

Preliminary Data Sheet

C30659-900-1060-1550nm Series

Silicon and InGaAs APD Preamplifier Modules

**Description**

PerkinElmer C30659 Series includes a Silicon or InGaAs Avalanche Photodiode with a hybrid preamplifier. It is supplied in a single modified 12-lead TO-8 package.

The avalanche photodiodes used in these devices are the C30817E, C30902E, C30954E, C30956E, C30645E and C30662E that provide very good response between 830 and 1550 nanometers and very fast rise and fall times at all wavelengths. The preamplifier section uses a very low noise GaAs FET front end designed to operate at higher transimpedance than the regular C30950 series.

The C30659 is pin to pin compatible with the C30950 series. The output of the C30659 is negative. An emitter follower is used as an output buffer stage. To obtain the wideband characteristics, the output of these devices should be AC (capacitively) coupled to a 50 Ohm termination. The module must not be DC coupled to loads of less than 2,000 Ohms.

For field use, it is recommended that a temperature compensated HV supply be employed to maintain responsivity constant over temperature.

Applications

- ▶ Range Finding
- ▶ Confocal Microscope
- ▶ LIDAR

Features

- ▶ System bandwidth 50 MHz and 200 MHz
- ▶ Ultra low noise equivalent power (NEP)
- ▶ Spectral response range:
Silicon APD: 400 to 1100nm
InGaAs APD: 1100 to 1700nm
- ▶ Power consumption (150 mW typ.)
- ▶ +/-5 Volts amplifier operating voltages
- ▶ 50 Ω AC Load capability
- ▶ Hermetically sealed TO-8 packages
- ▶ High reliability
- ▶ Fast overload recovery
- ▶ Pin compatible with the C30950 series
- ▶ Light entry angle $\varnothing 130^\circ$

Table 1. Electrical Characteristics at $T_A=22^\circ\text{C}$ Test Conditions: Ambient Temperature, $V_{\text{amp}} = \pm 5$ Volts, $HV = +V_R$ (see Note 1), $R_L = 50\Omega$ AC Coupled

| Detector Type | 900nm Silicon APD | | | | | | |
|---|------------------------------------|--------|------|------------------------------------|--------|------|------------------------|
| | C30659-900-R8A (Si APD C30817E) | | | C30659-900-R5B (Si APD C30902E) | | | |
| | Min | Typ | Max | Min | Typ | Max | |
| Active Diameter | 0.8 | | | 0.5 | | | mm |
| Active Area | 0.5 | | | 0.2 | | | mm ² |
| Bandwidth Range | 50 | | | 200 | | | MHz |
| Temperature Coefficient of V_R for constant Gain | - | 2.2 | - | - | 0.7 | - | V/ $^\circ\text{C}$ |
| V_R for specified responsivity | 275 | Note 1 | 435 | 180 | Note 1 | 260 | V |
| Temperature sensor sensitivity | -1.8 | -2.1 | -2.4 | -1.8 | -2.1 | -2.4 | mV/ $^\circ\text{C}$ |
| Responsivity | | | | | | | |
| At 830nm | - | 2700 | - | - | 460 | - | kV/W |
| At 900nm | - | 3000 | - | - | 400 | - | kV/W |
| R_F (Internal Feedback Resistor) | - | 82 | - | - | 12 | - | k Ω |
| Noise Equivalent Power (NEP) (note 3) f - 100 kHz, $\Delta f = 1.0$ Hz | | | | | | | |
| At 830nm | - | 14 | 17 | - | 35 | 55 | fW/ $\sqrt{\text{Hz}}$ |
| At 900nm | - | 12 | 15 | - | 40 | 65 | fW/ $\sqrt{\text{Hz}}$ |
| Output Spectral Noise Voltage: (f = 100 kHz - $f_{-3\text{dB}}$) | - | 35 | 45 | - | 15 | 25 | nV/ $\sqrt{\text{Hz}}$ |
| Output Impedance | 33 | 40 | 50 | 33 | 40 | 50 | Ω |
| System Bandwidth, $f_{-3\text{dB}}$ | 40 | 50 | - | 175 | 200 | - | MHz |
| Rise Time, t_r ($\lambda = 830$ and 900nm) 10% to 90% points | - | 7 | - | - | 2 | - | ns |
| Fall Time, t_f ($\lambda = 830$ and 900nm) 90% to 10% points | - | 7 | - | - | 2 | - | ns |
| Recovery time after overload (note 4) | - | - | 150 | - | - | 150 | ns |
| Output Voltage Swing (1k Ω load) (note 5) | 2 | 3 | - | 2 | 3 | - | V |
| Output Voltage Swing (50 Ω load) (note 5) | 0.7 | 0.9 | - | 0.7 | 0.9 | - | V |
| Output Offset Voltage | -1 | 0.25 | 1 | -1 | 0.25 | 1 | V |
| Positive Supply Current (V+) | - | 20 | 35 | - | 20 | 35 | mA |
| Negative Supply Current (V-) | - | 10 | 20 | - | 10 | 20 | mA |

Notes: 1. A specific value of V_R is supplied with each device. The V_R value will be within the specified ranges.2. $I_f = 0.1$ mA, 25°C

3. NEPmax is the Maximum Output Spectral Noise Voltage max divided by the typical Responsivity.

4. 0dBm, 250ns pulse.

5. Pulsed operation.

Table 2. Electrical Characteristics at T_A=22°C

Test Conditions: Ambient Temperature, V_{amp} = ±5 Volts, HV = +V_R (see Note 1), R_L = 50Ω AC Coupled

| Detector Type | 1060nm Silicon APD | | | | | | |
|---|------------------------------------|--------|------|-------------------------------------|--------|------|-----------------|
| | C30659-1060-3A (Si APD C30956E) | | | C30659-1060-R8B (Si APD C30954E) | | | |
| | Min | Typ | Max | Min | Typ | Max | |
| Active Diameter | | 3.0 | | | 0.8 | | mm |
| Active Area | | 7.1 | | | 0.5 | | mm ² |
| Bandwidth Range | | 50 | | | 200 | | MHz |
| Temperature Coefficient of V _R for constant Gain | - | 2.2 | - | - | 2.2 | - | V/°C |
| V _R for specified responsivity | 275 | Note 1 | 425 | 275 | Note 1 | 425 | V |
| Temperature sensor sensitivity | -1.8 | -2.1 | -2.4 | -1.8 | -2.1 | -2.4 | mV/°C |
| Responsivity | | | | | | | |
| At 900nm | - | 450 | - | - | 370 | - | kV/W |
| At 1060nm | - | 280 | - | - | 200 | - | kV/W |
| R _F (Internal Feedback Resistor) | - | 22 | - | - | 12 | - | k Ω |
| Noise Equivalent Power (NEP) (note 3) f - 100 kHz, Δf = 1.0 Hz | | | | | | | |
| At 900nm | - | 55 | 80 | - | 55 | 80 | fW/√Hz |
| At 1060nm | - | 90 | 125 | - | 100 | 150 | fW/√Hz |
| Output Spectral Voltage: (f = 100 kHz - f _{-3dB}) | - | 25 | 35 | - | 20 | 30 | nV/√Hz |
| Output Impedance | 33 | 40 | 50 | 33 | 40 | 50 | Ω |
| System Bandwidth, f _{-3dB} | 40 | 50 | - | 175 | 200 | - | MHz |
| Rise Time, t _r (λ = 900 and 1060nm) 10% to 90% points | - | 7 | - | - | 2 | - | ns |
| Fall Time, t _f (λ = 830 and 900nm) 90% to 10% points | - | 7 | - | - | 2 | - | ns |
| Recovery time after overload (note 4) | - | - | 150 | - | - | 150 | ns |
| Output Voltage Swing (1kΩ load) (note 5) | 2 | 3 | - | 2 | 3 | - | V |
| Output Voltage Swing (50Ω load) (note 5) | 0.7 | 0.9 | - | 0.7 | 0.9 | - | V |
| Output Offset Voltage | -1 | 0.25 | 1 | -1 | 0.25 | 1 | V |
| Positive Supply Current (V+) | - | 20 | 35 | - | 20 | 35 | mA |
| Negative Supply Current (V-) | - | 10 | 20 | - | 10 | 20 | mA |

- Notes: 1. A specific value of V_R is supplied with each device. The V_R value will be within the specified ranges.
 2. I_f = 0.1 mA, 25°C
 3. NEP_{max} is the Maximum Output Spectral Noise Voltage max divided by the typical Responsivity.
 4. 0dBm, 250ns pulse.
 5. Pulsed operation.

Table 3. Electrical Characteristics at $T_A=22^\circ\text{C}$ Test Conditions: Ambient Temperature, $V_{\text{amp}} = \pm 5$ Volts, $HV = +V_R$ (see Note 1), $R_L = 50\Omega$ AC Coupled

| Detector Type | 1550nm InGaAs APD | | | | | | |
|---|---|--------|------|--|--------|------|------------------------|
| | C30659-1550-R2A (InGaAs APD C30662E) | | | C30659-1550-R08B (InGaAs APD C30645E) | | | |
| | Min | Typ | Max | Min | Typ | Max | |
| Active Diameter | | 0.2 | | | 0.08 | | mm |
| Active Area | | 0.03 | | | 0.005 | | mm ² |
| Bandwidth Range | | 50 | | | 200 | | MHz |
| Temperature Coefficient of V_R for constant Gain | - | 0.2 | - | - | 0.2 | - | V/ $^\circ\text{C}$ |
| V_R for specified responsivity | 40 | Note 1 | 70 | 40 | Note 1 | 70 | V |
| Temperature sensor sensitivity | -1.8 | -2.1 | -2.4 | -1.8 | -2.1 | -2.4 | mV/ $^\circ\text{C}$ |
| Responsivity | | | | | | | |
| At 1300nm | - | 300 | - | - | 80 | - | kV/W |
| At 1550nm | - | 340 | - | - | 90 | - | kV/W |
| R_F (Internal Feedback Resistor) | - | 68 | - | - | 18 | - | k Ω |
| Noise Equivalent Power (NEP) (note 3) f - 100 kHz, $\Delta f = 1.0$ Hz | | | | | | | |
| At 1300nm | - | 150 | 180 | - | 250 | 375 | fW/ $\sqrt{\text{Hz}}$ |
| At 1550nm | - | 130 | 160 | - | 220 | 330 | fW/ $\sqrt{\text{Hz}}$ |
| Output Spectral Voltage: (f = 100 kHz - $f_{-3\text{dB}}$) | - | 45 | 55 | - | 20 | 30 | nV/ $\sqrt{\text{Hz}}$ |
| Output Impedance | 33 | 40 | 50 | 33 | 40 | 50 | Ω |
| System Bandwidth, $f_{-3\text{dB}}$ | 40 | 50 | - | 175 | 200 | - | MHz |
| Rise Time, t_r ($\lambda = 900$ and 1060nm) 10% to 90% points | - | 7 | - | - | 2 | - | ns |
| Fall Time, t_f ($\lambda = 830$ and 900nm) 90% to 10% points | - | 7 | - | - | 2 | - | ns |
| Recovery time after overload (note 4) | - | - | 150 | - | - | 150 | ns |
| Output Voltage Swing (1k Ω load) (note 5) | 2 | 3 | - | 2 | 3 | - | V |
| Output Voltage Swing (50 Ω load) (note 5) | 0.7 | 0.9 | - | 0.7 | 0.9 | - | V |
| Output Offset Voltage | -1 | -0.3 | 1 | -1 | -0.3 | 1 | V |
| Positive Supply Current (V+) | - | 20 | 35 | - | 20 | 35 | mA |
| Negative Supply Current (V-) | - | 10 | 20 | - | 10 | 20 | mA |

Notes: 1. A specific value of V_R is supplied with each device. The V_R value will be within the specified ranges.2. $I_f = 0.1$ mA, 25°C

3. NEPmax is the Maximum Output Spectral Noise Voltage divided by the typical Responsivity.

4. 0dBm, 250ns pulse.

5. Pulsed operation.

Figure 1. C30659 Series Block Diagram

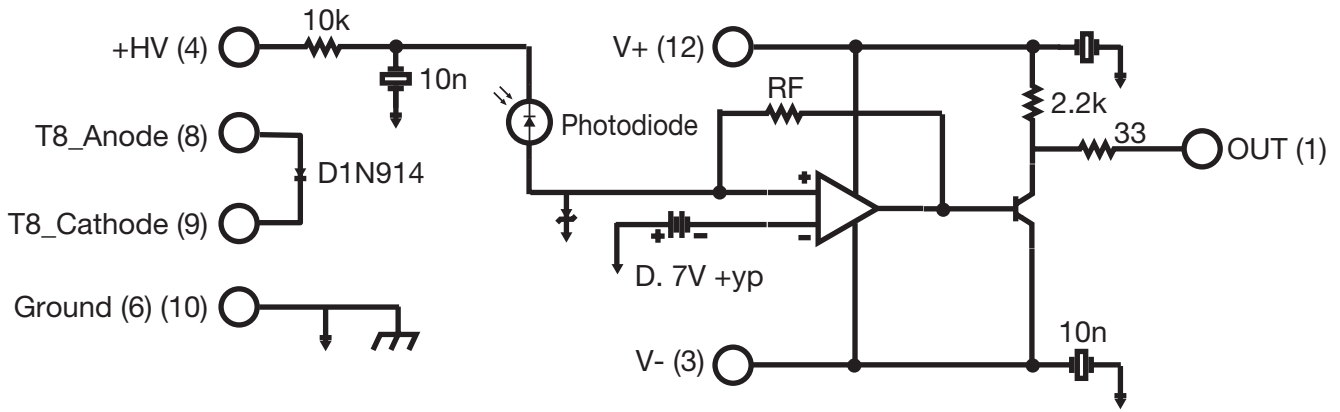


Figure 2. Spectral Responsivity

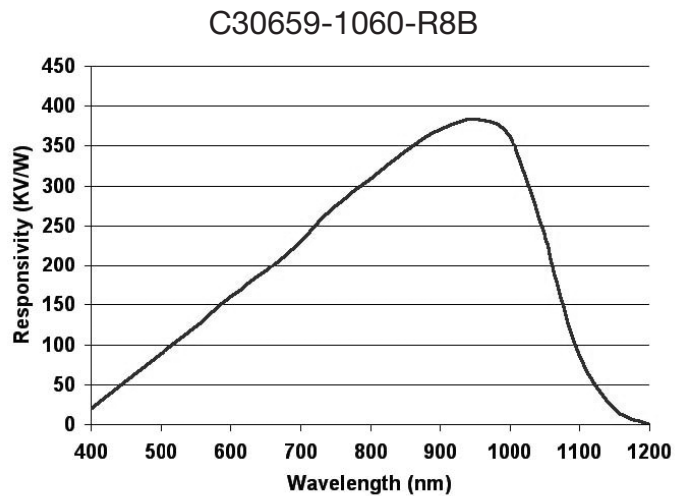
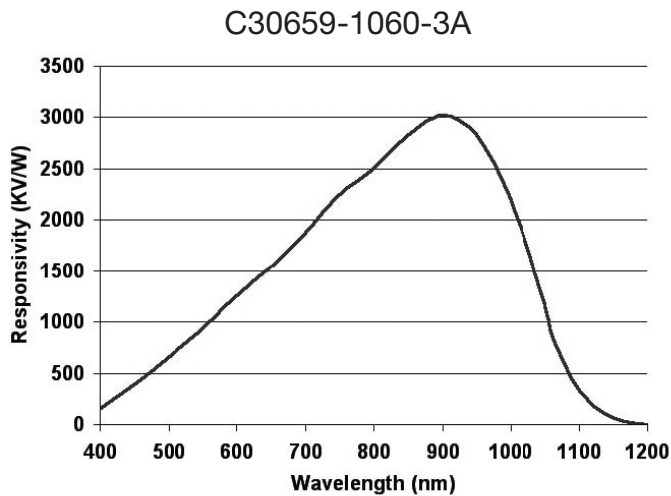
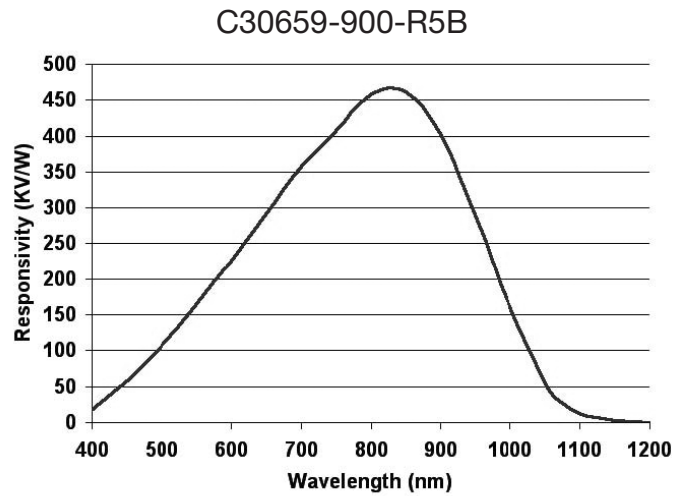
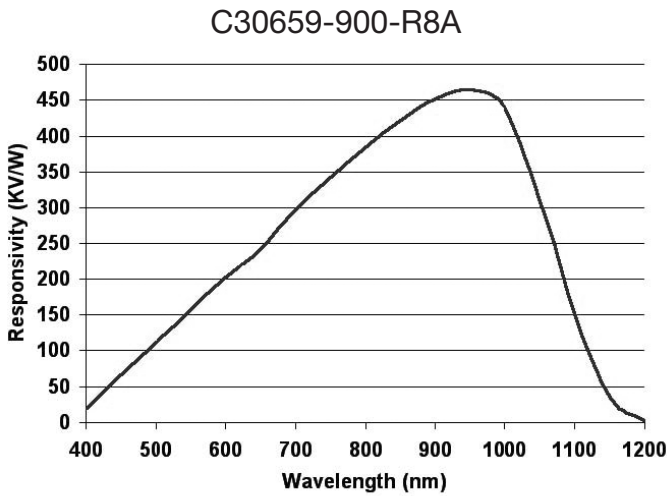


Figure 2. Spectral Responsivity, continued

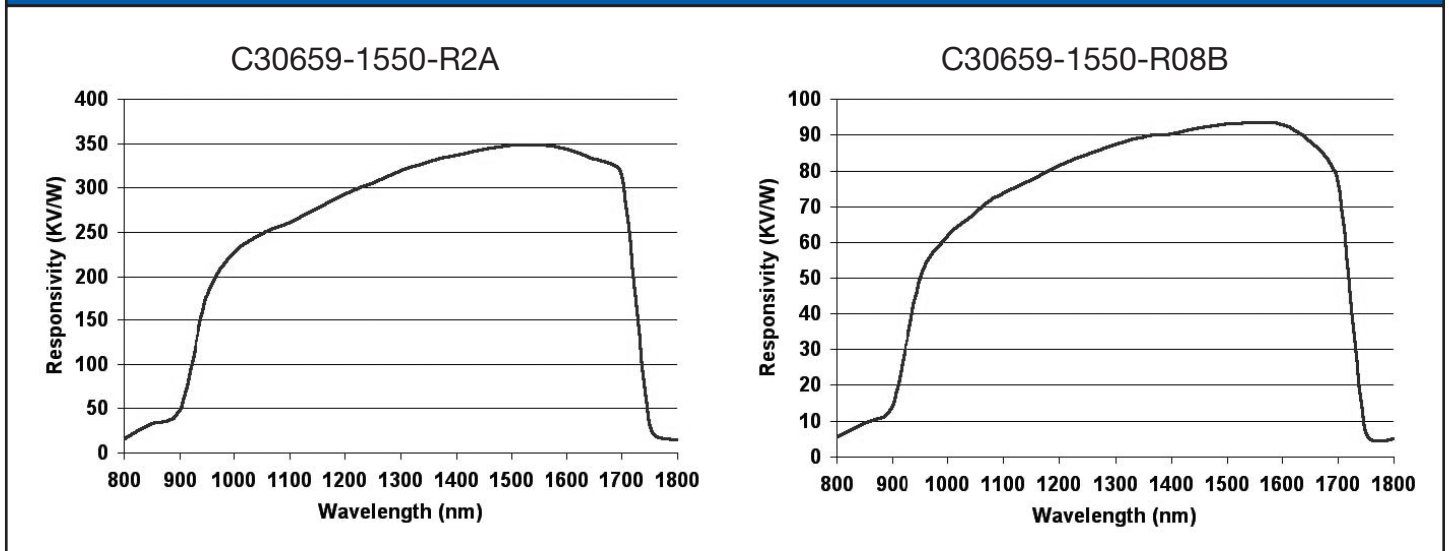


Figure 3. Responsivity

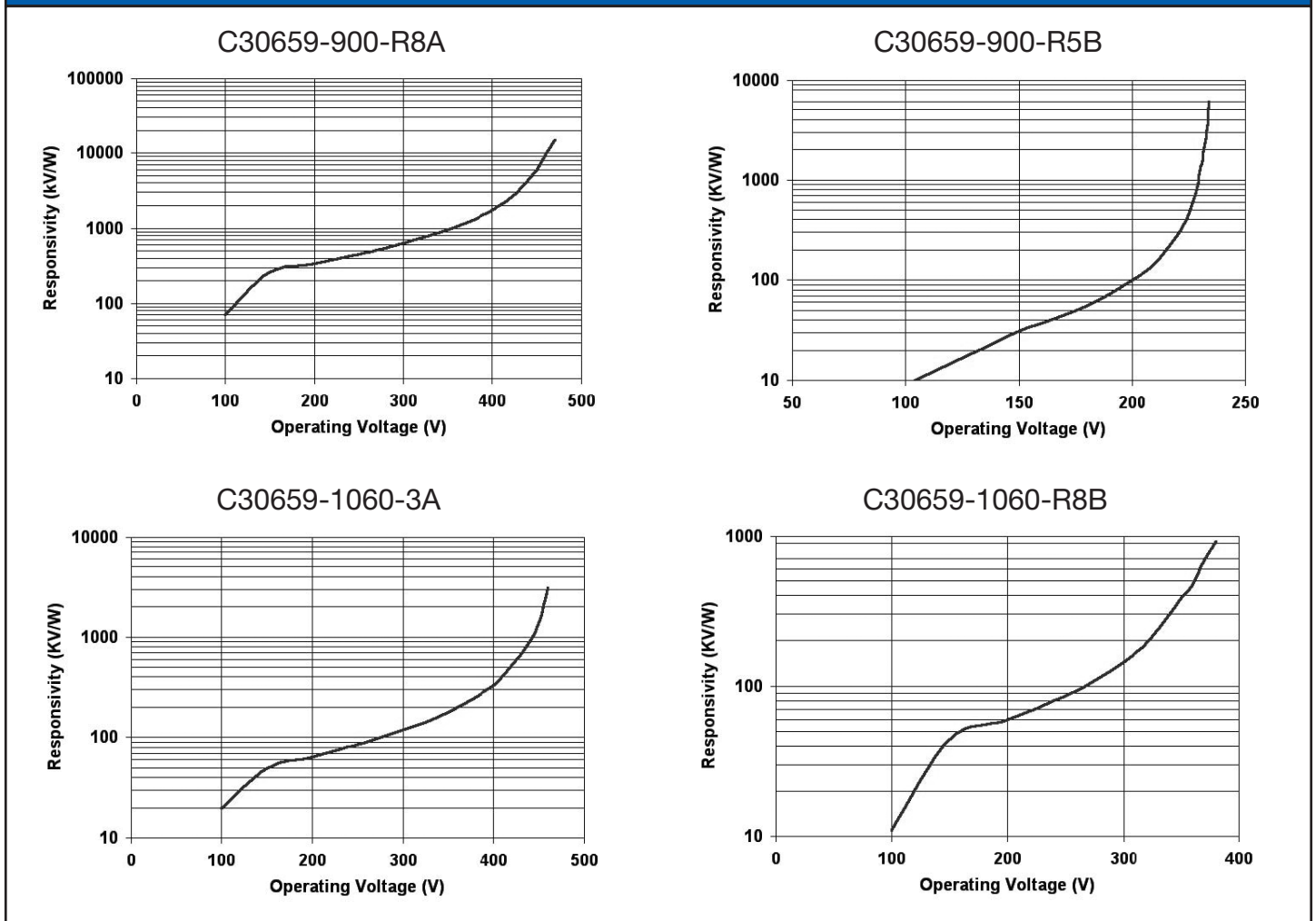


Figure 3. Responsivity, continued

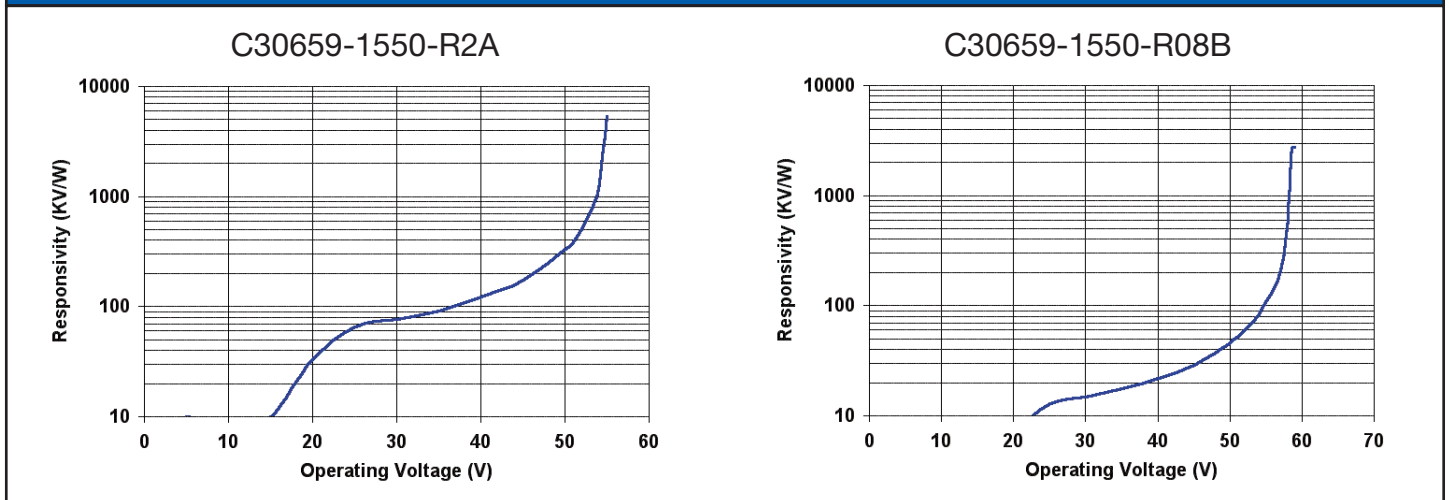


Figure 4. Typical Response / Noise Curves

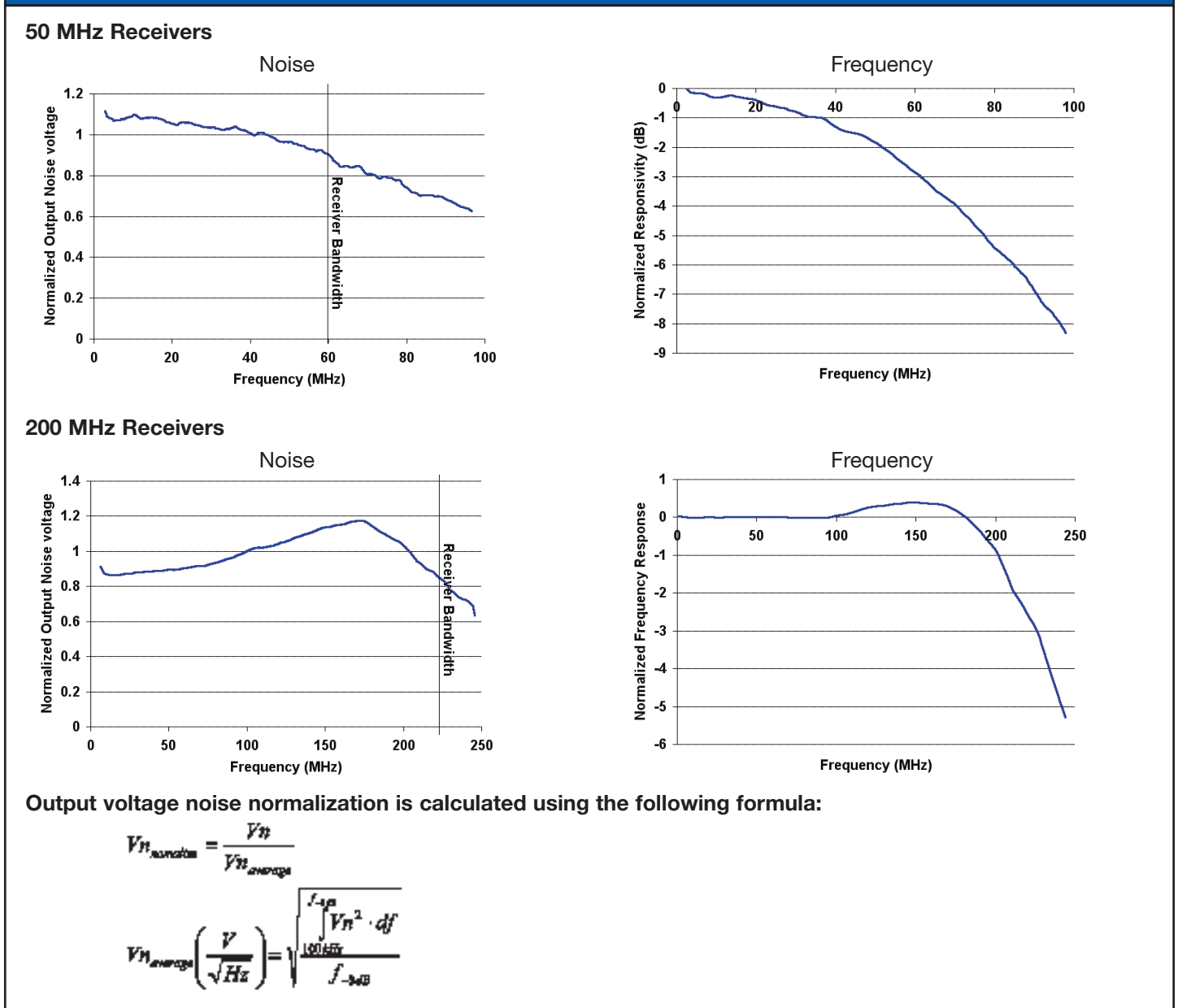
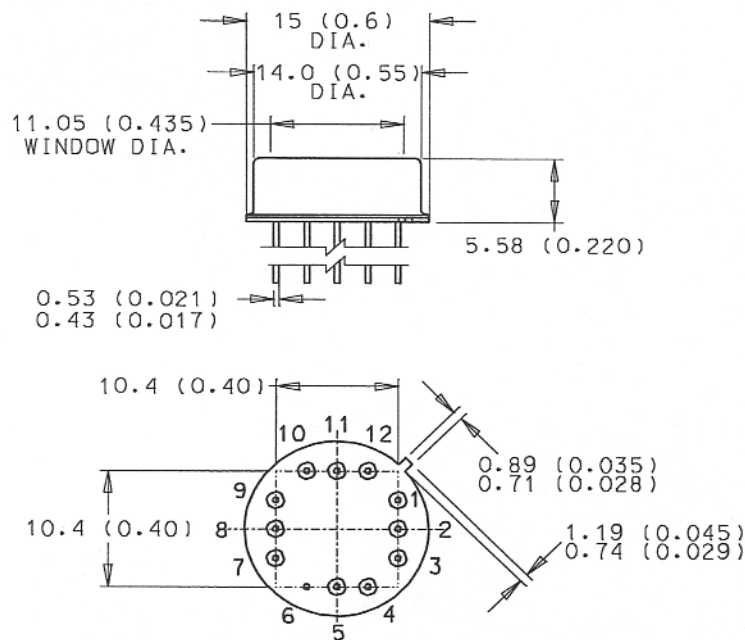


Table 4. Absolute - Maximum Ratings, Limiting Values

| | C30659-900 (Si) | | | C30659-1060 (Si) | | | C30659-1550 (InGaAs) | | | |
|--------------------------------|--------------------|-----|------------------|---------------------|-----|------------------|-------------------------|-----|-----------------|----|
| | Min | Typ | Max | Min | Typ | Max | Min | Typ | Max | |
| Photodiode Bias Voltage: | | | | | | | | | | |
| At TA = +70°C | - | - | 600 | - | - | 600 | - | - | 100 | V |
| At TA = -40°C | - | - | 300 | - | - | 300 | - | - | 50 | V |
| Incident Radiant Flux Φ_M | | | | | | | | | | |
| average | - | - | 0.1 ¹ | - | - | 0.1 ¹ | - | - | 2 ¹ | mW |
| peak | - | - | 50 ² | - | - | 50 ² | - | - | 50 ² | mW |
| Case Temperature: | | | | | | | | | | |
| Storage, T _{stg} | -50 | - | 100 | -50 | - | 100 | -50 | - | 100 | °C |
| Operating, T _A | -40 | - | 70 | -40 | - | 70 | -40 | - | 70 | °C |
| Preamplifier Voltage: | -4.5 | - | -5.5 | -4.5 | - | -5.5 | -4.5 | - | -5.5 | V |

Notes: 1. Based on 0.5W electrical power on high voltage supply.
2. Test with pulse width of 50 ns.

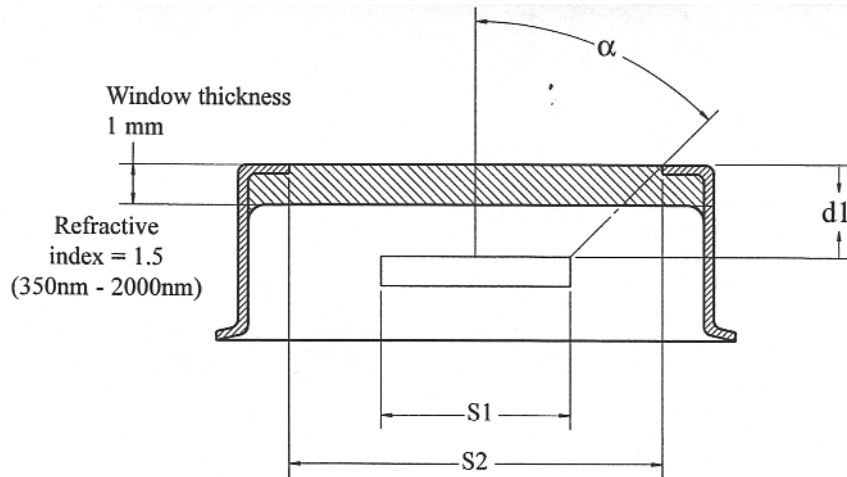
Figure 5. Mechanical Characteristics



PIN CONNECTIONS

- 1: Signal Output
- 2: No Connection
- 3: -Vcc Negative Amplifier Bias
- 4: Positive high voltage
- 5: No Connection
- 6: Case Ground
- 7: No Connection
- 8: Temp. Sensing Diode - Anode
- 9: Temp. Sensing Diode - Cathode
- 10: Ground, DC returns
- 11: No Connection
- 12: +Vcc Positive Amplifier Bias

Figure 6. Optical Geometry



| Model | Detector | S1 (mm) | S2 (mm) | d1 (mm) | α (deg) |
|------------------|----------|---------|---------|---------|----------------|
| C30659-900-R8A | C30817E | 0.80 | 11 | 1.4 | 70 |
| C30659-900-R5B | C30902E | 0.50 | 11 | 1.4 | 70 |
| C30659-1060-3A | C30956E | 3.00 | 11 | 1.3 | 65 |
| C30659-1060-R8B | C30954E | 0.80 | 11 | 1.3 | 70 |
| C30659-1550-R2A | C30662E | 0.20 | 11 | 1.5 | 70 |
| C30659-1550-R08B | C30645E | 0.08 | 11 | 1.5 | 70 |

Table 5. Ordering Guide

| Model | Description |
|------------------|--|
| C30659-900-R8A | 50 MHz, 900nm, 0.8mm Active Region Diameter |
| C30659-900-R5B | 200 MHz, 900nm, 0.5mm Active Region Diameter |
| C30659-1060-3A | 50 MHz, 1060nm, 3mm Active Region Diameter |
| C30659-1060-R8B | 200 MHz, 1060nm, 0.8mm Active Region Diameter |
| C30659-1550-R2A | 50 MHz, 1550nm, 0.2mm Active Region Diameter |
| C30659-1550-R08B | 200 MHz, 1550nm, 0.08mm Active Region Diameter |

Ordering Information

While the information in this data sheet is intended to describe the form, fit and function for this product, PerkinElmer reserves the right to make changes without notice.

For more information e-mail us at opto@perkinelmer.com or visit our web site at www.optoelectronics.perkinelmer.com. All values are nominal; specifications subject to change without notice.

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