1ch 300mA Load Switch IC

MM4009

Overview

This IC is load switch IC with built-in overcurrent protection function suitable for HDMI requirements (5V, 300mA) and other applications. Supports load currents up to 300mA, and when the output current to the load exceeds threshold, it switches to constant current operation and limits the output current to protect the load or input device from abnormal conditions. It also has a built-in soft start function to suppress inrush current and prevent voltage drop, and built-in function to prevent reverse current when the output voltage exceeds the input voltage, making it possible to protect the input device. Certified to the safety standard IEC62368-1, it is ideal for protecting power system circuits in a variety of

Features

- Over current protection
- reverse current / voltage blocking function
- Soft start function
- Low on resistance 70mΩ (Typ.)
- Certified to the safety standard IEC62368-1

Main specifications

- VIN Rating Voltage : 6V
- Recommended VIN Range : 2.7～5.5V
- Max Output Current : 300mA
- Current Limit Detection : 0.45A (Typ.) ±7% (Ta=25℃)
- Current Limit Response time : 10μs (Typ.)
- Output short Detection : 0.35A (Typ.) ±7% (Ta=25℃)
- Turn On Time : 0.7ms (Typ.)
- Reverse Current Protection : Threshold 0.35A (Typ.), Deglitch Time 4ms
- Reverse Current Protection : Threshold VOUT-VIN＞60mV(typ.), Response Time 40μs
- Built-in Abnormal Flag : OCP/Reverese Current or Voltage Block/Thermal Shut Down
- Thermal Shut Down : 140℃
- Recommended Temp.Range : -40～85℃
- Package : SOT-26F
- Dimensions : 2.8mm×2.9mm×1.45mm（W×D×H）

Packages

- SOT-26F

Application

- HDMI and other applications required circuit protection to limit current

Mitsumi Electric CO.,LTD.
Semiconductor Business Division
Strategy Engineering Department
tel:+81-46-230-3470

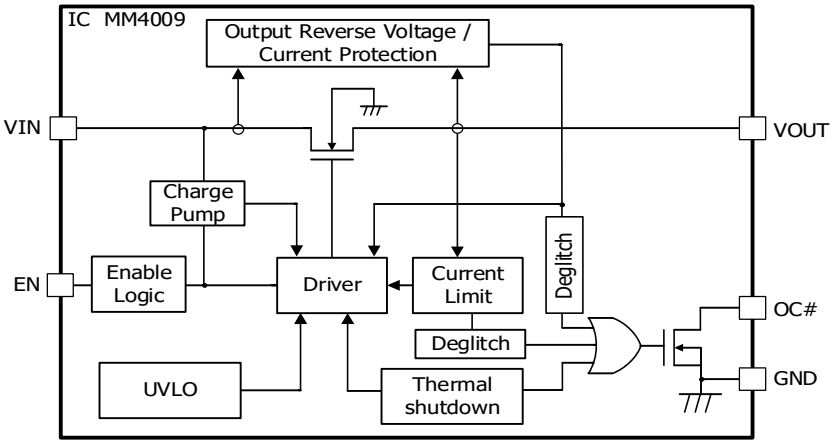
Model Name

M M 4 0 0 9 A N R E

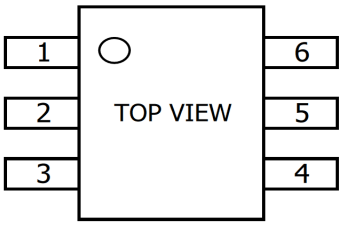
Series name (A) (B) (C) (D)

(A)	Function Type	A	Original Type
(B)	Package	N	SOT-26F
(C)	Packing Specifications	R	R HOUSING
(D)	Tape Material	E	EMBOSS TAPE

Block Diagram



Pin Configuration



Pin No.	Pin name	I/O	Function
1	VIN	In	Supply Input terminal
2	GND	-	Ground terminal
3	EN	In	Enable input terminal
4	OC#	Out	Open-drain fault terminal
5	NC	–	No connection
6	VOUT	Out	Output Voltage terminal

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit
VIN terminal voltage	VIN_max	-0.3	6.0	V
EN,OC#,VOUT terminal voltage	Vxx_max	-0.3	6.0	V
Junction Temperature	Tj_{MAX}	-	150	℃
Storage temperature	Tstg	-55	150	℃
Power Dissipation *1	Pd	-	0.49	W

*1:Board size:15×15mm,t=0.8mm, Wire rate: single side 30%

Recommended Operating Conditions

Parameter	Symbol	Min.	Max.	Unit
Operating Ambient temperature	Topr	-40	85	℃
VIN Operating voltage	Vop	2.7	5.5	V

Electrical Characteristics

(Ta=25℃, VIN = 5V, VEN = 5 V unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
General CHARACTERISTICS						
Input Supply Voltage	VIN		2.7	-	5.5	V
Input Quiescent Current	IIN_ON	IOUT=0A, VEN=5V	-	-	100	μA
Input Shutdown Current	IIN_OFF	VEN=0V	-	0.1	1.0	μA
Switch On Resistance	RON	IOUT=1A, Ta=25°C	-	70	120	mΩ
		IOUT=1A, Ta=-40 to 85°C *2	-	-	180	mΩ
Enable Input Logic High Threshold	VEN_H	EN rising	1.8	-	-	V
Enable Input Logic Low Threshold	VEN_L	EN falling	-	-	0.8	V
Enable Input Bias Current	IEN_BIAS	VEN=1.8V	-	0.3	1.0	μA
Under-voltage Protection						
Under-voltage Lockout Threshold	VUVLO_R	VIN rising	2.20	2.35	2.50	V
Under-voltage Lockout Hysteresis	VUVLO_HYS	VIN falling	-	0.1	-	V
Over-Current Protection						
Short Circuit Output Current	ISC	VOUT connected to GND, device enabled into short-circuit	0.315	0.35	0.375	A
		VOUT connected to GND, device enabled into short-circuit Ta=-5~80°C *2	0.305	0.35	0.385	A

Electrical Characteristics

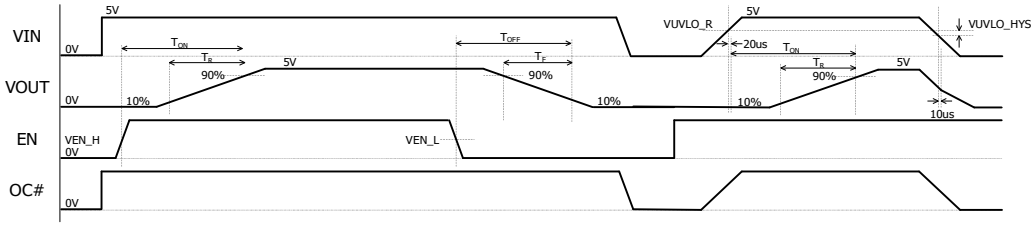
(Ta=25℃, VIN = 5V, VEN = 5 V unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Current Limit Threshold	IOC	current ramp <100A/s on VOUT, Ta=25°C	0.418	0.45	0.482	A
		current ramp <100A/s on VOUT, Ta=-5~80°C *2	0.405	0.45	0.495	A
Fault Flag (OC#)						
OC# Output Low Voltage	VOL	IOC#=5mA	-	-	0.4	V
OC# Off State Current	IOL	VOC# = 5.5V	-	-	1	uA
OC# Deglitch time	TOC	OC# assertion and deassertion delay	5	9	13	ms
Output Reverse Voltage Protection						
Output Reverse Voltage Trigger Point *2	VT_RV	VOUT-VIN, VOUT rising	10	60	120	mV
Output Reverse Voltage Release Trigger Point *2	VR_RV	VIN - VOUT, VOUT falling	5	40	110	mV
VOUT Shutdown Current	ISD_OUT	VOUT = 5.5V, VIN Short to GND	-	-	5	μA
Output Reverse Current Protection						
Output Reverse Current Threshold	IRCL		0.15	0.35	0.50	A
Output Reverse Current Deglitch Time	TDEG		-	4	-	ms
Thermal Shutdown						
Thermal Shutdown Threshold	TSD	Temperature rising	-	140	-	°C
Thermal Shutdown Hysteresis	TSD_HYS	Temperature falling	-	20	-	°C
Start-up Characteristics						
Turn On Time *2	TON	Cout = 1uF, RL = 100 Ω	0.3	0.7	1.2	ms
Turn Off Time *2	TOFF	Cout = 1uF, RL = 100 Ω	0.14	0.24	0.42	ms
Output Rise Time	TR	Cout = 1uF, RL = 100 Ω	0.2	0.5	0.8	ms
Output Fall Time	TF	Cout = 1uF, RL = 100 Ω	-	0.22	0.4	ms

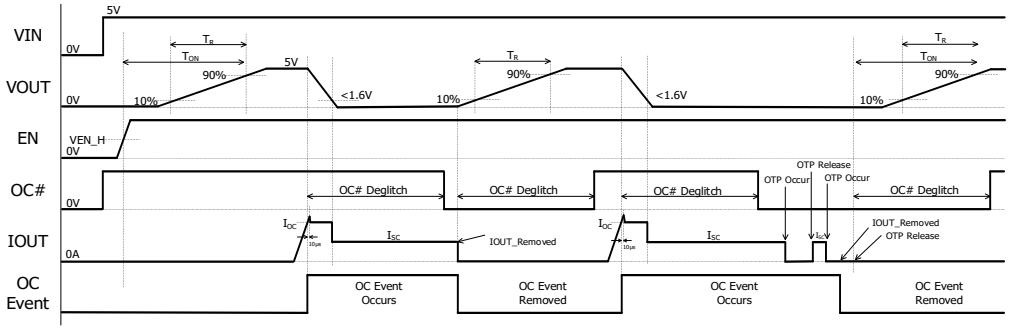
*2 Guaranteed by design, not tested.

Timing Chart

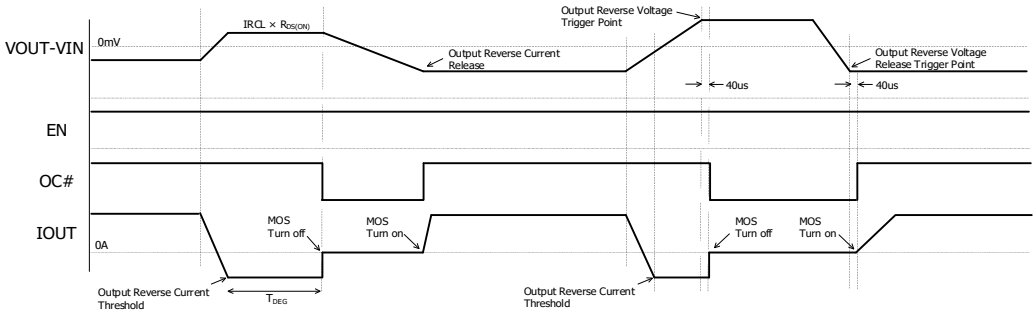
- Start-up / Shut-down / Under-voltage Protection



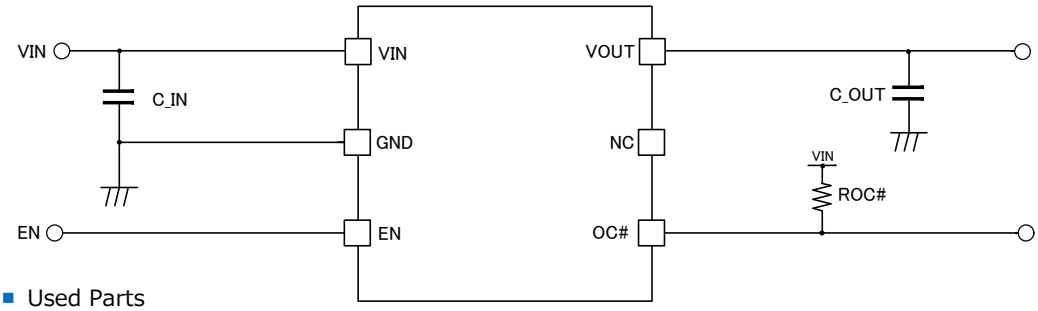
- Over-Current Protection



- Output Reverse Current Protection / Output Reverse Voltage Protection



Application Circuit



- Used Parts

C_IN	1μF
C_OUT	1μF
ROC#	100kΩ

- Application Hints

Place both C_IN and C_OUT bypass capacitors near to the device.

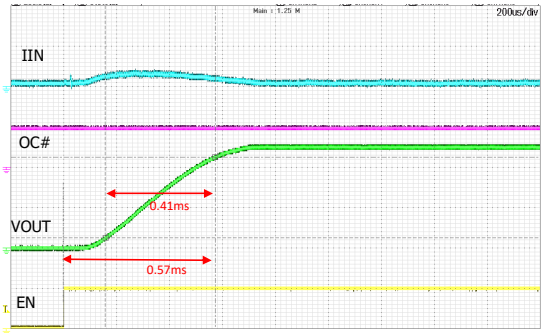
Keep all traces wide, short and direct tominimized the parasitic inductance.

Typical Performance Characteristics

(Ta=25℃, VIN = 5V, VEN = 5 V unless otherwise specified)

■ Start-up （EN=L⇒H, IOUT=0A）

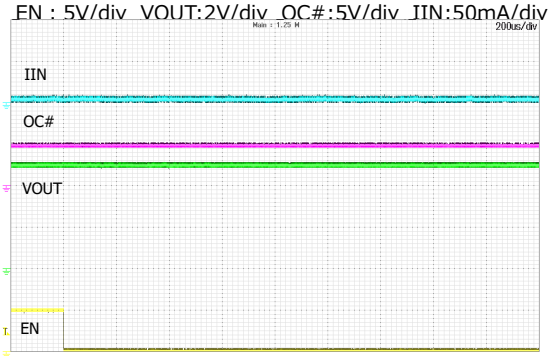
EN : 5V/div VOUT:2V/div OC#:5V/div IIN:50mA/div



200us/div

■ Shutdown （EN=H⇒L, IOUT=0A）

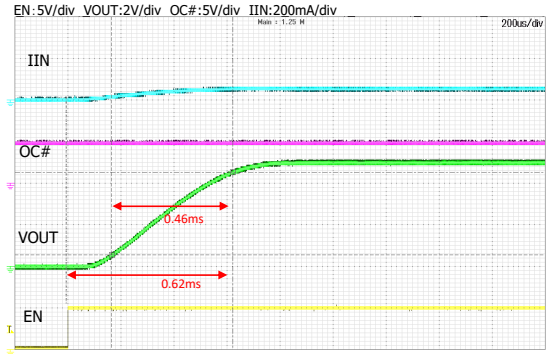
EN : 5V/div VOUT:2V/div OC#:5V/div IIN:50mA/div



200us/div

■ Start-up （EN=L⇒H, RL=100Ω）

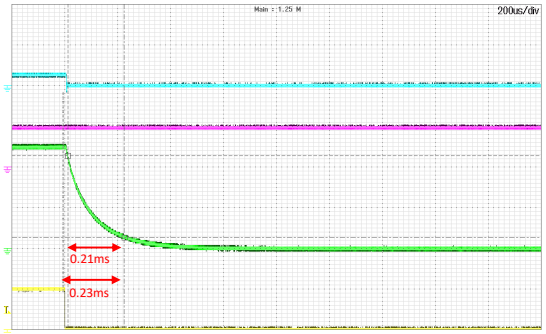
EN:5V/div VOUT:2V/div OC#:5V/div IIN:200mA/div



200us/div

■ Shutdown （EN=H⇒L, RL=100Ω）

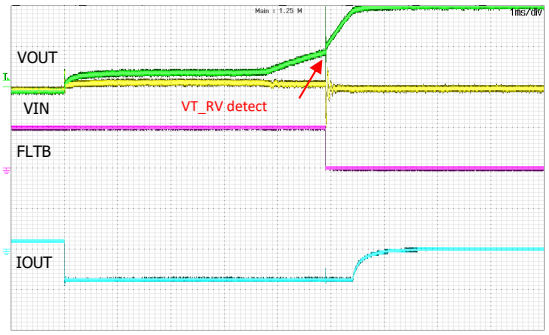
EN:5V/div VOUT:2V/div OC#:5V/div IIN:200mA/div



200us/div

■ Output Reverse Voltage Detection

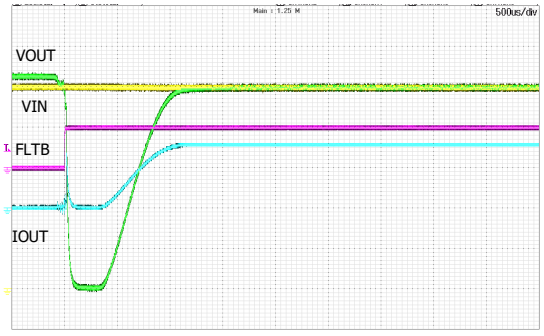
VIN : 100mV/div VOUT:100mV/div OC#:5V/div IOUT:50(



1ms/div

■ Output Reverse Voltage Release

VIN : 100mV/div VOUT:100mV/div OC#:5V/div IOUT:500mA/div



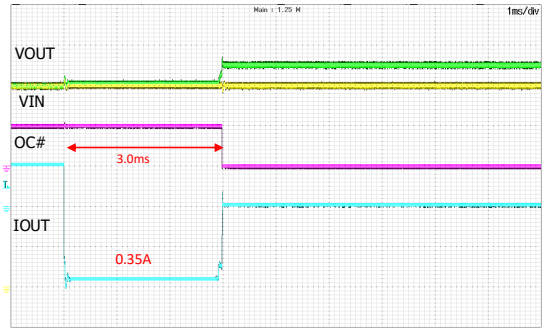
500us/div

Typical Performance Characteristics

(Ta=25℃, VIN = 5V, VEN = 5 V unless otherwise specified)

Output Reverse Current Detection

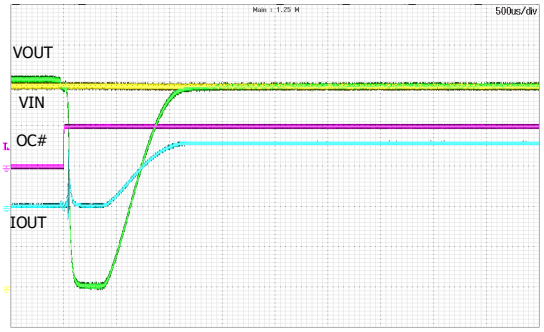
VIN : 1V/div VOUT:1V/div OC#:5V/div IOUT:200mA/div



1ms/div

Output Reverse Current Release

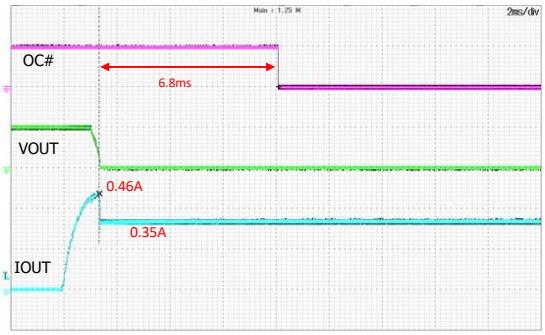
VIN : 1V/div VOUT:1V/div OC#:5V/div IOUT:200mA/div



500us/div

Current Limit Detection

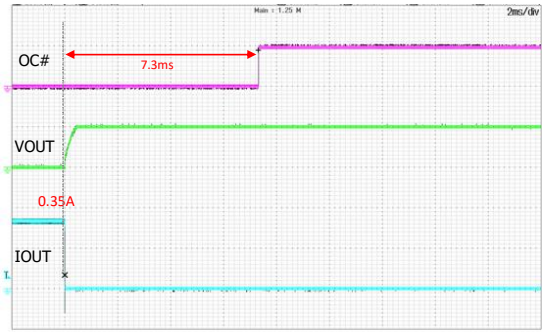
VOUT:2V/div OC#:5V/div IOUT:200mA/div



2ms/div

Current Limit Release

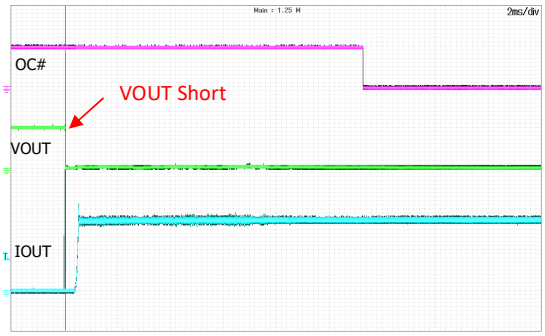
VOUT:2V/div OC#:5V/div IOUT:200mA/div



2ms/div

Hard Short circuit Detection

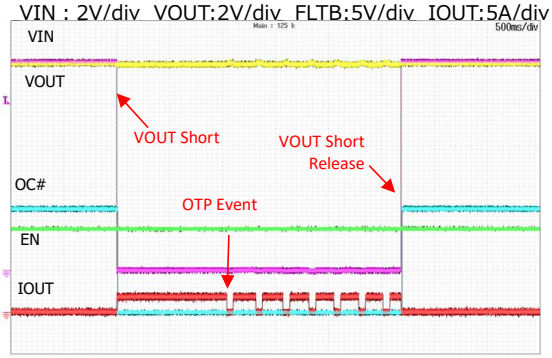
VIN : 2V/div VOUT:2V/div FLTB:5V/div IOUT:5A/div



2ms/div

Hard Short circuit protection

VIN : 2V/div VOUT:2V/div FLTB:5V/div IOUT:5A/div

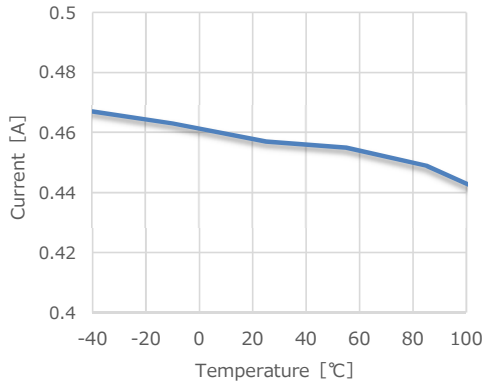


500ms/div

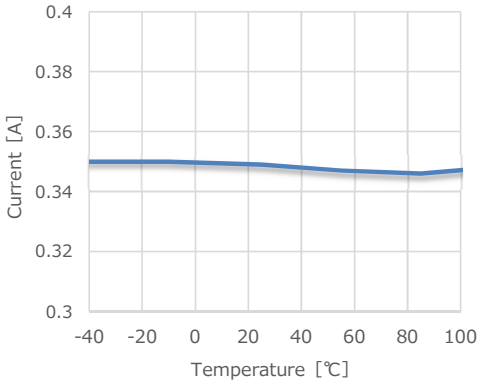
Typical Performance Characteristics

(Ta=25℃, VIN = 5V, VEN = 5 V unless otherwise specified)

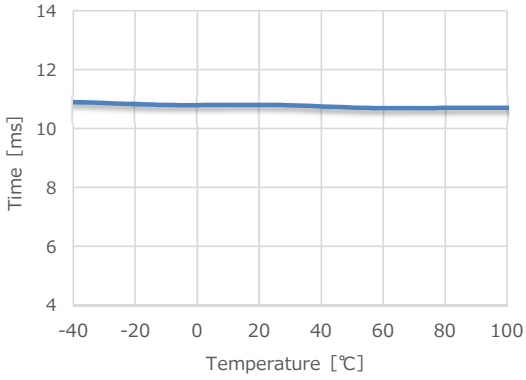
Over Current Trip Threshold



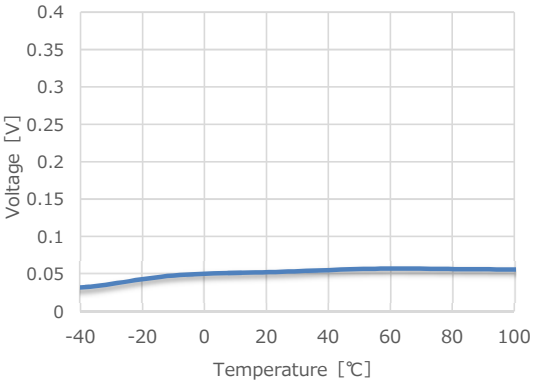
Short Circuit Output Current



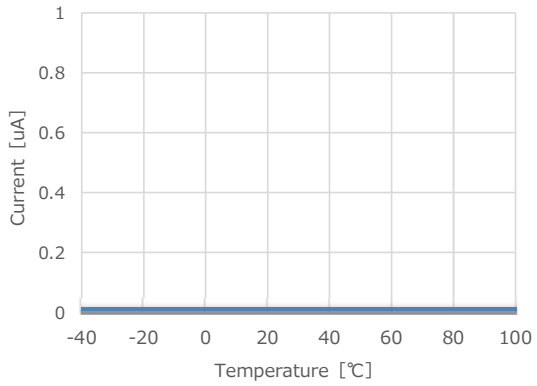
OC#Deglitch time



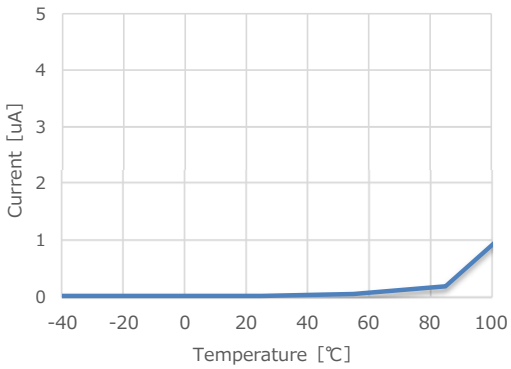
OC# Output Low Voltage



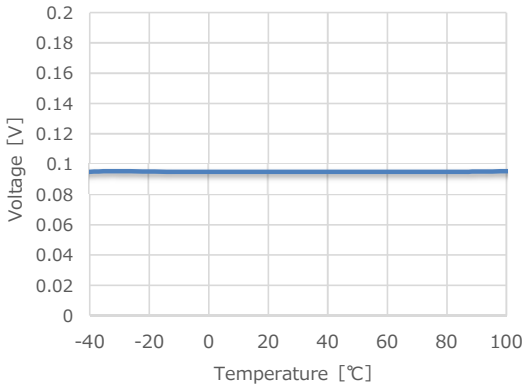
OC# Off State Current



VOUT Shutdown Current



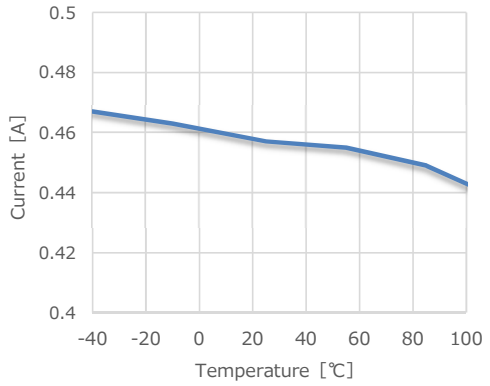
Under-voltage Lockout Hysteresis



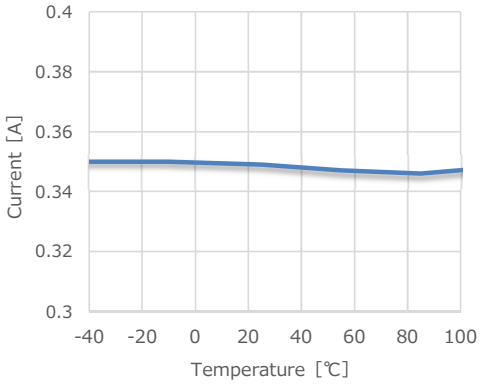
Typical Performance Characteristics

(Ta=25℃, VIN = 5V, VEN = 5 V unless otherwise specified)

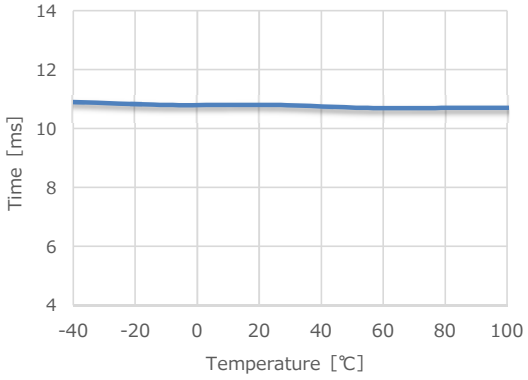
Over Current Trip Threshold



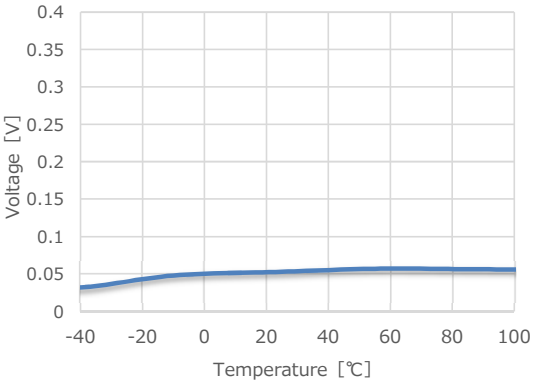
Short Circuit Output Current



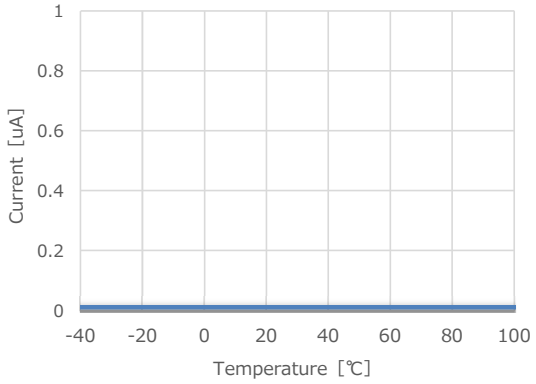
OC#Deglitch time



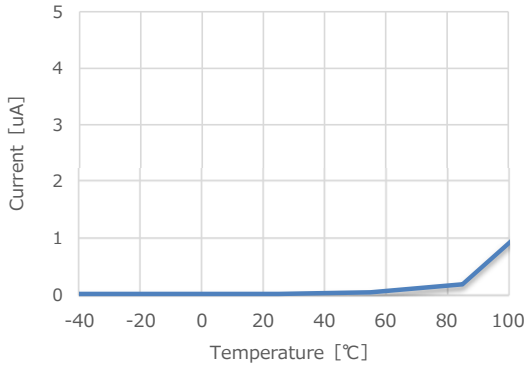
OC# Output Low Voltage



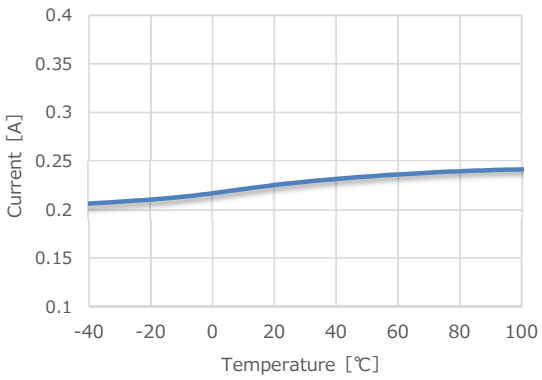
OC# Off State Current



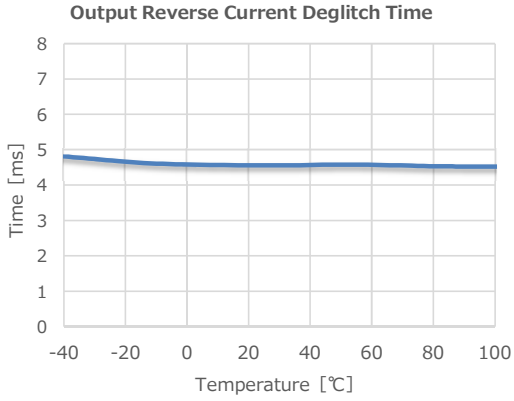
VOUT Shutdown Current



Output Reverse Current Threshold

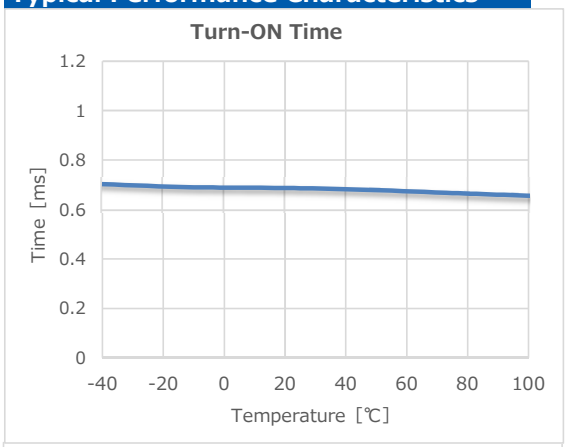


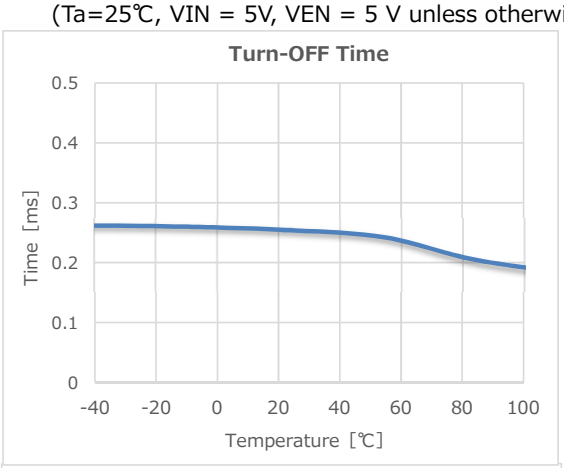
Output Reverse Current Deglitch Time

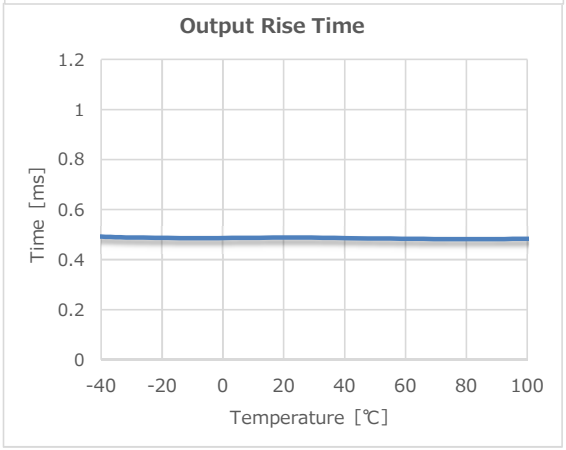


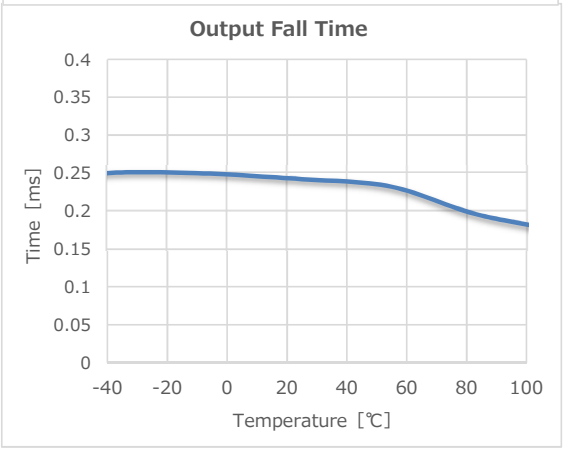
Typical Performance Characteristics

(Ta=25℃, VIN = 5V, VEN = 5 V unless otherwise specified)









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