RICOH

R5321D SERIES

CMOS 2ch-LDOs for RF Unit

NO. EA-062-130419

OUTLINE

The R5321D Series are CMOS-based 2 channels voltage regulator ICs with high output voltage accuracy, extremely low supply current, low noise, low ON-resistance and high ripple rejection. The R5321D Series contain two voltage regulators. Each of these voltage regulators in the R5321D Series consists of a voltage reference unit, an error amplifier, resistors for setting output voltage, a current limit circuit and a chip enable circuit.

The chip enable function contributes to prolong battery life. Further, regulators in the R5321D Series are with low dropout voltage, excellent load transient response and line transient response, thus the R5321D Series are very suitable for the power supply for hand-held communication equipment.

The output voltage of each regulator is fixed with high accuracy by laser trim.

Since the package for these ICs is SON-8 package, high density mounting of the ICs on boards is possible.

Discontinued Product

FEATURES

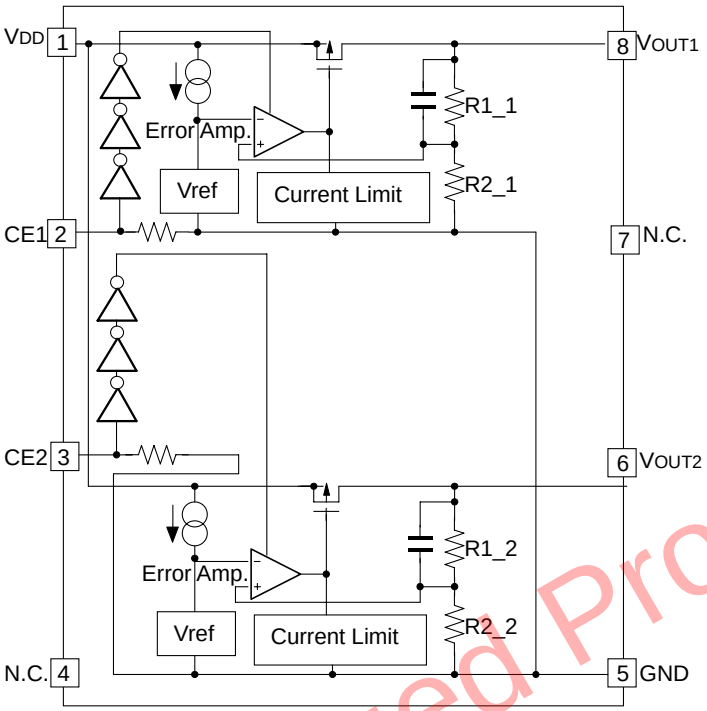
- Low Supply Current ..... Typ. 70µA (VR1, VR2)
- Low Standby Current ..... Typ. 0.1µA (VR1, VR2)
- Low Dropout Voltage..... Typ. 0.23V (VR1) (I_{OUT}=150mA,V_{OUT}=3.0V)
  Typ. 0.17V (VR2) (I_{OUT}=150mA,V_{OUT}=3.0V)
- Input Voltage Max.6.0V
- High Ripple Rejection ..... Typ. 70dB (f=1kHz)
- High Output Voltage Accuracy ..... ±2.0%
- Excellent Load Transient Response and Line Transient Response
- Small Package SON-8

APPLICATIONS

- Power source for cellular phones such as GSM, CDMA and Personal Handy-phone System.
- Power source for electrical appliances such as cameras, VCRs, camcorders, etc.
- Power source for battery-powered equipment.

BLOCK DIAGRAMS

R5324DxxxA



Discontinued Product

SELECTION GUIDE

The selection can be made with designating the part number as shown below:

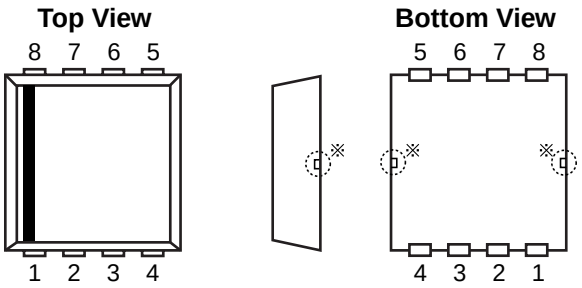
R5321DXXXX-XX-X ←Part Number
↑ ↑ ↑ ↑
a b c d

Code	Contents
a	Serial Number for Voltage setting from 001
b	Alphabetical Code for Mask Versions A : Standard
c	Designation of Taping Type (TR)
d	Designation of Composition of pin plating. -F : Lead free plating

Discontinued Product

PIN CONFIGURATIONS

SON-8



PIN DESCRIPTIONS

Pin No	Symbol	Pin Description
1	V_{DD}	Input Pin
2	CE1	Chip Enable Pin
3	CE2	Chip Enable Pin
4	N.C.	No Connection
5	GND	Ground Pin
6	V_{OUT2}	Output Pin
7	N.C.	No Connection
8	V_{OUT1}	Output Pin

* Tab in the ◌ parts have GND level. (They are connected to the reverse side of this IC.)
Do not connect to other wires or land patterns.

Discontinued Product

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	6.5	V
V_{CE}	Input Voltage (CE Pin)	-0.3~V_{IN}+0.3	V
V_{OUT}	Output Voltage	-0.3~V_{IN}+0.3	V
I_{OUT1}	Output Current (V_{OUT1})	200	mA
I_{OUT2}	Output Current (V_{OUT2})	200	mA
P_D	Power Dissipation	480	mW
Topt	Operating Temperature Range	-40~85	°C
Tstg	Storage Temperature Range	-55~125	°C

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

ELECTRICAL CHARACTERISTICS

- **R5321DxxxA**

VR1 Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	V_{IN}–V_{OUT}=1.0V 1mA ≦ I_{OUT} ≦ 50mA	×0.98		×1.02	V
I_{OUT}	Output Current	V_{IN}–V_{OUT}=1.0V	150			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	V_{IN}–V_{OUT}=1.0V 1mA ≦ I_{OUT} ≦ 80mA		12	40	mV
V_{DIF}	Dropout Voltage	Refer to Electrical Characteristic by Output Voltage (VR1)				
I_{SS}	Supply Current	V_{IN}–V_{OUT}=1.0V		70	120	µA
Istandby	Supply Current (Standby)	V_{IN}–V_{OUT}=1.0V, V_{CE}=GND		0.1	1.0	µA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	V_{OUT}+0.5V ≦ V_{IN} ≦ 6.0V I_{OUT}=30mA		0.05	0.20	%/V
RR	Ripple Rejection	f=1kHz,sinusoidal Ripple 1.0Vp-p V_{IN}–V_{OUT}=1.0V,V_{OUT} ≧ 1.9V		70		dB
		1.5V ≦ V_{IN} ≦ 1.8V		60		
V_{IN}	Input Voltage		2.0		6.0	V
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	I_{OUT}=50mA –40°C ≦ Topt ≦ 85°C		±100		ppm /°C
Ilim	Short Current Limit	V_{OUT}=0V		50		mA
R_{PD}	CE Pull-down Resistance		2.5	5.0	10.0	MΩ
V_{CEH}	CE Input Voltage “H”		1.5		V_{IN}	V
V_{CEL}	CE Input Voltage “L”		0.00		0.25	V
en	Output Noise	BW=10Hz~100kHz		60		µVrms

Discontinued Product

- **ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE (VR1)**

Topt = 25°C

Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)		
	Condition	Typ.	Max.
V_{OUT}=1.5	I_{OUT}=150mA	0.55	0.65
V_{OUT}=1.6		0.45	0.60
1.7 ≦ V_{OUT} ≦ 1.9		0.35	0.60
2.0 ≦ V_{OUT} ≦ 2.4		0.35	0.48
2.5 ≦ V_{OUT} ≦ 2.7		0.25	0.35
2.8 ≦ V_{OUT} ≦ 3.3		0.23	0.33
3.4 ≦ V_{OUT} ≦ 5.0		0.21	0.27

VR2

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	V_{IN}–V_{OUT}=1.0V 1mA ≦ I_{OUT} ≦ 50mA	×0.98		×1.02	V
I_{OUT}	Output Current	V_{IN}–V_{OUT}=1.0V	150			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	V_{IN}–V_{OUT}=1.0V 1mA ≦ I_{OUT} ≦ 80mA		12	40	mV
V_{DIF}	Dropout Voltage	Refer to Electrical Characteristic by Output Voltage (VR2)				
I_{SS}	Supply Current	V_{IN}–V_{OUT}=1.0V		70	120	µA
Istandby	Supply Current (Standby)	V_{IN}–V_{OUT}=1.0V, V_{CE}=GND		0.1	1.0	µA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	V_{OUT}+0.5V ≦ V_{IN} ≦ 6.0V I_{OUT}=30mA		0.05	0.20	%/V
RR	Ripple Rejection	f=1kHz,sinusoidal Ripple 1.0Vp-p V_{IN}–V_{OUT}=1.0V,V_{OUT} ≧ 1.9V		70		dB
		1.5V ≦ V_{IN} ≦ 1.8V		60		
V_{IN}	Input Voltage		2.0		6.0	V
$\Delta V_{OUT}/\Delta$Topt	Output Voltage Temperature Coefficient	I_{OUT}=50mA –40°C ≦ Topt ≦ 85°C		±100		ppm /°C
Ilim	Short Current Limit	V_{OUT}=0V		50		mA
R_{PD}	CE Pull-down Resistance		2.5	5.0	10.0	MΩ
V_{CEH}	CE Input Voltage “H”		1.5		V_{IN}	V
V_{CEL}	CE Input Voltage “L”		0.00		0.25	V
en	Output Noise	BW=10Hz~100kHz		60		µVrms

• ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE (VR2)

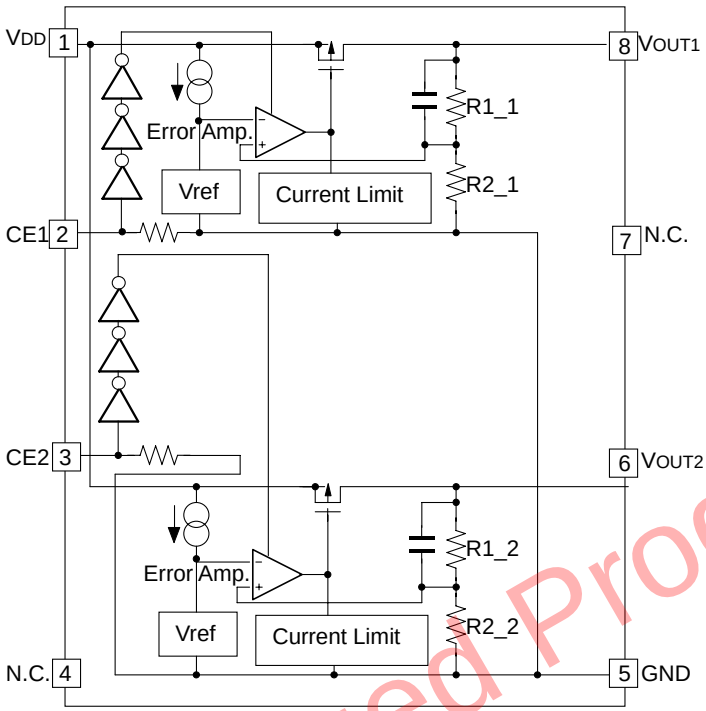
Topt = 25°C

Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)		
	Condition	Typ.	Max.
V_{OUT}=1.5	I_{OUT}=150mA	0.50	0.65
V_{OUT}=1.6		0.40	0.55
1.7 ≦ V_{OUT} ≦ 1.9		0.30	0.45
2.0 ≦ V_{OUT} ≦ 2.4		0.23	0.35
2.5 ≦ V_{OUT} ≦ 2.7		0.19	0.29
2.8 ≦ V_{OUT} ≦ 3.3		0.17	0.26
3.4 ≦ V_{OUT} ≦ 5.0		0.15	0.21

Discontinued Product

OPERATION

R5324DxxxA

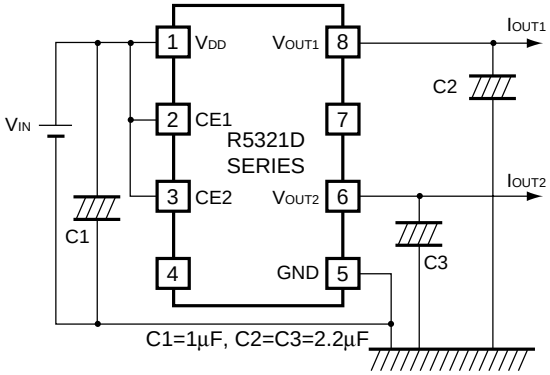


Discontinued Product

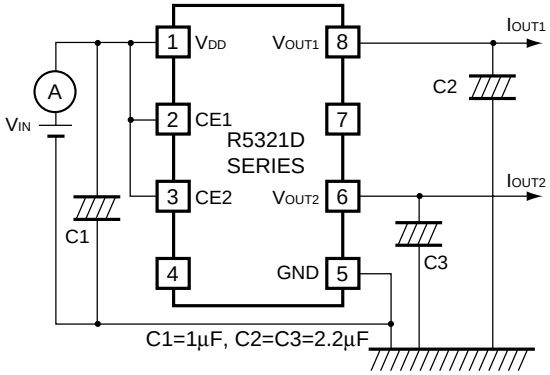
Fluctuation of each regulator's output voltage, or V_{OUT1}, V_{OUT2} is detected individually and put back to an error amplifier through feedback resistors, or R1_1, R2_1, R1_2, R2_2 and compared with a reference voltage and compensated for the result and make a constant voltage.

In each regulator, short protection is made by a current limit circuit and stand-by mode is available by a chip enable circuit.

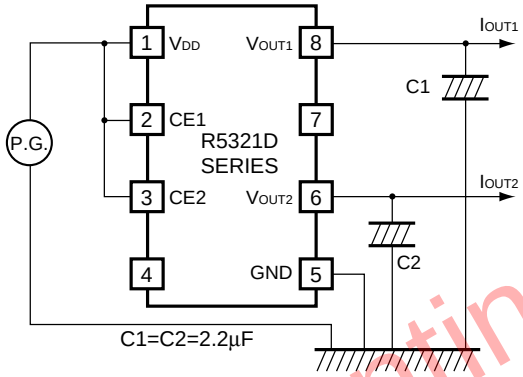
TEST CIRCUIT



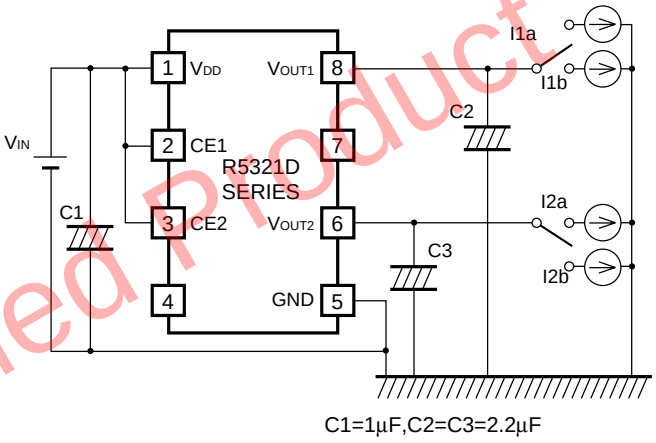
Basic Test Circuit



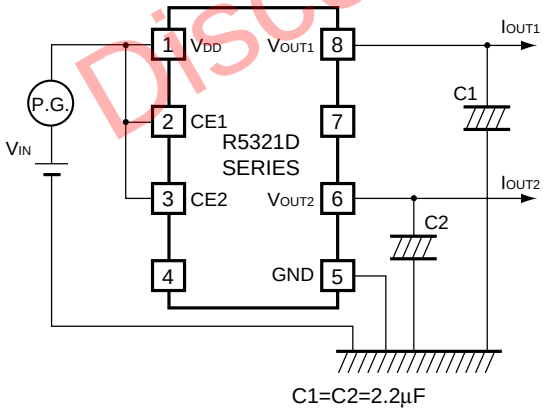
Test Circuit for Supply Current



Test Circuit for Line Transient Response



Test Circuit for Load Transient Response



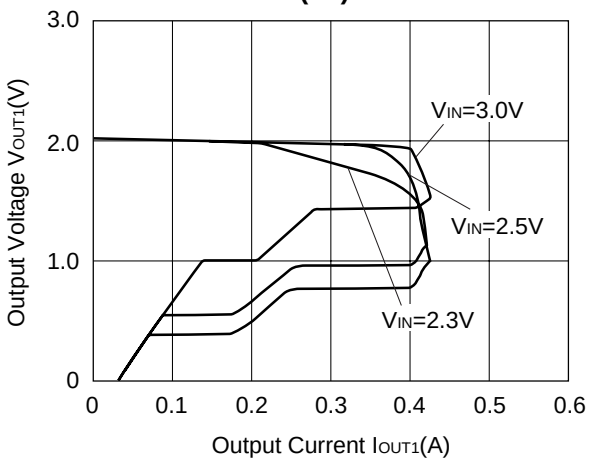
Test Circuit for Ripple Rejection

Discontinued Product

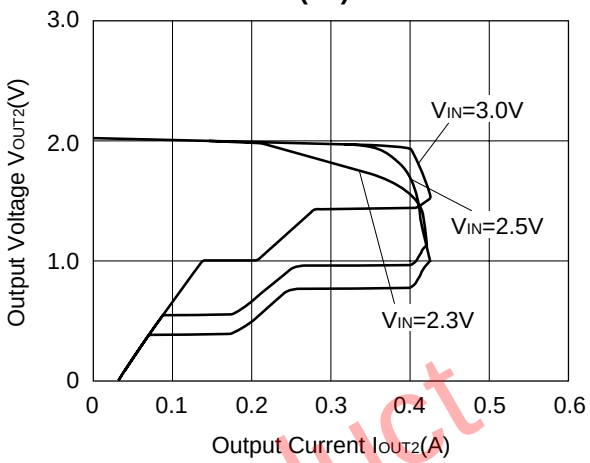
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

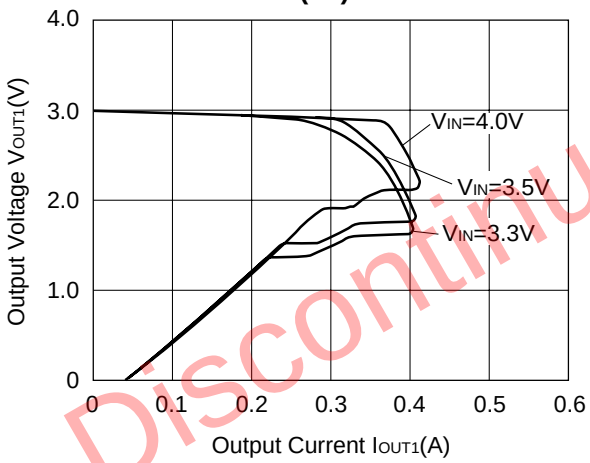
VR1 (2V)



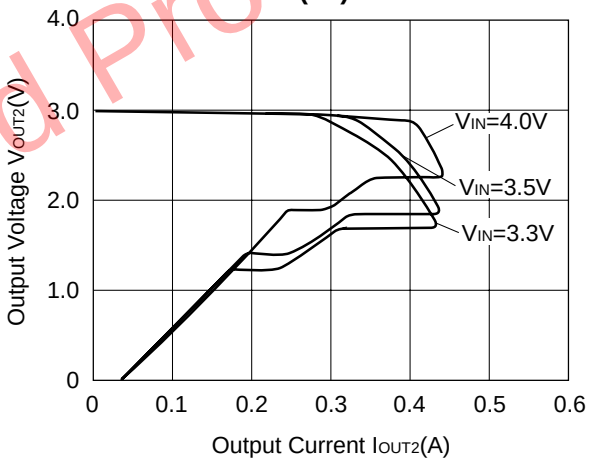
VR2 (2V)



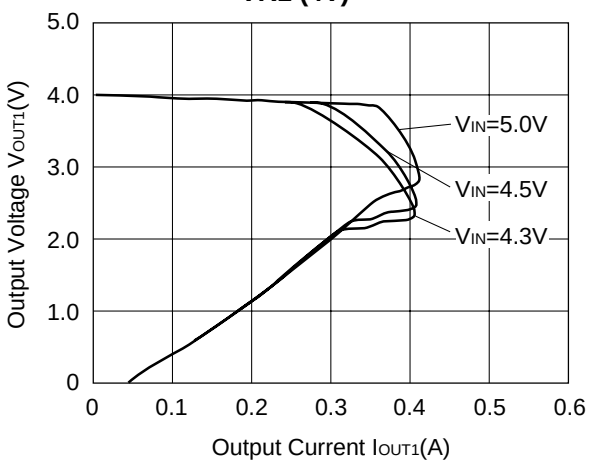
VR1 (3V)



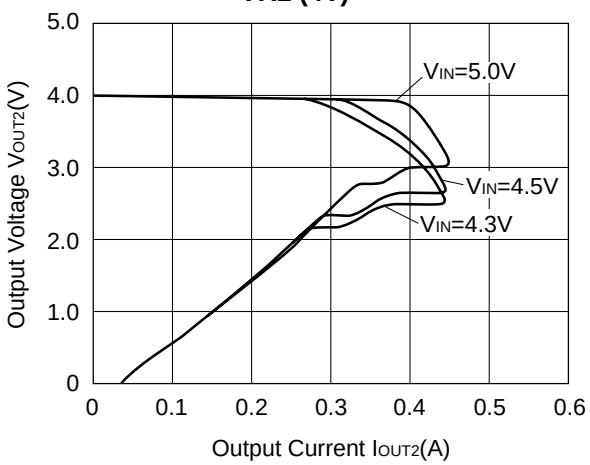
VR2 (3V)



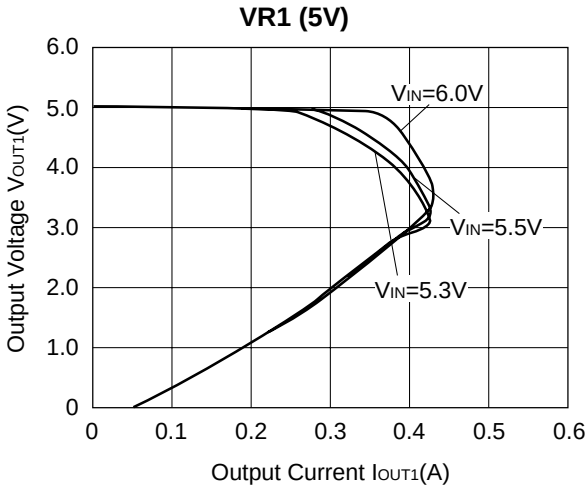
VR1 (4V)

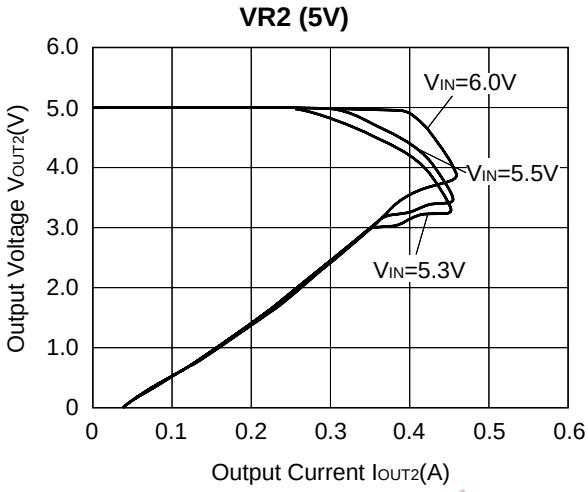


VR2 (4V)

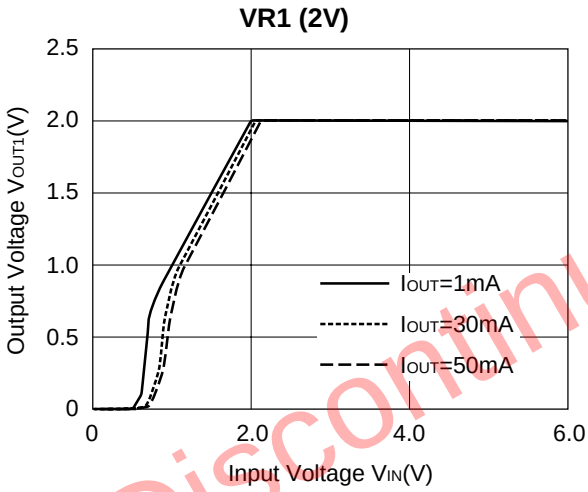


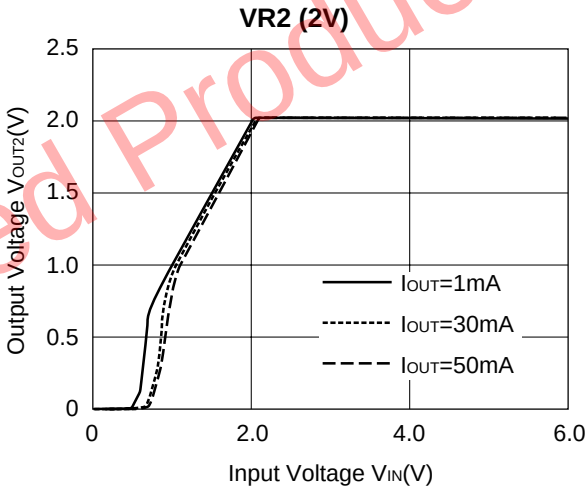
Discontinued Product

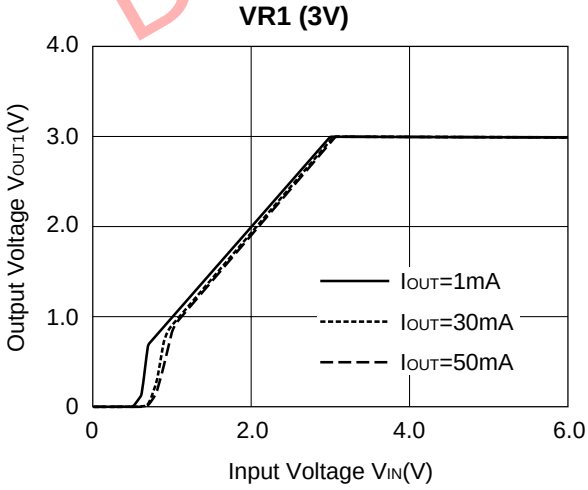


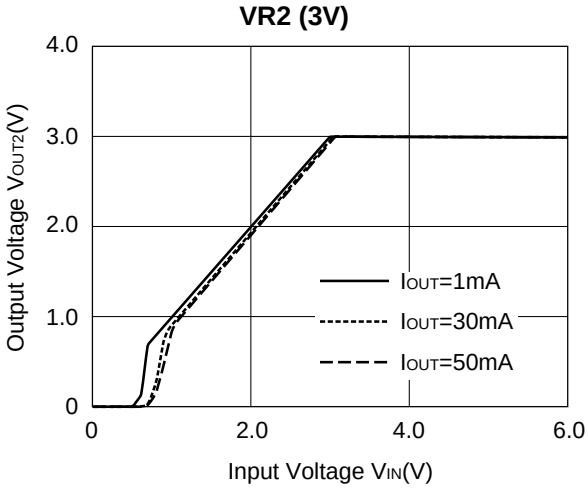


2) Output Voltage vs. Input Voltage









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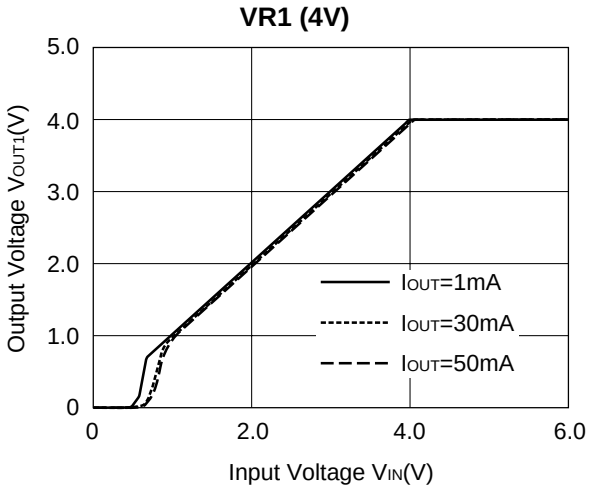
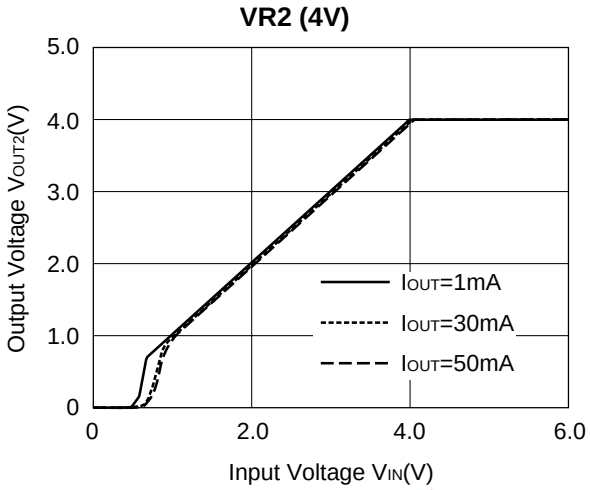
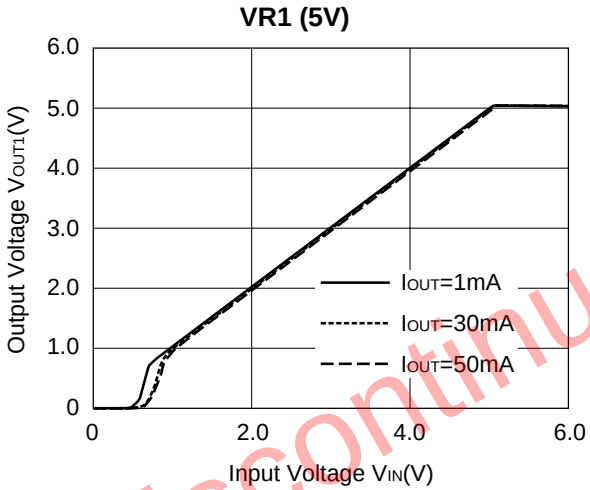
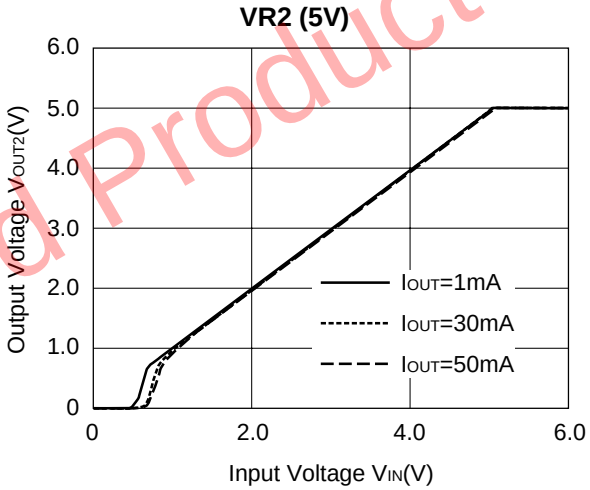


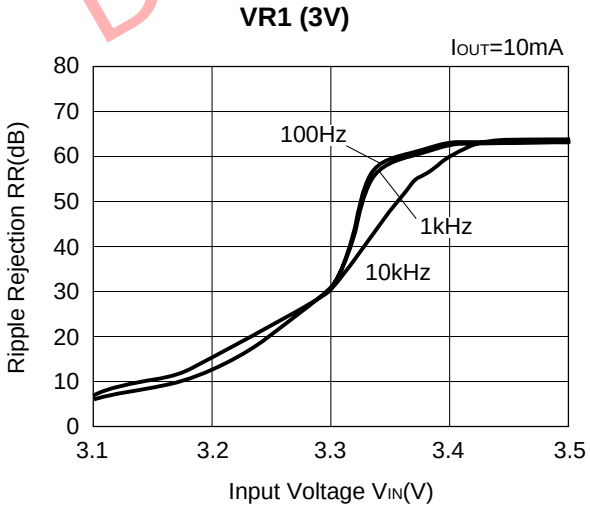


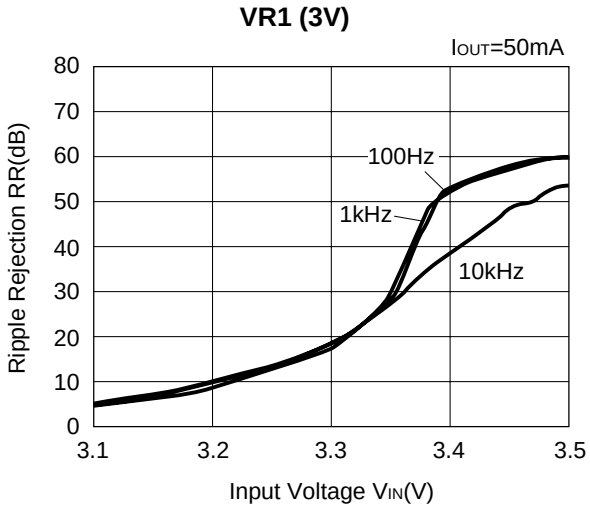


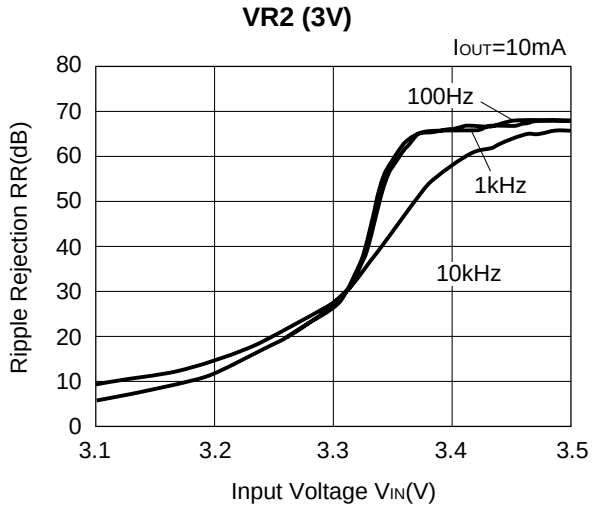


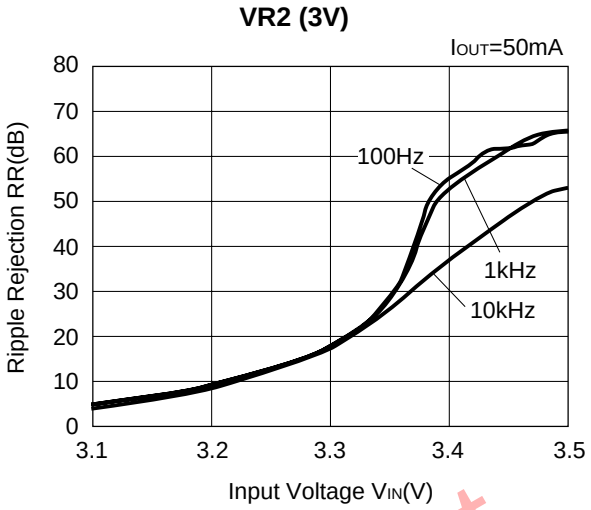
Discontinued Product

3) Ripple Rejection vs. Input Voltage (DC bias)

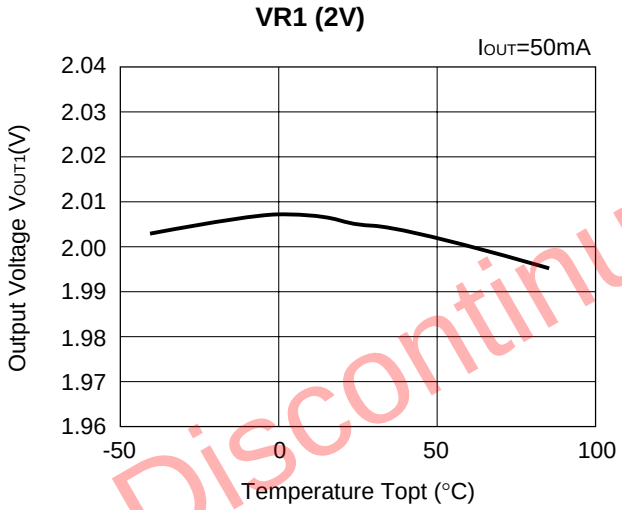


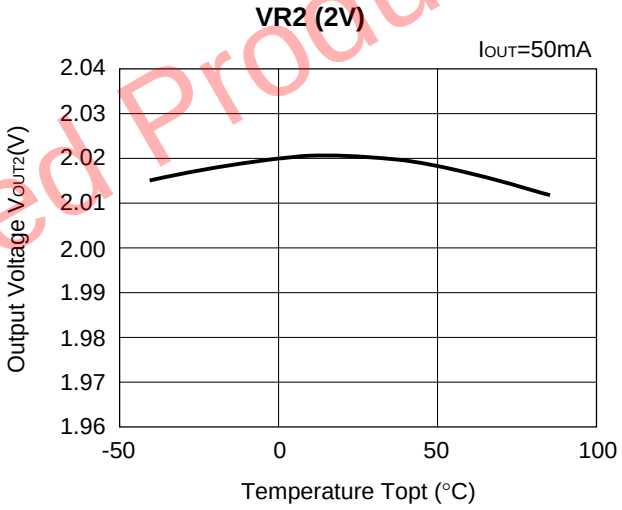


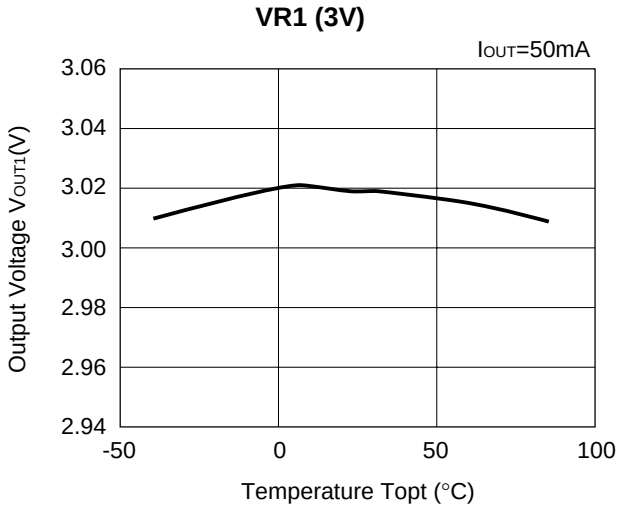


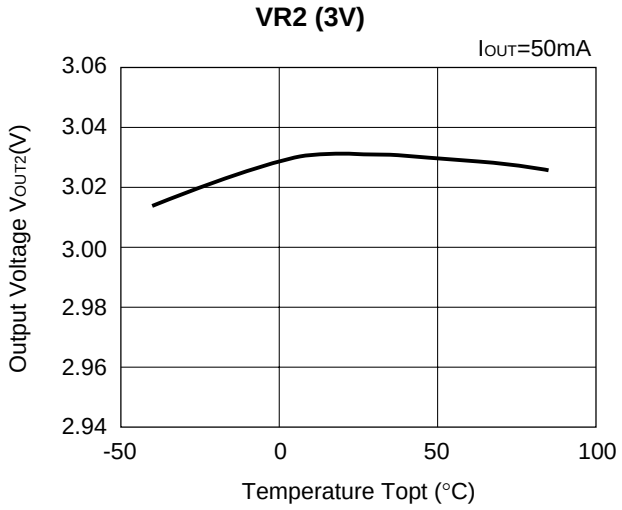


4) Output Voltage vs. Temperature









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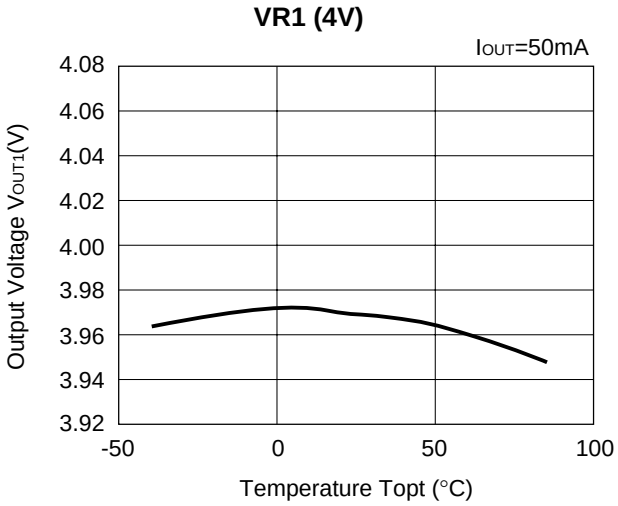
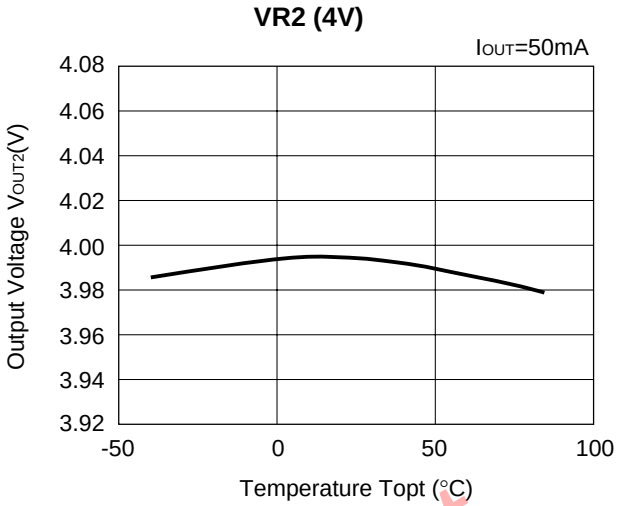
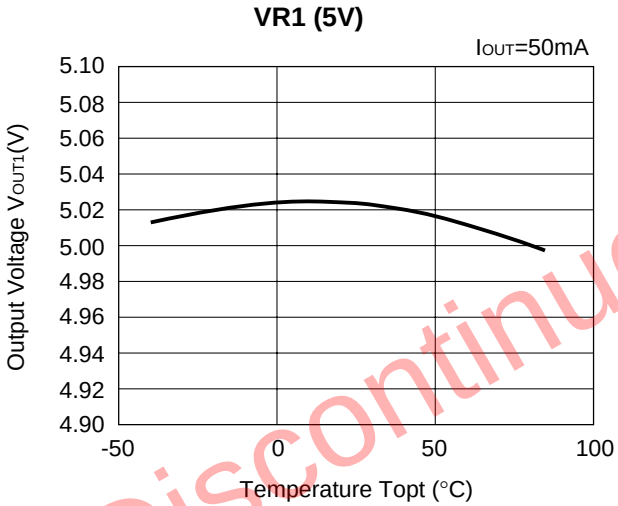
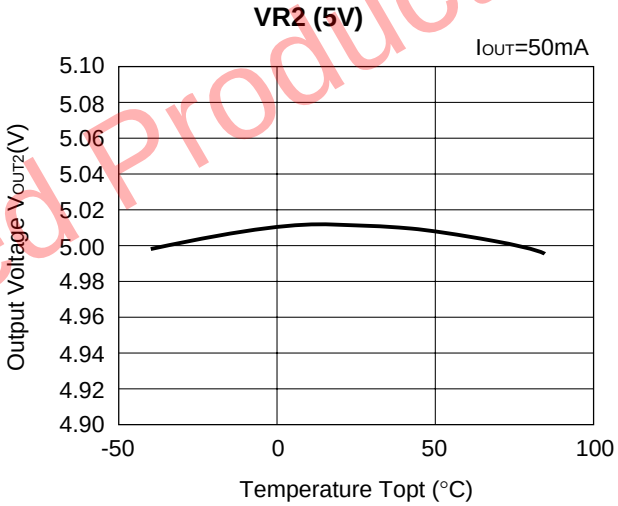


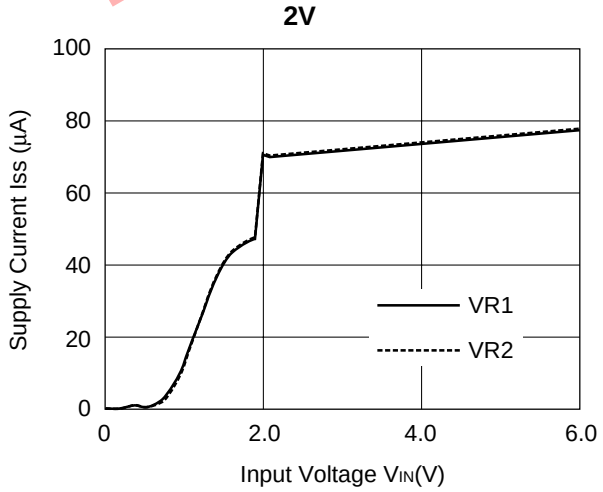


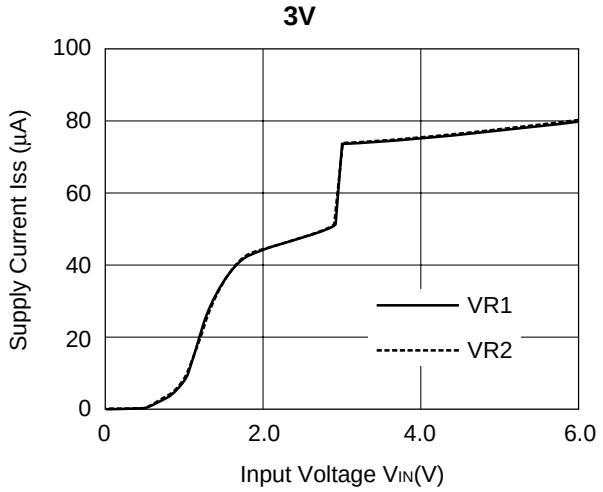


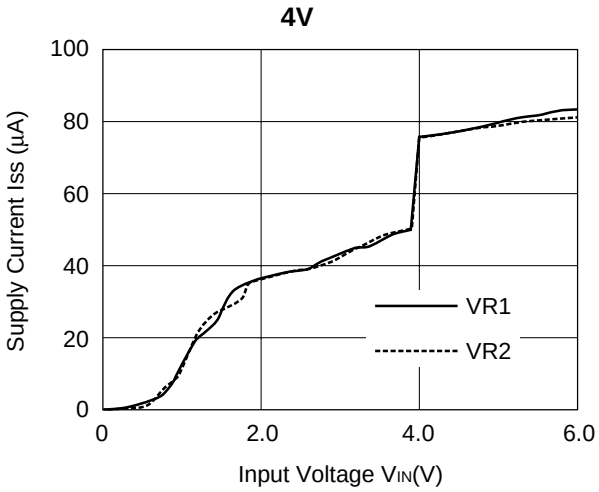


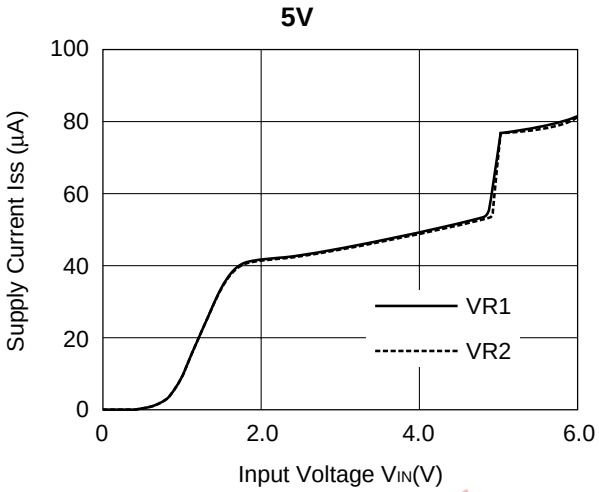
Discontinued Product

5) Input Voltage vs. Supply Current

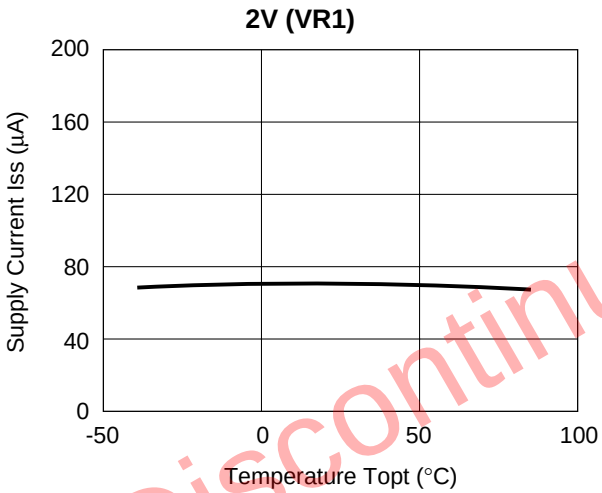


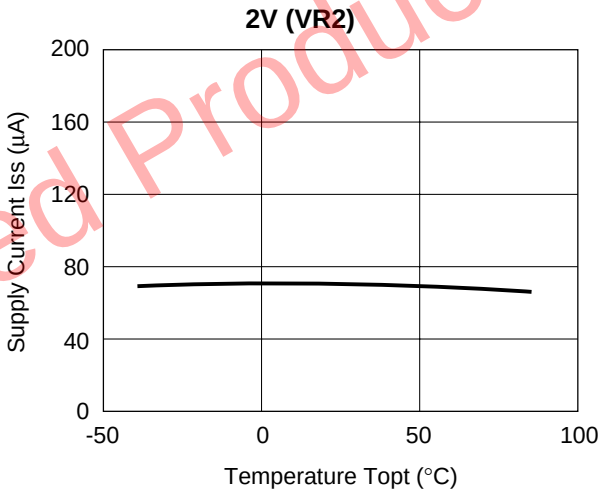


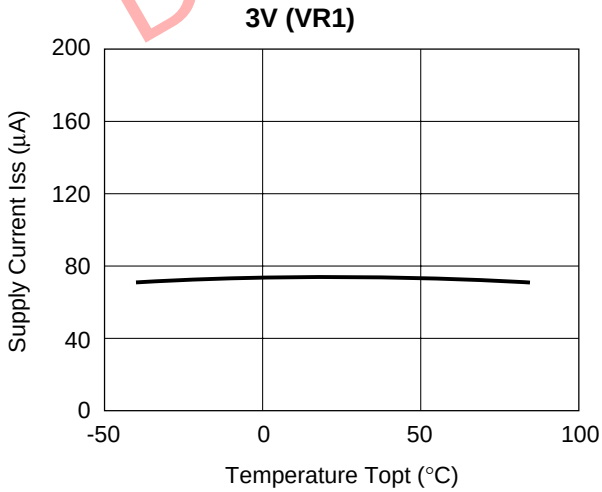


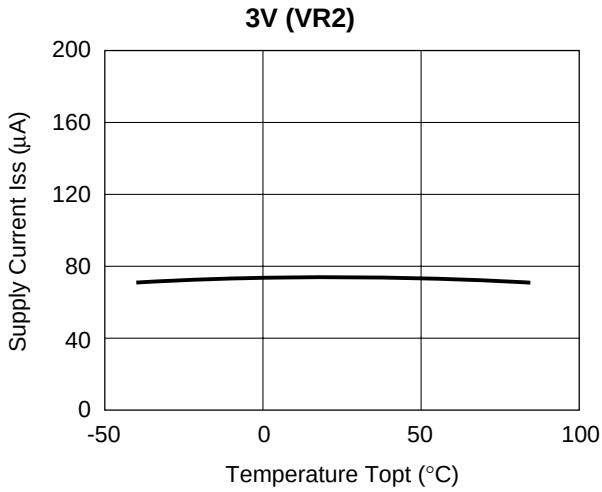


6) Supply Current vs. Temperature

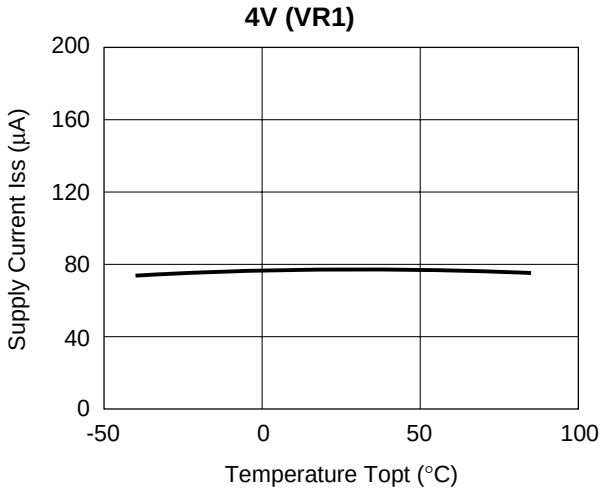


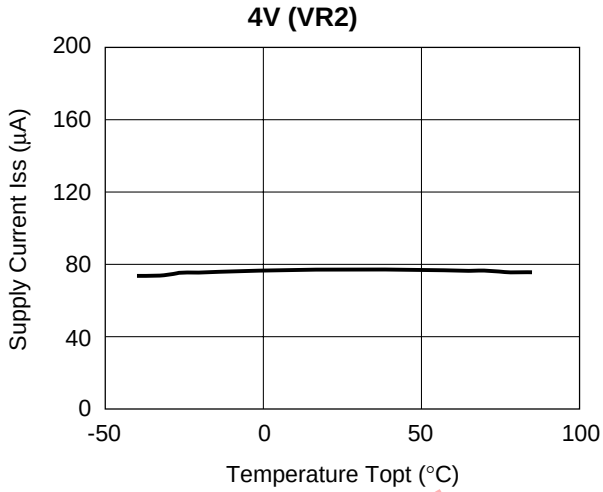


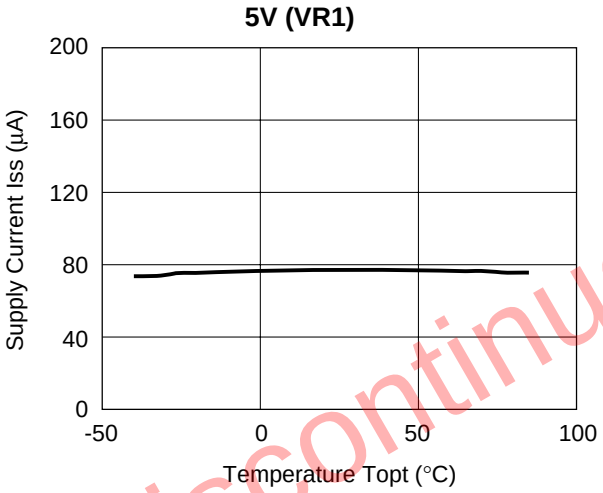


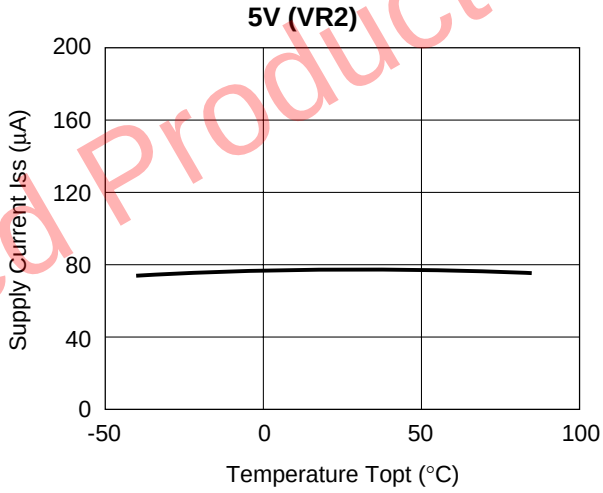


Discontinued Product



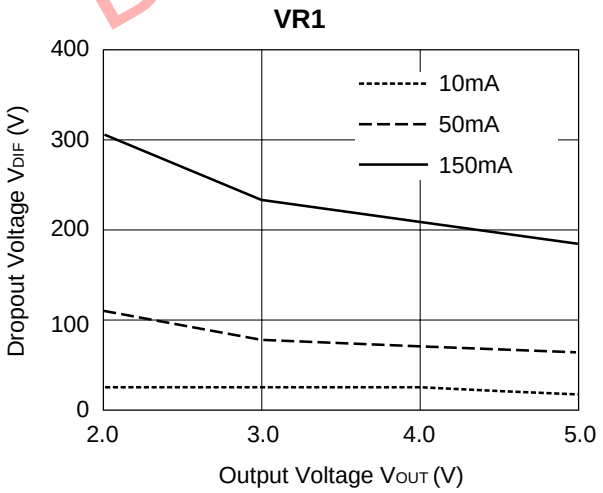


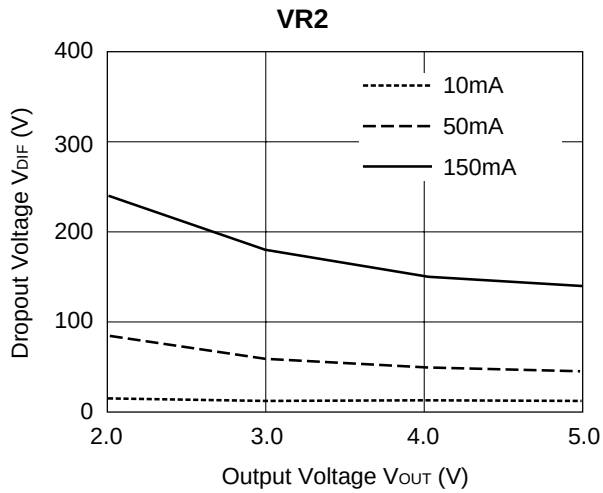




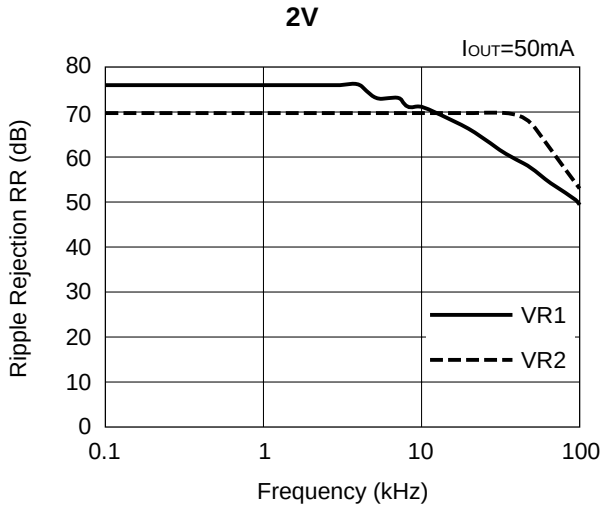
Discontinued Product

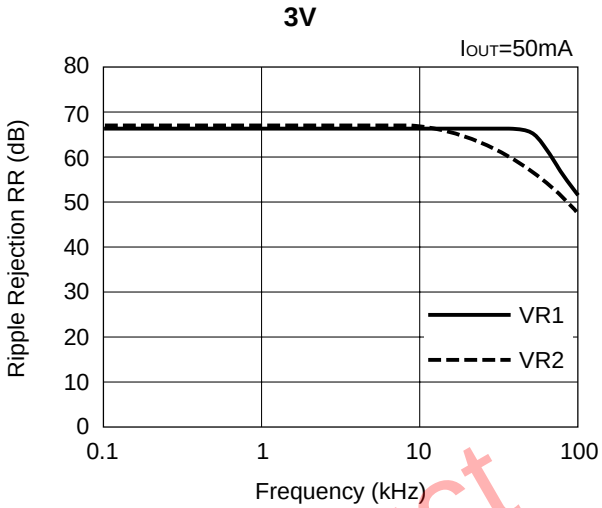
7) Dropout Voltage vs. Set Output Voltage

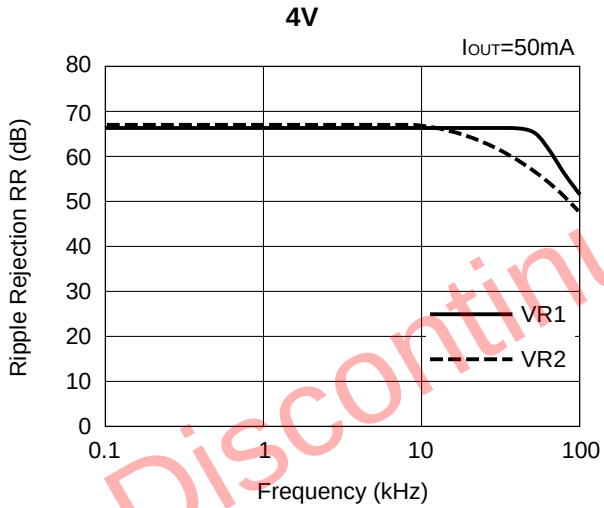


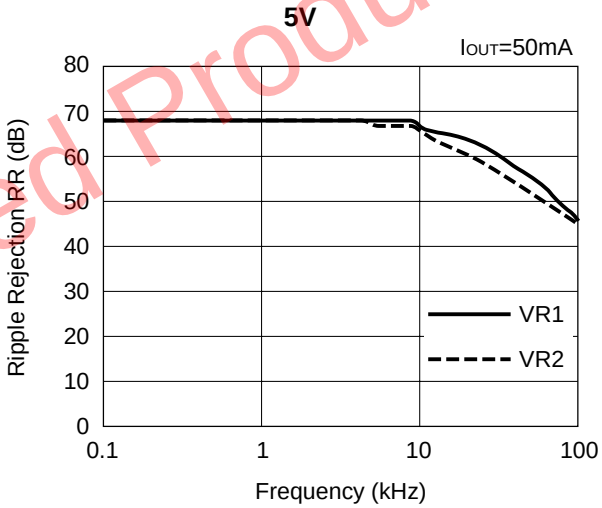


8) Ripple Rejection vs. Frequency



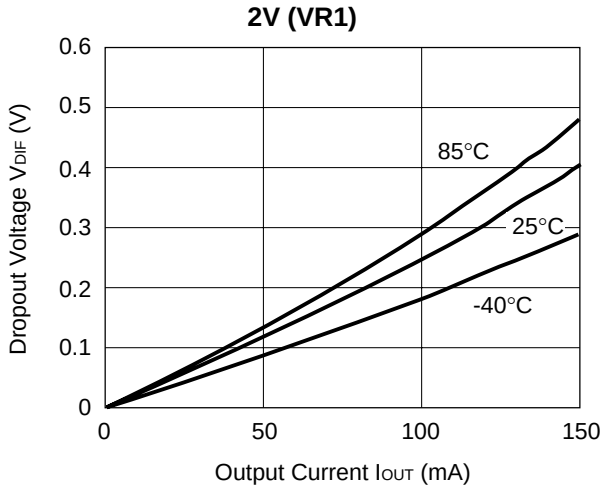


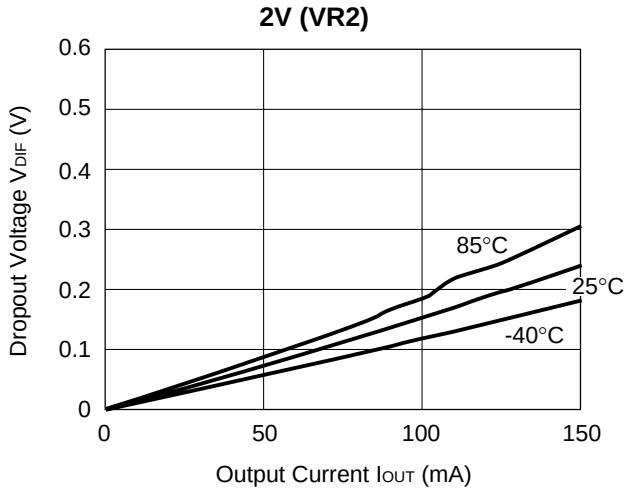


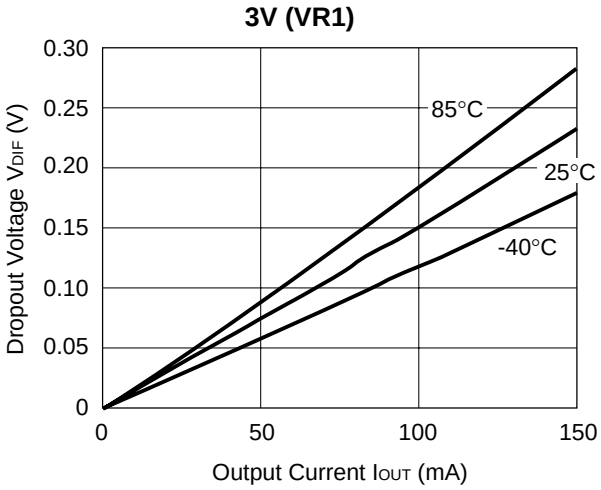


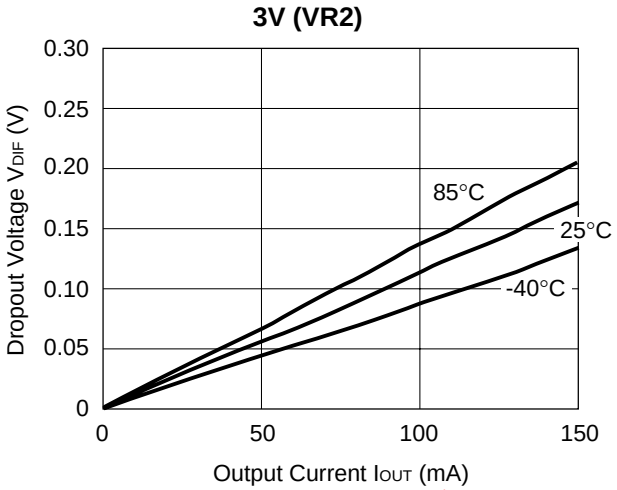
Discontinued Product

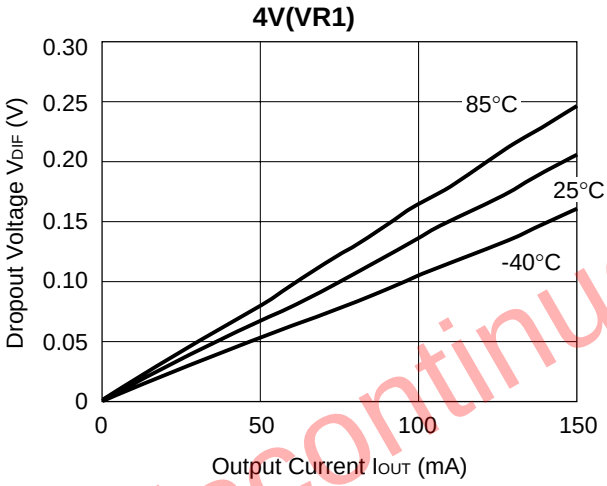
9) Dropout Voltage vs. Output Current

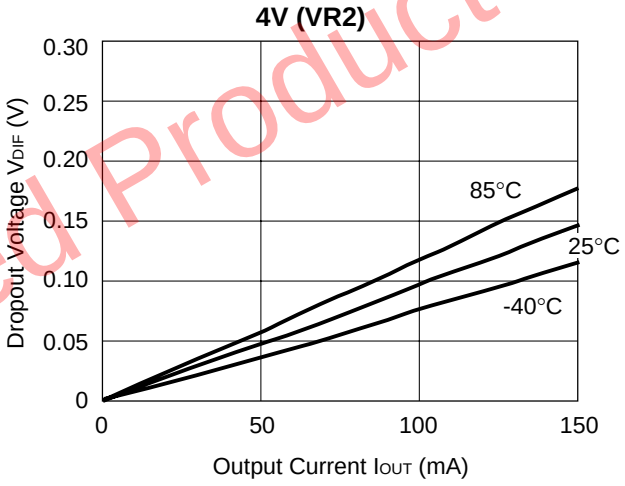


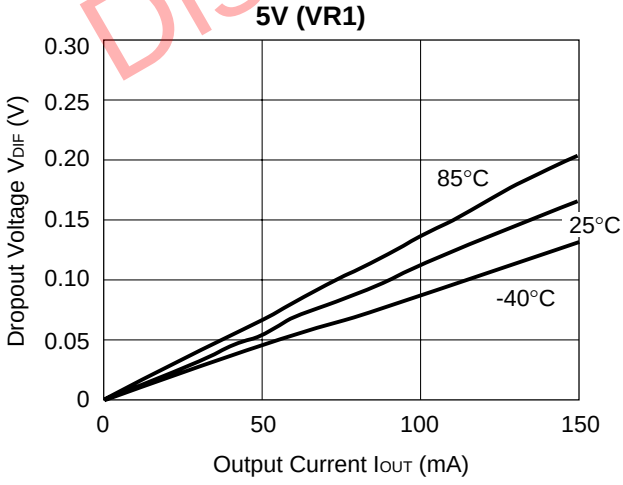


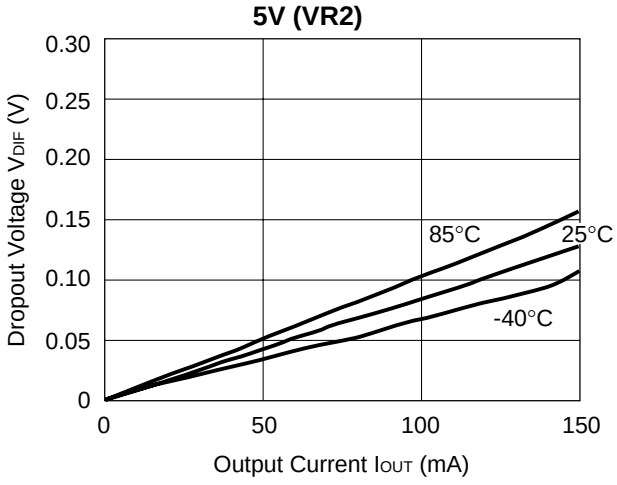










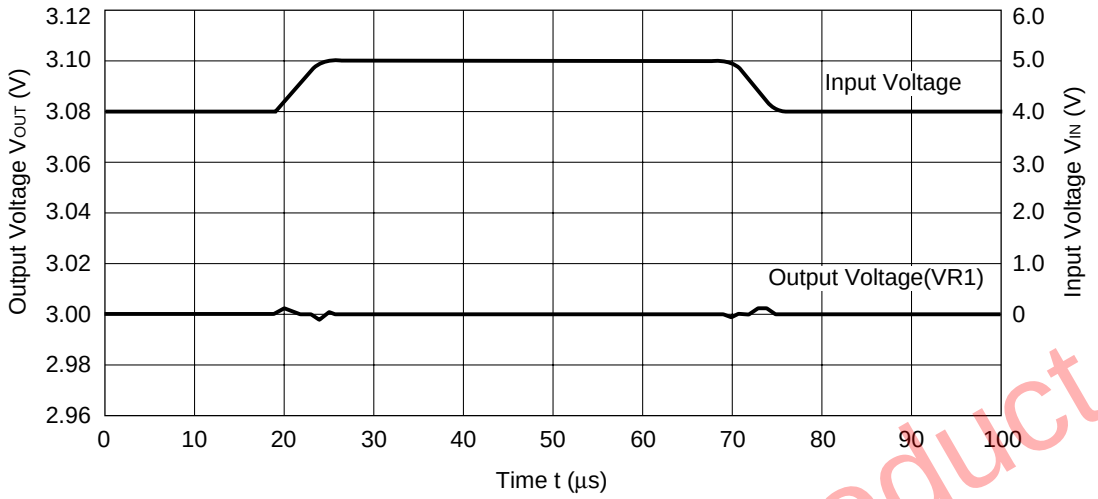


Discontinued Product

10) Line Transient Response

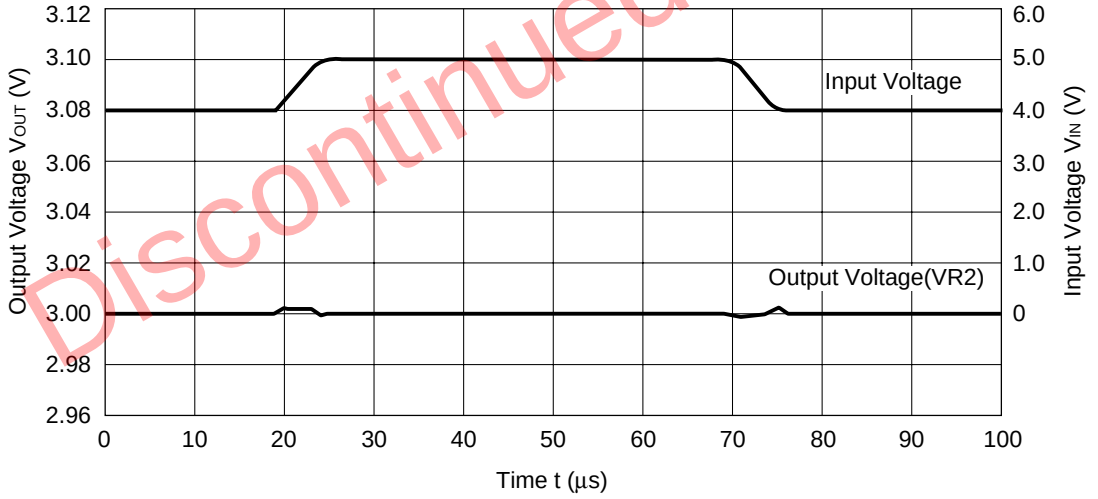
VR1 (3V)

Tr=Tf=5µs
I_{OUT1}=50mA C_{OUT1}=Tantalum 2.2µF



VR2 (3V)

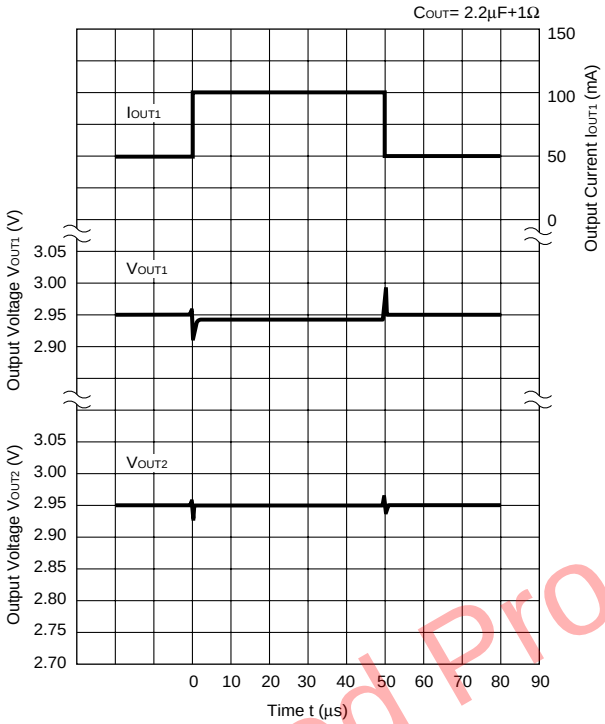
Tr=Tf=5µs
I_{OUT2}=50mA C_{OUT2}=Tantalum 2.2µF



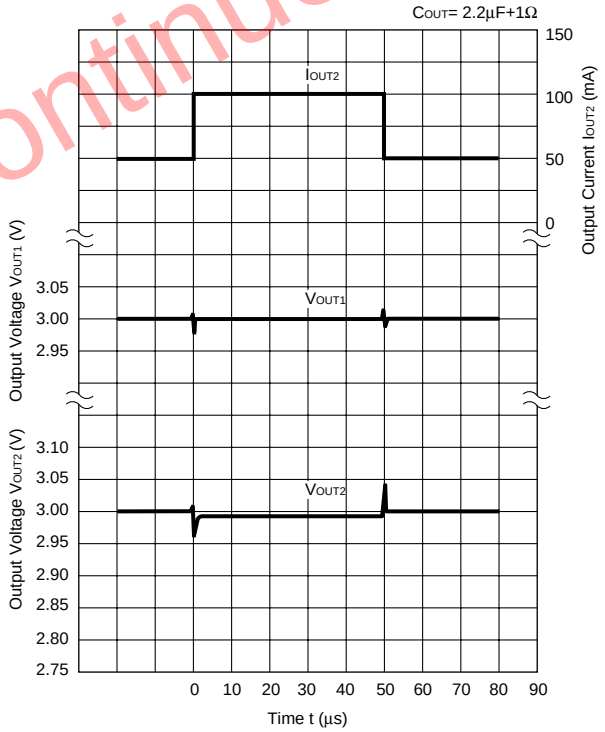
Discontinued Product

11) Load Transient Response

VR1



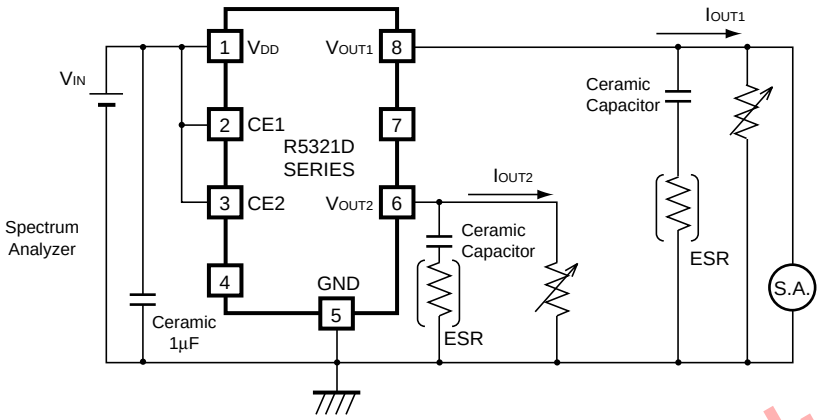
VR2



Discontinued Product

ESR vs. Output Current

To use this IC with ceramic capacitors, ESR should be set in the range of the following graphs.
Test circuit for Noise level measurement is shown below;

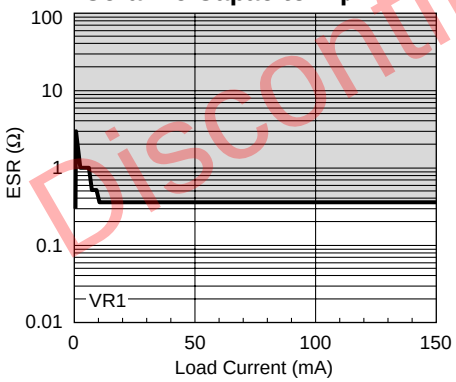


Noise level is measured with a spectrum analyzer and hatched area shows stable areas of which noise level is approximately equal or less than 40µV (Avg.). The relation between Load Current (I_{OUT}) and Equivalent Series Resistors (ESR) value of external output capacitor with the stable area is shown below;

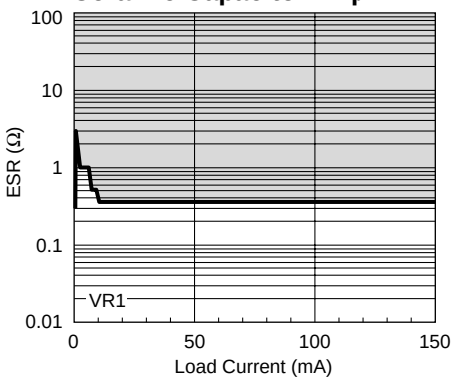
<Measuring Conditions>
Frequency Band: 10Hz to 1MHz
Temperature: 25°C

Discontinued Product

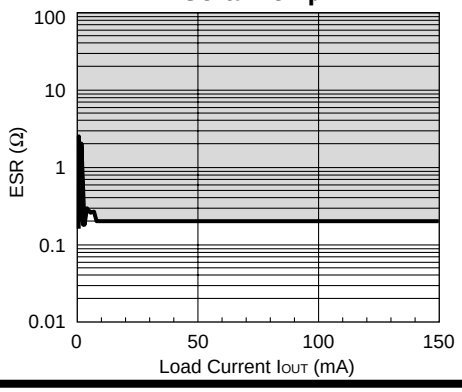
Ceramic Capacitor 1µF



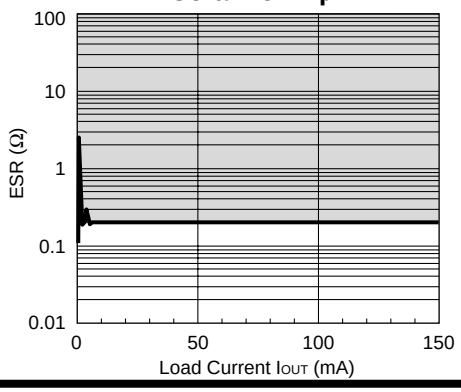
Ceramic Capacitor 2.2µF



VR2 Ceramic 1µF



VR2 Ceramic 2.2µF



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