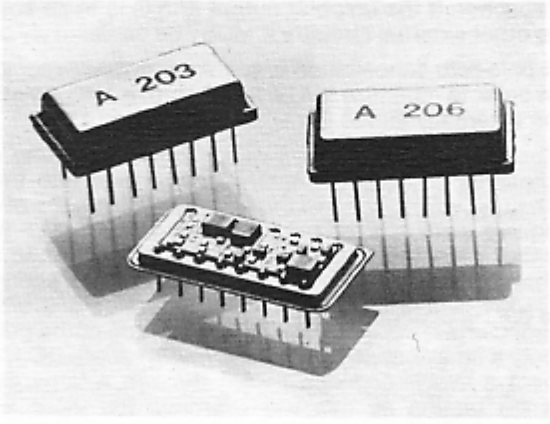
CHARGE SENSITIVE PREAMPLIFIER/ SHAPING AMPLIFIER

A-203

VOLTAGE AMPLIFIER/ LOW LEVEL DISCRIMINATOR

A-206

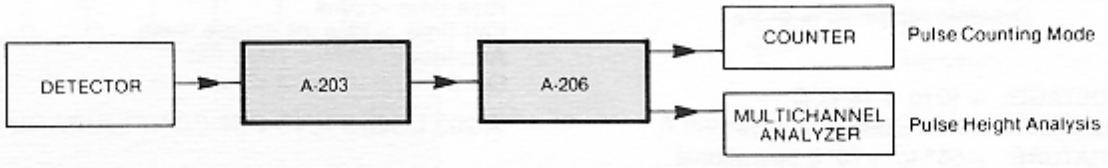


Models A-203 and A-206 are a Charge Sensitive Preamplifier/Shaping Amplifier and a matching Voltage Amplifier/Low Level Discriminator developed especially for instrumentation employing solid state detectors, proportional counters, photomultipliers or any charge producing detectors in the pulse height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



AMPTEK HIGH RELIABILITY SCREENING

1. PRECAP VISUAL:	MIL-STD-883, method 2017. Low Magnification, High Magnification.
2. SEALING:	Welded, hermetic seal.
3. STAMPING:	Date code and serial number.
4. STABILIZATION BAKE:	MIL-STD-883, method 1008, Condition C. + 150°C, 24 hours minimum.
5. TEMPERATURE CYCLE:	MIL-STD-883, method 1010, Condition C min. T = − 65°C to + 150°C. 10 minutes each extreme, 5 minutes maximum transfer time.
6. CENTRIFUGE:	MIL-STD-883, method 2001, Condition B. YI Axis; 10,000 G's.
7. ELECTRICAL TEST:	As per specifications.
8. BURN-IN TEST:	MIL-STD-883, method 1015, 160 hours at + 125°C.
9. FINE LEAK TEST:	MIL-STD-883, method 1014, Condition A. Rejection if leak rate in excess of 5×10^{-7} cc/sec.
10. GROSS LEAK TEST:	MIL-STD-883, method 1014, Condition C. Fluoro Carbon: Rejection if stream of bubbles is present.
11. ELECTRICAL TEST:	As per specifications.
12. EXTERNAL VISUAL:	MIL-STD-883, method 2009.

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A-203 CHARGE SENSITIVE PREAMPLIFIER / SHAPING AMPLIFIER

SPECIFICATIONS

(V_S = +15V, T = 25°C)

INPUT CHARACTERISTICS

SENSITIVITY: 1) For positive unipolar output (Pin 8): 210 mv/Mev (Si); 262 mv/Mev (Ge); 4.8×10^{12}v/coulomb; 0.76 μv/electron
2) For bipolar output (Pin 9): 115 mv/Mev (Si); 144 mv/Mev (Ge); 2.6×10^{12}v/coulomb; 0.42 μv/electron.

NOISE (Nominal): 1) Unipolar: 8 Kev FWHM (Si); 6.4 Kev FWHM (Ge); 1.4×10^{-16} coulomb rms; 875 electrons rms
2) Bipolar: 12 Kev FWHM (Si); 10 Kev FWHM (Ge); 2.2×10^{-16} coulomb rms

NOISE SLOPE (Typical): 100 ev/pf (Si); 80 ev/pf (Ge); 1.81×10^{-18} coulombs/pf

DYNAMIC INPUT CAPACITANCE: 3,500 pf

POLARITY: Negative

PROTECTION: Back-to-back diodes to ground

OUTPUT CHARACTERISTICS

1) CHARGE SENSITIVE PREAMPLIFIER OUTPUT-Pin 13:

Rise time: 50ns

Fall time: 30μs

AC Output impedance: 50Ω

2) SHAPING AMPLIFIER

Time constants: 250ns

Positive Unipolar, Pin 8: AC output impedance: 85Ω
Dynamic range: 75% of V_S
Pole-zero cancellation: External 1MΩ between Pins 12 and 13

Bipolar, Pin 9: AC output impedance: 2kΩ
Dynamic range: 35% of V_S

GENERAL

OPERATING VOLTAGE: +10 to +18 VDC

OPERATING CURRENT: 1.4 ma Quiescent @15V

TEMPERATURE: −55° to +70°C operational

PACKAGE: 16 Pin Dual In-Line (Metal)

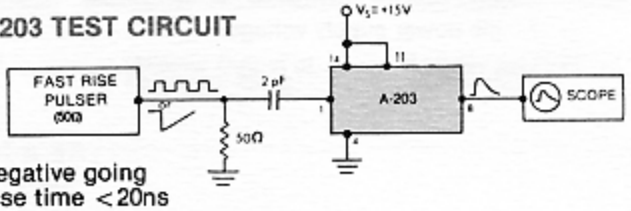
SCREENING: AMPTEK HIGH RELIABILITY

WARRANTY: One year

OPERATING NOTES

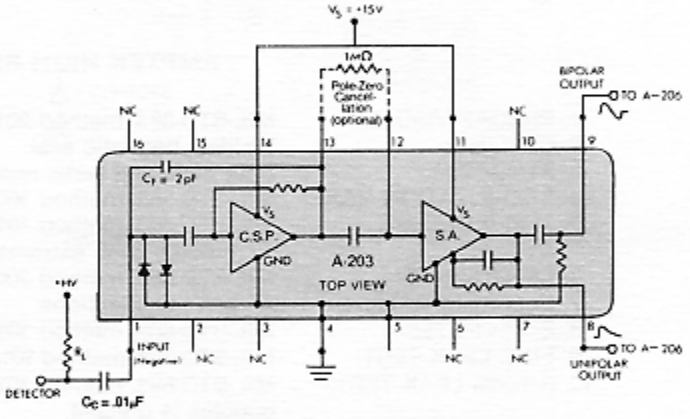
- The A-203 has two parts:
  1) A Charge Sensitive Preamplifier (CSP).
  2) A Shaping Amplifier (SA).
  The output of the CSP is internally connected to the input of the SA.
- Power to the CSP and SA are provided separately in order to provide maximum flexibility for independent operation. However, for normal operation Pin 11 and Pin 14 should be connected to Vs. 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 = 44/C in mv/Mev (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-206, 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 1MΩ 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 μs). 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 = total amount of charge delivered to input, C = test capacitor and V = amplitude of the pulse. Use only a small capacitor in this circuit (1-10pf). DO NOT connect a low impedance pulser 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



Negative going
Rise time <20ns
Fall time >10μs, or square wave
Amplitude: 22mv = 1Mev (Si)
Q = CV = $(2 \times 10^{-12}f) \times (22 \times 10^{-3}v) = 4.4 \times 10^{-14}$coulomb = 1Mev(Si)

A-203 LOGIC AND PIN CONFIGURATION



Pin 1	Charge Sensitive Preamplifier Input
Pins 2, 3, 6, 7, 10, 15, 16	No Connection
Pins 4, 5	Ground and case
Pin 8	Unipolar Shaping Amplifier Output
Pin 9	Bipolar Shaping Amplifier Output
Pin 11	V_S Shaping Amplifier (+10V to +18V)
Pin 12	Shaping Amplifier Input
Pin 13	Charge Sensitive Preamplifier Output
Pin 14	V_S C.S. Preamplifier (+10V to +18V)

A-206 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 ($R_B = 330K\Omega$) 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 >2MΩ)

GENERAL

OPERATING VOLTAGE: +10 to +18VDC

OPERATING CURRENT: 0.8 ma Quiescent @15V

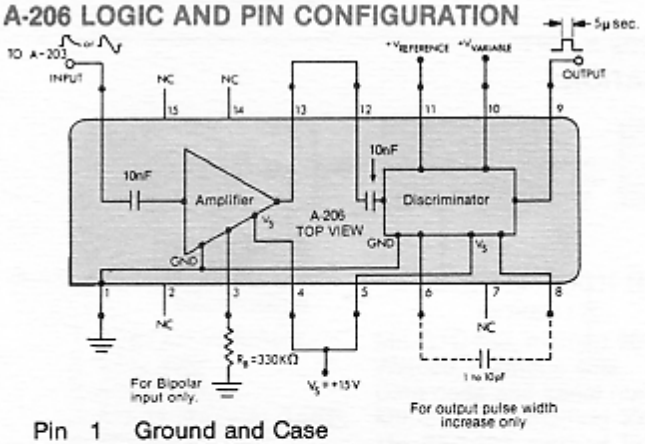
TEMPERATURE: −55°C to +70°C operational

PACKAGE: 16 Pin Dual In-Line (Metal)

SCREENING: AMPTEK HIGH RELIABILITY

WARRANTY: One year.

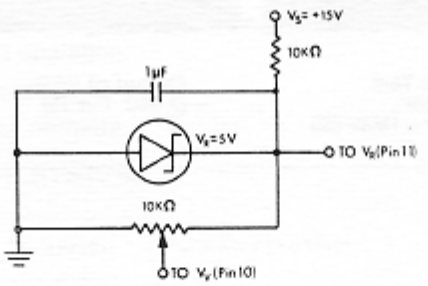
A-206 LOGIC AND PIN CONFIGURATION



Pin 1 Ground and Case
Pins 2, 7, 14, 15 No Connection
Pin 3 Bipolar Input Bias
Pin 4 V_S Amplifier (+10V to +18V)
Pin 5 V_S Discriminator (+10V to +18V)
Pin 6 Discriminator Pulse Width Adjust
Pin 8 Discriminator Pulse Width Adjust
Pin 9 Discriminator Output
Pin 10 +V_V variable ($V_V < V_R$)
Pin 11 +V_R reference (+4.5 to +5.5 VDC)
Pin 12 Discriminator Input
Pin 13 Amplifier Output
Pin 16 Amplifier Input

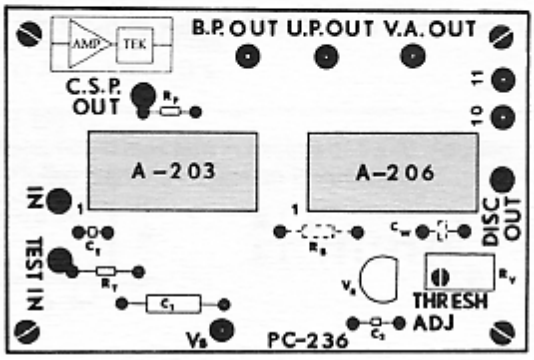
OPERATING NOTES

- The A-206 has two parts:
  1) A matching Voltage Amplifier (VA) to the A-203 or A-225
  2) A Lower Level Discriminator (LLD)
- The output of the VA is NOT internally connected to the LLD. Pin 13 MUST be connected to Pin 12 if the LLD is to be used.
- Power to the VA and LLD is provided separately in order to provide maximum flexibility for independent operation. However, for normal operation Pins 4 and 5 should be connected to V_S.
- The VA has an internal input coupling capacitor and no other external capacitor is needed when connecting to either unipolar or bipolar outputs of the A-203 or the A-225.
- If the output of the VA (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.
- For bipolar input pulses to the VA connect a 330kΩ resistor from Pin 3 to ground. This biases the amplifier for maximum dynamic range.
- The LLD requires a reference voltage V_R and a variable voltage V_V. Set V_R at a level between +4.5 and +5.5 volts and V_V to a lower voltage than V_R. The difference, V_R-V_V, is the discrimination level at which the unit will trigger. For example, if $V_R = +5V$ and $V_V = +3.5v$ any pulse of amplitude greater than +1.5v will trigger the discriminator.
- The LLD output pulse is typically a 5 μsec wide positive pulse. A wider pulse can be obtained by connecting a capacitor (1 to 10 pf) between Pins 6 and 8. Leave these pins unconnected if the standard pulse width is acceptable.
- A typical circuit to provide bias to the LLD is shown below.



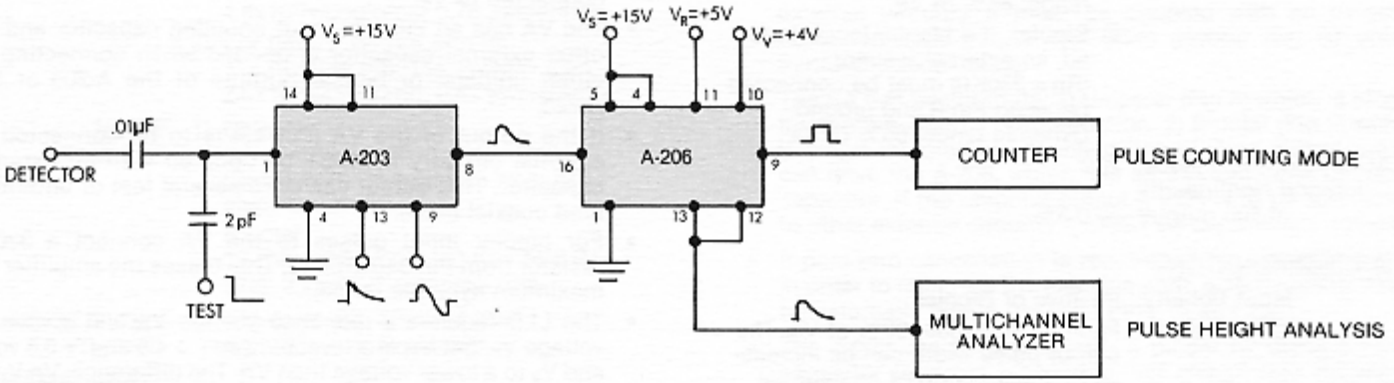
A temperature stable voltage reference should be used.

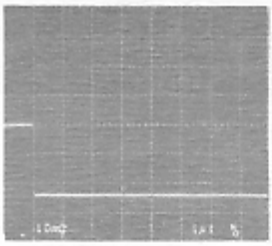
TEST BOARD
(ACTUAL SIZE)



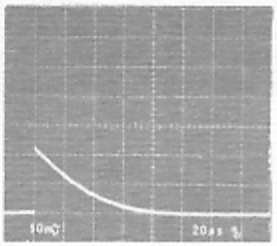
PC-236 test board for the A-203/A206.

THE A-203/A-206 COMPLETE SYSTEM AND TYPICAL WAVEFORMS

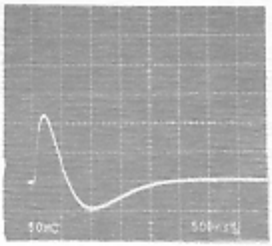




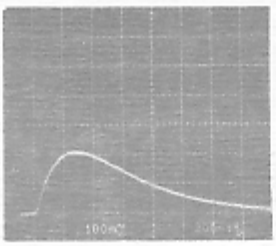
Input to Test Capacitor
– 22mv = 1Mev (Si)



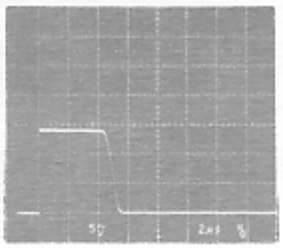
Output of CSP (A-203, Pin 13)



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

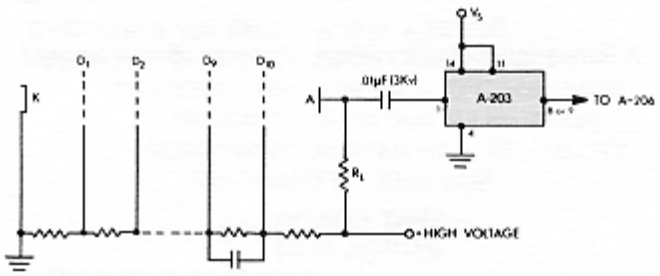


Unipolar Output of SA (A-203, Pin 8)

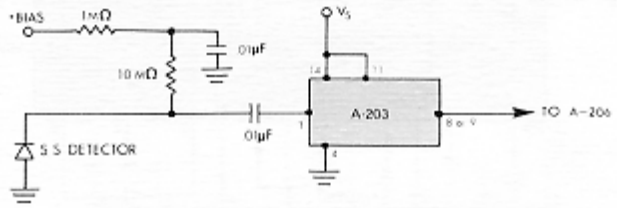


LLD Output-Positive (A-206, Pin 9)

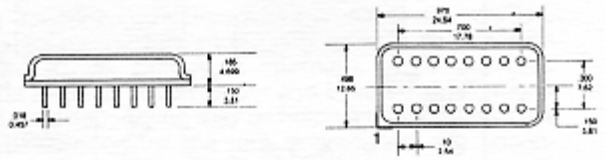
TYPICAL APPLICATIONS



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: $\frac{\text{inches}}{\text{mm}}$

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