JFET and Operational Amplifier Characteristics

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 leakage for improved system accuracy

Absolute maximum ratings

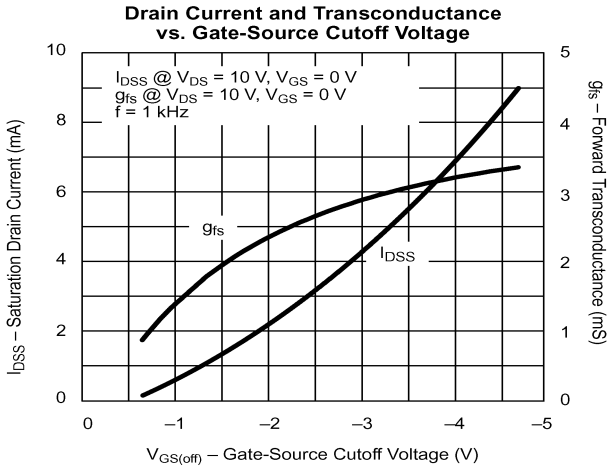
- Gate-Source / Gate-Drain voltage: -50 V
- Power dissipation: 50 mW

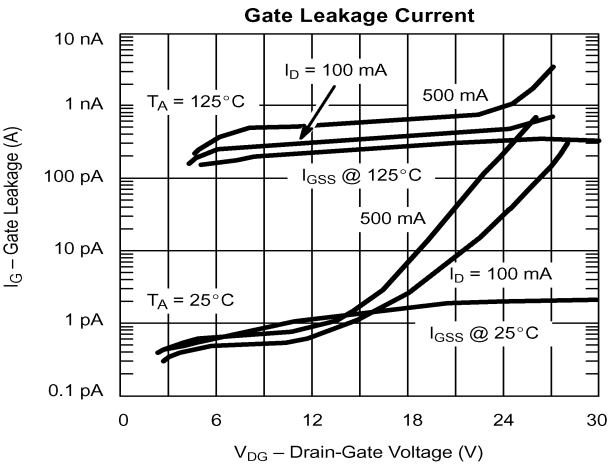
Specifications (T_A = 25 °C unless otherwise noted)

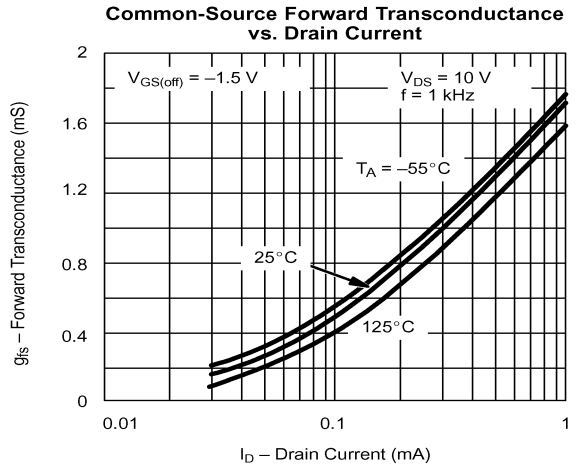
Parameter	Symbol	Test Condition	Limits		Unit
			Min	Max	
Static					
Gate-Source Breakdown Voltage	$-V_{(BR)GSS}$	I_G = -1 µA, V_{DS} = 0 V	50	-	V
Gate-Source Cutoff Voltage	$-V_{GS(off)}$	I_D = 0.1 µA, V_{DS} = 15 V	0.4	1.5	V
Saturation Drain Current	I_{DSS}	V_{DS} = 15 V, V_{GS} = 0 V	0.5	1.5	mA
Gate 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	-	10	nA
Gate Operating Current	$-I_{GSS}$	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	pA
Gate-Source Forward Voltage	$V_{GS(F)}$	I_G = 1 mA, V_{DS} = 0 V	-	0.8	V
Dynamic					
Common-Source Forward Transconductance	g_{fs}	V_{DS} = 15 V, V_{GS} = 0 V, f = 1 kHz	0.7	2.1	mS
Common-Source Output Transconductance	g_{os}		-	12	µS
Drain-Source On-Resistance	$r_{DS(on)}$	V_{DS} = 0 V, V_{GS} = 0 V, f = 1 kHz	-	2000	Ω
Common-Source Input Capacitance	C_{iss}	V_{DS} = 15 V, V_{GS} = 0 V, f = 1 MHz	-	7	pF
Common-Source Reverse Transfer Capacitance	C_{rss}		-	3	pF
Equivalent Input Noise Voltage	$\overline{e_n}$	V_{DS} = 10 V, V_{GS} = 0 V, f = 1 kHz	-	8	nV/√Hz

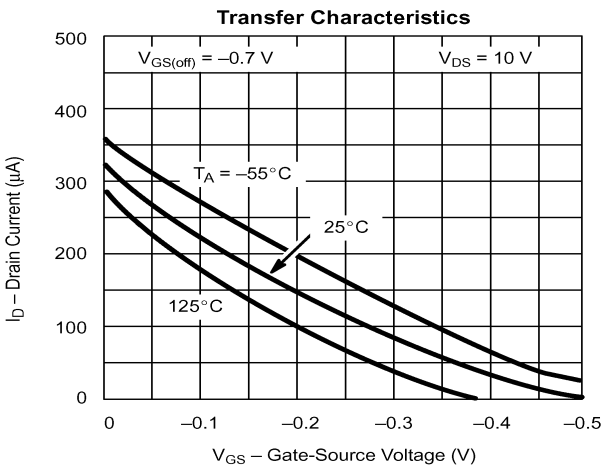
JFET and Operational Amplifier Characteristics

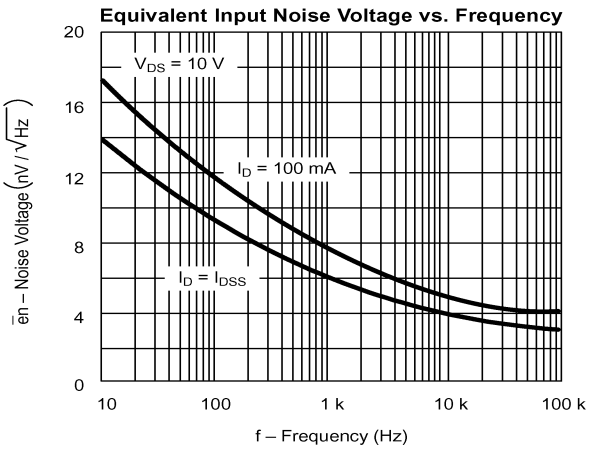
Standard JFET Specifications (T_A = 25 °C unless otherwise noted)

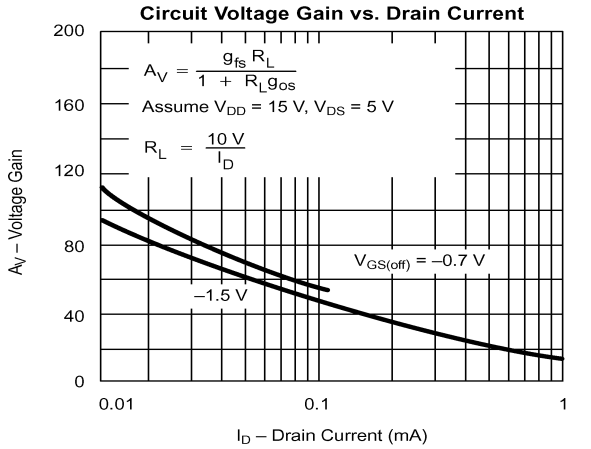












2 Special JFET - design for single and multi color detectors (on request)

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
- Ultra low leakage for improved system accuracy

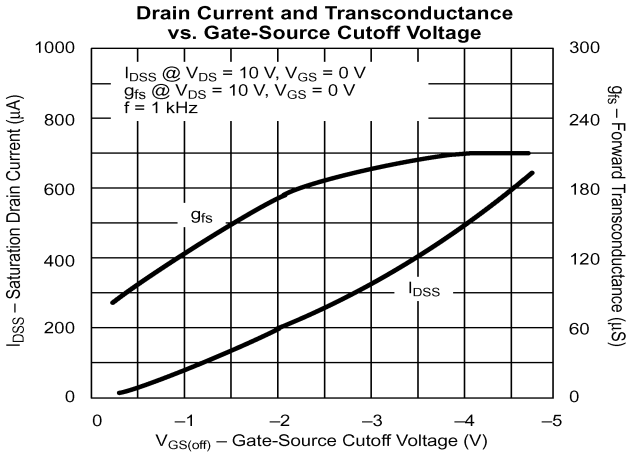
Absolute maximum ratings
- Gate-Source / Gate-Drain voltage: -50 V
- Power dissipation: 50 mW

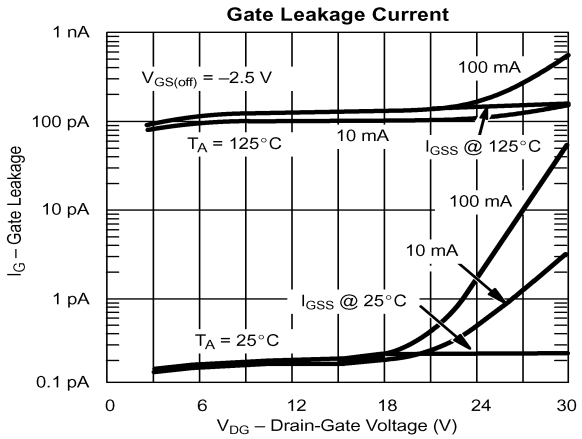
Specifications (T_A = 25°C unless otherwise noted)

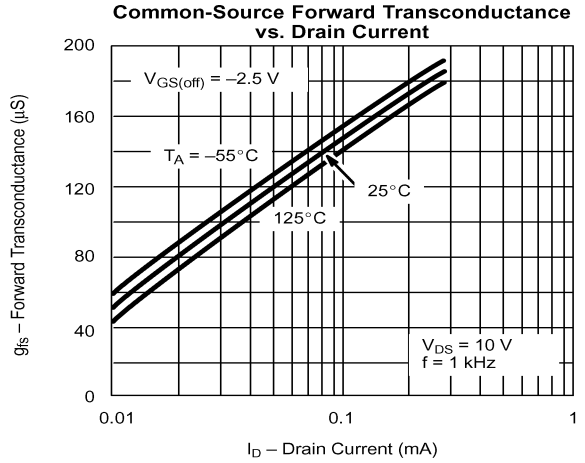
Parameter	Symbol	Test Condition	Limits Min	Limits Max	Unit
Static					
Gate-Source Breakdown Voltage	$-V_{(BR)GSS}$	I_G = -1 µA, V_{DS} = 0 V	40	-	V
Gate-Source Cutoff Voltage	$-V_{GS(off)}$	I_D = 0.1 µA, V_{DS} = 15 V	0.4	1.5	V
Saturation Drain Current	I_{DSS}	V_{DS} = 15 V, V_{GS} = 0 V	30	90	µA
Gate Reverse Current	$-I_{GSS}$	V_{DS} = 0 V, V_{GS} = -30 V, T_A = 25 °C	-	1	pA
		V_{DS} = 0 V, V_{GS} = -30 V, T_A = 150 °C	-	2.5	nA
Gate Operating Current	$-I_{GSS}$	I_D = 0.1 mA, V_{DG} = 15 V	-	0.5	pA
Drain Cutoff Current	$I_{D(off)}$	V_{DS} = 15 V, V_{GS} = -5 V	-	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	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	-	3	pF
Common-Source Reverse Transfer Capacitance	C_{rss}		-	1.5	pF
Equivalent Input Noise Voltage	$\overline{e_n}$	V_{DS} = 10 V, V_{GS} = 0 V, f = 1 kHz	-	20	nV/√Hz

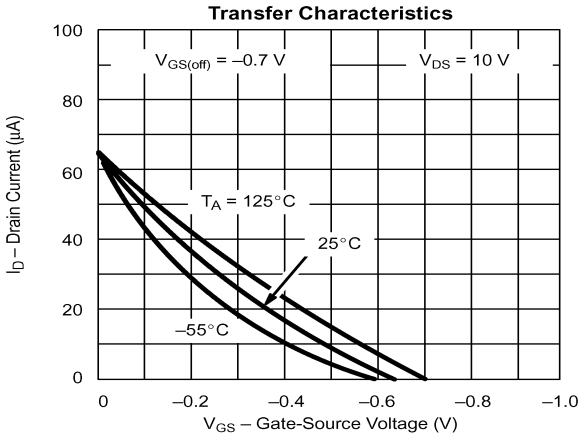
JFET and Operational Amplifier Characteristics

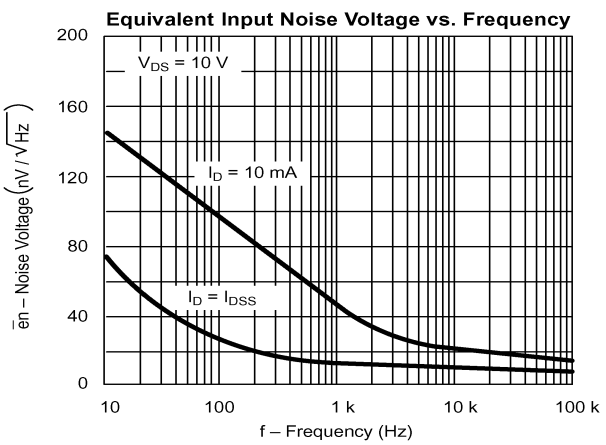
Special JFET Specifications (T_A = 25 °C unless otherwise noted)

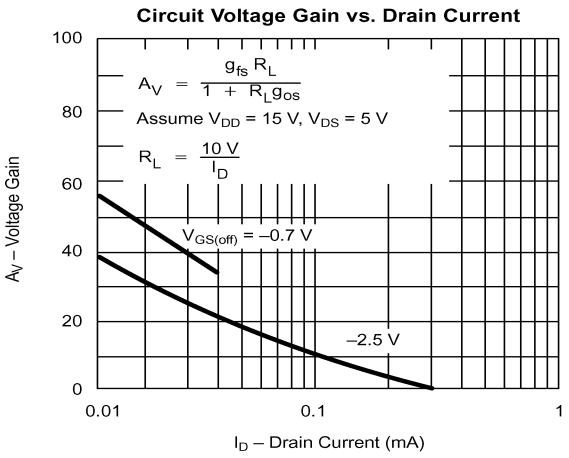












3 OpAmp1 - CMOS Micropower OpAmp for single and multi color detectors

LIE-235 / -241 / -245 / -251

Features

- Single [(4.5 ... 15) V] and split supply [(+3.5 / -1.5 ... ±8) V] operation
- Ultra low supply current [20 µA typical]; ultra low input bias current [10 fA typical]
- Rail-to-Rail output swing; high voltage gain [140 dB]

Absolute maximum ratings

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

Specifications

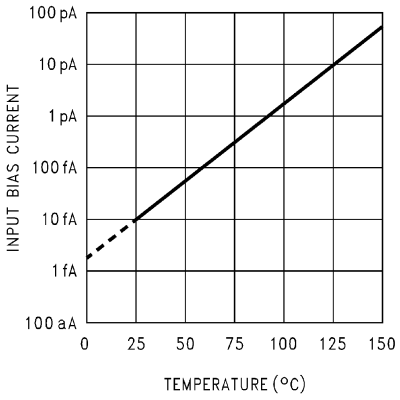
(T_A = 25 °C; V^+ = 5 V; V^- = 0 V; V_{CM} = 1.5 V; V_O = 2.5 V; R_L > 1 MΩ unless otherwise noted)

Parameter	Symbol	Test Condition	Limits			Unit
			Min @ 85 °C	typ	Max @ 85 °C	
Static						
Input Offset Voltage	V_{OS}		-	100	1300	µV
Input Bias Current	I_B		-	0.01	4	pA
Input Offset Current	I_{OS}		-	0.005	2	pA
Common Mode Rejection Ratio	CMRR	0.0V ≤ V_{CM} ≤ 12.0 V V^+ = 15 V	63	85	-	dB
Input Common-Mode Voltage Range	V_{CM}	V^+ = 5 V ... 15 V	V^+- 2.5	V^+- 1.9	-	V [MAX]
		for CMRR ≥ 60 dB	-	-0.4	0.0	V [MIN]
Large Signal Voltage Gain	A_V	R_L = 100 kΩ	200	4000	-	V/mV [Sourcing]
			60	3000	-	V/mV [Sinking]
		R_L = 25 kΩ	80	3000	-	V/mV [Sourcing]
			35	2000	-	V/mV [Sinking]
Output Swing	V_O	V^+ = 5 V	4.850	4.990	-	V [MAX]
		R_L = 25 kΩ to 2.5 V	-	0.010	0.150	V [MIN]
		V^+ = 15 V	14.925	14.990	-	V [MAX]
		R_L = 100 kΩ to 7.5 V	-	0.010	0.075	V [MIN]
Supply Current	I_S	V^+ = +5 V, V_O = 2.5 V	-	20	40	µA
		V^+ = +15 V, V_O = 7.5 V	-	24	48	µA
Dynamic						
Slew Rate	SR	V+ = 15 V; 10 V step voltage follower	7	35	-	V/ms
Gain-Bandwidth Product	SR		-	100	-	kHz
Phase Margin	GBW		-	50	-	Deg
Equivalent Input Noise Voltage	θ_m	f = 1 kHz	-	83	-	nV/√Hz
Equivalent Input Noise Current	$\overline{e_n}$	f = 1 kHz	-	0.2	-	fA/√Hz

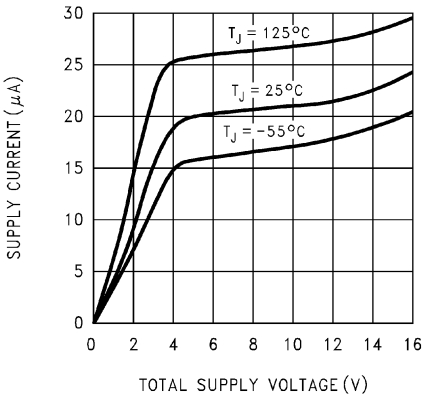
JFET and Operational Amplifier Characteristics

OpAmp1 Specifications (T_A = 25 °C; V^+ = 5 V; V^- = 0 V; V_{CM} = 1,5 V; V_O = 2,5 V; R_L > 1 MΩ unless otherwise noted)

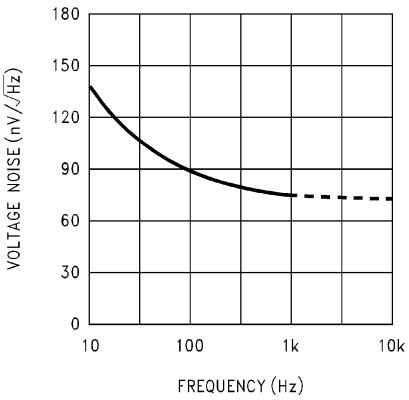
Input Bias Current vs Temperature



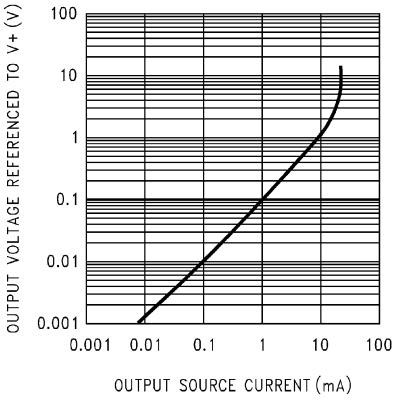
Supply Current vs Supply Voltage



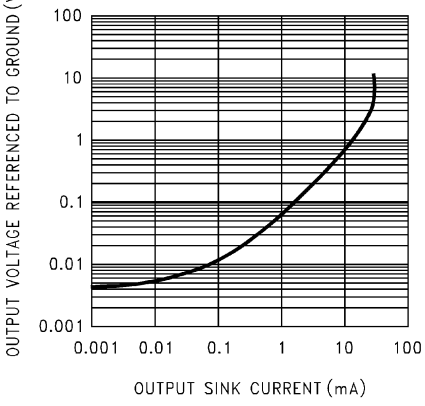
Input Voltage Noise vs Frequency



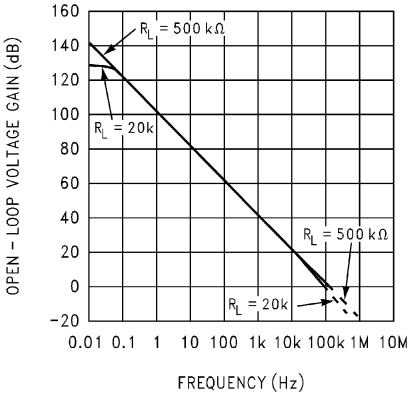
Output Characteristics Sourcing Current



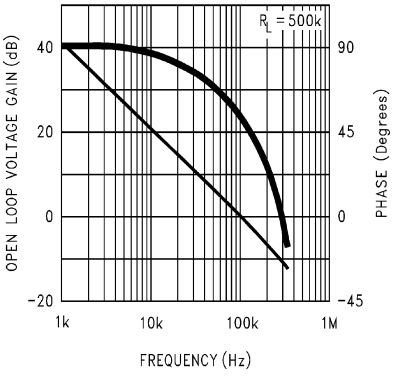
Output Characteristics Sinking Current



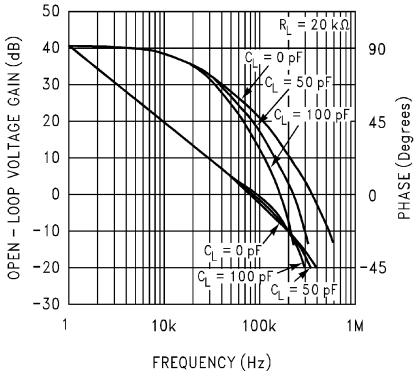
Open Loop Frequency Response



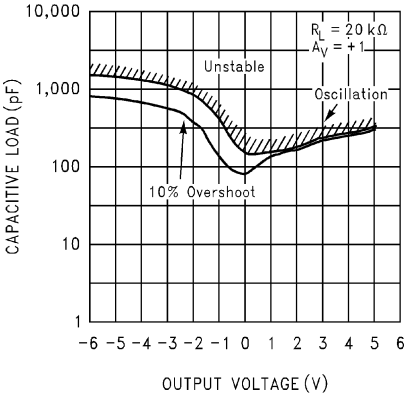
Gain and Phase Response vs Temperature (−55˚C to +125˚C)



Gain and Phase Response vs Capacitive Load with R_L = 20 kΩ



Stability vs Capacitive Load, R_L = 20 kΩ



4 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

Features

- Single [(4.5 ... 16) V] and split supply [(±2.2 ... 8) V] operation
- Low supply current [70 µA typical]; very low input bias current [100 fA typical]
- Rail-to-Rail output swing; high voltage gain [120 dB]

Absolute maximum ratings

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

Specifications

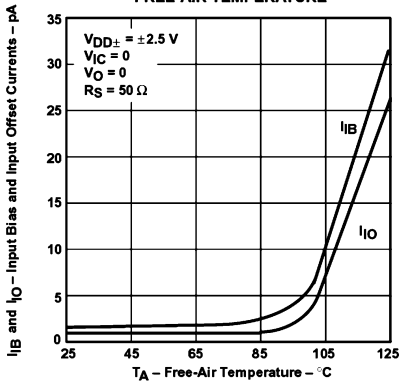
(T_A = 25 °C; V^+ = 5 V; V^- = 0 V; V_{CM} = 2.5 V; V_O = 2.5 V; R_L > 1 MΩ unless otherwise noted)

Parameter	Symbol	Test Condition	Limits			Unit
			Min @ 85°C	typ	Max @ 85°C	
Static						
Input Offset Voltage	V_{OS}		-	200	1500	µV
Input Bias Current	I_B		-	0.1	10	pA
Input Offset Current	I_{OS}		-	0.05	5	pA
Common Mode Rejection Ratio	CMRR	0.0 V ≤ V_{CM} ≤ 2.7 V	70	83	-	dB
Input Common-Mode Voltage Range	V_{CM}		V^+ -1.0	V^+ -0.8	-	V [MAX]
				-0.3	0.0	V [MIN]
Large Signal Voltage Gain	A_V	R_L = 1 MΩ	350	1700	-	V/mV
		R_L = 100 kΩ	100	350	-	V/mV
Output Swing	V_O	V^+ = 5 V	4.800	4.880	-	V [MAX]
		R_L = 100 kΩ to 2.5 V	-	0.090	0.150	V [MIN]
		V^+ = 10 V	9.700	9.980		V [MAX]
		R_L = 1 MΩ to 5.0 V	-	0.010	0.150	V [MIN]
Supply Current	I_S	V^+ = +5 V, V_O = 2.5 V	-	70	150	µA
		V^+ = +10 V, V_O = 5.0 V	-	80	150	µA
Dynamic						
Slew Rate	SR	1.5 ... 3.5 V step voltage follower	50	120	-	V/ms
Gain-Bandwidth Product	GBW		-	200	-	kHz
Phase Margin	θ_m		-	63	-	Deg
Equivalent Input Noise Voltage	$\overline{e_n}$	f = 1 kHz	-	19	-	nV/√Hz
Equivalent Input Noise Current	$\overline{i_n}$	f = 1 kHz	-	0.6	-	fA/√Hz

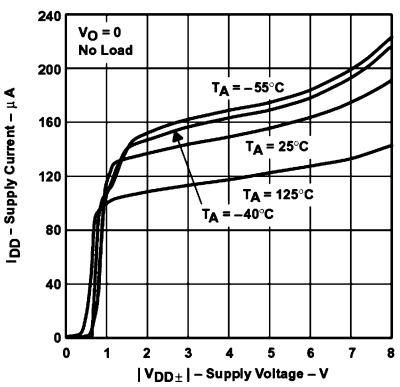
JFET and Operational Amplifier Characteristics

OpAmp2 Specifications (T_A = 25 °C; V^+ = 5 V; V^- = 0 V; V_{CM} = 2,5 V; V_O = 2,5 V; R_L > 1 MΩ unless otherwise noted)

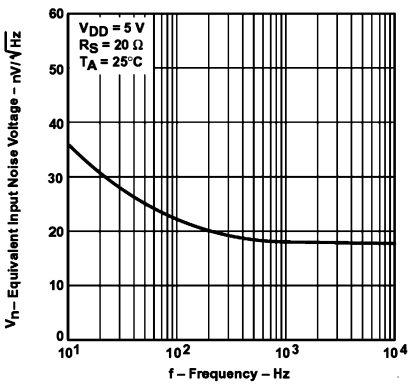
INPUT BIAS AND INPUT OFFSET CURRENTS† vs FREE-AIR TEMPERATURE



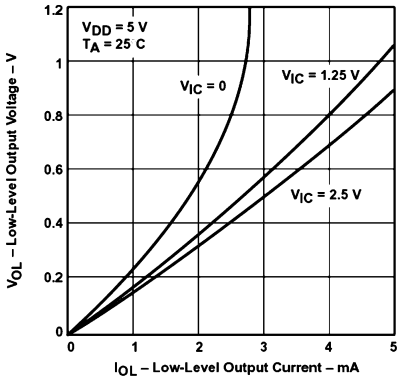
SUPPLY CURRENT† vs SUPPLY VOLTAGE



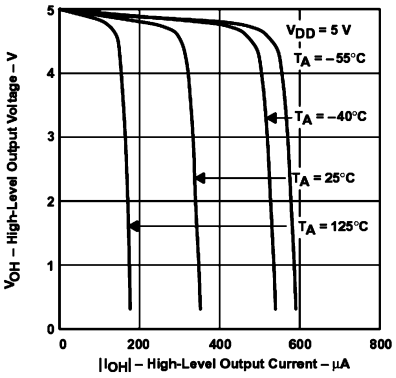
EQUIVALENT INPUT NOISE VOLTAGE† vs FREQUENCY



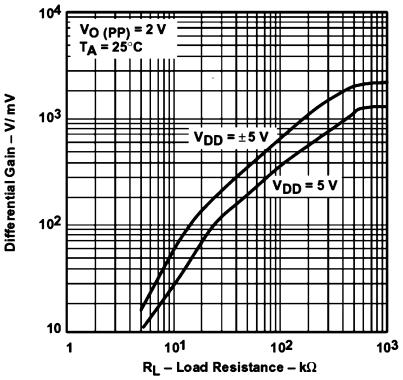
LOW-LEVEL OUTPUT VOLTAGE‡ vs LOW-LEVEL OUTPUT CURRENT



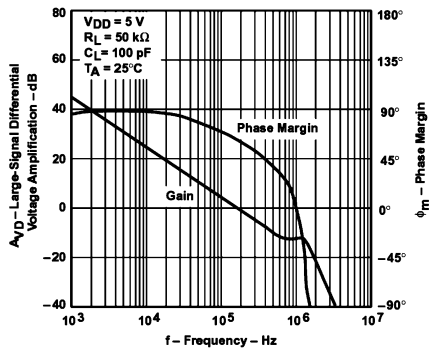
HIGH-LEVEL OUTPUT VOLTAGE†‡ vs HIGH-LEVEL OUTPUT CURRENT



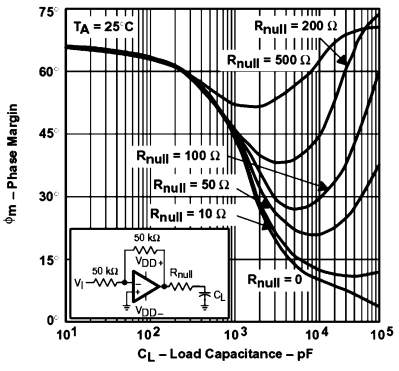
DIFFERENTIAL GAIN‡ vs LOAD RESISTANCE



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



PHASE MARGIN vs LOAD CAPACITANCE



GAIN MARGIN vs LOAD CAPACITANCE