AEC-Q100 Compliant

Voltage Regulator with Reset Function for Automotive Applications

No. EC-081-201020

OUTLINE

The R1150H is an input voltage regulator (VR) equipped with a voltage detector (VD). It features low dropout voltage, high output voltage accuracy, and ultra-low supply current. It offers internally fixed output voltages and detection voltages. And it offers a ±2.0% output voltage accuracy and a ±2.5% detection voltage accuracy.
The R1150HxxxA provides a CE pin and the R1150HxxxC/D provides a CD pin. The R1150HxxxC/D is capable of setting a reset delay time by connecting a capacitor to the CD pin. The R1150HxxxA/C is capable of supervising the input voltage, and the R1150HxxxB is capable of supervising the SENSE pin voltage by using the built-in detector. The R1150HxxxD is capable of supervising the VOUT voltage and the regulator output voltage. The R1150H is offered in a compact 5-pin SOT-89-5 package for achieving high density mounting on boards.

FEATURES

- Input Voltage (Maximum Rating).....Max. 24.0 V (26 V)
- Supply Current .....Typ. 7.0 μA
- Output Voltage Range.....2.1 V to 14.0 V, 0.1 V steps
- Output Voltage Accuracy.....±2.0%
- Detector Threshold Voltage Range.....2.0 V to 15.0 V (R1150HxxxB/C/D), 0.1 V steps
  2.3 V to 15.0 V (R1150HxxxA), 0.1 V steps
- Detector Threshold Accuracy.....±2.0% (VR), ±2.5% (VD)
- Output Current .....Min. 150 mA (V_{SET} = 5.0 V)
- Output Voltage Temperature Coefficient.....Typ. ±100 ppm/°C
- Detector Threshold Temperature Coefficient ....Typ. ±100 ppm/°C
- Package SOT-89-5
- Built-in Fold-Back Protection.....Typ. 45 mA
- Built-in Thermal Shutdown Protection.....Thermal Shutdown Temperature: Typ. 150°C
  Released Temperature: Typ. 120°C

APPLICATIONS

- Power Source for Car Accessories: Car Audios, Car Navigation Systems, and ETC Systems
- Power Source for ECUs: EV inverters, Battery Charge Controllers

SELECTION GUIDE

A set output voltage, a set detection voltage and the usage of No. 3 pin are user-selectable options.

Selection Guide

Product Name	Package	Quantity per Reel	Pb Free	Haloge Free
R1150Hxxx∗-T1-#E	SOT-89-5	1,000 pcs	Yes	Yes

xxx: Set Output Voltage (V_{SET}) and Set Detection Voltage ($-V_{DSET}$)

∗: Optional Functions

A: CE Pin, V_{IN} detection

B: SENSE Pin

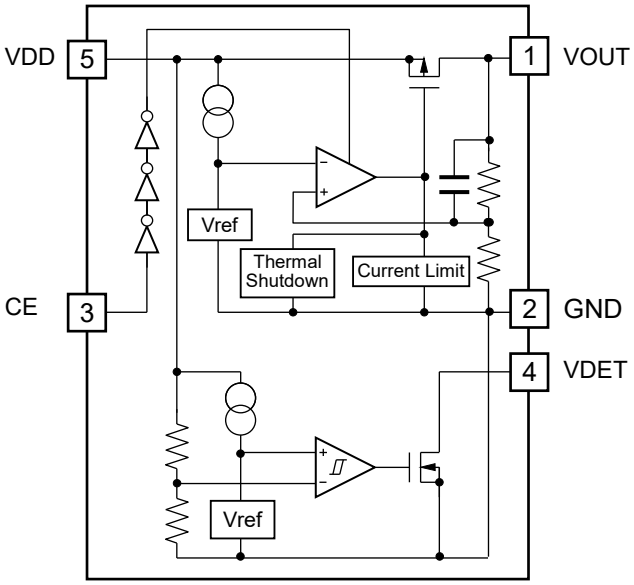
C: CD Pin, V_{IN} detection

D: CD Pin, V_{OUT} detection

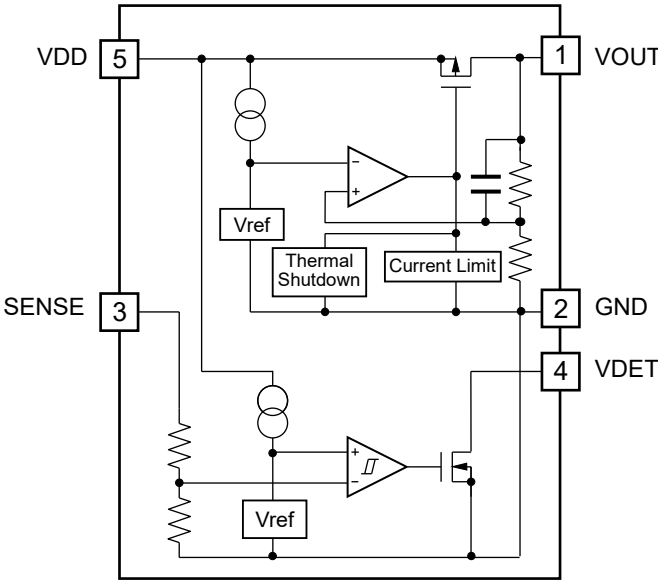
#: Quality Class

#	Operating Temp. Range	Test Temp.
A	−40°C to 125°C	25°C, High
H	−40°C to 125°C	Low, 25°C, High

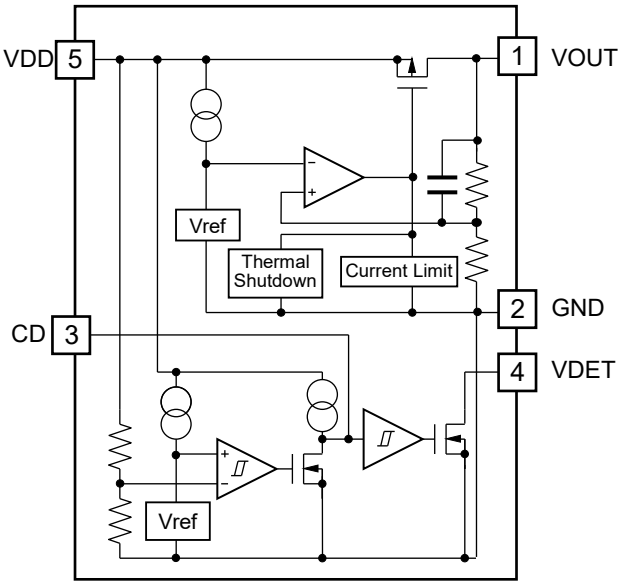
BLOCK DIAGRAMS



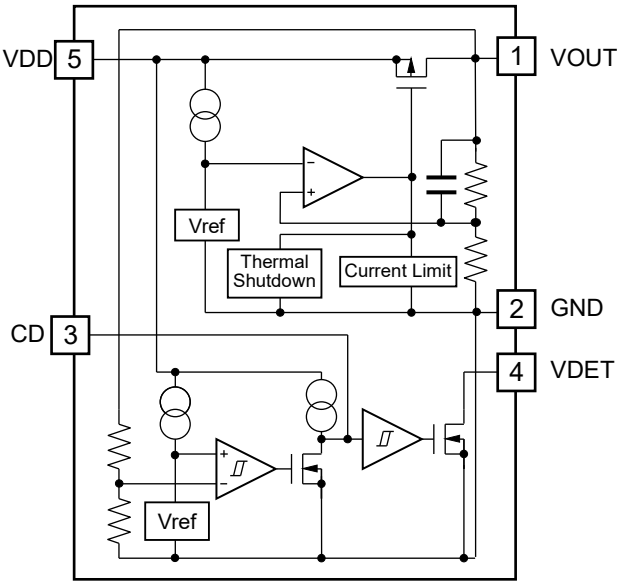
R1150HxxxA
CE Pin, V_{IN} Detection



R1150HxxxB
SENSE Detection

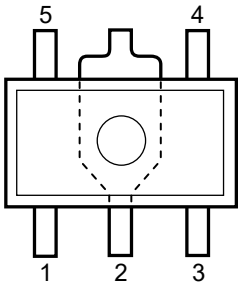


R1150HxxxC
CD Pin, V_{IN} Detection



R1150HxxxD
CD Pin, V_{OUT} Detection

PIN DESCRIPTION



SOT-89-5 Pin Configuration

Pin Description

Pin No.	Pin Name	Description
1	VOUT	Voltage Regulator Output Pin
2	GND	Ground Pin
3	CE	Chip Enable Pin (R1150HxxxA)
	SENSE	SENSE Pin for VD (R1150HxxxB)
	CD	CD Pin for Capacitor for Setting Output Delay of VD (R1150HxxxC/D)
4	VDET	Voltage Detection Output Pin
5	VDD	Input Pin

ABSOLUTE MAXIMUM RATINGS

Abosolute Maximum Ratings

Symbol	Parameter			Rating	Unit
VIN	Input Voltage			26.0	V
VCE	CE Pin Input Voltage (R1150HxxxA)			−0.3 to V_{IN} +0.3	V
VSENSE	SENSE Pin Input Voltage (R1150HxxxB)			−0.3 to V_{IN} +0.3	V
VCD	CD Pin Input Voltage (R1150HxxxC/D)			−0.3 to V_{IN} +0.3	V
VDET	Output Voltage (VD)			−0.3 to 26.0	V
VOUT	Output Voltage (VR)			−0.3 to V_{IN} +0.3	V
IOUT1	Output Current (VR)			250	mA
IOUT2	Output Current (VD)			10	mA
P_D	Power Dissipation(1)	SOT-89-5	JEDEC STD. 51-7	2600	mW
Tj	Junction Temperature			−40 to 125	°C
Tstg	Storage Temperature			−55 to 125	°C

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 are not assured.

RECOMMENDED OPERATING RATINGS

Recommended Operating Conditions

Symbol	Parameter	Rating	Unit
V_{DD}	Input Voltage	1.2 to 24.0	V
V_{SENSE}	SENSE Pin Input Voltage	0 to V_{IN} + 0.3	V
Ta	Operating Temperature Range	−40 to 85	°C

RECOMMENDED OPERATING CONDITIONS

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.

(1) Refer to *POWER DISSIPATION* for detailed information.

ELECTRICAL CHARACTERISTICS

R1150HxxxA Electrical Characteristics: for all **(Ta = 25°C)**

Symbol	Parameter	Test Conditions/Comments		Min.	Typ.	Max.	Unit
I_{SS}	Supply Current	$V_{OUT} \geq (-V_{DSET})$: $V_{IN} = V_{SET} + 2.0$ V, $V_{CE} = V_{IN}$ $V_{OUT} < (-V_{DSET})$: $V_{IN} = (-V_{DSET}) + 2.0$ V, $V_{CE} = V_{IN}$			7	14	μA
I_{STANBY}	Standby Current	V_{IN} = 24 V, V_{CE} = 0 V	$2.3 \leq -V_{DET} \leq 3.0$		2.5	5.0	μA
			$3.1 \leq -V_{DET} \leq 15.0$		3.0	6.0	
T_{TSD}	Thermal Shutdown Temperature	Junction Temperature			150		°C
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature			120		°C

VR Section **(Ta = 25°C)**

Symbol	Parameter	Test Conditions/Comments	Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	$V_{IN} = V_{SET} + 2.0$ V, I_{OUT} = 20 mA	×0.98		×1.02	V
I_{OUT1}	Output Current	$V_{IN} = V_{SET} + 2.0$ V	Refer to the *Product-specific Electrical Characteristics*			
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	$V_{IN} = V_{SET} + 2.0$ V, 1 mA ≤ I_{OUT} ≤ 40 mA				
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	$V_{SET} + 1$ V ≤ V_{IN} ≤ 24 V, I_{OUT} = 20 mA		0.05	0.15	%/V
V_{DIF}	Dropout Voltage	I_{OUT} = 20 mA	Refer to the *Product-specific Electrical Characteristics*			
I_{SC}	Short Current Limit	V_{OUT} = 0 V		45		mA
V_{CEH}	CE "H" Input Voltage		1.5		VIN	V
V_{CEL}	CE "L" Input Voltage		0		0.25	V

VD Section **(Ta = 25°C)**

Symbol	Parameter	Test Conditions/Comments	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
V_{DDL}	Output Current (Driver Output Pin)	(1)		0.9	1.2	V
I_{OUT2}	Minimum Operating Voltage	V_{IN} = 2 V, V_{DS} = 0.05 V	0.17			mA
t_{PLH}	Output Delay Time	(2)		0.5	1.0	ms

(1) This item means VDD voltage when output voltage is equal or less than 0.1 V. (Pull-up Resistor = 470 kW, Pull up Voltage = 5 V).
(2) VDET pin is pulled up to VDD via 470 kW. t_{PLH} means time interval from rising edge of VDD from $(-V_{DSET})$ -2.0 V to $(-V_{DSET})$ +2.0 V to the point of output voltage being 80% of pull-up voltage.

R1150HxxxB Electrical Characteristics: for all **(Ta = 25°C)**

Symbol	Parameter	Test Conditions/Comments	Min.	Typ.	Max.	Unit
I_{SS}	Supply Current	$V_{OUT} \geq (-V_{DSET})$: V_{IN} = SENSE = V_{SET} + 2.0 V $V_{OUT} < (-V_{DSET})$: V_{IN} = SENSE = $(-V_{DSET})$ + 2.0 V		7	14	µA
T_{TSD}	Thermal Shutdown Temperature	Junction Temperature		150		°C
T_{TSR}	Thermal Shutdown Temperature	Junction Temperature		120		°C

VR Section **(Ta = 25°C)**

Symbol	Parameter	Test Conditions/Comments	Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	$V_{IN} = V_{SET}$ + 2.0 V, I_{OUT} = 20 mA	×0.98		×1.02	V
I_{OUT1}	Output Current	$V_{IN} = V_{SET}$ + 2.0 V	Refer to the *Product-specific Electrical Characteristics*			
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	$V_{IN} = V_{SET}$ + 2.0 V, 1 mA ≤ I_{OUT} ≤ 40 mA				
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	V_{SET} + 1 V ≤ V_{IN} ≤ 24 V, I_{OUT} = 20 mA		0.05	0.15	%/V
V_{DIF}	Dropout Voltage	I_{OUT} = 20 mA	Refer to the *Product-specific Electrical Characteristics*			
I_{SC}	Short Current Limit	V_{OUT} = 0 V		45		mA

VD Section **(Ta = 25°C)**

Symbol	Parameter	Test Conditions/Comments	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
V_{DDL}	Minimum Operating Voltage	(1)		0.9	1.2	V
I_{OUT2}	Output Current (Driver Output Pin)	Refer to *Test Conditions for Output Current*.	0.17			mA
t_{PLH}	Output Delay Time	(2)		1.0	1.5	ms

Test Conditions for Output Current **(Ta = 25°C)**

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

(1) This item means VDD voltage when output voltage is equal or less than 0.1 V. (Pull-up Resistor = 470 kW, Pull up Voltage = 5 V).
(2) VDET pin is pulled up to VDD via 470 kW. t_{PLH} means time interval from rising edge of VDD from $(-V_{DSET})$ -2.0 V to $(-V_{DSET})$ +2.0 V to the point of output voltage being 80% of pull-up voltage.

R1150HxxxC Electrical Characteristics: for all **(Ta = 25°C)**

Symbol	Parameter	Test Conditions/Comments	Min.	Typ.	Max.	Unit
I_{SS}	Supply Current	$V_{OUT} \geq (-V_{DSET})$: $V_{IN} = V_{SET} + 2.0$ V $V_{OUT} < (-V_{DSET})$: $V_{IN} = (-V_{DSET}) + 2.0$ V		7	14	µA
T_{TSD}	Thermal Shutdown Temperature	Junction Temperature		150		°C
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature		120		°C

VR Section **(Ta = 25°C)**

Symbol	Parameter	Test Conditions/Comments	Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	$V_{IN} = V_{SET} + 2.0$ V, $I_{OUT} = 20$ mA	×0.98		×1.02	V
I_{OUT1}	Output Current	$V_{IN} = V_{SET} + 2.0$ V	Refer to the *Product-specific Electrical Characteristics*			
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	$V_{IN} = V_{SET} + 2.0$ V 1 mA ≤ I_{OUT} ≤ 40 mA				
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	$V_{SET} + 1$ V ≤ V_{IN} ≤ 24 V, $I_{OUT} = 20$ mA		0.05	0.15	%/V
V_{DIF}	Dropout Voltage	$I_{OUT} = 20$ mA	Refer to the *Product-specific Electrical Characteristics*			
I_{SC}	Short Current Limit	$V_{OUT} = 0$ V		45		mA

VD Section **(Ta = 25°C)**

Symbol	Parameter	Test Conditions/Comments	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
V_{DDL}	Minimum Operating Voltage	(1)		0.9	1.2	V
I_{OUT2}	Output Current (Driver Output Pin)	Refer to *Test Conditions for Output Current*.	0.17			mA
t_{PLH}	Output Delay Time	$C_D = 4.7$ nF (2)	20	30	50	ms

Test Conditions for Output Current **(Ta = 25°C)**

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

(1) This item means VDD voltage when output voltage is equal or less than 0.1 V. (Pull-up Resistor = 470 kW, Pull up Voltage = 5 V).
(2) VDET pin is pulled up to VDD via 470 kW. t_{PLH} means time interval from rising edge of VDD from $(-V_{DSET})$ -2.0 V to $(-V_{DSET})$ +2.0 V to the point of output voltage being 80% of pull-up voltage.

R1150HxxxD Electrical Characteristics: for all **(Ta = 25°C)**

Symbol	Parameter	Test Conditions/Comments	Min.	Typ.	Max.	Unit
I_{SS}	Supply Current	V_{IN} = V_{SET} + 2.0 V		7	14	µA
T_{TSD}	Thermal Shutdown Temperature			150		°C
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature		120		°C

VR Section **(Ta = 25°C)**

Symbol	Parameter	Test Conditions/Comments	Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	V_{IN} = V_{SET} + 2.0 V, I_{OUT} = 20 mA	×0.98		×1.02	V
I_{OUT1}	Output Current	V_{IN} = V_{SET} + 2.0 V	Refer to the *Product-specific Electrical Characteristics*			
ΔV_{OUT}/ ΔI_{OUT}	Load Regulation	V_{IN} = V_{SET} + 2.0 V 1 mA ≤ I_{OUT} ≤ 40 mA				
ΔV_{OUT}/ ΔV_{IN}	Line Regulation	V_{SET} + 1 V ≤ V_{IN} ≤ 24 V, I_{OUT} = 20 mA		0.05	0.15	%/V
V_{DIF}	Dropout Voltage	I_{OUT} = 20 mA	Refer to the *Product-specific Electrical Characteristics*			
I_{SC}	Short Current Limit	V_{OUT} = 0 V		45		mA

VD Section **(Ta = 25°C)**

Symbol	Parameter	Test Conditions/Comments	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
V_{DDL}	Minimum Operating Voltage	(1)		0.9	1.2	V
I_{OUT2}	Output Current (Driver Output Pin)	Refer to *Test Conditions for Output Current*.	0.17			mA
t_{PLH}	Output Delay Time	C_D = 4.7 nF (2)	20	30	50	ms
	Release Margin	V_{OUT} - 0.2 - ($-V_{DET}$) - V_{HYS}	50			mV

Test Conditions for Output Current **(Ta = 25°C)**

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

(1) This item means VDD voltage when output voltage is equal or less than 0.1 V. (Pull-up Resistor = 470 kW, Pull up Voltage = 5 V).
(2) VDET pin is pulled up to VDD via 470 kW. t_{PLH} means time interval from rising edge of VDD from ($-V_{DSET}$) -2.0 V to ($-V_{DSET}$) +2.0 V to the point of output voltage being 80% of pull-up voltage.

Product-specific Electrical Characteristics

VR Section **(Ta = 25°C)**

Product Name	V_{OUT} [V]			I_{OUT} [mA]		$\Delta V_{OUT}/\Delta I_{OUT}$ [mV]		V_{DIF} [V]	
	Min.	Typ.	Max.	Min.	Typ.	Typ.	Max.	Typ.	Max.
R1150H002x	3.234	3.300	3.366	120	170	25	45	0.25	0.35
R1150H003x	4.900	5.000	5.100	150	200	25	45	0.25	0.35
R1150H004x	2.450	2.500	2.550	90	140	15	35	0.3	0.4
R1150H005x	3.234	3.300	3.366	120	170	25	45	0.25	0.35
R1150H006x	4.900	5.000	5.100	150	200	25	45	0.25	0.35
R1150H007x	3.430	3.500	3.570	120	170	25	45	0.25	0.35
R1150H008x	3.234	3.300	3.366	120	170	25	45	0.25	0.35
R1150H009x	4.900	5.000	5.100	150	200	25	45	0.25	0.35
R1150H010x	2.940	3.000	3.060	120	170	15	35	0.3	0.4
R1150H011x	6.860	7.000	7.140	150	200	40	65	0.25	0.35
R1150H012x	11.760	12.000	12.240	150	200	50	80	0.3	0.5
R1150H013x	7.350	7.500	7.650	150	200	40	65	0.27	0.45
R1150H014x	7.350	7.500	7.650	150	200	40	65	0.27	0.45
R1150H015x	2.940	3.000	3.060	120	170	15	35	0.3	0.4
R1150H016x	4.900	5.000	5.100	150	200	25	45	0.25	0.35
R1150H017x	3.234	3.300	3.366	120	170	25	45	0.25	0.35
R1150H018x	4.900	5.000	5.100	150	200	25	45	0.25	0.35
R1150H019x	13.720	14.000	14.280	150	200	50	80	0.3	0.5
R1150H020x	4.900	5.000	5.100	150	200	25	45	0.25	0.35
R1150H021x	3.528	3.600	3.672	120	170	25	45	0.25	0.35
R1150H022x	3.234	3.300	3.366	120	170	25	45	0.25	0.35
R1150H023x	11.760	12.000	12.240	150	200	50	80	0.3	0.5
R1150H024x	3.234	3.300	3.366	120	170	25	45	0.25	0.35
R1150H025x	3.920	4.000	4.080	120	170	25	45	0.25	0.35
R1150H026x	3.234	3.300	3.366	120	170	25	45	0.25	0.35
R1150H027x	3.528	3.600	3.672	120	170	25	45	0.25	0.35
R1150H028x	4.900	5.000	5.100	150	200	25	45	0.25	0.35
R1150H029x	3.528	3.600	3.672	120	170	25	45	0.25	0.35
R1150H030x	3.234	3.300	3.366	120	170	25	45	0.25	0.35
R1150H031x	3.234	3.300	3.366	120	170	25	45	0.25	0.35
R1150H032x	3.332	3.400	3.468	120	170	25	45	0.25	0.35
R1150H033x	3.038	3.100	3.162	120	170	25	45	0.25	0.35
R1150H034x	4.900	5.000	5.100	150	200	25	45	0.25	0.35
R1150H035x	3.234	3.300	3.366	120	170	25	45	0.25	0.35
R1150H036x	3.234	3.300	3.366	120	170	25	45	0.25	0.35
R1150H037x	2.450	2.500	2.550	90	140	15	35	0.3	0.4
R1150H038x	4.900	5.000	5.100	150	200	25	45	0.25	0.35
R1150H039x	3.234	3.300	3.366	120	170	25	45	0.25	0.35

VR Section **(Ta = 25°C)**

Product Name	V_{OUT} [V]			I_{OUT} [mA]		$\Delta V_{OUT}/\Delta I_{OUT}$ [mV]		V_{DIF} [V]	
	Min.	Typ.	Max.	Min.	Typ.	Typ.	Max.	Typ.	Max.
R1150H040x	3.234	3.300	3.366	120	170	25	45	0.25	0.35
R1150H041x	6.860	7.000	7.140	150	200	40	65	0.25	0.35
R1150H042x	5.488	5.600	5.712	150	200	40	65	0.25	0.35
R1150H043x	8.820	9.000	9.180	150	200	40	65	0.27	0.45
R1150H044x	7.840	8.000	8.160	150	200	40	65	0.27	0.45
R1150H045x	4.900	5.000	5.100	150	200	25	45	0.25	0.35
R1150H046x	5.488	5.600	5.712	150	200	40	65	0.25	0.35
R1150H047x	11.760	12.000	12.240	150	200	50	80	0.3	0.5
R1150H048x	4.900	5.000	5.100	150	200	25	45	0.25	0.35
R1150H049x	2.793	2.850	2.907	90	140	15	35	0.3	0.4
R1150H050x	5.292	5.400	5.508	150	200	40	65	0.25	0.35
R1150H051x	3.234	3.300	3.366	120	170	25	45	0.25	0.35
R1150H052x	3.234	3.300	3.366	120	170	25	45	0.25	0.35

VD Section **(Ta = 25°C)**

Product Name	$-V_{DET}$ [V]			V_{HYS} [V]		
	Min.	Typ.	Max.	Min.	Typ.	Max.
R1150H002x	2.438	2.500	2.563	0.075	0.125	0.175
R1150H003x	4.193	4.300	4.408	0.129	0.215	0.301
R1150H004x	2.243	2.300	2.358	0.069	0.115	0.161
R1150H005x	2.828	2.900	2.973	0.087	0.145	0.203
R1150H006x	4.388	4.500	4.613	0.135	0.225	0.315
R1150H007x	3.023	3.100	3.178	0.093	0.155	0.217
R1150H008x	4.095	4.200	4.305	0.126	0.210	0.294
R1150H009x	3.998	4.100	4.203	0.123	0.205	0.287
R1150H010x	4.095	4.200	4.305	0.126	0.210	0.294
R1150H011x	2.730	2.800	2.870	0.084	0.140	0.196
R1150H012x	4.583	4.700	4.818	0.141	0.235	0.329
R1150H013x	4.193	4.300	4.408	0.129	0.215	0.301
R1150H014x	4.583	4.700	4.818	0.141	0.235	0.329
R1150H015x	2.438	2.500	2.563	0.075	0.125	0.175
R1150H016x	3.413	3.500	3.588	0.105	0.175	0.245
R1150H017x	2.828	2.900	2.973	0.087	0.145	0.203
R1150H018x	2.925	3.000	3.075	0.090	0.150	0.210
R1150H019x	14.625	15.000	15.375	0.450	0.750	1.050
R1150H020x	4.095	4.200	4.305	0.126	0.210	0.294
R1150H021x	4.193	4.300	4.408	0.129	0.215	0.301
R1150H022x	2.730	2.800	2.870	0.084	0.140	0.196
R1150H023x	4.095	4.200	4.305	0.126	0.210	0.294
R1150H024x	3.510	3.600	3.690	0.108	0.180	0.252
R1150H025x	4.875	5.000	5.125	0.150	0.250	0.350

VD Section **(Ta = 25°C)**

Product Name	$-V_{DET}$ [V]			V_{HYS} [V]		
	Min.	Typ.	Max.	Min.	Typ.	Max.
R1150H026x	2.243	2.300	2.358	0.069	0.115	0.161
R1150H027x	8.775	9.000	9.225	0.270	0.450	0.630
R1150H028x	2.048	2.100	2.153	0.063	0.105	0.147
R1150H029x	7.605	7.800	7.995	0.234	0.390	0.546
R1150H030x	2.145	2.200	2.255	0.066	0.110	0.154
R1150H031x	1.950	2.000	2.050	0.060	0.100	0.140
R1150H032x	1.950	2.000	2.050	0.060	0.100	0.140
R1150H033x	4.388	4.500	4.613	0.135	0.225	0.315
R1150H034x	12.675	13.000	13.325	0.390	0.650	0.910
R1150H035x	3.705	3.800	3.895	0.114	0.190	0.266
R1150H036x	5.460	5.600	5.740	0.168	0.280	0.392
R1150H037x	3.998	4.100	4.203	0.123	0.205	0.287
R1150H038x	2.243	2.300	2.358	0.069	0.115	0.161
R1150H039x	6.630	6.800	6.970	0.204	0.340	0.476
R1150H040x	4.875	5.000	5.125	0.150	0.250	0.350
R1150H041x	7.313	7.500	7.688	0.225	0.375	0.525
R1150H042x	4.388	4.500	4.613	0.135	0.225	0.315
R1150H043x	9.653	9.900	10.148	0.297	0.495	0.693
R1150H044x	8.678	8.900	9.123	0.267	0.445	0.623
R1150H045x	5.460	5.600	5.740	0.168	0.280	0.392
R1150H046x	2.925	3.000	3.075	0.090	0.150	0.210
R1150H047x	4.875	5.000	5.125	0.150	0.250	0.350
R1150H048x	7.313	7.500	7.688	0.225	0.375	0.525
R1150H049x	4.388	4.500	4.613	0.135	0.225	0.315
R1150H050x	2.925	3.000	3.075	0.090	0.150	0.210
R1150H051x	9.750	10.000	10.250	0.300	0.500	0.700
R1150H052x	7.313	7.500	7.688	0.225	0.375	0.525

THEORY OF OPERATION

Output Voltage and Detector Threshold Setting (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.

$(V_{SET} \times 0.975) - (-V_{DSET} \times 1.10) > 0.2$

Thermal Shutdown

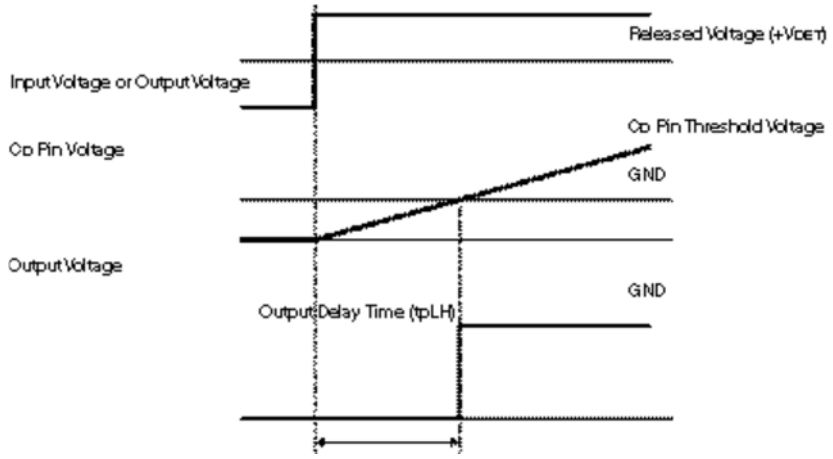
Thermal shutdown function is included in the R1150HxxxA/B/C/D, when the junction temperature is equal or more than +150°C (Typ.), the operation of regulator would stop. After that, when the junction temperature is equal or less than +120°C (Typ.), the operation of regulator would restart. Unless the 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 VIH and VIL. 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 CD pin. When an input voltage (R1150Hxx1C) or an output voltage (R1150Hxx1D) surpasses the release voltage ($+V_{DET}$) of its voltage detector, the capacitor which is connected to CD pin is started to be charged, as a result, CD pin voltage rises. When the CD pin voltage surpasses CD pin threshold voltage, the output voltage of the voltage detector outputs “H”.



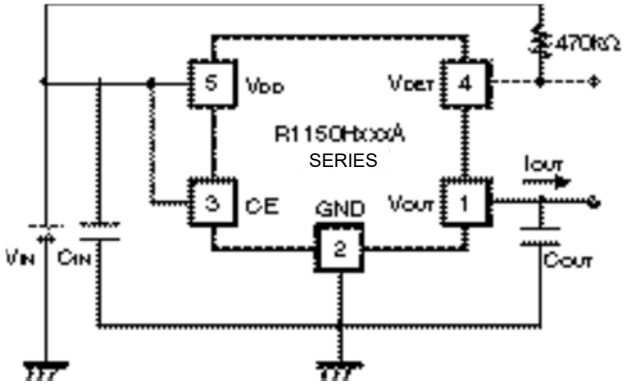
Output delay time for release voltage detector can be calculated with the next formula:

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

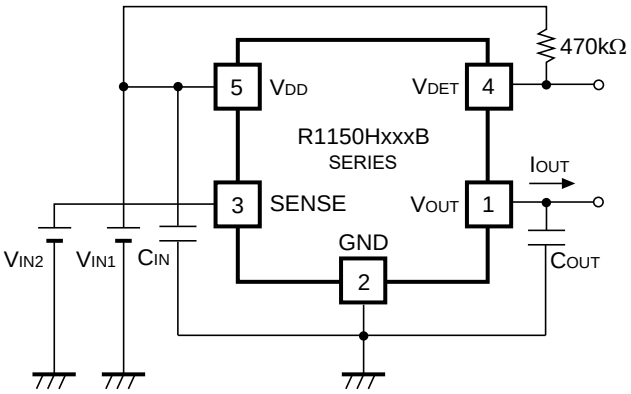
Input Transient Response

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

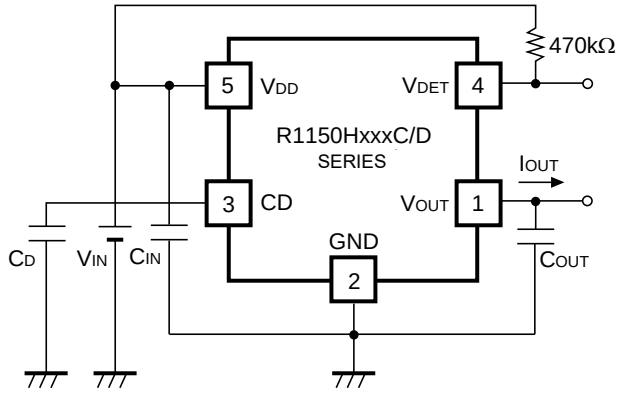
APPLICATION INFORMATION



R1150HxxxA Typical Application



R1150HxxxB Typical Application



R1150HxxxC/D Typical Application

TECHNICAL NOTES

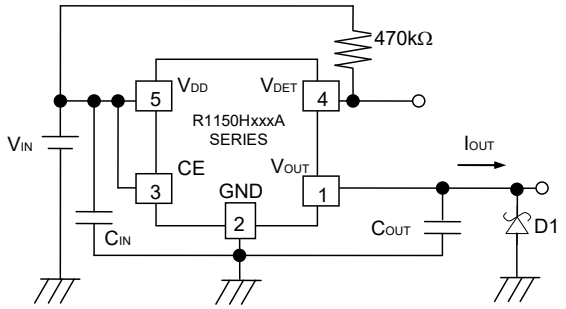
Phase Compensation

Phase Compensation of the R1150H 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 µF or more capacitors as C_{IN} and C_{OUT}. Wiring should be made as short as possible.

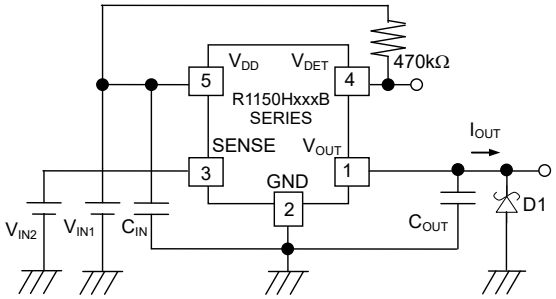
PCB Layout

Current flows into wiring for VDD 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 VDD pin and GND pin as close as possible.

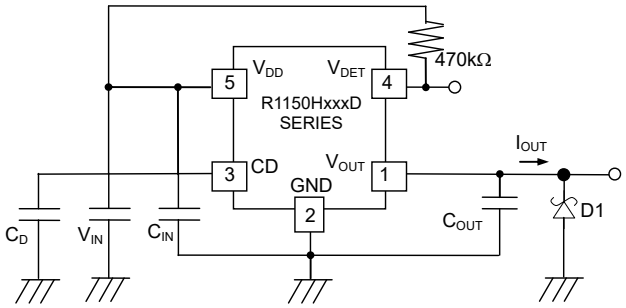
Typical Application for IC Chip Breakdown Prevention



R1150HxxxA



R1150HxxxB



R1150HxxxC/D

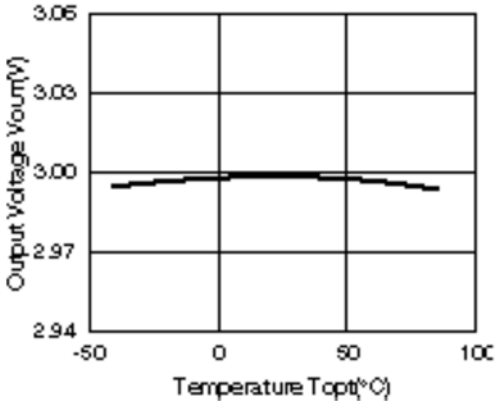
When a sudden surge of electrical current travels along the V_{OUT} pin and GND due to a short-circuit, electrical resonance of a circuit involving an output capacitor (C_{OUT}) and a short circuit inductor generates a negative voltage and may damage the device or the load devices. Connecting a schottky diode (D1) between the V_{OUT} pin and GND has the effect of preventing damage to them.

TYPICAL CHARACTERISTICS

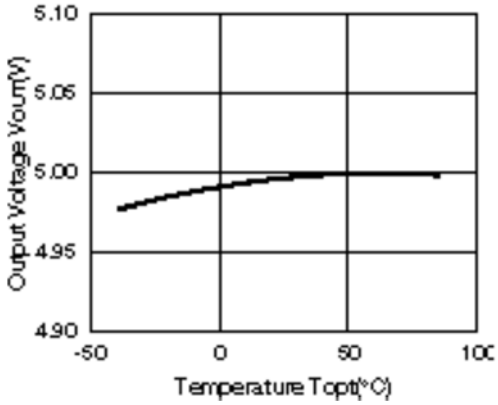
Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

1) Output Voltage vs. Temperature

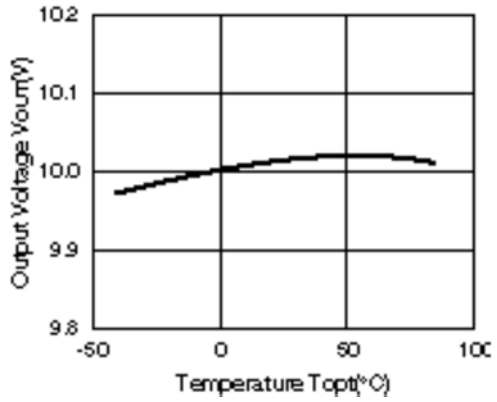
R1150H (V_{SET} = 3.0 V)



R1150H (V_{SET} = 5.0 V)

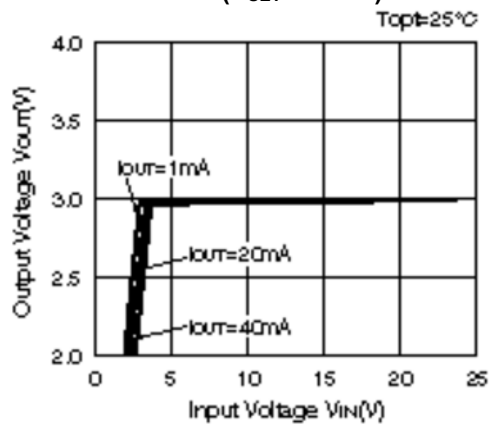


R1150H (V_{SET} = 10.0 V)

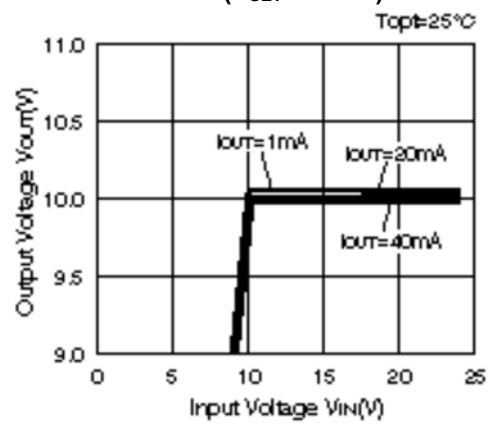


2) Output Voltage vs. Input Voltage

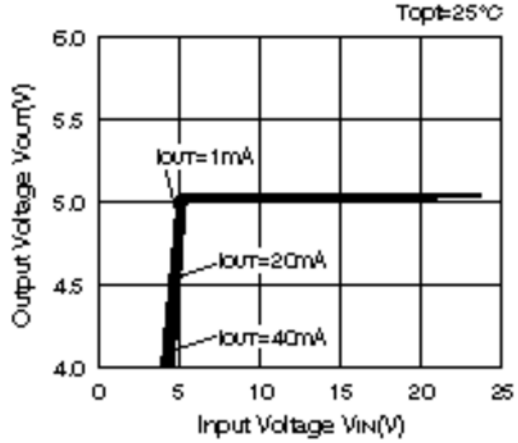
R1150H (V_{SET} = 3.0 V)



R1150H (V_{SET} = 5.0 V)

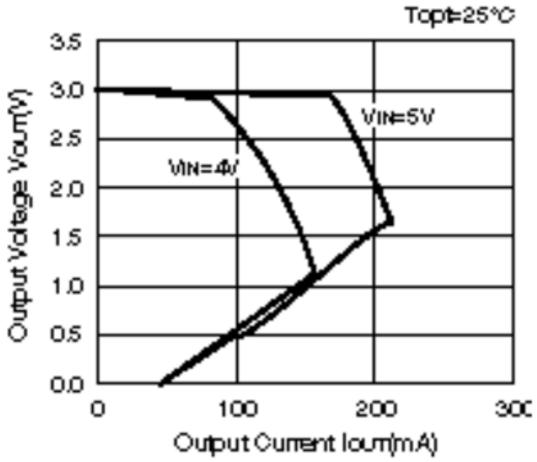


R1150H (V_{SET} = 10.0 V)

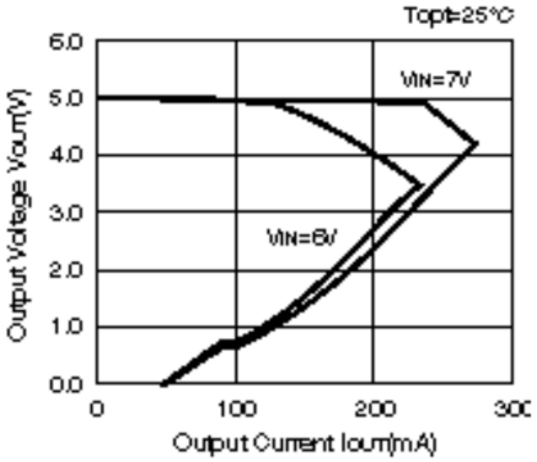


3) Output Voltage vs. Output Current

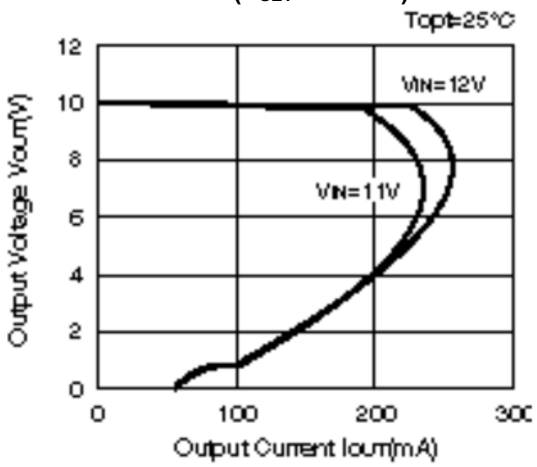
R1150H (V_{SET} = 3.0 V)



R1150H (V_{SET} = 5.0 V)

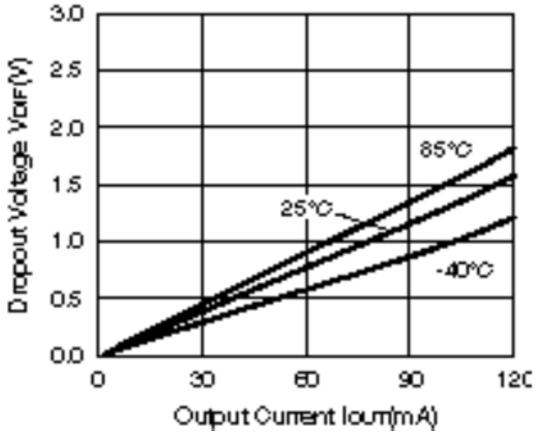


R1150H (V_{SET} = 10.0 V)

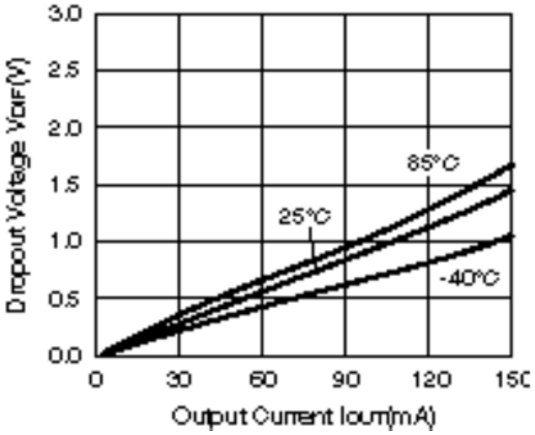


4) Dropout Voltage vs. Output Current

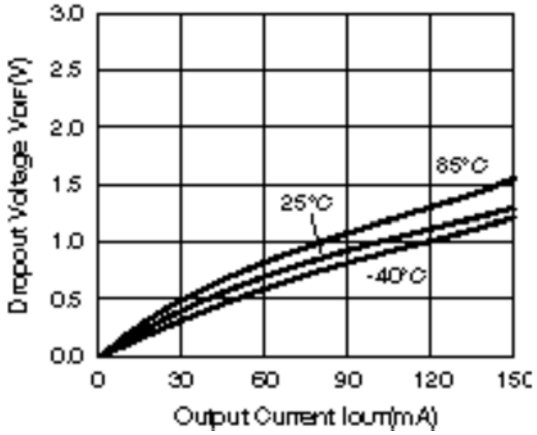
R1150H (V_{SET} = 3.0 V)



R1150H (V_{SET} = 5.0 V)

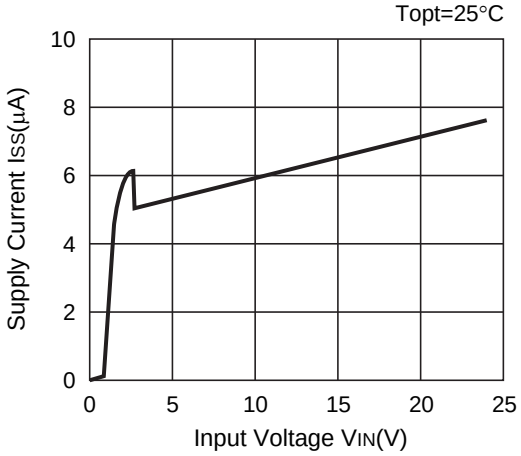


R1150H (V_{SET} = 10.0 V)

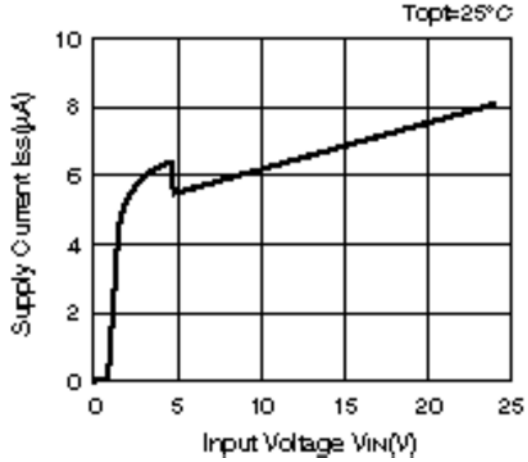


5) Supply Current vs. Input Voltage

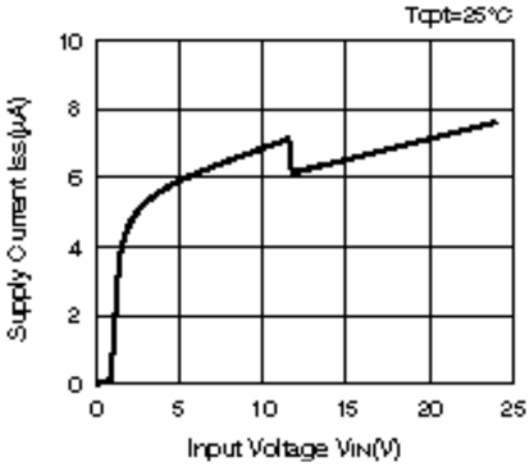
R1150H (V_{SET} = 3.0 V)



R1150H (V_{SET} = 5.0 V)

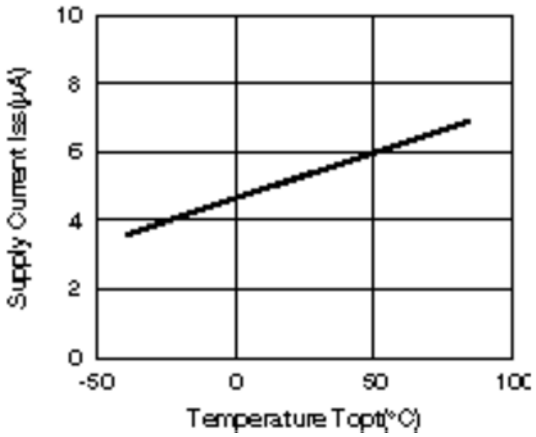


R1150H (V_{SET} = 10.0 V)

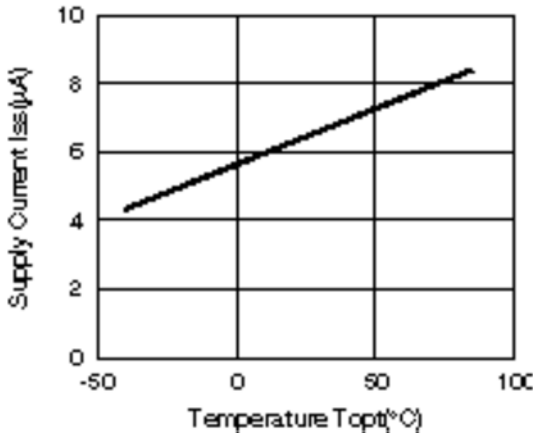


6) Supply Current vs. Temperature

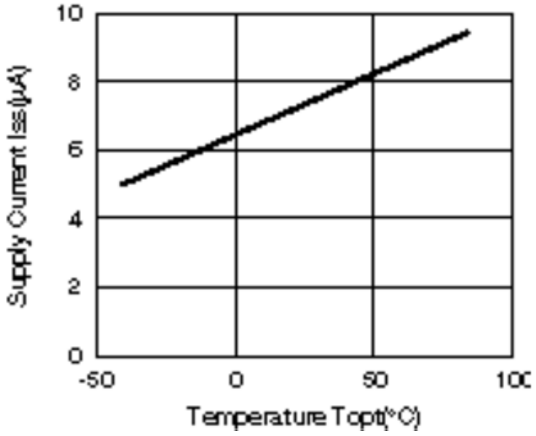
R1150H (V_{SET} = 3.0 V, $-V_{DSET}$ = 2.5 V)



R1150H (V_{SET} = 5.0 V, $-V_{DSET}$ = 4.5 V)

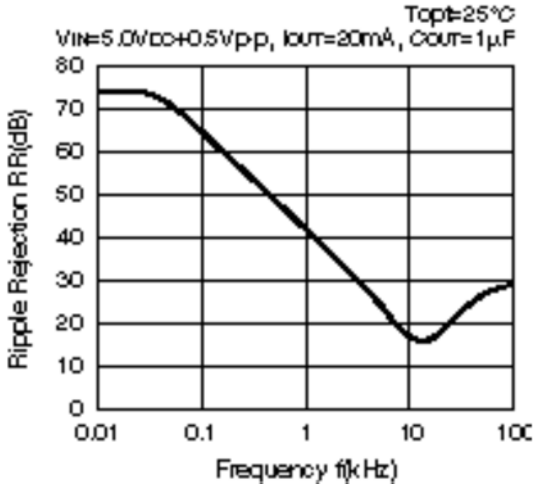


R1150H (V_{SET} = 10.0 V, $-V_{DSET}$ = 11.0 V)

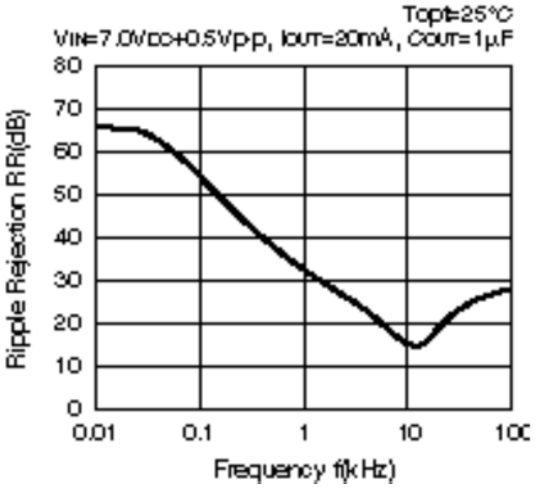


7) Ripple Rejection vs. Frequency

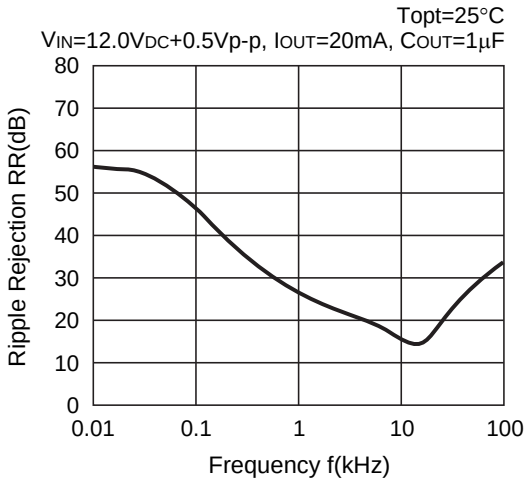
R1150H (V_{SET} = 3.0 V)



R1150H (V_{SET} = 5.0 V)

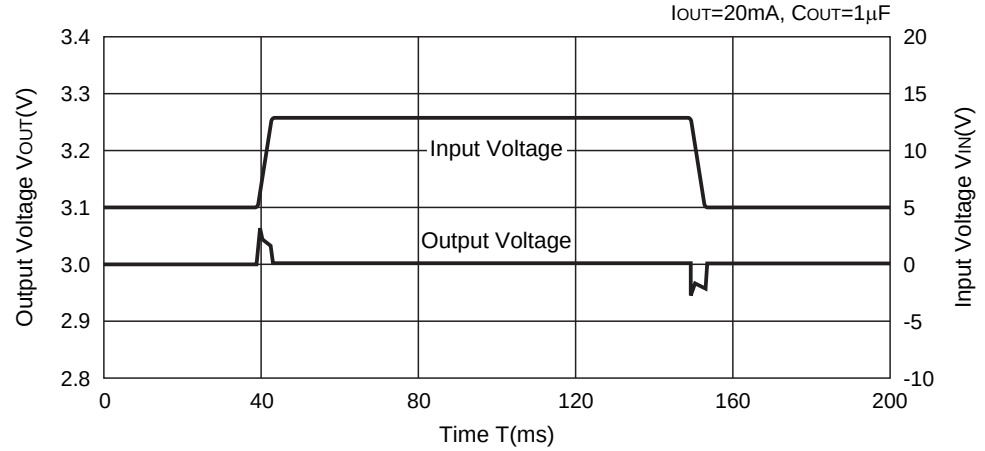


R1150H (V_{SET} = 10.0 V)

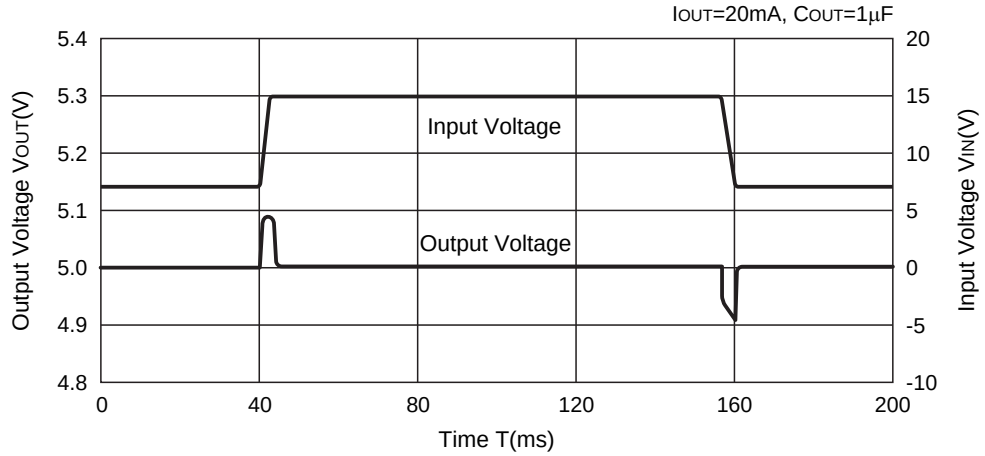


8) Input Transient Response

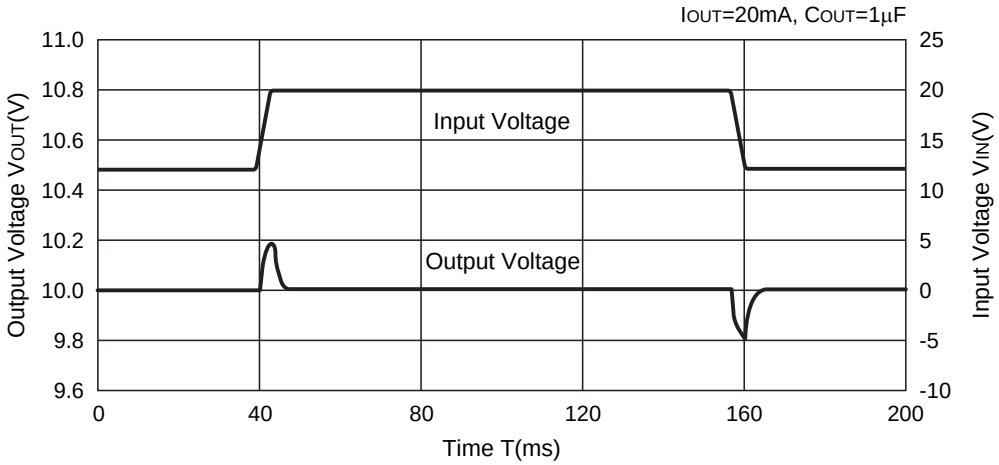
R1150H (V_{SET} = 3.0 V)



R1150H (V_{SET} = 5.0 V)

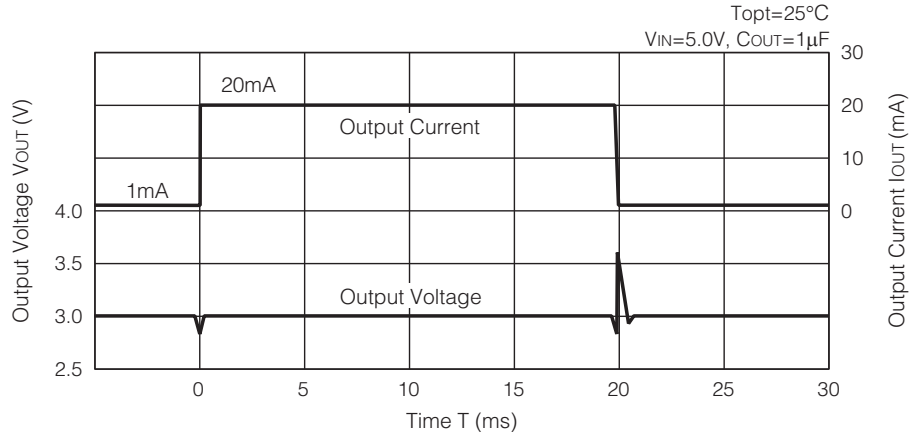


R1150H (V_{SET} = 10.0 V)

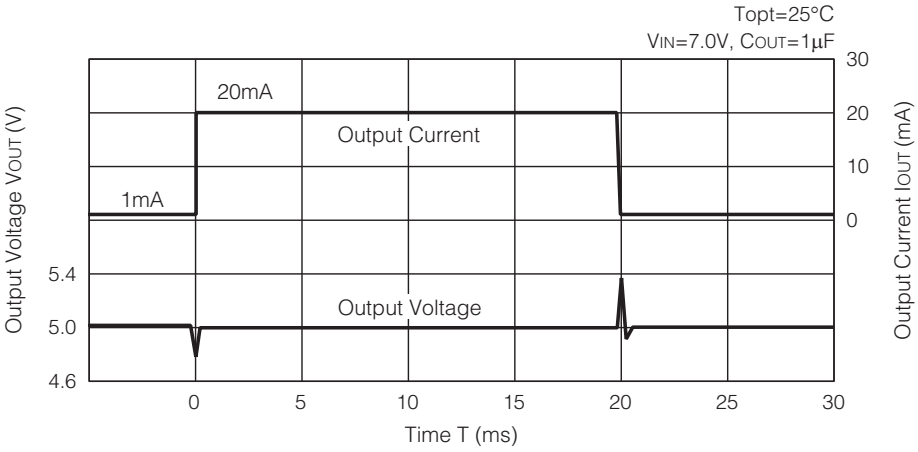


9) Load Transient Response

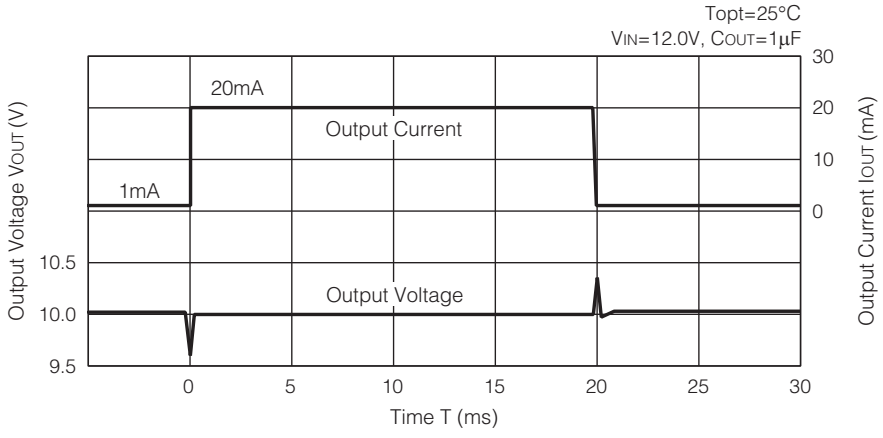
R1150H (V_{SET} = 3.0 V)



R1150H (V_{SET} = 5.0 V)

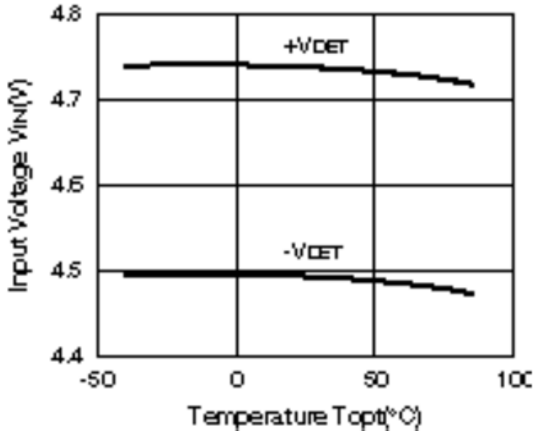


R1150H (V_{SET} = 10.0 V)

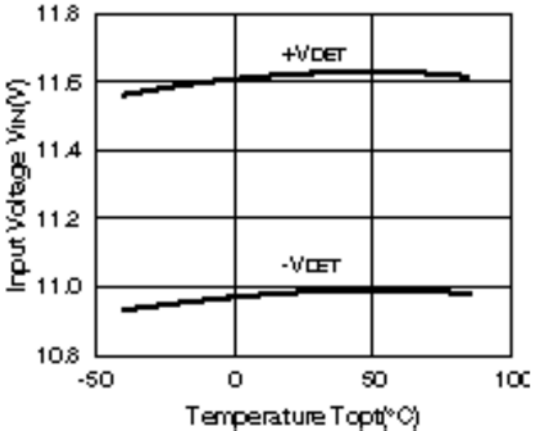


10) Detection Voltage vs. Temperature

R1150H (-V_{DSET} = 4.5 V)

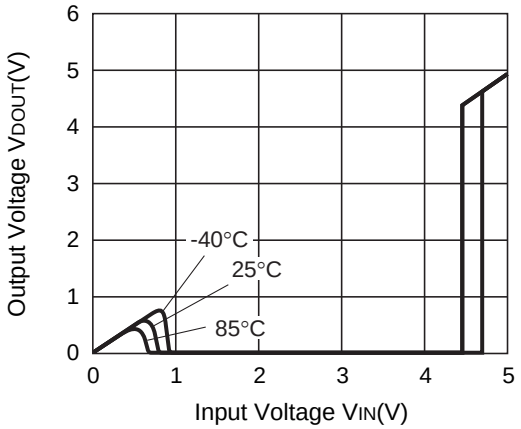


R1150H (-V_{DSET} = 11.0 V)

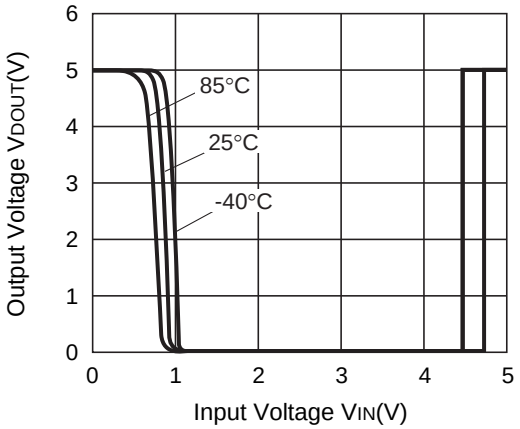


11) Detector Output Voltage vs. Input Voltage

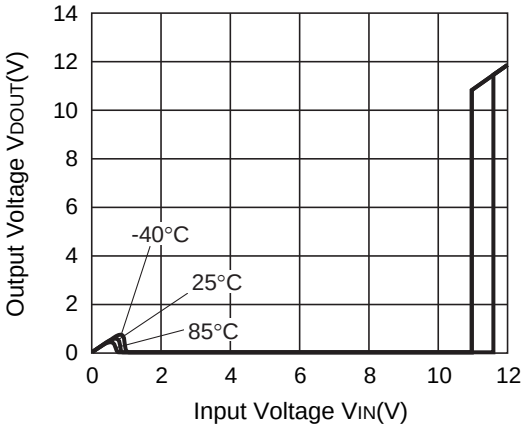
R1150H (-V_{DSET} = 4.5 V) Pull up to V_{IN}



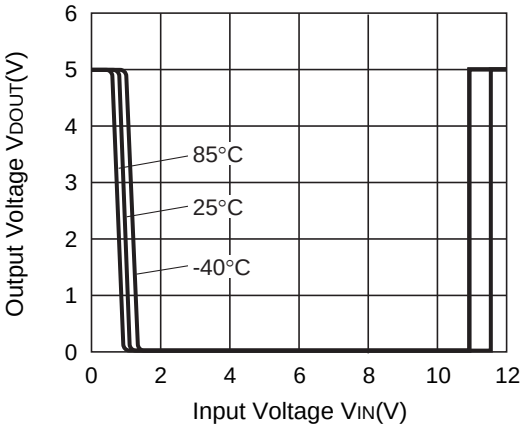
R1150H (-V_{DSET} = 4.5 V) Pull up to 5 V



R1150H (-V_{DSET} = 11.0 V) Pull up to V_{IN}

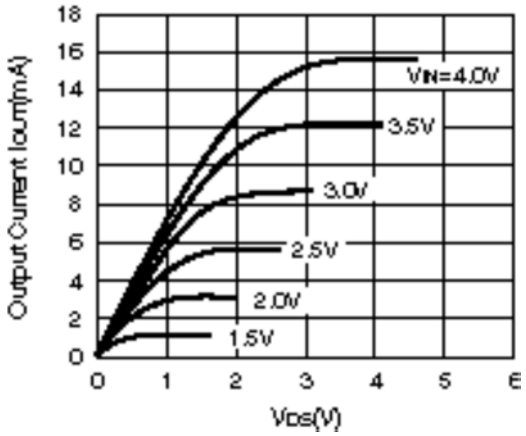


R1150H (-V_{DSET} = 11.0 V) Pull up to 5 V

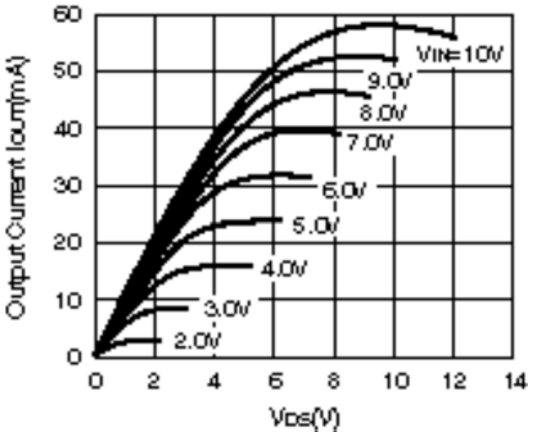


12) Nch Driver Output Current vs. VDS

R1150H (-V_{DSET} = 4.5 V)

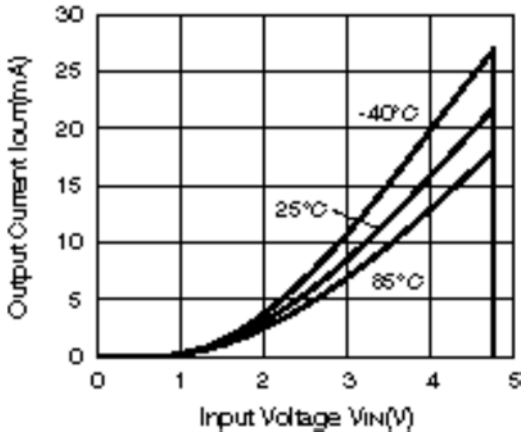


R1150H (-V_{DSET} = 11.0 V)

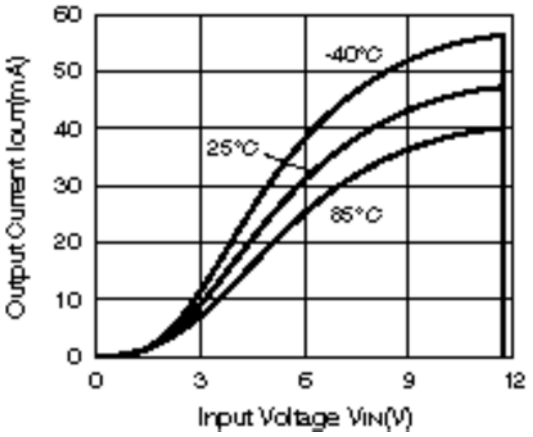


13) Nch Driver Output Current vs. Input Voltage

R1150H (-V_{DSET} = 4.5 V)

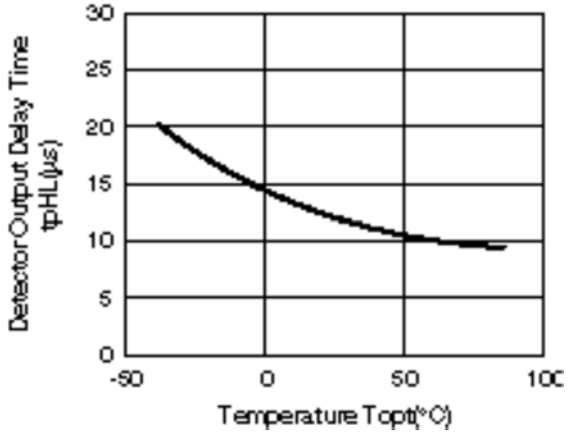


R1150H (-V_{DSET} = 11.0 V)



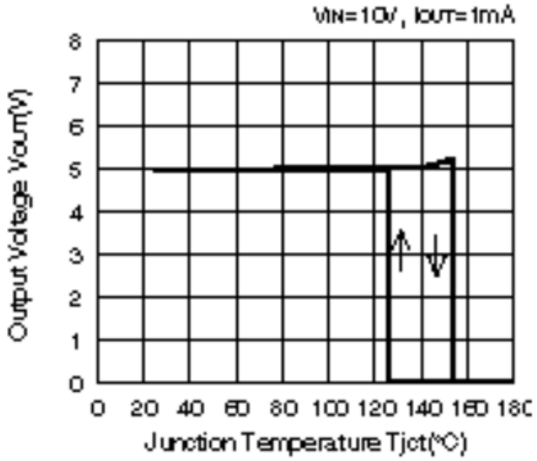
14) Detector Output Delay Time vs. Temperature

R1150H (-V_{DSET} = 4.5 V)



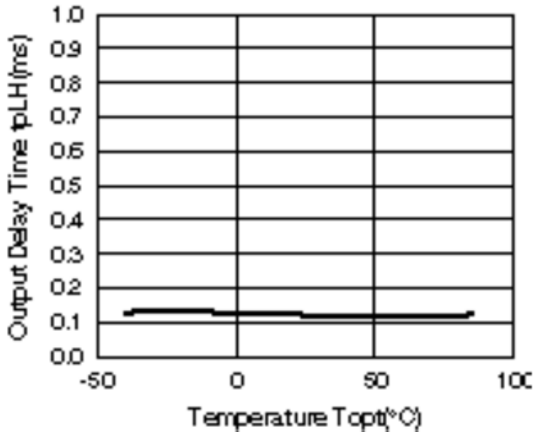
15) Thermal Shutdown Temperature vs Output Voltage

R1150H (V_{SET} = 5.0 V)



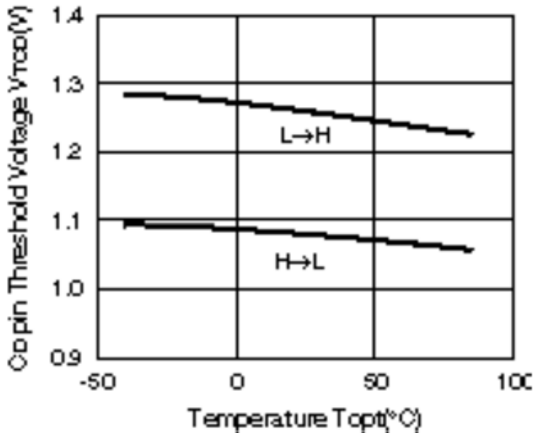
16) Output Delay Time vs. Temperature

R1150H ($-V_{DSET}$ = 4.5 V)

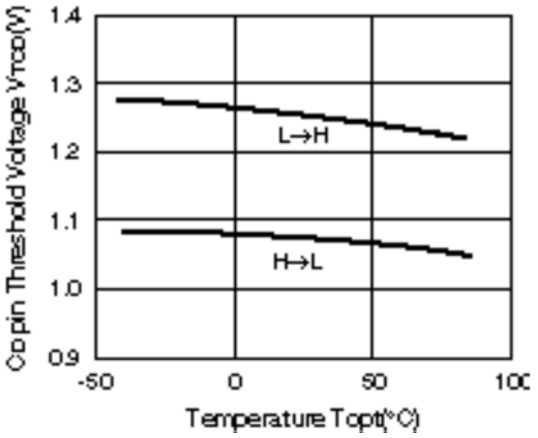


17) CD Pin Threshold Voltage vs. Temperature

R1150H ($-V_{DSET}$ = 4.0 V)

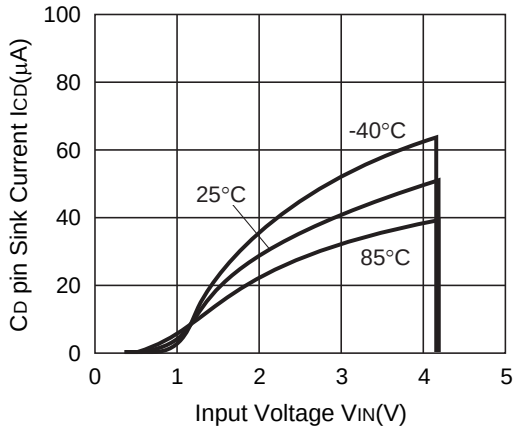


R1150H ($-V_{DSET}$ = 9.0 V)

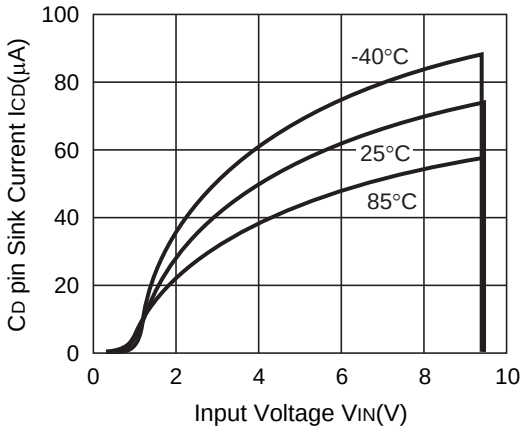


18) CD Pin Sink Current vs. Input Voltage

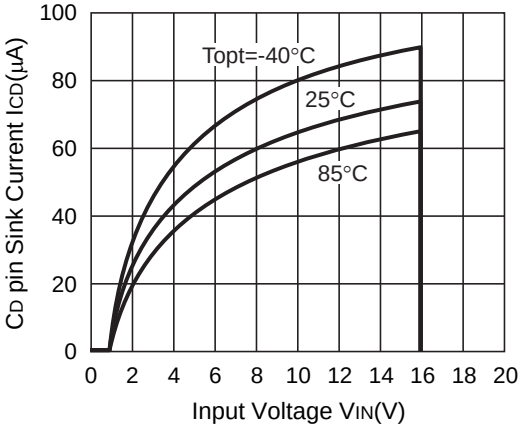
R1150H (-V_{DSET} = 4.0 V)



R1150HxxxD (-V_{DSET} = 9.0 V)

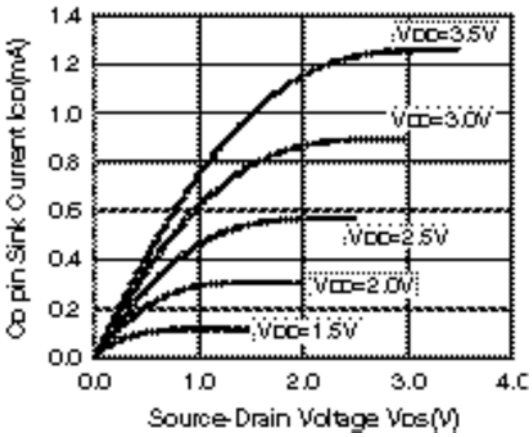


R1150H (-V_{DSET} = 15.0 V)

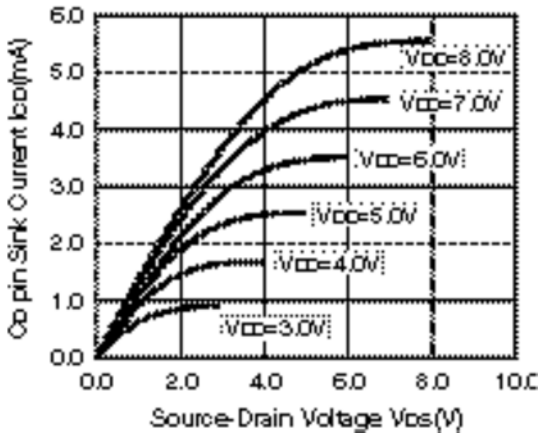


19) CD Pin Sink Current vs. VDS

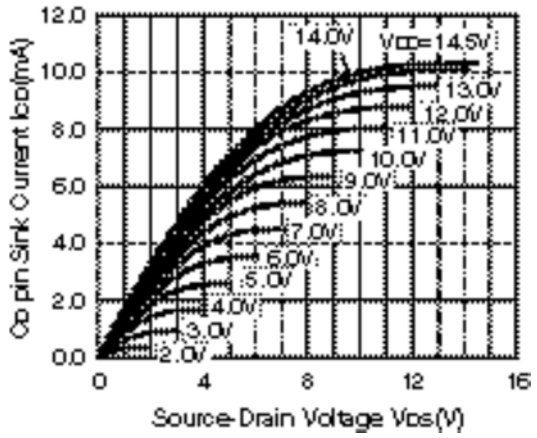
R1150H (-V_{DSET} = 4.0 V)



R1150H (-V_{DSET} = 9.0 V)

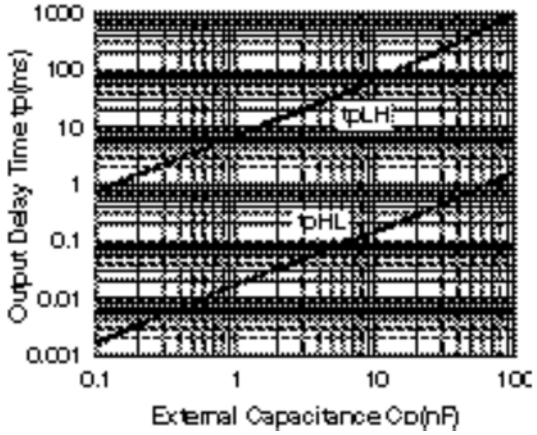


R1150H ($-V_{DSET}$ = 15.0 V)



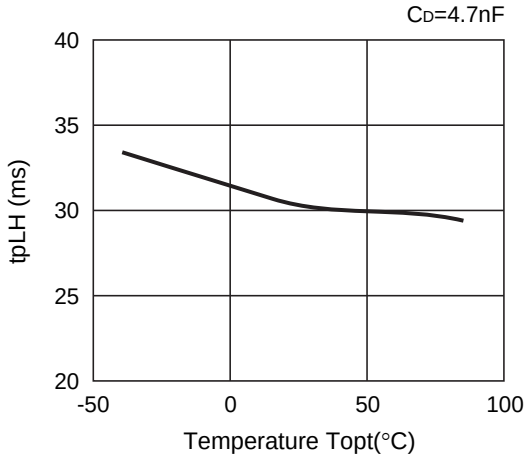
20) Output Delay Time vs. External Capacitance

R1150H ($-V_{DSET}$ = 4.0 V)

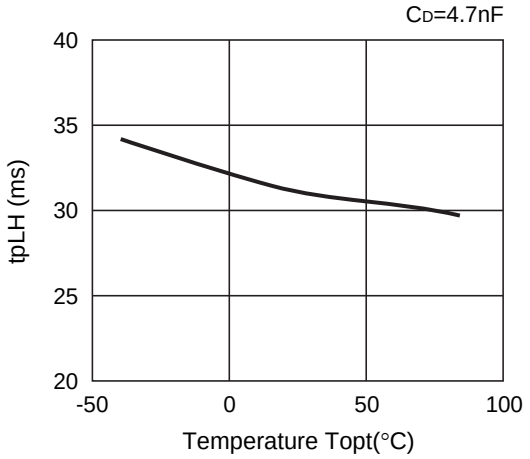


21) t_{PLH} Delay Time vs. Temperature

R1150HxxxD ($-V_{DSET}$ = 4.0 V)



R1150HxxxD ($-V_{DSET}$ = 9.0 V)



Ver. A

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-7.

Measurement Conditions

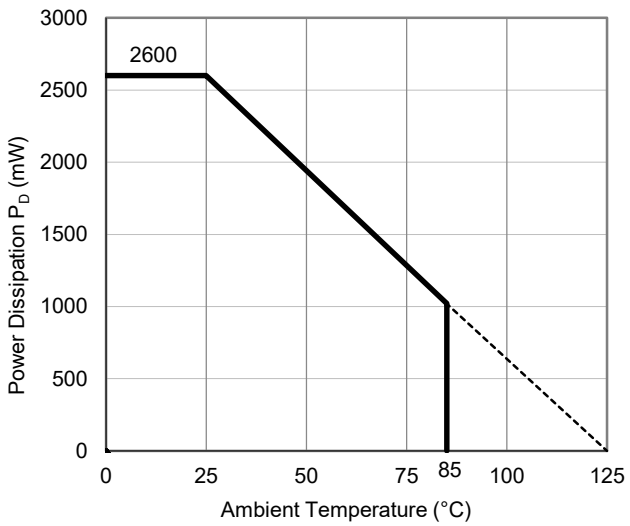
Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	ϕ 0.3 mm × 13 pcs

Measurement Result (Ta = 25°C, Tjmax = 125°C)

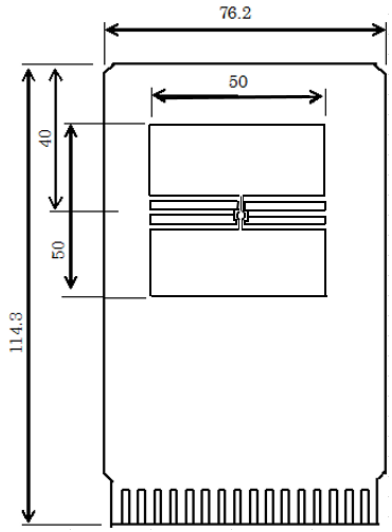
Item	Measurement Result
Power Dissipation	2600 mW
Thermal Resistance (θja)	θja = 38°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 13°C/W

θja: Junction-to-Ambient Thermal Resistance

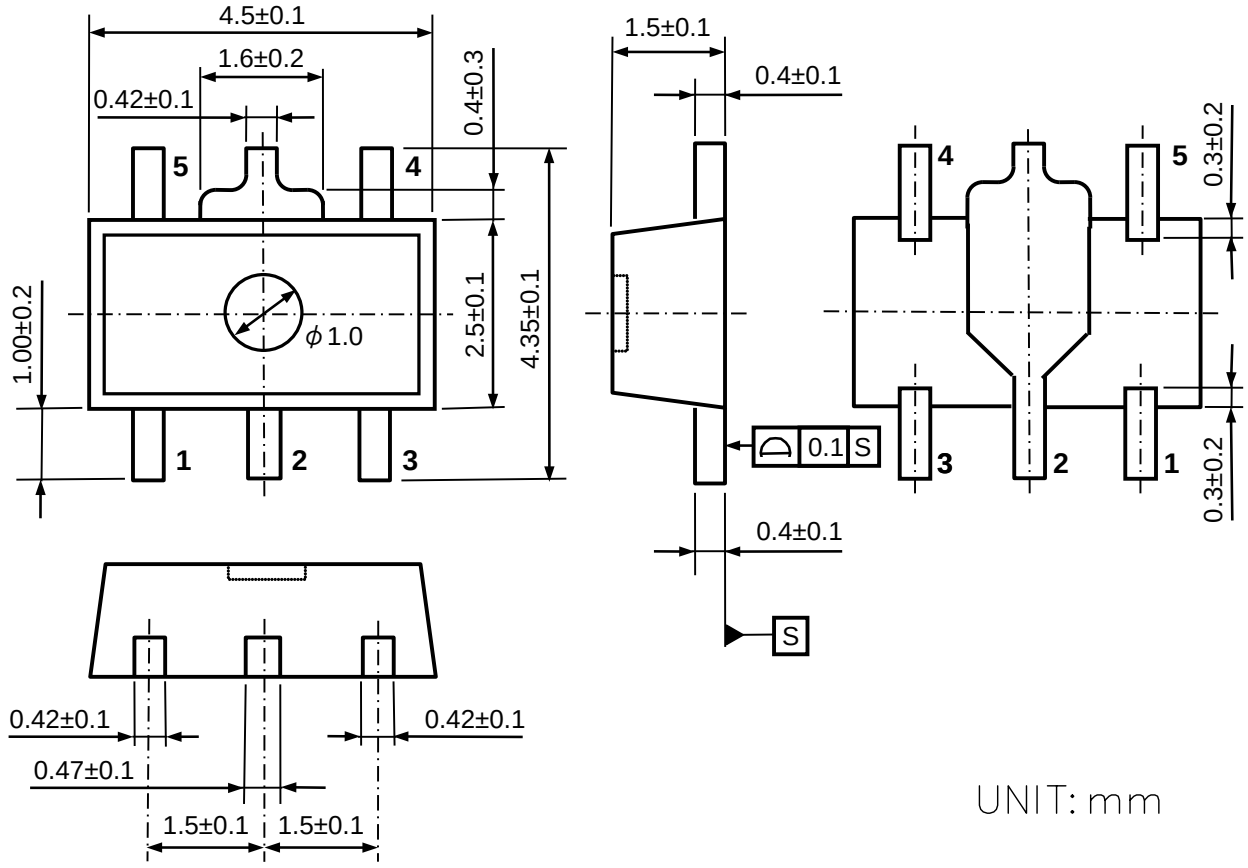
ψjt: Junction-to-Top Thermal Characterization Parameter



Power Dissipation vs. Ambient Temperature



Measurement Board Pattern



SOT-89-5 Package Dimensions

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8. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
9. WLCSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.
10. There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact our sales or our distributor before attempting to use AOI.
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