Features

- Low Supply Current ~ 55uA (Typ.)
- Low Shutdown Current ~0.1uA (Typ.)
- Output Current ~500mA
- High Power Supply Rejection Ratio ~75dB@1KHz
- 1.7~5.5V Operation
- ±1.5% Initial Voltage Accuracy
- Low Temperature Drift Coefficient ~50ppm
- Line Regulation ~0.02%/V(Typ.)
- Low ESR Capacitor ~1.0uF ceramic capacitor
- TDFN6-2x2、SOT-23-5、SOT-353 package
- Green Product (RoHS, Lead-Free, Halogen-Free Compliant)

Applications

- Portable communication equipment
- Notebook Computer
- Battery Powered Systems

General Description

The GS7156 is a CMOS linear regulator. It is featuring ultra-high power supply rejection ratio, low output voltage noise, low dropout voltage, low quiescent current and fast transient response. It guarantees delivery of 500mA output current, and supports preset 1.2V, 1.3V, 1.5V, 1.7V, 1.8V, 1.85V, 1.9V, 2.0V, 2.3V, 2.5V, 2.6V, 2.7V, 2.8V, 2.85V, 2.9V, 3.0V, 3.1V, 3.3V output voltage versions.

Based on its low quiescent current consumption and its less than 1uA shutdown mode, the GS7156 is ideal for battery- powered applications. The high power supply rejection ratio of the GS7156 holds well for low input voltages typically encountered in battery- operated systems. The regulator is stable with small ceramic capacitive loads (1μF typical).

Typical Application

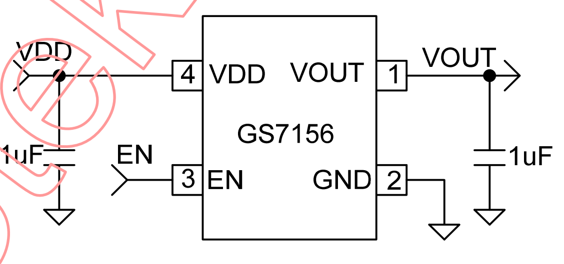


Figure 1 Typical Application of GS7156

Function Block Diagram

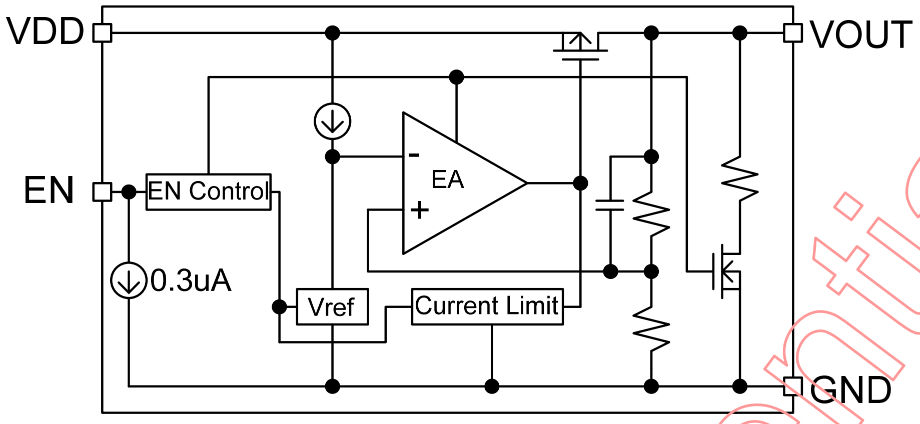


Figure 2a with auto discharge function

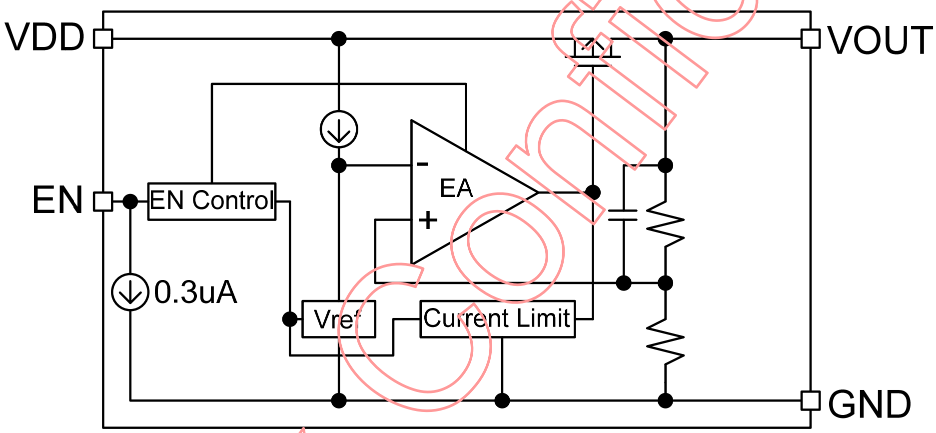


Figure 2b without auto discharge function

Figure 2 Function Block Diagram

Pin Configuration

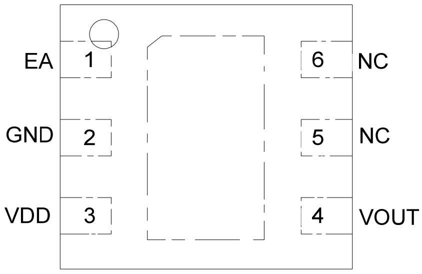


Figure 3a TDFN6-2x2 Package

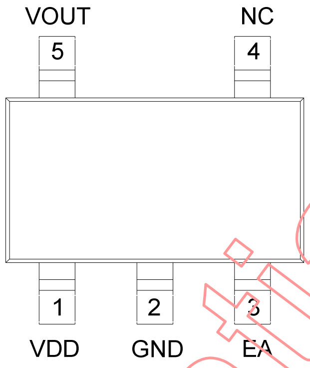


Figure 3b SOT-23-5/SOT-353 Package

Pin Descriptions

No		Name	I/O type	Description
TDFN6-2x2	SOT-23-5/SOT-353			
1	3	EA	I	Enable Pin
2	2	GND	O	Ground pin
3	1	VDD	I	Input Pin
4	5	VOUT	O	Output pin
5~6	4	NC		

Ordering Information

GS7156PP-XXX- R

1. Package
2. Output Voltage
3. Shipping

No	Item	Contents
1	Package	TD: TDFN6-2x2 ST: SOT-23-5 S5: SOT-353
2	Output Voltage	1P2: 1.2V, 1P3: 1.3V, 1P5: 1.5V, 1P7:1.7V, 1P8: 1.8V, 1P85: 1.85V, 1P9: 1.9V, 2P0: 2.0V, 2P3: 2.3V, 2P5: 2.5V, 2P6: 2.6V, 2P7: 2.7V, 2P8: 2.8V, 285: 2.85V, 2P9: 2.9V, 3P0: 3.0V, 3P1: 3.1V, 3P3: 3.3V
3	Shipping	R: Tape & Reel

Example: GS7156 2.5V SOT-23-5 Tape & Reel ordering information is “GS7156ST-2P5-R”

Absolute Maximum Rating (Note 1)

Parameter	Symbol	Limits	Units
VIN to GND	V_{IN}	$-0.3 < V_{IN} < 6$	V
VEN to GND	V_{EN}	$-0.3 < V_{EN} < 6$	V
Output Voltage	V_{OUT}	$-0.3 < V_{OUT} < V_{IN}+0.3$	V
Output Current	I_{OUT}	500	mA
Package Power Dissipation at T_A ≦25°C	$P_{D\_TDFN6\text{-}2x2}$	1087	mW
Package Power Dissipation at T_A ≦25°C	$P_{D\_SOT\text{-}23\text{-}5}$	420	mW
Package Power Dissipation at T_A ≦25°C	$P_{D\_SOT\text{-}353}$	300	mW
Junction Temperature	T_J	- 45 ~ 150	°C
Storage Temperature	T_{STG}	- 65 ~ 150	°C
Lead Temperature (Soldering) 10S	T_{LEAD}	260	°C
ESD (Human Body Mode) (Note 2)	V_{ESD_HBM}	2K	V
ESD (Machine Mode) (Note 2)	V_{ESD_MM}	200	V

Thermal Information (Note 3)

Parameter	Symbol	Limits	Units
Thermal Resistance Junction to Ambient	$\theta_{JA\_TDFN6\text{-}2x2}$	92	°C/W
Thermal Resistance Junction to Ambient	$\theta_{JA\_SOT\text{-}23\text{-}5}$	238	°C/W
Thermal Resistance Junction to Ambient	$\theta_{JA\_SOT\text{-}353}$	333	°C/W

Recommend Operating Condition (Note 4)

Parameter	Symbol	Limits	Units
VIN to GND	V_{IN}	1.7 to 5.5	V
Junction Temperature	T_J	- 40 ~ 125	°C
Operating Temperature Range	T_A	-40 ~ 85	°C

Electrical Characteristics

(V_{IN} = V_{OUT} + 1V, T_A = 25°C, C_{IN}=C_L=1uF, I_{OUT}=1mA, unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ	Max	Units
SUPPLY VOLTAGE SECTION							
Supply Voltage	V_{IN}			1.7		5.5	V
Supply Current	I_{VIN}	Unload			55	70	uA
Standby Current	I_{STBY}	V_{EN}=0			0.1	1.0	uA
EN Input Current	I_{EN}	V_{EN}=V_{IN}=5.5V			0.3		uA
Output Current(Note 5)	I_{OUT}			500 (Note 6)			mA
OUTPUT SECTION							
Output Voltage	V_{OUT}	T_A = 25°C		-1.5		+1.5	%
Dropout Voltage (Note 7)	V_{DROP}	I_{OUT}=500mA	V_{OUT}=1.2V		1000	1400	mV
			V_{OUT}=1.5V		630	820	
			V_{OUT}=2.5V		340	500	
			V_{OUT}=2.8V		370	460	
			V_{OUT}=3.3V		325	410	
Line Regulation	$\triangle V_{LNR}$	V_{IN} = V_{OUT} +0.5V to 5.5V, I_{OUT}=1mA			0.02	0.20	%/V
Load Regulation	$\triangle V_{LDR}$	V_{IN} = V_{OUT}+1V, I_{OUT}=1mA to 500mA				40	mV
Ripple Rejection Rate	PSRR	V_{IN}=MAX{V_{OUT}+1.0V, 3V}, Ripple 0.2Vp-p, I_{OUT}=30mA, f=1KHz			75		dB
Limit Current	Ilim	V_{OUT}=V_{IN}+1V			610		mA
Short Current	Ishort	V_{OUT}=0V			40		mA
EN Input Voltage High	V_{ENH}			1.2			V
EN Input Voltage Low	V_{ENL}					0.3	V
CL Auto-Discharge Resistance (Note 8)	Rdischg	V_{IN}=5.0V, V_{EN}=0V			95		Ω
Temperature Drift	$\triangle V_{OUT}/\triangle T_A$	I_{OUT}=1mA, T_A = -40°C to +85°C			40		ppm/°C
Over temperature shutdown	T_{SD}				160		°C
Return temperature					140		°C

Note 1. Stresses listed as the above "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.

Note 2. Devices are ESD sensitive. Handling precaution recommended.

Note 3. θ_{JA} is measured in the natural convection at T_A=25°C on a high effective thermal conductivity test board (40mm x 40mm x 1.6mm double sided board with 2oz, copper ratio: approx. 50%) of JEDEC 51-7 thermal measurement standard.

Note 4. The device is not guaranteed to function outside its operating conditions.

Note 5. The output current at which the output voltage becomes 95% of V_{OUT} after gradually increasing the output current.

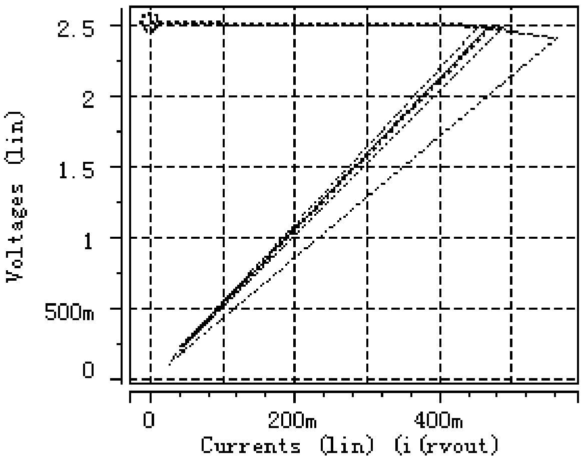
Note 6. The output current can be at least this value. Due to restrictions on the package power dissipation, this value may not be satisfied. Attention should be paid to the power dissipation of the package when the output current is large.
The specification is guaranteed by design.

Note 7. The dropout voltage is defined as V_{IN} - V_{OUT}, which is measured when V_{OUT} is 98%*V_{OUT}.

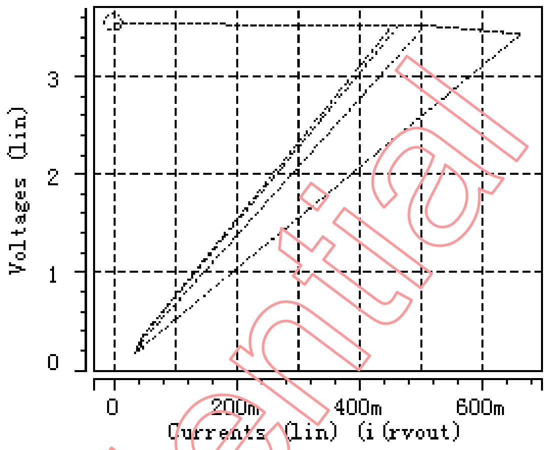
Note 8. The output voltage Auto discharge function is optional.

Typical Characteristics

1. Output Voltage vs. Output Current (Cin=1.0uF,Cout=1.0uF,Temp=25℃)

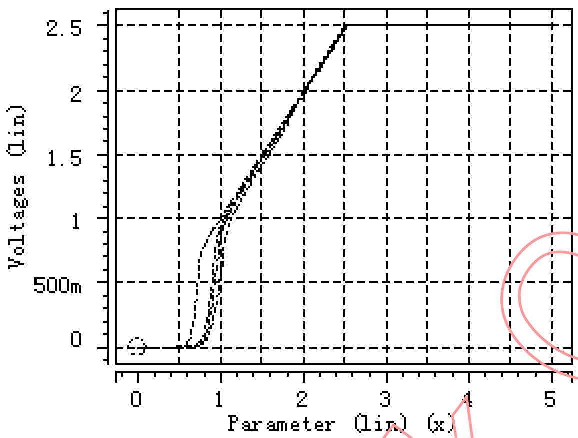


V_{OUT}=2.5V, V_{DD}=1.3V,1.5V,2.0V,3.0V,5.0V

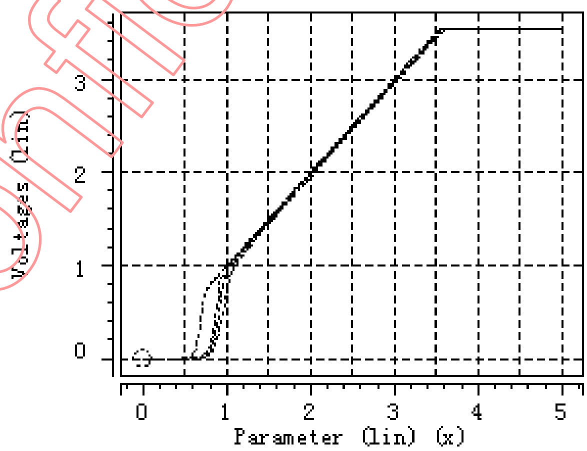


V_{OUT}=3.5V, V_{DD}=3.8V,4.0V,4.5V,5.0V

2. Output Voltage vs. Input Voltage (Cin=1.0uF,Cout=1.0uF,Temp=25℃)

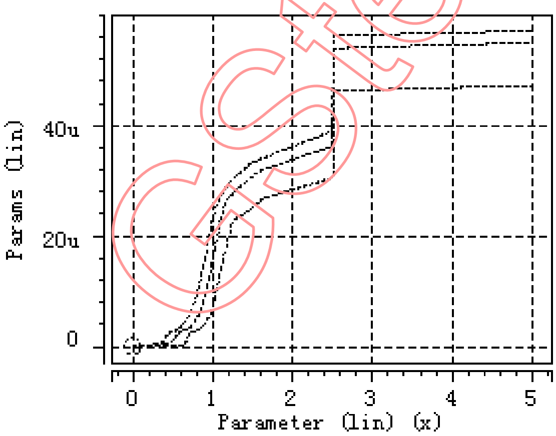


V_{OUT}=2.5V, I_{OUT}=1mA,30mA,50mA

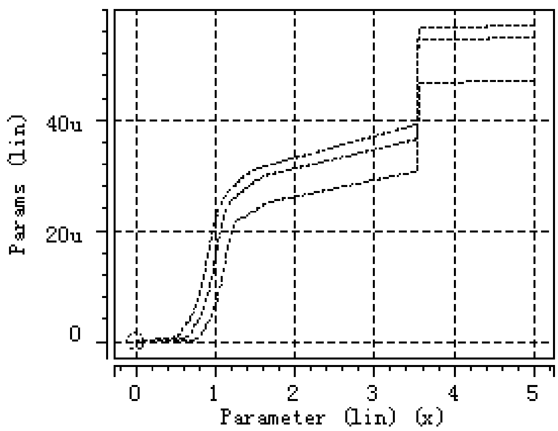


V_{OUT}=3.5V, I_{OUT}=1mA,30mA,50mA

3. Supply Current vs. Input Voltage (Cin=1.0uF,Cout=1.0uF,Temp=25℃)

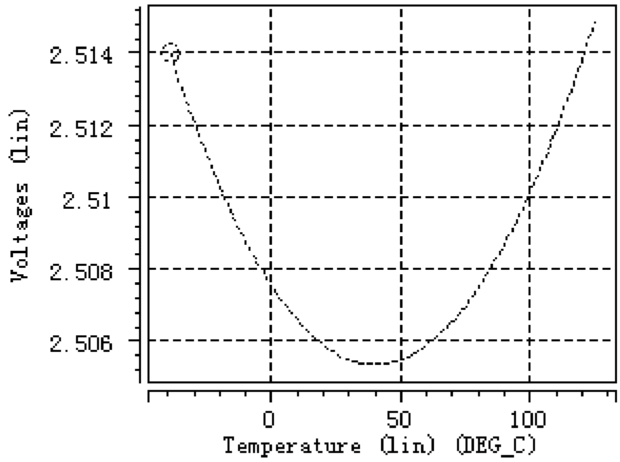


V_{OUT}=2.5V, no load

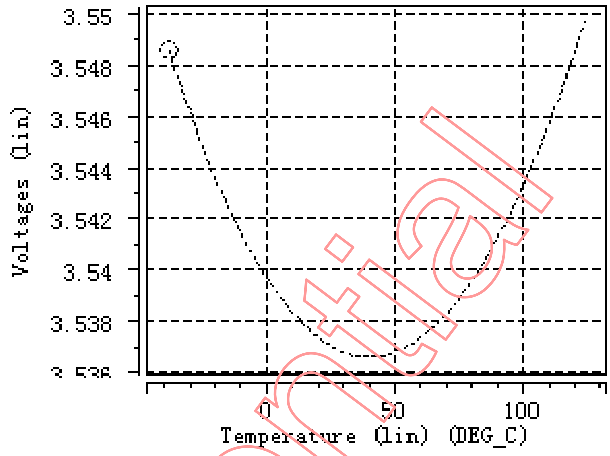


V_{OUT}=3.5V, no load

4. Output Voltage vs. Temperature (Cin=1.0uF,Cout=1.0uF,Iout=1mA)

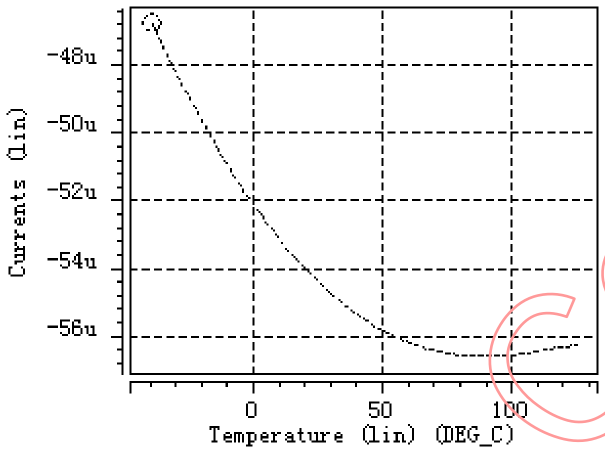


V_{OUT}=2.5V, V_{DD}=3.5V, no load

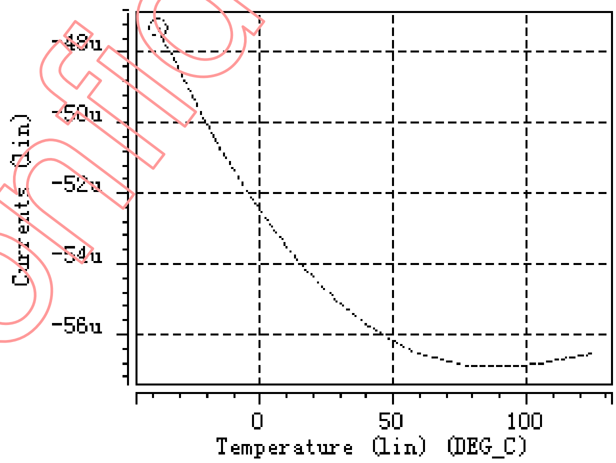


V_{OUT}=3.5V, V_{DD}=4.5V, no load

5. Supply Current vs. Temperature (Cin=1.0uF,Cout=1.0uF,Iout=0mA)

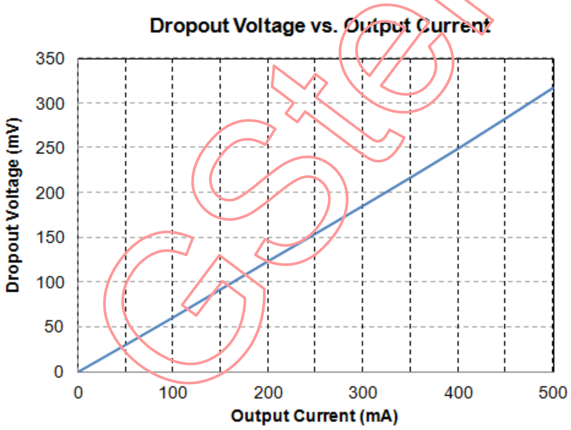


V_{OUT}=2.5V, V_{DD}=3.5V, no load



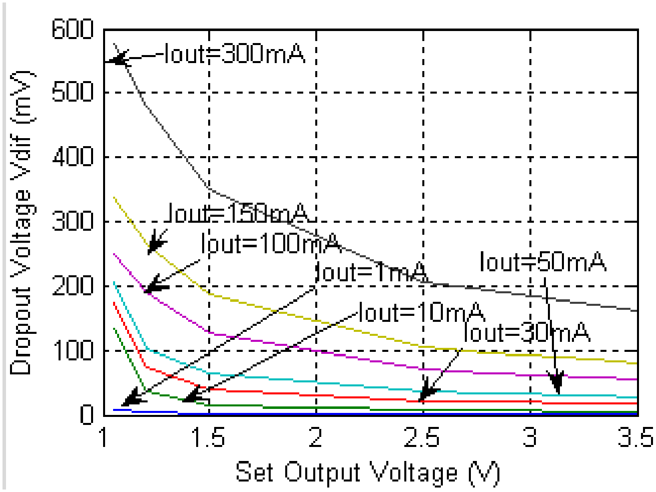
V_{OUT}=3.5V, V_{DD}=4.5V, no load

6. Dropout Voltage vs. Output Current (Cin=1.0uF,Cout=1.0uF)

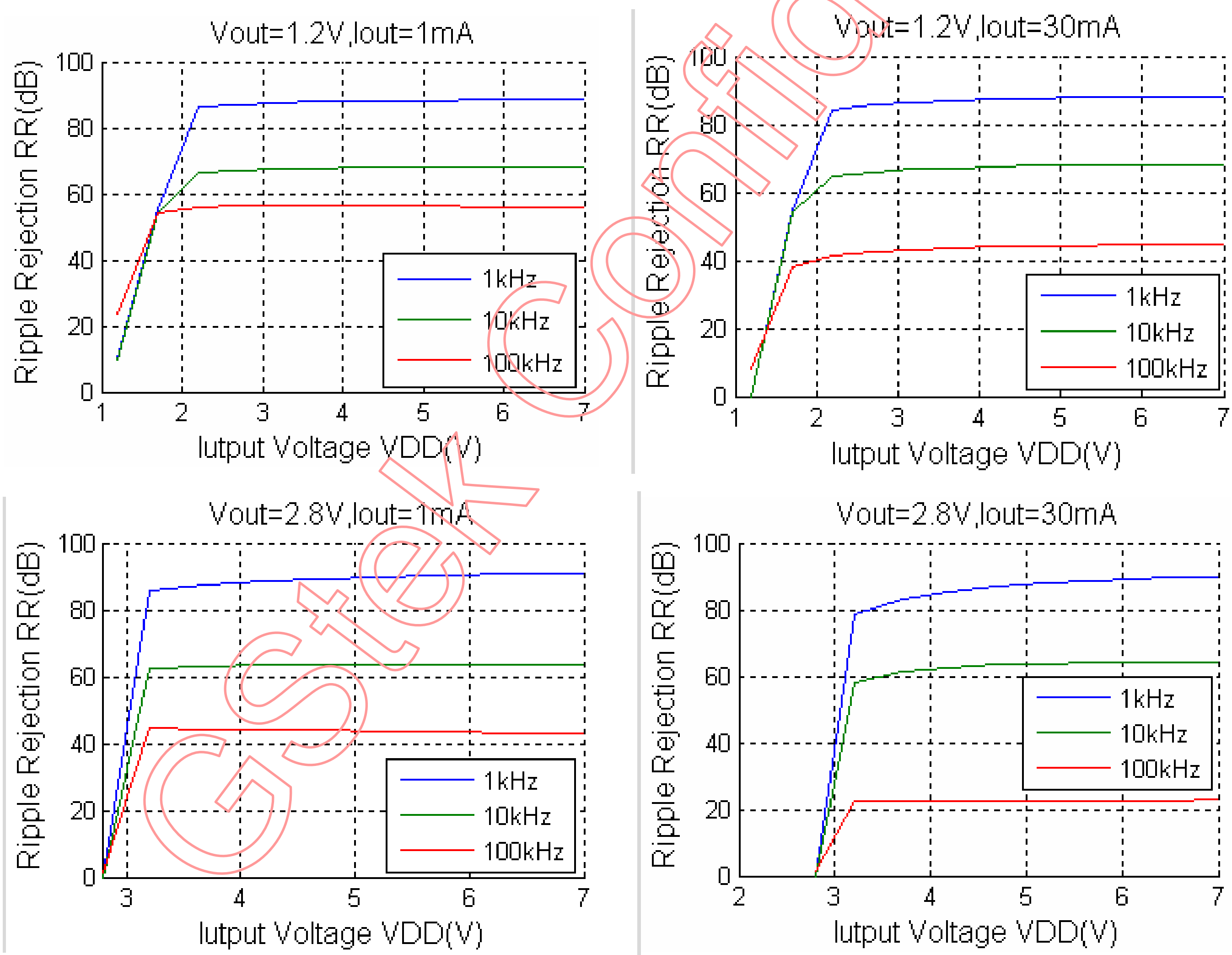


V_{OUT}=3.3V

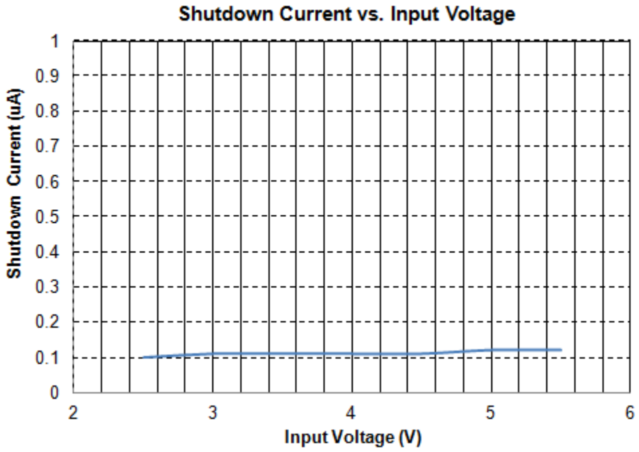
7. Dropout Voltage vs. Set Output Voltage (Cin=1.0uF,Cout=1.0uF,Temp=25℃)



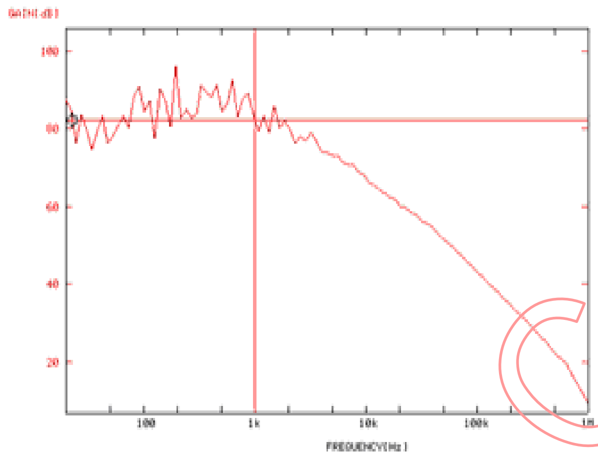
8. Ripple Rejection vs. Input Bias Voltage (Cin=none, Cout=1.0uF, Ripple=0.2Vp-p, Temp=25℃)



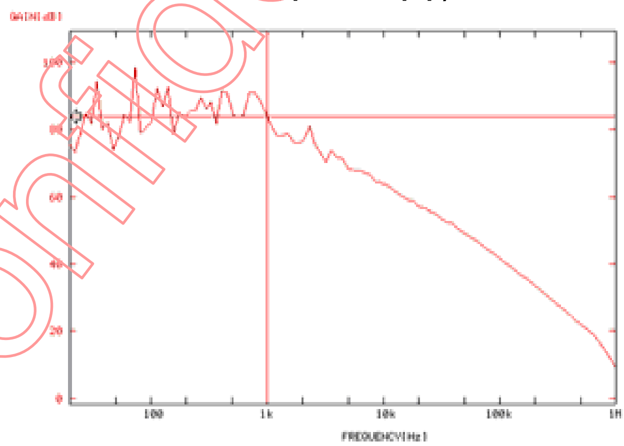
9. Shutdown Current vs. Input Voltage (Cin=1.0uF,Cout=1.0uF,Temp=25℃)



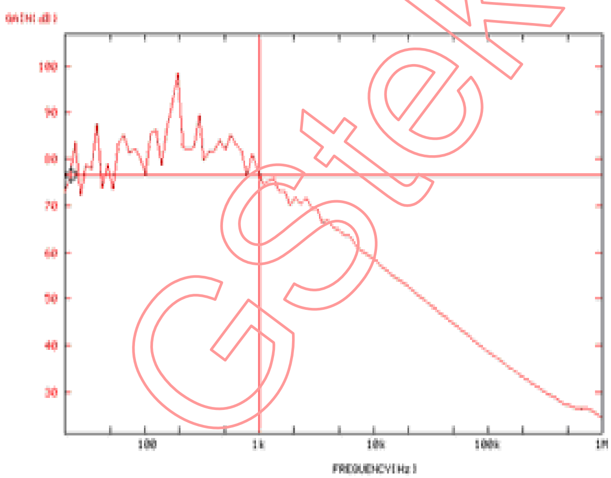
10. Ripple Rejection vs. Frequency (Cin=none, Cout=1.0uF, Ripple=0.2Vp-p)



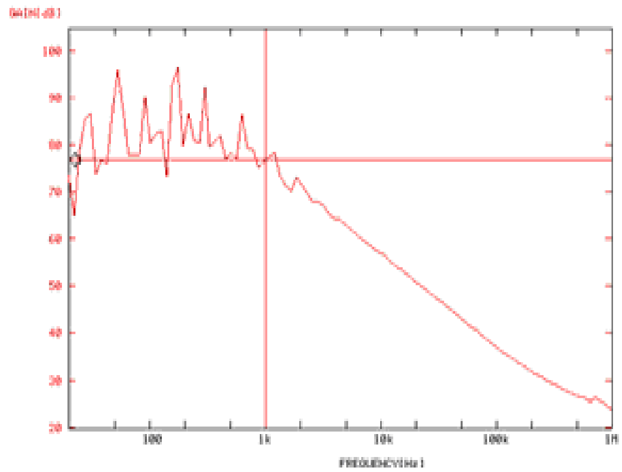
V_{OUT}=1.8V,V_{DD}=2.8V,I_{OUT}=30mA



V_{OUT}=1.8V,V_{DD}=4.8V,I_{OUT}=30mA

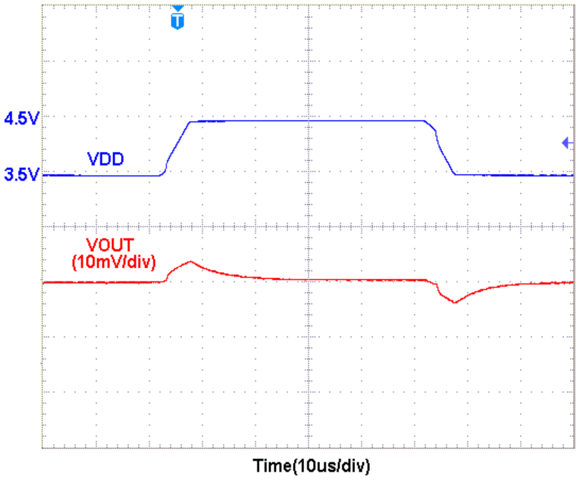


V_{OUT}=2.5V,V_{DD}=3.5V,I_{OUT}=30mA

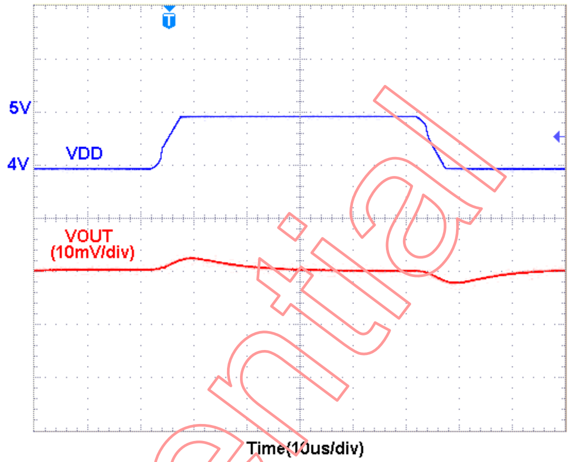


V_{OUT}=2.5V,V_{DD}=5.5V,I_{OUT}=30mA

11. Input Transient Response (Iout=30mA, tr=tf=5us, Temp=25℃)

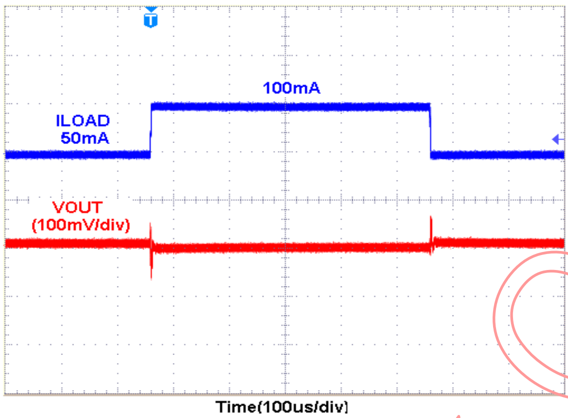


V_{OUT}=2.5V, V_{DD}=3.5V~4.5V~3.5V



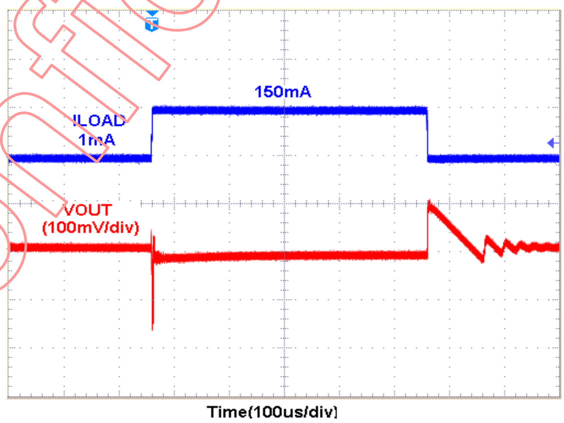
V_{OUT}=3.0V, V_{DD}=4.0V~5.0V~4.0V

12. Load Transient Response (Cout=1.0uF, Temp=25℃)



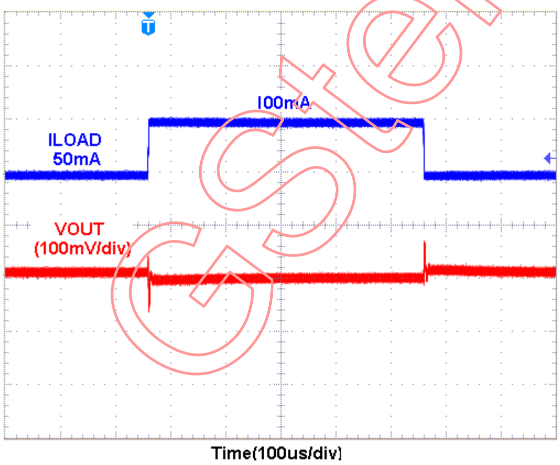
V_{OUT}=2.5V, I_{OUT}=50mA~100mA~50mA, V_{DD}=3.5V

tr=tf=0.5us



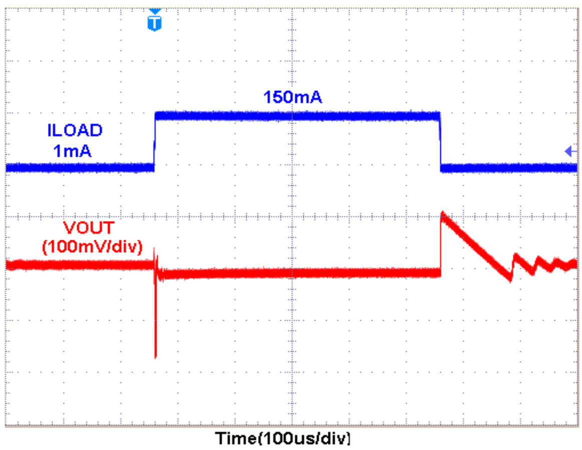
V_{OUT}=2.5V, I_{OUT}=1mA~150mA~1mA, V_{DD}=3.5V

tr=tf=0.5us



V_{OUT}=3.0V, I_{OUT}=50mA~100mA~50mA, V_{DD}=4.0V

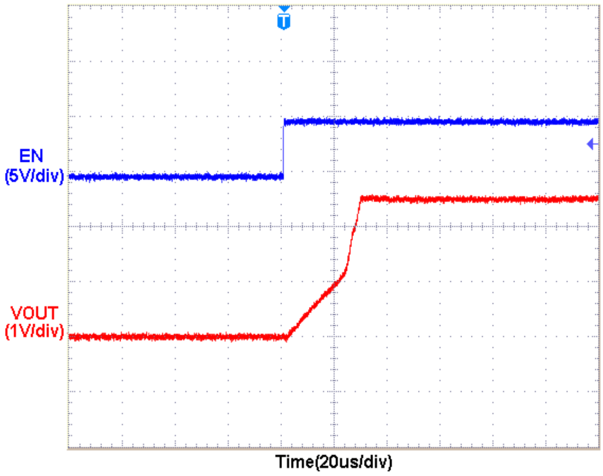
tr=tf=0.5us



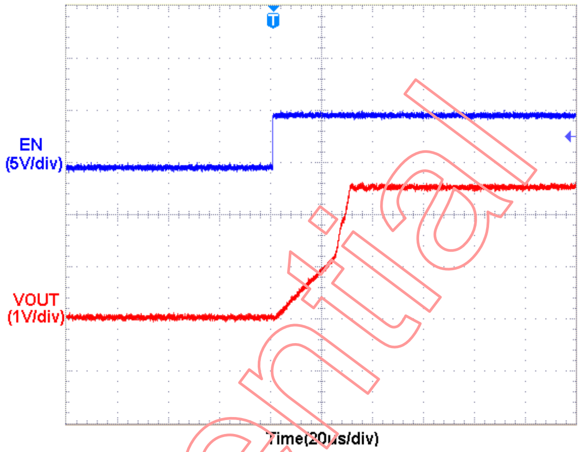
V_{OUT}=3.0V, I_{OUT}=1mA~150mA~1mA, V_{DD}=4.0V

tr=tf=0.5us

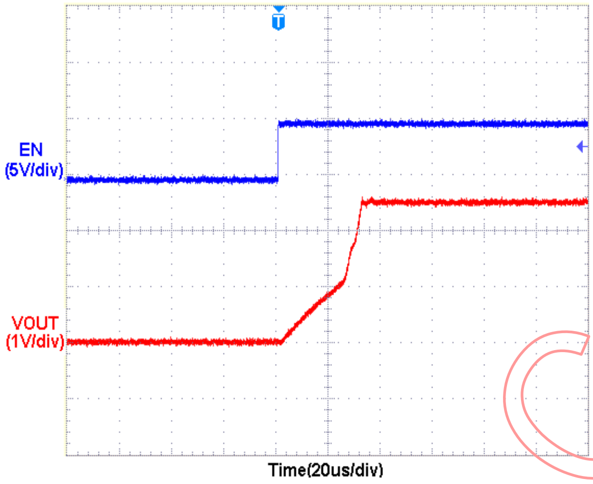
13. Turn On Speed with EN pin (Cin=1.0uF,Cout=1.0uF, Temp=25℃)



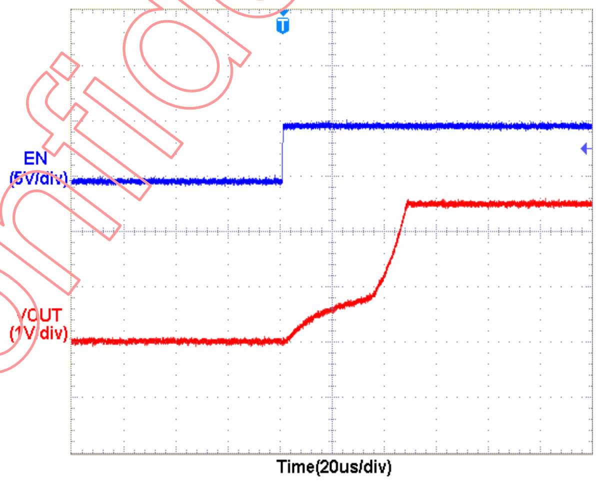
V_{OUT}=2.5V, I_{OUT}=0mA, V_{DD}=3.5V



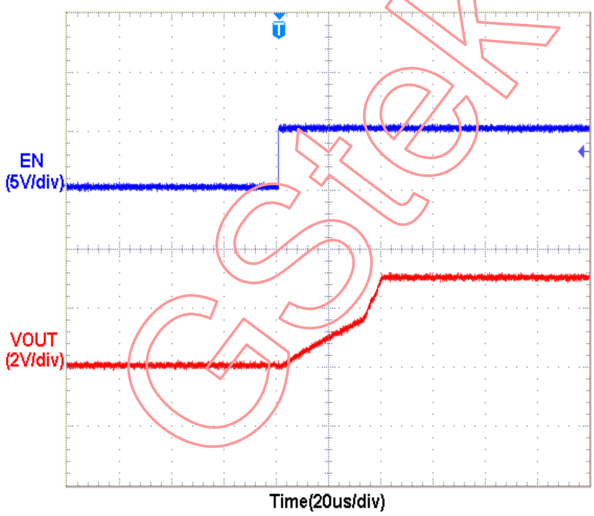
V_{OUT}=2.5V, I_{OUT}=10mA, V_{DD}=3.5V



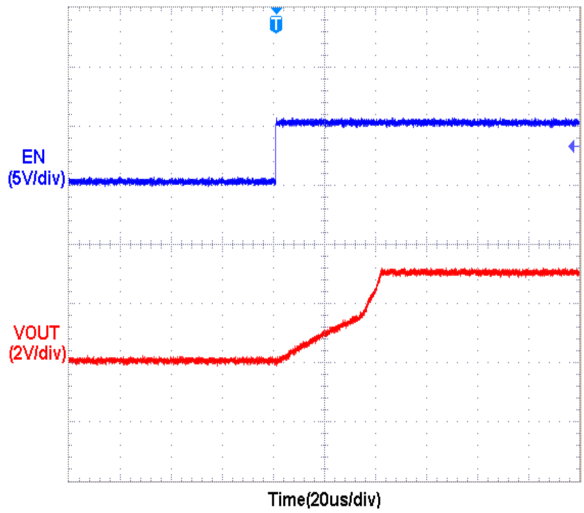
V_{OUT}=2.5V, I_{OUT}=30mA, V_{DD}=3.5V



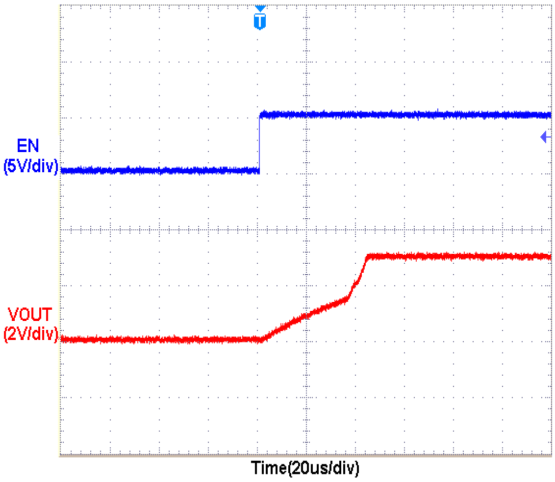
V_{OUT}=2.5V, I_{OUT}=150mA, V_{DD}=3.5V



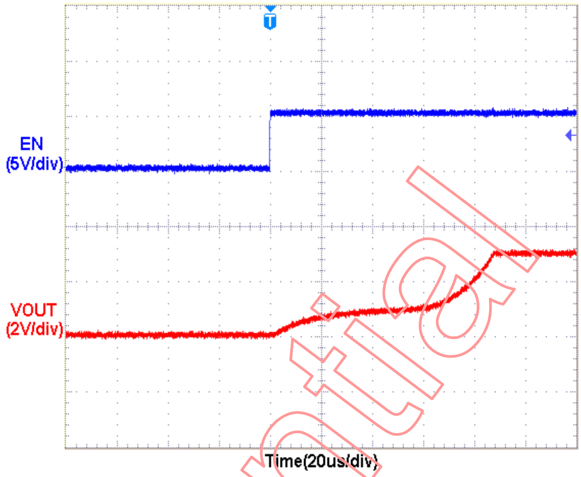
V_{OUT}=3.0V, I_{OUT}=0mA, V_{DD}=4.0V



V_{OUT}=3.0V, I_{OUT}=10mA, V_{DD}=4.0V

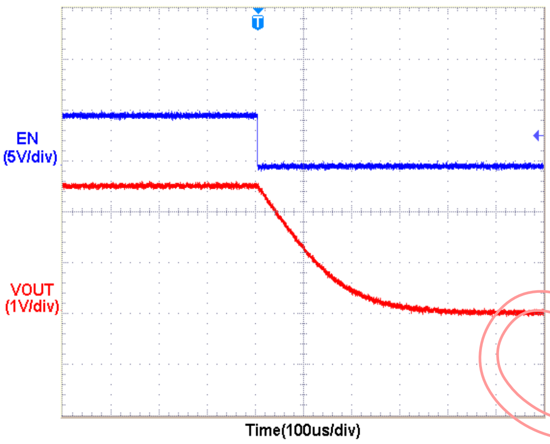


V_{OUT}=3.0V, I_{OUT}=30mA, V_{DD}=4.0V

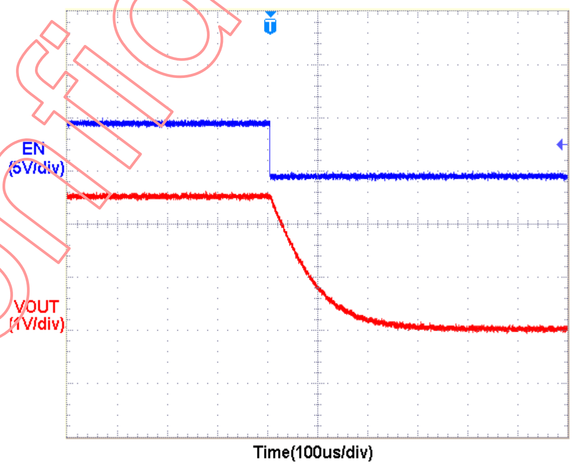


V_{OUT}=3.0V, I_{OUT}=150mA, V_{DD}=4.0V

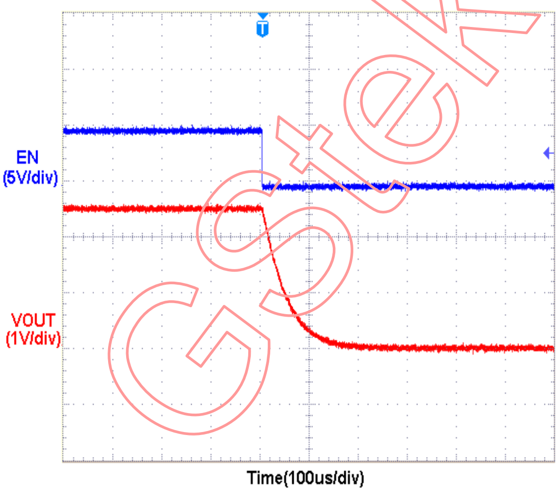
14. Turn Off Speed with EN pin (Auto Discharge) (Cin=1.0uF,Cout=1.0uF, Temp=25℃)



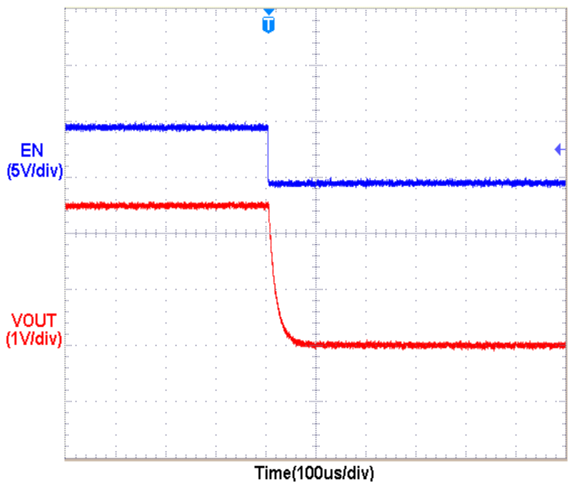
V_{OUT}=2.5V, I_{OUT}=0mA, V_{DD}=3.5V



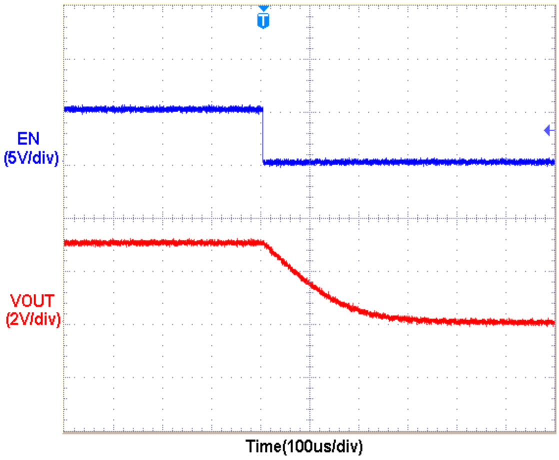
V_{OUT}=2.5V, I_{OUT}=10mA, V_{DD}=3.5V



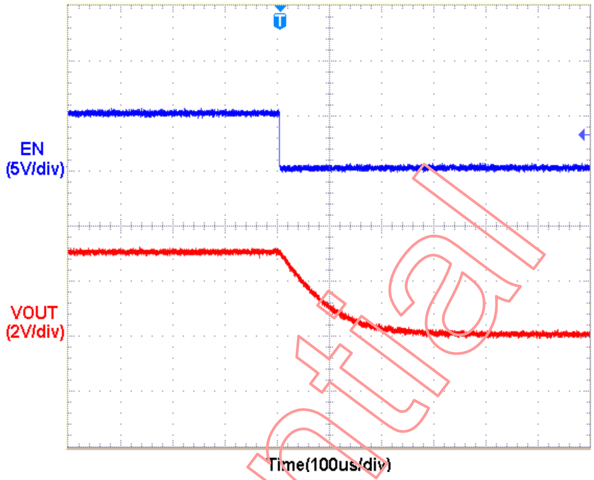
V_{OUT}=2.5V, I_{OUT}=30mA, V_{DD}=3.5V



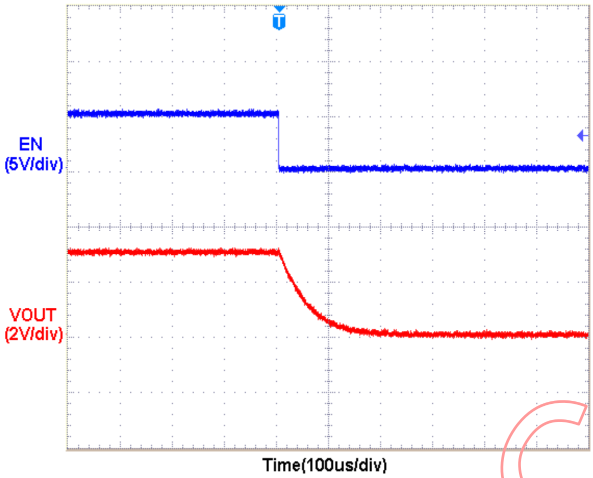
V_{OUT}=2.5V, I_{OUT}=150mA, V_{DD}=3.5V



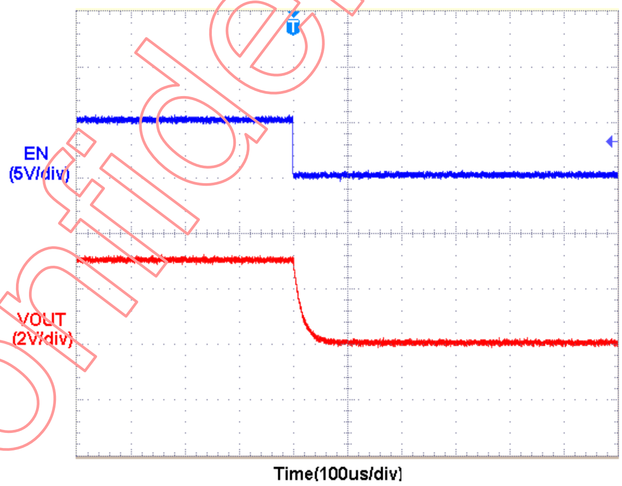
V_{OUT}=3.0V, I_{OUT}=0mA, V_{DD}=4.0V



V_{OUT}=3.0V, I_{OUT}=10mA, V_{DD}=4.0V



V_{OUT}=3.0V, I_{OUT}=30mA, V_{DD}=4.0V



V_{OUT}=3.0V, I_{OUT}=150mA, V_{DD}=4.0V

Application Information

Enable

The GS7156 has a dedicated enable pin(EN). When the EN pin is in the logic low (V_{EN}<0.3V), the regulator will be turned off, reducing the supply current to less than 1uA.

When the EN pin is in the logic high (V_{EN}>1.2V), the regulator will be turned on. Left open, the EN pin is pulled down by a internal resistor to shut down the regulator.

Current Limit and Short circuit current protection

The GS7156 use a current mirror to monitor the output current. A small portion of the PMOS output transistor's current is mirrored onto a resistor such that the voltage across this resistor is proportional to the output current; this voltage is compared against the feedback voltage. Once the output current cannot exceeds the limit. The current is set to 620mA typically.

When the output voltage is less than 0.2V, the short circuit current protection starts and maintains the loading current to 40mA. The output can be shorted to ground without damaging the device.

Output Capacitor

The GS7156 is specifically designed to employ ceramic output capacitors as low as 1uF (X7R). The ceramic capacitors offer significant cost and space savings, along with high frequency noise filtering. Place the capacitors physically as close as possible to the device with wide and direct PCB traces.

Ceramic capacitors have different temperature characteristics and bias characteristics which depend on their dimensions and manufacturers. If the setting voltage is 2.5V or more and the capacitor's dimensions for V_{OUT} equal to 1.0mm by 0.5mm or smaller than that, the capacitance value might be extremely low. As a result, the capacitance might be much less than expected value. In such cases, the operation might be unstable at low temperature (-25°C or less). In that case, use a larger capacity, or a large dimensions' capacitor. (For example 1.6mm by 0.8mm)

Input Capacitor

Good bypassing is recommended from input to ground to help improve AC performance. A 1uF (X7R) input capacitor or greater located as close as possible to the IC is recommended. Place the capacitors physically as close as possible to the device with wide and direct PCB traces.

Power Dissipation and Layout Considerations

Excessive power dissipation may cause thermal overload, and hence the increase of the IC junction temperature beyond a safe operating level. For continuous operation, it is highly recommended to keep the junction temperature below the maximum operation junction temperature 125°C for maximum reliability.

The relationship between θ_{JA} and $T_{J(MAX)}$ can be calculated as:

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

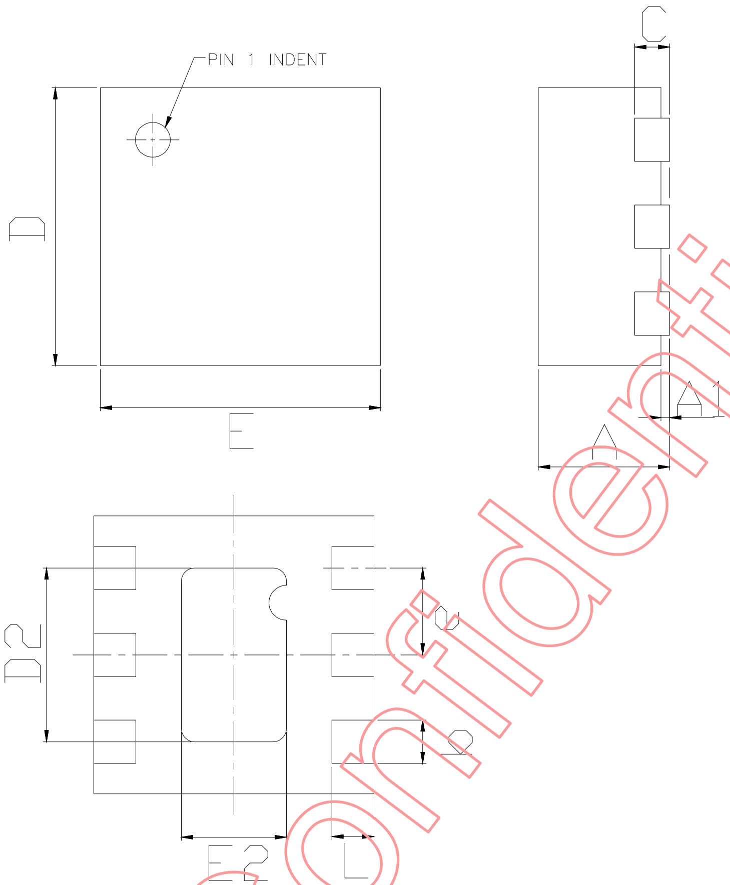
Where $T_{J(MAX)}$ is the maximum operation junction temperature 125°C, T_A is the ambient temperature and the θ_{JA} is the junction to ambient thermal resistance.

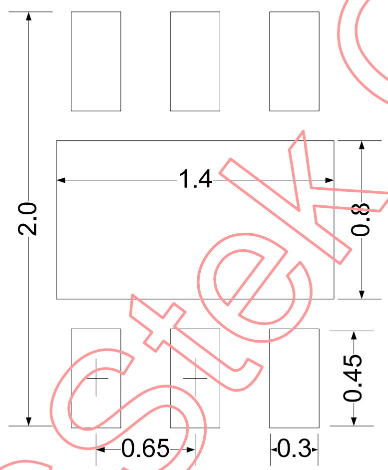
The power dissipation definition in device is:

$P_D = (V_{IN} - V_{OUT}) \times I_{OUT} + V_{DD} \times I_Q$

As the above equations indicate, it is desirable to work ICs whose θ_{JA} values are small such that $T_{J(MAX)}$ does not increase strongly with P_D. To avoid thermally overloading the GS7156, refrain from exceeding the absolute maximum junction temperature rating of 150°C under continuous operating condition. Overstressing the regulator with high loading currents and elevated input-to-output differential voltages can increase the IC die temperature significantly.

Package Dimensions, TDFN6-2x2





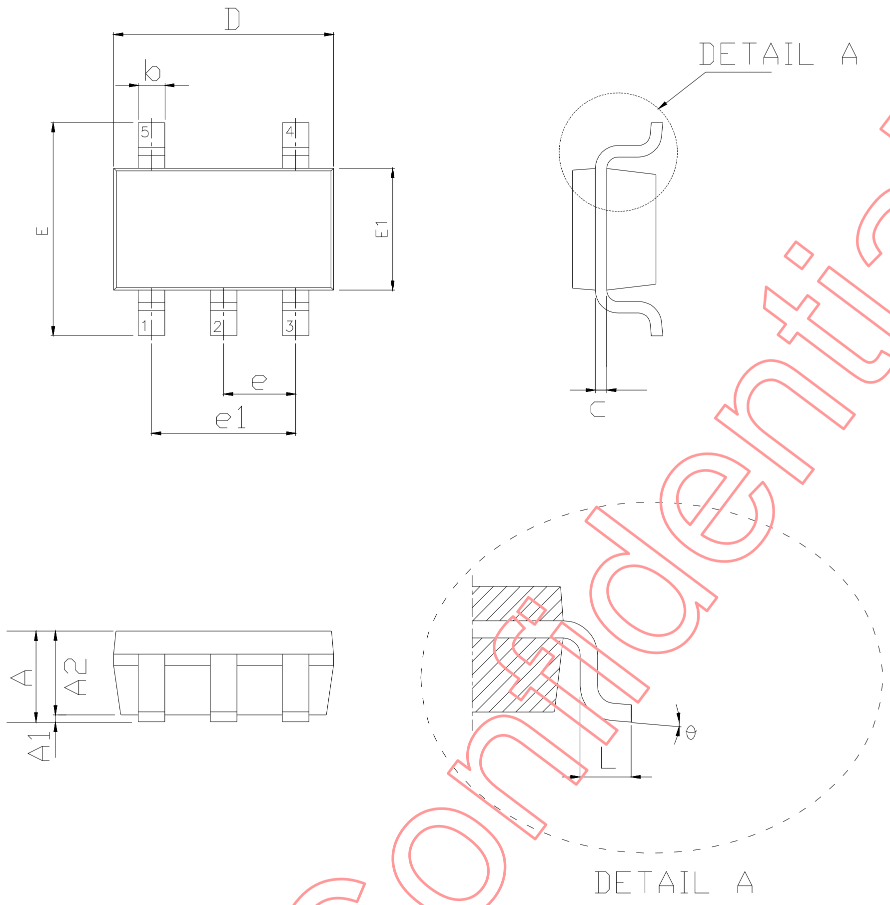
Unit: mm

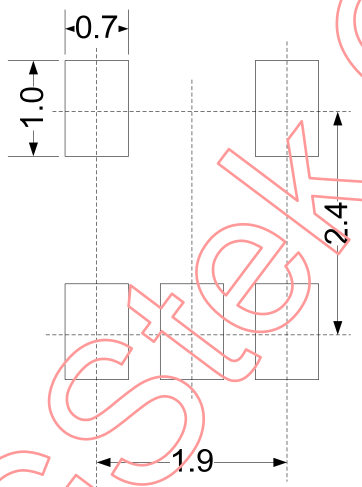
Symbol	Dimensions in Millimeters	
	Min.	Max.
A	0.70	0.90
A1	0.00	0.05
b	0.18	0.30
c	0.20 REF.	
D	1.90	2.10
D2	1.40 REF	
E	1.90	2.10
E2	0.80 REF	
e	0.65 REF.	
L	0.25	0.45

Note

1. Min.: Minimum dimension specified.
2. Max.: Maximum dimension specified.
3. REF.: Reference. Normal/Regular dimension specified for reference.

Package Dimensions, SOT-23-5





Unit: mm

Symbol	Dimensions in Millimeters	
	Min.	Max.
A	0.90	1.45
A1	0.00	0.15
A2	0.90	1.30
b	0.30	0.50
c	0.08	0.25
D	2.70	3.10
E	2.60	3.00
E1	1.20	1.80
e	0.95 REF.	
e1	1.90 REF.	
L	0.37 REF.	
θ	0°	10°

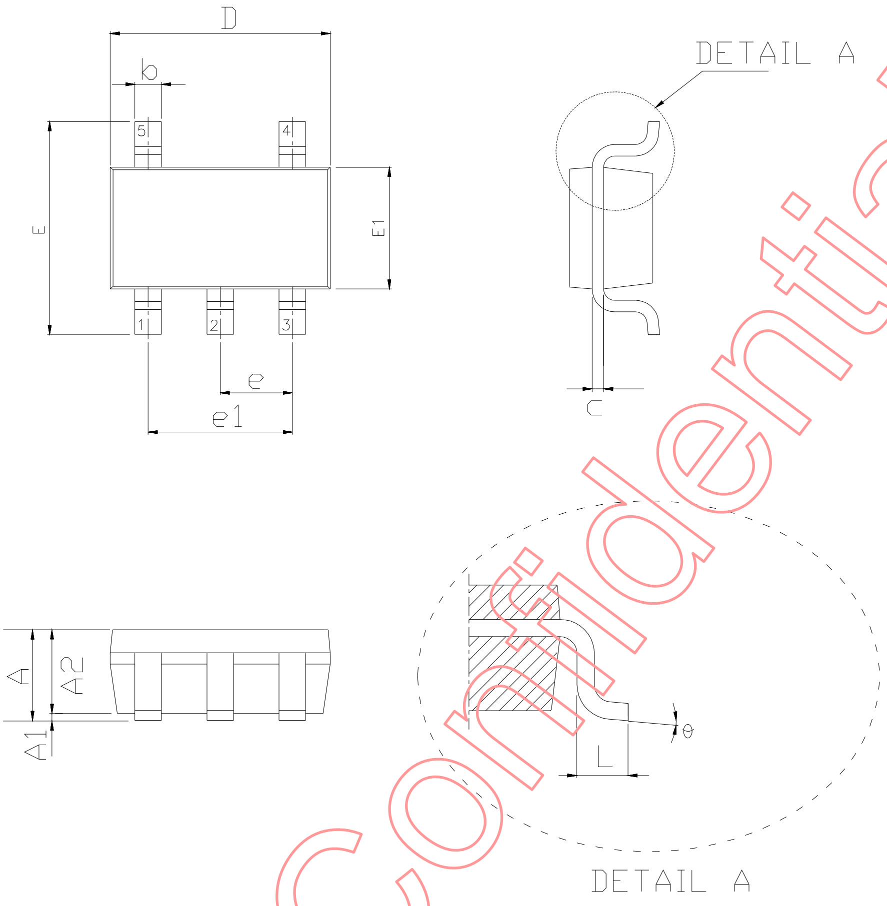
Note

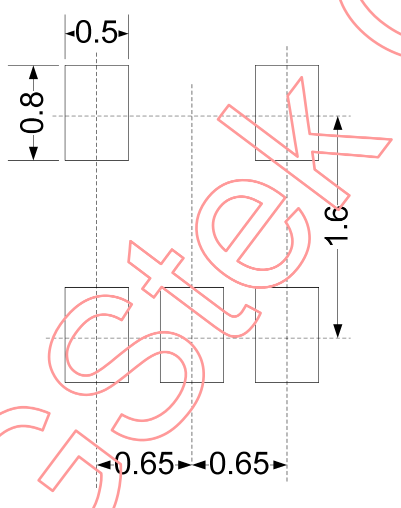
1.Min.: Minimum dimension specified.

2.Max.: Maximum dimension specified.

3.REF.: Reference. Normal/Regular dimension specified for reference.

Package Dimensions, SOT-353





Unit: mm

Symbol	Dimensions in Millimeters	
	Min.	Max.
A	0.80	1.10
A1	0.00	0.10
A2	0.70	1.00
b	0.15	0.35
c	0.08	0.22
D	1.80	2.20
E	1.80	2.45
E1	1.15	1.35
e	0.65 REF.	
e1	1.30 REF.	
L	0.36 REF.	
θ	0^{o}	8^{o}

Note

1.Min.: Minimum dimension specified.

2.Max.: Maximum dimension specified.

3.REF.: Reference. Normal/Regular dimension specified for reference.

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