Low On Resistance/ Low Voltage 1ch 500mA/ 1.0A Alternative LDO

NO.EA-274-121129

OUTLINE

The RP115x Series are CMOS-based positive voltage regulators featuring 500mA/ 1.0A that provide high ripple rejection, low dropout voltage, high output voltage accuracy, and low supply current. Internally, the RP115x Series consist of a voltage reference unit, an error amplifier, a resistor-net for output voltage setting, a current limit circuit, a thermal shutdown circuit, and a reverse current protection circuit.

The RP115x Series uses CMOS process for achieving low supply current, low On Resistance for low dropout voltage (TYP. 0.195V (DFN1216-8, I_{OUT}=1.0A, V_{SET}=1.2V)) and CE function for long battery life.

Excellent ripple rejection, input transient response, and load transient response make this series ideal for the power sources of mobile communication equipments.

The RP115x Series are available in the DFN1216-8 package for space saving and the SOT-89-5 (Output current: 1.0A fixed) package for higher power applications.

The RP115L Series (DFN1216-8 package) can choose the output current limit between 1.0A or 500mA by alternating the LCON pin between “H” or “L”.

The RP115H Series (SOT-89-5 package) can output only 1.0A since it does not include the LCON pin.

FEATURES

- Supply Current ····· TYP. 110μA
- Supply Current (Standby Mode) ····· TYP. 0.5μA
- Dropout Voltage ····· TYP. 0.195V (DFN1216-8: I_{OUT}=1.0A, V_{SET}=1.2 V)
  TYP. 0.235V (SOT-89-5: I_{OUT}=1.0A, V_{SET}=1.2 V)
- Ripple Rejection ····· TYP. 80dB (f=1kHz, V_{SET} ≤ 1.8V)
  TYP. 75dB (f=1kHz, V_{SET} > 1.8V)
- Output Voltage Accuracy ····· ±1.0% (V_{SET} ≥ 1.8V)
- Output Voltage Temperature Coefficient ····· TYP. ±30ppm/ ºC (V_{SET} ≥ 1.8V)
- Line Regulation ····· TYP. 0.02%/V
- Package ····· DFN1216-8, SOT-89-5
- Output Voltage Range ····· 0.7V to 4.3V[*1] (0.1V increments)
- Built-in Short Current Limit Circuit ····· TYP. 60mA (DFN1216-8: LCON = "L")
- Built-in Peak Current Limit
- Built-in Thermal Shutdown Circuit ····· Thermal Shutdown Temperature: 165ºC
- Built-in Constant Slope Circuit for Start-up
- Built-in Inrush Current Suppression Circuit ····· TYP. 300mA (DFN1216-8: LCON="L")
- Reverse Current Protection
- Recommended Ceramic Capacitors ····· 1.0μF or more

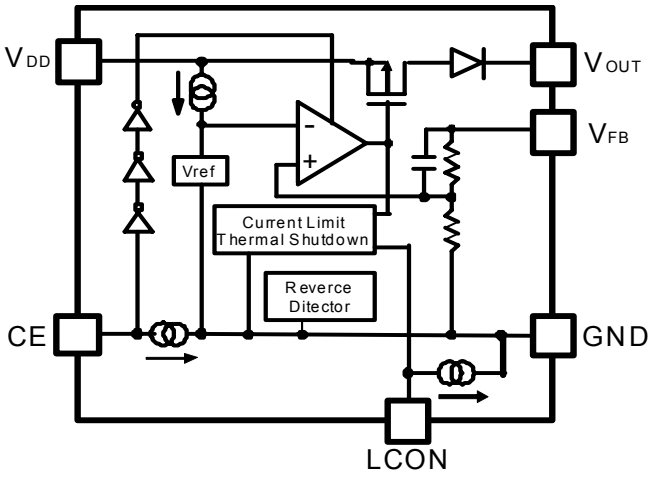
[*1] For the voltages in 0.05V increments, please refer to *MARK INFORMATIONS*.

APPLICATIONS

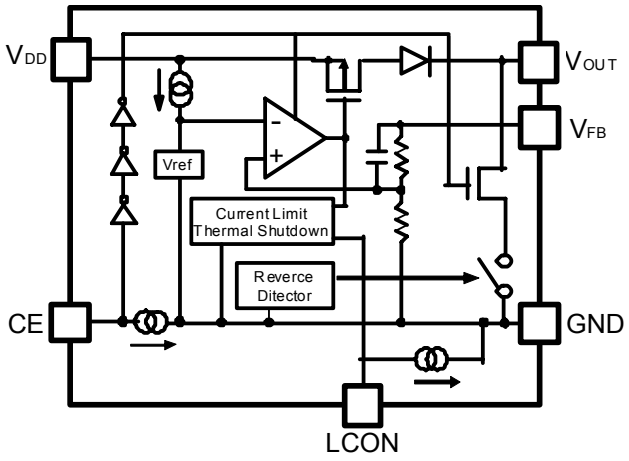
- Power source for portable communication equipments.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipments.
- Local power source for home appliances, printers, scanners, office equipment machines.

BLOCK DIAGRAMS

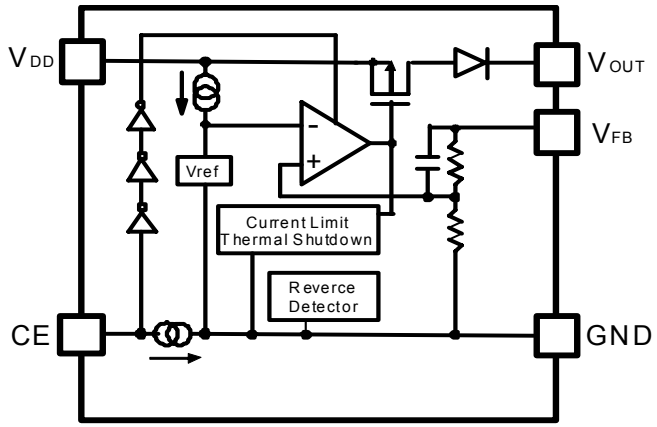
RP115Lxx1B



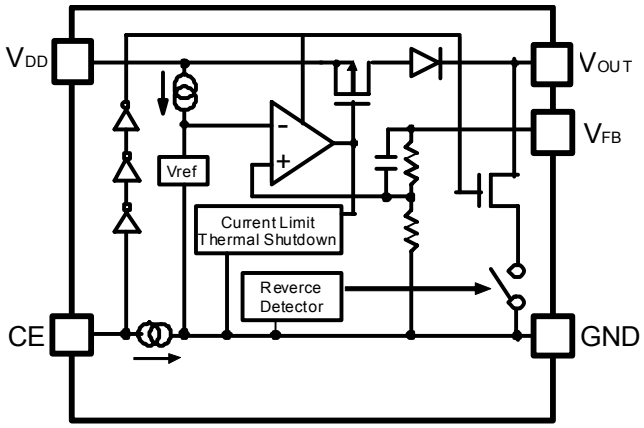
RP115Lxx1D



RP115Hxx1B



RP115Hxx1D



Notes: The RP115H does not include the LCON pin. The output current limit is fixed at 1A.

SELECTION GUIDE

The output voltage, the auto-discharge function[*2], and the package type for the ICs are user-selectable options.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RP115Lxx1∗(y)-E2	DFN1216-8	5,000	Yes	Yes
RP115Hxx1∗(y)-T1-FE	SOT-89-5	1,000	Yes	Yes

xx: Specify the output voltage (V_{SET}) within the range of 0.7V (07) to 4.3V (43) in 0.1V steps.

(y): If the output voltage includes the 3rd digit, indicate the digit of 0.01.
(0.75V, 1.15V, 1.25V, 1.35V, 1.85V, 2.85V)
Ex. If the output voltage is 1.25V, RP115x121∗5
If the output voltage is 1.85V, RP115x181∗5

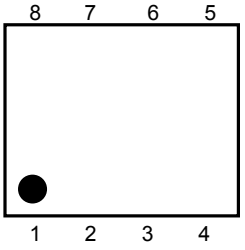
∗: Specify the version with auto-discharge function or without auto-discharge function.
(B) without auto-discharge function
(D) with auto-discharge function

[*2] Auto-Discharge function quickly lowers the output voltage to 0V by releasing the electrical charge in the external capacitor when the chip enable signal is switched from the active mode to the standby mode.

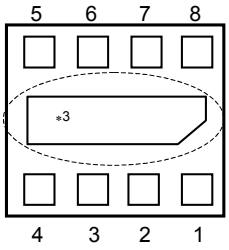
PIN CONFIGURATIONS

DFN1216-8

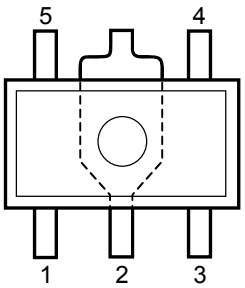
Top View



Bottom View



SOT-89-5



PIN DESCRIPTION

RP115L: DFN1216-8*3

Pin No	Symbol	Pin Description
1	V_{OUT}*4	Output Pin
2	V_{OUT}*4	Output Pin
3	LCON	Output Current Limit Alternate Pin (“H”=1A, “L”=500mA)
4	V_{FB}*4	Feedback Pin
5	GND	Ground Pin
6	CE	Chip Enable Pin
7	V_{DD}*5	Input Pin
8	V_{DD}*5	Input Pin

*3 The exposed tab on the bottom of the package enhances thermal performance and is electrically connected to GND (substrate level). It is recommended that the exposed tab be connected to the ground plane on the board or otherwise be left open.
*4 The V_{OUT} pins and the V_{FB} pin must be wired together when mouting on the board.
*5 The V_{DD} pins must be wired together when mouting on the board.

RP115H: SOT-89-5

Pin No	Symbol	Pin Description
1	V_{FB}*6	Feedback Pin
2	GND	Ground Pin
3	CE	Chip Enable Pin
4	V_{DD}	Input Pin
5	V_{OUT}*6	Output Pin

*6 The V_{OUT} pin and the V_{FB} pin must be wired together when mouting on the board.
Notes: Output Current Limit is fixed at 1A.

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating		Unit
V_{IN}	Input Voltage	6.0		V
V_{CE}	Input Voltage (CE Pin)	-0.3 to 6.0		V
V_{LCON}	Input Voltage (LCON Pin)	-0.3 to 6.0		V
V_{OUT}	Output Voltage	-0.3 to 6.0		V
P_D	Power Dissipation (Standard Land Pattern)[*7]	DFN1216-8	625	mW
		SOT-89-5	900	
Ta	Operating Temperature Range	-40 to +85		ºC
Tstg	Storage Temperature Range	-55 to +125		ºC

[*7] For Power Dissipation and Standard Land Pattern, please refer to *PACKAGE INFORMATION*.

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause the permanent damages and may degrade the lifetime 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 (ELECTRICAL CHARACTERISTICS)

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.

POWER DISSIPATION (DFN1216-8)

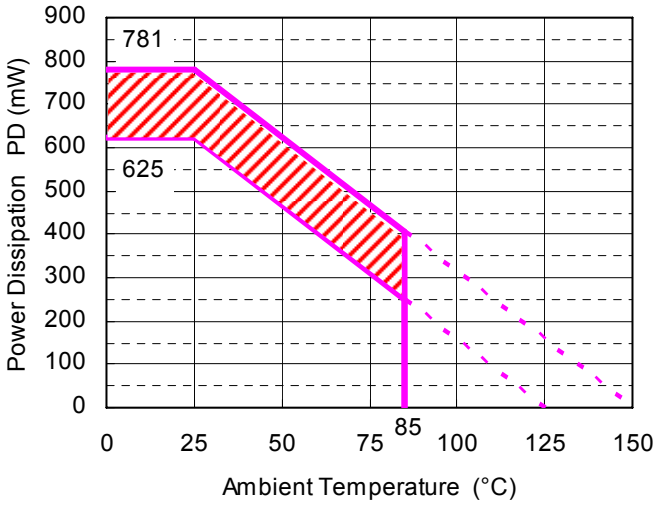
Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the Measurement Conditions below.

Measurement Conditions

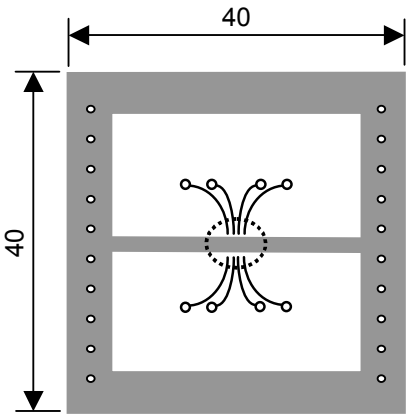
	Standard Land Pattern
Environment	Mounting on Board (Wind Velocity=0m/s)
Board Material	Glass Cloth Epoxy Plastic (Double-sided)
Board Dimensions	40mm x 40mm x 1.6mm
Copper Ratio	Topside: Approx. 50%, Backside: Approx. 50%
Through-holes	ϕ 0.5mm x 28pcs

Measurement Result (Ta=25°C, Tjmax=125°C)

	Standard Land Pattern
Power Dissipation	625mW
Thermal Resistance	θja = (125-25°C)/ 0.625W = 160°C/W
	θjc = 26 °C/W



Power Dissipation



Measurement Board Pattern

IC Mount Area (Unit : mm)

Note: The above graph shows the power dissipation of the package based on Tjmax=125ºC and Tjmax=150ºC. Operating the IC within the shaded area in the graph might have an influence on its lifetime. Operating time must be within the time limit described in the table below.

Operating Time	**Estimated Years (Operating 4 hrs/ day)**
13,000 hours	9 years

POWER DISSIPATION (SOT-89-5)

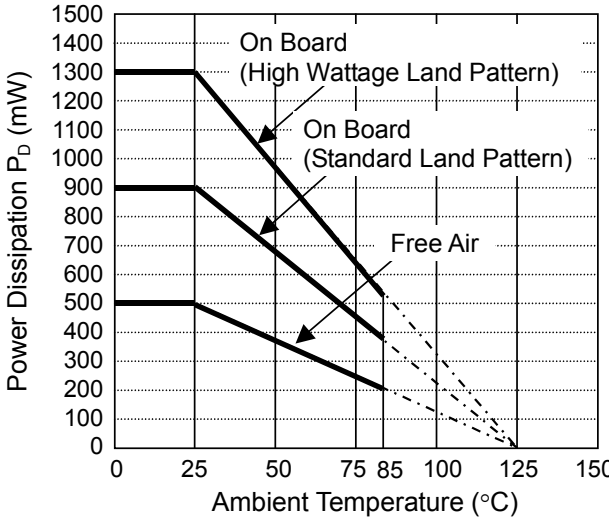
Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the Measurement Conditions below.

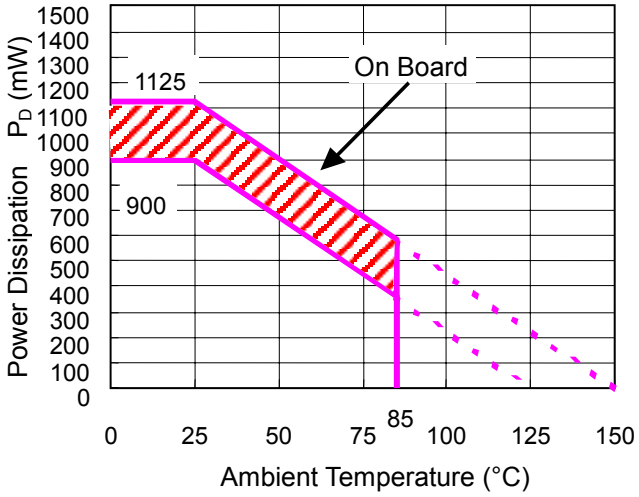
Measurement Conditions

	High Wattage Land Pattern	Standard Land Pattern
Environment	Mounting on Board (Wind Velocity=0m/s)	Mounting on Board (Wind Velocity=0m/s)
Board Material	Glass Cloth Epoxy Plastic (Double-sided)	Glass Cloth Epoxy Plastic (Double-sided)
Board Dimensions	30mm x 30mm x 1.6mm	50mm x 50mm x 1.6mm
Copper Ratio	Topside: Approx. 20% Backside: Approx. 100%	Topside: Approx. 10% Backside: Approx. 100%
Through-hole	ϕ0.85mm x 10pcs	-

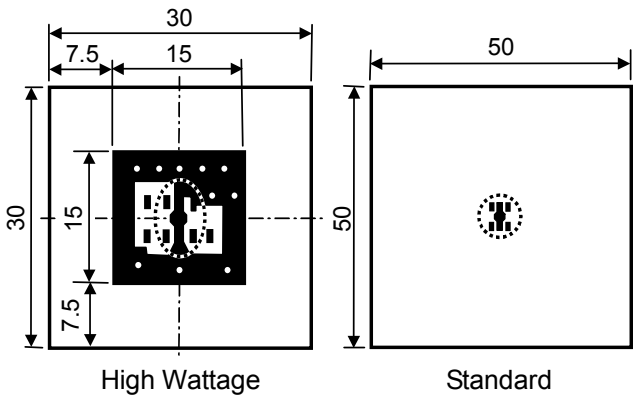
Measurement Result (Ta=25°C)

	High Wattage Land Pattern	Standard Land Pattern	Free Air
Power Dissipation	1300mW	900mW (Tjmax=125°C) 1125mW (Tjmax=150°C)	500mW
Thermal Resistance	77°C/W	111°C/W	200°C/W





Power Dissipation



Measurement Board Pattern

IC Mount Area Unit: mm

Note: The above graph shows the power dissipation of the package based on Tjmax=125°C and Tjmax=150°C. Operating the IC within the shaded area in The graph might have an influence on its lifetime. Operating time must be within the time limit described in the table below.

Operating Time	Estimated years (Operating four hours/day)
13,000 hours	9 years

ELECTRICAL CHARACTERISTICS

$V_{IN}=V_{SET}$[*8]+1.0V, I_{OUT}=1mA, $C_{IN}=C_{OUT}$=1.0µF, unless otherwise noted.

The values in [ ] are applicable under the condition of -40°C≤ Ta≤85°C.

RP115x (Ta=25ºC)

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	Ta=25°C	V_{SET}≥1.8V	x0.99		x1.01	V
			V_{SET}<1.8V	-18		+18	mV
		-40°C≤Ta≤85°C	V_{SET}≥1.8V	x0.985		x1.015	V
			V_{SET}<1.8V	-60		+40	mV
I_{LIM}	Output Current Limit	$V_{IN}=V_{SET}$+0.5V	LCON="L"	500			mA
			LCON="H"[*9]	1.0			A
ΔV_{OUT} /ΔI_{OUT}	Load Regulation	$V_{IN}=V_{SET}$+0.5V 1mA≤I_{OUT}≤500mA	LCON="L"		1	20	mV
		$V_{IN}=V_{SET}$+0.5V 1mA≤I_{OUT}≤1.0A	LCON="H"[*9]			40	
V_{DIF}	Dropout Voltage	Refer to *Table 1., 2. Dropout Voltage* (P.10).					
I_{SS}	Supply Current	I_{OUT}=0mA			110	160	µA
Istandby	Standby Current	V_{CE}=0V			0.5	3.0	µA
ΔV_{OUT} /ΔV_{IN}	Line Regulation	V_{SET}+0.5V≤V_{IN}≤5.25V (V_{IN}≥1.4V)			0.02	0.10	%/V
RR	Ripple Rejection	f=1kHz, Ripple 0.2Vp-p, $V_{IN}=V_{SET}$+1.0V, I_{OUT}=30mA	V_{SET}>1.8V		75		dB
			V_{SET}≤1.8V		80		dB
V_{IN}	Input Voltage*[10]			1.4		5.25	V
ΔV_{OUT} /ΔTa	Output Voltage Temperature Coefficient	-40°C≤Ta≤85°C	V_{SET}≥1.8V		±30		ppm /ºC
			V_{SET}<1.8V		±100		
I_{SC}	Short Current Limit	V_{OUT}=0V	LCON="L"		60		mA
			LCON="H"[*9]		110		
I_{CE}	CE Pull-down Current			0.05	0.3	0.6	µA
V_{CEH}	CE Input Voltage "H"			1.0			V
V_{CEL}	CE Input Voltage "L"					0.4	V

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
I_{LCON}	LCON Pull-down Current (RP115L only)			0.05	0.3	0.6	μA
V_{LCONH}	LCON Input Voltage "H" (RP115L only)			1.0			V
V_{LCONL}	LCON Input Voltage "L" (RP115L only)					0.4	V
T_{TSD}	Thermal Shutdown Temeprature	Junction Temperature			165		ºC
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature			110		ºC
I_{REV}	Reverse Current	$V_{OUT}=V_{SET}+1.0V$, $0\leq V_{IN}\leq V_{OUT}$	$V_{SET}\geq 1.8V$		7.5		μA
			$V_{SET}<1.8V$		10		
V_{REV_DET} [*11]	Detector Offset Voltage in Reverse Current Protection Mode [*12]	$V_{OUT}\geq 0.7V$, $0\leq V_{IN}\leq 5.25V$			20		mV
V_{REV_REL} [*11]	Release Offset Voltage in Reverse Current Protection Mode [*13]	$V_{OUT}\geq 0.7V$, $0\leq V_{IN}\leq 5.25V$			30	50	mV
en	Output Noise	BW=10Hz to 100kHz	$V_{SET}\geq 1.8V$		17 x V_{SET}		μVrms
			$V_{SET}<1.8V$		35 x V_{SET}		
R_{LOW}	Auto-discharge Nch Tr. ON Resistance (RP115xDxx1D only)	$V_{IN}=4.0V$, $V_{CE}=0V$			60		Ω
I_{RUSH}	Inrush Current Limit	CC Mode* [14]	LCON="L"		300		mA
			LCON="H" [*9]		500		

All test items listed under *Electrical Characteristics* are done under the pulse load condition (Tj≈Ta=25ºC) except Output Noise, Ripple Rejection, and Output Voltage Temperature Coefficient.

[*8] V_{SET}=Set Output Voltage

[*9] RP115H: Same Electrical Characteristics as LCON="H".

[*10] The maximum input voltage listed under *Electrical Characteristics* is 5.25V. If for any reason the input voltage exceeds 5.25V, it has to be no more than 5.5V with 500 cumulative operating hours.

[*11] Guaranteed operating range of reverse current protection circuit is $V_{OUT}\geq 0.7V$. When $V_{IN}=V_{OUT}=0V$, reverse current protection mode is constantly active.

[*12] $V_{REV\_DET}=V_{IN}-V_{OUT}$

[*13] $V_{REV\_REL}=V_{IN}-V_{OUT}$

[*14] For CC (Constant Current) Mode, please refer to *Start-up Characteristics* (P.14).

Table 1. Dropout Voltage

RP115L: DFN1216-8 (Ta=25ºC)

Set Output Voltage V_{SET} (V)	Dropout Voltage V_{DIF} (V)			
	I_{OUT}=500mA		I_{OUT}=1000mA	
	TYP.	MAX.	TYP.	MAX.
0.7 ≤ V_{SET} < 1.1	*15	*15	*15	*15
1.1 ≤ V_{SET} < 1.2	*15	*15	*15	0.300
1.2 ≤ V_{SET} < 1.3	*15	*15	0.195	0.275
1.3 ≤ V_{SET} < 1.5	0.095	0.135	0.185	0.260
1.5 ≤ V_{SET} < 1.8	0.085	0.120	0.165	0.235
1.8 ≤ V_{SET} < 2.6	0.075	0.110	0.150	0.215
2.6 ≤ V_{SET} < 3.3	0.065	0.090	0.130	0.180
3.3 ≤ V_{SET} ≤ 4.3	0.060	0.085	0.125	0.170

If the dropout voltage falls below the release offset value of reverse current protection mode (V_{REV_REL}), the reverse current protection circuit may repeat the detection and release operations. Please refer to *Reverse Current Protection Circuit* (P.12).

*15 Input voltage should be equal or more than the minimum operating voltage (1.4V).

Table 2. Dropout Voltage

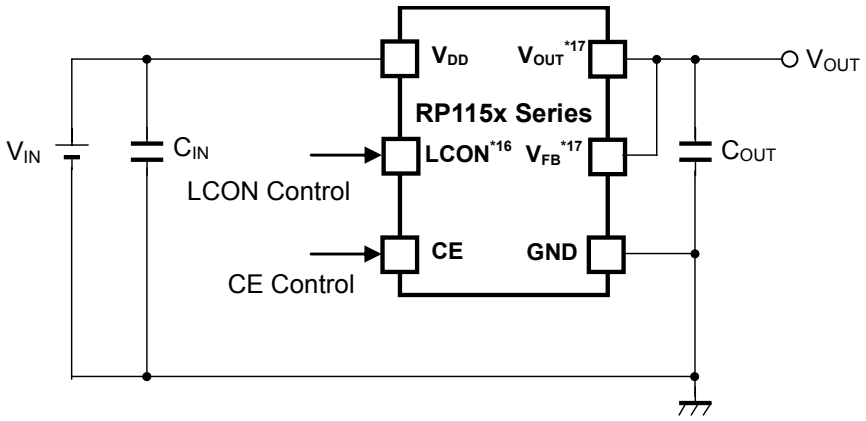
RP115H: SOT-89-5 (Ta=25ºC)

Set Output Voltage V_{SET} (V)	Dropout Voltage V_{DIF} (V)	
	I_{OUT}=1000mA	
	TYP.	MAX.
0.7 ≤ V_{SET} < 1.1	*15	*15
1.1 ≤ V_{SET} < 1.2	*15	0.350
1.2 ≤ V_{SET} < 1.3	0.235	0.330
1.3 ≤ V_{SET} < 1.5	0.225	0.320
1.5 ≤ V_{SET} < 1.8	0.205	0.295
1.8 ≤ V_{SET} < 2.6	0.190	0.270
2.6 ≤ V_{SET} < 3.3	0.170	0.240
3.3 ≤ V_{SET} ≤ 4.3	0.165	0.225

If the dropout voltage falls below the release offset value of reverse current protection mode (V_{REV_REL}), the reverse current protection circuit may repeat the detection and release operations. Please refer to *Reverse Current Protection Circuit* (P.12).

*15 Input voltage should be equal or more than the minimum operating voltage (1.4V).

TYPICAL APPLICATION



External Parts Example

C_{IN}, C_{OUT}: Ceramic Capacitor, 1.0µF, muRata GRM155B31A105KE15

Notes:

***16 The LCON pin is only included in RP115L (DFN1216-8).**

***17 The V_{OUT} pin and the V_{FB} pin should be wired together when mouting on the board.**

TECHNICAL NOTES

Phase Compensation

In LDO (Low Drop Out) regulators, phase compensation is provided to secure stable operation even when the load current is varied. For this purpose, use a capacitor C_{OUT} with 1.0µF or more and proper ESR (Equivalent Series Resistance).

If you use a tantalum type capacitor and the ESR value of the capacitor is large, the output might be unstable. Evaluate your circuit including consideration of frequency characteristics. Depending on the capacitor size, manufacturer, and part number, the bias characteristics and temperature characteristics are different. Evaluate the circuit taking actual characteristics into account.

PCB Layout

Ensure the V_{DD} and GND lines are sufficiently robust. If their impedance is too high, noise pickup or unstable operation may result. Connect a capacitor C_{IN} with 1.0µF or more between V_{DD} and GND pins, and as close as possible to the pins.

REVERSE CURRENT PROTECTION CIRCUIT

The RP115x Series include a Reverse Current Protection Circuit, which stops the reverse current from V_{OUT} pin to V_{DD} pin or to GND pin when V_{OUT} becomes higher than V_{IN}.

Usually, the LDO using Pch output transistor contains a parasitic diode between V_{DD} pin and V_{OUT} pin.

Therefore, if V_{OUT} is higher than V_{IN}, the parasitic diode becomes forward direction. As a result, the current flows from V_{OUT} pin to V_{DD} pin.

The ICs of this series switches the mode to the reverse current protection mode before V_{IN} becomes lower than V_{OUT} by connecting the parasitic diode of Pch output transistor to the backward direction, and connecting the gate to V_{OUT} pin. As a result, the Pch output transistor is turned off. However, from V_{OUT} pin to GND pin, via the internal divider resistors, very small current I_{REV} flows.

Switching to either the normal mode or to the reverse current protection mode is determined by the magnitude of V_{IN} voltage and V_{OUT} voltage. For the stable operation, offset and hysteresis are set as the threshold. The detector threshold is set to V_{REV_DET} and the released voltage is set to V_{REV_REL}. Therefore, the minimum dropout voltage under the small load current condition is restricted by the value of V_{REV_REL}.

Following figures show the diagrams of each mode, and the load characteristics of each mode. When giving the V_{OUT} pin a constant-voltage and decreasing the V_{IN} voltage, the dropout voltage will become lower than V_{REV_DET}. As a result, the reverse current protection starts to function to stop the load current.

By increasing the dropout voltage higher than V_{REV_REL}, the protection mode will be released to let the load current to flow. If the dropout voltage to be used is lower than V_{REV_REL}, the detection and the release may be repeated.

The operating voltage guaranteed level of the reverse current protection circuit is for $V_{OUT} \geq 0.7V$. If V_{IN}=0V, the reverse current protection mode becomes always active.

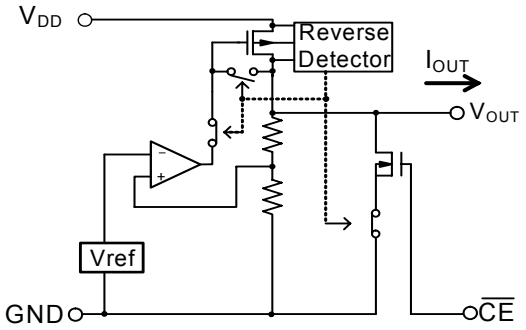


Figure 1. Normal Operation Mode

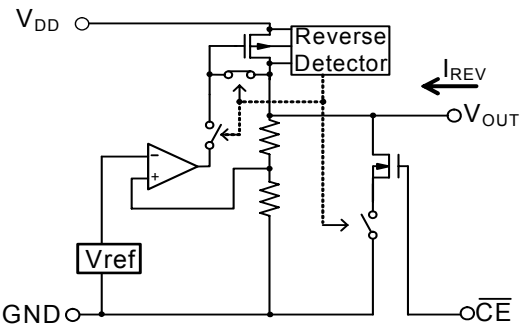


Figure 2. Reverse Current Protection Mode

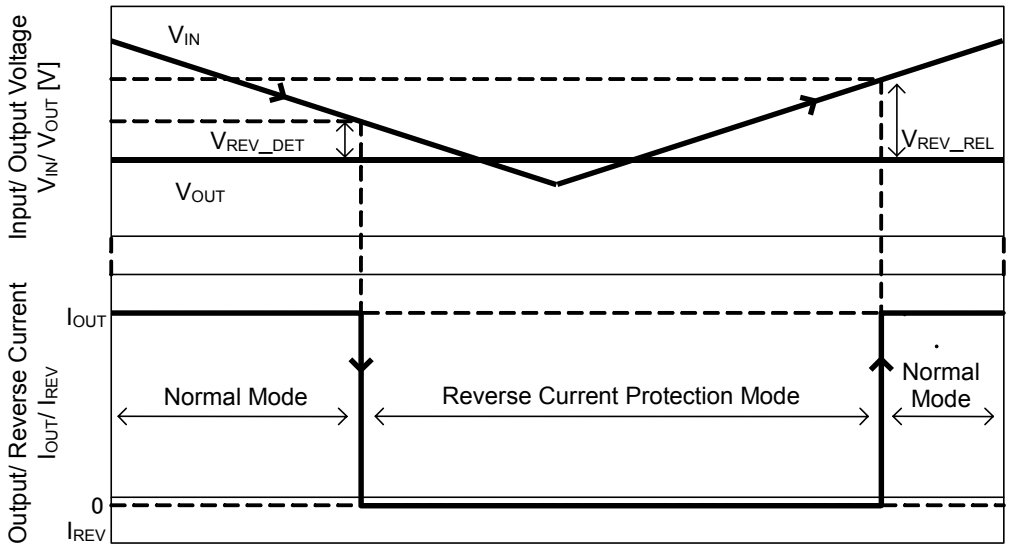


Figure 3. Detection/ Release Timing of Reverse Current Protection Function

START-UP CHARACTERISTICS

Constant slope circuit is included in the RP115x Series to prevent the overshoot of the output voltage. The start-up time (t_{ON}) is 100µs (Typ.).

If inrush current increases due to the large capacitance of C_{OUT}, the operation mode will be shifted from Constant Slope (CS) mode to Constant Current (CC) mode. The CC mode maintains a constant level of inrush current. In the CC mode, t_{ON} varies according to the size of C_{OUT} and the amount of load current.

Start-up Time and Inrush Current Estimations

Start-up time and inrush current in the CS mode and the CC mode can be estimated as follows.

・CS Mode

Start-up Time: t_{ON} = 100µs (TYP.)

Inrush Current: $I_{RUSH} = C_{OUT} \cdot V_{SET} / t_{ON} + I_{OUT}$ [*18]

Note: If the result of the above calculation is more than the following values, the operation mode will be shifted from the CS mode to the CC mode.

LCON="L"·····300mA (TYP.)

LCON="H"·····500mA (TYP.)

・CC Mode

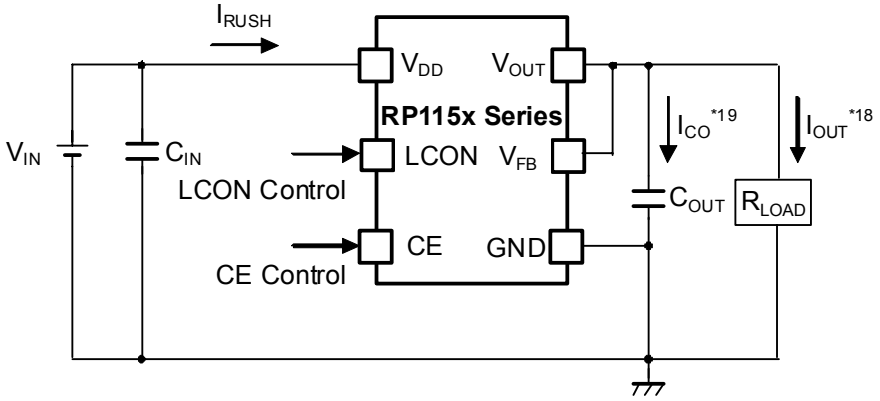
Start-up Time: $t_{ON} = C_{OUT} \cdot V_{SET} / I_{CO}$ [*19]

Inrush Current: I_{RUSH} LCON="L"·····300mA (TYP.)

LCON="H"·····500mA (TYP.)

[*18] I_{OUT}: When R_{LOAD} is connected to load, I_{OUT} can be calculated by $R_{LOAD} = V_{SET} / I_{OUT}$.

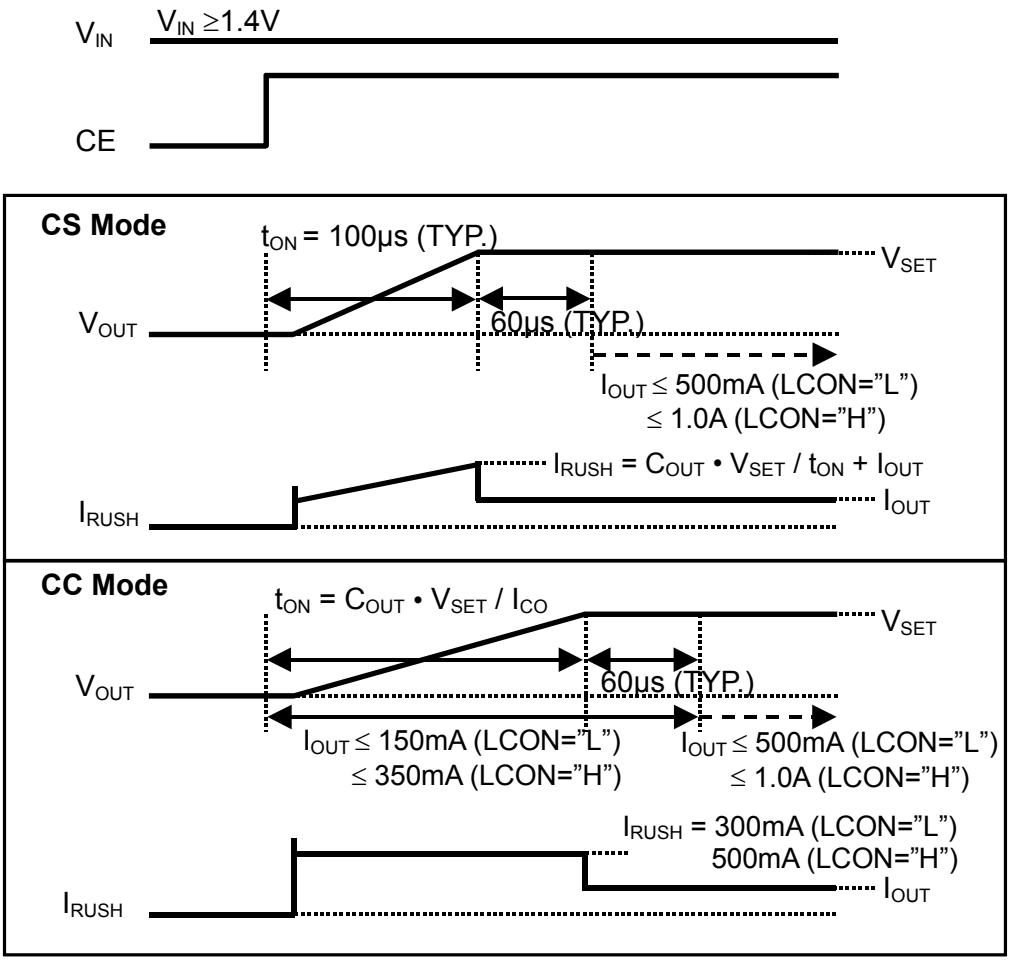
[*19] I_{CO}: I_{CO} is a charge current of C_{OUT} and can be calculated roughly by $I_{RUSH} \approx I_{CO} + I_{OUT}$.



Circuit Example

Notes: The LCON pin is only included in RP115L (DFN1216-8) only.

RP115H: Same Electrical Characteristics as LCON="H".



Start-up Operation Diagram

Precautions Before Use

During the start-up, the inrush current limit circuit is in operation; therefore, the load current (I_{OUT}) should be drawn after the output voltage (V_{OUT}) reached the preset value (Best timing: t_{ON} + 60µs or more). If the load current is drawn during the start-up, it should be within the following values.

LCON="L" ····· $I_{OUT} \leq 150mA$

LCON="H" ····· $I_{OUT} \leq 350mA$

In the CC mode, I_{RUSH} is limited until V_{OUT} reaches the preset value. $I_{RUSH} \approx I_{CO} + I_{OUT}$ is true; therefore, if large I_{OUT} is drawn during the start-up, the charge current (I_{CO}) of C_{OUT} decreases and t_{ON} becomes longer. Please refer to *Start-up Time and Inrush Current Estimations* (P.14).

In order to control the start-up operation by using the CS mode or CC mode, input "H" into the CE pin while $V_{IN} \geq 1.4V$. If "H" is input into the CE pin while V_{IN} is less than the minimum operating voltage, the operation may not be controlled by the CS mode or CC mode.

LCON PIN OPERATION

By alternating the LCON pin between “H” or “L”, the RP115L can choose the output current limit either 1.0A or 500mA. Please note that during start-up (t_{ON} + 60µs (TYP.)), do not change the logic of the LCON pin.

LCON=”L” ····· 500mA
LCON=”H” ····· 1.0A

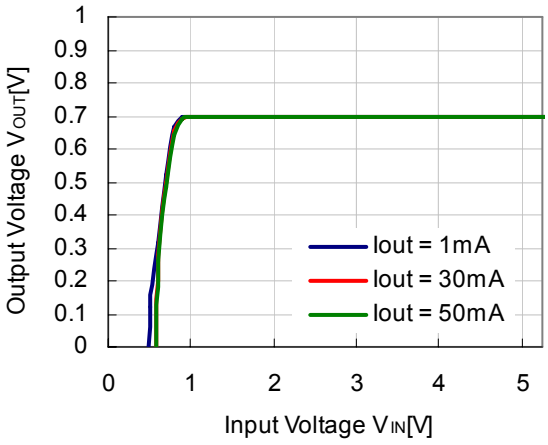
Application Example

Even when using the RP115L with LCON=”H”, I_{RUSH} in the CC mode can be reduced from 500mA (TYP.) to 300mA (TYP.) by starting up the IC with LCON=”L”. Please refer to *START-UP CHARACTERISTICS* (P.14).

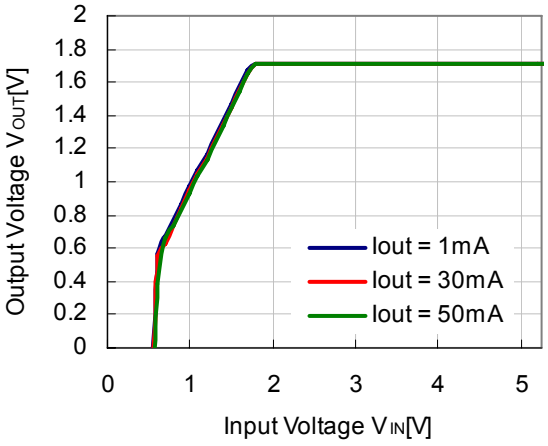
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Input Voltage (C_{IN}=Ceramic1.0µF, C_{OUT}=Ceramic1.0µF, Ta=25°C)

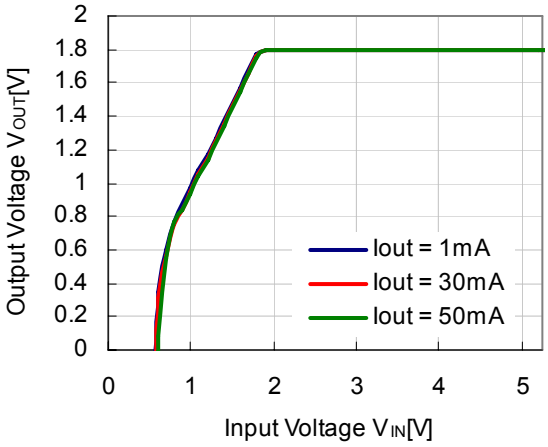
RP115x071x



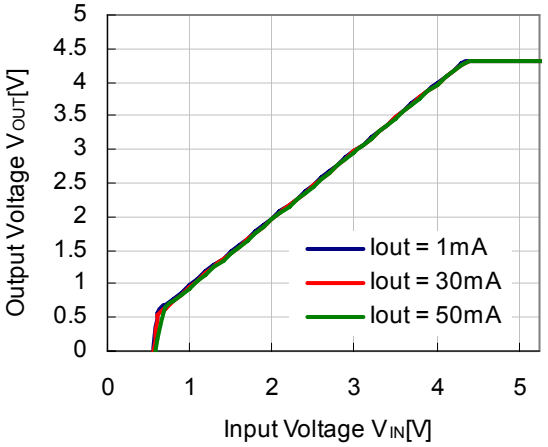
RP115x171x



RP115x181x

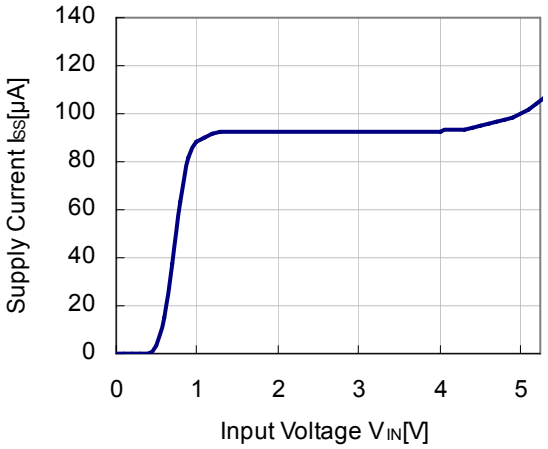


RP115x431x

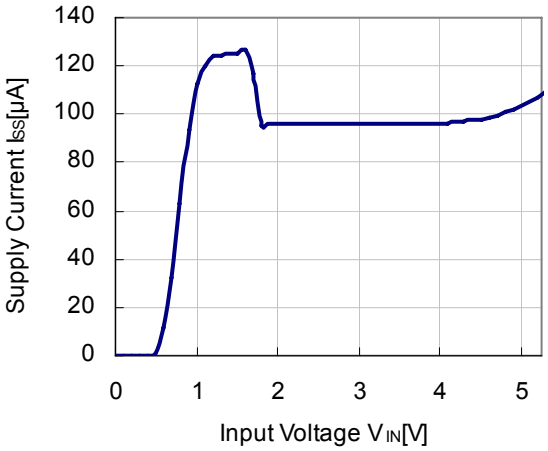


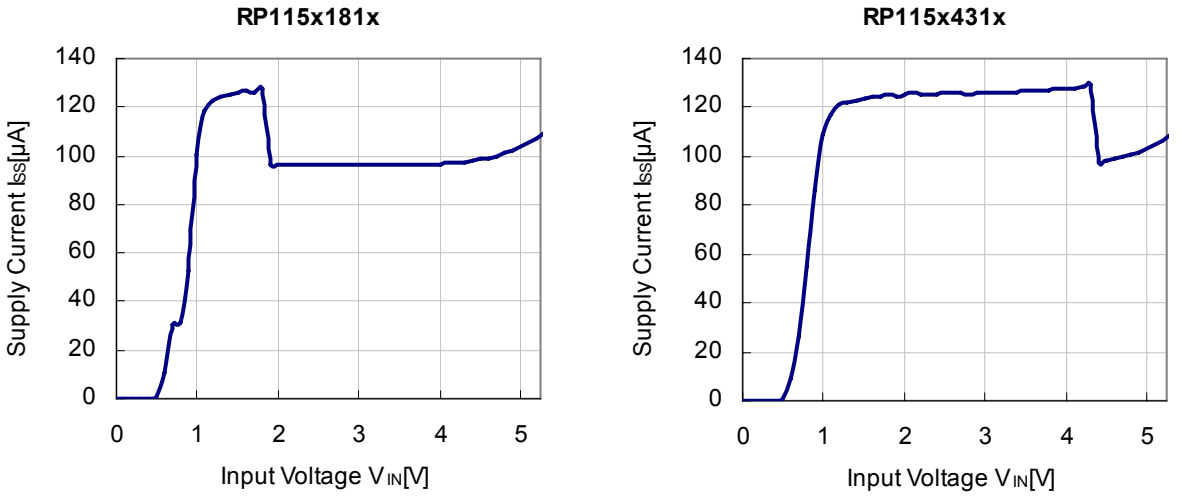
2) Supply Current vs. Input Voltage (C_{IN}=Ceramic1.0µF, C_{OUT}=Ceramic1.0µF, Ta=25°C)

RP115x071x



RP115x171x

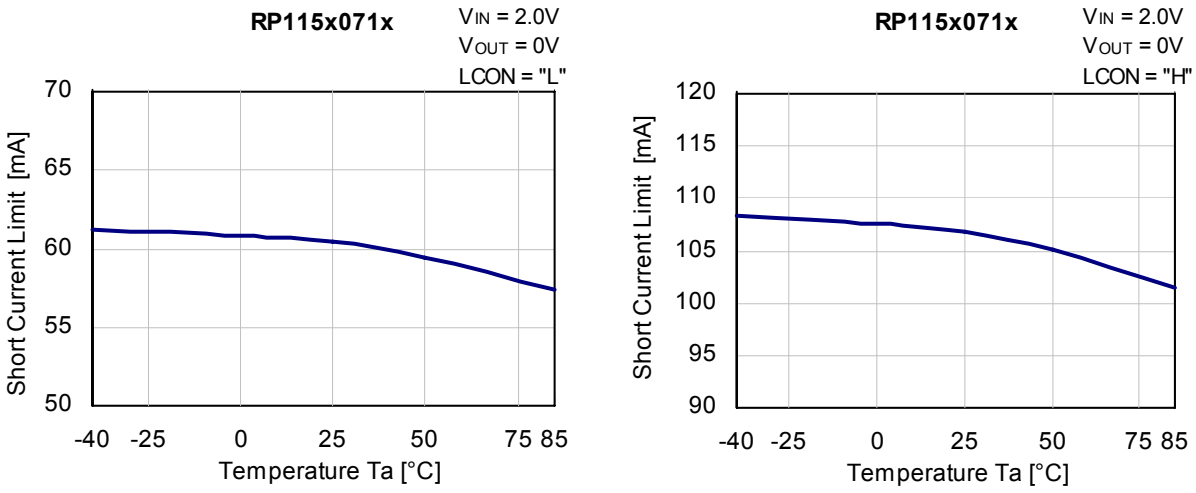




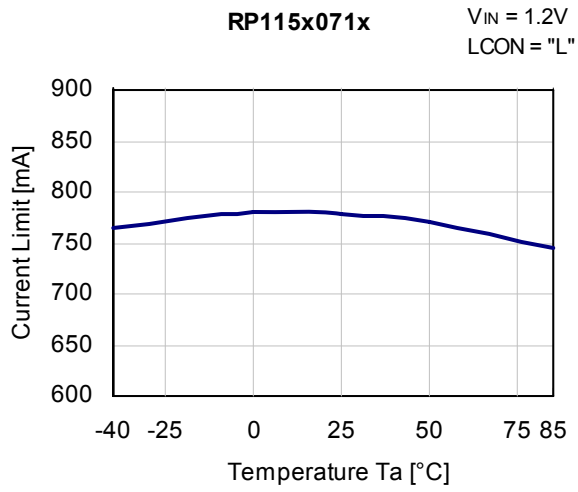
Short Current Limit vs. Temperature and Current Limit vs. Temperature

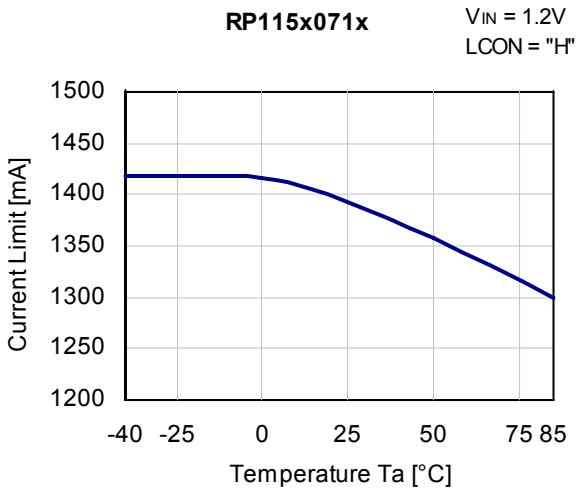
The RP115x contains a peak current limit circuit which protect the regulator from damage by overcurrent if the output pin (V_{OUT}) and the ground pin (GND) are shorted. The short-circuiting causes the overheating of the device which leads a thermal shutdown circuit to operate. If the peak current limit circuit and the thermal shutdown circuit work at the same time, fold-back type dropping characteristics cannot be measured. As for the short-circuit current and the peak current limit circuit, please refer to 3) Short Current Limit vs. Temperature and 4) Current Limit vs. Temperature.

3) Short Current Limit vs. Temperature

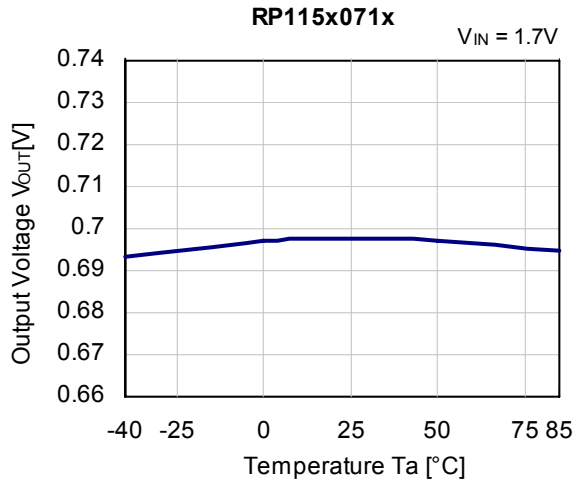


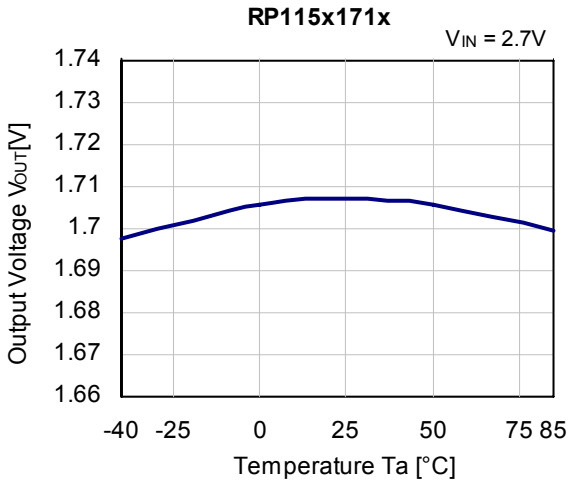
4) Peak Current Limit vs. Temperature

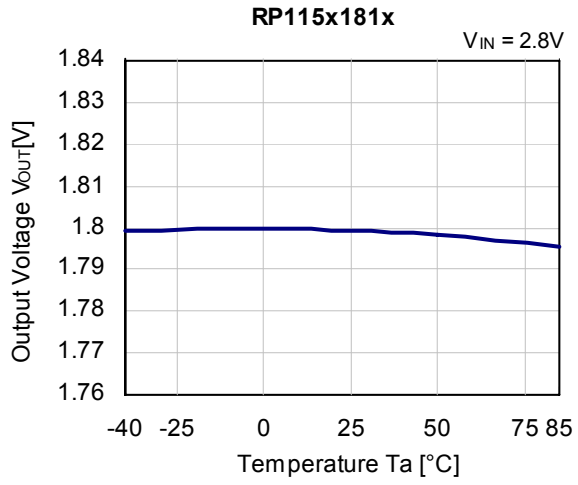


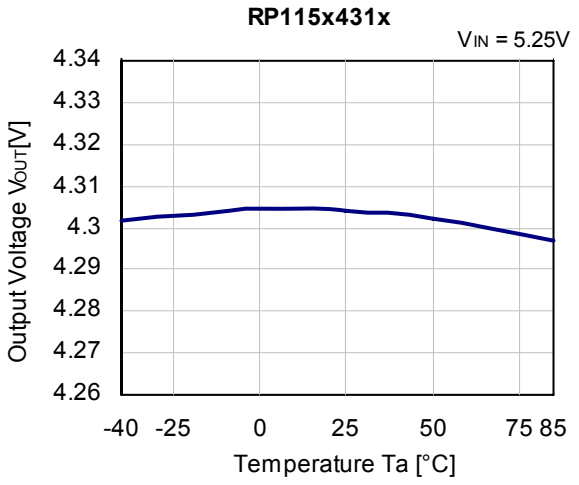


5) Output Voltage vs. Temperature (C_{IN}=Ceramic1.0µF, C_{OUT}=Ceramic1.0µF, I_{OUT}=1mA)

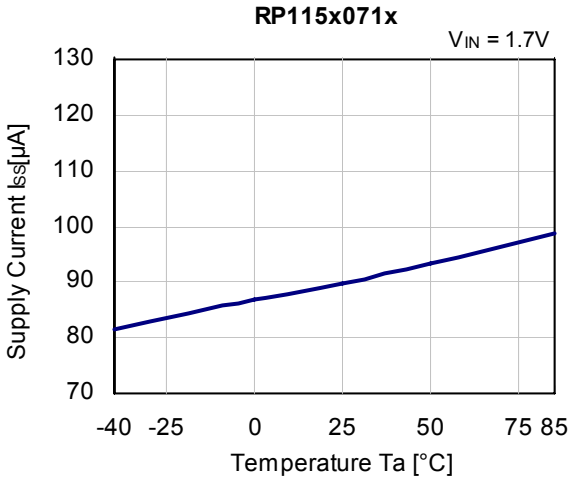


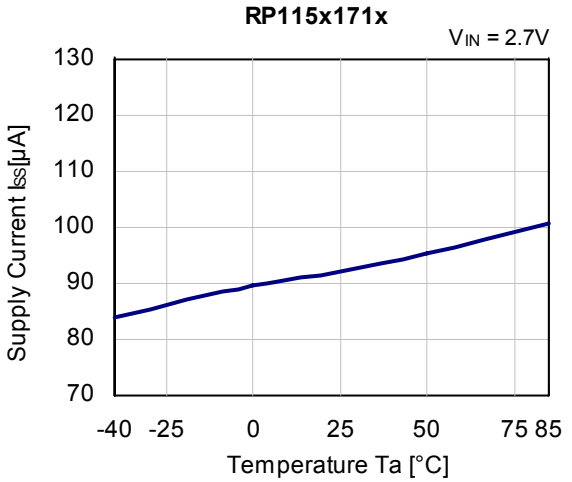


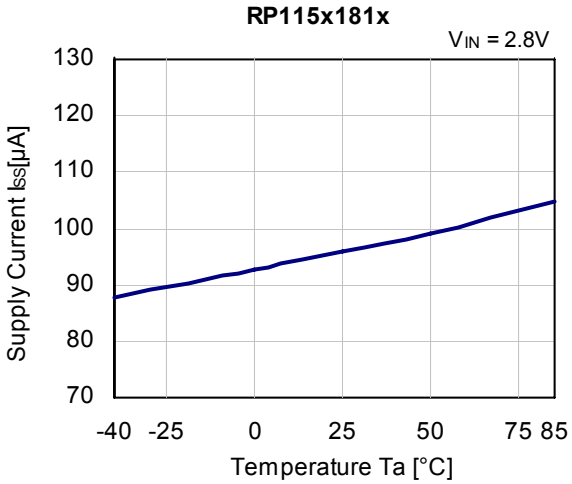


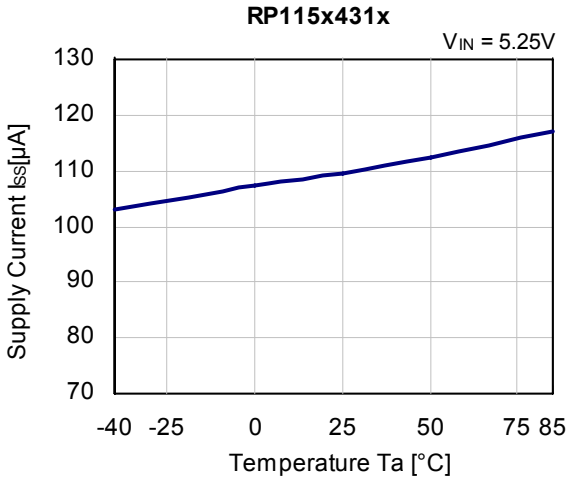


6) Supply Current vs. Temperature (C_{IN}=Ceramic1.0µF, C_{OUT}=Ceramic1.0µF, I_{OUT}=0mA)



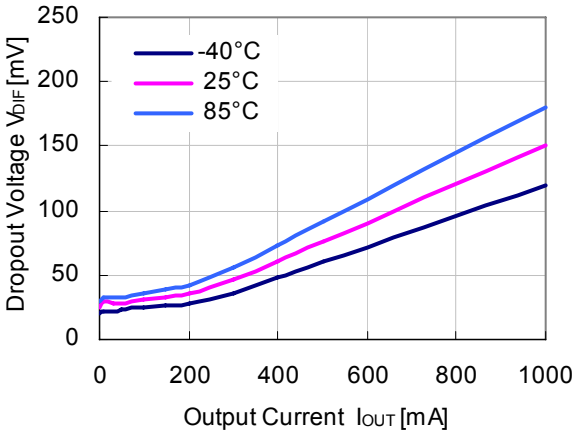




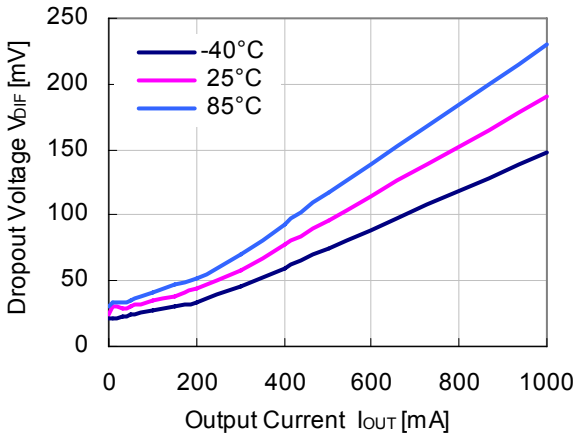


7) Dropout Voltage vs. Output Current (C_{IN}=Ceramic1.0µF, C_{OUT}=Ceramic1.0µF)

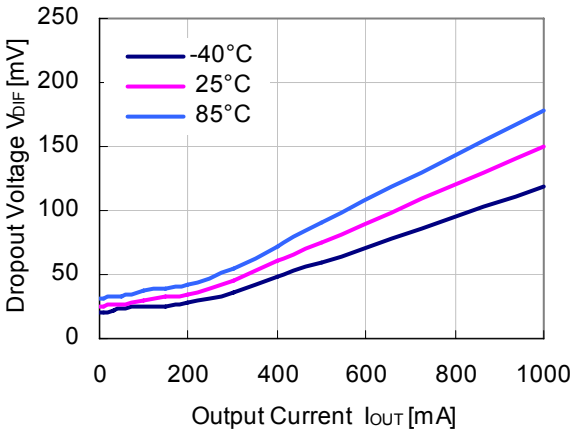
RP115L171x



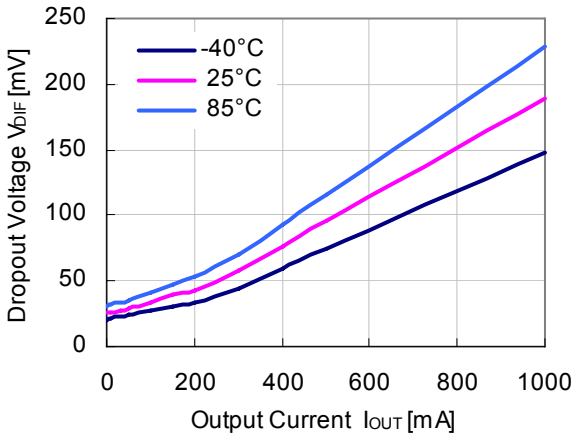
RP115H171x



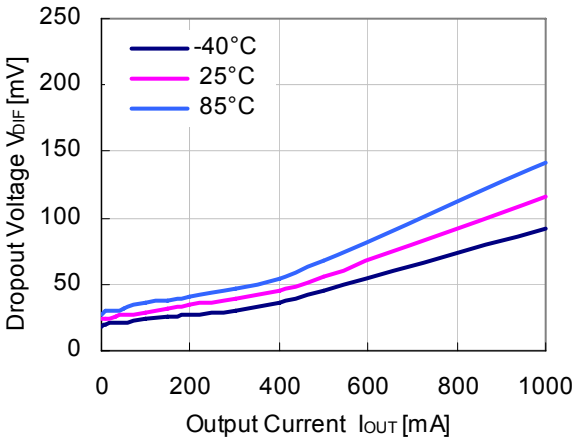
RP115L181x



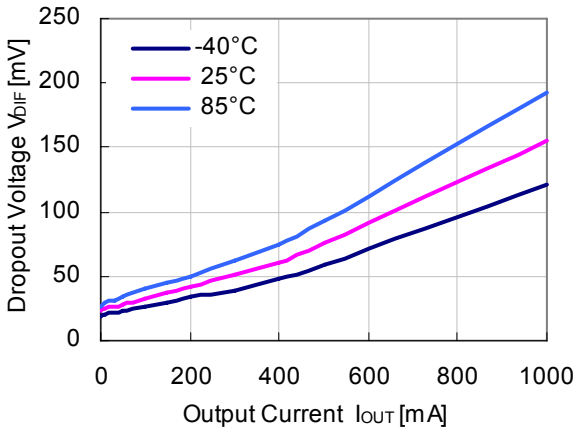
RP115H181x



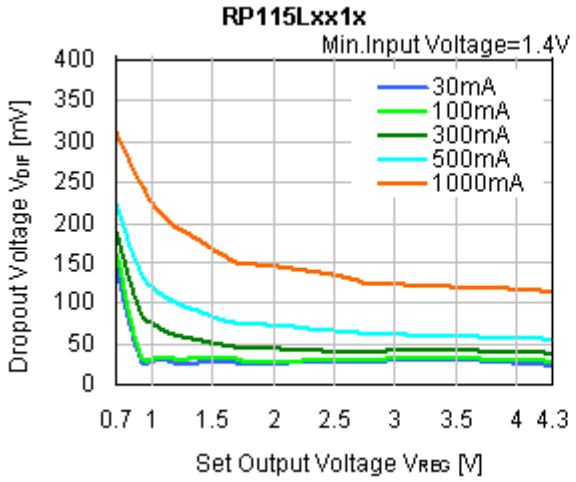
RP115L431x

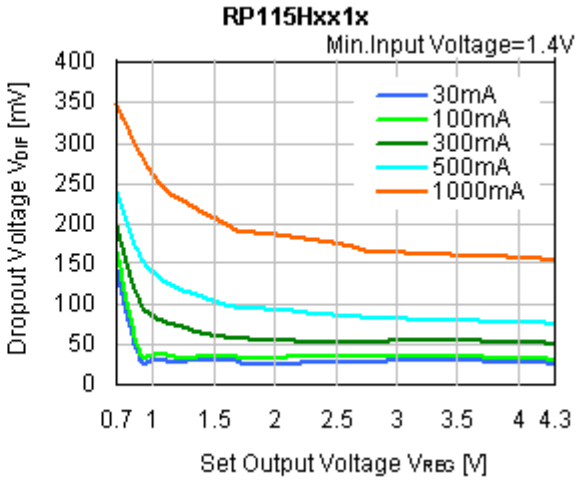


RP115H431x

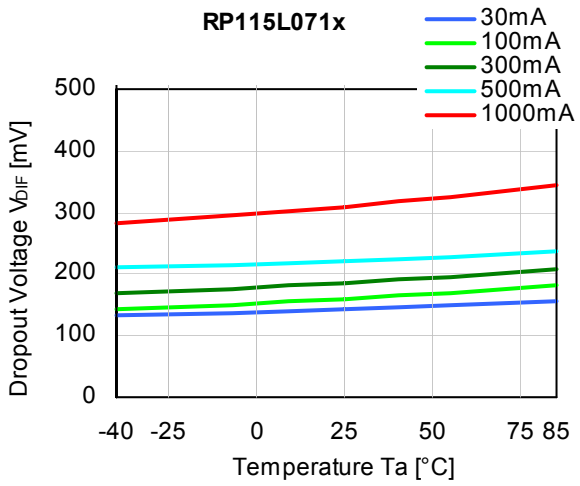


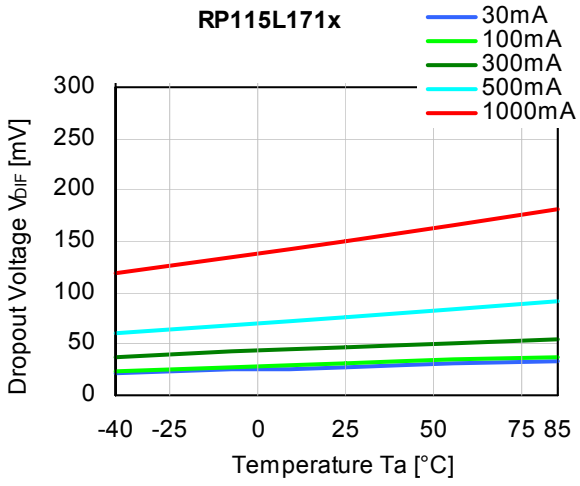
8) Dropout Voltage vs. Set Output Voltage (C_{IN}=Ceramic1.0µF, C_{OUT}=Ceramic1.0µF, Ta=25°C)

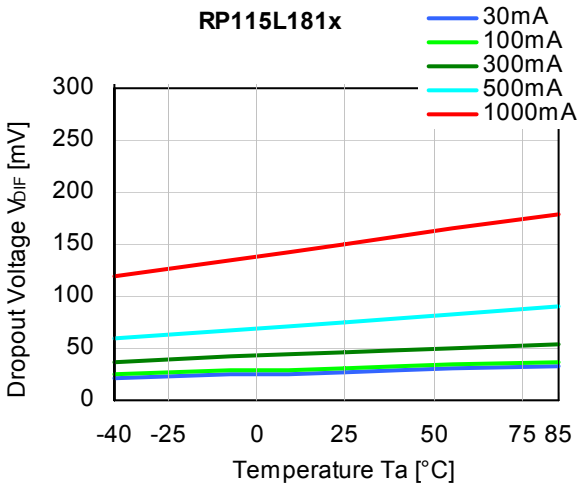


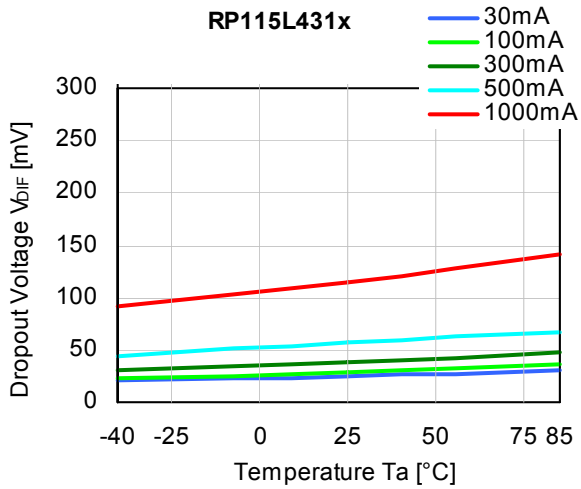


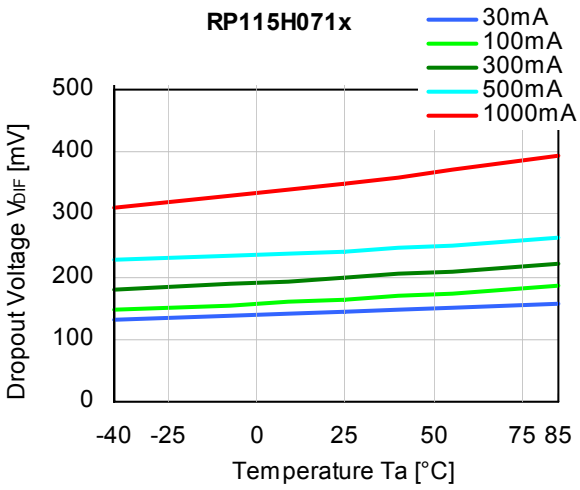
9) Dropout Voltage vs. Temperature (C_{IN}=Ceramic1.0µF, C_{OUT}=Ceramic1.0µF)

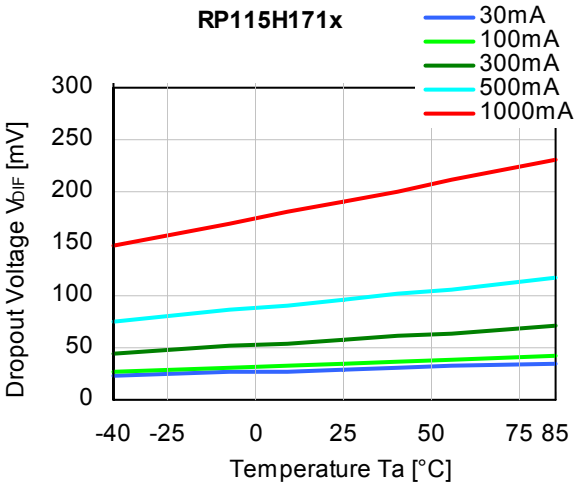


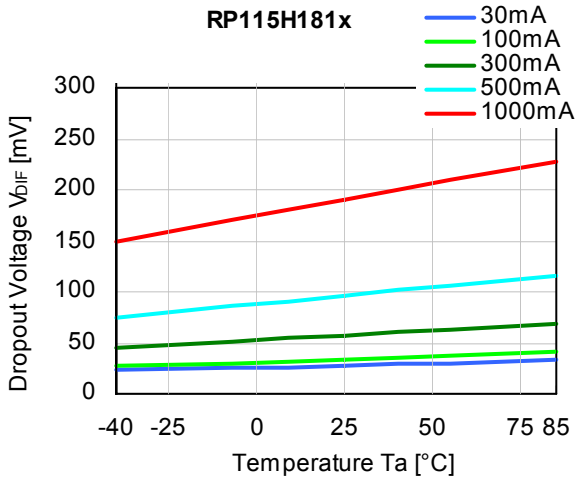


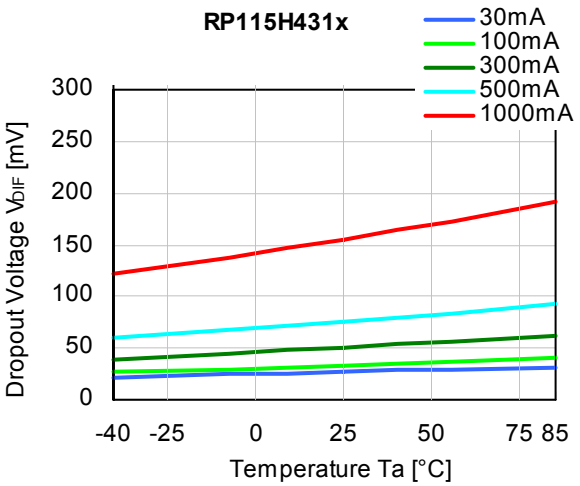




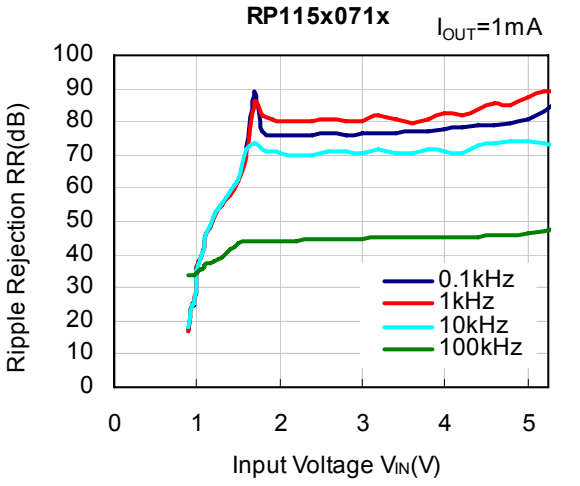


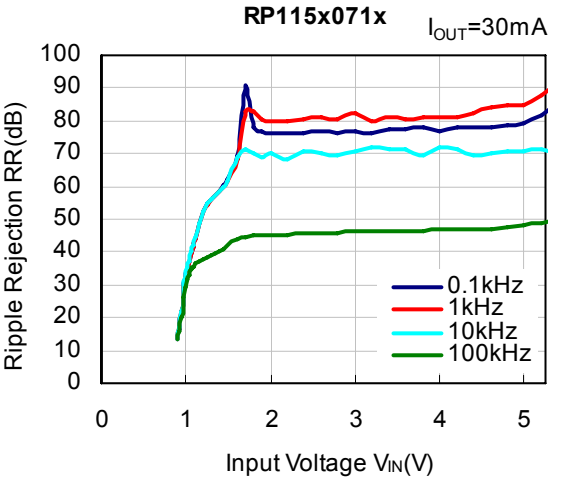


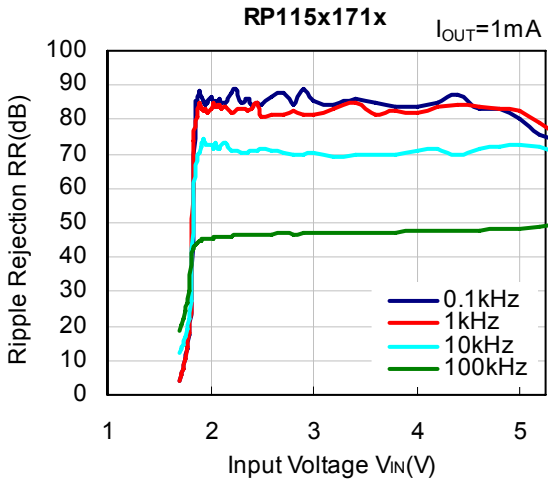


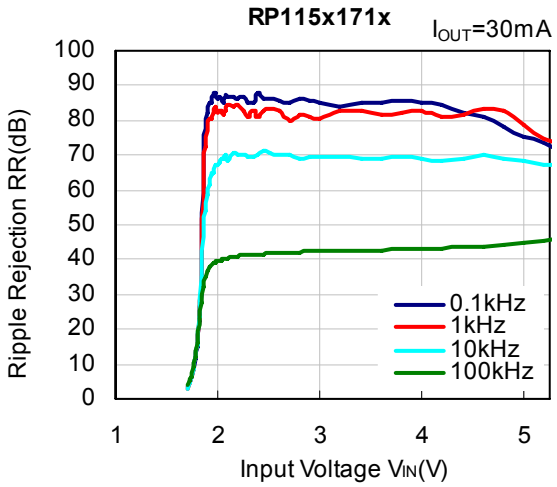


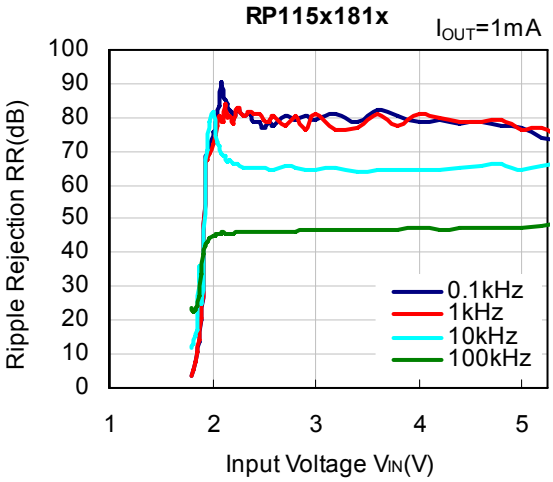
10) Ripple Rejection vs. Input Voltage (C_{IN}=none, C_{OUT}=Ceramic1.0µF, Ripple=0.2Vp-p, Ta=25°C)

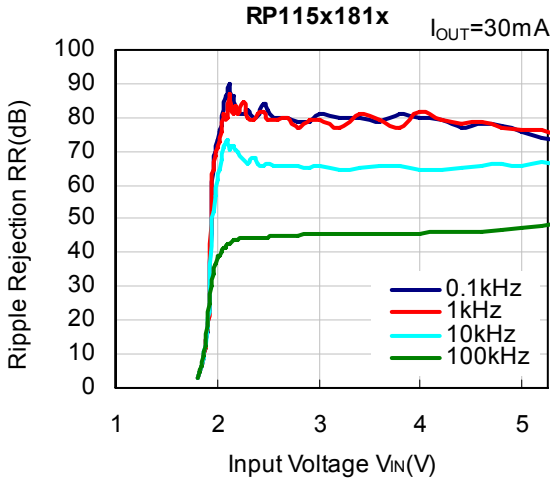


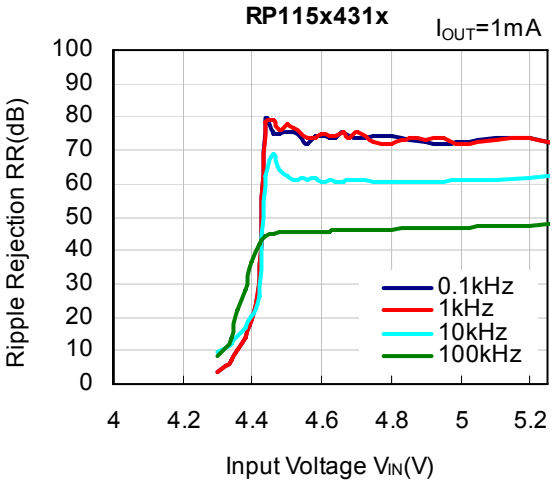


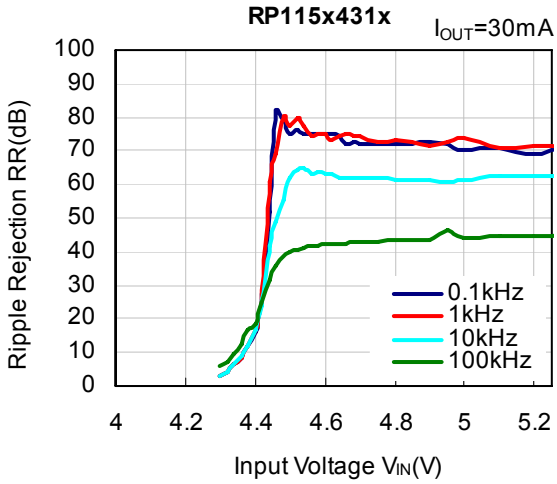

RP115x171x
IOUT=1mA
Ripple Rejection RR(dB)
Input Voltage VIN(V)
0.1kHz
1kHz
10kHz
100kHz


RP115x171x
IOUT=30mA
Ripple Rejection RR(dB)
Input Voltage VIN(V)
0.1kHz
1kHz
10kHz
100kHz

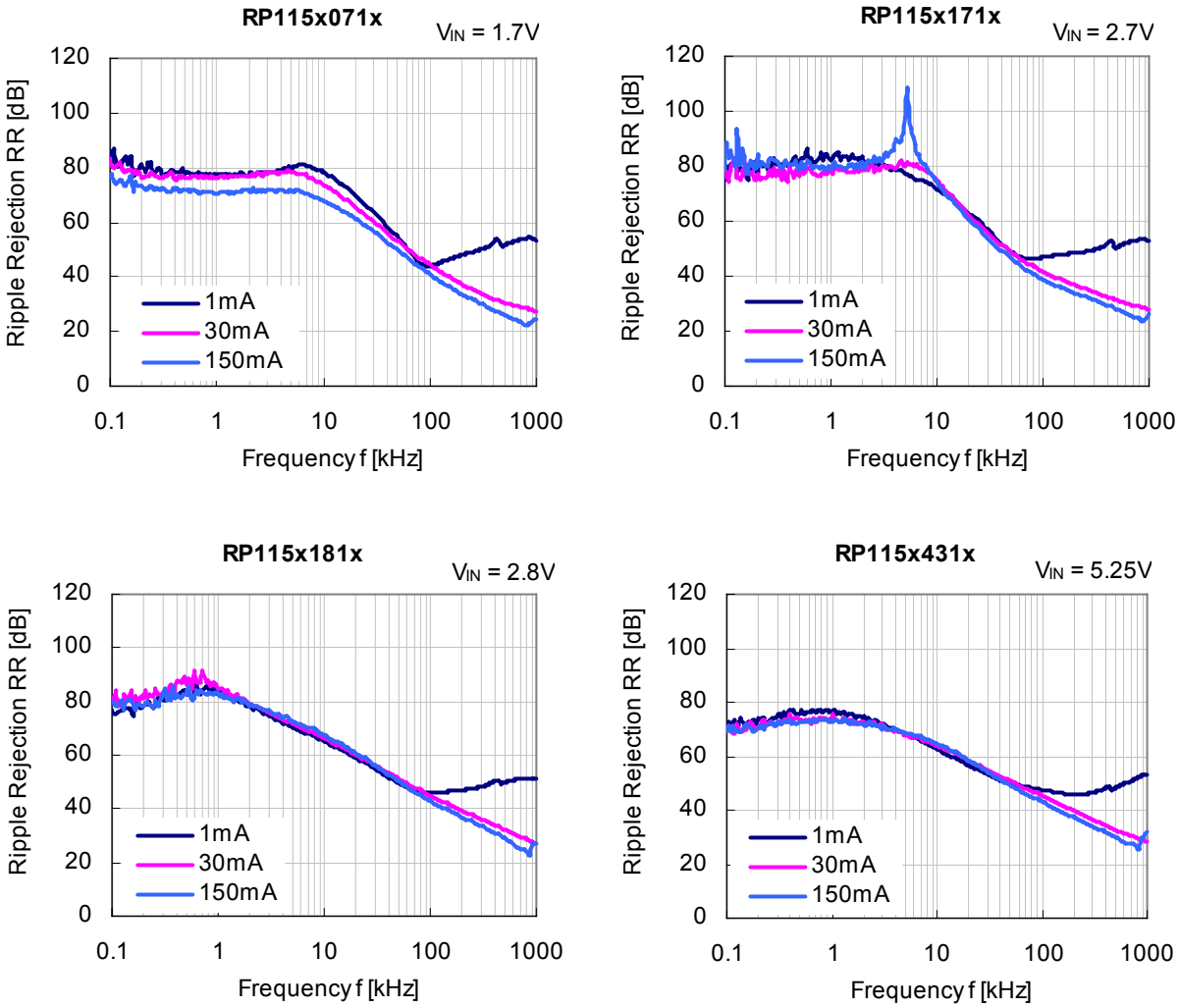

RP115x181x
IOUT=1mA
Ripple Rejection RR(dB)
Input Voltage VIN(V)
0.1kHz
1kHz
10kHz
100kHz


RP115x181x
IOUT=30mA
Ripple Rejection RR(dB)
Input Voltage VIN(V)
0.1kHz
1kHz
10kHz
100kHz

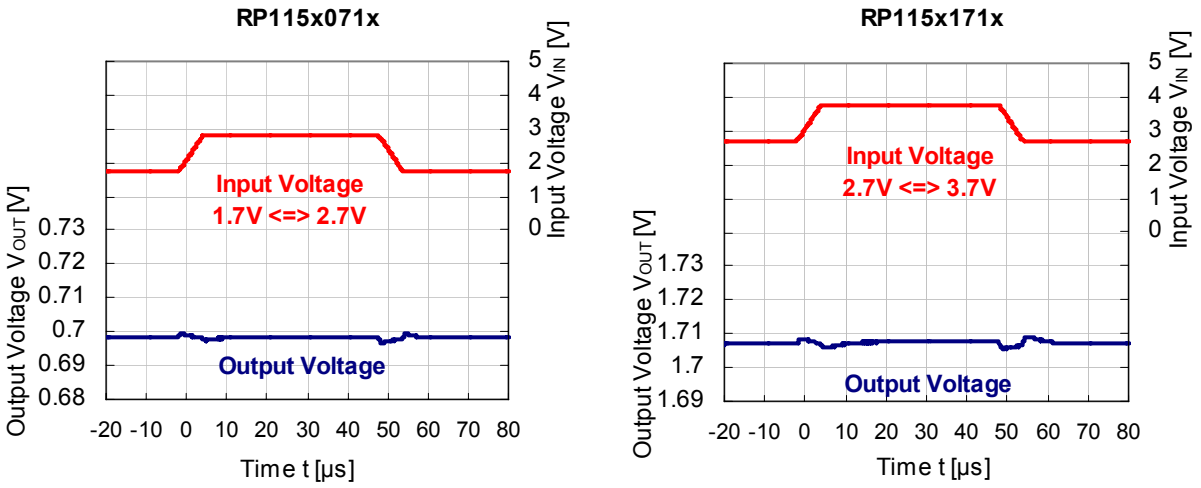

RP115x431x
IOUT=1mA
Ripple Rejection RR(dB)
Input Voltage VIN(V)
0.1kHz
1kHz
10kHz
100kHz

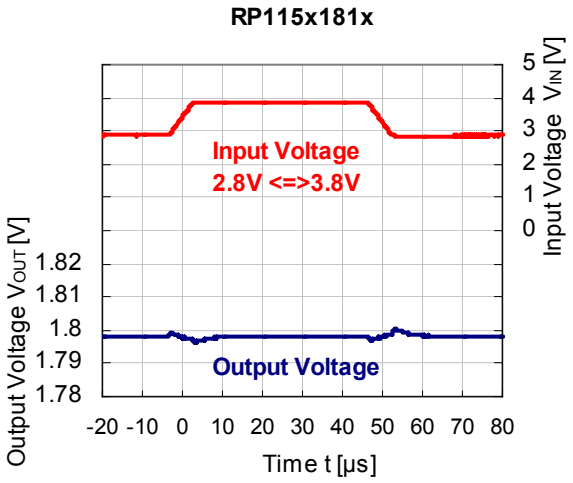

RP115x431x
IOUT=30mA
Ripple Rejection RR(dB)
Input Voltage VIN(V)
0.1kHz
1kHz
10kHz
100kHz

11) Ripple Rejection vs. Frequency (C_{IN}=none, C_{OUT}=Ceramic1.0µF, Ripple=0.2Vp-p, Ta=25°C)

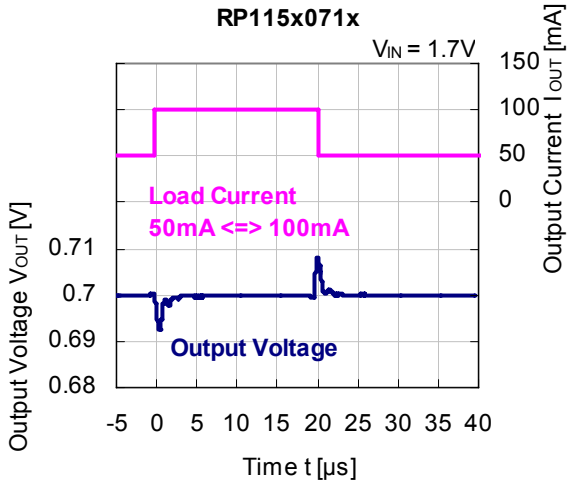


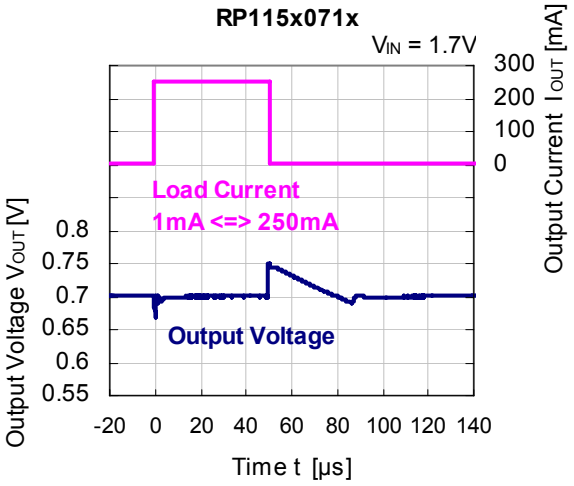
12) Line Transient Response (C_{IN}=none, C_{OUT}=Ceramic1.0µF, I_{OUT}=30mA, tr=tf=5µs, Ta=25°C)

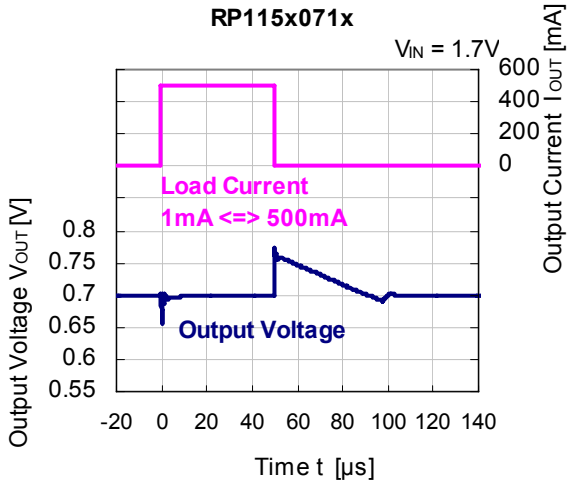


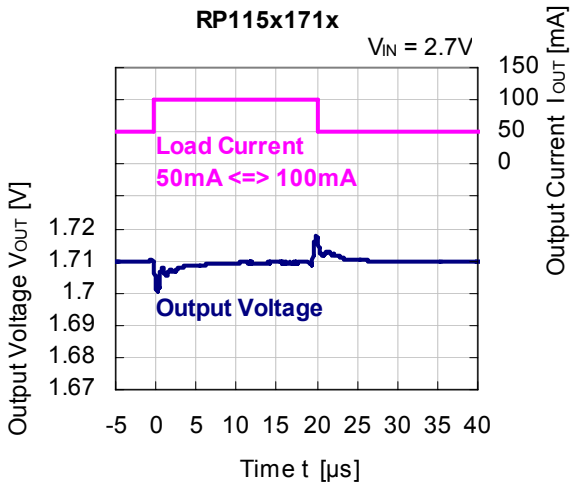


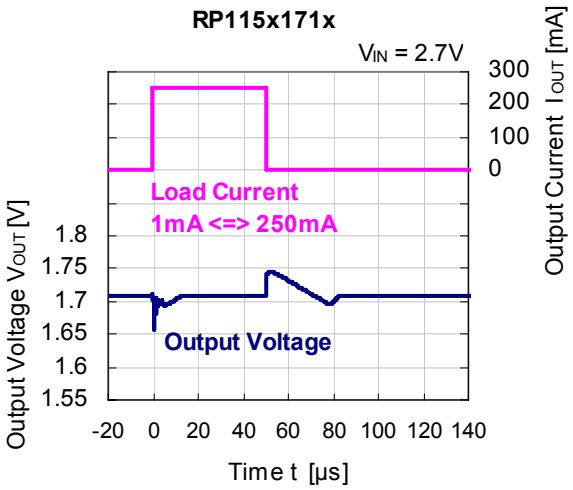
13) Load Transient Response (C_{IN}=Ceramic1.0µF, C_{OUT}=Ceramic1.0µF, tr=tf=0.5µs, Ta=25°C)

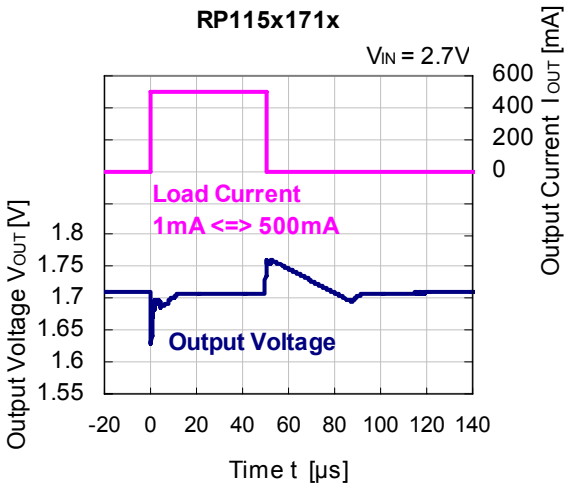


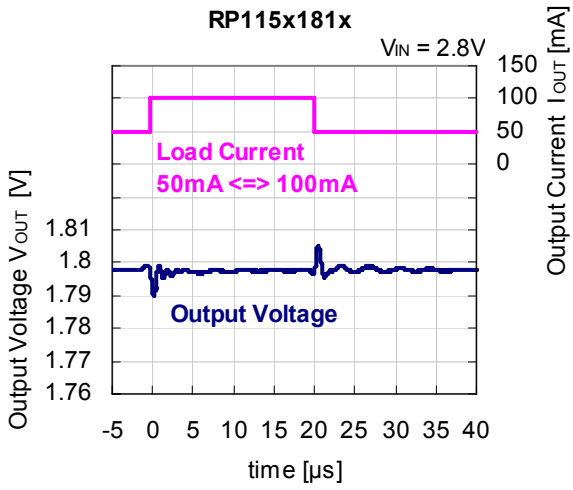


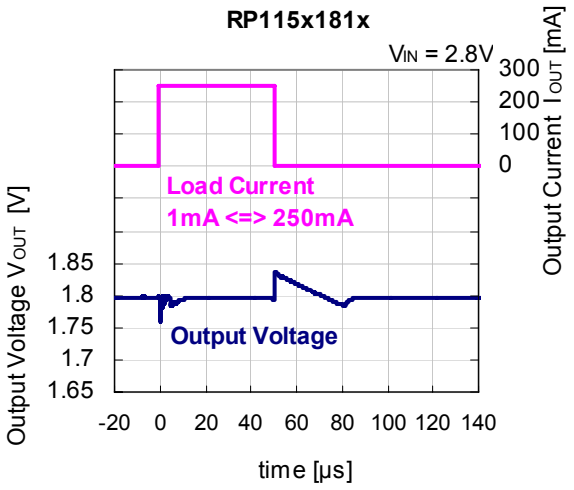


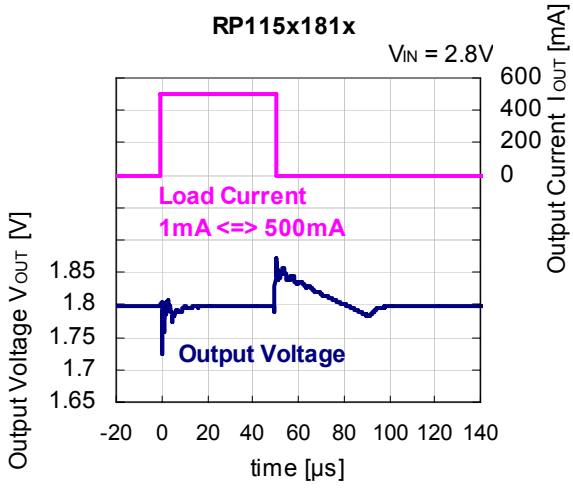


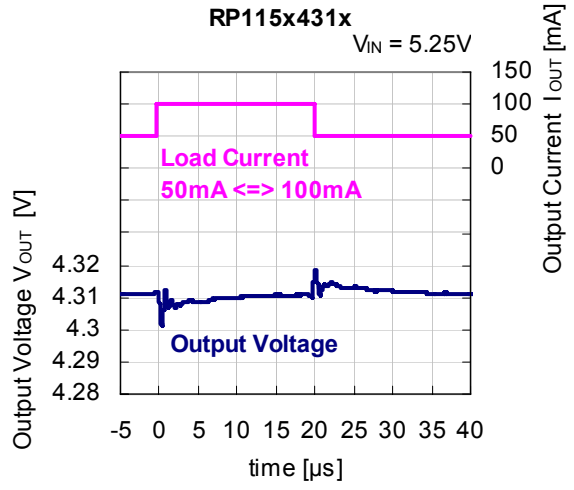

RP115x171x
VIN = 2.7V
Load Current
1mA <=> 250mA
Output Voltage
Output Voltage VOUT [V]
Output Current IOUT [mA]
Time t [µs]

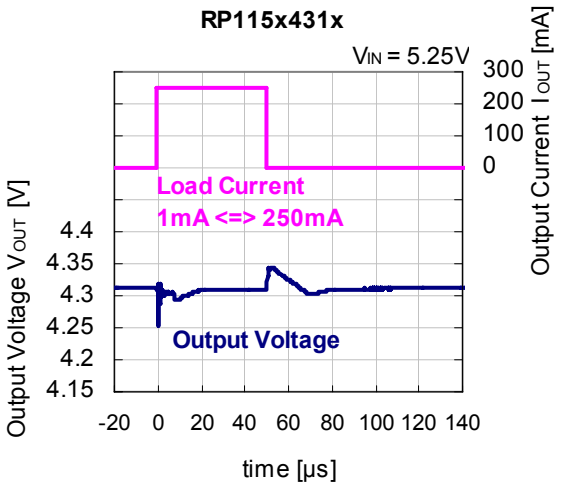

RP115x171x
VIN = 2.7V
Load Current
1mA <=> 500mA
Output Voltage
Output Voltage VOUT [V]
Output Current IOUT [mA]
Time t [µs]

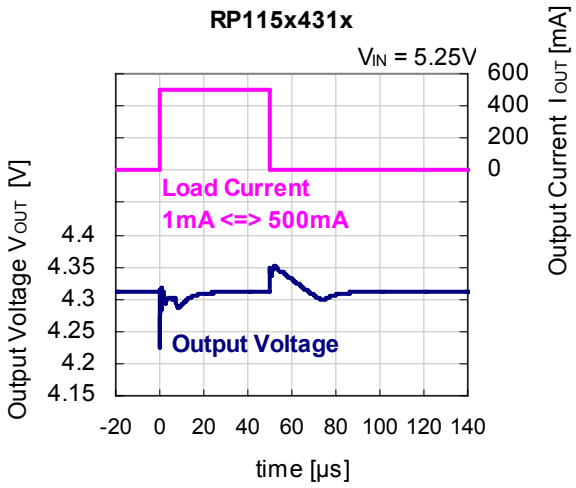

RP115x181x
VIN = 2.8V
Load Current
50mA <=> 100mA
Output Voltage
Output Voltage VOUT [V]
Output Current IOUT [mA]
time [µs]


RP115x181x
VIN = 2.8V
Load Current
1mA <=> 250mA
Output Voltage
Output Voltage VOUT [V]
Output Current IOUT [mA]
time [µs]

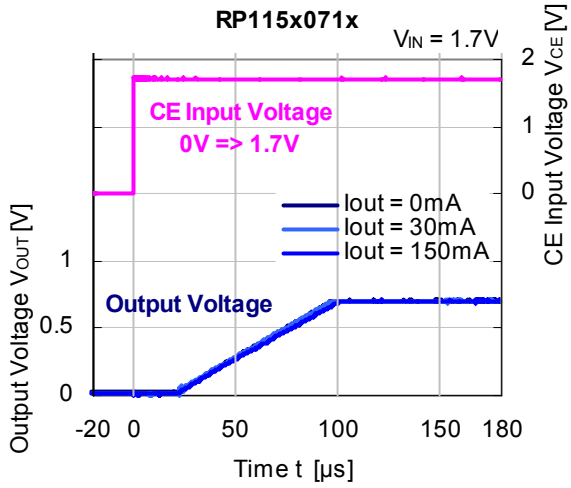

RP115x181x
VIN = 2.8V
Load Current
1mA <=> 500mA
Output Voltage
Output Voltage VOUT [V]
Output Current IOUT [mA]
time [µs]

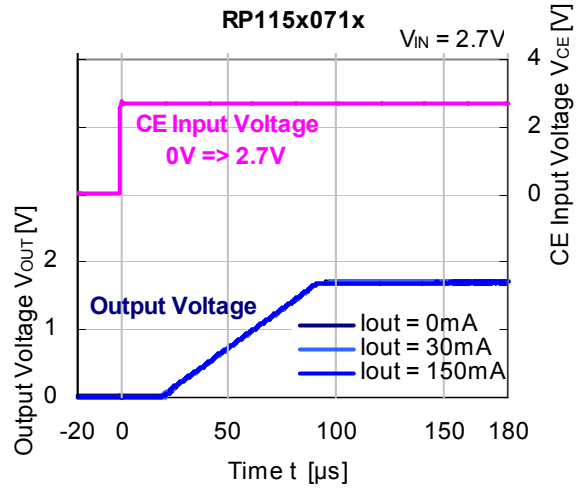

RP115x431x
VIN = 5.25V
Load Current
50mA <=> 100mA
Output Voltage
Output Voltage VOUT [V]
Output Current IOUT [mA]
time [µs]

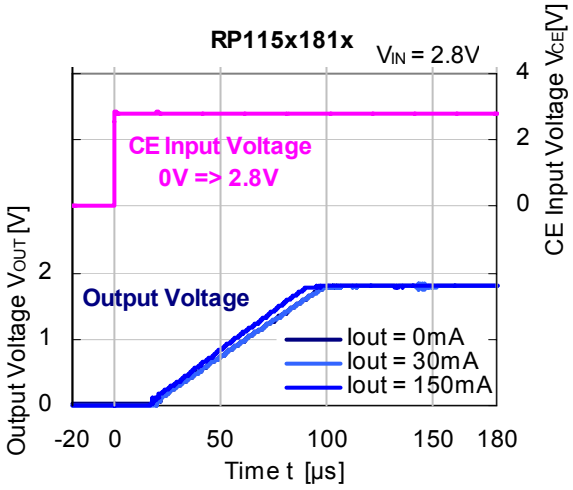


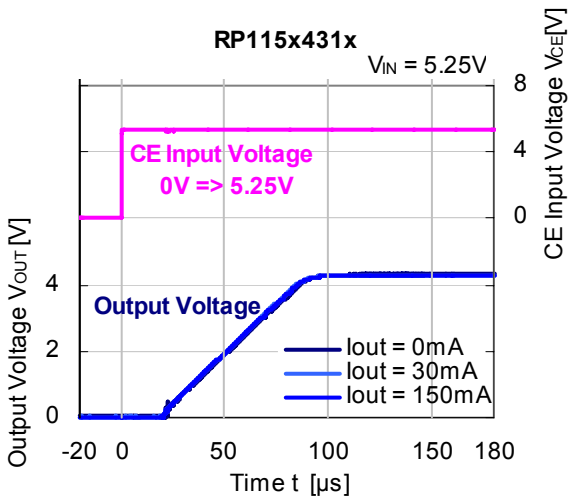


14) Turn-on Waveform by CE Pin Signal (C_{IN}=Ceramic1.0µF, C_{OUT}=Ceramic1.0µF, Ta=25°C)

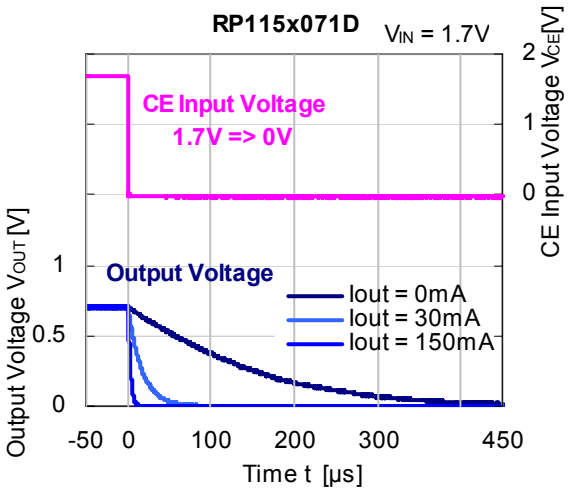


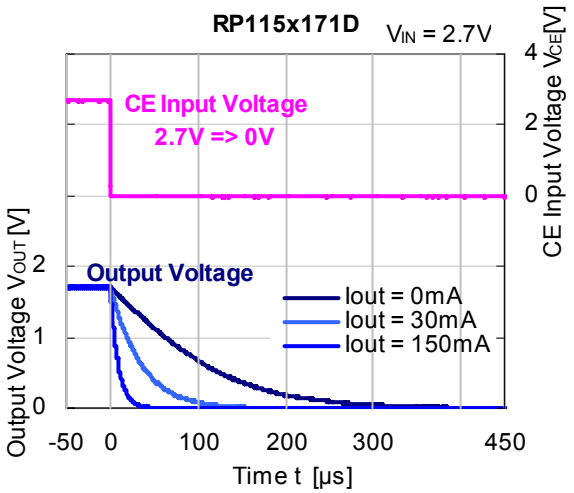


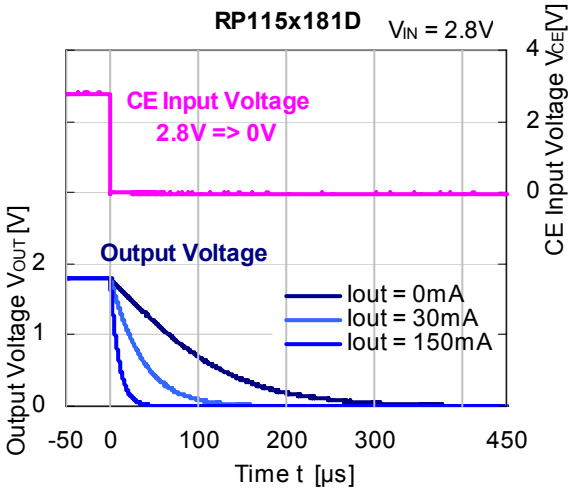


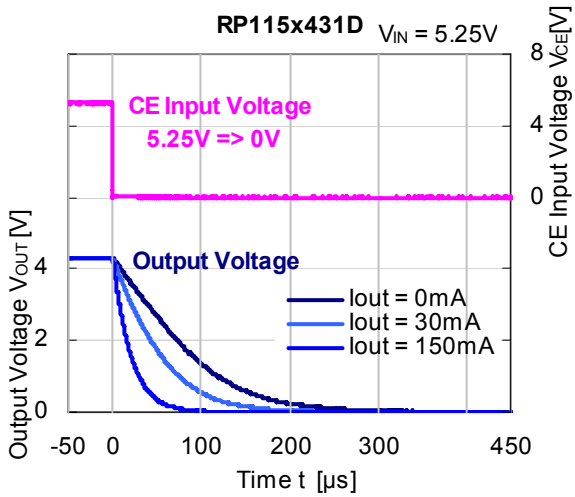


15) Turn-off Waveform by CE Pin Signal (C_{IN}=Ceramic1.0µF, C_{OUT}=Ceramic1.0µF, Ta=25°C)

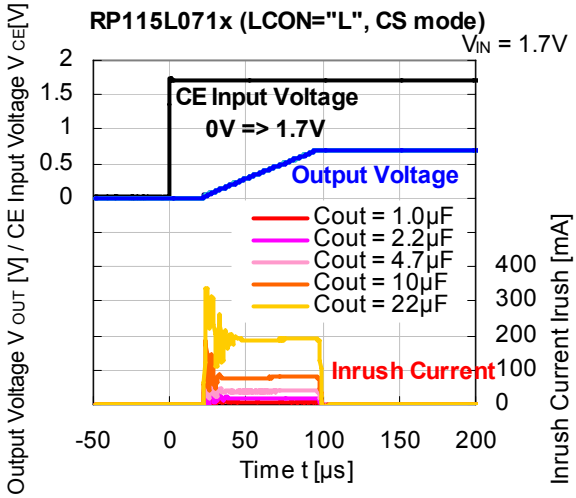


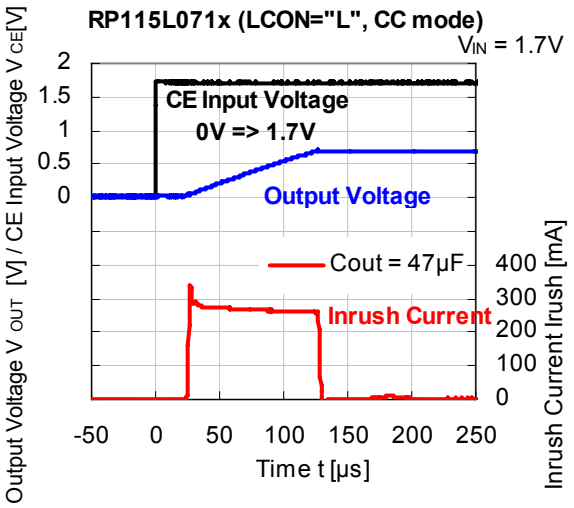


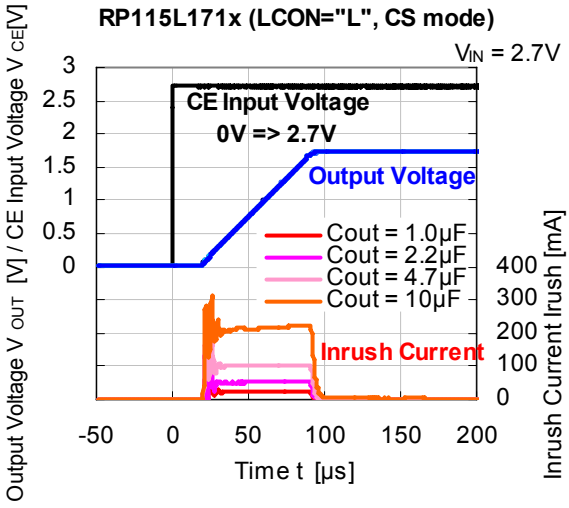


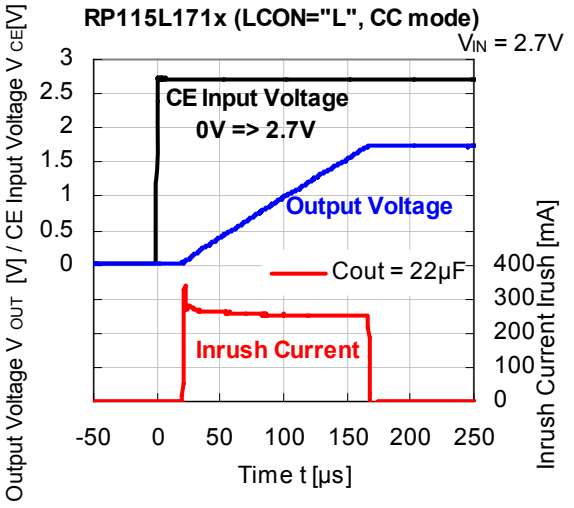


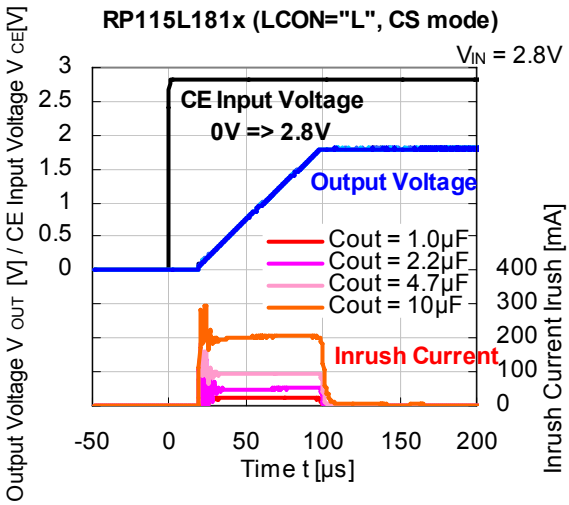
16) Inrush Current (C_{IN}=Ceramic1.0µF, I_{OUT}=0mA, Ta=25°C)

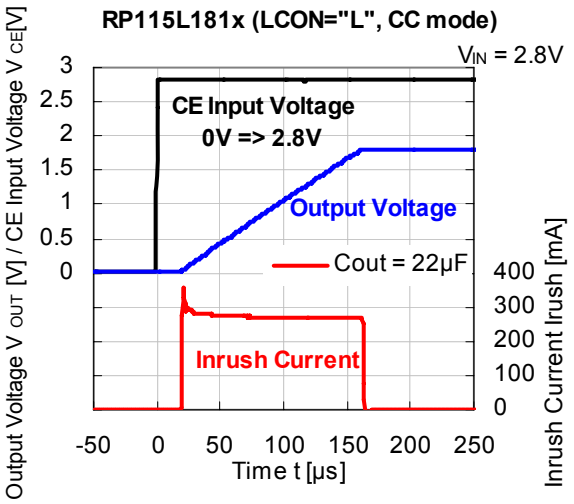


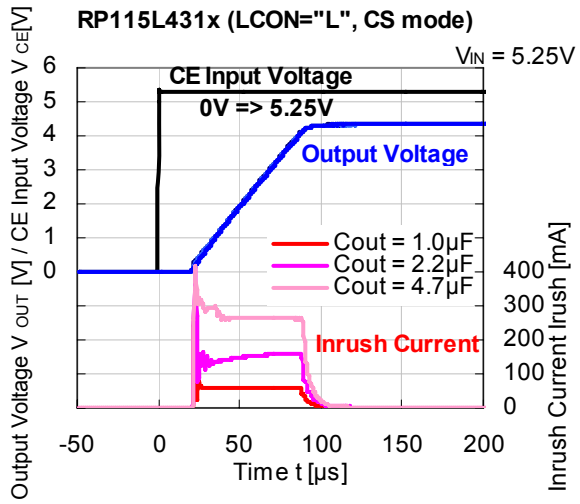


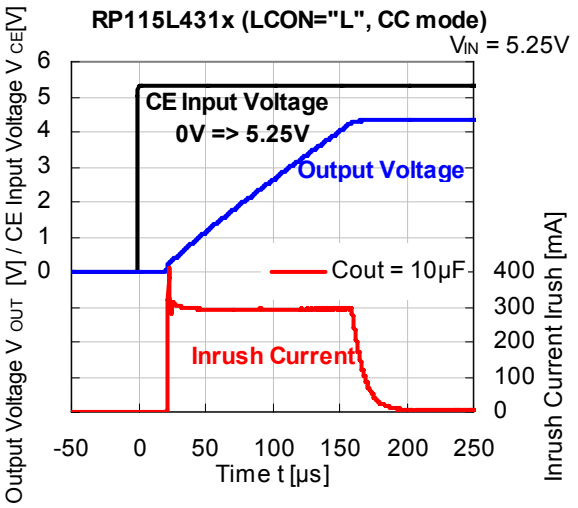


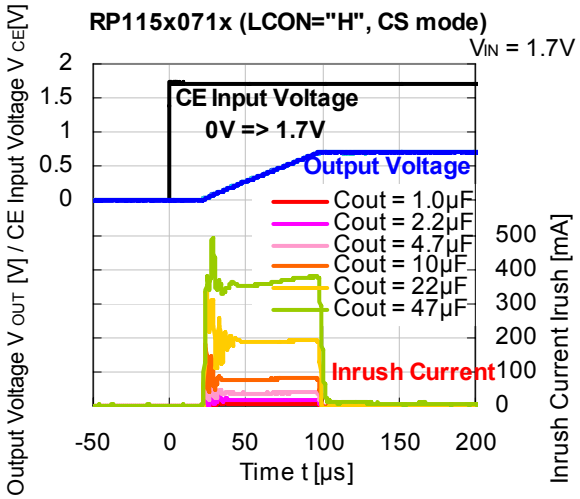


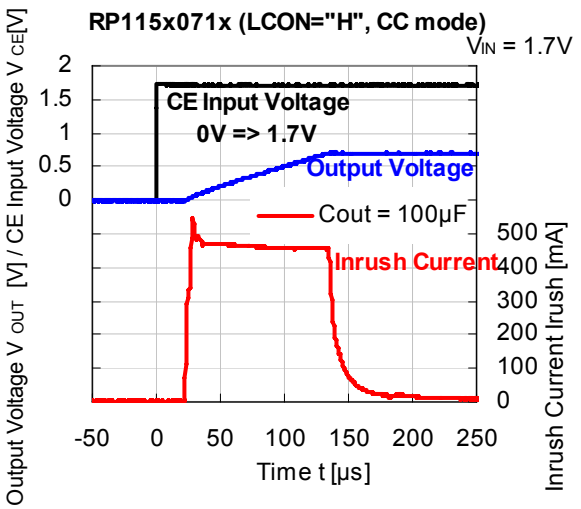


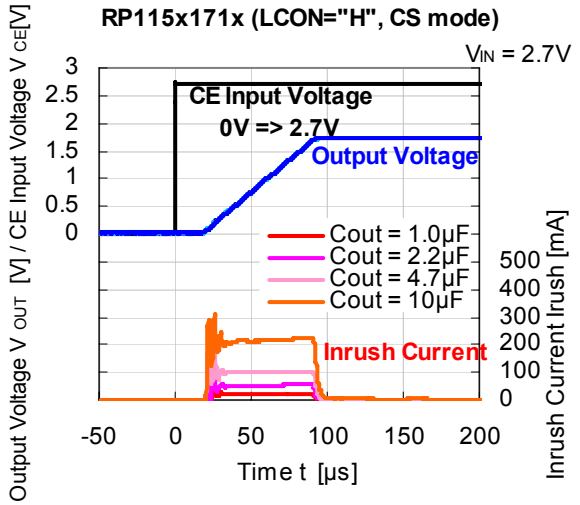


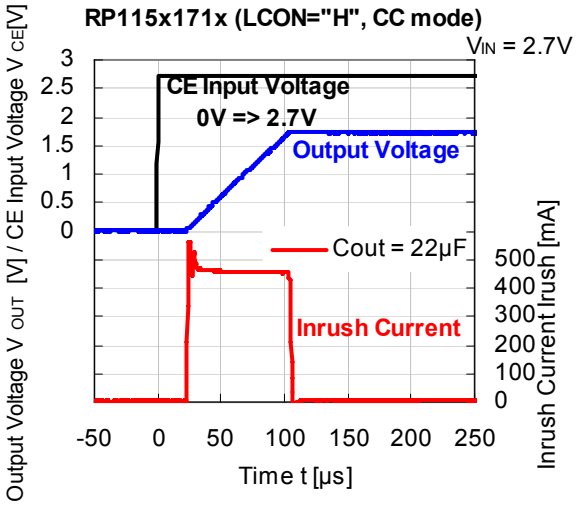

RP115L431x (LCON="L", CS mode)
VIN = 5.25V
CE Input Voltage
0V => 5.25V
Output Voltage
Cout = 1.0µF
Cout = 2.2µF
Cout = 4.7µF
Inrush Current
Output Voltage V OUT [V] / CE Input Voltage V CE[V]
Inrush Current Irush [mA]
Time t [µs]

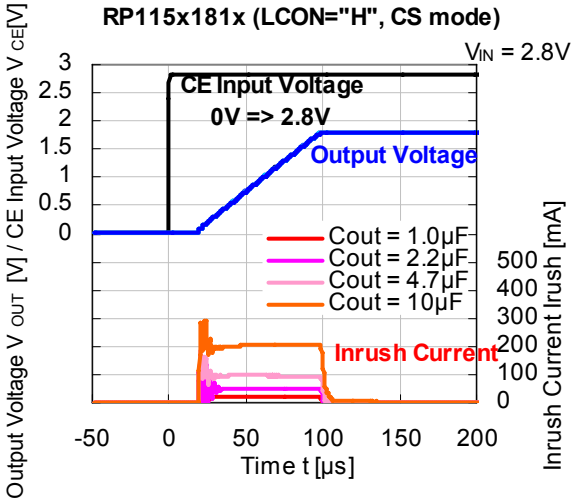

RP115L431x (LCON="L", CC mode)
VIN = 5.25V
CE Input Voltage
0V => 5.25V
Output Voltage
Cout = 10µF
Inrush Current
Output Voltage V OUT [V] / CE Input Voltage V CE[V]
Inrush Current Irush [mA]
Time t [µs]

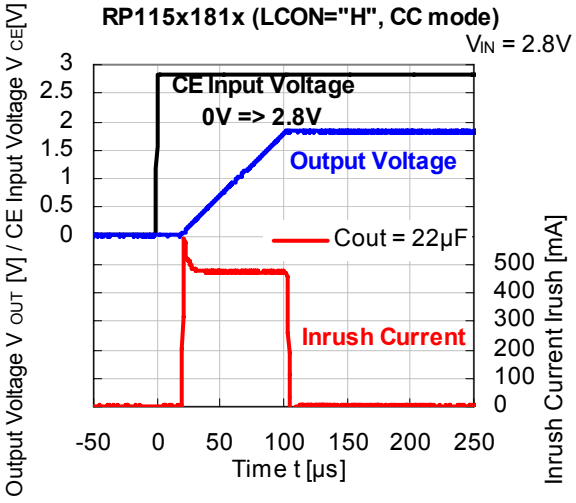

RP115x071x (LCON="H", CS mode)
VIN = 1.7V
CE Input Voltage
0V => 1.7V
Output Voltage
Cout = 1.0µF
Cout = 2.2µF
Cout = 4.7µF
Cout = 10µF
Cout = 22µF
Cout = 47µF
Inrush Current
Output Voltage V OUT [V] / CE Input Voltage V CE[V]
Inrush Current Irush [mA]
Time t [µs]

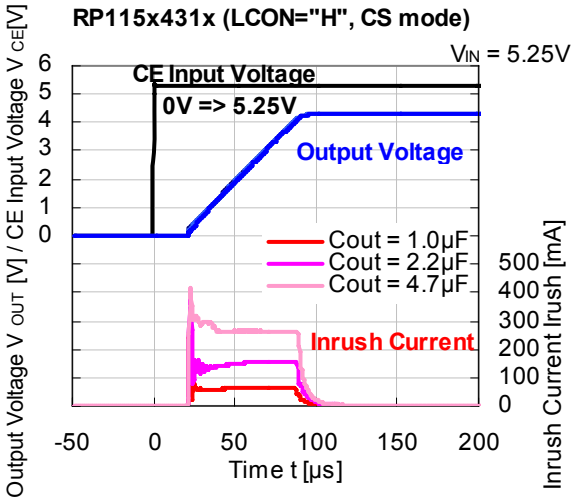

RP115x071x (LCON="H", CC mode)
VIN = 1.7V
CE Input Voltage
0V => 1.7V
Output Voltage
Cout = 100µF
Inrush Current
Output Voltage V OUT [V] / CE Input Voltage V CE[V]
Inrush Current Irush [mA]
Time t [µs]

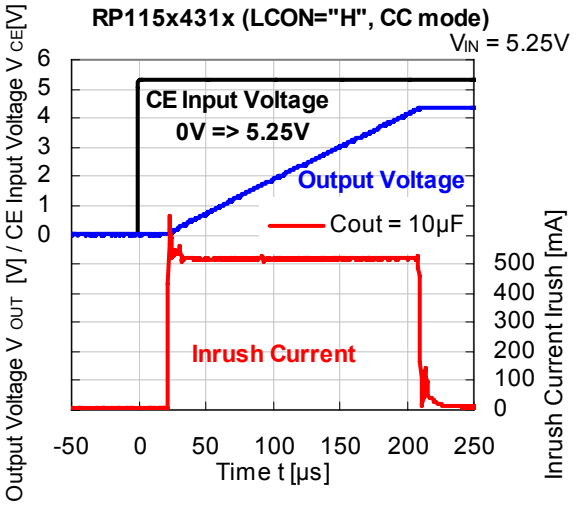

RP115x171x (LCON="H", CS mode)
VIN = 2.7V
CE Input Voltage
0V => 2.7V
Output Voltage
Cout = 1.0µF
Cout = 2.2µF
Cout = 4.7µF
Cout = 10µF
Inrush Current
Output Voltage V OUT [V] / CE Input Voltage V CE[V]
Inrush Current Irush [mA]
Time t [µs]


RP115x171x (LCON="H", CC mode)
VIN = 2.7V
CE Input Voltage
0V => 2.7V
Output Voltage
Cout = 22µF
Inrush Current
Output Voltage V OUT [V] / CE Input Voltage V CE[V]
Inrush Current Irush [mA]
Time t [µs]

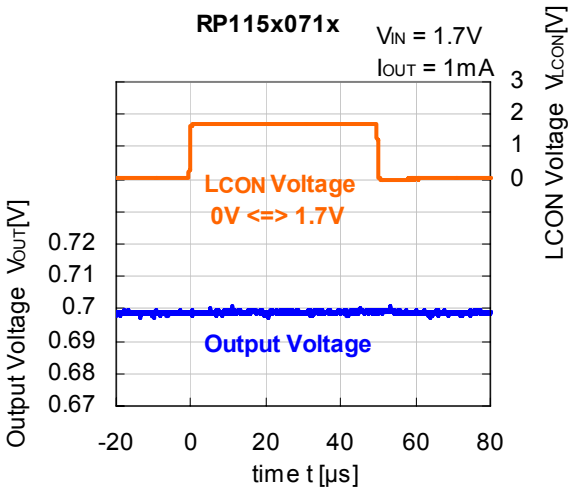

RP115x181x (LCON="H", CS mode)
VIN = 2.8V
CE Input Voltage
0V => 2.8V
Output Voltage
Cout = 1.0µF
Cout = 2.2µF
Cout = 4.7µF
Cout = 10µF
Inrush Current
Output Voltage V OUT [V] / CE Input Voltage V CE[V]
Inrush Current Irush [mA]
Time t [µs]

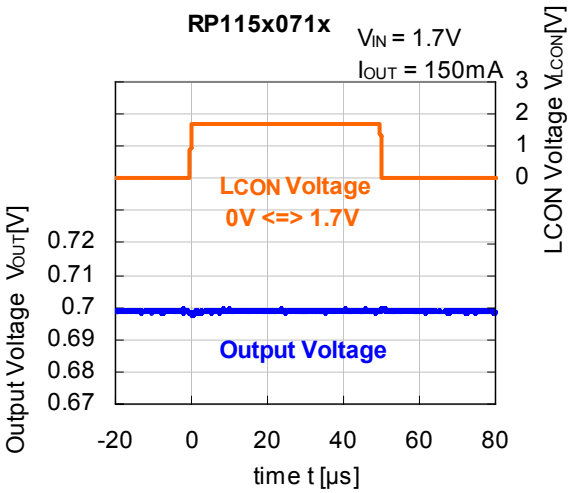

RP115x181x (LCON="H", CC mode)
VIN = 2.8V
CE Input Voltage
0V => 2.8V
Output Voltage
Cout = 22µF
Inrush Current
Output Voltage V OUT [V] / CE Input Voltage V CE[V]
Inrush Current Irush [mA]
Time t [µs]

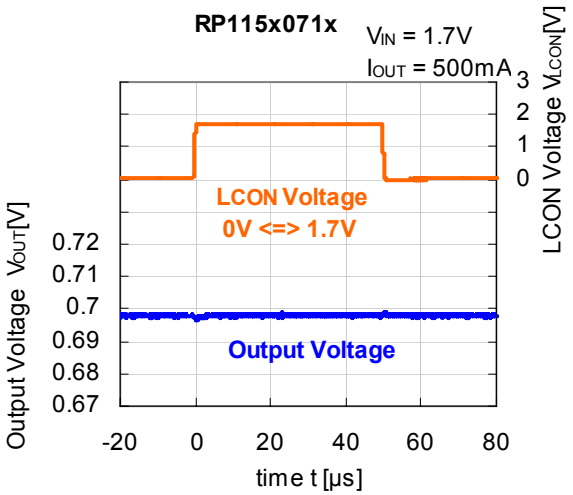

RP115x431x (LCON="H", CS mode)
VIN = 5.25V
CE Input Voltage
0V => 5.25V
Output Voltage
Cout = 1.0µF
Cout = 2.2µF
Cout = 4.7µF
Inrush Current
Output Voltage V OUT [V] / CE Input Voltage V CE[V]
Inrush Current Irush [mA]
Time t [µs]

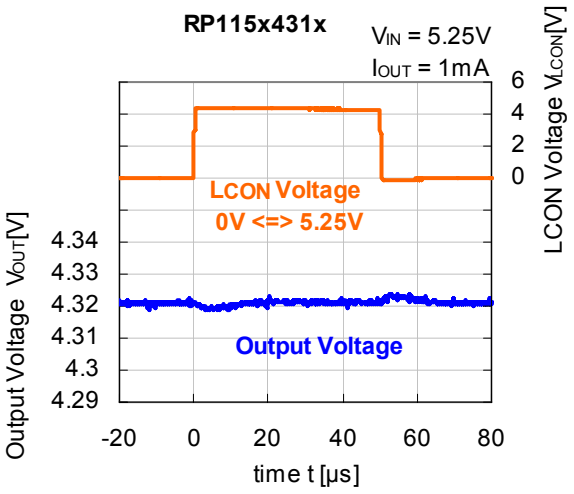

RP115x431x (LCON="H", CC mode)
VIN = 5.25V
CE Input Voltage
0V => 5.25V
Output Voltage
Cout = 10µF
Inrush Current
Output Voltage V OUT [V] / CE Input Voltage V CE[V]
Inrush Current Irush [mA]
Time t [µs]

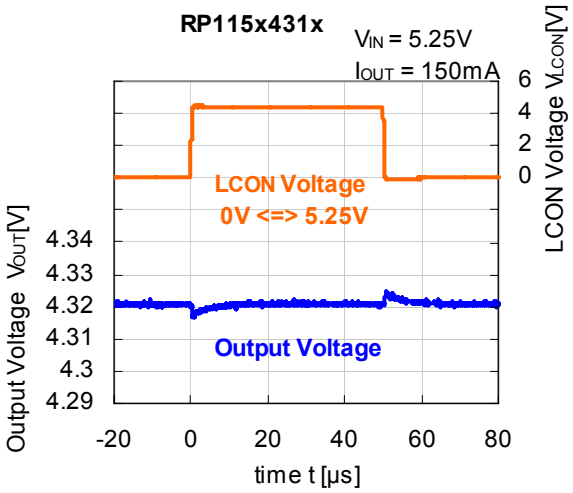
17) LCON Pin Transient Response (C_{IN}=Ceramic1.0µF, C_{OUT}=Ceramic1.0µF, Ta=25°C)

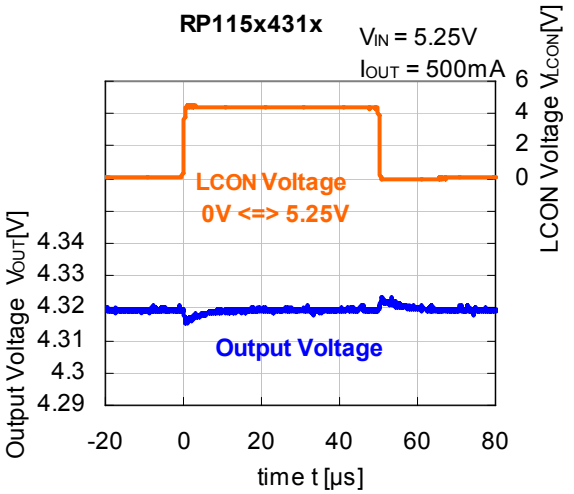












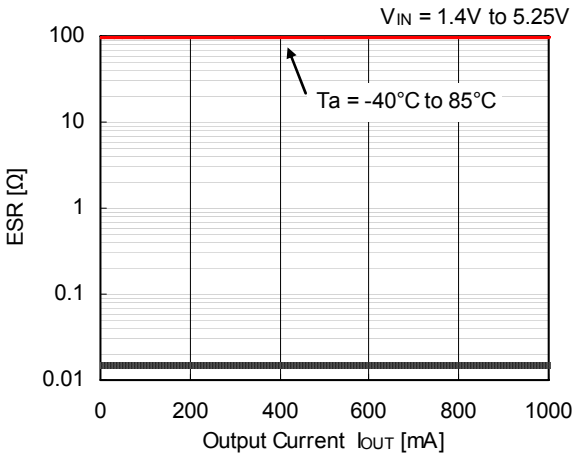
EQUIVALENT SERIES RESISTANCE (ESR) vs. OUTPUT CURRENT

Ceramic type output capacitor is recommended for the RP115x but any capacitor with low ESR can be used. The graphs below show the relation between I_{OUT} and ESR (noise level: average 40μV or less).

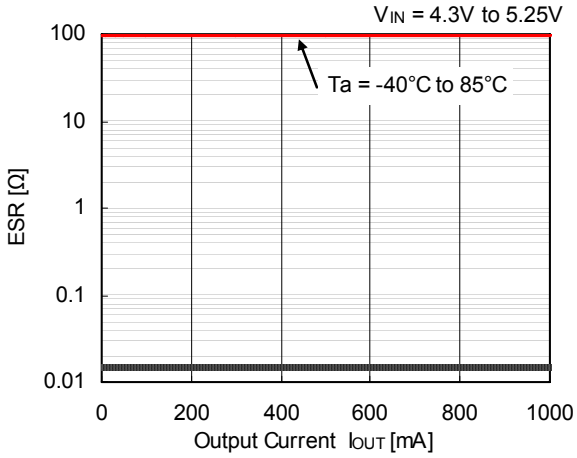
Measurement Conditions

- Noise Frequency Band Width: 10Hz to 2MHz
- Operating Temperature Range: −40°C to +85°C
- Hatched Area: Output noise level is average 40μV or less.
- C_{IN}, C_{OUT}: 1.0μF or more

RP115x071x



RP115x431x



1. The products and the product specifications described in this document are subject to change or discontinuation of production without notice for reasons such as improvement. Therefore, before deciding to use the products, please refer to Ricoh sales representatives for the latest information thereon.
2. The materials in this document may not be copied or otherwise reproduced in whole or in part without prior written consent of Ricoh.
3. Please be sure to take any necessary formalities under relevant laws or regulations before exporting or otherwise taking out of your country the products or the technical information described herein.
4. The technical information described in this document shows typical characteristics of and example application circuits for the products. The release of such information is not to be construed as a warranty of or a grant of license under Ricoh's or any third party's intellectual property rights or any other rights.
5. The products listed in this document are intended and designed for use as general electronic components in standard applications (office equipment, telecommunication equipment, measuring instruments, consumer electronic products, amusement equipment etc.). Those customers intending to use a product in an application requiring extreme quality and reliability, for example, in a highly specific application where the failure or misoperation of the product could result in human injury or death (aircraft, spacevehicle, nuclear reactor control system, traffic control system, automotive and transportation equipment, combustion equipment, safety devices, life support system etc.) should first contact us.
6. We are making our continuous effort to improve the quality and reliability of our products, but semiconductor products are likely to fail with certain probability. In order to prevent any injury to persons or damages to property resulting from such failure, customers should be careful enough to incorporate safety measures in their design, such as redundancy feature, firecontainment feature and fail-safe feature. We do not assume any liability or responsibility for any loss or damage arising from misuse or inappropriate use of the products.
7. Anti-radiation design is not implemented in the products described in this document.
8. Please contact Ricoh sales representatives should you have any questions or comments concerning the products or the technical information.

RoHS Compliant
Halogen Free

For the conservation of the global environment, Ricoh is advancing the decrease of the negative environmental impact material.
After Apr. 1, 2006, we will ship out the lead free products only. Thus, all products that will be shipped from now on comply with RoHS Directive.
Basically after Apr. 1, 2012, we will ship out the Power Management ICs of the Halogen Free products only. (Ricoh Halogen Free products are also Antimony Free.)

RICOH

RICOH COMPANY, LTD.
Electronic Devices Company

http://www.ricoh.com/LSI/

RICOH COMPANY, LTD.
Electronic Devices Company
● **Higashi-Shinagawa Office (International Sales)**
3-32-3, Higashi-Shinagawa, Shinagawa-ku, Tokyo 140-8655, Japan
Phone: +81-3-5479-2857 Fax: +81-3-5479-0502

RICOH EUROPE (NETHERLANDS) B.V.
● **Semiconductor Support Centre**
"Nieuw Kronenburg" Prof. W.H. Keesomlaan 1, 1183 DJ, Amstelveen, The Netherlands
P.O.Box 114, 1180 AC Amstelveen
Phone: +31-20-5474-309 Fax: +31-20-5474-791

RICOH ELECTRONIC DEVICES KOREA Co., Ltd.
11 floor, Haesung 1 building, 942, Daechidong, Gangnamgu, Seoul, Korea
Phone: +82-2-2135-5700 Fax: +82-2-2135-5705

RICOH ELECTRONIC DEVICES SHANGHAI Co., Ltd.
Room403, No.2 Building, 690#Bi Bo Road, Pu Dong New district, Shanghai 201203, People's Republic of China
Phone: +86-21-5027-3200 Fax: +86-21-5027-3299

RICOH COMPANY, LTD.
Electronic Devices Company
● **Taipei office**
Room109, 10F-1, No.51, Hengyang Rd., Taipei City, Taiwan (R.O.C.)
Phone: +886-2-2313-1621/1622 Fax: +886-2-2313-1623