CMOS Multi-LDOs for RF Unit
R5320G Series

■ OUTLINE

The R5320G Series are Multi voltage regulator ICs with high output voltage accuracy, extremely low supply current, low noise, low ON-resistance and high ripple rejection by CMOS process. The R5320G Series contain three voltage regulators. Each of these voltage regulators in the R5320G 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 R5320G Series are with low dropout voltage, excellent load transient response and line transient response, thus the R5320G 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 are SSOP8G package, high density mounting of the ICs on boards is possible.

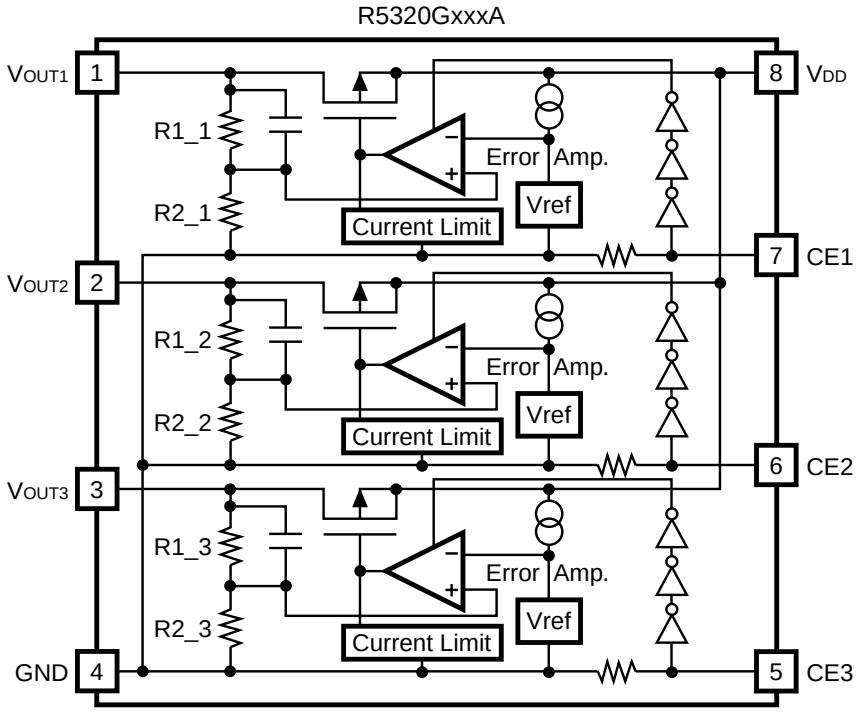
■ FEATURES

- Ultra-Low Supply Current.....TYP. 70μA:VR1, TYP. 70μA:VR2, TYP. 70μA:VR3
- Low Standby Current .....TYP. 0.1μA:VR1, TYP. 0.1μA:VR2, TYP. 0.1μA:VR3
- Low Dropout Voltage .....TYP. 0.22V (VR1) 0.16V (VR2,VR3)
  I_{OUT}=150mA:VR1,80mA:VR2,VR3 (ex. for 3.0V Output Type)
- High Ripple Rejection.....TYP.70dB (f=1kHz)
- High Output Voltage Accuracy.....±2.0%
- Excellent Load Transient Response and Line Transient Response
- Small Package .....8-Pin SSOP (0.65mm pitch)
- Input Voltage .....Max. 6V

■ 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 DIAGRAM



■ SELECTION GUIDE

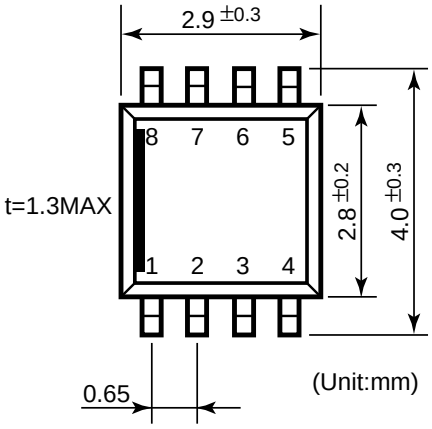
The selection can be made by designating the part number as shown below :

R5320Gxxxx-TR ←Part Number
↑ ↑
a b

Code	Descriptions
a	Serial Number for Voltage setting from 001
b	Alphabetical Code for Mask Versions A: Standard

■ PIN CONFIGURATION

SSOP8G PACKAGE



■ PIN DESCRIPTIONS

Pin NO.	Symbol	Descriptions
1	V_{OUT1}	Output Pin
2	V_{OUT2}	Output Pin
3	V_{OUT3}	Output Pin
4	GND	Ground Pin
5	CE3	Chip Enable Pin
6	CE2	Chip Enable Pin
7	CE1	Chip Enable Pin
8	V_{DD}	Input Pin

■ ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	7	V
CE	Input Voltage (CE Pin)	-0.3 ~ VIN+0.3	V
V_{OUT}	Output Voltage	-0.3 ~ VIN+0.3	V
I_{OUT1}	Output Current (V_{OUT1})	200	mA
I_{OUT2}	Output Current (V_{OUT2})	100	mA
I_{OUT3}	Output Current (V_{OUT3})	100	mA
PD	Power Dissipation	300	mW
Topt	Operating Temperature Range	-40 ~ 85	°C
Tstg	Storage Temperature Range	-55 ~ 125	°C

■ ELECTRICAL CHARACTERISTICS

● R5320GxxxA

VR1 Topt=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{OUT}	Output Voltage	V_{IN}-V_{OUT}=1.0V 1mA≤I_{OUT}≤30mA	×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}≤6V I_{OUT}=30mA		0.05	0.20	%/V
RR	Ripple Rejection	f=1kHz, sinusoidal 1Vp-p V_{IN}-V_{OUT}=1.0V		70		dB
V_{IN}	Input Voltage				6	V
$\Delta V_{OUT}/\Delta T$	Output Voltage Temperature Coefficient	I_{OUT}=50mA -40°C≤Topt≤85°C		±100		ppm/°C
I_{LIM}	Short Current Limit	V_{OUT}=0V		50		mA
R_{DN}	CE Pull-down Resistance		2.5	5	10	MΩ
V_{CEH}	CE Input Voltage "H"		1.5		V_{IN}	V
V_{CEL}	CE Input Voltage "L"		0		0.25	V
en	Output Noise	BW=10Hz-100kHz		60		µVrms

● ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE(VR1)

Topt=25°C

Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)		
	Conditions	TYP.	MAX.
2.0≤V_{OUT}≤2.4	I_{OUT}=150mA	0.35	0.55
2.5≤V_{OUT}≤2.7		0.3	0.45
2.8≤V_{OUT}≤3.3		0.22	0.35
3.4≤V_{OUT}≤5.0		0.2	0.3

VR2 Topt=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{OUT}	Output Voltage	V_{IN}-V_{OUT}=1.0V 1mA≤I_{OUT}≤30mA	×0.98		×1.02	V
I_{OUT}	Output Current	V_{IN}-V_{OUT}=1.0V	80			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	V_{IN}-V_{OUT}=1.0V 1mA≤I_{OUT}≤50mA		12	40	mV
V_{DIF}	Dropout Voltage	Refer to Electrical Characteristics 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}≤6V I≤=30mA		0.05	0.20	V
RR	Ripple Rejection	f=1kHz, sinusoidal 1Vp-p V_{IN}-V_{OUT}=1.0V		70		DB
V_{IN}	Input Voltage				6	V
$\Delta V_{OUT}/\Delta T$	Output Voltage Temperature Coefficient	I_{OUT}=30mA -40°C≤Topt≤85°C		±100		ppm/°C
I_{LIM}	Short Current Limit	V_{OUT}=0V		50		mA
R_{DN}	CE Pull-down Resistance		2.5	5	10	MΩ
V_{CEH}	CE Input Voltage "H"		1.5		V_{IN}	V
V_{CEL}	CE Input Voltage "L"		0		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)		
	Conditions	TYP.	MAX.
2.0≤V_{OUT}≤2.4	I_{OUT}=80mA	0.22	0.38
2.5≤V_{OUT}≤2.7		0.2	0.38
2.8≤V_{OUT}≤3.3		0.16	0.24
3.4≤V_{OUT}≤5.0		0.12	0.24

VR3 Topt=25°C

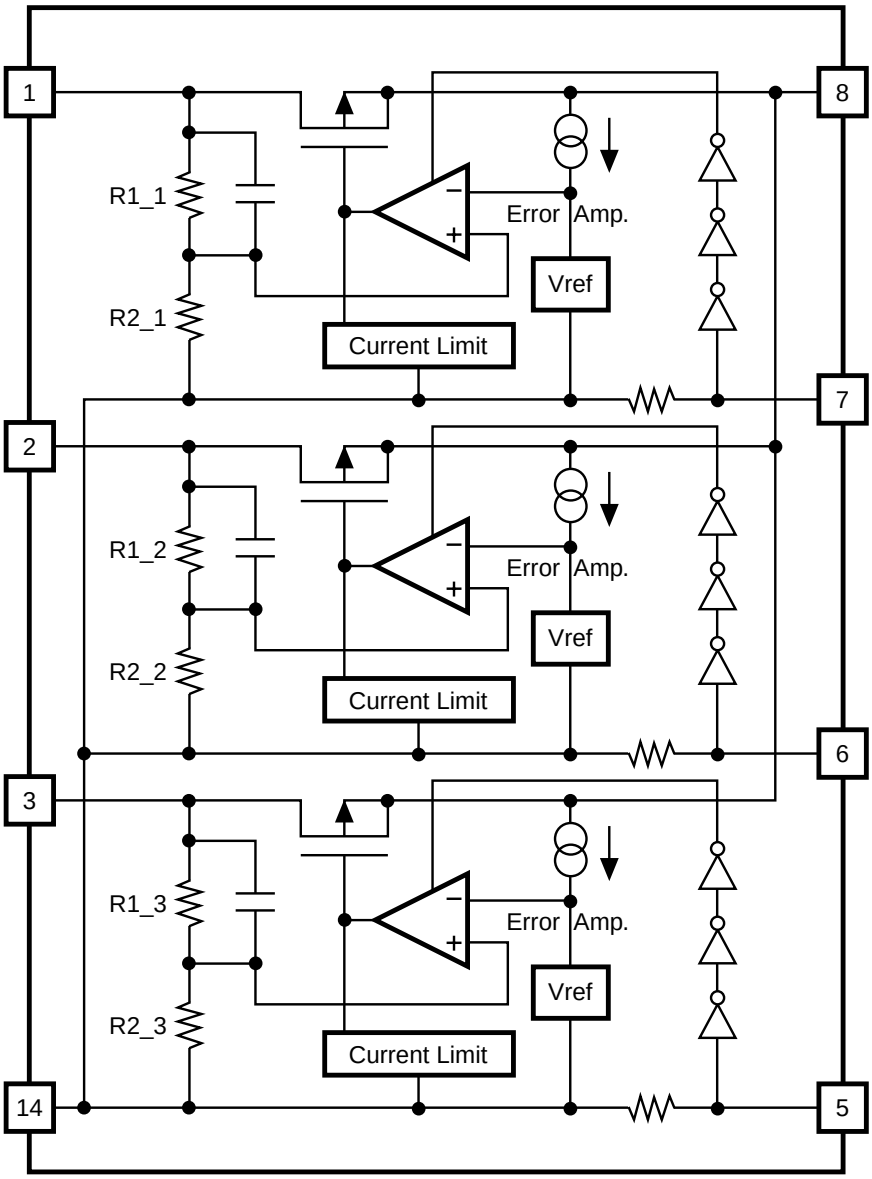
Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{OUT}	Output Voltage	V_{IN}-V_{OUT}=1.0V 1mA≤ I_{OUT} ≤30mA	×0.98		×1.02	V
I_{OUT}	Output Current	V_{IN}-V_{OUT}=1.0V	80			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	V_{IN}-V_{OUT}=1.0V 1mA≤I_{OUT}≤50mA		12	40	mV
V_{DIF}	Dropout Voltage	Refer to Electrical Characteristics by Dropout Voltage (VR3)				
I_{SS}	Supply Current	V_{OUT}+0.5V≤V_{IN}≤6V I_{OUT}=30mA		70	120	µA
Istandby	Supply Current (Standby)	f=1kHz, sinusoidal 1Vp-p V_{IN}-V_{OUT}=1.0V		0.1	1.0	µA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation			0.05	0.20	%/V
RR	Ripple Rejection	I_{OUT}=30mA -40°C≤Topt≤85°C		70		dB
V_{IN}	Input Voltage	V_{OUT}=0V			6	V
$\Delta V_{OUT}/\Delta T$	Output Voltage Temperature Coefficient			±100		ppm/°C
I_{LIM}	Short Current Limit	BW=10Hz-100KHz		50		mA
R_{DN}	CE Pull-down Resistance		2.5	5	10	MΩ
V_{CEH}	CE Input Voltage "H"		1.5		V_{IN}	V
V_{CEL}	CE Input Voltage "L"		0		0.25	V
en	Output Noise			60		µVrms

● ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE (VR3)

Topt=25°C

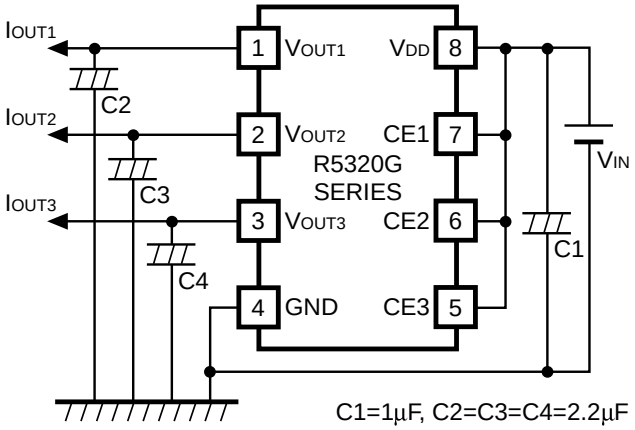
Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)		
	Conditions	TYP.	MAX.
2.0≤V_{OUT}≤2.4	I_{OUT}=80mA	0.24	0.38
2.5≤V_{OUT}≤2.7		0.22	0.28
2.8≤V_{OUT}≤3.3		0.16	0.24
3.4≤V_{OUT}≤5.0		0.15	0.24

■ OPERATION

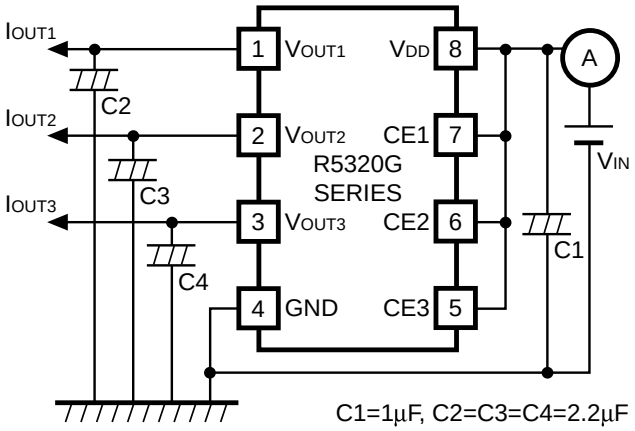


Fluctuation of each regulator'fs output voltage, or $V_{OUT1, 2, 3}$ is detected individually and put back to an error amplifier through feedback resistors, or R1_1, R2_1, R1_2, R2_2, R1_3, R2_3 and compared with a reference voltage and compensated for the result and make a constant voltage.
In each regulator, short protection is made by a current limit circuit and stand-by mode is available by a chip enable circuit.

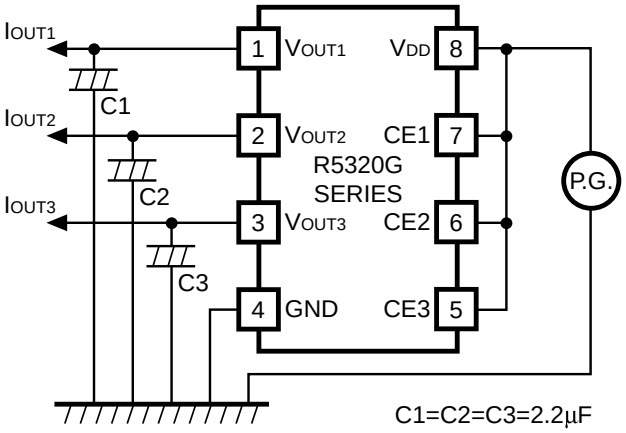
■ TEST CIRCUITS



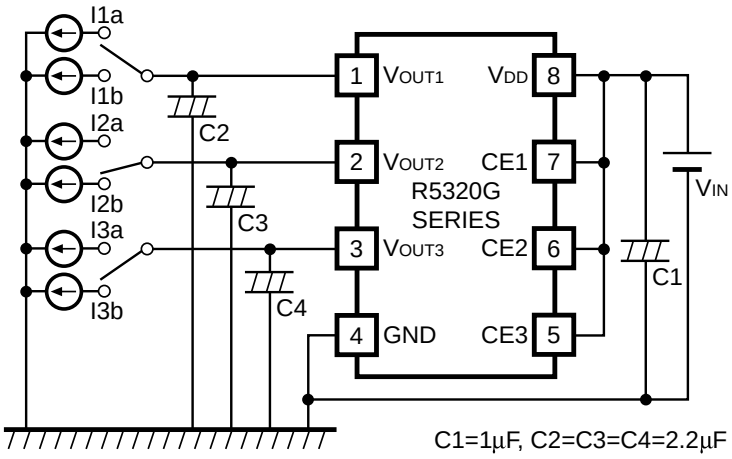
Basic Test Circuit



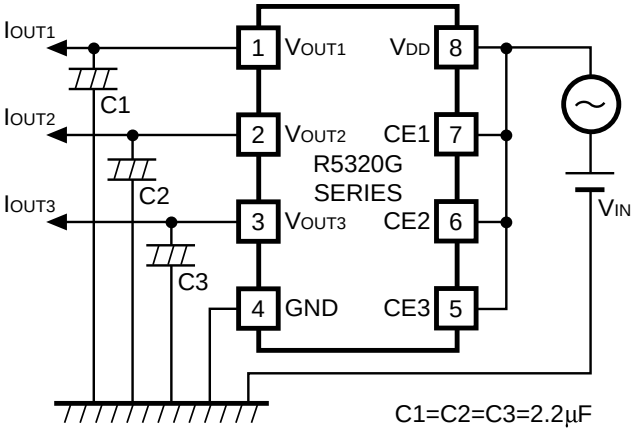
Test Circuit for Supply Current



Test Circuit for Line Transient Response



Test Circuit for Load Transient Response

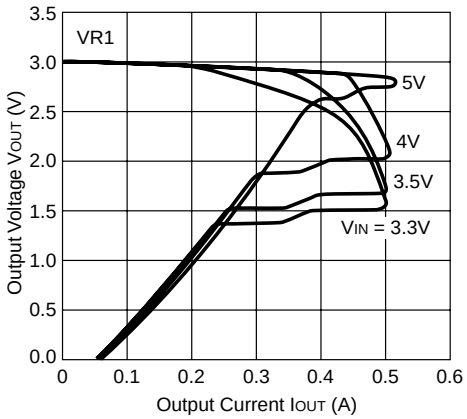


Test Circuit for Ripple Rejection

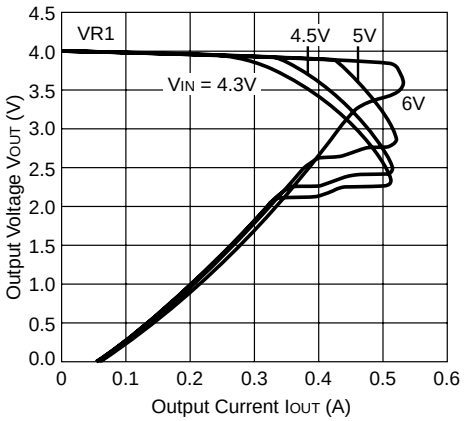
■ TYPICAL CHARACTERESTICS

1) Output Voltage vs. Output Current

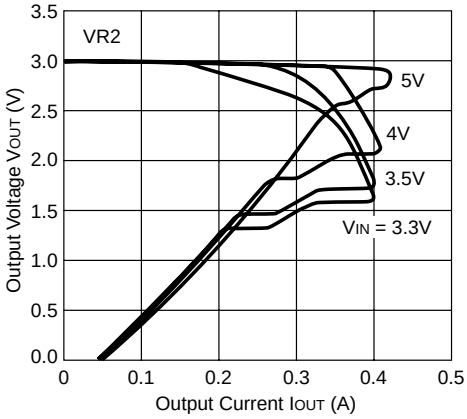
3V



4V



3V



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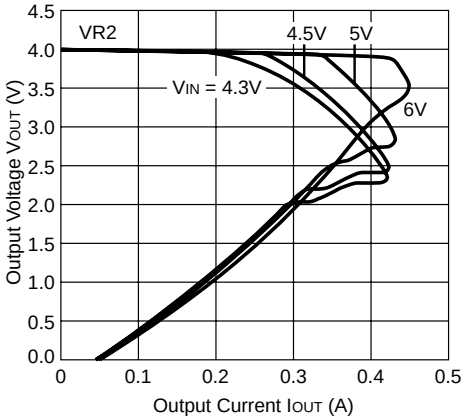
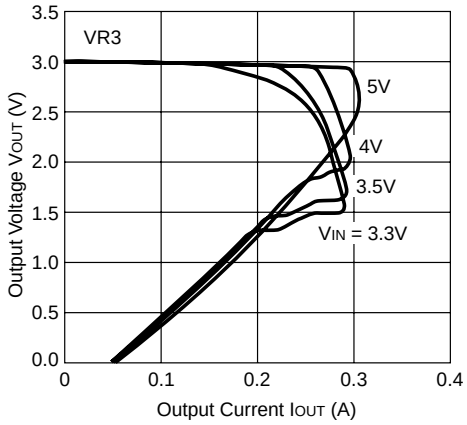


3V



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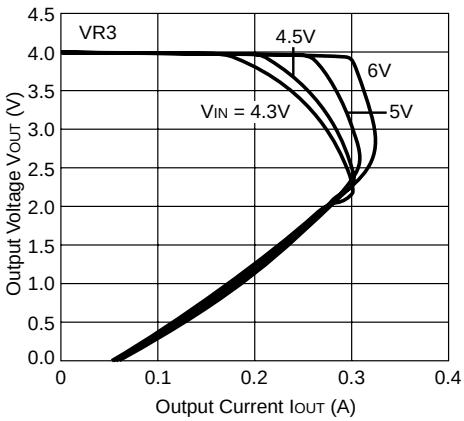
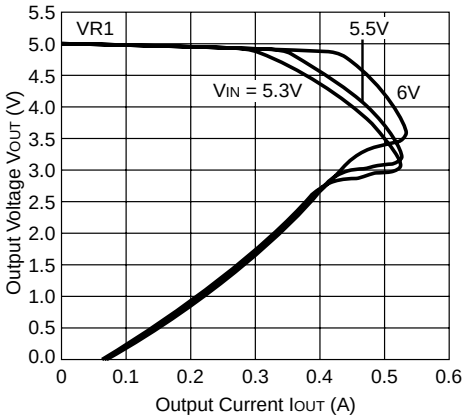
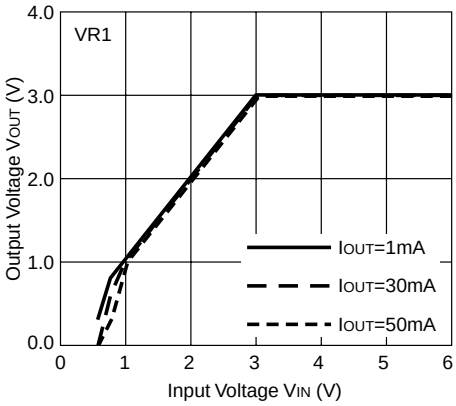


2) Output Voltage vs. Input Voltage

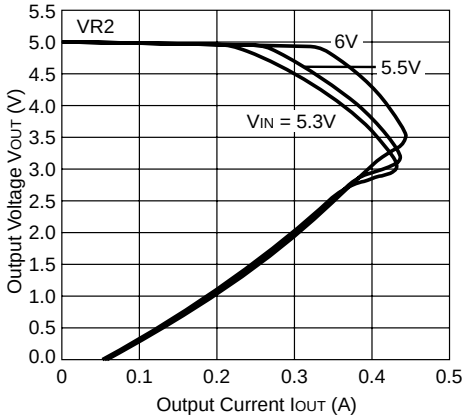
5V



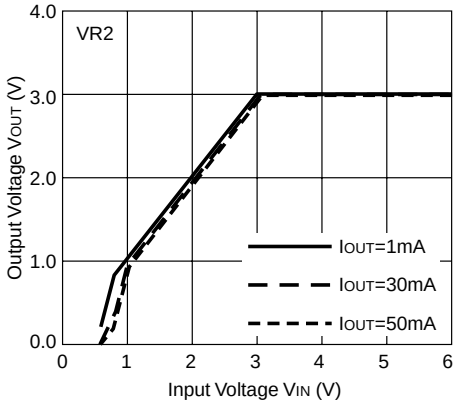
3V



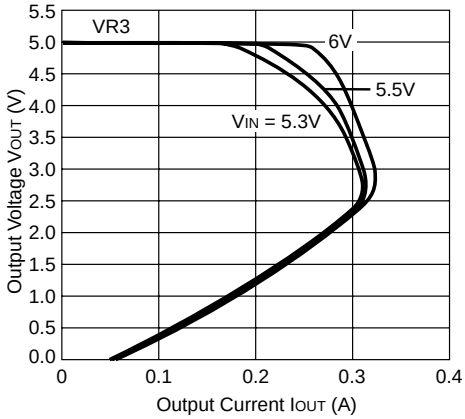
5V



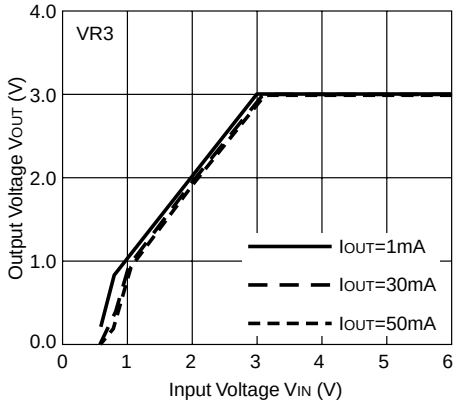
3V

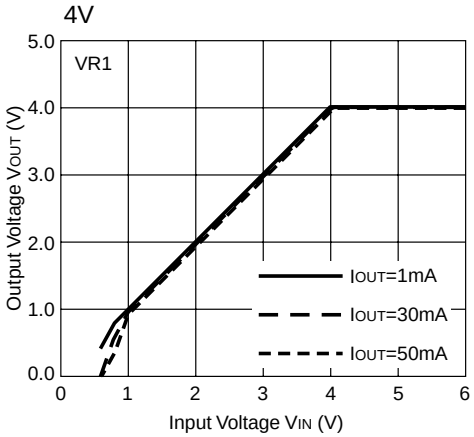


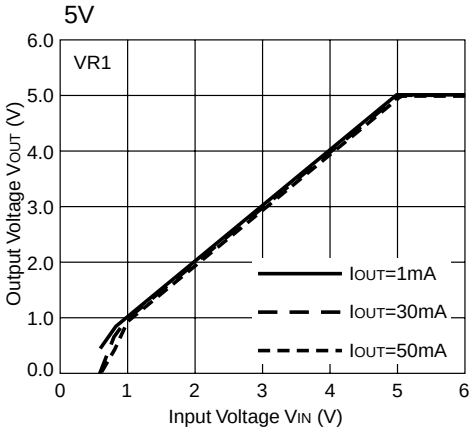
5V

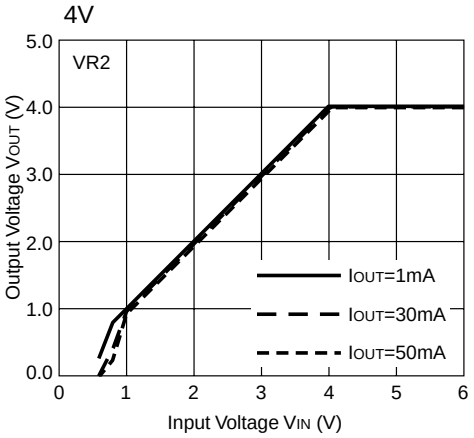


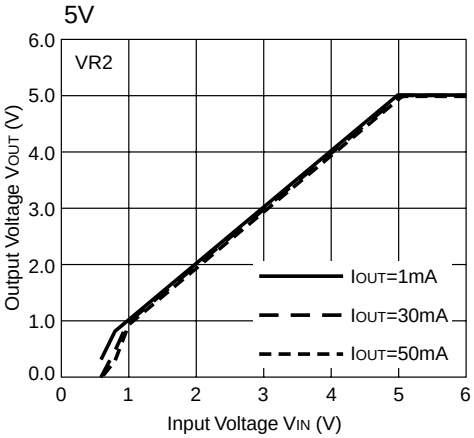
3V

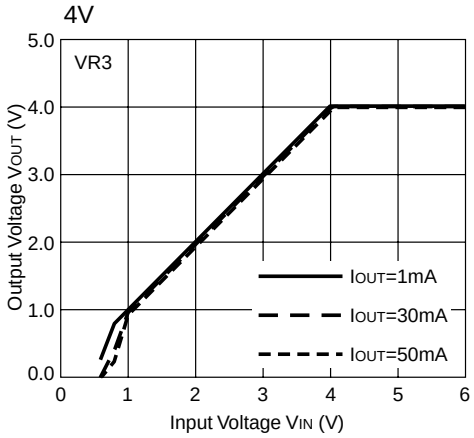


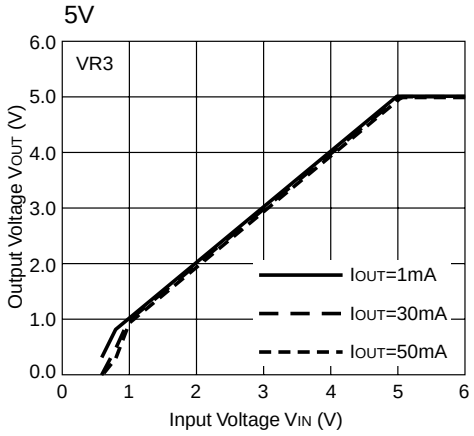








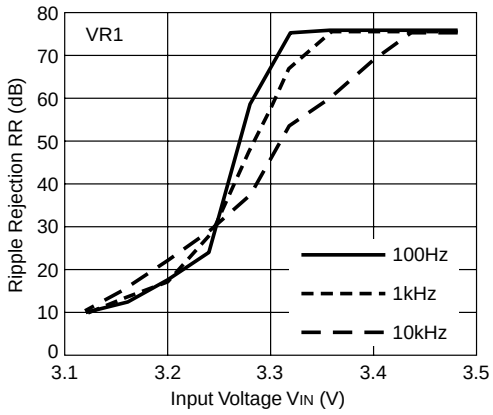


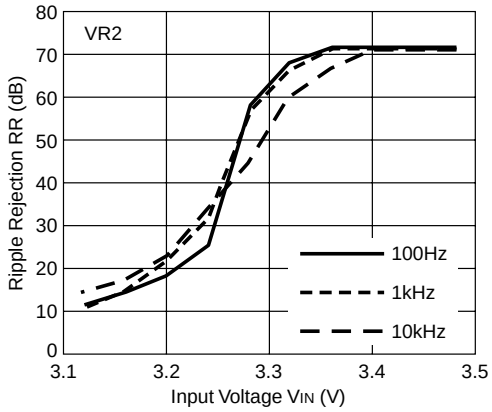


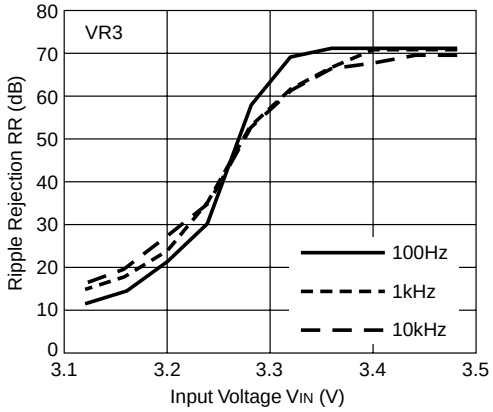
3) Ripple Rejection vs. Input Voltage (DC Bias)

3V

I_{OUT} = 10mA
C_{OUT} = tantal 2.2 µF

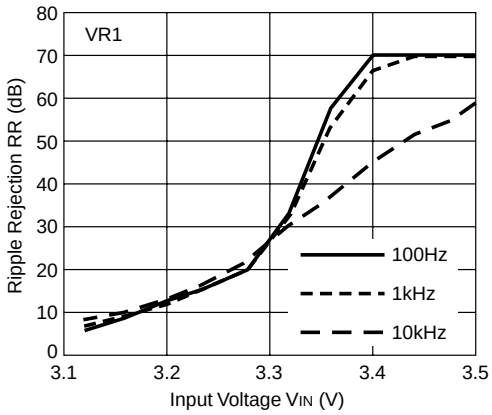


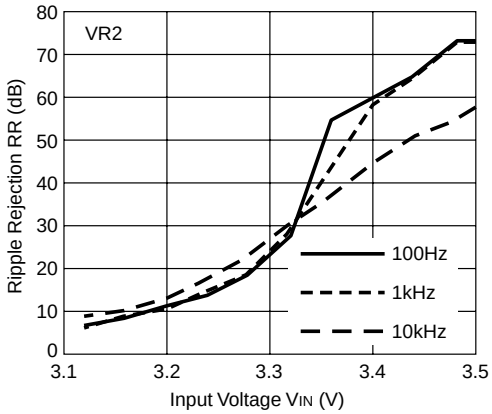


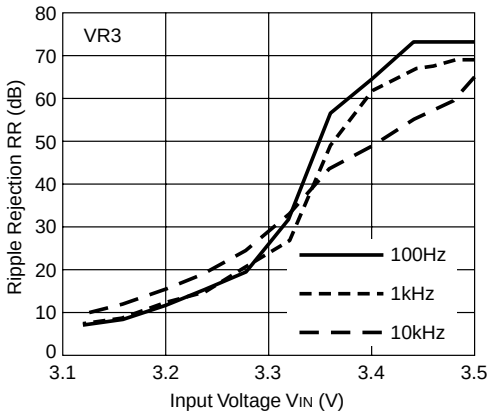


3V

I_{OUT} = 50mA
C_{OUT} = tantal 2.2 µF

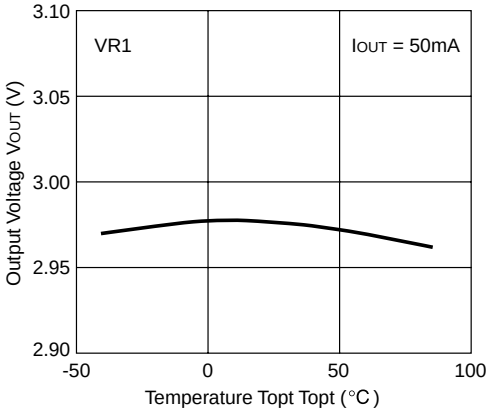




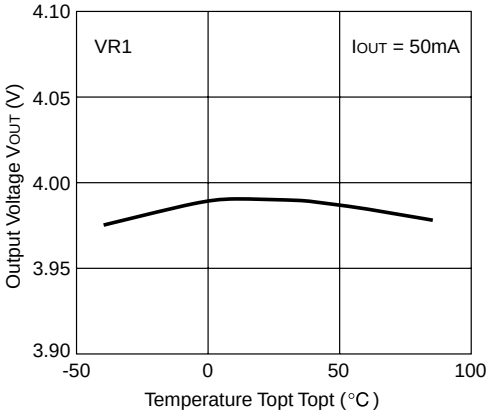


4) Output Voltage vs. Temperature

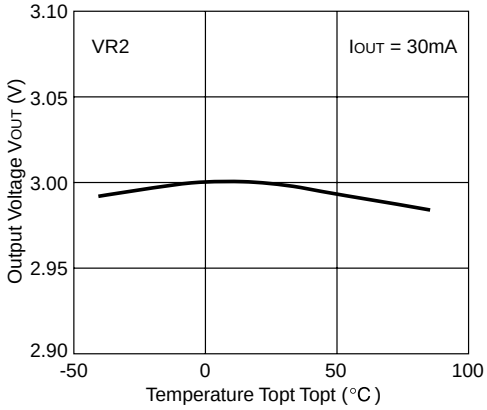
3V



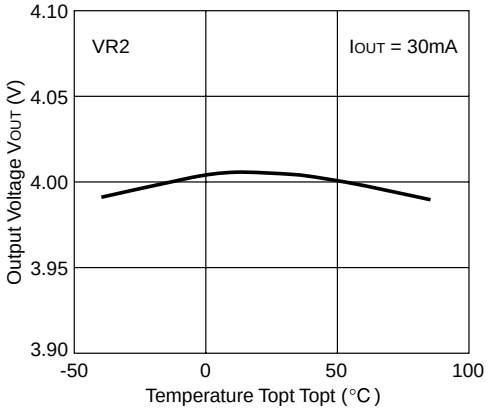
4V



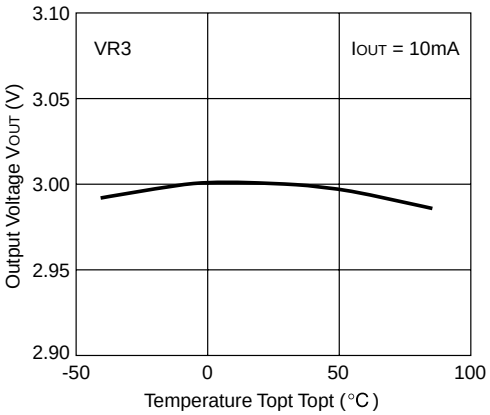
3V



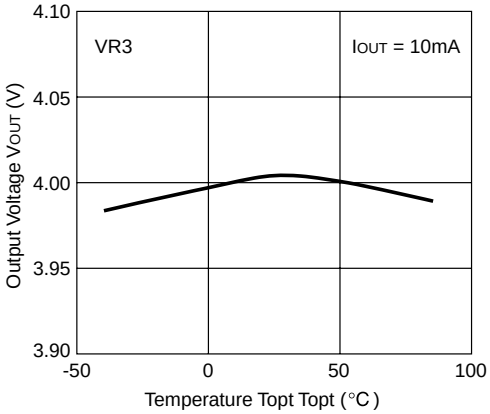
4V



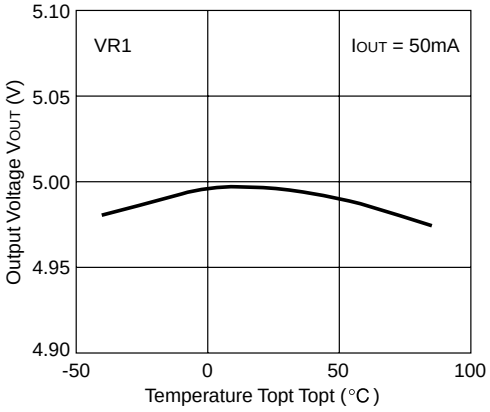
3V



4V

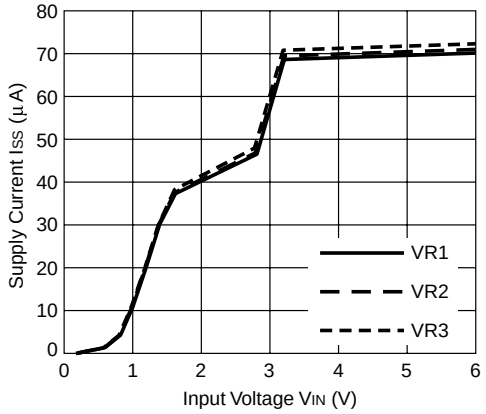


5V

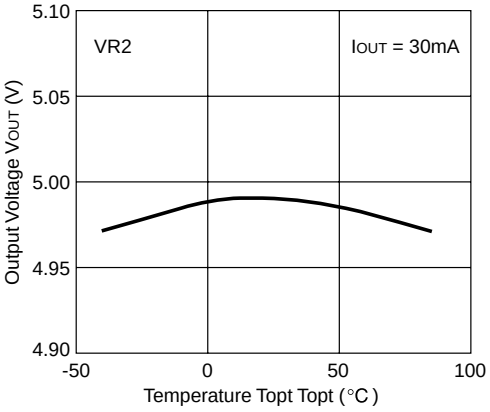


5) Supply Current vs. Input Voltage

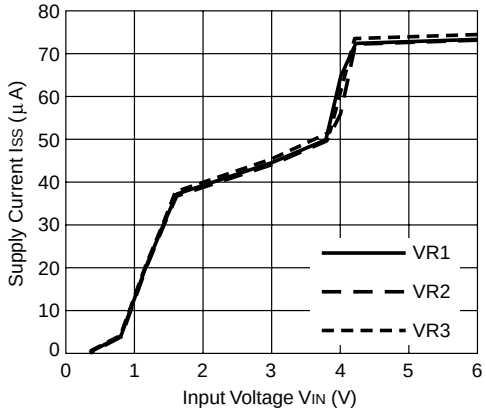
3V



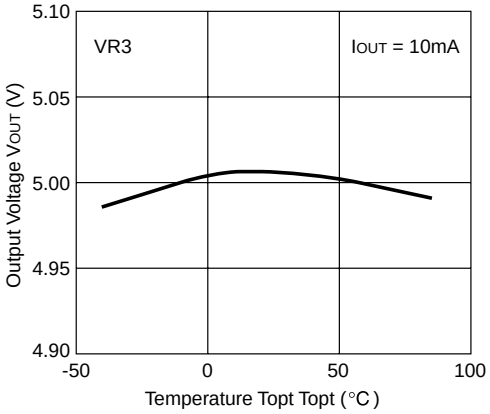
5V



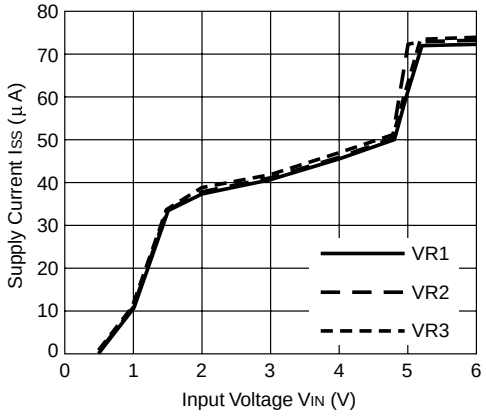
4V



5V

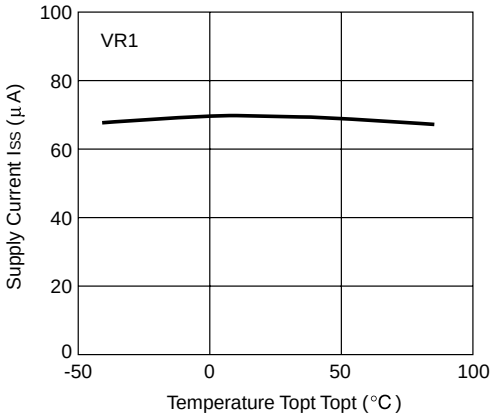


5V

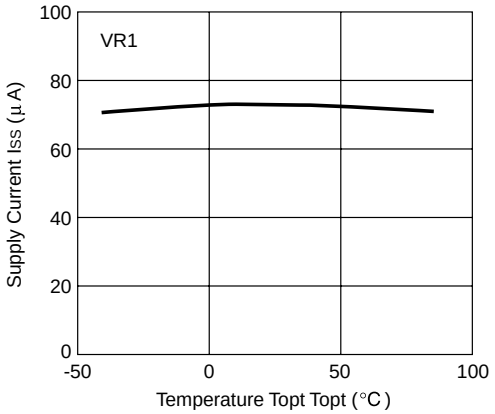


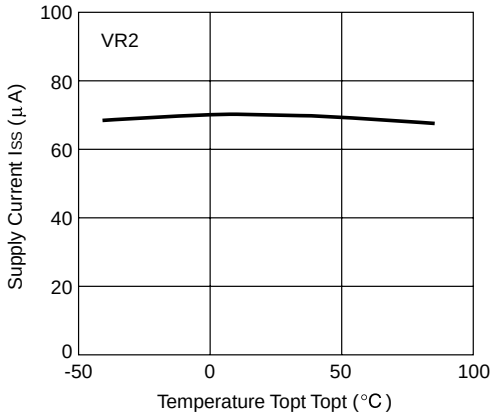
6) Supply Current vs. Temperature

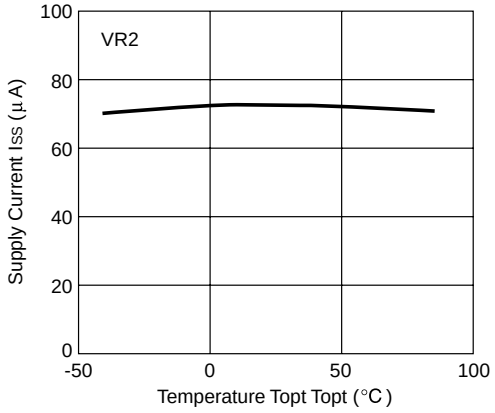
3V

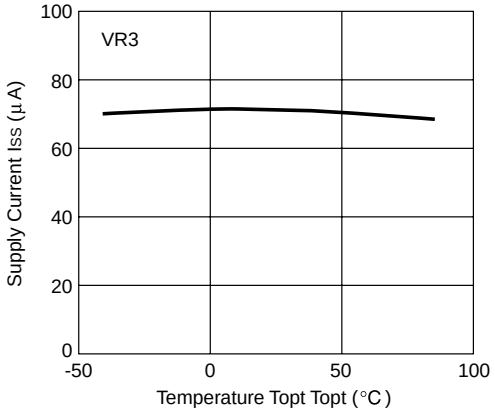


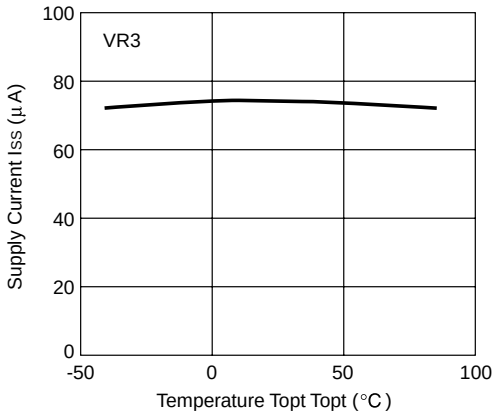
4V



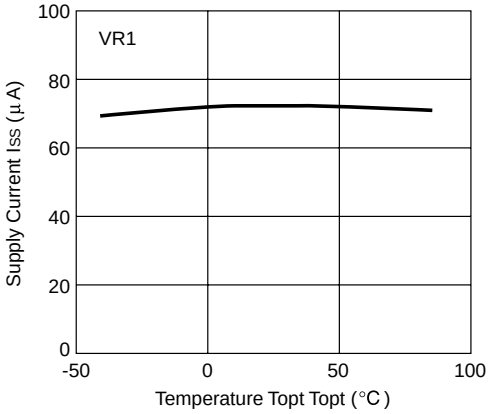


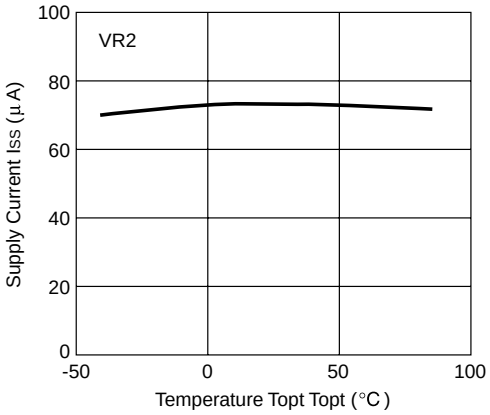


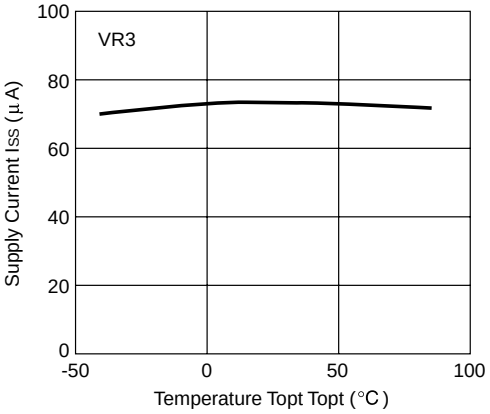




5V

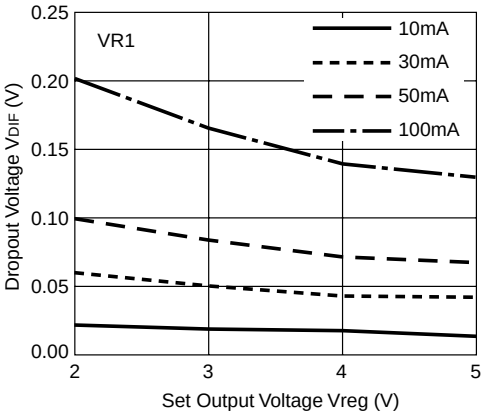


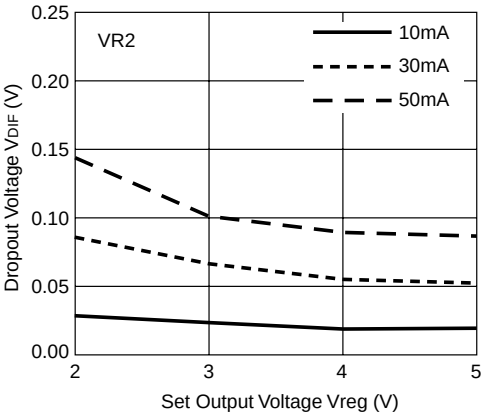


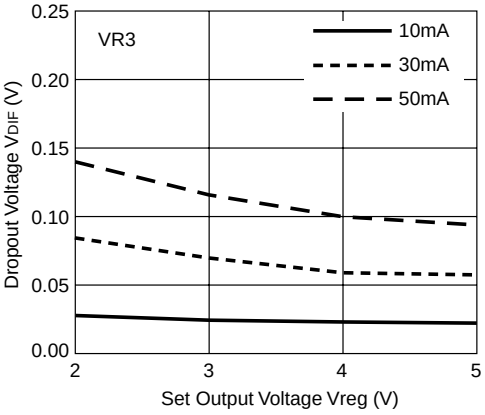


7) Dropout Voltage vs. Set Output Voltage

3V



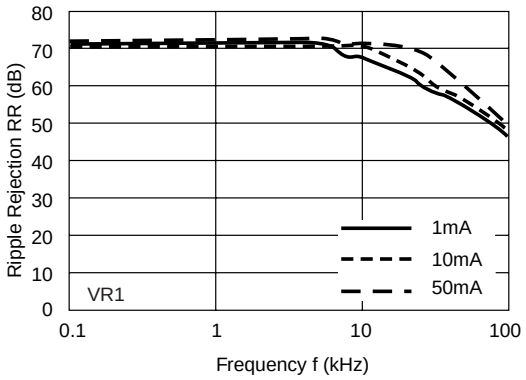




8) Ripple Rejection vs. Frequency

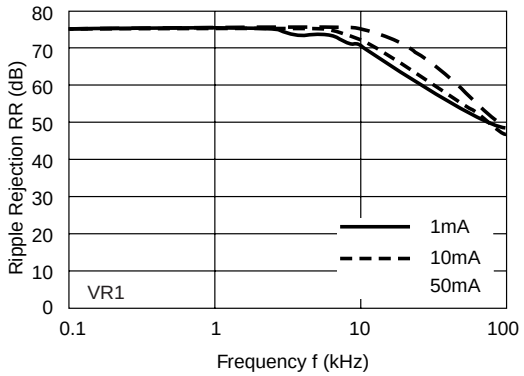
3V

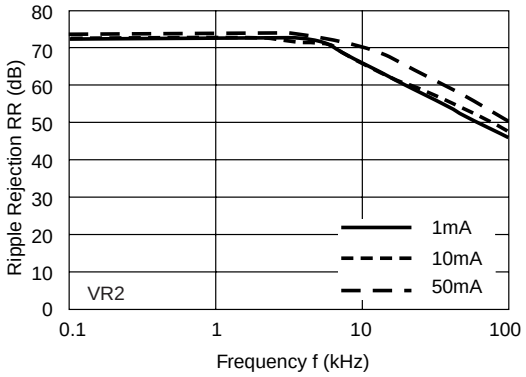
C_{OUT} = 0.47µF

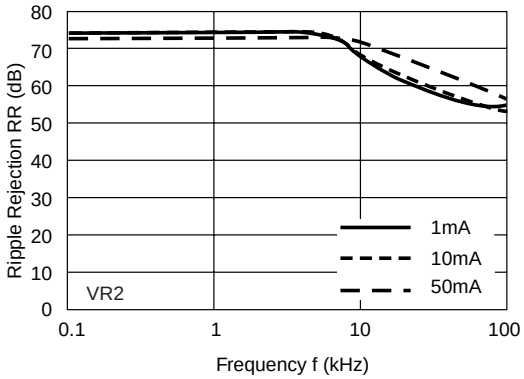


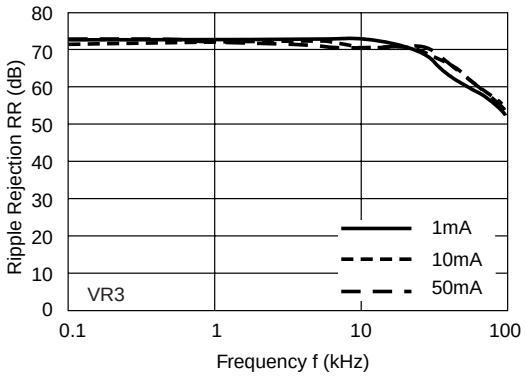
3V

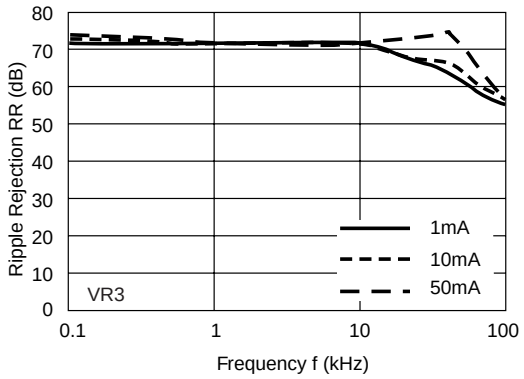
C_{OUT} = 2.2µF





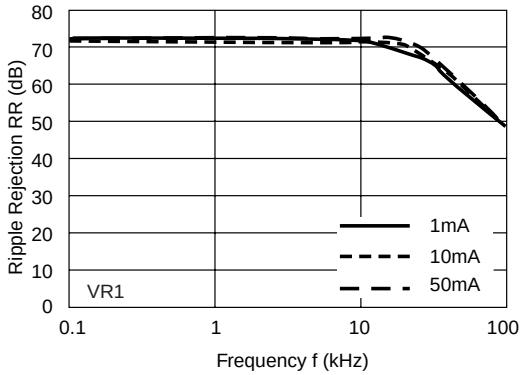


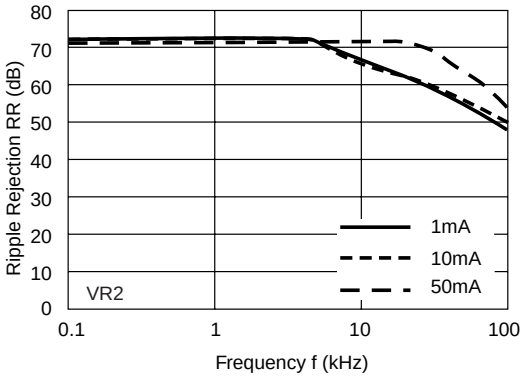


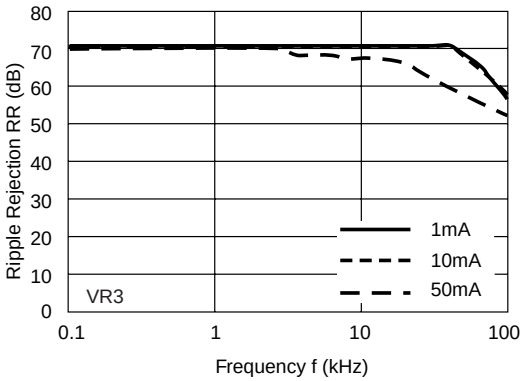


4V

COUT = 0.47µF

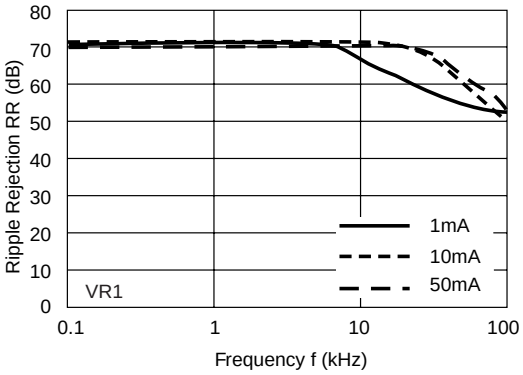


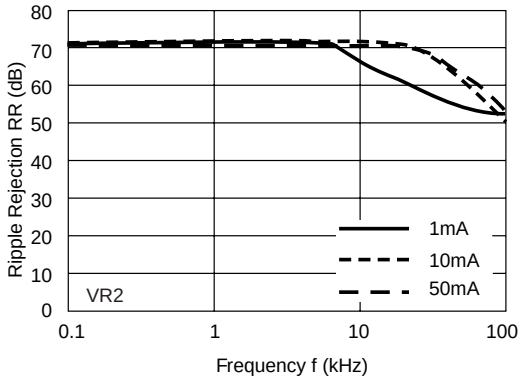


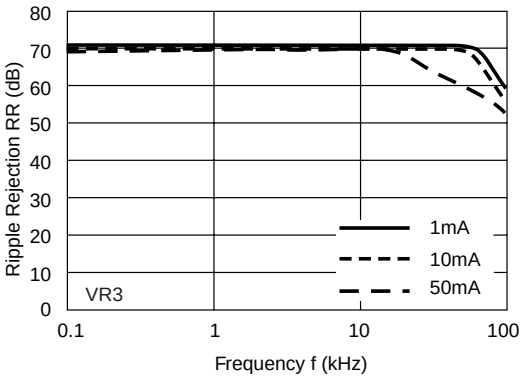


4V

COUT = 2.2µF

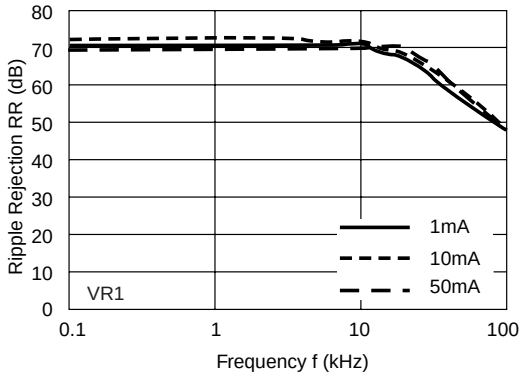


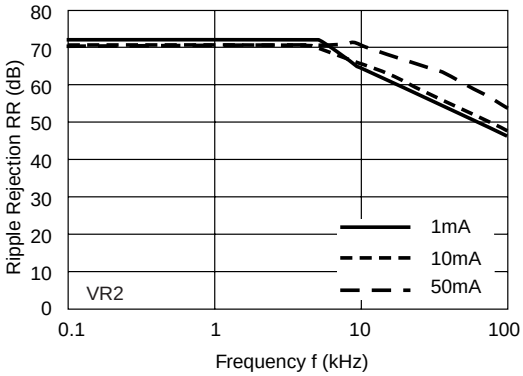


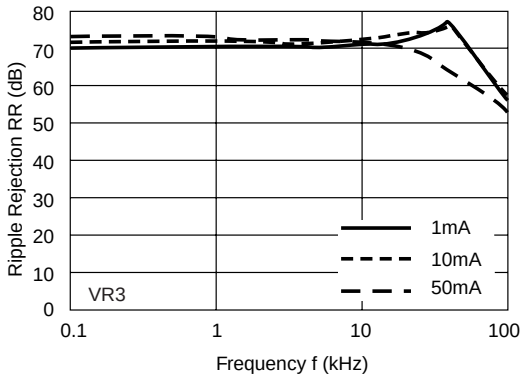


5V

COUT = 0.47µF

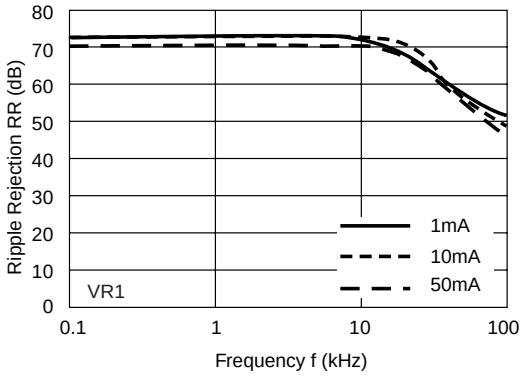


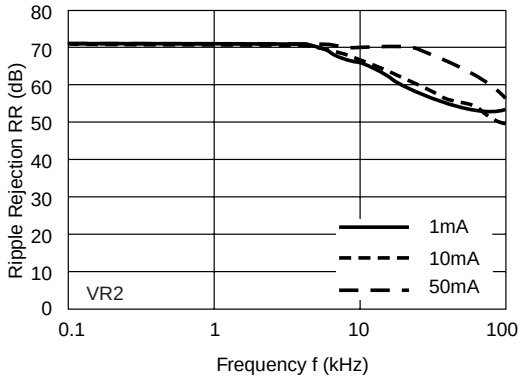


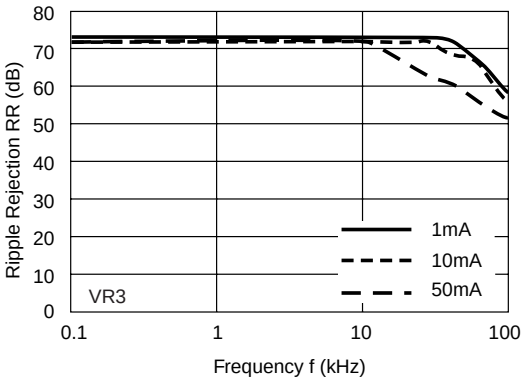


5V

COUT = 2.2µF

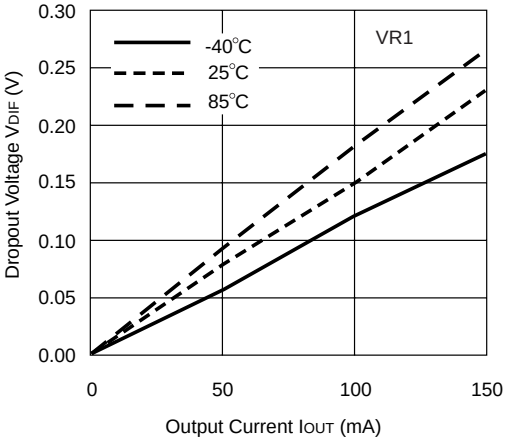




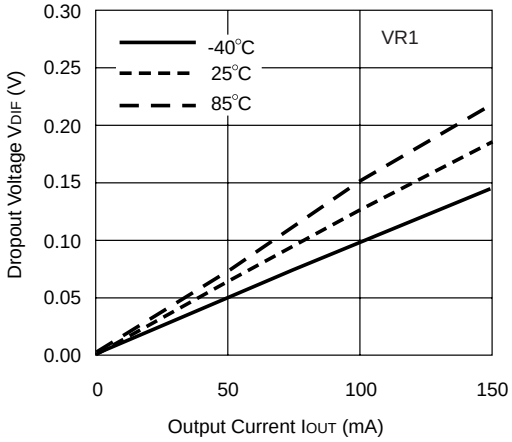


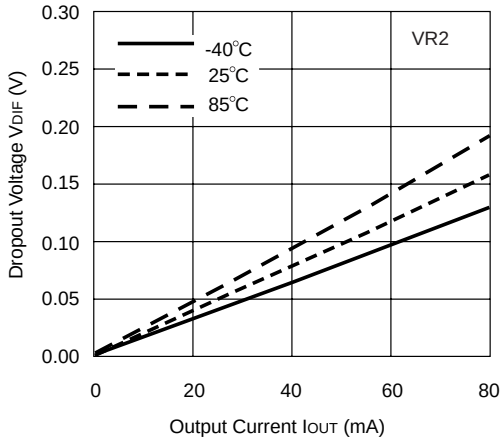
9) Dropout Voltage vs. Output Current

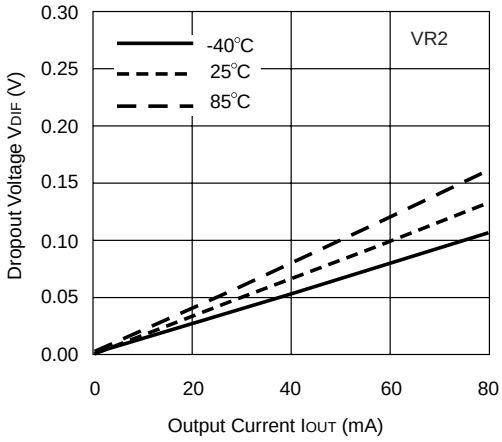
3V

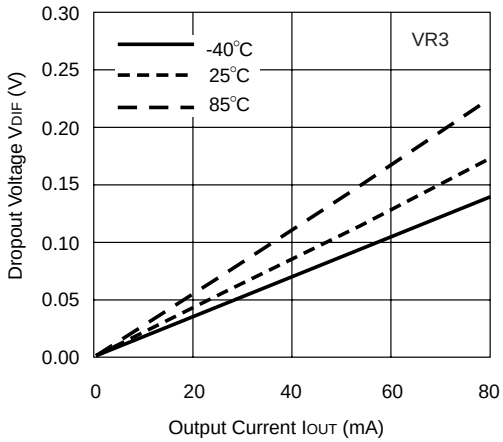


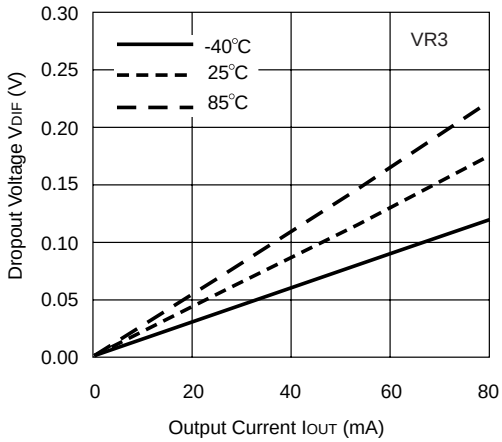
4V



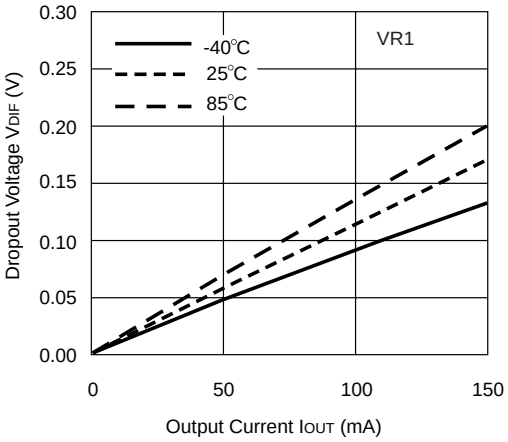


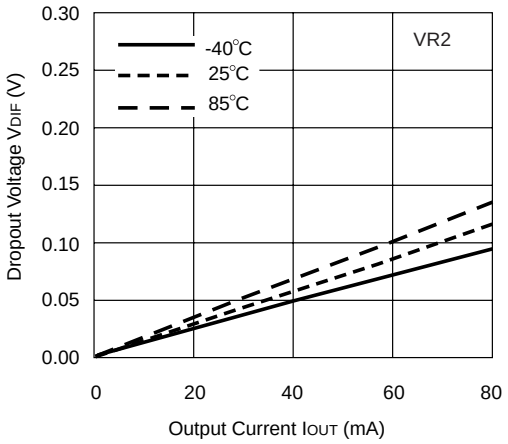


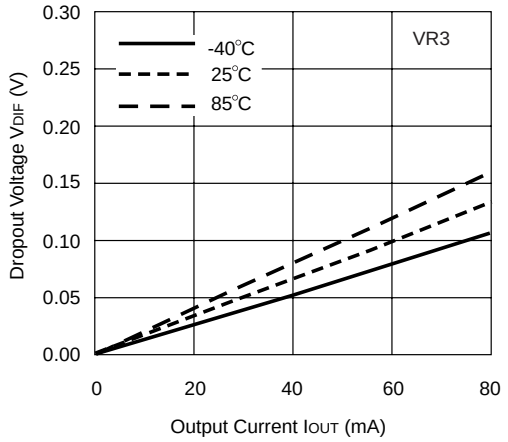




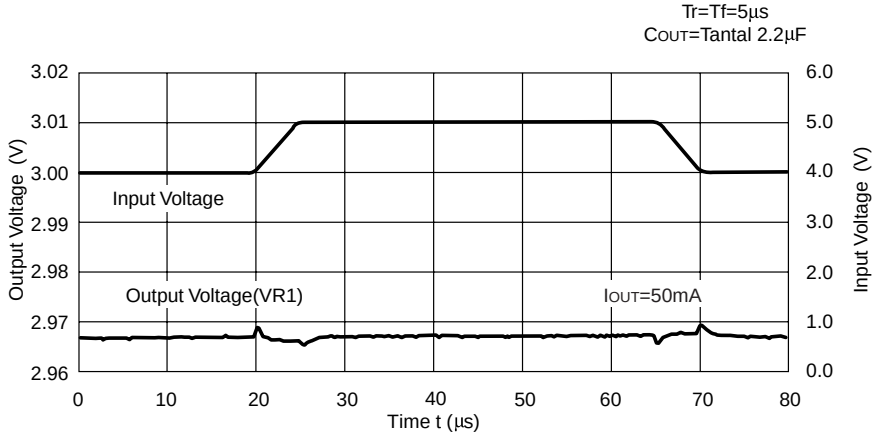
5V

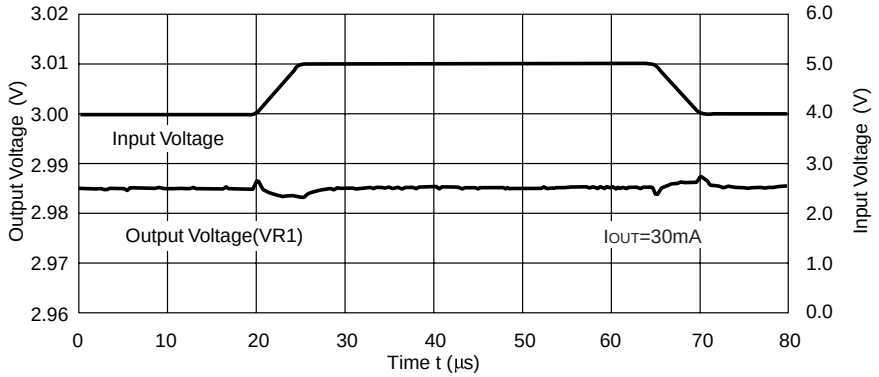


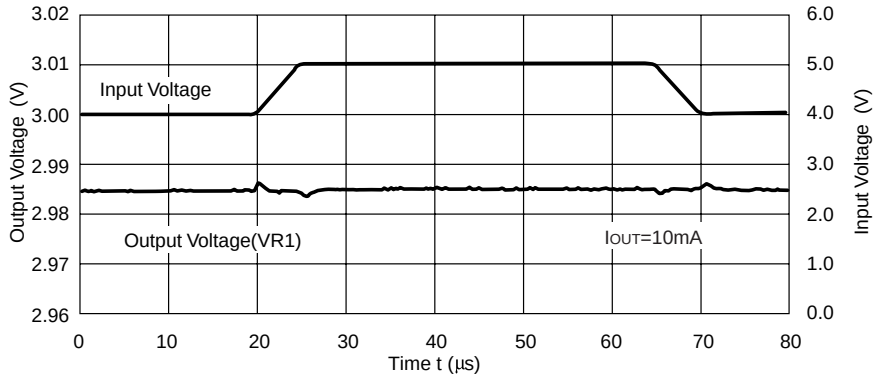


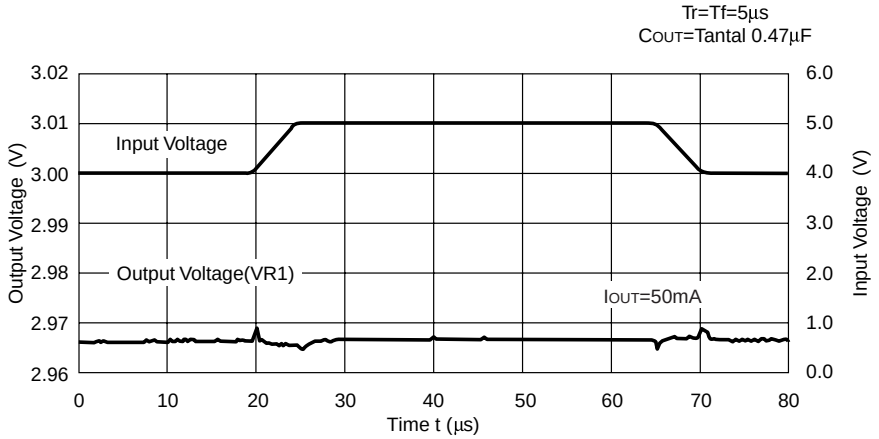


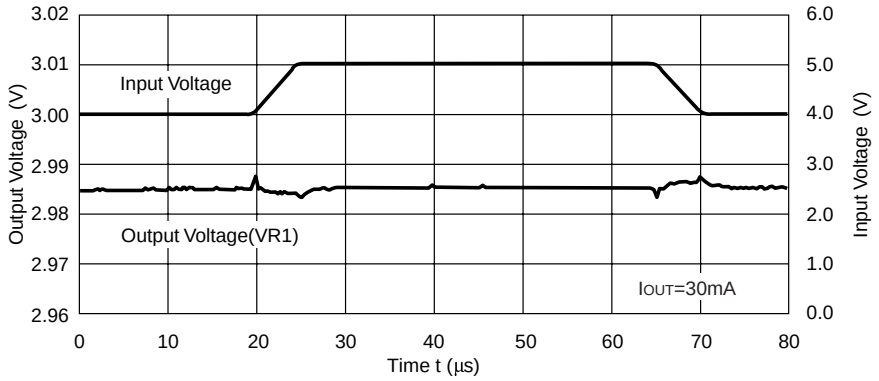
10) Line Transient Response

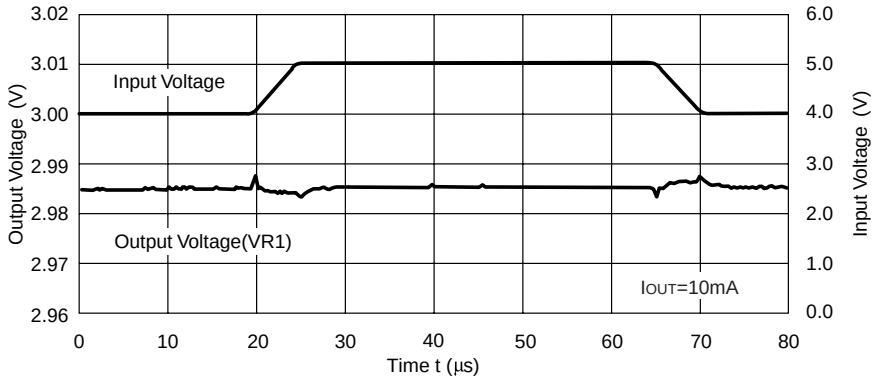


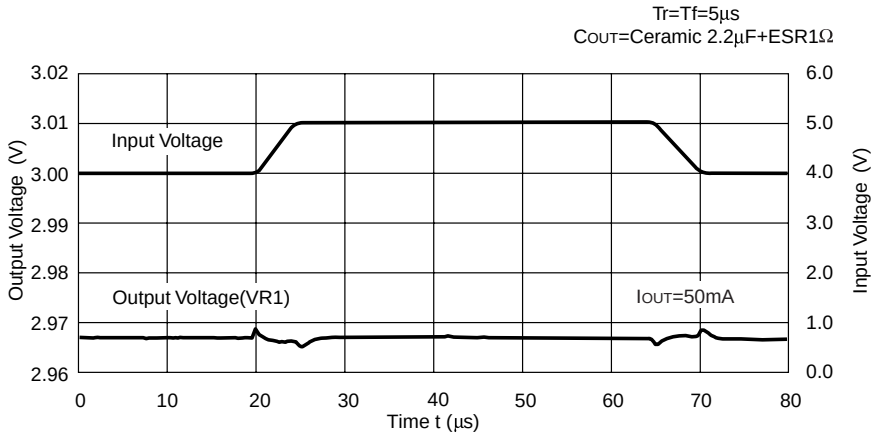


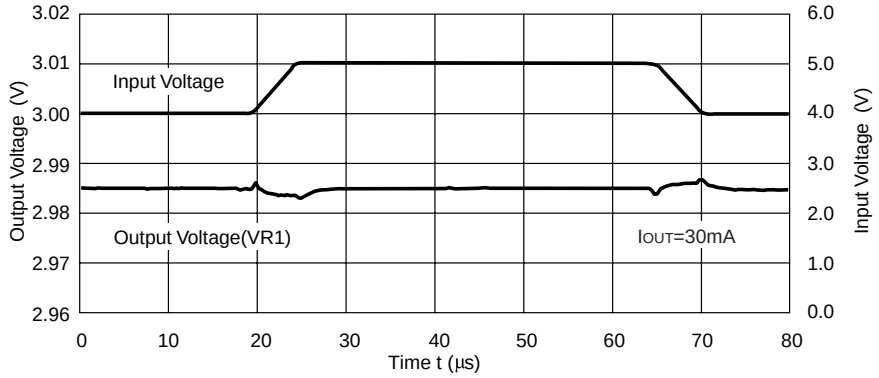


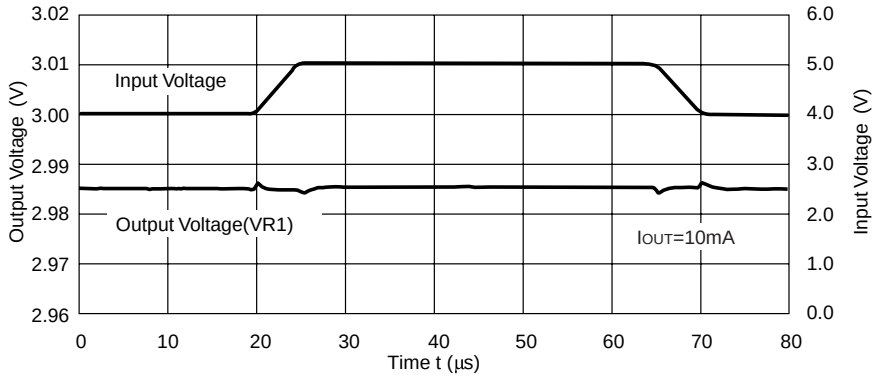




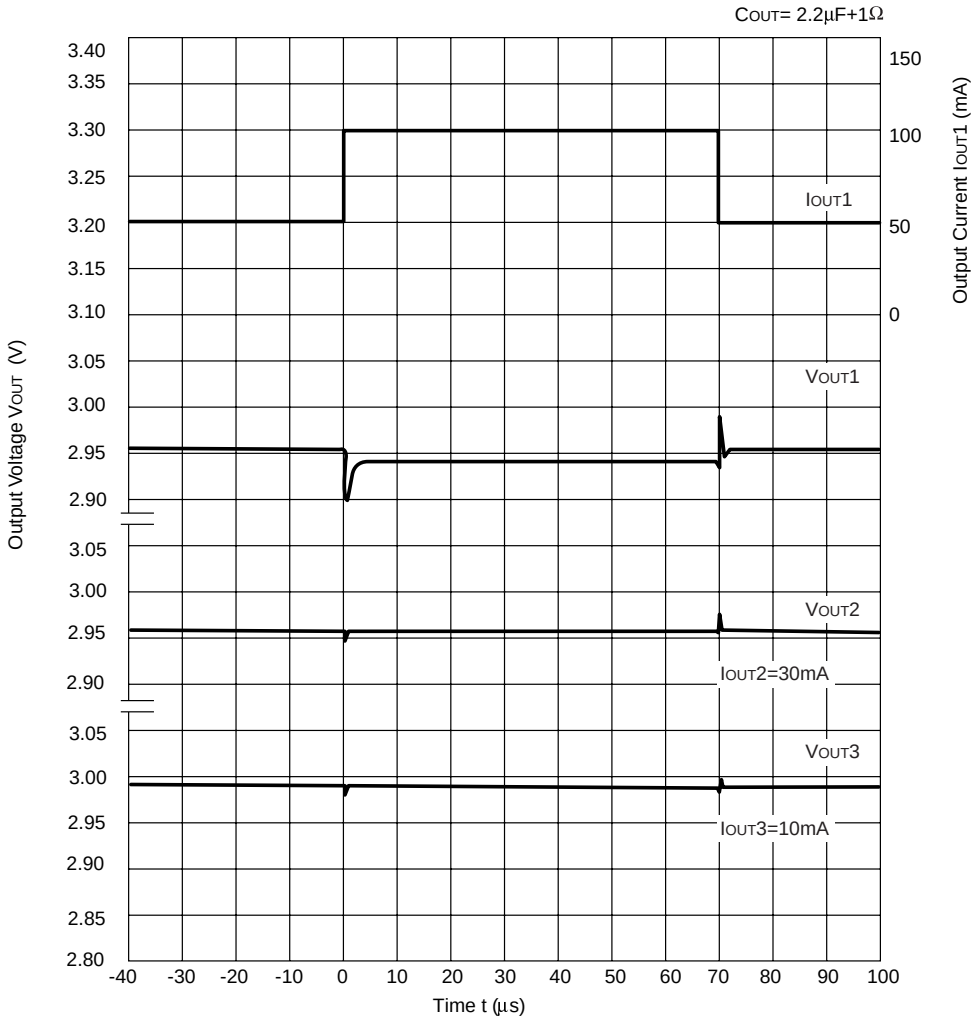


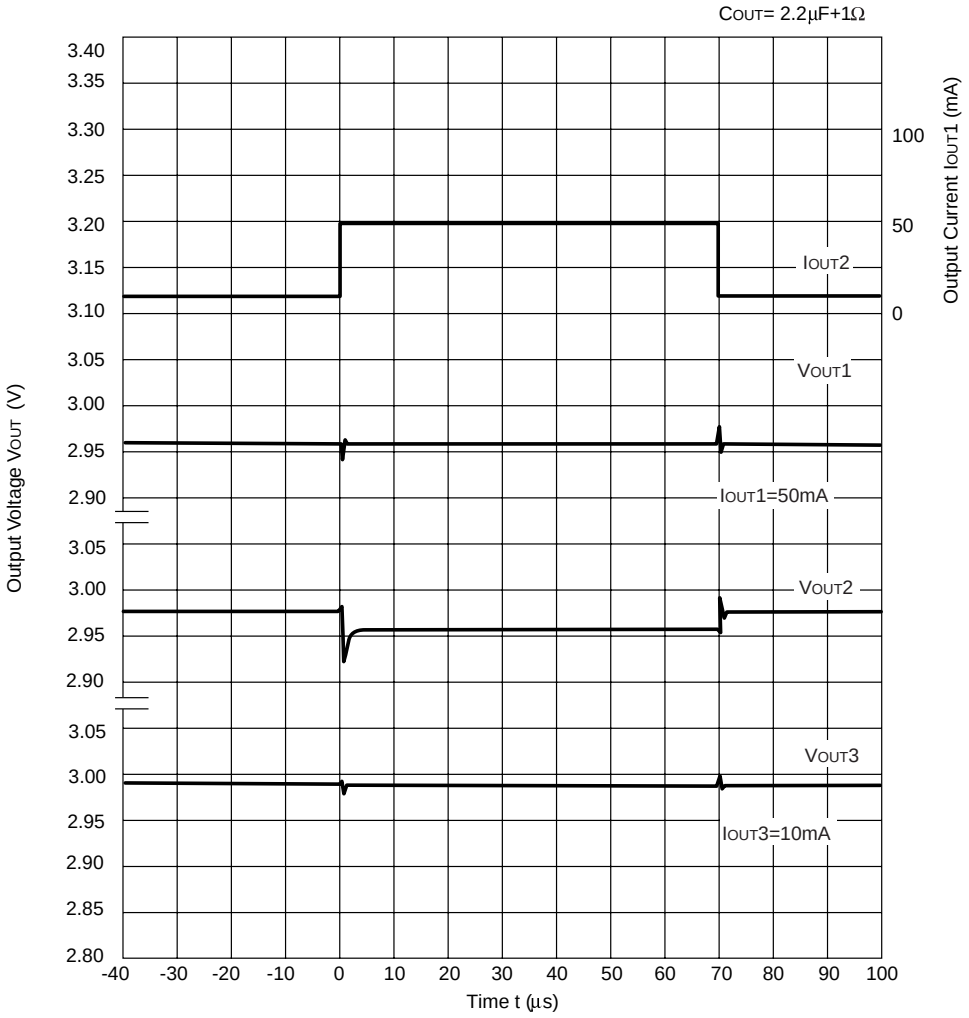


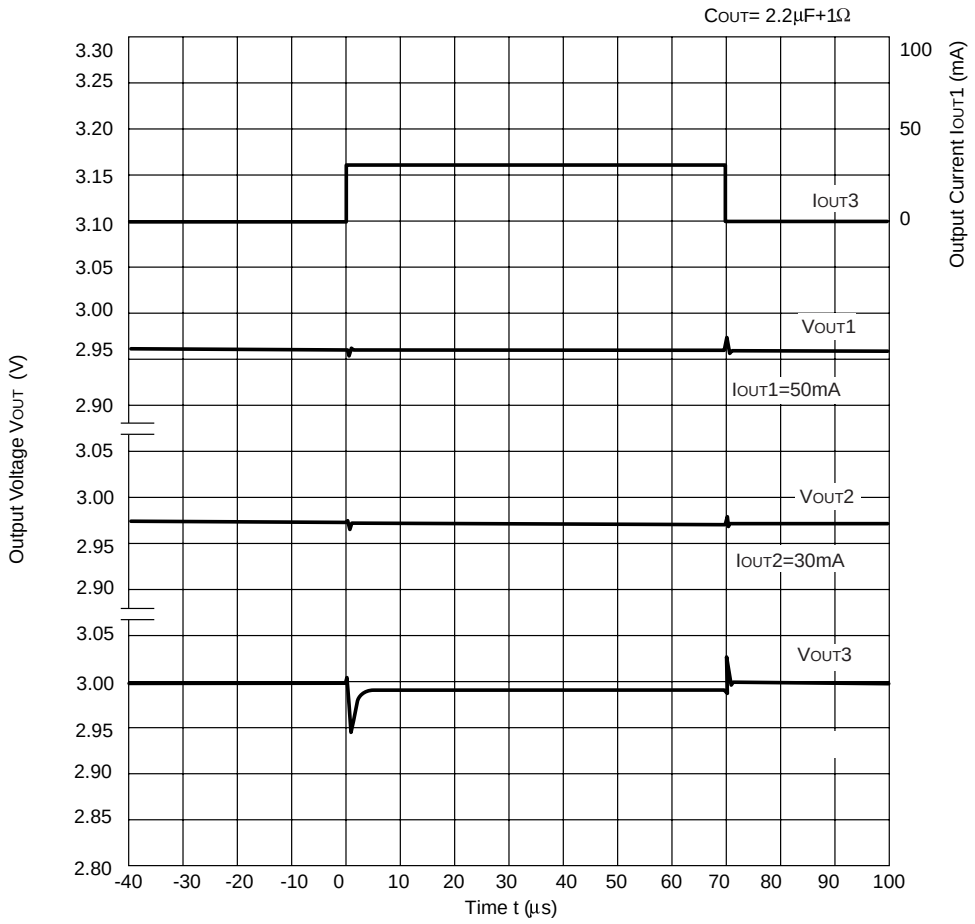




11) Load Transient Response

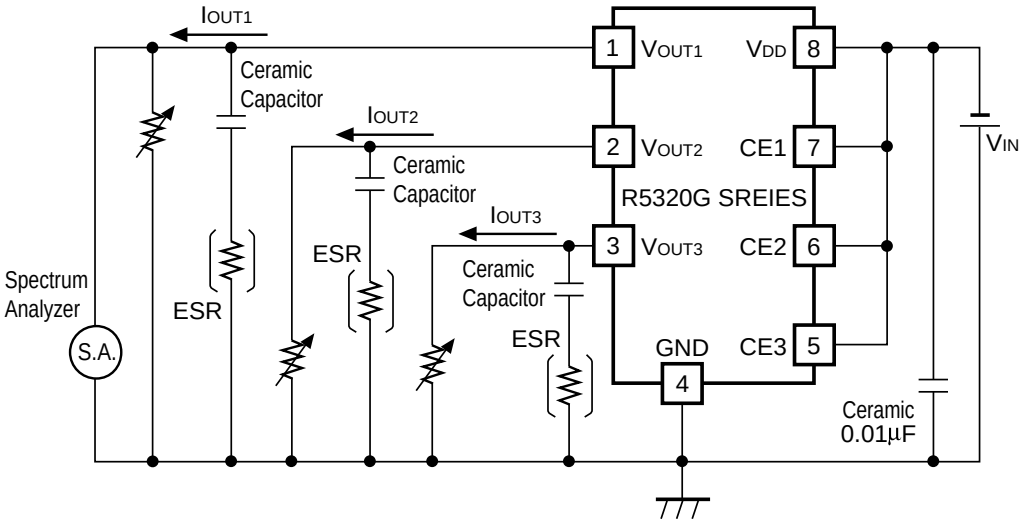






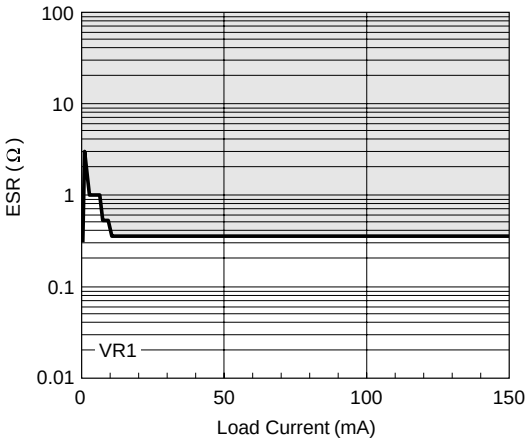
■ TECHNICAL NOTES

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;

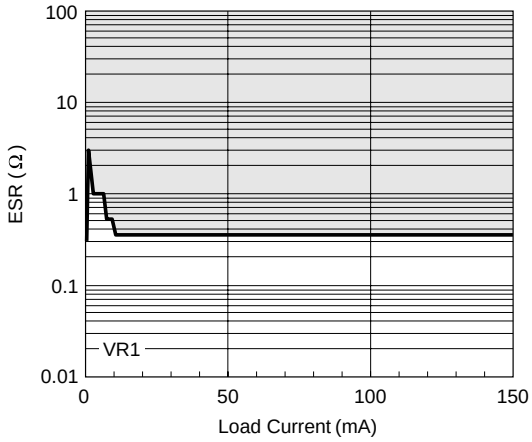


Noise level is measured with a spectrum analyzer and hatched area shows stable areas of which noise level is approximately equal or less than 40µV (Avg.). The relation between Load Current (I_{OUT}) and Equivalent Series Resistors (ESR) value of external output capacitor with the stable area is shown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

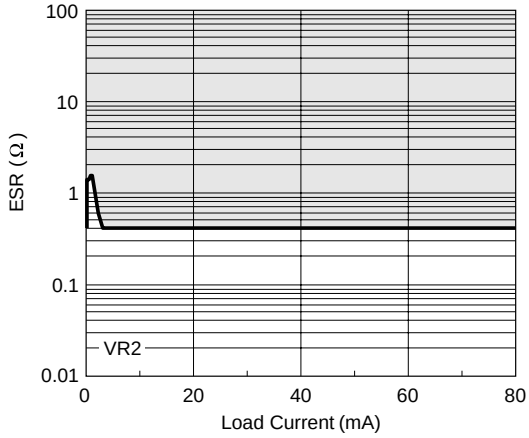
Ceramic Capacitor 1 µF



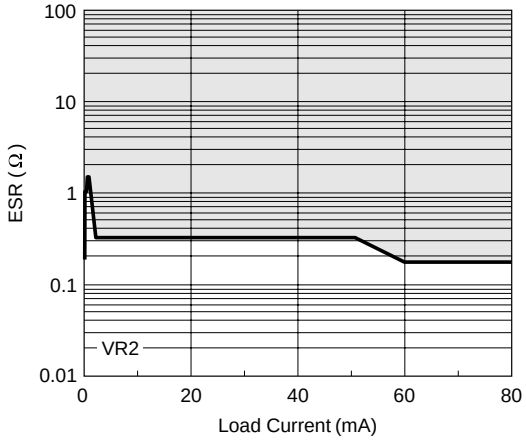
Ceramic Capacitor 2.2 µF

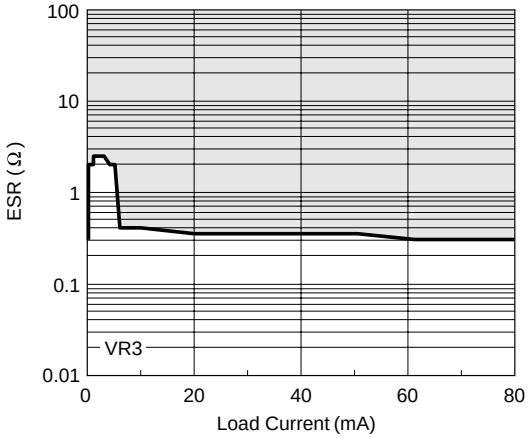


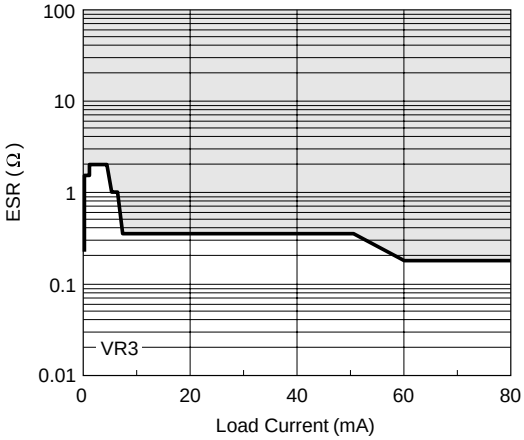
Ceramic Capacitor 1 µF



Ceramic Capacitor 2.2 µF







Measuring Conditions

Frequency Band : 10Hz to 1MHz

Temperature : 25°C