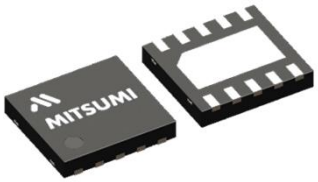
100mA LDO with connect error detection

MV1936 Series



Overview

This IC is a 100mA LDO with conection error detection for antenna.
The IC supplies the power for external connection equipment of car navigation (GPS, TV, Microphone), and detect open or short-circuit of output load.
To shut down LDO output automatically when short detection, it also improve safety.

Features

- Automotive grade (AEC-Q100 Grade 2)
- Open/Short circuit detection
- Setting error detect delay time by external capacitor
- ON/OFF control

Main specifications

- Maximum rating supply voltage : -0.3V to 16V
- Maximum rating output voltage : -0.3V to 18V
- Operating voltage range : V_{OUT}(Typ.)+Vio(Max.) to 14V
- Operating ambient temperature : -40℃ ～ 105℃
- Output current : 100mA
- Input current (OFF) : Max. 1μA
- No-load input current : Typ. 400μA (V_{OUT}≦5.0V)
- Output voltage range : 3.1V ~ 8.0V (0.1V step)
- Output voltage accuracy : ±3.5%(I_{OUT}=1mA, Ta=-40℃~105℃)
- Line regulation : Max. 0.1%/V (V_{IN}=V_{OUT}(Typ.)+1V~14V, I_{OUT}=1mA)
- Load regulation : Typ. 15mV (I_{OUT}=1mA~100mA)
- Dropout voltage : Typ. 0.2V (I_{OUT}=100mA)
- PSRR : Typ. 70dB (f=1kHz , VOUT≦5.0V)
- Rop pin current : +8.3% / -10% (I_{OUT}=5mA, Vrop=1V, Ta=-40℃~105℃)
- Rsc pin current : +16% / -16.7% (I_{OUT}=60mA, Vrsc=1V, Ta=-40℃~105℃)
- Error output : Open error, Short error
- Output capacitor : 2.2uF (Ceramic capacitor)
- Protection function : Over current protection, Thermal shutdown, Reverse current protection
- Additional function : ON/OFF control, Connection error detection (open/short flag output)
  Error detect delay time

Packages

- SSON-10C

Application

- In-vehicle infotainment device
- Power supply for antenna

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Strategy Engineering Department
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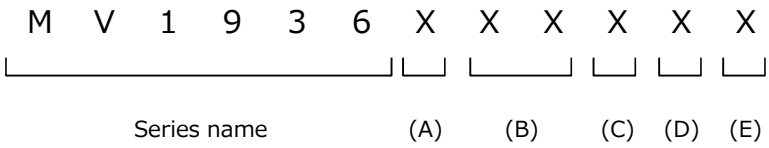
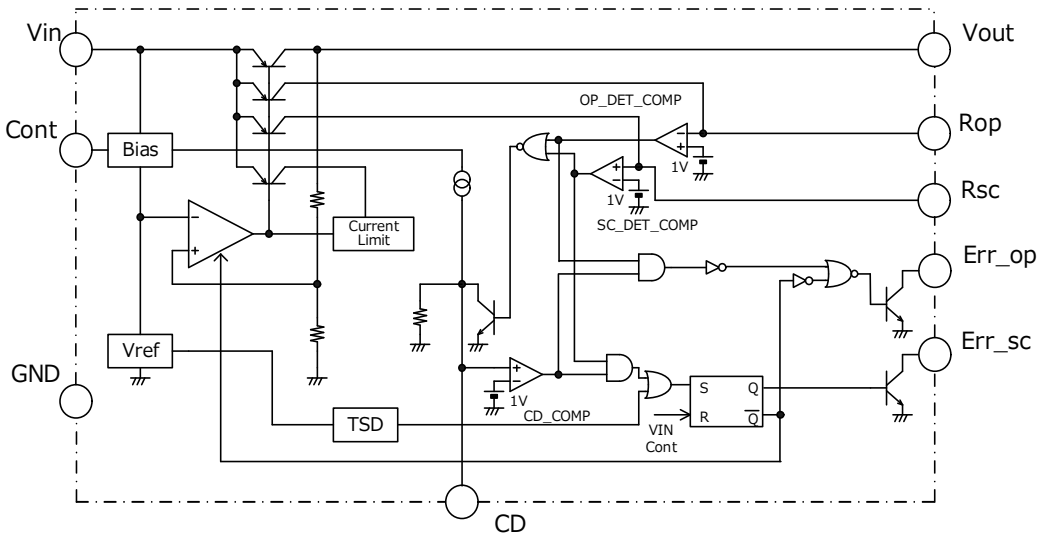
Feb, 2025 Rev.0

Model Name



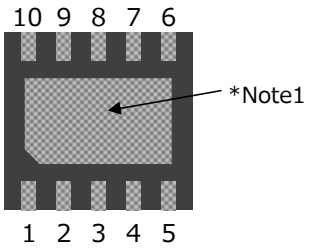
(A)	Function Type	A	Current limit : Typ.170mA
		B	Current limit : Typ.250mA
(B)	Output voltage rank	31	Output voltage can be designated in the range from 3.1V(31) to 8.0V(80) in 0.1V steps.
		≀	
		80	
(C)	Package	R	SSON-10C
(D)	Packing specifications 1	R	R housing (Standard)
		L	L housing
(E)	Packing specifications 2	E	Emboss tape / Halogen free

Block Diagram



Pin Configuration

- SSON-10C



Top view

Pin No.	Pin name	Function
1	V_{OUT}	Output voltage
2	Rop	Open load detection resistance
3	Rsc	Short-circuit detection resistance
4	CD	Delay time setting pin
5	GND	Ground
6	Cont	Control input
7	Err_sc	Short-circuit detection output
8	Err_op	Open load detection output
9	NC	No connection
10	V_{IN}	Power supply input

*Note1:Heat spreader bottom with GND.

Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit
Supply voltage	V_{IN}	-0.3	16	V
Output voltage *Note2	V_{OUT}	-0.3	18	V
Cont input voltage	Vcont	-0.3	16	V
Output current	Iomax	0	200	mA
Err_op/Err_sc voltage	Verr	-0.3	16	V
Err_op/Err_sc current	Ierr	-	5	mA
Junction temperature *Note3	Tj_{MAX}	-	150	℃
Storage temperature	Tstg	-55	150	℃
Power dissipation *Note4	Pd	-	3030	mW

*Note2:Battery-short test, t=3min.

*Note3:In consideration of product life, please examine the use in less than 80%.

*Note4: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	105	℃
Operating voltage	Vop	V_{OUT}(Typ.)+Vio(Max.)	14	V
Output current	Iop	0	100	mA

Electrical Characteristics

(V_{IN}=V_{OUT}(Typ.)+1V, Vcont=V_{IN}, Ta=-40℃ to 105℃, unless otherwise specified)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
No-Load Input Current	I_{CC}	I_{OUT}=0mA, V_{OUT}≦5.0V Rpu_op=Rpu_sc=∞	-	400	600	μA
		I_{OUT}=0mA, 5.0V<V_{OUT} Rpu_op=Rpu_sc=∞	-	500	750	μA
Input Current(OFF)	I_{CCOFF}	V_{CONT}=0V	-	0.1	3.5	μA
Output Voltage	V_{OUT}	I_{OUT}=1mA Ta=25℃	V_{OUT}(Typ.) ×0.98	V_{OUT}(Typ.)	V_{OUT}(Typ.) ×1.02	V
		I_{OUT}=1mA Ta=-40~105℃	V_{OUT}(Typ.) ×0.965	V_{OUT}(Typ.)	V_{OUT}(Typ.) ×1.035	V

Electrical Characteristics

(V_{IN}=V_{OUT}(Typ.)+1V, Vcont=V_{IN}, Ta=-40℃ to 105℃, unless otherwise specified)

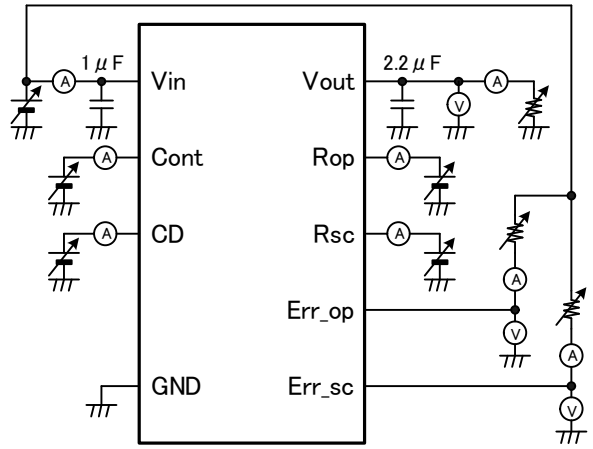
Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Dropout Voltage	Vio	V_{IN}=V_{OUT}-0.2V I_{OUT}=100mA, Ta=25℃	-	0.20	0.40	V
Line Regulation	V_{LINE}	V_{IN}=V_{OUT}+1V~14V I_{OUT}=1mA	-	-	0.1	%/V
Load Regulation	V_{LOAD}	I_{OUT}=1mA~100mA Ta=25℃	-	15	60	mV
Ripple Rejection	RR	f=1kHz, Vripple=0.2V I_{OUT}=10mA, V_{OUT}≦5.0V	-	70	-	dB
		f=1kHz, Vripple=0.2V I_{OUT}=10mA, 5.0V<V_{OUT}	-	65	-	dB
Current limit	Io_limit	Function Type:A Ta=25℃	120	170	-	mA
		Function Type:B Ta=25℃	180	250	-	mA
Cont PIN Input Current	Icont	Vcont=1.6V	-	3	12	μA
Cont Pin High Threshold Voltage	VcontH		1.6	-	-	V
Cont Pin Low Threshold Voltage	VcontL		-	-	0.3	V
Thermal shutdown temperature	Tsd		-	150	-	℃
Rop pin current	Iop	I_{OUT}=5mA Vrop=1V	215	240	260	μA
Rsc pin current	Isc	I_{OUT}=60mA Vrsc=1V	1250	1500	1740	μA
Rop pin threshold voltage	Vt_op	Vrop=H→L Verr_op=H→L	0.95	1.00	1.05	V
Rop pin hysteresis voltage	Vth_op	Vrop=L→H Verr_op=L→H	-	175	-	mV
Rsc pin threshold voltage	Vt_sc	Vrsc=L→H Verr_sc=H→L	0.95	1.00	1.05	V
Err_op output voltage	Verr_op	Vrop=L Ierr_op=100μA	-	-	0.2	V
Err_sc output voltage	Verr_sc	Vrsc=H Ierr_sc=100μA	-	-	0.2	V
CD pin current	Icd	Vcd=0V	-	5	-	μA
CD pin threshold voltage	Vt_cd	Vcd=L→H	0.90	1.00	1.10	V
CD pin hysteresis voltage	Vth_cd	Vcd=H→L	-	250	-	mV

Electrical Characteristics

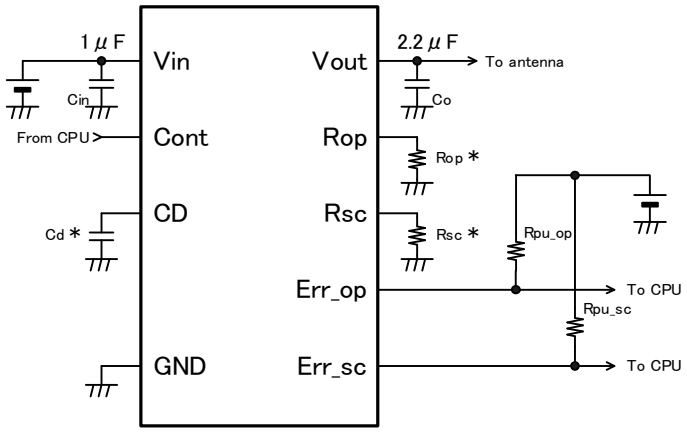
(V_{IN}=V_{OUT}(Typ.)+1V, Vcont=V_{IN}, Ta=-40℃ to 105℃, unless otherwise specified)

Model name	Item							
	Output voltage							
	V_{OUT} (V)							
	Conditions	Min.	Typ.	Max.	Conditions	Min.	Typ.	Max.
MV1936A31	Function Type:A IOUT=1mA Ta=25℃	3.038	3.100	3.162	Function Type:A IOUT=1mA Ta=-40℃ to 105℃	2.992	3.100	3.209
MV1936A46		4.508	4.600	4.692		4.439	4.600	4.761
MV1936A50		4.900	5.000	5.100		4.825	5.000	5.175
MV1936A80		7.840	8.000	8.160		7.720	8.000	8.280
MV1936B50	Function Type:B IOUT=1mA Ta=25℃	4.900	5.000	5.100	Function Type:B IOUT=1mA Ta=-40℃ to 105℃	4.825	5.000	5.175
MV1936B74		7.252	7.400	7.548		7.141	7.400	7.659
MV1936B80		7.840	8.000	8.160		7.720	8.000	8.280

Test Circuit



Application Circuit



*constant setting formula (for estimate)
Rop = Vt_op / Iop
Rsc = Vt_sc / Isc
Cd = (td * Icd) / Vt_cd

Vt_op:Rop threshold voltage
Iop:Open circuit detection current
Vt_sc:Rsc threshold voltage
Isc:Short circuit detection current
Icd:CD pin current
td:Delay time
Vt_cd:CD pin threshold voltage

* The formula of the fixed number setting is the rough estimate value.
Please check the application notebook and do fixed number setting.

(Example of external parts)

- Output capacitor Ceramic capacitor 2.2μF
- Input Capacitor Ceramic capacitor 1.0μF

- 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 between Vout and GND, is required 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 of output capacitor 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.

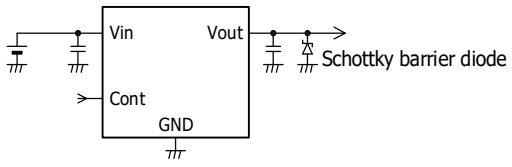
8. The input capacitor must be connected a distance of less than 1cm from input pin.
   In general, LDO may oscillate depending on the selection of external components.
   This IC recommends a ceramic capacitor with an input capacitor of 2.2μF or more.
   Perform a thorough evaluation, including the temperature characteristics, in the actual application before making a selection.

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 no dropout voltage margin.
    Please evaluate it enough when there is no dropout voltage margin.

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

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



13. The absolute maximum ratings of the output voltage is for short-circuit to power supply test.
    In normal operation, it must be used to Vin>Vout.

14. 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.

注意事項

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.

15. After set delay time of the timer, the turning off latch outputs it
when thermal shutdown starts or it detects it short. Please input Vin or Cont again to release the latch.

16. A reverse bias protection function is built in this IC.
When reverse bias occurs, You can use it without protection Diode.

17. When reverse biased, reverse current is generated.
In this case, when the voltage difference between input and output increases,
shut down the internal circuit to prevent heat generation.
Internal circuit shutdown is latch protected. (At this time, the Short flag is output as Low.)
Please input Vin or Cont again to release the latch.
For characteristics of Reverse bias protection, refer to "Reverse current - Reverse voltage"
in TYPICAL PERFORMANCE CHARACTERISTICS.

18. When establishing an open detect current, please consider a release hysteresis.

19. When LDO start up, inrush current occurs.
When start up, inrush current is detected, and there is a possibility that a short detect.
Please be sure to establish the detection delay time of the IC
so as not to detect a short circuit until LDO starts.

20. This IC limits inrush current with current limit.
Inrush current may temporarily exceed the rated current.
However, since the current flow time is short and the amount of heat generated is small,
there is generally no problem.

21. Detection delay time determined by CD pin capacitance.
The short detection delay time and the open detection delay time become same.

22. Accuracy of current detection is determined by detection current s accuracy,
detection comparator threshold accuracy, and detection setting resistance accuracy.
A separate calculation sheet is available. Please check it.
Please contact us for the calculation sheet.

23. When detect anomaly, each terminal output will be work as the following table.
Each output is latched at the time of short detection and thermal shut down (TSD) detection.
Please input Vin or Cont again to release the latch.

	Normal	Open	Short	TSD	Reverse bias protection
Err_op	High	Low	High	High	High
Err_sc	High	High	Low	Low	Low
Vout	Enabled	Enabled	Disabled	Disabled	Disabled
LATCHED	No	No	Yes	Yes	Yes

16. After checking the application notebook about details of MV1936.
Please contact us for application notebook.

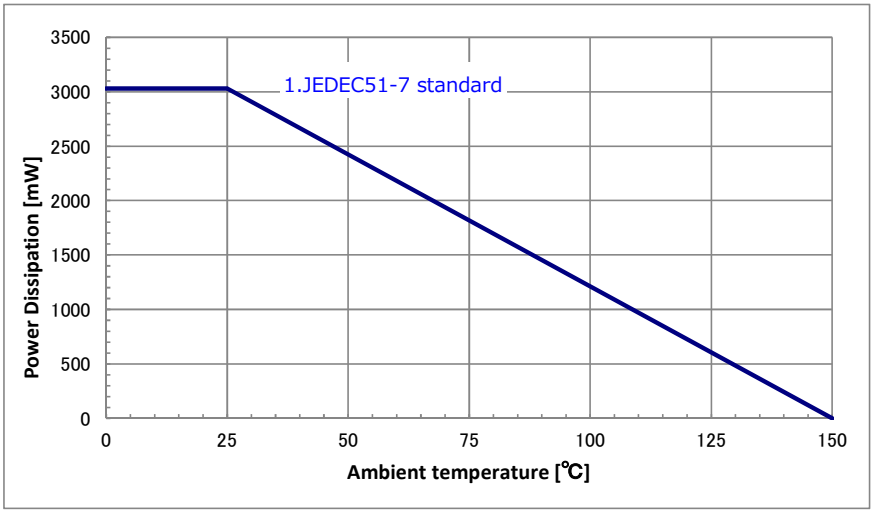
About Power Dissiopation

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.

- SSON-10C

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

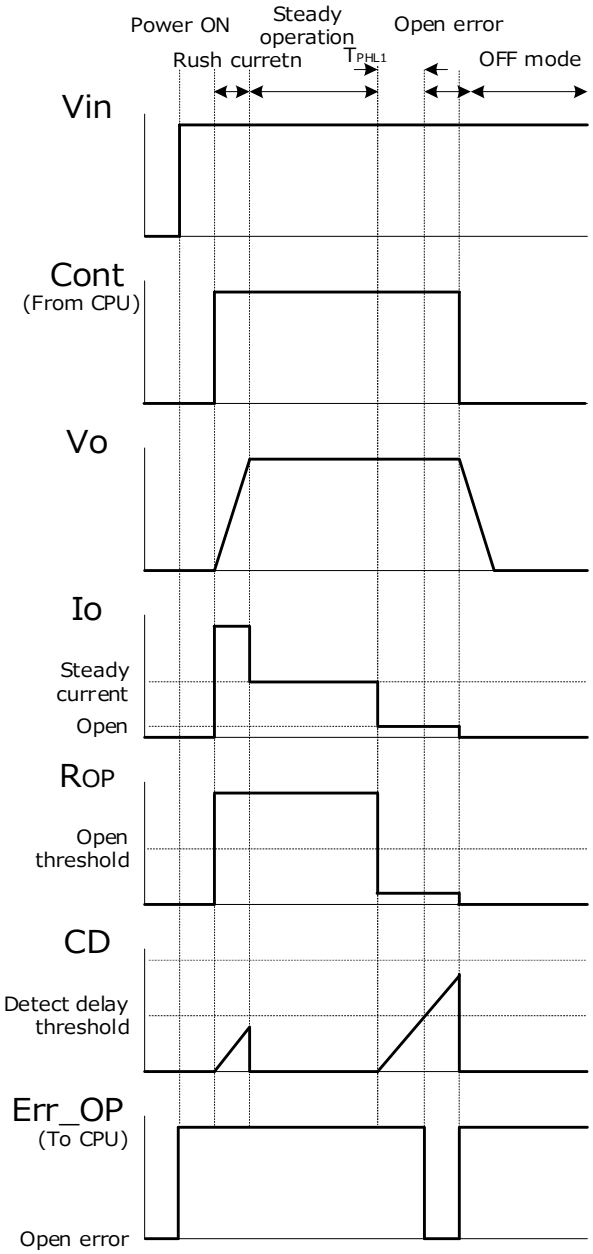
Board size	114.3mm×76.2mm t=1.6mm Copper foil area 80%
Power dissipation	3030mW Ta=25℃



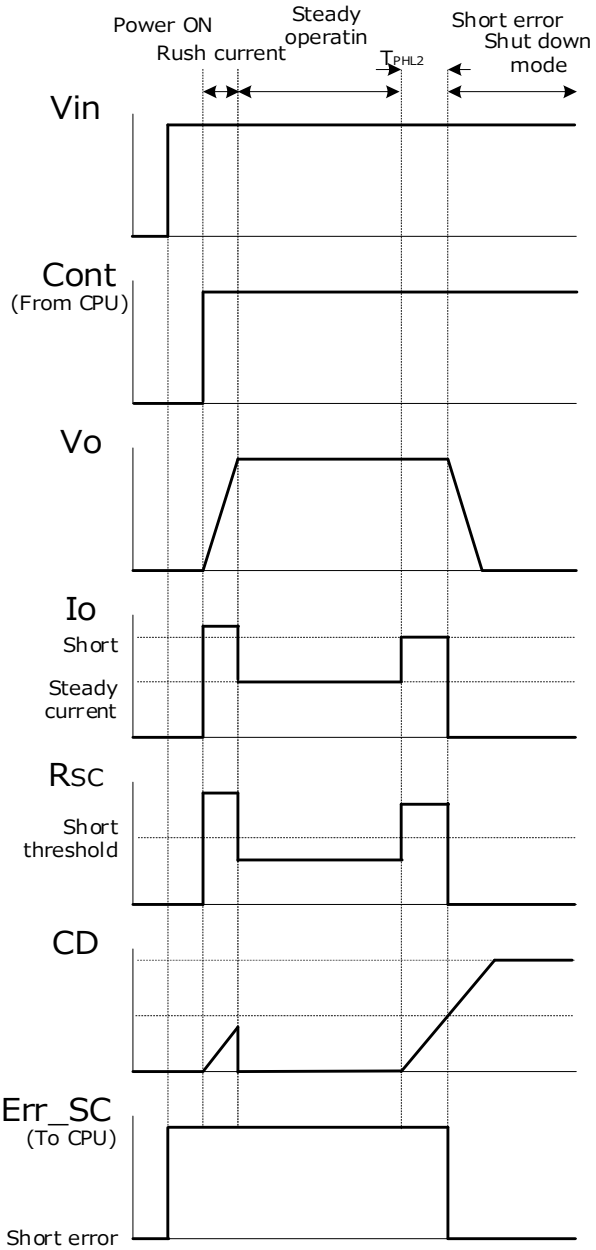
It is recommended to layout the VIA for heat radiation in the GND pattern of reverse (of IC) when there is the GND pattern in the inner layer (in using multiplayer substrate).
By increasing these copper foil pattern area of PCB, Power dissipation improves.

Timing Chart

■ Open error

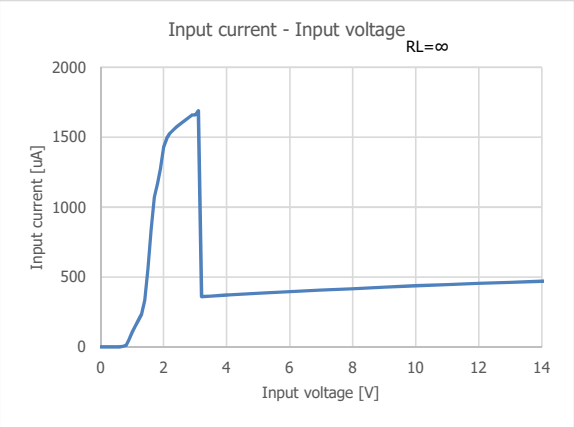


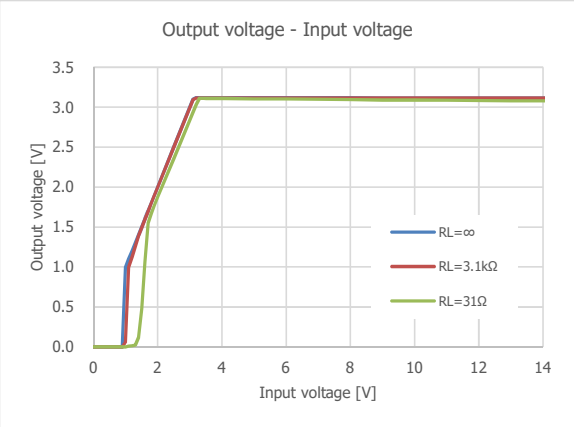
■ Short error

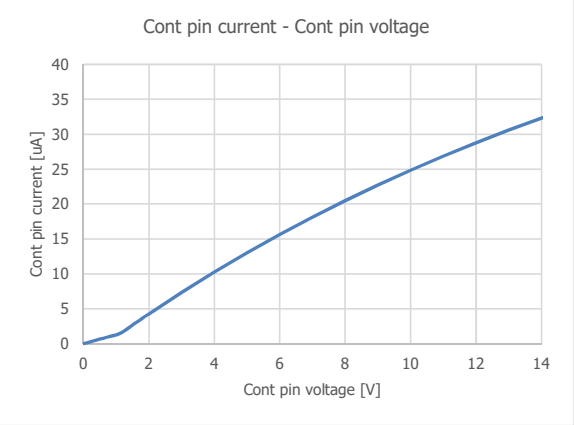


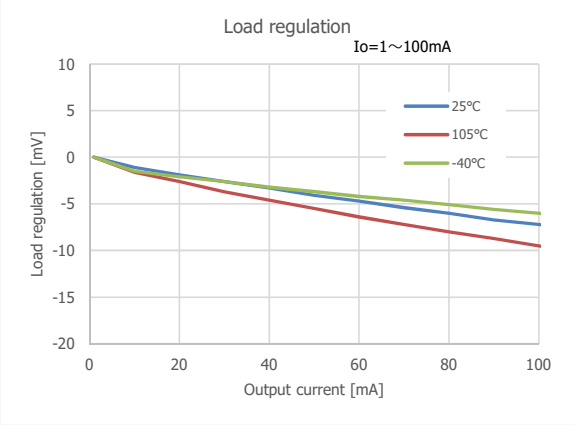
Typical Performance Characteristics (VOUT=3.1V/Function:A)

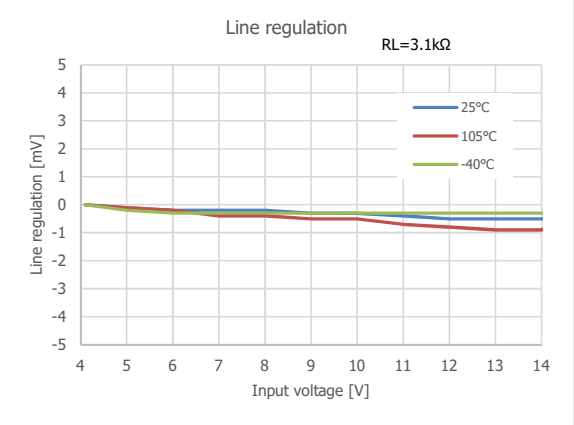
(V_{IN}=V_{OUT}(Typ.)+1V, Vcont=V_{IN}, Cin=1μF, Co=2.2μF, Ta=25℃, unless otherwise specified)

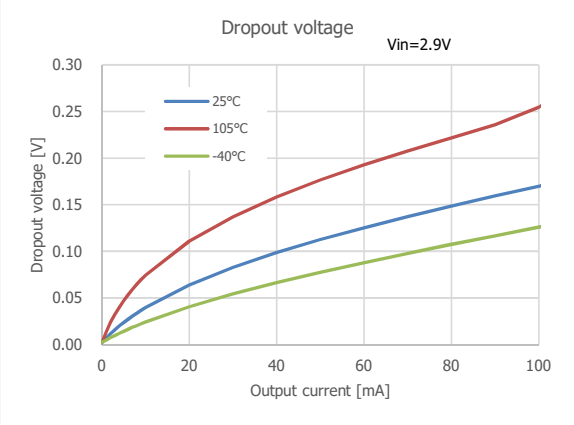












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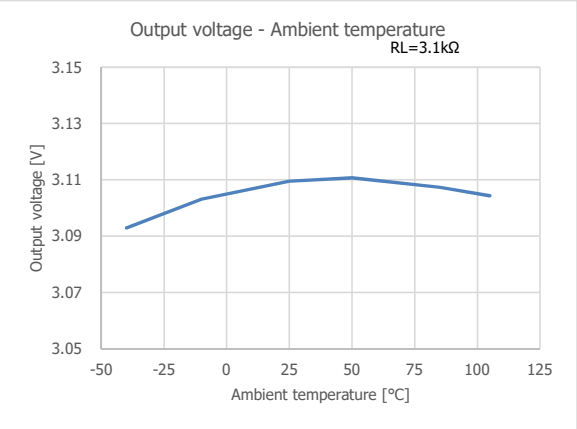

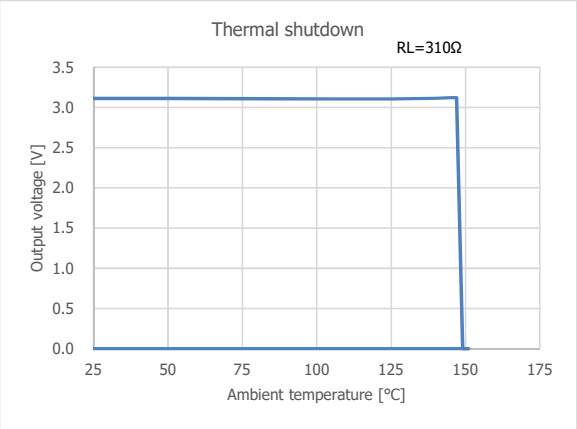

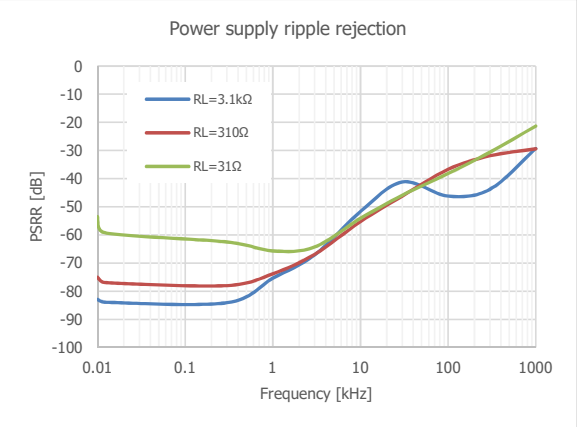

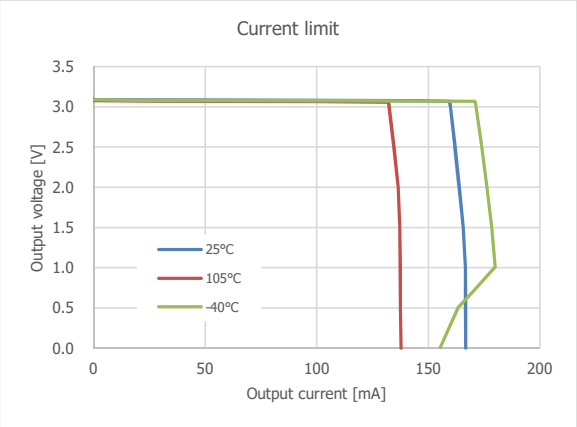

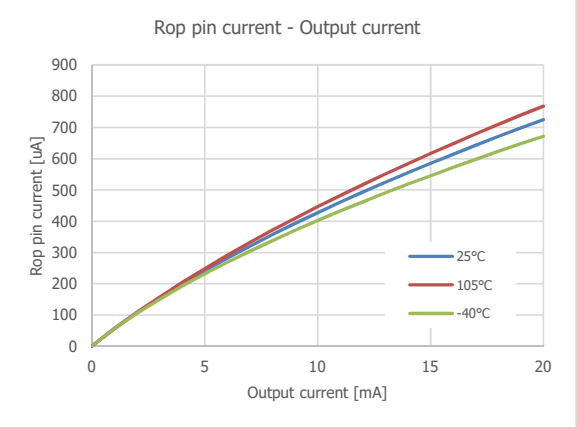

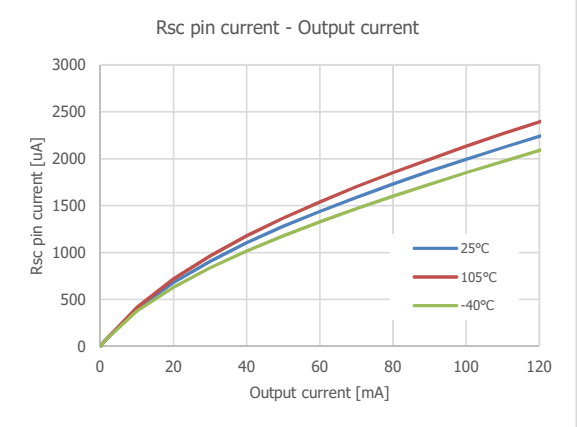

Typical Performance Characteristics (VOUT=3.1V/Function:A)

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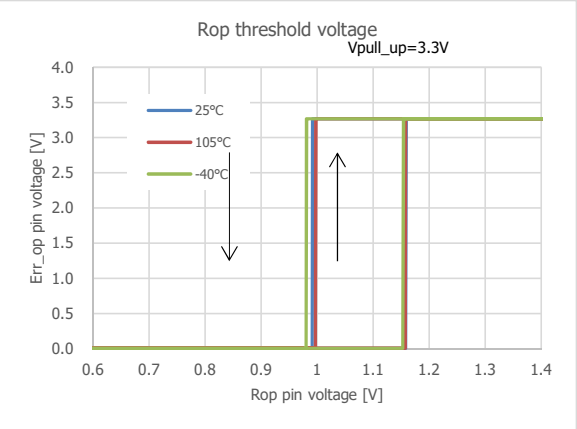
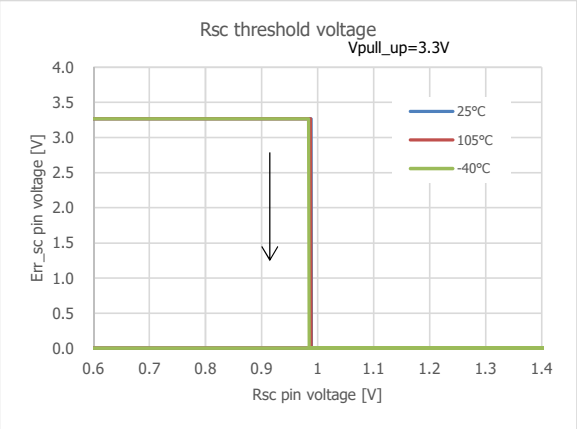
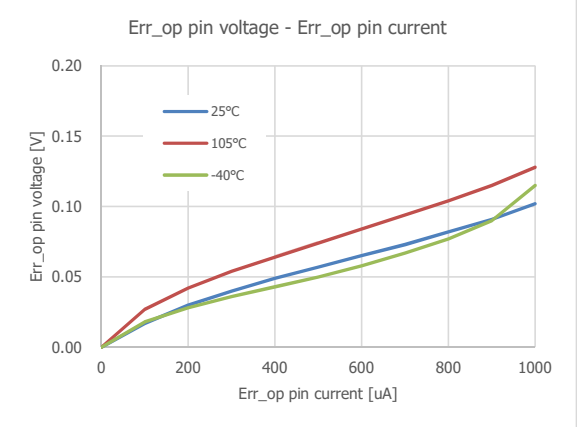
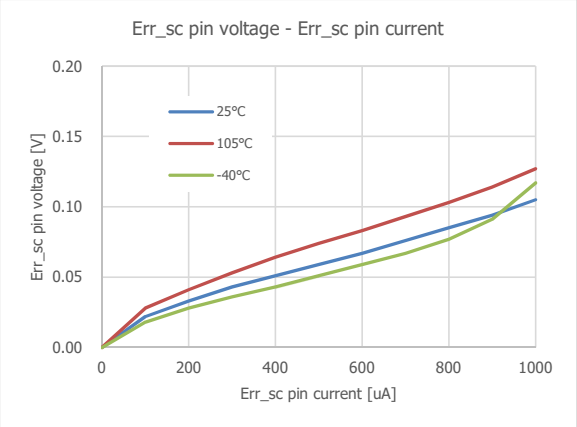
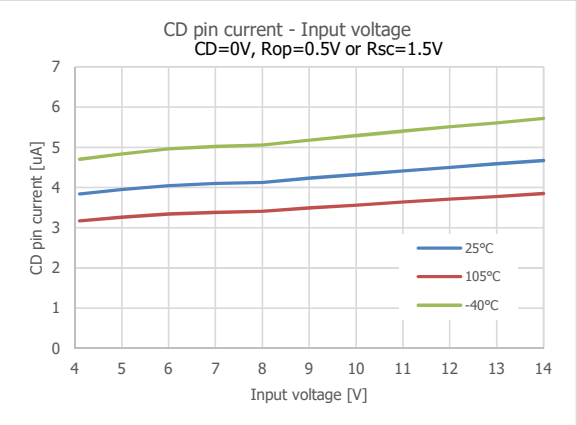
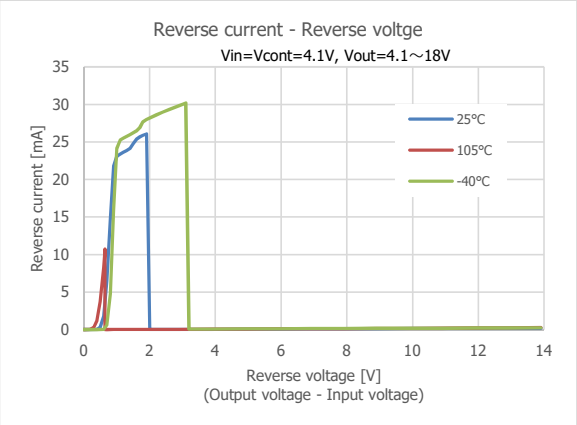






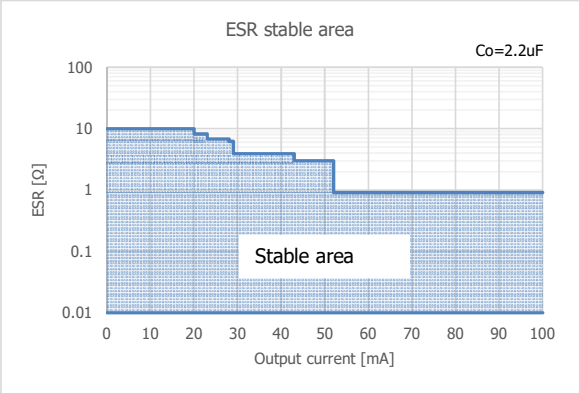


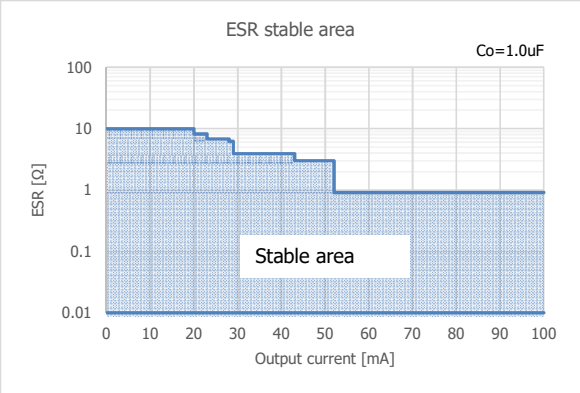




Typical Performance Characteristics (VOUT=3.1V/Function:A)

(V_{IN}=V_{OUT}(Typ.)+1V, Vcont=V_{IN}, Cin=1μF, Co=2.2μF, Ta=25℃, unless otherwise specified)





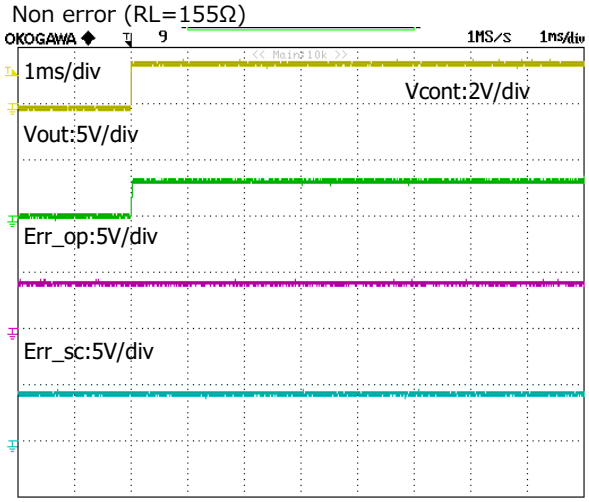
Typical Performance Characteristics (VOUT=3.1V/Function:A)

(V_{IN}=V_{OUT}(Typ.)+1V, Vcont=V_{IN}, Cin=1μF, Co=2.2μF, Ta=25℃, unless otherwise specified)

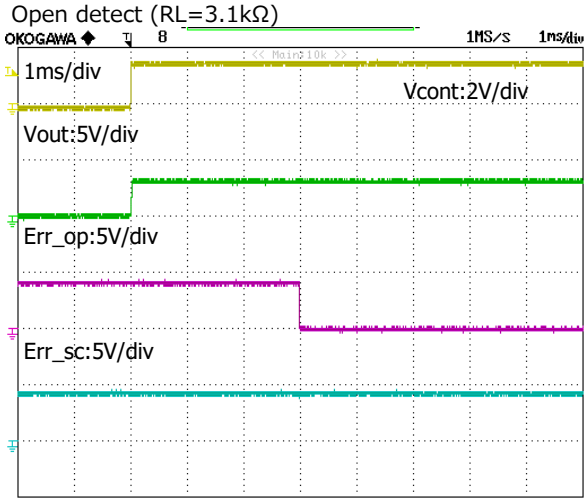
- Turn on transient response

  Open detect current=5mA, Short detect current=80mA

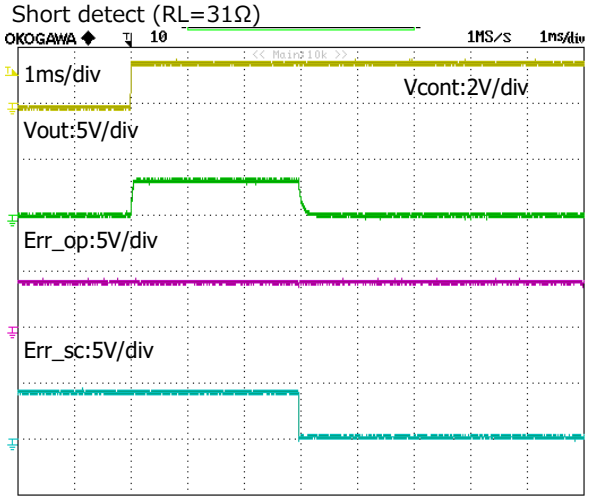
Non error (RL=155Ω)



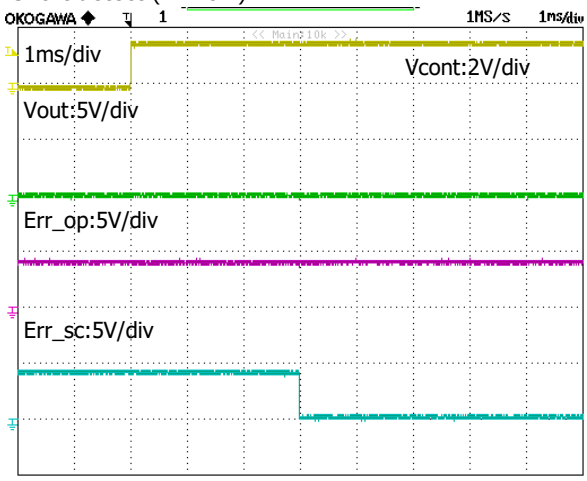
Open detect (RL=3.1kΩ)



Short detect (RL=31Ω)

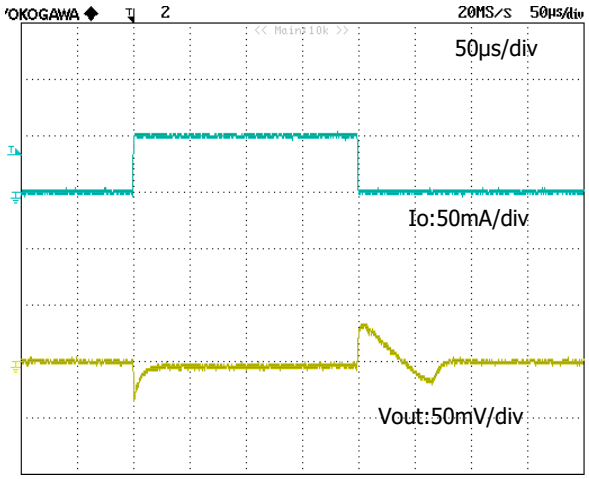


Short detect (RL=0Ω)

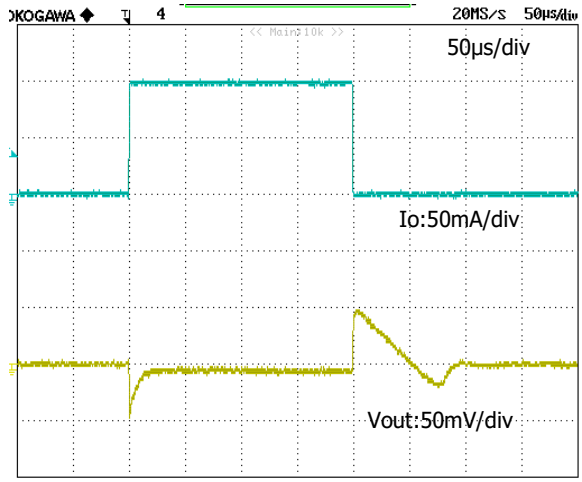


- Load transient response

Io=1⇔50mA

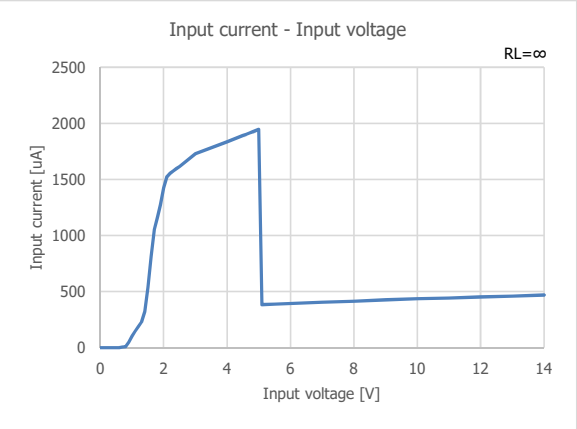


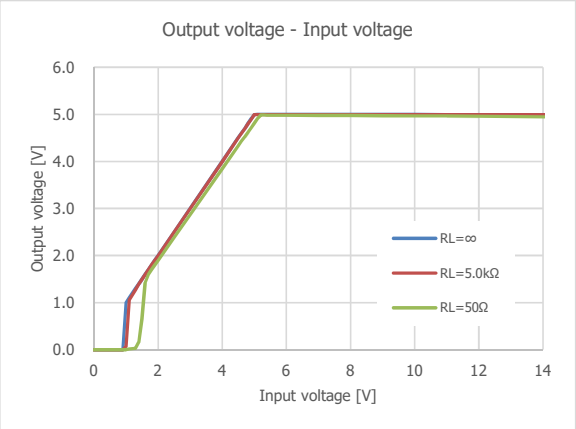
Io=1⇔100mA

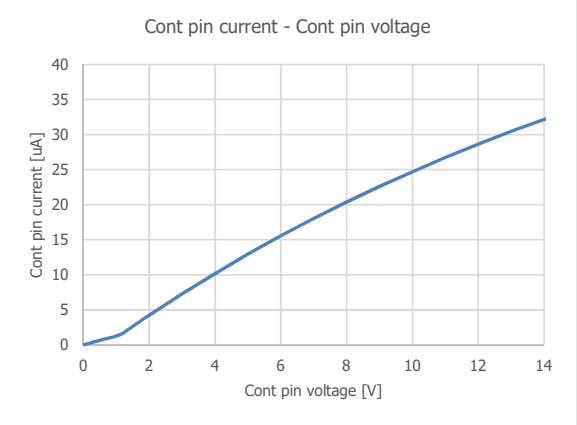


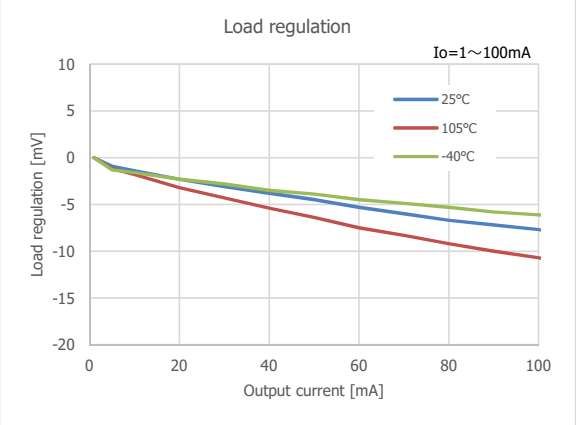
Typical Performance Characteristics (VOUT=5.0V/Function:A)

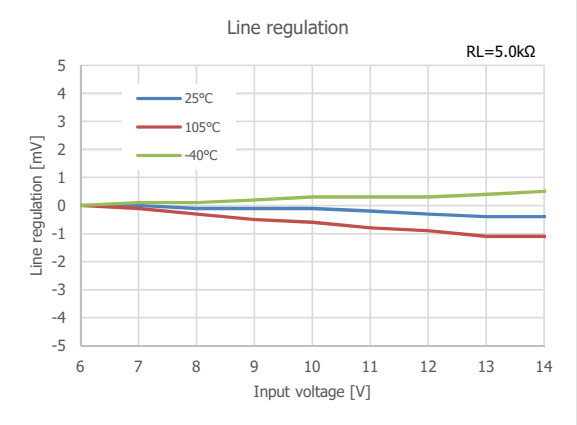
(V_{IN}=V_{OUT}(Typ.)+1V, Vcont=V_{IN}, Cin=1μF, Co=2.2μF, Ta=25℃, unless otherwise specified)

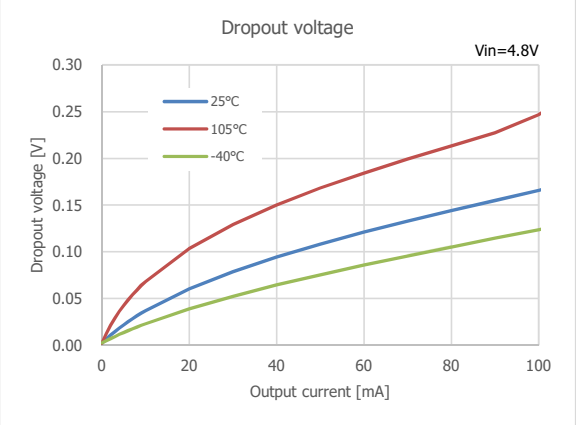






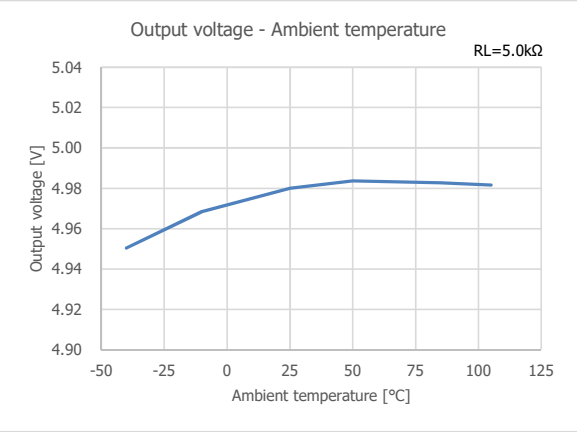


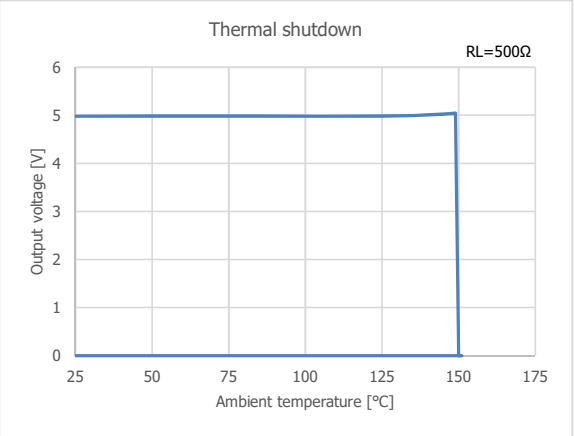


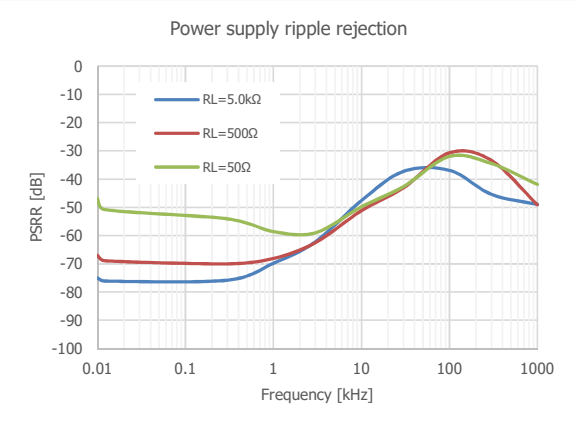


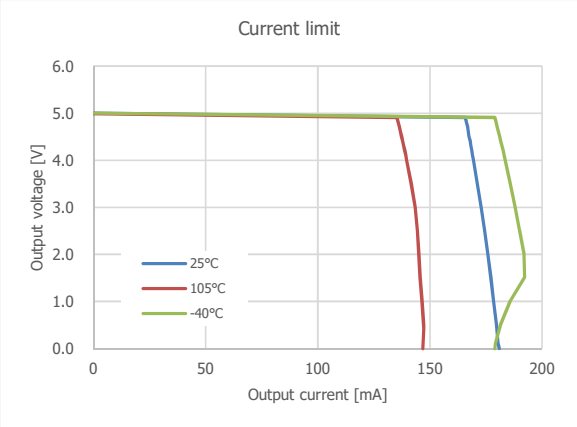
Typical Performance Characteristics (VOUT=5.0V/Function:A)

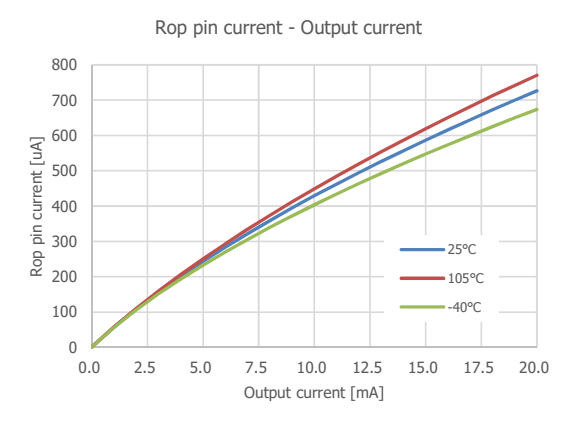
(V_{IN}=V_{OUT}(Typ.)+1V, Vcont=V_{IN}, Cin=1μF, Co=2.2μF, Ta=25℃, unless otherwise specified)

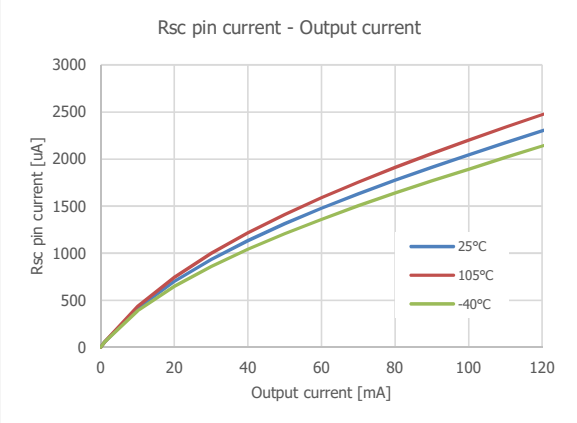






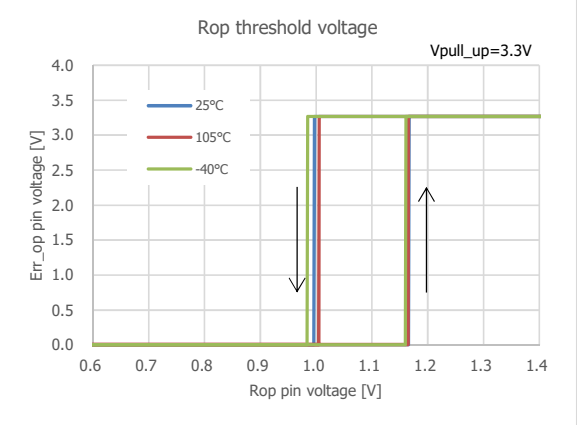


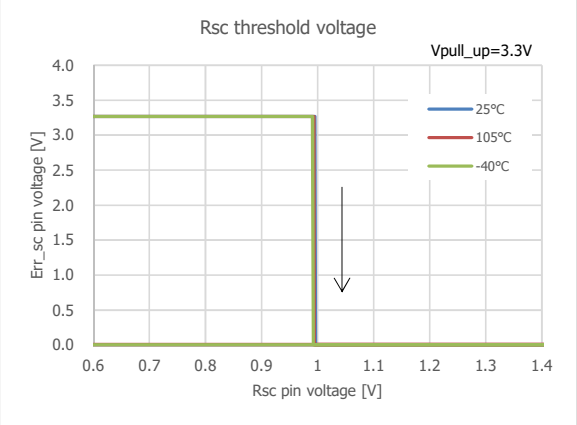


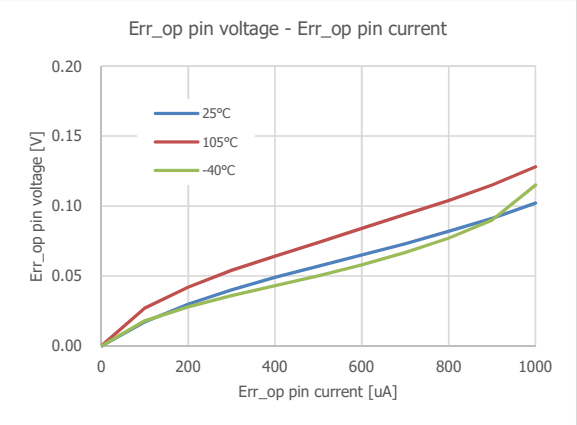


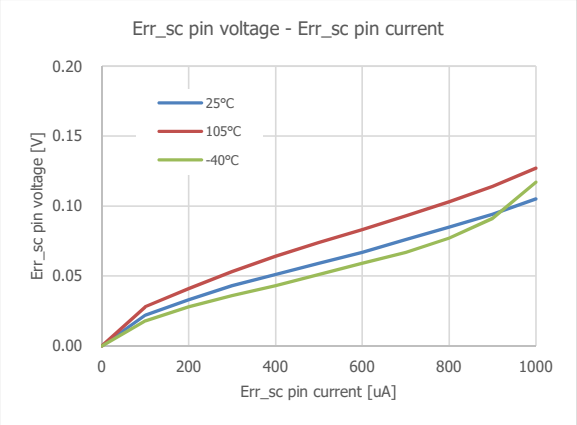
Typical Performance Characteristics (VOUT=5.0V/Function:A)

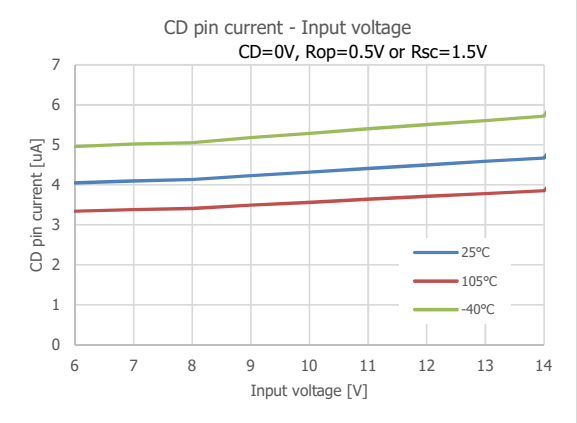
(V_{IN}=V_{OUT}(Typ.)+1V, Vcont=V_{IN}, Cin=1μF, Co=2.2μF, Ta=25℃, unless otherwise specified)

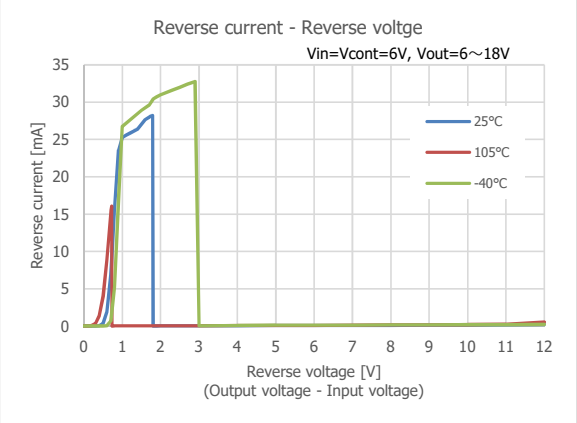






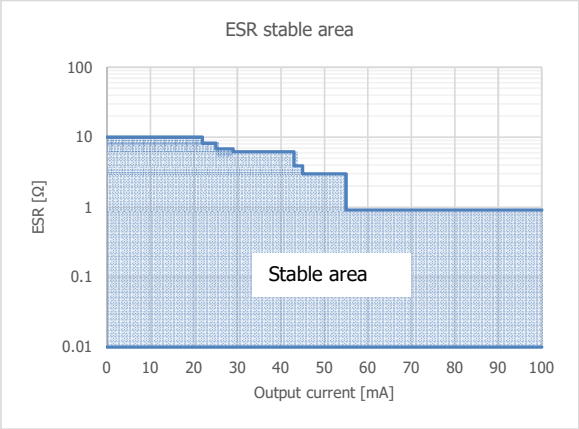


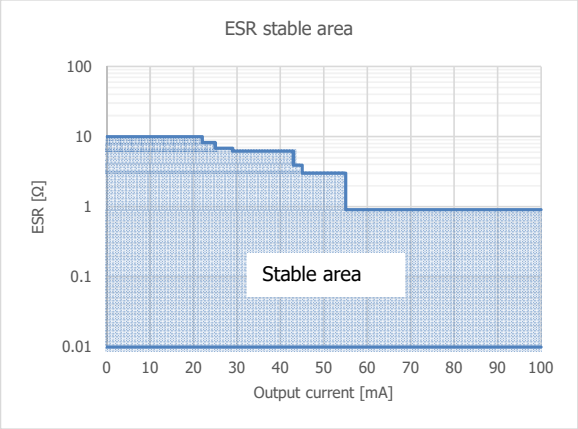




Typical Performance Characteristics (VOUT=5.0V/Function:A)

(V_{IN}=V_{OUT}(Typ.)+1V, Vcont=V_{IN}, Cin=1μF, Co=2.2μF, Ta=25℃, unless otherwise specified)





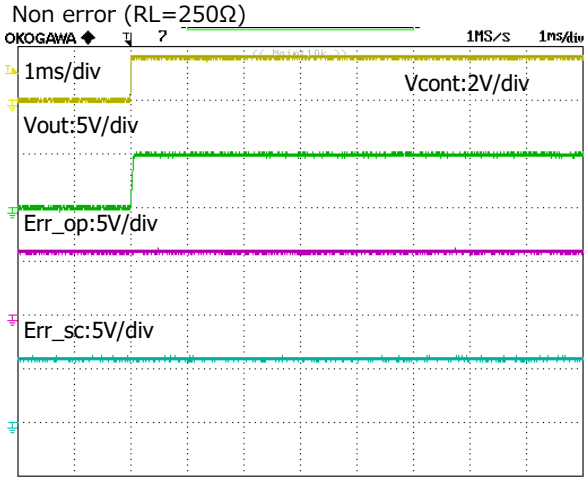
Typical Performance Characteristics (VOUT=5.0V/Function:A)

(V_{IN}=V_{OUT}(Typ.)+1V, Vcont=V_{IN}, Cin=1μF, Co=2.2μF, Ta=25℃, unless otherwise specified)

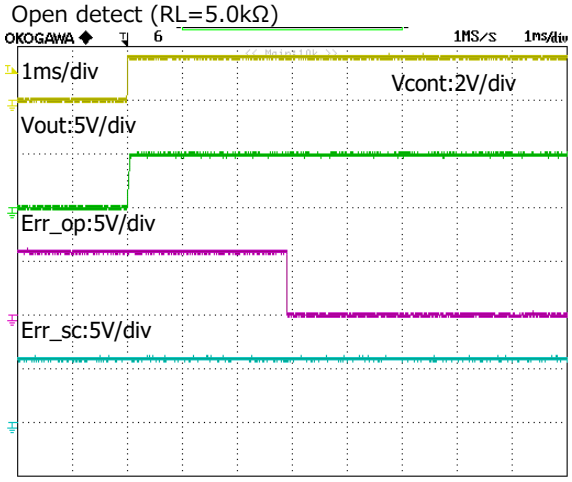
- Turn on transient response

  Open detect current=5mA, Short detect current=80mA

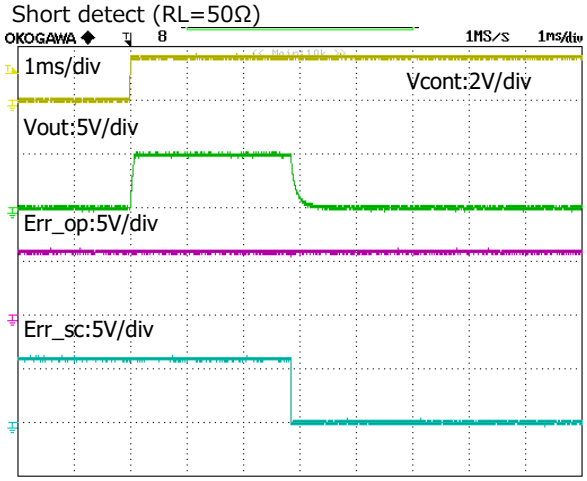
Non error (RL=250Ω)



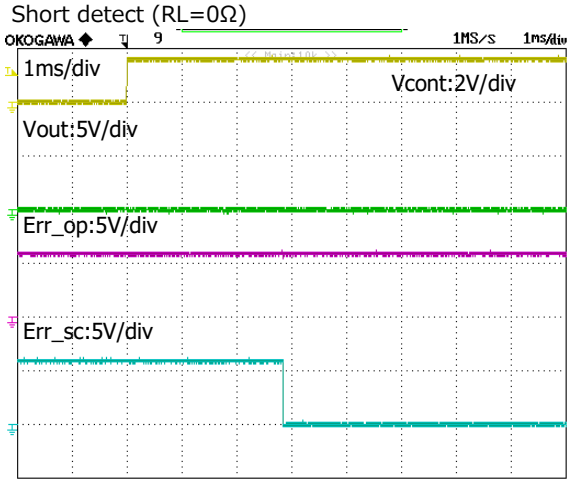
Open detect (RL=5.0kΩ)



Short detect (RL=50Ω)

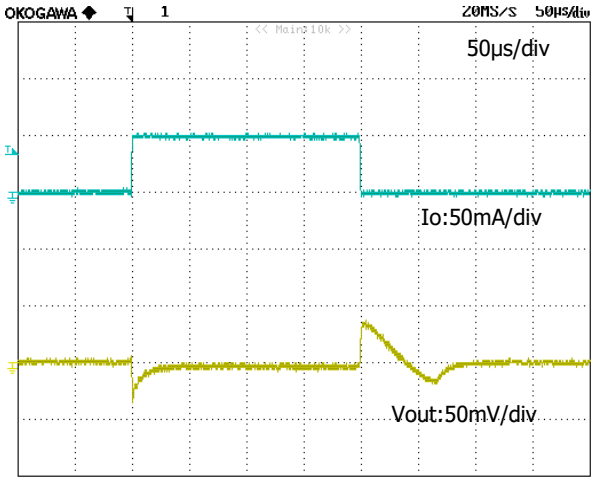


Short detect (RL=0Ω)

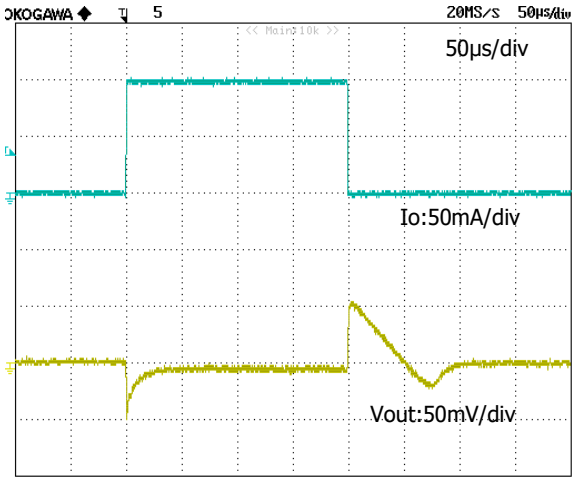


- Load transient response

Io=1⇔50mA

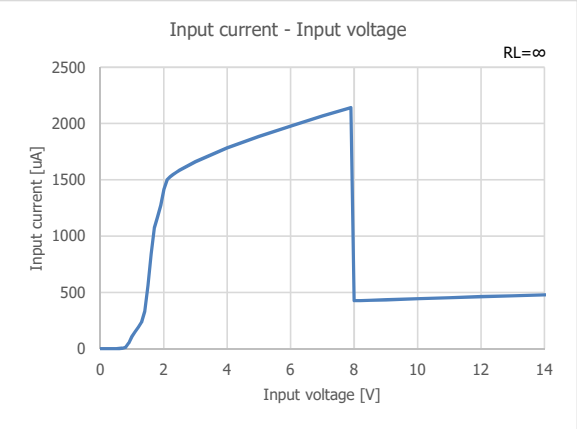


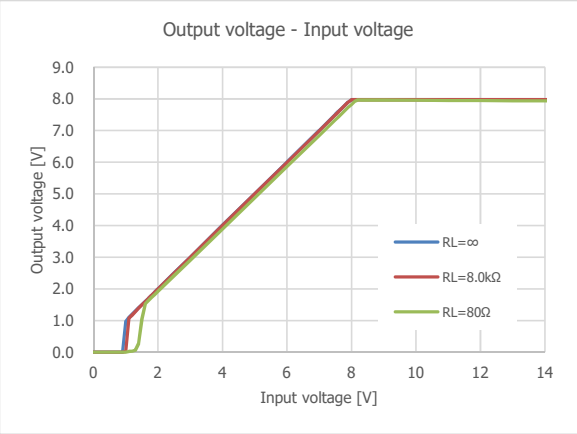
Io=1⇔100mA

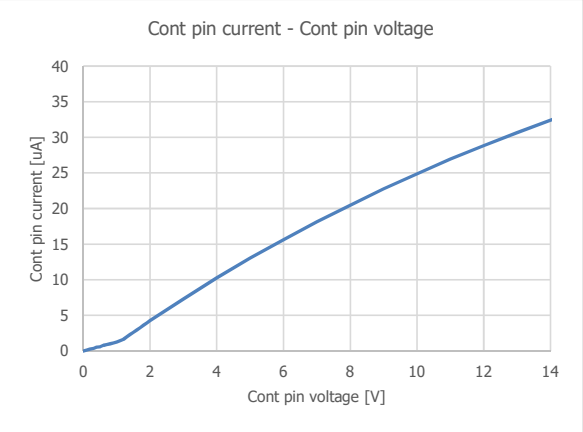


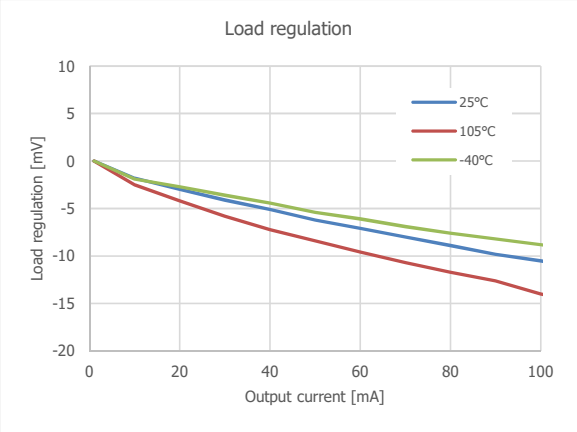
Typical Performance Characteristics (VOUT=8.0V/Function:A)

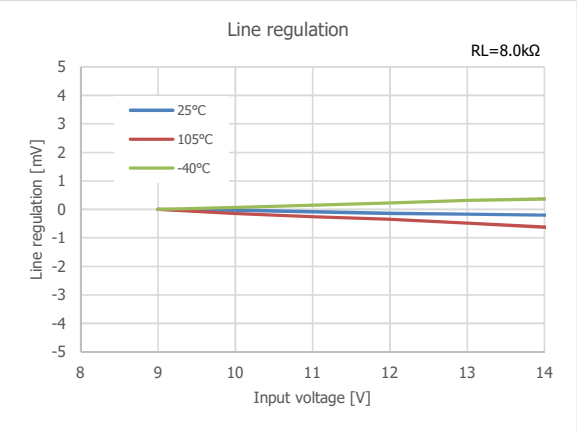
(V_{IN}=V_{OUT}(Typ.)+1V, Vcont=V_{IN}, Cin=1μF, Co=2.2μF, Ta=25℃, unless otherwise specified)

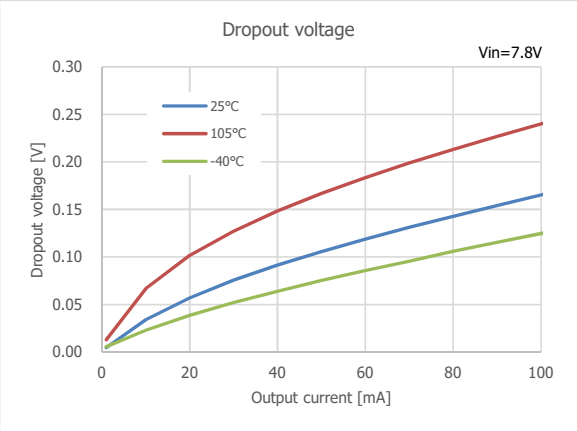






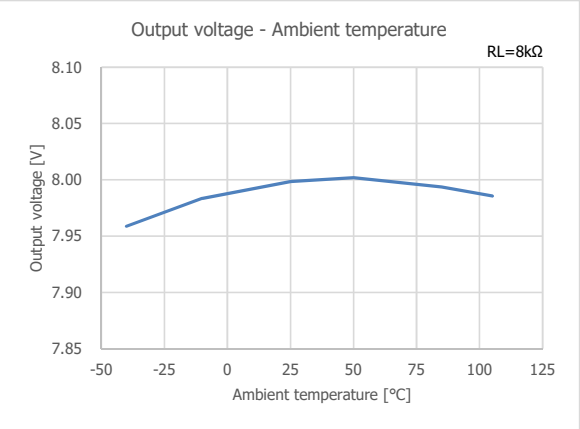


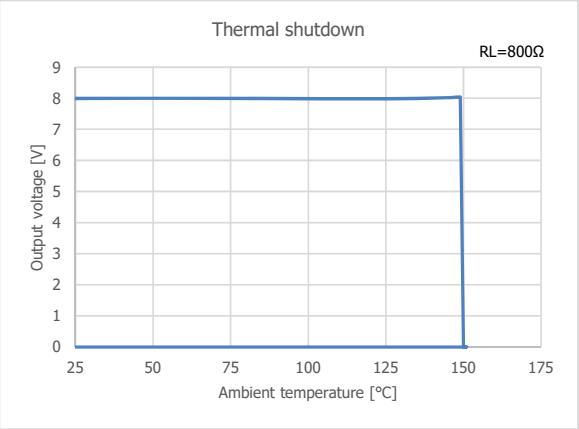


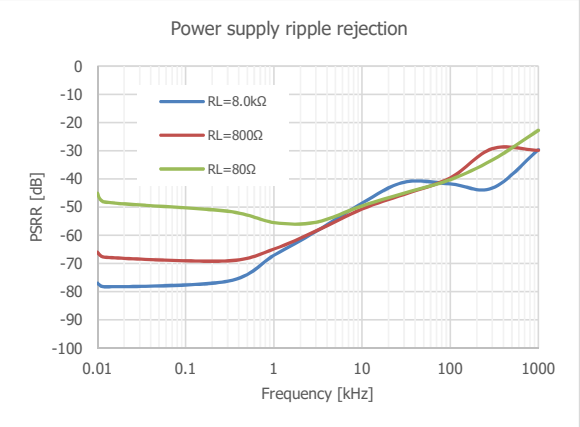


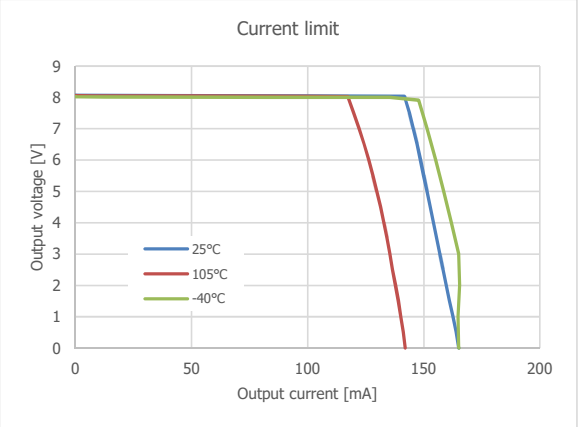
Typical Performance Characteristics (VOUT=8.0V/Function:A)

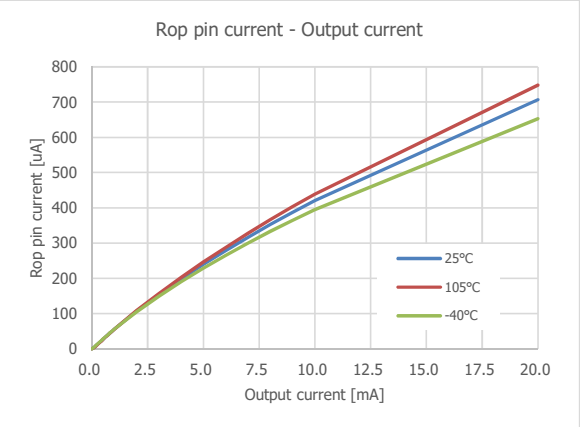
(V_{IN}=V_{OUT}(Typ.)+1V, Vcont=V_{IN}, Cin=1μF, Co=2.2μF, Ta=25℃, unless otherwise specified)

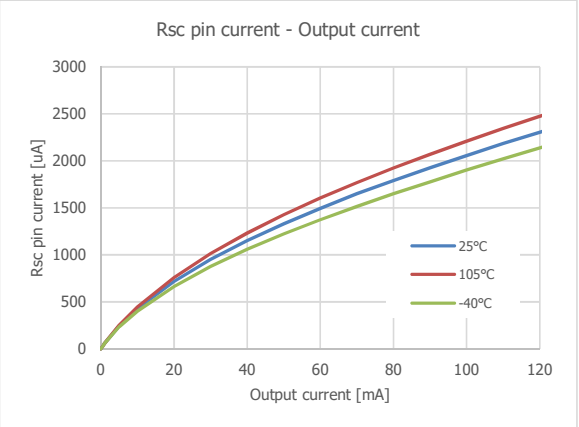






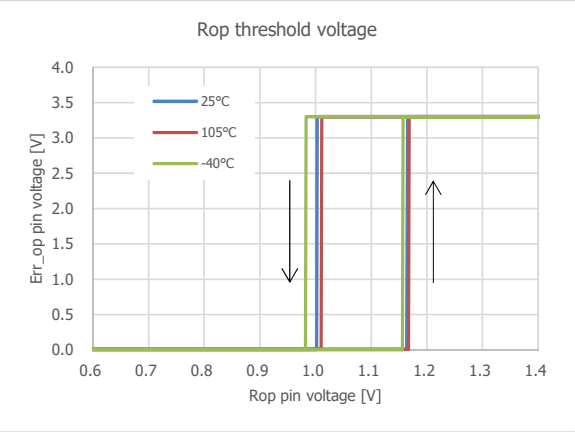


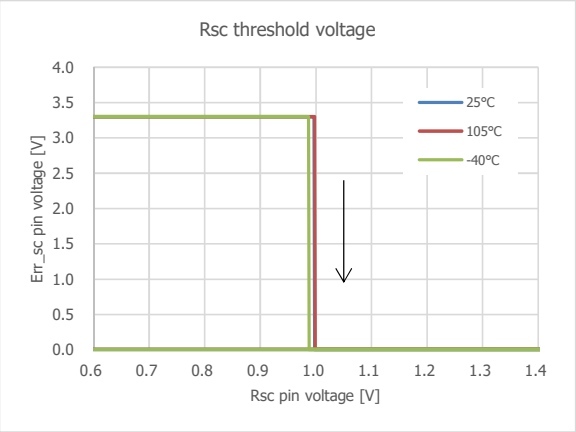


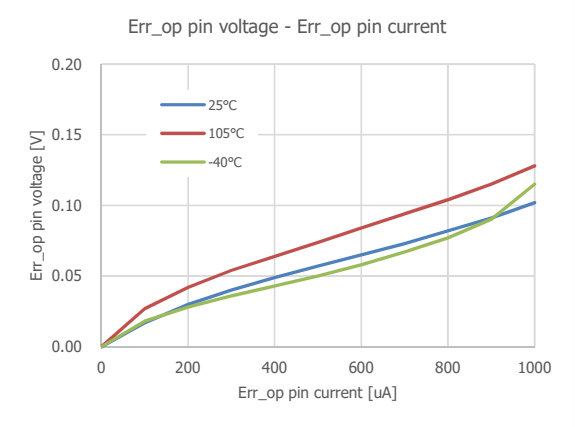


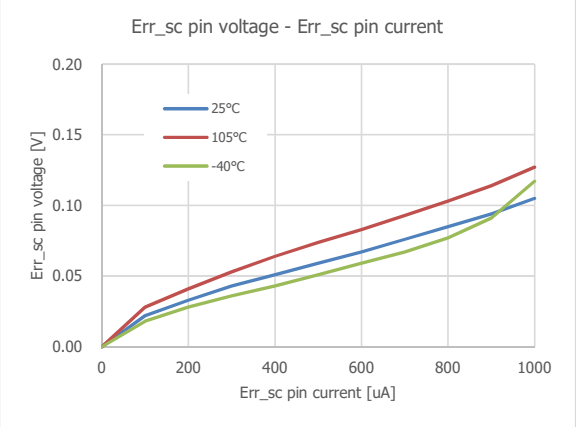
Typical Performance Characteristics (VOUT=8.0V/Function:A)

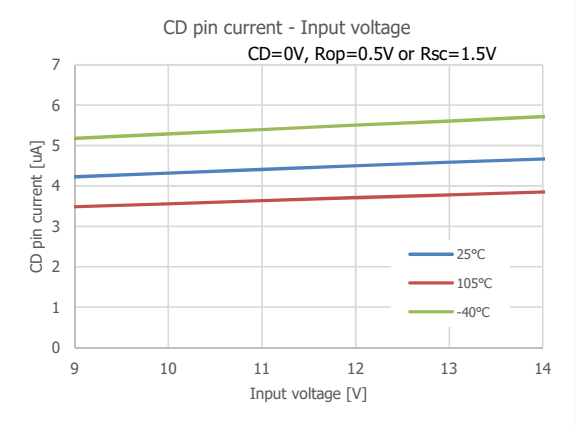
(V_{IN}=V_{OUT}(Typ.)+1V, Vcont=V_{IN}, Cin=1μF, Co=2.2μF, Ta=25℃, unless otherwise specified)

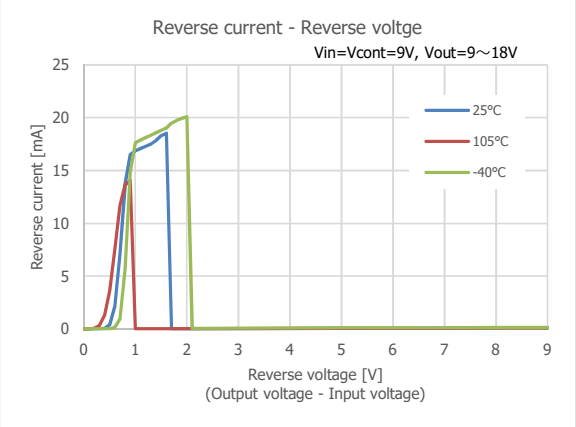






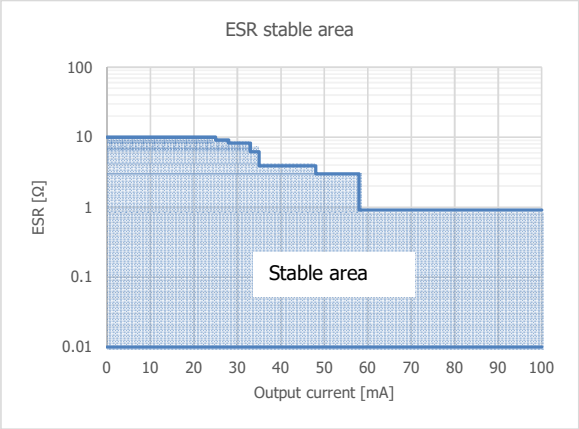


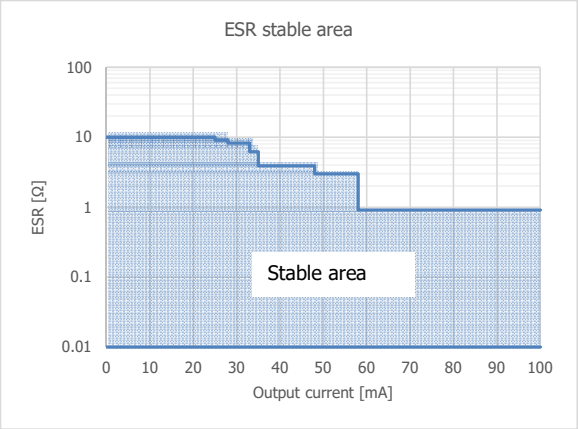




Typical Performance Characteristics (VOUT=8.0V/Function:A)

(V_{IN}=V_{OUT}(Typ.)+1V, Vcont=V_{IN}, Cin=1μF, Co=2.2μF, Ta=25℃, unless otherwise specified)





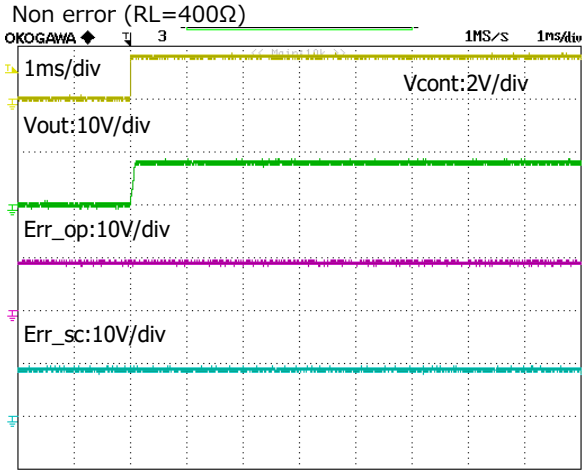
Typical Performance Characteristics (VOUT=8.0V/Function:A)

(V_{IN}=V_{OUT}(Typ.)+1V, Vcont=V_{IN}, Cin=1μF, Co=2.2μF, Ta=25℃, unless otherwise specified)

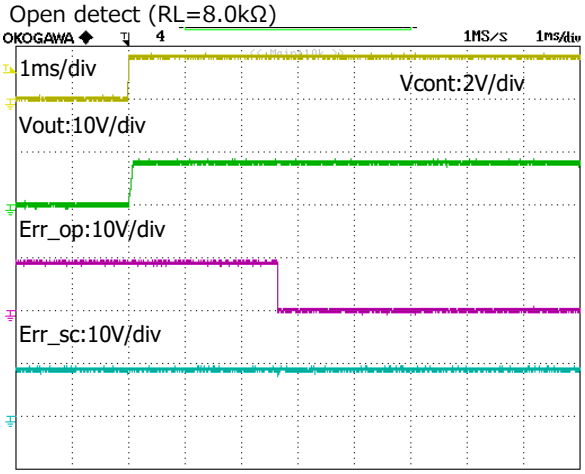
- Turn on transient response

  Open detect current=5mA, Short detect current=80mA

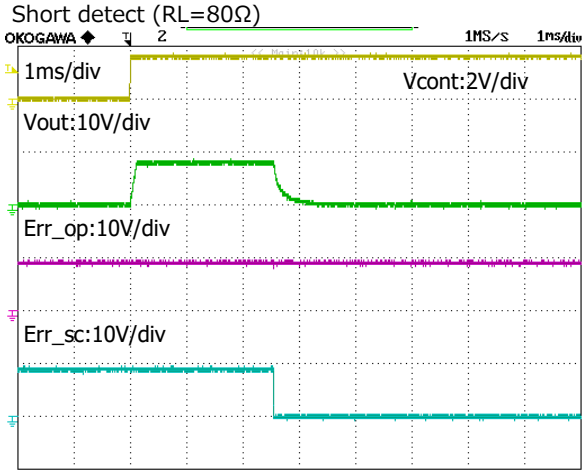
Non error (RL=400Ω)



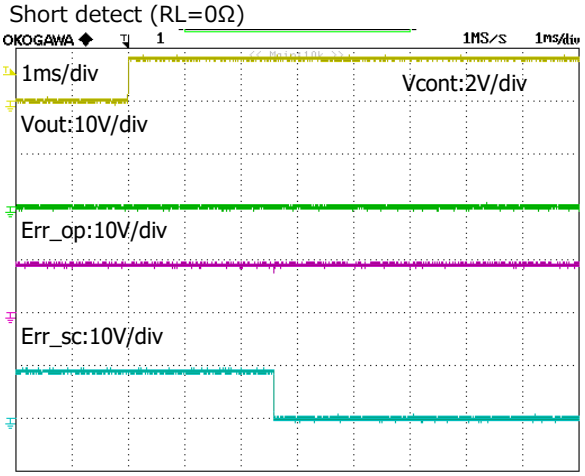
Open detect (RL=8.0kΩ)



Short detect (RL=80Ω)

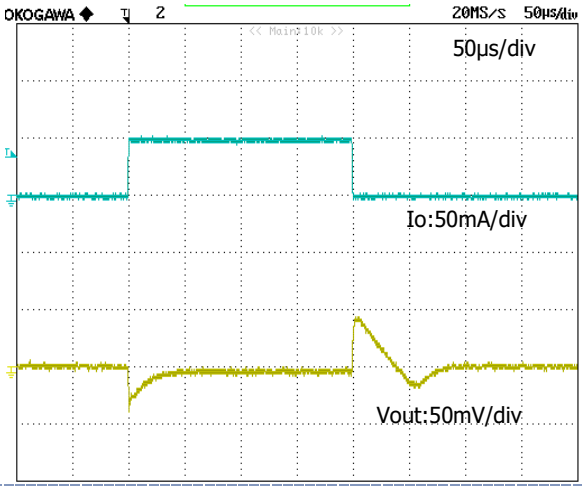


Short detect (RL=0Ω)

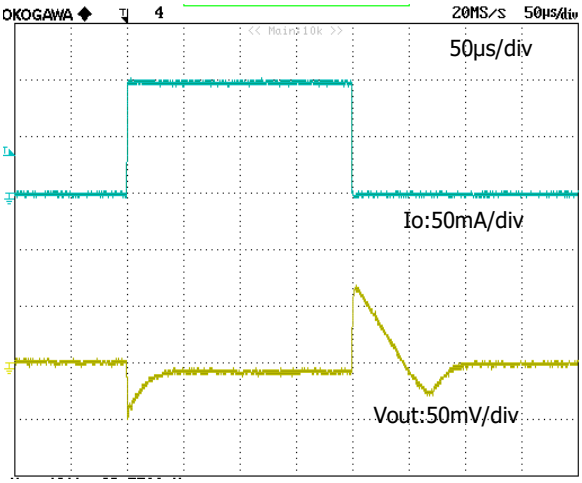


- Load transient response

Io=1⇔50mA



Io=1⇔100mA



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