
PWM Step-up DC/DC Converter

R1210N××1× Series

APPLICATION MANUAL

R1210N××1× Series

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, 'L_x switch', and a protection circuit for L_x 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

- ## BLOCK DIAGRAM

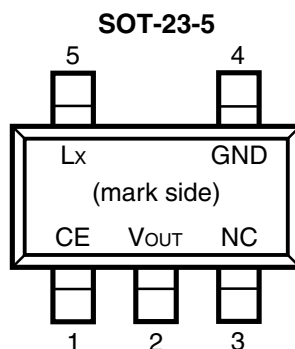


The selection can be made by designating the part number as shown below ;

a b c

2

PIN CONFIGURATION



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	L _x	Switching Pin (Nch Open Drain)

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V _{OUT}	V _{OUT} Pin Output Voltage	9.0	V
V _{LX}	L _x Pin Output Voltage	9.0	V
V _{CE}	CE Pin Input Voltage	9.0	V
I _{LX}	L _x Pin Output Current	400	mA
P _D	Power Dissipation	250	mW
T _{opt}	Operating Temperature Range	-40~+85	°C
T _{stg}	Storage Temperature Range	-55~+125	°C

ELECTRICAL CHARACTERISTICS

• R1210Nxx1x

(T_{opt} = 25°C)

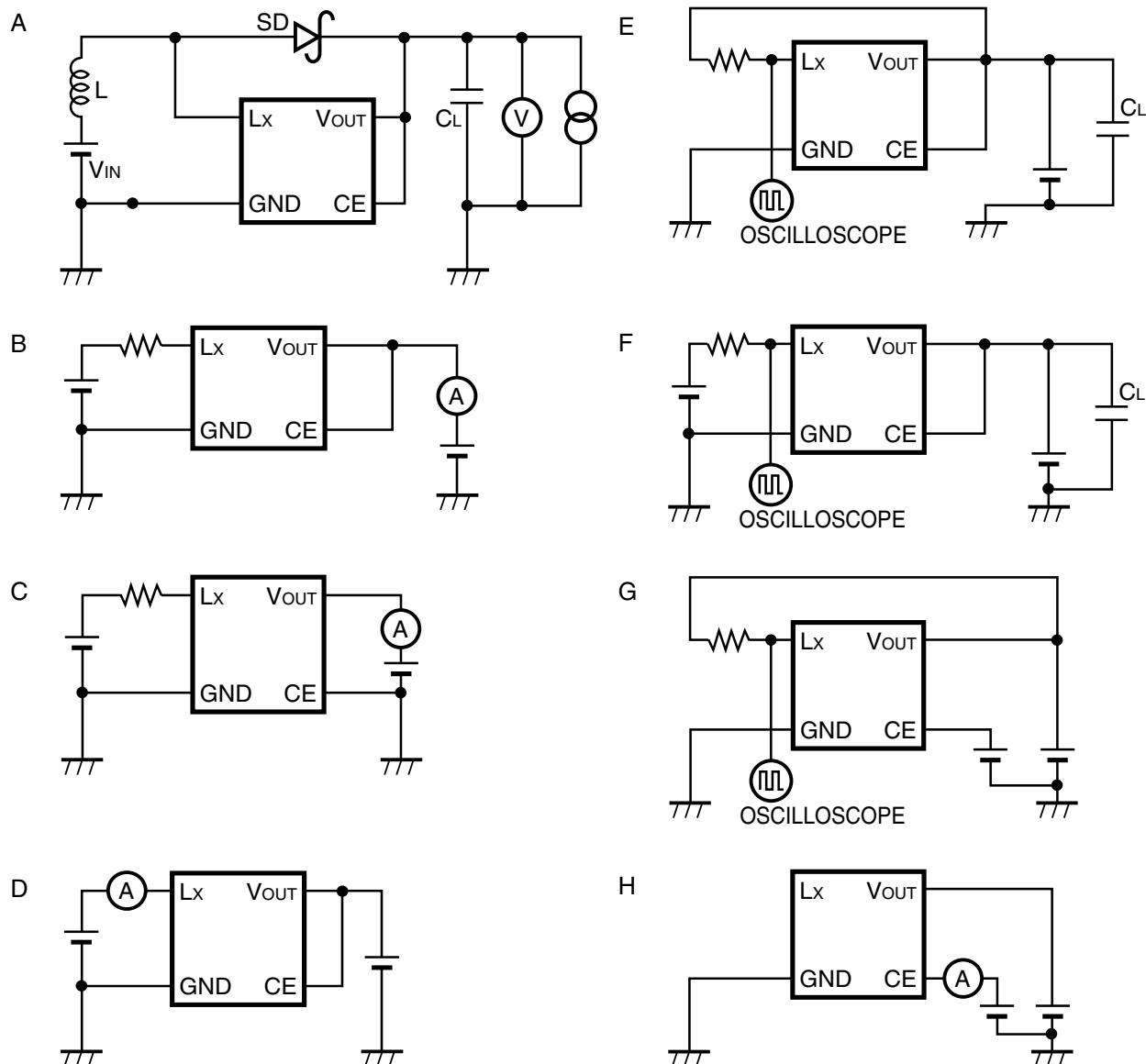
Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V _{OUT}	Output Voltage	V _{IN} = V _{SET} × 0.6, I _{OUT} = 1mA	×0.975		×1.025	V
V _{IN}	Maximum Input Voltage				8	V
ΔV _{OUT} / ΔT _{opt}	Step-up Output Voltage Temperature Coefficient	-40°C ≤ T _{opt} ≤ 85°C		±100		ppm/°C
V _{start}	Start-up Voltage	V _{IN} = 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} = 2V → 0V, 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} × 0.96		30	55	μA (××1A/C)
				50	80	μA (××1D)
		2.6V ≤ V _{SET} ≤ 3.0V V _{OUT} = V _{SET} × 0.96		35	60	μA (××1A/C)
				60	90	μA (××1D)
		3.1V ≤ V _{SET} ≤ 3.5V V _{OUT} = V _{SET} × 0.96		40	70	μA (××1A/C)
				70	100	μA (××1D)
		3.6V ≤ V _{SET} ≤ 4.0V V _{OUT} = V _{SET} × 0.96		45	80	μA (××1C)
				80	110	μA (××1D)
		4.1V ≤ V _{SET} ≤ 4.5V V _{OUT} = V _{SET} × 0.96		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 (××1C)
				100	130	μA (××1D)
		5.1V ≤ V _{SET} ≤ 5.5V V _{OUT} = V _{SET} × 0.96		80	110	μA (××1C)
				110	150	μA (××1D)
		5.6V ≤ V _{SET} ≤ 6.0V V _{OUT} = V _{SET} × 0.96		90	120	μA (××1C)
				130	170	μA (××1D)
I _{DD2}	Supply Current2	V _{OUT} = V _{CE} = V _{SET} + 0.5V		10	17	μA (××1A/C)
				15	24	μA (××1D)
I _{standby}	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
f _{osc}	Maximum Oscillator Frequency	V _{OUT} = V _{CE} = V _{SET} × 0.96	80	100	120	KHz (××1A/C)
			144	180	216	KHz (××1D)
Δf _{osc} / ΔT _{opt}	Oscillator Frequency Temperature Coefficient	-40°C ≤ T _{opt} ≤ 85°C		0.5		kHz/°C (××1A/C)
				0.6		kHz/°C (××1D)
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}	L _x 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 xx1A)	10	35	70	KHz

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

TEST CIRCUITS



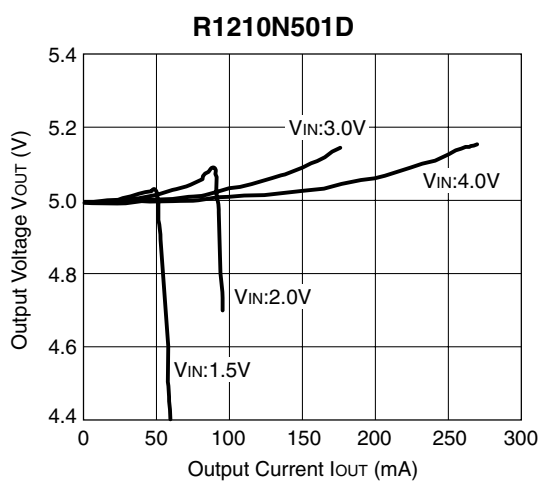
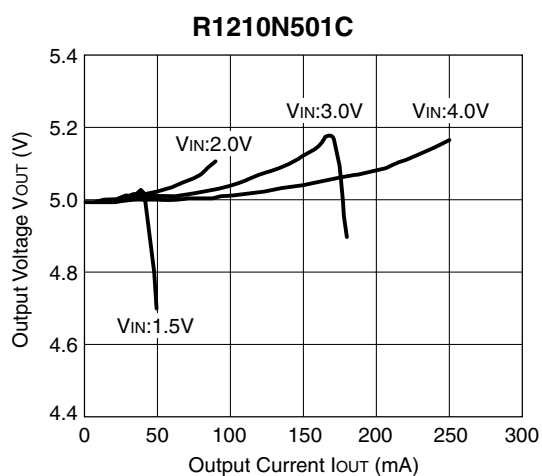
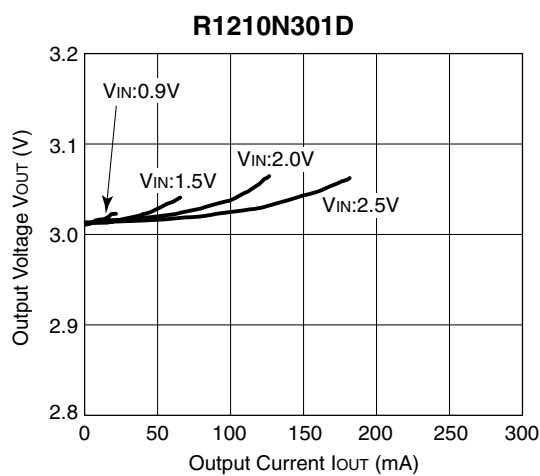
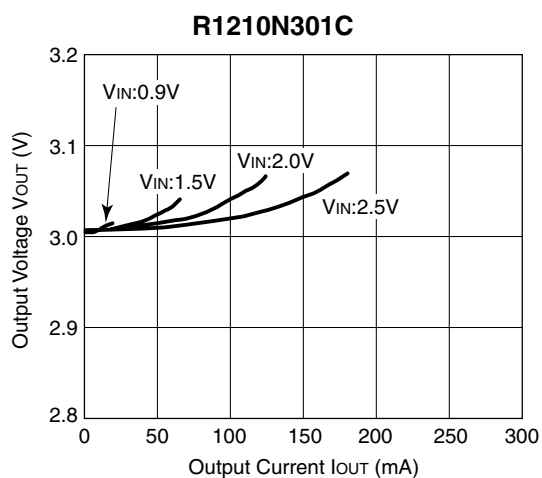
L: 100 μ H CD54 (Sumida Electric Co, LTD)

SD: MA721 (Matsushita Electronics Corporation, Schottky Type)

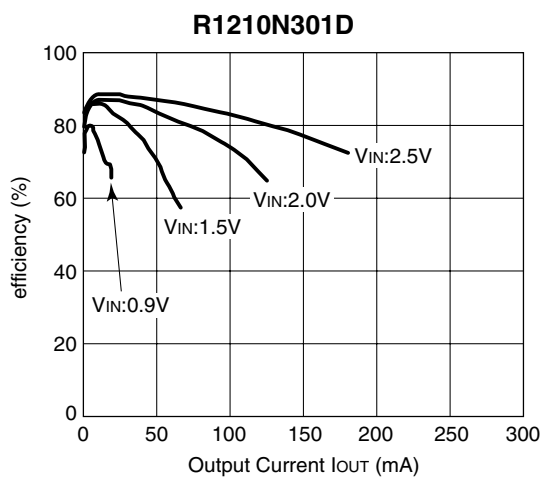
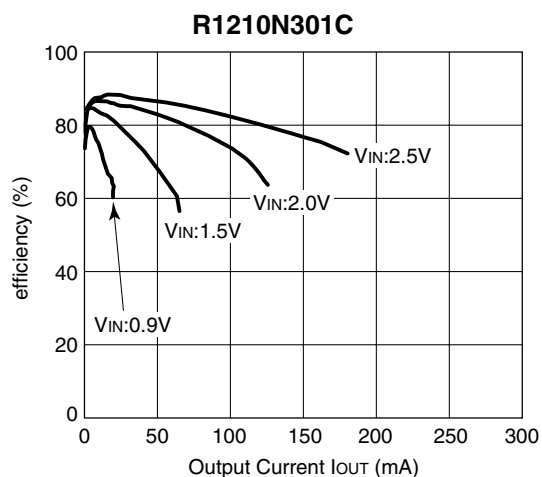
CL: 22 μ F $\times$ 2 (Tantalum Type)

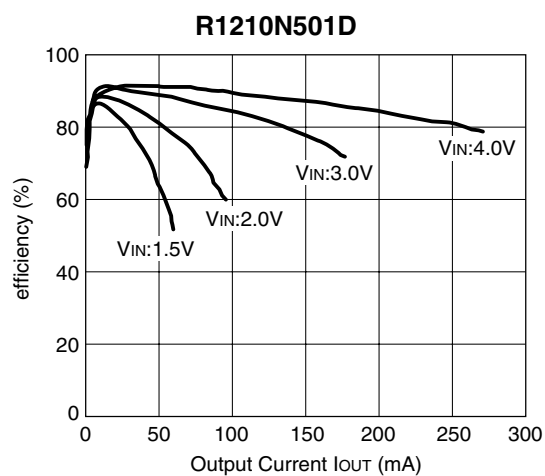
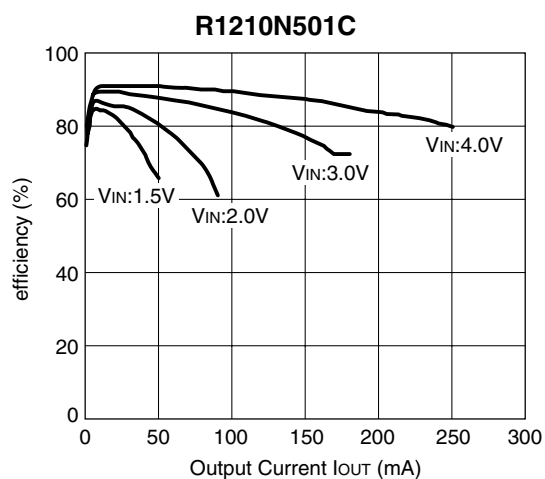
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

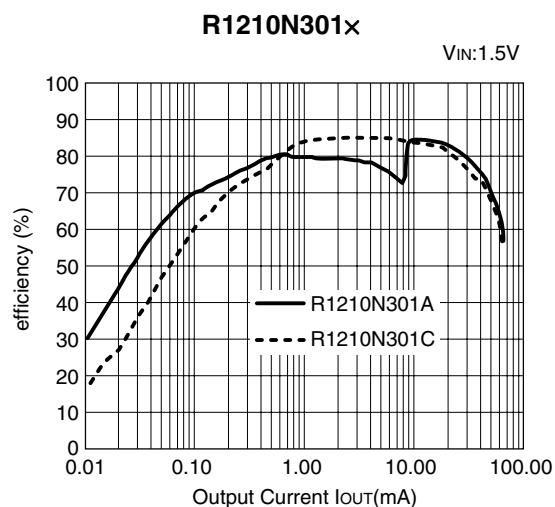


2) Efficiency vs. Output Current

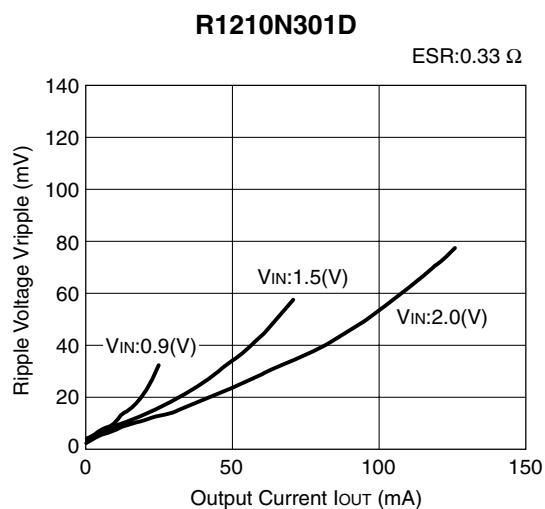
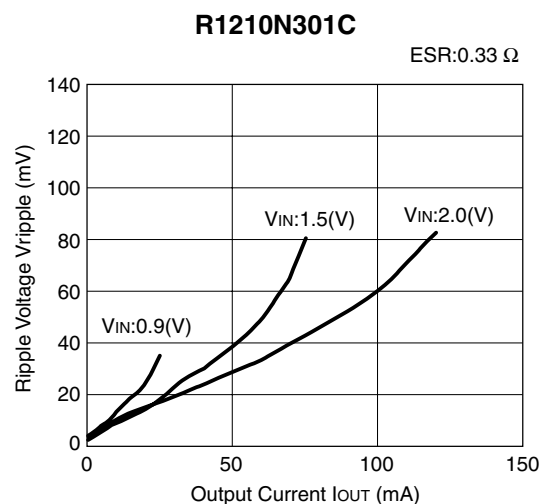


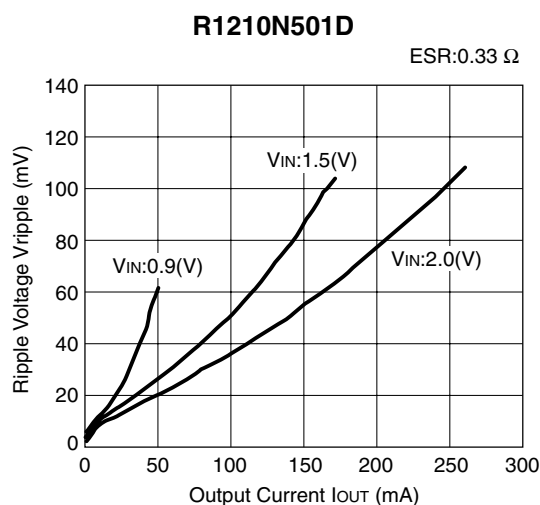
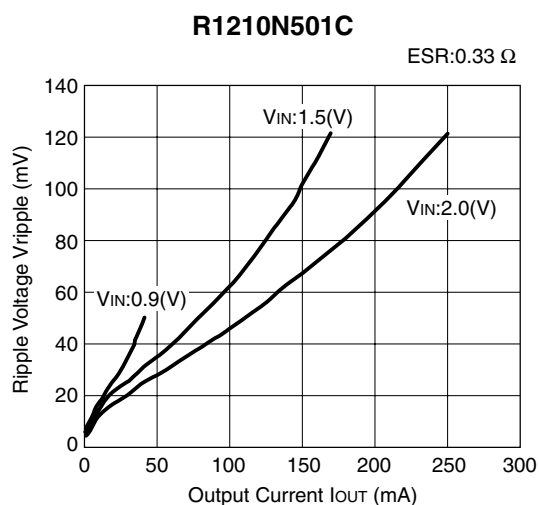


3) R1210Nxx1A/C Efficiency

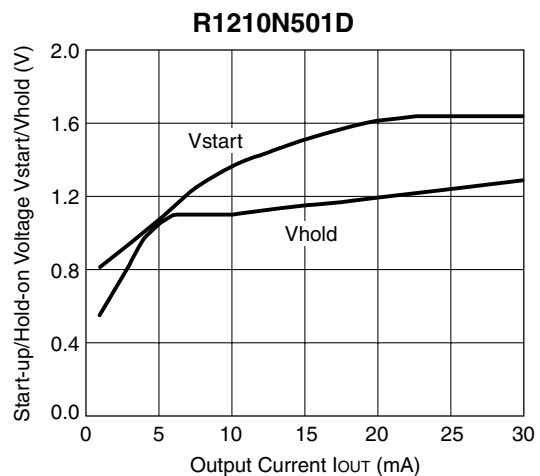
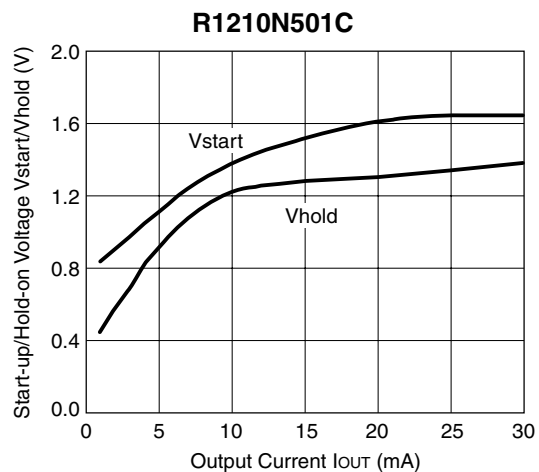
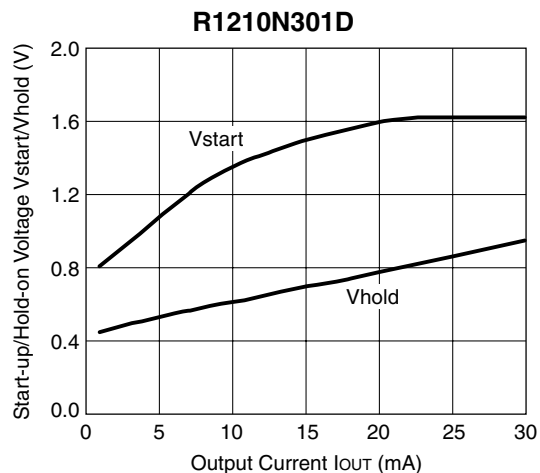
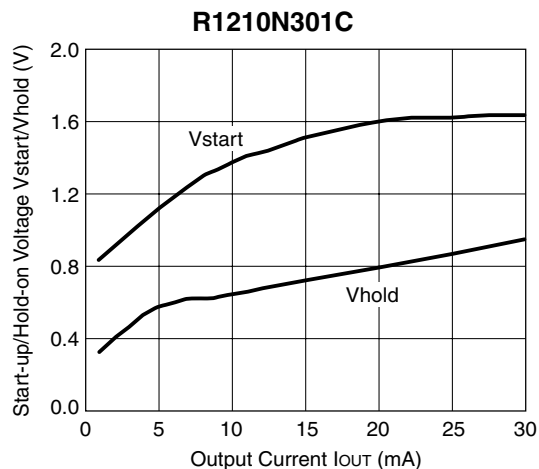


4) Ripple Voltage vs. Output Current

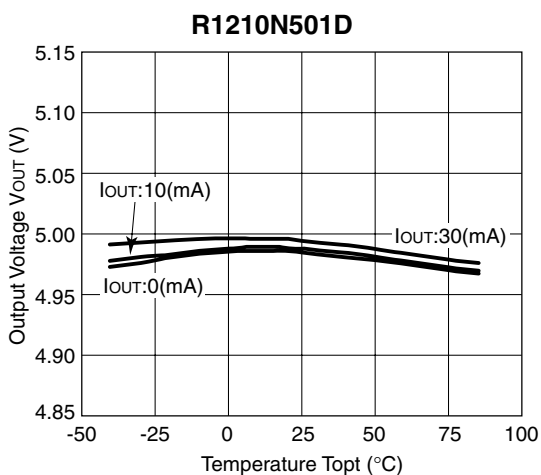
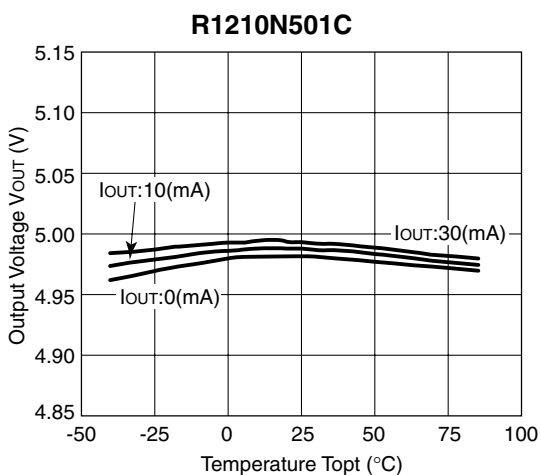
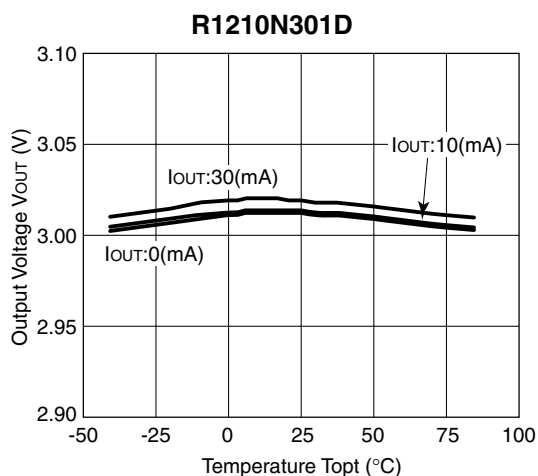
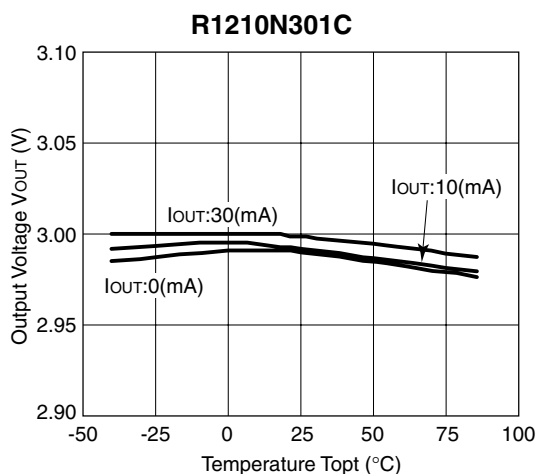




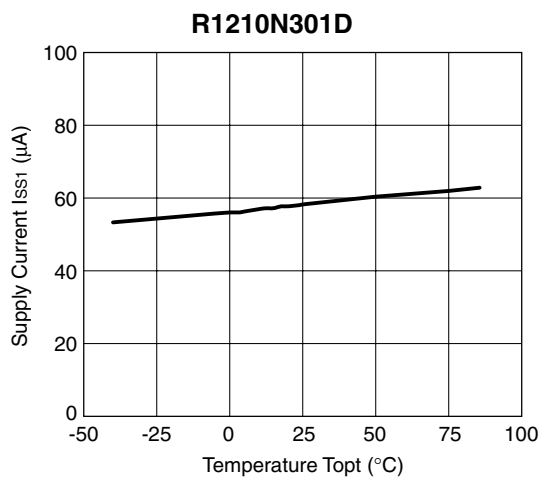
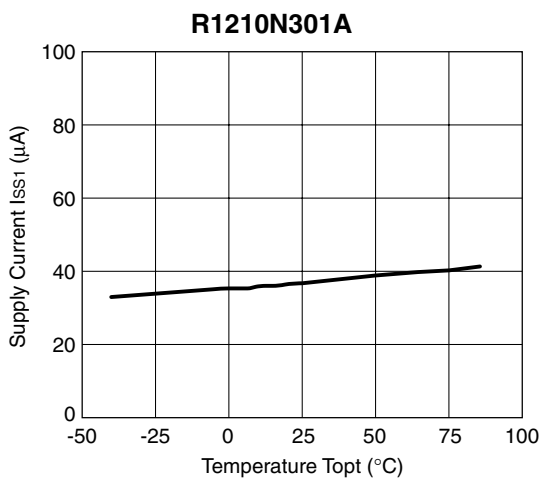
5) Start-up Voltage/Hold-on Voltage vs. Output Current (T_{opt}=25°C)

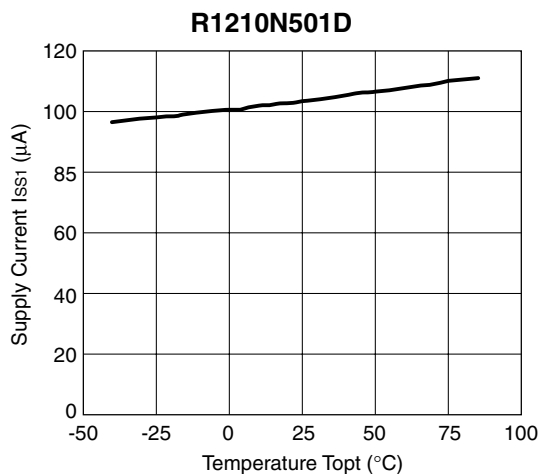
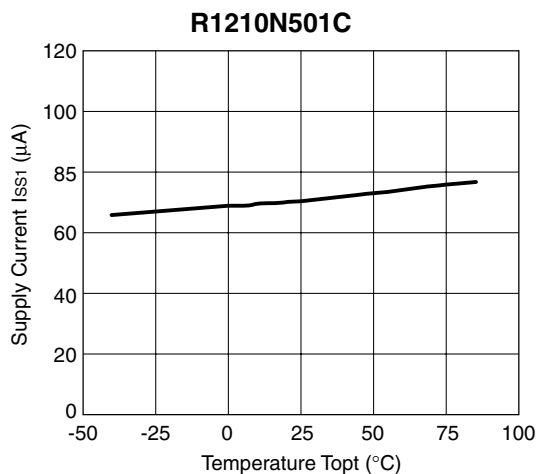


6) Output Voltage vs. Temperature

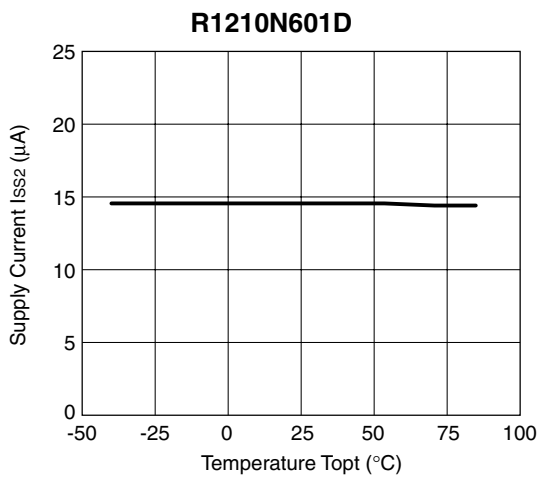
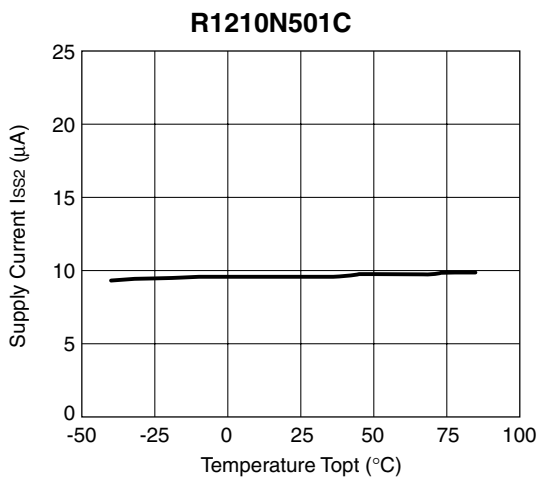
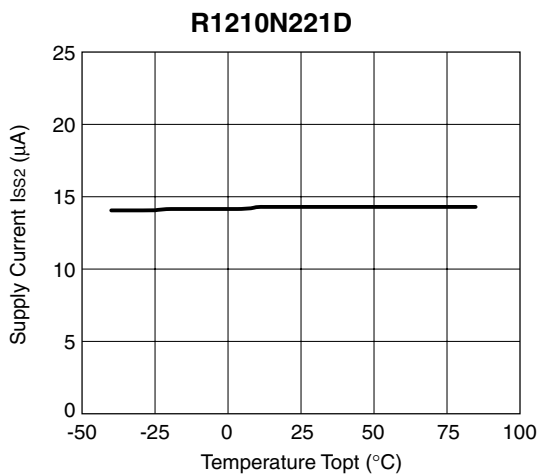
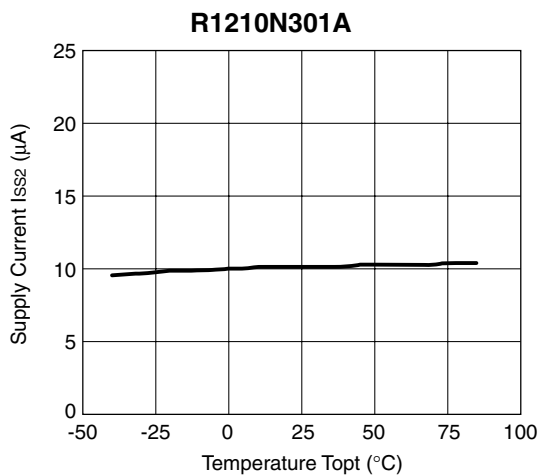


7) Supply Current 1 vs. Temperature

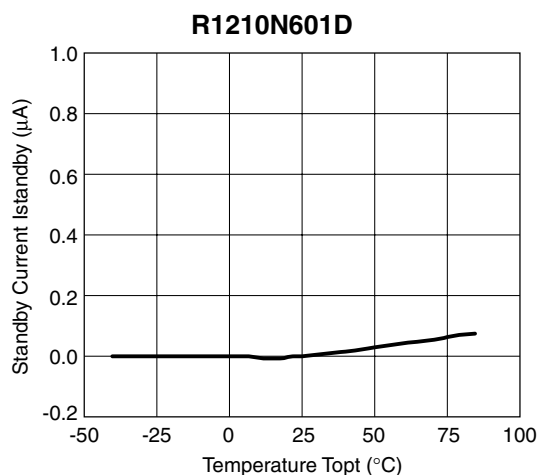
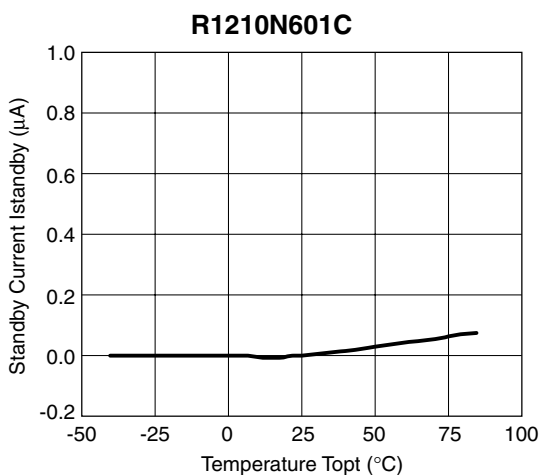
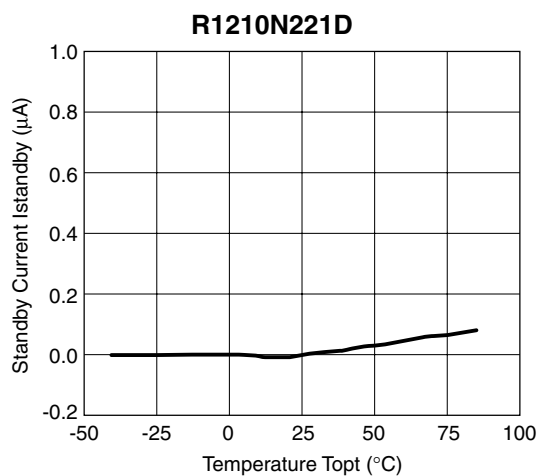
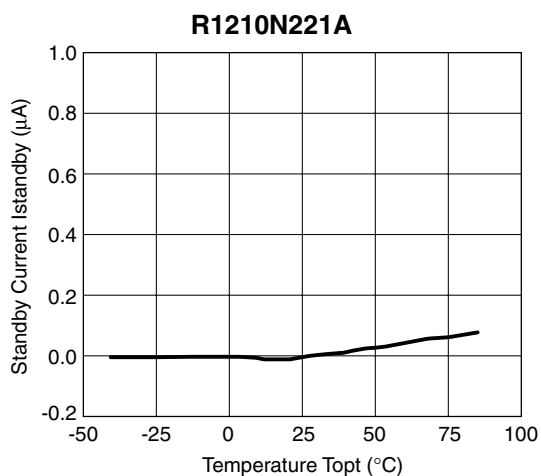




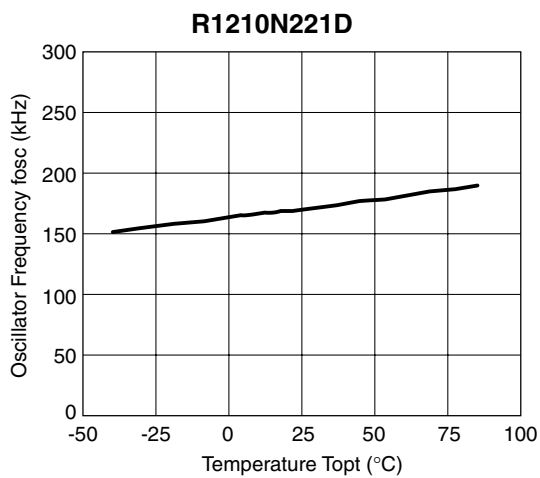
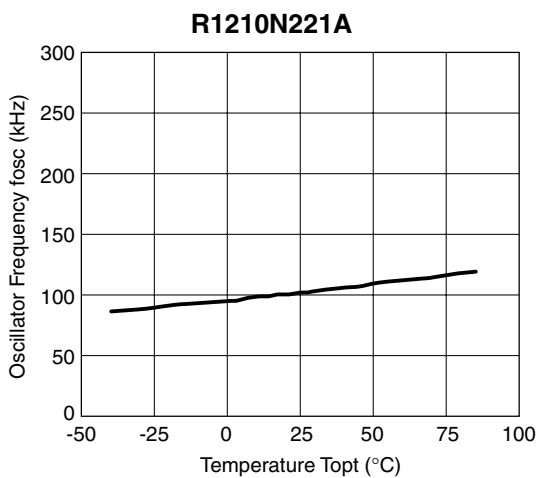
8) Supply Current2 vs. Temperature

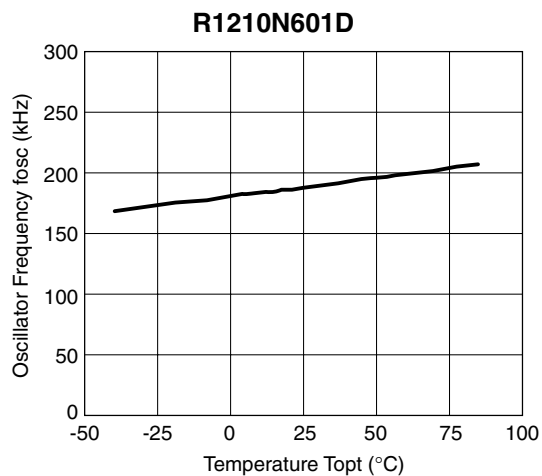
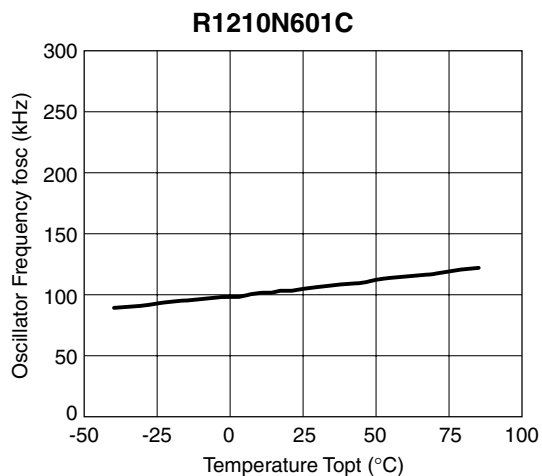


9) Standby Current vs. Temperature

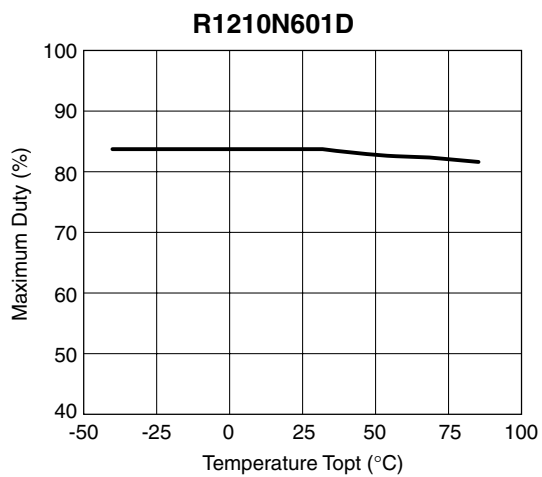
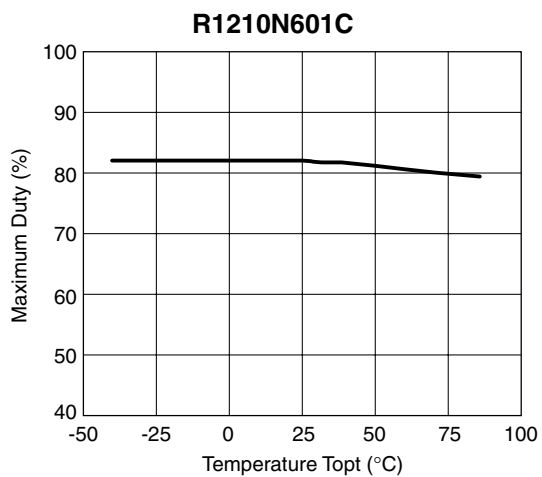
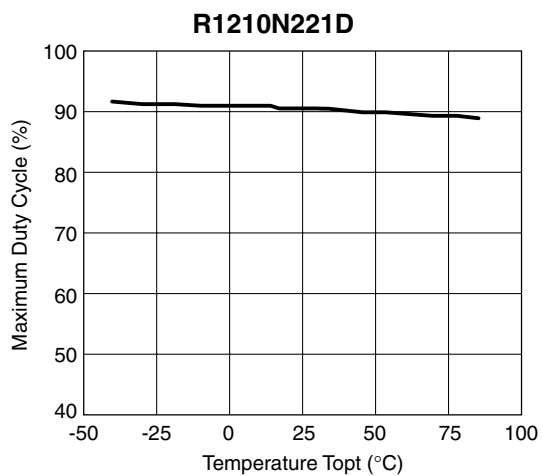
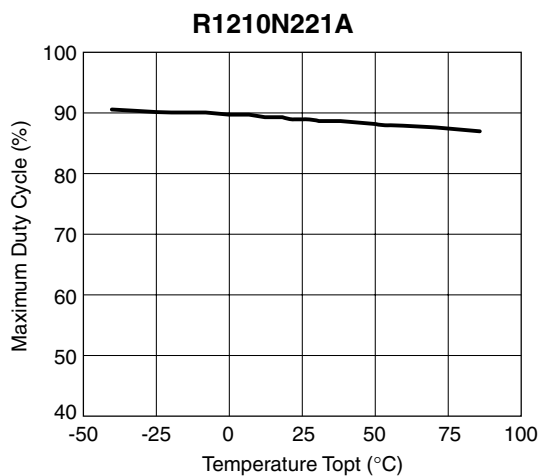


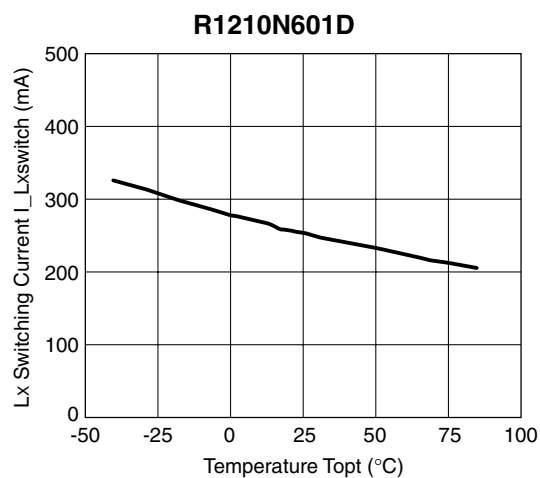
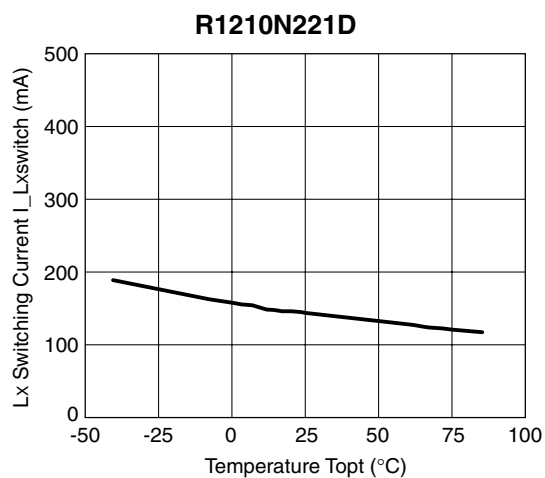
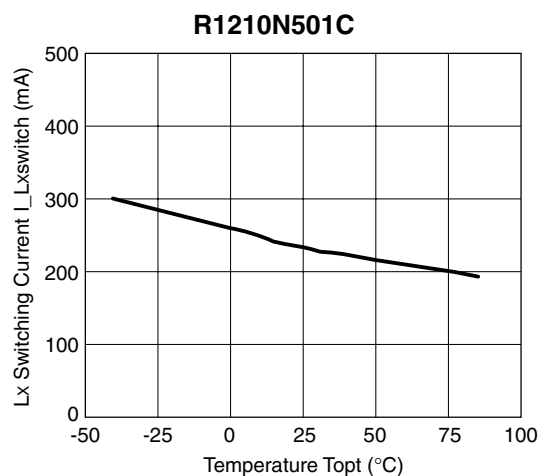
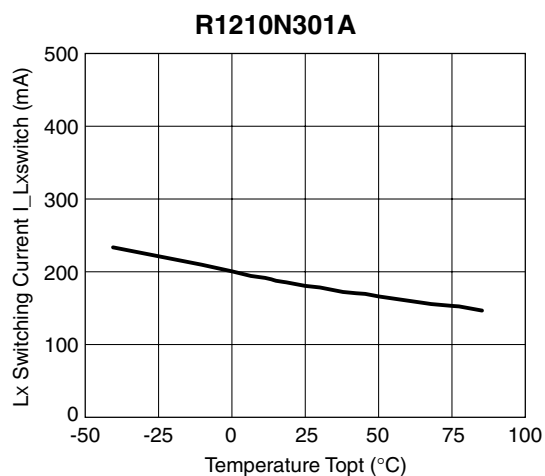
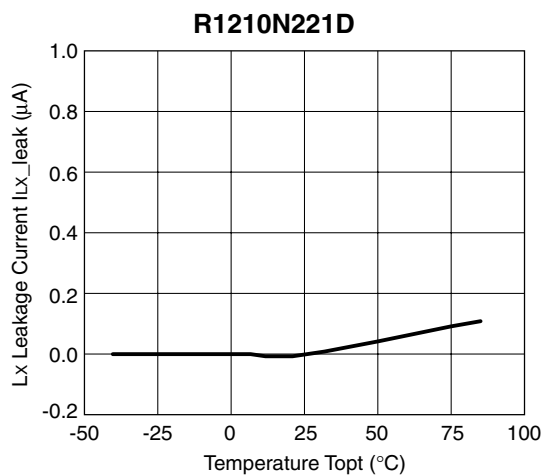
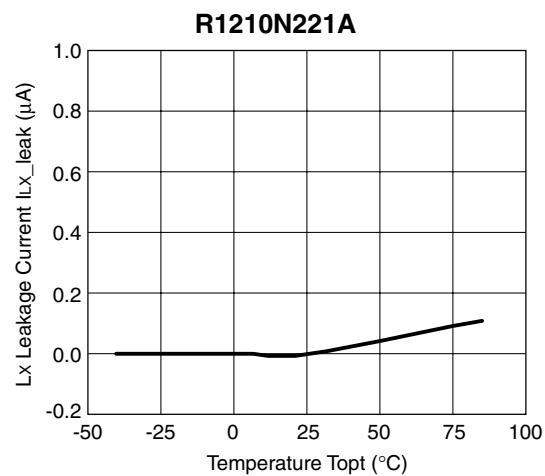
10) Oscillator Frequency vs. Temperature

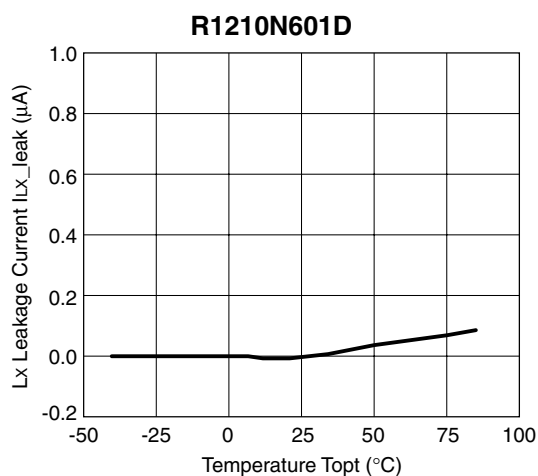
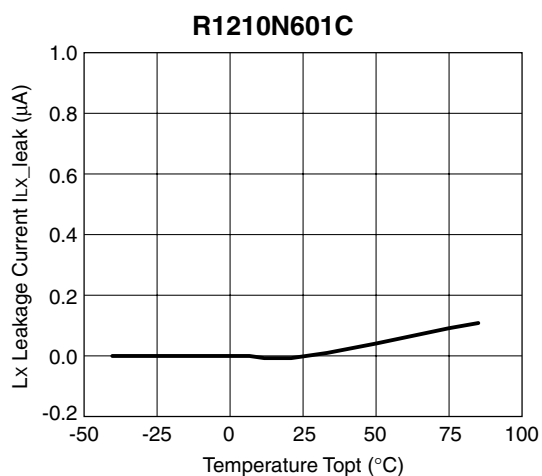




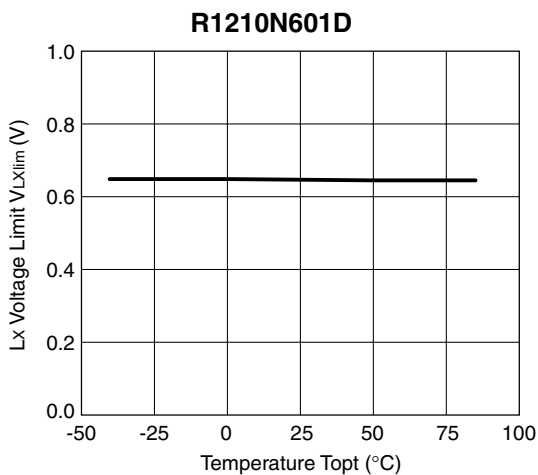
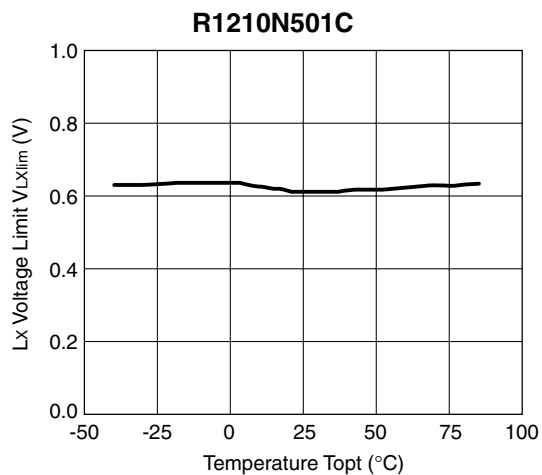
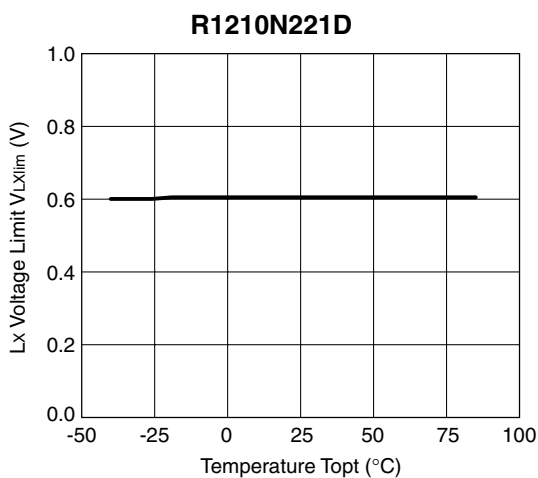
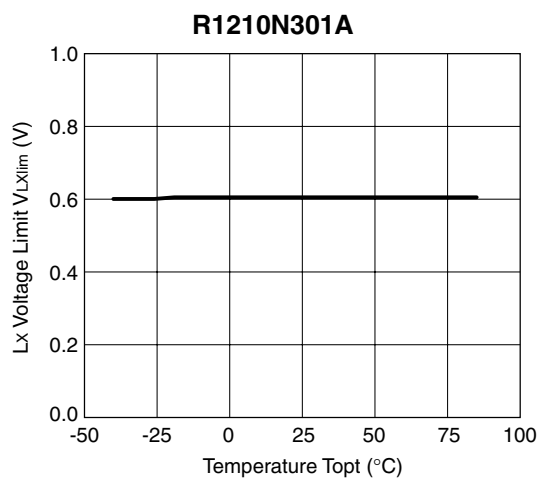
11) Maximum Duty Cycle vs. Temperature



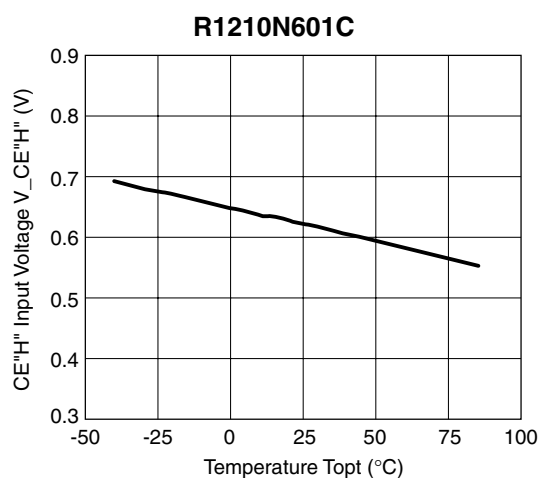
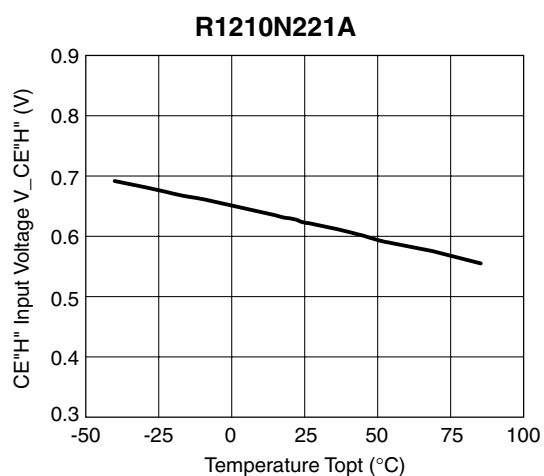
12) L_x Switching Current vs. Temperature13) L_x leakage Current vs. Temperature



14) V_{Lx} Voltage Limit vs. Temperature



15) CE "H" Input Voltage vs. Temperature



16) CE "L" Input Voltage vs. Temperature

