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

No. EA-274-221115

OUTLINE

The RP115x is a CMOS-based positive voltage regulator featuring 500 mA/ 1.0 A that provides high ripple rejection, low dropout voltage, high output voltage accuracy, and low supply current. Internally, it consists 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 uses a CMOS process for achieving low supply current, low On Resistance for low dropout voltage (Typ. 0.195 V (DFN1216-8, I_{OUT} = 1.0 A, V_{SET} = 1.2 V)) and CE function for long battery life. Excellent ripple rejection, input transient response, and load transient response make the RP115x ideal for the power sources of mobile communication equipment.
The RP115x is available in the DFN1216-8 package for space saving and the SOT-89-5 (Output Current: 1.0 A fixed) package for higher power applications. The RP115L (DFN1216-8) can choose the output current limit between 1.0 A or 500 mA by alternating the LCON pin between “H” or “L”. The RP115H (SOT-89-5) can output only 1.0 A since it does not include the LCON pin.

FEATURES

- Supply Current ··········· Typ. 110 µA
- Supply Current (Standby Mode) ··········· Typ. 0.5 µA
- Dropout Voltage ··········· Typ. 0.195 V (DFN1216-8: I_{OUT} = 1.0 A, V_{SET} = 1.2 V)
  Typ. 0.235 V (SOT-89-5: I_{OUT} = 1.0 A, V_{SET} = 1.2 V)
- Ripple Rejection ··········· Typ. 80 dB (f = 1 kHz, V_{SET} ≤ 1.8 V)
  Typ. 75 dB (f = 1 kHz, V_{SET} > 1.8 V)
- Output Voltage Accuracy ··········· ±1.0% (V_{SET} ≥ 1.75 V)
- Output Voltage Temperature Coefficient ··········· Typ. ±30 ppm/ ºC (V_{SET} ≥ 1.75 V)
- Line Regulation ··········· Typ. 0.02%/V
- Package ··········· DFN1216-8, SOT-89-5
- Output Voltage Range ··········· 0.7 V to 4.3 V with a 0.1-V step(1)
- Built-in Short Current Limit Circuit ··········· Typ. 60 mA (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. 300 mA (DFN1216-8: LCON = "L")
- Reverse Current Protection
- Recommended Ceramic Capacitors ··········· 1.0 µF or more

(1) For the output voltage with a 0.05-V step, refer to *SELECTION GUIDE*.

APPLICATIONS

- Portable Communication Equipment
- Electrical Appliances such as Cameras, VCRs and Camcorders
- Battery-powered Equipment
- Home Appliances, Printers, Scanners, Office Equipment Machines

SELECTION GUIDE

The package type, the set output voltage and the auto-discharge(1) are user-selectable options.

Selection Guide

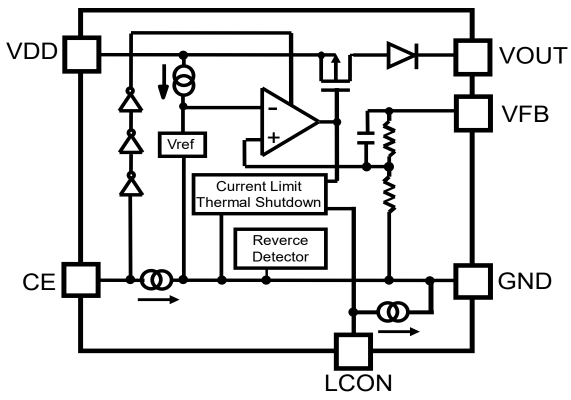
Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RP115Lxx1∗-E2	DFN1216-8	5,000 pcs	Yes	Yes
RP115Hxx1∗-T1-FE	SOT-89-5	1,000 pcs	Yes	Yes

xx: Specify the set output voltage (V_{SET}) within the range of 0.7 V to 4.3 V with a 0.1 V step.
Specify V_{SET} with a 0.05 V step as follows:
0.75 V: RP115x071∗5
1.15 V: RP115x111∗5
1.25 V: RP115x121∗5
1.35 V: RP115x131∗5
1.75 V: RP115x171∗5
1.85 V: RP115x181∗5
2.15 V: RP115x211∗5
2.75 V: RP115x271∗5
2.85 V: RP115x281∗5
2.95 V: RP115x291∗5

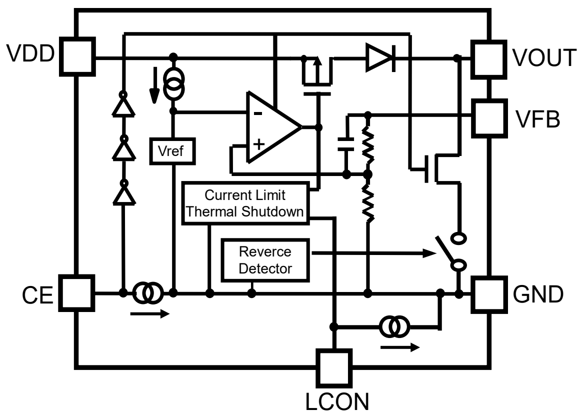
∗: Specify the CE pin polarity and the auto-discharge.
B: CE = Active-high, auto-discharge not included
D: CE = Active-high, auto-discharge included

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

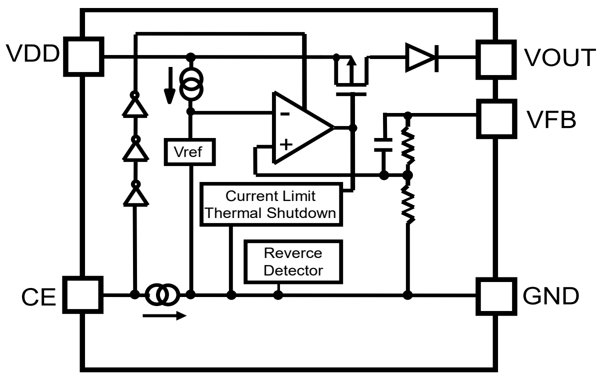
BLOCK DIAGRAMS



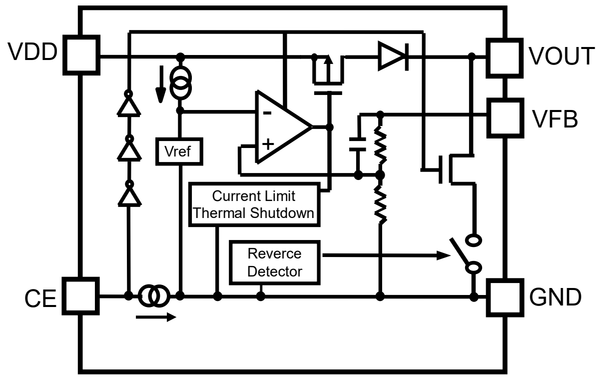
RP115Lxx1B Block Diagram



RP115Lxx1D Block Diagram



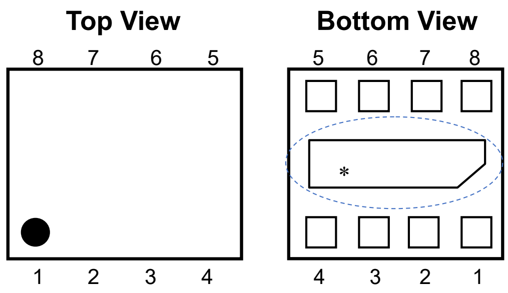
RP115Hxx1B[(1)] Block Diagram



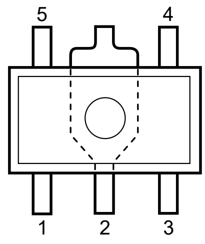
RP115Hxx1D Block Diagram

[(1)] The RP115H does not have the LCON pin, so the output current limit is fixed at 1 A.

PIN DESCRIPTION



DFN1216-8 Pin Configuration



SOT-89-5 Pin Configuration

RP115L: DFN1216-8

Pin No	Symbol	Pin Description
1	VOUT(1)	Output Pin
2	VOUT(1)	Output Pin
3	LCON	Output Current Limit Alternate Pin
4	VFB(1)	Feedback Pin
5	GND	Ground Pin
6	CE	Chip Enable Pin
7	VDD(2)	Input Pin
8	VDD(2)	Input Pin

* The tab on the bottom of the package shown by blue circle is a substrate potential (GND). It is recommended that this tab be connected to the ground plane on the board but it is possible to leave the tab floating.

RP115H(3): SOT-89-5

Pin No	Symbol	Pin Description
1	VFB(1)	Feedback Pin
2	GND	Ground Pin
3	CE	Chip Enable Pin
4	VDD	Input Pin
5	VOUT(1)	Output Pin

(1) The VOUT pin and the VFB pin must be wired together when mounting on the board.
(2) The VDD pins must be wired together when mounting on the board.
(3) The output current limit is fixed at 1 A.

ABSOLUTE MAXIMUM RATINGS

Absolute Maximum Ratings

Symbol	Parameter			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(1)	DFN1216-8	JEDEC STD. 51	1700	mW
		SOT-89-5	JEDEC STD. 51	2600	
Tj	Junction Temperature Range			−40 to 125	°C
Tstg	Storage Temperature Range			−55 to 125	°C

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

RECOMMENDED OPERATING CONDITIONS

Recommended Operating Conditions

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage(2)	1.4 to 5.25	V
Ta	Operating Temperature Range	−40 to 85	°C

RECOMMENDED OPERATING CONDITIONS
All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if 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.

(1) Refer to *POWER DISSIPATION* for detailed information.
(2) In case of operating the device beyond 5.25 V, do not exceed 5.5 V with 500 total operating hours.

ELECTRICAL CHARACTERISTICS

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

The specifications surrounded by $\boxed{}$ are guaranteed by design engineering at −40ºC ≤ Ta ≤ 85ºC.

RP115x Electrical Characteristics (Ta = 25°C)

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	Ta = 25°C	V_{SET} ≥ 1.75 V	x0.99		x1.01	V
			V_{SET} < 1.75 V	-18		+18	mV
		−40°C ≤ Ta ≤ 85°C	V_{SET} ≥ 1.75 V	x$\boxed{0.985}$		x$\boxed{1.015}$	V
			V_{SET} < 1.75 V	Refer to *Set Output Voltage-specific Output Voltage Characteristics*.			
I_{LIM}	Output Current Limit	$V_{IN} = V_{SET}$ + 0.5 V	LCON = ”L”	$\boxed{500}$			mA
			LCON = ”H”[2]	$\boxed{1.0}$			A
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	$V_{IN} = V_{SET}$ + 0.5 V 1 mA ≤ I_{OUT} ≤ 500 mA	LCON = ”L”		1	$\boxed{20}$	mV
		$V_{IN} = V_{SET}$ + 0.5 V 1 mA ≤ I_{OUT} ≤ 1.0 A	LCON = ”H”[2]			$\boxed{40}$	
V_{DIF}	Dropout Voltage	Refer to *Set Output Voltage-specific Dropout Voltage Characteristics*.					
I_{SS}	Supply Current	I_{OUT} = 0 mA			110	$\boxed{160}$	µA
Istandby	Standby Current	V_{CE} = 0 V			0.5	3.0	µA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	V_{SET} + 0.5 V ≤ V_{IN} ≤ 5.25 V (V_{IN} ≥ 1.4 V)			0.02	$\boxed{0.10}$	%/V
RR	Ripple Rejection	f = 1 kHz, Ripple 0.2 Vp-p, $V_{IN} = V_{SET}$ + 1.0 V, I_{OUT} = 30 mA	V_{SET} > 1.8 V		75		dB
			V_{SET} ≤ 1.8 V		80		dB
$\Delta V_{OUT}/\Delta Ta$	Output Voltage Temperature Coefficient	−40°C ≤ Ta ≤ 85°C	V_{SET} ≥ 1.75 V		±30		ppm/ºC
			V_{SET} < 1.75 V		±100		
I_{SC}	Short Current Limit	V_{OUT} = 0 V[3]	LCON = ”L”		60		mA
			LCON = ”H”[2]		110		
I_{CE}	CE Pull-down Current			$\boxed{0.05}$	0.3	$\boxed{0.6}$	µA
V_{CEH}	CE Input Voltage “H”			$\boxed{1.0}$			V
V_{CEL}	CE Input Voltage “L”					$\boxed{0.4}$	V
I_{LCON}	LCON Pull-down Current (RP115L only)			$\boxed{0.05}$	0.3	$\boxed{0.6}$	µA

[1] V_{SET}: Set Output Voltage

[2] The electrical characteristics of the RP115H is as same as when LCON = ”H”.

[3] The short current limit is the value when the VOUT pin is short circuited to GND after the device is completely started up. The inrush current flows when the VOUT pin is short circuited to GND while the VOUT pin is short-circuited to GND before the device is completely started up.

ELECTRICAL CHARACTERISTICS (continued)

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

The specifications surrounded by $\boxed{}$ are guaranteed by design engineering at -40ºC ≤ Ta ≤ 85ºC.

RP115x Electrical Characteristics (Ta = 25ºC)

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{LCONH}	LCON Input Voltage "H" (RP115L only)			$\boxed{1.0}$			V
V_{LCONL}	LCON Input Voltage "L" (RP115L only)					$\boxed{0.4}$	V
T_{TSD}	Thermal Shutdown Temeprature Threshold	Tj, Rising			165		ºC
T_{TSR}		Tj, Falling			110		ºC
I_{REV}	Reverse Current	$V_{OUT} = V_{SET}$ + 1.0 V, 0 ≤ V_{IN} ≤ V_{OUT}	V_{SET} ≥ 1.75 V		7.5		μA
			V_{SET} < 1.75 V		10		
V_{REV_DET}[2]	Detection Offset Voltage in Reverse Current Protection Mode[3]	V_{OUT} ≥ 0.7 V, 0 ≤ V_{IN} ≤ 5.25 V			20		mV
V_{REV_REL}[4]	Release Offset Voltage in Reverse Current Protection Mode[3]	V_{OUT} ≥ 0.7 V, 0 ≤ V_{IN} ≤ 5.25 V			30	$\boxed{50}$	mV
en	Output Noise	BW = 10 Hz to 100 kHz	V_{SET} ≥ 1.75 V		17 x V_{SET}		μVrms
			V_{SET} < 1.75 V		35 x V_{SET}		
R_{LOW}	Auto-discharge Nch Tr. On-resistance (RP115xx1D only)	V_{IN} = 4.0 V, V_{CE} = 0 V			60		Ω
I_{RUSH}	Inrush Current Limit	CC mode[5]	LCON = "L"		300		mA
			LCON = "H"[6]		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.

(1) V_{SET}: Set Output Voltage
(2) $V_{REV\_DET} = V_{IN} – V_{OUT}$
(3) The guaranteed operating voltage range of the reverse current protection circuit is V_{OUT} ≥ 0.7 V. When $V_{IN} = V_{OUT}$ = 0 V, the reverse current protection mode is constantly active.
(4) $V_{REV\_REL} = V_{IN} – V_{OUT}$
(5) For detailed information, refer to *Start-up Characteristics Using Constant Slope Circuit*.
(6) The electrical characteristics of the RP115H is as same as when LCON = "H".

Set Output Voltage-specific Output Voltage Characteristics

Set Output Voltage V_{SET} (V)	Output Voltage V_{OUT} (mV)	
	Min.	Max.
0.7	−33	+28
0.8	−35	+29
0.9	−37	+30
1.0	−39	+31
1.1	−41	+33
1.2	−43	+34
1.3	−45	+35
1.4	−47	+36
1.5	−49	+38
1.6	−51	+39
1.7	−53	+40

Set Output Voltage-specific Dropout Voltage Characteristics

RP115L: DFN1216-8 (Ta = 25°C)

Set Output Voltage V_{SET} (V)	Dropout Voltage V_{DIF} (V)					
	RP115L				RP115H	
	I_{OUT} = 500 mA		I_{OUT} = 1000 mA		I_{OUT} = 1000 mA	
	Typ.	Max.	Typ.	Max.	Typ.	Max.
$0.7 \le V_{SET} < 1.1$	*	*	*	*	*	*
$1.1 \le V_{SET} < 1.2$	*	*	*	0.300	*	0.350
$1.2 \le V_{SET} < 1.3$	*	*	0.195	0.275	0.235	0.330
$1.3 \le V_{SET} < 1.5$	0.095	0.135	0.185	0.260	0.225	0.320
$1.5 \le V_{SET} < 1.75$	0.085	0.120	0.165	0.235	0.205	0.295
$1.75 \le V_{SET} < 2.6$	0.075	0.110	0.150	0.215	0.190	0.270
$2.6 \le V_{SET} < 3.3$	0.065	0.090	0.130	0.180	0.170	0.240
$3.3 \le V_{SET} \le 4.3$	0.060	0.085	0.125	0.170	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.
* Input voltage should be equal or more than the minimum operating voltage (1.4 V).

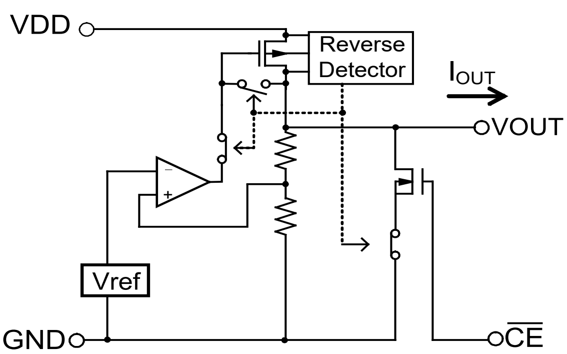
THEORY OF OPERATION

Reverse Current Protection Circuit

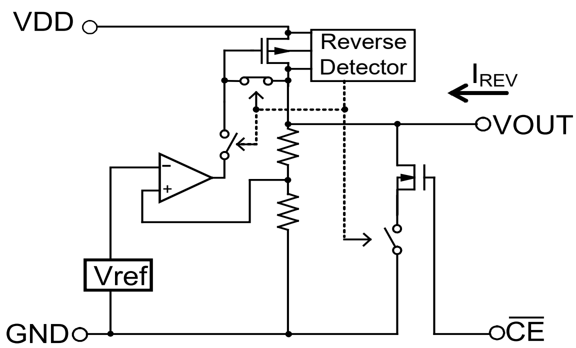
The RP115x includes a Reverse Current Protection Circuit, which stops the reverse current from V_{OUT} pin to V_{DD} pin or to GND pin when V_{OUT} becomes higher than V_{IN}. Usually, the LDO using Pch output transistor contains a parasitic diode between V_{DD} pin and V_{OUT} pin. Therefore, if V_{OUT} 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 RP115x 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}.

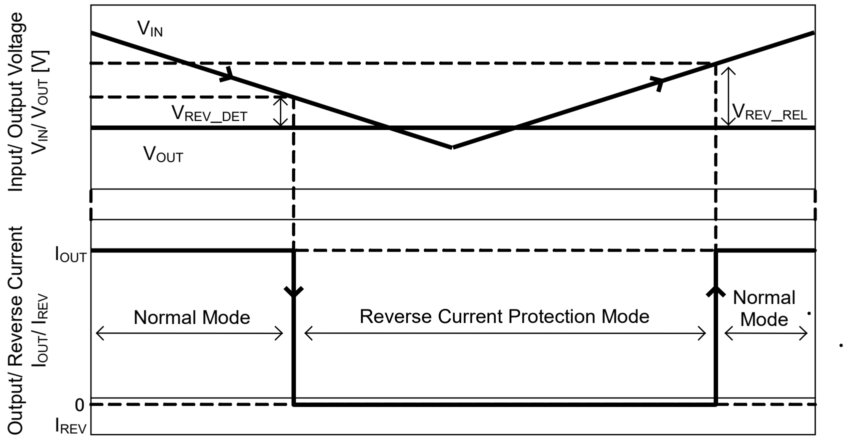
Following figures show the diagrams of each mode, and the load characteristics of each mode. When giving the V_{OUT} pin a constant-voltage and decreasing the V_{IN} voltage, the dropout voltage will become lower than V_{REV_DET}. As a result, the reverse current protection starts to function to stop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



Normal Operation Mode



Reverse Current Protection Mode



Detection/ Release Timing of Reverse Current Protection

Start-up Characteristics Using Constant Slope Circuit

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

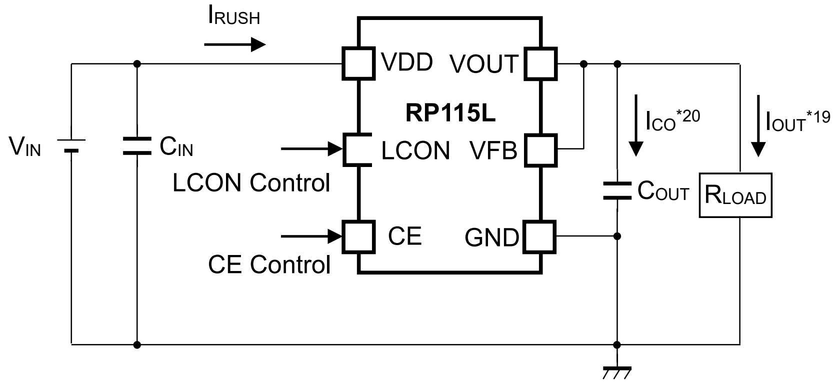
Start-up Time and Inrush Current Estimations

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} = 100 µs (Typ.)
Inrush Current: $I_{RUSH} = C_{OUT} \cdot V_{SET} / t_{ON} + I_{OUT}$(1)
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.

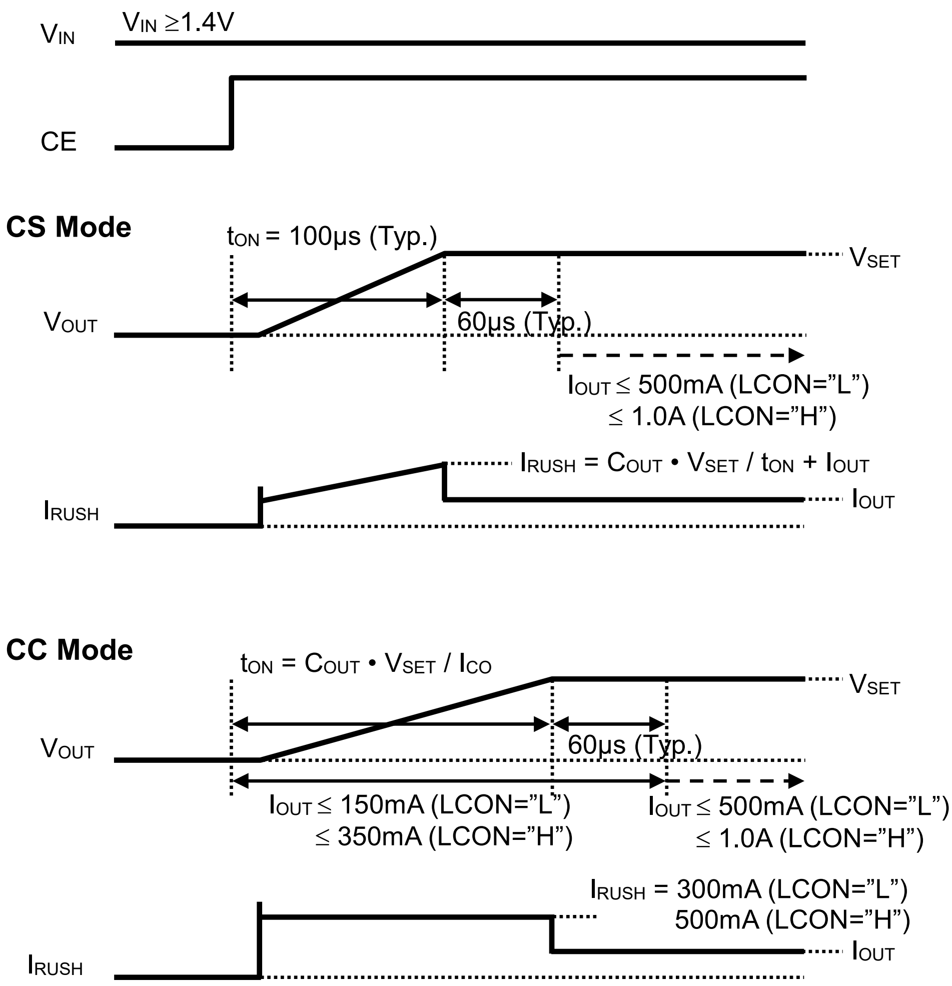
LCON = ”L” ·· 300 mA (Typ.)
LCON = ”H” ·· 500 mA (Typ.)

[CC Mode]
Start-up Time: $t_{ON} = C_{OUT} \cdot V_{SET} / I_{CO}$(2)
Inrush Current: I_{RUSH}
LCON = ”L” ·· 300 mA (Typ.)
LCON = ”H” ·· 500 mA (Typ.)

(1) I_{OUT}: When R_{LOAD} is connected to load, I_{OUT} can be calculated by $R_{LOAD} = V_{SET} / I_{OUT}$.
(2) 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



Timing Chart of Start-up Operation

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} + 60 µs or more). If the load current is drawn during the start-up, it should be within the following values.

LCON = ”L” ·· $I_{OUT} \leq 150$ mA
LCON = ”H”·· $I_{OUT} \leq 350$ mA

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*.

In order to control the start-up operation by using the CS mode or CC mode, input “H” into the CE pin while $V_{IN} \geq 1.4$ V. 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.

When starting up the device while the short circuit is occurring between the V_{OUT} pin and GND, the short current protection circuit does not control the current but the current limit circuit does.
When there’s excessive heat generation in the device, thermal shutdown circuit shuts down the circuitry before the device overheats dangerously.

LCON Pin (RP115L only)

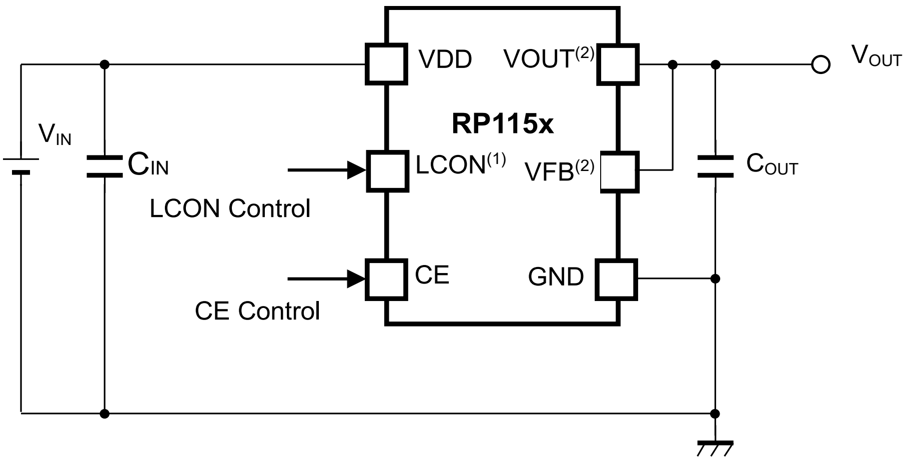
By alternating the LCON pin between “H” or “L”, the RP115L can choose the output current limit either 1.0 A or 500 mA. Please note that during start-up (t_{ON} + 60 µs (Typ.)), do not change the logic of the LCON pin.

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

Application Example

Even when using the RP115L with LCON = ”H”, I_{RUSH} in the CC mode can be reduced from 500 mA (Typ.) to 300 mA (Typ.) by starting up the IC with LCON = ”L”. Please refer to *Start-up Characteristics Using Constant Slope Circuit*.

APPLICATION INFORMATION



RP115x Typical Application Circuit

External Components

Symbol	Description
C_{IN}	1.0 µF, Ceramic Capacitor, GRM155R61A105KE15 (MURATA)
C_{OUT}	1.0 µF, Ceramic Capacitor, GRM155R61A105KE15 (MURATA) 2.2 µF, Ceramic Capacitor, GRM155R61A225KE95 (MURATA)

Precautions When Selecting External Components

- In this device, phase compensation is provided to secure stable operation even when the load current is varied. For this purpose, use a 1.0-µF or more output capacitor (C_{OUT}).
- A ceramic capacitor has different temperature characteristics and bias dependencies depending on the size, manufacturer or part number of a capacitor. Careful evaluation is required. When using a 1.75-V product under the environment of −20°C or lower, choose a 2.2-µF or more C_{OUT}.
- In case of using a tantalum-type capacitor with a large ESR (Equivalent Series Resistance), the output might become unstable. Careful evaluation on frequency characteristics is required.

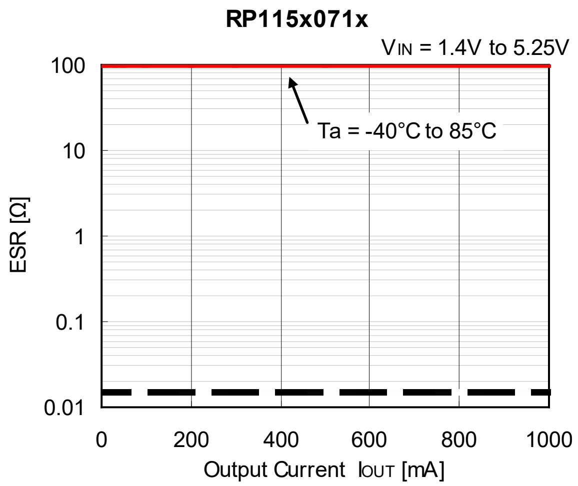
(1) The LCON pin is included in the RP115L (DFN2020-8B) only.
(2) Connect the VOUT and VFB pins together.

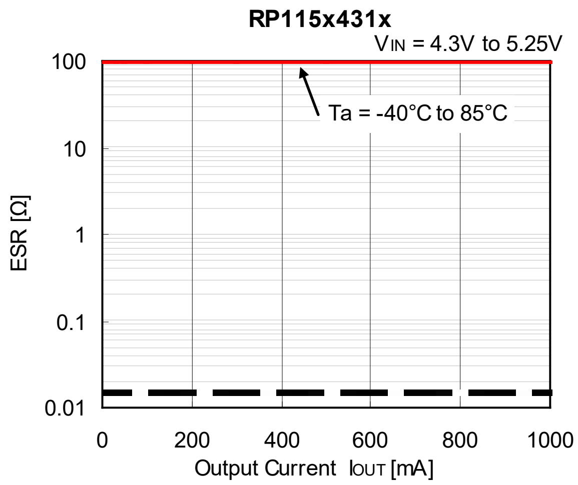
Equivalent Series Resistance (ESR) vs. Output Current

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 40 μV or less).

Measurement Conditions

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





TECHNICAL NOTES

The performance of a power source circuit using this device is highly dependent on a peripheral circuit. A peripheral component or the device mounted on PCB should not exceed its rated voltage, rated current or rated power. When designing a peripheral circuit, please be fully aware of the following points.

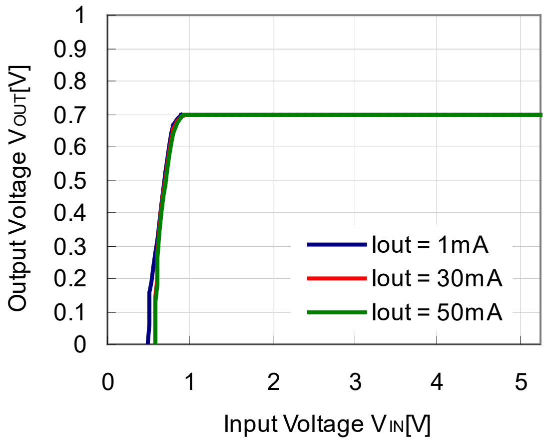
- Place the external components as close as possible to the device with shortest-distance wirings. Connect an input capacitor (C_{IN}) between the VIN and GND pins with shortest-distance wiring.
- Ensure the VDD and GND wirings are sufficiently robust. If the impedance of wiring between the VDD and GND pins is high, it may cause noise pickup or unstable operation.
- Connect an output capacitor (C_{OUT}) between the VOUT and GND pins with shortest-distance wiring.

TYPICAL CHARACTERISTICS

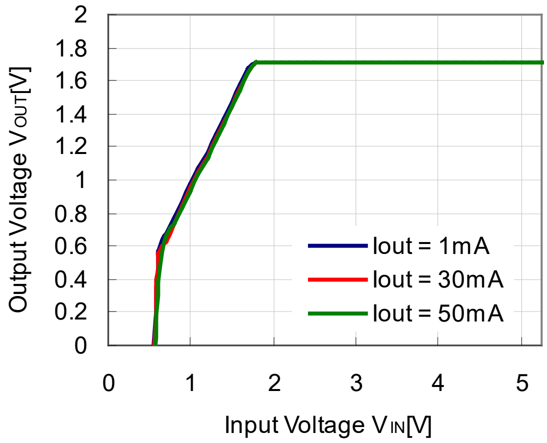
Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

1) Output Voltage vs. Input Voltage (C_{IN} = Ceramic 1.0 μF, C_{OUT} = Ceramic 1.0 μF, Ta = 25°C)

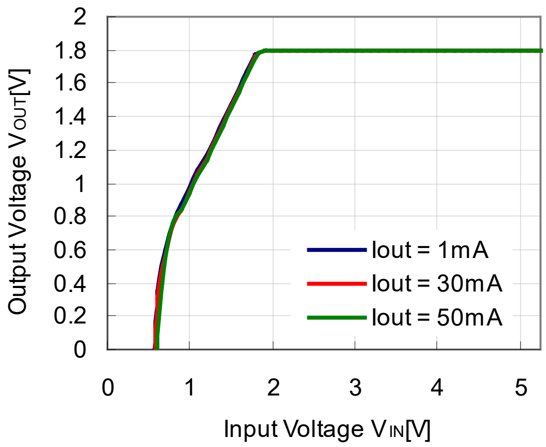
RP115x071x



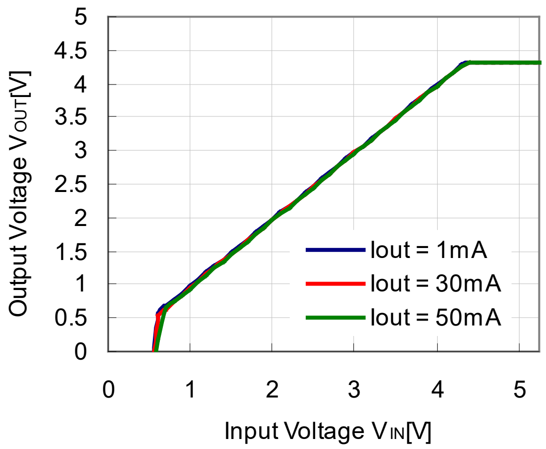
RP115x171x



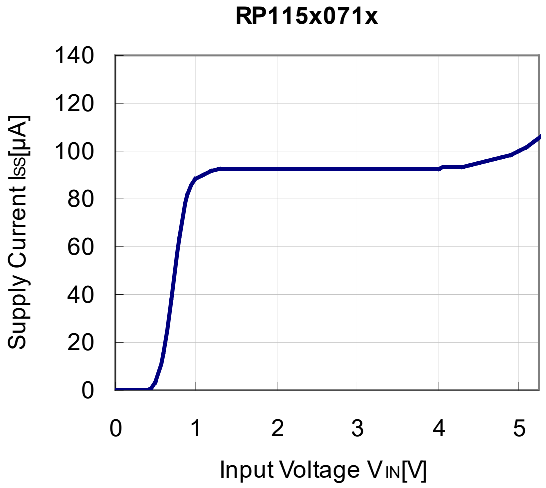
RP115x181x

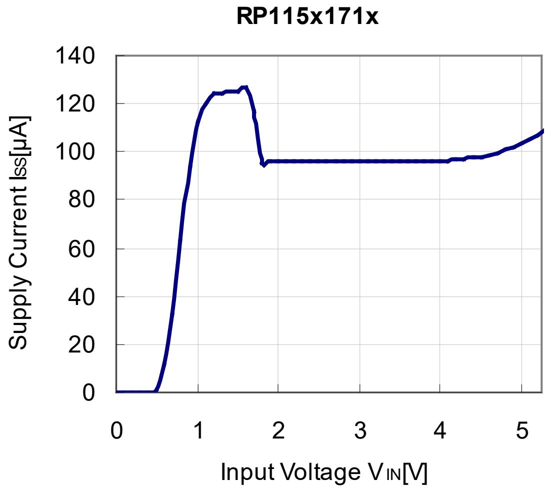


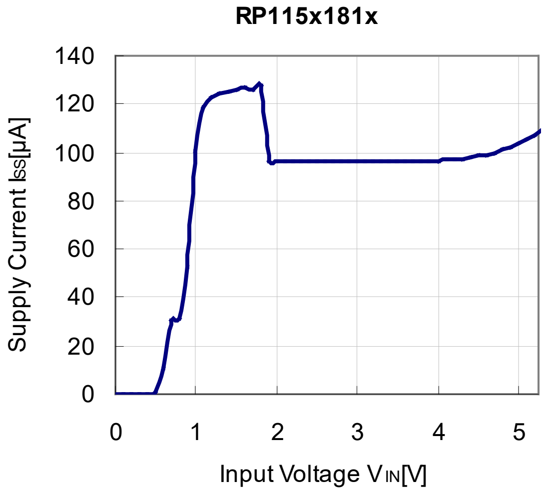
RP115x431x

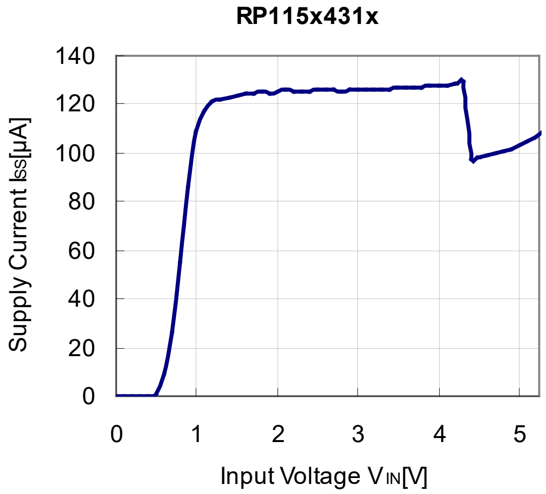


2) Supply Current vs. Input Voltage (C_{IN} = Ceramic 1.0 µF, C_{OUT} = Ceramic 1.0 µF, Ta = 25°C)





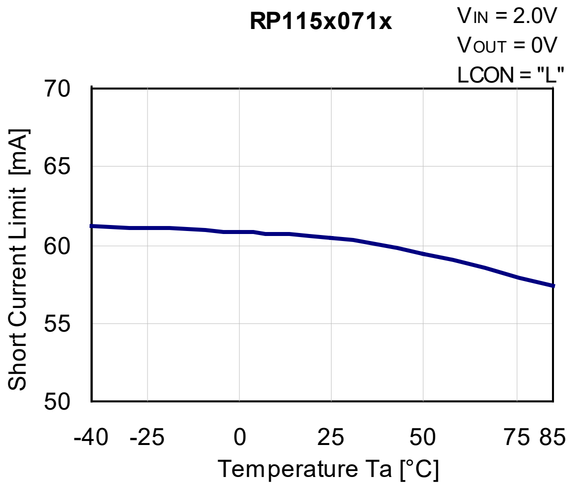


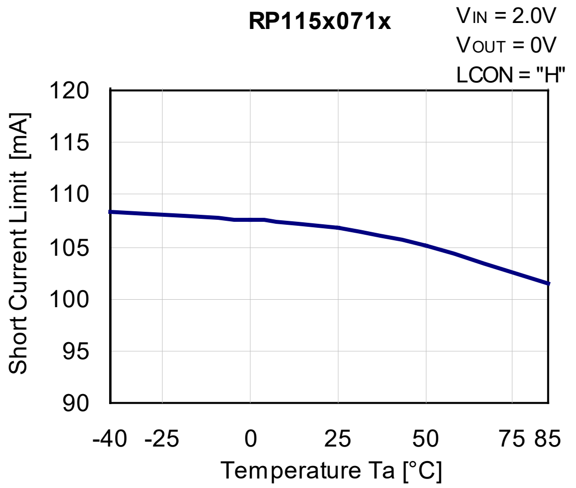


Short Current Limit vs. Temperature and Current Limit vs. Temperature

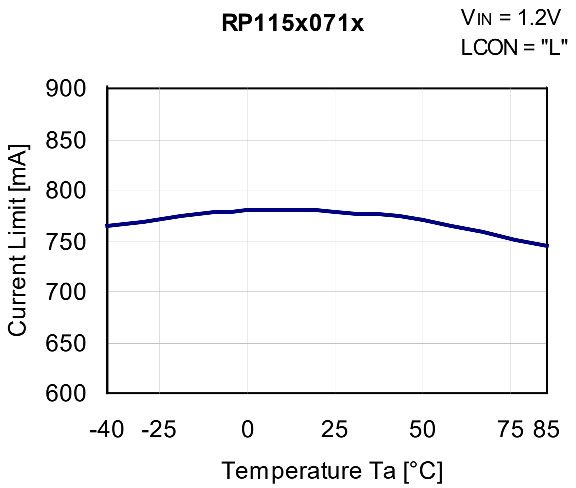
The RP115x contains a peak current limit circuit which protect the regulator from damage by overcurrent if the output pin (VOUT) and the ground pin (GND) are shorted. The short-circuiting causes the overheating of the device which leads a thermal shutdown circuit to operate. If the peak current limit 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.

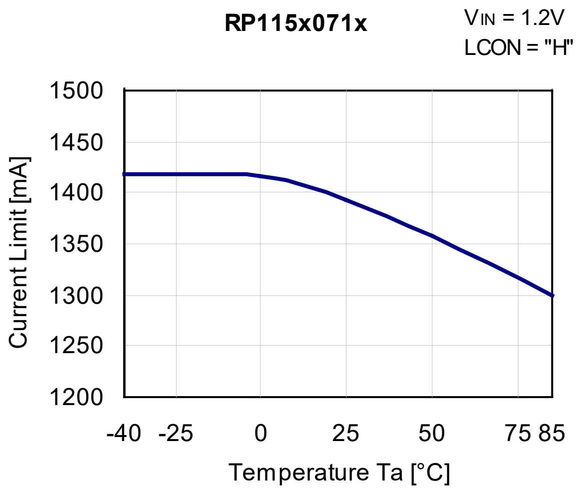
3) Short Current Limit vs. Temperature



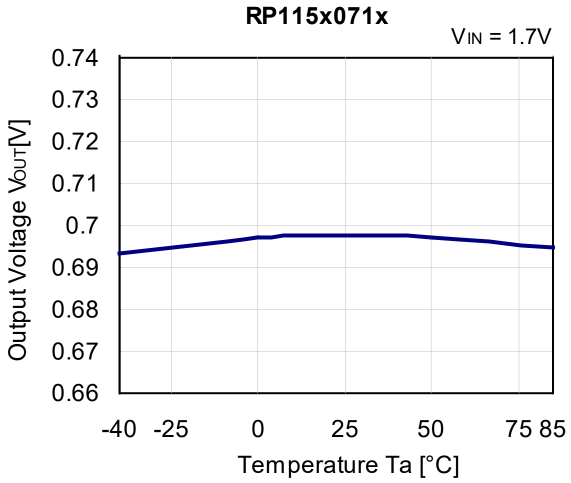


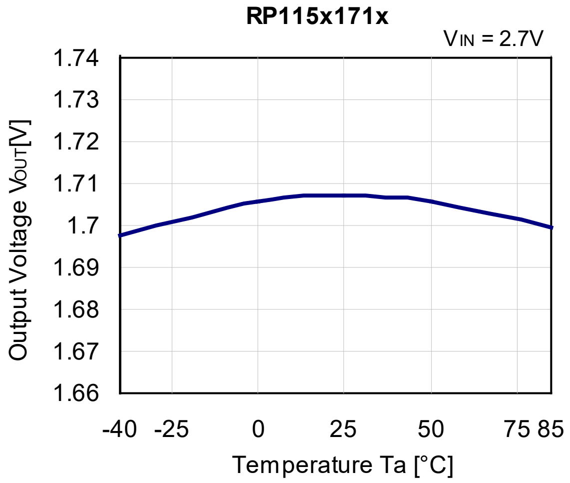
4) Peak Current Limit vs. Temperature

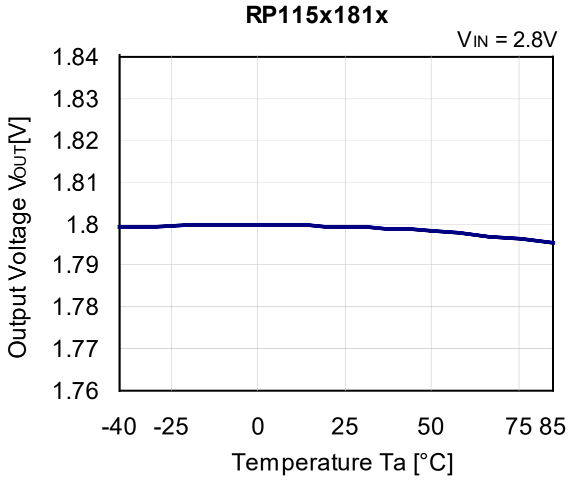


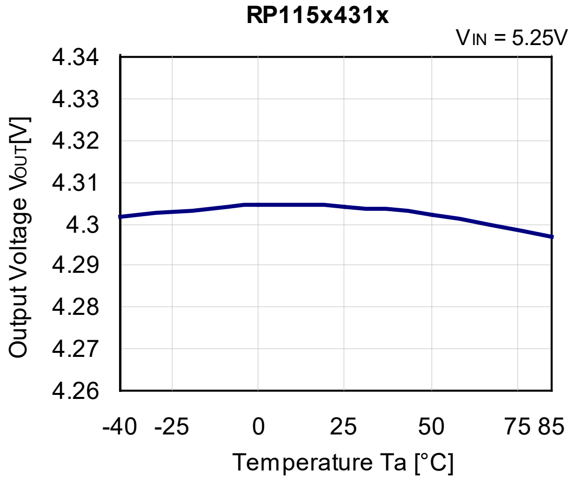


5) Output Voltage vs. Temperature (C_{IN} = Ceramic 1.0 μF, C_{OUT} = Ceramic 1.0 μF, I_{OUT} = 1 mA)

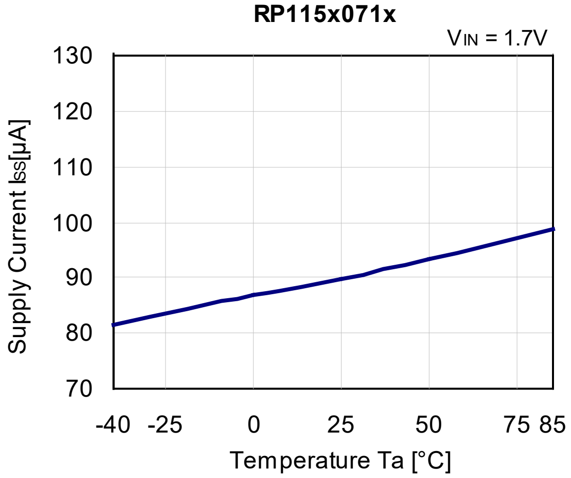


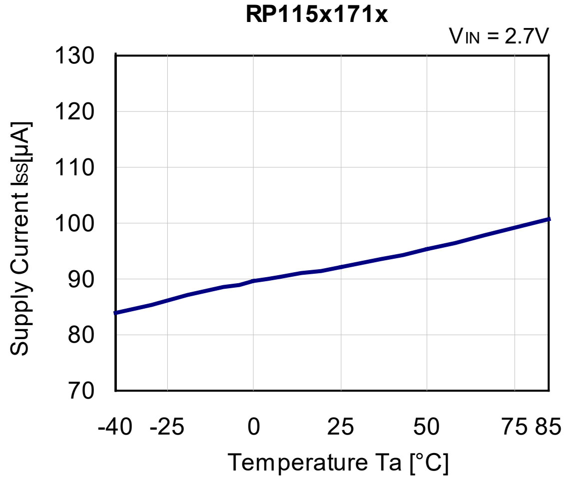


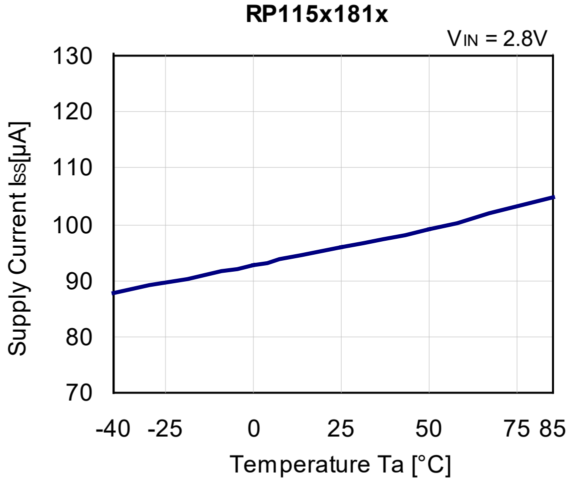


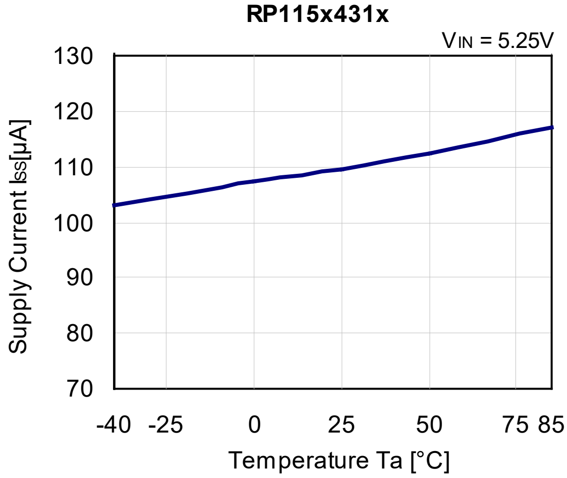


6) Supply Current vs. Temperature (C_{IN} = Ceramic 1.0 μF, C_{OUT} = Ceramic 1.0 μF, I_{OUT} = 0 mA)



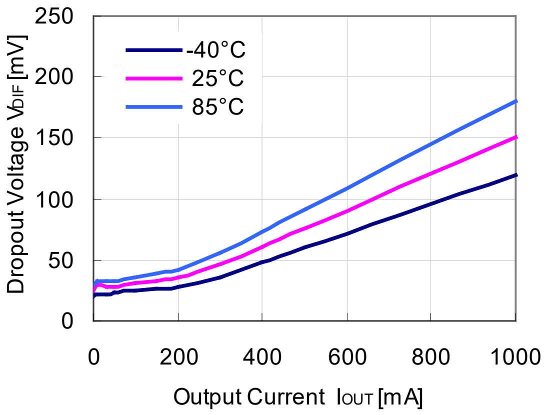




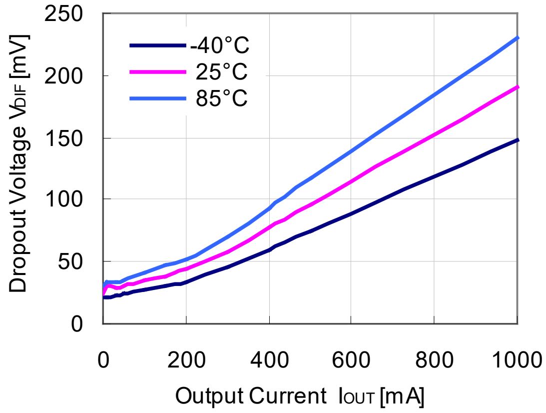


7) Dropout Voltage vs. Output Current (C_{IN} = Ceramic 1.0 μF, C_{OUT} = Ceramic 1.0 μF)

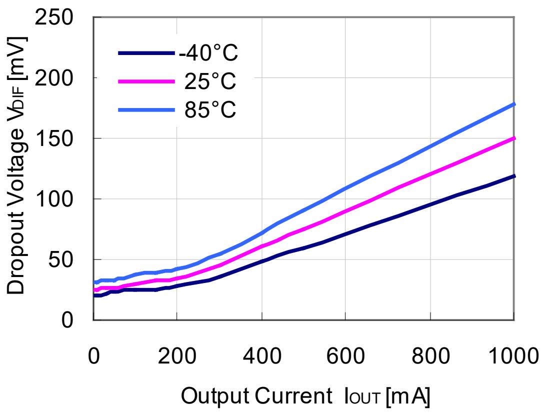
RP115L171x



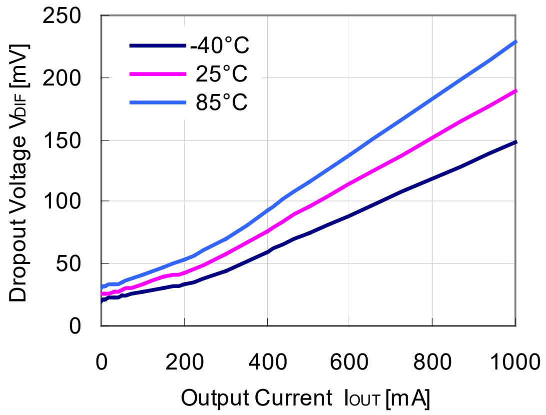
RP115H171x



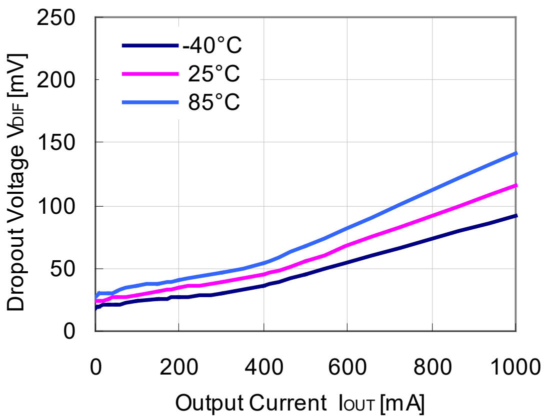
RP115L181x



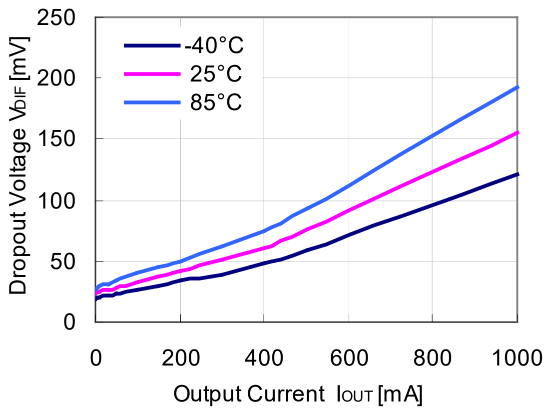
RP115H181x



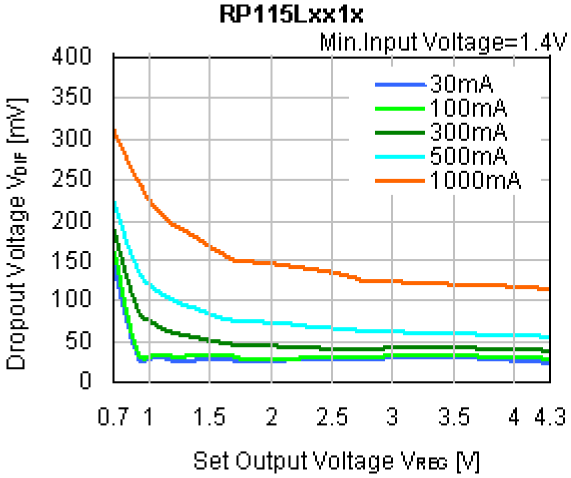
RP115L431x

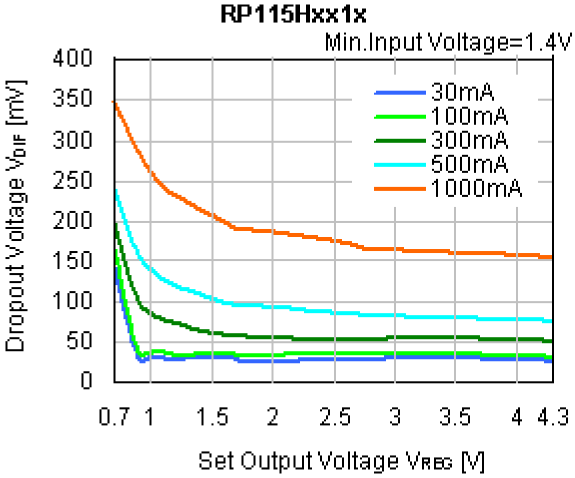


RP115H431x

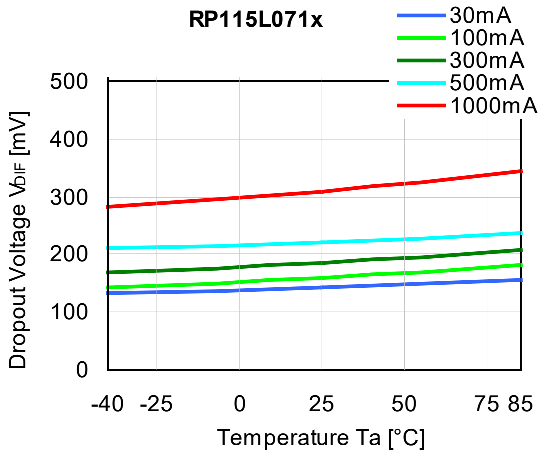


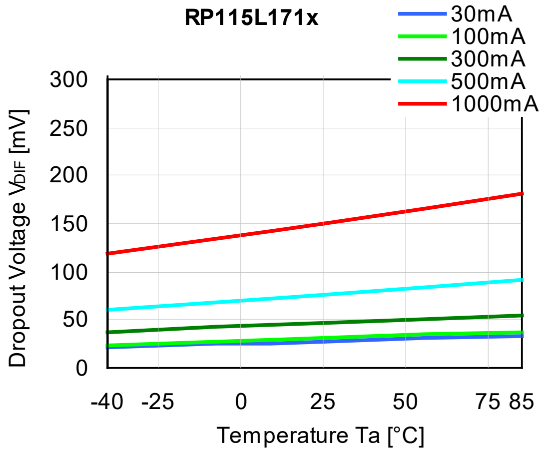
8) Dropout Voltage vs. Set Output Voltage (C_{IN} = Ceramic 1.0 μF, C_{OUT} = Ceramic 1.0 μF, Ta = 25°C)

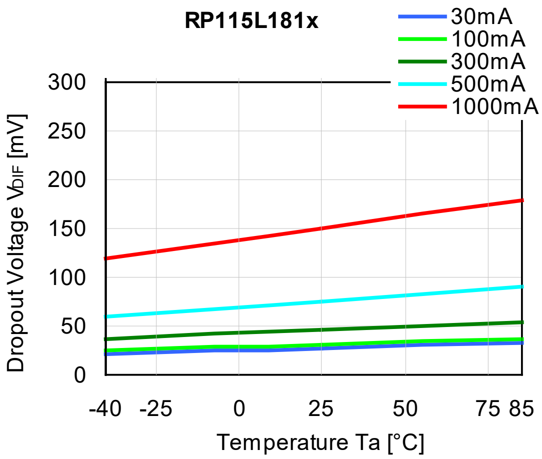


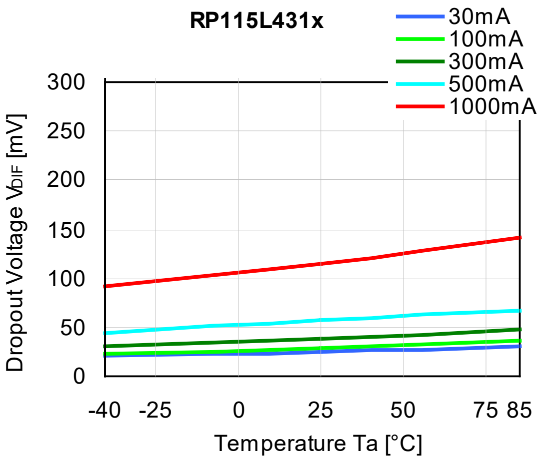


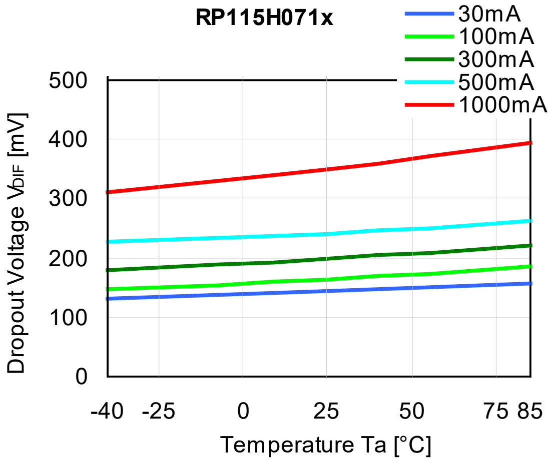
9) Dropout Voltage vs. Temperature (C_{IN} = Ceramic 1.0 μF, C_{OUT} = Ceramic 1.0 μF)

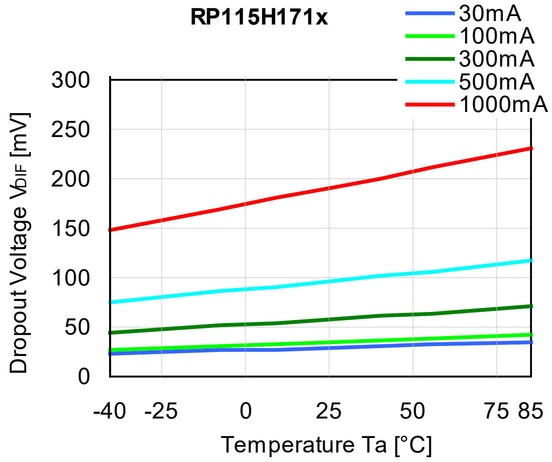


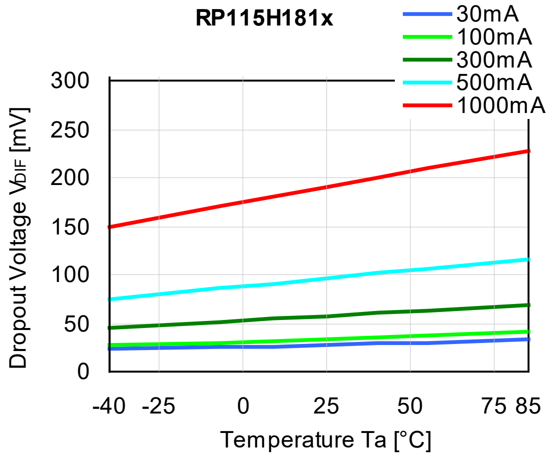


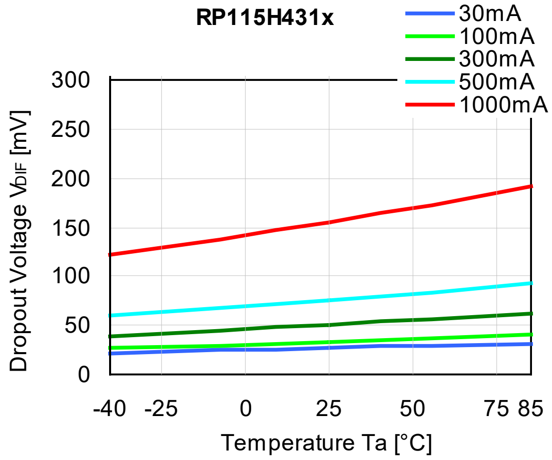




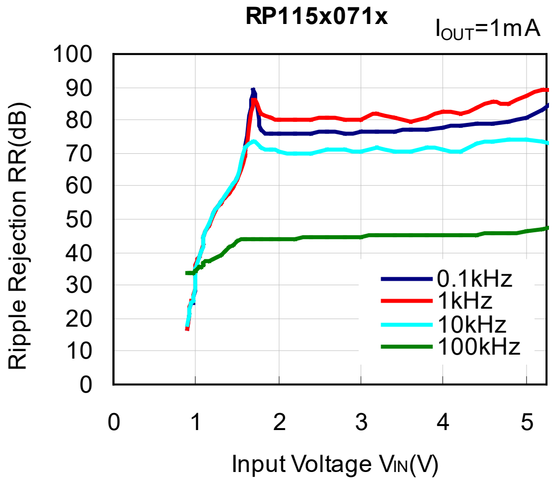


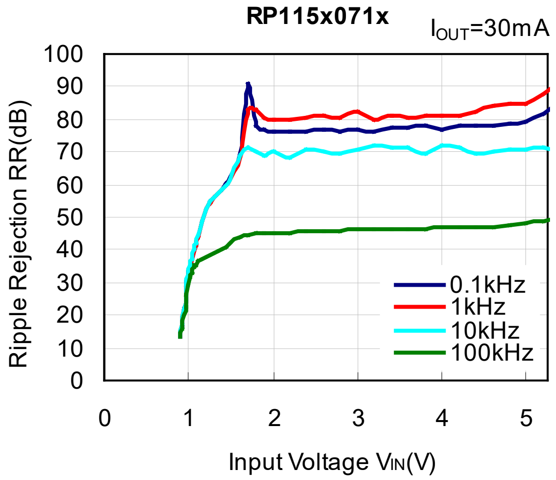


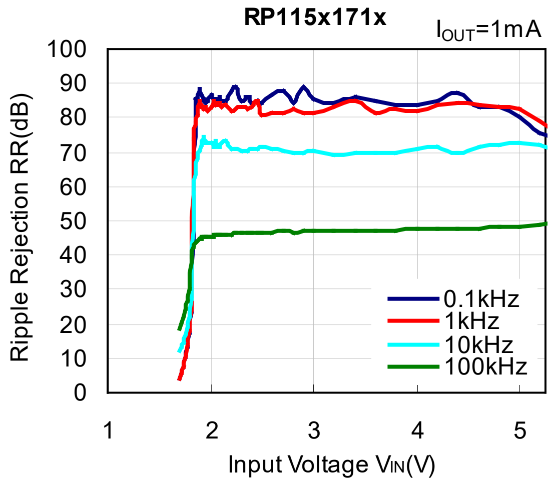


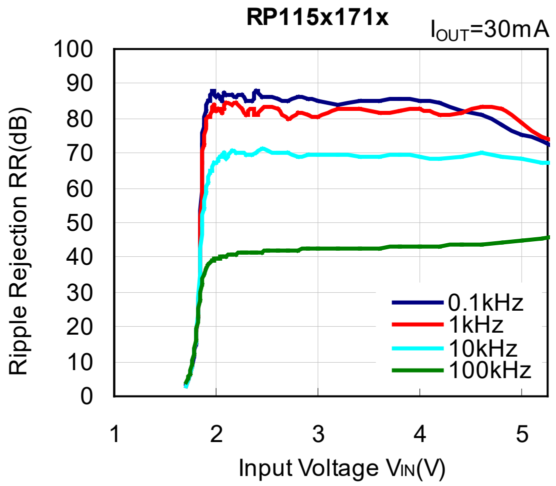


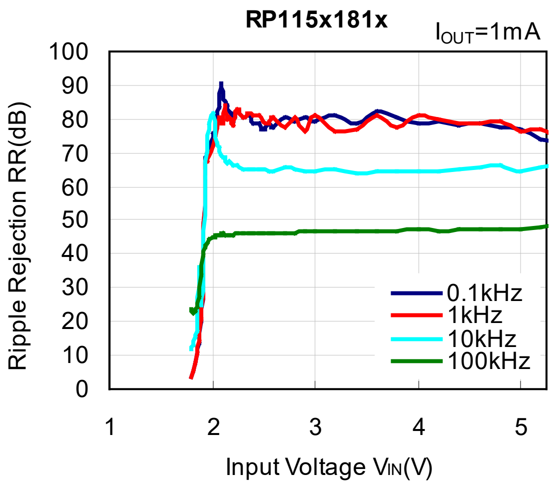
10) Ripple Rejection vs. Input Voltage (C_{IN} = none, C_{OUT} = Ceramic 1.0 µF, Ripple = 0.2 Vp-p, Ta = 25°C)

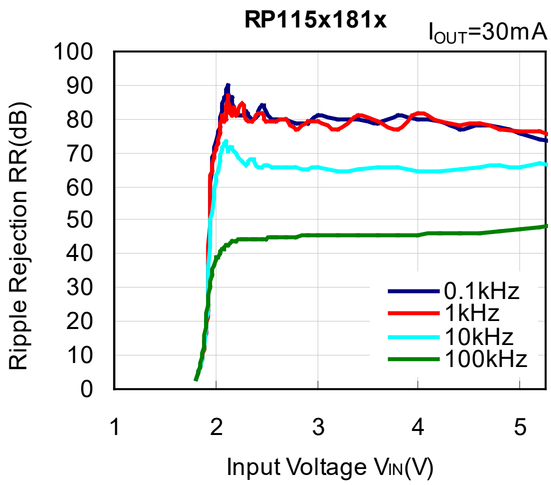


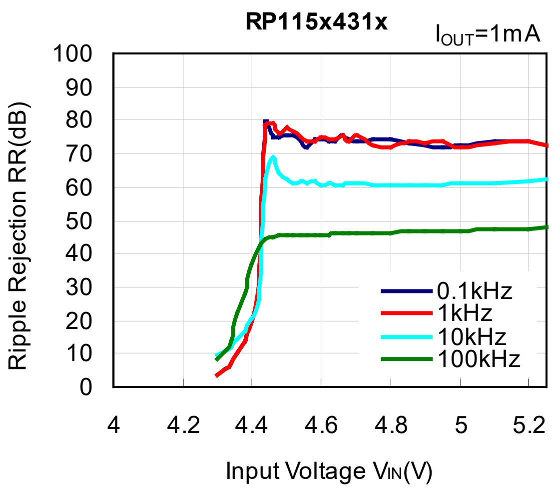


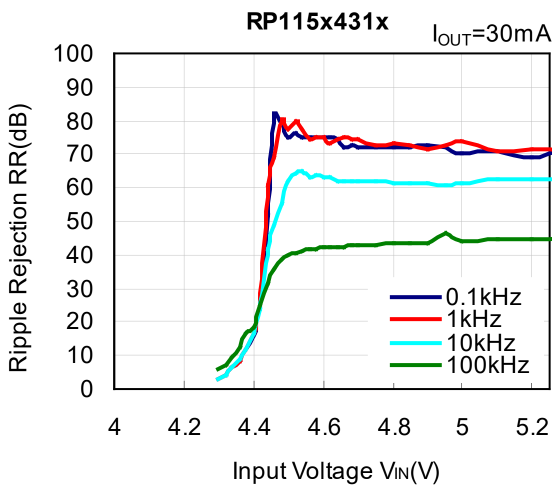

RP115x171x
IOUT=1mA
Ripple Rejection RR(dB)
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
Input Voltage VIN(V)
0.1kHz
1kHz
10kHz
100kHz


RP115x171x
IOUT=30mA
Ripple Rejection RR(dB)
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
Input Voltage VIN(V)
0.1kHz
1kHz
10kHz
100kHz


RP115x181x
IOUT=1mA
Ripple Rejection RR(dB)
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
Input Voltage VIN(V)
0.1kHz
1kHz
10kHz
100kHz

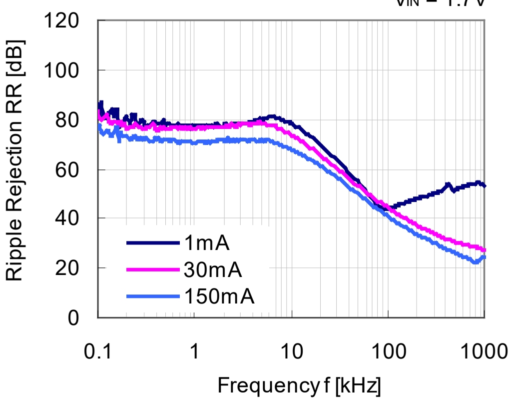

RP115x181x
IOUT=30mA
Ripple Rejection RR(dB)
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
Input Voltage VIN(V)
0.1kHz
1kHz
10kHz
100kHz


RP115x431x
IOUT=1mA
Ripple Rejection RR(dB)
100
90
80
70
60
50
40
30
20
10
0
4
4.2
4.4
4.6
4.8
5
5.2
Input Voltage VIN(V)
0.1kHz
1kHz
10kHz
100kHz

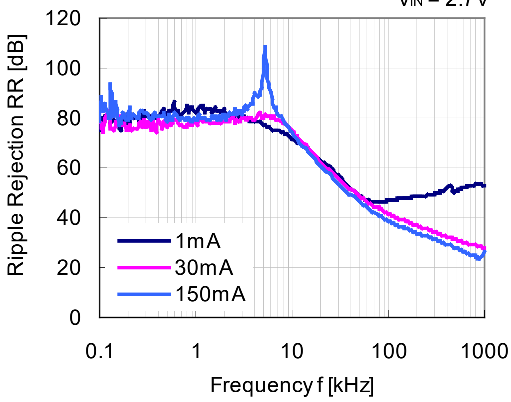

RP115x431x
IOUT=30mA
Ripple Rejection RR(dB)
100
90
80
70
60
50
40
30
20
10
0
4
4.2
4.4
4.6
4.8
5
5.2
Input Voltage VIN(V)
0.1kHz
1kHz
10kHz
100kHz

11) Ripple Rejection vs. Frequency (C_{IN} = none, C_{OUT} = Ceramic 1.0 µF, Ripple = 0.2 Vp-p, Ta = 25°C)

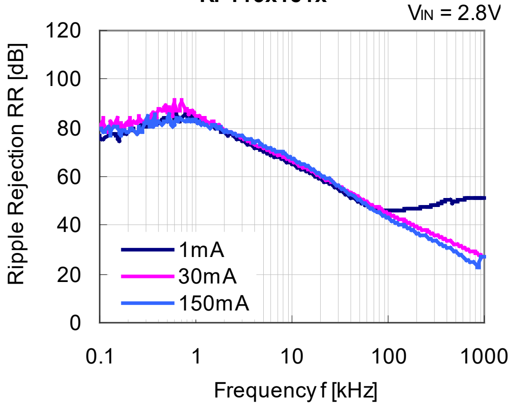
RP115x071x



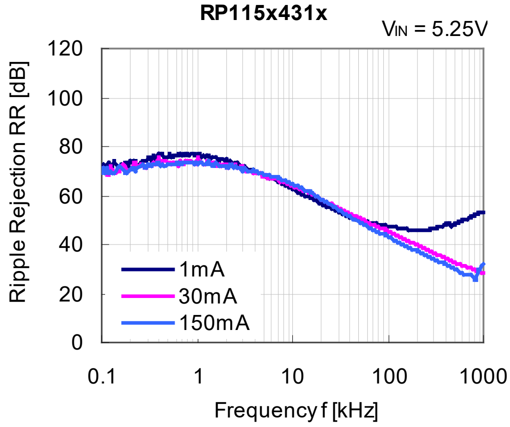
RP115x171x



RP115x181x

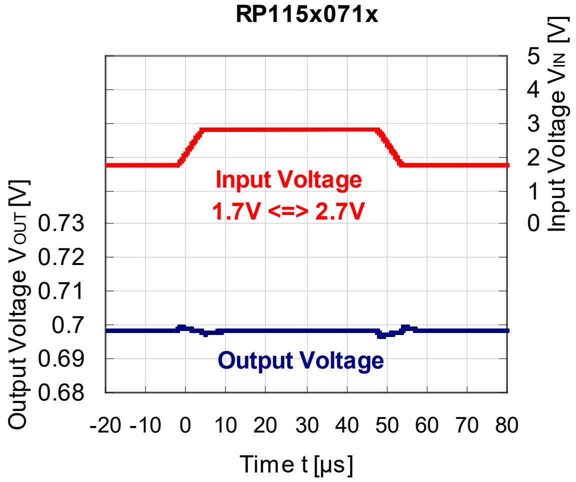


RP115x431x

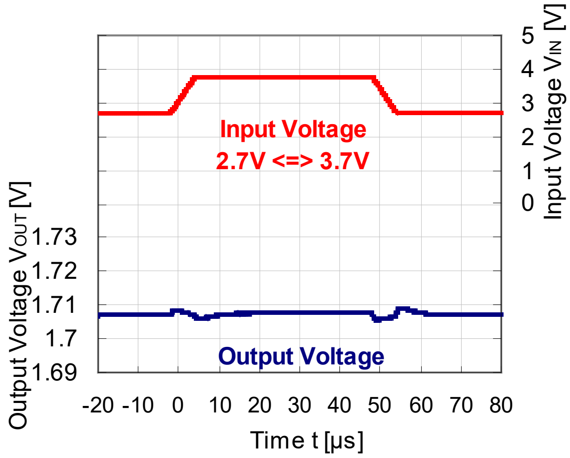


12) Line Transient Response C_{IN} = none, C_{OUT} = Ceramic 1.0 µF, I_{OUT} = 30 mA, tr = tf = 5 µs, Ta = 25°C)

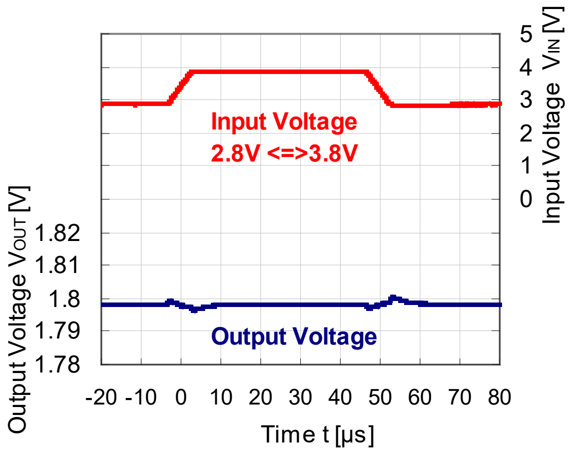
RP115x071x



RP115x171x

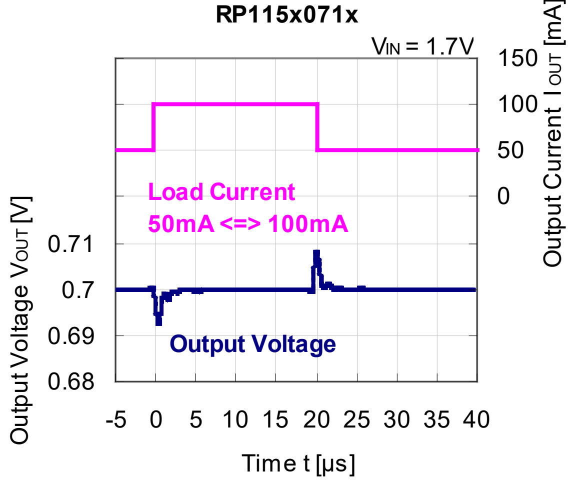


RP115x181x

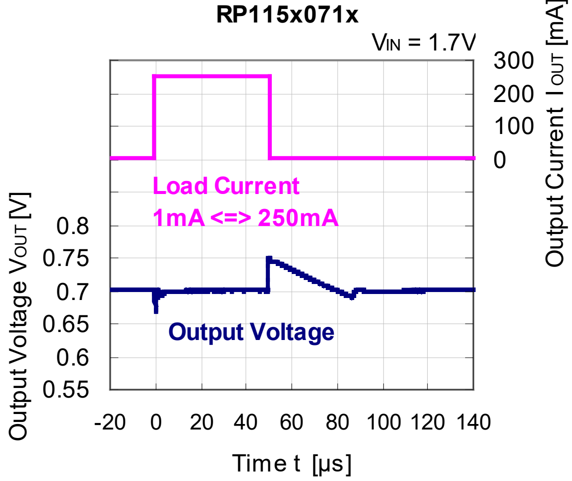


13) Load Transient Response (C_{IN} = Ceramic 1.0 µF, C_{OUT} = Ceramic 1.0 µF, tr = tf = 0.5 µs, Ta = 25°C)

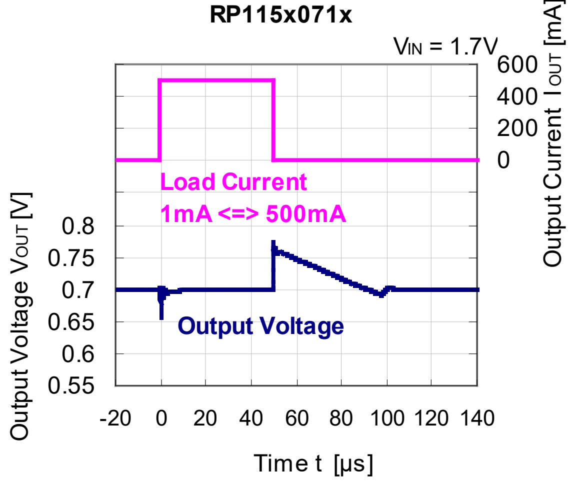
RP115x071x



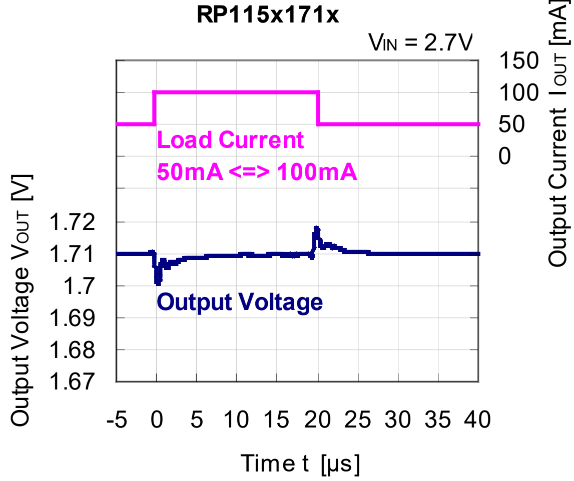
RP115x071x

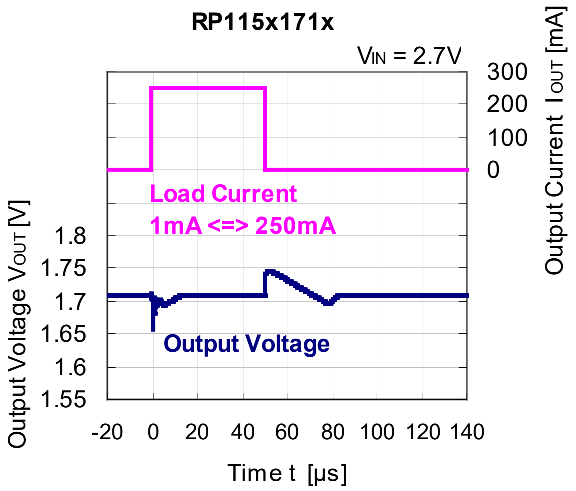


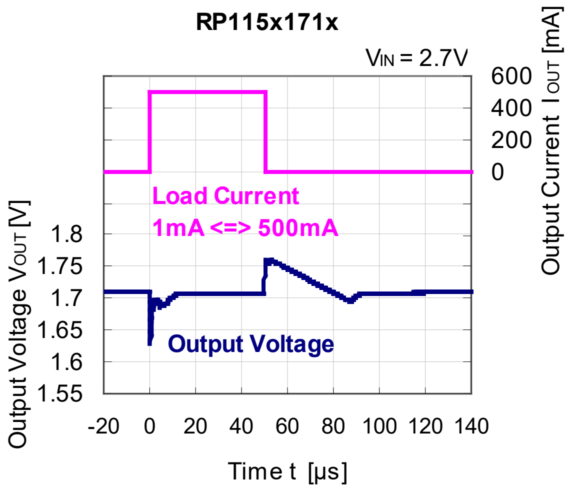
RP115x071x

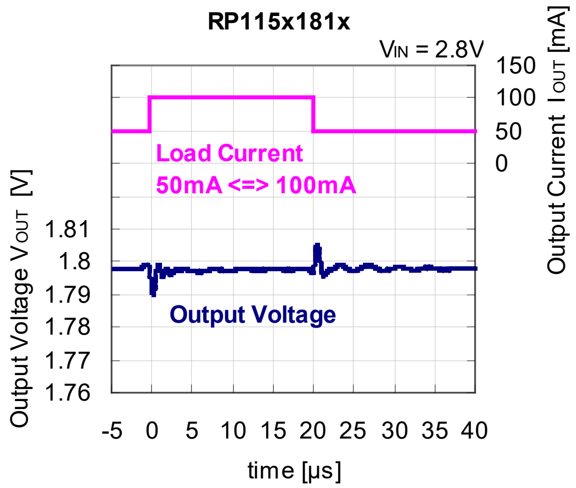


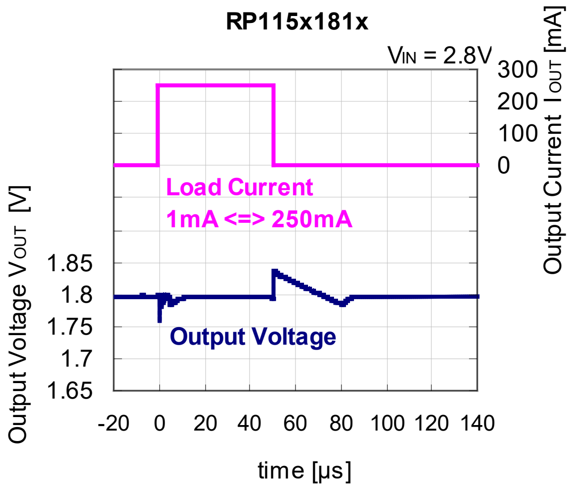
RP115x171x

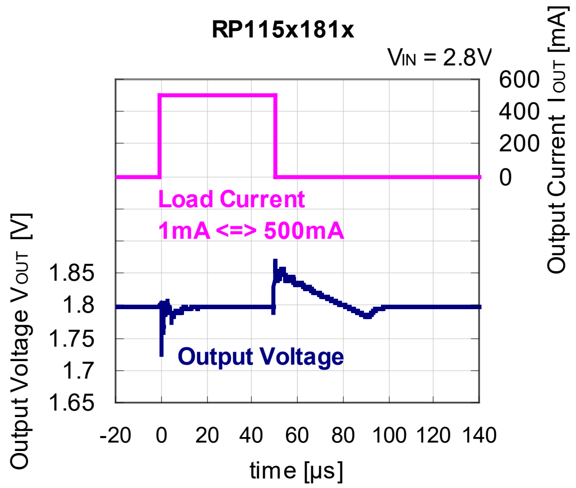


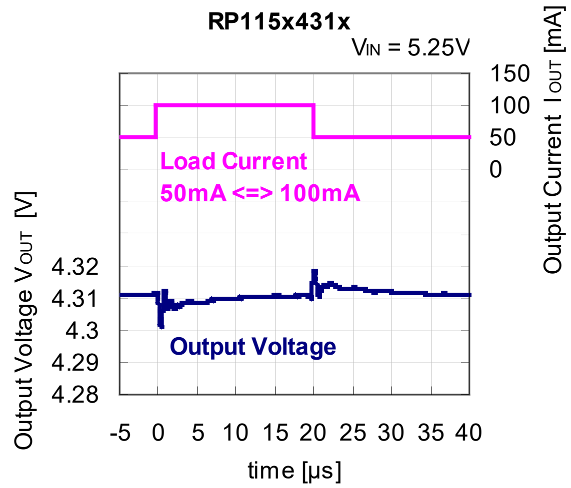

RP115x171x
VIN = 2.7V
Load Current
1mA <=> 250mA
Output Voltage
Output Voltage VOUT [V]
Output Current IOUT [mA]
Time t [µs]

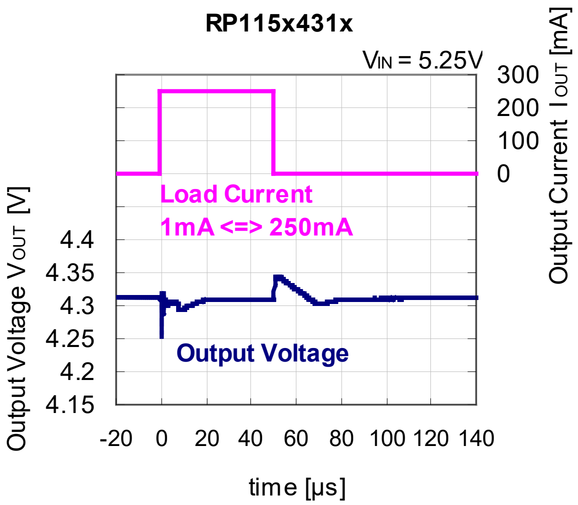

RP115x171x
VIN = 2.7V
Load Current
1mA <=> 500mA
Output Voltage
Output Voltage VOUT [V]
Output Current IOUT [mA]
Time t [µs]

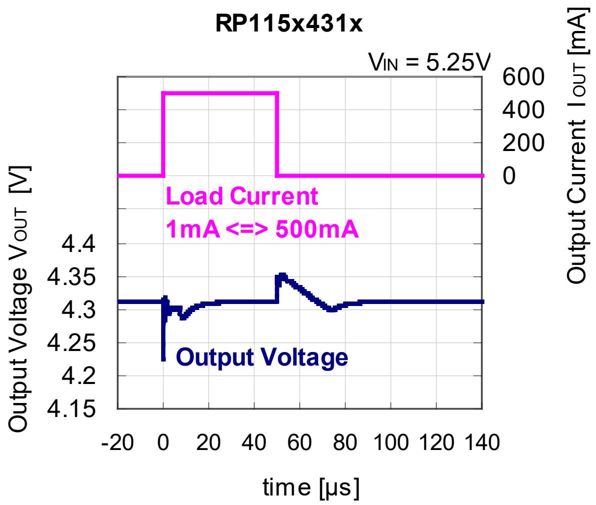

RP115x181x
VIN = 2.8V
Load Current
50mA <=> 100mA
Output Voltage
Output Voltage VOUT [V]
Output Current IOUT [mA]
time [µs]


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

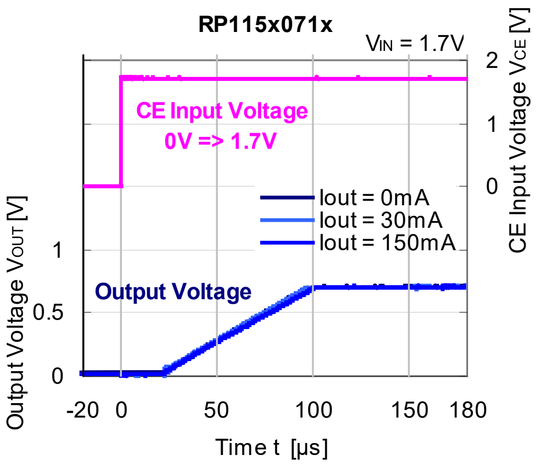

RP115x181x
VIN = 2.8V
Load Current
1mA <=> 500mA
Output Voltage
Output Voltage VOUT [V]
Output Current IOUT [mA]
time [µs]

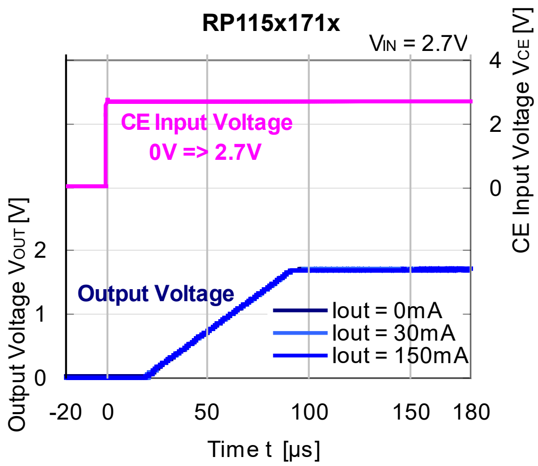

RP115x431x
VIN = 5.25V
Load Current
50mA <=> 100mA
Output Voltage
Output Voltage VOUT [V]
Output Current IOUT [mA]
time [µs]

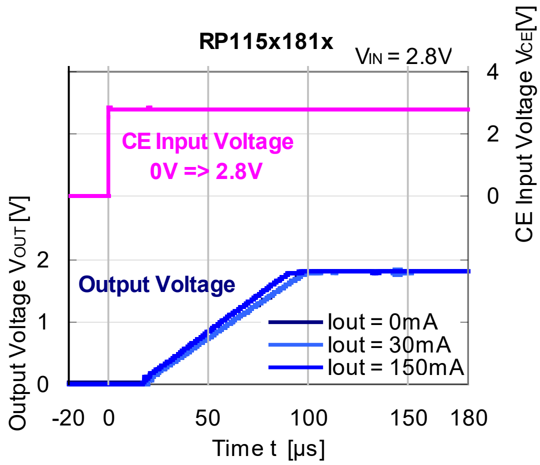


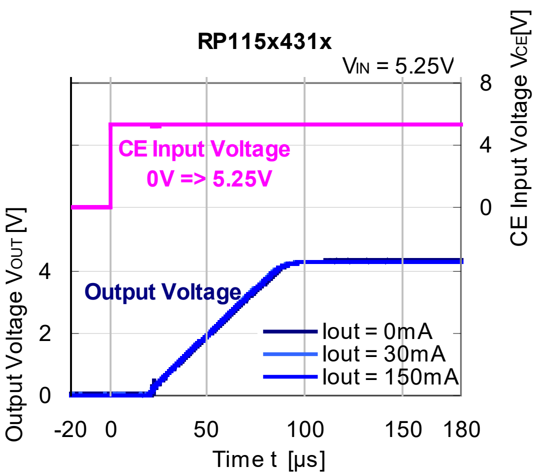


14) Turn-on Waveform by CE Pin Signal (C_{IN} = Ceramic 1.0 µF, C_{OUT} = Ceramic 1.0 µF, Ta = 25°C)

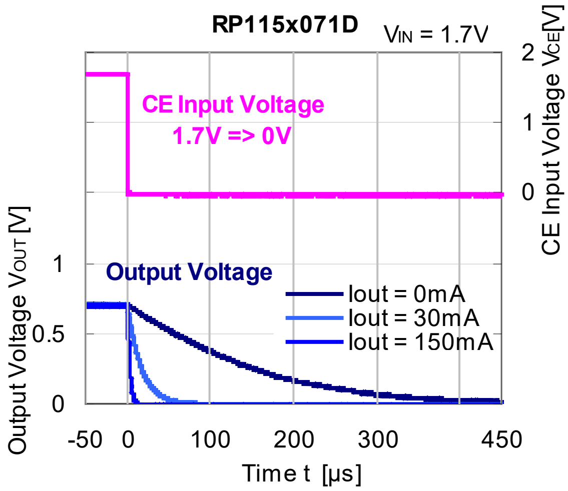


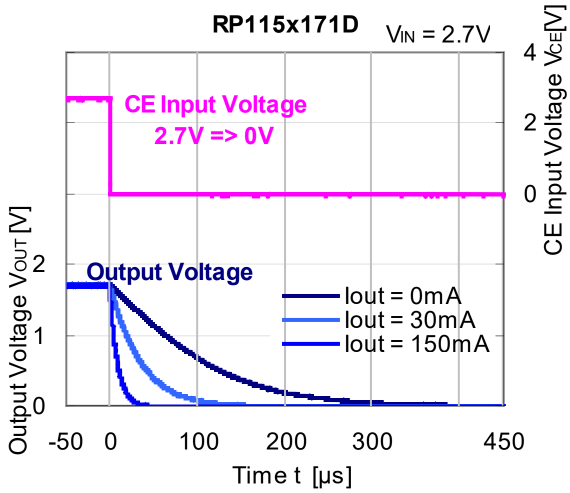


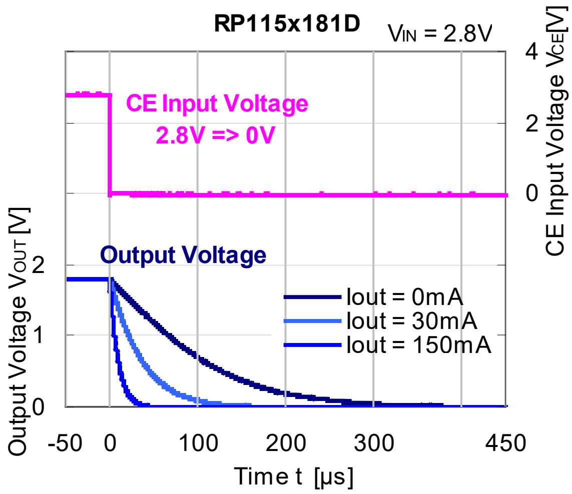


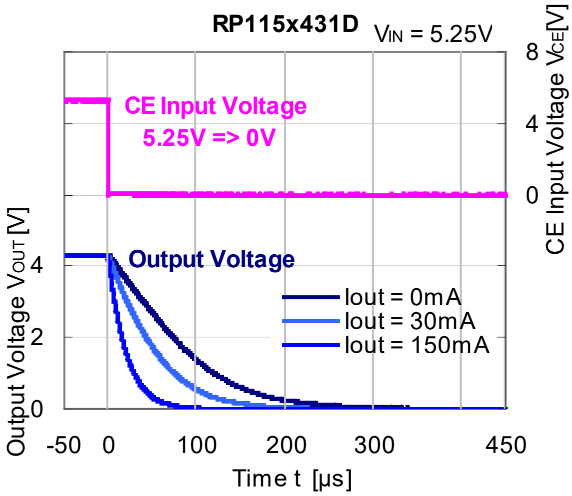


15) Turn-off Waveform by CE Pin Signal (C_{IN} = Ceramic 1.0 μF, C_{OUT} = Ceramic 1.0 μF, Ta = 25°C)

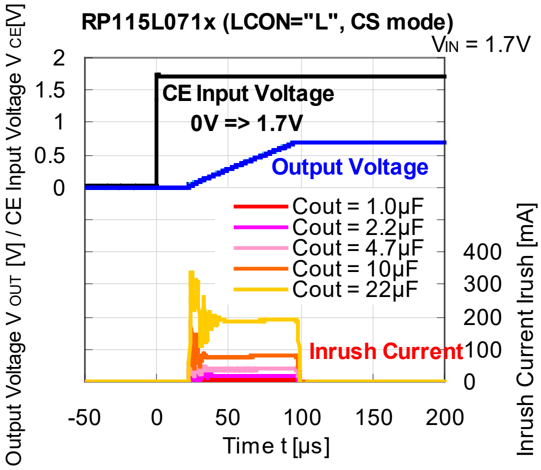


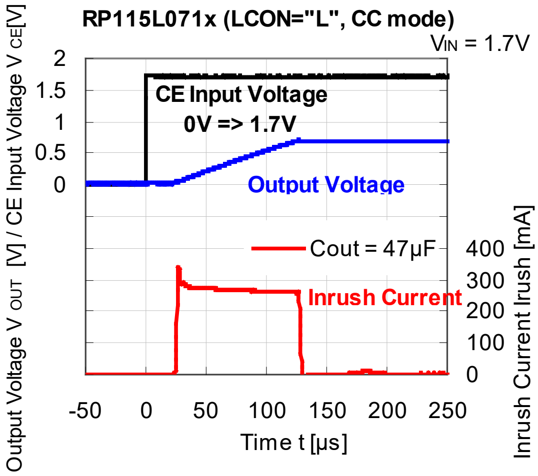


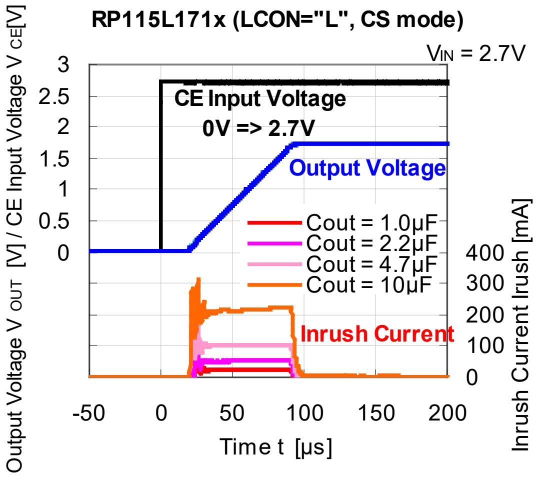


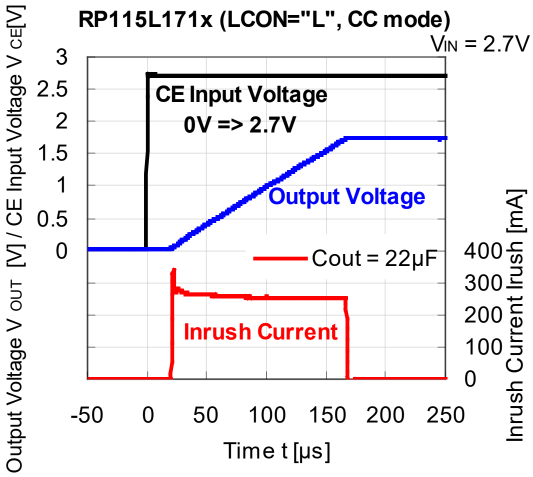


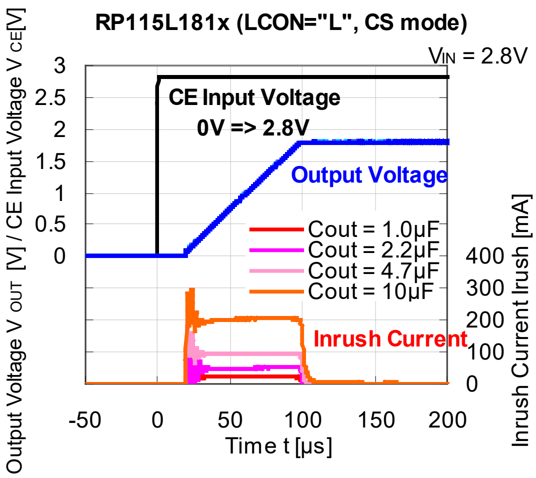
16) Inrush Current (C_{IN} = Ceramic 1.0 μF, I_{OUT} = 0 mA, Ta = 25°C)

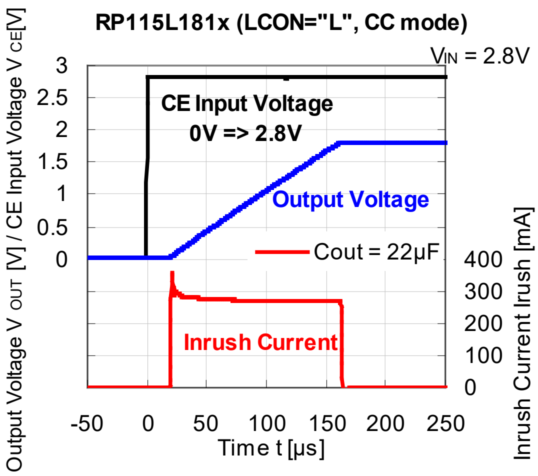


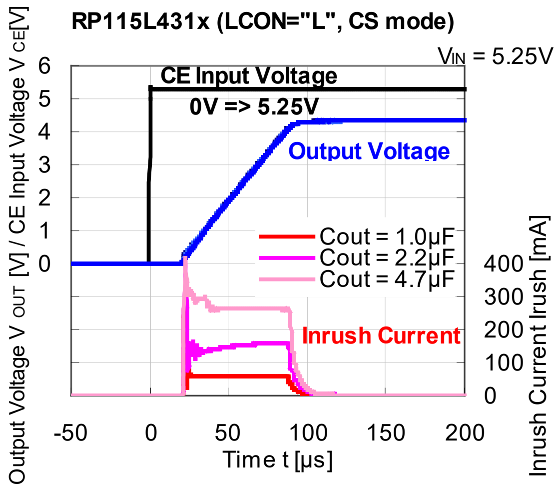


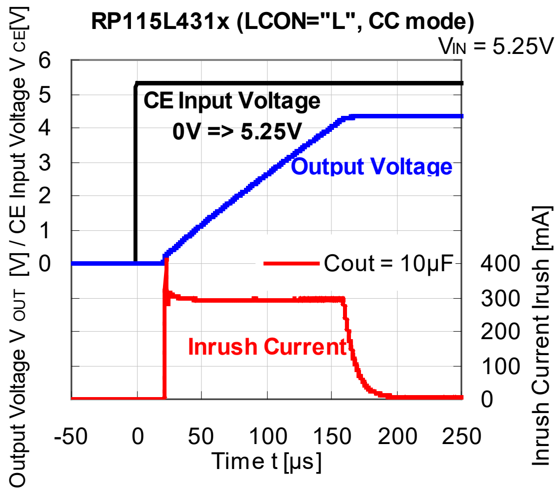


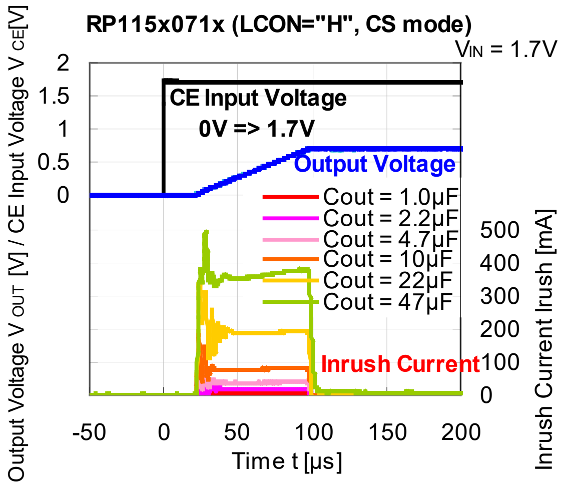


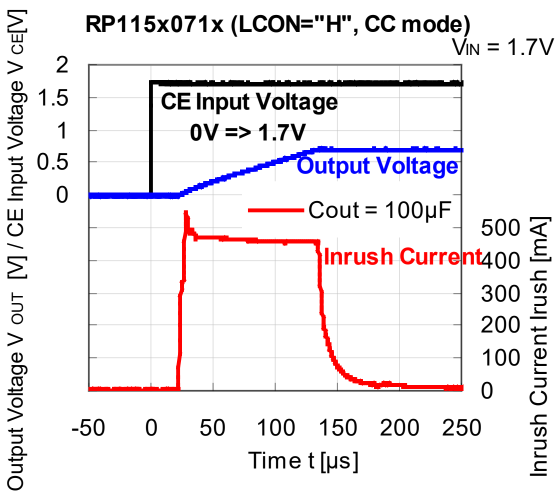


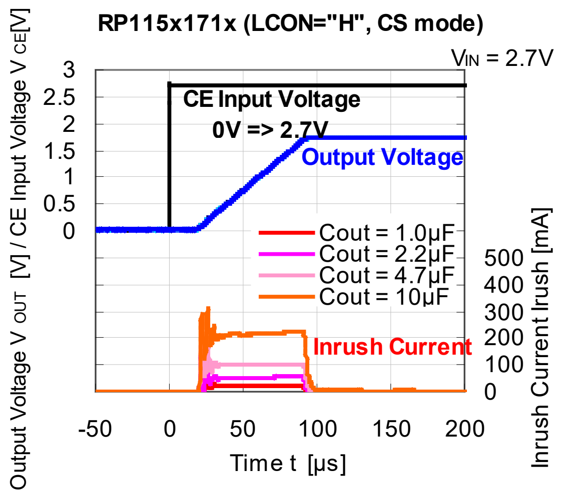


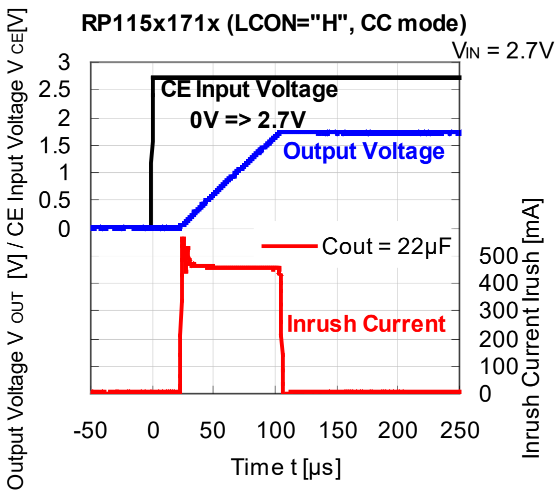

RP115L431x (LCON="L", CS mode)
VIN = 5.25V
CE Input Voltage
0V => 5.25V
Output Voltage
Cout = 1.0μF
Cout = 2.2μF
Cout = 4.7μF
Inrush Current
Output Voltage V OUT [V] / CE Input Voltage V CE[V]
Inrush Current Irush [mA]
Time t [μs]

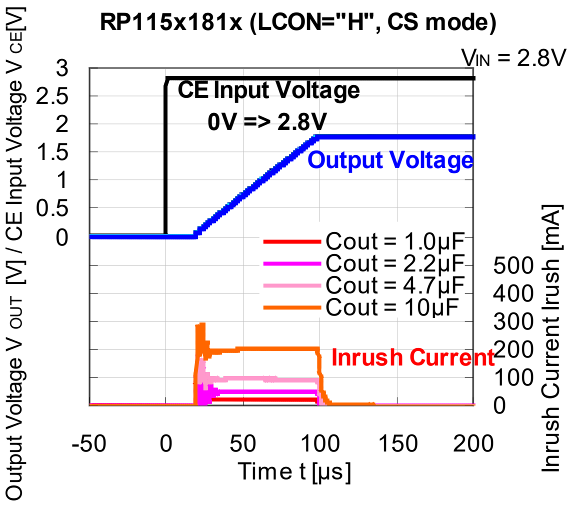

RP115L431x (LCON="L", CC mode)
VIN = 5.25V
CE Input Voltage
0V => 5.25V
Output Voltage
Cout = 10μF
Inrush Current
Output Voltage V OUT [V] / CE Input Voltage V CE[V]
Inrush Current Irush [mA]
Time t [μs]

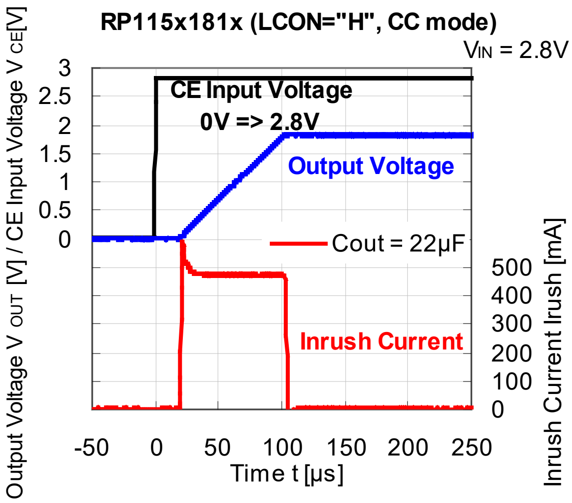

RP115x071x (LCON="H", CS mode)
VIN = 1.7V
CE Input Voltage
0V => 1.7V
Output Voltage
Cout = 1.0μF
Cout = 2.2μF
Cout = 4.7μF
Cout = 10μF
Cout = 22μF
Cout = 47μF
Inrush Current
Output Voltage V OUT [V] / CE Input Voltage V CE[V]
Inrush Current Irush [mA]
Time t [μs]

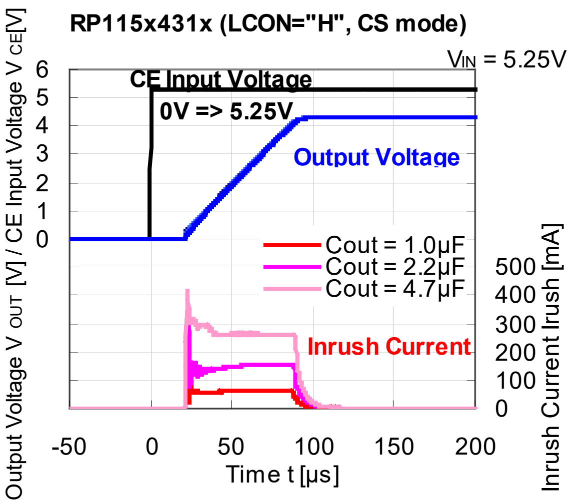

RP115x071x (LCON="H", CC mode)
VIN = 1.7V
CE Input Voltage
0V => 1.7V
Output Voltage
Cout = 100μF
Inrush Current
Output Voltage V OUT [V] / CE Input Voltage V CE[V]
Inrush Current Irush [mA]
Time t [μs]

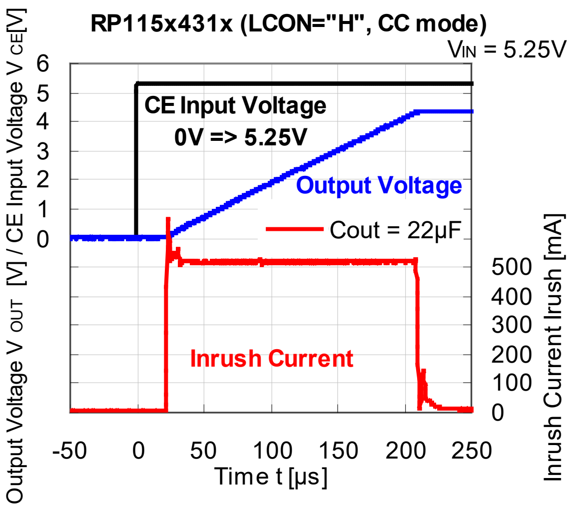

RP115x171x (LCON="H", CS mode)
VIN = 2.7V
CE Input Voltage
0V => 2.7V
Output Voltage
Cout = 1.0μF
Cout = 2.2μF
Cout = 4.7μF
Cout = 10μF
Inrush Current
Output Voltage V OUT [V] / CE Input Voltage V CE[V]
Inrush Current Irush [mA]
Time t [μs]


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]

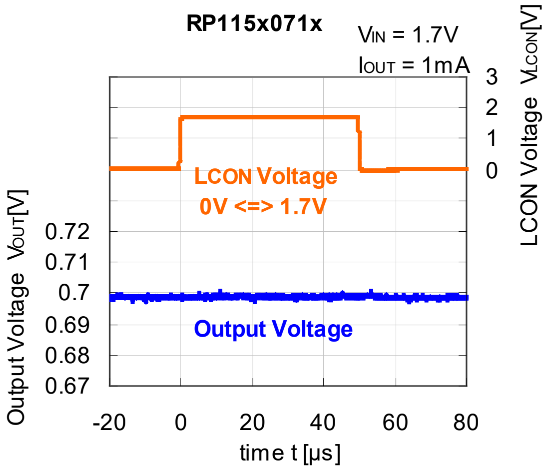

RP115x181x (LCON="H", CS mode)
VIN = 2.8V
CE Input Voltage
0V => 2.8V
Output Voltage
Cout = 1.0μF
Cout = 2.2μF
Cout = 4.7μF
Cout = 10μF
Inrush Current
Output Voltage V OUT [V] / CE Input Voltage V CE[V]
Inrush Current Irush [mA]
Time t [μs]

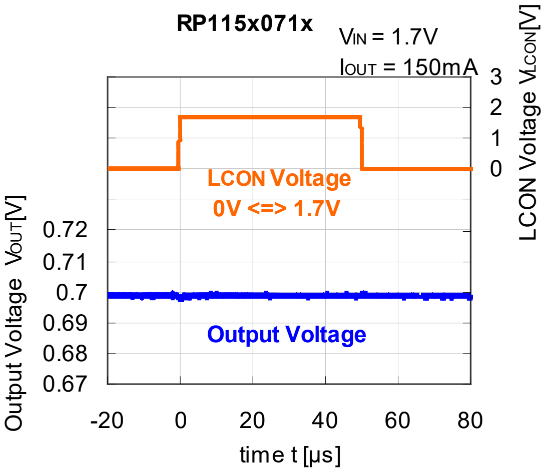

RP115x181x (LCON="H", CC mode)
VIN = 2.8V
CE Input Voltage
0V => 2.8V
Output Voltage
Cout = 22μF
Inrush Current
Output Voltage V OUT [V] / CE Input Voltage V CE[V]
Inrush Current Irush [mA]
Time t [μs]

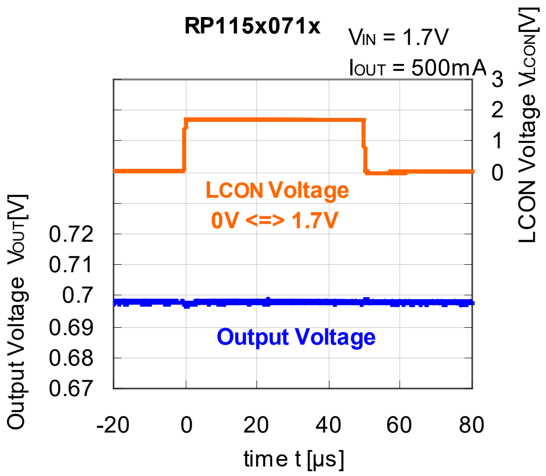

RP115x431x (LCON="H", CS mode)
VIN = 5.25V
CE Input Voltage
0V => 5.25V
Output Voltage
Cout = 1.0μF
Cout = 2.2μF
Cout = 4.7μF
Inrush Current
Output Voltage V OUT [V] / CE Input Voltage V CE[V]
Inrush Current Irush [mA]
Time t [μs]

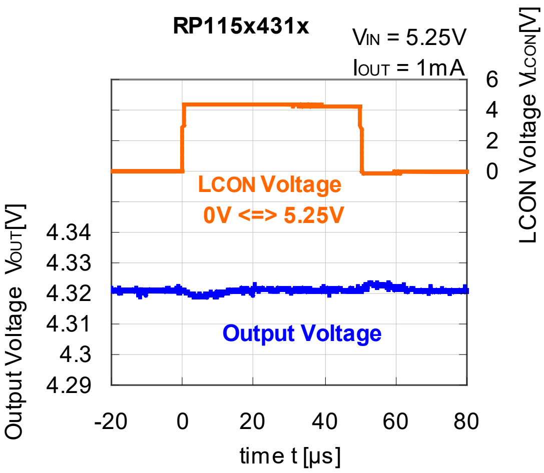

RP115x431x (LCON="H", CC mode)
VIN = 5.25V
CE Input Voltage
0V => 5.25V
Output Voltage
Cout = 22μF
Inrush Current
Output Voltage V OUT [V] / CE Input Voltage V CE[V]
Inrush Current Irush [mA]
Time t [μs]

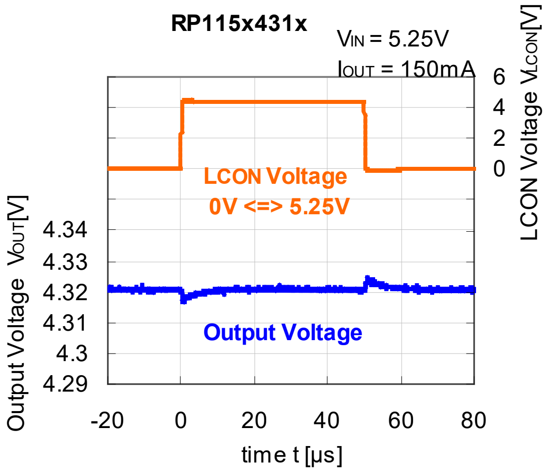
17) LCON Pin Transient Response (C_{IN} = Ceramic 1.0 μF, C_{OUT} = Ceramic 1.0 μF, Ta = 25°C)

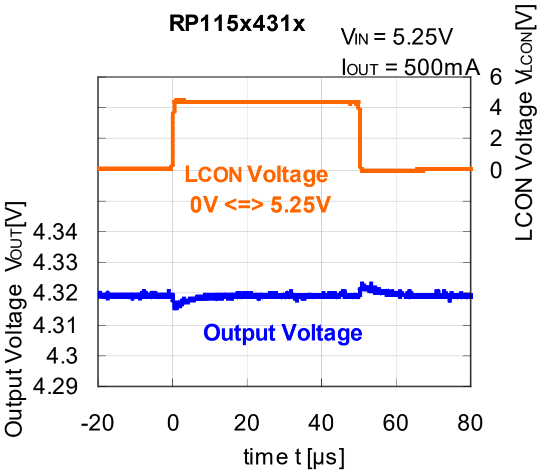












Ver. A

DFN1216-8 パッケージの許容損失について特性例を示します。なお、許容損失は実装条件に左右されます。本特性例は JEDEC STD. 51-7 に基づいた下記測定条件での参考データとなります。

測定条件

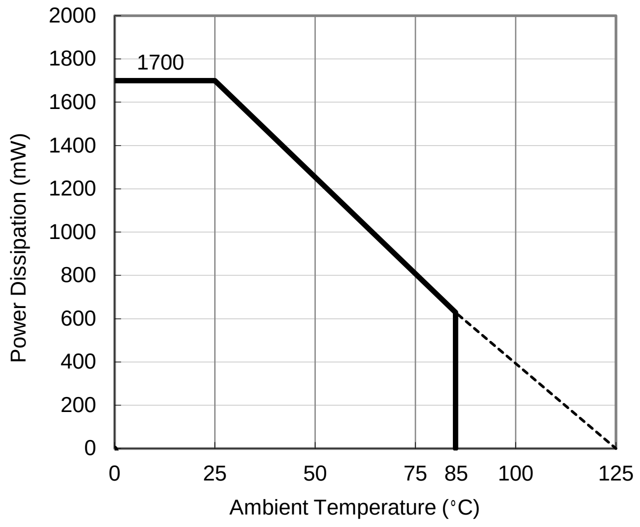
項目	測定条件
測定状態	基板実装状態 (風速 0 m/s)
基板材質	ガラスエポキシ樹脂 (4 層基板)
基板サイズ	76.2 mm × 114.3 mm × 0.8 mm
配線率	外層 (1 層) : 95%以下, 50 mm 角 内層 (2 層, 3 層) : 100%, 50 mm 角 外層 (4 層) : 100%, 50 mm 角
スルーホール	ϕ 0.2 mm × 15 個

測定結果 (Ta = 25°C, Tjmax = 125°C)

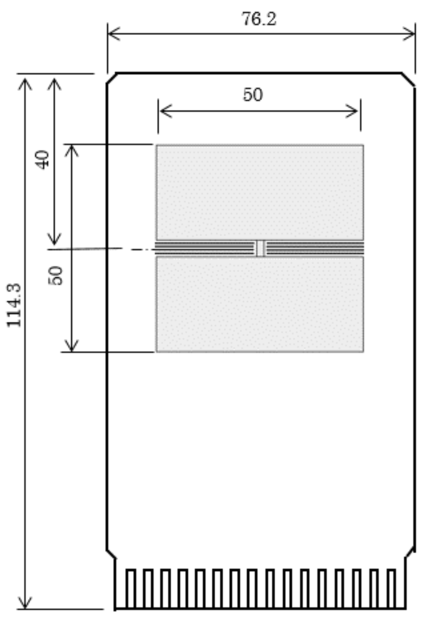
項目	測定結果
許容損失	1700 mW
熱抵抗 (θja)	θja = 56°C/W
熱特性 (ψjt)	ψjt = 18°C/W

θja : ジャンクション温度と周囲温度間の熱抵抗

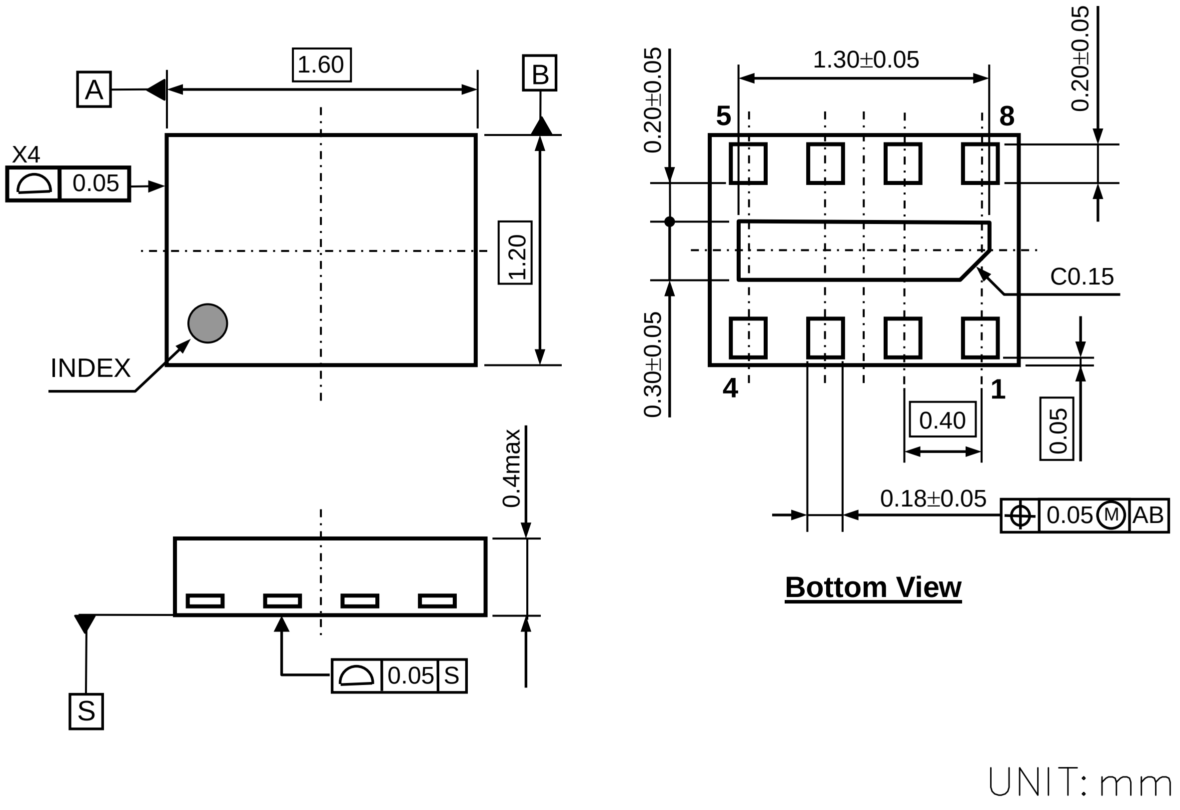
Ψjt : ジャンクション温度とパッケージマーク面中央温度間の熱特性



許容損失 対 周囲温度



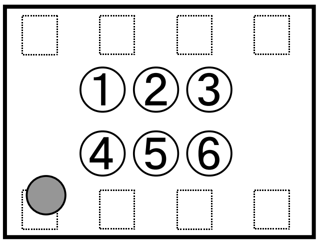
測定用基板レイアウト



DFN1216-8 Package Dimensions

MK-RP115L-JAEA-B

①②③④: Product Code ··· Refer to *Part Marking List*
⑤⑥: Lot Number ··· Alphanumeric Serial Number



DFN1216-8 Part Markings

NOTICE
There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact our sales or our distributor before attempting to use AOI.

MK-RP115L-JAEA-B

RP115Lxx1x Part Marking List

Product Name	①	②	③	④	Product Name	①	②	③	④
RP115L071B	D	U	0	7	RP115L071D	D	V	0	7
RP115L081B	D	U	0	8	RP115L081D	D	V	0	8
RP115L091B	D	U	0	9	RP115L091D	D	V	0	9
RP115L101B	D	U	1	0	RP115L101D	D	V	1	0
RP115L111B	D	U	1	1	RP115L111D	D	V	1	1
RP115L121B	D	U	1	2	RP115L121D	D	V	1	2
RP115L131B	D	U	1	3	RP115L131D	D	V	1	3
RP115L141B	D	U	1	4	RP115L141D	D	V	1	4
RP115L151B	D	U	1	5	RP115L151D	D	V	1	5
RP115L161B	D	U	1	6	RP115L161D	D	V	1	6
RP115L171B	D	U	1	7	RP115L171D	D	V	1	7
RP115L181B	D	U	1	8	RP115L181D	D	V	1	8
RP115L191B	D	U	1	9	RP115L191D	D	V	1	9
RP115L201B	D	U	2	0	RP115L201D	D	V	2	0
RP115L211B	D	U	2	1	RP115L211D	D	V	2	1
RP115L221B	D	U	2	2	RP115L221D	D	V	2	2
RP115L231B	D	U	2	3	RP115L231D	D	V	2	3
RP115L241B	D	U	2	4	RP115L241D	D	V	2	4
RP115L251B	D	U	2	5	RP115L251D	D	V	2	5
RP115L261B	D	U	2	6	RP115L261D	D	V	2	6
RP115L271B	D	U	2	7	RP115L271D	D	V	2	7
RP115L281B	D	U	2	8	RP115L281D	D	V	2	8
RP115L291B	D	U	2	9	RP115L291D	D	V	2	9
RP115L301B	D	U	3	0	RP115L301D	D	V	3	0
RP115L311B	D	U	3	1	RP115L311D	D	V	3	1
RP115L321B	D	U	3	2	RP115L321D	D	V	3	2
RP115L331B	D	U	3	3	RP115L331D	D	V	3	3
RP115L341B	D	U	3	4	RP115L341D	D	V	3	4
RP115L351B	D	U	3	5	RP115L351D	D	V	3	5
RP115L361B	D	U	3	6	RP115L361D	D	V	3	6
RP115L371B	D	U	3	7	RP115L371D	D	V	3	7
RP115L381B	D	U	3	8	RP115L381D	D	V	3	8
RP115L391B	D	U	3	9	RP115L391D	D	V	3	9
RP115L401B	D	U	4	0	RP115L401D	D	V	4	0
RP115L411B	D	U	4	1	RP115L411D	D	V	4	1
RP115L421B	D	U	4	2	RP115L421D	D	V	4	2
RP115L431B	D	U	4	3	RP115L431D	D	V	4	3
RP115L071B5	D	U	0	0	RP115L071D5	D	V	0	0
RP115L121B5	D	U	0	1	RP115L121D5	D	V	0	1
RP115L181B5	D	U	0	2	RP115L181D5	D	V	0	2
RP115L281B5	D	U	0	3	RP115L281D5	D	V	0	3
RP115L131B5	D	U	0	4	RP115L131D5	D	V	0	4
RP115L111B5	D	U	0	5	RP115L111D5	D	V	0	5
RP115L211B5	D	U	0	6	RP115L211D5	D	V	0	6
RP115L291B5	D	U	6	0	RP115L291D5	D	V	6	0
RP115L171B5	D	U	6	1	RP115L171D5	D	V	6	1
RP115L271B5	D	U	6	2	RP115L271D5	D	V	6	2

PD-SOT-89-5-(85125)-JE-A

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

Measurement Conditions

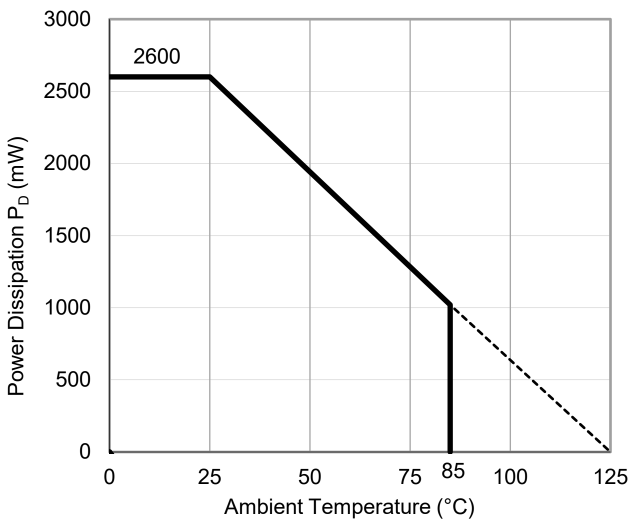
Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	ϕ 0.3 mm × 13 pcs

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

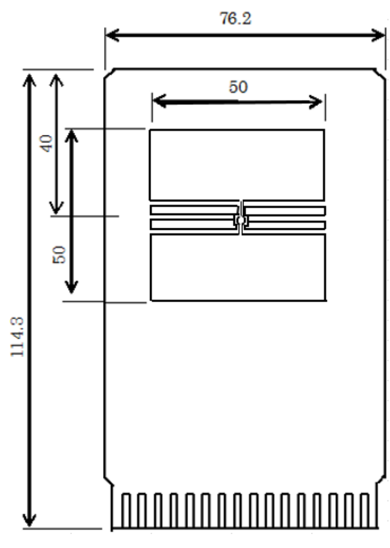
Item	Measurement Result
Power Dissipation	2600 mW
Thermal Resistance (θja)	θja = 38°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 13°C/W

θja: Junction-to-Ambient Thermal Resistance

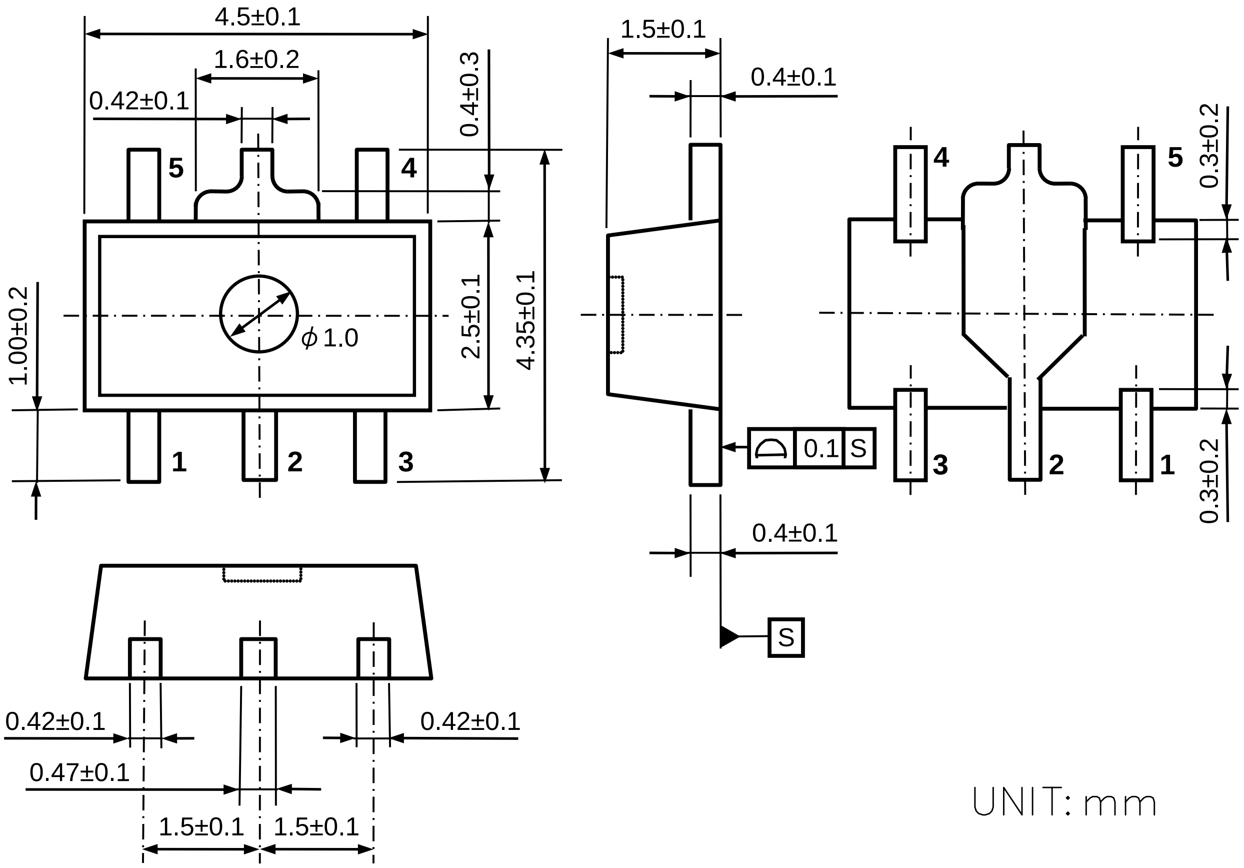
ψjt: Junction-to-Top Thermal Characterization Parameter



Power Dissipation vs. Ambient Temperature



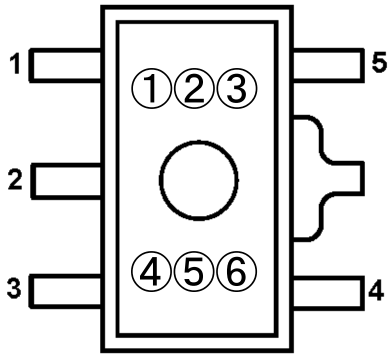
Measurement Board Pattern



SOT-89-5 Package Dimensions

MK-RP115H-JAEA-B

①②③④: Product Code ··· Refer to *Part Marking List*
⑤⑥: Lot Number ··· Alphanumeric Serial Number



SOT-89-5 Part Markings

NOTICE
There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact our sales or our distributor before attempting to use AOI.

MK-RP115H-JAEA-B

RP115Hxx1x Part Marking List

Product Name	①	②	③	④
RP115H071B	D	0	7	F
RP115H081B	D	0	8	F
RP115H091B	D	0	9	F
RP115H101B	D	1	0	F
RP115H111B	D	1	1	F
RP115H121B	D	1	2	F
RP115H131B	D	1	3	F
RP115H141B	D	1	4	F
RP115H151B	D	1	5	F
RP115H161B	D	1	6	F
RP115H171B	D	1	7	F
RP115H181B	D	1	8	F
RP115H191B	D	1	9	F
RP115H201B	D	2	0	F
RP115H211B	D	2	1	F
RP115H221B	D	2	2	F
RP115H231B	D	2	3	F
RP115H241B	D	2	4	F
RP115H251B	D	2	5	F
RP115H261B	D	2	6	F
RP115H271B	D	2	7	F
RP115H281B	D	2	8	F
RP115H291B	D	2	9	F
RP115H301B	D	3	0	F
RP115H311B	D	3	1	F
RP115H321B	D	3	2	F
RP115H331B	D	3	3	F
RP115H341B	D	3	4	F
RP115H351B	D	3	5	F
RP115H361B	D	3	6	F
RP115H371B	D	3	7	F
RP115H381B	D	3	8	F
RP115H391B	D	3	9	F
RP115H401B	D	4	0	F
RP115H411B	D	4	1	F
RP115H421B	D	4	2	F
RP115H431B	D	4	3	F
RP115H071B5	D	0	0	F
RP115H121B5	D	0	1	F
RP115H181B5	D	0	2	F
RP115H281B5	D	0	3	F
RP115H131B5	D	0	4	F
RP115H111B5	D	0	5	F
RP115H211B5	D	0	6	F
RP115H121B8	D	1	2	H

Product Name	①	②	③	④
RP115H071D	D	0	7	G
RP115H081D	D	0	8	G
RP115H091D	D	0	9	G
RP115H101D	D	1	0	G
RP115H111D	D	1	1	G
RP115H121D	D	1	2	G
RP115H131D	D	1	3	G
RP115H141D	D	1	4	G
RP115H151D	D	1	5	G
RP115H161D	D	1	6	G
RP115H171D	D	1	7	G
RP115H181D	D	1	8	G
RP115H191D	D	1	9	G
RP115H201D	D	2	0	G
RP115H211D	D	2	1	G
RP115H221D	D	2	2	G
RP115H231D	D	2	3	G
RP115H241D	D	2	4	G
RP115H251D	D	2	5	G
RP115H261D	D	2	6	G
RP115H271D	D	2	7	G
RP115H281D	D	2	8	G
RP115H291D	D	2	9	G
RP115H301D	D	3	0	G
RP115H311D	D	3	1	G
RP115H321D	D	3	2	G
RP115H331D	D	3	3	G
RP115H341D	D	3	4	G
RP115H351D	D	3	5	G
RP115H361D	D	3	6	G
RP115H371D	D	3	7	G
RP115H381D	D	3	8	G
RP115H391D	D	3	9	G
RP115H401D	D	4	0	G
RP115H411D	D	4	1	G
RP115H421D	D	4	2	G
RP115H431D	D	4	3	G
RP115H071D5	D	0	0	G
RP115H121D5	D	0	1	G
RP115H181D5	D	0	2	G
RP115H281D5	D	0	3	G
RP115H131D5	D	0	4	G
RP115H111D5	D	0	5	G
RP115H211D5	D	0	6	G
RP115H121D8	D	1	2	J

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 our 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 the prior written consent of us.
3. This product and any technical information relating thereto are subject to complementary export controls (so-called KNOW controls) under the Foreign Exchange and Foreign Trade Law, and related politics ministerial ordinance of the law. (Note that the complementary export controls are inapplicable to any application-specific products, except rockets and pilotless aircraft, that are insusceptible to design or program changes.) Accordingly, when exporting or carrying abroad this product, follow the Foreign Exchange and Foreign Trade Control Law and its related regulations with respect to the complementary export controls.
4. The technical information described in this document shows typical characteristics 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 our 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 should first contact us.
    - Aerospace Equipment
    - Equipment Used in the Deep Sea
    - Power Generator Control Equipment (nuclear, steam, hydraulic, etc.)
    - Life Maintenance Medical Equipment
    - Fire Alarms / Intruder Detectors
    - Vehicle Control Equipment (automotive, airplane, railroad, ship, etc.)
    - Various Safety Devices
    - Traffic control system
    - Combustion equipment

    In case your company desires to use this product for any applications other than general electronic equipment mentioned above, make sure to contact our company in advance. Note that the important requirements mentioned in this section are not applicable to cases where operation requirements such as application conditions are confirmed by our company in writing after consultation with your company.
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, fire containment 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. The products have been designed and tested to function within controlled environmental conditions. Do not use products under conditions that deviate from methods or applications specified in this datasheet. Failure to employ the products in the proper applications can lead to deterioration, destruction or failure of the products. We shall not be responsible for any bodily injury, fires or accident, property damage or any consequential damages resulting from misuse or misapplication of the products.
8. Quality Warranty

    8-1. Quality Warranty Period

    In the case of a product purchased through an authorized distributor or directly from us, the warranty period for this product shall be one (1) year after delivery to your company. For defective products that occurred during this period, we will take the quality warranty measures described in section 8-2. However, if there is an agreement on the warranty period in the basic transaction agreement, quality assurance agreement, delivery specifications, etc., it shall be followed.

    8-2. Quality Warranty Remedies

    When it has been proved defective due to manufacturing factors as a result of defect analysis by us, we will either deliver a substitute for the defective product or refund the purchase price of the defective product.
    Note that such delivery or refund is sole and exclusive remedies to your company for the defective product.

    8-3. Remedies after Quality Warranty Period

    With respect to any defect of this product found after the quality warranty period, the defect will be analyzed by us. On the basis of the defect analysis results, the scope and amounts of damage shall be determined by mutual agreement of both parties. Then we will deal with upper limit in Section 8-2. This provision is not intended to limit any legal rights of your company.
9. Anti-radiation design is not implemented in the products described in this document.
10. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
11. WLCSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.
12. Warning for handling Gallium and Arsenic (GaAs) products (Applying to GaAs MMIC, Photo Reflector). These products use Gallium (Ga) and Arsenic (As) which are specified as poisonous chemicals by law. For the prevention of a hazard, do not burn, destroy, or process chemically to make them as gas or power. When the product is disposed of, please follow the related regulation and do not mix this with general industrial waste or household waste.
13. Please contact our sales representatives should you have any questions or comments concerning the products or the technical information.

Nisshinbo Micro Devices Inc.

Official website
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