Description

The YB1901 is a low operation voltage, single N-channel MOSFET high-side power switch, optimized for low power consumption system. A small internal charge-pump circuitry is built in the YB1901 to drive the internal MOSFET switch for reaching an average $R_{DS(ON)}$ resistance of 120mΩ. A fault flag output is available to indicate an abnormal condition during operation.

Some other features include low in-rush current during plug-in, thermal shutdown to prevent switch failure from high-current loads, under-voltage lock-out to keep the chip off when below normal operation supply, a short-circuit protection to avoid grounded big current. The quiescent current needed to run the change-pump is as low as 60μA at 5V input. It makes the device ideal for portable battery operated system.

The YB1901 power switch is available in SOT-25, MSOP8, SOP8 packages.

Features

- Built-In N-Channel MOSFET
- Typical $R_{DS(ON)}$ Resistance : 120 mΩ
- Low Quiescent Current : 60μA at 5V
- Low Shutdown Current : <1μA
- Current Limit at 2.0A
- Wide Input Voltage Range : 2.7 ~ 5.5V
- Hot Plug-In Application
- 2.4V Under-Voltage Lock-Out
- Thermal Shutdown Protection
- Short-Circuit Protection
- Reverse Current Flow Blocking
- Open-Drain Fault Flag
- SOT-25, MSOP8, SOP8 Packages
- Green Package (RoHS) Available

Applications

- PDA, DSC, GPS
- USB Peripherals
- PC Cards
- PCMCIA Cards
- Notebook PC
- Battery-Charger Circuits
- Battery-Powered Instruments

Typical Application Circuit

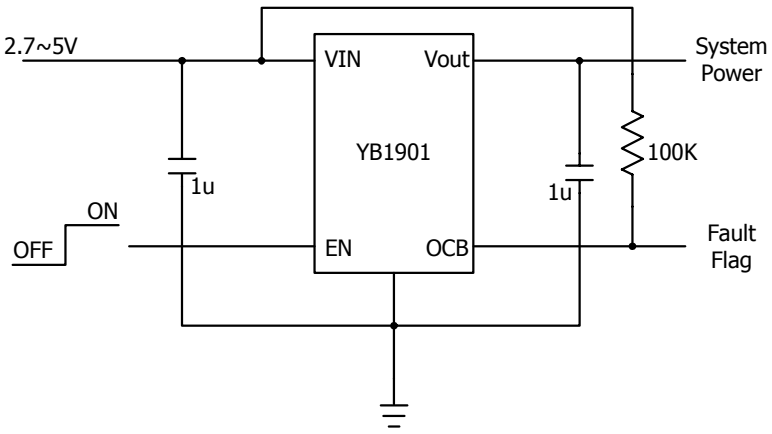


Figure 1: Typical Application Circuit

Pin Configuration

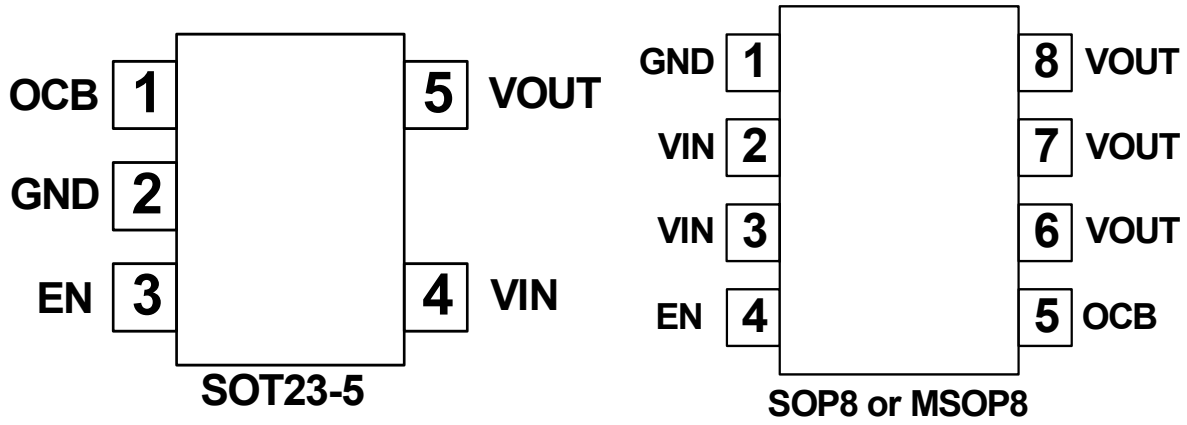


Figure 2: Pin Configuration

Pin Description

Table 1

Name	Description
EN	Pull low to enable the chip, active high (active low is optional).
GND	Ground pin.
OCB	Open-drain fault flag. Connect a 100KΩ resistor to VIN.
VIN	Input supply. Bypass with a capacitor to GND.
VOUT	Output voltage. Bypass with a capacitor to GND.

Ordering Information

Table 2

Order Number	Enable	Package Type	Supplied As	Package Marking
YB1901ST25H	Active High	SOT23-5	3000 Units Tape & Reel	Y90H
YB1901SPX8H	Active High	SOP-8	2500 Units Tape & Reel	第一行 Y90H 第二行 SPX8
YB1901MXX8H	Active High	MSOP-8	2500 Units Tape & Reel	Y90HM8
YB1901ST25L	Active Low	SOT23-5	3000 Units Tape & Reel	Y90L
YB1901SPX8L	Active Low	SOP-8	2500 Units Tape & Reel	第一行 Y90L 第二行 SPX8
YB1901MXX8L	Active Low	MSOP-8	2500 Units Tape & Reel	Y90LM8

Absolute Maximum Ratings (Note 1)

Supply Voltage ..... -0.3V to 6
Output Voltage ..... -0.3V to (V_{IN} + 0.3V)
Output Short-Circuit Duration ..... Infinite
Junction Temperature ..... 150℃
Storage Temperature ..... -65℃ to 150℃
Lead Temperature ..... 250℃
ESD Susceptibility (HBM) 3KV
ESD Susceptibility (MM) 300V

Recommended Operating Conditions (Note 2)

Input Supply Voltage ..... 2.7V to 5.5V
Operating Temperature ..... -40℃ to 85℃

Thermal Information (Note 3)

Thermal Resistance (SOT-25, θ_{JA}) ... 280℃/W
Internal Power Dissipation (SOT-25, P_D) .. 0.4W

Note:

1. Exceeding these ratings may damage the device.
2. The device is not guaranteed to function outside of its operating conditions.
3. θ_{JA} is measured in free air at T_A = 25℃ on a low effective thermal conductivity board.

Electrical Characteristics

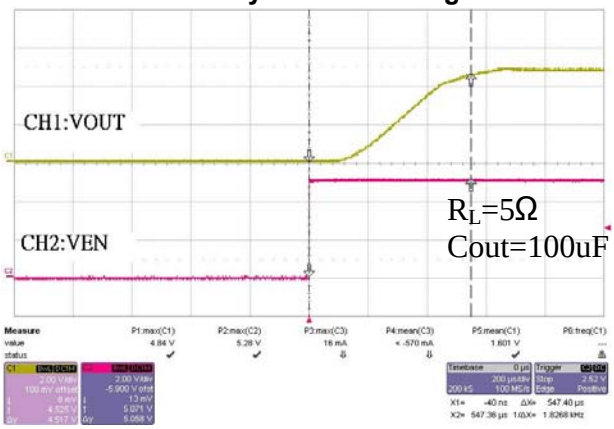
Table 3 (V_{IN}=5V, C_{IN}= C_{OUT}=1μF, T_A=25°C, unless otherwise noted.)

PARAMETER	CONDITION	MIN	TYP	MAX	Unit
Input Voltage Rage		2.7	5	5.5	V
Output MOS RDS(ON)	YB1901, IOUT=0.5A		120		mΩ
Supply Current	Iout=0		60		uA
Load current		500			mA
Output Turn-on Rising Time	R_L=10Ω, 90% Settling		420		us
Current Limit Threshold	YB1901, V_{OUT}=4V	1.6	2.2	2.8	A
Short-circuit Current	YB1901, Vout=0V	0.1	1.5	1.73	A
EN Input Threshold	V_{IN}=5V, Rising	1.5	1.7	1.85	V
EN Input Hysteresis			200		mV
Shutdown Supply Current				1	uA
Output Leakage Current	EN=Non-active, Vout=0V			1	uA
VIN Under Voltage Lockout			2.4		V
VIN Under Voltage Hysteresis			200		mV
Thermal Limit			135		°C
Thermal Limit Hysteresis			20		°C
OCB Deglitch	OCB assertion or deassertion		7.5	10	ms
OCB Output Low Voltage	I_{SINK} =1mA, V_{IN}=5V			0.4	V
OCB Off-State Current	V_{OCB} =V_{IN}			1	uA

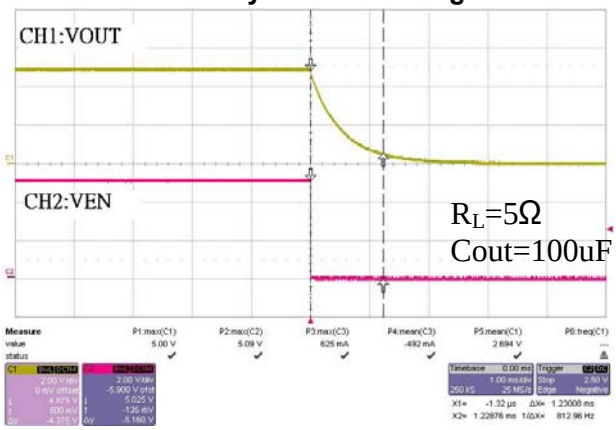
Typical Characteristics

At T_A=25℃, V_{IN}=5V, C_{IN}=C_{OUT}=1.0μF, V_{EN}=V_{IN}, unless otherwise noted.

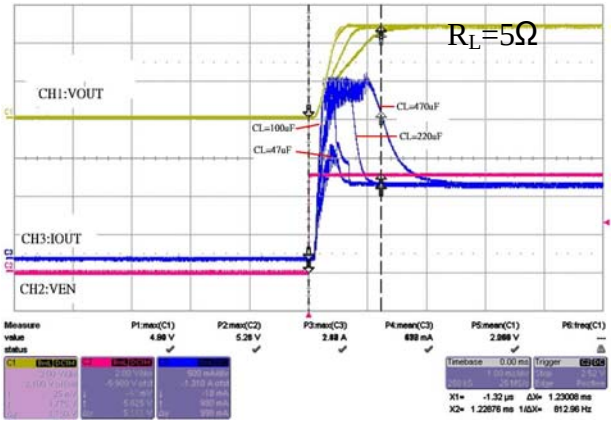
Turn on delay time and rising time



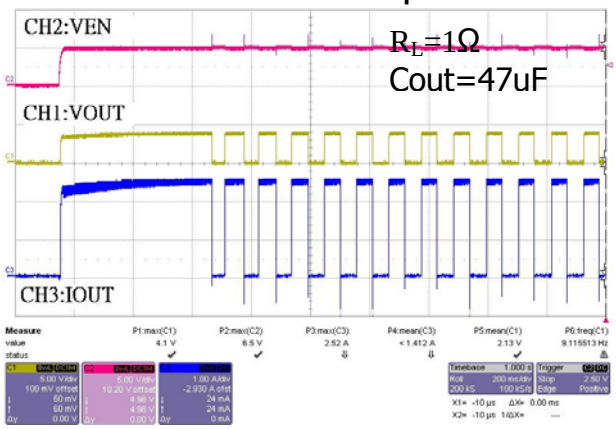
Turn off delay time and falling time



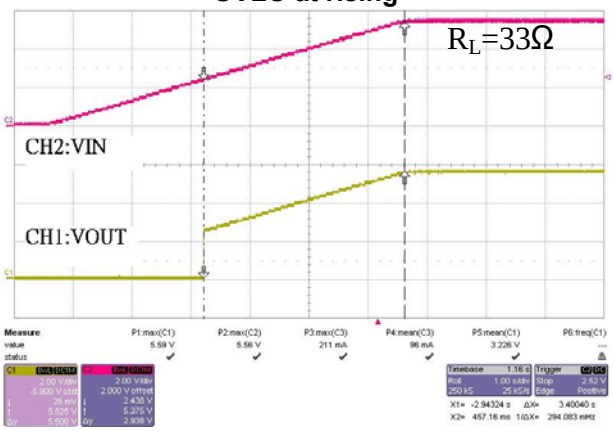
Inrush current and different load capacitance



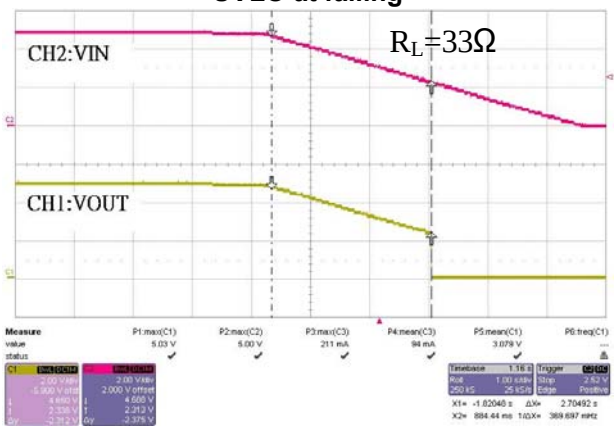
Thermal shutdown reponse



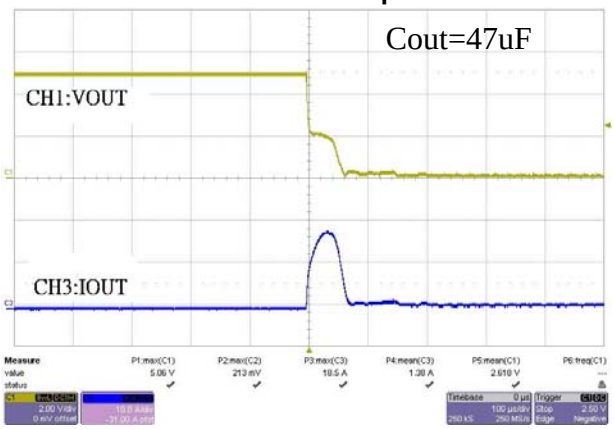
UVLO at rising



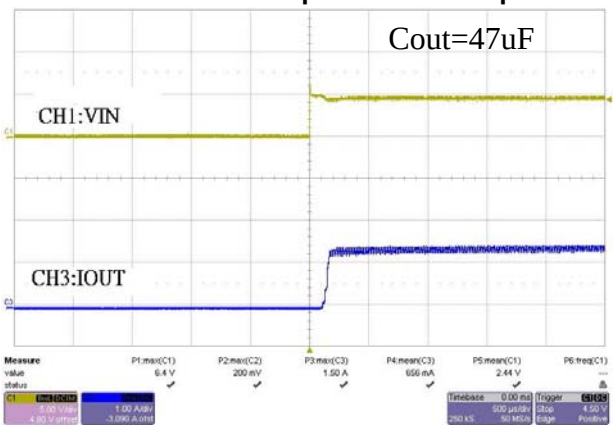
UVLO at falling



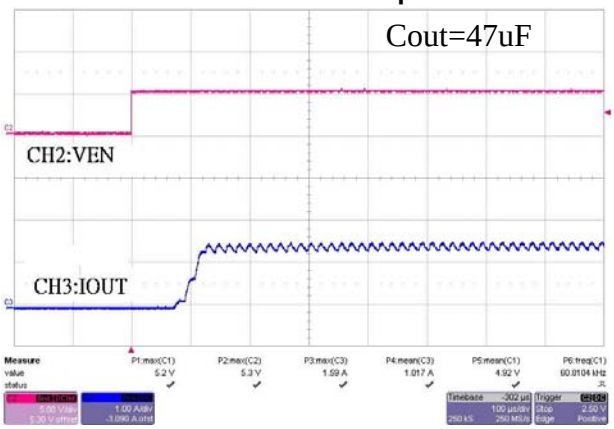
Inrush current response



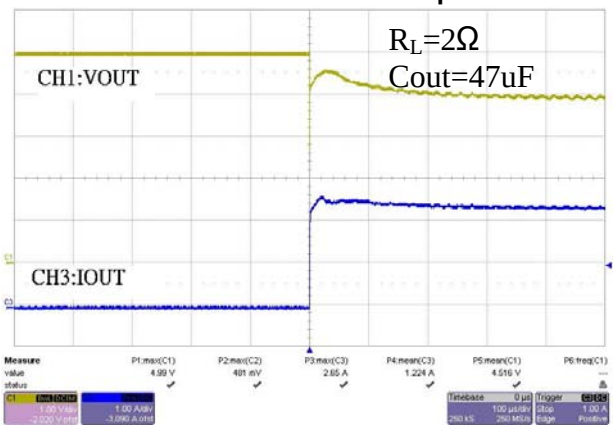
Short circuit response at start up



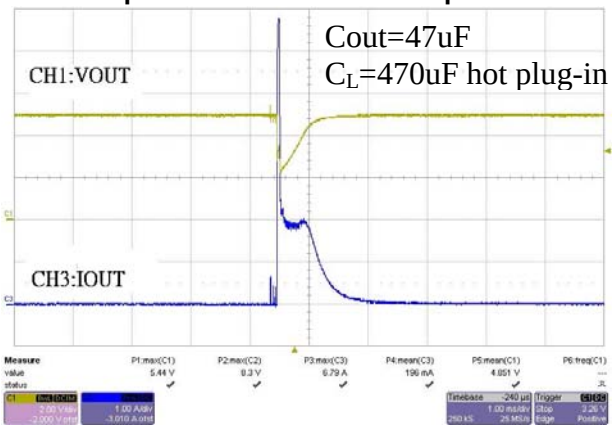
Short circuit and Enable pin enable



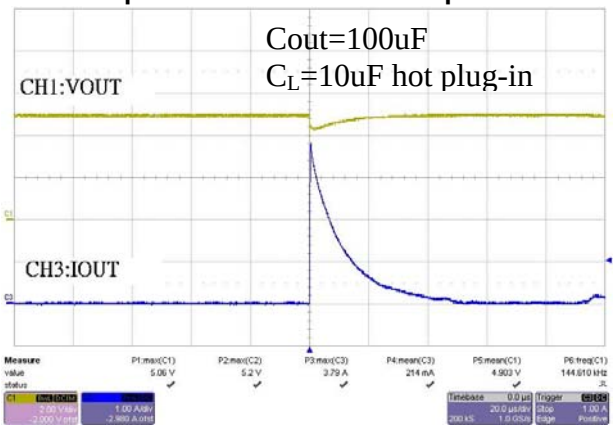
Resistance load inrush response



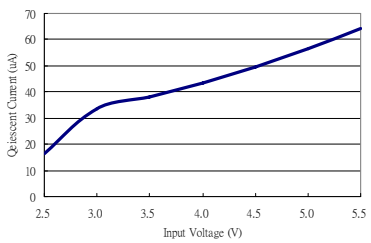
Capacitance load inrush response



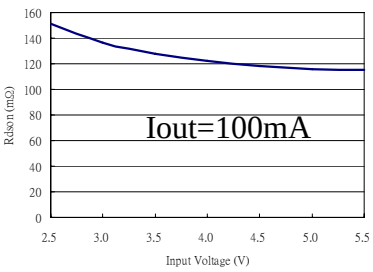
Capacitance load inrush response



Quiecsent current VS Input Voltage



R_{dson} VS Input Voltage



Function Block

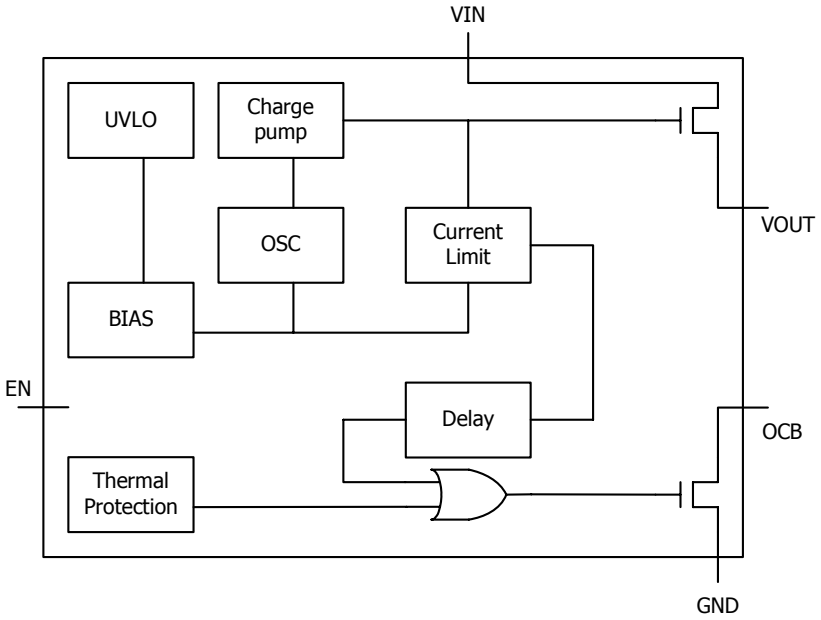


Figure 3: Function Block

Functional Description

The YB1901 is an N-channel high-side power switch with an internal charge-pump circuitry to drive the switch. The enable signal is either active high. It is ideal for battery-powered applications and adaptor card operation with less than 2.0A requirement.

NMOS Switch

The drain of the NMOS is connected to V_{IN} and the source to V_{OUT}. The bulk contact is grounded, instead of the source terminal, so there is no parasitic diode between the two terminals. It prevents reverse current flow from V_{OUT} to V_{IN} if V_{OUT} being forced to higher voltage than V_{IN} when the enable is inactive. This feature makes the main difference between YB1901 and a traditional external MOSFET.

Chip Enable

The enable signal is available with either or active low of customer's request. When the enable is inactive, the switch is turned off, the internal oscillation stopped, the charge pump discharged, and the whole chip current consumption is kept at lower than 0.1μA typically. When the enable is set active, the oscillation starts, the charge pump works. But it takes time building up the control voltage necessary to drive the MOSFET switch. The turn-on delay time is around 0.42ms typically.

Floating the enable pin may cause unpredictable operation. It should be avoided.

Under-Voltage Lock-Out (UVLO)

UVLO prevents the chip from turning on until a safe input voltage is reached. For YB1901 UVLO is set to around 2.4V, and there is a hysteresis voltage of 0.2V

between rising and falling. That UVLO shuts down the chip when input voltage drops below 2.4V and allows starting up the chip when input voltage above 2.6V.

Short-Circuit Protection

If the V_{OUT} pin is connected to ground or nearly ground level by mistake, the short-circuit protection circuit will come active and put a current limit over the switch to protect the switch from over-current. The current limit is set around 1.5A.

Overload Current Limit

The YB1901 is designed to work below 2.0A. If the current load outgrows 2.0A, it will trigger the Overload Current Limit Circuitry. The max current limit is set at 2.0A. If the protection circuit is activated, it send out a fault signal from the OCB pin. It does not shutdown the circuit.

Thermal Shutdown

The thermal shutdown is deployed to protect the switch from damage if the silicon temperature rises above 135°C approximately. If the circuit is triggered, the chip will turn on again when the silicon temperature drops around 20°C below.

Fault Flag

There is a fault flag signal (OCB) available with YB1901 to indicate the occurrence of abnormal operation. The abnormal operation includes Short-Circuit, Thermal shutdown and Overload Current Limit. When the fault happens and lasts for more than 7.5ms typically, the flag will be asserted. OCB is designed in open-drain structure. Connecting a resistor of 100K ohm to V_{IN} is necessary for the pin to signal (active low) a faulty condition.

Application Information

The YB1901 featured very low quiescent current and very low $R_{DS(ON)}$ and making them ideal for battery-powered applications. The ENABLE control pin is TTL compatible and driven by 1.7V beyond making the YB1901 an ideal level-shifting load switch.

Input Capacitor Selection

A 1μF or larger input capacitor is recommended to prevent load transients from affecting upstream circuits. C_{IN} should be located as close to the device V_{IN} pin as practically. There is no specific requirement type of capacitor is recommended. However, for higher current operation, ceramic capacitors are recommended for C_{IN}.

Output Capacitor Selection

For proper slew operation, a 0.1μF or greater is recommended. The output capacitor has also no specific capacitor type requirement. If desired, C_{OUT} maybe increased without limit to accommodate any load transient.

Reverse Output-to-Input Voltage Conditions and Protection

Under normal conditions, there is no parasitic diode between the output & input of the load switch. In case of V_{OUT} exceeding V_{IN}, there is no excessive current flow from V_{OUT} to V_{IN}. This reverse-blocking ability secures the use of such a power switch.

Thermal Considerations

The YB1901 is designed to deliver a continuous load current. The maximum limit is package power dissipation. At any given ambient temperature, the maximum package power dissipation can be determined by the following equation:

$$P_{D(MAX)} = [\ T_{J(MAX)} - T_A\ ] / \theta_{JA}$$

Constraints for the YB1901 are maximum junction temperature $T_{J(MAX)}$ = 125℃, and package thermal resistance, θ_{JA} =280℃/W.

The maximum continuous output current for YB1901 depends on package power dissipation and the $R_{DS(ON)}$ of MOSFET at $T_{J(MAX)}$. Typical conditions are calculated under normal ambient condition where T_A = 25℃. At 85℃, $P_{D(MAX)}$ = 143mW. At T_A = 25℃, $P_{D(MAX)}$ = 357mW.

The maximum current is calculated by the following equation:

$$I_{OUT} < (P_{D(MAX)} / R_{DS(MAX)})^{1/2}$$

For example, if V_{IN} = 5V, $R_{DS(MAX)}$ = 100mΩ and T_A = 25℃, $I_{OUT(MAX)}$ = 1.89A.

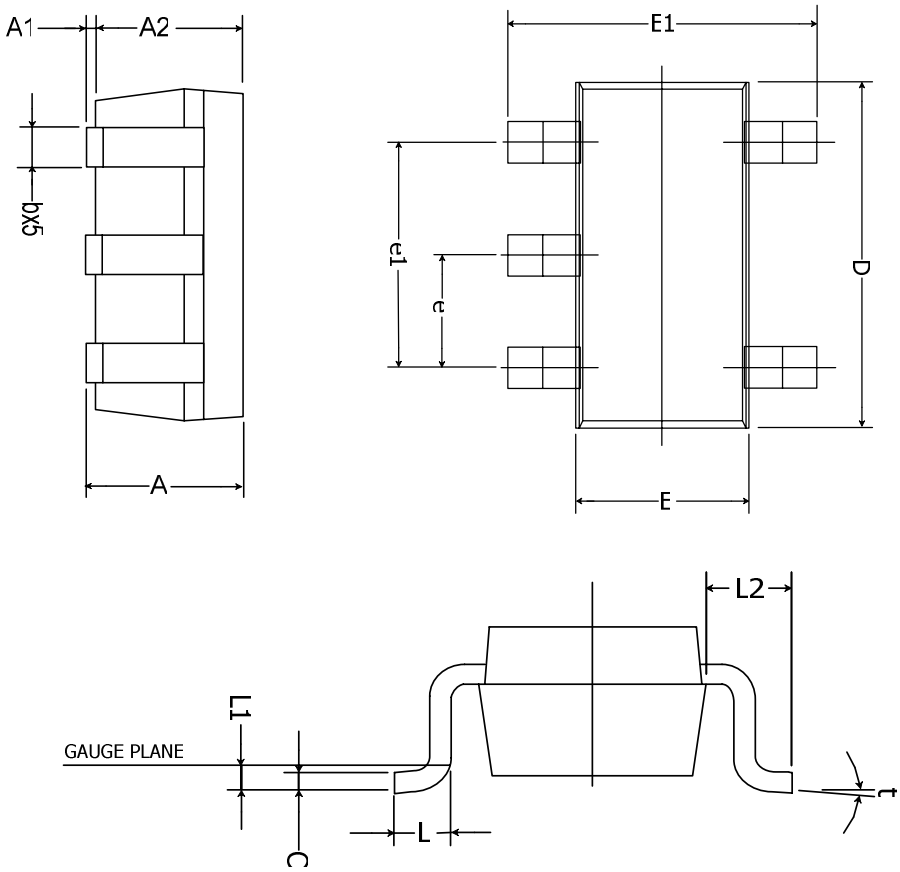
Thermal Shutdown is employed to protect the device damage when temperature is over 120℃.

PCB Layout Consideration

To maximize YB1901 performance, some board layout rules should be followed:

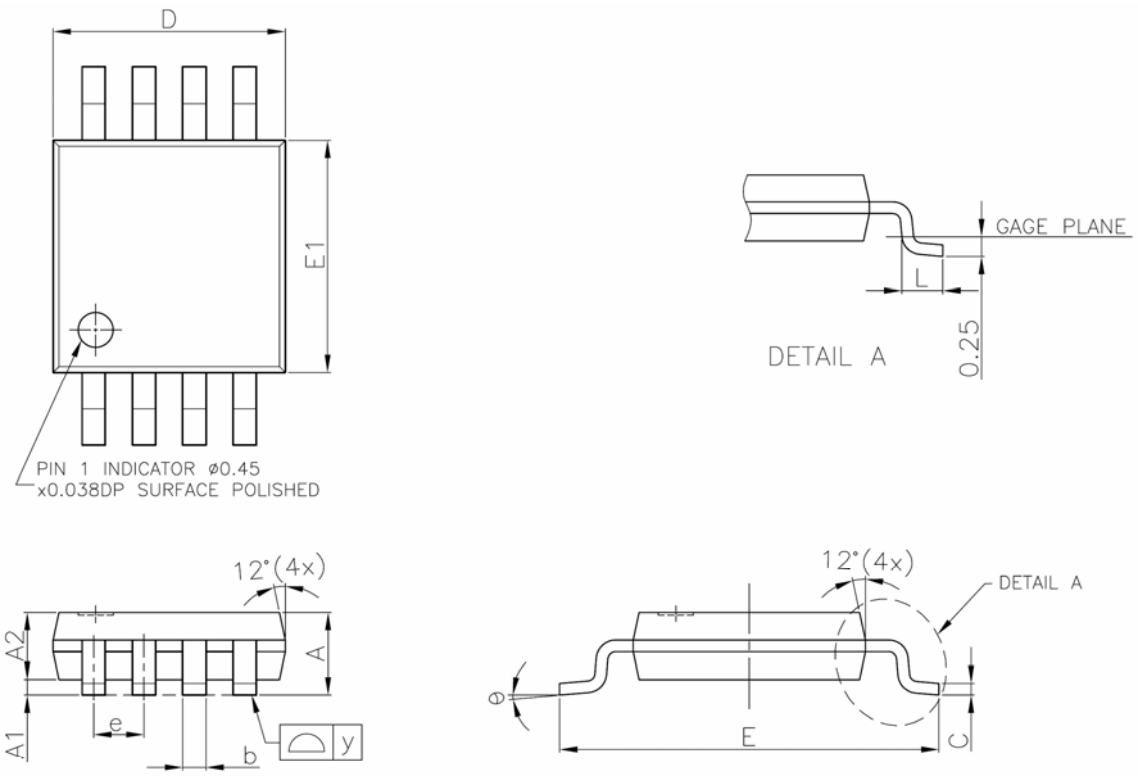
V_{IN} and V_{OUT} should be routed using wider than normal traces, and GND should be connected to a ground plane. For best performance, C_{IN} and C_{OUT} should be placed close to the package pins.

Package Information (SOT23-5)



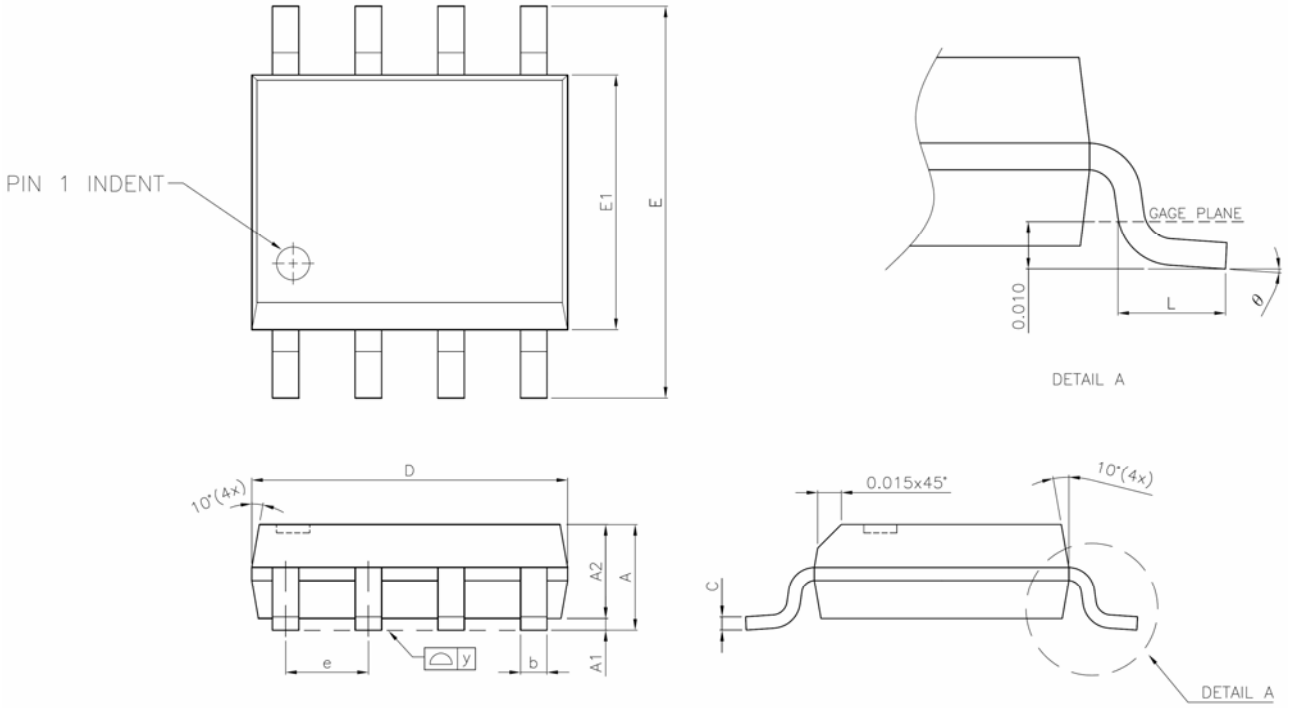
Symbol	milimeters		Inches	
	MIN.	MAX.	MIN.	MAX.
A	0.95	1.45	.037	.057
A1	0.05	0.15	.002	.006
A2	0.90	1.30	.035	.051
b	0.30	0.50	.0118	.019
C	0.08	0.20	.0031	.0078
D	2.84	3.00	.1118	.118
E	1.50	1.70	.059	.0669
E1	2.60	3.00	.102	.118
e	0.95 BSC.		.0374 BSC.	
e1	1.90 BSC.		.0748 BSC.	
L	0.35	0.55	.0137	.0216
L1	0.10 BSC.		.0039 BSC.	
L2	0.60 REF.		.0236 REF.	
t	0°	8°	0°	8°

Package Information (MSOP-8)



SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.81	1.02	1.10	0.032	0.040	0.043
A1	0.05	—	0.15	0.002	—	0.006
A2	0.76	0.86	0.95	0.030	0.034	0.037
b	0.28	0.30	0.38	0.011	0.012	0.015
C	0.13	0.15	0.23	0.005	0.006	0.009
D	2.90	3.00	3.10	0.114	0.118	0.122
E	4.80	4.90	5.00	0.189	0.193	0.197
E1	2.90	3.00	3.10	0.114	0.118	0.122
e	—	0.65	—	—	0.0256	—
L	0.40	0.53	0.66	0.016	0.021	0.026
y	—	—	0.076	—	—	0.003
θ	0°	3°	6°	0°	3°	6°

Package Information (SOP-8)



SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.47	1.60	1.73	0.058	0.063	0.068
A1	0.10	——	0.25	0.004	——	0.010
A2	——	1.45	——	——	0.057	——
b	0.33	0.41	0.51	0.013	0.016	0.020
C	0.19	0.20	0.25	0.0075	0.008	0.0098
D	4.80	4.85	4.95	0.189	0.191	0.195
E	5.80	6.00	6.20	0.228	0.236	0.244
E1	3.80	3.90	4.00	0.150	0.154	0.157
e	——	1.27	——	——	0.050	——
L	0.40	0.71	1.27	0.016	0.028	0.050
y	——	——	0.076	——	——	0.003
θ	0°	——	8°	0°	——	8°

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