150mA CMOS Voltage Regulator IC
Monolithic IC MM3376AX Series

Outline

This IC is a regulator IC providing low supply current (1.7μA) and low input voltage (1.2~6V), developed using the CMOS process, and supports longer battery life with a chip enable function. In addition, it is ideal to be used for a constant voltage power supply for backup as it includes a reverse current protection function to automatically prevent a current (0.1μA max.) from reversely flowing to the input terminal side if a voltage exceeding the input terminal voltage (V_{DD}) is applied to the output terminal (V_{OUT}) by monitoring the voltages of the output terminal (V_{OUT}) and input terminal (V_{DD}).

Features

1.	Input voltage range	1.2~6V
2.	Output voltage range	0.8~5.0V
3.	Output voltage accuracy	V_{OUT}±2%
4.	Maximum output current	150mA
5.	Supply current	1.7μA typ.(No-Load Input Current) 0.6μA typ.(OFF)
6.	Reverse current	0.1μA max.
7.	Output capacitor	0.1μF
8.	Dropout voltage	30mV typ. / 50mV max. (Io=10mA 3.3V≦V_{OUT}≦5.0V)
9.	Output short-circuit current	60mA typ.
10.	Line regulation	0.05%V typ. (Io=1mA)
11.	Load regulation	30mV typ. / 90mV max. (Io=1~150mA)

Package

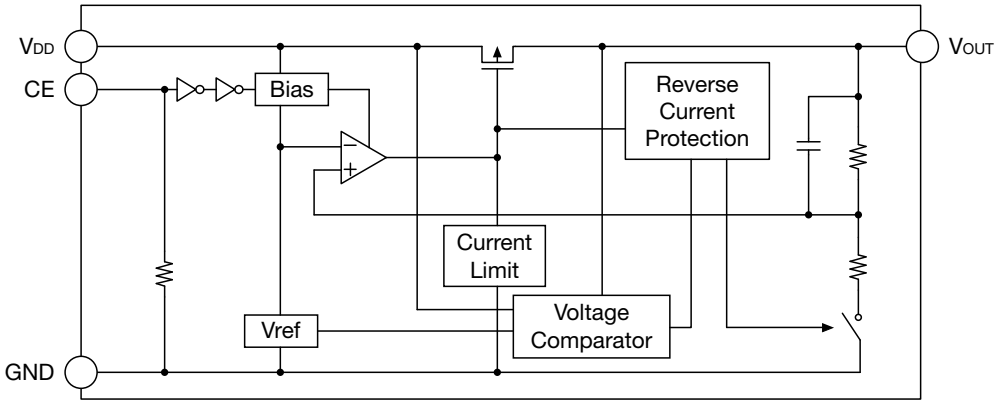
SOT-25A
SSON-4
SC-82

Applications

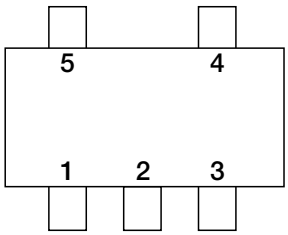
1. Cellular Phones
2. Portable Games
3. PDAs
4. Digital still Cameras
5. Note PCs

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Block Diagram

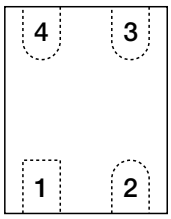


Pin Assignment



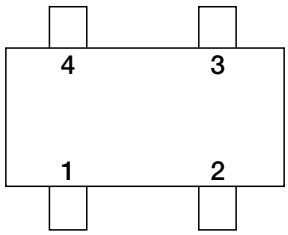
SOT-25A
(TOP VIEW)

1	VDD
2	GND
3	CE
4	NC
5	VOUT



SSON-4
(TOP VIEW)

1	GND
2	CE
3	VDD
4	VOUT



SC-82
(TOP VIEW)

1	CE
2	GND
3	VOUT
4	VDD

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Pin Description

SOT-25A

Pin No.	Pin name	Functions
1	V_{DD}	Voltage–supply pin
2	GND	Ground pin
3	CE	ON/OFF–Control pin CE: Low → OFF; High → ON Connect CE pin with V_{DD} pin, when it is not used.
4	NC	No connection
5	V_{OUT}	Output pin

SSON-4

Pin No.	Pin name	Functions
1	GND	Ground pin
2	CE	ON/OFF–Control pin CE: Low → OFF; High → ON Connect CE pin with V_{DD} pin, when it is not used.
3	V_{DD}	Voltage–supply pin
4	V_{OUT}	Output pin

SC-82

Pin No.	Pin name	Functions
1	CE	ON/OFF–Control pin CE: Low → OFF; High → ON Connect CE pin with V_{DD} pin, when it is not used.
2	GND	Ground pin
3	V_{OUT}	Output pin
4	V_{DD}	Voltage-supply pin

Absolute Maximum Ratings (Except where noted otherwise Ta=25°C)

Item	Symbol	Ratings	Units
Storage temperature	T_{STG}	−55~+150	°C
Supply voltage	V_{DD}	6.5	V
CE input voltage	V_{CE}	−0.3~6.5	V
Output voltage	V_{OUT}	−0.3~6.5	V
Output current	I_{OUT}	200	mA
Power dissipation	Pd	350(Note1) (SOT–25A)	mW
		330(Note2) (SSON–4B)	
		240(Note3) (SC–82ABB)	

Note1 : With PC Board of glass epoxy.
Note2 : With PC Board of glass epoxy 110 × 40 × 0.8^{t}mm
Note3 : With PC Boad of glass epoxy (The tab pin is not connected with PC Boad.) 100 × 100 × 1.6^{t}mm

Recommended Operating Conditions (Except where noted otherwise Ta=25°C)

Item	Symbol	Ratings	Units
Operating ambient temperature	T_{JOP}	−40~85	°C
Operating voltage	V_{OP}	Vo+0.3~6	V
Output current	I_{OUT}	0~150	mA

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Electrical Characteristics 1 (Except where noted otherwise V_{DD}=V_O(typ.)+1V, V_{CE}=V_{DD}, Ta=25°C)

Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Units
Input current (OFF)	I_{DD}off	V_{CE}=0V		0.6	1.2	µA
No-load input current	I_{DD}	I_{OUT}=0mA		1.7	3.5	µA
Output voltage	V_{OUT}	I_{OUT}=1mA	×0.98		×1.02	V
Line regulation	V_{LINE}	I_{OUT}=1mA V_{OUT}(typ.)+1V≦V_{DD}≦6V		0.05	0.20	%/V
Load regulation	V_{LOAD}	1mA≦I_{OUT}≦150mA		30	90	mV
Dropout voltage	Vio	Please refer to another page				V
Output short-circuit current (Note4)	Ilim	V_{OUT}=0V		60		mA
V_{OUT} temperature coefficient (Note4)	$\Delta V_{OUT}/\Delta T_{OP}$	I_{OUT}=30mA −40≦T_{OP}≦85°C		±100		ppm/°C
CE pin current	I_{CE}			0.5		µA
CE H threshold voltage	V_{CEH}		1.0		V_{DD}	V
CE L threshold voltage	V_{CEL}		0		0.3	V
Reverse current	I_{REV}	V_{OUT}>0.5V, 0V≦V_{DD}≦6V			0.1	µA

Note4 : The item is guaranteed by design.

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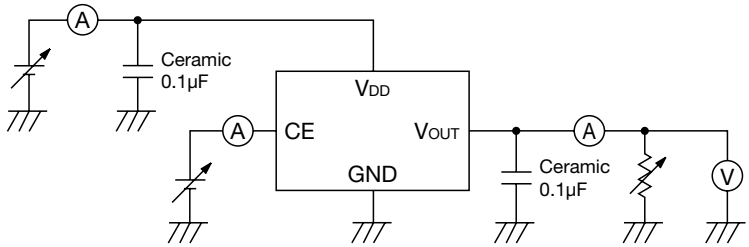
Electrical Characteristics 2 (Except where noted otherwise $V_{DD}=V_{OUT}$(typ.)+1V, $V_{CE}=V_{DD}$, Ta=25°C)

Model No.	Item							
	Output voltage				Dropout voltage			
	V_{OUT} (V)				Vio (V)			
	Measurement conditions	Min.	Typ.	Max.	Measurement conditions	Min.	Typ.	Max.
MM3376A08NRE	I_{OUT}=1mA	0.770	0.8	0.830	(Note5)			
MM3376A09NRE		0.870	0.9	0.930				
MM3376A10NRE		0.970	1.0	1.030				
MM3376A11NRE		1.070	1.1	1.130				
MM3376A12NRE		1.170	1.2	1.230				
MM3376A13NRE		1.270	1.3	1.330				
MM3376A14NRE		1.370	1.4	1.430				
MM3376A15NRE		1.470	1.5	1.530	I_{OUT}=10mA 1.5V≦V_{OUT}≦1.9V		0.12	0.15
MM3376A16NRE		1.568	1.6	1.632				
MM3376A17NRE		1.666	1.7	1.734				
MM3376A18NRE		1.764	1.8	1.836				
MM3376A19NRE		1.862	1.9	1.938				
MM3376A20NRE		1.960	2.0	2.040	I_{OUT}=10mA 2.0V≦V_{OUT}≦2.4V $V_{DD}=V_{OUT}$–0.2V		0.08	0.12
MM3376A21NRE		2.058	2.1	2.142				
MM3376A22NRE		2.156	2.2	2.244				
MM3376A23NRE		2.254	2.3	2.346				
MM3376A24NRE		2.352	2.4	2.448				
MM3376A25NRE		2.450	2.5	2.550	I_{OUT}=10mA 2.5V≦V_{OUT}≦2.9V $V_{DD}=V_{OUT}$–0.2V		0.06	0.08
MM3376A26NRE		2.548	2.6	2.652				
MM3376A27NRE		2.646	2.7	2.754				
MM3376A28NRE		2.744	2.8	2.856				
MM3376A29NRE		2.842	2.9	2.958				
MM3376A30NRE		2.940	3.0	3.060	I_{OUT}=10mA 3.0V≦V_{OUT}≦3.2V $V_{DD}=V_{OUT}$–0.2V		0.05	0.07
MM3376A31NRE		3.038	3.1	3.162				
MM3376A32NRE		3.136	3.2	3.264				
MM3376A33NRE		3.234	3.3	3.366	I_{OUT}=10mA 3.3V≦V_{OUT}≦5.0V $V_{DD}=V_{OUT}$–0.2V		0.03	0.05
MM3376A34NRE		3.332	3.4	3.468				
MM3376A35NRE		3.430	3.5	3.570				
MM3376A36NRE		3.528	3.6	3.672				
MM3376A37NRE		3.626	3.7	3.774				
MM3376A38NRE		3.724	3.8	3.876				
MM3376A39NRE		3.822	3.9	3.978				
MM3376A40NRE		3.920	4.0	4.080				
MM3376A41NRE		4.018	4.1	4.182				
MM3376A42NRE		4.116	4.2	4.284				
MM3376A43NRE		4.214	4.3	4.386				
MM3376A44NRE		4.312	4.4	4.488				
MM3376A45NRE		4.410	4.5	4.590				
MM3376A46NRE		4.508	4.6	4.692				
MM3376A47NRE		4.606	4.7	4.794				
MM3376A48NRE		4.704	4.8	4.896				
MM3376A49NRE		4.802	4.9	4.998				
MM3376A50NRE		4.900	5.0	5.100				

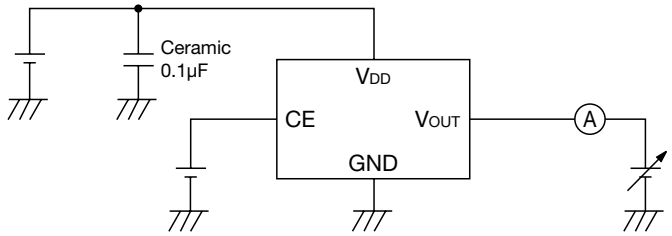
Note5 : The item is not guaranteed in the model less than V_{OUT}=1.4V .

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Measuring Circuit

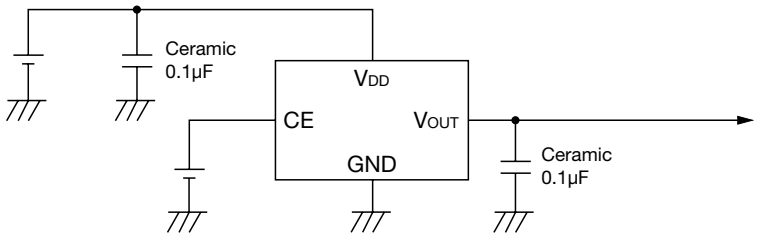


Basic Measuring Circuit



Reverse Current Measuring Circuit

Application Circuit



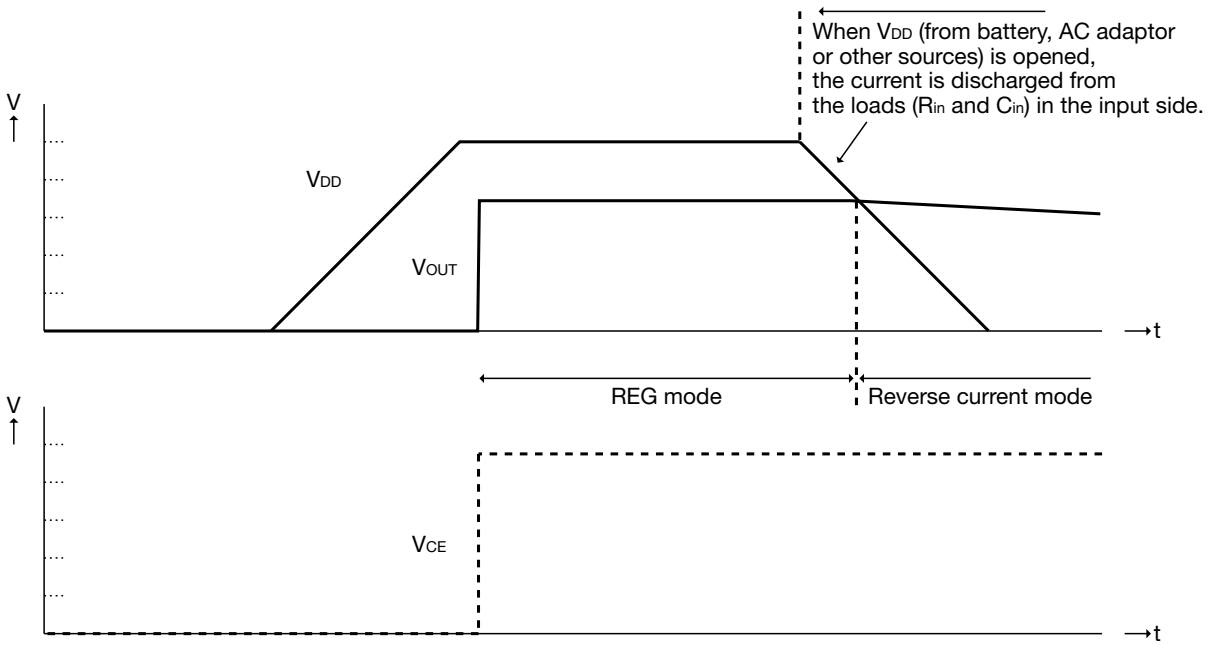
· Note

1. The output capacitor is required between output and GND to prevent oscillation.
2. The ESR of capacitor must be defined in ESR stability area.
   It is possible to use a ceramic capacitor without ESR resistance for output.
   The ceramic capacitor must be used more than 0.1μF and B temperature characteristics.
3. The wire of Vcc and GND is required to print full ground plane for noise and stability.
4. The input capacitor must be connected a distance of less than 1cm from input pin.
5. Be careful because it becomes easy to overshoot output voltage at the time of input voltage starting when an output capacitance is smaller than 0.47μF.

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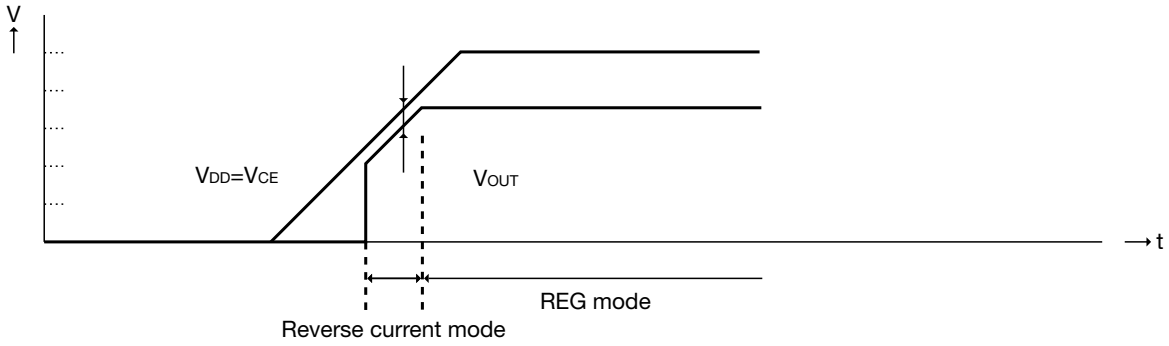
Timing Chart

1) Reverse current mode



2) During the input voltage build-up

When V_{CE} terminal is shorted to V_{DD}.



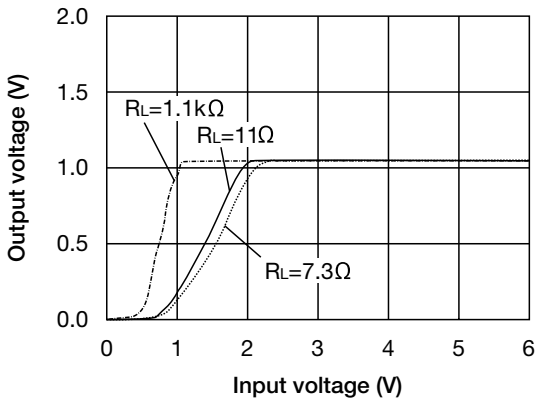
While voltage is building up in the input side,
this IC operates in the reverse current mode when
⊿V (Difference between input and output voltages)
is 30mV (Reverse current mode threshold voltage) or less.

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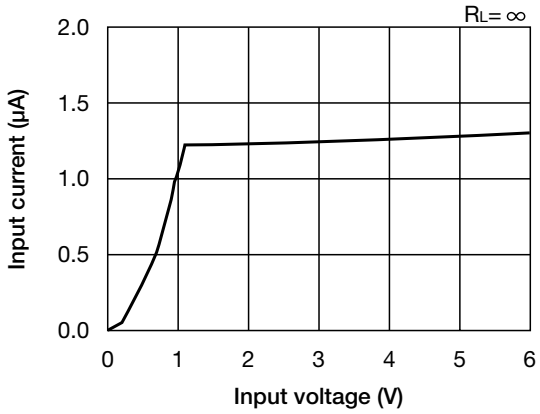
Characteristics (Vo=1.1V)

(Except where noted otherwise Ta=25°C, V_{DD}=V_{OUT} (typ.) +1V, V_{CE}=V_{DD}, Cin=0.1µF, Co=0.1µF)

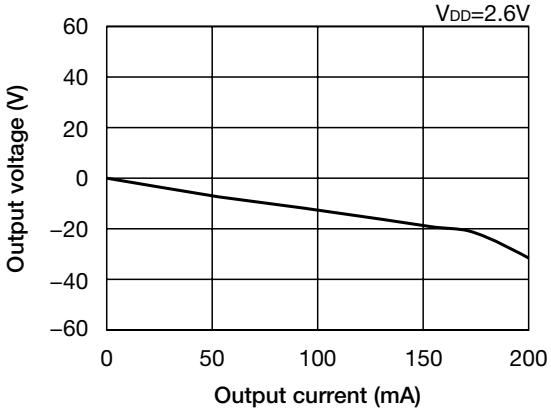
Input voltage - Output voltage



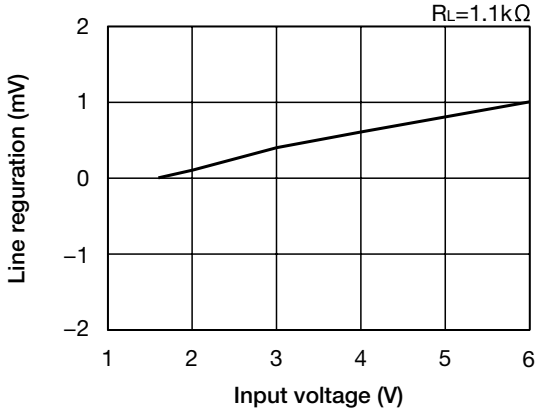
Input current - Input voltage



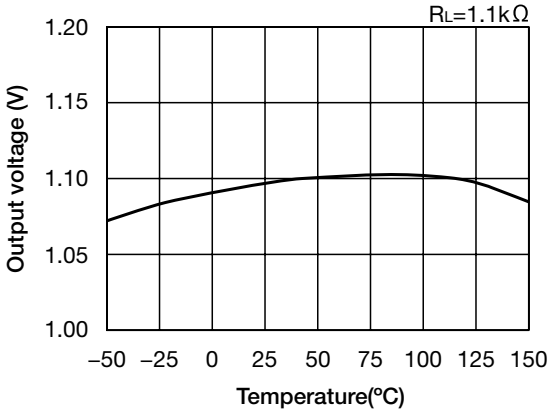
Load regulation



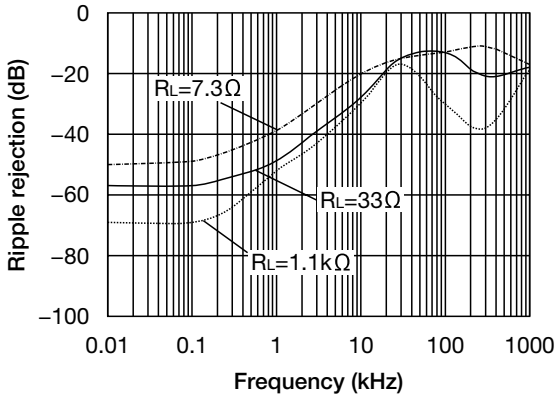
Line regulation



Temperature - output voltage



Ripple rejection

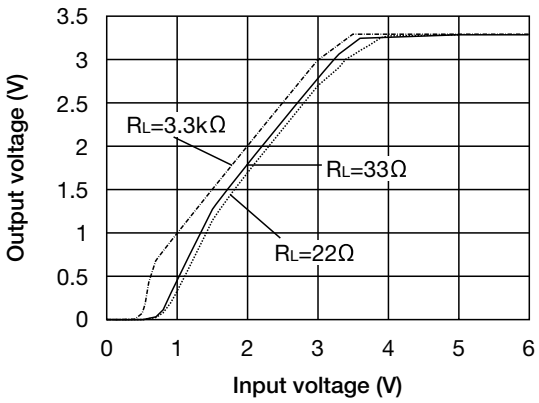


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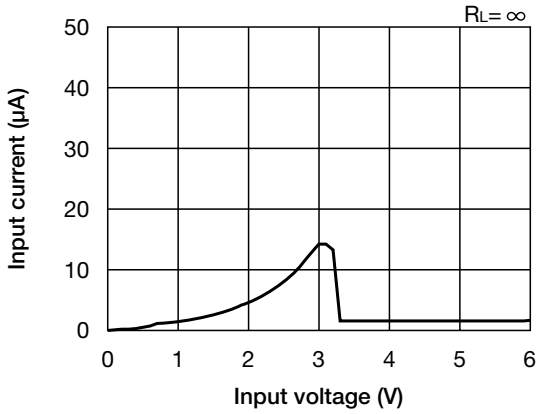
Characteristics (Vo=3.3V)

(Except where noted otherwise Ta=25°C, V_{DD}=V_{OUT} (typ.) +1V, V_{CE}=V_{DD}, Cin=0.1µF, Co=0.1µF)

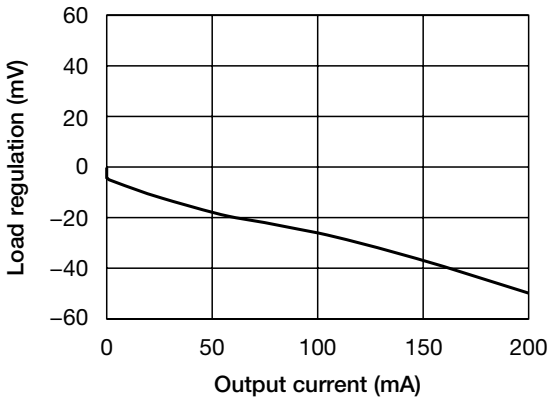
Input voltage - Output voltage



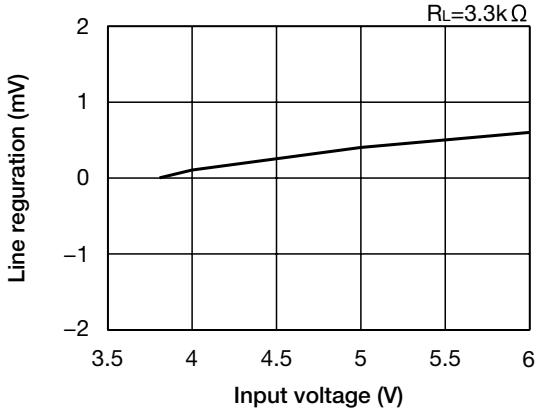
Input current - Input voltage



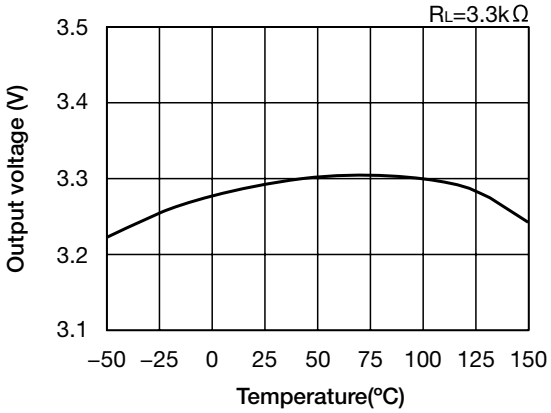
Load regulation



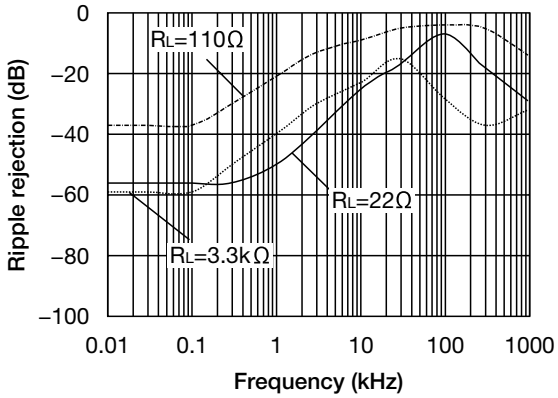
Line regulation



Temperature - output voltage



Ripple rejection

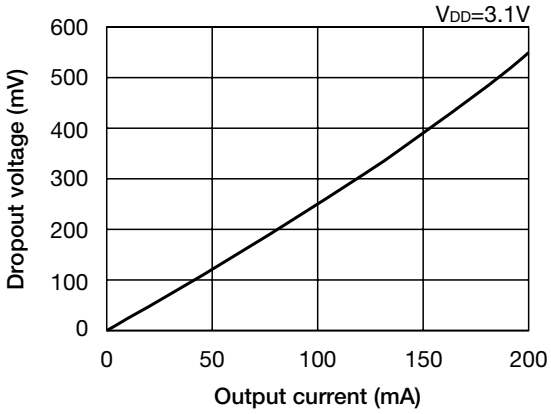


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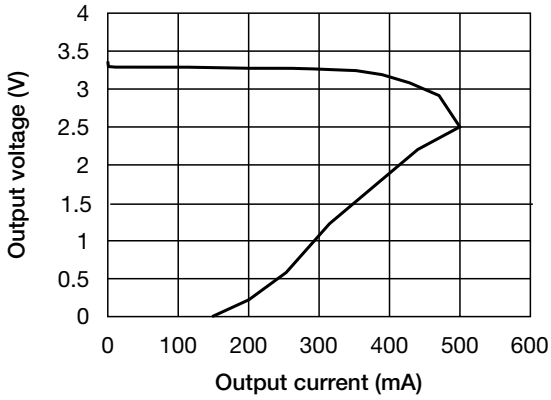
Characteristics (Vo=3.3V)

(Except where noted otherwise Ta=25°C, V_{DD}=V_{OUT} (typ.) +1V, V_{CE}=V_{DD}, Cin=0.1µF, Co=0.1µF)

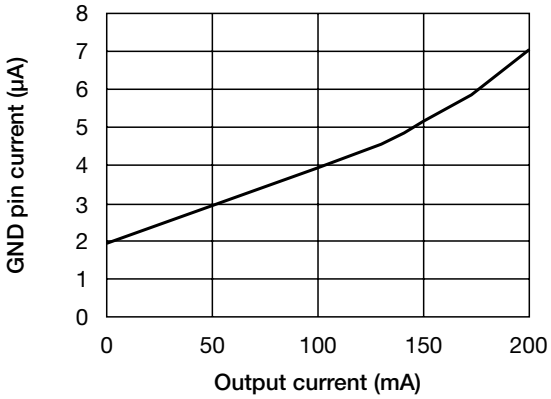
Dropout voltage



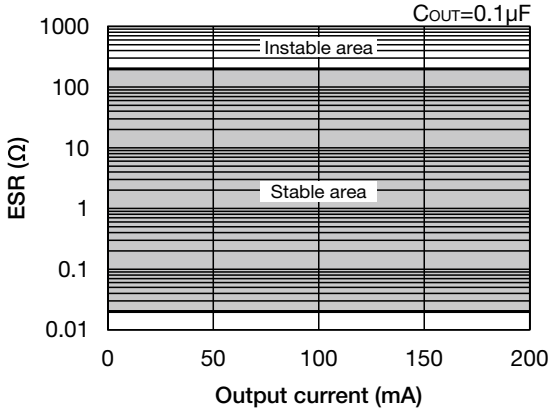
Current limit



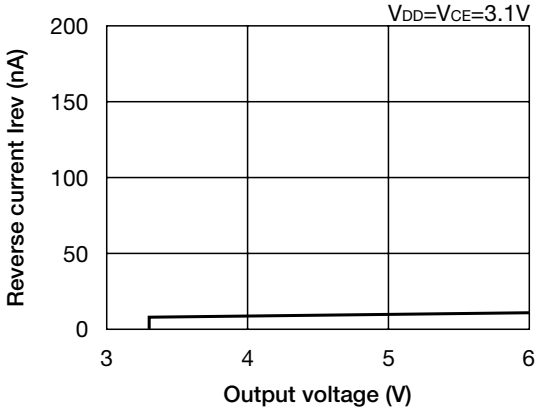
GND pin current



ESR stable area



Reverse current characteristics

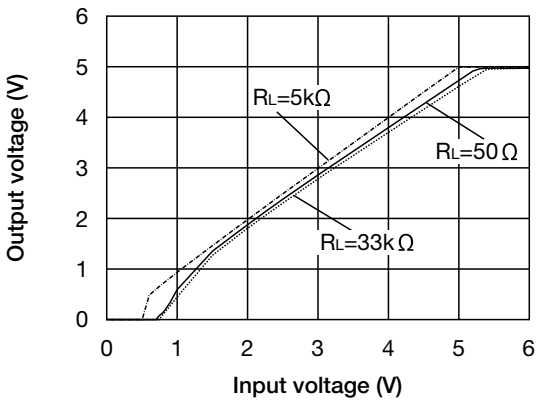


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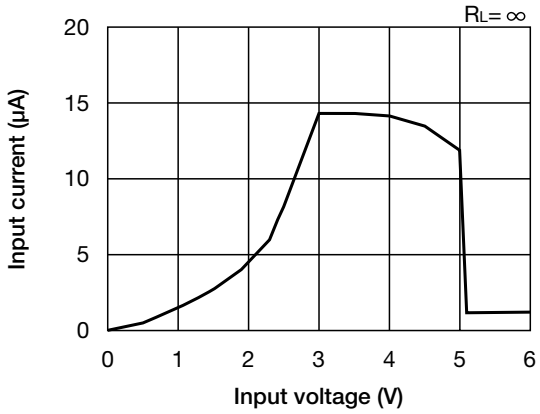
Characteristics (Vo=5.0V)

(Except where noted otherwise Ta=25°C, V_{DD}=V_{OUT} (typ.) +1V, V_{CE}=V_{DD}, Cin=0.1µF, Co=0.1µF)

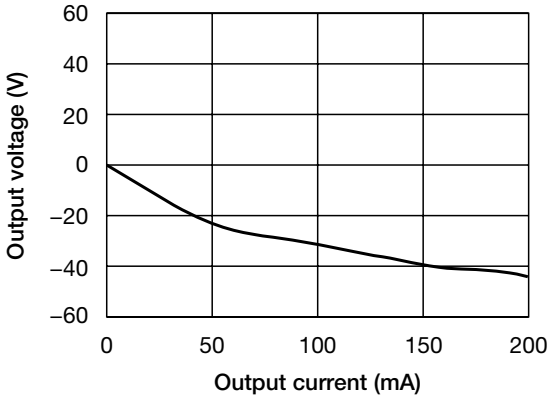
Input voltage - Output voltage



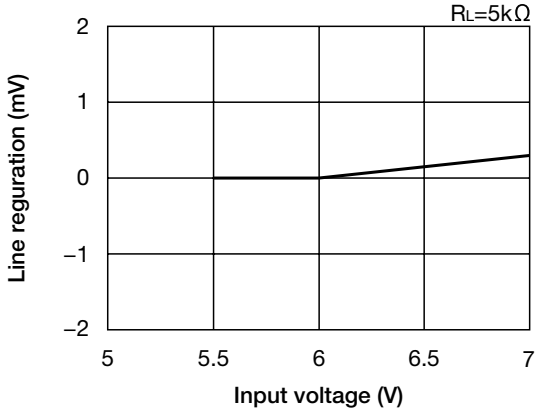
Input current - Input voltage



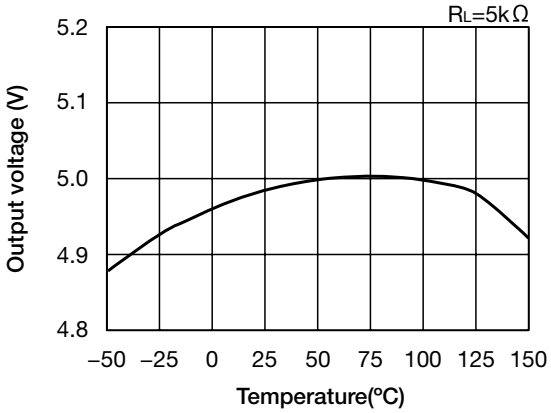
Load regulation



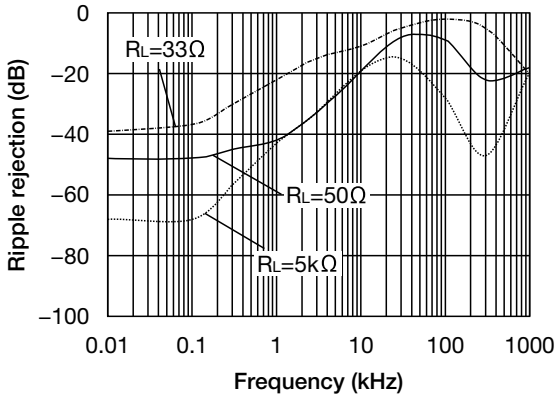
Line regulation



Temperature - output voltage



Ripple rejection



• Any products mentioned in this catalog are subject to any modification in their appearance and others for improvements without prior notification.
• The details listed here are not a guarantee of the individual products at the time of ordering. When using the products, you will be asked to check their specifications.