**TECHNICAL DATA**

**DN630**

*Designers' Data Sheet*

# LOW NOISE CHARGE SENSITIVE PREAMPLIFIER

The DN630 is a low noise low frequency Charge Sensitive Inverting Preamplifier for use with detectors with capacitance from less than one to several hundred picofarads. This includes detectors such as photodiodes, pyroelectric devices as well as other sensors that give up charge when stimulated.

Housed in a TO-99 Package, the input stage of this hybrid circuit amplifier is a low noise MOS Field Effect Transistor. A 1 pF capacitor in parallel with a $10^{11}$ Ω resistor provides internal feedback which gives the amplifier an initial sensitivity of one volt output per picocoulomb of input charge and a 1.6 Hz low frequency cutoff. The gain and frequency response of the amplifier can be modified by adding external feedback components. The internal feedback components can also be factory selected to meet a customers specific needs.

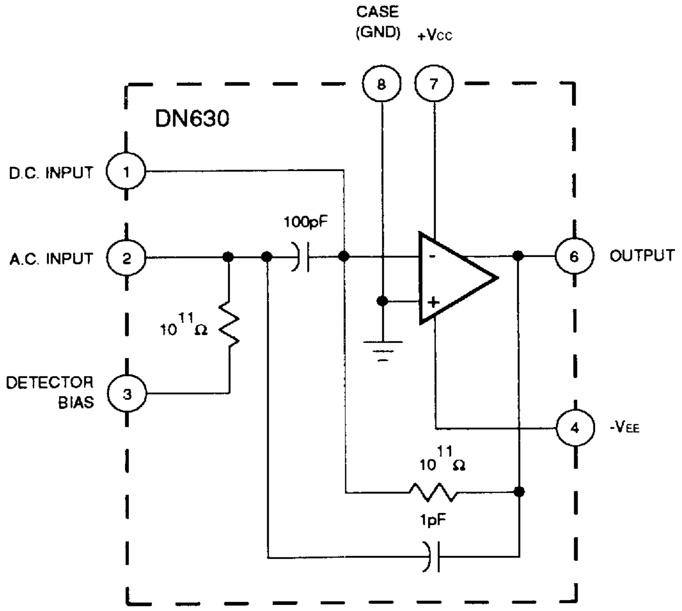
## FEATURES

- **Low Noise**
- **Internal Gain Set Components**
- **Ultra Low Frequency Cutoff**
- **Detector Bias Resistor**

## APPLICATIONS

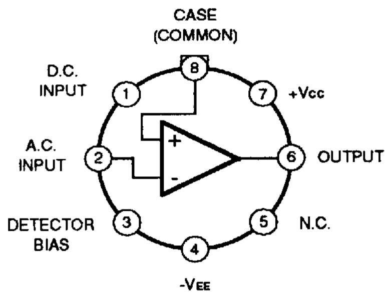
- **Piezoelectric Amplifiers**
- **Electrometer Amplifier**
- **Solid State Photo Detectors**
- **Capacitive Microphone Amplifier**
- **Nuclear Monitoring**
- **Pyroelectric Detectors**
- **Hydrophones**
- **Ultrasonic Transducers**

### SIMPLIFIED SCHEMATIC DIAGRAM



### PIN CONFIGURATION

TOP VIEW



T0-99 METAL PACKAGE

## ABSOLUTE MAXIMUM RATINGS

Supply Voltage.........................................................±16V
Internal Power Dissipation........................................500mW
Storage Temperature...................................-65°C to +150°C
Operating Temperature................................-25°C to +85°C
Lead Temperature (Soldering, 10sec).........................300°C

## ELECTRICAL CHARACTERISTICS ($T_A$ = 25°C UNLESS OTHERWISE SPECIFIED, $V_{SUPPLY}$ = ±15V)

| SYMBOL | PARAMETER | CONDITIONS | DN630 | | | UNIT |
|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | |
| Gvc | Electron charge Input to Output Voltage Gain (Measured in Volts per pico Coulomb) | See Fig. 3<br>$C_{FB}$ = 1.0pF | 0.75 | 1.0 | | V/pC |
| $R_{FB}$ | Feed Back Resistor | | | $10^{11}$ | | Ω |
| $C_{FB}$ | Internal Feed Back Capacitor | | | 1.0 | 1.4 | pF |
| Vo | D.C. Output Voltage | $V_{IN}$ = 0 | | | ± 50 | mV |
| $V_{OH}$ | Output Voltage Swing | $R_L$ = 10 KΩ | ±12 | | | V |
| SR | Slew Rate | See Fig. 1 | 1.6 | | | V/µs |
| BWp | Power Bandwidth | See Fig. 1 | 40 | | | KHz |
| Kv | Open Loop Voltage Gain | | 50 | | | V/mV |
| In | Equivalent Input Noise Current | fo = 10 Hz (Fig. 1) | | | 4.0 | fA/√Hz |
| Is | Supply Current | | | 350 | 500 | µA |

NOTES:

1. The settling time of the output of the DN630 will be several seconds after power is applied because of the large resistance value of the feedback resistor.
2. The primary source of low frequency noise in an amplifier such as the DN630 is current noise generated in the feed back resistor or other resistors connected to the inverting input node. For instance, a 10 MΩ resistor ($R_B$) will generate more than 1mV/√Hz of thermal noise at 5 Hz at the output of the amplifier illustrated in Figure 8. Figure 9 shows the thermal noise generated for various values of detector bias resistor ($R_B$). The detector bias resistor should be as large as possible in order to minimize low frequency resistor noise at the output of a charge amplifier. The maximum value of this resistor is generally limited by the current leakage properties of the detector.
3. The charge detector should be located as close as possible to the DN630 detector amplifier. Long leads or input connections that can vibrate will cause microphonic effects. Variations of less than 0.001pF in the capacitance of the lead connected to the amplifier can cause unwanted signals of 100mVolts or more in a biased detector application such as that illustrated in Figure 2.

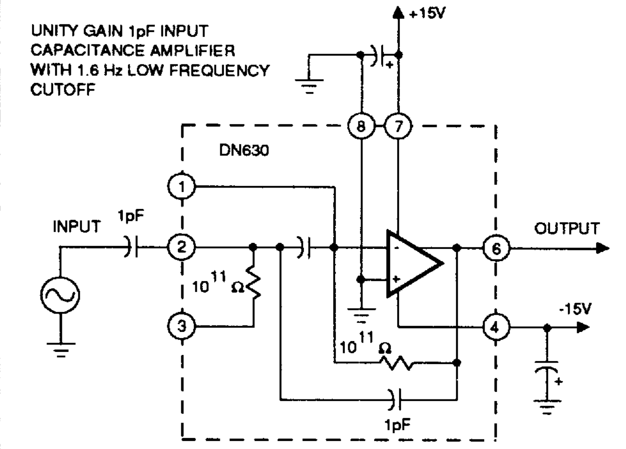


FIGURE 1

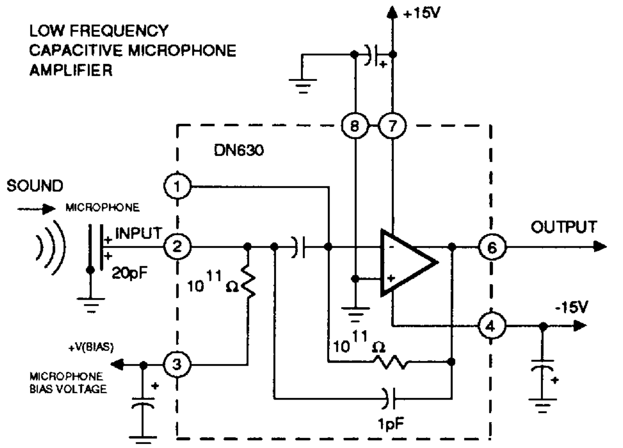


FIGURE 2

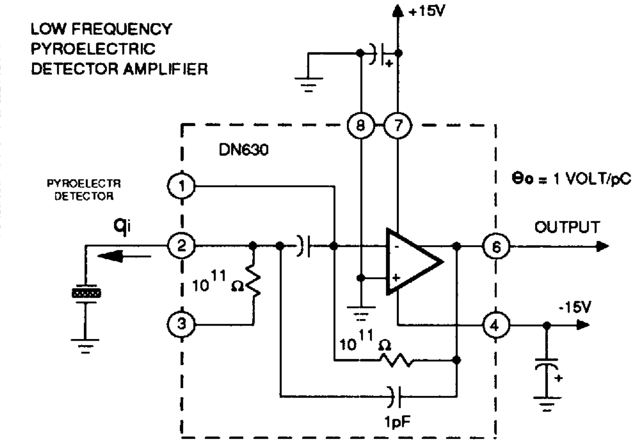


FIGURE 3

## THE EFFECT OF DETECTOR SOURCE CAPACITANCE ON THE DN630 HIGH FREQUENCY RESPONSE

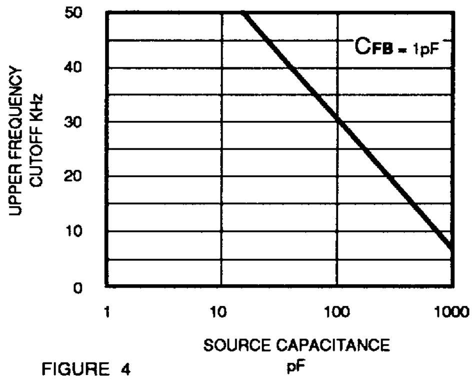


FIGURE 4

## OPEN LOOP VOLTAGE GAIN vs. FREQUENCY

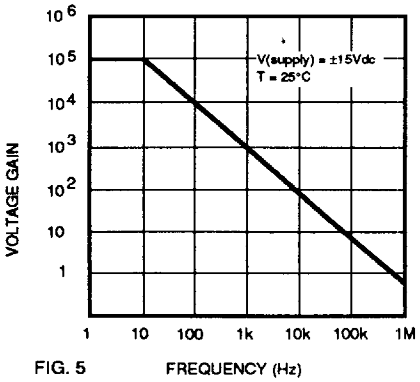


FIG. 5

## ± POWER SUPPLY REJECTION RATIO vs. SUPPLY VOLTAGE

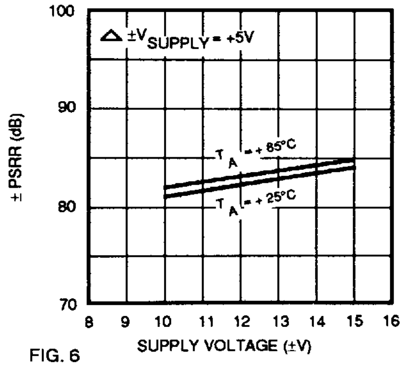


FIG. 6

## OUTPUT VOLTAGE SWING vs. SUPPLY VOLTAGE

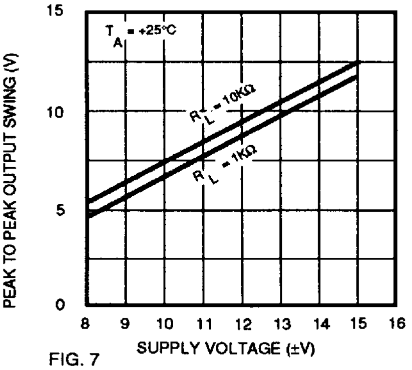
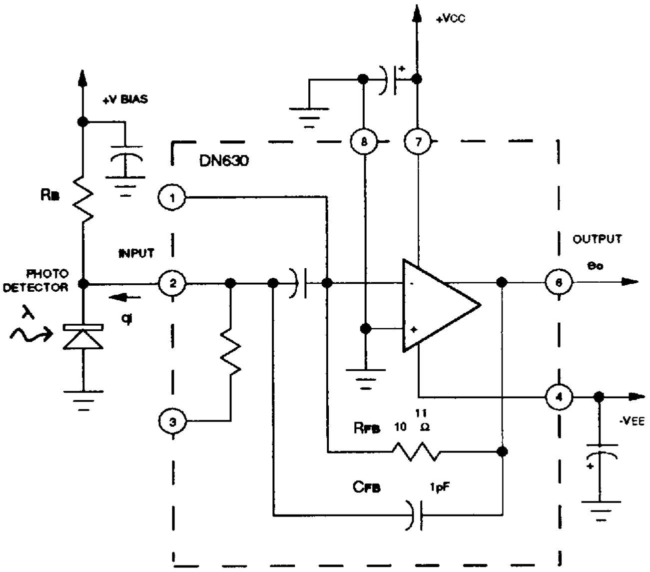


FIG. 7

**DAWN**
*Electronics, Inc.*

SOLID STATE DETECTOR AMPLIFIER



**GAIN EQUATION**

$$e_o = \frac{-q_i}{C_{FB}} = 1V/pC$$

FIGURE5

Where $C_{FB}$ is the feedback capacitor.

$C_{FB}$ = 1pF in the circuit shown.

NOISE AT THE OUTPUT OF THE AMPLIFIER
(FIGURE 4) DUE
TO THE DETECTOR BIAS RESISTOR ($R_B$)
VS
DETECTOR BIAS RESISTANCE ($R_B$)

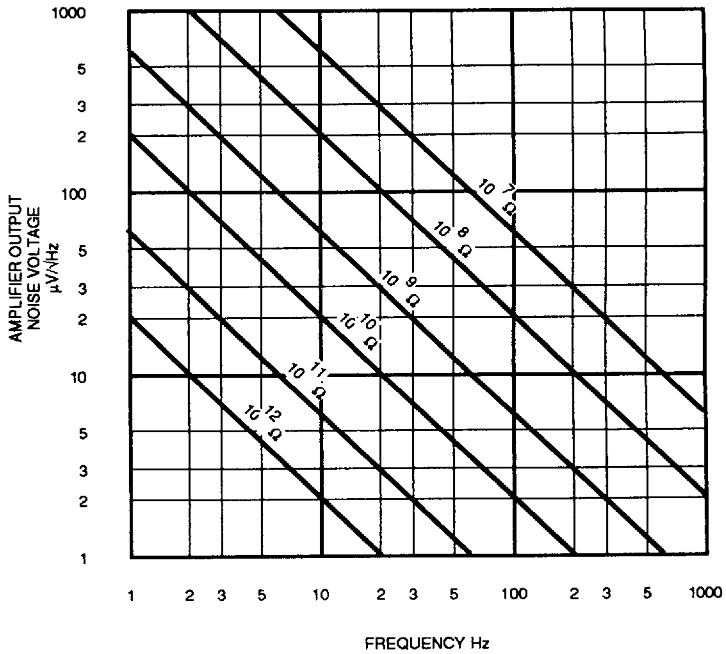
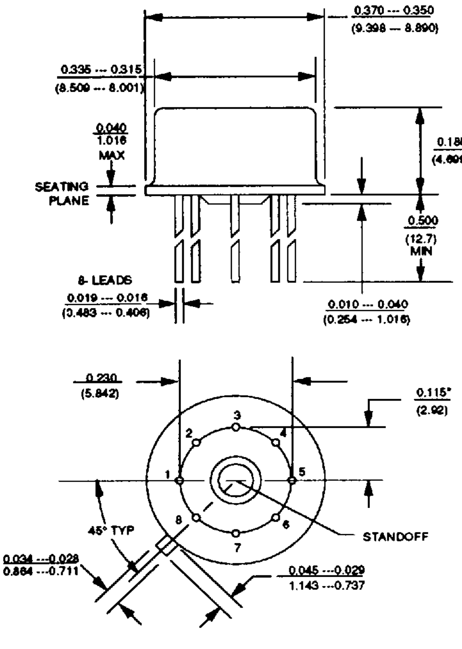


FIGURE5

## PACKAGE DIMENSIONS



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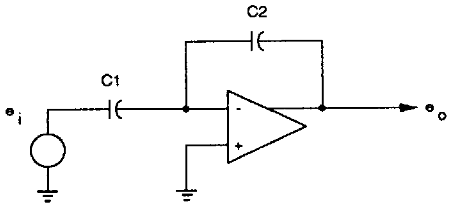
GAIN EQUATIONS FOR A TRANSCONDUCTANCE AMPLIFIER WITH CAPACITIVE INPUT AND FEEDBACK ELEMENTS.



$$K_v = -\frac{e_o}{e_i} = -\frac{C1}{C2}$$

EXAMPLE:

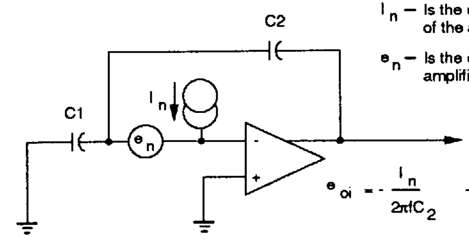
If C1 = 20 pF and C2 = 1 pF

then Kv = -20

OUTPUT NOISE OF A TRANSCONDUCTANCE AMPLIFIER WITH CAPACITIVE INPUT AND FEEDBACK ELEMENTS.

$I_n$ — Is the equivalent input current noise of the amplifier.

$e_n$ — Is the equivalent input voltage noise of the amplifier.



$$e_{oi} = -\frac{I_n}{2\pi f C_2}$$

This is the output noise of the amplifier due to noise current ($e_n = 0$)

$$e_{oi} = -e_n\left(1 + \frac{C_1}{C_2}\right)$$

This is the output noise of the amplifier due to noise voltage. ($I_n = 0$)

Note that the larger the detector capacitance C1 the larger the output voltage due to the equivlent amplifer input noise voltage $e_n$.