

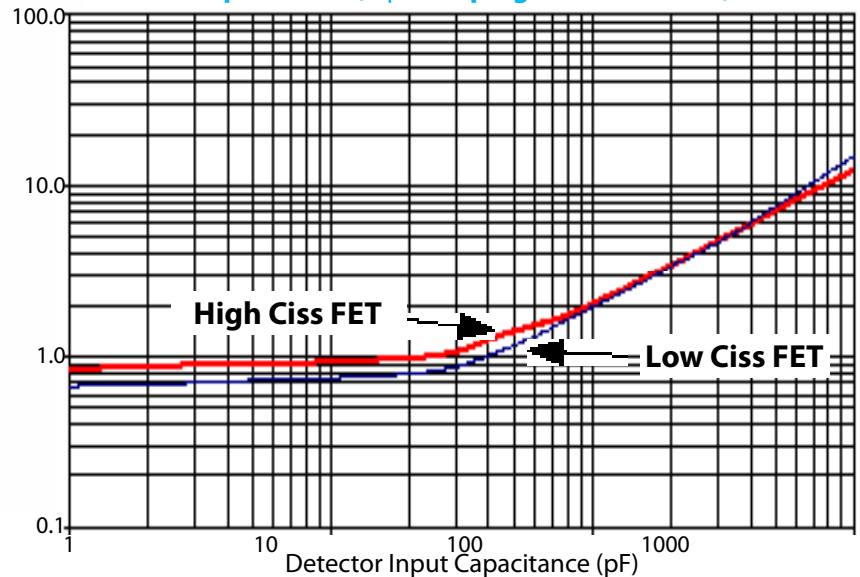
"CoolFET" CHARGE SENSITIVE PREAMPLIFIER

A250CF

AMPTEK Sets the New State-of-the-Art ... again! With **Cooled** FET



A250CF "CoolFET" Noise as a Function of Detector Input Capacitance (2 μ s Shaping Time Constant)



Noise: 670 eV FWHM (Si)

~76 electrons RMS

Noise Slope: 13 eV/pF with Low Ciss FET
11.5 eV/pF with High Ciss FET

Fast Rise Time: 2.5 ns

FEATURES:

- Thermoelectrically **Cooled** FET
- 3 internal FETs to match detector
- Lowest Noise and Noise Slope
- AC or DC coupling to the detector
- Easy to use
- Both Energy and Timing outputs
- Optional input protection

The Amptek A250CF, CoolFET® Charge Sensitive Preamplifier is the lowest noise, general purpose, preamplifier available. It is designed to give the ultimate performance when used with either low or high capacitance detectors and is a direct replacement for other higher noise charge sensitive preamplifiers.

The CoolFET® technology uses a 2-stage Peltier cooler to keep the input FET(s) at -50°C . Cooling is totally transparent to the user. Hence, the CoolFET® operates like a room temperature preamplifier. Based on the successful A250 preamplifier designed for high performance satellite instrumentation, the CoolFET® re-defines the new state-of-the-art.

Power to the CoolFET® is provided by an external stable power supply (included). Detector bias can be applied via an SHV connector. Input, E-Output, T-Output and Test are provided via BNC connectors.

RUN SILENT...RUN FAST...RUN **COOL**!

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A250CF - CoolFET® Charge Sensitive Preamplifier

DESCRIPTION

The input signal to the CoolFET® is provided by a radiation detector. This signal is the charge generated, proportional to the energy deposited in the detector. The duration of the input pulse ranges from a few ns to several μ s.

The primary output E of the CoolFET® is a voltage step whose amplitude is proportional to the total integrated charge of the input pulse. This step has a fast rise time of a few ns and a slow decay to baseline. The decay time constant is 500 μ s defined by the size of the RC feedback components ($R_f = 1 \text{ G}\Omega$, $C_f = 0.5 \text{ pF}$). This energy output is generally sent to a shaping amplifier and is used for spectroscopic measurements.

The timing output T of the CoolFET® has a much faster decay of 1 μ s, and is used as the input to a timing circuit.

The CoolFET® consists of several main function blocks. The core of the preamplifier is the charge amplifier itself, which consists of the CoolFET® hybrid, the A250 amplifier, and the feedback components. This circuit produces the voltage output for a current input, and determines the output noise and rise time.

The CoolFET® hybrid contains three FETs, two for low capacitance and one for high capacitance detectors. The FETs are placed on top of a 2-stage thermoelectric cooler and enclosed in a TO-8 package. There are two main advantages to cooling the FET: it reduces the leakage current and increases the transconductance, both of which reduce the electronic noise of the system. The increased transconductance provides a much improved noise slope (eV/pF) over un-cooled systems, which is especially important for large capacitance detectors.

The series noise of a preamplifier is at its minimum when the input capacitance is comparable to the FET capacitance, C_{iss} . The CoolFET® includes a jumper that permits the user to select 1 of 3 FETs, to match detector capacitance. Jumpers are used to connect the gates to the input, to connect the corresponding drains, and to select the proper drain resistor to set the drain current.

Additional circuit elements in the CoolFET®, include:

- (1) Connections to the detector bias.
- (2) Optional input protection circuitry (enabled when shipped from the factory).
- (3) Test input.
- (4) Amplifier to buffer the energy output and to provide for polarity and offset adjustments.
- (5) Amplifier to buffer the timing output and to provide for polarity adjustment.
- (6) Power supply circuitry.

A250CF - CoolFET® Charge Sensitive Preamplifier

SPECIFICATIONS

Performance

Noise at 0 pF, 2 μ s shaping: Low Ciss FET: 670 eV FWHM (DC) 1.00 (400M)
(DC coupling) High Ciss FET: 850eV FWHM (DC) 1.20 (400M)

Noise Slope (eV/pF): Low Ciss FET: 13 eV/pF
High Ciss FET: 11.5 eV/pF

The above performance is typical noise data for A250CF. The noise depends on (1) the detector capacitance, (2) input configuration (AC vs DC coupling, use of input protection), and (3) choice of FET used.

FET Capacitance

Low Ciss (FET 1 and 2): 8 pF

High Ciss (FET 3): 30 pF

General Characteristics

Rise Time: 2.5 ns (0 pF and no output buffer)
15 ns with output buffer

Decay Time: 500 μ s

Sensitivity: 176 mV/MeV (Si)
(Cf = 0.5 pF, Gain of 220 mV/MeV (Ge)
2 in the output buffer) 144 mV/MeV (CdTe)
152 mV/MeV (HgI2)
4 V/pC
0.64 μ V/electron

Integral Nonlinearity: < 0.03%

Detector Input: Positive or negative

Detector Bias Voltage: Maximum 1 kV, from a power supply

Test Input: Voltage pulses for system test and calibration

Energy (E) Output: Provides an output voltage step proportional to the input charge.
Polarity and DC offset are adjustable

Timing (T) Output: Provides a tail pulse (1 μ s decay) for system timing measurements.
Polarity is adjustable.

Output Impedance: 50 Ω
(Both E and T)

Dynamic Range: ± 4 V, offset adjustable to ± 6 V

Power and Connections

Input, Test,
Energy (E), Timing (T): BNC

Bias: SHV

Power: 3.3 V DC at 1.6 A (AC power adapter included)

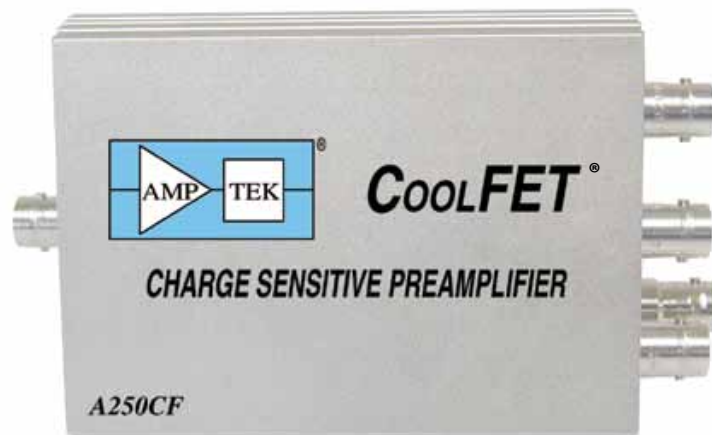
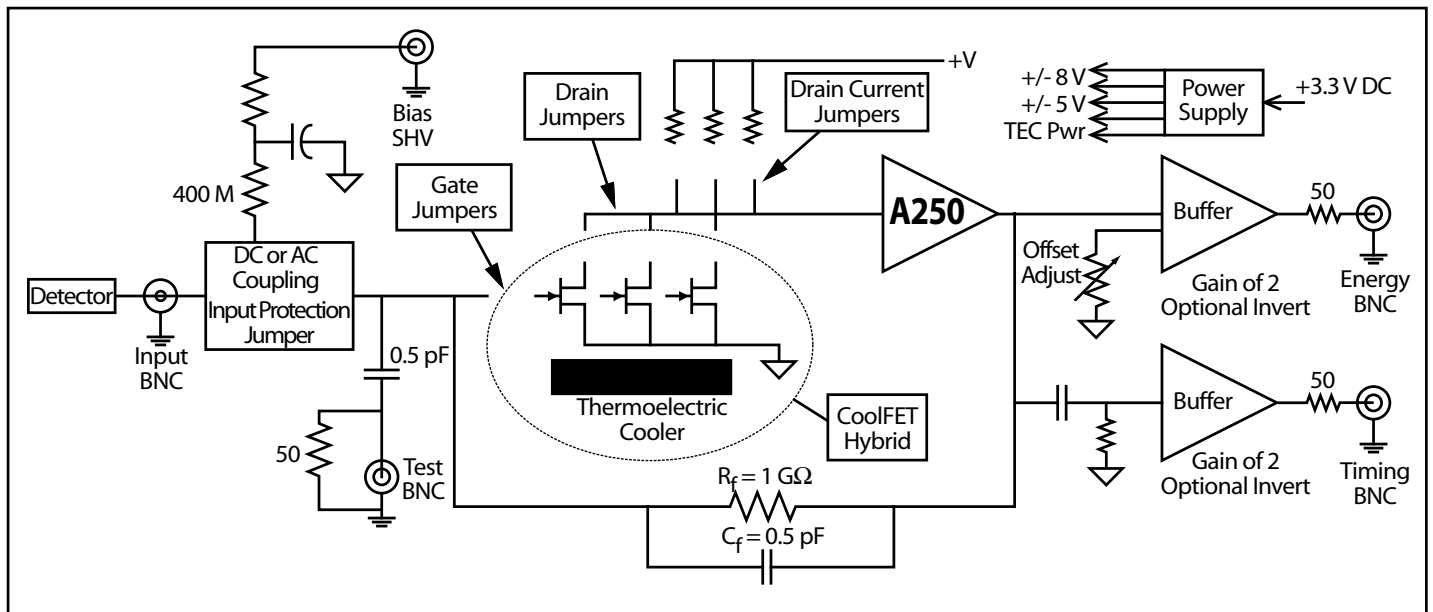
Mechanical

Size: 3.5" (8.89mm) x 2.5" (6.35mm)

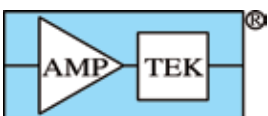
Weight: 2 oz (62g)

A250CF - CoolFET® Charge Sensitive Preamplifier

BLOCK DIAGRAM



A250CF "CoolFET®"
RUN SILENT...RUN FAST...RUN COOL!



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