SY20818

Programmable High Current Protection Switch With Integrated Reverse Blocking FET

General Description

The SY20818 is a programmable current limit switch with output voltage clamping. Extremely low $R_{DS(ON)}$ of the integrated protection N-channel FET helps to reduce power loss during normal operation. The programmable soft-start time controls the slew rate of the output voltage during the start-up time.

The SY20818 is available in a compact QFN 2mm×2mm-9pin package.

Features

- Input Voltage Range: 2.7V to 5.5V with Surge Up to 15V
- 5A Output Current Capability
- Extremely Low Power Path Resistance R_{PWPT}
  - R_{PWPT}=30mΩ (typ) at 3V Vin Conditions
- Reverse Blocking Function
- Programmable Current Limit
- Programmable Soft-Start Time
- Selectable Clamping Output Voltage Threshold
- Power Good Indicator Pin for Operation Status
- FLG Indicator Pin for Input Voltage Status
- RoHS Compliant and Halogen Free
- Compact package: QFN2×2-9

Applications

- SSD M.2 from Factor
- SSD Dual Input Power Applications
- SSD Load Switch

Typical Application Circuit

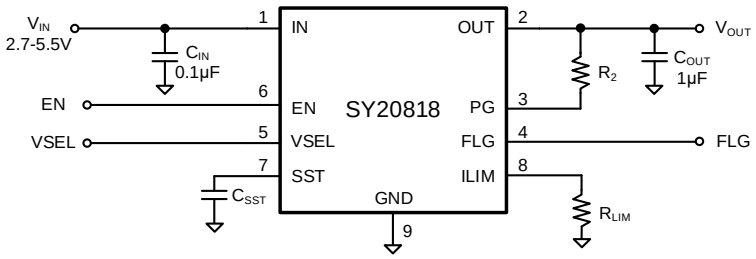


Figure 1. Schematic Diagram

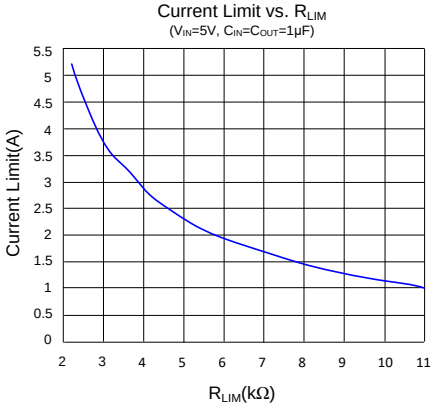


Figure 2. Current Limit vs. R_{LIM}

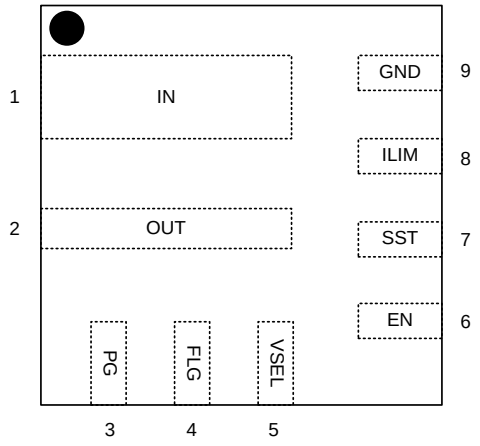
Ordering Information

Ordering Number	Package Type	Top Mark
SY20818RYC	QFN2×2-9 RoHS Compliant and Halogen Free	**Ud*xyz***

Device code: Ud

x=year code, y=week code, z= lot number code

Pinout (Top View)



(QFN2×2-9)

Pin Name	Pin Number	Pin Description
IN	1	Power input pin. Decouple high frequency noise by connecting at least a 0.1μF MLCC to the ground.
OUT	2	Output voltage pin.
EN	6	Pull high to enable SY20818. Do not leave it floating.
VSEL	5	Output clamp voltage selection based on the input voltage. Pull the VSEL pin high by connecting a resistor to IN, or pull the VSEL pin low by connecting a resistor to the ground.
ILIM	8	Input current limit program pin. Connect a resistor between this pin and GND to program input current limit.
SST	7	Soft-start time program pin. Connect a capacitor to the ground to program the soft start time. 600μs (typ.) for NC condition.
PG	3	Open drain indicator pin. PG is pulled high when the output voltage is stable in the normal range.
FLG	4	Open drain indicator pin. FLG is pulled down when the input voltage is larger than UVLO.
GND	9	Ground pin.

VSEL	V_{IN}	Clamping Threshold		
		Min	Typ	Max
LOW	3.3V	3.6V	3.8V	4V
HIGH	5V	5.4V	5.7V	6V

Block Diagram

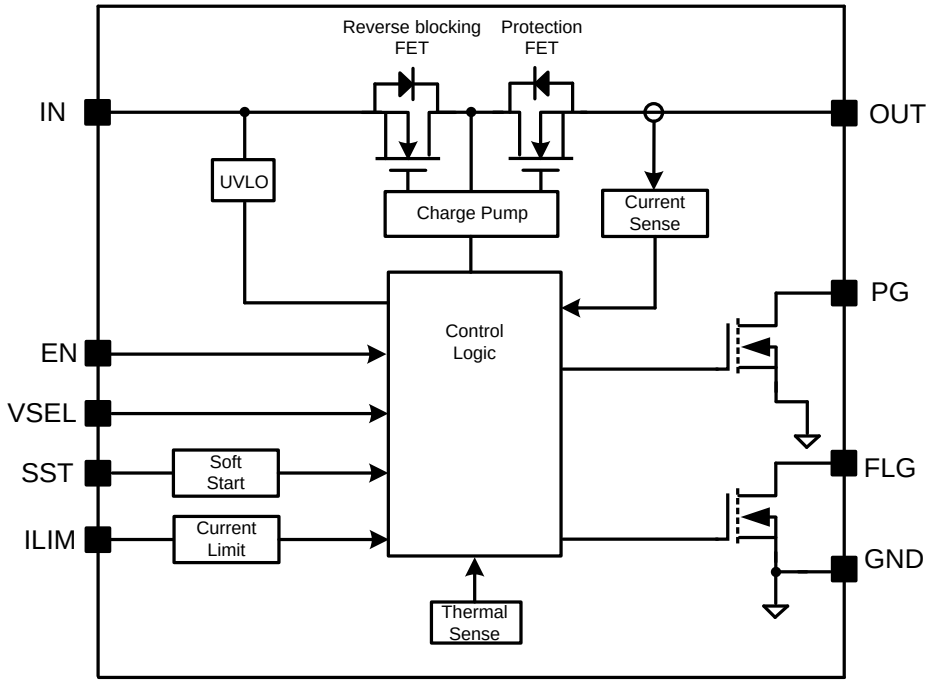


Figure 3. Block Diagram

Absolute Maximum Ratings

Parameter (Note 1)	Min	Max	Unit
IN, VSEL, EN, PG, FLG	-0.3	18	V
OUT	-0.3	7	
SST, ILIM	-0.3	3.6	
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	38.5	°C/W
θ_{JC} Junction-to-Case Thermal Resistance	11.5	
P_D Power Dissipation T_A = 25°C	2.6	W

Recommended Operating Conditions

Parameter (Note 3)	Min	Max	Unit
IN	2.7	5.5	V
VSEL, EN, PG, FLG	0	5.5	
SST, ILIM	0	3.3	
Junction Temperature, Operating	-40	125	°C

Electrical Characteristics

(V_{IN} = 2.7V to 5.5V, C_{IN}=0.1µF, C_{OUT}=1µF, T_A = 25°C, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage Range	V_{IN}		2.7		5.5	V
Input UVLO Threshold	V_{UVLO}				2.6	V
UVLO hysteresis	V_{HYS}			0.1		V
Shut Down Current	I_{SD}	EN=0		10		µA
Bias Current	I_{BIAS}			50		µA
Clamping Output Voltage	V_{CLP}	V_{SEL}=LOW	3.6	3.8	4.0	V
		V_{SEL}=HIGH	5.4	5.7	6.0	V
VSEL High Threshold	V_{SEL_HI}		1			V
VSEL Low Threshold	V_{SEL_LO}				0.4	V
EN High Threshold	V_{ENH}		1			V
EN Low Threshold	V_{ENL}				0.4	V
Resistance of Power Path	R_{PWPT}	V_{IN}=3V, I_{OUT}=200mA, from IN to OUT		30		mΩ
Reverse Blocking Threshold	V_{RBT}			50		mV
Soft start Time Program Range	t_{SST}	C_{SST}=100nF (Note 4)		23		ms
Soft-start Time Accuracy			-30%		30%	t_{SST}
Current Limit Program Range	I_{LIM}	(Note 5)	1		5	A
Current Limit Accuracy		I_{LMT} = 2A	-10%		10%	I_{LIM}
PG Low Voltage	V_{PGL}	V_{IO}=3.3V, I_{SINK}=1mA			0.2	V
PG Leakage Current	V_{PGLK}	V_{IO}=3.3V, PG high impedance			1	µA
FLG Low Voltage	V_{FAL}	V_{IO}=3.3V, I_{SINK}=1mA			0.2	V
FLG Leakage Current	V_{FALK}	V_{IO}=3.3V, FLG high impedance			1	µA
Thermal Shutdown Temperature	T_{SD}			150		°C
Thermal Shutdown Hysteresis	T_{HYS}			20		°C

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.

Note 4: Recommended Soft-Start Time Program Table:

SST cap (nF)	None	10	47	100
Rise time (ms)	0.6	2.3	10.8	23

Recommended formulas for C_{SST} and soft-start time calculations. Use the following formula if there is no external C_{SST}:

$$t_{SS} = t_{SS\_DLT}$$

Use the following equation if a longer soft-start time is needed:

$t_{SS} = \frac{0.85 \times C_{SST}}{I_{INT}}$, $t_{SS} > t_{SS\_DLT}$

Where, t_{SS_DLT} is the internally fixed default soft-start time of 0.6ms (typ.), when no external C_{SST} capacitor is used; I_{INT} is the internal current source, with a typical value of 3.7μA.

Note 5: Recommended Current Limit Program Table:

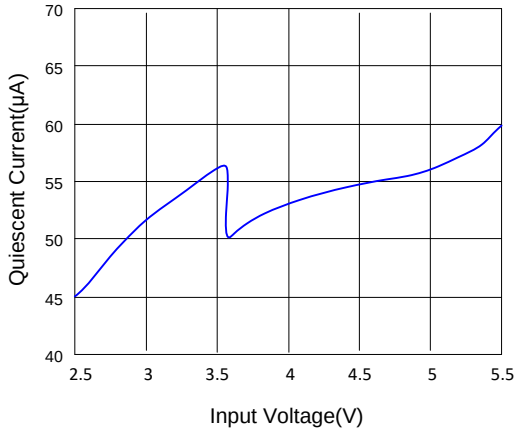
Current Limit Resistance (kΩ)	11	5.5	4.4	3.7	3.1	2.8	2.4	2.2
Current Limit (A)	1.0	2.0	2.5	3.0	3.5	4.0	4.5	5.0

Equation for R_{LIM} and current limit calculation:

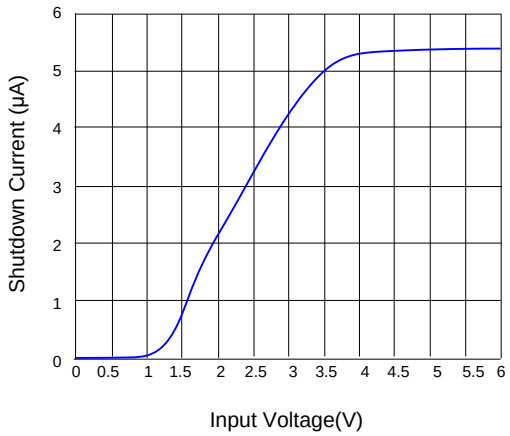
$$R_{LIM} = \frac{11k}{I_{LIM}}(\Omega)$$

Typical Performance Characteristics

Quiescent Current vs. Input Voltage

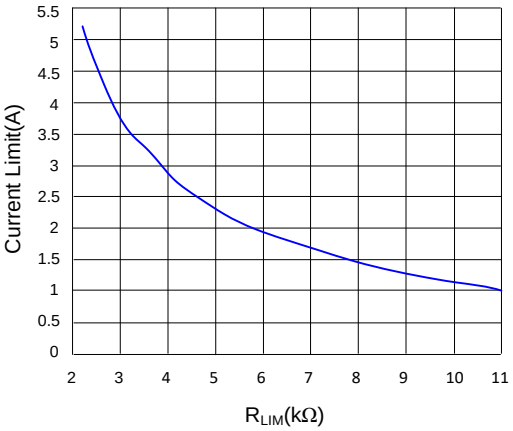


Shutdown Current vs. Input Voltage



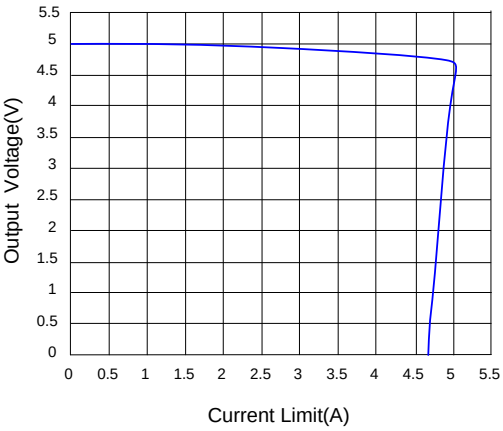
Current Limit vs. R_{LIM}

(V_{IN}=5V, C_{IN}=C_{OUT}=1μF)

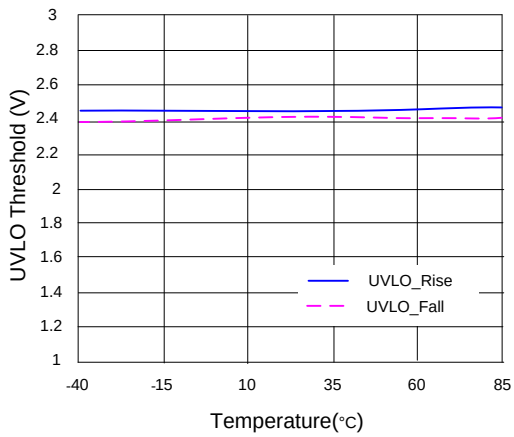


Output Voltage Vs. Current Limit

(V_{IN}=5V, C_{IN}=C_{OUT}=1μF, R_{SET}=2.2kΩ)

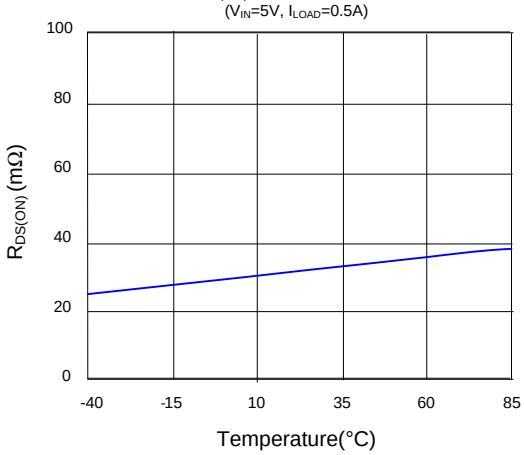


UVLO Threshold vs. Temperature

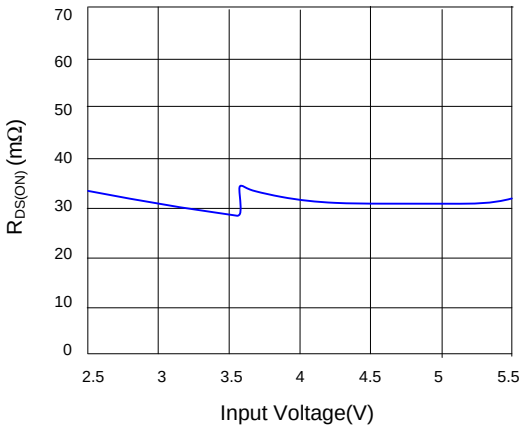


$R_{DS(ON)}$ vs. Temperature

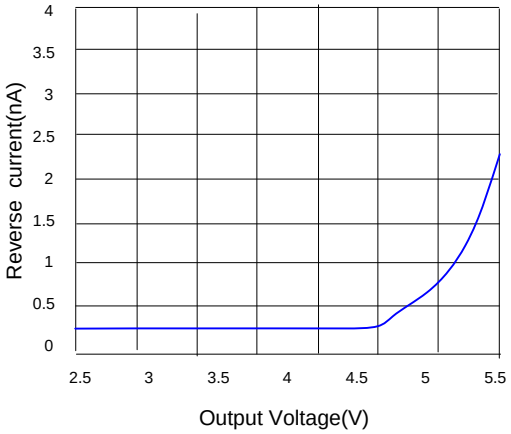
(V_{IN}=5V, I_{LOAD}=0.5A)



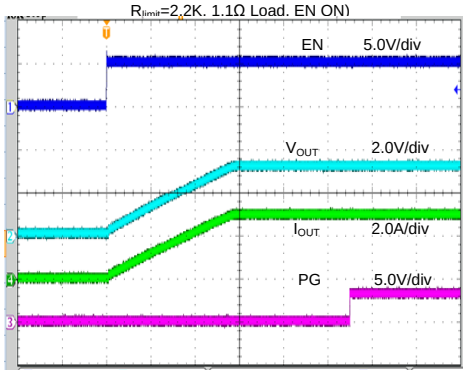
$R_{DS(ON)}$ vs. Input Voltage
(C_{IN}=C_{OUT}=1μF, I_{LOAD}=0.5A))



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

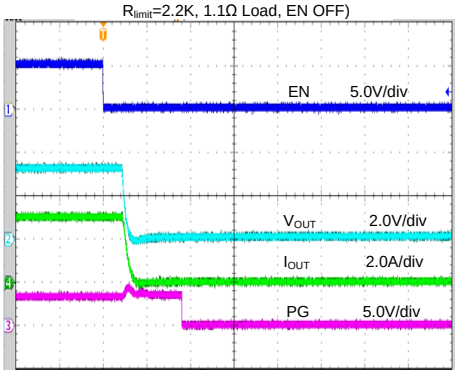


Startup from Enable
(V_{SEL}=Low, V_{IN}=3.3V, C_{IN}=C_{OUT}=1uF, C_{SST}=0.1uF,
R_{limit}=2.2K, 1.1Ω Load, EN ON)



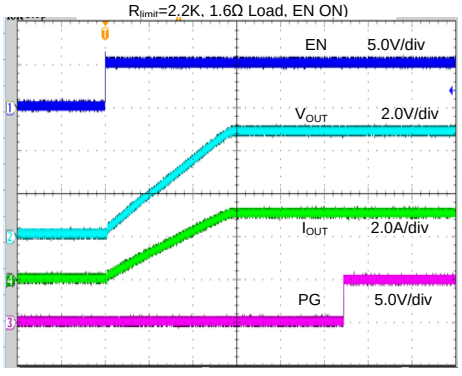
Time (10ms/div)

Shutdown from Enable
(V_{SEL}=Low, V_{IN}=3.3V, C_{IN}=C_{OUT}=1uF, C_{SST}=0.1uF,
R_{limit}=2.2K, 1.1Ω Load, EN OFF)



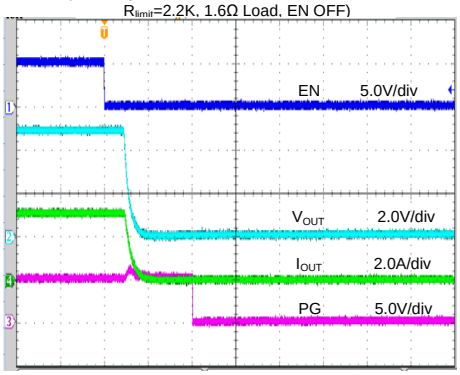
Time (10μs/div)

Startup from Enable
(V_{SEL}=High, V_{IN}=5V, C_{IN}=C_{OUT}=1uF, C_{SST}=0.1uF,
R_{limit}=2.2K, 1.6Ω Load, EN ON)



Time (10ms/div)

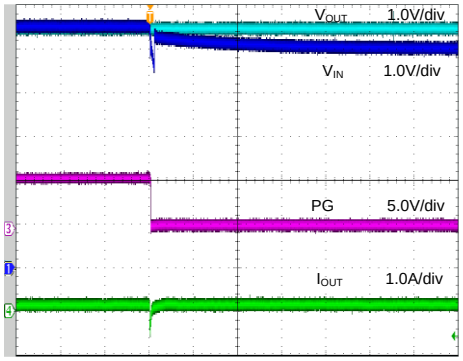
Shutdown from Enable
(V_{SEL}=High, V_{IN}=5V, C_{IN}=C_{OUT}=1uF, C_{SST}=0.1uF,
R_{limit}=2.2K, 1.6Ω Load, EN OFF)



Time (10μs/div)

Reverse-Voltage Protection Response

(V_{IN}=5.5V to 5.0V, V_{OUT}=5.5V, EN=ON, C_{IN}=C_{OUT}=10μF)

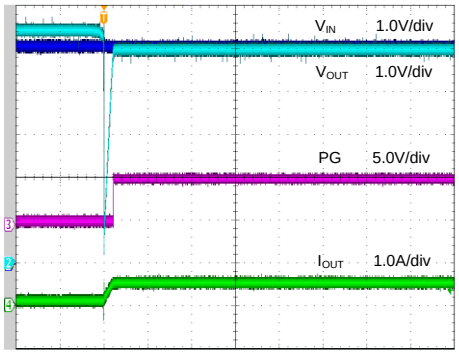


Time (800μs/div)

Reverse-Voltage Protection Recovery

(V_{IN}=5.0V, V_{OUT}=5.5V removed, EN=ON,

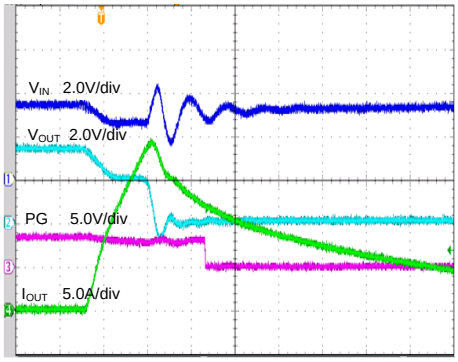
C_{IN}=C_{OUT}=10μF,RL=10Ω)



Time (100ms/div)

Short Circuit Response

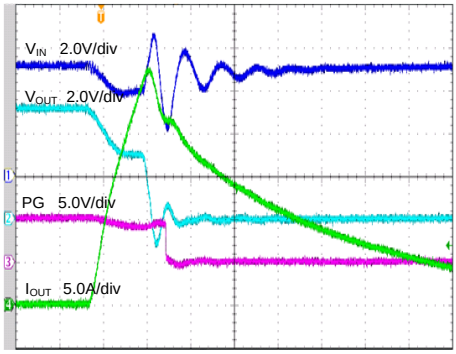
(V_{SEL}=Low ,V_{IN}=3.3V ,C_{IN}=C_{OUT} =1μF, C_{SST} Open)



Time (1.00μs/div)

Short Circuit Response

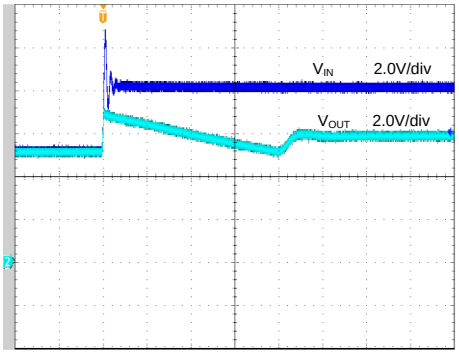
(V_{SEL}=High ,V_{IN}=5V ,C_{IN}=C_{OUT} =1μF, C_{SST} Open)



Time (1.00μs/div)

Clamp Protection Response

(V_{SEL}=High ,V_{IN}=5V to 8V ,C_{IN}=C_{OUT} =1μF, Null Load)



Time (40.0μs/div)

Application Information

The SY20818 is a current limited N-channel MOSFET power switch designed for high-side load-switching applications. It incorporates back-to-back N-channel MOSFETs to prevent current flow from OUT to IN when OUT is externally forced to a higher voltage than IN while the device is disabled.

Overcurrent Protection:

The SY20818 supports current limit programming. Connect a resistor R_{LIM} from the ILIM pin to the ground to program the current limit:

$$I_{LIM}=11000/R_{LIM}(\Omega)$$

The minimum current limit is 1A. A current limit beyond 5A is not recommended.

When an overcurrent condition is detected, the gate of the pass switch is controlled to achieve a constant output current. If the overcurrent condition persists for a long time, the junction temperature may exceed 150°C, and the overtemperature protection circuit will shut down the part. Once the chip temperature drops below 130°C, the part will restart.

Overvoltage Protection:

The SY20818 has an integrated overvoltage protection for the input pin. The output voltage is clamped at 5.7V (typ.) when V_{SEL}=HIGH, or the output voltage is clamped at 3.8V (typ.) when V_{SEL}=LOW. The PG is driven low when the output voltage is clamped.

Supply Filter Capacitor:

A capacitor with a minimum value of 0.1 µF is required. In order to prevent input voltage dropping during hotplug events, a 1µF ceramic capacitor from VIN to GND is strongly recommended. Higher capacitor values can further reduce input 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 the absolute maximum supply voltage, even for a short duration.

Output Filter Capacitor:

A 1µF output ceramic capacitor is recommended to be placed close to the device and output connector to reduce voltage drop during load transient. Higher output capacitor values can further reduce the drop during high-current applications.

PCB Layout Guide:

For best performance of the SY20818, the following guidelines must be followed:

1. Keep all VBUS traces as short and wide as possible and use at least 2-ounce copper for all VBUS traces.
2. Place the output capacitor as close to the connectors as possible to lower the impedance and inductance between the port and the capacitor and improve transient performance.
3. Place the input and output capacitors close to the device and connect them to the ground plane to reduce noise coupling.

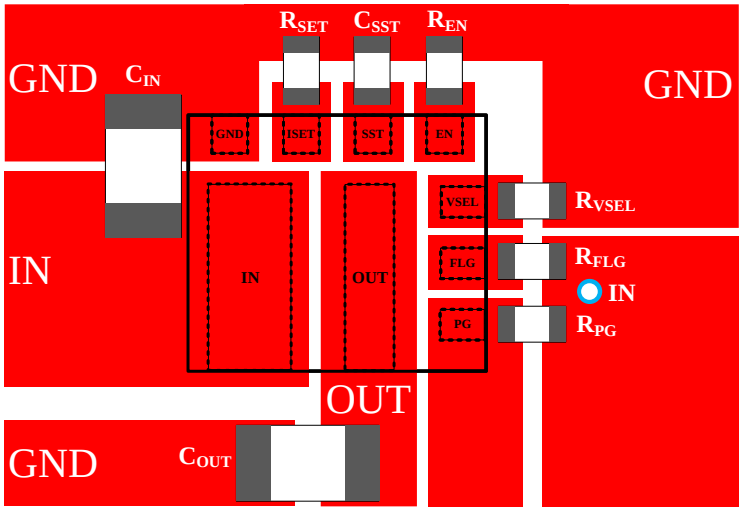
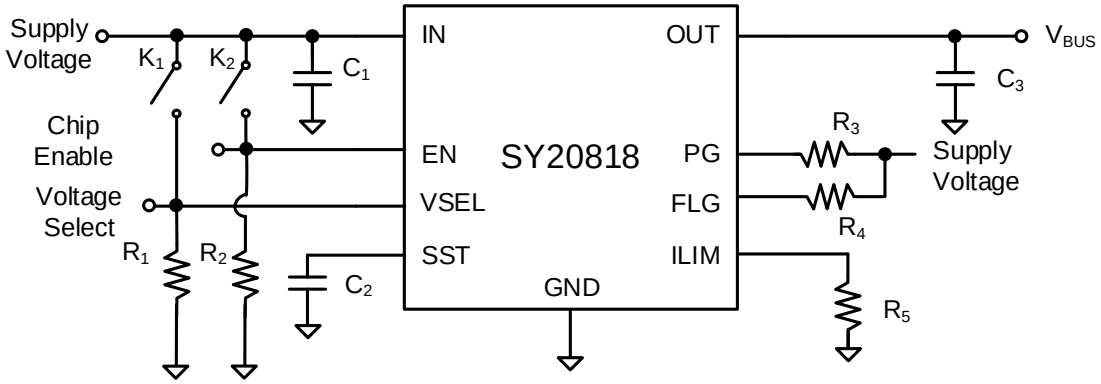


Figure 4. PCB Layout Suggestion

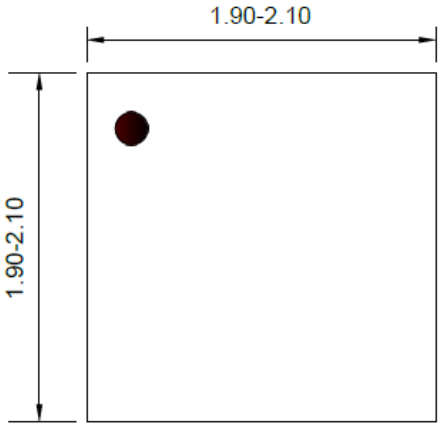
Schematic



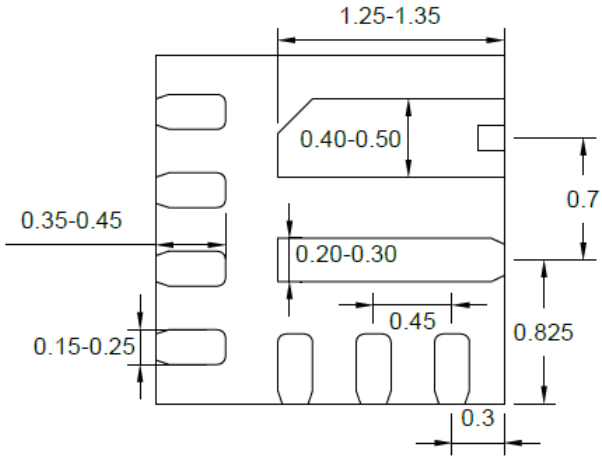
BOM List

Reference Designator	Description	Part Number	Manufacturer
C_1	1μF/50 V, 0603, X5R	C1608X5R1H105KT000N	TDK
C_3	1μF/50 V, 0603, X5R	C1608X5R1H105KT000N	TDK
C_2	100nF/6.3V, 0603, X5R	C1608X5R0J104KT000N	TDK
R_1	1MΩ, 1%, 0603	RC0603FR-071ML	YAGEO
R_2	1MΩ, 1%, 0603	RC0603FR-071ML	YAGEO
R_3	100kΩ, 1%, 0603	RC0603FR-07100KL	YAGEO
R_4	100kΩ, 1%, 0603	RC0603FR-07100KL	YAGEO
R_5	2.2kΩ, 1%, 0603	RC0603FR-072K2L	YAGEO

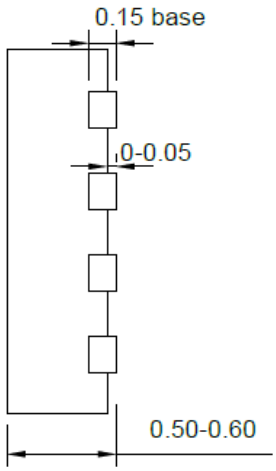
QFN2×2-9 Package Outline & PCB Layout



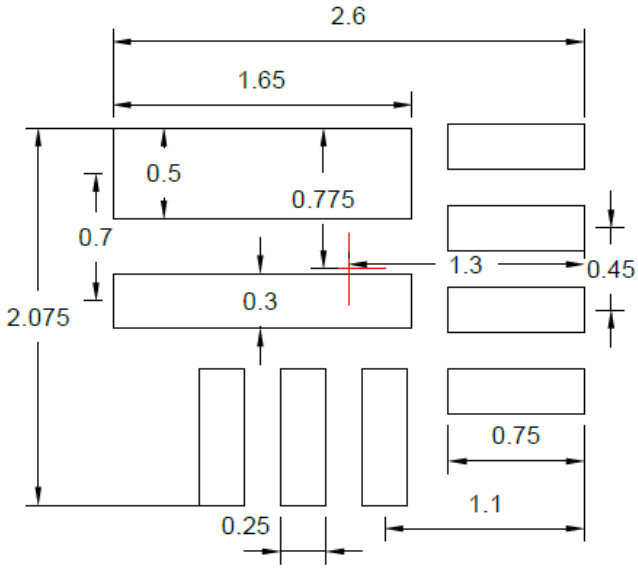
Top View



Bottom View



Side View

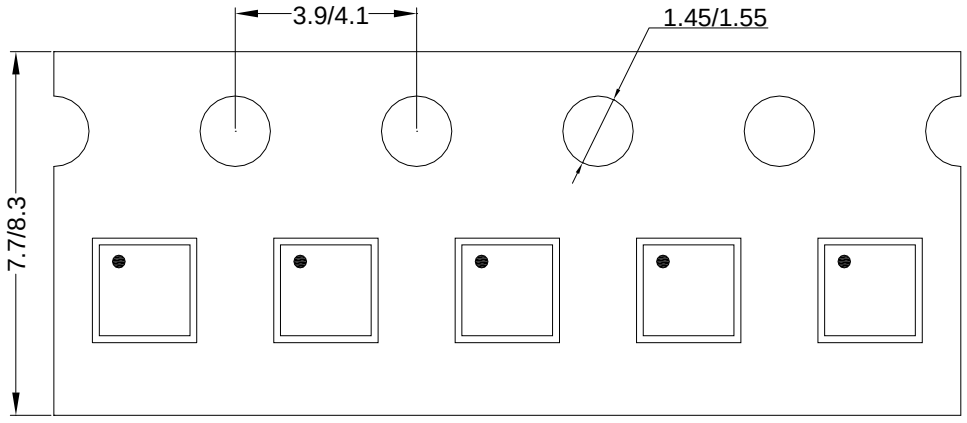


PCB Layout (Recommended)

Notes: 1. All dimensions are in millimeters and exclude mold flash and metal burr.
2: The center of the PCB diagram refers to the chip center.

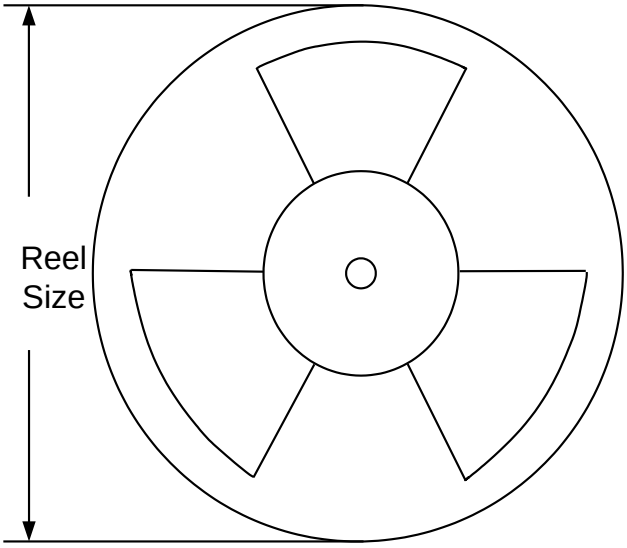
Taping & Reel Specification

1. QFN2×2 Taping Orientation



Feeding direction ⟶

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
QFN2×2	8	4	7"	400	160	3000

3. Others: NA

Revision History

The revision history provided is for informational purposes only and is believed to be accurate; however, it is not warranted. Please make sure that you have the latest revision.

Date	Revision	Change
Dec.12, 2023	Revision 1.0	Language improvements for clarity
Sep.03, 2018	Revision 0.9	Initial Release

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