

### LOW NOISE 150mA LDO REGULATOR

NO. EA-126-111026

#### OUTLINE

The R1116x Series are CMOS-based voltage regulator ICs with high output voltage accuracy, low supply current, low on Resistance, and high ripple rejection. Each of these ICs consists of a voltage reference unit, an error amplifier, resistor-net for voltage setting, a short current limit circuit, a chip enable circuit, and so on.

These ICs perform with low dropout voltage and the chip-enable function. The supply current at no load of this IC is only 10 $\mu$ A, and the line transient response and the load transient response of the R1116x Series are excellent, thus these ICs are very suitable for the power supply for hand-held communication equipment.

The supply current at no load of R1116x Series is remarkably reduced compared with R1114x Series. The mode change signal to reduce the supply current is not necessary. The output voltage accuracy is also improved. ( $\pm 1.5\%$ )

The output voltage of these ICs is fixed with high accuracy. Since the packages for these ICs are SOT-23-5 and SON1612-6 therefore high density mounting of the ICs on boards is possible.

R1126N Series that a pin configuration differs from R1116N Series are available.

#### FEATURES

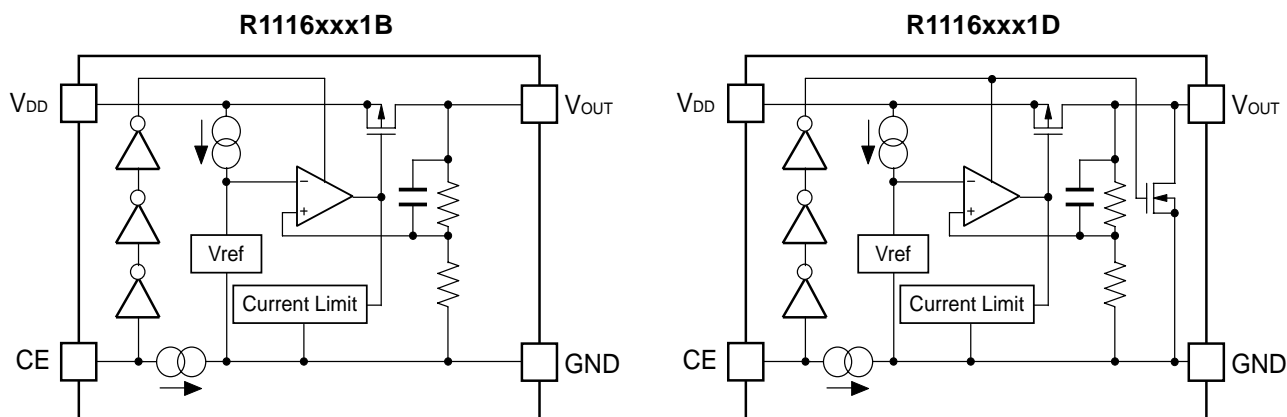
- Supply Current ..... Typ. 10 $\mu$ A
- Standby Current ..... Typ. 0.1 $\mu$ A
- Input Voltage Range ..... 1.8V to 6.0V
- Output Voltage Range ..... 1.5V to 4.0V (0.1V steps)  
(For other voltages, please refer to MARK INFORMATIONS.)
- Dropout Voltage ..... Typ. 0.29V ( $I_{OUT}=150\text{mA}, V_{OUT}=2.8\text{V}$ )
- Ripple Rejection ..... Typ. 70dB ( $f=1\text{kHz}, V_{OUT}=3.0\text{V}$ )  
Typ. 53dB ( $f=10\text{kHz}$ )
- Output Voltage Accuracy .....  $\pm 1.5\%$  ( $1.5\text{V} \leq V_{OUT} \leq 3.0\text{V}$ ),  $\pm 2.0\%$  ( $V_{OUT}>3.0\text{V}$ )
- Temperature-Drift Coefficient of Output Voltage ..... Typ.  $\pm 100\text{ppm}/^\circ\text{C}$
- Line Regulation ..... Typ. 0.02%/V
- Packages ..... SOT-23-5 , SON1612-6
- Built-in Fold Back Protection Circuit ..... Typ. 40mA (Current at short mode)
- Ceramic capacitors are recommended to be used with this IC ...  $C_{IN}=C_{OUT}=1.0\mu\text{F}$  (Ceramic)

#### APPLICATIONS

- Power source for portable communication equipment.
- Power source for portable music player.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

## R1116x

### BLOCK DIAGRAMS



### SELECTION GUIDE

The output voltage, auto discharge function, package, and the taping type, etc. for the ICs can be selected at the user's request.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1116Dxx1*-TR-FE	SON1612-6	4,000 pcs	Yes	Yes
R1116Nxx1*-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes

xx: The output voltage can be designated in the range from 1.5V(15) to 4.0V(40) in 0.1V steps.  
(For other voltages, please refer to MARK INFORMATIONS.)

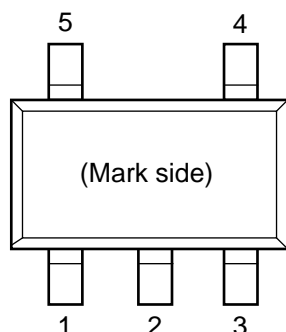
\* : CE pin polarity and auto discharge function at off state are options as follows.

(B) "H" active, without auto discharge function at off state

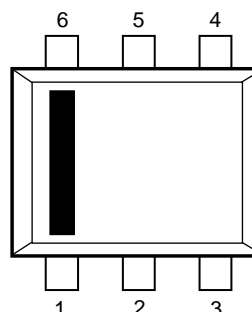
(D) "H" active, with auto discharge function at off state

## PIN CONFIGURATIONS

### ● SOT-23-5



### ● SON1612-6



## PIN DESCRIPTIONS

### ● SOT-23-5

Pin No.	Symbol	Description
1	V <sub>DD</sub>	Input Pin
2	GND	Ground Pin
3	CE	Chip Enable Pin
4	NC	No Connection
5	V <sub>OUT</sub>	Output pin

### ● SON1612-6

Pin No.	Symbol	Description
1	CE	Chip Enable Pin
2	GND	Ground Pin
3	V <sub>DD</sub>	Input Pin
4	V <sub>OUT</sub>	Output Pin
5	GND	Ground Pin
6	NC	No Connection

**R1116x**

**ABSOLUTE MAXIMUM RATINGS**

Symbol	Item	Rating	Unit
$V_{IN}$	Input Voltage	6.5	V
$V_{CE}$	Input Voltage (CE Pin)	6.5	V
$V_{OUT}$	Output Voltage	-0.3~ $V_{IN}+0.3$	V
$I_{OUT}$	Output Current	160	mA
$P_D$	Power Dissipation (SOT-23-5) *	420	mW
	Power Dissipation (SON1612-6)*	500	
$T_{opt}$	Operating Temperature Range	-40~85	°C
$T_{stg}$	Storage Temperature Range	-55~125	°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.

## ELECTRICAL CHARACTERISTICS

### • R1116xxx1B/D

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V <sub>OUT</sub>	Output Voltage	V <sub>IN</sub> = Set V <sub>OUT</sub> +1V 1mA ≤ I <sub>OUT</sub> ≤ 30mA	V <sub>OUT</sub> ≤ 3.4V ×0.985		×1.015	V
			V <sub>OUT</sub> > 3.4V ×0.980		×1.020	
I <sub>OUT</sub>	Output Current	V <sub>IN</sub> -V <sub>OUT</sub> =1.0V	150			mA
ΔV <sub>OUT</sub> / ΔI <sub>OUT</sub>	Load Regulation	V <sub>IN</sub> =Set V <sub>OUT</sub> +1V 1mA ≤ I <sub>OUT</sub> ≤ 150mA 1.5V ≤ V <sub>OUT</sub> < 2.0V 2.0V ≤ V <sub>OUT</sub> < 3.0V 3.0V ≤ V <sub>OUT</sub>		28 33 35	55 66 80	mV
V <sub>DIF</sub>	Dropout Voltage	Refer to the ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE				
I <sub>SS</sub>	Supply Current	V <sub>IN</sub> =Set V <sub>OUT</sub> +1V, I <sub>OUT</sub> =0mA		10	18	μA
I <sub>standby</sub>	Supply Current (Standby)	V <sub>IN</sub> =Set V <sub>OUT</sub> +1V, V <sub>CE</sub> =V <sub>DD</sub>		0.1	1.0	μA
ΔV <sub>OUT</sub> / ΔV <sub>IN</sub>	Line Regulation	I <sub>OUT</sub> =30mA Set V <sub>OUT</sub> +0.5V ≤ V <sub>IN</sub> ≤ 6.0V		0.02	0.10	%/V
RR	Ripple Rejection	f=1kHz f=10kHz Ripple 0.2Vp-p V <sub>IN</sub> -V <sub>OUT</sub> =1.0V, I <sub>OUT</sub> =30mA		70 53		dB
V <sub>IN</sub>	Input Voltage		1.8		6.0	V
ΔV <sub>OUT</sub> / ΔT <sub>opt</sub>	Output Voltage Temperature Coefficient	I <sub>OUT</sub> =30mA -40°C ≤ T <sub>opt</sub> ≤ 85°C		±100		ppm /°C
I <sub>SC</sub>	Short Current Limit	V <sub>OUT</sub> =0V		40		mA
I <sub>PD</sub>	CE Pull-down Current			0.5		μA
V <sub>CEH</sub>	CE Input Voltage "H"		1.0		6.0	V
V <sub>CEL</sub>	CE Input Voltage "L"		0.0		0.3	V
en	Output Noise	BW=10Hz to 100kHz		30		μVrms
R <sub>LOW</sub>	On Resistance of Nch Tr. for auto-discharge (Only for D version)	V <sub>CE</sub> =0V		70		Ω

### 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.

\* R1116D (SON1612-6) is the non-promotion product. As of March in 2014.

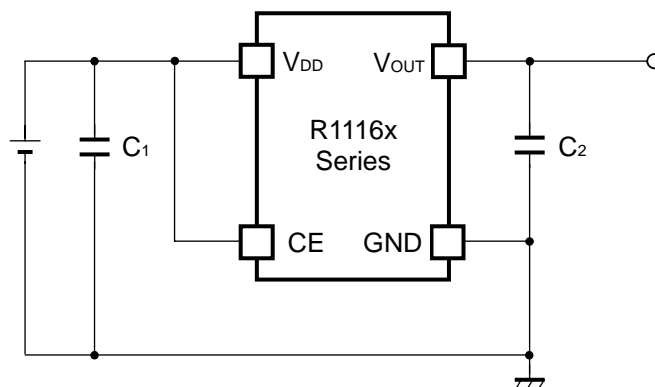
## R1116x

### • ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE

$T_{opt} = 25^{\circ}\text{C}$

Output Voltage $V_{OUT}$ (V)	Dropout Voltage $V_{DIF}$ (V)		
	Condition	Typ.	Max.
$V_{OUT} = 1.5\text{V}$	$I_{OUT}=150\text{mA}$	0.54	0.86
$1.5\text{V} < V_{OUT} \leq 1.6\text{V}$		0.50	0.75
$1.6\text{V} < V_{OUT} \leq 1.7\text{V}$		0.46	0.70
$1.7\text{V} < V_{OUT} \leq 2.0\text{V}$		0.44	0.65
$2.0\text{V} < V_{OUT} \leq 2.7\text{V}$		0.37	0.56
$2.7\text{V} < V_{OUT} \leq 4.0\text{V}$		0.29	0.46

### TYPICAL APPLICATIONS



(External Components)

$C_2$  Ceramic  $1.0\mu\text{F}$  Ex. Murata GRM155B30J105KE18B  
Kyocera CM05X5R105K06AB

$C_1$  Ceramic  $1.0\mu\text{F}$

## TEST CIRCUITS

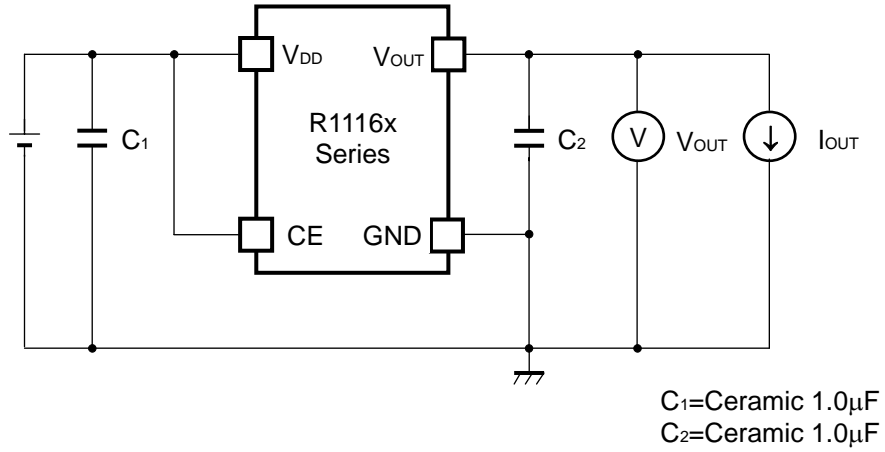


Fig.1 Standard test Circuit

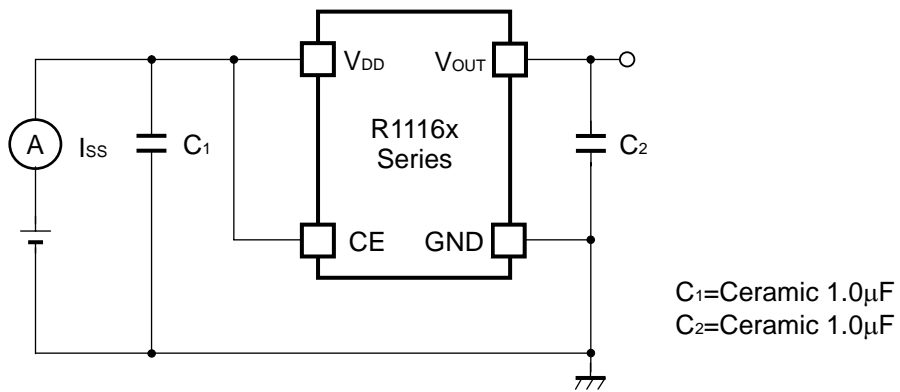


Fig.2 Supply Current Test Circuit

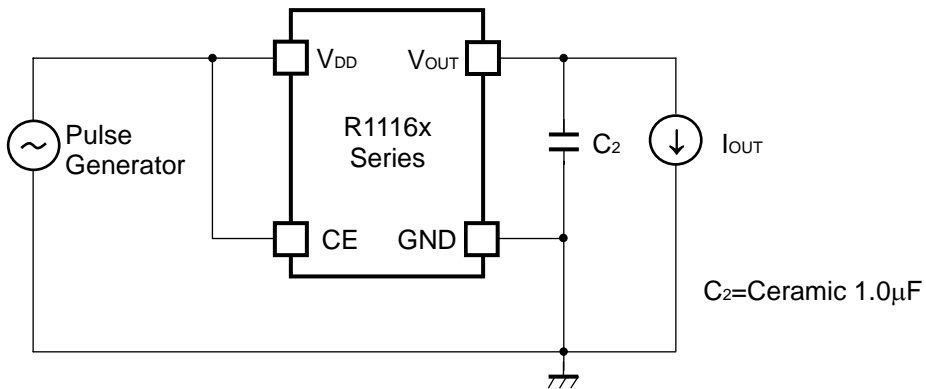
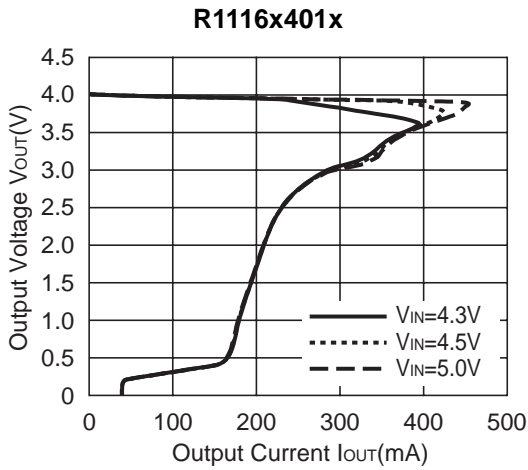
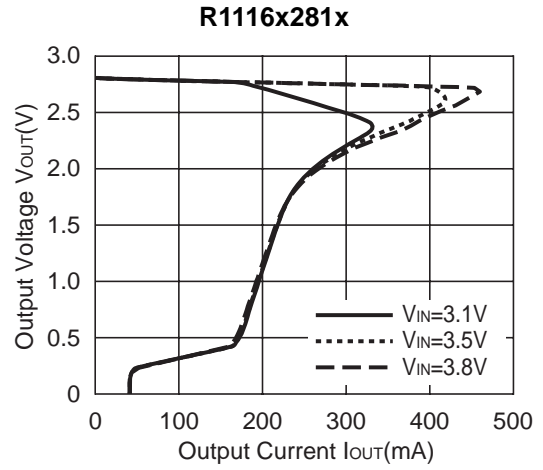
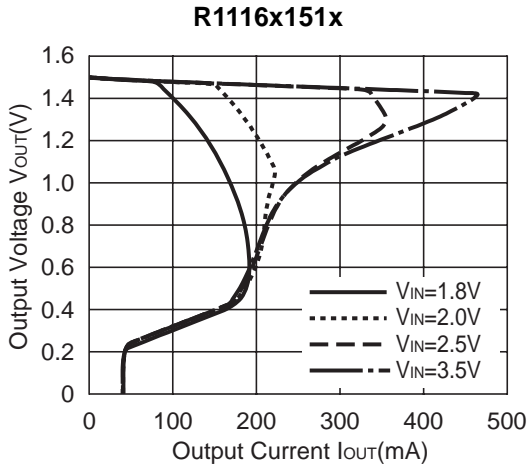


Fig.3 Ripple Rejection, Line Transient Response Test Circuit

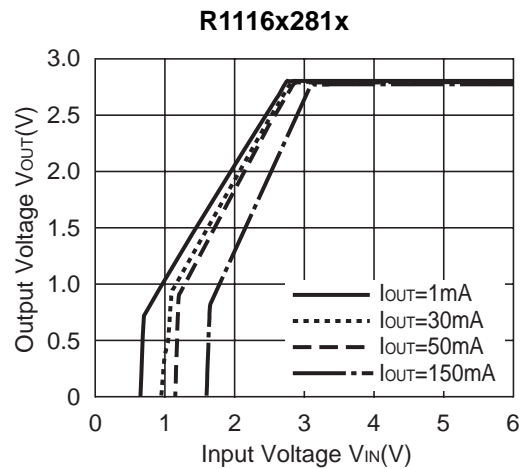
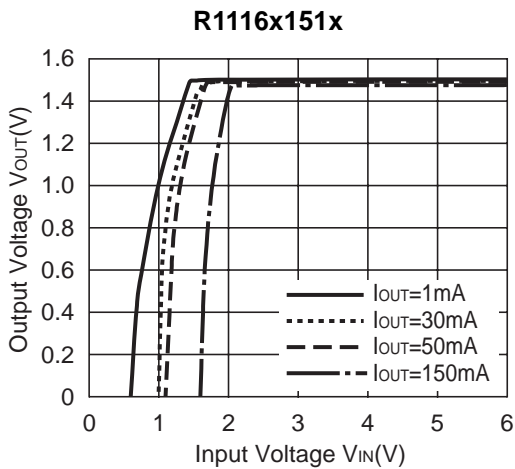
**R1116x**

**TYPICAL CHARACTERISTICS**

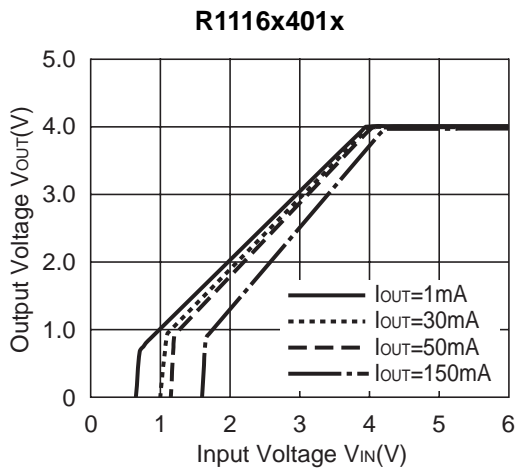
**1) Output Voltage vs. Output Current (T<sub>opt</sub>=25°C)**



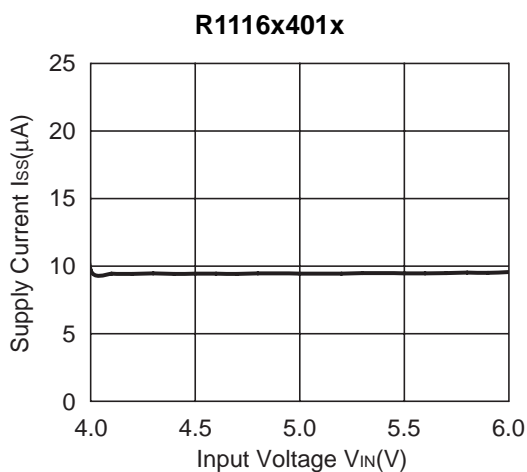
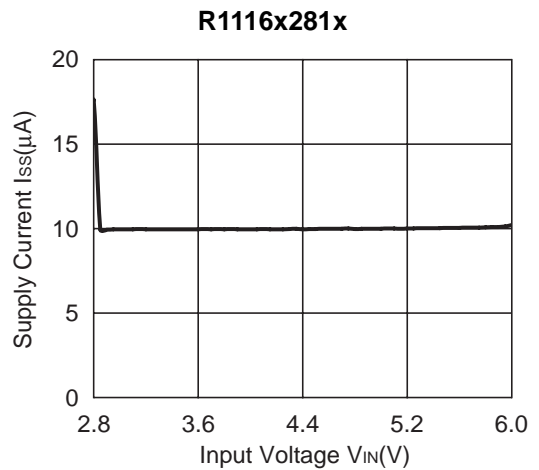
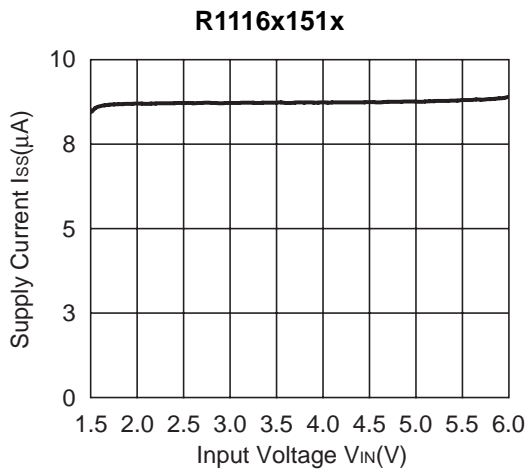
**2) Output Voltage vs. Input Voltage (T<sub>opt</sub>=25°C)**







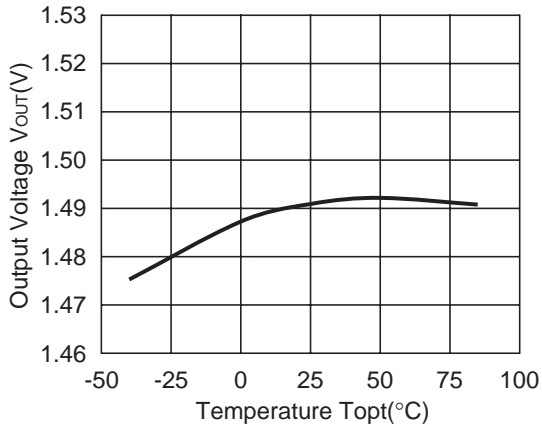
**3) Supply Current vs. Input Voltage ( $T_{opt}=25^{\circ}C$ )**



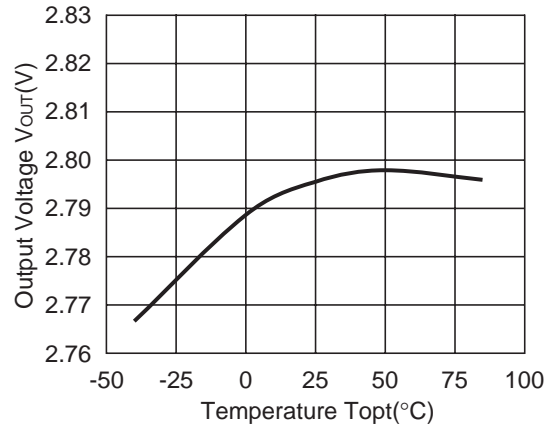
**R1116x**

**4) Output Voltage vs. Temperature**

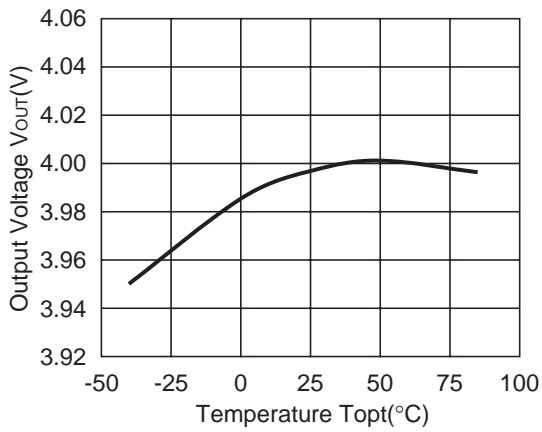
**R1116x151x**



**R1116x281x**

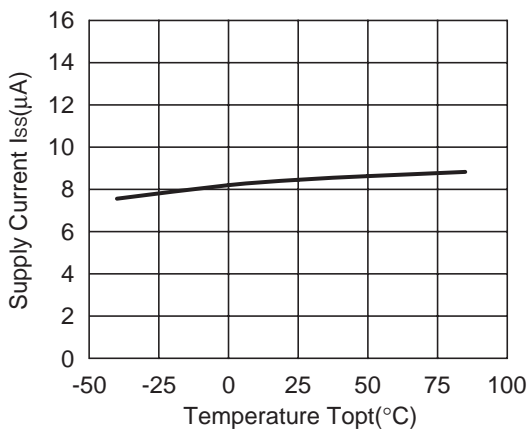


**R1116x401x**

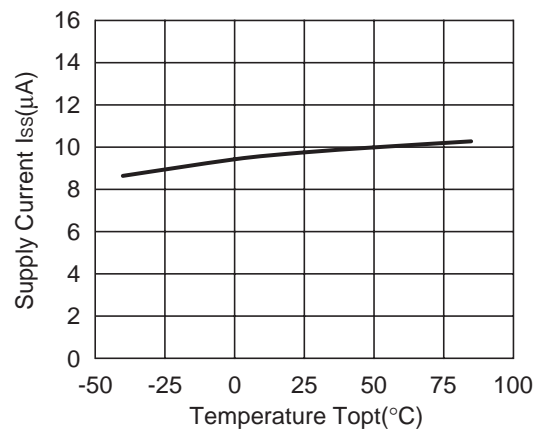


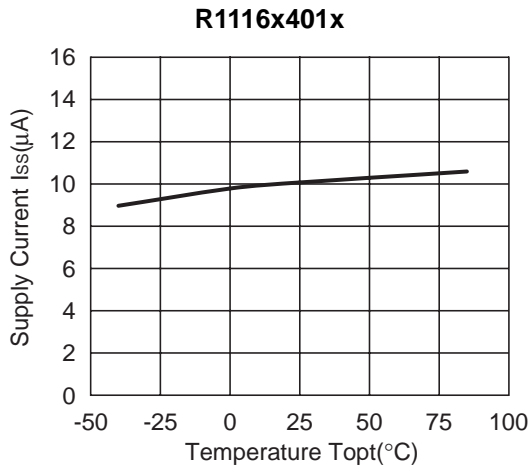
**5) Supply Current vs. Temperature**

**R1116x151x**

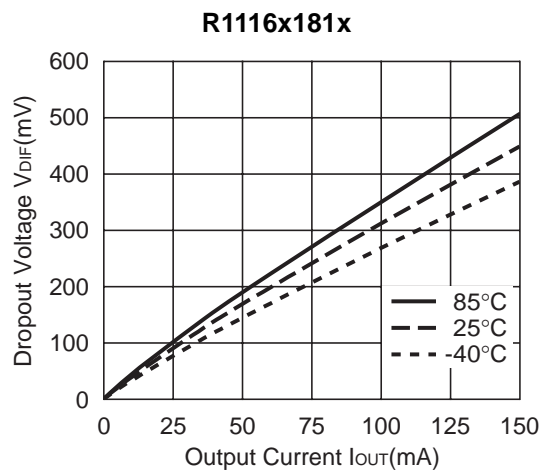
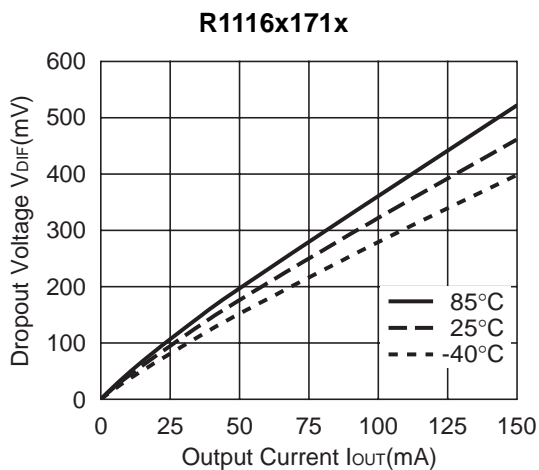
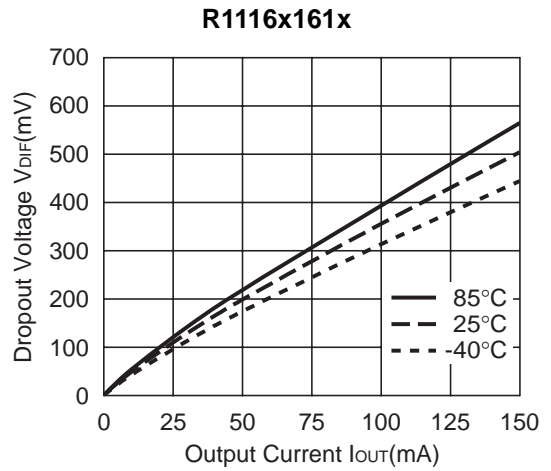
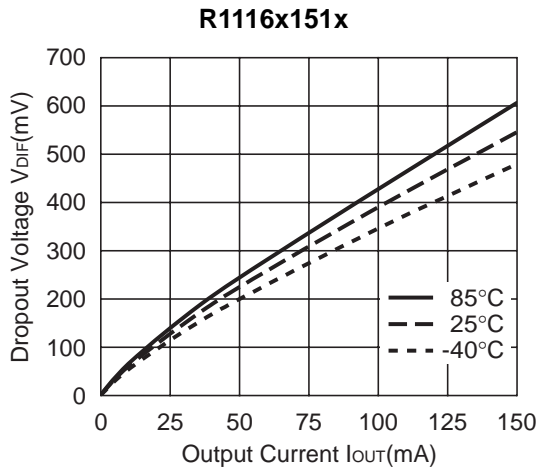


**R1116x281x**



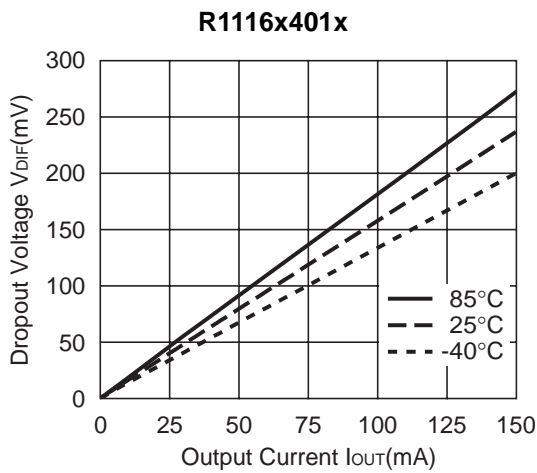
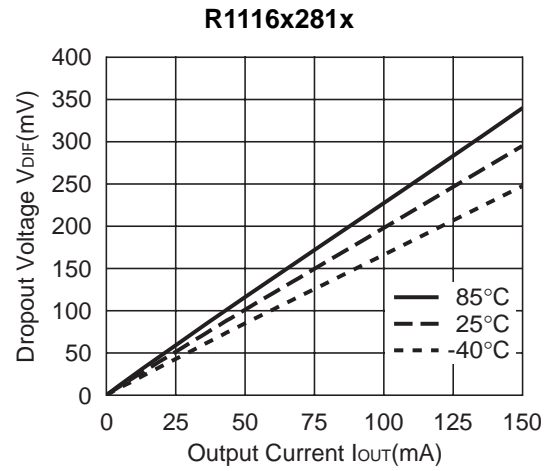
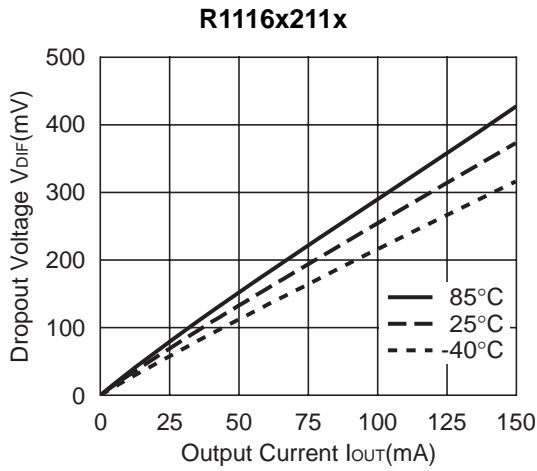


**6) Dropout Voltage vs. Temperature**

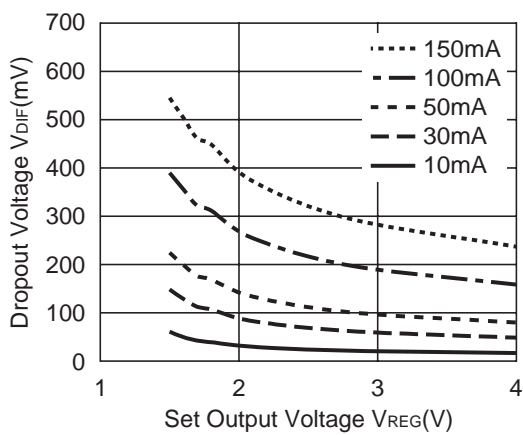


\* R1116D (SON1612-6) is the non-promotion product. As of March in 2014.

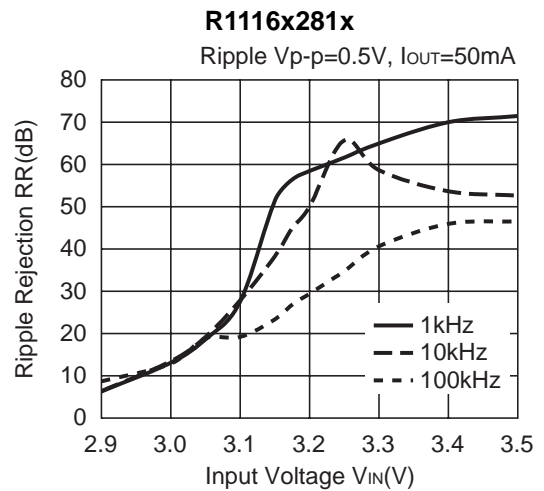
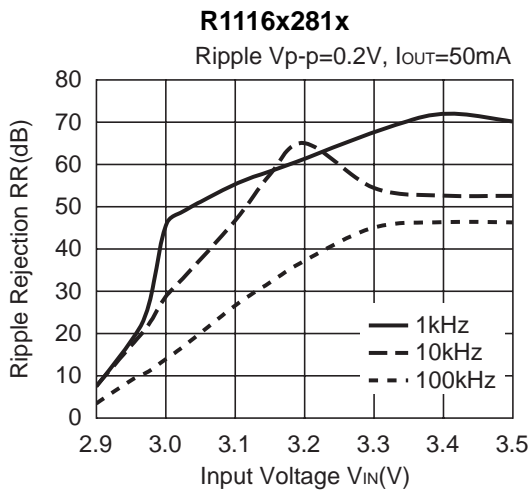
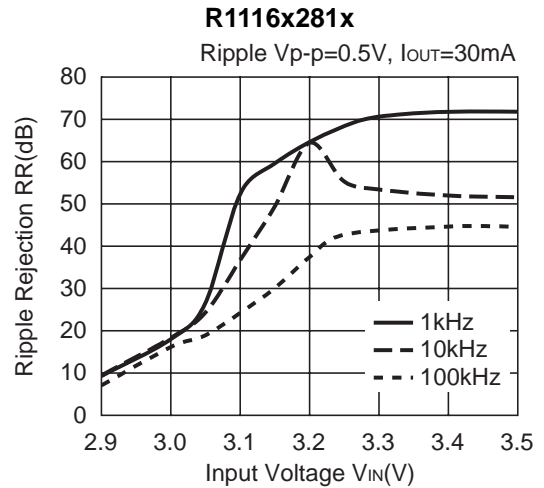
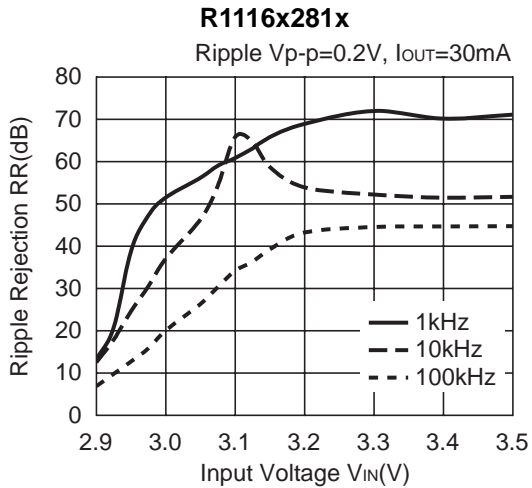
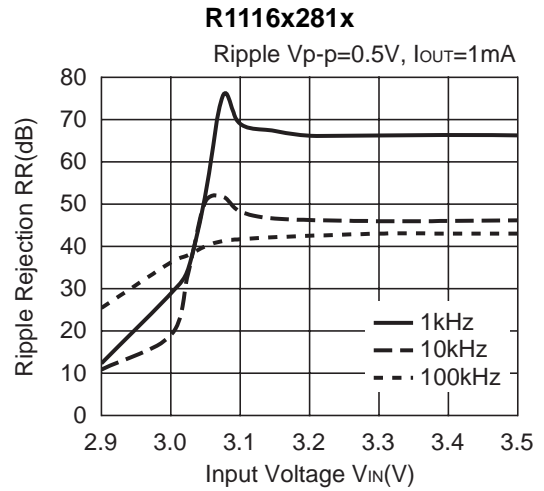
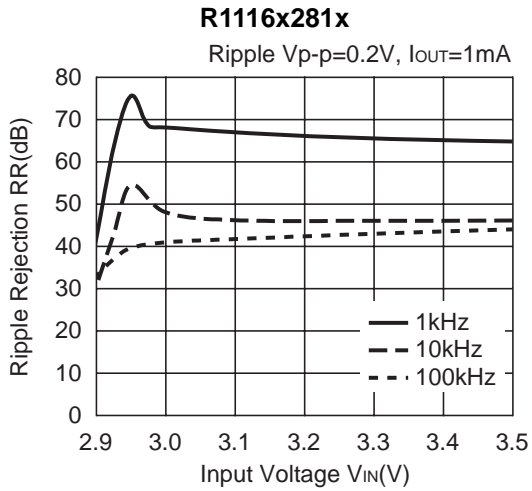
**R1116x**



**7) Dropout Voltage vs. Set Output Voltage (Topt=25°C)**

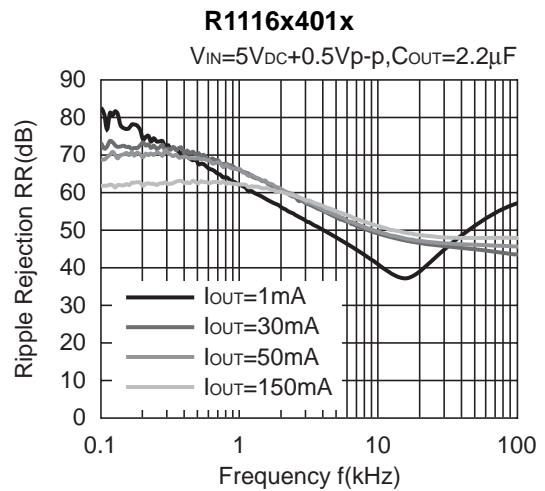
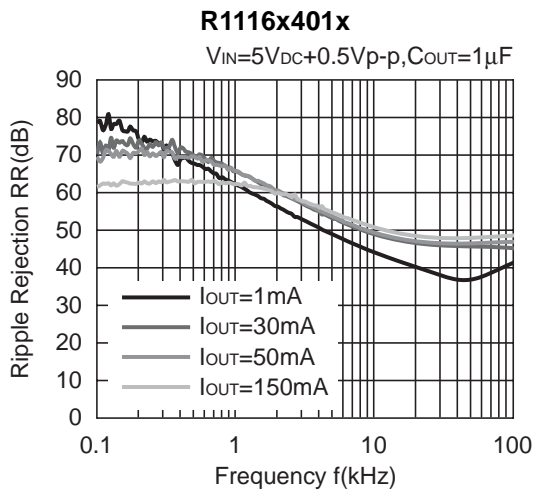
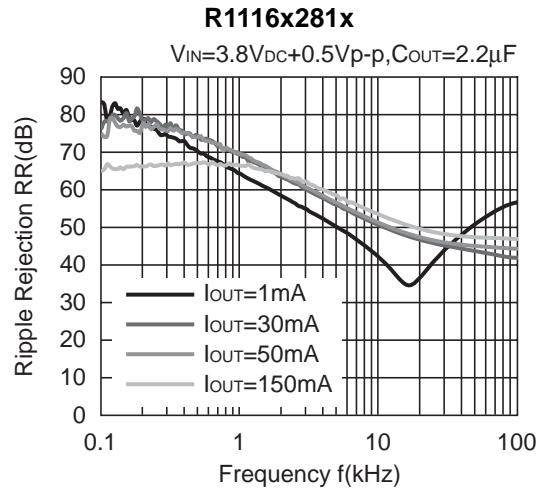
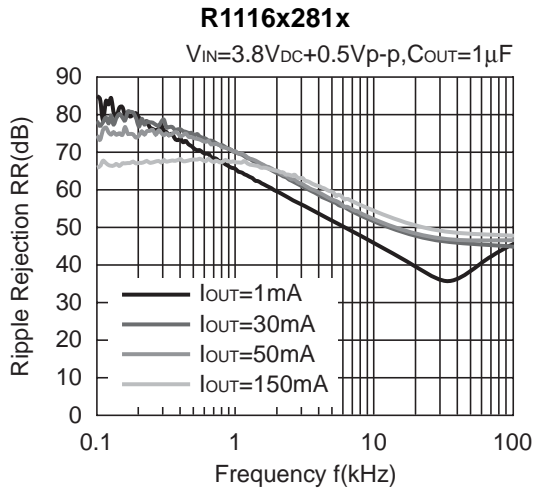
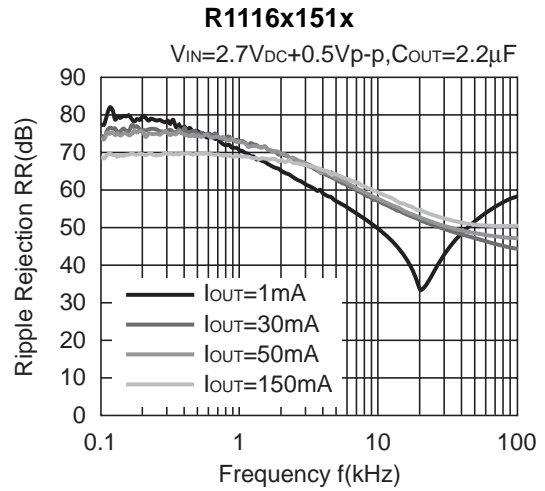
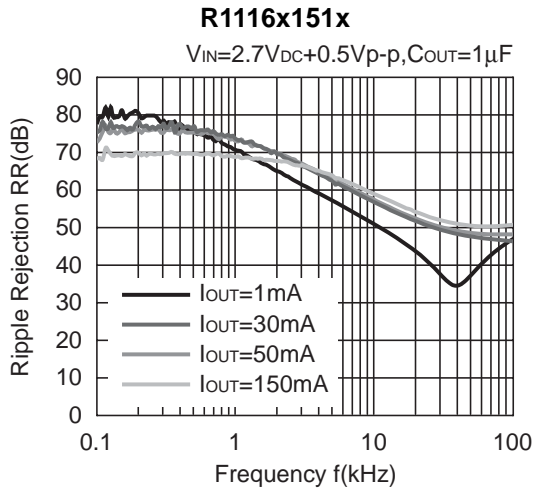


8) Ripple Rejection vs. Input Bias Voltage ( $T_{opt}=25^{\circ}\text{C}$ ,  $C_{IN} = \text{none}$ ,  $C_{OUT} = 1\mu\text{F}$ )

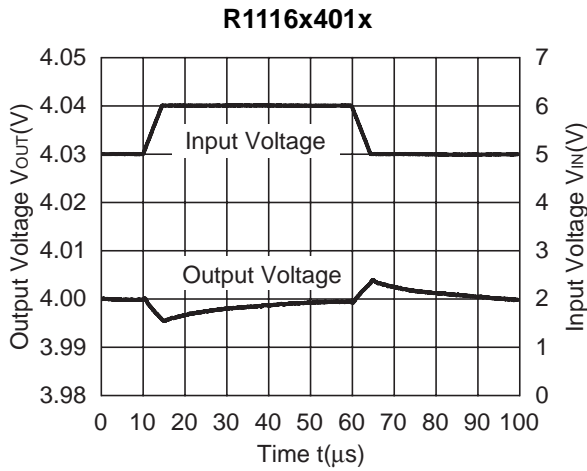
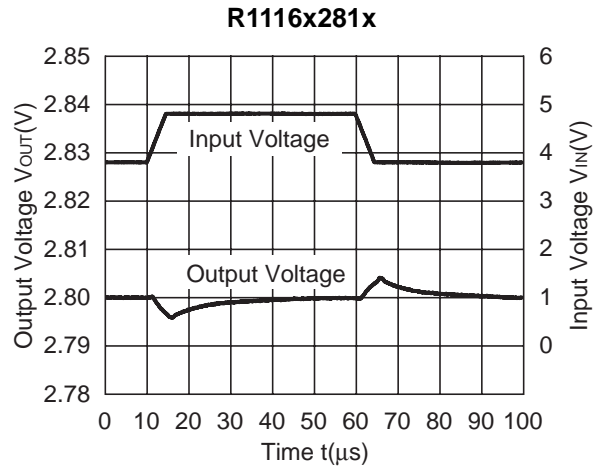
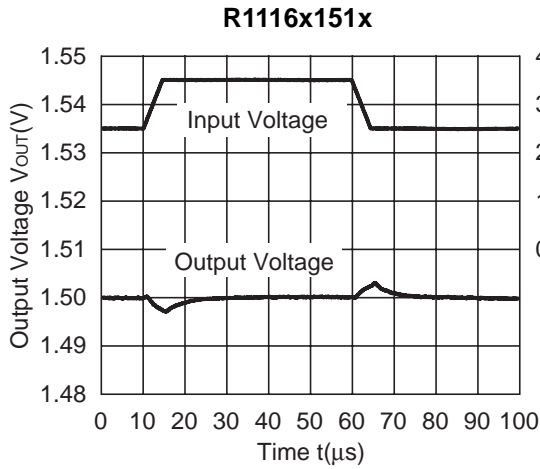


**R1116x**

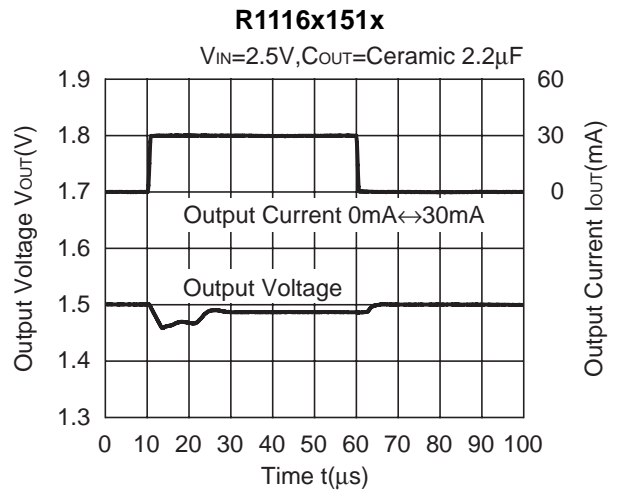
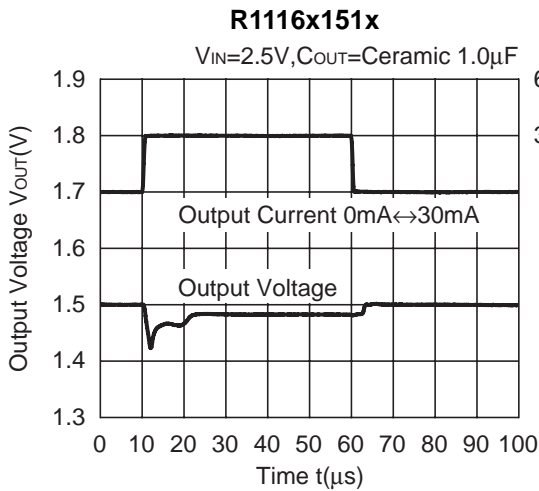
**9) Ripple Rejection vs. Frequency ( $C_{IN}$ =none)**



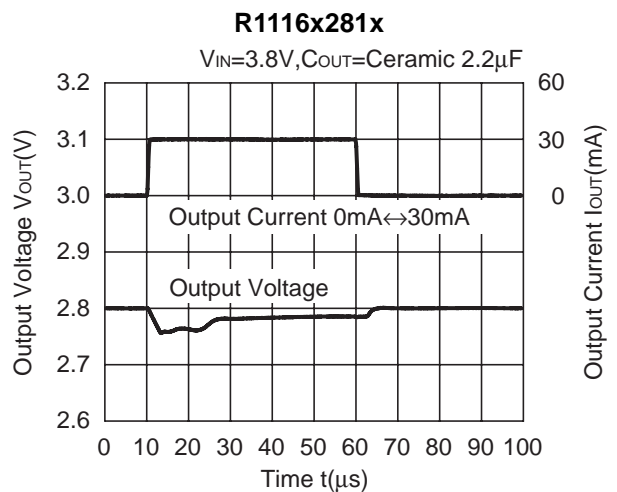
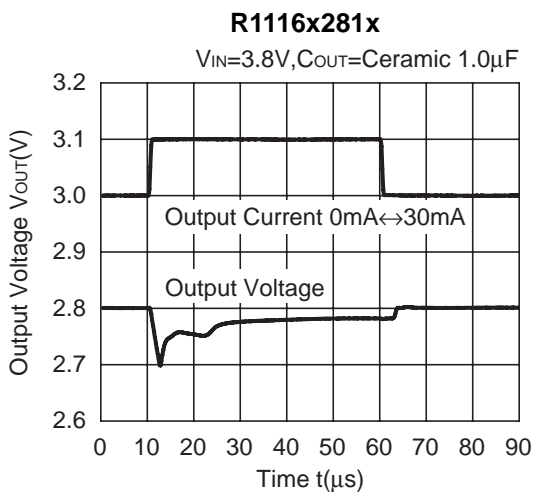
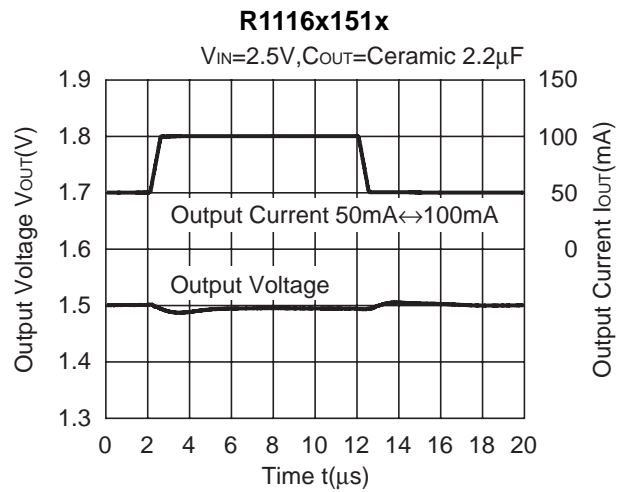
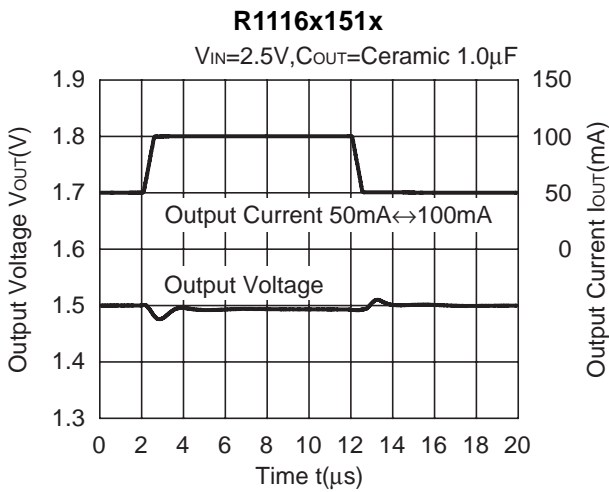
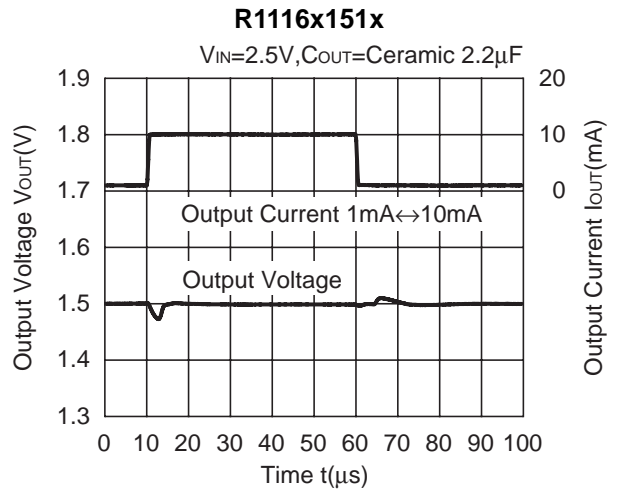
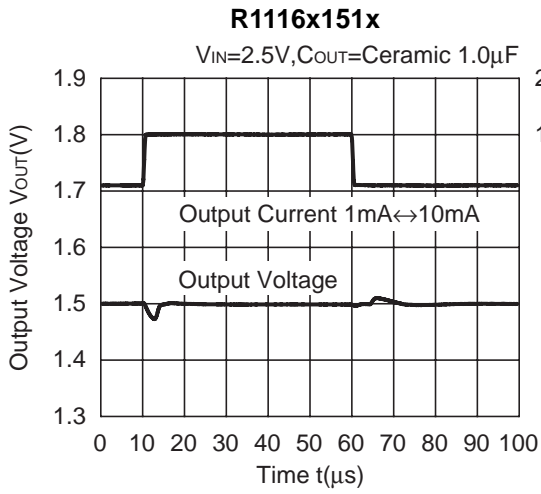
10) Input Transient Response ( $I_{OUT}=30mA$ ,  $C_{IN}=none$ ,  $t_r=t_f=5\mu s$ ,  $C_{OUT}=Ceramic\ 1\mu F$ )



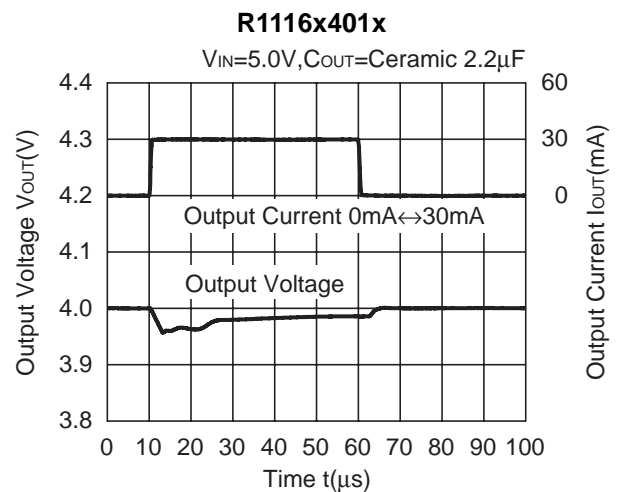
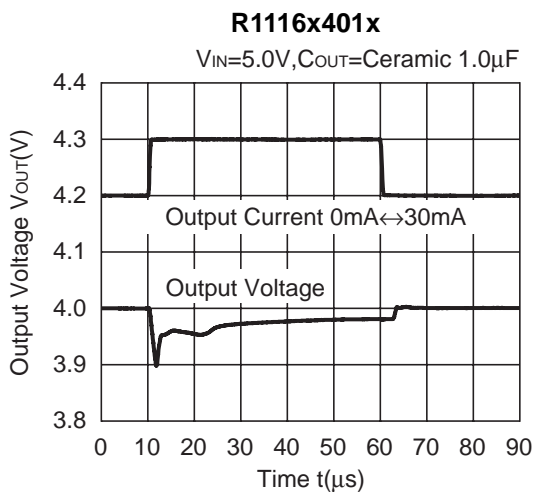
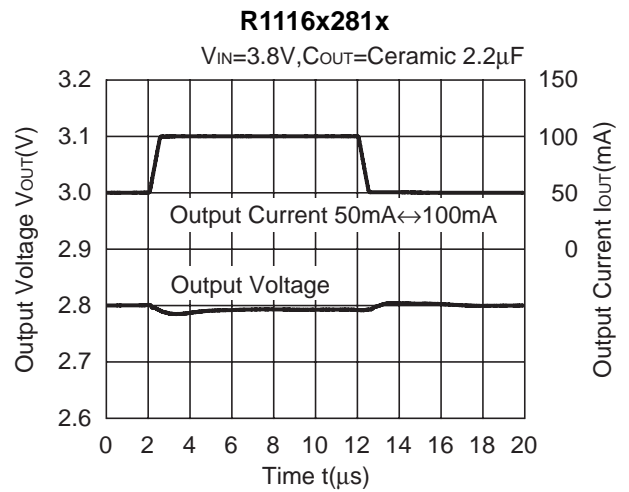
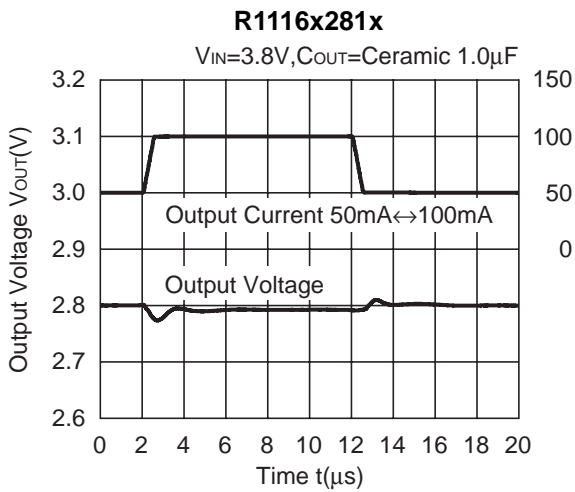
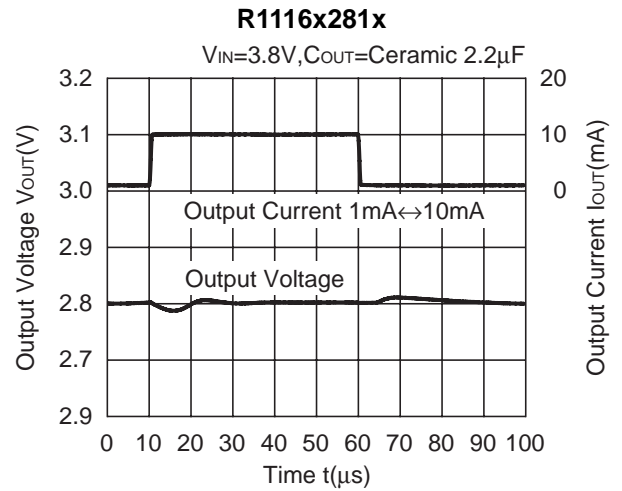
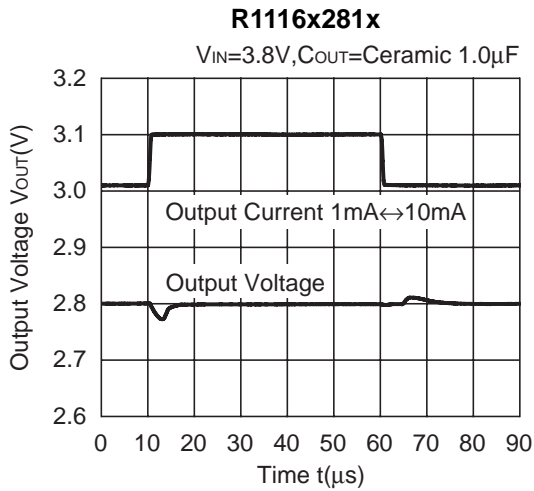
11) Load Transient Response ( $t_r=t_f=0.5\mu s$ ,  $C_{IN}=Ceramic\ 1\mu F$ )



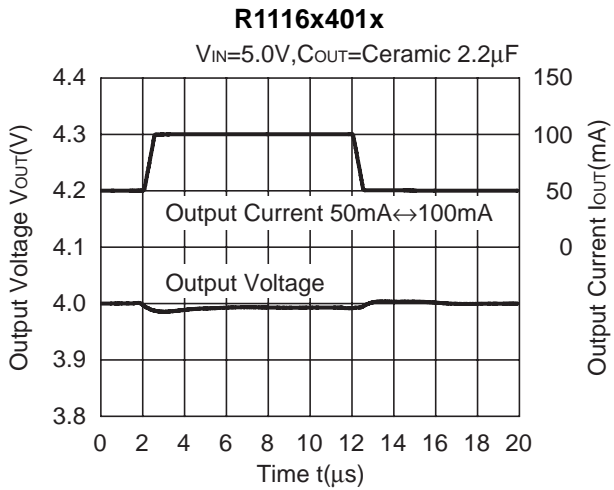
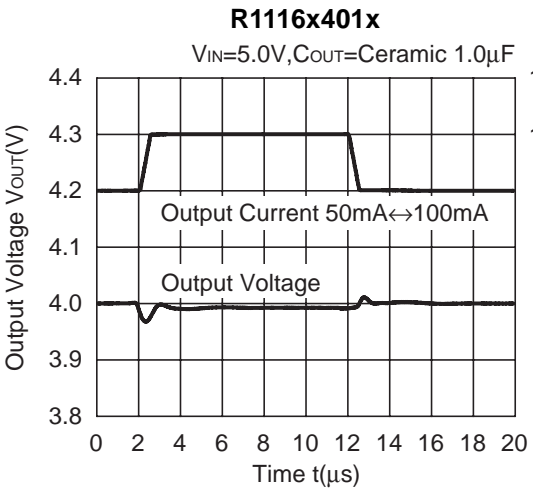
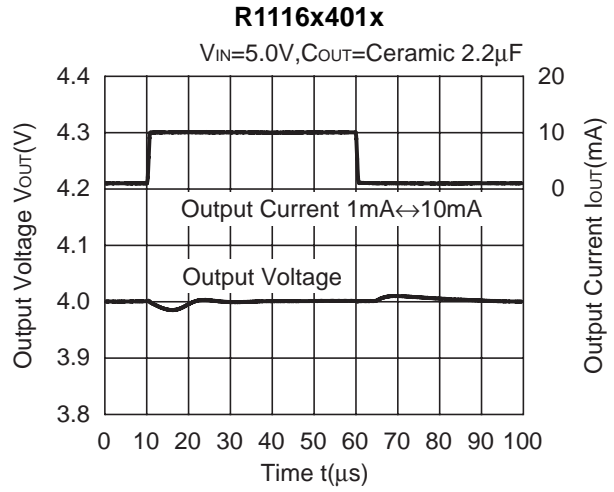
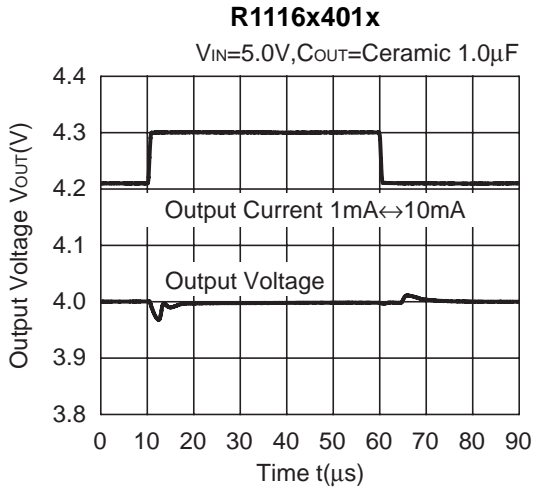
**R1116x**



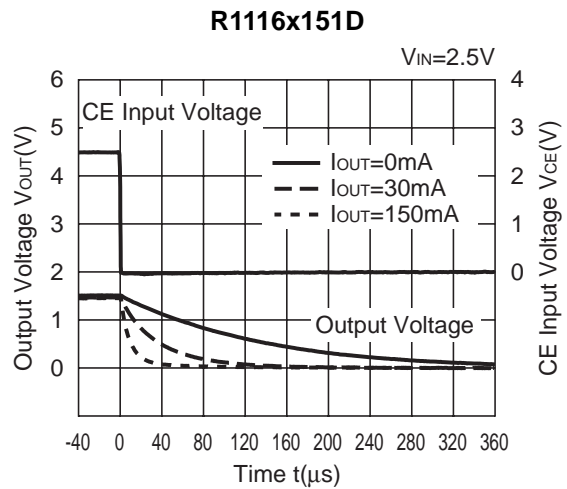
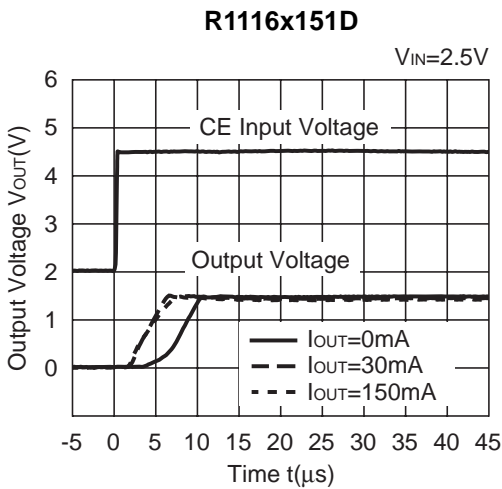




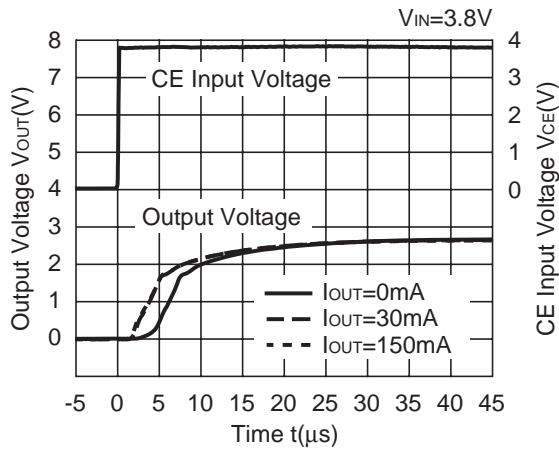
**R1116x**



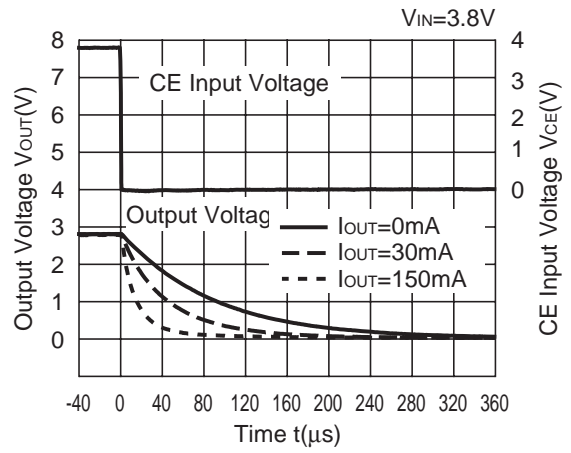
**12) Turn-on/off speed with CE pin (D version) ( $C_{IN}=\text{Ceramic } 1.0\mu F, C_{OUT}=\text{Ceramic } 1.0\mu F$ )**



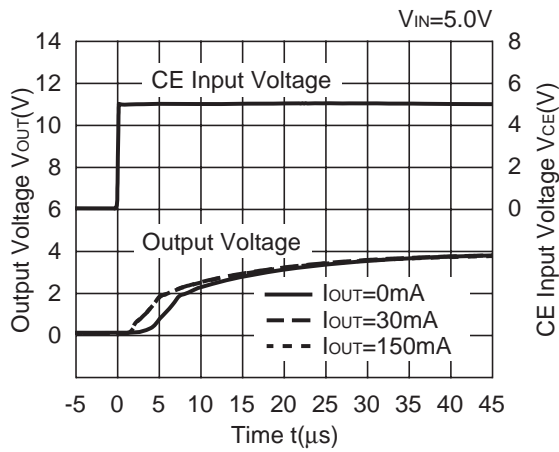
R1116x281D



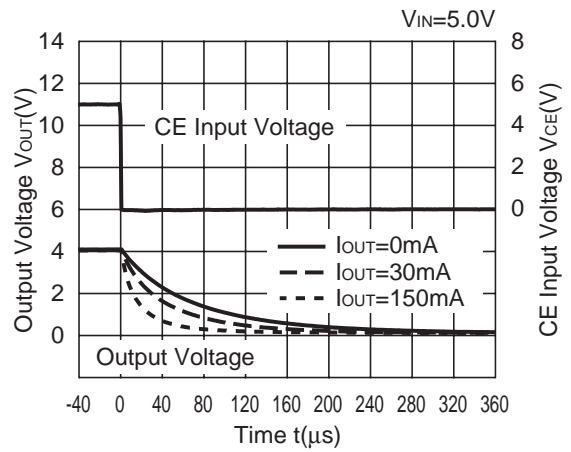
R1116x281D



R1116x401D

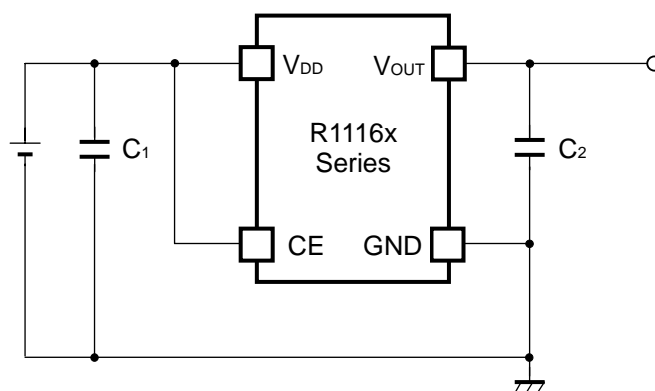


R1116x401D



## R1116x

### TECHNICAL NOTES



(External Components)

C<sub>2</sub> Ceramic 1.0 $\mu$ F Ex. Murata GRM155B30J105KE18B  
Kyocera CM05X5R105K06AB

C<sub>1</sub> Ceramic 1.0 $\mu$ F

When using these ICs, consider the following points:

#### 1. Mounting on PCB

Make V<sub>DD</sub> and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor with a capacitance value as much as 1.0 $\mu$ F or more as C<sub>1</sub> between V<sub>DD</sub> and GND pin, and as close as possible to the pins.

Set external components, especially the output capacitor, as close as possible to the ICs, and make wiring as short as possible.

#### 2. Phase Compensation

In these ICs, phase compensation is made for securing stable operation even if the load current is varied. For this purpose, use a capacitor C<sub>2</sub> with good frequency characteristics and ESR (Equivalent Series Resistance). (Note: If additional ceramic capacitors are connected with parallel to the output pin with an output capacitor for phase compensation, the operation might be unstable. Because of this, test these ICs with as same external components as ones to be used on the PCB.)

If you use a tantalum type capacitor and ESR value of the capacitor is large, output might be unstable. Evaluate your circuit with considering frequency characteristics.

Depending on the capacitor size, manufacturer, and part number, the bias characteristics and temperature characteristics are different. Evaluate the circuit with actual using capacitors.

## ESR vs. Output Current

When using these ICs, consider the following points:

The relations between  $I_{OUT}$  (Output Current) and ESR of an output capacitor are shown below.

The conditions when the white noise level is under  $40\mu\text{V}$  (Avg.) are marked as the hatched area in the graph.

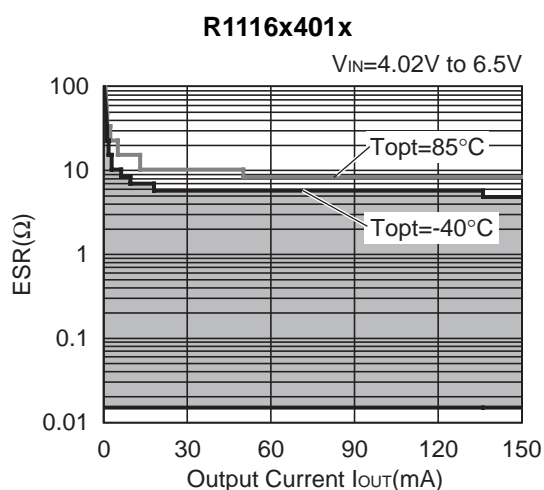
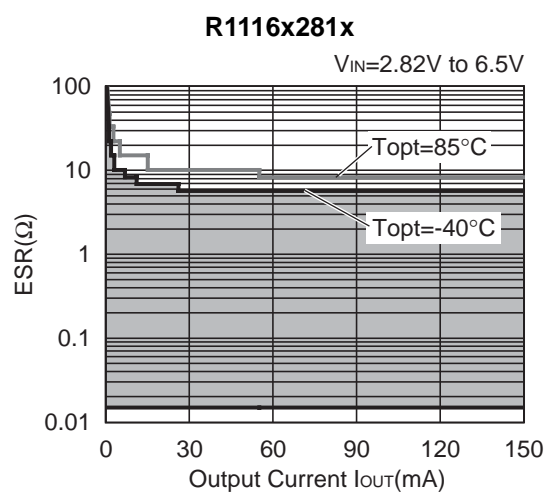
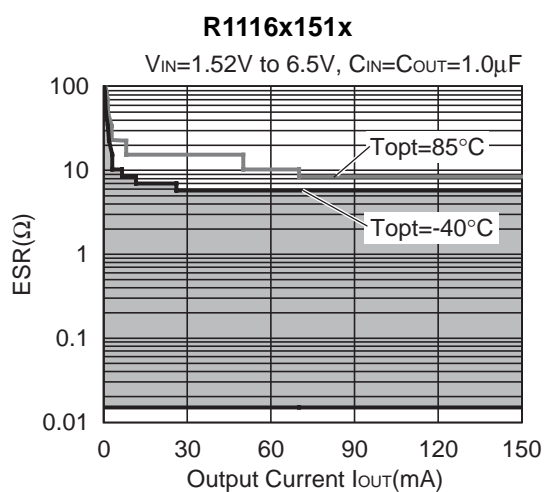
### Measurement conditions

$V_{IN}=V_{OUT}+1\text{V}$

$C_{OUT}$ : GRM155B30J105KE18B

Frequency Band: 10Hz to 2MHz

Temperature:  $-40^{\circ}\text{C}$  to  $25^{\circ}\text{C}$





1. The products and the product specifications described in this document are subject to change or discontinuation of production without notice for reasons such as improvement. Therefore, before deciding to use the products, please refer to Ricoh sales representatives for the latest information thereon.
2. The materials in this document may not be copied or otherwise reproduced in whole or in part without prior written consent of Ricoh.
3. Please be sure to take any necessary formalities under relevant laws or regulations before exporting or otherwise taking out of your country the products or the technical information described herein.
4. The technical information described in this document shows typical characteristics of and example application circuits for the products. The release of such information is not to be construed as a warranty of or a grant of license under Ricoh's or any third party's intellectual property rights or any other rights.
5. The products listed in this document are intended and designed for use as general electronic components in standard applications (office equipment, telecommunication equipment, measuring instruments, consumer electronic products, amusement equipment etc.). Those customers intending to use a product in an application requiring extreme quality and reliability, for example, in a highly specific application where the failure or misoperation of the product could result in human injury or death (aircraft, spacevehicle, nuclear reactor control system, traffic control system, automotive and transportation equipment, combustion equipment, safety devices, life support system etc.) should first contact us.
6. We are making our continuous effort to improve the quality and reliability of our products, but semiconductor products are likely to fail with certain probability. In order to prevent any injury to persons or damages to property resulting from such failure, customers should be careful enough to incorporate safety measures in their design, such as redundancy feature, fire containment feature and fail-safe feature. We do not assume any liability or responsibility for any loss or damage arising from misuse or inappropriate use of the products.
7. Anti-radiation design is not implemented in the products described in this document.
8. Please contact Ricoh sales representatives should you have any questions or comments concerning the products or the technical information.



**Ricoh is committed to reducing the environmental loading materials in electrical devices with a view to contributing to the protection of human health and the environment.**

Ricoh has been providing RoHS compliant products since April 1, 2006 and Halogen-free products since April 1, 2012.

**RICOH** RICOH ELECTRONIC DEVICES CO., LTD.

<http://www.e-devices.ricoh.co.jp/en/>

#### Sales & Support Offices

##### **RICOH ELECTRONIC DEVICES CO., LTD.**

**Higashi-Shinagawa Office (International Sales)**  
3-32-3, Higashi-Shinagawa, Shinagawa-ku, Tokyo 140-8655, Japan  
Phone: +81-3-5479-2857 Fax: +81-3-5479-0502

##### **RICOH EUROPE (NETHERLANDS) B.V.**

**Semiconductor Support Centre**  
Prof. W.H. Keesomlaan 1, 1183 DJ Amstelveen, The Netherlands  
Phone: +31-20-5474-309

##### **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 Bilbo 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 CO., LTD.**

**Taipei office**  
Room 109, 10F-1, No.51, Hengyang Rd., Taipei City, Taiwan (R.O.C.)  
Phone: +886-2-2313-1621/1622 Fax: +886-2-2313-1623

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Ricoch Electronics:](#)

[R1116N331D-TR-FE](#)



Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

**Телефон:** 8 (812) 309 58 32 (многоканальный)

**Факс:** 8 (812) 320-02-42

**Электронная почта:** [org@eplast1.ru](mailto:org@eplast1.ru)

**Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.