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, 'Lx switch', and a protection circuit for Lx 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.

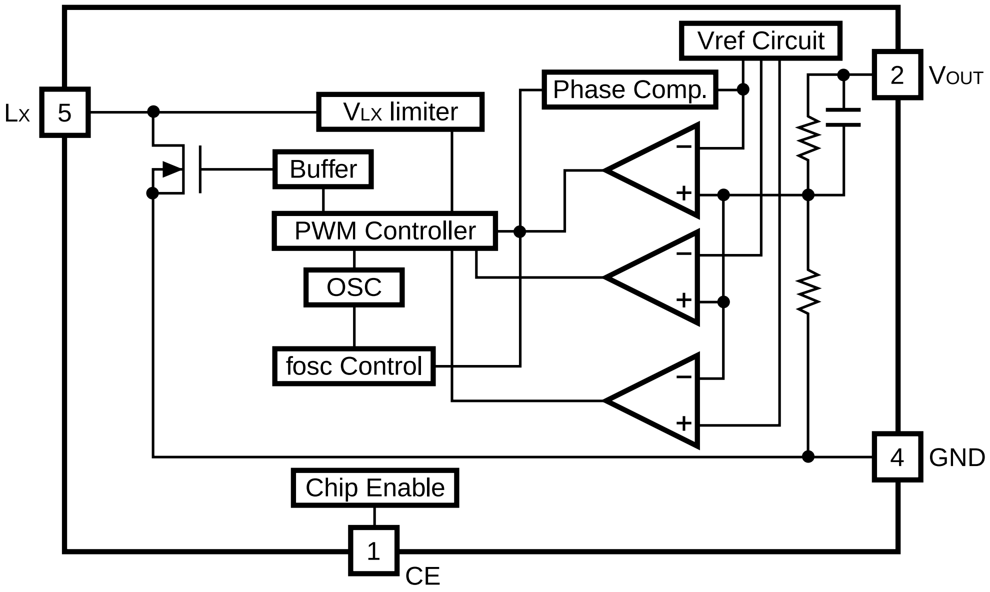
FEATURES

- 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

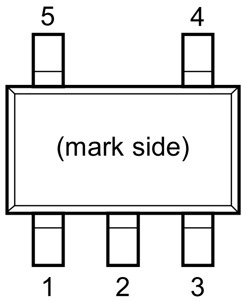
xx : The output voltage can be designated. (0.1V steps)
xx1A : 2.2V(22) to 3.5V(35)
xx1C/xx1D : 2.2V(22) to 6.0V(60)

∗ : 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
T_{opt}	Operating Temperature Range	–40 to 85	°C
T_{stg}	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}/ ΔT_{opt}	Step-up Output Voltage Temperature Coefficient	−40°C≤T_{opt}≤85°C			±100		ppm/°C
V_{start}	Start-up Voltage	V_{IN}=0V→2V, V_{OUT}:1.8kΩ pull-down				0.9	V
ΔV_{start}/ ΔT_{opt}	Start-up Voltage Temperature Coefficient	−40°C≤T_{opt}≤85°C			-3.2		mV/°C
V_{hold}	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
$I_{standby}$	Standby Current	V_{OUT}=6.5V, V_{CE}=0V				0.5	μA
I_{LXleak}	L_X Leakage Current	V_{OUT}=V_{LX}=8V				0.5	μA
f_{osc}	Maximum Oscillator Frequency	V_{OUT}=V_{CE}=V_{SET}×0.96	xx1A/C	80	100	120	kHz
			xx1D	144	180	216	kHz
Δf_{osc}/ ΔT_{opt}	Oscillator Frequency Temperature Coefficient	−40°C≤T_{opt}≤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
f_{osc2}	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	

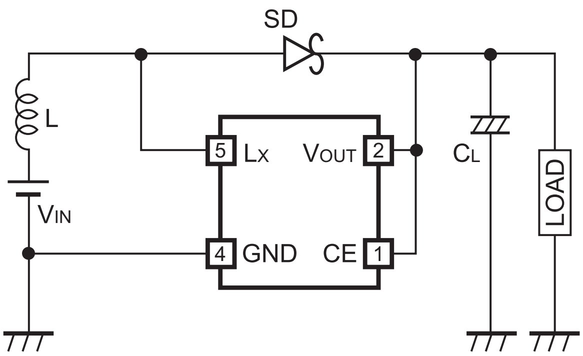
Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
I_{DD1}	Supply Current 1 (xx1D)	$V_{OUT}=V_{SET}\times0.96$	$2.2V\leq V_{SET}\leq2.5V$		50	80	μA
			$2.6V\leq V_{SET}\leq3.0V$		60	90	
			$3.1V\leq V_{SET}\leq3.5V$		70	100	
			$3.6V\leq V_{SET}\leq4.0V$		80	110	
			$4.1V\leq V_{SET}\leq4.5V$		90	120	
			$4.6V\leq V_{SET}\leq5.0V$		100	130	
			$5.1V\leq V_{SET}\leq5.5V$		110	150	
			$5.6V\leq V_{SET}\leq6.0V$		120	170	
I_{LX}	L_X Switching Current	$V_{LX}=0.4V$	$2.2V\leq V_{SET}\leq2.4V$	70			mA
			$2.5V\leq V_{SET}\leq2.9V$	85			
			$3.0V\leq V_{SET}\leq3.4V$	100			
			$3.5V\leq V_{SET}\leq3.9V$	120			
			$4.0V\leq V_{SET}\leq4.4V$	140			
			$4.5V\leq V_{SET}\leq4.9V$	150			
			$5.0V\leq V_{SET}\leq5.4V$	170			
			$5.5V\leq V_{SET}\leq6.0V$	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.

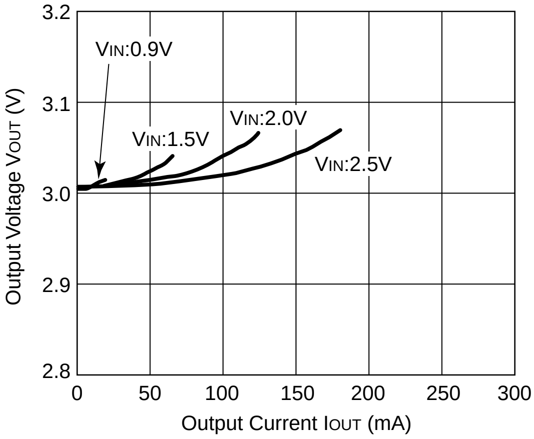
·Use a diode of a Schottky type with high switching speed, and also pay attention to its current capacity.

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

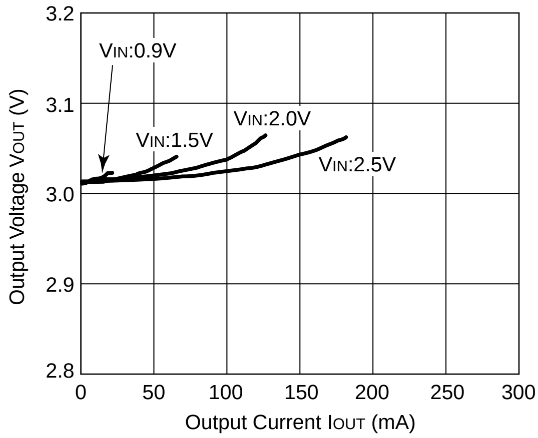
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

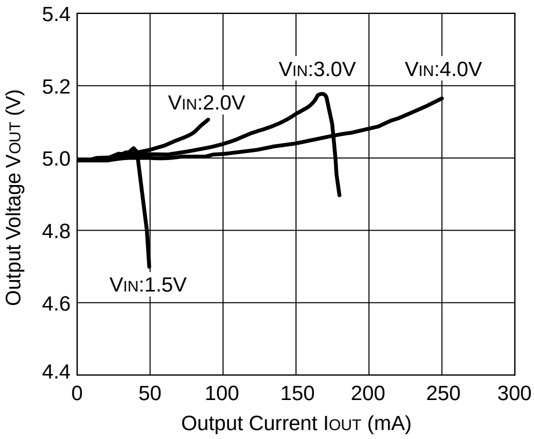
R1210N301C



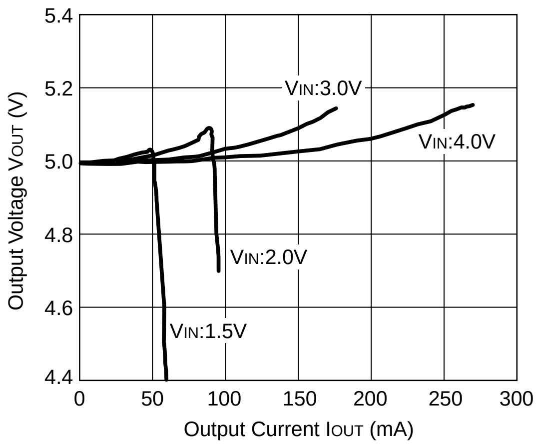
R1210N301D



R1210N501C

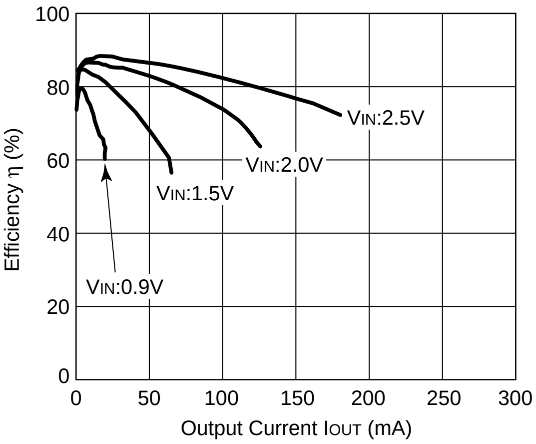


R1210N501D

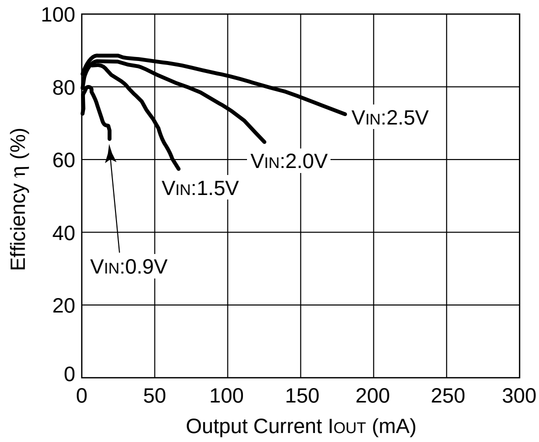


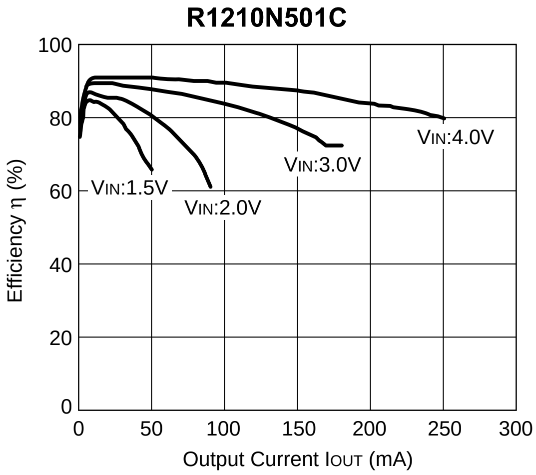
2) Efficiency vs. Output Current

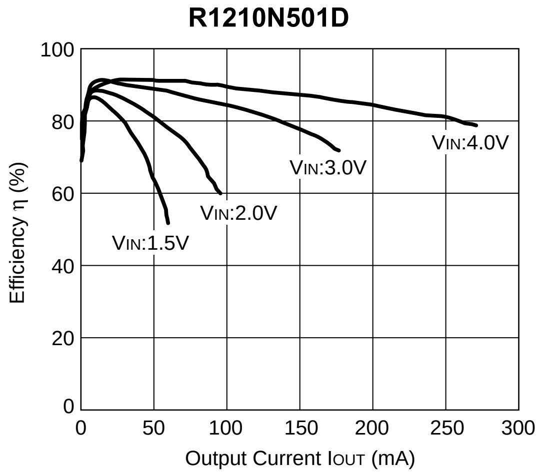
R1210N301C



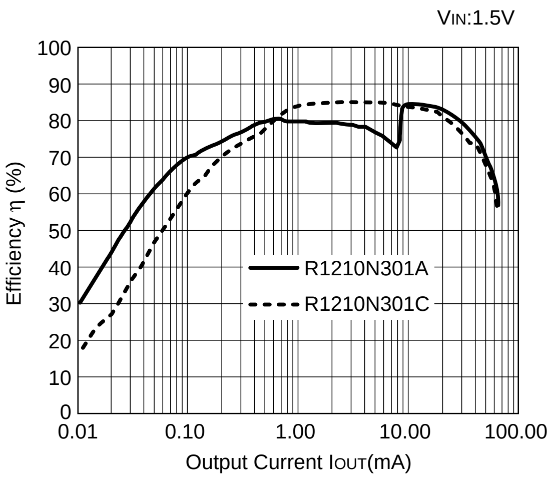
R1210N301D



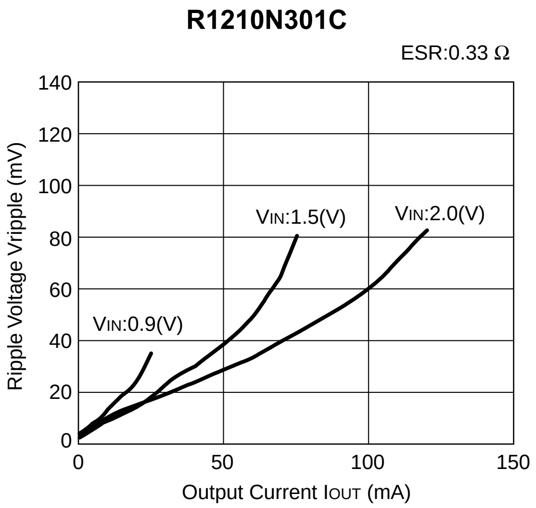


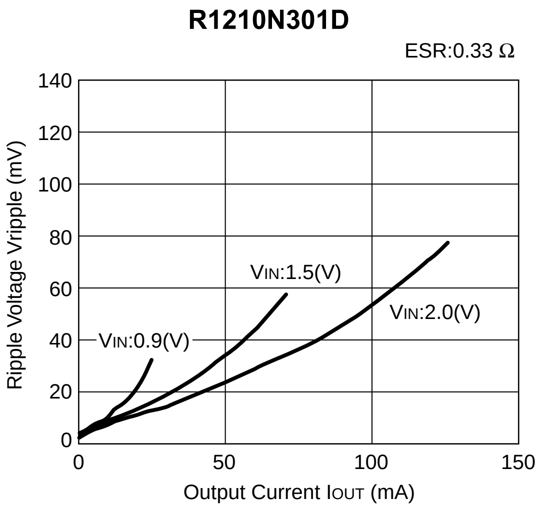


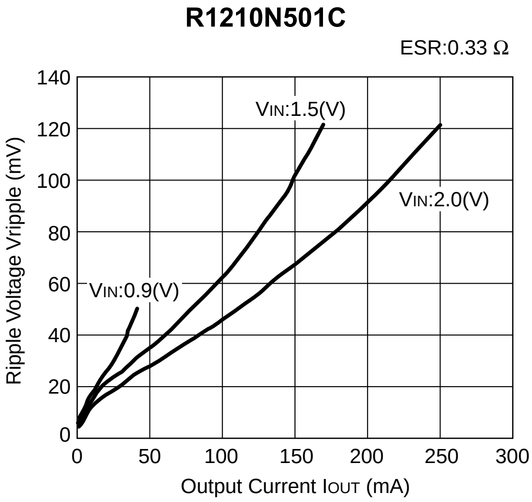
3) R1210Nxx1A/C Efficiency

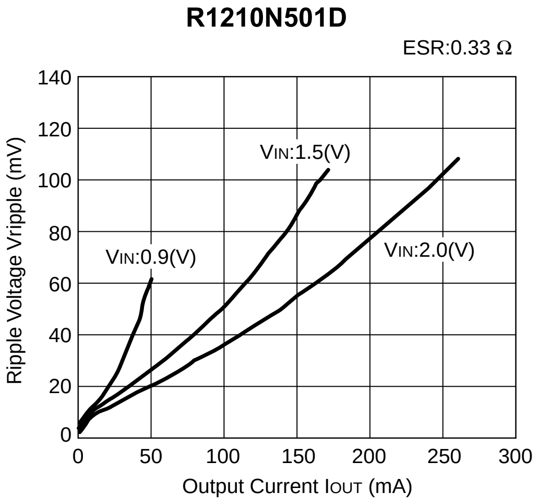


4) Ripple Voltage vs. Output Current

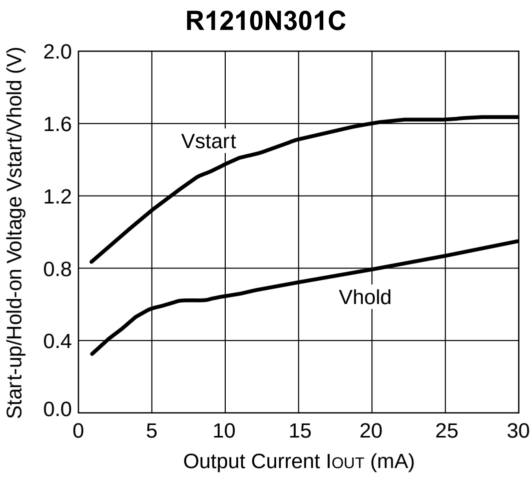


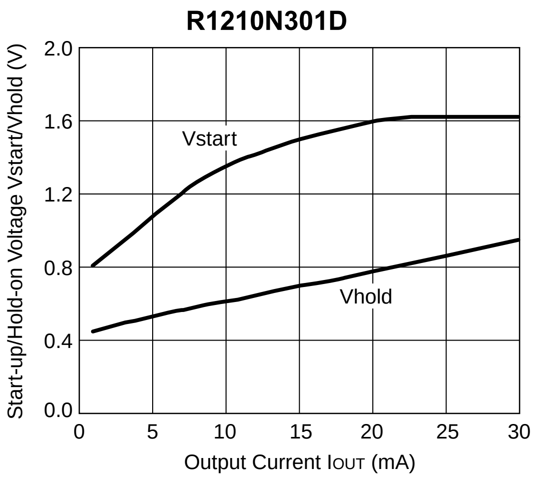


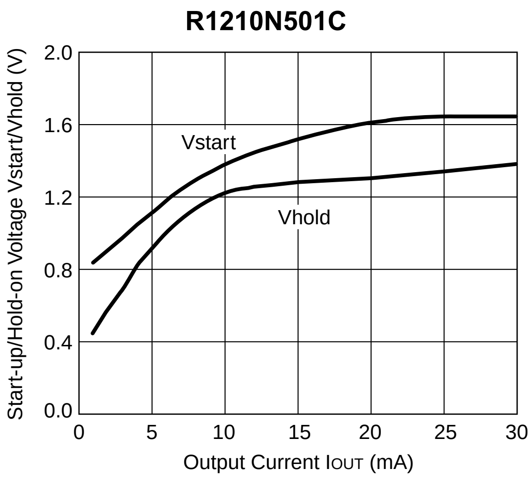


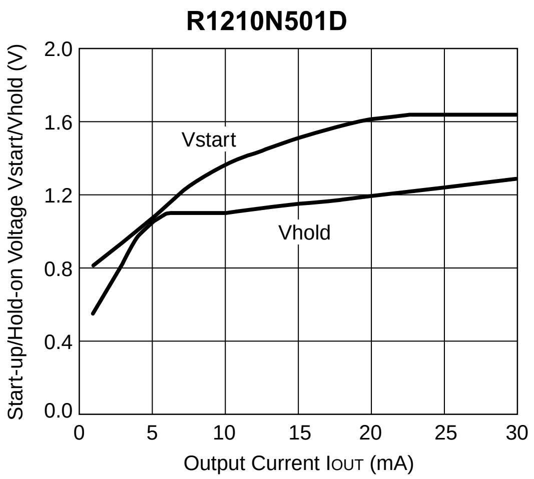


5) Start-up Voltage/Hold-on Voltage vs. Output Current (Topt=25°C)



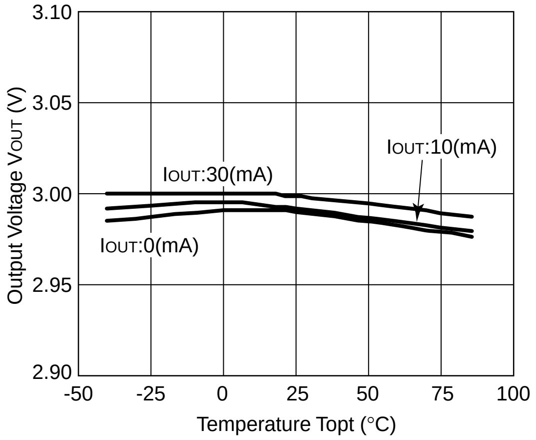




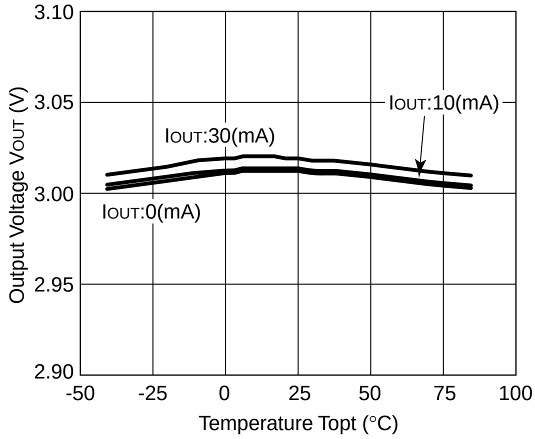


6) Output Voltage vs. Temperature

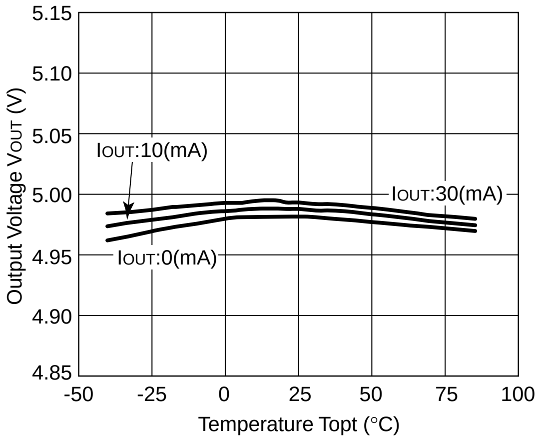
R1210N301C



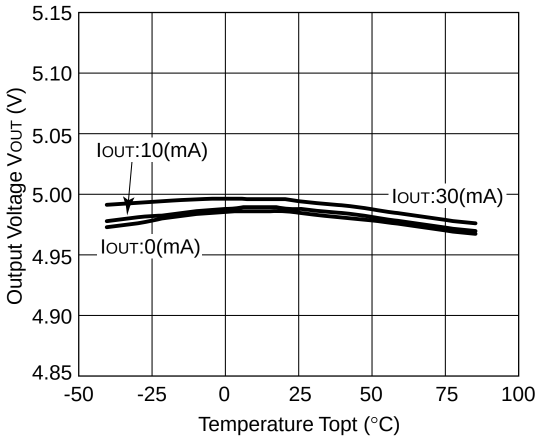
R1210N301D



R1210N501C

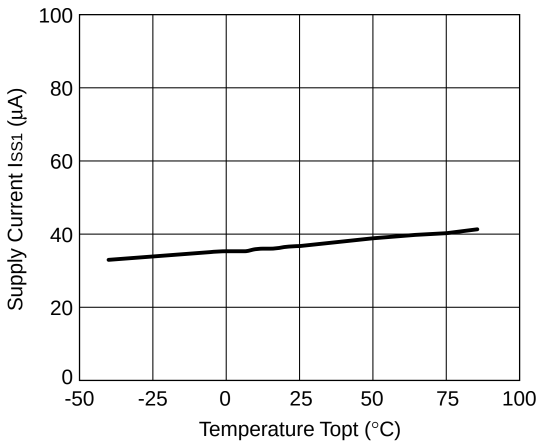


R1210N501D

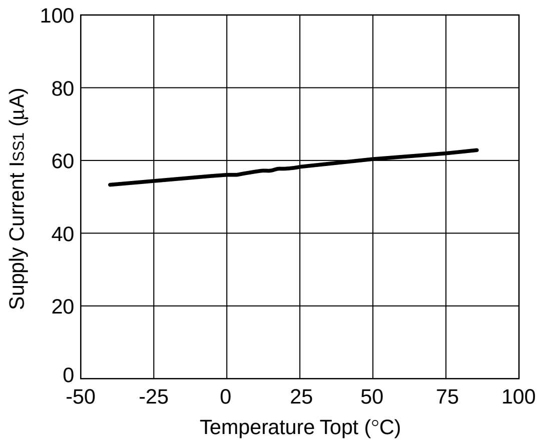


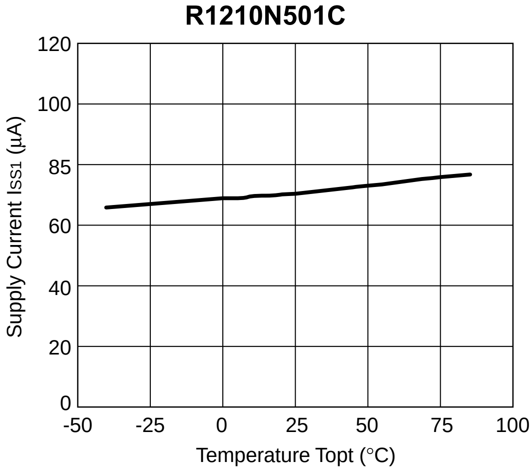
7) Supply Current 1 vs. Temperature

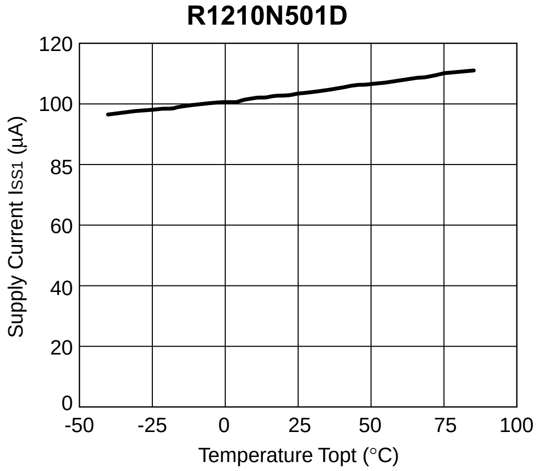
R1210N301A



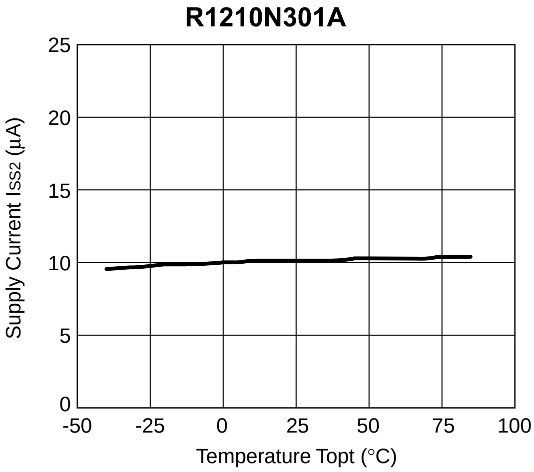
R1210N301D

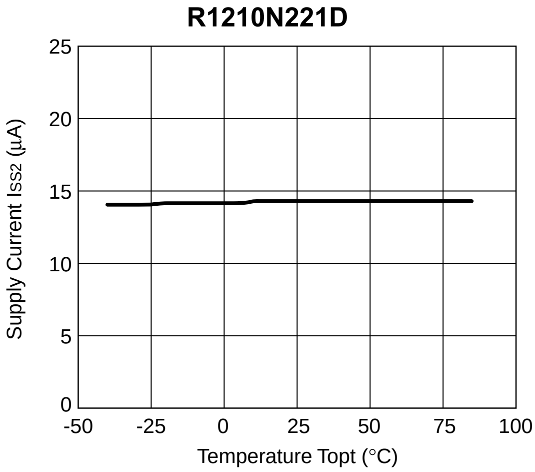


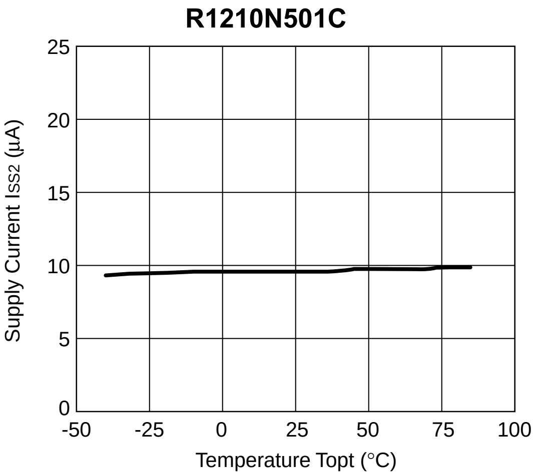


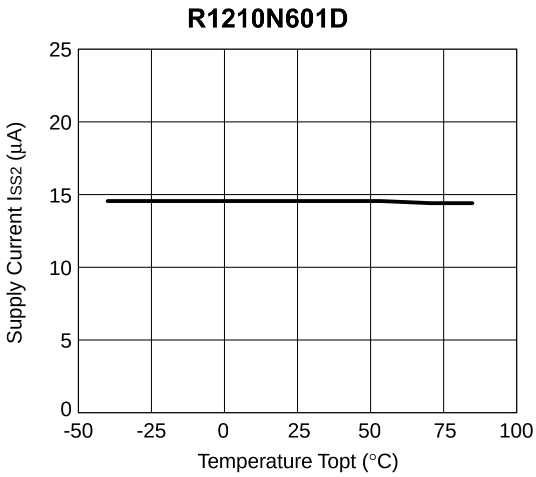


8) Supply Current2 vs. Temperature

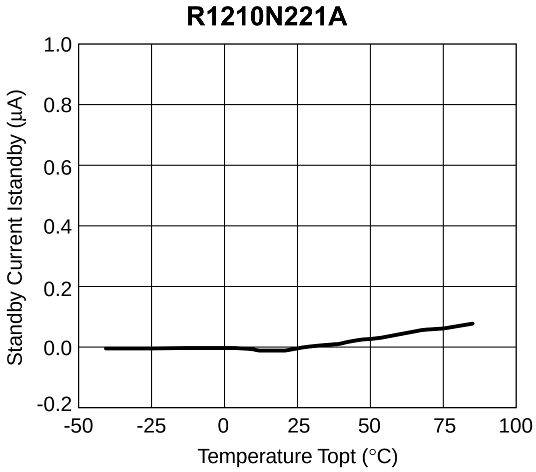


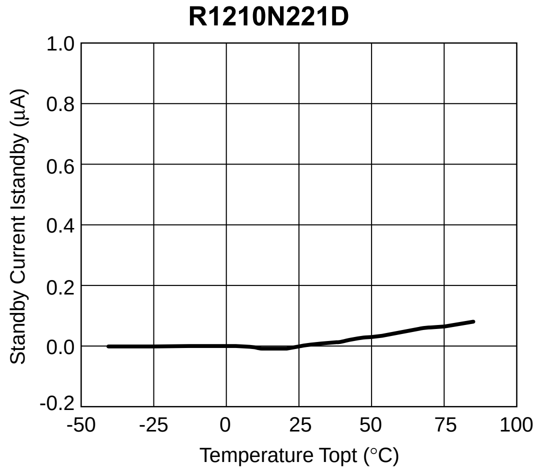


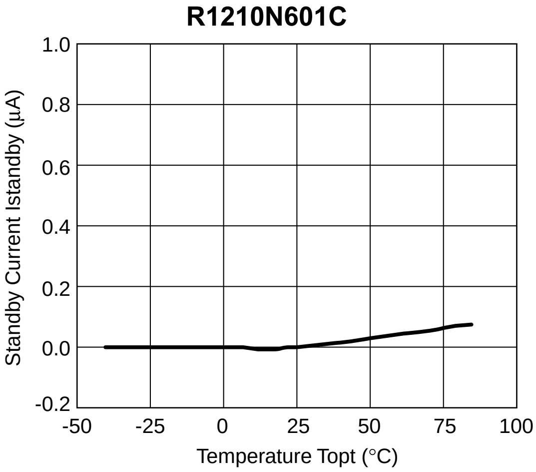


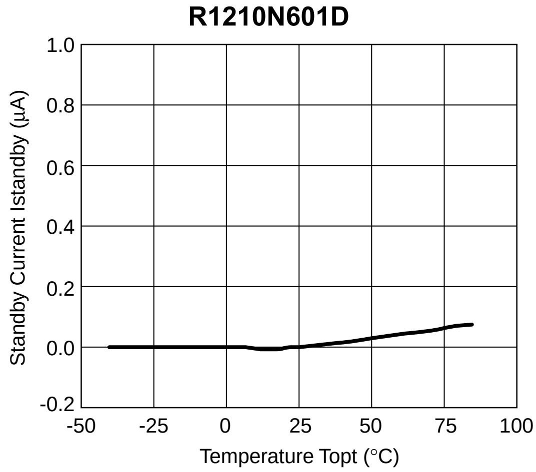


9) Standby Current vs. Temperature

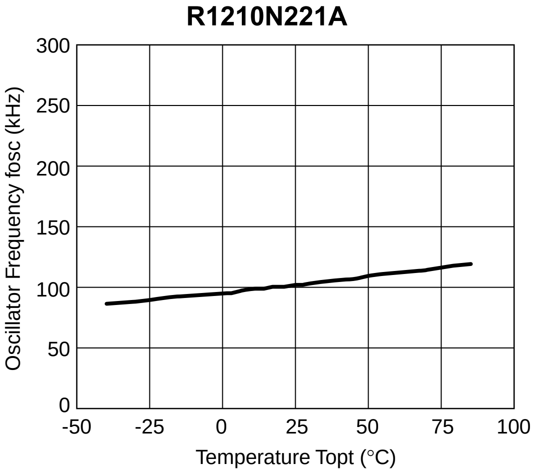


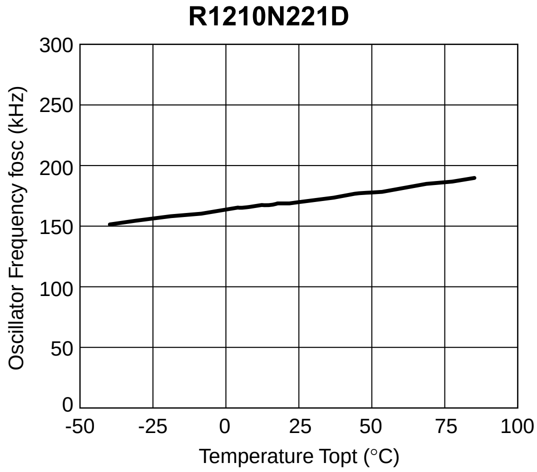


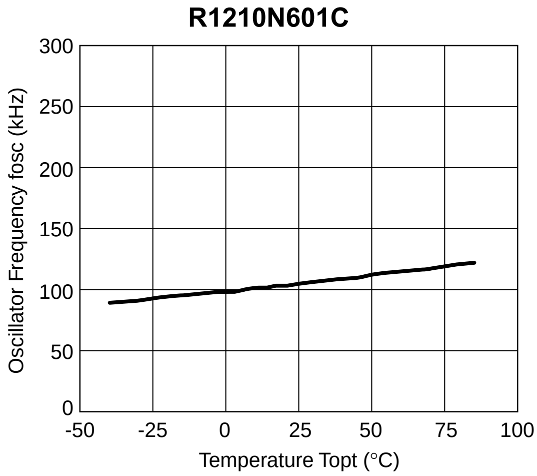


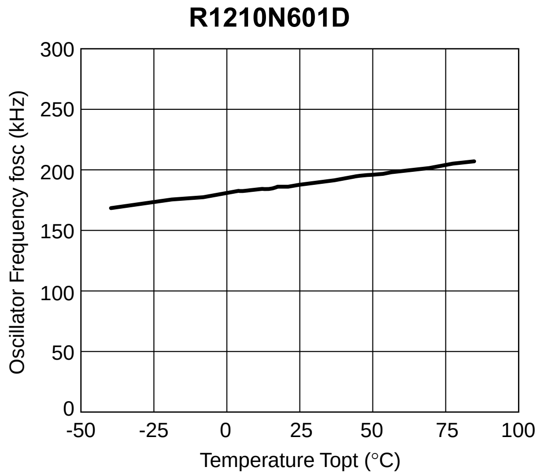


10) Oscillator Frequency vs. Temperature

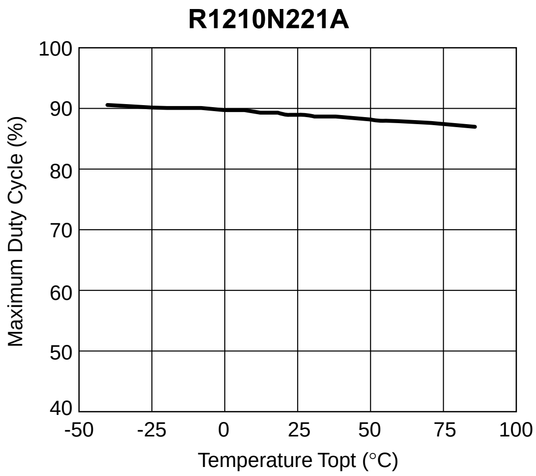


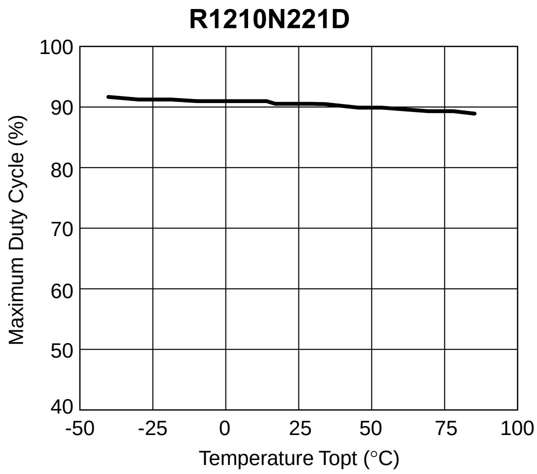


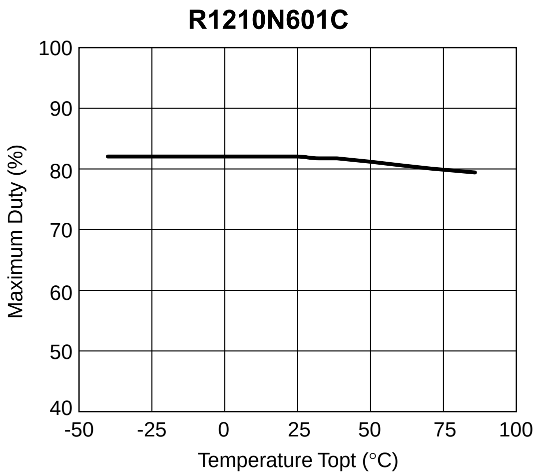


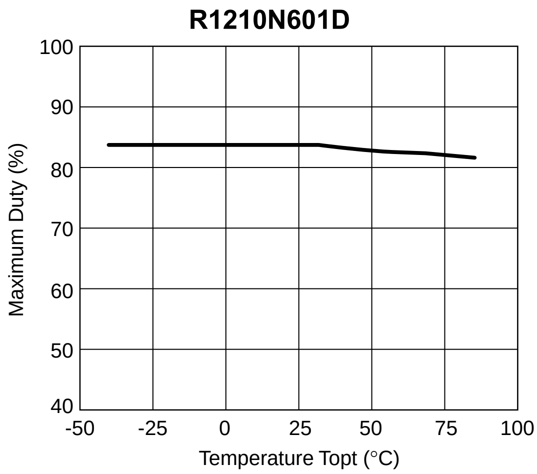


11) Maximum Duty Cycle vs. Temperature



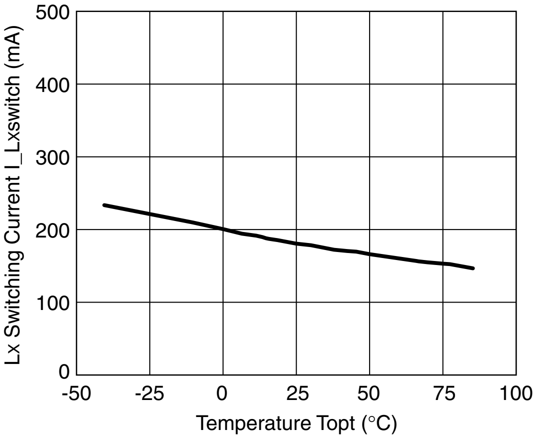




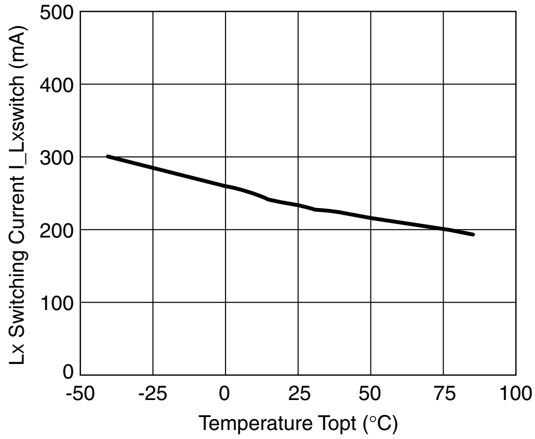


12) Lx Switching Current vs. Temperature

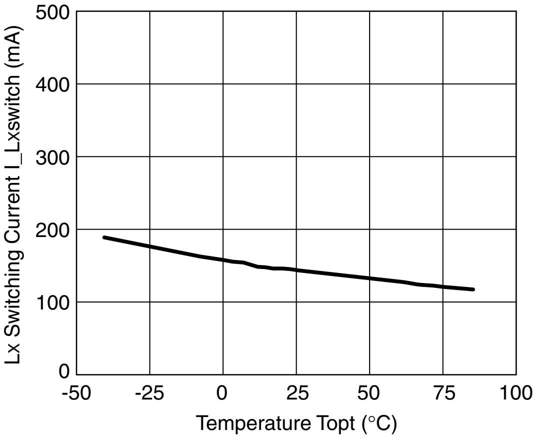
R1210N301A



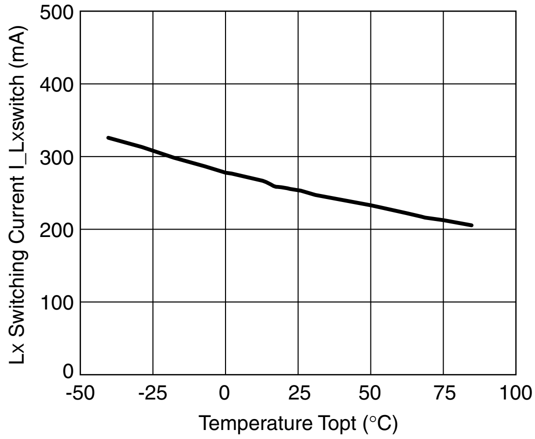
R1210N501C



R1210N221D

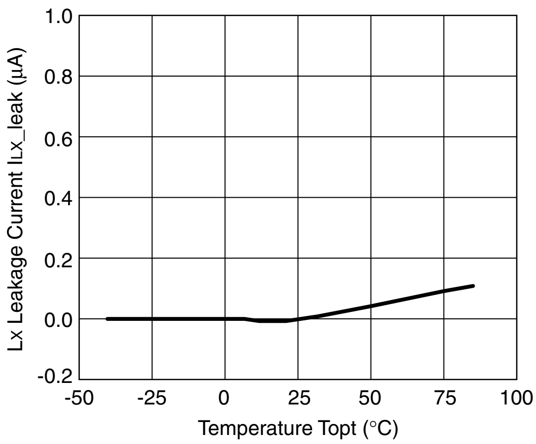


R1210N601D

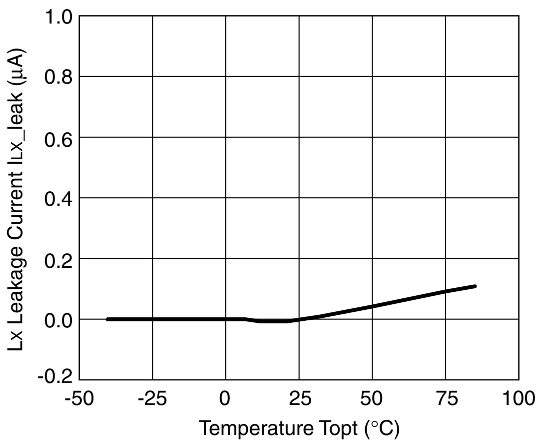


13) Lx leakage Current vs. Temperature

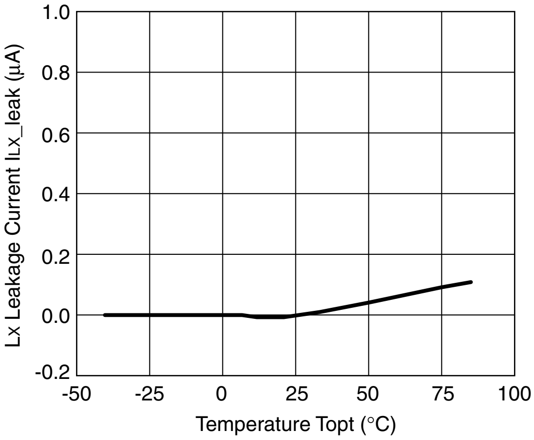
R1210N221A



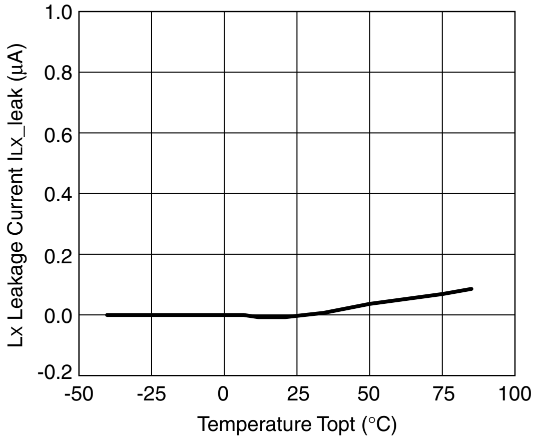
R1210N221D



R1210N601C

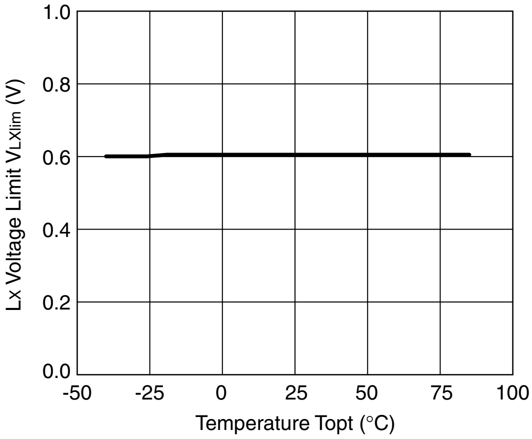


R1210N601D

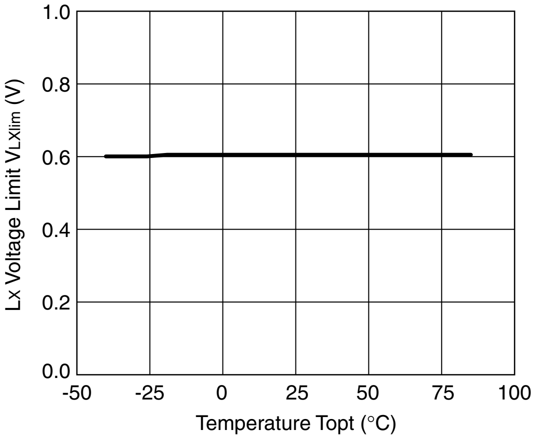


14) V_{LX} Voltage Limit vs. Temperature

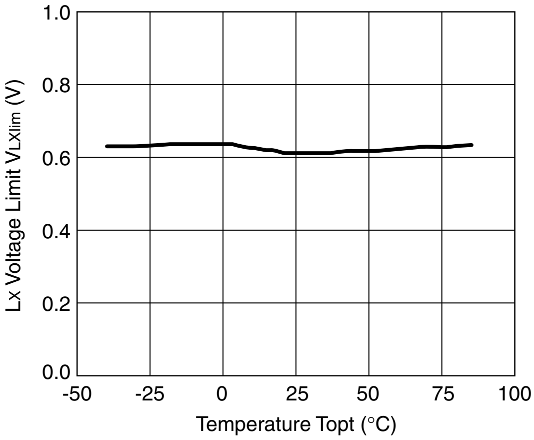
R1210N301A



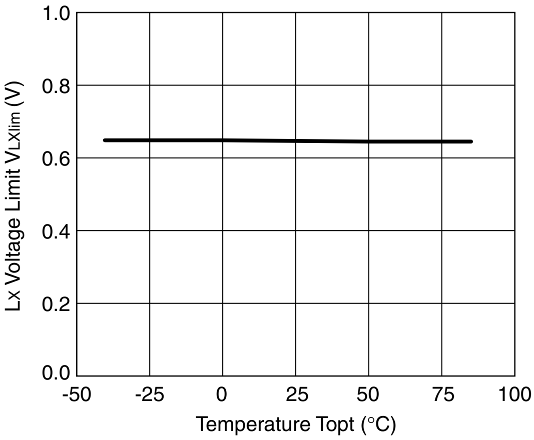
R1210N221D



R1210N501C

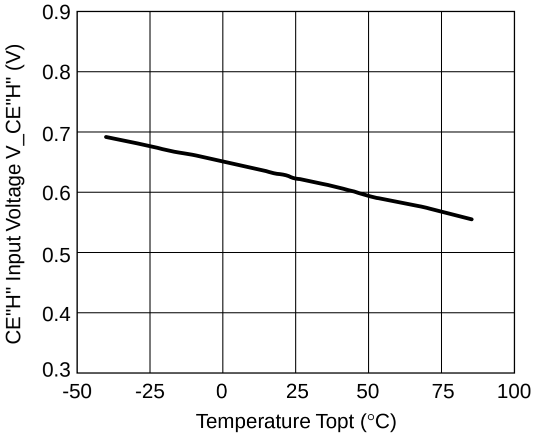


R1210N601D

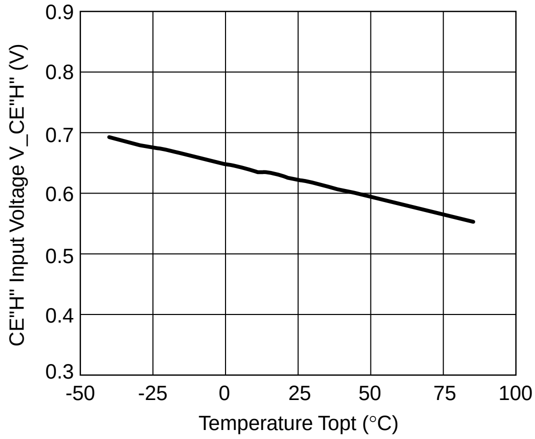


15) CE "H" Input Voltage vs. Temperature

R1210N221A

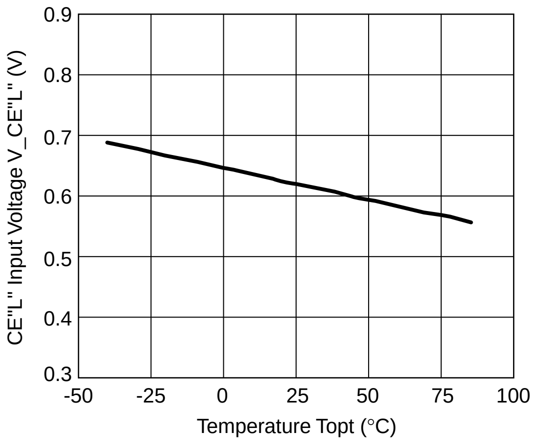


R1210N601C

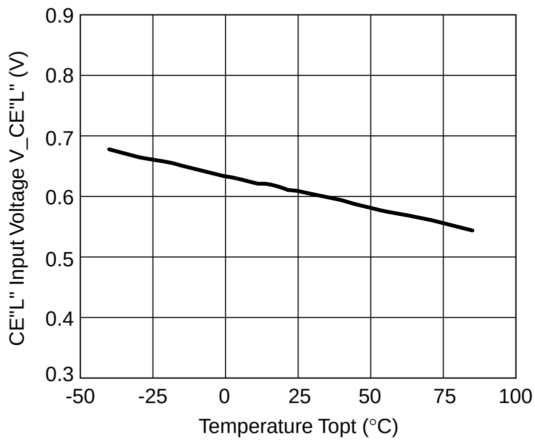


16) CE "L" Input Voltage vs. Temperature

R1210N221A



R1210N601C



RoHS Compliant
Halogen Free

Ricoh is committed to reducing the environmental loading materials in electrical devices with a view to contributing to the protection of human health and the environment.
Ricoh has been providing RoHS compliant products since April 1, 2006 and Halogen-free products since April 1, 2012.

RICOH ELECTRONIC DEVICES CO., LTD.

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

Sales & Support Offices

Ricoh Electronic Devices Co., Ltd.
Shin-Yokohama Office (International Sales)
2-3, Shin-Yokohama 3-chome, Kohoku-ku, Yokohama-shi, Kanagawa, 222-8530, Japan
Phone: +81-50-3814-7687 Fax: +81-45-474-0074

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

Ricoh Europe (Netherlands) B.V.
Semiconductor Support Centre
Prof. W.H. Keesomlaan 1, 1183 DJ Amstelveen, The Netherlands
Phone: +31-20-5474-309

Ricoh International B.V. - German Branch
Semiconductor Sales and Support Centre
Oberrather Strasse 6, 40472 Düsseldorf, Germany
Phone: +49-211-6546-0

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

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

Ricoh Electronic Devices Shanghai Co., Ltd.
Shenzhen Branch
1205, Block D(Jinlong Building), Kingkey 100, Hongbao Road, Luohu District, Shenzhen, China
Phone: +86-755-8348-7600 Ext 225

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