PWM STEP-UP DC/DC CONVERTER

NO.EA-075-181214

OUTLINE

The R1210Nxx1x Series are CMOS-based PWM step-up DC/DC Converter, with high accuracy, low supply current.

Each of the R1210Nxx1x Series consists of an oscillator, a PWM circuit, a reference voltage unit, an error amplifier, phase compensation circuit, resistors for voltage detection, a chip enable circuit. Further, includes a controller against drastic load transient, a control transistor with low ON-Resistance, 'L_X switch', and a protection circuit for L_X switch and an output voltage detector. R1210Nxx1A Series contain further a circuit for changeover oscillator frequency each. A low ripple, high efficiency step-up DC/DC converter can be composed of this IC with only three external components, or an inductor, a diode and a capacitor.

The R1210N Series can detect drastic change of output voltage with a circuit controller. The load transient response is improved compared with current model, furthermore the R1210Nxx1A Series have another function, that is, when the load current is small, oscillator frequency is decreased by a circuit for switching oscillator frequency from Typ. 100kHz to 35kHz, therefore, supply current is reduced.

The built-in chip enable circuit can make the standby mode with ultra low quiescent current.

Since the package for these ICs is small SOT-23-5, high density mounting of the ICs on board is possible.

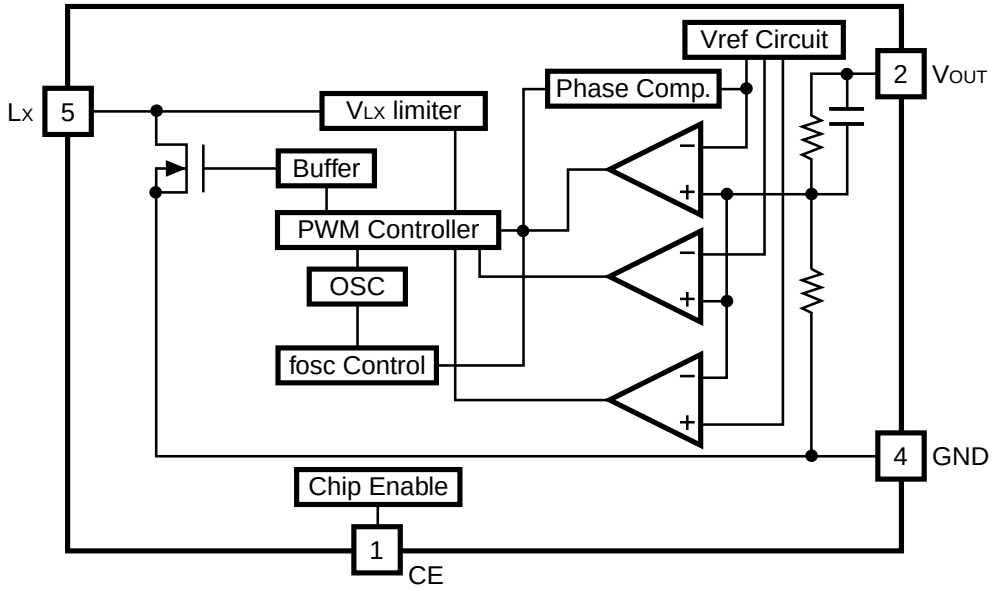
FEATURES

- External Components ..... Only an inductor, a diode, and a capacitor
- Standby Current ..... Max. 0.5μA
- Temperature-Drift Coefficient of Output Voltage Typ. ±100ppm/°C
- Output Voltage Range ..... 2.2V to 3.5V (xx1A), 2.2V to 6.0V (xx1C/D), 0.1V steps
- Two choices of Basic Oscillator Frequency 100kHz (xx1A/C), 180kHz (xx1D)
- Output Voltage Accuracy ..... ±2.5%
- Package SOT-23-5
- Efficiency ..... Typ. 88% (V_{IN}=Set Output Voltage×0.6 [V], I_{OUT}=10mA)
- Low Ripple, Low Noise
- Built-in a driver transistor with low on-resistance
- Start-up Voltage ..... Max. 0.9V
- Basic Frequency change-over circuit (only for xx1A type) from Typ. 100kHz to 35kHz

APPLICATIONS

- Power source for battery-powered equipment.
- Power source for portable communication appliances, cameras, VCRs
- Power source for appliances of which require higher voltage than battery voltage.

BLOCK DIAGRAMS



SELECTION GUIDE

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1210Nxx1∗-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes

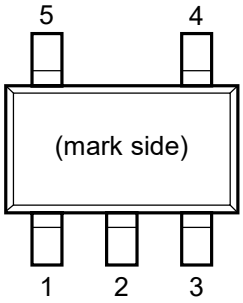
xx : The output voltage can be designated. (0.1V steps)
xx1A : 2.2V(22) to 3.5V(35)
xx1C/xx1D : 2.2V(22) to 6.0V(60)

∗ : The oscillator frequency and the Frequency Change-over circuit are options as follows.

Code	Oscillator frequency	Frequency Change-over circuit
A	100kHz	Yes
C	100kHz	No
D	180kHz	No

PIN CONFIGURATIONS

● **SOT-23-5**



PIN DESCRIPTIONS

● **SOT-23-5**

Pin No	Symbol	Pin Description
1	CE	Chip Enable Pin ("H" Active)
2	V_{OUT}	Pin for Monitoring Output Voltage
3	NC	No Connection
4	GND	Ground Pin
5	L_X	Switching Pin (Nch Open Drain)

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{OUT}	V_{OUT} Pin Output Voltage	−0.3 to 9.0	V
V_{LX}	L_X Pin Output Voltage	−0.3 to 9.0	V
V_{CE}	CE Pin Input Voltage	−0.3 to 9.0	V
I_{LX}	L_X Pin Output Current	400	mA
P_D	Power Dissipation* (SOT-23-5)	420	mW
Topt	Operating Temperature Range	−40 to 85	°C
Tstg	Storage Temperature Range	−55 to 125	°C

∗) For Power Dissipation, please refer to PACKAGE INFORMATION.

ABSOLUTE MAXIMUM RATINGS

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

ELECTRICAL CHARACTERISTICS

- **R1210Nxx1x**

Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	V_{IN}=V_{SET}×0.6, I_{OUT}=1mA		×0.975		×1.025	V
V_{IN}	Maximum Input Voltage					8	V
ΔV_{OUT}/ ΔTopt	Step-up Output Voltage Temperature Coefficient	−40°C≤Topt≤85°C			±100		ppm/°C
Vstart	Start-up Voltage	V_{IN}=0V→2V, V_{OUT}:1.8kΩ pull-down				0.9	V
ΔVstart/ ΔTopt	Start-up Voltage Temperature Coefficient	−40°C≤Topt≤85°C			-3.2		mV/°C
Vhold	Hold-on Voltage	V_{IN}=2.0V→0V, I_{OUT}=1mA	xx1A/C	0.7			V
			xx1D	0.9			
I_{DD2}	Supply Current 2	V_{OUT}=V_{CE}=V_{SET}+0.5V	xx1A/C		10	17	μA
			xx1D		15	24	μA
Istandby	Standby Current	V_{OUT}=6.5V, V_{CE}=0V				0.5	μA
I_{LXleak}	Lx Leakage Current	V_{OUT}=V_{LX}=8V				0.5	μA
fosc	Maximum Oscillator Frequency	V_{OUT}=V_{CE}=V_{SET}×0.96	xx1A/C	80	100	120	kHz
			xx1D	144	180	216	kHz
Δ fosc/ ΔTopt	Oscillator Frequency Temperature Coefficient	−40°C≤Topt≤85°C	xx1A/C		0.5		kHz/°C
			xx1D		0.6		kHz/°C
Maxduty	Oscillator Maximum Duty Cycle	V_{OUT}=V_{CE}=V_{SET}×0.96, (V_{LX} "L" Side)		70	85	97	%
V_{LXlim}	V_{LX} Limit Voltage	V_{OUT}=V_{CE}=V_{SET}×0.96, (V_{LX} "L" Side)		0.4	0.6	0.8	V
V_{CEH}	CE "H" Input Voltage	V_{OUT}=V_{SET}×0.96		0.9			V
V_{CEL}	CE "L" Input Voltage	V_{OUT}=V_{SET}×0.96				0.3	V
I_{CEH}	CE "H" Input Current	V_{OUT}=V_{CE}=6.5V		-0.1	0	0.1	μA
I_{CEL}	CE "L" Input Current	V_{IN}=6.5V, V_{CE}=0V		-0.1	0	0.1	μA
fosc2	Change-over frequency	V_{IN}=V_{SET}×0.6, I_{OUT}=0.5mA (only for xx1A)		10	35	70	kHz
I_{DD1}	Supply Current 1 (xx1A/C)	V_{OUT}= V_{SET}×0.96	2.2V≤V_{SET}≤2.5V		30	55	μA
			2.6V≤V_{SET}≤3.0V		35	60	
			3.1V≤V_{SET}≤3.5V		40	70	
			3.6V≤V_{SET}≤4.0V		45	80	
			4.1V≤V_{SET}≤4.5V		50	90	
			4.6V≤V_{SET}≤5.0V		70	100	
			5.1V≤V_{SET}≤5.5V		80	110	
			5.6V≤V_{SET}≤6.0V		90	120	

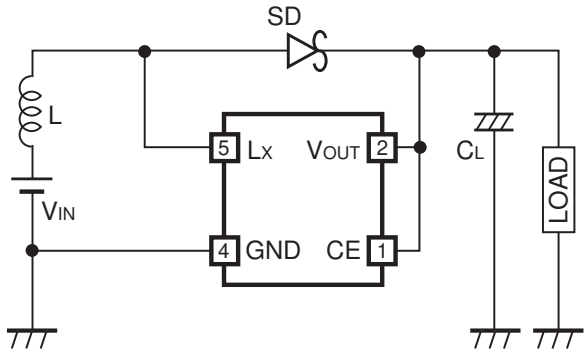
Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
I_{DD1}	Supply Current 1 (xx1D)	$V_{OUT}=V_{SET}\times0.96$	2.2V≤V_{SET}≤2.5V		50	80	μA
			2.6V≤V_{SET}≤3.0V		60	90	
			3.1V≤V_{SET}≤3.5V		70	100	
			3.6V≤V_{SET}≤4.0V		80	110	
			4.1V≤V_{SET}≤4.5V		90	120	
			4.6V≤V_{SET}≤5.0V		100	130	
			5.1V≤V_{SET}≤5.5V		110	150	
			5.6V≤V_{SET}≤6.0V		120	170	
I_{LX}	L_X Switching Current	V_{LX}=0.4V	2.2V≤V_{SET}≤2.4V	70			mA
			2.5V≤V_{SET}≤2.9V	85			
			3.0V≤V_{SET}≤3.4V	100			
			3.5V≤V_{SET}≤3.9V	120			
			4.0V≤V_{SET}≤4.4V	140			
			4.5V≤V_{SET}≤4.9V	150			
			5.0V≤V_{SET}≤5.4V	170			
			5.5V≤V_{SET}≤6.0V	190			

*Note: V_{SET} means setting Output Voltage.

RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

TYPICAL APPLICATIONS AND TECHNICAL NOTES



L : 100μH CD54NP (Sumida Electric Co, LTD)
SD : CRS10I30A (TOSHIBA, Schottky Type)
CL : 22μF×2 (Tantalum Type)

When you use these ICs, consider the following issues;

·Set external components as close as possible to the IC and minimize the connection between the components and the IC. In particular, a capacitor should be connected to V_{OUT} pin with the minimum connection.

·Make sufficient grounding. A large current flows through GND pin by switching. When the impedance of the GND connection is high, the potential within the IC is varied by the switching current. This may result in unstable operation of the IC.

·Use capacitors with a capacity of 22μF or more, and with good high frequency characteristics such as tantalum capacitors.
We recommend you to use output capacitors with an allowable voltage at least 3 times as much as setting output voltage. This is because there may be a case where a spike-shaped high voltage is generated by an inductor when an Lx transistor is off.

·Choose an inductor that has sufficiently small D.C. resistance and large allowable current and is hard to reach magnetic saturation.
And if the value of inductance of an inductor is extremely small, the I_{LX} may exceed the absolute maximum rating at the maximum loading.
Use an inductor with appropriate inductance.

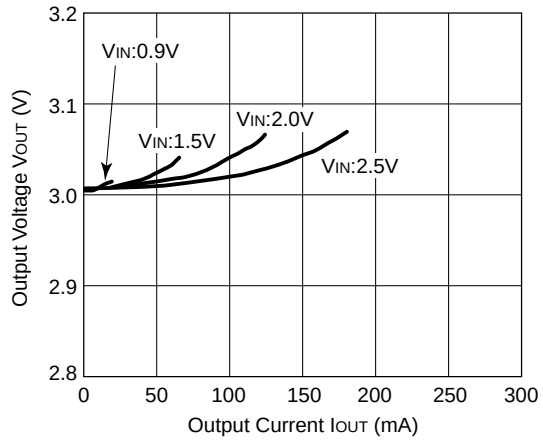
·Use a diode of a Schottky type with high switching speed, and also pay attention to its current capacity.

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

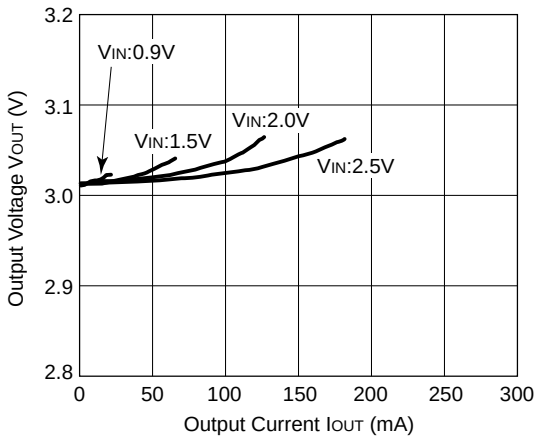
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

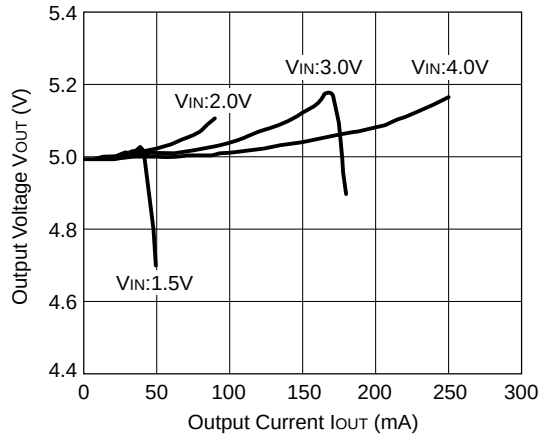
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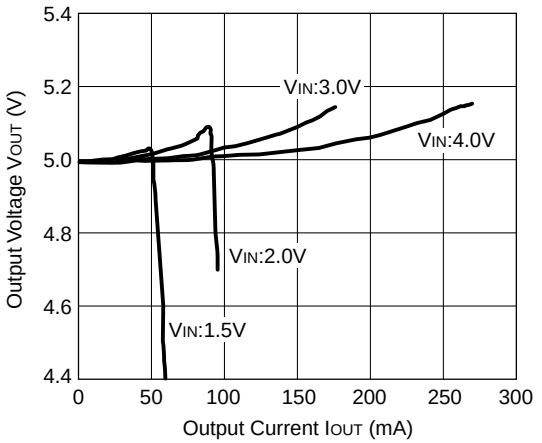
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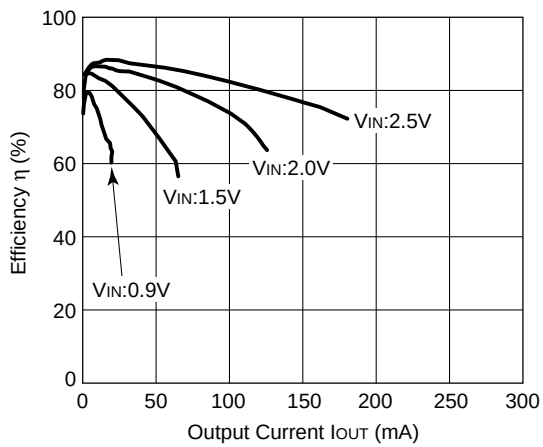


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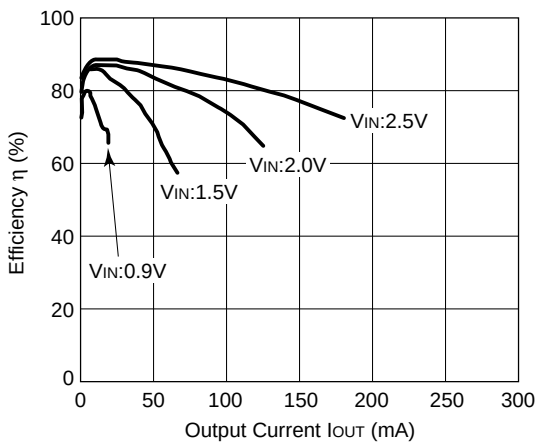


2) Efficiency vs. Output Current

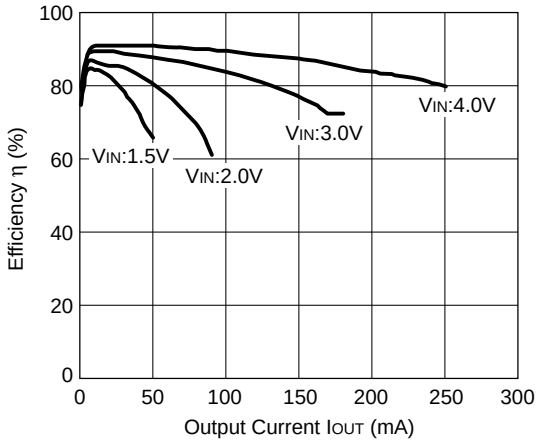
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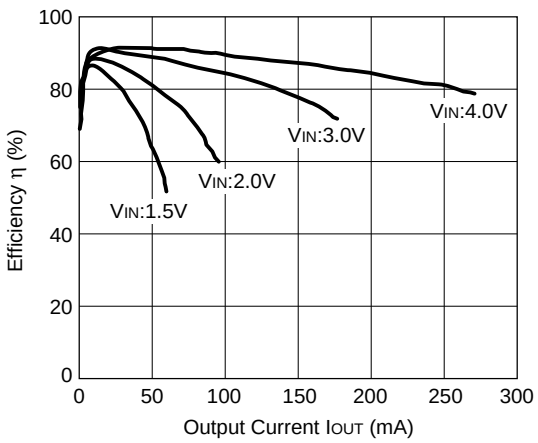
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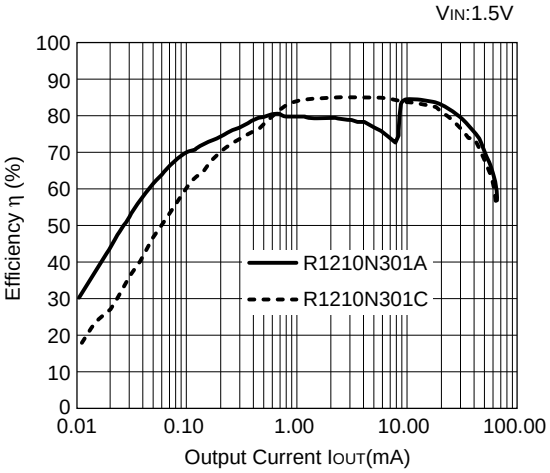


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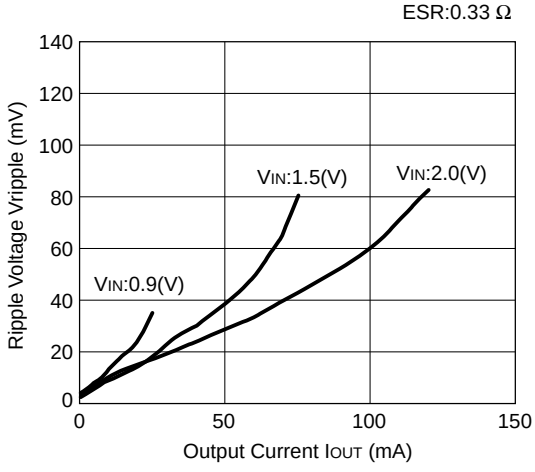
3) R1210Nxx1A/C Efficiency

R1210N301x

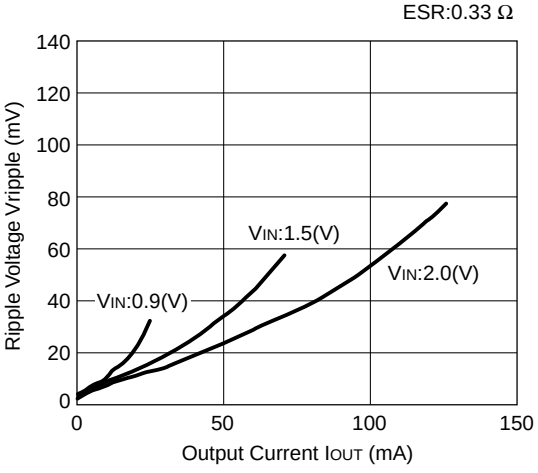


4) Ripple Voltage vs. Output Current

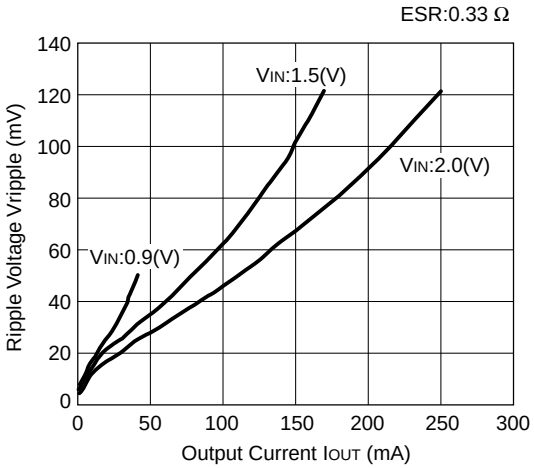
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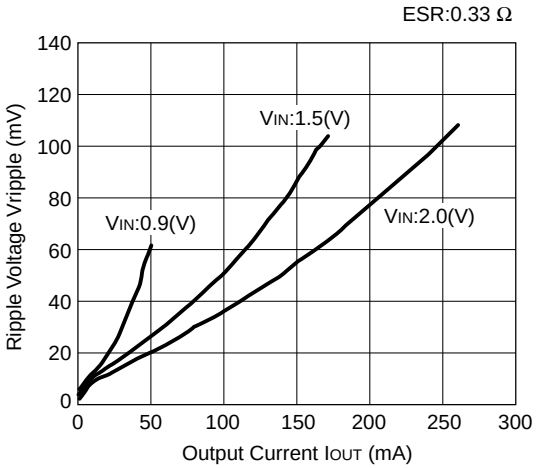
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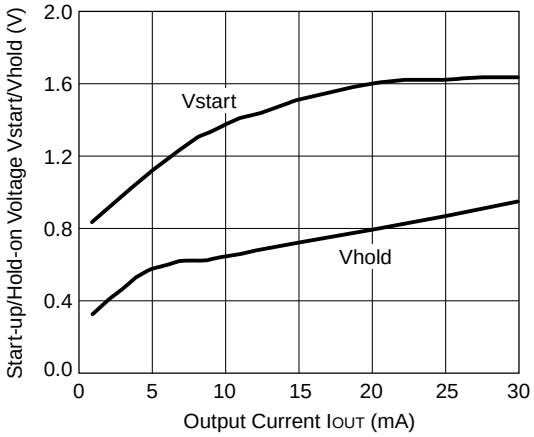


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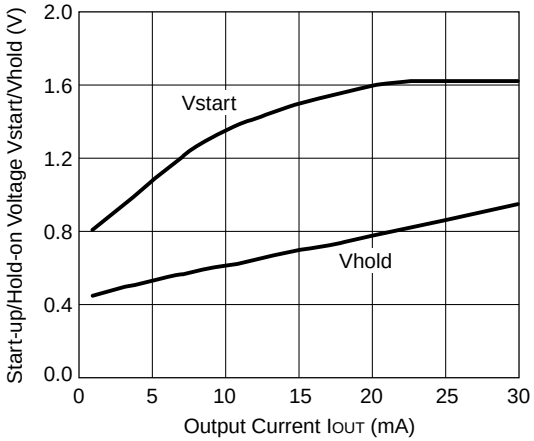


5) Start-up Voltage/Hold-on Voltage vs. Output Current (Topt=25°C)

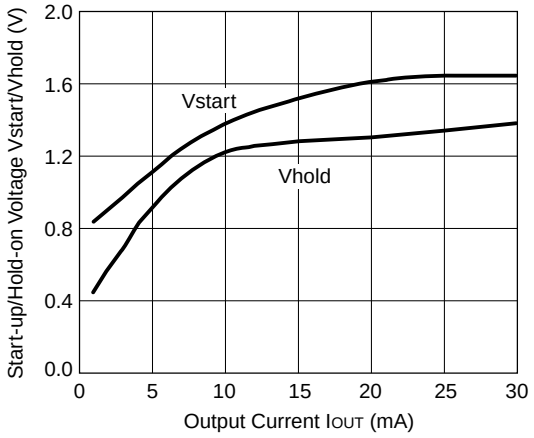
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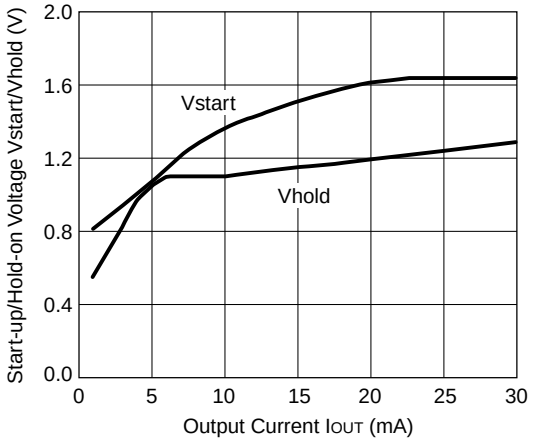
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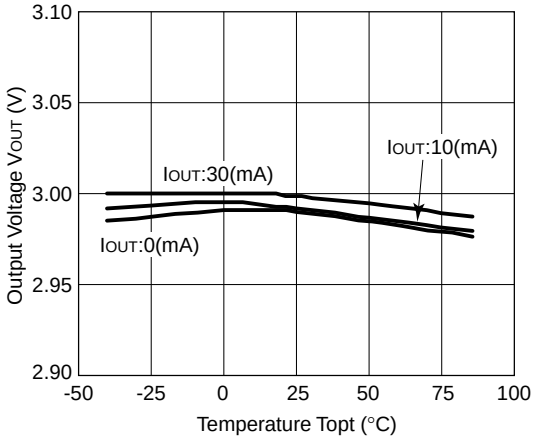


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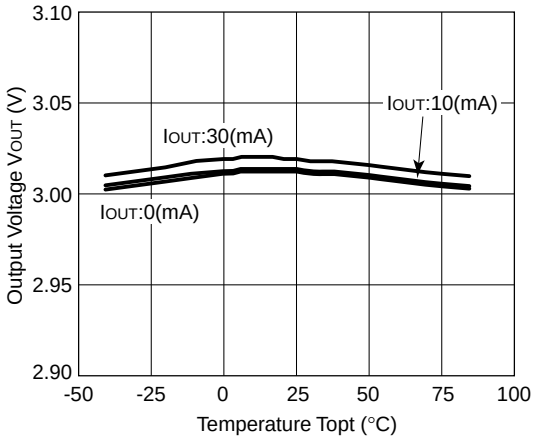


6) Output Voltage vs. Temperature

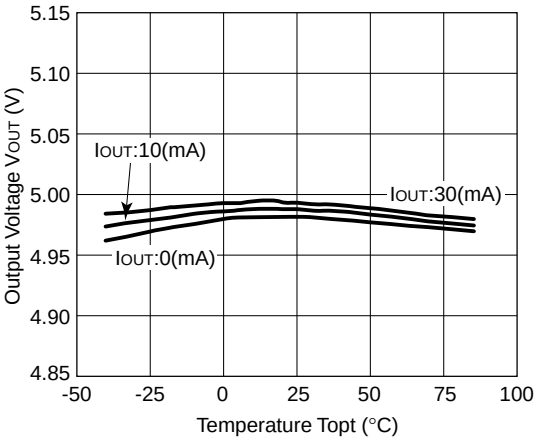
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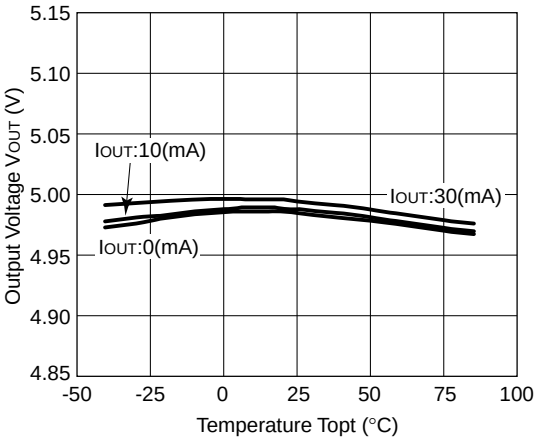
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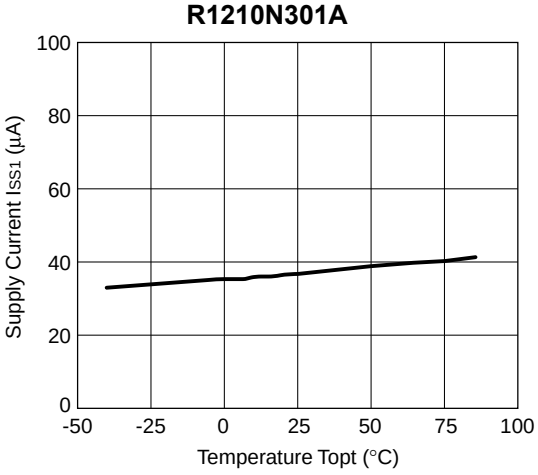


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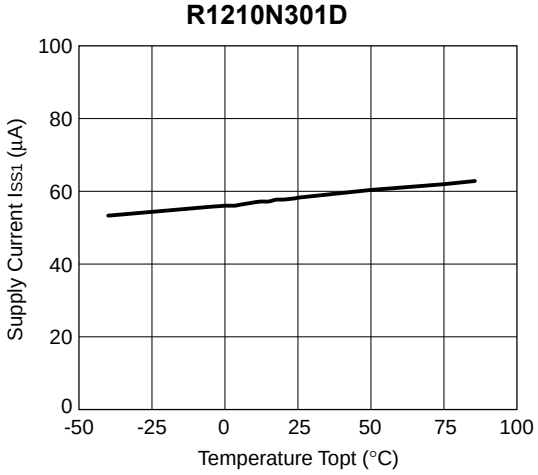


7) Supply Current 1 vs. Temperature

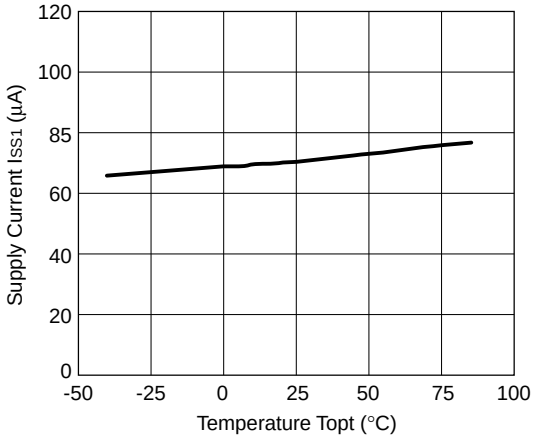
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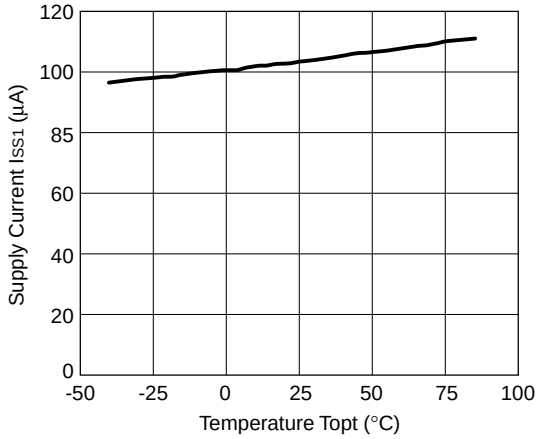
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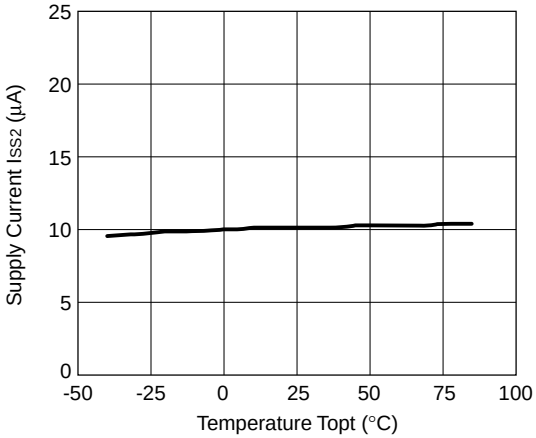


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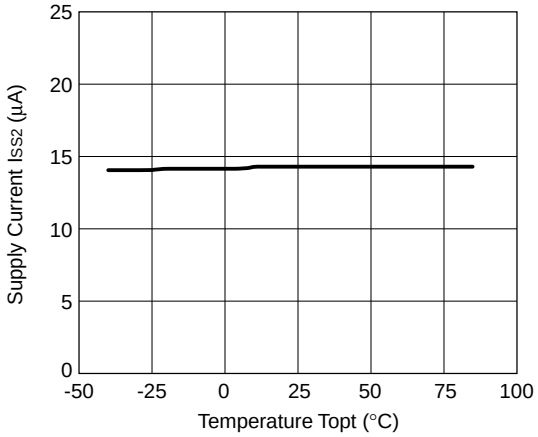


8) Supply Current2 vs. Temperature

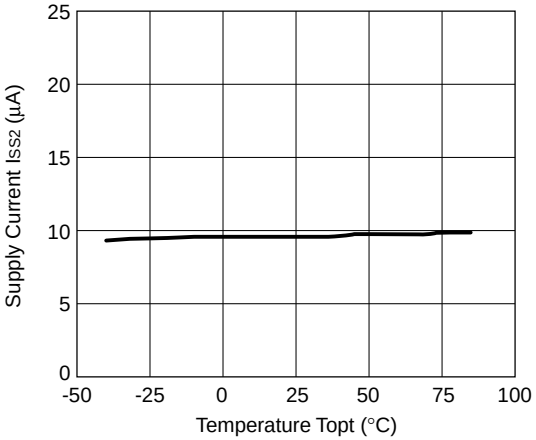
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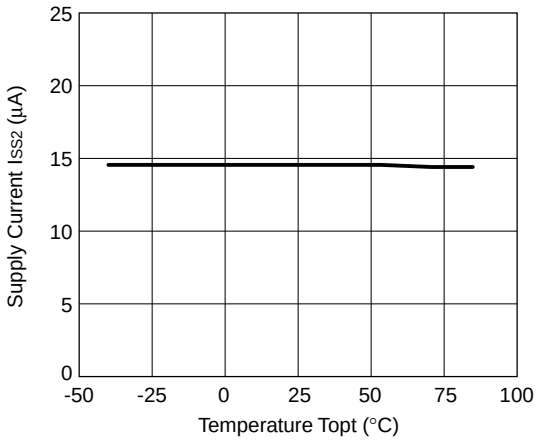
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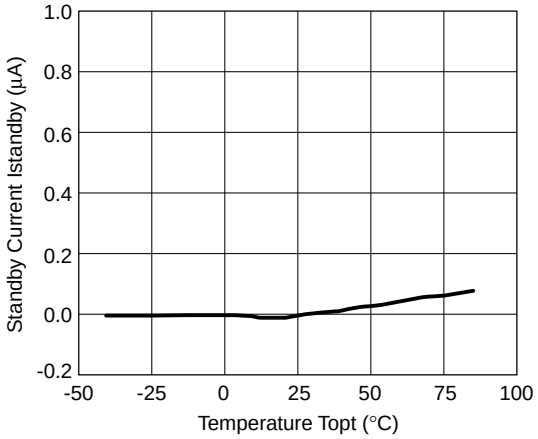


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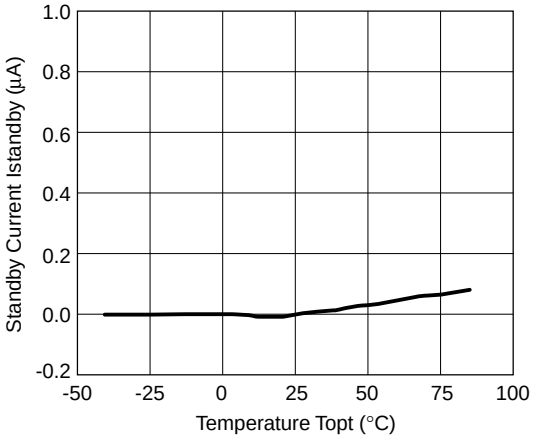


9) Standby Current vs. Temperature

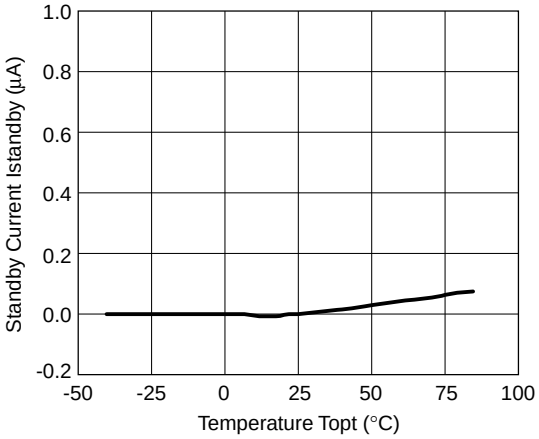
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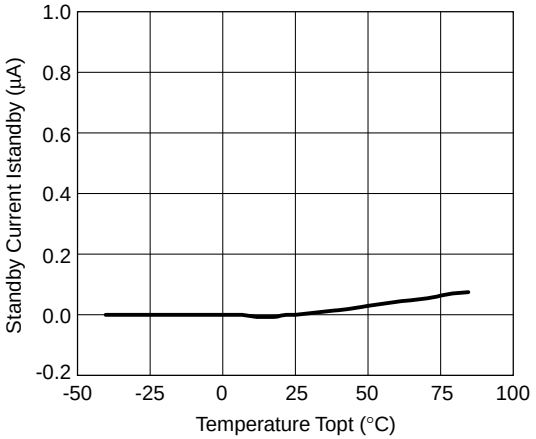
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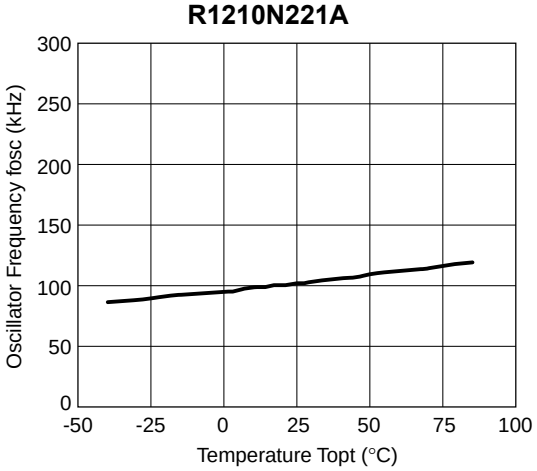


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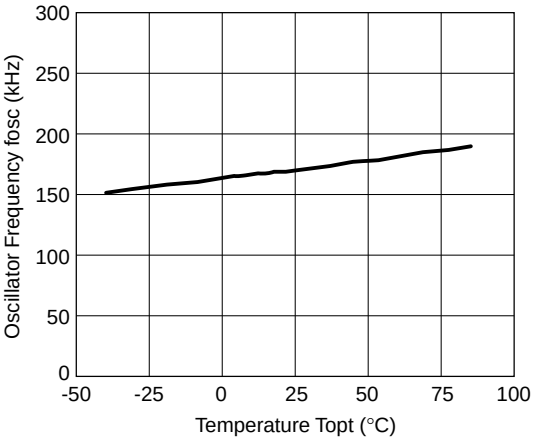


10) Oscillator Frequency vs. Temperature

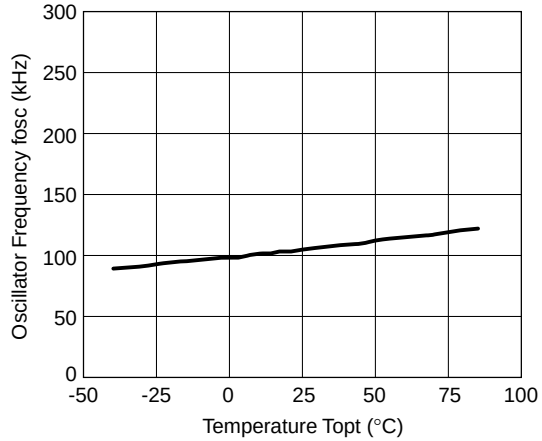
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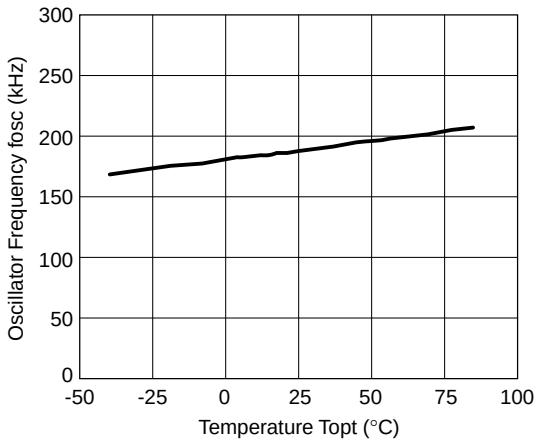
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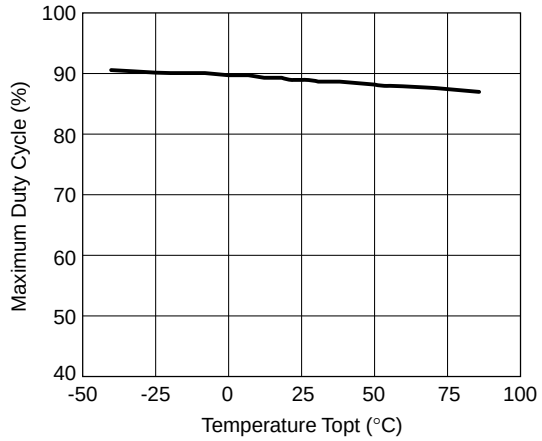


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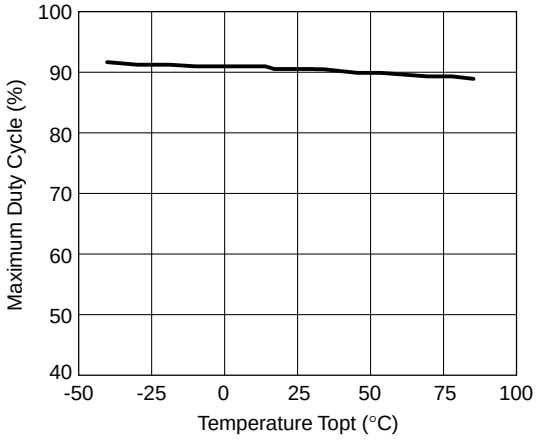


11) Maximum Duty Cycle vs. Temperature

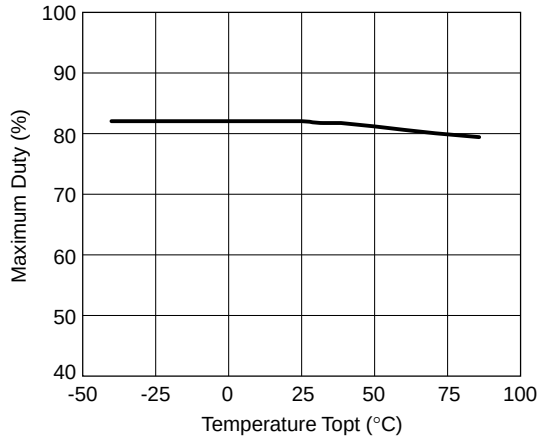
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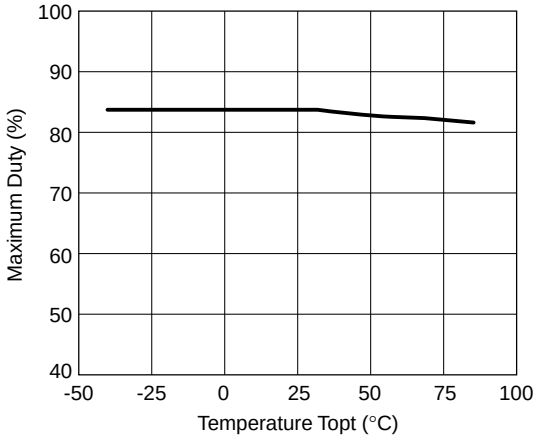
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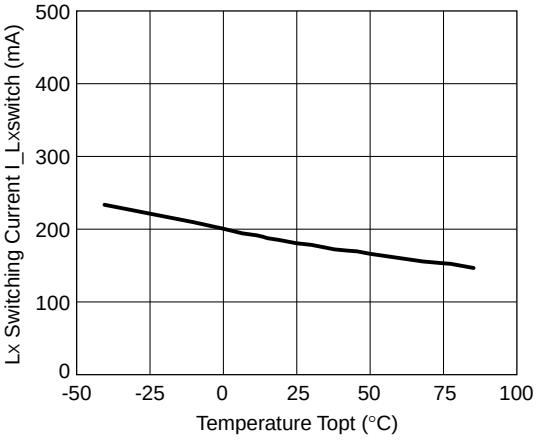


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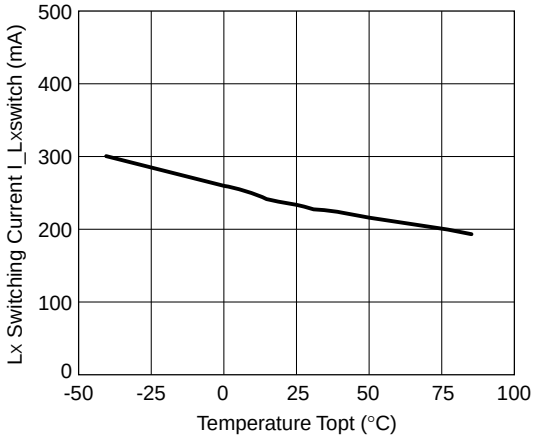


12) L_X Switching Current vs. Temperature

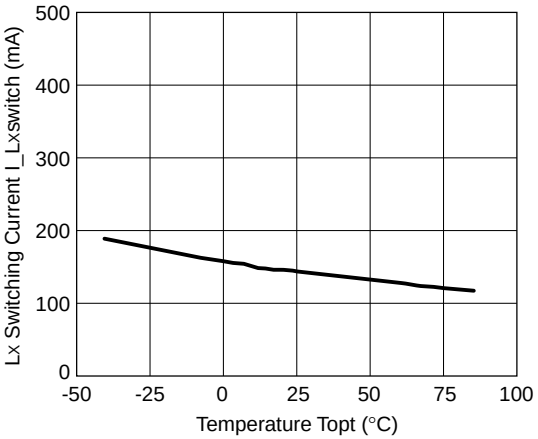
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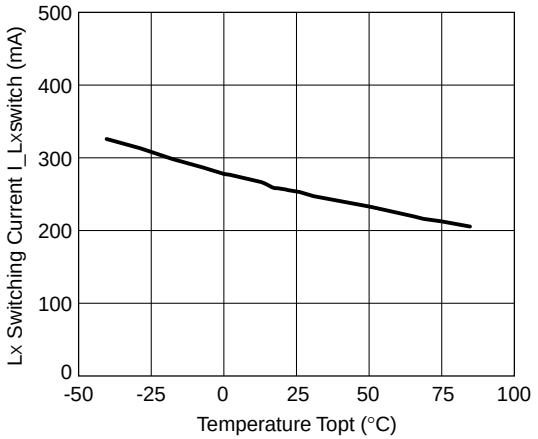
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R1210N221D

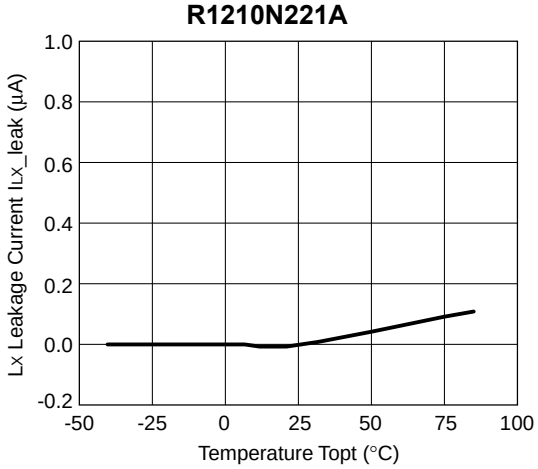


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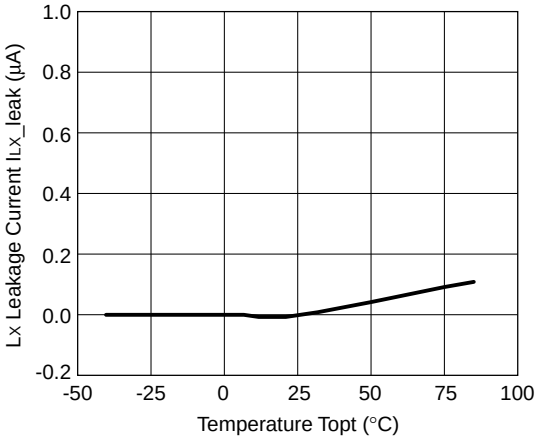


13) L_X leakage Current vs. Temperature

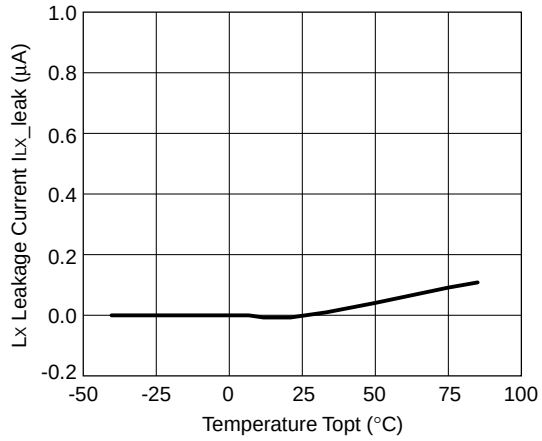
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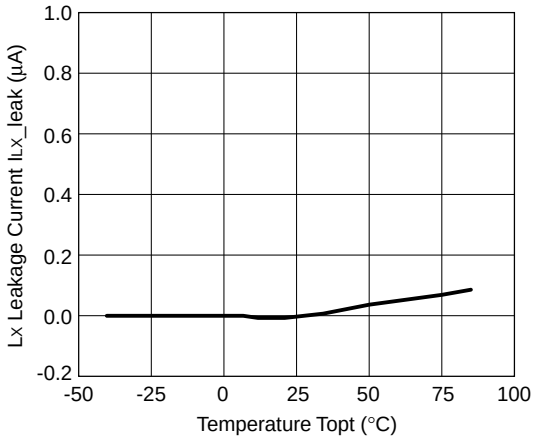
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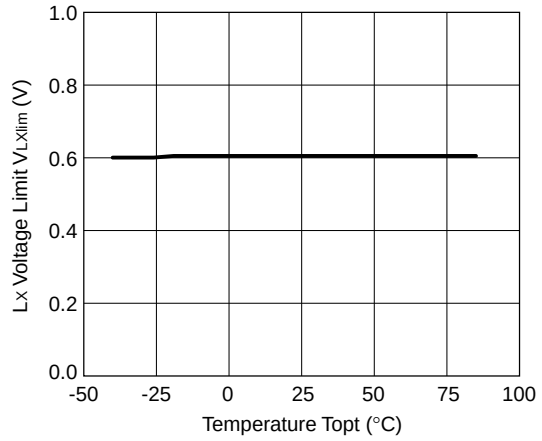


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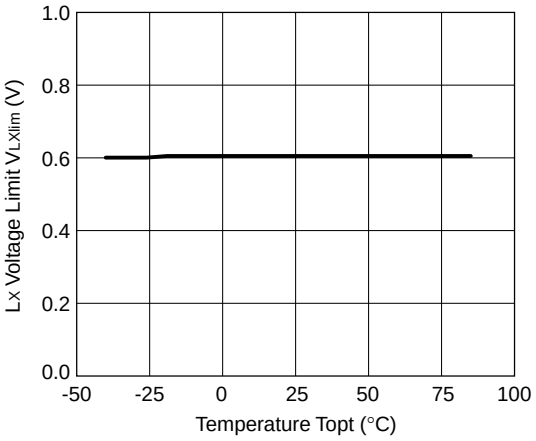


14) V_{LX} Voltage Limit vs. Temperature

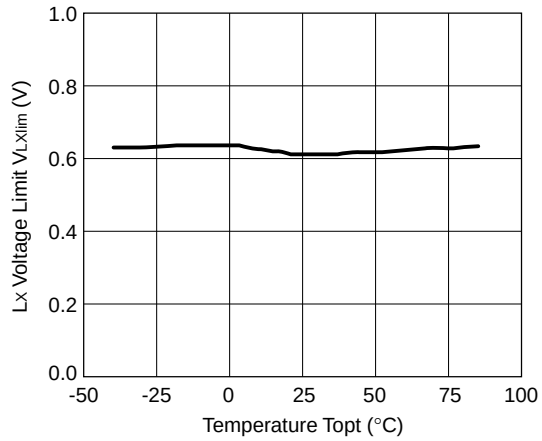
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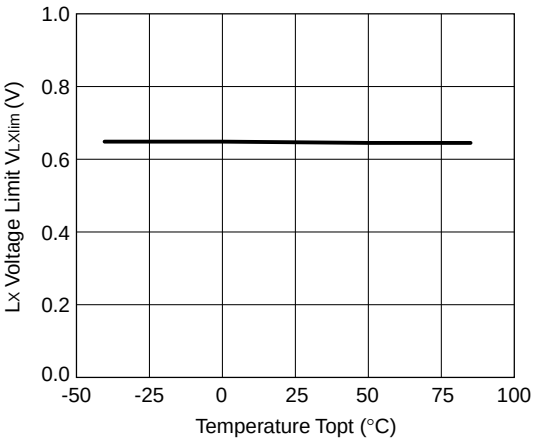
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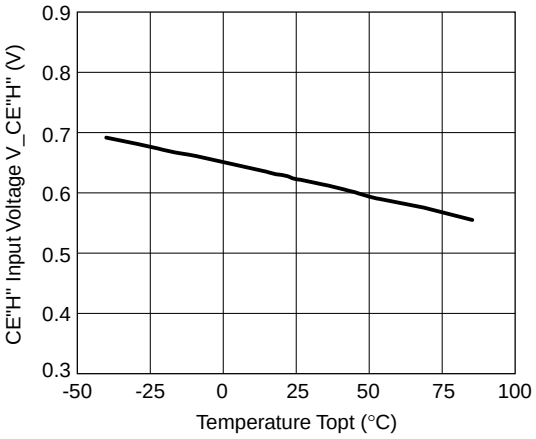


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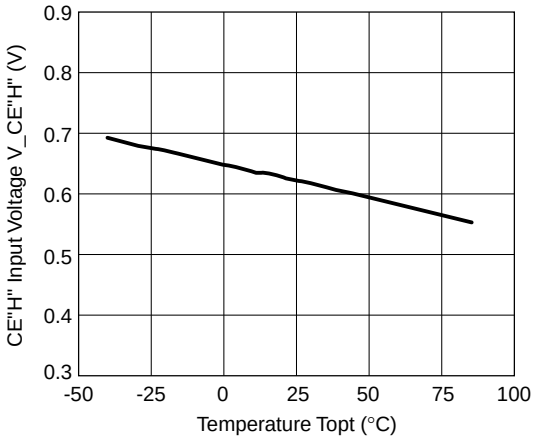


15) CE “H” Input Voltage vs. Temperature

R1210N221A

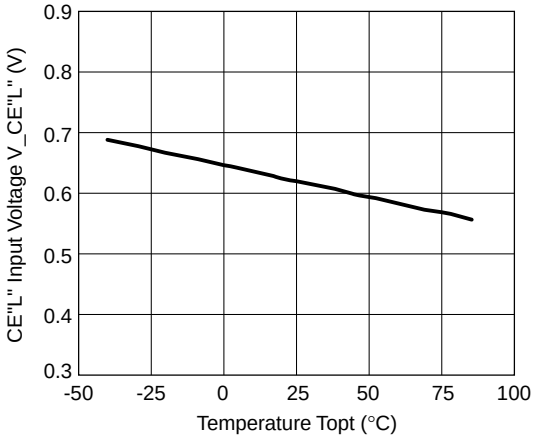


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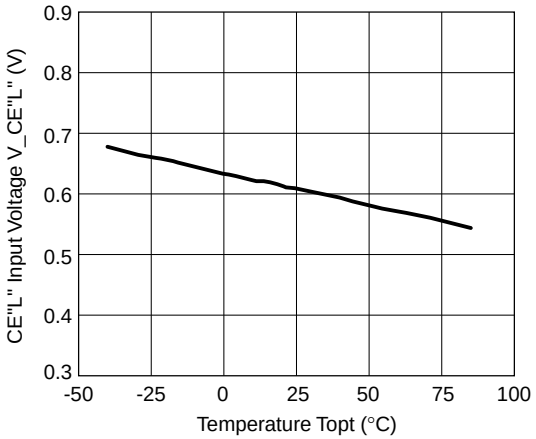


16) CE “L” Input Voltage vs. Temperature

R1210N221A



R1210N601C



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7. Anti-radiation design is not implemented in the products described in this document.
8. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
9. WLCSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.
10. There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact our sales or our distributor before attempting to use AOI.
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