Models A-203 and A-206 are a Charge Sensitive Preamplifier/Shaping Amplifier and a matching Voltage Amplifier/Low Level Discriminator developed especially for instrumentation employing solid state detectors, proportional counters, photomultipliers or any charge producing detectors in the pulse height analysis or pulse counting mode of operation.

While these units were specifically designed for satellite instrumentation, the following unique characteristics make them equally useful for space laboratory and commercial applications:

- Small Size (16 Pin Dual In-Line Package) allows mounting close to the detector.
- Power required is typically 18 milliwatts.
- Single power supply voltage.
- Low noise.
- Pole-zero cancellation (external).
- Unipolar and bipolar outputs.
- Both Pulse Height Analysis and Pulse Counting mode of operation.
- High Reliability.
- One year warranty.

THE A-203 / A-206 COMPLETE SYSTEM

1. PRECAP VISUAL: MIL-STD-883, method 1008, Condition C. + 150°C, 4 hours minimum.
2. SEALING: MIL-STD-883, method 1010, Condition C min. T = -65°C to +150°C.
3. STAMPING: MIL-STD-883, method 1001, Condition B. Y1 Axis; 10,000 G’s.
4. BURN-IN TEST: As per specifications.
5. FINE LEAK TEST: MIL-STD-883, method 1014, Condition A. Rejection if leak rate in excess of 5 x 10^-7 cc/sec.
7. ELECTRICAL TEST: As per specifications.
A-203

CHARGE SENSITIVE PREAMPLIFIER / SHAPING AMPLIFIER

SPECIFICATIONS

\( V_S = +15\text{V}, T = 25^\circ\text{C} \)

INPUT CHARACTERISTICS

SENSITIVITY:

1) For positive unipolar output (Pin 8):
   \( 210 \text{ mV/mV} (\text{SI}); 262 \text{ mV/mV} (\text{Ge}) \)
   \( 4.8 \times 10^{-15} \text{coulomb/0.76 } \mu\text{C/electron} \)

2) For bipolar output (Pin 9):
   \( 115 \text{ mV/mV} (\text{SI}); 144 \text{ mV/mV} (\text{Ge}) \)
   \( 2.6 \times 10^{-15} \text{coulomb/0.42 } \mu\text{C/electron} \)

NOISE:

1) Unipolar:
   (Nominal) 8 KeV FWHM (SI); 6.4 KeV FWHM (Ge); 1.4x10^{-10} \text{coulomb rms; 875 electrons rms}

2) Bipolar:
   12 KeV FWHM (SI); 10 KeV FWHM (Ge); 2.2x10^{-10} \text{coulomb rms}

NOISE SLOPE:

(Typical) 100 ev/\mu\text{f (SI); 80 ev/\mu\text{f (Ge)}}

DYNAMIC INPUT CAPACITANCE:

3,500 \text{pf}

POLARITY: Negative

PROTECTION:

Back-to-back diodes to ground

OUTPUT CHARACTERISTICS

1) CHARGE SENSITIVE PREAMPLIFIER OUTPUT-Pin 13:
   Rise time: 50ns
   Fall time: 30\mu s
   AC Output impedance: 50\text{ohm}

2) SHAPING AMPLIFIER
   Time constants: 250ns
   Positive Unipolar, Pin 8:
   AC output impedance: 850\text{ohm}
   Dynamic range: 75% of \( V_S \)
   Polezero cancellation: External 1M\text{ohm}
   between Pins 12 and 13
   Bipolar, Pin 9:
   AC output impedance: 2k\text{ohm}
   Dynamic range: 35% of \( V_S \)

GENERAL

OPERATING VOLTAGE: +10 to +15 VDC
OPERATING CURRENT: 1.4 ma Quiescent @15V
TEMPERATURE: -55\degree to +70\degree C operational
PACKAGE: 16 Pin Dual In-Line (Metal)
SCREENING: AMPTEK HIGH RELIABILITY
WARRANTY: One year

OPERATING NOTES

- The A-203 has two parts:
  1) A Charge Sensitive Preamplifier (CSP).
  2) A Shaping Amplifier (SA).
- The output of the CSP is internally connected to the input of the SA.
- Power to the CSP and SA are provided separately in order to provide maximum flexibility for independent operation. However, for normal operation Pin 11 and Pin 14 should be connected to \( V_S \). Supply is internally bypassed. Care should be taken in circuit layout and in some applications power supply decoupling may be helpful. If the leads of the A-203 are left long, or the unit is socketed, the unconnected Pins 2, 3, 6, 7, 10, 15, 16 should be grounded in order to minimize pick-up.
- The sensitivity of the CSP is defined by: \( G_S = 44/C \text{ in mV/mV (SI)} \), where C is the feedback capacitor (in pf). The feedback capacitor in the A-203 is 2pf. If a lower sensitivity is desired, an external capacitor may be added between Pins 1 and 13. A capacitor with good temperature stability should be used and the leads should be kept short.
- The detector must be capacitively coupled to Pin 1 with a capacitor of adequate voltage rating.
- If the output of the CSP (Pin 13) is to be connected to external circuitry it must be coupled with an external capacitor. This output can drive several feet of unterminated coaxial cable.
- The SA has two outputs: 1) Unipolar (Pin 8) which is single integration - single differentiation. 2) Bipolar (Pin 9) which is single integration - double differentiation. Either output can drive the A-203, which has an internal input coupling capacitor. If the unipolar output (Pin 8) is to be connected to other external circuitry it MUST be capacitively coupled.
- If pole-zero cancellation is required at the unipolar output in order to minimize the baseline shift, a 1M\text{ohm} resistor must be externally added between Pins 12 and 13.
- The A-203 can be tested with a pulser by using a small capacitor to inject a negative test charge into the input. The unit will respond to the negative-going edge of either a square wave or a tail pulse with long fall time (>10 \text{\mu s}). In either case the negative-going transition should be less than 20 ns. Charge transfer in the circuit is according to \( Q = CV \), where \( Q \) is total amount of charge delivered to input, \( C = \text{test capacitor} \) and \( V = \text{amplitude of the pulse. Use only a small capacitor in this circuit} (1-10pf). DO NOT connect a low impedance pulse through a large capacitor when testing as this will overdrive the input and may damage the unit.
- Example: A 22 mv tail pulse across a 2pf test capacitor is equivalent to 1 Mev energy loss in silicon (3.5 ev/pair) and will produce a 210 mv unipolar pulse at Pin 8.

A-203 TEST CIRCUIT

A-203 LOGIC AND PIN CONFIGURATION

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Charge Sensitive Preamplifier Input</td>
</tr>
<tr>
<td>2, 3, 6, 7, 10, 15, 16</td>
<td>No Connection</td>
</tr>
<tr>
<td>4, 5</td>
<td>Ground and case</td>
</tr>
<tr>
<td>8</td>
<td>Unipolar Shaping Amplifier Output</td>
</tr>
<tr>
<td>9</td>
<td>Bipolar Shaping Amplifier Output</td>
</tr>
<tr>
<td>11</td>
<td>( V_S ) Shaping Amplifier (+10V to +18V)</td>
</tr>
<tr>
<td>12</td>
<td>Shaping Amplifier Input</td>
</tr>
<tr>
<td>13</td>
<td>Charge Sensitive Preamplifier Output</td>
</tr>
<tr>
<td>14</td>
<td>( V_S ) C.S. Preamplifier (+10V to +18V)</td>
</tr>
</tbody>
</table>
VOLTAGE AMPLIFIER / LOW LEVEL DISCRIMINATOR

SPECIFICATIONS
(V_s = +15V, T = 25°C)

1) VOLTAGE AMPLIFIER
   Gain: x 10 nominal, non inverting
   Input polarity: 1) Positive Unipolar; Dynamic range: 85% of Vs
                   2) Bipolar. If a bipolar input is used, an external resistor (R_B = 330kΩ) must be connected
                      between Pin 3 and ground. Dynamic range: 65% of Vs
   AC Output Impedance: 20Ω
   Integral Nonlinearity
     at full output: ≤ 0.5%

2) DISCRIMINATOR
   Input Polarity: Positive or Bipolar
   Output pulse: Positive; 5μs wide; 90% of Vs. The output pulse width can be increased by the addition of an external
                 capacitor (1 to 10 pF) between Pins 6 and 8.
   Rise Time: 20 ns
   Reference voltage: Pin 11, V_R; Range: +4.5 to +5.5 VDC (Impedance >2 MΩ)
   Variable voltage: Pin 10, V_V (V_V < V_R)
   Discrimination Level: V_R - V_V (Impedance >2 MΩ)

GENERAL
OPERATING VOLTAGE: +10 to +18VDC
OPERATING CURRENT: 0.8 ma Quiescent @ 15V
TEMPERATURE: -55°C to +70°C operational
PACKAGE: 16 Pin Dual In-Line (Metal)
SCREENING: AMPTEK HIGH RELIABILITY
WARRANTY: One year.

A-206 LOGIC AND PIN CONFIGURATION

A temperature stable voltage reference should be used.

TEST BOARD (ACTUAL SIZE)

A-206 has two parts:
1) A matching Voltage Amplifier (VA) to the A-203 or A-225
2) A Lower Level Discriminator (LLD)

PC-236 test board for the A-203/A206.
THE A-203/A-206 COMPLETE SYSTEM AND TYPICAL WAVEFORMS

Input to Test Capacitor
- 22mv = 1Mev (Si)

Output of CSP
(A-203, Pin 13)

Bipolar Output of SA
(A-203, Pin 9)

Unipolar Output of SA
(A-203, Pin 8)

LLD Output-Positive
(A-206, Pin 9)

TYPICAL APPLICATIONS

Typical connection of a photomultiplier to the A-203

Typical connection of a solid state detector to the A-203

16 Pin Dual In-Line Typical Dimensions: \(\text{inches to mm}\)