SY20806A

1.05V to 5.5V 2A Load Switch

General Description

The SY20806A is an ultra-low $R_{DS(ON)}$, N-channel MOSFET single channel load switch with controlled turn-ON slew rate for minimum power loss. The device has an input voltage range of 1.05 V to 5.5 V and can support a maximum continuous current of 2 A.

The SY20806A small size and ultra-low $R_{DS(ON)}$ along with very low operating and shutdown currents makes it an ideal choice for space limited, battery powered applications.

In order to prevent the voltage droop during start-up with large capacitve loads, the part features a soft start circuit to reduce the inrush current.

SY20806A integrates a 120 Ω pull-down resistor for fast output discharge when the switch is open, further reducing the total solution size.

SY20806A uses a small, space saving 0.78mm ×0.78mm, 4-pin CSP package with 0.4mm pitch, and 0.5mm height.

The part is designed to operate between of -40 °C to+105 °C.

Features

- Input Voltage Range: 1.05V to 5.5V
- 2A Load Current Capability
- Ultra-low $R_{DS(ON)}$:
  - 37mΩ(typ) at V_{IN} = 5V
  - 38mΩ(typ) at V_{IN} = 3.3V
  - 43mΩ(typ) at V_{IN} = 1.8V
- Quiescent Current: 9.7μA (typ) at V_{IN}=3.3V
- Shutdown Current: 0.1 μA (typ) at V_{IN}= 3.3V
- Controlled Slew Rate:
  - 910μs rise time at V_{IN}=3.3V
- Compact Package: CSP 0.78mm×0.78mm.

Applications

- Notebook
- Cell Phone
- Digital Cameras
- IoT devices

Typical Application

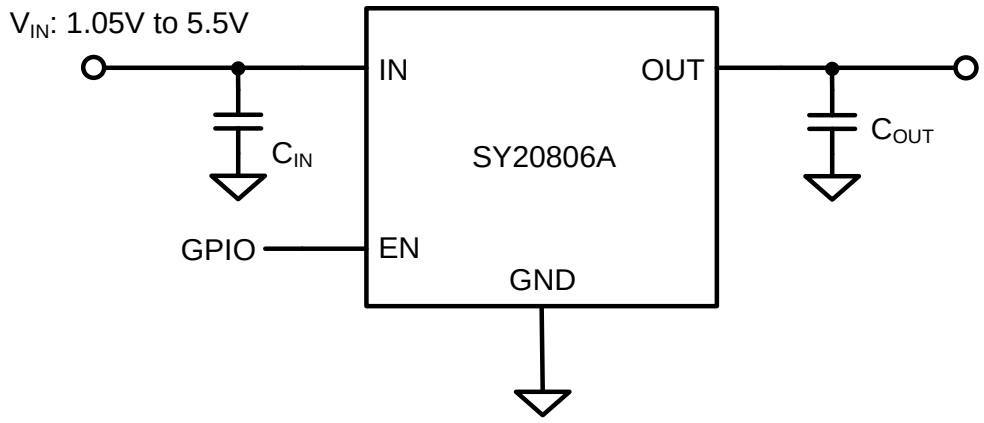


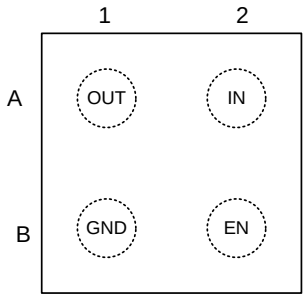
Figure1. Schematic Diagram

Ordering Information

Ordering Part Number	Package Type	Top Mark
SY20806APAC	CSP0.78×0.78– 4 RoHS Compliant and Halogen Free	**hG*xyz***

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

Pinout (top view)



Pin Name	Pin number	Pin Description
IN	A2	Input pin, decoupled with at least a 1μF MLCC capacitor to GND.
GND	B1	Ground pin.
OUT	A1	Output pin, decoupled with a 1μF MLCC capacitor to GND.
EN	B2	ON/OFF control. Do not leave it floating.

Block Diagram

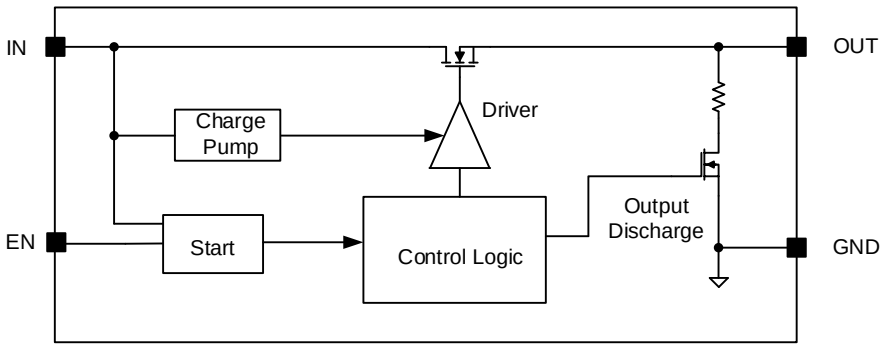


Figure2. Block Diagram

Absolute Maximum Ratings (1)	Min	Max	Unit
IN, OUT, EN to GND	-0.3	6	V
Junction Temperature, Operating	-40	150	℃
Lead Temperature (Soldering, 10sec.)		260	
Storage Temperature	-65	150	

Thermal Information (2)	Typ	Unit
θ_{JA} Junction-to-ambient Thermal Resistance	193	℃/W
θ_{JC} Junction-to-case Thermal Resistance	2.3	
P_D Power Dissipation T_A=25 ℃	0.52	W

ESD Susceptibility	Min	Max	Unit
HBM (Human Body Mode)		2	kV
CDM (Charged Device Mode)		500	V
Recommended Operating Conditions (3)	**Min**	**Max**	**Unit**
IN	1.05	5.5	V
OUT	0	V_{IN}	
EN	0	5.5	
Junction Temperature, Operating	-40	125	℃
Ambient Temperature	-40	105	

Electrical Characteristics (Unless otherwise noted, the specification in the following table applies over the operating ambient temperature –40°C≤ T_A≤+105°C. **Typical values are for TA = 25 ℃.)**

Parameter	Symbol	Test Conditions	T_A	Min	Typ	Max	Unit
Quiescent Current	I_Q	V_{IN}=V_{EN}=3.3V, I_{OUT}=0A	-40 ℃ to +85 ℃		9.7	12	μA
			-40 ℃ to +105 ℃			13	μA
Shutdown Current	I_{SHDN}	V_{IN}=3.3V, V_{EN}=0V,V_{OUT}=0V	-40 ℃ to +85 ℃		0.1	2	μA
			-40 ℃ to +105 ℃			3	μA
Switch On Resistance	R_{ON}	V_{IN}=5V, I_{OUT}=200mA	25 ℃		37	41	mΩ
			-40 ℃ to +85 ℃			51	mΩ
			-40 ℃ to +105 ℃			57	mΩ
		V_{IN}=3.3V, I_{OUT}=200mA	25 ℃		38	41	mΩ
			-40 ℃ to +85 ℃			52	mΩ
			-40 ℃ to +105 ℃			58	mΩ
		V_{IN}=1.8V, I_{OUT}=200mA	25 ℃		43	48	mΩ
			-40 ℃ to +85 ℃			59	mΩ
			-40 ℃ to +105 ℃			66	mΩ
		V_{IN}=1.2V, I_{OUT}=200mA	25 ℃		52	59	mΩ
			-40 ℃ to +85 ℃			73	mΩ
			-40 ℃ to +105 ℃			85	mΩ
		V_{IN}=1.05V, I_{OUT}=200mA	25 ℃		63	75	mΩ
			-40 ℃ to +85 ℃			102	mΩ
			-40 ℃ to +105 ℃			107	mΩ
EN Input Logic High	V_{IH}	V_{IN}=1.05V to 5.5V	25 ℃	1			V
EN Input Logic Low	V_{IL}	V_{IN}=1.05V to 5.5V	25 ℃			0.4	V

Electrical Characteristics (Unless otherwise noted, the specification in the following table applies over the operating ambient temperature –40°C≤ T_A≤+105°C. **Typical values are for TA = 25℃.)**

Parameter	Symbol	Test Conditions	T_A	Min	Typ	Max	Unit
EN Hysteresis	V_{HYS_EN}	V_{IN}=5.5V	25℃		102		mV
		V_{IN}=1.05V	25℃		92		mV
Discharge Resistance	R_{DSG}	V_{IN}=V_{OUT}=3.3V, V_{EN}=0V	-40℃ to +105℃		120	180	Ω

Switching Characteristics

Refer to the timing test circuit in Figure 2 (unless otherwise noted) for references to external components used for the test condition in the switching characteristics table. Switching characteristics shown below are only valid for the power-up sequence where V_{IN} is already in steady state condition before the EN pin is asserted high.

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
V_{IN}=5V, V_{ON}=5V, T_A=25℃ (Unless otherwise noted)						
Turn On Time	t_{ON}	R_L=10Ω, C_{IN}=1μF, C_{OUT}=0.1μF		1300		μs
Turn Off Time	t_{OFF}	R_L=10Ω, C_{IN}=1μF, C_{OUT}=0.1μF		2		μs
V_{OUT} Rise Time	t_R	R_L=10Ω, C_{IN}=1μF, C_{OUT}=0.1μF		1280		μs
V_{OUT} Fall Time	t_F	R_L=10Ω, C_{IN}=1μF, C_{OUT}=0.1μF		2		μs
Delay Time	t_D	R_L=10Ω, C_{IN}=1μF, C_{OUT}=0.1μF		660		μs
V_{IN}=3.3V, V_{ON}=5V, T_A=25℃ (Unless otherwise noted)						
Turn On Time	t_{ON}	R_L=10Ω, C_{IN}=1μF, C_{OUT}=0.1μF		1080		μs
Turn Off Time	t_{OFF}	R_L=10Ω, C_{IN}=1μF, C_{OUT}=0.1μF		2		μs
V_{OUT} Rise Time	t_R	R_L=10Ω, C_{IN}=1μF, C_{OUT}=0.1μF		910		μs
V_{OUT} Fall Time	t_F	R_L=10Ω, C_{IN}=1μF, C_{OUT}=0.1μF		2		μs
Delay Time	t_D	R_L=10Ω, C_{IN}=1μF, C_{OUT}=0.1μF		620		μs
V_{IN}=1.05V, V_{ON}=5V, T_A=25℃ (Unless otherwise noted)						
Turn On Time	t_{ON}	R_L=10Ω, C_{IN}=1μF, C_{OUT}=0.1μF		750		μs
Turn Off Time	t_{OFF}	R_L=10Ω, C_{IN}=1μF, C_{OUT}=0.1μF		3		μs
V_{OUT} Rise Time	t_R	R_L=10Ω, C_{IN}=1μF, C_{OUT}=0.1μF		410		μs
V_{OUT} Fall Time	t_F	R_L=10Ω, C_{IN}=1μF, C_{OUT}=0.1μF		2		μs
Delay Time	t_D	R_L=10Ω, C_{IN}=1μF, C_{OUT}=0.1μF		550		μs

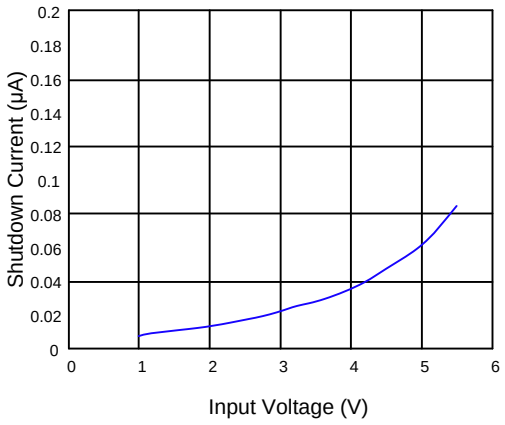
Note 1: Stresses beyond the "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute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

Note 2: θ_{JA} is measured in the natural convection at T_A = 25℃ on a low effective single layer thermal conductivity test board of JEDEC 51-3 thermal measurement standard.

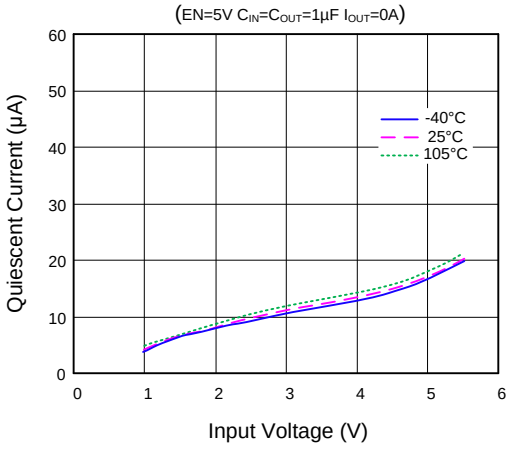
Note 3: The device is not guaranteed to function outside its operating conditions.

Typical Operating Characteristics

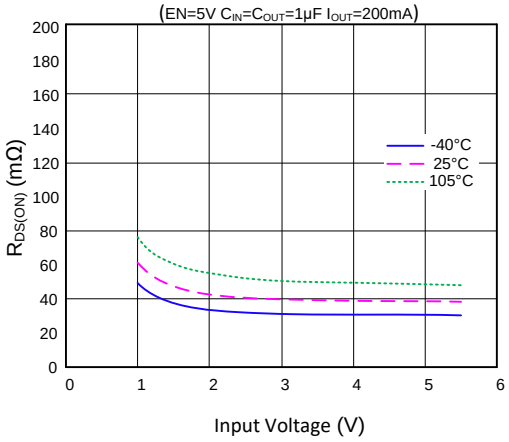
Shutdown Current vs. Input Voltage
(EN=0V C_{IN}=C_{OUT}=1μF I_{OUT}=0A)



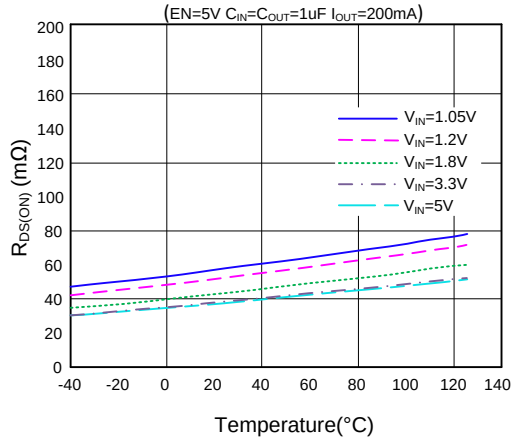
Quiescent Current vs. Input Voltage
(EN=5V C_{IN}=C_{OUT}=1μF I_{OUT}=0A)



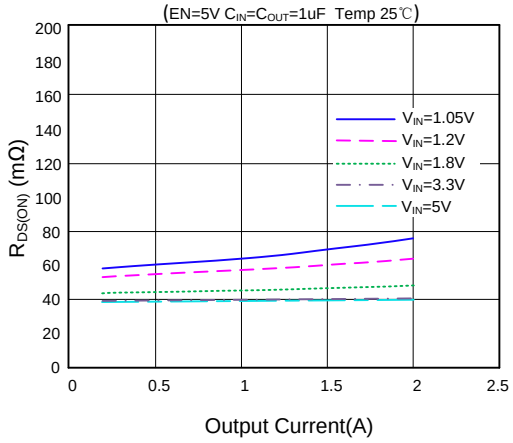
$R_{DS(ON)}$ vs. Input Voltage
(EN=5V C_{IN}=C_{OUT}=1μF I_{OUT}=200mA)



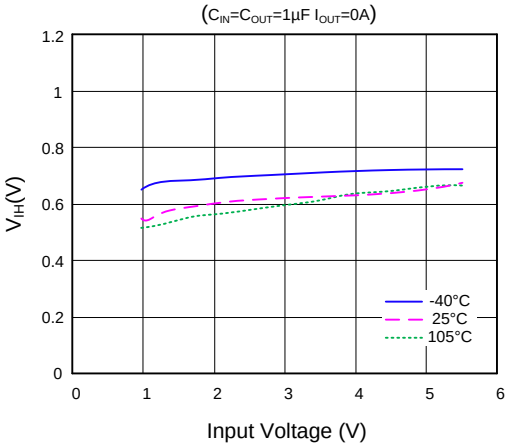
$R_{DS(ON)}$ vs. Temperature
(EN=5V C_{IN}=C_{OUT}=1uF I_{OUT}=200mA)



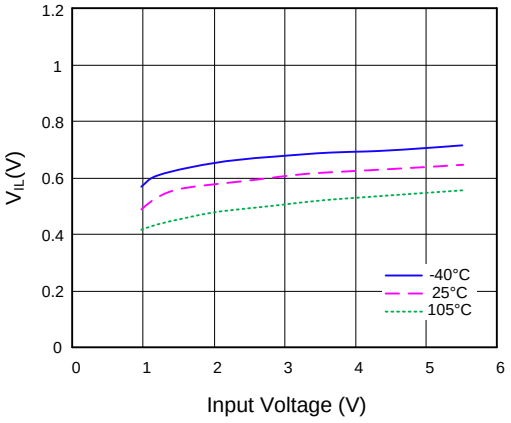
$R_{DS(ON)}$ vs. Output Current
(EN=5V C_{IN}=C_{OUT}=1uF Temp 25℃)



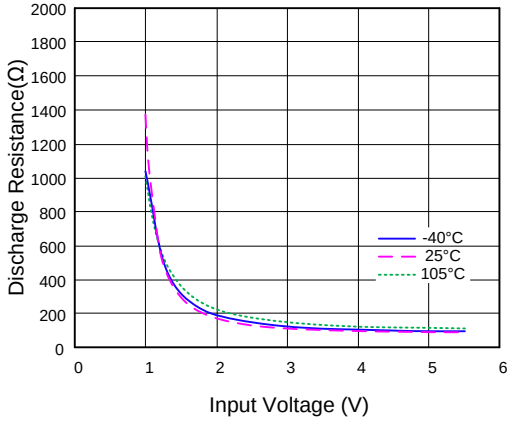
V_{IH} vs. Input Voltage
(C_{IN}=C_{OUT}=1μF I_{OUT}=0A)



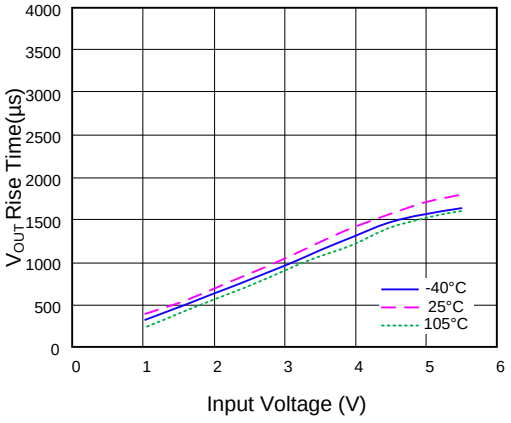
V_{IL} vs. Input Voltage
(C_{IN}=C_{OUT}=1μF I_{OUT}=0A)



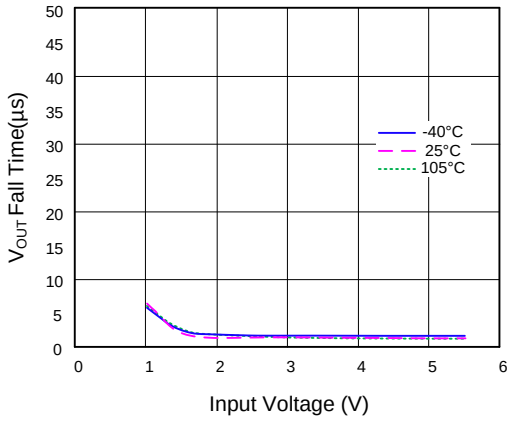
Discharge Resistance vs. Input Voltage
(V_{IN}=V_{OUT} EN=0V C_{IN}=C_{OUT}=1μF)



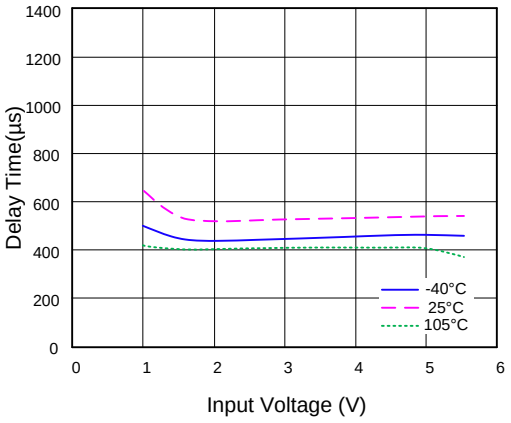
V_{OUT} Rise Time vs. Input Voltage
(V_{IN}=3.3V EN=0V to 5V C_{IN}=1μF C_{OUT}=0.1μF R_{Load}=10Ω)



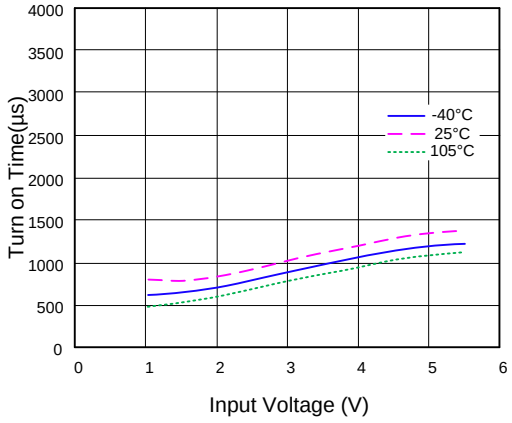
V_{OUT} Fall Time vs. Input Voltage
(V_{IN}=3.3V EN=5V to 0V C_{IN}=1μF C_{OUT}=0.1μF R_{Load}=10Ω)



Delay Time vs. Input Voltage
(V_{IN}=3.3V EN=0V to 5V C_{IN}=1μF C_{OUT}=0.1μF R_{Load}=10Ω)

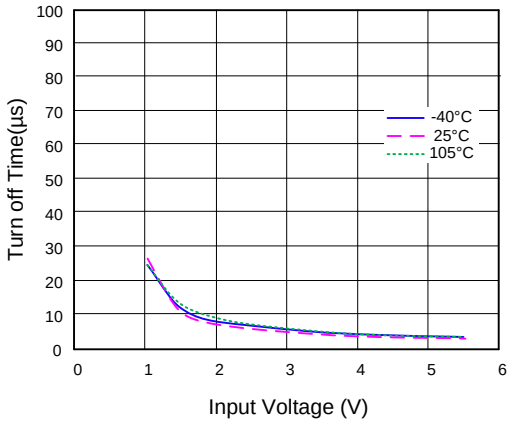


Turn on Time vs. Input Voltage
(V_{IN}=3.3V EN=0V to 5V C_{IN}=1μF C_{OUT}=0.1μF R_{Load}=10Ω)



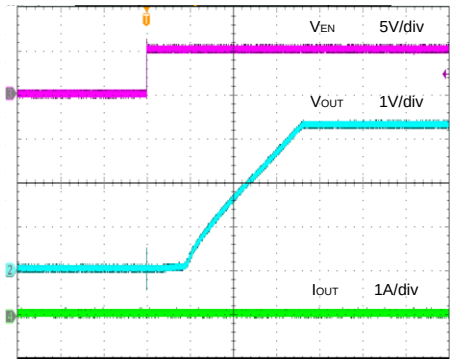
Turn off Time vs. Input Voltage

(V_{IN}=3.3V EN=5V to 0V C_{IN}=1μF C_{OUT}=0.1μF R_{Load}=10Ω)



Startup from Enable

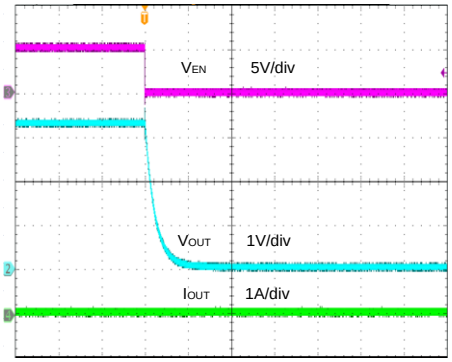
(V_{IN}=3.3V, EN=0V to 5V C_{IN}=1μF,C_{OUT}=1μF, Null Load)



Time (400μs/div)

Shutdown from Enable

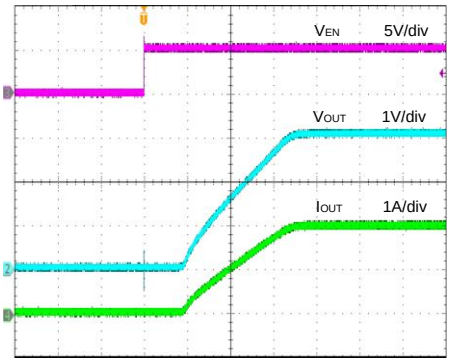
(V_{IN}=3.3V, EN=5V to 0V C_{IN}=1μF,C_{OUT}=1μF, Null Load)



Time (400μs/div)

Startup from Enable

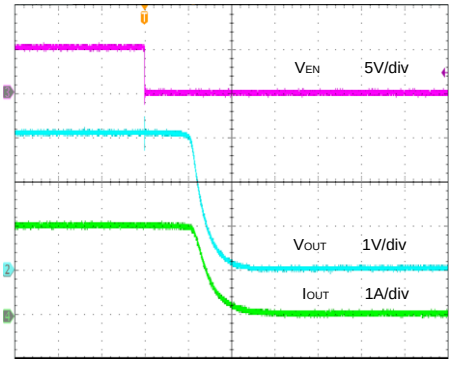
(V_{IN}=3.3V,EN=0V to 5V C_{IN}=1μF,C_{OUT}=1μF, 1.65Ω Load)



Time (400μs/div)

Shutdown from Enable

(V_{IN}=3.3V,EN=5V to 0V C_{IN}=1μF,C_{OUT}=1μF, 1.65Ω Load)



Time (400μs/div)

Operation

The SY20806A is an ultra-low $R_{DS(ON)}$, N-channel MOSFET single channel load switch with controlled slew rate for minimum power loss. The device has an input voltage range of 1.05 V to 5.5 V and can support a maximum continuous current of 2 A. The device is controlled by the EN input, which can directly interface with low-voltage control signals.

Application Information

Input Capacitor

To reduce device inrush current, a 1μF ceramic capacitor, C_{IN}, is recommended. A higher value of C_{IN} can be used to reduce the voltage drop experienced as the switch is turned ON into a large capacitive load. To optimize operation, C_{IN} should be placed as close as possible to the IN and GND pins.

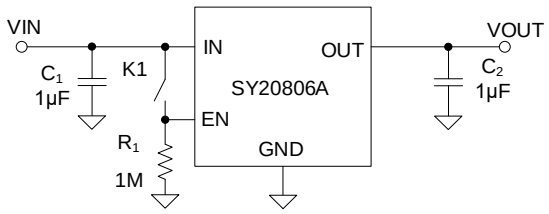
Output Capacitor

A 1μF ceramic output cap is recommended to prevent parasitic board inductance from forcing OUT below GND when turning off.

Output Discharge

SY20806A integrates a 120 Ω (typ) pull-down resistor for fast output discharge when the switch is turned OFF, further reducing the size of the overall solution.

Application Schematic



BOM List

Designator	Description	Part Number	Manufacturer
C_1, C_2	1μF/50V, 0603, X5R	GRM188R61H105K	Murata
R_1	1MΩ, 0603	RC0603FR-071ML	YAGEO

PCB Layout Guide

For best performance of the SY20806APAC, the following guidelines must be followed:

- Keep all power traces as short and wide as possible and use at least 1-ounce copper for all power traces.
- Place a ground plane under all circuitry to lower both resistance and inductance, and improve DC and transient performance.
- Place the output capacitors as close to the connectors as possible, to lower the impedance (mainly inductance) between the part 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.

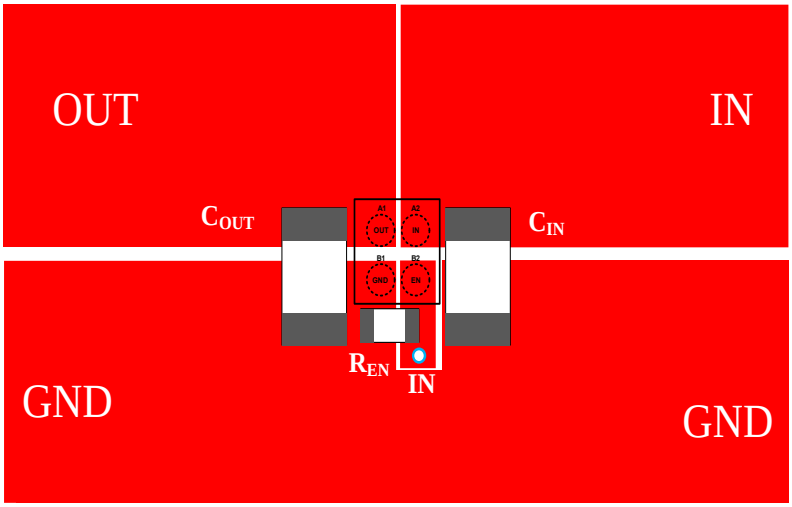
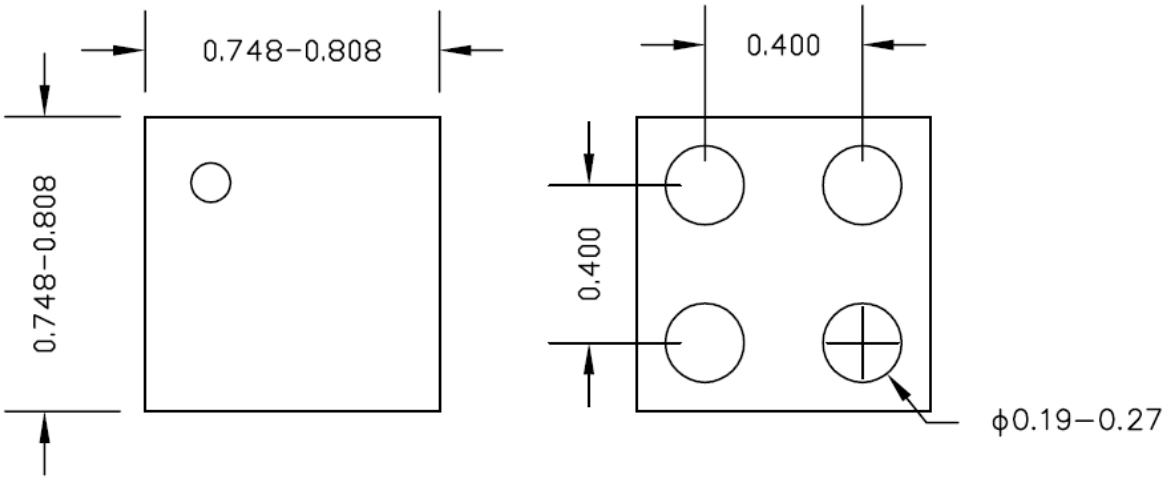
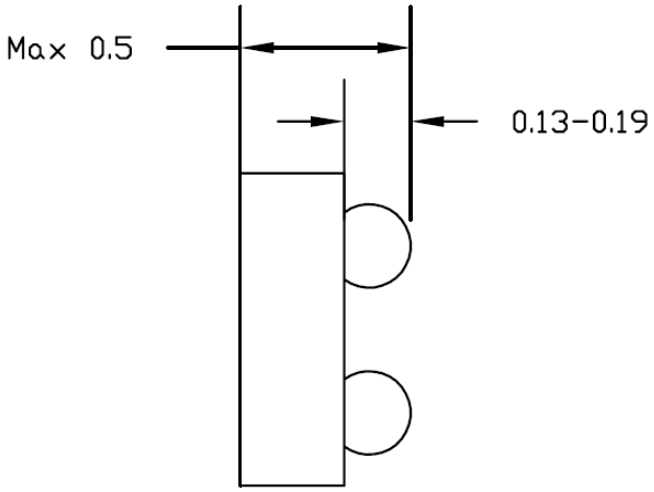


Figure3. PCB Layout Suggestion

CSP0.78×0.78-4 Package Outline



Top View **Bottom View**



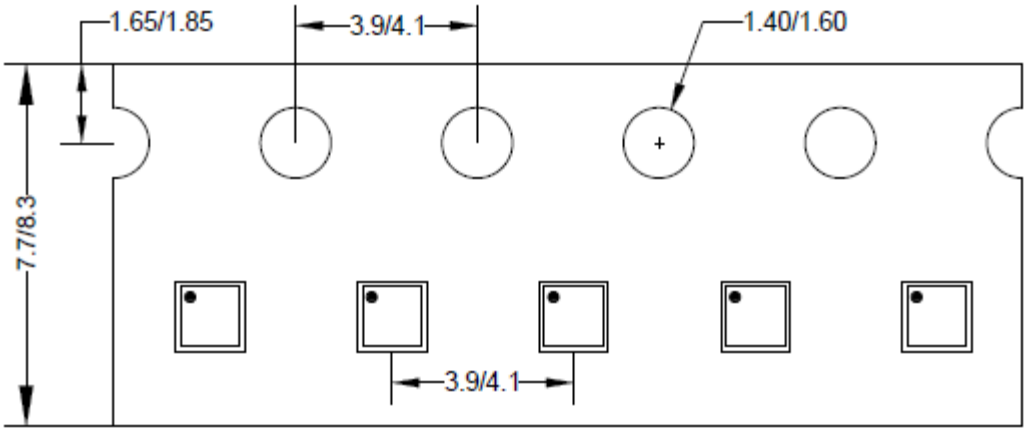
Side View

Notes: **All dimension in millimeter and exclude mold flash & metal burr.**

Taping & Reel Specification

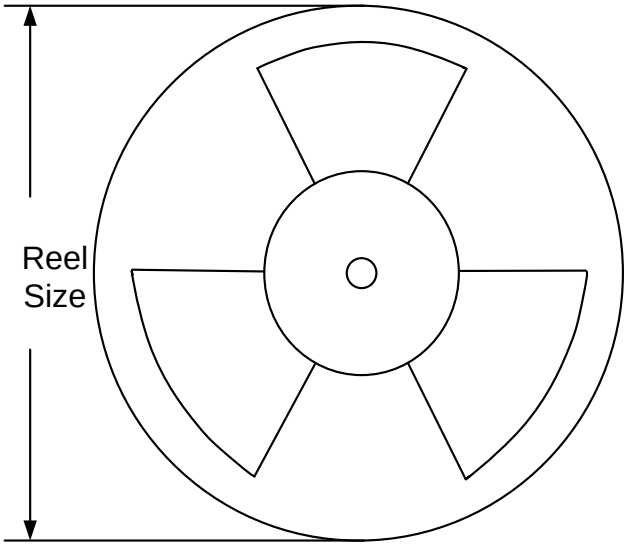
1. Taping orientation

CSP0.78×0.78



Feeding direction ⟶

2. Carrier Tape & Reel specification for packages



Package type	Tape width (mm)	Pocket pitch(mm)	Reel size (Inch)	Trailer length(mm)	Leader length (mm)	Qty per reel
CSP0.78×0.78	8	4	7"	400	160	5000

3. Others: NA

Revision History

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

Date	Revision	Change
Aug.20, 2021	Revision 1.0	Production Release.
Aug.14, 2020	Revision 0.9	Initial Release.

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