SY6816A

1.05V to 5.5V 2A Load Switch

General Description

The SY6816A is a small, low R_{ON}, single channel load switch with controlled slew rate. The device contains an N-channel MOSFET that can operate over an input voltage range of 1.05 V to 5.5 V and can support a maximum continuous current of 2 A. The switch is controlled by an on and off input, which is capable of interfacing directly with low-voltage control signals.

The small size and low R_{ON} makes the device ideal for being used in space constrained, battery powered applications. The wide input voltage range of the switch makes it a versatile solution for many different voltage rails. The controlled rise time of the device greatly reduces inrush current caused by large bulk load capacitances, thereby reducing or eliminating power supply droop.

The SY6816A further reduces the total solution size by integrating a 143Ω pull-down resistor for quick output discharge when the switch is turned off.

The SY6816A is available in a small, space-saving 0.78mm×0.78mm, 0.4-mm pitch, 0.5-mm height 4-pin CSP package. The device is characterized for operation over the free-air temperature range of –40°C to +105°C.

Features

- Wide input Voltage Range: 1.05V to 5.5V
- 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
- 2A Maximum Continuous Switch Current
- Low Quiescent Current: 9.7μA at V_{IN}=3.3V
- Controlled Slew Rate:
  - 913μs rise time at V_{IN}=3.3V
- Package: CSP0.78mm×0.78mm – 4.

Applications

- Note Book
- Cell Phone

Ordering Information

SY6816 □(□□)□
- Temperature Code
- Package Code
- Optional Spec Code

Ordering Number	Package Type	Note
SY6816APAC	CSP0.78×0.78– 4.	----

Typical Applications

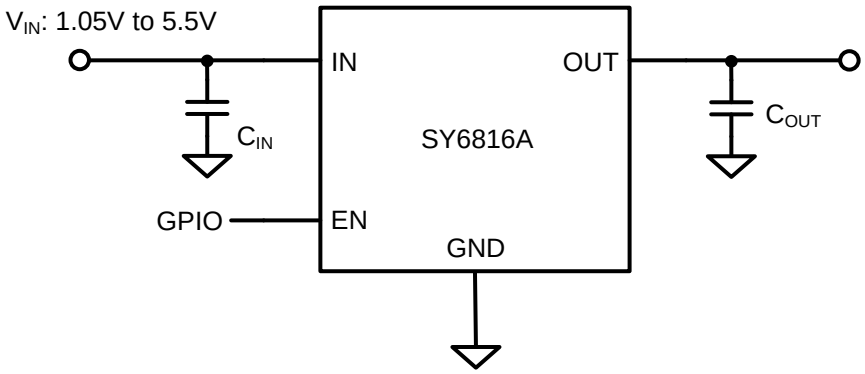
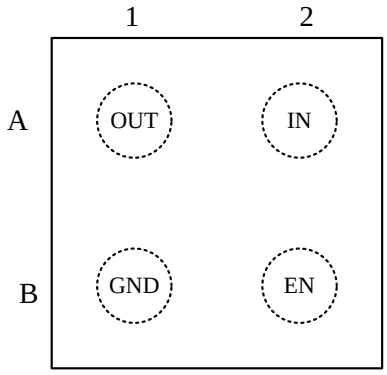


Figure1. Schematic Diagram

Pinout (Top view)



Package CSP0.78mm×0.78mm - 4

Top Mark: **hG*xyz***, (Device code: **hG**; ***x=year code, y=week code, z= lot number code***)

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

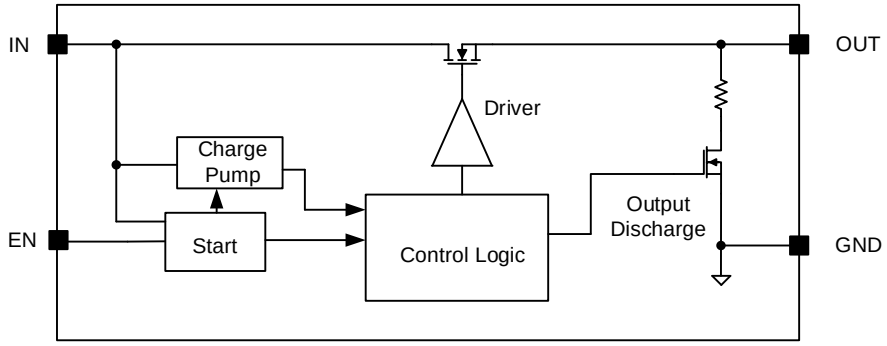


Figure2. Block Diagram

Absolute Maximum Ratings (Note 1)

IN, OUT, EN to GND ---------- -0.3V to 6V
Power Dissipation, P_D @ T_A = 25°C ---------- 0.52W
Package Thermal Resistance (Note 2)
θ_{JA} ---------- 193°C/W
θ_{JC} ---------- 2.3°C/W
Junction Temperature---------- -40°C to 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
CDM (Charged Device Mode) ---------- 500V

Recommended Operating Conditions (Note 3)

IN ---------- 1.05V to 5.5V
OUT ---------- 0V to V_{IN}
EN ---------- 0V to 5.5V
Junction Temperature Range ---------- -40°C to 125°C
Ambient Temperature Range ---------- -40°C to 105°C

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°C.**

Parameter	Symbol	Test Conditions	T_A	Min	Typ	Max	Unit
Quiescent Current	I_Q	V_{IN}=V_{EN}=3.3V, I_{OUT}=0A	-40°C to +85°C		9.7	12	μA
			-40°C to +105°C			13	μA
Shutdown Current	I_{SHDN}	V_{IN}=3.3V, V_{EN}=0V,V_{OUT}=0V	-40°C to +85°C		0.5	2	μA
			-40°C to +105°C			3	μA
Switch On Resistance	R_{ON}	V_{IN}=5V, I_{OUT}=200mA	25°C		37	41	mΩ
			-40°C to +85°C			51	mΩ
			-40°C to +105°C			57	mΩ
		V_{IN}=3.3V, I_{OUT}=200mA	25°C		38	41	mΩ
			-40°C to +85°C			52	mΩ
			-40°C to +105°C			58	mΩ
		V_{IN}=1.8V, I_{OUT}=200mA	25°C		43	48	mΩ
			-40°C to +85°C			59	mΩ
			-40°C to +105°C			66	mΩ
		V_{IN}=1.2V, I_{OUT}=200mA	25°C		52	61	mΩ
			-40°C to +85°C			73	mΩ
			-40°C to +105°C			85	mΩ
		V_{IN}=1.05V, I_{OUT}=200mA	25°C		63	96	mΩ
			-40°C to +85°C			102	mΩ
			-40°C to +105°C			107	mΩ
EN Input Logic High	V_{IH}	V_{IN}=1.05V to 5.5V	25°C	1			V
EN Input Logic Low	V_{IL}	V_{IN}=1.05V to 5.5V	25°C			0.4	V
EN Hysteresis	V_{HYS_EN}	V_{IN}=5.5V	25°C		102		mV
		V_{IN}=1.05V	25°C		92		mV
Discharge Resistance	R_{DSG}	V_{IN}=V_{OUT}=3.3V, V_{EN}=0V	-40°C to +105°C		143	200	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°C (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		1277		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		663		μs
V_{IN}=3.3V, V_{ON}=5V, T_A=25°C (Unless otherwise noted)						
Turn On Time	t_{ON}	R_L=10Ω, C_{IN}=1μF, C_{OUT}=0.1μF		1077		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		913		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		622		μs
V_{IN}=1.05V, V_{ON}=5V, T_A=25°C (Unless otherwise noted)						
Turn On Time	t_{ON}	R_L=10Ω, C_{IN}=1μF, C_{OUT}=0.1μF		752		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		409		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		547		μs

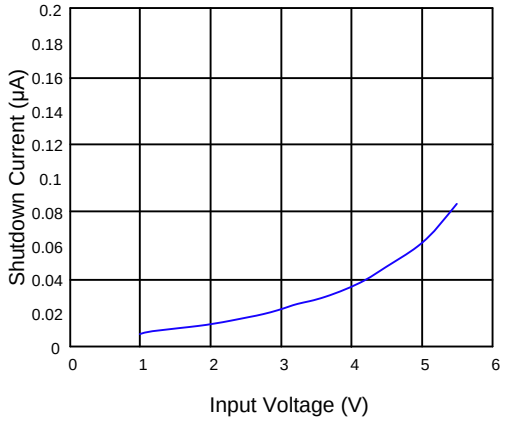
Note 1: Stresses beyond the "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute 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 a low effective single layer thermal conductivity test board of JEDEC 51-3 thermal measurement standard.

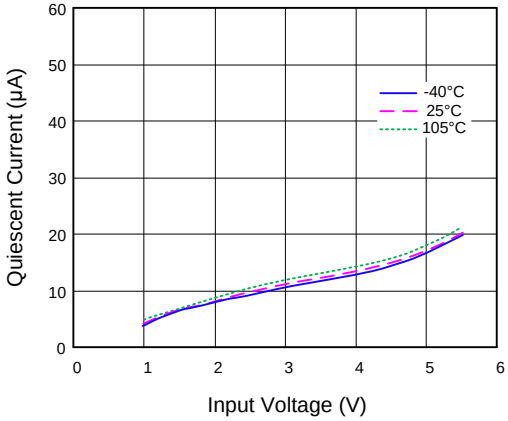
Note 3: The device is not guaranteed to function outside its operating conditions.

Typical Operating Characteristics

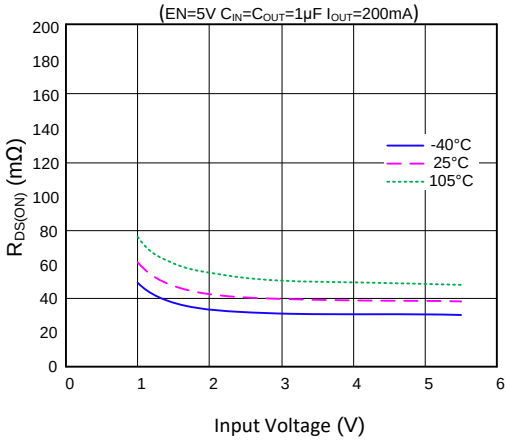
Shutdown Current vs. Input Voltage
(EN=0V C_{IN}=C_{OUT}=1μF I_{OUT}=0A)



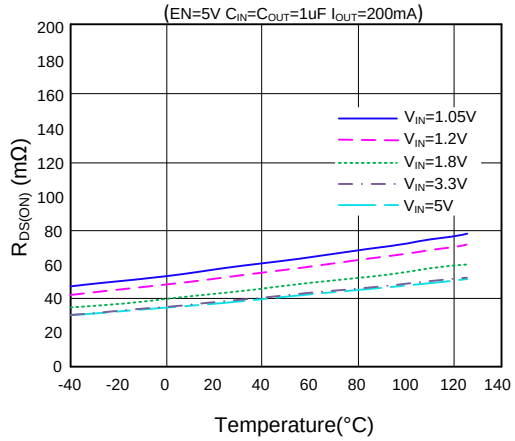
Quiescent Current vs. Input Voltage
(EN=5V C_{IN}=C_{OUT}=1μF I_{OUT}=0A)



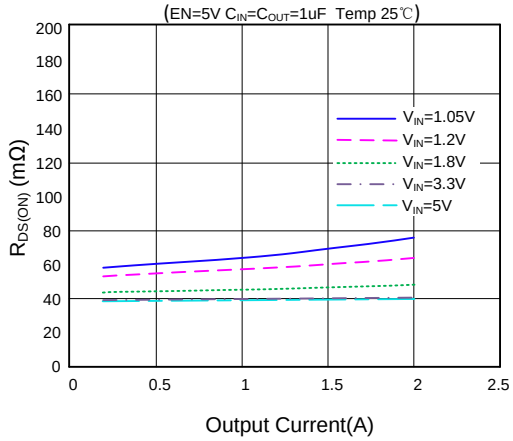
$R_{DS(ON)}$ vs. Input Voltage
(EN=5V C_{IN}=C_{OUT}=1μF I_{OUT}=200mA)



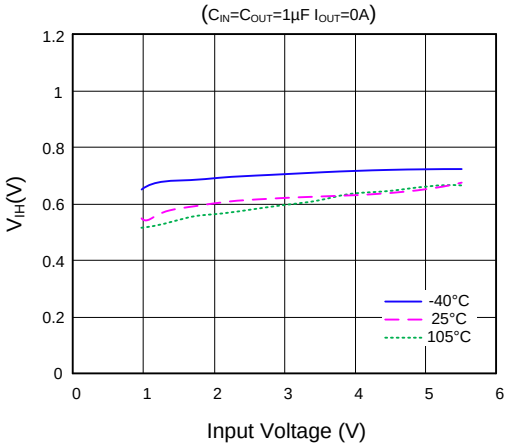
$R_{DS(ON)}$ vs. Temperature
(EN=5V C_{IN}=C_{OUT}=1uF I_{OUT}=200mA)



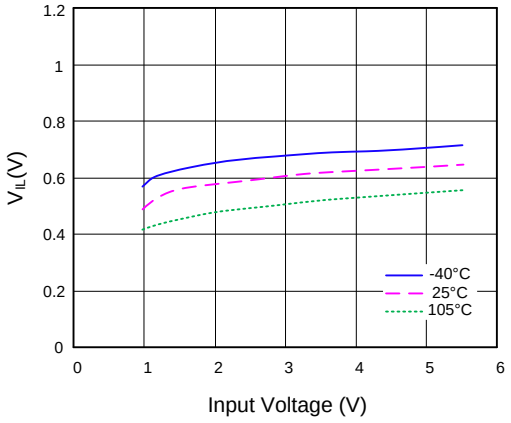
$R_{DS(ON)}$ vs. Output Current
(EN=5V C_{IN}=C_{OUT}=1uF Temp 25℃)



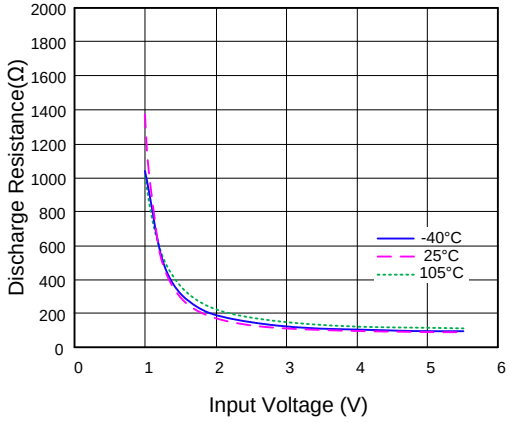
V_{IH} vs. Input Voltage
(C_{IN}=C_{OUT}=1μF I_{OUT}=0A)



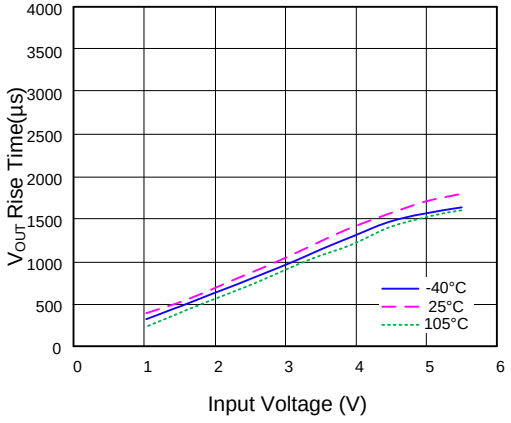
V_{IL} vs. Input Voltage
(C_{IN}=C_{OUT}=1μF I_{OUT}=0A)



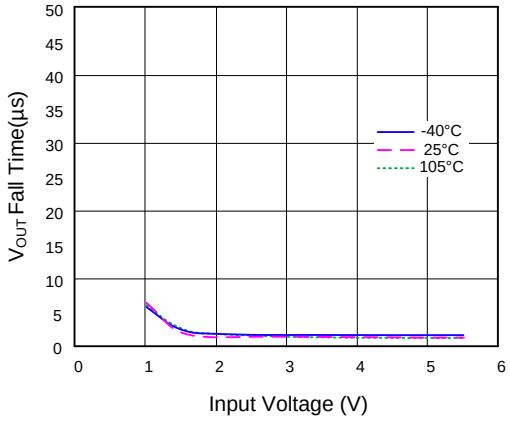
Discharge Resistance vs. Input Voltage
(V_{IN}=V_{OUT} EN=0V C_{IN}=C_{OUT}=1μF)



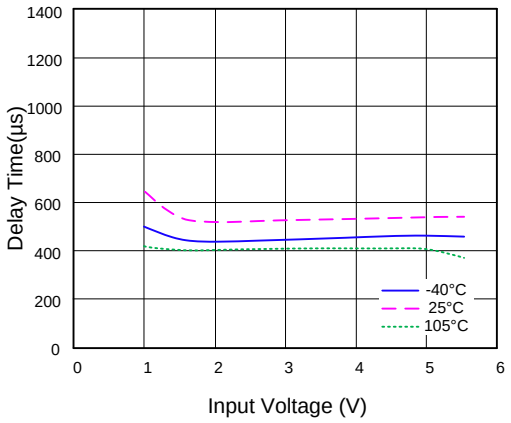
V_{OUT} Rise Time vs. Input Voltage
(V_{IN}=3.3V EN=0V to 5V C_{IN}=1μF C_{OUT}=0.1μF R_{Load}=10Ω)



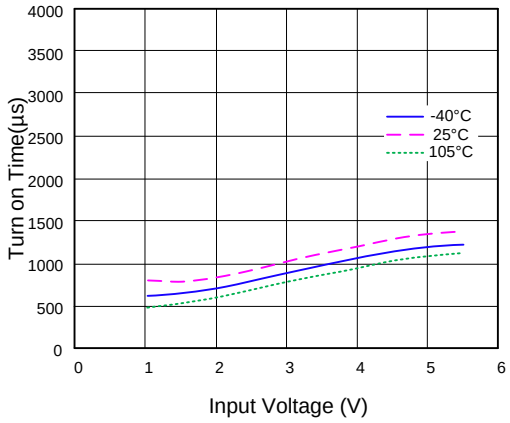
V_{OUT} Fall Time vs. Input Voltage
(V_{IN}=3.3V EN=5V to 0V C_{IN}=1μF C_{OUT}=0.1μF R_{Load}=10Ω)



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

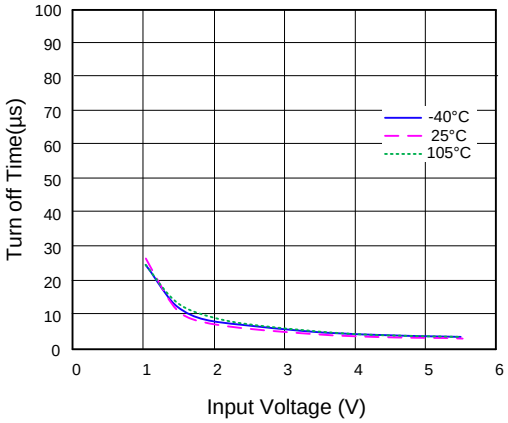


Turn on Time vs. Input Voltage
(V_{IN}=3.3V EN=0V to 5V C_{IN}=1μF C_{OUT}=0.1μF R_{Load}=10Ω)



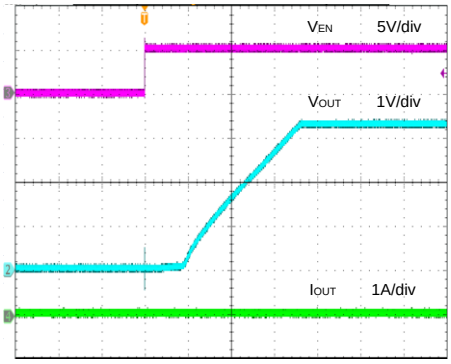
Turn off Time vs. Input Voltage

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



Startup from Enable

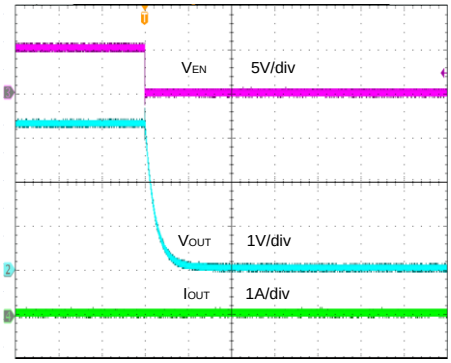
(V_{IN}=3.3V, EN=0V to 5V C_{IN}=1μF,C_{OUT}=1μF, Null Load)



Time (400μs/div)

Shutdown from Enable

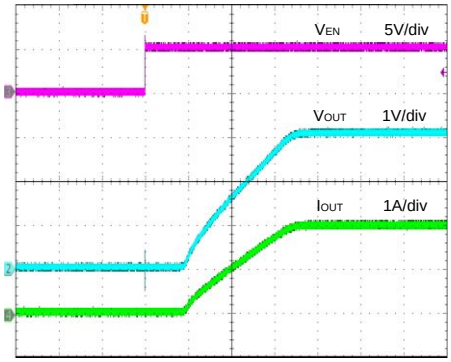
(V_{IN}=3.3V, EN=5V to 0V C_{IN}=1μF,C_{OUT}=1μF, Null Load)



Time (400μs/div)

Startup from Enable

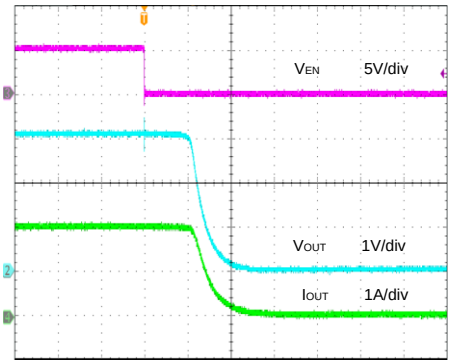
(V_{IN}=3.3V,EN=0V to 5V C_{IN}=1μF,C_{OUT}=1μF, 1.65Ω Load)



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 SY6816A is a small, low R_{ON}, single channel load switch with controlled slew rate. The device contains an N-channel MOSFET that can operate over an input voltage range of 1.05 V to 5.5V and can support a maximum continuous current of 2A.

The switch is controlled by an on and off input, which is capable of interfacing directly with low voltage control signals.

Applications Information

Input Capacitor

To reduce device inrush current, a 1μF ceramic capacitor, CIN, is recommended. A higher value of CIN can be used to reduce the voltage drop experienced as the switch is turned on into large capacitive load. To minimize the potential noise problem, CIN should be placed really close to the IN and GND pins.

Output Capacitor

A 1μF ceramic output cap is recommended to prevent parasitic board inductance from forcing VOUT below GND when switching off

Output Discharge

SY6816A integrate a 143Ω pull down resistor for quick output discharge. The resistor is activated when the switch is turned off.

PCB Layout Guide

For best performance of the SY6816APAC, the following guidelines must be strictly 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.
- ✧ Locate the output capacitors as close to the connectors as possible to lower the 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.

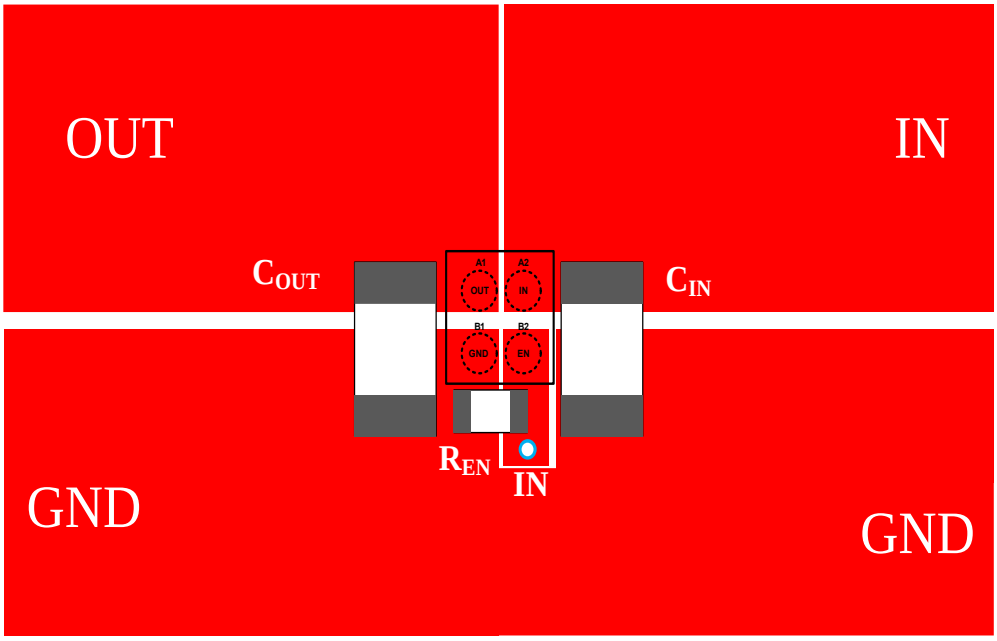
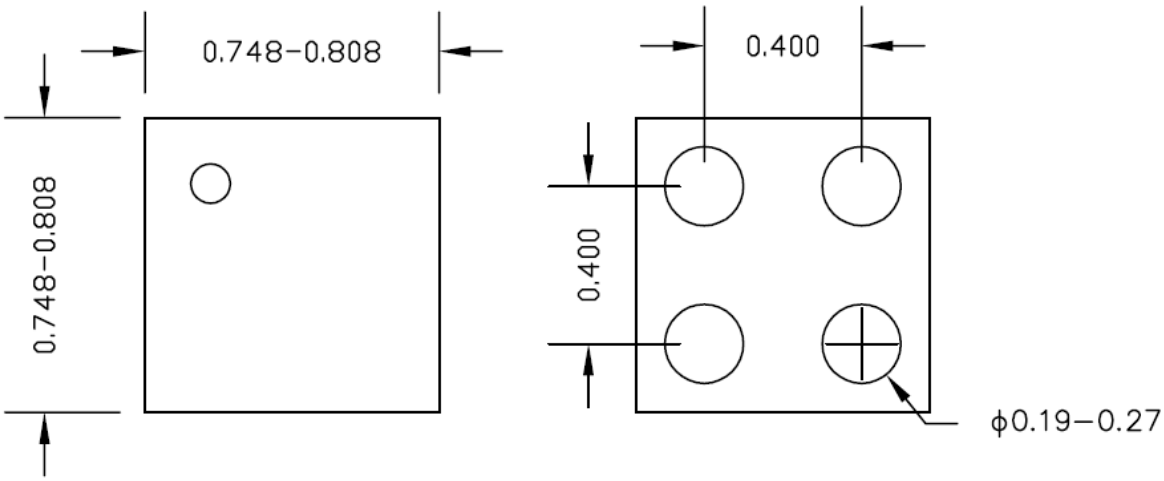
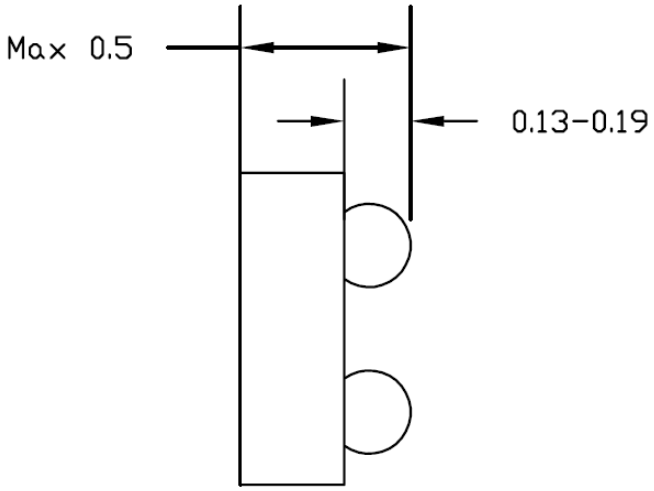


Figure3. PCB Layout Suggestion

CSP0.78×0.78-4 Package Outline



Top View **Bottom View**



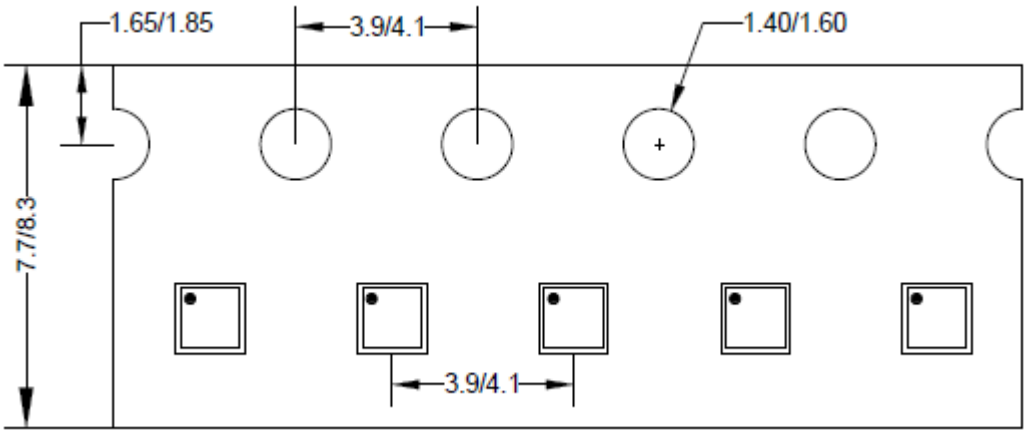
Side View

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

Taping & Reel Specification

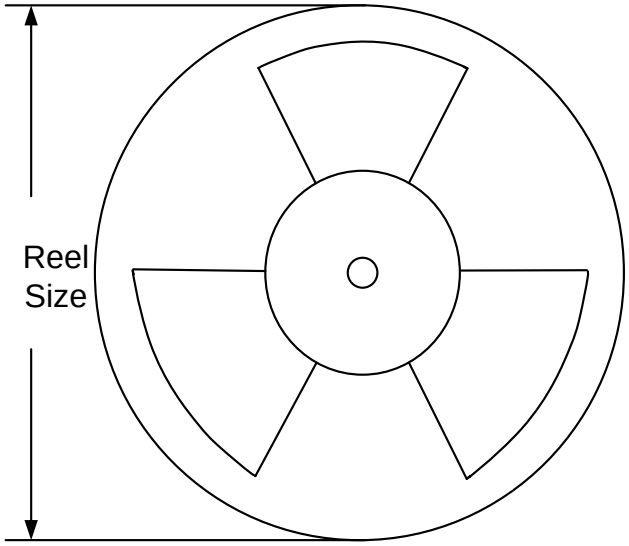
1. Taping orientation

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

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