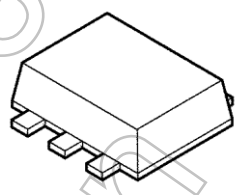
TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

TAR5S15U to TAR5S50U

Point Regulators (Low-Dropout Regulators)

1. Description

The TAR5SxxU Series consists of general-purpose bipolar LDO regulators with an on/off control pin and features overtemperature and overcurrent protection circuits.



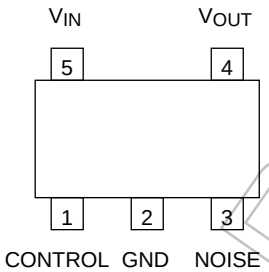
SON5-P-0202-0.65 (UFV)

Weight: 0.007 g (typ.)

2. Features

- Low standby current
- Overtemperature and overcurrent protections
- Wide operating voltage range
- High maximum output current
- Low input-to-output voltage differential
- Small package (UFV package similar to SOT-353)
- Allows use of ceramic capacitors as the input and output capacitors.

3. Pin Assignment (Top View)



The overtemperature and overcurrent protection features are not intended to guarantee correct operation below the absolute maximum ratings.

Do not use the TAR5SxxU under conditions where the absolute maximum ratings may be exceeded.

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Start of commercial production
2001-08

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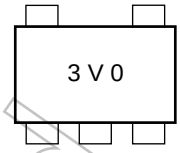
4. List of Part Numbers and Markings

Part No.	Marking	Part No.	Marking
TAR5S15U	1V5	TAR5S33U	3V3
TAR5S16U	1V6	TAR5S34U	3V4
TAR5S17U	1V7	TAR5S35U	3V5
TAR5S18U	1V8	TAR5S36U	3V6
TAR5S19U	1V9	TAR5S37U	3V7
TAR5S20U	2V0	TAR5S38U	3V8
TAR5S21U	2V1	TAR5S39U	3V9
TAR5S22U	2V2	TAR5S40U	4V0
TAR5S23U	2V3	TAR5S41U	4V1
TAR5S24U	2V4	TAR5S42U	4V2
TAR5S25U	2V5	TAR5S43U	4V3
TAR5S26U	2V6	TAR5S44U	4V4
TAR5S27U	2V7	TAR5S45U	4V5
TAR5S28U	2V8	TAR5S46U	4V6
TAR5S29U	2V9	TAR5S47U	4V7
TAR5S30U	3V0	TAR5S48U	4V8
TAR5S31U	3V1	TAR5S49U	4V9
TAR5S32U	3V2	TAR5S50U	5V0

Part Marking

Example: TAR5S30U (3.0-V output)



5. Absolute Maximum Ratings (Note) (Ta = 25 °C)

Characteristics	Symbol	Rating	Unit
Supply Voltage	V_{IN}	15	V
Output Current	I_{OUT}	200	mA
Power Dissipation	P_D	450 (Note 1)	mW
Operation Temp. Range	T_{opr}	−40 to 85	°C
Storage Temp. 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: Mounted on a glass epoxy circuit board of 30 mm × 30 mm; Pad dimension of 35 mm^2

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6. Electrical Characteristics

6.1. TAR5S15U to TAR5S22U

Electrical Characteristic (unless otherwise specified, $V_{IN} = V_{OUT} + 1$ V, $I_{OUT} = 50$ mA, $C_{IN} = 1$ µF, $C_{OUT} = 10$ µF, $C_{NOISE} = 0.01$ 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	$V_{OUT} + 1$ V ≤ V_{IN} ≤ 15 V, $I_{OUT} = 1$ mA	—	3	15	mV
Load regulation	Reg·load	1 mA ≤ I_{OUT} ≤ 150 mA	—	25	75	mV
Quiescent current	I_{B1}	$I_{OUT} = 0$ mA	—	170	—	µA
	I_{B2}	$I_{OUT} = 50$ mA	—	550	850	
Standby current	$I_{B (OFF)}$	$V_{CT} = 0$ V	—	—	0.1	µA
Output noise voltage	V_{NO}	$V_{IN} = V_{OUT} + 1$ V, $I_{OUT} = 10$ mA, 10 Hz ≤ f ≤ 100 kHz, $C_{NOISE} = 0.01$ µF, Ta = 25°C	—	30	—	μV_{rms}
Temperature coefficient	T_{CVO}	−40°C ≤ T_{opr} ≤ 85°C	—	100	—	ppm/°C
Input voltage	V_{IN}	—	2.4	—	15	V
Ripple rejection	R.R.	$V_{IN} = V_{OUT} + 1$ V, $I_{OUT} = 10$ mA, $C_{NOISE} = 0.01$ µF, f = 1 kHz, $V_{Ripple} = 500$ mV_{p-p}, Ta = 25°C	—	70	—	dB
Control voltage (ON)	$V_{CT (ON)}$	—	1.5	—	V_{IN}	V
Control voltage (OFF)	$V_{CT (OFF)}$	—	—	—	0.4	V
Control current (ON)	$I_{CT (ON)}$	$V_{CT} = 1.5$ V	—	3	10	µA
Control current (OFF)	$I_{CT (OFF)}$	$V_{CT} = 0$ V	—	0	0.1	µA

6.2. TAR5S23U to TAR5S50U

Electrical Characteristic (unless otherwise specified, $V_{IN} = V_{OUT} + 1$ V, $I_{OUT} = 50$ mA, $C_{IN} = 1$ µF, $C_{OUT} = 10$ µF, $C_{NOISE} = 0.01$ 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	$V_{OUT} + 1$ V ≤ V_{IN} ≤ 15 V, $I_{OUT} = 1$ mA	—	3	15	mV
Load regulation	Reg·load	1 mA ≤ I_{OUT} ≤ 150 mA	—	25	75	mV
Quiescent current	I_{B1}	$I_{OUT} = 0$ mA	—	170	—	µA
	I_{B2}	$I_{OUT} = 50$ mA	—	550	850	
Standby current	$I_{B (OFF)}$	$V_{CT} = 0$ V	—	—	0.1	µA
Output noise voltage	V_{NO}	$V_{IN} = V_{OUT} + 1$ V, $I_{OUT} = 10$ mA, 10 Hz ≤ f ≤ 100 kHz, $C_{NOISE} = 0.01$ µF, Ta = 25°C	—	30	—	μV_{rms}
Dropout volatge	$V_{IN} - V_{OUT}$	$I_{OUT} = 50$ mA	—	130	200	mV
Temperature coefficient	T_{CVO}	−40°C ≤ T_{opr} ≤ 85°C	—	100	—	ppm/°C
Input voltage	V_{IN}	—	V_{OUT} + 0.2 V	—	15	V
Ripple rejection	R.R.	$V_{IN} = V_{OUT} + 1$ V, $I_{OUT} = 10$ mA, $C_{NOISE} = 0.01$ µF, f = 1 kHz, $V_{Ripple} = 500$ mV_{p-p}, Ta = 25°C	—	70	—	dB
Control voltage (ON)	$V_{CT (ON)}$	—	1.5	—	V_{IN}	V
Control voltage (OFF)	$V_{CT (OFF)}$	—	—	—	0.4	V
Control current (ON)	$I_{CT (ON)}$	$V_{CT} = 1.5$ V	—	3	10	µA
Control current (OFF)	$I_{CT (OFF)}$	$V_{CT} = 0$ V	—	0	0.1	µA

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7. Output Voltage Accuracy

(V_{IN} = V_{OUT} + 1 V, I_{OUT} = 50 mA, C_{IN} = 1 μF, C_{OUT} = 10 μF, C_{NOISE} = 0.01 μF, T_j = 25 °C)

Part No.	Symbol	Min	Typ.	Max	Unit
TAR5S15U	V_{OUT}	1.44	1.5	1.56	V
TAR5S16U		1.54	1.6	1.66	
TAR5S17U		1.64	1.7	1.76	
TAR5S18U		1.74	1.8	1.86	
TAR5S19U		1.84	1.9	1.96	
TAR5S20U		1.94	2.0	2.06	
TAR5S21U		2.04	2.1	2.16	
TAR5S22U		2.14	2.2	2.26	
TAR5S23U		2.24	2.3	2.36	
TAR5S24U		2.34	2.4	2.46	
TAR5S25U		2.43	2.5	2.57	
TAR5S26U		2.53	2.6	2.67	
TAR5S27U		2.63	2.7	2.77	
TAR5S28U		2.73	2.8	2.87	
TAR5S29U		2.83	2.9	2.97	
TAR5S30U		2.92	3.0	3.08	
TAR5S31U		3.02	3.1	3.18	
TAR5S32U		3.12	3.2	3.28	
TAR5S33U		3.21	3.3	3.39	
TAR5S34U		3.31	3.4	3.49	
TAR5S35U		3.41	3.5	3.59	
TAR5S36U		3.51	3.6	3.69	
TAR5S37U		3.6	3.7	3.8	
TAR5S38U		3.7	3.8	3.9	
TAR5S39U		3.8	3.9	4.0	
TAR5S40U		3.9	4.0	4.1	
TAR5S41U		3.99	4.1	4.21	
TAR5S42U		4.09	4.2	4.31	
TAR5S43U		4.19	4.3	4.41	
TAR5S44U		4.29	4.4	4.51	
TAR5S45U		4.38	4.5	4.62	
TAR5S46U		4.48	4.6	4.72	
TAR5S47U		4.58	4.7	4.82	
TAR5S48U		4.68	4.8	4.92	
TAR5S49U		4.77	4.9	5.03	
TAR5S50U		4.87	5.0	5.13	

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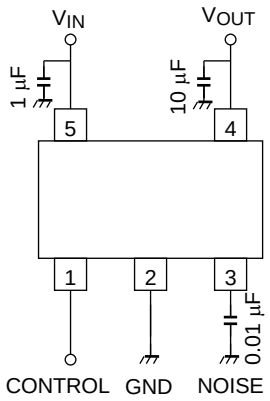
8. Application Notes

8.1. Recommended Application Circuit



CONTROL	Operation
HIGH	ON
LOW	OFF

A noise-damping capacitor should be connected between the NOISE pin and GND for stable operation. The recommended value is higher than 0.0047 µF.

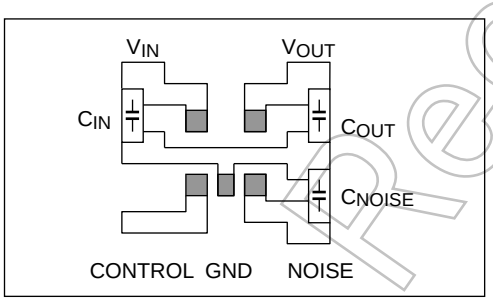
The above figure shows the recommended application circuit for the TAR5SxxU. Capacitors should be connected to V_{IN} and V_{OUT} for input/output stabilization.

If on/off control is not required, it is recommended to connect the CONTROL pin (pin 1) to V_{CC}.

8.2. Power Dissipation

The power dissipation rating (450 mW) is measured on a board shown below. More power can be safely dissipated by reducing the input voltage, output current and/or ambient temperature. It is recommended to use the TAR5SxxU at 70 % to 80 % of the absolute maximum power dissipation.

Thermal Resistance Evaluation Board



Material: Glass epoxy
Dimensions: 30 mm × 30 mm
Copper pad area: 35 mm^2, t = 0.8 mm

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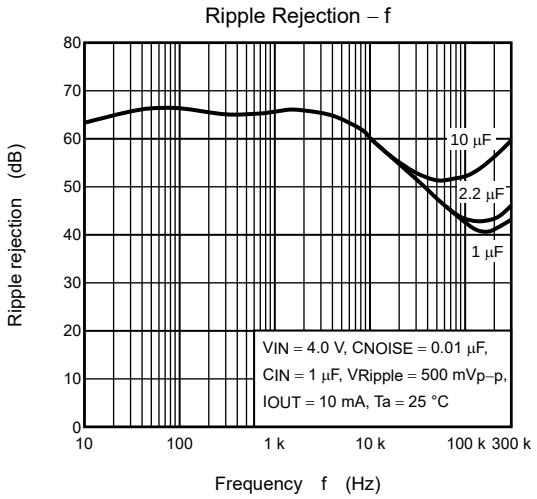
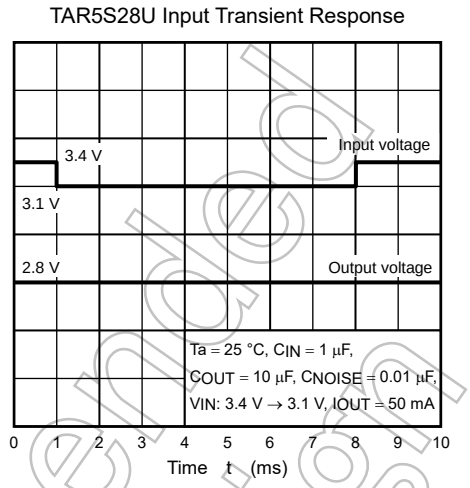
8.3. Ripple Rejection

The TAR5SxxU feature a good power supply ripple rejection and input transient response, making them an ideal solution for the RF block of cell phones.

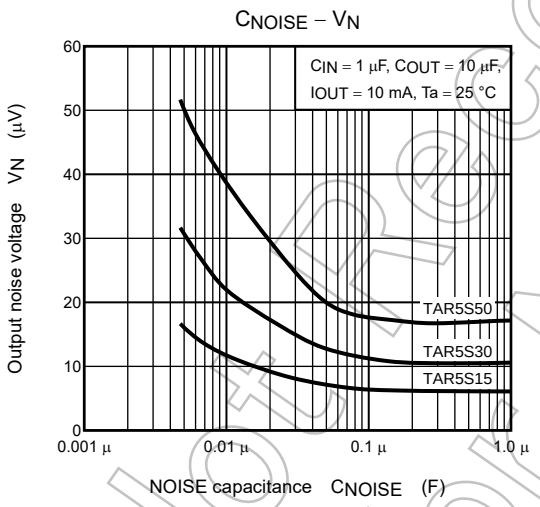


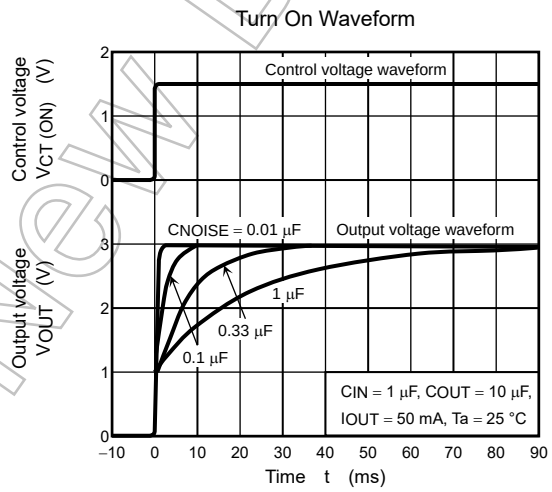


8.4. NOISE Pin

The TAR5SxxU have a pin named NOISE. To reduce the output noise and ensure stable operation, a capacitor should be inserted between the NOISE pin and GND. The capacitance value should be at least 0.0047 μF.

The output voltage rise time varies with the value of the capacitor connected to the NOISE pin.





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8.5. Examples of Performance Curves When Ceramic Capacitors Are Used

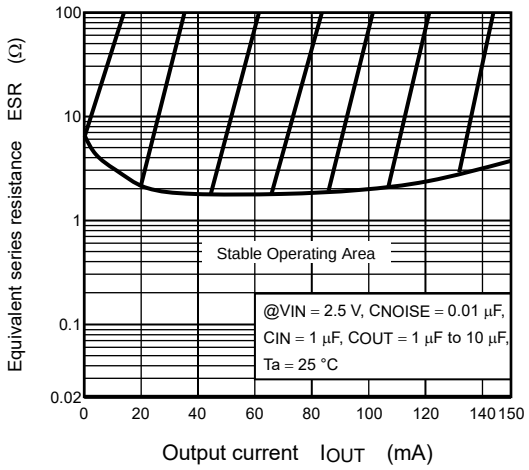
The stable operating area (SOA) is an area where the output voltage does not go into oscillation. The following figures represent the SOA obtained using an evaluation circuit shown below. The SOA is determined by the equivalent series resistance (ESR) of the output capacitor and the output current. The TAR5SxxU provide stable operation even when a ceramic capacitor is used as the output capacitor.

If the ripple frequency is 30 kHz or greater, the ripple rejection characteristics differ, depending on the type of the output capacitor (ceramic or tantalum) as shown by the bottom figure on this page.

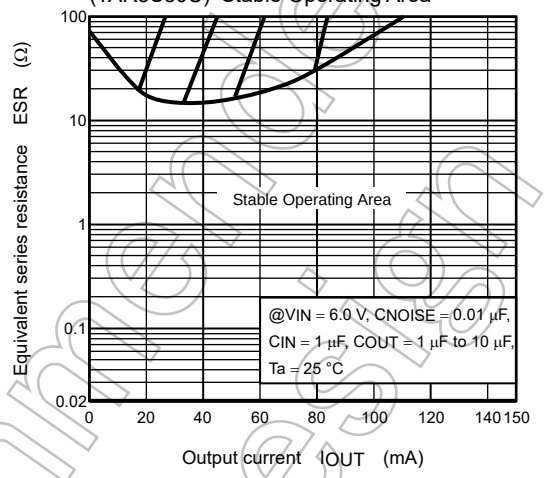
It is recommended to verify that TAR5SxxU operate properly under the intended conditions of use.

Examples of Safe Operating Area Characteristics

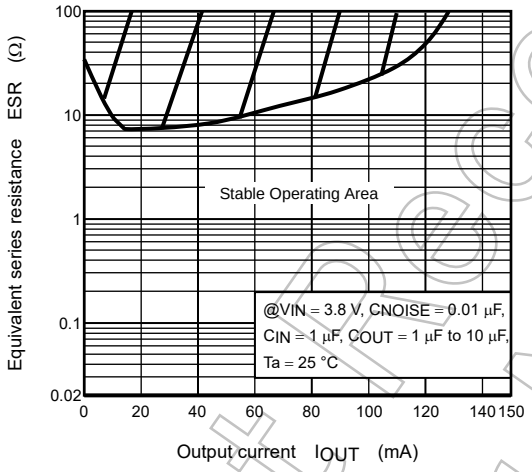
(TAR5S15U) Stable Operating Area



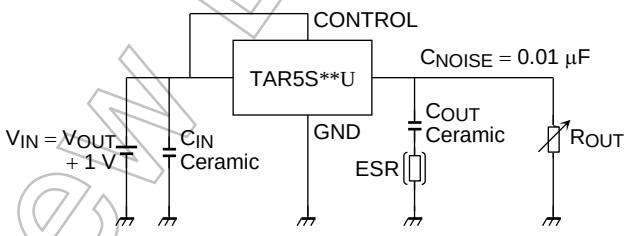
(TAR5S50U) Stable Operating Area



(TAR5S28U) Stable Operating Area



Circuit for Stable Operating Area Evaluation



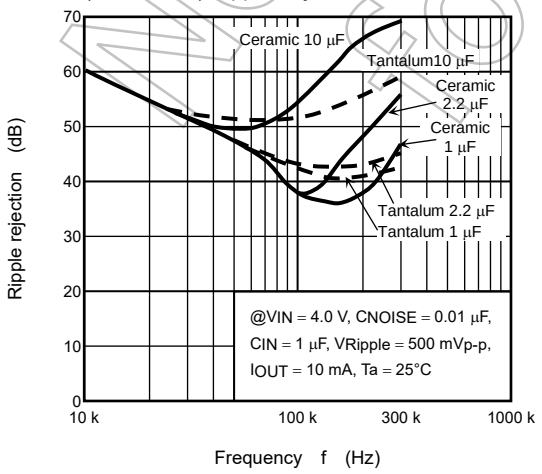
Capacitors used for evaluation

C_{IN}: Murata GRM40B105K

C_{OUT}: Murata GRM40B105K / GRM40B106K

Ripple Rejection Characteristic (f = 10 kHz to 300 kHz)

(TAR5S30U) Ripple Rejection – f



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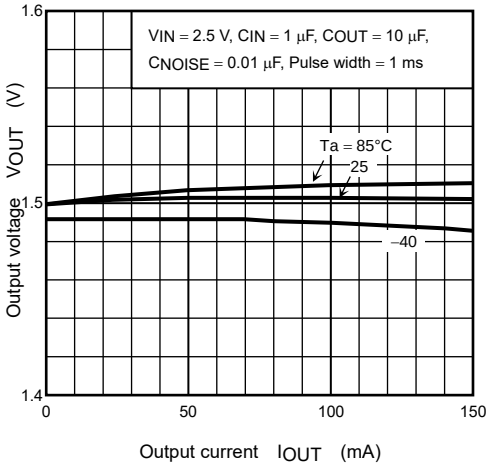
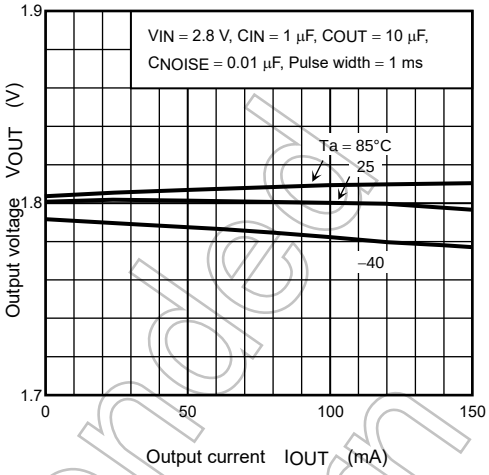
9. Representative Typical Characteristics (Note)

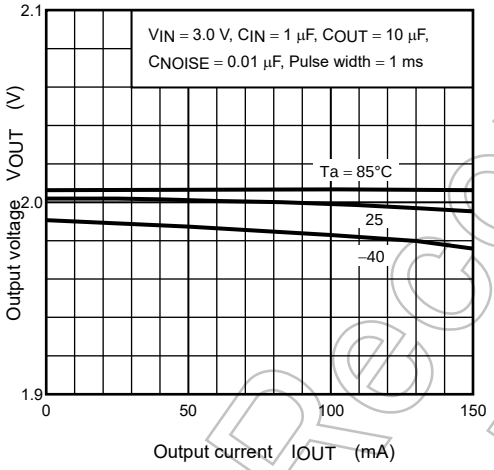
(TAR5S15U) I_{OUT} – V_{OUT}



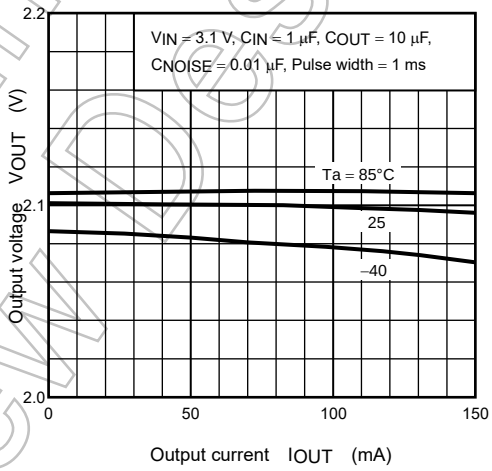
(TAR5S18U) I_{OUT} – V_{OUT}



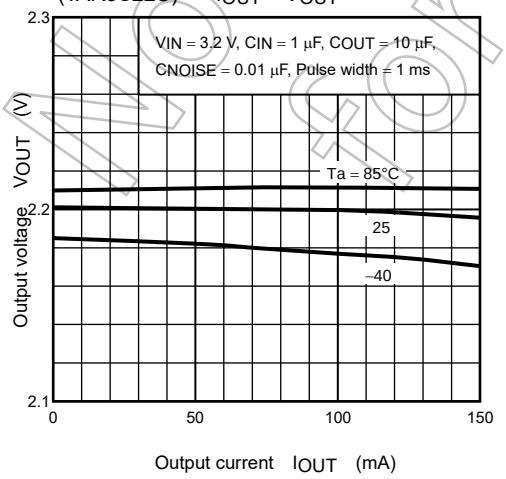
(TAR5S20U) I_{OUT} – V_{OUT}



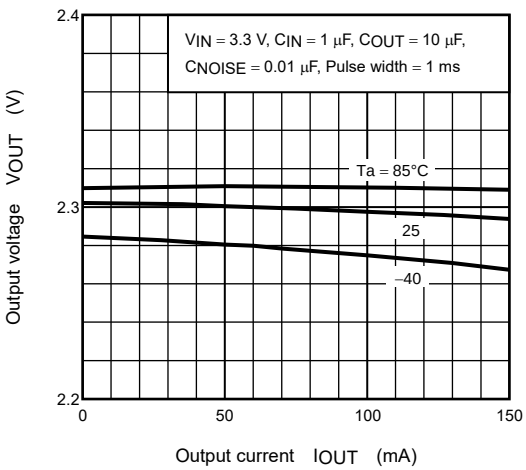
(TAR5S21U) I_{OUT} – V_{OUT}



(TAR5S22U) I_{OUT} – V_{OUT}



(TAR5S23U) I_{OUT} – V_{OUT}



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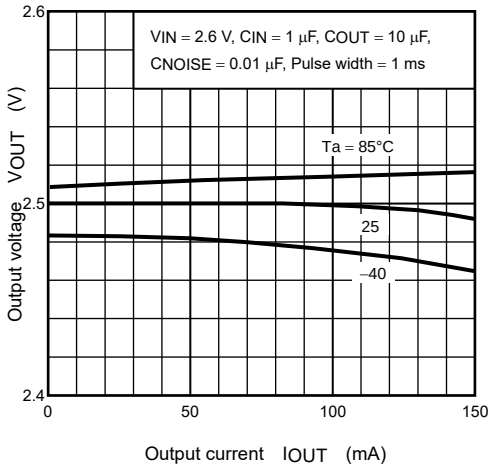
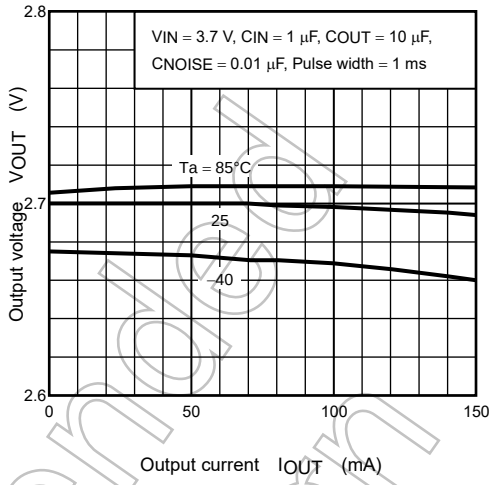
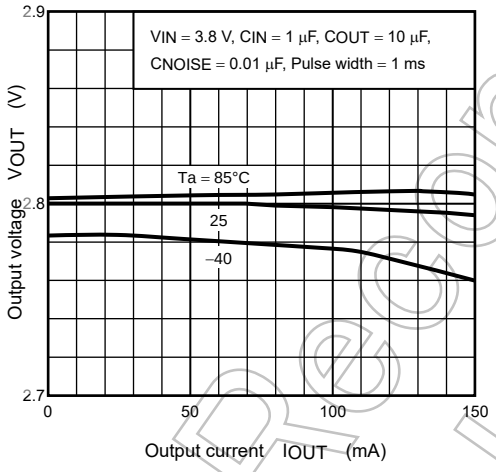
(TAR5S25U) I_{OUT} – V_{OUT}



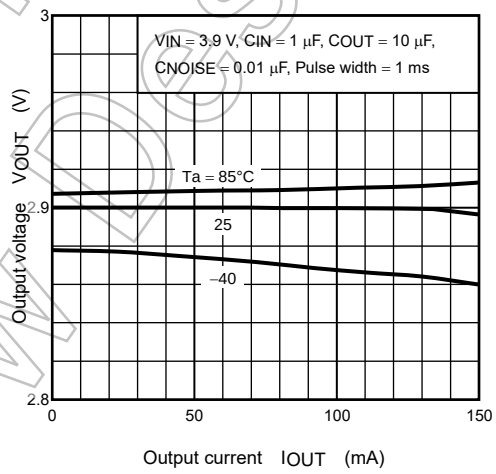
(TAR5S27U) I_{OUT} – V_{OUT}



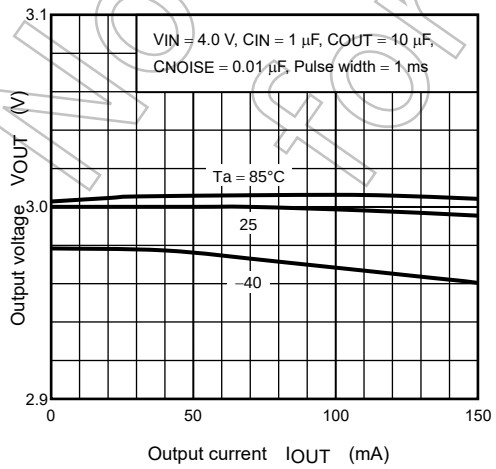
(TAR5S28U) I_{OUT} – V_{OUT}



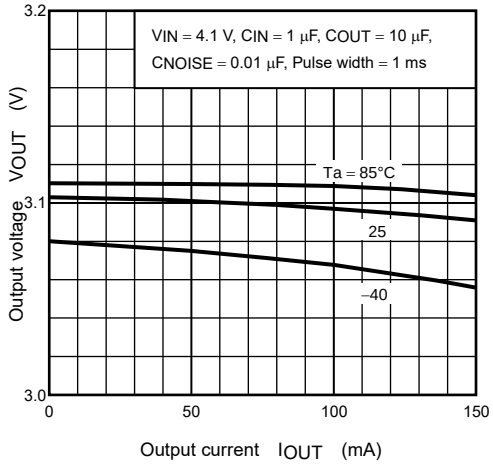
(TAR5S29U) I_{OUT} – V_{OUT}



(TAR5S30U) I_{OUT} – V_{OUT}



(TAR5S31U) I_{OUT} – V_{OUT}



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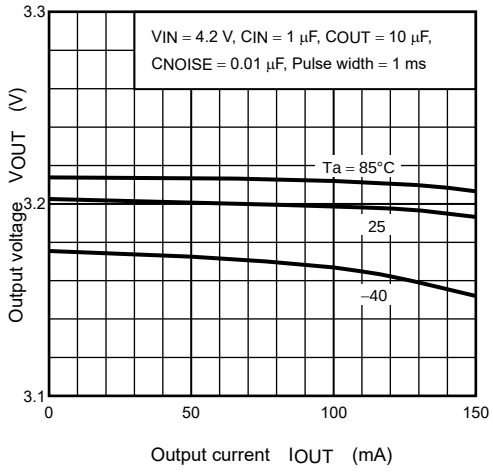
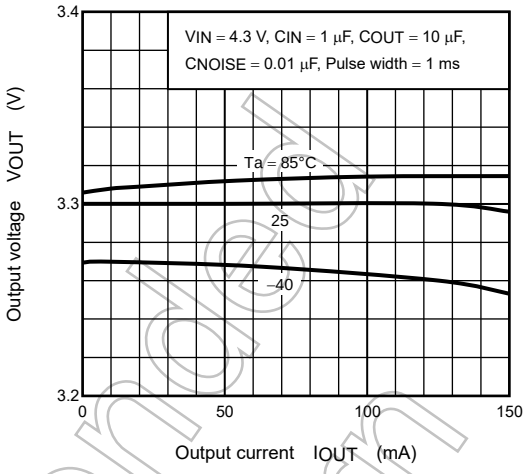
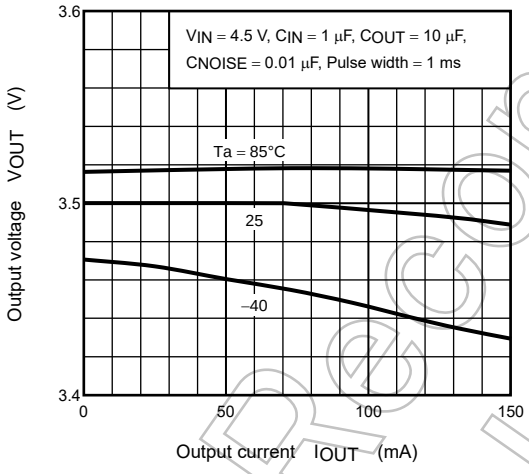
(TAR5S32U) I_{OUT} – V_{OUT}



(TAR5S33U) I_{OUT} – V_{OUT}



(TAR5S35U) I_{OUT} – V_{OUT}



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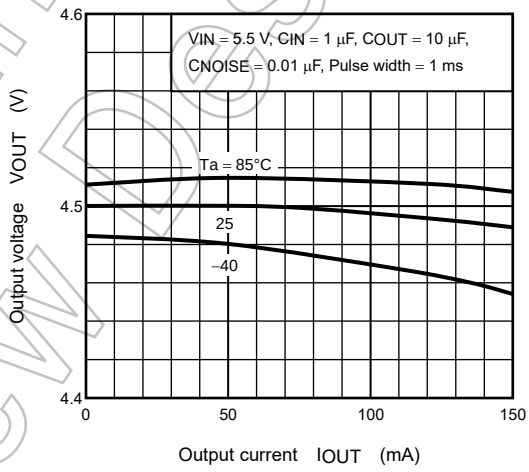

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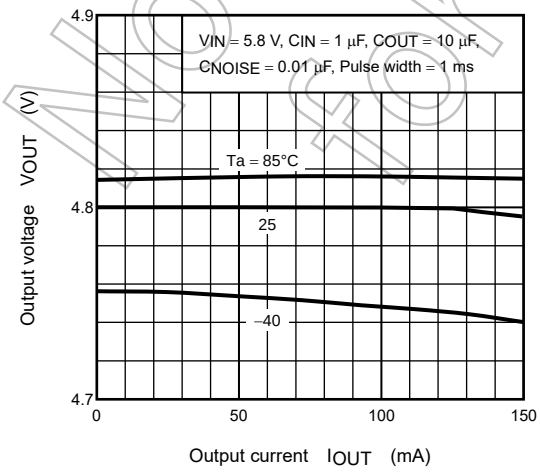

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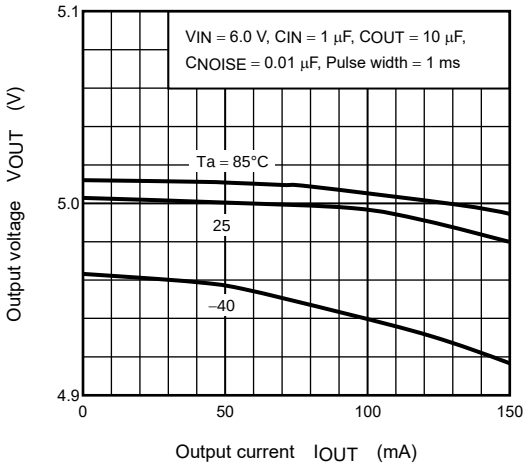

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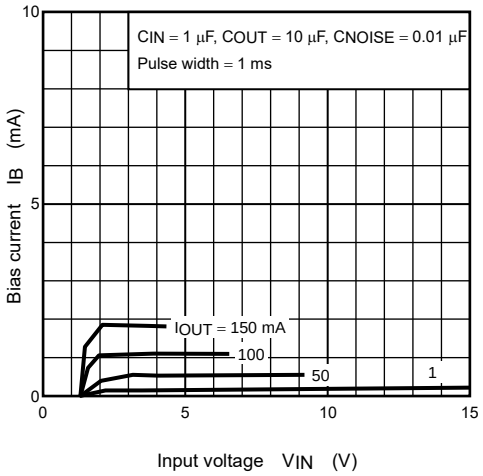
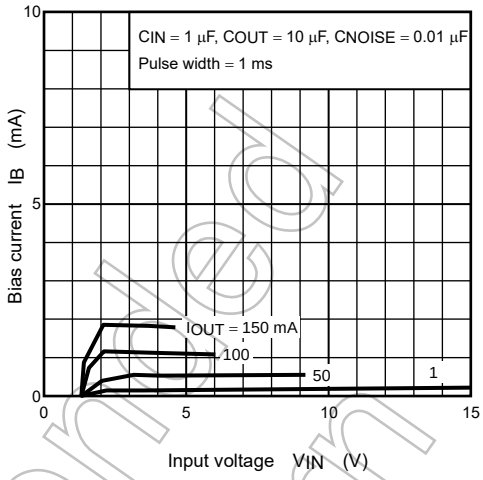
(TAR5S15U) $I_B - V_{IN}$



(TAR5S18U) $I_B - V_{IN}$



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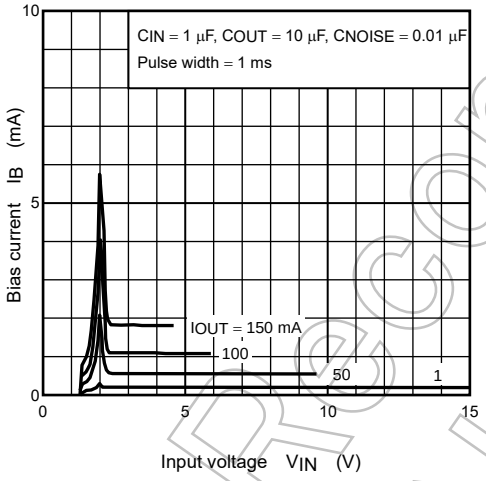

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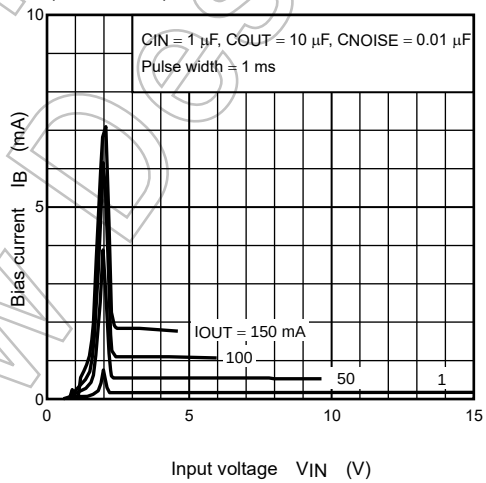
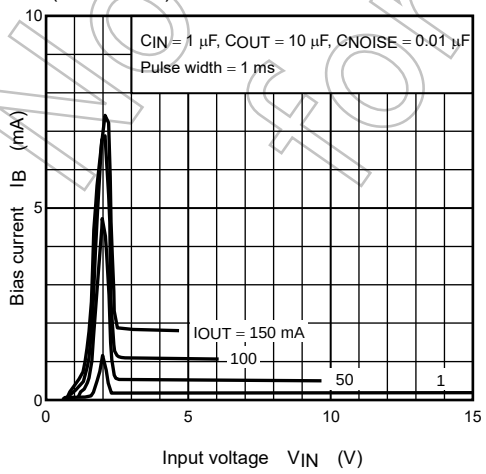


(TAR5S22U) $I_B - V_{IN}$



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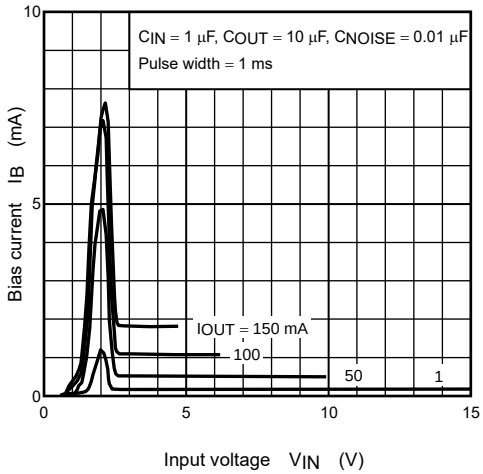

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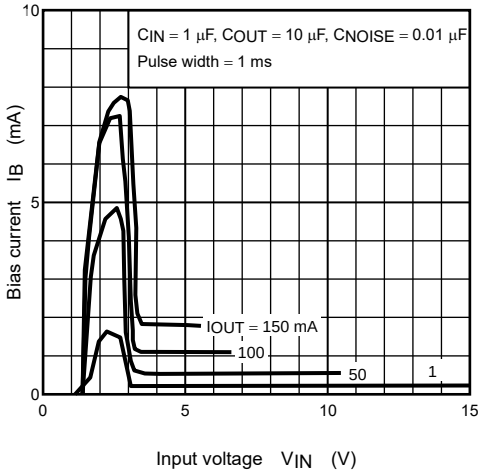
(TAR5S25U) $I_B - V_{IN}$



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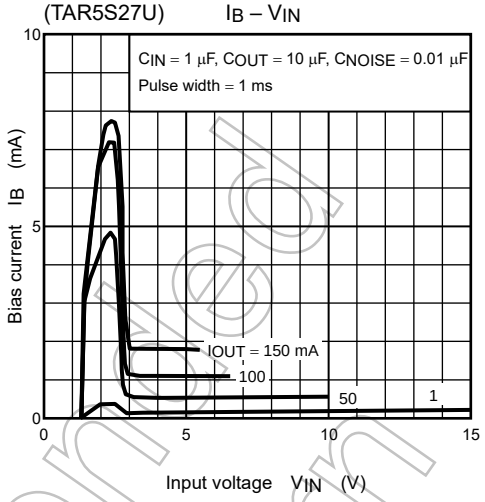

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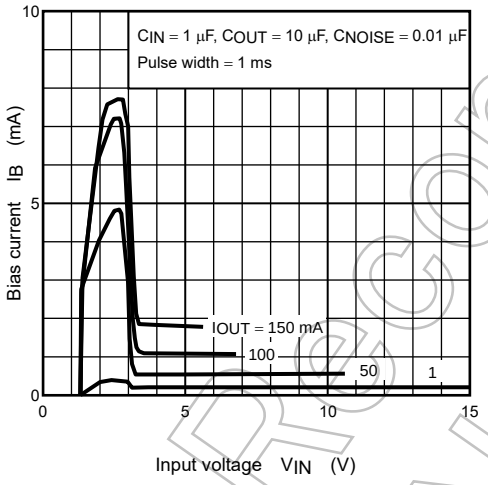
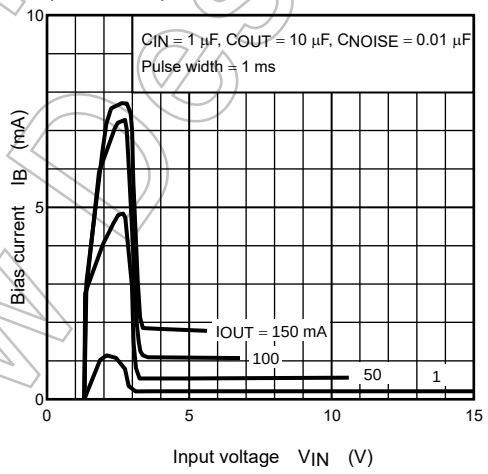
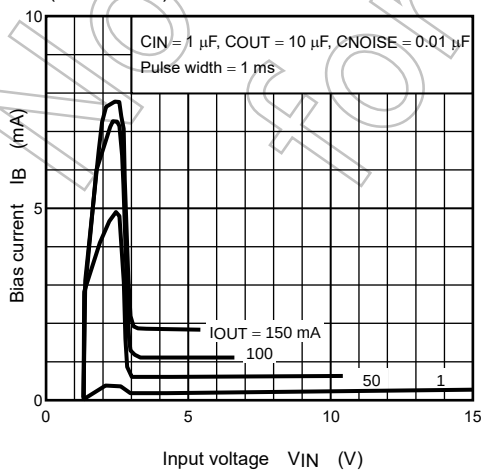


(TAR5S29U) $I_B - V_{IN}$



(TAR5S30U) $I_B - V_{IN}$



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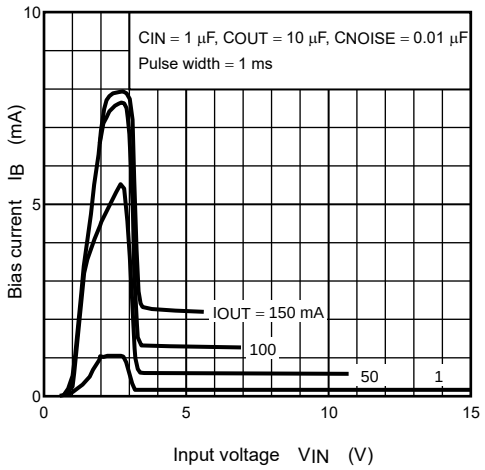

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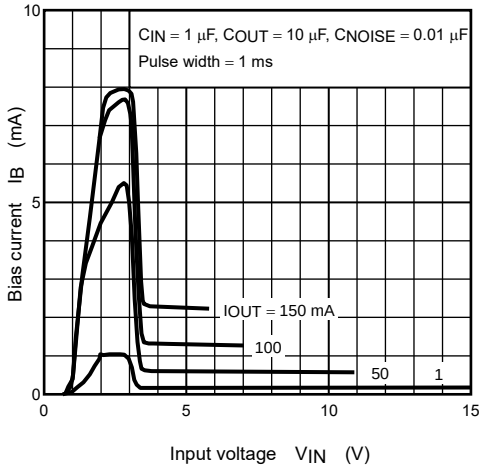
(TAR5S32U) $I_B - V_{IN}$



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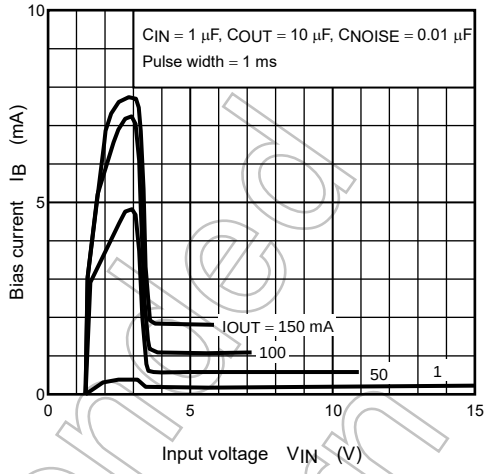

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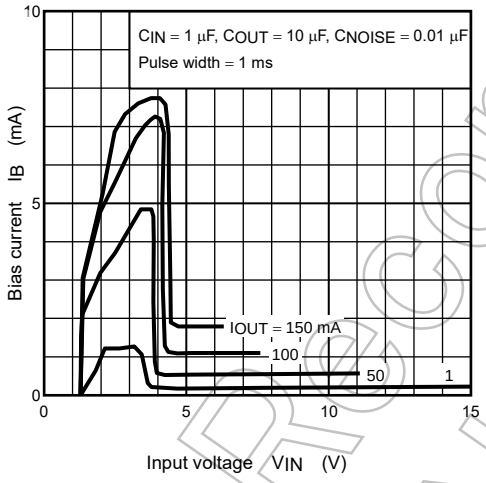

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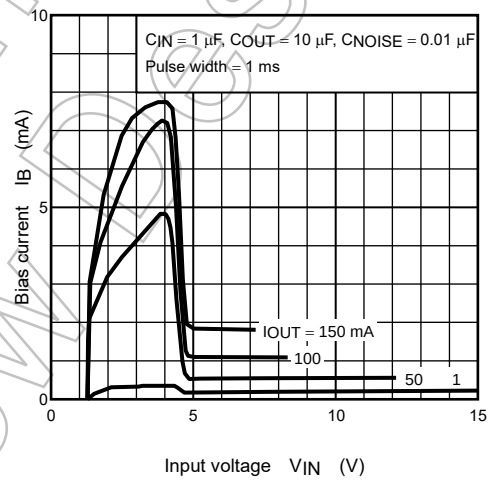

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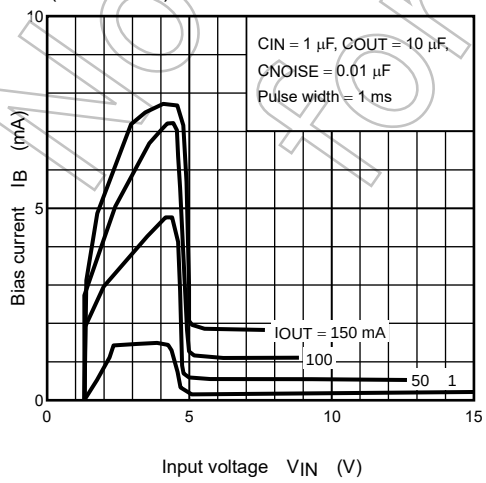

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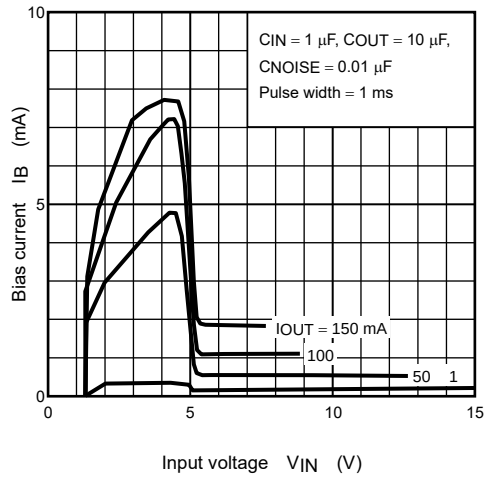

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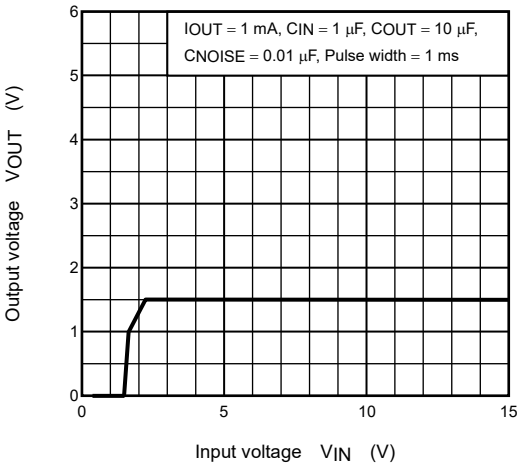
(TAR5S15U) $V_{OUT} - V_{IN}$



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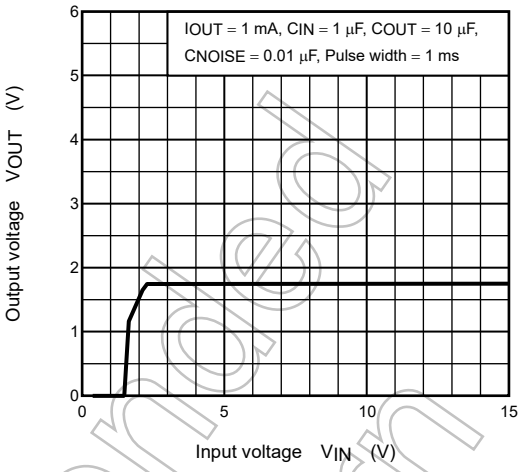

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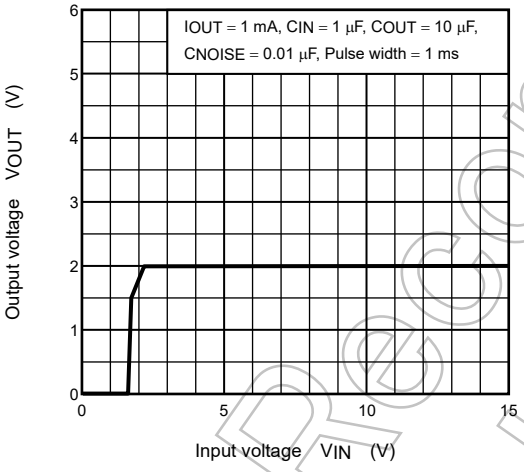

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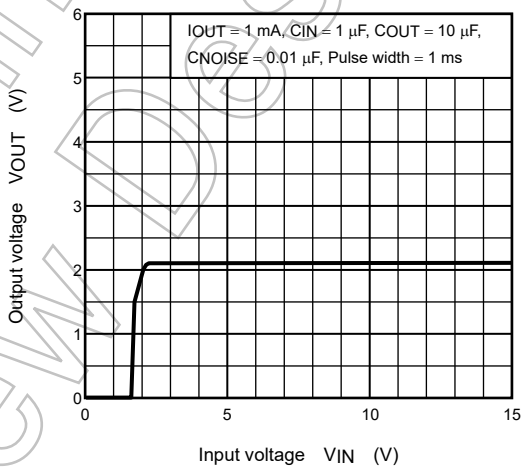

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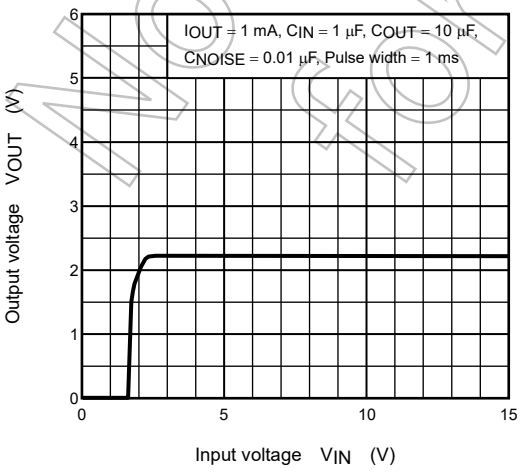

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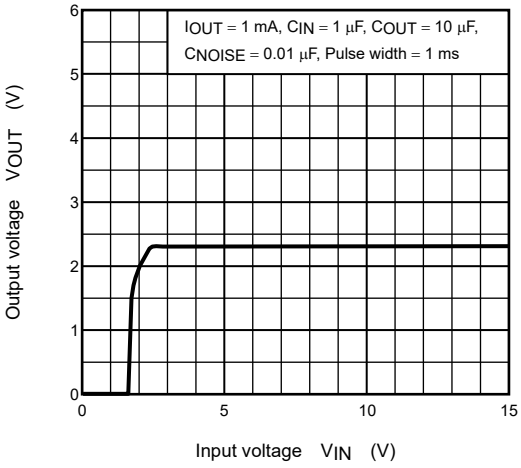

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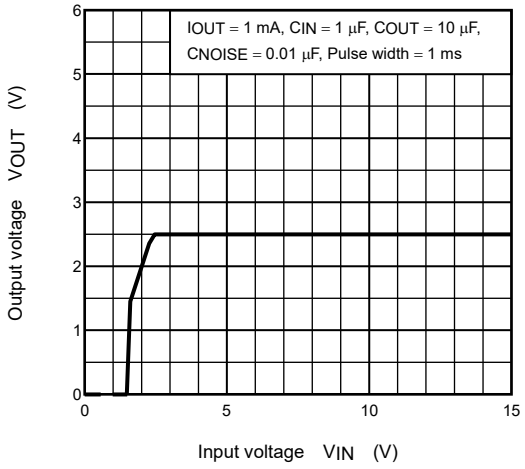
(TAR5S25U) $V_{OUT} - V_{IN}$



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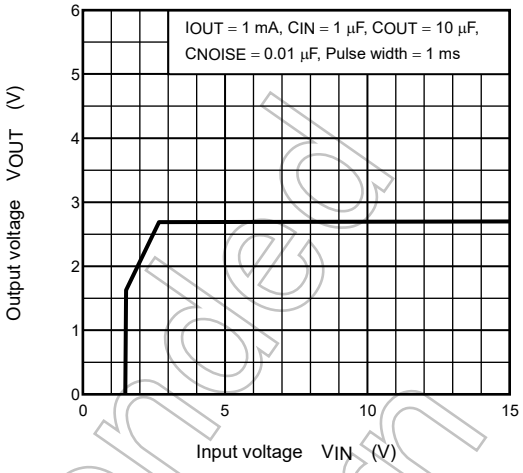

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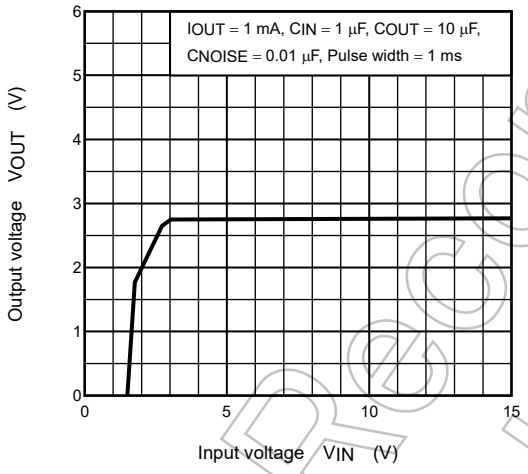

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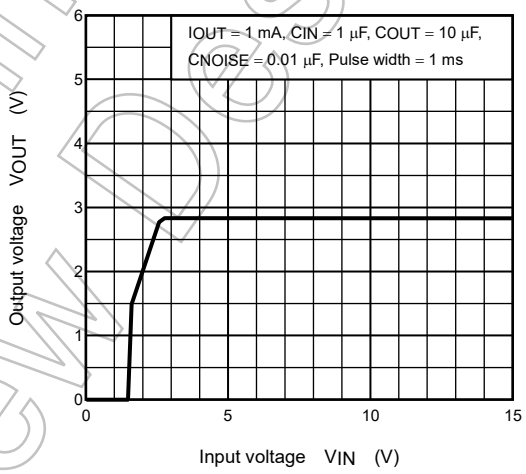

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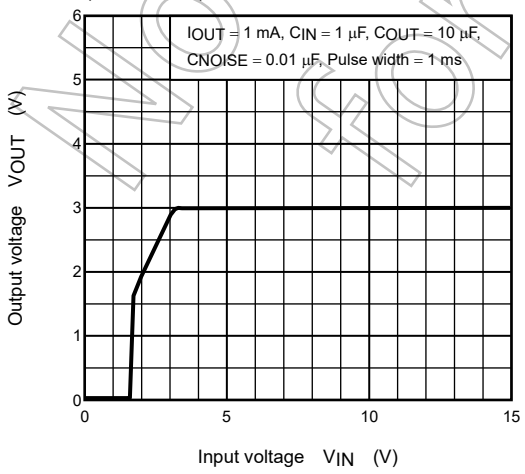

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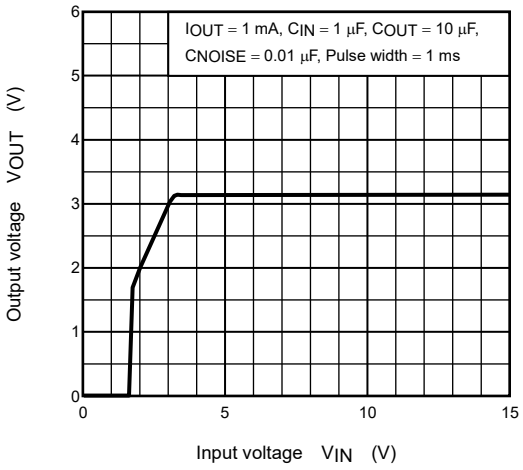

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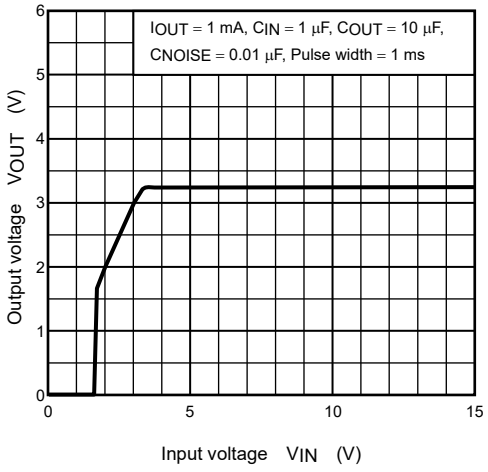
(TAR5S32U) $V_{OUT} - V_{IN}$



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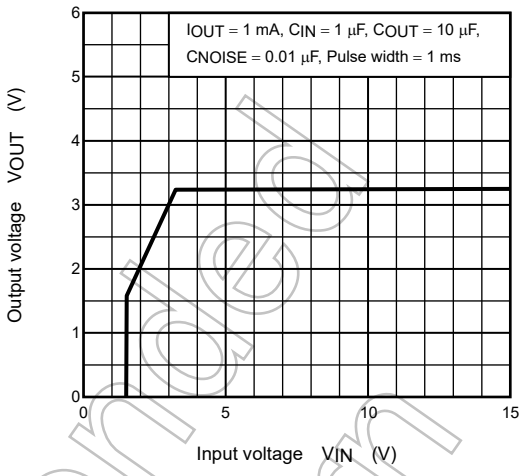

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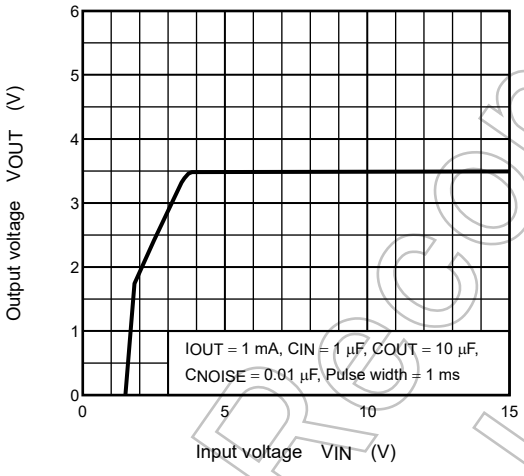

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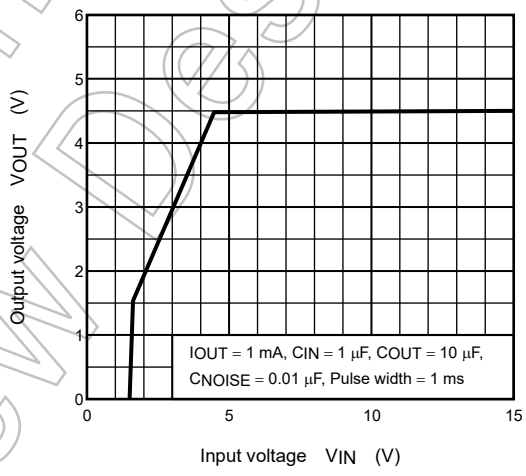

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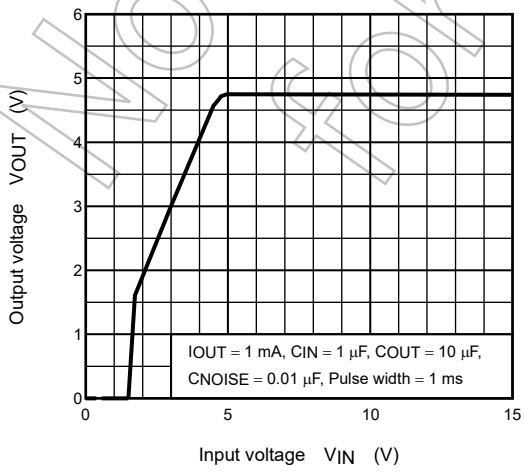

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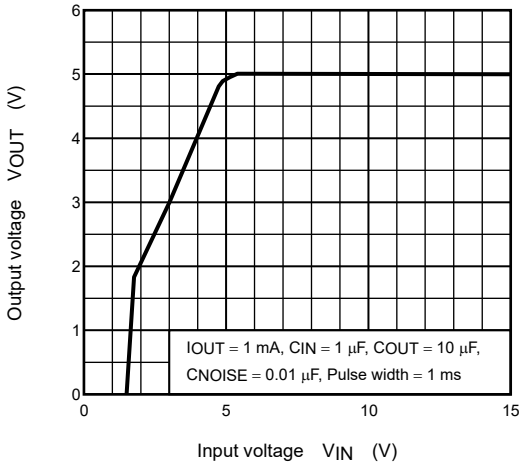

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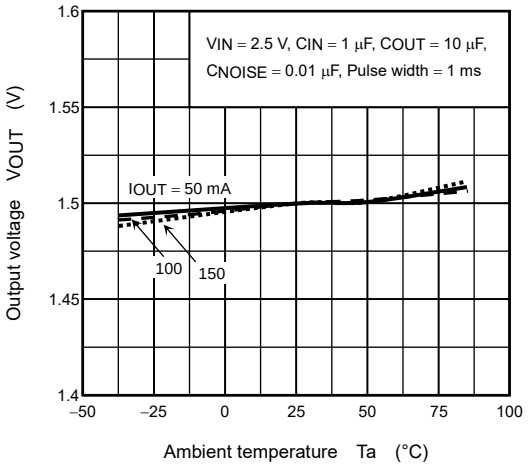
(TAR5S15U) V_{OUT} – Ta



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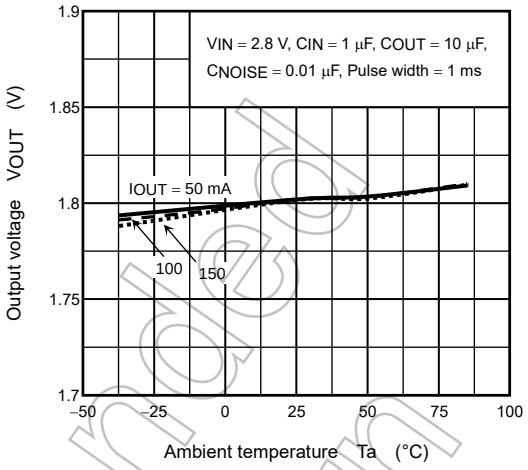

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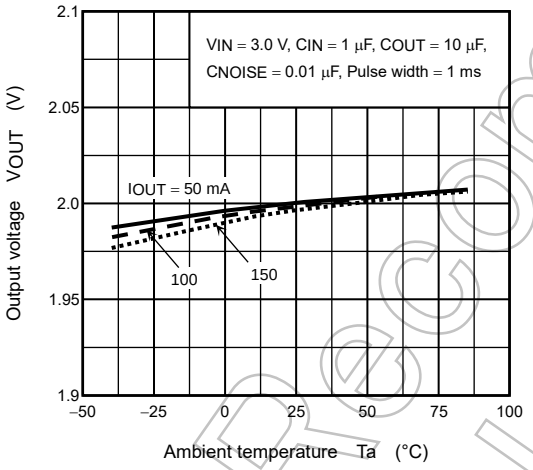

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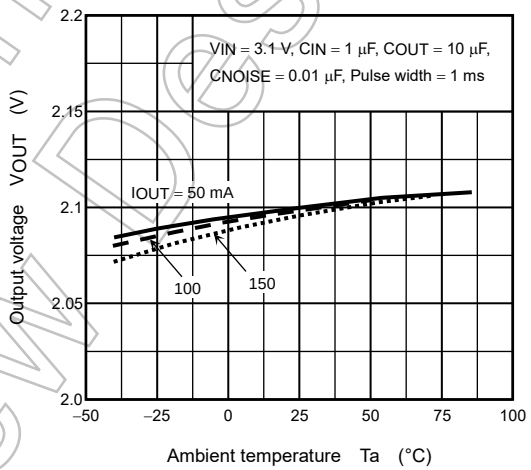

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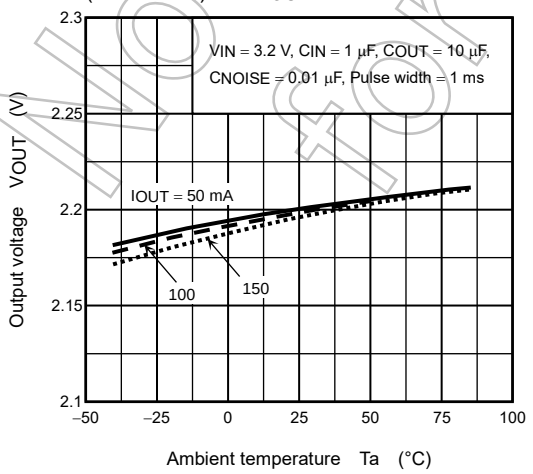

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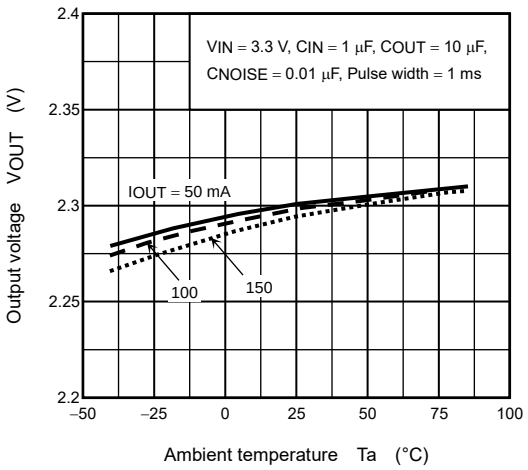

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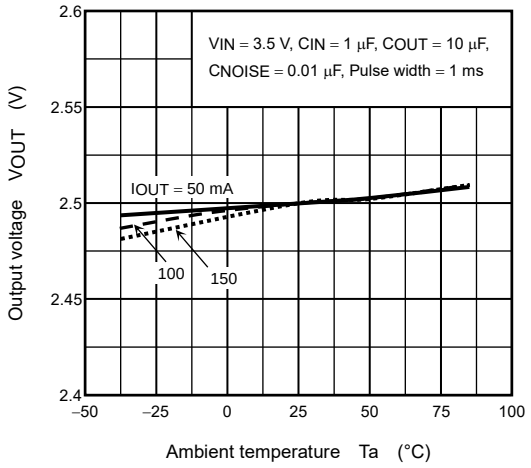
(TAR5S25U) V_{OUT} – Ta



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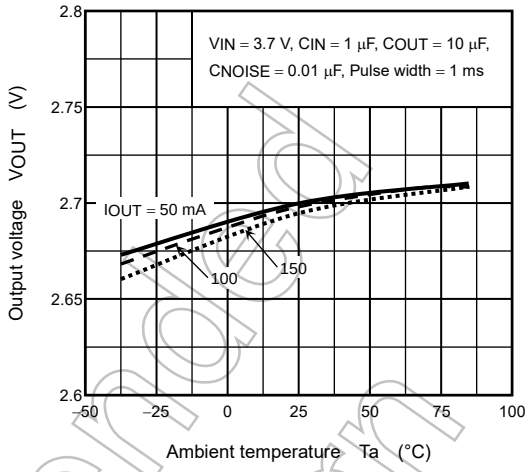
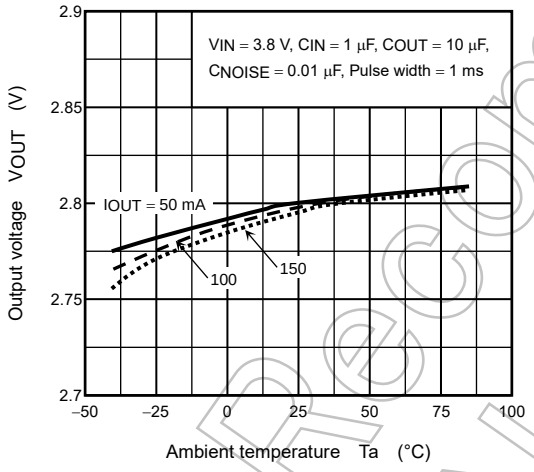
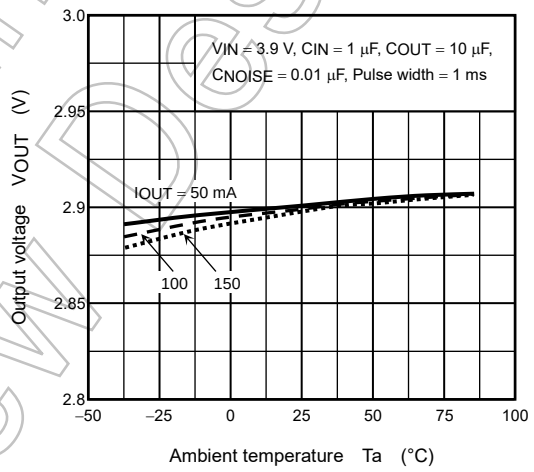


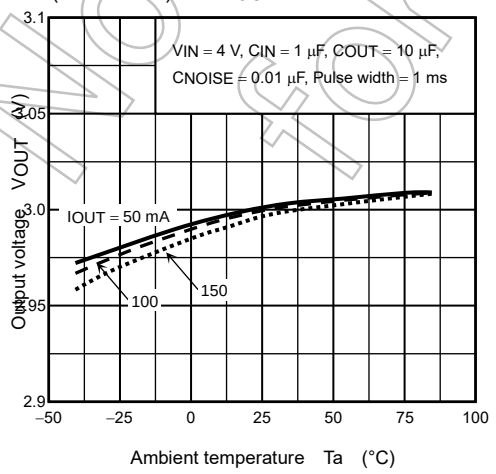
(TAR5S28U) V_{OUT} – Ta



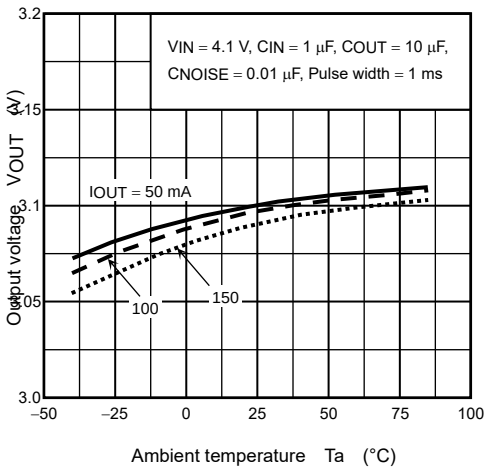
(TAR5S29U) V_{OUT} – Ta



(TAR5S30U) V_{OUT} – Ta



(TAR5S31U) V_{OUT} – Ta



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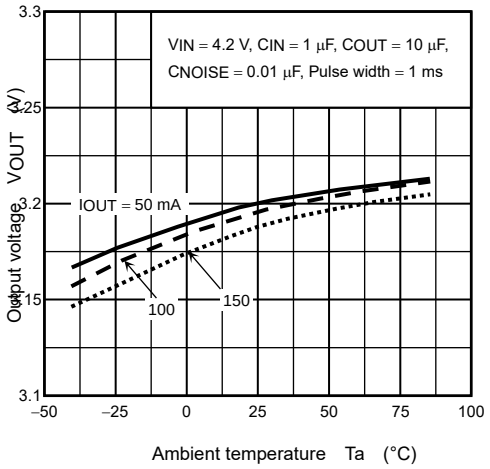
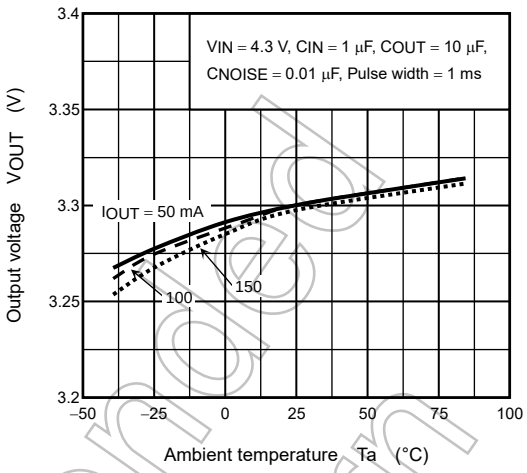
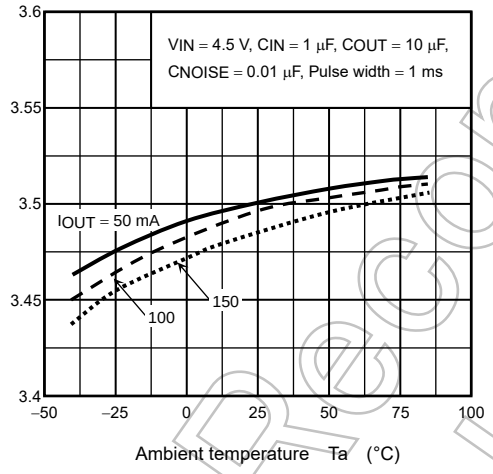
(TAR5S32U) V_{OUT} – Ta



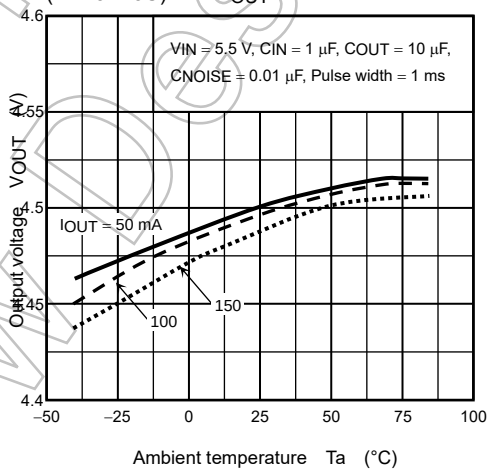
(TAR5S33U) V_{OUT} – Ta



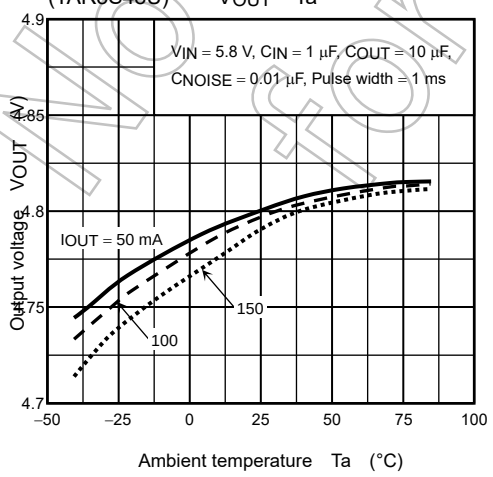
(TAR5S35U) V_{OUT} – Ta



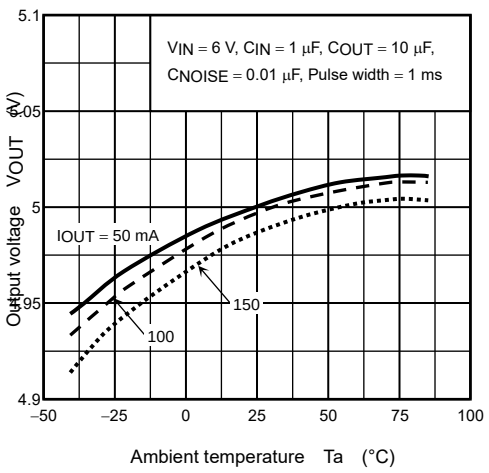
(TAR5S45U) V_{OUT} – Ta



(TAR5S48U) V_{OUT} – Ta



(TAR5S50U) V_{OUT} – Ta



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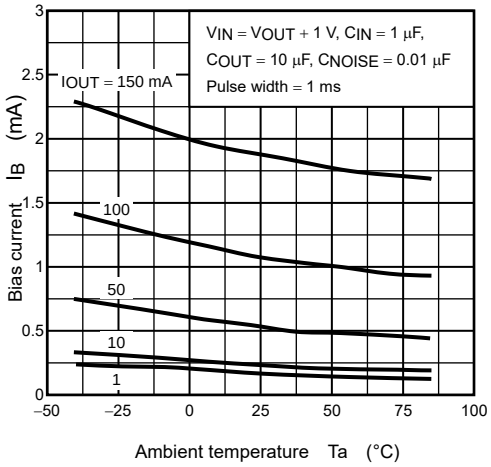
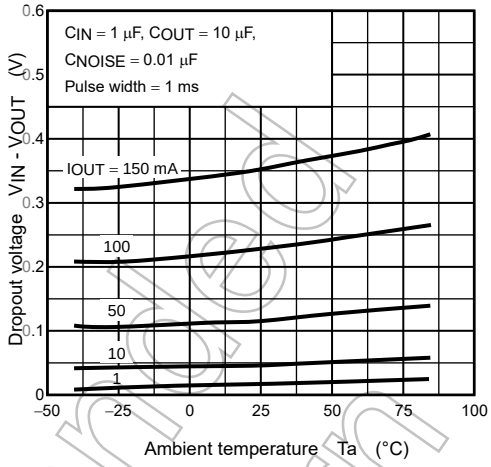
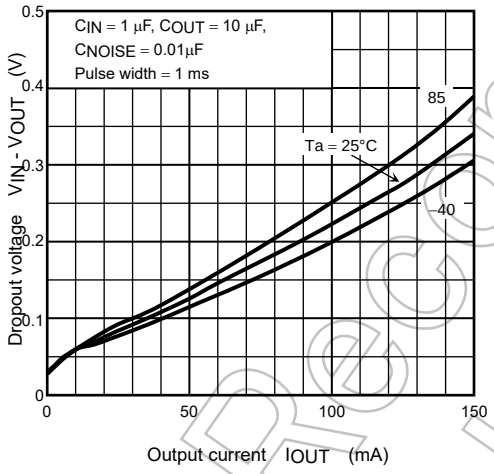
I_B – Ta



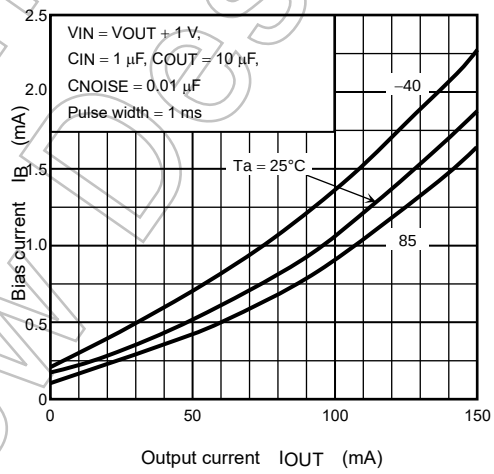
(TAR5S23U~TAR5S50U) V_{IN} - V_{OUT} – Ta



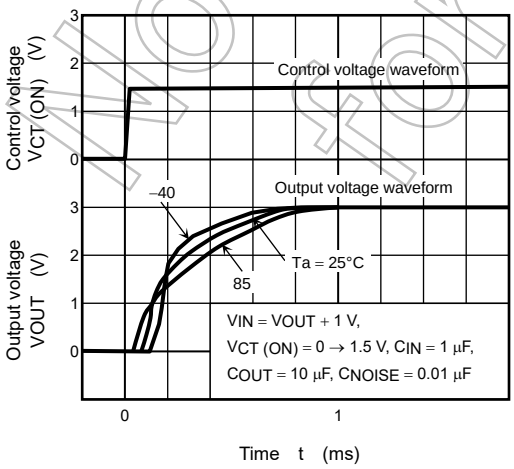
(TAR5S23U~TAR5S50U)V_{IN} - V_{OUT} – I_{OUT}



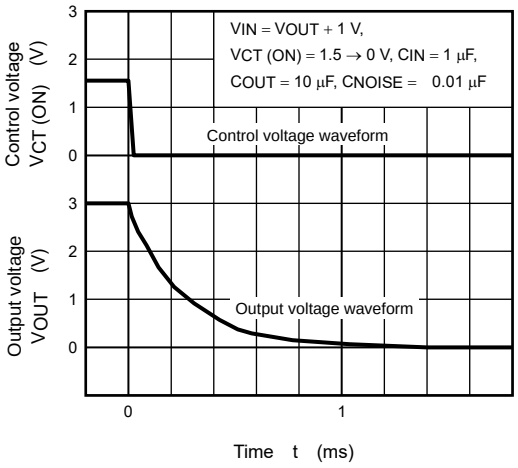
I_B – I_{OUT}



Turn On Waveform



Turn Off Waveform



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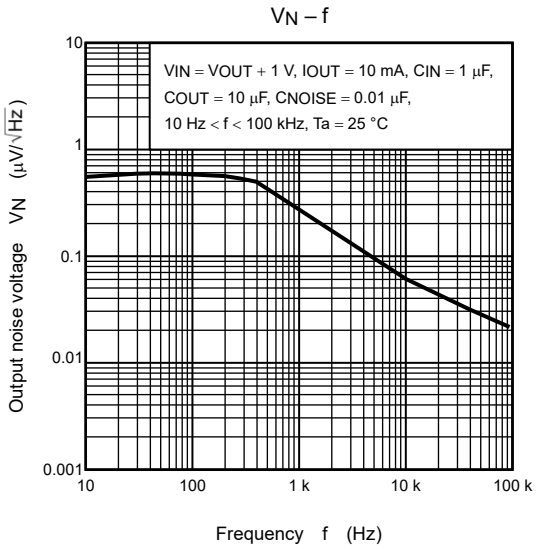

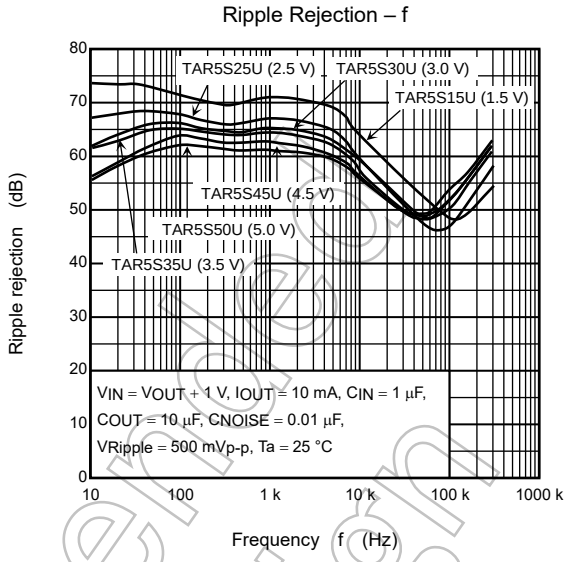

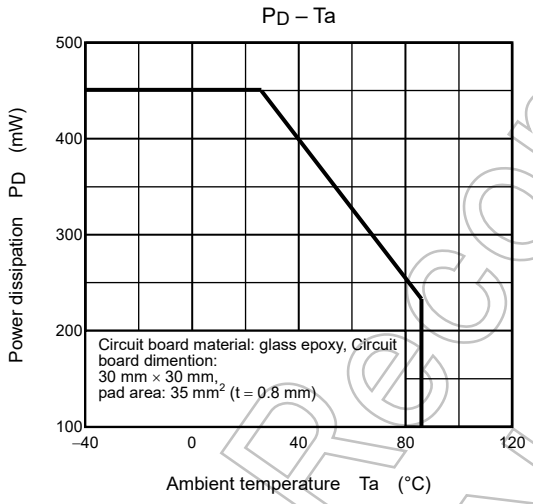

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

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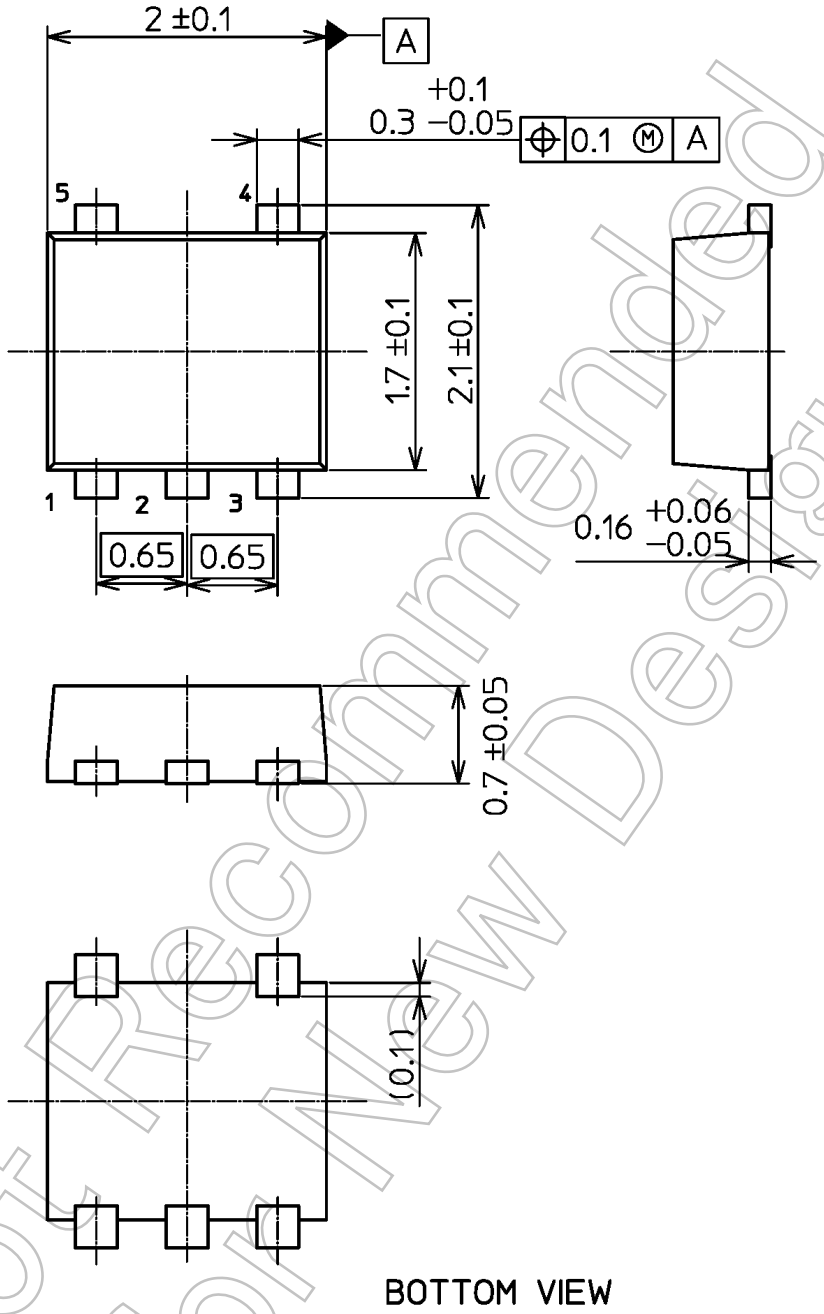
10. Package Dimensions

SON5-P-0202-0.65

Unit: mm



Weight: 0.007 g (typ.)

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