

FEATURES

- 3.0V to 5.5V Operating Range
- 1.0A Continuous Current
- 2.2A Accurate Current limiting
- 1.6A Short Circuit Current
- 80uA Typical On-State Supply Current
- 1uA Maximum Standby Supply Current
- Independent open-drain fault flag pins
- Thermal Shutdown Protection
- Under Voltage Lockout(UVLO)
- TJ2110H : Active High version
- TJ2110L : Active Low version
- UL Recognized. UL File No. E347996

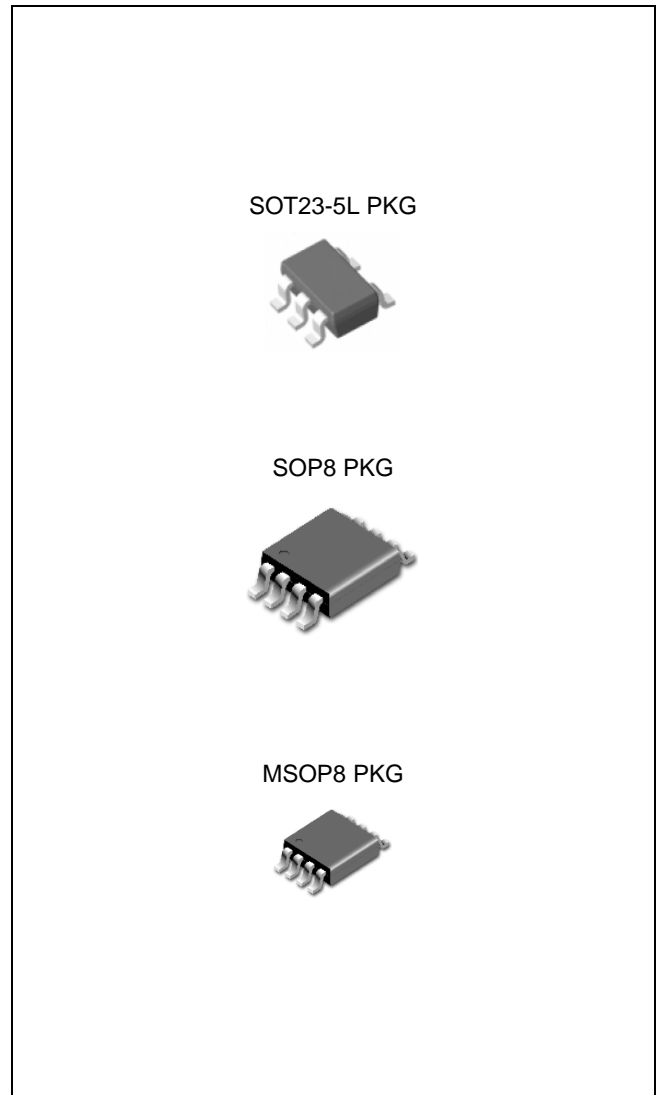
APPLICATION

- USB Peripherals
- General Purpose Power Switching
- ACPI Power Distribution
- Notebook PCs
- PDAs
- Hot Plug-in Power Supplies

DESCRIPTION

The TJ2110X is single-channel High-Side MOSFET switch optimized for general-purpose power distribution requiring circuit protection. The TJ2110 series support the following USB requirements. The TJ2110 series supply up to 1.0A as required by USB downstream devices. Switch's low on-resistance meets USB voltage drop requirement. Fault current is limited to typically 2.2A. Flag output indicate fault condition to the local USB controller. Soft-start prevents the transient voltage drop on the upstream port that can occur when the switch is enabled in bus-powered applications. Under voltage lockout (UVLO) feature disables the output switches until a valid input voltage. Also the TJ2110 include thermal shutdown to

prevent switch failure from high-current loads.



ORDERING INFORMATION

Device	Package
TJ2110HGSF5	SOT23-5L
TJ2110LGSF5	
TJ2110HGD	SOP8
TJ2110LGD	
TJ2110HGMD	MSOP8
TJ2110LGMD	

Absolute Maximum Ratings (Note 1)

Characteristic	Symbol	Min	Max	Unit
Supply Voltage	V_{IN}	-0.3	6.0	V
Enable Input Voltage (Note 2)	V_{EN}	-0.3	6.0	V
Fault Flag Voltage	V_{FLG}	-	6.0	V
Fault Flag Current	I_{FLAG}	-	25	mA
Output Voltage	V_{OUT}		6.0	V
Output Current	I_{OUT}		Internally Limited	
Storage Temperature Range	T_{STG}	-65	150	°C

Operating Ratings (Note 3)(Note 4)

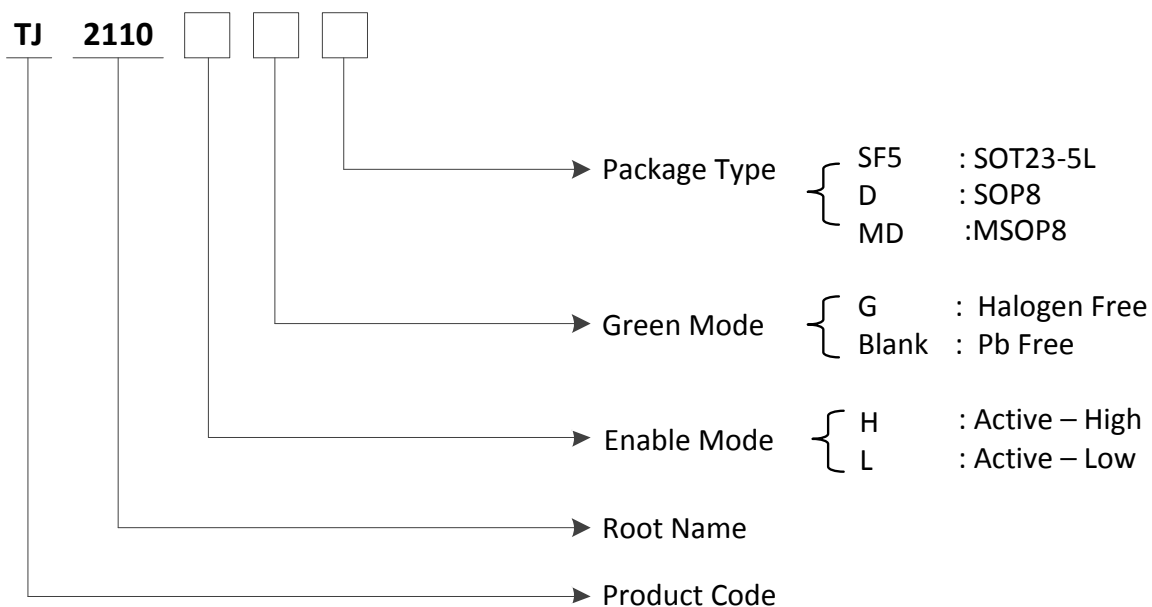
Characteristic	Symbol	Min	Max	Unit
Supply Voltage	V_{IN}	3.0	5.5	V
Ambient Temperature Range	T_A	-40	+85	°C
Operating Junction Temperature Range	T_J	-40	125	°C
Thermal Resistance Junction-to-Ambient	SOP8 (Note 5)	θ_{JA}	125	°C/W
	MSOP8(Note 6)		166	
	SOT-23-5L (Note 7)		250	
Thermal Resistance Junction-to-Case	SOP8 (Note 5)	θ_{JC}	33	°C/W
	MSOP8(Note 6)		44	
	SOT-23-5L (Note 7)		130	

Note:

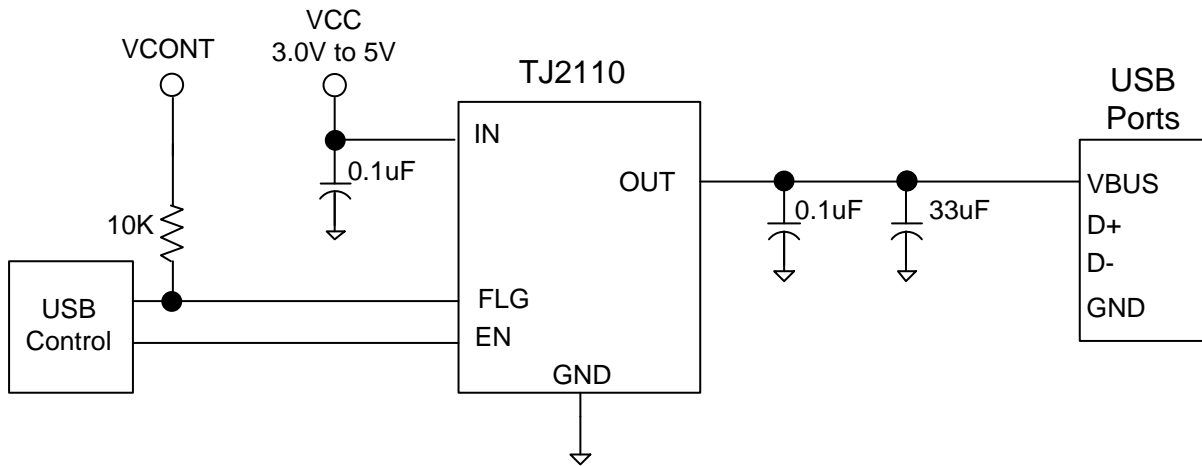
1. Exceeding the absolute maximum ratings may damage the device.
2. It is recommended for V_{EN} voltage not to exceed V_{IN} voltage.
3. The device is not guaranteed to function outside its operating rating.
4. Devices are ESD sensitive. Handling precautions are recommended.
5. Test Condition for SOP8 : Copper Area = 150mm², Board Size = 500 mm X 650mm, 1.6T
6. Test Condition for MSOP8 : Copper Area = 150mm², Board Size = 500 mm X 650mm, 1.6T
7. Test Condition for SOT-23-5L : Copper Area = 35mm², Board Size = 430 mm X 430mm, 1.6T

Ordering Information

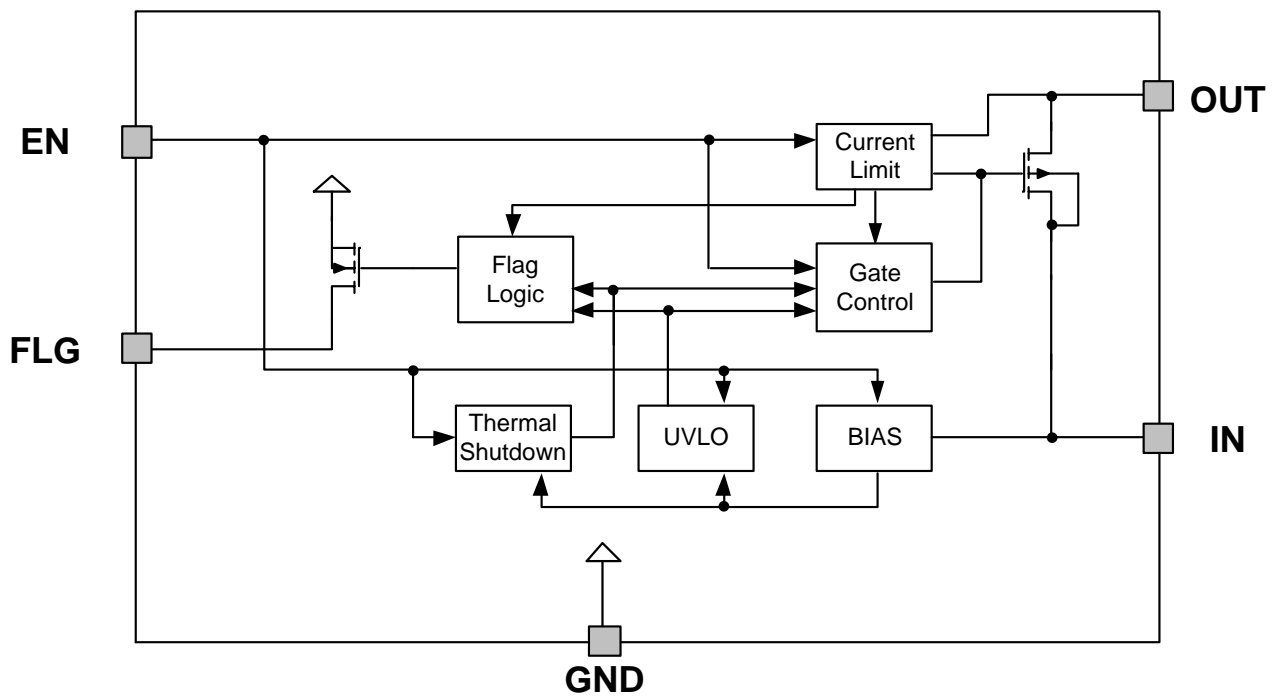
Package	Oder No.	Description	Marking	Compliance	Status
SOT23-5L	TJ2110LGSF5	1A, Active Low	2110LG	RoHS, Green	Contact Us
SOP8	TJ2110LGD	1A, Active Low	TJ2110LG	RoHS, Green	Contact Us
MSOP8	TJ2110LGMD	1A, Active Low	TJ2110LG	RoHS, Green	Contact Us
SOT23-5L	TJ2110HG5F5	1A, Active High	2110HG	RoHS, Green	Contact Us
SOP8	TJ2110HGD	1A, Active High	TJ2110HG	RoHS, Green	Contact Us
MSOP8	TJ2110HGMD	1A, Active High	TJ2110HG	RoHS, Green	Contact Us



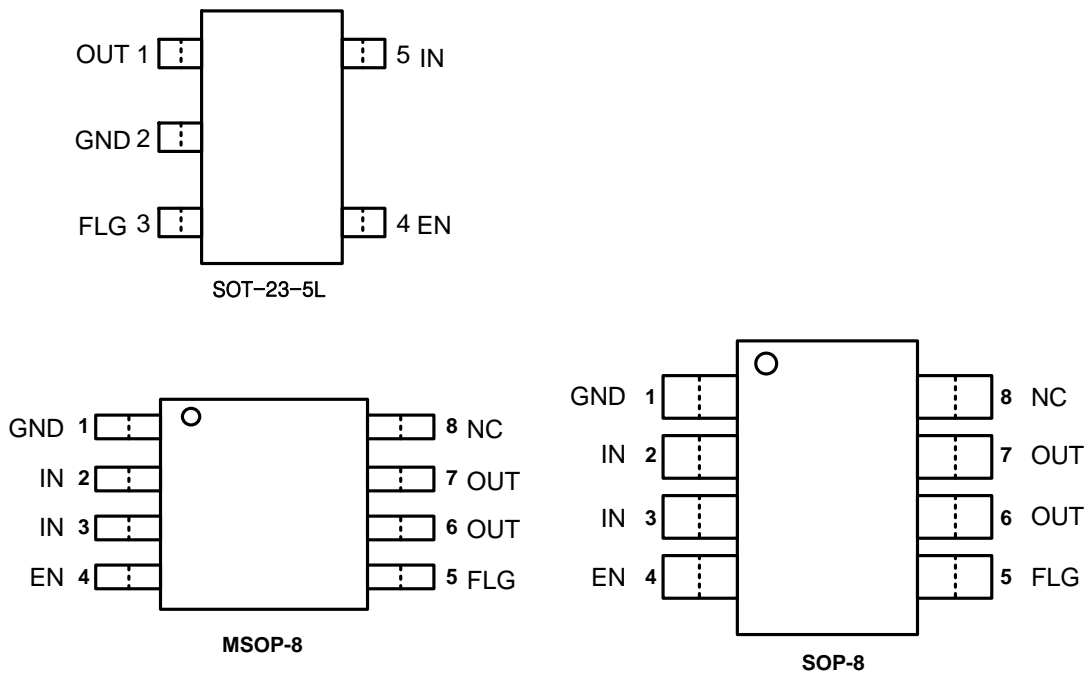
TYPICAL APPLICATION CIRCUIT



FUNCTION BLOCK DIAGRAM



PIN CONFIGURATION



PIN DESCRIPTION

Pin Name	Pin No.		Pin Description & Function
	SOP-8/MSOP-8	SOT23-5L	
GND	1	2	Ground
IN	2, 3	5	Supply Input: Output MOSFET drain. Also supplies IC's internal circuitry. Connect to positive supply.
EN	4	4	Enable: Logic-Compatible enable input. (H: active high, L: active low). Do not float.
FLG	5	3	Fault Flag: Active-low, open-drain output. Indicates over current, UVLO and Thermal shutdown.
OUT	6,7	1	Switch Output: Output MOSFET source. Typically connect to switched side of load.
NC	8	N/A	No internal connection; recommend tie to OUT pins

Single-Channel Power Distribution Switch

TJ2110

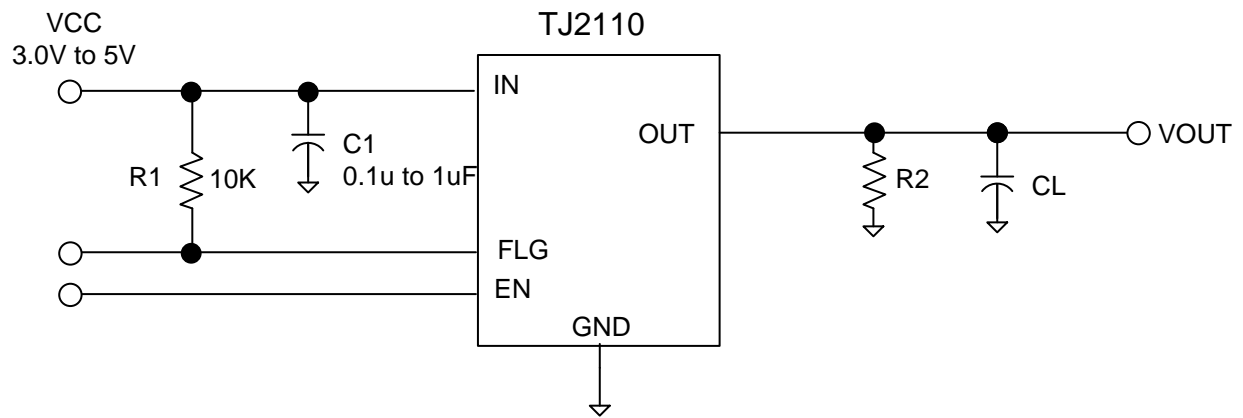
ELECTRICAL CHARACTERISTICS (Under the conditions of $V_{IN}=+5V$ and $T_A=25^{\circ}C$)

PARAMETER	Symbol	CONDITIONS	MIN	TYP	MAX	UNITS
Operating Voltage Range	V_{IN}		3.0		5.5	V
Supply Current	I_{CC}	Enable off ,OUT=Open		0.05	1	μA
		Enable on, OUT=Open		80	150	μA
Enable Input Threshold Voltage	V_{EN}	(Note 8)	0.8		2.0	V
Enable Input Current	I_{EN}	$V_{EN} = 0V$ to $5.5V$	-1	0.01	1	μA
Enable Input Capacitance	C_{EN}			1		pF
Switch Resistance	$R_{DS(ON)}$	$V_{IN}=5V, I_{OUT}=1.0A$		120	140	m Ω
		$V_{IN}=3.3V, I_{OUT}=1.0A$		140	160	m Ω
Output Turn-On Delay	T_{DON}	$R_L=5\Omega$ each output, $C_L=1\mu F$		70		μs
Output Turn-On Rise Time	T_R	$R_L=5\Omega$ each output, $C_L=1\mu F$		60		μs
Output Turn-Off Delay	T_{DOFF}	$R_L=5\Omega$ each output, $C_L=1\mu F$		5		μs
Output Turn-On Fall Time	T_F	$R_L=5\Omega$ each output, $C_L=1\mu F$		10		μs
Output leakage Current	I_{LEAK}	$V_{ENX} \leq 0.8V$		0.01	5	μA
Current Limit Threshold	I_{LIM}	Ramped load applied to output	1.7	2.2	2.7	A
Short Circuit Current Limit	I_{OS}	each output, $V_{OUT}=0V$	1.2	1.6	2.0	A
Over-Temperature Shutdown Threshold	T_{TS}	Temperature increasing switch		145		$^{\circ}C$
		Temperature decreasing switch		135		$^{\circ}C$
Error Flag Output Resistance	R_{FO}	$V_{IN}=5V, I_L=10mA$		10	25	Ω
		$V_{IN}=3.3V, I_L=10mA$		15	40	Ω
Error Flag Off Current	I_{FOH}	$V_{FLAG}=5V$		0.01	10	μA
UVLO Threshold	UVLO	$V_{IN} =$ increasing	2.1	2.25	2.6	V
		$V_{IN} =$ decreasing	1.9	2.05	2.45	V
Overcurrent Flag Response Delay	T_{DFOV}	$V_{IN}=5V$, apply $V_{OUT}=0V$ until FLG low	4	10	15	ms

Note:

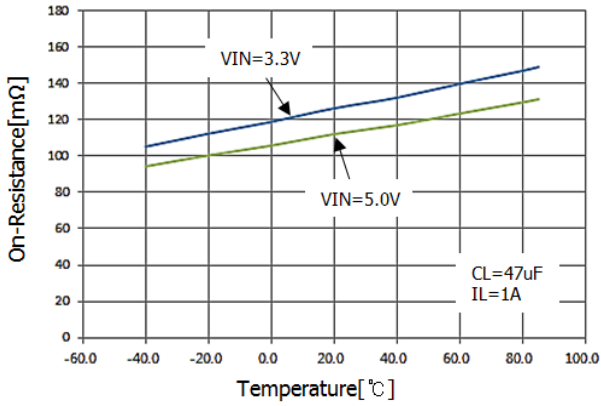
8. OFF is $V_{EN} \leq 0.8V$ and ON is $V_{EN} \geq 2.0V$ for the TJ2110H. OFF is $V_{EN} \geq 2.0V$ and ON is $V_{EN} \leq 0.8V$ for the TJ2110L.

Test Circuit

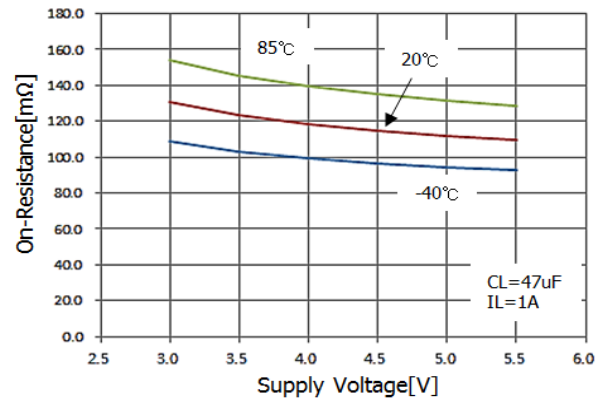


TYPICAL PERFORMANCE CHARACTERISTICS

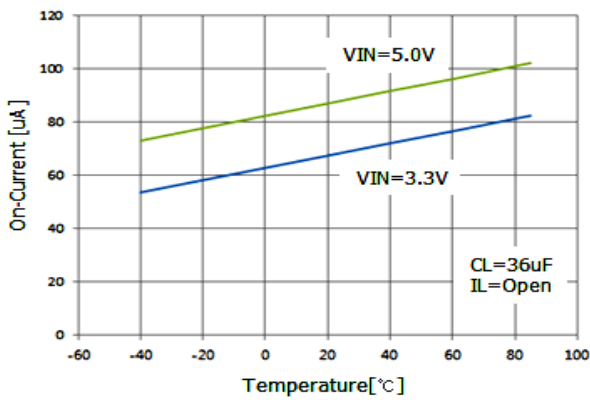
ON-Resistance vs. Temperature



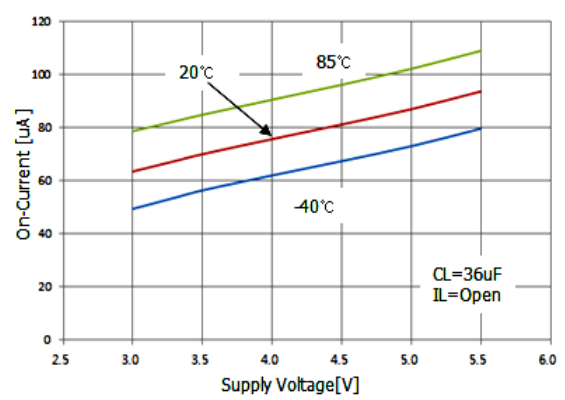
ON-Resistance vs. Supply Voltage



On-Current vs. Temperature

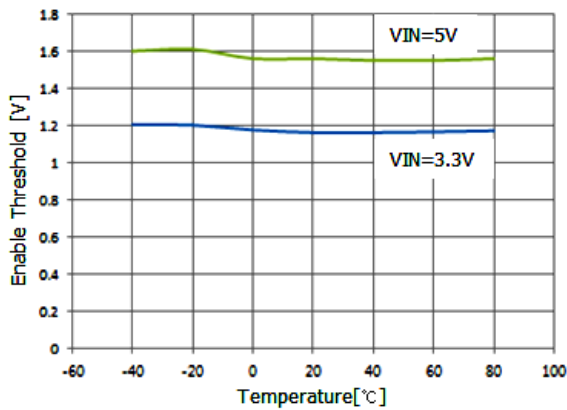


On-Current vs. Supply Voltage



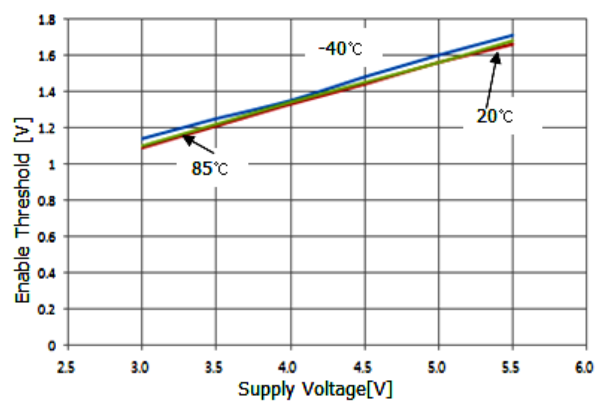
Enable Threshold vs. Temperature

(TJ2110L)



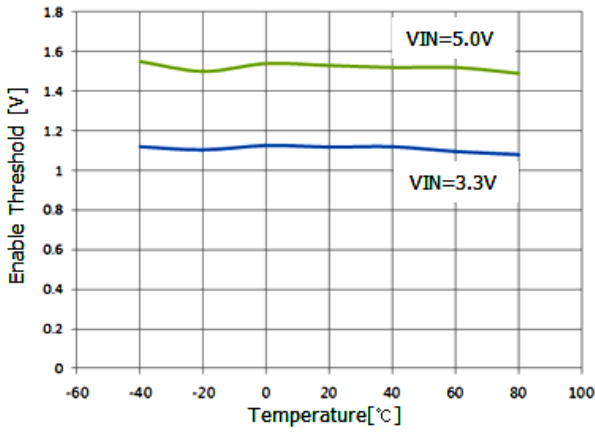
Enable Threshold vs. supply Voltage

(TJ2110L)

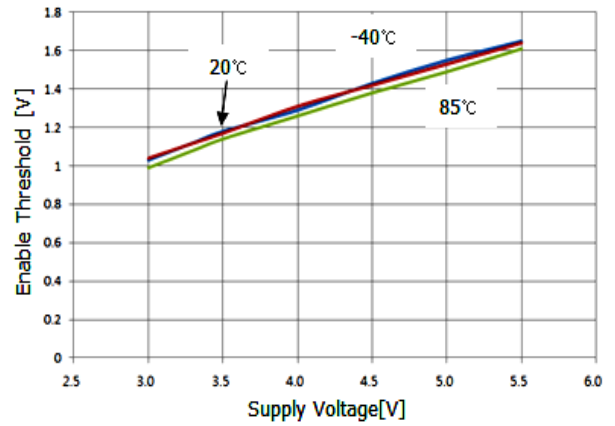


TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

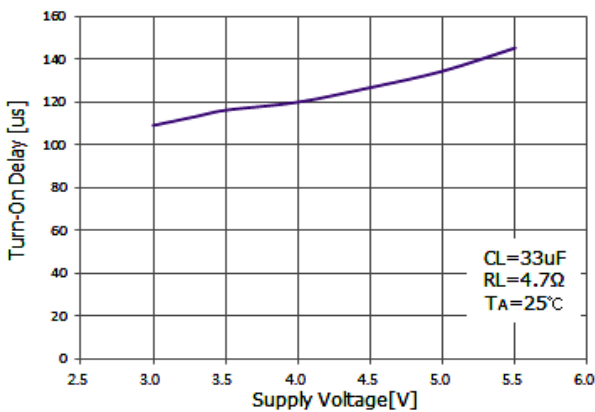
Disable Threshold vs. Temperature
(TJ2110L)



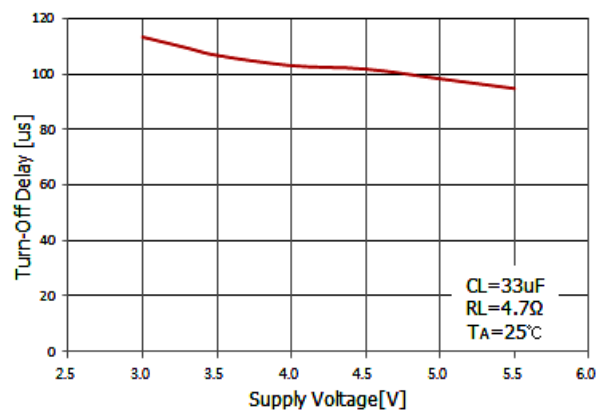
Disable Threshold vs. supply Voltage
(TJ2110L)



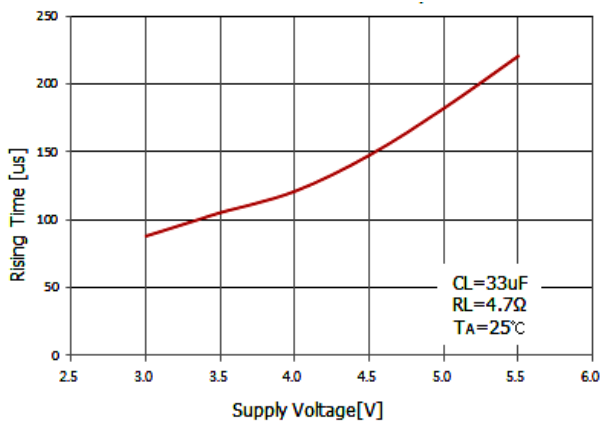
Turn-On Delay Time vs. Temperature



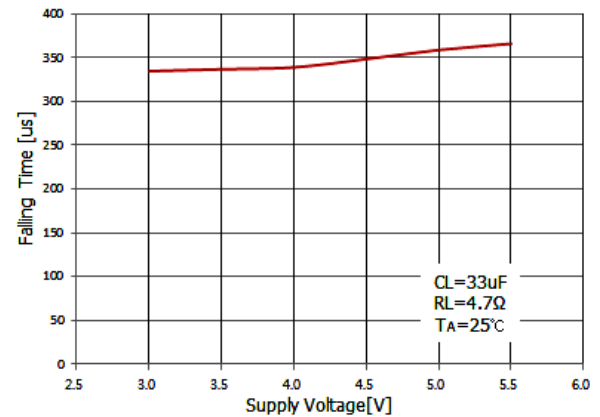
Turn-Off Delay Time vs. Supply voltage



Rising Time vs. Temperature

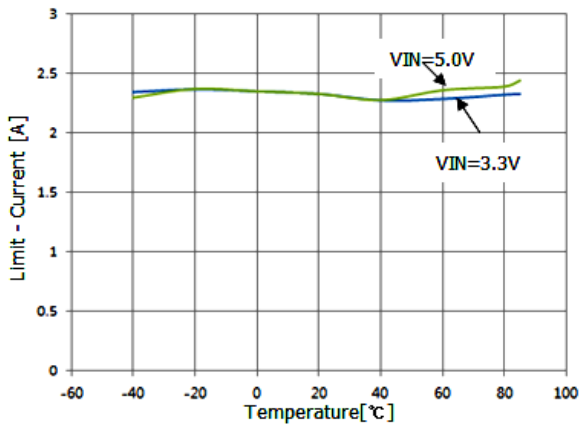


Falling Time vs. Supply Voltage

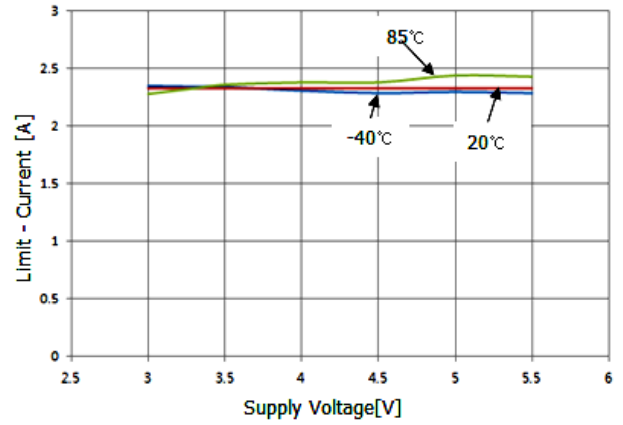


TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

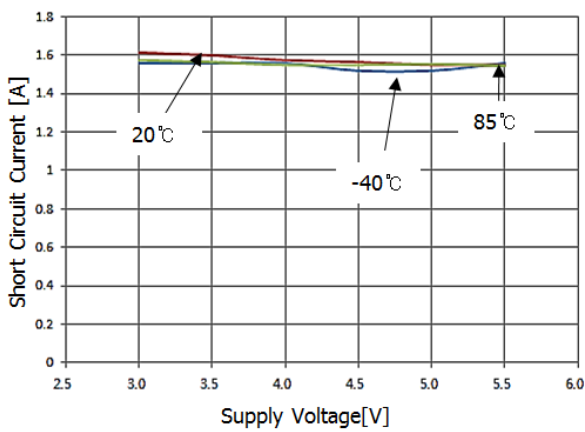
Current Limit Threshold vs. Temperature



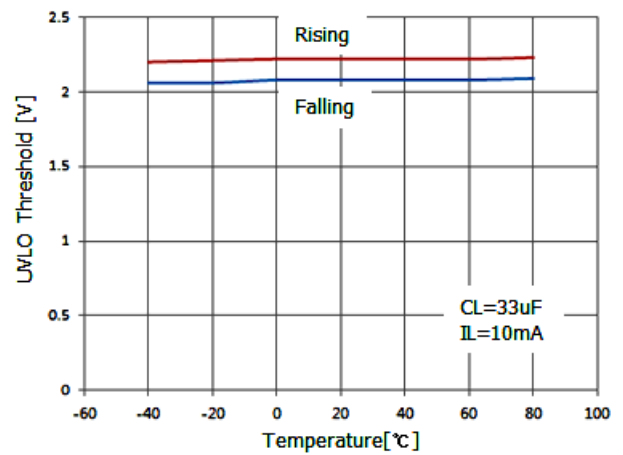
Current Limit Threshold vs. Supply Voltage



Short Circuit Current vs. Supply Voltage



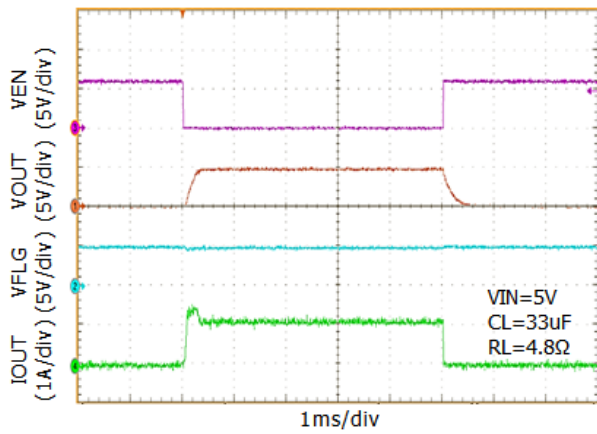
UVLO vs. Temperature



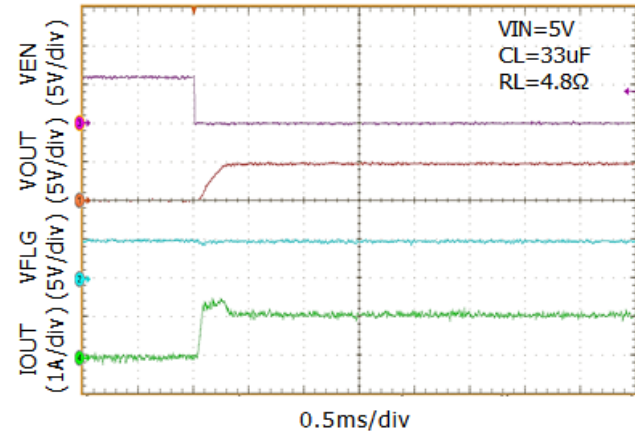
TYPICAL OPERATING CHARACTERISTICS

- $V_{IN}=5V$, $V_{EN}=0V$, $T_A=25^{\circ}C$, unless otherwise noted

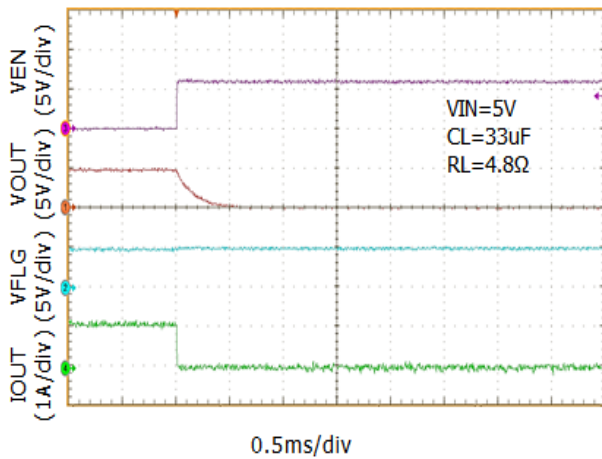
Turn – ON / Turn-OFF(TJ2110L)



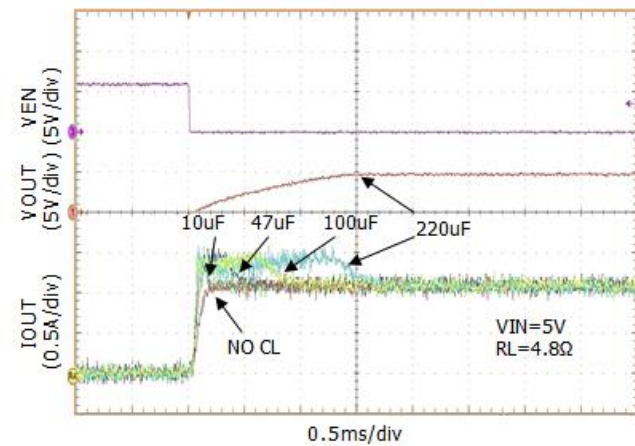
Turn – ON(TJ2110L)



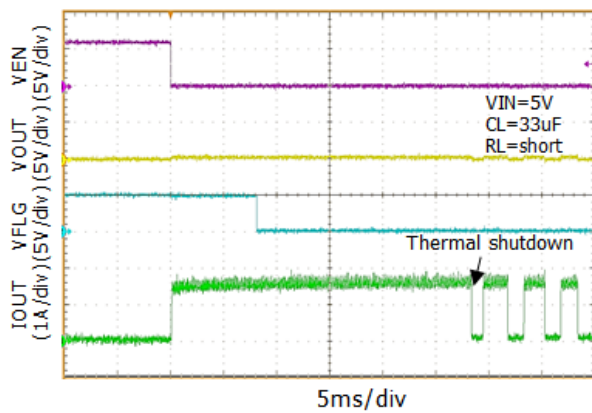
Turn – OFF(TJ2110L)



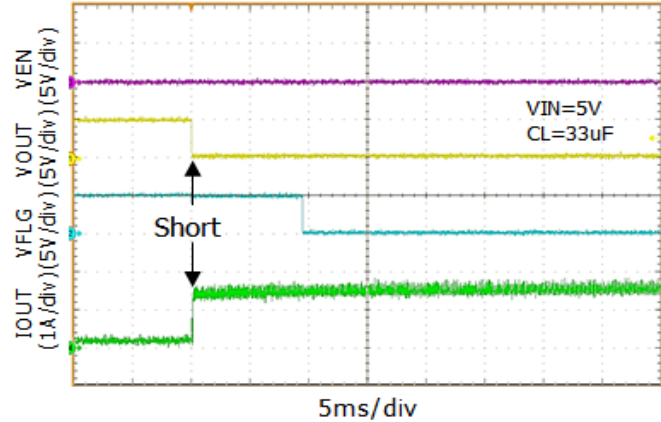
Inrush Current Response(TJ2110L)



Enable Into Short(TJ2110L)

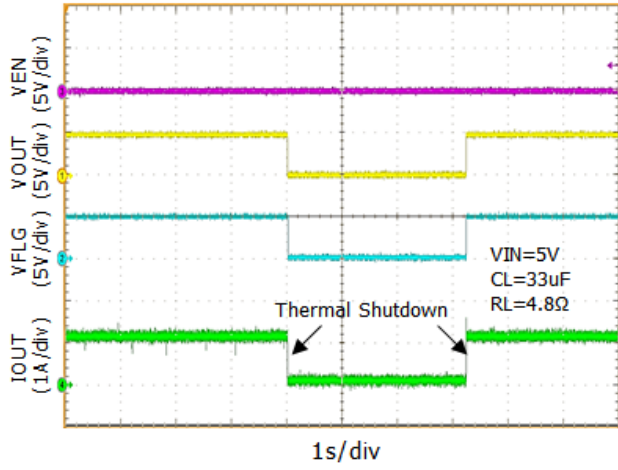


Stepped Short(TJ2110L)

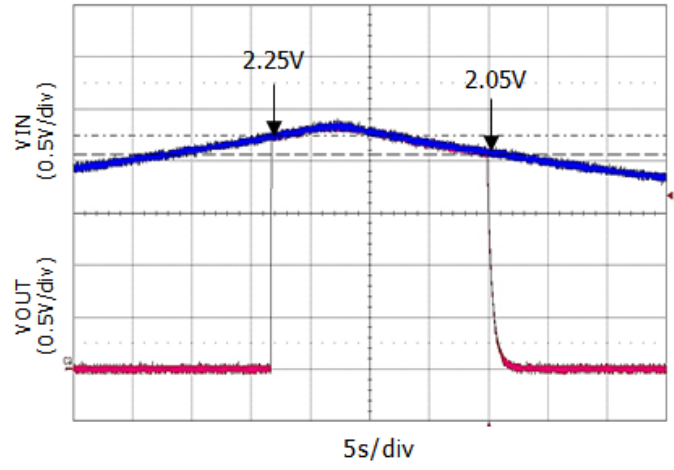


TYPICAL OPERATING CHARACTERISTICS (continued)

Thermal Shutdown



UVLO – VIN Rising & Falling



Function Description

Supply Filtering

A 0.1uF to 1uF bypass capacitor from IN pin to GND pin is recommended to control power supply transients. Without this bypass capacitor, an output short can cause ringing from supply lead inductance on the input and damage the internal control circuitry.

Input or output transients must never exceed the absolute maximum supply voltage ($V_{INmax} = 6V$)

Power Dissipation

The device's junction temperature depends on several factors such as the load, PCB layout, ambient temperature, and package type. Equations that can be used to calculate power dissipation of each channel and junction temperature are found below:

$$P_D = R_{DS(ON)} \times I_{OUT}^2$$

Total power dissipation of the device will be the summation of P_D for both channels. To relate this to junction temperature, the following equation can be used:

$$T_J = P_D \times \Theta_{JA} + T_A$$

Where:

T_J = Junction temperature

T_A = Ambient temperature

Θ_{JA} = Thermal resistance of the package

Enable/Shutdown

The EN control pin must be driven to a logic high or logic low for a clearly defined signal input. Floating these control lines may cause unpredictable operation.

Fault Flag

The FLG signal is open-drained output of N-channel MOSFET, the FLG output is pulled low to signal the following fault conditions: input under voltage, output current limit, and thermal shutdown.

Soft-Start Condition

The TJ2110 has high impedance when off, which gradually shifts to low impedance as the chip turns on. This prevents an inrush current from causing voltage drops that result from charging a capacitive load and can pull the USB voltage bus below specified levels. This satisfies the USB voltage droop requirements for bus-powered applications.

The TJ2110 can provide inrush current limiting for applications with large load capacitances where $C_L > 10\mu F$.

Current Sense

A sense MOSFET monitors the current supplied to the load. The sense MOSFET measures current more efficiently than conventional resistance methods. When an overload or short circuit is encountered, the current-sense circuitry sends a control signal to the driver. The driver in turn reduces the gate-source voltage and drives the power MOSFET into its saturation region, which switches the output into a constant-current mode and holds the current constant while varying the voltage on the load.

Over-Current and Short-Circuit Protection

The TJ2110 features an over-current protection circuitry to protect the device against overload conditions. The current limit threshold is preset internally. It protects the output MOSFET switches from damage due to undesirable short circuit conditions of excess inrush current often encountered during hot plug-in. The low limit of the current limit threshold of the TJ2110 allows a minimum current of 1.0A through the

MOSFET switches. A current limit condition will signal the error flag. These features can protect the load system effectively at any accidental circumstances.

Thermal Shutdown Protection

Thermal shutdown limits the TJ2110 junction temperature and protects the device from damage as a result of overheated.

Thermal protection turns off when the TJ2110's junction temperature 145°C reached, allowing it to cool down until 135°C. The TJ2110 is reactivated when a junction temperature drops to approximately 130°C. It depends on the power dissipation, thermal resistance, and ambient temperature.

Under Voltage Lockout

Under Voltage Lockout (UVLO) prevents the output MOSFET from turning on until V_{IN} exceeds approximately 2.3V. After the switch turns on, if the voltage drops below 2.1V typically, UVLO shuts off the output MOSFET. Under voltage detection functions only when the switch is enabled.

Printed Circuit Layout

The power circuitry of USB printed circuit boards requires a customized layout to maximize thermal dissipation and to minimize voltage drop and EMI.

USB Compliance

The TJ2110 is ideal for self-powered and bus powered Universal Serial Bus (USB) applications. A USB port provides a +5.0V bus and ground return line in addition to a twisted pair for data.

The TJ2110 will comply with the following USB requirements:

- 1) The fault current is well below the UL 25VA safety requirements.
- 2) The Flag Outputs are available to indicate fault conditions to USB controllers.
- 3) The MOSFET switches' low on-resistance meets USB voltage drop requirements.
- 4) The MOSFET switch channel can supply 1.0A as required by USB downstream devices.
- 5) Soft start eliminates any momentary voltage drops on the upstream port that may occur when the Switches are enabled in bus-powered applications.
- 6) An Under-voltage Lockout ensures that the device remains off unless there is a valid input supply voltage present.
- 7) +3.0V and +5.0V logic compatible enable inputs.
- 8) Thermal Shutdown prevents the possibility of catastrophic switch failure from high-current loads.
- 8) The device is available in both active-high and active-low versions.