TOSHIBA CMOS Linear Integrated Circuit Silicon Monolithic

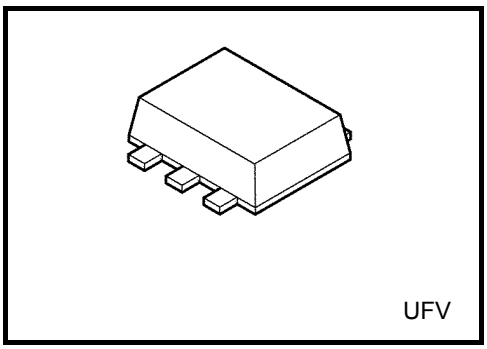
TCR5SB15U~TCR5SB50U

200-mA CMOS Low-Dropout Regulators (Point Regulators)

The TCR5SB15U to TCR5SB50U are CMOS general-purpose single-output voltage regulators with an on/off control input, featuring low dropout voltage and low quiescent bias current. The TCR5SB15U to TCR5SB50U can be enabled and disabled via the CONTROL pin.

These voltage regulators are available in fixed output voltages between 1.5 V and 5.0 V in 0.1-V steps and capable of driving up to 200 mA. They feature overcurrent protection.

The TCR5SB15U to TCR5SB50U are offered in the compact UFV package measuring 2.0 x 2.1 x 0.7 mm and allow the use of small ceramic input and output capacitors. Thus, these devices are ideal for portable applications that require high-density board assembly such as cellular phones.

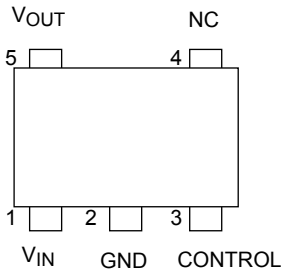


Weight: 0.007 g (typ.)

Features

- Low quiescent bias current (I_B = 40 μA (typ.) at I_{OUT} = 0 mA)
- Low stand-by current ($I_{B(OFF)}$ = 0.1 μA (typ.) at Stand-by mode)
- Low-dropout voltage (V_{IN} - V_{OUT} = 85 mV (typ.) at TCR5SB30U, I_{OUT} = 50 mA)
- High current output (I_{OUT} = 200 mA (max))
- High ripple rejection (R.R = 80 dB (typ) at I_{OUT} = 10 mA, f =1kHz)
- Low output noise voltage (V_{NO} = 30 μV_{rms} (typ.) at TCR5SB30U, 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, UFV (2.0 mm x 2.1 mm x 0.7 mm)

Pin Assignment (top view)

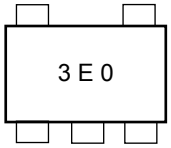


List of Products Number and Marking

Products No.	Marking	Products No.	Marking
TCR5SB15U	1E5	TCR5SB33U	3E3
TCR5SB16U	1E6	TCR5SB34U	3E4
TCR5SB17U	1E7	TCR5SB35U	3E5
TCR5SB18U	1E8	TCR5SB36U	3E6
TCR5SB19U	1E9	TCR5SB37U	3E7
TCR5SB20U	2E0	TCR5SB38U	3E8
TCR5SB21U	2E1	TCR5SB39U	3E9
TCR5SB22U	2E2	TCR5SB40U	4E0
TCR5SB23U	2E3	TCR5SB41U	4E1
TCR5SB24U	2E4	TCR5SB42U	4E2
TCR5SB25U	2E5	TCR5SB43U	4E3
TCR5SB26U	2E6	TCR5SB44U	4E4
TCR5SB27U	2E7	TCR5SB45U	4E5
TCR5SB28U	2E8	TCR5SB46U	4E6
TCR5SB29U	2E9	TCR5SB47U	4E7
TCR5SB30U	3E0	TCR5SB48U	4E8
TCR5SB31U	3E1	TCR5SB49U	4E9
TCR5SB32U	3E2	TCR5SB50U	5E0

Marking

Example: TCR5SB30U (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 to 6	V
Output voltage	V_{OUT}	-0.3 to V_{IN} + 0.3	V
Output current	I_{OUT}	200	mA
Power dissipation	P_D	450 (Note1)	mW
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).

Note1: Rating at mounting on a board

(Glass epoxy board dimmention : 30 mm × 30 mm, Copper pad area : 35 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	TCR5SB15U to TCR5SB20U	—	25	—	μV_{rms}
			TCR5SB21U to TCR5SB30U	—	30	—	
			TCR5SB31U to TCR5SB36U	—	35	—	
			TCR5SB37U to TCR5SB50U	—	40	—	
Dropout voltage	V_{IN}-V_{OUT}	Please refer to the Dropout voltage table.					
Temperature coefficient	T_{CVO}	−40°C ≤ $T_{op\ r}$ ≤ 85°C		—	100	—	ppm/°C
Input voltage	V_{IN}	—	TCR5SB15U to TCR5SB16U	V_{OUT} + 0.33 V	—	6.0	V
			TCR5SB17U to TCR5SB18U	V_{OUT} + 0.31 V	—	6.0	
			TCR5SB19U to TCR5SB23U	V_{OUT} + 0.25 V	—	6.0	
			TCR5SB24U to TCR5SB27U	V_{OUT} + 0.20 V	—	6.0	
			TCR5SB28U to TCR5SB50U	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 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)

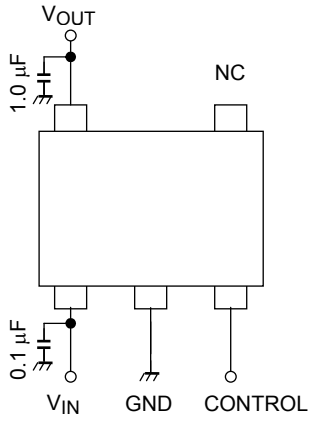
Product No.	Symbol	Min	Typ.	Max	Unit
TCR5SB15U	V_{OUT}	1.47	1.5	1.53	V
TCR5SB16U		1.56	1.6	1.64	
TCR5SB17U		1.66	1.7	1.74	
TCR5SB18U		1.76	1.8	1.84	
TCR5SB19U		1.86	1.9	1.94	
TCR5SB20U		1.96	2.0	2.04	
TCR5SB21U		2.05	2.1	2.15	
TCR5SB22U		2.15	2.2	2.25	
TCR5SB23U		2.25	2.3	2.35	
TCR5SB24U		2.35	2.4	2.45	
TCR5SB25U		2.45	2.5	2.55	
TCR5SB26U		2.54	2.6	2.66	
TCR5SB27U		2.64	2.7	2.76	
TCR5SB28U		2.74	2.8	2.86	
TCR5SB29U		2.84	2.9	2.96	
TCR5SB30U		2.94	3.0	3.06	
TCR5SB31U		3.03	3.1	3.17	
TCR5SB32U		3.13	3.2	3.27	
TCR5SB33U		3.23	3.3	3.37	
TCR5SB34U		3.33	3.4	3.47	
TCR5SB35U		3.43	3.5	3.57	
TCR5SB36U		3.52	3.6	3.68	
TCR5SB37U		3.62	3.7	3.78	
TCR5SB38U		3.72	3.8	3.88	
TCR5SB39U		3.82	3.9	3.98	
TCR5SB40U		3.92	4.0	4.08	
TCR5SB41U		4.01	4.1	4.19	
TCR5SB42U		4.11	4.2	4.29	
TCR5SB43U		4.21	4.3	4.39	
TCR5SB44U		4.31	4.4	4.49	
TCR5SB45U		4.41	4.5	4.59	
TCR5SB46U		4.50	4.6	4.70	
TCR5SB47U		4.60	4.7	4.80	
TCR5SB48U		4.70	4.8	4.90	
TCR5SB49U		4.80	4.9	5.00	
TCR5SB50U		4.90	5.0	5.10	

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
TCR5SB15U to TCR5SB16U	V_{IN}-V_{OUT}	—	150	330	mV
TCR5SB17U to TCR5SB18U		—	130	310	
TCR5SB19U to TCR5SB23U		—	110	250	
TCR5SB24U to TCR5SB27U		—	90	200	
TCR5SB28U to TCR5SB50U		—	85	190	

Application Note

1. Recommended Application Circuit



Control Level	Operation
HIGH	ON
LOW	OFF

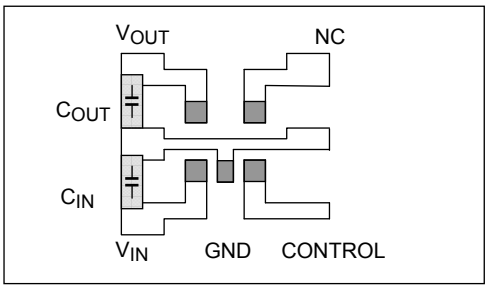
The figure above shows the recommended configuration for using a Low-Dropout regulator. Insert a capacitor at Vout and Vin pins for stable input/output operation. (Ceramic capacitors can be used)

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

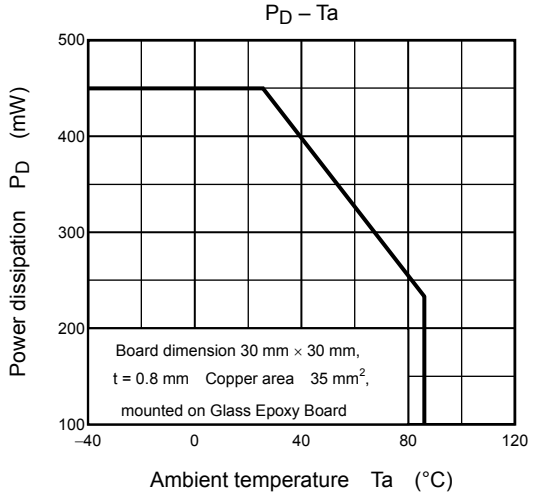
2. Power Dissipation

Power dissipation is measured on the board shown below.

Testing Board of Thermal Resistance



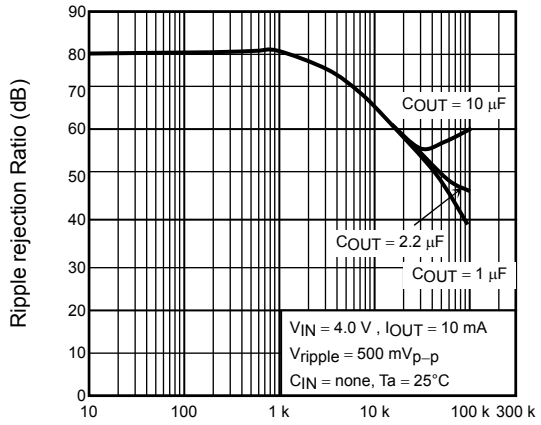
Board material: Glass Epoxy, Board dimension 30 mm × 30 mm
Copper area: 35 mm^2, t = 0.8 mm



3. Ripple Rejection

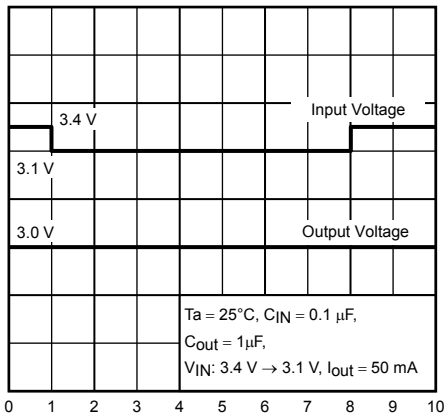
TCR5SBxxU series are designed for superior ripple rejection characteristic. Even an output changes with steep resistance rate of the power supply voltage, characteristic of Input Transient Response, the ripple rejection shows an extremely superior characteristics. Therefore these devices are suitable for use as RF block for every cellular phone system.

Ripple rejection Ratio (TCR5SB30U)



Frequency f (Hz)

Input Transient Response (TCR5SB30U)



Time t (ms)

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.

- 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.

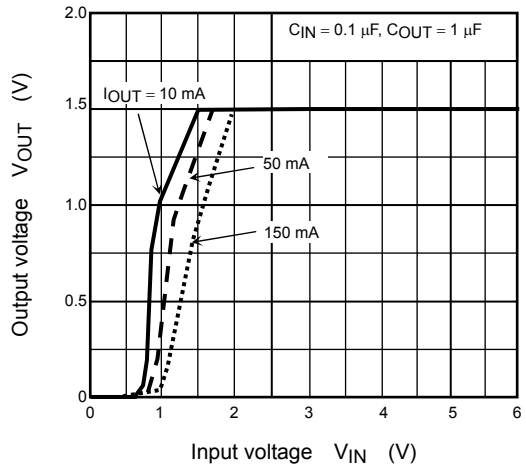
- Overcurrent Protection Circuit
  Overcurrent protection circuit is designed in these products, but this does not assure for the suppression of uprising device operation. If output pins and GND pins are shorted out, these products might be break down.

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.

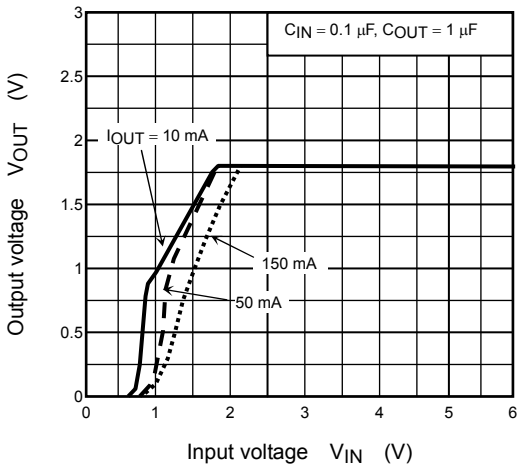
Representative Typical Characteristics

1) Output Voltage vs. Input Voltage

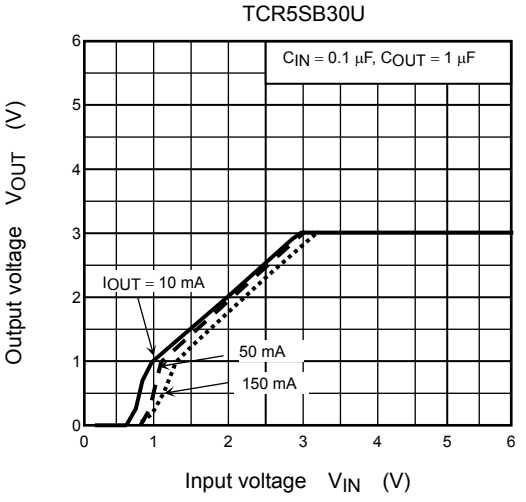
TCR5SB15U



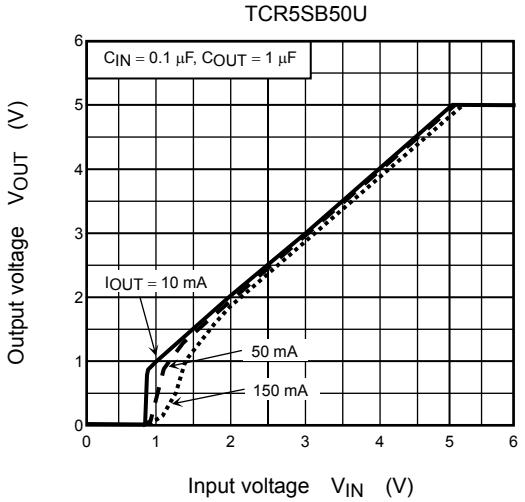
TCR5SB18U



TCR5SB30U

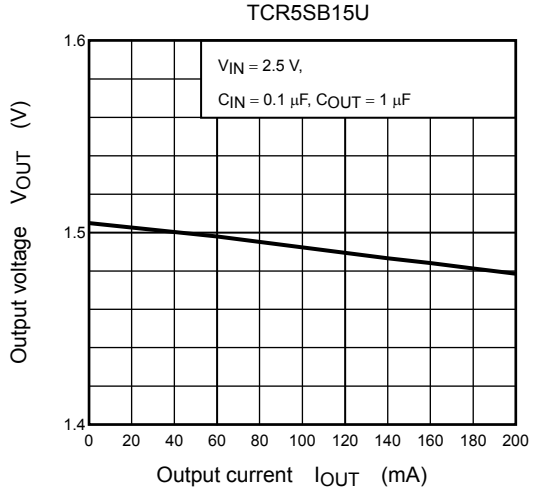


TCR5SB50U



2) Output Voltage vs. Output Current

TCR5SB15U



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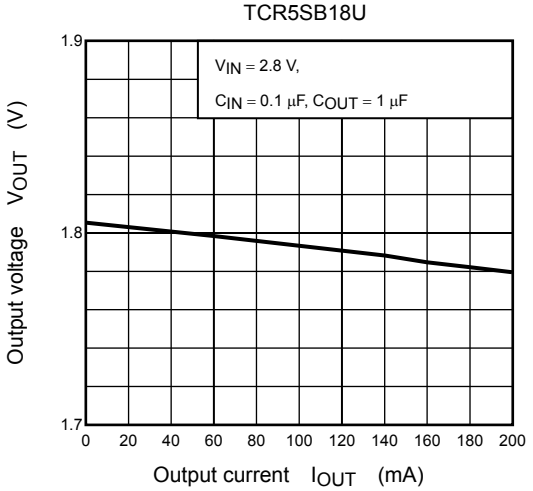

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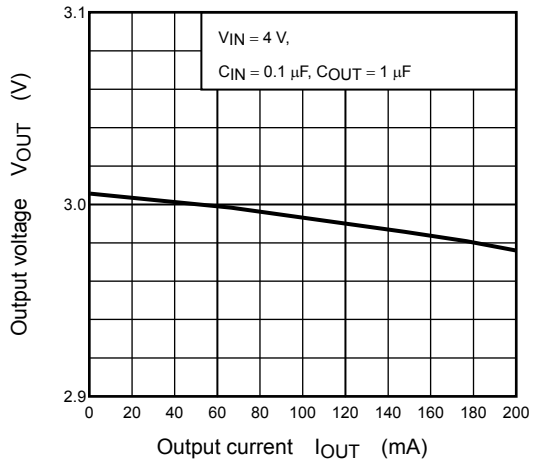

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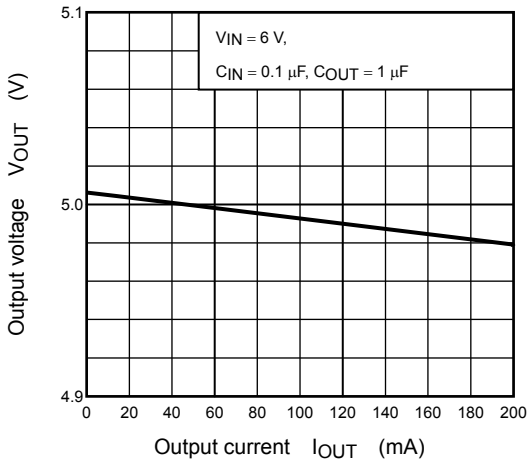
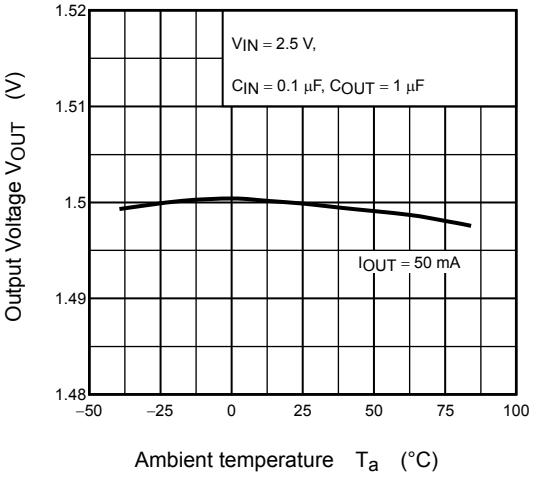


3) Output Voltage vs. Ambient temperature

TCR5SB15U



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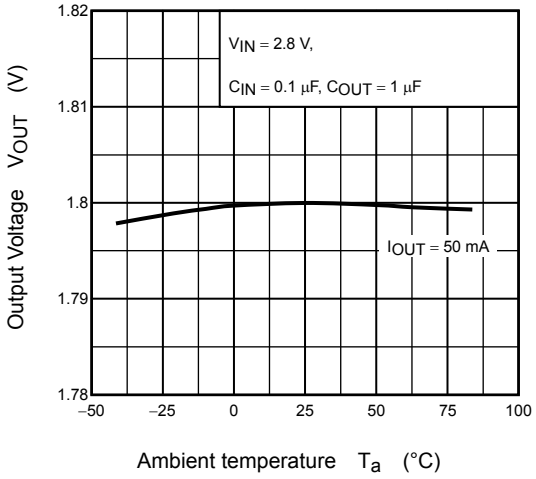

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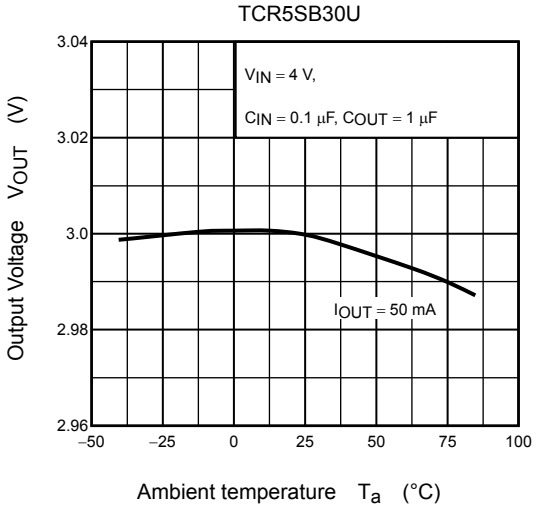

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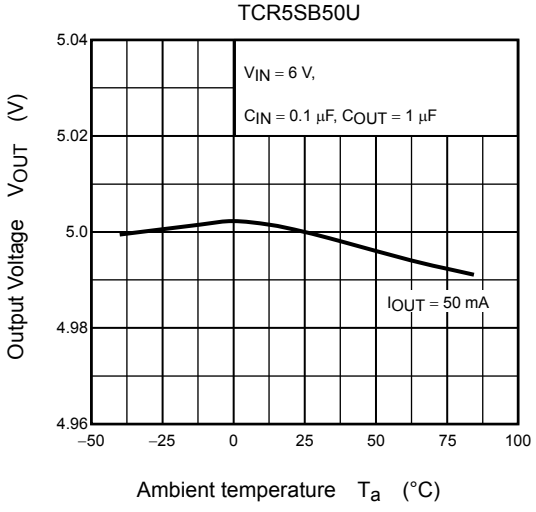
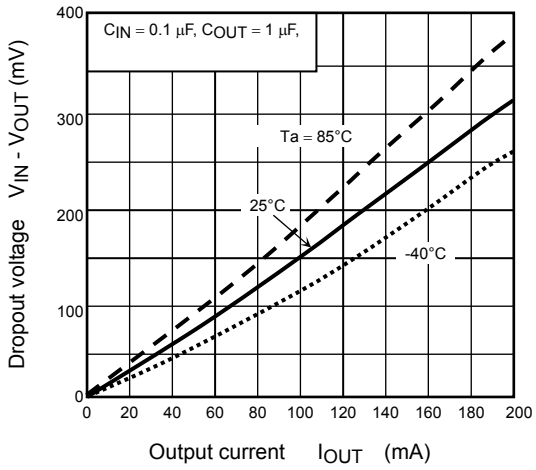


4) Dropout Voltage vs. Output Current

TCR5SB30U



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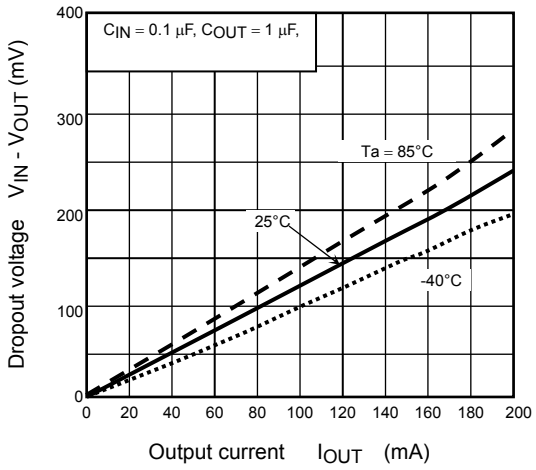
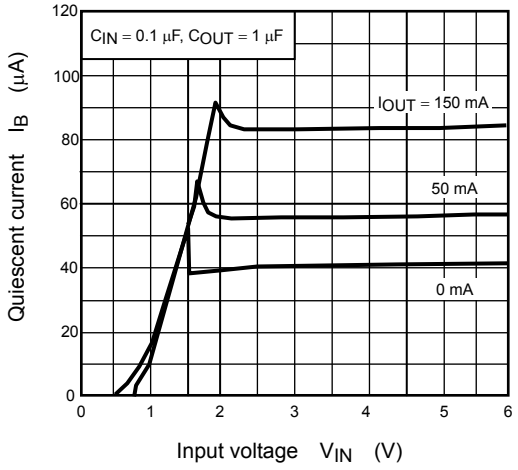


5) Quiessrnt Current vs. InputVoltage

TCR5SB15U



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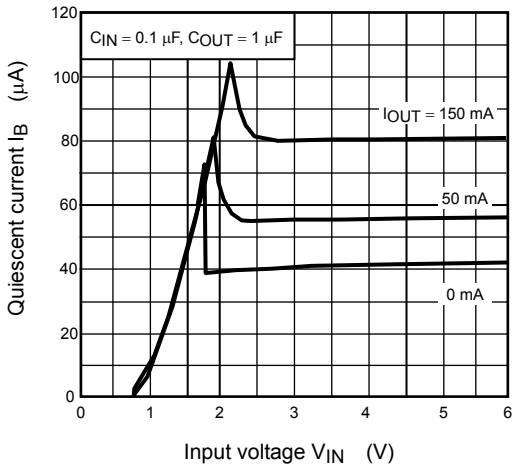

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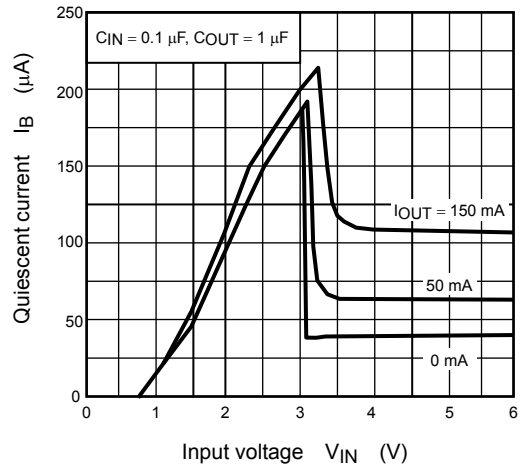
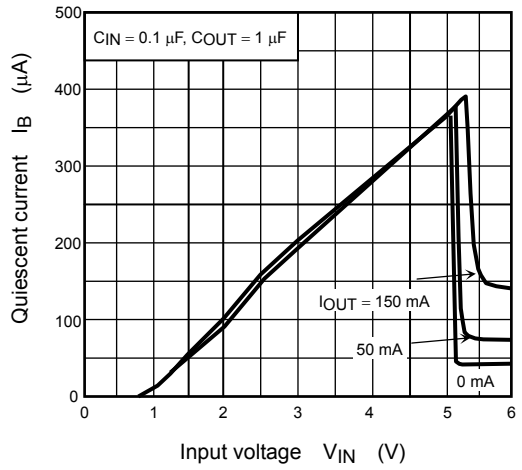
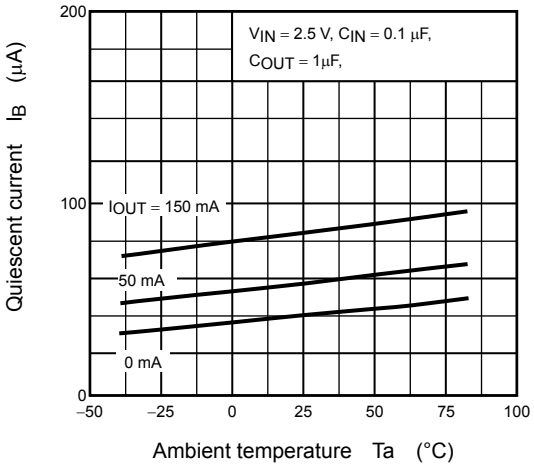


TCR5SB50U

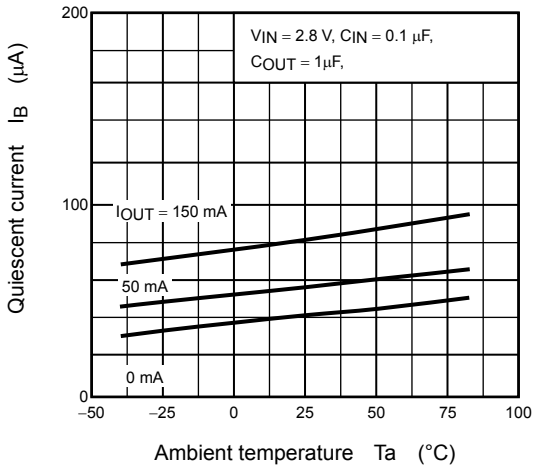


6) Quiessrnt Current vs. Ambient temperature

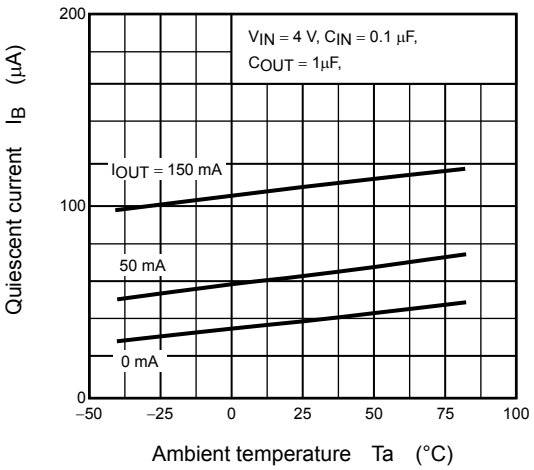
TCR5SB15U



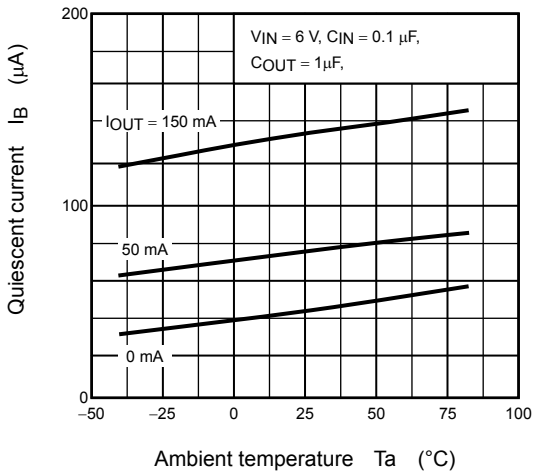
TCR5SB18U



TCR5SB30U

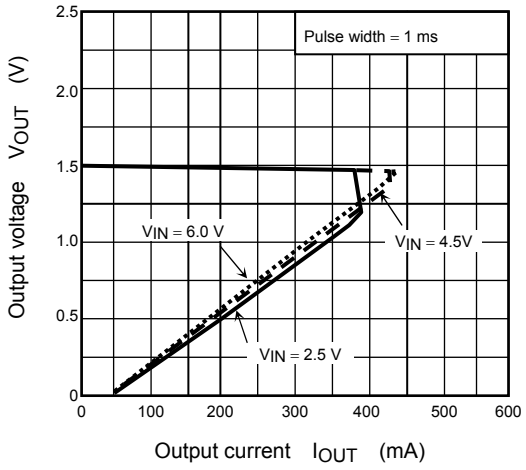


TCR5SB50U

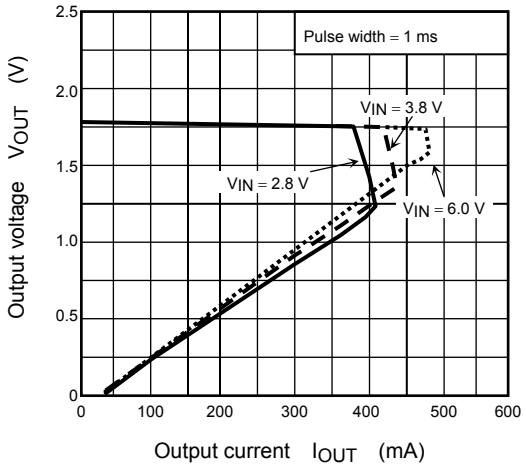


7) Overcurrent Protection Characteristics

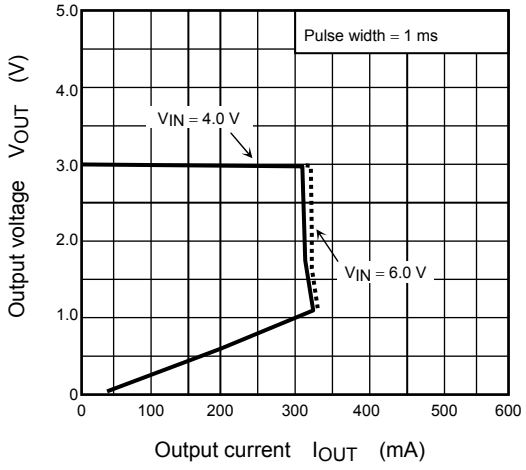
TCR5SB15U



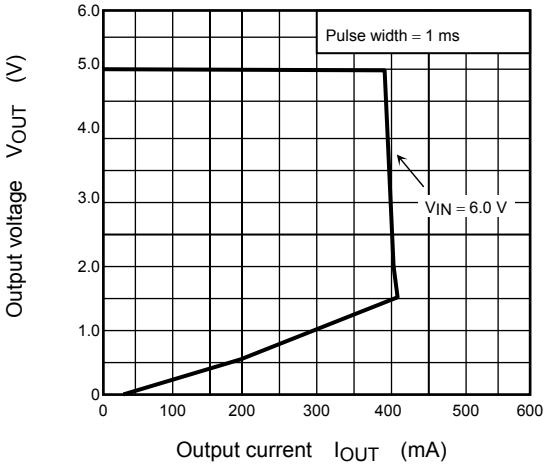
TCR5SB18U



TCR5SB30U

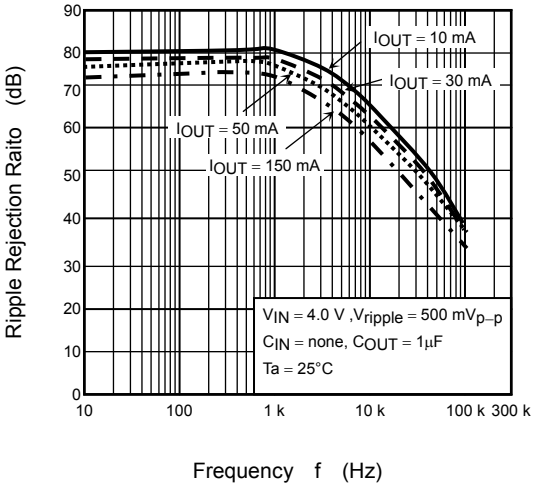


TCR5SB50U



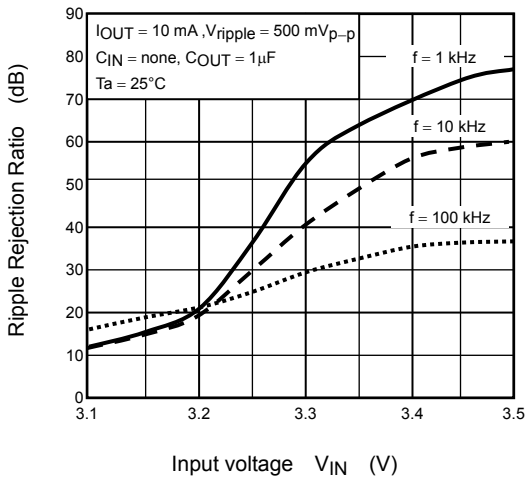
8) Ripple rejection Raito vs. Frequency（Dependence of Output current）

TCR5SB30U



9) Ripple rejection Ratio vs. Input Voltage

TCR5SB30U



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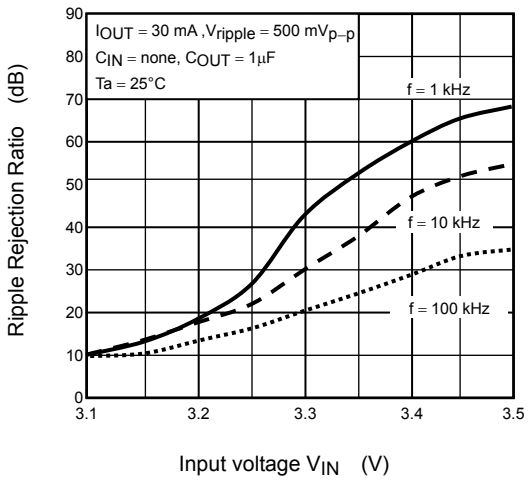

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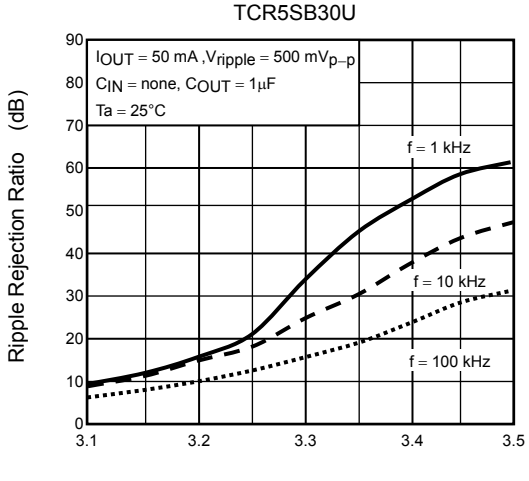
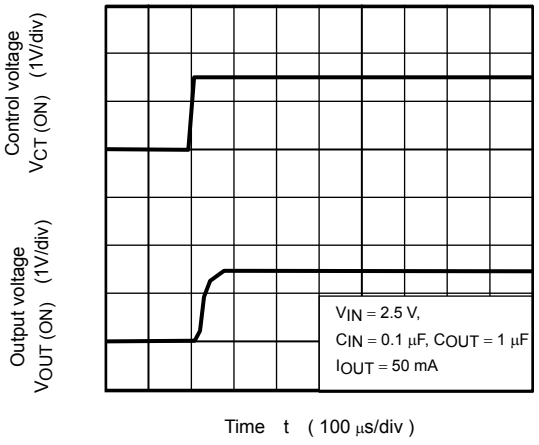


10) Control Transient Response

TCR5SB15U (Turn on wave form)



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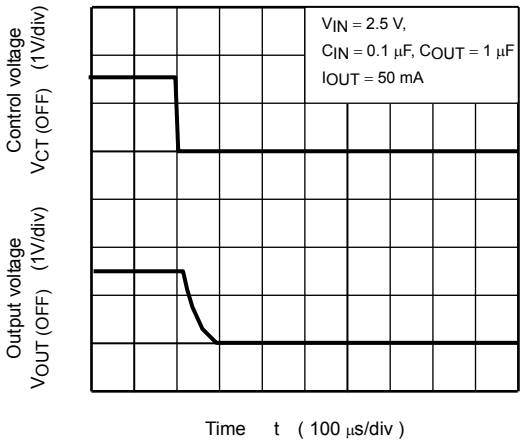
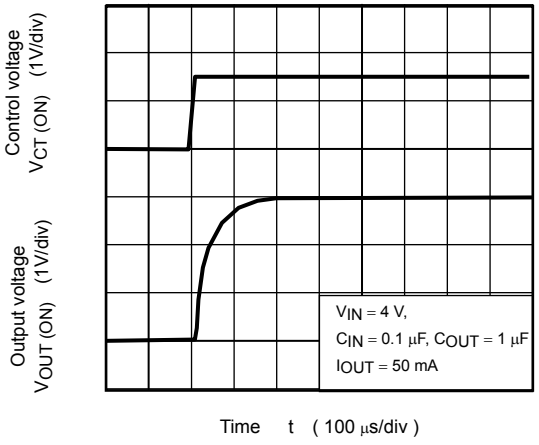
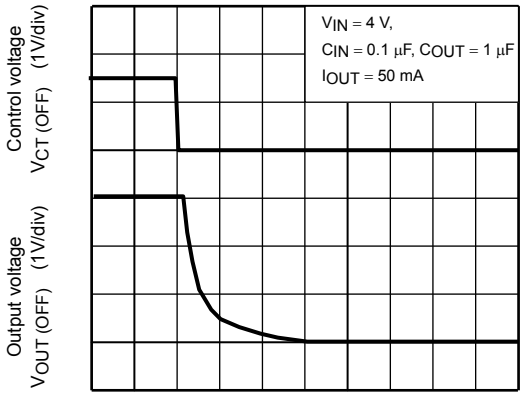


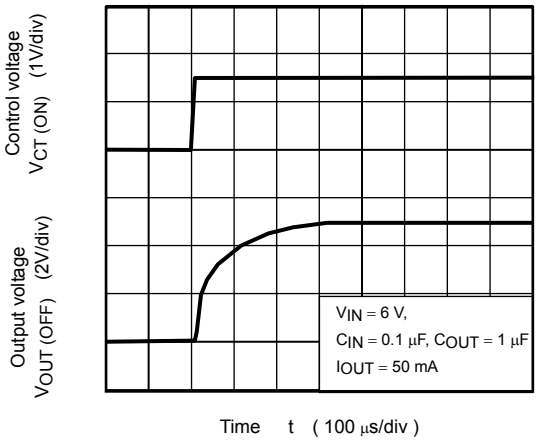
TCR5SB30U (Turn on wave form)



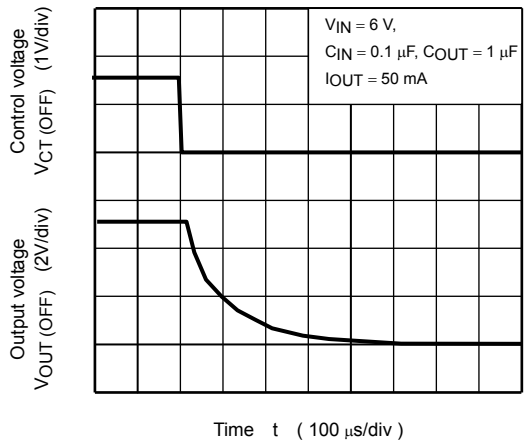
TCR5SB30U (Turn off wave form)



TCR5SB50U (Turn on wave form)

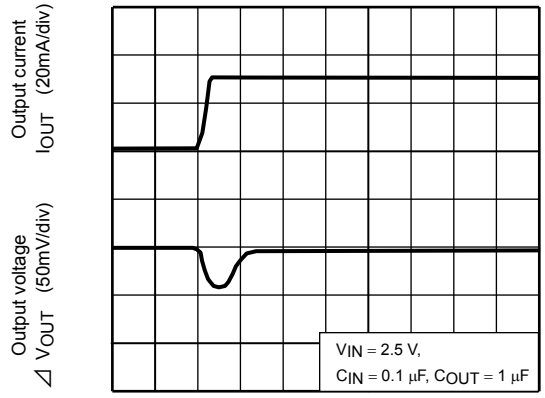


TCR5SB50U (Turn off wave form)

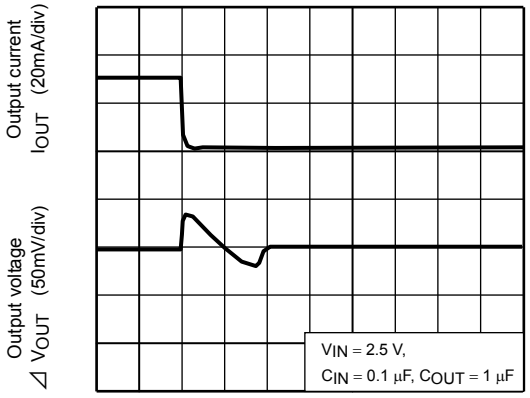


11) Load Transient Response

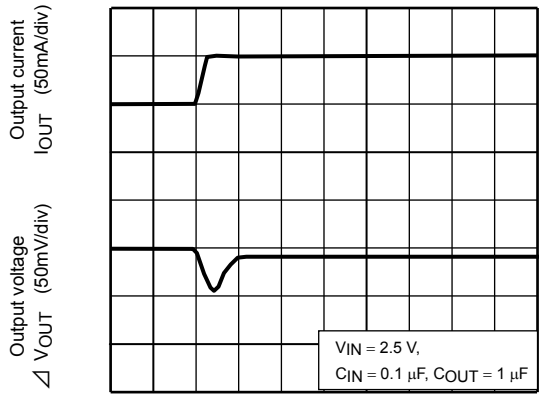
TCR5SB15U (I_{OUT} = 1m to 30mA)



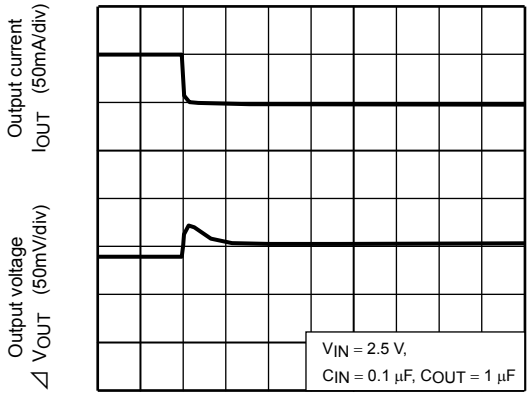
TCR5SB15U (I_{OUT} = 30m to 1mA)



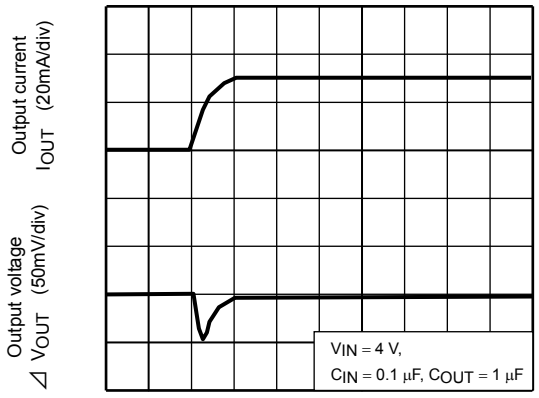
TCR5SB15U (I_{OUT} = 50m to 100mA)



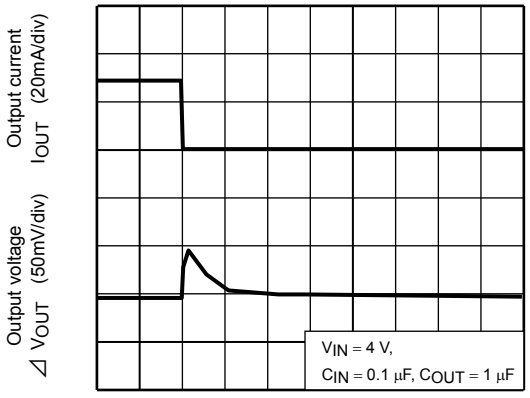
TCR5SB15U (I_{OUT} = 100m to 50mA)



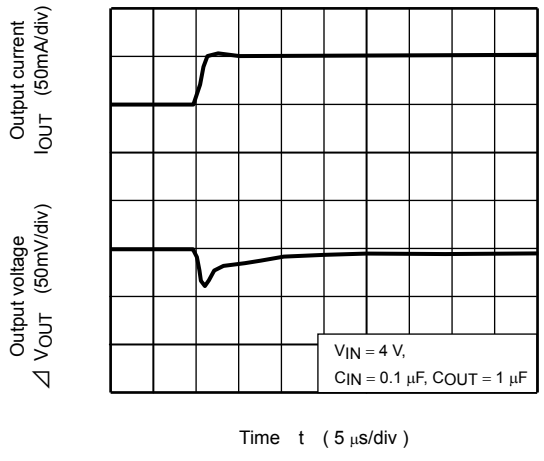
TCR5SB30U (I_{OUT} =1m to 30mA)



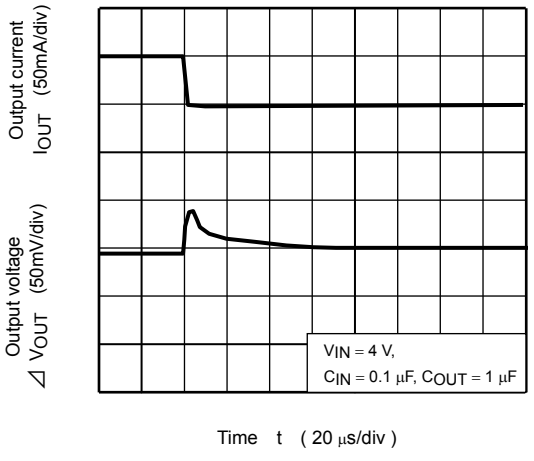
TCR5SB30U (I_{OUT} = 30m to 1mA)



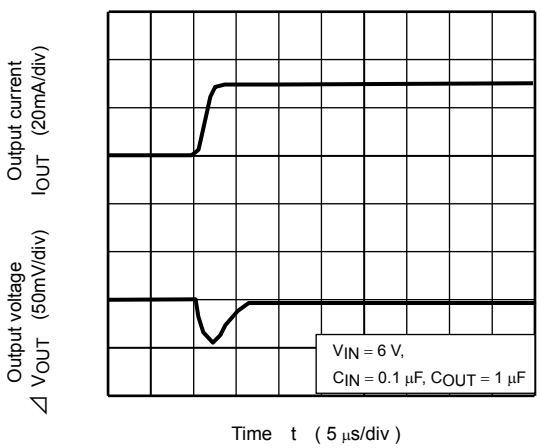
TCR5SB30U (I_{OUT} = 50m to 100mA)



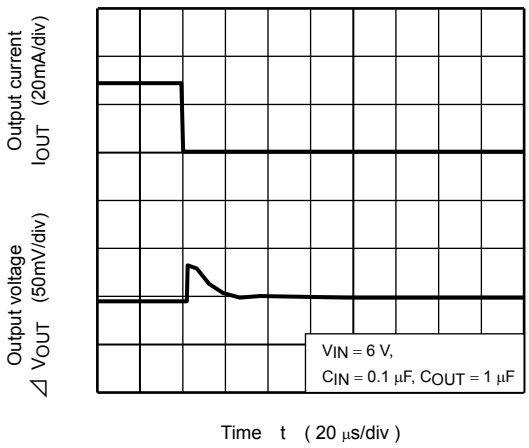
TCR5SB30U (I_{OUT} = 100m to 50mA)



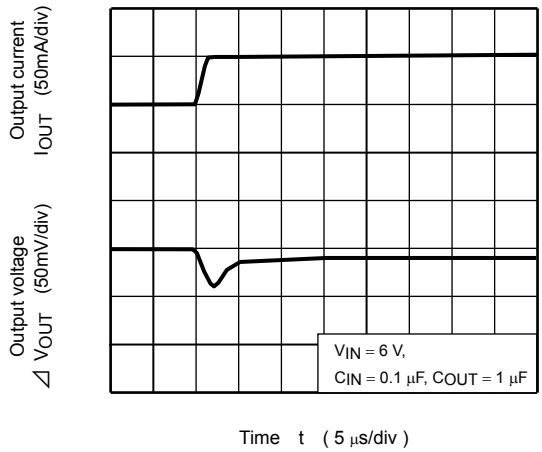
TCR5SB50U (I_{OUT} =1m to 30mA)



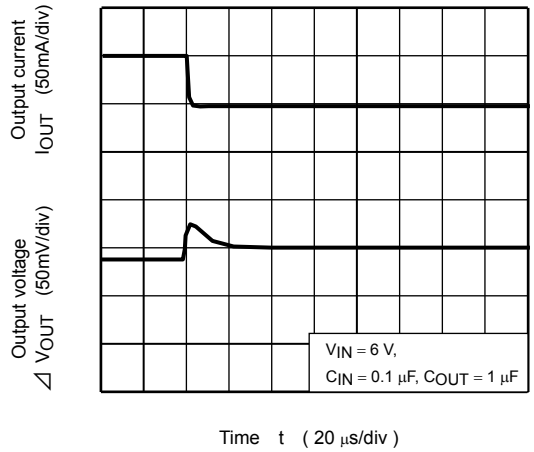
TCR5SB50U (I_{OUT} = 30m to 1mA)



TCR5SB50U (I_{OUT} = 50m to 100mA)

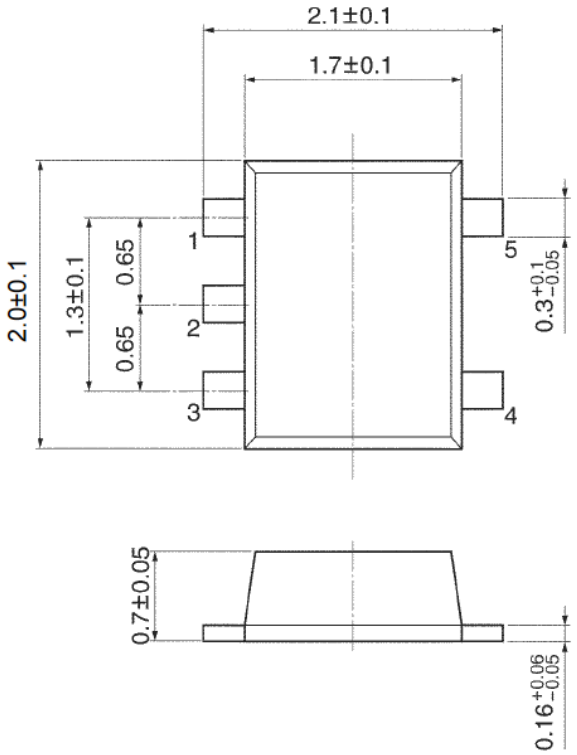


TCR5SB50U (I_{OUT} = 100m to 50mA)



Package Dimensions

UFV **Unit: mm**



Weight: 0.007 g (typ)

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