

# 1CH ADJ Current-Limited Power Distribution Switch

## Features

- Single-Channel Power Distribution Switch
- Programmable Current Limit in 0.4A~2A Output Current
- Enable polarity: Active High
- 2.4V to 5.5V Supply Range
- Under-Voltage Lockout
- -40°C to +85°C Ambient Temperature Range
- Accurate Current Limit
- 15 $\mu$ A Quiescent Current
- 80m $\Omega$  MOSFET
- Thermal-Shutdown Protection
- Built-In Soft Start
- Available in SOT23-5 Package

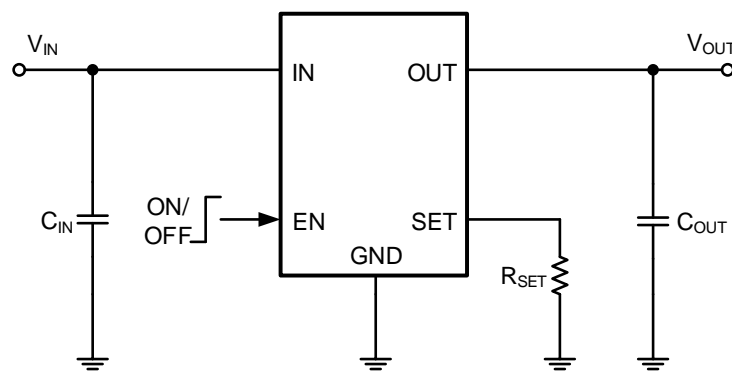
## Applications

- Set-Top Boxes
- Wi-Fi Router/AP
- USB 3G Datarcard/ USB Dongle
- High-Definition Digital TVs
- ONT Boxes
- USB Ports and Hubs, Laptops, and Desktops
- Smartphone and PDA
- MiniPCI Accessories

## General Description

The RY2121 Power Distribution Switch features internal current limiting to prevent damage to host devices due to faulty load conditions. The RY2121 develops ultra-low on-resistance switch with programmable current limiting to protect the power source from over current and short circuit conditions. It integrates the over temperature protection and discharges the output capacitor during the shutdown. The RY2121 is available in SOT23-5 package.

## Typical Application Circuit

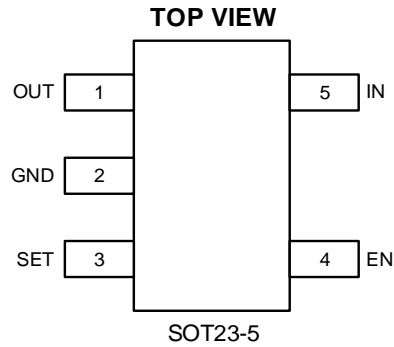


Basic Application Circuit

# 1CH ADJ Current-Limited Power Distribution Switch

## Pin Description

## Pin Configuration



Top Marking: MEYLL (device code: ME, Y=year code, LL= lot number code)

## Pin Description

Pin	Name	Function
1	OUT	Output Pin.
2	GND	Ground Pin.
3	SET	Current limit programming Pin. Connect a resistor $R_{SET}$ from this pin to GND to program the current limit.
4	EN	ON/OFF control. Pull High to enable IC, do not float.
5	IN	Power Supply Pin

## Order Information <sup>(1)</sup>

Marking	Part No.	Model	Description	Package	T/R Qty
ME <u>YLL</u>	70702013	RY2121	RY2121 1CH Current Limited IC, $V_{IN}$ 2.4V-5.5V, $I_{LIM}$ ADJ, Active High, SOT23-5	SOT23-5	3000PCS

Note (1): All RYCHIP parts are Pb-Free and adhere to the RoHS directive.

# 1CH ADJ Current-Limited Power Distribution Switch

## Specifications

### Absolute Maximum Ratings <sup>(1)</sup> <sup>(2)</sup>

Item	Min	Max	Unit
All pins voltage	-0.3	6	V
Power dissipation <sup>(3)</sup>	Internally Limited		
Operating junction temperature, T <sub>J</sub>	-40	150	°C
Storage temperature, T <sub>stg</sub>	-55	150	°C
Lead Temperature (Soldering, 10sec.)		260	°C

Note (1): Exceeding these ratings may damage the device.

Note (2): The device is not guaranteed to function outside of its operating conditions.

Note (3): The maximum allowable power dissipation is a function of the maximum junction temperature, T<sub>J(MAX)</sub>, the junction-to-ambient thermal resistance, R<sub>θJA</sub>, and the ambient temperature, T<sub>A</sub>. The maximum allowable power dissipation at any ambient temperature is calculated using:  $P_{D(MAX)} = (T_{J(MAX)} - T_A) / R_{\theta JA}$ . Exceeding the maximum allowable power dissipation causes excessive die temperature, and the regulator goes into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage. Thermal shutdown engages at T<sub>J</sub>=150°C (typical) and disengages at T<sub>J</sub>= 130°C (typical).

### ESD Ratings

Item	Description	Value	Unit
V <sub>(ESD-HBM)</sub>	Human Body Model (HBM) ANSI/ESDA/JEDEC JS-001-2014 Classification, Class: 2	±2000	V
V <sub>(ESD-CDM)</sub>	Charged Device Mode (CDM) ANSI/ESDA/JEDEC JS-002-2014 Classification, Class: C0b	±200	V
I <sub>LATCH-UP</sub>	JEDEC STANDARD NO.78E APRIL 2016 Temperature Classification, Class: I	±150	mA

### Recommended Operating Conditions

Item	Min	Max	Unit
Operating junction temperature <sup>(1)</sup>	-40	125	°C
Operating temperature range	-40	85	°C
Input voltage V <sub>IN</sub>	2.4	5.5	V

Note (1): All limits specified at room temperature (T<sub>A</sub> = 25°C) unless otherwise specified. All room temperature limits are 100% production tested. All limits at temperature extremes are ensured through correlation using standard Statistical Quality Control (SQC) methods. All limits are used to calculate Average Outgoing Quality Level (AOQL).

# 1CH ADJ Current-Limited Power Distribution Switch

## Thermal Information

Item	Description	Value	Unit
R <sub>θJA</sub>	Junction-to-ambient thermal resistance <sup>(1)(2)</sup>	180	°C/W
R <sub>θJC(top)</sub>	Junction-to-case (top) thermal resistance	130	°C/W
R <sub>θJB</sub>	Junction-to-board thermal resistance	45	°C/W
ψ <sub>JT</sub>	Junction-to-top characterization parameter	35	°C/W
ψ <sub>JB</sub>	Junction-to-board characterization parameter	45	°C/W

Note (1): The package thermal impedance is calculated in accordance to JESD 51-7.

Note (2): Thermal Resistances were simulated on a 4-layer, JEDEC board.

## Electrical Characteristics <sup>(1)</sup>

(V<sub>IN</sub> = 5V, C<sub>L</sub>=1μF, per channel, T<sub>A</sub> = 25°C unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ.	Max	Unit
Input Voltage Range	V <sub>IN</sub>		2.4		5.5	V
Shutdown Input Current	I <sub>SHDN</sub>	Open load, IC Disabled		0.6	1	μA
Quiescent Supply Current	I <sub>Q</sub>	Open load, IC Enabled		20		μA
FET RON	R <sub>DS(ON)1</sub>			80		mΩ
ENB Rising Threshold	V <sub>ENB(H)</sub>		1.2			V
ENB Falling Threshold	V <sub>ENB(L)</sub>				0.8	V
ENB Leakage	I <sub>ENB</sub>	V <sub>ENB</sub> =5.5V			1	μA
IN UVLO Threshold	V <sub>IN,UVLO</sub>				2.3	V
IN UVLO Hysteresis	V <sub>IN,HYS</sub>			0.1		V
Current Limit	I <sub>LIM</sub>	RSET=10 kΩ	0.75	1	1.25	A
	I <sub>LIM(MIN)</sub>			0.4		A
	I <sub>LIM(MAX)</sub>			2		A
Trip Current	I <sub>Trip</sub>			1.25		A
Turn-ON Time <sup>(2)</sup>	T <sub>ON</sub>	R <sub>L</sub> =10Ω, C <sub>L</sub> =1uF		120		μS
Turn-OFF Time <sup>(2)</sup>	T <sub>OFF</sub>	R <sub>L</sub> =10Ω, C <sub>L</sub> =1uF		10		μS
OUT Shutdown Discharge Resistance	R <sub>DIS</sub>			150		Ω
Thermal Shutdown Temperature	T <sub>SD</sub>			130		°C
Thermal Shutdown Hysteresis	T <sub>HYS</sub>			20		°C

Note (1): The device is not guaranteed to function outside its operating conditions.

Note (2): Measured from (50%) EN signal to (90%) output signal.

# 1CH ADJ Current-Limited Power Distribution Switch

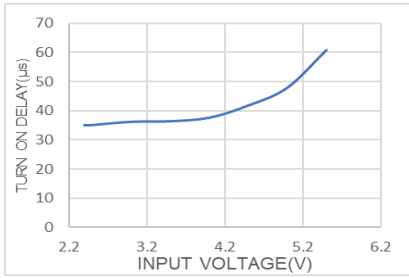
## Typical Performance Characteristics (1) (2)

Note (1): Performance waveforms are tested on the evaluation board.

Note (2):  $V_{IN}=5V$ ,  $C_{OUT}=1\mu F$ ,  $T_A = +25^\circ C$ , unless otherwise noted.

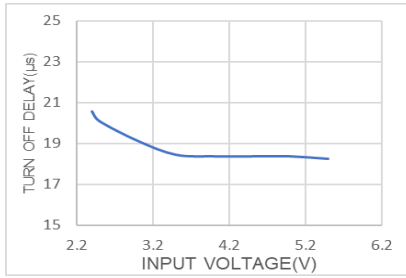
Turn on Delay vs. Input Voltage

$V_{EN}=5V$ ,  $R_{LOAD}=5.5\Omega$



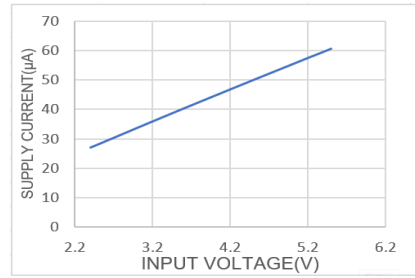
Turn off Delay vs. Input Voltage

$V_{EN}=5V$ ,  $R_{LOAD}=5.5\Omega$



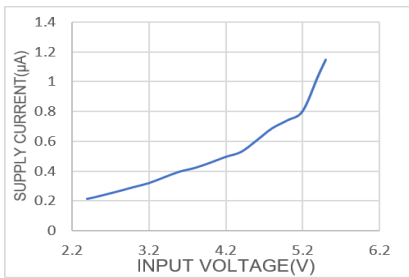
Supply Current, Output Enabled vs. Input Voltage

$V_{EN} = 5V$



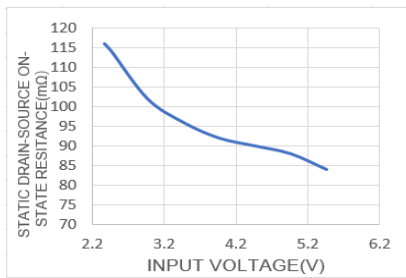
Supply Current, Output Disabled vs. Input Voltage

$V_{EN} = 0V$



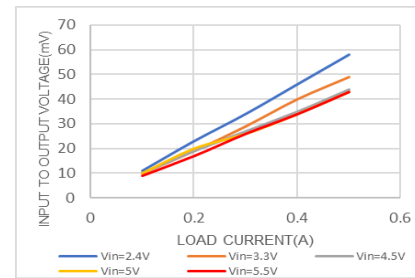
Static Drain-Source On-State Resistance vs. Input Voltage

$V_{EN} = 5V$ ,  $I_{LOAD}=0.5A$

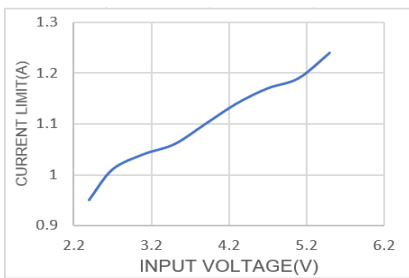


Input to Output Voltage vs. Load Current

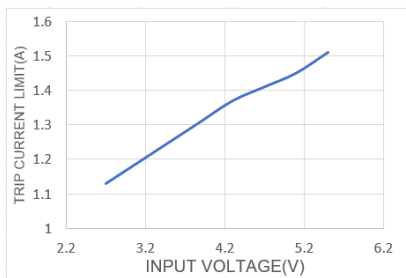
$V_{EN} = 5V$



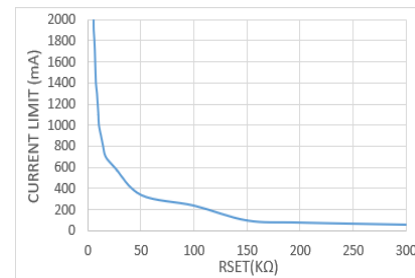
Current Limit vs. Input Voltage



Threshold Trip Current vs. Input Voltage



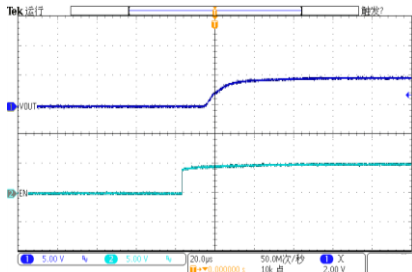
Current Limit vs. RSET



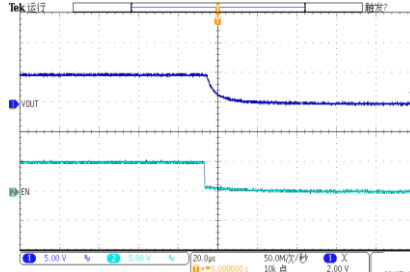
# 1CH ADJ Current-Limited Power Distribution Switch

Turn on Delay Rise Time

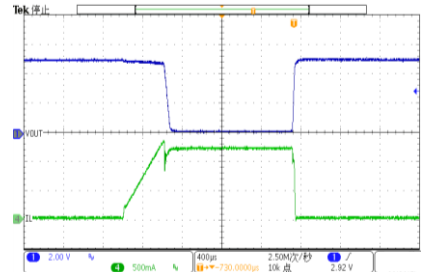
$V_{EN} = 5V$ ,  $R_{LOAD} = 5\Omega$



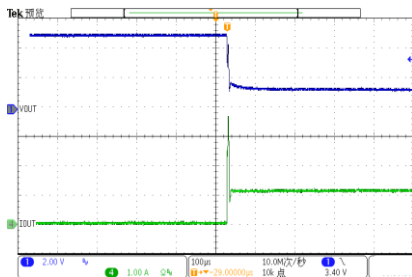
Turn off Delay Fall Time



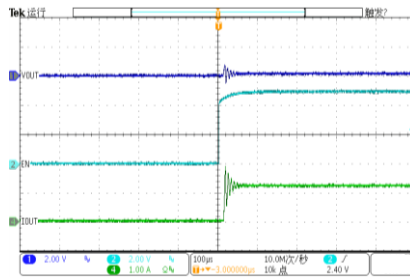
Threshold Trip Current with Ramped Load Enabled Device



1Ω Load Connected to Enabled Device

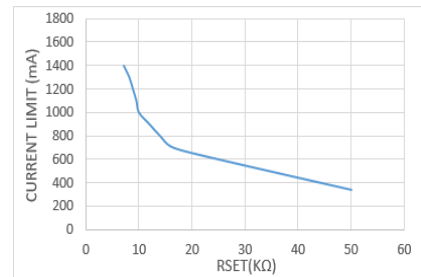


Short Circuit Current, Device Enabled into Short



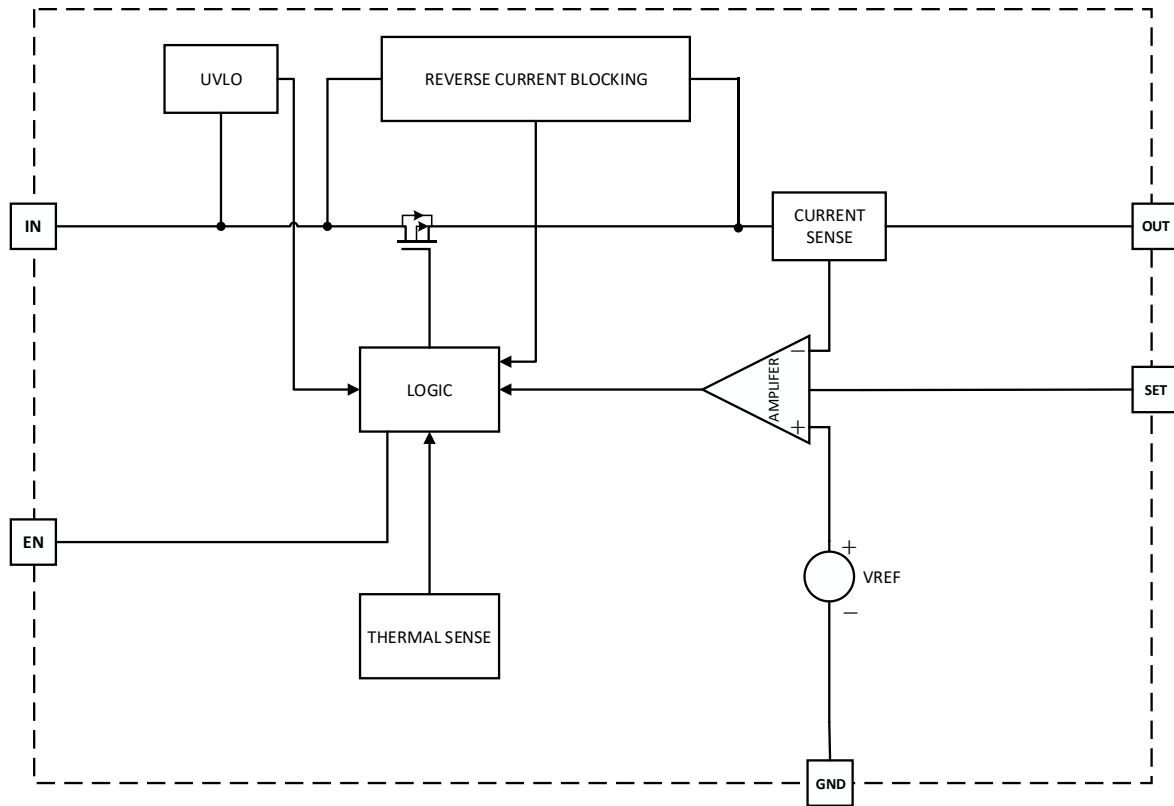
Current Limit vs. R<sub>SET</sub>

$I_{LIM} = 0.4 \sim 1.5A$



# 1CH ADJ Current-Limited Power Distribution Switch

## Functional Block Diagram



Block Diagram

## Functions Description

### Current Limit

The RY2121 provides a constant current limit that can be programmed by an external resistor. Once the device reaches its current limit threshold, the internal circuit regulates the gate voltage to hold the current in the power MOSFET constant. Below table can be taken as a reference to choose  $R_{SET}$  to set the current limit threshold. Following table are all tested with 5V input as the test condition

$R_{SET}$ (k $\Omega$ )	Typical Current Limit (mA)
4.99	2000
5.1	1900
5.76	1800
6.49	1600
8.87	1200
9.53	1100
10	1000
12	900
30	600
50	350
100	250

# 1CH ADJ Current-Limited Power Distribution Switch

## Over Current

When the load exceeds trip current (minimum threshold current triggering constant-current mode) or short circuited, RY2121 switches into to constant-current mode (current limit value). RY2121 will be shut down only if the overcurrent condition stays long enough to trigger thermal protection.

Trigger overcurrent protection for different overload conditions occurring in applications:

- 1) The output has been shorted or overloaded before the device is enabled or input applied. RY2121 detects the short or overload and immediately switches into a constant-current mode.
- 2) A short or an overload occurs after the device is enabled. The device switches into constant current mode after the current-limit circuit has been tripped (reached the trip current threshold). However, high current may flow for a short period of time before the current-limit circuit can react.
- 3) Output current has been gradually increased beyond the recommended operating current. The load current rises until the trip current threshold is reached or until the thermal limit of the device is exceeded. Once the trip threshold has been reached, the device switches into its constant-current mode.

## Thermal Protection

If the current limit block starts to regulate the output current, the power loss on power MOSFET will cause the IC temperature rise. The die temperature is internally monitored until the thermal limit is reached. Once this temperature is reached, the switch will turn off to allow the chip to cool until the over temperature fault remove. The over temperature threshold is 130°C and hysteresis is 20°C.

## Under-voltage Lockout (UVLO)

This circuit is used to monitor the input voltage to ensure that the RY2121 is operating correctly. This UVLO circuit also ensures that there is no operation until the input voltage reaches the minimum spec.

## Output Discharge

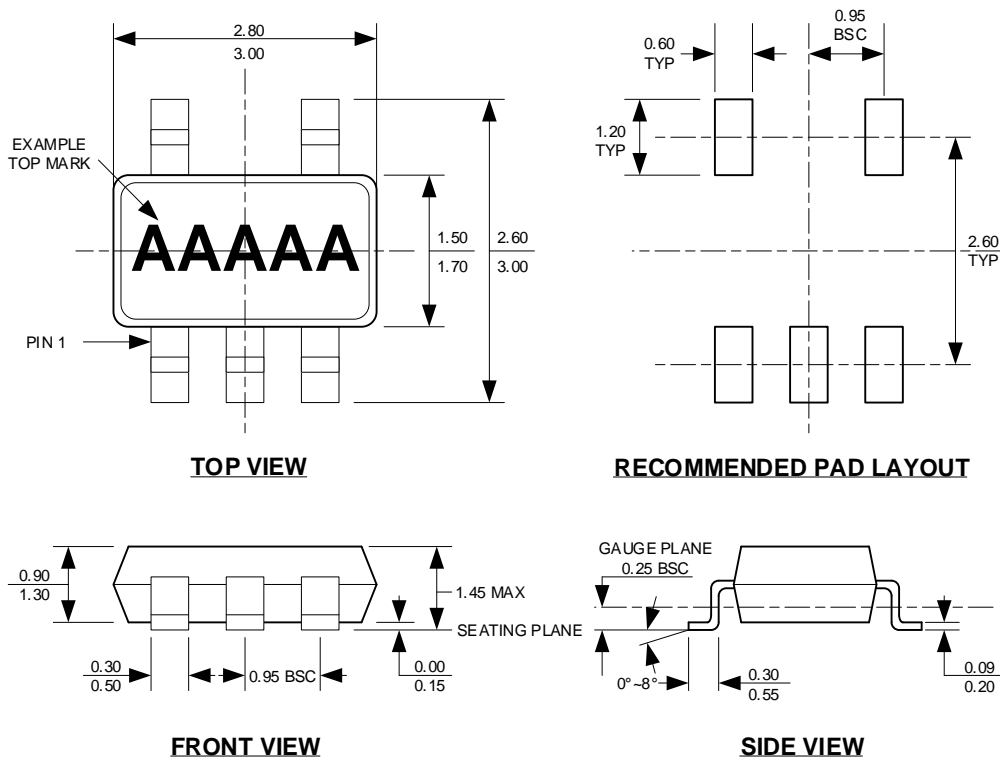
RY2121 has output discharge function. It can discharge the output capacitor by internal pulldown resistance during shutdown.



# 1CH ADJ Current-Limited Power Distribution Switch

## Package Description

### SOT23-5



- NOTE:**
1. CONTROL DIMENSION IS IN INCHES. DIMENSION IN BRACKET IS IN MILLIMETERS.
  2. PACKAGE LENGTH DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
  3. PACKAGE WIDTH DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSIONS.
  4. LEAD COPLANARITY (BOTTOM OF LEADS AFTER FORMING) SHALL BE 0.004" INCHES MAX.
  5. DRAWING CONFORMS TO JEDEC MS-012, VARIATION BA.
  6. DRAWING IS NOT TO SCALE.