JFET and OpAmp

Pyroelectric detectors of InfraTec use for the first signal processing stage Junction Field Effect Transistors (JFET) and CMOS Operational Amplifiers (OpAmp) built-in in the detector housing. Specifications are adapted for high-impedance pyroelectric elements.

1 Standard JFET – For single and multi color detectors

Features

- Very low voltage and current noise
- High input impedance
- Full performance from low-voltage power supply, down to 2.5 V
- Low Gate leakage current for improved system accuracy

Absolute maximum ratings

- Gate-Source / Gate-Drain voltage: -50 V
- Power dissipation: 50 mW

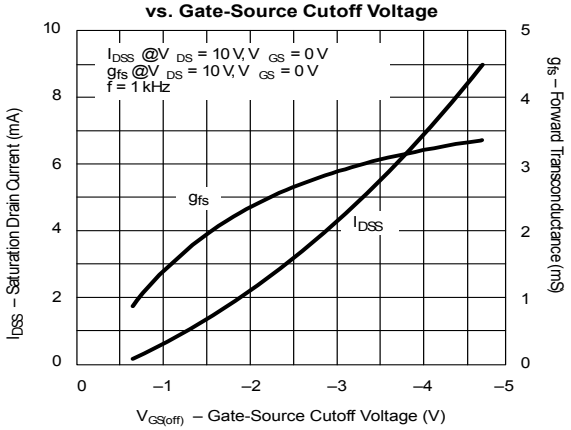
Specifications (T_A = 25 °C unless otherwise noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Static						
Gate-Source Breakdown Voltage	$-V_{(BR)GSS}$	I_G = -1 µA, V_{DS} = 0 V	50	60		V
Gate-Source Cutoff Voltage	$-V_{GS(off)}$	I_D = 0.1 µA, V_{DS} = 15 V	0.4		1.5	
Saturation Drain Current	I_{DSS}	V_{DS} = 15 V, V_{GS} = 0 V	0.5		1.5	mA
Gate Reverse Current	$-I_{GSS}$	V_{DS} = 0 V, V_{GS} = -30 V, T_A = 25 °C			2	pA
		V_{DS} = 0 V, V_{GS} = -30 V, T_A = 150 °C			100	nA
Gate Operating Current	$-I_G$	I_D = 0.1 mA, V_{DG} = 15 V			2	pA
Drain Cutoff Current	$I_{D(off)}$	V_{DS} = 15 V, V_{GS} = -5 V			50	
Gate-Source Forward Voltage	$V_{GS(F)}$	I_G = 1 mA, V_{DS} = 0 V	0.7			V
Dynamic						
Common-Source Forward Transconductance	g_{fs}	V_{DS} = 15 V, V_{GS} = 0 V, f = 1 kHz	0.8	2.2	2.4	mS
Common-Source Output Transconductance	g_{os}				15	µS
Drain-Source On-Resistance	$r_{DS(on)}$	V_{DS} = 0 V, V_{GS} = 0 V, f = 1 kHz			1,700	Ω
Common-Source Input Capacitance	C_{iss}	V_{DS} = 15 V, V_{GS} = 0 V, f = 1 MHz		3.5	7	pF
Common-Source Reverse Transfer Capacitance	C_{rss}			1.2	3	
Equivalent Input Noise Voltage	e_n	V_{DS} = 10 V, V_{GS} = 0 V, f = 1 kHz		6		nV/√Hz

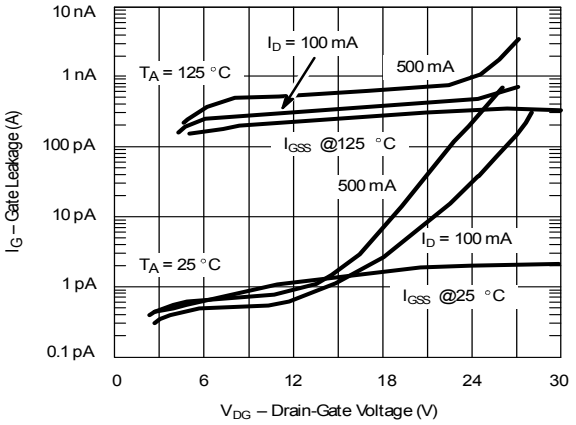
JFET and OpAmp

Standard JFET Specifications (T_A = 25 °C unless otherwise noted)

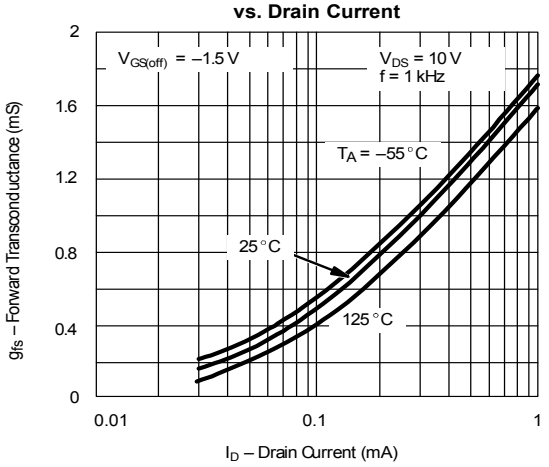
Drain Current and Transconductance vs. Gate-Source Cutoff Voltage



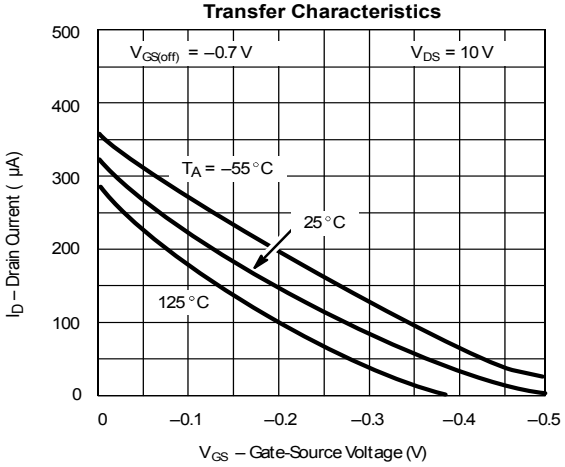
Gate Leakage Current



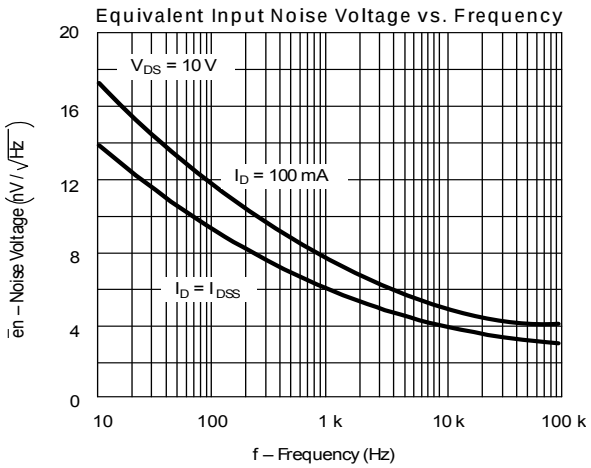
Common-Source Forward Transconductance vs. Drain Current



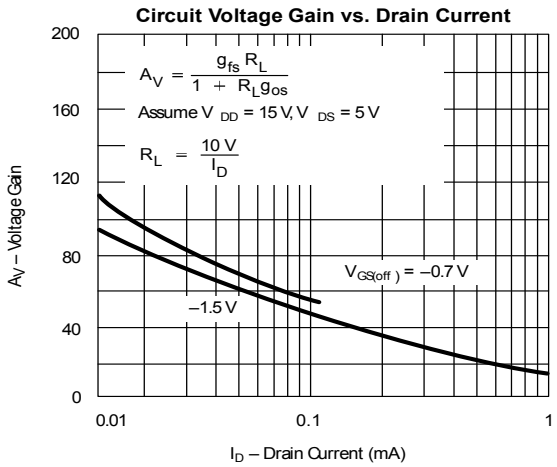
Transfer Characteristics



Equivalent Input Noise Voltage vs. Frequency



Circuit Voltage Gain vs. Drain Current



JFET and OpAmp

2 Special JFET – Design for single and multi color detectors (on request)

Benefits
Reliable operation at high temperature or increased ionizing radiation

Disadvantage related to standard JFET
Lower gain; higher output impedance

Features
- Ultra high input impedance
- Low Gate leakage current for improved system accuracy

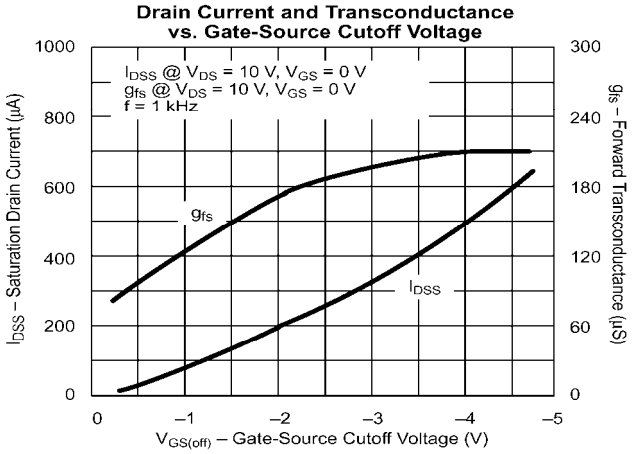
Absolute maximum ratings
- Gate-Source / Gate-Drain voltage: -50 V
- Power dissipation: 50 mW

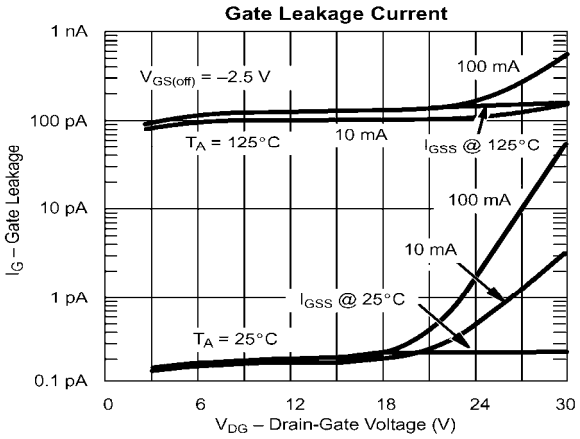
Specifications (T_A = 25 °C unless otherwise noted)

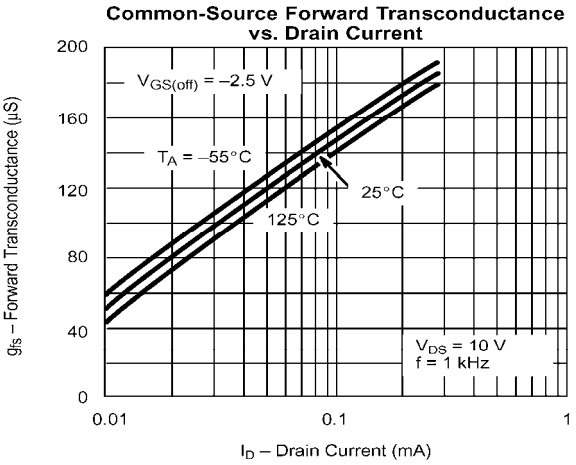
Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Static						
Gate-Source Breakdown Voltage	$-V_{(BR)GSS}$	I_G = -1 µA, V_{DS} = 0 V	40	50		V
Gate-Source Cutoff Voltage	$-V_{GS(off)}$	I_D = 0.1 µA, V_{DS} = 15 V	0.4		1.5	V
Saturation Drain Current	I_{DSS}	V_{DS} = 15 V, V_{GS} = 0 V	30		90	µA
Gate Reverse Current	$-I_{GSS}$	V_{DS} = 0 V, V_{GS} = -20 V, T_A = 25 °C			1	pA
		V_{DS} = 0 V, V_{GS} = -20 V, T_A = 150 °C			2.5	nA
Gate Operating Current	$-I_G$	I_D = 0.1 mA, V_{DG} = 15 V		0.2		pA
Drain Cutoff Current	$I_{D(off)}$	V_{DS} = 15 V, V_{GS} = -5 V		0.2	10	pA
Gate-Source Forward Voltage	$V_{GS(F)}$	I_G = 1 mA, V_{DS} = 0 V		0.7		V
Dynamic						
Common-Source Forward Transconductance	g_{fs}	V_{DS} = 15 V, V_{GS} = 0 V, f = 1 kHz	70	175	210	µS
Common-Source Output Transconductance	g_{os}				3	µS
Drain-Source On-Resistance	$r_{DS(on)}$	V_{DS} = 0 V, V_{GS} = 0 V, f = 1 kHz			18	kΩ
Common-Source Input Capacitance	C_{iss}	V_{DS} = 15 V, V_{GS} = 0 V, f = 1 MHz		2	3	pF
Common-Source Reverse Transfer Capacitance	C_{rss}			0.9	1.5	pF
Equivalent Input Noise Voltage	e_n	V_{DS} = 10 V, V_{GS} = 0 V, f = 1 kHz		15		nV/√Hz

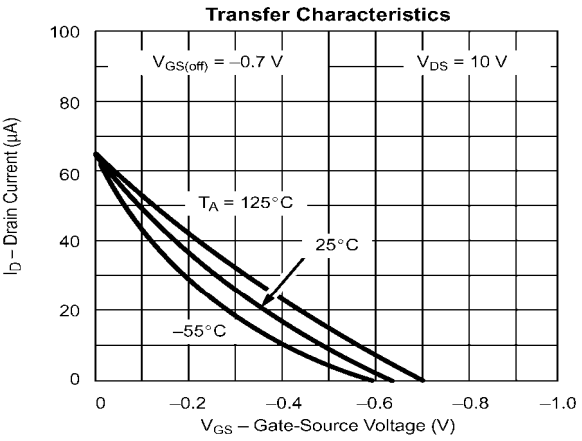
JFET and OpAmp

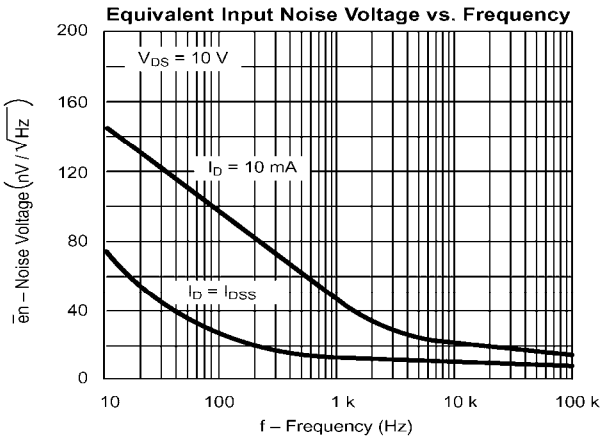
Special JFET Specifications (T_A = 25 °C unless otherwise noted)

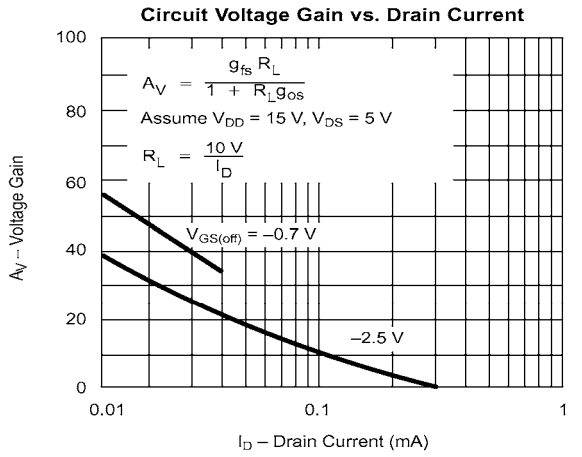












3 OpAmp2 – CMOS very low power OpAmp for single and multi color detectors

LME-335, /-337, /-341, /-345, /-351, /-353, /-392, /-553, /-541, /-551; LIM-052, /-054, /-162, /-262; LMM-242, /-244; LFP-3041L-337; LFP-3950-337; LFP-80105-337

Features

- Single [(4.5 ... 16) V] and split supply [(±2.2 ... ±8) V] operation
- Low supply current; very low input bias current
- Rail-to-Rail output swing; high voltage gain

Absolute maximum ratings

- Supply voltage (V^+ - V^-): 16V
- Differential input voltage: ± supply voltage
- Voltage at output pin: (V^-) -0.3 V ... (V^+) +0.3 V
- Current at input pin: ±5 mA
- Current at output pin: ±30 mA
- Current at power supply pin: ±40 mA
- Power dissipation: 10 mW

Specifications

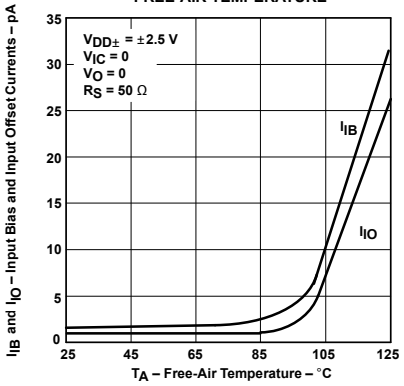
(T_A = 25 °C; V^+ = 5 V; V^- = -5 V; R_L > 1 MΩ unless otherwise noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
		Static				
Input Offset Voltage	V_{OS}			200	1500	µV
Input Bias Current	I_B			1	60	pA
Input Offset Current	I_{OS}			0.5	60	pA
Common Mode Rejection Ratio	CMRR	-5.0 V ≤ V_{IC} ≤ 2.7 V	75	88		dB
Input Common-Mode Voltage Range	V_{ICR}		-5 to 4	-5.3 to 4,2		V
Large Signal Voltage Gain	A_V	R_L = 1 MΩ		3000		V/mV
		R_L = 100 kΩ	45	650		V/mV
Output Swing positive peak	V_O	R_L = 1 MΩ to Gnd		4.98		V
		R_L = 100 kΩ to Gnd	4,9	4.93		
Output Swing negative peak		R_L = 1 MΩ to Gnd		-4.99		
		R_L = 100 kΩ to Gnd	-4.85	-4.91		
Supply Current	I_S	V_O = 0V, No Load		80	125	µA
		Dynamic				
Slew Rate	SR	V_O = ± 1.9V, R_L = 100 kΩ, C_L =100pF	70	120		V/ms
Gain-Bandwidth Product	GBW			210		kHz
Phase Margin	θ_m			63		Deg
Equivalent Input Noise Voltage	V_n	f = 1 kHz		19		nV/√Hz
Equivalent Input Noise Current	I_n	f = 1 kHz		0.6		fA/√Hz

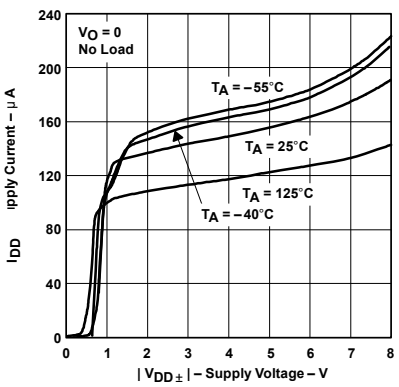
JFET and OpAmp

OpAmp2 Specifications

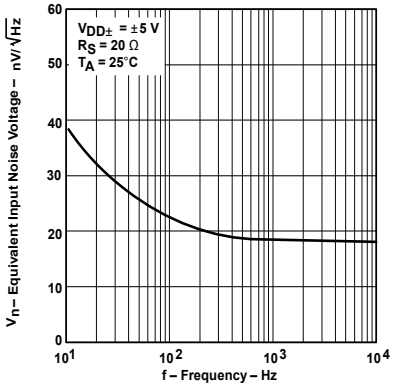
INPUT BIAS AND INPUT OFFSET CURRENTS† vs FREE-AIR TEMPERATURE



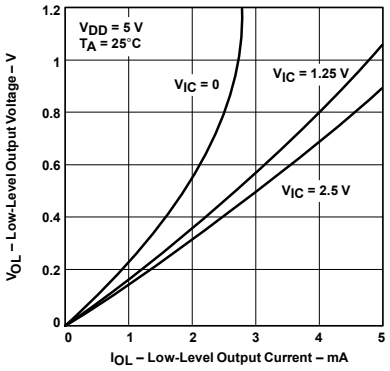
SUPPLY CURRENT† vs SUPPLY VOLTAGE



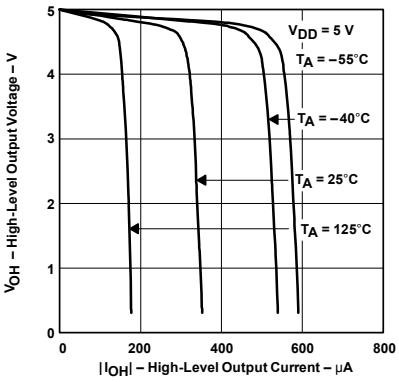
EQUIVALENT INPUT NOISE VOLTAGE vs FREQUENCY



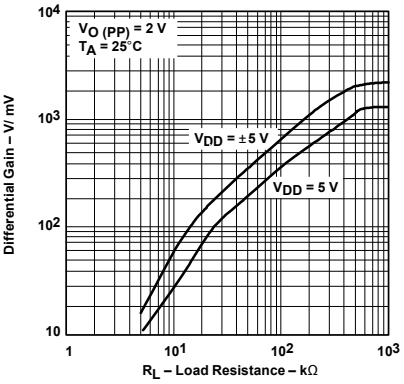
LOW-LEVEL OUTPUT VOLTAGE‡ vs LOW-LEVEL OUTPUT CURRENT



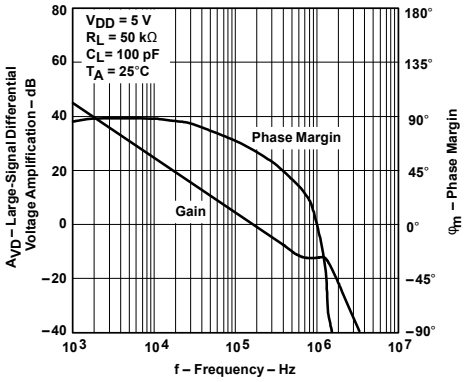
HIGH-LEVEL OUTPUT VOLTAGE†‡ vs HIGH-LEVEL OUTPUT CURRENT



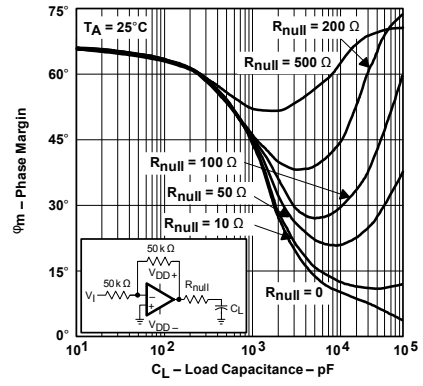
DIFFERENTIAL GAIN‡ vs LOAD RESISTANCE



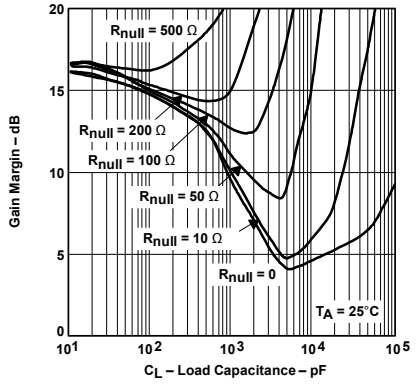
LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE MARGIN† vs FREQUENCY



PHASE MARGIN vs LOAD CAPACITANCE



GAIN MARGIN vs LOAD CAPACITANCE



4 OpAmp3 – CMOS very low power OpAmp for use in single supply detectors and low current detectors

LME-336, /-346, /-352, LIE-235, /-241, /-245, /-251

Features

- Single supply [(2.7 ... 10) V] operation and split supply [(±1.35 … ±5) V] operation
- Ultra Low supply current; low input bias current
- Rail-to-Rail output swing; high voltage gain

Absolute maximum ratings

- Single-Supply voltage (V^+ - V^-/GND): 10V
- Differential input voltage: ± supply voltage
- Voltage at output pin: (V^-) -0.3 V ... (V^+) +0.3 V
- Current at output pin: ±50 mA
- Current at power supply pin: ±50 mA
- Power dissipation: 10 mW (R_L≥10kOhm)

Specifications

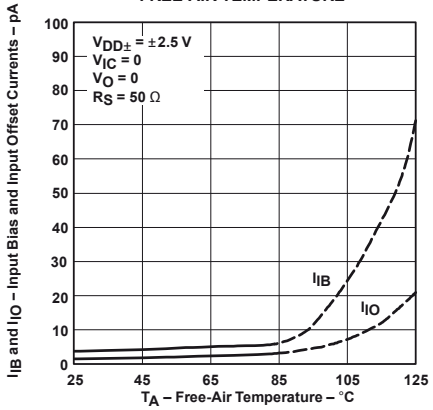
(T_A = 25 °C; V^+ = 3 V; V^- = 0 V; R_L > 10 kΩ unless otherwise noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
		Static				
Input Offset Voltage	V_{OS}			0.47	3	mV
Input Bias Current	I_B			1	60	pA
Input Offset Current	I_{OS}			0.5	60	pA
Common Mode Rejection Ratio	CMRR	0.0 V ≤ V_{IC} ≤ 1.7 V	65	83		dB
Input Common-Mode Voltage Range	V_{ICR}		0 to 2	0 to 2,2		V
Large Signal Voltage Gain	A_V	R_L = 1 MΩ		600		V/mV
		R_L = 10 kΩ	3	7		V/mV
Output Swing positive peak	V_O	R_L = 1 MΩ to Gnd		2.94		V
		R_L = 10 kΩ to Gnd		2.85		
Output Swing negative peak		R_L = 1 MΩ to V^+		0.015		
		R_L = 10 kΩ to V^+		0,15		
Supply Current	I_S	V_O = +1.5 V, No load		11	25	µA
		Dynamic				
Slew Rate	SR	V_O = 1.1 to 1.9V (R_L = 10 kΩ, C_L =100pF to 1.5V)	10	25		V/ms
Gain-Bandwidth Product	GBW			56		kHz
Phase Margin	θ_m			56		Deg
Equivalent Input Noise Voltage	V_n	f = 1 kHz		22		nV/√Hz
Equivalent Input Noise Current	I_n	f = 1 kHz		0.6		fA/√Hz

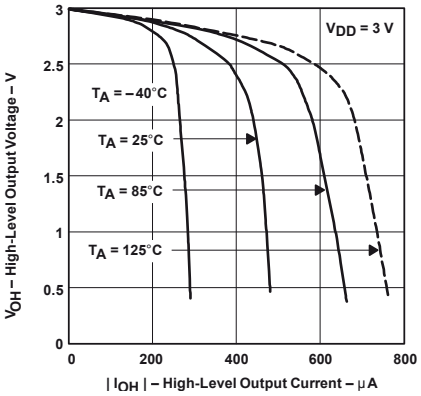
JFET and OpAmp

OpAmp3 Specifications

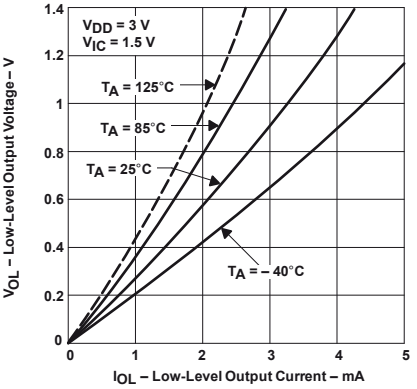
INPUT BIAS AND INPUT OFFSET CURRENTS† vs FREE-AIR TEMPERATURE



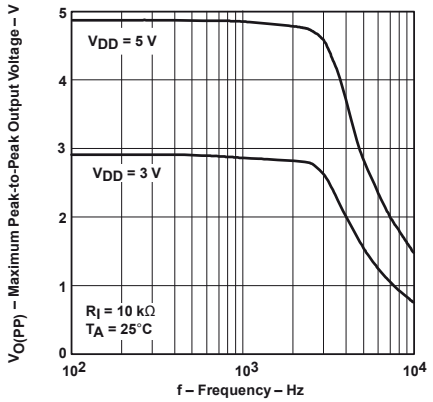
HIGH-LEVEL OUTPUT VOLTAGE†‡ vs HIGH-LEVEL OUTPUT CURRENT



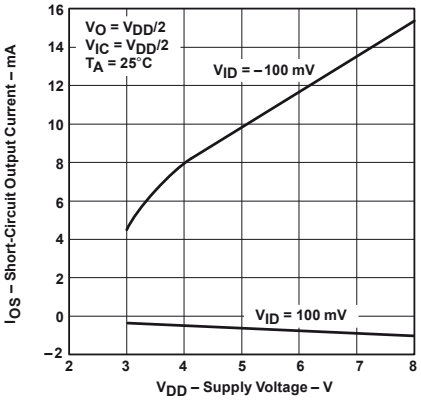
LOW-LEVEL OUTPUT VOLTAGE†‡ vs LOW-LEVEL OUTPUT CURRENT



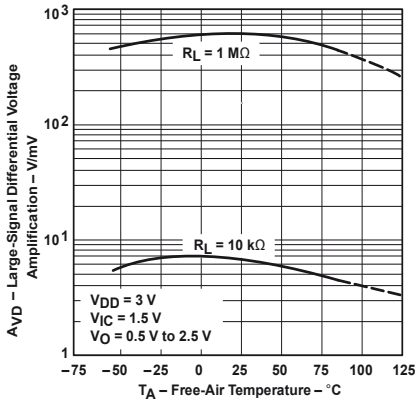
MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE‡ vs FREQUENCY



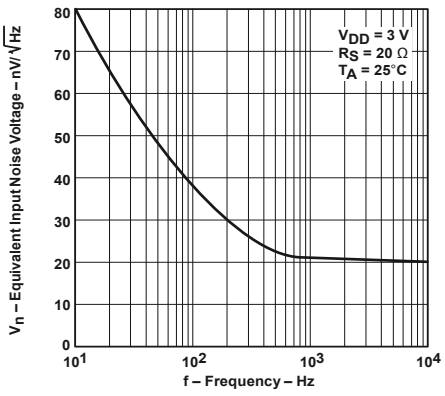
SHORT-CIRCUIT OUTPUT CURRENT vs SUPPLY VOLTAGE



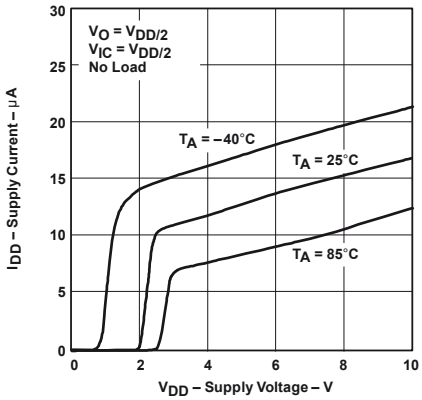
LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION†‡ vs FREE-AIR TEMPERATURE



EQUIVALENT INPUT NOISE VOLTAGE† vs FREQUENCY



SUPPLY CURRENT† vs SUPPLY VOLTAGE



UNITY-GAIN BANDWIDTH vs LOAD CAPACITANCE