RICOH R1202x Series

STEP-UP DC/DC CONVERTER with SHUTDOWN FUNCTION

NO.EA-255-180703

OUTLINE

The R1202x Series are CMOS-based PWM step-up DC/DC converter ICs with low supply current.

Each of these ICs consists of an NMOS FET, NPN transistor, an oscillator, a PWM comparator, a voltage reference unit, an error amplifier, a current limit circuit, an under voltage lockout circuit (UVLO), an over-voltage protection circuit (OVP), a soft-start circuit, a Maxduty limit circuit, and a thermal shutdown protection circuit. By simply using an inductor, a resistor, and capacitors as external components, a high-efficiency step-up DC/DC converter can be easily configured. At the standby mode, a rectifier transistor can separate the output from the input.

The R1202x Series include a thermal shut-down circuit and an under-voltage lockout circuit (UVLO) which separate the output from the input to shut down the current when the overheat caused when the output is connected to the Gnd is detected and also during the UVLO detection. As other protection functions, the R1202x Series contain a cycle by cycle current limit circuit that limits the Lx peak current, and an over-voltage protection circuit (OVP) that detects the output overvoltage.

The R1202x Series offer three versions: the R1202xxxxA/B versions, which are optimized for constant-voltage power supply and the R1202xxxxD version, which is optimized to drive serial white LEDs with constant current. While the R1202xxxxA version discharges the V_{OUT} output to 0V at the shutdown, the R1202xxxxB version doesn't. The brightness of the white LEDs can be adjusted quickly by applying a PWM signal (200Hz to 300kHz) to the CE pin.

The R1202x Series are available in DFN1616-6B and TSOT-23-6 packages.

FEATURES

- Input Voltage Range .... 2.3V to 5.5V (R1202xxxxA/B)
  1.8V to 5.5V (R1202xxxxD)
- Supply Current .... Typ. 800µA
- Standby Current .... Max. 5µA
- Feedback Voltage .... 1.0V±15mV (R1202xxxxA/B)
  0.2V±10mV (R1202xxxxD)
- Oscillator Frequency .... Typ. 1.2MHz
- Maximum Duty Cycle .... Typ. 91%
- UVLO Function Typ.2.0V (Hys.Typ.0.2V) (R1202xxxxA/B)
  Typ.1.6V (Hys.Typ.0.1V) (R1202xxxxD)
- Lx Current Limit Function .... Select from 350mA, 700mA
- Over Voltage Protection .... Select from 14V-23V (Refer the Selection Guide)
- LED dimming control for R1202xxxxD .... by external PWM signal (Frequency 200Hz to 300kHz)
- Thermal Protection Function .... Typ.150ºC(Hys.Typ.50ºC)
- Built-in Auto Discharge Function R1202xxxxA
- NMOS ON Resistance 1.35Ω
- Packages DFN1616-6B, TSOT-23-6

APPLICATION

- Constant Voltage Power Source for portable equipment
- OLED power supply for portable equipment
- White LED Backlight for portable equipment

SELECTION GUIDE

The OVP threshold voltage, current limit, package and V_{FB}/Auto discharge are user-selectable options.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1202Lyz1∗-TR	DFN1616-6B	5,000 pcs	Yes	Yes
R1202Nyz3∗-TR-FE	TSOT-23-6	3,000 pcs	Yes	Yes

y : Designation of OVP threshold
- (3) 14V : R1202xxxxA/B/D
- (4) 17V : R1202xxxxA/B
- (5) 19V : R1202xxxxA/B
- (6) 21V : R1202xxxxA/B
- (7) 23V : R1202xxxxA/B/D

z : Designation of current limit
- (1) 350mA
- (2) 700mA

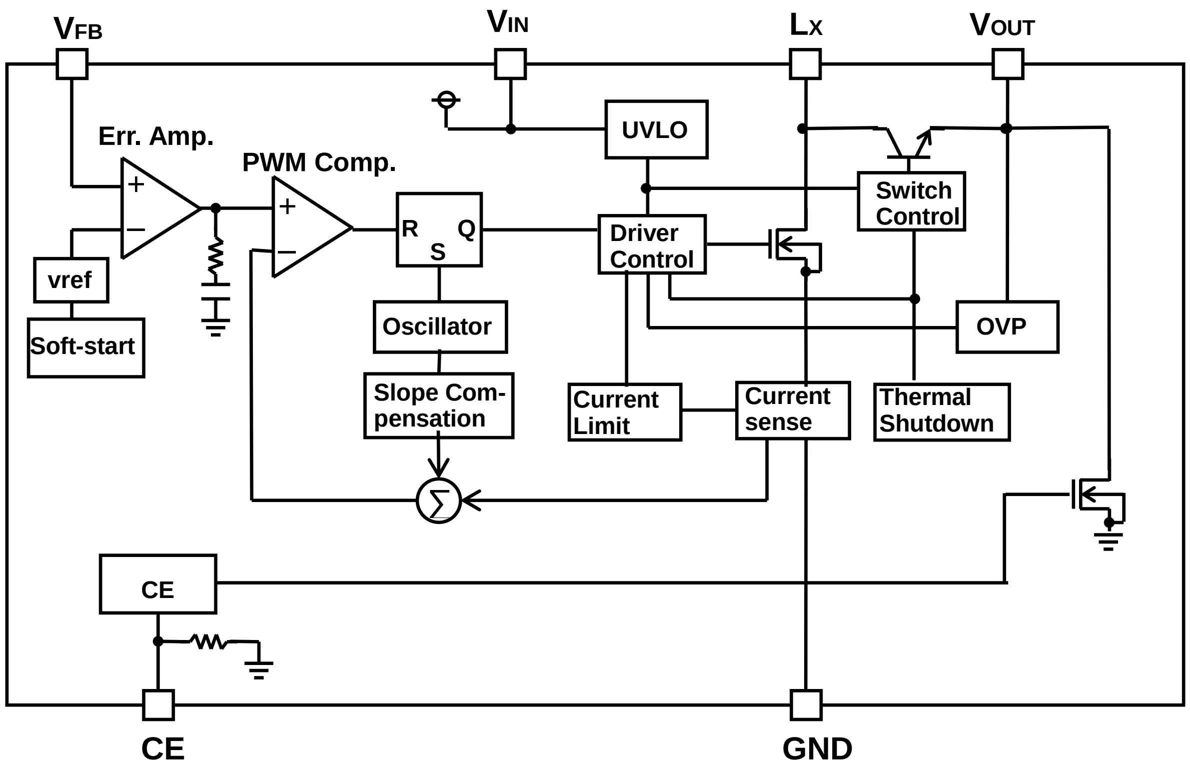
∗ : Designation of VFB, auto discharge function

	VFB	Auto discharge
A	1.0V	○
B	1.0V	×
D	0.2V	×

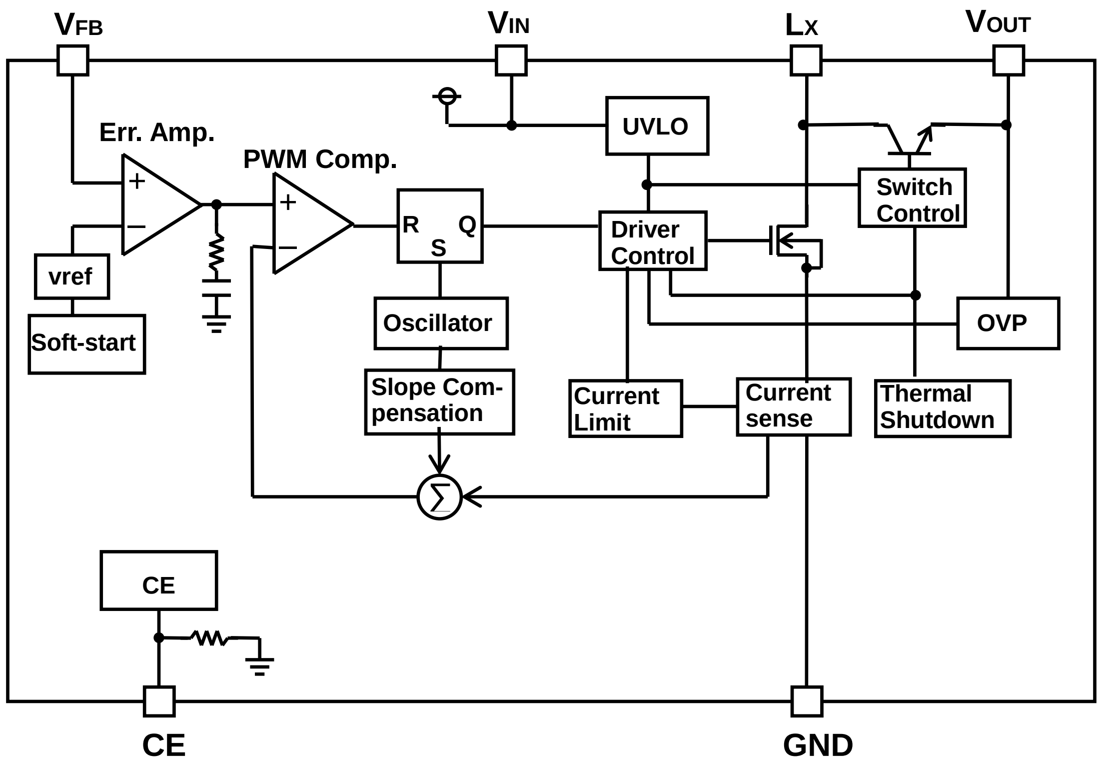
Auto-discharge function quickly lowers the output voltage to 0V, when the chip enable signal is switched from the active mode to the standby mode, by releasing the electrical charge accumulated in the external capacitor.

BLOCK DIAGRAMS

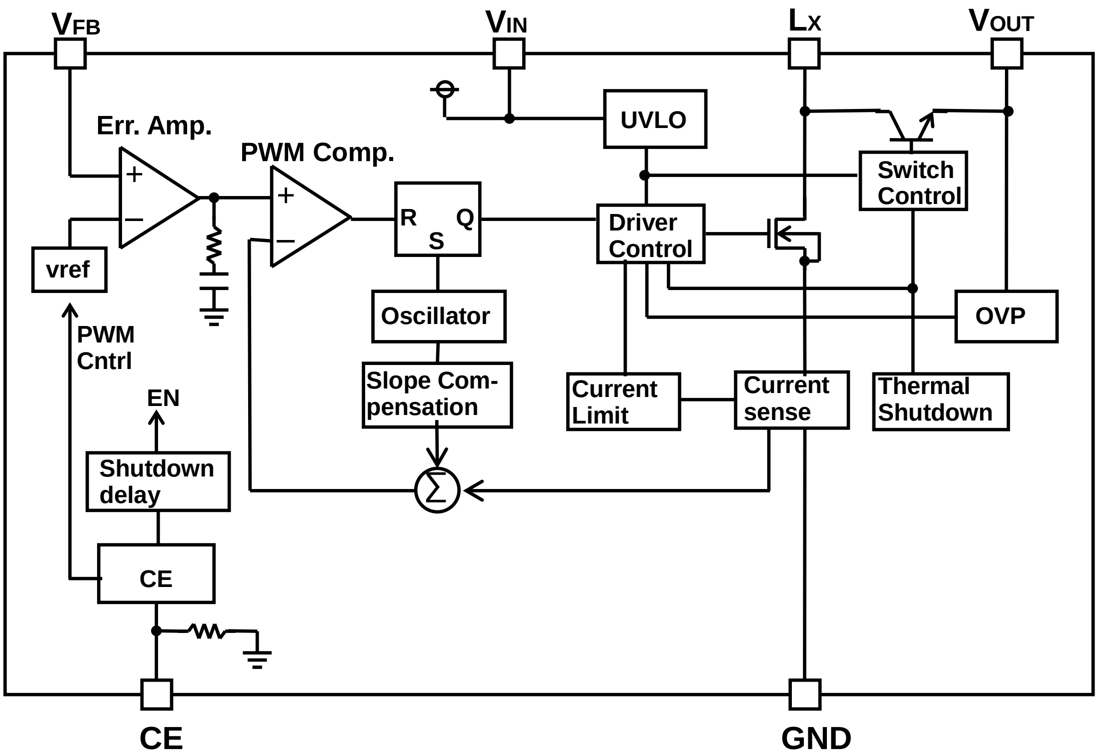
R1202xxxxA



R1202xxxxB

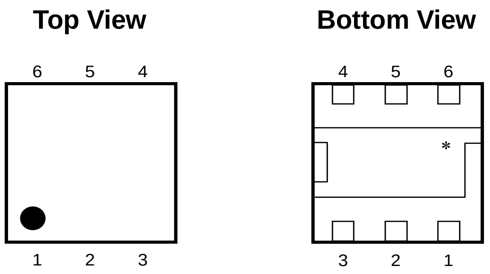


R1202xxxxD

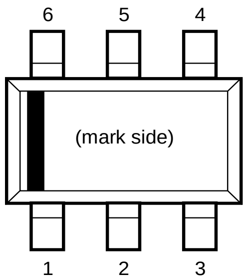

VFB
VIN
LX
VOUT
Err. Amp.
PWM Comp.
UVLO
Switch Control
R
Q
S
Driver Control
vref
Oscillator
OVP
PWM Cntrl
Slope Com-pensation
Current Limit
Current sense
Thermal Shutdown
EN
Shutdown delay
CE
CE
GND

PIN DESCRIPTIONS

● DFN1616-6B



● TSOT-23-6



DFN1616-6B

Pin No	Symbol	Pin Description
1	CE	Chip Enable Pin ("H" Active)
2	V_{FB}	Feedback Pin
3	L_X	Switching Pin (Open Drain Output)
4	GND	Ground Pin
5	V_{IN}	Input Pin
6	V_{OUT}	Output Pin

∗) The tab is substrate level (GND). The tab is better to be connected to the GND, but leaving it open is also acceptable.

TSOT-23-6

Pin No	Symbol	Pin Description
1	CE	Chip Enable Pin ("H" Active)
2	V_{OUT}	Output Pin
3	V_{IN}	Input Pin
4	L_X	Switching Pin (Open Drain Output)
5	GND	Ground Pin
6	V_{FB}	Feedback Pin

ABSOLUTE MAXIMUM RATINGS

(GND=0V)

<table>
<tr><th>Symbol</th><th colspan="2">Item</th><th>Rating</th><th>Unit</th></tr>
<tr><td>V_{IN}</td><td colspan="2">V_{IN} Pin Voltage</td><td>-0.3 to 6.5</td><td>V</td></tr>
<tr><td>V_{CE}</td><td colspan="2">CE Pin Voltage</td><td>-0.3 to 6.5</td><td>V</td></tr>
<tr><td>V_{FB}</td><td colspan="2">V_{FB} Pin Voltage</td><td>-0.3 to 6.5</td><td>V</td></tr>
<tr><td>V_{OUT}</td><td colspan="2">V_{OUT} Pin Voltage</td><td>-0.3 to 25</td><td>V</td></tr>
<tr><td>V_{LX}</td><td colspan="2">L_X Pin Voltage</td><td>-0.3 to 25</td><td>V</td></tr>
<tr><td>I_{LX}</td><td colspan="2">L_X Pin Current</td><td>1000</td><td>mA</td></tr>
<tr><td rowspan="2">P_D</td><td rowspan="2">Power Dissipation *</td><td>DFN1616-6B
(JEDEC STD. 51-7 Test Land Pattern)</td><td>2400</td><td rowspan="2">mW</td></tr>
<tr><td>TSOT-23-6 (Standard Test Land Pattern)</td><td>460</td></tr>
<tr><td>Tj</td><td colspan="2">Junction Temperature Range</td><td>-40 to 125</td><td>°C</td></tr>
<tr><td>Tstg</td><td colspan="2">Storage Temperature Range</td><td>-55 to 125</td><td>°C</td></tr>
</table>

∗) Refer to *POWER DISSIPATION* for detailed 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

<table>
<tr><th>Symbol</th><th>Item</th><th colspan="2">Rating</th><th>Unit</th></tr>
<tr><td rowspan="2">V_{IN}</td><td rowspan="2">Operating Input Voltage</td><td>R1202xxxxA/B</td><td>2.3 V to 5.5 V</td><td>V</td></tr>
<tr><td>R1202xxxxD</td><td>1.8 V to 5.5 V</td><td>V</td></tr>
<tr><td>Ta</td><td>Operating Temperature Range</td><td colspan="2">−40 to 85</td><td>°C</td></tr>
</table>

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

ELECTRICAL CHARACTERISTICS

R1202x (Ta=25°C)

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
I_{DD}	Supply Current	V_{IN}=5.5V , V_{FB}=0V , L_X at no load			0.8	1.2	mA
$I_{standby}$	Standby Current	V_{IN}=5.5V , V_{CE}=0V			1.0	5.0	μA
V_{UVLO1}	UVLO Detect Threshold Voltage	V_{IN} falling	R1202xxxxA/B	1.9	2.0	2.1	V
			R1202xxxxD	1.5	1.6	1.7	V
V_{UVLO2}	UVLO Release Voltage	V_{IN} rising	R1202xxxxA/B		V_{UVLO1} +0.2	2.3	V
			R1202xxxxD		V_{UVLO1} +0.1	1.8	V
V_{CEH}	CE Input Voltage "H"	V_{IN}=5.5V		1.5			V
V_{CEL}	CE Input Voltage "L"					0.5	V
R_{CE}	CE Pull Down Resistance				1200		kΩ
V_{FB}	V_{FB} Voltage Accuracy	V_{CE}=3.6V	R1202xxxxA/B	0.985	1.000	1.015	V
			R1202xxxxD	0.19	0.2	0.21	
$\Delta V_{FB}/\Delta Ta$	V_{FB} Voltage Temperature Coefficient	V_{CE}=3.6V, -40°C $\leqq$ Ta $\leqq$ 85°C			±150		ppm/°C
I_{FB}	V_{FB} Input Current	V_{IN}=5.5V, V_{FB}=0V or 5.5V		-0.1		0.1	μA
t_{start}	Soft-start Time	*R1202xxxxA/B			2.0		ms
R_{ON}	Driver ON Resistance	V_{CE}=3.6V, I_{LX}=100mA			1.35		Ω
I_{OFF}	Driver Leakage Current	V_{LX}=22V				3.0	μA
I_{LIM}	Driver Current Limit	V_{IN}=3.6V	R1202xx1xx	250	350	450	mA
			R1202xx2xx	500	700	900	
V_F	NPN Forward Voltage	I_{LX}=100mA			0.8		V
I_{SWOFF1}	NPN Leakage Current 1	V_{OUT}=22V, V_{LX}=0V				10	μA
I_{SWOFF2}	NPN Leakage Current 2	V_{OUT}=0V, V_{LX}=5.5V				3	μA
f_{osc}	Oscillator Frequency	V_{IN}=3.6V, V_{FB}=0V		1000	1200	1400	kHz

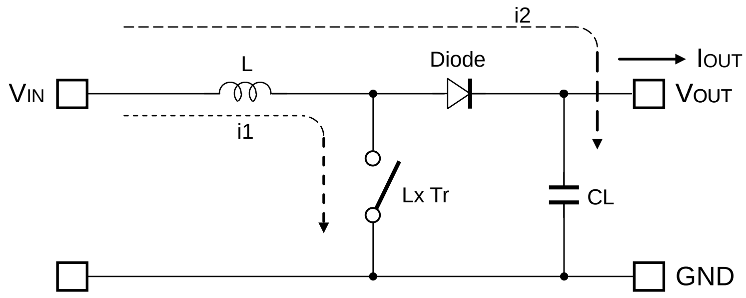
(Ta=25ºC)

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
M_{axduty}	Maximum Duty Cycle	V_{IN}=3.6V, V_{FB}=0V		86	91		%
V_{OVP1}	OVP Detect Voltage	V_{IN}=3.6V, V_{OUT} rising	R1202x3xxA/B/D	13.2	14	14.8	V
			R1202x4xxA/B	16.2	17	17.8	
			R1202x5xxA/B	18.2	19	19.8	
			R1202x6xxA/B	20.2	21	21.8	
			R1202x7xxA/B/D	22.2	23	23.8	
V_{OVP2}	OVP Release Voltage	V_{IN}=3.6V, V_{OUT} falling	R1202x3xxA/B/D		V_{OVP1} -1.1		V
			R1202x4xxA/B		V_{OVP1} -1.3		
			R1202x5xxA/B		V_{OVP1} -1.4		
			R1202x6xxA/B		V_{OVP1} -1.5		
			R1202x7xxA/B/D		V_{OVP1} -1.7		
T_{TSD}	Thermal Shutdown Detect Temperature	V_{IN}=3.6V			150		°C
T_{TSR}	Thermal Shutdown Release Temperature	V_{IN}=3.6V			100		°C

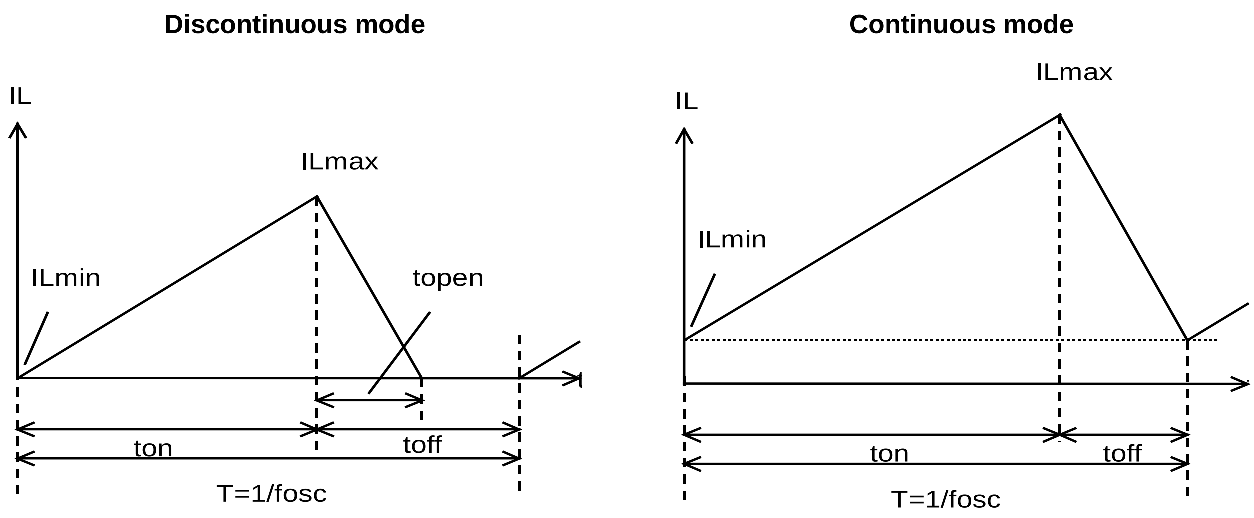
THEORY OF OPERATION

Operation of Step-Up DC/DC Converter and Output Current

<Basic Circuit>



<Current through L>



There are two operation modes of the step-up PWM control-DC/DC converter. That is the continuous mode and discontinuous mode by the continuousness inductor.

When the transistor turns ON, the voltage of inductor L becomes equal to V_{IN} voltage. The increase value of inductor current (i1) will be

$\Delta i1 = V_{IN} \times ton / L$ .... Formula 1

As the step-up circuit, during the OFF time (when the transistor turns OFF) the voltage is continually supply from the power supply. The decrease value of inductor current (i2) will be

$\Delta i2 = (V_{OUT} - V_{IN}) \times topen / L$.. Formula 2

At the PWM control-method, the inductor current become continuously when $t_{open}=t_{off}$, the DC/DC converter operate as the continuous mode.

In the continuous mode, the variation of current of i1 and i2 is same at regular condition.

$V_{IN} \times t_{on} / L = (V_{OUT} - V_{IN}) \times t_{off} / L$ .... Formula 3

The duty at continuous mode will be

duty (%)= $t_{on} / (t_{on} + t_{off}) = (V_{OUT} - V_{IN}) / V_{OUT}$ .... Formula 4

The average of inductor current at tf = t_{off} will be

$IL(Ave.) = V_{IN} \times t_{on} / (2 \times L)$ .... Formula 5

If the input voltage = output voltage, the I_{OUT} will be

$I_{OUT} = V_{IN}^2 \times t_{on} / (2 \times L \times V_{OUT})$ .... Formula 6

If the I_{OUT} value is large than above the calculated value (Formula 6), it will become the continuous mode, at this status, the peak current (IL_{max}) of inductor will be

$IL_{max} = I_{OUT} \times V_{OUT} / V_{IN} + V_{IN} \times t_{on} / (2 \times L)$ .... Formula 7

$IL_{max} = I_{OUT} \times V_{OUT} / V_{IN} + V_{IN} \times T \times (V_{OUT} - V_{IN}) / (2 \times L \times V_{OUT})$ .... Formula 8

The peak current value is larger than the I_{OUT} value. In case of this, selecting the condition of the input and the output and the external components by considering of IL_{max} value.
The explanation above is based on the ideal calculation, and the loss caused by L_X switch and the external components are not included.
The actual maximum output current will be between 50% and 80% by the above calculations. Especially, when the IL is large or V_{IN} is low, the loss of V_{IN} is generated with on resistance of the switch. Moreover, it is necessary to consider V_f of the diode (approximately 0.8V) about V_{OUT}.

Soft-Start (R1202xxxxA/B)

The output and referrence of the error amplifier start from 0V and the referrence gradually rises up to 1.0V. After the softstart time (T_{SS}), output voltage rise up to the setting voltage.

Protect Function

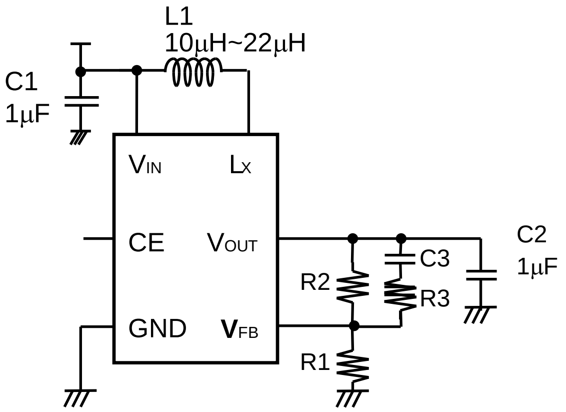
If the over current is detected, internal mosfet will turn-off soon. At the next operating period, mosfet will turn-on again and continue to watch the current.
The UVLO function and the thermal shutdown function are turned off the NMOS-driver and NPN-transister when the V_{IN} decreases more than the UVLO detect threshold voltage or the inside of IC exceeds the thermal shutdown detect temperature, and reset IC when the V_{IN} rises more than the UVLO release voltage or the inside of IC falls below the thermal shutdown release temperature, and restart the operation.

● **Shutdown**

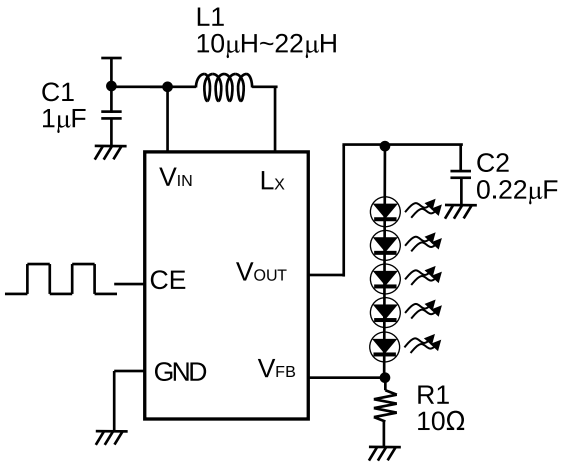
At standby mode, the output is completely separated from the input and shutdown by the NPN transistor of internal IC. However, the leakage current is generated when the L_X pin voltage is higher than V_{IN} pin voltage at standby mode.
R1202xxxxA (with auto discharge function): In the term of standby mode, the switch between V_{OUT} to GND is turned ON and output capacitor is discharged.

APPLICATION INFORMATION

Typical Applications



R1202xxxxA/B



R1202xxxxD

● Selection of Inductor

The peak current of the inductor at normal mode can be estimated as the next formula when the efficiency is 80%.

$$I_{Lmax} = 1.25 \times I_{OUT} \times V_{OUT} / V_{IN} + 0.5 \times V_{IN} \times (V_{OUT} - V_{IN}) / (L \times V_{OUT} \times f_{osc})$$

In the case of start-up or dimming control by CE pin, inductor transient current flows, and the peak current of it must be equal or less than the current limit of the IC. The peak current should not beyond the rated current of the inductor. The recommended inductance value is 10µH -22µH.

Table 1 Peak current value in each condition

Condition				
V_{IN} (V)	V_{OUT} (V)	I_{OUT} (mA)	L (µH)	I_{Lmax} (mA)
3	14	20	10	215
3	14	20	22	160
3	21	20	10	280
3	21	20	22	225

Table 2 Recommended inductors

L (µH)	Part No.	Rated current (mA)	Size (mm)
10	LQH32CN100K53	450	3.2x2.5x1.55
10	LQH2MC100K02	225	2.0x1.6x0.9
10	VLF3010A-100	490	2.8x2.6x0.9
10	VLS252010-100	520	2.5x2.0x1.0
10	VLF403212MT-100M	900	4.0×3.2×1.2
22	LQH32CN220K53	250	3.2x2.5x1.55
22	LQH2MC220K02	185	2.0x1.6x0.9
22	VLF3010A-220	330	2.8x2.6x0.9
22	VLF504015MT-220M	930	5.0×4.0×1.5

● Selection of Capacitor

Set 1µF or more value bypass capacitor C1 between V_{IN} pin and GND pin as close as possible.

R1202xxxxA/R1202xxxxB

Set 1µF – 4.7µF or more capacitor C2 between V_{OUT} and GND pin.

R1202xxxxD

Set 0.22µF or more capacitor C2 between V_{OUT} and GND pin.
The rated voltage of C2 should be 25V or more.

Table 3 Recommended components for R1202xxxxA/R1202xxxxB

	Rated voltage(V)	Part No.
C1	6.3	CM105B105K06
C2	25	GRM21BR11E105K
C3	25	22pF
R1		For V_{OUT} Setting
R2		For V_{OUT} Setting
R3		2kΩ

Table 4 Recommended components for R1202xxxxD

	Rated voltage(V)	Part No.
C1	6.3	CM105B105K06
C2	25	GRM21BR11E224

● External Components Setting

If the spike noise of V_{OUT} may be large for R1202xxxxA/B, the spike noise may be picked into V_{FB} pin and make the operation unstable. In this case, use a R3 of the resistance value in the range from 1kΩ to 5kΩ to reduce a noise level of V_{FB}.

● The Method of Output Voltage Setting (R1202xxxxA/B)

The output voltage (V_{OUT}) can be calculated with divider resistors (R1 and R2) values as the following formula:

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

The total value of R1 and R2 should be equal or less than 300kΩ. Make the V_{IN} and GND line sufficient. The large current flows through the V_{IN} and GND line due to the switching. If this impedance (V_{IN} and GND line) is high, the internal voltage of the IC may shift by the switching current, and the operating may become unstable. Moreover, when the built-in L_X switch is turn OFF, the spike noise caused by the inductor may be generated. As a result of this, recommendation voltage rating of capacitor (C2) value is equal 1.5 times larger or more than the setting output voltage.

● **LED Current setting (R1202xxxxD)**

When CE pin input is "H" (Duty=100%), LED current can be set with feedback resistor (R1)

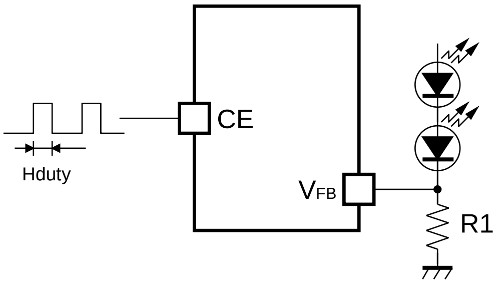
$I_{LED} = V_{FB} / R1$

● **LED Dimming Control (R1202xxxxD)**

The LED brightness can be controlled by inputting the PWM signal to the CE pin. If the CE pin input is "L" in the fixed time (Typ.0.5ms), the IC becomes the standby mode and turns OFF LEDs.
The current of LEDs can be controlled by Duty of the PWM signal of the input CE pin. The current of LEDs when High-Duty of the CE input is "Hduty" reaches the value as calculatable following formula.

$I_{LED} = Hduty \times V_{FB} / R1$

The frequency of the PWM signal is using the range between 200Hz to 300kHz.
When controlling the LED brightness by the PWM signal of 20kHz or less, the increasing or decreasing of the inductor current might be make a sounds in the hearable sound wave area. In that case, please use the PWM signal in the high frequency area.



Dimming control by CE pin input

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TECHNICAL NOTES

● Current Path on PCB

The current paths in an application circuit are shown in Fig. 1 and 2.
A current flows through the paths shown in Fig. 1 at the time of MOSFET-ON, and shown in Fig. 2 at the time of MOSFET-OFF. In the paths pointed with red arrows in Fig. 2, current flows just in MOSFET-ON period or just in MOSFET-OFF period. Parasitic impedance / inductance and the capacitance of these paths influence stability of the system and cause noise outbreak. So please minimize this side effect. In addition, please shorten the wiring of other current paths shown in Fig. 1 and 2 except for the paths of LED load.

● Layout Guide for PCB

- Please shorten the wiring of the input capacitor (C1) between V_{IN} pin and GND pin of IC. The GND pin should be connected to the strong GND plane.

- The area of L_X land pattern should be smaller.

- Please put output capacitor (C2) close to the V_{OUT} pin.

- Please make the GND side of output capacitor (C2) close to the GND pin of IC.

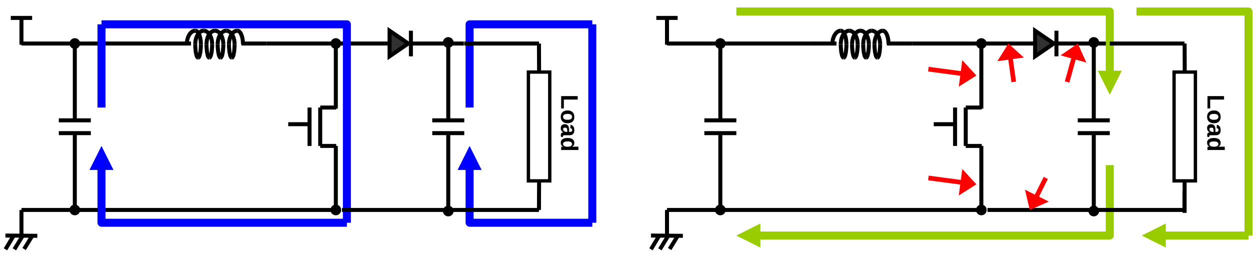
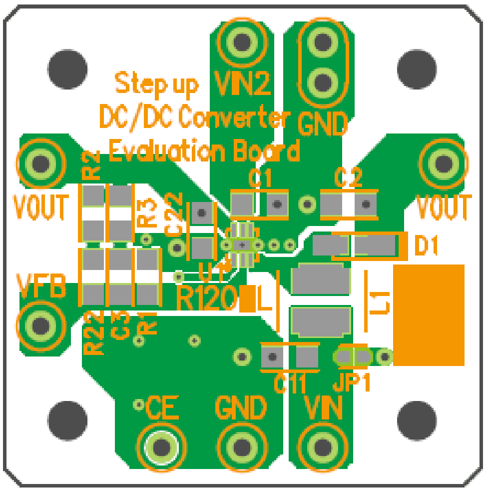
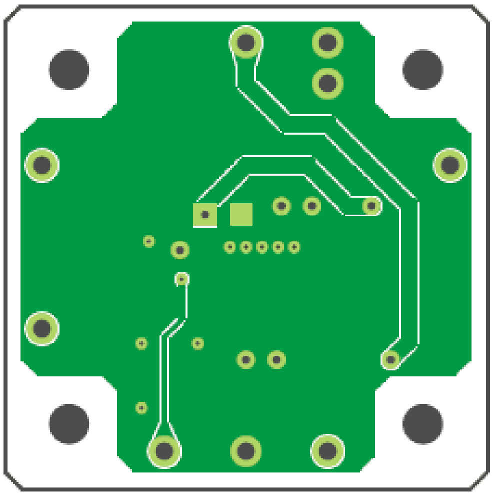


Fig. 1 **MOSFET-ON** **Fig. 2** **MOSFET-OFF**

● PCB Layout

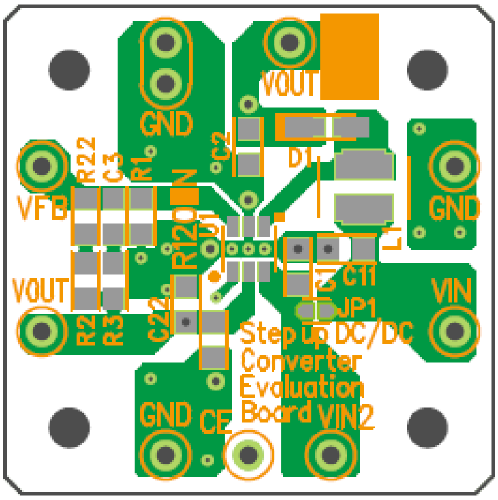
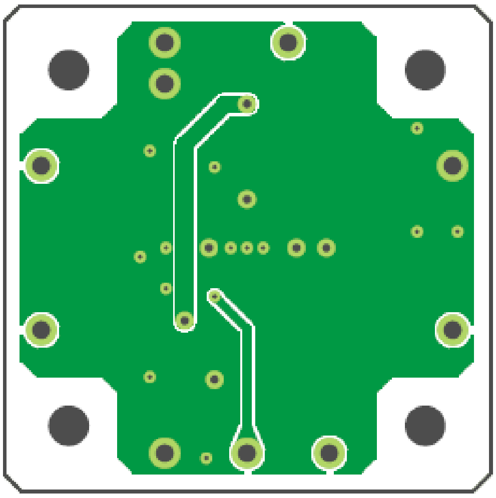
・PKG:DFN1616-6B pin

R1202LxxxA/R1202LxxxB/R1202LxxxD typical board layout

Top Layer	Back Layer
	

・PKG: TSOT-23-6 pin

R1202NxxxA/R1202NxxxB/R1202NxxxD Typical Board Layout

Top Layer	Back Layer
	

U1-● indicates the position of No.1 pin.

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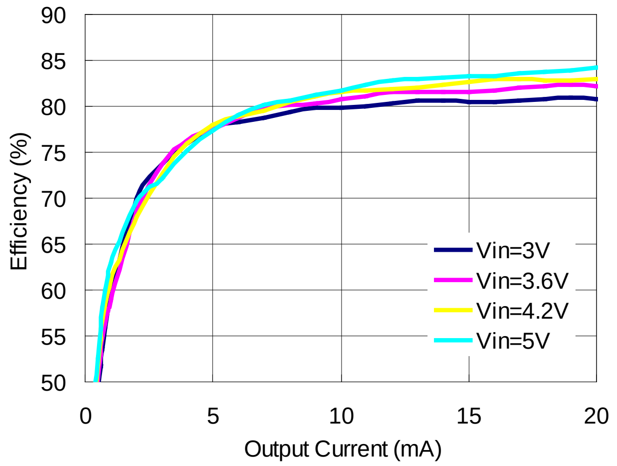
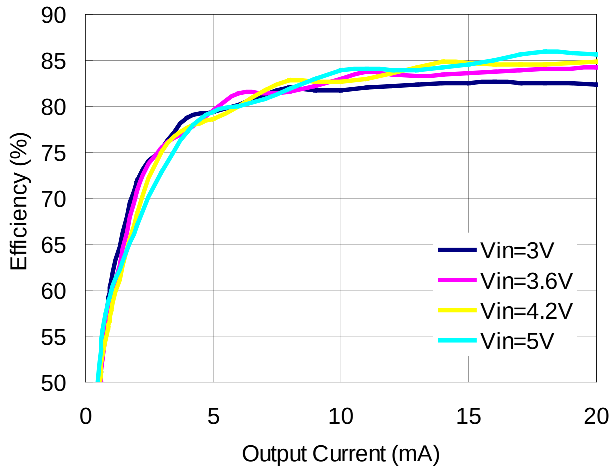
TYPICAL CHARACTERISTICS

1) Efficiency vs. Output Current (R1202N723A)

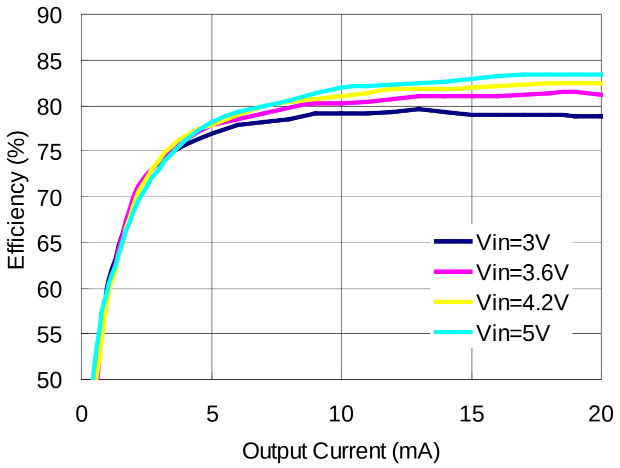
V_{OUT}=10V, L=10μH (LQH32CN100K53)



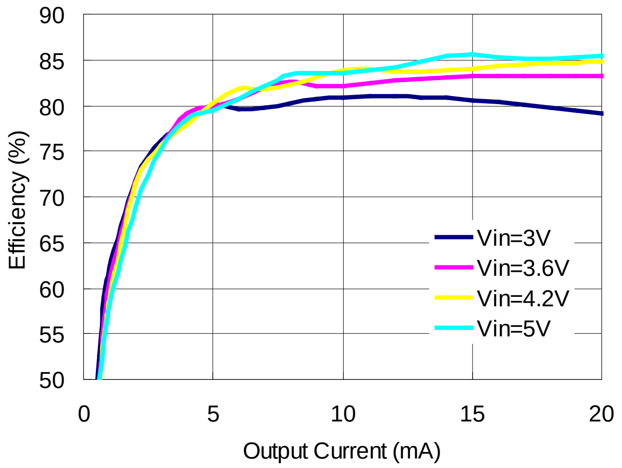
V_{OUT}=10V, L=22μH (LQH32CN220K53)



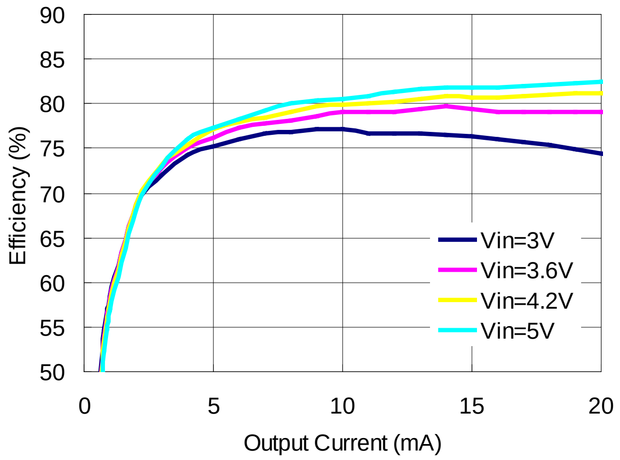
V_{OUT}=15V, L=10μH(LQH32CN100K53)



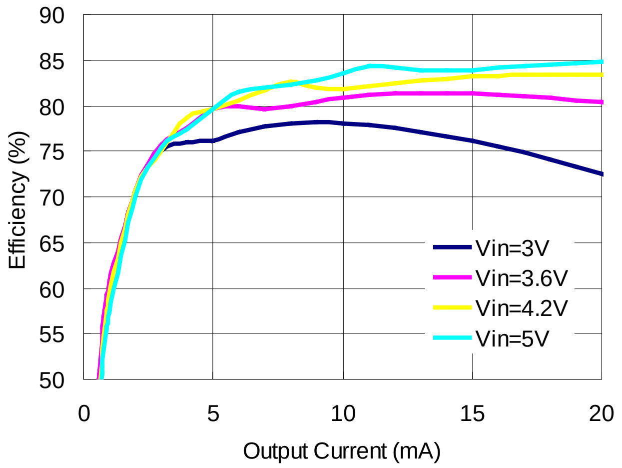
V_{OUT}=15V, L=22μH (LQH32CN220K53)



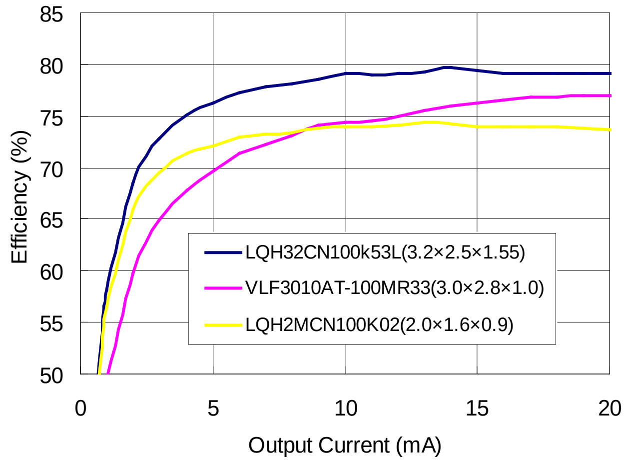
V_{OUT}=20V, L=10μH (LQH32CN100K53)



V_{OUT}=20V, L=22μH (LQH32CN220K53)

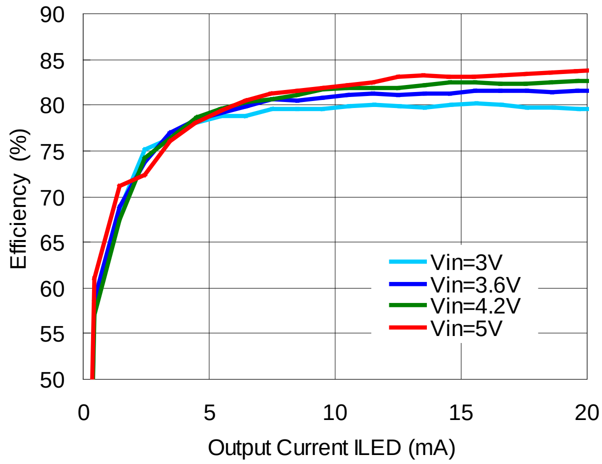


V_{OUT}=20V, V_{IN}=3.6V

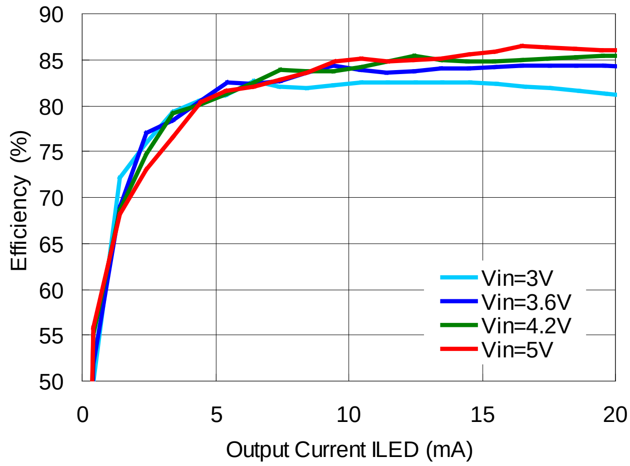


2) Efficiency vs. Output Current (R1202N713D)

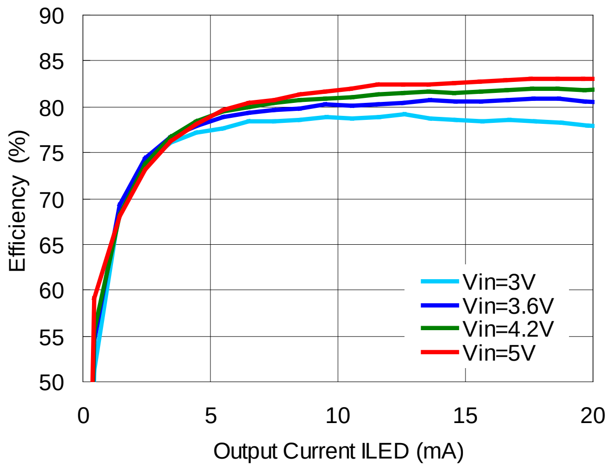
4LED, L=10µH (LQH32CN100K53)



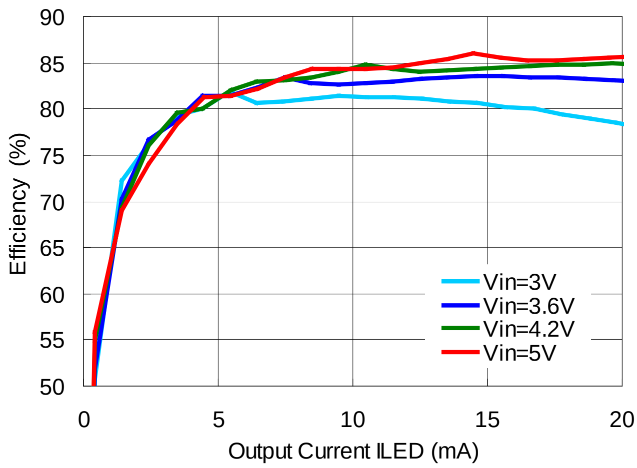
4LED, L=22µH (LQH32CN220K53)



5LED, L=10µH (LQH32CN100K53)

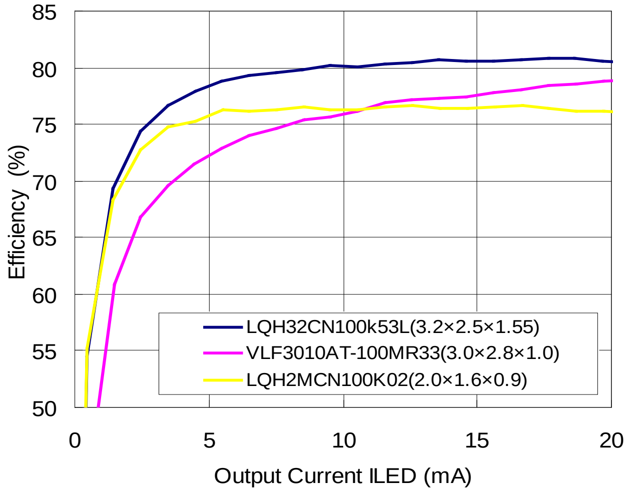


5LED, L=22µH (LQH32CN220K53)



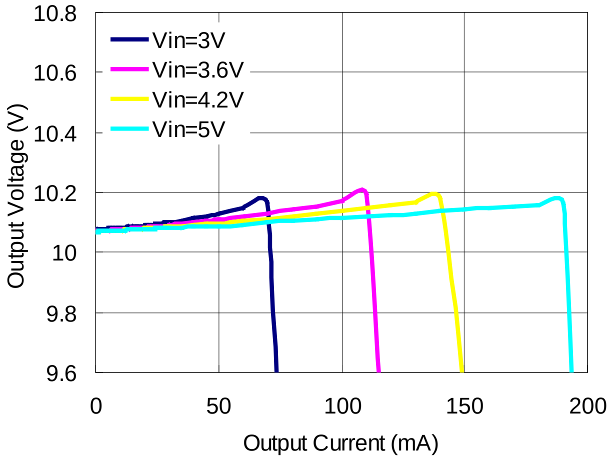
3) Efficiency vs. Output Current (R1202N713D)

5LED, V_{IN}=3.6V

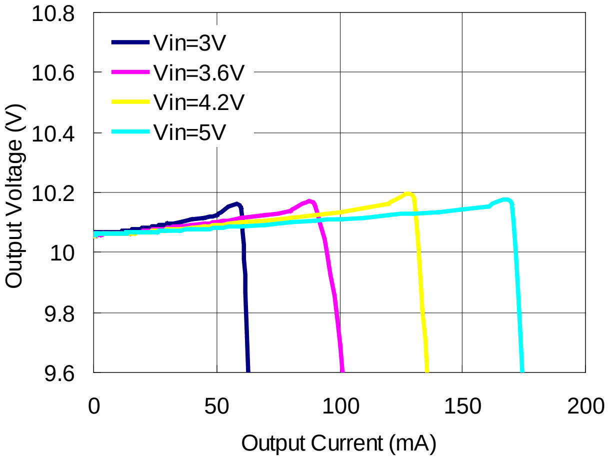


4) Output Voltage vs. Output Current (R1202N723A)

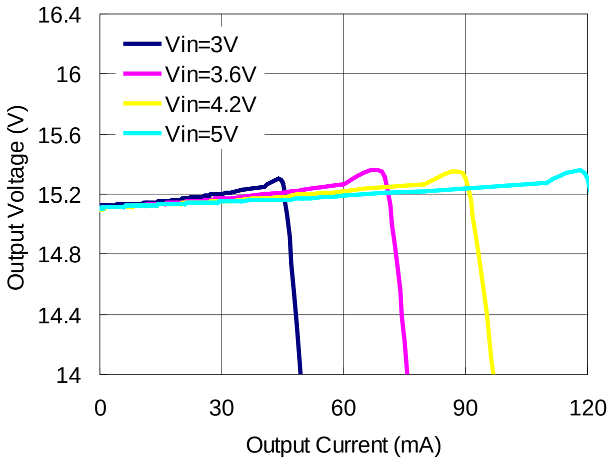
V_{OUT}=10V, L=10µH (LQH32CN100K53)



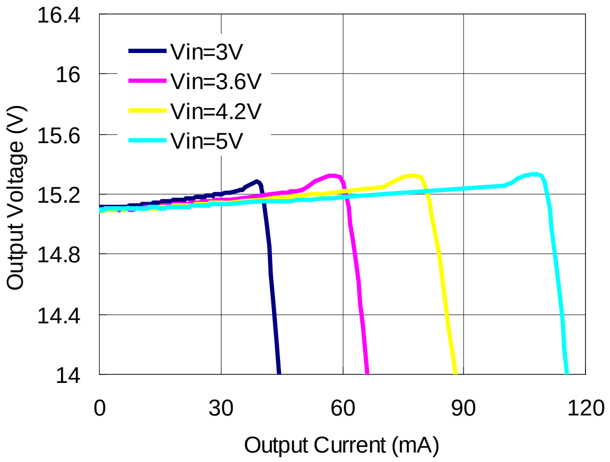
V_{OUT}=10V, L=22µH (LQH32CN220K53)

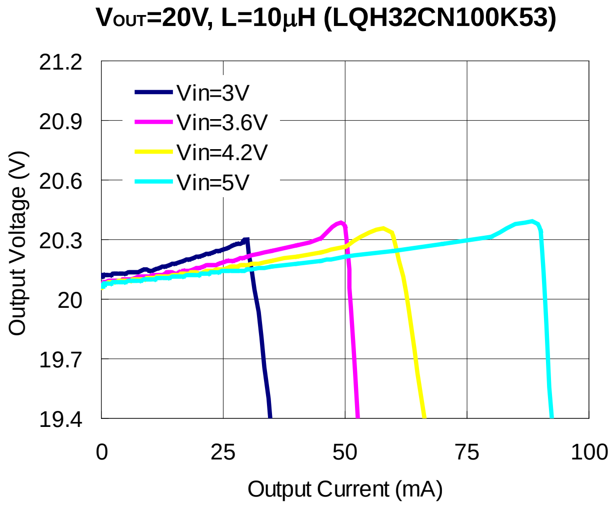


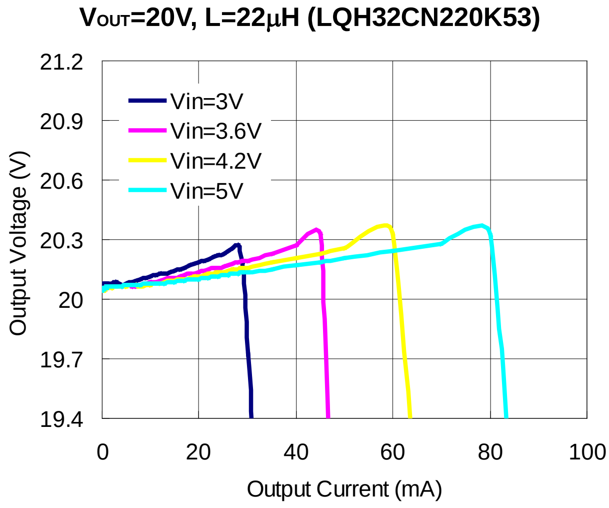
V_{OUT}=15V, L=10µH (LQH32CN100K53)

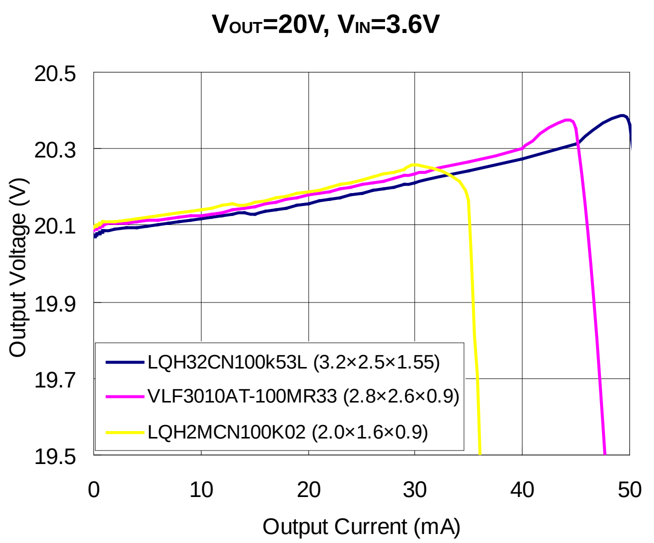


V_{OUT}=15V, L=22µH (LQH32CN220K53)

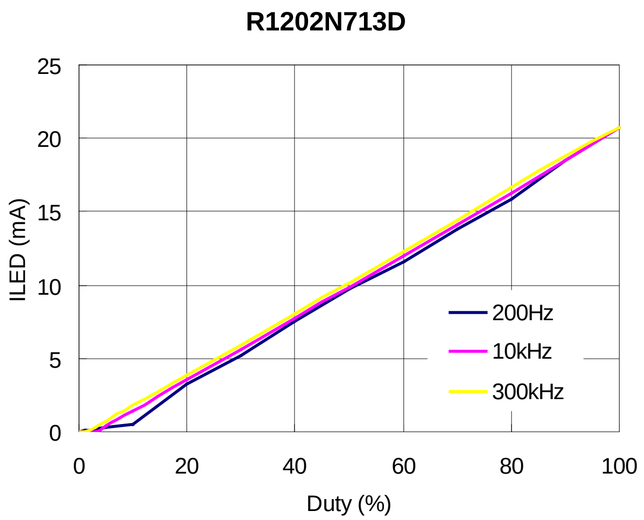




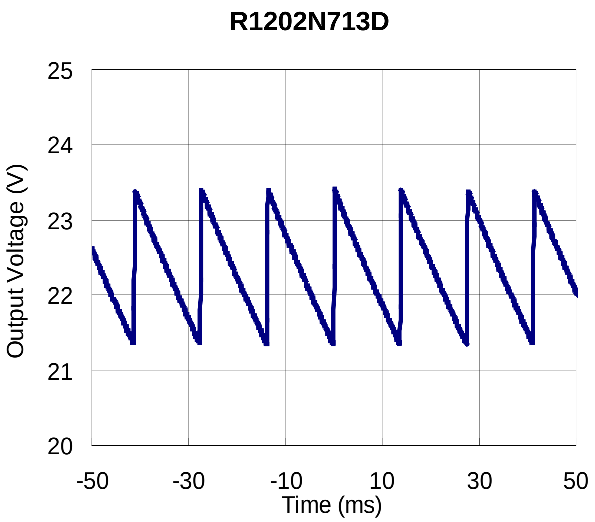




5) Maxduty vs. ILED

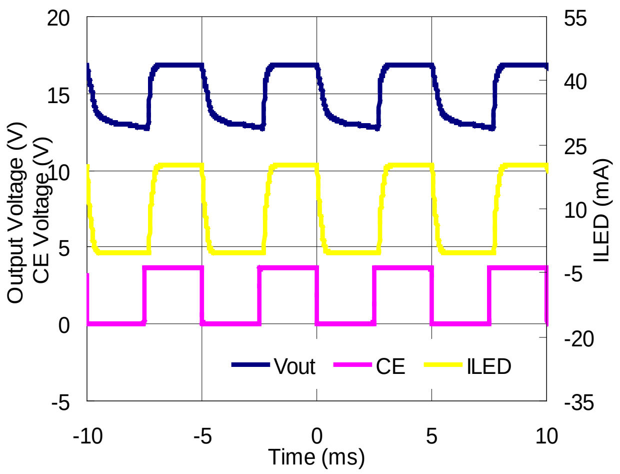


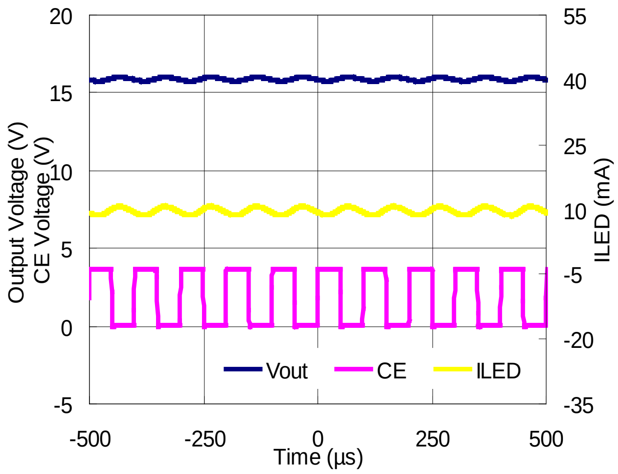
6) OVP Output Waveform

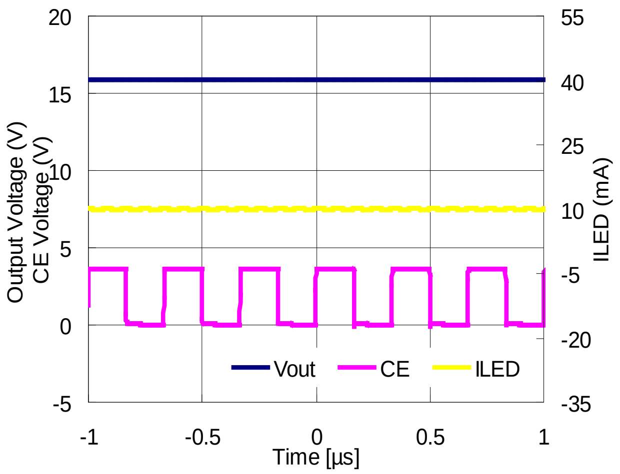


RICOH

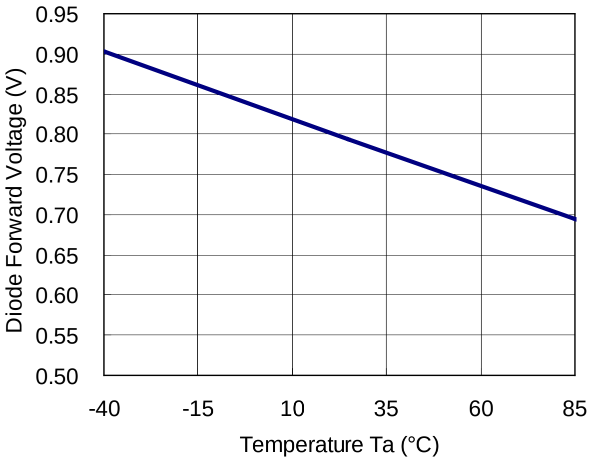
7) Waveform (5LED)



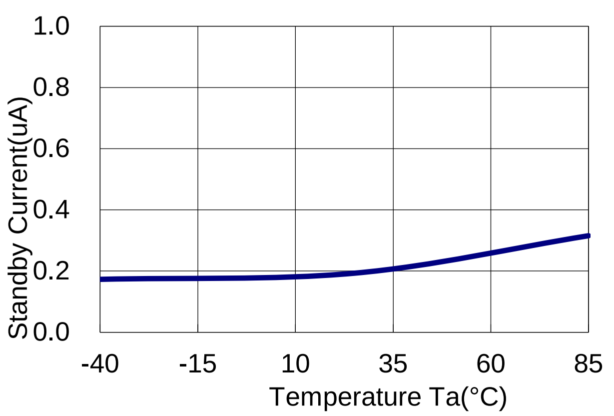




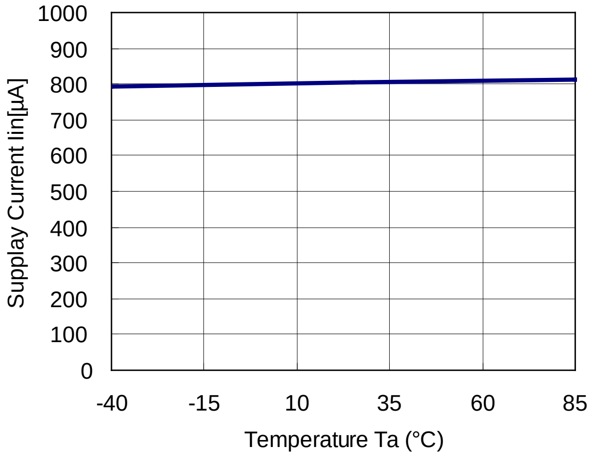
8) Diode Forward Voltage vs. Temperature



9) Standby Current vs. Temperature

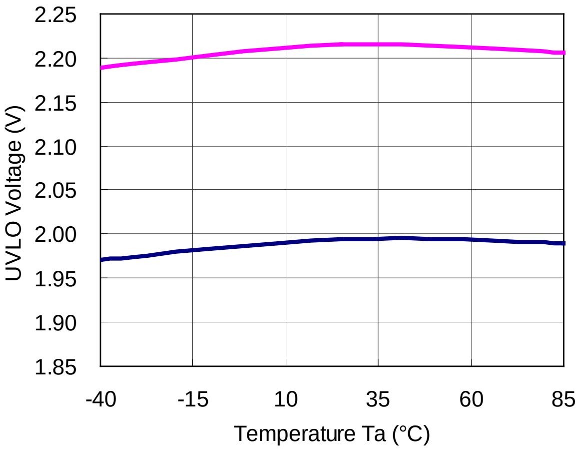


10) Supply Current Iin vs. Temperature

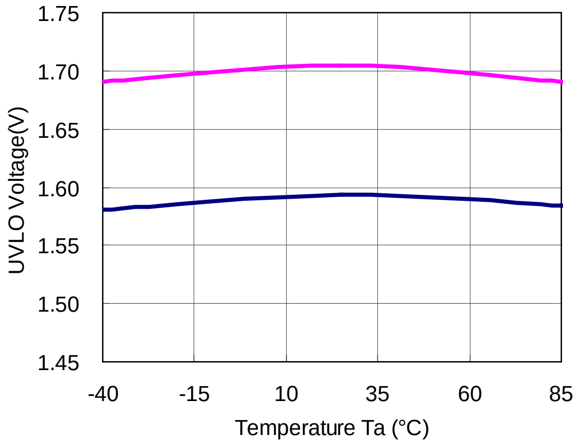


11) UVLO Voltage vs. Temperature

R1202xxxxA/B

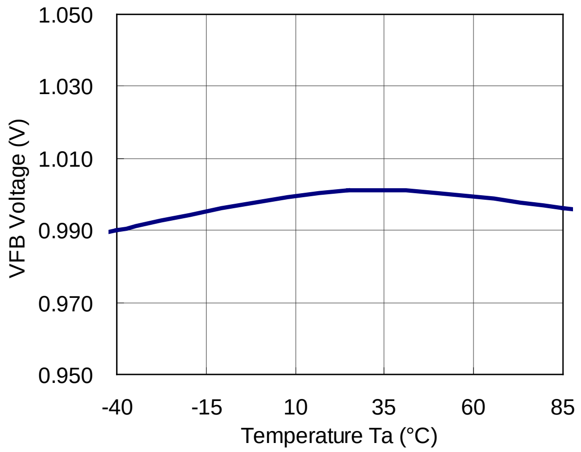


R1202xxxxD

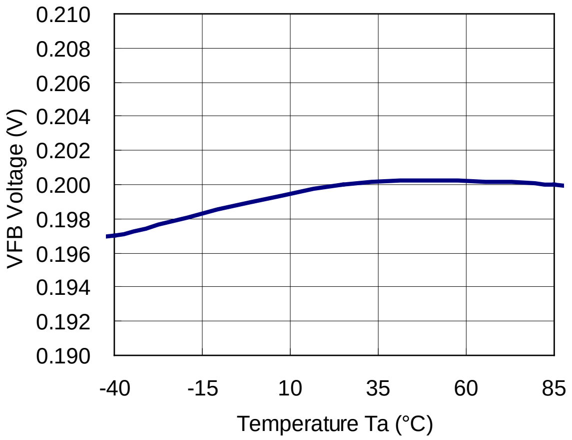


12) VFB Voltage vs. Temperature

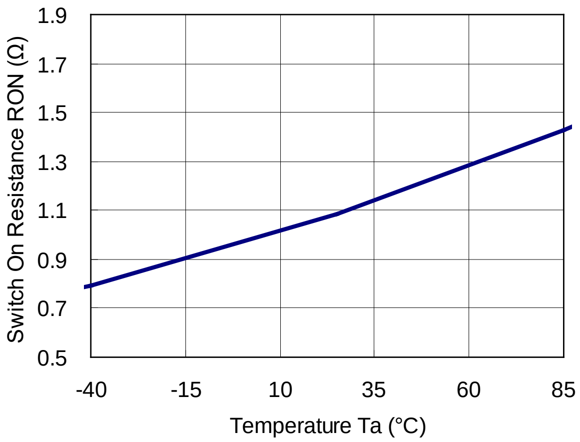
R1202xxxxA/B



R1202xxxxD

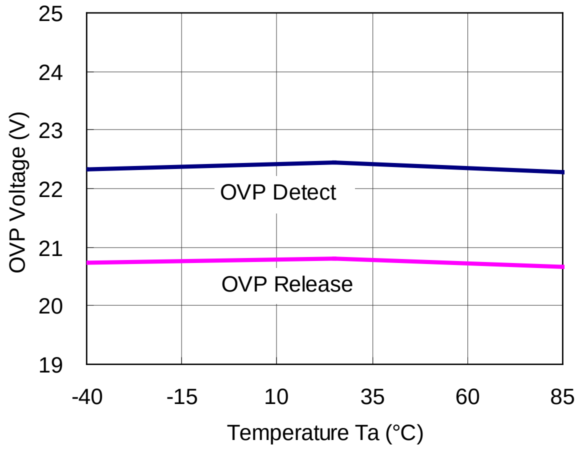


13) Switch ON Resistance RON vs. Temperature



14) OVP Voltage vs. Temperature

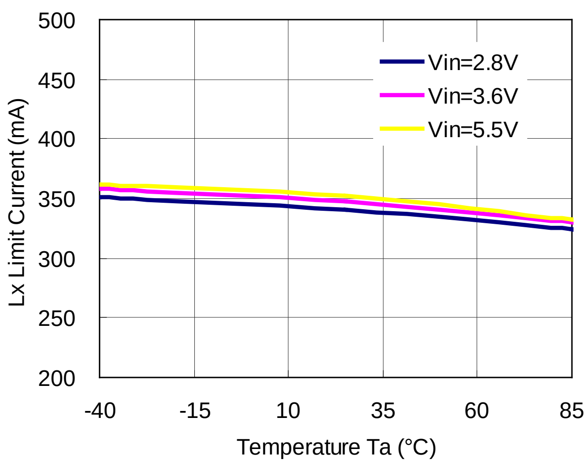
R1202x7xxx



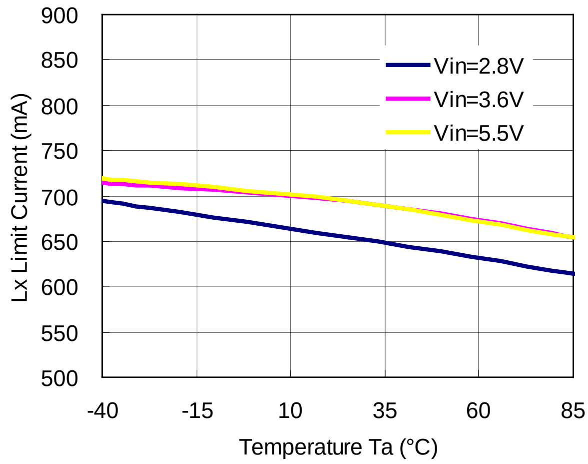
RICOH

15) Lx Limit Current vs. Temperature

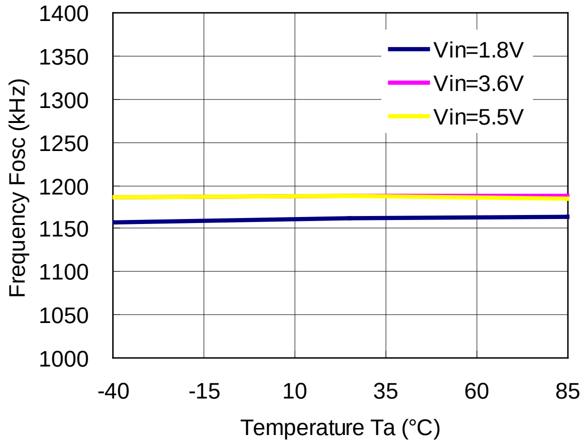
R1202xx1xx



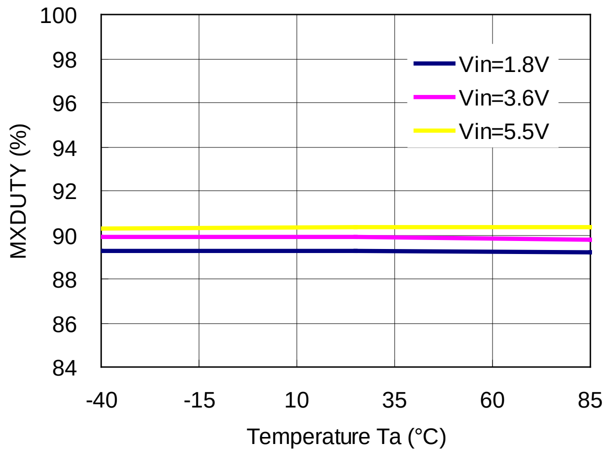
R1202xx2xx



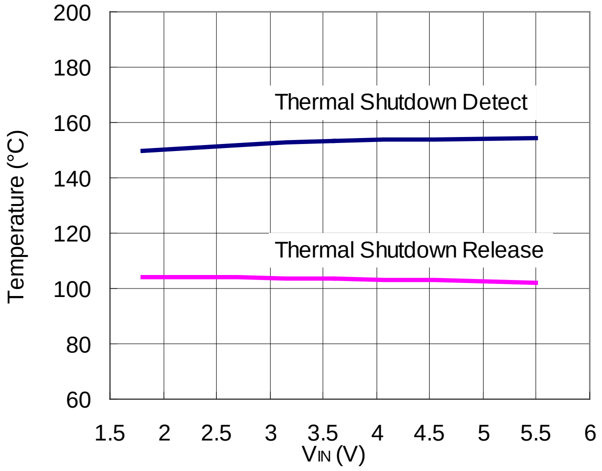
16) Frequency Fosc vs. Temperature



17) MaxDuty vs. Temperature

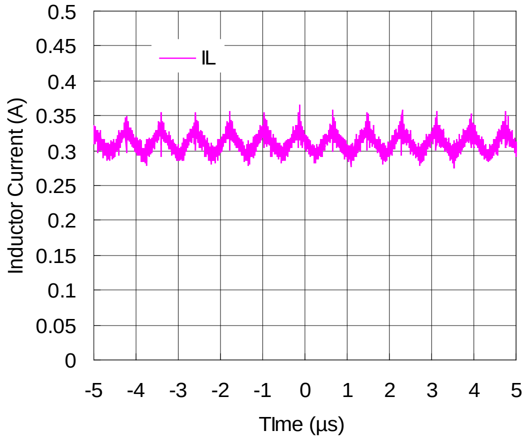


18) Thermal Shutdown Detect / Release Temperature vs. Input Voltage

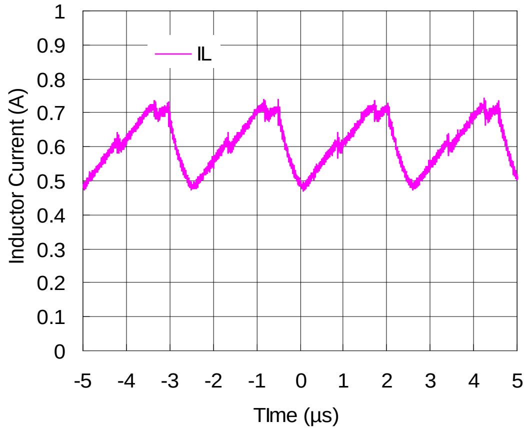


19) Inductor Current (output-GND short)

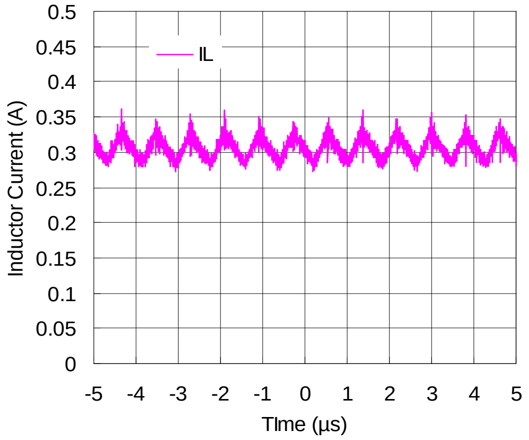
5LED(V_{IN}=3V)
R1202N713D



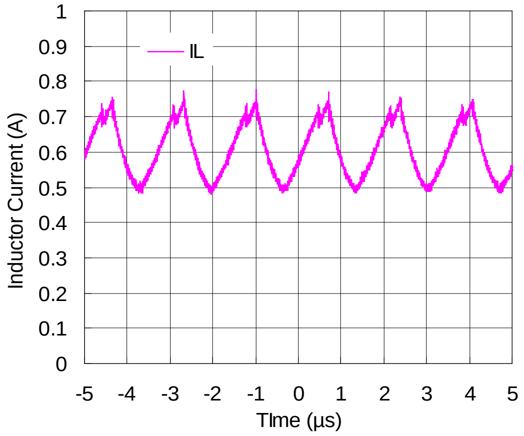
5LED(V_{IN}=3V)
R1202N723D



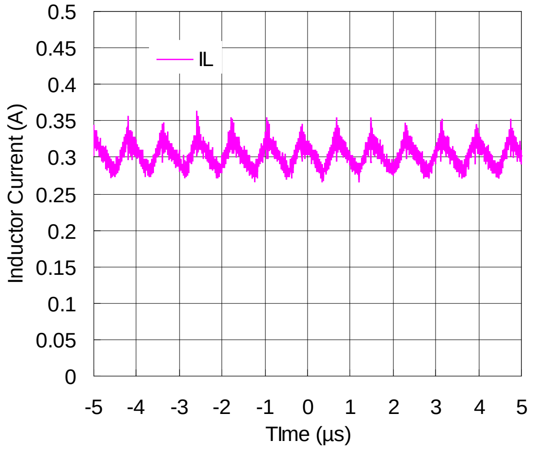
5LED(V_{IN}=3.6V)
R1202N713D



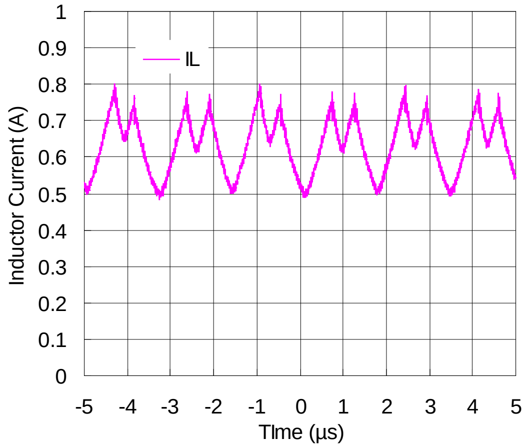
5LED(V_{IN}=3.6V)
R1202N723D



5LED(V_{IN}=4.2V)
R1202N713D



5LED(V_{IN}=4.2V)
R1202N723D



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

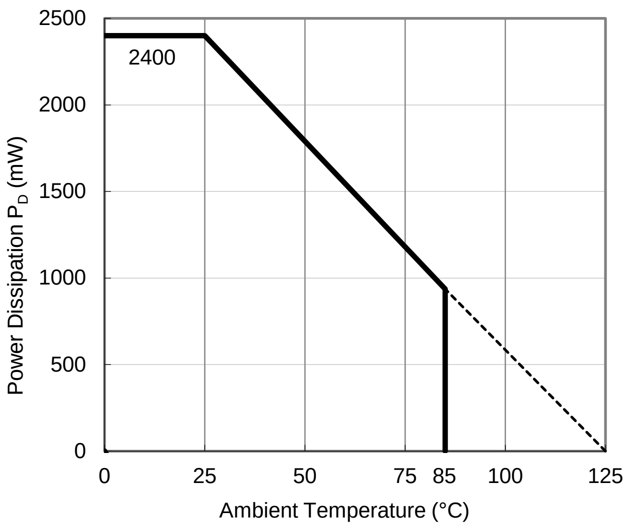
Item	Measurement Conditions (JEDEC STD. 51-7)
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	1st Layer: Less than 95% of 50 mm Square 2nd, 3rd, 4th Layers: Approx. 100% of 50 mm Square
Through-holes	ϕ 0.2 mm × 15 pcs

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

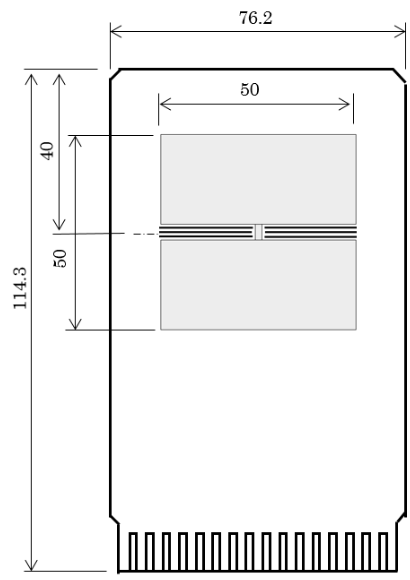
Item	Measurement Result
Power Dissipation	2400 mW
Thermal Resistance (θja)	θja = 41°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 11°C/W

θja: Junction-to–ambient thermal resistance.

ψjt: Junction–to-top of package thermal characterization parameter.

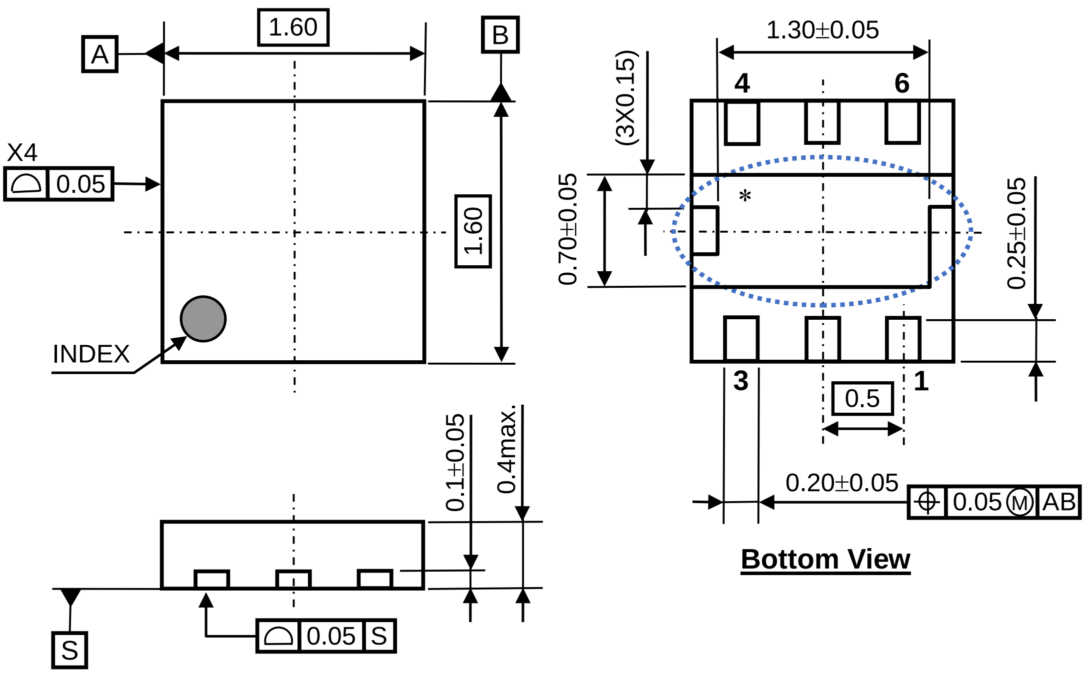


Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

Ver. A



DFN1616-6B Package Dimensions (Unit: mm)

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

Ver. A

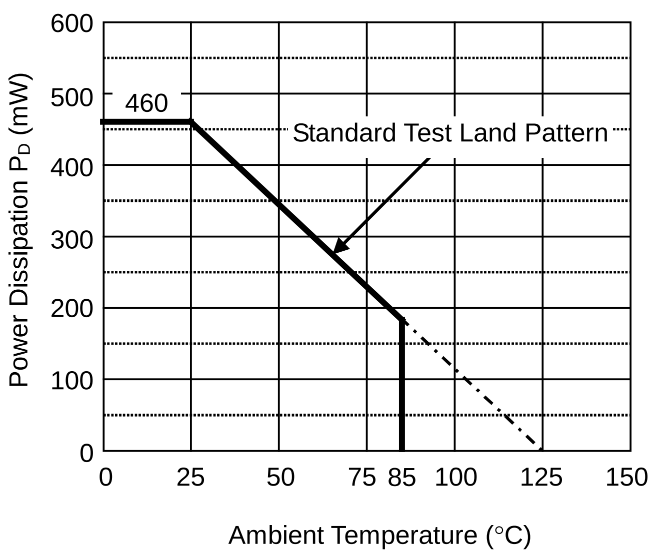
The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following conditions are used in this measurement.

Measurement Conditions

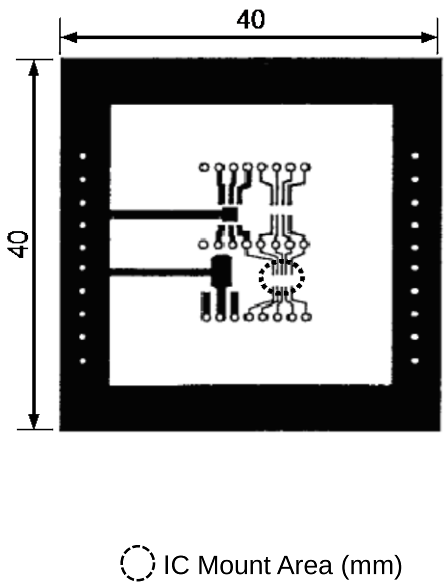
	Standard Test Land Pattern
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Double-Sided Board)
Board Dimensions	40 mm × 40 mm × 1.6 mm
Copper Ratio	Top Side: Approx. 50% Bottom Side: Approx. 50%
Through-holes	ϕ 0.5 mm × 44 pcs

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

	Standard Test Land Pattern
Power Dissipation	460 mW
Thermal Resistance	θja = (125 − 25°C) / 0.46 W = 217°C/W θjc = 40°C/W

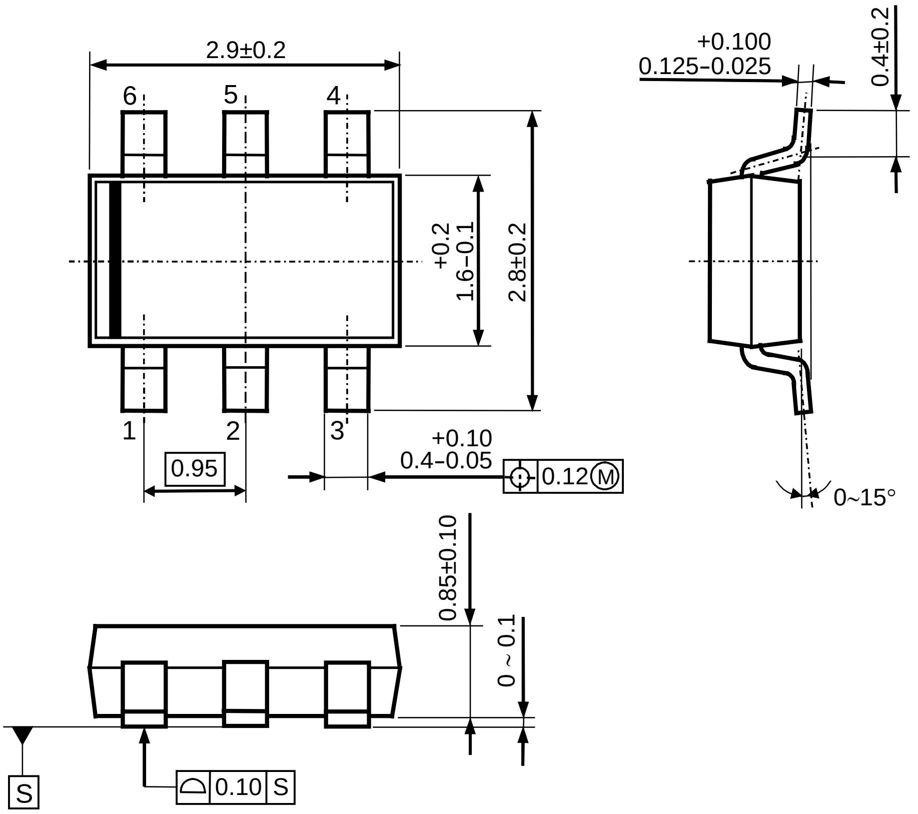


Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

Ver. A



TSOT-23-6 Package Dimensions (Unit: mm)

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