

Dual Output Load Switch with Adjustable Current Regulation

Features

- Low Input Voltage: 2.2V to 5.5V
- Enable/Disable and current regulation setting from ISNS pins.
- 24uA Supply Current
- 500nA Shutdown Current
- Ultra-Low On-State Resistance (R_{ON})
 - $R_{ON} = 100m\Omega$ at $V_{IN} = 5.0V$
- 2A Maximum Total Continuous Current
- Quick Output Discharge
- Reverse Current Blocking for both channels.
- Tiny 0.67mm x 1.02mm 6-pin WLP with 0.35mm pitch

Applications

- Wearables
- Smartphones
- Tablets
- Portable Device

General Description

YHM2511 is a dual output, ultra-small, low R_{ON} and active low load switch. The device contains two N-channel MOSFETs that operate over an input voltage range of 2.2V to 5.5V. The switch is controlled by ISNS pin.

YHM2511 device limits the output current to a safe level by using a constant current mode when the output load exceeds the current regulation threshold. The current regulation threshold is adjusted by an external resistor added to ISNS pin. It has hard short protection for some abnormal situation at OUTx pins.

An internal reverse voltage comparator disables the power switch when the output voltage is driven higher than the input to protect devices on the input side of the switch when ISNS is logic low.

YHM2511 is available in a 6-bump, 0.35mm pitch, 0.67mm x 1.02mm wafer-level package (WLP).

Internal Block diagram

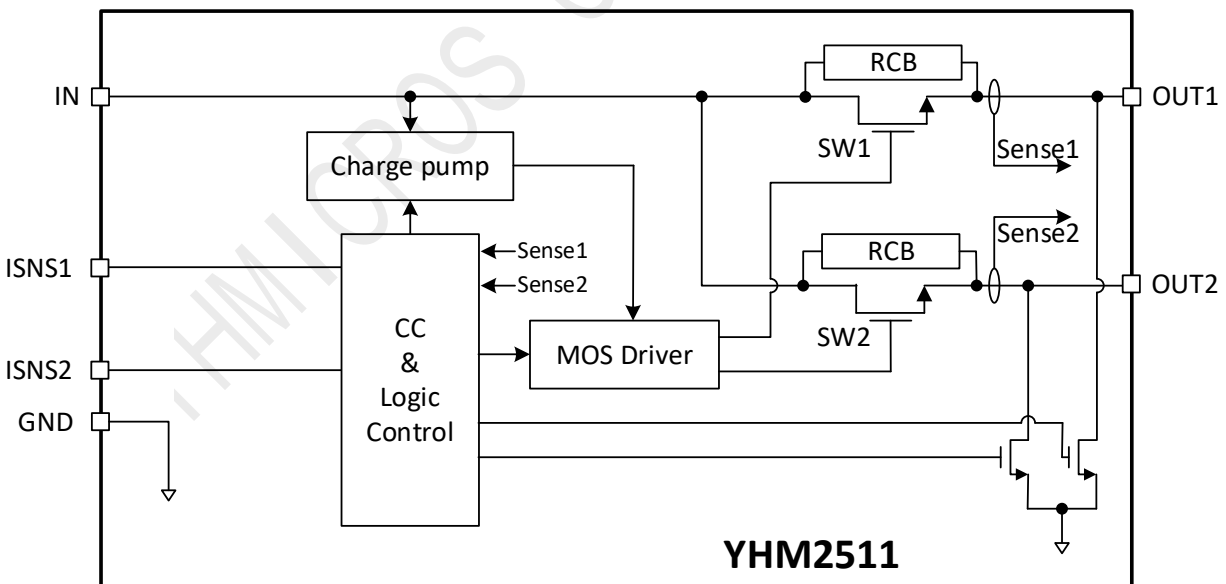


Figure 1. YHM2511 Internal Block Diagram

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Pin Configurations

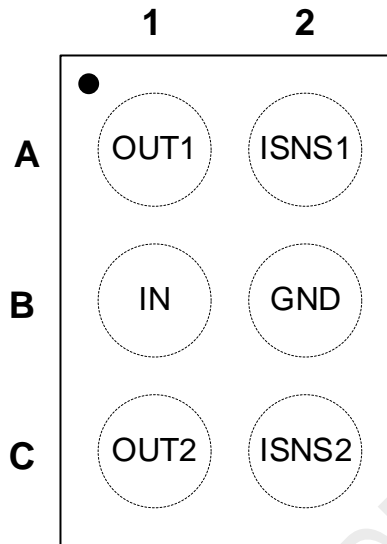


Figure 2. YHM2511 WLP-6 Pin Assignment (Top Through View)

YHM2511 WLP Pin Descriptions

WLP	Name	Description
A1	OUT1	Output 1. Internal pull down to GND when switch off.
B1	IN	Input and Power Supply. Bypass this input with 1 μ F or greater ceramic capacitor to ground.
C1	OUT2	Output 2. Internal pull down to GND when switch off.
A2	ISNS1	Enable and current regulation setting for output 1. <ul style="list-style-type: none"> • Connect external 0.1% resistor to set current regulation threshold. • Pull high to disable the switch 1. • Pull to GND to disable current regulation.
B2	GND	Ground.
C2	ISNS2	Enable and current regulation setting for output 2. <ul style="list-style-type: none"> • Connect external 0.1% resistor to set current regulation threshold. • Pull high to disable the switch 2. • pull to GND to disable current regulation.

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1 Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Disclaimer: YHMICROS reserves the right to make any change in circuit design, specification or other related things if needed without notice at any time.

Symbol	Parameters		Min.	Max.	Unit
V_{IN}	IN to GND		-0.3	6	V
V_{OUT}	OUT1/2 to GND		-0.3	6	V
V_{ISNS}	ISNS1/2 to GND		-0.3	6	V
I_{OUT}	Continuous Output Current for each output			1500	mA
I_{IN}	Continuous Input Current			2500	mA
T_{STG}	Storage Junction Temperature		-65	+150	°C
T_J	Operating Junction Temperature			+150	°C
T_L	Lead Temperature (Soldering, 10 Seconds)			+260	°C
All Pins	Electrostatic Discharge Capability	Human Body Model, EIA/JESD22-A114	5		KV
		Charged Device Model, JESD22-C101	2		

2 Recommend Operation Range

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance.

Parameters	Min.	Max.	Unit
Input Voltage: V_{IN}	2.2	5.5	V
Peak Output Current: $I_{OUT1/2}$		1.2	A
Ambient Temperature Range	-40	85	°C

3 Electrical Characteristics

Condition: $V_{IN} = 5V$, $T_A = -40^{\circ}C$ to $+85^{\circ}C$. Typical values are at $T_A = +25^{\circ}C$, unless otherwise noted. (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range	V_{IN}		2.2		5.5	V
Quiescent Supply Current	I_{IN}	$T_A = 25^{\circ}C$, $I_{OUT} = 0$		24		μA
		$-40^{\circ}C \leq T_A \leq 85^{\circ}C$, $I_{OUT} = 0$			30	
Shutdown Current	I_{SHDN}	$V_{ISNS} = 1.2V$, $V_{OUT} = 0$		0.1	1.5	μA
IN UVLO Threshold	V_{UVLO}	VIN rising		1.9		V
IN UVLO Hysteresis	V_{UVLO_HYS}			100		mV
ISNS Logic High Threshold	V_{IH}		0.92			V
ISNS Logic Low Threshold	V_{IL}				0.4	V
Output Pull-Down Resistance	R_{PD}	$V_{IN} = 1.8V$, $V_{ISNS} = 1.2V$, $I_{OUT} = 0$			500	Ω
Output One Shot Pull-Down Time	t_{PD}			20		ms

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PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
On Resistance	R_{ON}	$V_{IN} = 5V, I_{OUT} = 200mA$		100		$m\Omega$
Current Regulation Accuracy	Acc	$I_{LIMIT} = 275mA, T_A = +25^\circ C$	-6		6	%
RCB Active Voltage	V_{RCB}	$V_{OUT} - V_{IN}$		20		mV
RCB Activation Time	t_{RCB}			400		μs
Short Protection Response Time(Note 2)	t_{ACT}			1		μs
Short Protection Active Time(Note 2)	t_{SHORT}			20		μs
Short Protection Recover Time(Note 2)	t_{REC}			100		ms
Thermal Shutdown	T_{SHDN}			150		$^\circ C$
Thermal Hysteresis	T_{HYS}			20		$^\circ C$
SWITCHING SPECIFICATIONS						
(C _{Load} = 0.1 μ F, R _{Load} = 10 Ω . T _a = 25 $^\circ$ C All timing is 10% to 90% for rise time and 90% to 10% for fall time).						
Turn On Delay Time	t_{DELAY}	Time from $V_{ISNS} < V_{IL}$ to $V_{OUT} = 0.1 \times V_{IN}$		500		μs
Soft Start Time (Rise Time)	t_{SS}			3		ms
Turn Off Delay Time	t_{OFF}	Time from $V_{ISNS} > V_{IH}$ to $V_{OUT} = 0.9 \times V_{IN}$		40		μs
Fall Time	t_{FALL}			10		μs

Note 1: All specifications are 100% production tested at $T_A = +25^\circ C$, unless otherwise noted. Specifications are over $T_A = -40^\circ C$ to $+85^\circ C$ are guaranteed by design.

Note 2: Guaranteed by design; not production test.

4 Description

4.1 General Introduction

The YHM2511 is a dual output, ultra-small, low R_{ON} and active low load switch. The device contains two N-channel MOSFETs that operate over an input voltage range of 2.2V to 5.5V. The total input current is 2A, and each channel supports 1A continuous current at the same time.

4.2 Switch Enable Control

When V_{IN} rise above 1.9V, the switch statuses are following below table. SW1 and SW2 are controlled independently. turns on after a delay time with soft start function. Turn off the switch would enable quick output discharge function, which means a discharge resistor is connected between OUT and GND.

Switch Name		SWn
ISNSn	$>V_{IH}$	OFF
	$<V_{IL}$	ON

Table 1. Switch Control

Note1: N=1,2. SW is switch name. ISNS is pin name.

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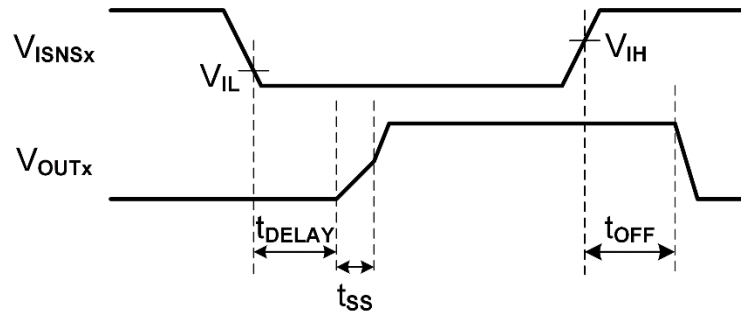


Figure 3. YHM2511 Power Up and Power Down Sequence

4.3 Over Current Protection and Current Monitor

4.3.1 Current Regulation Threshold calculation

The YHM2511 responds to over current condition by regulating output current to the I_{LIM} . Default I_{LIM} ($I_{DEFAULT}$) is adjustable by an external resistor which added to ISNS pin. When an over current condition is detected, the device maintains a constant output current and reduces the output voltage accordingly until thermal shutdown. The resistor can be calculated by:

$$R_{SNS}(\Omega) = 550800 / I_{LIM}(mA) \quad (1)$$

YHM2511 can regulate the output current from 20mA to 1A by adding proper R_{SNS} . For example, if want to regulate output current to 50mA, choose $R_{SNS} = 11.016K\Omega$. If want to regulate output current to 500mA, choose $R_{SNS} = 1.1016K\Omega$.

4.4 Soft Start (SS)

YHM2511 integrated soft start function to avoid large inrush current during switches change from OFF to ON period. During this period, the current following through each switch is regulated in low level. Soft start time is about 500us after delay time from ISNS goes low. During this time, CC function is disabled. The inrush current may be become large after this time if the output capacitor is too large. The device may trigger CC condition.

4.5 Short Protection

YHM2511 has OUT1/2 short to GND protection. If the device detects the output current larger than I_{SHORT} when switch on, YHM2511 will regulate the corresponding switch current to a small one within a very short time (t_{ACT}) (typical: 1 μ s) and turn off switch after t_{SHORT} . (Typical: 20 μ s) This function is independent of current regulation. The device will try to close switch after t_{REC} (Typical 100ms) if the other conditions do not change. The SS period is added.

4.6 Reverse Current Protection

The reverse voltage protection turns off the N-channel MOSFET whenever the output voltage exceeds the input voltage by 20mV (TYP) for 400 μ s (TYP). This prevents damage to devices on the input side of the YHM2511. The YHM2511 device allows the N-channel MOSFET to turn on once the output voltage goes below the input voltage.

4.7 Thermal shutdown

When the part is in current regulation mode, to protect the chip from over temperature, the power path will be turned off when the junction temperature exceeds 150°C. The power path switch will be turned on and enter SS status again when temperature drop below 130°C. The device power dissipation capability is dependent on-board design and layout.

5 Application information

YHM2511 is designed to operate with an input range of 2.2V to 5.5V. The power supply must be well regulated and placed as close to the device terminal as possible. The power supply must be able to withstand all transient load current steps. In most situations, using an input capacitance (C_{IN}) of 1 μ F is sufficient to prevent the supply voltage from dipping when the switch is turned on. In cases where the power supply is slow to respond to a large transient current or large

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load current step, additional bulk capacitance may be required on the input. Placing a high-value electrolytic capacitor on the output pin is recommended when large transient currents are expected on the output.

5.1 1:2 Load Switch with Fixed CC Threshold

In this application, MCU two GPIOs connect to ISNSx^{Note1} pins with R_{SNSx} in series.

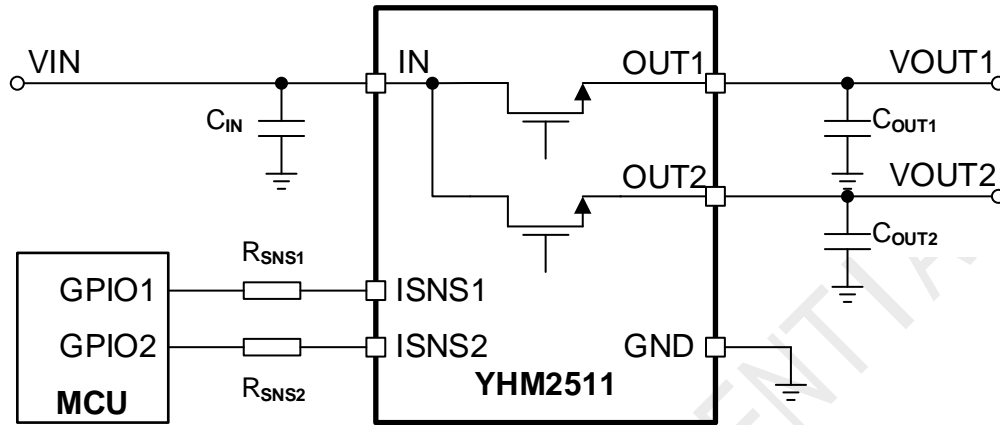


Figure 4. Typical Application 1: 1:2 Load Switch with Fixed CC Threshold

MCU pull down GPIO to GND to close SW1 or SW2 independently. Current regulation thresholds for each switch are set by R_{SNSx}^{Note1}. The threshold can be different for each channel. If the application does not need CC function, R_{SNSx}^{Note1} should be removed. MCU pull GPIO voltage higher than V_{IH} to open switches.

Note1: X=1, 2.

6 Parameter Measurement Information

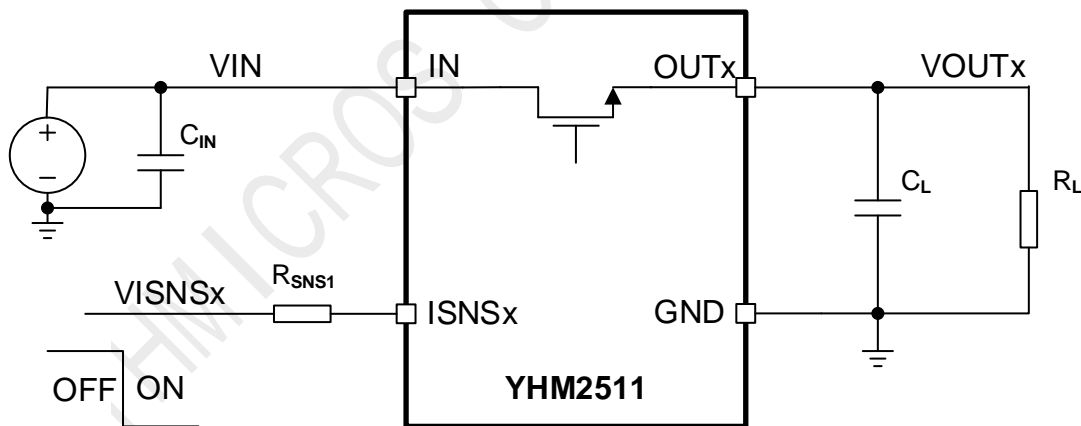
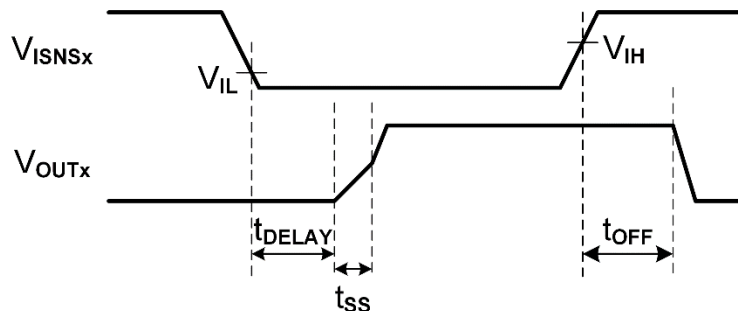


Figure 5. Test Circuit for Power Sequence



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7 Typical Operating Characteristics

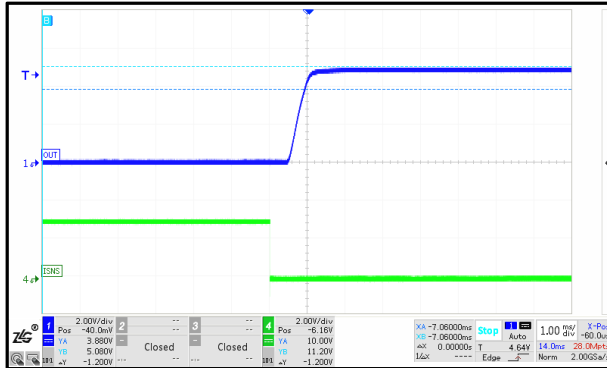


Figure 6 Switch Turn-on

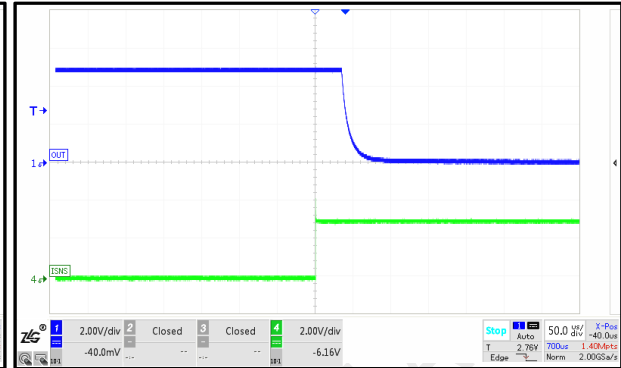


Figure 7 Switch Turn-off



Figure 8 Single Channel RCB

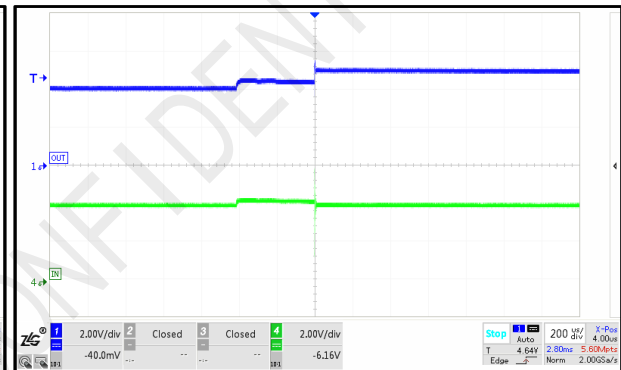


Figure 9 Dual Channel (Short together) RCB

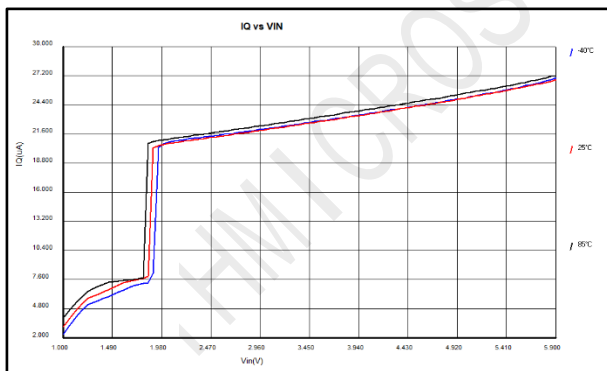


Figure 10 Quiescent Current

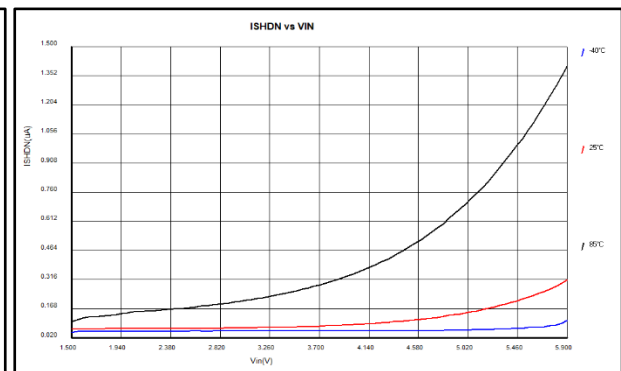


Figure 11 Shut Down Current

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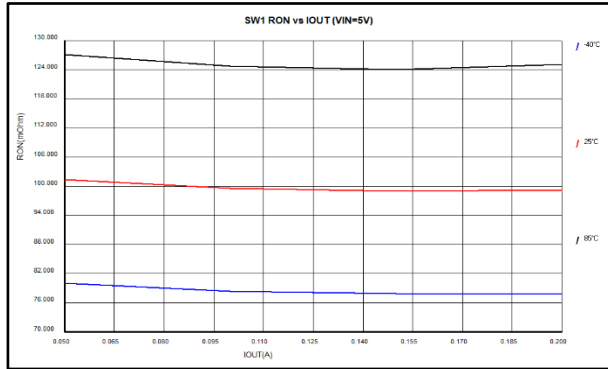


Figure 12 Switch 1 Rdson(VIN=5V)

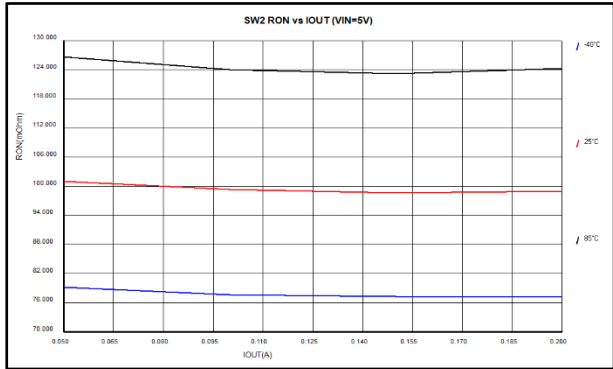


Figure 13 Switch 2 Rdson(VIN=5V)

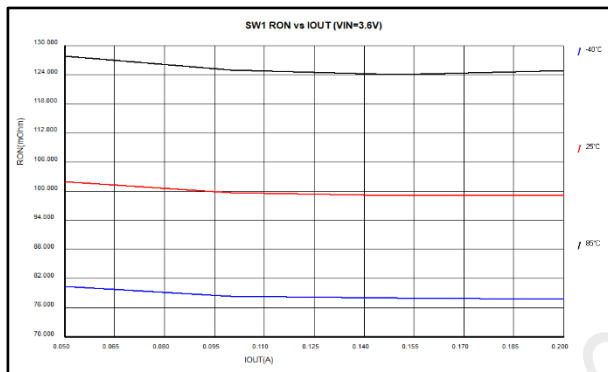


Figure 14 Switch 1 Rdson(VIN=3.6V)

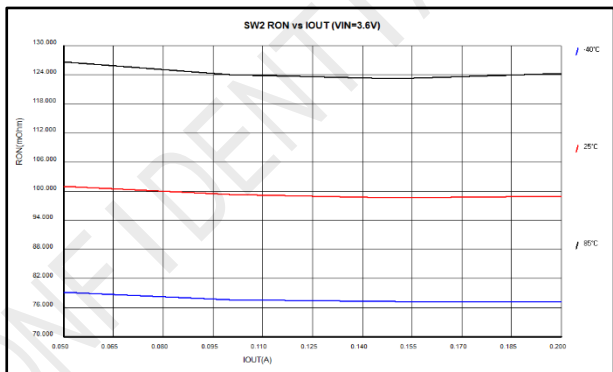


Figure 15 Switch 2 Rdson(VIN=3.6V)

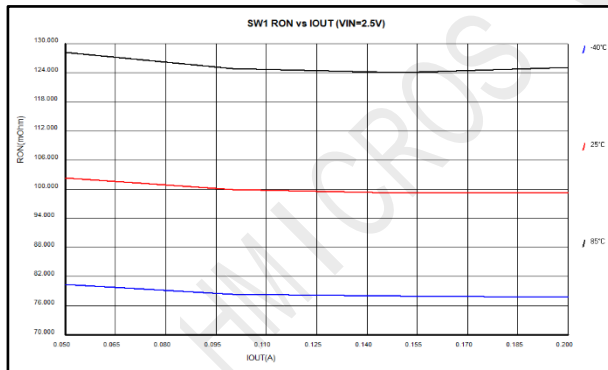


Figure 16 Switch 1 Rdson(VIN=2.5V)

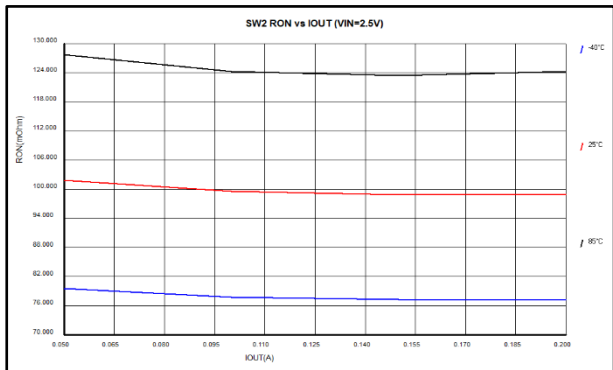


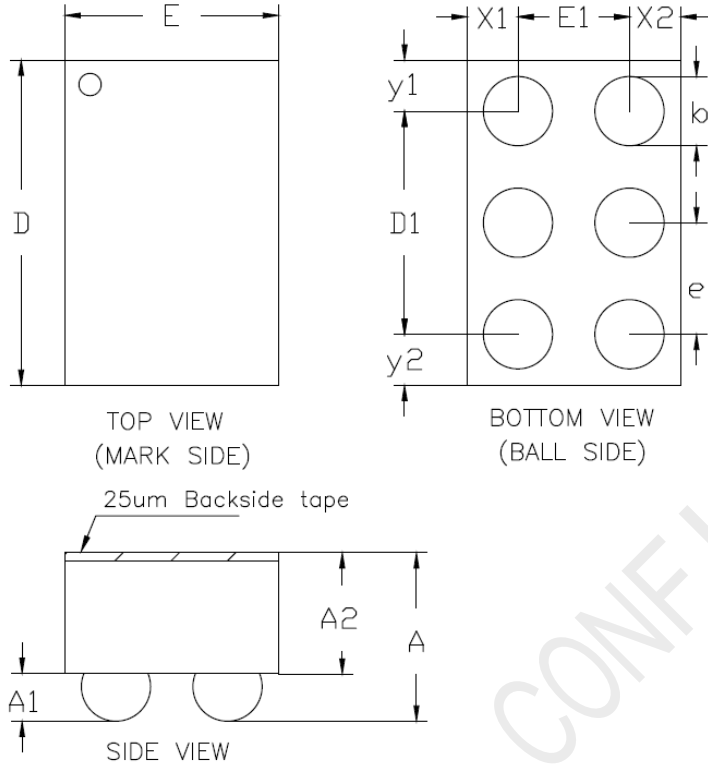
Figure 17 Switch 2 Rdson(VIN=2.5V)

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8 Package Dimensions

WLCSP-6 0.67mmx1.02mm



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	0.483	0.528	0.573
A1	0.130	0.150	0.170
A2	0.353	0.378	0.403
D	1.000	1.020	1.040
D1		0.700BSC	
E	0.650	0.670	0.690
E1		0.350BSC	
b	0.200	0.220	0.240
e		0.350BSC	
x1		0.160 REF	
x2		0.160 REF	
y1		0.160 REF	
y2		0.160 REF	

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9 Order Information

Part Number	Package	Top Mark (Note 1)	MOQ
YHM2511W6T	6 WLCSP	xxxx	3000

Note 1: The x letters are Lot id and production date information.

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Datasheet Change History

Rev	Date	Changes
1.0	Aug/2023	Initial Version

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