

FEATURES

- Low Quiescent Current
- Very Low Dropout Voltage
- Very High PSRR
- Excellent Line and Load Regulation
- Guaranteed Output Current of 300mA
- Fixed Output Voltage: 0.8V to 3.6V
- Logic Controlled Shutdown Option
- Stable with 1 μ F MLCC
- Output Auto Discharge Function (D version)
- Fast Turn-On Time
- Over Current Protection
- Over Temperature Protection
- Available in very small packages: 1mm x 1mm DFN, SC70-5, SOT23-3 and SOT23-5.

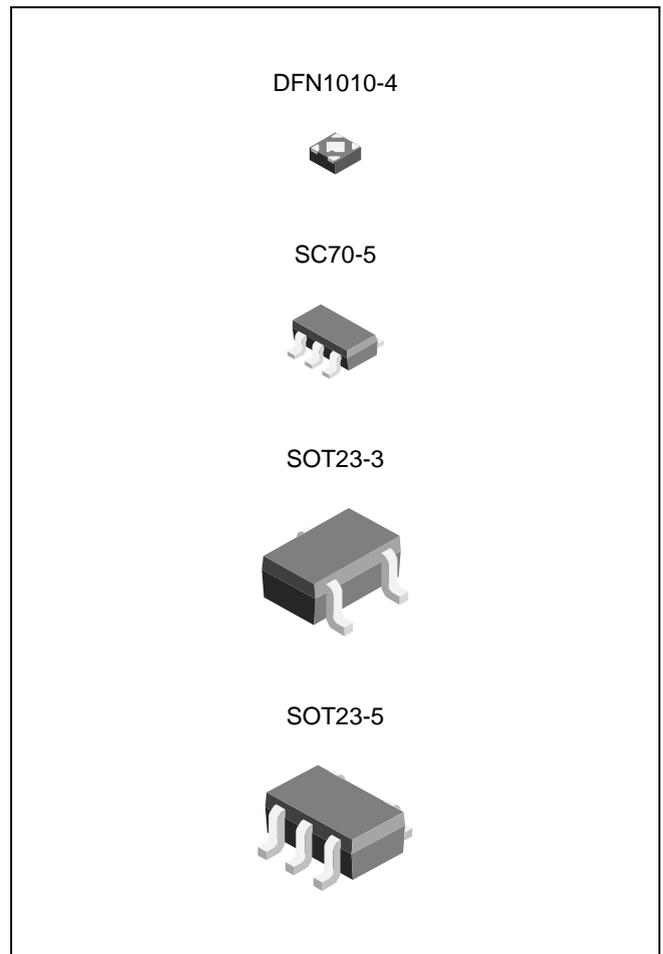
APPLICATION

- Mobile Phones and Smart Phones
- Digital Cameras and Camcorders
- Portable Communication Devices
- GPS, PDAs and handhelds
- Battery-Powered Devices

DESCRIPTION

The TJ9198 is a series of 300mA high performance low dropout linear voltage regulator ideal for mobile or portable applications with high output voltage accuracy, very low quiescent current, very low dropout voltage, and very high power supply ripple rejection (PSRR). The TJ9198 series include enable function to save power moreover the D version provides output auto-discharge function when it is disabled. The series are available with fixed output voltages between 0.8V to 3.6V with 0.1V step. The TJ9198 is stable with 1 μ F MLCC.

The TJ9198 series are available in a very small 1.0mm x 1.0mm thin DFN4 package, a small SC70-5 package, a SOT23-3 and a SOT23-5 package, which are ideal for high density form factor portable equipment.



ORDERING INFORMATION

Device	Package
TJ9198GQA4-x.xD	DFN1010-4
TJ9198GTF5-x.xD	SC70-5
TJ9198GSF-x.xD	SOT23-3
TJ9198GSF5-x.xD	SOT23-5
TJ9198GQA4-x.xS	DFN1010-4
TJ9198GTF5-x.xS	SC70-5
TJ9198GSF-x.xS	SOT23-3
TJ9198GSF5-x.xS	SOT23-5

X.X = Output Voltage

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	MIN.	MAX.	UNIT
Input Supply Voltage (Survival)	V_{IN}	-0.3	6	V
Enable Input Voltage (Survival)	V_{EN}	-0.3	$V_{IN} + 0.3$	V
Output Voltage (Survival)	V_{OUT}	-0.3	$V_{IN} + 0.3$	V
Maximum Output Current	I_{OUT}			°C
ESD Rating, HBM		2		kV
Junction Temperature Range	T_J	-40	125	°C
Storage Temperature Range	T_{STG}	-55	150	°C

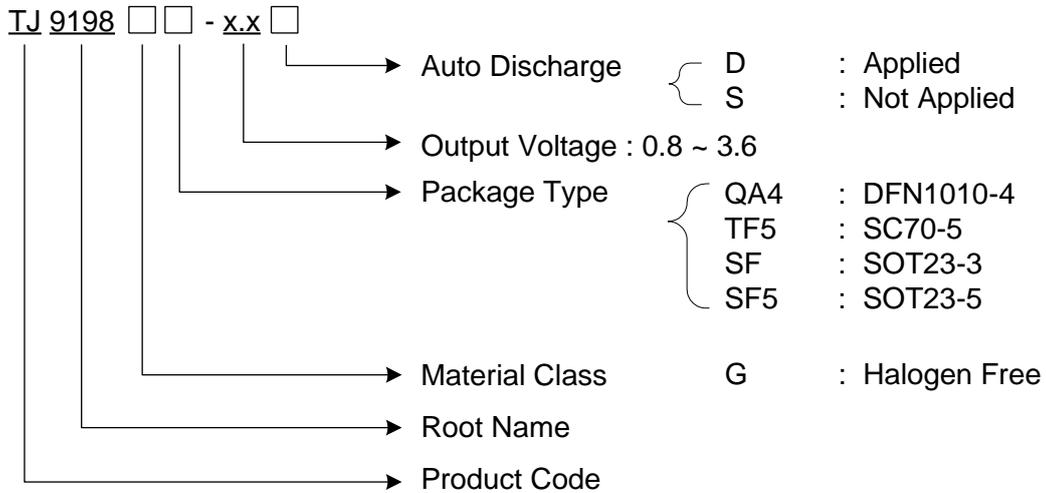
OPERATING RATINGS

PARAMETER	SYMBOL	MIN.	MAX.	UNIT
Input Supply Voltage	V_{IN}	2.2	5.5	V
Enable Input Voltage	V_{EN}	0	V_{IN}	V
Operating Temperature Range	T_{OPR}	-40	85	°C

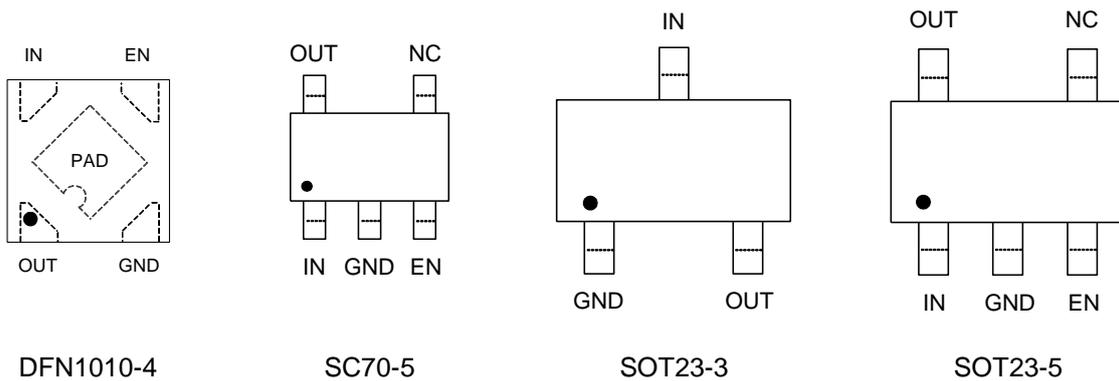
ORDERING INFORMATION

V_{OUT}	Order No.	Package	Description	Compliant	Remark
x.x(*)	TJ9198GQA4-x.xD	DFN1010-4	Enable, Auto Discharge	RoHS, Green	Description
	TJ9198GTF5-x.xD	SC70-5	Enable, Auto Discharge	RoHS, Green	Description
	TJ9198GSF-x.xD	SOT23-3	Enable, Auto Discharge	RoHS, Green	Description
	TJ9198GSF5-x.xD	SOT23-5	Enable, Auto Discharge	RoHS, Green	Description
	TJ9198GQA4-x.xS	DFN1010-4	Enable	RoHS, Green	Description
	TJ9198GTF5-x.xS	SC70-5	Enable	RoHS, Green	Description
	TJ9198GSF-x.xS	SOT23-3	Enable	RoHS, Green	Description
	TJ9198GSF5-x.xS	SOT23-5	Enable	RoHS, Green	Description

* The various output voltages (0.8 ~ 3.6V, 100mV (or 50mV) step) are available upon request of customer. Please contact us.



PIN CONFIGURATION

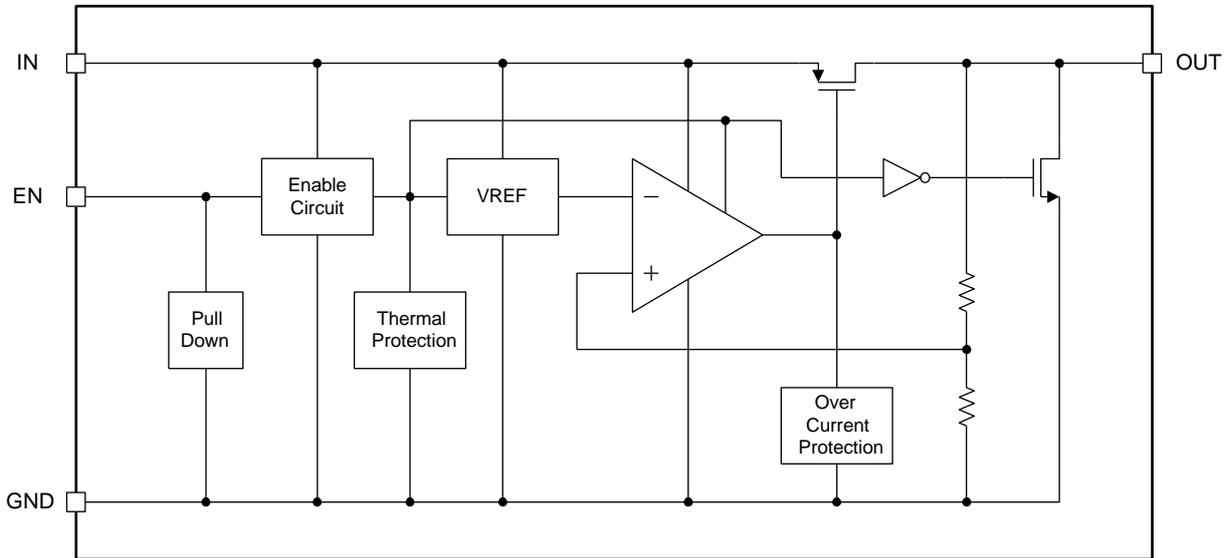


PIN DESCRIPTION

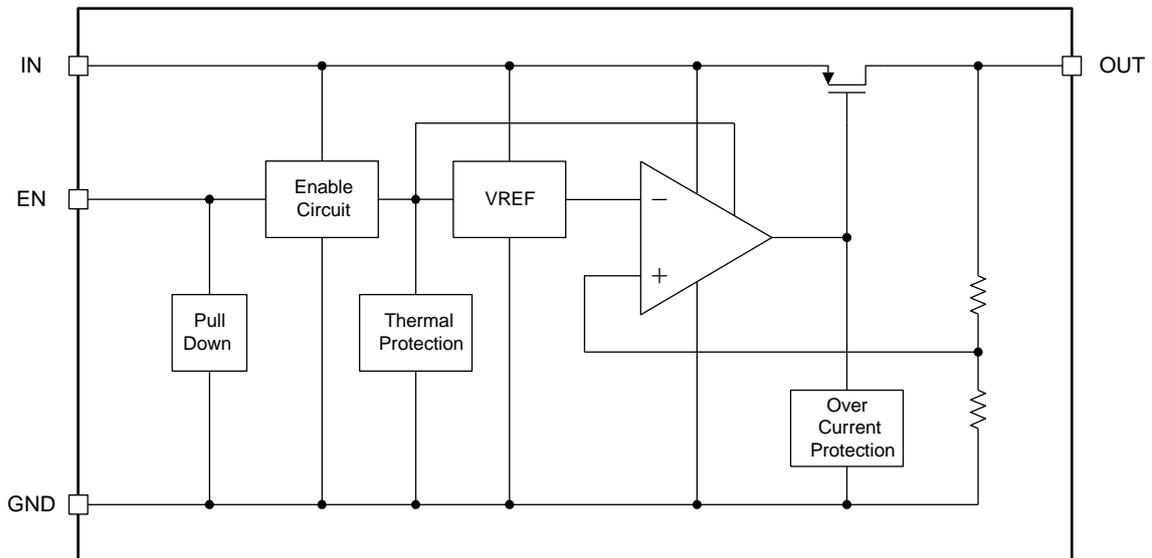
Pin No.				Pin Name	Pin Function
DFN1010-4	SC70-5	SOT23-3	SOT23-5		
1	5	2	5	OUT	Output Voltage.
2	2	1	2	GND	Ground.
3	3	-	3	EN	Chip Enable.
4	1	3	1	IN	Supply Input.
-	4	-	4	NC	No Connection.
PAD	-	-	-	Thermal Exposed PAD	Connect to ground.

BLOCK DIAGRAM

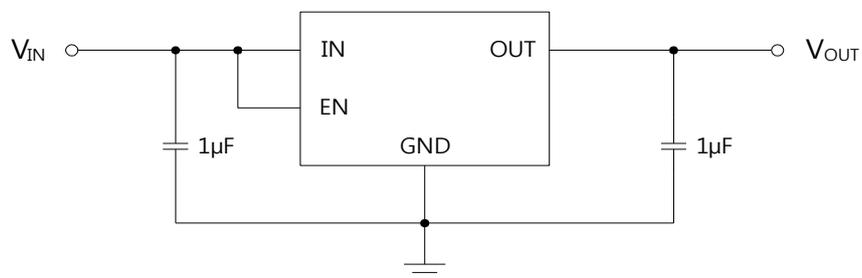
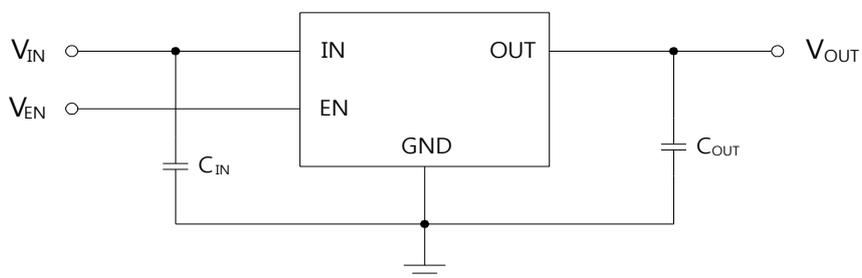
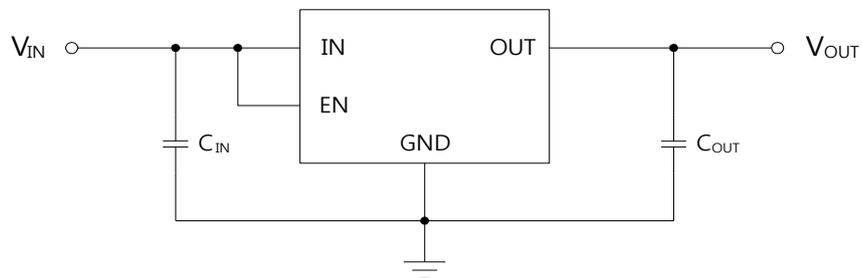
D Version (TJ9198Gxxx-xxD)



S Version (TJ9198Gxxx-xxS)



TYPICAL APPLICATION



* See application information for the details over external capacitor.

** TJ9198 can deliver a continuous current of 300mA over the full operating temperature. However, the output current is limited by the restriction of power dissipation which differs from packages. A heat sink may be required depending on the maximum power dissipation and maximum ambient temperature of application. With respect to the applied package, the maximum output current of 300mA may be still undeliverable.

*** For the details, see Application Information.

ELECTRICAL CHARACTERISTICS

Limits in standard typeface are for $T_J=25^\circ\text{C}$, and limits in **boldface** type apply over the **full operating temperature range**.
 $V_{IN} = V_{O(NOM.)} + 1\text{ V}$ or $V_{IN} = 2.5\text{ V}$, whichever is greater; $V_{EN} = V_{IN}$, $I_L = 1\text{ mA}$, $C_{IN} = C_{OUT}=1\mu\text{F}$, unless otherwise specified.

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT	
Input Voltage Range (Note 1)	V_{IN}		2.2	-	5.5	V	
Output Voltage Tolerance	V_{OUT}	$V_{OUT} + 1\text{ V} \leq V_{IN} \leq 5.0\text{ V}$	-2	-	2	%	
Output Current	I_{OUT}		300	-	-	mA	
Line Regulation (Note 2)	$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	$V_{OUT} + 1\text{ V} \leq V_{IN} \leq 5.0\text{ V}$	-	0.2	-	%/V	
Load Regulation (Note 3)	ΔV_{OUT}	$1\text{ mA} \leq I_{OUT} \leq 300\text{ mA}$	-	15	30	mV	
Dropout Voltage (Note 4)	V_{DROP}	$I_{OUT} = 300\text{ mA}$	$2.2\text{ V} \leq V_{OUT} < 2.5\text{ V}$	-	220	330	mV
			$2.5\text{ V} \leq V_{OUT} < 3.0\text{ V}$	-	200	300	mV
			$3.0\text{ V} \leq V_{OUT} < 3.6\text{ V}$	-	190	290	mV
Quiescent Current (Note 5)	I_Q	$I_{OUT} = 0\text{ mA}$	-	35	60	μA	
Shutdown Current (Note 6)	I_{SD}	$V_{EN} < 0.2\text{ V}$	-	0.1	1	μA	
Power Supply Ripple Rejection	PSRR	$V_{IN} = V_{OUT} + 1\text{ V}$ or 3 V (Note 7) $f = 1\text{ kHz}$, $I_{OUT}=30\text{ mA}$	-	75	-	dB	
EN Pin Input Current	I_{EN}	$V_{EN} = V_{IN}$	-	0.3	-	μA	
Enable Threshold	Logic Low	V_{ENL}	Output = Low	-	-	0.4	V
	Logic High	V_{ENH}	Output = High	1.2	-	V_{IN}	V
Thermal Shutdown Temperature	T_{SD}		-	165	-	$^\circ\text{C}$	
Thermal Shutdown Hysteresis	ΔT_{SD}		-	20	-	$^\circ\text{C}$	

Note 1. The minimum operating value for input voltage is equal to either $(V_{OUT,NOM} + V_{DROP})$ or 2.2V, whichever is greater.

Note 2. Output voltage line regulation is defined as the change in output voltage from the nominal value due to change in the input line voltage.
 Output voltage load regulation is defined as the change in output voltage from the nominal value due to change in load current.

Note 3. Regulation is measured at constant junction temperature by using a 10ms current pulse. Devices are tested for load regulation in the load range from 1mA to 0.3A.

Note 4. Dropout voltage is defined as the minimum input to output differential voltage at which the output drops 2% below the nominal value.
 Dropout voltage specification applies only to output voltages of 2.2V and above. For output voltages below 2.2V, the dropout voltage is nothing but the input to output differential, since the minimum input voltage is 2.2V

Note 5. Ground current, or quiescent current, is the difference between input and output currents. It's defined by $I_{GND1} = I_{IN} - I_{OUT}$ under the given loading condition. The total current drawn from the supply is the sum of the load current plus the ground pin current.

Note 6. Shutdown current, or standby current, is the input current drawn by a regulator when the output voltage is disabled by an enable signal.

Note 7. $V_{IN} = V_{OUT} + 1\text{ V}$ or 3 V , whichever is greater.

APPLICATION INFORMATION

The TJ9198 is a high performance low dropout linear regulator designed for mobile and portable application that requires high PSRR and low noise with fast transient response. The TJ9198 is fully protected from damage due to fault conditions, offering constant current limiting and thermal shutdown.

Input Supply Voltage

The TJ9198 internal circuitry is supplied by the IN pin which requires low quiescent current at the no output current level. A decoupling capacitor on the IN pin is mandatory to improve the performance of the TJ9198 during line and load transient. The input voltage must be its dropout voltage above the output voltage.

Enable

The TJ9198 feature an active high Enable input (EN) that allows on/off control of the regulator. The enable function of TJ9198 has hysteresis characteristics. The enable input allows on control of the regulator with the enable pin voltage of 1.1V or above. When the enable input voltage lowers under 0.5V, the enable input allows off control of the regulator. If not in used for logic control, EN pin must be tied to IN pin for proper operation.

Auto Discharge Function

The TJ9198 D version provides an auto discharge function that is used for faster discharging of the output capacitor. This function is automatically activated when the EN input goes into an active low state.

Input Capacitor

An input capacitor of minimum 1 μ F of MLCC is recommended. Larger values will help to improve ripple rejection by bypassing the input to the regulator, further improving the integrity of the output voltage. X7R or X5R dielectrics are recommended and it should be placed as close as to the IN pin as possible.

Output Capacitor

The TJ9198 requires a minimum output capacitance to maintain stability. The TJ9198 is designed to be stable with a MLCC with very low equivalent series resistance (ESR). A 1 μ F of MLCC would satisfy most applications. Larger values and lower ESR improves dynamic performance. X7R or X5R dielectrics are recommended to maintain sufficient capacitance over its full operating temperature. It should be placed as close as OUT pin as possible.

Current Limit Operation

The TJ9198 includes constant current limit function and it helps protect the regulator during fault conditions. It does not limit current up to its capability in normal operation. For reliable operation, the regulator should not be operated in exceeding of its guaranteed output current.

Maximum Output Current Capability

The TJ9198 can deliver a continuous current of 300mA over the full operating junction temperature range. However, the output current is limited by the restriction of power dissipation which differs from packages. A heat sink may be required depending on the maximum power dissipation and maximum ambient temperature of application. With respect to the applied package, the maximum output current of 300mA may be still undeliverable due to the restriction of the power dissipation of TJ9198. Under all possible conditions, the junction temperature must be within the range specified under operating conditions. The temperatures over the

device are given by :

$$T_C = T_A + P_D \times \theta_{CA} \quad / \quad T_J = T_C + P_D \times \theta_{JC} \quad / \quad T_J = T_A + P_D \times \theta_{JA}$$

Where T_J is the junction temperature, T_C is the case temperature, T_A is the ambient temperature, P_D is the total power dissipation of the device, θ_{CA} is the thermal resistance of case-to-ambient, θ_{JC} is the thermal resistance of junction-to-case, and θ_{JA} is the thermal resistance of junction to ambient.

The total power dissipation of the device is given by:

$$P_D = P_{IN} - P_{OUT} = \{(V_{IN} \times I_{IN}) + (V_{BIAS} \times I_{BIAS})\} - (V_{OUT} \times I_{OUT})$$

The maximum allowable temperature rise (T_{Rmax}) depends on the maximum ambient temperature (T_{Amax}) of the application, and the maximum allowable junction temperature (T_{Jmax}):

$$T_{Rmax} = T_{Jmax} - T_{Amax}$$

The maximum allowable value for junction-to-ambient thermal resistance, θ_{JA} , can be calculated using the formula:

$$\theta_{JA} = T_{Rmax} / P_D = (T_{Jmax} - T_{Amax}) / P_D$$

TJ9198 is available in DFN1010-4, SC70-5, SOT23-3 and SOT23-5 packages. The thermal resistance depends on amount of copper area or heat sink, and on air flow.

If proper cooling solution such as heat sink, copper plane area, air flow is applied, the maximum allowable power dissipation could be increased. However, if the ambient temperature is increased, the allowable power dissipation would be decreased.

The θ_{JA} could be decreased with respect to the copper plane area. So, the specification of maximum power dissipation for an application is fixed, the proper copper plane area could be estimated by following graphs. Wider copper plane area leads lower θ_{JA} .

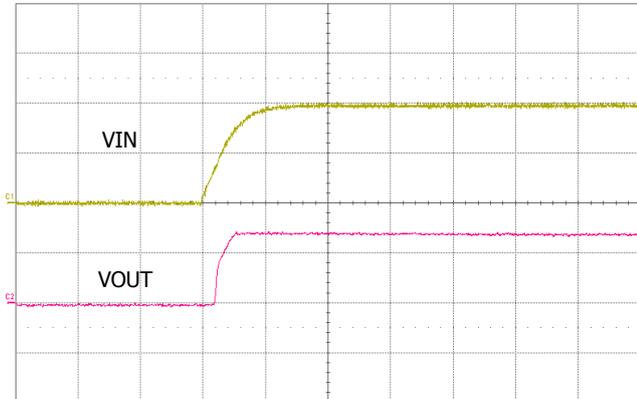
The maximum allowable power dissipation is also influenced by the ambient temperature. With the θ_{JA} -Copper plane area relationship, the maximum allowable power dissipation could be evaluated with respect to the ambient temperature. As shown in graph, the higher copper plane area leads θ_{JA} . And the higher ambient temperature leads lower maximum allowable power dissipation.

All this relationship is based on the aforesaid equation :

$$\theta_{JA} = T_{Rmax} / P_D = (T_{Jmax} - T_{Amax}) / P_D$$

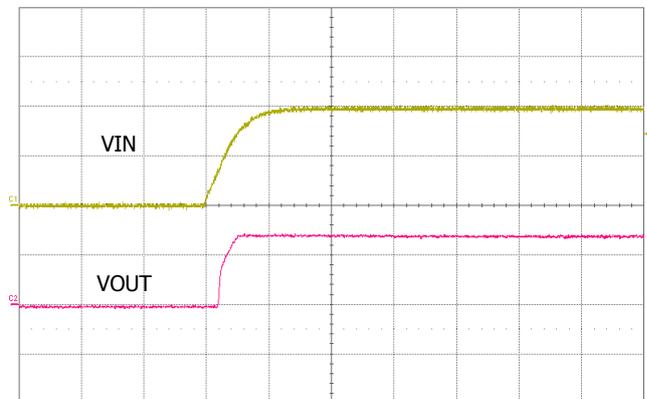
TYPICAL OPERATING CHARACTERISTICS

VOUT=2.8V



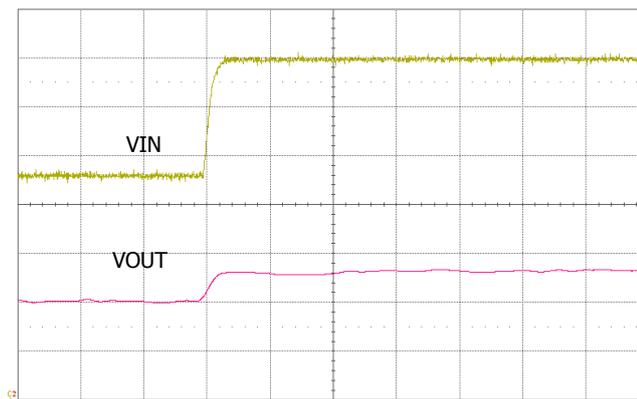
VIN : 2.0V/div, VOUT : 2.0V/div, Time : 500us/div
Vin=3.8V, Vout=2.8V

Start Up @ Iout=1mA



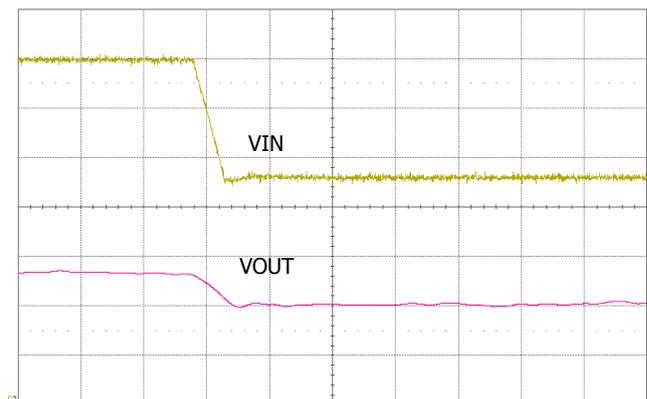
VIN : 2.0V/div, VOUT : 2.0V/div, Time : 500us/div
Vin=3.8V, Vout=2.8V

Start Up @ Iout=300mA



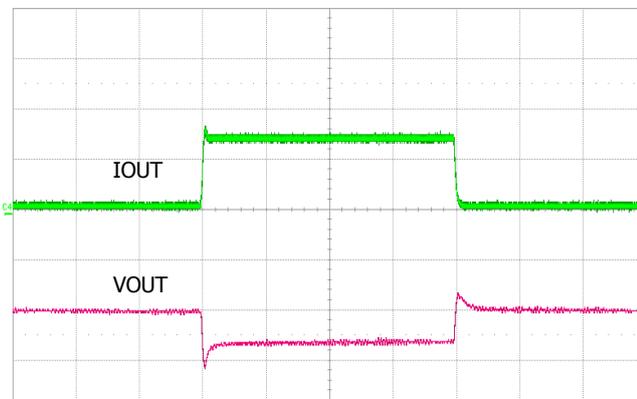
VIN : 0.5V/div, VOUT : 20mV/div, Time : 2ms/div
Vin:3.8 to 5.0V, Vout=2.8V @ Iout=1mA

Line Transient response



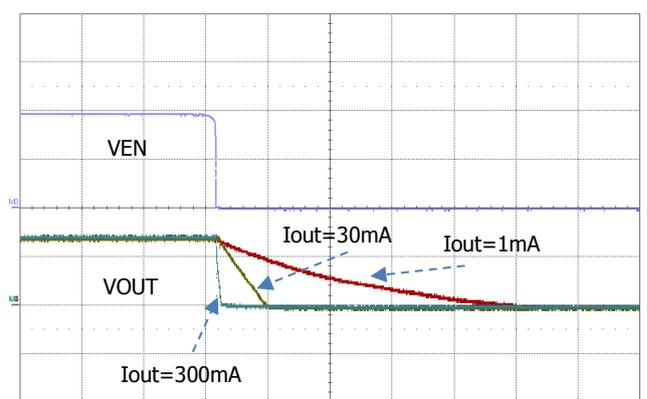
VIN : 0.5V/div, VOUT : 20mV/div, Time : 2ms/div
Vin:5.0 to 3.8V, Vout=2.8V @ Iout=1mA

Line Transient response



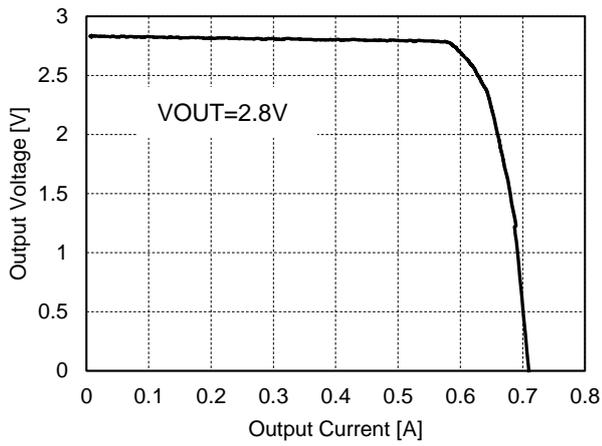
IOUT : 200mA/div, VOUT : 20mV/div, Time : 500us/div
Vin=3.8V, Vout=2.8V @ Iout=1mA to 0.3A

Load Transient response

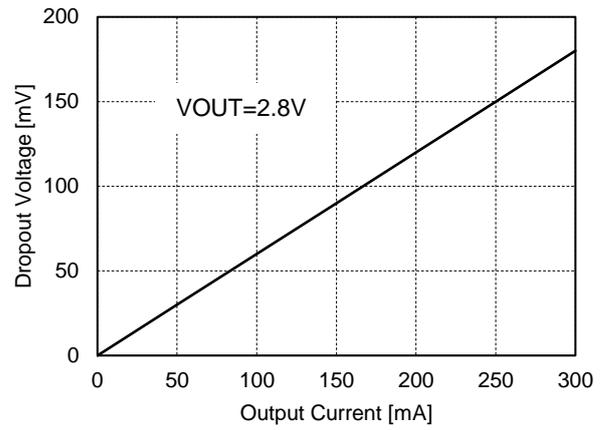


VIN : 2.0V/div, VOUT : 2.0V/div, Time : 200us/div

EN off (D version only)



Output Voltage vs Output Current



Dropout Voltage

REVISION NOTICE

The description in this datasheet can be revised without any notice to describe its electrical characteristics properly.

REVISION HISTORY

Revision Number	Revision Date	Remark
R1.0	2015. 10	-
R1.1	2016. 12	Revision of Electrical Characteristic (Quiescent Current, Load Regulation)