SY20808C20/D20

Low Loss 5.5V 2A Power Distribution Switch

General Description

The SY20808C20/D20 is an ultra-low $R_{DS(ON)}$ switch. It operates over an input voltage range of 2.5V to 5.5V. It has a current limit to protect the power source from overcurrent and short-circuit conditions.

Active high or low polarity options for enabling the part are available for flexibility.

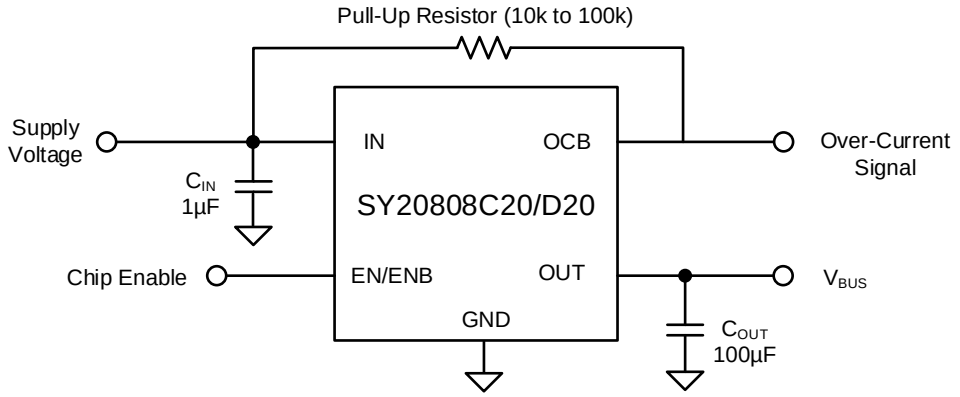
The SY20808C20/D20 incorporates soft-start, overtemperature protection and reverse blocking functions. The OCB open-drain fault indicator can be used to signal the event to a system host.

The device is available in a standard SOT23-5 package.

Features

- Input Voltage: 2.5V to 5.5V
- Quiescent Current I_Q 35µA (typ.)
- Shutdown Current I_{SHDN} 0.1 µA (typ.)
- Overtemperature Shutdown and Automatic Retry
- Reverse Blocking (No Body Diode)
- At Shutdown, OUT can be Forced Higher than IN
- Fault Flag (OCB) Output for Overcurrent and Fault Conditions
- Automatic Output Discharge at Shutdown
- Built-In Soft-Start
- 1.6ms Rise Time at 3.3V_{IN} Conditions
- RoHS Compliant and Halogen Free
- Compact Package: SOT23-5

Typical Application Circuit



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

Figure 1. Schematic Diagram

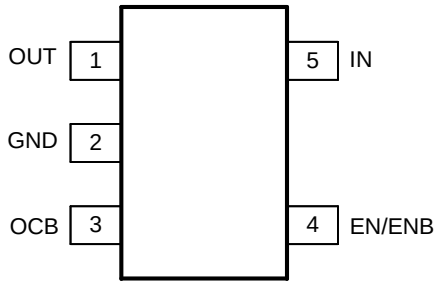
Ordering Information

Ordering Number	Package Type	Top Mark	Note
SY20808C20AAC	SOT23-5	**RTxyz**	2A/Active High
SY20808D20AAC	SOT23-5	**RE*xyz***	2A/Active Low

RoHS Compliant and Halogen Free

Device code: RT, RE
x=year code, y=week code, z= lot number code

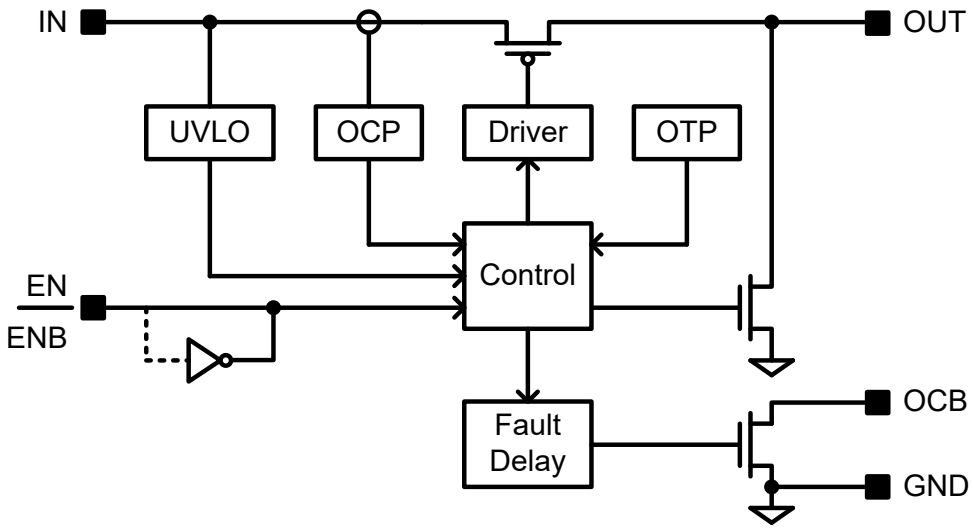
Pinout (Top View)



(SOT23-5)

Pin Name	Pin Number	Pin Description
IN	5	Input pin
GND	2	Ground pin
OUT	1	Output pin
EN-SY20808C20 ENB-SY20808D20	4	ON/OFF control. Do not leave it floating. EN: Active high; ENB: Active low.
OCB	3	Open Drain Fault Flag. Active low

Block Diagram



Absolute Maximum Ratings

Parameter (Note 1)	Min	Max	Unit
OUT, OCB, EN/ENB, IN	-0.3	6	V
Lead Temperature (Soldering, 10s)		260	°C
Junction Temperature, Operating	-40	150	
Storage Temperature	-65	150	

Thermal Information

Parameter (Note 2)	Typ	Unit
θ_{JA} Junction-to-Ambient Thermal Resistance	100	°C/W
θ_{JC} Junction-to-Case Thermal Resistance	30	
P_D Power Dissipation T_A = 25°C	1	W

ESD Susceptibility

Parameter	Min	Max	Unit
HBM (Human Body Mode)		2	kV
MM (Machine Mode)		200	V

Recommended Operating Conditions

Parameter (Note 3)	Min	Max	Unit
IN	2.5	5.5	V
OUT, OCB, EN/ENB	0	5.5	
Junction Temperature, Operating	-40	125	°C
Ambient Temperature	-40	85	

Electrical Characteristics

(V_{IN} = 5V, C_L=1μF, 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}	SY20808C20/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=1μF	1.4	1.9	2.5	ms
			V_{IN}=5.0V, R_L=5 Ω, C_L=1μF	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		μs

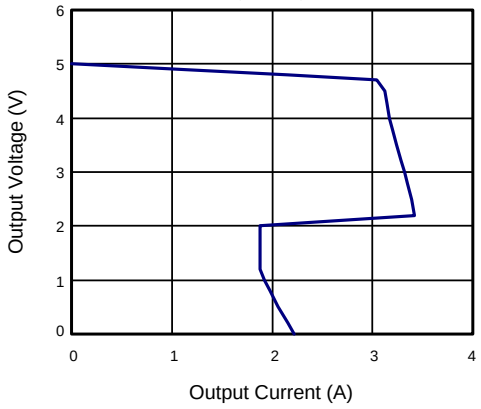
Note 1: Stresses beyond the “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute 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 the Silergy Evaluation Board.

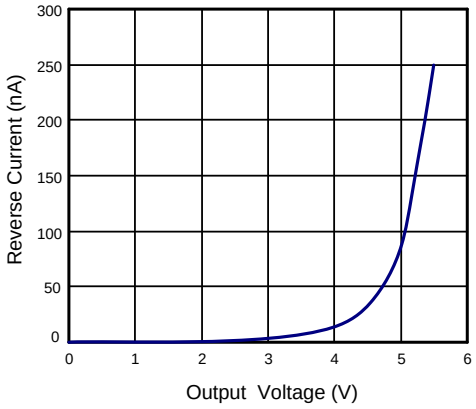
Note 3: The device is not guaranteed to function outside its operating conditions

Typical Performance Characteristics

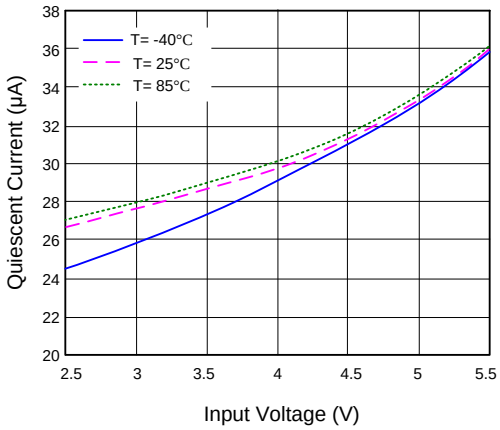
Output Voltage vs. Output Current
(V_{IN}=5.0V)



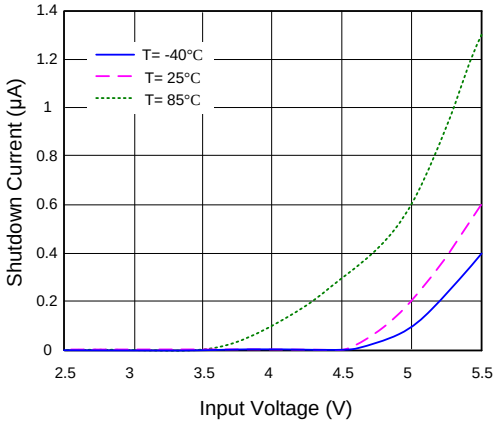
Reverse Current vs. Output Voltage
(V_{IN}=0V, EN OFF)



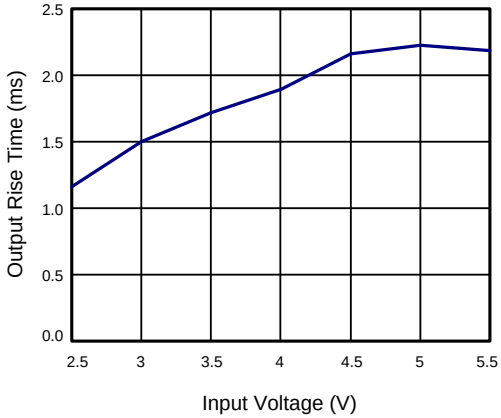
Quiescent Current vs. Input Voltage



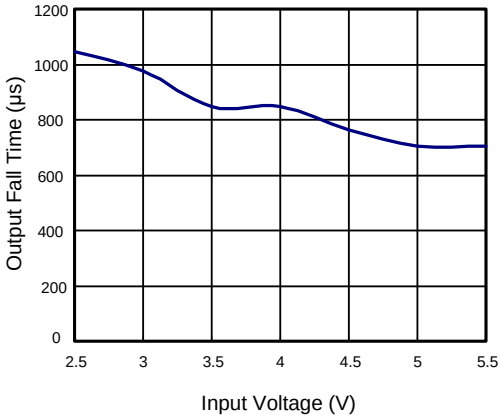
Shutdown Current vs. Input Voltage



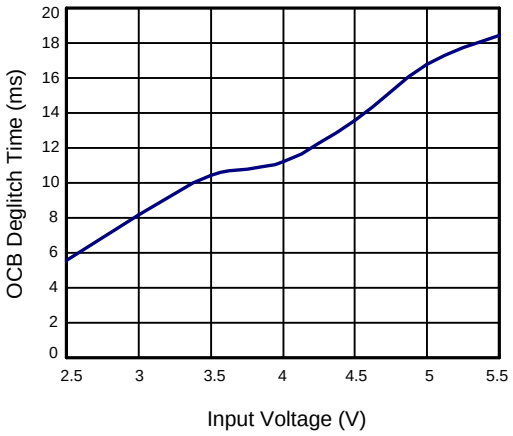
Output Rise Time vs. Input Voltage
(R_{LOAD}=Open, C_{IN}=10μF,C_{OUT}=4.7μF)



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

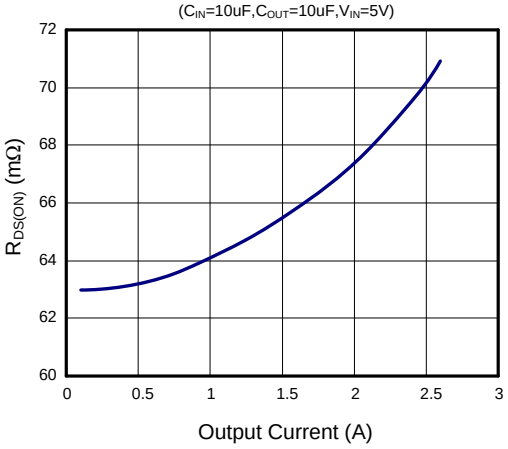


OCB Deglitch Time vs. Input Voltage

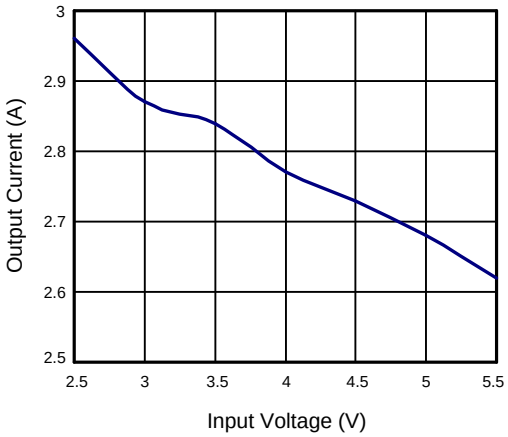


$R_{DS(ON)}$ vs. Output Current

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

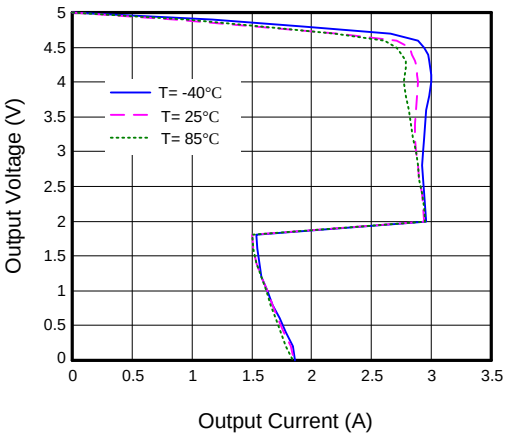


Current Limit vs. Input Voltage



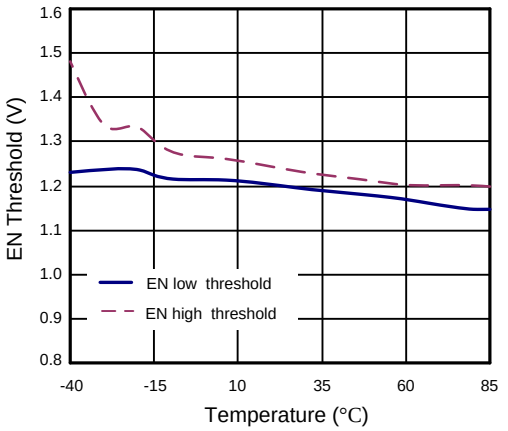
Current Limit vs. Output Voltage

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

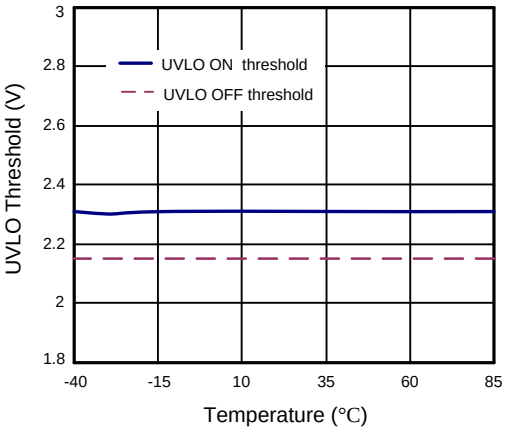


Enable Threshold vs. Temperature

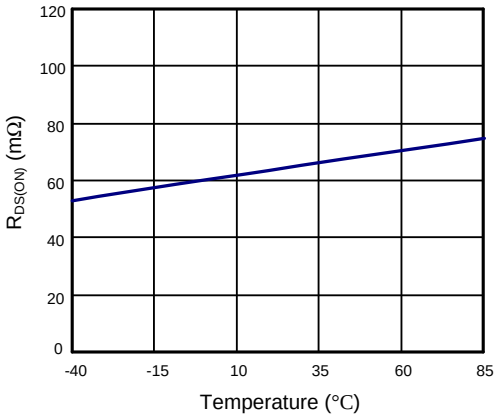
(V_{IN}=5V)



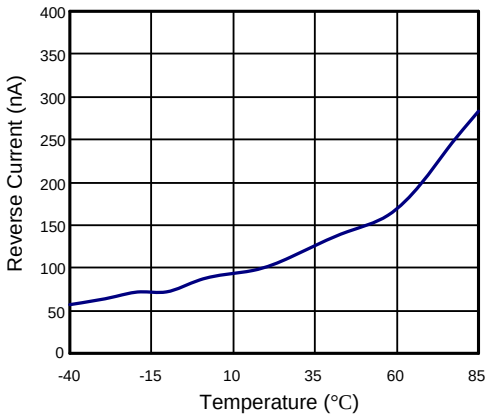
UVLO Threshold vs. Temperature



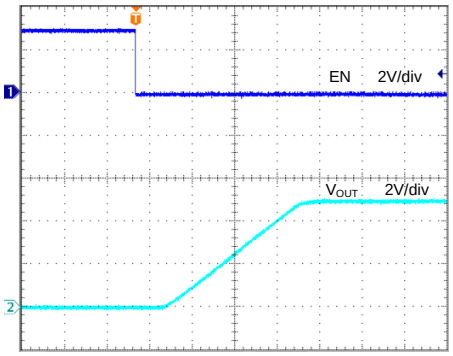
$R_{DS(ON)}$ vs. Temperature
(V_{IN}=5V,I_{LOAD}=1A)



Reverse Current vs. Temperature
(V_{OUT}-V_{IN}=5V, EN OFF)

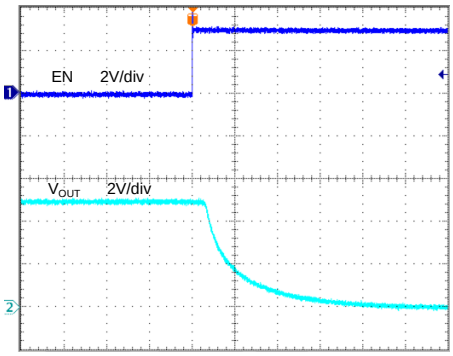


Turn On Response
(V_{IN}=5.0V,C_{OUT}=4.7μF,R_{LOAD}=10Ω)



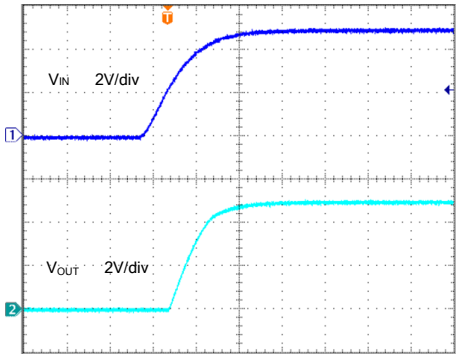
Time (1ms/div)

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



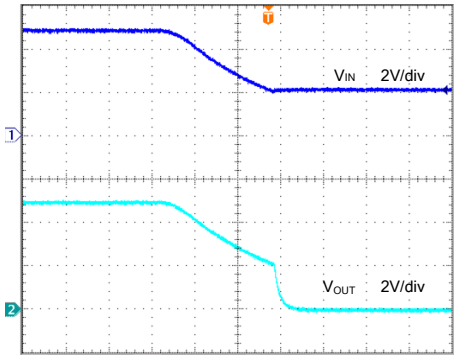
Time (40μs/div)

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



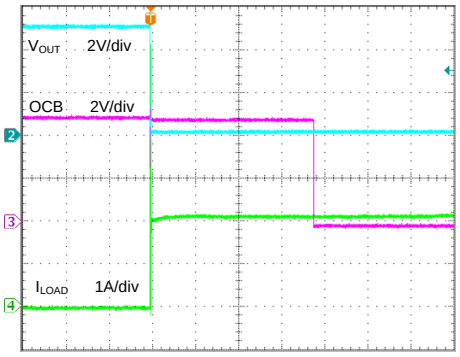
Time (1ms/div)

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



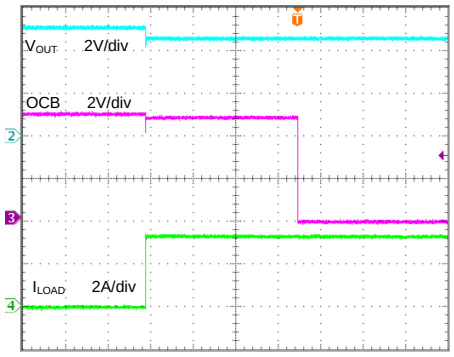
Time (400μs/div)

OCB Response during Short Circuit



Time (4ms/div)

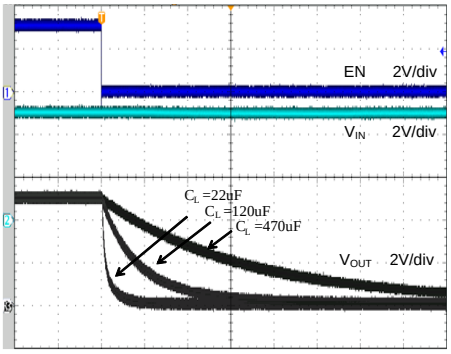
OCB Response during Over Load



Time (4ms/div)

Turn off Delay Time and Fall Time

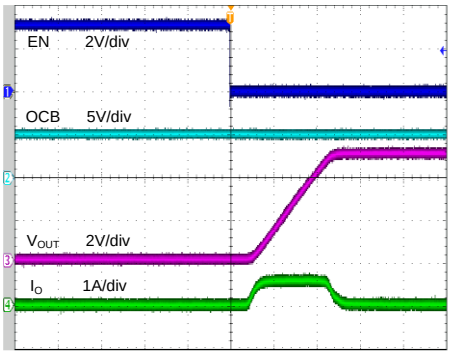
(C_{IN}=10uF,C_{OUT}=10uF,R_L=10Ω)



Time (800μs/div)

Inrush Current with Different Load Capacitance

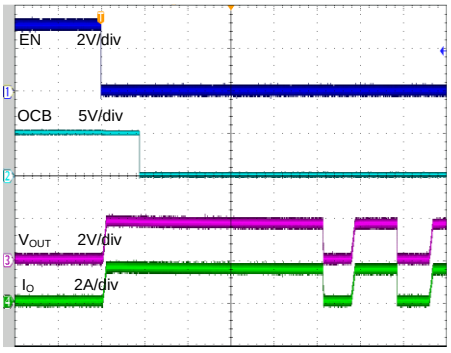
(C_{IN}=10uF,C_{OUT}=10uF,C_L=470uF,R_L=10Ω)



Time (2ms/div)

Thermal Shutdown Response

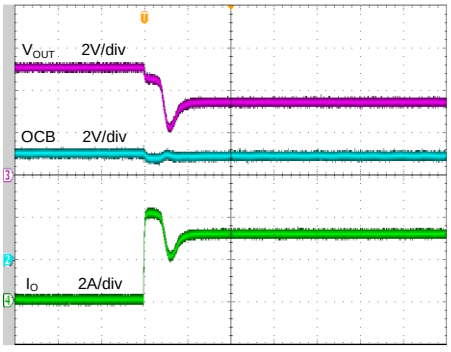
(C_{IN}=10uF,C_{OUT}=10uF,R_L=1.3Ω,V_{IN}=5V)



Time (20ms/div)

Resistance Load Inrush Response

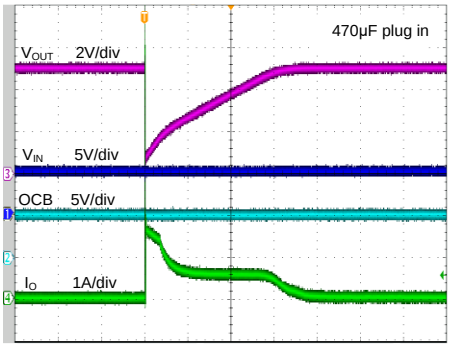
(C_{IN}=10uF,C_{OUT}=10uF,R_L=1.3Ω,V_{IN}=5V)



Time (40μs/div)

Capacitance Load Inrush Response

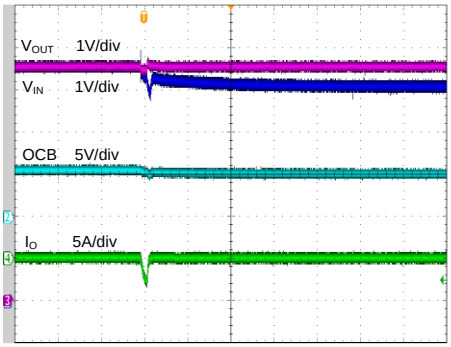
(C_{IN}=10uF,C_{OUT}=10uF,R_L=10Ω,V_{IN}=5V)



Time (800μs/div)

Reverse-Voltage Protection Response

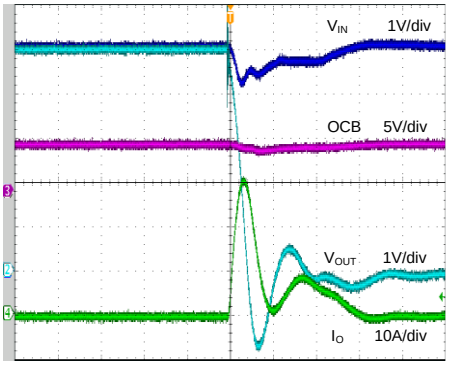
(C_{IN}=10uF,C_{OUT}=10uF, V_{IN}=5.5V →5.0V, V_{OUT}=5.5V)



Time (800μs/div)

Short Circuit Response

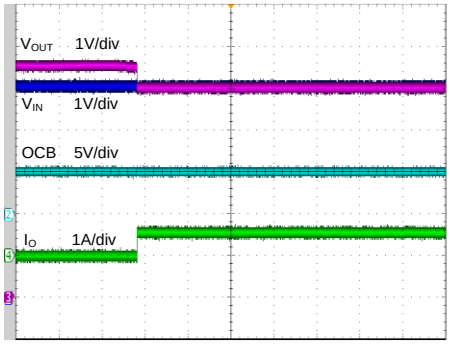
(V_{IN}=5V, C_{IN}=10uF,C_{OUT}=4.7uF)



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)

Application Information

The SY20808C20/D20 is a current limited P-channel MOSFET power switch designed for high-side load-switching applications. There is no parasitic body diode between the drain and source of the MOSFET, so the SY20808C20/D20 prevents current flow from out to input when out is externally forced to a higher voltage than VIN when the chip is disabled.

Overcurrent Protection:

When the overcurrent condition is sensed, the gate of the pass switch is controlled to achieve a constant output current. Under output short-circuit conditions, the current limit will fold back by 50% to the $I_{FBC.}$

Thermal Shutdown Protection:

If the overcurrent condition persists for a long enough time, the device's junction temperature may exceed the thermal protection threshold (typically 150 °C). In this case, the overtemperature protection will shut down the device. Once the temperature drops below 130°C, the part will restart.

Fault Flag (OCB):

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

The open-drain output requires a pull-up resistor for proper operation. The pin can be tied to GND or left floating if not used.

Supply Filter Capacitor:

Connecting at least a 1uF ceramic capacitor from IN to GND is strongly recommended to prevent the input voltage from dropping during hot-plug events. Higher output capacitor values can further reduce the voltage drop. Without an input capacitor, an output short can cause ringing on the input, which could destroy the internal circuitry when the input transient exceeds 6V, the absolute maximum supply voltage, even for a short duration.

Output Filter Capacitor:

A low-ESR 10µF capacitor is sufficient for most applications where the transient voltage drop between IN and OUT is not important.
It is recommended to place a low-ESR 100µF aluminum electrolytic or tantalum capacitor between VOUT and GND to ensure compliance with a 330mV maximum transient voltage drop. For optimal performance, standard bypass methods should be employed to minimize inductance and resistance between the bypass capacitor and the downstream connector. This not only reduces EMI but also enhances transient performance.

Schematic

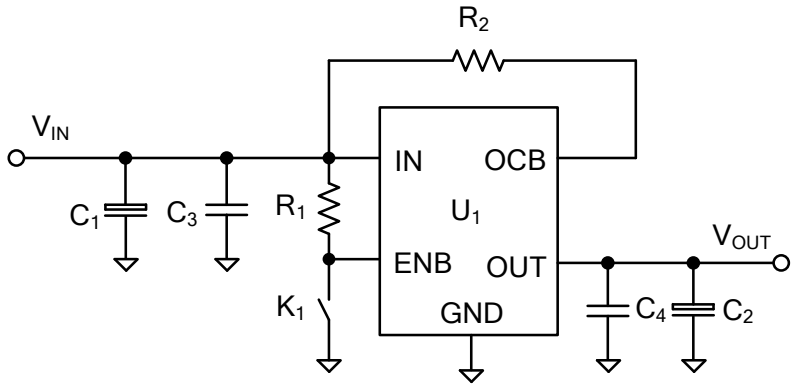


Figure 1. Schematic Diagram

BOM List

Reference Designator	Description	Part Number	Manufacturer
U1	Low Loss Power Distribution Switch	SY20808D20AAC	
C3, C4	10uF/10V,0805,X5R	C2012X5R1A106M	TDK
R1	510kΩ, 0603		
R2	100kΩ		

PCB Layout Guide

For best performance of the SY20808C20/D20, the following guidelines must be followed:

1. Keep all V_{BUS} traces as short and wide as possible, and use at least 2 ounce copper for all V_{BUS} traces
2. Place a ground plane under all the circuitry to lower resistance and inductance to improve DC and transient performance.
3. Place the output capacitor as close to the connectors as possible to lower the impedance and inductance between the port and the capacitor to improve the transient performance.
4. The input and output capacitors should be placed close to the device and connected to the ground plane to reduce noise coupling.
5. Place the ceramic bypass capacitors as close as possible to the VIN and VOUT pins of the SY20808C20/D20.

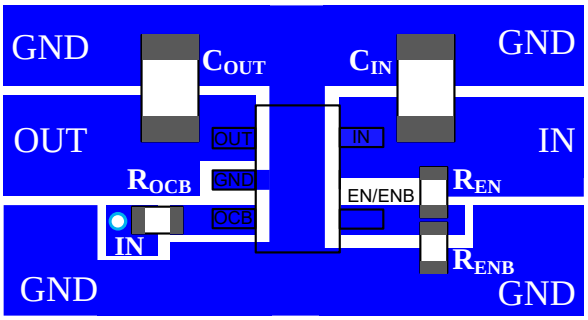
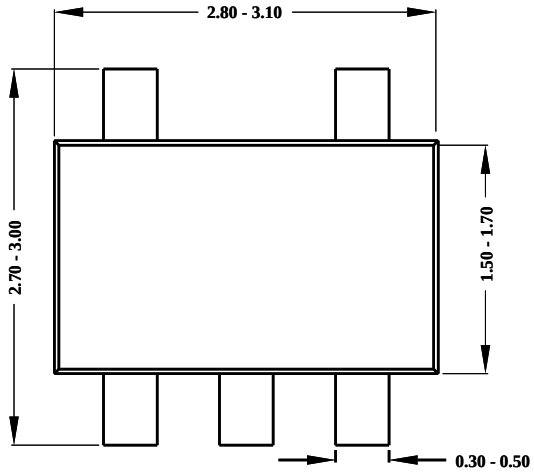
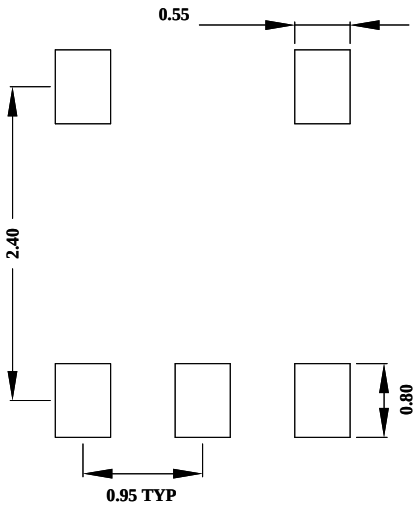


Figure 2. PCB Layout Suggestion

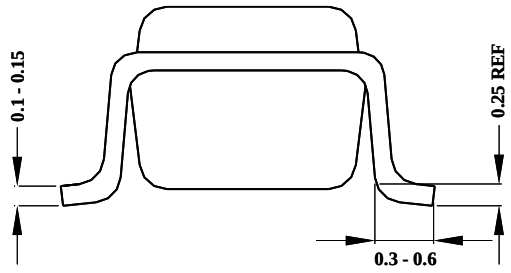
SOT23-5 Package Outline & PCB Layout Design



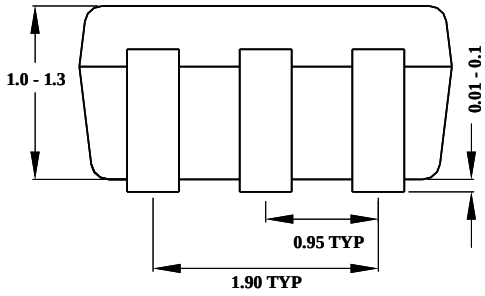
Top View



Recommended Pad Layout



Side View

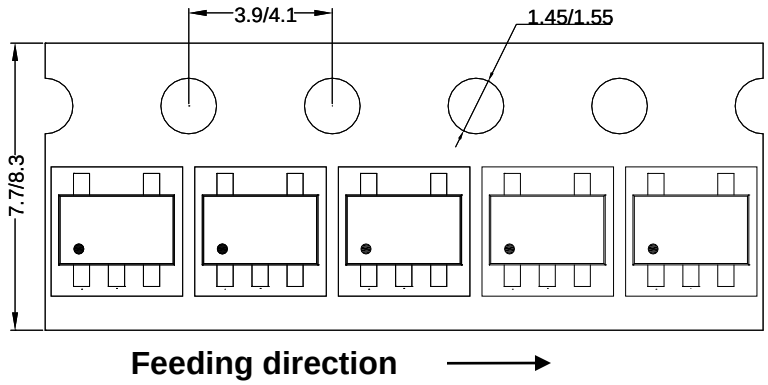


Front View

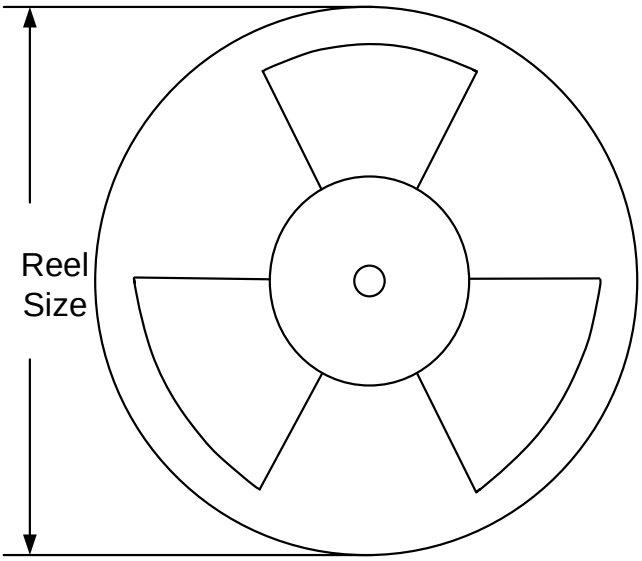
Note: All dimensions are in millimeters and exclude mold flash and metal burr.

Taping & Reel Specification

SOT23-5 Taping Orientation



Carrier Tape & Reel Specification for Packages



Package types	Tape width (mm)	Pocket pitch (mm)	Reel size (Inch)	Reel width (mm)	Trailer length (mm)	Leader length (mm)	Qty per reel
SOT23-5	8	4	7"	8.4	280	160	3000

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