SY6288C20/D20

Low Loss Power Distribution Switch

General Description

The SY6288C20/D20 is an ultra-low $R_{DS(ON)}$ switch with current limiting function to protect the power source from over current and short circuit conditions.

Ordering Information

SY6288□(□□)□

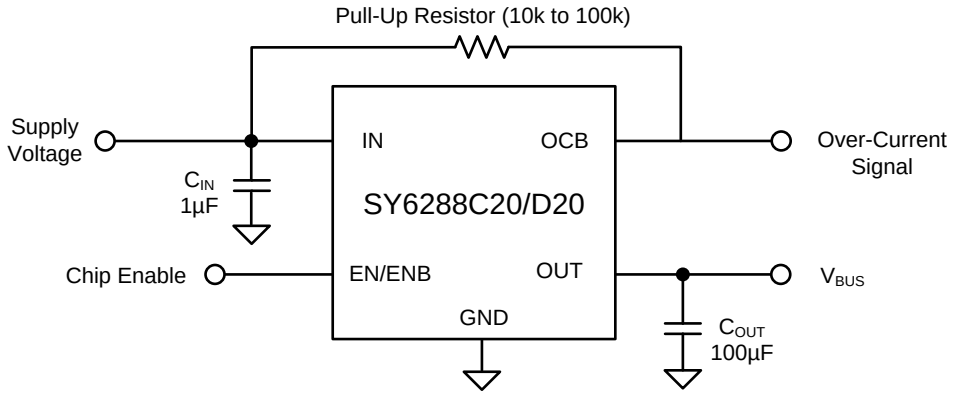
- Temperature Code
- Package Code
- Optional Spec Code

Ordering Number	Package type	Note
SY6288C20AAC	SOT23-5	2A/Active High
SY6288D20AAC	SOT23-5	2A/Active Low

Features

- Distribution Voltage: 2.5V to 5.5V
- Over Temperature Shutdown and Automatic Retry
- Reverse Blocking (No Body Diode)
- At Shutdown, OUT can be Forced Higher than IN
- Fault Flag (OCB) Output for Over Current and Fault Conditions
- Automatic Output Discharge at Shutdown
- Built-in Soft-start
- 1.6ms Rise Time at $3.3V_{IN}$ Condition
- RoHS Compliant and Halogen Free
- Compact Package Minimizes Board Space: SOT23-5
- TUV Certification NO. R50188769
- UL Certification NO. E491480
- CB Certification by IEC 62368-1

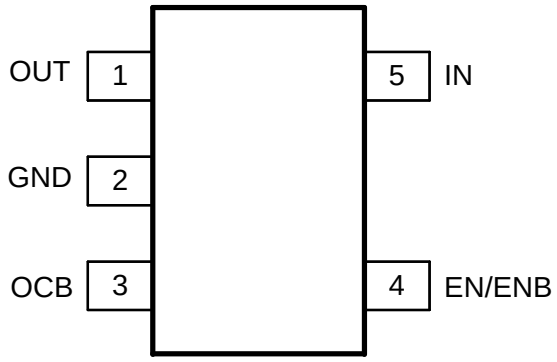
Typical Application Circuit



Note: If 1uF input cap will lead to large Vin voltage spike, it is strongly recommended to add additional 10uF ceramic cap.

Figure 1. Schematic Diagram

Pinout (Top View)



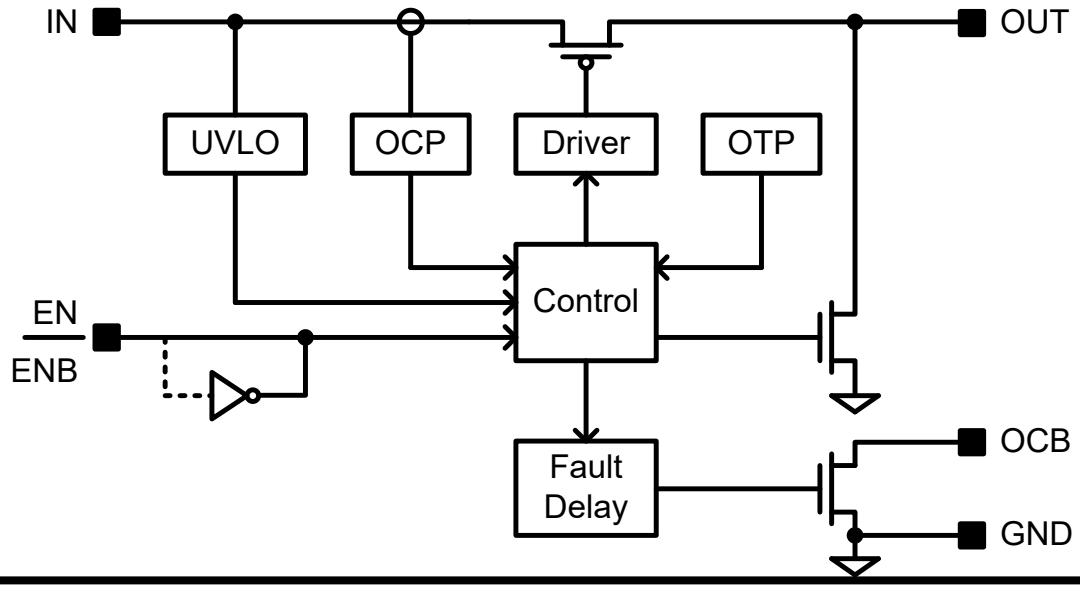
SOT23-5

Part Number	Package type	Top Mark①
SY6288C20AAC	SOT23-5	**RTxyz**
SY6288D20AAC	SOT23-5	**RE*xyz***

Note①： ***x=year code, y=week code, z= lot number code***

Pin Name	Pin Number (SOT23-5)	Pin Description
IN	5	Input pin.
GND	2	Ground pin.
OUT	1	Output pin.
EN-SY6288C20 ENB-SY6288D20	4	ON/OFF control. Do not leave it floating. EN: Active high; ENB: Active low.
OCB	3	Open Drain Fault Flag.

Block diagram



Absolute Maximum Ratings (Note 1)

All pins---------- 6V
Power Dissipation, P_D @ T_A = 25°C, SOT23-5 ---------- 1W
Package Thermal Resistance (Note 2)
SOT23-5, θ_{JA} ---------- 100°C/W
SOT23-5, θ_{JC} ---------- 30°C/W
Junction Temperature Range ---------- 150°C
Lead Temperature (Soldering, 10 sec.) ----------260°C
Storage Temperature Range ---------- -65°C to 150°C
ESD Susceptibility (Note 2)
HBM (Human Body Mode) ---------- 2kV
MM (Machine Mode) ---------- 200V

Recommended Operating Conditions (Note 3)

IN---------- 2.5V to 5.5V
All other pins ---------- 0-5.5V
Junction Temperature Range ---------- -40°C to 125°C
Ambient Temperature Range ---------- -40°C to 85°C

Electrical Characteristics

(V_{IN} = 5V, C_L=1uF, per channel, T_A = 25°C unless otherwise specified)

Parameter		Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage Range		V_{IN}		2.5		5.5	V
Shutdown Input Current		I_{SHDN}	Open load, switch off		0.1	1	μA
			Output grounded, switch off		0.1	1	μA
Quiescent Supply Current		I_Q	Open load, switch on		35		μA
FET $R_{DS(ON)}$		$R_{DS(ON)}$	SOT23-5, V_{IN}=5V I_{OUT}=0.5A	60	65	75	mΩ
Current Limit		I_{LIM}	SY6288C20/D20	2.2	3.0	3.8	A
Fold back Current		I_{FBC}	V_{IN}>3.5V, V_{OUT}<1V		2.1	2.8	A
EN/ $\overline{EN}$ Threshold	Logic-Low Voltage	V_{IL}				0.5	V
	Logic-High Voltage	V_{IH}	V_{IN}=5V, T_A=25°C	1.5			V
			V_{IN}=3.3V, T_A=25°C	1.35			V
IN UVLO Threshold		$V_{IN,UVLO}$				2.45	V
IN UVLO Hysteresis		$V_{IN,HYS}$			0.1		V
Rise Time		T_{RISE}	V_{IN}=3.3V, R_L=3 Ω, C_L=1uF	1.4	1.9	2.5	ms
			V_{IN}=5.0V, R_L=5 Ω, C_L=1uF	2.2	3.0	3.8	ms
OCB Low Resistance		R_{OCB}			10		Ω
OCB Delay Time		T_{OCB_Delay}			15		ms
OUT Shutdown Discharge Resistance		R_{DIS}		80	90	100	Ω
Thermal Shutdown Temperature		T_{SD}			150		°C
Thermal Shutdown Hysteresis		T_{HYS}			20		°C
Short Circuit Response Time		T_{SC}			2		us

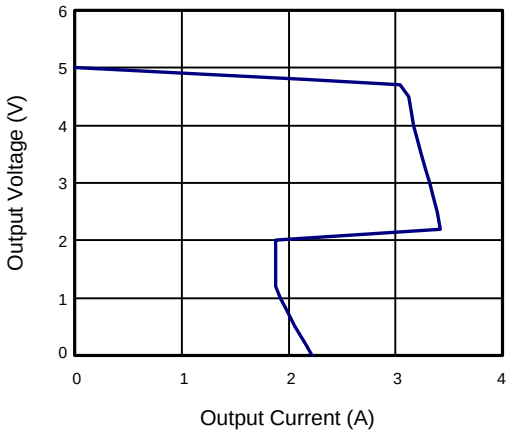
Note 1: Stresses beyond the "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Note 2: θ_{JA} is measured in the natural convection at T_A = 25°C on Silergy Evaluation Board.

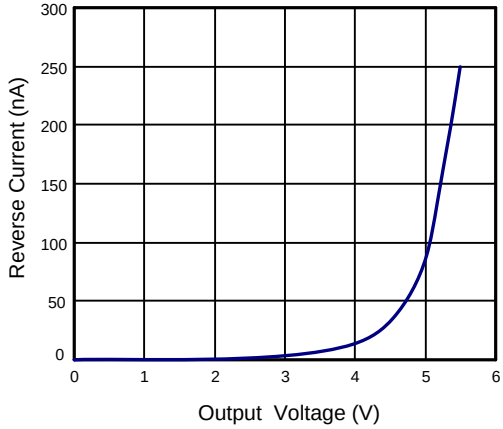
Note 3: The device is not guaranteed to function outside its operating conditions

Typical Operating Characteristics

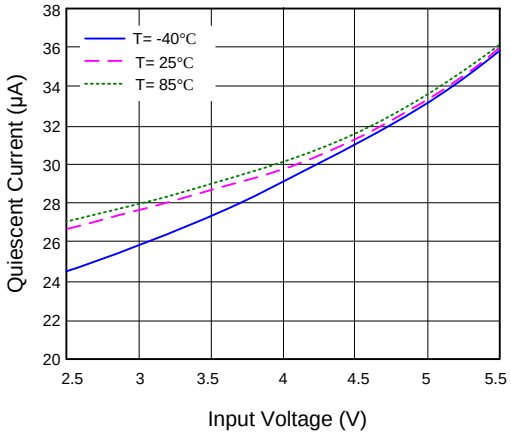
Output Voltage vs. Output Current
(V_{IN}=5.0V)



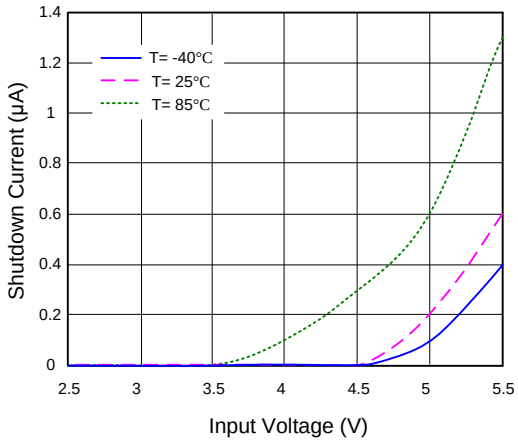
Reverse Current vs. Output Voltage
(V_{IN}=0V, EN OFF)



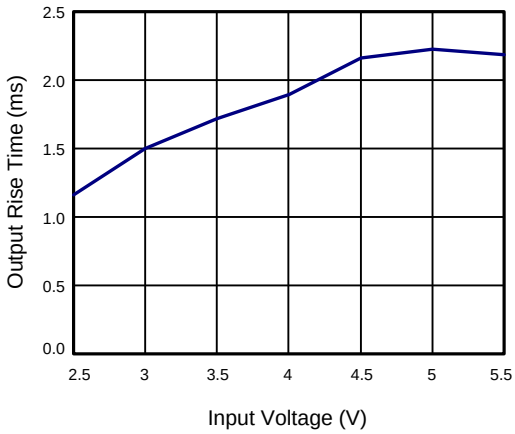
Quiescent Current vs. Input Voltage



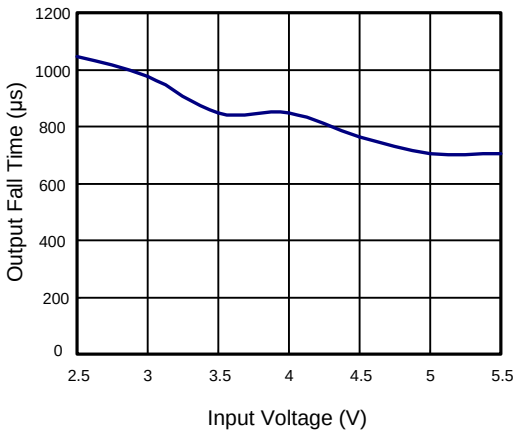
Shutdown Current vs. Input Voltage



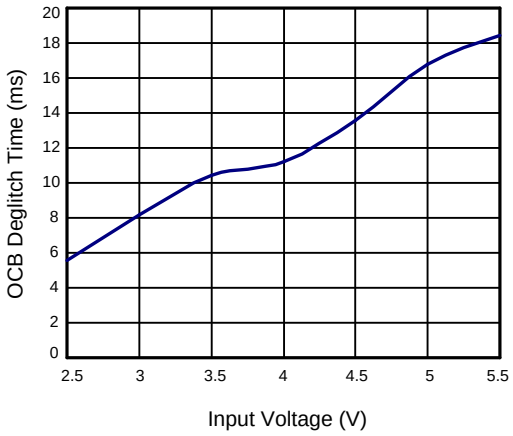
Output Rise Time vs. Input Voltage
(R_{LOAD}=Open, C_{IN}=10μF,C_{OUT}=4.7μF)



Output Fall Time vs. Input Voltage
(R_{LOAD}=Open, C_{IN}=10μF,C_{OUT}=4.7μF)

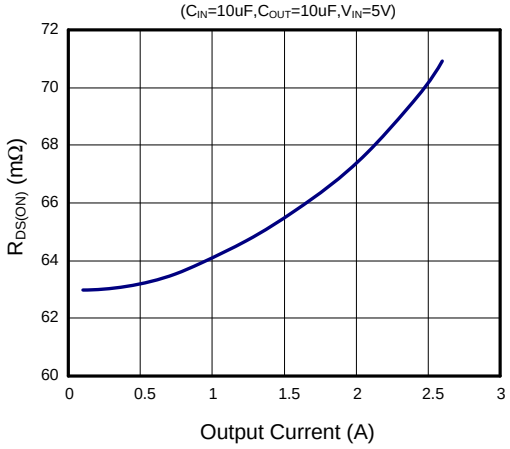


OCB Deglitch Time vs. Input Voltage

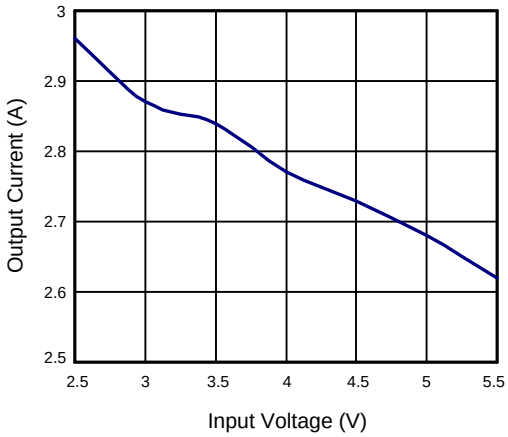


$R_{DS(ON)}$ vs. Output Current

(C_{IN}=10uF,C_{OUT}=10uF,V_{IN}=5V)

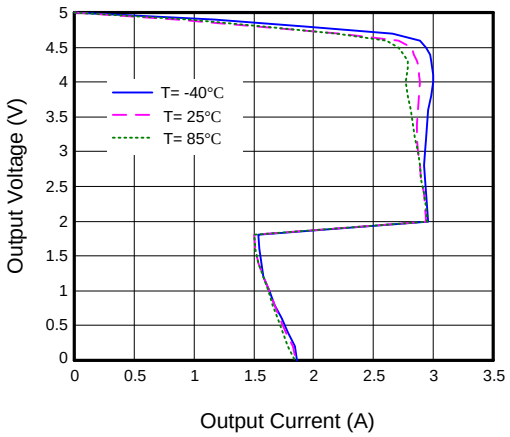


Current Limit vs. Input Voltage



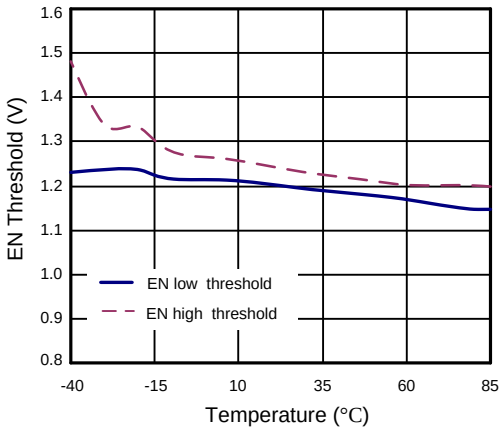
Current Limit vs. Output Voltage

(V_{IN}=5V, C_{IN}=10uF,C_{OUT}=10uF)

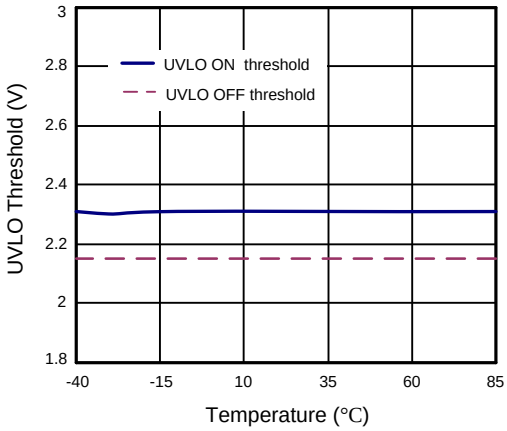


Enable Threshold vs. Temperature

(V_{IN}=5V)

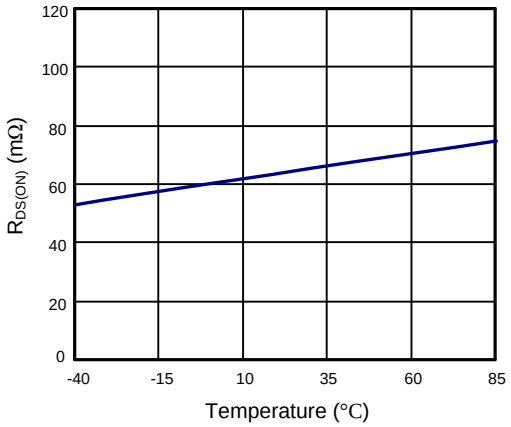


UVLO Threshold vs. Temperature



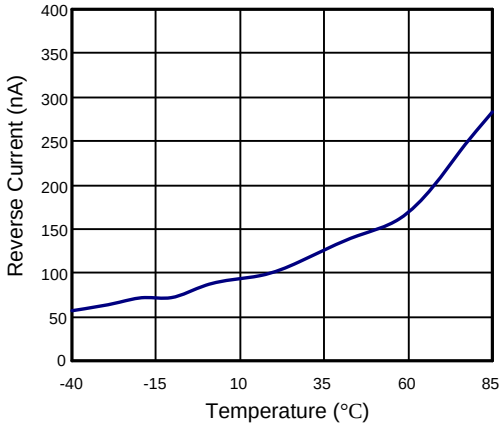
$R_{DS(ON)}$ vs. Temperature

(V_{IN}=5V,I_{LOAD}=1A)



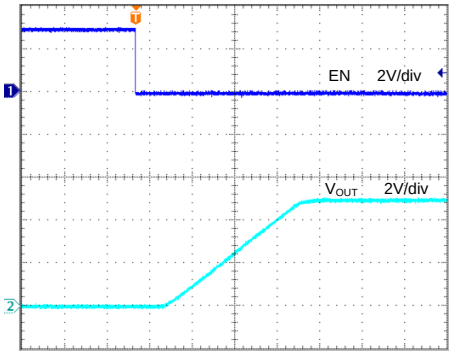
Reverse Current vs. Temperature

(V_{OUT}-V_{IN}=5V, EN OFF)



Turn On Response

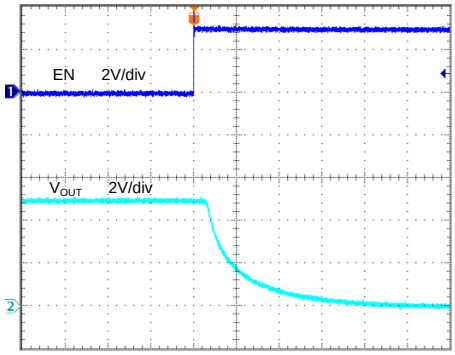
(V_{IN}=5.0V,C_{OUT}=4.7μF,R_{LOAD}=10Ω)



Time (1ms/div)

Turn Off Response

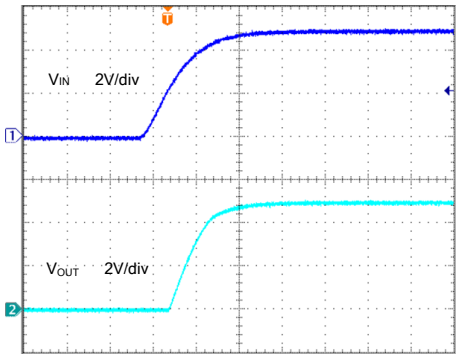
(V_{IN}=5.0V,C_{OUT}=4.7μF,R_{LOAD}=10Ω)



Time (40μs/div)

UVLO at Rising

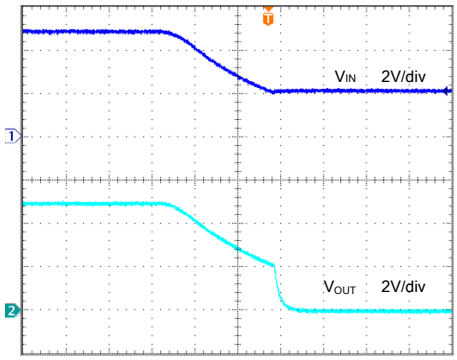
(V_{IN}=5.0V,C_{OUT}=4.7μF,R_{LOAD}=10Ω)



Time (1ms/div)

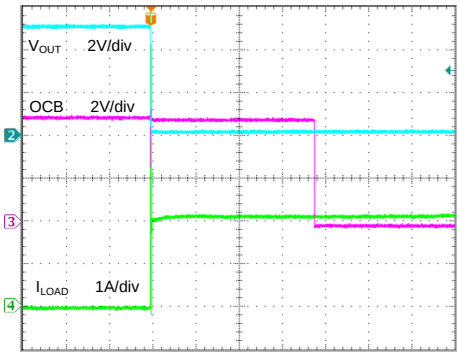
UVLO at Falling

(V_{IN}=5.0V,C_{OUT}=4.7μF,R_{LOAD}=10Ω)



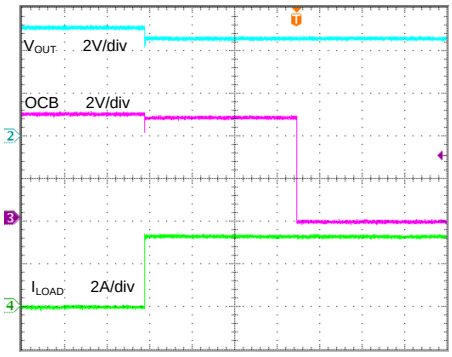
Time (400μs/div)

OCB Response during Short Circuit



Time (4ms/div)

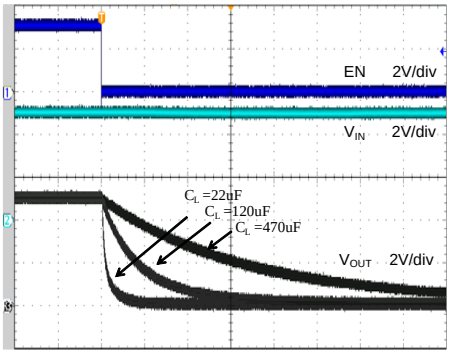
OCB Response during Over Load



Time (4ms/div)

Turn off Delay Time and Fall Time

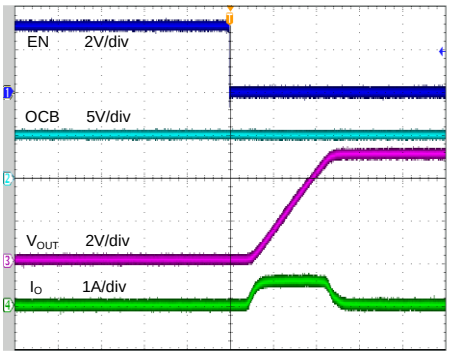
(C_{IN}=10uF,C_{OUT}=10uF,R_L=10Ω)



Time (800μs/div)

Inrush Current with Different Load Capacitance

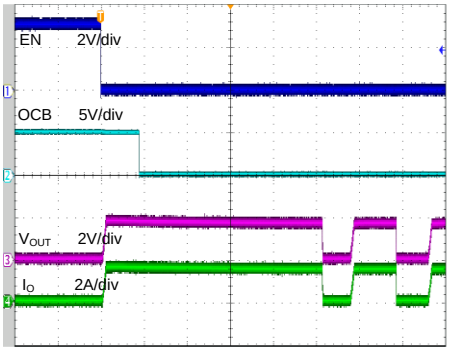
(C_{IN}=10uF,C_{OUT}=10uF,C_L=470uF,R_L=10Ω)



Time (2ms/div)

Thermal Shutdown Response

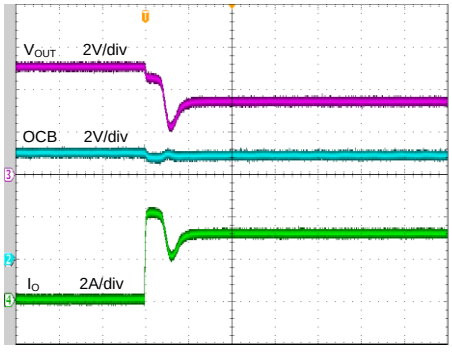
(C_{IN}=10uF,C_{OUT}=10uF,R_L=1.3Ω,V_{IN}=5V)



Time (20ms/div)

Resistance Load Inrush Response

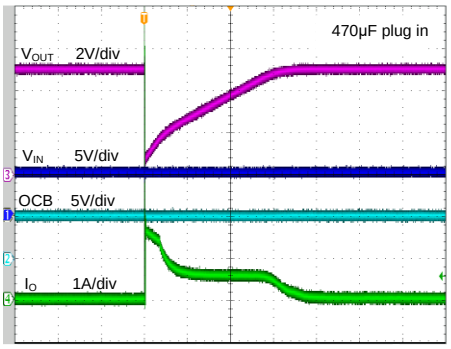
(C_{IN}=10uF,C_{OUT}=10uF,R_L=1.3Ω,V_{IN}=5V)



Time (40μs/div)

Capacitance Load Inrush Response

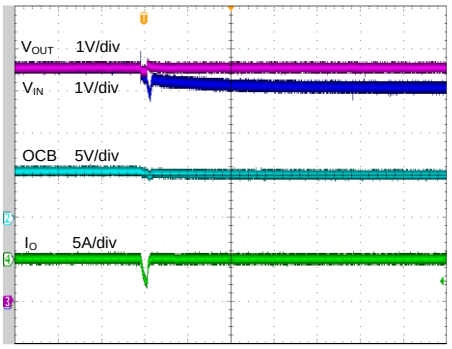
(C_{IN}=10uF,C_{OUT}=10uF,R_L=10Ω,V_{IN}=5V)



Time (800μs/div)

Reverse-Voltage Protection Response

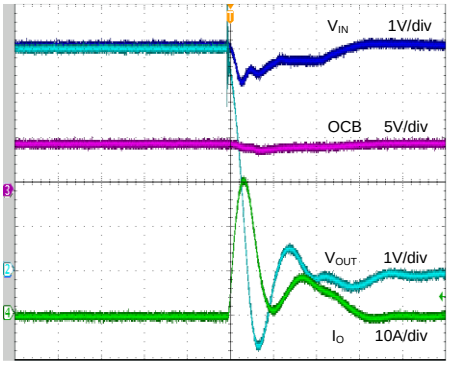
(C_{IN}=10uF,C_{OUT}=10uF, V_{IN}=5.5V →5.0V, V_{OUT}=5.5V)



Time (800μs/div)

Short Circuit Response

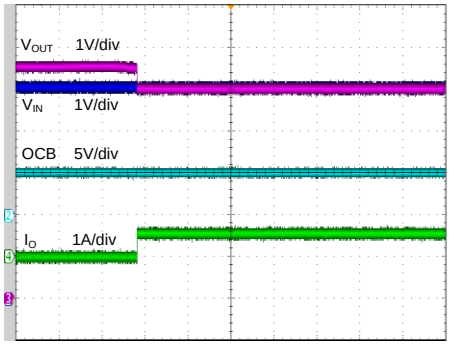
(V_{IN}=5V, C_{IN}=10uF,C_{OUT}=4.7uF)



Time (4μs/div)

Reverse-Voltage Protection Recovery

(C_{IN}=10uF,C_{OUT}=10uF,R_L=10Ω, V_{IN}=5.0V, 5.5V V_{OUT} Removed)



Time (200ms/div)

Operation

The SY6288C20/D20 is a current limited P-channel MOSFET power switch designed for high-side load-switching applications. There is no parasitic body diode between drain and source of the MOSFET, so the SY6288C20/D20 prevents current flow from out to input when out being externally forced to a higher voltage than vin when chip is disabled.

Over-current Protection

When the over-current condition is sensed, the gate of the pass switch is modulated to achieve constant output current. Under output short circuit conditions, the normal current limit is folded back to 50%. If the over current condition presists for a long enough time, the junction temperature may exceed 150C, and over-temperature protection will shut down the part. Once the chip temperature drops below 130C, the part will restart.

Fault Flag (OCB)

The OCB output is asserted (active low) when an over temperature shutdown condition or over current condition persists for 15ms. The output remains asserted until the over current or
Over temperature condition is removed. Connecting a heavy capacitive load to an enabled device can cause a momentary over current condition; however, no false reporting on OCB occurs due to the 15-ms deglitch circuit.

Supply Filter Capacitor

In order to prevent the input voltage drooping during hot-plug events, a 1uF ceramic capacitor form IN to GND is strongly recommended. However, higher capacitor values could reduce the voltage droop on the input further. Furthermore, an output short will cause ringing on the input without the input capacitor. It could destroy the internal circuitry when the input transient exceed 6V which is the absolute maximum supply voltage even for a short duration.

Output Filter Capacitor

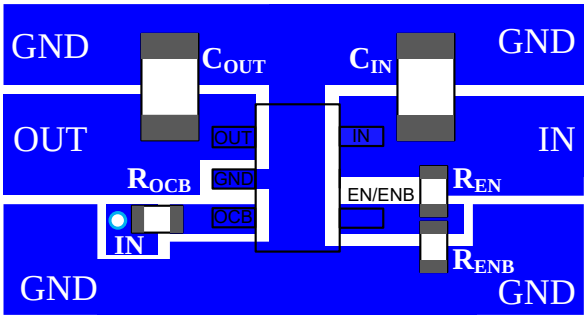
Between OUT and GND, a low-ESR 150uF alumimum electrolytic or tantalum capacitor is strongly recommended to meet the 330mV maximum droop requirement. Standard bypass methods should be used to minimize inductance and resistance between the bypass capacitor and the downsteam connector. This will reduce EMI and improve the transient performance.

PCB Layout Guide

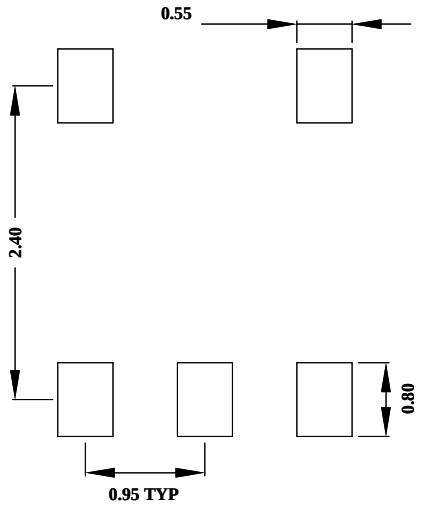
For best performance of the SY6288C20/D20, the following guidelines must be strictly followed:

- Keep all V_{BUS} traces as short and wide as possible and use at least 2 ounce copper for all V_{BUS} traces.
- Place a ground plane under all circuitry to lower both resistance and inductance and improve DC and transient performance.
- Locate the output capacitor as close to the connectors as possible to lower impedance(mainly inductance) between the port and the capacitor and improve transient performance.
- Input and output capacitors should be placed closed to the IC and connected to ground plane to reduce noise coupling.
- Locate the ceramic bypass capacitors as close as possible to the IN pins and OUT pins of SY6288C20/D20.

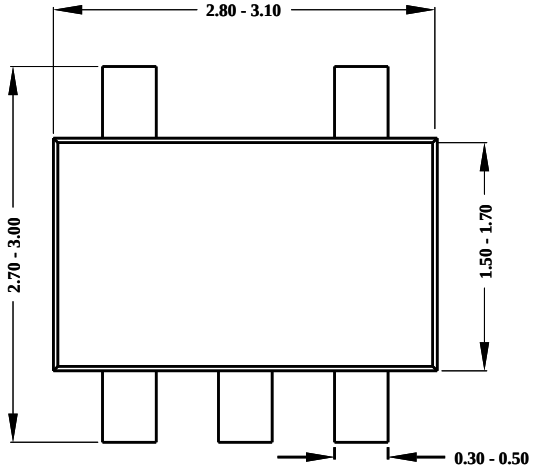
PCB Layout Suggestion

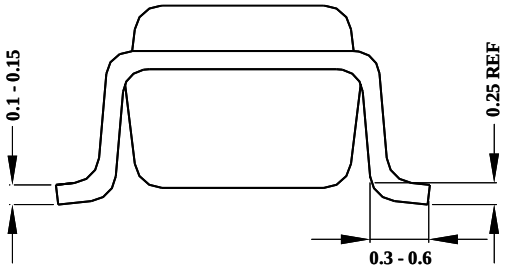


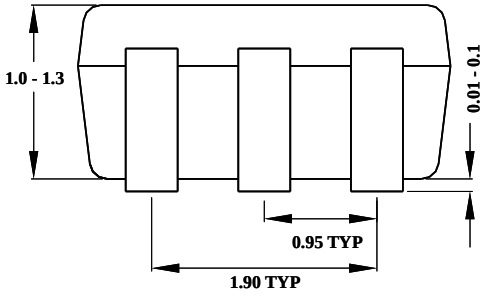
SOT23-5 Package outline & PCB layout design



Recommended Pad Layout





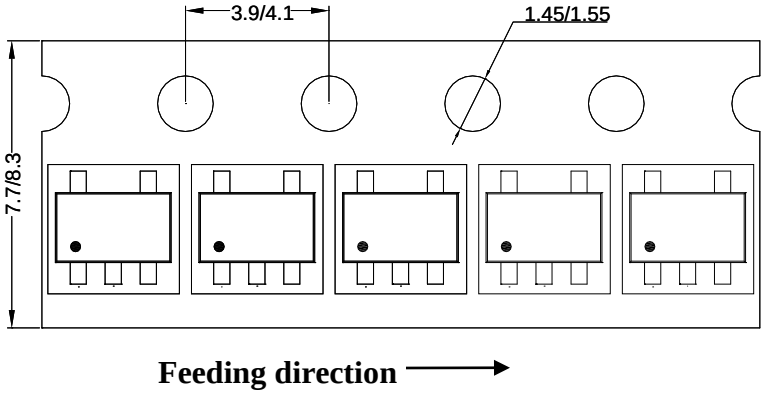


Notes: All dimensions are in millimeters.
All dimensions don't include mold flash & metal burr.

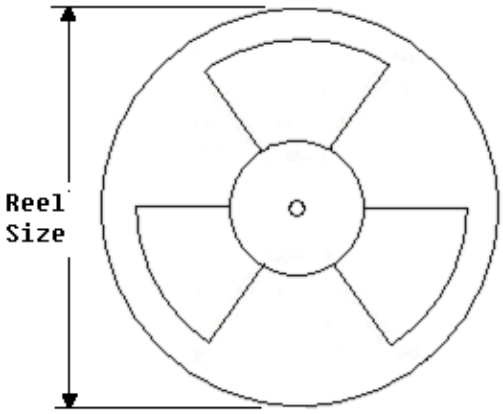
Taping & Reel Specification

1. Taping orientation

SOT23-5



2. Carrier Tape & Reel specification for packages



Package types	Tape width (mm)	Pocket pitch(mm)	Reel size (Inch)	Trailer length(mm)	Leader length (mm)	Qty per reel
SOT23-5	8	4	7"	280	160	3000

3. Others: NA

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