150mA DUAL LDO REGULATOR WITH SEQUENCE CONTROL

NO. EA-200-090729

OUTLINE

The RP152x Series are CMOS-based voltage regulator ICs with high output voltage accuracy, low supply current, low dropout, and high ripple rejection. Each of these voltage regulator ICs consists of a voltage reference unit, an error amplifier, resistors for setting Output Voltage, a current limit circuit, and a chip enable circuit. Moreover, in C Version of RP152x, the start-up sequence circuit is built-in.

These ICs perform with low dropout voltage due to built-in transistor with low ON resistance, and a chip enable function prolongs the battery life of each system. The line transient response and load transient response of the RP152x Series are excellent, thus these ICs are very suitable for the power supply for hand-held communication equipment.

The output voltage of these ICs is internally fixed with high accuracy. Since the packages for these ICs are SOT-23-6 and DFN1212-6, dual LDO regulators are included in each package are high density mounting of the ICs on boards is possible.

FEATURES

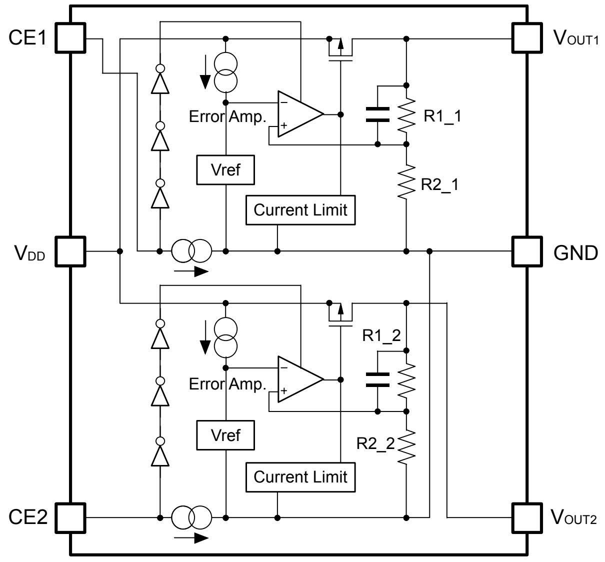
- Supply Current .... Typ. 40μA×2 (VR1&VR2)
- Standby Current .... Typ. 0.1μA×2 (VR1&VR2)
- Ripple Rejection .... Typ. 70dB (f=1kHz)
- Input Voltage Range .... 1.4V to 5.25V
- Output Voltage Range .... 0.8V to 3.6V
- Output Voltage Accuracy .... ±1.0% (V_{OUT}>2.0V, T_{opt}=25°C)
- Temperature-Drift Coefficient of Output Voltage .... Typ. ±80ppm/°C
- Dropout Voltage .... Typ. 0.22V (I_{OUT}=150mA, V_{OUT}=2.8V)
- Line Regulation .... Typ. 0.02%/V
- Packages DFN1212-6, SOT-23-6
- Built-in Fold Back Protection Circuit .... Typ. 40mA
- Ceramic capacitors are recommended to be used with this IC .... 0.22μF or more

APPLICATIONS

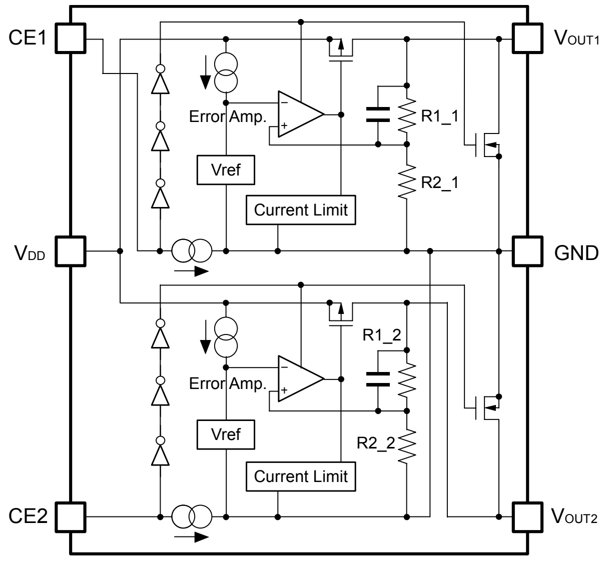
- Power source for portable communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

BLOCK DIAGRAMS

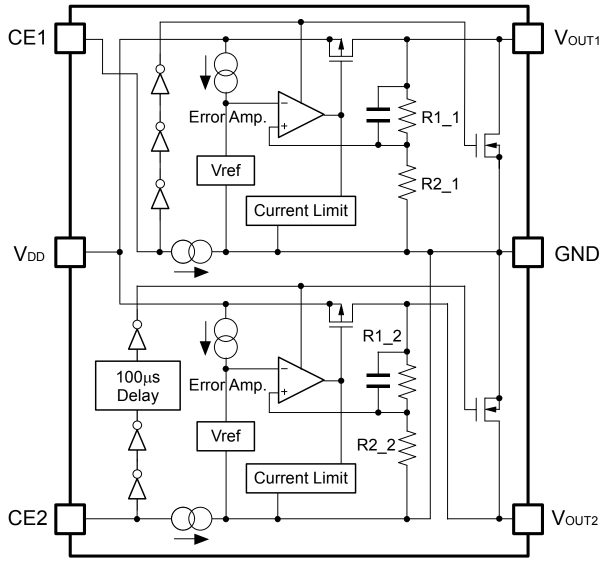
RP152xxxxA



RP152xxxxB



RP152xxxxC



SELECTION GUIDE

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

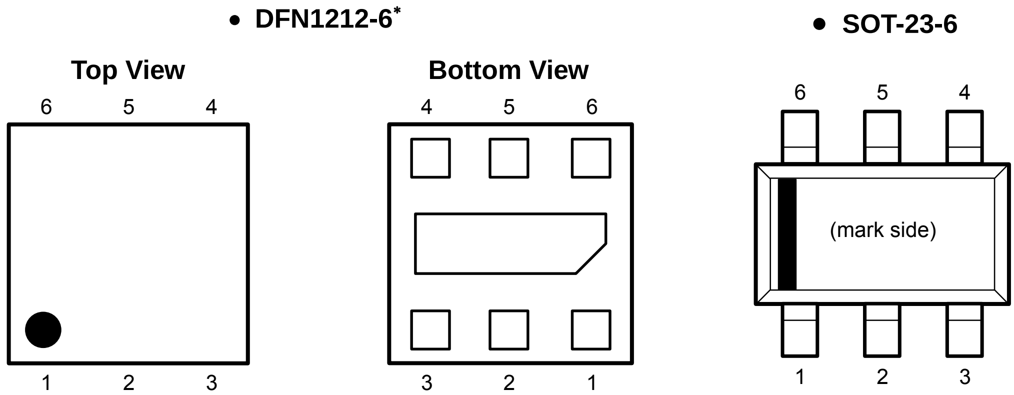
The selection can be made with designating the part number as shown below;

RP152xxxxx-xx -x ←Part Number
↑ ↑ ↑ ↑ ↑
a b c d e

Code	Contents
a	Designation of Package Type: L: DFN1212-6 N: SOT-23-6
b	Setting combination of 2ch Output Voltage (V_{OUT}): Serial Number for Voltage setting from 001, Stepwise setting in the range of 0.8V to 3.6V is possible for each channel.
c	Designation of Mask Option: A: without auto discharge function* at OFF state. B: with auto discharge function* at OFF state C: The start-up sequence function with auto-discharge*
d	Designation of Taping Type: Ex. TR (refer to Taping Specifications; TR type is the standard direction.)
e	Designation of composition of plating: -F : Lead free plating (SOT-23-6) None : Pd plating (DFN1212-6)

*) When the mode is into standby with CE signal, auto discharge transistor turns on, and it makes the turn-off speed faster than normal type.

PIN CONFIGURATIONS



PIN DESCRIPTIONS

- **DFN1212-6***

Pin No.	Symbol	Description
1	V_{OUT1}	Output Pin 1
2	V_{OUT2}	Output Pin 2
3	GND	Ground Pin
4	CE2	Chip Enable Pin 2 ("H" Active)
5	V_{DD}	Input Pin
6	CE1	Chip Enable Pin 1 ("H" Active)

∗) 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-23-6**

Pin No.	Symbol	Description
1	CE1	Chip Enable Pin 1 ("H" Active)
2	V_{DD}	Input Pin
3	CE2	Chip Enable Pin 2 ("H" Active)
4	V_{OUT2}	Output Pin 2
5	GND	Ground Pin
6	V_{OUT1}	Output Pin 1

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	6.0	V
V_{CE}	Input Voltage (CE Pin)	–0.3 to 6.0	V
V_{OUT1} , V_{OUT2}	Output Voltage	–0.3 to V_{IN}+0.3	V
I_{OUT1} , I_{OUT2}	Output Current	180	mA
P_D	Power Dissipation (DFN1212-6)*	600	mW
	Power Dissipation (SOT-23-6)*	420	
T_{opt}	Operating Temperature Range	–40 to 85	°C
T_{stg}	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.

ELECTRICAL CHARACTERISTICS

V_{IN}=Set V_{OUT}+1.0V (V_{OUT}>1.5V), V_{IN}=2.5V (V_{OUT}≤1.5V) , I_{OUT}=1mA, C_{IN}=C_{OUT}=0.22μF, unless otherwise noted.
The specification in ☐ is checked and guaranteed by design engineering at –40°C ≦ Topt ≦ 85°C.

- **RP152x**

Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	T_{opt}=25°C	V_{OUT} > 2.0V	×0.99		×1.01	V
			V_{OUT} ≤ 2.0V	–20		+20	mV
		–40°C ≤ Topt ≤ 85°C	V_{OUT} > 2.0V	×0.97		×1.03	V
			V_{OUT} ≤ 2.0V	–60		+60	mV
I_{OUT}	Output Current			150			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	1mA ≤ I_{OUT} ≤ 150mA	0.8V ≤ V_{OUT} < 1.1V		10	40	mV
			1.1V ≤ V_{OUT} < 1.6V		15	50	
			1.6V ≤ V_{OUT} < 2.0V		15	55	
			2.0V ≤ V_{OUT} ≤ 3.6V		15	60	
V_{DIF}	Dropout Voltage	Refer to the following table.					
I_{SS}	Supply Current	I_{OUT}=0mA			40	60	μA
Istandby	Standby Current	V_{CE}=0V			0.1	1.0	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	Set V_{OUT}+0.5V ≤ V_{IN} ≤ 5.0V			0.02	0.10	%/V
RR	Ripple Rejection	f=1kHz, Ripple 0.2Vp-p V_{IN}=Set V_{OUT}+1V, I_{OUT}=30mA (In case that V_{OUT} ≤ 2.0V, V_{IN}=3V)			70		dB
V_{IN}	Input Voltage*			1.40		5.25	V
$\Delta V_{OUT}/\Delta T_{opt}$	Output Voltage Temperature Coefficient	–40°C ≤ Topt ≤ 85°C			±80		ppm/°C
Ilim	Short Current Limit	V_{OUT}=0V			40		mA
I_{PD}	CE Pull-down Current				0.3		μA
V_{CEH}	CE Input Voltage "H"			1.0			V
V_{CEL}	CE Input Voltage "L"					0.4	V
en	Output Noise	BW=10Hz to 100kHz			60		μVrms
R_{LOW}	Low Output Nch Tr. ON Resistance (of B/C version)	V_{IN}=4.0V,V_{CE}=0V	C version (VR2)		10		Ω
			Others		50		

*) The maximum Input Voltage of the ELECTRICAL CHARACTERISTICS is 5.25V. In case of exceeding this specification, the IC must be operated on condition that the Input Voltage is up to 5.5V and the total operating time is within 500hrs.

- **Dropout Voltage by Output Voltage**

Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)		
	Condition	Typ.	Max.
V_{OUT}=0.8	I_{OUT}=150mA	0.63	0.87
V_{OUT}=0.9		0.55	0.80
$1.0 \le V_{OUT} < 1.2$		0.50	0.72
$1.2 \le V_{OUT} < 1.4$		0.42	0.62
$1.4 \le V_{OUT} < 1.7$		0.37	0.55
$1.7 \le V_{OUT} < 2.1$		0.30	0.46
$2.1 \le V_{OUT} < 2.5$		0.25	0.39
$2.5 \le V_{OUT} < 3.0$		0.23	0.35
$3.0 \le V_{OUT} \le 3.6$		0.21	0.32

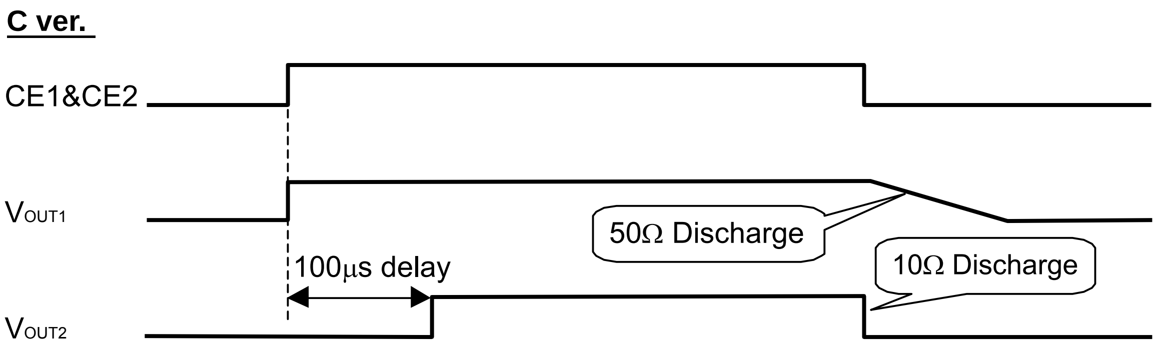
RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)

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.

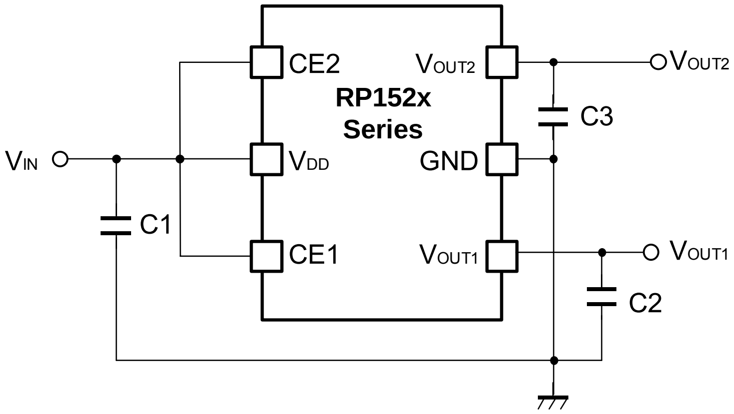
THE START-UP SEQUENSE CIRCUIT

The Start-up sequence circuit is applied in C Version.

When the CE of VR1 and VR2 started-up at the same time, VR2 stands-up in 100μs delay after VR1 stands up simultaneously with CE. Moreover, to disabling is depending upon the setting output voltage and the external capacitors. VR1 reduces the output voltage by the Nch driver of about 50Ω, and VR2 reduces the output voltage by the Nch driver of about 10Ω.



TYPICAL APPLICATIONS



C1=C2=C3=Ceramic 0.22μF
(External Components)
Murata : GRM155B31A224KE18B

TECHNICAL NOTES

When using these ICs, consider the following points:

PCB Layout

In these ICs, phase compensation is made for securing stable operation even if the load current is varied.

For this purpose, use capacitors (0.22μF or more) for C2 and C3 with good frequency characteristics and ESR (Equivalent Series Resistance).

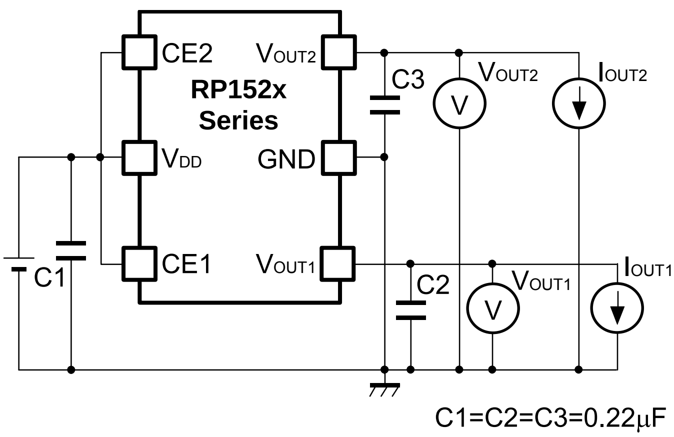
(Note: If additional ceramic capacitors are connected with parallel to the output pin with an output capacitor for phase compensation, the operation might be unstable. Because of this, test these ICs with as same external components as ones to be used on the PCB.)

Phase Compensation

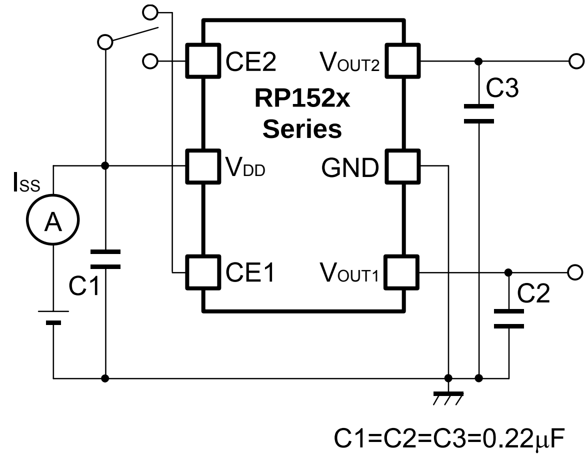
Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect capacitors with a capacitance value as much as 0.22μF or more between V_{DD} and GND pin, and as close as possible to the pins (C1).

Set external components, especially the output capacitors, as close as possible to the ICs, and make wiring as short as possible (C2 / C3).

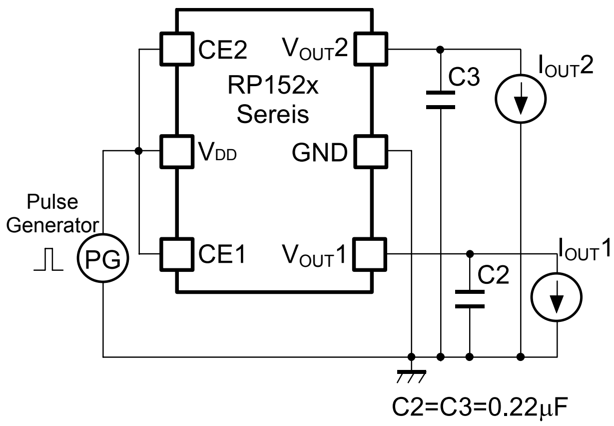
TEST CIRCUITS



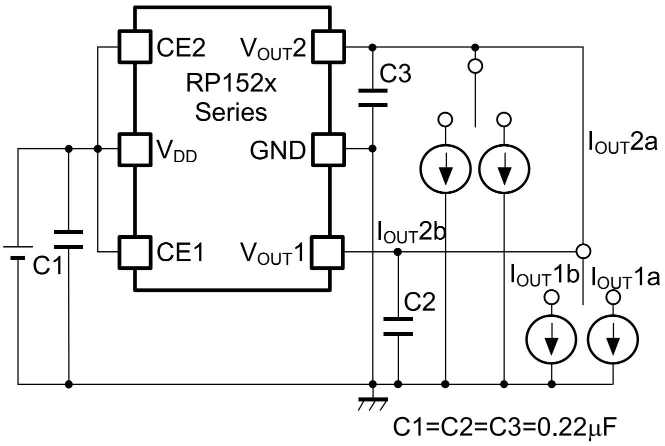
Basic Test Circuit



Test Circuit for Supply Current



Test Circuit for Ripple Rejection & Line Transient Response

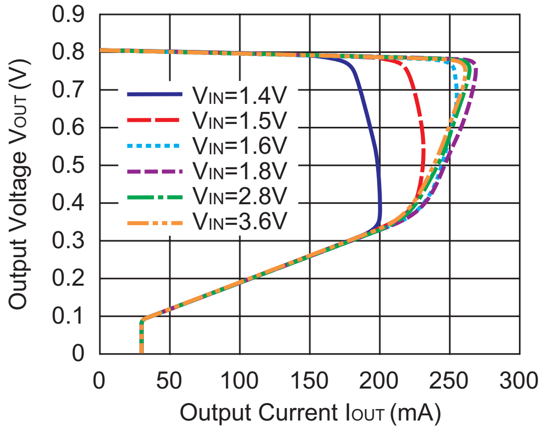


Test Circuits for Load Transient Response

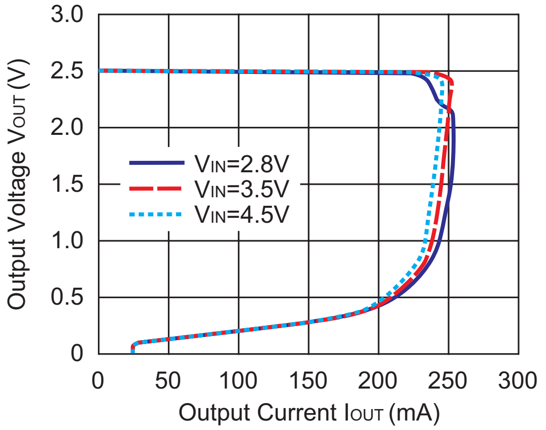
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current (Topt=25°C)

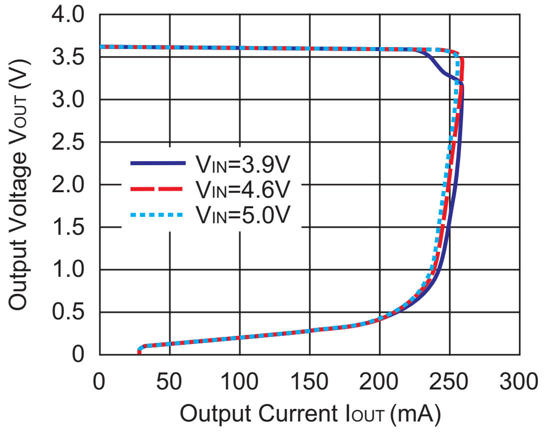
0.8V(VR1/VR2)



2.5V(VR1/VR2)

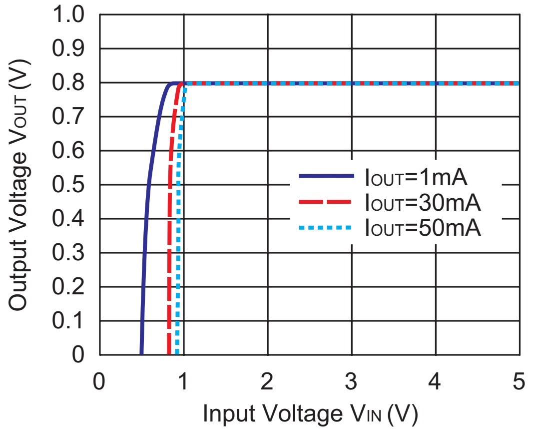


3.6V(VR1/VR2)

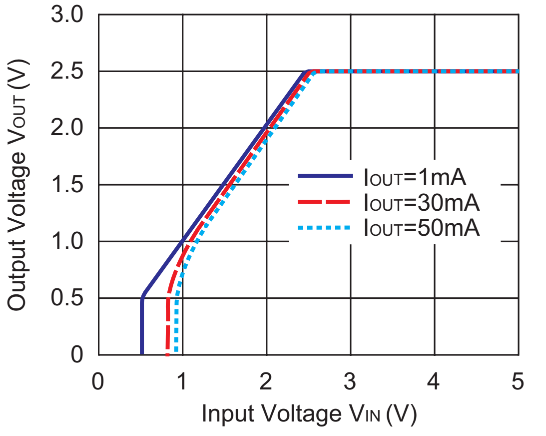


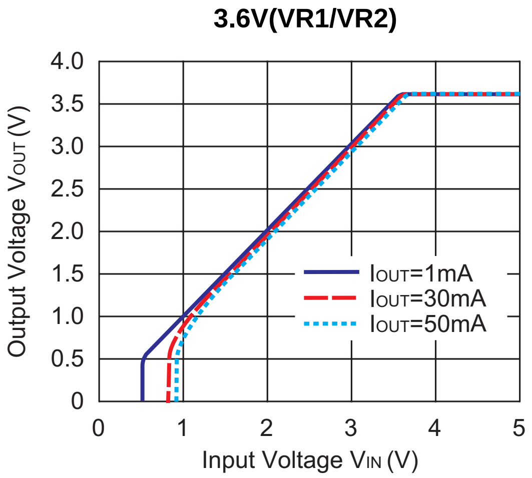
2) Output Voltage vs. Input Voltage (Topt=25°C)

0.8V(VR1/VR2)

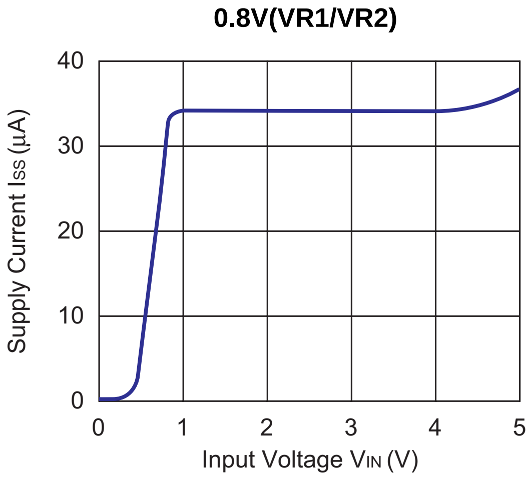


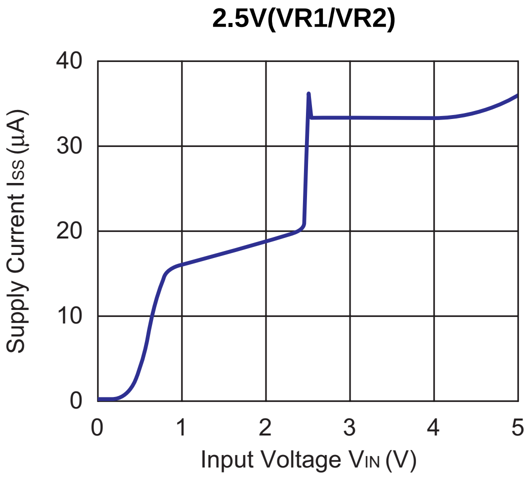
2.5V(VR1/VR2)

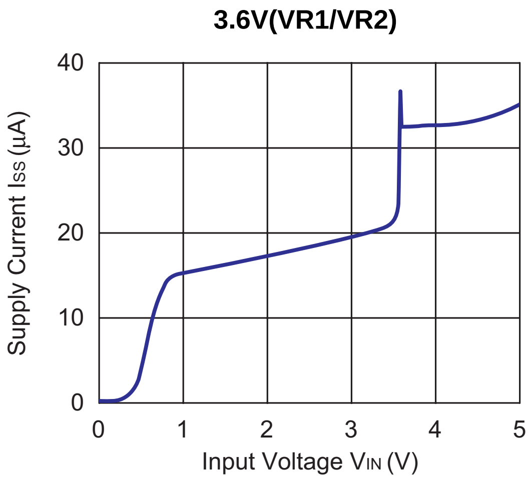




3) Supply Current vs. Input Voltage

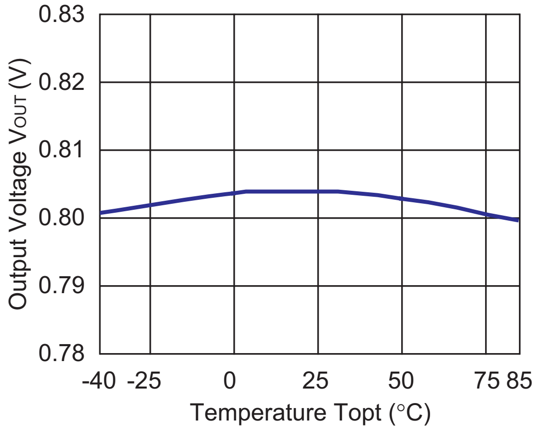




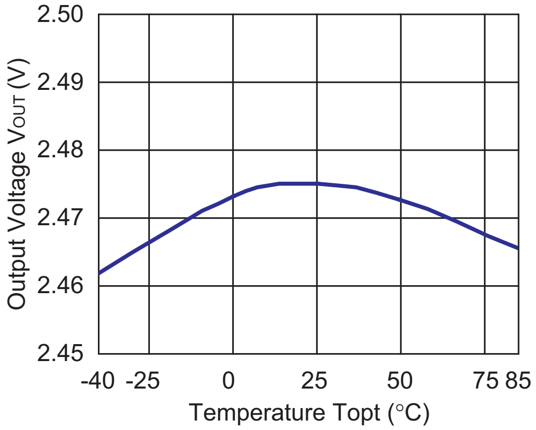


4) Output Voltage vs. Temperature

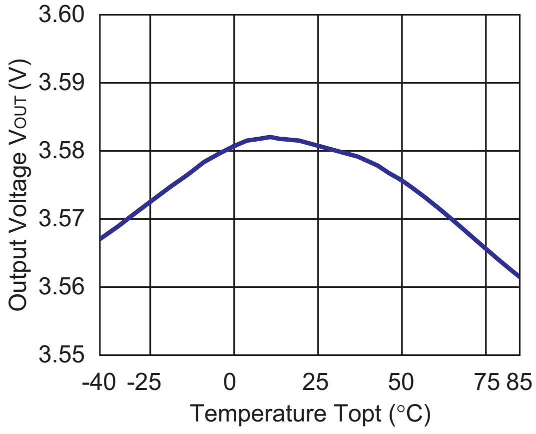
0.8V(VR1/VR2)



2.5V(VR1/VR2)

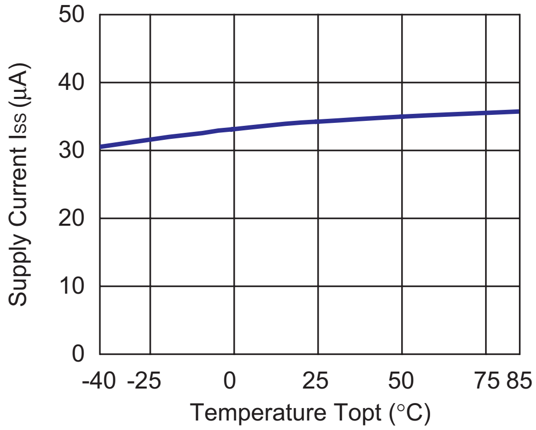


3.6V(VR1/VR2)

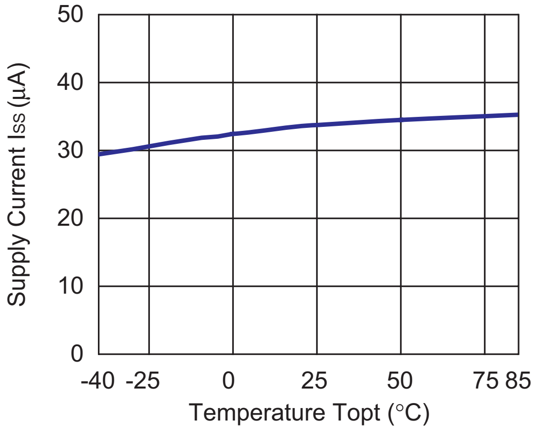


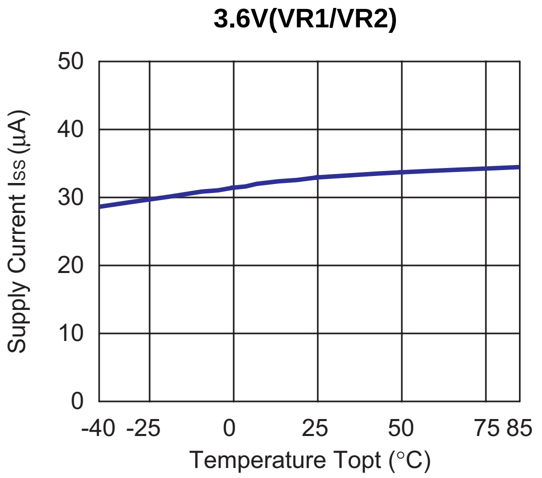
5) Supply Current vs. Temperature

0.8V(VR1/VR2)

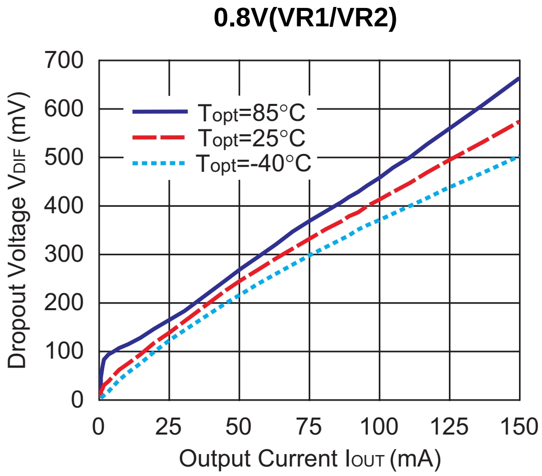


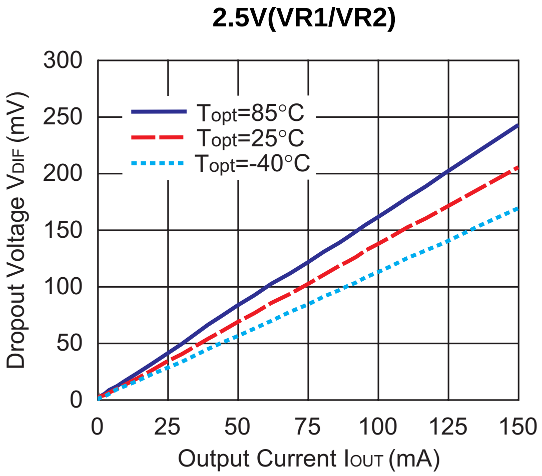
2.5V(VR1/VR2)

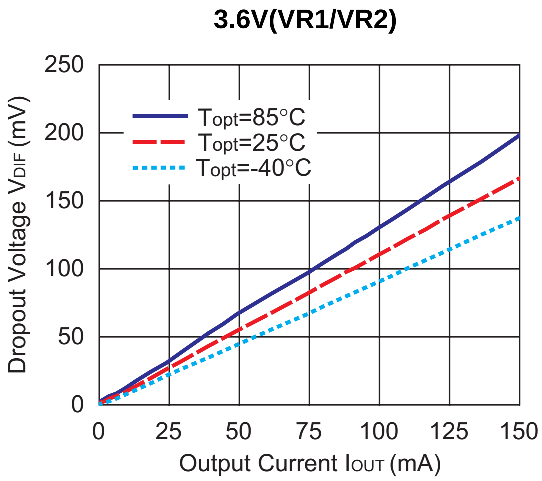




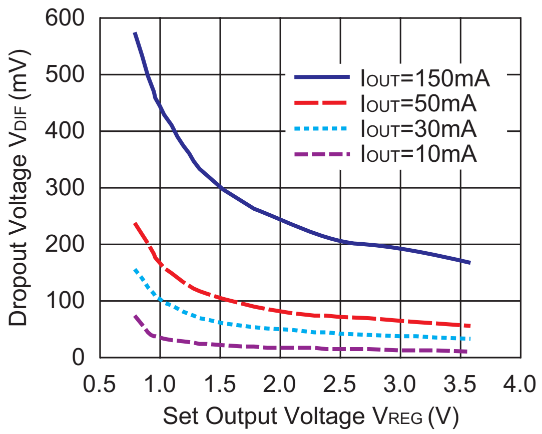
6) Dropout Voltage vs. Output Current



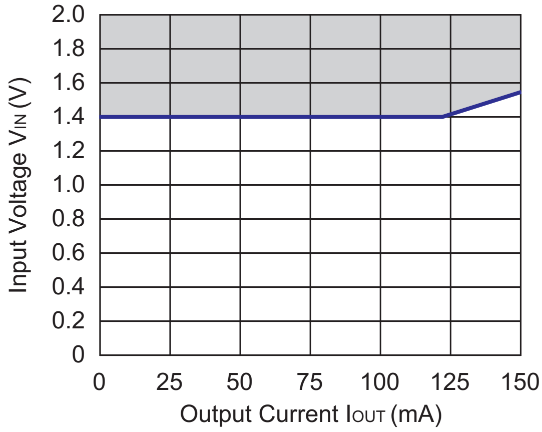




7) Dropout Voltage vs. Set Output Voltage

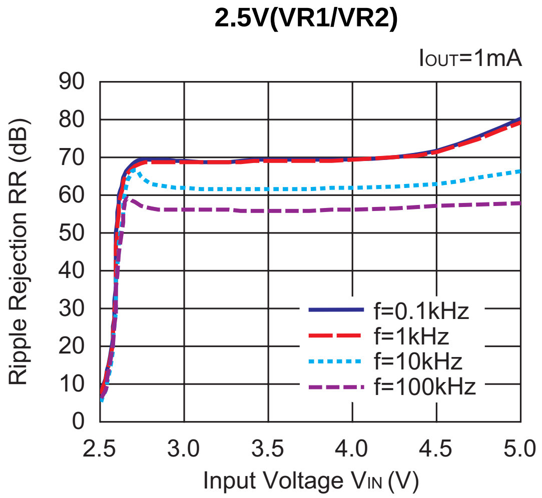


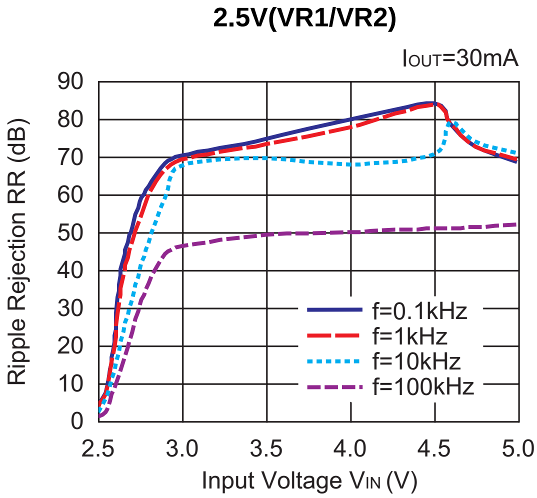
8) Minimum Operating Voltage



Hatched area is available
for 0.8V output

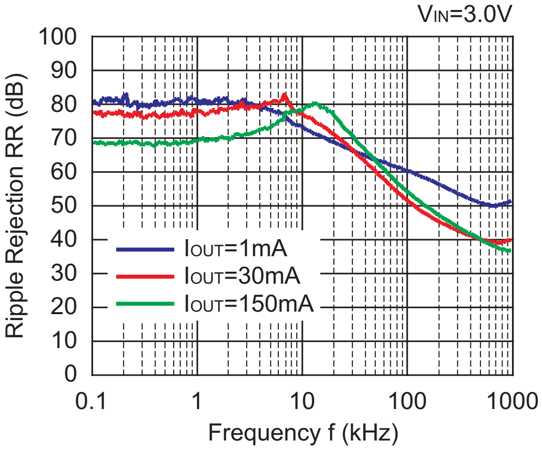
9) Ripple Rejection vs. Input Voltage (C1=none, C2=Ceramic 0.22μF, Ripple=0.2Vp-p,Topt=25°C)



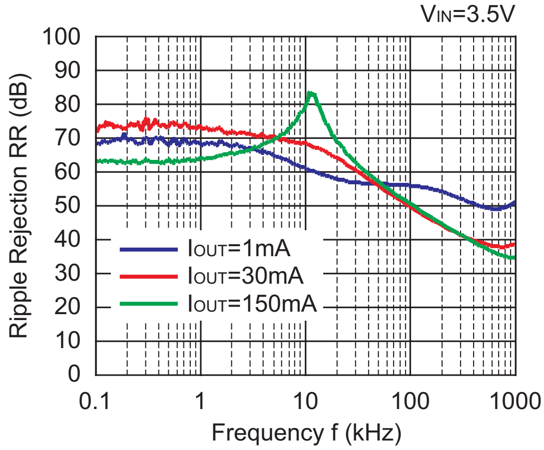


10) Ripple Rejection vs. Frequency (C1=none, C2=Ceramic 0.22µF, Ripple=0.2Vp-p, Topt=25°C)

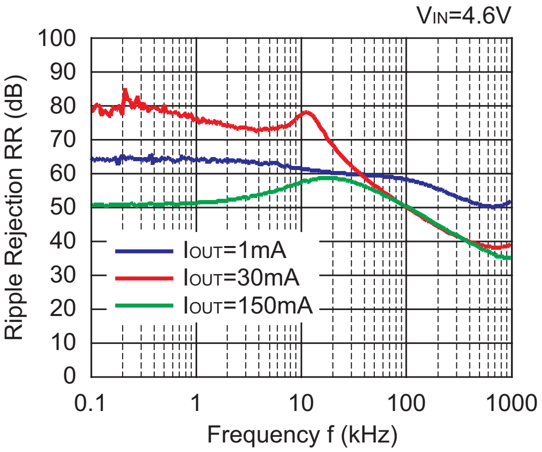
0.8V(VR1/VR2)



2.5V(VR1/VR2)

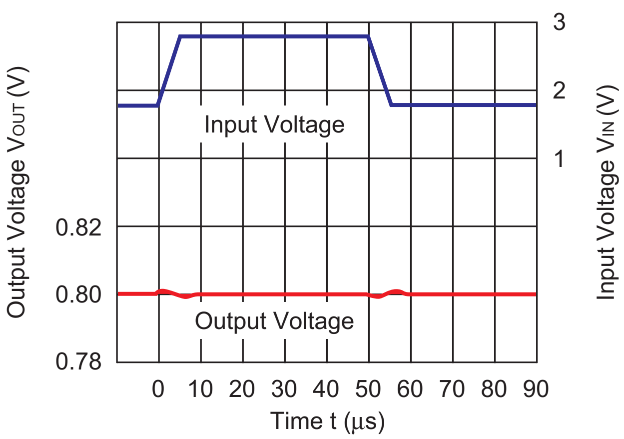


3.6V(VR1/VR2)

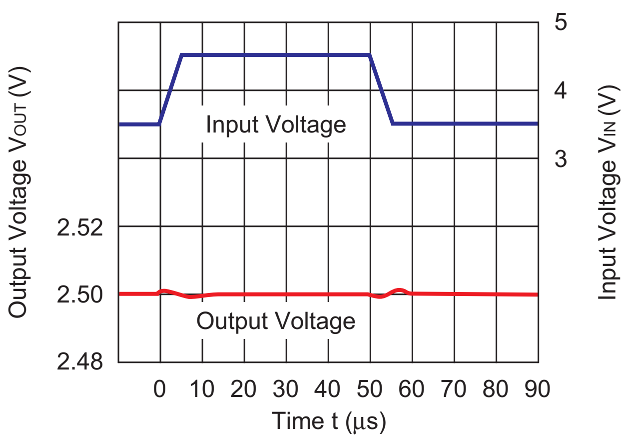


11) Input Transient Response (IOUT=30mA, tr=tf=5µs, C1=none, C2=0.22µF, Topt=25°C)

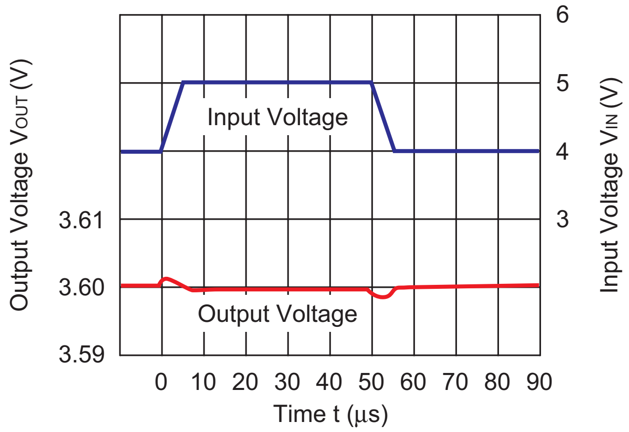
0.8V(VR1/VR2)



2.5V(VR1/VR2)

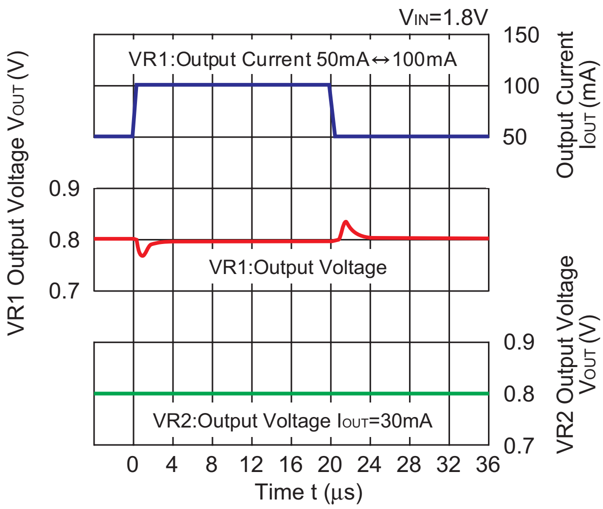


3.6V(VR1/VR2)

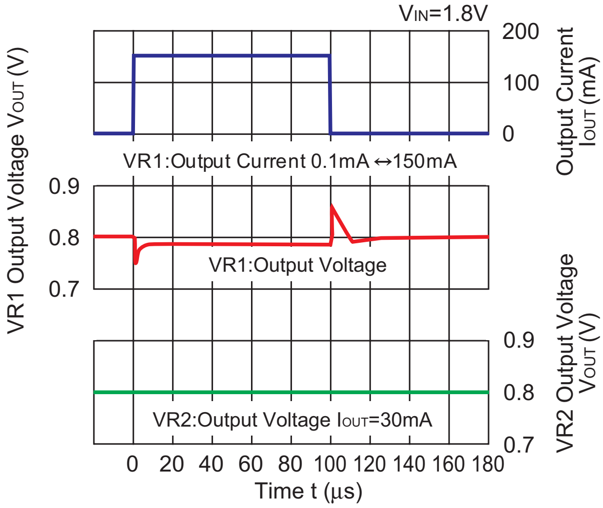


12) Load Transient Response (tr=tf=500µs, C1=C2=0.22µF, Topt=25°C)

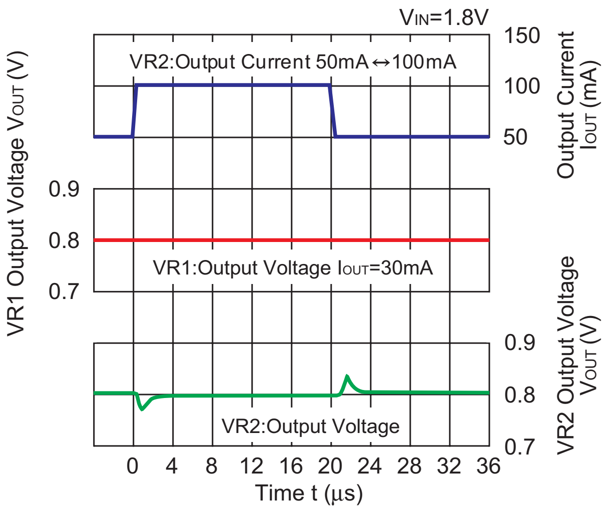
0.8V(VR1/VR2)



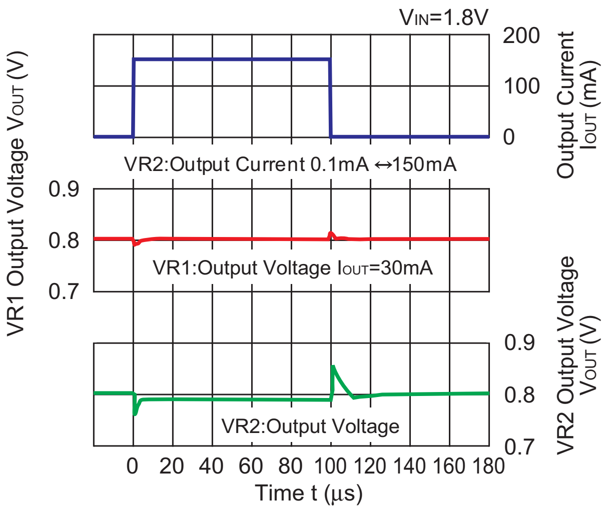
0.8V(VR1/VR2)



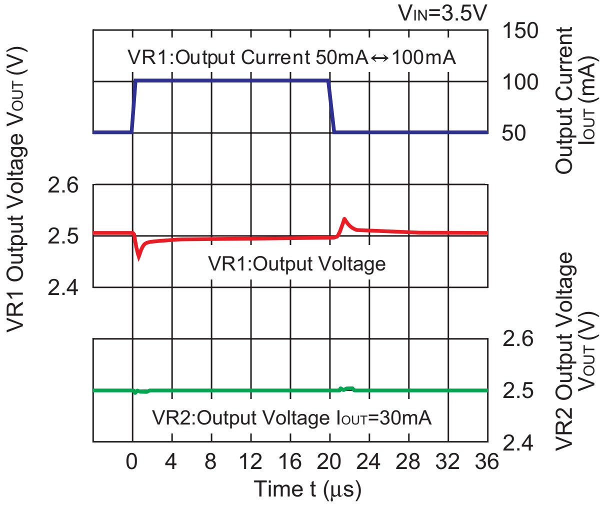
0.8V(VR1/VR2)



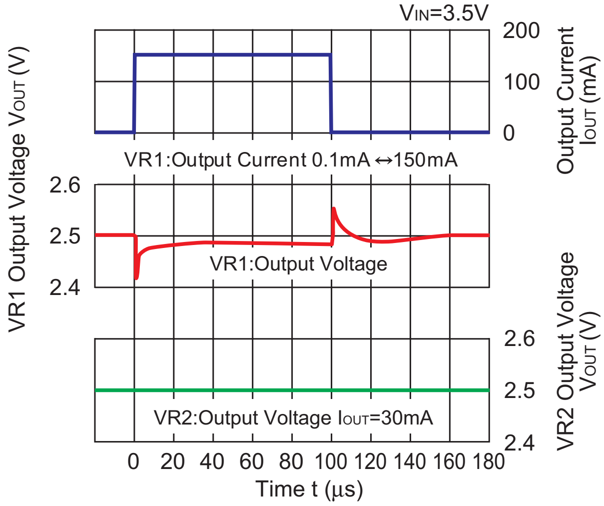
0.8V(VR1/VR2)



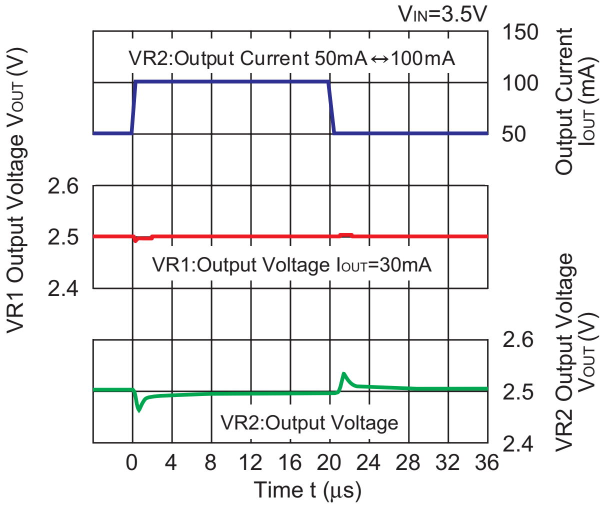
2.5V(VR1/VR2)



2.5V(VR1/VR2)



2.5V(VR1/VR2)



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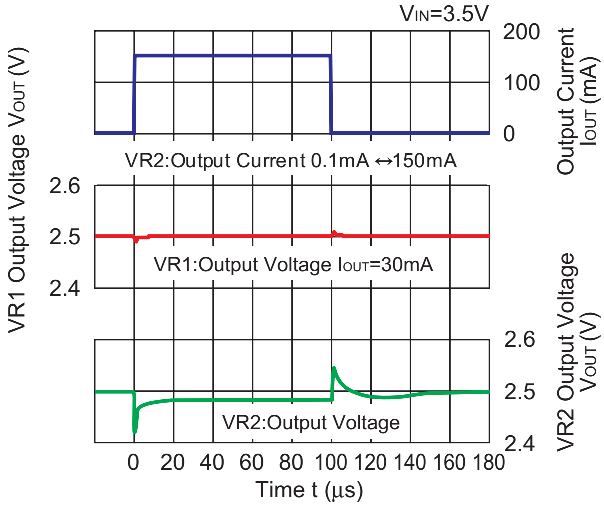
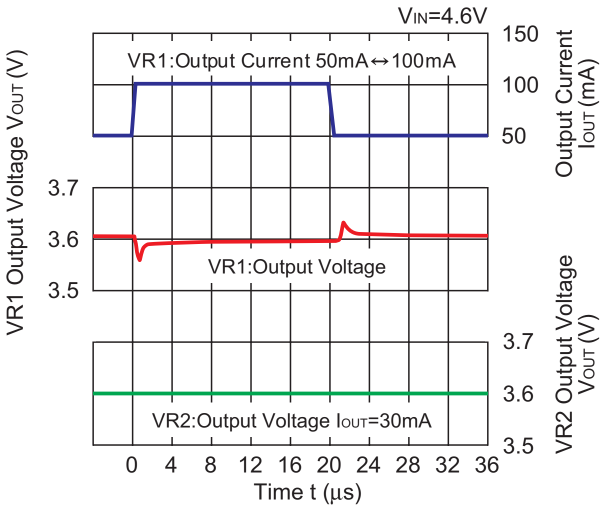
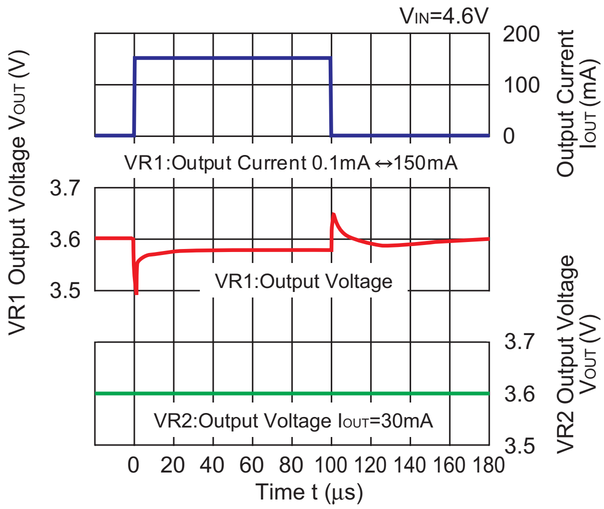


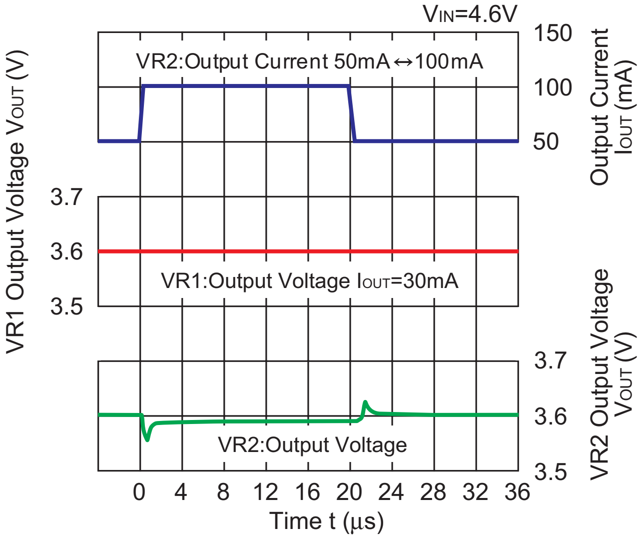
3.6V(VR1/VR2)



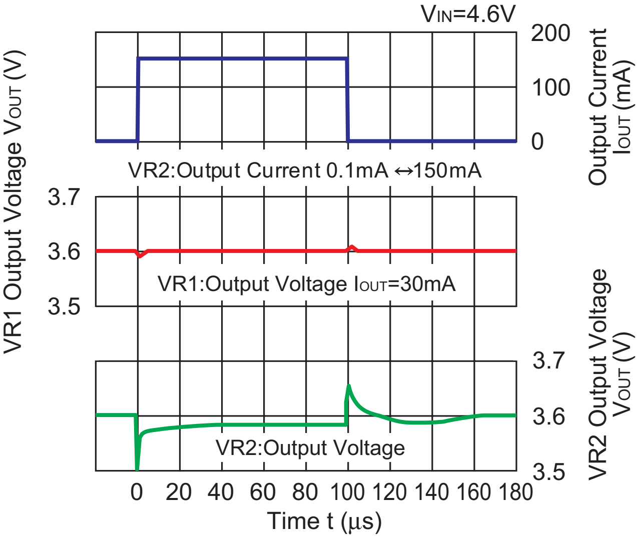
3.6V(VR1/VR2)



3.6V(VR1/VR2)

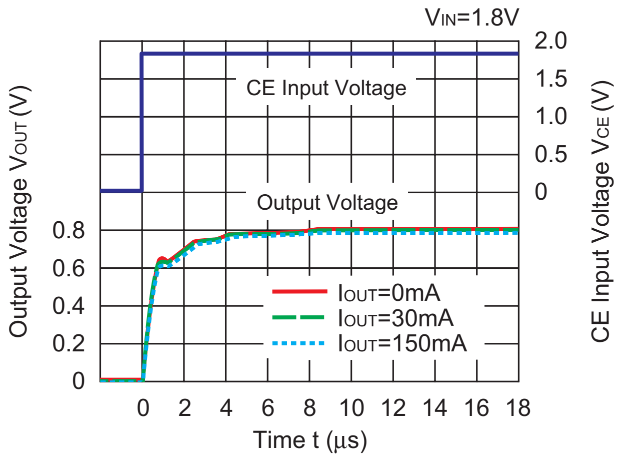


3.6V(VR1/VR2)

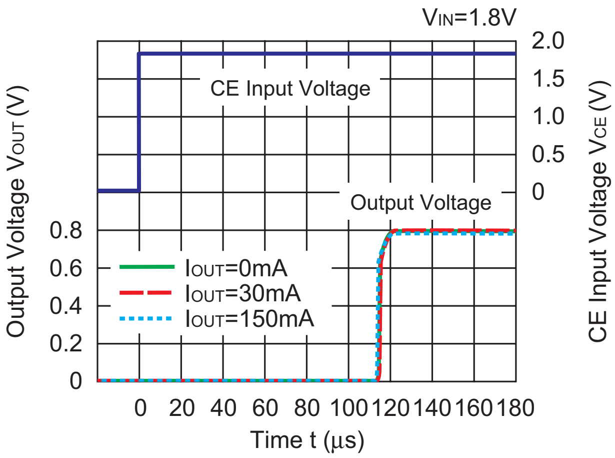


13) Turn On Speed with CE pin (C1=C2=0.22µF, Topt=25°C)

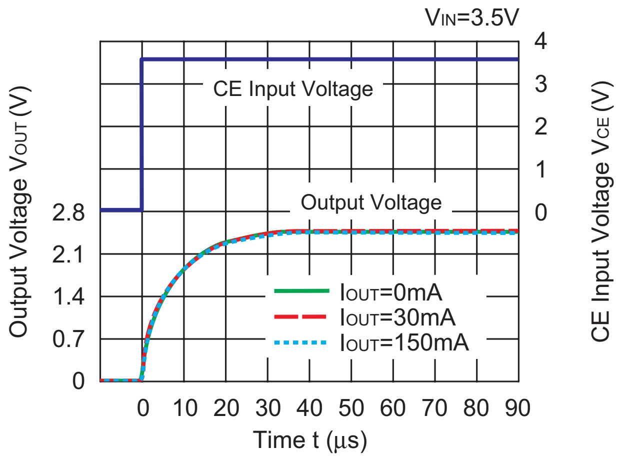
0.8V A/B Version (VR1/ VR2), C Version (VR1)



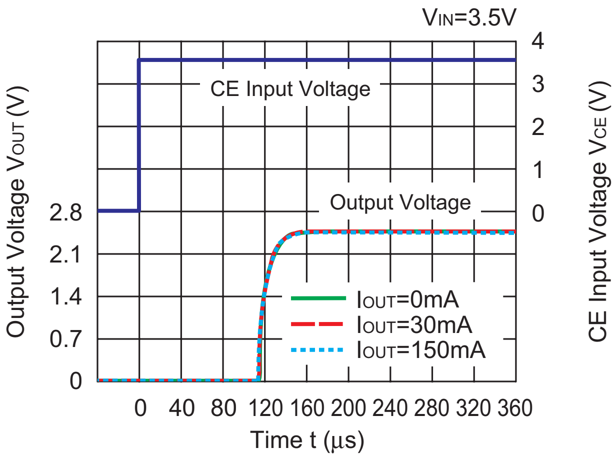
0.8V C Version (VR2)



2.5V A/B Version (VR1/ VR2), C Version (VR1)



2.5V C Version (VR2)



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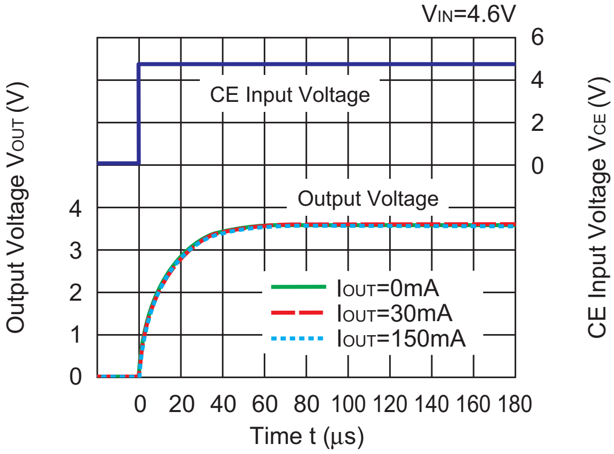
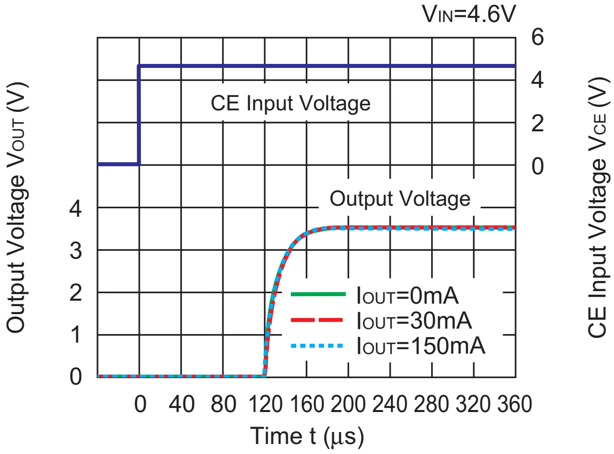
3.6V A/B Version (VR1/ VR2), C Version (VR1)

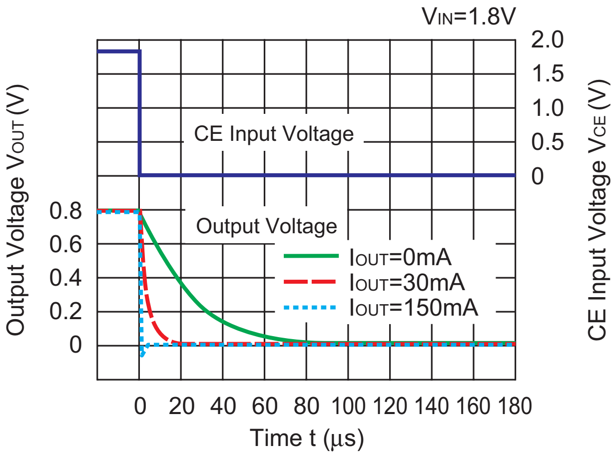


3.6V C Version (VR2)

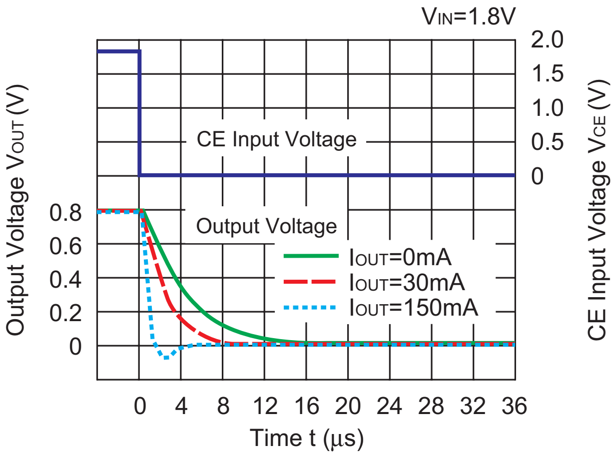


14) Turn Off Speed with CE pin (C1=C2=0.22μF, Topt=25°C)

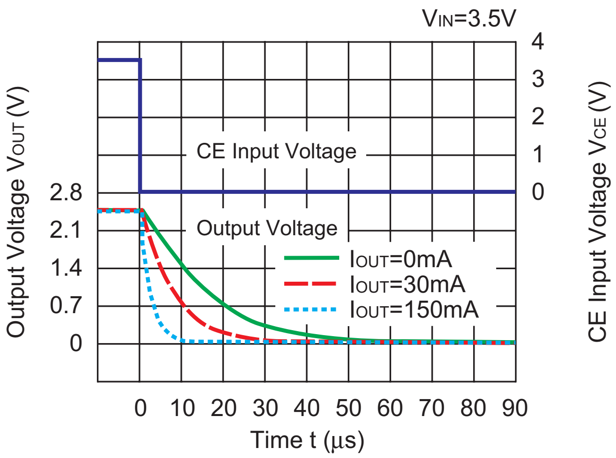
0.8V B Version(VR1/ VR2), C Version (VR1)



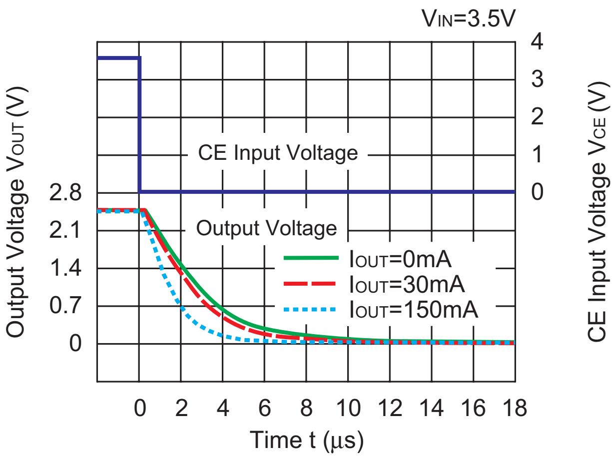
0.8V C Version (VR2)



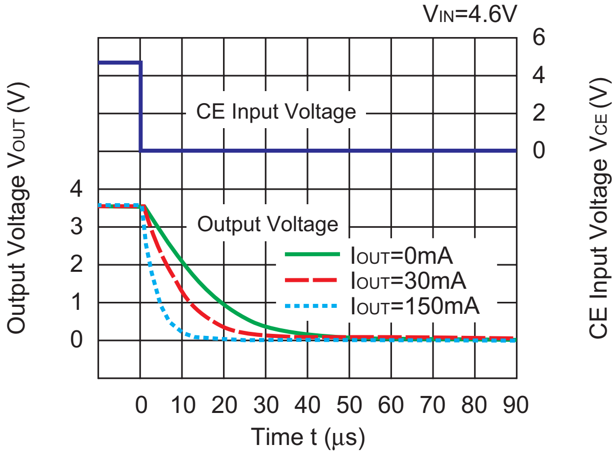
2.5V B Version(VR1/ VR2), C Version (VR1)



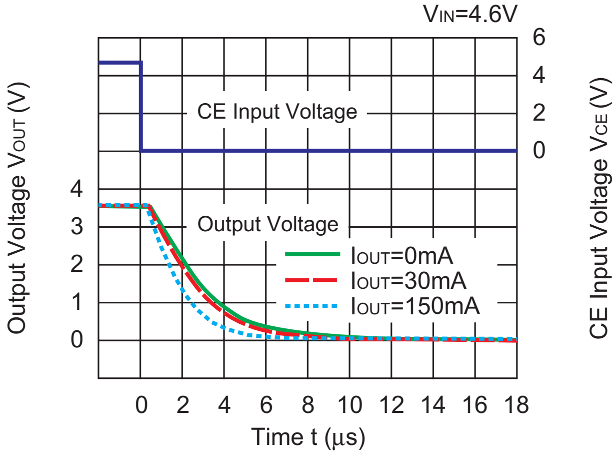
2.5V C Version (VR2)



3.6V B Version(VR1/ VR2), C Version (VR1)



3.6V C Version (VR2)



ESR vs. Output Current

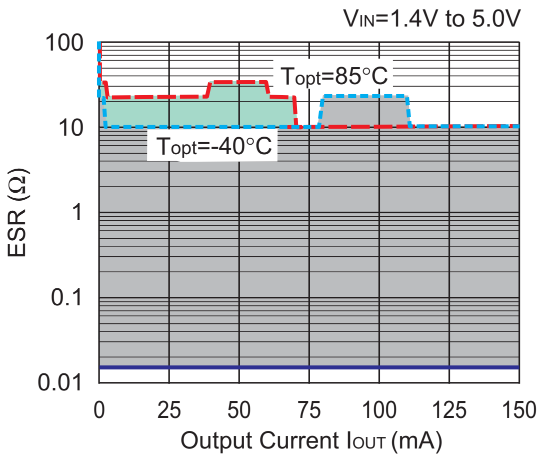
When using these ICs, consider the following points:

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.

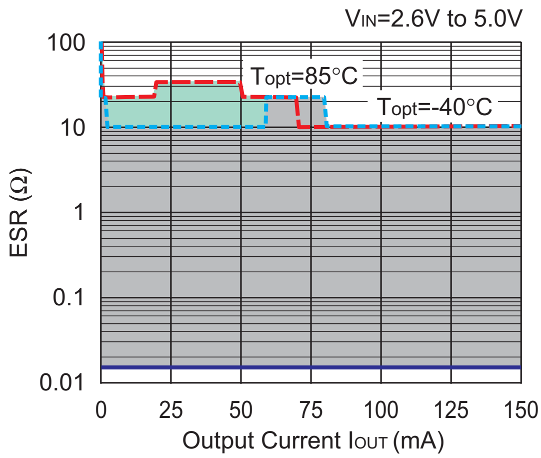
Measurement conditions

Frequency Band: 10Hz to 2MHz
Temperature : –40°C to 85°C
C1, C2 : 0.22µF (Murata , GRM155B10J224KE01)

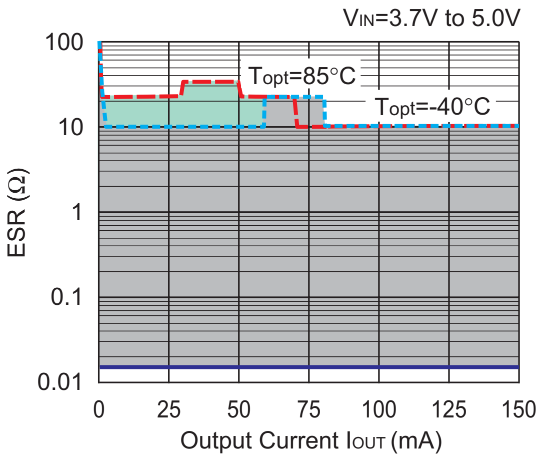
0.8V(VR1/ VR2)



2.5V(VR1/ VR2)



3.6V(VR1/ VR2)



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