300mA LDO with adjustable output by voltage control

MM1937 Series

Overview

This IC is voltage control adjustable output voltage 300mA LDO.The output voltage can be linearly changed by input voltage at Vadj pin. When used as a power supply for the DC-Fan motor, Adjustable output voltage can make it easy to control air flow and reducing noise without an external parts.

Features

- Adjustable output by voltage control
- Over current protection
- Thermal shutdown

Main specifications

- Maximum rating supply voltage : -0.3V to 16V
- Operating voltage range : 6.5V to 14V
- Operating ambient temperature : -40℃ to 85℃
- Output current : 300mA
- Input current (OFF) : Max. 1μA
- No-load input current : Typ. 300μA
- Output voltage range : 2.0V to 12.0V
- Output voltage accuracy : ±2% (Vadj=0V), ±3% (Vadj=3.3V)
- Line regulation : Max. 0.1%/V (V_{IN}=9V to 14V)
- Load regulation : Typ. 25mV (I_{OUT}=1mA to 300mA)
- Dropout voltage : Typ. 0.3V (I_{OUT}=300mA)
- PSRR : Typ. 60dB (f=1kHz)
- Output capacitor : 2.2uF (Ceramic capacitor)
- Protection function : Over current protection, Thermal shutdown
- Additional function : ON/OFF control

Packages

- SOT89-5A

Application

- Power supply for DC fan
- In-vehicle infotainment device
- Audio visual equipment
- Office equipment / Printer

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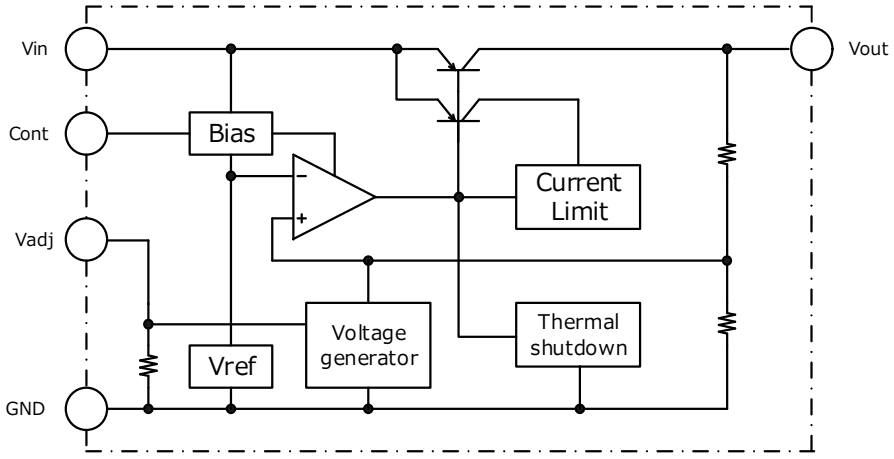
Model Name

M M 1 9 3 7 X X X X X X

Series name (A) (B) (C) (D) (E)

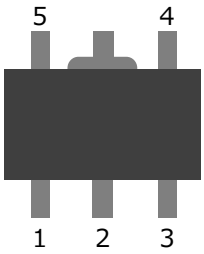
(A)	Function Type	A	$V_{OUT}=V_{OUT\_Low}$ (V_{adj}=0V), $V_{OUT}=V_{OUT\_High}$ (V_{adj}=3.3V)
		B	$V_{OUT}=V_{OUT\_High}$ (V_{adj}=0V), $V_{OUT}=V_{OUT\_Low}$ (V_{adj}=3.3V)
(B)	Output voltage rank	01	Two-digit serial number starting with "01" for V_{OUT1} and V_{OUT2} combinations. Output voltage can be designated in the range from 3.0V to 12.0V in 0.1V steps.
		≀	
(C)	Package	P	SOT89-5A
(D)	Packing specifications 1	R	R housing (Standard)
		L	L housing
(E)	Packing specifications 2	H	Emboss tape / Halogen free

Block Diagram



Pin Configuration

■ SOT89-5A



Top view

Pin No.	Pin name	Function
1	V_{adj}	Output voltage variable pin
2	GND	GND pin
3	Cont	ON/OFF-control pin Connect Cont pin with V_{IN} pin, when it is not used.
4	V_{IN}	Voltage supply pin
5	V_{OUT}	Output pin

Absolute Maximum Ratings

Item		Symbol	Min.	Max.	Unit
Storage temperature		Tstg	-55	150	℃
Junction temperature *Note1		Tj_{MAX}	-	150	℃
Supply voltage		V_{IN}	-0.3	16	V
Cont input voltage		V_{cont}	-0.3	16	V
V_{adj} pin input voltage		V_{adj}	-0.3	16	V
Output Voltage		V_{OUT}	-0.3	V_{IN}+0.3V	V
Output current		Iomax	0	400	mA
Power Dissipation *Note2	SOT89-5A	Pd	-	1780	mW

*Note1:In consideration of product life, please examine the use in less than 80%.

*Note2:JEDEC51-7 standard 114.3mm×76.2mm t=1.6mm Copper foil area 80%

Recommended Operating Conditions

Item	Symbol	Min.	Max.	Unit
Operating Ambient temperature	Topr	-40	85	℃
Operating voltage	Vop	6.5	14.0	V
Output Current	Iop	0	300	mA
V_{adj} input voltage	V_{adj}	0	3.8	V

Electrical Characteristics

(V_{IN}=9V, Iout=1mA, V_{Cont}=1.6V, Ta=25℃, unless otherwise specified)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
No-Load Input Current	I_{CC}	I_{OUT}=0mA V_{CONT}=V_{IN}	-	300	500	μA
Input Current(OFF)	I_{CCOFF}	V_{CONT}=0V	-	0	1	μA
Output Voltage 1 *Note3	V_{OUT1}	I_{OUT}=1mA	×0.980	-	×1.020	V
Output Voltage 2 *Note3	V_{OUT2}	I_{OUT}=1mA, Vadj=3.3V Rank A	×0.975	-	×1.025	V
		I_{OUT}=1mA, Vadj=3.3V Rank B	×0.965	-	×1.035	V
Dropout Voltage	Vio	V_{IN}=V_{OUT}-0.2V I_{OUT}=300mA	-	0.3	0.5	V
Line Regulation	V_{LINE}	V_{IN}=V_{OUT}+1V to 14V	-	-	0.1	%/V
Load Regulation	V_{LOAD}	I_{OUT}=1mA to 300mA	-	25	75	mV
Current Limit	Iout_lmt		300	450	-	mA
Thermal shutdown *Note4	T_{SD}		-	160	-	℃
Thermal shutdown hysteresis *Note4	T_{SD_h}		-	40	-	℃

*Note3:Please refer to another page.

*Note4:The parameter is guaranteed by design.

Electrical Characteristics

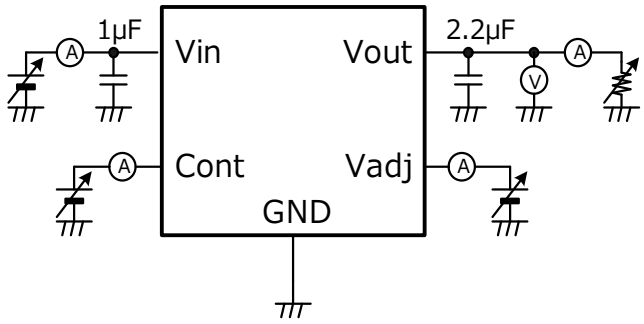
(V_{IN}=9V, Iout=1mA, V_{Cont}=1.6V, Ta=25℃, unless otherwise specified)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
VOUT Temperature Coefficient *Note4	⊿Vout/⊿T	Ta=-40℃ to +85℃	-	±100	-	ppm/℃
Ripple Rejection 1 *Note4	RR1	f=1kHz, Vripple=1V V_{adj}=0V, I_{OUT}=10mA	-	70	-	dB
Ripple Rejection 2 *Note4	RR2	f=1kHz, Vripple=1V V_{adj}=1.65V, I_{OUT}=10mA	-	60	-	dB
Ripple Rejection 3 *Note4	RR3	f=1kHz, Vripple=1V V_{adj}=3.3V, I_{OUT}=10mA	-	55	-	dB
Cont PIN Input Current	Icont	Vcont=1.6V	-	4	12	μA
Cont Pin High Threshold Voltage	VcontH		1.6	-	-	V
Cont Pin Low Threshold Voltage	VcontL		-	-	0.3	V
Vadj Pin Input Current	Ivadj	Vadj=3.3V	-	3.3	4.6	μA

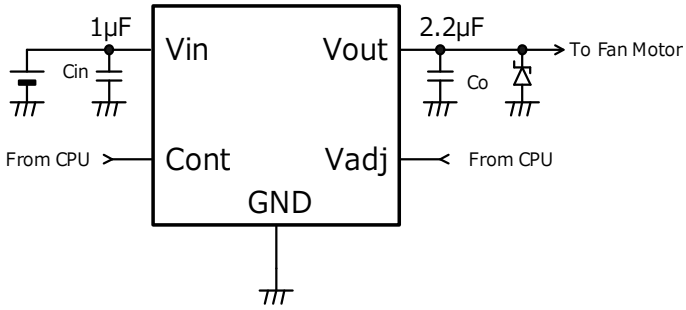
*Note4:The parameter is guaranteed by design.

Model name	Conditions	Output Voltage 1 [V] Vout1			Conditions	Output Voltage 2 [V] Vout2		
		Min.	Typ.	Max.		Min.	Typ.	Max.
MM1937A01	Iout=1mA Vadj=0V	2.940	3.000	3.060	Iout=1mA Vadj=3.3V	7.215	7.400	7.585
MM1937A02		3.136	3.200	3.264		5.070	5.200	5.330
MM1937A03		3.136	3.200	3.264		4.583	4.700	4.818
MM1937A04		3.430	3.500	3.570		4.388	4.500	4.613
MM1937A05		3.920	4.000	4.080		4.875	5.000	5.125
MM1937B01		7.252	7.400	7.548		2.895	3.000	3.105

Test Circuit



Application Circuit



(Example of external parts)

- Output capacitor Ceramic capacitor 2.2μF
- Input Capacitor Ceramic capacitor 1.0μF *Temperature characteristics : B

- In the event a problem which may affect industrial property or any other rights of us or a third party is encountered during the use of information described in these circuit, we shall not be liable for any such problem, nor grant a license therefore.

Note

1. There is possibility with deterioration and destruction of IC when using it exceeding the absolute maximum rating.
   The absolute maximum rating, Never exceed it. The functional operation is not assured.

2. There is a possibility that it becomes impossible to maintain this performance and reliability IC original when using exceeding recommended operation voltage.
   Please use it in recommended operation voltage.

3. Due to restrictions on the package power dissipation, the output current value may not be satisfied.
   Attention should be paid to the power dissipation of the package when the output current is large or the voltage between Input and Output is high.

4. The output capacitor is required between output and GND to prevent oscillation.

5. The ESR of capacitor must be defined in ESR stability area.
   It is possible to use a ceramic capacitor without ESR resistance for output.

6. The capacitor has dependency by the supply voltage and temperature.
   It is able to unstable operation when you use the capacitor with intense capacitance change such as micro.
   Please use the effective capacity to exceed 1μF, because the value changes by the environment used.

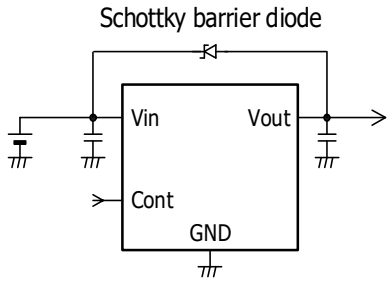
7. The wire of Vin and GND is required to print full ground plane for noise and stability.

8. The input capacitor must be connected a distance of less than 1cm from input pin.

9. The over current protection circuit of the vertical type is built into this IC.

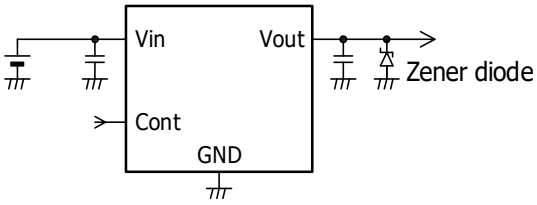
10. It is possible to become unstable operation when using it with Dropout voltage no margin.
    Please evaluate it enough when there is no margin in Dropout voltage.

11. In case the output voltage is above the input voltage, the overcurrent flow by internal parasitic diode from output to input.In such application, the external bypass diode must be connected between output and input pin.



Note

12. If the output voltage becomes higher than the input voltage due to back electromotive force, take measures to connect a zener diode between Vout - GND.
    In that case, use a zener diode whose voltage satisfies Vout < Vz and Vz ≦ Vin.



13. There is a possibility that IC generates heat when the output terminal is short-circuited.
    However, the thermal shutdown circuit operates, and it will do operation that protects IC.
    The thermal shutdown circuit is designed only to shut the IC off to prevent thermal runaway.
    Do not continue to use the IC in an environment where the operation of this circuit is assumed.
    The characteristic changes depending on the substrate condition.
    Please evaluate IC in the set.

14. It returns automatically in temperature returned after it shuts down by self-generation of heat.
    After it returns, it shuts down again by self-generation of heat.
    It is necessary to change the environment used (IC consumption, temperature)
    if it operates in upper cycle.

15. It is possible to increase output voltage
    if the condition is low output current (under 1mA) and high temperature.
    The provision is to add load (over 1mA).

16. If negative voltage over maximum rating for Vout,
    Connected schottky barrier diode between Vout-GND, and the voltage is in within rating.

17. It is possible to unstable when this IC is used in high electromagnetic field.
    Please evaluate IC on the set.

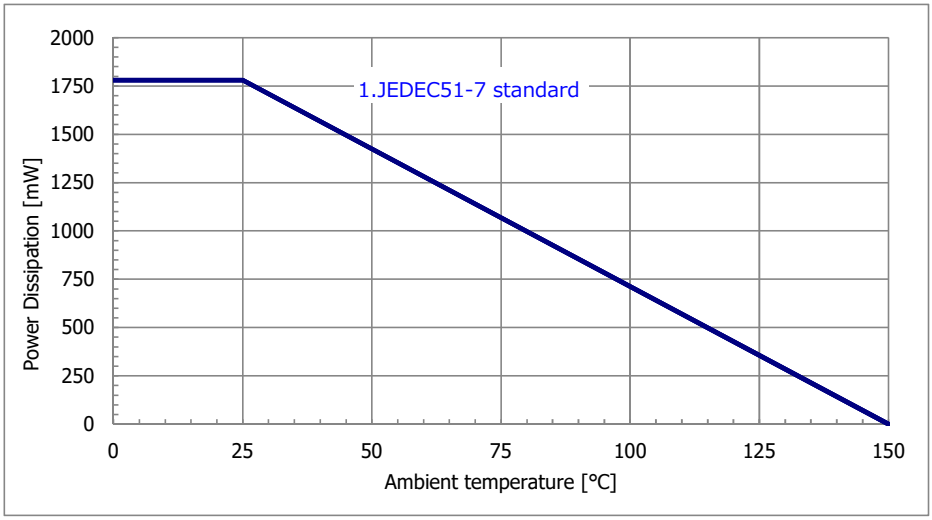
About Power Dissiopation

The Power dissipation change if board to mount IC change because radiative heat fix at board.
It is reference data below, Evaluate IC in the set.

- SOT-25A

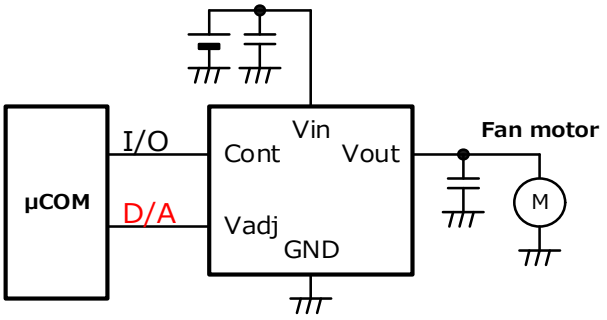
1. JEDEC51-7 standard (4 layer FR-4 board)

Board size	114.3mm×76.2mm t=1.6mm Copper foil area 80%
Power dissipation	1780mW Ta=25℃

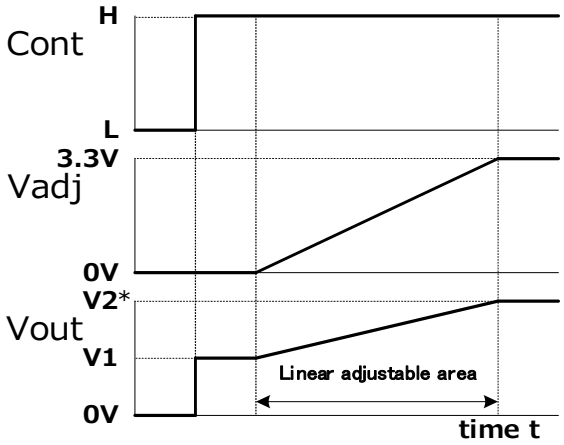


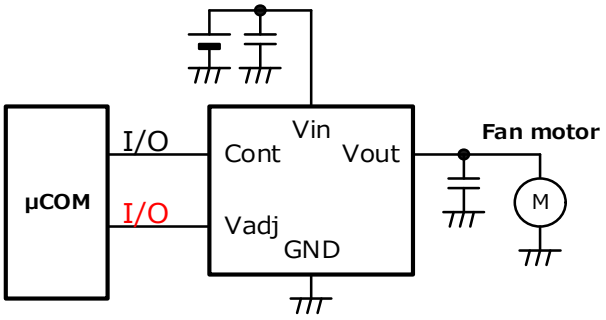
It is recommended to layout the VIA for heat radiation in the GND pattern of reverse (of IC) when there is the GND pattern in the inner layer (in using multiplayer substrate).
By increasing these copper foil pattern area of PCB, Power dissipation improves.

Timing chart

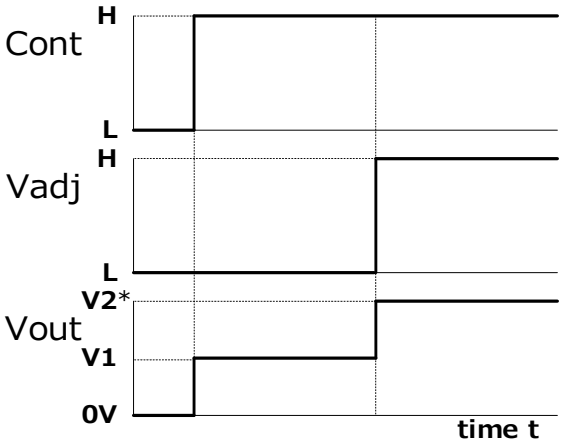


■ MM1937A linear adjustable application

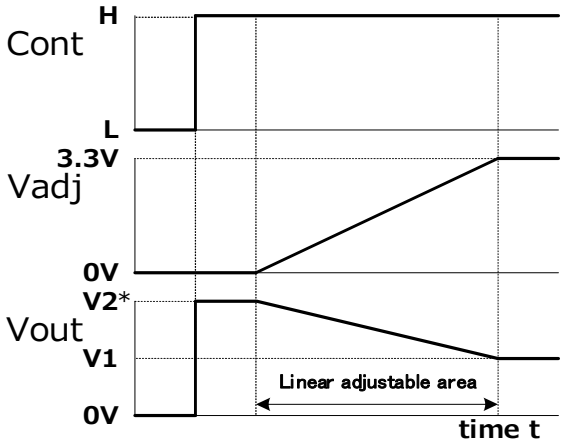




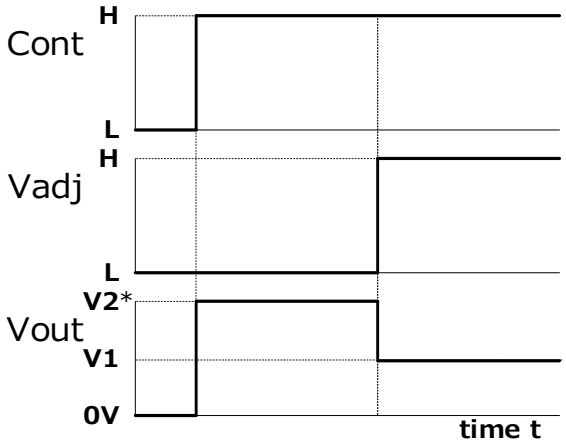
■ MM1937A binaly adjustable application



■ MM1937B linear adjustable application



■ MM1937B binaly adjustable application



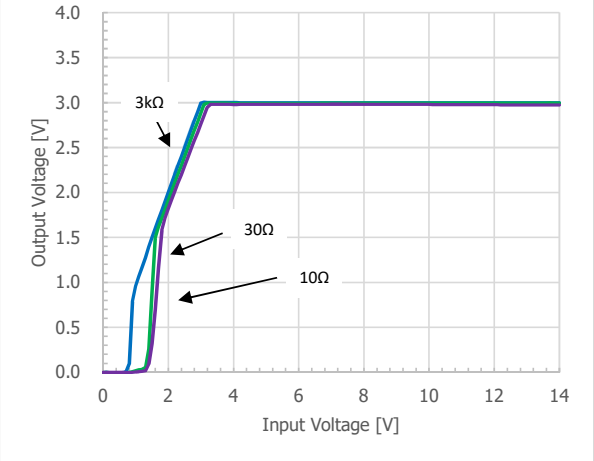
*V1 and V2 are fixed in internal IC.

Typical Performance Characteristics (MM1937A01)

(Vin=9V, Iout=1mA, Vcont=1.6V, Ta=25℃, unless otherwise specified)

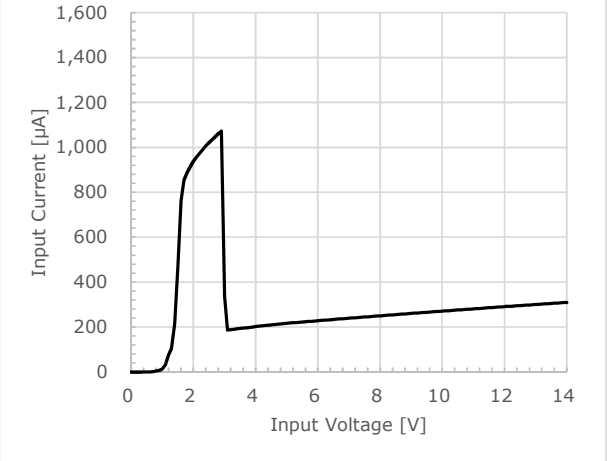
■ Output Voltage - Input Voltage

Vadj=0V

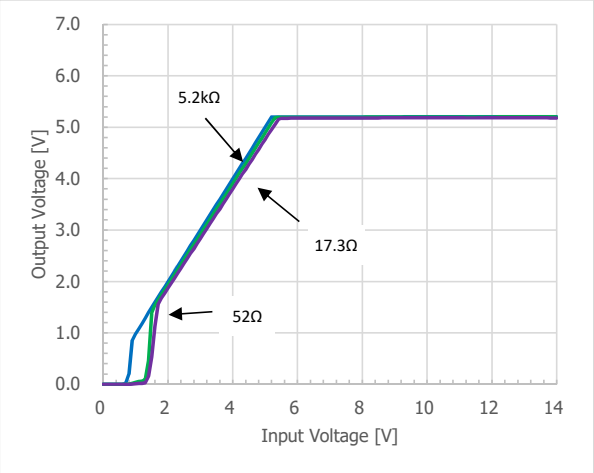


■ Input Current - Input Voltage

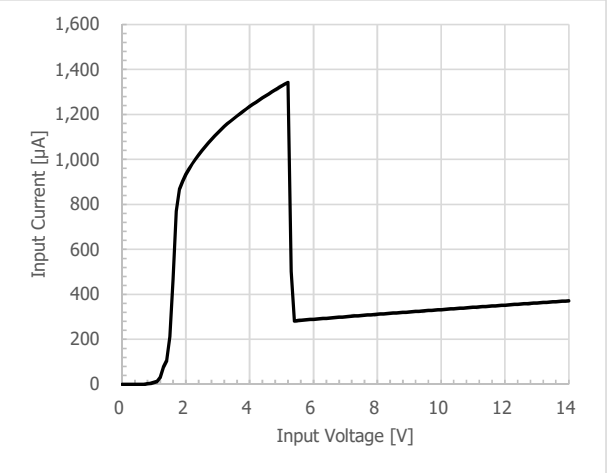
Vadj=0V, RL=∞



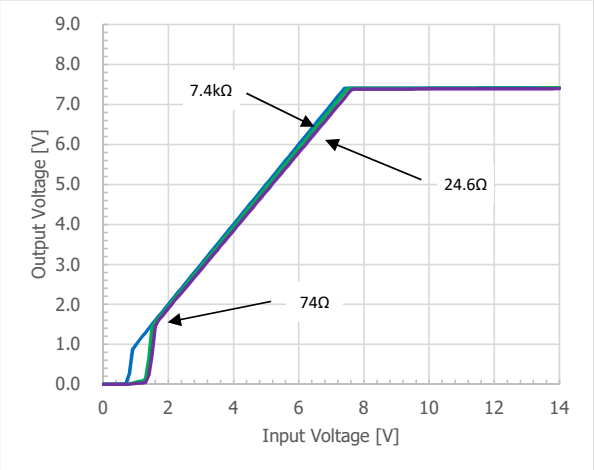
Vadj=1.65V



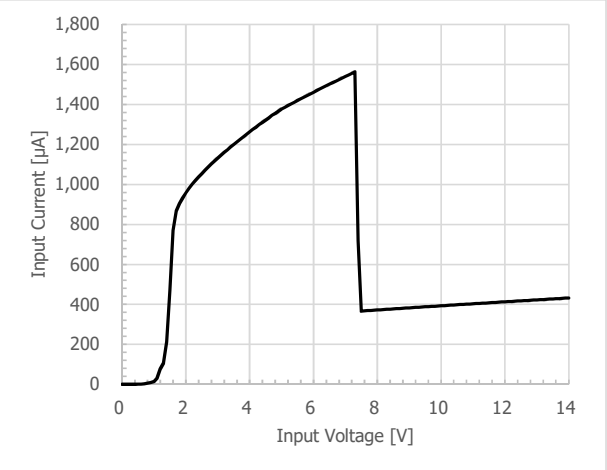
Vadj=1.65V, RL=∞



Vadj=3.3V



Vadj=3.3V, RL=∞

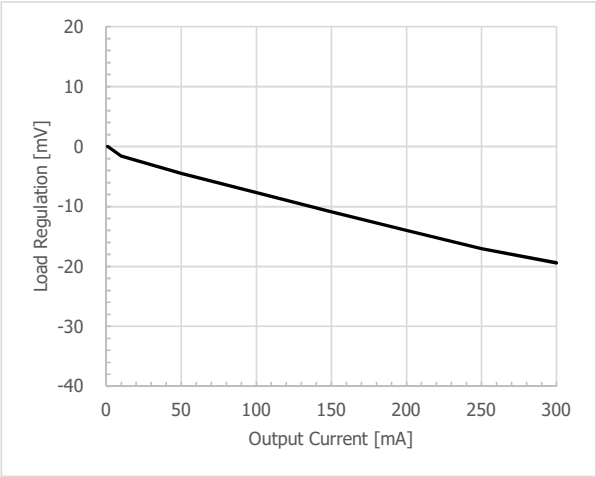


Typical Performance Characteristics (MM1937A01)

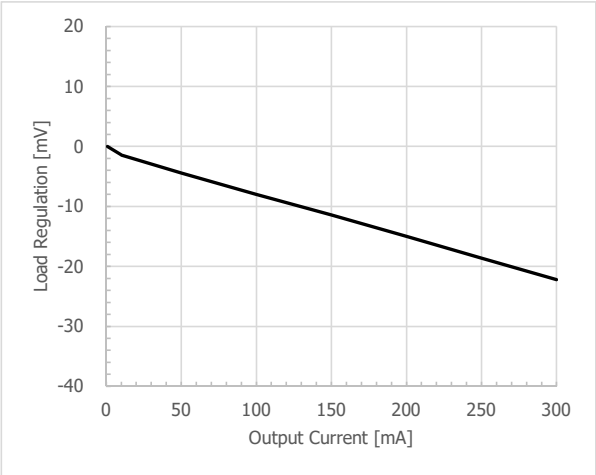
(Vin=9V, Iout=1mA, Vcont=1.6V, Ta=25℃, unless otherwise specified)

■ Load Regulation

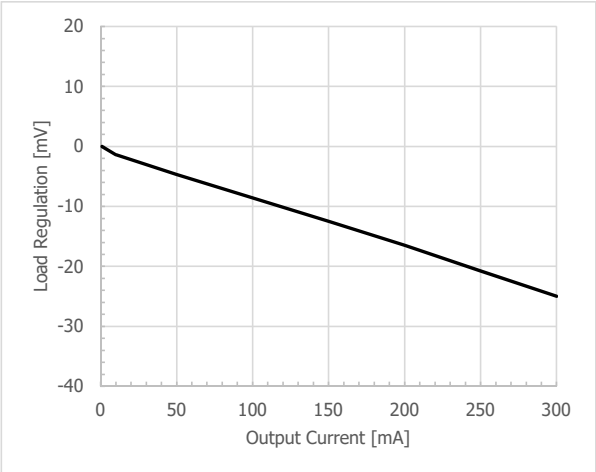
Vadj=0V



Vadj=1.65V

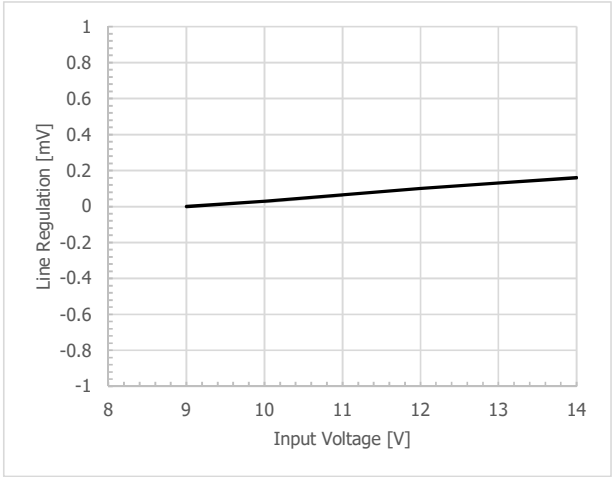


Vadj=3.3V

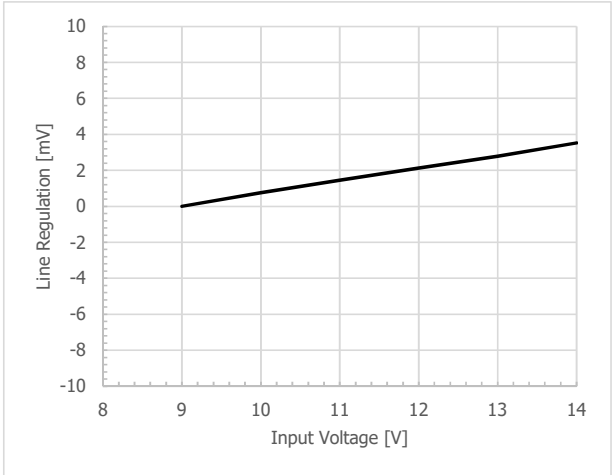


■ Line Regulation

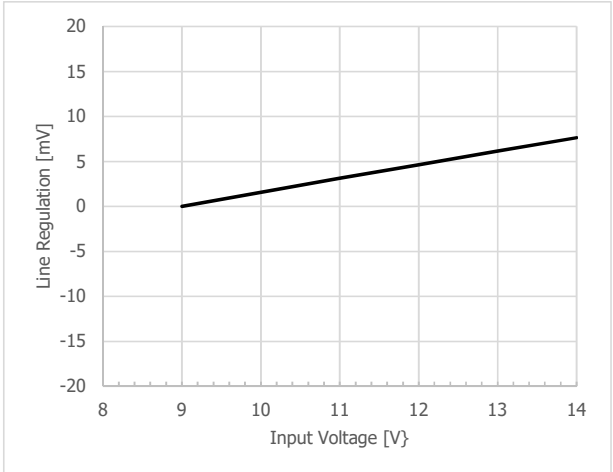
Vadj=0V



Vadj=1.65V



Vadj=3.3V

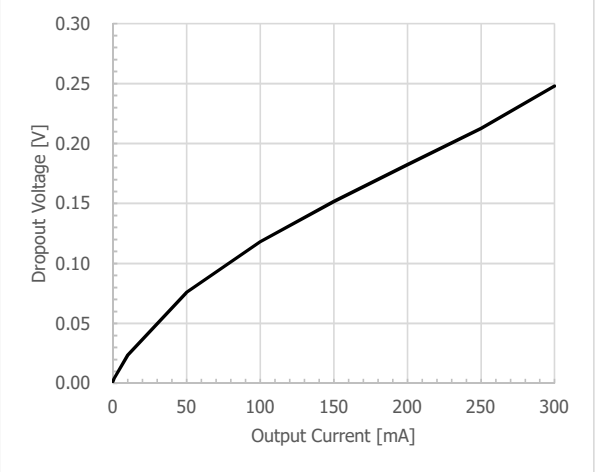


Typical Performance Characteristics (MM1937A01)

(Vin=9V, Iout=1mA, Vcont=1.6V, Ta=25℃, unless otherwise specified)

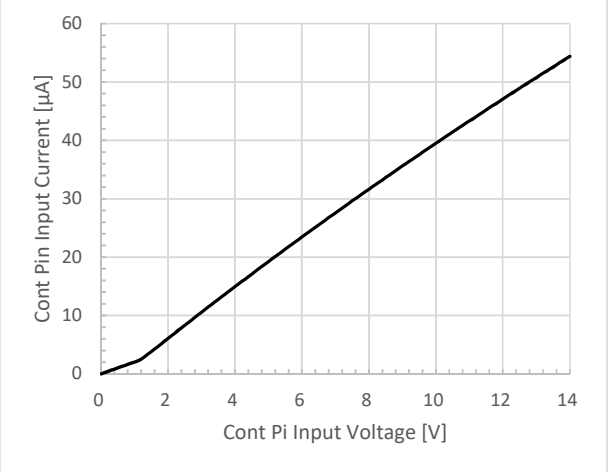
■ Dropout Voltage - Output Current

Vadj=0V

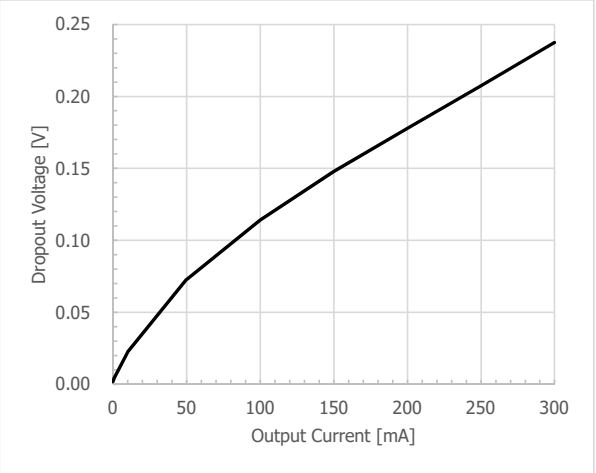


■ Cont Pin Input Current - Cont Pin Input Voltage

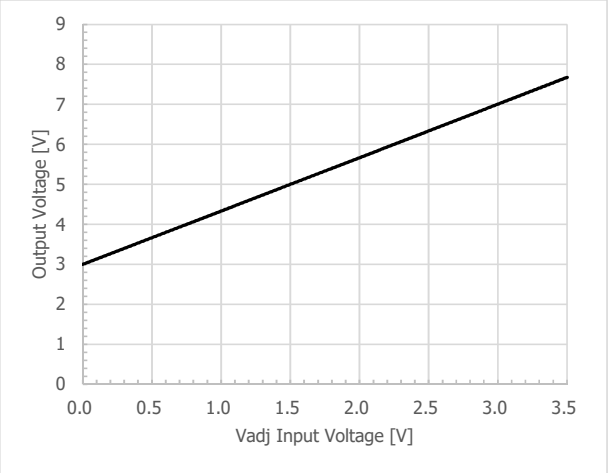
Vadj=0V, 1.65V, 3.3V



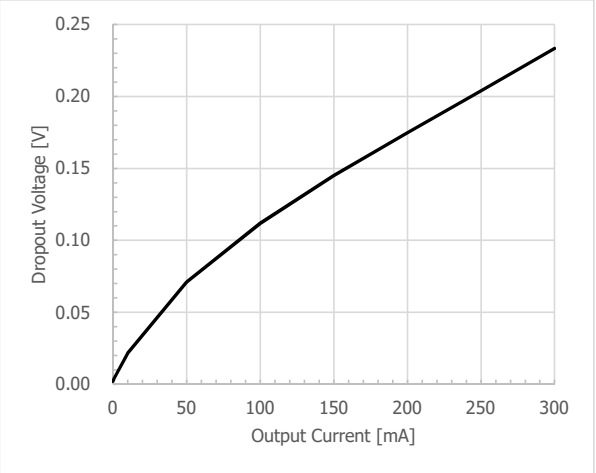
Vadj=1.65V



■ Output Voltage - Vadj Input Voltage

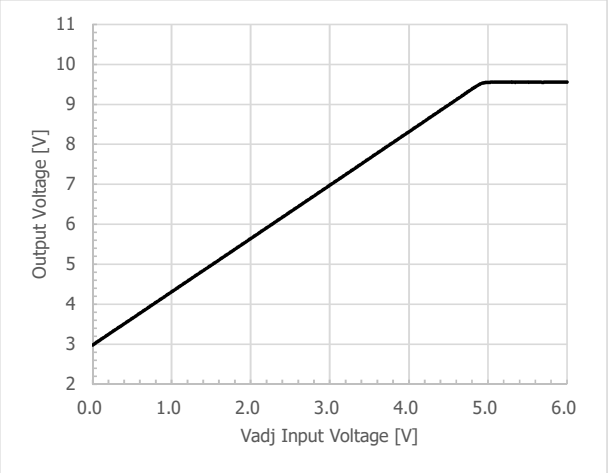


Vadj=3.3V



■ Output Voltage - Vadj Input Voltage

Vin=14V

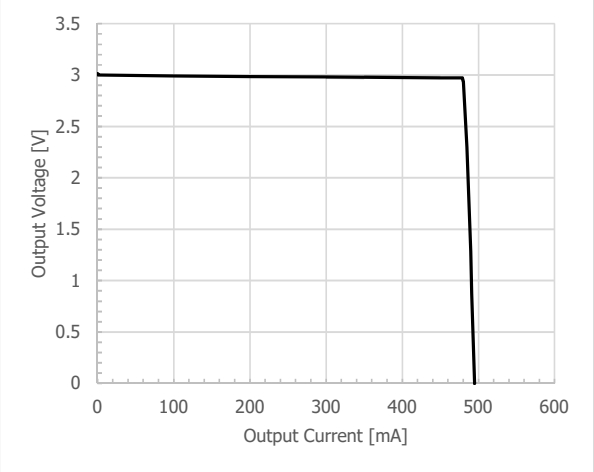


Typical Performance Characteristics (MM1937A01)

(Vin=9V, Iout=1mA, Vcont=1.6V, Ta=25℃, unless otherwise specified)

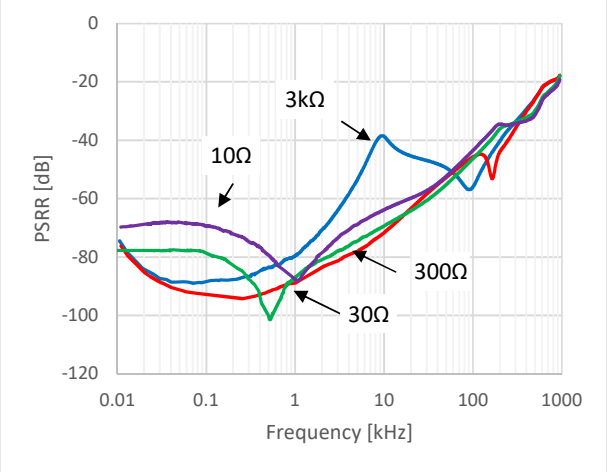
■ Current Limit

Vadj=0V

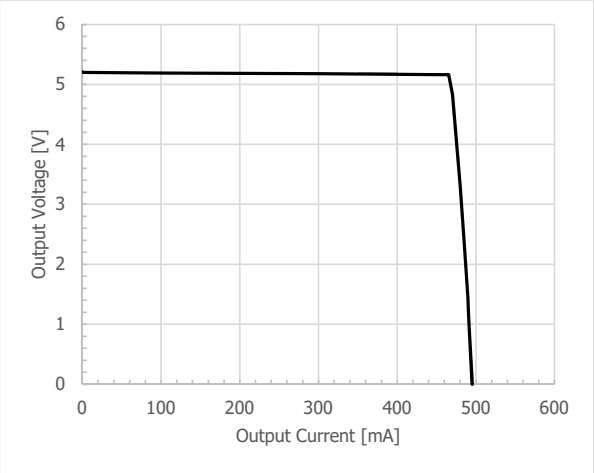


■ Power Supply Ripple Rejection

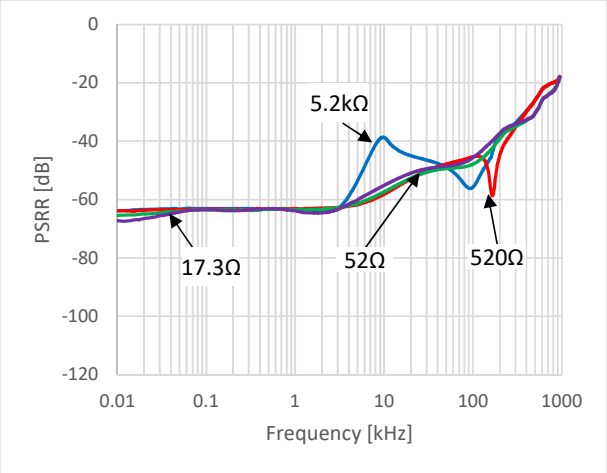
Vadj=0V



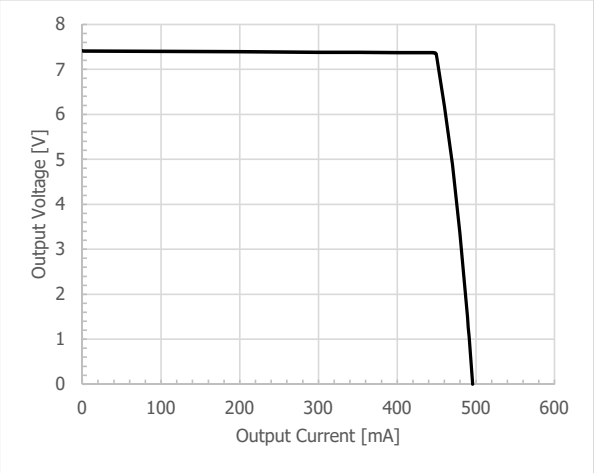
Vadj=1.65V



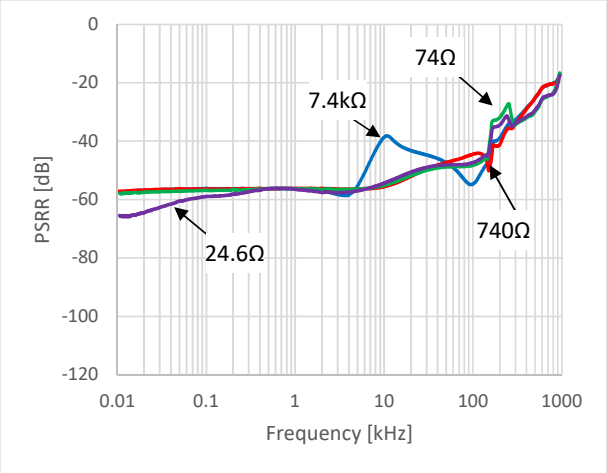
Vadj=1.65V



Vadj=3.3V



Vadj=3.3V

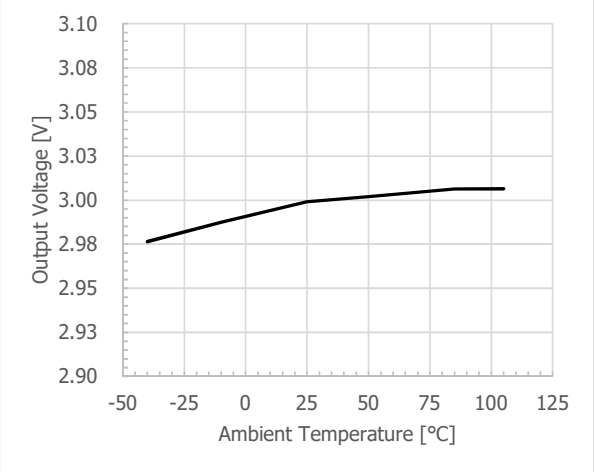


Typical Performance Characteristics (MM1937A01)

(Vin=9V, Iout=1mA, Vcont=1.6V, Ta=25℃, unless otherwise specified)

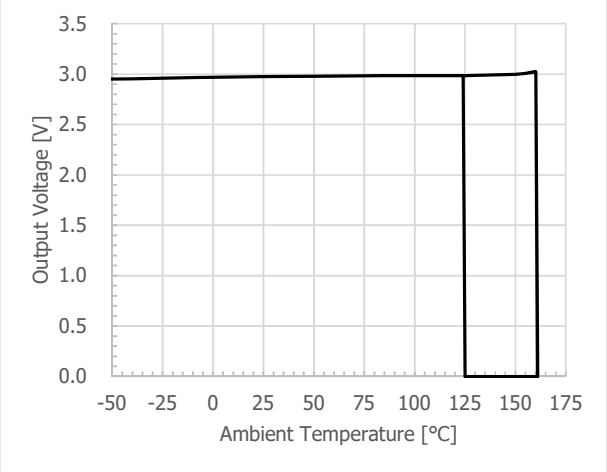
■ Output Voltage -Ambient Temperature

Vadj=0V

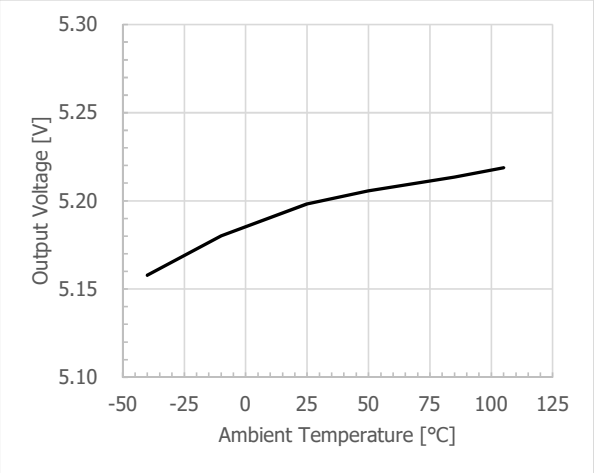


■ Thermal shutdown

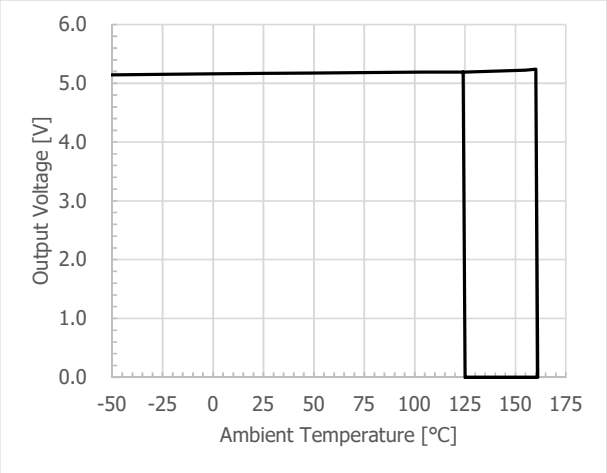
Vadj=0V



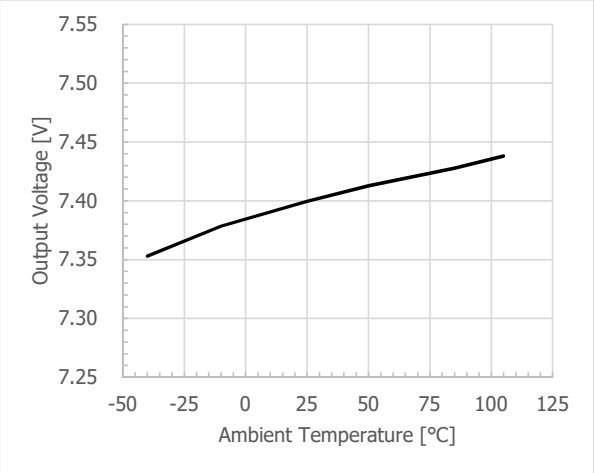
Vadj=1.65V



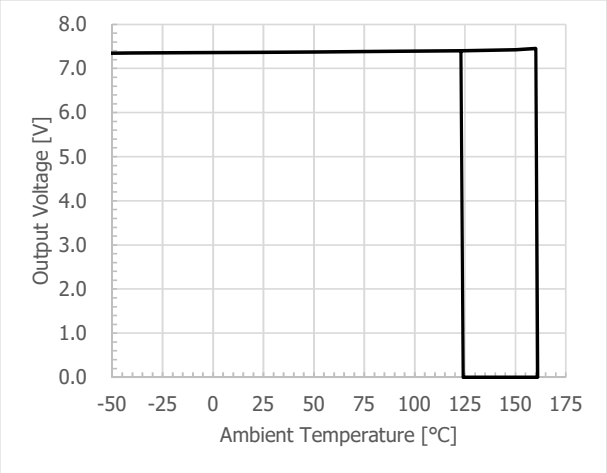
Vadj=1.65V



Vadj=3.3V



Vadj=3.3V

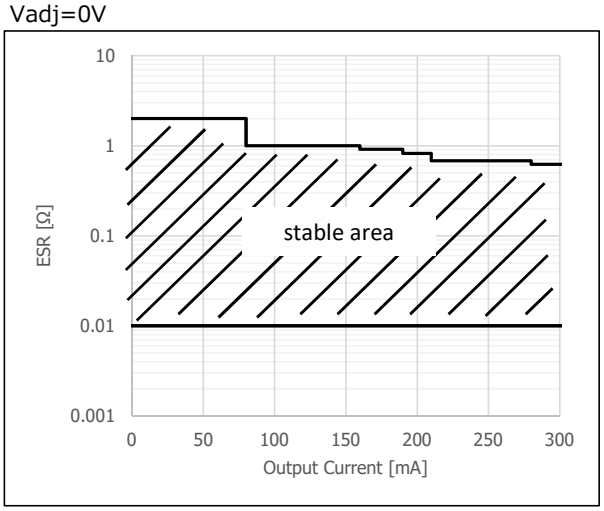


Typical Performance Characteristics (MM1937A01)

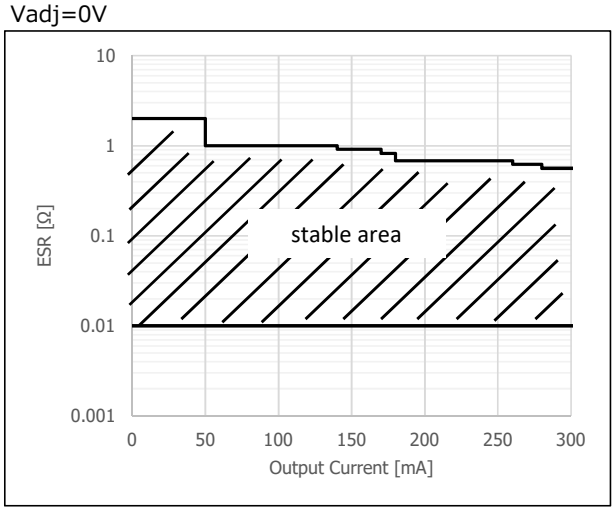
(Vin=9V, Iout=1mA, Vcont=1.6V, Ta=25℃, unless otherwise specified)

■ ESR stable area

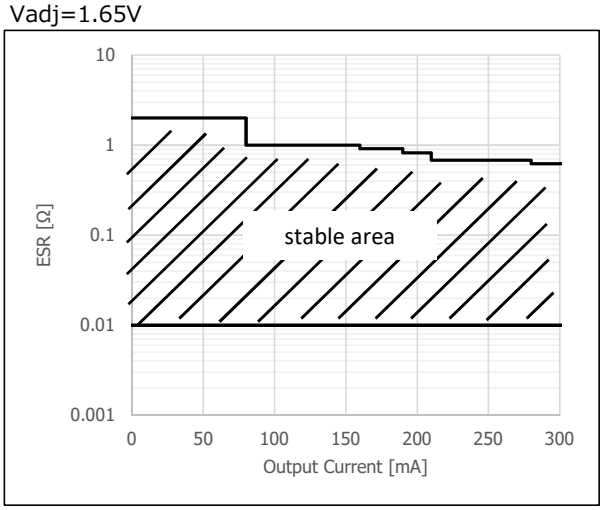
Vadj=0V



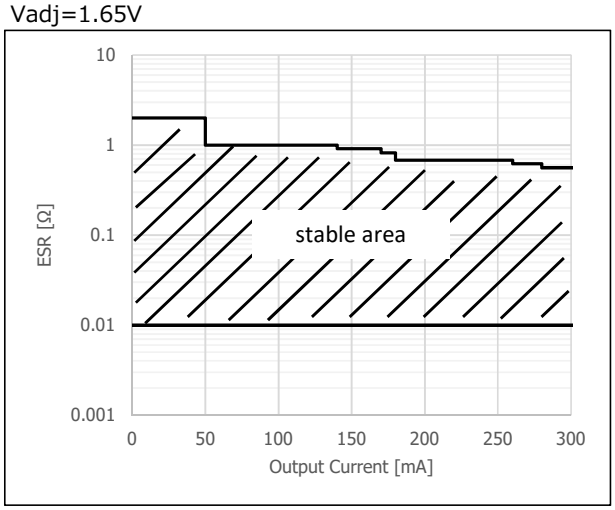
Vadj=0V



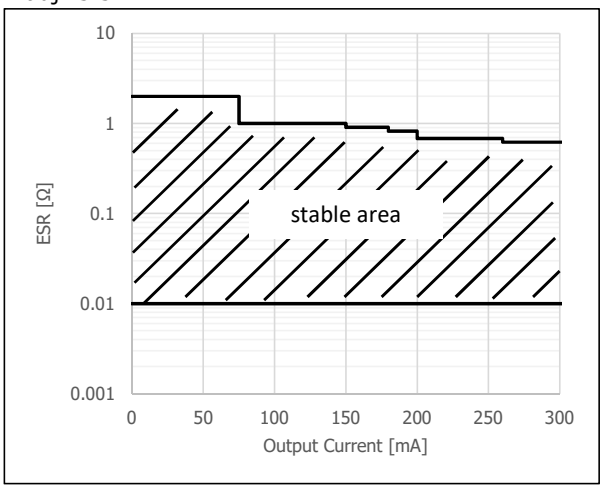
Vadj=1.65V



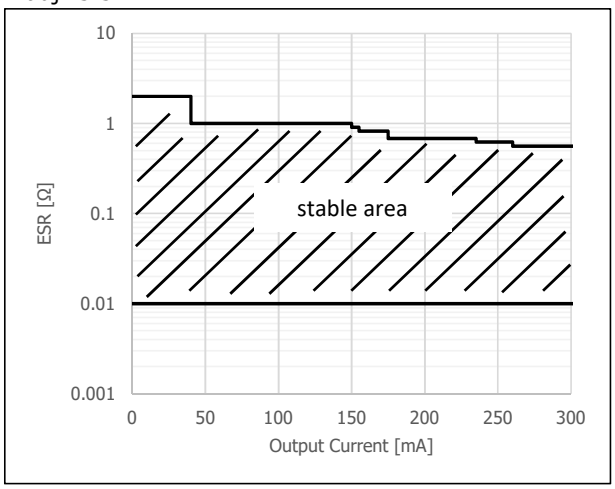
Vadj=1.65V



Vadj=3.3V



Vadj=3.3V



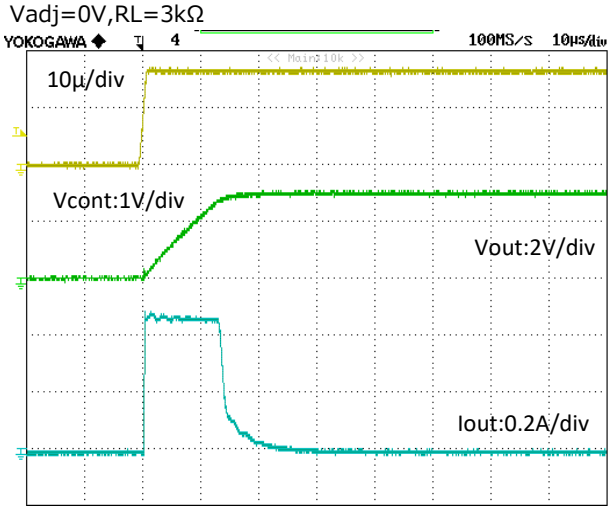
Typical Performance Characteristics (MM1937A01)

(Vin=9V, Iout=1mA, Vcont=1.6V, Ta=25℃, unless otherwise specified)

■ Turn - On Transient response

Vcont=0V→1.6V

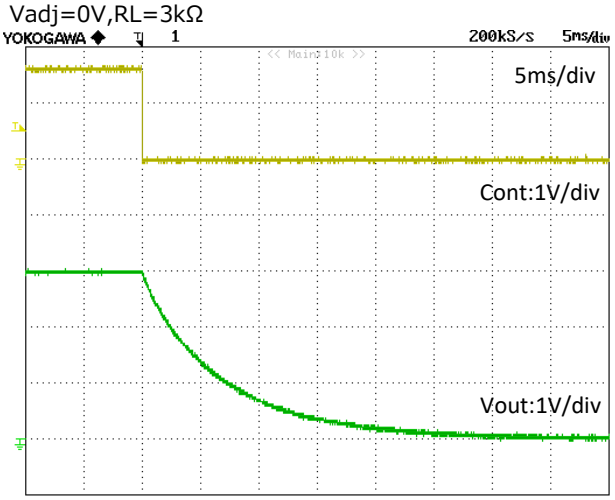
Vadj=0V,RL=3kΩ



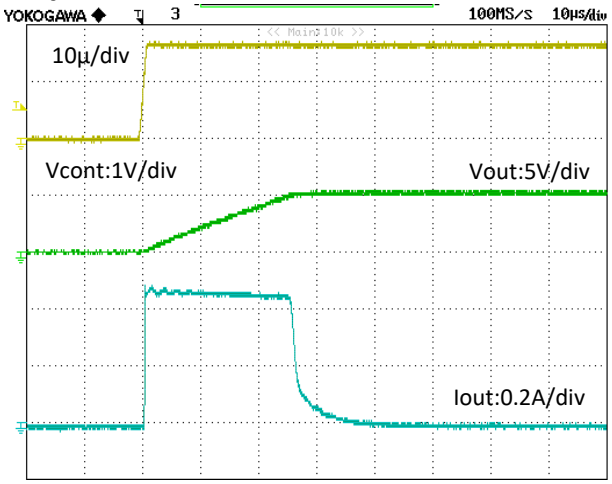
■ Turn - Off Transient response

Vcont1.6V→0V

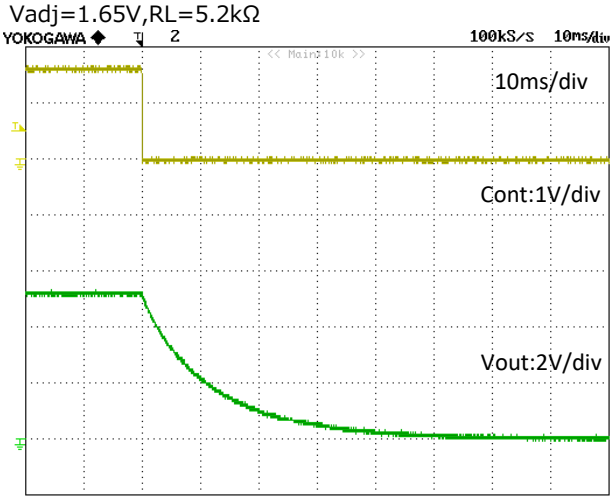
Vadj=0V,RL=3kΩ



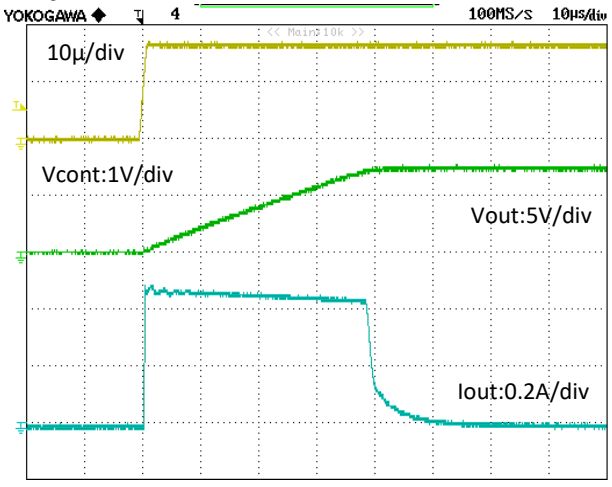
Vadj=1.65V,RL=5.2kΩ



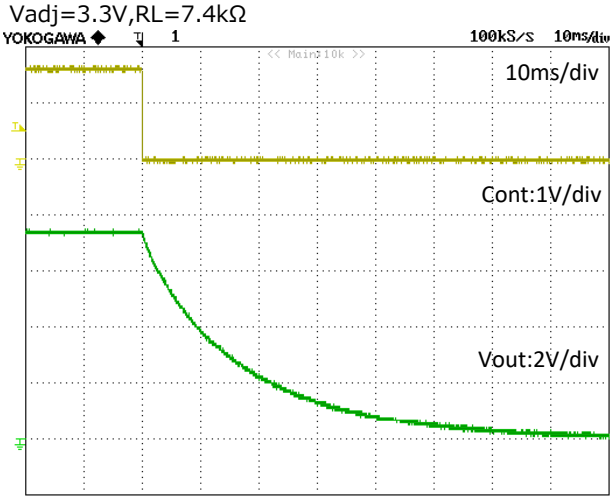
Vadj=1.65V,RL=5.2kΩ



Vadj=3.3V,RL=7.4kΩ



Vadj=3.3V,RL=7.4kΩ



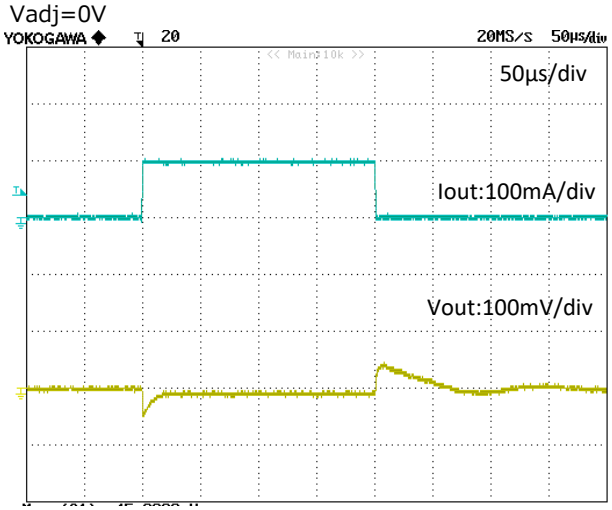
Typical Performance Characteristics (MM1937A01)

(Vin=9V, Iout=1mA, Vcont=1.6V, Ta=25℃, unless otherwise specified)

■ Load Transient response

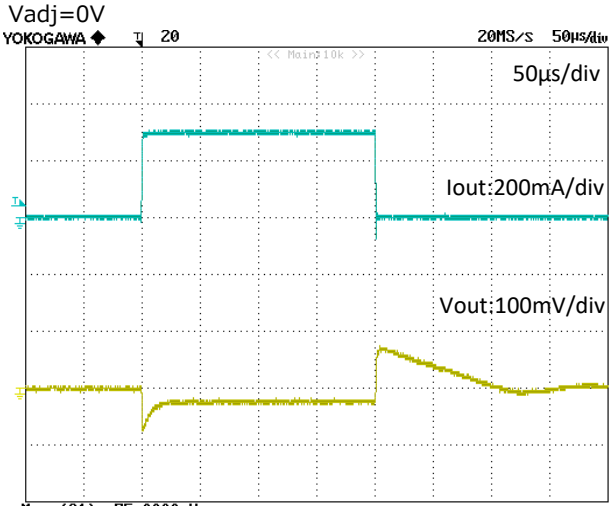
Iout=1mA ⇔ 100mA

Vadj=0V

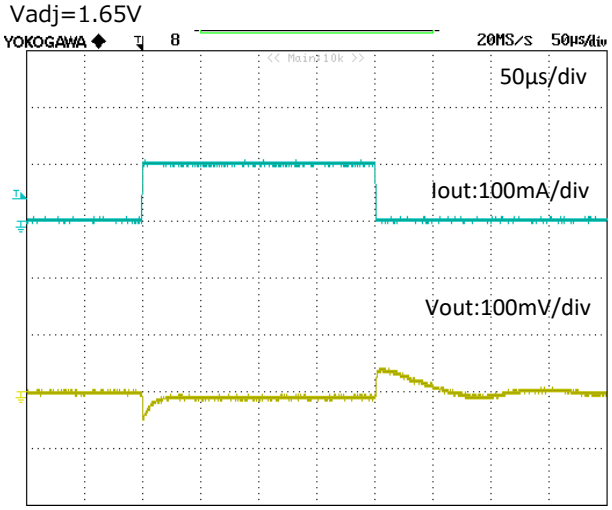


Iout=1mA ⇔ 300mA

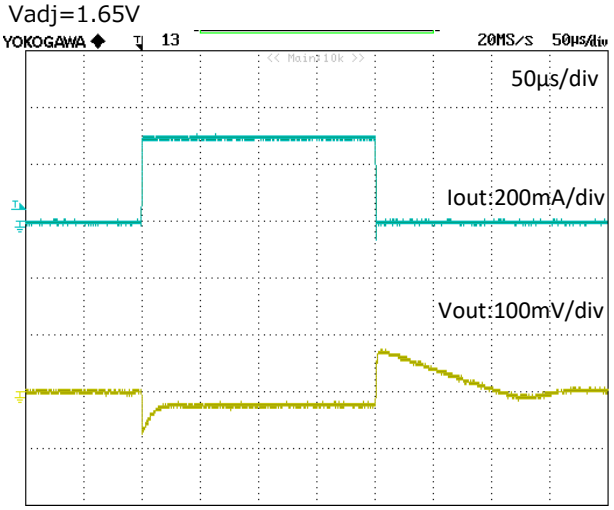
Vadj=0V



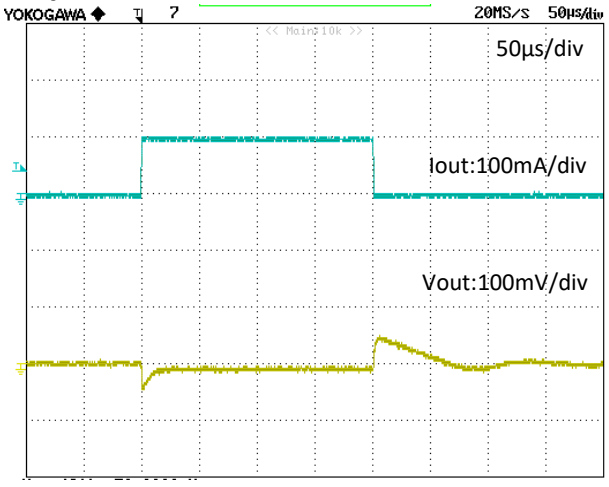
Vadj=1.65V



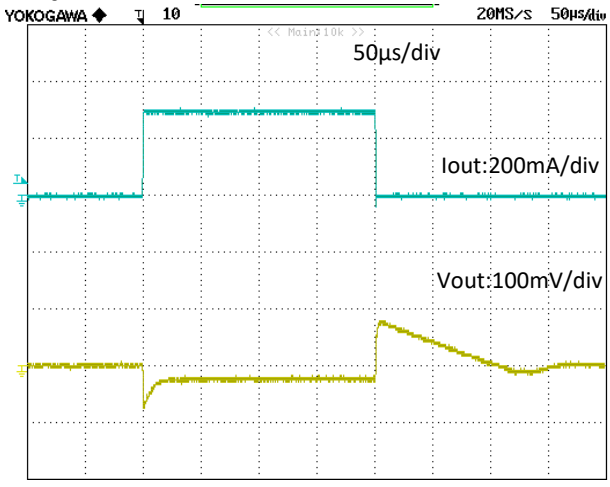
Vadj=1.65V



Vadj=3.3V



Vadj=3.3V



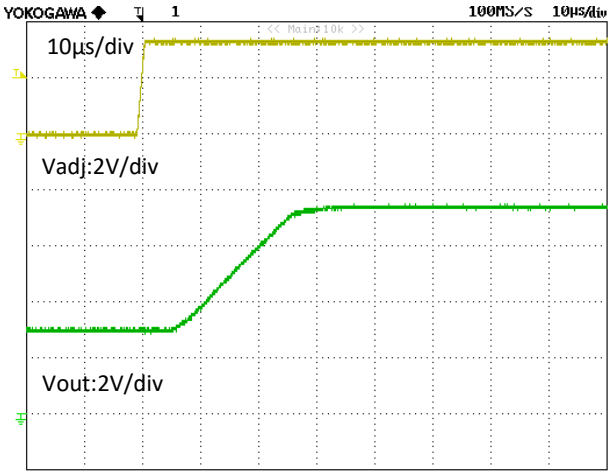
Typical Performance Characteristics (MM1937A01)

(Vin=9V, Iout=1mA, Vcont=1.6V, Ta=25℃, unless otherwise specified)

■ Vadj Transient response

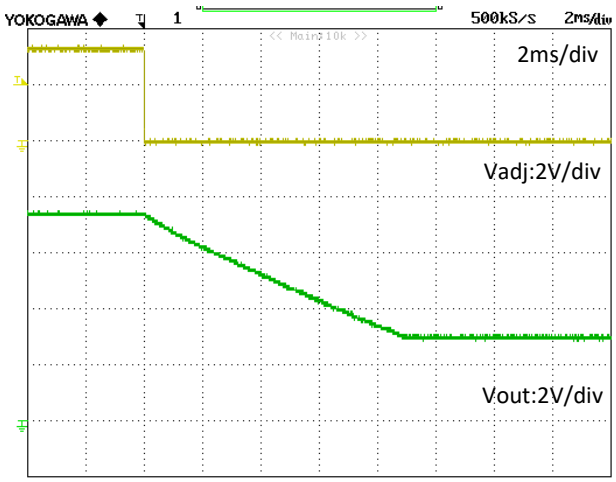
Vadj=0V ⇔ 3.3V

Iout=1mA

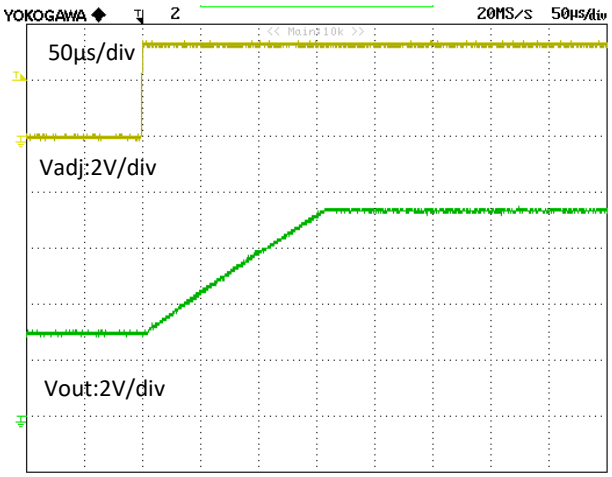


Vadj=3.3V ⇔ 0V

Iout=1mA



Iout=300mA



Iout=300mA