RICOH

R1150H SERIES

VOLTAGE REGULATOR (with Wide Input Voltage Range) with RESET

NO.EA-081-090324

OUTLINE

The R1150H series are CMOS-based voltage regulator (VR) ICs equipped with a voltage detector (V_{DET}). VR function of the R1150Hxxxx has features of low dropout voltage, high output voltage accuracy, and ultra-low supply current. Each of the R1150HxxxA types includes also a chip enable circuit. The output of built-in voltage detector is Nch open drain type. The R1150HxxxC/D types have a pin for connecting external capacitor to set a certain reset delay time instead of chip enable control pin.

The regulator output voltage and the detector threshold voltage are fixed in the IC, Output Voltage Accuracy is ±2.0%, while Detector Threshold Accuracy is ±2.5%. The R1150HxxxA (with chip enable function) and C series can supervise input voltage by the built-in detector. R1150HxxxB type can supervise SENSE pin voltage by the built-in detector. R1150HxxxD type can supervise V_{OUT} voltage, or Regulator Output Voltage of this IC itself.

Since the package for these ICs is the SOT-89-5 package, high density mounting of the ICs on boards is possible.

FEATURES

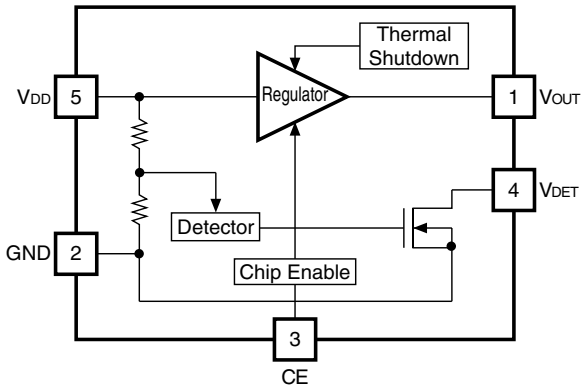
- Supply Current ..... Typ. 7.0μA
- Input Voltage ..... Max. 24.0V
- Output Voltage (VR) ..... 2.1V to 14.0V
- Detector Threshold Voltage (V_{DET}) ..... 2.3V to 15.0V
- Output Voltage Accuracy ..... ±2.0% (VR), ±2.5% (VD)
- Output Current ..... Min. 150mA (V_{OUT}=5.0V)
- Package SOT-89-5
- Built-in Current Limit Circuit, Thermal Shutdown Circuit (VR)
- Monitoring V_{DD} voltage .....A/C type
- Monitoring sense pin (SENSE) voltage .....B type
- Monitoring V_{OUT} pin voltage .....D type

APPLICATIONS

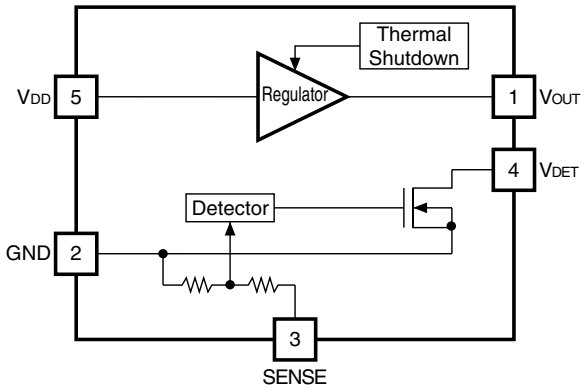
- Power source and Reset circuit for cameras, videos and mobile telecommunication equipment.
- Power source and Reset circuit for battery-operated equipment.
- Power source and Reset circuit for home appliances.

BLOCK DIAGRAMS

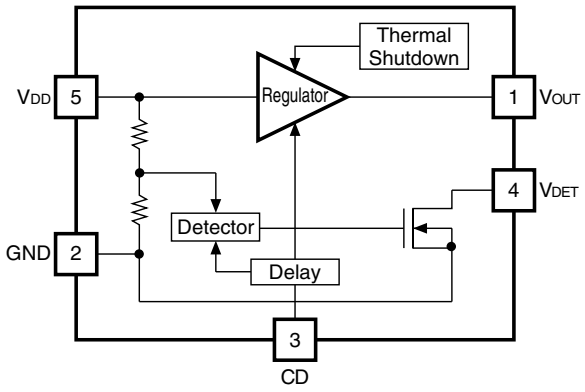
R1150HxxxA



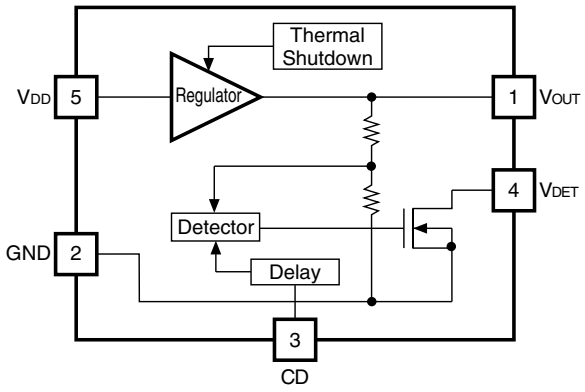
R1150HxxxB



R1150HxxxC



R1150HxxxD



SELECTION GUIDE

The output voltage and the usage of pin No.3 (as a kind of types in the R1150Hxxxx series) can be selected at the user's request. The selection can be made with designating the part number as follows;

R1150HXXXX-XX-X ←Part Number

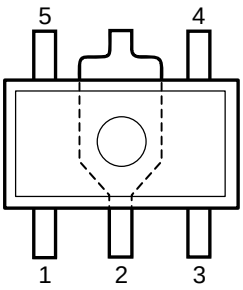
↑ ↑ ↑ ↑ ↑

a b c d e

Code	Contents
a	Designation of package type; H: SOT-89-5
b	Serial Number for Voltage Setting
c	Designation of option; A: Built-in Chip Enable Circuit (V_{DET} supervises V_{IN} level.) B: V_{DET} supervises SENSE pin. C: Used with an external capacitor for setting output delay time of V_{DET}. (V_{DET} supervises V_{IN}.) D: Used with an external capacitor for setting output delay time of V_{DET}. (V_{DET} supervises V_{OUT}.)
d	Designation of Taping Type; (Refer to Taping Specifications)
e	Designation of composition of pin plating: F: Lead free solder plating

PIN CONFIGURATION

● **SOT-89-5**



PIN DESCRIPTION

Pin No.	Symbol	Description
1	V_{OUT}	Voltage Regulator Output Pin
2	GND	Ground Pin
3	CE (A type)	Chip Enable Pin
	SENSE (B type)	Sense Pin for Voltage Detector
	CD (C/D type)	Pin for External Capacitor for Setting Output Delay of Voltage Detector
4	V_{DET}	Voltage Detector Output Pin
5	V_{DD}	Input Pin

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	26.0	V
V_{CE}	Input Voltage (CE Input Pin, A Version)	-0.3 to V_{IN}+0.3	V
V_{SENSE}	Input Voltage (SENSE Input Pin, B Version)	-0.3 to V_{IN}+0.3	V
V_{CD}	Input Voltage (CD Input Pin, C/D Version)	-0.3 to V_{IN}+0.3	V
V_{DET}	Output Voltage (V_{DET} Output Pin)	-0.3 to 26.0	V
V_{OUT}	Output Voltage	-0.3 to V_{IN}+0.3	V
I_{OUT1}	Output Current (VR)	250	mA
I_{OUT2}	Output Current (VD)	10	mA
P_D	Power Dissipation (SOT-89-5)*	900	mW
Topt	Operating Temperature	-40 to 85	°C
Tstg	Storage Temperature	-55 to 125	°C

∗) For Power Dissipation, please refer to PACKAGE INFORMATION to be described.

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause the permanent damages and may degrade the life time and safety for both device and system using the device in the field. The functional operation at or over these absolute maximum ratings is not assured.

ELECTRICAL CHARACTERISTICS

- **R1150HxxxA**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Input Voltage				24.0	V
I_{SS}	Supply Current	$V_{IN}=V_{CE}$ $V_{OUT} \geq (-V_{DET})$: $V_{IN}=V_{OUT}+2.0V$ $V_{OUT}<(-V_{DET})$: $V_{IN}=(-V_{DET})+2.0V$		7	14	μA
$I_{standby}$	Standby Current	V_{DD}=24V, V_{CE}=0V	Refer to Supply Current Table			
T_{TSD}	Thermal Shutdown Temperature	Junction Temperature		150		°C
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature		120		°C

VR

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	$V_{IN}=V_{OUT}+2.0V$, I_{OUT}=20mA	×0.98		×1.02	V
I_{OUT1}	Output Current	$V_{IN}=V_{OUT}+2.0V$	Refer to Output Current Table			
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	$V_{IN}=V_{OUT}+2.0V$ 1mA ≦ I_{OUT} ≦ 40mA	Refer to Load Regulation Table			
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	$V_{IN}=V_{OUT}+2.0V$, I_{OUT}=20 mA $V_{OUT}+1V \leq V_{IN} \leq 24V$		0.05	0.15	%/V
V_{DIF}	Dropout Voltage	I_{OUT}=20mA	Refer to Dropout Voltage Table			
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	$V_{IN}=V_{OUT}+2.0V$, I_{OUT}=20mA -40°C ≦ Topt ≦ 85°C		±100		ppm/°C
I_{lim}	Short Current Limit	V_{OUT}=0V		45		mA
V_{CEH}	CE "H" Input Voltage		1.5		V_{IN}	V
V_{CEL}	CE "L" Input Voltage		0		0.25	V

VD

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
$-V_{DET}$	Detector Threshold		×0.975		×1.025	V
V_{HYS}	Detector Threshold Hysteresis		$-V_{DET}$ ×0.03	$-V_{DET}$ ×0.05	$-V_{DET}$ ×0.07	V
I_{OUT2}	Output Current (Driver Output Pin)	Refer to Test Conditions for Output Current Table	0.17			mA
V_{DDL}	Minimum Operating Voltage	*Note 1		0.9	1.2	V
$\Delta -V_{DET}/\Delta Topt$	Detector Threshold Temperature Coefficient	-40°C ≦ Topt ≦ 85°C		±100		ppm/°C
t_{PLH}	Output Delay Time	*Note 2		0.5	1.0	ms

Note 1) This item means V_{DD} Voltage when Output Voltage is equal or less than 0.1V.
(Pull-up Resistor=470kW, Pull up Voltage=5V)

Note 2) V_{DET} pin is pulled up to V_{DD} via 470kW. t_{PLH} means time interval from rising edge of V_{DD} from $(-V_{DET})$-2.0V to $(-V_{DET})$+2.0V to the point of Output Voltage being 80% of pull-up voltage.

- **Supply Current 2 (OFF state with CE) (Topt=25°C)**

Detector Threshold Voltage $-V_{DET}$ (V)	Supply Current (μA)	
	Typ.	Max.
2.3V ≦ ($-V_{DET}$) ≦ 3.0V	2.5	5.0
3.1V ≦ ($-V_{DET}$) ≦ 15.0V	3.0	6.0

- **Output Current (Topt=25°C)**

Output Voltage V_{OUT} (V)	Output Current (mA)	
	Min.	Typ.
2.1V ≦ V_{OUT} ≦ 2.9V	90	140
3.0V ≦ V_{OUT} ≦ 4.0V	120	170
4.1V ≦ V_{OUT} ≦ 14.0V	150	200

- **Load Regulation (Topt=25°C)**

Output Voltage V_{OUT} (V)	Load Regulation (mV)	
	Typ.	Max.
2.1V ≦ V_{OUT} ≦ 3.0V	15	35
3.1V ≦ V_{OUT} ≦ 5.0V	25	45
5.1V ≦ V_{OUT} ≦ 10.0V	40	65
10.1V ≦ V_{OUT} ≦ 14.0V	50	80

- **Dropout Voltage (Topt=25°C)**

Output Voltage V_{OUT} (V)	Dropout Voltage (V)	
	Typ.	Max.
2.1V ≦ V_{OUT} ≦ 2.4V	0.40	0.60
2.5V ≦ V_{OUT} ≦ 3.0V	0.30	0.40
3.1V ≦ V_{OUT} ≦ 7.0V	0.25	0.35
7.1V ≦ V_{OUT} ≦ 10.0V	0.27	0.45
10.1V ≦ V_{OUT} ≦ 14.0V	0.30	0.50

- **Test Conditions for Output Current**

Detector Threshold Voltage $-V_{DET}$ (V)	Conditions
2.1V ≦ ($-V_{DET}$) ≦ 15.0V	V_{IN}=2V, V_{DS}=0.05V
($-V_{DET}$) = 2.0	V_{IN}=1.9V, V_{DS}=0.05V

RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

- **R1150HxxxB**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Input Voltage				24.0	V
I_{SS}	Supply Current	$V_{OUT} \geq (-V_{DET})$: V_{IN}=SENSE=V_{OUT}+2.0V $V_{OUT} < (-V_{DET})$: V_{IN}=SENSE=$(-V_{DET})$+2.0V		7	14	µA
T_{TSD}	Thermal Shutdown Temperature	Junction Temperature		150		°C
T_{TSR}	Thermal Shutdown Temperature	Junction Temperature		120		°C

VR

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	V_{IN}=V_{OUT}+2.0V I_{OUT}=20mA	×0.98		×1.02	V
I_{OUT1}	Output Current	V_{IN}=V_{OUT}+2.0V	Refer to Output Current Table			
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	V_{IN}=V_{OUT}+2.0V 1mA ≦ I_{OUT} ≦ 40mA	Refer to Load Regulation Table			
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	I_{OUT}=20mA V_{OUT}+1V ≦ V_{IN} ≦ 24V		0.05	0.15	%/V
V_{DIF}	Dropout Voltage	I_{OUT}=20mA	Refer to Dropout Voltage Table			
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	V_{IN}=V_{OUT}+2.0V I_{OUT}=20mA -40°C ≦ Topt ≦ 85°C		±100		ppm/°C
Ilim	Short Current Limit	V_{OUT}=0V		45		mA

VD

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
$-V_{DET}$	Detector Threshold		×0.975		×1.025	V
V_{HYS}	Detector Threshold Hysteresis		$-V_{DET}$ ×0.03	$-V_{DET}$ ×0.05	$-V_{DET}$ ×0.07	V
I_{OUT2}	Output Current (Driver Output Pin)	Refer to Test Conditions for Output Current Table	0.17			mA
V_{DDL}	Minimum Operating Voltage	*Note 1		0.9	1.2	V
$\Delta-V_{DET}/\Delta Topt$	Detector Threshold Temperature Coefficient	-40°C ≦ Topt ≦ 85°C		±100		ppm/°C
t_{PLH}	Output Delay Time	*Note 2		1.0	1.5	ms

Note 1) This item means V_{DD} Voltage when Output Voltage is equal or less than 0.1V. (Pull-up Resistor=470kW, Pull up Voltage=5V)

Note 2) V_{DET} pin is pulled up to V_{DD} via 470kW. t_{PLH} means time interval from rising edge of V_{DD} from $(-V_{DET})$-2.0V to $(-V_{DET})$+2.0V to the point of Output Voltage being 80% of pull-up voltage.

- **Output Current (Topt=25°C)**

Output Voltage V_{OUT} (V)	Output Current (mA)	
	Min.	Typ.
2.1V ≦ V_{OUT} ≦ 2.9V	90	140
3.0V ≦ V_{OUT} ≦ 4.0V	120	170
4.1V ≦ V_{OUT} ≦ 14.0V	150	200

- **Load Regulation (Topt=25°C)**

Output Voltage V_{OUT} (V)	Load Regulation (mV)	
	Typ.	Max.
2.1V ≦ V_{OUT} ≦ 3.0V	15	35
3.1V ≦ V_{OUT} ≦ 5.0V	25	45
5.1V ≦ V_{OUT} ≦ 10.0V	40	65
10.1V ≦ V_{OUT} ≦ 14.0V	50	80

- **Dropout Voltage (Topt=25°C)**

Output Voltage V_{OUT} (V)	Dropout Voltage (V)	
	Typ.	Max.
2.1V ≦ V_{OUT} ≦ 2.4V	0.40	0.60
2.5V ≦ V_{OUT} ≦ 3.0V	0.30	0.40
3.1V ≦ V_{OUT} ≦ 7.0V	0.25	0.35
7.1V ≦ V_{OUT} ≦ 10.0V	0.27	0.45
10.1V ≦ V_{OUT} ≦ 14.0V	0.30	0.50

- **Test Conditions for Output Current**

Detector Threshold Voltage $-V_{DET}$ (V)	Conditions
2.1V ≦ ($-V_{DET}$) ≦ 15.0V	V_{IN}=2V, V_{DS}=0.05V
($-V_{DET}$) = 2.0	V_{IN}=1.9V, V_{DS}=0.05V

RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

- **R1150HxxxC**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Input Voltage				24.0	V
I_{SS}	Supply Current	$V_{OUT} \geq (-V_{DET})$:$V_{IN}=V_{OUT}+2.0V$ $V_{OUT} < (-V_{DET})$:$V_{IN}=(-V_{DET})+2.0V$		7	14	µA
T_{TSD}	Thermal Shutdown Temperature	Junction Temperature		150		°C
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature		120		°C

VR

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	$V_{IN}=V_{OUT}+2.0V$ $I_{OUT}=20mA$	×0.98		×1.02	V
I_{OUT1}	Output Current	$V_{IN}=V_{OUT}+2.0V$	Refer to Output Current Table			
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	$V_{IN}=V_{OUT}+2.0V$ $1mA \leqq I_{OUT} \leqq 40mA$	Refer to Load Regulation Table			
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	$I_{OUT}=20mA$ $V_{OUT}+1V \leqq V_{IN} \leqq 24V$		0.05	0.15	%/V
V_{DIF}	Dropout Voltage	$I_{OUT}=20mA$	Refer to Dropout Voltage Table			
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	$V_{IN}=V_{OUT}+2.0V$ $I_{OUT}=20mA$ $-40°C \leqq Topt \leqq 85°C$		±100		ppm/°C
Ilim	Short Current Limit	$V_{OUT}=0V$		45		mA

VD

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
$-V_{DET}$	Detector Threshold		×0.975		×1.025	V
V_{HYS}	Detector Threshold Hysteresis		$-V_{DET}$ ×0.03	$-V_{DET}$ ×0.05	$-V_{DET}$ ×0.07	V
I_{OUT2}	Output Current (Driver Output Pin)	Refer to Test Conditions for Output Current Table	0.17			mA
V_{DDL}	Minimum Operating Voltage	*Note 1		0.9	1.2	V
$\Delta -V_{DET}/\Delta Topt$	Detector Threshold Temperature Coefficient	$-40°C \leqq Topt \leqq 85°C$		±100		ppm/°C
t_{PLH}	Output Delay Time	C_D=4.7nF, *Note 2	20	30	50	ms

Note 1) This item means V_{DD} Voltage when Output Voltage is equal or less than 0.1V.
(Pull-up Resistor=470kW, Pull up Voltage=5V)

Note 2) V_{DET} pin is pulled up to V_{DD} via 470kW. t_{PLH} means time interval from rising edge of V_{DD} from $(-V_{DET})$-2.0V to $(-V_{DET})$+2.0V to the point of Output Voltage being 80% of pull-up voltage.

- **Output Current (Topt=25°C)**

Output Voltage V_{OUT} (V)	Output Current (mA)	
	Min.	Typ.
2.1V ≦ V_{OUT} ≦ 2.9V	90	140
3.0V ≦ V_{OUT} ≦ 4.0V	120	170
4.1V ≦ V_{OUT} ≦ 14.0V	150	200

- **Load Regulation (Topt=25°C)**

Output Voltage V_{OUT} (V)	Load Regulation (mV)	
	Typ.	Max.
2.1V ≦ V_{OUT} ≦ 3.0V	15	35
3.1V ≦ V_{OUT} ≦ 5.0V	25	45
5.1V ≦ V_{OUT} ≦ 10.0V	40	65
10.1V ≦ V_{OUT} ≦ 14.0V	50	80

- **Dropout Voltage (Topt=25°C)**

Output Voltage V_{OUT} (V)	Dropout Voltage (V)	
	Typ.	Max.
2.1V ≦ V_{OUT} ≦ 2.4V	0.40	0.60
2.5V ≦ V_{OUT} ≦ 3.0V	0.30	0.40
3.1V ≦ V_{OUT} ≦ 7.0V	0.25	0.35
7.1V ≦ V_{OUT} ≦ 10.0V	0.27	0.45
10.1V ≦ V_{OUT} ≦ 14.0V	0.30	0.50

- **Test Conditions for Output Current**

Detector Threshold Voltage $-V_{DET}$ (V)	Conditions
2.1V ≦ ($-V_{DET}$) ≦ 15.0V	V_{IN}=2V, V_{DS}=0.05V
($-V_{DET}$) = 2.0	V_{IN}=1.9V, V_{DS}=0.05V

RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

- **R1150HxxxD**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Input Voltage				24.0	V
I_{SS}	Supply Current	$V_{IN}=V_{OUT}+2.0V$		7	14	µA
T_{SD}	Thermal Shutdown Temperature			150		°C
T_{SR}	Thermal Shutdown Released Temperature	Junction Temperature		120		°C

VR

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	$V_{IN}=V_{OUT}+2.0V$ $I_{OUT}=20mA$	×0.98		×1.02	V
I_{OUT}	Output Current	$V_{IN}=V_{OUT}+2.0V$	Refer to Output Current Table			
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	$V_{IN}=V_{OUT}+2.0V$ $1mA \leqq I_{OUT} \leqq 40mA$	Refer to Load Regulation Table			
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	$I_{OUT}=20mA$ $V_{OUT}+1V \leqq V_{IN} \leqq 24V$		0.05	0.15	%/V
V_{DIF}	Dropout Voltage	$I_{OUT}=20mA$	Refer to Dropout Voltage Table			
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	$V_{IN}=V_{OUT}+2.0V$ $I_{OUT}=20mA$ $-40°C \leqq Topt \leqq 85°C$		±100		ppm/°C
Ilim	Short Current Limit	$V_{OUT}=0V$		45		mA

VD

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
$-V_{DET}$	Detector Threshold		×0.975		×1.025	V
V_{HYS}	Detector Threshold Hysteresis		$-V_{DET}$ ×0.03	$-V_{DET}$ ×0.05	$-V_{DET}$ ×0.07	V
I_{OUT2}	Output Current (Driver Output Pin)	Refer to Test Conditions for Output Current Table	0.17			mA
V_{DDL}	Minimum Operating Voltage	*Note 1		0.9	1.2	V
$\Delta -V_{DET}/\Delta Topt$	Detector Threshold Temperature Coefficient	$-40°C \leqq Topt \leqq 85°C$		±100		ppm/°C
t_{PLH}	Output Delay Time	$C_D=4.7nF$, *Note 2	20	30	50	ms
	Release Margin	$V_{OUT}-0.2-(-V_{DET})-V_{HYS}$	50			mV

Note 1) This item means V_{DD} Voltage when Output Voltage is equal or less than 0.1V. (Pull-up Resistor=470kW, Pull up Voltage=5V)

Note 2) V_{DET} pin is pulled up to V_{DD} via 470kW. t_{PLH} means time interval from rising edge of V_{DD} from $(-V_{DET})-2.0V$ to $(-V_{DET})+2.0V$ to the point of Output Voltage being 80% of pull-up voltage.

- **Output Current (Topt=25°C)**

Output Voltage V_{OUT} (V)	Output Current (mA)	
	Min.	Typ.
2.1V ≦ V_{OUT} ≦ 2.9V	90	140
3.0V ≦ V_{OUT} ≦ 4.0V	120	170
4.1V ≦ V_{OUT} ≦ 14.0V	150	200

- **Load Regulation (Topt=25°C)**

Output Voltage V_{OUT} (V)	Load Regulation (mV)	
	Typ.	Max.
2.1V ≦ V_{OUT} ≦ 3.0V	15	35
3.1V ≦ V_{OUT} ≦ 5.0V	25	45
5.1V ≦ V_{OUT} ≦ 10.0V	40	65
10.1V ≦ V_{OUT} ≦ 14.0V	50	80

- **Dropout Voltage (Topt=25°C)**

Output Voltage V_{OUT} (V)	Dropout Voltage (V)	
	Typ.	Max.
2.1V ≦ V_{OUT} ≦ 2.4V	0.40	0.60
2.5V ≦ V_{OUT} ≦ 3.0V	0.30	0.40
3.1V ≦ V_{OUT} ≦ 7.0V	0.25	0.35
7.1V ≦ V_{OUT} ≦ 10.0V	0.27	0.45
10.1V ≦ V_{OUT} ≦ 14.0V	0.30	0.50

- **Test Conditions for Output Current**

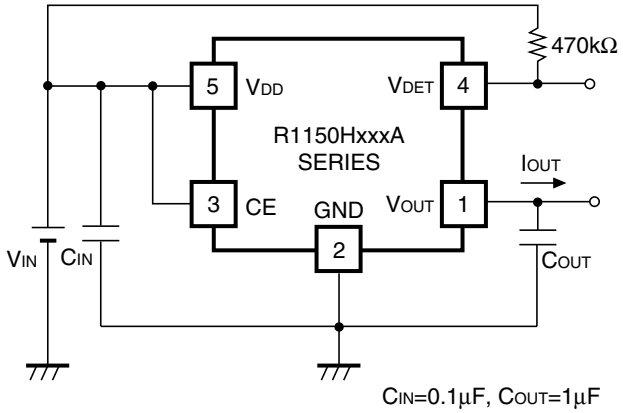
Detector Threshold Voltage $-V_{DET}$ (V)	Conditions
2.1V ≦ ($-V_{DET}$) ≦ 15.0V	V_{IN}=2V, V_{DS}=0.05V
($-V_{DET}$) = 2.0	V_{IN}=1.9V, V_{DS}=0.05V

RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)

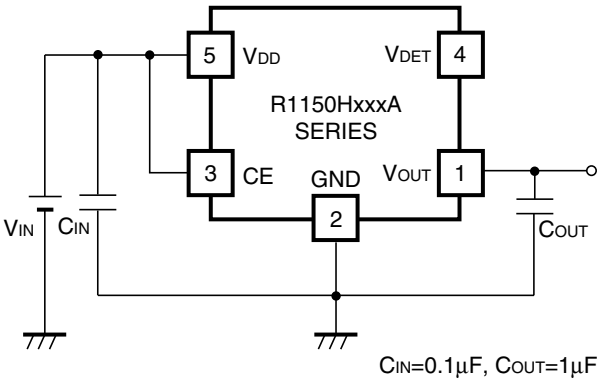
All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

TEST CIRCUITS

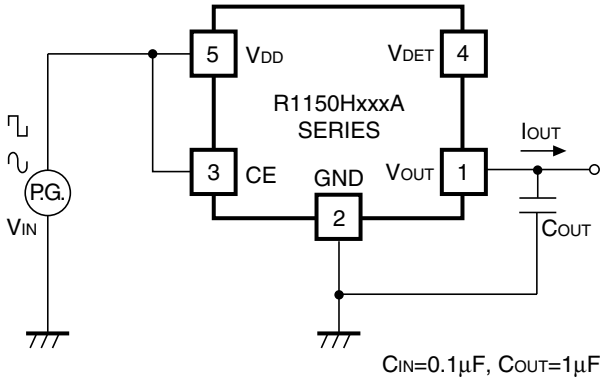
- **R1150HxxxA**



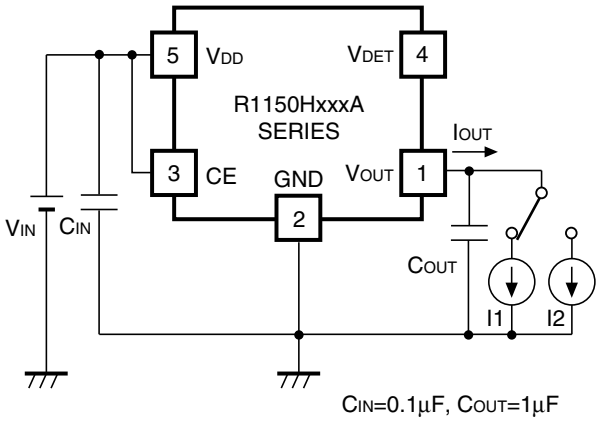
Standard Test Circuit



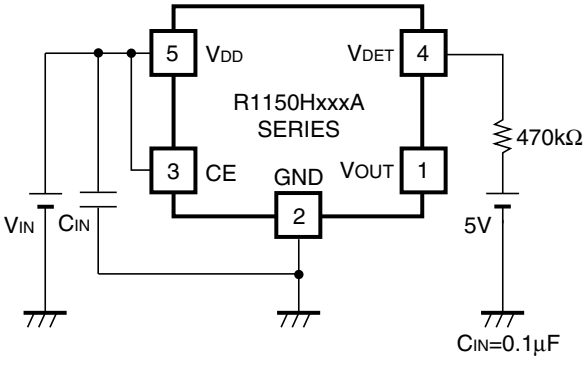
Supply Current Test Circuit



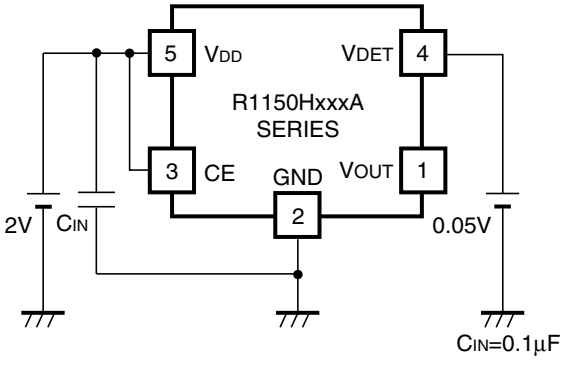
Input Transient Response/
Ripple Rejection Test Circuit



Load Transient Response Test Circuit

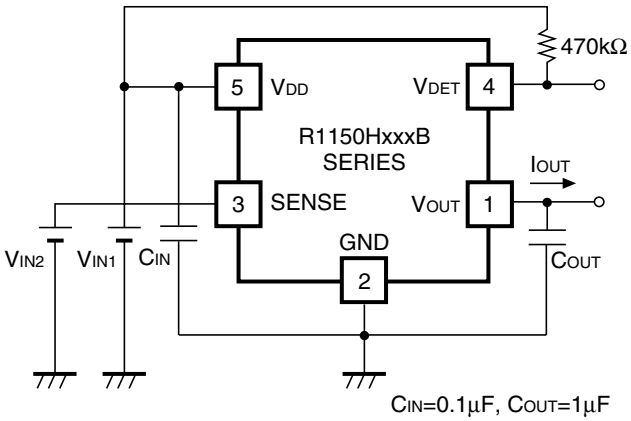


Minimum Operating Voltage Test Circuit

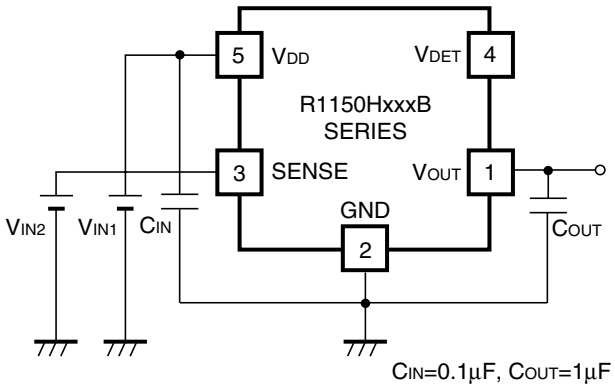


VD Output Current Test Circuit

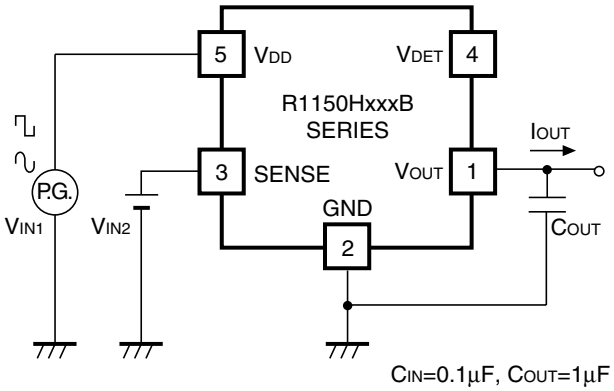
- **R1150HxxxB**



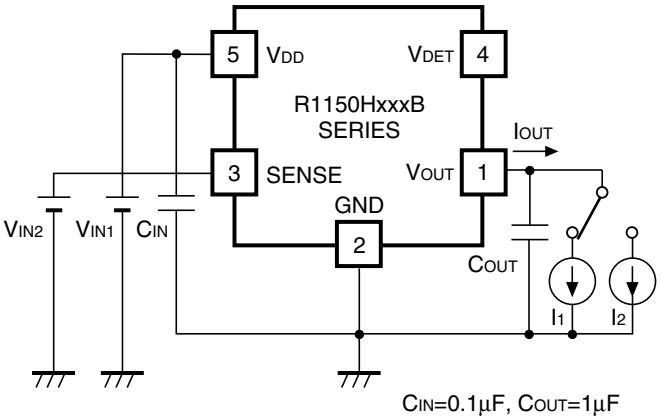
Standard Test Circuit



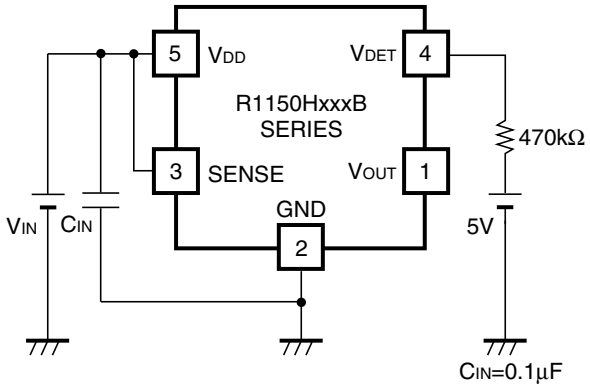
Supply Current Test Circuit



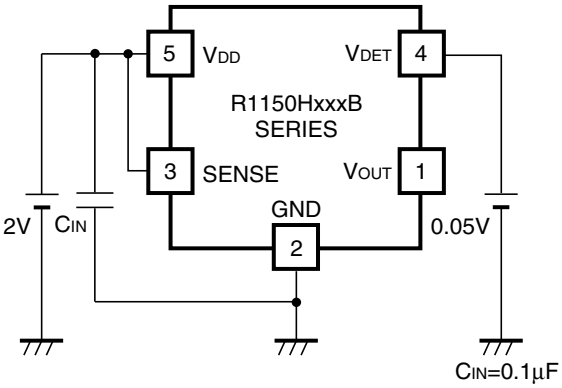
Input Transient Response/
Ripple Rejection Test Circuit



Load Transient Response Test Circuit

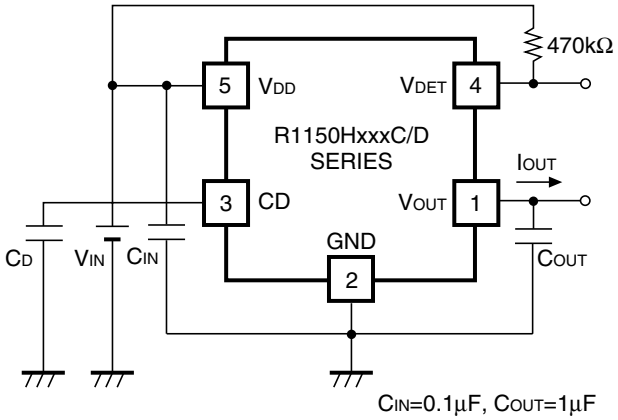


V_{DET} Minimum Operating Voltage Test Circuit

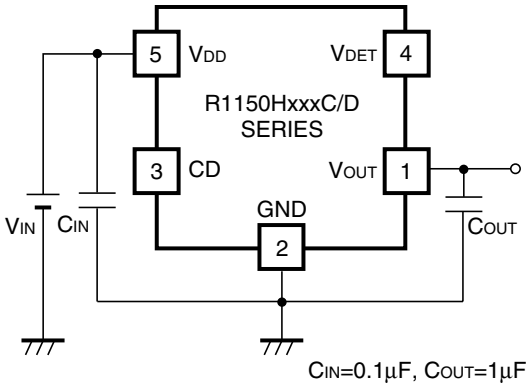


VD Output Current Test Circuit

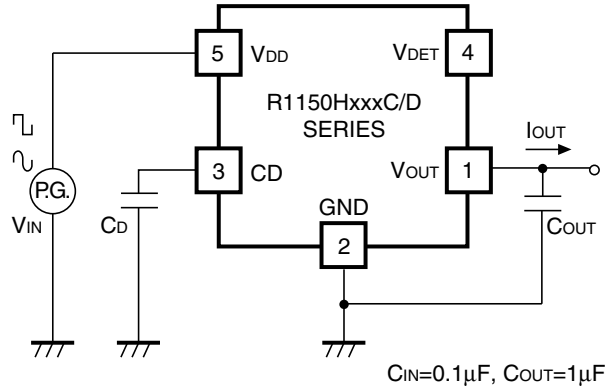
- **R1150HxxxC/D**



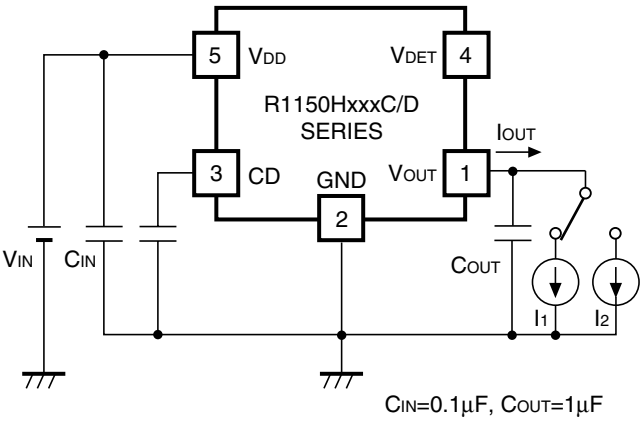
Standard Test Circuit



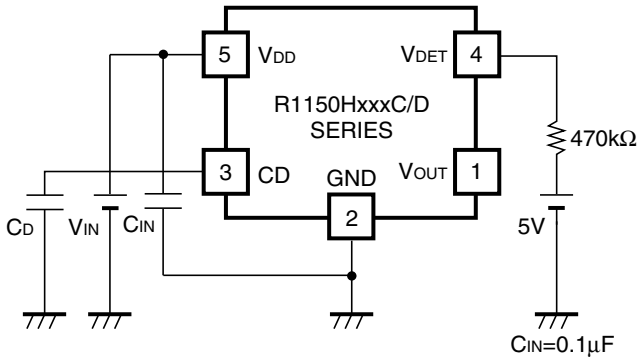
Supply Current Test Circuit



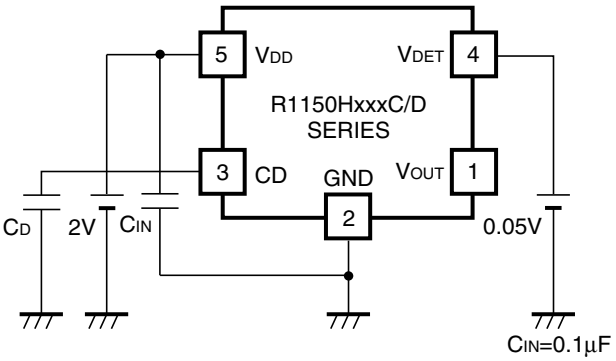
Input Transient Response/
Ripple Rejection Test Circuit



Load Transient Response Test Circuit



VDET Minimum Operating Voltage Test Circuit

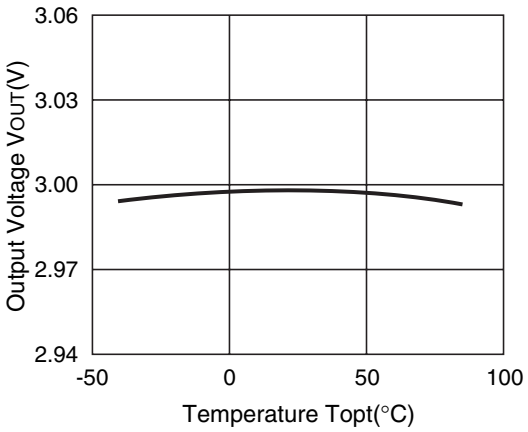


VD Output Current Test Circuit

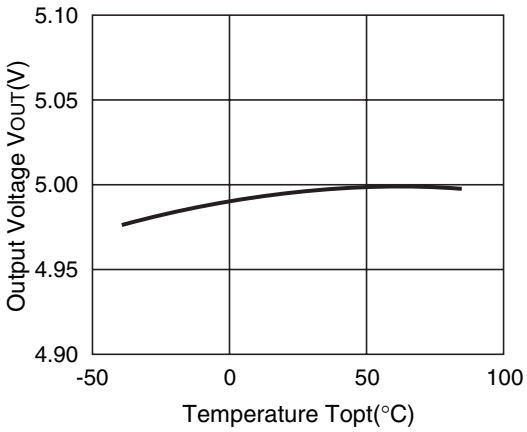
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Temperature

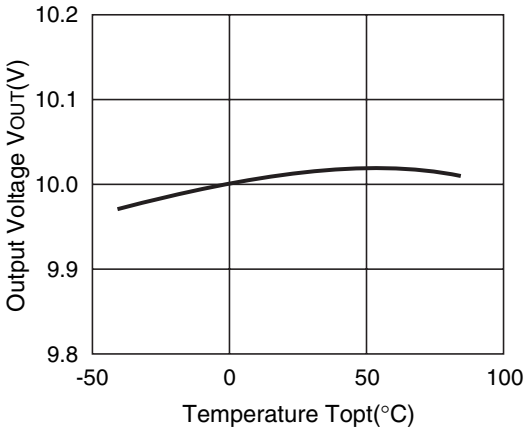
R1150H (VR=3.0V)



R1150H (VR=5.0V)

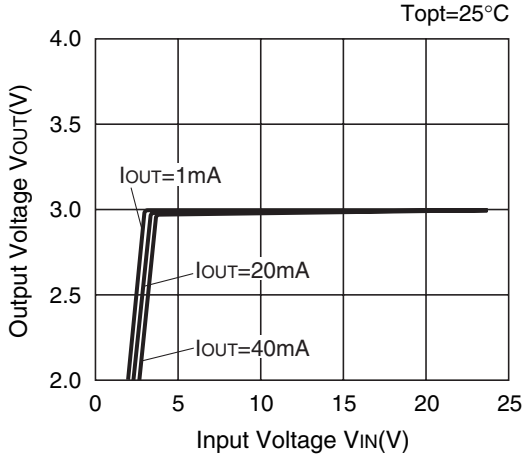


R1150H (VR=10.0V)

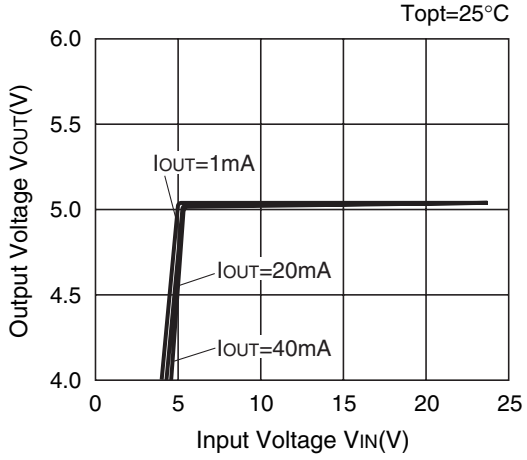


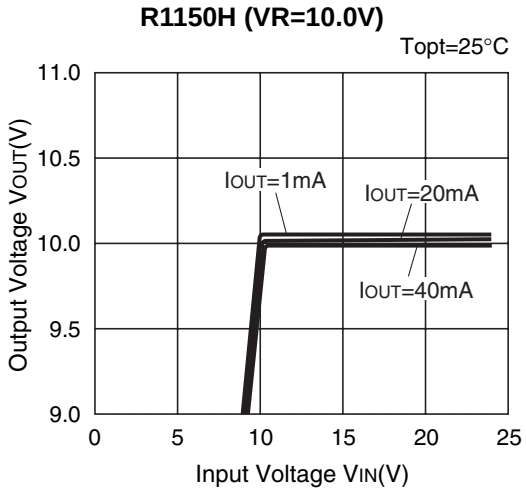
2) Input Voltage vs. Output Voltage

R1150H (VR=3.0V)

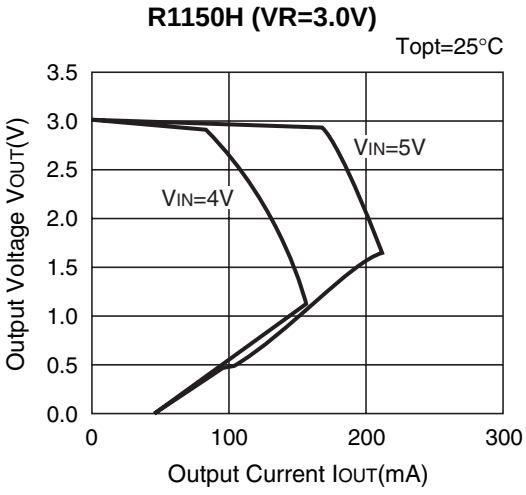


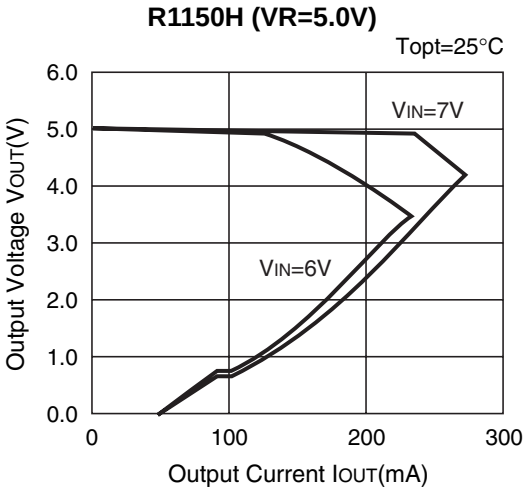
R1150H (VR=5.0V)

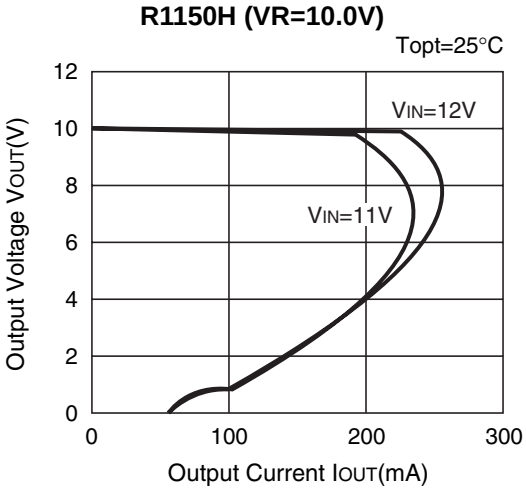




3) Output Voltage vs. Output Current

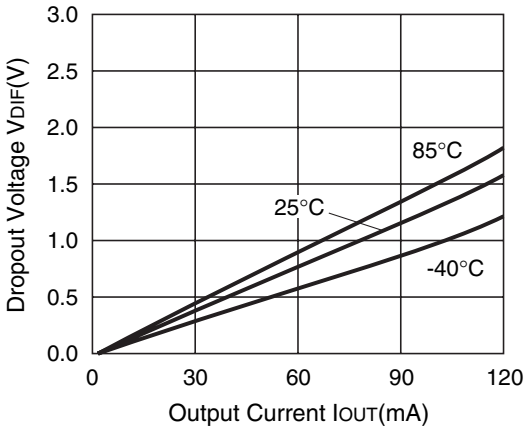




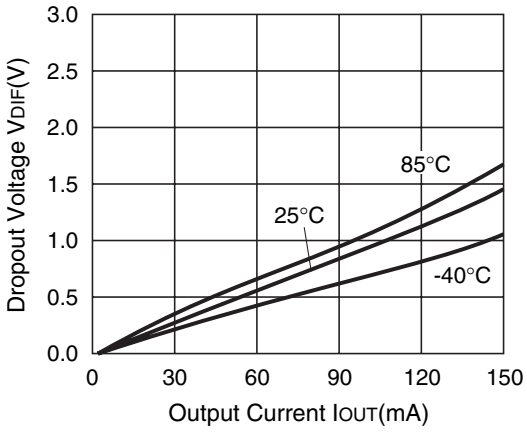


4) Dropout Voltage vs. Output Current

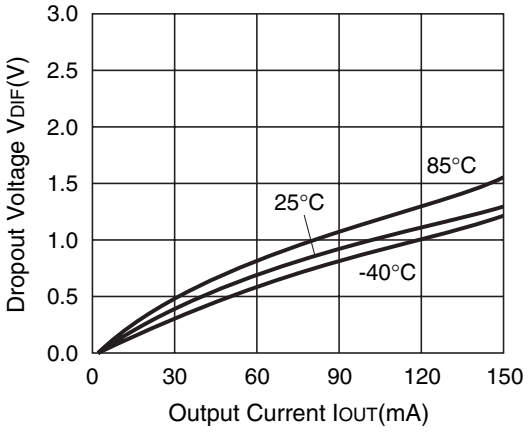
R1150H (VR=3.0V)



R1150H (VR=5.0V)

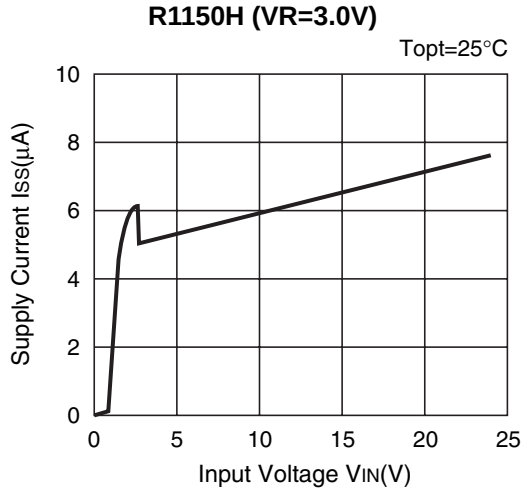


R1150H (VR=10.0V)

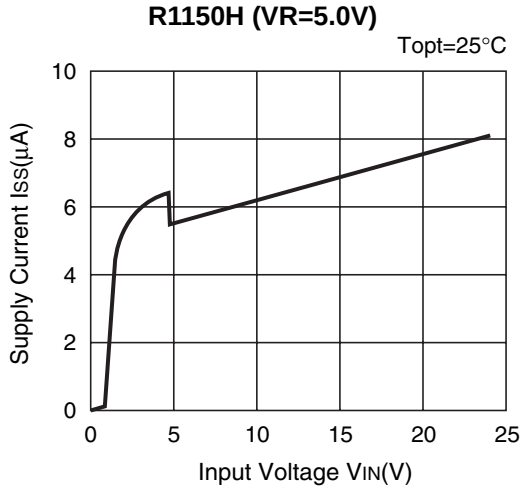


5) Supply Current vs. Input Voltage

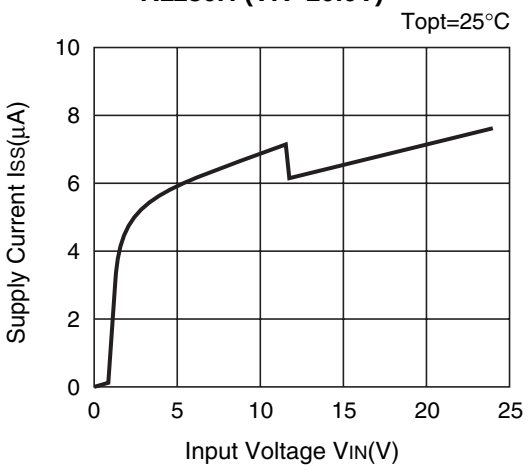
R1150H (VR=3.0V)



R1150H (VR=5.0V)

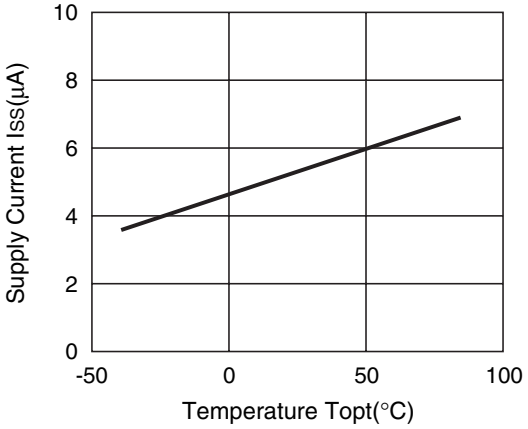


R1150H (VR=10.0V)

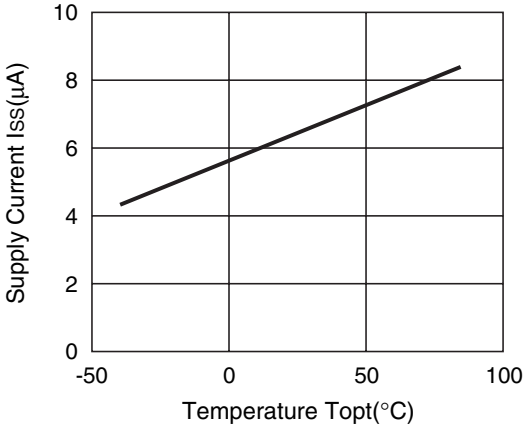


6) Supply Current vs. Temperature

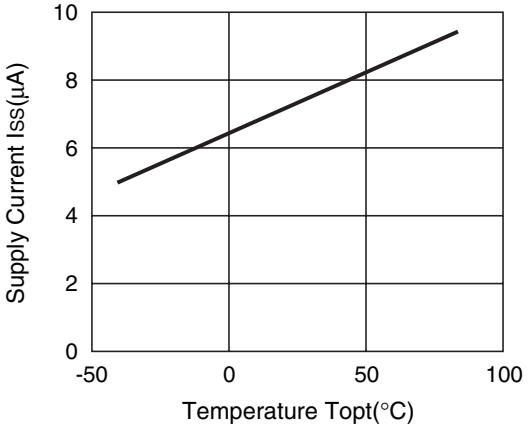
R1150H (VR=3.0V, V_{DET}=2.5V)



R1150H (VR=5.0V, V_{DET}=4.5V)

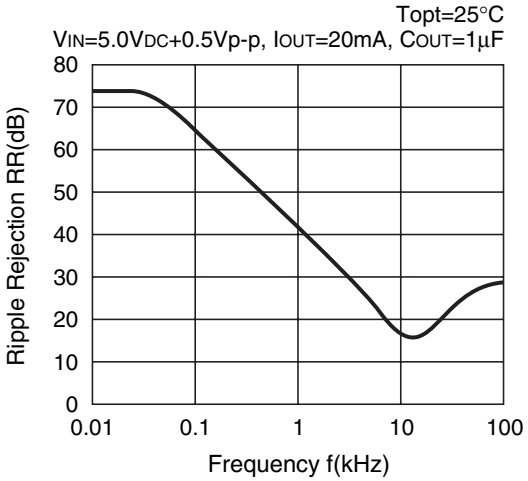


R1150H (VR=10.0V, V_{DET}=11.0V)

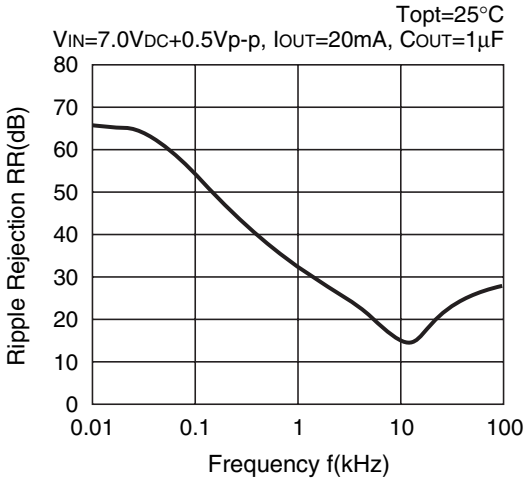


7) Ripple Rejection vs. Frequency

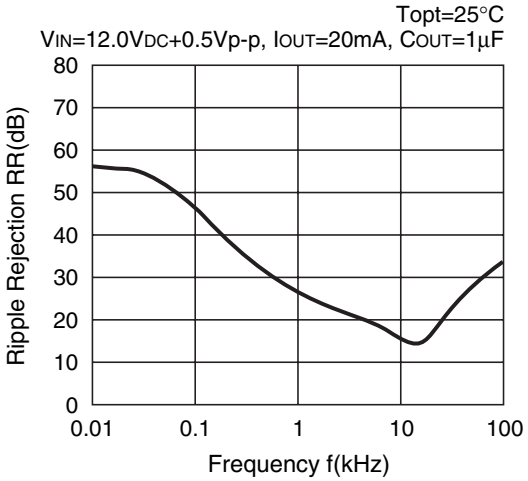
R1150H (VR=3.0V)



R1150H (VR=5.0V)

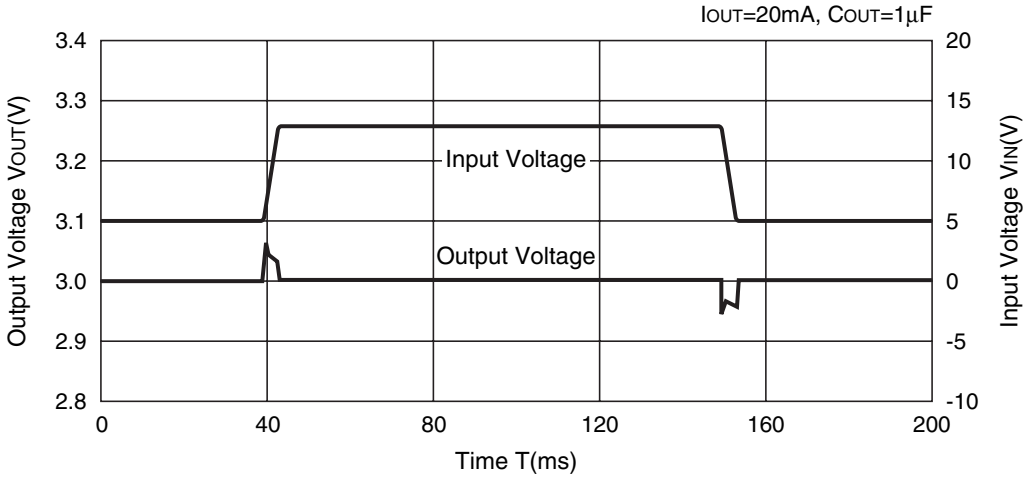


R1150H (VR=10.0V)

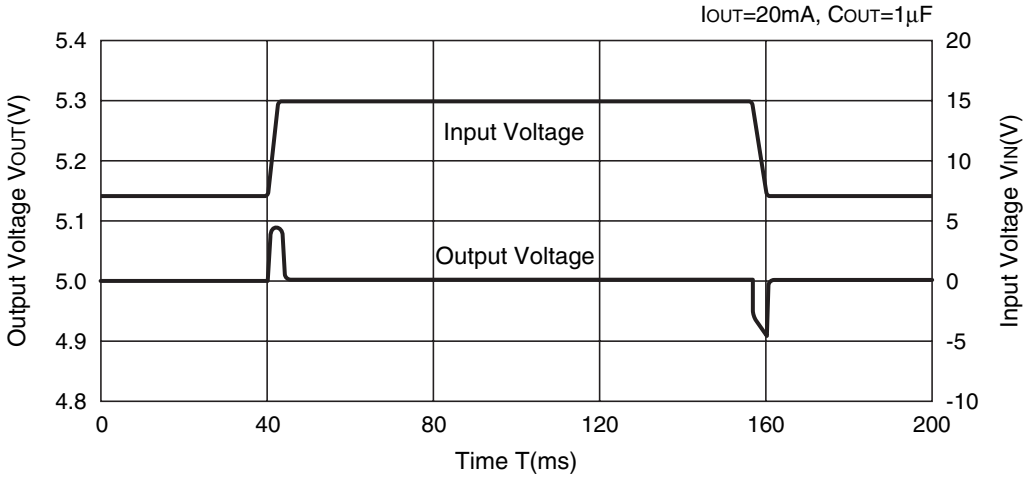


8) Input Transient Response

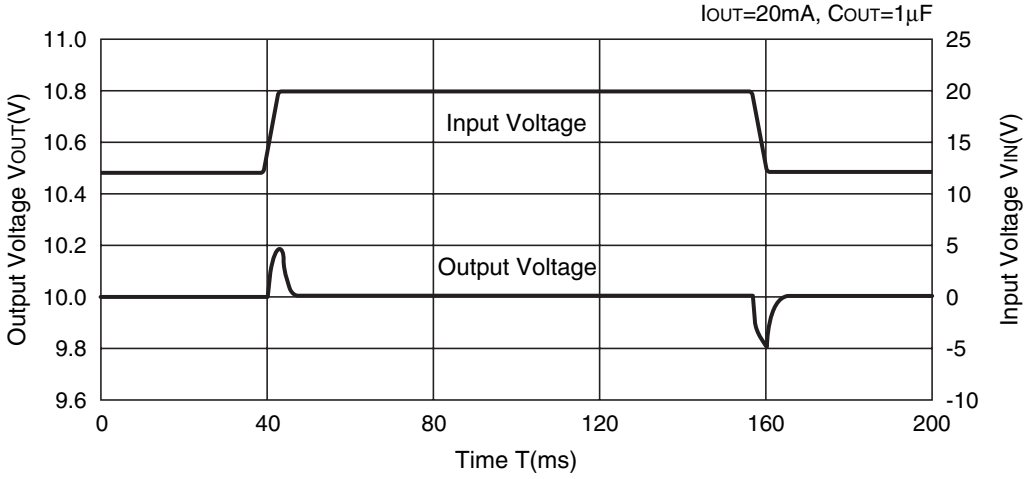
R1150H (VR=3.0V)



R1150H (VR=5.0V)

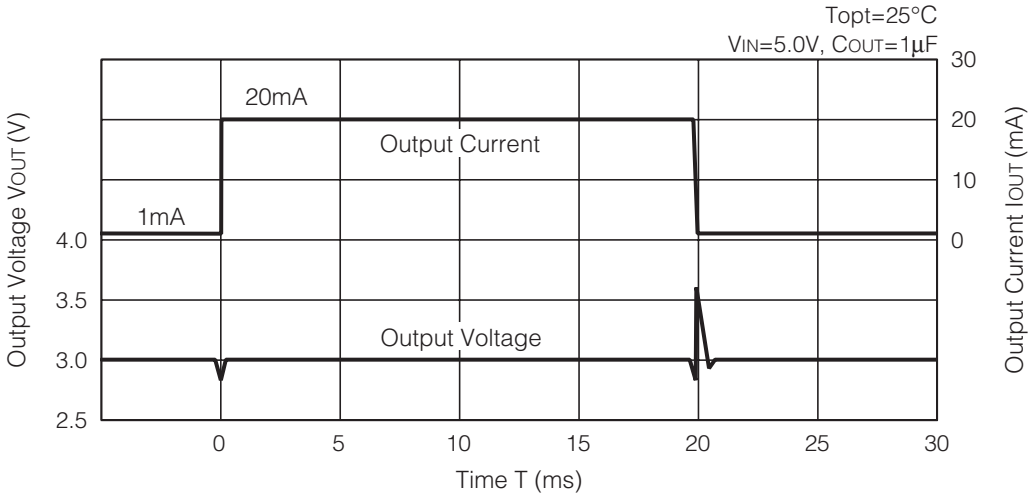


R1150H (VR=10.0V)

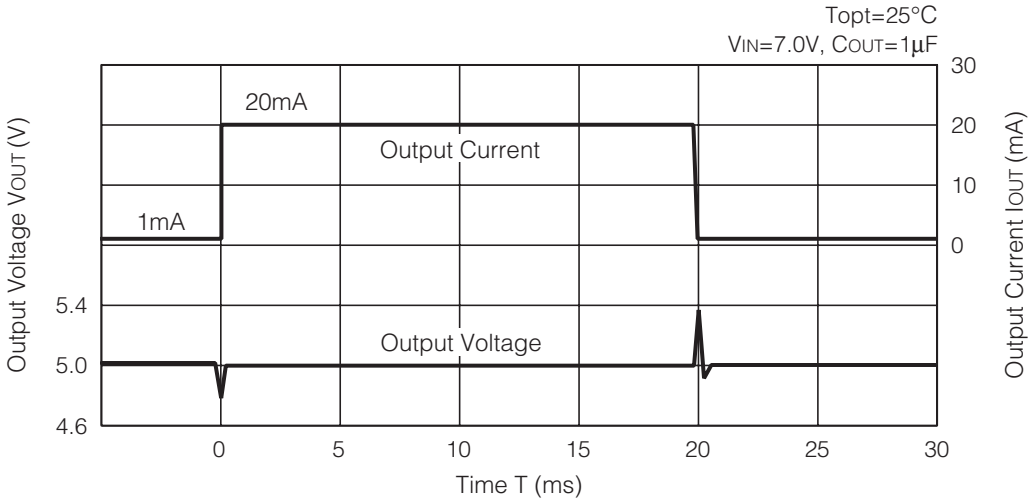


9) Load Transient Response

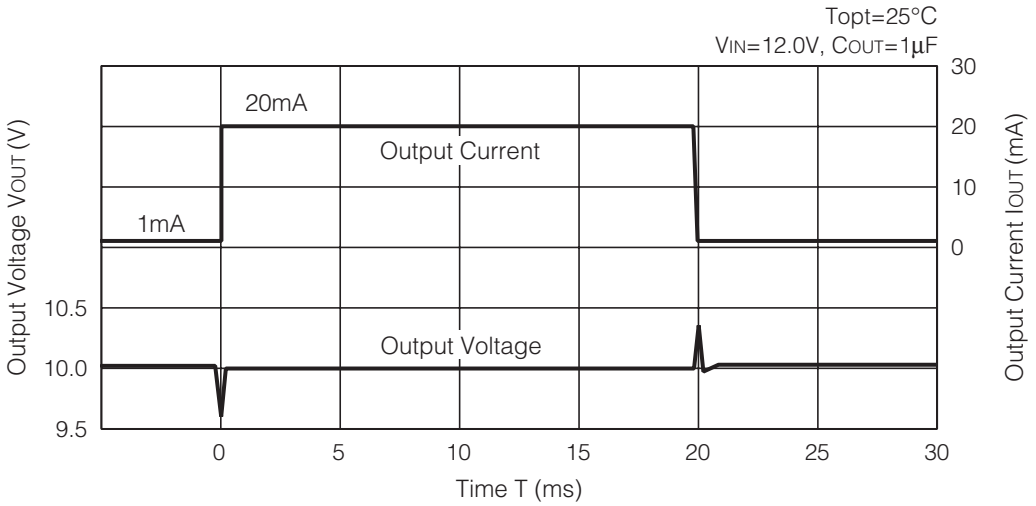
R1150H (VR=3.0V)



R1150H (VR=5.0V)

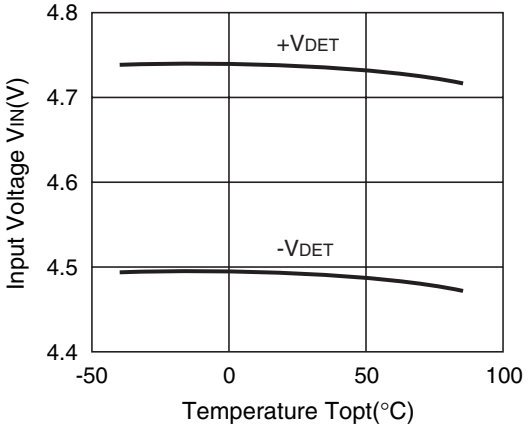


R1150H (VR=10.0V)

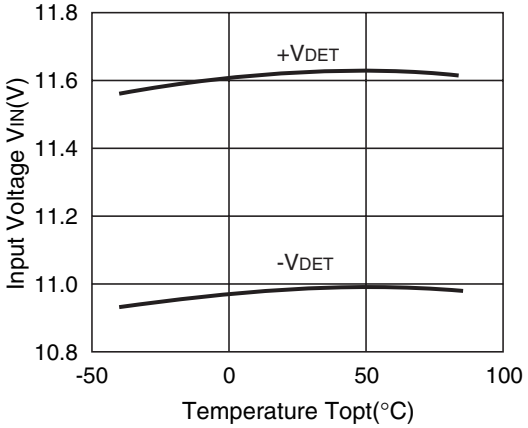


10) Detector Threshold vs. Temperature

R1150H (-V_{DET}=4.5V)

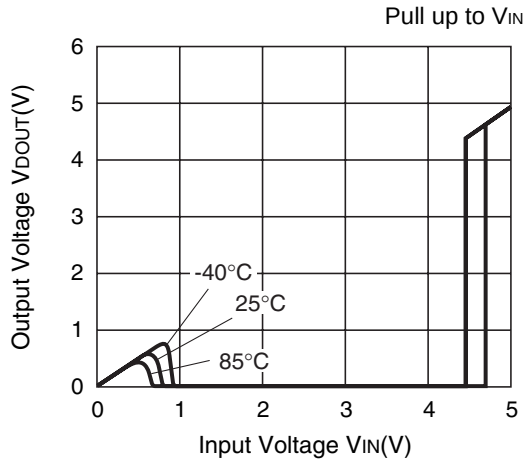


R1150H (-V_{DET}=11.0V)

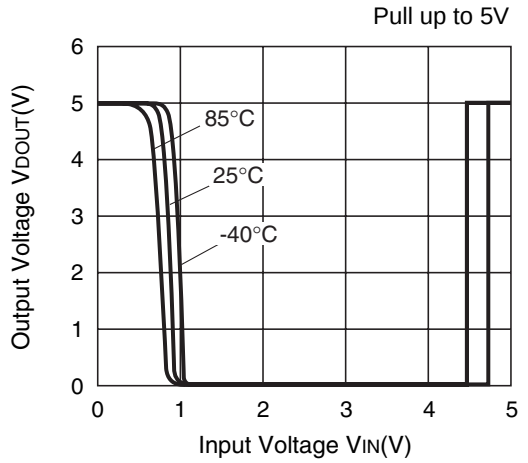


11) Detector Threshold vs. Input Voltage

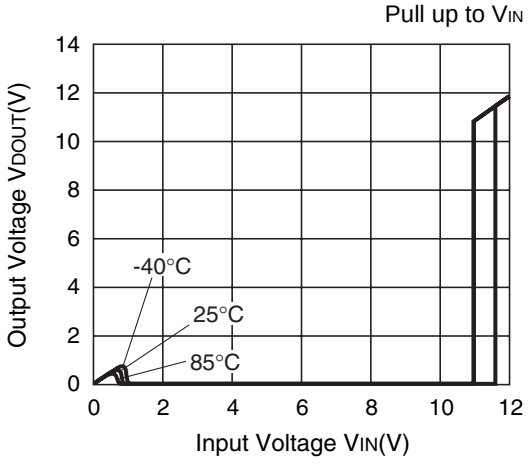
R1150H (-V_{DET}=4.5V)



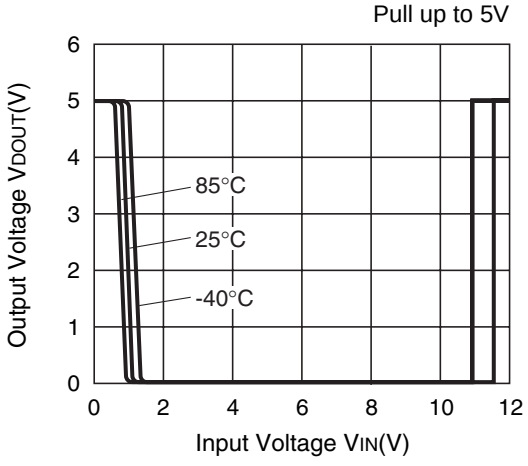
R1150H (-V_{DET}=4.5V)



R1150H (-V_{DET}=11.0V)

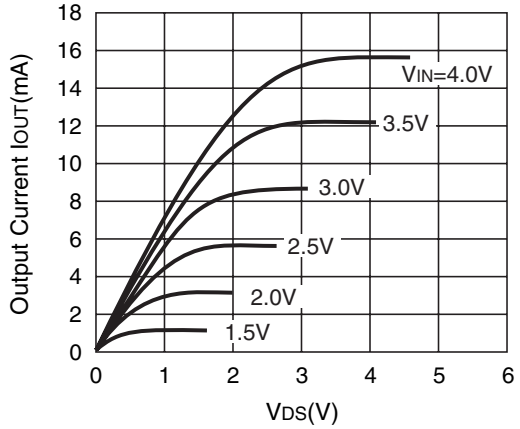


R1150H (-V_{DET}=11.0V)

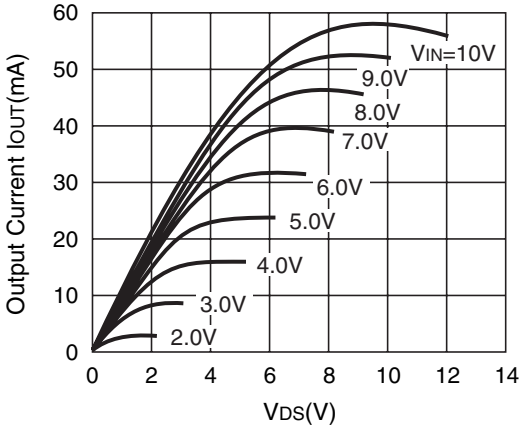


12) Nch Driver Output Current vs. V_{DS}

R1150H (-V_{DET}=4.5V)

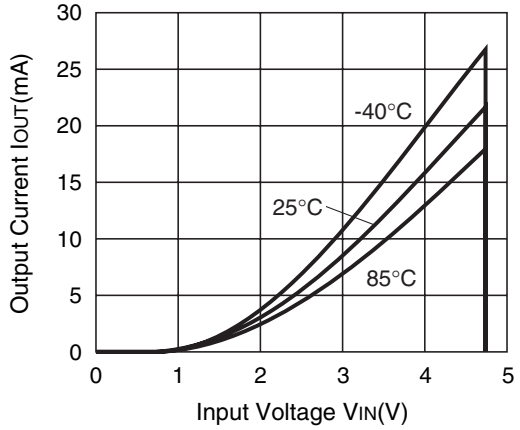


R1150H (-V_{DET}=11.0V)

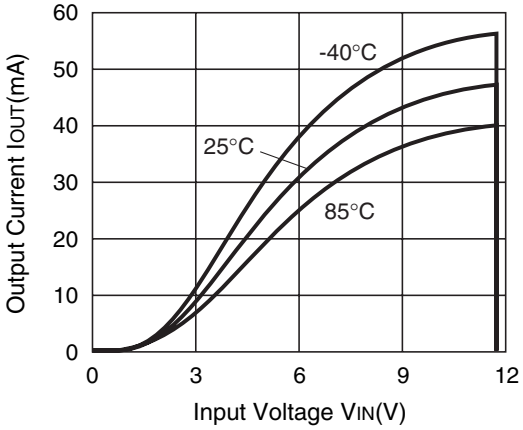


13) Nch Driver Output Current vs. Input Voltage

R1150H (-V_{DET}=4.5V)

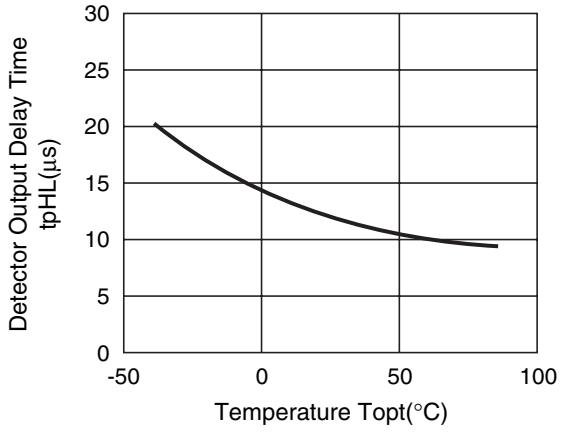


R1150H (-V_{DET}=11.0V)



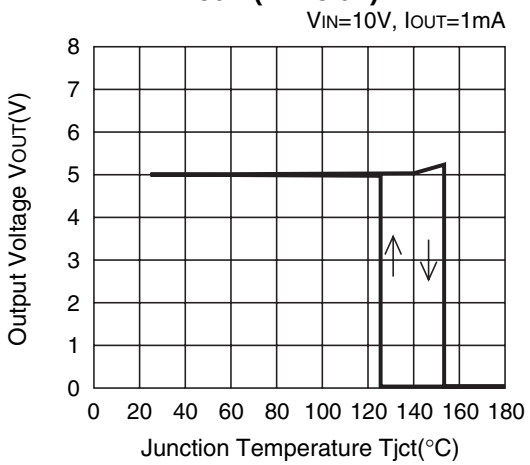
14) Detector Output Delay Time vs. Temperature

R1150H (-V_{DET}=4.5V)



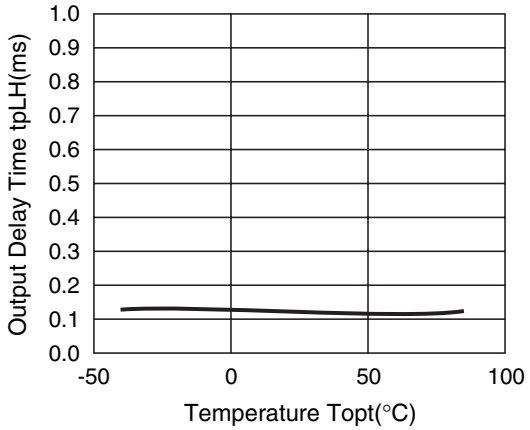
15) Thermal Shutdown Temperature vs. Output Voltage

R1150H (VR=5.0V)



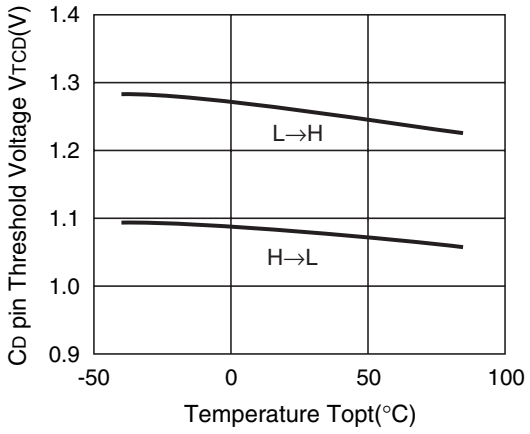
16) Output Delay Time vs. Temperature

R1150H (-V_{DET}=4.5V)

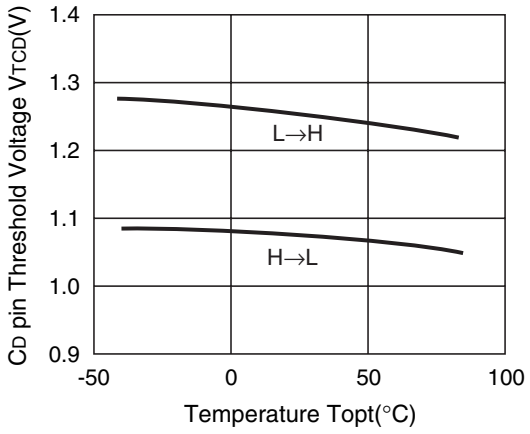


17) C_D pin Threshold Voltage vs. Temperature

R1150H (V_{DET}=4.0V)

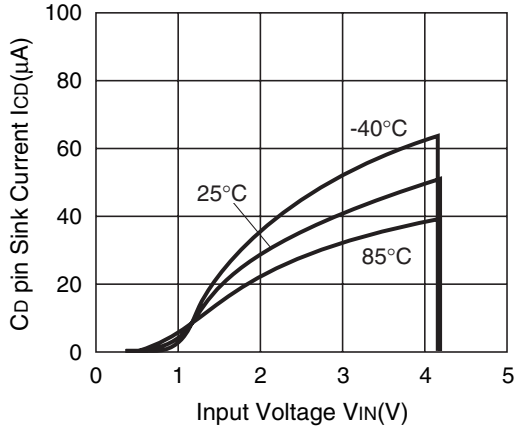


R1150H (V_{DET}=9.0V)

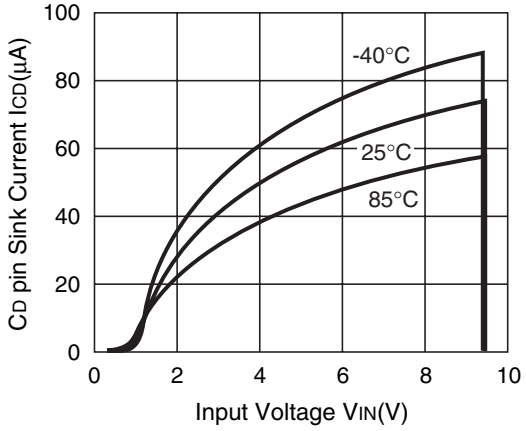


18) C_D pin Sink Current vs. Input Voltage

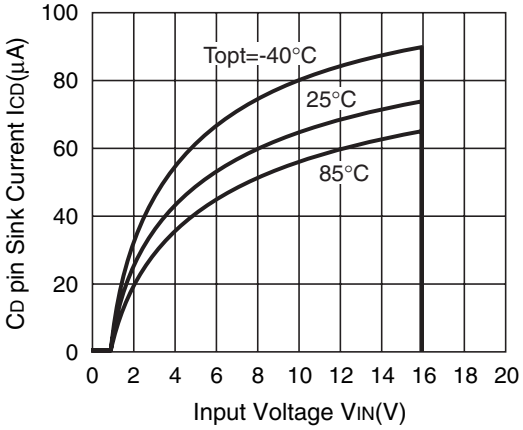
R1150H (V_{DET}=4.0V)



R1150HxxxD (V_{DET}=9.0V)

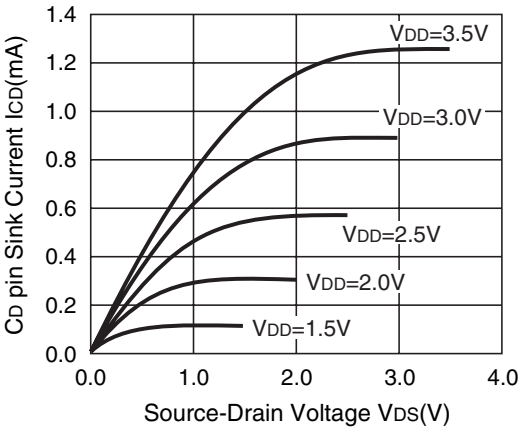


R1150H (V_{DET}=15.0V)

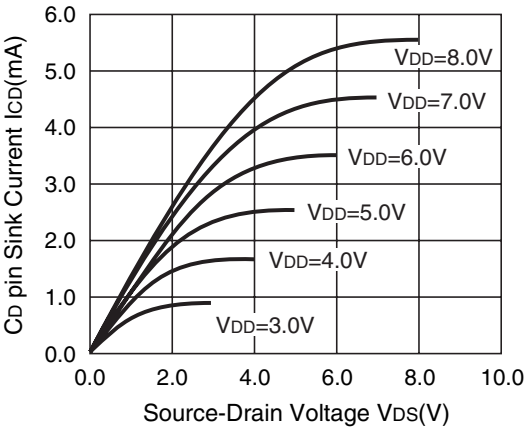


19) C_D pin Sink Current vs. V_{DS}

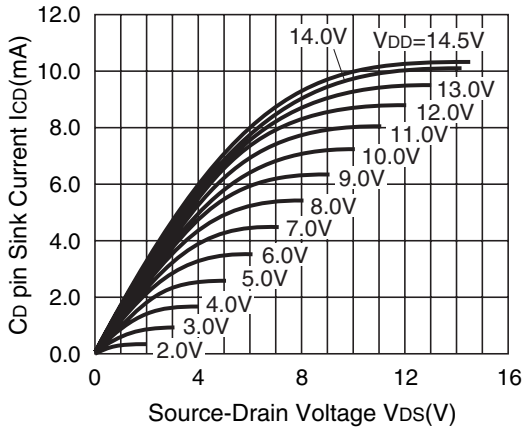
R1150H (V_{DET}=4.0V)



R1150H (V_{DET}=9.0V)

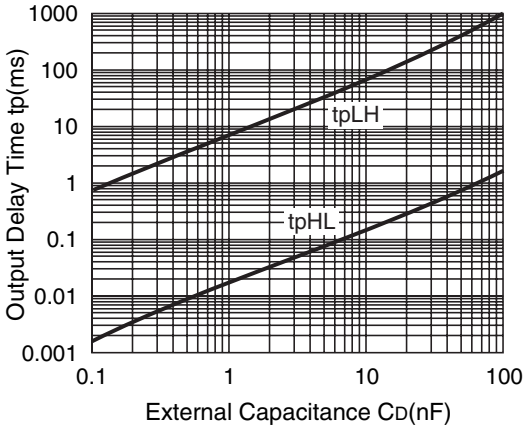


R1150H (V_{DET}=15.0V)



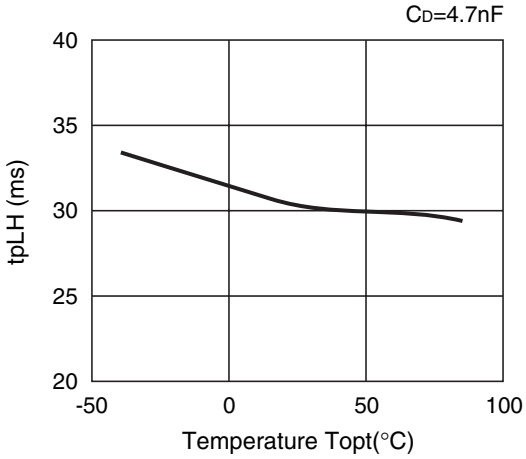
20) Output Delay Time vs. External Capacitance

R1150H (V_{DET}=4.0V)

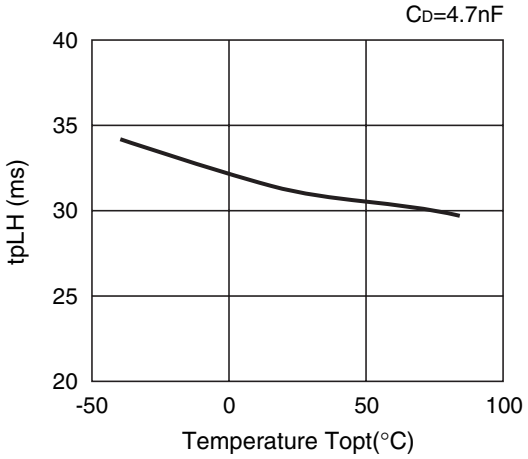


21) t_{PLH}delay vs. Temperature

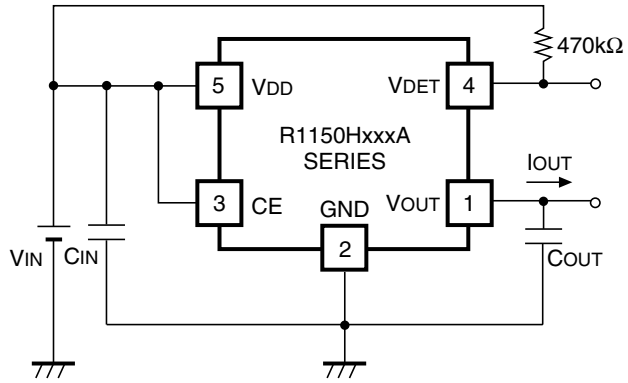
R1150HxxxD (V_{DET}=4.0V)



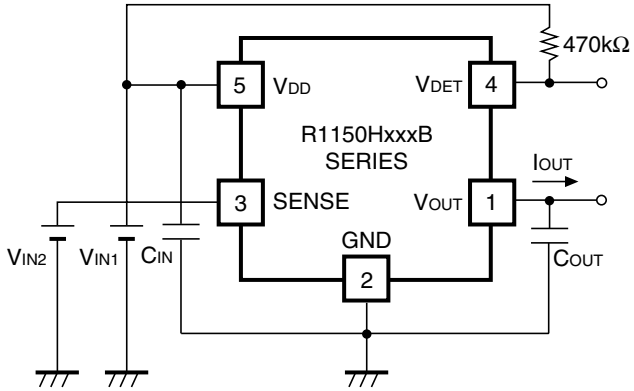
R1150HxxxD (V_{DET}=9.0V)



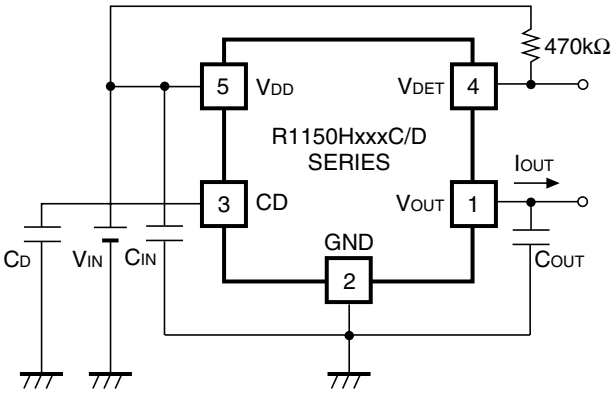
TYPICAL APPLICATIONS



R1150HxxxA



R1150HxxxB



R1150HxxxC

TECHNICAL NOTES

Phase Compensation

Phase Compensation of the R1150H Series has been made internally for stable operation even though the load current would vary. Therefore, without the capacitors, C_{IN} and C_{OUT}, Output Voltage is regulated, but for more stable operation, use 0.1µF or more capacitors as C_{IN} and C_{OUT}. Wiring should be made as short as possible.

PCB layout

Current flows into wiring for V_{DD} or GND, thus, if the impedance of the wiring is rather high, it may cause of making noise or unstable operation, thus width and pattern should be enough wide to avoid such problems. Connect the capacitor, C_{IN} between V_{DD} pin and GND pin as close as possible.

About the output voltage and the detector threshold setting (In case of R1150HxxxD)

When the value difference between release voltage of voltage detector and the output voltage of voltage regulator is little, the release function may not operate after detective, due to change the output voltage of voltage detector. Pay attention for setting of the release voltage.

Refer to the following formula for setting the voltage of output and detective value.
$(V_{OUT} \times 0.975) - (-V_{DET} \times 1.10) > 0.2$

Thermal Shutdown

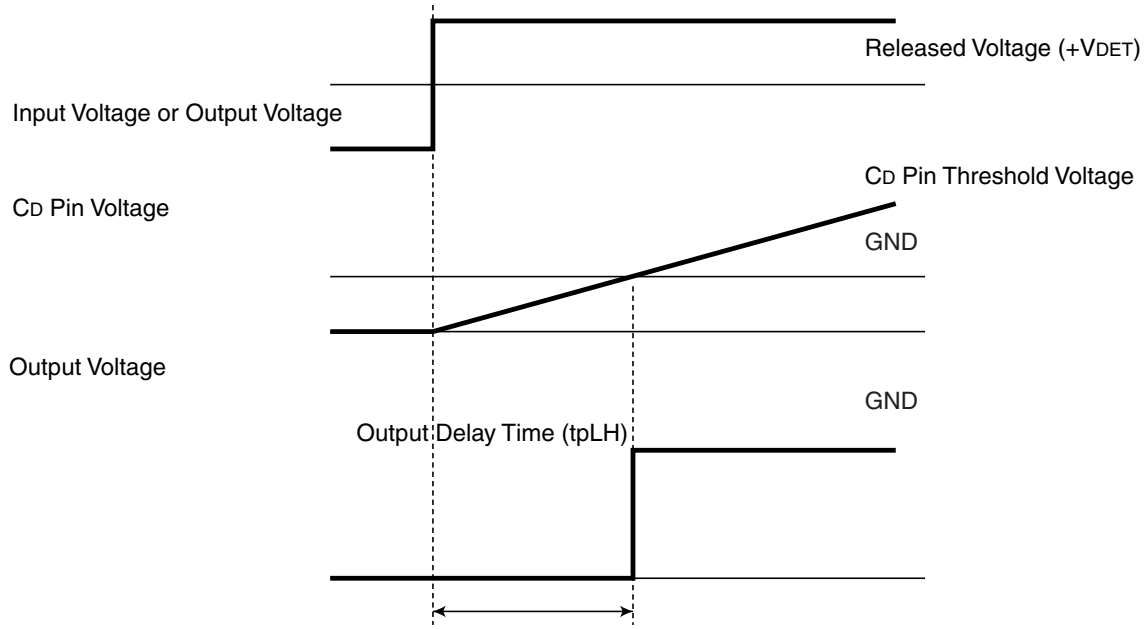
Thermal shutdown function is included in the R1150HxxxA/B/C/D Series, when the junction temperature is equal or more than +150°C (Typ.), the operation of regulator would stop. After that, when the junction temperature is equal or less than +120°C (Typ.), the operation of regulator would restart. Unless the cause of rising temperature would remove, the regulator repeats on and off, and output waveform would be like consecutive pulses.

Chip Enable Circuit

Do not make voltage level of chip enable pin keep floating level, or in between V_{IH} and V_{IL}. Unless otherwise, Output voltage would be unstable or indefinite, or unexpected current would flow internally.

Output Delay Time for Release V_{DET}

In the R1150Hxx1C/D can set an output delay time for release voltage detector with connecting a capacitor to C_D pin. When an input voltage (in the case of R1150Hxx1C) or an output voltage (in the case of R1150Hxx1D) surpasses the release voltage of its voltage detector ($+V_{DET}$), the capacitor which is connected to C_D pin is started to be charged, as a result, C_D pin voltage rises. When the C_D pin voltage surpasses C_D pin threshold voltage, the output voltage of the voltage detector outputs “H”.



Output delay time for release voltage detector can be calculated with the next formula:
$t_{PLH}=1.25/200\times10^{9}\times C$ (sec)

Input Transient Response

If the input transient speed is equal or faster than 80mV/μs and the transient level difference is equal or more than 1.5V, the output response may be extremely worse than normal operation. In that case, add a capacitor between V_{IN} and GND, and make the transient speed of V_{IN} slower than 80mV/μs.