∗R5220D (SON-6) is the discontinued product as of March 2019.

RICOH

R5220x SERIES

PWM Step-down DC/DC Converter with switch function

NO.EA-121-120113

OUTLINE

The R5220x Series are CMOS-based PWM step-down DC/DC Converters with synchronous rectifier, low supply current and LDO mode.

DC/DC converter of the R5220x consists of an oscillator, a PWM control circuit, a reference voltage unit, an error amplifier, a soft-start circuit, protection circuits, a protection against miss operation under low voltage (UVLO), PWM-DC to DC converter / LDO alternative circuit, a chip enable circuit, and a driver transistor. A high efficiency step-down DC/DC converter can be easily composed of this IC with only a few kinds of external components, or an inductor and capacitors.

LDO of the R5220x consists of a vortage reference unit, an error amplifier, resistors for voltage setting, output current limit circuit, a driver transistor, and so on. The output voltage is fixed internally in the R5220x. The output voltage of the DC/DC converter and the LDO can be set independently.

PWM step-down DC/DC converter / LDO alternative circuit is active with Mode Pin of the R5220x Series. Thus, when the load current is small, the operation can be switching into the LDO operation from PWM operation by the logic of MODE pin and the consumption current of the IC itself will be small at light load current. As protection circuits, the current limit circuit which limits peak current of Lx at each clock cycle, and the latch type protection circuit which works if the term of the over-current condition keeps on a certain time in PWM mode. Latch-type protection circuit works to latch an internal driver with keeping it disable. To release the protection, after disable this IC with a chip enable circuit, enable it again, or restart this IC with power-on or make the supply voltage at UVLO detector threshold level or lower than UVLO.

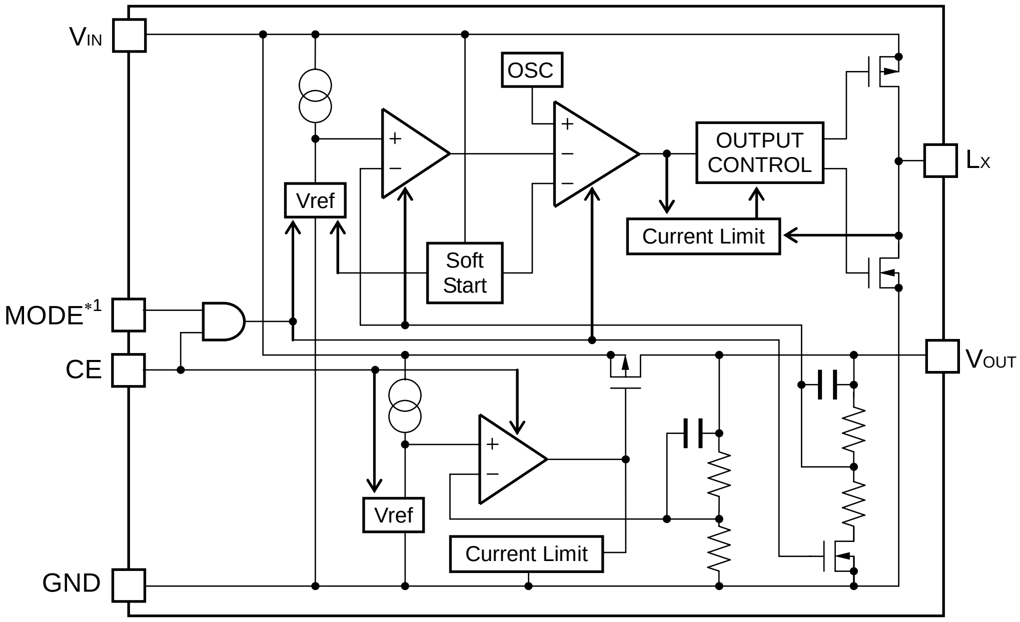
FEATURES

- Supply Current .... Typ. 350μA (DC/DC), Typ. 5μA (VR)
- Standby Current .... Typ. 0.1μA
- Built-in Driver ON Resistance .... P-channel 0.5Ω, N-channel 0.5Ω (at V_{IN}=3.6V)
- Output Current .... Min. 400mA (DC/DC), Min. 50mA (VR)
- Input Voltage .... 2.8V to 5.5V (Absolute Input Maximum: 6.5V)
- Output Voltage .... 1.0V to 3.3V (0.1V steps)
  (For other voltages, please refer to MARK INFORMATIONS.)
- Output Voltage Accuracy... ±2.0% (V_{OUT} ≧ 1.5), ±30mV (V_{OUT} <1.5V)
- Oscillator Frequency (DC/DC) .... Typ. 1.2MHz
- Package .... SON-6, DFN(PLP)2514-6
- Built-in Soft-start Function... Typ. 0.2ms
- Latch-type Protection Function (Delay Time).................. Typ. 3.0ms
- Built-in fold-back protection circuit (DC/DC, VR)
- Ceramic Capacitor is recommended.

APPLICATIONS

- Power source for portable equipment such as DSC, DVC, and communication equipment.

BLOCK DIAGRAM



*1) R5220xxxxA: DC/DC mode: Mode pin= "H", VR mode: Mode pin= "L"
R5220xxxxB: DC/DC mode: Mode pin= "L", VR mode: Mode pin= "H"

SELECTION GUIDE

In the R5220x Series, the output voltage, the version and the pin polalities for the ICs can be selected at the user's request.

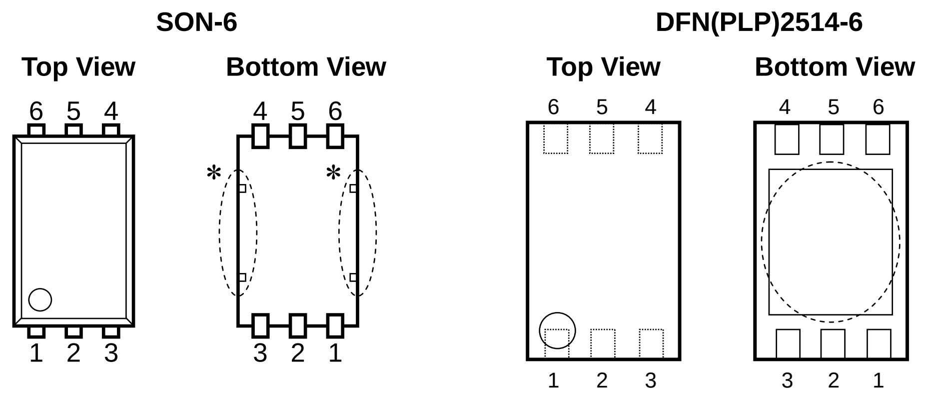
Product Name	package	Quantity per Reel	Pb Free	Halogen Free
R5220Kxx∗$-TR	DFN(PLP)2514-6	5,000 pcs	○	○
R5220Dxx∗$-TR-FE	SON-6	3,000 pcs	○	○

xx : Output Voltage (V_{OUT}) or serial number.
The output voltage can be designed in the range from 1.0V(10) to 3.3V(33) in 0.1V steps.
(If selected the custum-made product)The output voltage can be designed by Serial numbers.
Please refer to the attached Mark Informations.

∗ : (1) Standard (DC/DC output voltage = LDO output voltage)
(2) Custom-made (DC/DC output voltage ≠ LDO output voltage)

$: Designation of chip enable and Mode pin polarities
(A) Mode pin; "H"=DC/DC converter mode, "L"=LDO Mode
(B) Mode pin; "L"=DC/DC converter mode, "H"=LDO Mode

PIN CONFIGURATIONS



PIN DESCRIPTIONS

Pin No	Symbol	Description
1	Lx	Lx Pin Voltage Supply Pin
2	GND	Ground Pin
3	MODE	Mode changer Pin (Refer to the Selection Guide)
4	CE	Chip Enable Pin (active with "H")
5	V_{OUT}	Output Pin
6	V_{IN}	Voltage Supply Pin

∗1) Tab is GND level. (They are connected to the reverse side of this IC.)
The tab is better to be connected to the GND, but leaving it open is also acceptable.

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	V_{IN} Supply Voltage	6.5	V
V_{LX}	L_X Pin Voltage	–0.3 to V_{IN}+0.3	V
V_{CE}	CE Pin Input Voltage	–0.3 to 6.5	V
V_{MODE}	MODE Pin Input Voltage	–0.3 to 6.5	V
V_{OUT}	V_{OUT} Pin Voltage	–0.3 to V_{IN}+0.3	V
I_{LX}	L_X Pin Output Current	600	mA
I_{OUT}	V_{OUT} Pin Output Current	200	mA
P_D	Power Dissipation (SON-6)*	500	mW
	Power Dissipation (DFN(PLP)2514-6)*	730	
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.

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.

ELECTRICAL CHARACTERISTICS

- **R5220xxxxA**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Input Voltage		2.8		5.5	V
I_{SS1}	Supply Current 1 (Standby mode)	V_{IN}=V_{OUT1}+1.0V, V_{CE}=GND, V_{MODE}=GND or V_{IN} V_{OUT1}:DC/DC Set V_{OUT}		0.1	1.0	μA
I_{SS2}	Supply Current 2 (Power Save mode)	V_{IN}=V_{CE}=V_{OUT2}+1.0V, V_{MODE}=GND V_{OUT2}:VR Set V_{OUT}, I_{OUT}=0mA		5	10	μA
I_{SS3}	Supply Current 3	V_{IN}=V_{CE}=V_{MODE}=3.6V		350	450	μA

DC/DC Part

Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT1}	Output Voltage	V_{IN}=3.6V I_{OUT}=50mA	V_{OUT1} ≧ 1.5	×0.98		×1.02	V
			V_{OUT1} < 1.5	−0.03		+0.03	
fosc	Oscillator Frequency	V_{IN}=3.6V		0.96	1.20	1.44	MHz
T_{START}	Soft-start Time	V_{IN}=3.6V	V_{OUT1} < 1.5		0.15	0.30	ms
			V_{OUT1} ≧ 1.5		0.20	0.35	
R_{ONP}	ON Resistance of Pch Transistor	V_{IN}=3.6V, I_{LX}=−100mA			0.5		Ω
R_{ONN}	ON Resistance of Nch Transistor	V_{IN}=3.6V, I_{LX}=−100mA			0.5		Ω
I_{LXLEAK}	Lx Leakage Current	V_{IN}=5.5V, V_{CE}=0V, L_X=5.5V/0V		−1.0		1.0	μA
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	−40°C ≦ Topt ≦ 85°C			±150		ppm/°C
Maxduty	Oscillator Maximum Duty Cycle	V_{OUT}=0V		100			%
I_{LXlim}	Lx Current Limit	V_{IN}=3.6V		500	800		mA
Tprot	Protection Delay Circuit	V_{IN}=3.6V		1.0	3.0	7.0	ms
V_{UVLO1}	UVLO Threshold Voltage	V_{IN}=V_{CE}=V_{MODE}, V_{OUT}=0V		2.00	2.35	2.75	V
V_{UVLO2}	UVLO Released Voltage	V_{IN}=V_{CE}=V_{MODE}, V_{OUT}=0V		2.05	2.45	2.80	V
V_{MODEH}	MODE "H" Input Voltage			1.0			V
V_{MODEL}	MODE "L" Input Voltage			0		0.3	V

VR Part

Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT2}	Output Voltage	V_{IN}=V_{OUT2}+1.0V I_{OUT}=10mA	V_{OUT2} ≧ 1.5	×0.98		×1.02	V
			V_{OUT2} < 1.5	−0.03		+0.03	
I_{OUT}	Output Current	V_{IN}=V_{OUT2}+1.0V		50			mA
$\Delta V_{OUT2}/\Delta I_{OUT}$	Load Regulation	V_{IN}=V_{OUT2}+1.0V 10μA ≦ I_{OUT} ≦ 25mA	V_{OUT2} < 2.3		15	40	mV
			2.3 ≦ V_{OUT2} < 3.0		25	50	
			V_{OUT2} ≧ 3.0		35	65	
V_{DIF}	Dropout Voltage	I_{OUT}=50mA	V_{OUT2} < 1.8		0.7		V
			V_{OUT2} ≧ 1.8		0.3		
$\Delta V_{OUT2}/\Delta V_{IN}$	Line Regulation	2.8V ≦ V_{IN} ≦ 5.5V I_{OUT}=25mA	V_{OUT2} < 2.3			0.2	%/V
		V_{OUT2}+0.5V ≦ V_{IN} ≦ 5.5V I_{OUT}=25mA	V_{OUT2} ≧ 2.3				
RR	Ripple Rejection	Refer to Typical Characteristics					dB
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	I_{OUT}=30mA, −40°C ≦ Topt ≦ 85°C			±100		ppm/°C
I_{lim}	Short Current Limit	V_{OUT}=0V			60		mA
I_{PDC}	CE pull-down current			0.12	0.40	0.70	μA
V_{CEH}	CE "H" Input Voltage			1.0			V
V_{CEL}	CE "L" Input Voltage			0		0.3	V

- **R5220xxxxB**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Input Voltage		2.8		5.5	V
I_{SS1}	Supply Current 1 (Standby mode)	$V_{IN}=V_{OUT1}+1.0V$, V_{CE}=GND, V_{MODE}=GND or V_{IN} V_{OUT1}:DC/DC Set V_{OUT}		0.1	1.0	μA
I_{SS2}	Supply Current 2 (Power Save mode)	$V_{IN}=V_{CE}=V_{MODE}=V_{OUT2}+1.0V$, V_{OUT2}:VR Set V_{OUT}, I_{OUT}=0mA		5	10	μA
I_{SS3}	Supply Current 3	$V_{IN}=V_{CE}$=3.6V, V_{MODE}=GND		350	450	μA

DC/DC Part

Topt=25°C

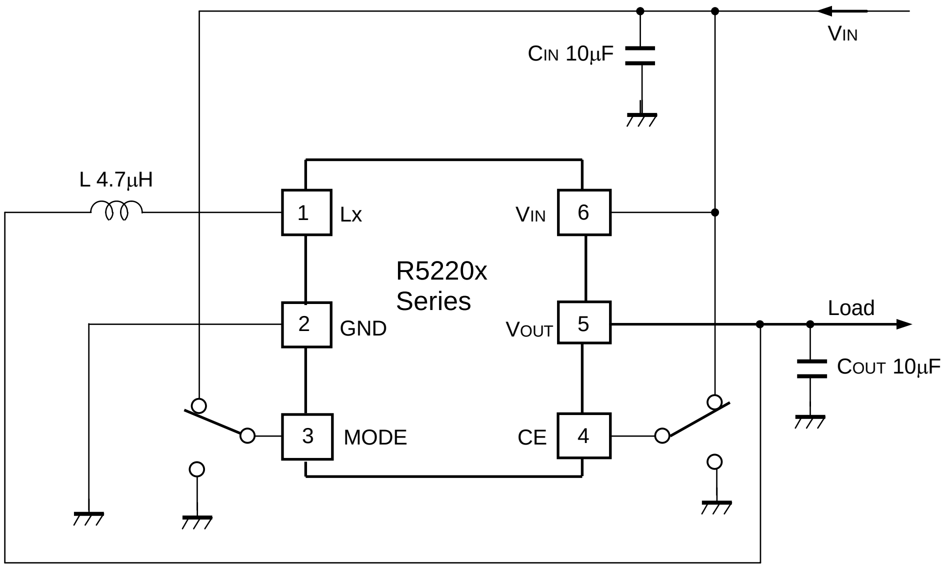
Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT1}	Output Voltage	V_{IN}=3.6V I_{OUT}=50mA	$V_{OUT1} \geqq 1.5$	×0.98		×1.02	V
			$V_{OUT1}<1.5$	−0.03		+0.03	
fosc	Oscillator Frequency	$V_{IN}=V_{SET1}+1.5V$		0.96	1.20	1.44	MHz
T_{START}	Soft-start Time	V_{IN}=3.6V	$V_{OUT1}<1.5$		0.15	0.30	ms
			$V_{OUT1} \geqq 1.5$		0.20	0.35	
R_{ONP}	ON Resistance of Pch Transistor	V_{IN}=3.6V, I_{LX}=−100mA			0.5		Ω
R_{ONN}	ON Resistance of Nch Transistor	V_{IN}=3.6V, I_{LX}=−100mA			0.5		Ω
I_{LXLEAK}	Lx Leakage Current	V_{IN}=5.5V, V_{CE}=0V, L_X=5.5V/0V		−1.0		1.0	μA
ΔV_{OUT}/ ΔTopt	Output Voltage Temperature Coefficient	−40°C ≦ Topt ≦ 85°C			±150		ppm/°C
Maxduty	Oscillator Maximum Duty Cycle	V_{OUT}=0V		100			%
I_{LXlim}	Lx Current Limit	V_{IN}=3.6V		500	800		mA
Tprot	Protection Delay Circuit	V_{IN}=3.6V		1.0	3.0	7.0	ms
V_{UVLO1}	UVLO Threshold Voltage	$V_{CE}=V_{IN}$, V_{MODE}=GND, V_{OUT}=0V		2.00	2.35	2.75	V
V_{UVLO2}	UVLO Released Voltage	$V_{CE}=V_{IN}$, V_{MODE}=GND, V_{OUT}=0V		2.05	2.45	2.80	V
V_{MODEH}	MODE "H" Input Voltage			1.0			V
V_{MODEL}	MODE "L" Input Voltage			0		0.3	V

VR Part

Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT2}	Output Voltage	$V_{IN}=V_{OUT2}+1.0V$ I_{OUT}=10mA	$V_{OUT2} \geqq 1.5$	×0.98		×1.02	V
			$V_{OUT2}<1.5$	−0.03		+0.03	
I_{OUT}	Output Current	$V_{IN}=V_{OUT2}+1.0V$		50			mA
ΔV_{OUT2}/ ΔI_{OUT}	Load Regulation	$V_{IN}=V_{OUT2}+1.0V$ 10μA ≦ I_{OUT} ≦ 25mA	$V_{OUT2}<2.3$		15	40	mV
			$2.3 \leqq V_{OUT2}<3.0$		25	50	
			$V_{OUT2} \geqq 3.0$		35	65	
V_{DIF}	Dropout Voltage	I_{OUT}=50mA	$V_{OUT2}<1.8V$		0.7		V
			$V_{OUT2} \geqq 1.8V$		0.3		
ΔV_{OUT2}/ ΔV_{IN}	Line Regulation	2.8V ≦ V_{IN} ≦ 5.5V I_{OUT}=25mA	$V_{OUT2}<2.3V$			0.2	%/V
		V_{OUT2}+0.5V ≦ V_{IN} ≦ 5.5V I_{OUT}=25mA	$V_{OUT2} \geqq 2.3V$				
RR	Ripple Rejection	Refer to Typical Characteristics					dB
ΔV_{OUT}/ ΔTopt	Output Voltage Temperature Coefficient	I_{OUT}=30mA, −40°C ≦ Topt ≦ 85°C			±100		ppm/°C
I_{lim}	Short Current Limit	V_{OUT}=0V			60		mA
I_{PDC}	CE pull-down current			0.12	0.40	0.70	μA
V_{CEH}	CE "H" Input Voltage			1.0			V
V_{CEL}	CE "L" Input Voltage			0		0.3	V

TYPICAL APPLICATION



Parts Recommendation

C_{IN}	10µF Ceramic Capacitor C2012JB0J106K (TDK)
C_{OUT}	10µF Ceramic Capacitor C2012JB0J106K (TDK)
L	4.7µH VLP5610T-4R7MR90 (TDK)

External Components

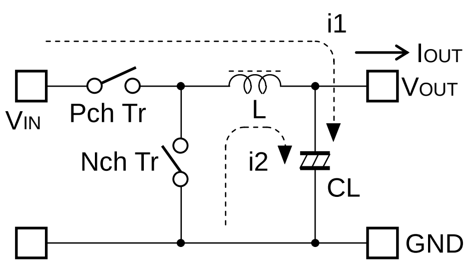
- Set external components such as an inductor, C_{IN}, C_{OUT} as close as possible to the IC, in particular, minimize the wiring to V_{IN} pin and GND pin. If V_{DD} line or GND line's impedance is high, the internal voltage level of the IC may fluctuate and the operation may be unstable. Make GND line and V_{DD} line sufficient. Through the V_{DD} line, the GND line, the inductor, Lx pin, and V_{OUT} line, a large current caused by switching may flow, therefore, those lines should be sufficient and avoid the cross talk with other sensitive lines. Use the individual line from the V_{OUT} pin of the IC for the inductor and the capacitor and load.
- Use a low ESR ceramic capacitor C_{OUT}/C_{IN} with a capacity of 10µF or more.
- Select an inductor with an inductance range from 4.7µH to 10µH. The internal phase compensation is secured with these inductance values and C_{OUT} value. Choose the inductor with a low DC resistance and enough permissible current and hard to reach magnetic saturation. In terms of inductance value, choose the appropriate value with considering the conditions of the input voltage range and the output voltage, and load current. If the inductance value is too small and the load current is large, the peak current of Lx may reach the Lx current limit, and the protection against over-current may work.
- The protection circuit against over-current is affected by the self-heating and the heat radiation environment. Therefore evaluate under the considerable environment of the application.

The performance of power source circuits using these ICs extremely depends upon the peripheral circuits. Pay attention in the selection of the peripheral circuits. In particular, design the peripheral circuits in a way that the values such as voltage, current, and power of each component, PCB patterns and the IC do not exceed their respected rated values.

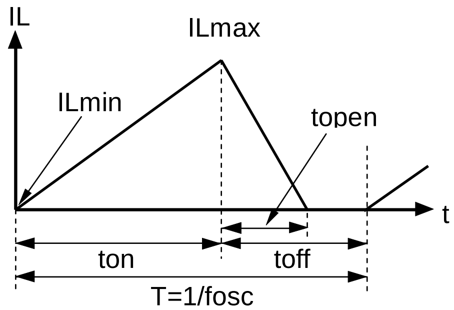
OPERATION of step-down DC/DC converter and Output Current

The step-down DC/DC converter charges energy in the inductor when Lx transistor is ON, and discharges the energy from the inductor when Lx transistor is OFF and controls with less energy loss, so that a lower output voltage than the input voltage is obtained. The operation will be explained with reference to the following diagrams:

<Basic Circuits>



<Current through L>



Step 1: P-channel Tr. turns on and current IL (=i1) flows, and energy is charged into CL. At this moment, IL increases from ILmin (=0) to reach ILmax in proportion to the on-time period (ton) of P-channel Tr.

Step 2: When P-channel Tr. turns off, Synchronous rectifier N-channel Tr. turns on in order that L maintains IL at ILmax, and current IL (=i2) flows.

Step 3: IL (=i2) decreases gradually and reaches IL=ILmin=0 after a time period of topen, and N-channel Tr. Turns off. Provided that in the continuous mode, next cycle starts before IL becomes to 0 because toff time is not enough. In this case, IL value increases from this ILmin (>0).

In the case of PWM control system, the output voltage is maintained by controlling the on-time period (ton), with the oscillator frequency (fosc) being maintained constant.

The maximum value (ILmax) and the minimum value (ILmin) of the current flowing through the inductor are the same as those when P-channel Tr. turns on and off.

The difference between ILmax and ILmin, which is represented by ΔI;

$$\Delta I = ILmax - Ilmin = V_{OUT} \times topen / L = (V_{IN} - V_{OUT}) \times ton / L \text{ .... Equation 1}$$

wherein, $T = 1 / fosc = ton + toff$

$duty\ (\%) = ton / T \times 100 = ton \times fosc \times 100$

$topen \leqq toff$

In Equation 1, $V_{OUT} \times topen / L$ and $(V_{IN} - V_{OUT}) \times ton / L$ respectively show the change of the current at "ON", and the change of the current at "OFF".

OUTPUT CURRENT AND SELECTION OF EXTERNAL COMPONENTS

When P-channel Tr. of L_X is ON:

(Wherein, Ripple Current P-P value is described as I_{RP}, ON resistance of P-channel Tr. and N-channel Tr. of L_X are respectively described as R_{ONP} and R_{ONN}, and the DC resistor of the inductor is described as R_L.)

$$V_{IN} = V_{OUT} + (R_{ONP} + R_L) \times I_{OUT} + L \times I_{RP} / ton \quad \text{Equation 2}$$

When P-channel Tr. of L_X is "OFF" (N-channel Tr. is "ON"):

$$L \times I_{RP} / toff = R_{ONN} \times I_{OUT} + V_{OUT} + R_L \times I_{OUT} \quad \text{Equation 3}$$

Put Equation 3 to Equation 2 and solve for ON duty of P-channel transistor, ton / (toff + ton) = D_{ON},

$$D_{ON} = (V_{OUT} - R_{ONN} \times I_{OUT} + R_L \times I_{OUT}) / (V_{IN} + R_{ONN} \times I_{OUT} - R_{ONP} \times I_{OUT}) \quad \text{Equation 4}$$

Ripple Current is as follows;

$$I_{RP} = (V_{IN} - V_{OUT} - R_{ONP} \times I_{OUT} - R_L \times I_{OUT}) \times D_{ON} / fosc / L \quad \text{Equation 5}$$

wherein, peak current that flows through L, and L_X Tr. is as follows;

$$ILmax = I_{OUT} + I_{RP} / 2 \quad \text{Equation 6}$$

Consider ILmax, condition of input and output and select external components.

✰ The above explanation is directed to the calculation in an ideal case in continuous mode.

TIMING CHART

1) IC start-up

The timing chart as shown in the next describes the operation starting the IC is enabled with CE. When the CE pin voltage becomes higher than the threshold voltage, the IC's operations starts. At first, only the voltage regulator (VR) starts. The threshold level of the CE pin is between CE "H" input voltage and CE "L" input voltage. After starting the operation, the output capacitor (C_{OUT}) is charged with the output current of the VR, and the output level becomes the set VR output voltage. At this moment, the output of Lx is "off", ("Hi-Z"), the pin voltage, $V_{LX}=V_{OUT}$ through the external inductor L.

Secondly, the Mode pin voltage is higher than the threshold voltage, internal operation of DC/DC starts. The threshold level is between Mode "H" input voltage and Mode "L" input voltage. The soft-start circuit inside the DC/DC converter's operation is as follows:

(Case 1) DC/DC output voltage < VR output voltage

After the soft-start time, while the output voltage level is down from the VR output voltage to DC/DC output voltage, the circuit is waiting for the start of DC/DC operation. When the output voltage reaches so set DC/DC output voltage level, the actual DC/DC operation starts.

(Case 2) DC/DC output voltage> VR output voltage

The soft-start circuit of DC/DC converter makes the voltage reference unit of the IC rise gradually and be constant. After the voltage reference unit reaches the constant level which the output voltage of DC/DC converter can balance becomes the output voltage of VR, the set output voltage of DC/DC converter may be realized.

Therefore, the soft-start time means the time range of starting to the time when the voltage reference unit reaches the constant level, and the soft-start time is different from turning on speed in some cases. The operation starting time depends on the ability of the power supply, the load current, the inductance value, the capacitance value, and the voltage difference between the set VR output and the set DC/DC output.

If CE and Mode are on at once, the same operation as above is happened except the VR start-up and Soft-start operation start at the same time.

If Mode signal is forced earlier than CE signal, this IC is stand-by until CE signal comes. Therefore when the CE signal is set, the IC operation starts as above.

• V_{OUT} voltage rising speed at start-up with power supply is affected by the next conditions:

1.The turning on speed of V_{IN} voltage limited by the power supply to the IC and the input capacitor C_{IN}.
2.The output capacitor, C_{OUT} value and load current.

• DC/DC operation starting time

1.If the VR output ≧ DC/DC output, the operation starting time of the DC/DC converter is approximately equal to the next formula.

$T_{DC/DC\_ACT} = T_{SS} + (V_{OUT\_VR} - V_{OUT\_DC/DC} + 15mV) \times C_{OUT}$ / (load current at mode change + 1μA)

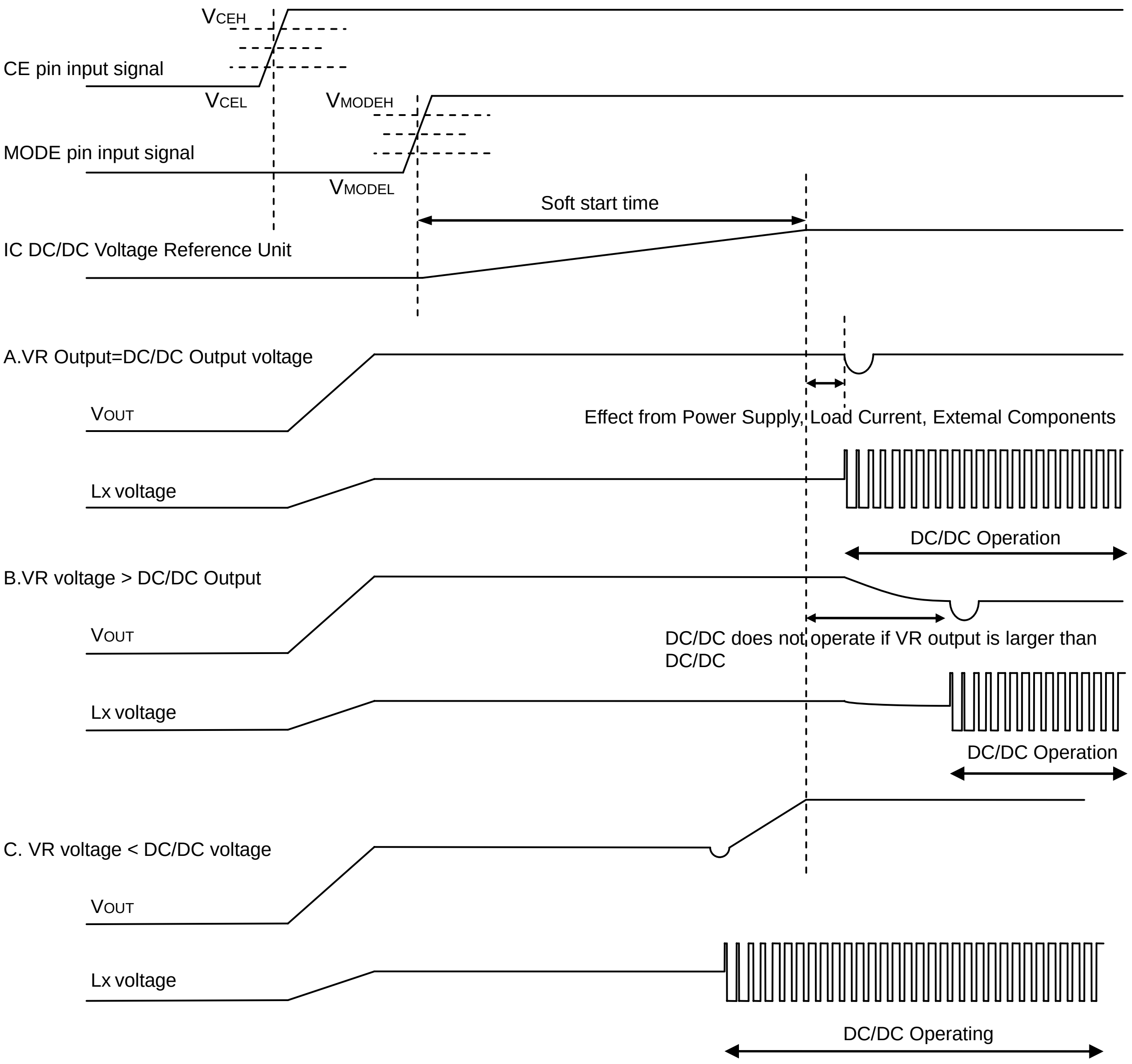
T_{SS}: Soft-start time

V_{OUT_VR}: VR output voltage

$V_{OUT\_DC/DC}$: DC/DC Output Voltage

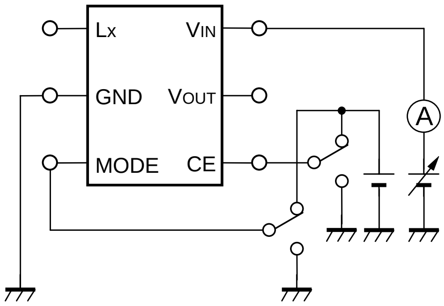
*1μA is the supply current of the IC itself for the output.

2.If the VR output < DC/DC output, the operation starting time is the soft-start time + starting operation time which depends on the power supply, the load current, and the external components.

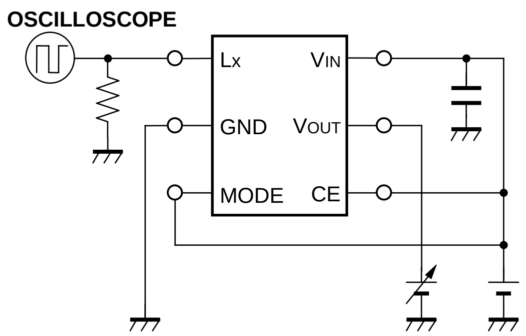


If CE pin input signal is forced earlier than the supply voltage, the voltage difference between the input and the output which is according to the input voltage to V_{IN}, is maintained and the V_{OUT} is rising up.

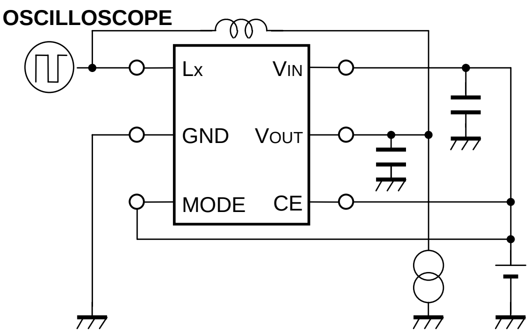
TEST CIRCUITS



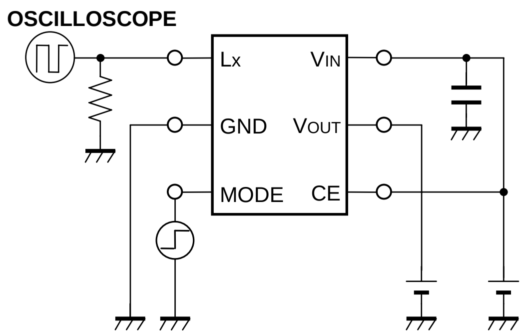
Supply Current 1,2,3



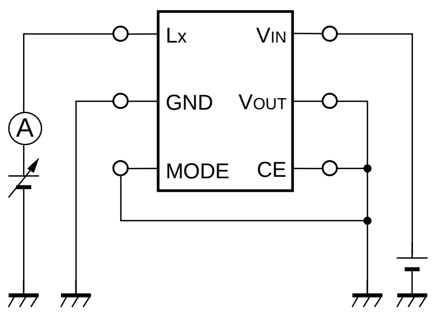
Output Voltage(DC/DC)



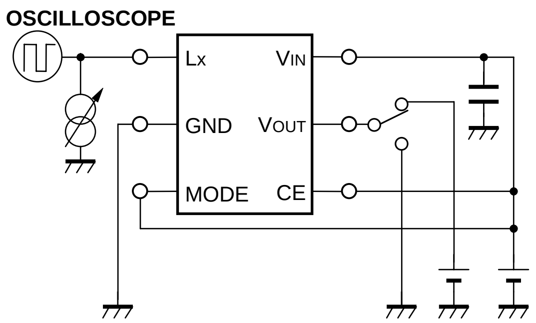
Oscillator Frequency



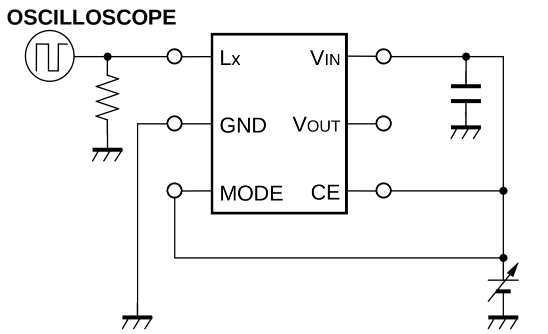
Soft-start Time



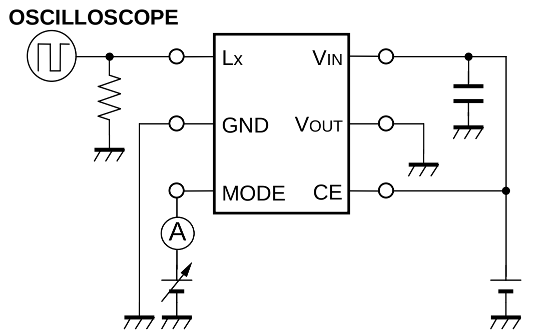
Lx Leakage Current



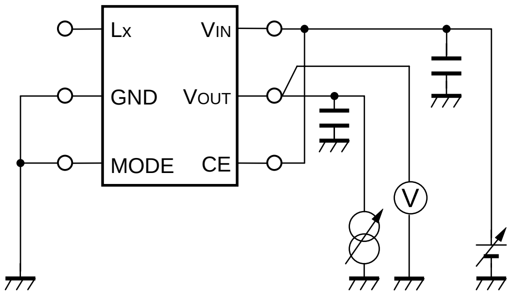
Lx Current Limit, Output Delay for Protection
Lx Pch transistor ON resistance
Nch transistor ON resistance



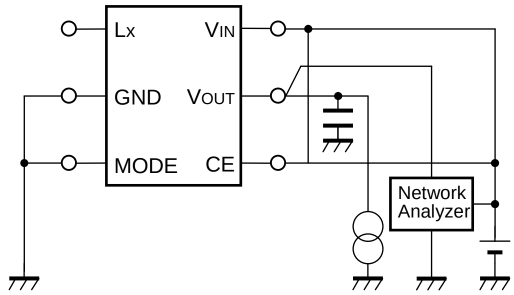
UVLO Detector Threshold UVLO Release Voltage



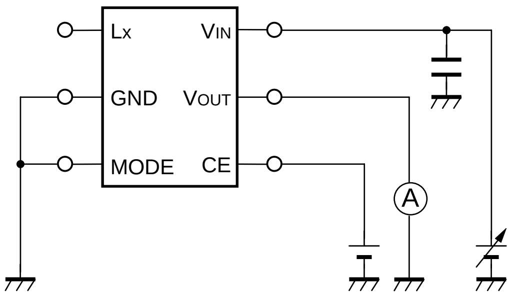
MODEInput Voltage ”H”,”L” Input Current



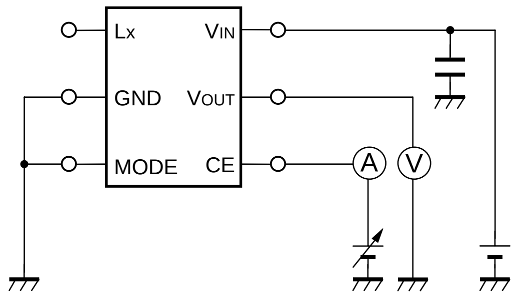
Output Voltage (VR), Load Regulation
Line Regulation, Dropout Voltage



(J) RippleRejection



Short Current Limit



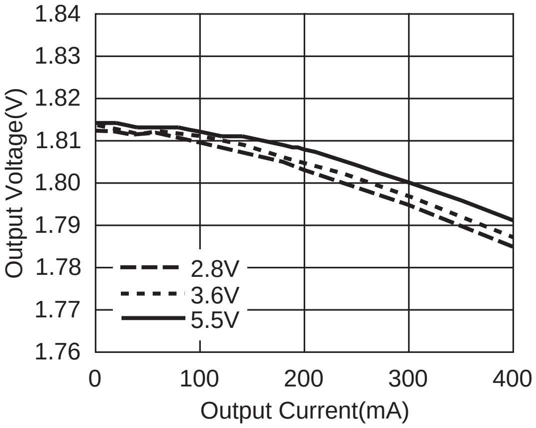
CE=”H”/”L” Input Voltage/ Input Current

TYPICAL CHARACTERISTICS

1) DC/DC Converter

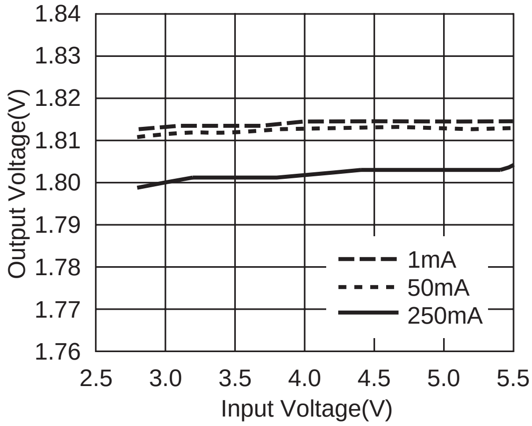
1-1) DC/DC Output Voltage vs. Output Current

R5220x181A



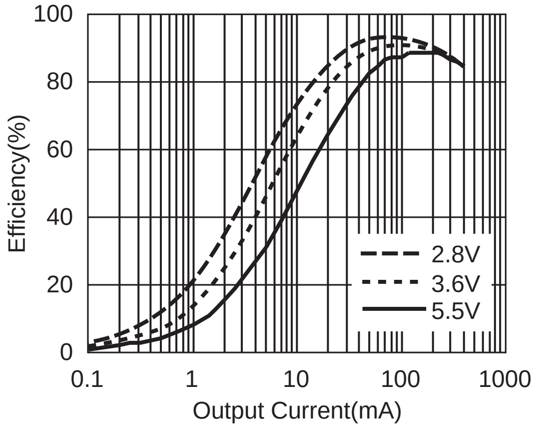
1-2) DC/DC Output Voltage vs. Input Voltage

R5220x181A

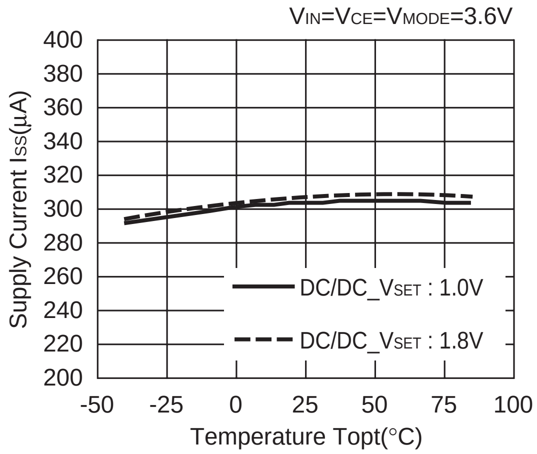


1-3) DC/DC Efficiency vs. Output Current

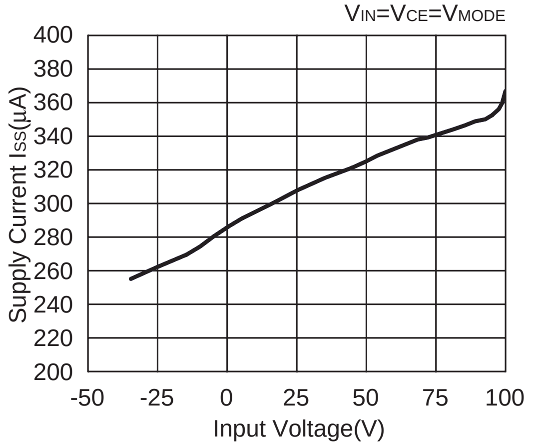
R5220x181A



1-4) DC/DC Supply Current vs. Temperature

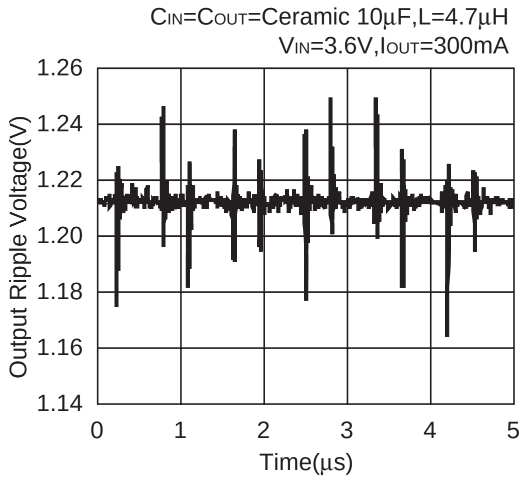


1-5) DC/DC Supply Current vs. Input Voltage



1-6) DC/DC Output Waveform

R5220x121A



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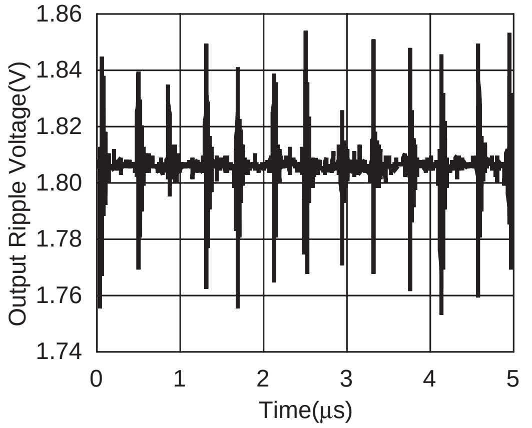
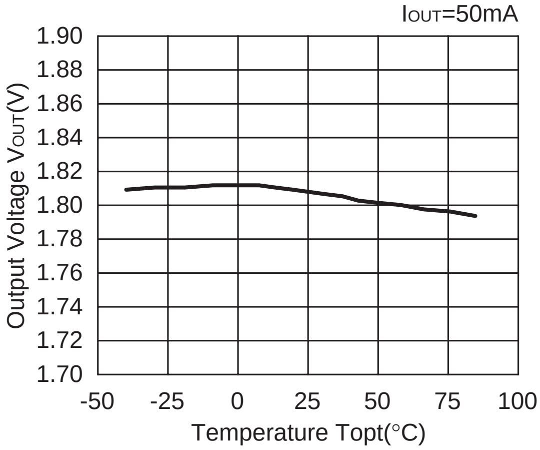
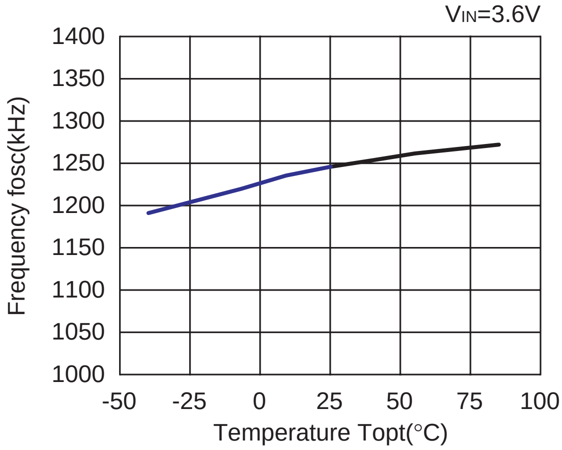


1-7) DC/DC Output Voltage vs. Temperature

R5220x181A

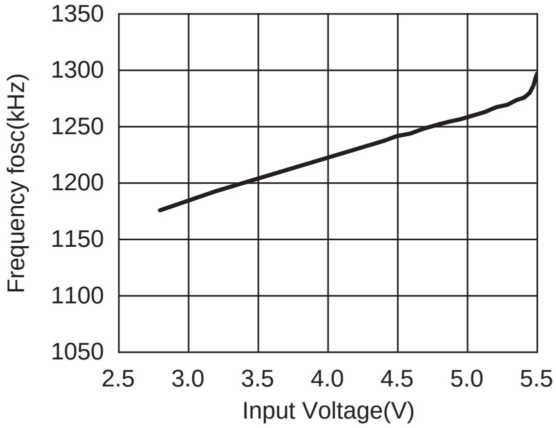


1-8) DC/DC Oscillator Frequency vs. Temperature

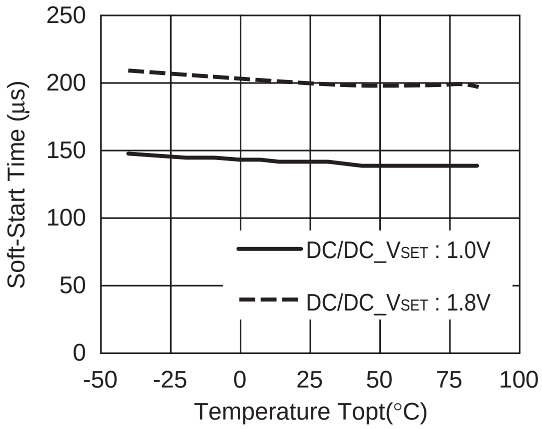


1-9) DC/DC Oscillator Frequency vs. Input Voltage

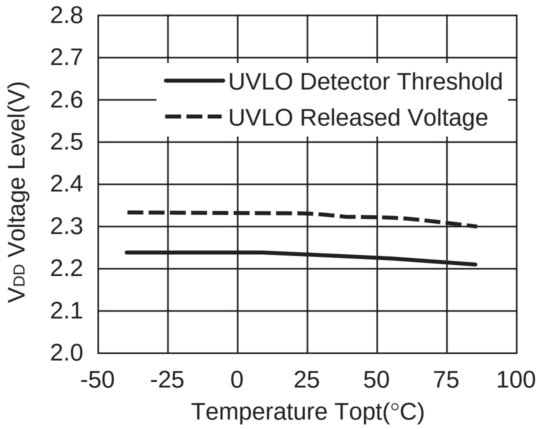
R5220x181A



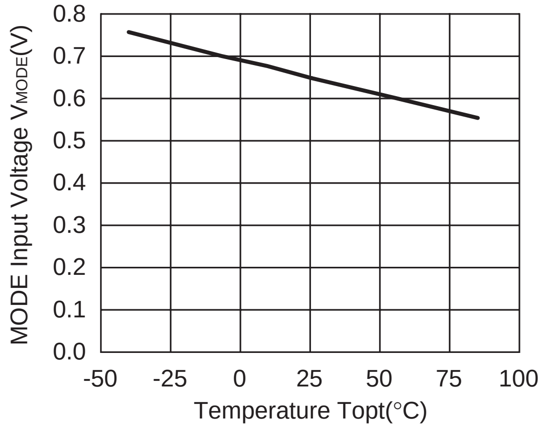
1-10) Soft-start time vs. Temperature



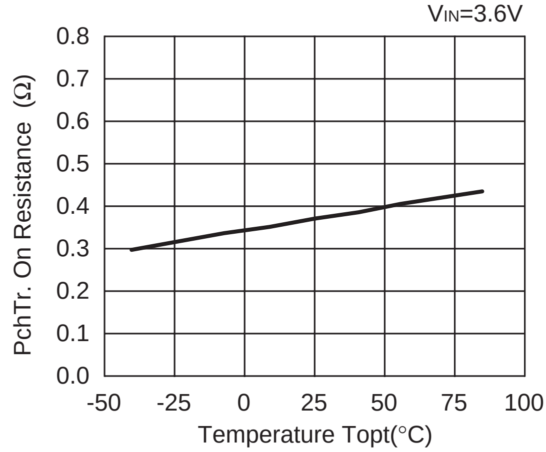
1-11) UVLO Detector Threshold/ Released Voltage vs. Temperature



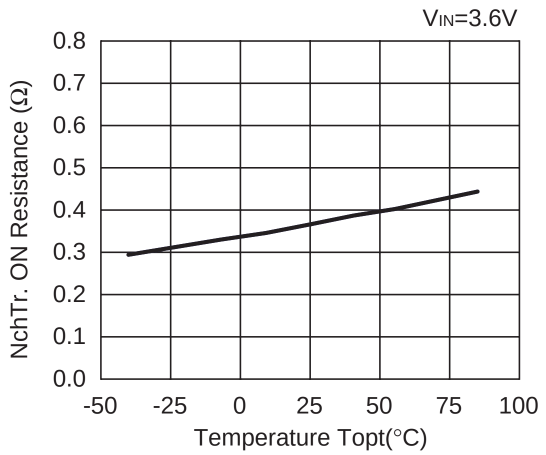
1-12) MODE Input Voltage vs. temperature



1-13) Pch Transistor On Resistance vs. Temperature

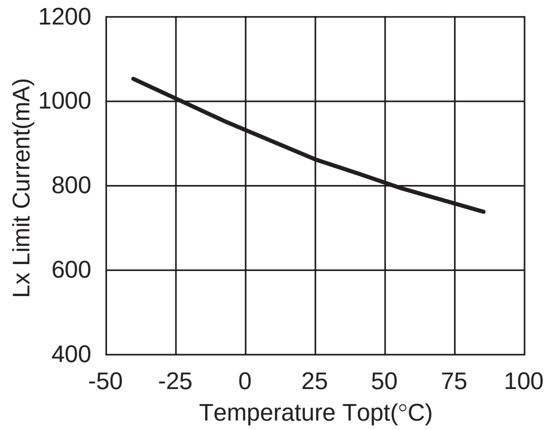


1-14) Nch Transistor On Resistance vs. Temperature



1-15) DC/DC Lx Current Limit vs. Temperature

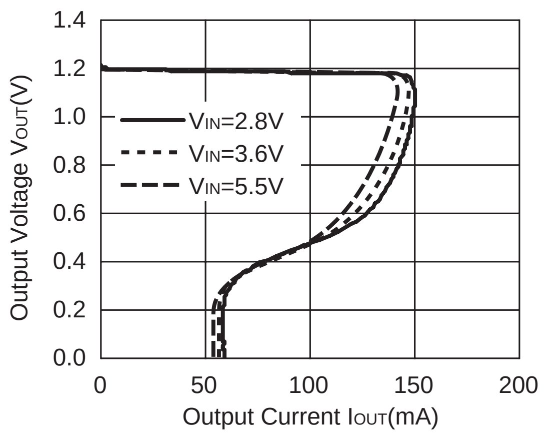
R5220x131A



2) VR

2-1) VR Output Voltage vs. Output Current

R5220x121A



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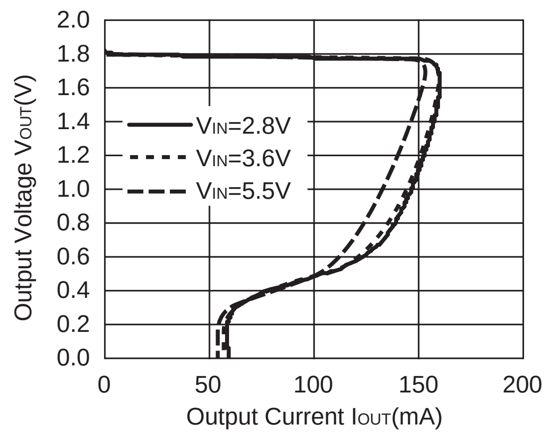
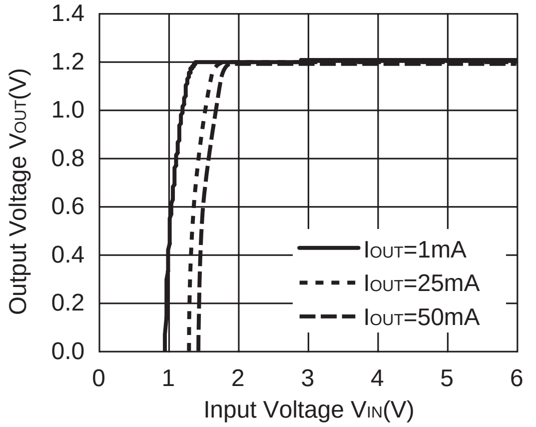


2-2) VR Output Voltage vs. Input Voltage

R5220x121A



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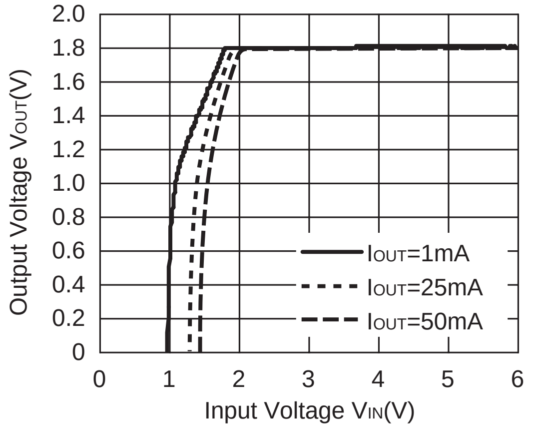
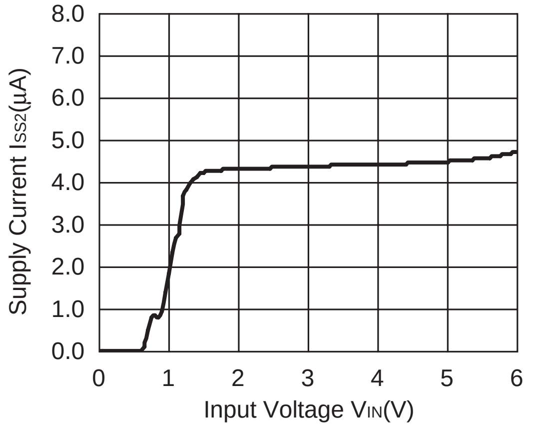
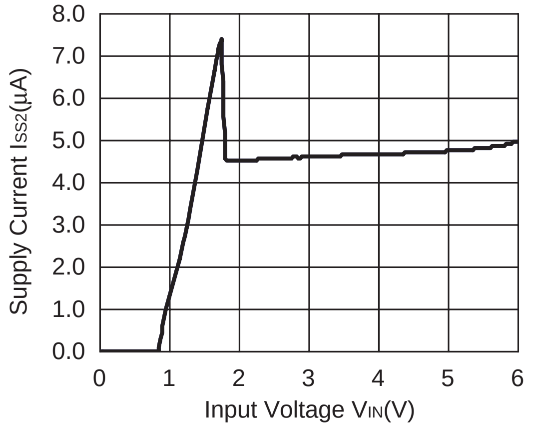


2-3) VR Supply Current vs. Input Voltage

R5220x121A

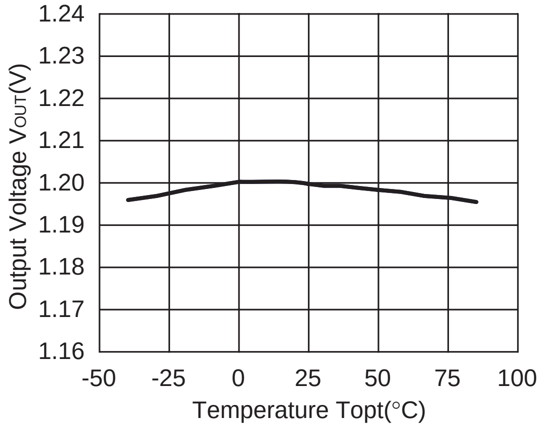


R5220x181A



2-4) VR Output Voltage vs. Temperature

R5220x121A



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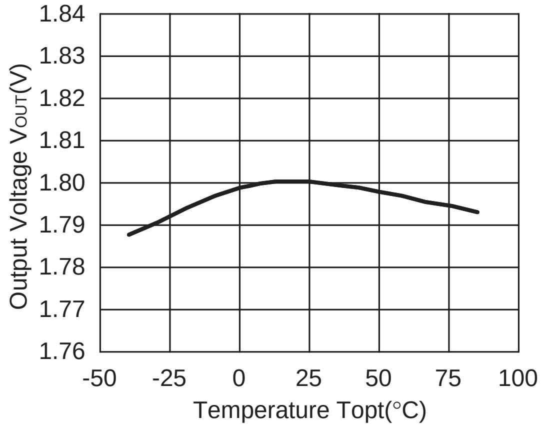
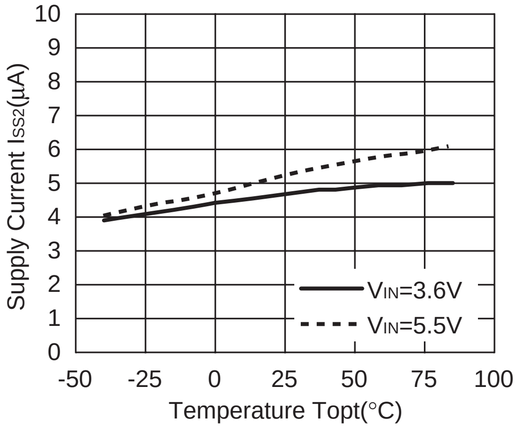
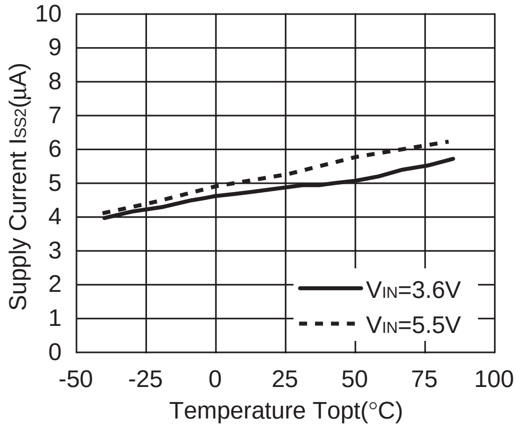


2-5) VR Supply Current vs. Temperature

R5220x121A

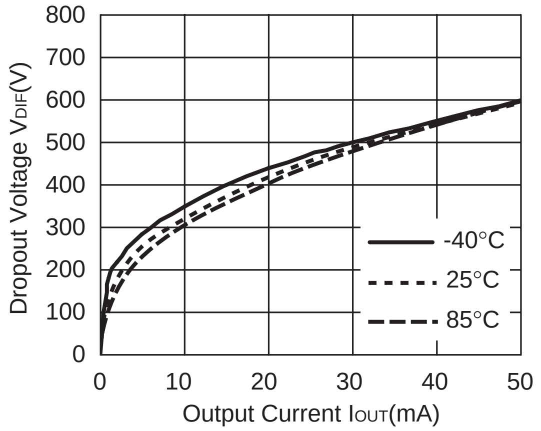


R5220x181A

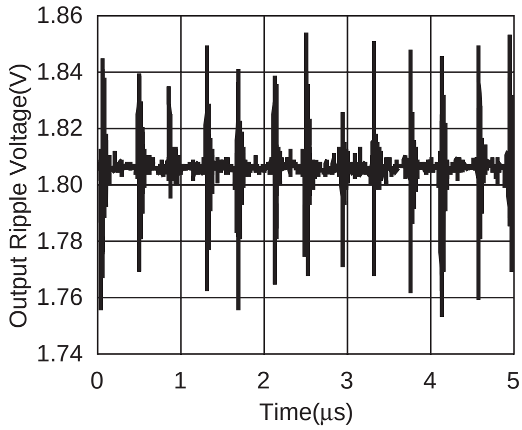


2-6) Dropout Voltage vs. Output Current

R5220x121A



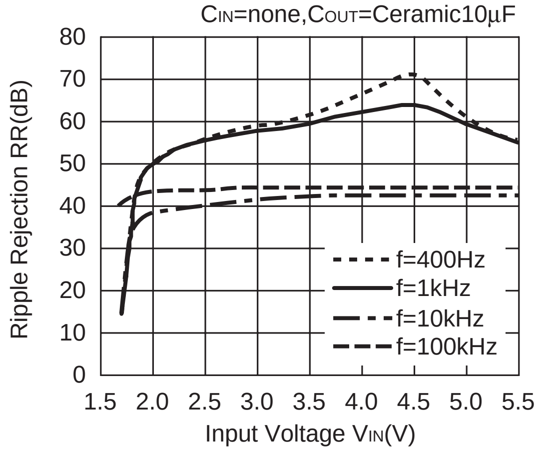
R5220x181A



2-7) Ripple Rejection vs. Input Voltage

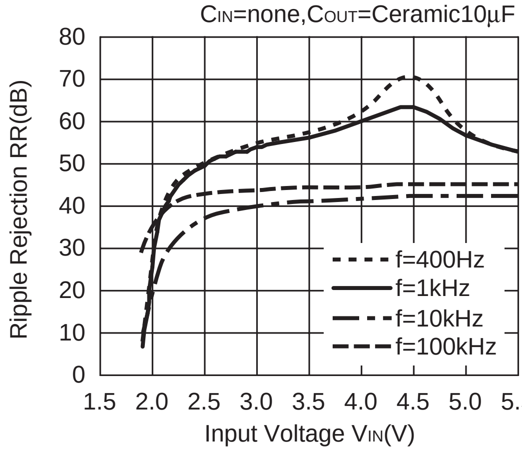
R5220x121A

Ripple 0.2Vp-p, I_{OUT}=25mA,
C_{IN}=none, C_{OUT}=Ceramic10μF



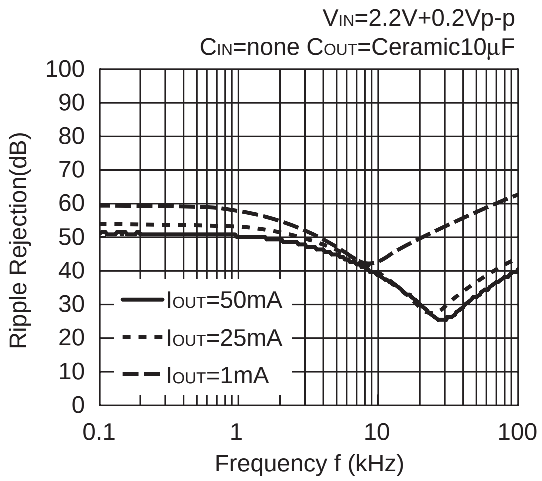
R5220x181A

Ripple 0.2Vp-p, I_{OUT}=25mA,
C_{IN}=none, C_{OUT}=Ceramic10μF

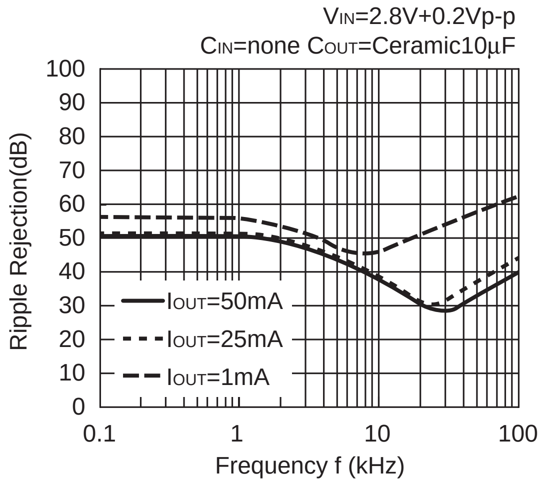


2-8) VR Ripple Rejection vs. Frequency

R5220x121A

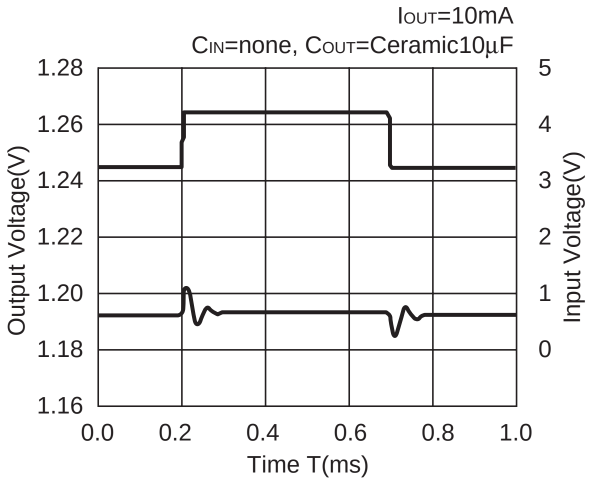


R5220x181A

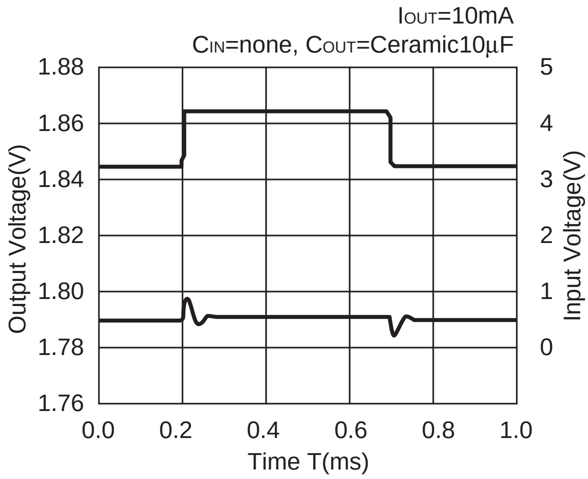


2-9) Input Transient Response

R5220x121A

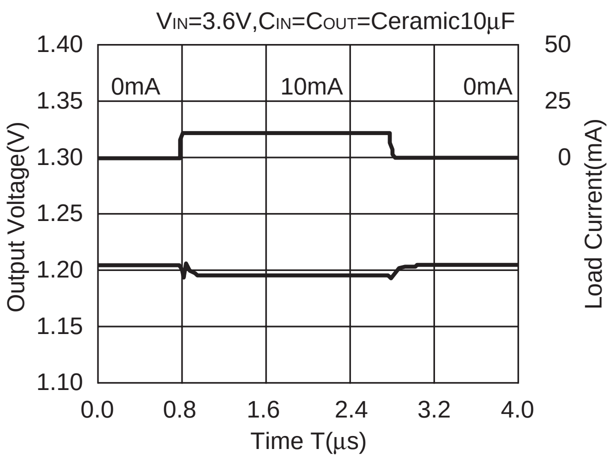


R5220x181A

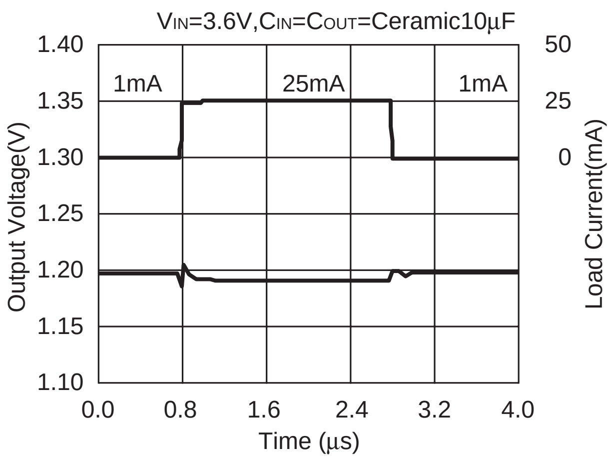


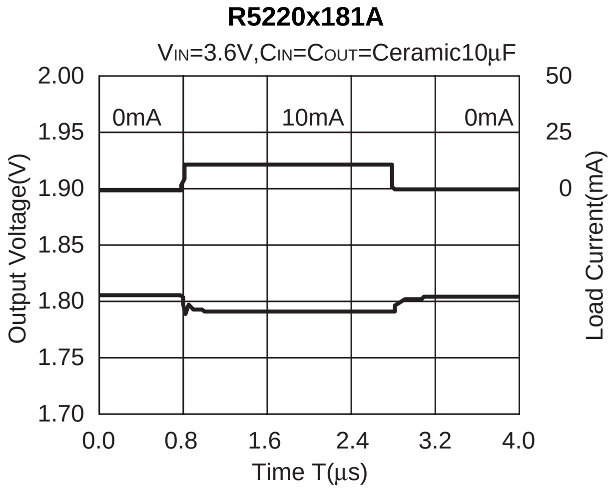
2-10) Load Transient Response

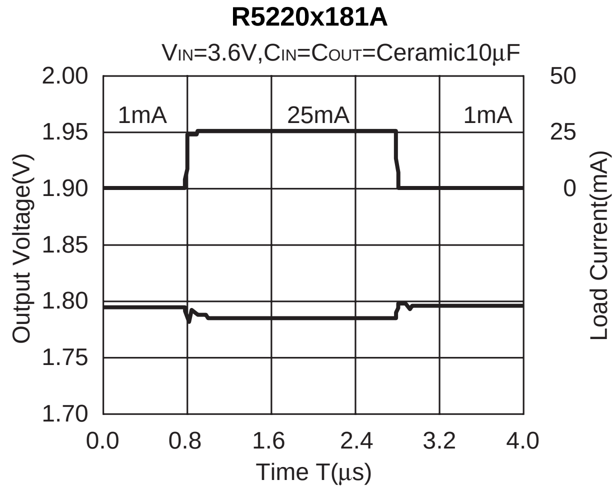
R5220x121A



R5220x121A

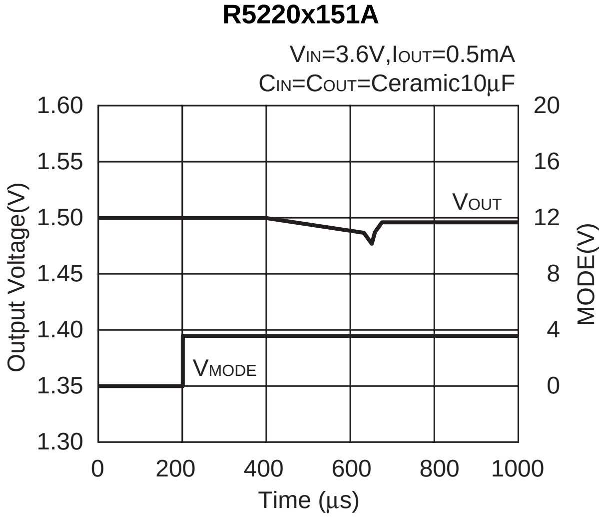




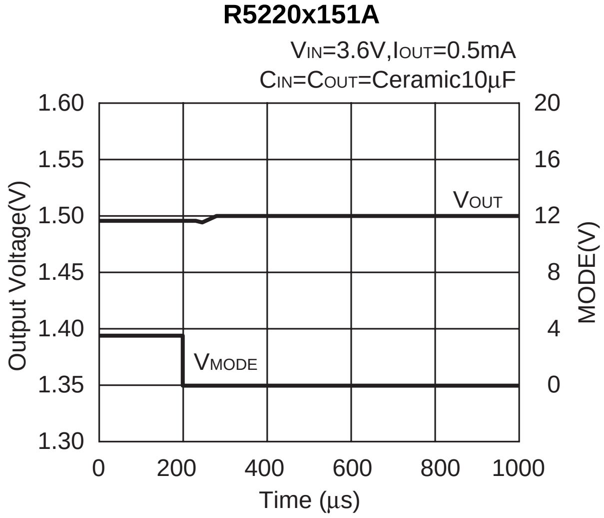


3) Mode Transient Response between VR and DC/DC

3-1) VR to DC/DC Mode Transient Response



3-2) DC/DC to VR Mode Transient Response



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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.
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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