TOSHIBA CMOS Linear Integrated Circuit Silicon Monolithic

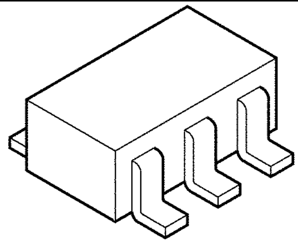
TCR5SB15～TCR5SB50

200mA CMOS Low-Dropout Regulator (Point Regulator)

TCR5SB15~TCR5SB50 are single output voltage regulators for general purpose in CMOS process, and these provide low dropout, low bias current, and control function. TCR5SB15~TCR5SB50 perform ON/OFF operation for IC by control pin.

Output voltage is fixed from 1.5V to 5.0V by per 0.1V step. Maximum output current is 200mA, and overcurrent protection circuit is designed in.

Package sizes are available in SMV (SOT23-5) (SC-74A), and compact ceramic capacitors can be used at input and output. These devices are suitable for use of portable equipment such as cellular phone.



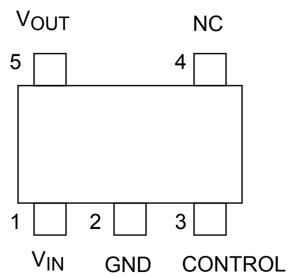
SSOP5-P-0.95 (SMV)

Weight: 0.014 g (typ.)

Features

- Low quiescent current (I_B = 40 μA (typ.) at I_{OUT} = 0 mA)
- Low stand-by current ($I_{B(OFF)}$ = 0.1 μA (typ.) @ Stand-by mode)
- Low-dropout voltage (V_{IN} - V_{OUT} = 85 mV (typ.) at TCR5SB30, I_{OUT} = 50 mA)
- High current output (I_{OUT} = 200 mA (max))
- High ripple rejection (R.R = 80 dB (typ) @ I_{OUT} = 10 mA, f =1kHz)
- Low output noise voltage (V_{NO} = 30 μV_{rms} (typ.) @ TCR5SB30, I_{OUT} = 10 mA, 10 Hz ≦ f ≦ 100 kHz)
- Control voltage can be allowed from -0.3 to 6 V regardless of V_{IN} voltage.
- Overcurrent protection
- Ceramic capacitors can be used (C_{IN} = 0.1μF, C_{OUT} =1.0 μF)
- Wide range voltage listing (Please see Output Voltage Accuracy at page 4 for variety of the output voltage)
- Small package, SMV (SOT23-5) (SC-74A)
- RoHS compatible

Pin Assignment (top view)

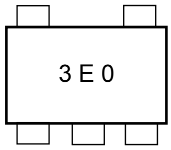


List of Products Number and Marking

Products No.	Marking	Products No.	Marking
TCR5SB15	1E5	TCR5SB33	3E3
TCR5SB16	1E6	TCR5SB34	3E4
TCR5SB17	1E7	TCR5SB35	3E5
TCR5SB18	1E8	TCR5SB36	3E6
TCR5SB19	1B9	TCR5SB37	3E7
TCR5SB20	2E0	TCR5SB38	3E8
TCR5SB21	2E1	TCR5SB39	3E9
TCR5SB22	2E2	TCR5SB40	4E0
TCR5SB23	2E3	TCR5SB41	4E1
TCR5SB24	2E4	TCR5SB42	4E2
TCR5SB25	2E5	TCR5SB43	4E3
TCR5SB26	2E6	TCR5SB44	4E4
TCR5SB27	2E7	TCR5SB45	4E5
TCR5SB28	2E8	TCR5SB46	4E6
TCR5SB29	2E9	TCR5SB47	4E7
TCR5SB30	3E0	TCR5SB48	4E8
TCR5SB31	3E1	TCR5SB49	4E9
TCR5SB32	3E2	TCR5SB50	5E0

Marking

Example: TCR5SB30 (3.0 V output)



Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Input voltage	V_{IN}	6	V
Control voltage	V_{CT}	-0.3~ 6	V
Output voltage	V_{OUT}	-0.3~ V_{IN} + 0.3	V
Output current	I_{OUT}	200	mA
Power dissipation	P_D	200 (Note 1)	mW
		380 (Note 2)	
Operation temperature range	T_{opr}	−40~85	°C
Junction temperature	T_j	150	°C
Storage temperature range	T_{stg}	−55~150	°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 Ratintg

Note 2: Rating at mounting on a board
(Glass epoxy board dimmention : 30 mm × 30 mm, Copper pad area : 50 mm^2)

Electrical Characteristics

(Unless otherwise specified, $V_{IN} = V_{OUT} + 1$ V, $I_{OUT} = 50$ mA, $C_{IN} = 0.1$ μF, $C_{OUT} = 1.0$ μF, $T_j = 25$°C)

Characteristics	Symbol	Test Condition		Min	Typ.	Max	Unit
Output voltage	V_{OUT}	Please refer to the Output Voltage Accuracy table					
Line regulation	Reg·line	V_{OUT} + 0.5 V ≦ V_{IN} ≦ 6 V, I_{OUT} = 1 mA		—	3	15	mV
Load regulation	Reg·load	1 mA ≦ I_{OUT} ≦ 150 mA		—	25	75	mV
Quiescent current	I_B	I_{OUT} = 0 mA		—	40	75	μA
Stand-by current	$I_{B\ (OFF)}$	V_{CT} = 0 V		—	0.1	1.0	μA
Output noise voltage	V_{NO}	V_{IN} = V_{OUT} + 1 V, I_{OUT} = 10 mA, 10 Hz ≦ f ≦ 100 kHz, Ta = 25°C	TCR5SB15～TCR5SB20	—	25	—	μV_{rms}
			TCR5SB21～TCR5SB30	—	30	—	
			TCR5SB31～TCR5SB36	—	35	—	
			TCR5SB37～TCR5SB50	—	40	—	
Dropout voltage	V_{IN}-V_{OUT}	Please refer to the Dropout voltage table.					
Temperature coefficient	T_{CVO}	−40°C ≦ T_{opr} ≦ 85°C		—	100	—	ppm/°C
Input voltage	V_{IN}	—	TCR5SB15～TCR5SB16	V_{OUT} + 0.33 V	—	6.0	V
			TCR5SB17～TCR5SB18	V_{OUT} + 0.31 V	—	6.0	
			TCR5SB19～TCR5SB23	V_{OUT} + 0.25 V		6.0	
			TCR5SB24～TCR5SB27	V_{OUT} + 0.20 V		6.0	
			TCR5SB28～TCR5SB50	V_{OUT} + 0.19 V	—	6.0	
Ripple rejection ratio	R.R.	V_{IN} = V_{OUT} + 1 V, I_{OUT} = 10 mA, f = 1 kHz, V_{Ripple} = 500 mV_{p-p}, Ta = 25°C		—	80	—	dB
Control voltage (ON)	$V_{CT\ (ON)}$	—		1.5	—	6.0	V
Control voltage (OFF)	$V_{CT\ (OFF)}$	—		0	—	0.25	V
Control current (ON)	$I_{CT\ (ON)}$	V_{CT} = 6.0 V		—	—	0.1	μA
Control current (OFF)	$I_{CT\ (OFF)}$	V_{CT} = 0.25 V		—	—	0.1	μA

Output Voltage Accuracy
($V_{IN} = V_{OUT} + 1$ V, $I_{OUT} = 50$ mA, $C_{IN} = 0.1$ μF, $C_{OUT} = 1.0$ μF, $T_j = 25$°C)

Product No.	Symbol	Min	Typ.	Max	Unit
TCR5SB15	V_{OUT}	1.47	1.5	1.53	V
*TCR5SB16		1.56	1.6	1.64	
*TCR5SB17		1.66	1.7	1.74	
TCR5SB18		1.76	1.8	1.84	
TCR5SB19		1.86	1.9	1.94	
*TCR5SB20		1.96	2.0	2.04	
*TCR5SB21		2.05	2.1	2.15	
*TCR5SB22		2.15	2.2	2.25	
*TCR5SB23		2.25	2.3	2.35	
*TCR5SB24		2.35	2.4	2.45	
TCR5SB25		2.45	2.5	2.55	
*TCR5SB26		2.54	2.6	2.66	
TCR5SB27		2.64	2.7	2.76	
TCR5SB28		2.74	2.8	2.86	
TCR5SB29		2.84	2.9	2.96	
TCR5SB30		2.94	3.0	3.06	
TCR5SB31		3.03	3.1	3.17	
*TCR5SB32		3.13	3.2	3.27	
TCR5SB33		3.23	3.3	3.37	
*TCR5SB34		3.33	3.4	3.47	
*TCR5SB35		3.43	3.5	3.57	
*TCR5SB36		3.52	3.6	3.68	
*TCR5SB37		3.62	3.7	3.78	
*TCR5SB38		3.72	3.8	3.88	
*TCR5SB39		3.82	3.9	3.98	
*TCR5SB40		3.92	4.0	4.08	
*TCR5SB41		4.01	4.1	4.19	
*TCR5SB42		4.11	4.2	4.29	
*TCR5SB43		4.21	4.3	4.39	
*TCR5SB44		4.31	4.4	4.49	
*TCR5SB45		4.41	4.5	4.59	
*TCR5SB46		4.50	4.6	4.70	
*TCR5SB47		4.60	4.7	4.80	
*TCR5SB48		4.70	4.8	4.90	
*TCR5SB49		4.80	4.9	5.00	
TCR5SB50		4.90	5.0	5.10	

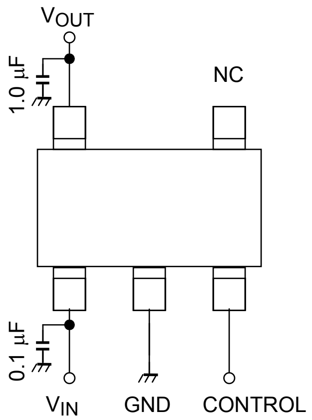
Please contact us if prefer products with * sign from above lists

Dropout Voltage
(I_{OUT} = 50 mA, C_{IN} = 0.1 μF, C_{OUT} = 1.0 μF, T_j = 25°C)

Product No.	Symbol	Min	Typ.	Max	Unit
TCR5SB15～TCR5SB16	V_{IN}-V_{OUT}	—	150	330	mV
TCR5SB17～TCR5SB18		—	130	310	
TCR5SB19～TCR5SB23		—	110	250	
TCR5SB24～TCR5SB27		—	90	200	
TCR5SB28～TCR5SB50		—	85	190	

Application Note

1. Recommended Application Circuit



Control Level	Operation
HIGH	ON
LOW	OFF

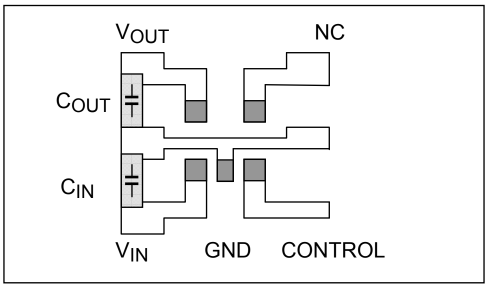
The figure above shows the recommended configuration for using a Low-Dropout regulator. Insert a capacitor at Vout and Vin pins for stable input/output operation. (Ceramic capacitors can be used)

If the control function is not to be used, Toshiba recommend that the control pin is connected to the V_{IN} pin.

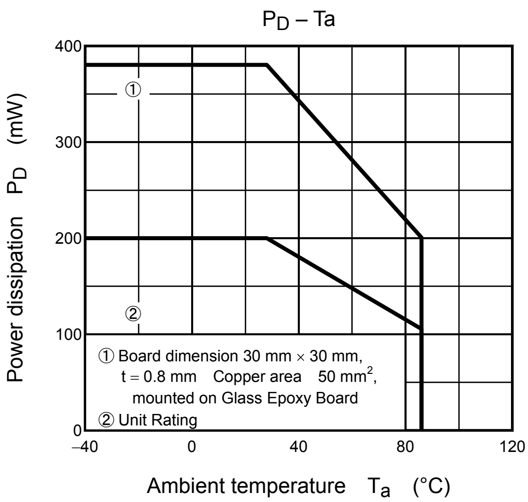
2. Power Dissipation

Power dissipation of TCR5SBxx series is independent and shows in Absolute Maximum Ratings when it is mounted on the board. Testing size and pattern shows below.

Testing Board of Thermal Resistance

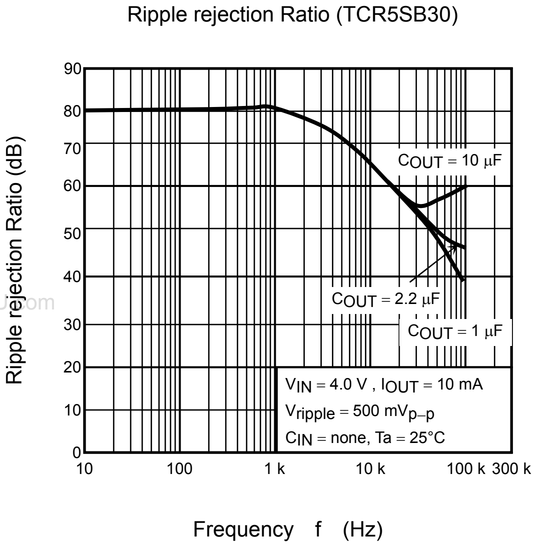


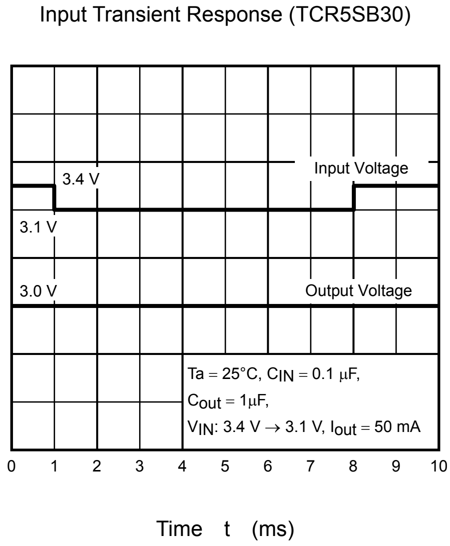
Board material: Glass Epoxy, Board dimension 30 mm × 30 mm
Copper area: 50 mm^2, t = 0.8 mm



3. Ripple Rejection

TCR5SBxx series are designed for superior ripple rejection characteristic. Even an output changes with steep resistance rate of the power supply voltage, characteristic of Input Transient Response, the ripple rejection shows an extremely superior characteristics. Therefore these devices are suitable for use as RF block for every cellular phone system.





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 GND pattern need to be large and make the wire impedance small as possible.

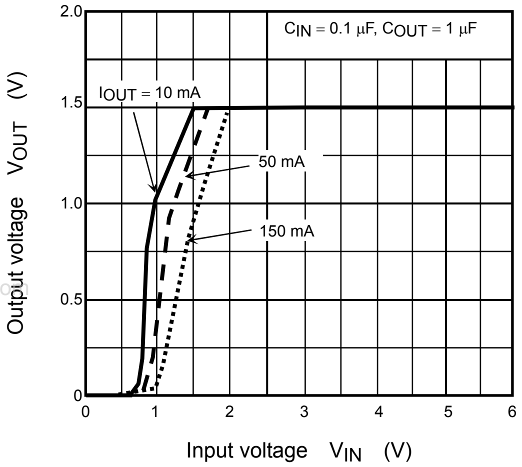
- Permissible Loss
  Please have enough design patterns for expected maximum permissible loss. And under consideration of surrounding temperature, input voltage, and output current etc, we recommend proper dissipation ratings for maximum permissible loss; in general maximum dissipation rating is 70 to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

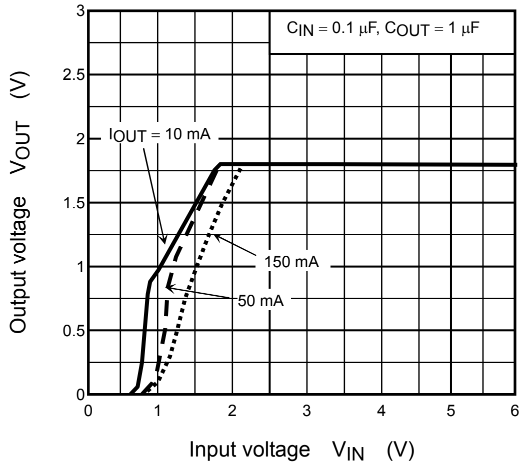
Representative Typical Characteristics

1) Output Voltage vs. Input Voltage

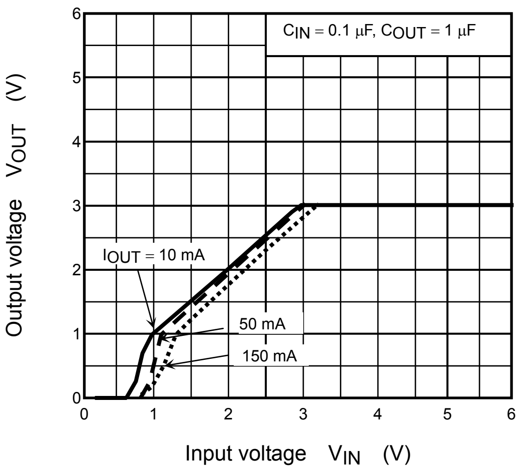
TCR5SB15



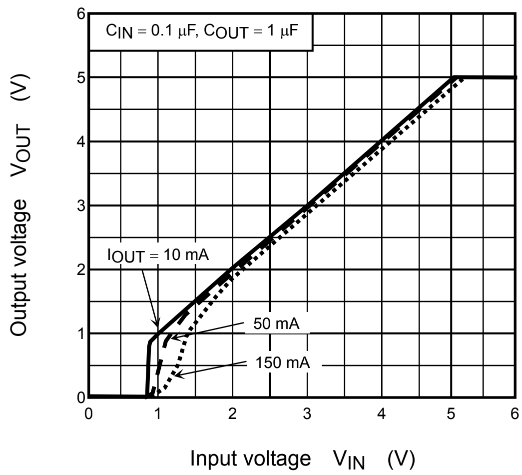
TCR5SB18



TCR5SB30

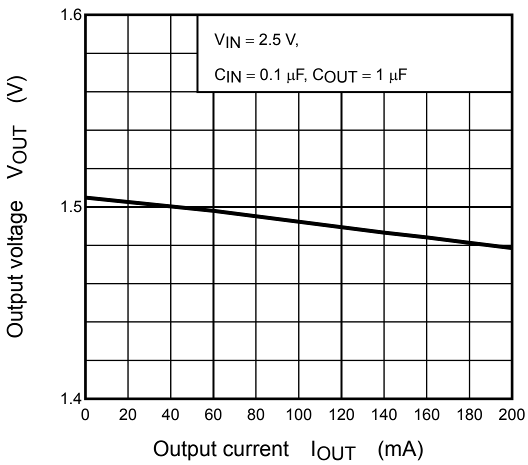


TCR5SB50

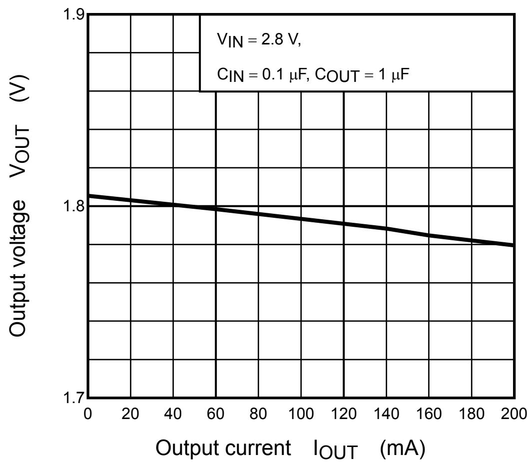


2) Output Voltage vs. Output Current

TCR5SB15



TCR5SB18



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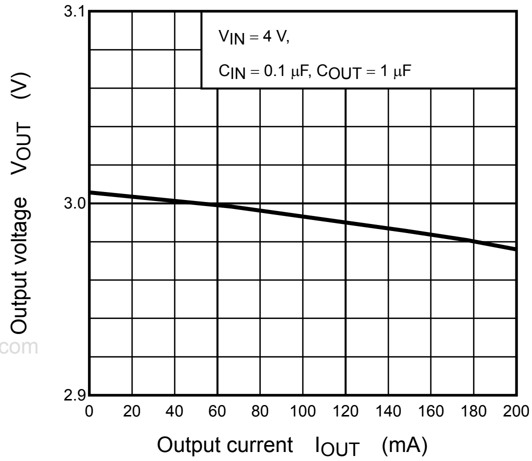

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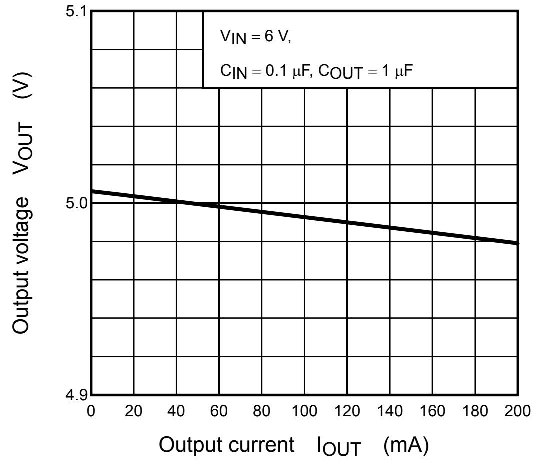
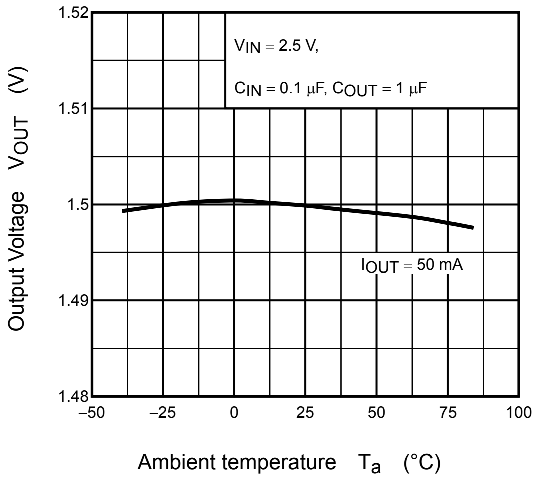
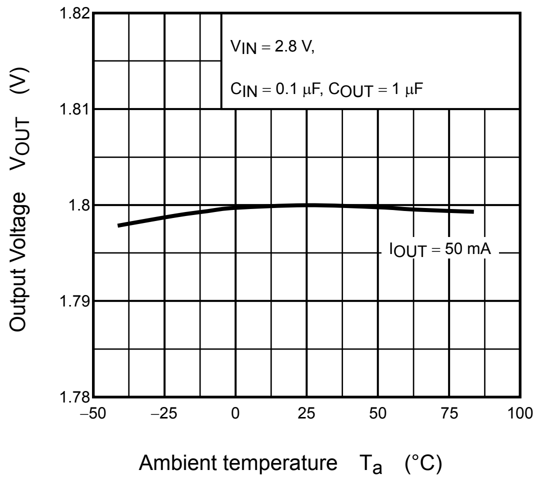


3) Output Voltage vs. Ambient temperature

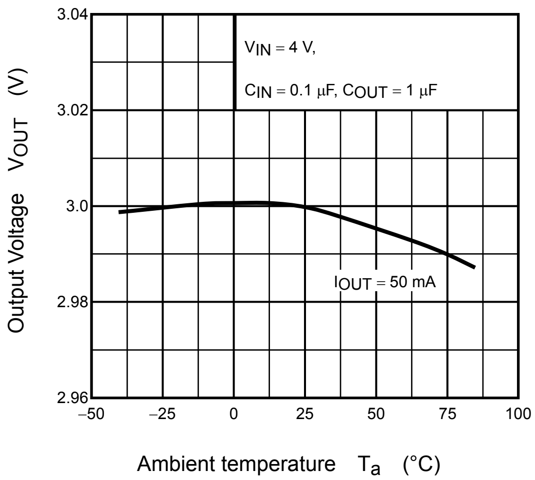
TCR5SB15



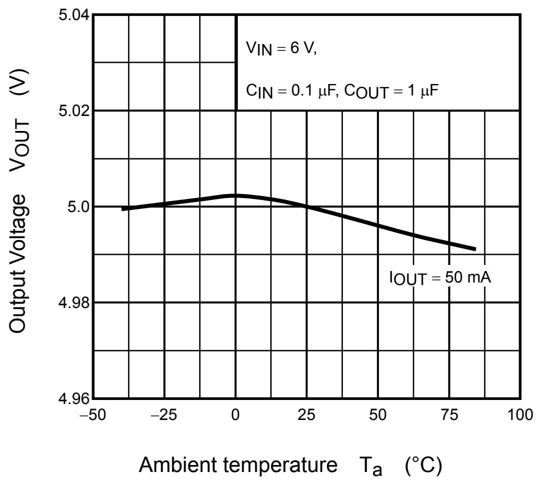
TCR5SB18



TCR5SB30

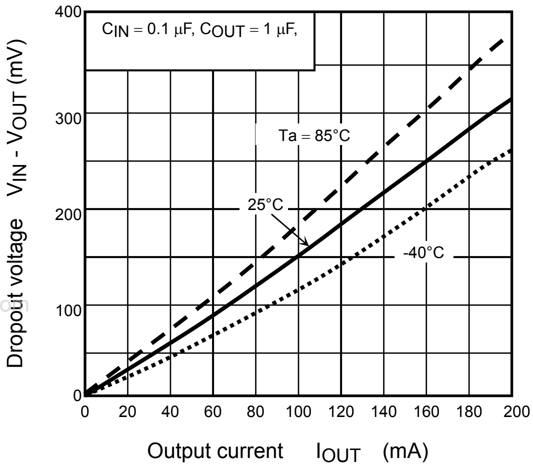


TCR5SB50

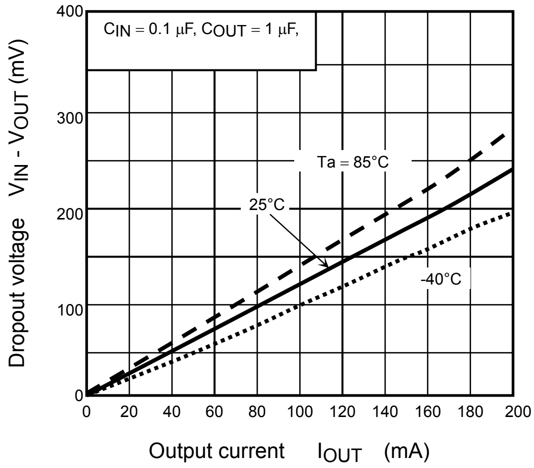


4) Dropout Voltage vs. Output Current

TCR5SB30

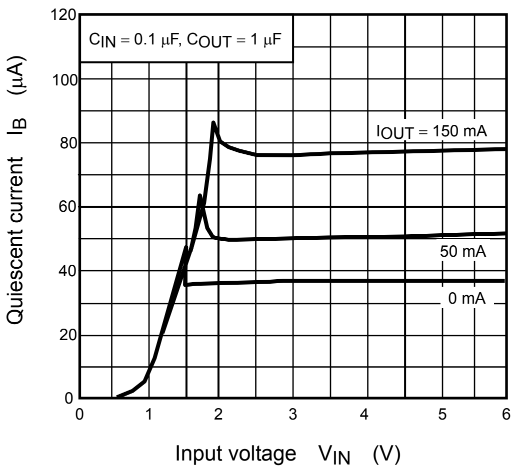


TCR5SB50

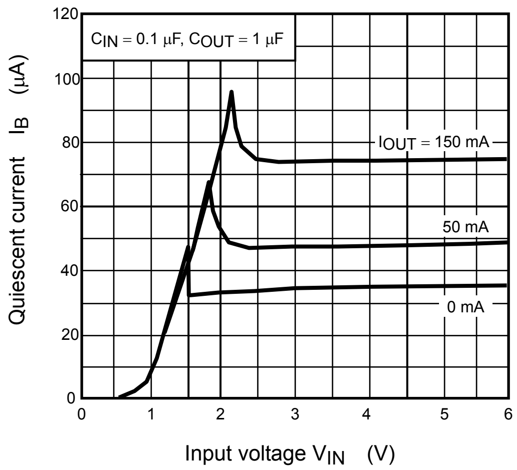


5) Quiessrnt Current vs. InputVoltage

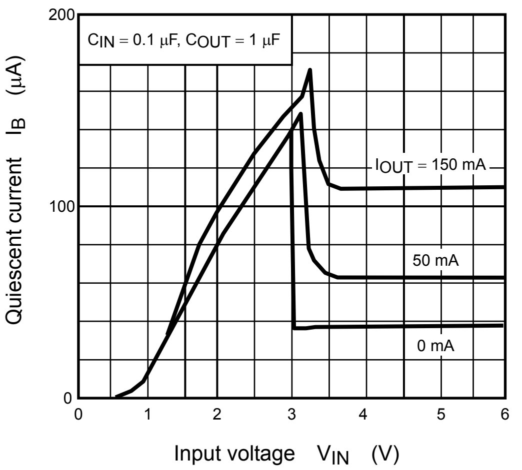
TCR5SB15



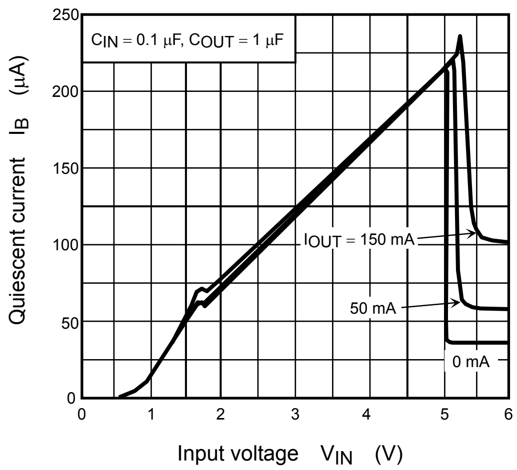
TCR5SB18



TCR5SB30

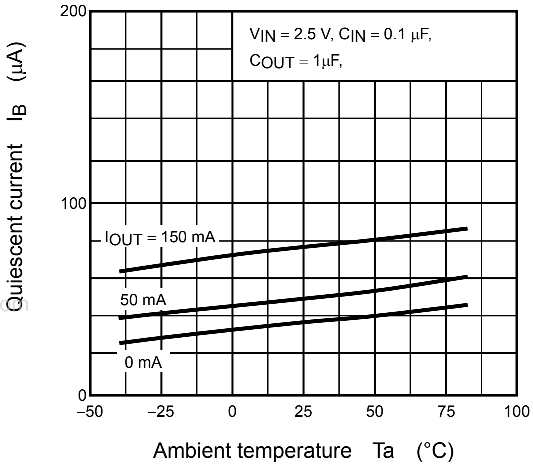


TCR5SB50

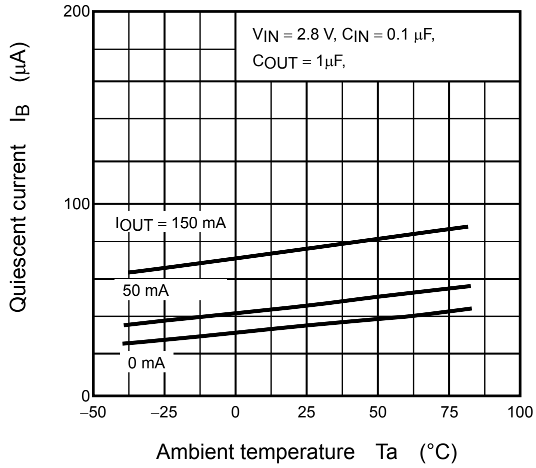


6) Quiessrnt Current vs. Ambient temperature

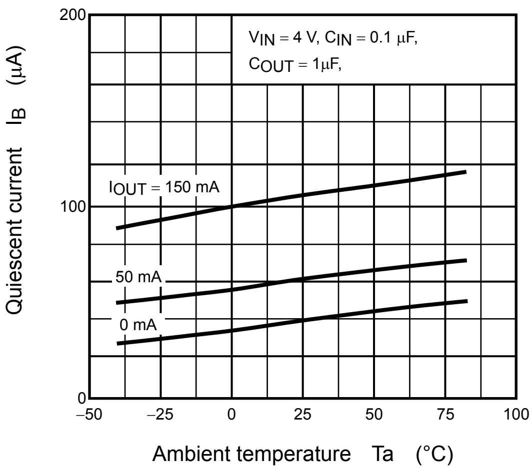
TCR5SB15



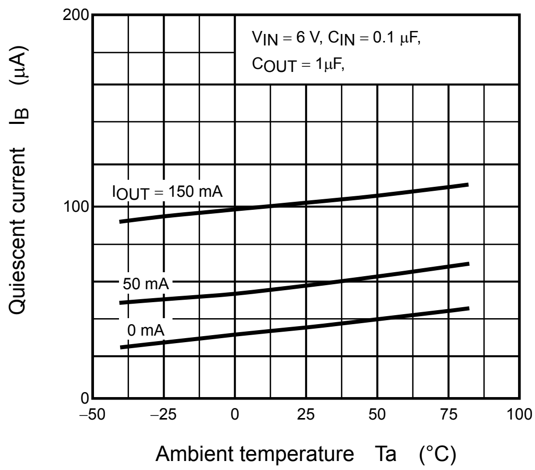
TCR5SB18



TCR5SB30

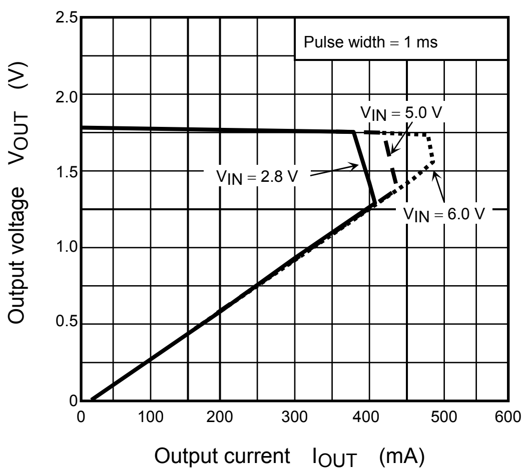


TCR5SB50

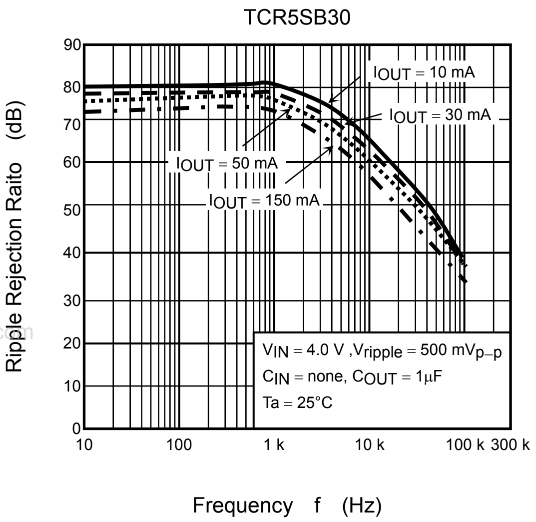


7) Overcurrent Protection Characteristics

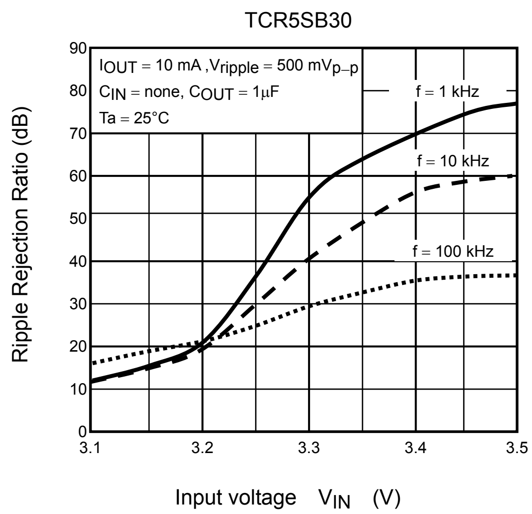
TCR5SB18

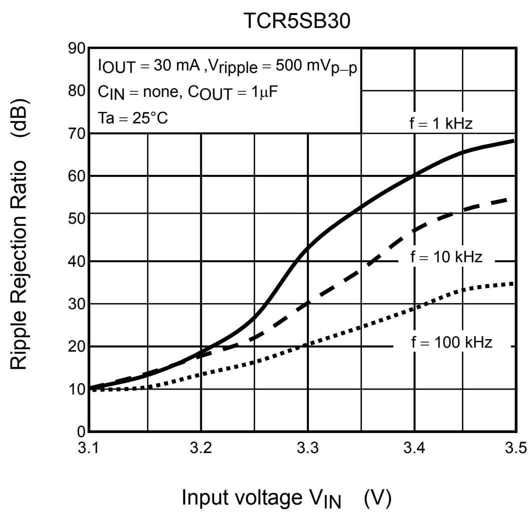


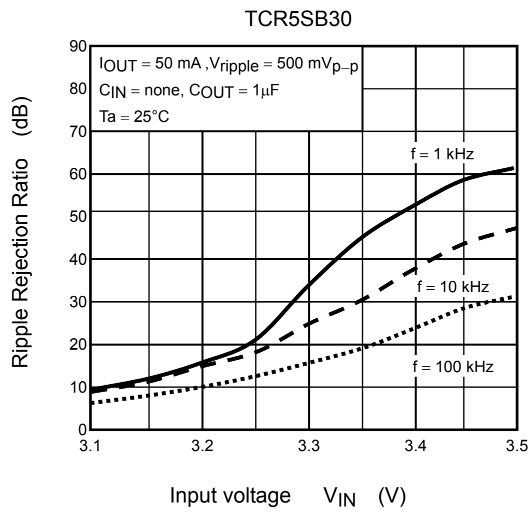
8) Ripple rejection Raito vs. Frequency（Dependence of Output current）



9) Ripple rejection Ratio vs. Input Voltage

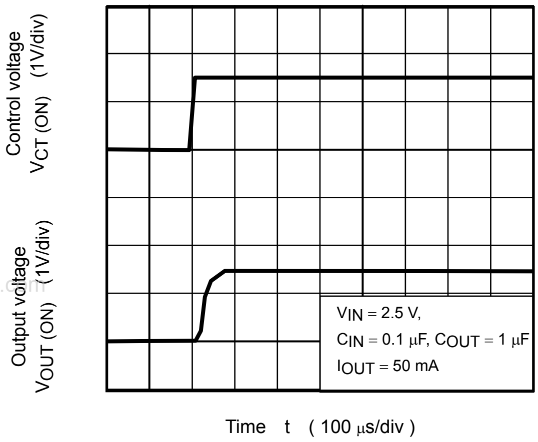




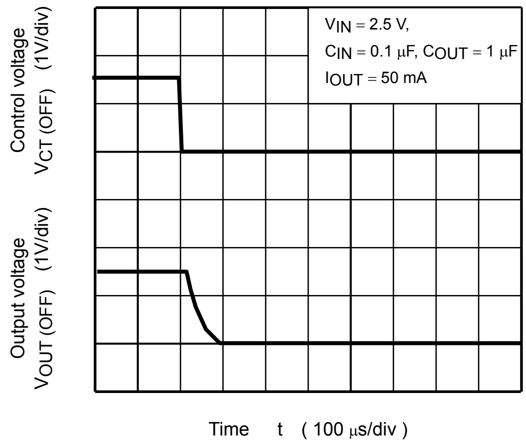


10) Control Transient Response

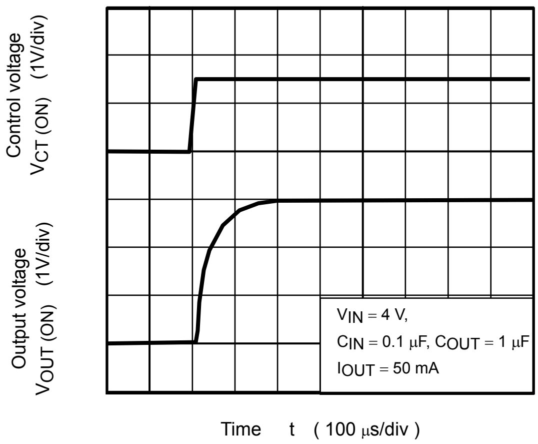
TCR5SB15 (Turn on wave form)



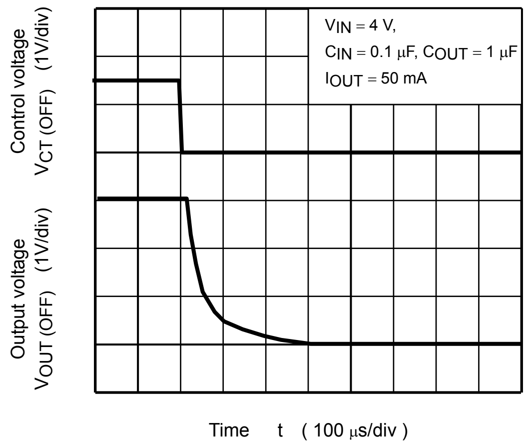
TCR5SB15 (Turn off wave form)



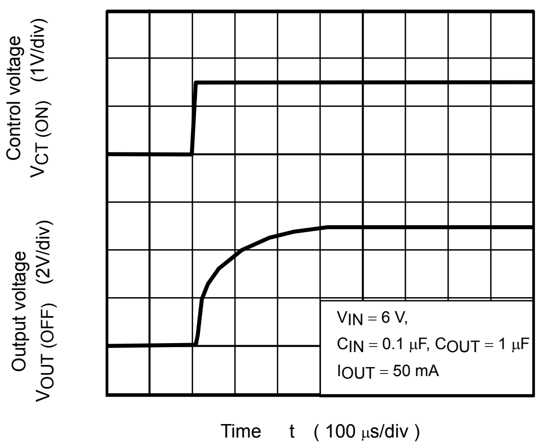
TCR5SB30 (Turn on wave form)



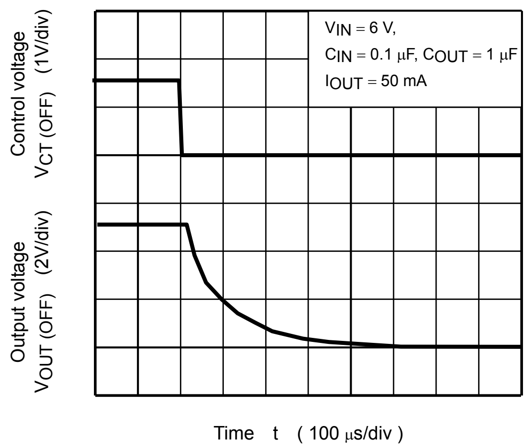
TCR5SB30 (Turn off wave form)



TCR5SB50 (Turn on wave form)

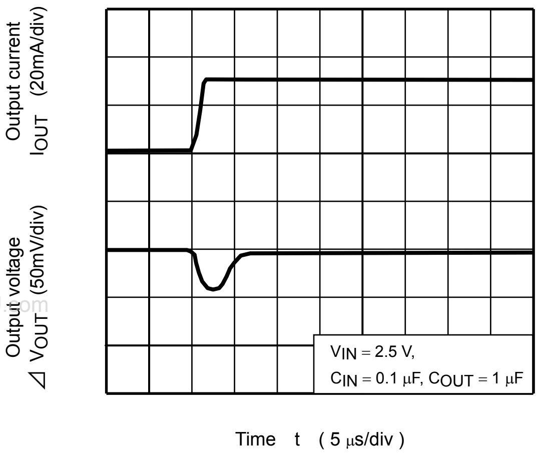


TCR5SB50 (Turn off wave form)

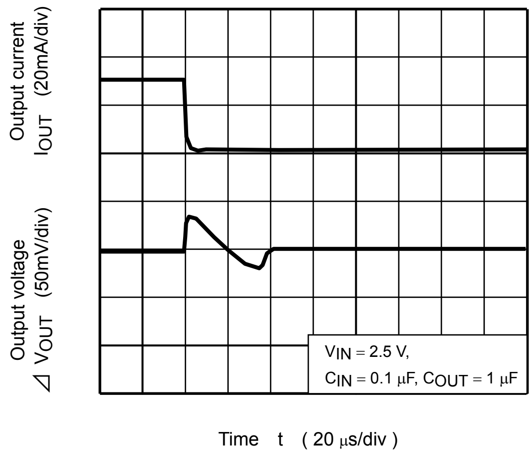


11) Load Transient Response

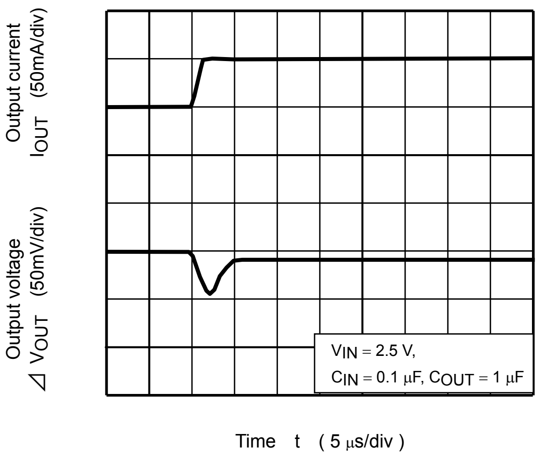
TCR5SB15 (I_{OUT} = 1m to 30mA)



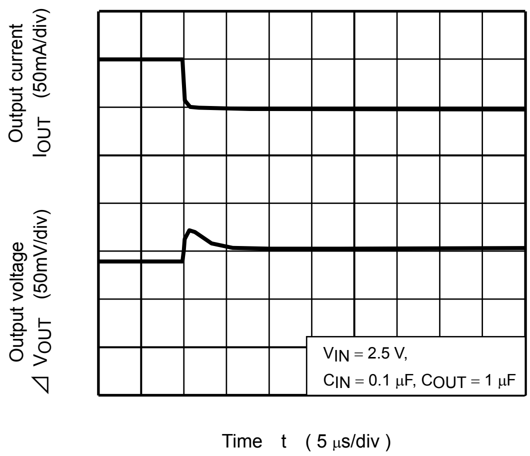
TCR5SB15 (I_{OUT} = 30m to 1mA)



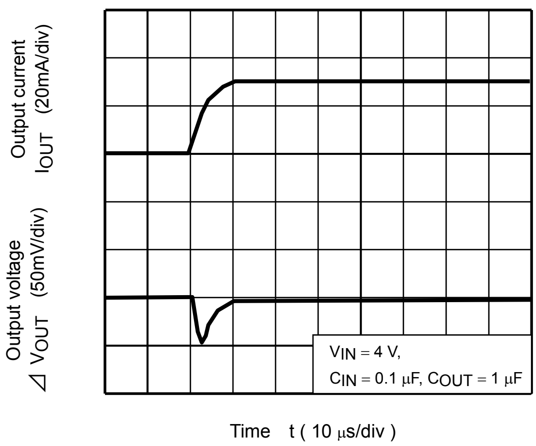
TCR5SB15 (I_{OUT} = 50m to 100mA)



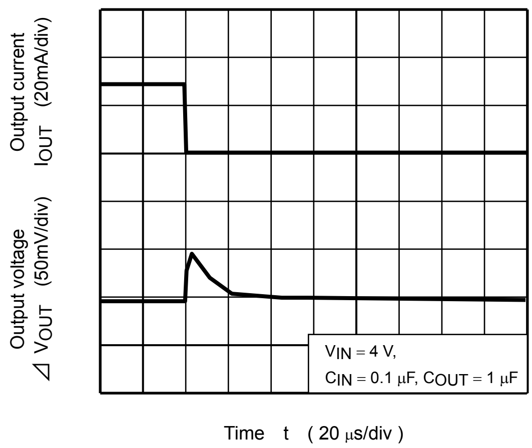
TCR5SB15 (I_{OUT} = 100m to 50mA)



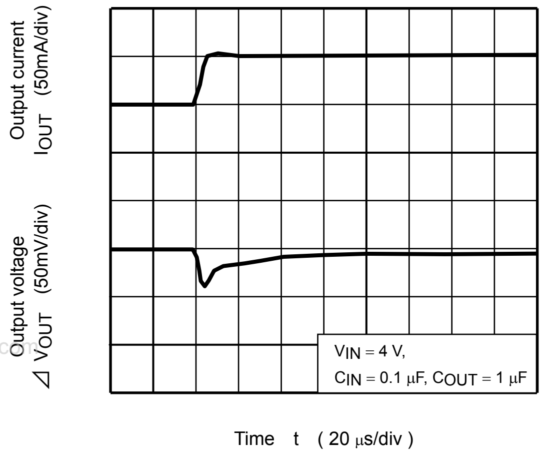
TCR5SB30 (I_{OUT} =1m to 30mA)



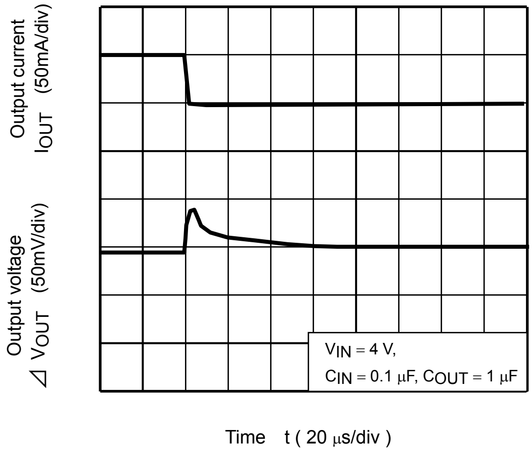
TCR5SB30 (I_{OUT} = 30m to 1mA)



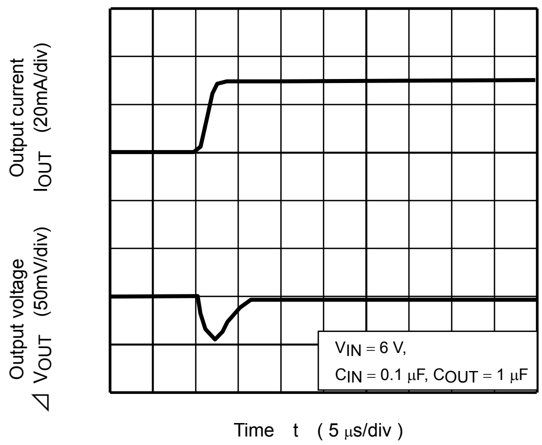
TCR5SB30 (I_{OUT} = 50m to 100mA)



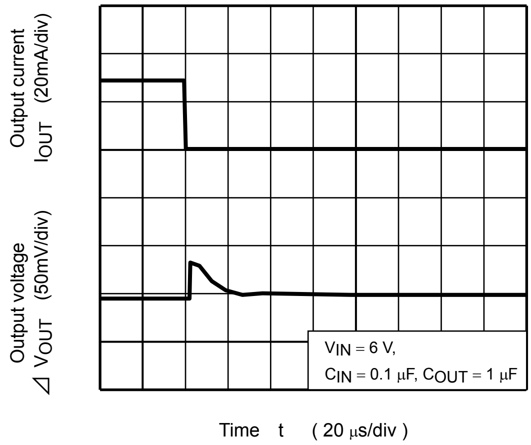
TCR5SB30 (I_{OUT} = 100m to 50mA)



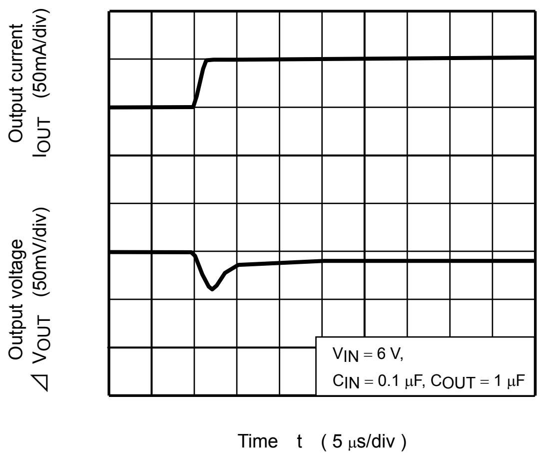
TCR5SB50 (I_{OUT} =1m to 30mA)



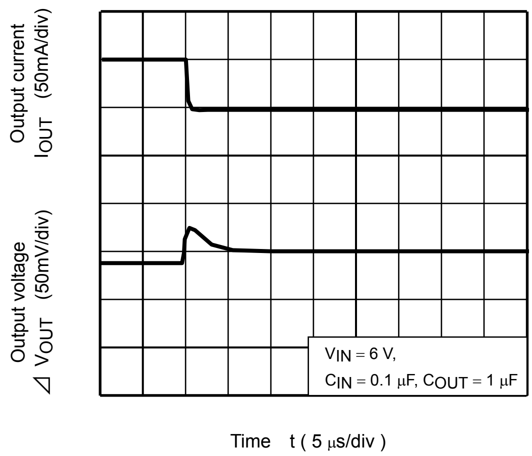
TCR5SB50 (I_{OUT} = 30m to 1mA)



TCR5SB50 (I_{OUT} = 50m to 100mA)



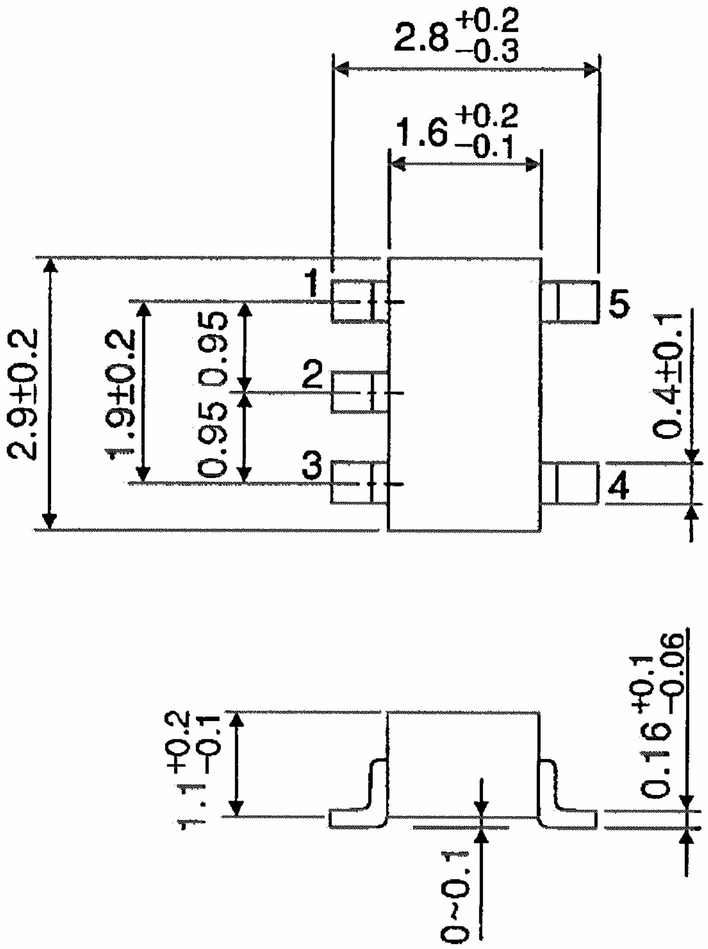
TCR5SB50 (I_{OUT} = 100m to 50mA)



Package Dimensions

SSOP5-P-0.95

Unit : mm



Weight: 0.016 g (typ)

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20070701-EN GENERAL

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