PWM Step-up DC/DC Converter

R1210N××1× Series

APPLICATION MANUAL

NO. EA-075-0012

PWM Step-up DC/DC Converter

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OUTLINE

The R1210N××1× Series are PWM step-up DC/DC Converter, with high accuracy, low supply current by CMOS process.

Each of the R1210N××1× 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. R1210N××1A 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 R1210N××1A 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.

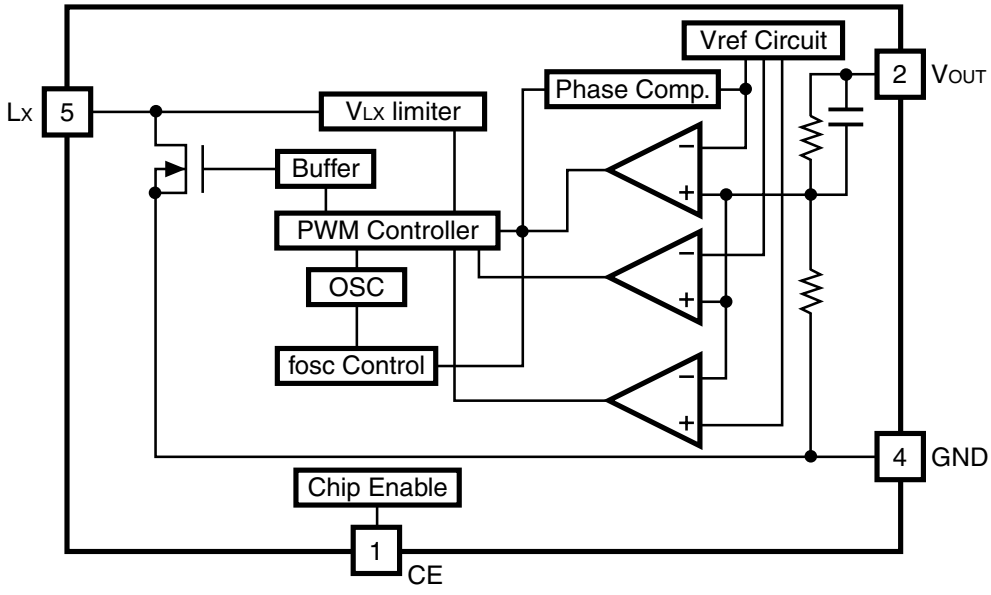
FEATURES

- External Components ..... Only an inductor, a diode, and a capacitor
- Standby Current ..... TYP. 0μA
- Low Temperature-Drift Coefficient of Output Voltage..... TYP. ±100ppm/°C
- Output Voltage..... Stepwise Setting with a step of 0.1V in the range of
  2.2V to 6.0V (××1C/D)
  2.2V to 3.5V (××1A)
- Two choices of Basic Oscillator Frequency..... 100kHz (××1A/C), 180kHz (××1D)
- Small Package ..... SOT-23-5 (Mini-mold)
- High 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 ××1A 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 DIAGRAM



SELECTION GUIDE

In the R1210N Series, the output voltage, the oscillator frequency, the optional function, and the taping type for the ICs can be selected at the user's request.

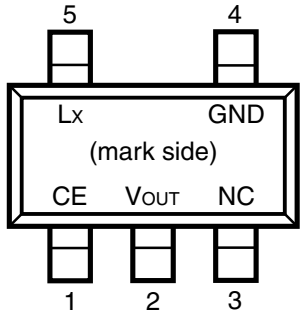
The selection can be made by designating the part number as shown below ;

R1210N××1×-××
↑ ↑ ↑
a b c

Code	Contents
a	Setting Output Voltage (V_{OUT}) : Stepwise setting with a step of 0.1V in the range of 2.2V to 6.0V (for ××1C/D version) or 2.2V to 3.5V (for ××1A version) is possible.
b	Designation of Oscillator Frequency A : 100kHz with a Frequency Change-over circuit C : 100kHz without a Frequency Change-over circuit D : 180kHz without a Frequency Change-over circuit
c	Designation of Taping Type; Ex. :TR, TL (refer to Taping Specification) "TR" is prescribed as a standard.

PIN CONFIGURATION

SOT-23-5



PIN DESCRIPTION

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

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{OUT}	V_{OUT} Pin Output Voltage	9.0	V
V_{LX}	Lx Pin Output Voltage	9.0	V
V_{CE}	CE Pin Input Voltage	9.0	V
I_{LX}	Lx Pin Output Current	400	mA
P_D	Power Dissipation	250	mW
Topt	Operating Temperature Range	-40~+85	°C
Tstg	Storage Temperature Range	-55~+125	°C

ELECTRICAL CHARACTERISTICS

- **R1210Nxx1x**

(Topt=25°C)

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{OUT}	Output Voltage	$V_{IN}=V_{SET}\times0.6$, $I_{OUT}=1mA$	×0.975		×1.025	V
V_{IN}	Maximum Input Voltage				8	V
$\Delta V_{OUT}/\Delta Topt$	Step-up Output Voltage Temperature Coefficient	-40°C≤ Topt ≤ 85°C		±100		ppm/°C
Vstart	Start-up Voltage	$V_{IN}=0V\rightarrow2V$ V_{OUT}:1.8kΩ pull-down			0.9	V
$\Delta Vstart/\Delta Topt$	Start-up Voltage Temperature Coefficient	-40°C≤ Topt ≤ 85°C		-3.2		mV/°C
Vhold	Hold-on Voltage	$V_{IN}=2V\rightarrow0V$, $I_{OUT}=1mA$	0.7			V (××1A/C)
			0.9			V (××1D)
I_{DD1}	Supply Current1	2.2V≤V_{SET}≤2.5V $V_{OUT}=V_{SET}\times0.96$		30	55	μA (××1A/C)
				50	80	μA (××1D)
		2.6V≤V_{SET}≤3.0V $V_{OUT}=V_{SET}\times0.96$		35	60	μA (××1A/C)
				60	90	μA (××1D)
		3.1V≤V_{SET}≤3.5V $V_{OUT}=V_{SET}\times0.96$		40	70	μA (××1A/C)
				70	100	μA (××1D)
		3.6V≤V_{SET}≤4.0V $V_{OUT}=V_{SET}\times0.96$		45	80	μA (××1C)
				80	110	μA (××1D)
		4.1V≤V_{SET}≤4.5V $V_{OUT}=V_{SET}\times0.96$		50	90	μA (××1C)
				90	120	μA (××1D)

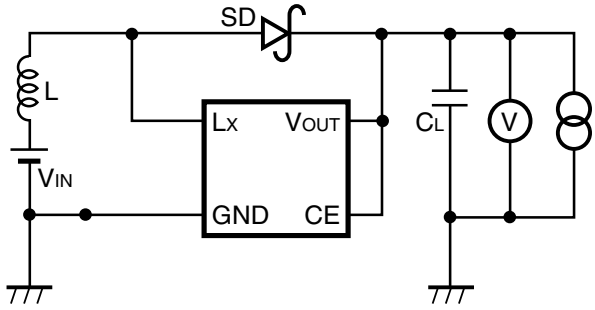
Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
I_{DD1}	Supply Current1	4.6V≤V_{SET}≤5.0V V_{OUT}=V_{SET}×0.96		70	100	μA (xx1C)
				100	130	μA (xx1D)
		5.1V≤V_{SET}≤5.5V V_{OUT}=V_{SET}×0.96		80	110	μA (xx1C)
				110	150	μA (xx1D)
		5.6V≤V_{SET}≤6.0V V_{OUT}=V_{SET}×0.96		90	120	μA (xx1C)
				130	170	μA (xx1D)
I_{DD2}	Supply Current2	V_{OUT}=V_{CE}=V_{SET}+0.5V		10	17	μA (xx1A/C)
				15	24	μA (xx1D)
Istandby	Standby Current	V_{OUT}=6V, V_{CE}=0V			0.5	μA
I_{LXleak}	L_X Leakage Current	V_{OUT}=V_{LX}=8V			0.5	μA
fosc	Maximum Oscillator Frequency	V_{OUT}=V_{CE}=V_{SET}×0.96	80	100	120	KHz (xx1A/C)
			144	180	216	KHz (xx1D)
Δfosc/ ΔTopt	Oscillator Frequency Temperature Coefficient	-40°C≤ Topt ≤ 85°C		0.5		kHz/°C (xx1A/C)
				0.6		kHz/°C (xx1D)
Maxdty	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

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
I_{LX}	Lx Switching Current	2.2V≤V_{SET}≤2.4V V_{LX}=0.4V	70			mA
		2.5V≤V_{SET}≤2.9V V_{LX}=0.4V	85			mA
		3.0V≤V_{SET}≤3.4V V_{LX}=0.4V	100			mA
		3.5V≤V_{SET}≤3.9V V_{LX}=0.4V	120			mA
		4.0V≤V_{SET}≤4.4V V_{LX}=0.4V	140			mA
		4.5V≤V_{SET}≤4.9V V_{LX}=0.4V	150			mA
		5.0V≤V_{SET}≤5.4V V_{LX}=0.4V	170			mA
		5.5V≤V_{SET}≤6.0V V_{LX}=0.4V	190			mA
fosc2	Change-over frequency	V_{IN}=V_{SET}×0.6, I_{OUT}=0.5mA (only for ××1A)	10	35	70	KHz

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

TEST CIRCUITS

A



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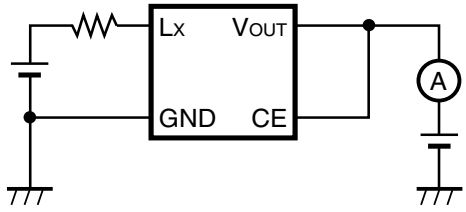

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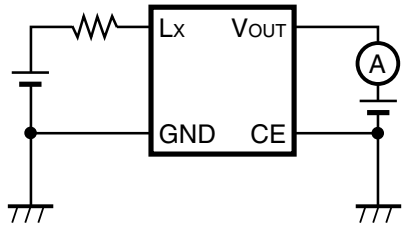

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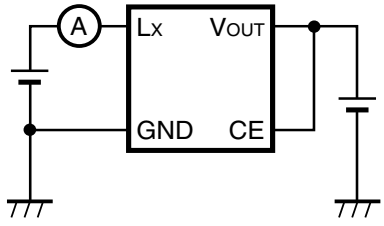

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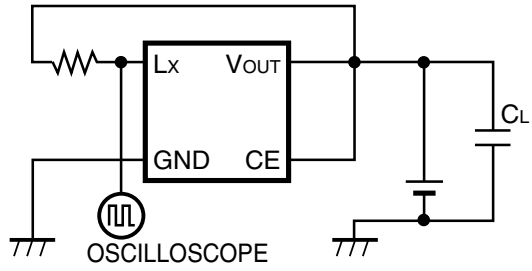

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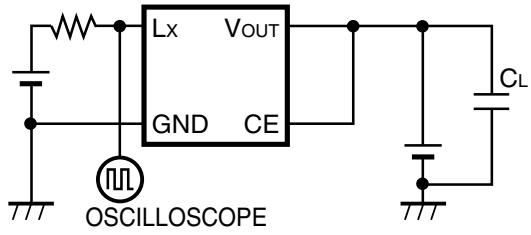

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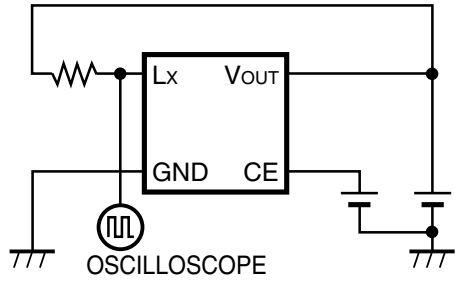

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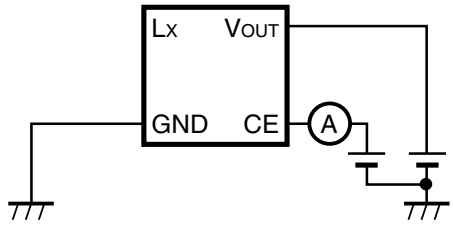


L: 100μH CD54 (Sumida Electric Co, LTD)

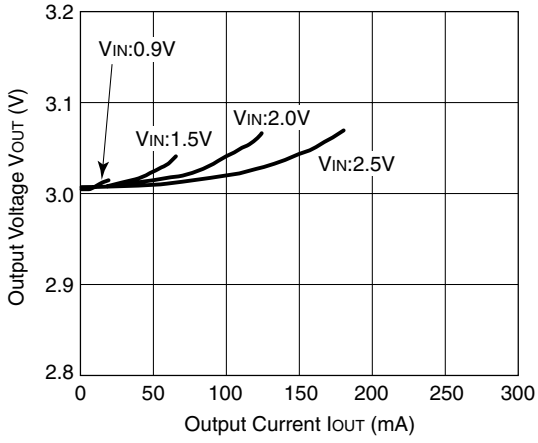
SD: MA721 (Matsushita Electronics Corporation, Schottky Type)

CL: 22μF×2 (Tantalum Type)

TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

R1210N301C



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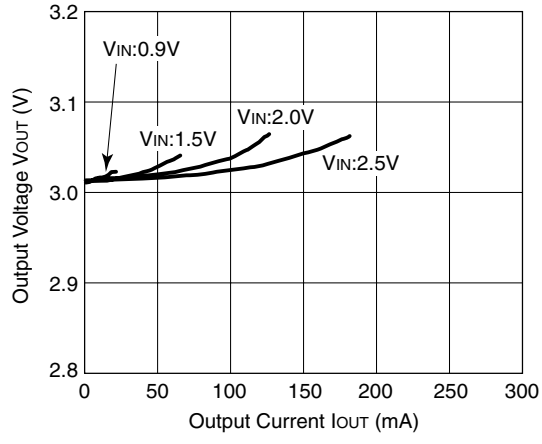

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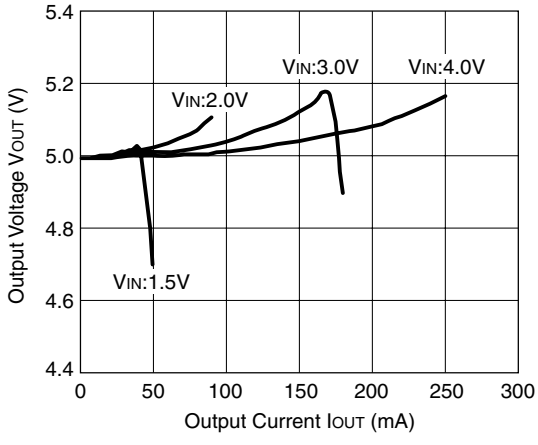

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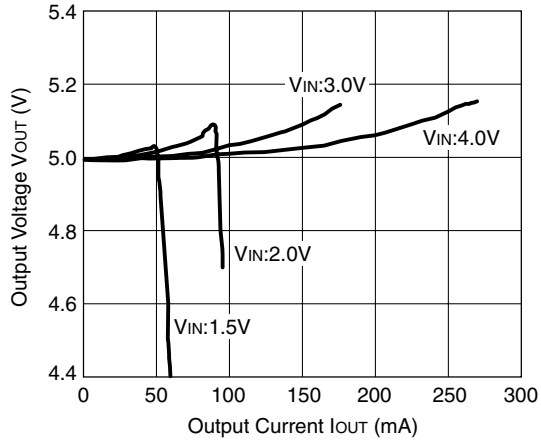

2) Efficiency vs. Output Current

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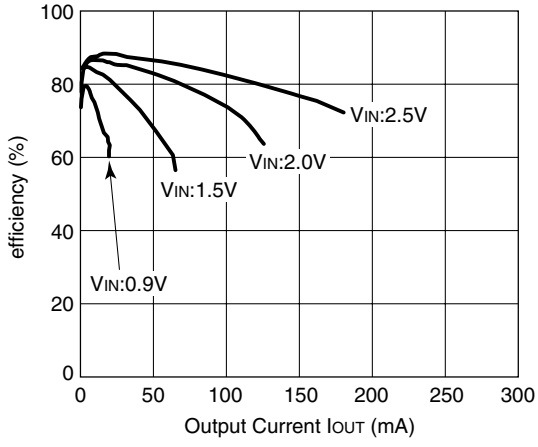

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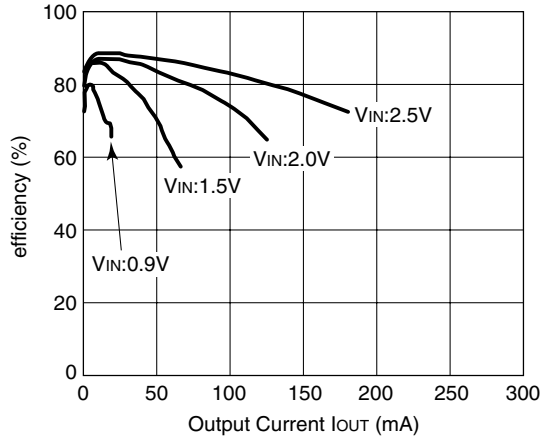

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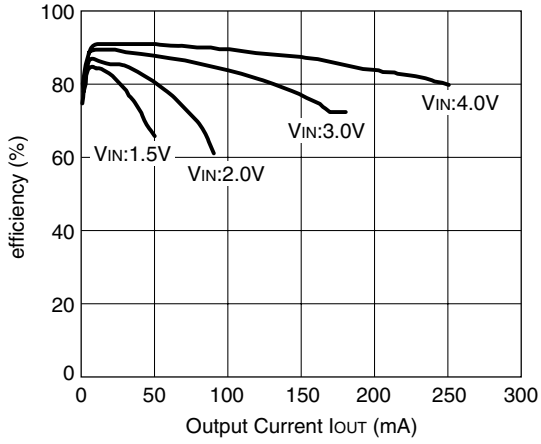

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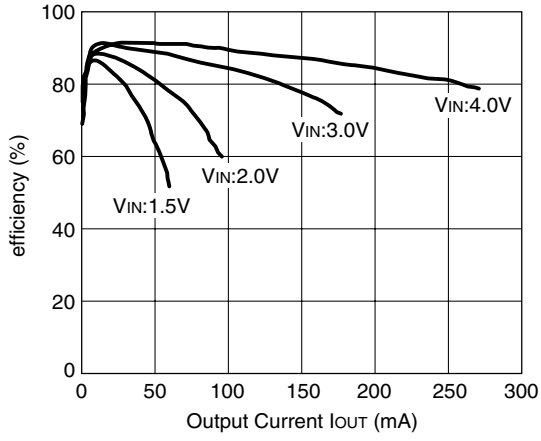
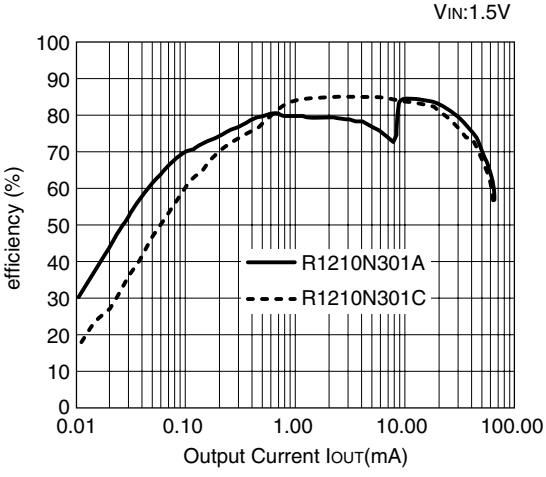


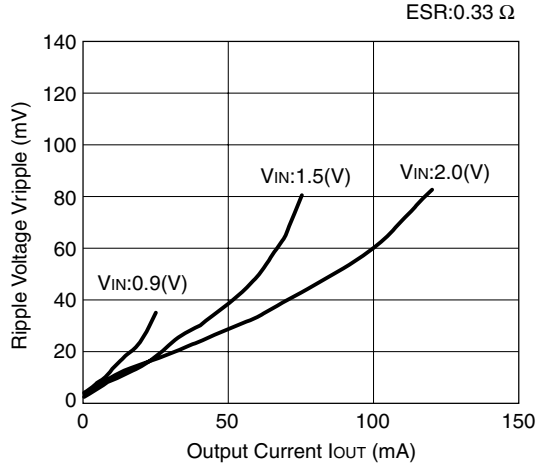
3) R1210Nxx1A/C Efficiency

R1210N301x



4) Ripple Voltage vs. Output Current

R1210N301C



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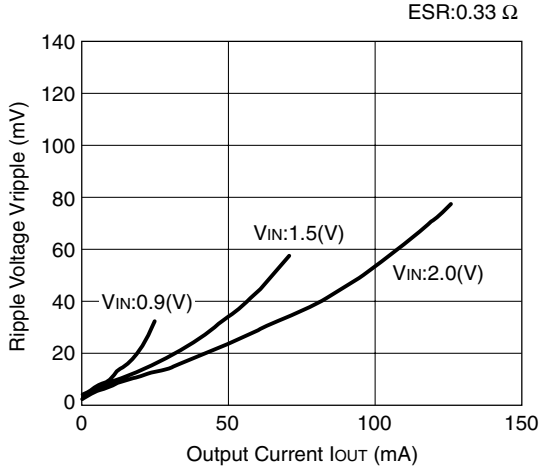

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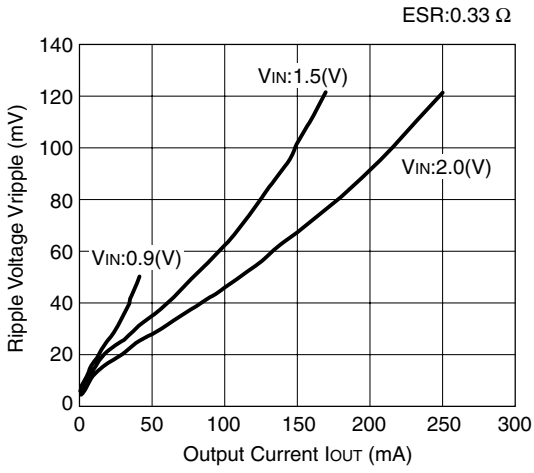

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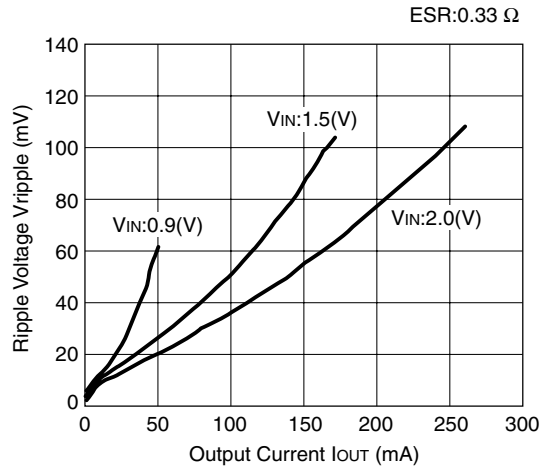
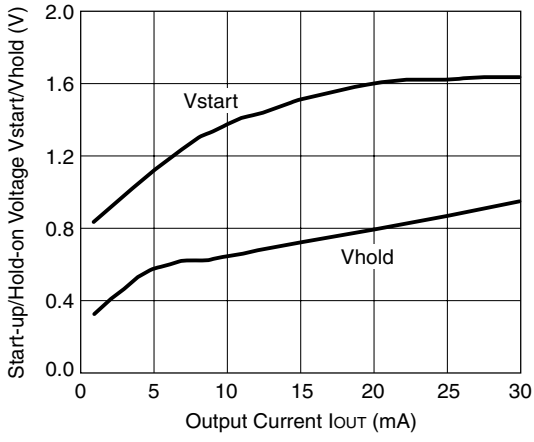


5) Start-up Voltage/Hold-on Voltage vs. Output Current (Topt=25°C)

R1210N301C



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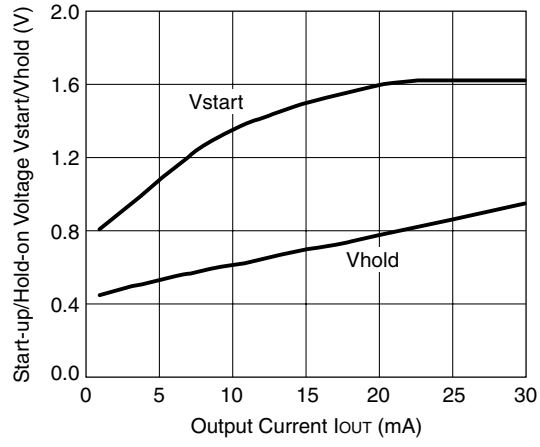

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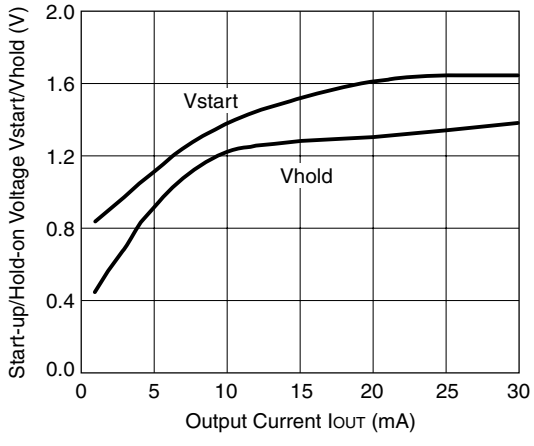

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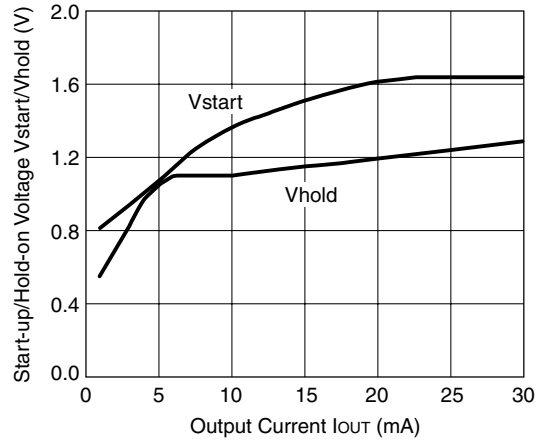

6) Output Voltage vs. Temperature

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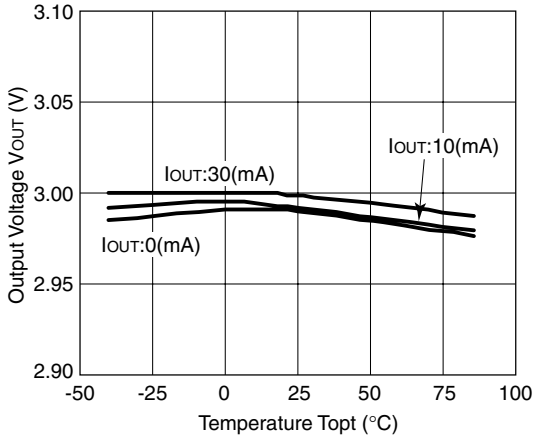

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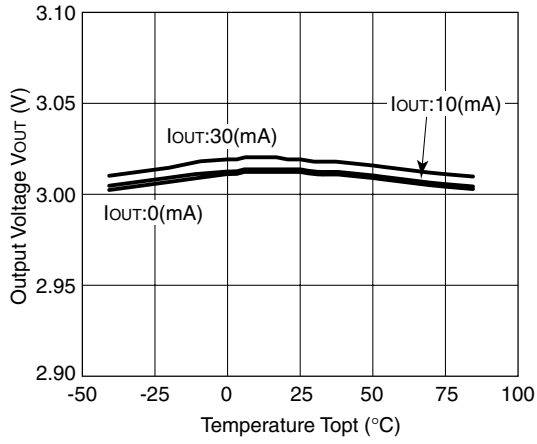

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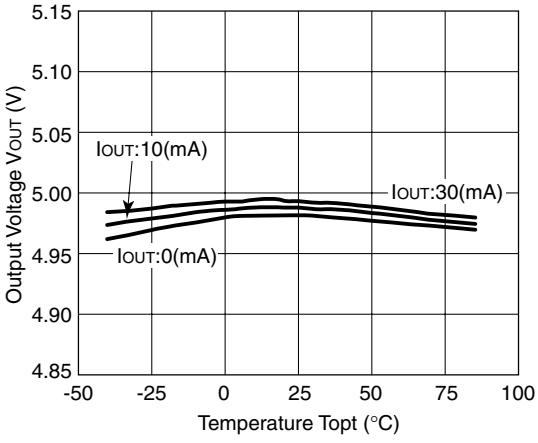

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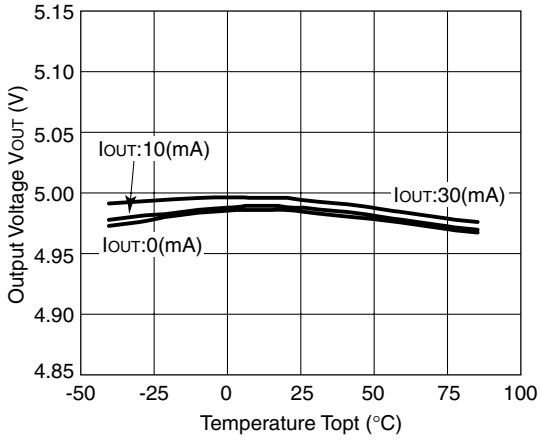
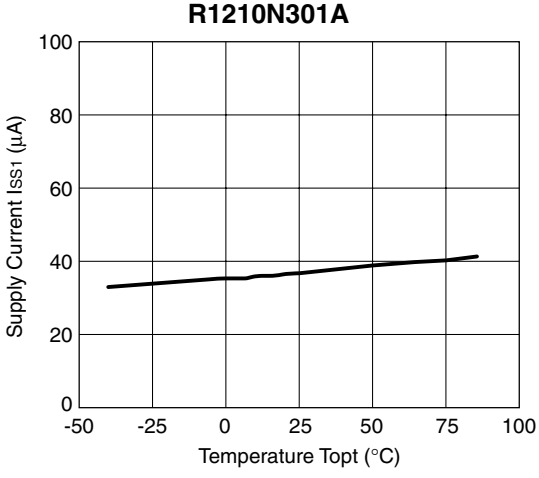


7) Supply Current 1 vs. Temperature

R1210N301A



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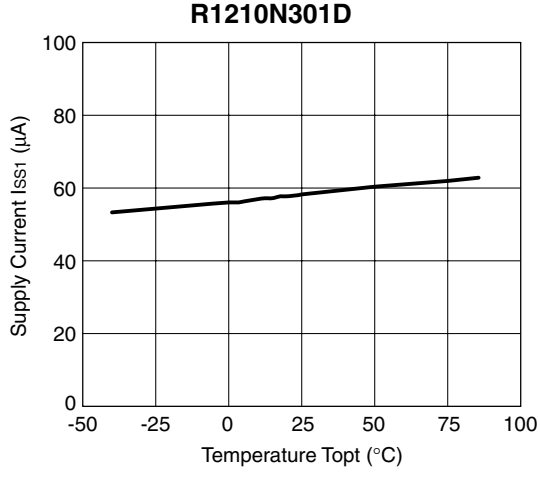

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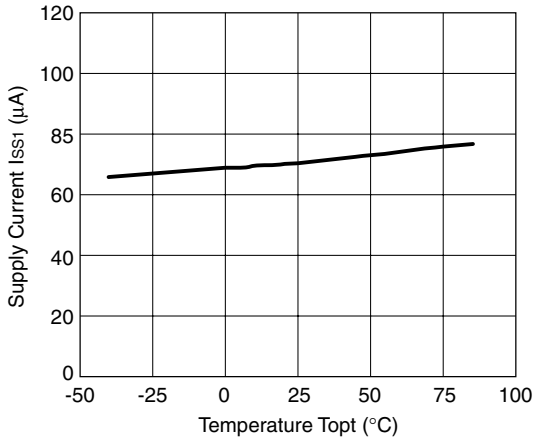

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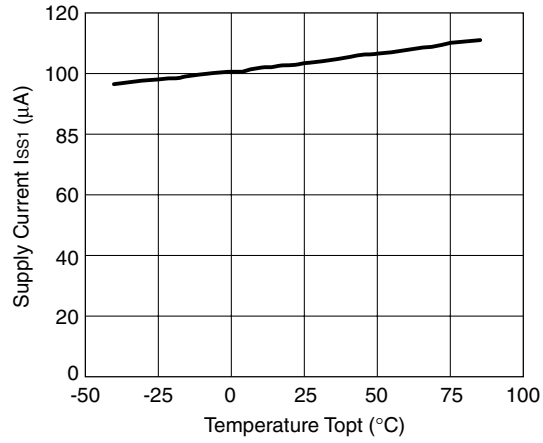
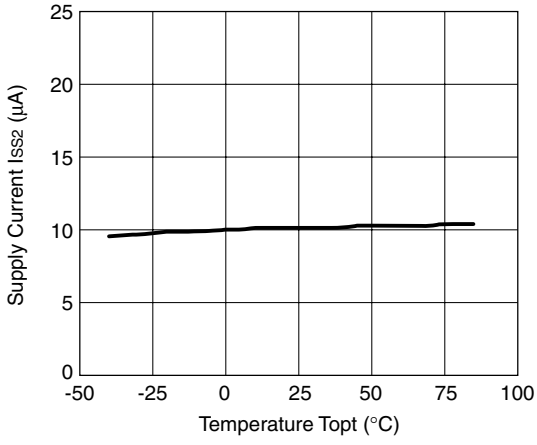


8) Supply Current2 vs. Temperature

R1210N301A



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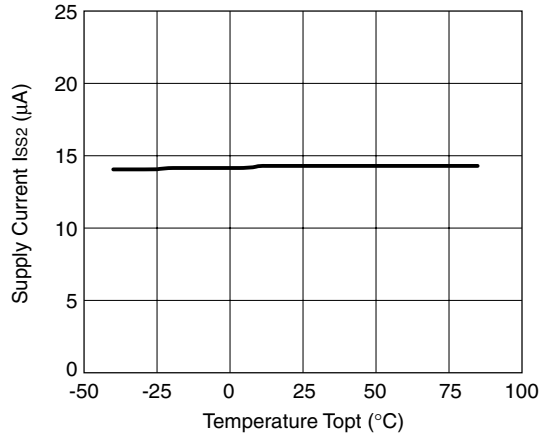
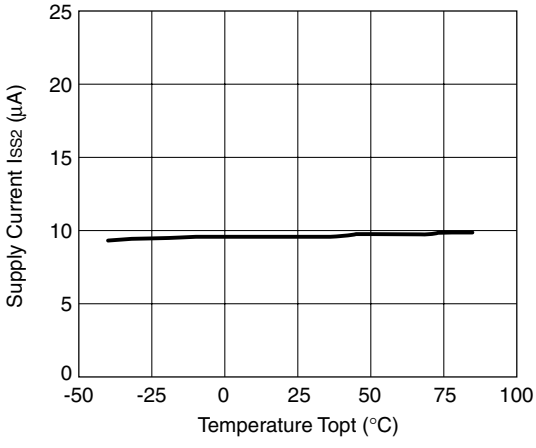
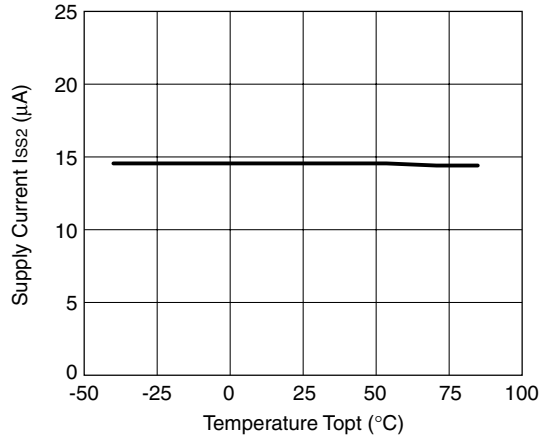


R1210N501C

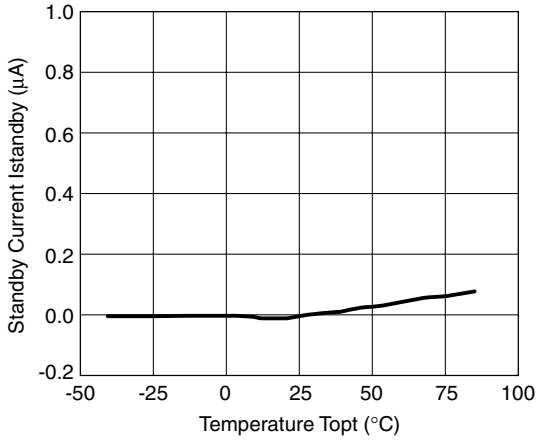


R1210N601D



9) Standby Current vs. Temperature

R1210N221A



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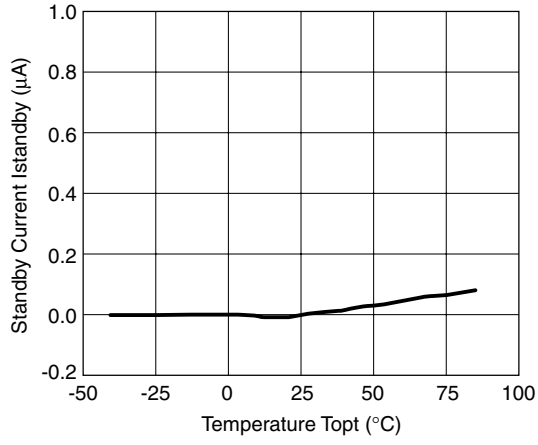
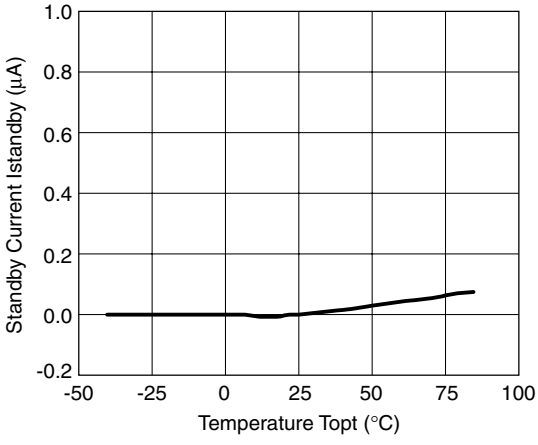


R1210N601C



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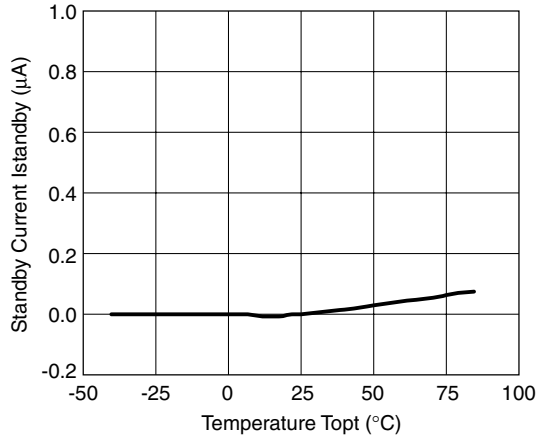
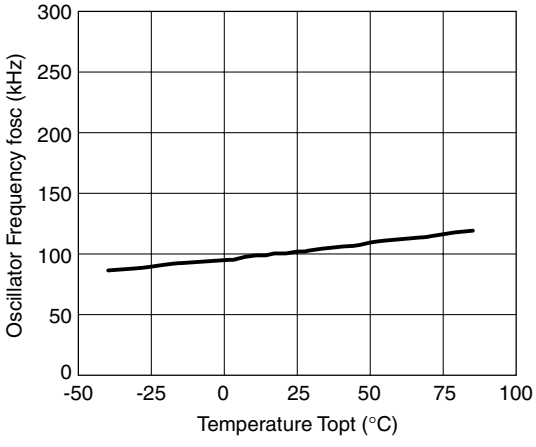


10) Oscillator Frequency vs. Temperature

R1210N221A



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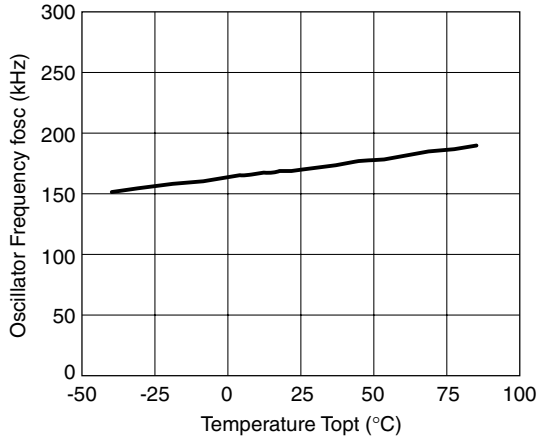

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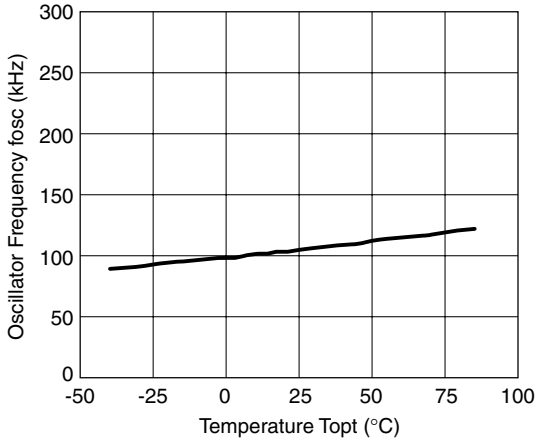

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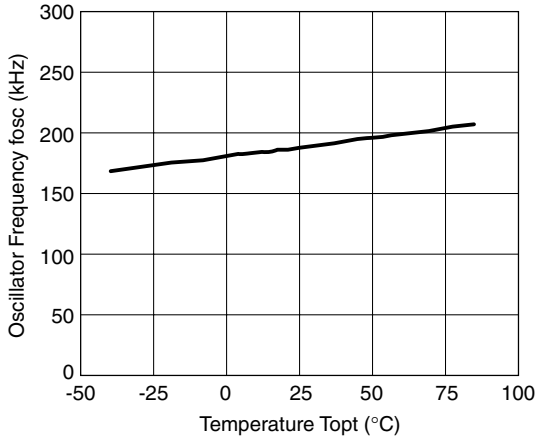
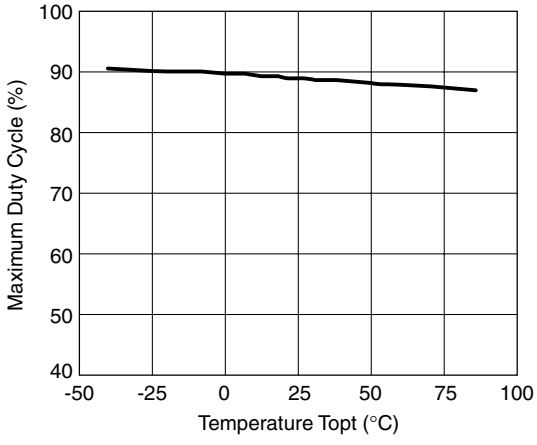


11) Maximum Duty Cycle vs. Temperature

R1210N221A



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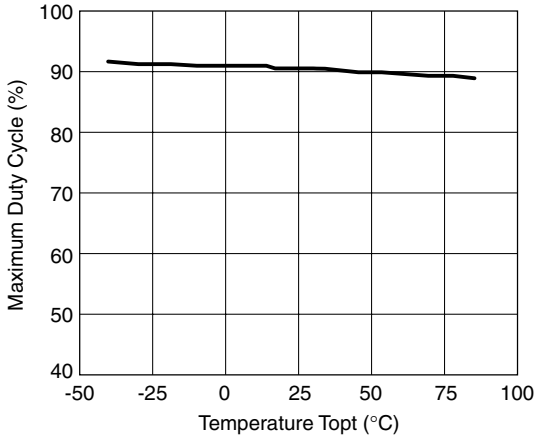

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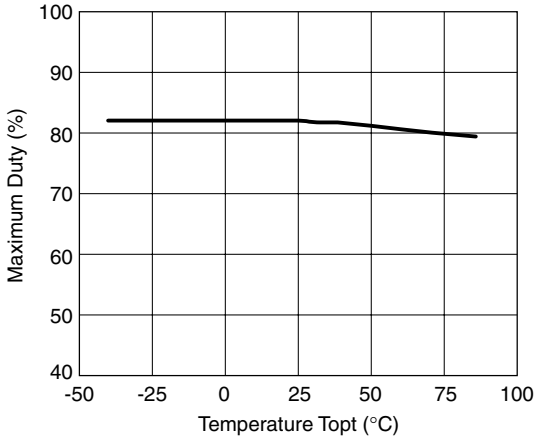

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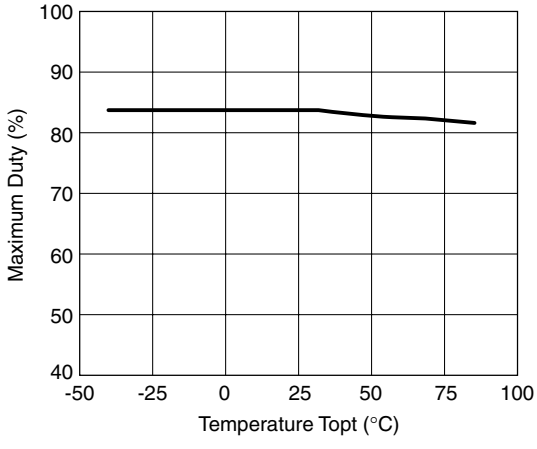
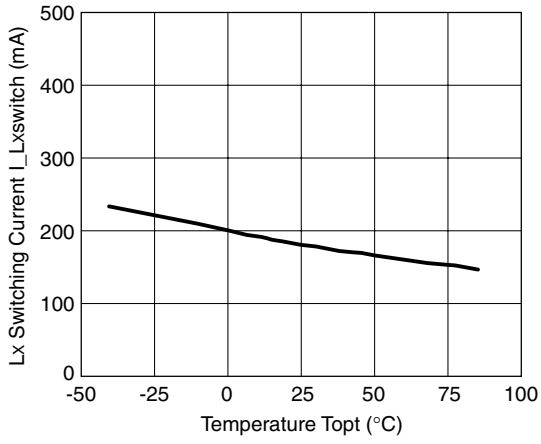
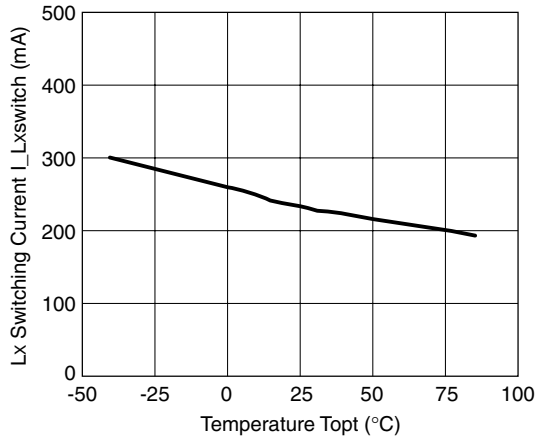


12) L_X Switching Current vs. Temperature

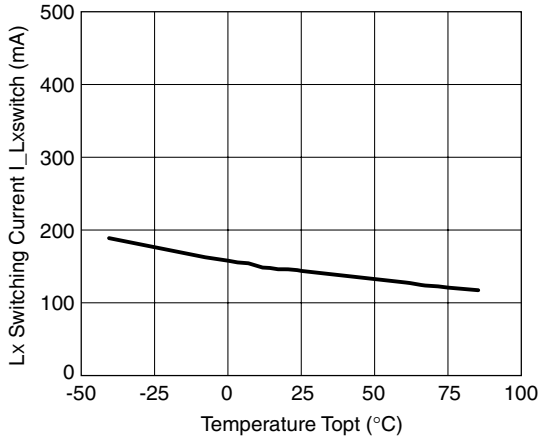
R1210N301A



R1210N501C



R1210N221D



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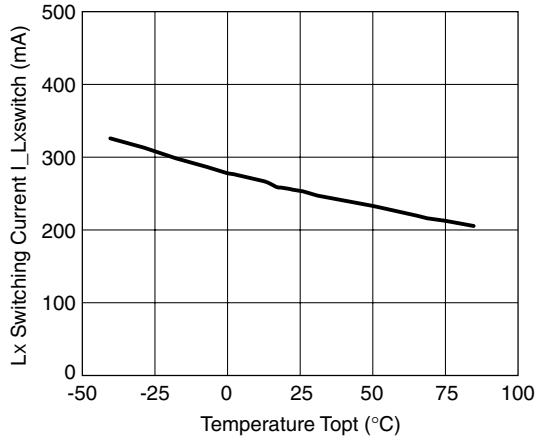
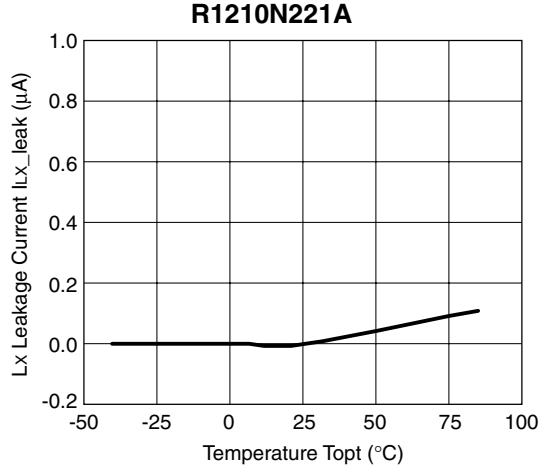


13) L_X leakage Current vs. Temperature

R1210N221A



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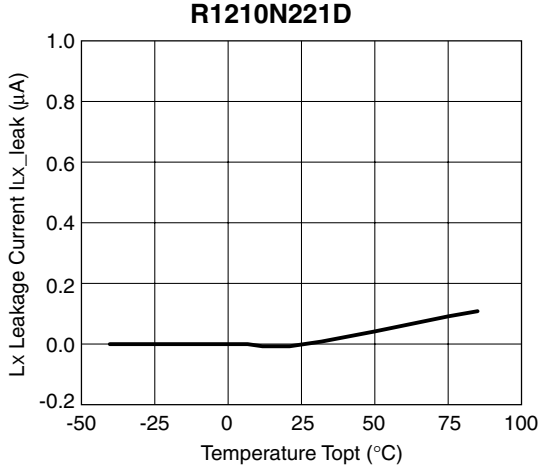

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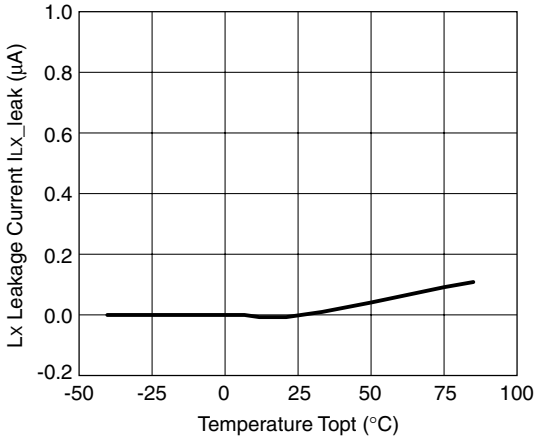

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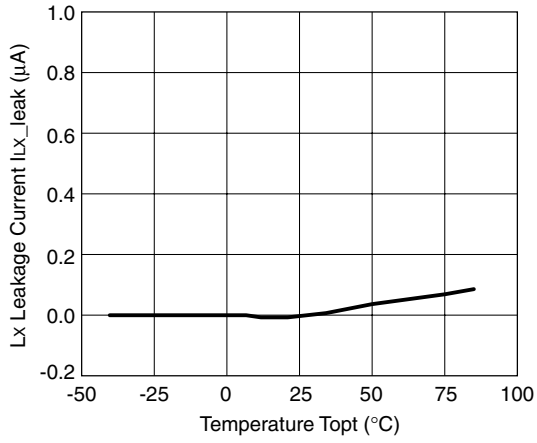
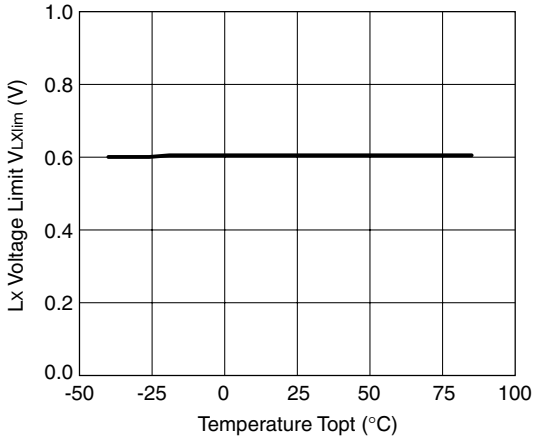


14) V_{LX} Voltage Limit vs. Temperature

R1210N301A



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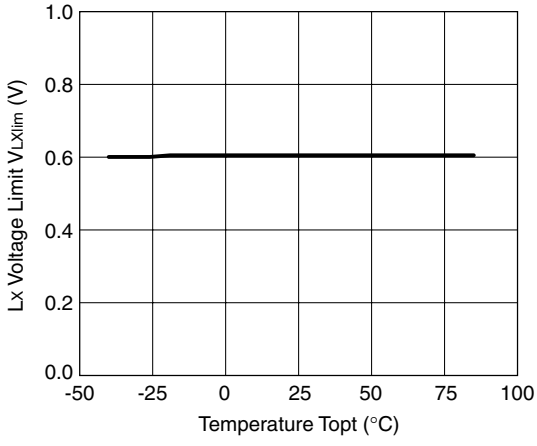

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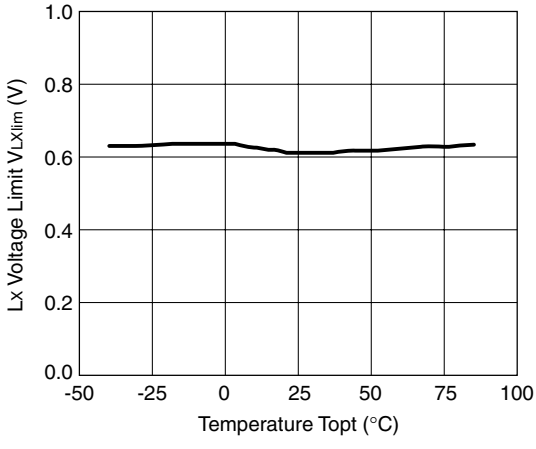

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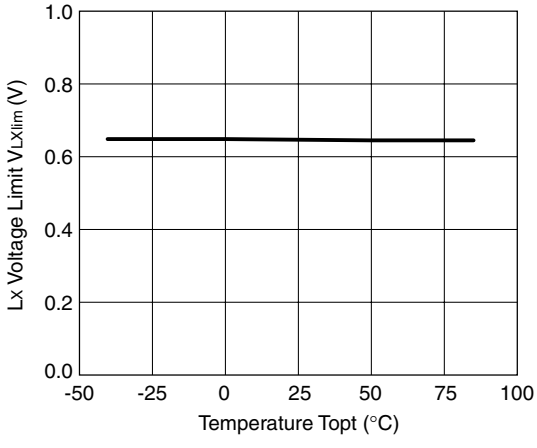
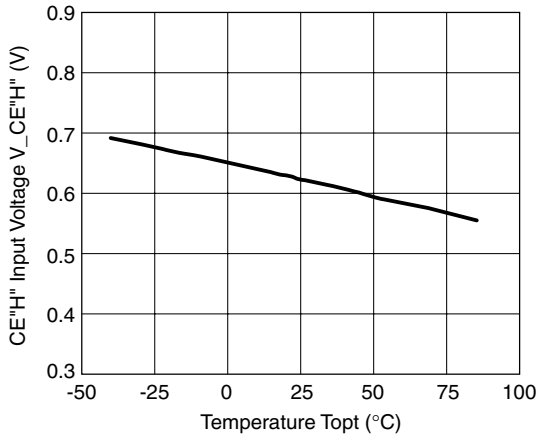


15) CE “H” Input Voltage vs. Temperature

R1210N221A



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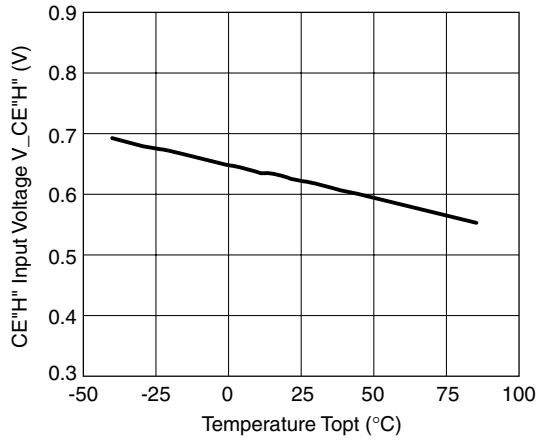
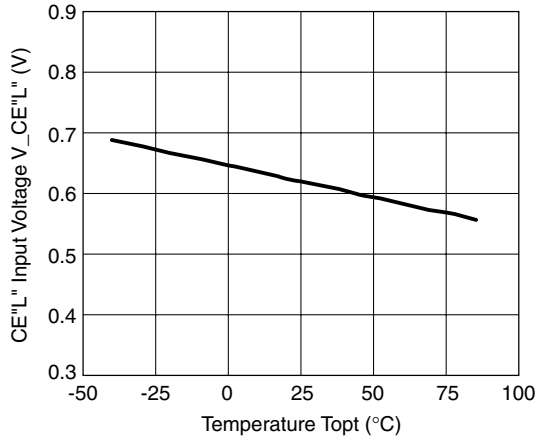


16) CE “L” Input Voltage vs. Temperature

R1210N221A



R1210N601C