

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

NO. EA-274-150708

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

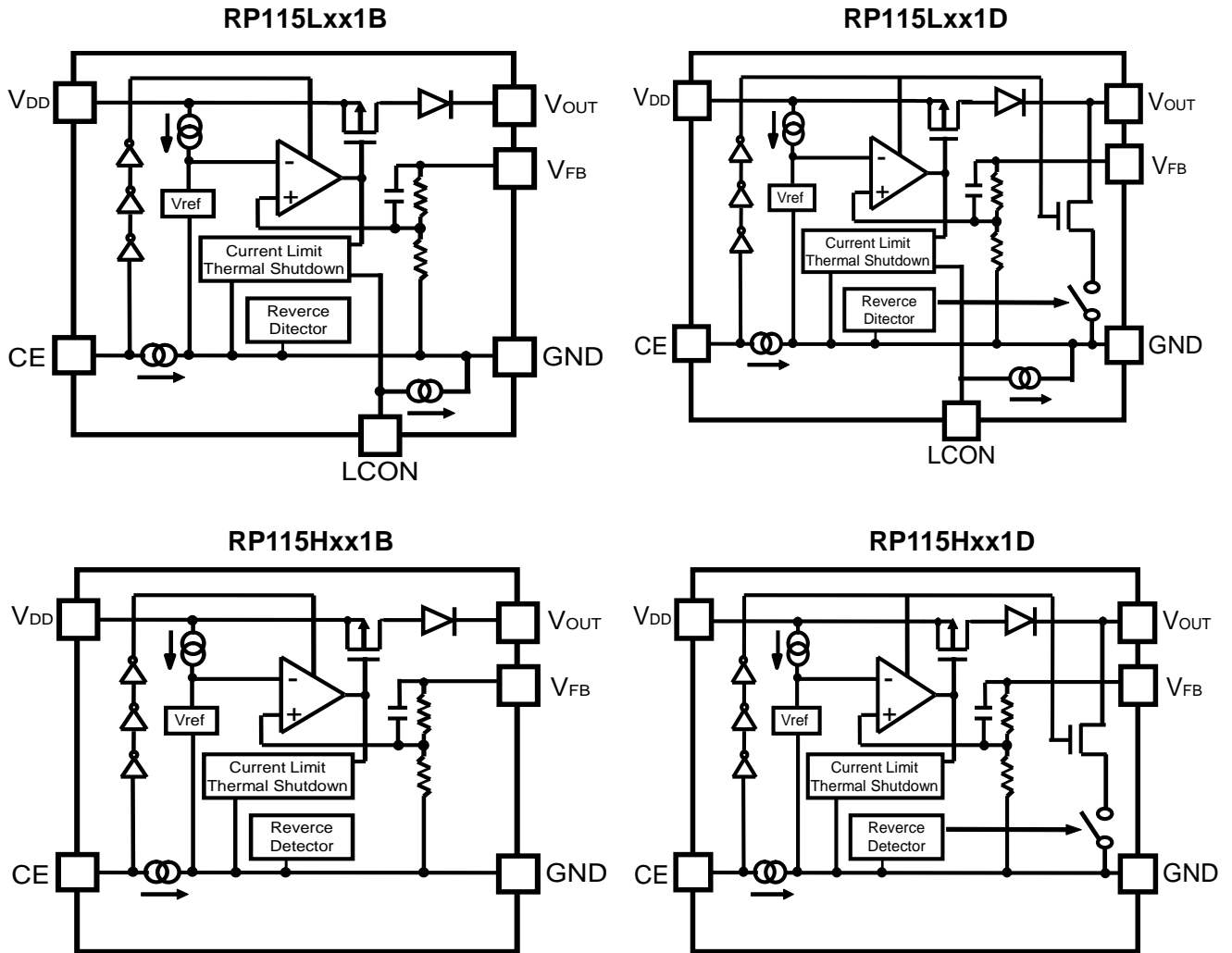
- Supply Current TYP. 110μA
- Supply Current (Standby Mode) TYP. 0.5μA
- Dropout Voltage TYP. 0.195V (DFN1216-8: I_{OUT}=1.0A, V_{SET}=1.2 V)
TYP. 0.235V (SOT-89-5: I_{OUT}=1.0A, V_{SET}=1.2 V)
- Ripple Rejection TYP. 80dB (f=1kHz, V_{SET} ≤ 1.8V)
TYP. 75dB (f=1kHz, V_{SET} > 1.8V)
- Output Voltage Accuracy ±1.0% (V_{SET} ≥ 1.75V)
- Output Voltage Temperature Coefficient TYP. ±30ppm/ °C (V_{SET} ≥ 1.75V)
- 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: 165°C
- 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 SELECTION GUIDE.

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



Note: 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.

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

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

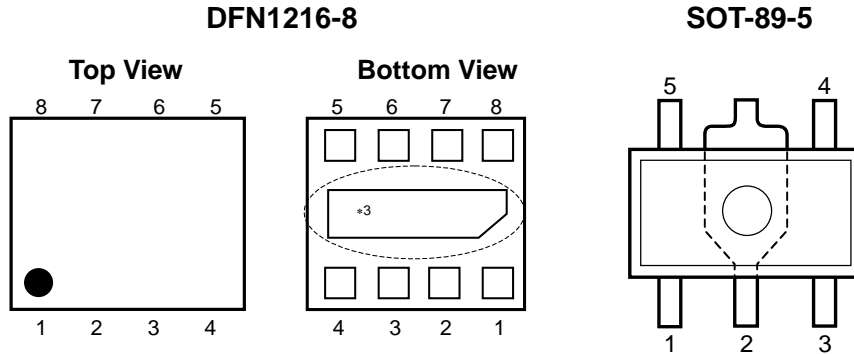
(y): If the output voltage includes the 3rd digit, indicate the digit of 0.01.
(0.75V, 1.15V, 1.25V, 1.35V, 1.75V, 1.85V, 2.15V, 2.85V, 2.95V)

Ex. If the output voltage is 0.75V, RP115x071*5
 1.15V, RP115x111*5
 1.25V, RP115x121*5
 1.35V, RP115x131*5
 1.75V, RP115x171*5
 1.85V, RP115x181*5
 2.15V, RP115x211*5
 2.85V, RP115x281*5
 2.95V, RP115x291*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



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 mounting on the board.

^{*5} The V_{DD} pins must be wired together when mounting 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 mounting 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 | |
| T _a | Operating Temperature Range | -40 to +85 | | °C |
| T _{stg} | Storage Temperature Range | -55 to +125 | | °C |

^{*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.

RP115x

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ELECTRICAL CHARACTERISTICS

$V_{IN}=V_{SET}+1.0V$, $I_{OUT}=1mA$, $C_{IN}=C_{OUT}=1.0\mu F$, unless otherwise noted.

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

RP115x

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

| Symbol | Item | Conditions | Min. | Typ. | Max. | Unit | | |
|-----------------------------------|--|--|--|---|--|--|---|---|
| V_{OUT} | Output Voltage | $T_a=25^{\circ}C$ | $V_{SET} \geq 1.75V$ | x0.99 | | x1.01 | V | |
| | | | $V_{SET} < 1.75V$ | -18 | | +18 | mV | |
| | | $-40^{\circ}C \leq T_a \leq 85^{\circ}C$ | $V_{SET} \geq 1.75V$ | x 0.985 | | | x 1.015 | V |
| | | | $V_{SET} < 1.75V$ | Refer to <i>Output Voltage</i> | | | | |
| I_{LIM} | Output Current Limit | $V_{IN}=V_{SET}+0.5V$ | LCON="L" | 500 | | | mA | |
| | | | LCON="H" ^{*9} | 1.0 | | | A | |
| $\Delta V_{OUT} / \Delta I_{OUT}$ | Load Regulation | $V_{IN}=V_{SET}+0.5V$ $1mA \leq I_{OUT} \leq 500mA$ | LCON="L" | | 1 | 20 | mV | |
| | | $V_{IN}=V_{SET}+0.5V$ $1mA \leq I_{OUT} \leq 1.0A$ | LCON="H" ^{*9} | | | 40 | | |
| V_{DIF} | Dropout Voltage | Refer to <i>Dropout Voltage</i> | | | | | | |
| I_{SS} | Supply Current | $I_{OUT}=0mA$ | | 110 | 160 | μA | | |
| $I_{standby}$ | Standby Current | $V_{CE}=0V$ | | 0.5 | 3.0 | μA | | |
| $\Delta V_{OUT} / \Delta V_{IN}$ | Line Regulation | $V_{SET}+0.5V \leq V_{IN} \leq 5.25V$ ($V_{IN} \geq 1.4V$) | | 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 | |
| | | | $V_{SET} \leq 1.8V$ | | 80 | | dB | |
| V_{IN} | Input Voltage ^{*10} | | 1.4 | | 5.25 | V | | |
| $\Delta V_{OUT} / \Delta T_a$ | Output Voltage Temperature Coefficient | $-40^{\circ}C \leq T_a \leq 85^{\circ}C$ | $V_{SET} \geq 1.75V$ | | ± 30 | ppm/ $^{\circ}C$ | | |
| | | | $V_{SET} < 1.75V$ | | ± 100 | | | |
| I_{SC} | Short Current Limit | $V_{OUT}=0V$ ^{*11} | 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 | | |
| 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 Temperature | Junction Temperature | | 165 | | $^{\circ}C$ | | |
| T_{TSR} | Thermal Shutdown Released Temperature | Junction Temperature | | 110 | | $^{\circ}C$ | | |

| Symbol | Item | Conditions | | Min. | Typ. | Max. | Unit |
|-------------------------------------|---|--|-------------------------|------|--------------------------|------|-------|
| I _{REV} | Reverse Current | V _{OUT} =V _{SET} +1.0V, 0≤V _{IN} ≤V _{OUT} | V _{SET} ≥1.75V | | 7.5 | | μA |
| | | | V _{SET} <1.75V | | 10 | | |
| V _{REV_DET} ^{*12} | Detector Offset Voltage in Reverse Current Protection Mode ^{*13} | V _{OUT} ≥0.7V, 0≤V _{IN} ≤5.25V | | | 20 | | mV |
| V _{REV_REL} ^{*12} | Release Offset Voltage in Reverse Current Protection Mode ^{*14} | V _{OUT} ≥0.7V, 0≤V _{IN} ≤5.25V | | | 30 | 50 | mV |
| en | Output Noise | BW=10Hz to 100kHz | V _{SET} ≥1.75V | | 17 x V _{SET} | | μVrms |
| | | | V _{SET} <1.75V | | 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 ^{*15} | LCON="L" | | 300 | | mA |
| | | | LCON="H" ^{*9} | | 500 | | |

All test items listed under *Electrical Characteristics* are done under the pulse load condition (T_j≈T_a=25°C) 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} Short Current is the value when V_{OUT} and GND are short-circuited after the device starts up. Inrush Current flows when the device starts up while V_{OUT} and GND are short-circuited.

^{*12} Guaranteed operating range of reverse current protection circuit is V_{OUT}≥0.7V. When V_{IN}=V_{OUT}=0V, reverse current protection mode is constantly active.

^{*13} V_{REV_DET}=V_{IN}-V_{OUT}

^{*14} V_{REV_REL}=V_{IN}-V_{OUT}

^{*15} For CC (Constant Current) Mode, please refer to *Start-up Characteristics*.

Output Voltage

| Set Output Voltage V _{SET} (V) | Output Voltage V _{OUT} (mV) | |
|--|---|------|
| | TYP. | 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 |

RP115x

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Dropout Voltage**RP115L: DFN1216-8**

(Ta=25°C)

| 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 | *16 | *16 | *16 | *16 |
| 1.1 ≤ V _{SET} < 1.2 | *16 | *16 | *16 | 0.300 |
| 1.2 ≤ V _{SET} < 1.3 | *16 | *16 | 0.195 | 0.275 |
| 1.3 ≤ V _{SET} < 1.5 | 0.095 | 0.135 | 0.185 | 0.260 |
| 1.5 ≤ V _{SET} < 1.75V | 0.085 | 0.120 | 0.165 | 0.235 |
| 1.75V ≤ 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*.

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

RP115H: SOT-89-5

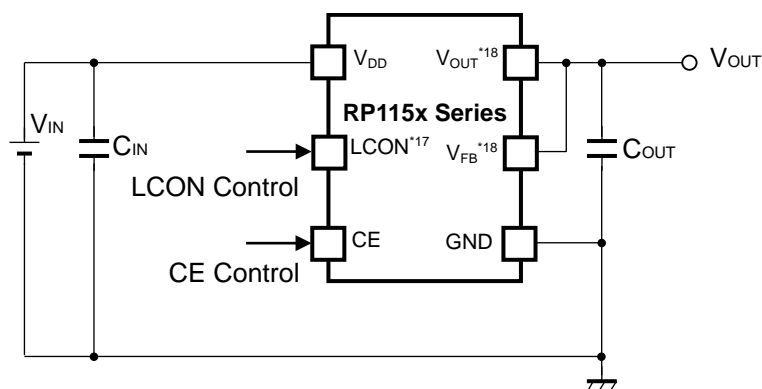
(Ta=25°C)

| Set Output Voltage V _{SET} (V) | Dropout Voltage V _{DIF} (V) | |
|--|---|-------|
| | I _{OUT} =1000mA | |
| | TYP. | MAX. |
| 0.7 ≤ V _{SET} < 1.1 | *16 | *16 |
| 1.1 ≤ V _{SET} < 1.2 | *16 | 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} < 1.75V | 0.205 | 0.295 |
| 1.75V ≤ 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*.

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

TYPICAL APPLICATION



External Parts Example

C_{IN} : Ceramic Capacitor, 1.0 μ F, muRata GRM155R61A105KE15

C_{OUT} : Ceramic Capacitor, 1.0 μ F, muRata GRM155R61A105KE15
 Ceramic Capacitor, 2.2 μ F, muRata GRM155R61A225KE95

Notes:

^{*17} The LCON pin is only included in RP115L (DFN1216-8).

^{*18} The V_{OUT} pin and the V_{FB} pin should be wired together when mounting 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 1.0 μ F or more and proper ESR (Equivalent Series Resistance).

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. Especially for the 1.75-V-output product, it is recommended to use 2.2 μ F or higher output capacitor when the product is used under the low-temperature environment such as -20°C or lower.

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.

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 1.0 μ F or more between V_{DD} and GND pins, and as close as possible to the pins.

Likewise, connect C_{OUT} capacitor with suitable values between the V_{OUT} 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.

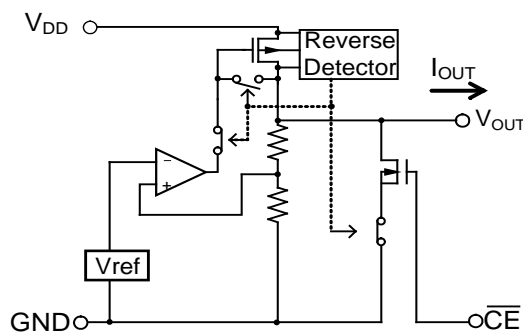


Figure 1. Normal Operation Mode

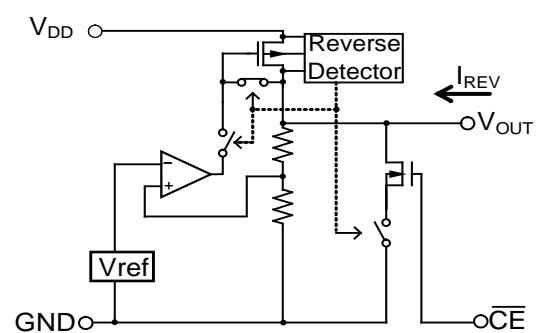


Figure 2. Reverse Current Protection Mode

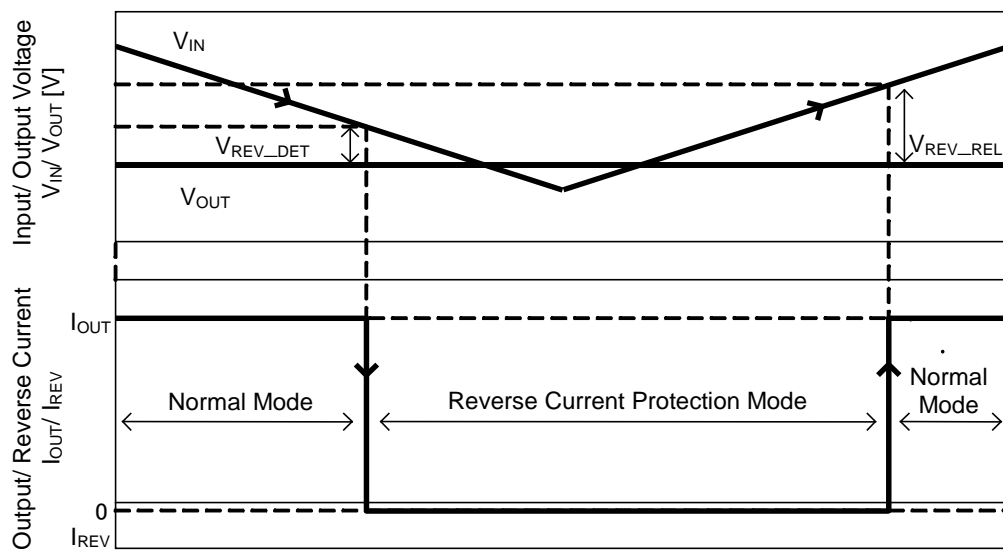


Figure 3. Detection/ Release Timing of Reverse Current Protection Function

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 100 μ s (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: $t_{ON} = 100\mu\text{s}$ (TYP.)

Inrush Current: $I_{RUSH} = C_{OUT} \cdot V_{SET} / t_{ON} + I_{OUT}^{*19}$

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

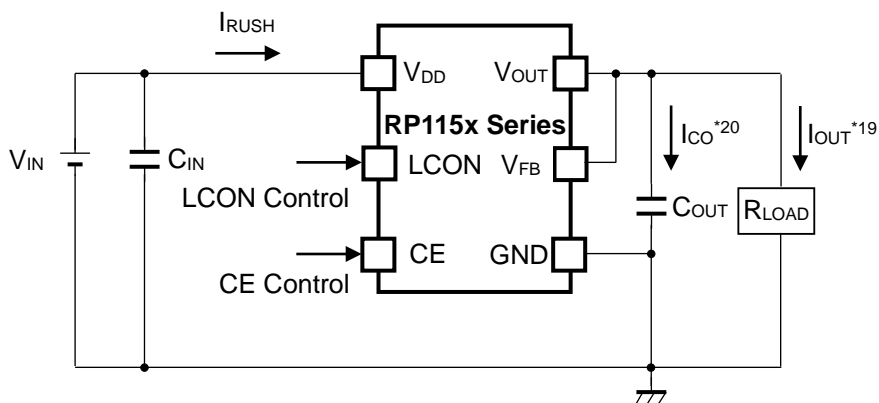
Start-up Time: $t_{ON} = C_{OUT} \cdot V_{SET} / I_{CO}^{*20}$

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

LCON="H"..... 500mA (TYP.)

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

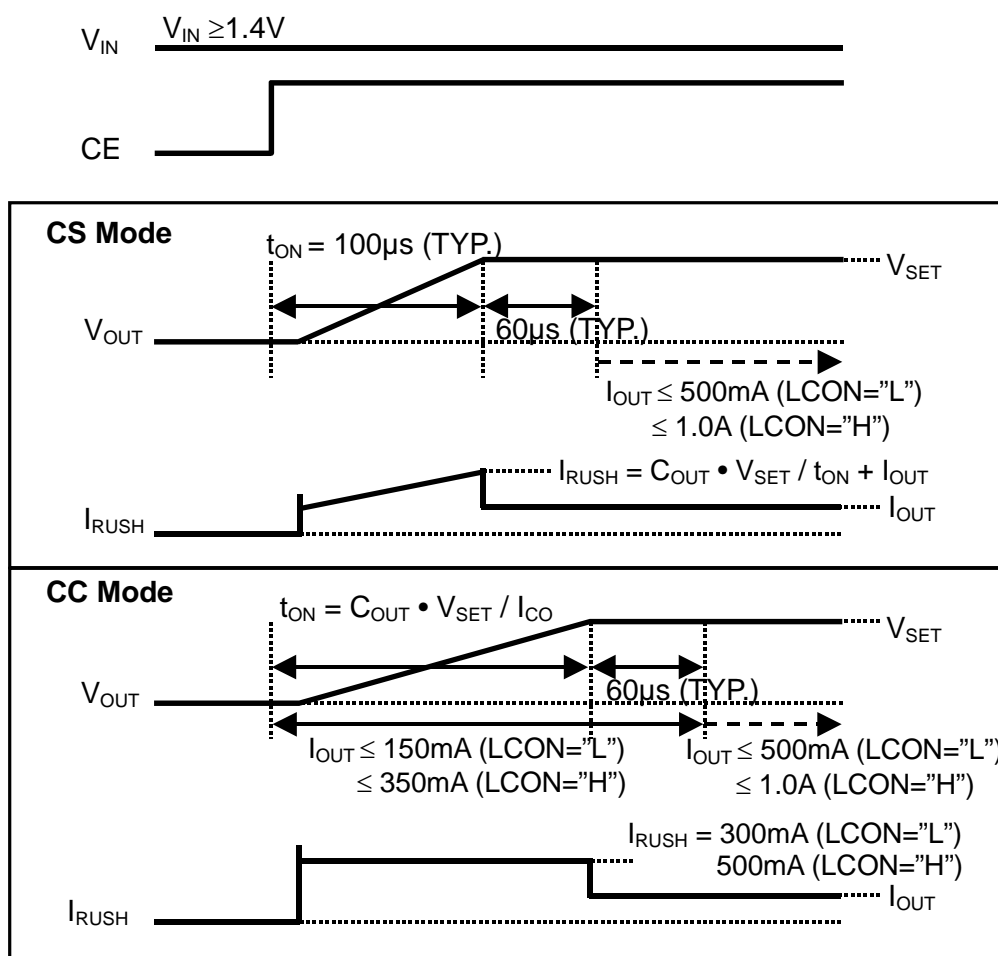
*20 I_{CO} : I_{CO} is a charge current of C_{OUT} and can be calculated roughly by $I_{RUSH} \approx I_{CO} + I_{OUT}$.



Circuit Example

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

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



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: $t_{ON} + 60\mu s$ 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*.

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.

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 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 ($t_{ON} + 60\mu s$ (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*.

PACKAGE INFORMATION

Power Dissipation (DFN1216-8)

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

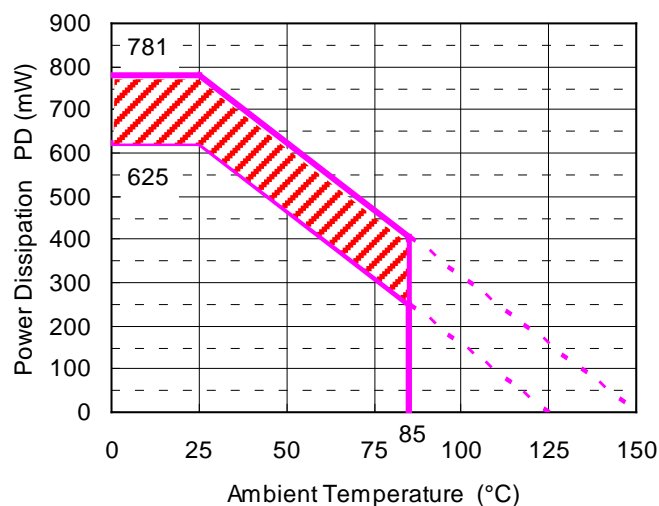
Measurement Conditions

| | Standard Land Pattern |
|------------------|---|
| Environment | Mounting on Board (Wind Velocity=0m/s) |
| Board Material | Glass cloth epoxy plastic (Double sided) |
| Board Dimensions | 40mm*40mm*1.6mm |
| Copper Ratio | Top side: Approx. 50%, Back side: Approx. 50% |
| Through-holes | ϕ 0.5mm * 28pcs |

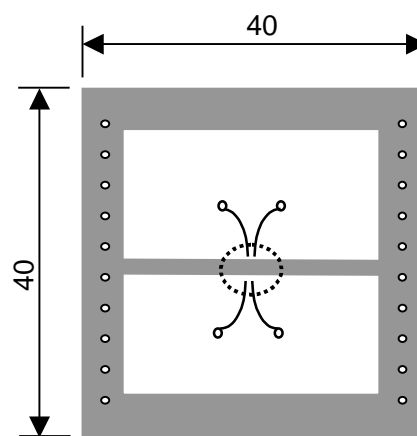
Measurement Result

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

| | Standard Land Pattern |
|--------------------|--|
| Power Dissipation | 625mW ($T_{jmax}=125^\circ\text{C}$) 781mW ($T_{jmax}=150^\circ\text{C}$) |
| Thermal Resistance | $\theta_{ja} = (125-25^\circ\text{C})/0.625\text{W} = 160^\circ\text{C/W}$ $\theta_{jc} = 26^\circ\text{C/W}$ |



Power Dissipation



Measurement Board Pattern

 IC Mount Area (Unit: mm)

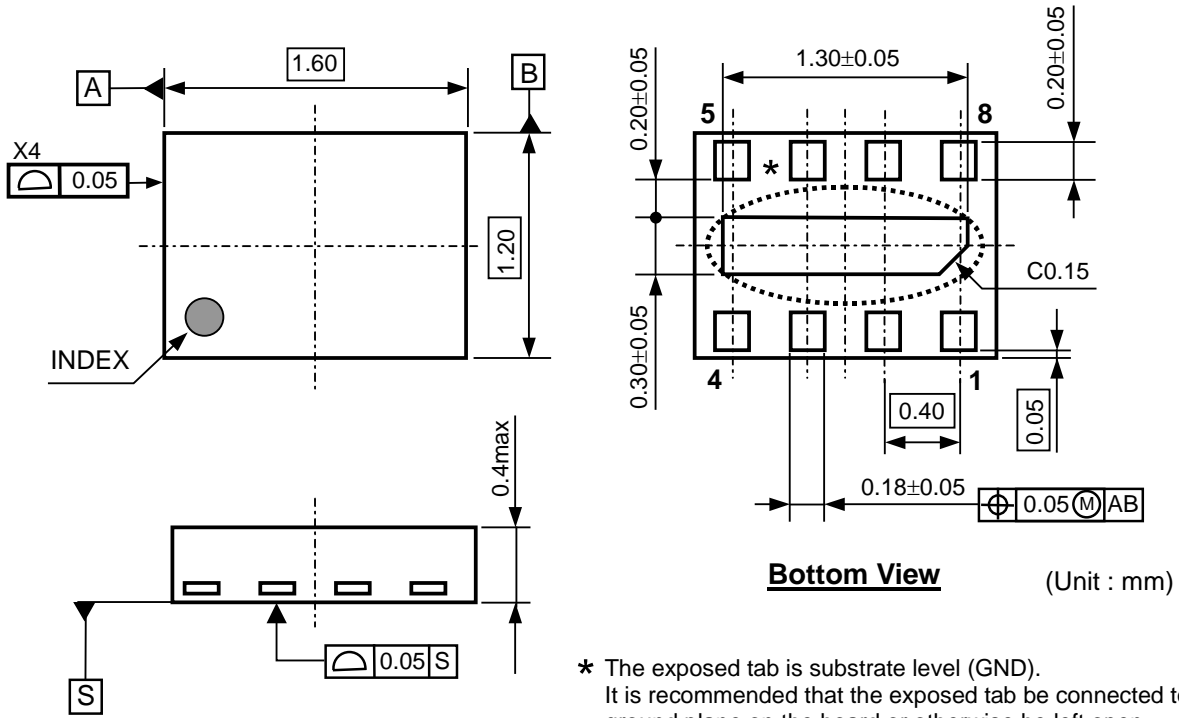
Note: The above graph shows the power dissipation of the package based on $T_{jmax}=125^\circ\text{C}$ and $T_{jmax}=150^\circ\text{C}$. Operating the IC within the shaded area in the graph might have an influence on its lifetime. Operating time must be within the time limit described in the table below.

| Operating Time | Estimated Years (Operating 4 hrs/ day) |
|----------------|---|
| 13,000 hours | 9 Years |

RP115x

NO. EA-274-150708

Package Dimensions (DFN1216-8)

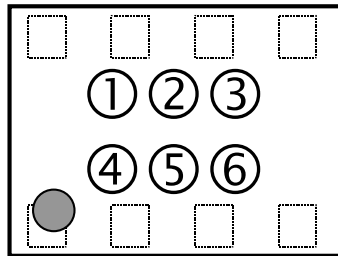


* The exposed tab is substrate level (GND).
 It is recommended that the exposed tab be connected to the ground plane on the board or otherwise be left open.
 The GND pins must be wired together when mouting on the board.

DFN1216-8 Package Dimensions

Mark Specification (DFN1216-8)

- ①②③④: Product Code ... **Please refer to Mark Specification Table (DFN1216-8).**
- ⑤⑥: Lot Number ... Alphanumeric Serial Number



DFN1216-8 Mark Specification

Mark Specification Table (DFN1216-8)

RP115Lxx1B

| Product Name | ①②③④ | V _{SET} |
|--------------|------|------------------|
| RP115L071B | DU07 | 0.7V |
| RP115L081B | DU08 | 0.8V |
| RP115L091B | DU09 | 0.9V |
| RP115L101B | DU10 | 1.0V |
| RP115L111B | DU11 | 1.1V |
| RP115L121B | DU12 | 1.2V |
| RP115L131B | DU13 | 1.3V |
| RP115L141B | DU14 | 1.4V |
| RP115L151B | DU15 | 1.5V |
| RP115L161B | DU16 | 1.6V |
| RP115L171B | DU17 | 1.7V |
| RP115L181B | DU18 | 1.8V |
| RP115L191B | DU19 | 1.9V |
| RP115L201B | DU20 | 2.0V |
| RP115L211B | DU21 | 2.1V |
| RP115L221B | DU22 | 2.2V |
| RP115L231B | DU23 | 2.3V |
| RP115L241B | DU24 | 2.4V |
| RP115L251B | DU25 | 2.5V |
| RP115L261B | DU26 | 2.6V |
| RP115L271B | DU27 | 2.7V |
| RP115L281B | DU28 | 2.8V |
| RP115L291B | DU29 | 2.9V |
| RP115L301B | DU30 | 3.0V |
| RP115L311B | DU31 | 3.1V |
| RP115L321B | DU32 | 3.2V |
| RP115L331B | DU33 | 3.3V |
| RP115L341B | DU34 | 3.4V |
| RP115L351B | DU35 | 3.5V |
| RP115L361B | DU36 | 3.6V |
| RP115L371B | DU37 | 3.7V |
| RP115L381B | DU38 | 3.8V |
| RP115L391B | DU39 | 3.9V |
| RP115L401B | DU40 | 4.0V |
| RP115L411B | DU41 | 4.1V |
| RP115L421B | DU42 | 4.2V |
| RP115L431B | DU43 | 4.3V |
| RP115L071B5 | DU00 | 0.75V |
| RP115L121B5 | DU01 | 1.25V |
| RP115L181B5 | DU02 | 1.85V |
| RP115L281B5 | DU03 | 2.85V |
| RP115L131B5 | DU04 | 1.35V |
| RP115L111B5 | DU05 | 1.15V |
| RP115L211B5 | DU06 | 2.15V |
| RP115L291B5 | DU60 | 2.95V |
| RP115L171B5 | DU61 | 1.75V |

RP115Lxx1D

| Product Name | ①②③④ | V _{SET} |
|--------------|------|------------------|
| RP115L071D | DV07 | 0.7V |
| RP115L081D | DV08 | 0.8V |
| RP115L091D | DV09 | 0.9V |
| RP115L101D | DV10 | 1.0V |
| RP115L111D | DV11 | 1.1V |
| RP115L121D | DV12 | 1.2V |
| RP115L131D | DV13 | 1.3V |
| RP115L141D | DV14 | 1.4V |
| RP115L151D | DV15 | 1.5V |
| RP115L161D | DV16 | 1.6V |
| RP115L171D | DV17 | 1.7V |
| RP115L181D | DV18 | 1.8V |
| RP115L191D | DV19 | 1.9V |
| RP115L201D | DV20 | 2.0V |
| RP115L211D | DV21 | 2.1V |
| RP115L221D | DV22 | 2.2V |
| RP115L231D | DV23 | 2.3V |
| RP115L241D | DV24 | 2.4V |
| RP115L251D | DV25 | 2.5V |
| RP115L261D | DV26 | 2.6V |
| RP115L271D | DV27 | 2.7V |
| RP115L281D | DV28 | 2.8V |
| RP115L291D | DV29 | 2.9V |
| RP115L301D | DV30 | 3.0V |
| RP115L311D | DV31 | 3.1V |
| RP115L321D | DV32 | 3.2V |
| RP115L331D | DV33 | 3.3V |
| RP115L341D | DV34 | 3.4V |
| RP115L351D | DV35 | 3.5V |
| RP115L361D | DV36 | 3.6V |
| RP115L371D | DV37 | 3.7V |
| RP115L381D | DV38 | 3.8V |
| RP115L391D | DV39 | 3.9V |
| RP115L401D | DV40 | 4.0V |
| RP115L411D | DV41 | 4.1V |
| RP115L421D | DV42 | 4.2V |
| RP115L431D | DV43 | 4.3V |
| RP115L071D5 | DV00 | 0.75V |
| RP115L121D5 | DV01 | 1.25V |
| RP115L181D5 | DV02 | 1.85V |
| RP115L281D5 | DV03 | 2.85V |
| RP115L131D5 | DV04 | 1.35V |
| RP115L111D5 | DV05 | 1.15V |
| RP115L211D5 | DV06 | 2.15V |
| RP115L291D5 | DV60 | 2.95V |
| RP115L171D5 | DV61 | 1.75V |

RP115x

NO. EA-274-150708

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.

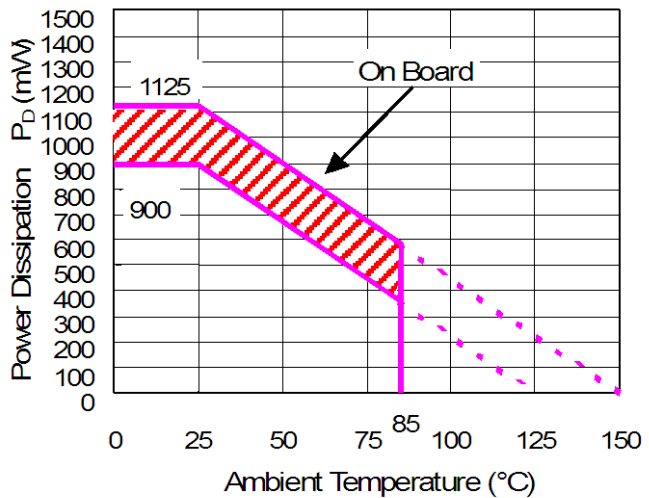
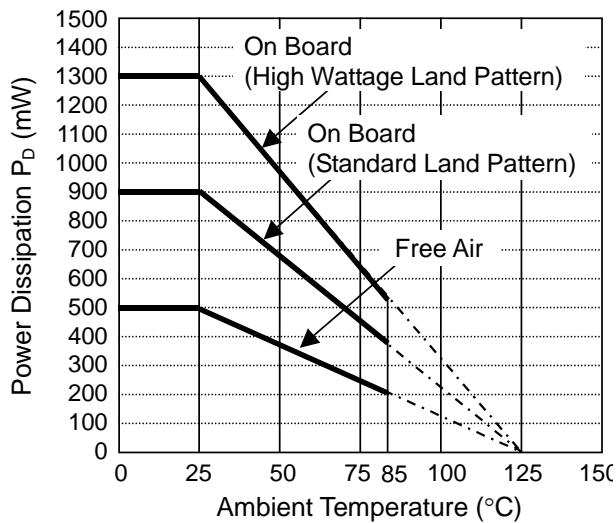
Measurement Conditions

| | 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 | $\phi 0.85\text{mm} \times 10\text{pcs}$ | - |

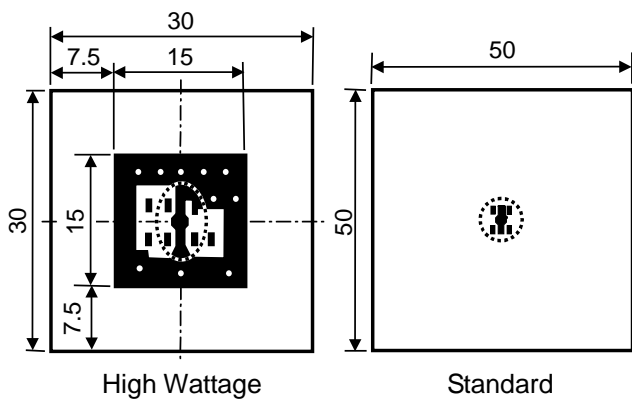
Measurement Result

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

| | High Wattage Land Pattern | Standard Land Pattern | Free Air |
|--------------------|---------------------------|---|-----------------------|
| Power Dissipation | 1300mW | 900mW ($T_{j\text{max}}=125^\circ\text{C}$) 1125mW ($T_{j\text{max}}=150^\circ\text{C}$) | 500mW |
| Thermal Resistance | 77°C/W | 111°C/W | 200°C/W |



Power Dissipation



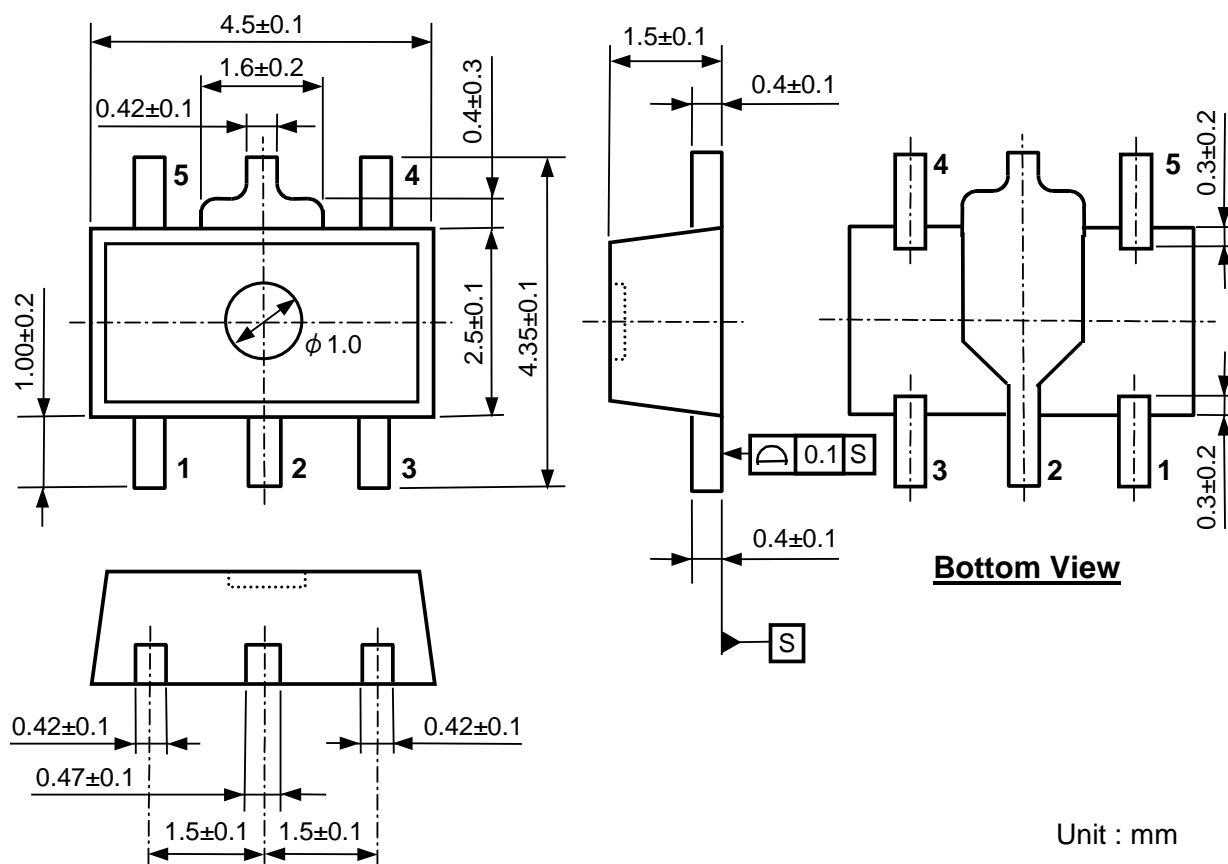
Measurement Board Pattern

○ IC Mount Area Unit: mm

Note: The above graph shows the power dissipation of the package based on $T_{j\text{max}}=125^\circ\text{C}$ and $T_{j\text{max}}=150^\circ\text{C}$. 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 |

Package Dimensions (SOT-89-5)



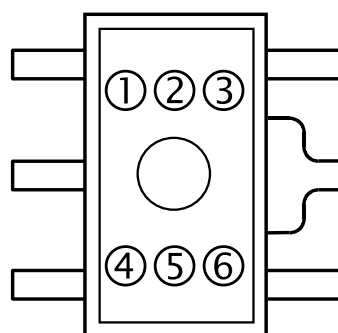
Unit : mm

SOT-89-5 Package Dimensions

Mark Specification (SOT-89-5)

①②③④: Product Code ... Please refer to RP115H Series Mark Specification Table.

⑤⑥: Lot Number ... Alphanumeric Serial Number



SOT-89-5 Mark Specification

RP115xNO. EA-274-150708

Mark Specification Table (SOT-89-5)**RP115Hxx1B**

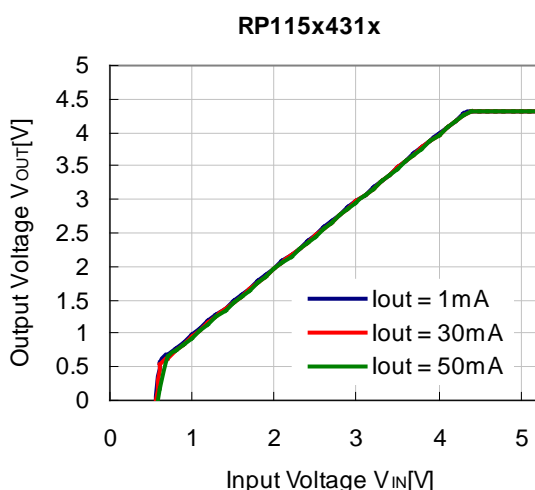
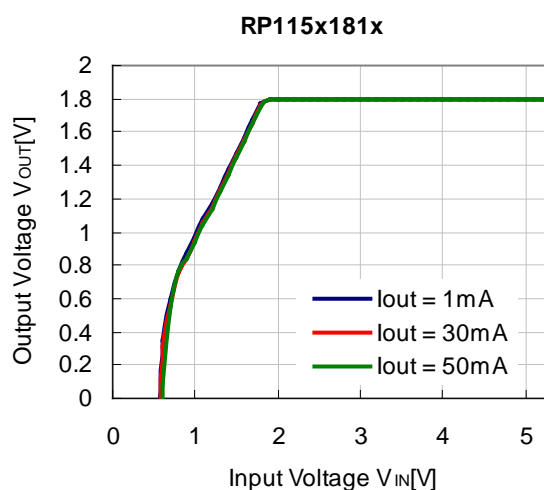
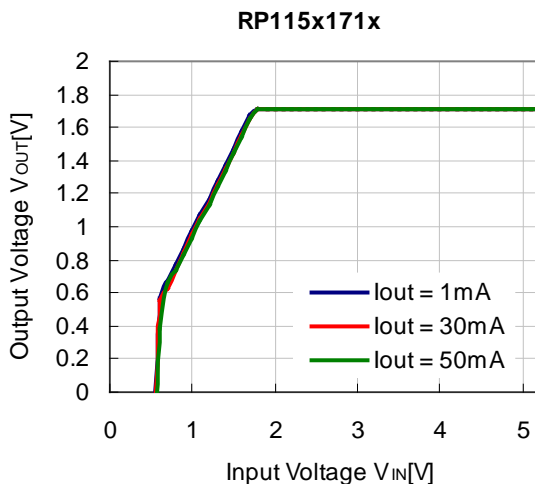
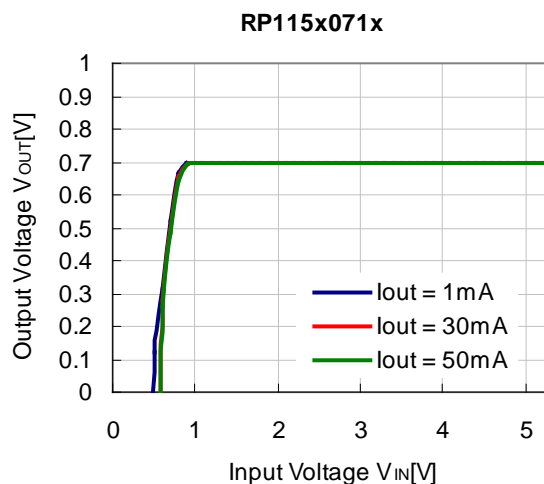
| Product Name | ①②③④ | V _{SET} |
|--------------|------|------------------|
| RP115H071B | D07F | 0.7V |
| RP115H081B | D08F | 0.8V |
| RP115H091B | D09F | 0.9V |
| RP115H101B | D10F | 1.0V |
| RP115H111B | D11F | 1.1V |
| RP115H121B | D12F | 1.2V |
| RP115H131B | D13F | 1.3V |
| RP115H141B | D14F | 1.4V |
| RP115H151B | D15F | 1.5V |
| RP115H161B | D16F | 1.6V |
| RP115H171B | D17F | 1.7V |
| RP115H181B | D18F | 1.8V |
| RP115H191B | D19F | 1.9V |
| RP115H201B | D20F | 2.0V |
| RP115H211B | D21F | 2.1V |
| RP115H221B | D22F | 2.2V |
| RP115H231B | D23F | 2.3V |
| RP115H241B | D24F | 2.4V |
| RP115H251B | D25F | 2.5V |
| RP115H261B | D26F | 2.6V |
| RP115H271B | D27F | 2.7V |
| RP115H281B | D28F | 2.8V |
| RP115H291B | D29F | 2.9V |
| RP115H301B | D30F | 3.0V |
| RP115H311B | D31F | 3.1V |
| RP115H321B | D32F | 3.2V |
| RP115H331B | D33F | 3.3V |
| RP115H341B | D34F | 3.4V |
| RP115H351B | D35F | 3.5V |
| RP115H361B | D36F | 3.6V |
| RP115H371B | D37F | 3.7V |
| RP115H381B | D38F | 3.8V |
| RP115H391B | D39F | 3.9V |
| RP115H401B | D40F | 4.0V |
| RP115H411B | D41F | 4.1V |
| RP115H421B | D42F | 4.2V |
| RP115H431B | D43F | 4.3V |
| RP115H071B5 | D00F | 0.75V |
| RP115H121B5 | D01F | 1.25V |
| RP115H181B5 | D02F | 1.85V |
| RP115H281B5 | D03F | 2.85V |
| RP115H131B5 | D04F | 1.35V |
| RP115H111B5 | D05F | 1.15V |
| RP115H211B5 | D06F | 2.15V |

RP115Hxx1D

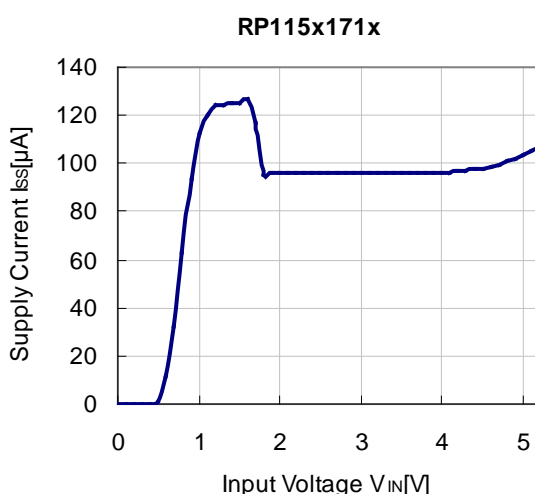
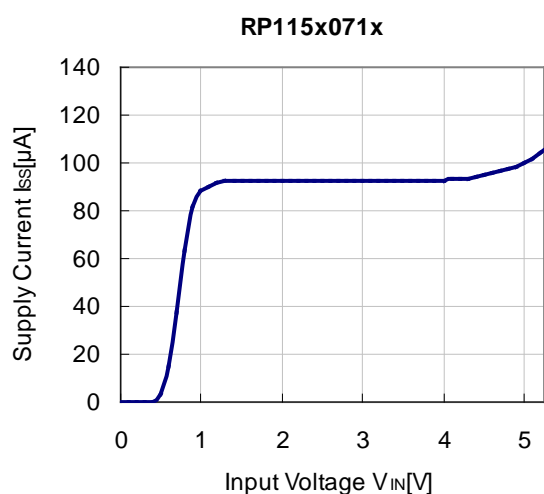
| Product Name | ①②③④ | V _{SET} |
|--------------|------|------------------|
| RP115H071D | D07G | 0.7V |
| RP115H081D | D08G | 0.8V |
| RP115H091D | D09G | 0.9V |
| RP115H101D | D10G | 1.0V |
| RP115H111D | D11G | 1.1V |
| RP115H121D | D12G | 1.2V |
| RP115H131D | D13G | 1.3V |
| RP115H141D | D14G | 1.4V |
| RP115H151D | D15G | 1.5V |
| RP115H161D | D16G | 1.6V |
| RP115H171D | D17G | 1.7V |
| RP115H181D | D18G | 1.8V |
| RP115H191D | D19G | 1.9V |
| RP115H201D | D20G | 2.0V |
| RP115H211D | D21G | 2.1V |
| RP115H221D | D22G | 2.2V |
| RP115H231D | D23G | 2.3V |
| RP115H241D | D24G | 2.4V |
| RP115H251D | D25G | 2.5V |
| RP115H261D | D26G | 2.6V |
| RP115H271D | D27G | 2.7V |
| RP115H281D | D28G | 2.8V |
| RP115H291D | D29G | 2.9V |
| RP115H301D | D30G | 3.0V |
| RP115H311D | D31G | 3.1V |
| RP115H321D | D32G | 3.2V |
| RP115H331D | D33G | 3.3V |
| RP115H341D | D34G | 3.4V |
| RP115H351D | D35G | 3.5V |
| RP115H361D | D36G | 3.6V |
| RP115H371D | D37G | 3.7V |
| RP115H381D | D38G | 3.8V |
| RP115H391D | D39G | 3.9V |
| RP115H401D | D40G | 4.0V |
| RP115H411D | D41G | 4.1V |
| RP115H421D | D42G | 4.2V |
| RP115H431D | D43G | 4.3V |
| RP115H071D5 | D00G | 0.75V |
| RP115H121D5 | D01G | 1.25V |
| RP115H181D5 | D02G | 1.85V |
| RP115H281D5 | D03G | 2.85V |
| RP115H131D5 | D04G | 1.35V |
| RP115H111D5 | D05G | 1.15V |
| RP115H211D5 | D06G | 2.15V |

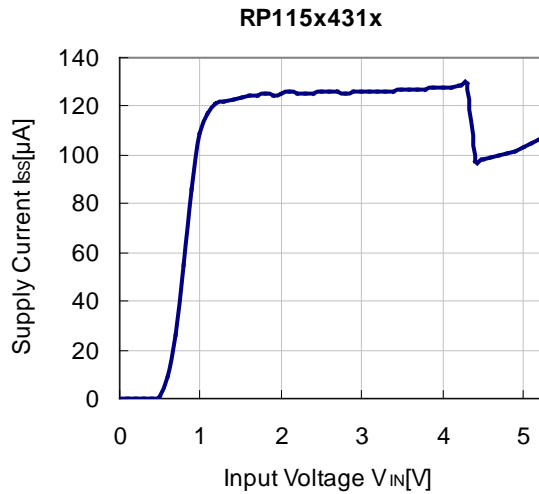
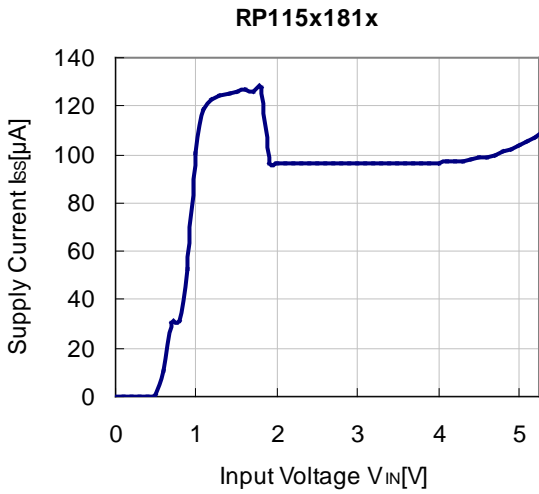
TYPICAL CHARACTERISTICS

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



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

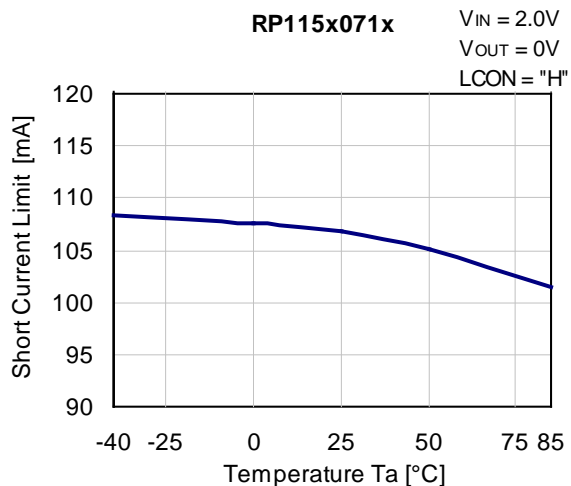
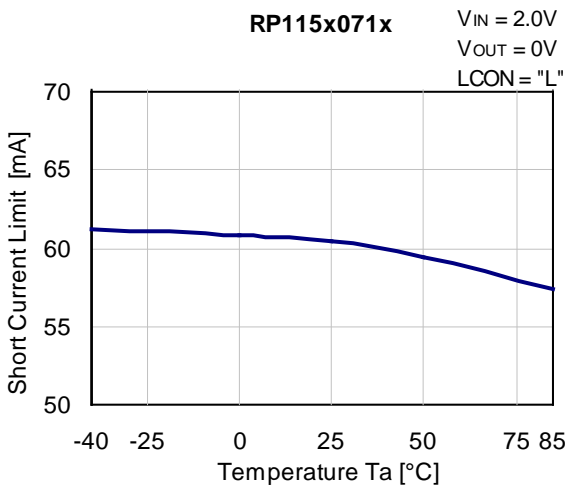




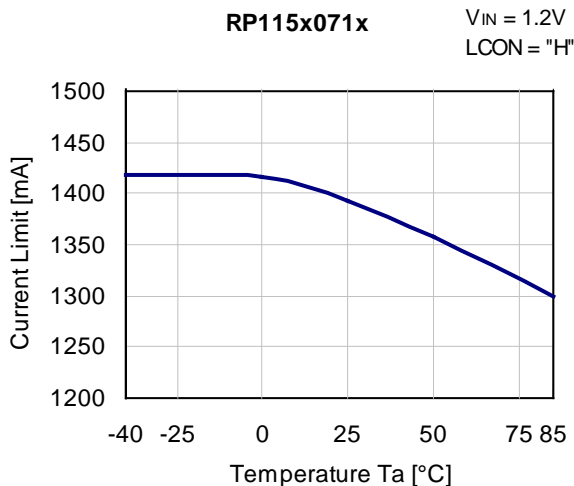
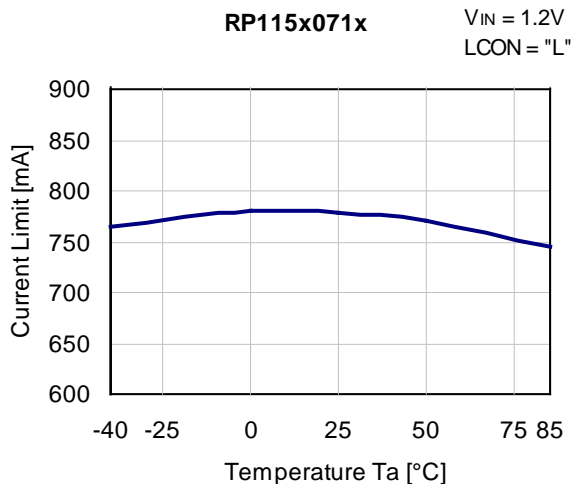
Short Current Limit vs. Temperature and Current Limit vs. Temperature

The RP115x contains a peak current limit circuit which protect the regulator from damage by overcurrent if the output pin (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.

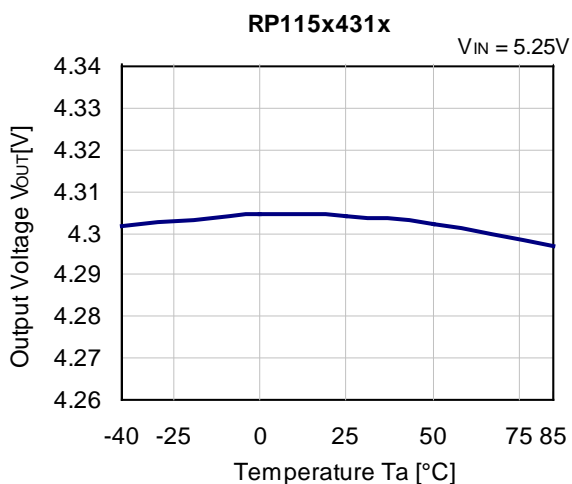
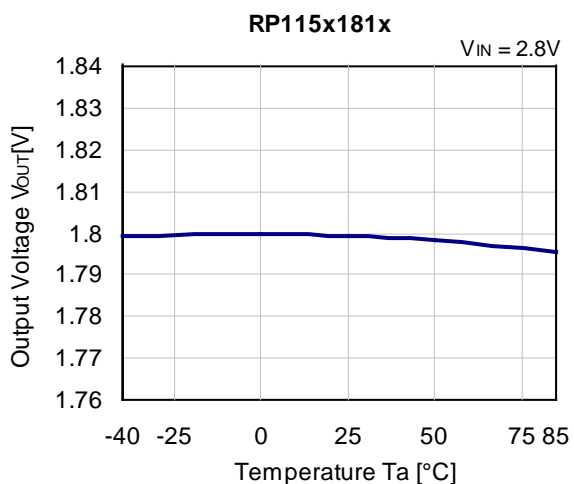
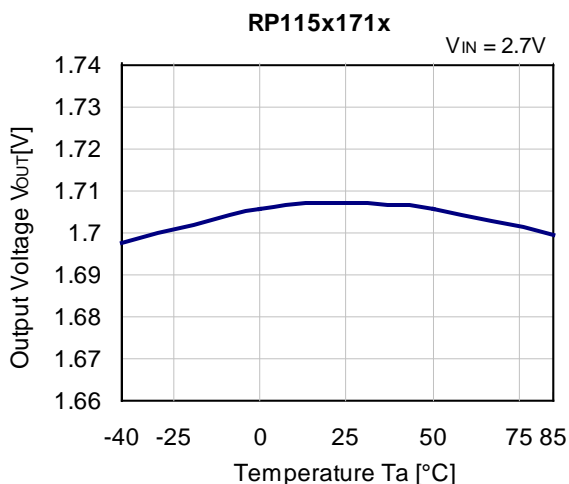
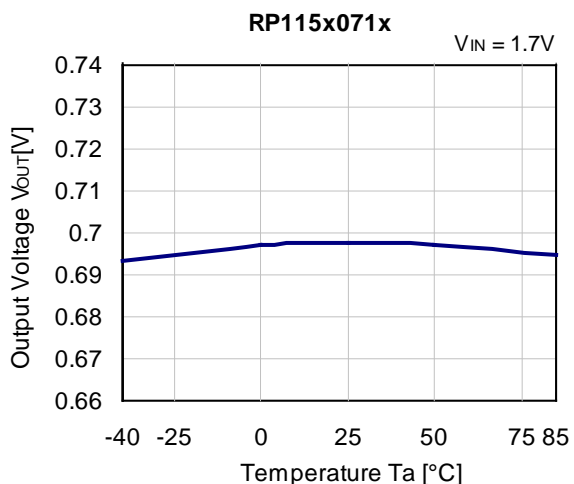
3) Short Current Limit vs. Temperature



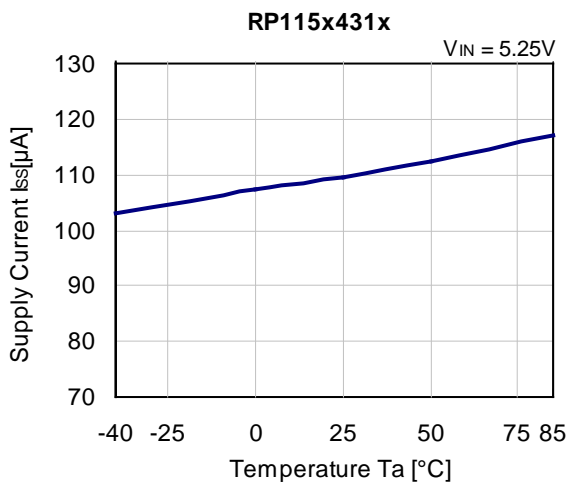
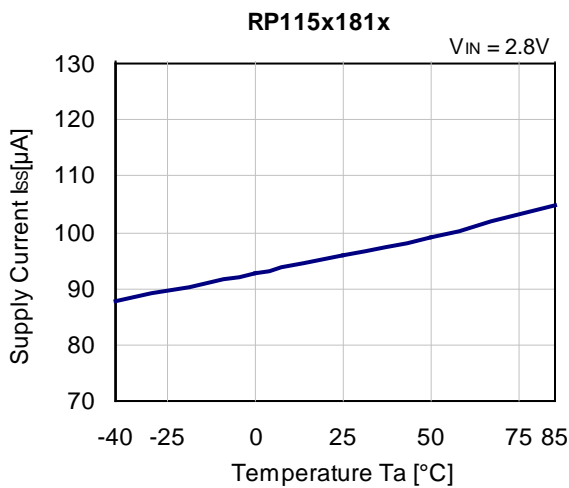
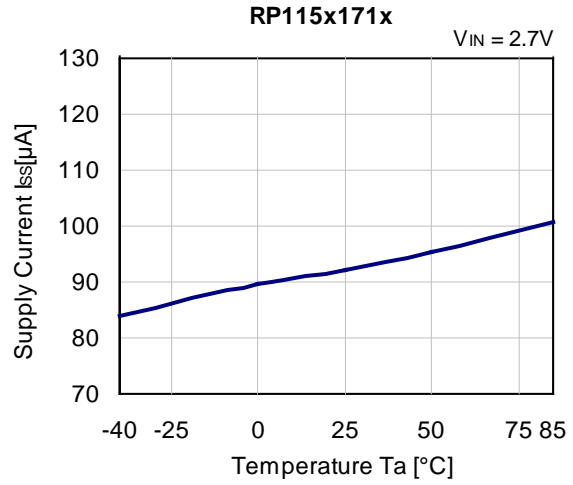
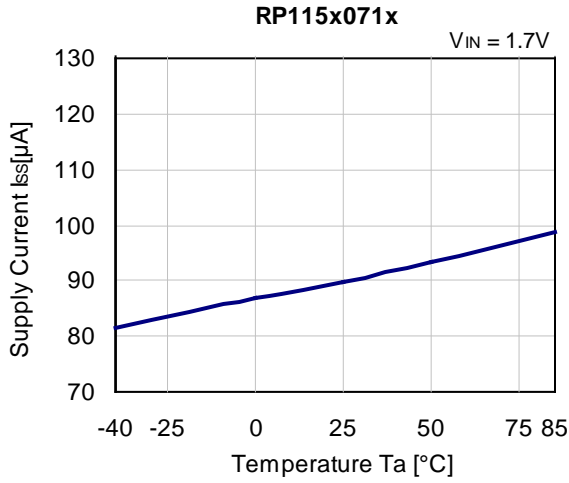
4) Peak Current Limit vs. Temperature



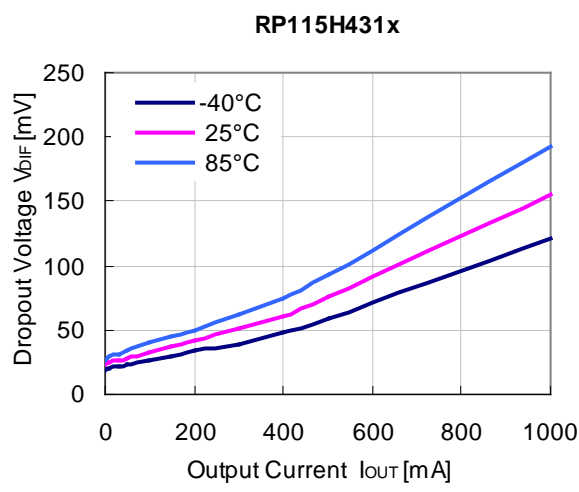
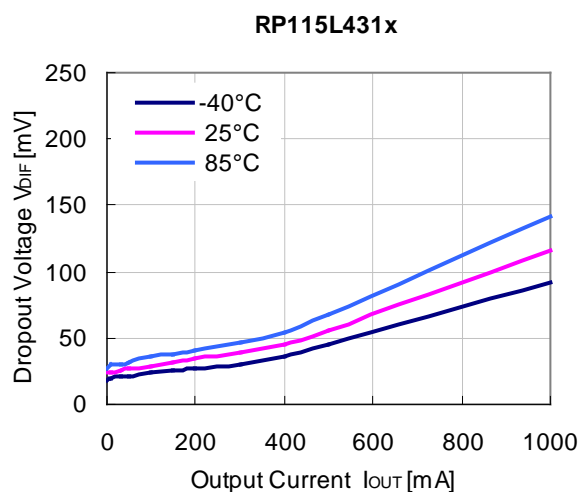
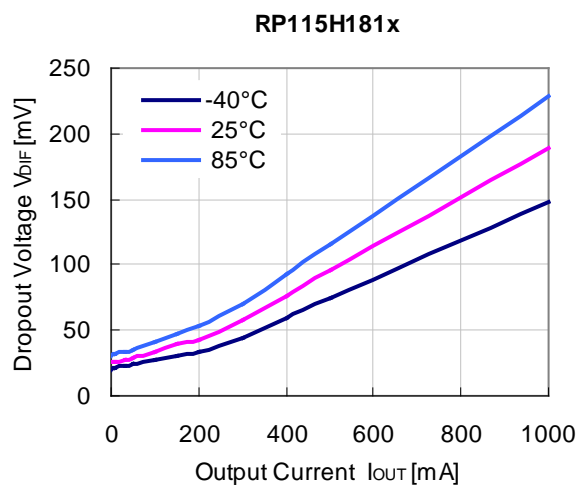
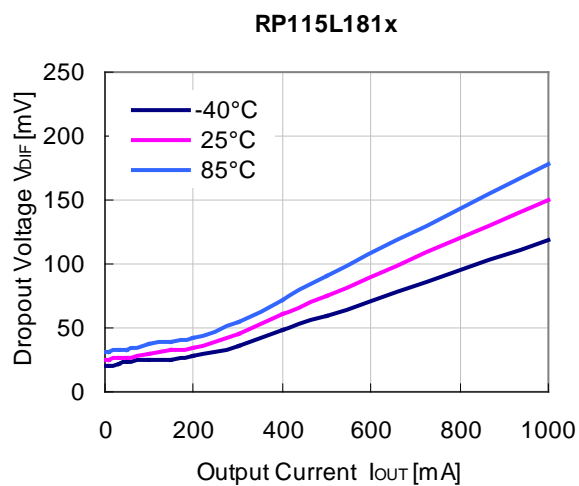
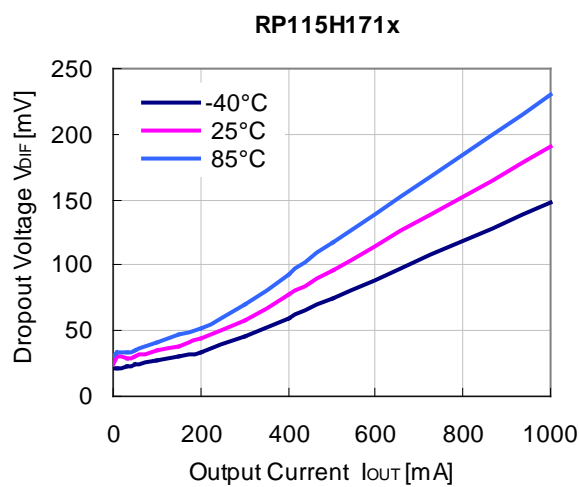
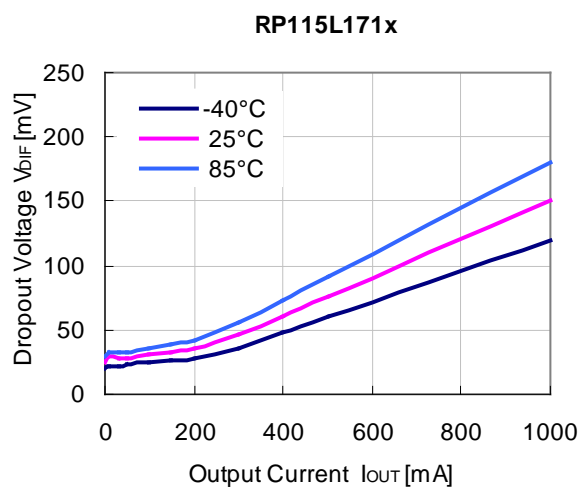
5) Output Voltage vs. Temperature (C_{IN} =Ceramic1.0 μ F, C_{OUT} =Ceramic1.0 μ F, I_{OUT} =1mA)



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



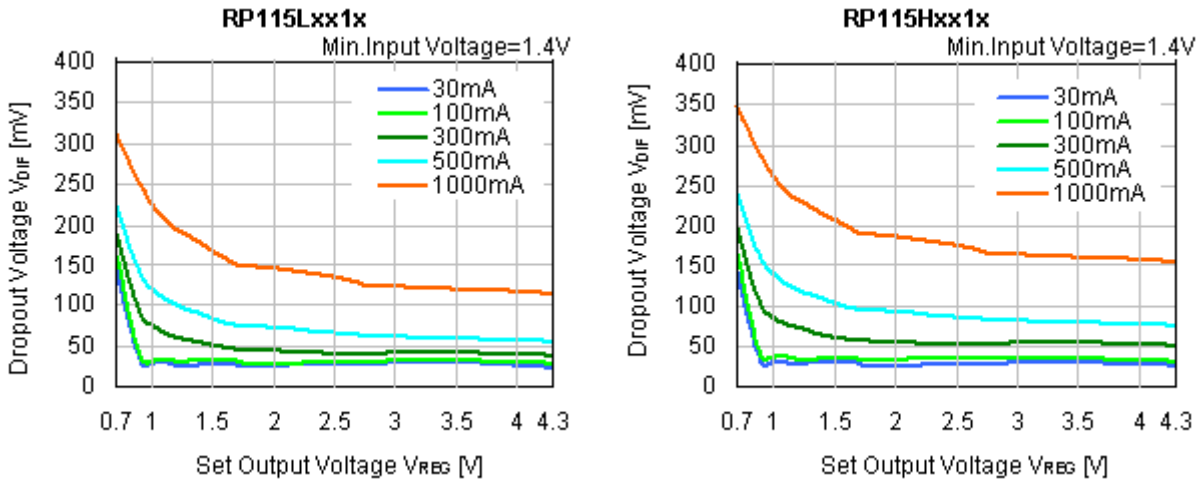
7) Dropout Voltage vs. Output Current (C_{IN} =Ceramic1.0 μ F, C_{OUT} =Ceramic1.0 μ F)



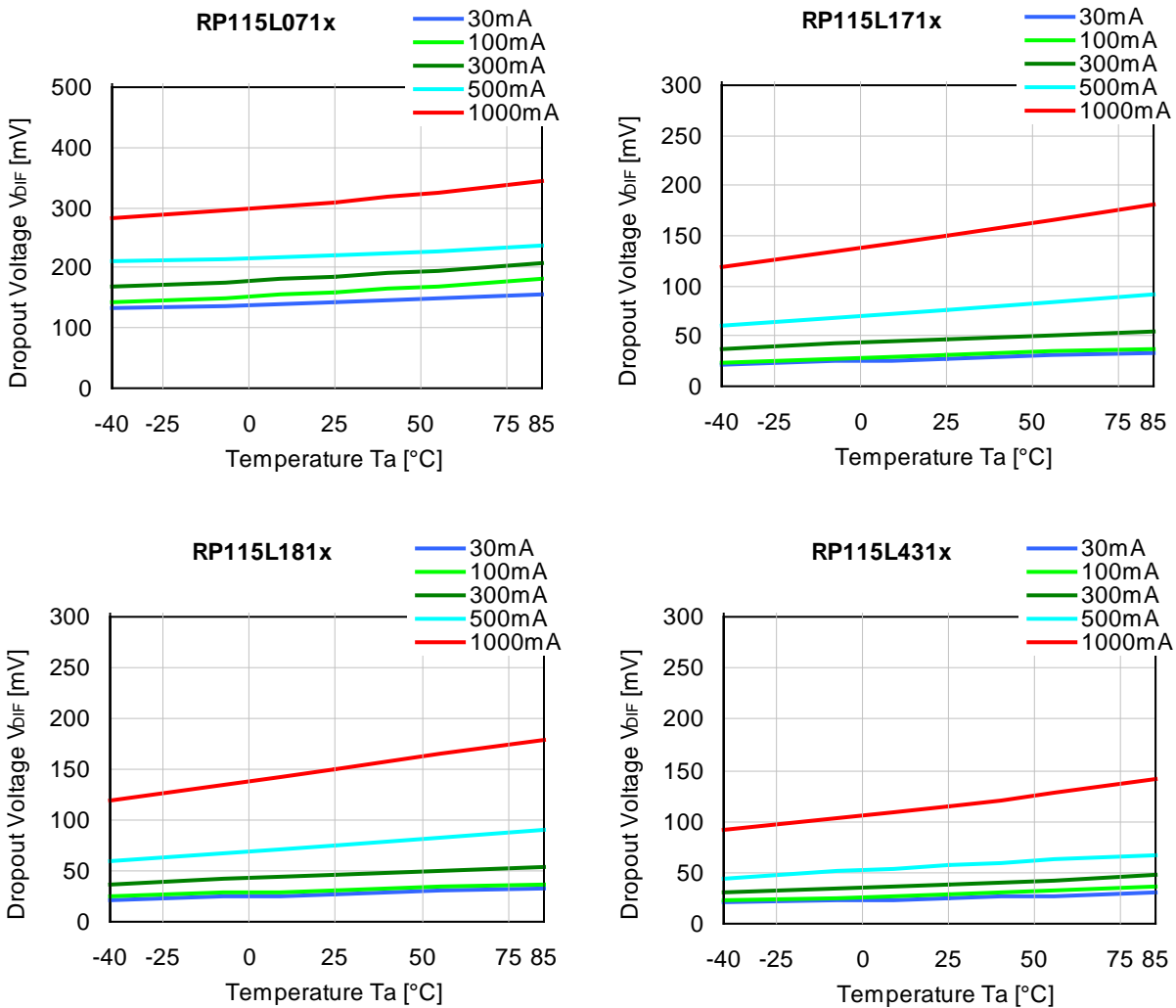
RP115x

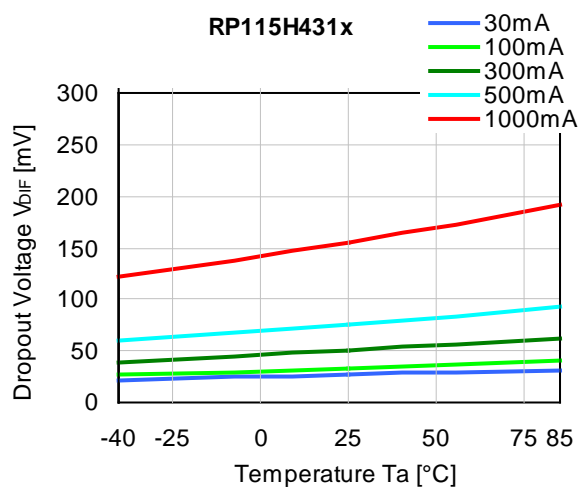
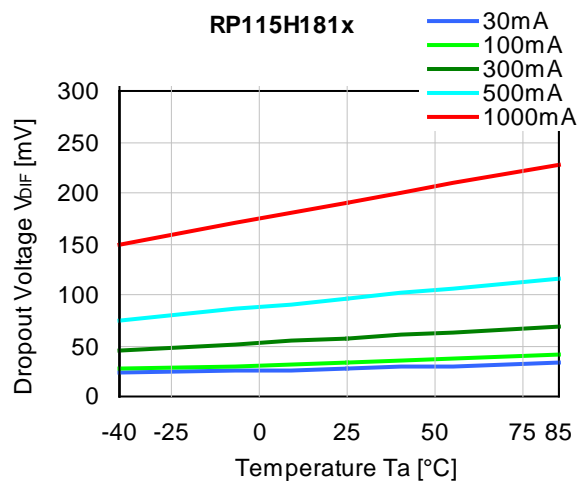
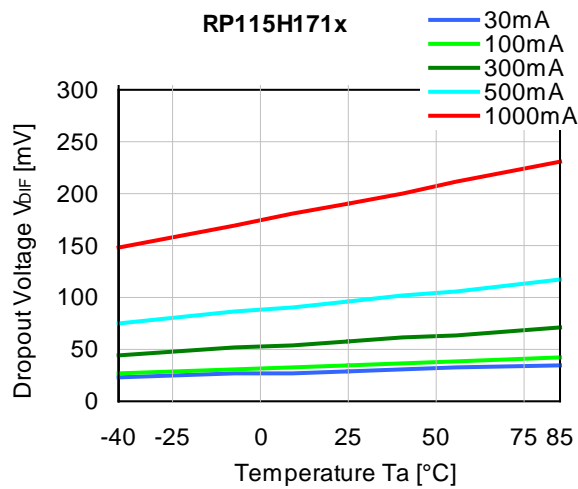
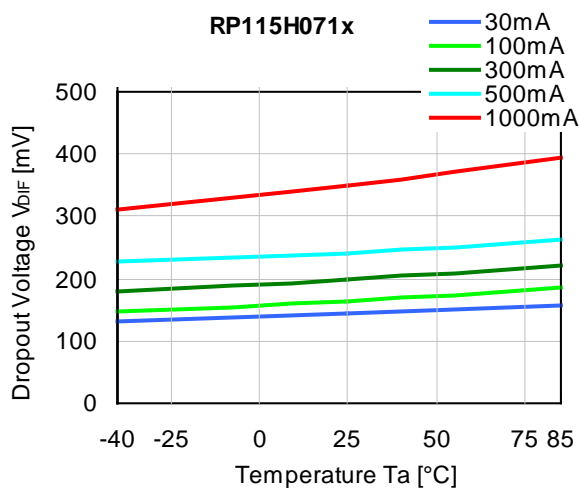
NO. EA-274-150708

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

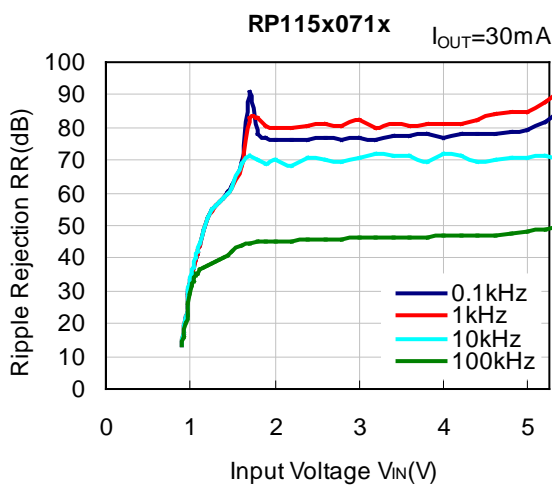
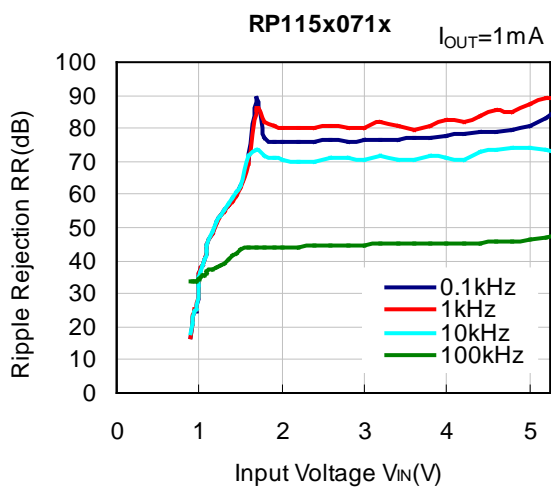


9) Dropout Voltage vs. Temperature (C_{IN} =Ceramic1.0 μ F, C_{OUT} =Ceramic1.0 μ F)



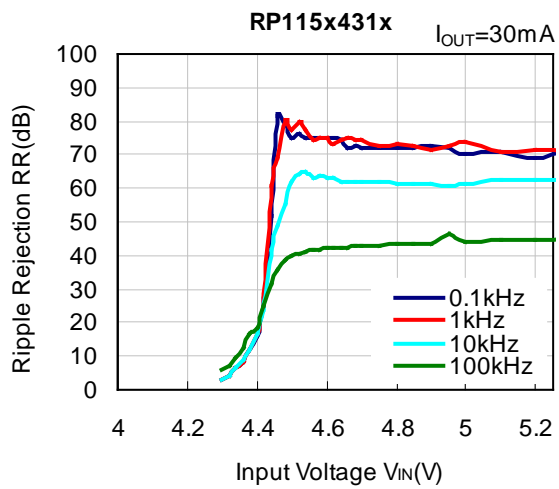
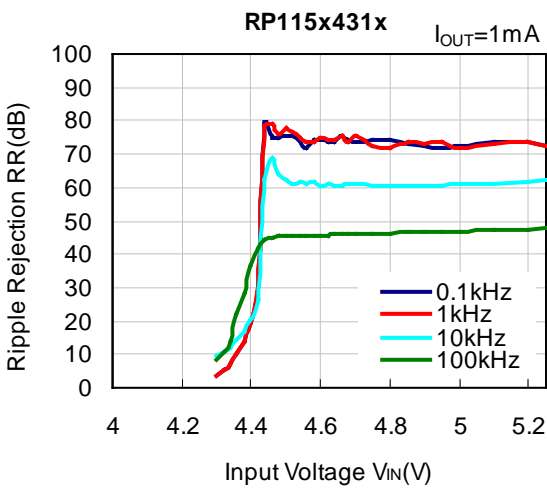
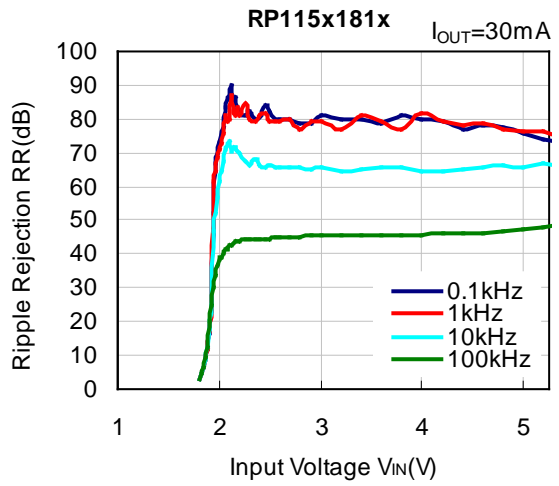
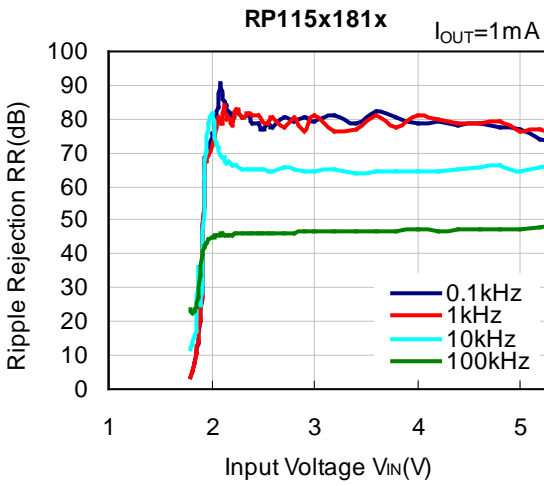
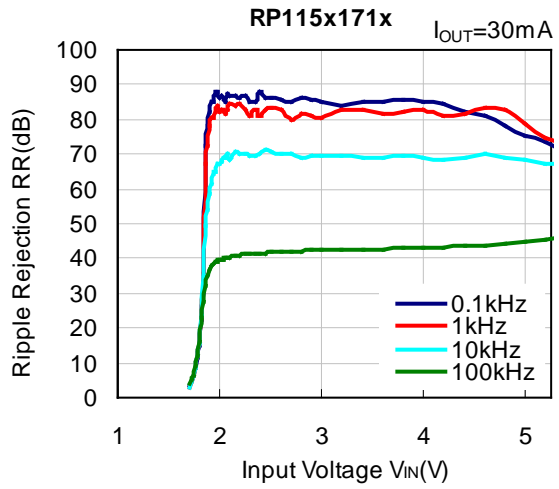
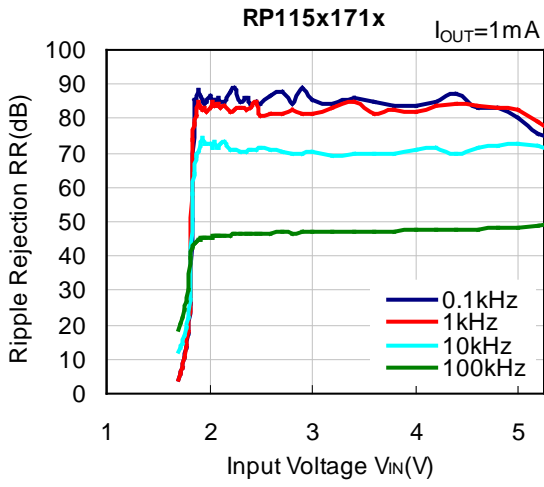


10) Ripple Rejection vs. Input Voltage (C_{IN} =none, C_{OUT} =Ceramic1.0 μ F, Ripple=0.2Vp-p, T_a =25°C)

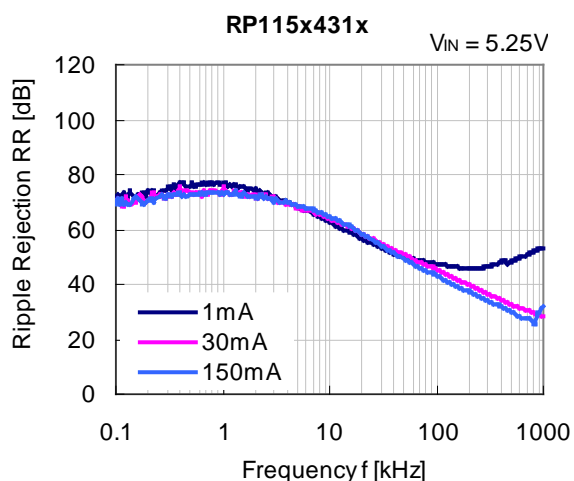
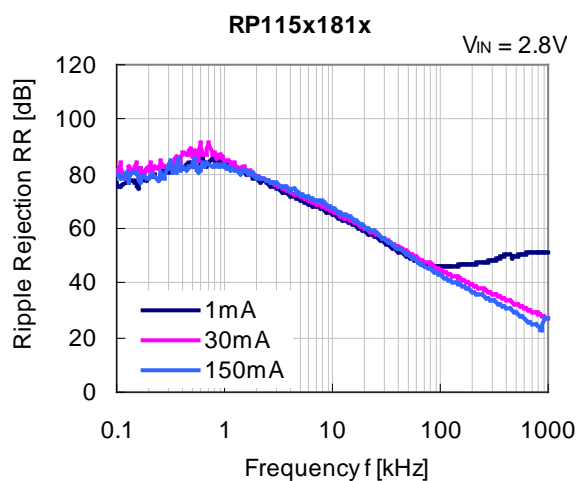
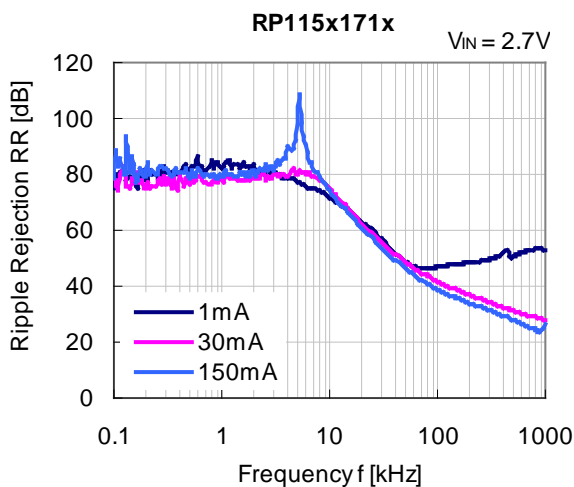
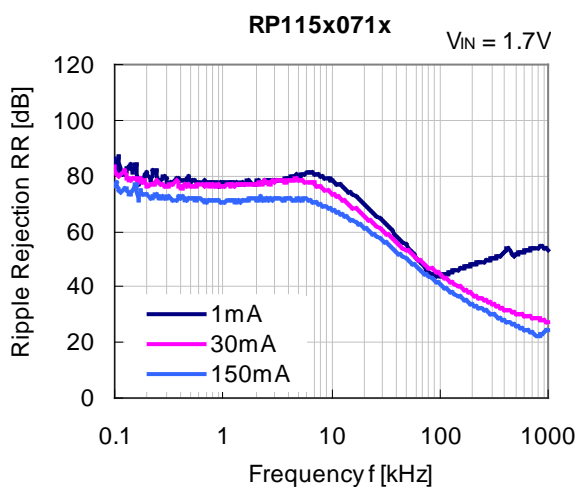


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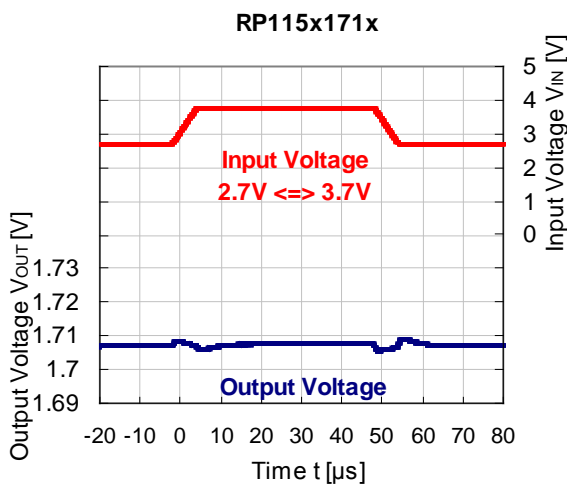
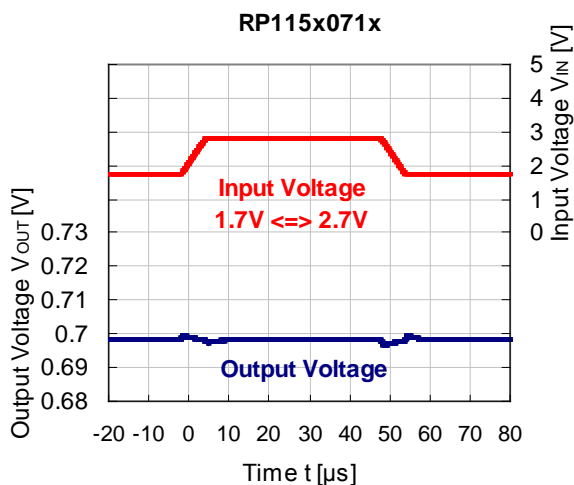
NO. EA-274-150708

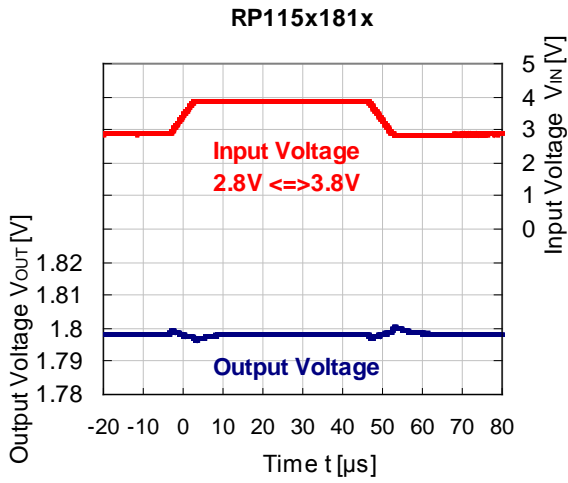


11) Ripple Rejection vs. Frequency (C_{IN} =none, C_{OUT} =Ceramic1.0 μ F, Ripple=0.2Vp-p, T_a =25°C)

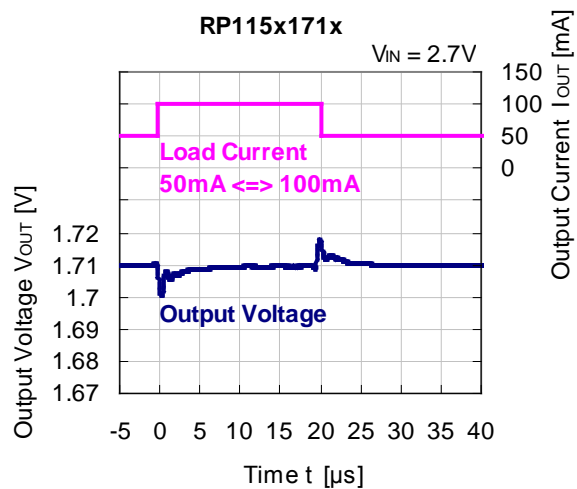
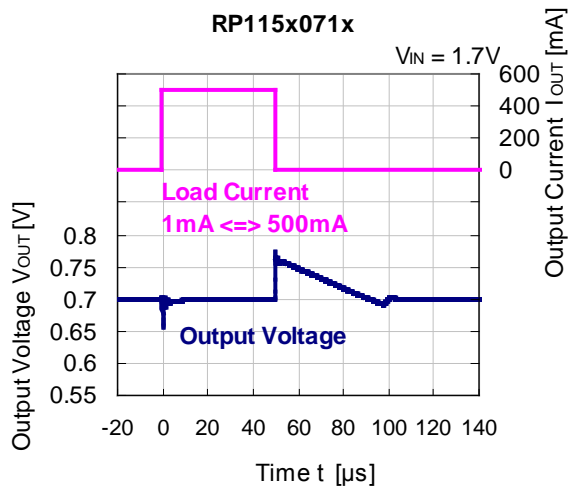
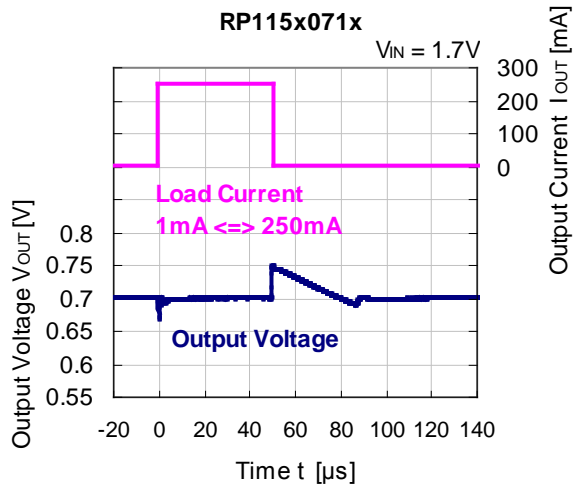
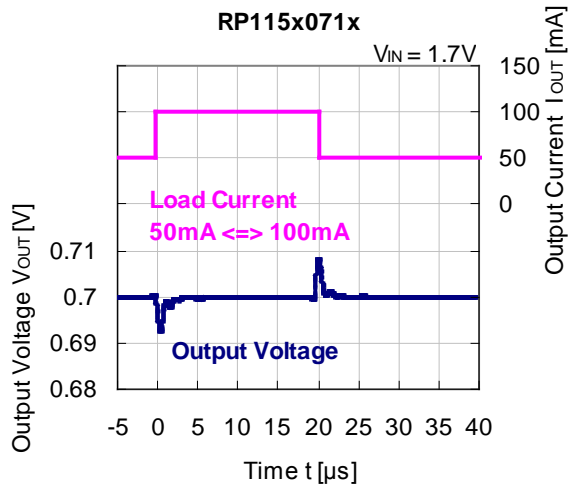


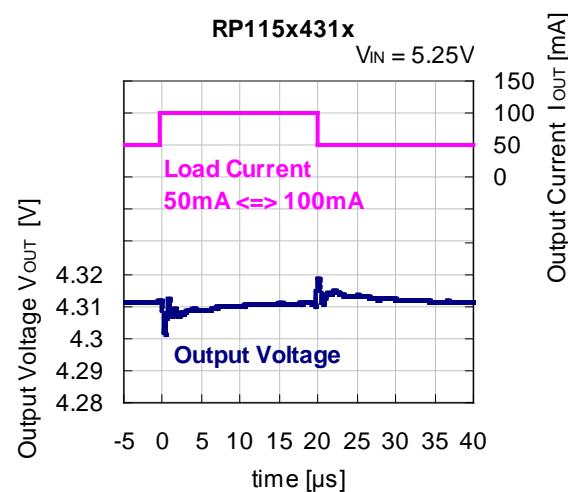
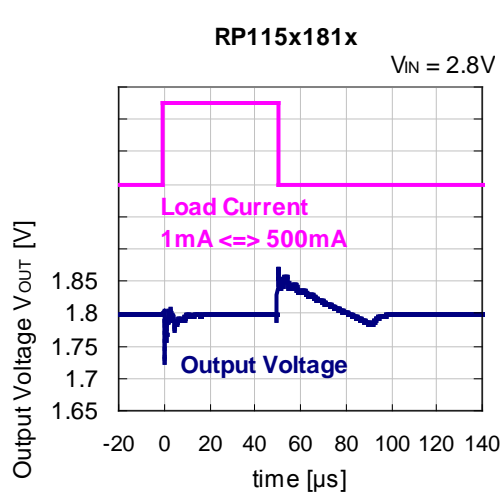
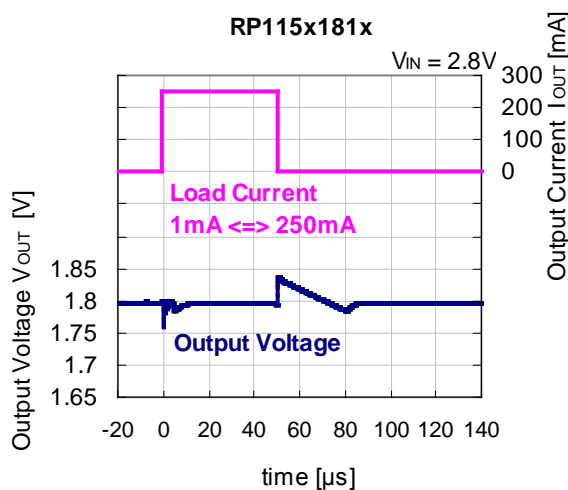
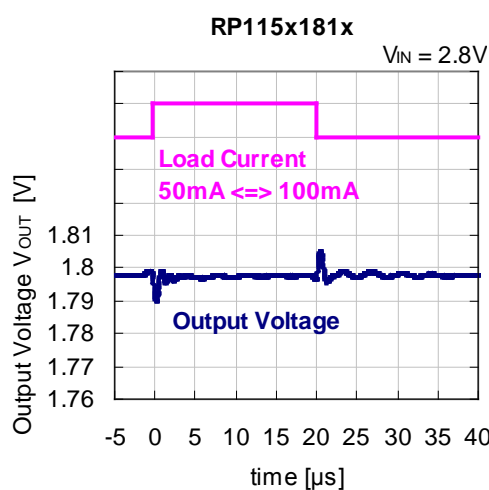
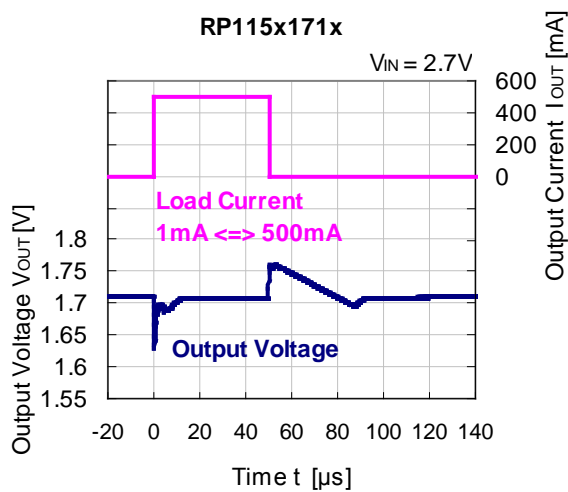
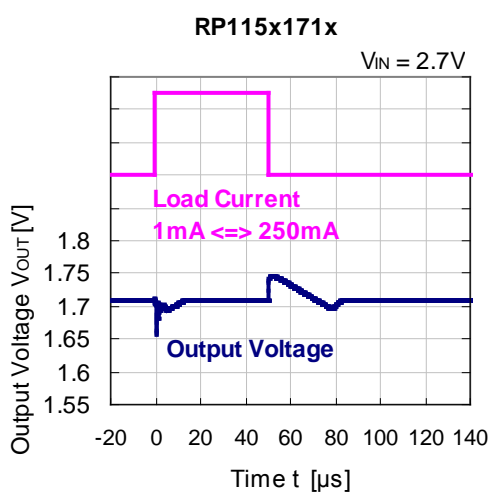
12) Line Transient Response (C_{IN} =none, C_{OUT} =Ceramic1.0 μ F, I_{OUT} =30mA, t_r = t_f =5 μ s, T_a =25°C)





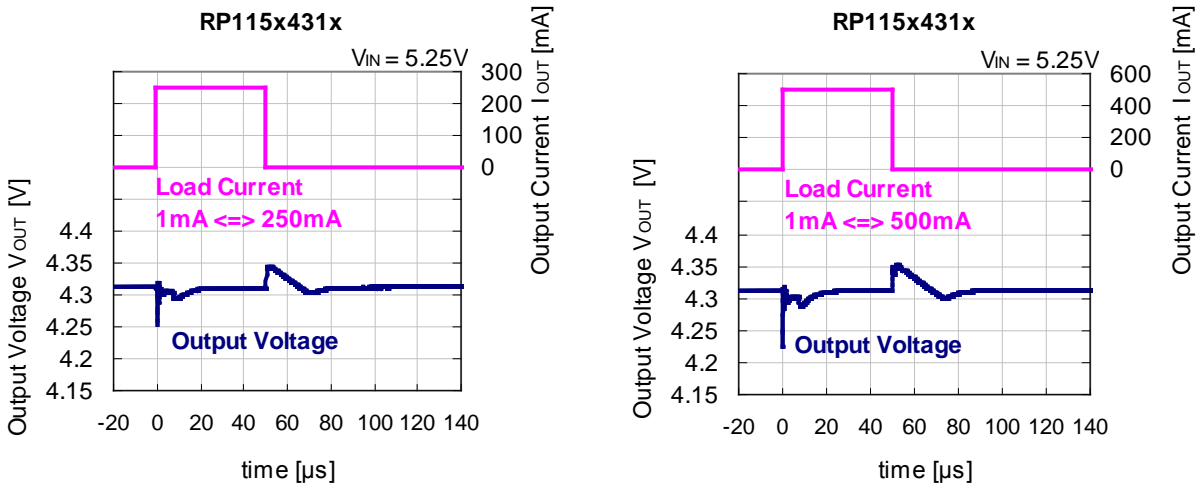
13) Load Transient Response (C_{IN} =Ceramic1.0 μ F, C_{OUT} =Ceramic1.0 μ F, t_r = t_f =0.5 μ s, T_a =25°C)



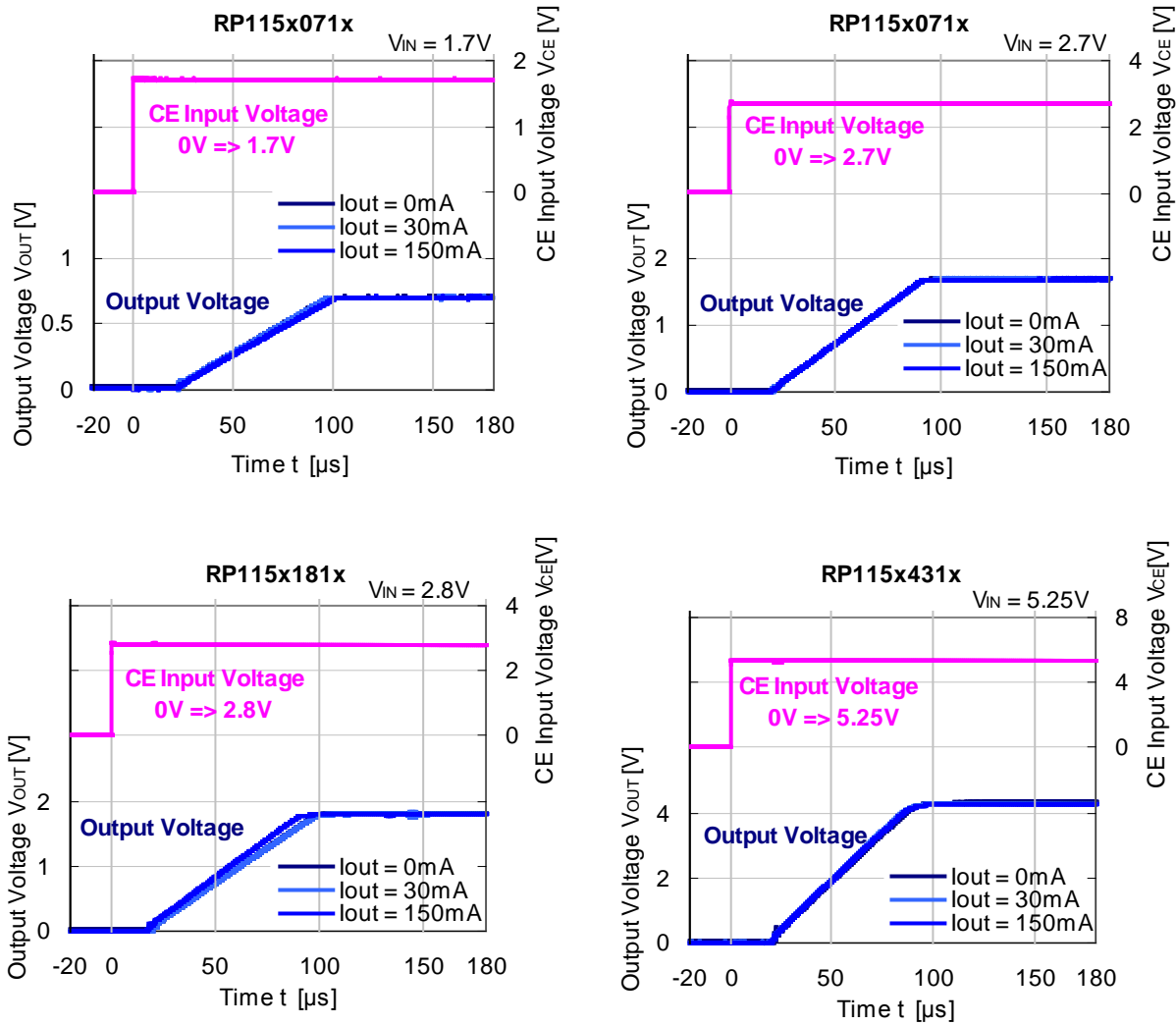


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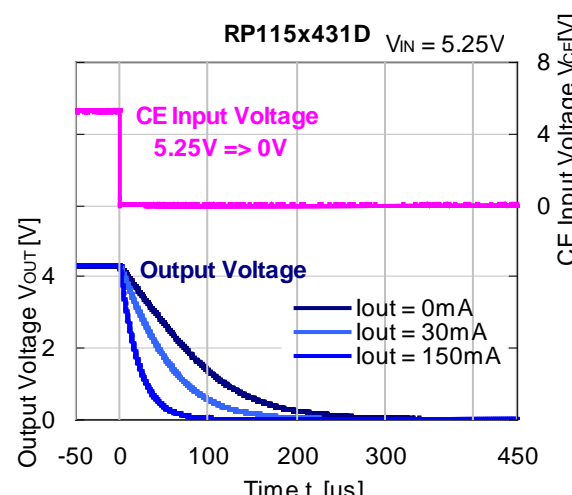
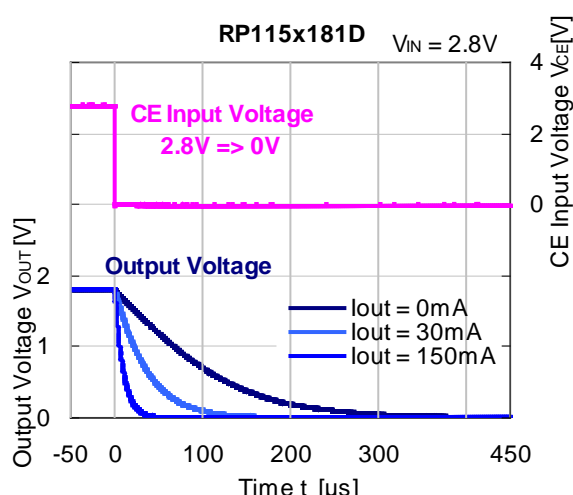
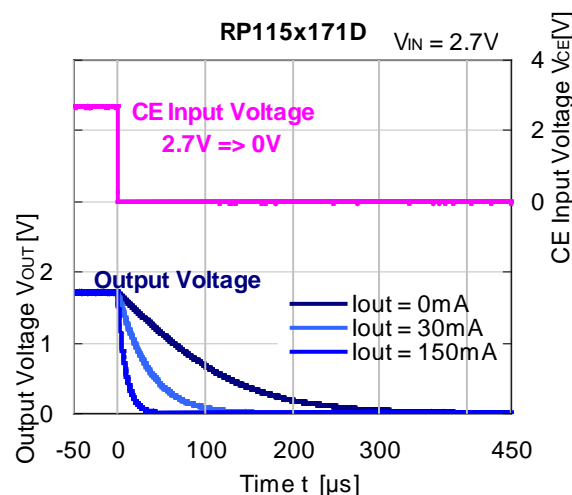
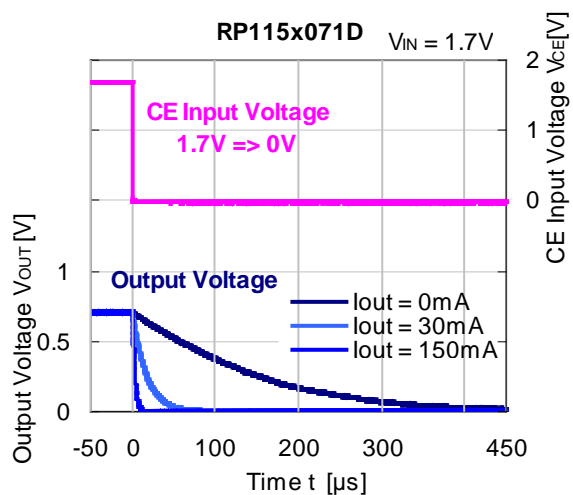
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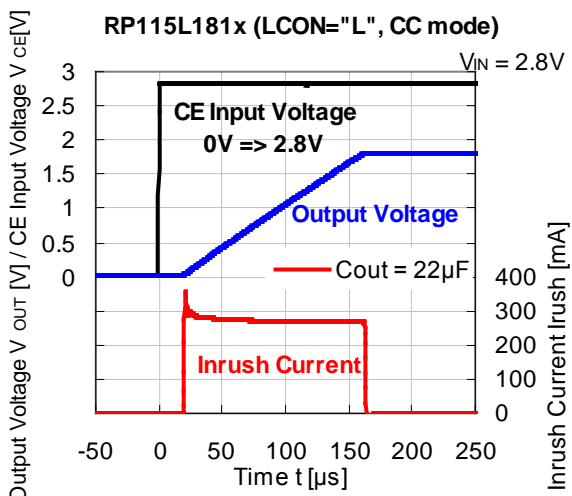
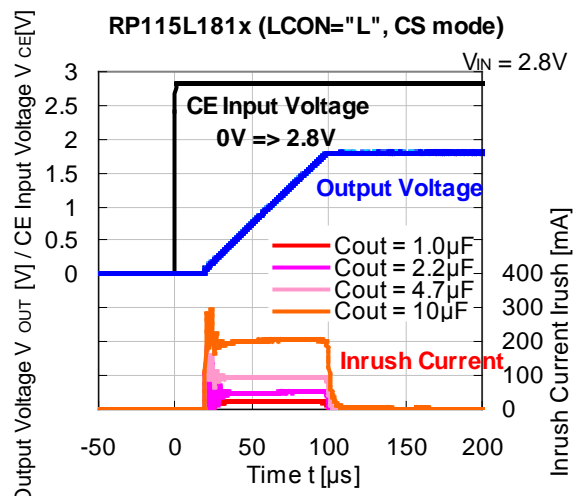
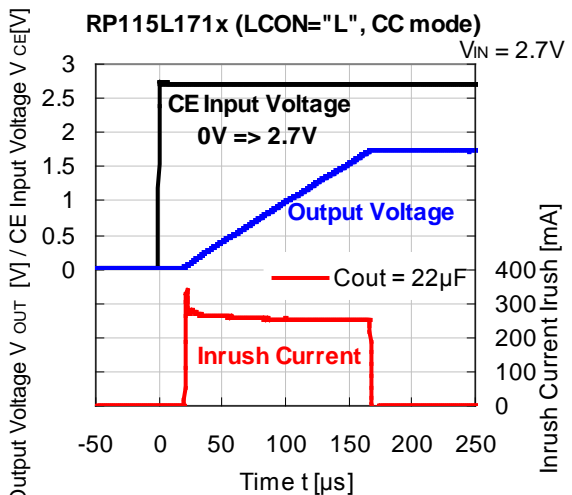
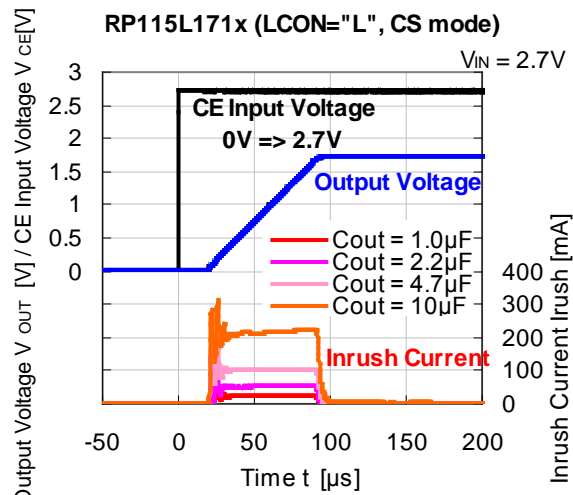
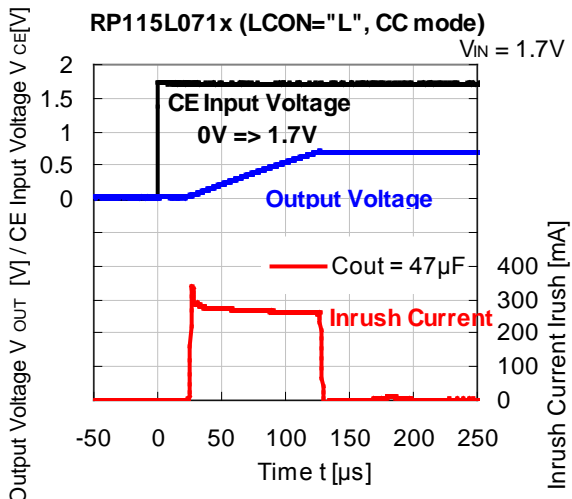
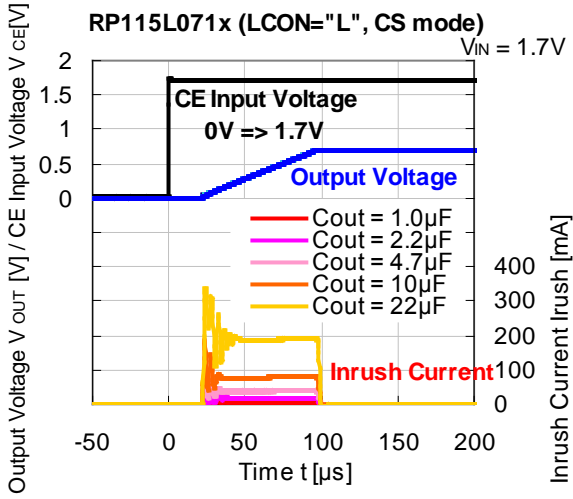
14) Turn-on Waveform by CE Pin Signal (C_{IN} =Ceramic1.0 μF , C_{OUT} =Ceramic1.0 μF , $T_a=25^\circ C$)

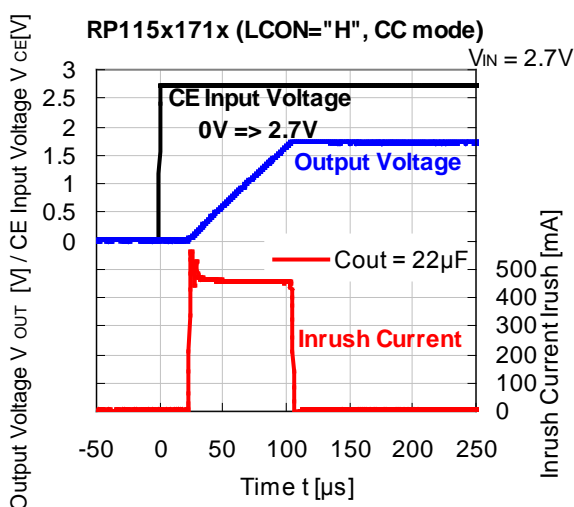
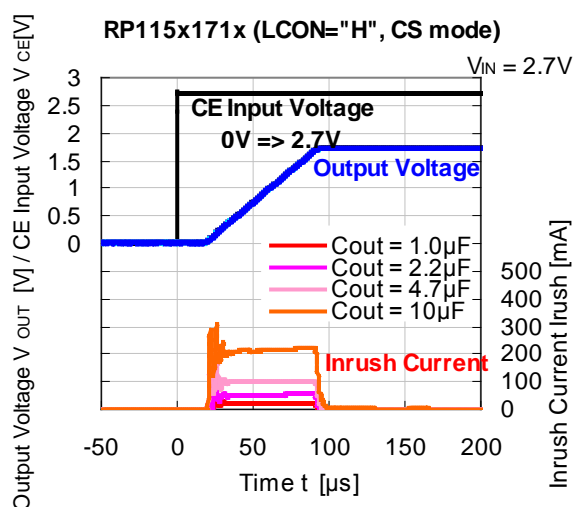
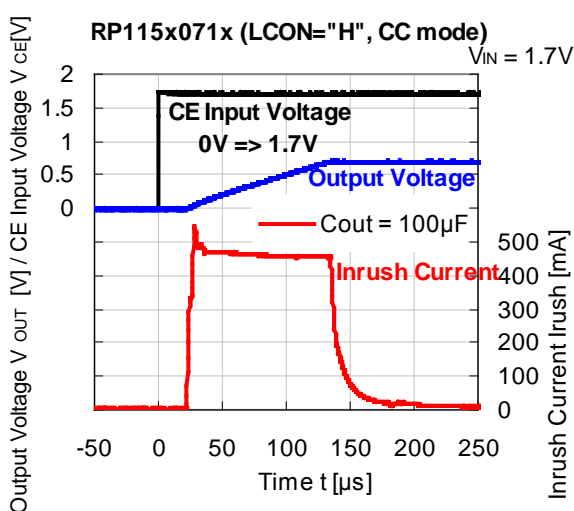
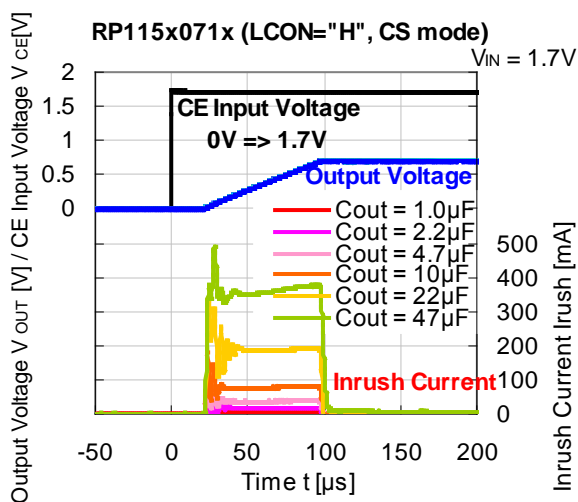
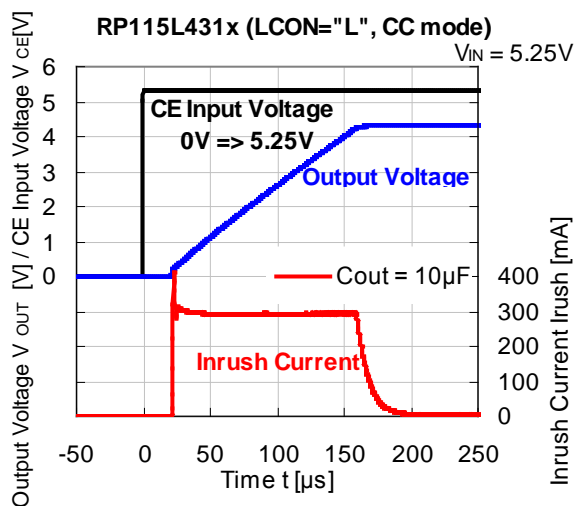
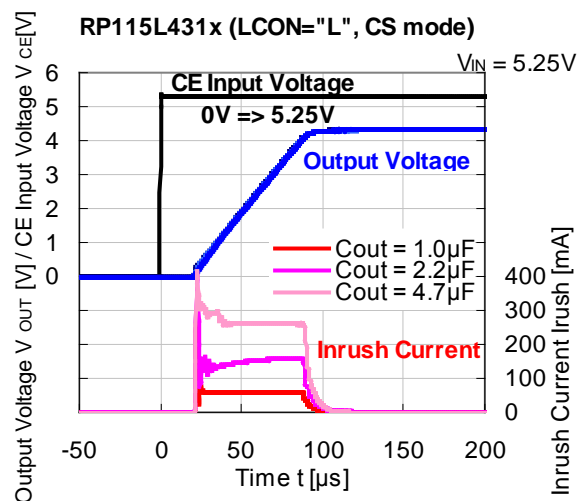


15) Turn-off Waveform by CE Pin Signal (C_{IN} =Ceramic1.0 μ F, C_{OUT} =Ceramic1.0 μ F, T_a =25°C)



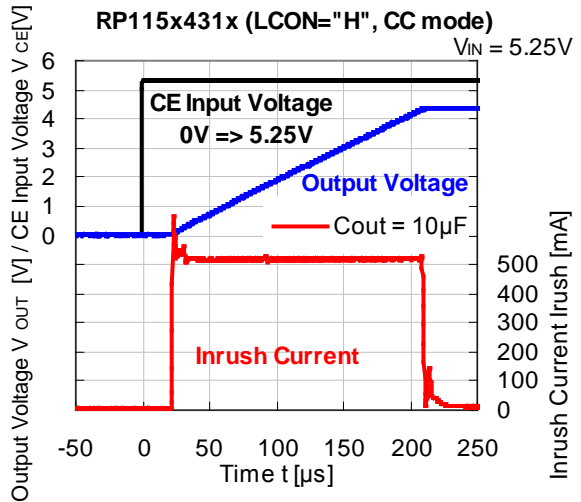
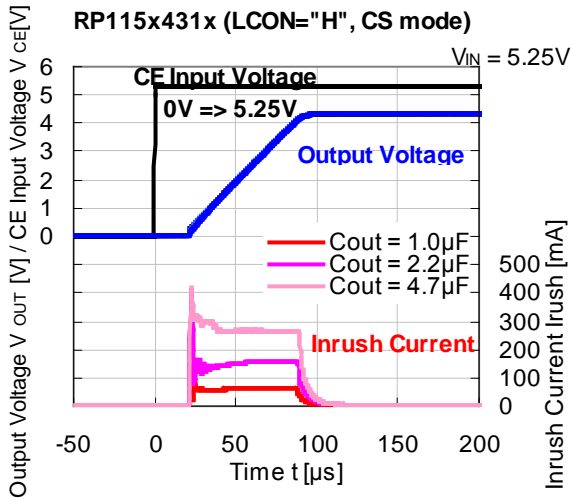
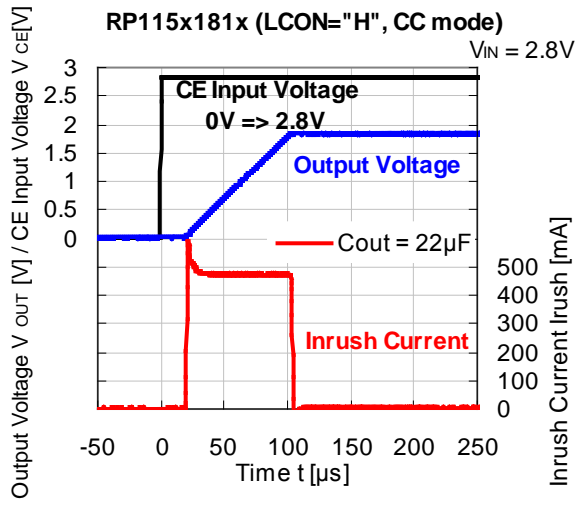
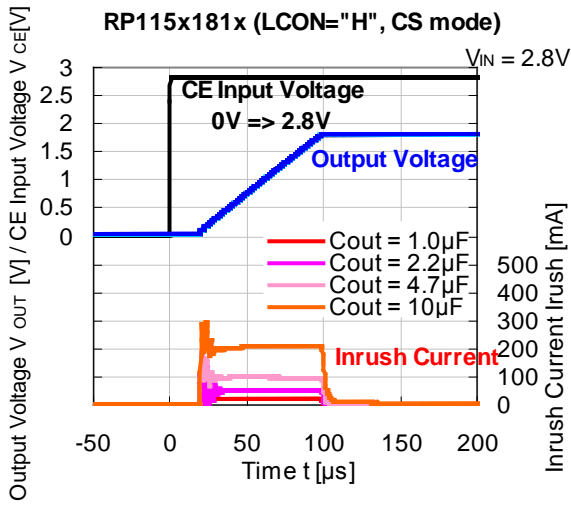
16) Inrush Current (C_{IN} =Ceramic $1.0\mu\text{F}$, I_{OUT} = 0mA , T_a = 25°C)



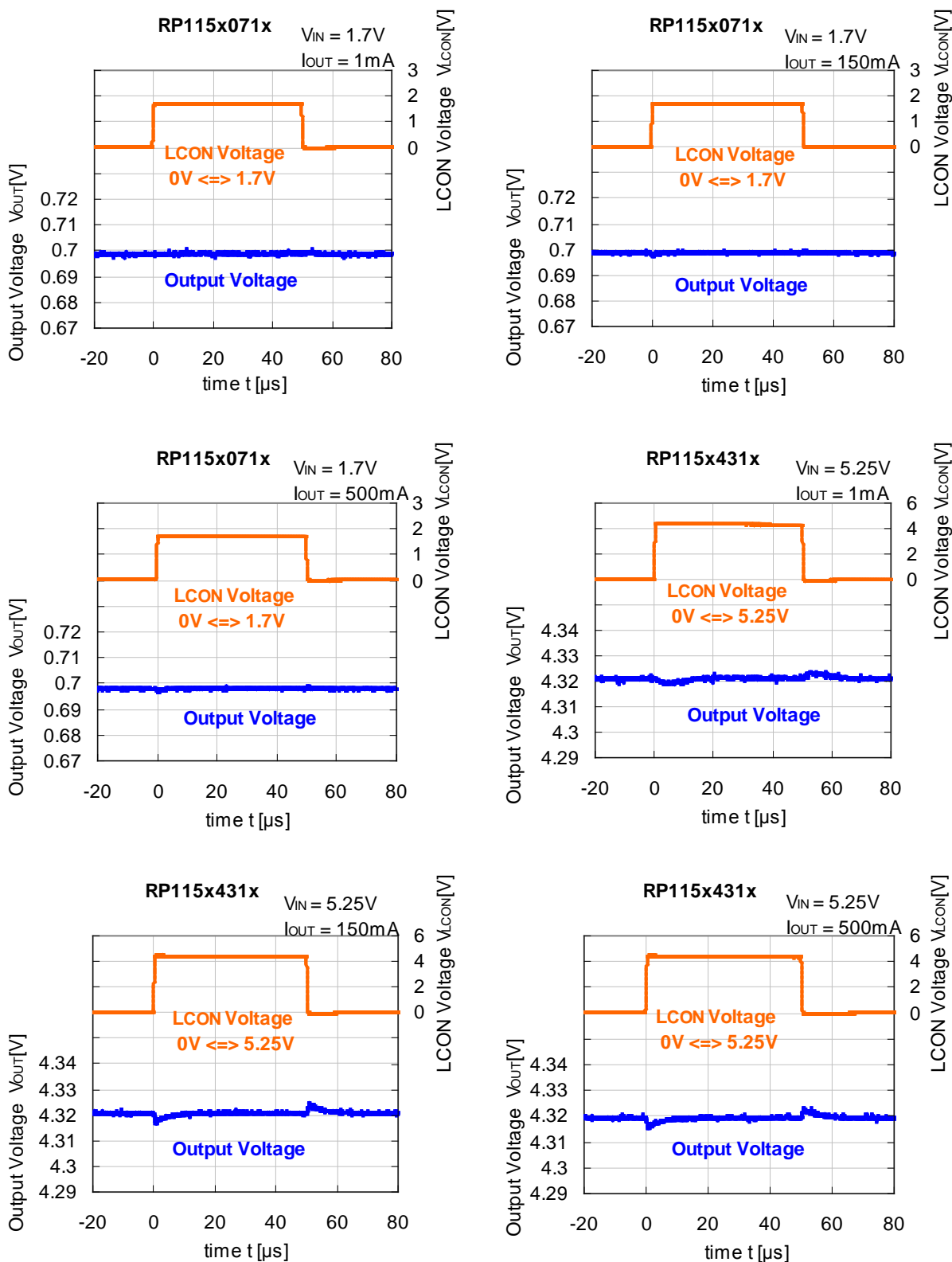


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17) LCON Pin Transient Response (C_{IN} =Ceramic1.0 μ F, C_{OUT} =Ceramic1.0 μ F, T_a =25°C)

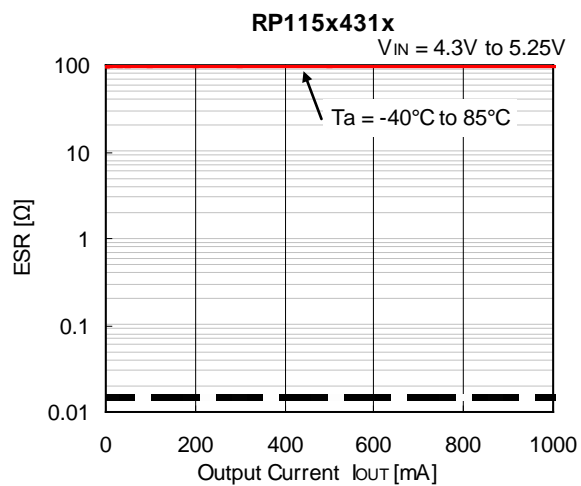
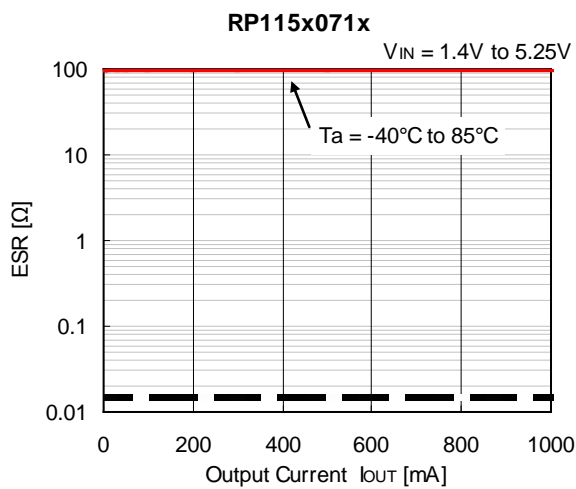


EQUIVALENT SERIES RESISTANCE (ESR) vs. OUTPUT CURRENT

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 40 μ V or less).

Measurement Conditions

- Noise Frequency Band Width: 10Hz to 2MHz
- Operating Temperature Range: -40°C to $+85^{\circ}\text{C}$
- Hatched Area: Output noise level is average 40 μ V or less.
- C_{IN} , C_{OUT} : 1.0 μ F or more





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