

---

### PWM Step-up DC/DC Controller

---

NO.EA-109-180705

## OUTLINE

The R1212D is a CMOS-based PWM step-up DC/DC controller with low supply current. Internally, the R1212D consists of an oscillator, a PWM comparator circuit, a reference voltage unit, an error amplifier, a reference current unit, a protection circuit, and an under voltage lockout (UVLO) circuit. A low ripple, high efficiency step-up DC/DC converter can be composed of this IC with some external components, or an inductor, a diode, a power MOSFET, divider resistors, and capacitors.

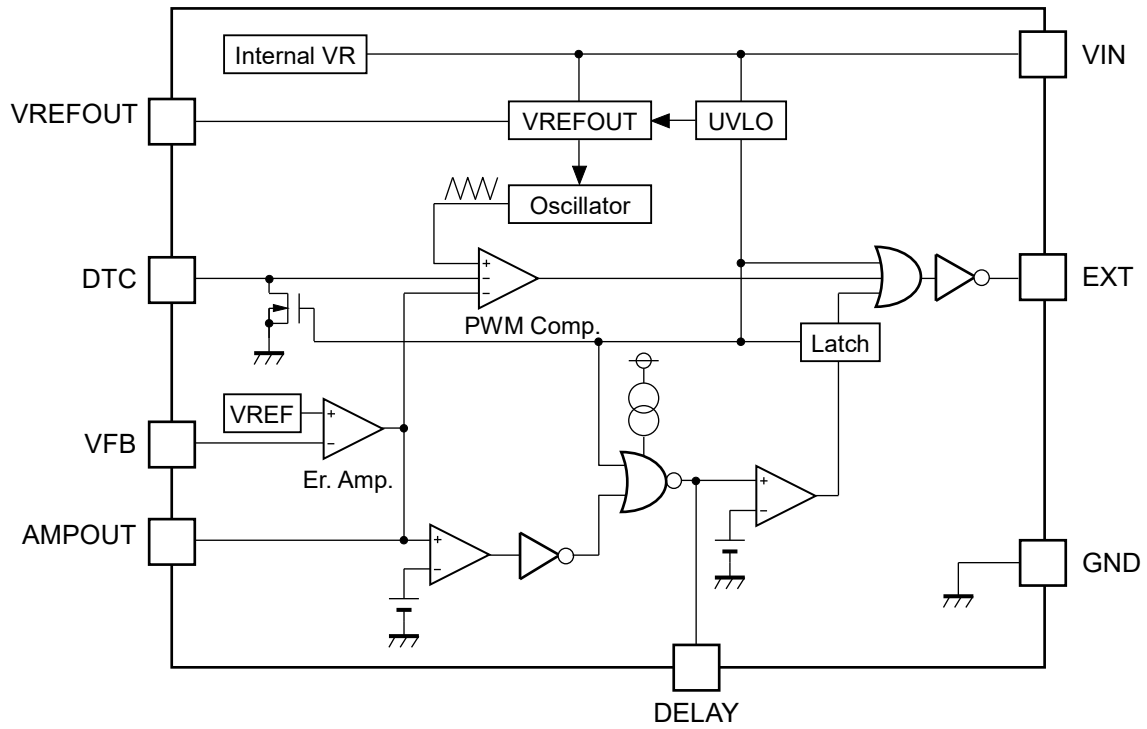
The maximum duty cycle and the soft start time are easily adjustable with external resistors and capacitors. In terms of maximum duty cycle, with or without internal limit can be set by mask options. As for the protection circuit, after the soft-starting time, if the maximum duty cycle is continued for a certain period, the R1212D latches the external driver with its off state, or the latch-type protection circuit works. The delay time for latch the state can be set with an external capacitor. To release the protection circuit, restart with power-on (Voltage supplier is equal or less than UVLO detector threshold level).

## FEATURES

- Input Voltage Range ..... 2.2 V to 5.5 V
- Built-in Latch-type Protection Function (Output Delay Time can be set with an external capacitor)
- Two Options of Basic Oscillator Frequency..... 700 kHz, 1.4 MHz, 300 kHz
- Maximum Duty Cycle/Soft-start time ..... Adjustable with external capacitors  
(If internal limit is set by version, Typ. 90% or Typ. 91.5%)
- High Reference Voltage Accuracy .....  $\pm 1.5\%$
- UVLO Threshold level ..... Typ. 1.9 V/ 2.1 V/ 2.8 V by mask option
- Small Temperature Coefficient of Reference Voltage ..... Typ.  $\pm 150\text{ppm}/^\circ\text{C}$
- Package..... SON-8

## APPLICATIONS

- Constant Voltage Power Source for portable equipment
- Constant Voltage Power Source for LCD and CCD

**BLOCK DIAGRAM****R1212D Block Diagram**

## SELECTION GUIDE

The oscillator frequency, UVLO detector threshold, and oscillator maximum duty cycle internal limit for the ICs can be selected at the user's request.

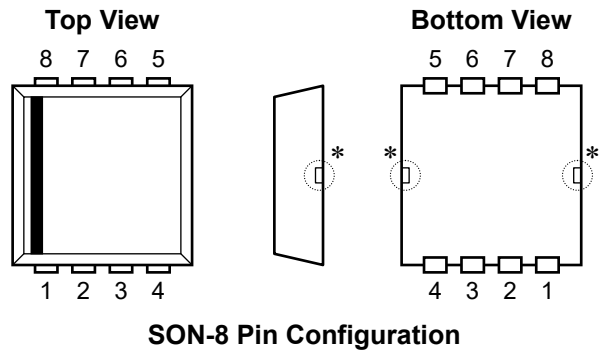
### Selection Guide

| Product Name     | Package | Quantity per Reel | Pb Free | Halogen Free |
|------------------|---------|-------------------|---------|--------------|
| R1212D10xx-TR-FE | SON-8   | 3,000 pcs         | Yes     | Yes          |

xx: The combination of the oscillator frequency, oscillator maximum duty cycle internal limit, and UVLO detect voltage can be designated.

| Code | Oscillator Frequency | UVLO Detector Threshold | Internal Maximum Duty Limit |
|------|----------------------|-------------------------|-----------------------------|
| 0A   | Typ. 700 kHz         | Typ. 1.9 V              | No                          |
| 0B   | Typ. 1.4 MHz         | Typ. 1.9 V              | No                          |
| 1A   | Typ. 700 kHz         | Typ. 2.1 V              | Typ. 90%                    |
| 1C   | Typ. 300 kHz         | Typ. 2.1 V              | Typ. 91.5%                  |
| 2A   | Typ. 700 kHz         | Typ. 2.8 V              | Typ. 90%                    |
| 2C   | Typ. 300 kHz         | Typ. 2.8 V              | Typ. 91.5%                  |

## PIN CONFIGURATION



## PIN DESCRIPTION

### Pin Description

| Pin No | Symbol  | Description                                                         |
|--------|---------|---------------------------------------------------------------------|
| 1      | EXT     | External FET Drive Pin (CMOS Output)                                |
| 2      | GND     | Ground Pin                                                          |
| 3      | DTC     | Pin for Setting Maximum Duty Cycle and Soft start time              |
| 4      | DELAY   | Pin for External Capacitor (for Setting Output Delay of Protection) |
| 5      | VFB     | Feedback Pin for monitoring Output Voltage                          |
| 6      | VREFOUT | Reference Voltage Output Pin                                        |
| 7      | AMPOUT  | Amplifier Output Pin                                                |
| 8      | VIN     | Power Supply Pin for the IC                                         |

\* Tab suspension leads are GND level. (They are connected to the reverse side of this IC.) The tab suspension leads should be open and do not connect to other wires or land patterns.

## ABSOLUTE MAXIMUM RATINGS

### Absolute Maximum Ratings

(GND = 0 V)

| Symbol       | Item                                                       | Rating                   | Unit |
|--------------|------------------------------------------------------------|--------------------------|------|
| $V_{IN}$     | VIN Pin Voltage                                            | 6.5                      | V    |
| $V_{EXT}$    | EXT Pin Output Voltage                                     | $-0.3 \sim V_{IN} + 0.3$ | V    |
| $V_{DLY}$    | DELAY Pin Voltage                                          | $-0.3 \sim V_{IN} + 0.3$ | V    |
| $V_{REFOUT}$ | VREFOUT Pin Voltage                                        | $-0.3 \sim V_{IN} + 0.3$ | V    |
| $V_{AMP}$    | AMPOUT Pin Voltage                                         | $-0.3 \sim V_{IN} + 0.3$ | V    |
| $V_{FB}$     | DTC Pin Voltage                                            | $-0.3 \sim V_{IN} + 0.3$ | V    |
| $V_{DTC}$    | VFB Pin Voltage                                            | $-0.3 \sim V_{IN} + 0.3$ | V    |
| $I_{AMP}$    | AMPOUT Pin Current                                         | $\pm 10$                 | V    |
| $I_{ROUT}$   | VREFOUT Pin Current                                        | 30                       | mA   |
| $I_{EXT}$    | EXT Pin Inductor Drive Output Current                      | $\pm 80$                 | mA   |
| $P_D$        | Power Dissipation (SON-8)<br>(Standard Test Land Pattern)* | 480                      | mW   |
| $T_{opt}$    | Operating Temperature Range                                | $-40 \sim 85$            | °C   |
| $T_{stg}$    | Storage Temperature Range                                  | $-55 \sim 125$           | °C   |

\* For Power Dissipation, 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 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 (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.

**R1212D**

NO.EA-109-180705

**ELECTRICAL CHARACTERISTICS****R1212D100A Electrical Characteristics**(T<sub>opt</sub> = 25°C)

| Symbol                              | Item                                         | Conditions                                                                        | Min.  | Typ.                    | Max.  | Unit   |
|-------------------------------------|----------------------------------------------|-----------------------------------------------------------------------------------|-------|-------------------------|-------|--------|
| V <sub>IN</sub>                     | Operating Input Voltage                      |                                                                                   | 2.2   |                         | 5.5   | V      |
| V <sub>FB</sub>                     | VFB Voltage Tolerance                        | V <sub>IN</sub> = 3.3 V                                                           | 0.985 | 1.000                   | 1.015 | V      |
| $\Delta V_{FB}/\Delta V_{IN}$       | VFB Voltage Line Regulation                  | V <sub>IN</sub> = 2.2 V to 5.5 V                                                  |       | 3                       |       | mV     |
| $\Delta V_{FB}/\Delta T_{opt}$      | VFB Voltage Temperature Coefficient          | -40°C ≤ T <sub>opt</sub> ≤ 85°C                                                   |       | ±150                    |       | ppm/°C |
| I <sub>FB</sub>                     | VFB Input Current                            | V <sub>IN</sub> = 5.5 V, V <sub>FB</sub> = 0 V or 5.5 V                           | -0.1  |                         | 0.1   | μA     |
| A <sub>V</sub>                      | Open Loop Voltage Gain                       | V <sub>IN</sub> = 3.3 V                                                           |       | 100                     |       | dB     |
| f <sub>T</sub>                      | Unity Gain Frequency Band                    | V <sub>IN</sub> = 3.3 V, A <sub>V</sub> = 0                                       |       | 1.0                     |       | MHz    |
| f <sub>osc</sub>                    | Oscillator Frequency                         | V <sub>IN</sub> = 3.3 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V                 | 595   | 700                     | 805   | kHz    |
| $\Delta f_{osc}/\Delta V_{IN}$      | Oscillator Frequency Line Regulation         | V <sub>IN</sub> = 2.2 V to 5.5 V                                                  |       | 50                      |       | kHz    |
| $\Delta f_{osc}/\Delta T_{opt}$     | Oscillator Frequency Temperature Coefficient | -40°C ≤ T <sub>opt</sub> ≤ 85°C                                                   |       | ±1.0                    |       | kHz/°C |
| I <sub>DD1</sub>                    | Supply Current 1                             | V <sub>IN</sub> = 5.5 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V, EXT at no load |       | 600                     | 1000  | μA     |
| V <sub>REFOUT</sub>                 | VREFOUT Voltage                              | V <sub>IN</sub> = 3.3 V, I <sub>ROUT</sub> = 1 mA                                 | 1.478 | 1.500                   | 1.522 | V      |
| I <sub>OUT</sub>                    | VREFOUT Maximum Output Current               | V <sub>IN</sub> = 3.3 V                                                           | 10    |                         |       | mA     |
| $\Delta V_{REFOUT}/\Delta V_{IN}$   | VREFOUT Line Regulation                      | V <sub>IN</sub> = 2.2 V to 5.5 V                                                  |       | 5                       | 10    | mV     |
| $\Delta V_{REFOUT}/\Delta I_{ROUT}$ | VREFOUT Load Regulation                      | V <sub>IN</sub> = 3.3 V, I <sub>ROUT</sub> = 0.1 mA to 5 mA                       |       | 6                       | 15    | mV     |
| I <sub>lim</sub>                    | VREFOUT Short Current Limit                  | V <sub>IN</sub> = 3.3 V, V <sub>REFOUT</sub> = 0 V                                |       | 20                      |       | mA     |
| $\Delta V_{REFOUT}/\Delta T_{opt}$  | VREFOUT Voltage Temperature Coefficient      | -40°C ≤ T <sub>opt</sub> ≤ 85°C                                                   |       | ±150                    |       | ppm/°C |
| R <sub>EXTH</sub>                   | EXT "H" ON Resistance                        | V <sub>IN</sub> = 3.3 V, I <sub>EXT</sub> = -50 mA                                |       | 2.5                     | 6.0   | Ω      |
| R <sub>EXTL</sub>                   | EXT "L" ON Resistance                        | V <sub>IN</sub> = 3.3 V, I <sub>EXT</sub> = 50 mA                                 |       | 1.5                     | 4.0   | Ω      |
| t <sub>r</sub>                      | EXT Rising Time                              | V <sub>IN</sub> = 3.3 V, C <sub>L</sub> = 1000 pF                                 |       | 12                      |       | ns     |
| t <sub>f</sub>                      | EXT Falling Time                             | V <sub>IN</sub> = 3.3 V, C <sub>L</sub> = 1000 pF                                 |       | 8                       |       | ns     |
| I <sub>DLY1</sub>                   | DELAY Pin Charge Current                     | V <sub>IN</sub> = 3.3 V, V <sub>DLY</sub> = 0 V, V <sub>FB</sub> = 0 V            | 3.0   | 5.5                     | 8.0   | μA     |
| I <sub>DLY2</sub>                   | DELAY Pin Discharge Current                  | V <sub>IN</sub> = V <sub>FB</sub> = 2.2 V, V <sub>DLY</sub> = 0.1 V               | 0.08  | 0.20                    | 0.36  | mA     |
| V <sub>DLY</sub>                    | DELAY Pin Detector Threshold                 | V <sub>IN</sub> = 3.3 V, V <sub>FB</sub> = 0 V, V <sub>DLY</sub> = 0 V→2 V        | 0.95  | 1.00                    | 1.05  | V      |
| V <sub>UVLO1</sub>                  | UVLO Detector Threshold                      | V <sub>IN</sub> = 3.3 V→0 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V             | 1.8   | 1.9                     | 2.0   | V      |
| V <sub>UVLO2</sub>                  | UVLO Released Voltage                        | V <sub>IN</sub> = 0 V→3.3 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V             |       | V <sub>UVLO1</sub> +0.2 | 2.2   | V      |
| V <sub>DTC0</sub>                   | Duty = 0% DTC Pin Voltage                    | V <sub>IN</sub> = 3.3 V                                                           | 0.05  | 0.18                    | 0.25  | V      |
| V <sub>DTC20</sub>                  | Duty = 20% DTC Pin Voltage                   | V <sub>IN</sub> = 3.3 V                                                           |       | 0.3                     |       | V      |
| V <sub>DTC80</sub>                  | Duty = 80% DTC Pin Voltage                   | V <sub>IN</sub> = 3.3 V                                                           |       | 0.75                    |       | V      |
| V <sub>DTC100</sub>                 | Duty = 100% DTC Pin Voltage                  | V <sub>IN</sub> = 3.3 V                                                           | 0.80  | 0.87                    | 1.00  | V      |
| I <sub>AMPH</sub>                   | AMP "H" Output Current                       | V <sub>IN</sub> = 3.3 V, V <sub>AMP</sub> = 1.0 V, V <sub>FB</sub> = 0.9 V        | 0.5   | 1.0                     | 1.8   | mA     |
| I <sub>AMPL</sub>                   | AMP "L" Output Current                       | V <sub>IN</sub> = 3.3 V, V <sub>AMP</sub> = 1.0 V, V <sub>FB</sub> = 1.1 V        | 60    | 100                     | 160   | μA     |

## R1212D100B Electrical Characteristics

(T<sub>opt</sub> = 25°C)

| Symbol                              | Item                                         | Conditions                                                                       | Min.  | Typ.                     | Max.  | Unit   |
|-------------------------------------|----------------------------------------------|----------------------------------------------------------------------------------|-------|--------------------------|-------|--------|
| V <sub>IN</sub>                     | Operating Input Voltage                      |                                                                                  | 2.2   |                          | 5.5   | V      |
| V <sub>FB</sub>                     | VFB Voltage Tolerance                        | V <sub>IN</sub> = 3.3 V                                                          | 0.985 | 1.000                    | 1.015 | V      |
| $\Delta V_{FB}/\Delta V_{IN}$       | VFB Voltage Line Regulation                  | V <sub>IN</sub> = 2.2 V to 5.5 V                                                 |       | 3                        |       | mV     |
| $\Delta V_{FB}/\Delta T_{opt}$      | VFB Voltage Temperature Coefficient          | -40°C ≤ T <sub>opt</sub> ≤ 85°C                                                  |       | ±150                     |       | ppm/°C |
| I <sub>FB</sub>                     | VFB Input Current                            | V <sub>IN</sub> = 5.5 V, V <sub>FB</sub> = 0 V or 5.5 V                          | -0.1  |                          | 0.1   | μA     |
| A <sub>V</sub>                      | Open Loop Voltage Gain                       | V <sub>IN</sub> = 3.3 V                                                          |       | 100                      |       | dB     |
| f <sub>T</sub>                      | Unity Gain Frequency Band                    | V <sub>IN</sub> = 3.3 V, A <sub>V</sub> = 0                                      |       | 1.0                      |       | MHz    |
| f <sub>osc</sub>                    | Oscillator Frequency                         | V <sub>IN</sub> = 3.3 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V                | 1.19  | 1.40                     | 1.61  | MHz    |
| $\Delta f_{osc}/\Delta V_{IN}$      | Oscillator Frequency Line Regulation         | V <sub>IN</sub> = 2.2 V to 5.5 V                                                 |       | 100                      |       | kHz    |
| $\Delta f_{osc}/\Delta T_{opt}$     | Oscillator Frequency Temperature Coefficient | -40°C ≤ T <sub>opt</sub> ≤ 85°C                                                  |       | ±2.0                     |       | kHz/°C |
| I <sub>DD1</sub>                    | Supply Current 1                             | V <sub>IN</sub> = 5.5 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V EXT at no load |       | 900                      | 1800  | μA     |
| V <sub>REFOUT</sub>                 | VREFOUT Voltage                              | V <sub>IN</sub> = 3.3 V, I <sub>ROUT</sub> = 1 mA                                | 1.478 | 1.500                    | 1.522 | V      |
| I <sub>OUT</sub>                    | VREFOUT Maximum Output Current               | V <sub>IN</sub> = 3.3 V                                                          | 10    |                          |       | mA     |
| $\Delta V_{REFOUT}/\Delta V_{IN}$   | VREFOUT Line Regulation                      | V <sub>IN</sub> = 2.2 V to 5.5 V                                                 |       | 5                        | 10    | mV     |
| $\Delta V_{REFOUT}/\Delta I_{ROUT}$ | VREFOUT Load Regulation                      | V <sub>IN</sub> = 3.3 V, I <sub>ROUT</sub> = 0.1 mA to 5 mA                      |       | 6                        | 15    | mV     |
| I <sub>lim</sub>                    | VREFOUT Short Current Limit                  | V <sub>IN</sub> = 3.3 V, V <sub>REFOUT</sub> = 0 V                               |       | 20                       |       | mA     |
| $\Delta V_{REFOUT}/\Delta T_{opt}$  | VREFOUT Voltage Temperature Coefficient      | -40°C ≤ T <sub>opt</sub> ≤ 85°C                                                  |       | ±150                     |       | ppm/°C |
| R <sub>EXTH</sub>                   | EXT "H" ON Resistance                        | V <sub>IN</sub> = 3.3 V, I <sub>EXT</sub> = -50 mA                               |       | 2.5                      | 6.0   | Ω      |
| R <sub>EXTL</sub>                   | EXT "L" ON Resistance                        | V <sub>IN</sub> = 3.3 V, I <sub>EXT</sub> = 50 mA                                |       | 1.5                      | 4.0   | Ω      |
| t <sub>r</sub>                      | EXT Rising Time                              | V <sub>IN</sub> = 3.3 V, C <sub>L</sub> = 1000 pF                                |       | 12                       |       | ns     |
| t <sub>f</sub>                      | EXT Falling Time                             | V <sub>IN</sub> = 3.3 V, C <sub>L</sub> = 1000 pF                                |       | 8                        |       | ns     |
| I <sub>DLY1</sub>                   | DELAY Pin Charge Current                     | V <sub>IN</sub> = 3.3 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V                | 3.0   | 5.5                      | 8.0   | μA     |
| I <sub>DLY2</sub>                   | DELAY Pin Discharge Current                  | V <sub>IN</sub> = V <sub>FB</sub> = 2.2 V, V <sub>DLY</sub> = 0.1 V              | 0.08  | 0.20                     | 0.36  | mA     |
| V <sub>DLY</sub>                    | DELAY Pin Detector Threshold                 | V <sub>IN</sub> = 3.3 V, V <sub>FB</sub> = 0 V, V <sub>DLY</sub> = 0 V → 2 V     | 0.95  | 1.00                     | 1.05  | V      |
| V <sub>UVLO1</sub>                  | UVLO Detector Threshold                      | V <sub>IN</sub> = 3.3 V → 0 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V          | 1.8   | 1.9                      | 2.0   | V      |
| V <sub>UVLO2</sub>                  | UVLO Released Voltage                        | V <sub>IN</sub> = 0 V → 3.3 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V          |       | V <sub>UVLO1</sub> + 0.2 | 2.2   | V      |
| V <sub>DTC0</sub>                   | Duty = 0% DTC Pin Voltage                    | V <sub>IN</sub> = 3.3 V                                                          | 0.05  | 0.18                     | 0.25  | V      |
| V <sub>DTC20</sub>                  | Duty = 20% DTC Pin Voltage                   | V <sub>IN</sub> = 3.3 V                                                          |       | 0.3                      |       | V      |
| V <sub>DTC80</sub>                  | Duty = 80% DTC Pin Voltage                   | V <sub>IN</sub> = 3.3 V                                                          |       | 0.75                     |       | V      |
| V <sub>DTC100</sub>                 | Duty = 100% DTC Pin Voltage                  | V <sub>IN</sub> = 3.3 V                                                          | 0.80  | 0.87                     | 1.00  | V      |
| I <sub>AMPH</sub>                   | AMP "H" Output Current                       | V <sub>IN</sub> = 3.3 V, V <sub>AMP</sub> = 1.0 V, V <sub>FB</sub> = 0.9 V       | 0.5   | 1.0                      | 1.8   | mA     |
| I <sub>AMPL</sub>                   | AMP "L" Output Current                       | V <sub>IN</sub> = 3.3 V, V <sub>AMP</sub> = 1.0 V, V <sub>FB</sub> = 1.1 V       | 60    | 100                      | 160   | μA     |

**R1212D**

NO.EA-109-180705

**R1212D101A Electrical Characteristics**(T<sub>opt</sub> = 25°C)

| Symbol                              | Item                                         | Conditions                                                                        | Min.  | Typ.                     | Max.  | Unit   |
|-------------------------------------|----------------------------------------------|-----------------------------------------------------------------------------------|-------|--------------------------|-------|--------|
| V <sub>IN</sub>                     | Operating Input Voltage                      |                                                                                   | 2.5   |                          | 5.5   | V      |
| V <sub>FB</sub>                     | VFB Voltage Tolerance                        | V <sub>IN</sub> = 3.3 V                                                           | 0.985 | 1.000                    | 1.015 | V      |
| $\Delta V_{FB}/\Delta V_{IN}$       | VFB Voltage Line Regulation                  | V <sub>IN</sub> = 2.5 V to 5.5 V                                                  |       | 3                        |       | mV     |
| $\Delta V_{FB}/\Delta T_{opt}$      | VFB Voltage Temperature Coefficient          | -40°C ≤ T <sub>opt</sub> ≤ 85°C                                                   |       | ±150                     |       | ppm/°C |
| I <sub>FB</sub>                     | VFB Input Current                            | V <sub>IN</sub> = 5.5 V, V <sub>FB</sub> = 0 V or 5.5 V                           | -0.1  |                          | 0.1   | μA     |
| A <sub>v</sub>                      | Open Loop Voltage Gain                       | V <sub>IN</sub> = 3.3 V                                                           |       | 100                      |       | dB     |
| f <sub>r</sub>                      | Unity Gain Frequency Band                    | V <sub>IN</sub> = 3.3 V, A <sub>v</sub> = 0                                       |       | 1.0                      |       | MHz    |
| f <sub>osc</sub>                    | Oscillator Frequency                         | V <sub>IN</sub> = 3.3 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V                 | 595   | 700                      | 805   | kHz    |
| $\Delta f_{osc}/\Delta V_{IN}$      | Oscillator Frequency Line Regulation         | V <sub>IN</sub> = 2.5 V to 5.5 V                                                  |       | 50                       |       | kHz    |
| $\Delta f_{osc}/\Delta T_{opt}$     | Oscillator Frequency Temperature Coefficient | -40°C ≤ T <sub>opt</sub> ≤ 85°C                                                   |       | ±1.0                     |       | kHz/°C |
| I <sub>DD1</sub>                    | Supply Current 1                             | V <sub>IN</sub> = 5.5 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V, EXT at no load |       | 600                      | 1000  | μA     |
| V <sub>REFOUT</sub>                 | VREFOUT Voltage                              | V <sub>IN</sub> = 3.3 V, I <sub>ROUT</sub> = 1 mA                                 | 1.478 | 1.500                    | 1.522 | V      |
| I <sub>OUT</sub>                    | VREFOUT Maximum Output Current               | V <sub>IN</sub> = 3.3 V                                                           | 10    |                          |       | mA     |
| $\Delta V_{REFOUT}/\Delta V_{IN}$   | VREFOUT Line Regulation                      | V <sub>IN</sub> = 2.5 V to 5.5 V                                                  |       | 5                        | 10    | mV     |
| $\Delta V_{REFOUT}/\Delta I_{ROUT}$ | VREFOUT Load Regulation                      | V <sub>IN</sub> = 3.3 V, I <sub>ROUT</sub> = 0.1 mA ~ 5 mA                        |       | 6                        | 15    | mV     |
| I <sub>lim</sub>                    | VREFOUT Short Current Limit                  | V <sub>IN</sub> = 3.3 V, V <sub>REFOUT</sub> = 0 V                                |       | 20                       |       | mA     |
| $\Delta V_{REFOUT}/\Delta T_{opt}$  | VREFOUT Voltage Temperature Coefficient      | -40°C ≤ T <sub>opt</sub> ≤ 85°C                                                   |       | ±150                     |       | ppm/°C |
| R <sub>EXTH</sub>                   | EXT "H" ON Resistance                        | V <sub>IN</sub> = 3.3 V, I <sub>EXT</sub> = -50 mA                                |       | 2.5                      | 6.0   | Ω      |
| R <sub>EXTL</sub>                   | EXT "L" ON Resistance                        | V <sub>IN</sub> = 3.3 V, I <sub>EXT</sub> = 50 mA                                 |       | 1.5                      | 4.0   | Ω      |
| t <sub>r</sub>                      | EXT Rising Time                              | V <sub>IN</sub> = 3.3 V, C <sub>L</sub> = 1000 pF                                 |       | 12                       |       | ns     |
| t <sub>f</sub>                      | EXT Falling Time                             | V <sub>IN</sub> = 3.3 V, C <sub>L</sub> = 1000 pF                                 |       | 8                        |       | ns     |
| I <sub>DLY1</sub>                   | DELAY Pin Charge Current                     | V <sub>IN</sub> = 3.3 V, V <sub>DLY</sub> = 0 V, V <sub>FB</sub> = 0 V            | 3.0   | 5.5                      | 8.0   | μA     |
| I <sub>DLY2</sub>                   | DELAY Pin Discharge Current                  | V <sub>IN</sub> = V <sub>FB</sub> = 2.5 V, V <sub>DLY</sub> = 0.1 V               | 0.08  | 0.20                     | 0.36  | mA     |
| V <sub>DLY</sub>                    | DELAY Pin Detector Threshold                 | V <sub>IN</sub> = 3.3 V, V <sub>FB</sub> = 0 V, V <sub>DLY</sub> = 0 V → 2 V      | 0.95  | 1.00                     | 1.05  | V      |
| V <sub>UVLO1</sub>                  | UVLO Detector Threshold                      | V <sub>IN</sub> = 3.3 V → 0 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V           | 2.0   | 2.1                      | 2.2   | V      |
| V <sub>UVLO2</sub>                  | UVLO Released Voltage                        | V <sub>IN</sub> = 0 V → 3.3 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V           |       | V <sub>UVLO1</sub> + 0.2 | 2.45  | V      |
| V <sub>DTC0</sub>                   | Duty□0% DTC Pin Voltage                      | V <sub>IN</sub> = 3.3 V                                                           | 0.05  | 0.18                     | 0.25  | V      |
| V <sub>DTC20</sub>                  | Duty□20% DTC Pin Voltage                     | V <sub>IN</sub> = 3.3 V                                                           |       | 0.3                      |       | V      |
| V <sub>DTC80</sub>                  | Duty□80% DTC Pin Voltage                     | V <sub>IN</sub> = 3.3 V                                                           |       | 0.75                     |       | V      |
| Maxduty                             | Maximum Duty Cycle                           | V <sub>IN</sub> = 3.3 V                                                           | 84    | 90                       | 96    | %      |
| I <sub>AMPH</sub>                   | AMP "H" Output Current                       | V <sub>IN</sub> = 3.3 V, V <sub>AMP</sub> = 1.0 V, V <sub>FB</sub> = 0.9 V        | 0.5   | 1.0                      | 1.8   | mA     |
| I <sub>AMPL</sub>                   | AMP "L" Output Current                       | V <sub>IN</sub> = 3.3 V, V <sub>AMP</sub> = 1.0 V, V <sub>FB</sub> = 1.1 V        | 60    | 100                      | 160   | μA     |

## R1212D101C Electrical Characteristics

(T<sub>opt</sub> = 25°C)

| Symbol                              | Item                                         | Conditions                                                                        | Min.  | Typ.                     | Max.  | Unit   |
|-------------------------------------|----------------------------------------------|-----------------------------------------------------------------------------------|-------|--------------------------|-------|--------|
| V <sub>IN</sub>                     | Operating Input Voltage                      |                                                                                   | 2.5   |                          | 5.5   | V      |
| V <sub>FB</sub>                     | VFB Voltage Tolerance                        | V <sub>IN</sub> = 3.3 V                                                           | 0.985 | 1.000                    | 1.015 | V      |
| $\Delta V_{FB}/\Delta V_{IN}$       | VFB Voltage Line Regulation                  | V <sub>IN</sub> = 2.5 V to 5.5 V                                                  |       | 3                        |       | mV     |
| $\Delta V_{FB}/\Delta T_{opt}$      | VFB Voltage Temperature Coefficient          | -40°C ≤ T <sub>opt</sub> ≤ 85°C                                                   |       | ±150                     |       | ppm/°C |
| I <sub>FB</sub>                     | VFB Input Current                            | V <sub>IN</sub> = 5.5 V, V <sub>FB</sub> = 0 V or 5.5 V                           | -0.1  |                          | 0.1   | μA     |
| A <sub>V</sub>                      | Open Loop Voltage Gain                       | V <sub>IN</sub> = 3.3 V                                                           |       | 100                      |       | dB     |
| f <sub>T</sub>                      | Unity Gain Frequency Band                    | V <sub>IN</sub> = 3.3 V, A <sub>V</sub> = 0                                       |       | 1.0                      |       | MHz    |
| f <sub>osc</sub>                    | Oscillator Frequency                         | V <sub>IN</sub> = 3.3 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V                 | 240   | 300                      | 360   | kHz    |
| $\Delta f_{osc}/\Delta V_{IN}$      | Oscillator Frequency Line Regulation         | V <sub>IN</sub> = 2.5 V to 5.5 V                                                  |       | 25                       |       | kHz    |
| $\Delta f_{osc}/\Delta T_{opt}$     | Oscillator Frequency Temperature Coefficient | -40°C ≤ T <sub>opt</sub> ≤ 85°C                                                   |       | ±0.5                     |       | kHz/°C |
| I <sub>DD1</sub>                    | Supply Current 1                             | V <sub>IN</sub> = 5.5 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V, EXT at no load |       | 400                      | 800   | μA     |
| V <sub>REFOUT</sub>                 | VREFOUT Voltage                              | V <sub>IN</sub> = 3.3 V, I <sub>ROUT</sub> = 1 mA                                 | 1.478 | 1.500                    | 1.522 | V      |
| I <sub>OUT</sub>                    | VREFOUT Maximum Output Current               | V <sub>IN</sub> = 3.3 V                                                           | 10    |                          |       | mA     |
| $\Delta V_{REFOUT}/\Delta V_{IN}$   | VREFOUT Line Regulation                      | V <sub>IN</sub> = 2.5 V to 5.5 V                                                  |       | 5                        | 10    | mV     |
| $\Delta V_{REFOUT}/\Delta I_{ROUT}$ | VREFOUT Load Regulation                      | V <sub>IN</sub> = 3.3 V, I <sub>ROUT</sub> = 0.1 mA to 5 mA                       |       | 6                        | 15    | mV     |
| I <sub>lim</sub>                    | VREFOUT Short Current Limit                  | V <sub>IN</sub> = 3.3 V, V <sub>REFOUT</sub> = 0 V                                |       | 20                       |       | mA     |
| $\Delta V_{REFOUT}/\Delta T_{opt}$  | VREFOUT Voltage Temperature Coefficient      | -40°C ≤ T <sub>opt</sub> ≤ 85°C                                                   |       | ±150                     |       | ppm/°C |
| R <sub>EXTH</sub>                   | EXT "H" ON Resistance                        | V <sub>IN</sub> = 3.3 V, I <sub>EXT</sub> = -50 mA                                |       | 2.5                      | 6.0   | Ω      |
| R <sub>EXTL</sub>                   | EXT "L" ON Resistance                        | V <sub>IN</sub> = 3.3 V, I <sub>EXT</sub> = 50 mA                                 |       | 1.5                      | 4.0   | Ω      |
| t <sub>r</sub>                      | EXT Rising Time                              | V <sub>IN</sub> = 3.3 V, C <sub>L</sub> = 1000 pF                                 |       | 12                       |       | ns     |
| t <sub>f</sub>                      | EXT Falling Time                             | V <sub>IN</sub> = 3.3 V, C <sub>L</sub> = 1000 pF                                 |       | 8                        |       | ns     |
| I <sub>DLY1</sub>                   | DELAY Pin Charge Current                     | V <sub>IN</sub> = 3.3 V, V <sub>DLY</sub> = 0 V, V <sub>FB</sub> = 0 V            | 2.0   | 4.5                      | 7.0   | μA     |
| I <sub>DLY2</sub>                   | DELAY Pin Discharge Current                  | V <sub>IN</sub> = V <sub>FB</sub> = 2.5 V, V <sub>DLY</sub> = 0.1 V               | 0.08  | 0.20                     | 0.36  | mA     |
| V <sub>DLY</sub>                    | DELAY Pin Detector Threshold                 | V <sub>IN</sub> = 3.3 V, V <sub>FB</sub> = 0 V, V <sub>DLY</sub> = 0 V → 2 V      | 0.95  | 1.00                     | 1.05  | V      |
| V <sub>UVLO1</sub>                  | UVLO Detector Threshold                      | V <sub>IN</sub> = 3.3 V → 0 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V           | 2.0   | 2.1                      | 2.2   | V      |
| V <sub>UVLO2</sub>                  | UVLO Released Voltage                        | V <sub>IN</sub> = 0 V → 3.3 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V           |       | V <sub>UVLO1</sub> + 0.2 | 2.45  | V      |
| V <sub>DTC0</sub>                   | Duty = 0% DTC Pin Voltage                    | V <sub>IN</sub> = 3.3 V                                                           | 0.05  | 0.18                     | 0.25  | V      |
| V <sub>DTC20</sub>                  | Duty = 20% DTC Pin Voltage                   | V <sub>IN</sub> = 3.3 V                                                           |       | 0.3                      |       | V      |
| V <sub>DTC80</sub>                  | Duty = 80% DTC Pin Voltage                   | V <sub>IN</sub> = 3.3 V                                                           |       | 0.75                     |       | V      |
| Maxduty                             | Maximum Duty Cycle                           | V <sub>IN</sub> = 3.3 V                                                           | 85.5  | 91.5                     | 97.5  | %      |
| I <sub>AMPH</sub>                   | AMP "H" Output Current                       | V <sub>IN</sub> = 3.3 V, V <sub>AMP</sub> = 1.0 V, V <sub>FB</sub> = 0.9 V        | 0.5   | 1.0                      | 1.8   | mA     |
| I <sub>AMPL</sub>                   | AMP "L" Output Current                       | V <sub>IN</sub> = 3.3 V, V <sub>AMP</sub> = 1.0 V, V <sub>FB</sub> = 1.1 V        | 50    | 90                       | 150   | μA     |

**R1212D**

NO.EA-109-180705

**R1212D102A Electrical Characteristics**(T<sub>opt</sub> = 25°C)

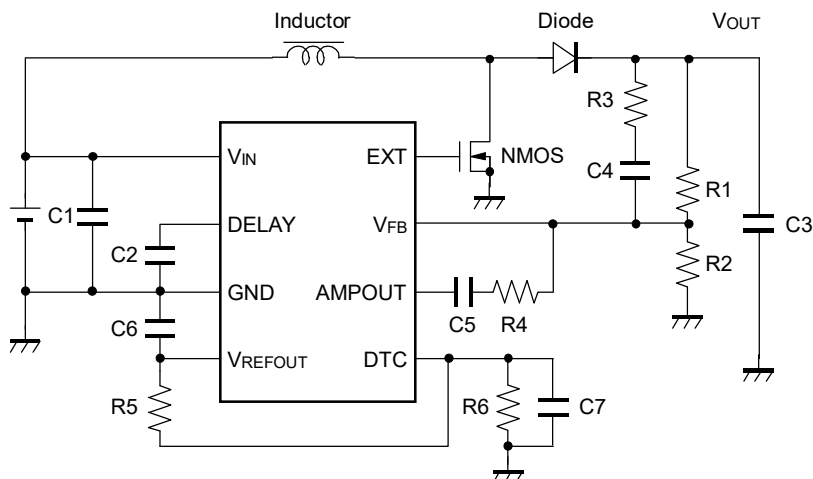
| Symbol                              | Item                                         | Conditions                                                                        | Min.  | Typ.                      | Max.  | Unit   |
|-------------------------------------|----------------------------------------------|-----------------------------------------------------------------------------------|-------|---------------------------|-------|--------|
| V <sub>IN</sub>                     | Operating Input Voltage                      |                                                                                   | 3.3   |                           | 5.5   | V      |
| V <sub>FB</sub>                     | VFB Voltage Tolerance                        | V <sub>IN</sub> = 3.3 V                                                           | 0.985 | 1.000                     | 1.015 | V      |
| $\Delta V_{FB}/\Delta V_{IN}$       | VFB Voltage Line Regulation                  | V <sub>IN</sub> = 3.3 V to 5.5 V                                                  |       | 3                         |       | mV     |
| $\Delta V_{FB}/\Delta T_{opt}$      | VFB Voltage Temperature Coefficient          | -40°C ≤ T <sub>opt</sub> ≤ 85°C                                                   |       | ±150                      |       | ppm/°C |
| I <sub>FB</sub>                     | VFB Input Current                            | V <sub>IN</sub> = 5.5 V, V <sub>FB</sub> = 0 V or 5.5 V                           | -0.1  |                           | 0.1   | μA     |
| A <sub>V</sub>                      | Open Loop Voltage Gain                       | V <sub>IN</sub> = 3.3 V                                                           |       | 100                       |       | dB     |
| f <sub>T</sub>                      | Unity Gain Frequency Band                    | V <sub>IN</sub> = 3.3 V, A <sub>V</sub> = 0                                       |       | 1.0                       |       | MHz    |
| f <sub>osc</sub>                    | Oscillator Frequency                         | V <sub>IN</sub> = 3.3 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V                 | 595   | 700                       | 805   | kHz    |
| $\Delta f_{osc}/\Delta V_{IN}$      | Oscillator Frequency Line Regulation         | V <sub>IN</sub> = 3.3 V to 5.5 V                                                  |       | 50                        |       | kHz    |
| $\Delta f_{osc}/\Delta T_{opt}$     | Oscillator Frequency Temperature Coefficient | -40°C ≤ T <sub>opt</sub> ≤ 85°C                                                   |       | ±1.0                      |       | kHz/°C |
| I <sub>DD1</sub>                    | Supply Current 1                             | V <sub>IN</sub> = 5.5 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V, EXT at no load |       | 600                       | 1000  | μA     |
| V <sub>REFOUT</sub>                 | VREFOUT Voltage                              | V <sub>IN</sub> = 3.3 V, I <sub>ROUT</sub> = 1 mA                                 | 1.478 | 1.500                     | 1.522 | V      |
| I <sub>OUT</sub>                    | VREFOUT Maximum Output Current               | V <sub>IN</sub> = 3.3 V                                                           | 10    |                           |       | mA     |
| $\Delta V_{REFOUT}/\Delta V_{IN}$   | VREFOUT Line Regulation                      | V <sub>IN</sub> = 3.3 V to 5.5 V                                                  |       | 5                         | 10    | mV     |
| $\Delta V_{REFOUT}/\Delta I_{ROUT}$ | VREFOUT Load Regulation                      | V <sub>IN</sub> = 3.3 V, I <sub>ROUT</sub> = 0.1 mA ~ 5 mA                        |       | 6                         | 15    | mV     |
| I <sub>lim</sub>                    | VREFOUT Short Current Limit                  | V <sub>IN</sub> = 3.3 V, V <sub>REFOUT</sub> = 0 V                                |       | 20                        |       | mA     |
| $\Delta V_{REFOUT}/\Delta T_{opt}$  | VREFOUT Voltage Temperature Coefficient      | -40°C ≤ T <sub>opt</sub> ≤ 85°C                                                   |       | ±150                      |       | ppm/°C |
| R <sub>EXTH</sub>                   | EXT "H" ON Resistance                        | V <sub>IN</sub> = 3.3 V, I <sub>EXT</sub> = -50 mA                                |       | 2.5                       | 6.0   | Ω      |
| R <sub>EXTL</sub>                   | EXT "L" ON Resistance                        | V <sub>IN</sub> = 3.3 V, I <sub>EXT</sub> = 50 mA                                 |       | 1.5                       | 4.0   | Ω      |
| t <sub>r</sub>                      | EXT Rising Time                              | V <sub>IN</sub> = 3.3 V, C <sub>L</sub> = 1000 pF                                 |       | 12                        |       | ns     |
| t <sub>f</sub>                      | EXT Falling Time                             | V <sub>IN</sub> = 3.3 V, C <sub>L</sub> = 1000 pF                                 |       | 8                         |       | ns     |
| I <sub>DLY1</sub>                   | DELAY Pin Charge Current                     | V <sub>IN</sub> = 3.3 V, V <sub>DLY</sub> = 0 V, V <sub>FB</sub> = 0 V            | 3.0   | 5.5                       | 8.0   | μA     |
| I <sub>DLY2</sub>                   | DELAY Pin Discharge Current                  | V <sub>IN</sub> = V <sub>FB</sub> = 3.3 V, V <sub>DLY</sub> = 0.1 V               | 0.08  | 0.20                      | 0.36  | mA     |
| V <sub>DLY</sub>                    | DELAY Pin Detector Threshold                 | V <sub>IN</sub> = 3.3 V, V <sub>FB</sub> = 0 V, V <sub>DLY</sub> = 0 V → 2 V      | 0.95  | 1.00                      | 1.05  | V      |
| V <sub>UVLO1</sub>                  | UVLO Detector Threshold                      | V <sub>IN</sub> = 3.3 V → 0 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V           | 2.6   | 2.8                       | 3.0   | V      |
| V <sub>UVLO2</sub>                  | UVLO Released Voltage                        | V <sub>IN</sub> = 0 V → 3.3 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V           |       | V <sub>UVLO1</sub> + 0.25 | 3.3   | V      |
| V <sub>DTC0</sub>                   | Duty = 0% DTC Pin Voltage                    | V <sub>IN</sub> = 3.3 V                                                           | 0.05  | 0.18                      | 0.25  | V      |
| V <sub>DTC20</sub>                  | Duty = 20% DTC Pin Voltage                   | V <sub>IN</sub> = 3.3 V                                                           |       | 0.3                       |       | V      |
| V <sub>DTC80</sub>                  | Duty = 80% DTC Pin Voltage                   | V <sub>IN</sub> = 3.3 V                                                           |       | 0.75                      |       | V      |
| Maxduty                             | Maximum Duty Cycle                           | V <sub>IN</sub> = 3.3 V                                                           | 84    | 90                        | 96    | %      |
| I <sub>AMPH</sub>                   | AMP "H" Output Current                       | V <sub>IN</sub> = 3.3 V, V <sub>AMP</sub> = 1.0 V, V <sub>FB</sub> = 0.9 V        | 0.5   | 1.0                       | 1.8   | mA     |
| I <sub>AMPL</sub>                   | AMP "L" Output Current                       | V <sub>IN</sub> = 3.3 V, V <sub>AMP</sub> = 1.0 V, V <sub>FB</sub> = 1.1 V        | 60    | 100                       | 160   | μA     |

## R1212D102C Electrical Characteristics

(T<sub>opt</sub> = 25°C)

| Symbol                              | Item                                         | Conditions                                                                       | Min.  | Typ.                      | Max.  | Unit   |
|-------------------------------------|----------------------------------------------|----------------------------------------------------------------------------------|-------|---------------------------|-------|--------|
| V <sub>IN</sub>                     | Operating Input Voltage                      |                                                                                  | 3.3   |                           | 5.5   | V      |
| V <sub>FB</sub>                     | VFB Voltage Tolerance                        | V <sub>IN</sub> = 3.3 V                                                          | 0.985 | 1.000                     | 1.015 | V      |
| $\Delta V_{FB}/\Delta V_{IN}$       | VFB Voltage Line Regulation                  | V <sub>IN</sub> = 3.3 V to 5.5 V                                                 |       | 3                         |       | mV     |
| $\Delta V_{FB}/\Delta T_{opt}$      | VFB Voltage Temperature Coefficient          | -40°C ≤ T <sub>opt</sub> ≤ 85°C                                                  |       | ±150                      |       | ppm/°C |
| I <sub>FB</sub>                     | VFB Input Current                            | V <sub>IN</sub> = 5.5 V, V <sub>FB</sub> = 0 V or 5.5 V                          | -0.1  |                           | 0.1   | μA     |
| A <sub>V</sub>                      | Open Loop Voltage Gain                       | V <sub>IN</sub> = 3.3 V                                                          |       | 100                       |       | dB     |
| f <sub>T</sub>                      | Unity Gain Frequency Band                    | V <sub>IN</sub> = 3.3 V, A <sub>V</sub> = 0                                      |       | 1.0                       |       | MHz    |
| f <sub>osc</sub>                    | Oscillator Frequency                         | V <sub>IN</sub> = 3.3 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V                | 240   | 300                       | 360   | kHz    |
| $\Delta f_{osc}/\Delta V_{IN}$      | Oscillator Frequency Line Regulation         | V <sub>IN</sub> = 3.3 V to 5.5 V                                                 |       | 25                        |       | kHz    |
| $\Delta f_{osc}/\Delta T_{opt}$     | Oscillator Frequency Temperature Coefficient | -40°C ≤ T <sub>opt</sub> ≤ 85°C                                                  |       | ±0.5                      |       | kHz/°C |
| I <sub>DD1</sub>                    | Supply Current 1                             | V <sub>IN</sub> = 5.5 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V, EXT at noload |       | 400                       | 800   | μA     |
| V <sub>REFOUT</sub>                 | VREFOUT Voltage                              | V <sub>IN</sub> = 3.3 V, I <sub>ROUT</sub> = 1 mA                                | 1.478 | 1.500                     | 1.522 | V      |
| I <sub>OUT</sub>                    | VREFOUT Maximum Output Current               | V <sub>IN</sub> = 3.3 V                                                          | 10    |                           |       | mA     |
| $\Delta V_{REFOUT}/\Delta V_{IN}$   | VREFOUT Line Regulation                      | V <sub>IN</sub> = 3.3 V to 5.5 V                                                 |       | 5                         | 10    | mV     |
| $\Delta V_{REFOUT}/\Delta I_{ROUT}$ | VREFOUT Load Regulation                      | V <sub>IN</sub> = 3.3 V, I <sub>ROUT</sub> = 0.1 mA ~ 5 mA                       |       | 6                         | 15    | mV     |
| I <sub>lim</sub>                    | VREFOUT Short Current Limit                  | V <sub>IN</sub> = 3.3 V, V <sub>REFOUT</sub> = 0 V                               |       | 20                        |       | mA     |
| $\Delta V_{REFOUT}/\Delta T_{opt}$  | VREFOUT Voltage Temperature Coefficient      | -40°C ≤ T <sub>opt</sub> ≤ 85°C                                                  |       | ±150                      |       | ppm/°C |
| R <sub>EXTH</sub>                   | EXT "H" ON Resistance                        | V <sub>IN</sub> = 3.3 V, I <sub>EXT</sub> = -50 mA                               |       | 2.5                       | 6.0   | Ω      |
| R <sub>EXTL</sub>                   | EXT "L" ON Resistance                        | V <sub>IN</sub> = 3.3 V, I <sub>EXT</sub> = 50 mA                                |       | 1.5                       | 4.0   | Ω      |
| t <sub>r</sub>                      | EXT Rising Time                              | V <sub>IN</sub> = 3.3 V, C <sub>L</sub> = 1000 pF                                |       | 12                        |       | ns     |
| t <sub>f</sub>                      | EXT Falling Time                             | V <sub>IN</sub> = 3.3 V, C <sub>L</sub> = 1000 pF                                |       | 8                         |       | ns     |
| I <sub>DLY1</sub>                   | DELAY Pin Charge Current                     | V <sub>IN</sub> = 3.3 V, V <sub>DLY</sub> = 0 V, V <sub>FB</sub> = 0 V           | 2.0   | 4.5                       | 7.0   | μA     |
| I <sub>DLY2</sub>                   | DELAY Pin Discharge Current                  | V <sub>IN</sub> = V <sub>FB</sub> = 3.3 V, V <sub>DLY</sub> = 0.1 V              | 0.08  | 0.20                      | 0.36  | mA     |
| V <sub>DLY</sub>                    | DELAY Pin Detector Threshold                 | V <sub>IN</sub> = 3.3 V, V <sub>FB</sub> = 0 V, V <sub>DLY</sub> = 0 V → 2 V     | 0.95  | 1.00                      | 1.05  | V      |
| V <sub>UVLO1</sub>                  | UVLO Detector Threshold                      | V <sub>IN</sub> = 3.3 V → 0 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V          | 2.6   | 2.8                       | 3.0   | V      |
| V <sub>UVLO2</sub>                  | UVLO Released Voltage                        | V <sub>IN</sub> = 0 V → 3.3 V, V <sub>DLY</sub> = V <sub>FB</sub> = 0 V          |       | V <sub>UVLO1</sub> + 0.25 | 3.30  | V      |
| V <sub>DTC0</sub>                   | Duty = 0% DTC Pin Voltage                    | V <sub>IN</sub> = 3.3 V                                                          | 0.05  | 0.18                      | 0.25  | V      |
| V <sub>DTC20</sub>                  | Duty = 20% DTC Pin Voltage                   | V <sub>IN</sub> = 3.3 V                                                          |       | 0.3                       |       | V      |
| V <sub>DTC80</sub>                  | Duty = 80% DTC Pin Voltage                   | V <sub>IN</sub> = 3.3 V                                                          |       | 0.75                      |       | V      |
| Maxduty                             | Maximum Duty Cycle                           | V <sub>IN</sub> = 3.3 V                                                          | 85.5  | 91.5                      | 97.5  | %      |
| I <sub>AMPH</sub>                   | AMP "H" Output Current                       | V <sub>IN</sub> = 3.3 V, V <sub>AMP</sub> = 1.0 V, V <sub>FB</sub> = 0.9 V       | 0.5   | 1.0                       | 1.8   | mA     |
| I <sub>AMPL</sub>                   | AMP "L" Output Current                       | V <sub>IN</sub> = 3.3 V, V <sub>AMP</sub> = 1.0 V, V <sub>FB</sub> = 1.1 V       | 50    | 90                        | 150   | μA     |

## TYPICAL APPLICATIONS AND TECHNICAL NOTES



**R1212D Typical Application**

|          |                                                  |
|----------|--------------------------------------------------|
| Inductor | VLF504012MT-100M (TDK: 10 $\mu$ H) [R1212DxxxA]  |
|          | VLF504012MT-4R7M (TDK: 4.7 $\mu$ H) [R1212DxxxB] |
|          | VLF504012MT-220M (TDK: 22 $\mu$ H) [R1212DxxxC]  |
| NMOS     | CPH6415 (Sanyo)                                  |
| Diode    | CRS10I30A (Toshiba)                              |

|    |                      |               |                |                |                |
|----|----------------------|---------------|----------------|----------------|----------------|
| C1 | 2.2 $\mu$ F          | Set $V_{OUT}$ | 5 V            | 10 V           | 15 V           |
| C2 | 1 $\mu$ F            | R1            | 120 k $\Omega$ | 180 k $\Omega$ | 140 k $\Omega$ |
| C3 | 1.5 $\mu$ F          | R2            | 30 k $\Omega$  | 20 k $\Omega$  | 10 k $\Omega$  |
| C4 | 1000 pF [R1212DxxxA] | R3            | 1 k $\Omega$   |                |                |
|    | 680 pF [R1212DxxxB]  | R4            | 4.7 k $\Omega$ |                |                |
|    | 1500 pF [R1212DxxxC] | R5            | 240 k $\Omega$ |                |                |
| C5 | 1000 pF [R1212DxxxA] | R6            | 300 k $\Omega$ |                |                |
|    | 680 pF [R1212DxxxB]  |               |                |                |                |
|    | 1500 pF [R1212DxxxC] |               |                |                |                |
| C6 | 0.1 $\mu$ F          |               |                |                |                |
| C7 | 0.1 $\mu$ F          |               |                |                |                |

- Use a 1  $\mu\text{F}$  or more capacitance value of bypass capacitor between VIN pin and GND, C1 as shown in the typical application above. Connect the capacitor as short as possible to the IC.
- In terms of the capacitor for setting delay time of the latch protection, C2 is shown in typical application above. Latch delay time depends on this C2 value. Refer to the Latch Protection Operation Timing Chart.
- Connect a 1  $\mu\text{F}$  or more value of capacitor between VOUT and GND, C3 as shown in typical application above. (Recommended value is from 10  $\mu\text{F}$  to 22  $\mu\text{F}$ .) If the operation of the composed DC/DC converter may be unstable, use a tantalum type capacitor instead of ceramic type
- Connect a capacitor between VREFOUT and GND, C6 as shown in typical application of the previous page. The capacitance value of C6 is between 0.1  $\mu\text{F}$  and 1.0  $\mu\text{F}$ .
- Output Voltage Setting Method and Phase Compensation Making Method  
The feedback voltage is controlled into 1.0 V. The output voltage can be set with divider resistors for voltage setting, R1 and R2 as shown in typical application of the previous page. Refer to the next formula.

$$\text{Output Voltage} = V_{\text{FB}} \times (R1 + R2) / R2$$

Output Voltage is adjustable with setting various resistor values combination.  $R1 + R2$  should be equal or less than 500  $\text{k}\Omega$

As for the DC/DC converter, depending on the load current and external components such as L and C, phase may loss around  $180^\circ$ . In such case, phase margin becomes less and may be unstable. To avoid this situation, make the phase margin more.

The pole is made with external components L and C.

$$F_{\text{pole}} \sim 1 / \{2 \times \pi \times \sqrt{(L \times C3)}\}$$

C4, C5, R3, and R4 shown in the diagram are for making phase compensation. The gain of the system can be set with using these resistors and capacitors. Each value in the diagram is just an example. R4 and C5 make zero (the backward phase).

$$F_{\text{zero}} \sim 1 / (2 \times \pi \times R4 \times C5)$$

Choose the R4 and C5 value so as to make the cutoff frequency of this zero point close to the cutoff frequency of the pole by external components, L and C.

For example, supposed that  $L = 10 \mu\text{H}$  and  $C_{\text{OUT}} (C3) = 10 \mu\text{F}$ , the cutoff frequency of the pole is approximately 16 kHz. Therefore make the cutoff frequency of the zero point close to 16 kHz. Then  $R4 = 4.7 \text{ k}\Omega$  and  $C5 = 1000 \text{ pF}$  are appropriate values.

As for setting the gain, the ratio of the composite resistor ( $R_T$ :  $R_T = R_1 \times R_2 / (R_1 + R_2)$ ) to  $R_4$  is the key. If the  $R_4$  against the composite resistor,  $R_T$ , is large, the gain becomes also large. If the gain is large, the response characteristic is improved, however, too large gain makes the system be unstable.

If the spike noise of  $V_{OUT}$  may be large, the spike noise may be picked into  $V_{FB}$  pin, and the unstable operation may result. In this case, a resistor  $R_3$ , shown in typical application of the previous page. The recommended resistance value of  $R_3$  is in the range from 1 k $\Omega$  to 5 k $\Omega$ . Then, noise level will be decreased.

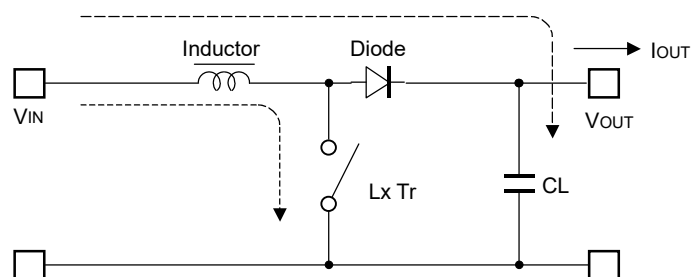
Further,  $R_1$  and  $C_4$  makes another zero point (the backward phase).

$$F_{zero} \sim 1 / (2 \times \pi \times R_1 \times C_4)$$

Make the cutoff frequency of this zero point be lower than the cutoff frequency of the pole by external components, or,  $L$  and  $C$ . Herein,  $R_1 = 180$  k $\Omega$  and  $C_4 = 1000$  pF are appropriate values.

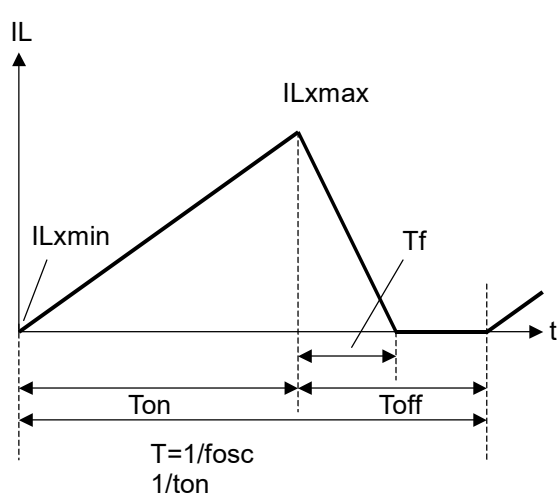
- Select the Power MOSFET, the diode, capacitors and the inductor within ratings (Voltage, Current, Power) of this IC. Choose the power MOSFET with low threshold voltage depending on the input voltage to be able to turn on the FET completely. Choose the diode with low  $V_F$  such as Schottky type with low reverse current  $I_R$ , and with fast switching speed. When an external transistor is switching, spike voltage may be generated caused by an inductor, therefore recommended voltage tolerance of capacitor connected to  $V_{OUT}$  is twice as much as the setting voltage or more.
- The soft-start time and the maximum duty cycle setting method  
The soft-start time and the maximum duty cycle can be set with  $R_5$ ,  $R_6$ , and  $C_7$  values connected to the  $V_{REFOUT}$  pin and the DTC pin. (Refer to the timing chart: Soft-start operation.)

## OUTPUT CURRENT AND SELECTION OF EXTERNAL COMPONENTS

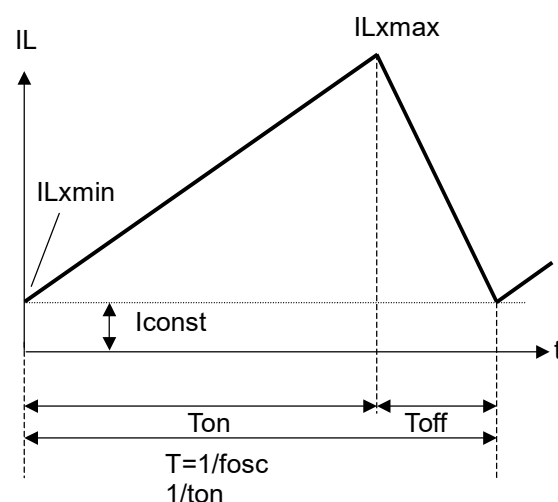


R1212D Typical Application

Current Flowing through L



Discontinuous Mode



Continuous Mode

There are two modes, or discontinuous mode and continuous mode for the PWM step-up switching regulator depending on the continuous characteristic of inductor current. During on time of the transistor, when the voltage added on to the inductor is described as  $V_{IN}$ , the current is  $V_{IN} \times t/L$ . Therefore, the electric power,  $P_{ON}$ , which is supplied with input side, can be described as in next formula.

$$P_{ON} = \int_0^{T_{on}} V_{IN}^2 \times t/L \, dt \dots\dots\dots \text{Formula 1}$$

With the step-up circuit, electric power is supplied from power source also during off time. In this case, input current is described as  $(V_{OUT} - V_{IN}) \times t/L$ , therefore electric power,  $P_{OFF}$  is described as in next formula.

$$P_{OFF} = \int_0^{Tf} V_{IN} \times (V_{OUT} - V_{IN}) \times t/L \, dt \dots\dots\dots \text{Formula 2}$$

In this formula, Tf means the time of which the energy saved in the inductance is being emitted. Thus average electric power, or P<sub>AV</sub> is described as in the next formula.

$$P_{AV} = 1/(T_{ON} + T_{OFF}) \times \left\{ \int_0^{T_{ON}} V_{IN}^2 \times t/L \, dt + \int_0^{Tf} V_{IN} \times (V_{OUT} - V_{IN}) \times t/L \, dt \right\} \dots\dots\dots \text{Formula 3}$$

In PWM control, when Tf = T<sub>off</sub> is true, the inductor current becomes continuous, then the operation of switching regulator becomes continuous mode. In the continuous mode, the deviation of the current is equal between on time and off time.

$$V_{IN} = T_{ON}/L = (V_{OUT} - V_{IN}) \times T_{OFF}/L \dots\dots\dots \text{Formula 4}$$

Further, the electric power, P<sub>AV</sub> is equal to output electric power, V<sub>OUT</sub> × I<sub>OUT</sub>, thus,

$$I_{OUT} = f_{OSC} \times V_{IN}^2 \times T_{ON}^2 / \{2 \times L \times (V_{OUT} - V_{IN})\} = V_{IN}^2 \times T_{ON} / (2 \times L \times V_{OUT}) \dots\dots\dots \text{Formula 5}$$

When I<sub>OUT</sub> becomes more than formula 5, the current flows through the inductor, then the mode becomes continuous. The continuous current through the inductor is described as I<sub>const</sub>, then,

$$I_{OUT} = f_{OSC} \times V_{IN}^2 \times T_{ON}^2 / \{2 \times L \times (V_{OUT} - V_{IN})\} + V_{IN} \times I_{const} / V_{OUT} \dots\dots\dots \text{Formula 6}$$

In this moment, the peak current, IL<sub>xmax</sub> flowing through the inductor and the driver Tr. is described as follows:

$$IL_{x \, max} = I_{const} + V_{IN} \times T_{ON} / L \dots\dots\dots \text{Formula 7}$$

With the formula 4,6, and IL<sub>xmax</sub> is,

$$IL_{x \, max} = V_{OUT} / V_{IN} \times I_{OUT} + V_{IN} \times T_{ON} / (2 \times L) \dots\dots\dots \text{Formula 8}$$

Therefore, peak current is more than I<sub>OUT</sub>. Considering the value of IL<sub>xmax</sub>, the condition of input and output, and external components should be selected.

In the formula 7, peak current IL<sub>xmax</sub> at discontinuous mode can be calculated. Put I<sub>const</sub>=0 in the formula. The explanation above is based on the ideal calculation, and the loss caused by L<sub>x</sub> switch and external components is not included. The actual maximum output current is between 50% and 80% of the calculation. Especially, when the IL<sub>x</sub> is large, or V<sub>IN</sub> is low, the loss of V<sub>IN</sub> is generated with the on resistance of the switch. As for V<sub>OUT</sub>, Vf (as much as 0.3V) of the diode should be considered.

## TIMING CHART

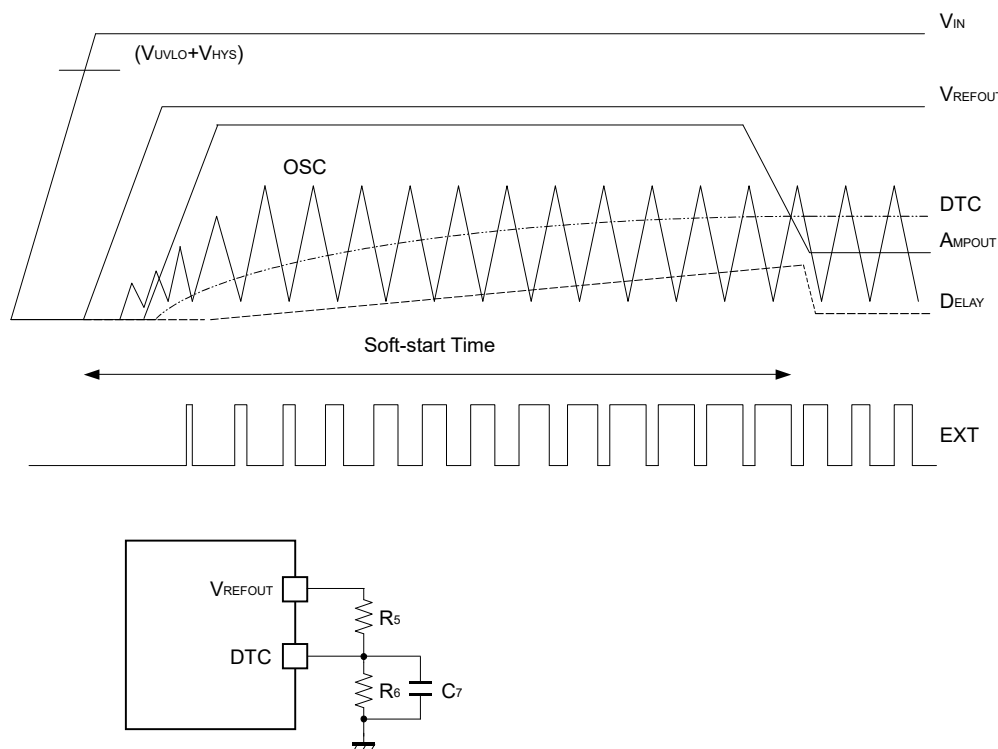
### Soft-start Operation

The timing chart below describes the state of each pin from the power-on until the IC entering the stable operation. By raising the voltage of the DTC pin slowly, the switching duty cycle is limited, and prevent the drastic voltage rising (over-shoot) and inrush current.

When the  $V_{IN}$  voltage becomes equal or more than the UVLO released voltage ( $V_{UVLO}+V_{HYS}$ ),  $V_{REFOUT}$  operation starts. Following with the increase of the voltage level of  $V_{REFOUT}$ , the internal oscillator begins to operate, then the DTC voltage is also rising, then, soft-start operation starts. When the DTC voltage crosses the chopping wave level inside the IC, EXT pin starts switching, then, step-up operation begins. During this term, the output voltage does not reach the set output voltage. Therefore the output of the amplifier is "H". Besides, the protection circuit may work and the IC charges the DELAY pin. Because of this, the soft-start time should be set shorter than the latch protection delay time.

After the initial stage, when the output voltage reaches the set output voltage, the level of AMPOUT becomes the normal state. In other words, the level is determined with the input voltage, the output voltage, and the output current. When the level of AMPOUT becomes falling, charging the DELAY pin stops and discharges to the GND. The soft-start time (the time for the DTC pin voltage becoming to  $V_{DTC}$  level) can be estimated with the next formula.

$T \cong 1/\alpha \times \ln(V_{DTC} \times \alpha / \beta + 1)$ , herein,  $\alpha = -1/C7 \times (1/R5 + 1/R6)$ , and  $\beta = V_{REFOUT}/(C7 \times R5)$ .



**Latch Protection Operation**

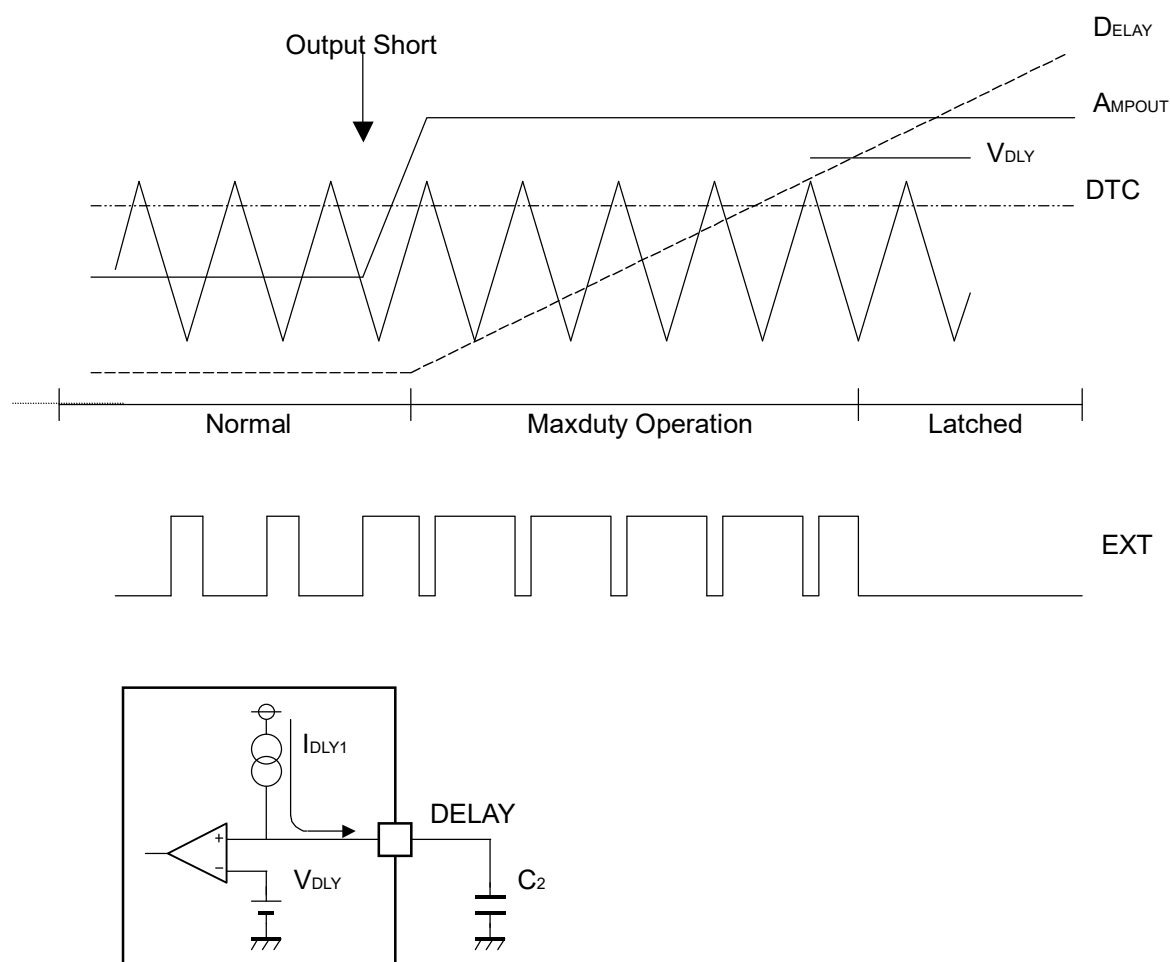
The operation of Latch protection circuit is as follows: When AMPOUT becomes "H" and the IC detects maximum duty cycle, charge to an external capacitor, C2 of DELAY pin starts. The maximum duty cycle continues and the voltage of DELAY pin reaches delay voltage detector threshold,  $V_{DLY}$ , outputs "L" to EXT pin and turns off the external power MOSFET.

To release the latch protection operation, make the supply voltage down to UVLO detector threshold or lower, and make it rise up to the normal input voltage.

Once after becoming the maximum duty cycle, if the duty cycle decreases before latch operation works, the charging the capacitor stops immediately, and the DELAY pin voltage is fixed at GND level with  $I_{DLY2}$ .

The delay time of latch protection can be calculated with C2,  $V_{DLY}$ , and the delay pin charge current,  $I_{DLY1}$ , as in the next formula.

$$t = C2 \times V_{DLY} / I_{DLY1}$$



## TEST CIRCUITS

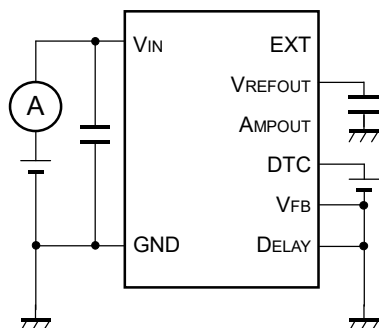


Fig. 1 Consumption Current Test Circuit

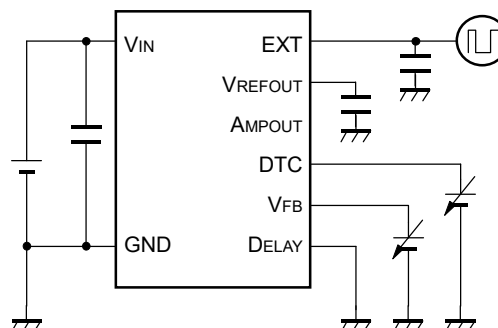


Fig. 2 Oscillator Frequency,  $V_{FB}$  Voltage, Duty Cycle, EXT Rising Time/ Falling Time Test Circuit

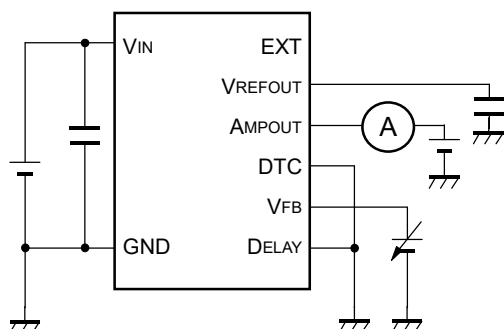


Fig. 3 AMP "L" Output Current/ "H" Output Current Test Circuit

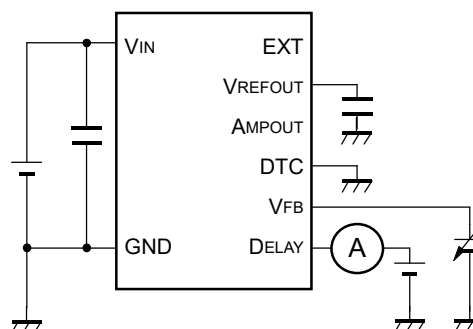


Fig. 4  $DELAY$  Pin Charge Current/ Discharge Current Test Circuit

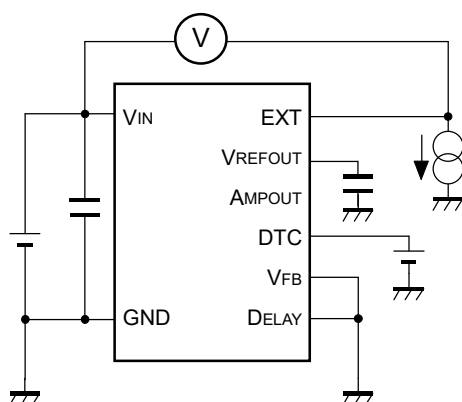


Fig. 5 EXT "H" ON Resistance Test Circuit

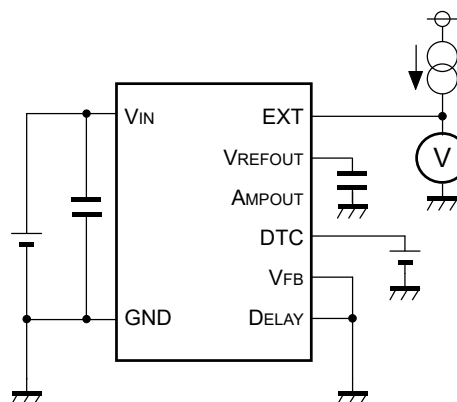
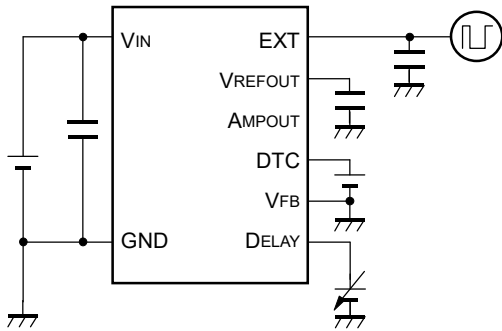
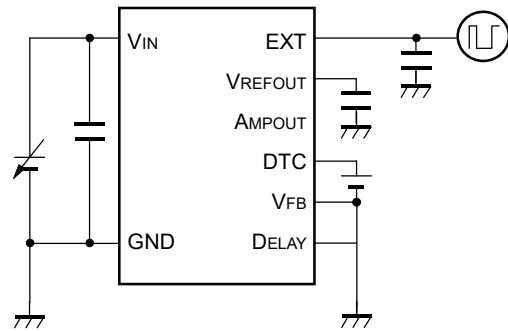


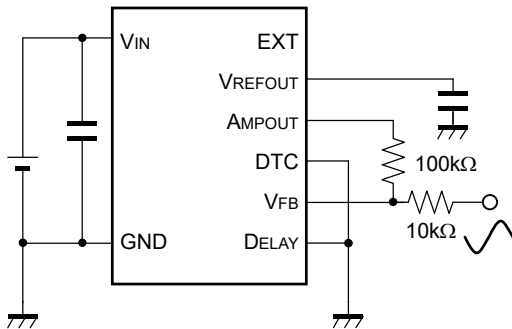
Fig. 6 EXT "L" ON Resistance Test Circuit



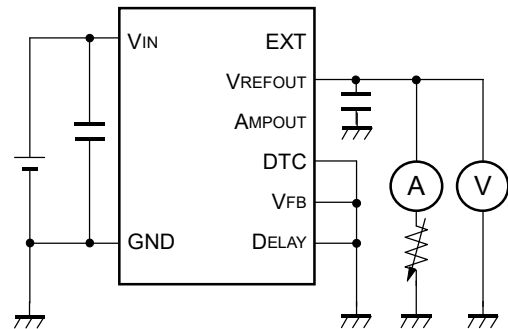
**Fig. 7 DELAY Pin Detector Threshold Test Circuit**



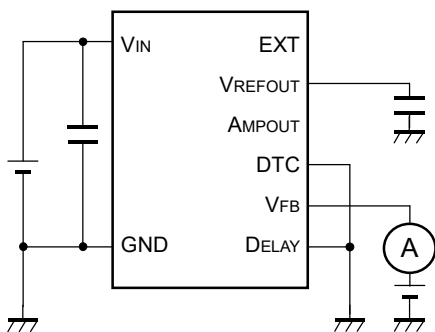
**Fig. 8 UVLO Detector Threshold/ Released Voltage Test Circuit**



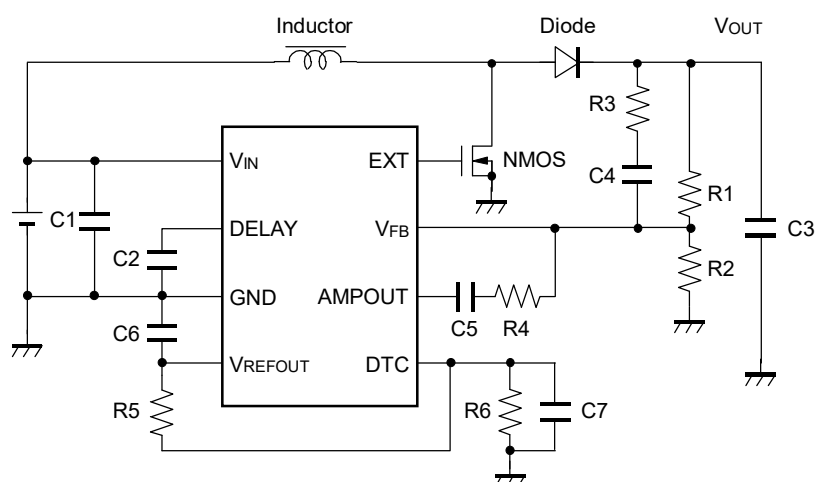
**Fig. 9 Error AMP Gain/ Phase Test Circuit**



**Fig. 10 VREFOUT Voltage Test Current**

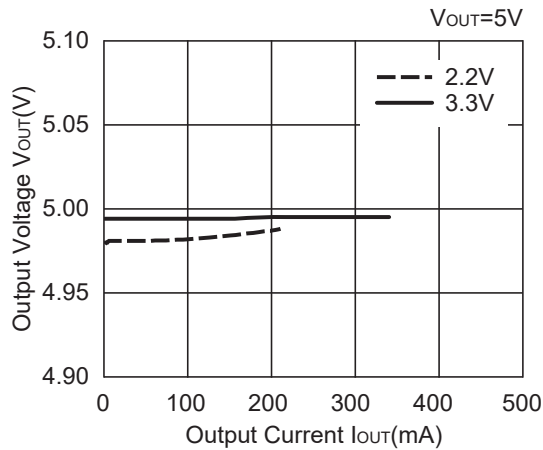
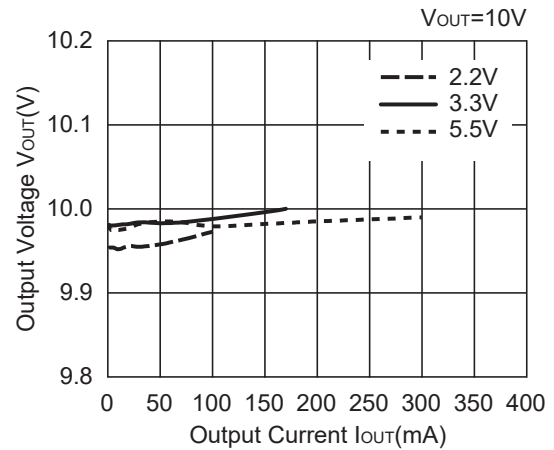
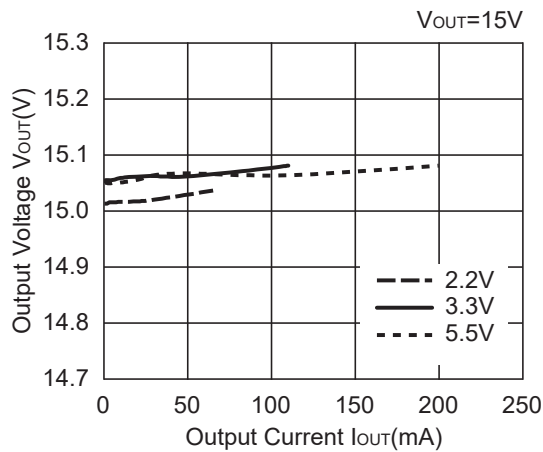
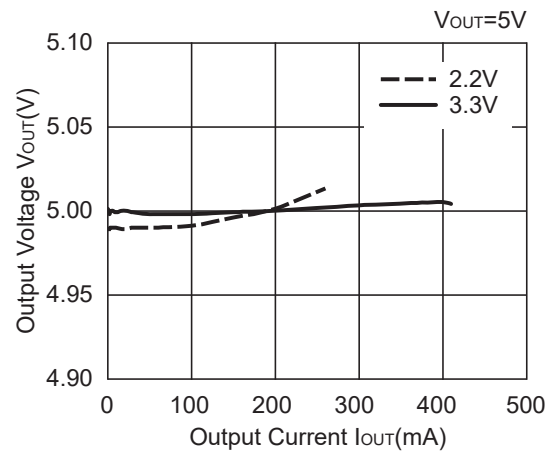
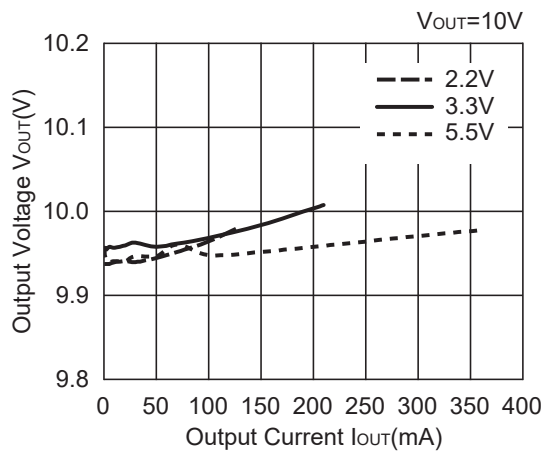
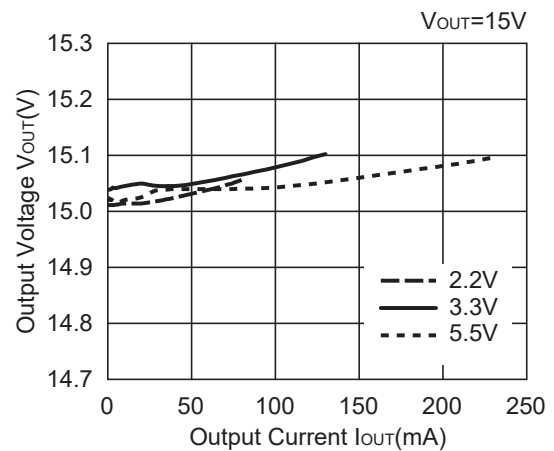


**Fig. 11 VFB Leakage Current Test Circuit**

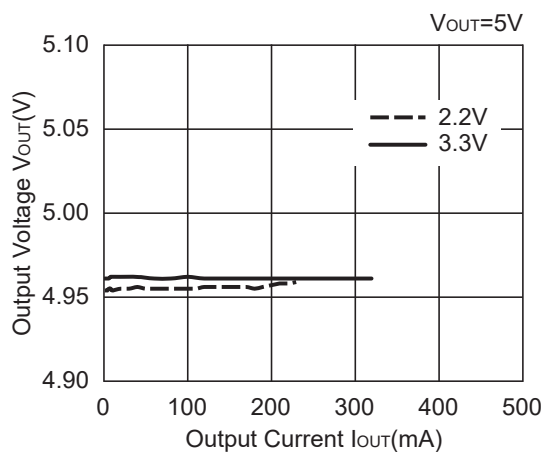


**Fig. 12 Output Current vs. Output Voltage/ Efficiency, Response Characteristics Test Circuit**

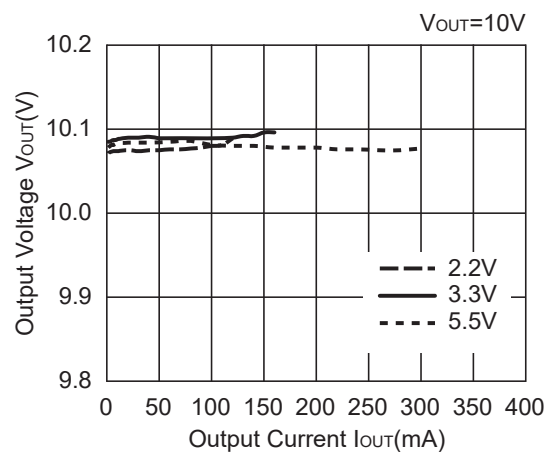
|          |                                                  |      |                |                |                |
|----------|--------------------------------------------------|------|----------------|----------------|----------------|
| Inductor | VLF504012MT-100M (TDK: 10 $\mu$ H) [R1212DxxxA]  |      |                |                |                |
|          | VLF504012MT-4R7M (TDK: 4.7 $\mu$ H) [R1212DxxxB] |      |                |                |                |
|          | VLF504012MT-220M (TDK: 22 $\mu$ H) [R1212DxxxC]  |      |                |                |                |
| NMOS     | CPH6415 (Sanyo)                                  |      |                |                |                |
| Diode    | CRS10I30A (Toshiba)                              |      |                |                |                |
| C1       | 2.2 $\mu$ F                                      | C6   | 0.1 $\mu$ F    |                |                |
| C2       | 1 $\mu$ F                                        | C7   | 0.1 $\mu$ F    |                |                |
| C3       | 15 $\mu$ F                                       | SetV | 5 V            | 10 V           | 15 V           |
| C4       | 1000 pF [R1212DxxxA]                             | R1   | 120 k $\Omega$ | 180 k $\Omega$ | 140 k $\Omega$ |
|          | 680 pF [R1212DxxxB]                              | R2   | 30 k $\Omega$  | 20 k $\Omega$  | 10 k $\Omega$  |
|          | 1500 pF [R1212DxxxC]                             | R3   | 1 k $\Omega$   |                |                |
| C5       | 1000 pF [R1212DxxxA]                             | R4   | 4.7 k $\Omega$ |                |                |
|          | 680 pF [R1212DxxxB]                              | R5   | 240 k $\Omega$ |                |                |
|          | 1500 pF [R1212DxxxC]                             | R6   | 300 k $\Omega$ |                |                |

**TYPICAL CHARACTERISTICS****1) Output Voltage vs. Output Current (T<sub>opt</sub> = 25°C)****R1212D100A****R1212D100A****R1212D100A****R1212D100B****R1212D100B****R1212D100B**

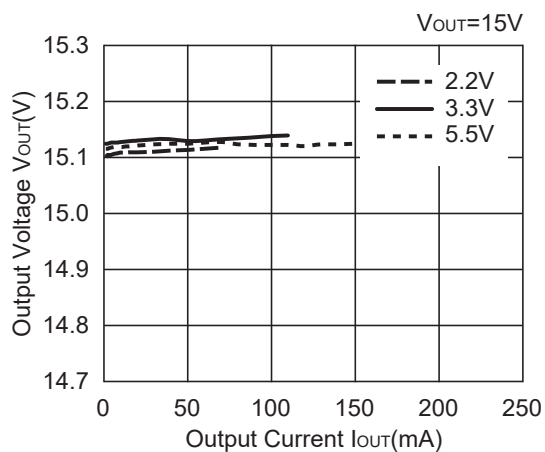
R1212D101C



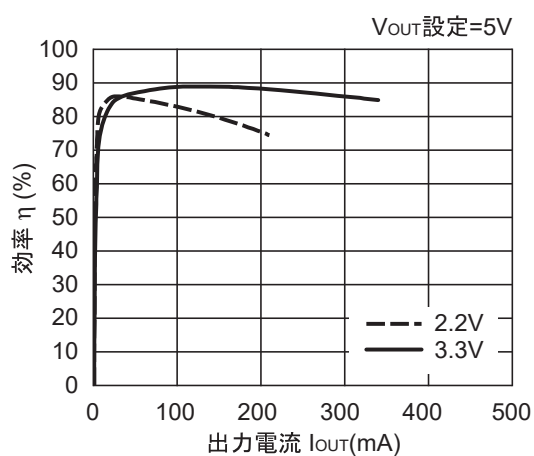
R1212D101C



R1212D101C

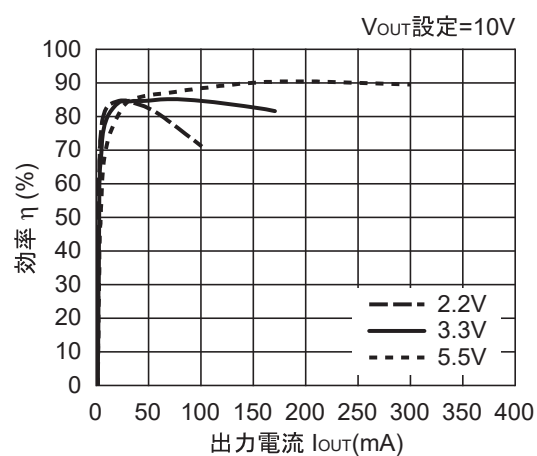
2) Efficiency vs. Output Current ( $T_{opt} = 25^{\circ}C$ )

R1212D100A



R1212D100A

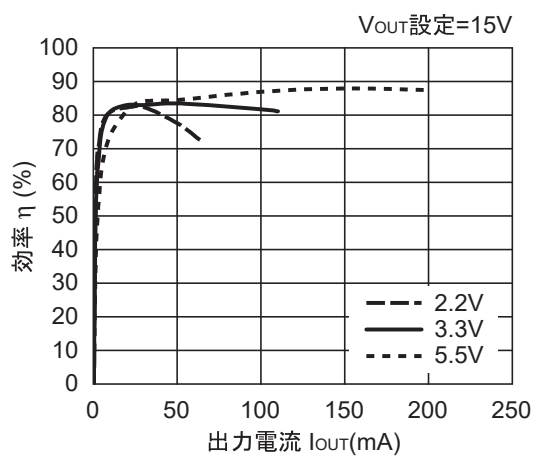
R1212D100A



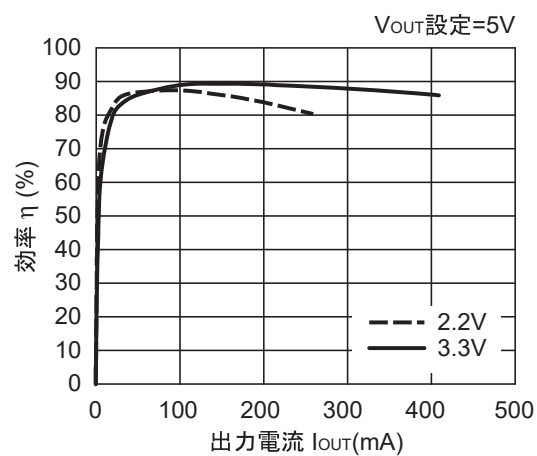
R1212D100B

## R1212D

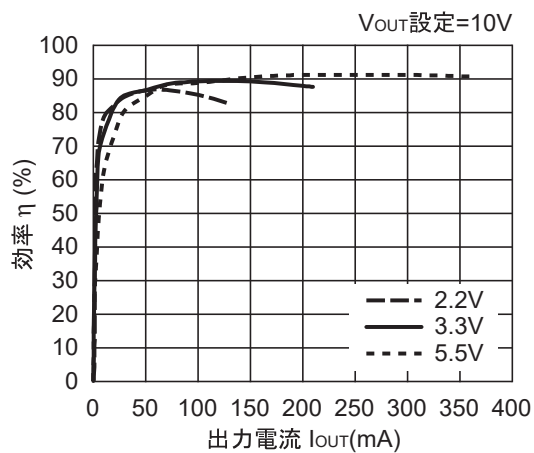
NO.EA-109-180705



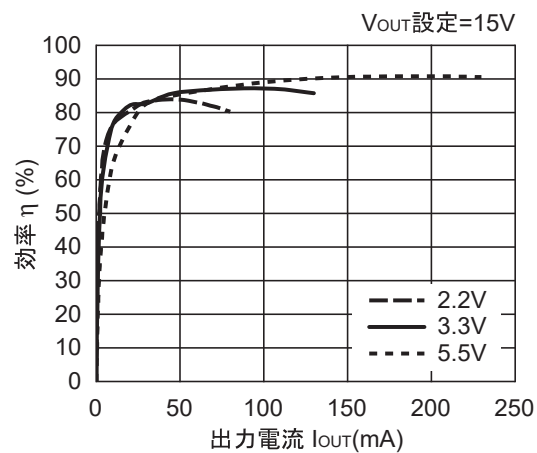
**R1212D100B**



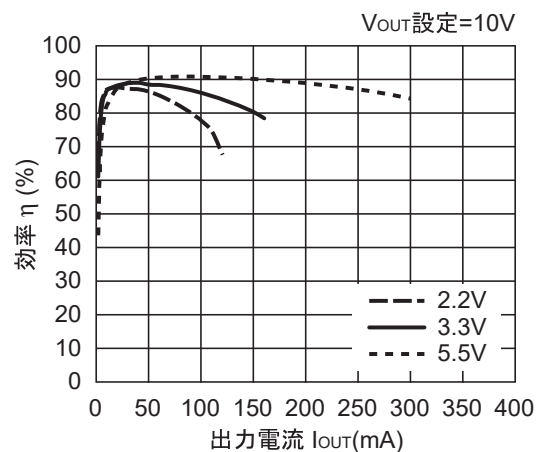
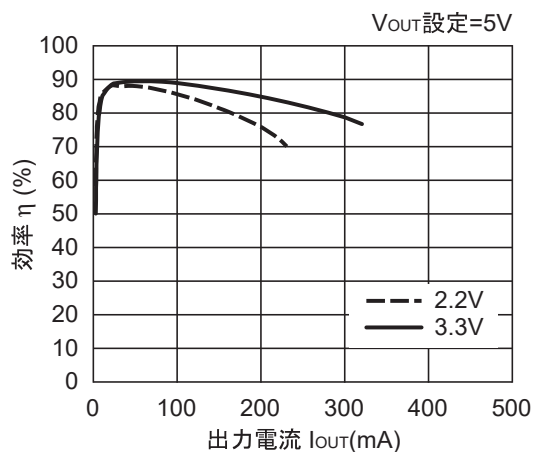
**R1212D100B**

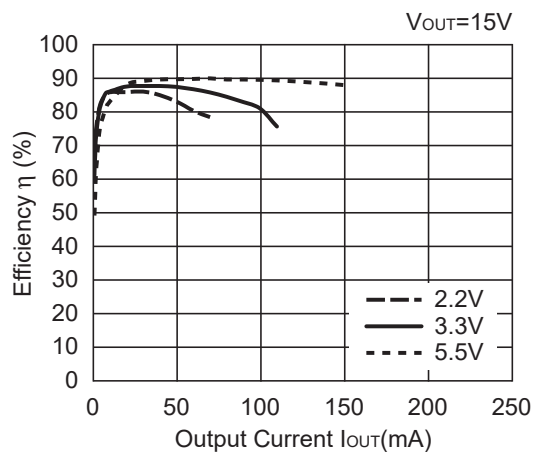
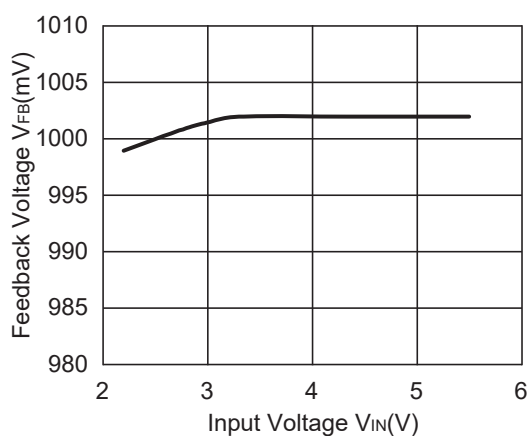
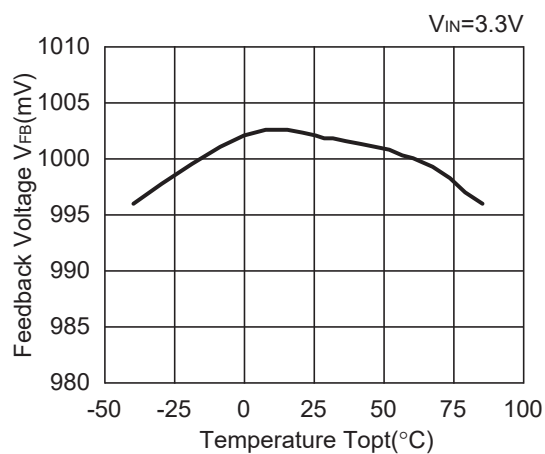
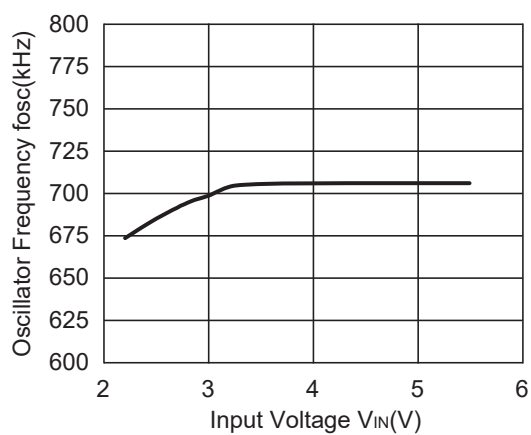
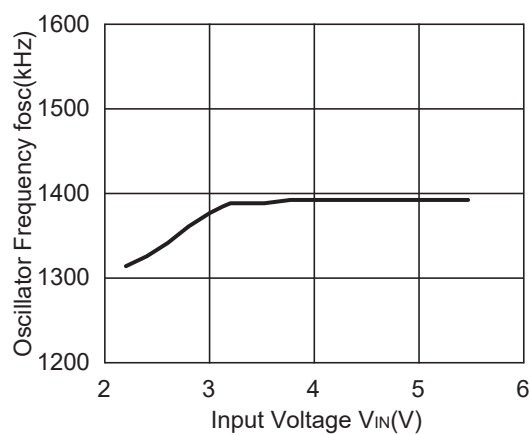


**R1212D101C**



**R1212D101C**

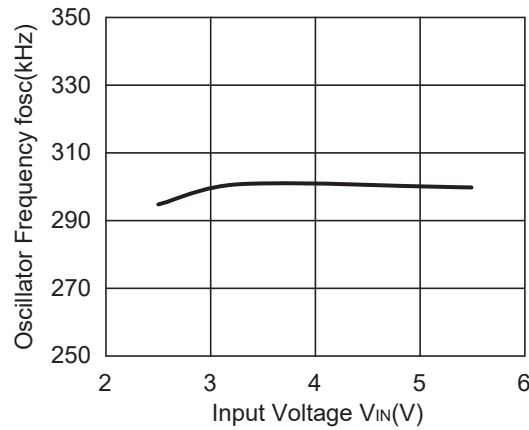


**R1212D101C**
**3) VFB Voltage vs. Input Voltage ( $T_{opt} = 25^{\circ}C$ )**  
**R1212D100x**

**4) VFB Voltage vs. Temperature**  
**R1212D100x**

**5) Oscillator Frequency vs. Input Voltage ( $T_{opt} = 25^{\circ}C$ )**  
**R1212D100A**
**R1212D100B**

**R1212D**

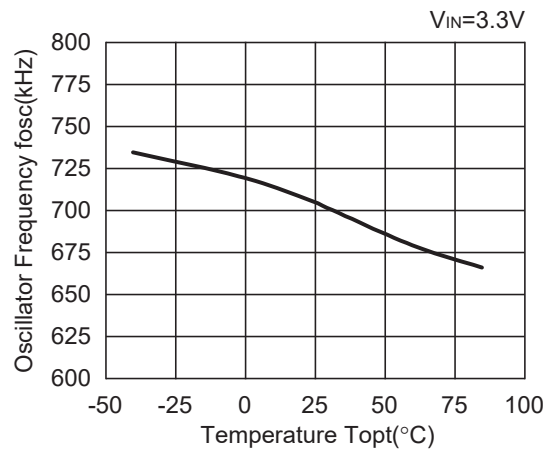
NO.EA-109-180705

**R1212D101C**

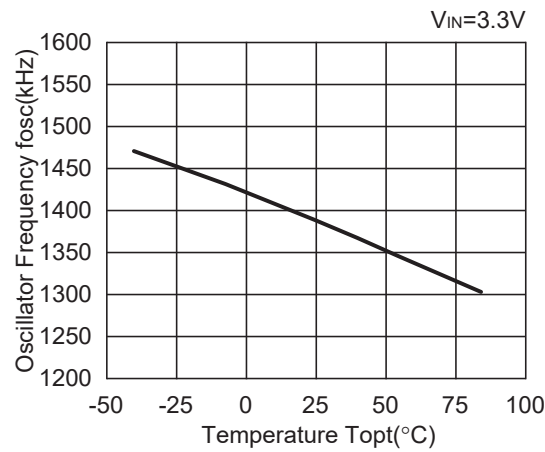


**6) Oscillator Frequency vs. Temperature**

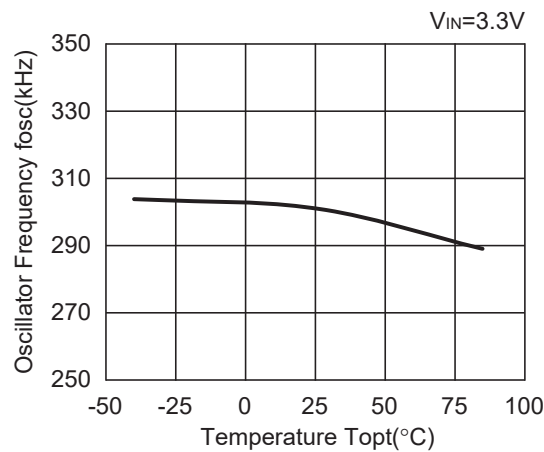
**R1212D10xA**



**R1212D10xB**

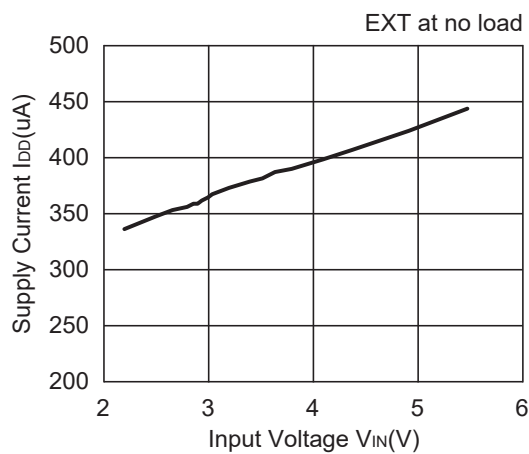


**R1212D10xC**

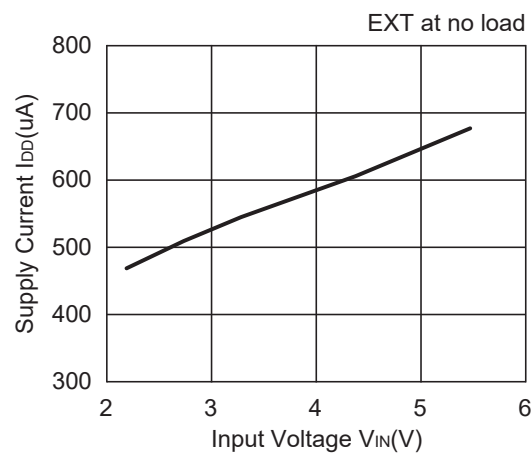


7) Supply Current vs. Input Voltage ( $T_{opt} = 25^{\circ}\text{C}$  at no load)

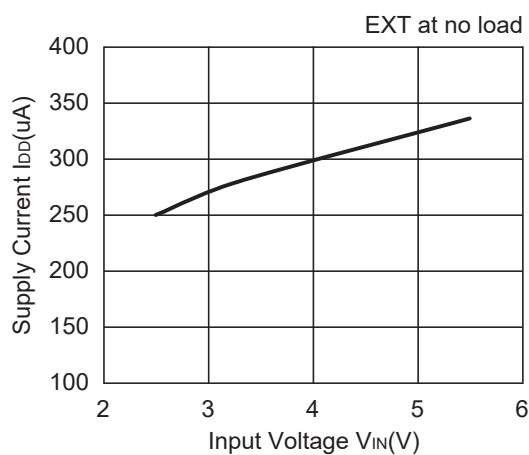
R1212D100A



R1212D100B

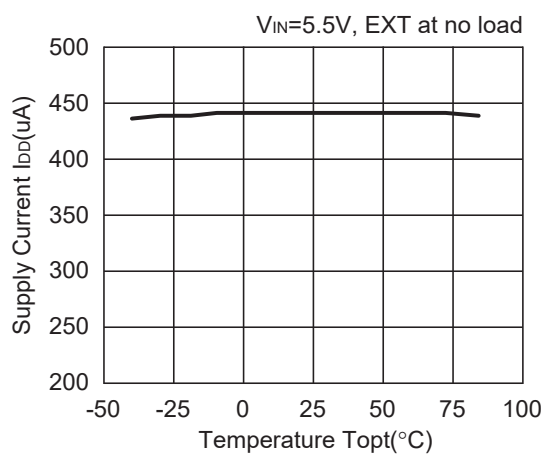


R1212D101C

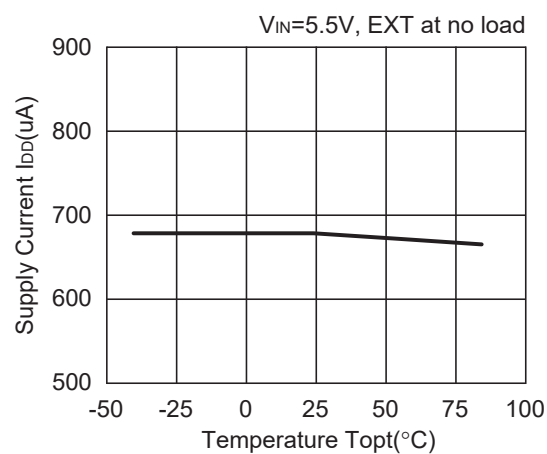


## 8) Supply Current vs. Temperature

R1212D10xA



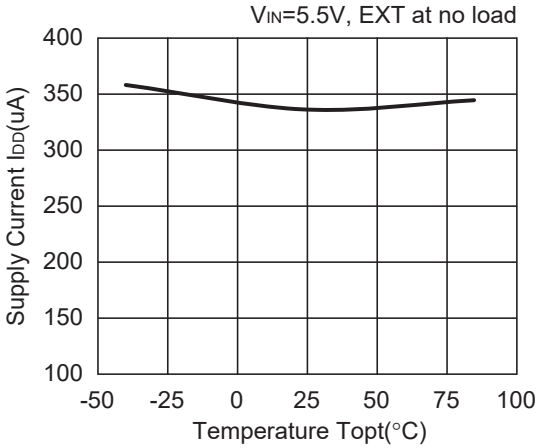
R1212D10xB



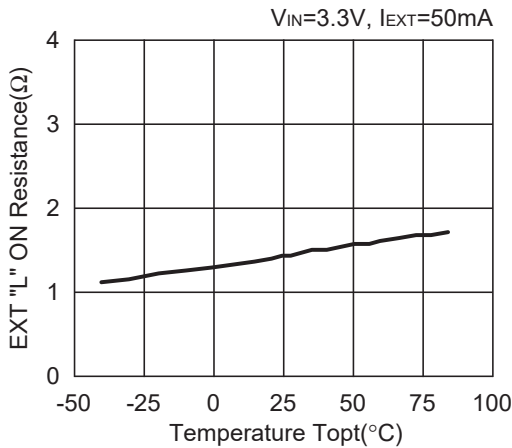
**R1212D**

NO.EA-109-180705

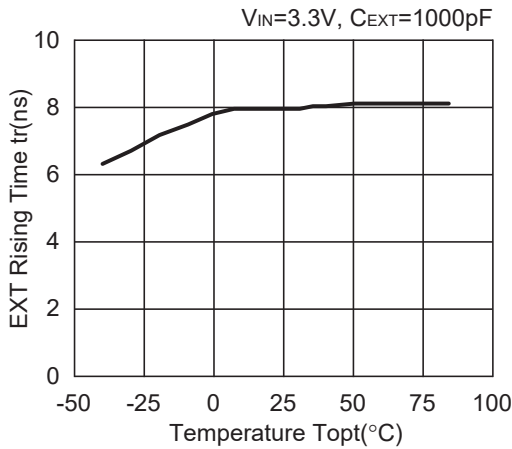
**R1212D10xC**



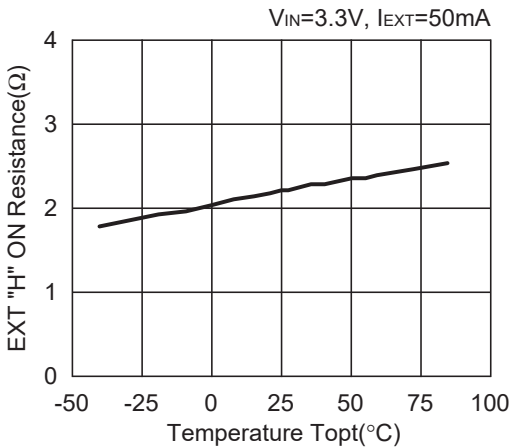
**9) EXT "L" On Resistance vs. Temperature**  
**R1212D10xx**



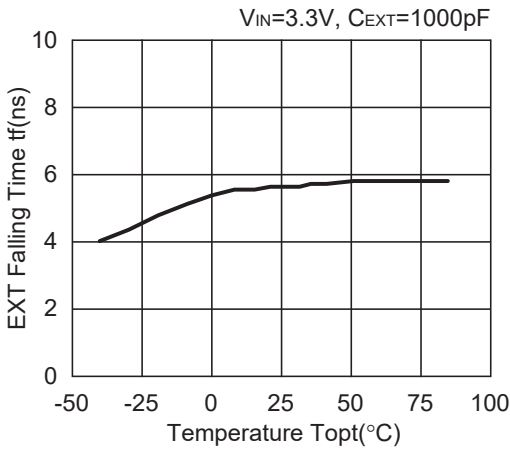
**11) EXT Rising Time vs. Temperature**  
**R1212D10xx**



**10) EXT "H" On Resistance vs. Temperature**  
**R1212D10xx**

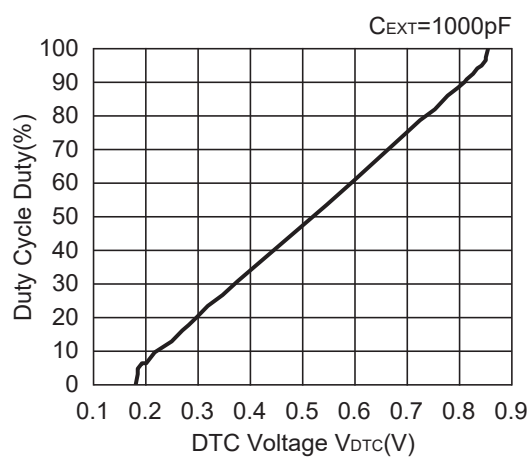


**12) EXT Falling Time vs. Temperature**  
**R1212D10xx**

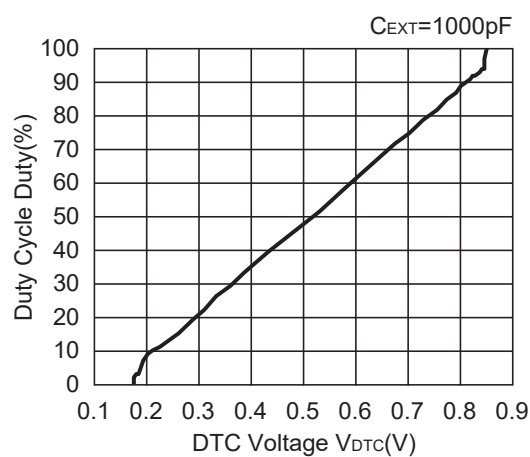


## 13) Duty Cycle vs. DTC Voltage (0% to 100%) (Topt = 25°C)

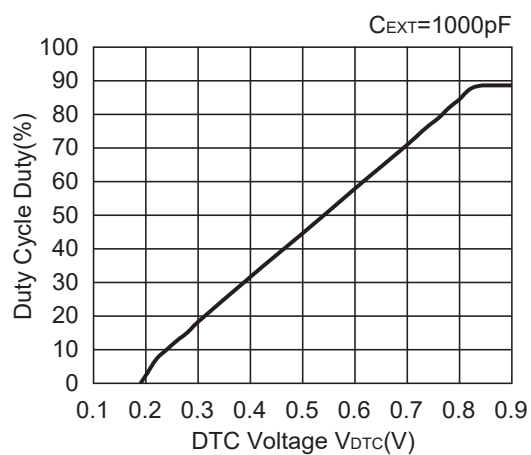
R1212D100A



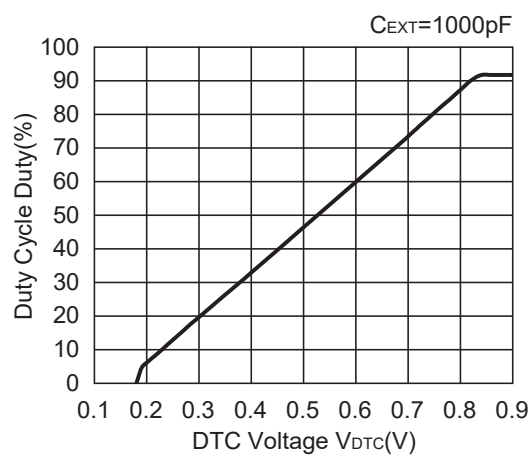
R1212D100B



R1212D101A

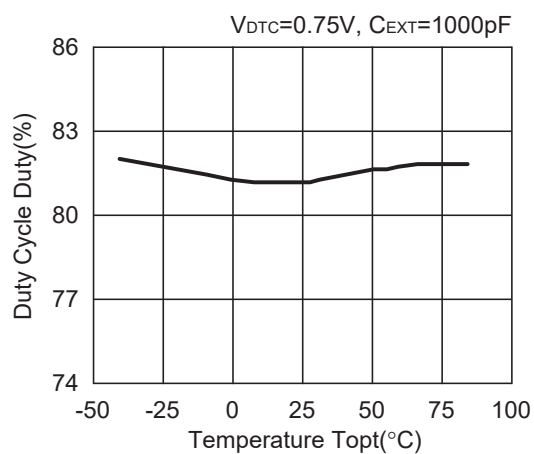


R1212D101C

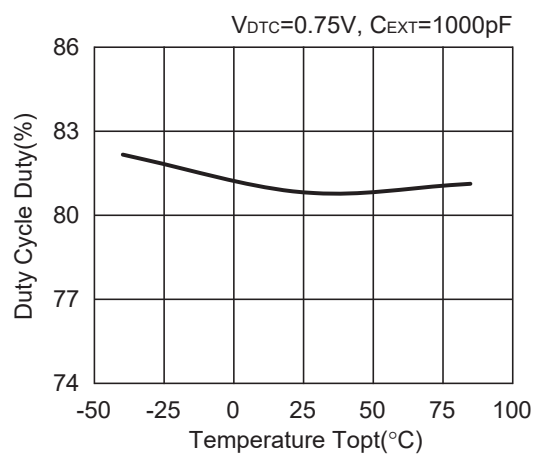


## 14) Duty Cycle vs. Temperature

R1212D100A



R1212D100B



---

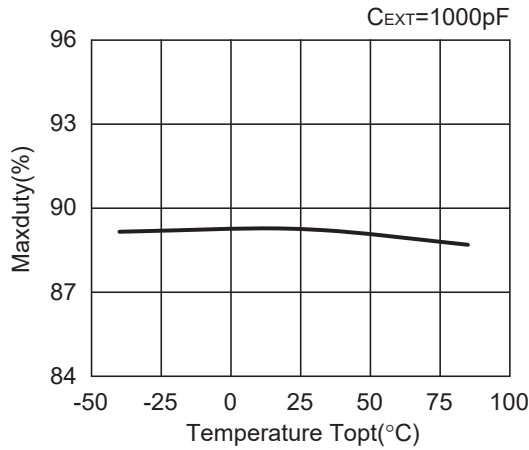
# R1212D

---

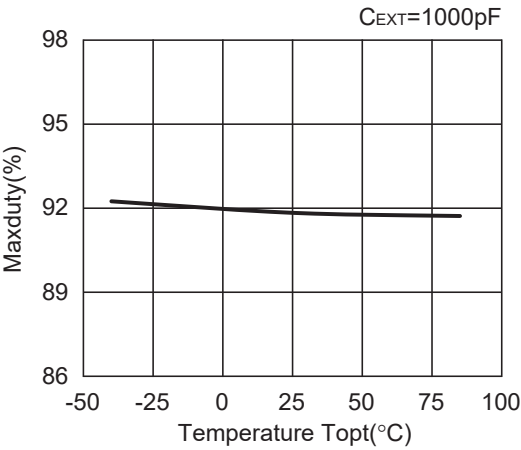
NO.EA-109-180705

## 15) Maxduty vs. Temperature

R1212D101A

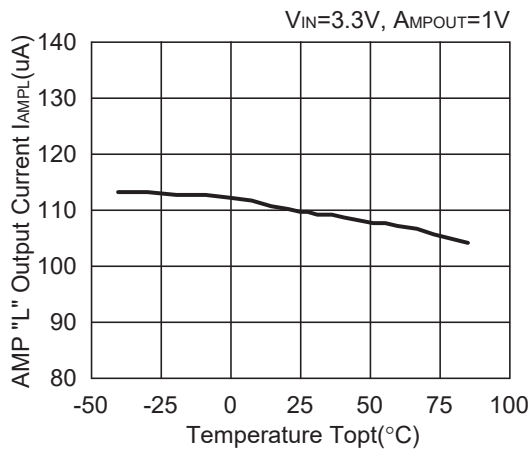


R1212D101C

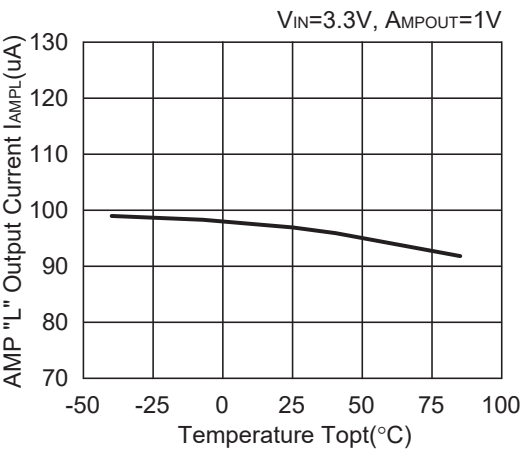


## 16) AMP "L" Output Current vs. Temperature

R1212D10xA/B

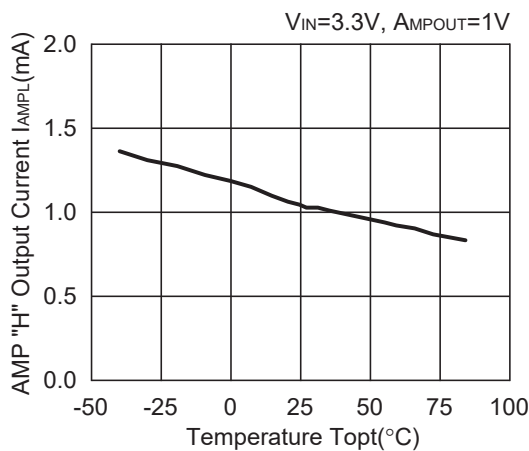


R1212D10xC



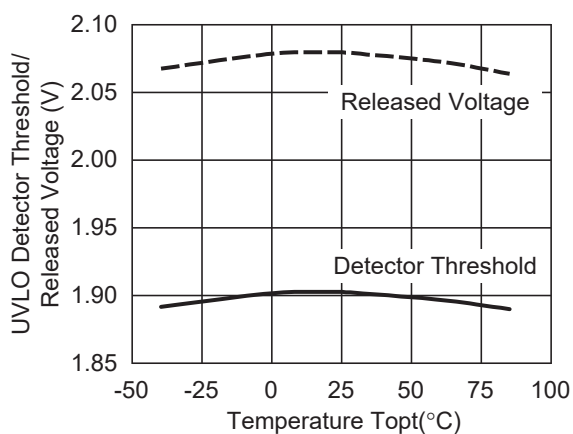
## 17) AMP "H" Output Current vs. Temperature

R1212D10xx

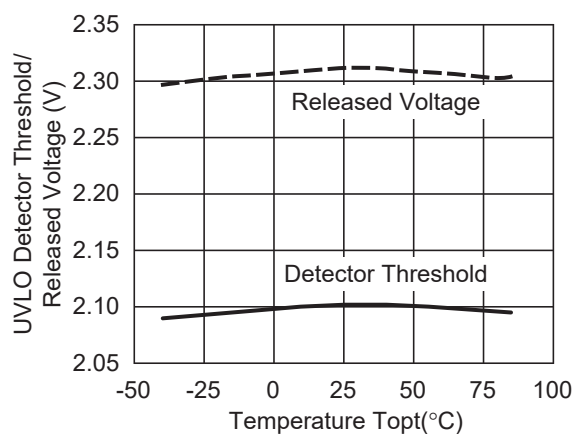


## 18) UVLO Detector Threshold UVLO Released Voltage vs. Temperature

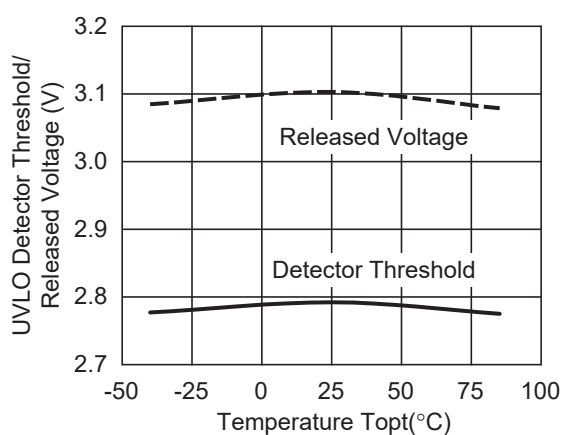
R1212D100x



R1212D101x

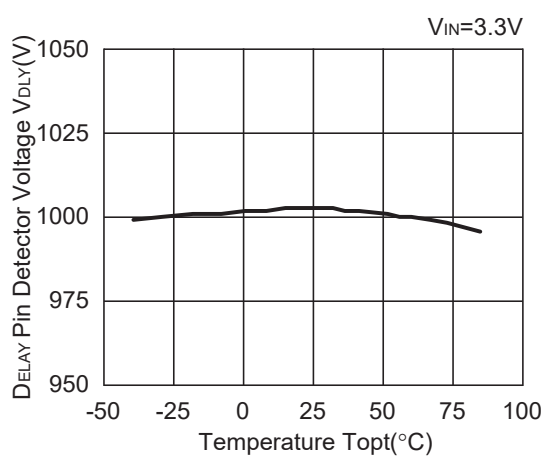


R1212D102x



## 19) DELAY Pin Detector Threshold vs. Temperature

R1212D10xx

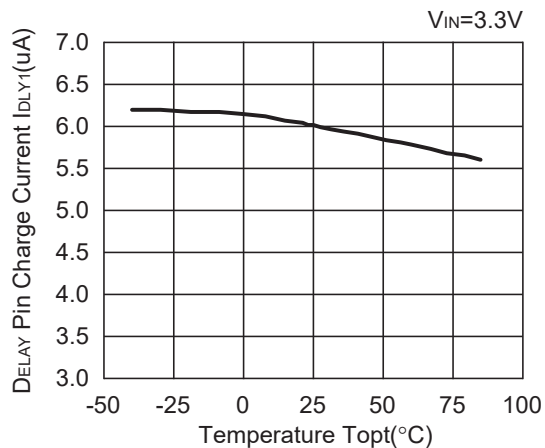


## R1212D

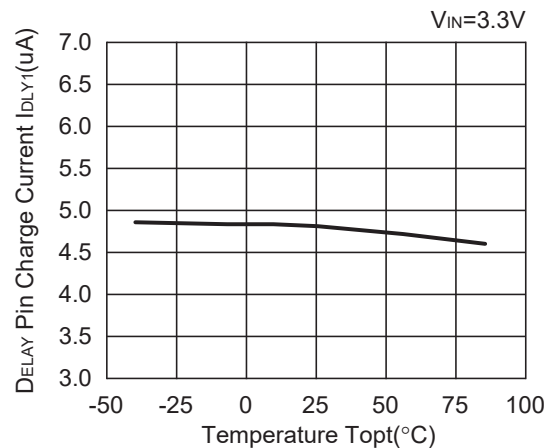
NO.EA-109-180705

### 20) DELAY Pin Charge Current vs. Temperature

R1212D10xA/B

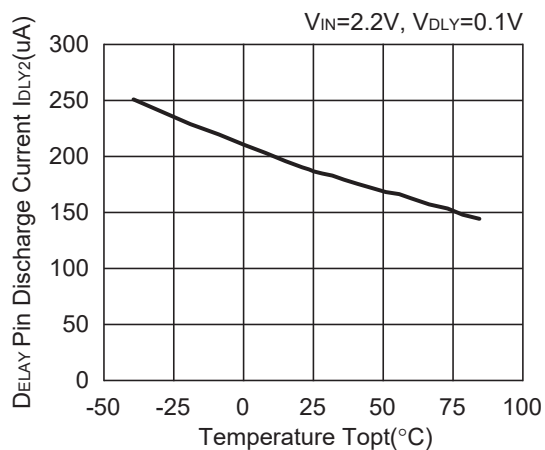


R1212D10xC

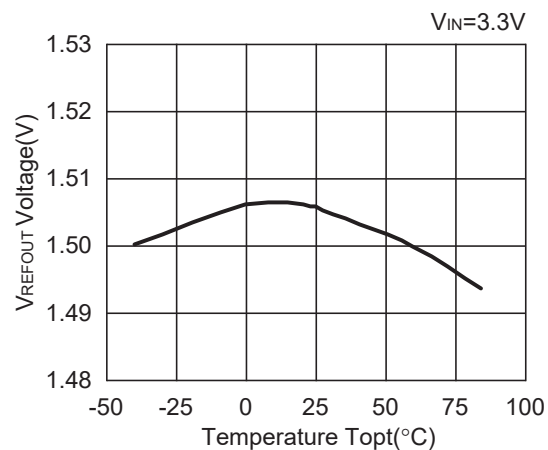


### 21) DELAY Pin Discharge Current vs. Temperature 22) VREFOUT Voltage vs. Temperature

R1212D10xx

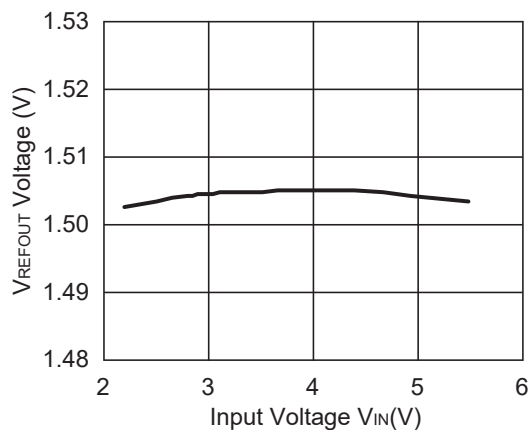


R1212D10xx



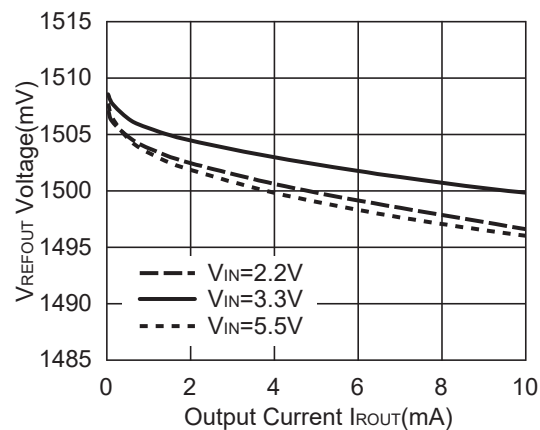
### 23) VREFOUT Voltage vs. Input Voltage (Topt = 25°C)

R1212D10xx



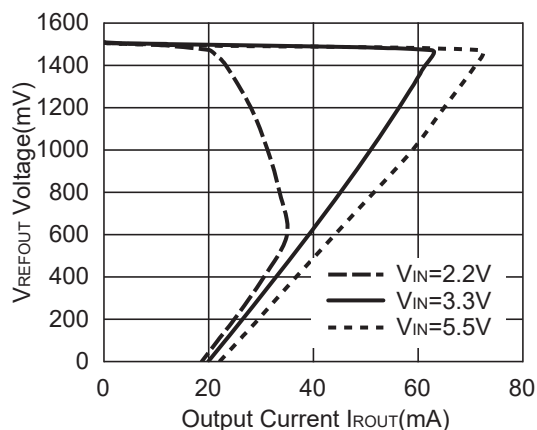
### 24) VREFOUT Voltage vs. Output Current (1) (Topt = 25°C)

R1212D100x

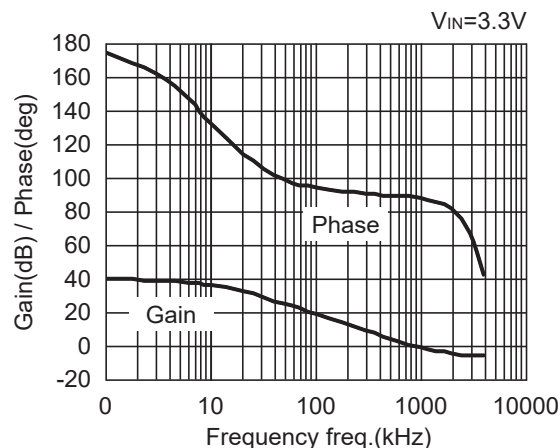


**25) VREFOUT Voltage vs. Output Current (2) (Topt = 25°C) 26) Error Amplifier Gain/Phase vs. Frequency (Topt = 25°C)**

**R1212D100x**

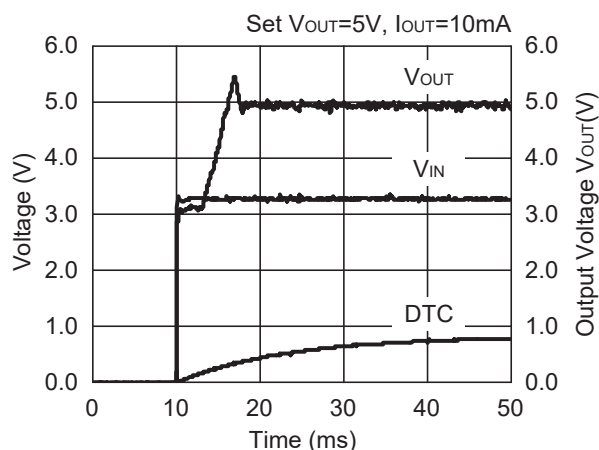


**R1212D100xx**

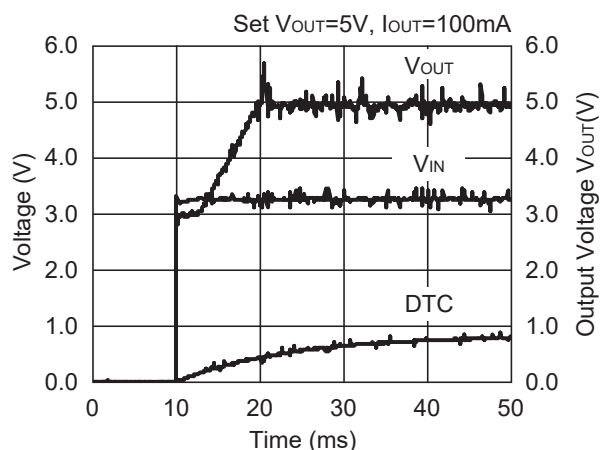


**27) Power-on Response (VIN = 3.3 V, Topt = 25°C)**

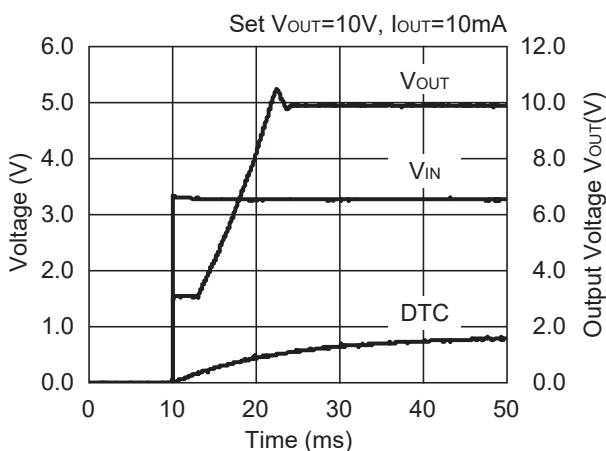
**R1212D100A**



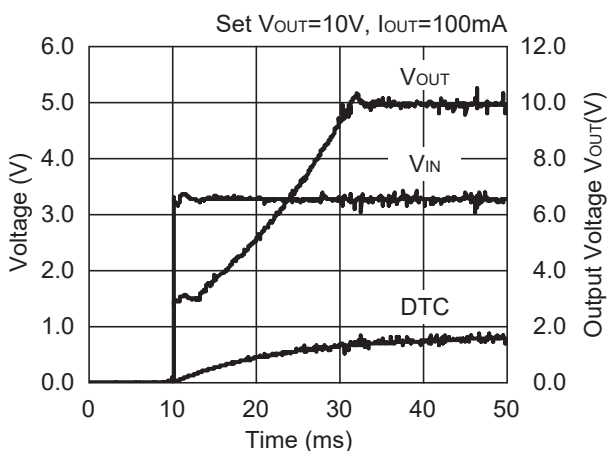
**R1212D100A**

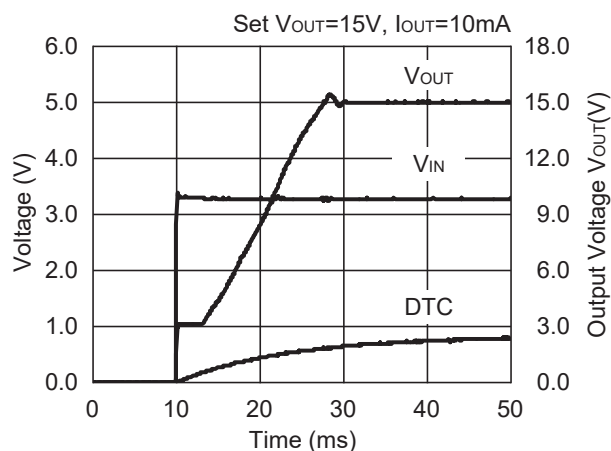
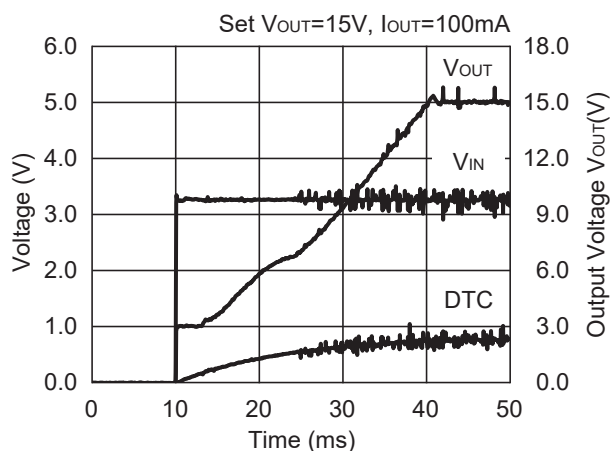
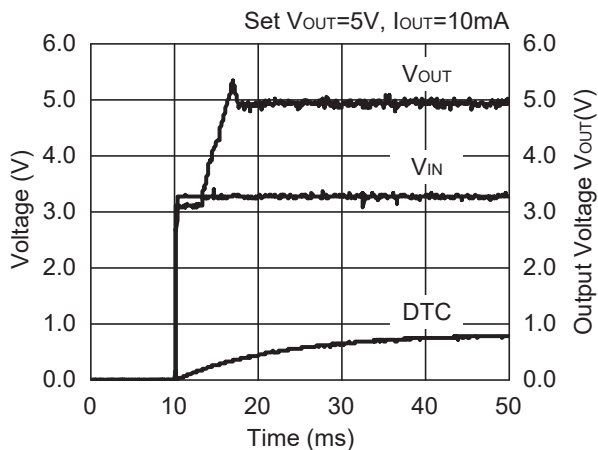
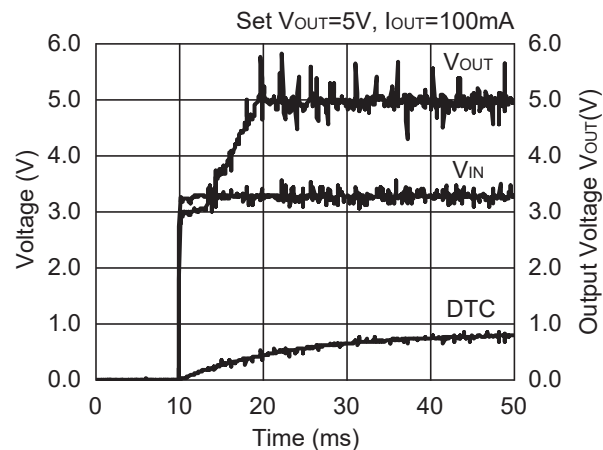
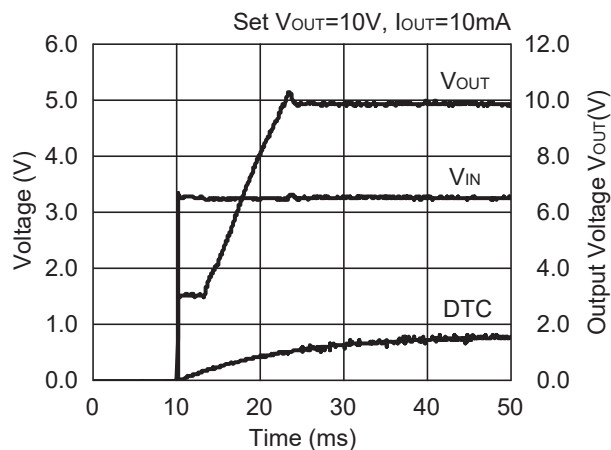
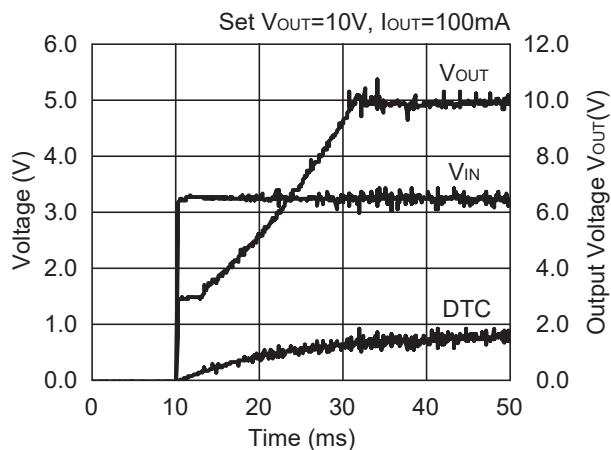


**R1212D100A**

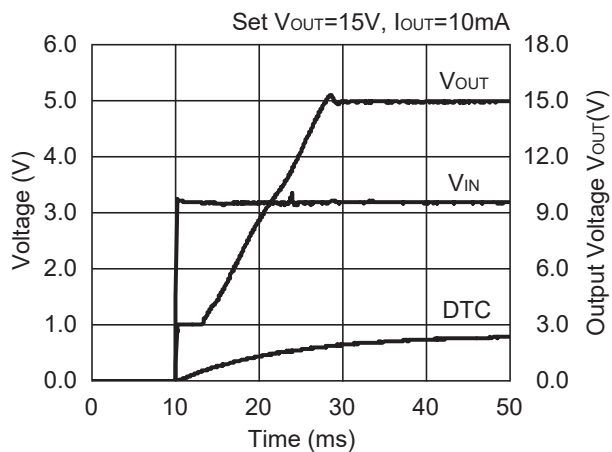


**R1212D100A**

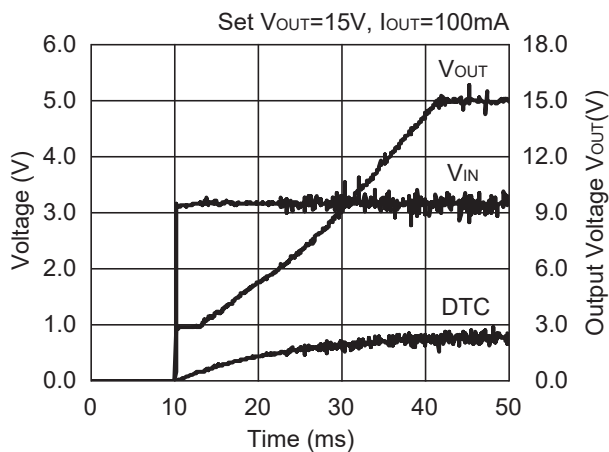


**R1212D100A**

**R1212D100A**

**R1212D100B**

**R1212D100B**

**R1212D100B**

**R1212D100B**


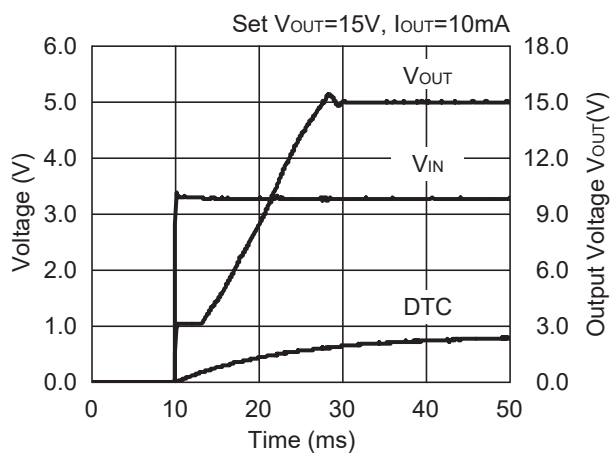
R1212D100B



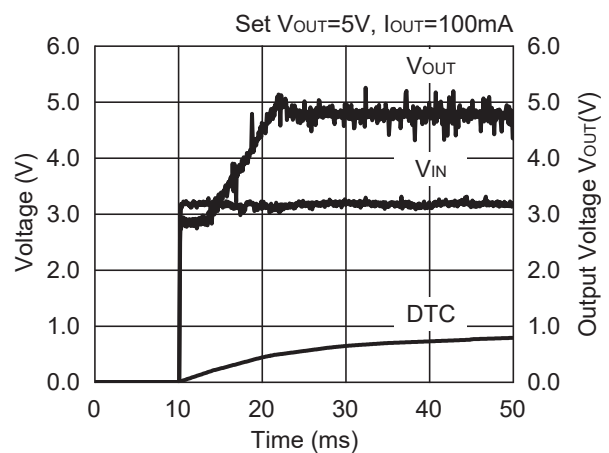
R1212D100B



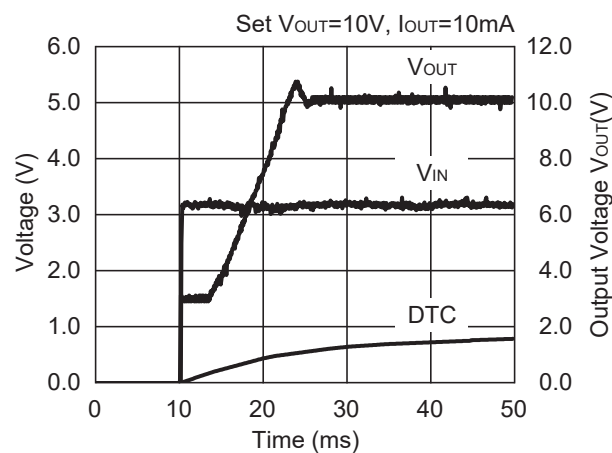
R1212D101C



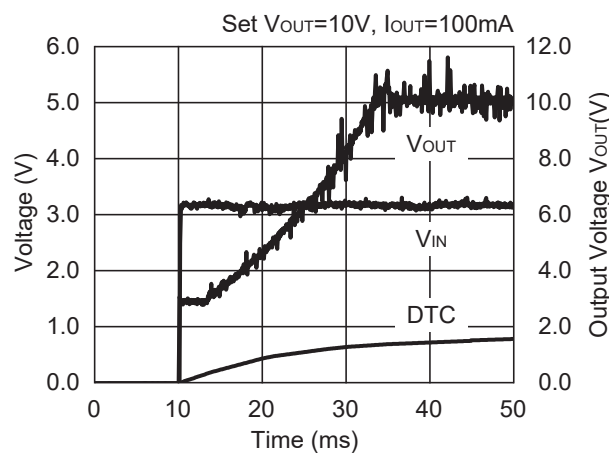
R1212D101C

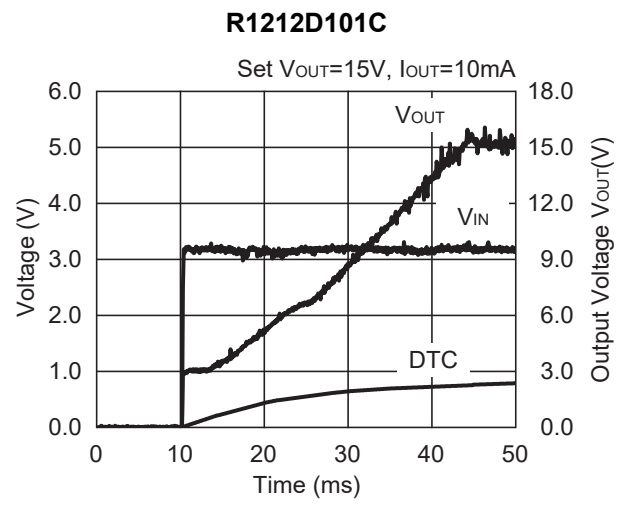
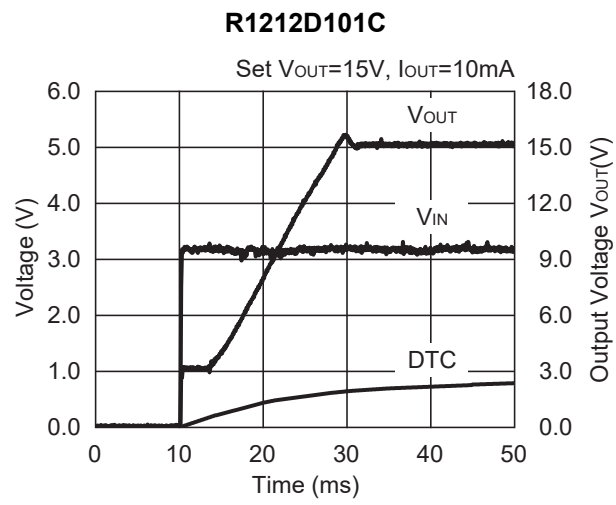


R1212D101C



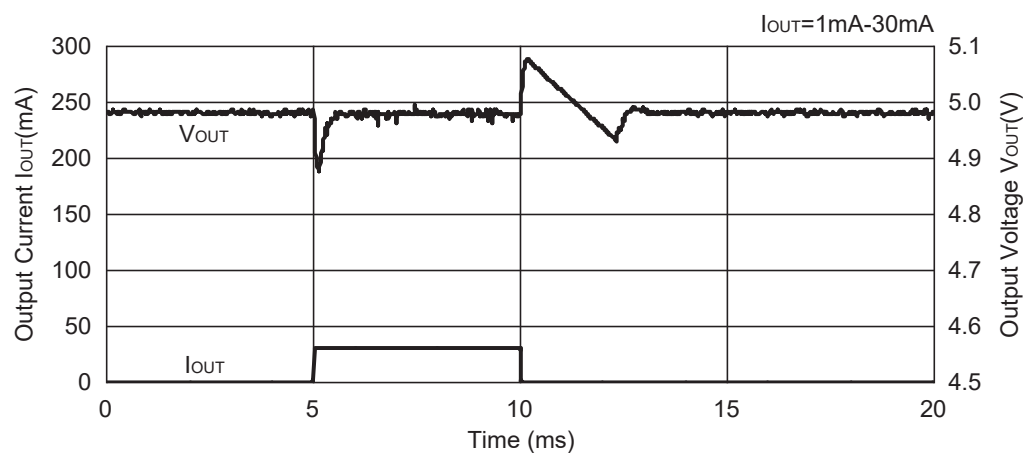
R1212D101C



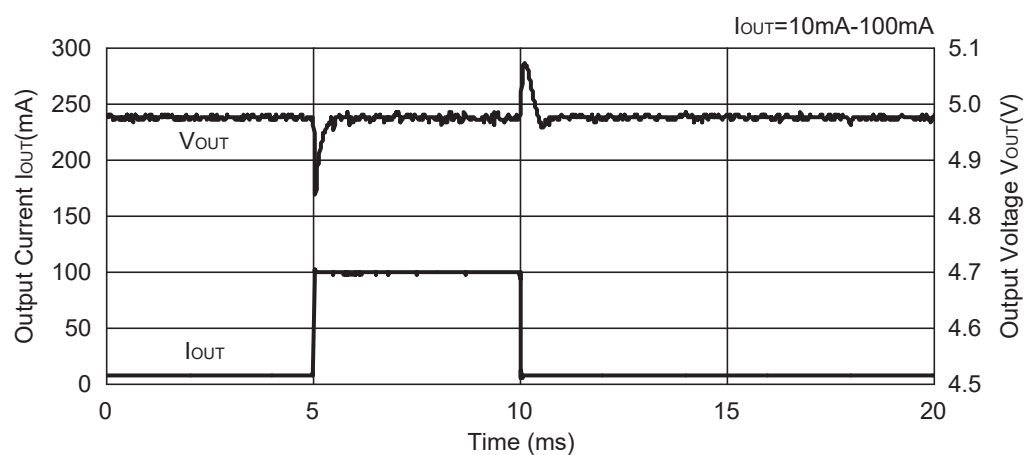


28) Load Transient Response ( $V_{IN} = 3.3\text{ V}$ ,  $T_{opt} = 25^{\circ}\text{C}$ )

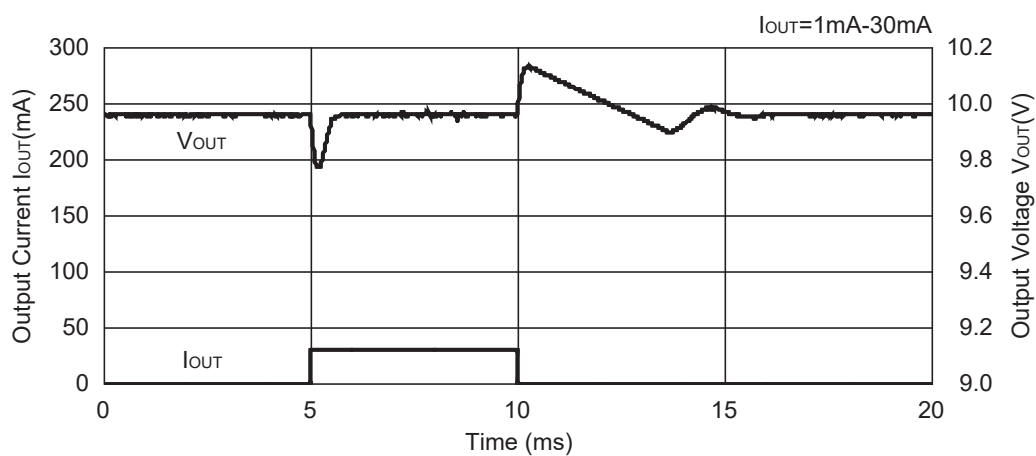
## R1212D100A



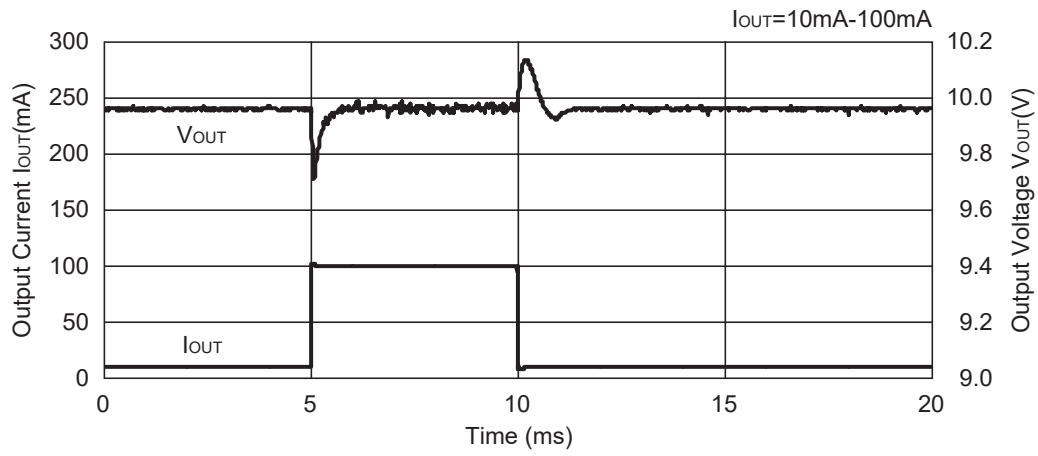
## R1212D100A



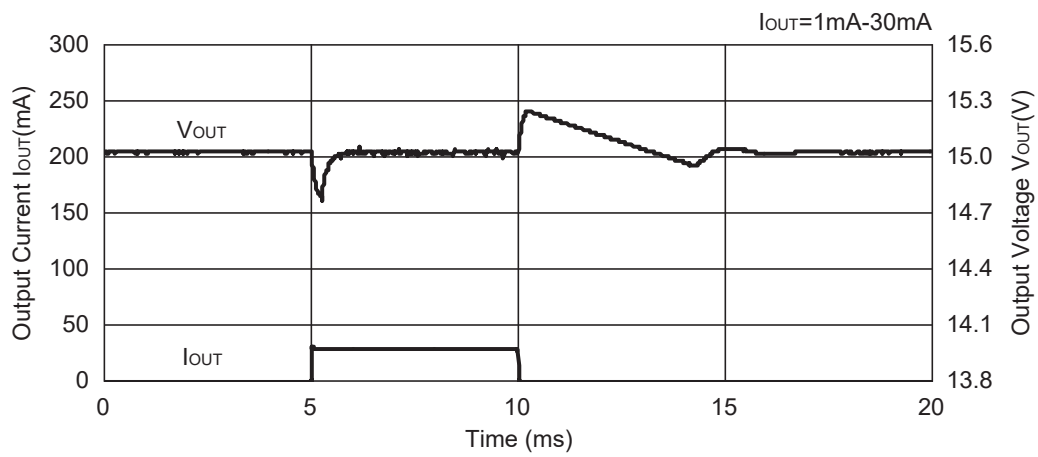
## R1212D100A



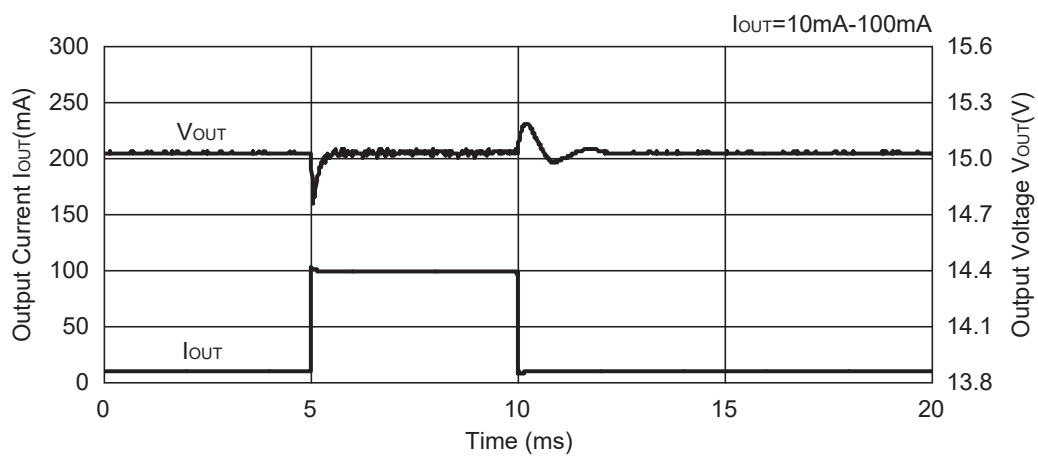
R1212D100A



R1212D100A

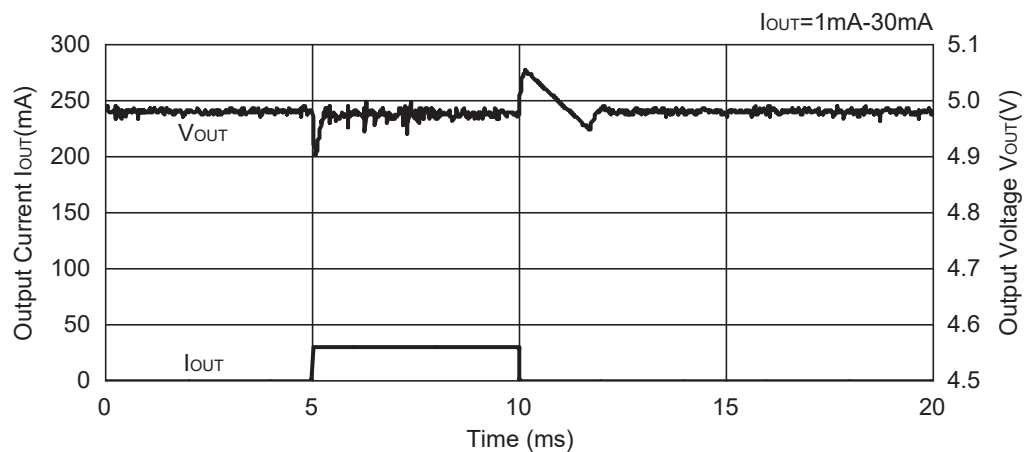


R1212D100A

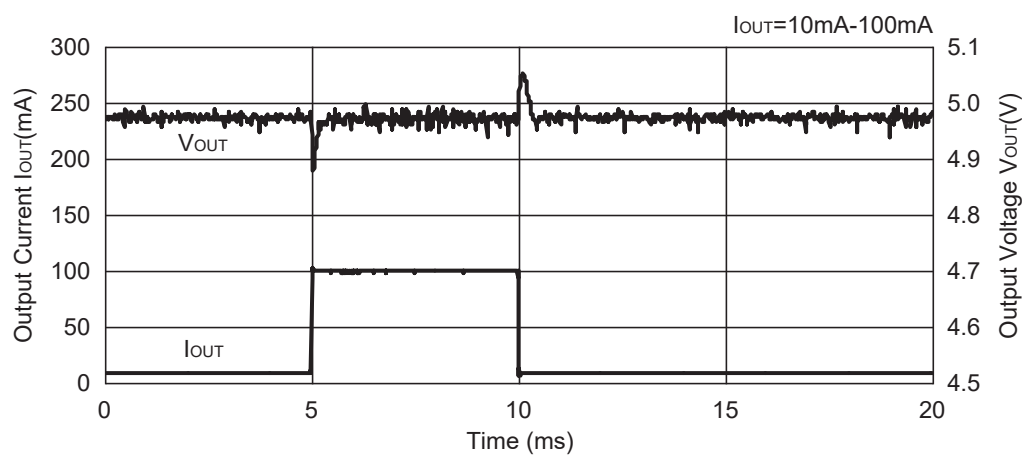


R1212D100A

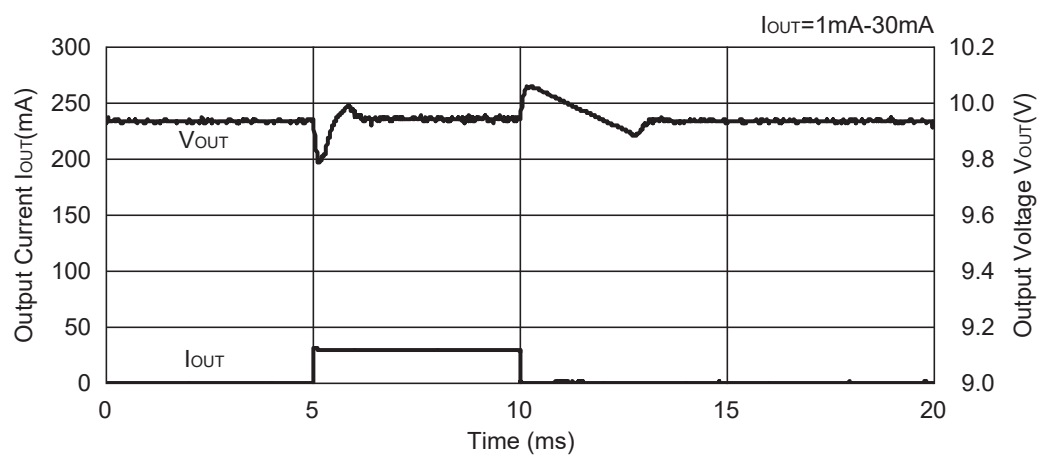
## R1212D100B



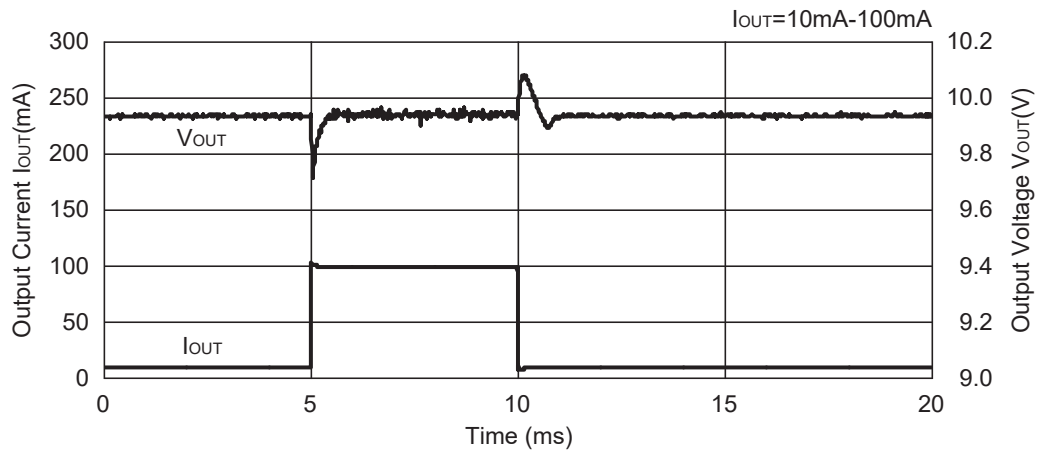
## R1212D100B



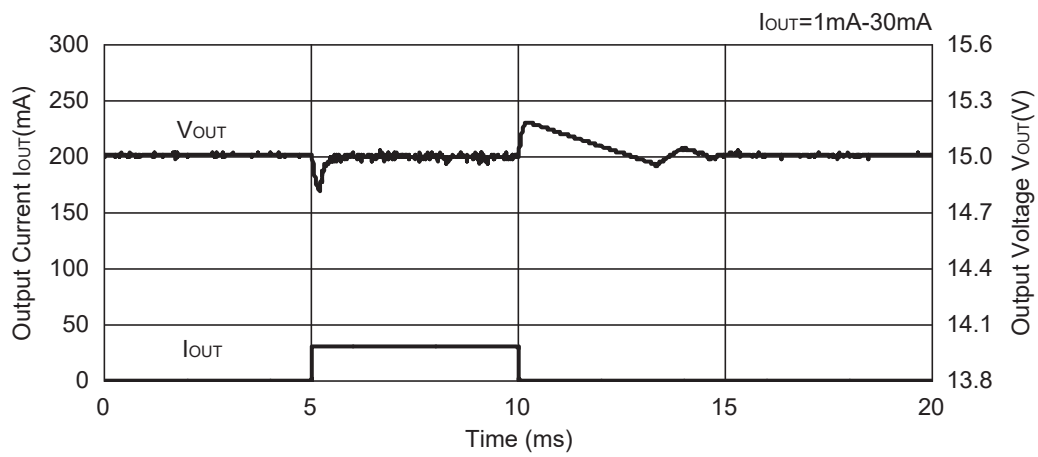
## R1212D100B



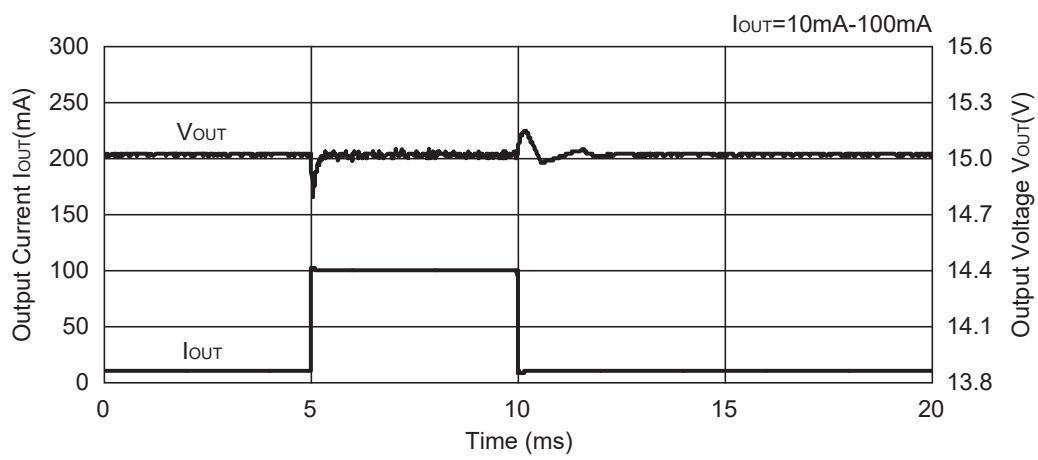
R1212D100B



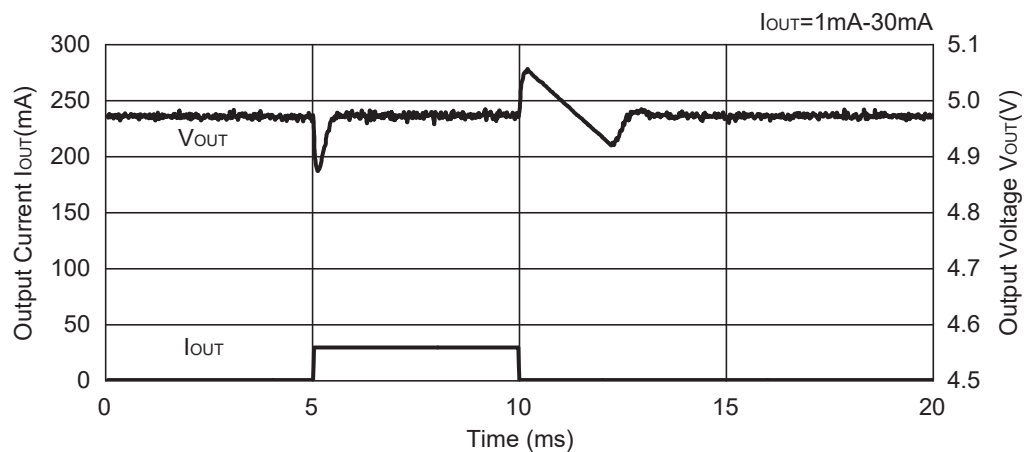
R1212D100B



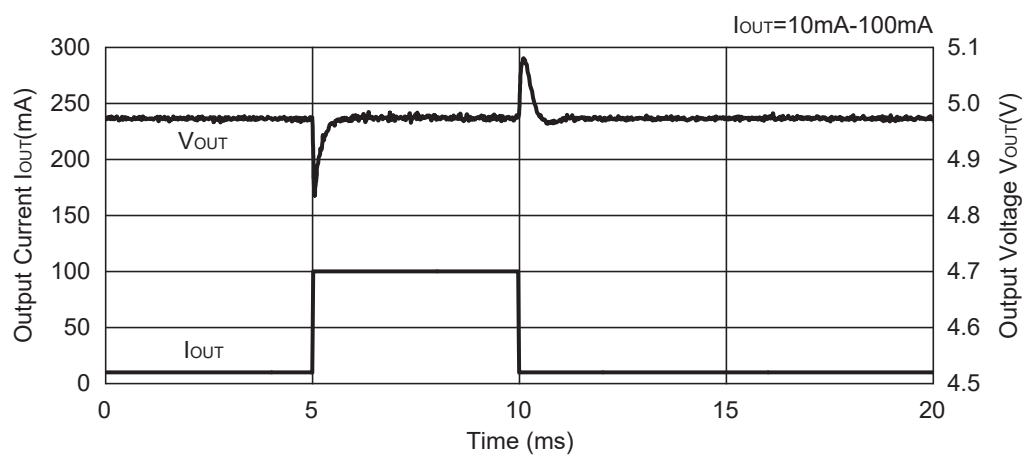
R1212D100B



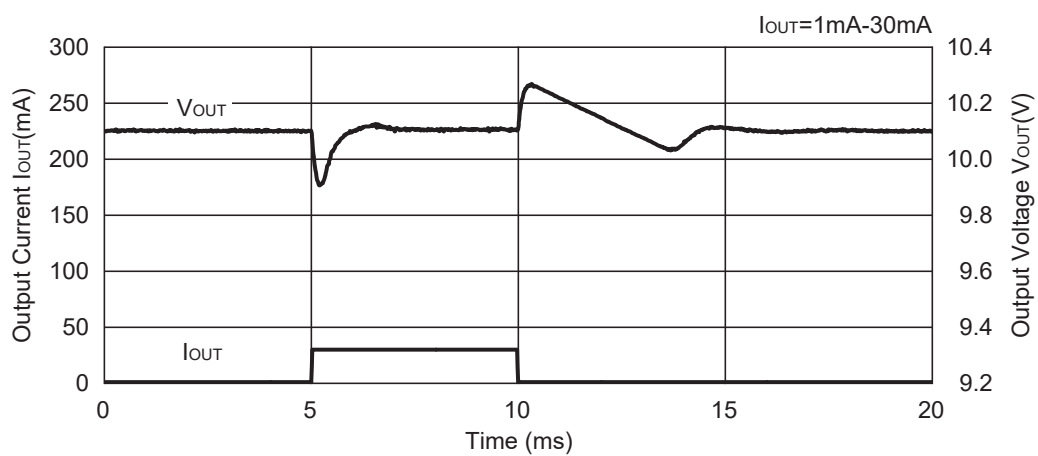
## R1212D101C



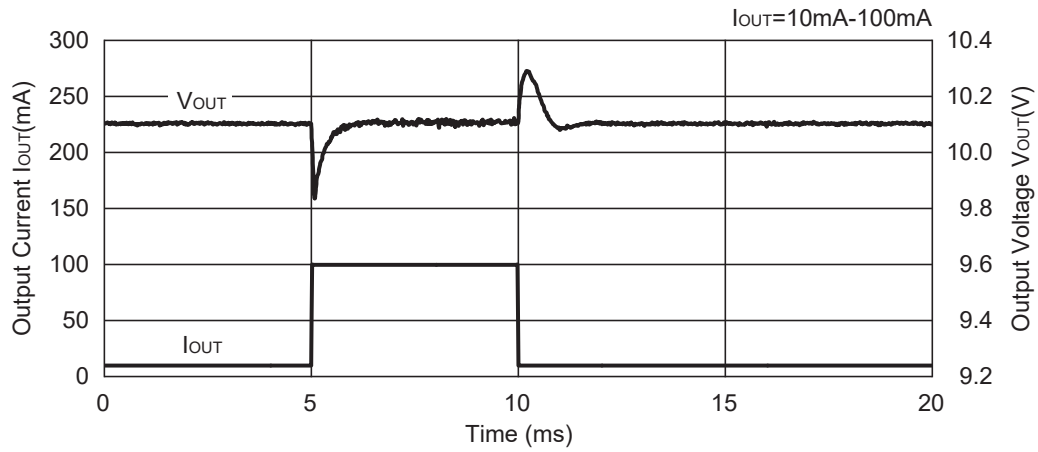
## R1212D101C



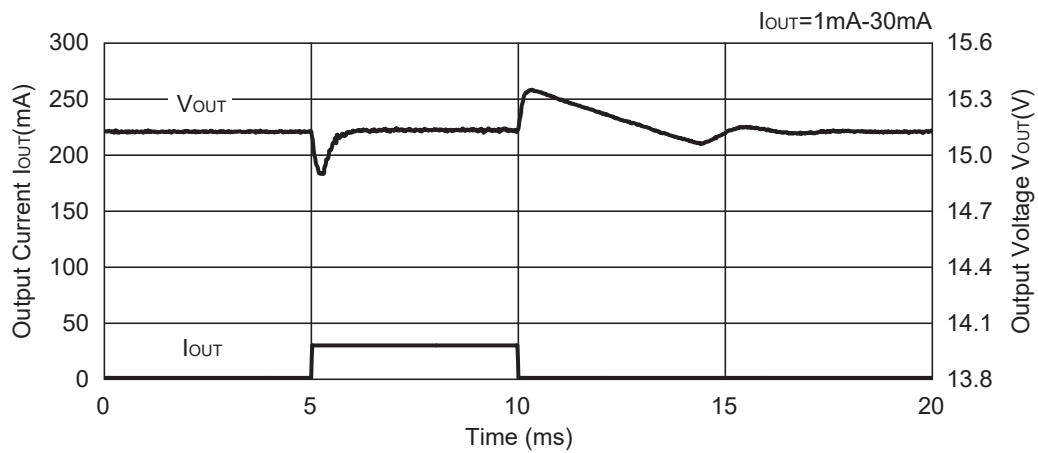
## R1212D101C



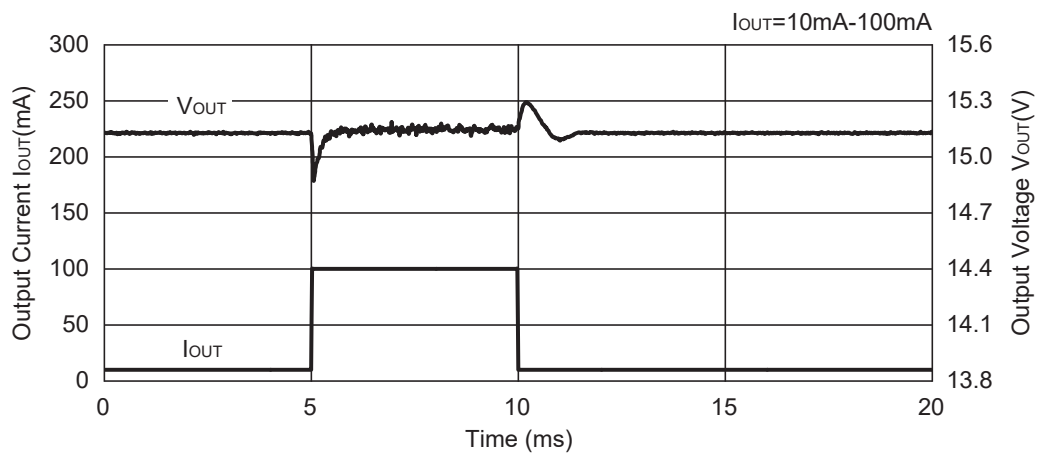
R1212D101C



R1212D101C



R1212D101C





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

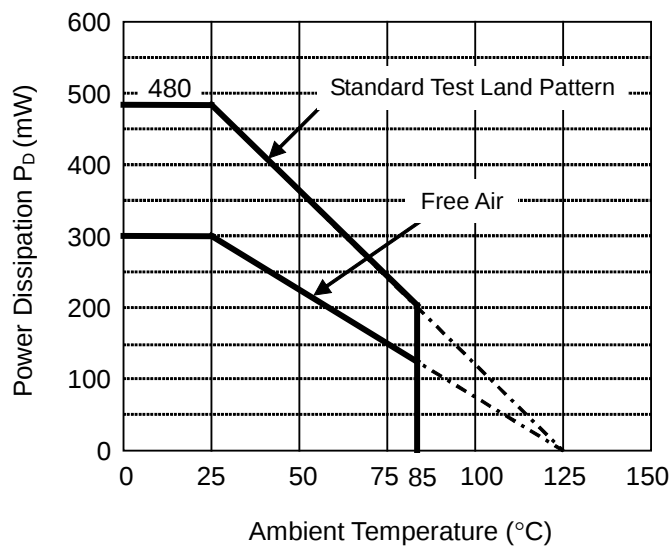
Measurement Conditions

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

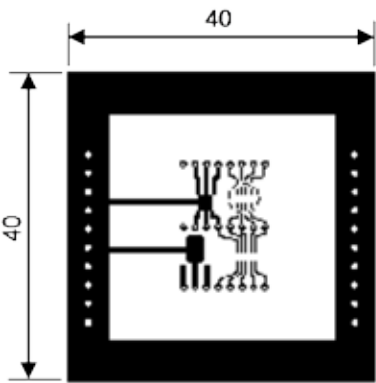
Measurement Result

(Ta = 25°C, Tjmax = 125°C)

|                    | Standard Test Land Pattern                                                         | Free Air                 |
|--------------------|------------------------------------------------------------------------------------|--------------------------|
| Power Dissipation  | 480 mW                                                                             | 300 mW                   |
| Thermal Resistance | $\theta_{JA} = (125 - 25^{\circ}\text{C}) / 0.48\text{ W} = 208^{\circ}\text{C/W}$ | 333 $^{\circ}\text{C/W}$ |



Power Dissipation vs. Ambient Temperature



○ IC Mount Area (mm)

Measurement Board Pattern



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



**Ricoh is committed to reducing the environmental loading materials in electrical devices with a view to contributing to the protection of human health and the environment.**

Ricoh has been providing RoHS compliant products since April 1, 2006 and Halogen-free products since April 1, 2012.

**RICOH** RICOH ELECTRONIC DEVICES CO., LTD.

<https://www.e-devices.ricoh.co.jp/en/>

#### Sales & Support Offices

##### **Ricoh Electronic Devices Co., Ltd.**

##### **Shin-Yokohama Office (International Sales)**

2-3, Shin-Yokohama 3-chome, Kohoku-ku, Yokohama-shi, Kanagawa, 222-8530, Japan  
Phone: +81-50-3814-7687 Fax: +81-45-474-0074

##### **Ricoh Americas Holdings, Inc.**

675 Campbell Technology Parkway, Suite 200 Campbell, CA 95008, U.S.A.  
Phone: +1-408-610-3105

##### **Ricoh Europe (Netherlands) B.V.**

##### **Semiconductor Support Centre**

Prof. W.H. Keesomlean 1, 1183 DJ Amstelveen, The Netherlands  
Phone: +31-20-5474-309

##### **Ricoh International B.V. - German Branch**

##### **Semiconductor Sales and Support Centre**

Oberrather Strasse 6, 40472 Düsseldorf, Germany  
Phone: +49-211-6546-0

##### **Ricoh Electronic Devices Korea Co., Ltd.**

3F, Haesung Bldg, 504, Teheran-ro, Gangnam-gu, Seoul, 135-725, Korea  
Phone: +82-2-2135-5700 Fax: +82-2-2051-5713

##### **Ricoh Electronic Devices Shanghai Co., Ltd.**

Room 403, No.2 Building, No.690 Bibo Road, Pu Dong New District, Shanghai 201203,  
People's Republic of China  
Phone: +86-21-5027-3200 Fax: +86-21-5027-3299

##### **Ricoh Electronic Devices Shanghai Co., Ltd.**

##### **Shenzhen Branch**

1205, Block D(Jinlong Building), Kingkey 100, Hongbao Road, Luohu District,  
Shenzhen, China  
Phone: +86-755-8348-7600 Ext 225

##### **Ricoh Electronic Devices Co., Ltd.**

##### **Taipei office**

Room 109, 10F-1, No.51, Hengyang Rd., Taipei City, Taiwan  
Phone: +886-2-2313-1621/1622 Fax: +886-2-2313-1623

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Ricoh Electronics:](#)

[R1212D100A-TR-FE](#) [R1212D100B-TR-FE](#)