

## VOLTAGE REGULATOR (with Wide Input Voltage Range) with RESET

NO.EA-081-111027

### 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 R1150HxxxxA series includes also a chip enable circuit. The output of built-in voltage detector is Nch open drain type. The R1150HxxxC/D 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  $\pm 2.0\%$ , while Detector Threshold Accuracy is  $\pm 2.5\%$ . The R1150HxxxxA (with chip enable function) and R1150HxxxC series can supervise input voltage by the built-in detector. R1150HxxxB 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.

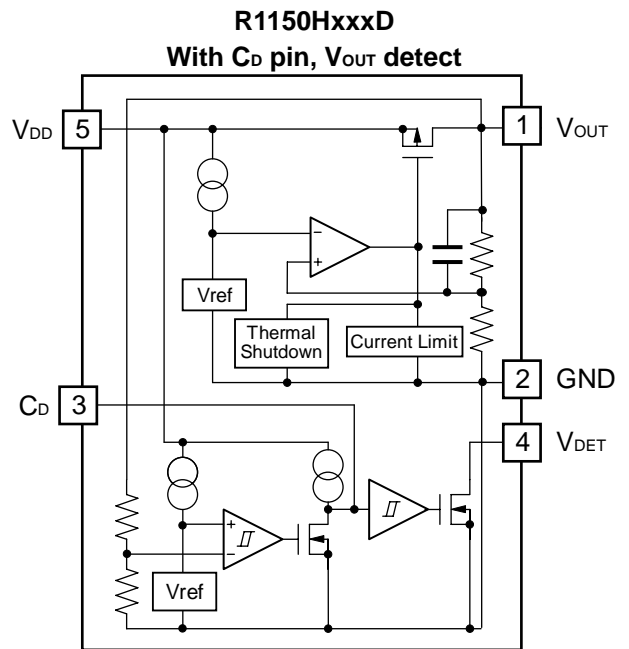
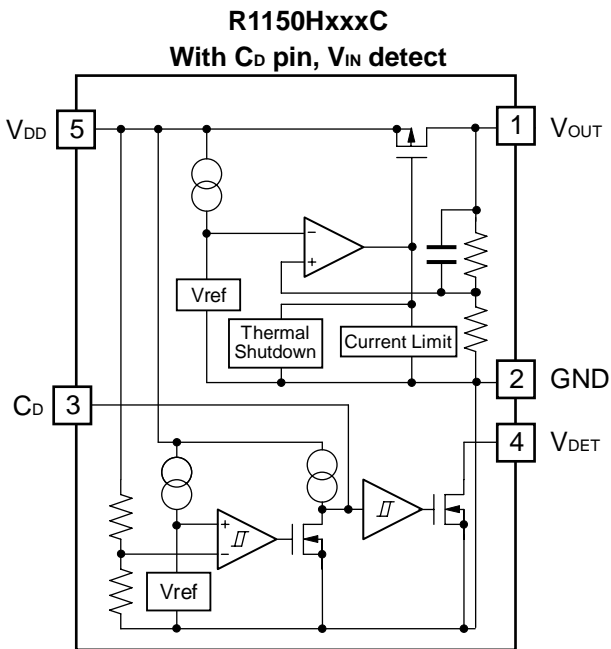
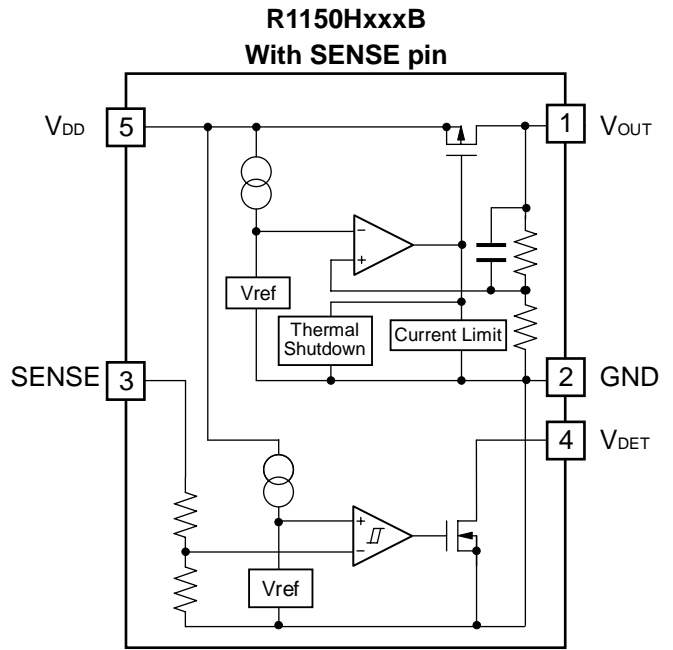
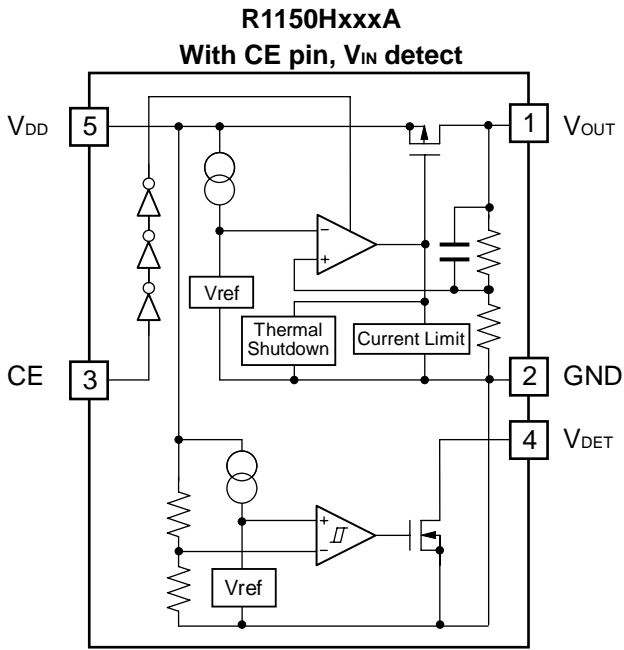
### FEATURES

- Supply Current ..... Typ.  $7.0\mu A$
- Input Voltage ..... Max. 24.0V
- Output Voltage (VR) ..... 2.1V to 14.0V (0.1V steps)  
(For other voltages, please refer to MARK INFORMATION.)
- Detector Threshold Voltage ( $V_{DET}$ ) ..... 2.0V to 15.0V (R1150HxxxB/C/D)  
2.3V to 15.0V (R1150HxxxxA)
- Output Voltage Accuracy .....  $\pm 2.0\%$  (VR),  $\pm 2.5\%$  (VD)
- Output Current ..... Min. 150mA ( $V_{OUT}=5.0V$ )
- Package ..... SOT-89-5
- Built-in Fold-Back Protection Circuit ..... Typ. 45mA (Current at short mode)
- Built-in Thermal Shutdown Circuit (VR) ..... Thermal Shutdown Temperature ; Typ.  $150^{\circ}C$   
Released Temperature ; Typ.  $120^{\circ}C$
- Monitoring  $V_{DD}$  voltage ..... R1150HxxxA/C
- Monitoring sense pin (SENSE) voltage ..... R1150HxxxB
- Monitoring  $V_{OUT}$  pin voltage ..... R1150HxxxD

### 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**

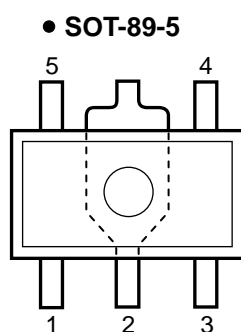


## SELECTION GUIDE

The output voltage, detector threshold and the usage of pin No.3 (as a kind of types in the R1150H Series ) for the ICs can be selected at the user's request.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1150Hxxx*-T1-FE	SOT-89-5	1,000 pcs	Yes	Yes
xxx : Specify a combination of output voltage and detector threshold.				
* : Designation of the usage of pin No.3 and detector function; (A) with CE pin and $V_{IN}$ detect (B) with SENSE pin (C) with $C_D$ pin and $V_{IN}$ detect (D) with $C_D$ pin and $V_{OUT}$ detect				

## PIN CONFIGURATION



## PIN DESCRIPTION

Pin No.	Symbol	Description
1	$V_{OUT}$	Voltage Regulator Output Pin
2	GND	Ground Pin
3	CE	Chip Enable Pin (A Ver.)
	SENSE	Sense Pin for Voltage Detector (B Ver.)
	$C_D$	Pin for Capacitor for Setting Output Delay of Voltage Detector (C/D Ver.)
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 ( $C_D$ 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
$T_{opt}$	Operating Temperature	-40 to 85	°C
$T_{stg}$	Storage Temperature	-55 to 125	°C

\*) For Power Dissipation, please refer to PACKAGE INFORMATION.

### 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

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V <sub>IN</sub>	Input Voltage				24.0	V
I <sub>SS</sub>	Supply Current	V <sub>IN</sub> =V <sub>CE</sub> V <sub>OUT</sub> ≥ (-V <sub>DET</sub> ): V <sub>IN</sub> =V <sub>OUT</sub> +2.0V V <sub>OUT</sub> < (-V <sub>DET</sub> ): V <sub>IN</sub> =(-V <sub>DET</sub> )+2.0V		7	14	μA
I <sub>standby</sub>	Standby Current	V <sub>DD</sub> =24V, V <sub>CE</sub> =0V	Refer to Supply Current Table			
T <sub>TSD</sub>	Thermal Shutdown Temperature	Junction Temperature		150		°C
T <sub>TSR</sub>	Thermal Shutdown Released Temperature	Junction Temperature		120		°C

### VR

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V <sub>OUT</sub>	Output Voltage	V <sub>IN</sub> =V <sub>OUT</sub> +2.0V, I <sub>OUT</sub> =20mA	×0.98		×1.02	V
I <sub>OUT1</sub>	Output Current	V <sub>IN</sub> =V <sub>OUT</sub> +2.0V	Refer to Output Current Table			
ΔV <sub>OUT</sub> /ΔI <sub>OUT</sub>	Load Regulation	V <sub>IN</sub> =V <sub>OUT</sub> +2.0V 1mA ≤ I <sub>OUT</sub> ≤ 40mA	Refer to Load Regulation Table			
ΔV <sub>OUT</sub> /ΔV <sub>IN</sub>	Line Regulation	V <sub>IN</sub> =V <sub>OUT</sub> +2.0V, I <sub>OUT</sub> =20 mA V <sub>OUT</sub> +1V ≤ V <sub>IN</sub> ≤ 24V		0.05	0.15	%/V
V <sub>DIF</sub>	Dropout Voltage	I <sub>OUT</sub> =20mA	Refer to Dropout Voltage Table			
ΔV <sub>OUT</sub> /ΔT <sub>opt</sub>	Output Voltage Temperature Coefficient	V <sub>IN</sub> =V <sub>OUT</sub> +2.0V, I <sub>OUT</sub> =20mA -40°C ≤ T <sub>opt</sub> ≤ 85°C		±100		ppm/°C
I <sub>SC</sub>	Short Current Limit	V <sub>OUT</sub> =0V		45		mA
V <sub>CEH</sub>	CE "H" Input Voltage		1.5		V <sub>IN</sub>	V
V <sub>CEL</sub>	CE "L" Input Voltage		0		0.25	V

### VD

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
-V <sub>DET</sub>	Detector Threshold		×0.975		×1.025	V
V <sub>HYS</sub>	Detector Threshold Hysteresis		-V <sub>DET</sub> ×0.03	-V <sub>DET</sub> ×0.05	-V <sub>DET</sub> ×0.07	V
I <sub>OUT2</sub>	Output Current (Driver Output Pin)	Refer to Test Conditions for Output Current Table	0.17			mA
V <sub>DDL</sub>	Minimum Operating Voltage	*Note 1		0.9	1.2	V
Δ-V <sub>DET</sub> /ΔT <sub>opt</sub>	Detector Threshold Temperature Coefficient	-40°C ≤ T <sub>opt</sub> ≤ 85°C		±100		ppm/°C
t <sub>PLH</sub>	Output Delay Time	*Note 2		0.5	1.0	ms

Note 1) This item means V<sub>DD</sub> Voltage when Output Voltage is equal or less than 0.1V.  
(Pull-up Resistor=470kΩ, Pull up Voltage=5V)

Note 2) V<sub>DET</sub> pin is pulled up to V<sub>DD</sub> via 470kΩ. t<sub>PLH</sub> means time interval from rising edge of V<sub>DD</sub> from (-V<sub>DET</sub>)-2.0V to (-V<sub>DET</sub>)+2.0V to the point of Output Voltage being 80% of pull-up voltage.

- Standby Current (T<sub>opt</sub>=25°C)

Detector Threshold Voltage -V <sub>DET</sub> (V)	Supply Current (μA)	
	Typ.	Max.
$2.3V \leq (-V_{DET}) \leq 3.0V$	2.5	5.0
$3.1V \leq (-V_{DET}) \leq 15.0V$	3.0	6.0

## VR part

- Output Current (T<sub>opt</sub>=25°C)

Output Voltage V <sub>OUT</sub> (V)	Output Current (mA)	
	Min.	Typ.
$2.1V \leq V_{OUT} \leq 2.9V$	90	140
$3.0V \leq V_{OUT} \leq 4.0V$	120	170
$4.1V \leq V_{OUT} \leq 14.0V$	150	200

- Load Regulation (T<sub>opt</sub>=25°C)

Output Voltage V <sub>OUT</sub> (V)	Load Regulation (mV)	
	Typ.	Max.
$2.1V \leq V_{OUT} \leq 3.0V$	15	35
$3.1V \leq V_{OUT} \leq 5.0V$	25	45
$5.1V \leq V_{OUT} \leq 10.0V$	40	65
$10.1V \leq V_{OUT} \leq 14.0V$	50	80

- Dropout Voltage (T<sub>opt</sub>=25°C)

Output Voltage V <sub>OUT</sub> (V)	Dropout Voltage (V)	
	Typ.	Max.
$2.1V \leq V_{OUT} \leq 2.4V$	0.40	0.60
$2.5V \leq V_{OUT} \leq 3.0V$	0.30	0.40
$3.1V \leq V_{OUT} \leq 7.0V$	0.25	0.35
$7.1V \leq V_{OUT} \leq 10.0V$	0.27	0.45
$10.1V \leq V_{OUT} \leq 14.0V$	0.30	0.50

## VD part

- Test Conditions for Output Current

Detector Threshold Voltage -V <sub>DET</sub> (V)	Conditions
$2.3V \leq (-V_{DET}) \leq 15.0V$	V <sub>IN</sub> =2V, V <sub>DS</sub> =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

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V <sub>IN</sub>	Input Voltage				24.0	V
I <sub>SS</sub>	Supply Current	V <sub>OUT</sub> ≥ (-V <sub>DET</sub> ): V <sub>IN</sub> =SENSE=V <sub>OUT</sub> +2.0V V <sub>OUT</sub> < (-V <sub>DET</sub> ): V <sub>IN</sub> =SENSE=(-V <sub>DET</sub> )+2.0V		7	14	μA
T <sub>TSD</sub>	Thermal Shutdown Temperature	Junction Temperature		150		°C
T <sub>TSR</sub>	Thermal Shutdown Temperature	Junction Temperature		120		°C

## VR

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V <sub>OUT</sub>	Output Voltage	V <sub>IN</sub> =V <sub>OUT</sub> +2.0V I <sub>OUT</sub> =20mA	×0.98		×1.02	V
I <sub>OUT1</sub>	Output Current	V <sub>IN</sub> =V <sub>OUT</sub> +2.0V	Refer to Output Current Table			
ΔV <sub>OUT</sub> /ΔI <sub>OUT</sub>	Load Regulation	V <sub>IN</sub> =V <sub>OUT</sub> +2.0V 1mA ≤ I <sub>OUT</sub> ≤ 40mA	Refer to Load Regulation Table			
ΔV <sub>OUT</sub> /ΔV <sub>IN</sub>	Line Regulation	I <sub>OUT</sub> =20mA V <sub>OUT</sub> +1V ≤ V <sub>IN</sub> ≤ 24V		0.05	0.15	%/V
V <sub>DIF</sub>	Dropout Voltage	I <sub>OUT</sub> =20mA	Refer to Dropout Voltage Table			
ΔV <sub>OUT</sub> /ΔT <sub>opt</sub>	Output Voltage Temperature Coefficient	V <sub>IN</sub> =V <sub>OUT</sub> +2.0V I <sub>OUT</sub> =20mA -40°C ≤ T <sub>opt</sub> ≤ 85°C		±100		ppm/°C
I <sub>SC</sub>	Short Current Limit	V <sub>OUT</sub> =0V		45		mA

## VD

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
-V <sub>DET</sub>	Detector Threshold		×0.975		×1.025	V
V <sub>HYS</sub>	Detector Threshold Hysteresis		-V <sub>DET</sub> ×0.03	-V <sub>DET</sub> ×0.05	-V <sub>DET</sub> ×0.07	V
I <sub>OUT2</sub>	Output Current (Driver Output Pin)	Refer to Test Conditions for Output Current Table	0.17			mA
V <sub>DDL</sub>	Minimum Operating Voltage	*Note 1		0.9	1.2	V
Δ-V <sub>DET</sub> /ΔT <sub>opt</sub>	Detector Threshold Temperature Coefficient	-40°C ≤ T <sub>opt</sub> ≤ 85°C		±100		ppm/°C
t <sub>PLH</sub>	Output Delay Time	*Note 2		1.0	1.5	ms

Note 1) This item means V<sub>DD</sub> Voltage when Output Voltage is equal or less than 0.1V.  
(Pull-up Resistor=470kΩ, Pull up Voltage=5V)

Note 2) V<sub>DET</sub> pin is pulled up to V<sub>DD</sub> via 470kΩ. t<sub>PLH</sub> means time interval from rising edge of V<sub>DD</sub> from (-V<sub>DET</sub>)-2.0V to (-V<sub>DET</sub>)+2.0V to the point of Output Voltage being 80% of pull-up voltage.

- Output Current (Topt=25°C)

Output Voltage V <sub>OUT</sub> (V)	Output Current (mA)	
	Min.	Typ.
2.1V ≤ V <sub>OUT</sub> ≤ 2.9V	90	140
3.0V ≤ V <sub>OUT</sub> ≤ 4.0V	120	170
4.1V ≤ V <sub>OUT</sub> ≤ 14.0V	150	200

## VR part

- Load Regulation (Topt=25°C)

Output Voltage V <sub>OUT</sub> (V)	Load Regulation (mV)	
	Typ.	Max.
2.1V ≤ V <sub>OUT</sub> ≤ 3.0V	15	35
3.1V ≤ V <sub>OUT</sub> ≤ 5.0V	25	45
5.1V ≤ V <sub>OUT</sub> ≤ 10.0V	40	65
10.1V ≤ V <sub>OUT</sub> ≤ 14.0V	50	80

- Dropout Voltage (Topt=25°C)

Output Voltage V <sub>OUT</sub> (V)	Dropout Voltage (V)	
	Typ.	Max.
2.1V ≤ V <sub>OUT</sub> ≤ 2.4V	0.40	0.60
2.5V ≤ V <sub>OUT</sub> ≤ 3.0V	0.30	0.40
3.1V ≤ V <sub>OUT</sub> ≤ 7.0V	0.25	0.35
7.1V ≤ V <sub>OUT</sub> ≤ 10.0V	0.27	0.45
10.1V ≤ V <sub>OUT</sub> ≤ 14.0V	0.30	0.50

## VD part

- Test Conditions for Output Current

Detector Threshold Voltage -V <sub>DET</sub> (V)	Conditions
2.1V ≤ (-V <sub>DET</sub> ) ≤ 15.0V	V <sub>IN</sub> =2V, V <sub>DS</sub> =0.05V
(-V <sub>DET</sub> )=2.0	V <sub>IN</sub> =1.9V, V <sub>DS</sub> =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

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V <sub>IN</sub>	Input Voltage				24.0	V
I <sub>SS</sub>	Supply Current	V <sub>OUT</sub> ≥ (-V <sub>DET</sub> ): V <sub>IN</sub> =V <sub>OUT</sub> +2.0V V <sub>OUT</sub> < (-V <sub>DET</sub> ): V <sub>IN</sub> =(-V <sub>DET</sub> )+2.0V		7	14	μA
T <sub>TSD</sub>	Thermal Shutdown Temperature	Junction Temperature		150		°C
T <sub>TSR</sub>	Thermal Shutdown Released Temperature	Junction Temperature		120		°C

## VR

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V <sub>OUT</sub>	Output Voltage	V <sub>IN</sub> =V <sub>OUT</sub> +2.0V I <sub>OUT</sub> =20mA	×0.98		×1.02	V
I <sub>OUT1</sub>	Output Current	V <sub>IN</sub> =V <sub>OUT</sub> +2.0V	Refer to Output Current Table			
ΔV <sub>OUT</sub> /ΔI <sub>OUT</sub>	Load Regulation	V <sub>IN</sub> =V <sub>OUT</sub> +2.0V 1mA ≤ I <sub>OUT</sub> ≤ 40mA	Refer to Load Regulation Table			
ΔV <sub>OUT</sub> /ΔV <sub>IN</sub>	Line Regulation	I <sub>OUT</sub> =20mA V <sub>OUT</sub> +1V ≤ V <sub>IN</sub> ≤ 24V		0.05	0.15	%/V
V <sub>DIF</sub>	Dropout Voltage	I <sub>OUT</sub> =20mA	Refer to Dropout Voltage Table			
ΔV <sub>OUT</sub> /ΔT <sub>opt</sub>	Output Voltage Temperature Coefficient	V <sub>IN</sub> =V <sub>OUT</sub> +2.0V I <sub>OUT</sub> =20mA -40°C ≤ T <sub>opt</sub> ≤ 85°C		±100		ppm/°C
I <sub>SC</sub>	Short Current Limit	V <sub>OUT</sub> =0V		45		mA

## VD

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
-V <sub>DET</sub>	Detector Threshold		×0.975		×1.025	V
V <sub>HYS</sub>	Detector Threshold Hysteresis		-V <sub>DET</sub> ×0.03	-V <sub>DET</sub> ×0.05	-V <sub>DET</sub> ×0.07	V
I <sub>OUT2</sub>	Output Current (Driver Output Pin)	Refer to Test Conditions for Output Current Table	0.17			mA
V <sub>DDL</sub>	Minimum Operating Voltage	*Note 1		0.9	1.2	V
Δ-V <sub>DET</sub> /ΔT <sub>opt</sub>	Detector Threshold Temperature Coefficient	-40°C ≤ T <sub>opt</sub> ≤ 85°C		±100		ppm/°C
t <sub>PLH</sub>	Output Delay Time	C <sub>D</sub> =4.7nF, *Note 2	20	30	50	ms

Note 1) This item means V<sub>DD</sub> Voltage when Output Voltage is equal or less than 0.1V.  
(Pull-up Resistor=470kΩ, Pull up Voltage=5V)

Note 2) V<sub>DET</sub> pin is pulled up to V<sub>DD</sub> via 470kΩ. t<sub>PLH</sub> means time interval from rising edge of V<sub>DD</sub> from (-V<sub>DET</sub>)-2.0V to (-V<sub>DET</sub>)+2.0V to the point of Output Voltage being 80% of pull-up voltage.

- Output Current (T<sub>opt</sub>=25°C)

Output Voltage V <sub>OUT</sub> (V)	Output Current (mA)	
	Min.	Typ.
2.1V ≤ V <sub>OUT</sub> ≤ 2.9V	90	140
3.0V ≤ V <sub>OUT</sub> ≤ 4.0V	120	170
4.1V ≤ V <sub>OUT</sub> ≤ 14.0V	150	200

- Load Regulation (T<sub>opt</sub>=25°C)

Output Voltage V <sub>OUT</sub> (V)	Load Regulation (mV)	
	Typ.	Max.
2.1V ≤ V <sub>OUT</sub> ≤ 3.0V	15	35
3.1V ≤ V <sub>OUT</sub> ≤ 5.0V	25	45
5.1V ≤ V <sub>OUT</sub> ≤ 10.0V	40	65
10.1V ≤ V <sub>OUT</sub> ≤ 14.0V	50	80

- Dropout Voltage (T<sub>opt</sub>=25°C)

Output Voltage V <sub>OUT</sub> (V)	Dropout Voltage (V)	
	Typ.	Max.
2.1V ≤ V <sub>OUT</sub> ≤ 2.4V	0.40	0.60
2.5V ≤ V <sub>OUT</sub> ≤ 3.0V	0.30	0.40
3.1V ≤ V <sub>OUT</sub> ≤ 7.0V	0.25	0.35
7.1V ≤ V <sub>OUT</sub> ≤ 10.0V	0.27	0.45
10.1V ≤ V <sub>OUT</sub> ≤ 14.0V	0.30	0.50

- Test Conditions for Output Current

Detector Threshold Voltage -V <sub>DET</sub> (V)	Conditions
2.1V ≤ (-V <sub>DET</sub> ) ≤ 15.0V	V <sub>IN</sub> =2V, V <sub>DS</sub> =0.05V
(-V <sub>DET</sub> )=2.0	V <sub>IN</sub> =1.9V, V <sub>DS</sub> =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

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V <sub>IN</sub>	Input Voltage				24.0	V
I <sub>SS</sub>	Supply Current	V <sub>IN</sub> =V <sub>OUT</sub> +2.0V		7	14	μA
T <sub>SD</sub>	Thermal Shutdown Temperature			150		°C
T <sub>SR</sub>	Thermal Shutdown Released Temperature	Junction Temperature		120		°C

## VR

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V <sub>OUT</sub>	Output Voltage	V <sub>IN</sub> =V <sub>OUT</sub> +2.0V I <sub>OUT</sub> =20mA	×0.98		×1.02	V
I <sub>OUT</sub>	Output Current	V <sub>IN</sub> =V <sub>OUT</sub> +2.0V	Refer to Output Current Table			
ΔV <sub>OUT</sub> /ΔI <sub>OUT</sub>	Load Regulation	V <sub>IN</sub> =V <sub>OUT</sub> +2.0V 1mA ≤ I <sub>OUT</sub> ≤ 40mA	Refer to Load Regulation Table			
ΔV <sub>OUT</sub> /ΔV <sub>IN</sub>	Line Regulation	I <sub>OUT</sub> =20mA V <sub>OUT</sub> +1V ≤ V <sub>IN</sub> ≤ 24V		0.05	0.15	%/V
V <sub>DIF</sub>	Dropout Voltage	I <sub>OUT</sub> =20mA	Refer to Dropout Voltage Table			
ΔV <sub>OUT</sub> /ΔT <sub>opt</sub>	Output Voltage Temperature Coefficient	V <sub>IN</sub> =V <sub>OUT</sub> +2.0V I <sub>OUT</sub> =20mA -40°C ≤ T <sub>opt</sub> ≤ 85°C		±100		ppm/°C
I <sub>SC</sub>	Short Current Limit	V <sub>OUT</sub> =0V		45		mA

## VD

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
-V <sub>DET</sub>	Detector Threshold		×0.975		×1.025	V
V <sub>HYS</sub>	Detector Threshold Hysteresis		-V <sub>DET</sub> ×0.03	-V <sub>DET</sub> ×0.05	-V <sub>DET</sub> ×0.07	V
I <sub>OUT2</sub>	Output Current (Driver Output Pin)	Refer to Test Conditions for Output Current Table	0.17			mA
V <sub>DDL</sub>	Minimum Operating Voltage	*Note 1		0.9	1.2	V
Δ-V <sub>DET</sub> /ΔT <sub>opt</sub>	Detector Threshold Temperature Coefficient	-40°C ≤ T <sub>opt</sub> ≤ 85°C		±100		ppm/°C
t <sub>PLH</sub>	Output Delay Time	C <sub>D</sub> =4.7nF, *Note 2	20	30	50	ms
	Release Margin	V <sub>OUT</sub> -0.2-(-V <sub>DET</sub> )-V <sub>HYS</sub>	50			mV

Note 1) This item means V<sub>DD</sub> Voltage when Output Voltage is equal or less than 0.1V.  
(Pull-up Resistor=470kΩ, Pull up Voltage=5V)

Note 2) V<sub>DET</sub> pin is pulled up to V<sub>DD</sub> via 470kΩ. t<sub>PLH</sub> means time interval from rising edge of V<sub>DD</sub> from (-V<sub>DET</sub>)-2.0V to (-V<sub>DET</sub>)+2.0V to the point of Output Voltage being 80% of pull-up voltage.

- Output Current (T<sub>opt</sub>=25°C)

Output Voltage V <sub>OUT</sub> (V)	Output Current (mA)	
	Min.	Typ.
2.1V ≤ V <sub>OUT</sub> ≤ 2.9V	90	140
3.0V ≤ V <sub>OUT</sub> ≤ 4.0V	120	170
4.1V ≤ V <sub>OUT</sub> ≤ 14.0V	150	200

- Load Regulation (T<sub>opt</sub>=25°C)

Output Voltage V <sub>OUT</sub> (V)	Load Regulation (mV)	
	Typ.	Max.
2.1V ≤ V <sub>OUT</sub> ≤ 3.0V	15	35
3.1V ≤ V <sub>OUT</sub> ≤ 5.0V	25	45
5.1V ≤ V <sub>OUT</sub> ≤ 10.0V	40	65
10.1V ≤ V <sub>OUT</sub> ≤ 14.0V	50	80

- Dropout Voltage (T<sub>opt</sub>=25°C)

Output Voltage V <sub>OUT</sub> (V)	Dropout Voltage (V)	
	Typ.	Max.
2.1V ≤ V <sub>OUT</sub> ≤ 2.4V	0.40	0.60
2.5V ≤ V <sub>OUT</sub> ≤ 3.0V	0.30	0.40
3.1V ≤ V <sub>OUT</sub> ≤ 7.0V	0.25	0.35
7.1V ≤ V <sub>OUT</sub> ≤ 10.0V	0.27	0.45
10.1V ≤ V <sub>OUT</sub> ≤ 14.0V	0.30	0.50

- Test Conditions for Output Current

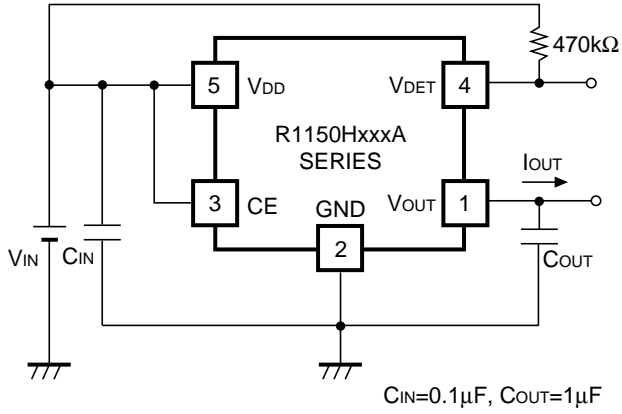
Detector Threshold Voltage -V <sub>DET</sub> (V)	Conditions
2.1V ≤ (-V <sub>DET</sub> ) ≤ 15.0V	V <sub>IN</sub> =2V, V <sub>DS</sub> =0.05V
(-V <sub>DET</sub> )=2.0	V <sub>IN</sub> =1.9V, V <sub>DS</sub> =0.05V

#### RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)

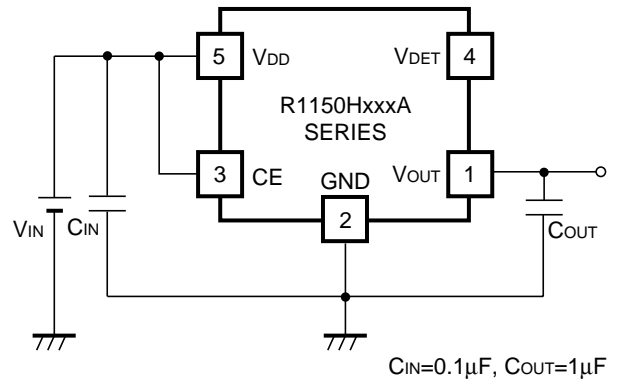
All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic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

## TEST CIRCUITS

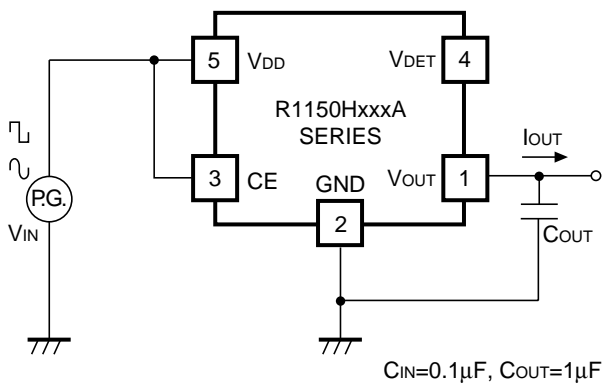
• R1150HxxxA



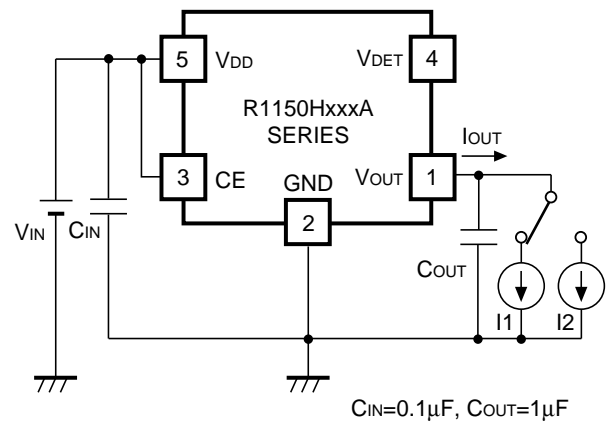
**Standard Test Circuit**



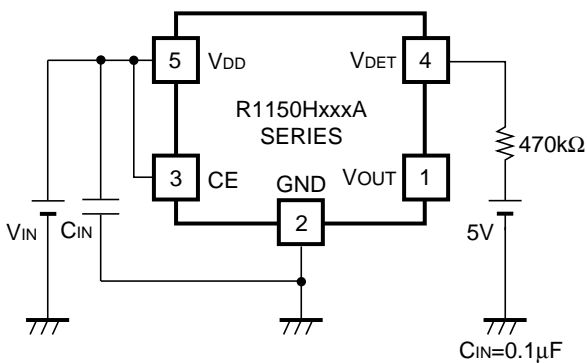
**Supply Current Test Circuit**



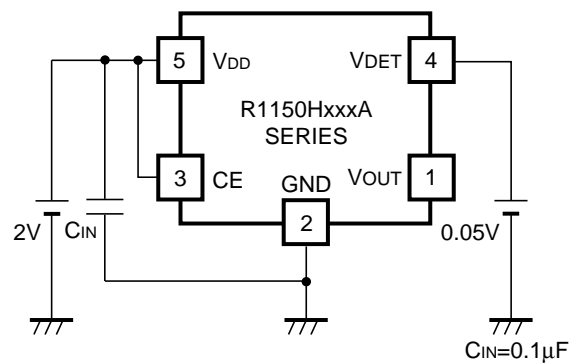
**Input Transient Response/  
Ripple Rejection Test Circuit**



**Load Transient Response Test Circuit**

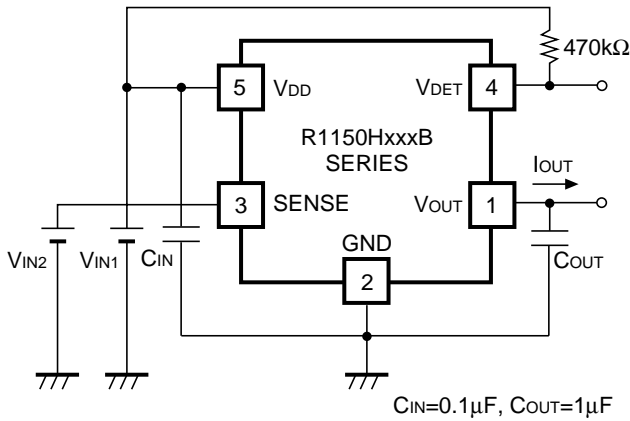


**Minimum Operating Voltage Test Circuit**

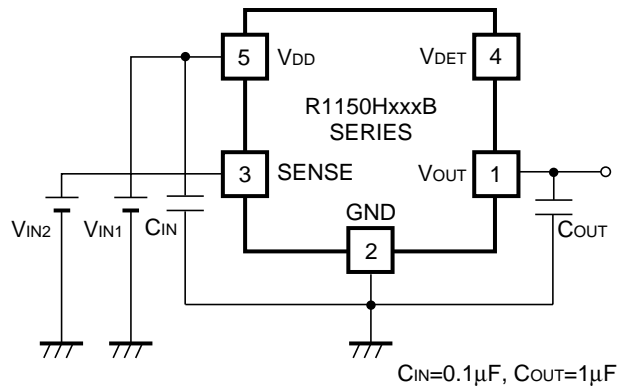


**VD Output Current Test Circuit**

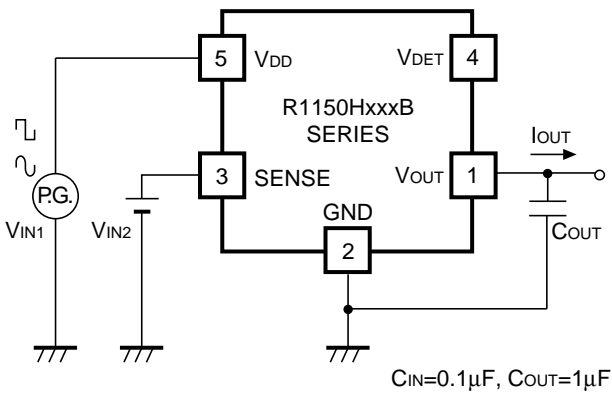
• R1150HxxxB



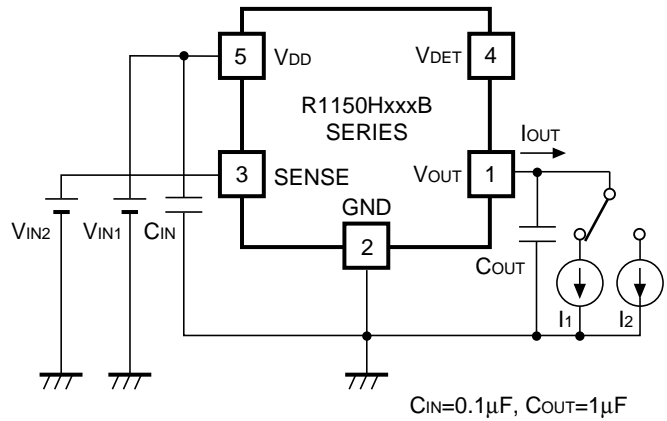
Standard Test Circuit



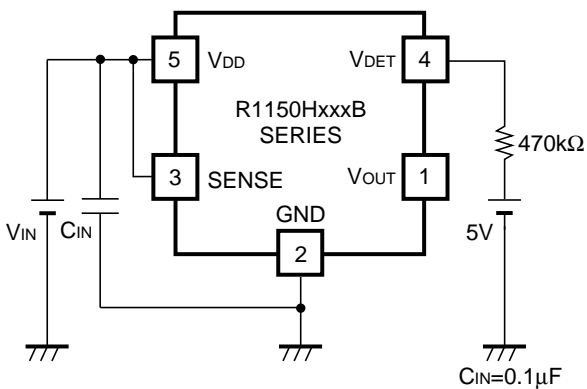
Supply Current Test Circuit



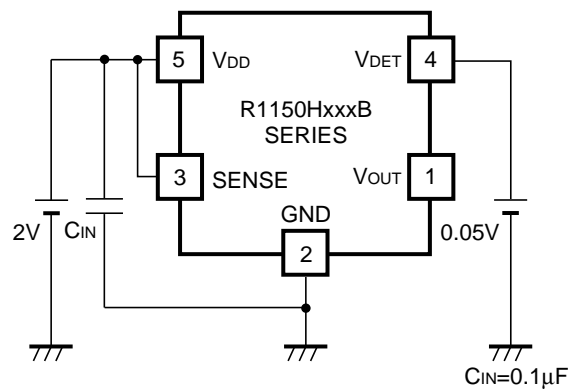
Input Transient Response/  
Ripple Rejection Test Circuit



Load Transient Response Test Circuit

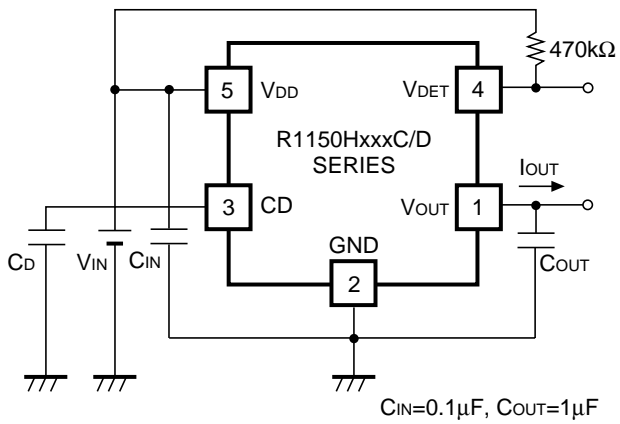


VDET Minimum Operating Voltage Test Circuit

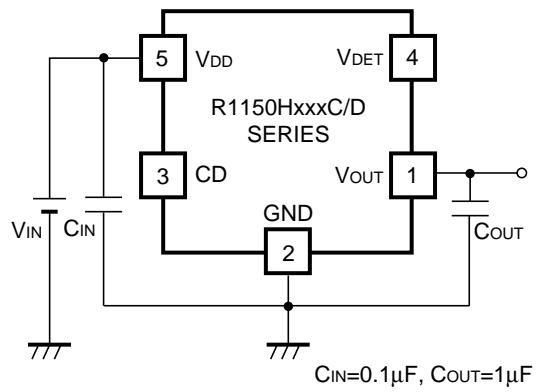


VD Output Current Test Circuit

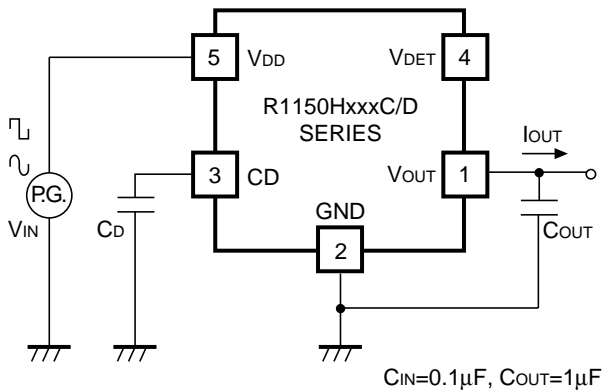
• R1150HxxxC/D



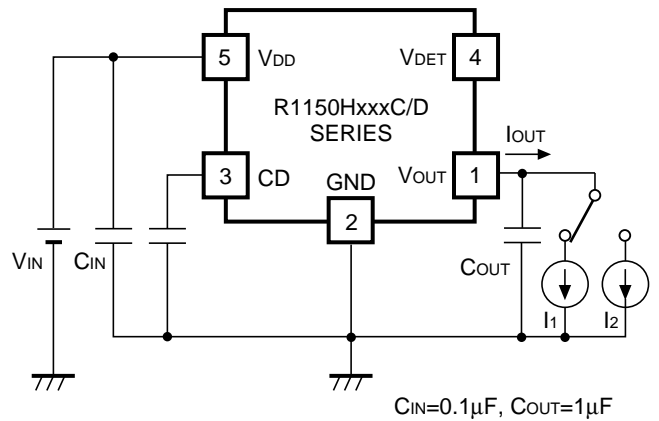
Standard Test Circuit



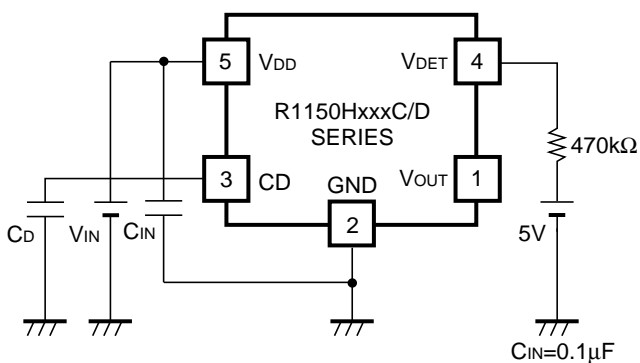
Supply Current Test Circuit



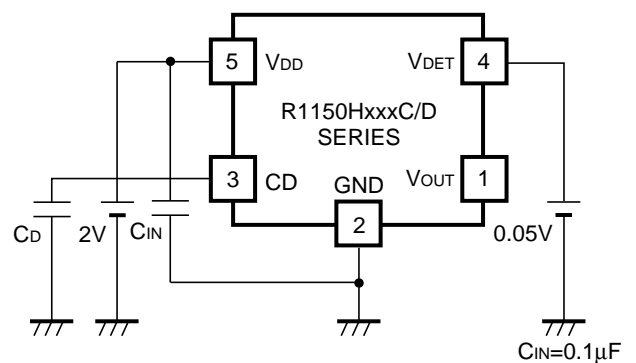
Input Transient Response/  
Ripple Rejection Test Circuit



Load Transient Response Test Circuit



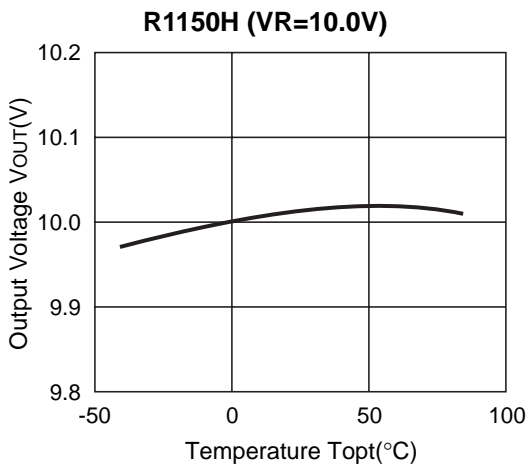
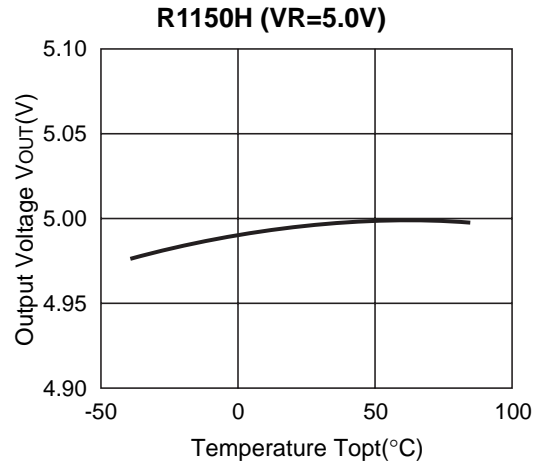
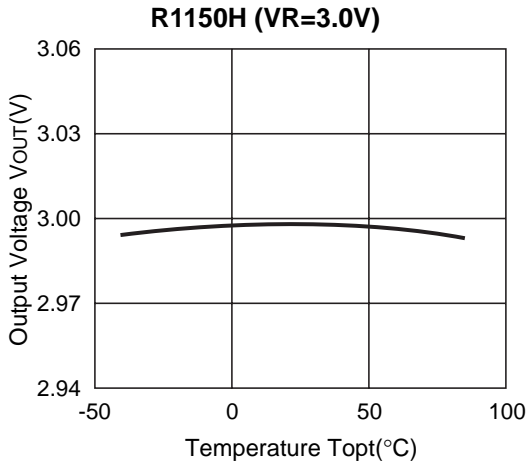
VDET Minimum Operating Voltage Test Circuit



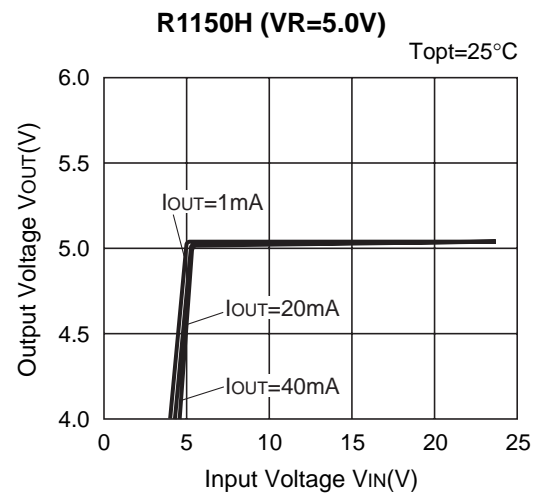
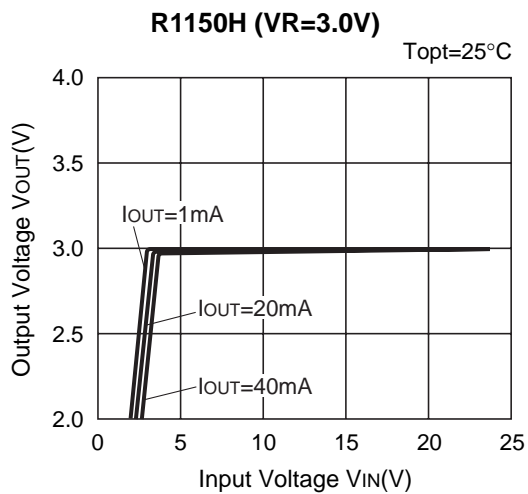
VD Output Current Test Circuit

## TYPICAL CHARACTERISTICS

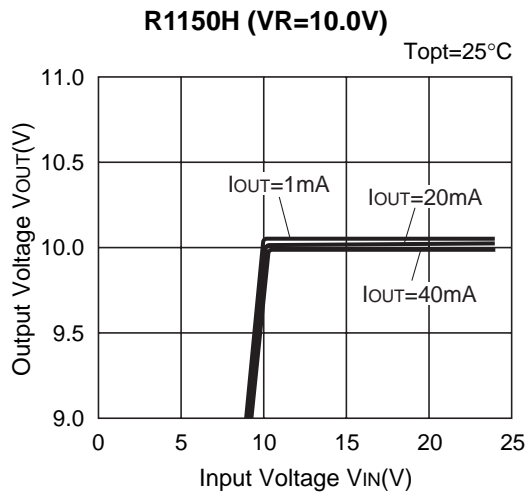
### 1) Output Voltage vs. Temperature



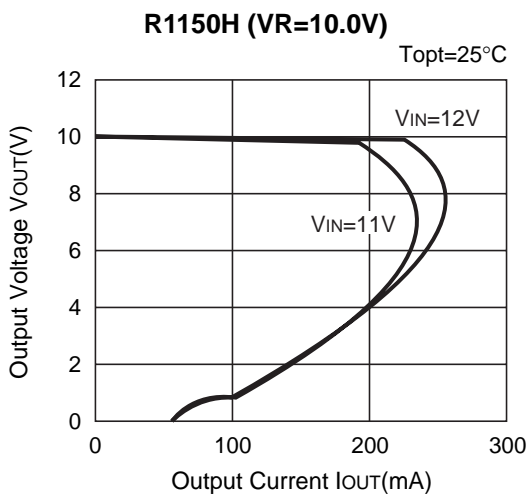
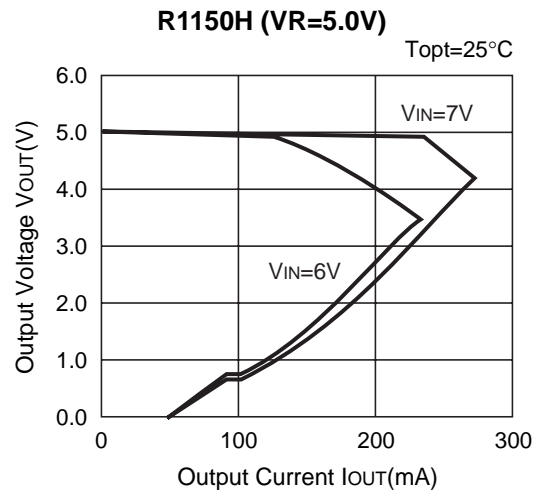
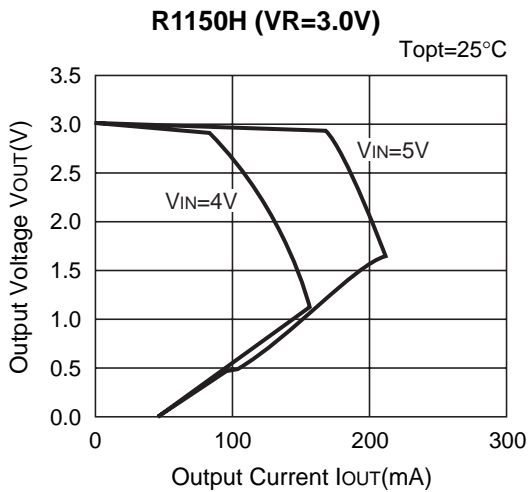
### 2) Output Voltage vs. Input Voltage



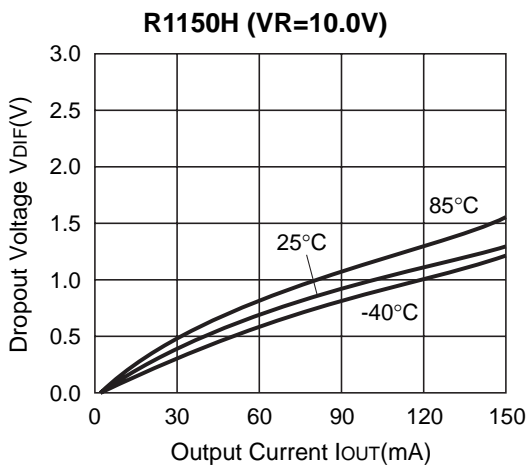
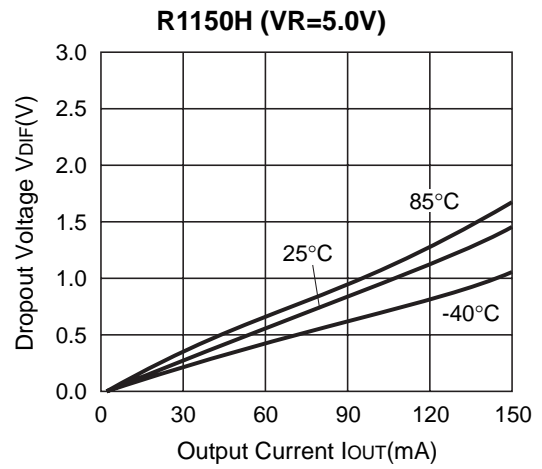
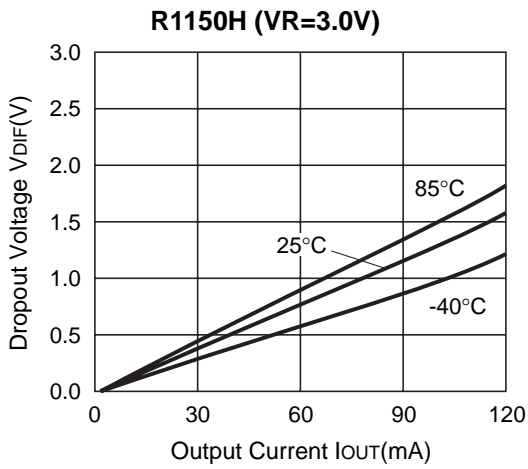




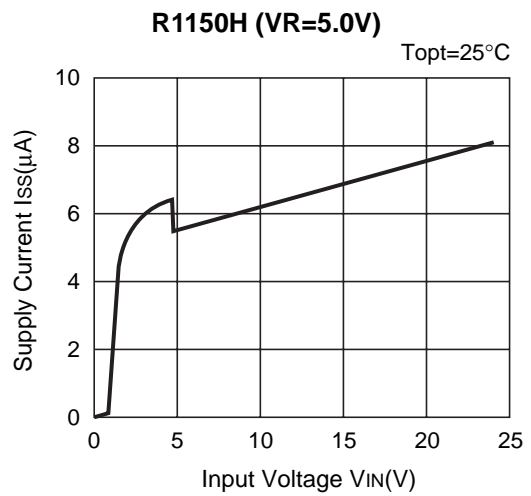
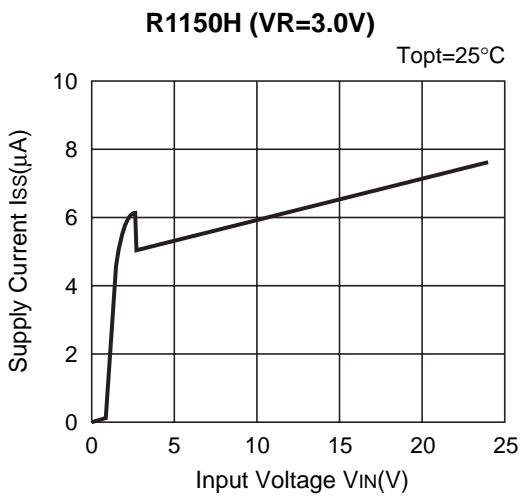
**3) Output Voltage vs. Output Current**

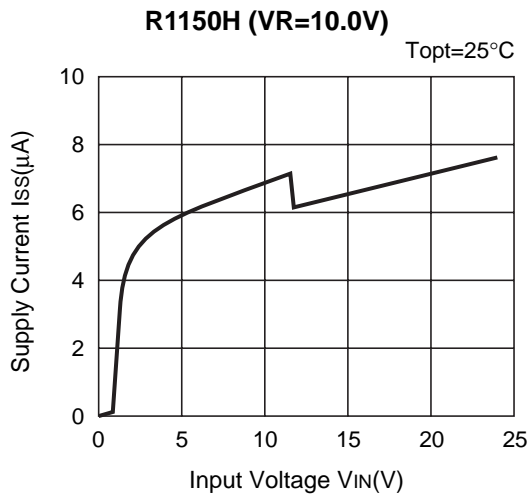


4) Dropout Voltage vs. Output Current

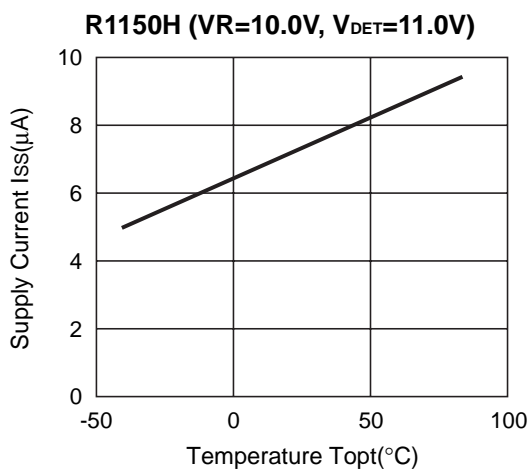
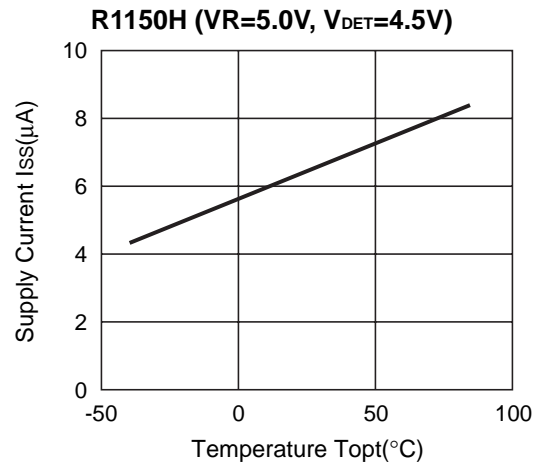
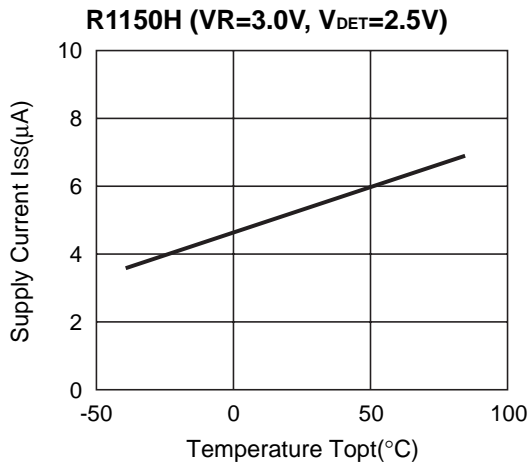


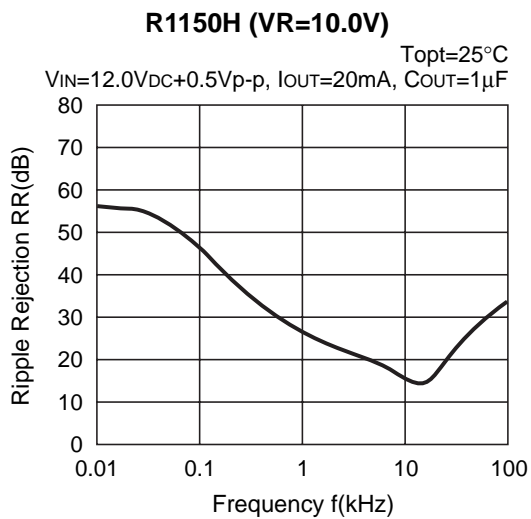
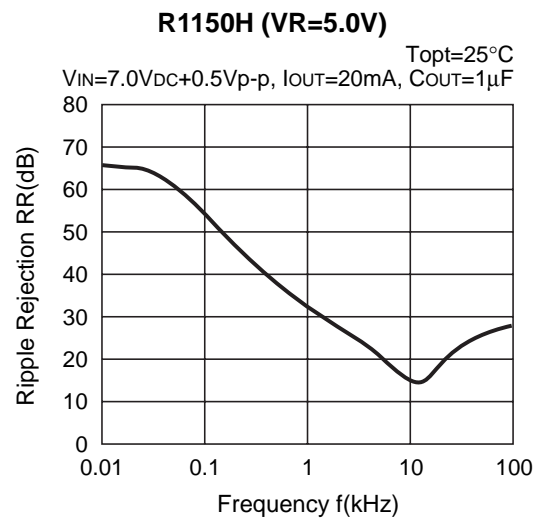
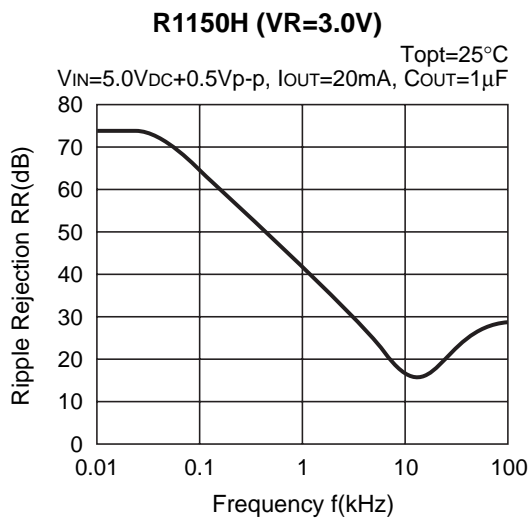
5) Supply Current vs. Input Voltage





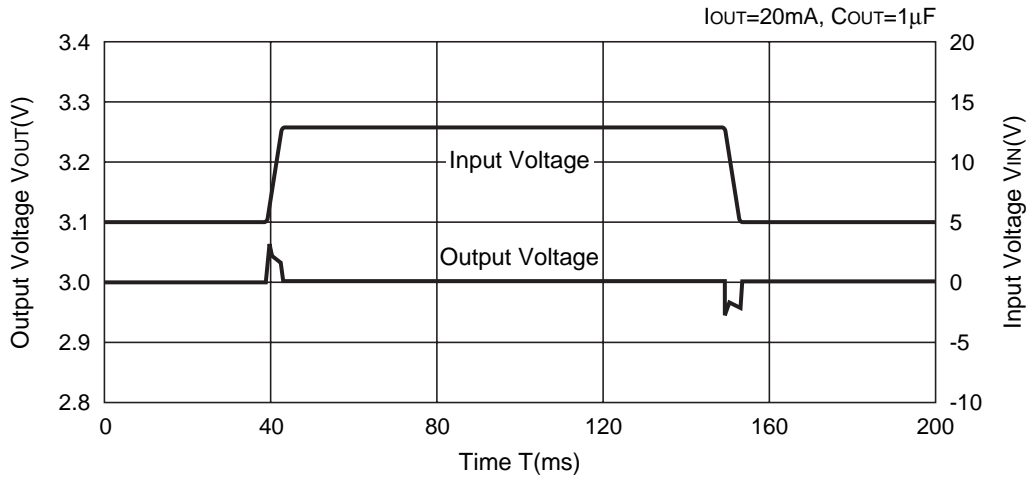
**6) Supply Current vs. Temperature**



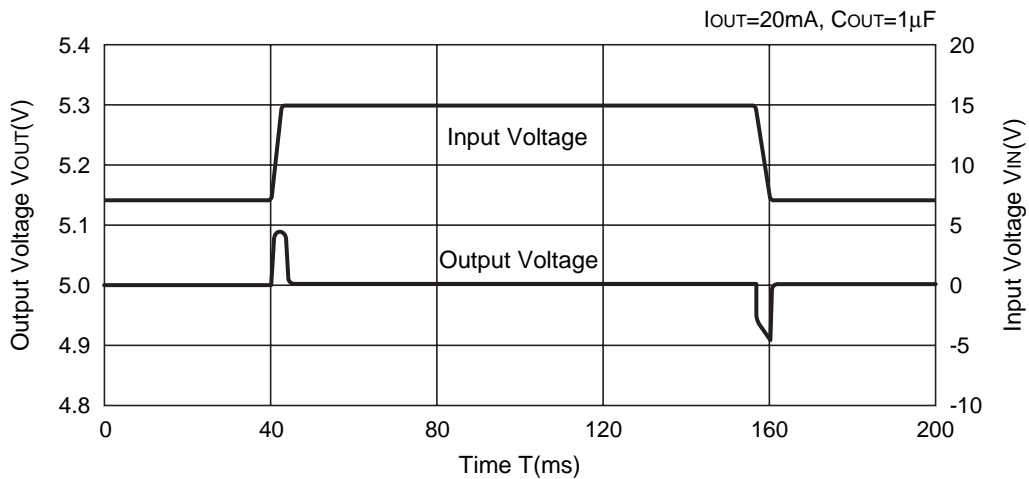
**7) Ripple Rejection vs. Frequency**

8) Input Transient Response

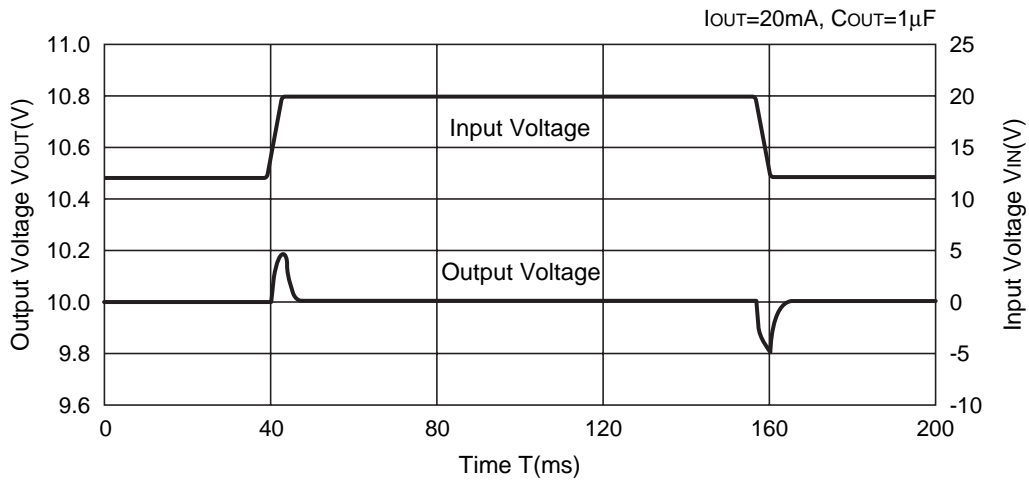
R1150H (VR=3.0V)



R1150H (VR=5.0V)

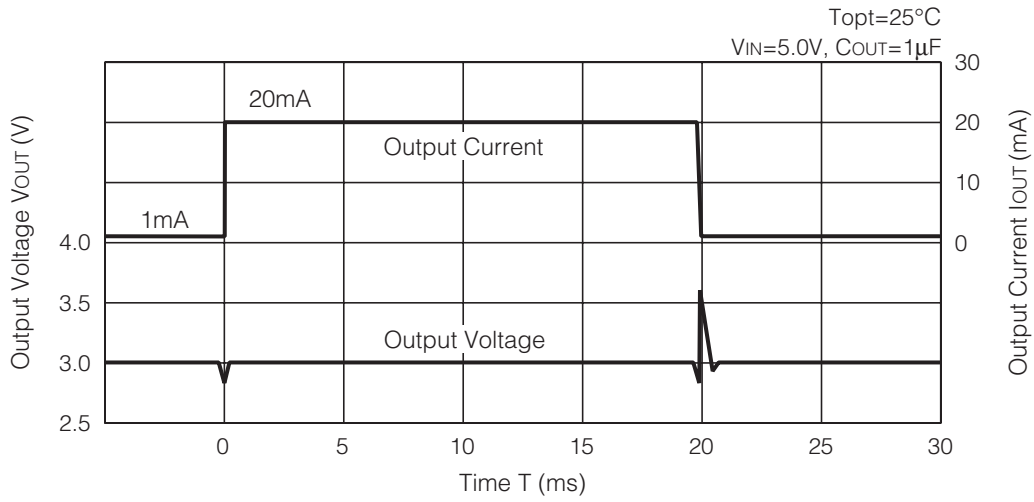


R1150H (VR=10.0V)

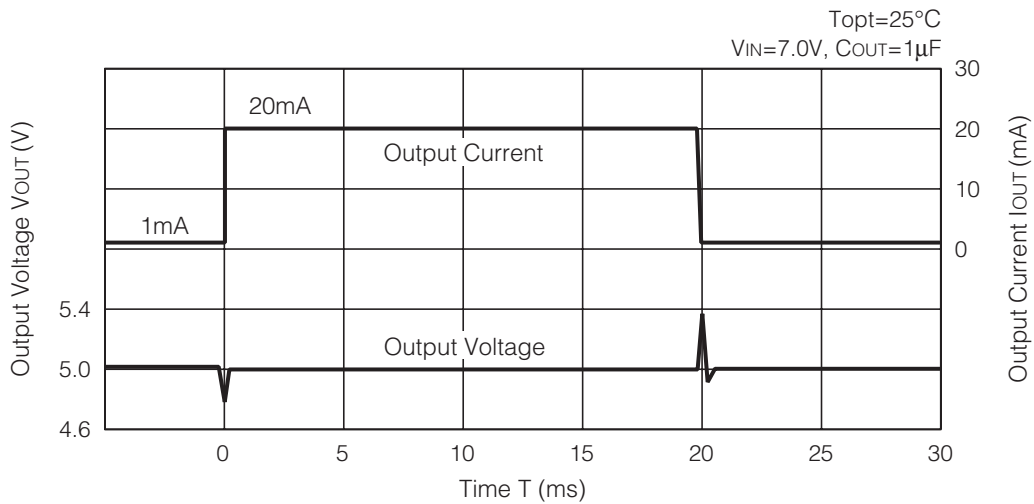


9) Load Transient Response

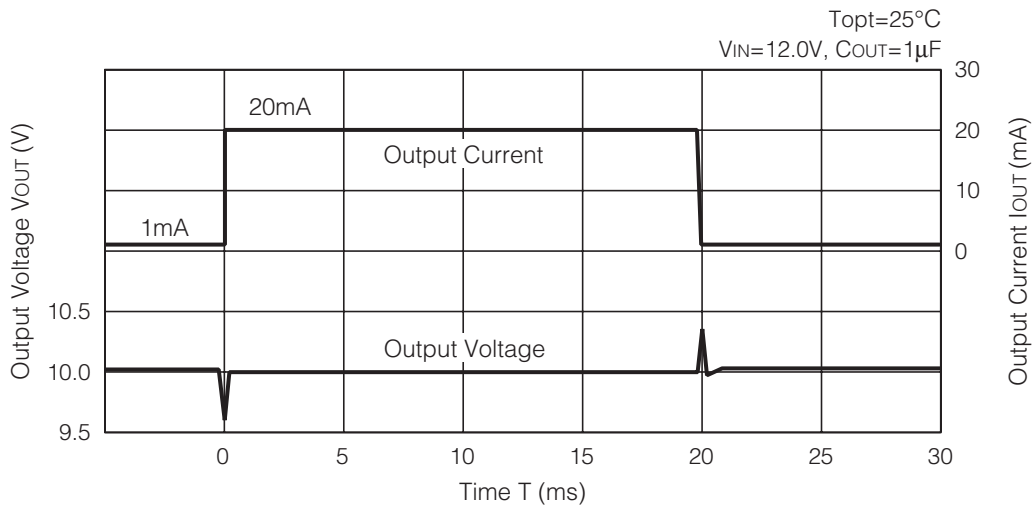
R1150H (VR=3.0V)



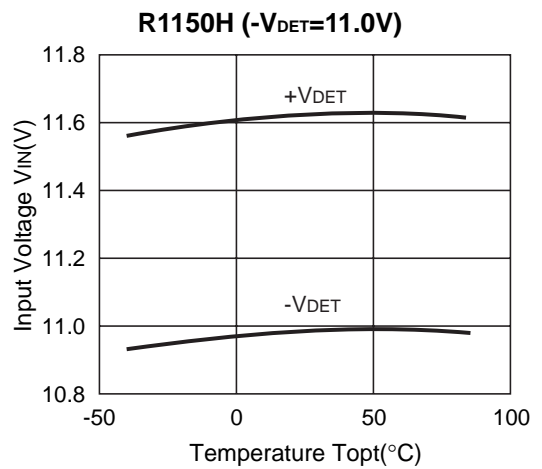
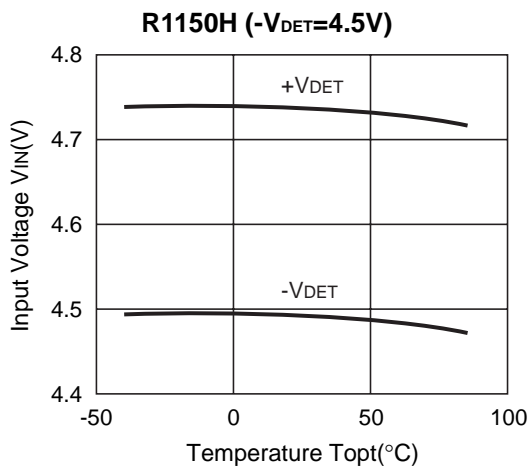
R1150H (VR=5.0V)



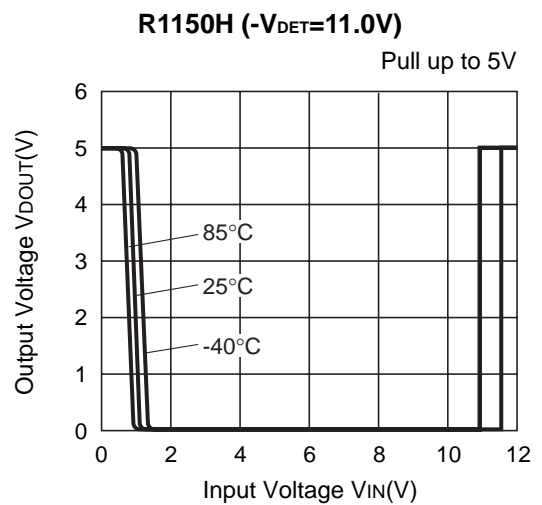
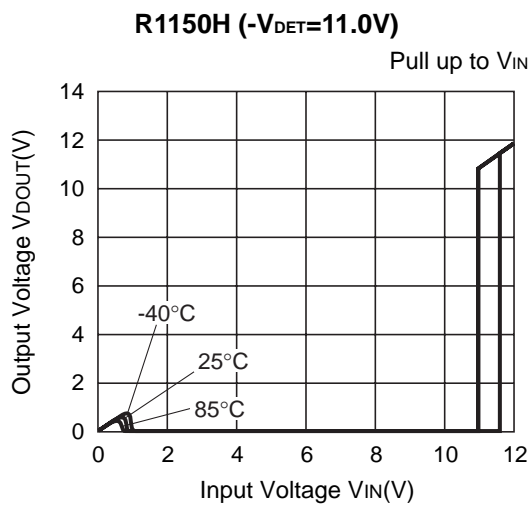
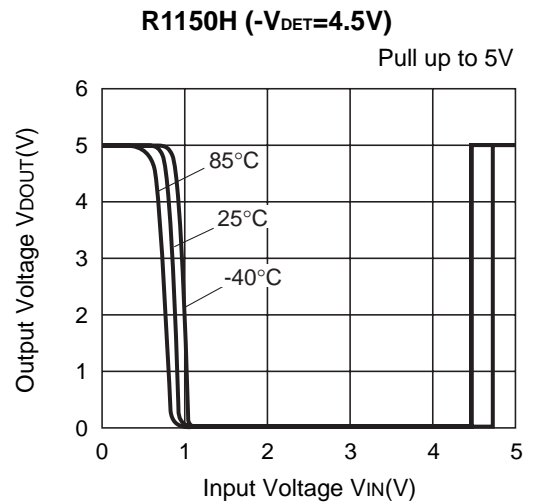
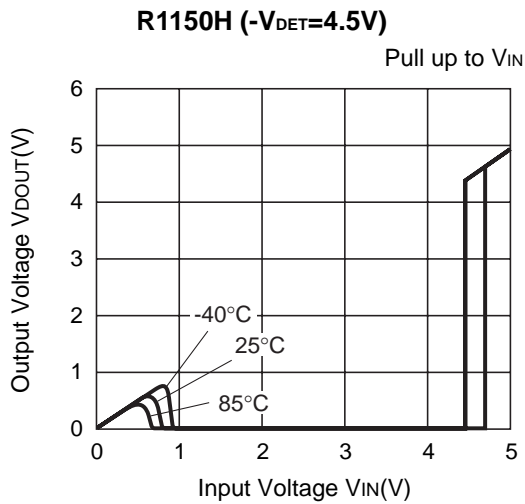
R1150H (VR=10.0V)



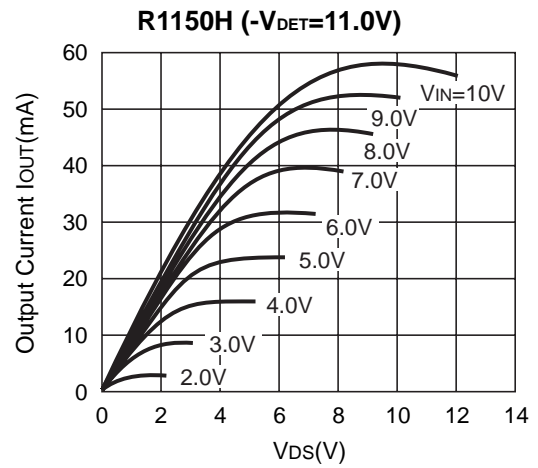
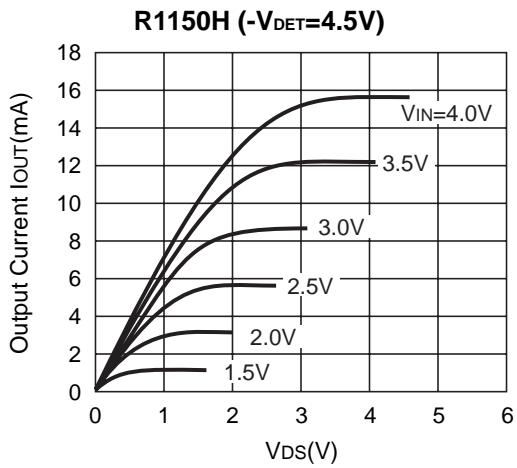
10) Detector Threshold vs. Temperature



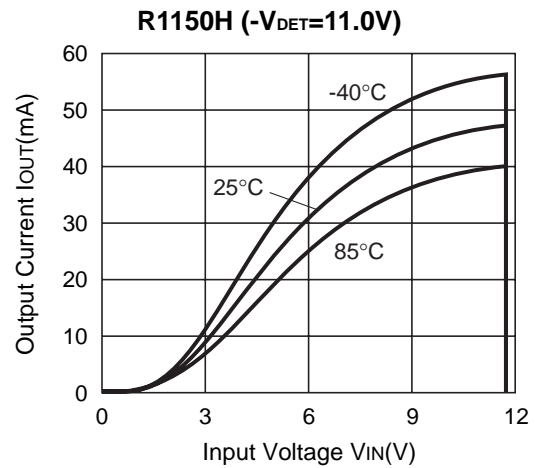
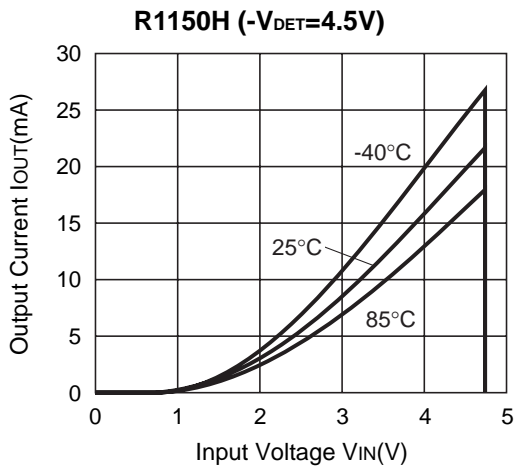
11) Detector Threshold vs. Input Voltage



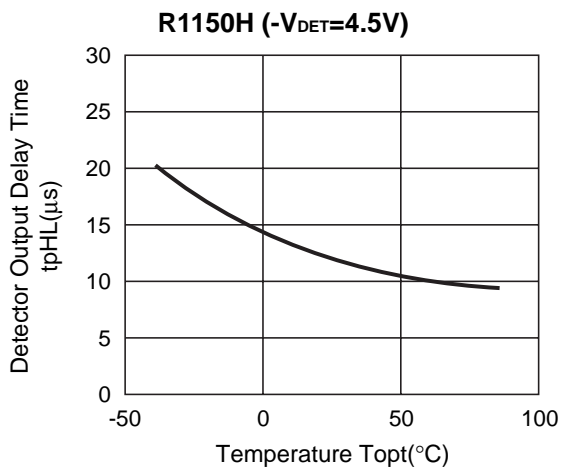
12) Nch Driver Output Current vs.  $V_{DS}$



13) Nch Driver Output Current vs. Input Voltage

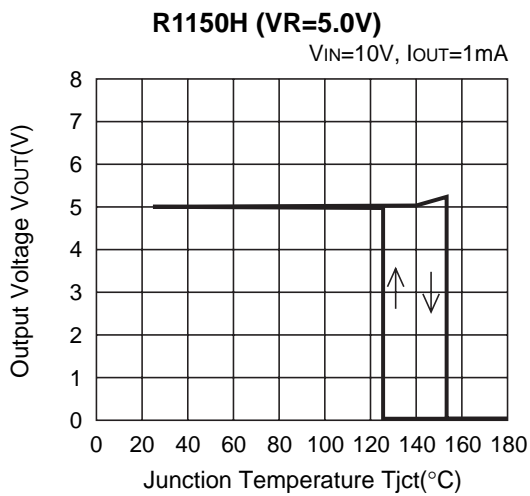


14) Detector Output Delay Time vs. Temperature

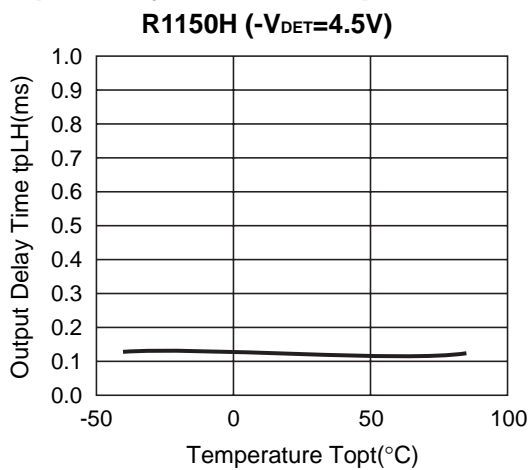




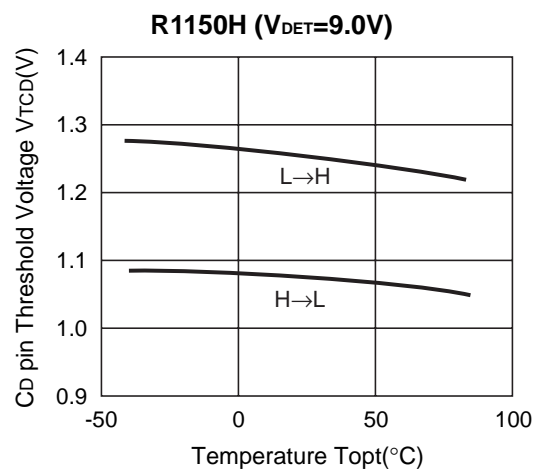
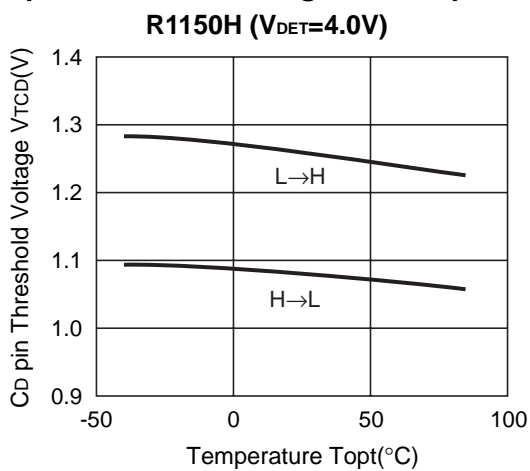
15) Thermal Shutdown Temperature vs. Output Voltage



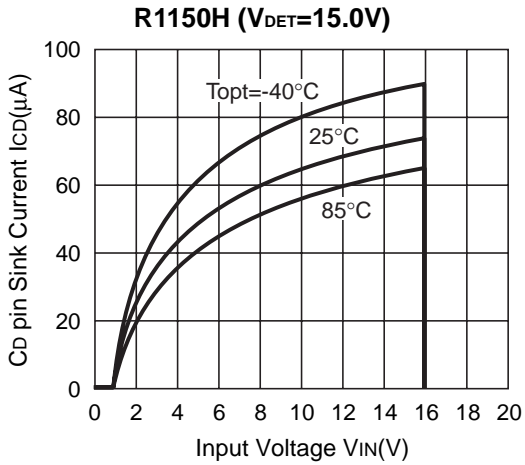
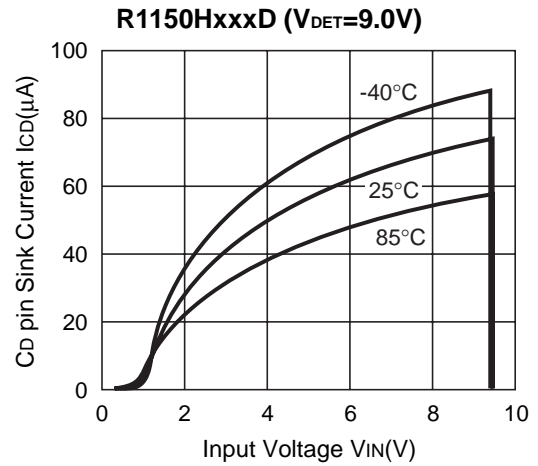
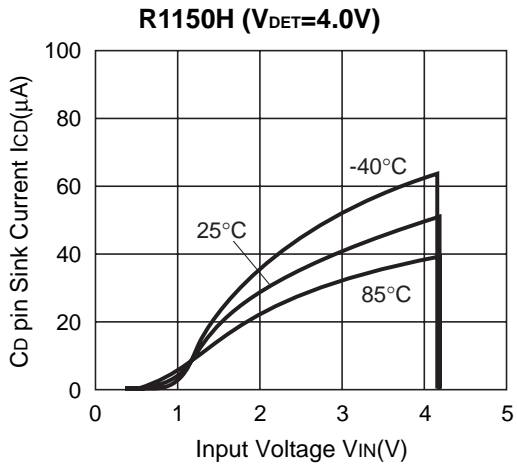
16) Output Delay Time vs. Temperature



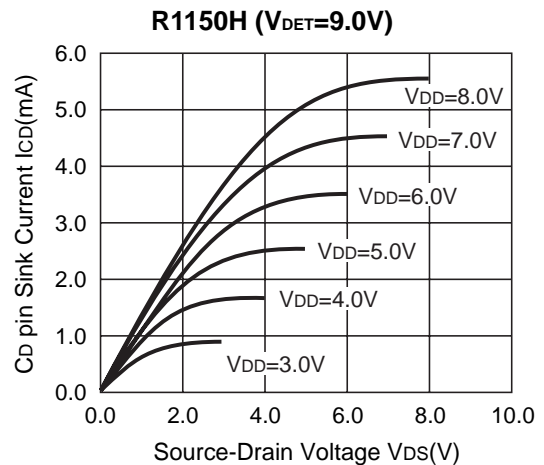
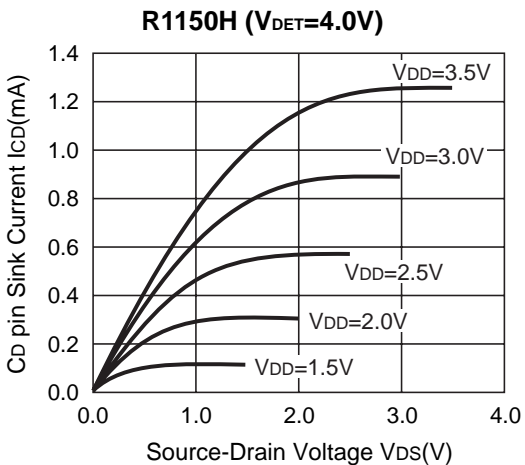
17)  $C_D$  pin Threshold Voltage vs. Temperature

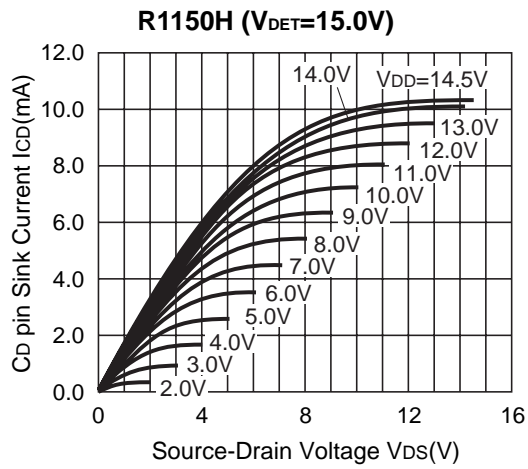


18)  $C_D$  pin Sink Current vs. Input Voltage

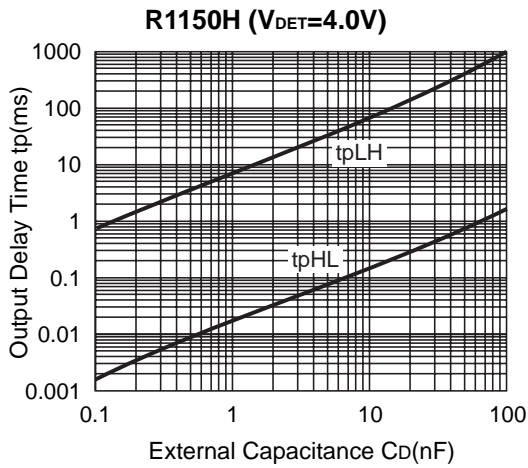


19)  $C_D$  pin Sink Current vs.  $V_{DS}$

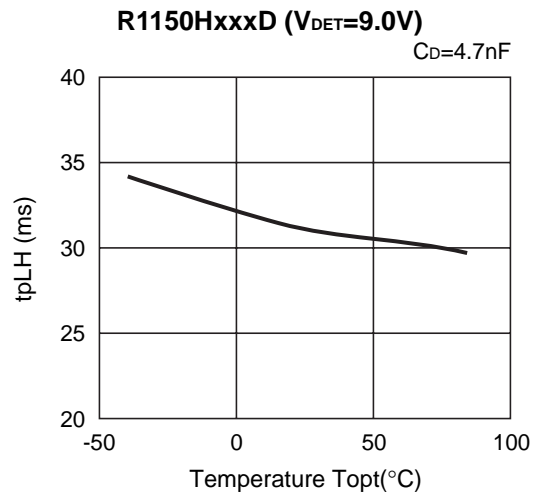
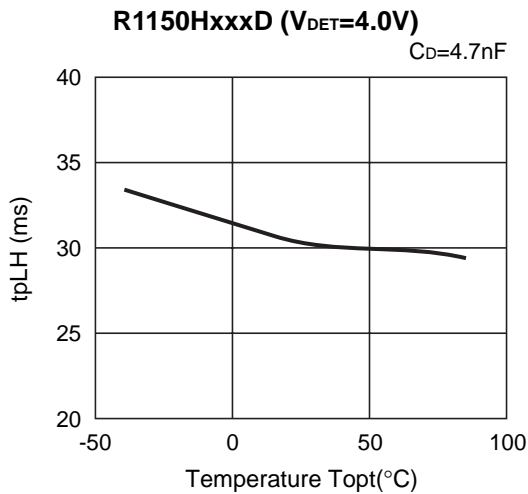




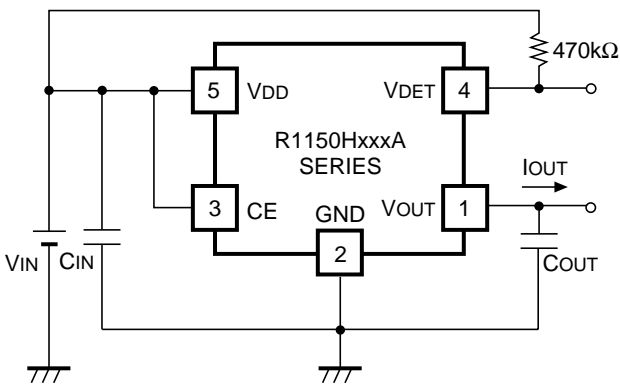
**20) Output Delay Time vs. External Capacitance**



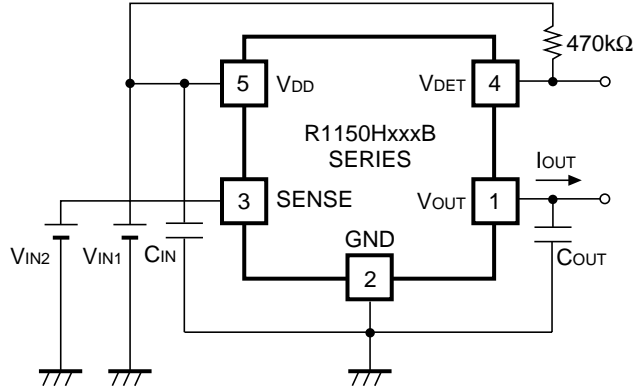
**21) t<sub>PLH</sub>delay vs. Temperature**



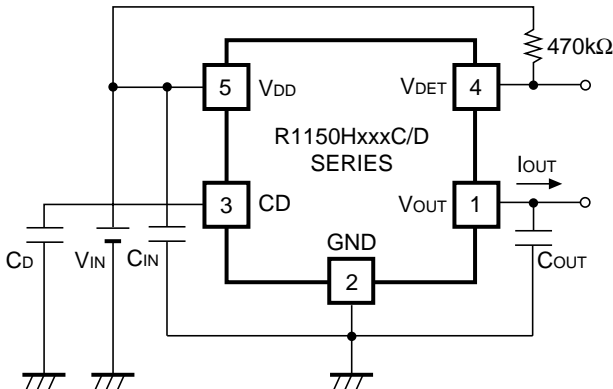
**TYPICAL APPLICATIONS**



**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 0.1 $\mu$ F 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

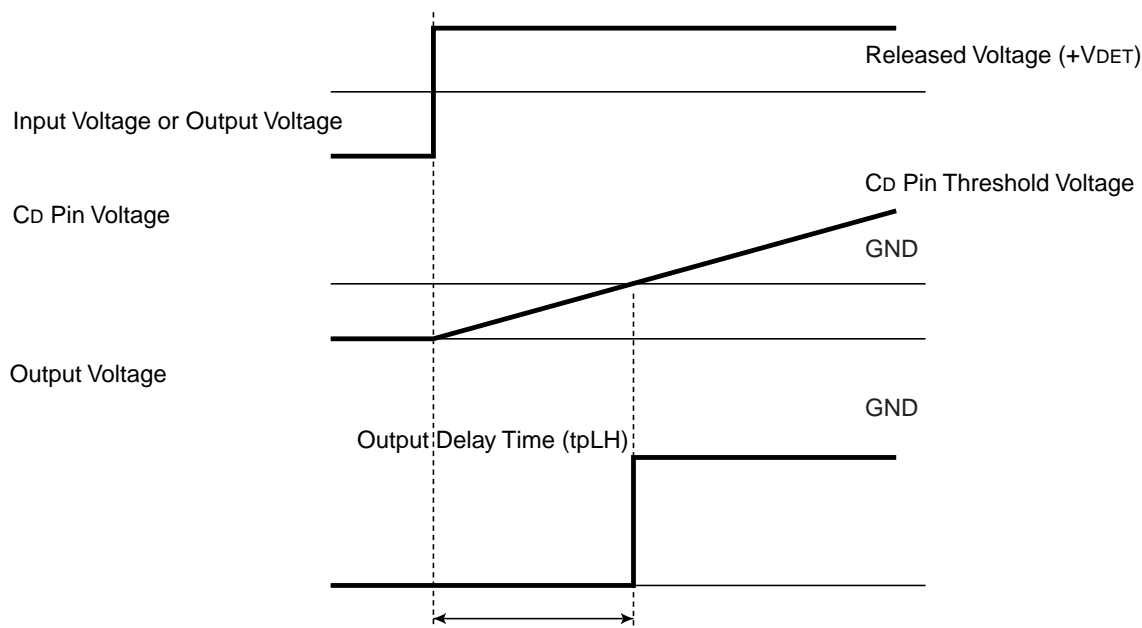
Thermal shutdown function is included in the R1150HxxxA/B/C/D Series, when the junction temperature is equal or more than +150°C (Typ.), the operation of regulator would stop. After that, when the junction temperature is equal or less than +120°C (Typ.), the operation of regulator would restart. Unless 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:

$$t_{PLH} = 1.25/200 \times 10^9 \times C_D \text{ (sec)}$$

### Input Transient Response

If the input transient speed is equal or faster than 80mV/ $\mu$ s 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/ $\mu$ s.



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