

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.

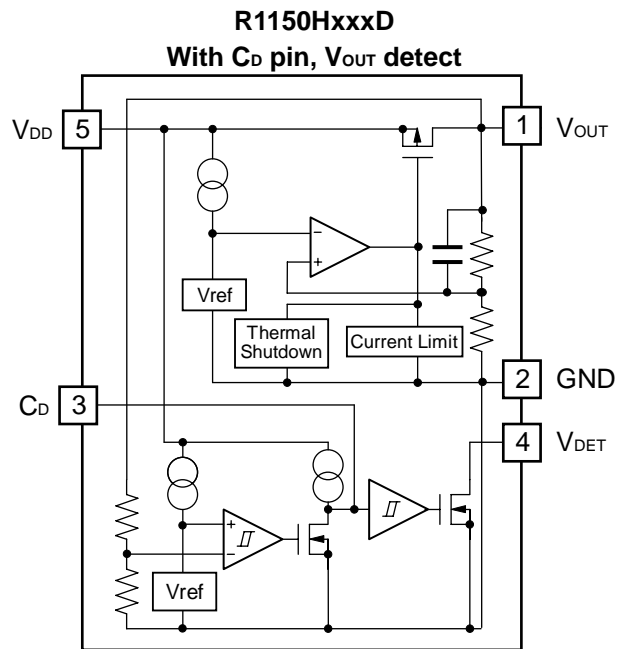
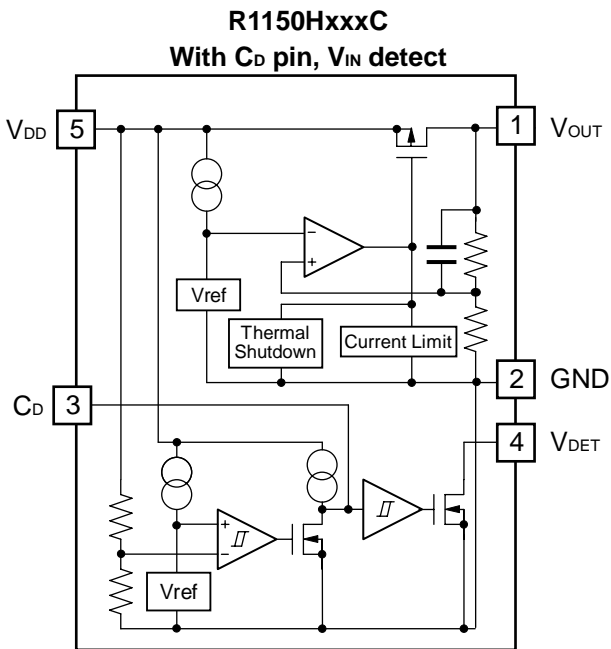
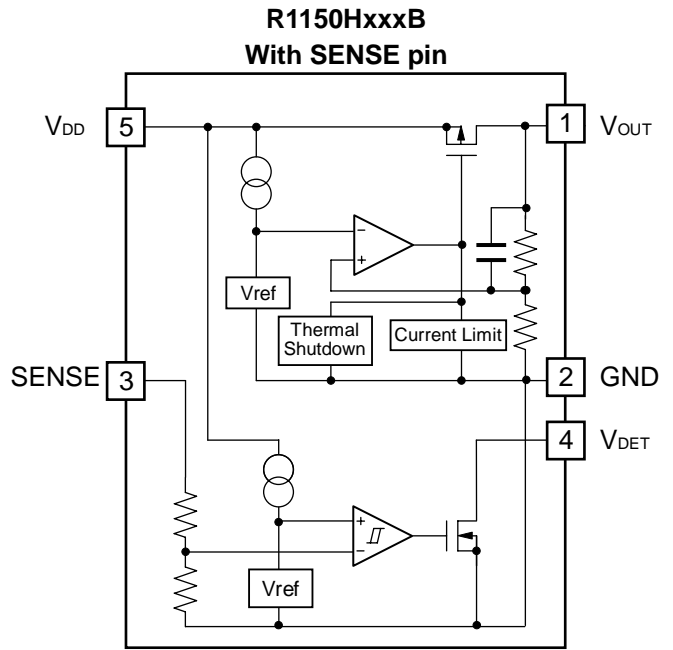
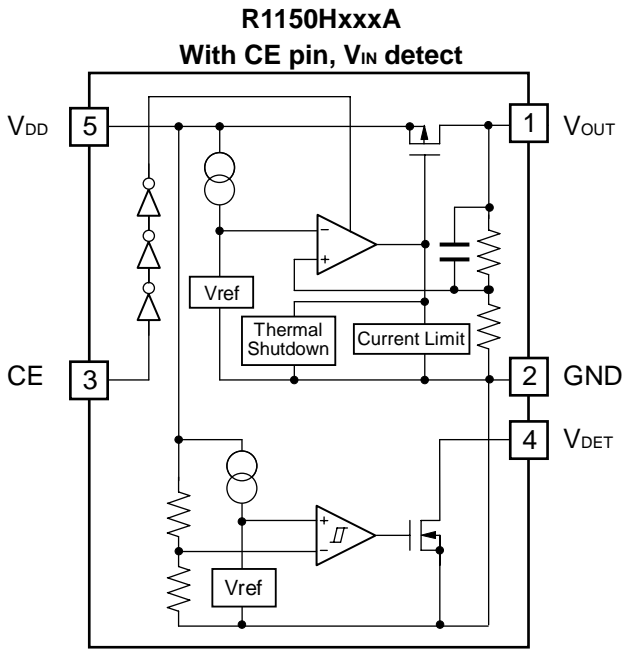
FEATURES

- 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

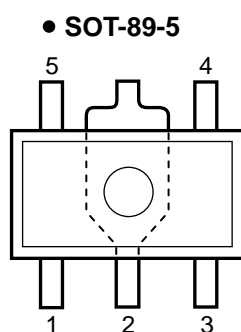


SELECTION GUIDE

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_{opt}=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} ≥ (-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

T_{opt}=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 | | | |
| ΔV _{OUT} /ΔI _{OUT} | Load Regulation | V _{IN} =V _{OUT} +2.0V 1mA ≤ I _{OUT} ≤ 40mA | Refer to Load Regulation Table | | | |
| ΔV _{OUT} /ΔV _{IN} | Line Regulation | V _{IN} =V _{OUT} +2.0V, I _{OUT} =20 mA V _{OUT} +1V ≤ V _{IN} ≤ 24V | | 0.05 | 0.15 | %/V |
| V _{DIF} | Dropout Voltage | I _{OUT} =20mA | Refer to Dropout Voltage Table | | | |
| ΔV _{OUT} /ΔT _{opt} | Output Voltage Temperature Coefficient | V _{IN} =V _{OUT} +2.0V, I _{OUT} =20mA -40°C ≤ T _{opt} ≤ 85°C | | ±100 | | ppm/°C |
| I _{SC} | 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

T_{opt}=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 |
| Δ-V _{DET} /ΔT _{opt} | Detector Threshold Temperature Coefficient | -40°C ≤ T _{opt} ≤ 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=470kΩ, Pull up Voltage=5V)

Note 2) V_{DET} pin is pulled up to V_{DD} via 470kΩ. 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.

- Standby Current (T_{opt}=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 |

VR part

- Output Current (T_{opt}=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 (T_{opt}=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 (T_{opt}=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 |

VD part

- Test Conditions for Output Current

| Detector Threshold Voltage -V _{DET} (V) | Conditions |
|---|---|
| 2.3V ≤ (-V _{DET}) ≤ 15.0V | V _{IN} =2V, 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

T_{opt}=25°C

| Symbol | Item | Conditions | Min. | Typ. | Max. | Unit |
|------------------|------------------------------|---|------|------|------|------|
| V _{IN} | Input Voltage | | | | 24.0 | V |
| I _{SS} | Supply Current | V _{OUT} ≥ (-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

T_{opt}=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 | | | |
| ΔV _{OUT} /ΔI _{OUT} | Load Regulation | V _{IN} =V _{OUT} +2.0V 1mA ≤ I _{OUT} ≤ 40mA | Refer to Load Regulation Table | | | |
| ΔV _{OUT} /ΔV _{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 | | | |
| ΔV _{OUT} /ΔT _{opt} | Output Voltage Temperature Coefficient | V _{IN} =V _{OUT} +2.0V I _{OUT} =20mA -40°C ≤ T _{opt} ≤ 85°C | | ±100 | | ppm/°C |
| I _{SC} | Short Current Limit | V _{OUT} =0V | | 45 | | mA |

VD

T_{opt}=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 |
| Δ-V _{DET} /ΔT _{opt} | Detector Threshold Temperature Coefficient | -40°C ≤ T _{opt} ≤ 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=470kΩ, Pull up Voltage=5V)

Note 2) V_{DET} pin is pulled up to V_{DD} via 470kΩ. 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 (T_{opt}=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 |

VR part

- Load Regulation (T_{opt}=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 (T_{opt}=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 |

VD part

- 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

T_{opt}=25°C

| Symbol | Item | Conditions | Min. | Typ. | Max. | Unit |
|------------------|---------------------------------------|---|------|------|------|------|
| V _{IN} | Input Voltage | | | | 24.0 | V |
| I _{SS} | Supply Current | V _{OUT} ≥ (-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

T_{opt}=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 | | | |
| ΔV _{OUT} /ΔI _{OUT} | Load Regulation | V _{IN} =V _{OUT} +2.0V 1mA ≤ I _{OUT} ≤ 40mA | Refer to Load Regulation Table | | | |
| ΔV _{OUT} /ΔV _{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 | | | |
| ΔV _{OUT} /ΔT _{opt} | Output Voltage Temperature Coefficient | V _{IN} =V _{OUT} +2.0V I _{OUT} =20mA -40°C ≤ T _{opt} ≤ 85°C | | ±100 | | ppm/°C |
| I _{SC} | Short Current Limit | V _{OUT} =0V | | 45 | | mA |

VD

T_{opt}=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 |
| Δ-V _{DET} /ΔT _{opt} | Detector Threshold Temperature Coefficient | -40°C ≤ T _{opt} ≤ 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=470kΩ, Pull up Voltage=5V)

Note 2) V_{DET} pin is pulled up to V_{DD} via 470kΩ. 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 (T_{opt}=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 (T_{opt}=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 (T_{opt}=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

T_{opt}=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

T_{opt}=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 | | | |
| ΔV _{OUT} /ΔI _{OUT} | Load Regulation | V _{IN} =V _{OUT} +2.0V 1mA ≤ I _{OUT} ≤ 40mA | Refer to Load Regulation Table | | | |
| ΔV _{OUT} /ΔV _{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 | | | |
| ΔV _{OUT} /ΔT _{opt} | Output Voltage Temperature Coefficient | V _{IN} =V _{OUT} +2.0V I _{OUT} =20mA -40°C ≤ T _{opt} ≤ 85°C | | ±100 | | ppm/°C |
| I _{SC} | Short Current Limit | V _{OUT} =0V | | 45 | | mA |

VD

T_{opt}=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 |
| Δ-V _{DET} /ΔT _{opt} | Detector Threshold Temperature Coefficient | -40°C ≤ T _{opt} ≤ 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=470kΩ, Pull up Voltage=5V)

Note 2) V_{DET} pin is pulled up to V_{DD} via 470kΩ. 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 (T_{opt}=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 (T_{opt}=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 (T_{opt}=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

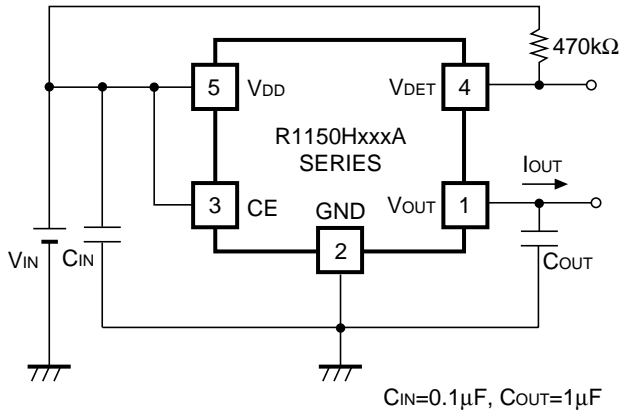
| Detector Threshold Voltage -V _{DET} (V) | Conditions |
|---|---|
| 2.1V ≤ (-V _{DET}) ≤ 15.0V | V _{IN} =2V, V _{DS} =0.05V |
| (-V _{DET})=2.0 | V _{IN} =1.9V, V _{DS} =0.05V |

RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)

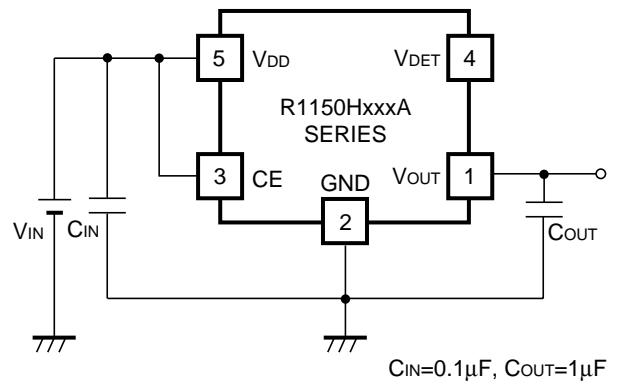
All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic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

TEST CIRCUITS

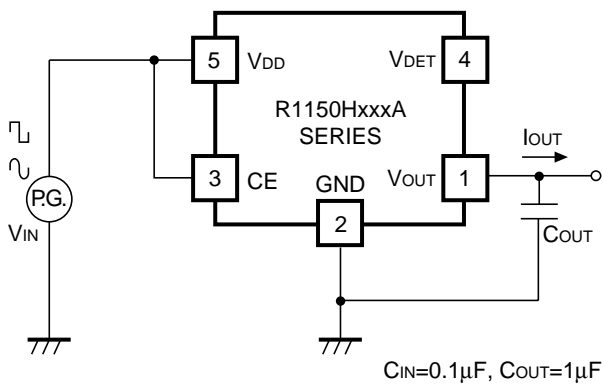
• R1150HxxxA



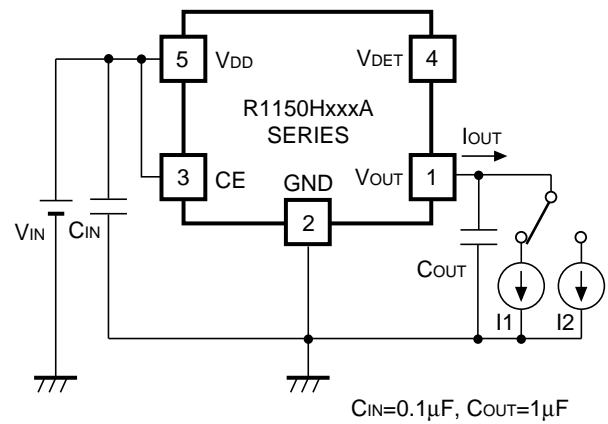
Standard Test Circuit



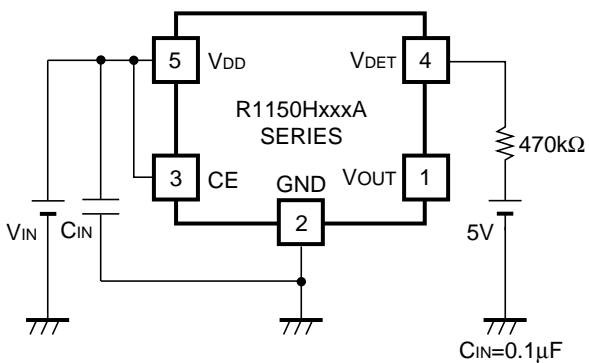
Supply Current Test Circuit



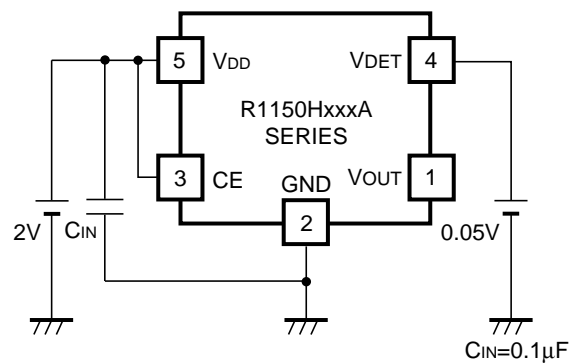
Input Transient Response/
Ripple Rejection Test Circuit



Load Transient Response Test Circuit

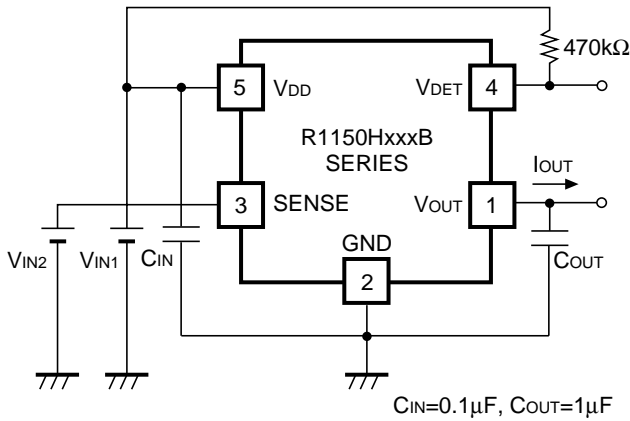


Minimum Operating Voltage Test Circuit

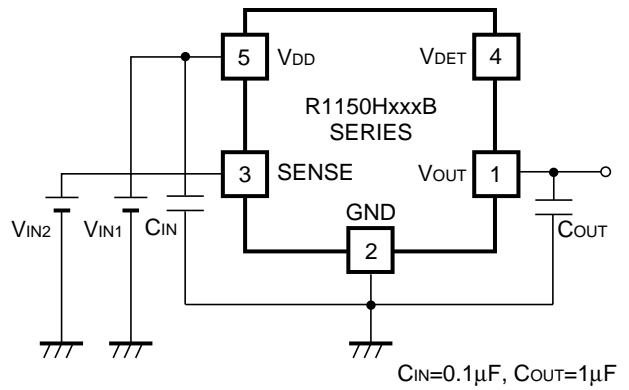


VD Output Current Test Circuit

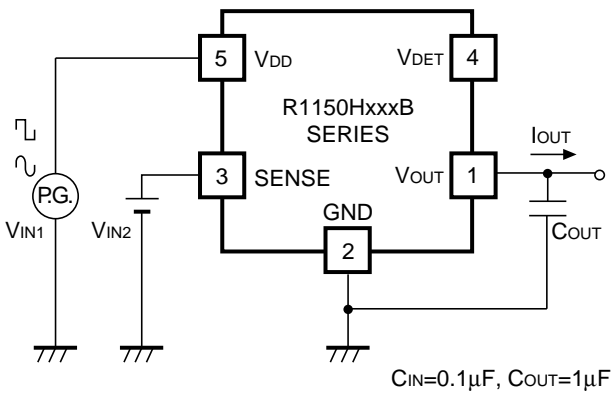
• R1150HxxxB



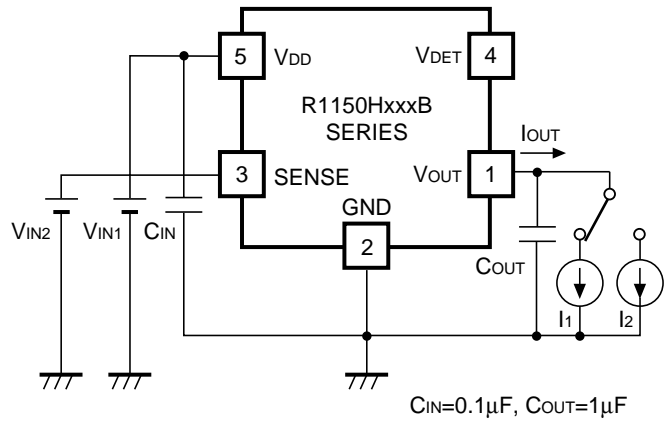
Standard Test Circuit



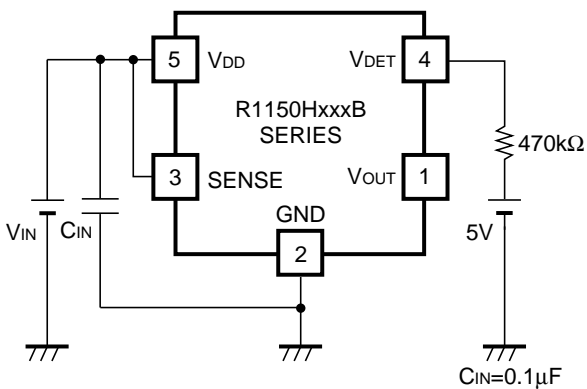
Supply Current Test Circuit



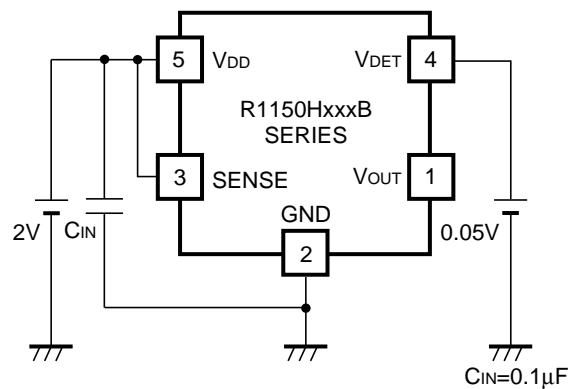
Input Transient Response/
Ripple Rejection Test Circuit



Load Transient Response Test Circuit

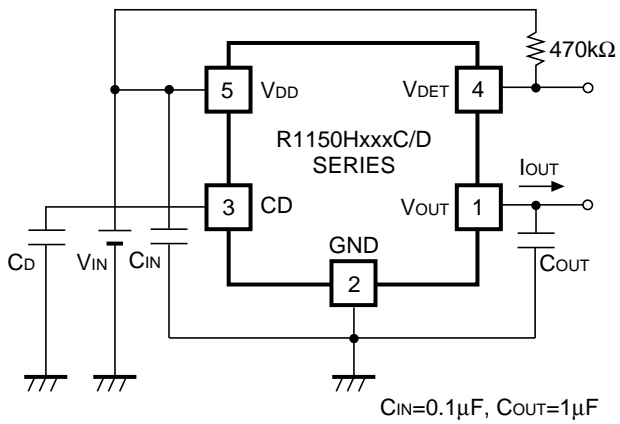


VDET Minimum Operating Voltage Test Circuit

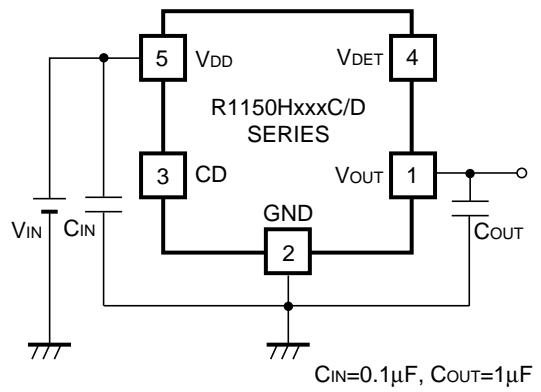


VD Output Current Test Circuit

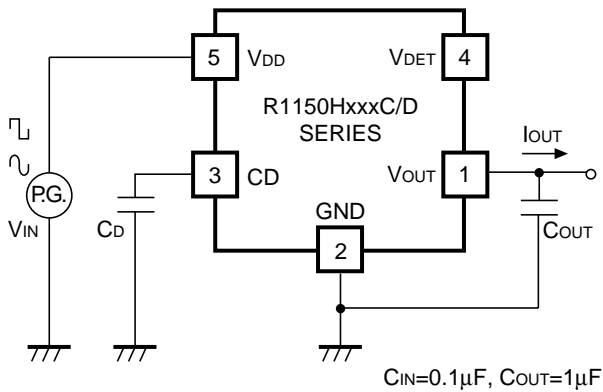
• R1150HxxxC/D



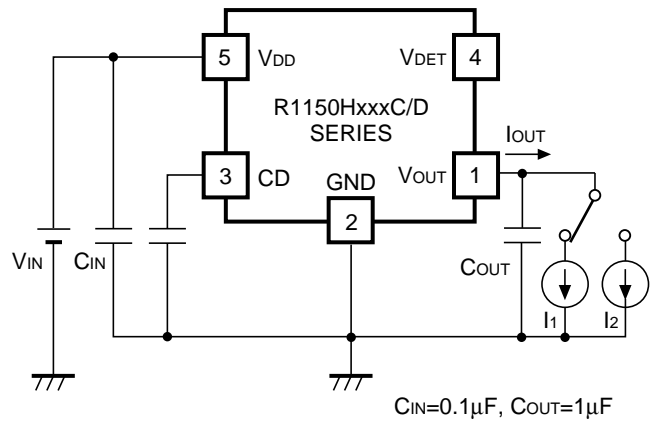
Standard Test Circuit



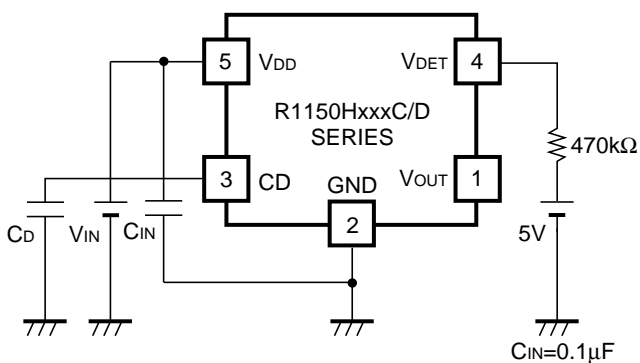
Supply Current Test Circuit



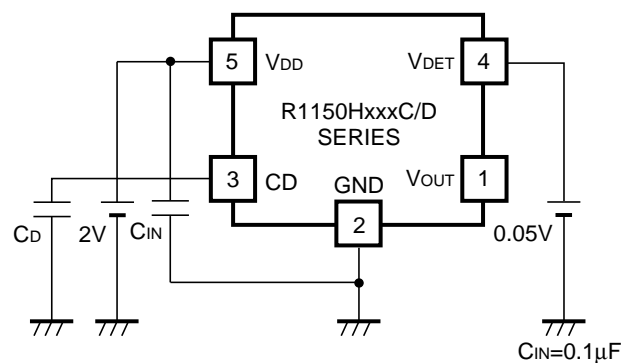
Input Transient Response/
Ripple Rejection Test Circuit



Load Transient Response Test Circuit



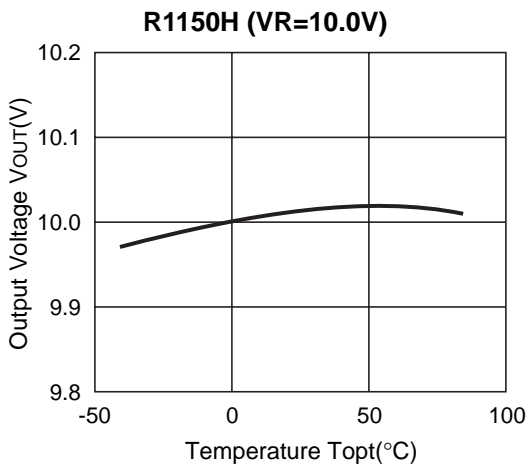
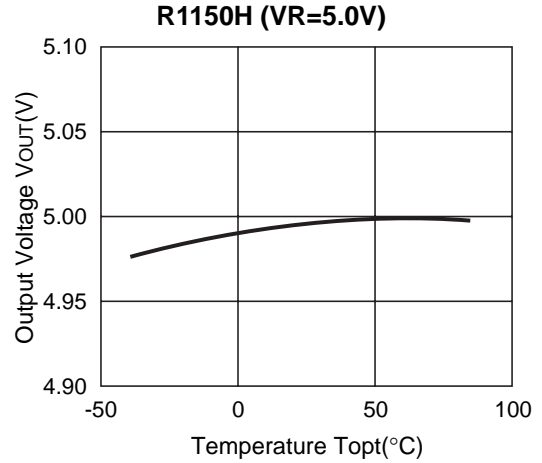
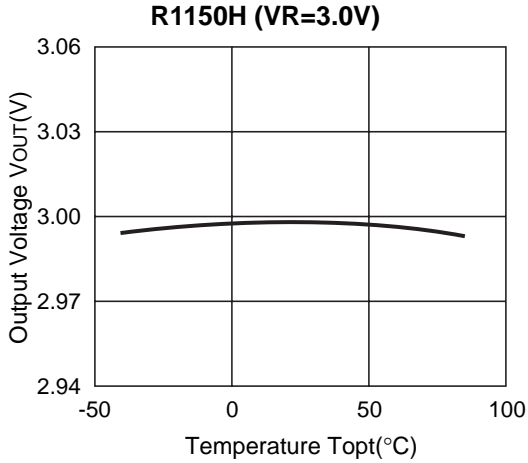
V_{DET} Minimum Operating Voltage Test Circuit



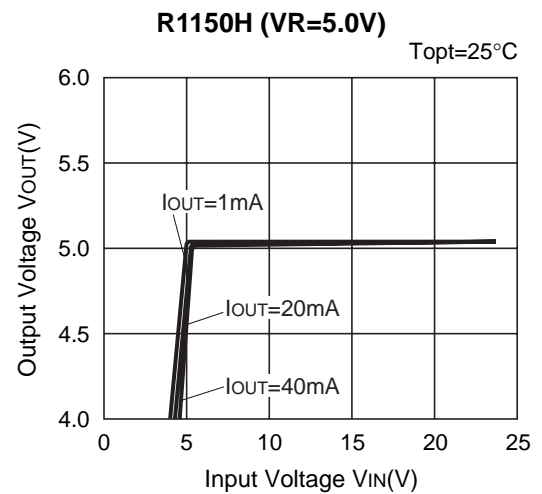
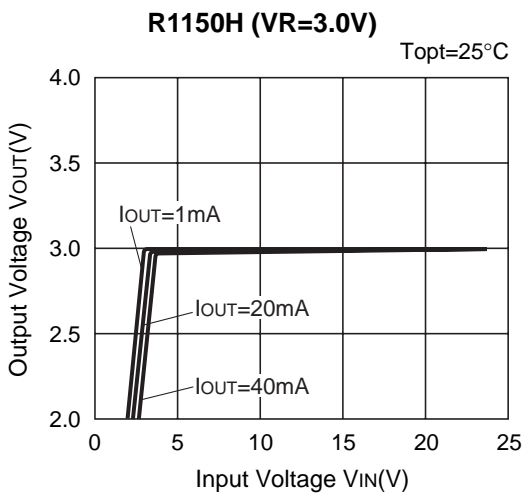
V_D Output Current Test Circuit

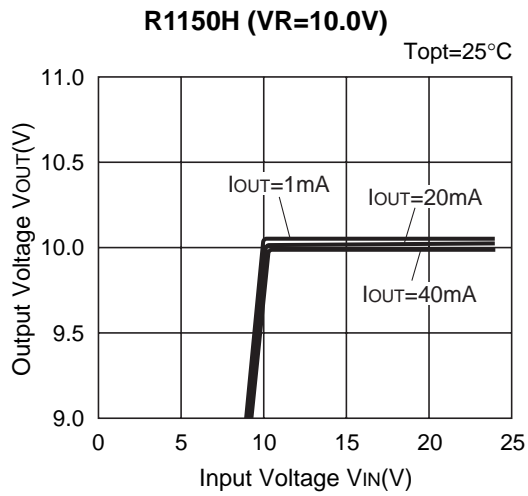
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Temperature

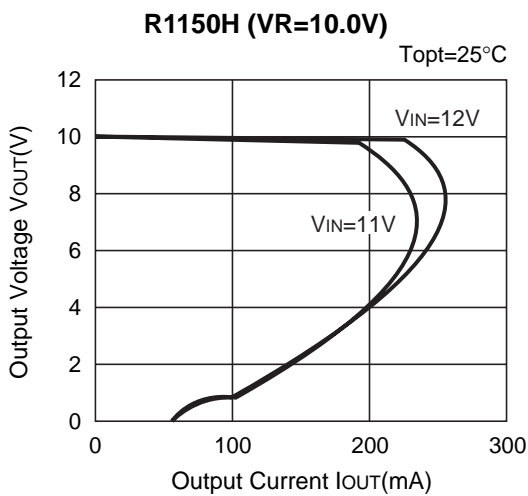
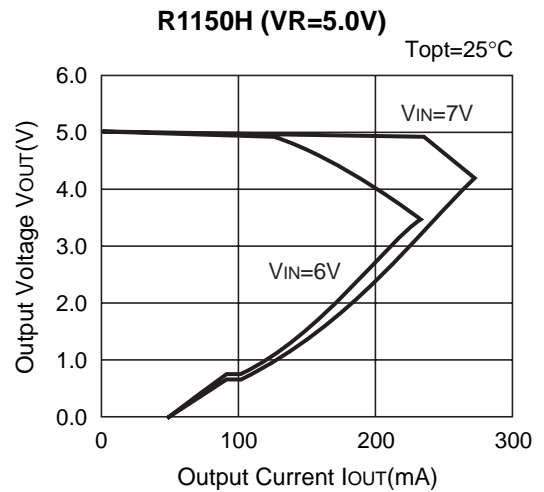
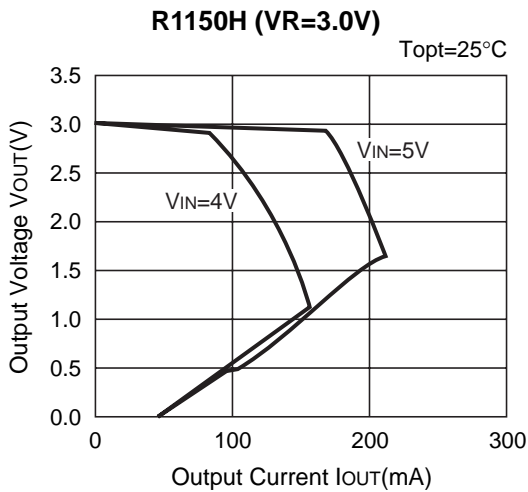


2) Output Voltage vs. Input Voltage

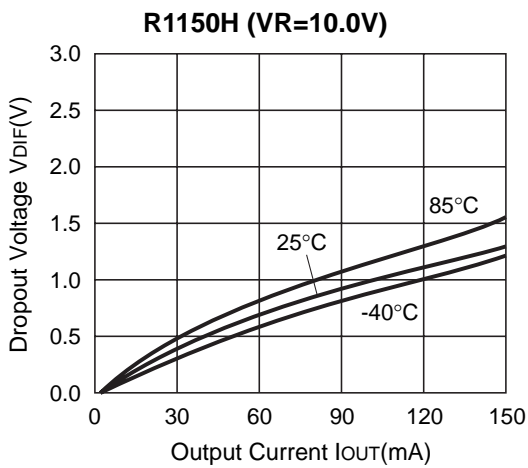
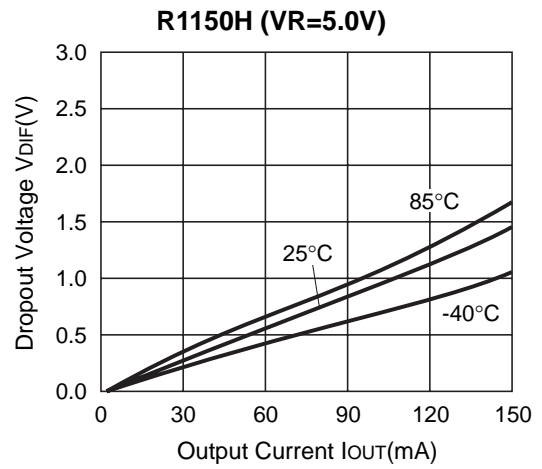
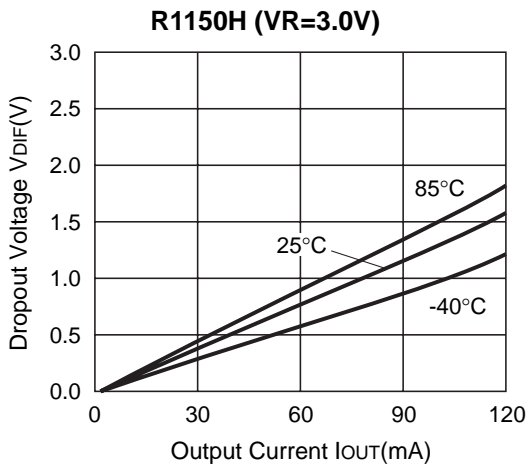




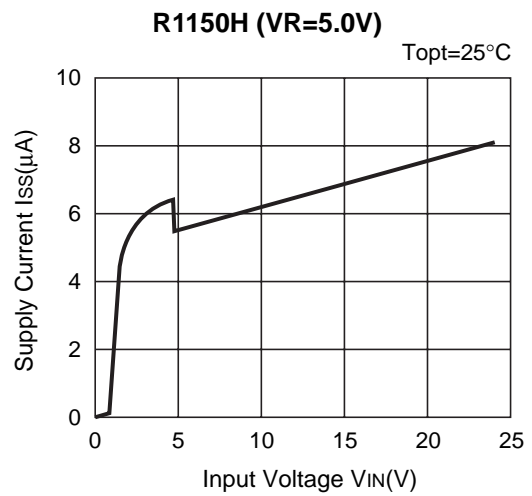
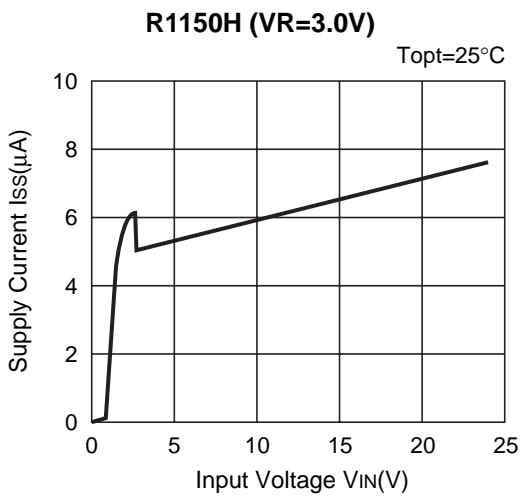
3) Output Voltage vs. Output Current

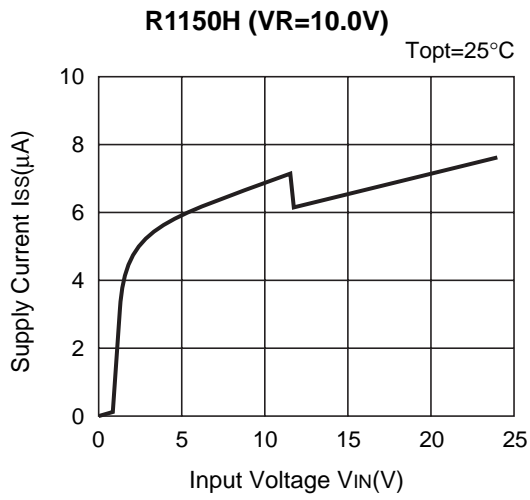


4) Dropout Voltage vs. Output Current

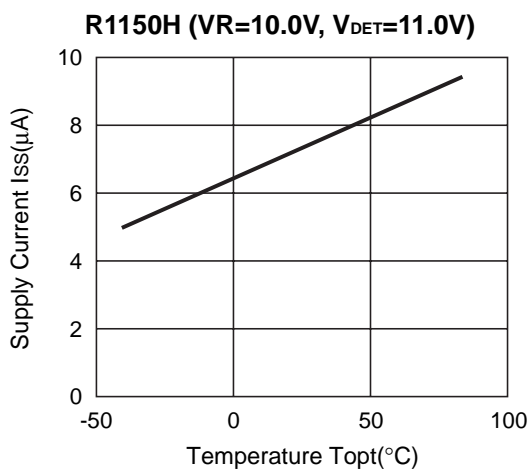
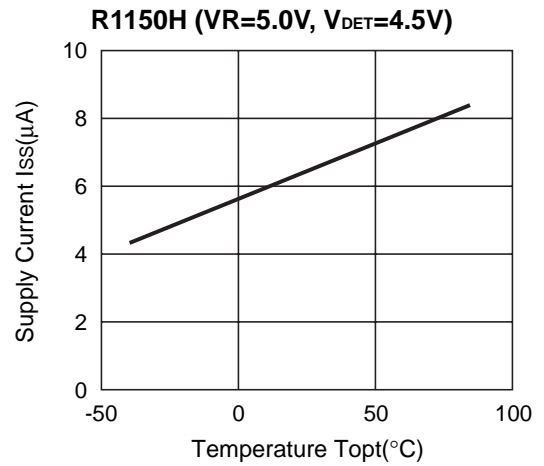
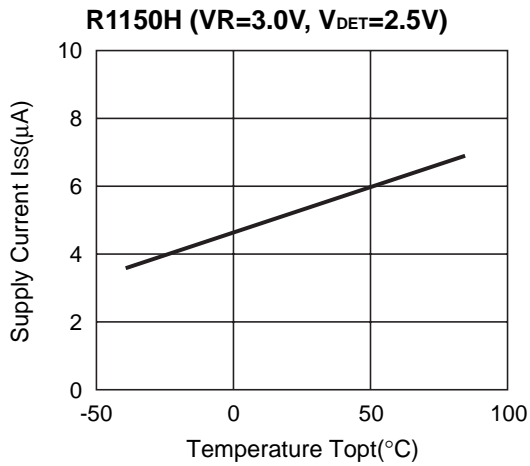


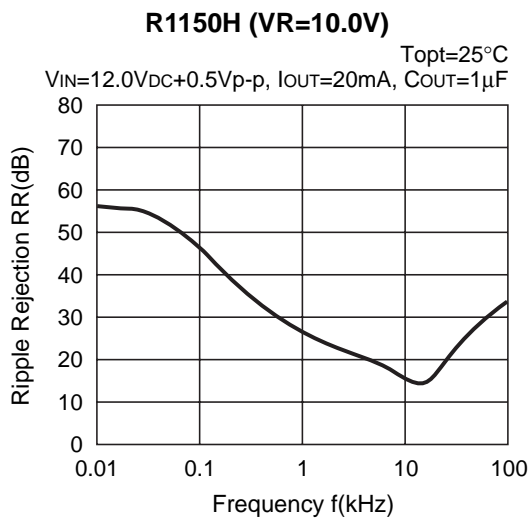
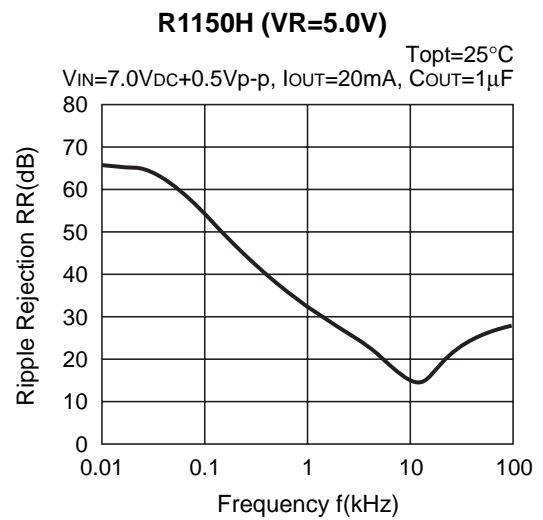
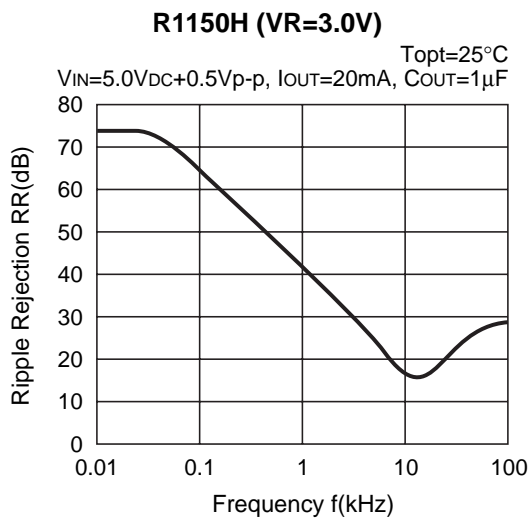
5) Supply Current vs. Input Voltage





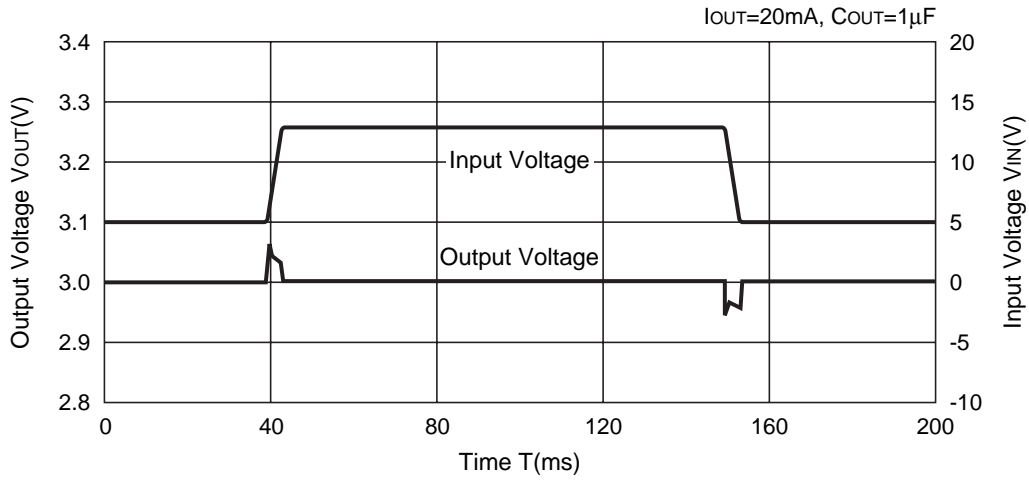
6) Supply Current vs. Temperature



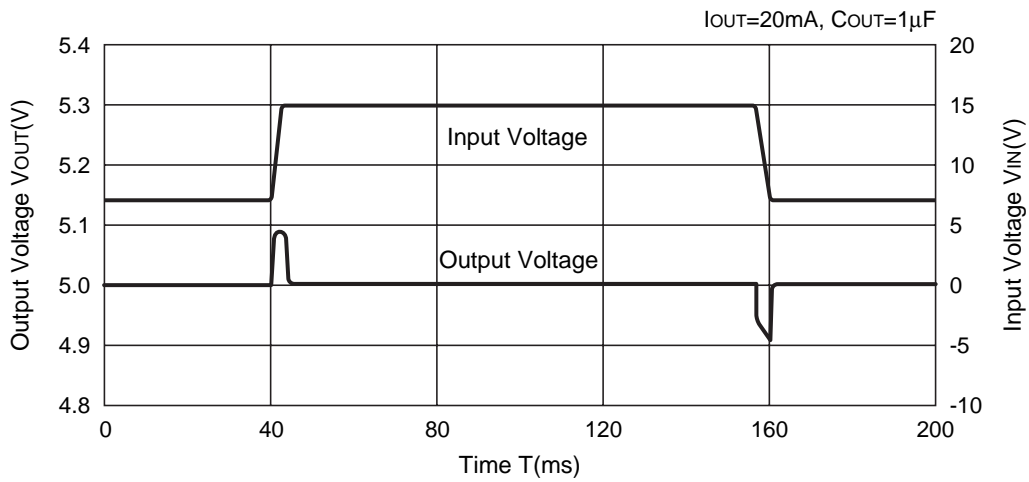
7) Ripple Rejection vs. Frequency

8) Input Transient Response

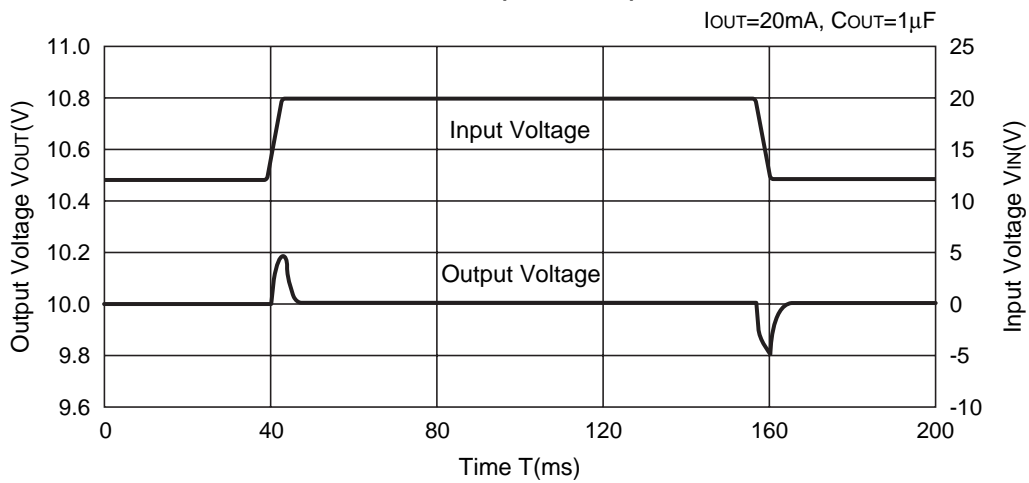
R1150H (VR=3.0V)



R1150H (VR=5.0V)

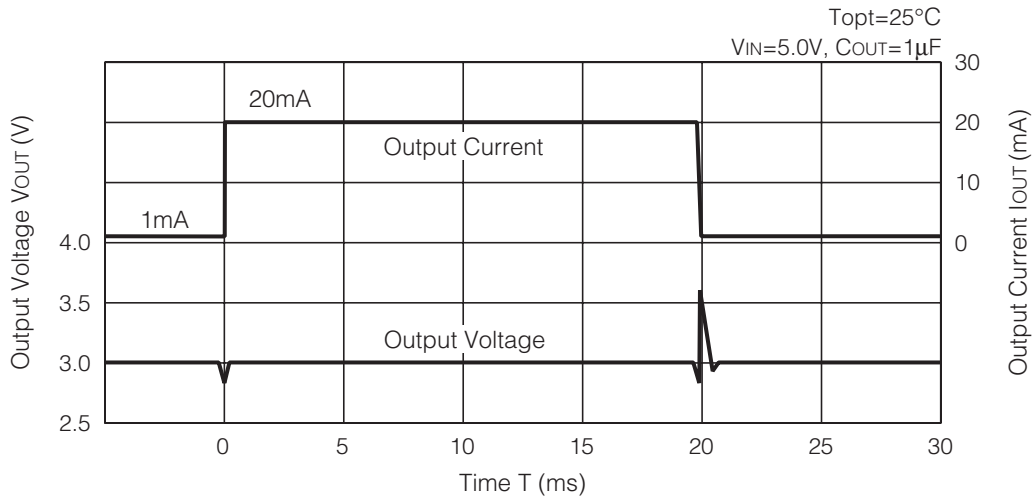


R1150H (VR=10.0V)

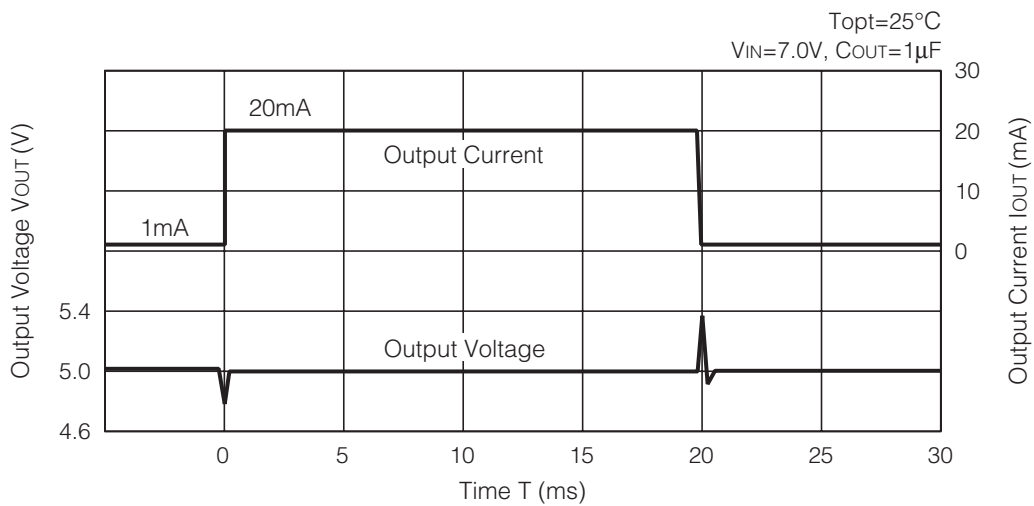


9) Load Transient Response

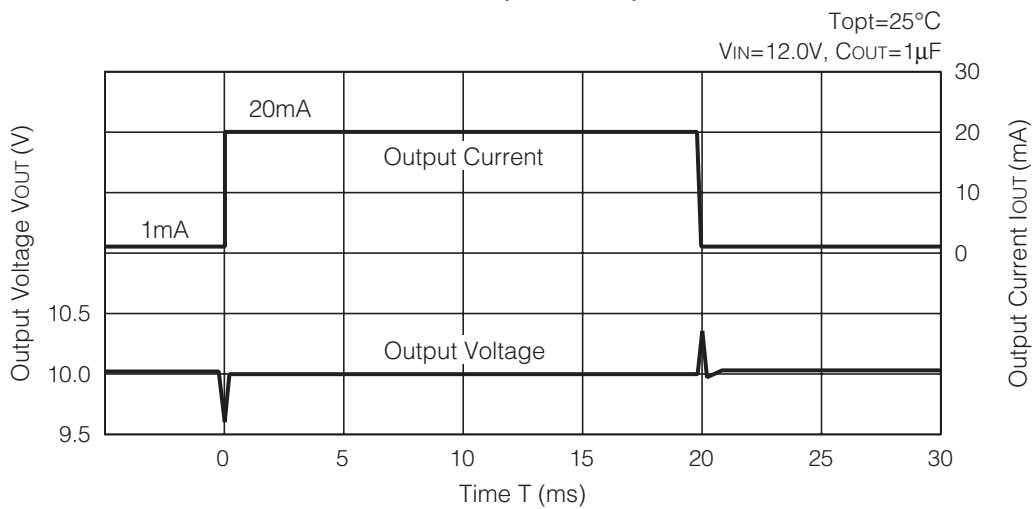
R1150H (VR=3.0V)



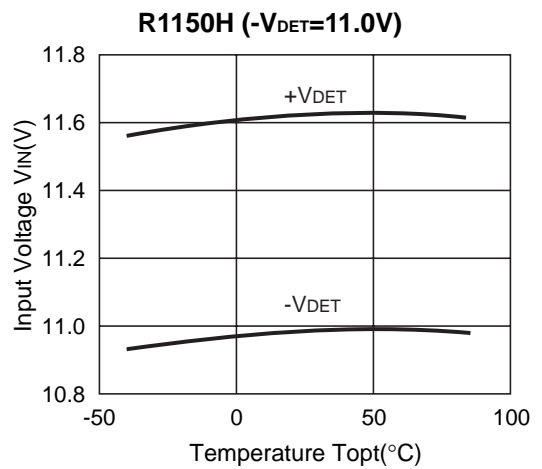
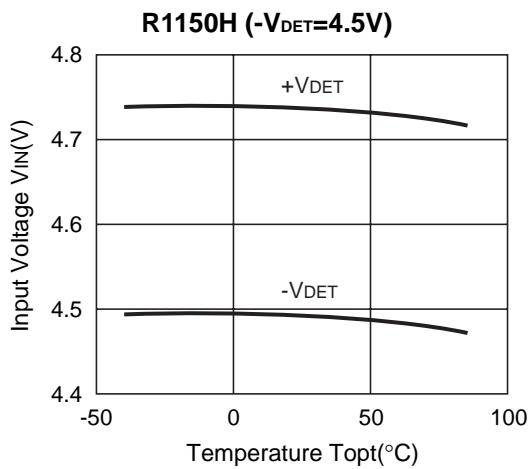
R1150H (VR=5.0V)



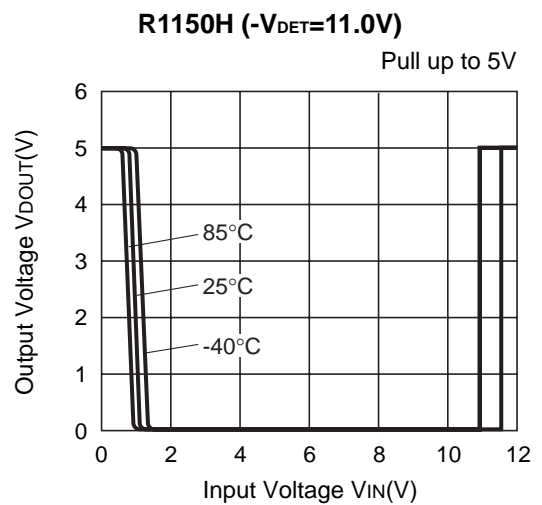
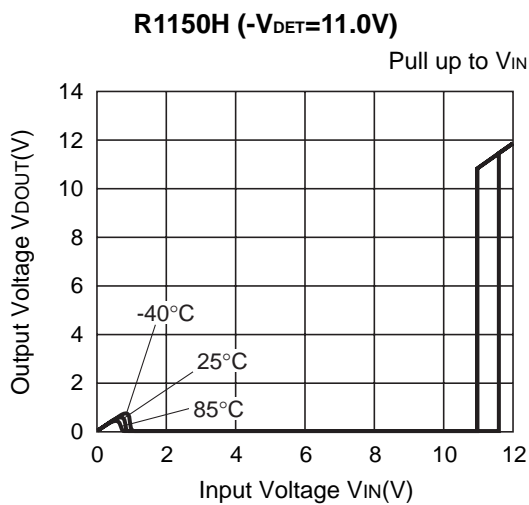
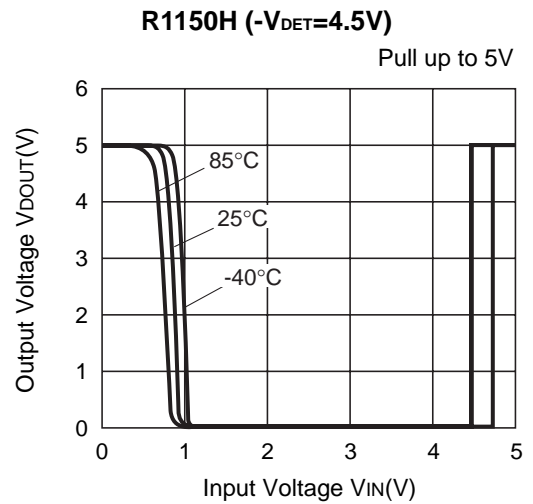
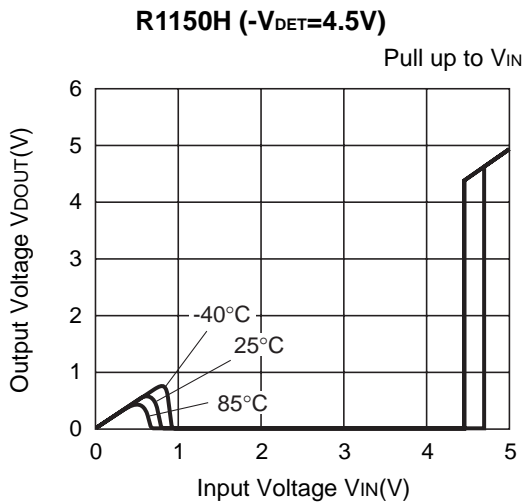
R1150H (VR=10.0V)



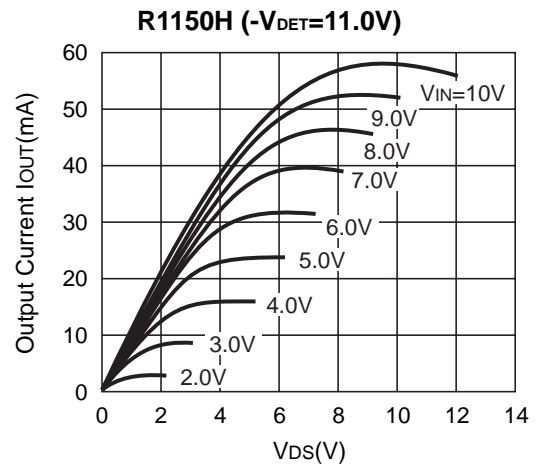
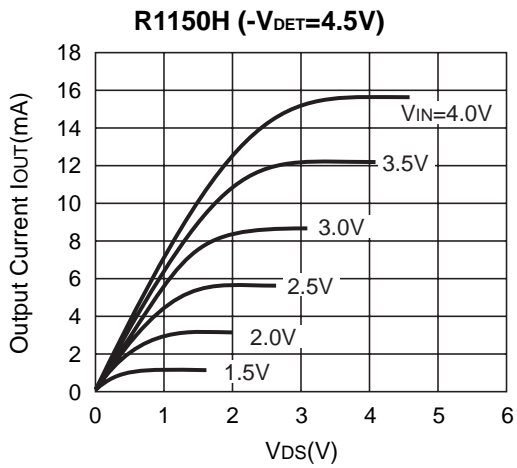
10) Detector Threshold vs. Temperature



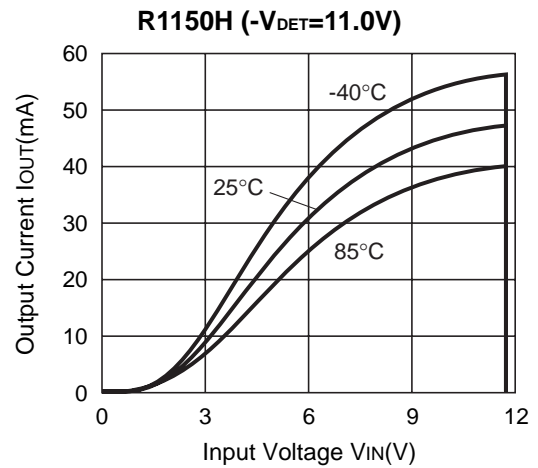
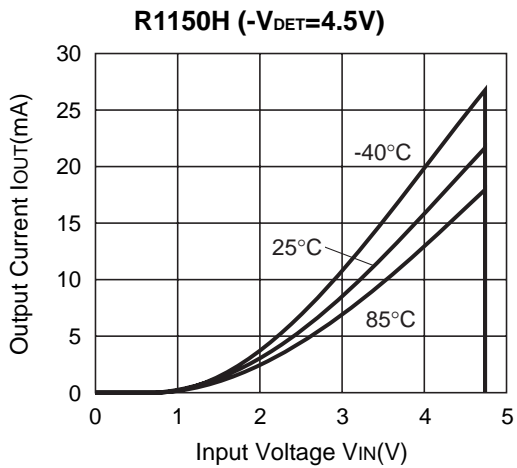
11) Detector Threshold vs. Input Voltage



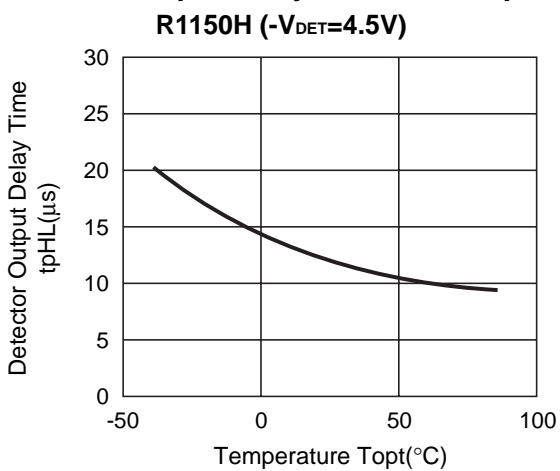
12) Nch Driver Output Current vs. V_{DS}



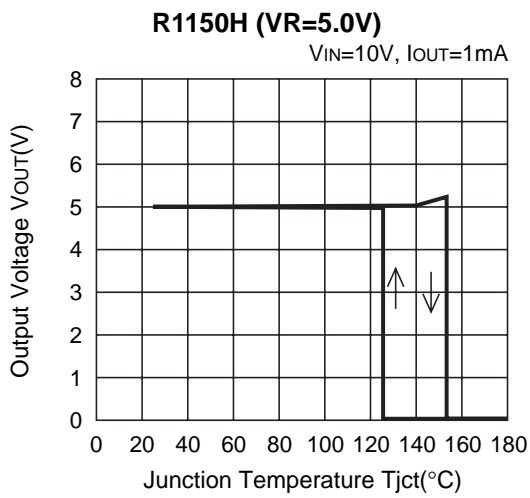
13) Nch Driver Output Current vs. Input Voltage



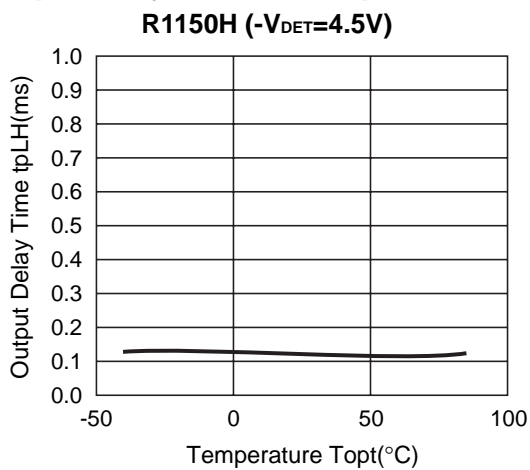
14) Detector Output Delay Time vs. Temperature



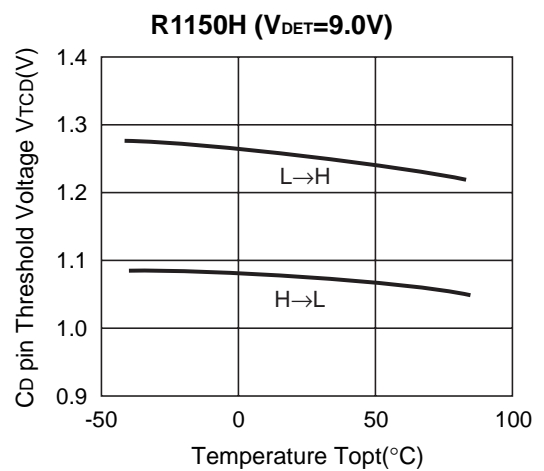
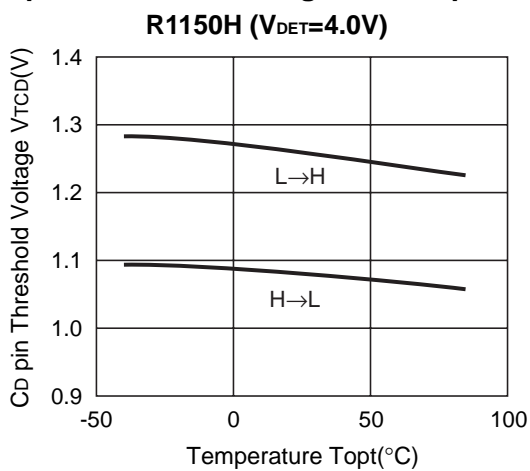
15) Thermal Shutdown Temperature vs. Output Voltage



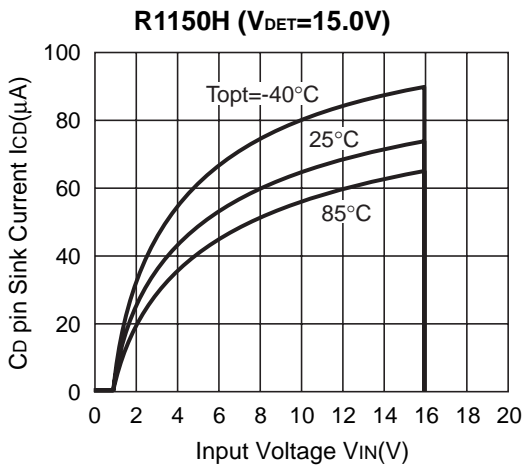
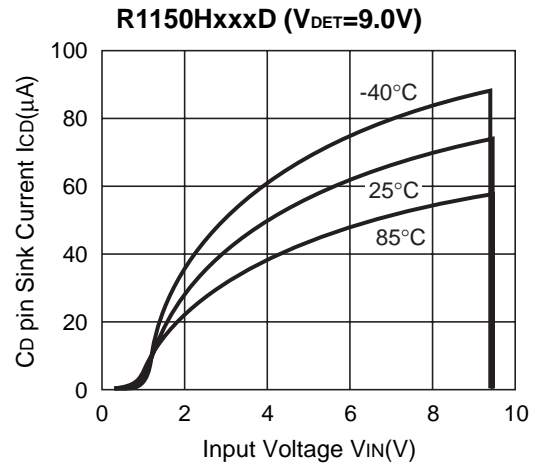
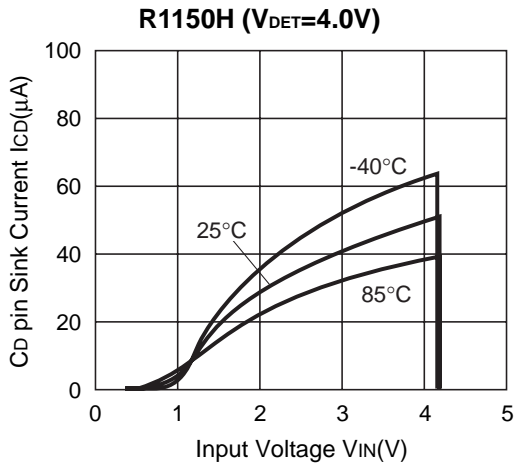
16) Output Delay Time vs. Temperature



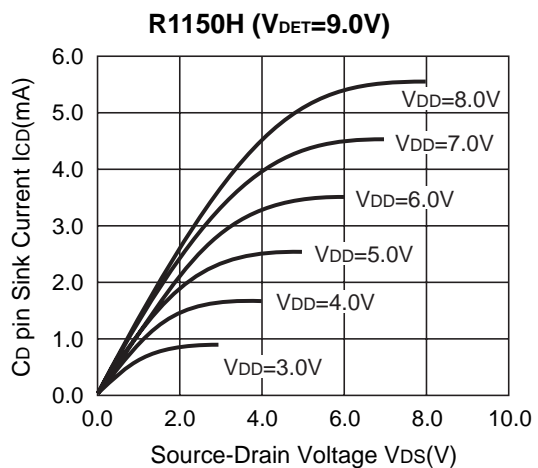
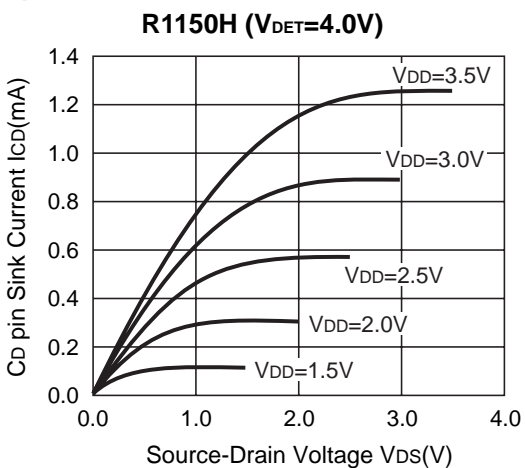
17) C_D pin Threshold Voltage vs. Temperature

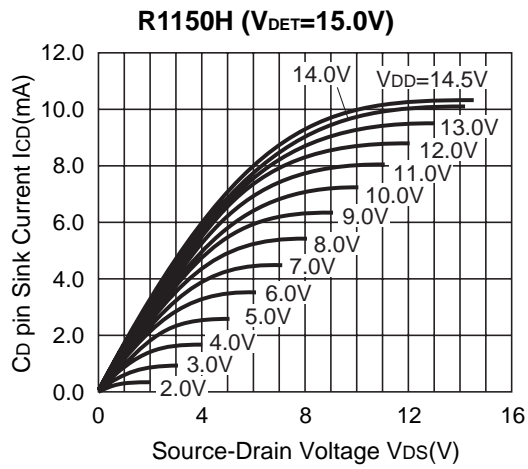


18) C_D pin Sink Current vs. Input Voltage

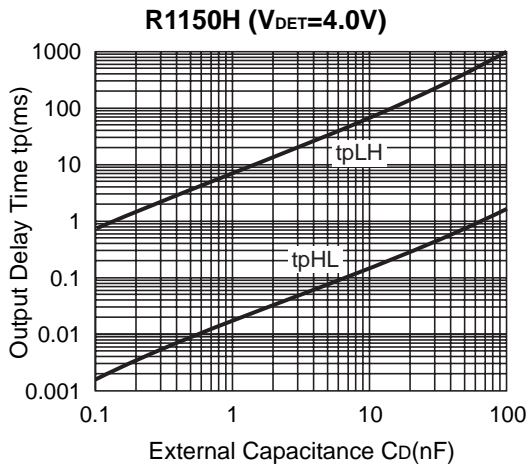


19) C_D pin Sink Current vs. V_{DS}

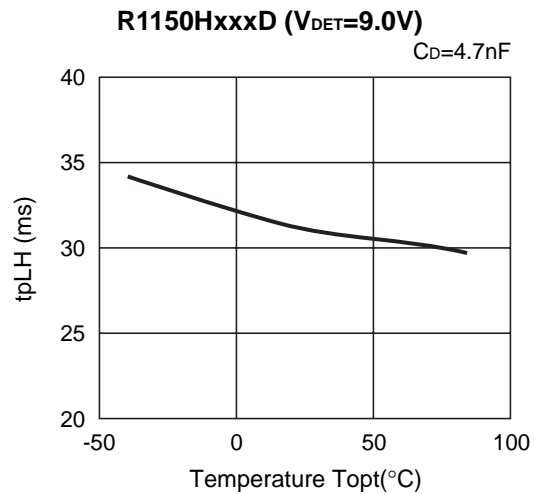
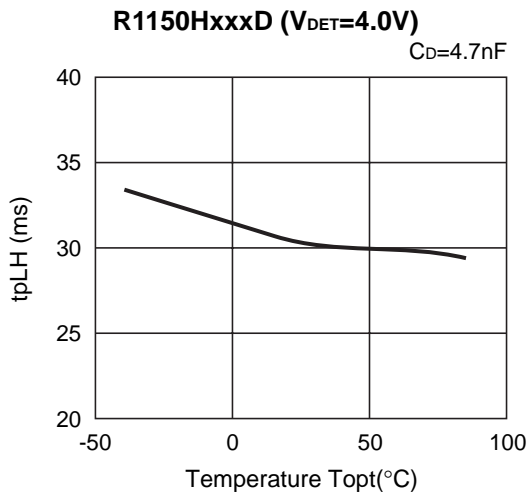




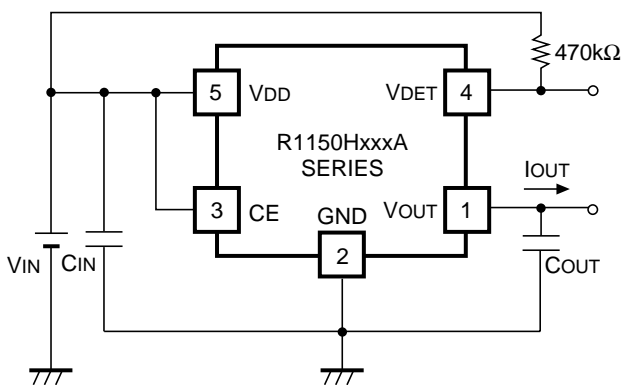
20) Output Delay Time vs. External Capacitance



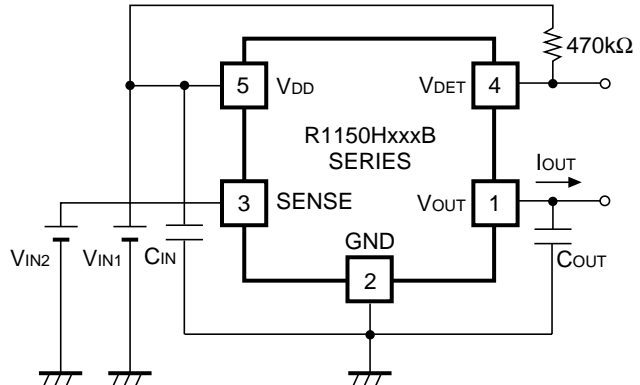
21) t_{PLH}delay vs. Temperature



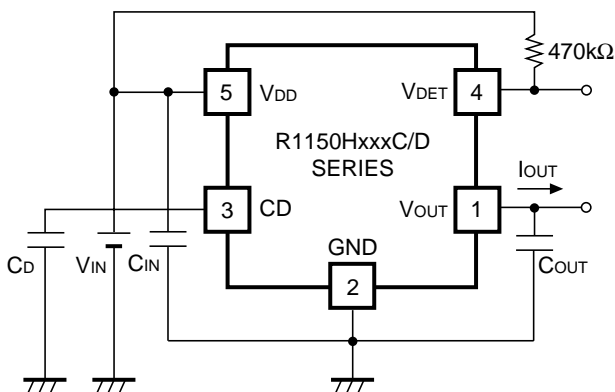
TYPICAL APPLICATIONS



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 $0.1\mu\text{F}$ 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

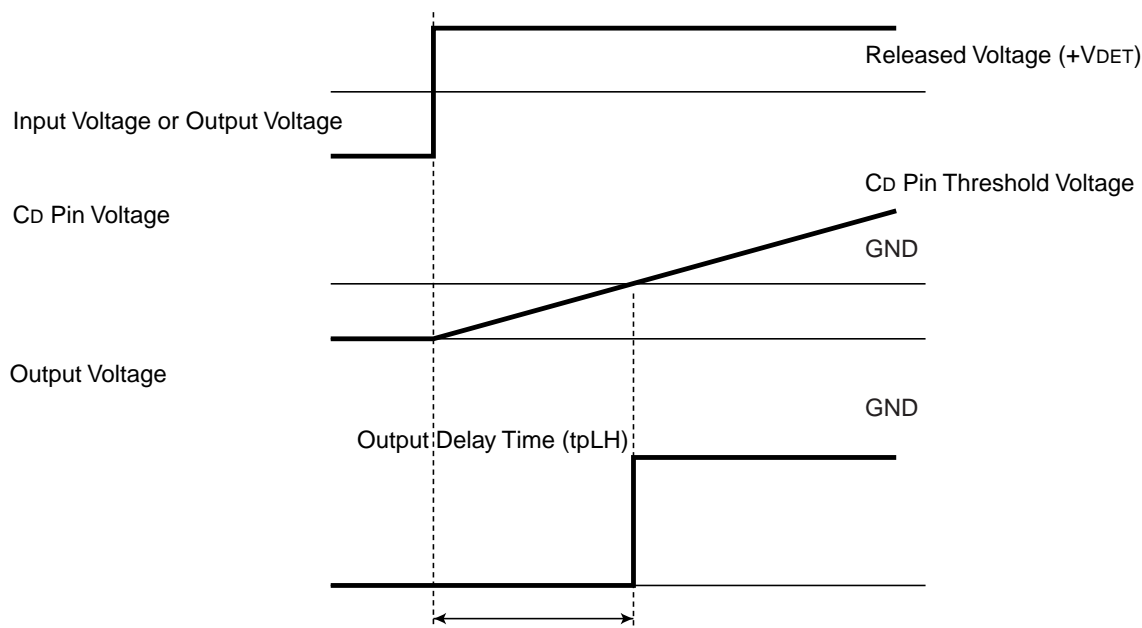
Thermal shutdown function is included in the R1150HxxxA/B/C/D Series, when the junction temperature is equal or more than +150°C (Typ.), the operation of regulator would stop. After that, when the junction temperature is equal or less than +120°C (Typ.), the operation of regulator would restart. Unless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



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RICOH RICOH ELECTRONIC DEVICES CO., LTD.

<http://www.e-devices.ricoh.co.jp/en/>

Sales & Support Offices

RICOH ELECTRONIC DEVICES CO., LTD.

Higashi-Shinagawa Office (International Sales)
3-32-3, Higashi-Shinagawa, Shinagawa-ku, Tokyo 140-8655, Japan
Phone: +81-3-5479-2857 Fax: +81-3-5479-0502

RICOH EUROPE (NETHERLANDS) B.V.

Semiconductor Support Centre
Prof. W.H. Keesomlaan 1, 1183 DJ Amstelveen, The Netherlands
Phone: +31-20-5474-309

RICOH ELECTRONIC DEVICES KOREA CO., LTD.

3F, Haesung Bldg. 504, Teheran-ro, Gangnam-gu, Seoul, 135-725, Korea
Phone: +82-2-2135-5700 Fax: +82-2-2051-5713

RICOH ELECTRONIC DEVICES SHANGHAI CO., LTD.

Room 403, No.2 Building, No.690 Bilbo Road, Pu Dong New District, Shanghai 201203,
People's Republic of China
Phone: +86-21-5027-3200 Fax: +86-21-5027-3299

RICOH ELECTRONIC DEVICES CO., LTD.

Taipei office
Room 109, 10F-1, No.51, Hengyang Rd., Taipei City, Taiwan (R.O.C.)
Phone: +886-2-2313-1621/1622 Fax: +886-2-2313-1623

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Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный)

Факс: 8 (812) 320-02-42

Электронная почта: org@eplast1.ru

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.