300mA LDO REGULATOR with the Reverse Current Protection

NO.EA-229-111026

OUTLINE

R1191x Series are a low supply current voltage regulator with high output voltage accuracy. The maximum operating voltage is 16V. These ICs can switch to the fast mode and the low power mode by the low power / fast mode changer pin (ECO pin) without changing the output voltage value.

Each of these ICs consists of a voltage reference unit, an error amplifier, a resistor-net for voltage setting, a short current limit circuit, a thermal shutdown circuit and a chip enable circuit.

Moreover, the R1191x Series has the reverse current protection function, which protects the reverse current flow into V_{DD} pin when the output pin voltage becomes higher than the V_{DD} pin voltage. Thus it is suitable for the back-up circuit.

Since the packages for these ICs are SOT-89-5, SOT-23-5 and DFN1616-6, therefore high density mounting of the ICs on boards is possible.

FEATURES

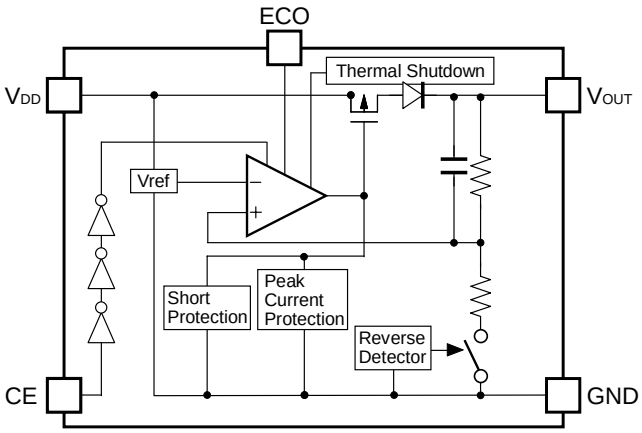
- Supply Current ..... Typ. 50μA (Fast Mode),
  Typ. 6.0μA (Low Power Mode)
- Standby Mode ..... Typ. 0.3μA
- Reverse Current..... Max. 0.1μA
- Output Current ..... Min. 300mA
- Input Voltage Range ..... 3.5V to 16.0V
- Output Voltage Range..... 2.0V to 15.0V (0.1V steps)
  (For other voltages, please refer to MARK INFORMATIONS.)
- Output Voltage Accuracy..... ±1.5% (Fast Mode)
  ±2.5% (Low Power Mode)
- Temperature-Drift Coefficient of Output Voltage .. Typ. ±80ppm/°C
- Dropout Voltage ..... Typ. 0.55V (Fast Mode, I_{OUT}=300mA ,V_{OUT}=5.0V)
  Typ. 0.70V (Low Power Mode, I_{OUT}=300mA,V_{OUT}=5.0V)
- Ripple Rejection..... Typ. 60dB (f=1kHz,V_{OUT}=5.0V, Fast Mode)
- Line Regulation ..... Typ. 0.02%/V (Fast Mode)
- Packages DFN1616-6, SOT-23-5, SOT-89-5
- Built-in fold-back protection circuit ..... Typ. 50mA (Current at short mode)
- Built-in Thermal Shutdown Circuit..... Shutdown Temperature at 150°C
- Ceramic capacitors are recommended to be used with this IC ····C_{IN}=2.2μF or more, C_{OUT}=4.7μF or more

APPLICATIONS

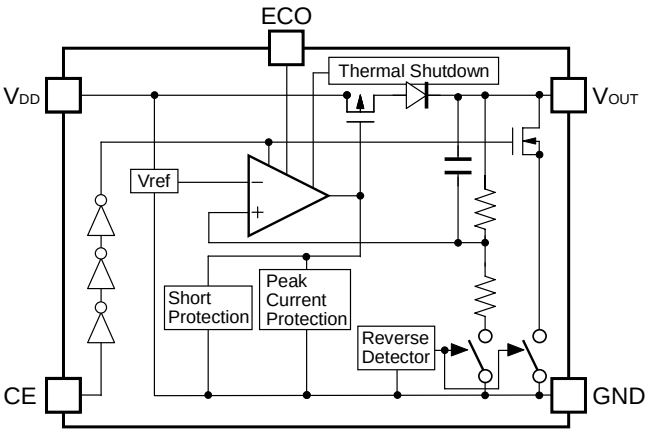
- Power source for digital home appliances
- Power source for audio visual equipment

BLOCK DIAGRAM

R1191xxxxB



R1191xxxxD



SELECTION GUIDE

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

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1191Lxxx∗-TR	DFN1616-6	5,000 pcs	Yes	Yes
R1191Nxxx∗-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes
R1191Hxxx∗-T1-FE	SOT-89-5	1,000 pcs	Yes	Yes

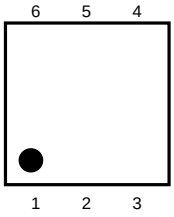
xxx : The output voltage can be designated in the range from 2.0V(020) to 15.0V(150) in 0.1V steps.
(For other voltages, please refer to MARK INFORMATIONS.)

∗ : The auto discharge function at off state are options as follows.
(B) without auto discharge function at off state.
(D) with auto discharge function at off state.

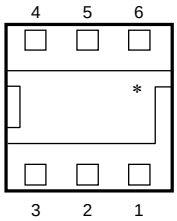
PIN CONFIGURATIONS

● **DFN1616-6*[1]**

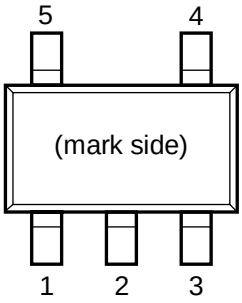
Top View



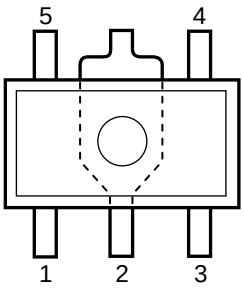
Bottom View



● **SOT-23-5**



● **SOT-89-5**



PIN DISCRIPTIONS

● **DFN1616-6*[1]**

Pin No	Symbol	Pin Description
1	ECO	Low Power / Fast Mode Changer Pin ("H": Fast Mode)
2	NC	No Connection
3	V_{DD}	Input Pin
4	V_{OUT}	Output pin
5	GND	Ground Pin
6	CE	Chip Enable Pin ("H" Active)

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

● **SOT-23-5**

Pin No	Symbol	Pin Description
1	ECO	Low Power / Fast Mode Changer Pin ("H": Fast Mode)
2	GND	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
4	V_{OUT}	Output pin
5	V_{DD}	Input Pin

● **SOT-89-5**

Pin No	Symbol	Pin Description
1	V_{OUT}	Output pin
2	GND	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
4	ECO	Low Power / Fast Mode Changer Pin ("H": Fast Mode)
5	V_{DD}	Input Pin

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	−0.3 to 18.0	V
V_{CE}	Input Voltage (CE Pin)	−0.3 to 18.0	V
V_{ECO}	Input Voltage (ECO Pin)	−0.3 to V_{IN} + 0.3 ≤ 18.0	V
V_{OUT}	Output Voltage	−0.3 to 18.0	V
I_{OUT}	Output Current	400	mA
P_D	Power Dissipation (DFN1616-6)*	640	mW
	Power Dissipation (SOT-23-5)*	420	
	Power Dissipation (SOT-89-5)*	900	
Topt	Operating Temperature Range	−40 to +85	°C
Tstg	Storage Temperature Range	−55 to +125	°C

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

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause the permanent damages and may degrade the life time and safety for both device and system using the device in the field.
The functional operation at or over these absolute maximum ratings is not assured.

RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

ELECTRICAL CHARACTERISTICS

V_{IN}=V_{CE}=Set V_{OUT}+3.0V (Max.16V), C_{IN}=2.2µF, C_{OUT}=4.7µF I_{OUT}=1mA, unless otherwise noted.
The values in ☐ are applicable under the condition of −40°C ≤ Topt ≤ 85°C.

R1191xxxxB/D Topt=25°C

Symbol	Item		Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	Fast Mode	V_{ECO}=V_{IN}	Topt=25°C	×0.985		×1.015	V
				−40°C ≤ Topt ≤ 85°C	☐×0.970		☐×1.030	
		Low Power Mode	V_{ECO}=0V	Topt=25°C	×0.975		×1.025	
				−40°C ≤ Topt ≤ 85°C	☐×0.960		☐×1.040	
ΔV_{OUT}	Output Voltage Deviation between Fast Mode and Low Power Mode				☐−1.5	0	☐1.5	%
I_{OUT}	Output Current				☐300			mA
ΔV_{OUT}/ ΔI_{OUT}	Load Regulation	Fast Mode	V_{ECO}=V_{IN}, 1mA ≤ I_{OUT} ≤ 300mA			50	☐120	mV
		Low Power Mode	V_{ECO}=GND, 1mA ≤ I_{OUT} ≤ 300mA			60	☐130	
V_{DIF}	Dropout Voltage		Refer to the following table					
I_{SS1}	Supply Current (Fast Mode)		V_{ECO}=V_{IN}, I_{OUT}=0mA			50	☐100	µA
I_{SS2}	Supply Current (Low Power Mode)		V_{ECO}=GND, I_{OUT}=0mA			6	☐15	µA
Istandby	Supply Current (Standby)		V_{IN}=16V, V_{CE}=0V (If V_{OUT} < 3.0V, V_{IN}=14V)			0.3	1.0	µA
ΔV_{OUT}/ ΔV_{IN}	Line Regulation		Set V_{OUT}+0.5V ≤ V_{IN} ≤ 16V (If Set V_{OUT} < 3.0V, 3.5V ≤ V_{IN} ≤ 14V)			0.02	☐0.10	%/V
RR	Ripple Rejection		f=1kHz, I_{OUT}=30mA Ripple 0.2Vp-p, V_{IN}=V_{ECO}= Set V_{OUT}+1V	2.0V≤V_{OUT}<5.0V		70		dB
				5.0V≤V_{OUT}<12V		60		
				12V ≤ V_{OUT}		60		
V_{IN}	Input Voltage		2.0V ≤ V_{OUT} < 3.0V		☐3.5		☐14.0	V
			3.0V ≤ V_{OUT}				☐16.0	
ΔV_{OUT}/ ΔTopt	Output Voltage Temperature Coefficient		−40°C ≤ Topt ≤ 85°C			±80		ppm /°C
I_{SC}	Short Current Limit		V_{OUT}=0V			50		mA
V_{CEH}	CE, ECO Input Voltage "H"				☐1.6		V_{IN}	V
V_{CEL}	CE, ECO Input Voltage "L"				0		☐0.6	V
T_{TSD}	Thermal Shutdown Temperature		Junction Temperature			150		°C
T_{TSR}	Thermal Shutdown Released Temperature		Junction Temperature			130		°C
R_{LOW}	Low Output Nch Tr. ON Resistance (of D Version)		V_{IN}=5V, V_{CE}=0V, V_{OUT}=0.3V			150		Ω
I_{REV}	Reverse Current		V_{OUT}> 0.6V, 0V ≤ V_{IN} ≤ 16V			0	☐0.1	µA

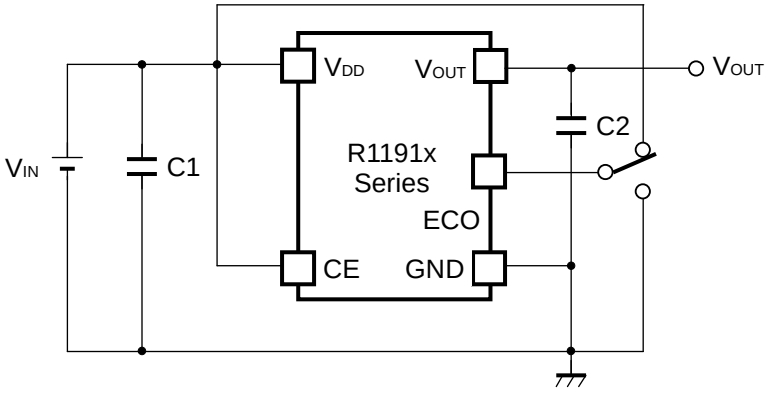
∗) The values in ☐ have been tested and guaranteed by Design Engineering.
All test categories were tested on the products under the pulse load condition (Tj≈Ta=25°C) except the following test categories: ripple rejection, output voltage temperature coefficient, and thermal shutdown.

ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE

Topt=25°C

Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)				
	Condition	ECO="H"		ECO="L"	
		Typ.	Max.	Typ.	Max.
2.0 ≤ V_{OUT} < 2.5	I_{OUT}=300mA	1.20	1.80	2.5	3.0
2.5 ≤ V_{OUT} < 3.3		1.00	1.50	2.0	2.5
3.3 ≤ V_{OUT} < 5.0		0.75	1.00	1.5	1.8
5.0 ≤ V_{OUT} < 12.0		0.55	0.75	0.7	1.0
12.0 ≤ V_{OUT}		0.40	0.60	0.4	0.6

TYPICAL APPLICATION



(External Components)

Ex. C1: Ceramic Capacitor 2.2μF Murata GRM32RB11E225KC01B
C2: Ceramic Capacitor 4.7μF Murata GCM31CR71E475KA40

TECHNICAL NOTES

When using these ICs, consider the following points:

- **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 C2 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.)

- **PCB Layout**

Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C1 with a capacitance value as much as 2.2μF or more between V_{DD} and GND pin, and as close as possible to the pins.

Set external components, especially the capacitor C2, as close as possible to the ICs, and make wiring as short as possible.

- **Thermal Shutdown Function**

There is the built-in thermal-shutdown function in R1191x series. It discontinues operation of the IC when the junction temperature becomes over 150°C (Typ.) and IC re-operates when the junction temperature under 130°C (Typ.). If the temperature increasing keeps the IC repeats ON and OFF operating. The output becomes the pulse condition.

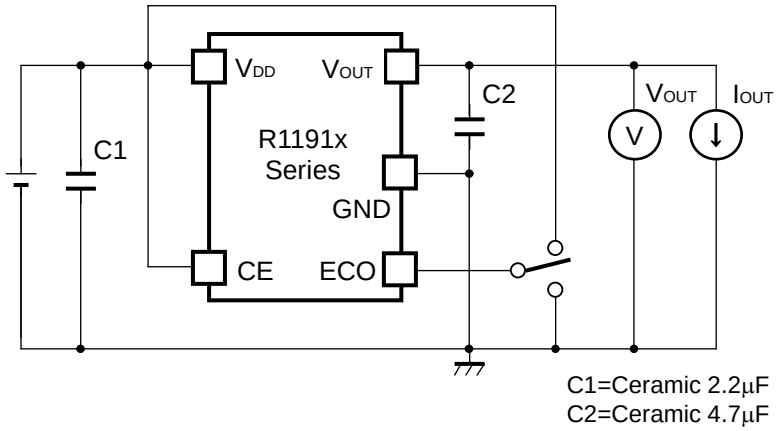
- **Chip Enable (CE) Circuit and High-speed/ Low Supply Current Switching (ECO) Circuit**

To maintain the stability of the output voltage, please do not use the intermediate electric potentials (the voltage values between V_{CEH} and V_{CEL}) for the CE pin and the ECO pin. The use of the intermediate electric potentials increases the supply current and causes the unstable output voltage.

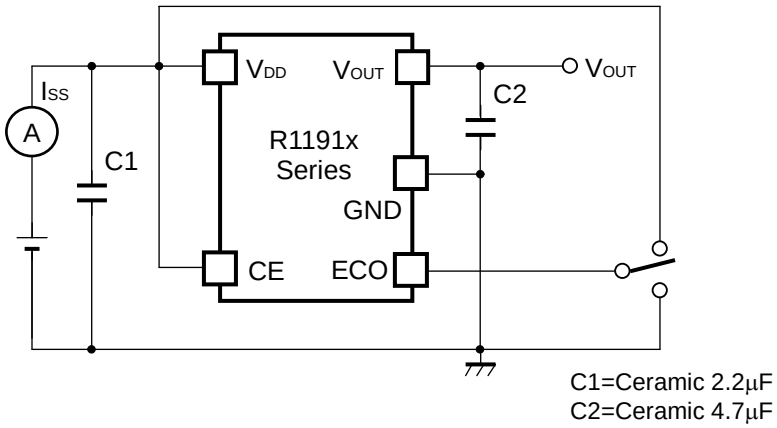
- **Auto-discharge Function**

R1191xxxxD has adopted Auto-discharge function, which decreases the output voltage quickly to 0V by turning on the transistor between V_{OUT} pin and GND pin when switching “Active” to “Standby” and releases the electrical charges accumulated in the external capacitor.

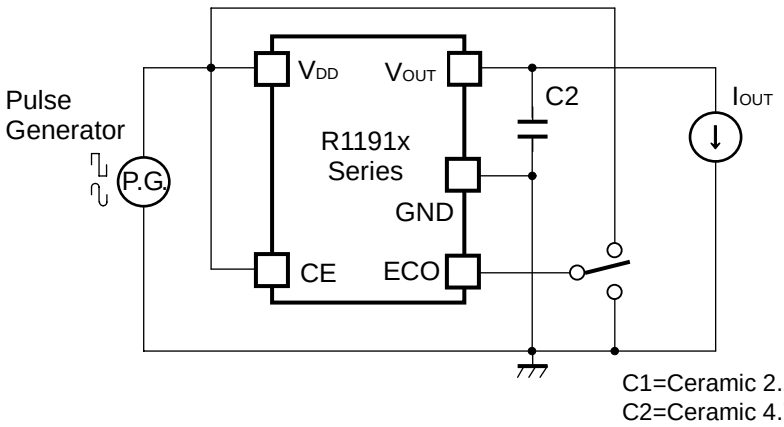
TEST CIRCUITS



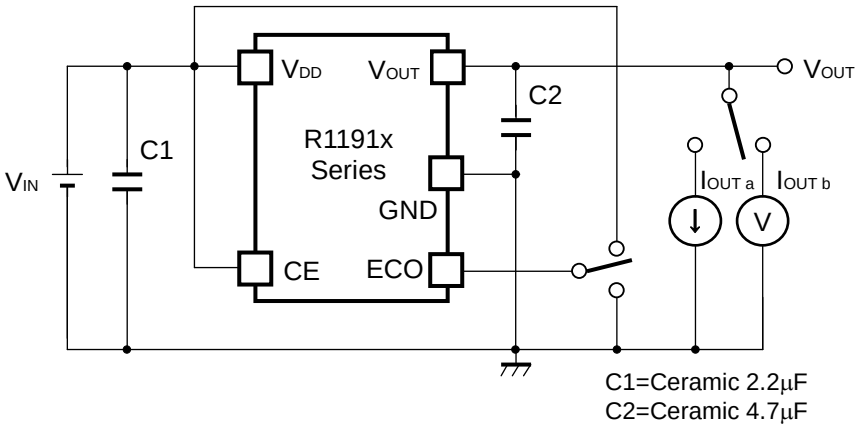
Basic Test Circuit



Test Circuit for Supply Current



Test Circuit for Ripple Rejection

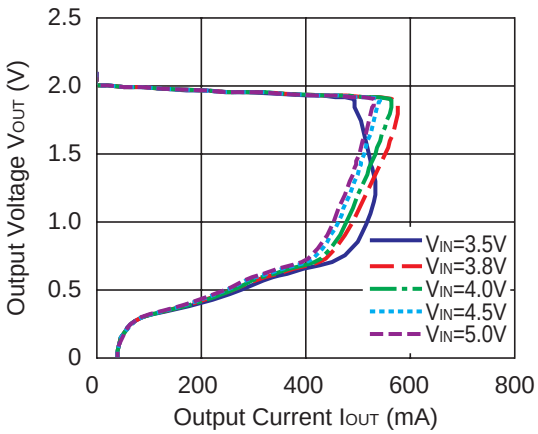


Test Circuit for Load Transient Response

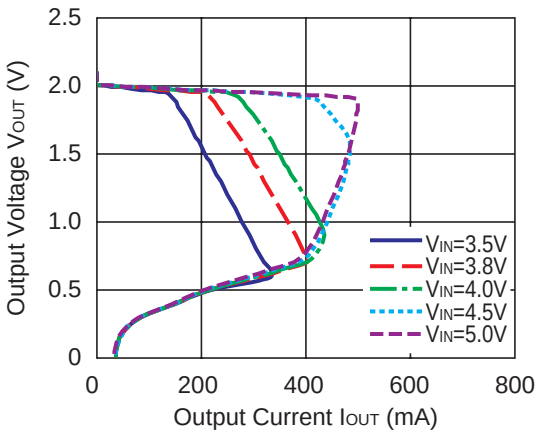
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current (C1=2.2µF, C2=4.7µF, Topt=25°C)

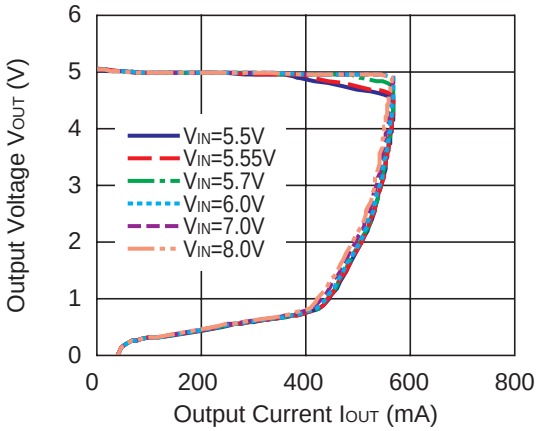
R1191x020x ECO=H



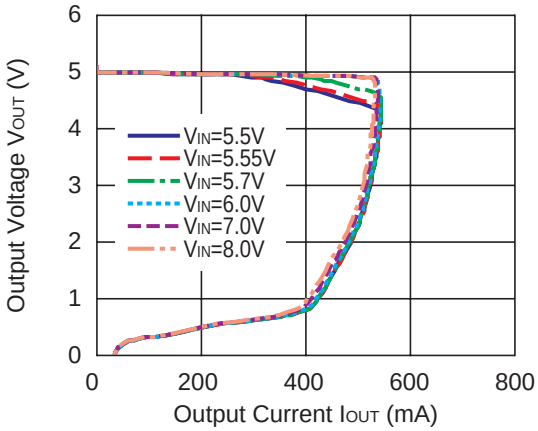
R1191x020x ECO=L



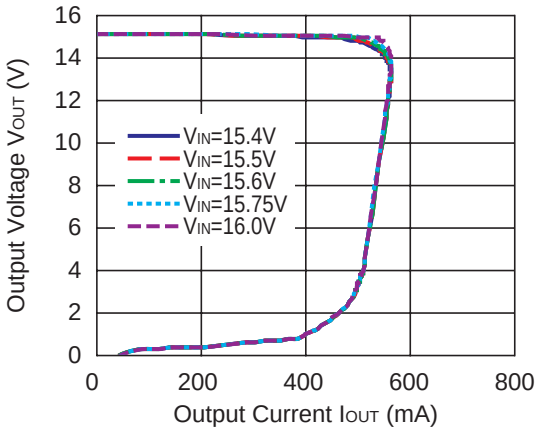
R1191x050x ECO=H



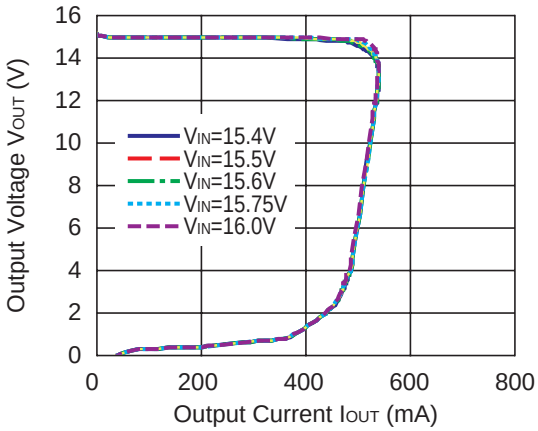
R1191x050x ECO=L



R1191x150x ECO=H

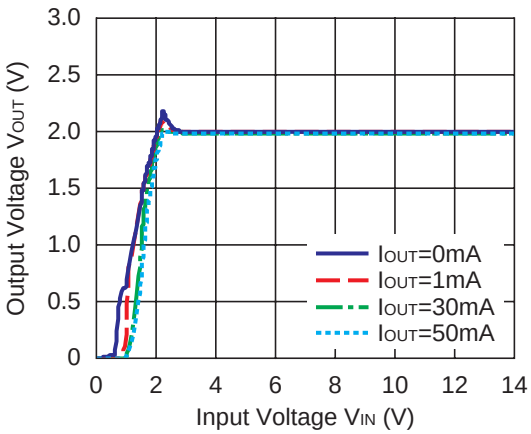


R1191x150x ECO=L

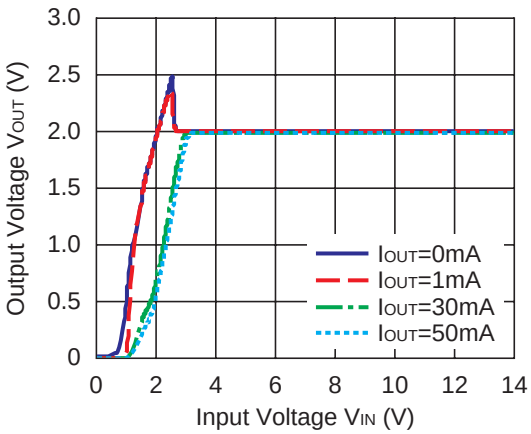


2) Output Voltage vs. Input Voltage (C1=2.2μF, C2=4.7μF, Topt=25°C)

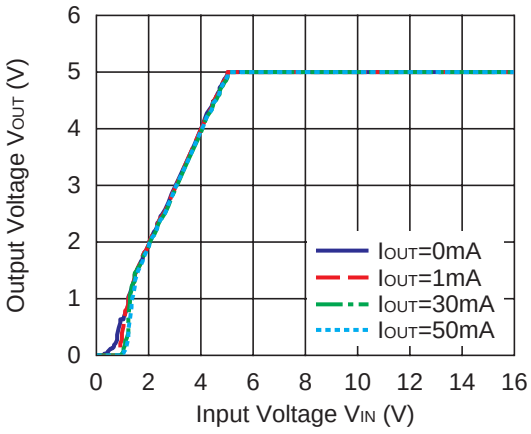
R1191x020x ECO=H



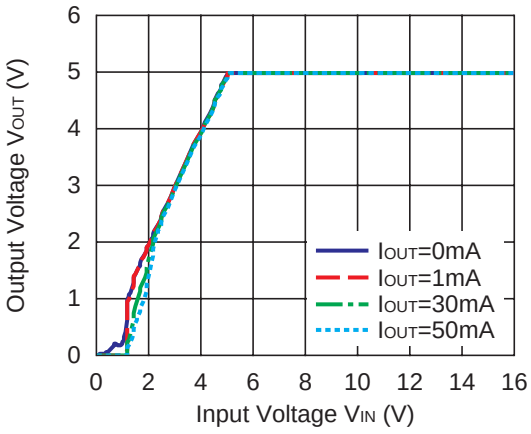
R1191x020x ECO=L



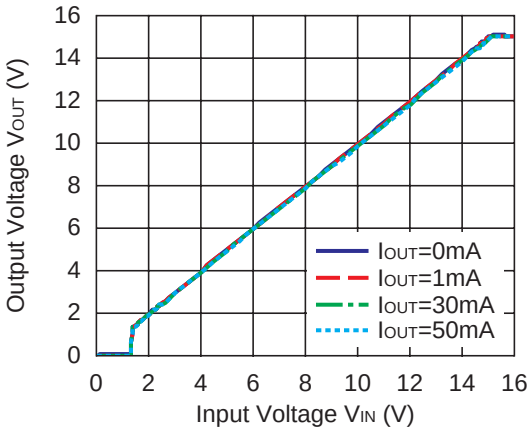
R1191x050x ECO=H



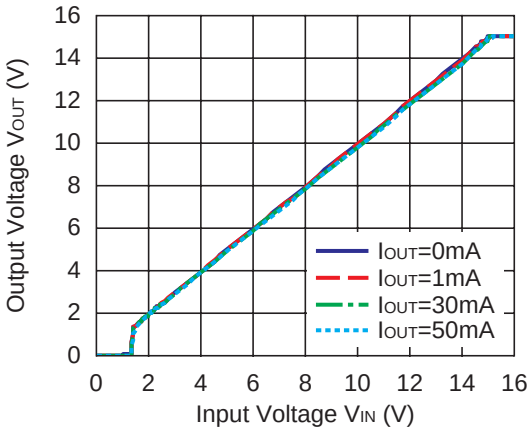
R1191x050x ECO=L



R1191x150x ECO=H

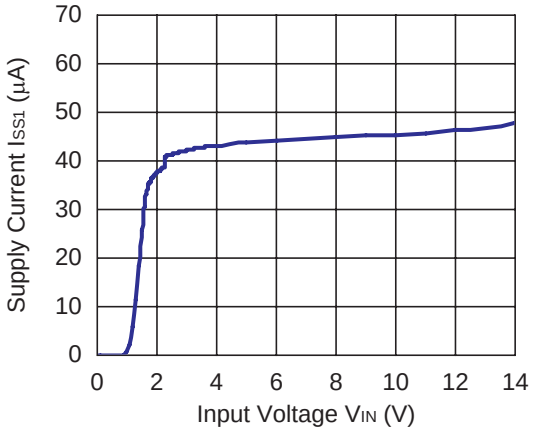


R1191x150x ECO=L

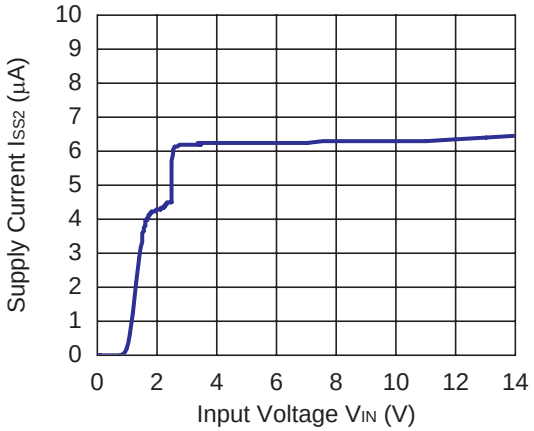


3) Supply Current vs. Input Voltage (C1=2.2μF, C2=4.7μF, Topt=25°C)

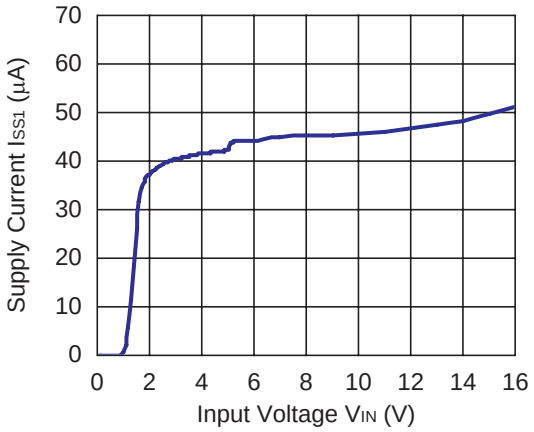
R1191x020x ECO=H



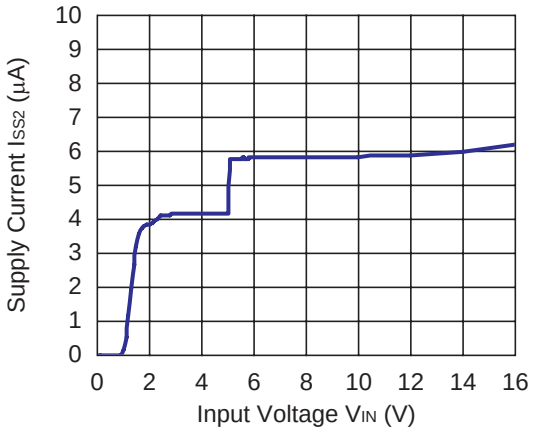
R1191x020x ECO=L



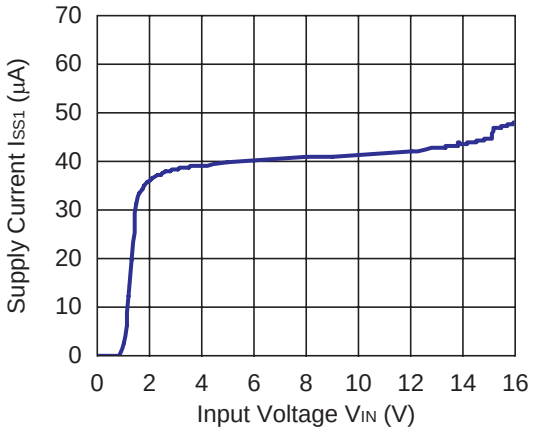
R1191x050x ECO=H



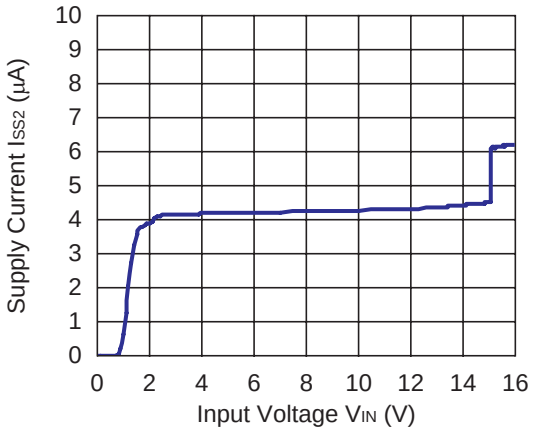
R1191x050x ECO=L



R1191x150x ECO=H

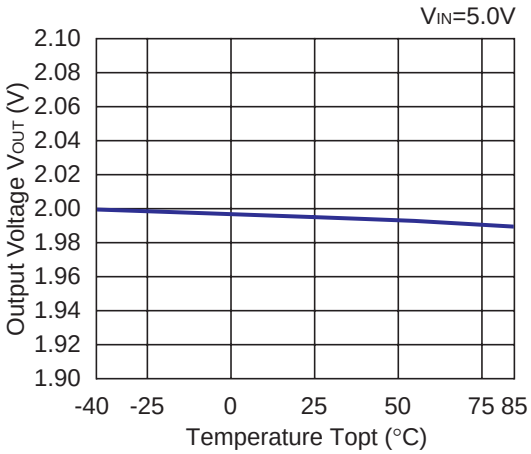


R1191x150x ECO=L

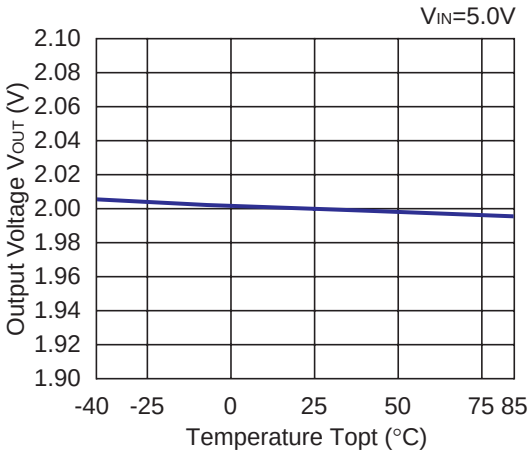


4) Output Voltage vs. Temperature (C1=2.2μF, C2=4.7μF, I_{OUT}=1mA)

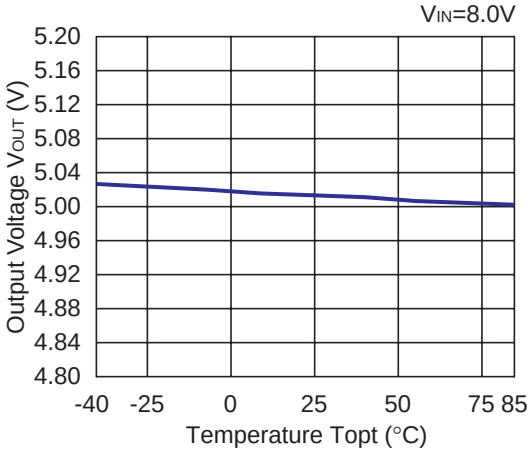
R1191x020x ECO=H



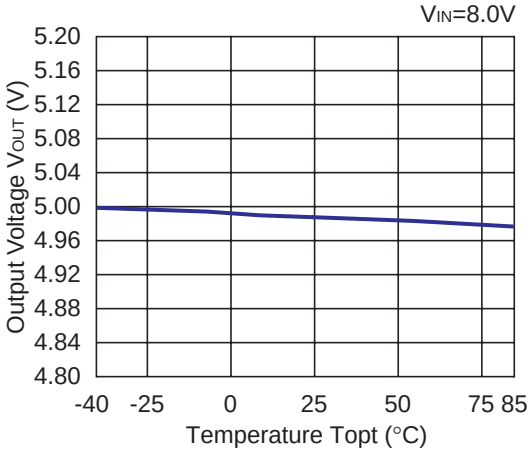
R1191x020x ECO=L



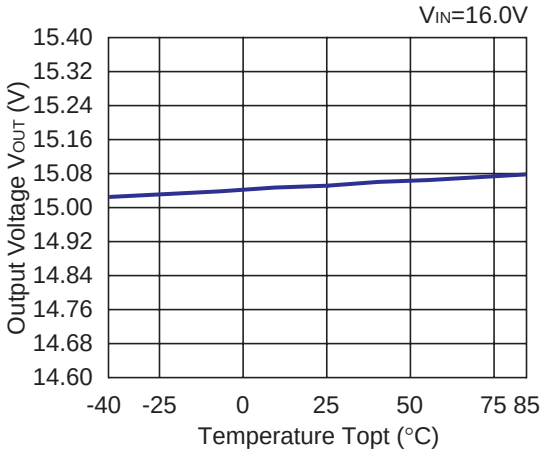
R1191x050x ECO=H



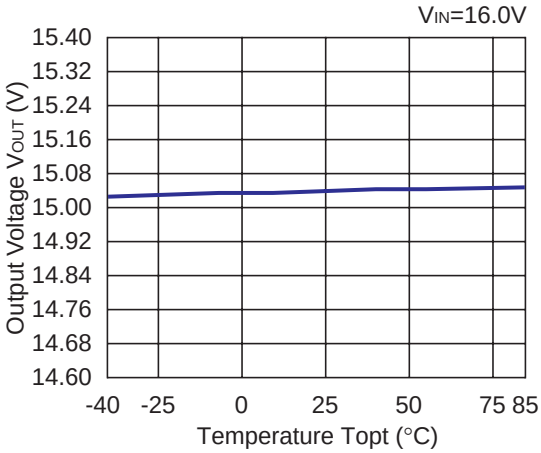
R1191x050x ECO=L



R1191x150x ECO=H

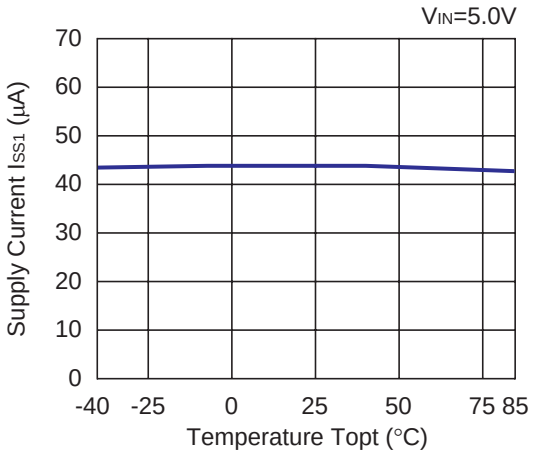


R1191x150x ECO=L

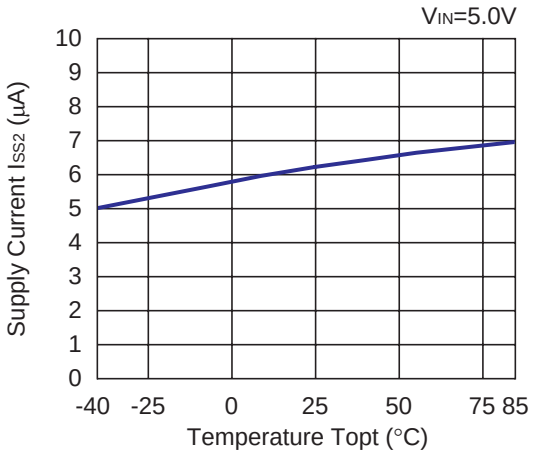


5) Supply Current vs. Temperature (C1=2.2μF, C2=4.7μF)

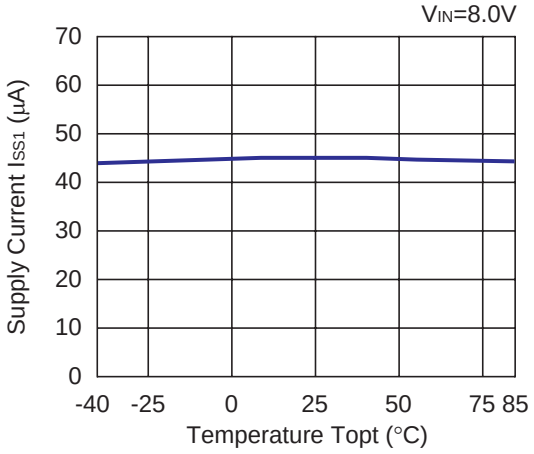
R1191x020x ECO=H



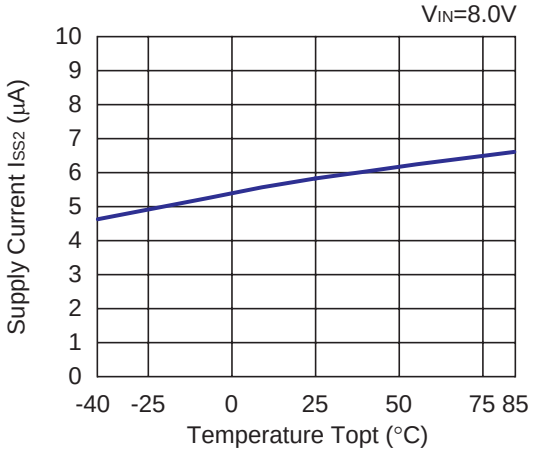
R1191x020x ECO=L



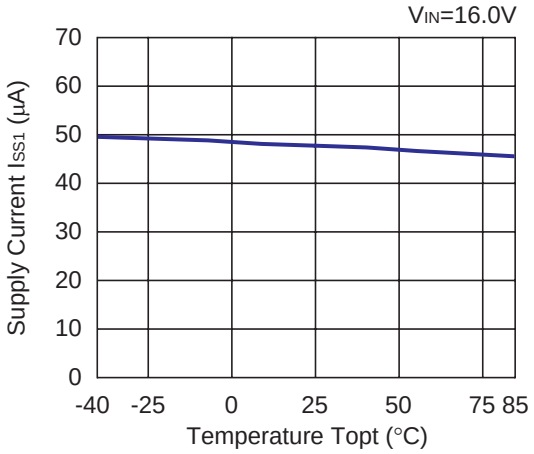
R1191x050x ECO=H



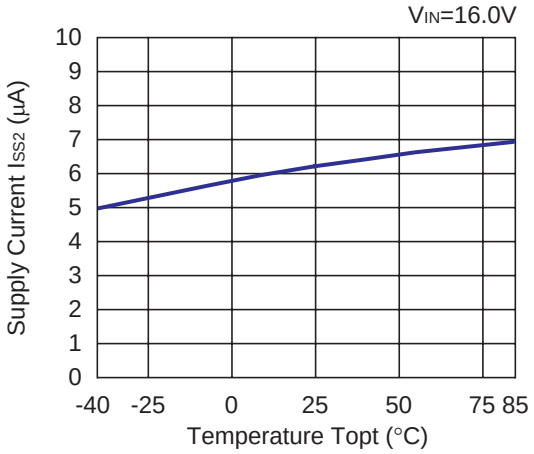
R1191x050x ECO=L



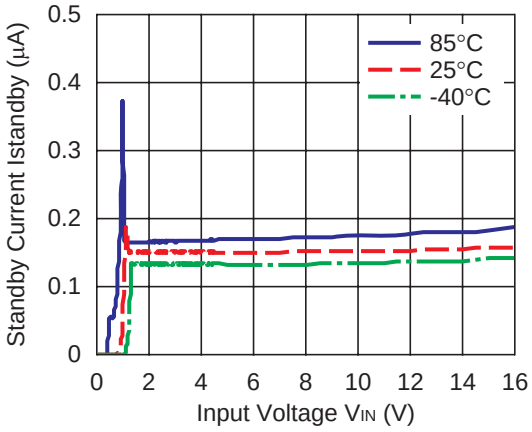
R1191x150x ECO=H



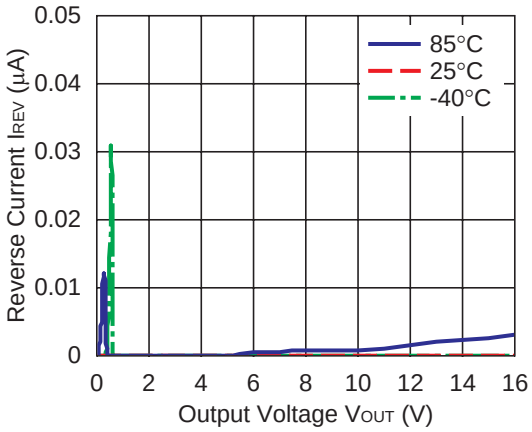
R1191x150x ECO=L



6) Standby Current vs. Input Voltage (C1=2.2µF, C2=4.7µF)

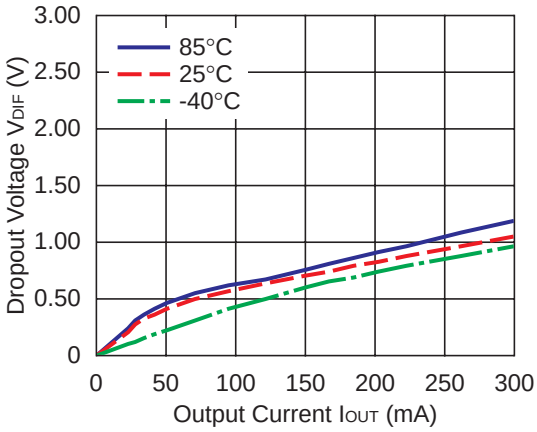


7) Reverse Current vs. Output Voltage (C1=2.2µF, C2=4.7µF, V_{IN}=0V)

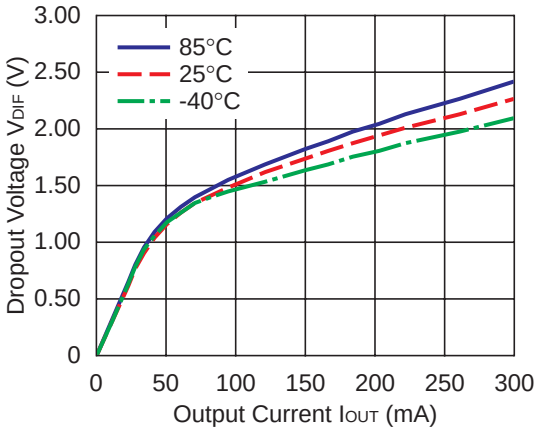


8) Dropout Voltage vs. Output Current (C1=2.2µF, C2=4.7µF)

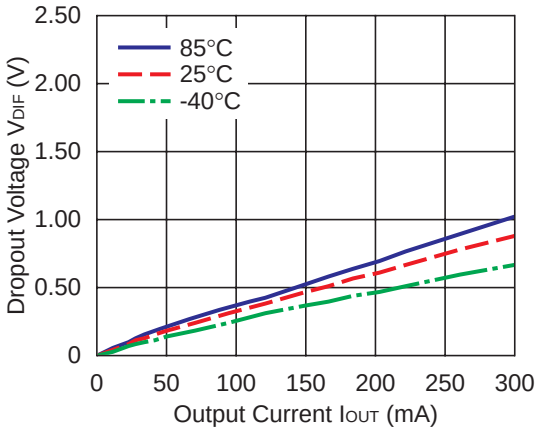
R1191x020x ECO=H



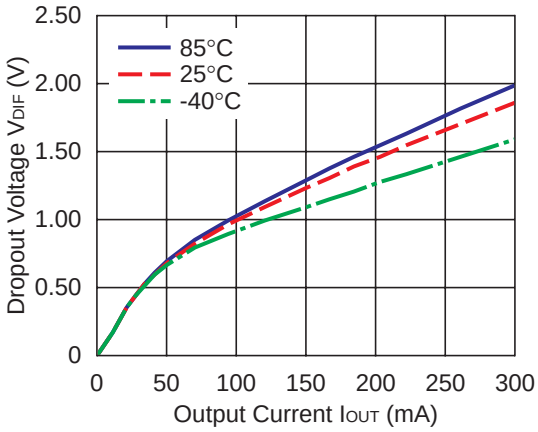
R1191x020x ECO=L



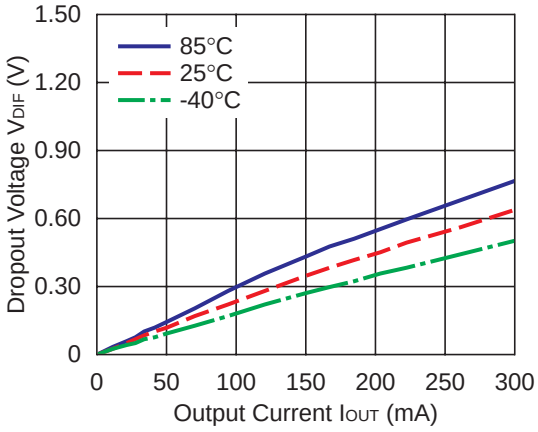
R1191x025x ECO=H



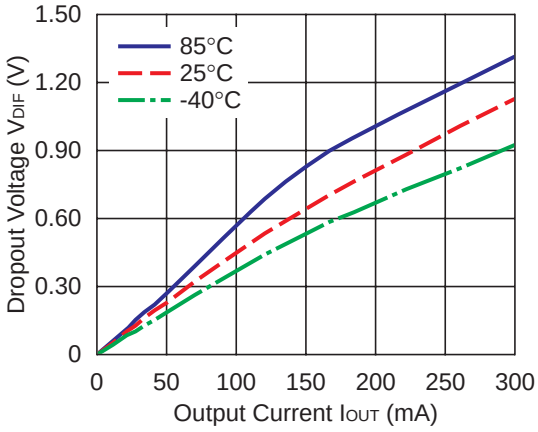
R1191x025x ECO=L



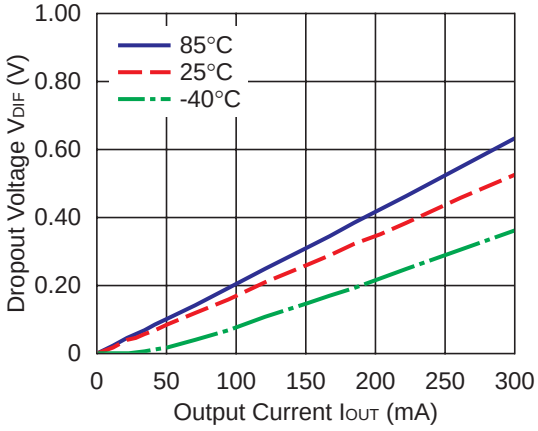
R1191x033x ECO=H



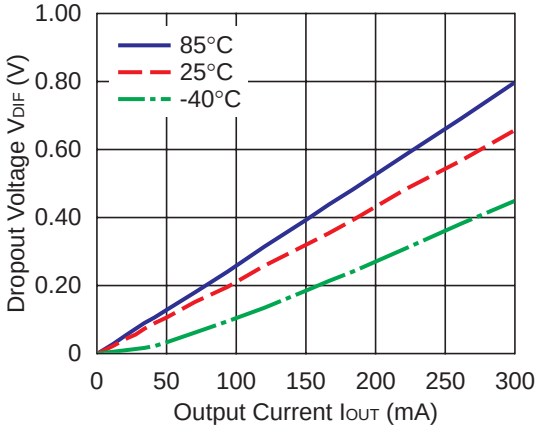
R1191x033x ECO=L



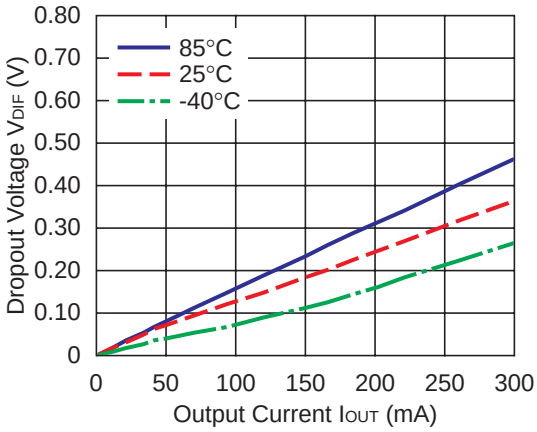
R1191x050x ECO=H



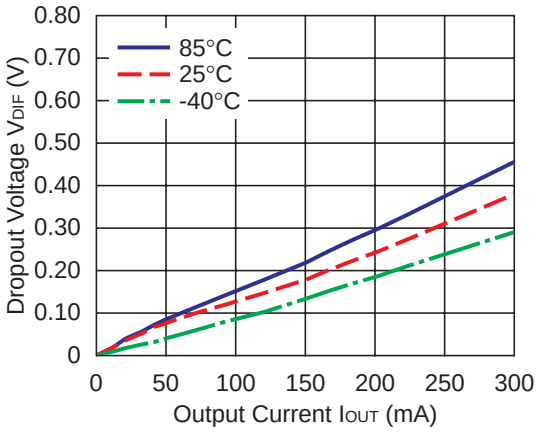
R1191x050x ECO=L



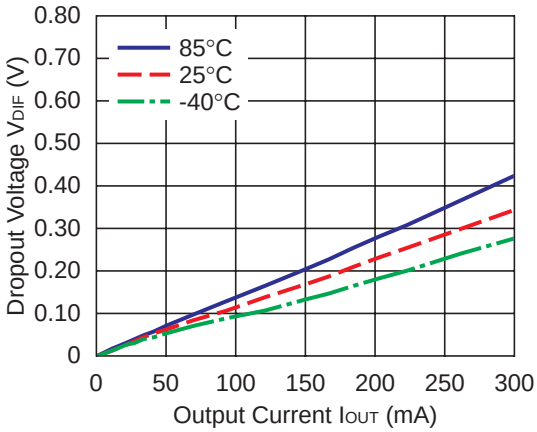
R1191x120x ECO=H



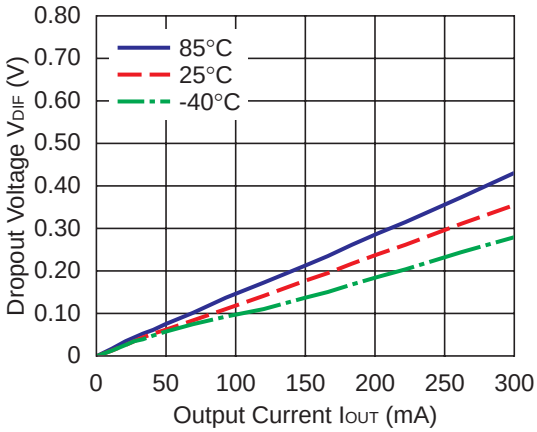
R1191x120x ECO=L



R1191x150x ECO=H

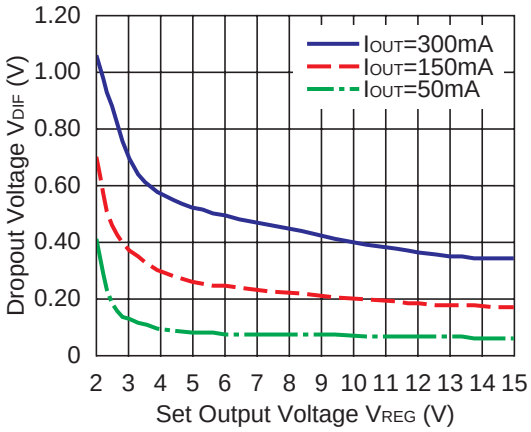


R1191x150x ECO=L

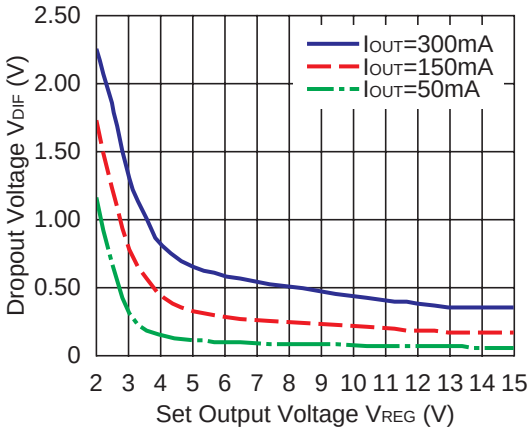


9) Dropout Voltage vs Set Output Voltage (C1=2.2µF, C2=4.7µF,Topt=25°C)

R1191x ECO=H

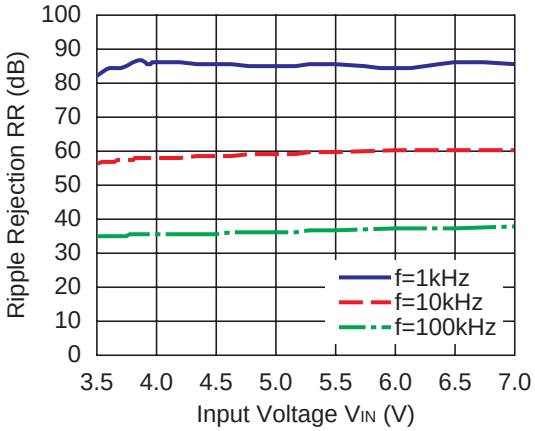


R1191x ECO=L

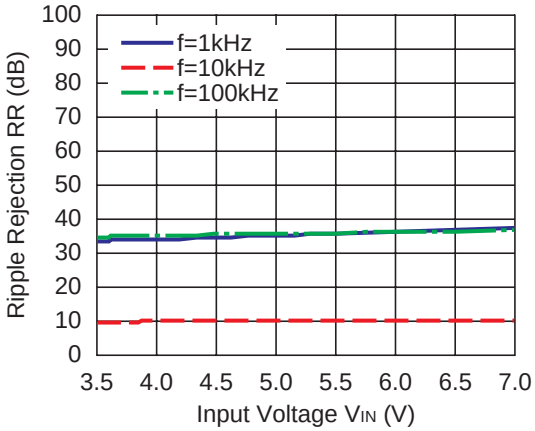


10) Ripple Rejection vs. Input Voltage (C1=none, C2=4.7µF, I_{OUT}=30mA, Ripple=0.5Vp-p, Topt=25°C)

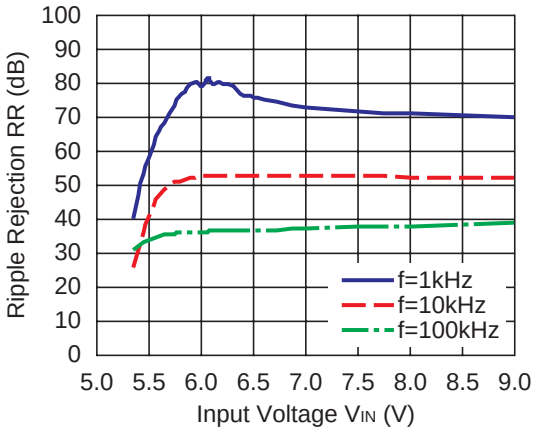
R1191x020x ECO=H



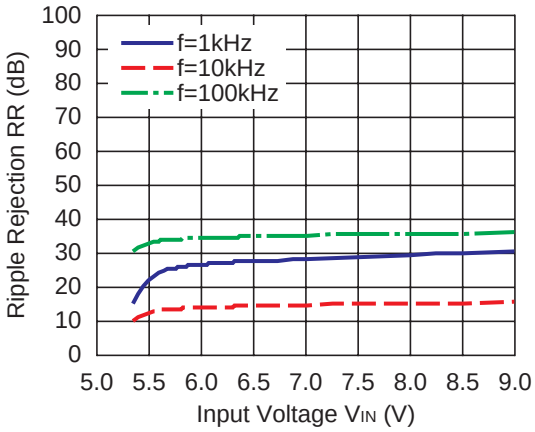
R1191x020x ECO=L



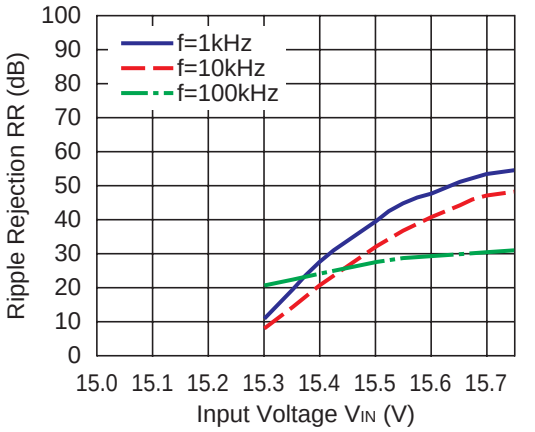
R1191x050x ECO=H



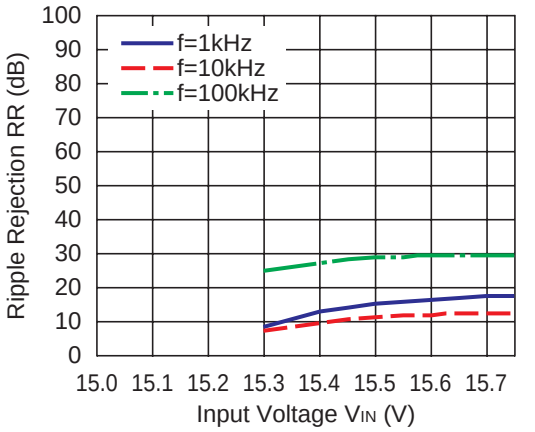
R1191x050x ECO=L



R1191x150x ECO=H

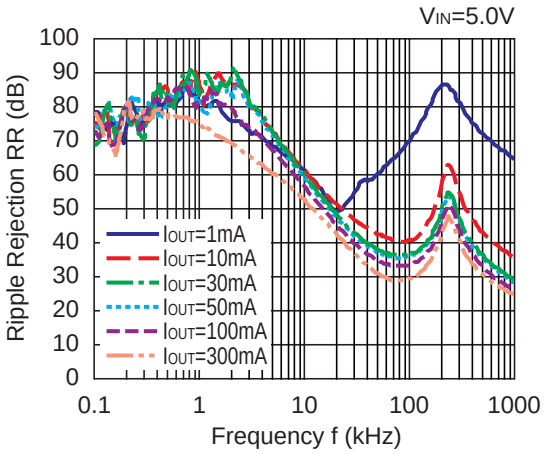


R1191x150x ECO=L

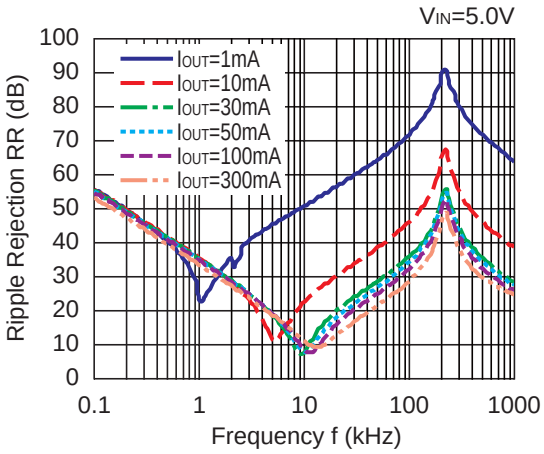


11) Ripple Rejection vs. Frequency (C1= none, C2=4.7μF, Ripple=0.5Vp-p, Topt=25°C)

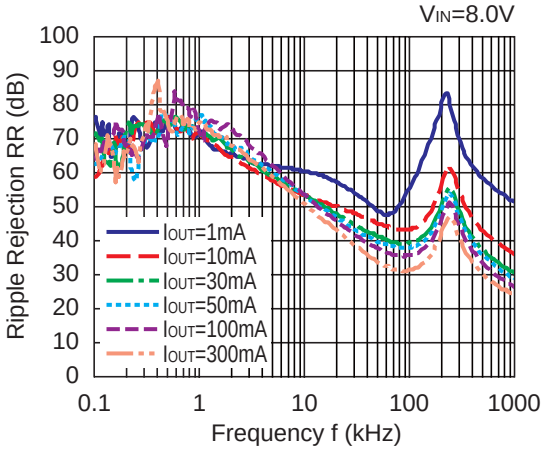
R1191x020x ECO=H



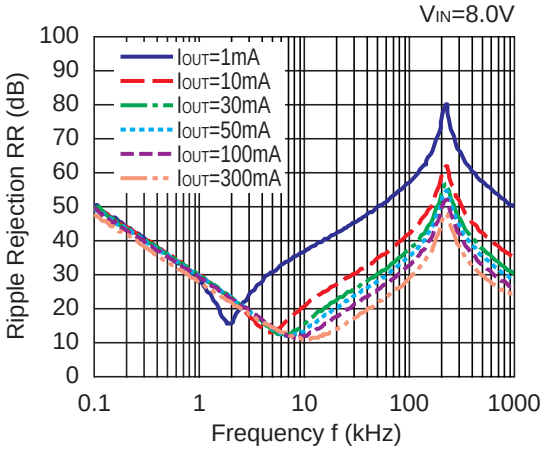
R1191x020x ECO=L



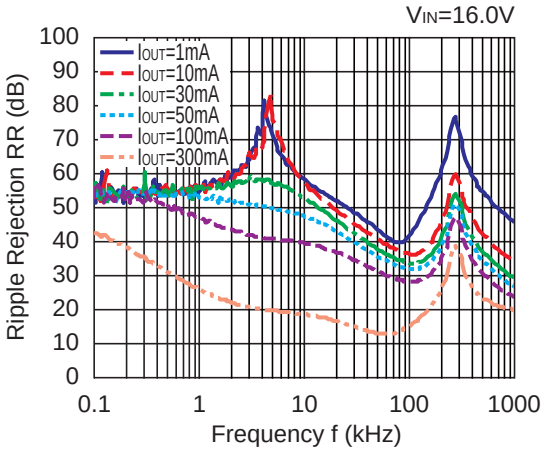
R1191x050x ECO=H



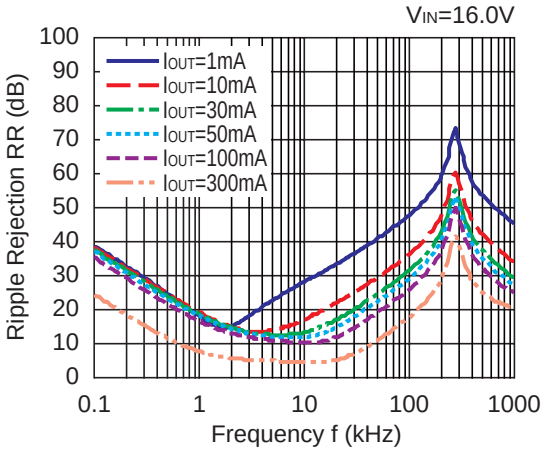
R1191x050x ECO=L



R1191x150x ECO=H

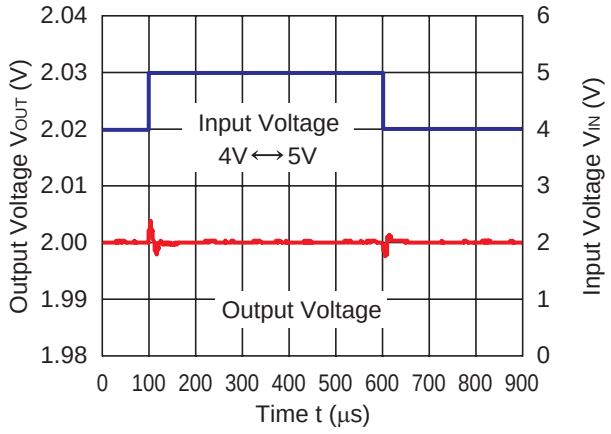


R1191x150x ECO=L

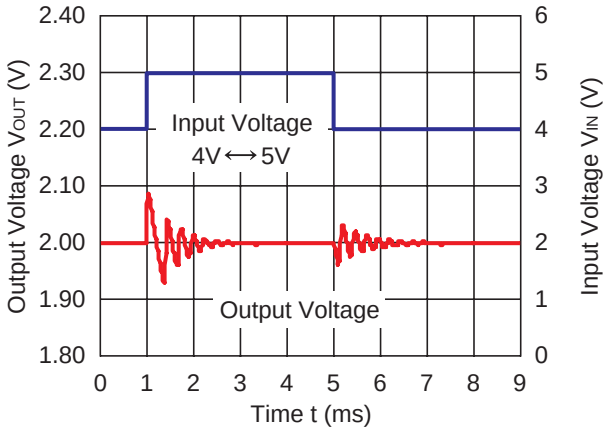


12) Input Transient Response (C1=none, C2=4.7µF, I_{OUT}=1mA, tr=tf=1µs, Topt=25°C)

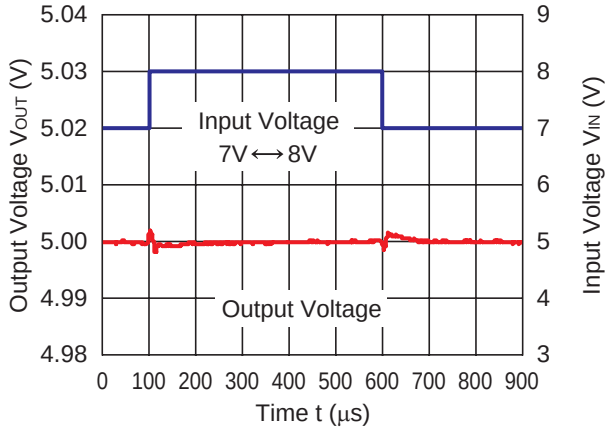
R1191x020x ECO=H



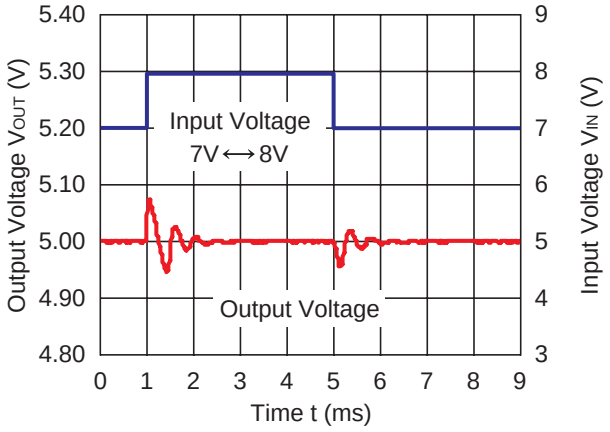
R1191x020x ECO=L



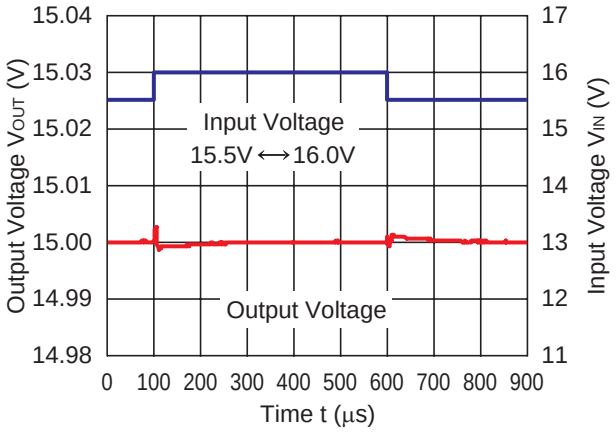
R1191x050x ECO=H



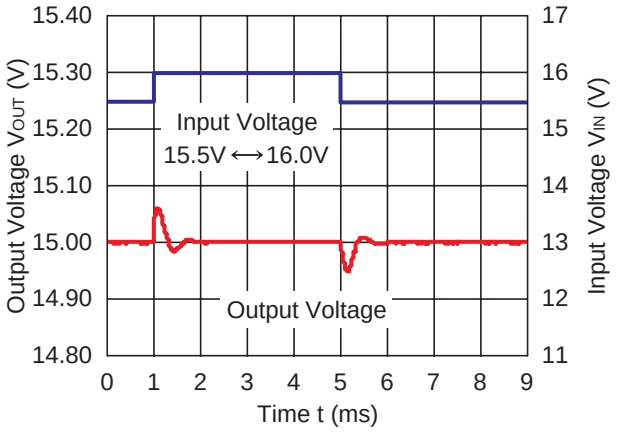
R1191x050x ECO=H



R1191x150x ECO=H

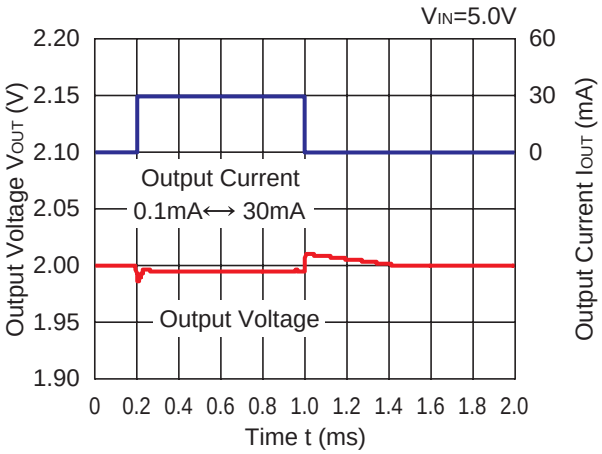


R1191x150x ECO=L

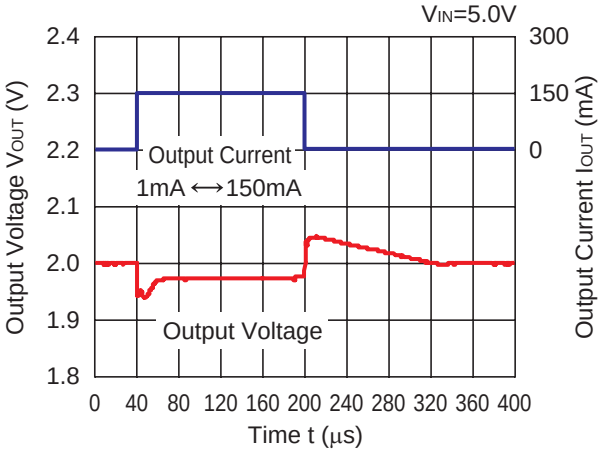


13) Load Transient Response (C1=2.2μF, C2=4.7μF, tr=tf=0.1μs, Topt=25°C)

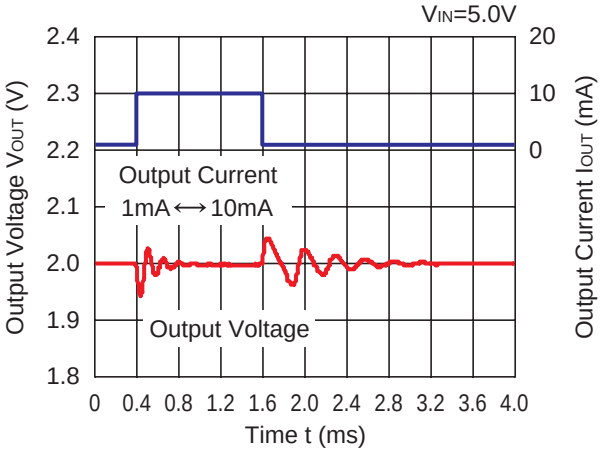
R1191x020x ECO=H



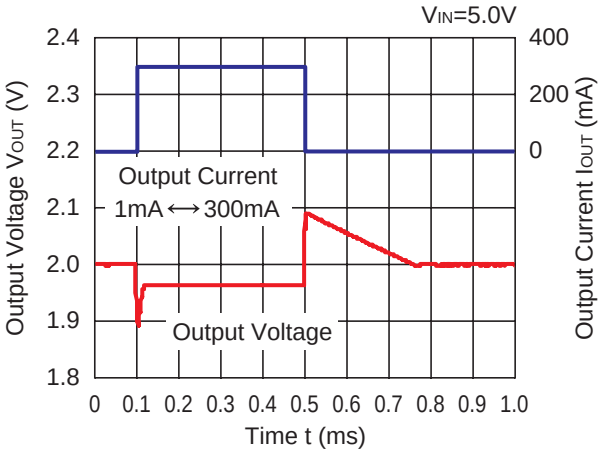
R1191x020x ECO=H



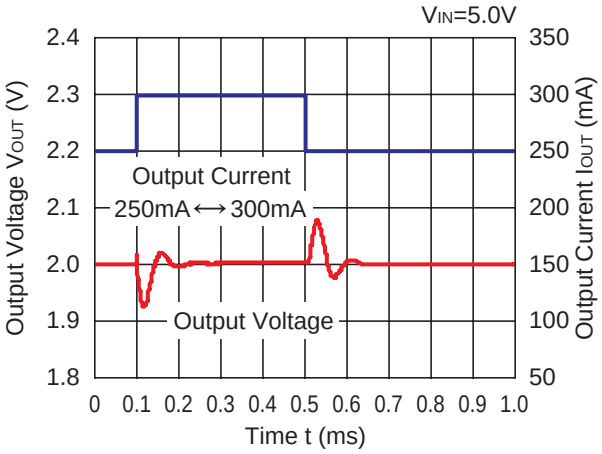
R1191x020x ECO=L



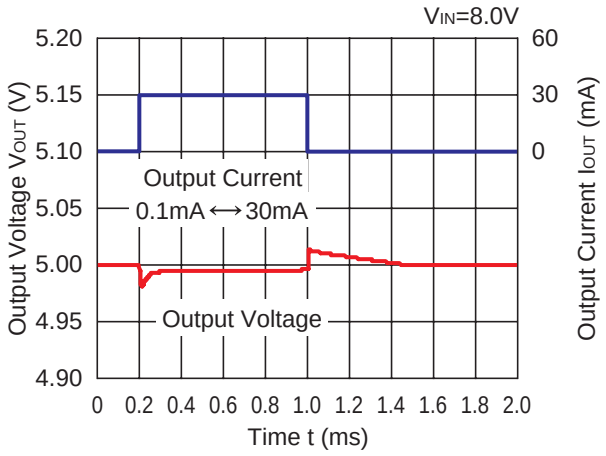
R1191x020x ECO=H



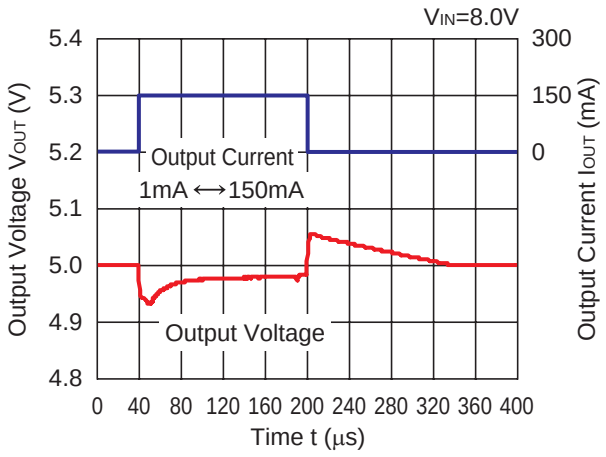
R1191x020x ECO=L



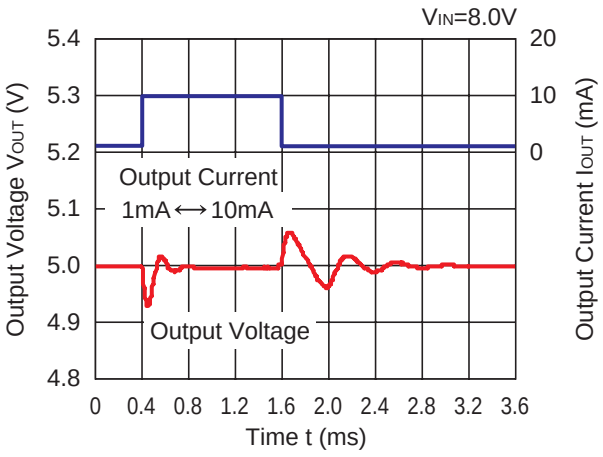
R1191x050x ECO=H



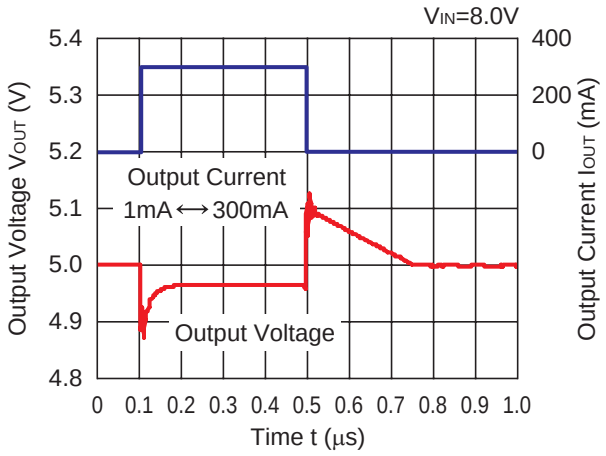
R1191x050x ECO=H



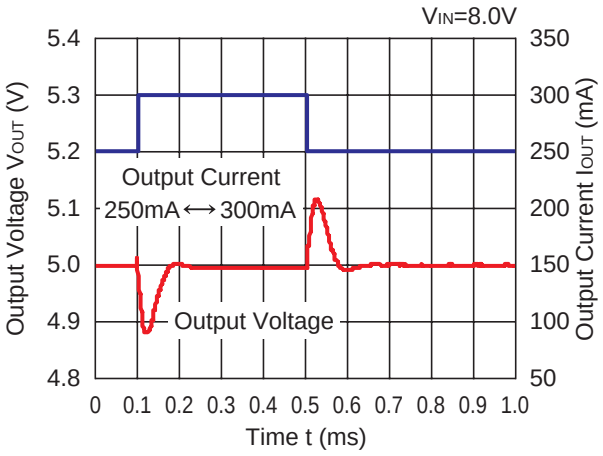
R1191x050x ECO=L



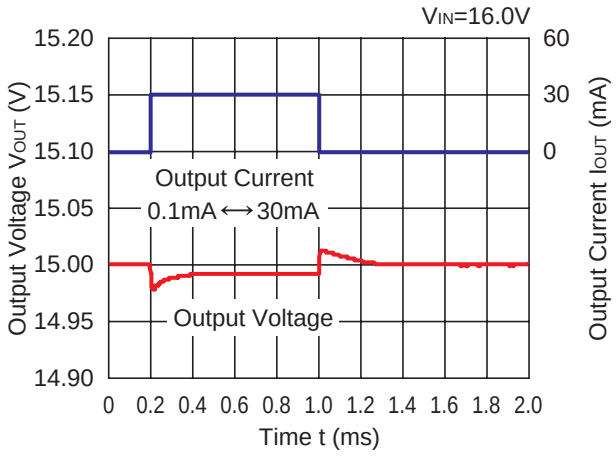
R1191x050x ECO=H



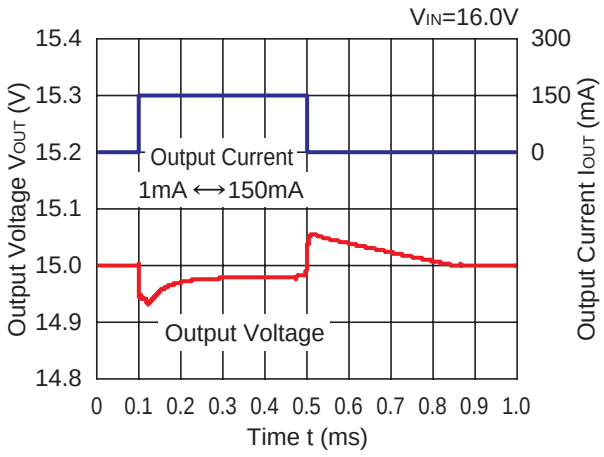
R1191x050x ECO=L



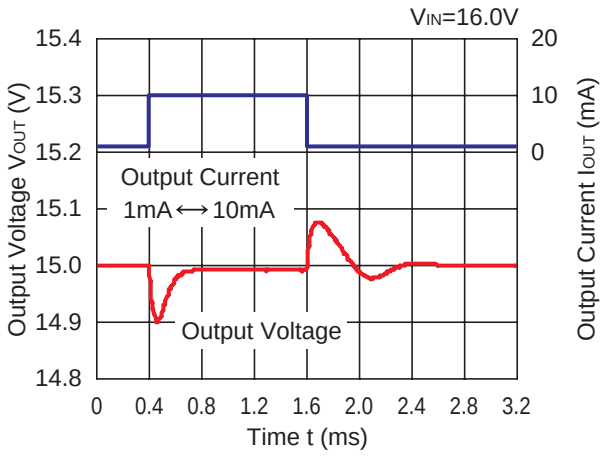
R1191x150x ECO=H



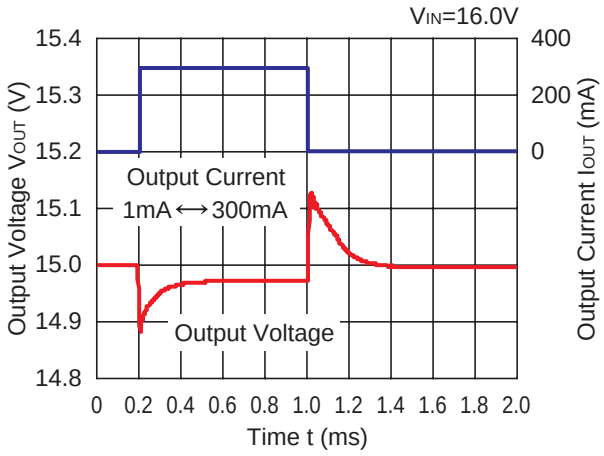
R1191x150x ECO=H



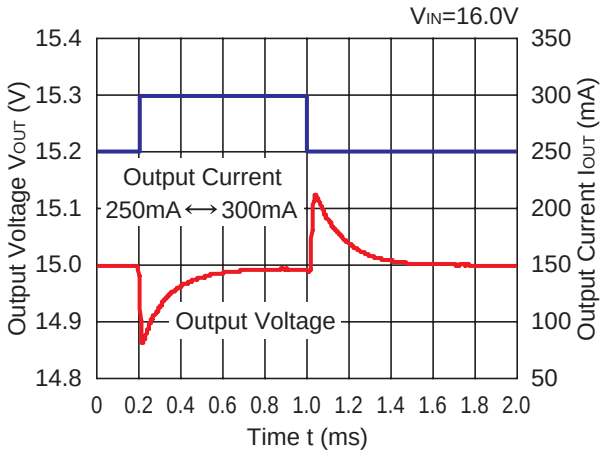
R1191x150x ECO=L



R1191x150x ECO=H

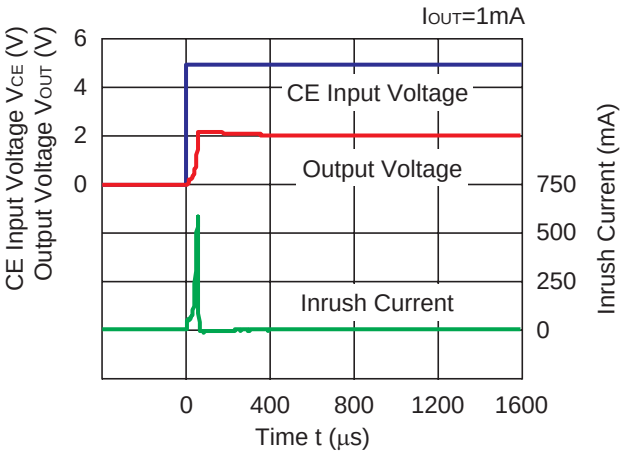


R1191x150x ECO=L

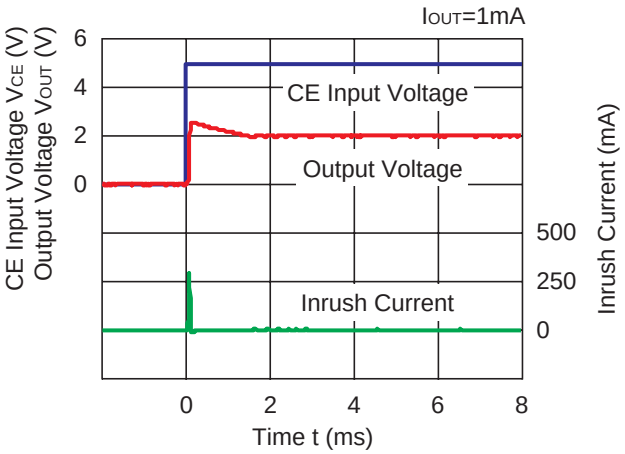


14) Inrush Current at Turn on(C1=2.2μF, C2=4.7μF, tr=0.1μs, Topt=25°C)

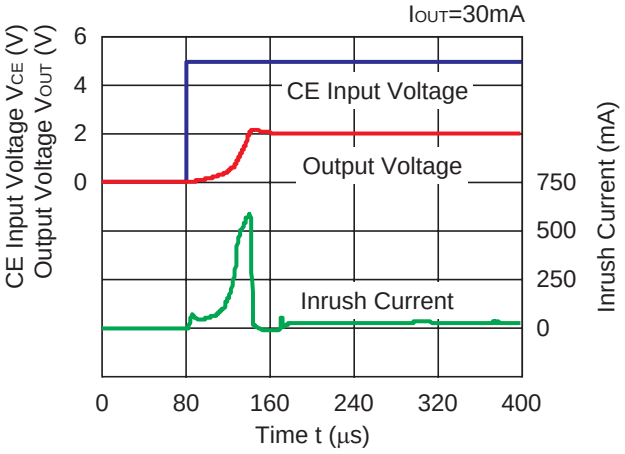
R1191x020x ECO=H



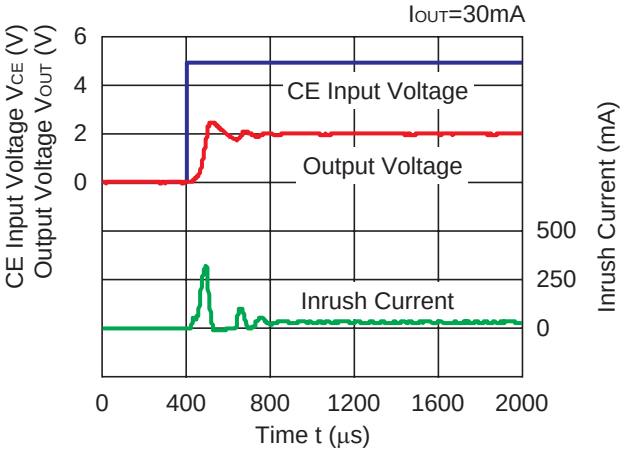
R1191x020x ECO=L



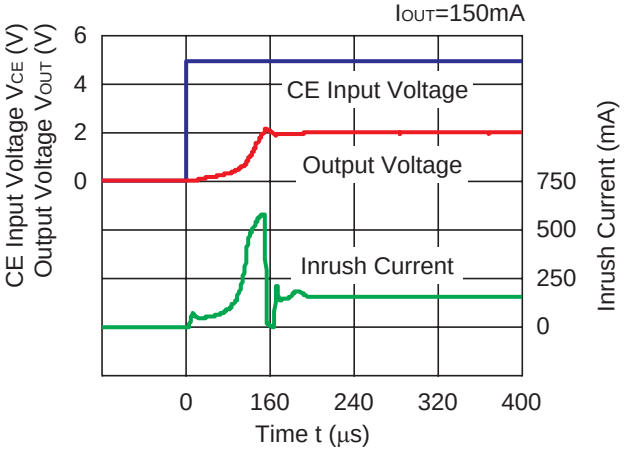
R1191x020x ECO=H



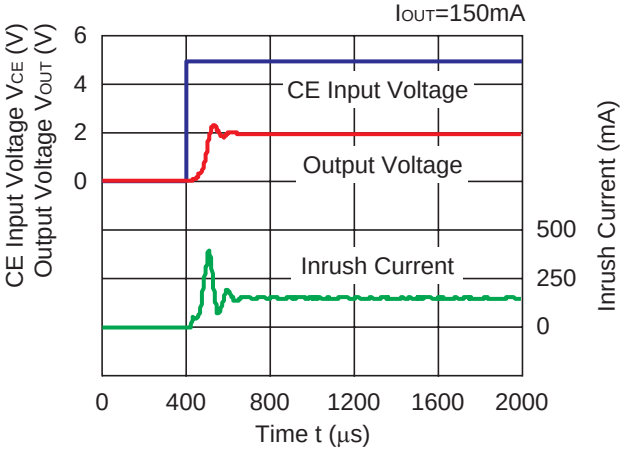
R1191x020x ECO=L



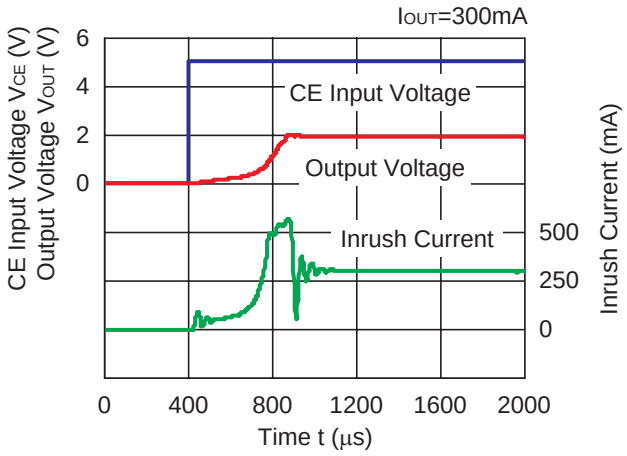
R1191x020x ECO=H



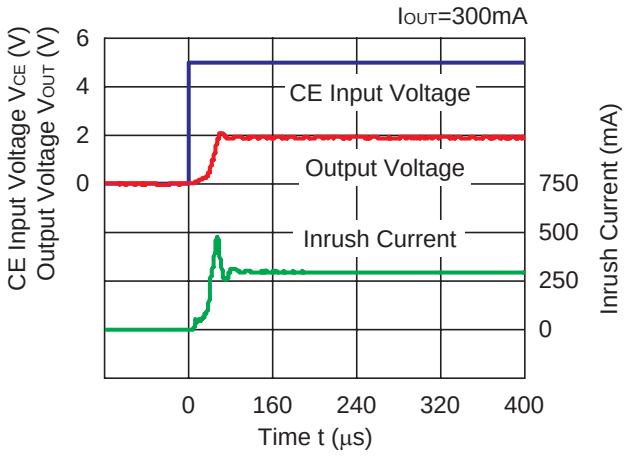
R1191x020x ECO=L



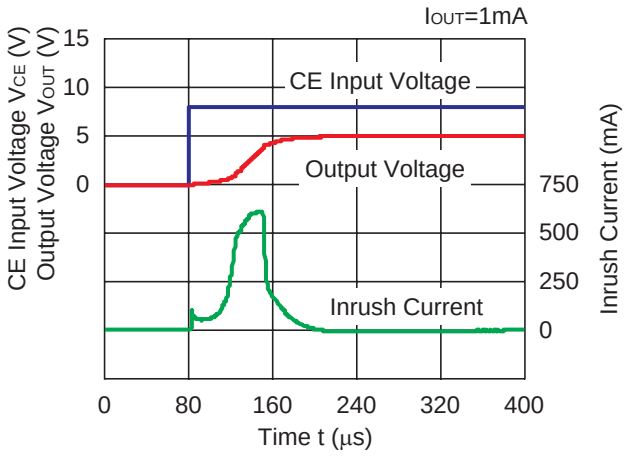
R1191x020x ECO=H



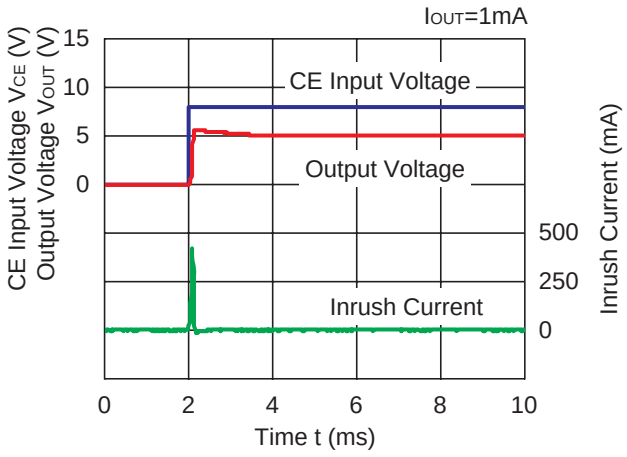
R1191x020x ECO=L



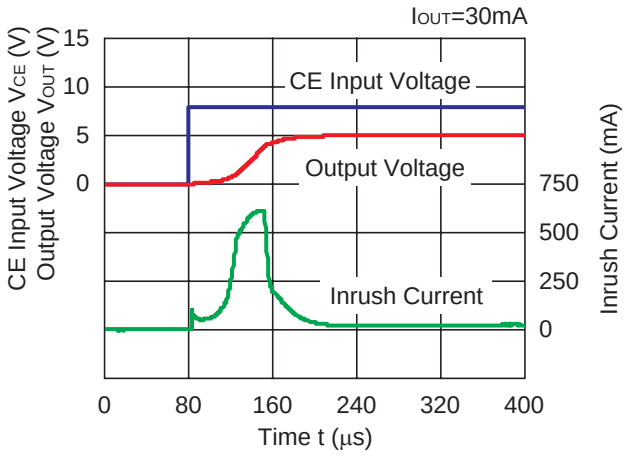
R1191x050x ECO=H



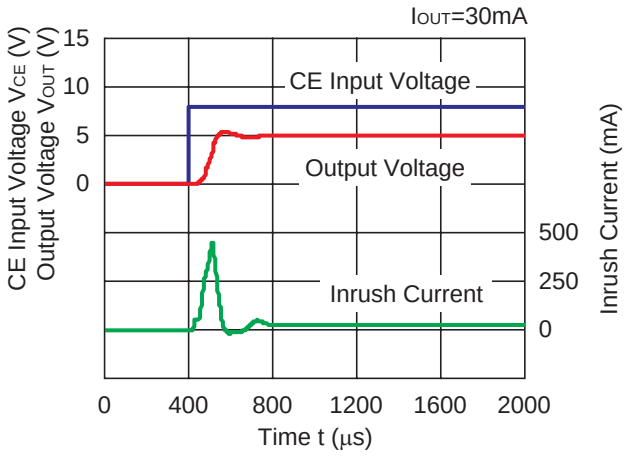
R1191x050x ECO=L



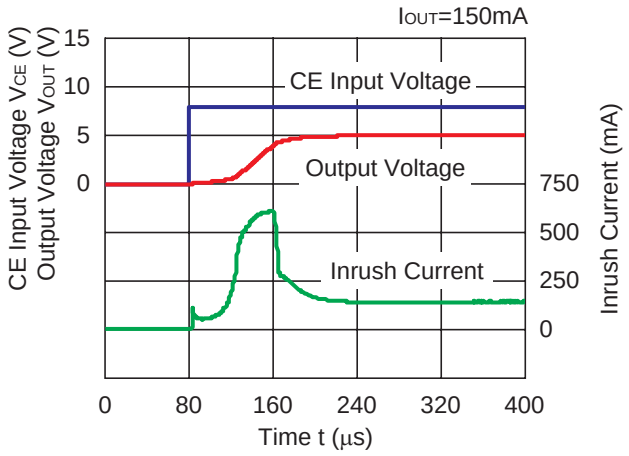
R1191x050x ECO=H



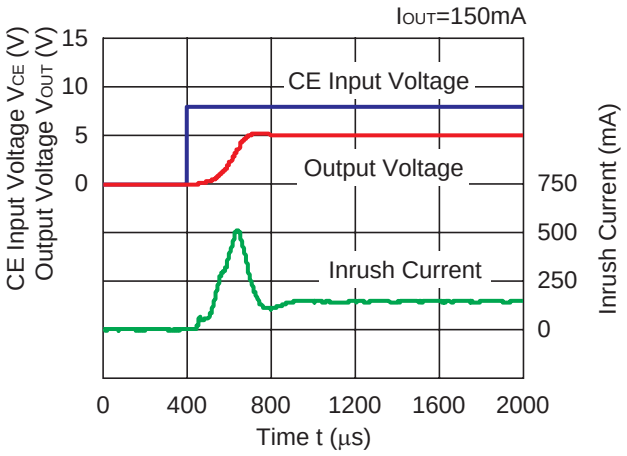
R1191x050x ECO=L



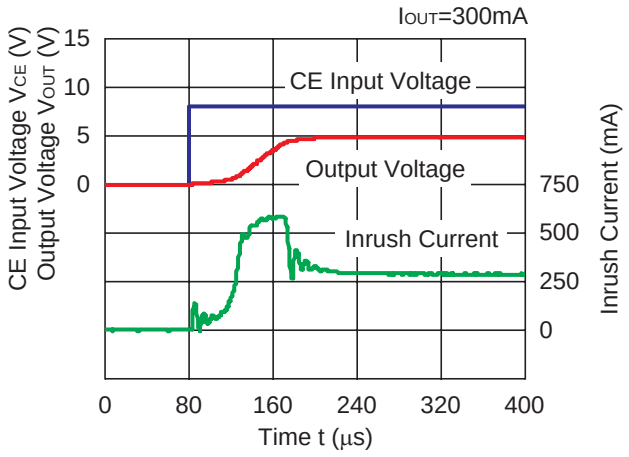
R1191x050x ECO=H



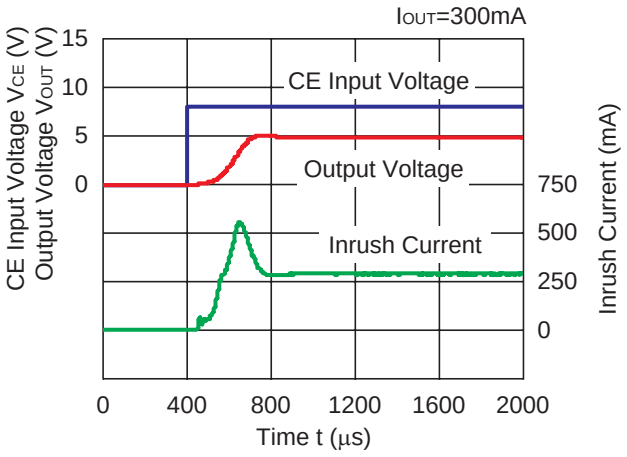
R1191x050x ECO=L



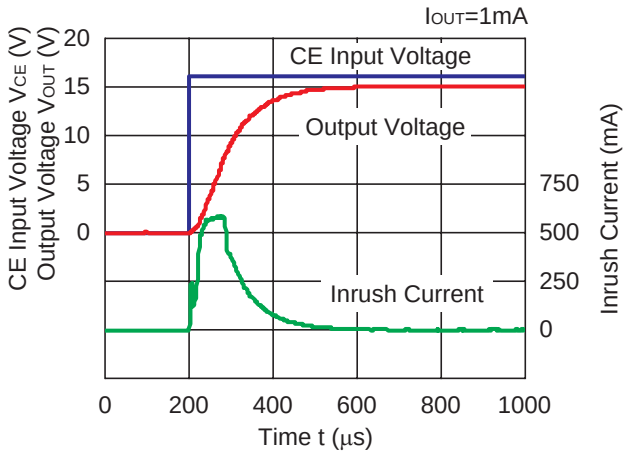
R1191x050x ECO=H



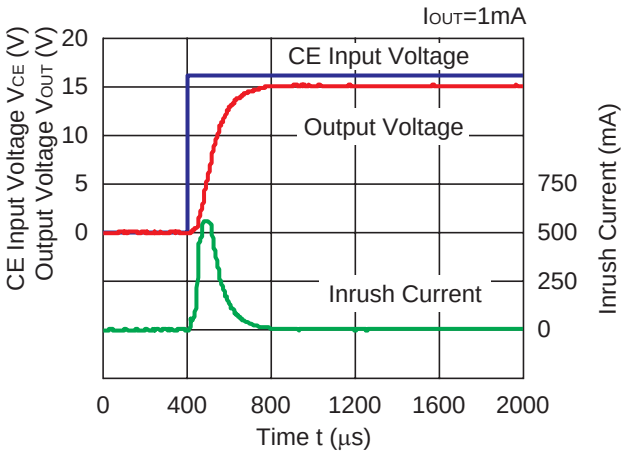
R1191x050x ECO=L



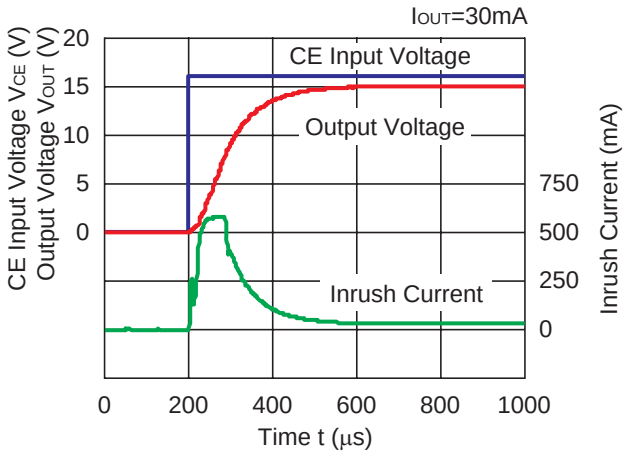
R1191x150x ECO=H



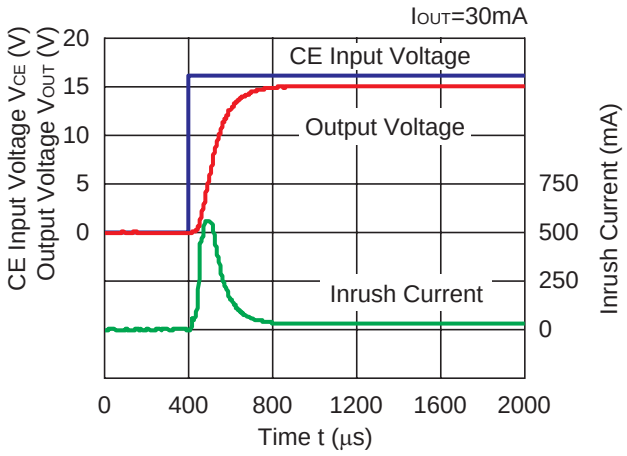
R1191x150x ECO=L



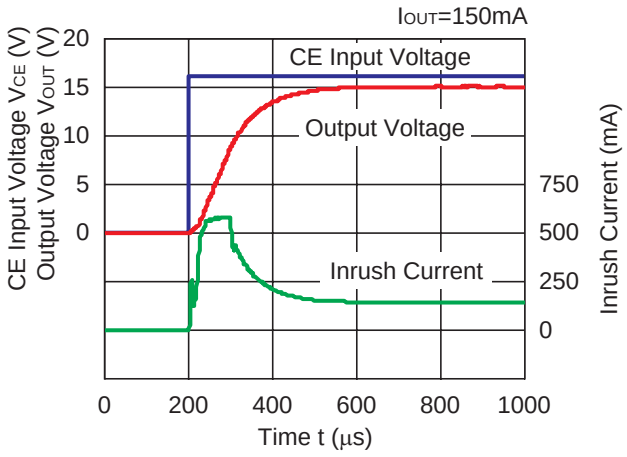
R1191x150x ECO=H



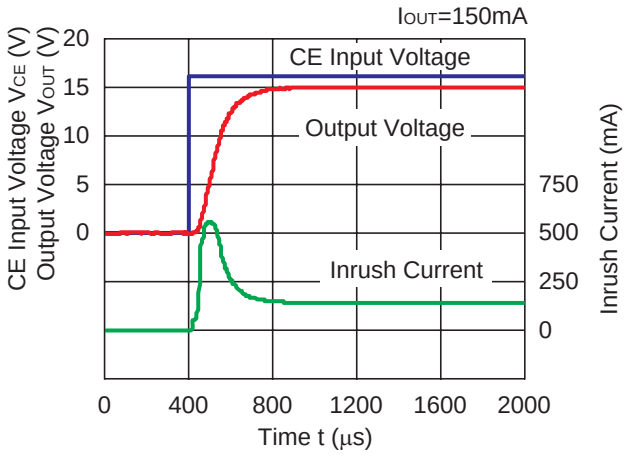
R1191x150x ECO=L



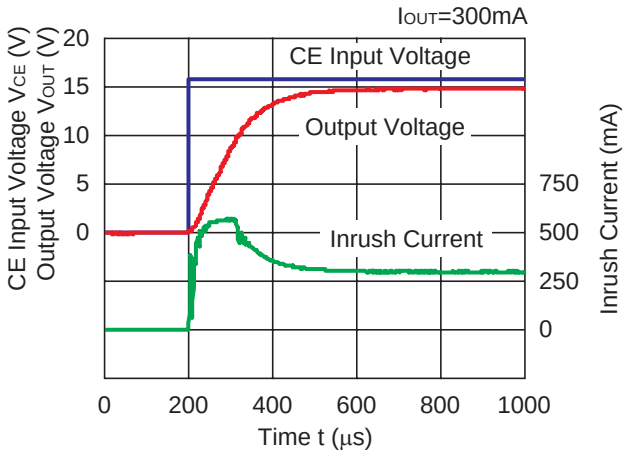
R1191x150x ECO=H



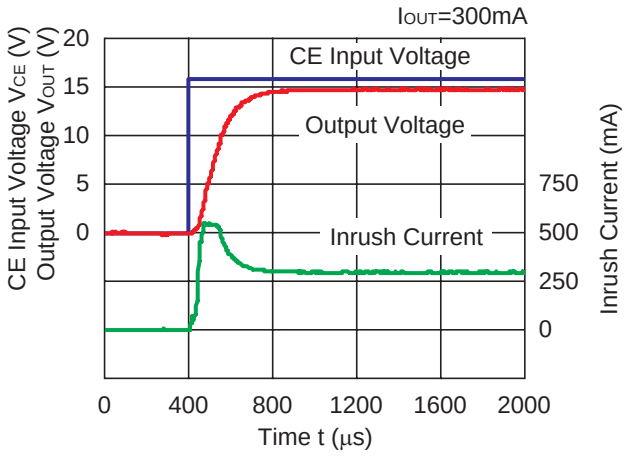
R1191x150x ECO=L



R1191x150x ECO=H

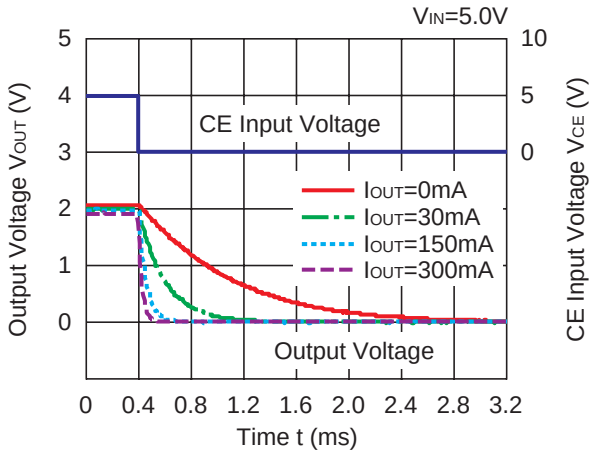


R1191x150x ECO=L

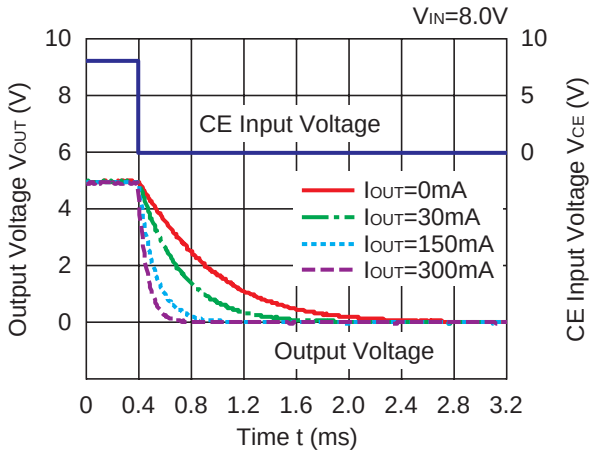


15) Turn Off Speed with CE pin (D Version) (C1=2.2μF, C2=4.7μF, tf=0.1μs, Topt=25°C)

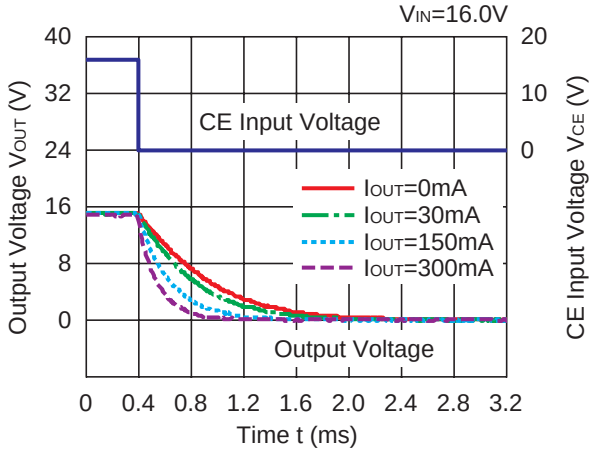
R1191x020D



R1191x050D

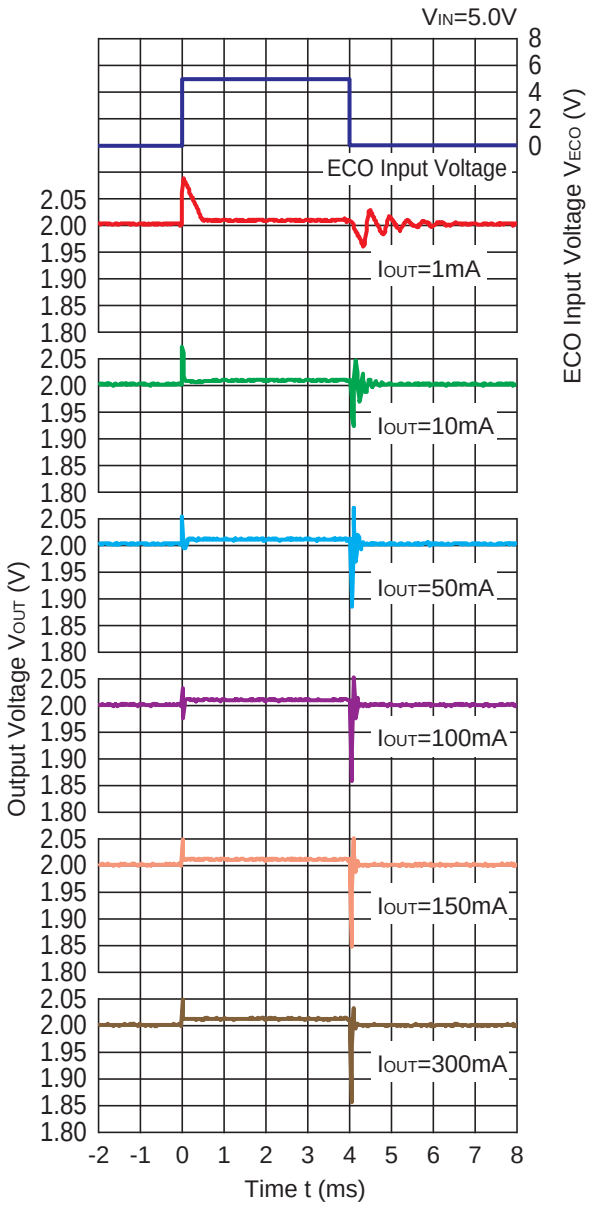


R1191x150D

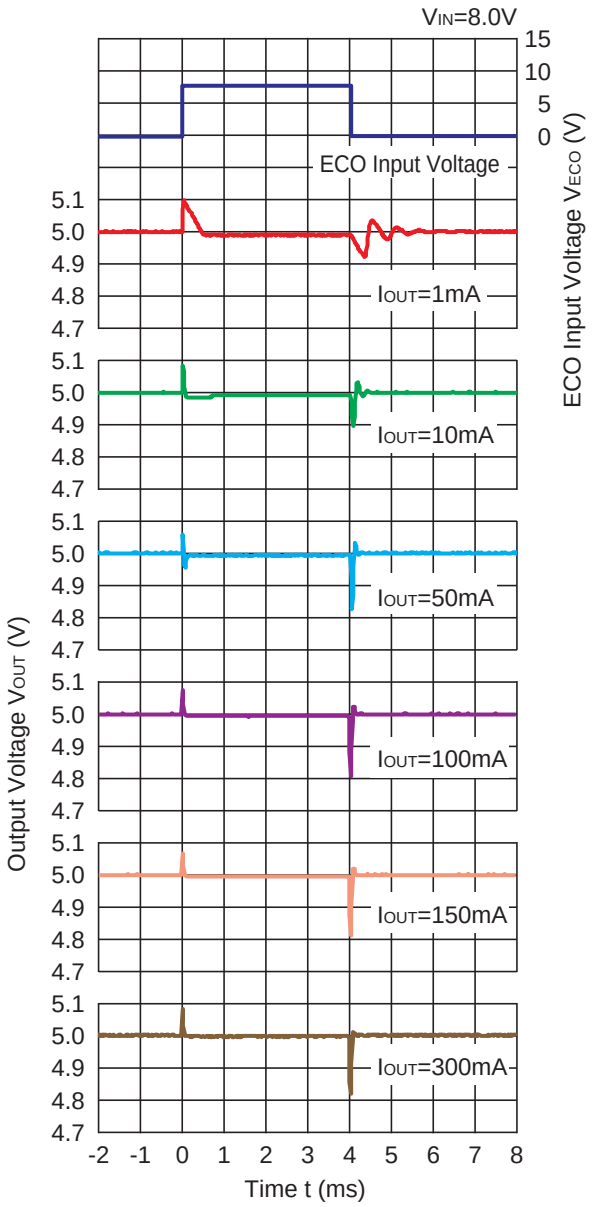


16) Output Voltage at Mode alternative point (C1=2.2µF, C2=4.7µF, tr=tf=0.1µs, Topt=25°C)

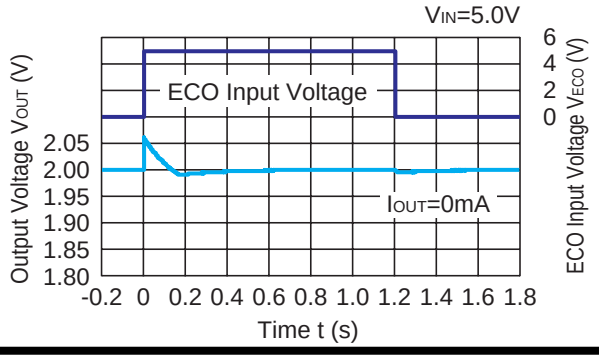
R1191x020x



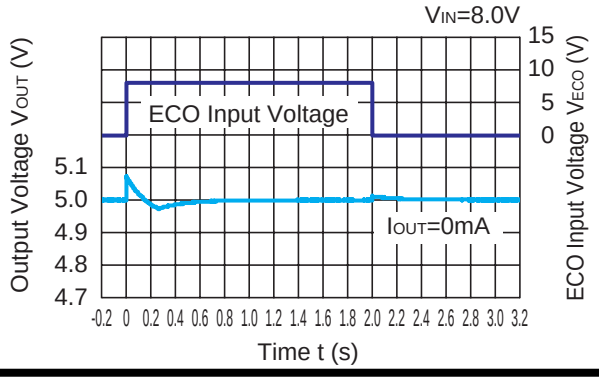
R1191x050x



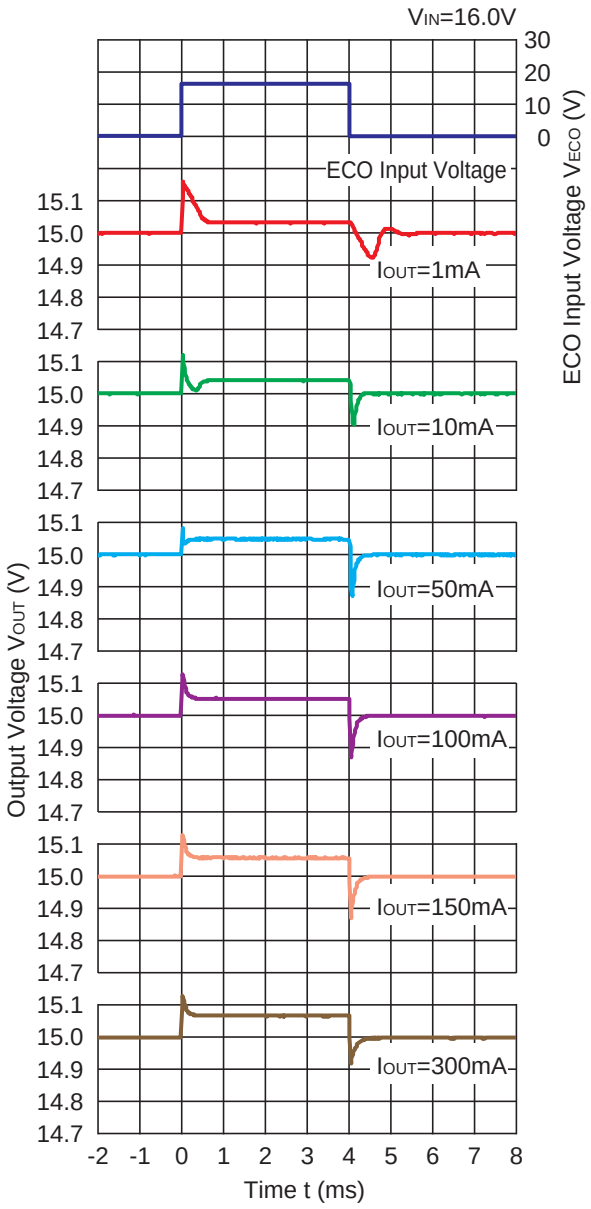
R1191x020x



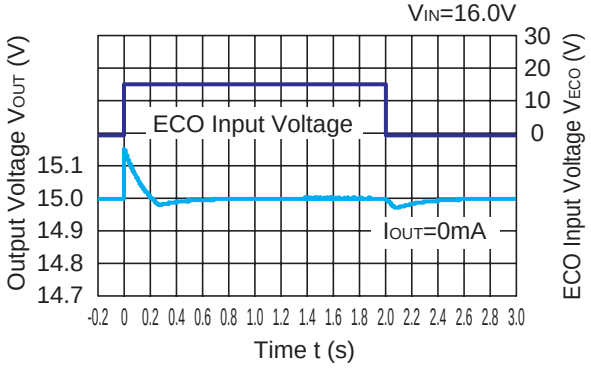
R1191x050x



R1191x150x

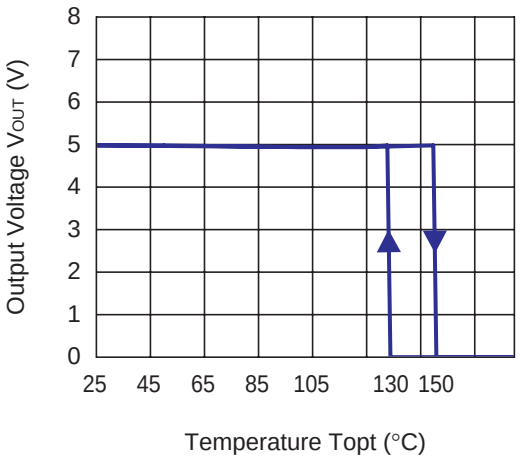


R1191x150x

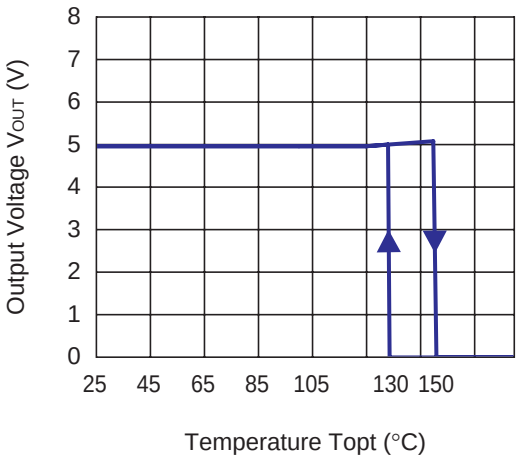


17) Thermal Shutdown Circuit ($C1=2.2\mu F$, $C2=4.7\mu F$, $V_{IN}=16V$, $R_{LOAD}=1k\Omega$)

R1191x050x ECO=H



R1191x050x ECO=L



ESR vs. Output Current

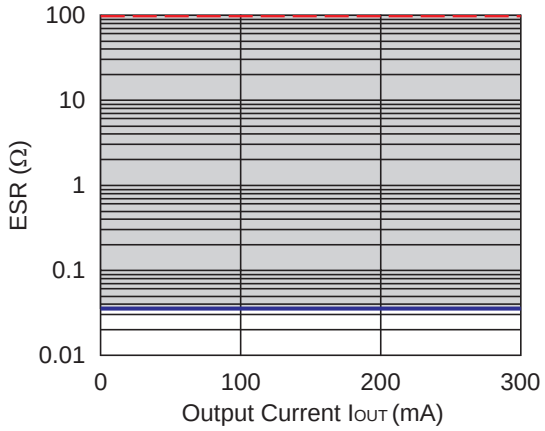
When using these ICs, consider the following points:

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 40μV (Avg.) are marked as the hatched area in the graph.

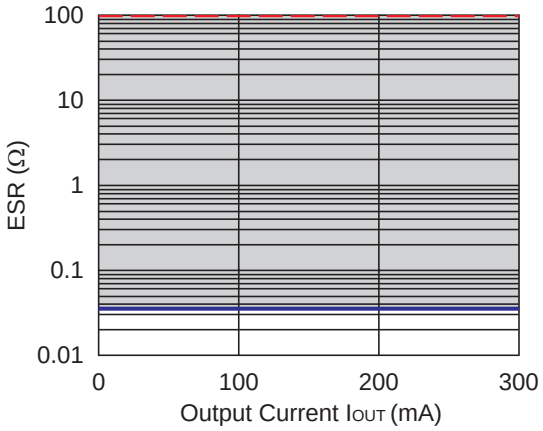
Measurement conditions

Frequency Band : 10Hz to 1MHz
Temperature : −40°C to 85°C
Hached Area : Noise level is under 40μVms(Avg.)
C_{IN} : 2.2μF Murata (GRM32RB11E225KC01B)
C_{OUT} : 4.7μF Murata (GCM31CR71E475KA40)

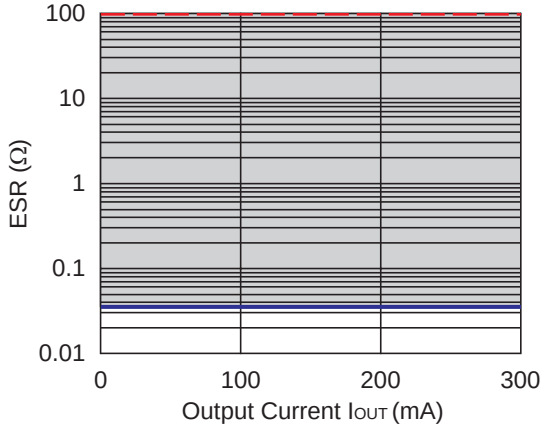
R1191x020x ECO=H, ECO=L



R1191x050x ECO=H, ECO=L



R1191x150x ECO=H, ECO=L



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.

RoHS Compliant
Halogen Free

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 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 Bibo Road, Pu Dong New District, Shanghai 201203, People's Republic of China
Phone: +86-21-5027-3200 Fax: +86-21-5027-3299

RICOH ELECTRONIC DEVICES 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:

Ricoh Electronics:

R1191N030B-TR-FE R1191H150D-T1-FE R1191N050B-TR-FE R1191N050D-TR-FE R1191H033B-T1-FE R1191L030D-TR R1191L050D-TR R1191L028D-TR R1191N090B-TR-FE R1191L033D-TR R1191L090D-TR R1191N090D-TR-FE R1191L150D-TR R1191H030D-T1-FE R1191H090B-T1-FE R1191N120D-TR-FE R1191L120D-TR R1191N033D-TR-FE R1191N150D-TR-FE R1191H050D-T1-FE R1191H033D-T1-FE R1191N033B-TR-FE R1191H050B-T1-FE R1191N030D-TR-FE R1191N120B-TR-FE R1191H030B-T1-FE

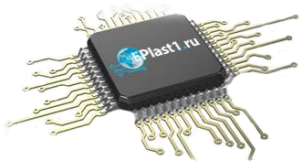
Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

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