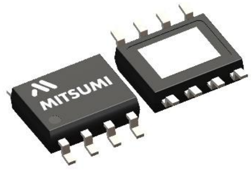
1000mA LDO with Over current detection / OCP auto-retry

MM4051 Series



Overview

This IC is a 1A LDO with Over current detection and OCP auto-retry function. The over current detection function can set threshold current by the external resister Rsc and output an error flag when the load current over the threshold current.The OCP auto-retry function enables overcurrent protection to operate intermittently, greatly reducing heat generation during overcurrent.

Features

- Over current detection
- OCP auto-retry
- Soft start

Main specifications

- Maximum rating supply voltage : -0.3V to 7.0V
- Operating voltage range : 2.0V to 6.5V
- Operating ambient temperature : -40℃ to 105℃
- Output current : 1000mA (2.0V≦V_{OUT}(Typ.))
  500mA (V_{OUT}(Typ.)<2.0V)
- Input current (OFF) : Typ. 0.1uA
- No-load input current : Typ. 130uA
- Output voltage range : 1.0V ~ 5.0V (0.1V step)
- Output voltage accuracy : ±1% (1.5V≦V_{OUT}(Typ.), I_{OUT}=10mA)
  ±15mV (V_{OUT}(Typ.)<1.5V, I_{OUT}=10mA)
- Line regulation : Typ. 0.05%/V (2.0V≦V_{OUT}(Typ.), V_{DD}=V_{OUT}(Typ.)+0.5V to 6.5V)
  Typ. 0.05%/V (V_{OUT}(Typ.)<2.0V, V_{DD}=2.5V to 6.5V)
- Load regulation : Typ. 25mV (2.0V≦V_{OUT}(Typ.), I_{OUT}=1mA to 1000mA)
  Typ. 12mV (V_{OUT}(Typ.)<2.0V, I_{OUT}=1mA to 500mA)
- Dropout voltage : Typ. 0.46V (I_{OUT}=1000mA, V_{OUT}(Typ.)=3V)
- PSRR : Typ. 70dB (V_{OUT}(Typ.)<1.5V, f=1kHz)
  Typ. 65dB (1.5V≦V_{OUT}(Typ.)<3.4V, f=1kHz)
  Typ. 60dB (3.4V≦V_{OUT}(Typ.)≦5.0V, f=1kHz)
- Output rise time : Typ. 1.5ms (Cs=0.01uF, 1.5V≦V_{OUT}(Typ.))
- Over current detection accuracy : ±23% (V_{DD}=6V,)
- Output capacitor : 1.0uF (Ceramic capacitor)
- Protection function : Over current protection (auto-retry), Thermal shutdown
- Additional function : Over current detection, ON/OFF control, Auto discharge

Packages

- HSOP-8E

Application

- Audio visual equipment
- Photographing / Imaging device
- Office equipment / Printer
- Home appliance equipment
- In-vehicle infotainment device

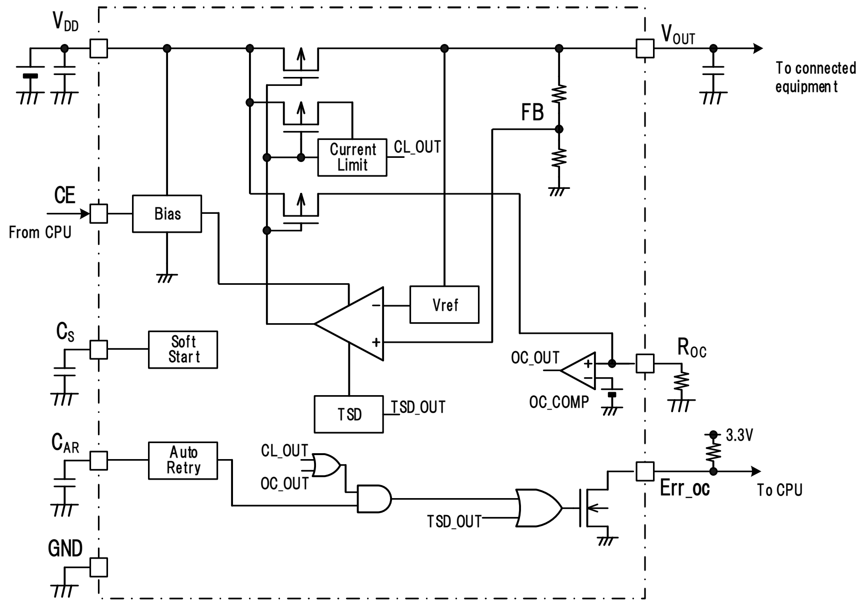
Model Name

M M 4 0 5 1 X X X X X X

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

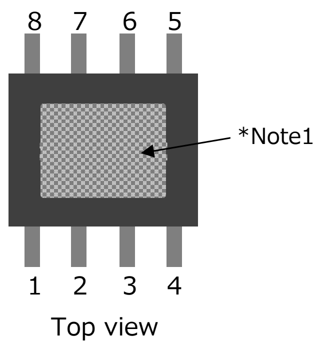
(A)	Function Type	F	Au wire typ (HSOP-8E)
(B)	Output voltage rank	10 ≀ 50	Output voltage can be designated in the range from 1.0V(10) to 5.0V(50) in 0.1V steps.
(C)	Package	H	HSOP-8E
(D)	Packing specifications 1	B	B housing (Standard)
(E)	Packing specifications 2	E	Emboss tape / Halogen free

Block Diagram



Pin Configuration

- HSOP-8E



Pin No.	Pin name	Function
1	V_{OUT}	Output voltage
2	R_{OC}	Over current detection resistance pin
3	Cs	Soft start pin Must be connect capacitor to soft start pin.
4	GND	GND pin
5	CE	ON/OFF-control pin Connect CE pin with VDD pin, when it is not used.
6	C_{AR}	Auto retry setting pin Must be connect capacitor to auto retry setting pin.
7	Err_oc	Over current detection output pin
8	V_{DD}	Power-supply input pin

*Note1:Heat spreader bottom with GND.

Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit
Storage temperature	Tstg	-55	150	℃
Junction temperature	Tj_{MAX}	-	150	℃
Supply voltage	V_{DD}	-0.3	7	V
CE input voltage	V_{CE}	-0.3	7	V
Output voltage	V_{OUT}	-0.3	V_{DD}+0.3V	V
Err_oc pin voltage	Verr_oc	-0.3	7	V
Err_oc pin current	Ierr_oc	-	10	mA
Output current	Iomax	-	1.2	A
Power dissipation *Note2 *Note3	Pd	-	3500	mW

*Note2:JEDEC51-7 standard 114.3mm×76.2mm t=1.6mm

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

Recommended Operating Conditions

Item	Symbol	Min.	Max.	Unit
Operating ambient temperature	Topr	-40	105	℃
Operating voltage	Vop	2.0	6.5	V
Output current	I_{OUT}	0	1.0	A

Electrical Characteristics

(V_{DD}=V_{OUT}(Typ.)+1V, V_{CE}=V_{DD}, Ta=25℃, unless otherwise specified)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input current(OFF)	I_{DDOff}	V_{CE}=0V	-	0.1	1.0	μA
No-load input current	I_{DD}	I_{OUT}=0mA	-	130	200	μA
Output voltage1	V_{OUT1}	I_{OUT}=10mA, 1.5V≦V_{OUT}(Typ.)	×0.99	-	×1.01	V
		I_{OUT}=10mA, V_{OUT}(Typ.)<1.5V	-0.015	-	0.015	
Output voltage2 *Note4	V_{OUT2}	I_{OUT}=10mA, 1.5V≦V_{OUT}(Typ.) Ta=-40℃~105℃	×0.965	-	×1.035	V
		I_{OUT}=10mA, V_{OUT}(Typ.)<1.5V Ta=-40℃~105℃	-0.06	-	+0.06	
Line regulation	V_{LINE}	V_{OUT}(Typ.)+0.5V≦V_{DD}≦6.5V I_{OUT}=10mA, 2.0V≦V_{OUT}(Typ.)	-	0.05	0.20	%/V
		2,5V≦V_{DD}≦6.5V I_{OUT}=10mA, V_{OUT}(Typ.)<2.0V				
Load regulation	V_{LOAD}	1mA≦I_{OUT}≦1000mA 2.0V≦V_{OUT}(Typ.)	-	25	70	mV
		1mA≦I_{OUT}≦500mA V_{OUT}(Typ.)<2.0V	-	12	35	mV
Dropout voltage	Vio	Please refer to another page.	-	-	-	V

*Note4:The parameter is guaranteed by design.

Electrical Characteristics

(V_{DD}=V_{OUT}(Typ.)+1V, V_{CE}=V_{DD}, Ta=25℃, unless otherwise specified)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Ripple rejection *Note4	RR	f=1kHz, Vripple=0.5V, I_{OUT}=10mA VDD=2.5V, V_{OUT}(Typ.)<1.5V	-	70	-	dB
		f=1kHz, Vripple=0.5V, I_{OUT}=10mA 1.5V≦V_{OUT}(Typ.)<3.4V	-	65	-	
		f=1kHz, Vripple=0.5V, I_{OUT}=10mA 3.4V≦V_{OUT}(Typ.)<5.0V	-	60	-	
V_{OUT} temperature coefficient *Note4	⊿V_{OUT} /⊿T_{OP}	I_{OUT}=10mA -40≦Top≦85℃	-	±140	-	ppm/℃
Output short-circuit current	Ishort	V_{OUT}=0V 2.0V≦V_{OUT}(Typ.)	1.0	1.8	-	A
		V_{OUT}=0V V_{OUT}(Typ.)<2.0V	0.5	1.0	-	A
Thermal shutdown detect temperature *Note4	T_{SD}	I_{OUT}=10mA	-	165	-	℃
Thermal shutdown release temperature *Note4	T_{SR}	I_{OUT}=10mA	-	145	-	℃
Output rise time *Note4	tr	V_{OUT}<1.6V, Cs=0.01μF	-	2.0	-	ms
		1.6V≦V_{OUT}, Cs=0.01μF	-	1.5	-	
CE high threshold voltage	V_{CEH}		1.2	-	6.5	V
CE low threshold voltage	V_{CEL}		0	-	0.4	V
CE pin current	I_{CE}	V_{CE}=2.0V	-	0.2	-	μA
Output NMOS ON resistance *Note4	R_{DON}	V_{CE}=0V, V_{DD}=4V	-	10	-	Ω

*Note4:The parameter is guaranteed by design.

Electrical Characteristics

(V_{DD}=V_{OUT}(Typ.)+1V, V_{CE}=V_{DD}, Ta=25℃, unless otherwise specified)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
ROC pin current	I_{OC}	V_{DD}=6V, 2.0V≦V_{OUT}(typ.) I_{OUT}=1A, V_{ROC}=1.2V	136	160	184	μA
		V_{DD}=3.3V, V_{OUT}(typ.)<2.0V I_{OUT}=500mA, V_{ROC}=1.2V	68	80	92	μA
ROC threshold voltage H	Vth_oc_H	V_{DD}=6V	1.10	1.20	1.30	V
ROC threshold voltage L	Vth_oc_L	V_{DD}=6V	1.05	1.14	1.23	V
Err_oc output voltage	Verr_oc	V_{ROC}=H Ierr_oc=100μA	-	-	0.2	V
CAR pin current(charge) *Note4	Iar1	V_{DD}=6V, V_{ROC}=L V_{CAR}=1.0V	-	35	-	μA
CAR pin current(discharge) *Note4	Iar2	V_{DD}=6V, V_{ROC}=H V_{CAR}=0.3V	-	0.11	-	μA
CAR threshold voltage 1	Vth_ar1	V_{DD}=6V, V_{CAR}=L → H V_{OUT}=H→L	0.88	1.00	1.12	V
CAR threshold voltage 2	Vth_ar2	V_{DD}=6V, V_{CAR}=H → L V_{OUT}=L→H	-	0.30	-	V
CAR threshold voltage 3	Vth_ar3	V_{DD}=6V, V_{CAR}=H → L Err_oc=L→H	-	0.21	-	V

*Note4:The parameter is guaranteed by design.

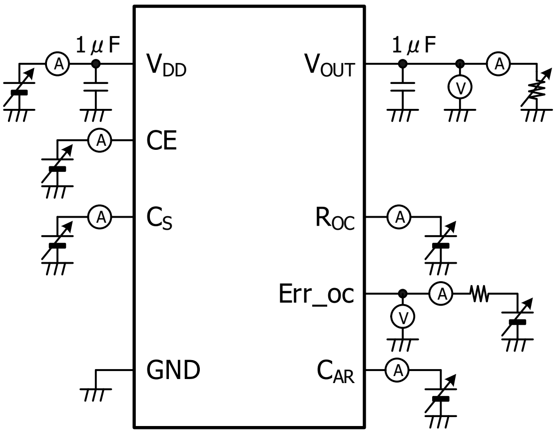
Electrical Characteristics

(V_{DD}=V_{OUT}(Typ.)+1V, V_{CE}=V_{DD}, Ta=25℃, unless otherwise specified)

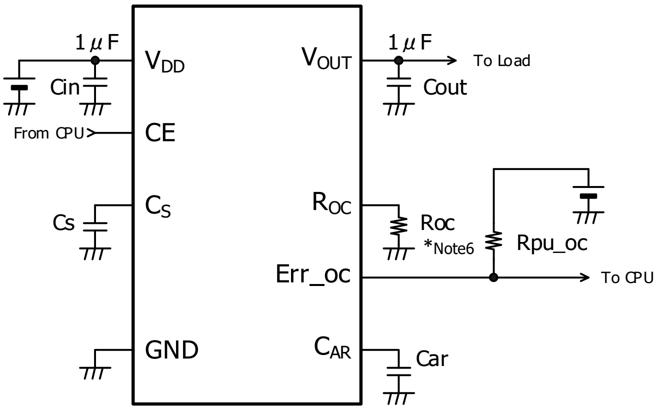
Model name	Item							
	Output voltage V_{OUT} (V)				Dropout voltage Vio (mV)			
	Conditions	Min.	Typ.	Max.	Conditions	Min.	Typ.	Max.
MM4051F10	I_{OUT}=10mA	0.985	1.000	1.015	I_{OUT}=0.5mA, V_{OUT}(typ.)<2.0V *Note5	-	0.80	1.00
MM4051F11		1.085	1.100	1.115				
MM4051F12		1.185	1.200	1.215				
MM4051F13		1.285	1.300	1.315				
MM4051F14		1.385	1.400	1.415				
MM4051F15		1.485	1.500	1.515		-	0.70	0.90
MM4051F16		1.584	1.600	1.616				
MM4051F17		1.683	1.700	1.717				
MM4051F18		1.782	1.800	1.818				
MM4051F19		1.881	1.900	1.919				
MM4051F20		1.980	2.000	2.020	I_{OUT}=1A, 2.0V≦V_{OUT}(Typ.) V_{DD}=V_{OUT}(Typ.)-0.2V	-	0.70	0.90
MM4051F21		2.079	2.100	2.121				
MM4051F22		2.178	2.200	2.222				
MM4051F23		2.277	2.300	2.323				
MM4051F24		2.376	2.400	2.424				
MM4051F25		2.475	2.500	2.525				
MM4051F26		2.574	2.600	2.626				
MM4051F27		2.673	2.700	2.727		-	0.46	0.70
MM4051F28		2.772	2.800	2.828				
MM4051F29		2.871	2.900	2.929				
MM4051F30		2.970	3.000	3.030				
MM4051F31		3.069	3.100	3.131				
MM4051F32		3.168	3.200	3.232				
MM4051F33		3.267	3.300	3.333				
MM4051F34		3.366	3.400	3.434				
MM4051F35		3.465	3.500	3.535				
MM4051F36		3.564	3.600	3.636				
MM4051F37		3.663	3.700	3.737				
MM4051F38		3.762	3.800	3.838				
MM4051F39		3.861	3.900	3.939				
MM4051F40		3.960	4.000	4.040				
MM4051F41		4.059	4.100	4.141				
MM4051F42		4.158	4.200	4.242				
MM4051F43		4.257	4.300	4.343				
MM4051F44		4.356	4.400	4.444				
MM4051F45		4.455	4.500	4.545				
MM4051F46		4.554	4.600	4.646				
MM4051F47		4.653	4.700	4.747				
MM4051F48		4.752	4.800	4.848				
MM4051F49		4.851	4.900	4.949				
MM4051F50		4.950	5.000	5.050				

*Note5:Dropout voltage maximum value in the input and it is confirmed that there is no output abnormal voltage impression the 500mA in the model less than VOUT(typ.)=2.0V.

Test Circuit



Application Circuit



(Reference example of external parts)

- Output capacitor Cout — Ceramic capacitor 1.0μF
- Input capacitor Cin — Ceramic capacitor 1.0μF
- Soft start capacitor Cs — Ceramic capacitor 0.01μF
- Auto retry capacitor Car — Ceramic capacitor 0.01μF
- Err_oc pullup resistance Rpu_oc — 100kΩ

*Note6:Refer to Featsure description for Roc settings.

- 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.

Timing Chart

■ Over current detect ~ Over current protection ~ Auto retry function

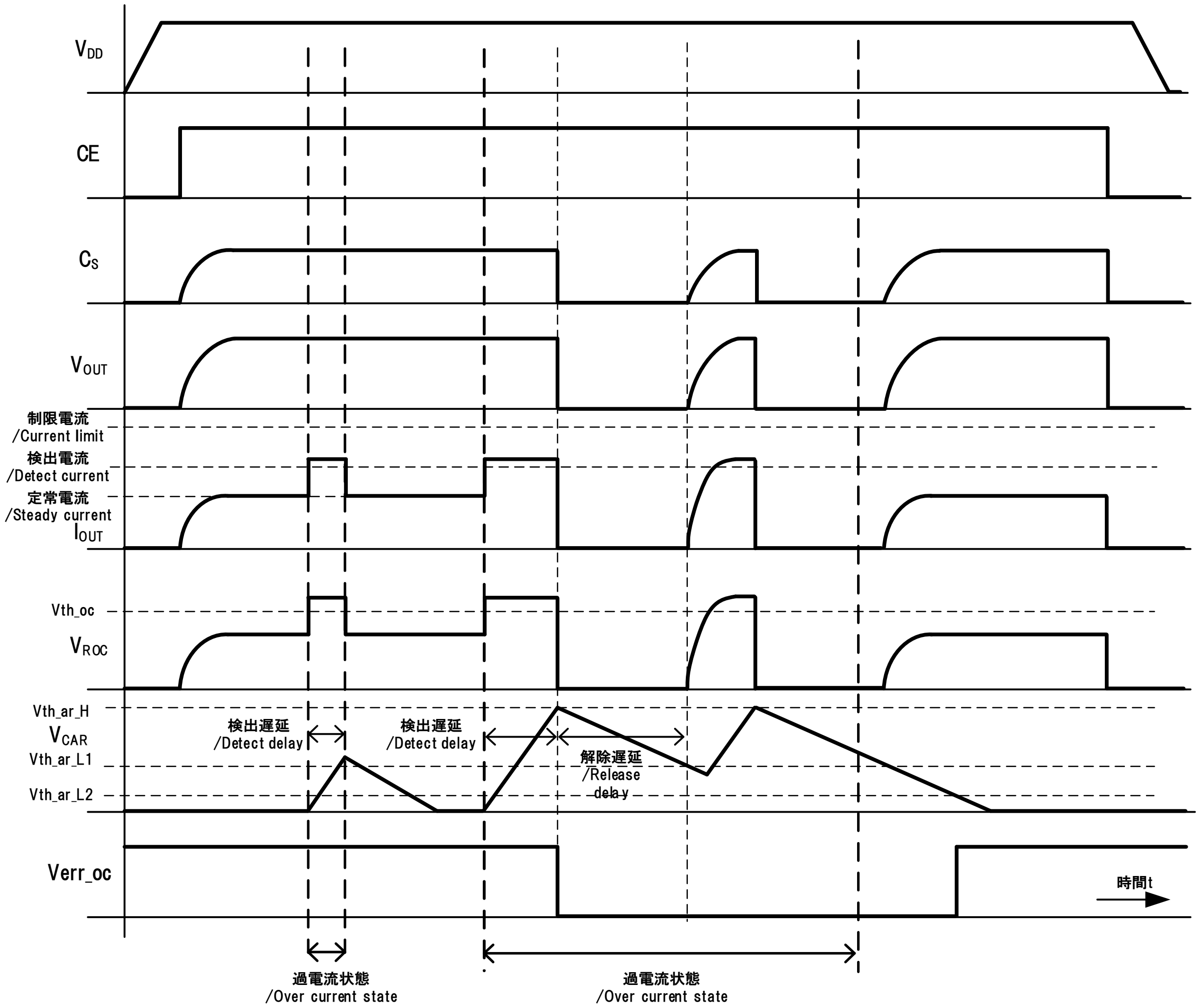


Table 1 shows the function of VOUT and Err_oc by CAR threshold voltage.

Table 1. V_{OUT} and Err_oc function by Vth_ar_H, L1, L2

	V_{OUT}	Err_oc
C_{AR} threshold voltage H/ Vth_ar_H	Enable → Disable	High → Low
C_{AR} threshold voltage L1/ Vth_ar_L1 (at V_{CAR}=H→L)	Disable → Enable	Keep
C_{AR} threshold voltage L2/ Vth_ar_L2 (at V_{CAR}=H→L)	Keep	Low → High

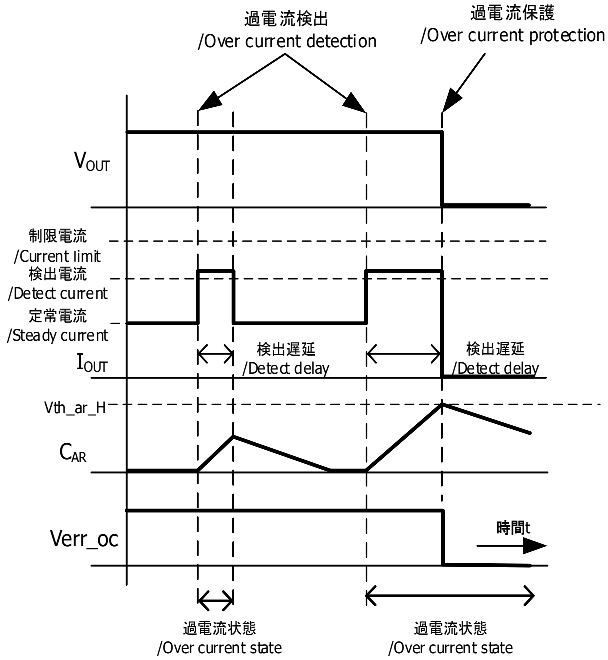
Timing Chart

■ About over current detection

The detection current is set by over current detection resistance Roc.

Over current protection(OCP) turns on after detect delay.

When OCP turns on, VOUT turns off and Verr_oc turns low.



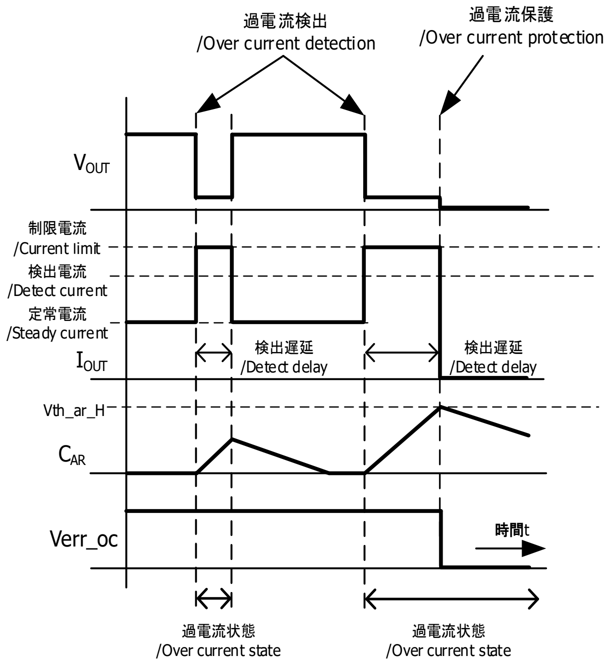
■ In case of VOUT is GND short mode

In case of short mode, output current is clamped by current limit and VOUT drops.

During the detect delay, output current flows to the current limit.

Over current protection(OCP) turns on after detect delay.

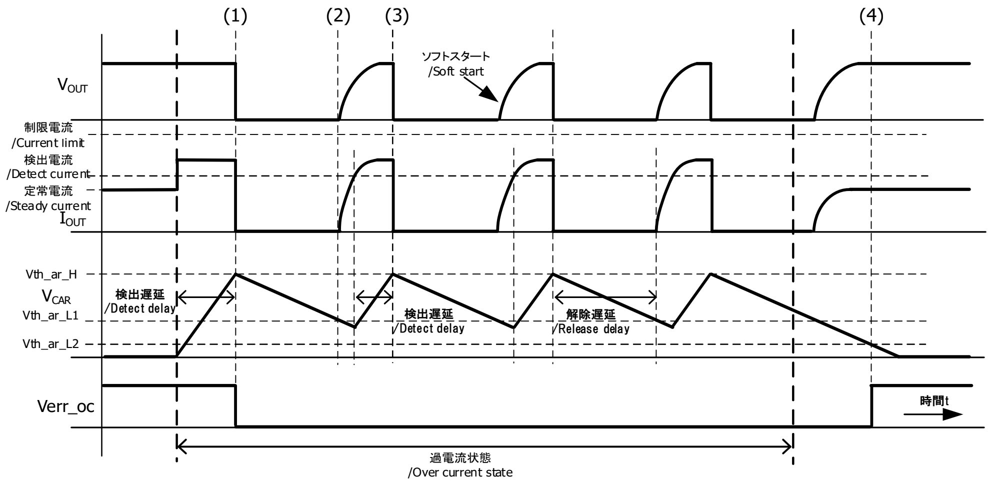
When OCP turns on, VOUT turns off and Verr_oc turns low.



Timing Chart

- About auto retry function

  Auto retry function suppresses power consumption at abnormal occurs.
  This function reduces the heat generated by power consumption.
  (1) When OCP turns on, VOUT turns off and IOUT is zero （VCAR＞Vth_ar_H).
  (2) VOUT is auto recover after release delay (VCAR<Vth_ar_L1).
  (3) When an over current state continues at the recover of the voltage, VOUT is off again.
  Repeat movement from (1) to (3) until over current state is removed.
  While over current protection works, Verr_oc is fixed to low.
  (4) Verr_oc returns to high from low when VCAR higher than Vth_oc.



Feature Description

1. Each terminal output when detecting it abnormally, will be the following table1.

Table 1 Each terminal output

Pin	Normal	Abnormal state	
		Short	TSD
LDO output	Enabled	Disable	Disable
Err_oc	High	Low	Low

2. The setting of the over current detection resistance can calculate in formula (1).

Roc=Vth_oc÷Ioc ・・・(1)

Roc : Over current detect resistance
Vth_oc : R_{OC} threshold voltage
I_{OC} : R_{OC} pin current

Refer to table 2 for Vth_oc.

Table 2 Specification of Vth_oc

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
R_{OC} threshold voltage	Vth_oc	V_{DD}=6V	1.10	1.20	1.30	V

Refer to figure 1 for I_{OC}.

Condition:VDD=6V, VOUT=3.3V, Ta=25℃

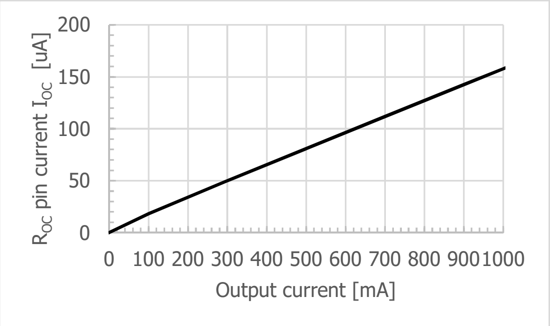


figure 1 Output current vs R_{OC} pin current

Example>
In case of setting overcurrent detection at 500mA.
Vth_oc = 1.2V(typ.) from table 2.
I_{OC} = 80μA at I_{OUT}=500mA from fig-1.

R_{OC}=15kΩ by formula (1).
Roc=Vth_oc÷Ioc
=1.2V÷80uA
=15kΩ

Note

1. There is a 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 it 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.

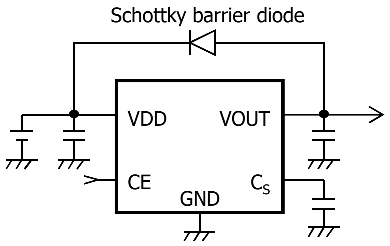
5. The ESR of capacitor must be defined in ESR stability area. It is possible to use a ceramic capacitor without ESR resistance for output capacitor.

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 1.0μF, because the value changes by the environment used.

7. The wire of VDD 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 VDD pin.

9. 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.



10. Please connect the soft-start capacitor(Cs) more than 0.001μF with the Cs pin.

11. Please set Cout and Cs that the peak of rush current is not over a recommended range of IOUT.

12. When rush current exceeds current limit characteristics, it is restricted with the current limit set up with the IC, an output rise time is uncontrollable by soft-start capacitor.

13. When VDD rise time is longer than Vout soft start time, the output voltage may happen than the setting voltage without a soft start function working normally. Please set to soft-start capacitor for the VDD rise time in the slash area shown in Fig1. Please choose to a capacitor in consideration of the dispersion . Refer to Fig2 for a measurement circuit.

Note

Condition : VDD=VOUT(typ.)+1V、CE=VDD, Ta=-40℃～85℃

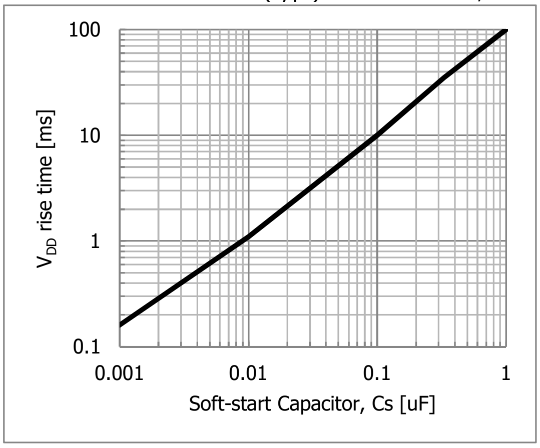
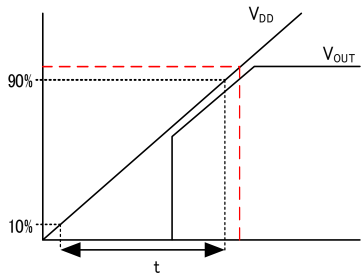


図1 Soft-start capacitor vs VDD rise time



* V_{DD} rise time (t) of V_{DD} is judged in time (10%-90%) until V_{DD} reaches V_{OUT} setting voltage.

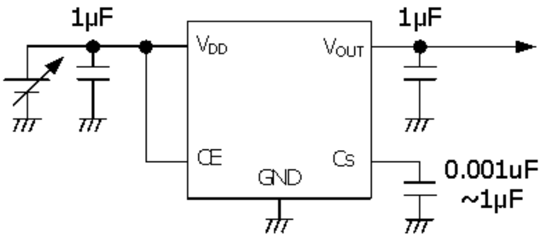


図2 Test circuit

14. When it starts in the state that the voltage remains on the Cs pin, normally cannot start. VOUT may be overshoot.

15. Please do not give the voltage to the Cs pin. When the voltage is applied to the Cs pin, a leak current flows in VOUT pin.

16. Please connect the auto-retry capacitor(Car) with the CAR pin.

17. Please connect the over current detection resistance with the ROC pin.

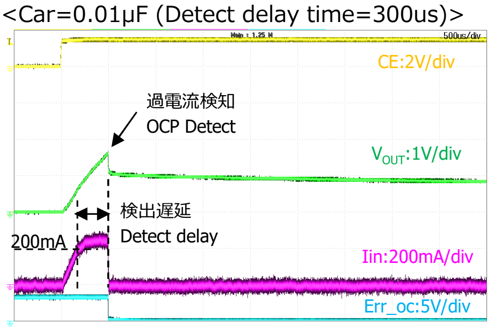
18. Please do not give the voltage to the ROC pin and CAR pin. When the voltage is applied to the ROC pin or CAR pin, VOUT may not be output normally.

19. A rush current starting LDO occurs. When the over current protection is turned on by a rush current, reduce a rush current to the value that over current protection does not turn on by increase soft start capacitor. Increase detect delay time by increasing auto-retry capacitor(Car), OCP function caused by rush current can be masked. However, increasing detect delay time also increases the release delay time of over current protection. Please refer to 13-6.CAR pin characteristics for the relationship between Car and detect/release delay time.

Note

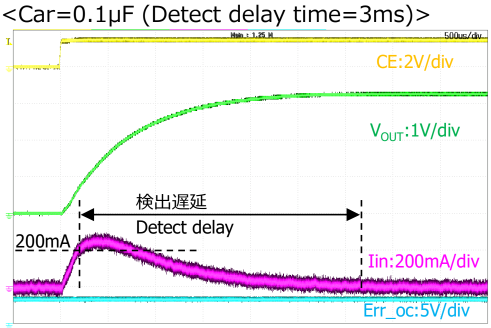
Condition : VDD=6V, CE=0V→1.2V, Ta=25℃, RL=330Ω, Cout=100uF, ROC=37.5kΩ(OCP=200mA)

<Car=0.01μF (Detect delay time=300us)>



Car setting is NG

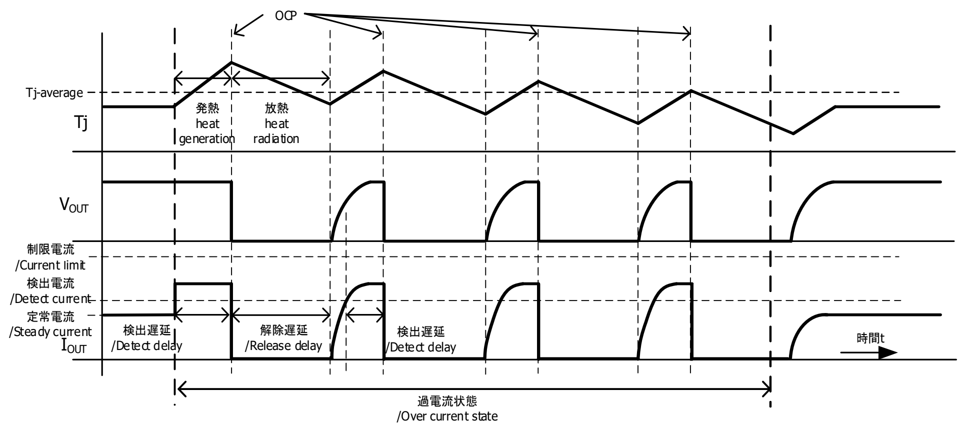
<Car=0.1μF (Detect delay time=3ms)>



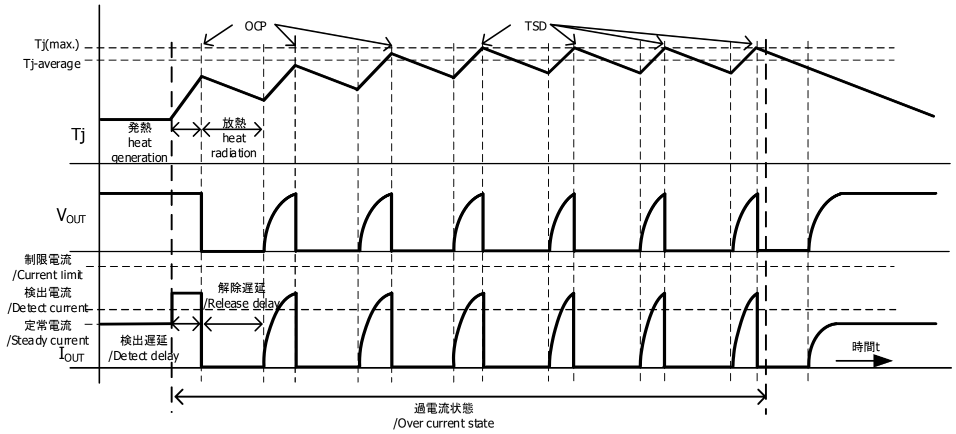
Car setting is OK

20. When the release delay time to set with Car is short, VOUT restart interval becomes shorter.
    In the case, the thermal reduction effect caused by auto retry function may not be effective enough.

・Case of the release delay time is long, Tj average is low.



・Case of the release delay time is short, Tj average is high.

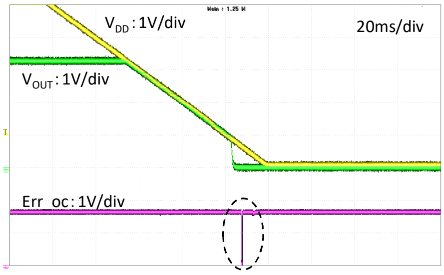


21. It is possible to increase output voltage
    if the condition is low output current(under 1mA) and high temperature.
    The provision is to add load(over 1mA).

Note

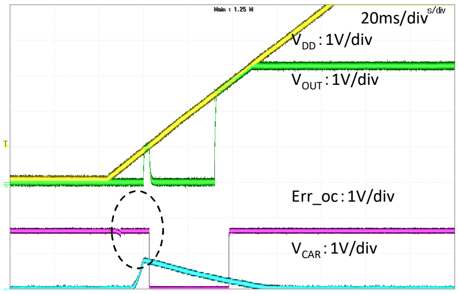
22. When VDD stopping by the condition, Err_oc flag reacts.
    This is influence of start up sequence of the inner circuit. It isn't an abnormal reaction.
    If this is problem, please set that it will not be detected by microcomputer.

    Condition : VDD=6V→0V(S.R.=0.1V/ms), CE=VDD, RL=330Ω, Ta=25℃



23. The slew rate of VDD is slower than 0.1V/ms , auto retry circuit may turns over on the condition with less than 1.5V of VDD. When auto retry circuit turns over, Vcar rises, VOUT and Err_oc are off.
    In this case start slew rate of VDD earlier than 0.1V/ms.

    Condition : VDD=0V→6V(S.R.=0.1V/ms), CE=VDD, RL=330Ω, Ta=85℃



24. 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.

25. It returns automatically in temperature returned after it thermal shut 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 power consumption, temperature) if it operates in upper cycle.

26. The output voltage may not start up with thermal shut down detect mode when VDD turn on/turn off.

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

28. This IC don't include to be protected for Battery short to VOUT.
    Please use in maximum voltage.

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

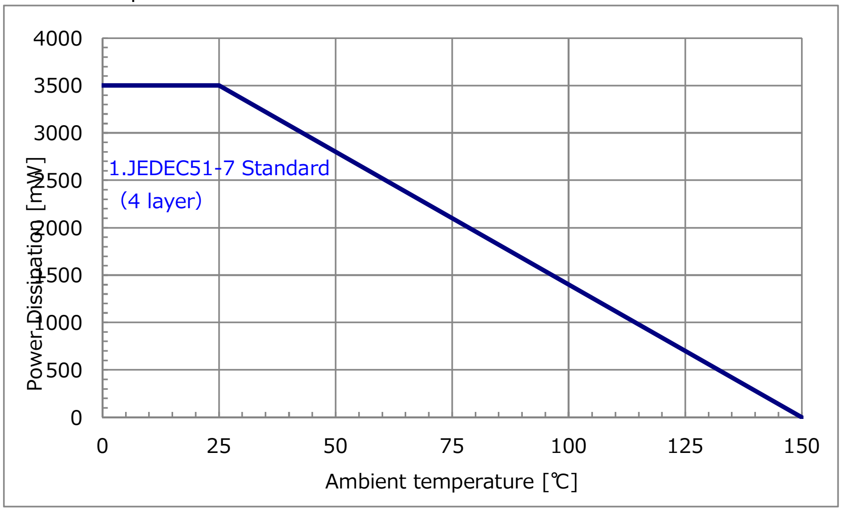
About Power dissipation

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.

- HSOP-8E

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

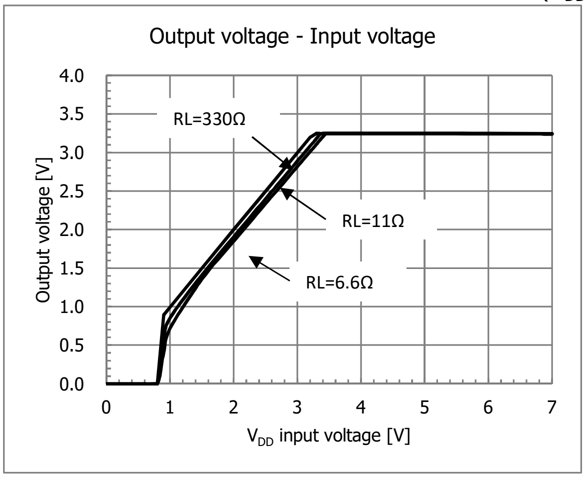
Board size	114.3mm×76.2mm t=1.6mm Copper foil area 80%
Power dissipation	3500mW Ta=25℃

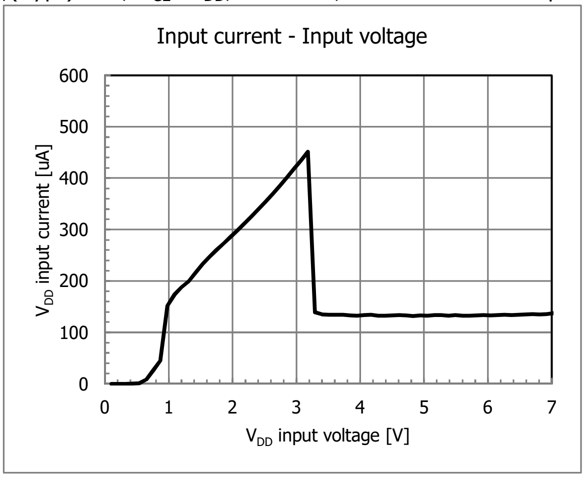


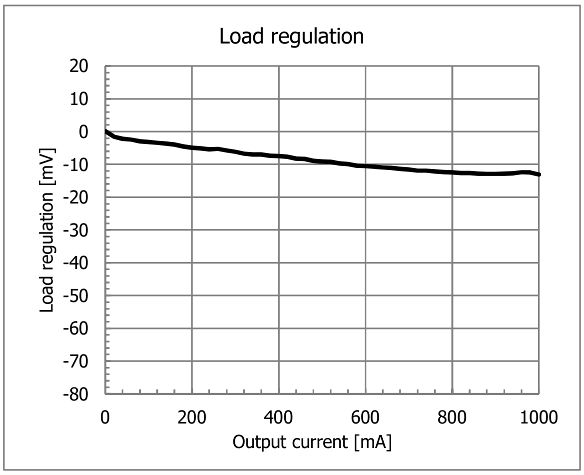
It is recommended to layout the VIA for heat radiation in the GND pattern of reverse (of IC) when there is the GND pattern in the inner layer (in using multiplayer substrate).
By increasing these copper foil pattern area of PCB, Power dissipation improves.

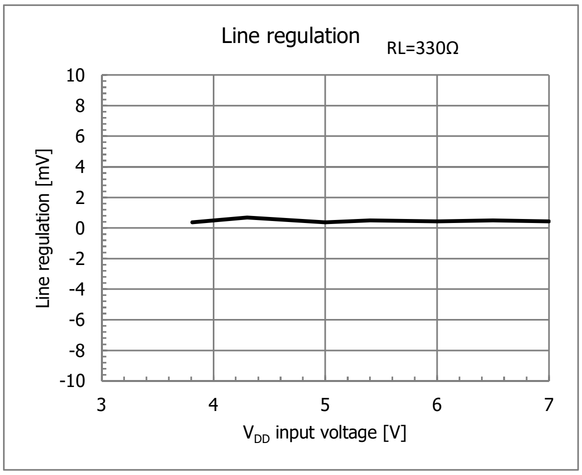
Typical Performance Characteristics (V_{OUT}=3.3V)

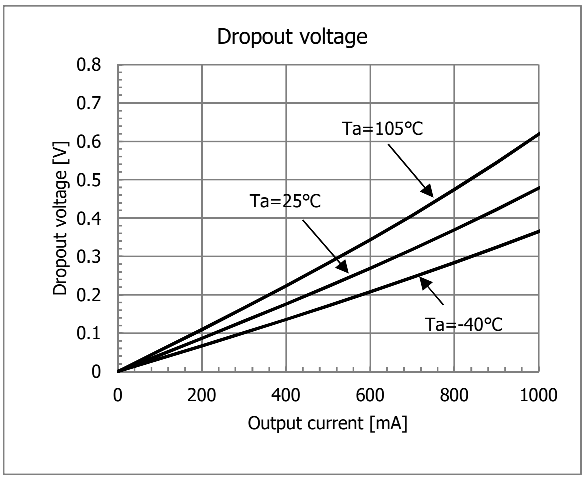
(V_{DD}=V_{OUT}(Typ.)+1V, V_{CE}=V_{DD}, Ta=25℃, unless otherwise specified)

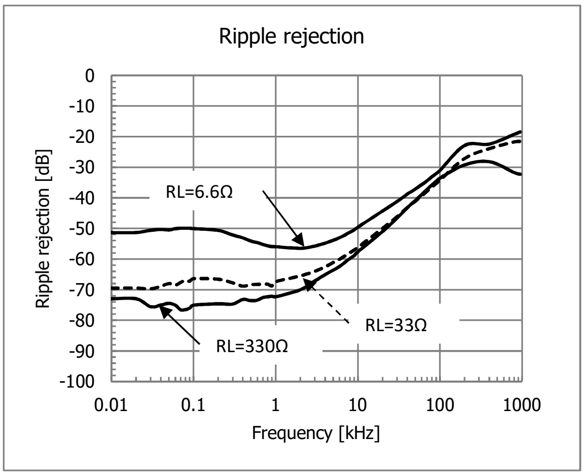






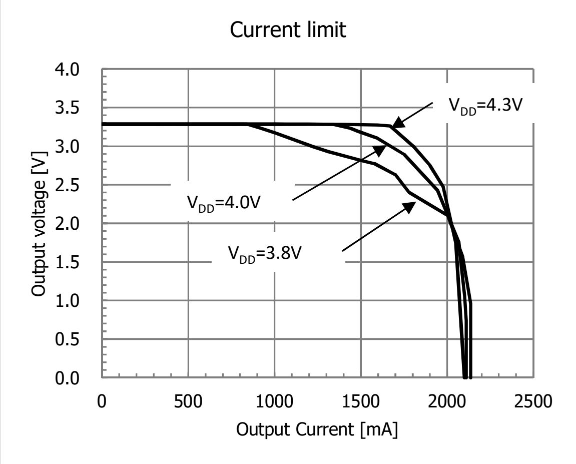


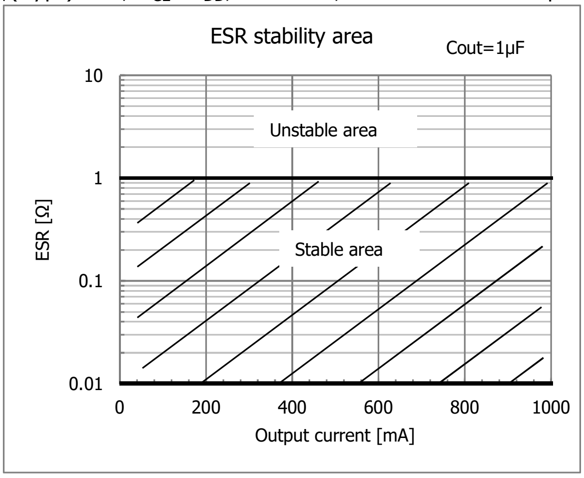


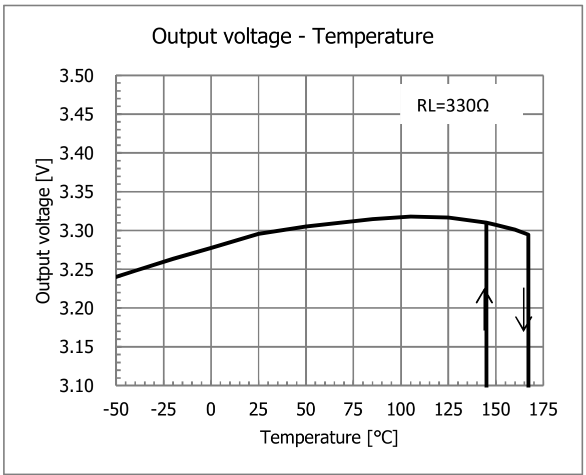


Typical Performance Characteristics (V_{OUT}=3.3V)

(V_{DD}=V_{OUT}(Typ.)+1V, V_{CE}=V_{DD}, Ta=25℃, unless otherwise specified)

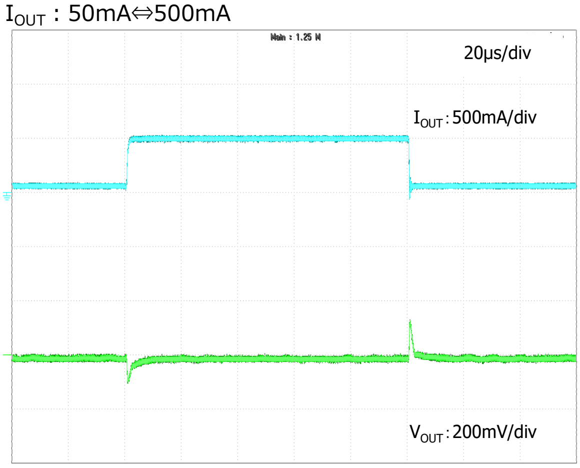




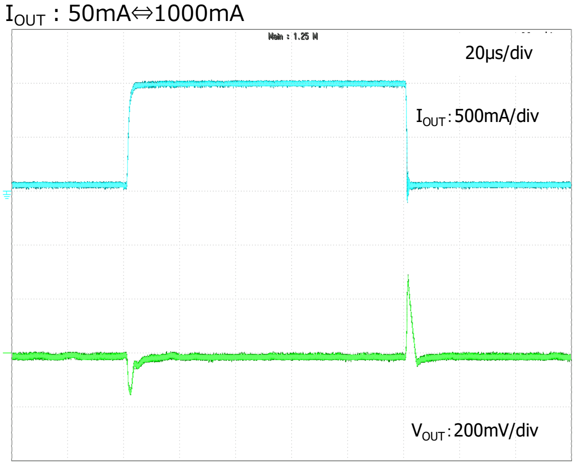


■ Load transient response (Cin=Cout=1μF)

I_{OUT} : 50mA⇔500mA



I_{OUT} : 50mA⇔1000mA

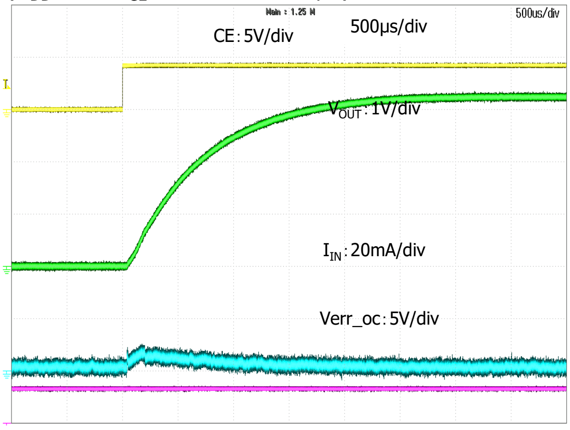


Typical Performance Characteristics (V_{OUT}=3.3V)

(V_{DD}=V_{OUT}(Typ.)+1V, V_{CE}=V_{DD}, Ta=25℃, unless otherwise specified)

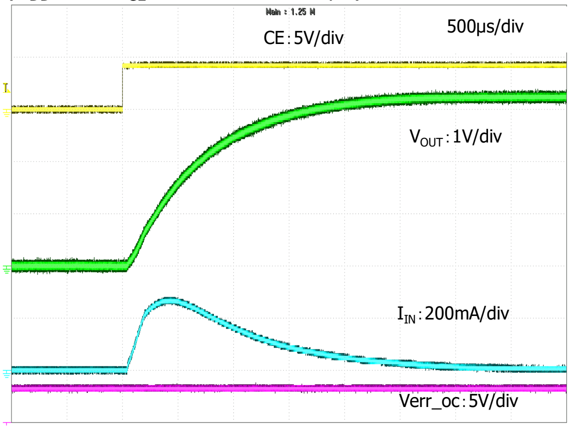
■ CE rise characteristics1

(V_{DD}=2V, V_{CE}=0V→2V, Co=1μF)



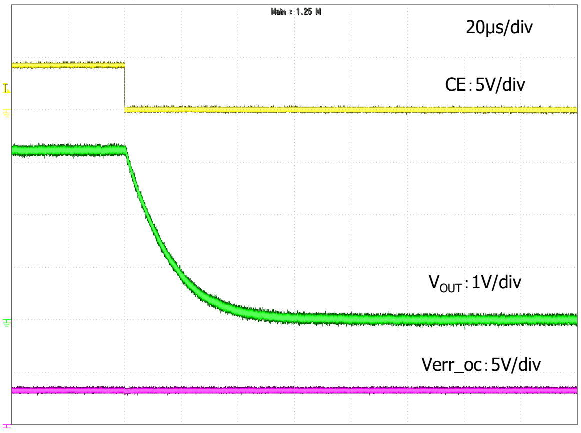
■ CE rise characteristics2

(V_{DD}=2V, V_{CE}=0V→2V, Co=10μF)



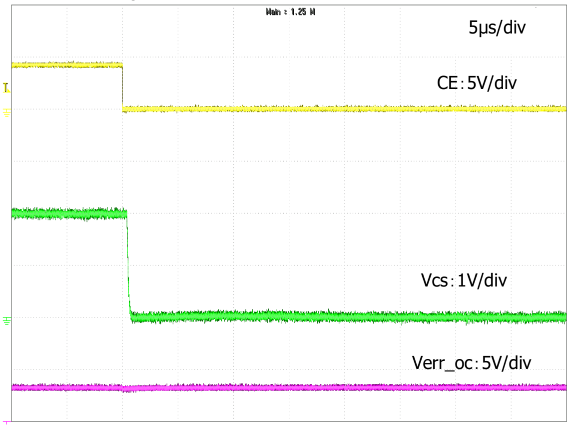
■ V_{OUT} discharge characteristics

(V_{DD}=2V, V_{CE}=2V→0V, Co=1μF)



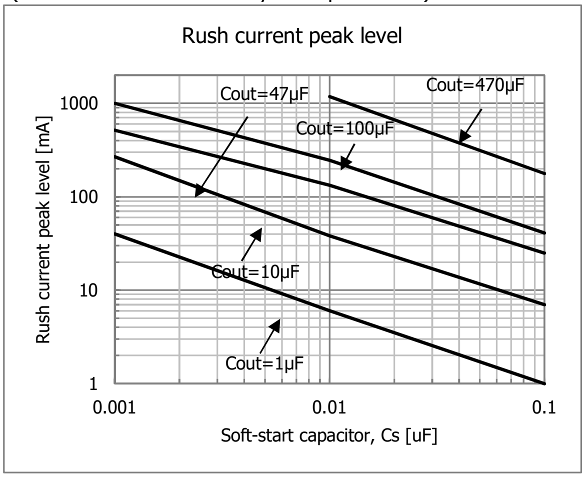
■ Vcs discharge characteristics

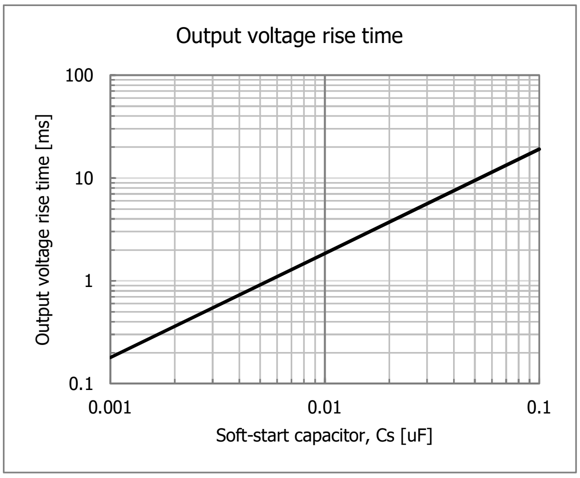
(V_{DD}=2V, V_{CE}=2V→0V, Cs=0.01μF)



■ Rush Current characteristics

(Co: aluminum electrolytic capacitor *)

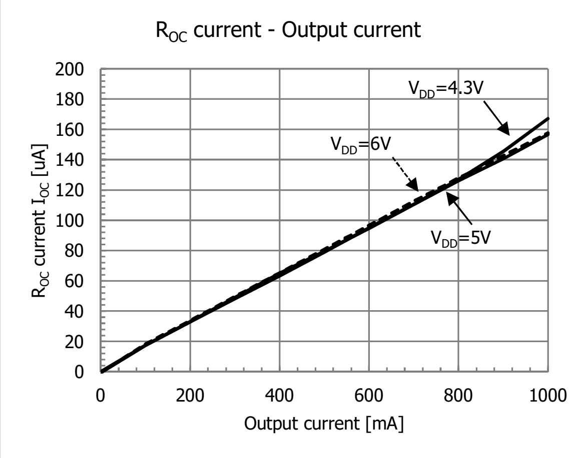


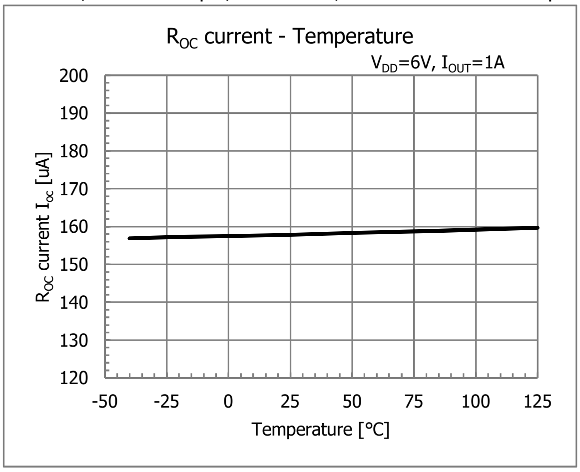


* When use the aluminum electrolytic capacitor, connect seramic capacitor to parallel in consideration of ESR.

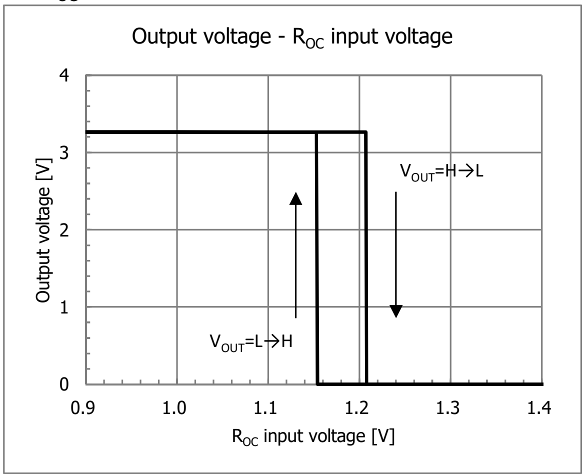
Typical Performance Characteristics (Over current detection)

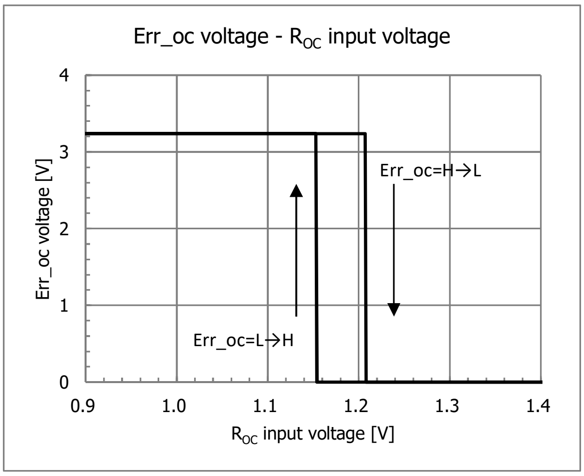
(V_{DD}=6V, V_{CE}=V_{DD}, Roc=1kΩ, Car=0.01μF, Ta=25℃, unless otherwise specified)

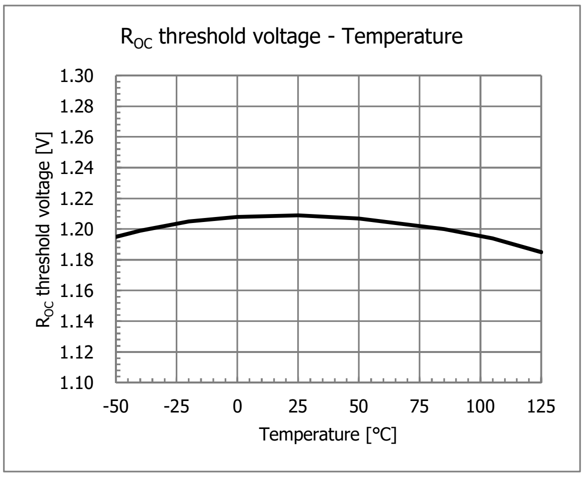




■ R_{OC}スレッショルド電圧

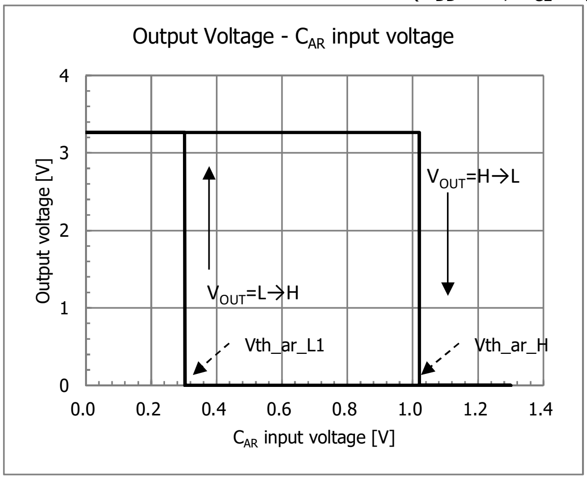


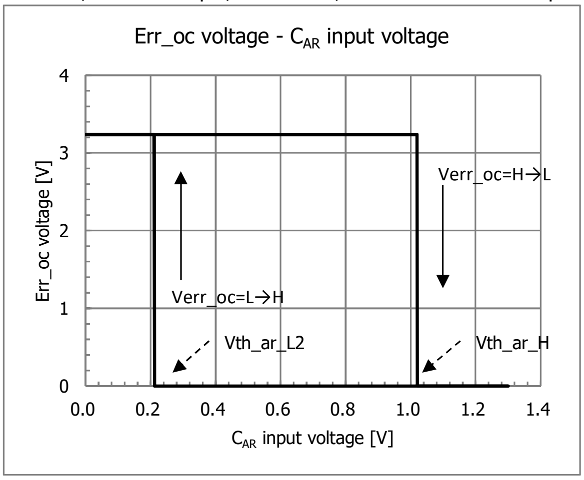


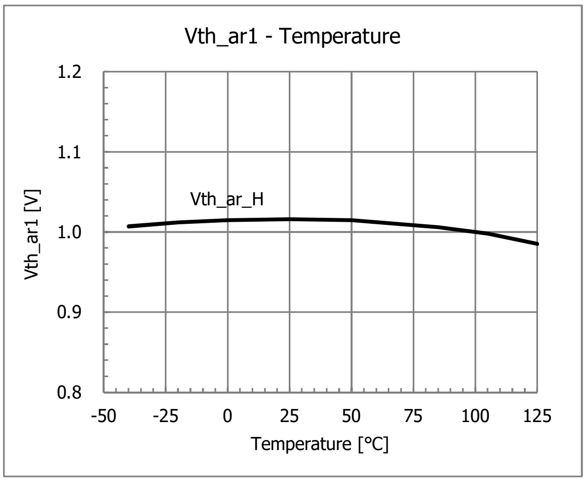


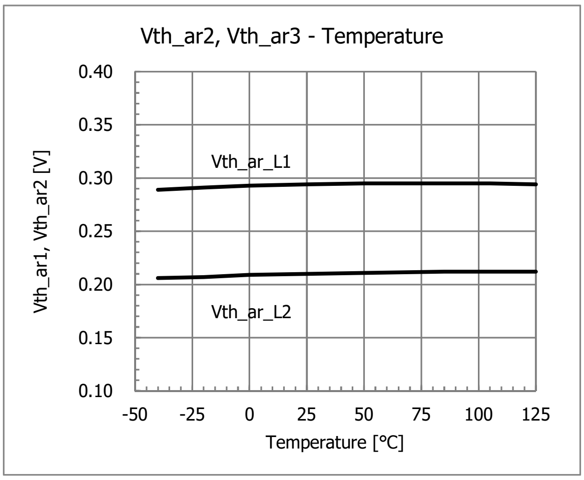
Typical Performance Characteristics (C_{AR} pin characteristics)

(V_{DD}=6V, V_{CE}=V_{DD}, Roc=1kΩ, Car=0.01μF, Ta=25℃, unless otherwise specified)



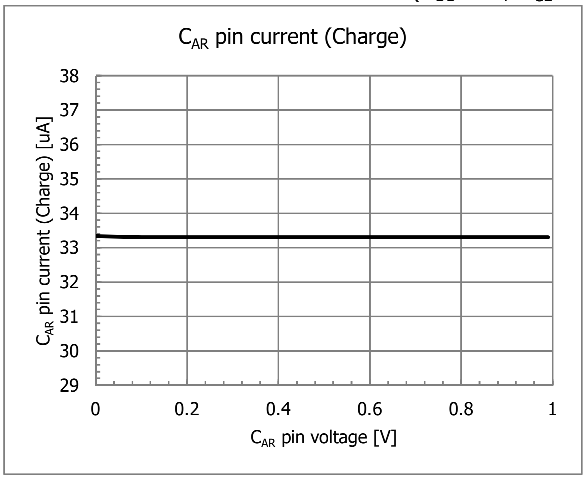


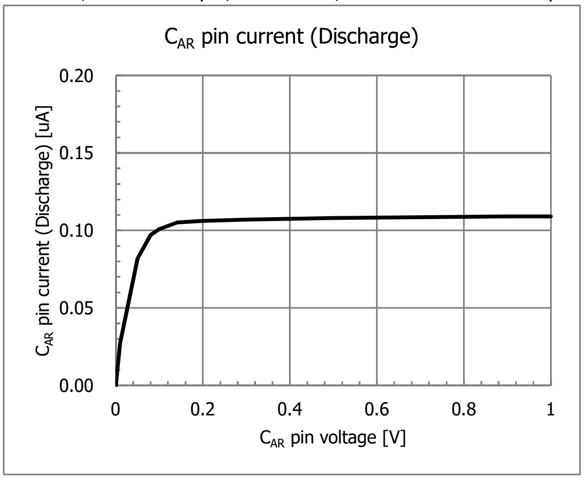


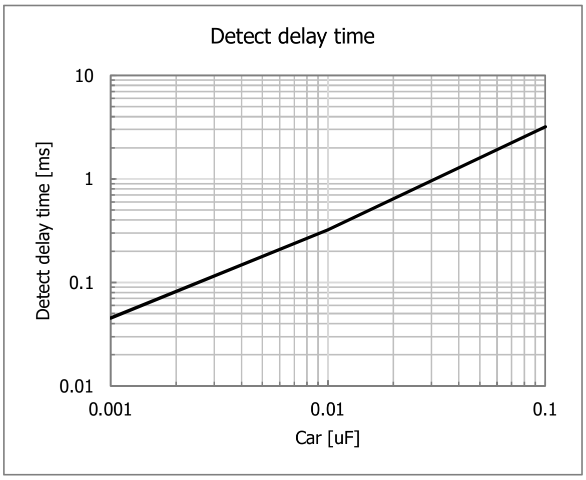


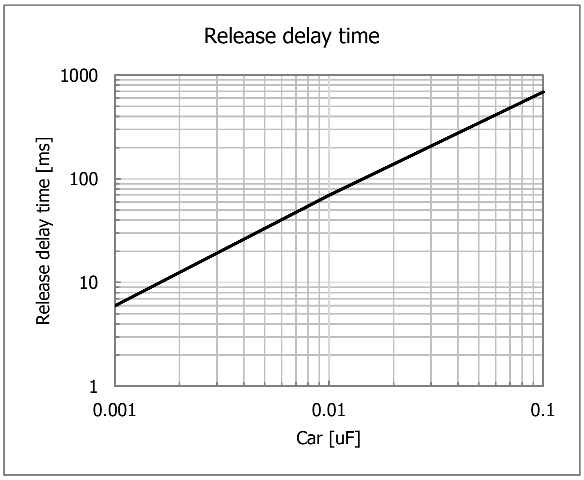
Typical Performance Characteristics (C_{AR} pin characteristics)

(V_{DD}=6V, V_{CE}=V_{DD}, Roc=1kΩ, Car=0.01μF, Ta=25℃, unless otherwise specified)









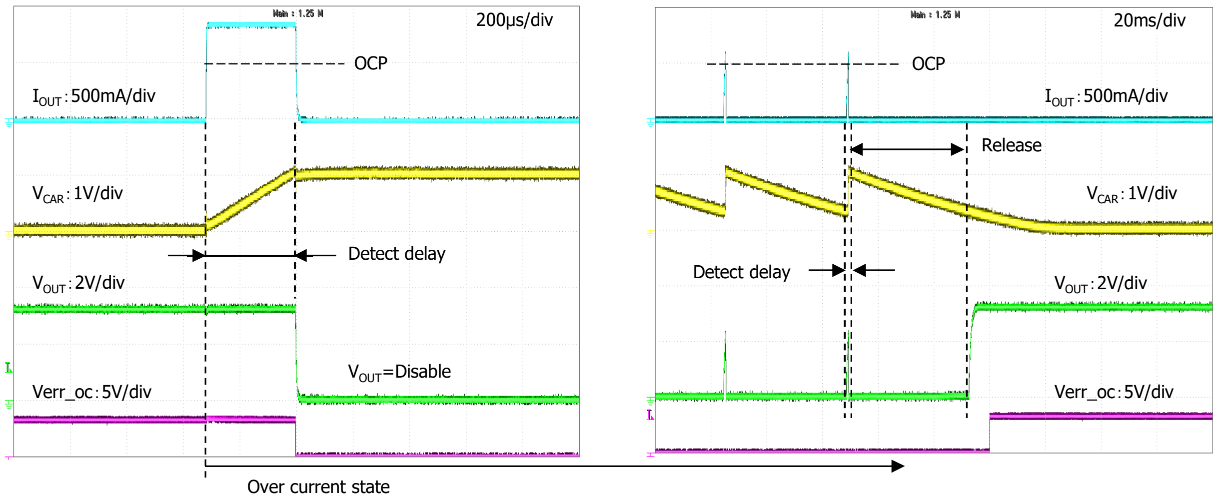
Typical Performance Characteristics (OCP Auto-retry function)

(V_{DD}=6V, V_{CE}=V_{DD}, Roc=1kΩ, Car=0.01μF, Ta=25℃, unless otherwise specified)

- Load transient response

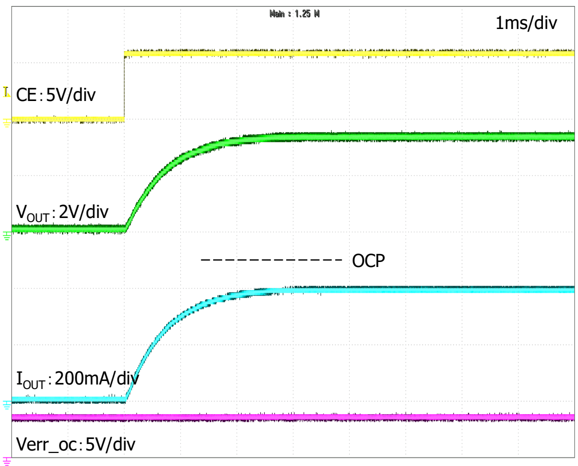
OCP detect
OCP=500mA at Roc=15kΩ,
I_{OUT}=0mA→800mA (RL=OPEN→4.1Ω),
Err_oc=Pull up to 3.3V with 100kΩ

OCP release
OCP=500mA at Roc=15kΩ,
I_{OUT}=800mA→0mA (RL=4.1Ω→OPEN),
Err_oc=Pull up to 3.3V with 100kΩ

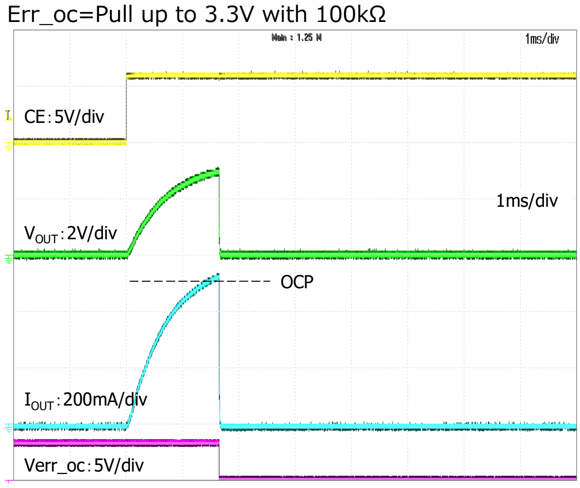


- Turn on transient response

Normal current state
OCP=500mA at Roc=15kΩ,
I_{OUT}=400mA (RL=8.2Ω),
Err_oc=Pull up to 3.3V with 100kΩ



Over current state
OCP=500mA at Roc=15kΩ,
I_{OUT}=600mA (RL=5.5Ω),
Err_oc=Pull up to 3.3V with 100kΩ



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