STEP-UP DC/DC CONTROLLER

NO.EA-088-0604

OUTLINE

The R1211x Series are CMOS-based PWM step-up DC/DC converter controllers with low supply current.

Each of the R1211x Series consists of an oscillator, a PWM control 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 resisters, and capacitors.

Phase compensation has been made internally in the R1211x002B/D Series, while phase compensation can be made externally as for R1211x002A/C Series. B/D version has stand-by mode.

Max duty cycle is internally fixed typically at 90%. Soft start function is built-in, and Soft-starting time is set typically at 9ms(A/B, 700kHz version) or 10.5ms(C/D, 300kHz version). As for the protection circuit, after the soft-starting time, if the maximum duty cycle is continued for a certain period, the R1211x Series latch the external driver with its off state, or 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), or once after making the circuit be stand-by with chip enable pin and enable the circuit again.

FEATURES

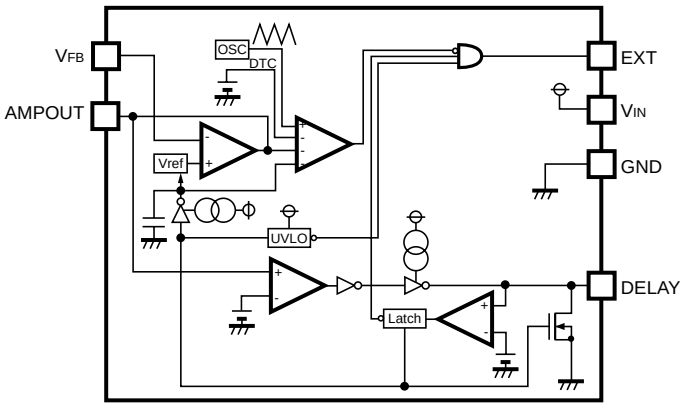
- Standby Current .....Typ. 0μA (for B/D version)
- Input Voltage Range .....2.5V to 6.0V
- Built-in Latch-type Protection Function (Output Delay Time can be set with an external capacitor)
- Two Options of Basic Oscillator Frequency 300kHz, 700kHz
- Max Duty Cycle .....Typ. 90%
- High Reference Voltage Accuracy .....±1.5%
- U.V.L.O. Threshold level .....Typ. 2.2V (Hysteresis Typ. 0.13V)
- Small Packages .....SOT-23-6W or thin (package height Max. 0.85mm) SON-6

APPLICATIONS

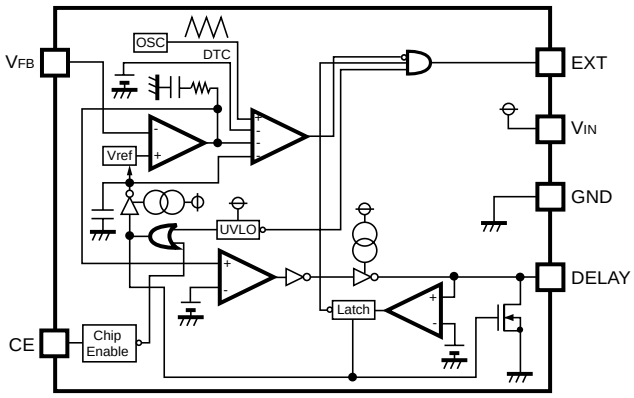
- Constant Voltage Power Source for portable equipment.
- Constant Voltage Power Source for LCD and CCD.

BLOCK DIAGRAMS

Version A/C



Version B/D



SELECTION GUIDE

In the R1211x Series, the oscillator frequency, the optional function, and the package type for the ICs can be selected at the user's request.

The selection can be made with designating the part number as shown below;

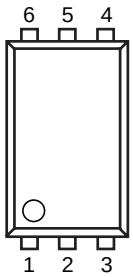
R1211x002x-TR ←Part Number
a b

Code	Contents
a	Designation of Package Type: D: SON-6 N: SOT23-6W
b	Designation of Optional Function A : 700kHz, with AMPOUT pin (External Phase Compensation Type) B : 700kHz, with CE pin (Internal Phase Compensation Type, with Stand-by) C : 300kHz, with AMPOUT pin (External Phase Compensation Type) D : 300kHz, with CE pin (Internal Phase Compensation Type, with Stand-by)

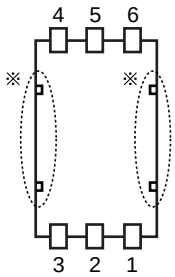
PIN CONFIGURATIONS

SON-6

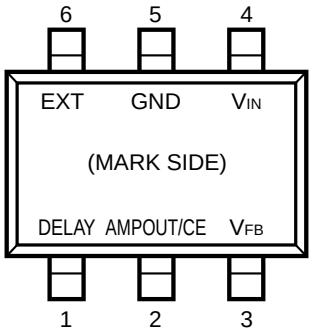
Top View



Bottom View



SOT-23-6W



PIN DESCRIPTIONS

Pin No		Symbol	Pin Description
SON6	SOT23-6W		
1	1	DELAY	Pin for External Capacitor (for Setting Output Delay of Protection)
2	5	GND	Ground Pin
3	6	EXT	External FET Drive Pin (CMOS Output)
4	4	V_{IN}	Power Supply Pin
5	3	V_{FB}	Feedback Pin for monitoring Output Voltage
6	2	AMPOUT or CE	Amplifier Output Pin(A/C Version) or Chip Enable Pin(B/D Version, Active at "H")

* Tab in the ◌ parts have GND level. (They are connected to the reverse side of this IC.)
Do not connect to other wires or land patterns.

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	V_{IN} Pin Voltage	6.5	V
V_{EXT}	EXT Pin Output Voltage	−0.3 ~ V_{IN}+0.3	V
V_{DLY}	DELAY Pin Voltage	−0.3 ~ V_{IN}+0.3	V
V_{AMP}	AMPOUT Pin Voltage	−0.3 ~ V_{IN}+0.3	V
V_{CE}	CE Pin Input Voltage	−0.3 ~ V_{IN}+0.3	V
V_{FB}	V_{FB} Pin Voltage	−0.3 ~ V_{IN}+0.3	V
I_{AMP}	AMPOUT Pin Current	±10	mA
I_{EXT}	EXT Pin Inductor Drive Output Current	±50	mA
P_D	Power Dissipation (SOT-23-6W)*	430	
	Power Dissipation (SON-6)*	500	mW
Topt	Operating Temperature Range	−40 ~ +85	°C
Tstg	Storage Temperature Range	−55 ~ +125	°C

*) For Power Dissipation, please refer to PACKAGE INFORMATION to be described.

ELECTRICAL CHARACTERISTICS

- **R1211x002A**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating Input Voltage		2.5		6.0	V
V_{FB}	V_{FB} Voltage Tolerance	V_{IN}=3.3V	0.985	1.000	1.015	V
$\Delta V_{FB}/\Delta T$	V_{FB} Voltage Temperature Coefficient	−40°C ≦ Topt ≦ 85°C		±150		ppm/°C
I_{FB}	V_{FB} Input Current	V_{IN}=6V, V_{FB}=0V or 6V	−0.1		0.1	μA
f_{OSC}	Oscillator Frequency	V_{IN}=3.3V, V_{DLY}=V_{FB}=0V	595	700	805	kHz
$\Delta f_{OSC}/\Delta T$	Oscillator Frequency Temperature Coefficient	−40°C ≦ Topt ≦ 85°C		±1.4		kHz/°C
I_{DD1}	Supply Current 1	V_{IN}=6V, V_{DLY}=V_{FB}=0V, EXT at no load		600	900	μA
maxdty	Maximum Duty Cycle	V_{IN}=3.3V, EXT "H" side	82	90	94	%
R_{EXTH}	EXT "H" ON Resistance	V_{IN}=3.3V, I_{EXT}=−20mA		5	10	Ω
R_{EXTL}	EXT "L" ON Resistance	V_{IN}=3.3V, I_{EXT}=20mA		3	6	Ω
I_{DLY1}	Delay Pin Charge Current	V_{IN}=3.3V, V_{DLY}=V_{FB}=0V	2.5	5.0	7.5	μA
I_{DLY2}	Delay Pin Discharge Current	V_{IN}=V_{FB}=2.5V, V_{DLY}=0.1V	2.5	5.5	9.0	mA
V_{DLY}	Delay Pin Detector Threshold	V_{IN}=3.3V, V_{FB}=0V,V_{DLY}=0V→2V	0.95	1.00	1.05	V
T_{START}	Soft-start Time	V_{IN}=3.3V at 90% of rising edge	4.5	9.0	13.5	ms
V_{UVLO1}	UVLO Detector Threshold	V_{IN}=3.3V→0V, V_{DLY}=V_{FB}=0V	2.1	2.2	2.3	V
V_{UVLO2}	UVLO Detector Hysteresis	V_{IN}=0V→3.3V, V_{DLY}=V_{FB}=0V	0.08	0.13	0.18	V
I_{AMP1}	AMP "H" Output Current	V_{IN}=3.3V, V_{AMP}=1V, V_{FB}=0.9V	0.45	0.90	1.50	mA
I_{AMP2}	AMP "L" Output Current	V_{IN}=3.3V, V_{AMP}=1V, V_{FB}=1.1V	30	60	90	μA

- **R1211x002B**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating Input Voltage		2.5		6.0	V
V_{FB}	V_{FB} Voltage Tolerance	V_{IN}=3.3V	0.985	1.000	1.015	V
$\Delta V_{FB}/\Delta T$	V_{FB} Voltage Temperature Coefficient	−40°C ≦ Topt ≦ 85°C		±150		ppm/°C
I_{FB}	VFB Input Current	V_{IN}=6V, V_{FB}=0V or 6V	−0.1		0.1	μA
f_{OSC}	Oscillator Frequency	V_{IN}=3.3V, V_{DLY}=V_{FB}=0V	595	700	805	kHz
$\Delta f_{OSC}/\Delta T$	Oscillator Frequency Temperature Coefficient	−40°C ≦ Topt ≦ 85°C		±1.4		kHz/°C
I_{DD1}	Supply Current 1	V_{IN}=6V, V_{DLY}=V_{FB}=0V, EXT at no load		600	900	μA
maxdty	Maximum Duty Cycle	V_{IN}=3.3V, EXT "H" side	82	90	94	%
R_{EXTH}	EXT "H" ON Resistance	V_{IN}=3.3V, I_{EXT}=−20mA		5	10	Ω
R_{EXTL}	EXT "L" ON Resistance	V_{IN}=3.3V, I_{EXT}=20mA		3	6	Ω
I_{DLY1}	Delay Pin Charge Current	V_{IN}=3.3V, V_{DLY}=V_{FB}=0V	2.5	5.0	7.5	μA
I_{DLY2}	Delay Pin Discharge Current	V_{IN}=V_{FB}=2.5V, V_{DLY}=0.1V	2.5	5.5	9.0	mA
V_{DLY}	Delay Pin Detector Threshold	V_{IN}=3.3V, V_{FB}=0V, V_{DLY}=0V→2V	0.95	1.00	1.05	V
T_{START}	Soft-start Time	V_{IN}=3.3V	4.5	9.0	13.5	ms
V_{UVLO1}	UVLO Detector Threshold	V_{IN}=3.3V→0V, V_{DLY}=V_{FB}=0V	2.1	2.2	2.3	V
V_{UVLO2}	UVLO Detector Hysteresis	V_{IN}=0V→3.3V, V_{DLY}=V_{FB}=0V	0.08	0.13	0.18	V
I_{STB}	Standby Current	V_{IN}=6V, V_{CE}=0V		0	1	μA
I_{CEH}	CE "H" Input Current	V_{IN}=6V, V_{CE}=6V	−0.5		0.5	μA
I_{CEL}	CE "L" Input Current	V_{IN}=6V, V_{CE}=0V	−0.5		0.5	μA
V_{CEH}	CE "H" Input Voltage	V_{IN}=6V, V_{CE}=0V→6V	1.5			V
V_{CEL}	CE "L" Input Voltage	V_{IN}=2.5V, V_{CE}=2V→0V			0.3	V

- **R1211x002C**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating Input Voltage		2.5		6.0	V
V_{FB}	V_{FB} Voltage Tolerance	V_{IN}=3.3V	0.985	1.000	1.015	V
$\Delta V_{FB}/\Delta T$	V_{FB} Voltage Temperature Coefficient	−40°C ≦ Topt ≦ 85°C		±150		ppm/°C
I_{FB}	VFB Input Current	V_{IN}=6V, V_{FB}=0V or 6V	−0.1		0.1	μA
f_{OSC}	Oscillator Frequency	V_{IN}=3.3V, V_{DLY}=V_{FB}=0V	240	300	360	kHz
$\Delta f_{OSC}/\Delta T$	Oscillator Frequency Temperature Coefficient	−40°C ≦ Topt ≦ 85°C		±0.6		kHz/°C
I_{DD1}	Supply Current 1	V_{IN}=6V, V_{DLY}=V_{FB}=0V, EXT at no load		300	500	μA
maxdty	Maximum Duty Cycle	V_{IN}=3.3V, EXT "H" side	82	90	94	%
R_{EXTH}	EXT "H" ON Resistance	V_{IN}=3.3V, IEXT=−20mA		5	10	Ω
R_{EXTL}	EXT "L" ON Resistance	V_{IN}=3.3V, IEXT=20mA		3	6	Ω
I_{DLY1}	Delay Pin Charge Current	V_{IN}=3.3V, V_{DLY}=V_{FB}=0V	2.0	4.5	7.0	μA
I_{DLY2}	Delay Pin Discharge Current	V_{IN}=V_{FB}=2.5V, V_{DLY}=0.1V	2.5	5.5	9.0	mA
V_{DLY}	Delay Pin Detector Threshold	V_{IN}=3.3V, V_{FB}=0V, V_{DLY}=0V→2V	0.95	1.00	1.05	V
T_{START}	Soft-start Time	V_{IN}=3.3V	5.0	10.5	16.0	ms
V_{UVLO1}	UVLO Detector Threshold	V_{IN}=3.3V→0V, V_{DLY}=V_{FB}=0V	2.1	2.2	2.3	V
V_{UVLO2}	UVLO Detector Hysteresis	V_{IN}=0V→3.3V, V_{DLY}=V_{FB}=0V	0.08	0.13	0.18	V
I_{AMP1}	AMP "H" Output Current	V_{IN}=3.3V, V_{AMP}=1V, V_{FB}=0.9V	0.45	0.90	1.50	mA
I_{AMP2}	AMP "L" Output Current	V_{IN}=3.3V, V_{AMP}=1V, V_{FB}=1.1V	25	50	75	μA

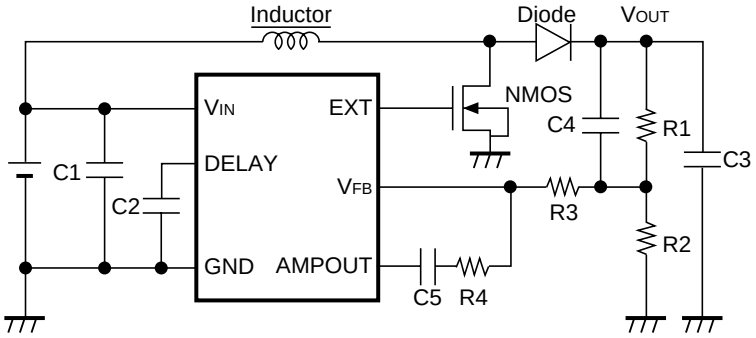
- **R1211x002D**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating Input Voltage		2.5		6.0	V
V_{FB}	V_{FB} Voltage Tolerance	V_{IN}=3.3V	0.985	1.000	1.015	V
$\Delta V_{FB}/\Delta T$	V_{FB} Voltage Temperature Coefficient	−40°C ≦ Topt ≦ 85°C		±150		ppm/°C
I_{FB}	V_{FB} Input Current	V_{IN}=6V, V_{FB}=0V or 6V	−0.1		0.1	μA
f_{OSC}	Oscillator Frequency	V_{IN}=3.3V, V_{DLY}=V_{FB}=0V	240	300	360	kHz
$\Delta f_{OSC}/\Delta T$	Oscillator Frequency Temperature Coefficient	−40°C ≦ Topt ≦ 85°C		±0.6		kHz/°C
I_{DD1}	Supply Current 1	V_{IN}=6V, V_{DLY}=V_{FB}=0V, EXT at no load		300	500	μA
maxdty	Maximum Duty Cycle	V_{IN}=3.3V, EXT "H" side	82	90	94	%
R_{EXTH}	EXT "H" ON Resistance	V_{IN}=3.3V, IEXT=−20mA		5	10	Ω
R_{EXTL}	EXT "L" ON Resistance	V_{IN}=3.3V, IEXT=20mA		3	6	Ω
I_{DLY1}	Delay Pin Charge Current	V_{IN}=3.3V, V_{DLY}=V_{FB}=0V	2.0	4.5	7.0	μA
I_{DLY2}	Delay Pin Discharge Current	V_{IN}=V_{FB}=2.5V, V_{DLY}=0.1V	2.5	5.5	9.0	mA
V_{DLY}	Delay Pin Detector Threshold	V_{IN}=3.3V, V_{FB}=0V, V_{DLY}=0V→2V	0.95	1.00	1.05	V
T_{START}	Soft-start Time	V_{IN}=3.3V	5.0	10.5	16.0	ms
V_{UVLO1}	UVLO Detector Threshold	V_{IN}=3.3V→0V, V_{DLY}=V_{FB}=0V	2.1	2.2	2.3	V
V_{UVLO2}	UVLO Detector Hysteresis	V_{IN}=0V→3.3V, V_{DLY}=V_{FB}=0V	0.08	0.13	0.18	V
I_{STB}	Standby Current	V_{IN}=6V, V_{CE}=0V		0	1	μA
I_{CEH}	CE "H" Input Current	V_{IN}=6V, V_{CE}=6V	−0.5		0.5	μA
I_{CEL}	CE "L" Input Current	V_{IN}=6V, V_{CE}=0V	−0.5		0.5	μA
V_{CEH}	CE "H" Input Voltage	V_{IN}=6V, V_{CE}=0V→6V	1.5			V
V_{CEL}	CE "L" Input Voltage	V_{IN}=2.5V, V_{CE}=2V→0V			0.3	V

TYPICAL APPLICATIONS AND TECHNICAL NOTES

<R1211x002A/R1211x002C>

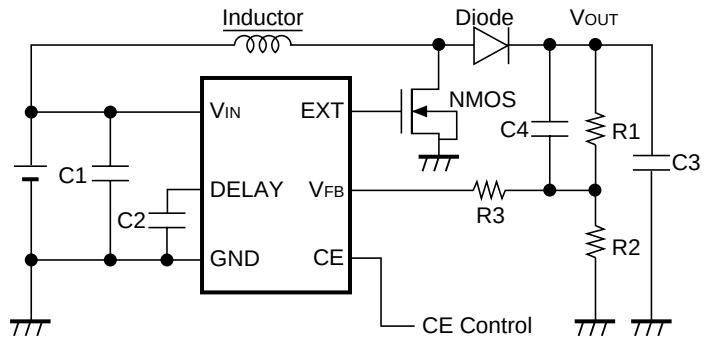


NMOS : IRF7601 (International Rectifier)
Inductor : LDR655312T-100 10µH (TDK) for R1211x002A
: LDR655312T-220 22µH (TDK) for R1211x002C
Diode : CRS02 (Toshiba)

C1 : 4.7µF (Ceramic)
C2 : 0.22µF (Ceramic)
C3 : 10µF (Ceramic)
C4 : 680pF (Ceramic)
C5 : 2200pF (Ceramic)

R1 : Output Voltage Setting Resistor 1
R2 : Output Voltage Setting Resistor 2
R3 : 30kΩ
R4 : 30kΩ

<R1211x002B/R1211x002D>



NMOS : IRF7601 (International Rectifier)
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: LDR655312T-220 22µH (TDK) for R1211x002D
Diode : CRS02 (Toshiba)

C1 : 4.7µF (Ceramic)
C2 : 0.22µF (Ceramic)
C3 : 10µF (Ceramic)
C4 : 680pF (Ceramic)

R1 : Setting Output Voltage Resistor 1
R2 : Setting Output Voltage Resistor 2
R3 : 30kΩ

[**Note**]

These example circuits may be applied to the output voltage requirement is 15V or less. If the output voltage requirement is 15V or more, ratings of NMOS and diode as shown above is over the limit, therefore, choose other external components.

Use a 1μF or more capacitance value of bypass capacitor between V_{IN} pin and GND, C1 as shown in the typical applications above.

- In terms of the capacitor for setting delay time of the latch protection, C2 as shown in typical applications of the previous page, connect between Delay pin and GND pin of the IC with the minimum wiring distance.

- Connect a 1μF or more value of capacitor between V_{OUT} and GND, C3 as shown in typical applications of the previous page. (Recommended value is from 10μF to 22μF.) 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 V_{OUT} and the dividing point, C4 as shown in typical applications of the previous page. The capacitance value of C4 depends on divider resistors for output voltage setting. Typical value is between 100pF and 1000pF.

- Output Voltage can be set with divider resistors for voltage setting, R1 and R2 as shown in typical applications of the previous page. Refer to the next formula.

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

  R1+R2=100kΩ is recommended range of resistances.

- The operation of Latch protection circuit is as follows: When the IC detects maximum duty cycle, charge to an external capacitor, C2 of DELAY pin starts. And maximum duty cycle continues and the voltage of D_{ELAY} 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 IC be standby mode with CE pin and make it active in terms of B/D version. Otherwise, restart with power on.

  The delay time of latch protection can be calculated with C2, V_{DLY}, and Delay Pin Charge Current, I_{DLY1}, as in the next formula.

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

  Once after the maximum duty is detected and released before delay time, charge to the capacitor is halt and delay pin outputs "L".

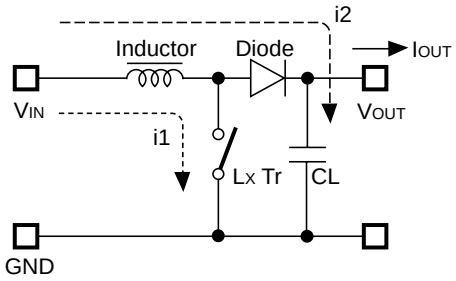
- As for R1211x002A/C version, the values and positioning of C4, C5, R3, and R4 shown in the above diagram are just an example combination. These are for making phase compensation. If the spike noise of V_{OUT} may be large, the spike noise may be picked into V_{FB} pin and make the operation unstable. In this case, a resistor R3, shown in typical applications of the previous page. The recommended resistance value of R3 is in the range from 10kΩ to 50kΩ. Then, noise level will be decreased.

- As for R1211x002B/D version, EXT pin outputs GND level at standby mode.
- Select the Power MOSFET, the diode, and the inductor within ratings (Voltage, Current, Power) of this IC. Choose the power MOSFET with low threshold voltage depending on Input Voltage to be able to turn on the FET completely. Choose the diode with low V_F such as Shottky 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 three times of setting voltage or more.

∗ The performance of power circuit with using this IC depends on external components. Choose the most suitable components for your application.

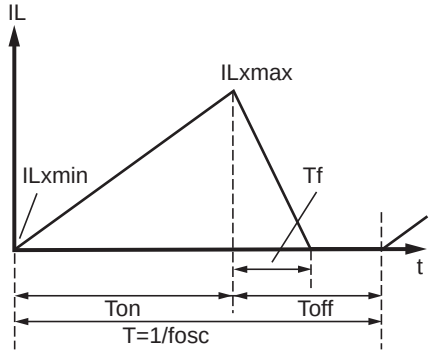
Output Current and Selection of External Components

<Basic Circuit>

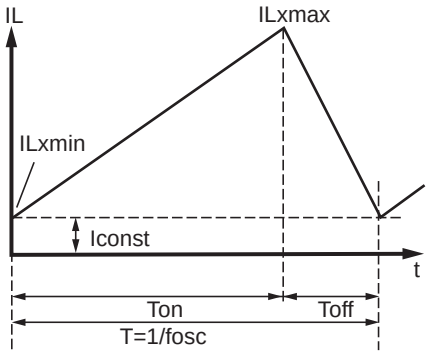


<Circuit through L>

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.

$$P_{ON} = \int_0^{Ton} V_{IN}^2 \times t/L \, dt \quad \text{..... Formula 1}$$

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.

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

In this formula, Tf means the time of which the energy saved in the inductance is being emitted. Thus average electric power, P_{AV} is described as in the next formula.

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

In PWM control, when Tf = Toff is true, the inductor current becomes continuos, 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.

$$V_{IN} \times T_{ON}/L = (V_{OUT} - V_{IN}) \times Toff/L \quad \text{..... Formula 4}$$

Further, the electric power, P_{AV} is equal to output electric power, $V_{OUT} \times I_{OUT}$, thus,

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

When I_{OUT} 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 Iconst, then,

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

In this moment, the peak current, ILxmax flowing through the inductor and the driver Tr. is described as follows:

$$ILxmax = Iconst + V_{IN} \times T_{ON}/L \quad \text{.....Formula 7}$$

With the formula 4,6, and ILxmax is,

$$ILxmax = V_{OUT}/V_{IN} \times I_{OUT} + V_{IN} \times T_{ON}/(2 \times L) \quad \text{.....Formula 8}$$

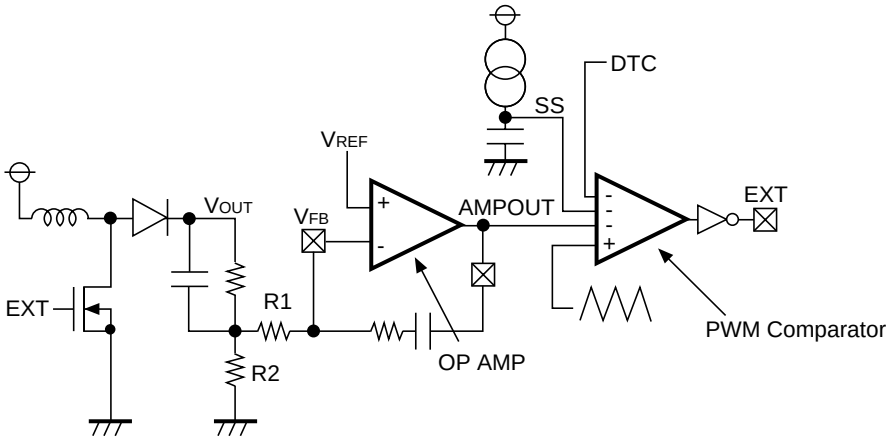
Therefore, peak current is more than I_{OUT}. Considering the value of ILxmax, the condition of input and output, and external components should be selected.

In the formula 7, peak current ILxmax at discontinuous mode can be calculated. Put Iconst=0 in the formula.

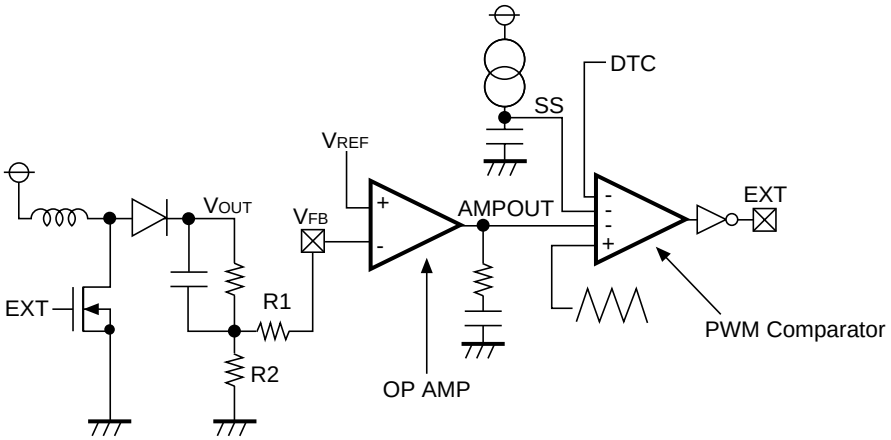
The explanation above is based on the ideal calculation, and the loss caused by Lx switch and external components is not included. The actual maximum output current is between 50% and 80% of the calculation. Especially, when the ILx is large, or V_{IN} is low, the loss of V_{IN} is generated with the on resistance of the switch. As for V_{OUT}, Vf (as much as 0.3V) of the diode should be considered.

TIMING CHART

- **R1211x002A/R1211x002C**



- **R1211x002B/R1211x002D**



<Soft-start Operation>

Soft-start operation is starting from power-on as follows:

(Step1)

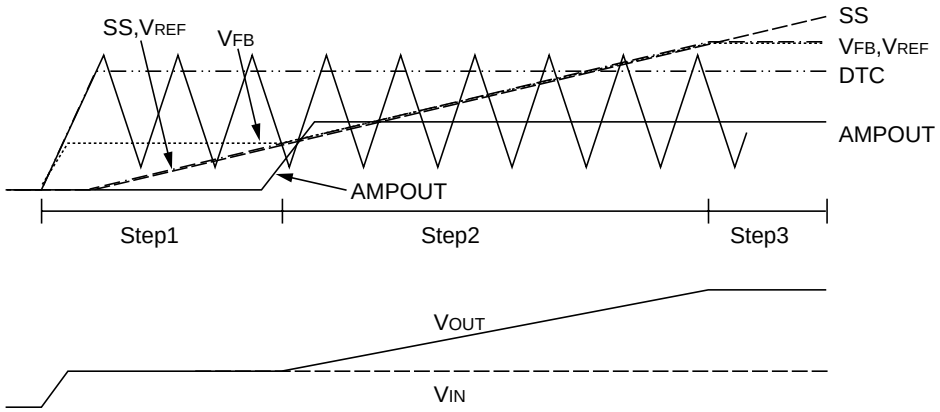
The voltage level of SS is rising gradually by constant current circuit of the IC and a capacitor. V_{REF} level which is input to OP AMP is also gradually rising. V_{OUT} is rising up to input voltage level just after the power-on, therefore, V_{FB} voltage is rising up to the setting voltage with input voltage and the ration of R1 and R2. AMPOUT is at "L", and switching does not start.

(Step2)

When the voltage level of SS becomes the setting voltage with the ration of R1 and R2 or more, switching operation starts. V_{REF} level gradually increases together with SS level. V_{OUT} is also rising with balancing V_{REF} and V_{FB}. Duty cycle depends on the lowest level among AMPOUT, SS, and DTC of the 4 input terminals in the PWM comparator.

(Step3)

When SS reaches 1V, soft-start operation finishes. V_{REF} becomes constant voltage (=1V). Then the switching operation becomes normal mode.



<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. And 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.

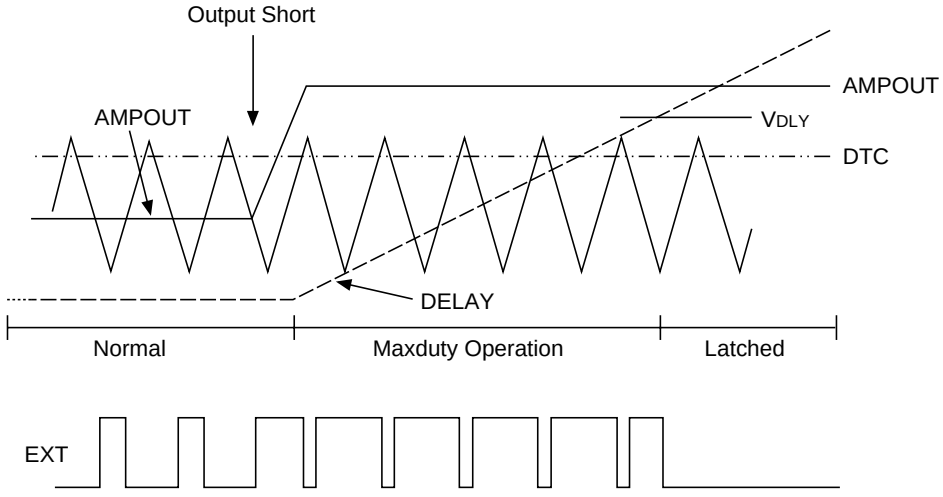
To release the latch protection operation, make the IC be standby mode with CE pin and make it active in terms of R1211x002B/D version. Otherwise, make supply voltage down to UVLO detector threshold or lower, and make it rise up to the normal input voltage.

During the soft-start time, if the duty cycle may be the maximum, protection circuit does not work and DELAY pin is fixed at GND level.

The delay time of latch protection can be calculated with C2, V_{DLY}, and Delay Pin Charge Current, I_{DLY1}, as in the next formula.

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

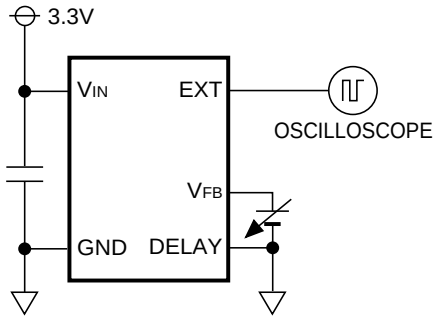
Once after the maximum duty is detected and released before delay time, charge to the capacitor is halt and delay pin outputs "L".



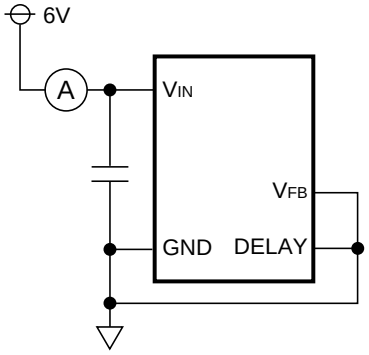
TEST CIRCUITS

- **R1211x002A/R1211x002C**

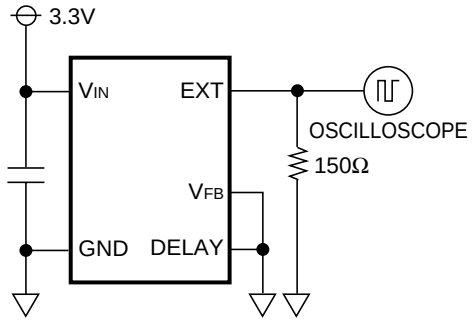
∗Oscillator Frequency,
Maximum Duty Cycle, V_{FB} Voltage Test



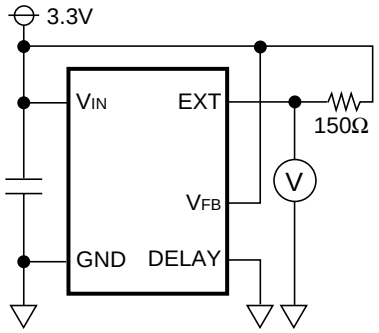
∗Consumption Current Test



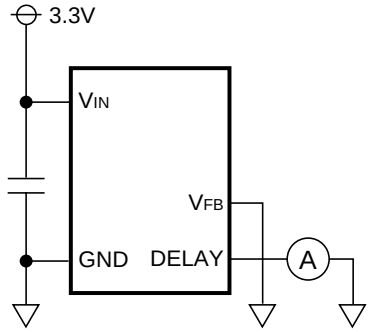
∗EXT "H" ON Resistance



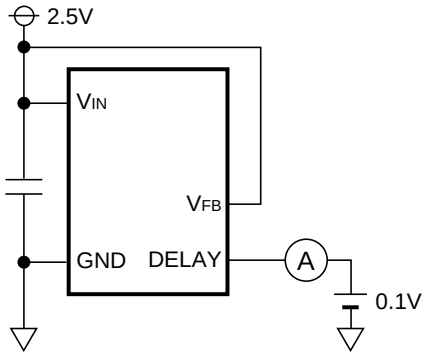
∗EXT "L" ON Resistance



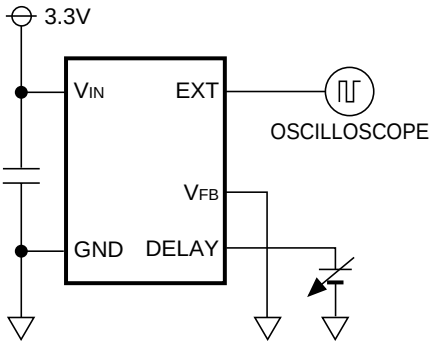
∗DELAY Pin Charge Current



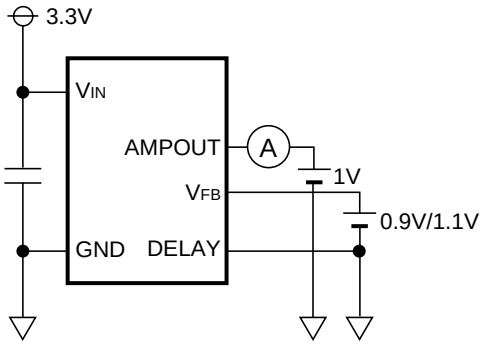
∗DELAY Pin Discharge Current



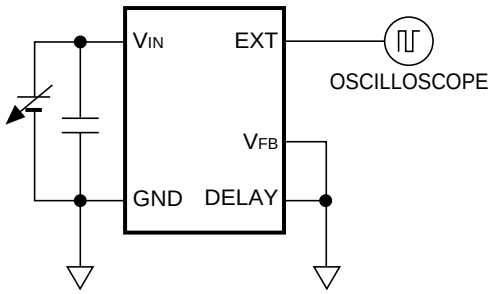
∗DELAY Pin Detector Threshold Voltage Test



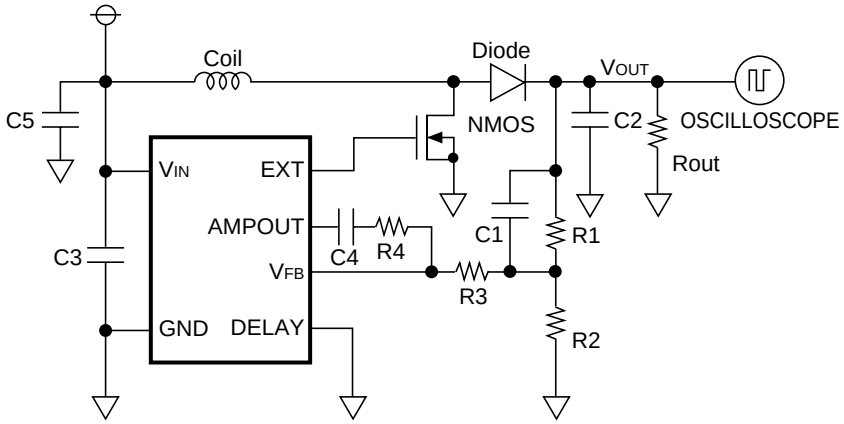
∗AMP "H" Output Current/"L" Output Current Test



∗UVLO Detector Threshold/Hysteresis Range Test



∗Soft-start Time Test

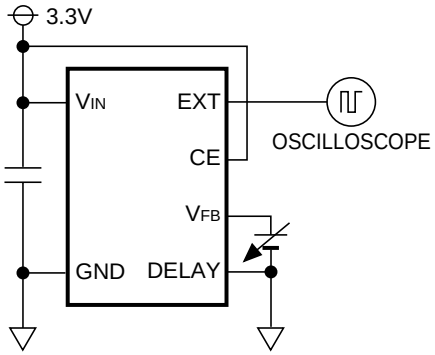


<Components>

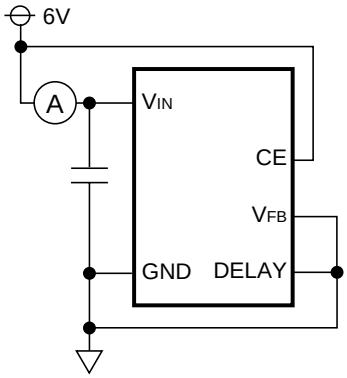
Inductor (L)	:	22μH (TDK LDR655312T-220)
Diode (SD)	:	CRS02 (Toshiba)
Capacitors		C1:680pF(Ceramic), C2:22μF (Tantalum)+2.2μF (Ceramic), C3:68μF (Tantalum)+2.2μF (Ceramic), C4:2200pF(Ceramic), C5:22μF(Tantalum)
NMOS Transistor	:	IRF7601 (International Rectifier)
Resistors	:	R1: 90kΩ, R2:10kΩ, R3:30kΩ, R4:30kΩ, Rout:1kΩ/330Ω

- **R1211x002B/R1211x002D**

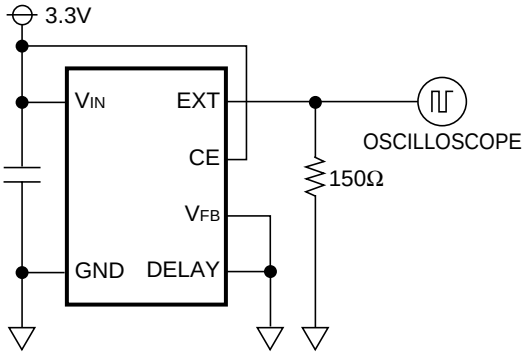
∗Oscillator Frequency,
Maximum Duty Cycle, V_{FB} Voltage Test



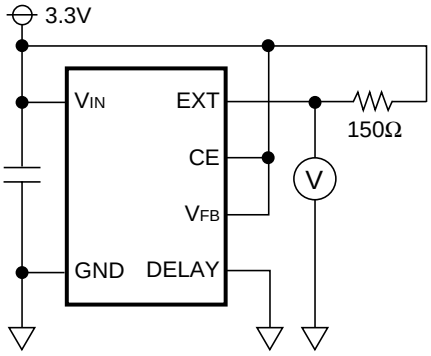
∗Consumption Current Test



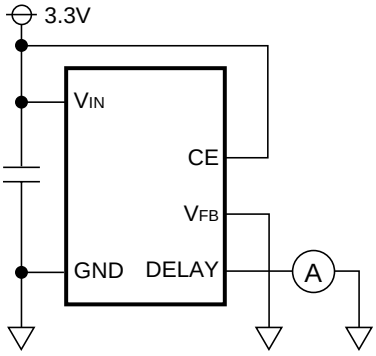
∗EXT "H" ON Resistance



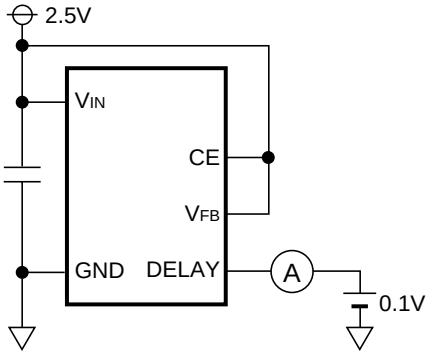
∗EXT "L" ON Resistance



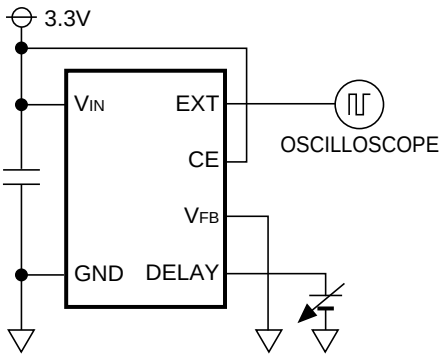
∗DELAY Pin Charge Current



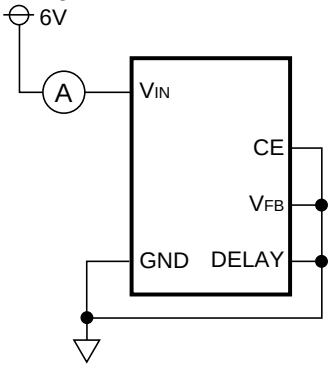
∗DELAY Pin Discharge Current



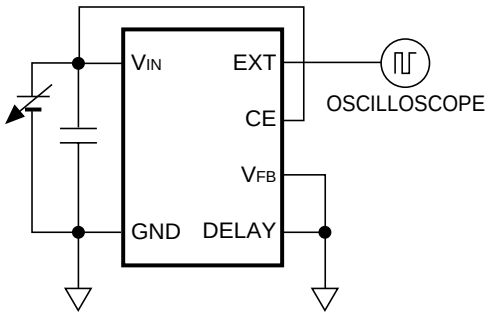
∗DELAY Pin Detector Threshold Voltage Test



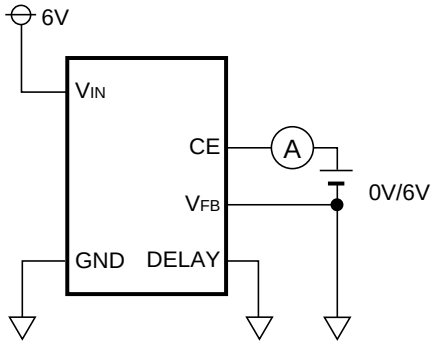
∗Standby Current Test



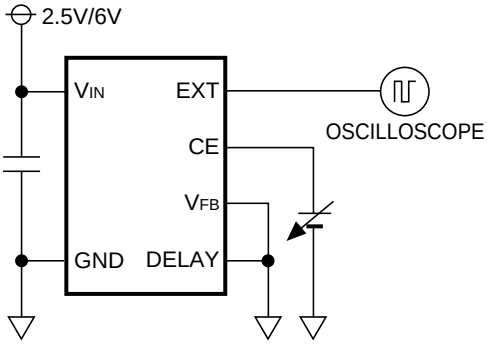
∗UVLO Detector Threshold/ Hysteresis Range Test



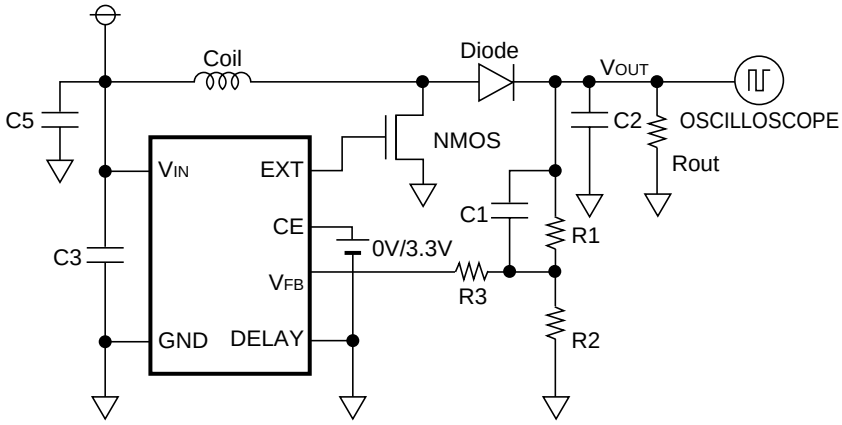
∗ CE "L" Input Current/"H" Input Current Test



∗CE "L" Input Voltage/"H" Input Voltage Test



∗Soft-start Time Test



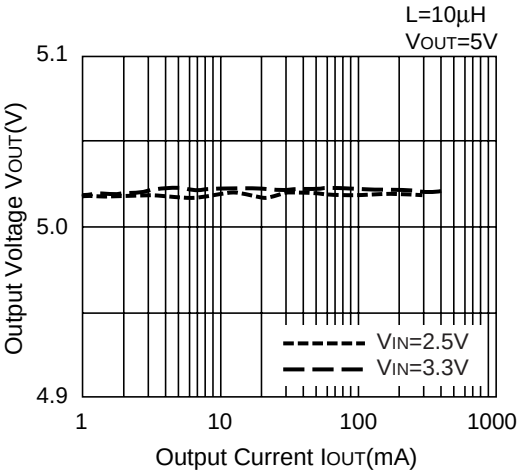
<Components>

Inductor (L)	: 22μH (TDK LDR655312T-220)
Diode (SD)	: CRS02 (Toshiba)
Capacitors	C1 : 680pF (Ceramic), C2: 22μF (Tantalum)+2.2μF (Ceramic),
	C3 : 68μF (Tantalum)+2.2μF (Ceramic), C5: 22μF (Tantalum)
NMOS Transistor	: IRF7601 (International Rectifier)
Resistors	: R1: 90kΩ, R2: 10kΩ, R3: 30kΩ

TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

R1211x002A



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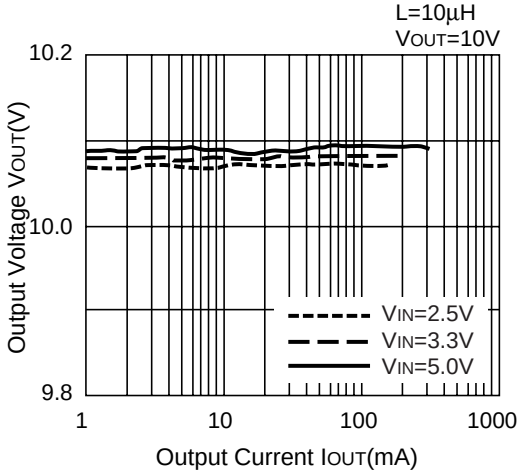

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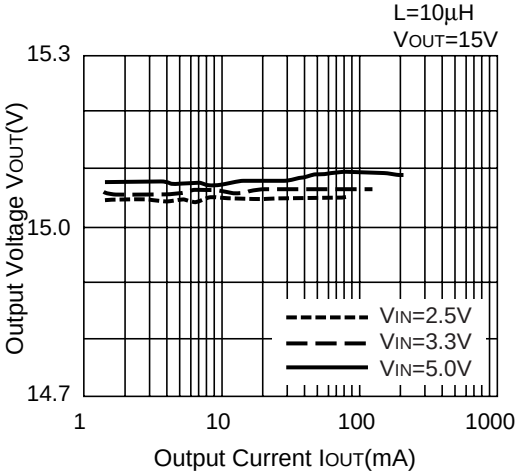
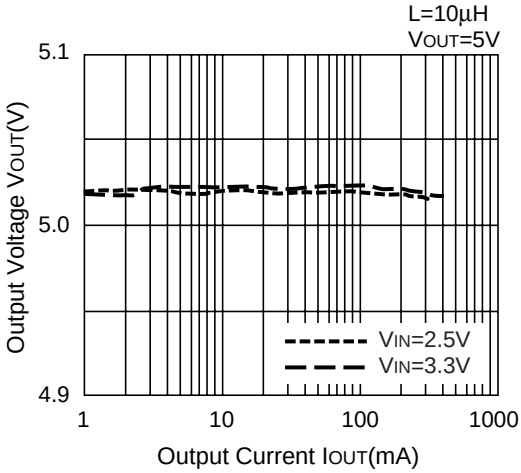


R1211x002B



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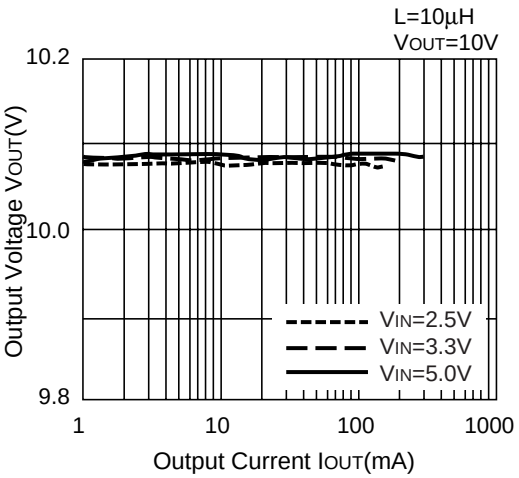

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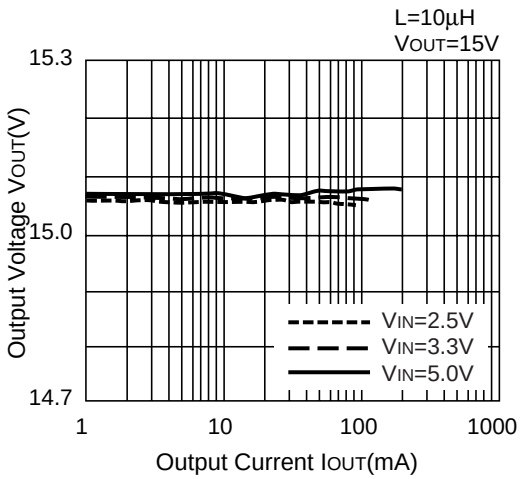
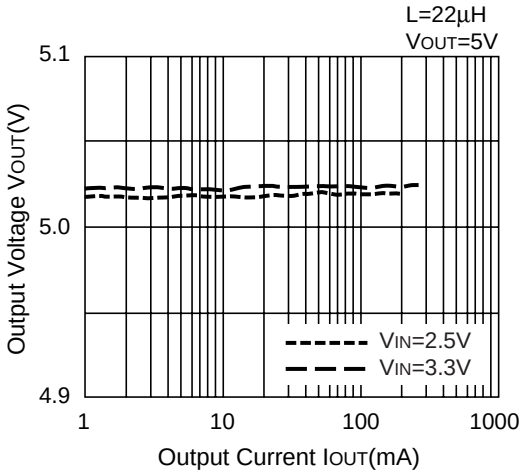


R1211x002C



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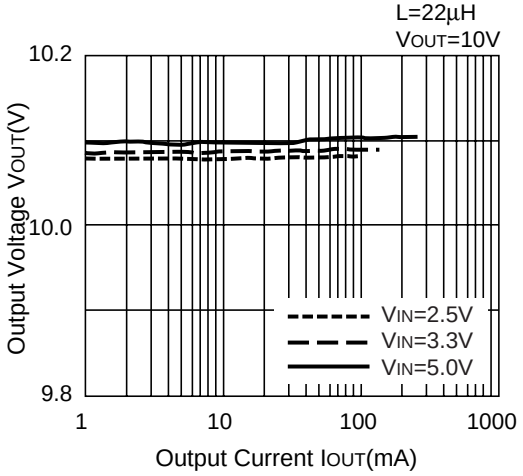

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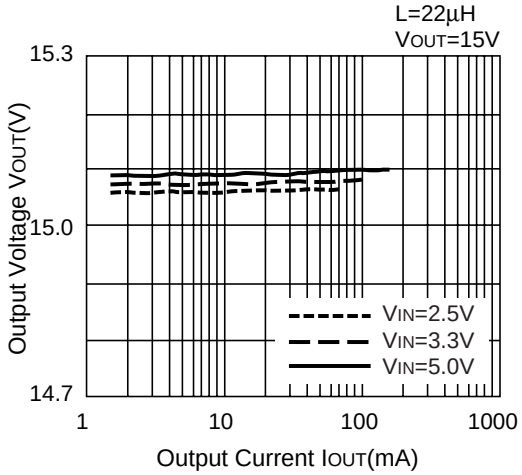
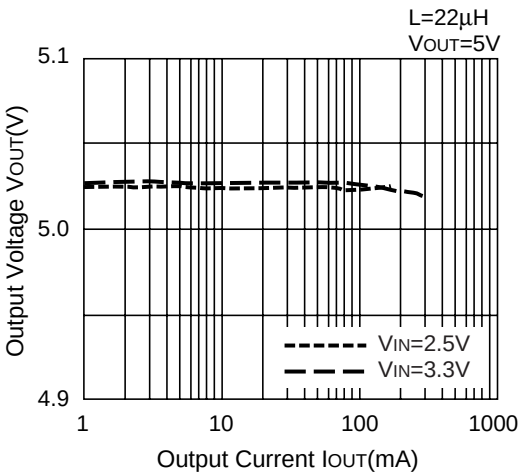


R1211x002D



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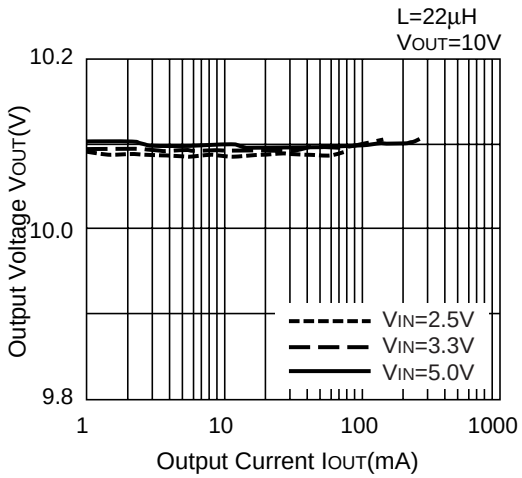

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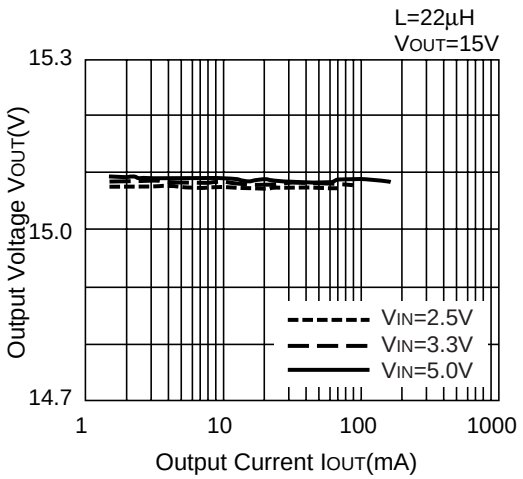
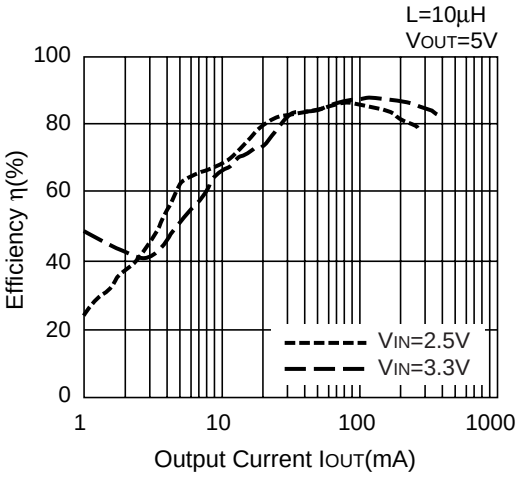
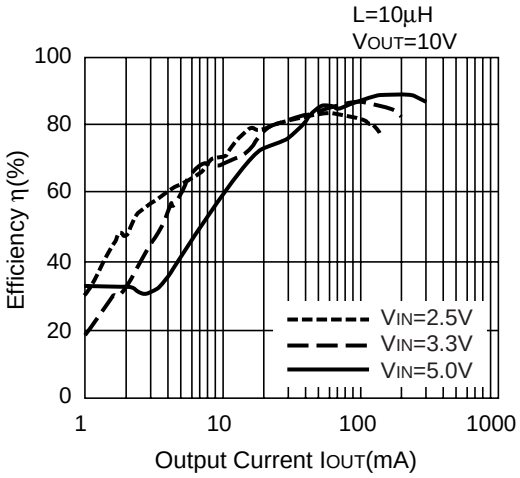


2) Efficiency vs. Output Current

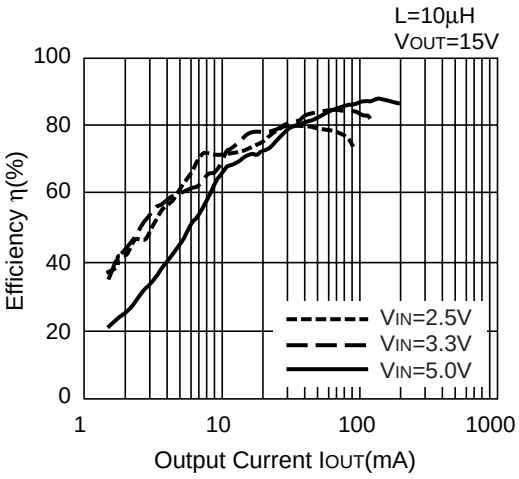
R1211x002A



R1211x002A



R1211x002A



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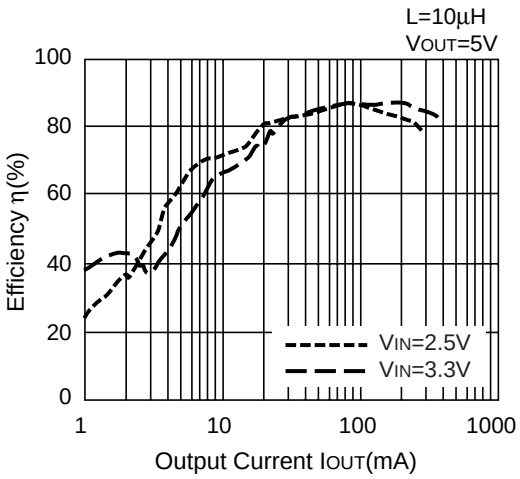
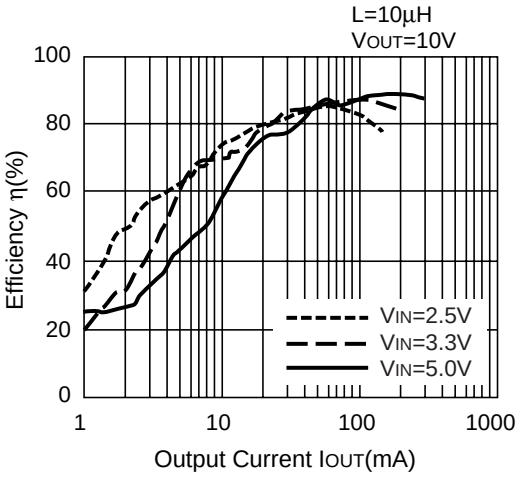


R1211x002B



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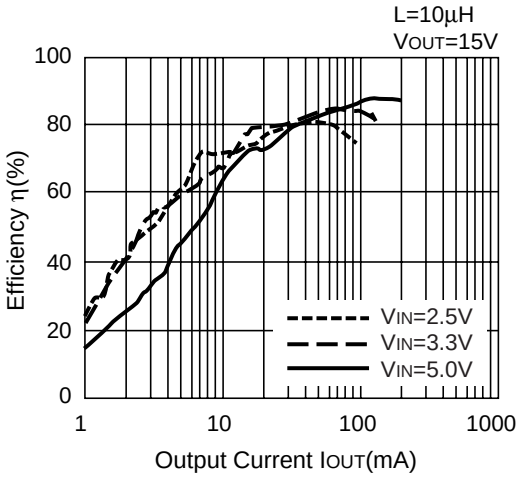
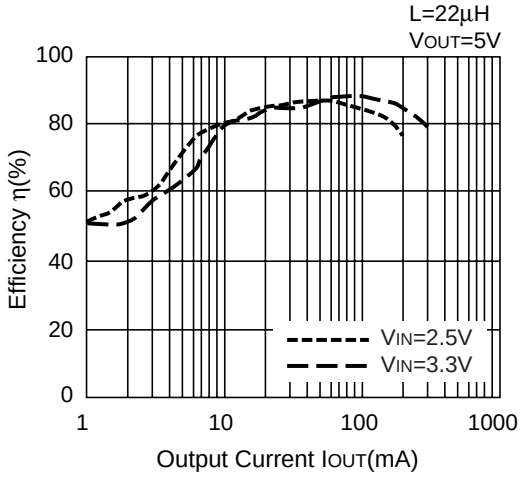
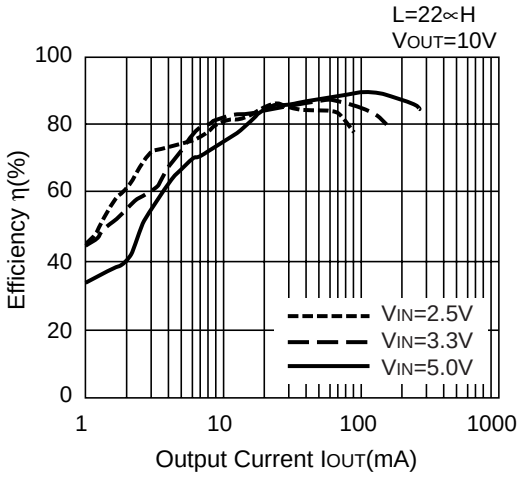


R1211x002C



R1211x002C



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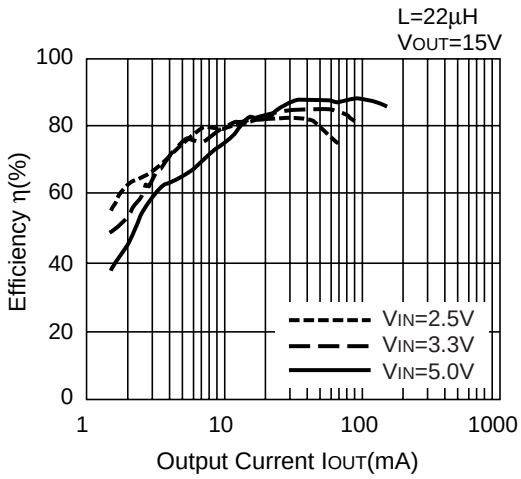

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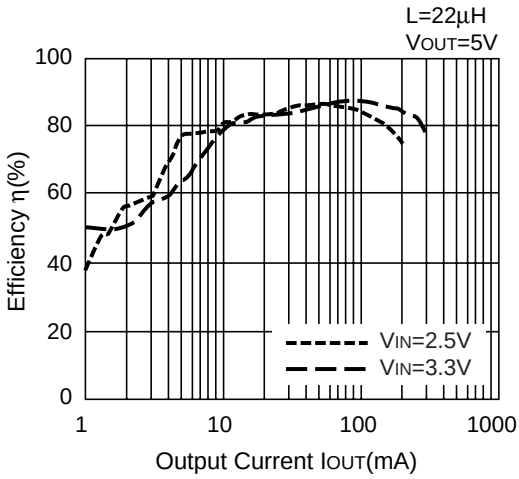

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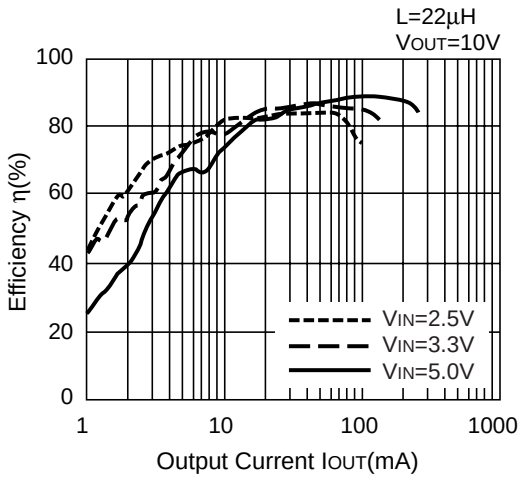

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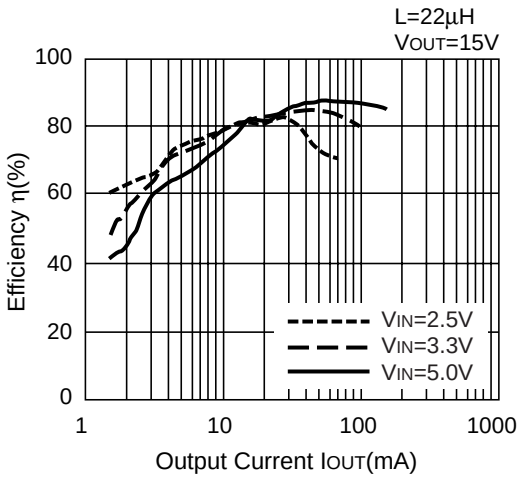
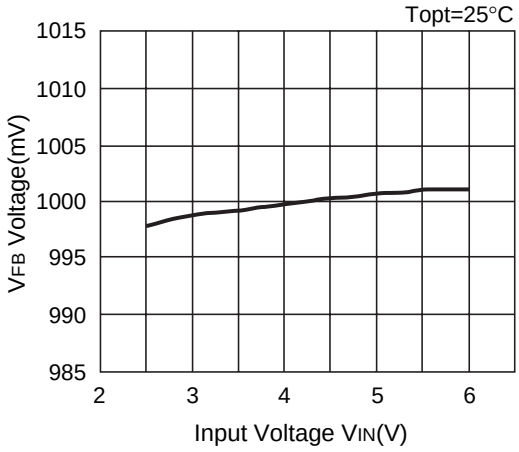


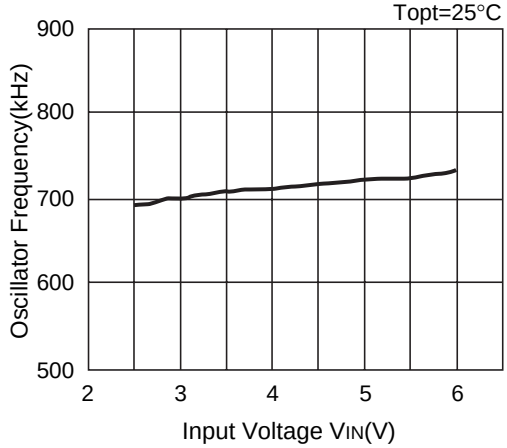
3) V_{FB} Voltage vs. Input Voltage (Topt=25°C)

R1211x002x

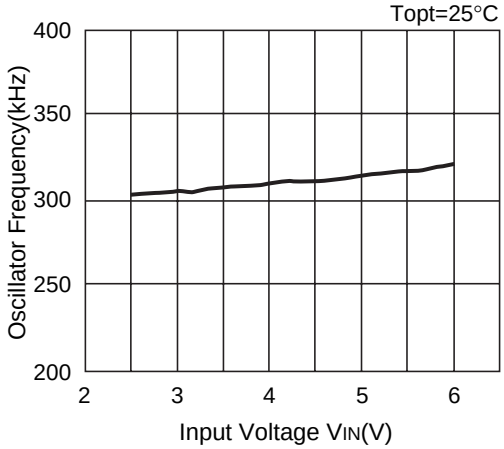


4) Oscillator Frequency vs. Input Voltage (Topt=25°C)

R1211x002A/B

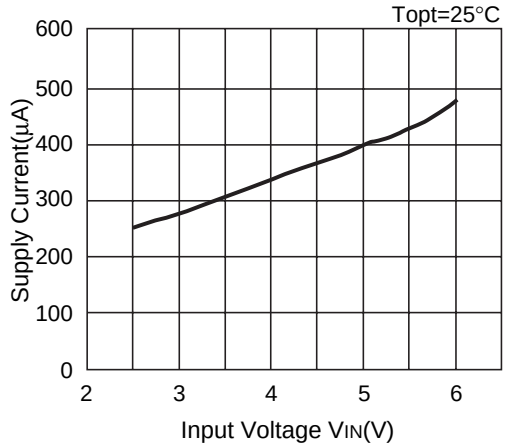


R1211x002C/D

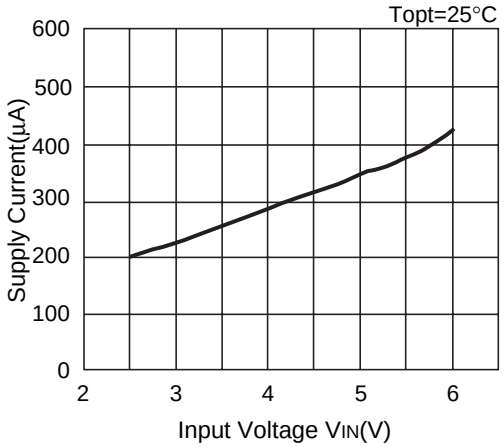


5) Supply Current vs. Input Voltage (Topt=25°C)

R1211x002A



R1211x002B



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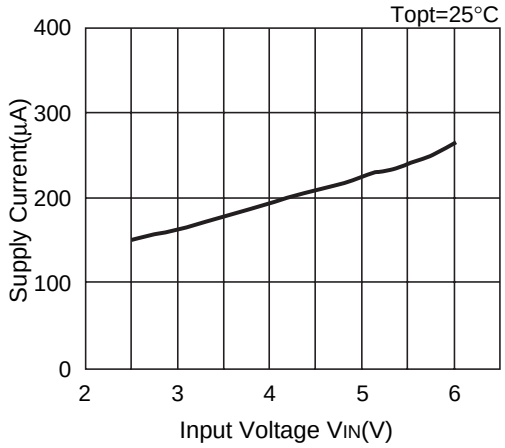

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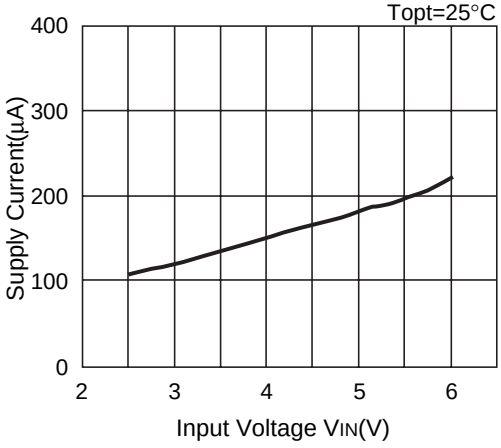
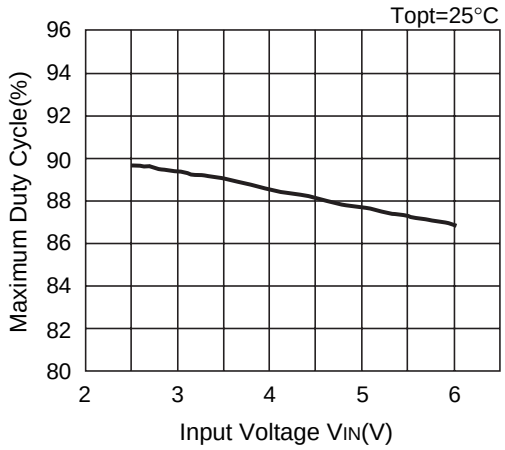
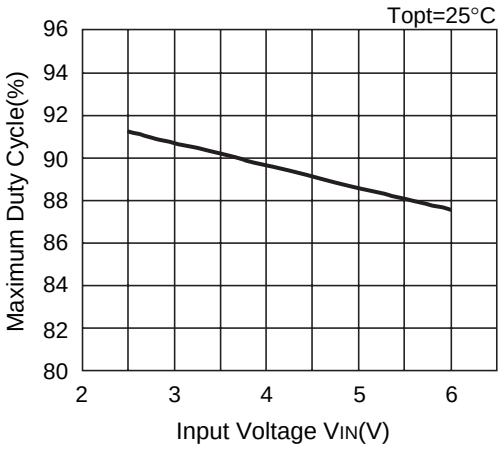


6) Maximum Duty Cycle vs. Input Voltage (Topt=25°C)

R1211x002A/B

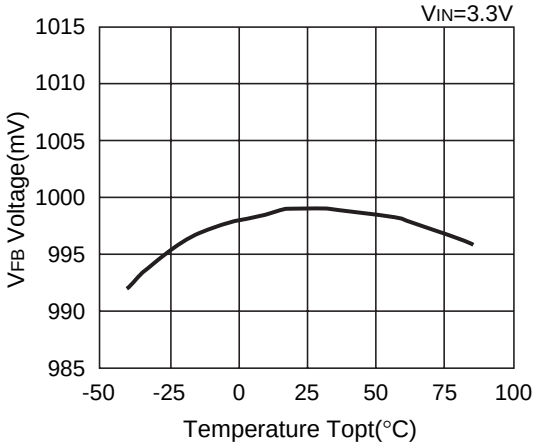


R1211x002C/D



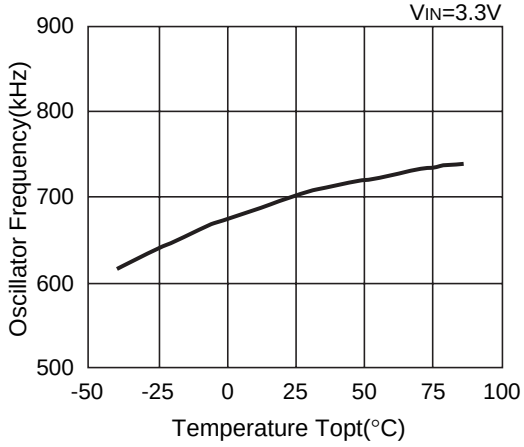
7) V_{FB} Voltage vs. Temperature

R1211x002x

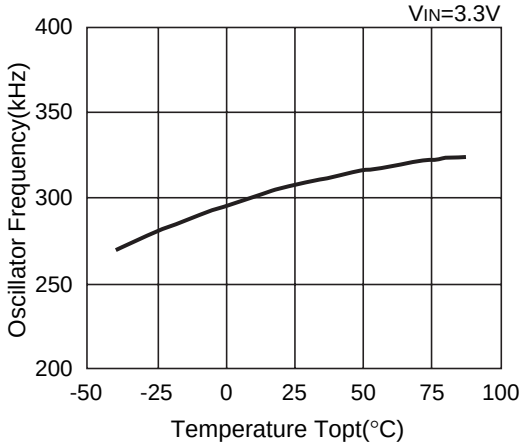


8) Oscillator Frequency vs. Temperature

R1211x002A/B

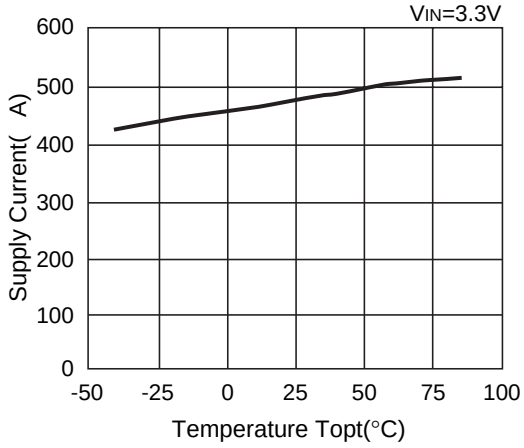


R1211x002C/D

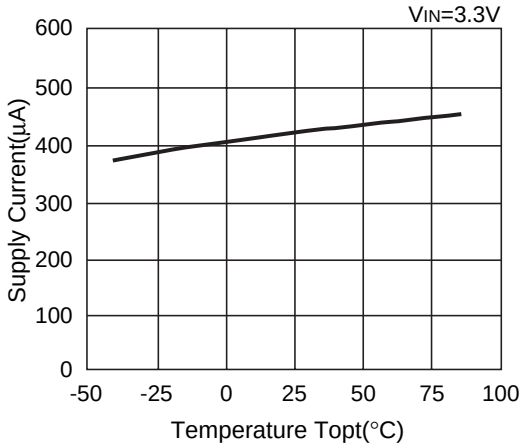


9) Supply Current vs. Temperature

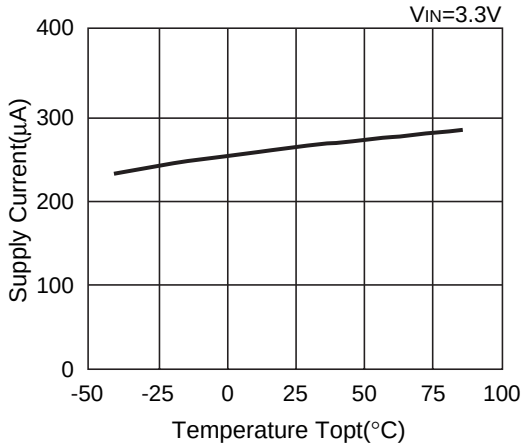
R1211x002A



R1211x002B



R1211x002C



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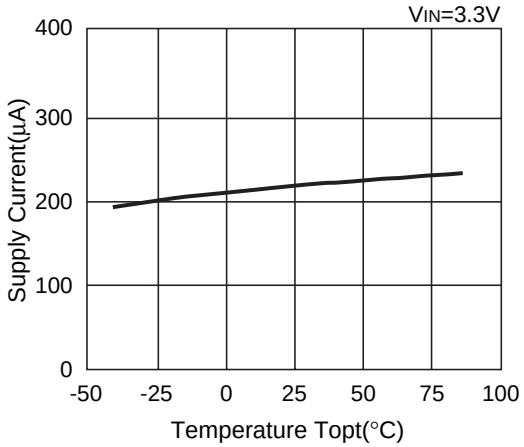
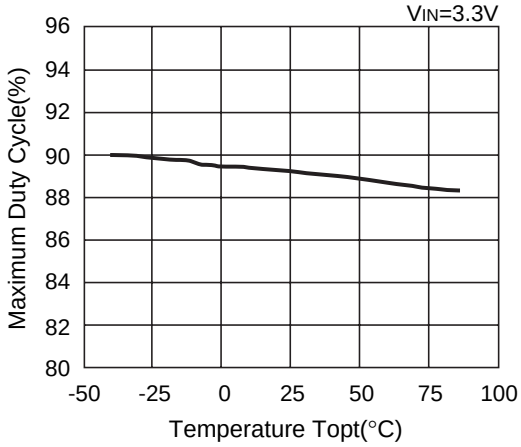
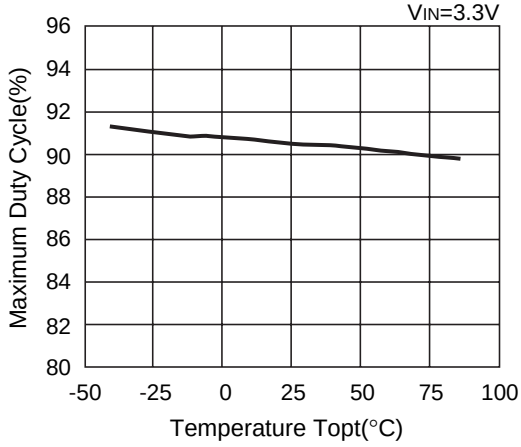


10) Maximum Duty Cycle vs. Temperature

R1211x002A/B

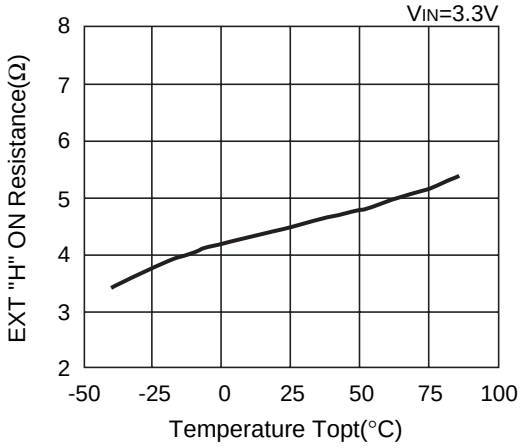


R1211x002C/D



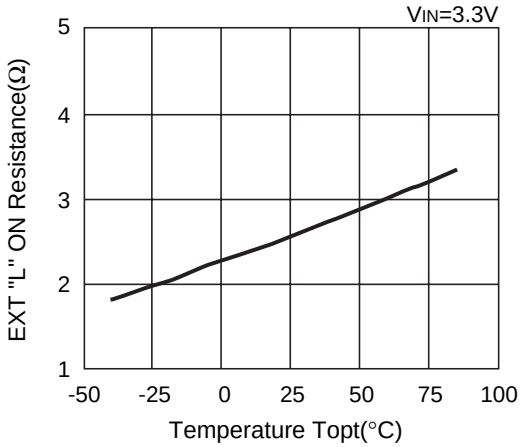
11) EXT "H" On Resistance vs. Temperature

R1211x002x



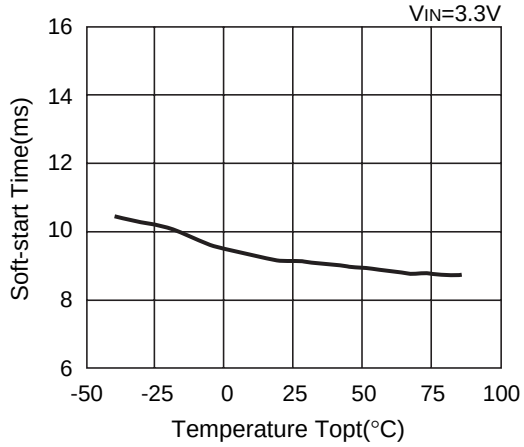
12) EXT "L" On Resistance vs. Temperature

R1211x002x

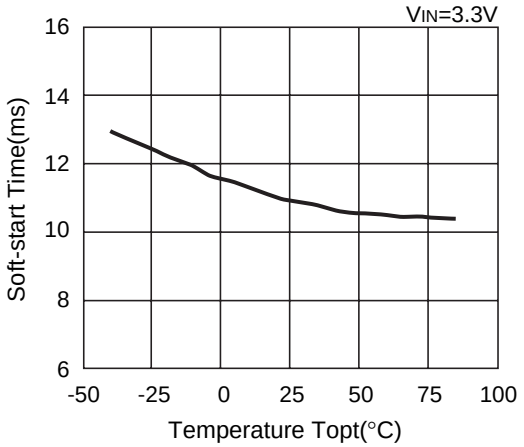


13) Soft-start Time vs. Temperature

R1211x002A/B

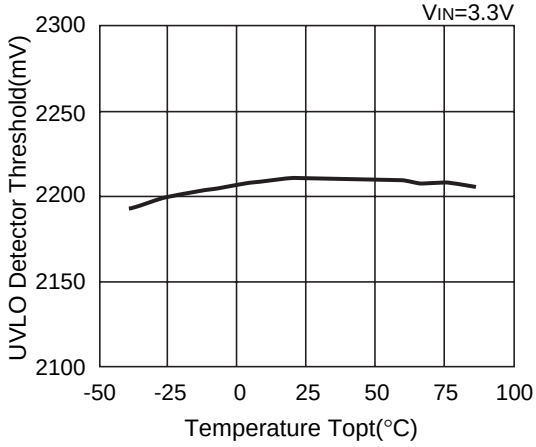


R1211x002C/D



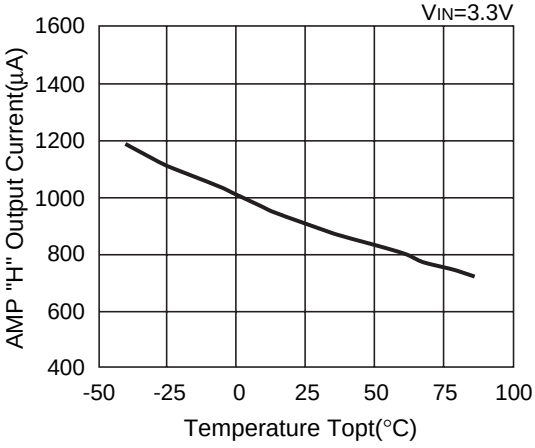
14) UVLO Detector Threshold vs. Temperature

R1211x002x



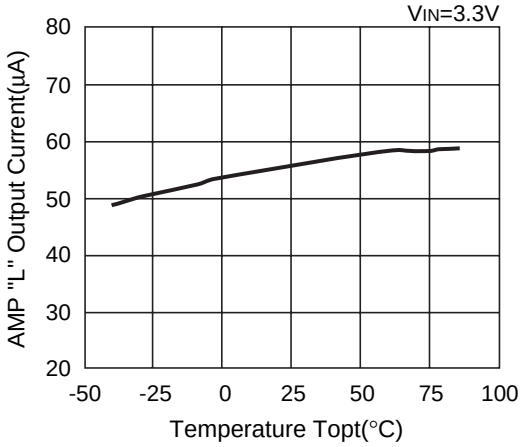
15) AMP "H" Output Current vs. Temperature

R1211x002A/C

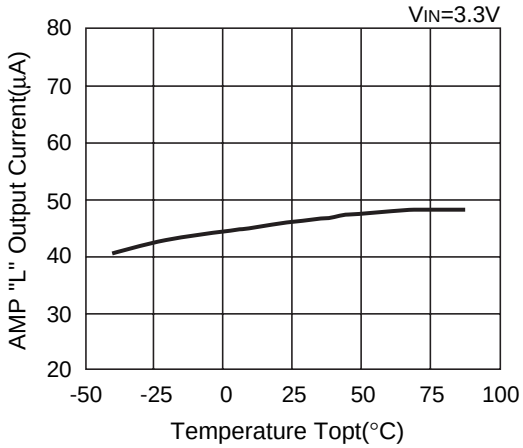


16) AMP "L" Output Current vs. Temperature

R1211x002A

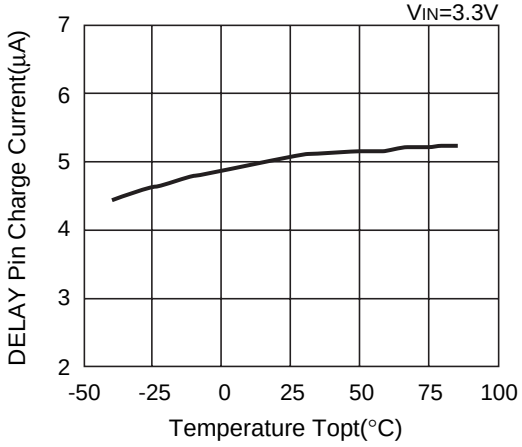


R1211x002C

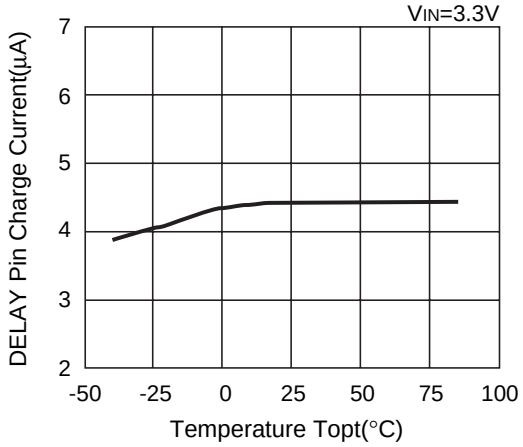


17) DELAY Pin Charge Current vs. Temperature

R1211x002A/B

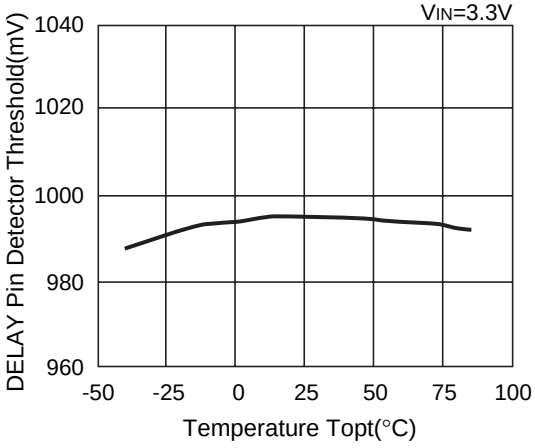


R1211x002C/D



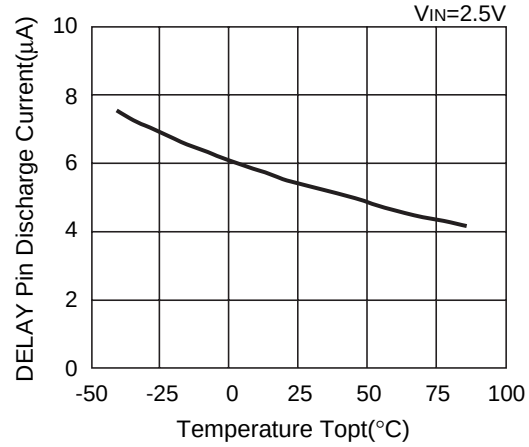
18) DELAY Pin Detector Threshold vs. Temperature

R1211x002x



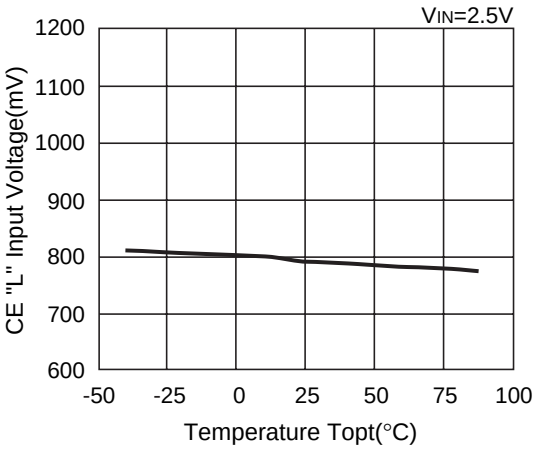
19) DELAY Pin Discharge Current vs. Temperature

R1211x002x



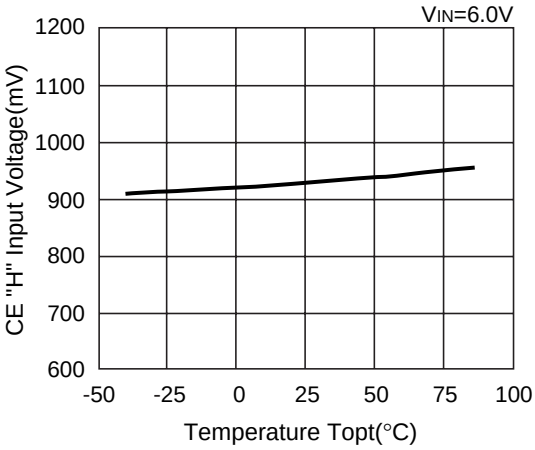
20) CE "L" Input Voltage vs. Temperature

R1211x002B/D



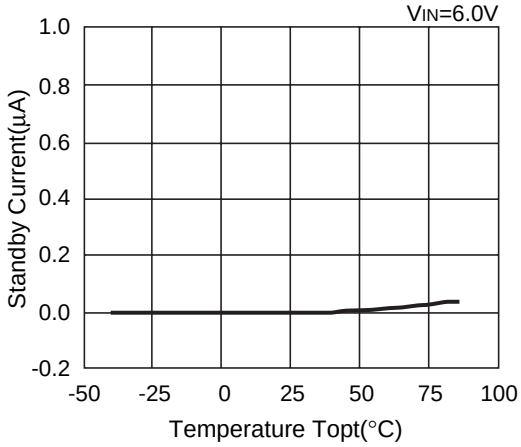
21) CE "H" Input Voltage vs. Temperature

R1211x002B/D



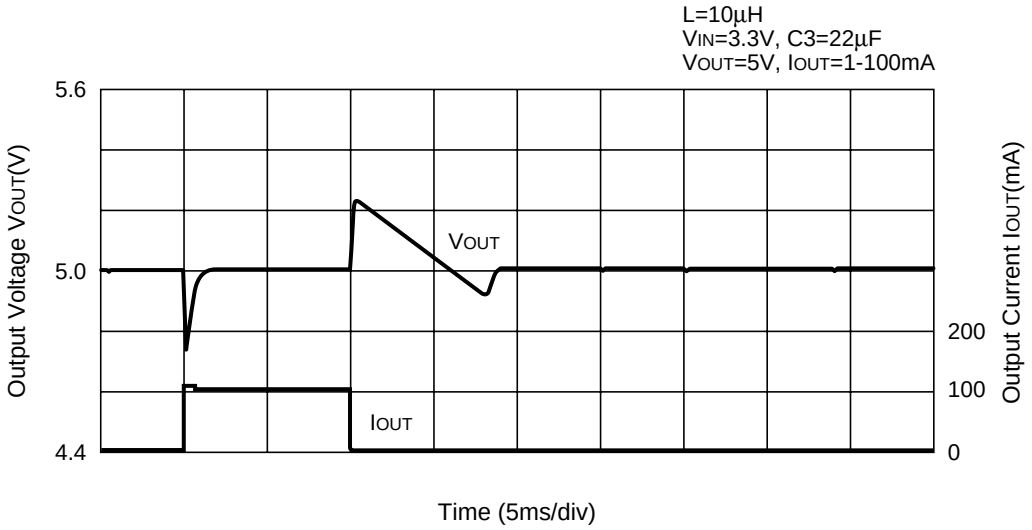
22) Standby Current vs. Temperature

R1211x002B/D



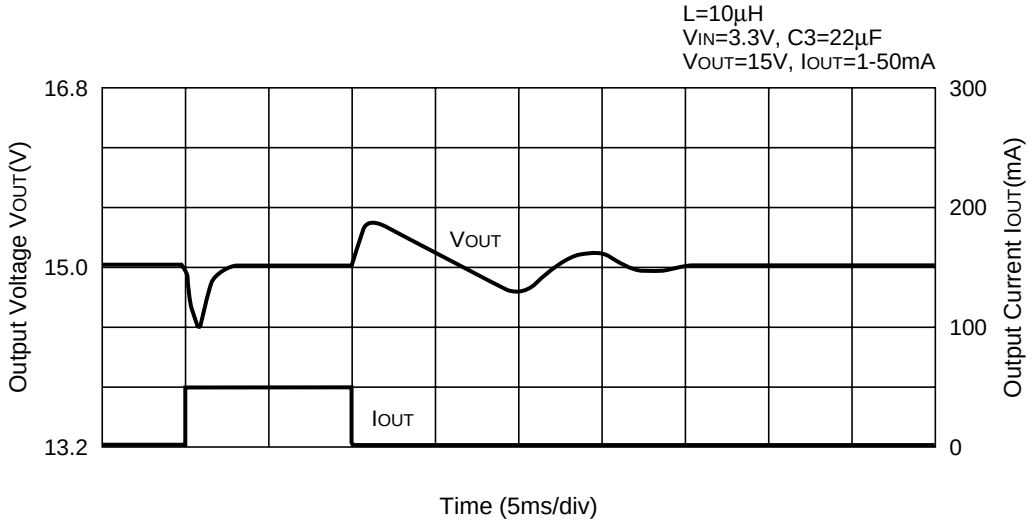
23) Load Transient Response

R1211x002A



R1211x002A

R1211x002A



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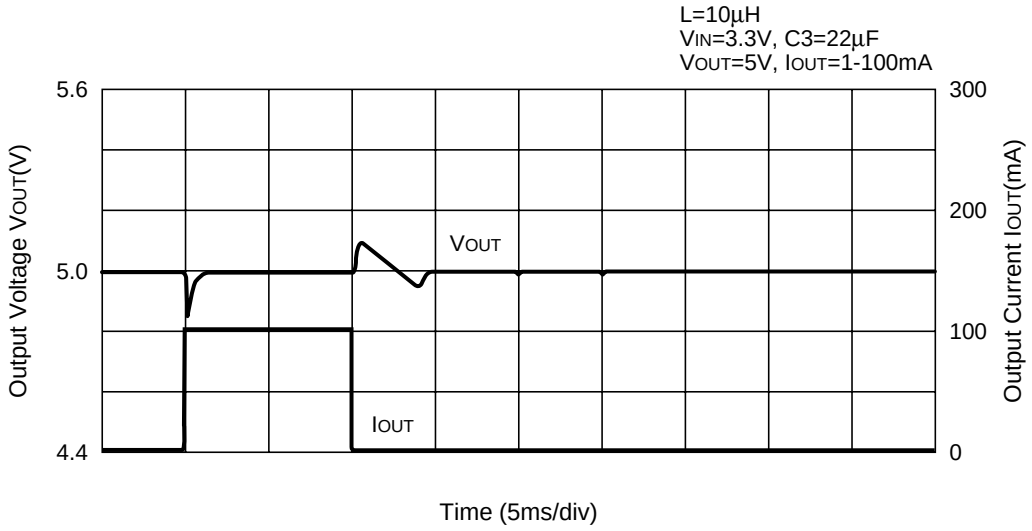

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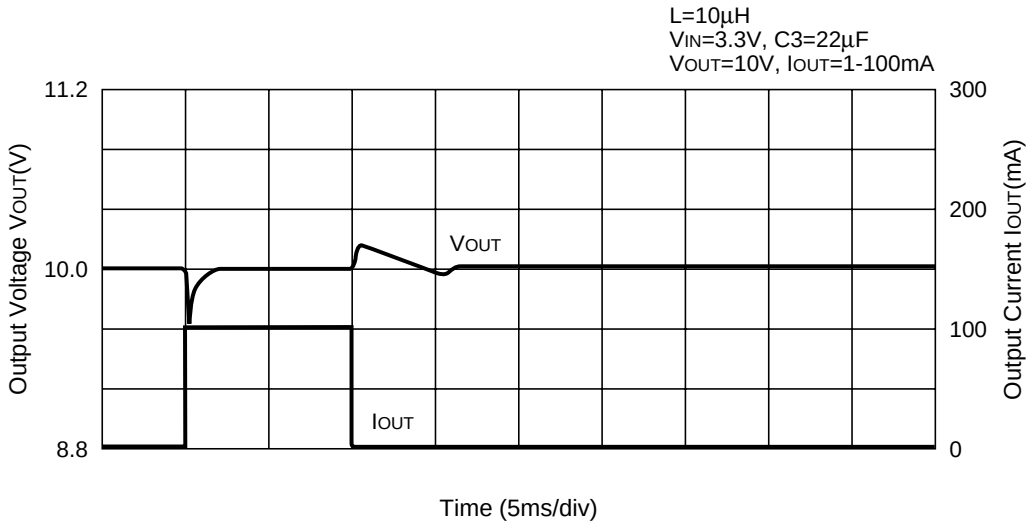

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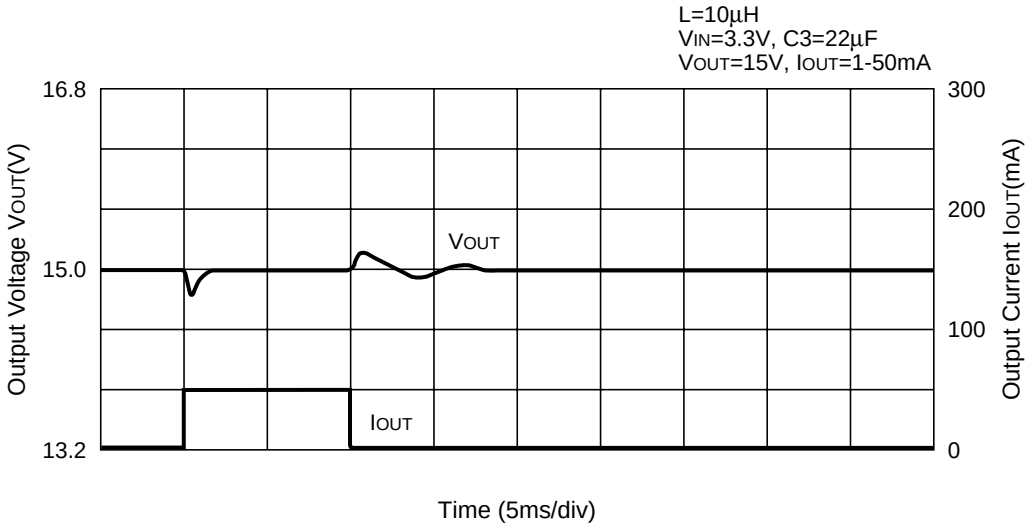

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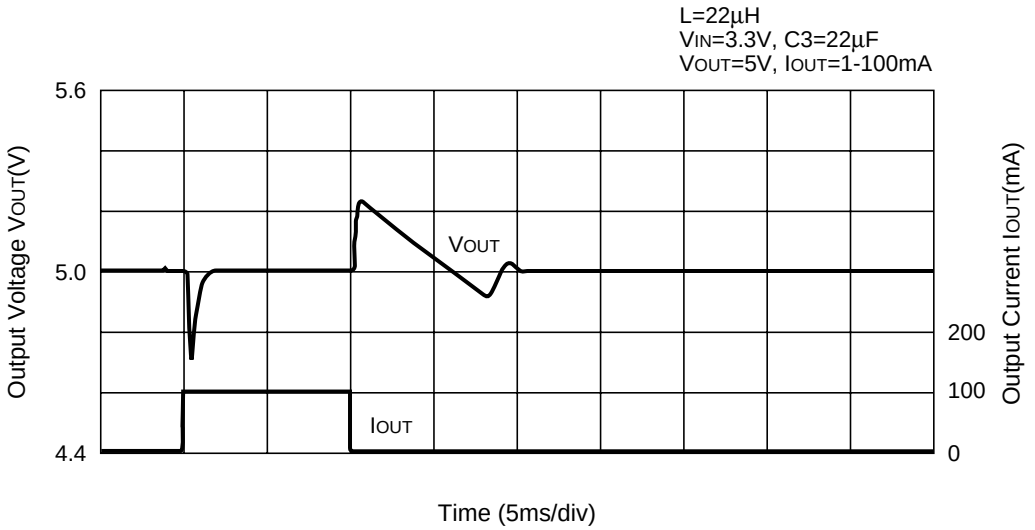

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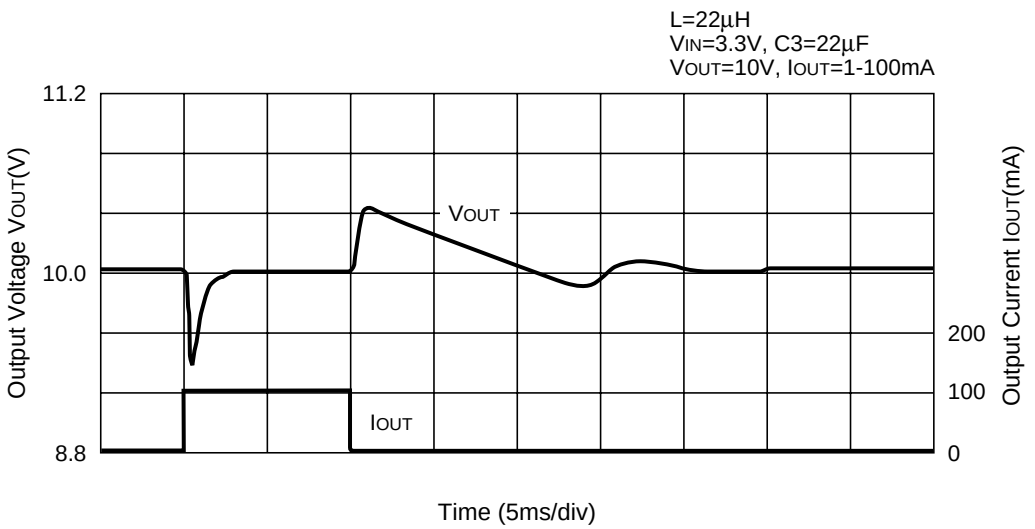
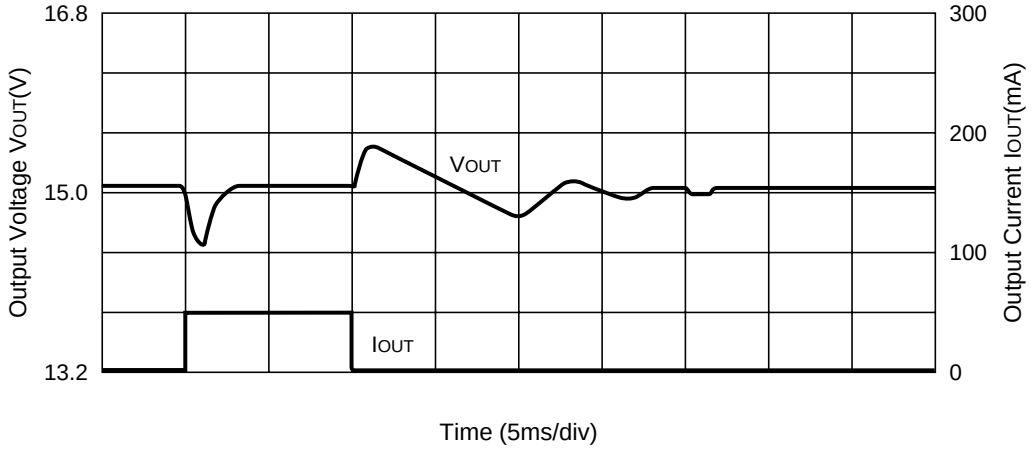


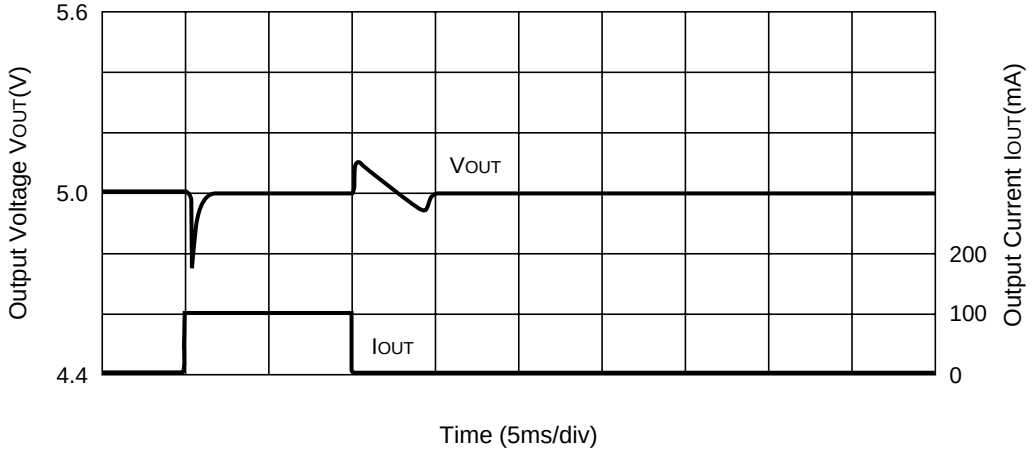
R1211x002C

L=22µH
V_{IN}=3.3V, C3=22µF
V_{OUT}=15V, I_{OUT}=1-50mA



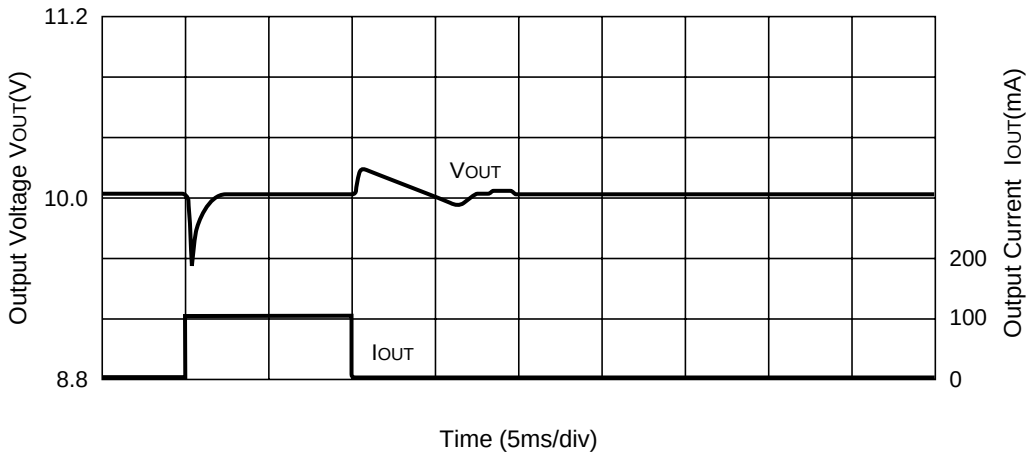
R1211x002D

L=22µH
V_{IN}=3.3V, C3=22µF
V_{OUT}=5V, I_{OUT}=1-100mA

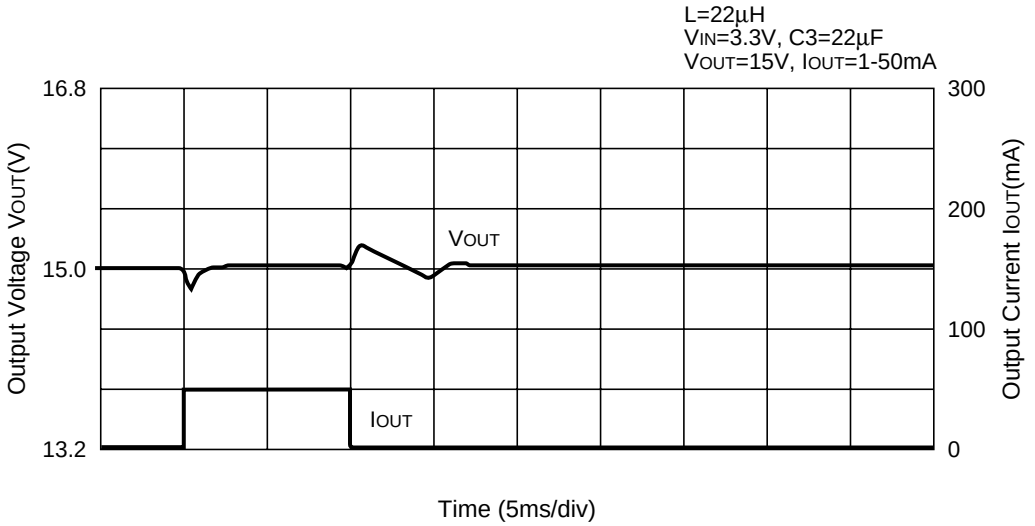


R1211x002D

L=22µH
V_{IN}=3.3V, C3=22µF
V_{OUT}=10V, I_{OUT}=1-100mA

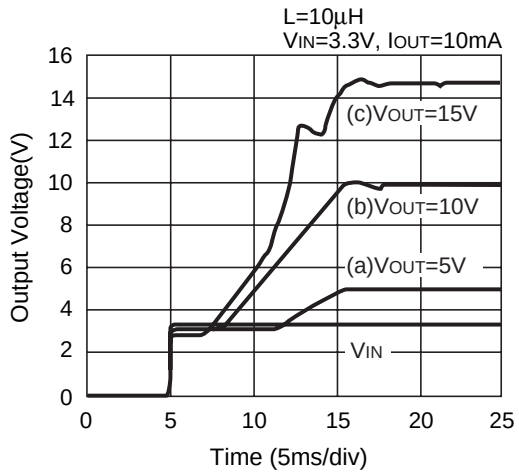


R1211x002D

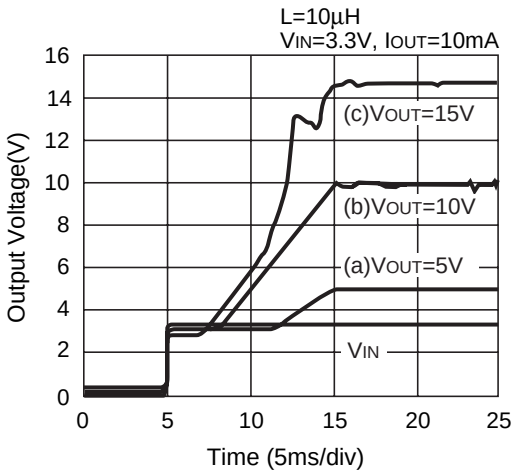


24) Power-on Response

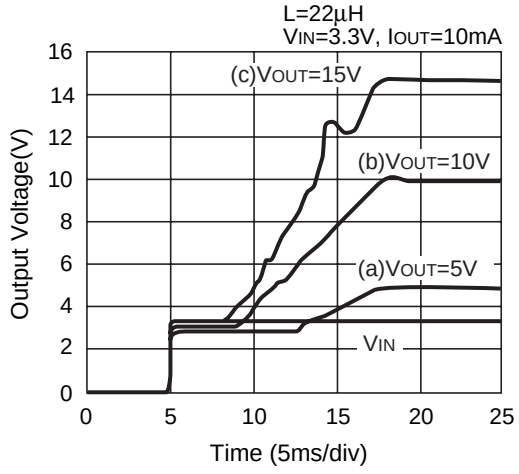
R1211x002A



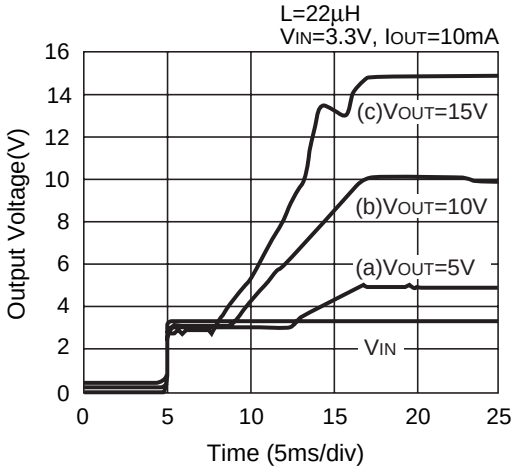
R1211x002B



R1211x002C

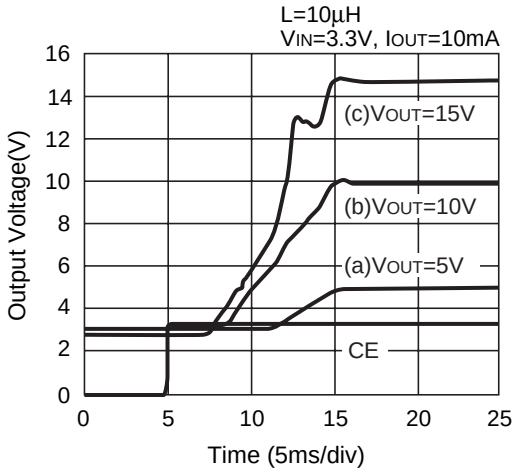


R1211x002D

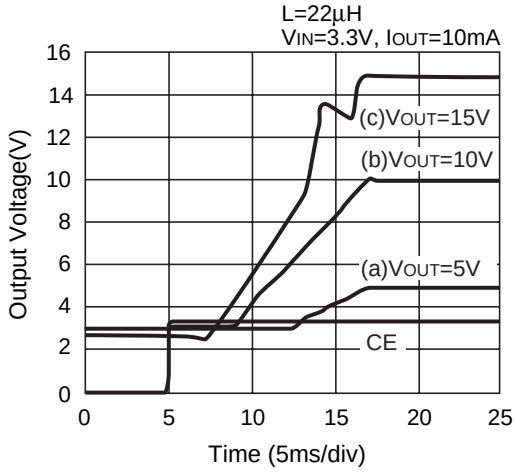


25) Turn-on speed with CE pin

R1211x002B



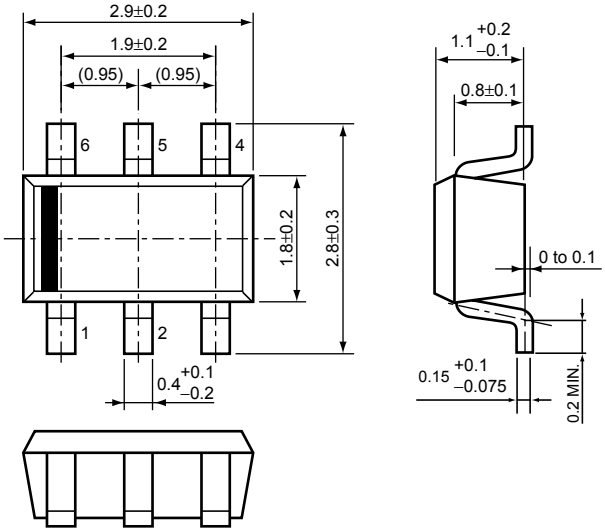
R1211x002D



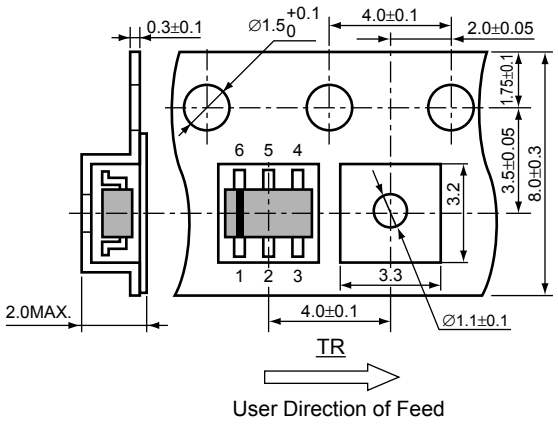
- **SOT-23-6W**

Unit: mm

PACKAGE DIMENSIONS

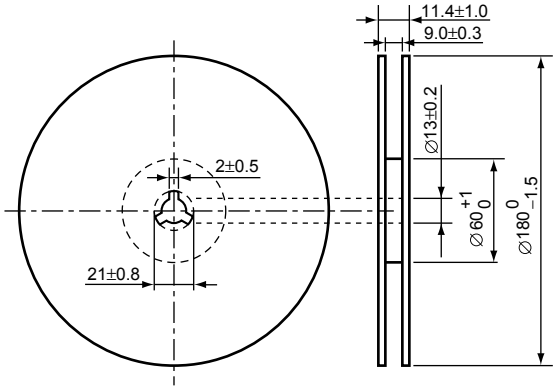


TAPING SPECIFICATION



TAPING REEL DIMENSIONS

(1reel=3000pcs)



POWER DISSIPATION (SOT-23-6W)

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

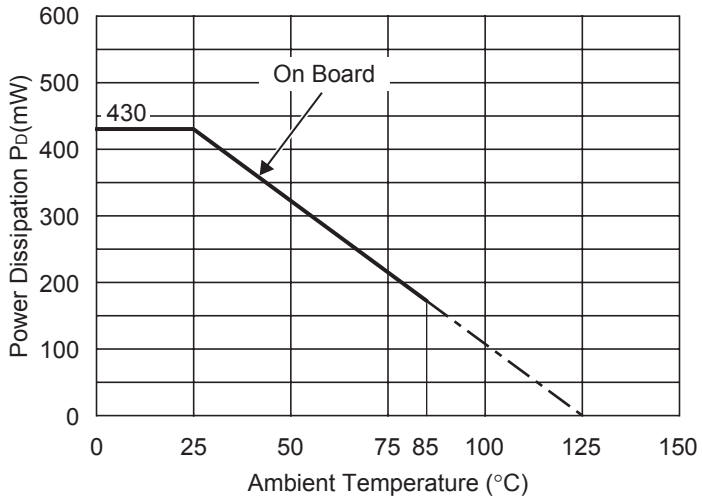
Measurement Conditions

	Standard Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plactic (Double sided)
Board Dimensions	40mm × 40mm × 1.6mm
Copper Ratio	Top side : Approx. 50% , Back side : Approx. 50%
Through-hole	ϕ0.5mm × 44pcs

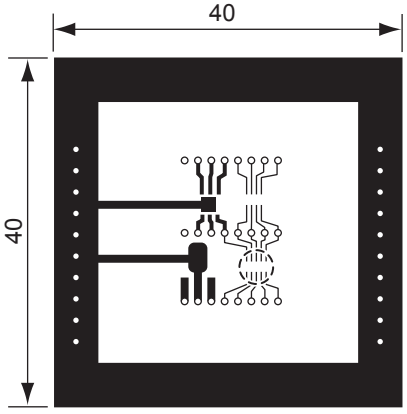
Measurement Result

(Topt=25°C,Tjmax=125°C)

	Standard Land Pattern
Power Dissipation	430mW
Thermal Resistance	θja=(125−25°C)/0.43W=233°C/W



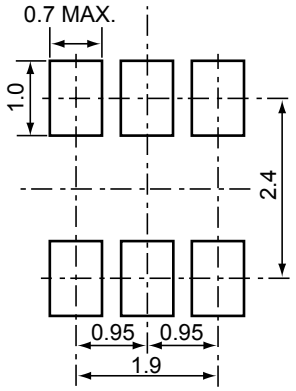
Power Dissipation



Measurement Board Pattern

IC Mount Area Unit : mm

RECOMMENDED LAND PATTERN (SOT-23-6W)

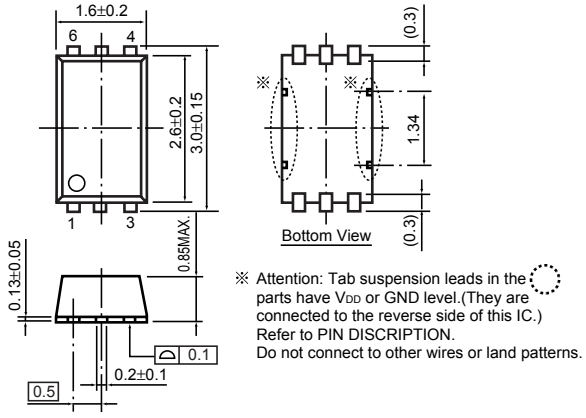


(Unit: mm)

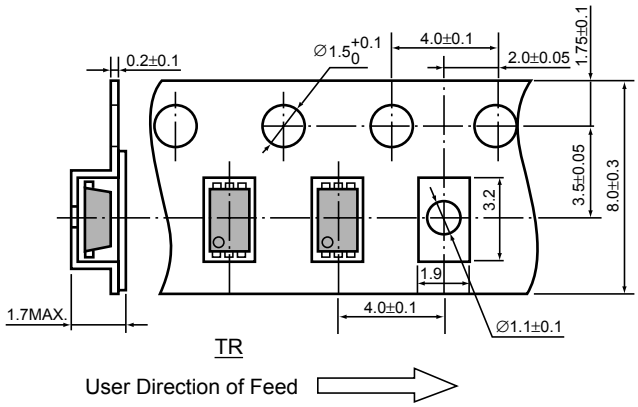
- **SON-6**

Unit: mm

PACKAGE DIMENSIONS

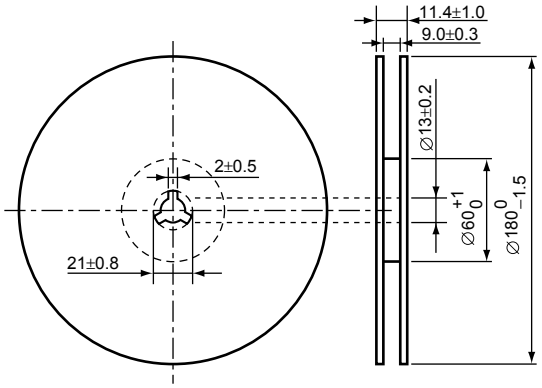


TAPING SPECIFICATION



TAPING REEL DIMENSIONS

(1reel=3000pcs)



POWER DISSIPATION (SON-6)

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

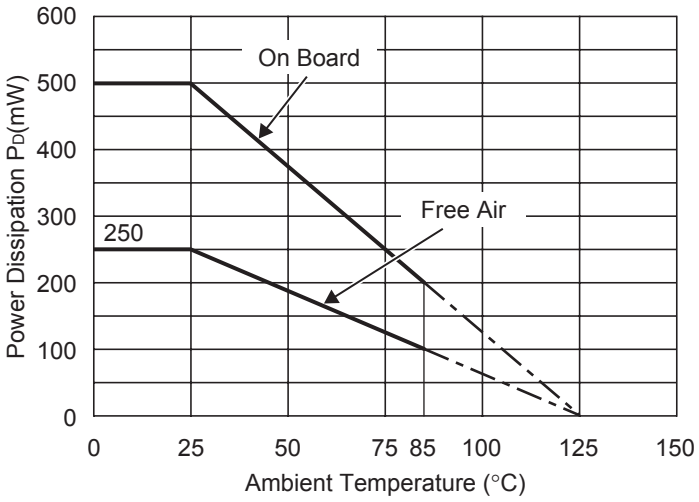
Measurement Conditions

	Standard Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plactic (Double sided)
Board Dimensions	40mm × 40mm × 1.6mm
Copper Ratio	Top side : Approx. 50% , Back side : Approx. 50%
Through-hole	ϕ0.5mm × 44pcs

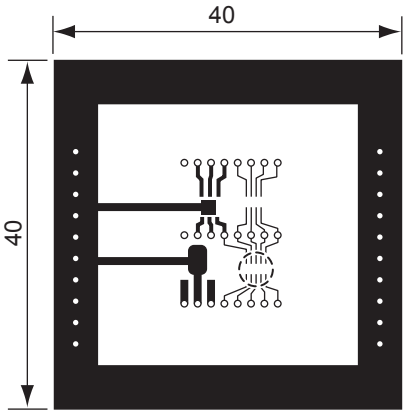
Measurement Result

(Topt=25°C,Tjmax=125°C)

	Standard Land Pattern	Free Air
Power Dissipation	500mW	250mW
Thermal Resistance	θja=(125−25°C)/0.5W=200°C/W	-



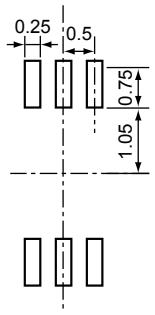
Power Dissipation



Measurement Board Pattern

IC Mount Area (Unit : mm)

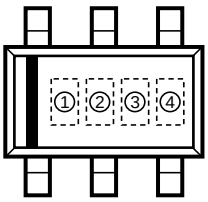
RECOMMENDED LAND PATTERN



(Unit: mm)

R1211N SERIES MARK SPECIFICATION

- **SOT-23-6W**



①, ② : Product Code (refer to Part Number vs. Product Code)

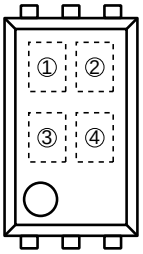
③, ④ : Lot Number

- **Part Number vs. Product Code**

Part Number	Product Code	
	①	②
R1211N002A	L	0
R1211N002B	L	1
R1211N002C	L	2
R1211N002D	L	3

R1211D SERIES MARK SPECIFICATION

- **SON-6**



①, ② : Product Code (refer to Part Number vs. Product Code)

③, ④ : Lot Number

- **Part Number vs. Product Code**

Part Number	Product Code	
	①	②
R1211D002A	L	0
R1211D002B	L	1
R1211D002C	L	2
R1211D002D	L	3
R1211D100A	L	4
R1211D101A	L	5

Part Number	Product Code	
	①	②
R1211D102A	L	6
R1211D101C	L	7
R1211D102C	L	8
R1211D103A	L	9
R1211D103C	L	A
R1211D104A	L	B

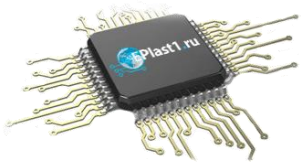
Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

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