

TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

**TAR5S15, TAR5S18, TAR5S20, TAR5S21, TAR5S22, TAR5S23,  
TAR5S25, TAR5S27, TAR5S28, TAR5S29, TAR5S30, TAR5S31,  
TAR5S32, TAR5S33, TAR5S35, TAR5S45, TAR5S48, TAR5S50**

### Point Regulators (Low-Dropout Regulator)

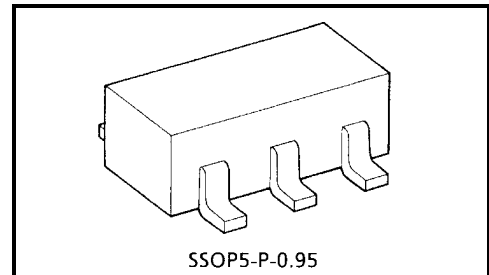
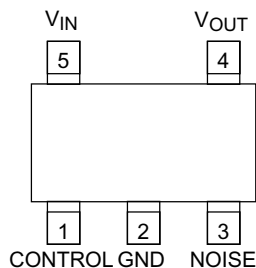
The TAR5Sxx Series is comprised of general-purpose bipolar single-power-supply devices incorporating a control pin which can be used to turn them ON/OFF.

Overtemperature and overcurrent protection circuits are built into the devices' output circuit.

### Features

- Low stand-by current
- Overtemperature/overcurrent protection
- Operation voltage range is wide.
- Maximum output current is high.
- Difference between input voltage and output voltage is low.
- Small package.
- Ceramic capacitors can be used.

### Pin Assignments (top view)



Weight: 0.014 g (typ.)

Overtemperature protection and overcurrent protection functions are not necessary guarantee of operating ratings below the maximum ratings.

Do not use devices under conditions in which their maximum ratings will be exceeded.

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In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc..

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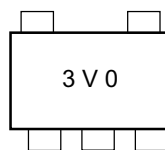
• The information contained herein is subject to change without notice.

## List of Products Number and Marking

Products No.	Marking
TAR5S15	1V5
TAR5S18	1V8
TAR5S20	2V0
TAR5S21	2V1
TAR5S22	2V2
TAR5S23	2V3
TAR5S25	2V5
TAR5S27	2V7
TAR5S28	2V8
TAR5S29	2V9
TAR5S30	3V0
TAR5S31	3V1
TAR5S32	3V2
TAR5S33	3V3
TAR5S35	3V5
TAR5S45	4V5
TAR5S48	4V8
TAR5S50	5V0

## Marking on the Product

Example: TAR5S30 (3.0 V output)



## Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{IN}$	15	V
Output current	$I_{OUT}$	200	mA
Power dissipation	$P_D$	200 (Note1)	mW
		380 (Note2)	
Operation temperature range	$T_{opr}$	-40 to 85	°C
Storage temperature range	$T_{stg}$	-55 to 150	°C

Note1: Unit Rating

Note2: Mounted on a glass epoxy circuit board of 30 × 30 mm. Pad dimension of 50 mm<sup>2</sup>

## TAR5S15~TAR5S22

**Electrical Characteristic (unless otherwise specified,  $V_{IN} = V_{OUT} + 1\text{ V}$ ,  $I_{OUT} = 50\text{ mA}$ ,  $C_{IN} = 1\text{ }\mu\text{F}$ ,  $C_{OUT} = 10\text{ }\mu\text{F}$ ,  $C_{NOISE} = 0.01\text{ }\mu\text{F}$ ,  $T_j = 25^\circ\text{C}$ )**

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Output voltage	$V_{OUT}$	Please refer to the Output Voltage Accuracy table.				
Line regulation	Reg. line	$V_{OUT} + 1\text{ V} \leq V_{IN} \leq 15\text{ V}$ , $I_{OUT} = 1\text{ mA}$	—	3	15	mV
Load regulation	Reg. load	$1\text{ mA} \leq I_{OUT} \leq 150\text{ mA}$	—	25	75	mV
Quiescent current	$I_{B1}$	$I_{OUT} = 0\text{ mA}$	—	170	—	$\mu\text{A}$
	$I_{B2}$	$I_{OUT} = 50\text{ mA}$	—	550	850	
Stand-by current	$I_B$ (OFF)	$V_{CT} = 0\text{ V}$	—	—	0.1	$\mu\text{A}$
Output noise voltage	$V_{NO}$	$V_{IN} = V_{OUT} + 1\text{ V}$ , $I_{OUT} = 10\text{ mA}$ , $10\text{ Hz} \leq f \leq 100\text{ kHz}$ , $C_{NOISE} = 0.01\text{ }\mu\text{F}$ , $T_a = 25^\circ\text{C}$	—	30	—	$\mu\text{V}_{rms}$
Temperature coefficient	$T_{CVO}$	$-40^\circ\text{C} \leq T_{opr} \leq 85^\circ\text{C}$	—	100	—	ppm/ $^\circ\text{C}$
Input voltage	$V_{IN}$	—	2.4	—	15	V
Ripple rejection	R.R.	$V_{IN} = V_{OUT} + 1\text{ V}$ , $I_{OUT} = 10\text{ mA}$ , $C_{NOISE} = 0.01\text{ }\mu\text{F}$ , $f = 1\text{ kHz}$ , $V_{Ripple} = 500\text{ mV}_{p-p}$ , $T_a = 25^\circ\text{C}$	—	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)	$V_{CT} = 1.5\text{ V}$	—	3	10	$\mu\text{A}$
Control current (OFF)	$I_{CT}$ (OFF)	$V_{CT} = 0\text{ V}$	—	0	0.1	$\mu\text{A}$

## TAR5S23~TAR5S50

**Electrical Characteristic (unless otherwise specified,  $V_{IN} = V_{OUT} + 1\text{ V}$ ,  $I_{OUT} = 50\text{ mA}$ ,  $C_{IN} = 1\text{ }\mu\text{F}$ ,  $C_{OUT} = 10\text{ }\mu\text{F}$ ,  $C_{NOISE} = 0.01\text{ }\mu\text{F}$ ,  $T_j = 25^\circ\text{C}$ )**

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Output voltage	$V_{OUT}$	Please refer to the Output Voltage Accuracy table.				
Line regulation	Reg. line	$V_{OUT} + 1\text{ V} \leq V_{IN} \leq 15\text{ V}$ , $I_{OUT} = 1\text{ mA}$	—	3	15	mV
Load regulation	Reg. load	$1\text{ mA} \leq I_{OUT} \leq 150\text{ mA}$	—	25	75	mV
Quiescent current	$I_{B1}$	$I_{OUT} = 0\text{ mA}$	—	170	—	$\mu\text{A}$
	$I_{B2}$	$I_{OUT} = 50\text{ mA}$	—	550	850	
Stand-by current	$I_B$ (OFF)	$V_{CT} = 0\text{ V}$	—	—	0.1	$\mu\text{A}$
Output noise voltage	$V_{NO}$	$V_{IN} = V_{OUT} + 1\text{ V}$ , $I_{OUT} = 10\text{ mA}$ , $10\text{ Hz} \leq f \leq 100\text{ kHz}$ , $C_{NOISE} = 0.01\text{ }\mu\text{F}$ , $T_a = 25^\circ\text{C}$	—	30	—	$\mu\text{V}_{rms}$
Dropout voltage	$V_{IN} - V_{OUT}$	$I_{OUT} = 50\text{ mA}$	—	130	200	mV
Temperature coefficient	$T_{CVO}$	$-40^\circ\text{C} \leq T_{opr} \leq 85^\circ\text{C}$	—	100	—	ppm/ $^\circ\text{C}$
Input voltage	$V_{IN}$	—	$V_{OUT} + 0.2\text{ V}$	—	15	V
Ripple rejection	R.R.	$V_{IN} = V_{OUT} + 1\text{ V}$ , $I_{OUT} = 10\text{ mA}$ , $C_{NOISE} = 0.01\text{ }\mu\text{F}$ , $f = 1\text{ kHz}$ , $V_{Ripple} = 500\text{ mV}_{p-p}$ , $T_a = 25^\circ\text{C}$	—	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)	$V_{CT} = 1.5\text{ V}$	—	3	10	$\mu\text{A}$
Control current (OFF)	$I_{CT}$ (OFF)	$V_{CT} = 0\text{ V}$	—	0	0.1	$\mu\text{A}$

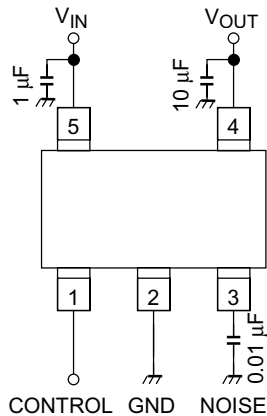
## Output Voltage Accuracy

( $V_{IN} = V_{OUT} + 1\text{ V}$ ,  $I_{OUT} = 50\text{ mA}$ ,  $C_{IN} = 1\text{ }\mu\text{F}$ ,  $C_{OUT} = 10\text{ }\mu\text{F}$ ,  $C_{NOISE} = 0.01\text{ }\mu\text{F}$ ,  $T_j = 25^\circ\text{C}$ )

Product No.	Symbol	Min	Typ.	Max	Unit
TAR5S15	V <sub>OUT</sub>	1.44	1.5	1.56	V
TAR5S18		1.74	1.8	1.86	
TAR5S20		1.94	2.0	2.06	
TAR5S21		2.04	2.1	2.16	
TAR5S22		2.14	2.2	2.26	
TAR5S23		2.24	2.3	2.36	
TAR5S25		2.43	2.5	2.57	
TAR5S27		2.63	2.7	2.77	
TAR5S28		2.73	2.8	2.87	
TAR5S29		2.83	2.9	2.97	
TAR5S30		2.92	3.0	3.08	
TAR5S31		3.02	3.1	3.18	
TAR5S32		3.12	3.2	3.28	
TAR5S33		3.21	3.3	3.39	
TAR5S35		3.41	3.5	3.59	
TAR5S45		4.38	4.5	4.62	
TAR5S48		4.68	4.8	4.92	
TAR5S50	4.87	5.0	5.13		

## Application Note

### 1. Recommended Application Circuit



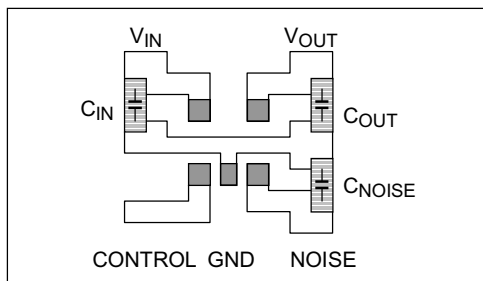
Control Level	Operation
HIGH	ON
LOW	OFF

The figure above shows the recommended configuration for using a point regulator. Insert a capacitor for stable input/output operation. If the control function is not to be used, Toshiba recommend that the control pin (pin 1) be connected to the VCC pin.

### 2. Power Dissipation

The power dissipation for board-mounted TAR5Sxx Series devices (rated at 380 mW) is measured using a board whose size and pattern are as shown below. When incorporating a device belonging to this series into your design, derate the power dissipation as far as possible by reducing the levels of parameters such as input voltage, output current and ambient temperature. Toshiba recommend that these devices should typically be derated to 70%~80% of their absolute maximum power dissipation value.

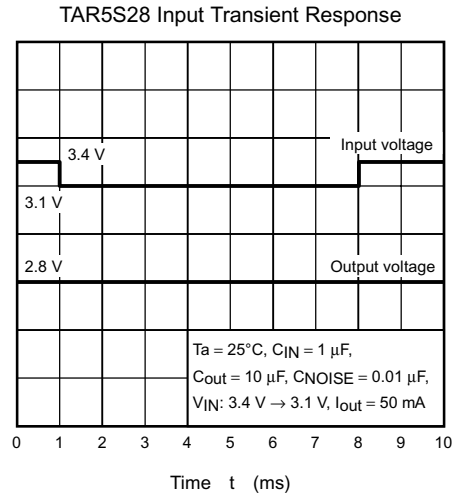
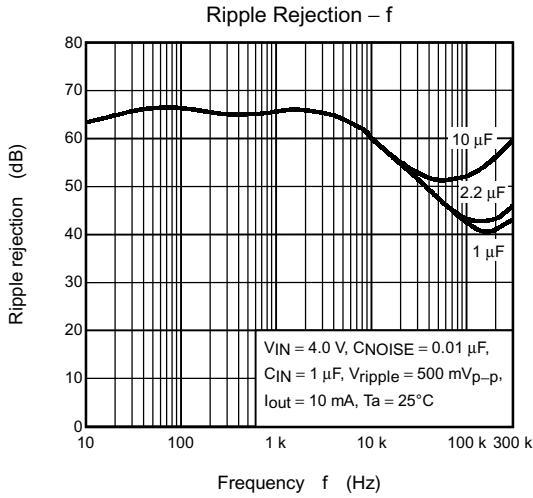
### Thermal Resistance Evaluation Board



Circuit board material: glass epoxy,  
 Circuit board dimension: 30 mm × 30 mm,  
 Copper foil pad area: 50 mm<sup>2</sup> (t = 0.8 mm)

**3. Ripple Rejection**

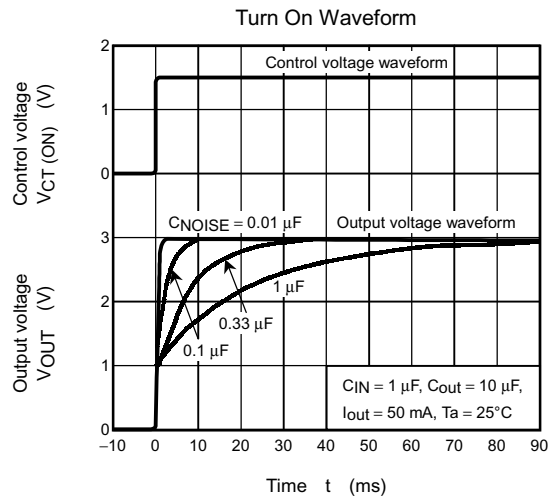
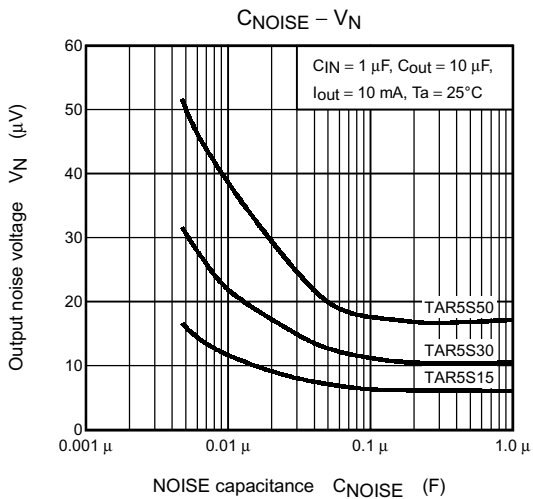
The devices of the TAR5Sxx Series feature a circuit with an excellent ripple rejection characteristic. Because the circuit also features an excellent output fluctuation characteristic for sudden supply voltage drops, the circuit is ideal for use in the RF blocks incorporated in all mobile telephones.



**4. NOISE Pin**

TAR5Sxx Series devices incorporate a NOISE pin to reduce output noise voltage. Inserting a capacitor between the NOISE pin and GND reduces output noise. To ensure stable operation, insert a capacitor of 0.0047  $\mu\text{F}$  or more between the NOISE pin and GND.

The output voltage rise time varies according to the capacitance of the capacitor connected to the NOISE pin.



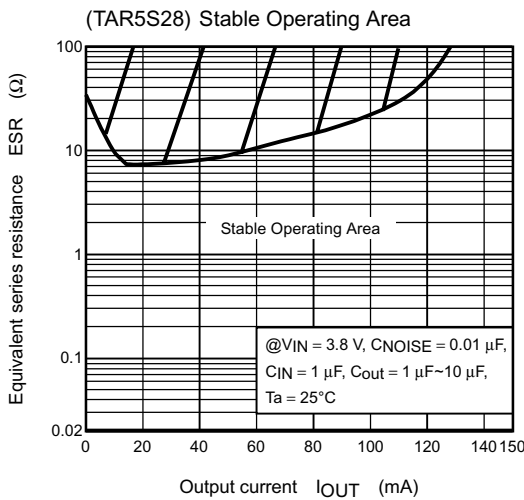
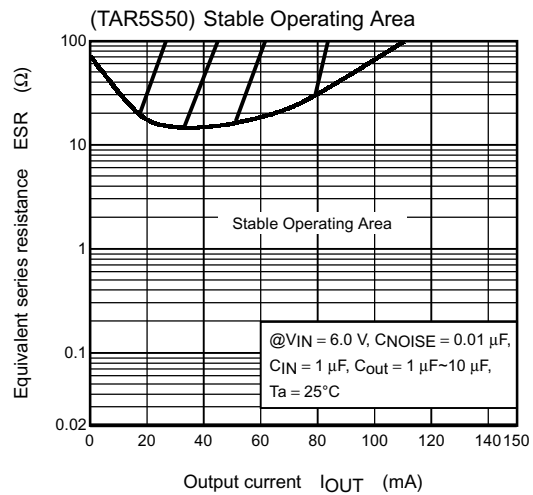
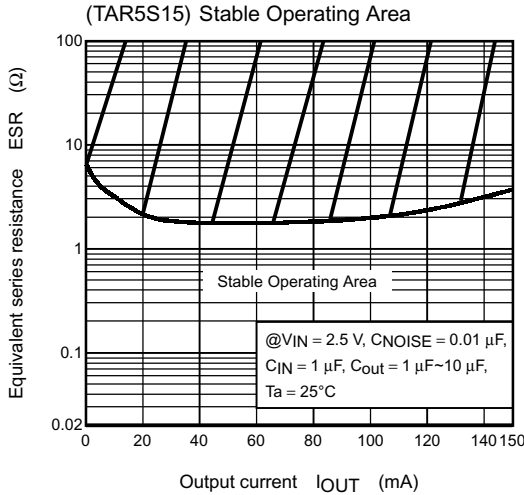
**5. Example of Characteristics when Ceramic Capacitor is Used**

Shown below is the stable operation area, where the output voltage does not oscillate, evaluated using a Toshiba evaluation circuit. The equivalent series resistance (ESR) of the output capacitor and output current determines this area. TAR5Sxx Series devices operate stably even when a ceramic capacitor is used as the output capacitor.

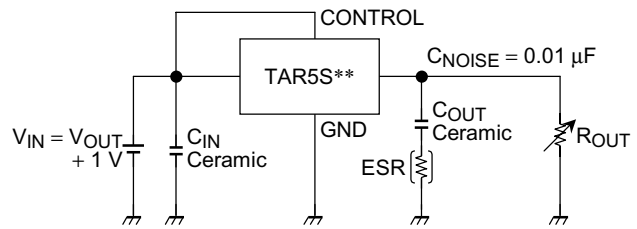
If a ceramic capacitor is used as the output capacitor and the ripple frequency is 30 kHz or more, the ripple rejection differs from that when a tantalum capacitor is used. This is shown below.

Toshiba recommend that users check that devices operate stably under the intended conditions of use.

**Examples of safe operating area characteristics**

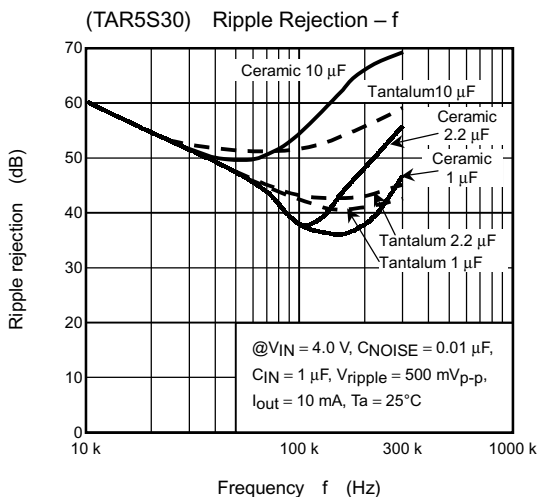


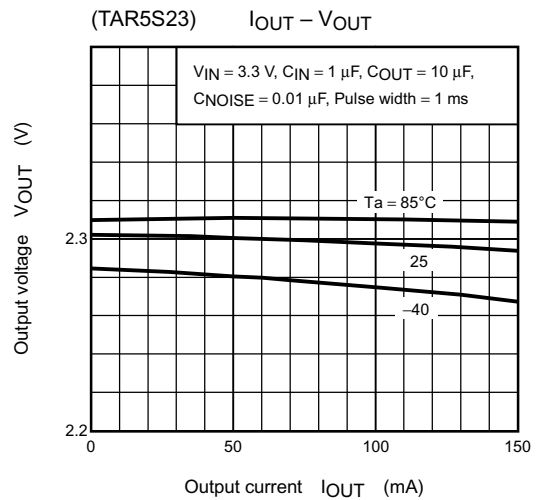
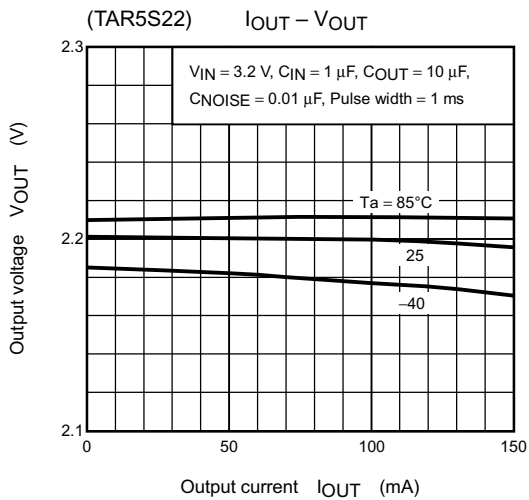
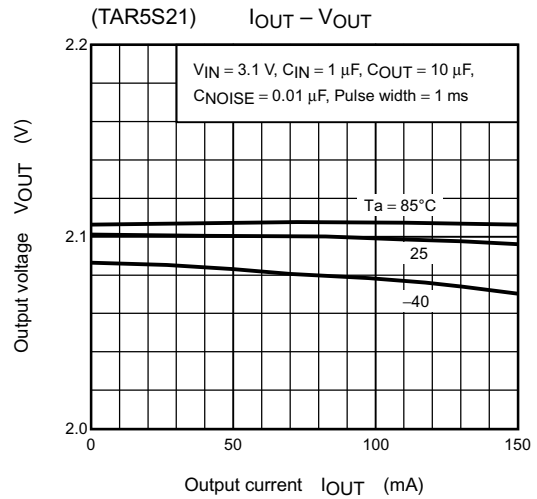
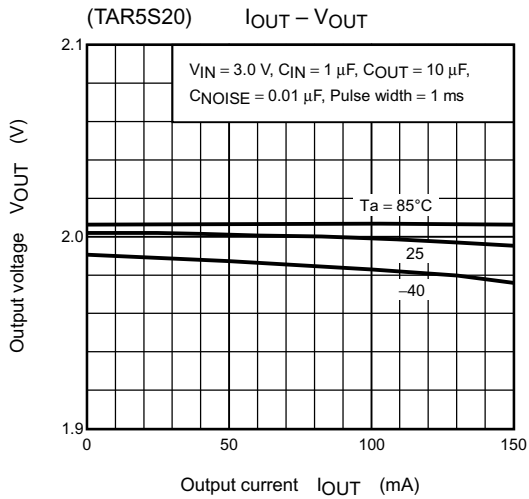
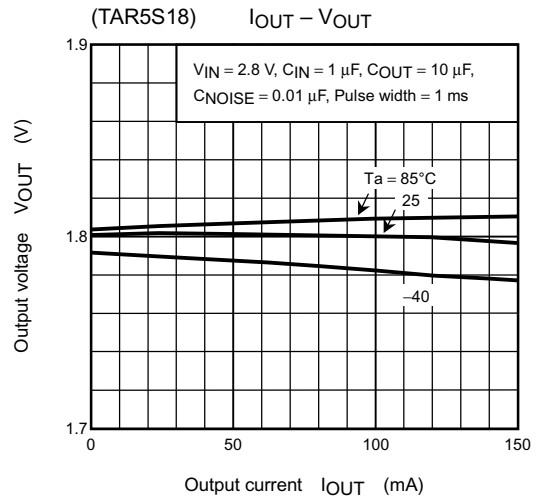
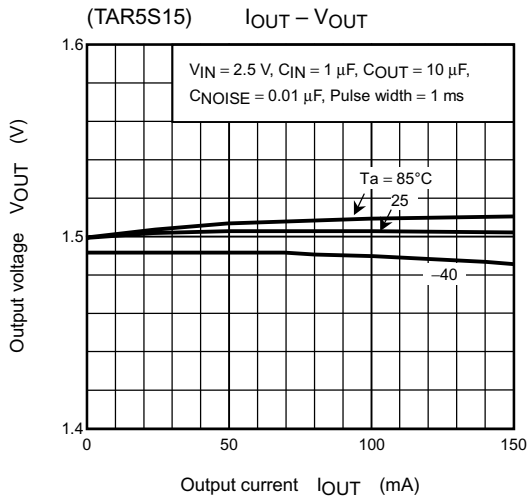
**Evaluation Circuit for Stable Operating Area**



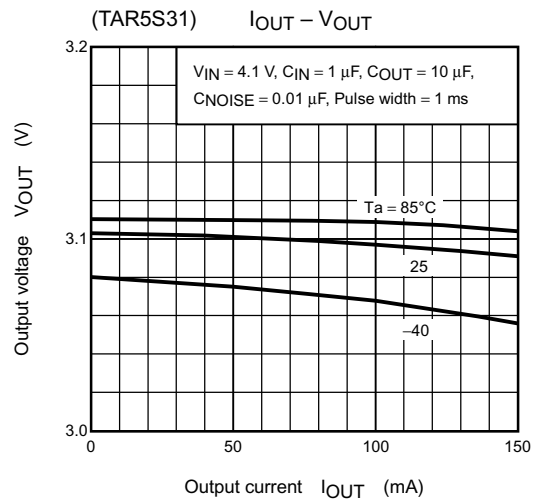
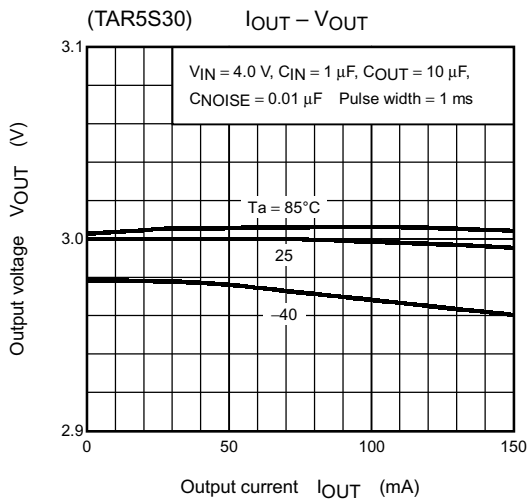
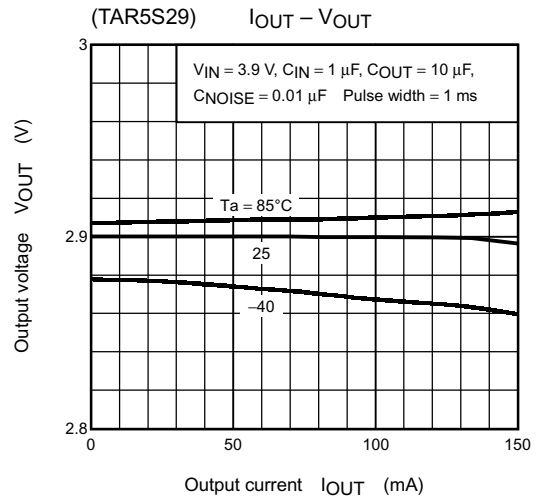
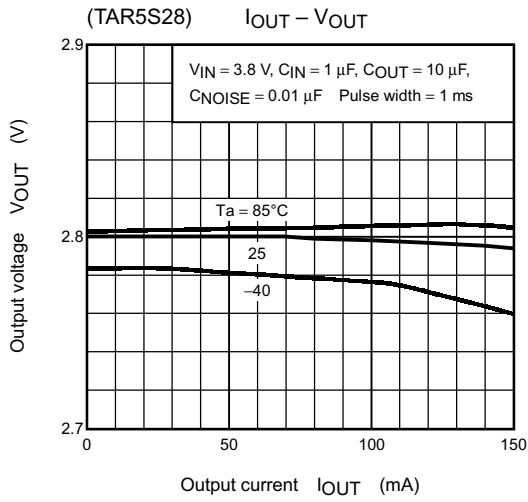
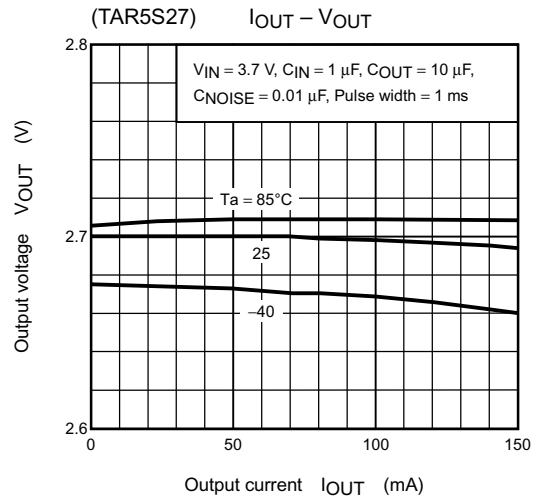
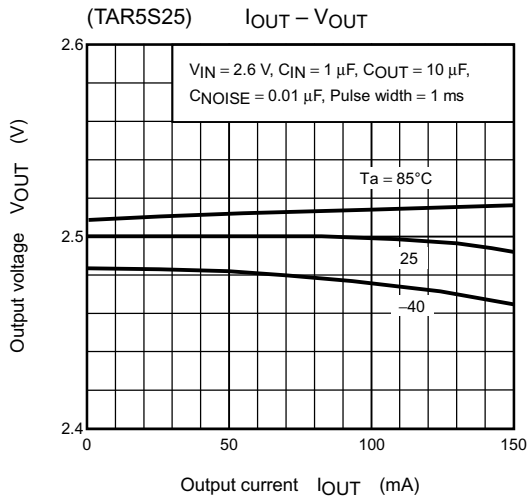
Capacitors used for evaluation  
 Made by Murata CIN: GRM40B105K  
 COUT: GRM40B105K/GRM40B106K

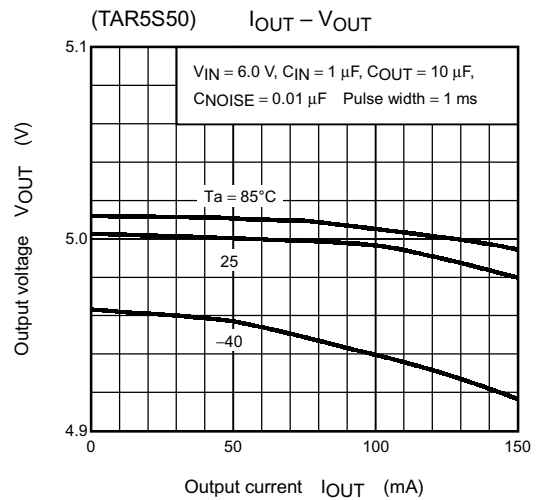
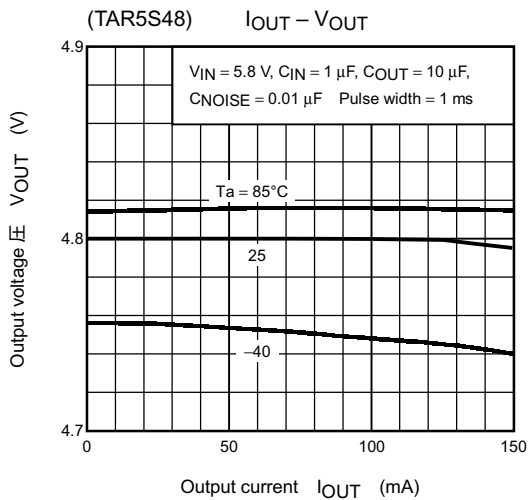
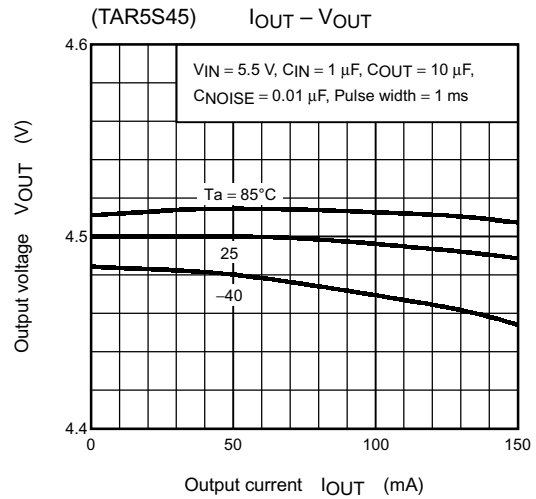
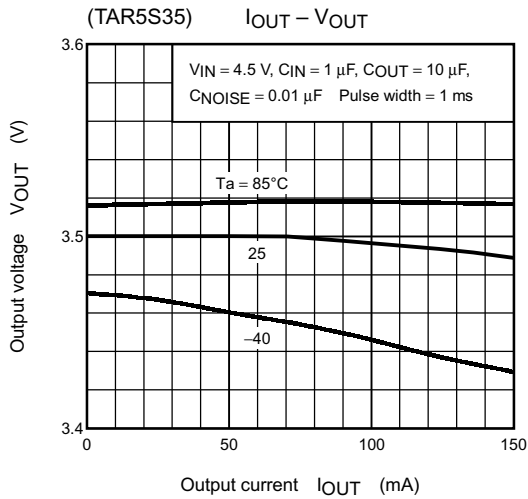
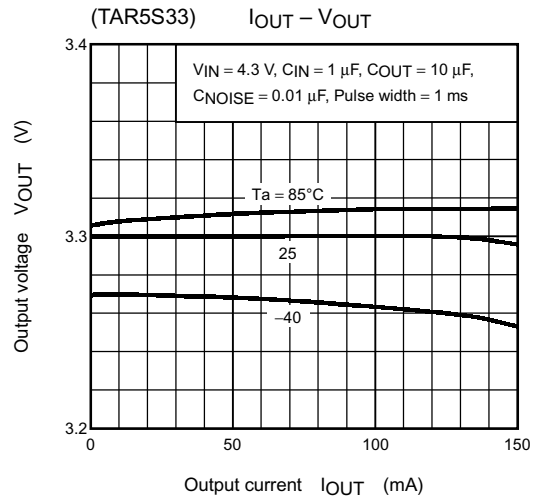
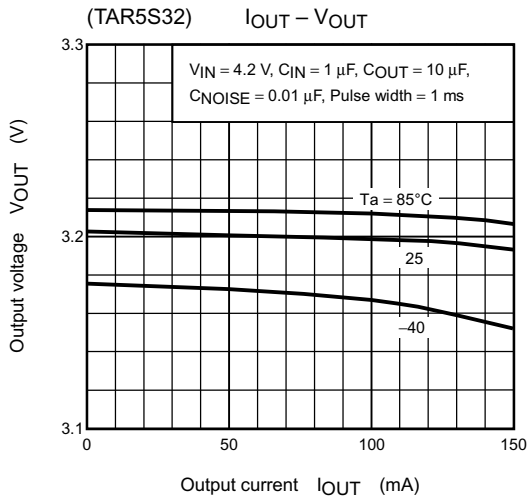
**Ripple Rejection Characteristic (f = 10 kHz~300 kHz)**

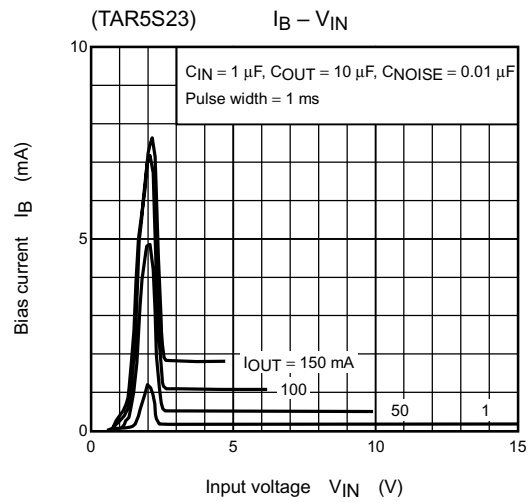
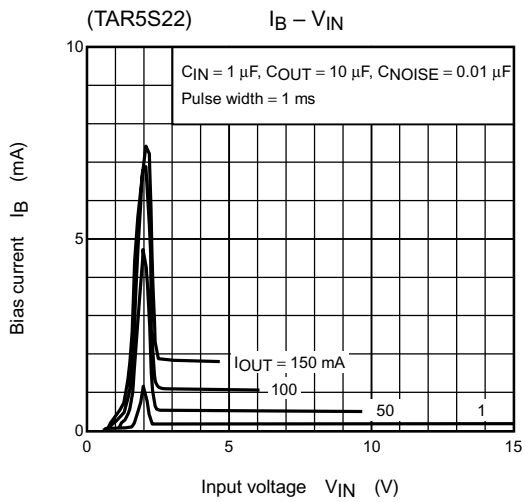
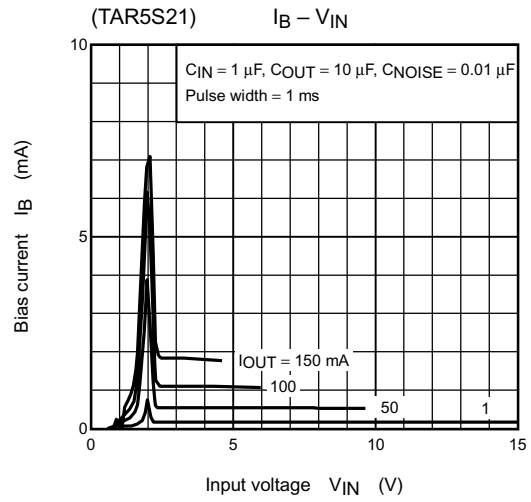
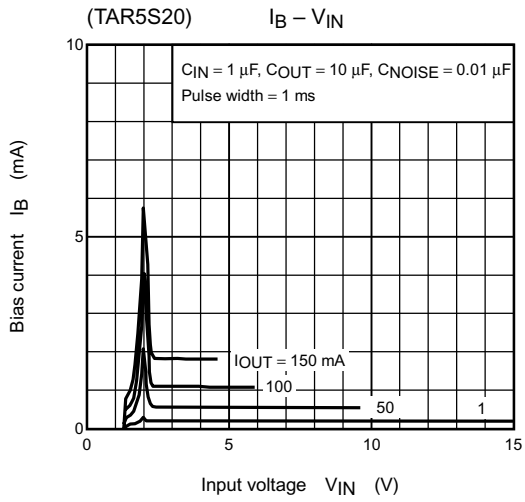
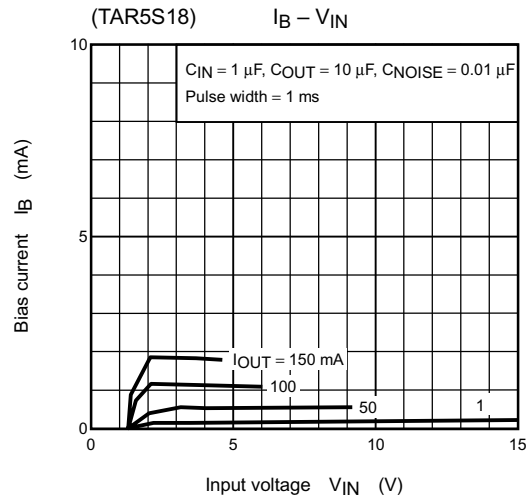
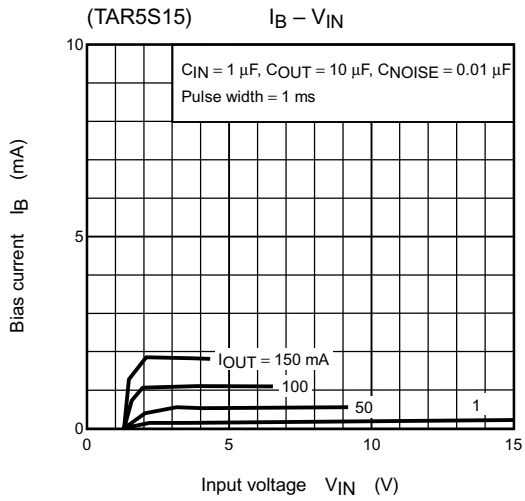


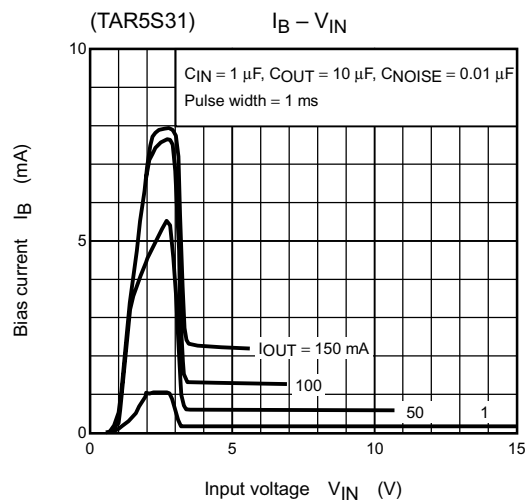
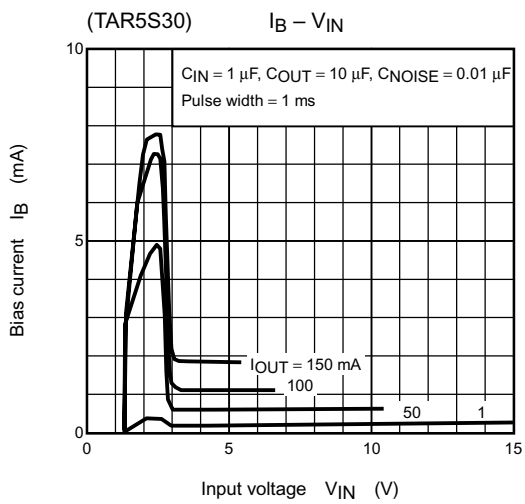
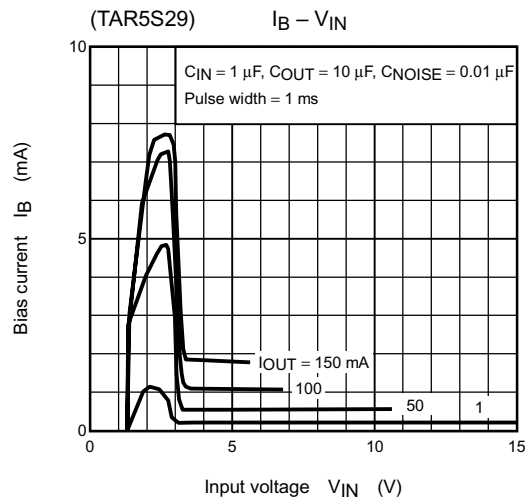
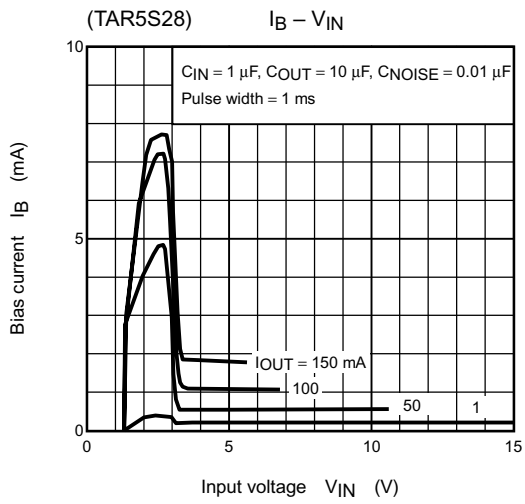
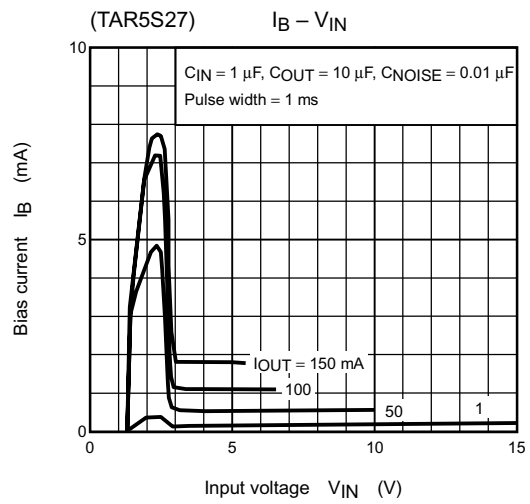
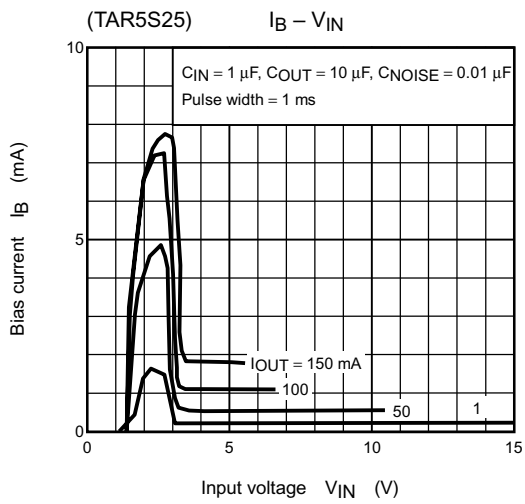


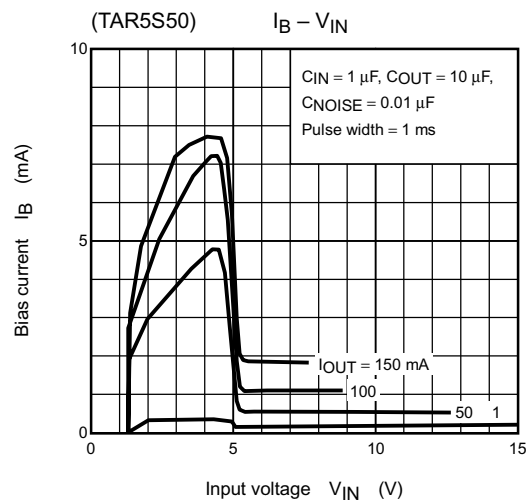
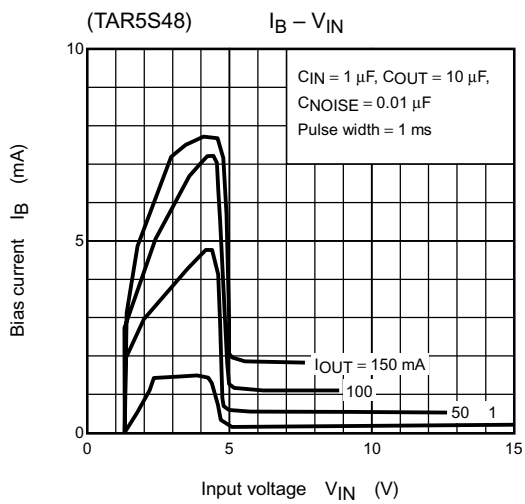
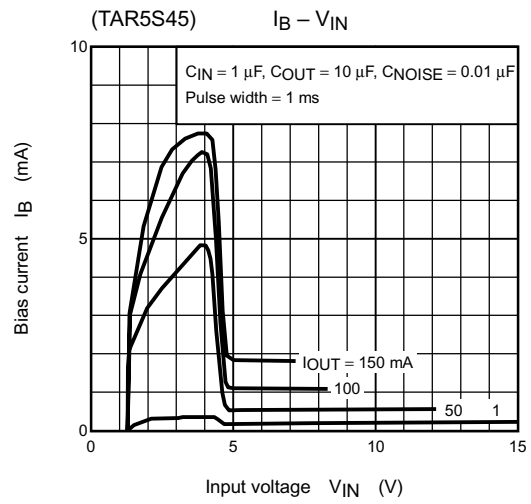
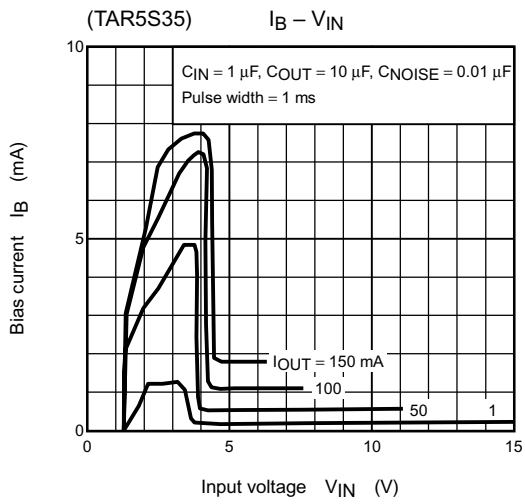
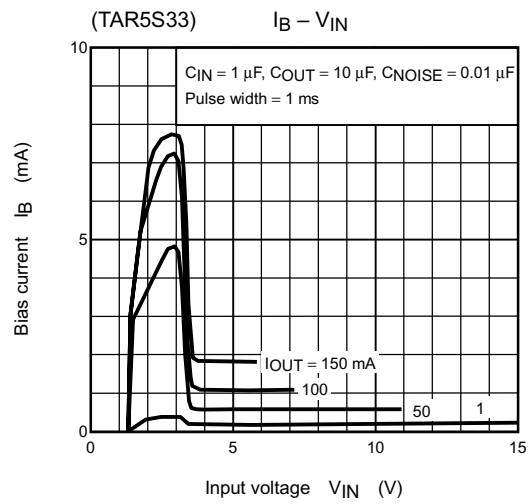
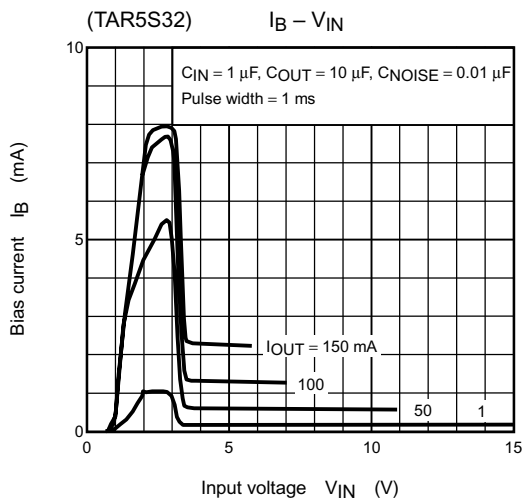


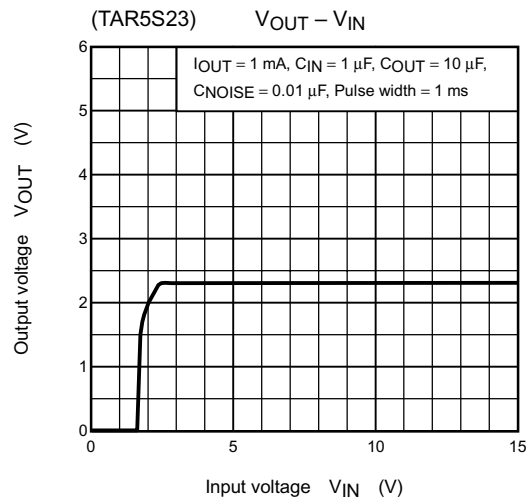
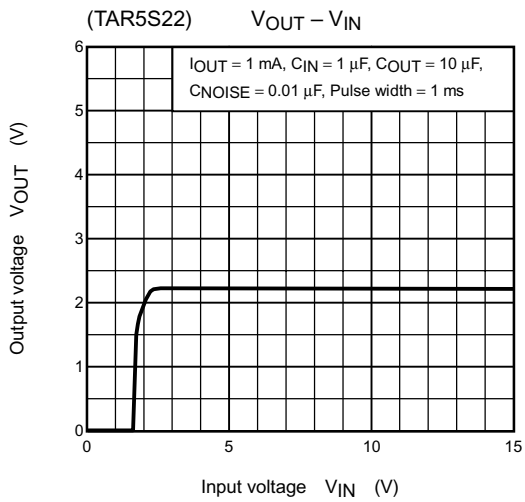
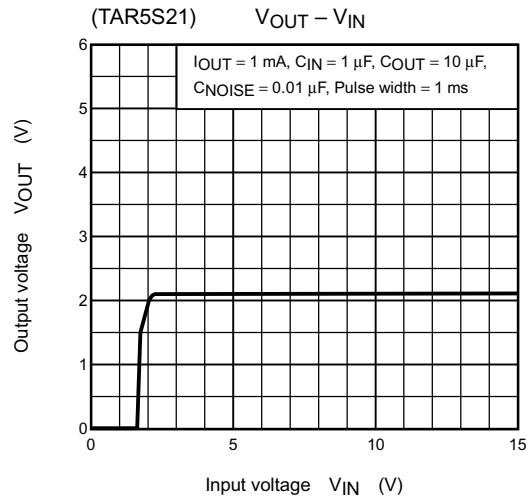
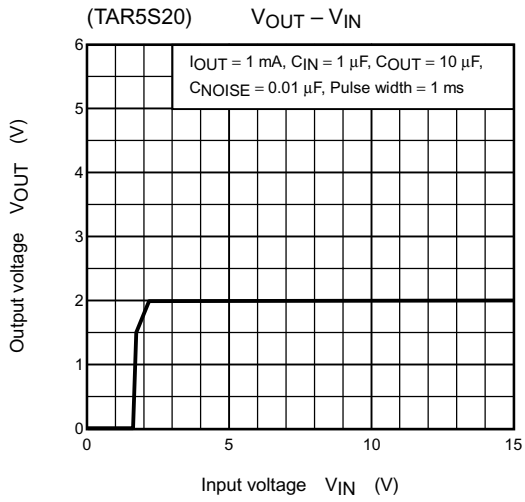
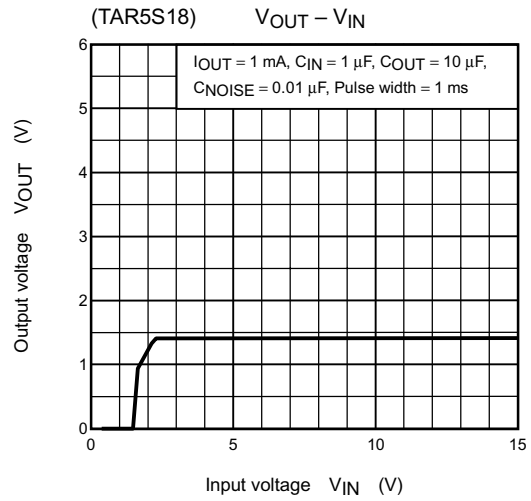
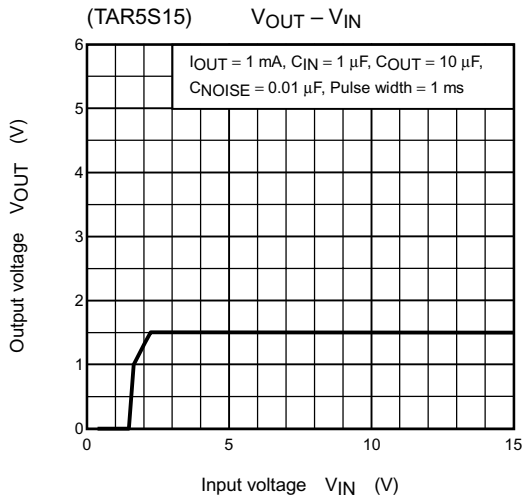


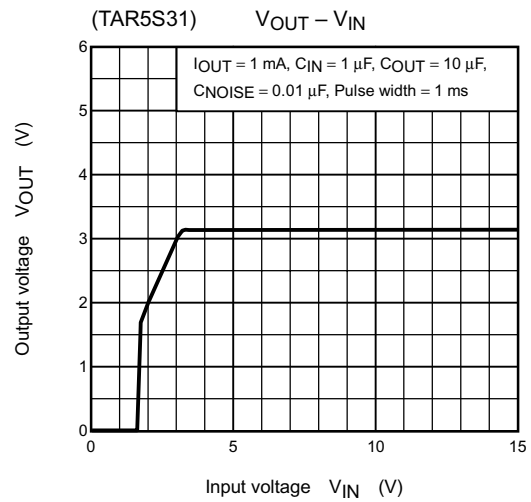
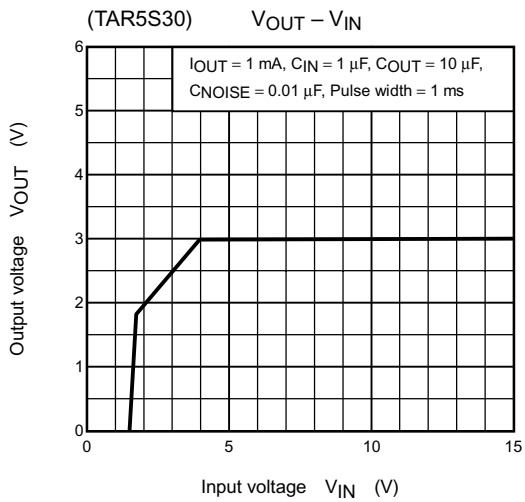
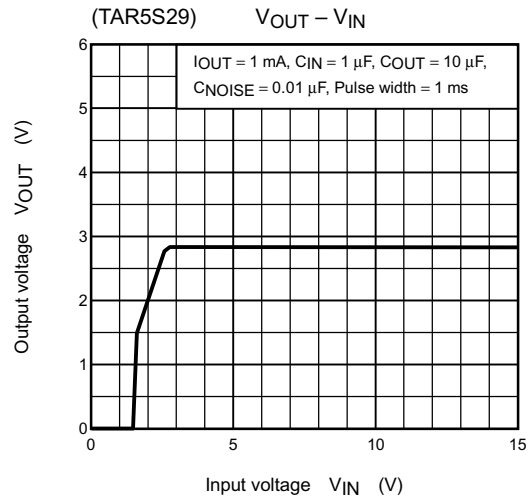
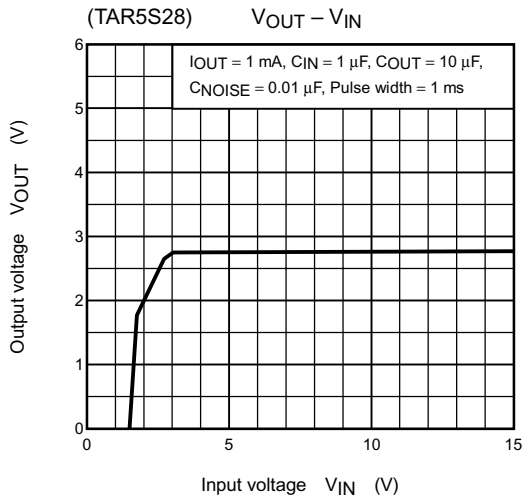
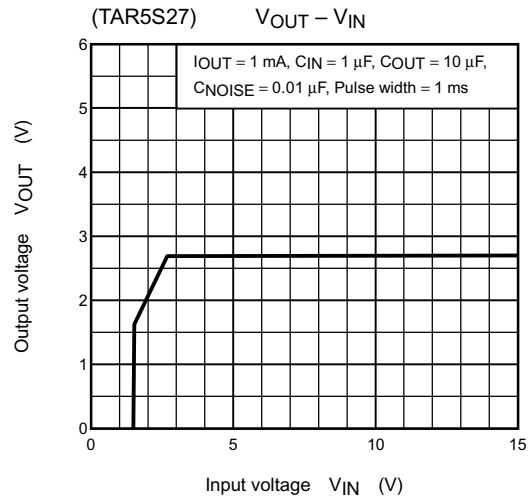
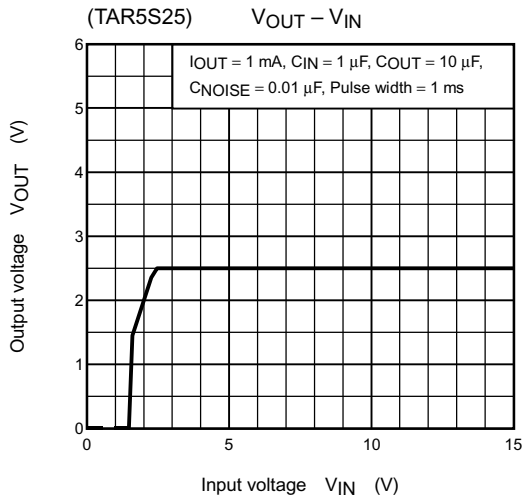


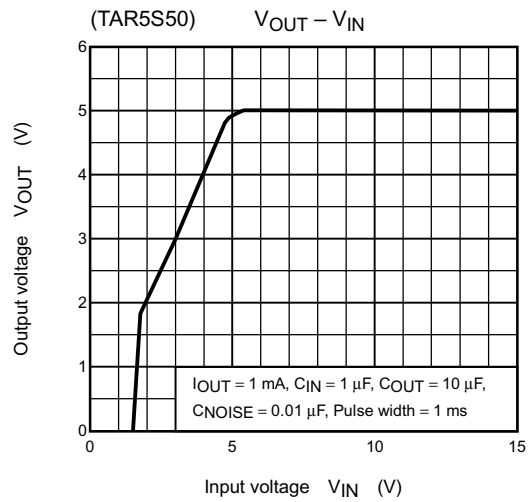
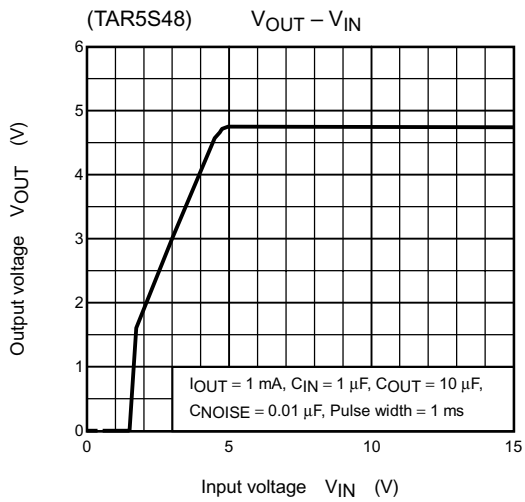
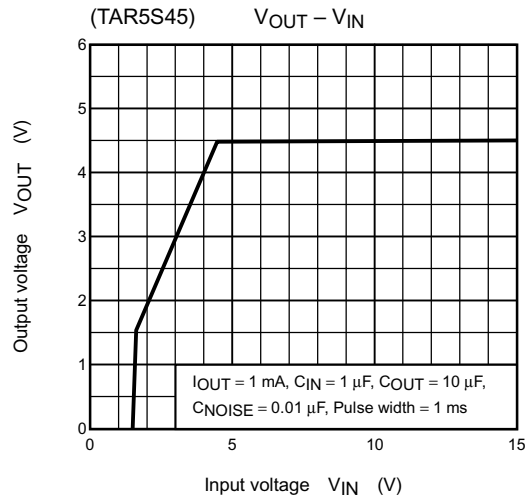
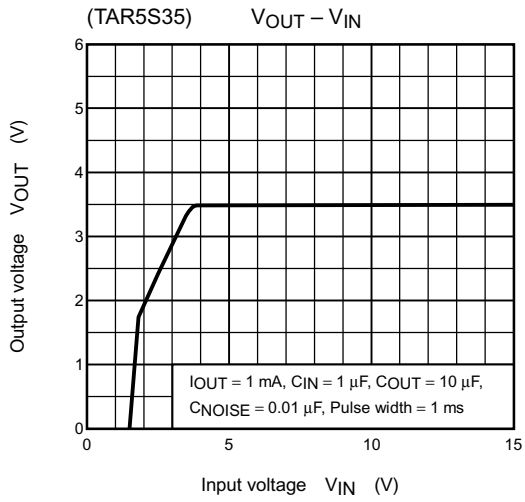
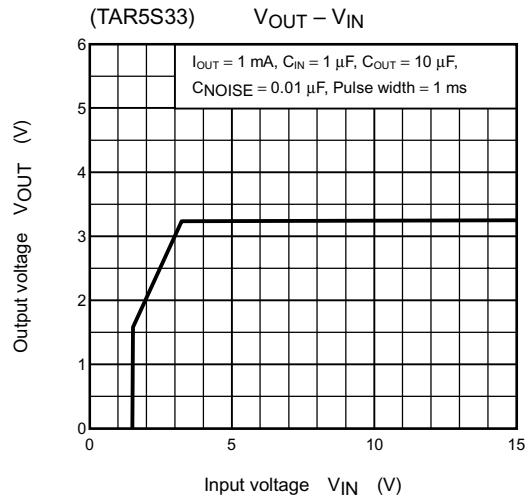
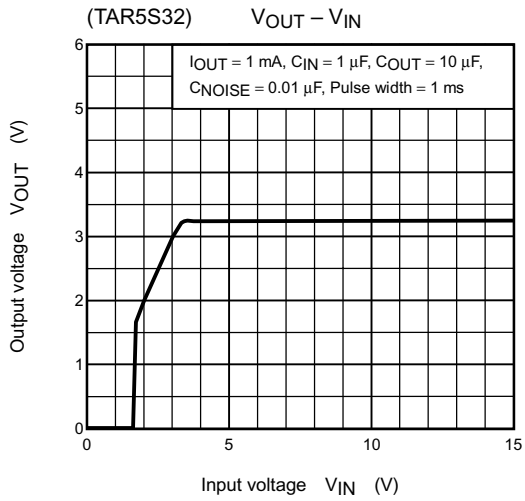




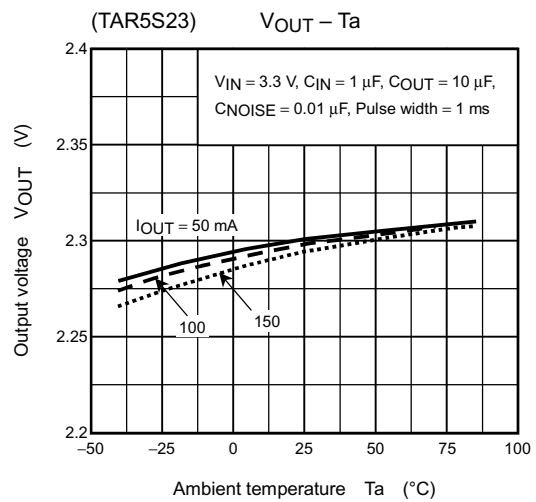
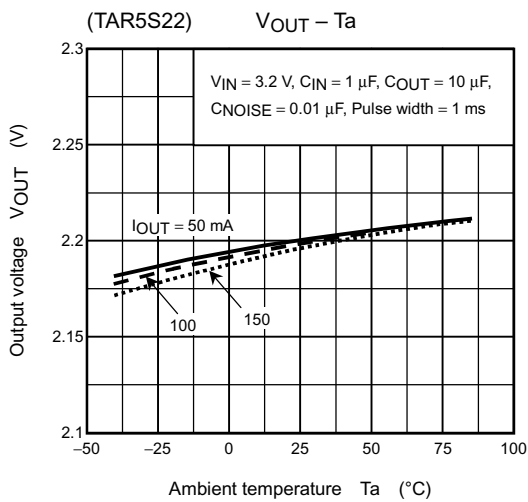
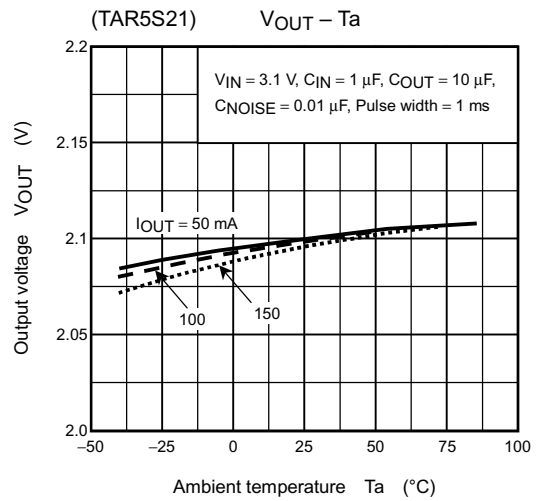
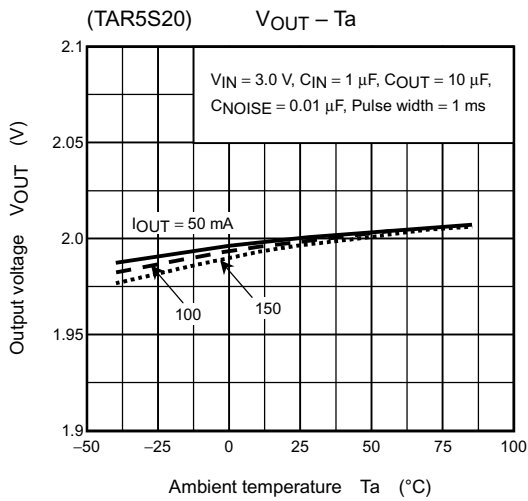
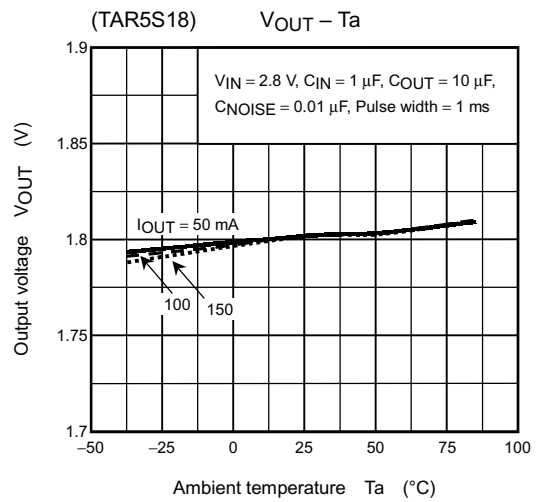
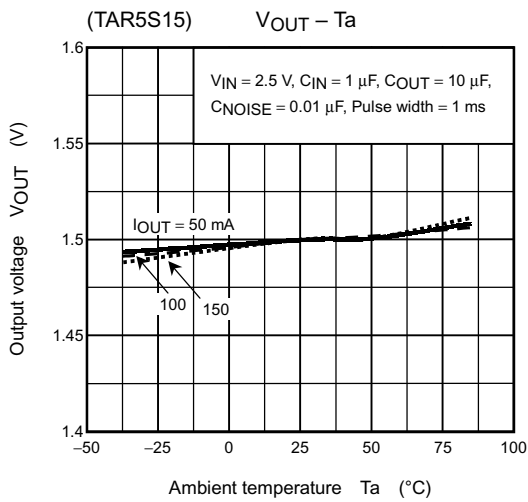


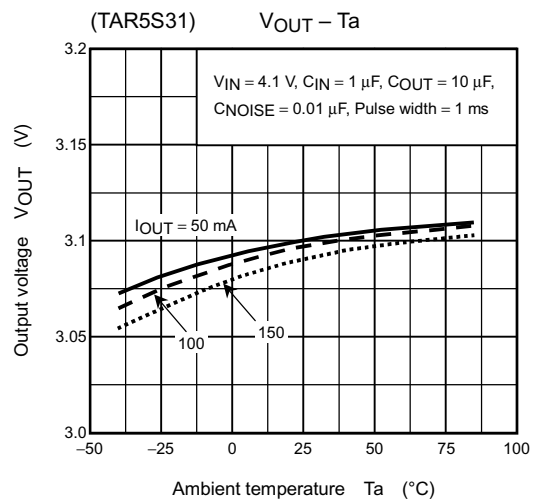
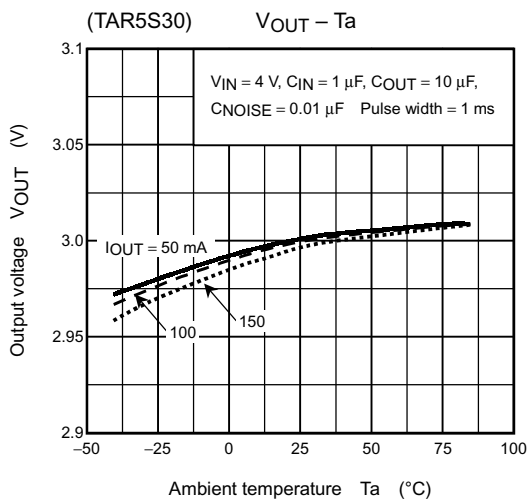
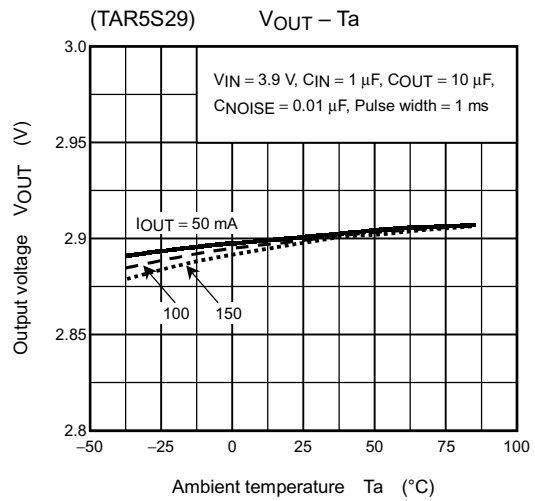
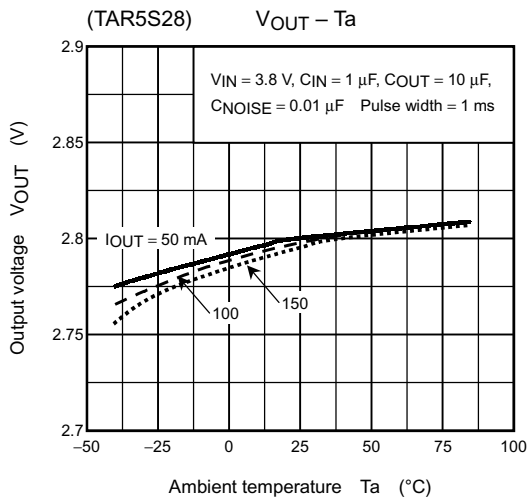
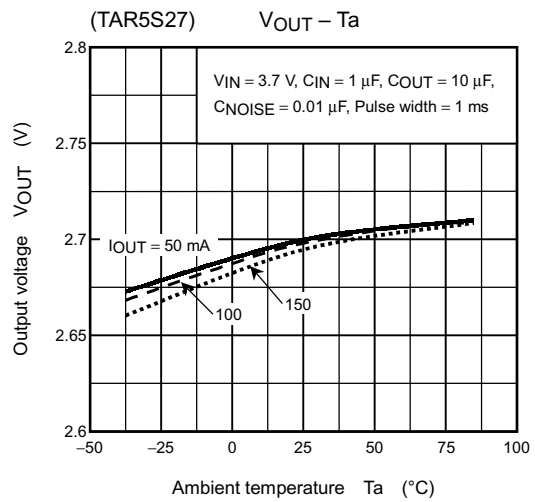
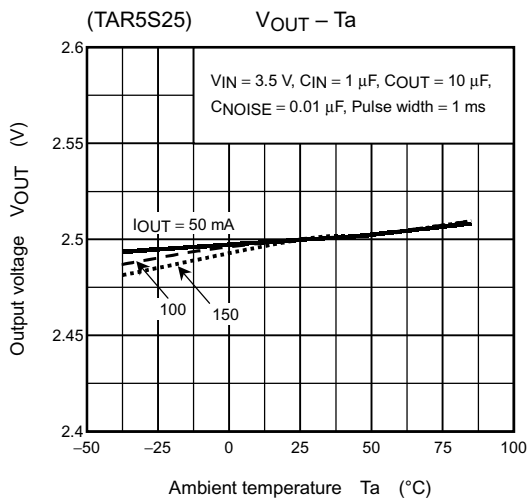


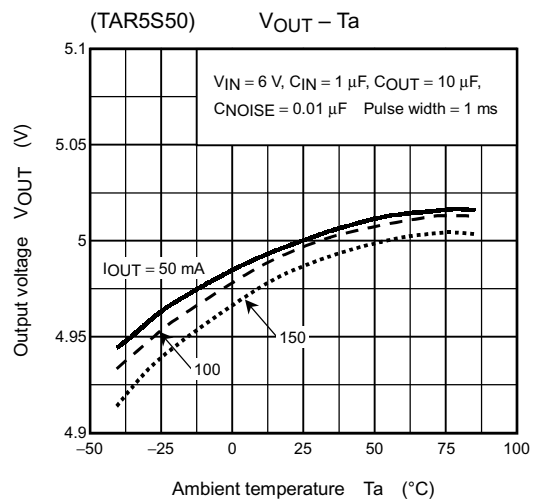
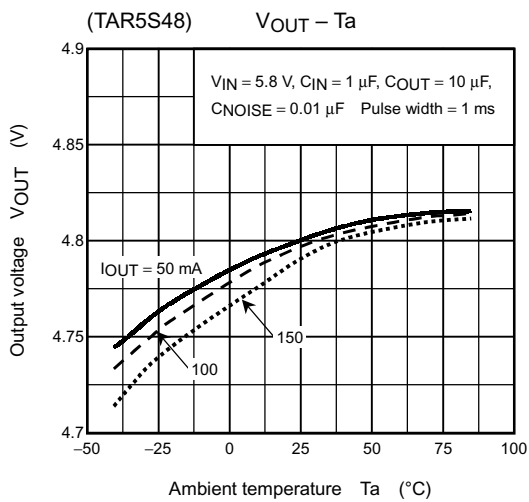
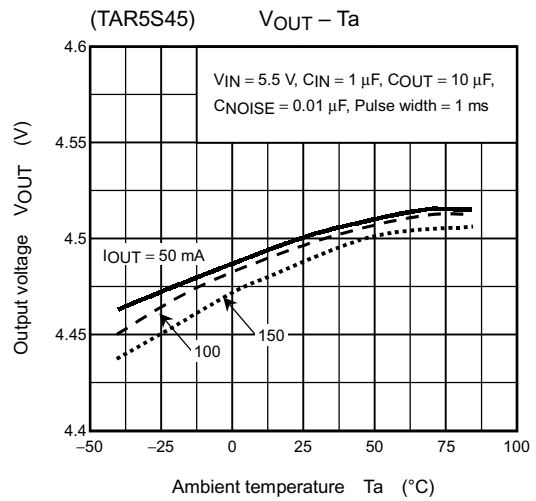
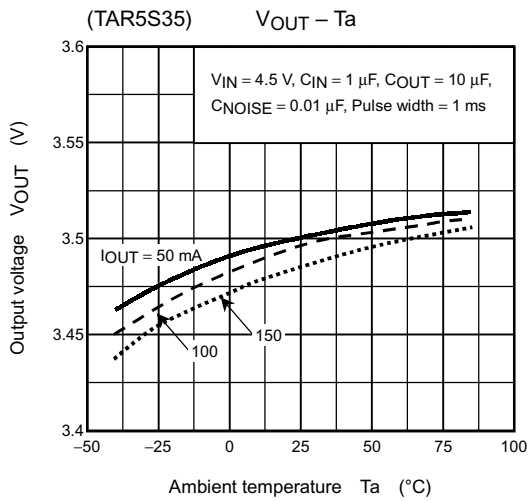
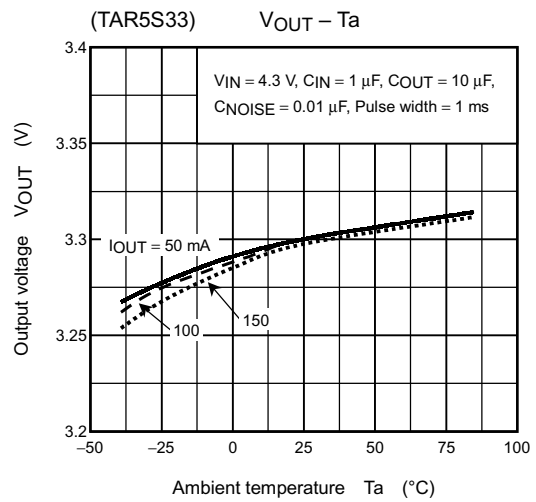
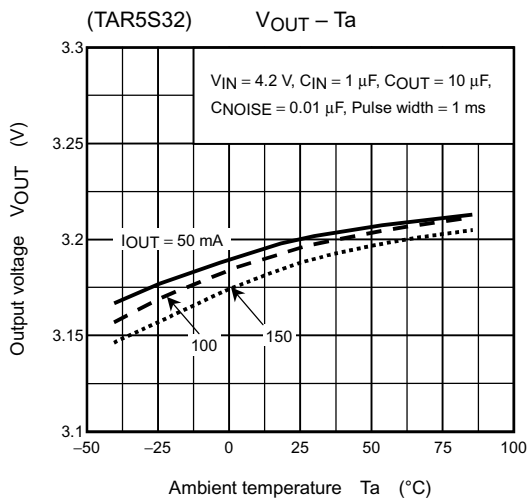


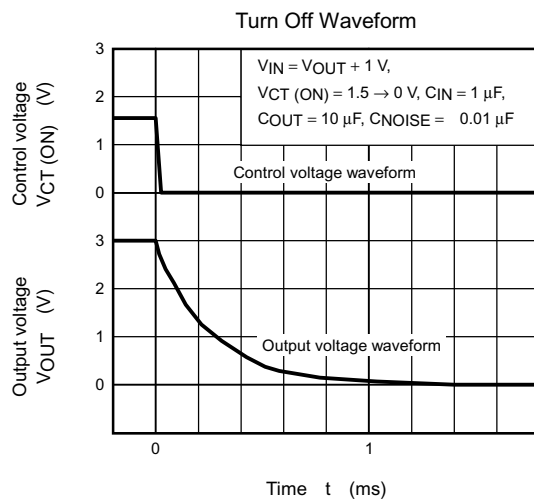
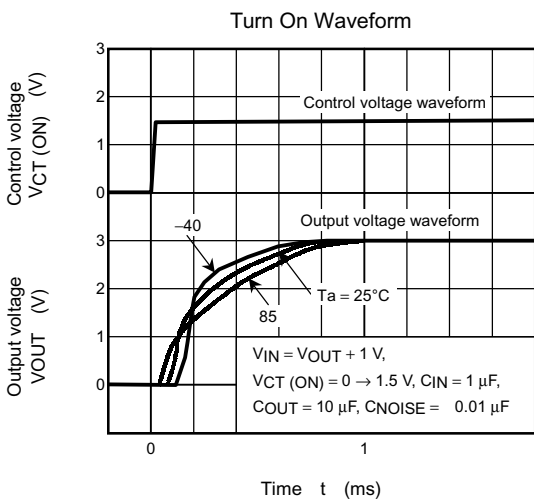
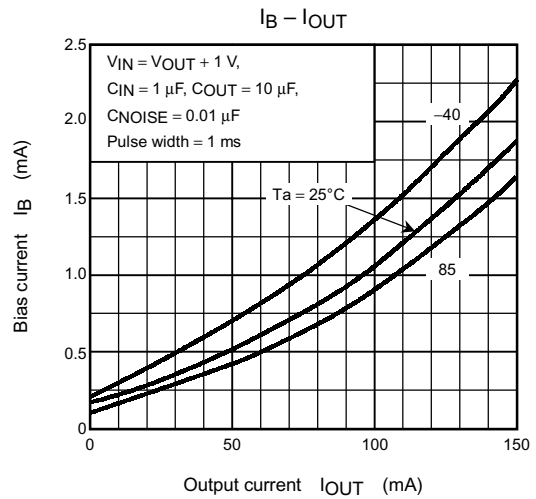
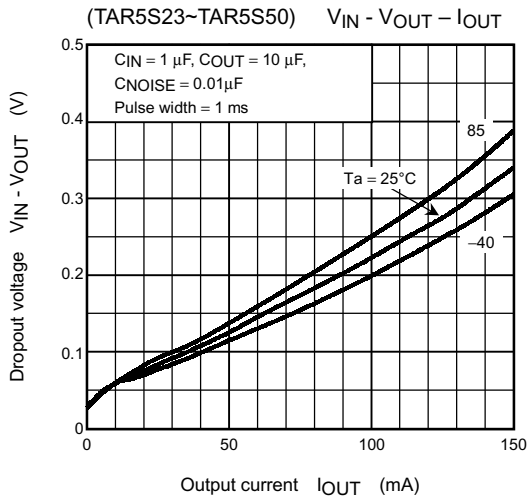
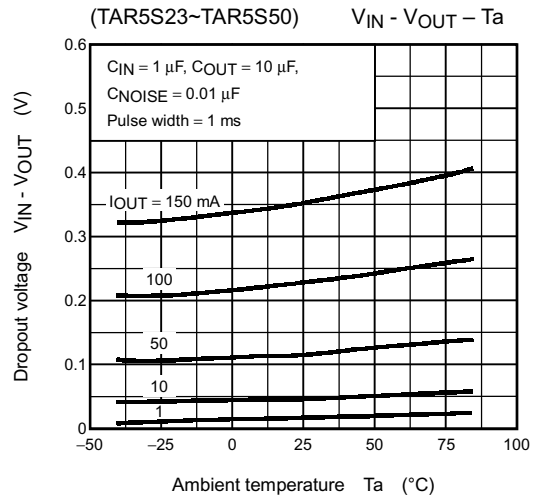
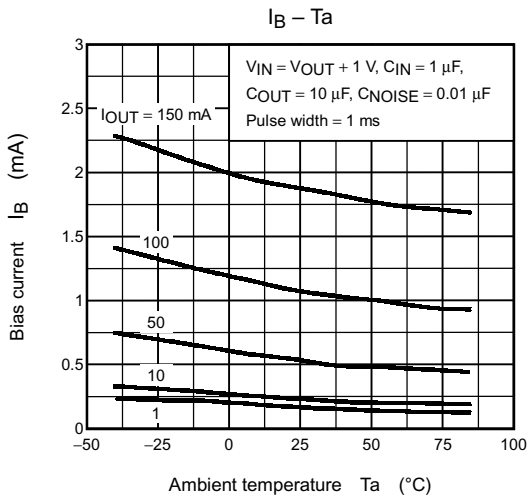


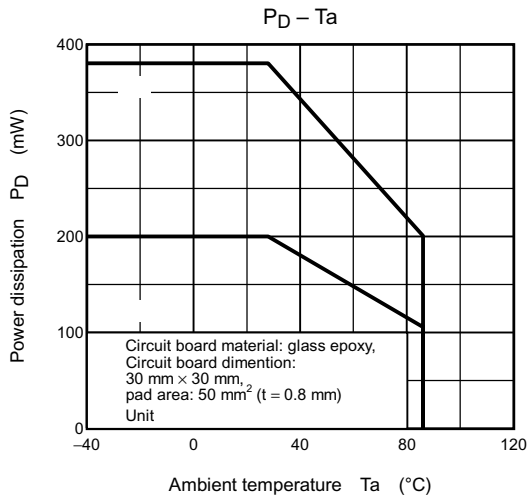
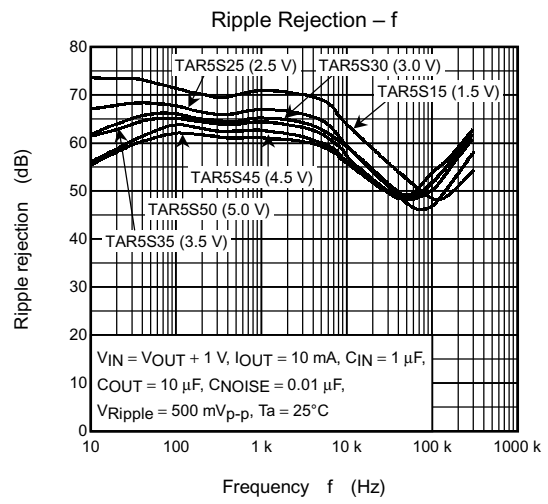
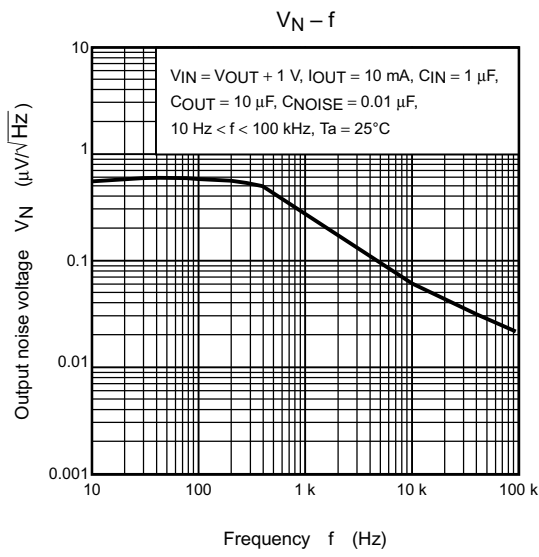








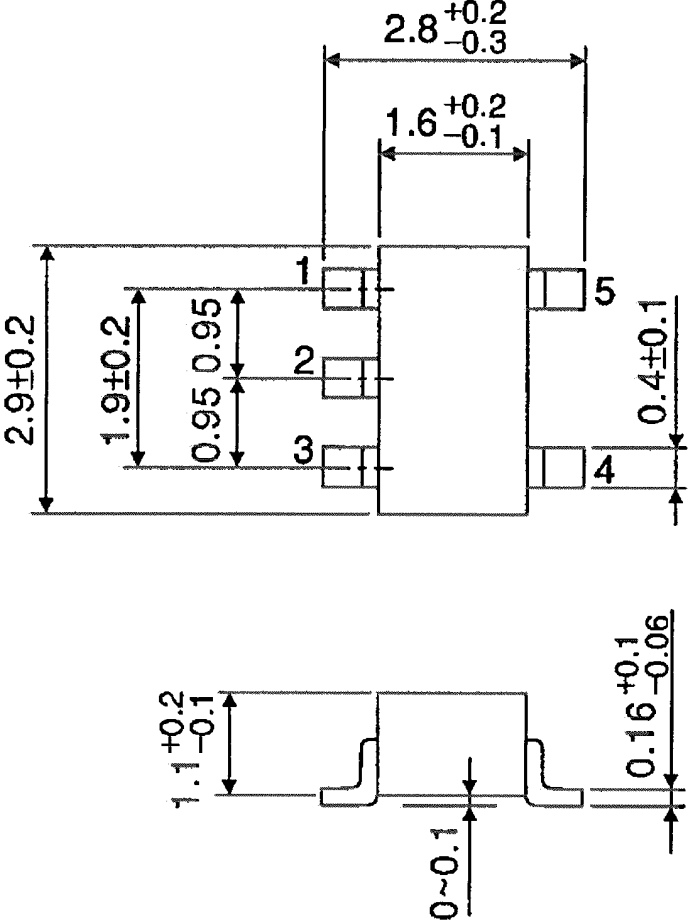




Package Dimensions

SSOP5-P-0.95

Unit : mm



Weight: 0.014 g (typ.)