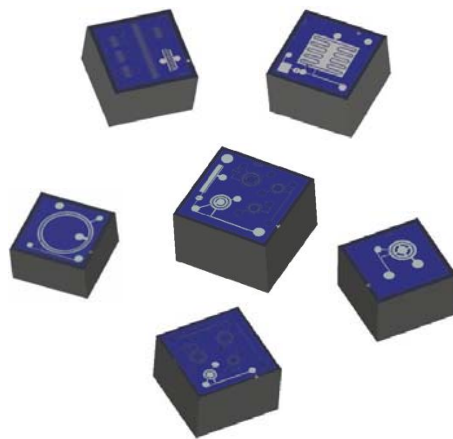


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# *N-Channel Ultra-low Noise JFETs*

## *Data Overview*

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# N-Channel Ultra-low Noise JFETs

## Data Overview

### Introduction

MOXTEK ultra-low noise JFETs are ideal for a variety of applications including microanalysis, Energy Dispersive X-ray Fluorescence (EDXRF), and X-ray Diffraction (XRD). MOXTEK manufactures 3- and 4-pin N-channel JFETs. Moxtek ultra-low noise JFETs have a low leakage current, high transconductance ( $g_m$ ) and low input capacitance ( $C_{gs}$ ). Each packaged JFET is tested and guaranteed.

JFETs are available as a bare die and in a variety of packages. For more information about JFET packages please see the “JFET Packages” section, Page 3.

JFET mask drawings with labeled pads are shown in the “JFET Drawings” section on Page 4. Here you can learn about differences between each JFET manufactured by Moxtek.

The “JFET Characteristics” section shows detailed characteristics of each JFET under specific conditions (see Pages 5 and 6).

Noise characteristics of Moxtek JFET products are shown in the “Noise Characteristics” section (see Page 7).

For price and delivery information please contact Moxtek or for any other ordering related questions please visit our website link: <http://www.moxtek.com/order.html>

### Features for Optimal Detector Resolution

Ultra-low noise  
 Free of generation recombination noise  
 High transconductance ( $g_m$ ) and low input capacitance ( $C_{gs}$ )  
 Low leakage current

### Benefits

High Low-Level Signal Amplification  
 Low Noise  
 Very high input impedance  
 Excellent gain and very low distortion

### Applications

#### X-ray Detectors

- Si(Li) Detectors
- Si-PIN Detectors
- Silicon Drift Detectors (SDD)

### Products Summary

The “Product Summary” section is a quick overview of JFET characteristics to show differences between Moxtek JFET products. For detailed description and characteristics of these parameters please read the “JFET Characteristics” section (pages 5 and 6).

JFET	$BV_{gss}$ (V)	$V_{gs(off)}$ (V)	$I_{dss}$ (mA)	$g_m$ (mS)	$C_{gs}$ (pF)
<b>Test Conditions</b>	$V_{ds}=0V,$ $I_g=1\mu A,$ $V_{sub}=0V$	$V_{sub}=0V,$ $I_d=1nA$	$V_{gs}=0V,$ $V_{sub}=0V$	$V_{ds}=4V,$ $I_d=5mA,$ $20^\circ C$	$V_{ds}=4V,$ $I_d=5mA,$ $V_{gs}=0V$
<b>MX-11rc*</b>	25	2.5	20	5	0.7
<b>MX-16</b>	26	10	300	28	4
<b>MX-120</b>	27	9	64	16	1.7
<b>MX-16rc</b>	30	5.5	52	8	2.7
<b>MX-20</b>	26	10	29	8	0.9
<b>MX-30</b>	31	10	20	6	0.6
<b>MX-40</b>	27	9	12	4.5	0.4

\* The MX-11rc JFET is a 3-terminal device. All other JFETs are 4-terminal devices



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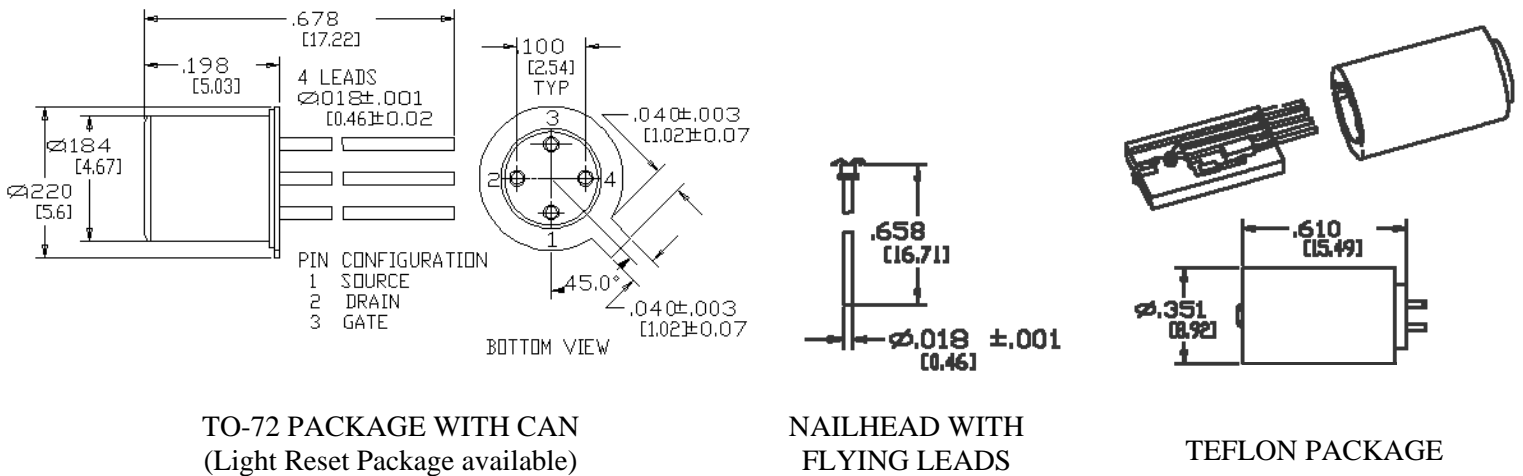
# N-Channel Ultra-low Noise JFETs

## Data Overview

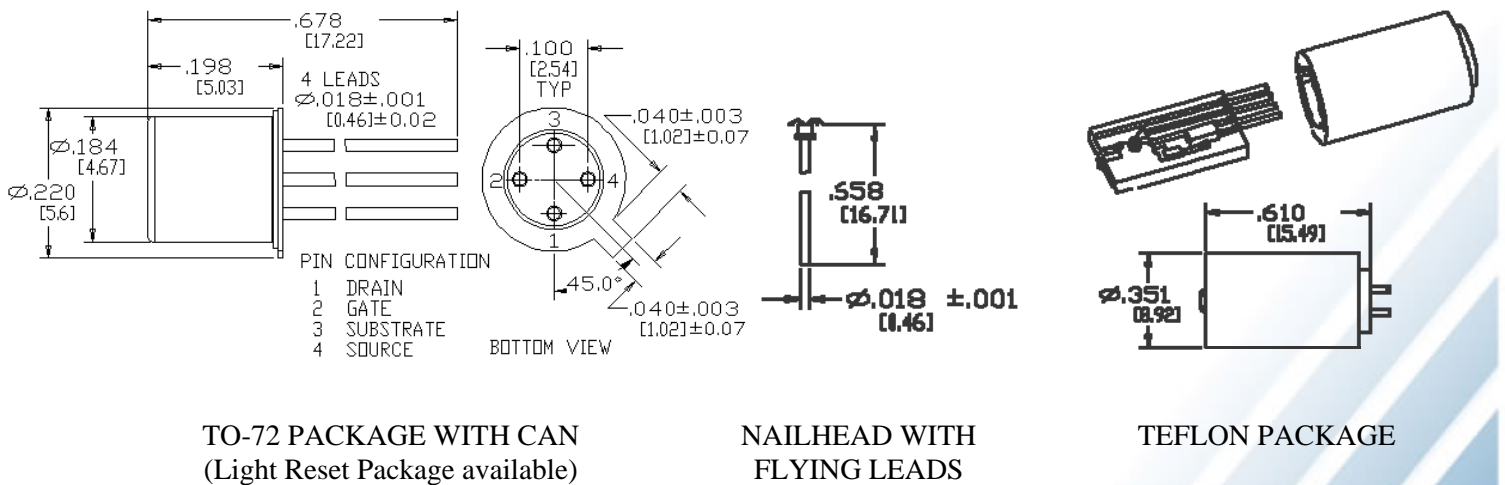
### JFET Packages

The drawings below show different packaging options for MOXTEK JFET products. The only difference between the drawing of the 3-pin JFET (MX-11rc) and all other JFETs is the pin configuration of TO-72 package.

#### MX-11rc JFET Packages



#### MX-16, MX-16rc, MX-30, MX-40, MX-120 JFET Packages



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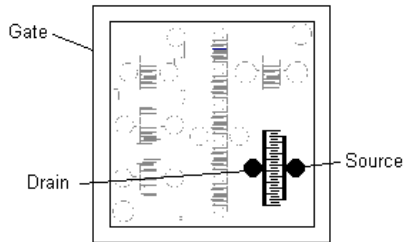
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# N-Channel Ultra-low Noise JFETs Data Overview

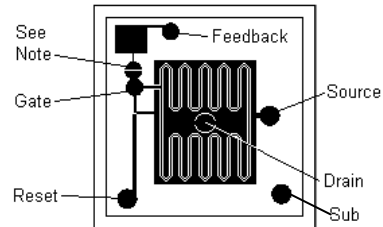
## JFET Drawings

JFET mask drawings with the pads labeled below show what the JFET looks like under the microscope and how each pad is identified.

**MX-11rc JFET**

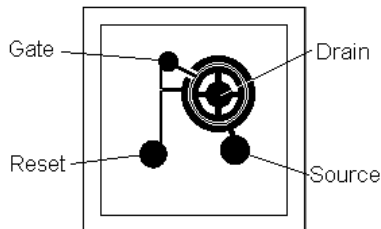


**MX-16, MX-16rc JFET**



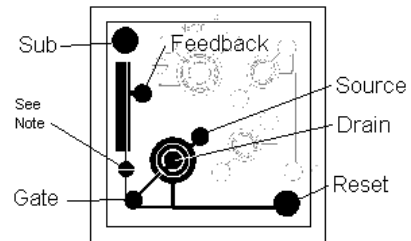
The bottom gate on this 4 terminal JFET is the substrate. Feedback capacitance = 0.5pF  
Feedback and substrate pads are custom and are not generally bonded.

**MX-20 JFET**



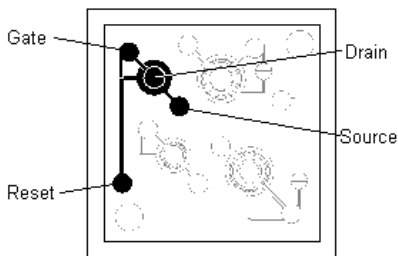
The bottom gate on this 4 terminal JFET is the substrate.

**MX-30 JFET**



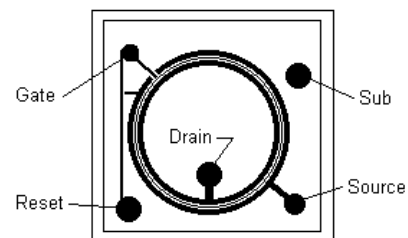
The bottom gate on this 4 terminal JFET is the substrate. Feedback capacitance = 0.5pF  
Feedback and substrate pads are custom and are not generally bonded.

**MX-40 JFET**



The bottom gate on this 4 terminal JFET is the substrate.

**MX-120 JFET**



The bottom gate on this 4 terminal JFET is the substrate. Substrate pad is custom and is not generally bonded.



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# N-Channel Ultra-low Noise JFETs

## Data Overview

### JFET Characteristics

The following tables show electrical parameters of Moxtek JFETs tested under specific conditions.

Static Characteristics												
JFET	Gate-Source Breakdown Voltage			Gate-Source Cutoff Voltage			Drain Saturation Current			Reverse Leakage Current		
	Symbol: $V_{(BV)_{gss}}$ Unit: V			Symbol: $V_{gs(off)}$ Unit: V			Symbol: $I_{dss}$ Unit: mA			Symbol: $I_{gss}$ Unit: pA		
	Test Conditions <sup>*</sup> : $V_{ds}=0V, I_g=1mA, V_{sub}=0V$			Test Conditions <sup>*</sup> : $V_{sub}=0V, I_d=1nA$			Test Conditions <sup>*</sup> : $V_{gs}=0V, V_{sub}=0V$			Test Conditions: $V_{gs} = -10V$		
	Temperature: 20°C			Temperature: 20°C			Temperature: 20°C			Temperature: 20°C		
	Typ	Min	Max	Typ	Min	Max	Typ	Min	Max	Typ	Min	Max
MX-11rc	25.0	23.0	25.0	2.4	2.1	2.6	11.0	10.0	13.0	0.7	0.8	0.6
MX-40	27.0	26.0	28.0	9.1	8.7	9.4	12.0	12.0	13.0	0.1	0.2	0.1
MX-30	31.0	30.0	34.0	9.9	8.9	11.6	20.0	18.0	23.0	0.1	0.2	0.0
MX-20	26.0	26.0	27.0	9.8	9.0	10.0	29.0	26.0	32.0	0.6	0.7	0.5
MX-16rc	31.0	28.0	32.0	5.4	4.3	5.9	52.0	44.0	58.0	4.0	8.4	2.8
MX-120	27.0	26.0	27.0	9.3	9.0	10.0	64.0	62.0	70.0	0.2	1.5	0.0
MX-16	26.0	25.0	26.0	9.4	8.9	9.8	299.0	290.0	315.0	0.4	0.6	0.3

Dynamic Characteristics									
JFET	Transconductance			Transconductance			Gate-Source Capacitance		
	Symbol: $g_m$ Unit: mS			Symbol: $g_m$ Unit: mS			Symbol: $C_{gs}$ Unit: pF		
	Test Conditions <sup>**</sup> : $V_{ds}=4V, I_d=5mA, V_{gs}=0V$			Test Conditions <sup>**</sup> : $V_{ds}=4V, I_d=5mA, V_{gs}=0V$			Test Conditions <sup>**</sup> : $I_d=5mA, V_{ds}=4V, V_{gs}=0V$		
	Temperature: 20°C			Temperature: -100°C			Temperature: 20°C		
	Typ	Min	Max	Typ	Min	Max	Typ	Min	Max
MX-11rc	5.4	5.3	5.7	7.8	7.6	8.3	0.7	0.7	0.7
MX-40	4.5	4.3	4.7	5.7	5.4	5.9	0.4	0.4	0.4
MX-30	6.2	6.0	6.4	8.2	7.9	8.5	0.6	0.5	0.6
MX-20	8.0	7.7	8.3	10.7	10.4	11.0	0.9	0.8	1.0
MX-16rc	8.3	8.0	8.5	11.0	10.6	11.3	2.7	2.6	3.0
MX-120	16.6	15.7	17.3	23.2	22.7	24.1	1.7	1.6	1.9
MX-16	28.4	27.5	30.4	40.3	38.8	42.8	4.0	3.8	4.2

\*  $V_{sub}$  bias condition doesn't apply to the MX-11rc JFET

\*\*  $V_{gs}$  bias condition doesn't apply to the MX-11rc JFET



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# N-Channel Ultra-low Noise JFETs Data Overview

Noise Characteristics																				
Equivalent Voltage Noise																				
JFET	Symbol: $\sqrt{e_n^2}$			Symbol: $\sqrt{e_n^2}$			Symbol: $\sqrt{e_n^2}$			Symbol: $\sqrt{e_n^2}$			Symbol: $\sqrt{e_n^2}$			Symbol: $\sqrt{e_n^2}$				
	Unit: nV/ $\sqrt{\text{Hz}}$			Unit: nV/ $\sqrt{\text{Hz}}$			Unit: nV/ $\sqrt{\text{Hz}}$			Unit: nV/ $\sqrt{\text{Hz}}$			Unit: nV/ $\sqrt{\text{Hz}}$			Unit: nV/ $\sqrt{\text{Hz}}$				
	Test Conditions : $V_{ds}=4\text{V}, I_d=5\text{mA}, V_{gs}=0\text{V}$			Test Conditions : $V_{ds}=4\text{V}, I_d=5\text{mA}, V_{gs}=0\text{V}$			Test Conditions : $V_{ds}=4\text{V}, I_d=5\text{mA}, V_{gs}=0\text{V}$			Test Conditions : $V_{ds}=4\text{V}, I_d=5\text{mA}, V_{gs}=0\text{V}$			Test Conditions : $V_{ds}=4\text{V}, I_d=5\text{mA}, V_{gs}=0\text{V}$			Test Conditions : $V_{ds}=4\text{V}, I_d=5\text{mA}, V_{gs}=0\text{V}$				
	Temperature: 20°C			Temperature: 20°C			Temperature: 20°C			Temperature: -100°C			Temperature: -100°C			Temperature: -100°C				
	Frequency: 1 kHz			Frequency: 10 kHz			Frequency: 100 kHz			Frequency: 1 kHz			Frequency: 10 kHz			Frequency: 100 kHz				
	Typ	Min	Max	Typ	Min	Max	Typ	Min	Max	Typ	Min	Max	Typ	Min	Max	Typ	Min	Max	Typ	Min
<b>MX-11rc</b>	2.8	2.5	3.1	2.2	2	2.4	2.1	2.0	2.2	2.3	1.9	2.7	1.6	1.5	1.8	1.5	1.4	1.6		
<b>MX-40</b>	3.3	3.1	3.5	2.7	2.6	2.7	2.6	2.5	2.7	3.0	2.8	3.2	2.1	2.1	2.2	2.1	2.0	2.1		
<b>MX-30</b>	2.4	2.3	2.5	2.0	2.0	2.2	2.0	1.9	2.1	2.2	2.1	2.4	1.7	1.6	1.7	1.6	1.5	1.7		
<b>MX-16rc</b>	1.9	1.9	2.0	1.6	1.6	1.7	1.6	1.5	1.6	1.7	1.6	1.8	1.3	1.3	1.3	1.2	1.2	1.3		
<b>MX-20</b>	1.8	1.7	1.9	1.6	1.5	1.7	1.6	1.5	1.7	1.6	1.5	1.7	1.3	1.2	1.3	1.2	1.2	1.3		
<b>MX-120</b>	1.2	1.2	1.3	1.0	1.0	1.1	1.0	1.0	1.1	1.2	1.1	1.4	0.8	0.8	1.1	0.8	0.7	0.9		
<b>MX-16</b>	1.0	1.0	1.2	0.8	0.8	0.8	0.8	0.8	0.7	0.9	0.9	1.0	0.6	0.6	0.6	0.6	0.5	0.6		

\*  $V_{gs}$  bias condition doesn't apply to the MX-11rc JFET



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# N-Channel Ultra-low Noise JFETs Data Overview

## Noise Characteristics

The plots below show differences between the equivalent noise voltages of different JFETs at three frequencies compared at 20°C and -100°C.

The MX-40 JFET being the smallest device has the highest noise levels; whereas, the MX-16 JFET being the largest device has the lowest noise level.

