripherals
- Notebook Computers
- Battery-Charger Circuits
- Personal Communication Devices

Reference News

SOT-23-5	Pin Configuration	Marking
		

Pin Description

Pin Name	Pin Number	Description
VOUT	1	Power-switch output
GND	2	Ground connection; connect externally to Power PAD
SET	3	External resistor used to set current-limit threshold
EN	4	Enable input, logic high turns on power switch
VIN	5	Input voltage; connect a 10uF or greater ceramic capacitor from VINto GND as close tothe IC as possible

TYPICAL APPLICATION

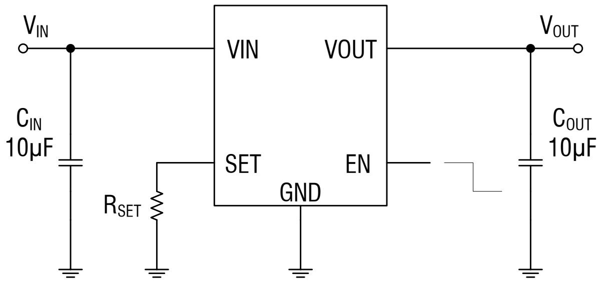
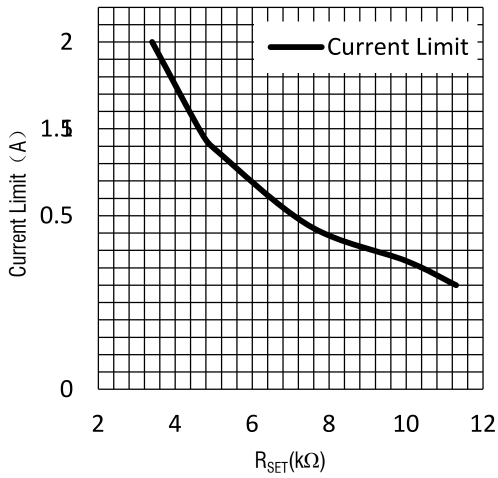


Figure 1. Basic Application Circuit



ABSOLUTEMAXIMUMRATINGS (Note 1)

Input Supply Voltage……………-0.3V to 7V
EN Voltages………… ....-0.3Vto (V_{IN}+0.3V)
SET Voltage……………-0.3V to (V_{IN}+0.3V)
Power Dissipation…………………../..0.4W
Thermal Resistanceθ_{JC}…………..130°C/W
Thermal Resistanceθ_{JA}…………250°C/W

Junction Temperature(Note2)……......….........150°C
Operating Temperature Range…….......-40°Cto 85°C
Lead Temperature(Soldering,10s)....................300°C
Storage Temperature Range….........-65°C to 150°C
ESD HBM(Human Body Mode)…….....................2kV
ESD MM(Machine Mode)……………...................200V

ELECTRICAL CHARACTERISTICS (Note 3)

(V_{IN} =5V, T_A =-40°C to 85°C, unless otherwise noted.)

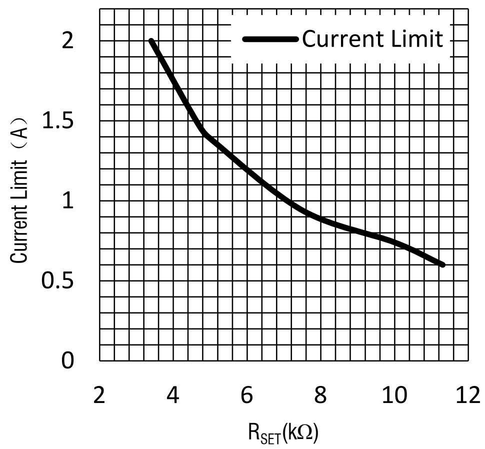
PARAMETER		SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Input Voltage Range		V_{IN}		2.4		5.5	V
Switch On Resistance		$R_{DS(ON)}$	V_{IN}=5V		80	100	mΩ
			V_{IN}=3V		90	110	mΩ
Operation Quiescent Current		I_Q	V_{IN}=5V,EN=Active, No load		15	25	μA
Off Supply Current		$I_{Q(OFF)}$	V_{IN} =5.5V,EN=Inactive			1	μA
Off Switch Current		$I_{Q(SW\_OFF)}$	V_{IN} =5.5V,EN=Inactive			1	μA
Under-voltage Lockout		V_{UVLO}	V_{IN} Increasing		1.8	2.4	V
Under-voltage Lockout Hysteresis		ΔV_{UVLO}	V_{IN} decreasing		0.1		V
Current Limit Threshold		I_{LIM}	R_{SET} =6.8kΩ		1		A
EN Threshold	Logic-Low Voltage	V_{IL}	V_{IN} =2.5V to 5.5V			0.8	V
	Logic-High Voltage	V_{IH}	V_{IN} =2.5V to 5.5V	2			V
Output Leakage Current		I_{LEAK}	EN=Inactive, R_{LOAD} =0Ω		0.5	10	μA
Current Limit Response Time		T_{RESP}	V_{IN} =5V		1		μs
Thermal Shutdown Protection		T_{SD}			150		°C
Thermal Shutdown Hysteresis		ΔT_{SD}			20		°C

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

Note 2: T_J is calculated from the ambient temperature T_A and power dissipation P_D according to the following formula: $T_J = T_A + (P_D) \times (250°C/W)$.

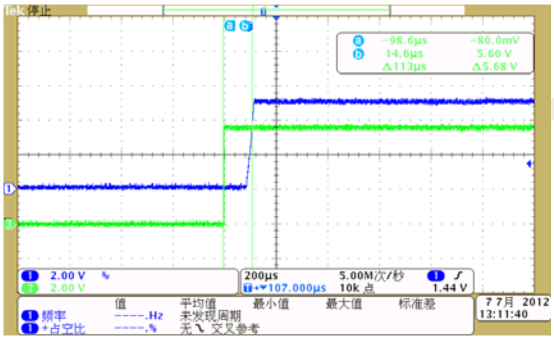
Note 3: 100% production test at 25°C. Specifications over the temperature range are guaranteed by design and characterization.

TYPICAL PERFORMANCE CHARACTERISTICS



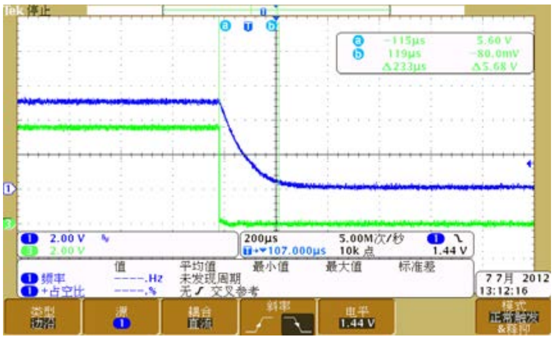
NCP380 TURN ON

V_{IN}=5V,C_{OUT}=10uF,T_A=25℃



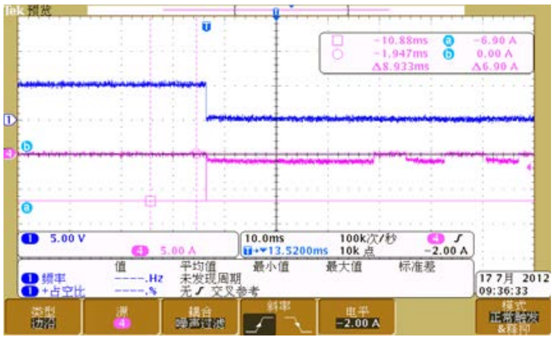
NCP380 TURN OFF

V_{IN}=5V,C_{OUT}=10uF,T_A=25℃



Short Response

V_{IN}=5V,C_{OUT}=10uF,T_A=25℃



FUNCTIONAL BLOCK DIAGRAM

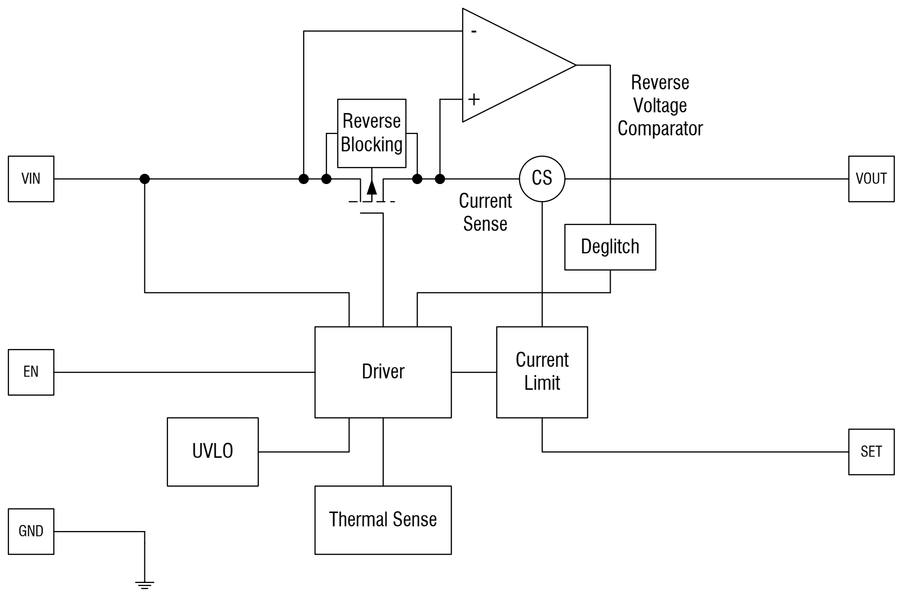


Figure 2. MNCP380HSN05AAT1G Block Diagram

APPLICATIONS INFORMATION

The MNCP380HSN05AAT1G is a single channel c urrent limiting load switch that is intended to pr otect against short circuit and over current event s by current limiting to a preset level. This device i s optimized for self-powered and bus-powered Universal Serial Bus (USB) applications. The s witch's low $R_{DS(ON)}$, 80mΩ, meets USB volt age drop requirements; and a flag output is av ailable to indicate fault conditions to the lo cal USB controller.

Input and Output

V_{IN} (input) is the power source connection to the internal circuitry and the source of the MOSFET. V_{OUT} (output) is the drain of the MOSFET. In a typical application, current flows through the switch from V_{IN} to V_{OUT} toward the load. If V_{OUT} is greater than V_{IN}, current will flow from V_{OUT} to V_{IN} since the MOSFET is bidirectional when on. The MNCP380HSN05AAT1G's reverse current blocking feature prevents current prevents current to flow from V_{OUT} to V_{IN} when the device is disabled.

Soft Start for Hot Plug-In Applications

In order to eliminate the upstream voltage droop caused by the large inrush current during hot-plug events,the “soft-start” feature effectively isolates the power source from extremely large capacitive loads,satisfying the USB voltage droop requirements.

Input capacitor

The input capacitor C_{IN} protects the power supply from current transients generated by the load attached to the MNCP380HSN05AAT1G. When a short circuit is suddenly applied to the output of the MNCP380HSN05AAT1G, a large current, limited only by the $R_{DS(ON)}$ of the MOSFET, will flow for less than 2 μs before the current limit circuitry activates. In this event, a moderately sized CIN will dramatically reduce the voltage transient seen by the power supply and by other circuitry upstream from the MNCP380HSN05AAT1G. The extremely fast short -circuit response time of the MNCP380HSN05AA T1G reduces the size requirement for C_{IN}. C_{IN} shou ld be located as close to the device V_{IN} pin as prac tically possible.Ceramic, tantalum, or aluminum el ectrolytic capacitors are appropriate for C_{IN}. There is no specific capacitor ESR requirement for C_{IN}. However, for higher current operation, ceramic ca pacitors are recommended for C_{IN} due to their inh erent capability over tantalum capacitors to withst and input current surges from low impedance sources such as batteries in portable devices.

Output capacitor

A low-ESR 150μF aluminum electrolytic or tantalum between V_{OUT} and GND is strongly recommended to meet the 330mV maximum droop requirement in the hub V_{BUS} (Per USB 2.0, output ports must have a minimum 120μF of low-ESR bulk capacitance per hub). Standard bypass methods should be used to minimize inductance and resistance between the bypass capacitor and the downstream connector to reduce EMI and decouple voltage droop caused when downstream cables are hot-insertion transients. Ferrite beads in series with V_{BUS}, the ground line and the 0.1μF bypass capacitors at the power connector pins are recommended for EMI and ESD protection. The bypass capacitor itself should have a low dissipation factor to allow decoupling at higher frequencies.

Thermal Considerations

Since the MNCP380HSN05AAT1G has internal current limit and over temperature protection,junction temperature is rarely a concern. However, if the application requires large currents in a hot environment, it is possible that temperature, rather than current limit, will be the dominant regulating condition. In these applications,the maximum current available without risk of an over-temperature condition must be calculated.Power dissipation can be calculated based on the output current and the $R_{DS(ON)}$ of switch as below.

$$P_D = R_{DS(ON)} \times I_{OUT}^2$$

Although the devices are rated for 2A(max) of output current, but the application may limit the amount of output current based on the total power dissipation and the ambient temperature. The final operating junction temperature for any set of conditions can be estimated by the following thermal equation :

$$P_{D(MAX)} = \frac{T_{J(MAX)} - T_A}{\theta_{JA}}$$

Where $T_{J(MAX)}$ is the maximum operation junction temperature 150°C,T_A is the ambient temperature and the θ_{JA} is the junction to ambient thermal resistance. The junction to ambient thermal resistance θ_{JA} is layout dependent. For SOT23-5 and TSOT23-5 packages, the thermal resistance θ_{JA} is 250°C/W. The maximum power dissipation at T_A = 25°C is 0.4W for SOT23-5 and TSOT23-5 Package.

Current limit threshold Setting

Current limit threshold is programmed with a resistor from SET to ground marked as R_{SET}. It can be estimated by the following equation:

$$I_{SET}(A) = \frac{6.8k\Omega}{R_{SET}(k\Omega)}$$

Such as the following table.

I_{SET}(mA)	R_{SET}(kΩ)
600	11.3
800	8.45
1000	6.8
1500	4.53
2000	3.4

PCB Layout Recommendations

When laying out the printed circuit board, the following checking should be used to ensure proper operation of the MNCP380HSN05AAT1G. Check the following in your layout:

- Does the (+) plates of C_{IN} connect to VIN as closely as possible. This capacitor provides the AC current to the internal power MOSFETs.
- Keep the (-) plates of C_{IN} and C_{OUT} as close as possible

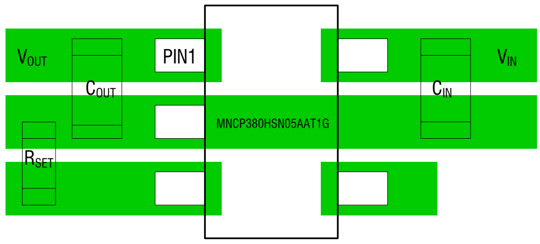
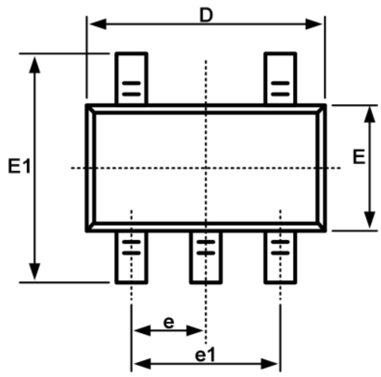
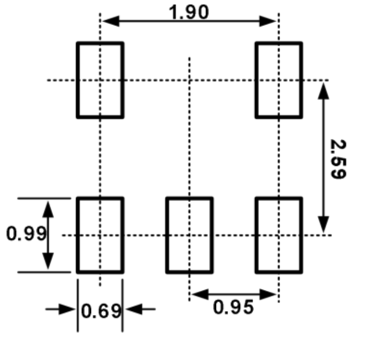


Figure 3. MNCP380HSN05AAT1G Suggested Layout

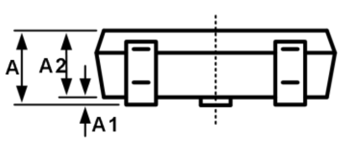
Package Outline

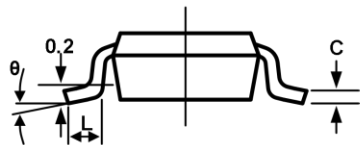
SOT23-5





Recommended Land Pattern (Unit: mm)





Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950BSC		0.037BSC	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
L1	0.600REF		0.024REF	
θ	0°	8°	0°	8°

Order information

Orderable Device	Package	Packing Option
MNCP380HSN05AAT1G	SOT23-5	3000PCS

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