

### Low Voltage 400 mA LDO Regulator

No. EA-179-180419

#### OUTLINE

The RP105x is a 400 mA output type CMOS-based voltage regulator with capability of low input voltage (Min. 0.9 V) and low output voltage (Min. 0.6 V). This device is remarkably improved the performance at low input voltage compared with conventional low voltage LDOs, and two power supply voltage type. (Another power source,  $V_{BIAS}$  pin voltage must be Min. 2.4 V). The device consists of a voltage reference unit, an error amplifier, resistor-net for voltage setting, a current limit circuit to avoid the destruction, a UVLO circuit with monitoring input voltage, and so on.

The RP105x has the ultra-low on resistance output driver, the on resistance is Typ.  $0.4 \Omega$  ( $V_{OUT} = 0.8 \text{ V}$ ,  $I_{OUT} = 300 \text{ mA}$ ). The built-in driver is Nch MOSFET, thus the load transient response is excellent, (under the condition of the current between 1 mA and 400 mA,  $t_r = 0.5 \mu\text{s}$ , the undershoot level is approximately 50 mV).

The output voltage of this device is fixed with high accuracy. Since the packages for the device are DFN(PLP)1212-6, DFN1212-5, SOT-23-5 and SC-88A therefore high density mounting of the IC on boards is possible.

#### FEATURES

- Supply Current ..... Typ.  $28 \mu\text{A}$
- Standby Current ..... Typ.  $0.1 \mu\text{A}$
- Ripple Rejection ..... Typ. 80 dB ( $f = 1 \text{ kHz}$ ,  $V_{IN}$  Ripple)  
Typ. 50 dB ( $f = 1 \text{ kHz}$ ,  $V_{BIAS}$  Ripple)
- Output Voltage Range ..... 0.6 V to 1.5 V (0.1 V step)  
For other voltages, refer to *MARKING SPECIFICATION*
- Input Voltage Range ( $V_{BIAS}$ ) ..... 2.4 V to 5.25 V ( $V_{OUT} < 0.8 \text{ V}$ )  
Set  $V_{OUT} + 1.6 \text{ V}$  to 5.25 V ( $V_{OUT} \geq 0.8 \text{ V}$ )
- Input Voltage Range ( $V_{IN}$ ) ..... RP105xxxxB/D: 0.9 V to  $V_{BIAS}$  ( $V_{OUT} < 0.8 \text{ V}$ )  
Set  $V_{OUT} + 0.1 \text{ V}$  to  $V_{BIAS}$  ( $V_{OUT} \geq 0.8 \text{ V}$ )  
RP105xxxxE/F: 0.9 V to  $V_{BIAS}$
- Output Voltage Accuracy ..... Typ.  $\pm 15 \text{ mV}$  ( $T_a = 25^\circ\text{C}$ )
- Temperature-Drift Coefficient of Output Voltage ..... Typ.  $\pm 50 \text{ ppm}/^\circ\text{C}$
- Dropout Voltage ..... DFN1212-5: Typ. 105 mV  
( $I_{OUT} = 400 \text{ mA}$ ,  $V_{OUT} = 1.5 \text{ V}$ ,  $V_{BIAS} = 3.6 \text{ V}$ )
- Line Regulation ..... Typ. 0.02%/V
- Packages ..... DFN(PLP)1212-6, SC-88A, SOT-23-5, DFN1212-5
- Built-in Fold Back Protection Circuit ..... Typ. 120 mA (Current at short mode)
- Ceramic capacitors are recommended .....  $C_{BIAS} = C_{IN} = 1.0 \mu\text{F}$  or more,  $C_{OUT} = 2.2 \mu\text{F}$  or more

#### APPLICATIONS

- Power source for battery-powered equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for portable communication equipment.

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## SELECTION GUIDE

The output voltage, the UVLO circuit, the auto-discharge function<sup>(1)</sup>, the package, and the taping type for the device are user-selectable options.

### Selection Guide

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RP105Kxx1*-TR	DFN(PLP)1212-6	5,000 pcs	Yes	Yes
RP105Qxx2*-TR-FE <sup>(2)</sup>	SC-88A	3,000 pcs	Yes	Yes
RP105Nxx1*-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes
RP105Lxx1*-TR	DFN1212-5	5,000 pcs	Yes	Yes

xx: The set output voltage ( $V_{SET}$ ) can be designated within the range of 0.6 V (06) to 1.5 V (15) in 0.1 V step.

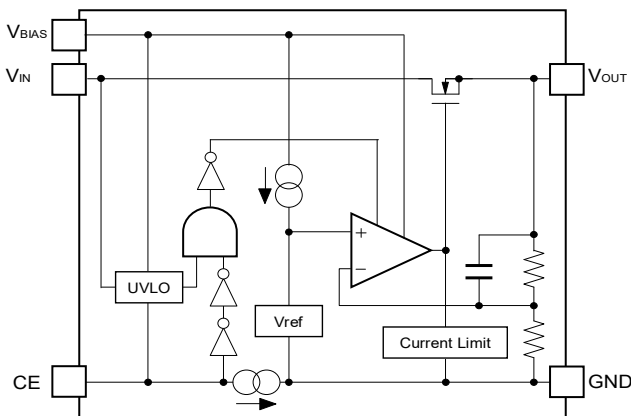
If the set output voltage ( $V_{SET}$ ) is designated in 0.01 V step, indicate the product name as follows.

1.05 V: RP105x10x\*5-TR

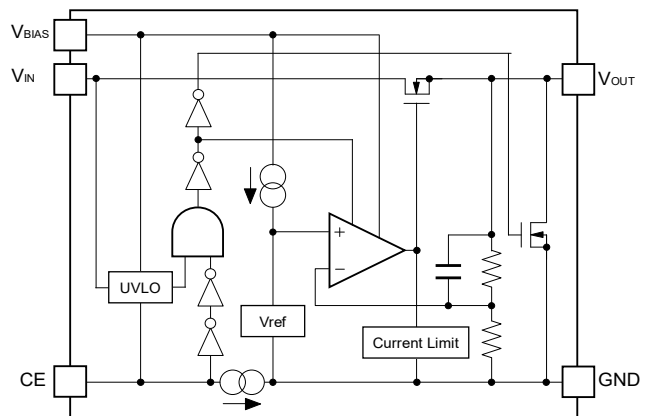
\* : CE pin polarity and auto-discharge function of the product can be defined as follows.

- (B) "H" active, auto-discharge function is not included, UVLO is included
- (D) "H" active, auto-discharge function is included, UVLO is included
- (E) "H" active, auto-discharge function is not included, UVLO is not included
- (F) "H" active, auto-discharge function is included, UVLO is not included

## BLOCK DIAGRAMS



RP105xxxxB/E Block Diagram

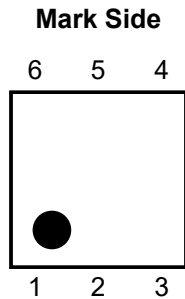


RP105xxxxD/F Block Diagram

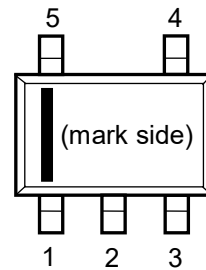
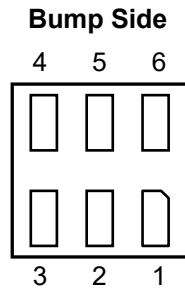
<sup>(1)</sup> Auto-discharge function quickly lowers the output voltage to 0 V, when the chip enable signal is switched from the active mode to the standby mode, by releasing the electrical charge accumulated in the external capacitor.

<sup>(2)</sup> RP105Qxx2\*-TR-FE supports only RP105Qxx2B/D.

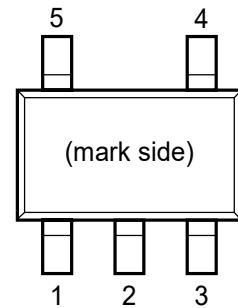
## PIN DESCRIPTIONS



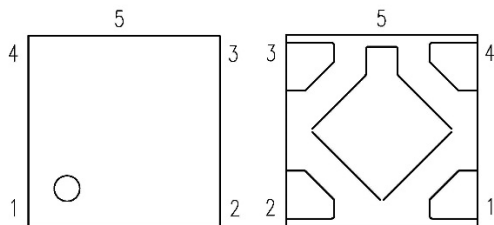
**DFN(PLP)1212-6 Pin Configuration**



**SC-88A Pin Configuration**



**SOT-23-5 Pin Configuration**



**DFN1212-5 Pin Configuration**

### DFN(PLP)1212-6 Pin Description

Pin No	Symbol	Pin Description
1	$V_{BIAS}$	Input Pin 1
2	GND	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
4	$V_{IN}$	Input Pin 2
5	NC	No Connection
6	$V_{OUT}$	Output Pin

### SC-88A Pin Description

Pin No	Symbol	Pin Description
1	$V_{BIAS}$	Input Pin 1
2	GND	Ground Pin
3	$V_{OUT}$	Output Pin
4	$V_{IN}$	Input Pin 2
5	CE	Chip Enable Pin ("H" Active)

\*RP105Q (SC-88A) is the discontinued product as of April, 2018.

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**SOT-23-5 Pin Description**

Pin No	Symbol	Pin Description
1	V <sub>IN</sub>	Input Pin 2
2	GND	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
4	V <sub>BIAS</sub>	Input Pin 1
5	V <sub>OUT</sub>	Output Pin

**DFN1212-5 Pin Description**

Pin No	Symbol	Pin Description
1	V <sub>OUT</sub>	Output Pin
2	V <sub>BIAS</sub>	Input Pin 1
3	CE	Chip Enable Pin ("H" Active)
4	V <sub>IN</sub>	Input Pin 2
5	GND	Ground Pin

## ABSOLUTE MAXIMUM RATINGS

### Absolute Maximum Ratings

Symbol	Item		Rating	Unit	
V <sub>BIAS</sub>	Input Voltage		6.0	V	
V <sub>IN</sub>	Input Voltage (for Driver)		-0.3 to V <sub>BIAS</sub> + 0.3	V	
V <sub>CE</sub>	Input Voltage (CE Pin)		6.0	V	
V <sub>OUT</sub>	Output Voltage		-0.3 to V <sub>IN</sub> + 0.3	V	
I <sub>OUT</sub>	Output Current		500	mA	
P <sub>D</sub>	Power Dissipation <sup>(1)</sup>	DFN(PLP)1212-6	JEDEC STD. 51-7 Test Land Pattern	450	mW
		SC-88A	Standard Test Land Pattern	380	
		SOT-23-5	JEDEC STD. 51-7 Test Land Pattern	660	
		DFN1212-5	JEDEC STD. 51-7 Test Land Pattern	560	
T <sub>j</sub>	Junction Temperature Range		-40 to 125	°C	
T <sub>stg</sub>	Storage Temperature Range		-55 to 125	°C	

### ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause the permanent damages and may degrade the life time and safety for both device and system using the device in the field. The functional operation at or over these absolute maximum ratings is not assured.

## RECOMMENDED OPERATING CONDITIONS

### Recommended Operating Conditions

Symbol	Item	Rating	Unit
V <sub>BIAS</sub>	Input Voltage Range	2.4 to 5.25	V
V <sub>IN</sub>		0.9 to V <sub>BIAS</sub>	V
		V <sub>SET</sub> + 0.1 to V <sub>BIAS</sub> (RP105xxxxB/D and when V <sub>SET</sub> ≥ 0.8 V)	V
T <sub>a</sub>	Operating Temperature Range	-40 to 85	°C

### RECOMMENDED OPERATING CONDITIONS

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

<sup>(1)</sup> Refer to *POWER DISSIPATION* for detailed information.

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## ELECTRICAL CHARACTERISTICS

$V_{BIAS} = V_{CE} = 3.6\text{ V}$ ,  $V_{IN} = \text{Set } V_{OUT} + 0.5\text{ V}$ ,  $I_{OUT} = 1\text{ mA}$ ,  $C_{BIAS} = C_{IN} = 1.0\text{ }\mu\text{F}$ ,  $C_{OUT} = 2.2\text{ }\mu\text{F}$ , unless otherwise noted. The specifications surrounded by   are guaranteed by design engineering at  $-40^{\circ}\text{C} \leq T_a \leq 85^{\circ}\text{C}$ .

### RP105x

( $T_a = 25^{\circ}\text{C}$ )

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
$V_{OUT}$	Output Voltage	$T_a = 25^{\circ}\text{C}$	Set $V_{OUT}$ -15 mV		Set $V_{OUT}$ + 15 mV	V
		$-40^{\circ}\text{C} \leq T_a \leq 85^{\circ}\text{C}$	<span style="border: 1px solid black; padding: 0 2px;">Set <math>V_{OUT}</math> -20 mV</span>		<span style="border: 1px solid black; padding: 0 2px;">Set <math>V_{OUT}</math> + 20 mV</span>	V
$I_{OUT}$	Output Current		<span style="border: 1px solid black; padding: 0 2px;">400</span>			mA
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation (K, Q, N package)	$1\text{ mA} \leq I_{OUT} \leq 400\text{ mA}$		30	<span style="border: 1px solid black; padding: 0 2px;">50</span>	mV
	Load Regulation (L package)	$1\text{ mA} \leq I_{OUT} \leq 400\text{ mA}$		15	<span style="border: 1px solid black; padding: 0 2px;">35</span>	mV
$V_{DIF}$	Dropout Voltage	Refer to <i>PRODUCT-SPECIFIC ELECTRICAL CHARACTERISTICS</i>				
$I_{SS}$	Supply Current	$I_{OUT} = 0\text{ mA}$		28	<span style="border: 1px solid black; padding: 0 2px;">40</span>	$\mu\text{A}$
$I_{standby}$	Standby Current	$V_{CE} = 0\text{ V}$		0.1	3.0	$\mu\text{A}$
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation	$2.4\text{ V} \leq V_{BIAS} \leq 5.0\text{ V}$		0.02	<span style="border: 1px solid black; padding: 0 2px;">0.1</span>	%V
		Set $V_{OUT} + 0.3\text{ V} \leq V_{IN} \leq 2.4\text{ V}$		0.02	<span style="border: 1px solid black; padding: 0 2px;">0.1</span>	
RR	Ripple Rejection	$I_{OUT} = 30\text{ mA}$ , $f = 1\text{ kHz}$ $V_{IN}$ Ripple 0.2 Vp-p		80		dB
		$I_{OUT} = 30\text{ mA}$ , $f = 1\text{ kHz}$ $V_{BIAS}$ Ripple 0.2 Vp-p		50		
$V_{BIAS}$	Input Voltage <sup>(1)</sup>	$V_{OUT} < 0.8\text{ V}$	<span style="border: 1px solid black; padding: 0 2px;">2.4</span>		<span style="border: 1px solid black; padding: 0 2px;">5.25</span>	V
		$V_{OUT} \geq 0.8\text{ V}$	Set $V_{OUT}$ + 1.6		<span style="border: 1px solid black; padding: 0 2px;">5.25</span>	
$V_{IN}$	Input Voltage (for Driver) <sup>(1)</sup>	RP105xxxxB/D	$V_{OUT} < 0.8\text{ V}$	<span style="border: 1px solid black; padding: 0 2px;">0.9</span>	$V_{BIAS}$	V
			$V_{OUT} \geq 0.8\text{ V}$	Set $V_{OUT}$ + 0.1	$V_{BIAS}$	
		RP105xxxxE/F	<span style="border: 1px solid black; padding: 0 2px;">0.9</span>	$V_{BIAS}$		
$\frac{\Delta V_{OUT}}{\Delta T_a}$	Output Voltage Temperature Coefficient	$-40^{\circ}\text{C} \leq T_a \leq 85^{\circ}\text{C}$		$\pm 50$		ppm/ $^{\circ}\text{C}$
$I_{SC}$	Short Current Limit	$V_{OUT} = 0\text{ V}$		120		mA
$I_{CEPD}$	CE Pull-down Current			1.0		$\mu\text{A}$

All test items listed under Electrical Characteristics are done under the pulse load condition ( $T_j \approx T_a = 25^{\circ}\text{C}$ ) except Output Noise, Ripple Rejection and Output Voltage Temperature Coefficient.

<sup>(1)</sup> The maximum Input Voltage listed under Electrical Characteristics is 5.25 V. If for any reason the input voltage exceeds 5.25 V, it has to be no more than 5.5 V with 500 hours of the total operating time.

## ELECTRICAL CHARACTERISTICS (continued)

$V_{BIAS} = V_{CE} = 3.6\text{ V}$ ,  $V_{IN} = \text{Set } V_{OUT} + 0.5\text{ V}$ ,  $I_{OUT} = 1\text{ mA}$ ,  $C_{BIAS} = C_{IN} = 1.0\text{ }\mu\text{F}$ ,  $C_{OUT} = 2.2\text{ }\mu\text{F}$ , unless otherwise noted. The specifications surrounded by   are guaranteed by design engineering at  $-40^{\circ}\text{C} \leq T_a \leq 85^{\circ}\text{C}$ .

### RP105x

( $T_a = 25^{\circ}\text{C}$ )

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
$V_{CEH}$	CE Input Voltage "H"		<span style="border: 1px solid black; padding: 0 2px;">0.8</span>			V
$V_{CEL}$	CE Input Voltage "L"				<span style="border: 1px solid black; padding: 0 2px;">0.3</span>	V
$V_{IN\text{ UVLO}}$	$V_{IN}$ Under Voltage Lock Out (only RP105xxxxB/D)	$I_{OUT} = 1.0\text{ }\mu\text{A}$		Set $V_{OUT} + 50\text{ mV}$	<span style="border: 1px solid black; padding: 0 2px;">Set <math>V_{OUT} + 100\text{ mV}</math></span>	V
t <sub>delay</sub>	Detector Delay Time (only RP105xxxxB/D)			100		$\mu\text{s}$
en	Output Noise	BM = 10 Hz to 100 kHz $I_{OUT} = 30\text{ mA}$ , Set $V_{OUT} = 0.6\text{ V}$		70		$\mu\text{V}_{rms}$
$R_{LOW}$	Nch On Resistance For auto-discharge (only RP105xxxxD/F)	$V_{BIAS} = 3.6\text{ V}$ , $V_{CE} = \text{"L"}$		50		$\Omega$

All test items listed under Electrical Characteristics are done under the pulse load condition ( $T_j \approx T_a = 25^{\circ}\text{C}$ ) except Output Noise, Ripple Rejection and Output Voltage Temperature Coefficient.

\*RP105Q (SC-88A) is the discontinued product as of April, 2018.

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## PRODUCT-SPECIFIC ELECTRICAL CHARACTERISTICS

### DFN(PLP)1212-6, SC-88A, SOT-23-5

The specifications surrounded by   are guaranteed by design engineering at  $-40^{\circ}\text{C} \leq T_a \leq 85^{\circ}\text{C}$

#### Dropout Voltage

Set $V_{\text{OUT}}$ (V)	$V_{\text{BIAS}}$ (V)	$V_{\text{GS}}$ (V)	$V_{\text{DIF}}$ ( $I_{\text{OUT}} = 300 \text{ mA}$ ) (V)		$V_{\text{DIF}}$ ( $I_{\text{OUT}} = 400 \text{ mA}$ ) (V)	
			Typ.	Max.	Typ.	Max.
0.6	3.6	3.0	0.115	0.180	0.180	0.320
0.7	3.6	2.9	0.120	0.190	0.180	0.320
0.8	3.6	2.8	0.120	0.190	0.180	0.300
0.9	3.6	2.7	0.120	0.190	0.180	0.300
1.0	3.6	2.6	0.120	0.190	0.180	0.280
1.1	3.6	2.5	0.120	0.190	0.180	0.280
1.2	3.6	2.4	0.130	0.200	0.180	0.280
1.3	3.6	2.3	0.130	0.200	0.180	0.260
1.4	3.6	2.2	0.130	0.200	0.180	0.260
1.5	3.6	2.1	0.130	0.200	0.180	0.260

#### Dropout Voltage ( $V_{\text{GS}}$ (V), $V_{\text{DIF}}$ (V), $I_{\text{OUT}} = 200 \text{ mA}$ )

( $T_a = 25^{\circ}\text{C}$ )

Set $V_{\text{OUT}}$ (V)	$V_{\text{BIAS}} = 2.5 \text{ V}$		$V_{\text{BIAS}} = 3.0 \text{ V}$		$V_{\text{BIAS}} = 3.3 \text{ V}$		$V_{\text{BIAS}} = 3.6 \text{ V}$		$V_{\text{BIAS}} = 4.2 \text{ V}$		$V_{\text{BIAS}} = 5.0 \text{ V}$	
	$V_{\text{GS}}$ (V)	$V_{\text{DIF}}$ (V)	$V_{\text{GS}}$ (V)	$V_{\text{DIF}}$ (V)	$V_{\text{GS}}$ (V)	$V_{\text{DIF}}$ (V)	$V_{\text{GS}}$ (V)	$V_{\text{DIF}}$ (V)	$V_{\text{GS}}$ (V)	$V_{\text{DIF}}$ (V)	$V_{\text{GS}}$ (V)	$V_{\text{DIF}}$ (V)
0.6	1.9	-	2.4	-	2.7	-	3.0	-	3.6	-	4.4	-
0.7	1.8	-	2.3	-	2.6	-	2.9	-	3.5	-	4.3	-
0.8	1.7	0.098	2.2	0.093	2.5	0.093	2.8	0.092	3.4	0.092	4.2	0.092
0.9	1.6	0.098	2.1	0.094	2.4	0.093	2.7	0.092	3.3	0.092	4.1	0.092
1.0	/	/	2.0	0.094	2.3	0.093	2.6	0.092	3.2	0.092	4.0	0.092
1.1	/	/	1.9	0.096	2.2	0.094	2.5	0.094	3.1	0.093	3.9	0.093
1.2	/	/	1.8	0.098	2.1	0.096	2.4	0.095	3.0	0.095	3.8	0.094
1.3	/	/	1.7	0.098	2.0	0.096	2.3	0.095	2.9	0.095	3.7	0.095
1.4	/	/	1.6	0.098	1.9	0.096	2.2	0.095	2.8	0.095	3.6	0.095
1.5	/	/	/	/	1.8	0.096	2.1	0.095	2.7	0.095	3.5	0.095

All of units are tested and specified under load conditions such that  $T_j \approx T_a = 25^{\circ}\text{C}$  except for Output Noise, Ripple Rejection and Output Voltage Temperature Coefficient items.

   $V_{\text{BIAS}}$  pin voltage must be equal or more than  $\text{Set } V_{\text{OUT}} + 1.6 \text{ V}$ .



**DFN1212-5**



















The specifications surrounded by   are guaranteed by design engineering at  $-40^{\circ}\text{C} \leq T_a \leq 85^{\circ}\text{C}$

**Dropout Voltage**


Set V <sub>OUT</sub> (V)	V <sub>BIAS</sub> (V)	V <sub>GS</sub> (V)	V <sub>DIF</sub> (I <sub>OUT</sub> = 300 mA) (V)		V <sub>DIF</sub> (I <sub>OUT</sub> = 400 mA) (V)	
			Typ.	Max.	Typ.	Max.
0.6	3.6	3.0	-	-	-	-
0.7	3.6	2.9	-	-	-	-
0.8	3.6	2.8	0.077	<span style="border: 1px solid black; padding: 0 2px;">0.130</span>	0.105	<span style="border: 1px solid black; padding: 0 2px;">0.170</span>
0.9	3.6	2.7	0.077	<span style="border: 1px solid black; padding: 0 2px;">0.130</span>	0.105	<span style="border: 1px solid black; padding: 0 2px;">0.170</span>
0.95	3.6	2.65	0.077	<span style="border: 1px solid black; padding: 0 2px;">0.130</span>	0.105	<span style="border: 1px solid black; padding: 0 2px;">0.170</span>
1.0	3.6	2.6	0.077	<span style="border: 1px solid black; padding: 0 2px;">0.130</span>	0.105	<span style="border: 1px solid black; padding: 0 2px;">0.170</span>
1.05	3.6	2.55	0.077	<span style="border: 1px solid black; padding: 0 2px;">0.130</span>	0.105	<span style="border: 1px solid black; padding: 0 2px;">0.170</span>
1.1	3.6	2.5	0.077	<span style="border: 1px solid black; padding: 0 2px;">0.130</span>	0.105	<span style="border: 1px solid black; padding: 0 2px;">0.170</span>
1.2	3.6	2.4	0.077	<span style="border: 1px solid black; padding: 0 2px;">0.130</span>	0.105	<span style="border: 1px solid black; padding: 0 2px;">0.170</span>
1.3	3.6	2.3	0.077	<span style="border: 1px solid black; padding: 0 2px;">0.130</span>	0.105	<span style="border: 1px solid black; padding: 0 2px;">0.170</span>
1.4	3.6	2.2	0.077	<span style="border: 1px solid black; padding: 0 2px;">0.130</span>	0.105	<span style="border: 1px solid black; padding: 0 2px;">0.170</span>
1.5	3.6	2.1	0.077	<span style="border: 1px solid black; padding: 0 2px;">0.130</span>	0.105	<span style="border: 1px solid black; padding: 0 2px;">0.170</span>

**Dropout Voltage (V<sub>GS</sub> (V), V<sub>DIF</sub> (V), I<sub>OUT</sub> = 200 mA)**

(T<sub>a</sub> = 25°C)

Set V <sub>OUT</sub> (V)	V <sub>BIAS</sub> = 2.5 V		V <sub>BIAS</sub> = 3.0 V		V <sub>BIAS</sub> = 3.3 V		V <sub>BIAS</sub> = 3.6 V		V <sub>BIAS</sub> = 4.2 V		V <sub>BIAS</sub> = 5.0 V	
	V <sub>GS</sub> (V)	V <sub>DIF</sub> (V)	V <sub>GS</sub> (V)	V <sub>DIF</sub> (V)	V <sub>GS</sub> (V)	V <sub>DIF</sub> (V)	V <sub>GS</sub> (V)	V <sub>DIF</sub> (V)	V <sub>GS</sub> (V)	V <sub>DIF</sub> (V)	V <sub>GS</sub> (V)	V <sub>DIF</sub> (V)
0.6	1.9	-	2.4	-	2.7	-	3.0	-	3.6	-	4.4	-
0.7	1.8	-	2.3	-	2.6	-	2.9	-	3.5	-	4.3	-
0.8	1.7	-	2.2	-	2.5	-	2.8	-	3.4	-	4.2	-
0.9	1.6	0.059	2.1	0.054	2.4	0.053	2.7	0.051	3.3	0.050	4.1	0.048
0.95			2.05	0.054	2.35	0.053	2.65	0.051	3.25	0.050	4.05	0.048
1.0			2.0	0.054	2.3	0.053	2.6	0.051	3.2	0.050	4.0	0.048
1.05			1.95	0.054	2.25	0.053	2.55	0.051	3.15	0.050	3.95	0.048
1.1			1.9	0.054	2.2	0.053	2.5	0.051	3.1	0.050	3.9	0.048
1.2			1.8	0.054	2.1	0.053	2.4	0.051	3.0	0.050	3.8	0.048
1.3			1.7	0.054	2.0	0.053	2.3	0.051	2.9	0.050	3.7	0.048
1.4			1.6	0.054	1.9	0.053	2.2	0.051	2.8	0.050	3.6	0.048
1.5					1.8	0.053	2.1	0.051	2.7	0.050	3.5	0.048

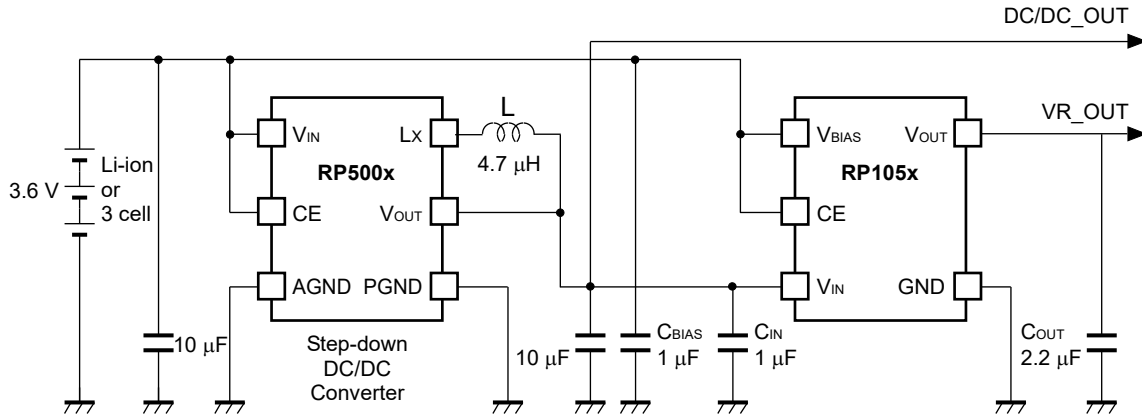
All of units are tested and specified under load conditions such that T<sub>j</sub> ≈ T<sub>a</sub> = 25°C except for Output Noise, Ripple Rejection and Output Voltage Temperature Coefficient items.

 V<sub>BIAS</sub> pin voltage must be equal or more than Set V<sub>OUT</sub> + 1.6 V.

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## APPLICATION INFORMATION

### TYPICAL APPLICATION



### External Components

Symbol	Descriptions
C <sub>OUT</sub>	2.2 μF, Ceramic Capacitor, GRM155B30J225ME15, MURATA
C <sub>BIAS</sub> , C <sub>IN</sub>	1.0 μF, Ceramic Capacitor, GRM155B31A105KE15, MURATA

## TECHNICAL NOTES

### UVLO (Undervoltage Lockout)

In RP105xxxxB/D, UVLO detects and turns off the output when the input voltage  $V_{IN}$  drops lower than or equal to  $V_{SET} + 50$  mV (Typ.) while CE = "H". Since RP105xxxxE/F does not have UVLO, it continues to output even if  $V_{IN}$  drops to  $V_{SET} + 50$  mV (Typ.) or lower.

When  $V_{IN}$  drops below the set output voltage  $V_{SET}$ , UVLO does not turn off the output in RP105xxxxE/F while CE = "H", therefore the current flows from  $V_{BIAS}$  pin to  $V_{IN}$  pin via the inside IC. This will not be generated in RP105xxxxB/D since UVLO turns off the output when  $V_{IN}$  is lower than or equal to  $V_{SET} + 50$  mV (Typ).

### Phase Compensation

In this device, phase compensation is made for securing stable operation even if the load current is varied. For this purpose, use a capacitor for  $C_{OUT}$  with the capacity of equal or more than 2.2  $\mu$ F.

If tantalum capacitors are connected as  $C_{OUT}$ , and if the equivalent series resistance (ESR) value is large, the operation might be unstable. Because of this, test the device with as same external components as ones to be used on the PCB.

### PCB Layout

Make  $V_{BIAS}$ ,  $V_{IN}$ , and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor with a capacitance value as much as 1.0  $\mu$ F or more between  $V_{BIAS}$  pin and GND, between  $V_{IN}$  pin and GND, and as close as possible to the pins.

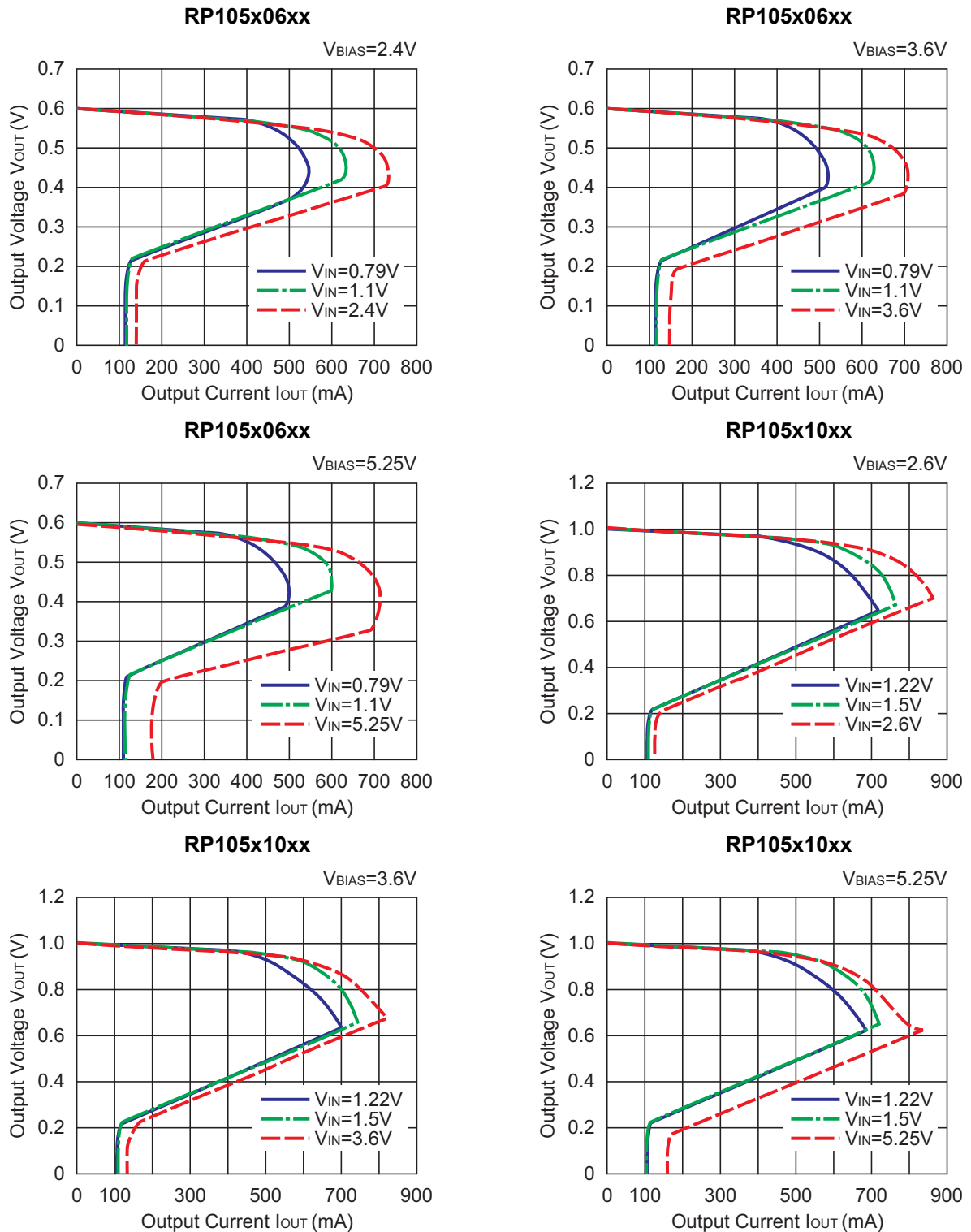
Set external components, especially the output capacitor, as close as possible to the device, and make wiring as short as possible.  $V_{IN}$  source is supposed to be the output of the DC/DC converter. The value should be equal or lower than  $V_{BIAS}$  voltage.

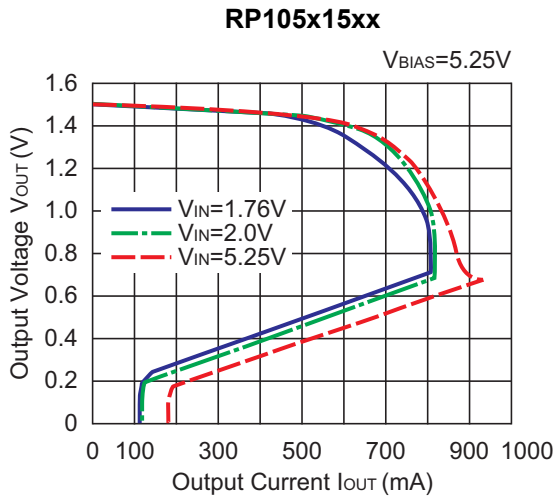
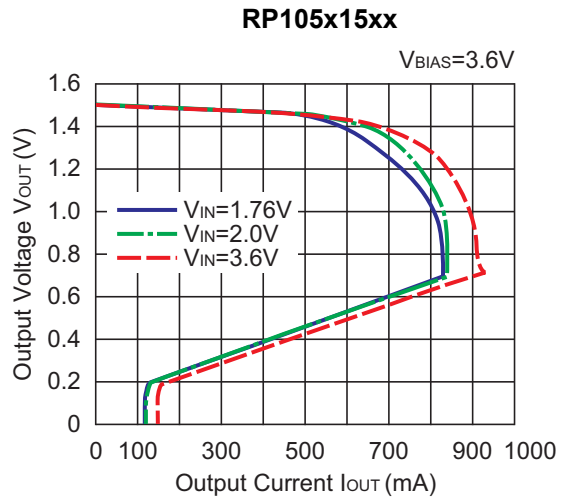
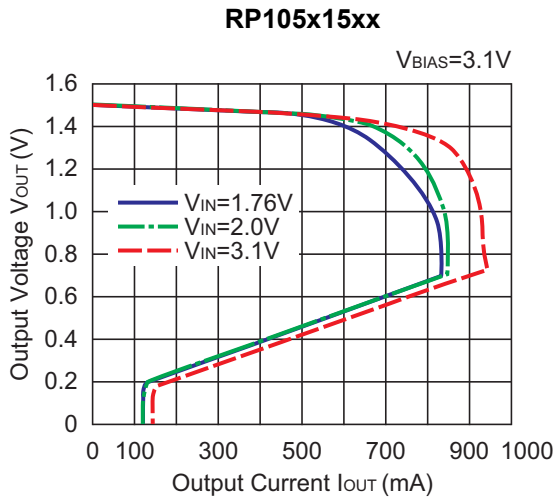
No. EA-179-180419

## TYPICAL CHARACTERISTICS

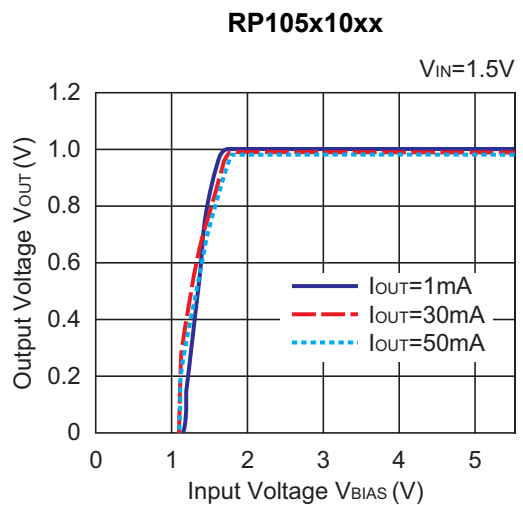
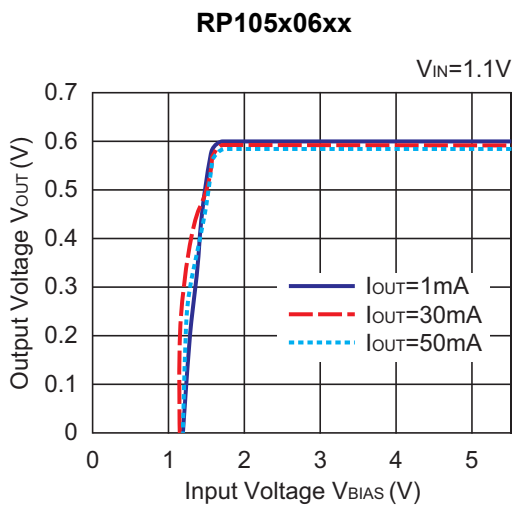
Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

### 1) Output Voltage vs. Output Current ( $C_{BIAS} = 1.0 \mu\text{F}$ , $C_{IN} = C_{OUT} = 2.2 \mu\text{F}$ , $T_a = 25^\circ\text{C}$ )

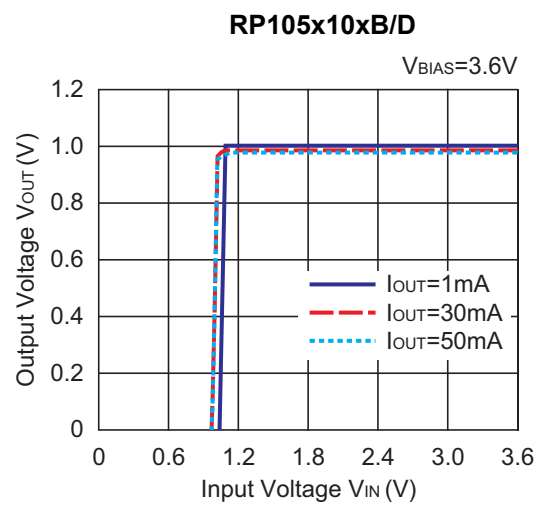
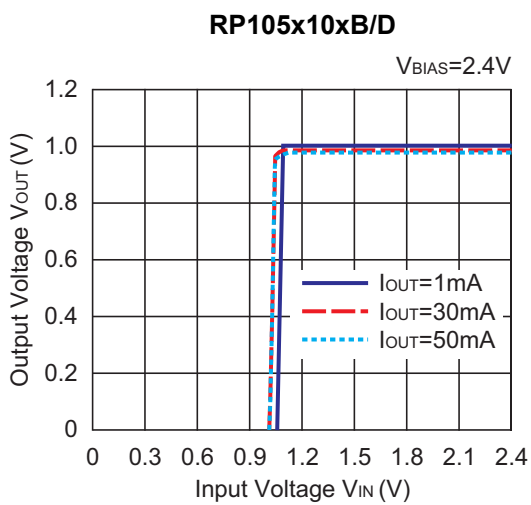
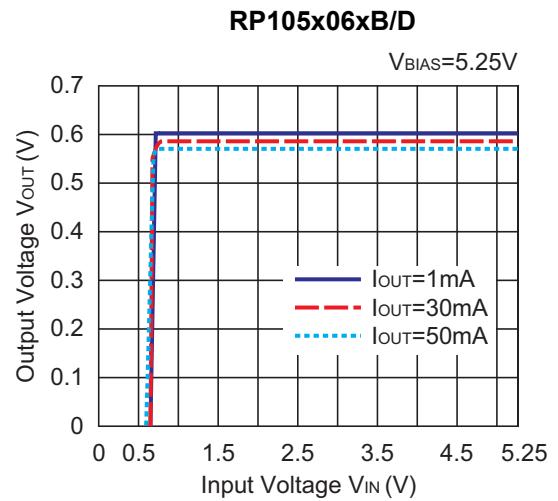
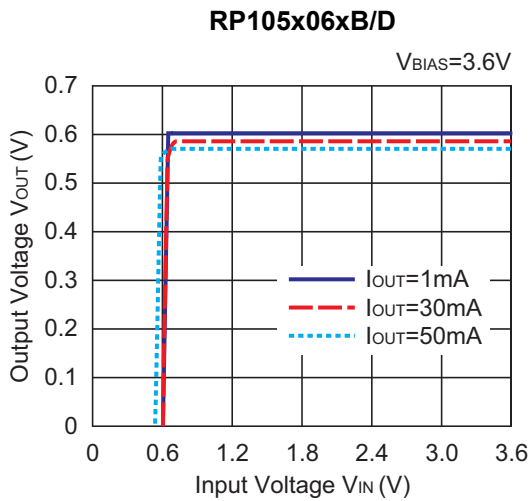
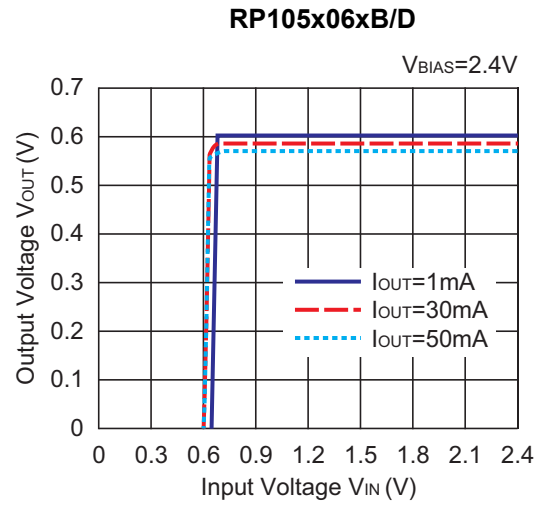
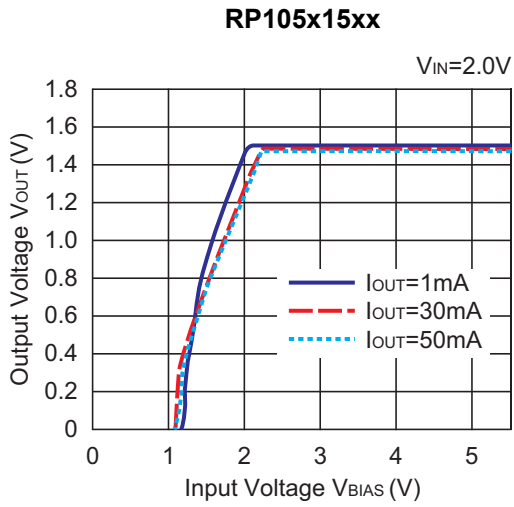




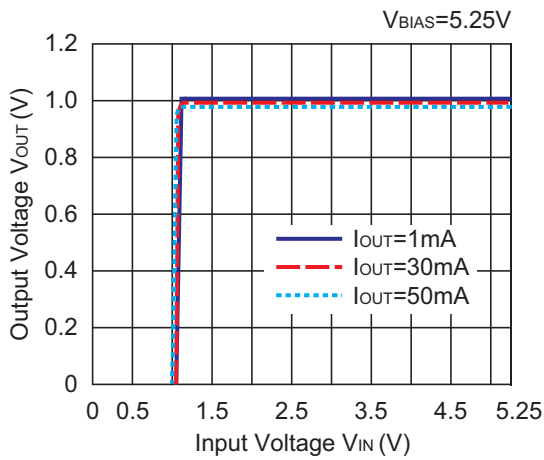
**2) Output Voltage vs. Input Voltage ( $C_{BIAS} = 1.0 \mu F$ ,  $C_{IN} = C_{OUT} = 2.2 \mu F$ ,  $T_a = 25^\circ C$ )**



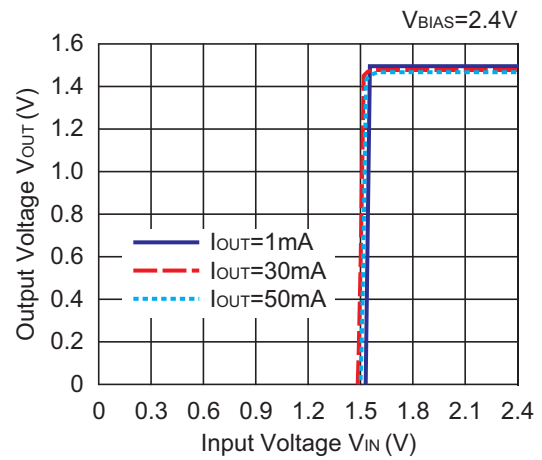
No. EA-179-180419



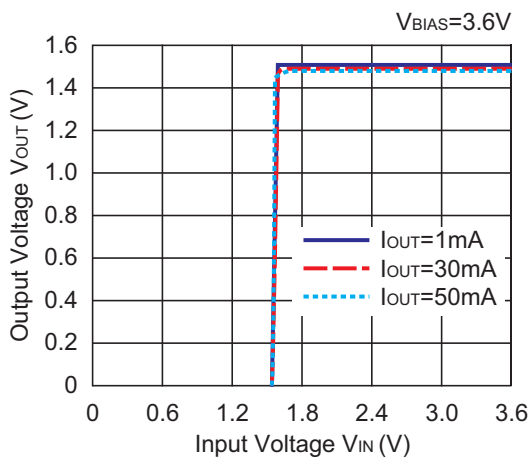
**RP105x10xB/D**



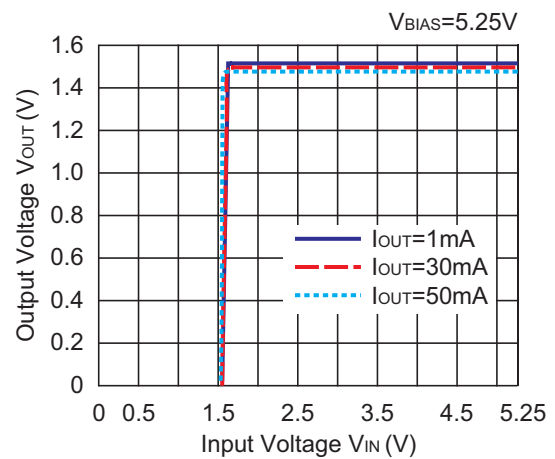
**RP105x15xB/D**



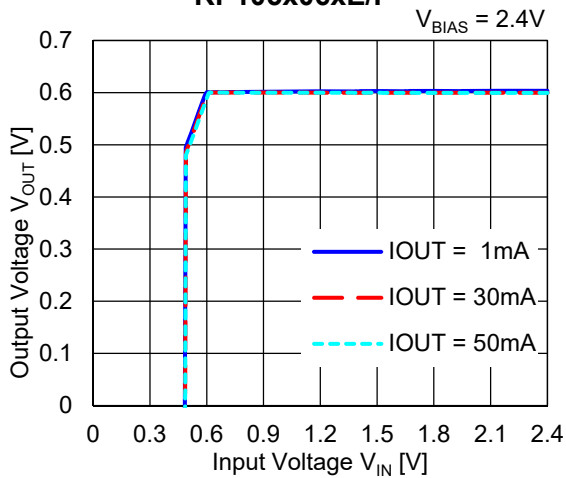
**RP105x15xB/D**



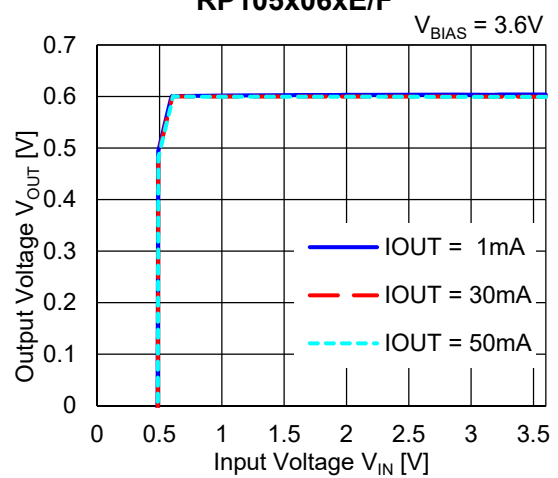
**RP105x15xB/D**



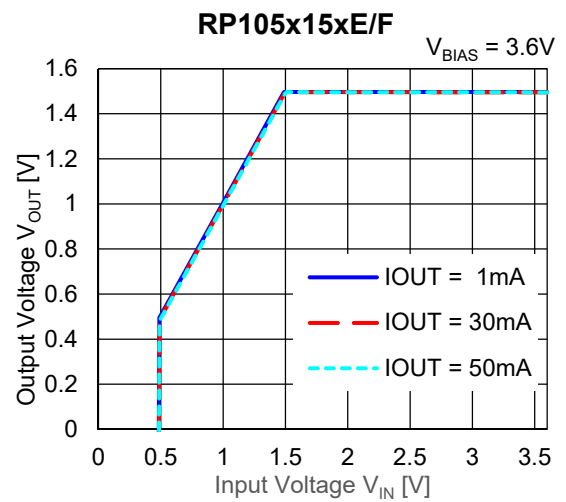
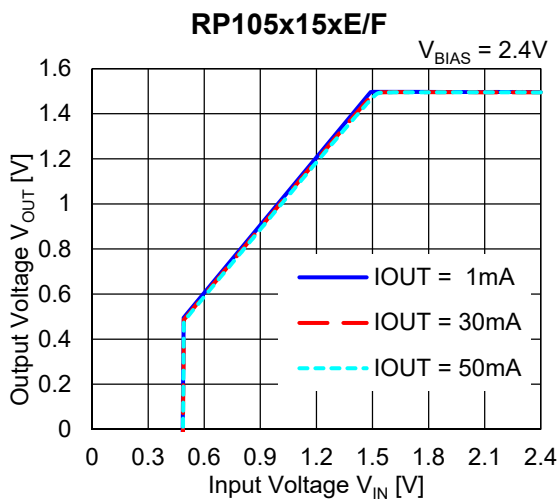
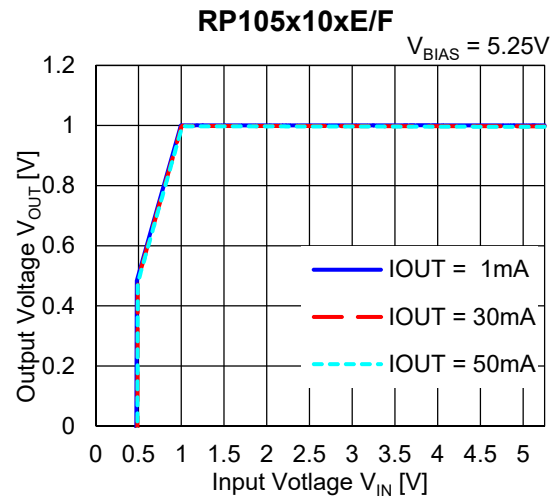
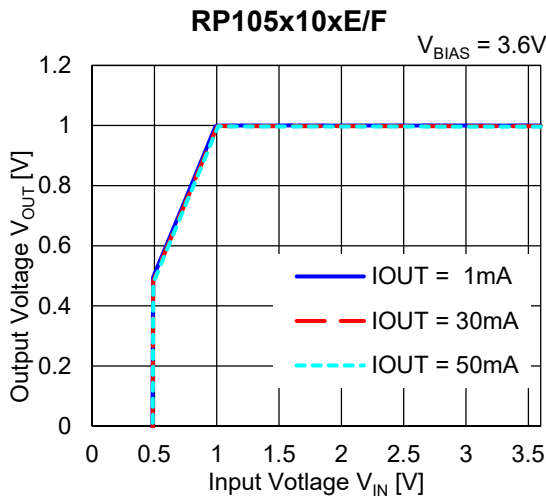
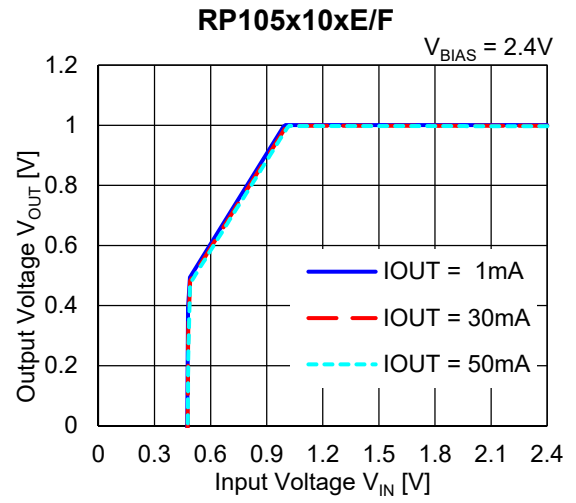
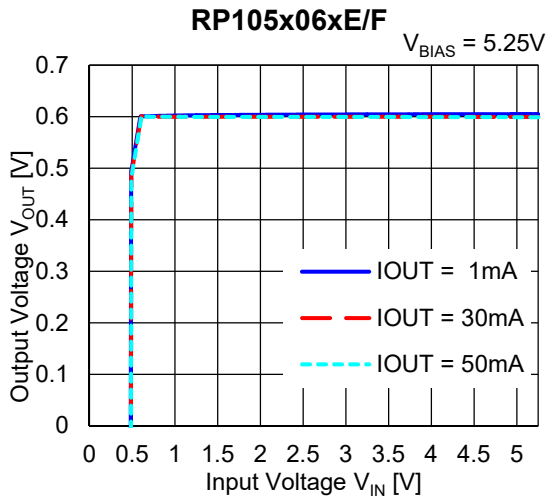
**RP105x06xE/F**



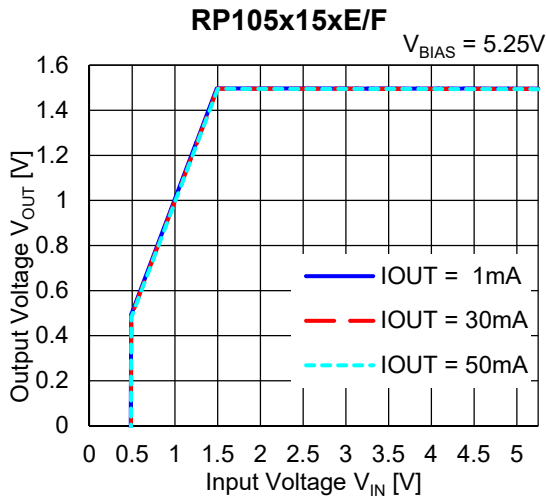
**RP105x06xE/F**



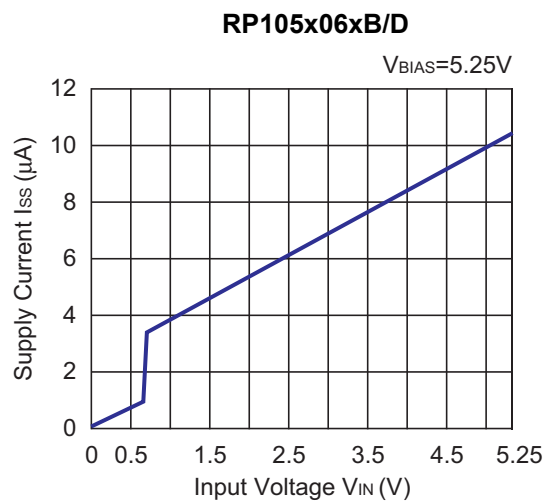
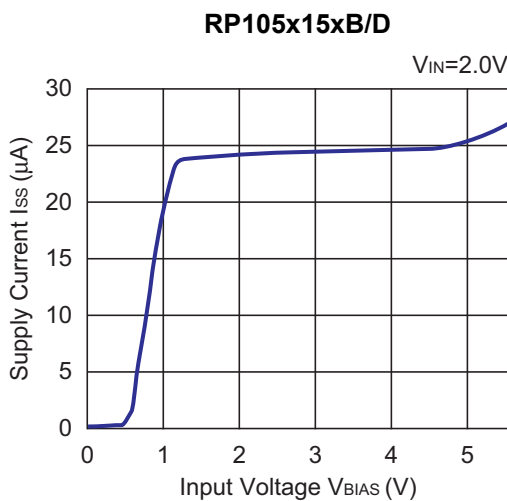
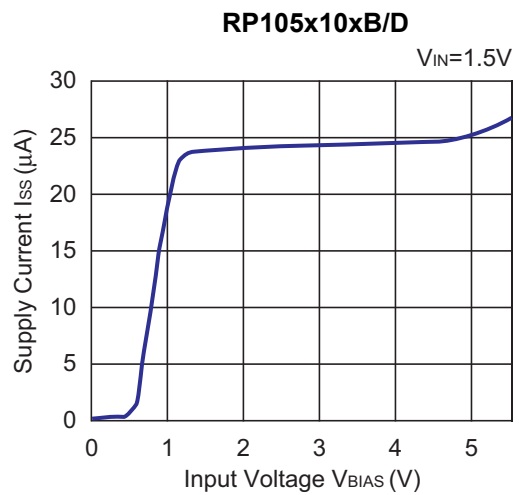
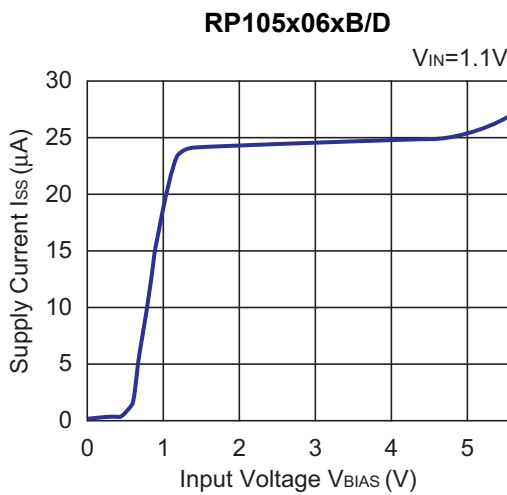
No. EA-179-180419





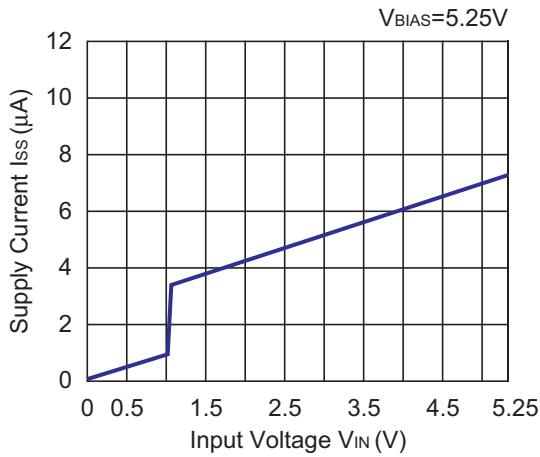


**3) Supply Current vs. Input Voltage ( $C_{BIAS} = C_{IN} = C_{OUT} = \text{none}$ ,  $T_a = 25^\circ C$ )**

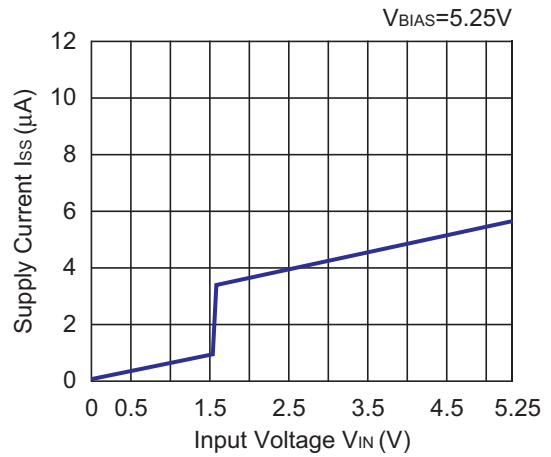


No. EA-179-180419

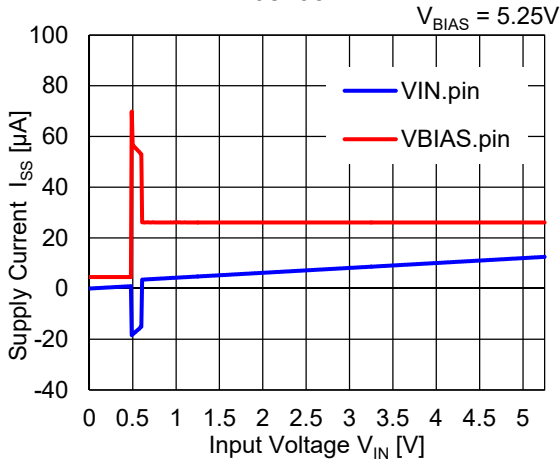
**RP105x10xB/D**



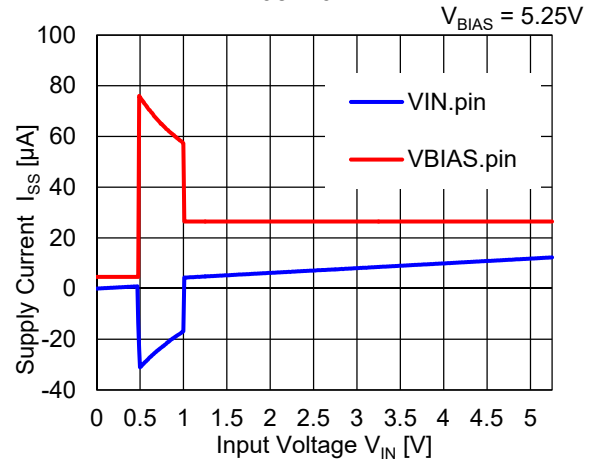
**RP105x15xB/D**



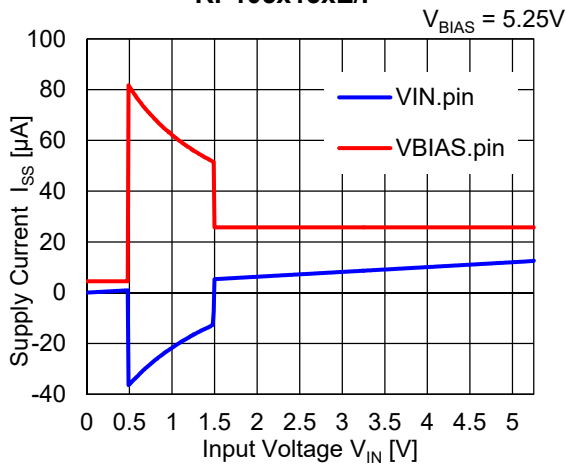
**RP105x06xE/F**



**RP105x10xE/F**

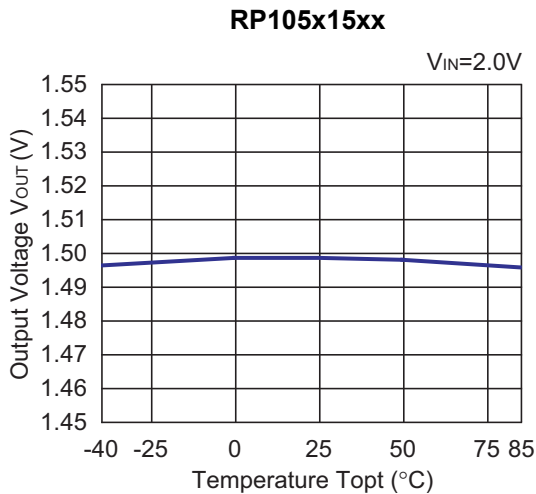
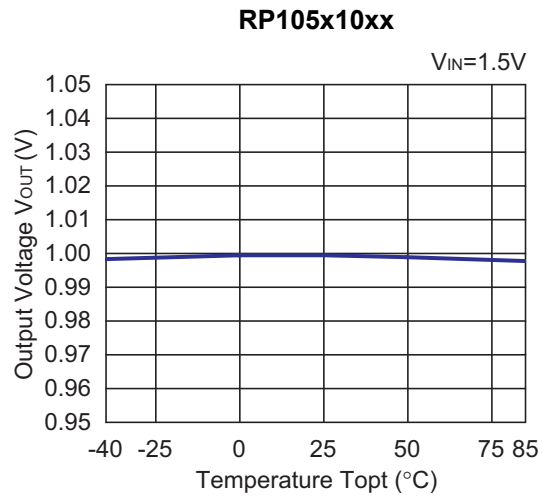
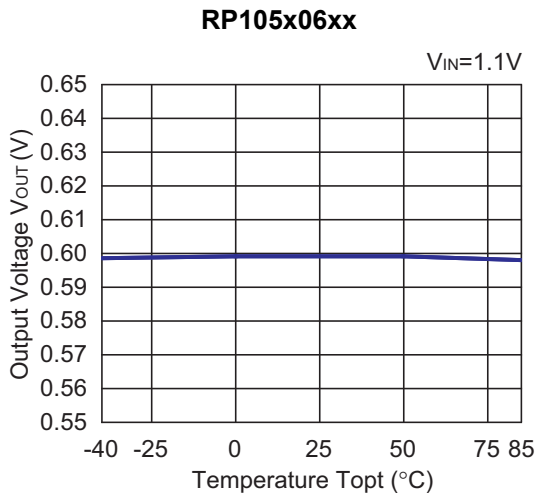


**RP105x15xE/F**

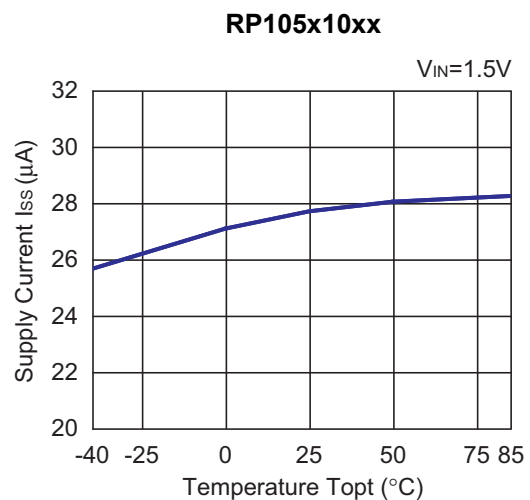
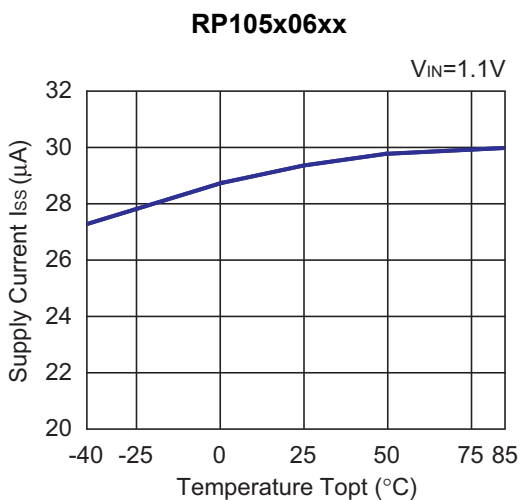


In RP105xxxxE/F, the current flows from  $V_{BIAS}$  pin to  $V_{IN}$  pin via the inside IC when the input voltage  $V_{IN}$  drops below the set output voltage  $V_{SET}$ .

4) Output Voltage vs. Temperature ( $C_{BIAS} = 1.0 \mu F$ ,  $C_{IN} = C_{OUT} = 2.2 \mu F$ ,  $I_{OUT} = 1 \text{ mA}$ ,  $V_{BIAS} = 3.6 \text{ V}$ )

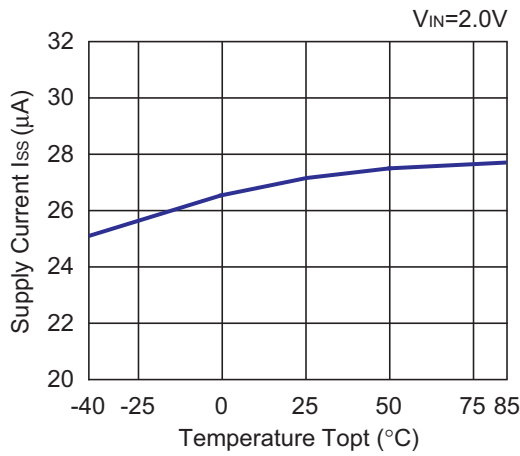


5) Supply Current vs. Temperature ( $C_{BIAS} = C_{IN} = C_{OUT} = \text{none}$ ,  $V_{BIAS} = 3.6 \text{ V}$ )



No. EA-179-180419

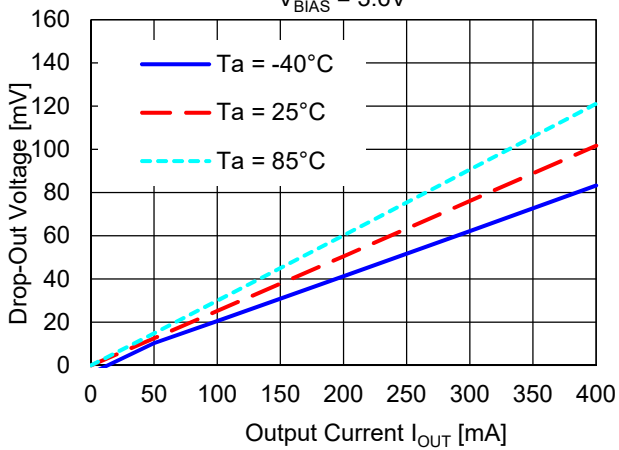
**RP105x15xx**



**6) Dropout Voltage vs. Output Current ( $C_{BIAS} = 1.0 \mu F$ ,  $C_{IN} = C_{OUT} = 2.2 \mu F$ )**

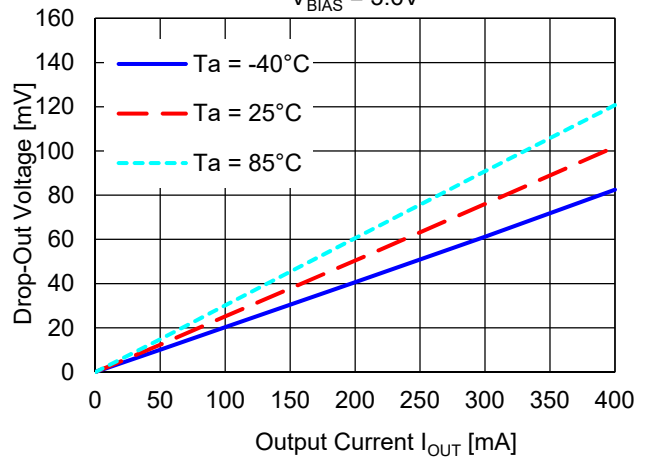
**RP105L061E/F**

$V_{BIAS} = 3.6V$



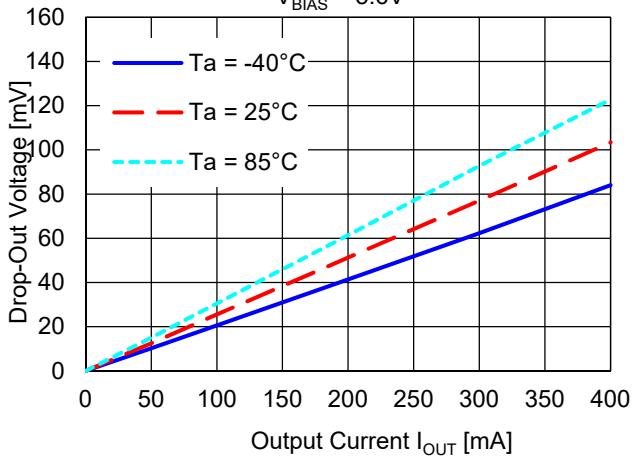
**RP105L101E/F**

$V_{BIAS} = 3.6V$

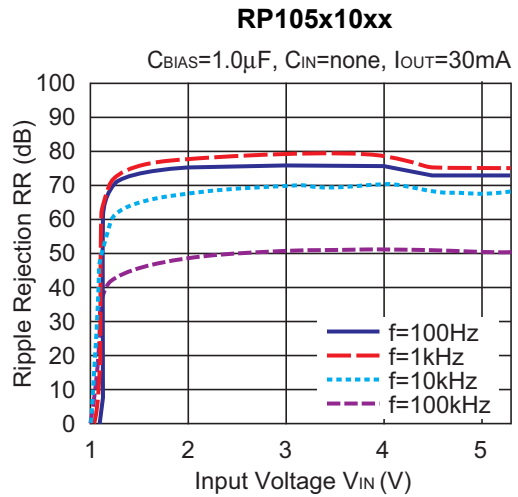
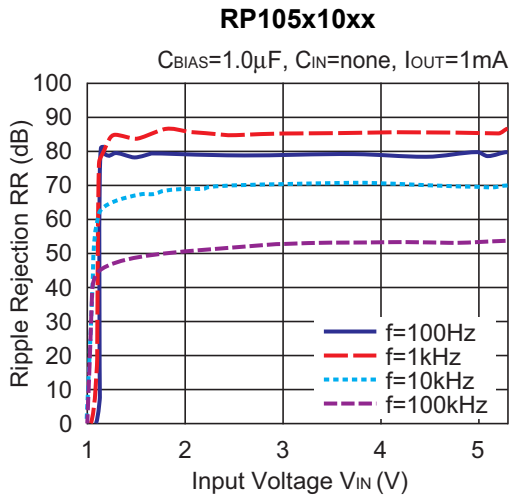
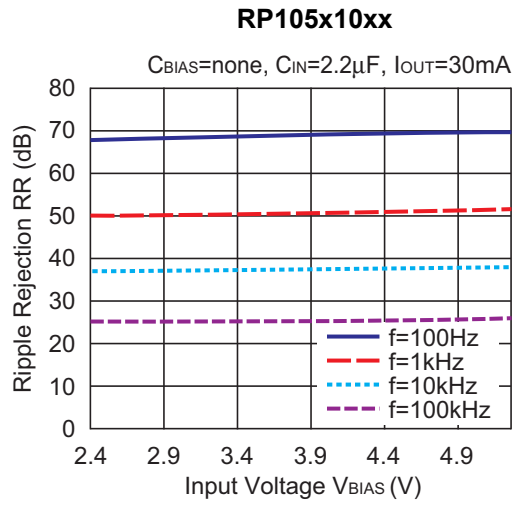
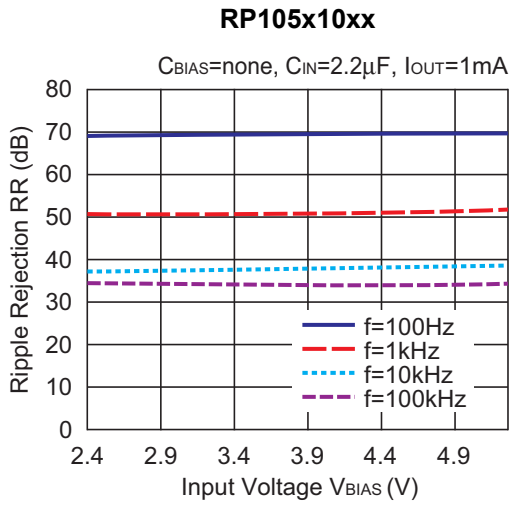


**RP105L151E/F**

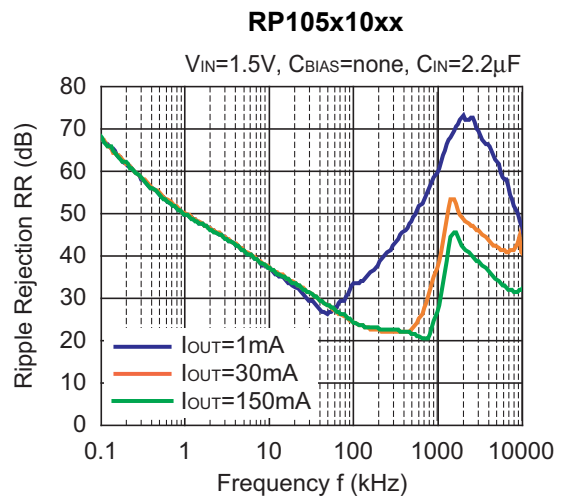
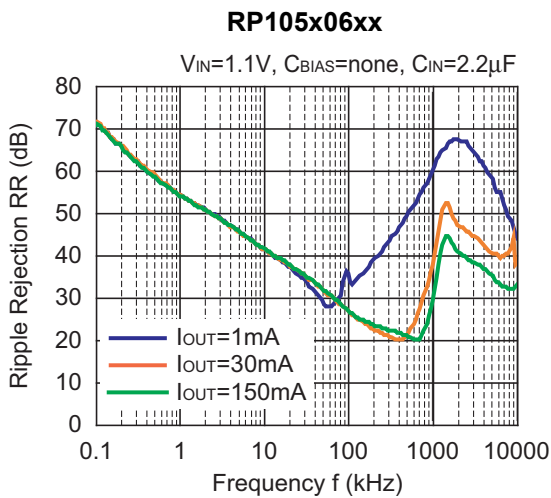
$V_{BIAS} = 3.6V$



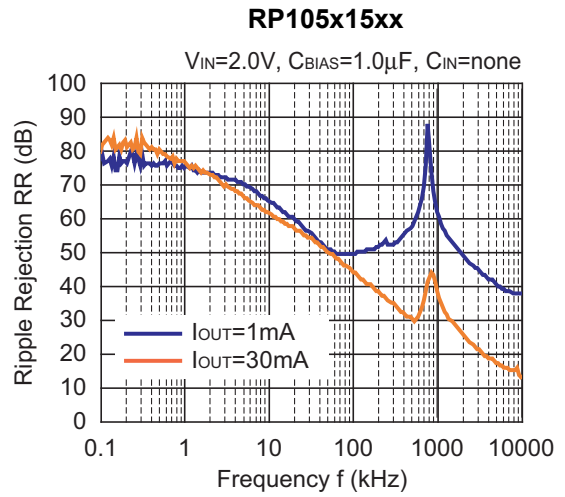
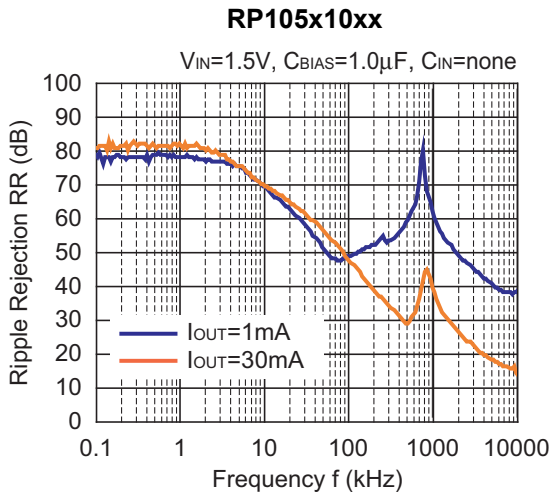
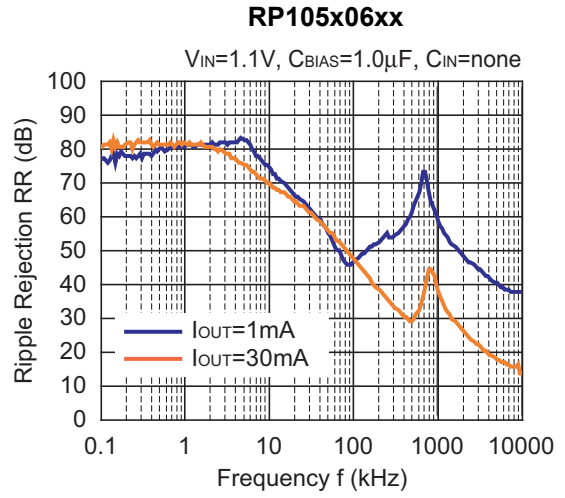
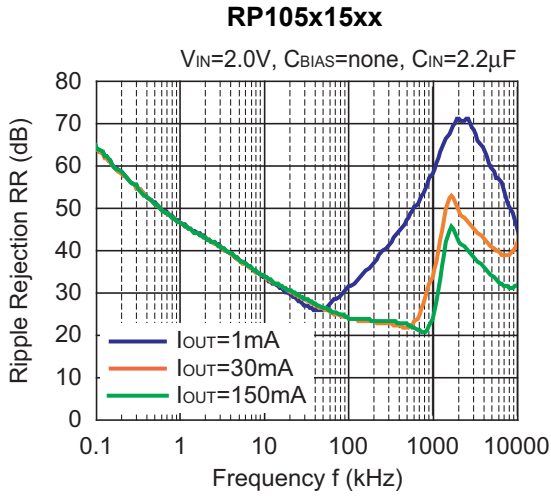
7) Ripple Rejection vs. Input Bias Voltage ( $C_{OUT} = 2.2 \mu\text{F}$ , Ripple = 0.2 Vp-p,  $T_a = 25^\circ\text{C}$ )



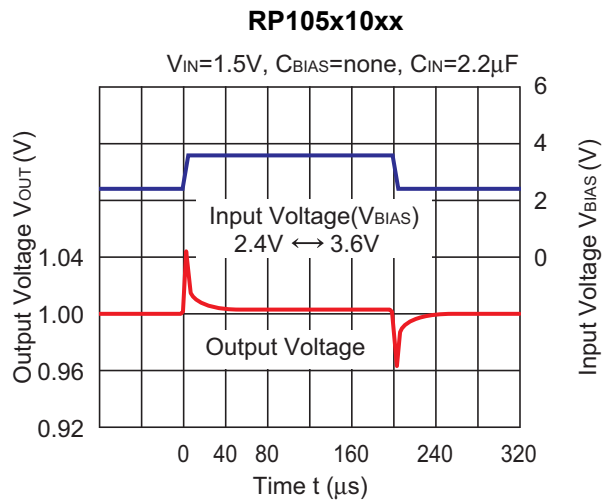
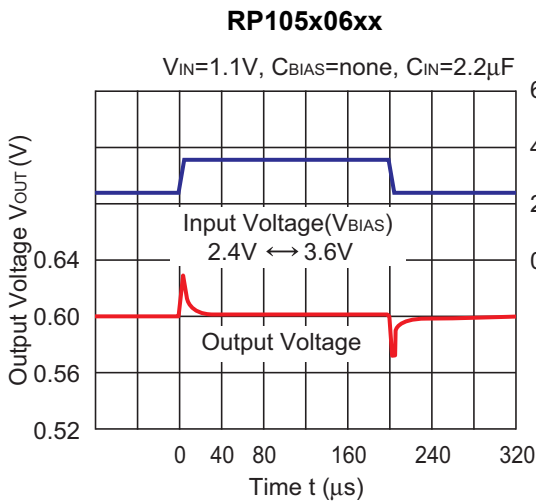
8) Ripple Rejection vs. Frequency ( $V_{BIAS} = 3.6 \text{ V}$ ,  $C_{OUT} = 2.2 \mu\text{F}$ ,  $T_a = 25^\circ\text{C}$ )

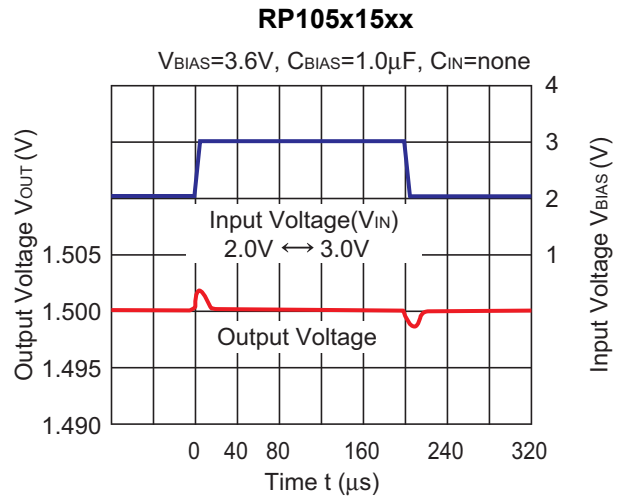
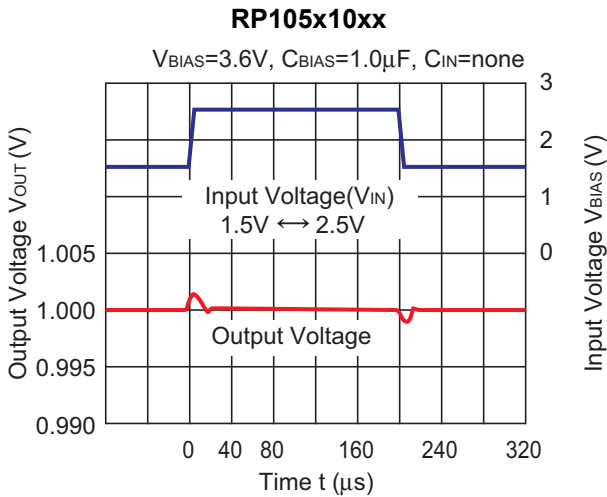
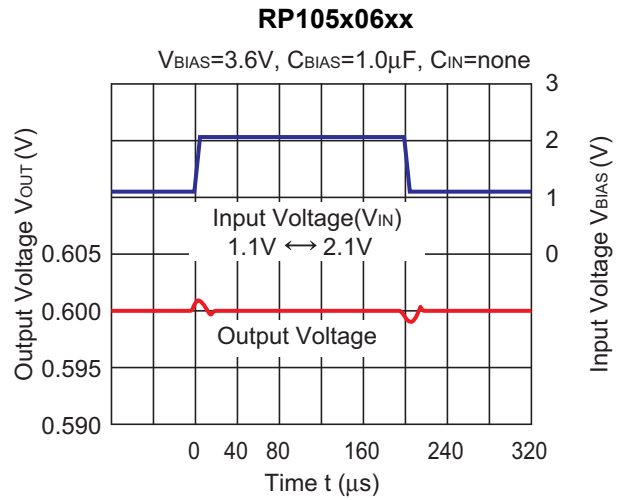
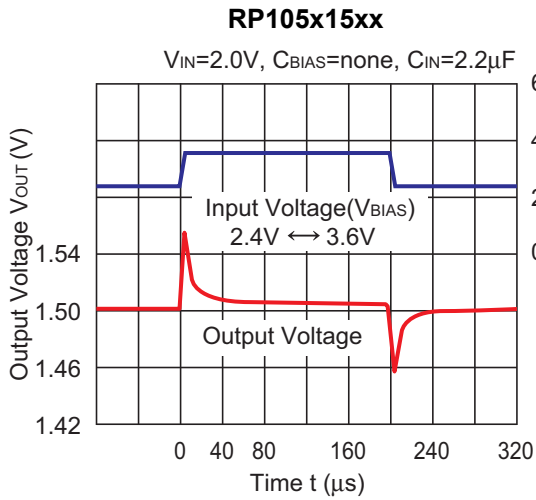


No. EA-179-180419

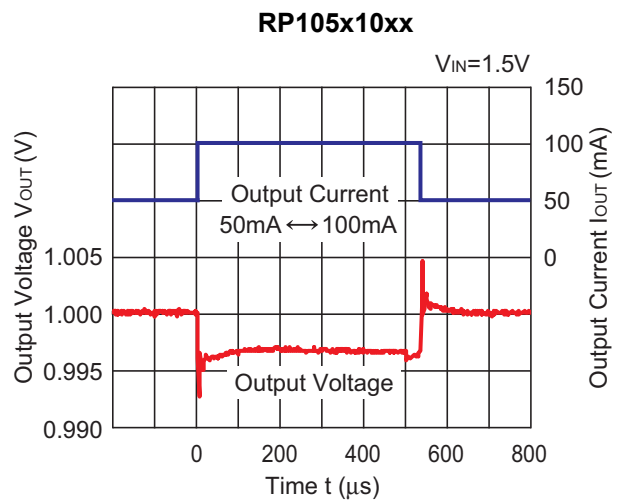
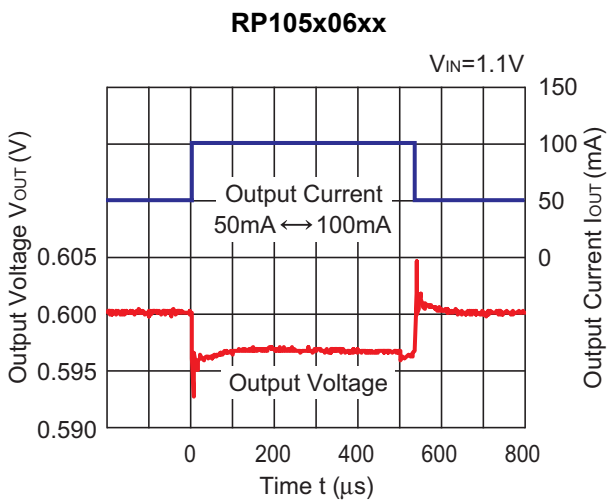


**9) Input Transient Response ( $I_{OUT} = 30\text{ mA}$ ,  $C_{OUT} = 1.0\ \mu\text{F}$ ,  $t_r = t_f = 5\ \mu\text{s}$ ,  $T_a = 25^\circ\text{C}$ )**

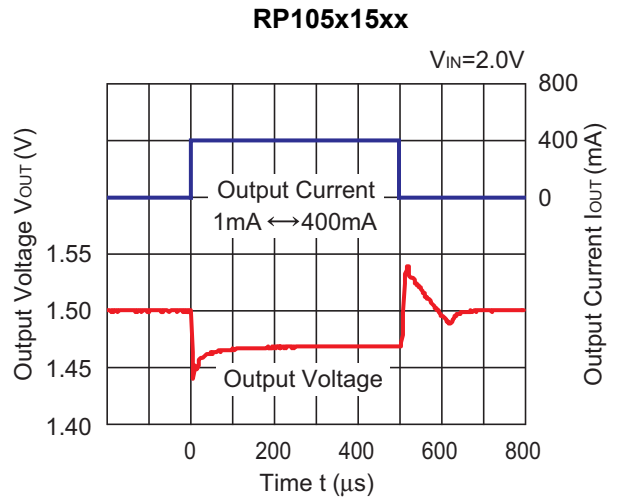
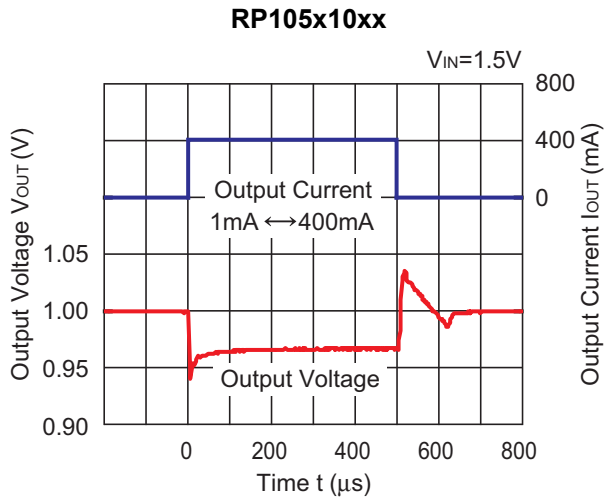
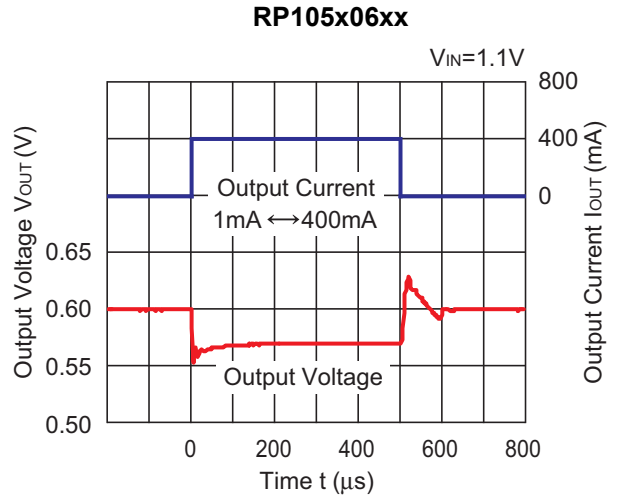
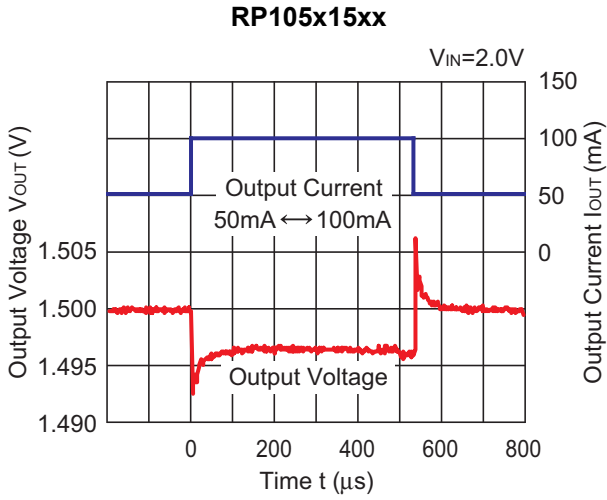




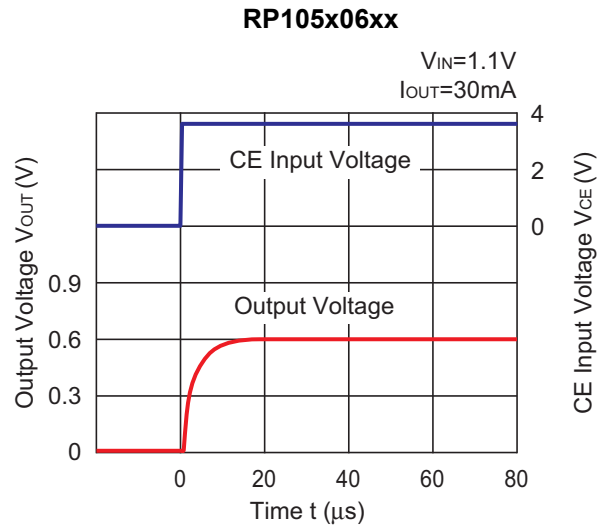
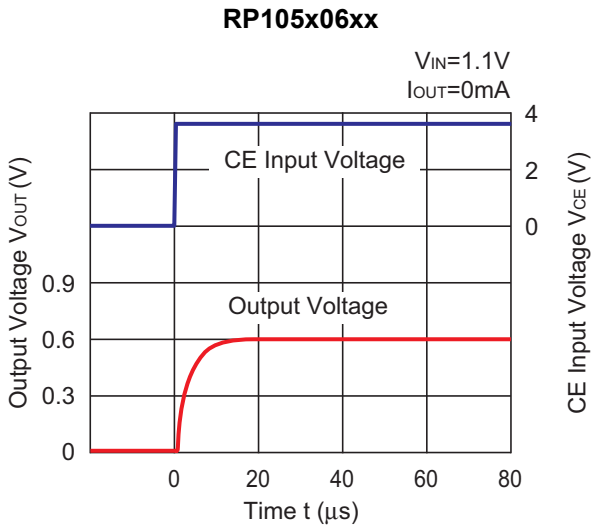
**10) Load Transient Response ( $V_{BIAS} = 3.6 V, C_{BIAS} = 1.0 \mu F, C_{IN} = C_{OUT} = 2.2 \mu F, tr = tf = 0.5 \mu s, Ta = 25^\circ C$ )**



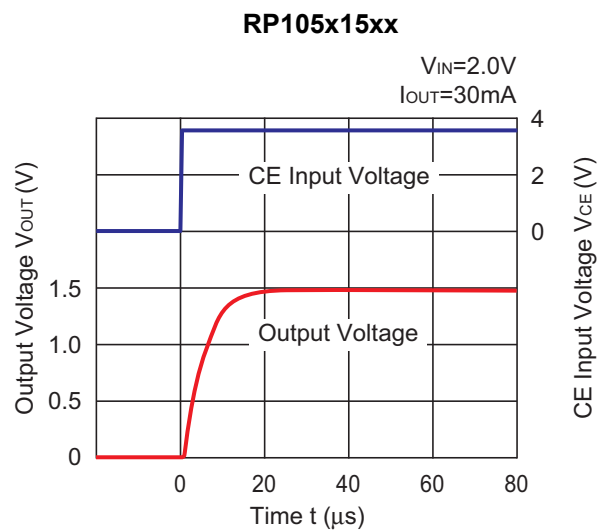
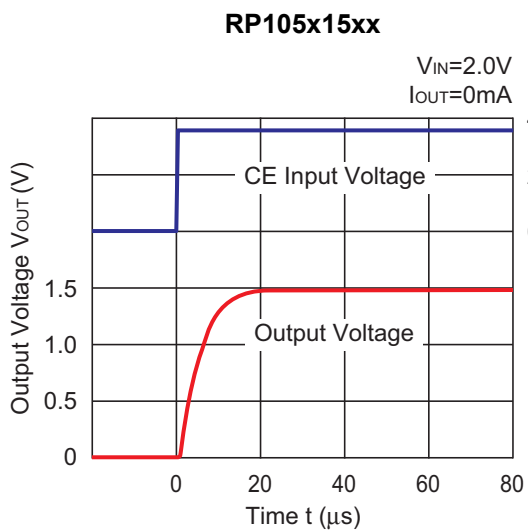
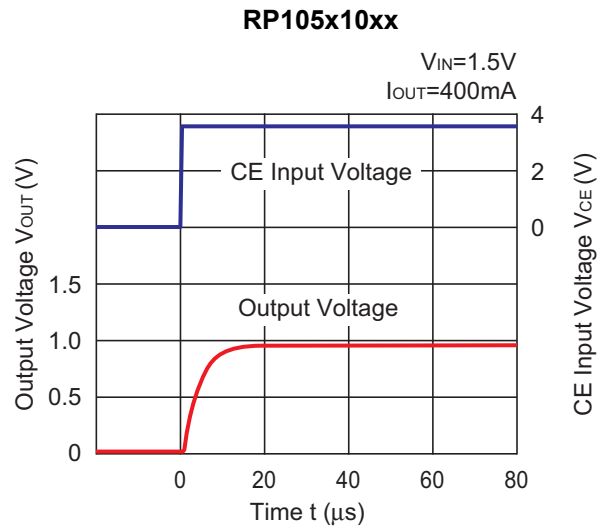
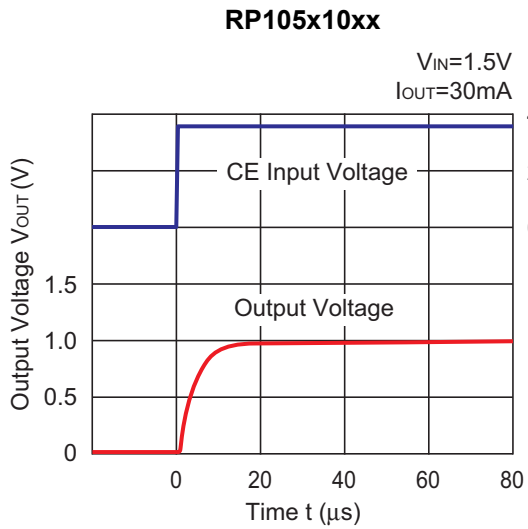
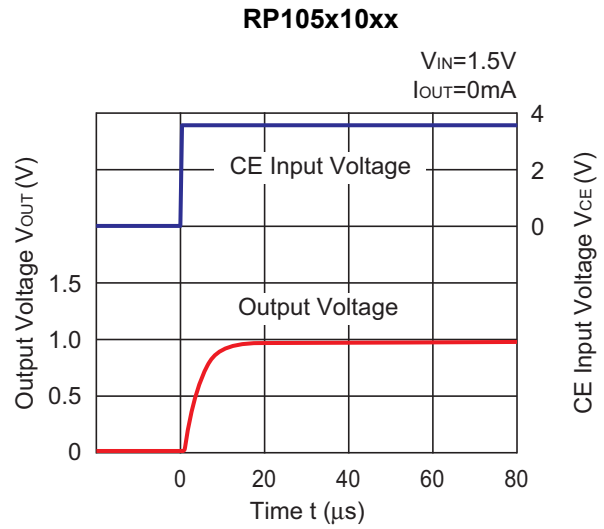
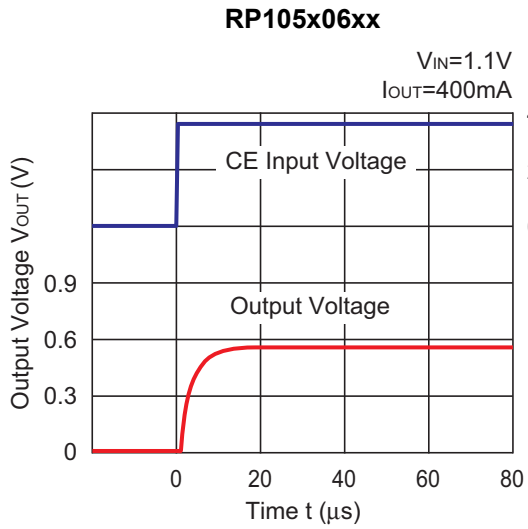
No. EA-179-180419



**11) Turn On Speed with CE pin ( $V_{BIAS} = 3.6V$ ,  $C_{BIAS} = 1.0\mu F$ ,  $C_{IN} = C_{OUT} = 2.2\mu F$ ,  $T_a = 25^\circ C$ )**

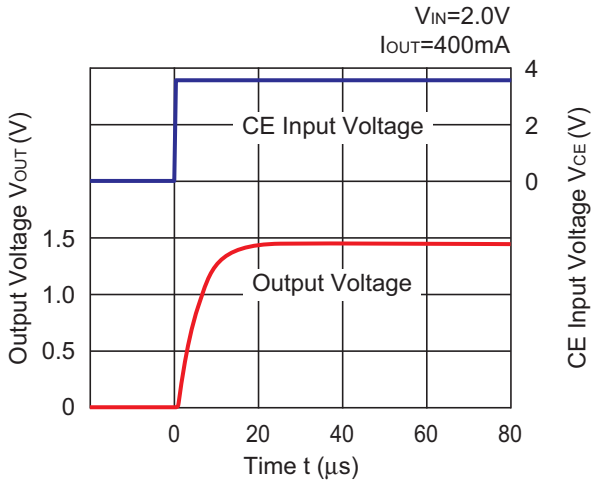






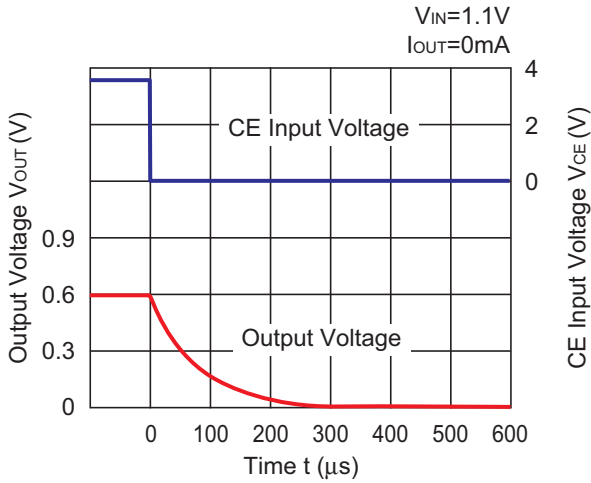
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**RP105x15xx**

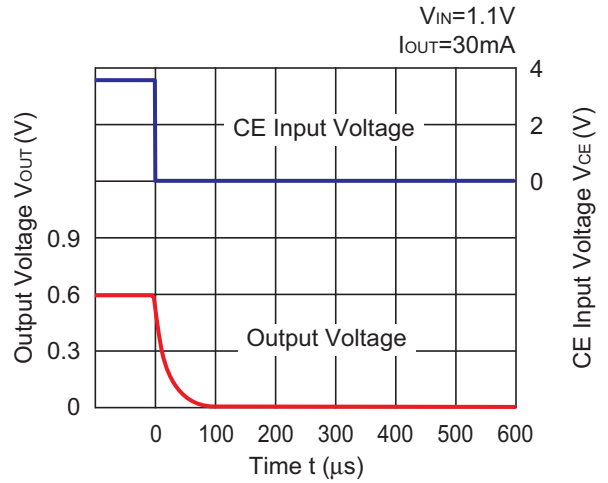


**12) Turn Off Speed with CE Pin ( $V_{BIAS} = 3.6 V$ ,  $C_{BIAS} = 1.0 \mu F$ ,  $C_{IN} = C_{OUT} = 2.2 \mu F$ ,  $T_a = 25^\circ C$ )**

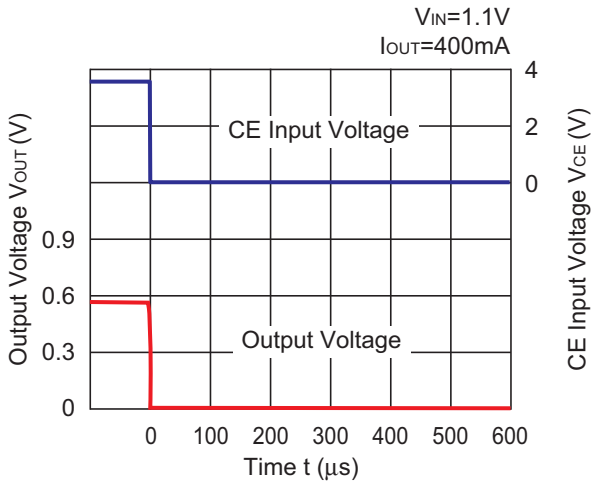
**RP105x06xD/F**



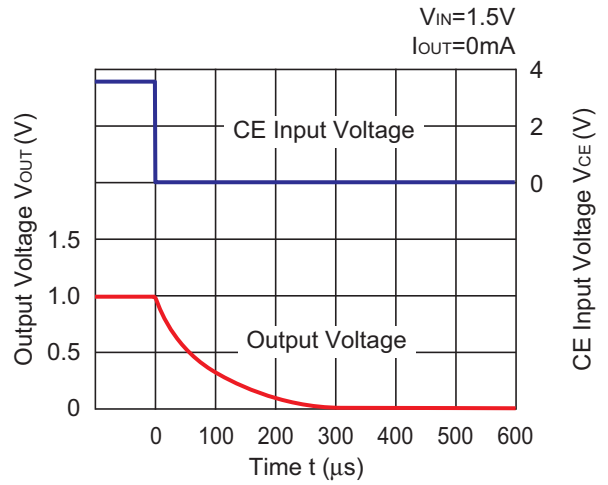
**RP105x06xD/F**

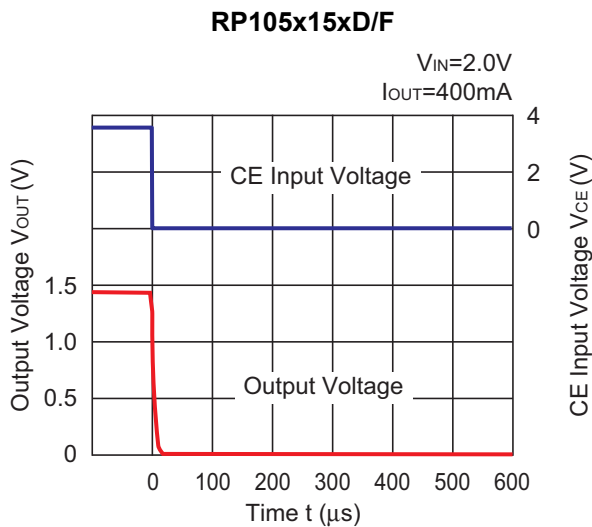
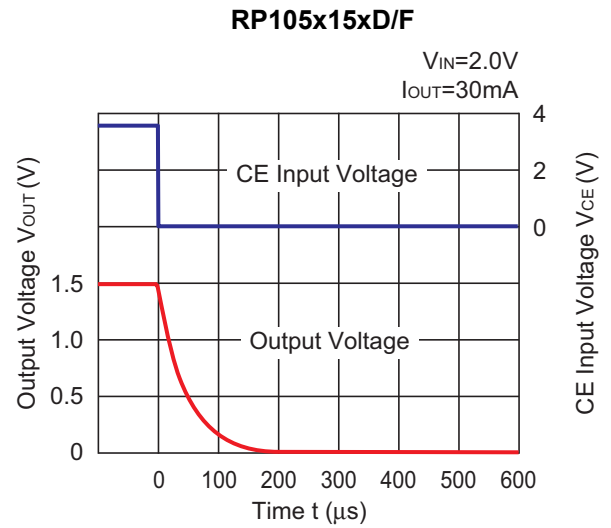
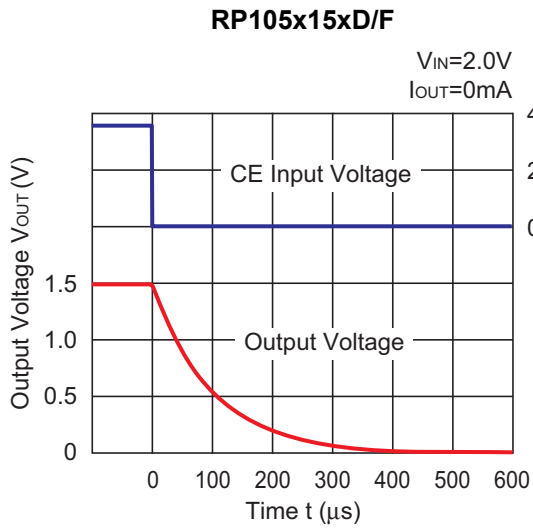
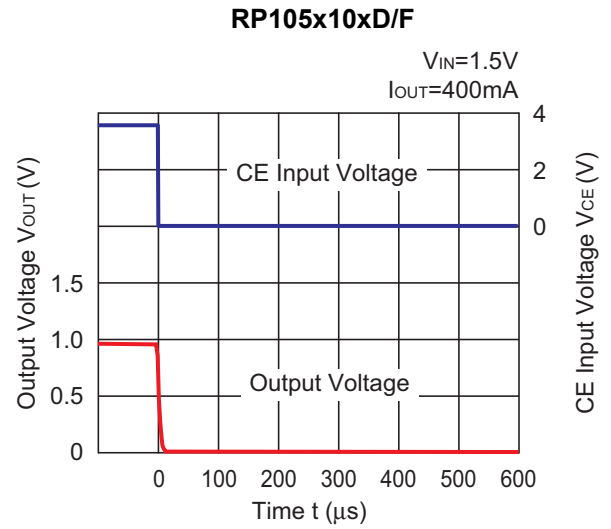
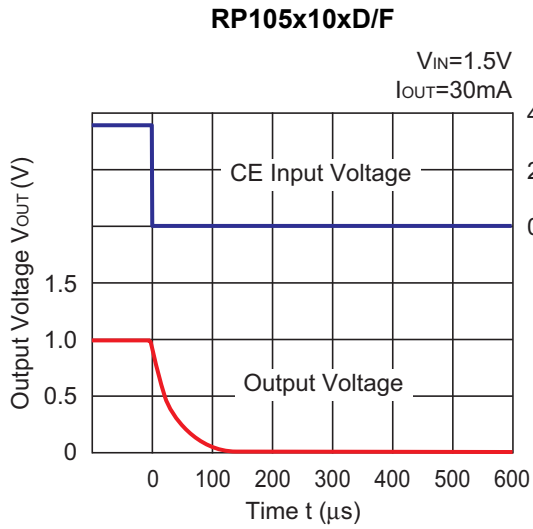


**RP105x06xD/F**



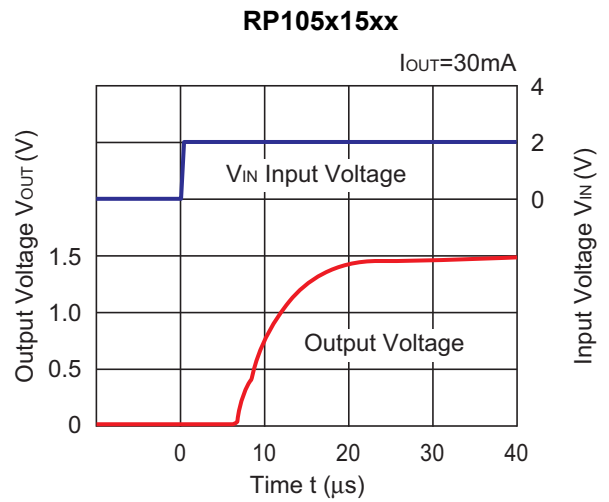
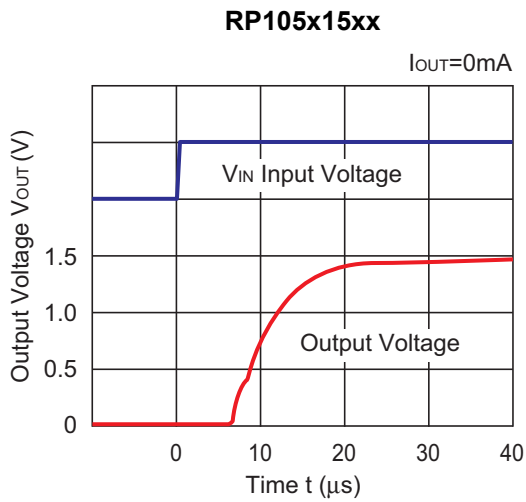
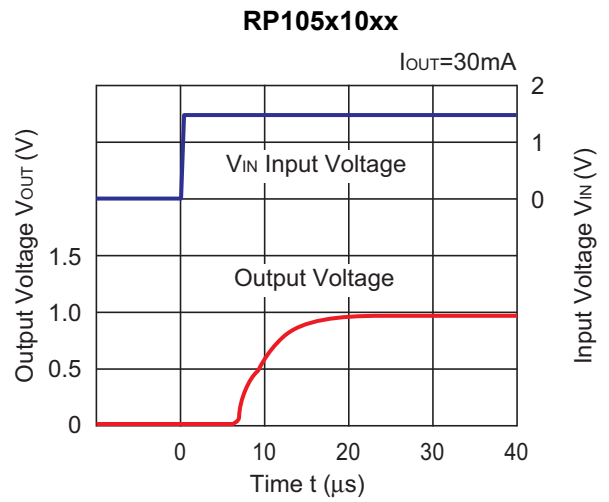
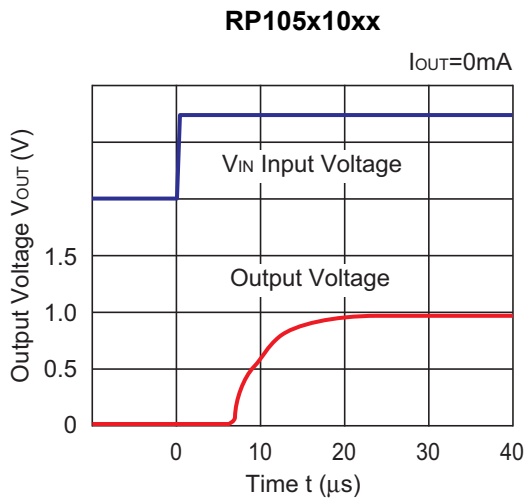
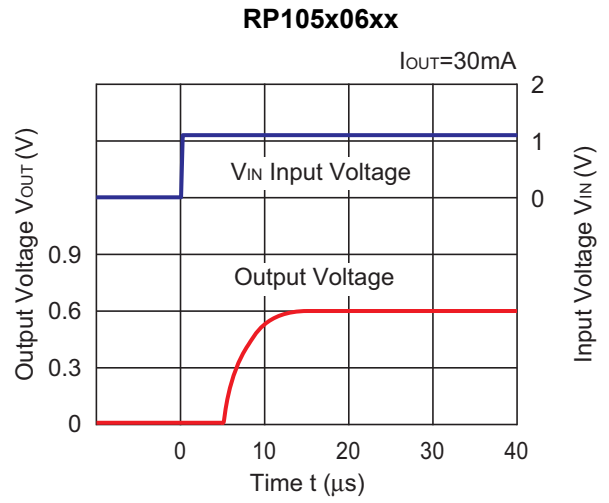
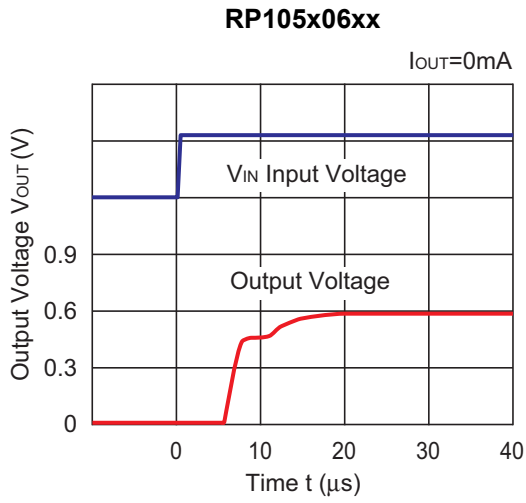
**RP105x10xD/F**





No. EA-179-180419

13) Turn On Transient with  $V_{IN}$  pin ( $V_{BIAS} = 3.6\text{ V}$ ,  $C_{BIAS} = 1.0\ \mu\text{F}$ ,  $C_{IN} = \text{none}$ ,  $C_{OUT} = 2.2\ \mu\text{F}$ ,  $T_a = 25^\circ\text{C}$ )



## ESR vs. Output Current

Ceramic type output capacitor is recommended for this series; however, the other output capacitors with low ESR also can be used. The relations between  $I_{OUT}$  (Output Current) and ESR of an output capacitor are shown below. The conditions when the white noise level is under  $40 \mu\text{V}$  (Avg.) are marked as the hatched area in the graph.

### Measurement conditions

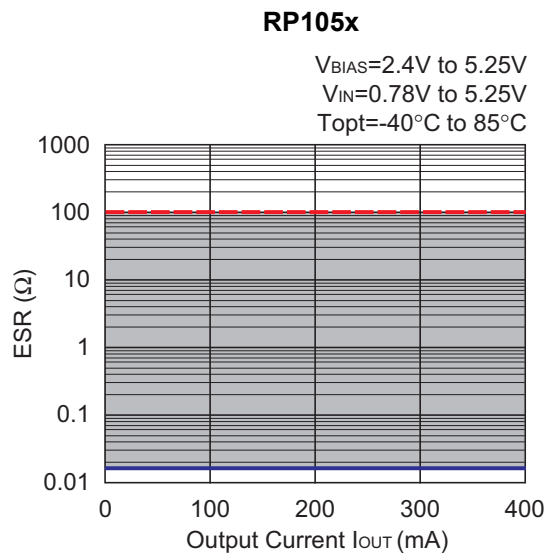
Frequency Band: 10 Hz to 2 MHz

Temperature :  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$

Hatched Area : Noise level is under  $40 \mu\text{V}$  (Avg.)

$C_{BIAS}, C_{IN}$  :  $1.0 \mu\text{F}$

$C_{OUT}$  :  $2.2 \mu\text{F}$



The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-7.

**Measurement Conditions**

Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	φ 0.2 mm × 14 pcs

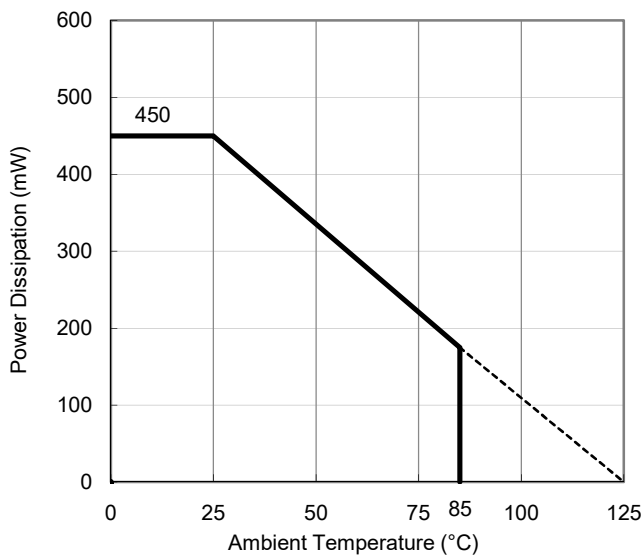
**Measurement Result**

(Ta = 25°C, Tjmax = 125°C)

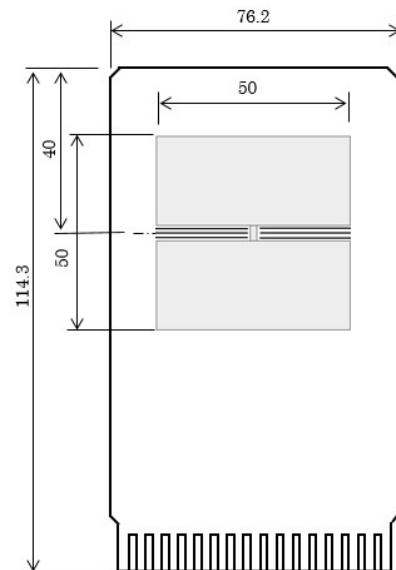
Item	Measurement Result
Power Dissipation	450 mW
Thermal Resistance (θja)	θja = 218°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 105°C/W

θja: Junction-to-Ambient Thermal Resistance

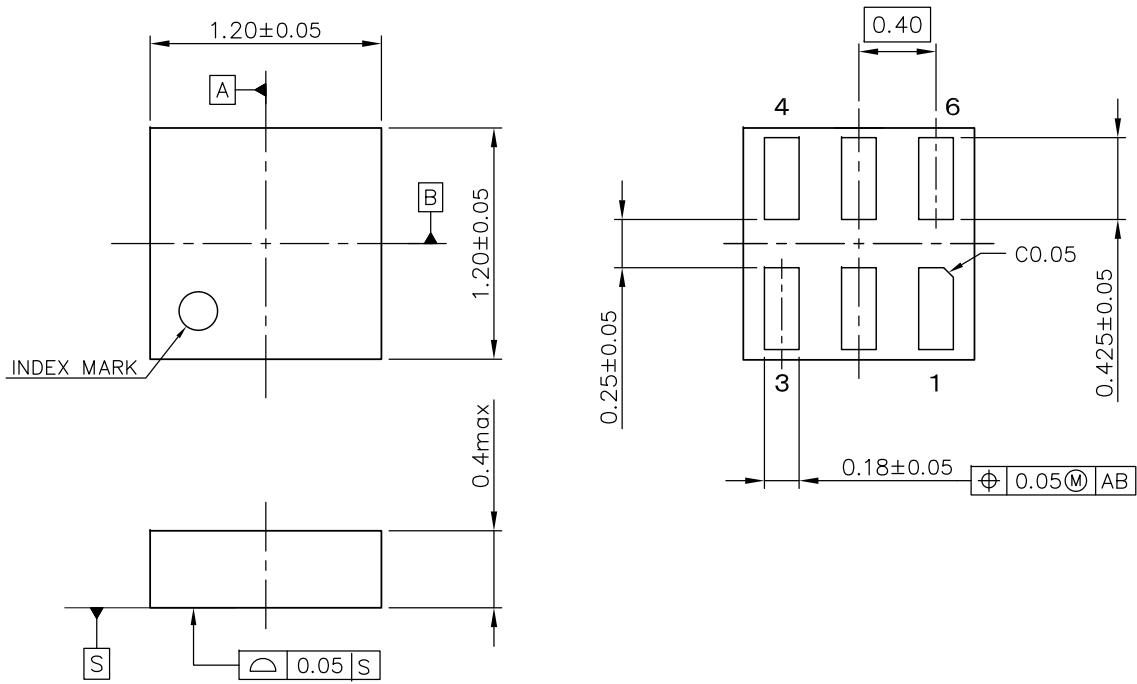
ψjt: Junction-to-Top Thermal Characterization Parameter



**Power Dissipation vs. Ambient Temperature**



**Measurement Board Pattern**



UNIT: mm

DFN(PLP)1212-6 Package Dimensions

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following conditions are used in this measurement.

**Measurement Conditions**

Item	Standard Test Land Pattern
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Double-Sided Board)
Board Dimensions	40 mm × 40 mm × 1.6 mm
Copper Ratio	Top Side: Approx. 50% Bottom Side: Approx. 50%
Through-holes	φ 0.5 mm × 44 pcs

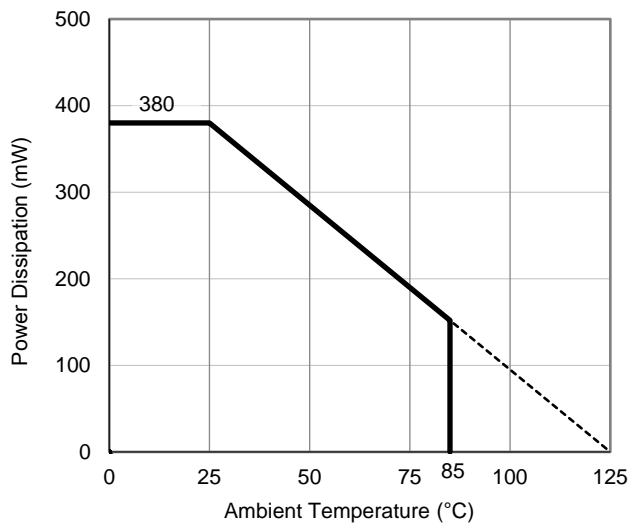
**Measurement Result**

(Ta = 25°C, Tjmax = 125°C)

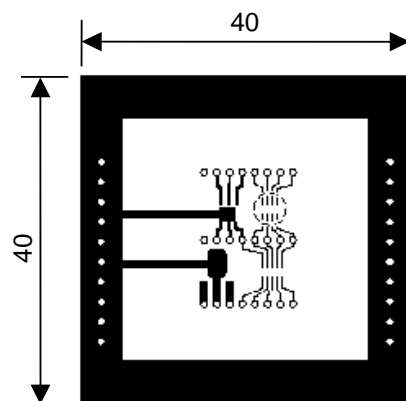
Item	Standard Test Land Pattern
Power Dissipation	380 mW
Thermal Resistance (θja)	θja = 263°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 75°C/W

θja: Junction-to-Ambient Thermal Resistance

ψjt: Junction-to-Top Thermal Characterization Parameter

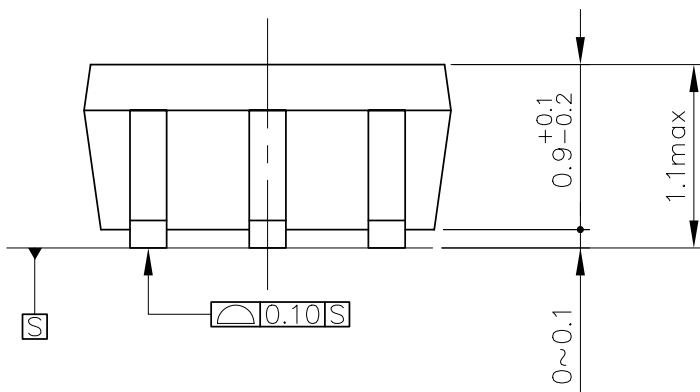
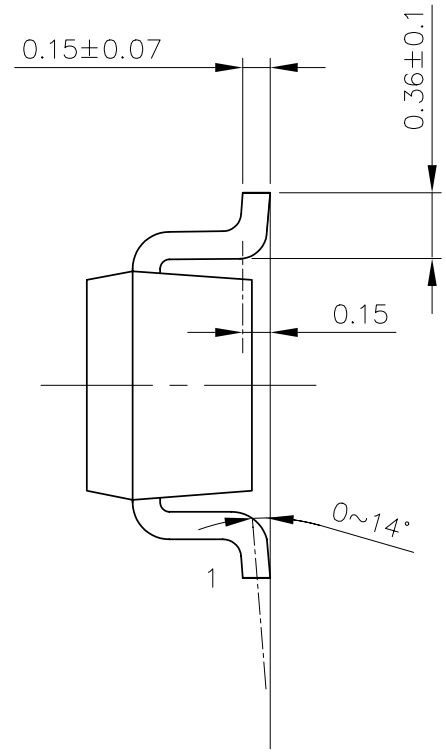
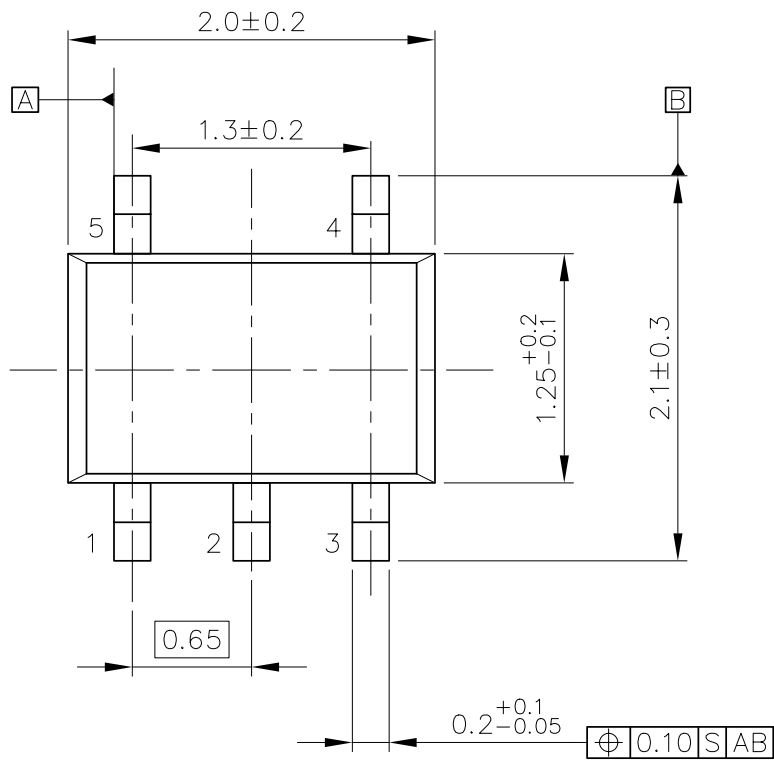


**Power Dissipation vs. Ambient Temperature**



**Measurement Board Pattern**





UNIT: mm

SC-88A Package Dimensions

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-7.

**Measurement Conditions**

Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	φ 0.3 mm × 7 pcs

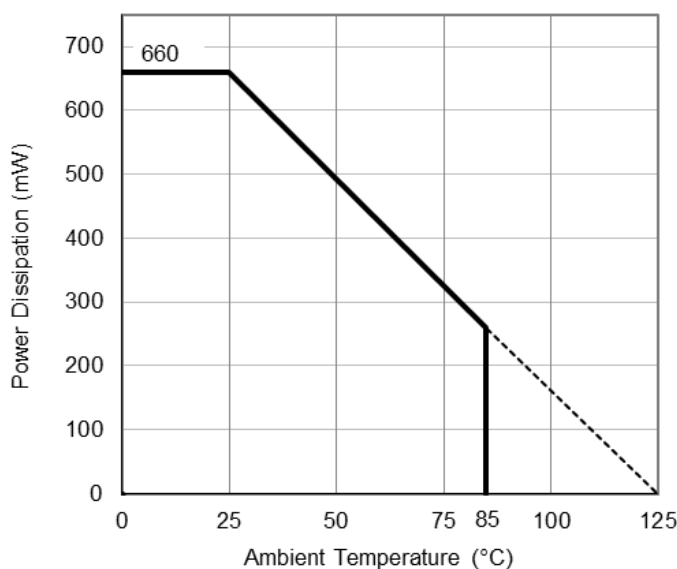
**Measurement Result**

(Ta = 25°C, Tjmax = 125°C)

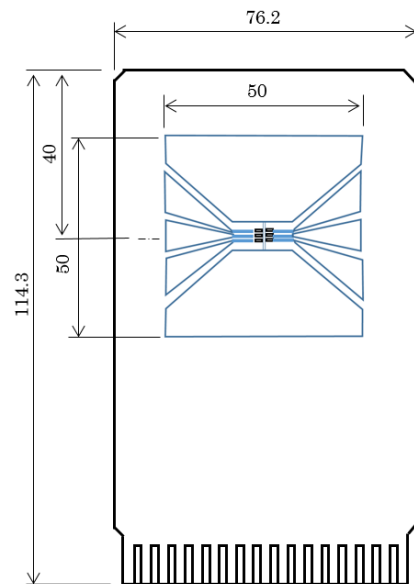
Item	Measurement Result
Power Dissipation	660 mW
Thermal Resistance ( $\theta_{ja}$ )	$\theta_{ja} = 150^{\circ}\text{C/W}$
Thermal Characterization Parameter ( $\psi_{jt}$ )	$\psi_{jt} = 51^{\circ}\text{C/W}$

$\theta_{ja}$ : Junction-to-Ambient Thermal Resistance

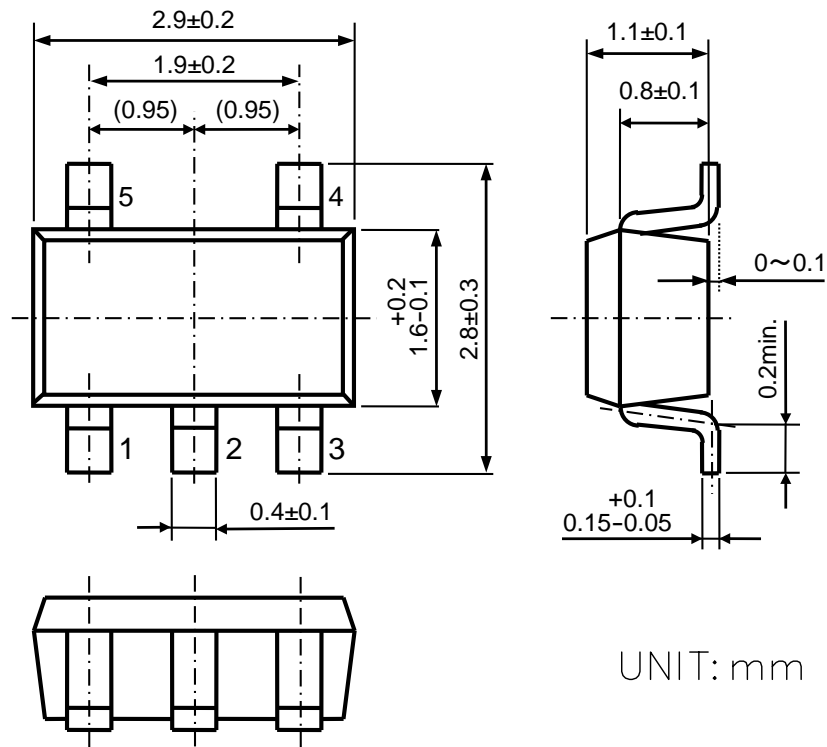
$\psi_{jt}$ : Junction-to-Top Thermal Characterization Parameter



**Power Dissipation vs. Ambient Temperature**



**Measurement Board Pattern**



SOT-23-5 Package Dimensions

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-7.

**Measurement Conditions**

Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	φ 0.2 mm × 14 pcs

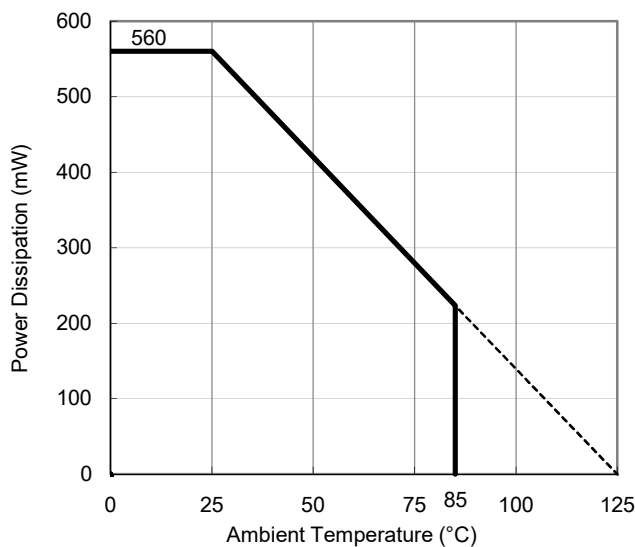
**Measurement Result**

(Ta = 25°C, Tjmax = 125°C)

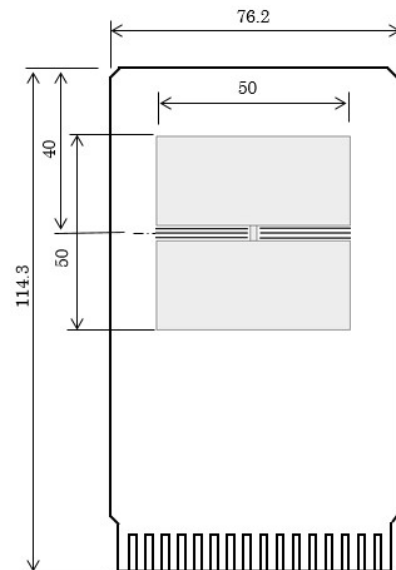
Item	Measurement Result
Power Dissipation	560 mW
Thermal Resistance (θja)	θja = 178°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 105°C/W

θja: Junction-to-Ambient Thermal Resistance

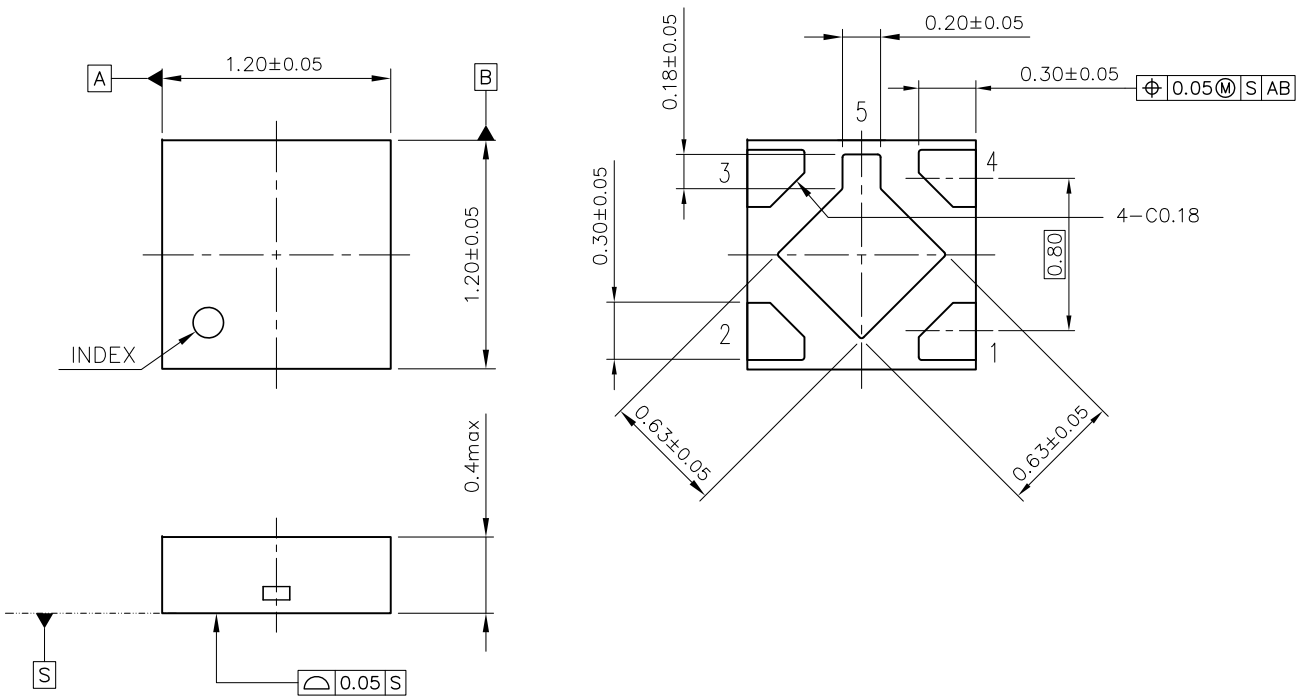
ψjt: Junction-to-Top Thermal Characterization Parameter



**Power Dissipation vs. Ambient Temperature**



**Measurement Board Pattern**



**DFN1212-5 Package Dimensions (Unit: mm)**



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[AZ1117ID-ADJTRG1](#) [TCR3DG12,LF](#) [MIC5514-3.3YMT-T5](#) [MIC5512-1.2YMT-T5](#) [MIC5317-2.8YM5-T5](#) [SCD7912BTG](#)  
[NCP154MX180270TAG](#) [SCD33269T-5.0G](#) [NCV8170BMX330TCG](#) [NCV8170AMX120TCG](#) [NCP706ABMX300TAG](#)  
[NCP153MX330180TCG](#) [NCP114BMX075TCG](#) [MC33269T-3.5G](#) [CAT6243-ADJCMT5T](#) [TCR3DG33,LF](#) [AP2127N-1.0TRG1](#)  
[TCR4DG35,LF](#) [LT1117CST-3.3](#) [TAR5S15U\(TE85L,F\)](#) [TAR5S18U\(TE85L,F\)](#) [TCR3UG19A,LF](#) [TCR4DG105,LF](#) [NCV8170AMX360TCG](#)