

### Low Voltage 400 mA LDO Regulator

NO.EA-179-160420

#### 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

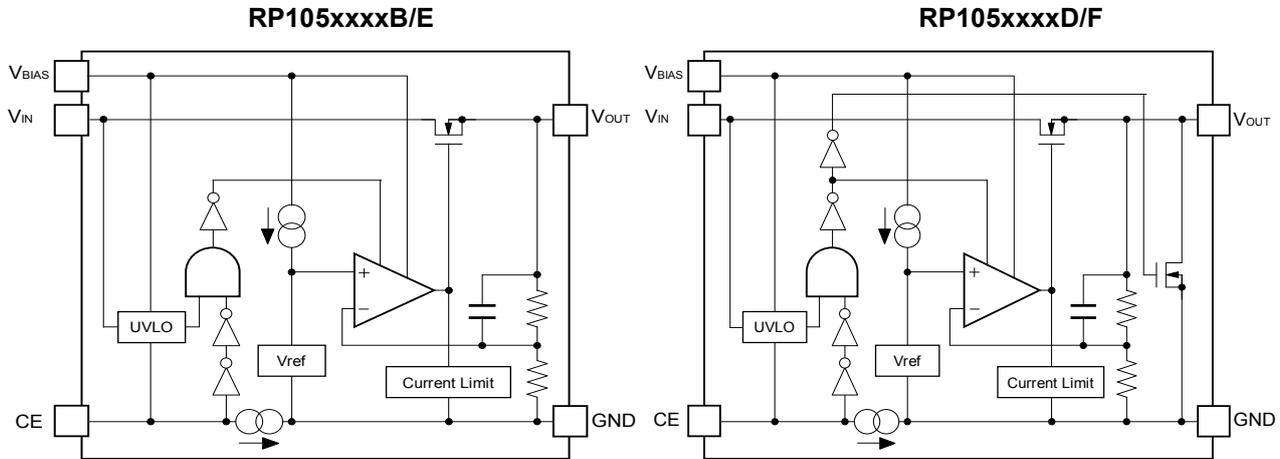
- Supply Current ..... Typ.  $28 \mu\text{A}$
- Standby Current ..... Typ.  $0.1 \mu\text{A}$
- Ripple Rejection ..... Typ. 80 dB ( $f = 1 \text{ kHz}$ ,  $V_{IN}$  Ripple)  
Typ. 50 dB ( $f = 1 \text{ kHz}$ ,  $V_{BIAS}$  Ripple)
- Output Voltage Range ..... 0.6 V to 1.5 V (0.1 V step)  
Contact Ricoh sales representatives for other voltages.
- 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.

NO.EA-179-160420

## BLOCK DIAGRAMS



## 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.

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.

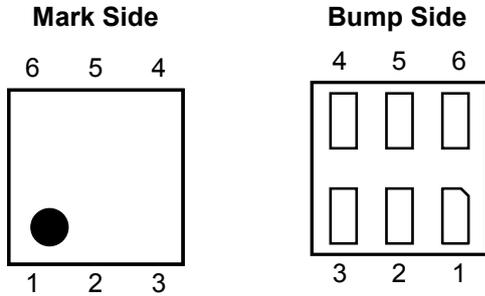
- (B) "H" active, auto-discharge function is not included, UVLO is included
- (D) "H" active, auto-discharge function is included, UVLO is included
- (E) "H" active, auto-discharge function is not included, UVLO is not included
- (F) "H" active, auto-discharge function is included, UVLO is not included

<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.

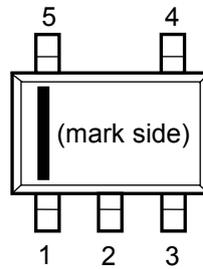
<sup>(2)</sup> RP105Qxx2\*-TR-FE supports only RP105Qxx2B/D.

## PIN DESCRIPTIONS

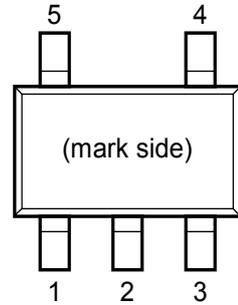
### ● DFN(PLP)1212-6



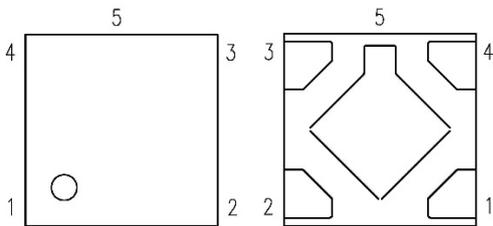
### ● SC-88A



### ● SOT-23-5



### ● DFN1212-5



### ● DFN(PLP)1212-6

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 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 June, 2016.

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NO.EA-179-160420

● SOT-23-5

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 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

\*RP105Q (SC-88A) is the discontinued product as of June, 2016.

NO.EA-179-160420

## ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit	
$V_{BIAS}$	Input Voltage	6.0	V	
$V_{IN}$	Input Voltage (for Driver)	-0.3 to $V_{BIAS} + 0.3$	V	
$V_{CE}$	Input Voltage (CE Pin)	6.0	V	
$V_{OUT}$	Output Voltage	-0.3 to $V_{IN} + 0.3$	V	
$I_{OUT}$	Output Current	500	mA	
$P_D$	Power Dissipation (Standard Test Land Pattern) <sup>(1)</sup>	DFN(PLP)1212-6	400	mW
		SC-88A	380	
		SOT-23-5	420	
		DFN1212-5	650	
$T_a$	Operating Temperature	-40 to 85	°C	
$T_{stg}$	Storage Temperature	-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.

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

NO.EA-179-160420

## 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: 2px;">Set <math>V_{OUT}</math> -20 mV</span>		<span style="border: 1px solid black; padding: 2px;">Set <math>V_{OUT}</math> + 20 mV</span>	V
$I_{OUT}$	Output Current		<span style="border: 1px solid black; padding: 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: 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: 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: 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: 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: 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: 2px;">2.4</span>		<span style="border: 1px solid black; padding: 2px;">5.25</span>	V
		$V_{OUT} \geq 0.8\text{ V}$	Set $V_{OUT}$ + 1.6		<span style="border: 1px solid black; padding: 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: 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: 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 /°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"		0.8			V
$V_{CEL}$	CE Input Voltage "L"				0.3	V
$V_{IN\text{ UVLO}}$	$V_{IN}$ Under Voltage Lock Out (only B/D version)	$I_{OUT} = 1.0\text{ }\mu\text{A}$		Set $V_{OUT} + 50\text{ mV}$	Set $V_{OUT} + 100\text{ mV}$	V
$t_{delay}$	Detector Delay Time (only B/D version)			100		$\mu\text{s}$
$e_n$	Output Noise	BM = 10 Hz to 100 kHz $I_{OUT} = 30\text{ mA}$ , Set $V_{OUT} = 0.6\text{ V}$		70		$\mu\text{Vrms}$
$R_{LOW}$	Nch On Resistance For auto-discharge (only D/F version)	$V_{BIAS} = 3.6\text{ V}$ , $V_{CE} = \text{"L"}$		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 June, 2016.

NO.EA-179-160420

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

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

**PRODUCT-SPECIFIC ELECTRICAL CHARACTERISTICS**

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	<span style="border: 1px solid black; padding: 0 2px;">0.180</span>	0.180	<span style="border: 1px solid black; padding: 0 2px;">0.320</span>
0.7	3.6	2.9	0.120	<span style="border: 1px solid black; padding: 0 2px;">0.190</span>	0.180	<span style="border: 1px solid black; padding: 0 2px;">0.320</span>
0.8	3.6	2.8	0.120	<span style="border: 1px solid black; padding: 0 2px;">0.190</span>	0.180	<span style="border: 1px solid black; padding: 0 2px;">0.300</span>
0.9	3.6	2.7	0.120	<span style="border: 1px solid black; padding: 0 2px;">0.190</span>	0.180	<span style="border: 1px solid black; padding: 0 2px;">0.300</span>
1.0	3.6	2.6	0.120	<span style="border: 1px solid black; padding: 0 2px;">0.190</span>	0.180	<span style="border: 1px solid black; padding: 0 2px;">0.280</span>
1.1	3.6	2.5	0.120	<span style="border: 1px solid black; padding: 0 2px;">0.190</span>	0.180	<span style="border: 1px solid black; padding: 0 2px;">0.280</span>
1.2	3.6	2.4	0.130	<span style="border: 1px solid black; padding: 0 2px;">0.200</span>	0.180	<span style="border: 1px solid black; padding: 0 2px;">0.280</span>
1.3	3.6	2.3	0.130	<span style="border: 1px solid black; padding: 0 2px;">0.200</span>	0.180	<span style="border: 1px solid black; padding: 0 2px;">0.260</span>
1.4	3.6	2.2	0.130	<span style="border: 1px solid black; padding: 0 2px;">0.200</span>	0.180	<span style="border: 1px solid black; padding: 0 2px;">0.260</span>
1.5	3.6	2.1	0.130	<span style="border: 1px solid black; padding: 0 2px;">0.200</span>	0.180	<span style="border: 1px solid black; padding: 0 2px;">0.260</span>

**PRODUCT-SPECIFIC ELECTRICAL CHARACTERISTICS ( $V_{\text{GS}}$  (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)										
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 Set  $V_{\text{OUT}} + 1.6 \text{ V}$ .

**DFN1212-5**

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

**PRODUCT-SPECIFIC ELECTRICAL CHARACTERISTICS**

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>
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>

**PRODUCT-SPECIFIC ELECTRICAL CHARACTERISTICS (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)										
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
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

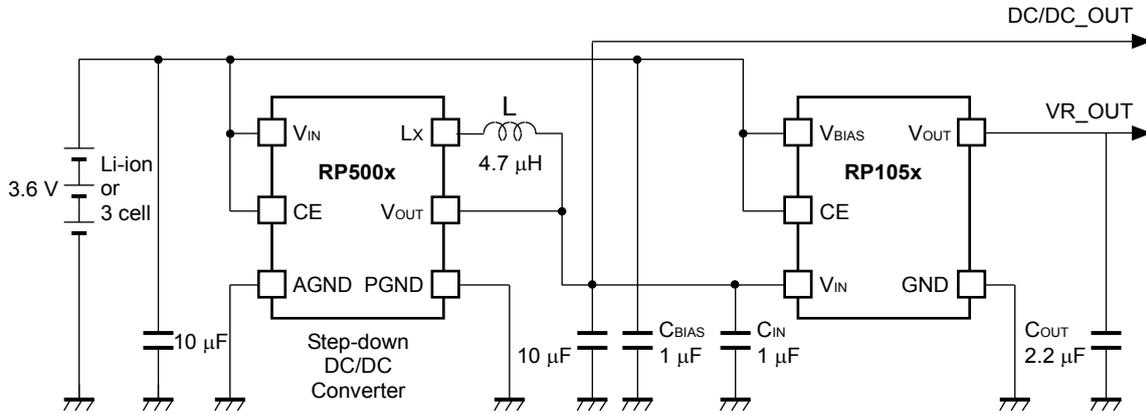
All of units are tested and specified under load conditions such that T<sub>j</sub> ≈ T<sub>a</sub> = 25°C except for Output Noise, Ripple Rejection and Output Voltage Temperature Coefficient items.

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

NO.EA-179-160420

## 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.

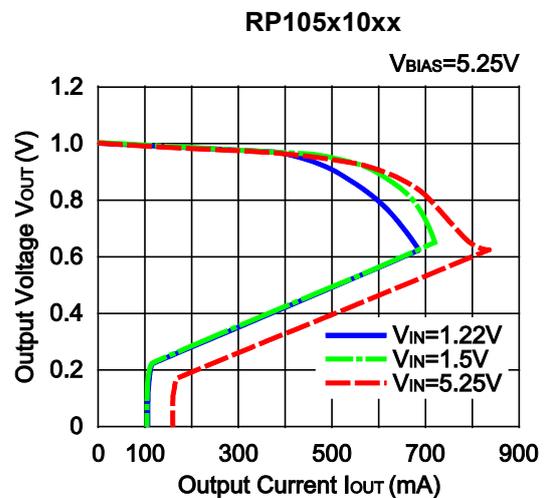
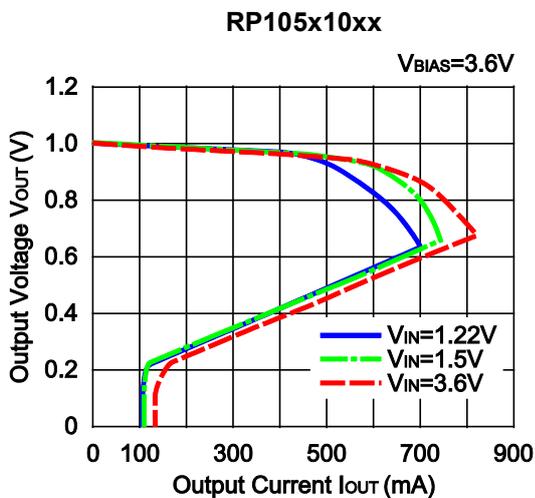
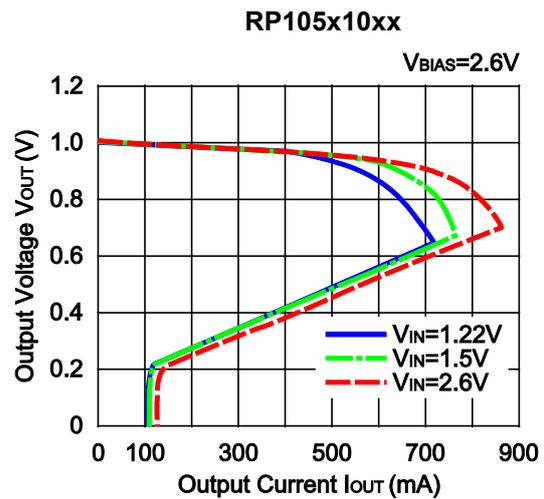
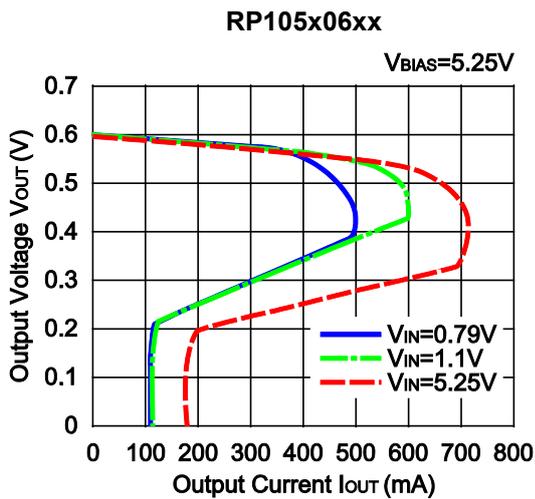
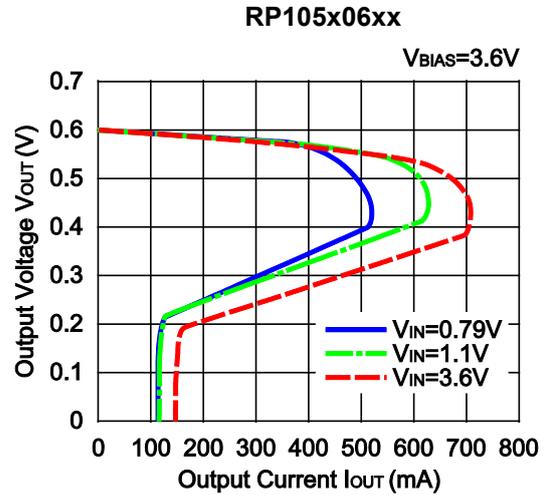
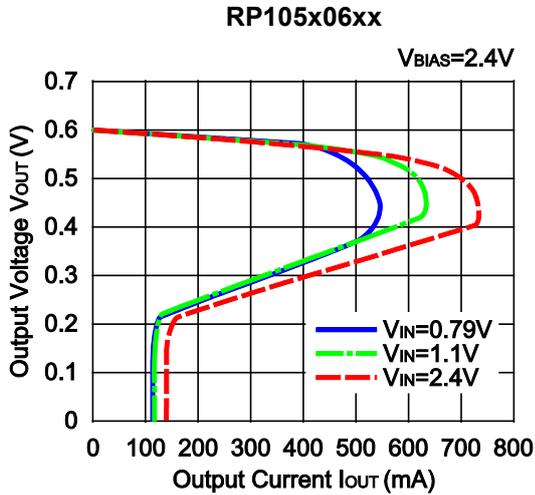
Set external components, especially the output capacitor, as close as possible to the device, and make wiring as short as possible.  $V_{IN}$  source is supposed to be the output of the DC/DC converter. The value should be equal or lower than  $V_{BIAS}$  voltage.

NO.EA-179-160420

## TYPICAL CHARACTERISTICS

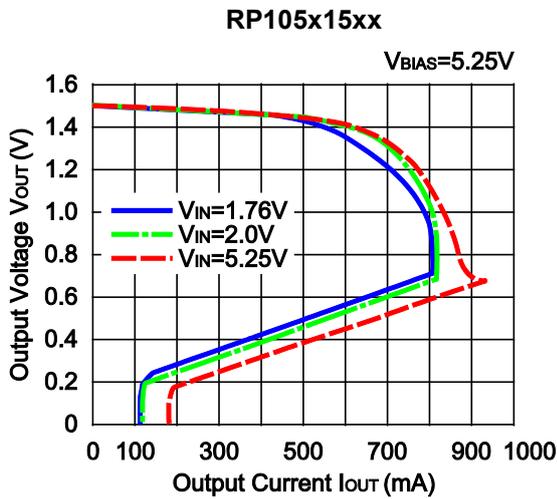
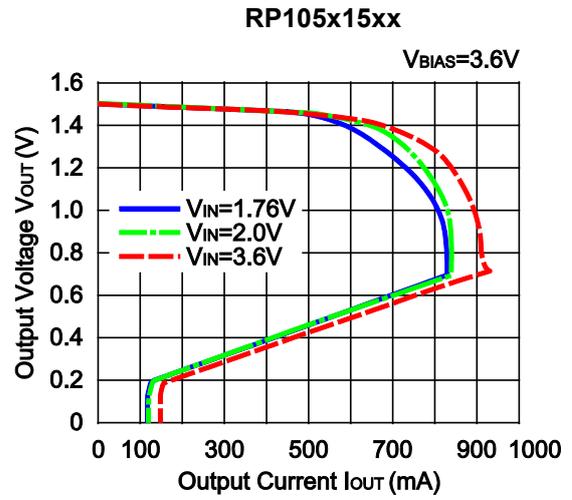
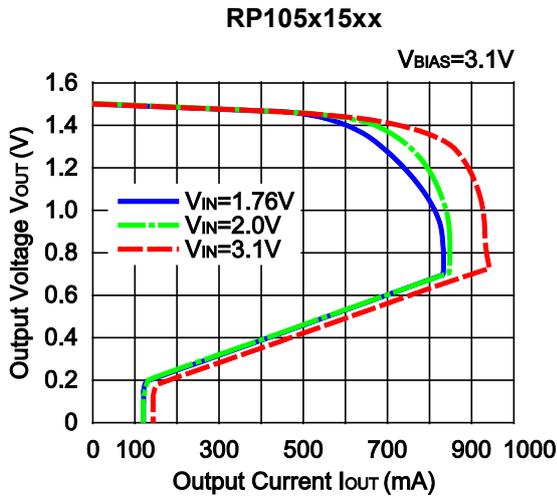
Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

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

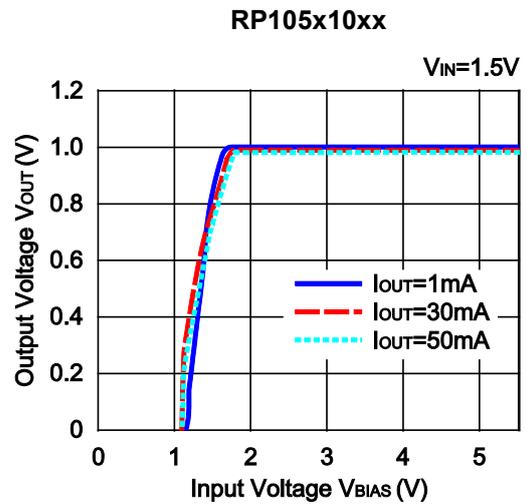
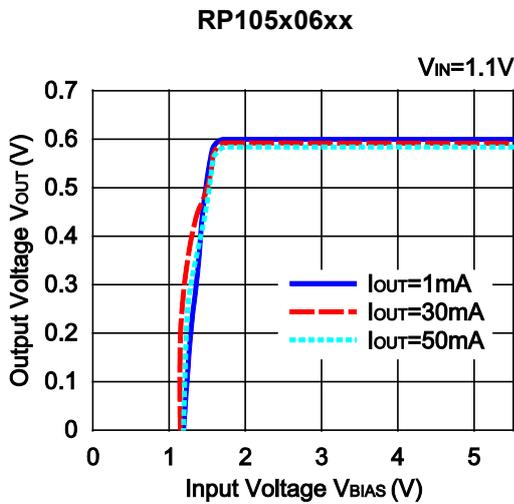


\*RP105Q (SC-88A) is the discontinued product as of June, 2016.

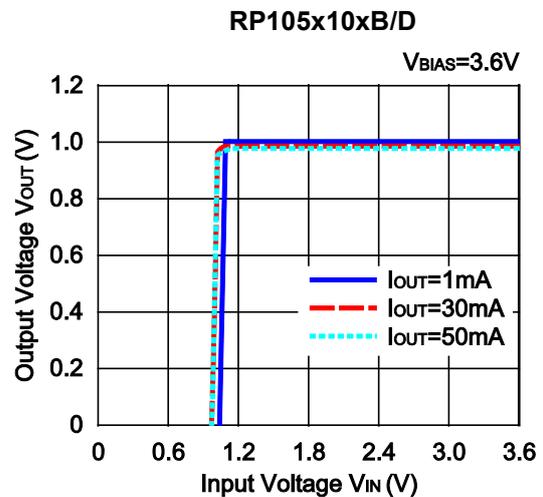
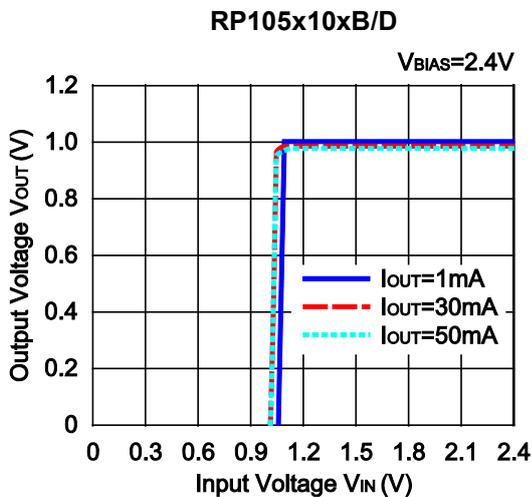
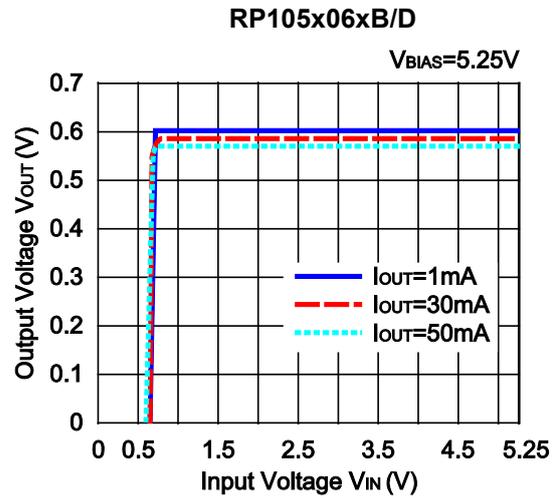
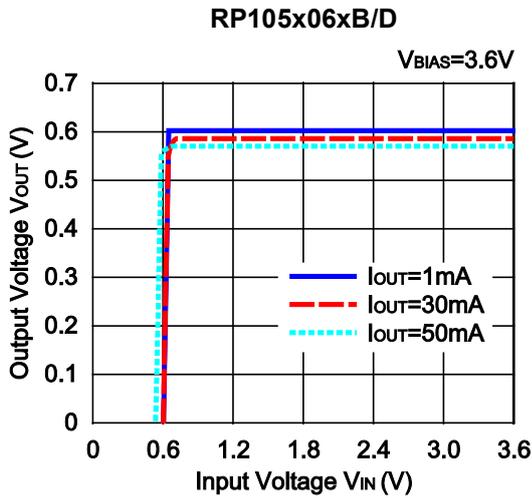
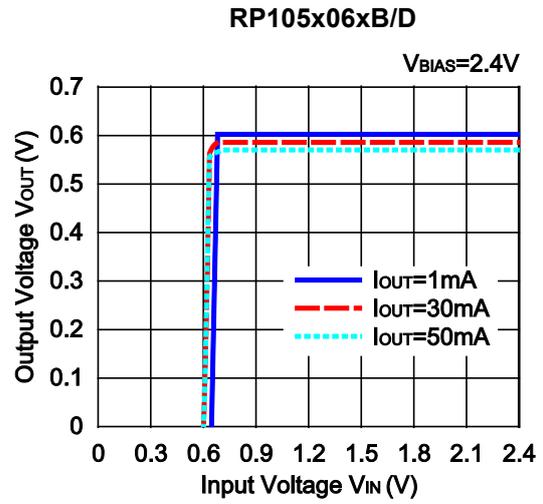
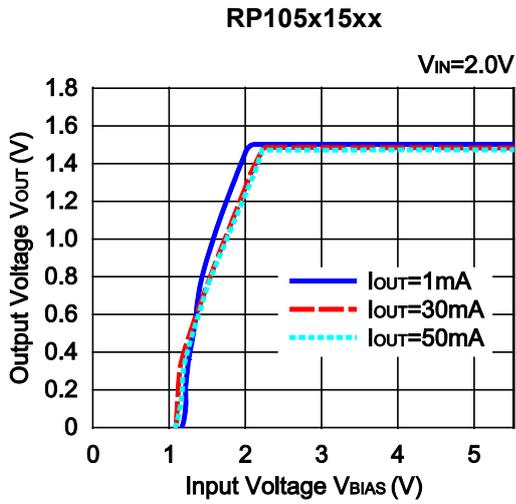
NO.EA-179-160420

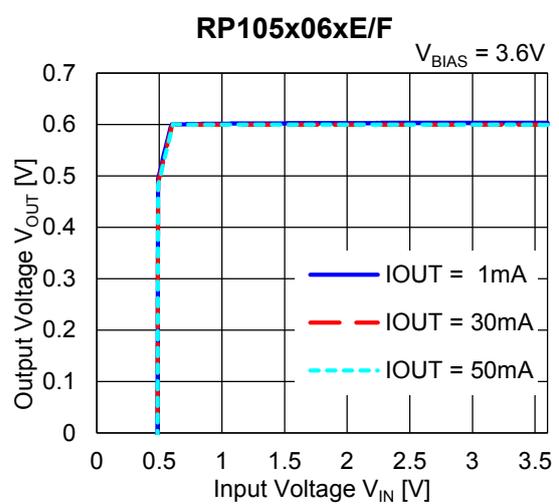
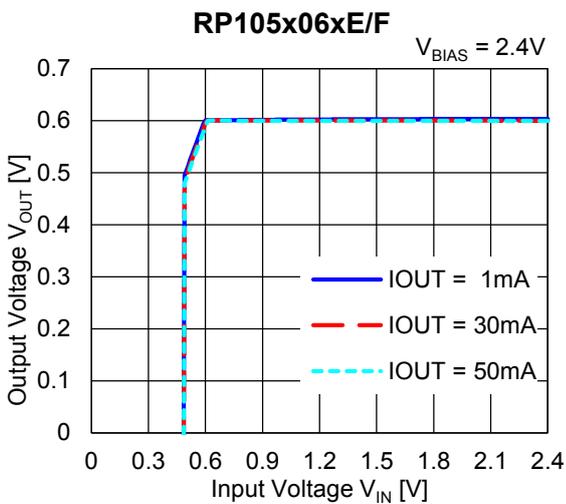
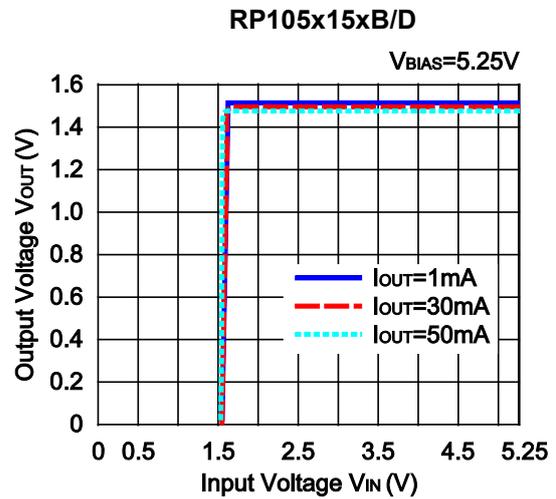
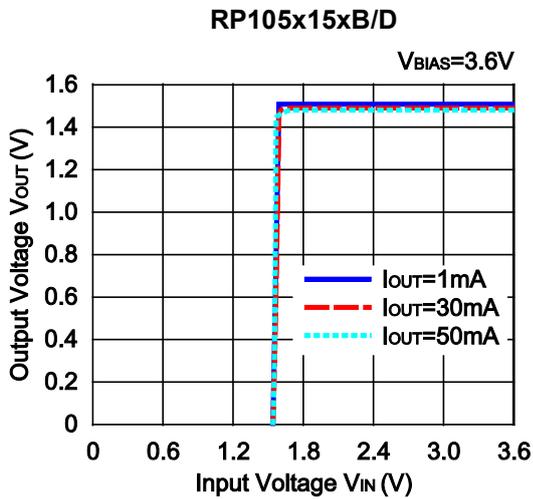
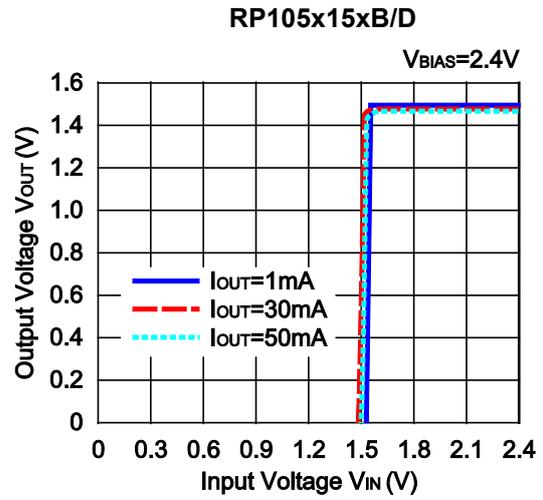
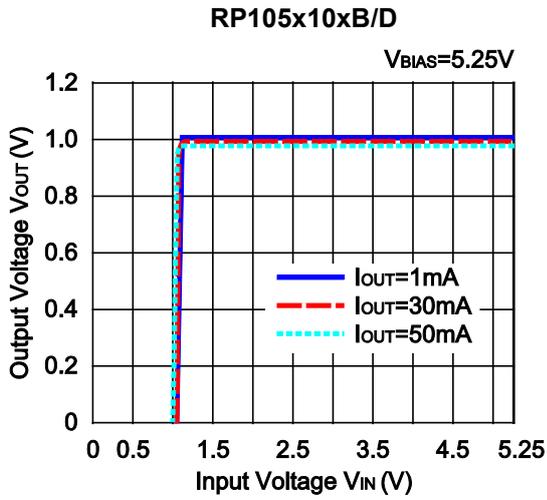


2) Output Voltage vs. Input Voltage ( $C_{BIAS} = 1.0 \mu F$ ,  $C_{IN} = C_{OUT} = 2.2 \mu F$ ,  $T_a = 25^\circ C$ )

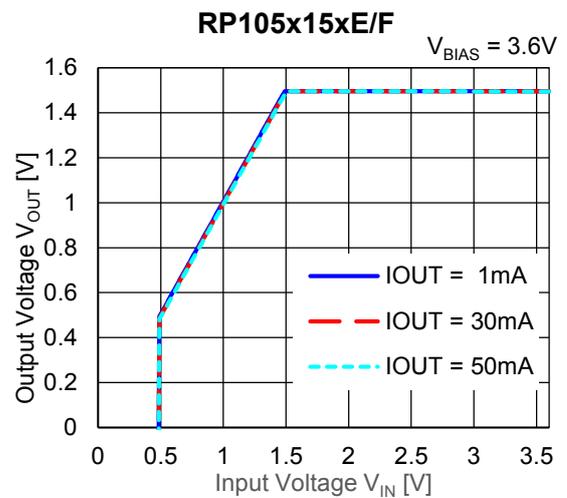
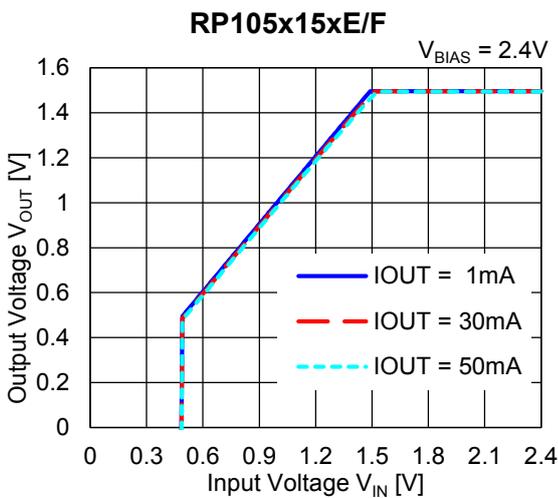
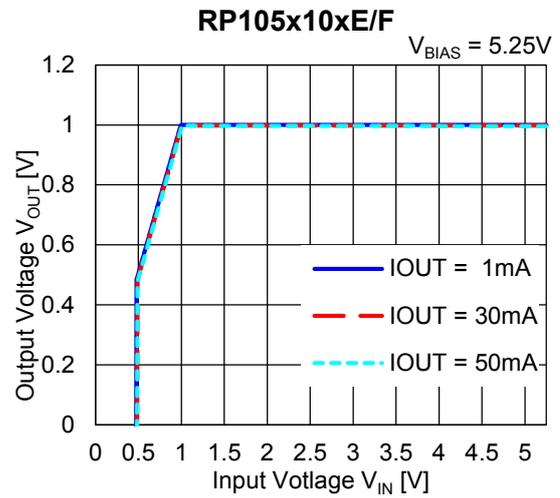
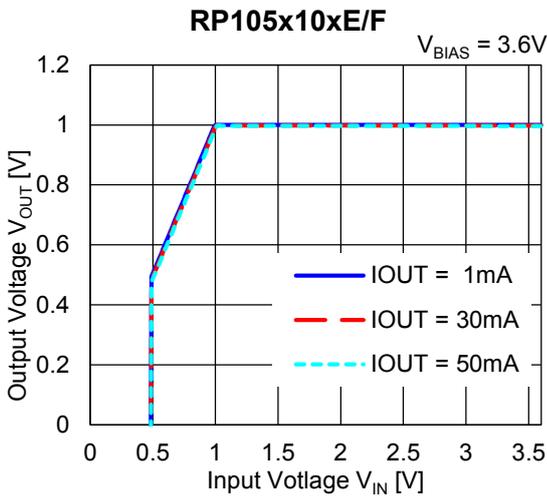
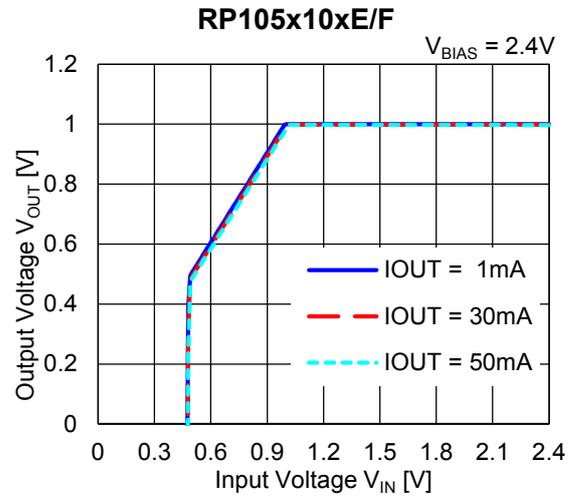
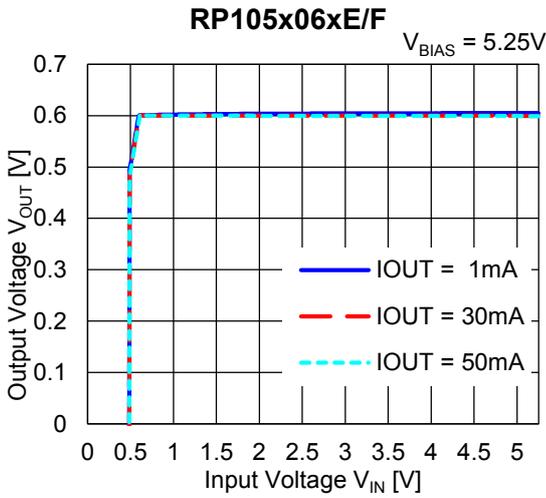


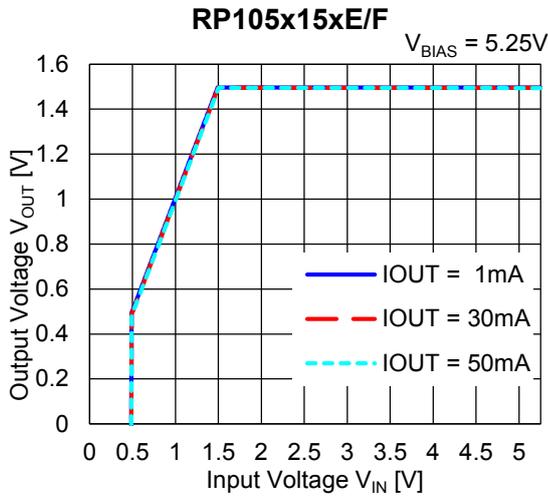
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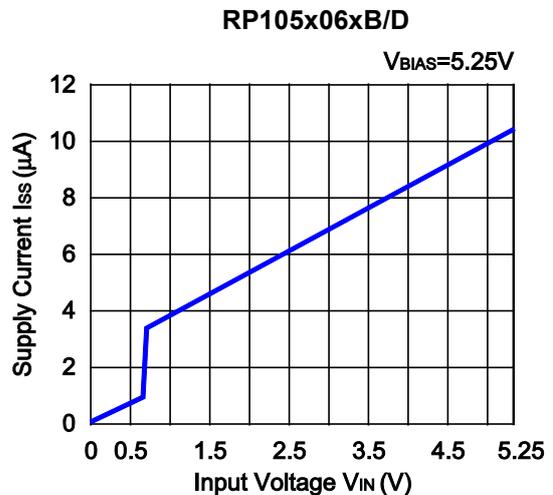
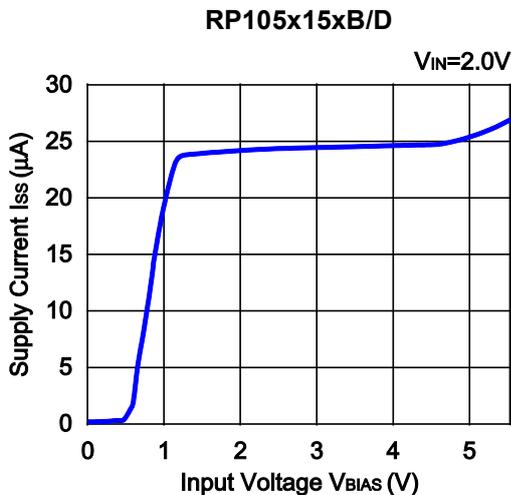
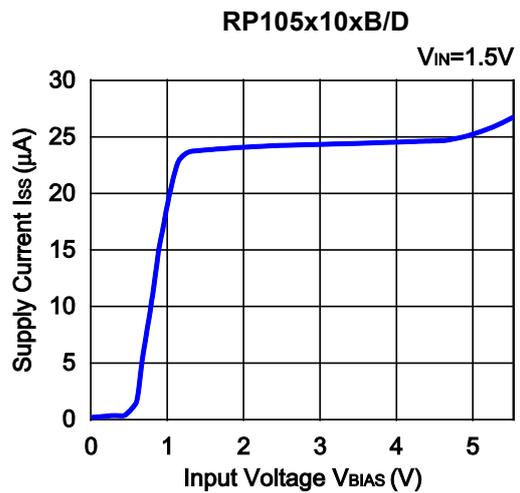
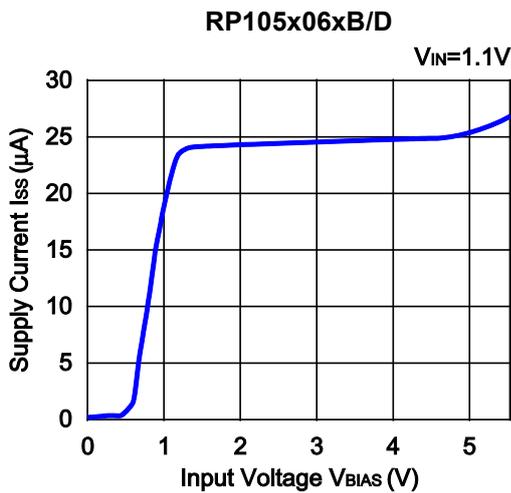


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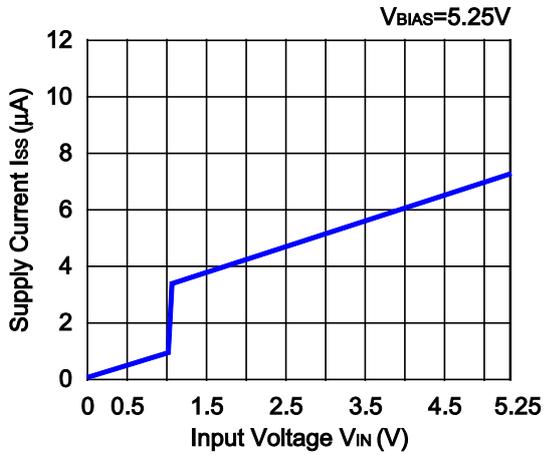


3) Supply Current vs. Input Voltage ( $C_{BIAS} = C_{IN} = C_{OUT} = \text{none}$ ,  $T_a = 25^\circ C$ )

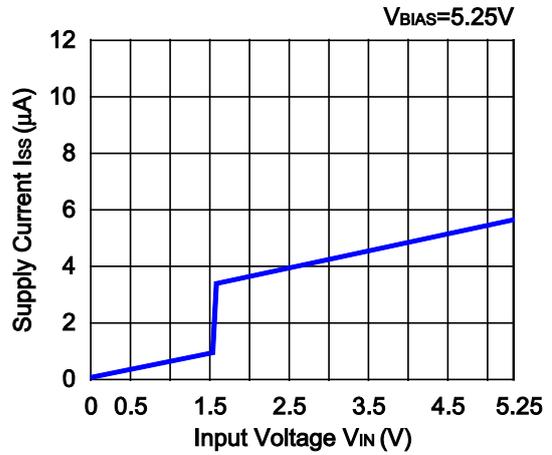


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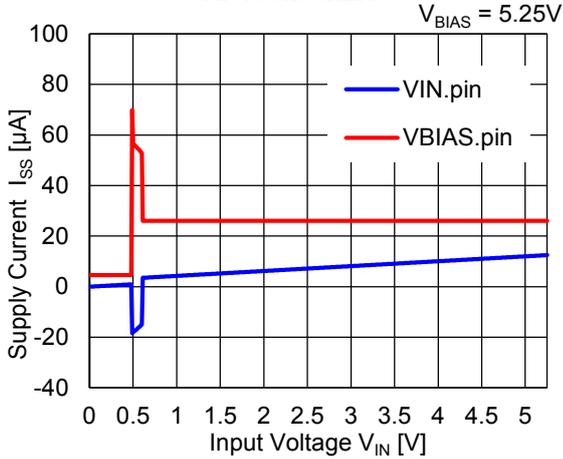
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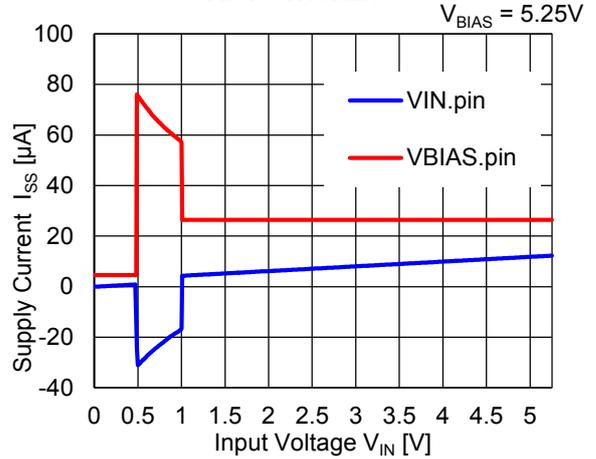
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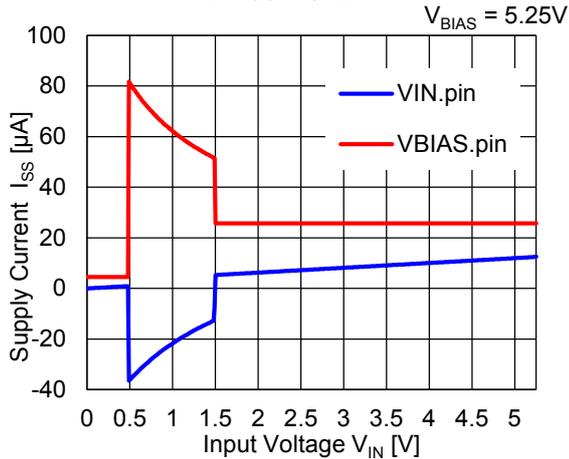
RP105x06xE/F



RP105x10xE/F

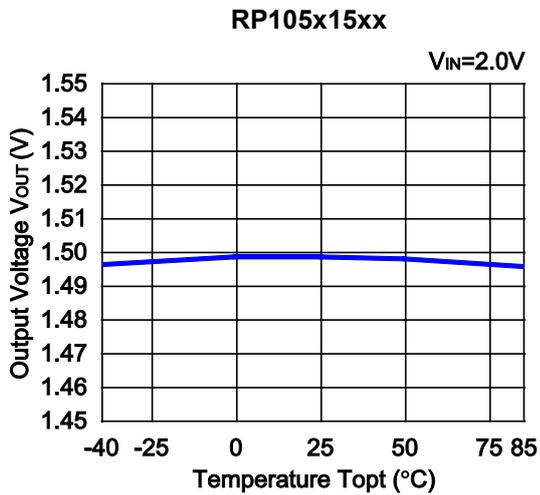
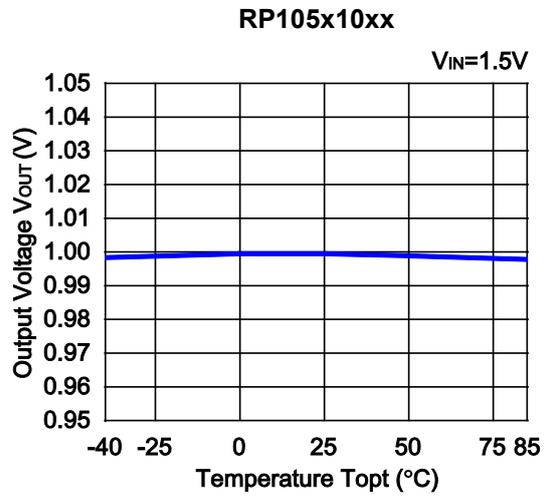
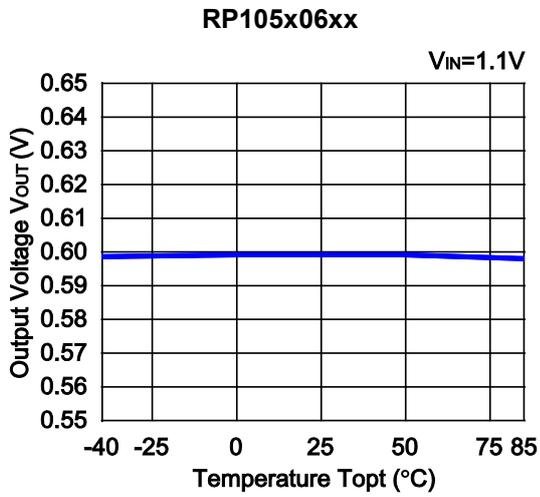


RP105x15xE/F

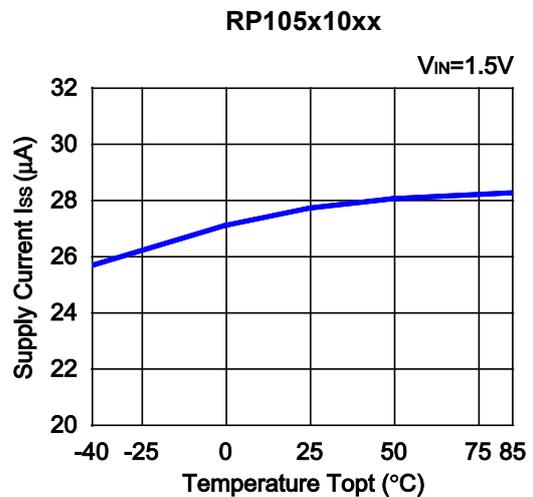
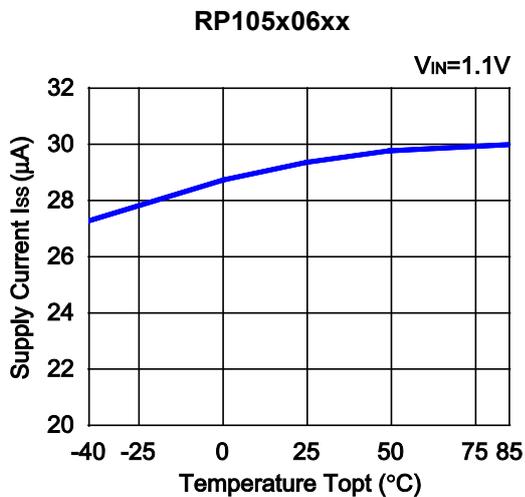


In RP105xxxxE/F, the current flows from  $V_{BIAS}$  pin to  $V_{IN}$  pin via the inside IC when the input voltage  $V_{IN}$  drops below the set output voltage  $V_{SET}$ .

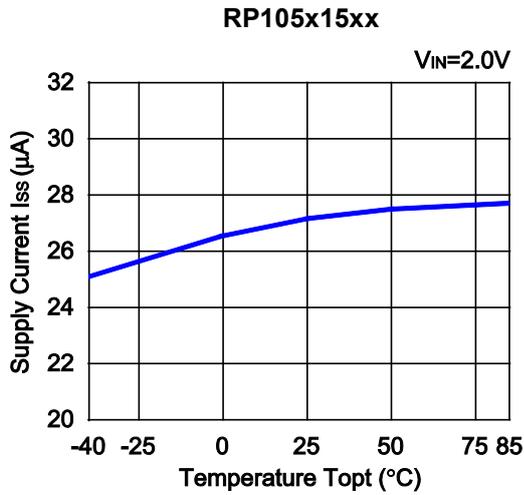
4) Output Voltage vs. Temperature ( $C_{BIAS} = 1.0 \mu F$ ,  $C_{IN} = C_{OUT} = 2.2 \mu F$ ,  $I_{OUT} = 1 \text{ mA}$ ,  $V_{BIAS} = 3.6 \text{ V}$ )



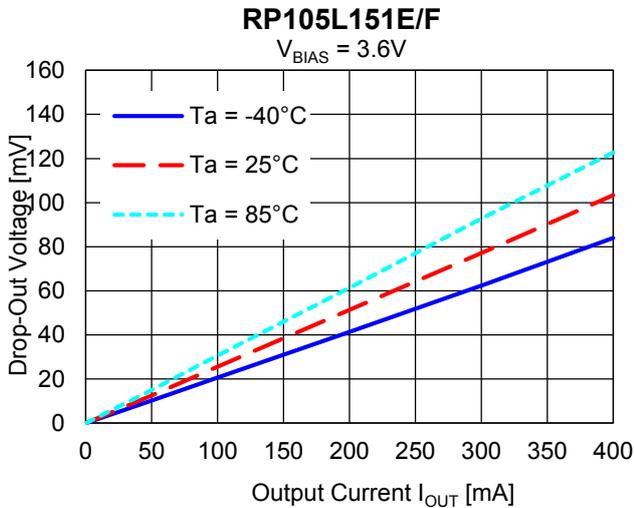
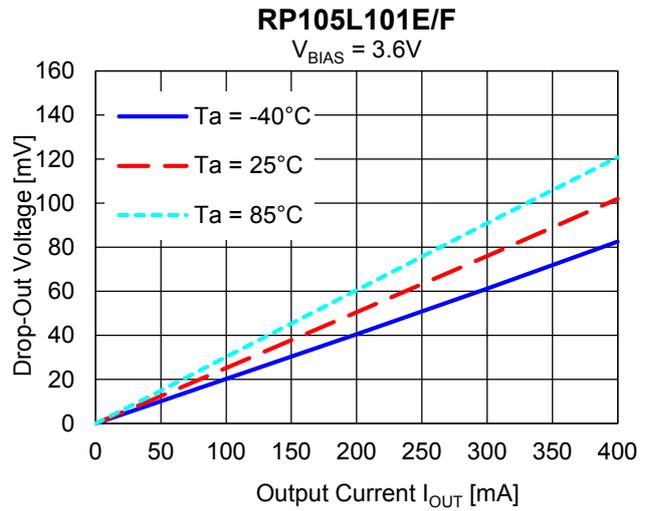
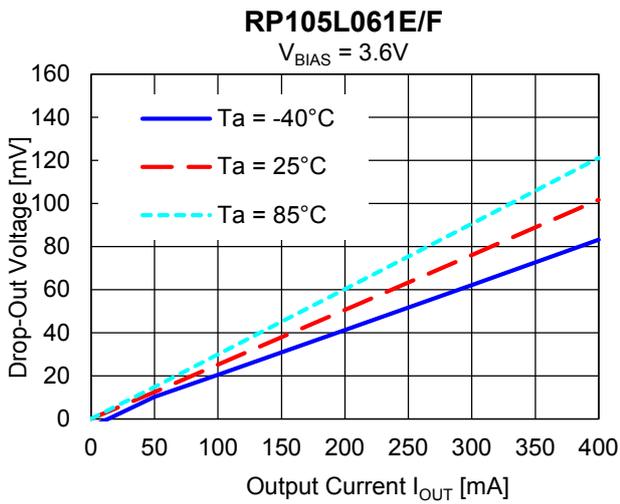
5) Supply Current vs. Temperature ( $C_{BIAS} = C_{IN} = C_{OUT} = \text{none}$ ,  $V_{BIAS} = 3.6 \text{ V}$ )



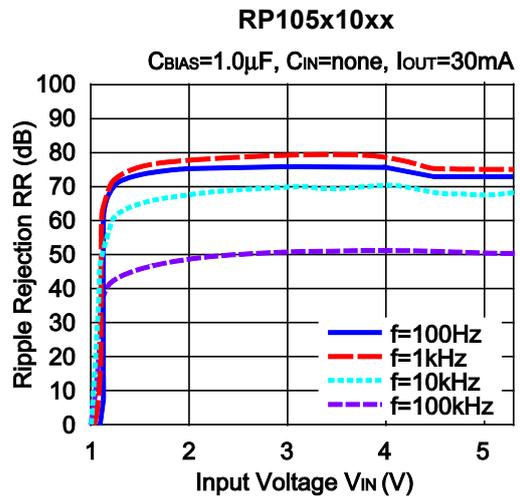
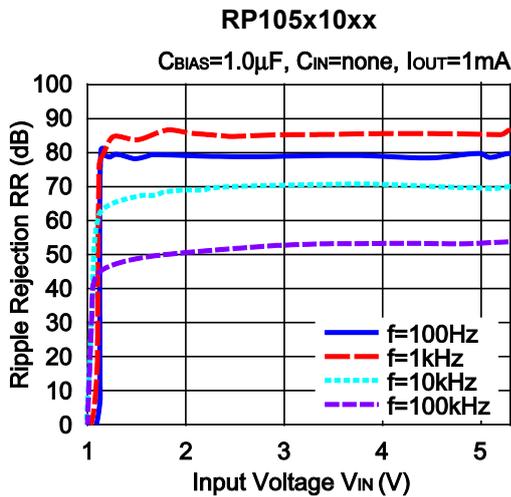
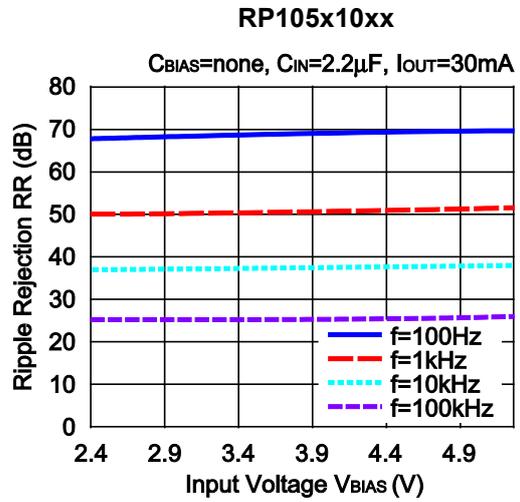
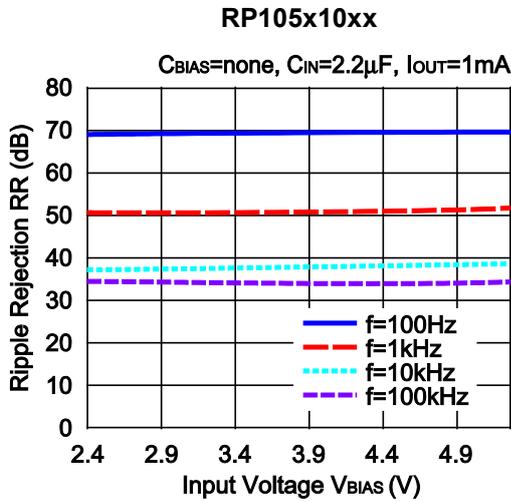
NO.EA-179-160420



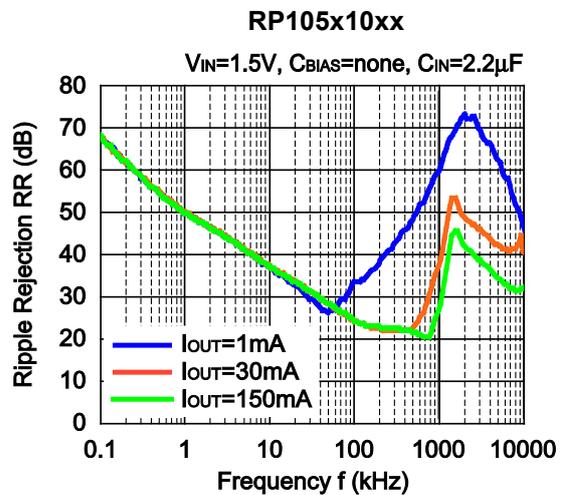
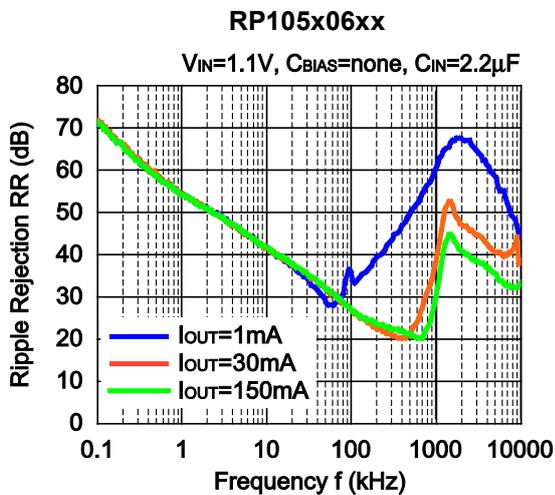
**6) Dropout Voltage vs. Output Current ( $C_{BIAS} = 1.0 \mu F$ ,  $C_{IN} = C_{OUT} = 2.2 \mu F$ )**



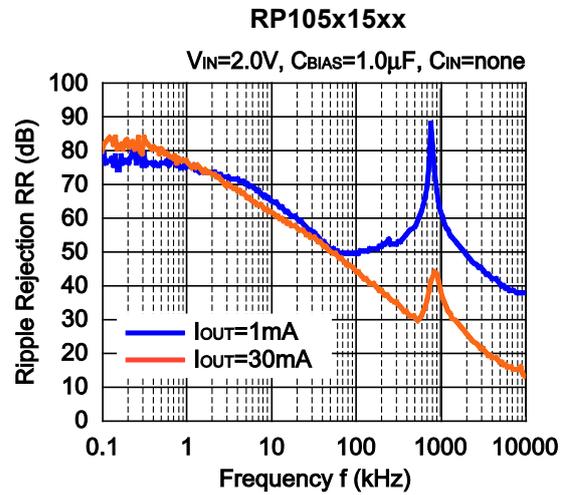
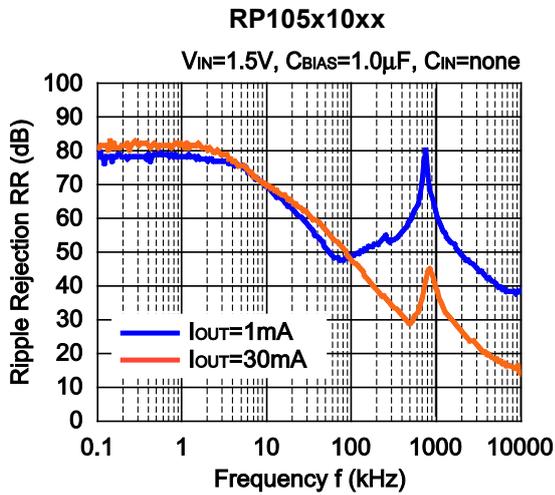
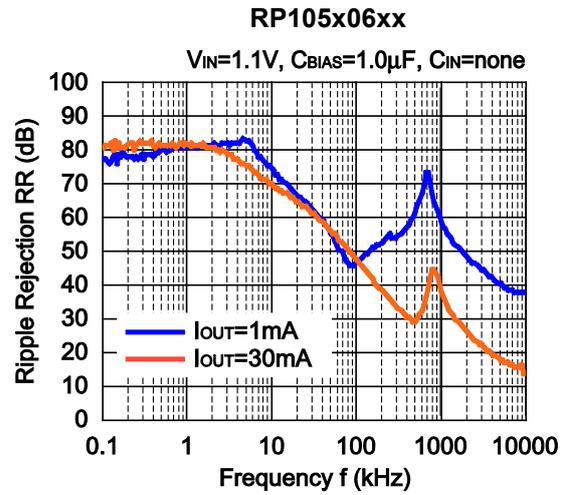
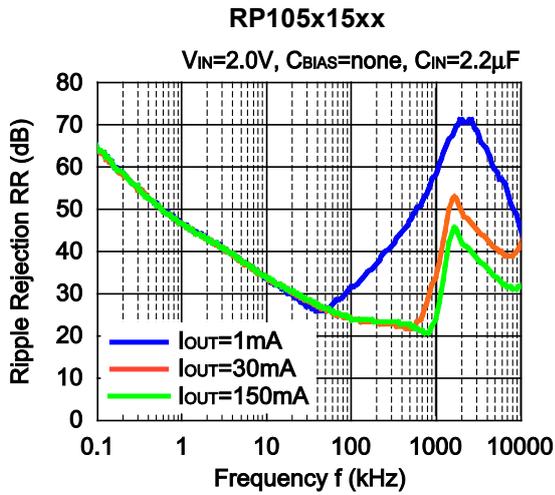
7) Ripple Rejection vs. Input Bias Voltage ( $C_{OUT} = 2.2 \mu F$ , Ripple = 0.2 Vp-p,  $T_a = 25^\circ C$ )



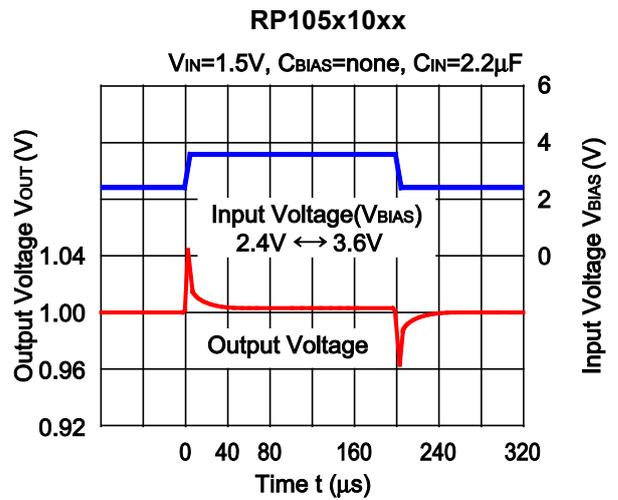
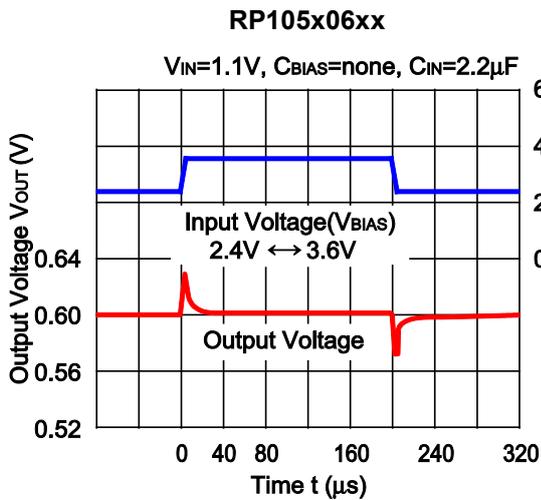
8) Ripple Rejection vs. Frequency ( $V_{BIAS} = 3.6 \text{V}$ ,  $C_{OUT} = 2.2 \mu F$ ,  $T_a = 25^\circ C$ )

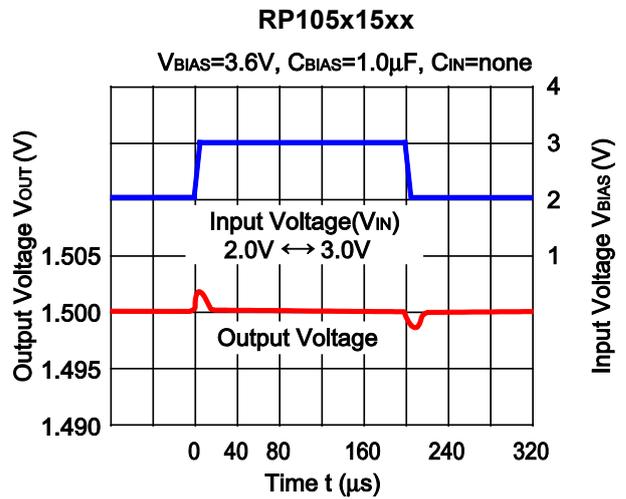
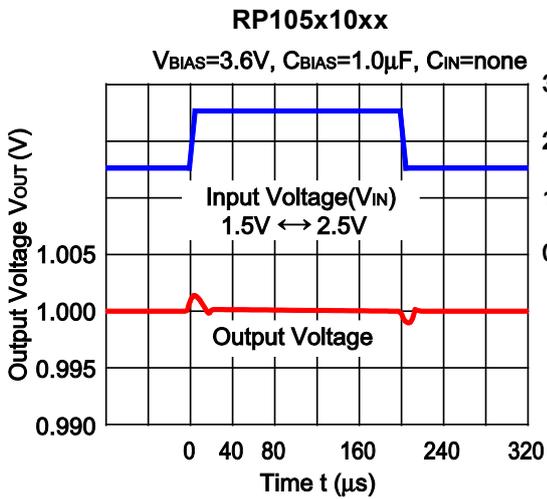
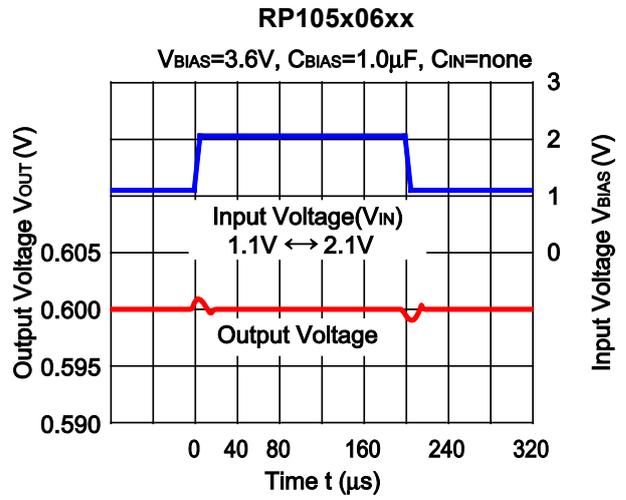
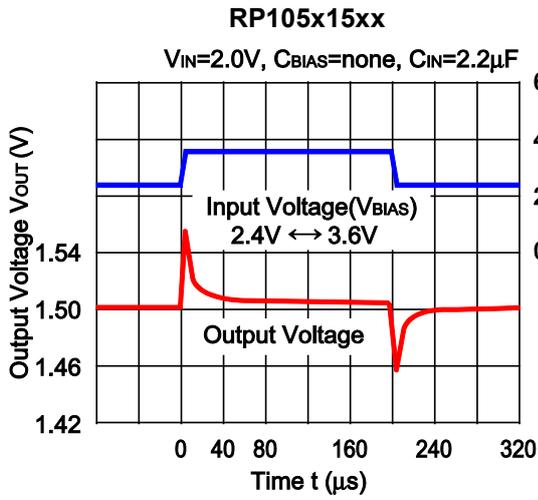


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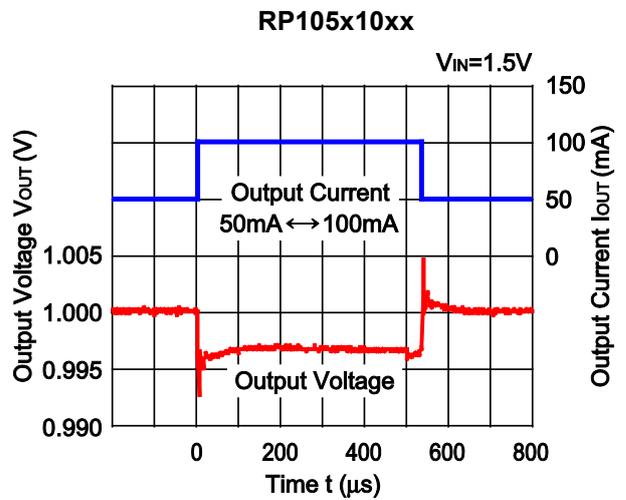
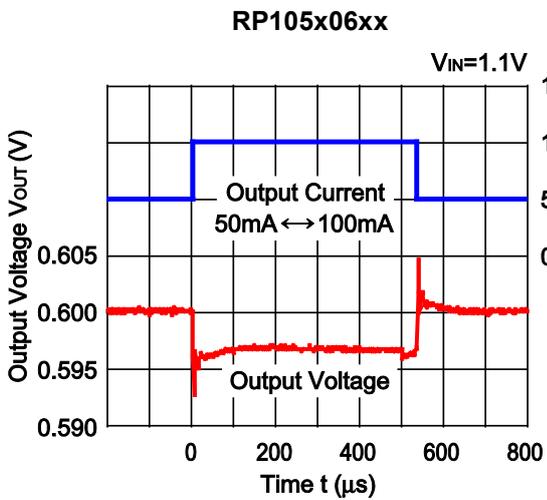


9) Input Transient Response ( $I_{OUT} = 30\text{ mA}$ ,  $C_{OUT} = 1.0\ \mu\text{F}$ ,  $t_r = t_f = 5\ \mu\text{s}$ ,  $T_a = 25^\circ\text{C}$ )

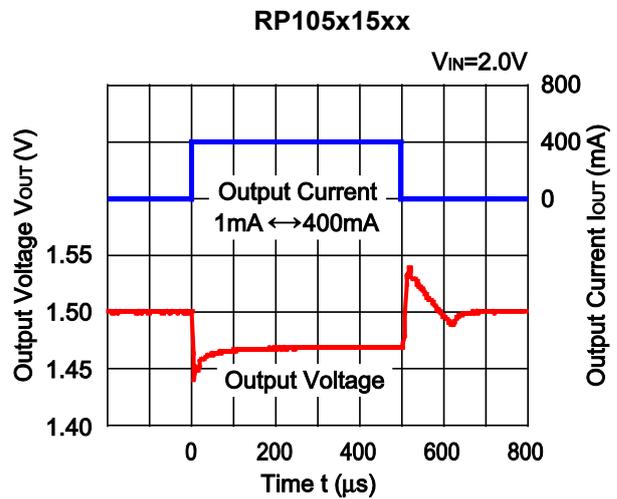
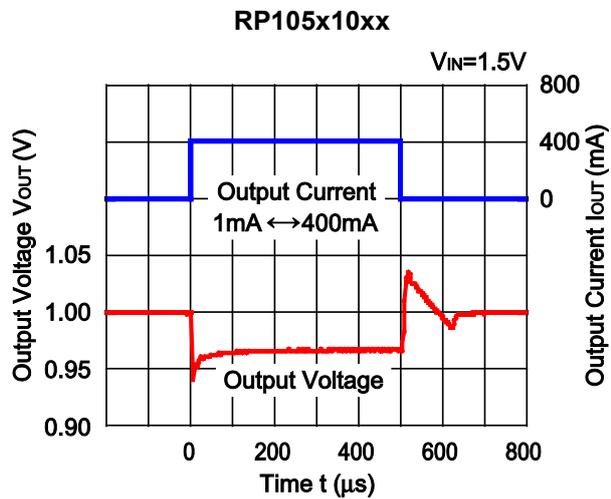
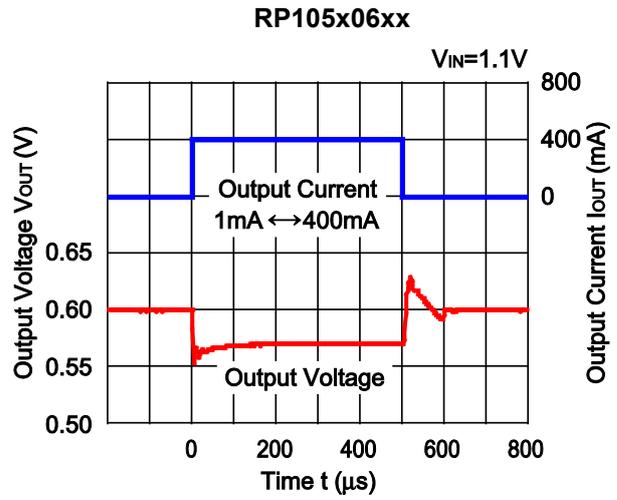
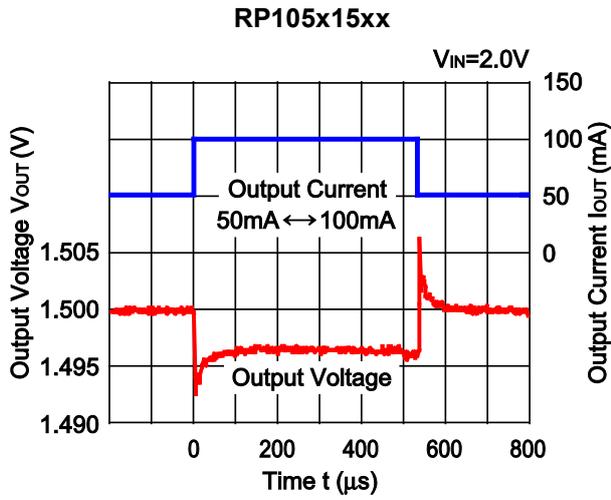




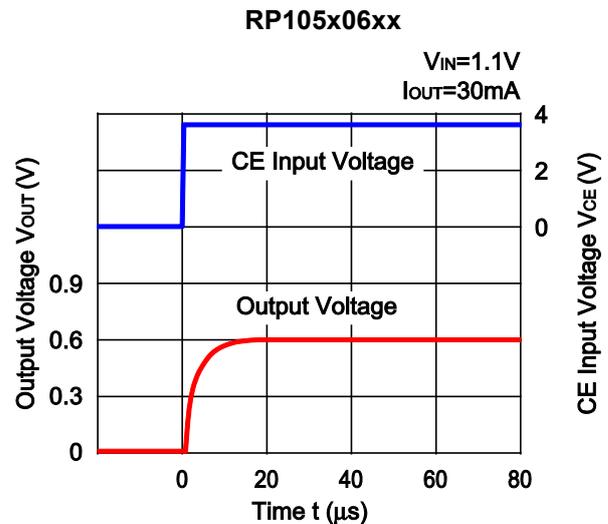
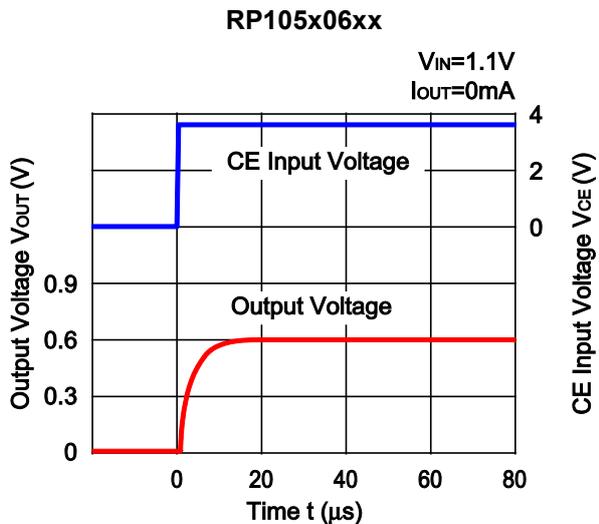
10) Load Transient Response ( $V_{BIAS} = 3.6V$ ,  $C_{BIAS} = 1.0\mu F$ ,  $C_{IN} = C_{OUT} = 2.2\mu F$ ,  $t_r = t_f = 0.5\mu s$ ,  $T_a = 25^\circ C$ )

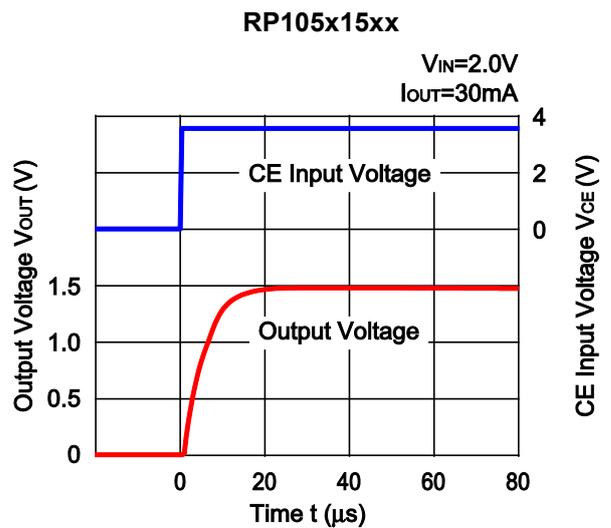
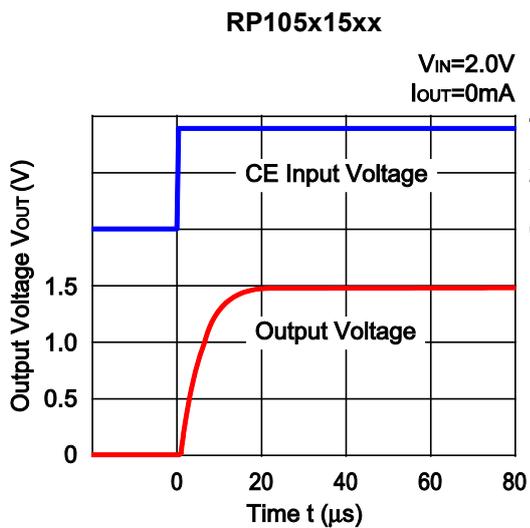
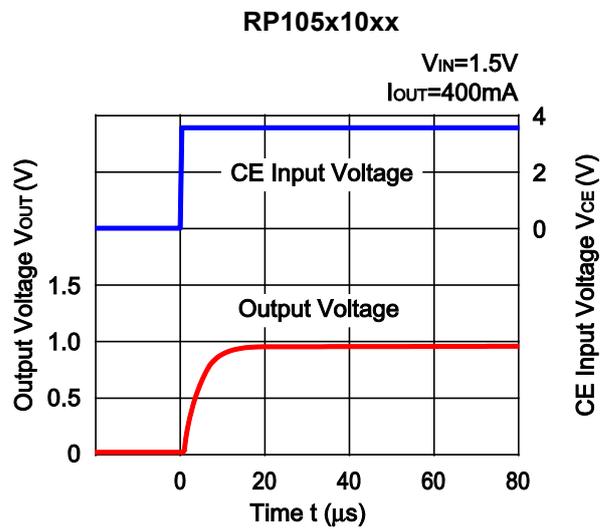
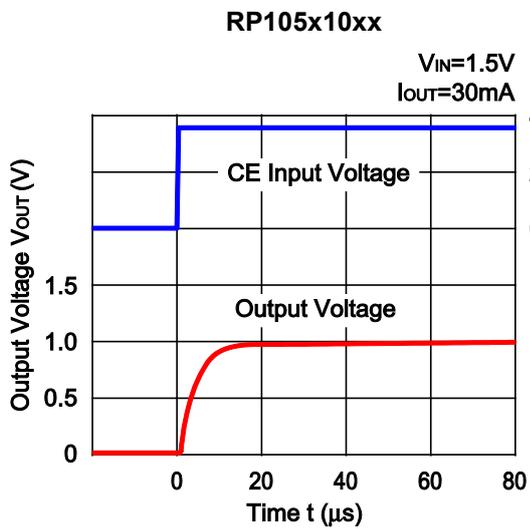
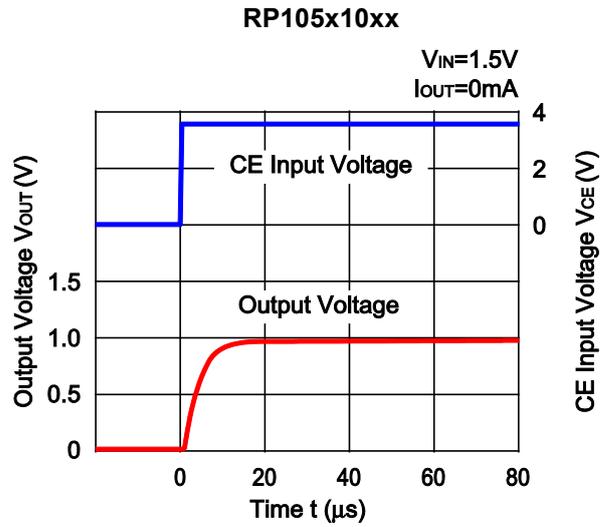
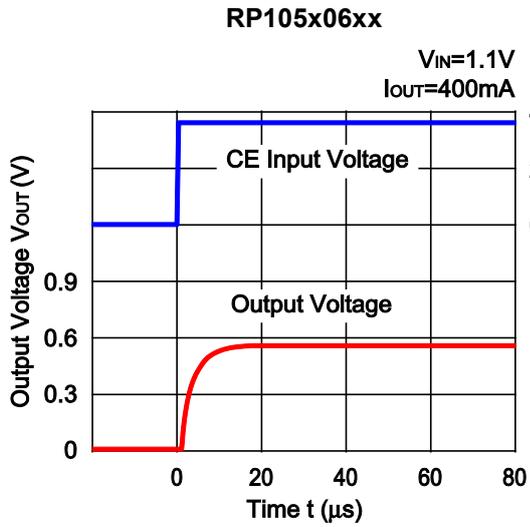


NO.EA-179-160420

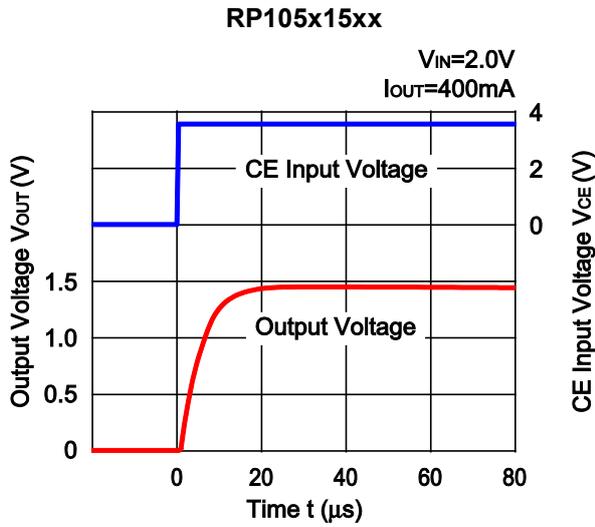


11) Turn On Speed with CE pin ( $V_{BIAS} = 3.6V$ ,  $C_{BIAS} = 1.0\mu F$ ,  $C_{IN} = C_{OUT} = 2.2\mu F$ ,  $T_a = 25^\circ C$ )

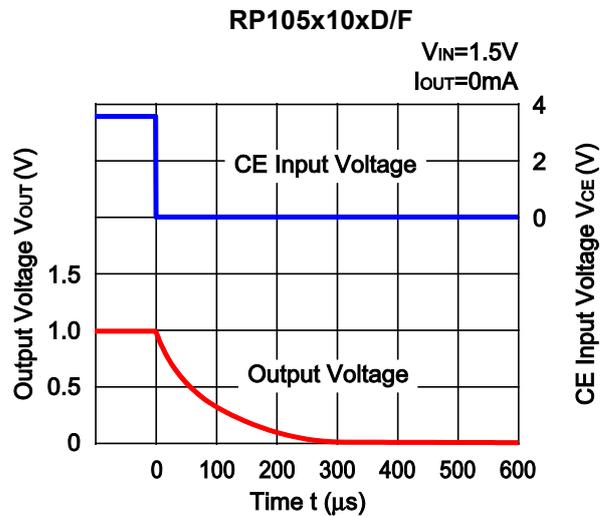
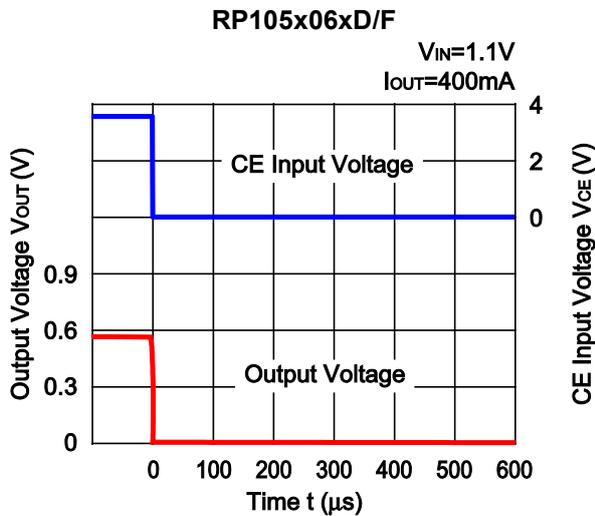
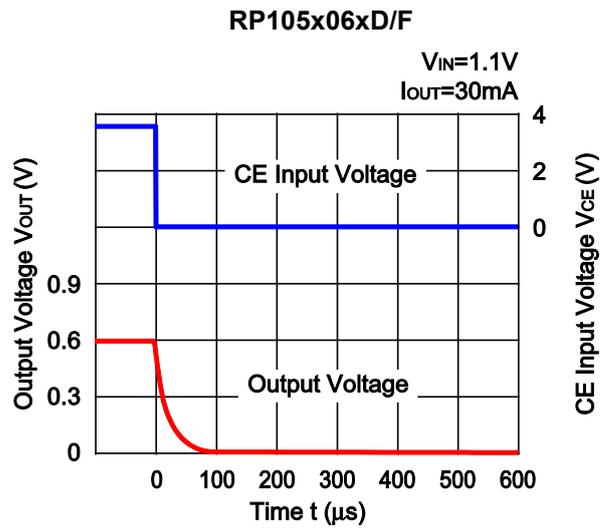
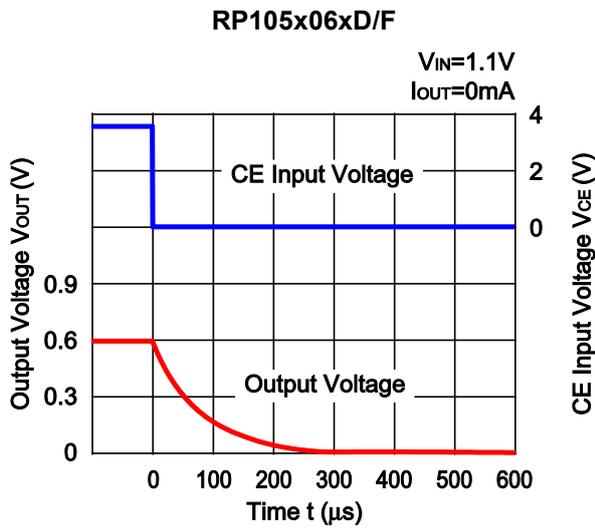


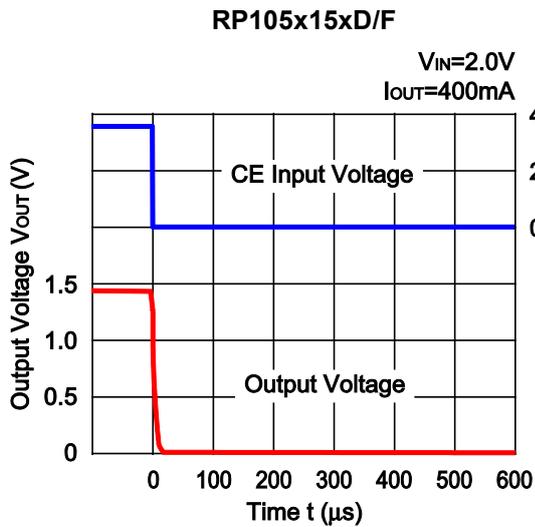
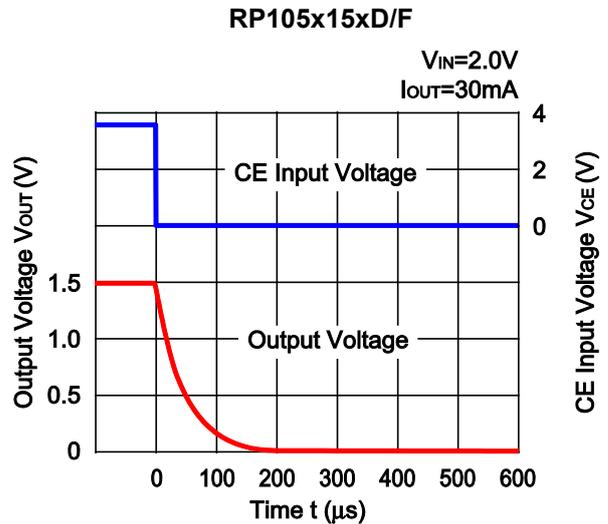
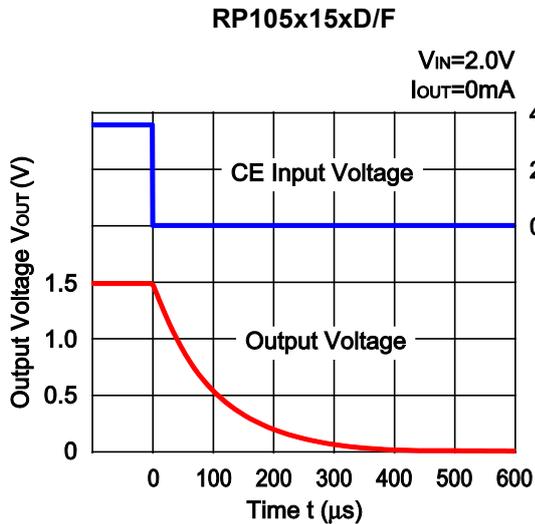
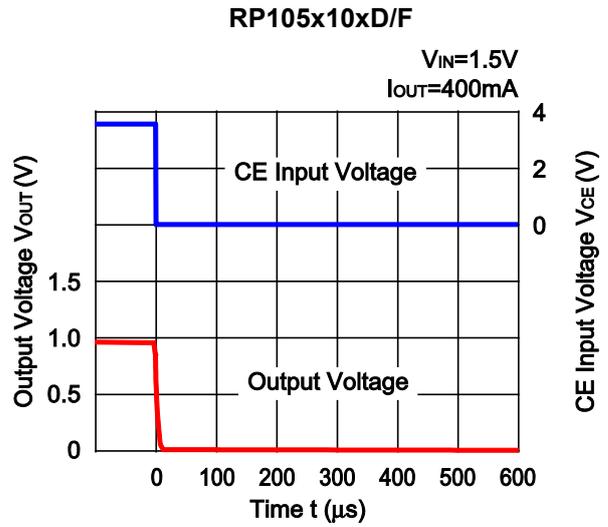
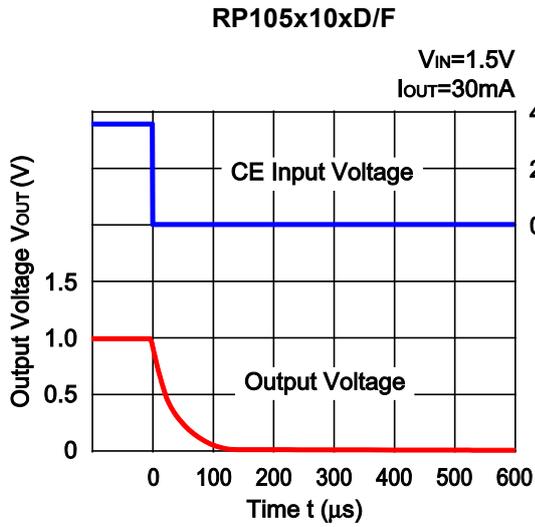


NO.EA-179-160420



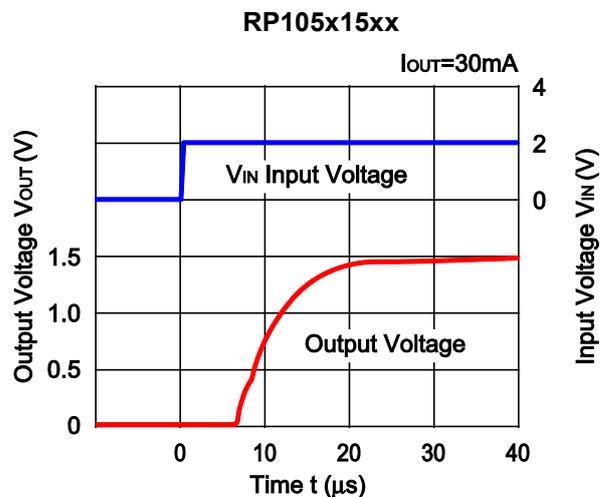
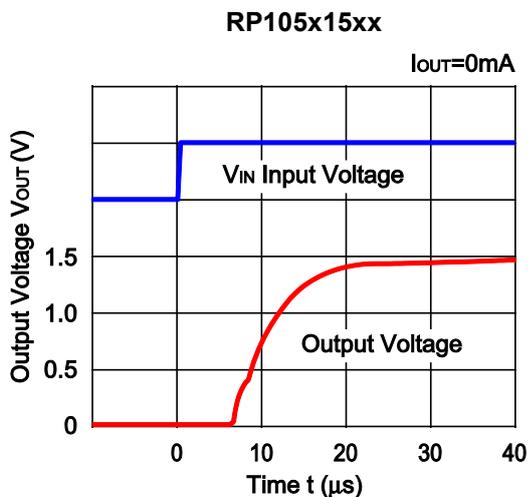
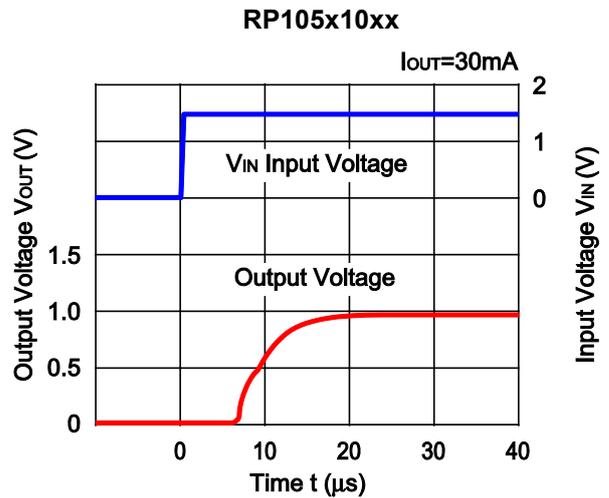
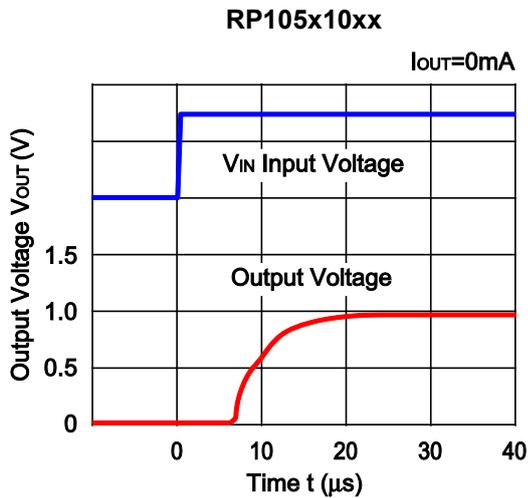
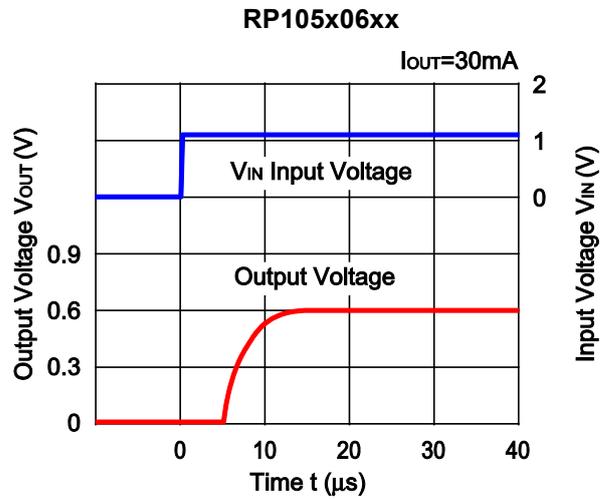
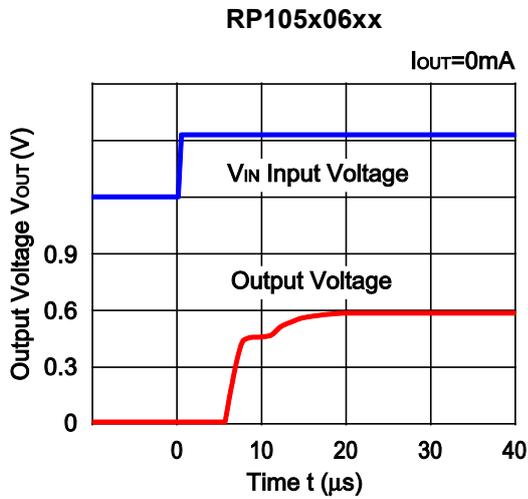
12) Turn Off Speed with CE Pin ( $V_{BIAS} = 3.6 V$ ,  $C_{BIAS} = 1.0 \mu F$ ,  $C_{IN} = C_{OUT} = 2.2 \mu F$ ,  $T_a = 25^\circ C$ )





NO.EA-179-160420

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

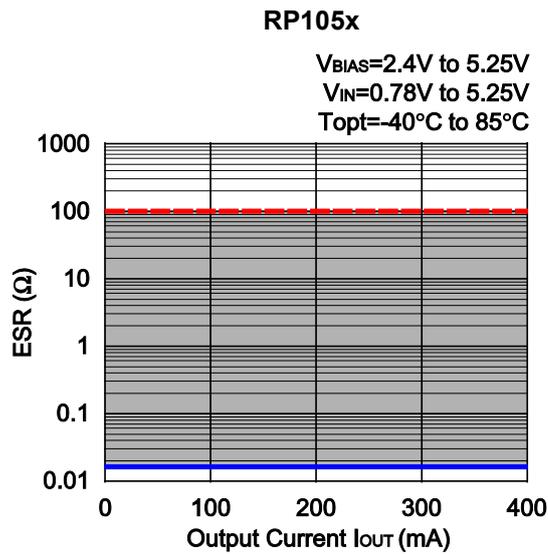
Frequency Band : 10 Hz to 2 MHz

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

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

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

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



Power Dissipation ( $P_D$ ) depends on conditions of mounting on board. This specification is based on the measurement at the condition below.

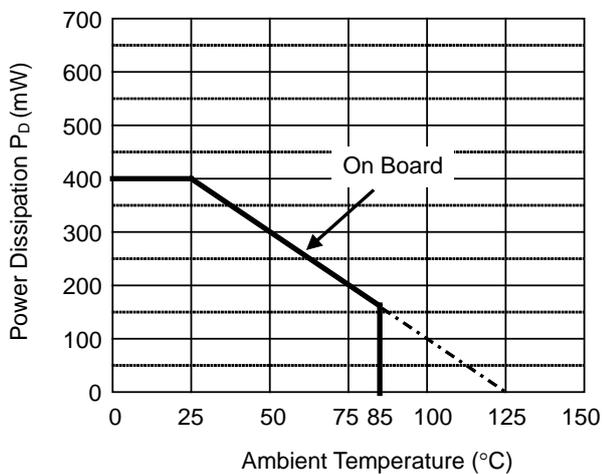
**Measurement Conditions**

	<b>Standard Test Land Pattern</b>
Environment	Mounting on Board (Wind velocity = 0 m/s)
Board Material	Glass cloth epoxy plastic (Double-Sided Board)
Board Dimensions	40 mm x 40 mm x 1.6 mm
Copper Ratio	Top side: 50%, Back side: 50%
Through-holes	$\phi$ 0.54 mm x 28 pcs

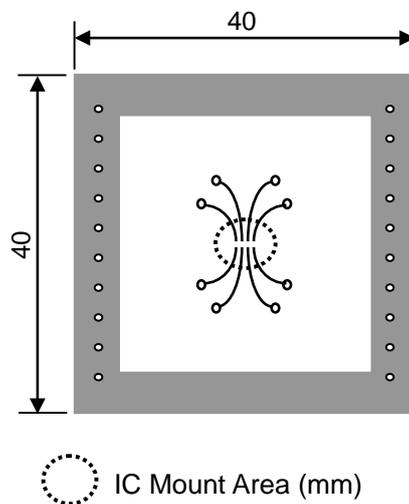
**Measurement Result**

( $T_a = 25^\circ\text{C}$ ,  $T_{j\text{max}} = 125^\circ\text{C}$ )

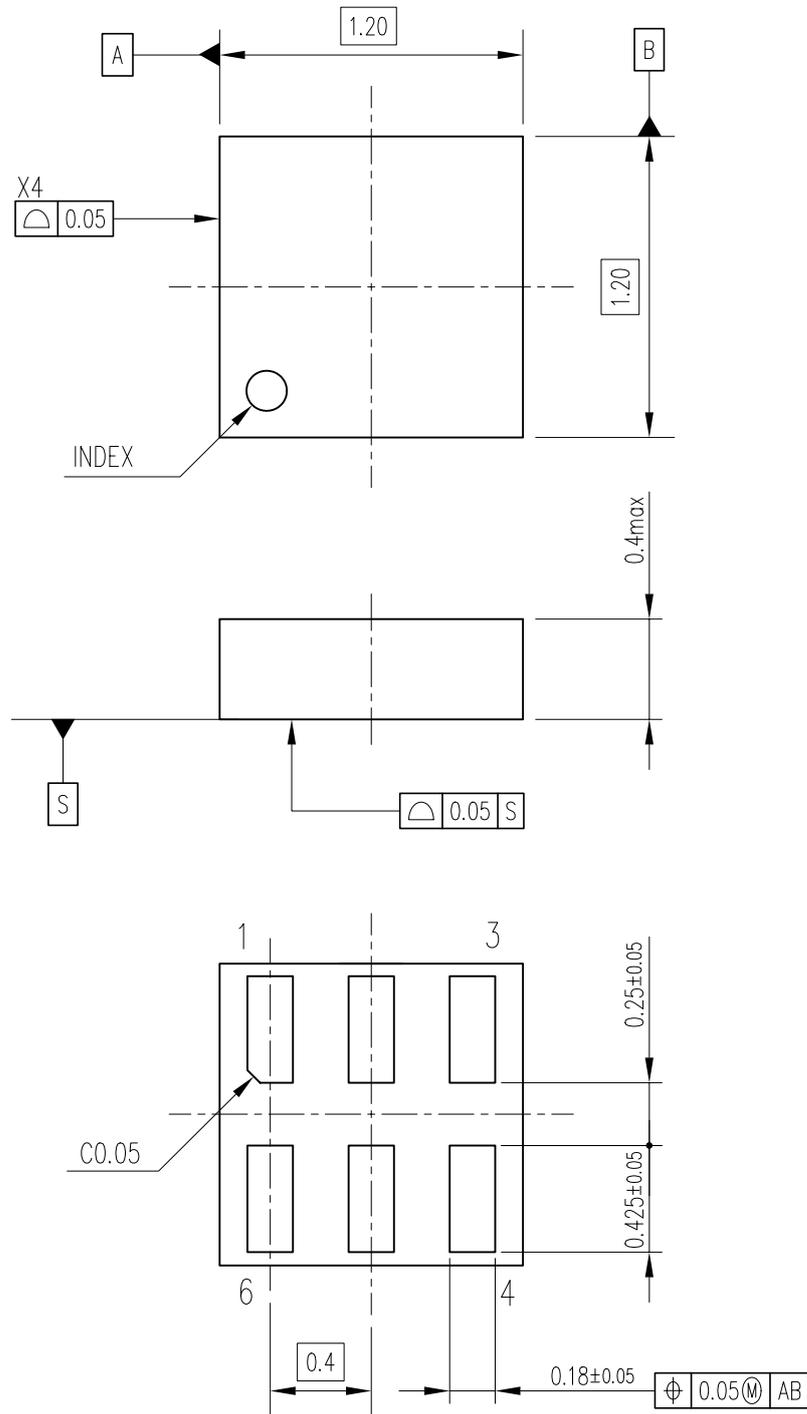
	<b>Standard Land Pattern</b>
Power Dissipation	400 mW
Thermal Resistance	$\theta_{ja} = (125 - 25^\circ\text{C}) / 0.4 \text{ W} = 250^\circ\text{C/W}$
	$\theta_{jc} = 67^\circ\text{C/W}$



**Power Dissipation vs. Ambient Temperature**



**Measurement Board Pattern**



DFN(PLP)1212-6 Package Dimensions (Unit: mm)

Power Dissipation ( $P_D$ ) depends on conditions of mounting on board. This specification is based on the measurement at the condition below.

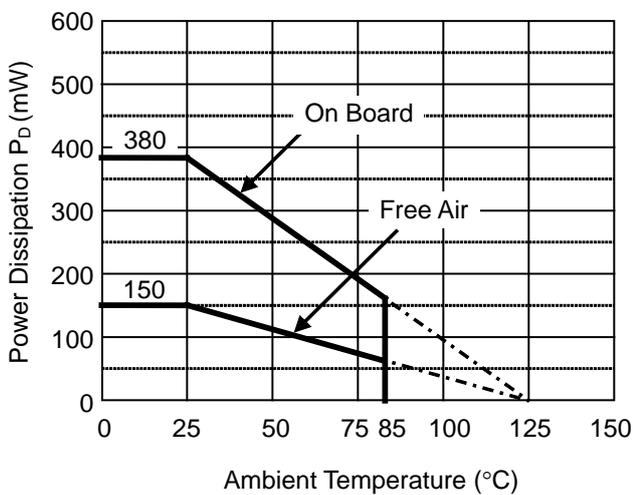
**Measurement Conditions**

	<b>Standard Test Land Pattern</b>
Environment	Mounting on Board (Wind velocity = 0 m/s)
Board Material	Glass cloth epoxy plastic (Double-Sided Board)
Board Dimensions	40 mm x 40 mm x 1.6 mm
Copper Ratio	Top side: 50%, Back side: 50%
Through-holes	$\phi$ 0.5 mm x 44 pcs

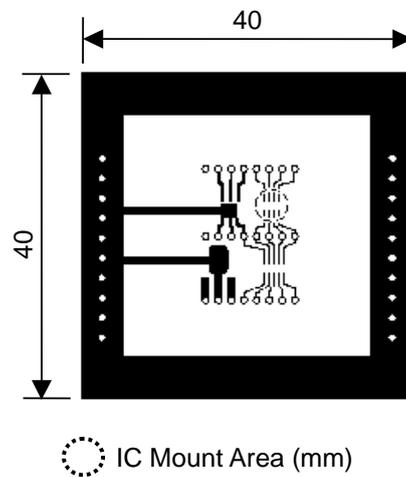
**Measurement Result**

( $T_a = 25^\circ\text{C}$ ,  $T_{j\text{max}} = 125^\circ\text{C}$ )

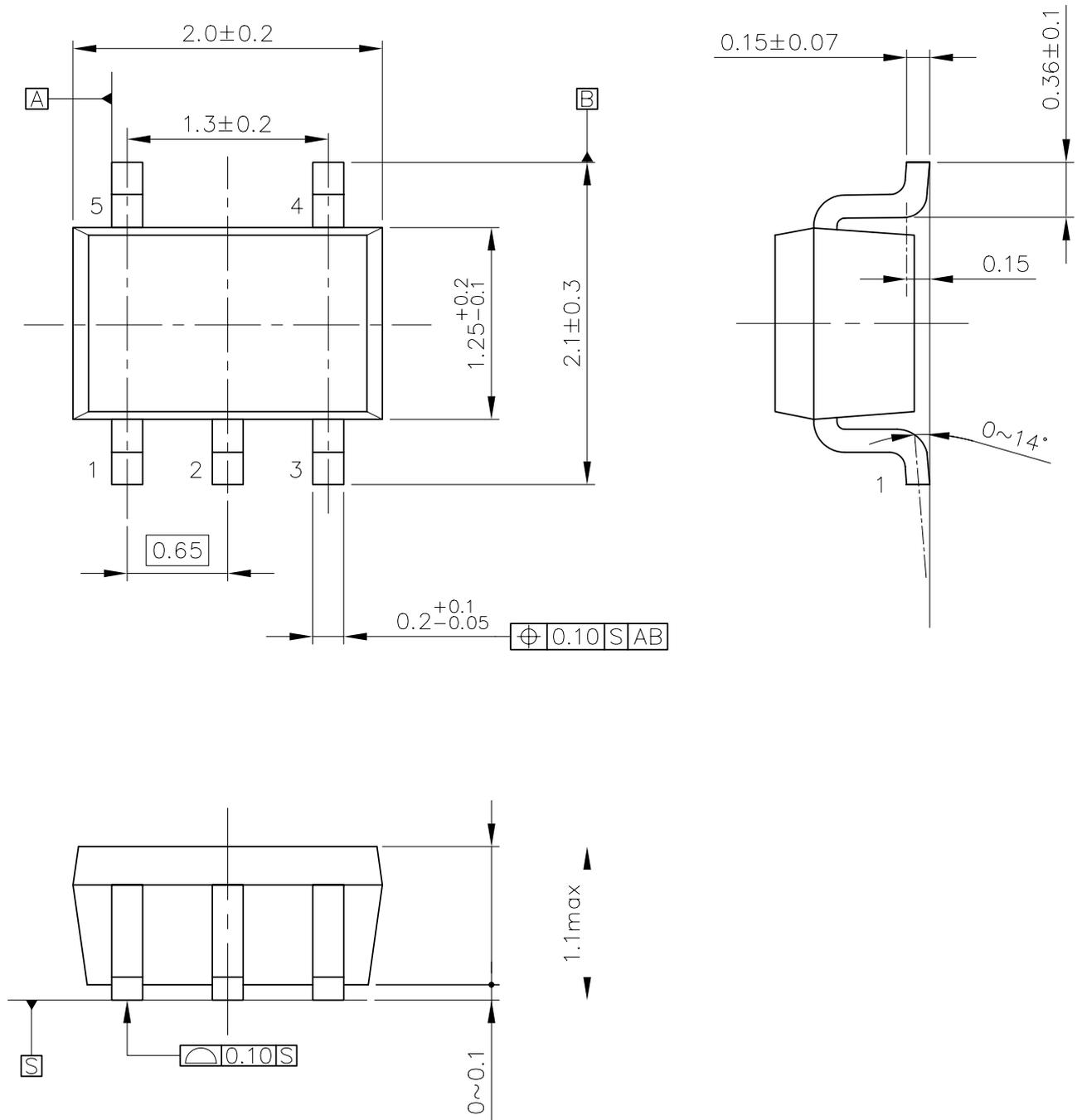
	<b>Standard Land Pattern</b>	<b>Free Air</b>
Power Dissipation	380 mW	150 mW
Thermal Resistance	$\theta_{ja} = (125 - 25^\circ\text{C}) / 0.38 \text{ W} = 263^\circ\text{C/W}$	$\theta_{ja} = (125 - 25^\circ\text{C}) / 0.15 \text{ W} = 667^\circ\text{C/W}$
	$\theta_{jc} = 75^\circ\text{C/W}$	-



**Power Dissipation vs. Ambient Temperature**



**Measurement Board Pattern**



SC-88A Package Dimensions (Unit: mm)

Power Dissipation ( $P_D$ ) depends on conditions of mounting on board. This specification is based on the measurement at the condition below (Power Dissipation (SOT-23-5) is substitution of SOT-23-6).

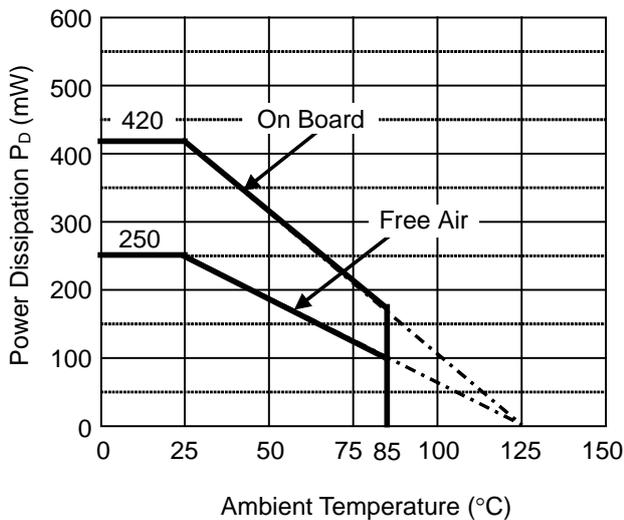
**Measurement Conditions**

	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 x 40 mm x 1.6 mm
Copper Ratio	Top side: 50%, Back side: 50%
Through-holes	$\phi$ 0.5 mm x 44 pcs

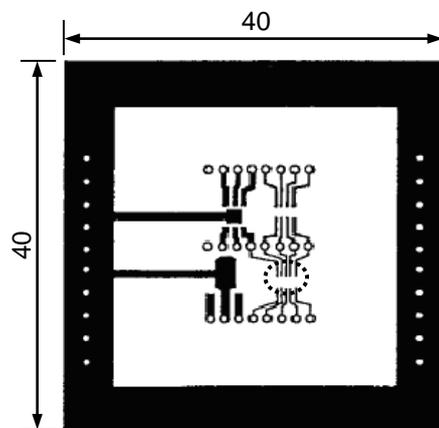
**Measurement Result**

( $T_a = 25^\circ\text{C}$ ,  $T_{j\text{max}} = 125^\circ\text{C}$ )

	Standard Land Pattern	Free Air
Power Dissipation	420 mW	250 mW
Thermal Resistance	$\theta_{ja} = (125 - 25^\circ\text{C}) / 0.42 \text{ W} = 238^\circ\text{C/W}$	400 $^\circ\text{C/W}$

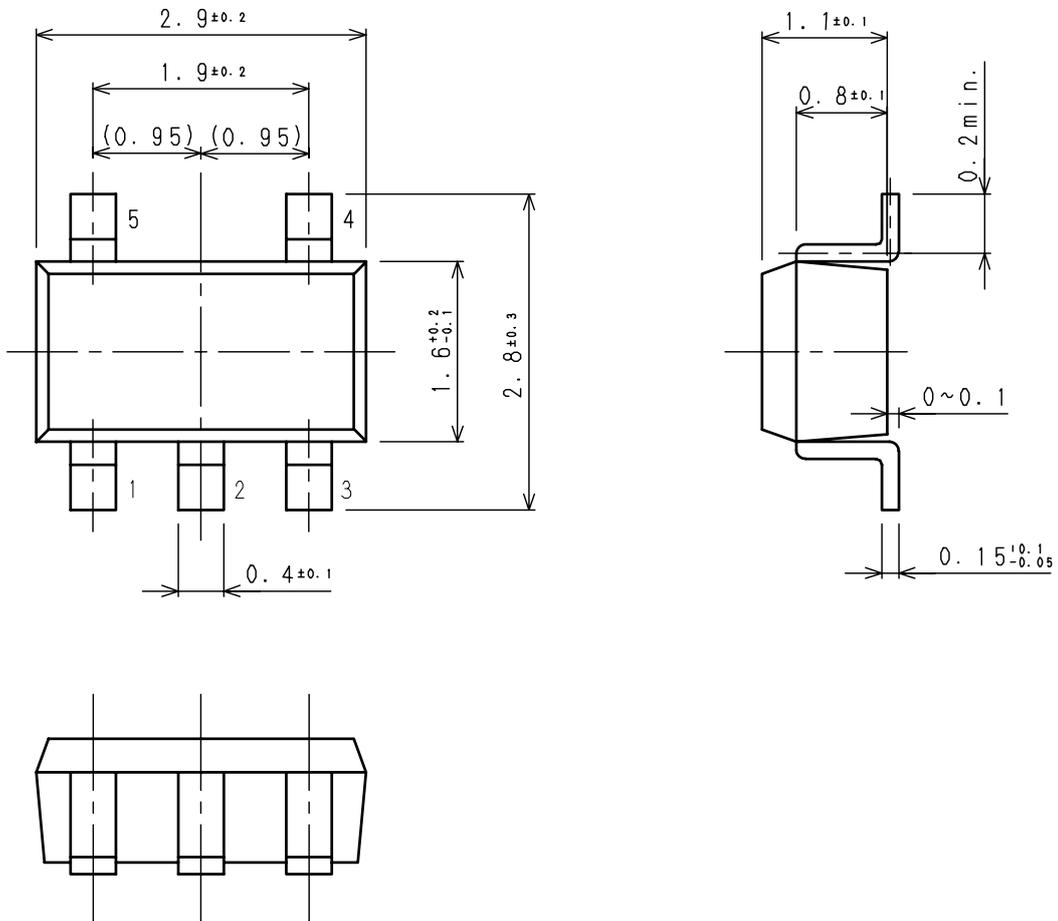


**Power Dissipation vs. Ambient Temperature**



 IC Mount Area (mm)

**Measurement Board Pattern**



SOT-23-5 Package Dimensions (Unit: mm)

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

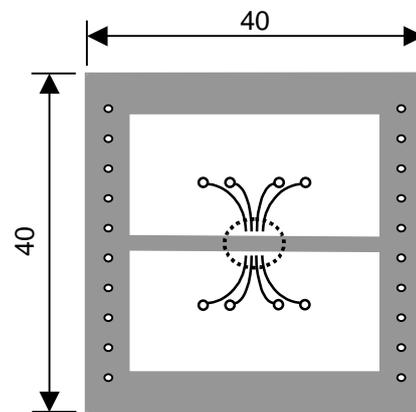
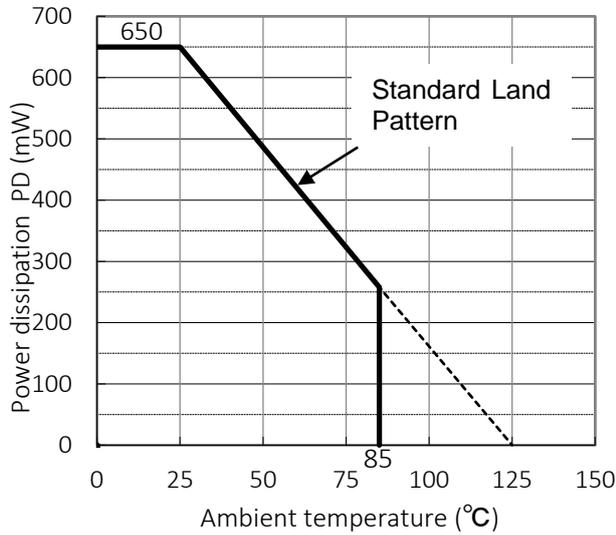
**Measurement Conditions**

	<b>Standard Land Pattern</b>
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Two-Layer Boards)
Board Dimensions	40 mm x 40 mm x 1.6 mm
Copper Ratio	Font-side, Approx. 50%    Back-side, Approx. 50%
Through-holes	φ 0.5 mm x 28 pcs

**Measurement Result**

(Ta = 25°C, Tjmax = 125°C)

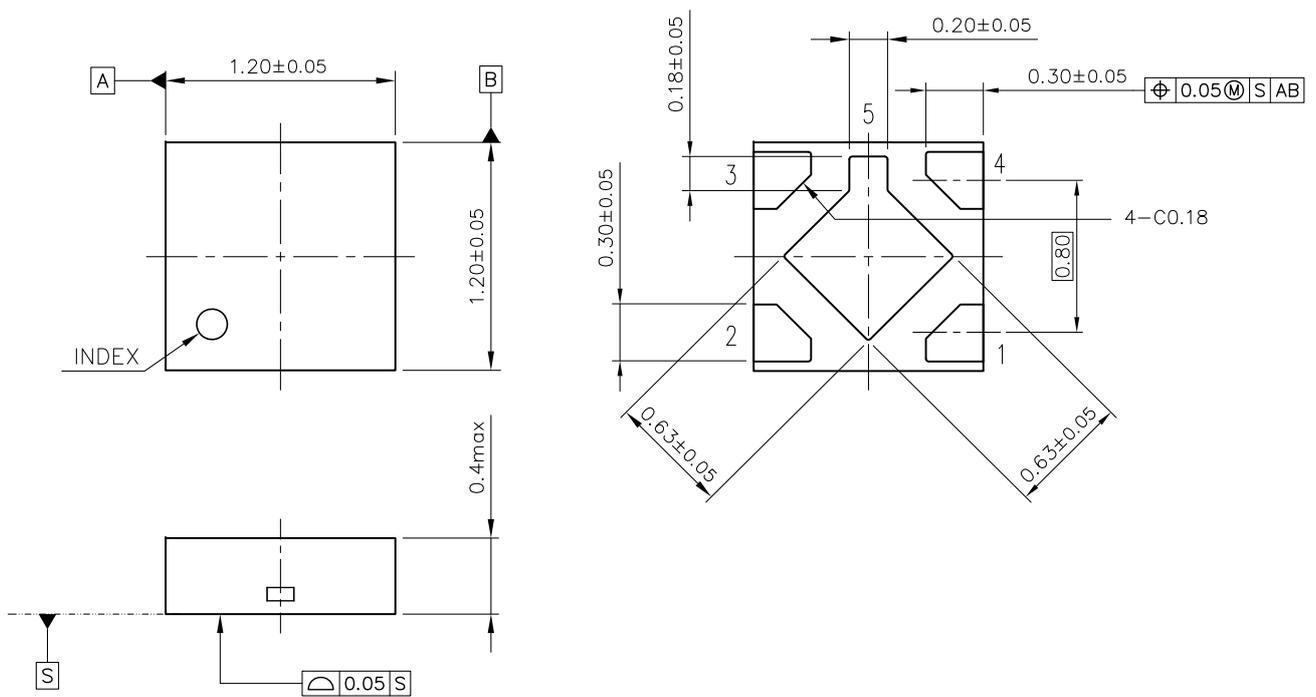
	<b>Standard Land Pattern</b>
Power Dissipation	650 mW
Thermal Resistance	$\theta_{ja} = (125 - 25^\circ\text{C}) / 0.65 \text{ W} = 153^\circ\text{C/W}$ $\theta_{jc} = 30^\circ\text{C/W}$



○ IC Mount Area (mm)

**Power Dissipation vs. Ambient Temperature**

**Measurement Board Pattern**



DFN1212-5 Package Dimensions (Unit: mm)



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