TOSHIBA CMOS Linear Integrated Circuit Silicon Monolithic

TCR2LF series
TCR2LE series

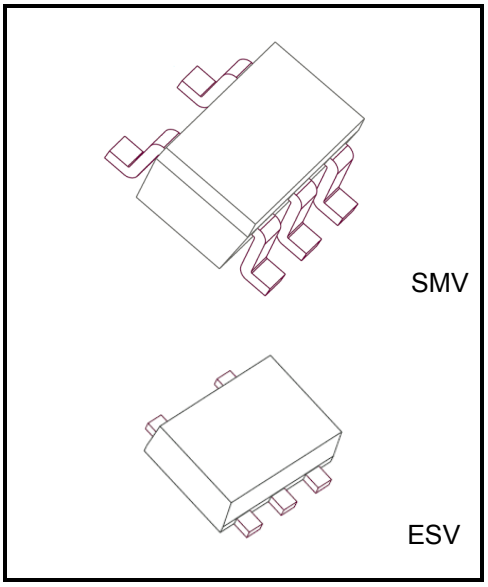
Ultra low quiescent current
200 mA CMOS Low Drop-Out Regulator in ultra small package

The TCR2LF and TCR2LE series are CMOS general-purpose single-output voltage regulators with an on/off control input, featuring ultra low quiescent bias current and low dropout voltage.

These voltage regulators are available in fixed output voltages between 0.8 V and 3.6 V and capable of driving up to 200 mA. They feature overcurrent protection and Auto-discharge function.

The package is general SMV(SOT-25) (2.8 mm x 2.9 mm x 1.1 mm) and ESV(SOT-553) (1.6 mm x 1.6 mm x 0.55 mm), and has a low dropout voltage of 270 mV (2.5 V output, IOUT = 150 mA).

As small ceramic input and output capacitors 0.1μF can be used with the TCR2LF and TCR2LE series, these devices are ideal for portable applications that require high-density board assembly such as cellular phones.



Weight :
SMV (SOT-25)(SC-74A) : 16.0 mg (typ.)
ESV (SOT-553) : 3.0 mg (typ.)

Features

- Low quiescent bias current (I_B = 2 μA (max) at I_{OUT} = 0 mA, T_j = -40 to 85°C)
- Low Drop-Out voltage
  V_{IN}-V_{OUT} = 270 mV (typ.) at 2.5 V-output, I_{OUT} = 150 mA
- Wide range output voltage line up (V_{OUT} = 0.8 to 3.6 V)
- High V_{OUT} accuracy ±1.0% (1.8V ≤ V_{OUT})
- Overcurrent protection
- Auto-discharge
- Pull down connection between CONTROL and GND
- Ceramic capacitors can be used (C_{IN} = 0.1 μF, C_{OUT} =0.1 μF)
- General package SMV(SOT-25) (2.8 mm x 2.9 mm x 1.1 mm) and ESV(SOT-553) (1.6 mm x 1.6 mm x 0.55 mm)

Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating			Unit
Input voltage	V_{IN}	6.0			V
Control voltage	V_{CT}	-0.3 to 6.0			V
Output voltage	V_{OUT}	-0.3 to V_{IN} + 0.3			V
Output current	I_{OUT}	200			mA
Power dissipation	P_D	SMV	200	(Note1)	mW
			580	(Note 2)	
		ESV	150	(Note 1)	
			320	(Note 3)	
Operation temperature range	T_{opr}	−40 to 85			°C
Junction temperature	T_j	150			°C
Storage temperature range	T_{stg}	−55 to 150			°C

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook (“Handling Precautions”/“Derating Concept and Methods”) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

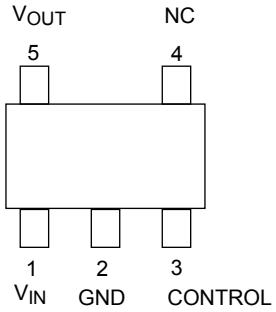
Note 1: Unit Rating

Note 2: Rating at mounting on a board
(FR4 board: 25.4 mm × 25.4 mm × 1.6 mm)

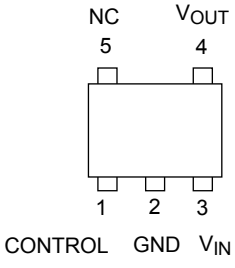
Note 3: Rating at mounting on a board
(FR4 board dimension: 30 mm × 30 mm × 0.8 mm)

Pin Assignment (top view)

SMV(SOT-25)(SC-74A)



ESV(SOT-553)



List of Products Number, Output voltage and Marking

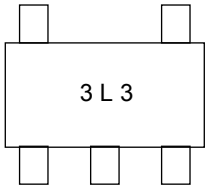
TCR2LF and TCR2LE series

Product No.		V_{OUT}(V) (typ.)	Marking	Product No.		V_{OUT}(V) (typ.)	Marking
SMV(SOT-25)	ESV(SOT-553)			SMV(SOT-25)	ESV(SOT-553)		
TCR2LF08	TCR2LE08	0.8	0L8	TCR2LF19	TCR2LE19	1.9	1L9
TCR2LF085	TCR2LE085	0.85	0LD	TCR2LF20	TCR2LE20	2.0	2L0
TCR2LF09	TCR2LE09	0.9	0L9	TCR2LF21	TCR2LE21	2.1	2L1
TCR2LF095	TCR2LE095	0.95	0LE	TCR2LF25	TCR2LE25	2.5	2L5
TCR2LF10	TCR2LE10	1.0	1L0	TCR2LF27	TCR2LE27	2.7	2L7
TCR2LF105	TCR2LE105	1.05	1LA	TCR2LF28	TCR2LE28	2.8	2L8
TCR2LF11	TCR2LE11	1.1	1L1	TCR2LF285	TCR2LE285	2.85	2LD
TCR2LF115	TCR2LE115	1.15	1LB	TCR2LF30	TCR2LE30	3.0	3L0
TCR2LF12	TCR2LE12	1.2	1L2	TCR2LF31	TCR2LE31	3.1	3L1
TCR2LF13	TCR2LE13	1.3	1L3	TCR2LF32	TCR2LE32	3.2	3L2
TCR2LF15	TCR2LE15	1.5	1L5	TCR2LF33	TCR2LE33	3.3	3L3
TCR2LF18	TCR2LE18	1.8	1L8	TCR2LF36	TCR2LE36	3.6	3L6

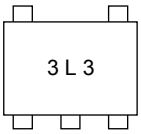
* Please contact local Toshiba representative if you are interested in product that output voltage is not in the list.

Marking (top view)

Example: TCR2LF33 (3.3 V output)



Example: TCR2LE33 (3.3 V output)



Electrical Characteristics

(Unless otherwise specified,

V_{IN} = V_{OUT}+1 V (V_{OUT}>1.5V), V_{IN}=2.5V (V_{OUT}≤1.5V), I_{OUT} = 50 mA, C_{IN} = 0.1 μF, C_{OUT} = 0.1 μF)

Characteristics	Symbol	Test Condition		T_j = 25°C			T_j = -40 to 85°C		Unit
				Min	Typ.	Max	Min	Max	
Output voltage accuracy	V_{OUT}	I_{OUT} = 50 mA (Note 4)	V_{OUT} <1.8 V	-18	—	+18	—	—	mV
			1.8V ≤ V_{OUT}	-1.0	—	+1.0	—	—	%
Input voltage	V_{IN}	I_{OUT} = 1 mA		1.5	—	5.5	1.5	5.5	V
Line regulation	Reg·line	V_{OUT} + 0.5 V ≤ V_{IN} ≤ 5.5 V, I_{OUT} = 1 mA		—	1	15	—	—	mV
Load regulation	Reg·load	1 mA ≤ I_{OUT} ≤ 150 mA		—	15	30	—	—	mV
Quiescent current	I_B	I_{OUT} = 0 mA (Note 5)		—	1.0	—	—	2.0	μA
Stand-by current	$I_{B\ (OFF)}$	V_{CT} = 0 V		—	0.1	—	—	1.0	μA
Control pull down current	I_{CT}	—		—	0.1	—	—	—	μA
Drop-out voltage	V_{IN}-V_{OUT}	I_{OUT} = 150 mA	V_{OUT} = 1.8V	—	370	—	—	620	mV
			V_{OUT} = 3.0V	—	220	—	—	300	mV
Temperature coefficient	T_{CVO}	−40°C ≤ T_{opr} ≤ 85°C		—	75	—	—	—	ppm/°C
Control voltage (ON)	$V_{CT\ (ON)}$	—		1.0	—	5.5	1.0	5.5	V
Control voltage (OFF)	$V_{CT\ (OFF)}$	—		0	—	0.4	0	0.4	V
Discharge on resistance	R_{SD}	—		—	20	—	—	—	Ω

Note 4: Stable state with fixed I_{OUT} condition
Note 5: Except Control pull down current

Drop-out voltage

(I_{OUT} = 150 mA, C_{IN} = 0.1 μF, C_{OUT} = 0.1 μF, T_j = 25°C)

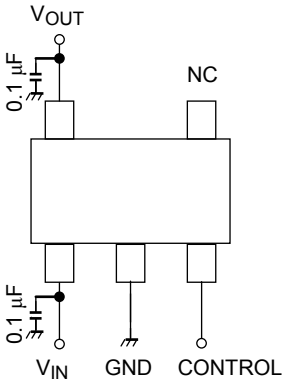
Output voltages	Symbol	Min	Typ.	Max(Note 6)	Unit
0.8 V ≦ V_{OUT} < 0.9 V	V_{IN}-V_{OUT}	—	1020	1580	mV
0.9 V ≦ V_{OUT} < 1.0 V		—	940	1480	
1.0 V ≦ V_{OUT} < 1.1 V		—	860	1400	
1.1 V ≦ V_{OUT} < 1.2 V		—	780	1300	
1.2 V ≦ V_{OUT} < 1.3 V		—	700	1250	
1.3 V ≦ V_{OUT} < 1.6 V		—	620	1130	
1.6 V ≦ V_{OUT} < 1.8 V		—	470	860	
1.8 V ≦ V_{OUT} < 2.0 V		—	370	620	
2.0 V ≦ V_{OUT} < 2.5 V		—	320	560	
2.5 V ≦ V_{OUT} < 3.0 V		—	270	380	
3.0 V ≦ V_{OUT} ≦ 3.6 V		—	220	300	

Note 6: T_j = -40 to 85°C

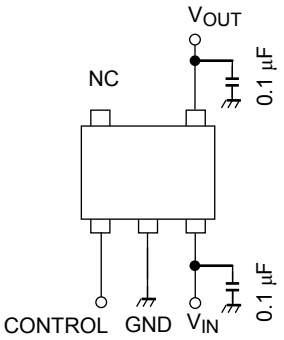
Application Note

1. Recommended Application Circuit

●SMV



●ESV



CONTROL pin connection	Operation
HIGH	ON
LOW	OFF
OPEN	OFF

The figure above shows the recommended configuration for using a Low-Dropout regulator. Insert a capacitor at V_{OUT} and V_{IN} pins for stable input/output operation. (Ceramic capacitors can be used).

2. Power Dissipation

Both unit and board-mounted power dissipation ratings for TCR2LF series and TCR2LE series are available in the Absolute Maximum Ratings table.

Power dissipation is measured on the board shown below.

Testing Board of Thermal Resistance

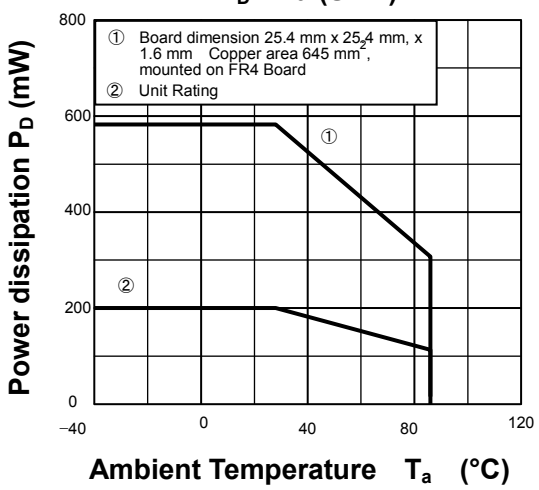
SMV

*Board material: FR4 board
Board dimension: 25.4 mm × 25.4 mm × 1.6 mm
Copper area: 645 mm^2

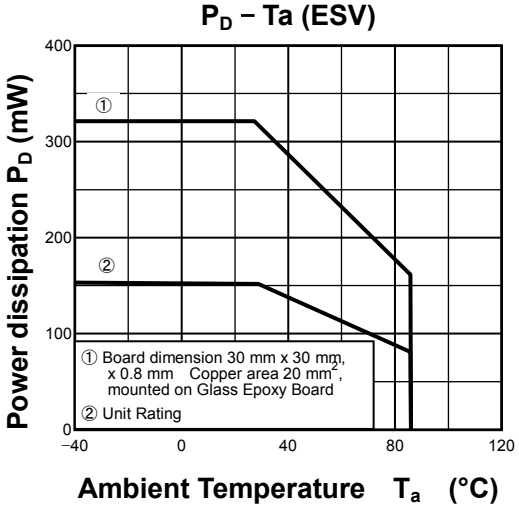
ESV

*Board material: FR4
Board dimension: 30 mm × 30 mm × 0.8 mm
Copper area: 20 mm^2

P_D − Ta (SMV)



P_D − Ta (ESV)



Attention in Use

- Output Capacitors
  Ceramic capacitors can be used for these devices. However, because of the type of the capacitors, there might be unexpected thermal features. Please consider application condition for selecting capacitors. And Toshiba recommend the ESR of ceramic capacitor is under 10 Ω.

- Mounting
  The long distance between IC and output capacitor might affect phase assurance by impedance in wire and inductor. For stable power supply, output capacitor need to mount near IC as much as possible. Also VIN and GND pattern need to be large and make the wire impedance small as possible.

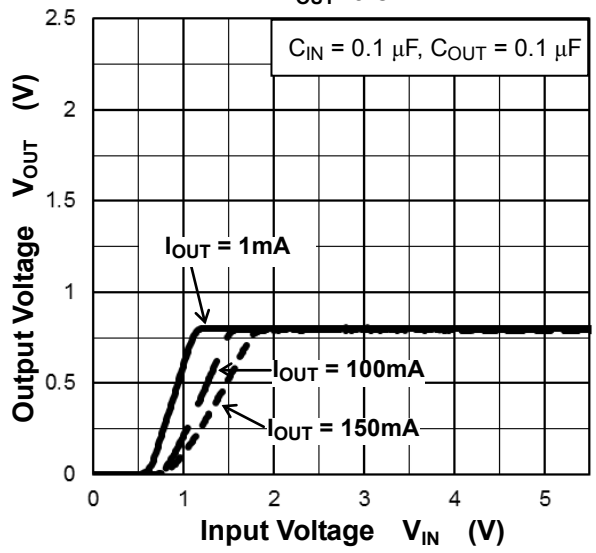
- Permissible Loss
  Please have enough design patterns for expected maximum permissible loss. And under consideration of surrounding temperature, input voltage, and output current etc, we recommend proper dissipation ratings for maximum permissible loss; in general maximum dissipation rating is 70 to 80 percent.

- Overcurrent Protection Circuit
  Overcurrent protection circuit is designed in these products, but this does not assure for the suppression of uprising device operation. If output pins and GND pins are shorted out, these products might be break down.
  In use of these products, please read through and understand dissipation idea for absolute maximum ratings from the above mention or our ‘Semiconductor Reliability Handbook’. Then use these products under absolute maximum ratings in any condition. Furthermore, Toshiba recommend inserting failsafe system into the design.

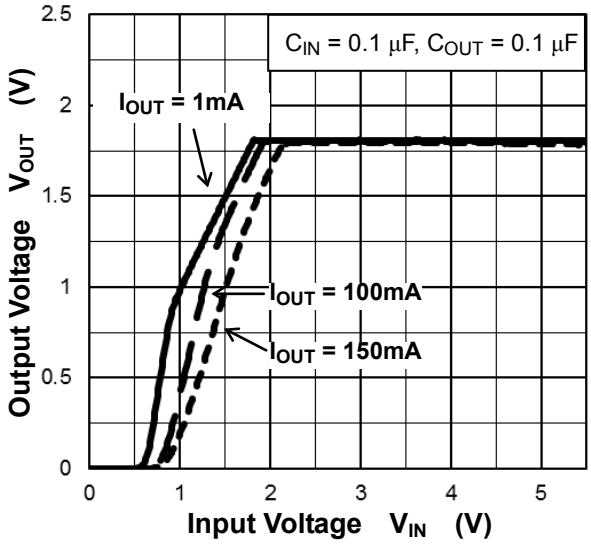
Representative Typical Characteristics

1) Output Voltage vs. Input Voltage

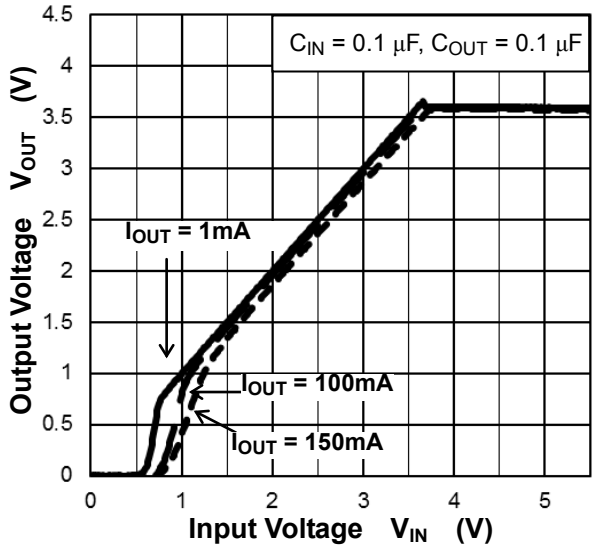
V_{OUT}=0.8V



V_{OUT}=1.8V

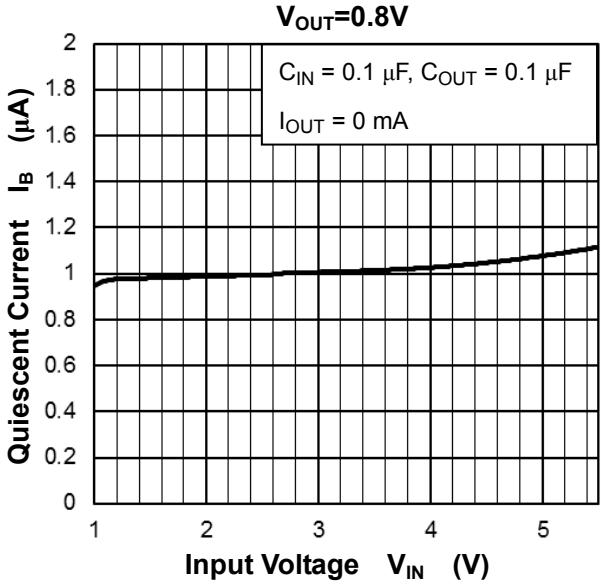


V_{OUT}=3.6V

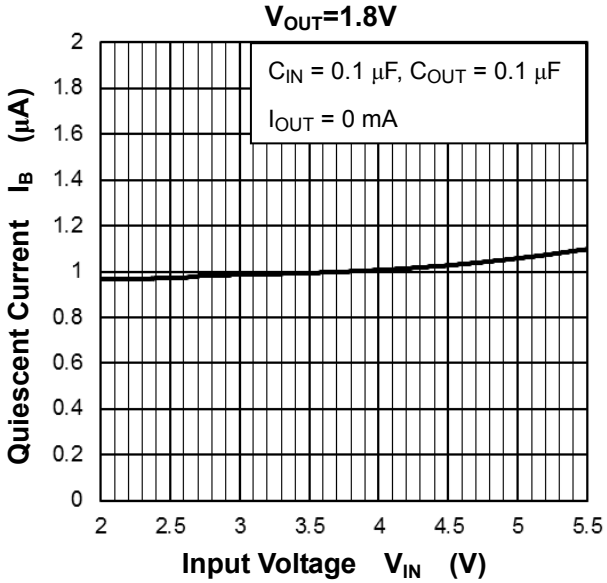


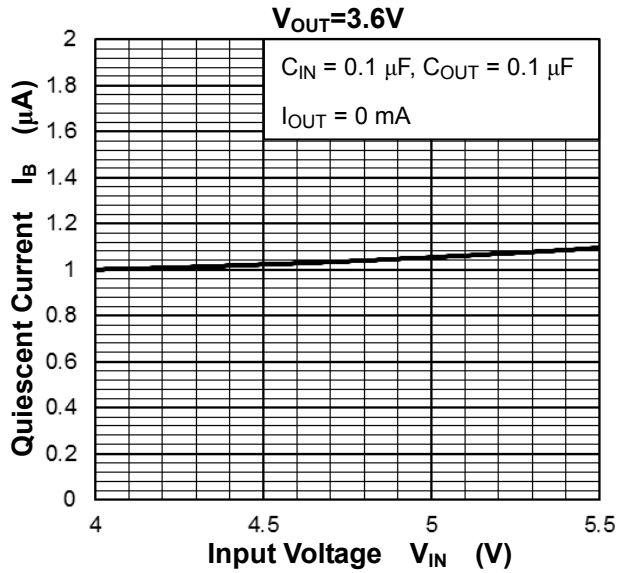
2) Quiescent Current vs. Input Voltage

V_{OUT}=0.8V

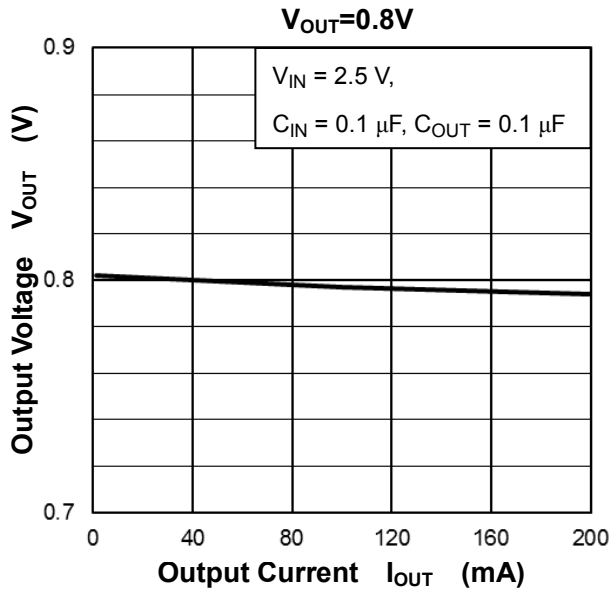


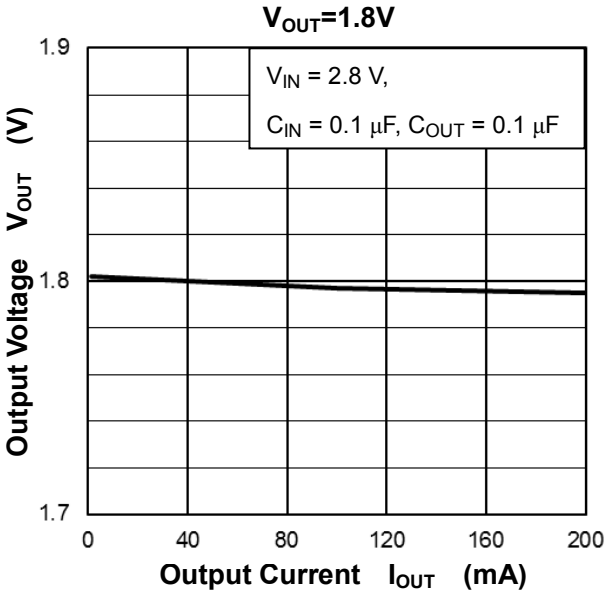
V_{OUT}=1.8V

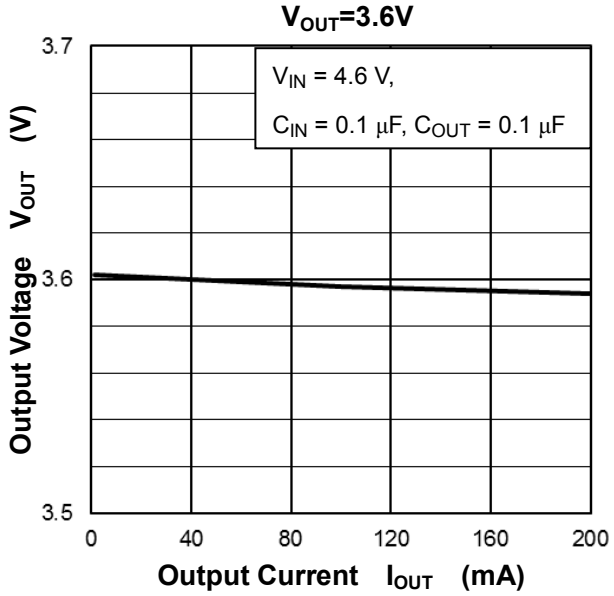




3) Output Voltage vs. Output Current

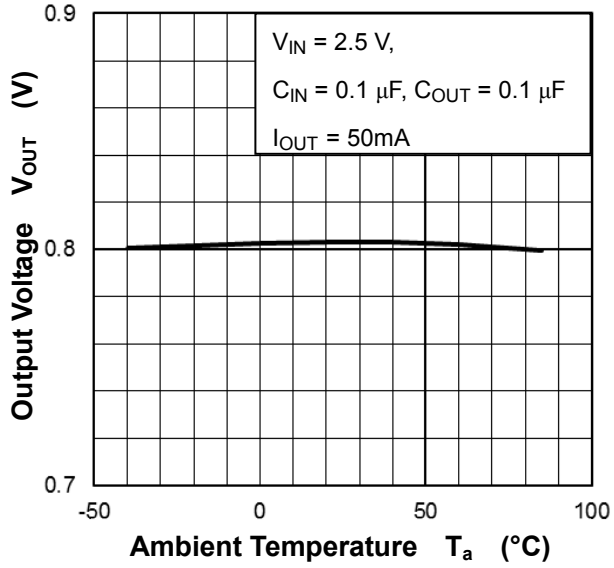




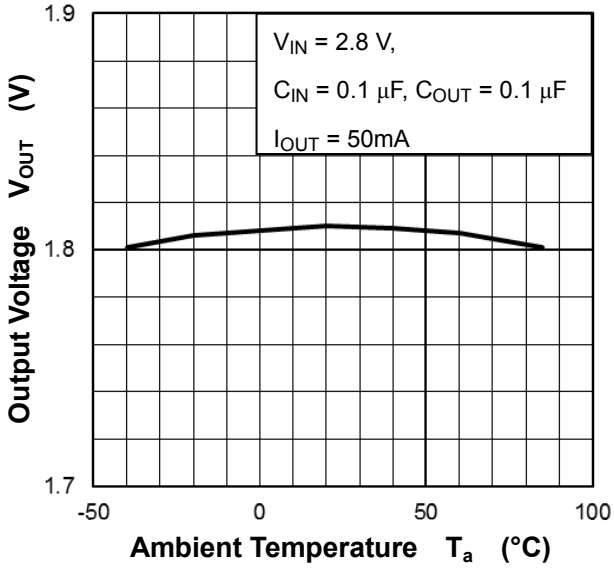


4) Output Voltage vs. Ambient Temperature

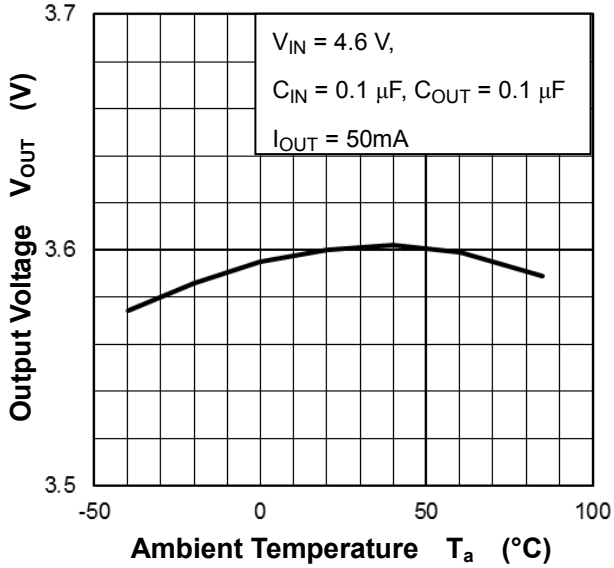
V_{OUT}=0.8V



V_{OUT}=1.8V

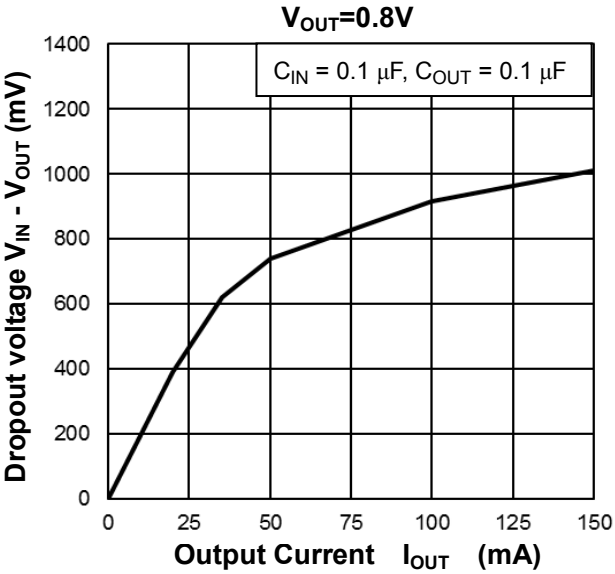


V_{OUT}=3.6V

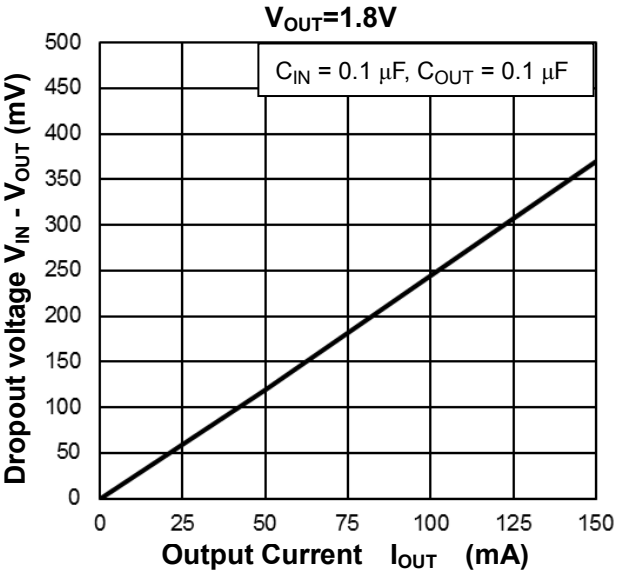


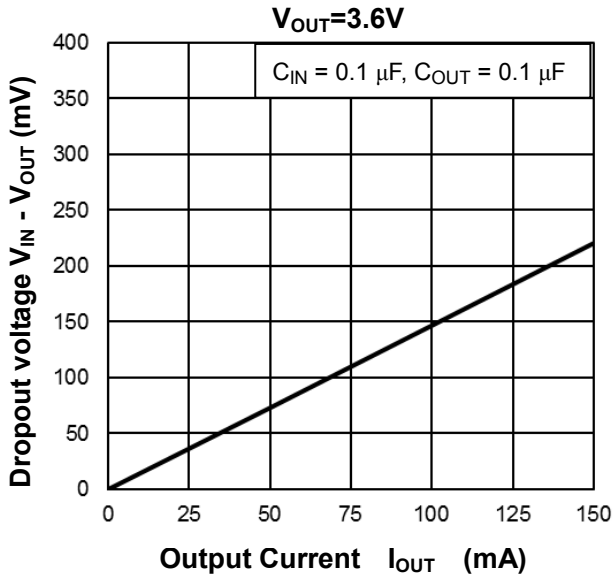
5) Dropout Voltage vs. Output Current

V_{OUT}=0.8V

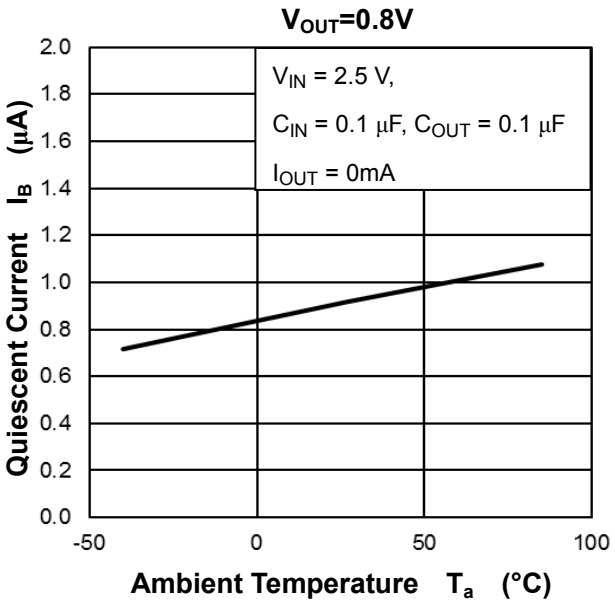


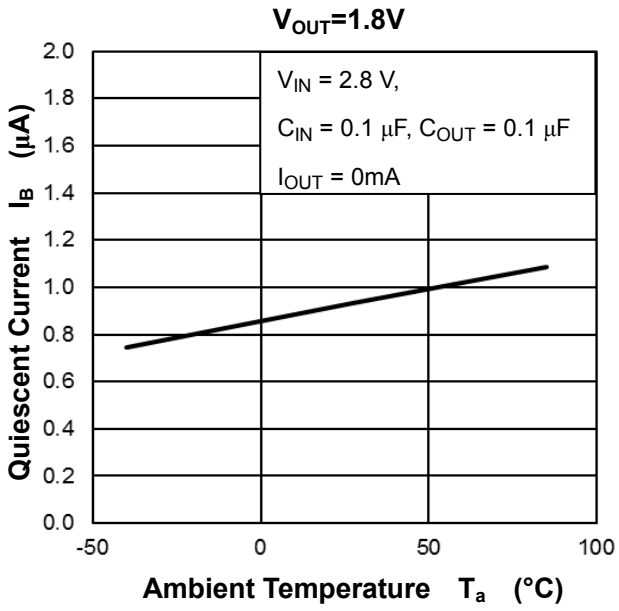
V_{OUT}=1.8V

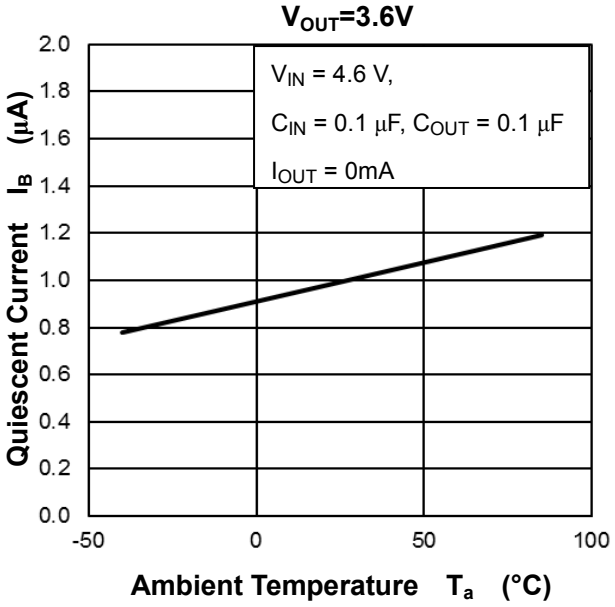




6) Quiescent Current vs. Ambient Temperature

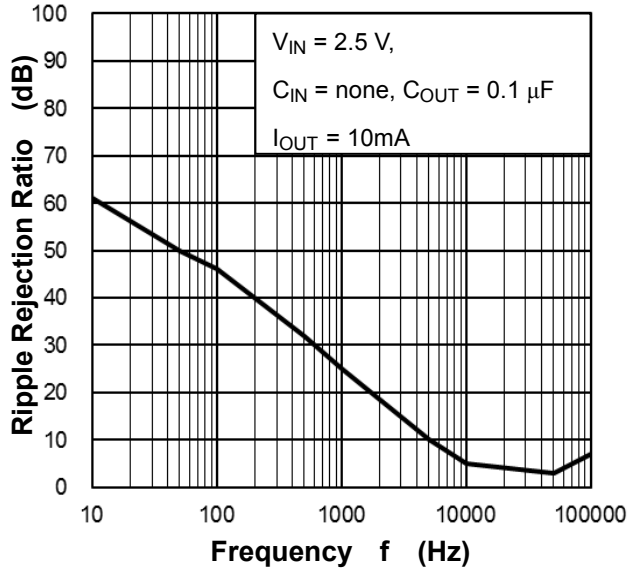




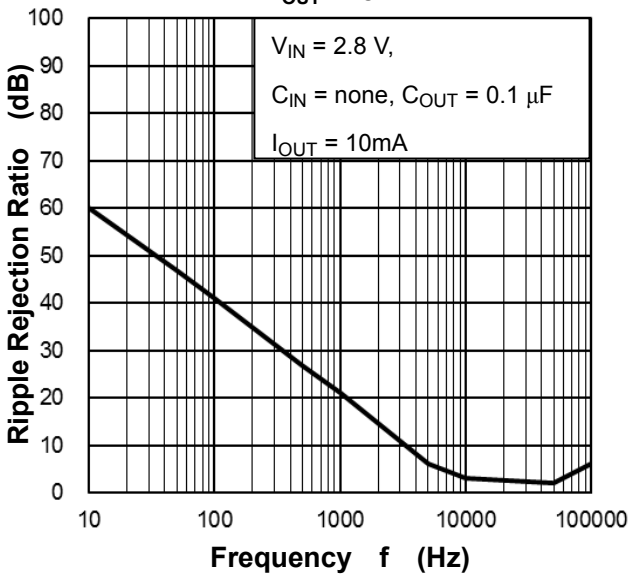


7) Ripple Rejection Ratio vs. Frequency

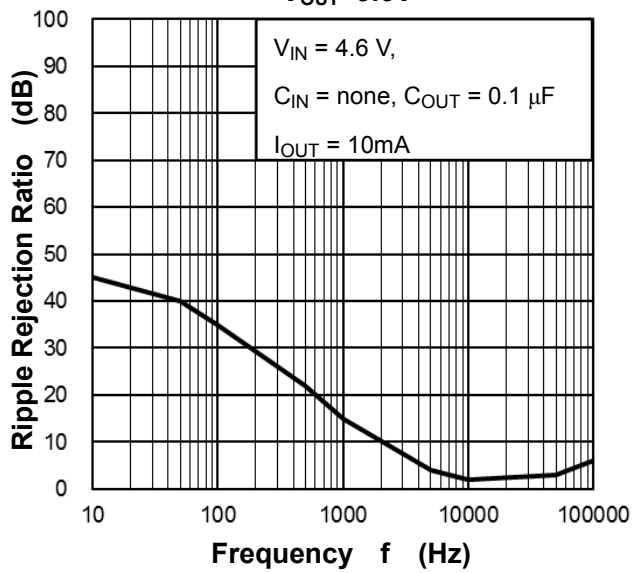
V_{OUT}=0.8V



V_{OUT}=1.8V

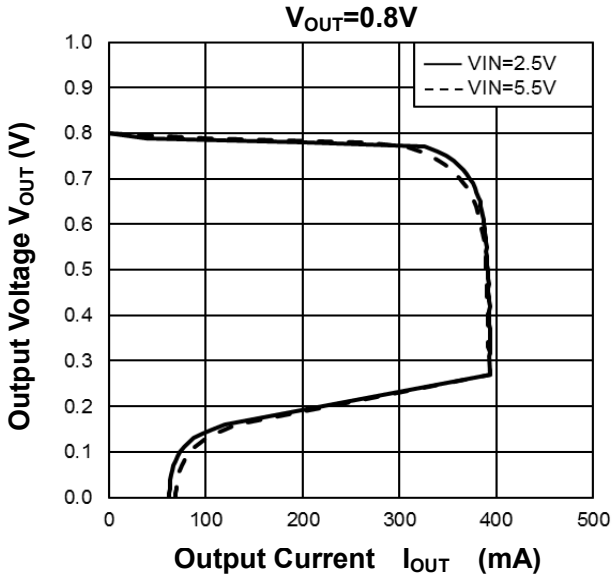


V_{OUT}=3.6V

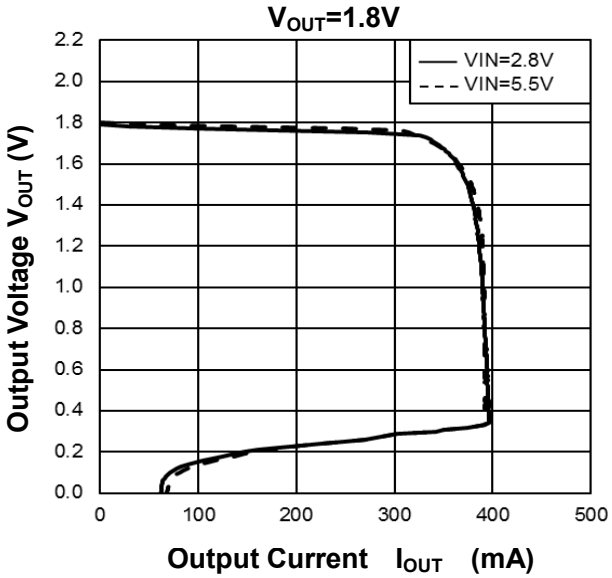


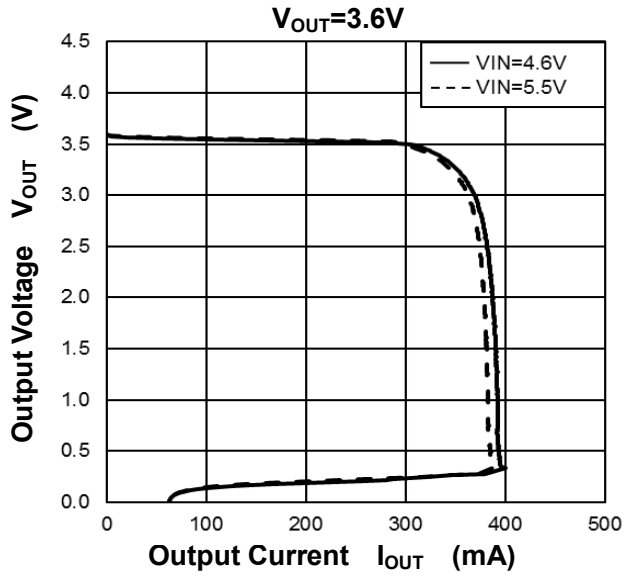
8) Output Voltage vs. Output Current

V_{OUT}=0.8V

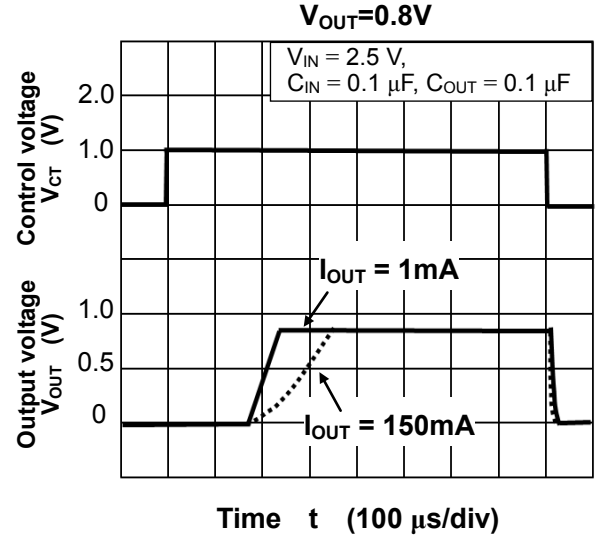


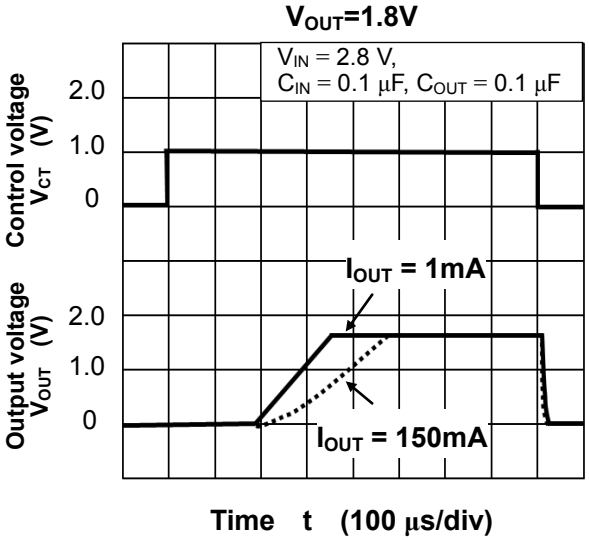
V_{OUT}=1.8V

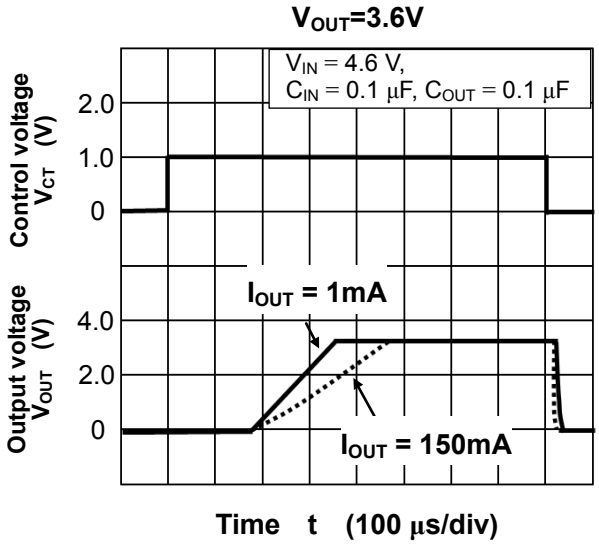




9) Control Transient vs. Response

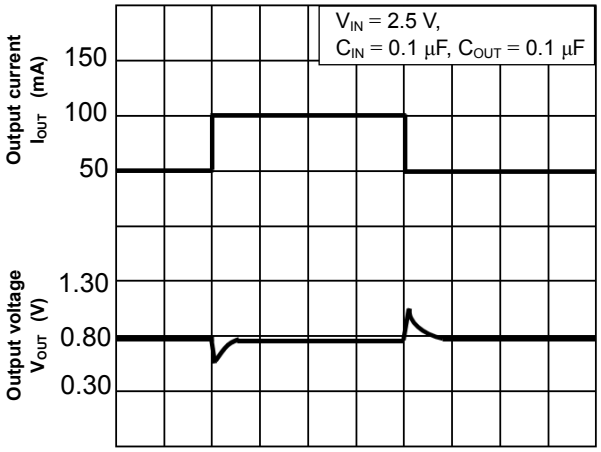




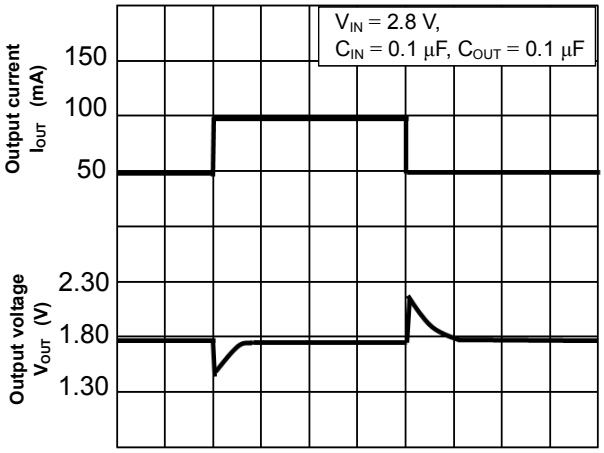


10) Load Transient Response

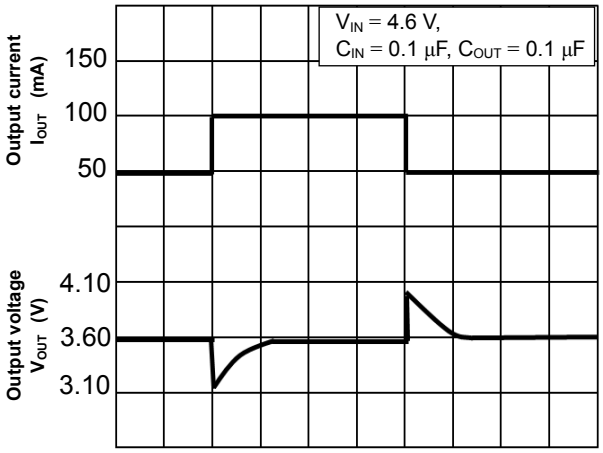
V_{OUT}=0.8V
(I_{OUT} = 50mA ⇔ 100mA)



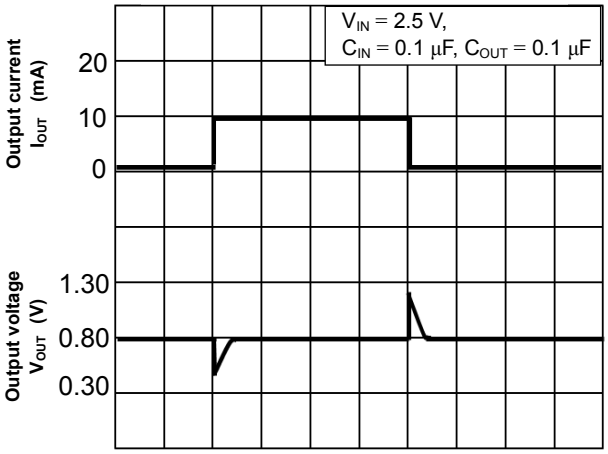
V_{OUT}=1.8V
(I_{OUT} = 50mA ⇔ 100mA)



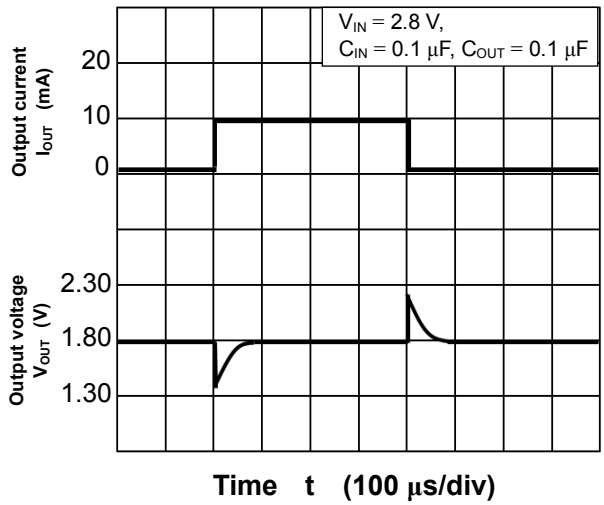
V_{OUT}=3.6V
(I_{OUT} = 50mA ⇔ 100mA)



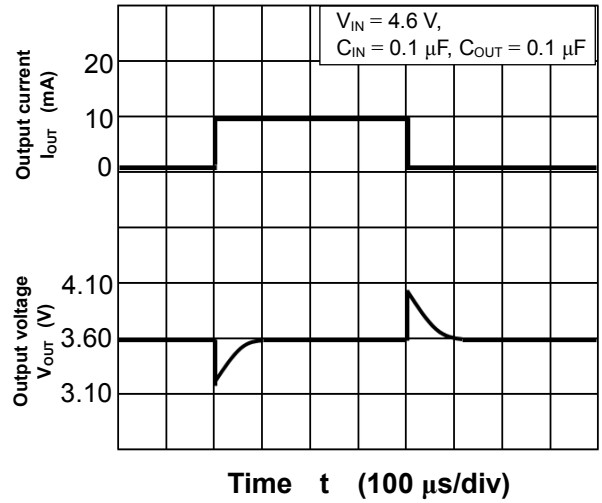
V_{OUT}=0.8V
(I_{OUT} = 1mA ⇔ 10mA)



V_{OUT}=1.8V
(I_{OUT} = 1mA ⇔ 10mA)

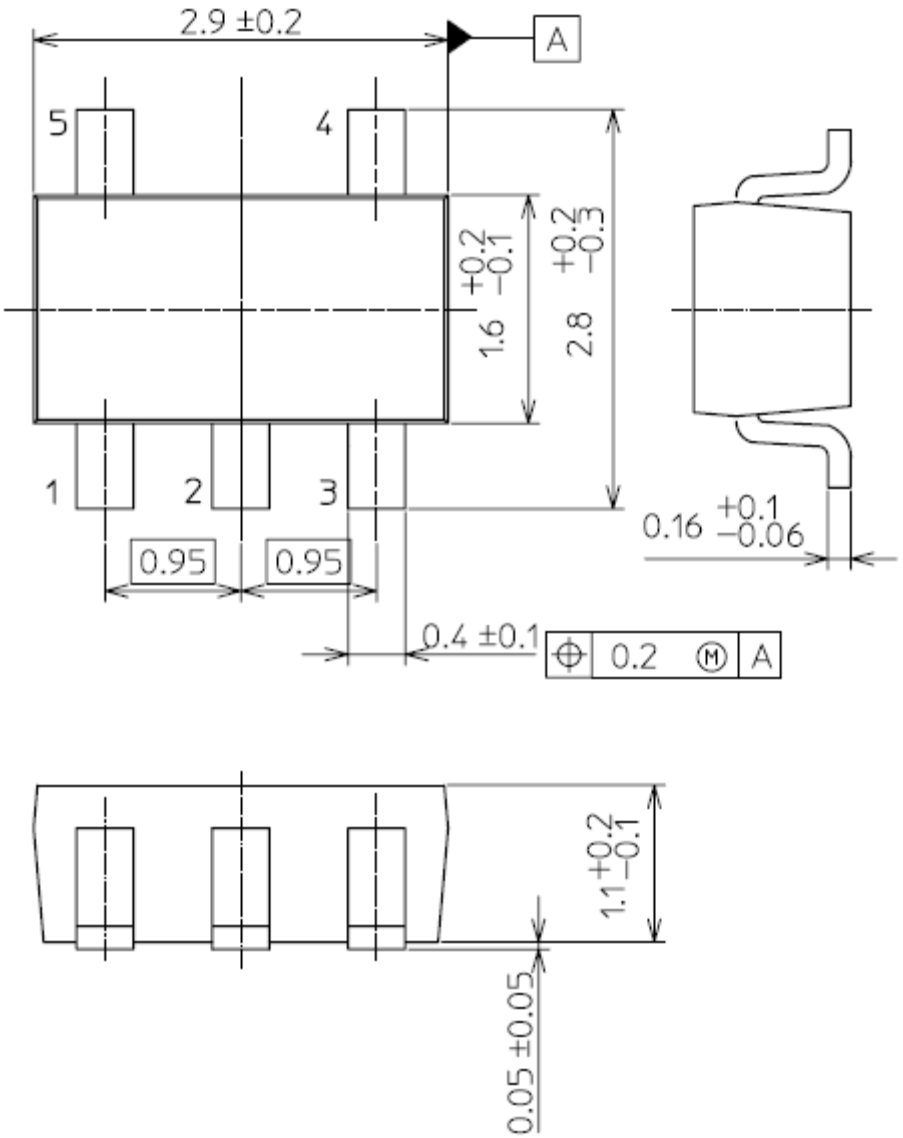


V_{OUT}=3.6V
(I_{OUT} = 1mA ⇔ 10mA)



Package Dimensions

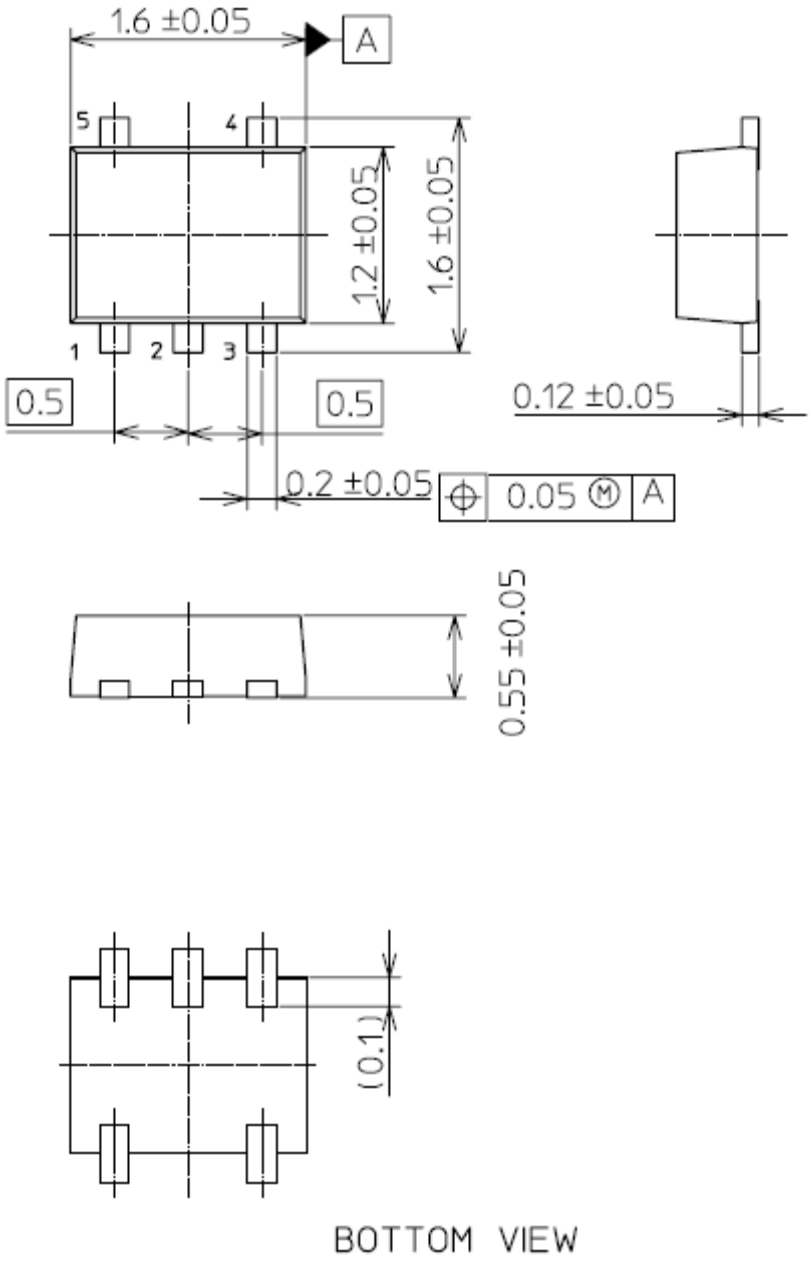
SMV (SOT-25)(SC-74A) **Unit: mm**



Weight : 16.0 mg (typ.)

Package Dimensions

ESV (SOT-553) **Unit: mm**



Weight: 3.0 mg (typ.)

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