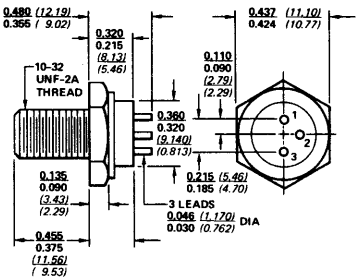
N-CHANNEL SILICON JUNCTION FIELD-EFFECT TRANSISTOR

FOR POWER AMPLIFIERS AND SWITCHES

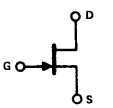
- **High Power Capability – 10 W**
- **High g_{fs} – 80,000 μmhos Minimum**
- **High I_{DSS} – 300 mA Minimum**
- **No Thermal Runaway**
- **No Secondary Breakdown**



ALL DIMENSIONS IN INCHES.
(ALL DIMENSIONS IN MILLIMETERS.)

BOTTOM VIEW

TO-60



PIN	OUT
1	S
2	D
3	G

ABSOLUTE MAXIMUM RATINGS (25°C)

Gate-Drain and Gate-Source Voltage ..... -25 V
Drain Current ..... 900 mA
Total Device Dissipation at 25°C
Case Temperature (Note 2) ..... 10 W
Storage Temperature Range ..... -65 to +150°C
Operating Junction Temperature Range .... -55 to +150°C

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

		Characteristic		Min	Max	Unit	Test Conditions	
1	STATIC	I_{GSS}	Gate Reverse Current		-1	nA	V_{GS} = -15 V, V_{DS} = 0	
2					-1	μA		150°C
3		$I_{D(off)}$	Drain Cutoff Current		1	nA	V_{DS} = 5 V, V_{GS} = -10 V	
4					1	μA		150°C
5		BV_{GSS}	Gate-Source Breakdown Voltage	-25		V	I_G = -1 μA, V_{DS} = 0	
6		$V_{GS(off)}$	Gate-Source Cutoff Voltage	-3.5	-8	V	V_{DS} = 10 V, I_D = 1 mA	
7		I_{DSS}	Saturation Drain Current (Note 1)	300	900	mA	V_{DS} = 10 V, V_{GS} = 0	
8		$r_{DS(on)}$	Static Drain-Source On Resistance		10	Ω	V_{GS} = 0, I_D = 10 mA	
9	DYN	g_{fs}	Common-Source Forward Transconductance (Note 3)	80,000	200,000	μmho	V_{DS} = 10 V, V_{GS} = 0	f = 1 kHz
10		C_{iss}	Common-Source Input Capacitance		35	pF	V_{DS} = 0 = -10 V	f = 1 MHz
11		C_{rss}	Common-Source Reverse Transfer Capacitance		15		V_{DS} = 0, V_{GS} = -10 V	f = 1 MHz

NI

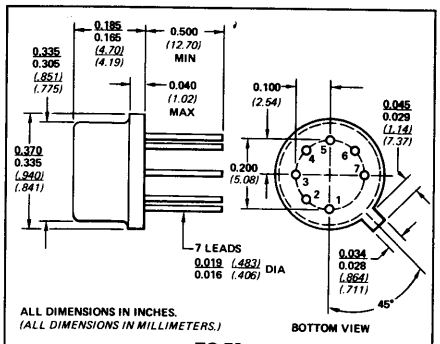
NOTES:
1. Pulse test duration = 2 ms.
2. Derate linearly to 150°C case temperature at rate of 80 mW/°C.

Performance Curves NZF
See Page 4-49

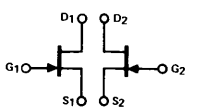
MATCHED DUAL N-CHANNEL SILICON JUNCTION FIELD-EFFECT TRANSISTOR

MATCHED FET PAIRS FOR WIDEBAND DIFFERENTIAL AMPLIFIERS

- g_{fs} greater than 5000 μmho from dc to 100 MHz
- Matched V_{GS}, g_{fs} and g_{os}



TO-78



PIN	OUT	PIN	OUT
1	S_1	4	C
2	D_1	5	S_2
3	G_1	6	D_2
		7	G_2

ABSOLUTE MAXIMUM RATINGS (25°C)

Gate-Drain or Gate-Source Voltage ..... -25 V
Gate Current ..... 50 mA
Device Dissipation (Each Side), T_A = 85°C
(Derate 3.85 mW/°C) ..... 250 mW
Total Device Dissipation, T_A = 85°C
(Derate 7.7 mW/°C) ..... 500 mW
Storage Temperature Range ..... -65 to +150°C

ELECTRICAL CHARACTERISTICS (25° unless otherwise noted)

		Characteristic		Min	Max	Unit	Test Conditions	
1	STATIC	I_{GSS}	Gate Reverse Current		-100	pA	V_{GS} = 15 V, V_{DS} = 0	
2					-250	nA		150°C
3		BV_{GSS}	Gate-Source Breakdown Voltage	-25		V	I_G = -1 μA, V_{DS} = 0	
4		$V_{GS(off)}$	Gate-Source Cutoff Voltage	-1	-5		V_{DS} = 10 V, I_D = 1 nA	
5		I_{DSS}	Saturation Drain Current (Note 1)	5	40	mA	V_{DS} = 10 V, V_{GS} = 0	
6	DYNAMIC	g_{fs}	Common-Source Forward Transconductance	5000	10,000	μmho	V_{DS} = 10 V, I_D = 5 mA	f = 1 kHz
7		g_{fs}	Common-Source Forward Transconductance	5000	10,000		V_{DG} = 10 V, I_D = 5 mA	f = 100 MHz
8		g_{os}	Common-Source Output Conductance		150		V_{DS} = 10 V, I_D = 5 mA	f = 1 kHz
9		g_{oss}	Common-Source Output Conductance		150		V_{DG} = 10 V, I_D = 5 mA	f = 100 MHz
10		C_{iss}	Common-Source Input Capacitance		5	pF		f = 1 MHz
11		C_{rss}	Common-Source Reverse Transfer Capacitance		1.2			
12		$\overline{e_n}$	Equivalent Input Noise Voltage		30	$\frac{nV}{\sqrt{Hz}}$		f = 10 kHz
13	MATCHING	$\frlap{\frac{I_{DSS1}}{I_{DSS2}}}$	Drain Current Ratio at Zero Gate Voltage (Note 1)	0.85	1		V_{DS} = 10 V, V_{GS} = 0	
14		$\lvert V_{GS1}-V_{GS2}\rvert$	Differential Gate-Source Voltage		100	mV	V_{DG} = 10 V, I_D = 5 mA	
15		$\frlap{\frac{g_{fs1}}{g_{fs2}}}$	Transconductance Ratio	0.85	1			f = 1 kHz
16		$\lvert g_{os1}-g_{os2}\rvert$	Differential Output Conductance		20	μmho		

NOTE:
1. Pulse test required, pulse width = 300 μs, duty cycle ≤ 30%.

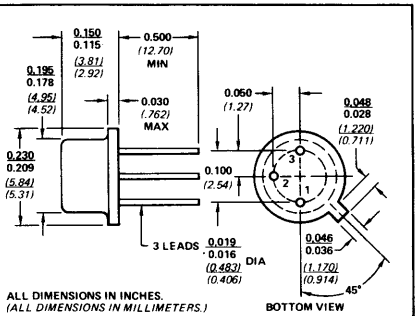
NZF

Performance Curves NVA
See Page 4-48

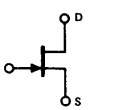
N-CHANNEL SILICON JUNCTION FIELD-EFFECT TRANSISTORS

FOR ANALOG SWITCHES, COMMUTATORS, AND CHOPPERS

- Low ON Resistance < 2.5 Ohms on U290
- $I_{D(off)}$ < 1 nA



TO-52



PIN	OUT
1	S
2	D
3	G,C

ABSOLUTE MAXIMUM RATINGS (25°C)

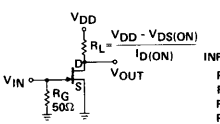
Reverse Gate-Drain or Gate-Source Voltage ..... -30 V
Gate Current ..... 100 mA
Drain Current ..... 1.5 A
Total Device Dissipation at 25°C
Free-Air Temperature (Note 2) ..... 300 mW
Storage Temperature Range ..... -65 to +150°C
Lead Temperature
(1/16" from case for 10 seconds) ..... 300°C

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

		Characteristic		U290 Min	U290 Max	U291 Min	U291 Max	Unit	Test Conditions	
1	STATIC	I_{GSS}	Gate Reverse Current		-1		-1	nA	V_{GS} = -15 V, V_{DS} = 0	
2					-1		-1	μA		150°C
3		BV_{GSS}	Gate-Source Breakdown Voltage	-30		-30		V	I_G = -1 μA, V_{DS} = 0	
4		$V_{GS(off)}$	Gate-Source Cutoff Voltage	-4	-10	-1.5	-4.5		V_{DS} = 15 V, I_D = 3 nA	
5		$I_{D(off)}$	Drain Cutoff Current		1		1	nA	V_{DS} = 5 V, V_{GS} = -10 V	
6					1		1	μA		150°C
7		$V_{DS(on)}$	Drain-Source ON Voltage		25		70	mV	V_{GS} = 0, I_D = 10 mA	
8		I_{DSS}	Saturation Drain Current (Note 2)	500		200		mA	V_{DS} = 10 V, V_{GS} = 0	
9		$r_{DS(on)}$	Static Drain-Source ON Resistance	1.0	2.5	2	7	Ω	V_{GS} = 0 V, I_D = 10 mA	
10	DYNAMIC	$r_{ds(on)}$	Drain-Source ON Resistance	1.0	2.5	2	7	Ω	V_{GS} = 0, I_D = 0	f = 1 kHz
11		C_{SGO}	Source-Gate OFF Capacitance		30		30	pF	V_{SG} = 15 V, I_D = 0	f = 1 MHz
12		C_{DGO}	Drain-Gate OFF Capacitance		30		30		V_{DG} = 15 V, I_S = 0	
13		$C_{SG}+C_{DG}$	Source Gate Plus Drain Gate On Capacitance		160		160		V_{DS} = 0, V_{GS} = 0	
14	SW	t_d	Turn-ON Delay Time		15		15	ns	V_{DD} = 1.5 V, $I_{D(on)}$ = 30 mA, $V_{GS(on)}$ = 0, $V_{GS(off)}$ = -12 V (U290) - 7 V (U291)	
15		t_r	Rise Time		20		20			
16		t_{off} *	Turn-OFF Time		15		15			
17		t_f	Fall Time		20		20			

NOTES:

1. Derate linearly at the rate of 2.3 mW/°C.
2. Pulse test required pulsewidth 300 μs, duty cycle ≤ 3%.



INPUT PULSE
RISE TIME 1 ns
FALL TIME 1 ns
PULSE WIDTH 200 ns
PULSE RATE 550 pps

SAMPLING SCOPE
RISE TIME 0.4 ns
INPUT RESISTANCE 10 M
INPUT CAPACITANCE 1.5 pF

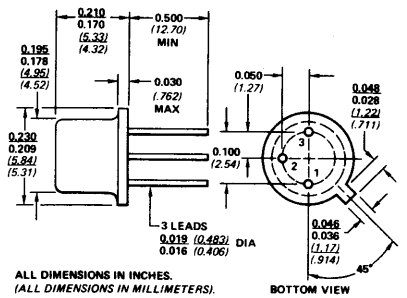
NVA

Performance Curves PS
See Page 4-61

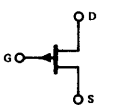
P-CHANNEL SILICON JUNCTION FIELD-EFFECT TRANSISTORS

FOR INDUSTRIAL AND CONSUMER AMPLIFIER APPLICATIONS

- High g_{fs}, 12,000 μmhos typical at $V_{GS} = 0$
- $I_{D(off)} < 100$ pA
- Low Noise, 40 nV/ $\sqrt{Hz}$ at 1 kHz



TO-18



PIN	OUT
1	S
2	G,C
3	D

*ABSOLUTE MAXIMUM RATINGS (25°C)

Reverse Gate-Drain or Gate-Source Voltage (Note 1) ..... 40 V
Gate Current ..... 50 mA
Total Device Dissipation, Free-Air (Derate 2.4 mW/°C) ..... 300 mW
Storage Temperature Range ..... -65 to +150°C
Lead Temperature (1/16" from case for 60 seconds) ..... 300°C

*ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

		Characteristic		U300 Min	U300 Max	U301 Min	U301 Max	Unit	Test Conditions		
1	STATIC	I_{GSS}	Gate Reverse Current		100		100	pA	$V_{GS} = 20$ V, $V_{DS} = 0$		
2		$I_{D(off)}$	Drain Cutoff Current		-100		-100		$V_{DS} = -15$ V, $V_{GS} = 12$ V		
3		BV_{GSS}	Gate-Source Breakdown Voltage	40		40		V	$I_G = 1.0$ μA, $V_{DS} = 0$		
4		$V_{GS(off)}$	Gate-Source Cutoff Voltage	5.0	10.0	2.5	6.0		$V_{DS} = -15$ V, $I_D = -1$ nA		
5		I_{DSS}	Saturation Drain Current	-30	-90	-15	-60	mA	$V_{DS} = -15$ V, $V_{GS} = 0$		
6		$r_{DS(on)}$	Static Drain-Source ON Resistance		60		100	Ω	$V_{GS} = 0$, $I_D = -1$ mA		
7	DYNAMIC	g_{fs}	Common-Source Forward Transconductance	8000	12,000			μmho	$V_{DS} = -15$ V	$I_D = -15$ mA	f = 1 kHz
8						7000	11,000			$I_D = -7$ mA	
9		C_{iss}	Common-Source Input Capacitance		20			pF		$I_D = -15$ mA	f = 1 MHz
10							20			$I_D = -7$ mA	
11		C_{rss}	Common-Source Reverse Transfer Capacitance		5.5					$I_D = -15$ mA	
12							5.5			$I_D = -7$ mA	
13		$\bar{e}_n$	Short-Circuit Equivalent Input Spot Noise Voltage		40			$\frac{nV}{\sqrt{Hz}}$		$I_D = -15$ mA	f = 1 kHz
14							40			$I_D = -7$ mA	

NOTES:
1. Due to symmetrical geometry these units may be operated with source and drain leads interchanged.
2. Pulse test duration = 2 ms.

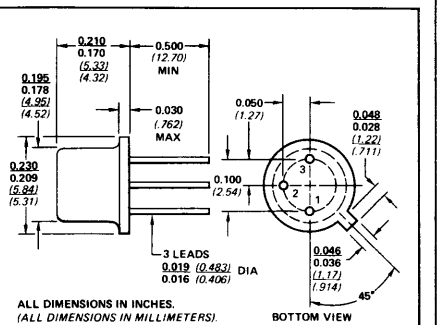
PS

Performance Curves PS
See Page 4-61

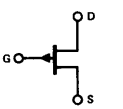
P-CHANNEL SILICON JUNCTION FIELD-EFFECT TRANSISTORS

FOR ANALOG SWITCHES, COMMUTATORS AND CHOPPERS

- Replacement for 2N5114, 2N5115, and 2N5116 in applications where switching times are not critical
- $r_{DS(on)} < 85$ ohms on U304
- $I_{D(off)} < 500$ pA



TO-18



PIN	OUT
1	S
2	G,C
3	D

ABSOLUTE MAXIMUM RATINGS (25°C)

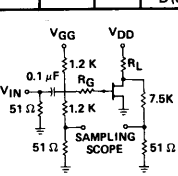
Reverse Gate-Drain or Gate-Source Voltage ..... 30 V
Gate Current ..... 50 mA
Total Device Dissipation, Free-Air
(Derate 2.8 mW/°C) ..... 350 mW
Storage Temperature Range ..... -65 to +150°C
Lead Temperature
(1/16" from case for 60 seconds) ..... 300°C

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

		Characteristic		U304 Min	U304 Max	U305 Min	U305 Max	U306 Min	U306 Max	Unit	Test Conditions	
1	STATIC	I_{GSS}	Gate Reverse Current		500		500		500	pA	V_{GS} = 20 V, V_{DS} = 0	
2					1.0		1.0		1.0	μA		150°C
3		BV_{GSS}	Gate-Source Breakdown Voltage	30		30		30		V	I_G = 1 μA, V_{DS} = 0	
4		$V_{GS(off)}$	Gate-Source Cutoff Voltage	5	10	3	6	1	4		V_{DS} = -15 V, I_D = -1 μA	
5		$V_{DS(on)}$	Drain-Source ON Voltage		-1.3		-0.8		-0.6		V_{GS} = 0 I_D = -15 mA = U304 / - 7 mA = U305 / - 3 mA = U306	
6		I_{DSS}	Saturation Drain Current	-30	-90	-15	-60	-5	-25	mA	V_{DS} = -15 V, V_{GS} = 0	
7		$I_{D(off)}$	Drain Cutoff Current		-500		-500		-500	pA	V_{DS} = -15 V, V_{GS} = 12 V = U304 / 7 V = U305 / 5 V = U306	
8					-1.0		-1.0		-1.0	μA		150°C
9		$r_{DS(on)}$	Static Drain-Source ON Resistance		85		110		175	Ω	V_{GS} = 0, I_D = -1 mA	
10	DYN	$r_{ds(on)}$	Drain-Source ON Resistance		85		110		175	Ω	V_{GS} = 0, I_D = 0	f = 1 kHz
11	DYN	C_{iss}	Common-Source Input Capacitance		27		27		27	pF	V_{DS} = -15 V, V_{GS} = 0	f = 1 MHz
12	DYN	C_{rss}	Common-Source Reverse Transfer Capacitance		7		7		7		V_{DS} = 0, V_{GS} = 12 V = U304 / 7 V = U305 / 5 V = U306	

	SWITCH									ns		U304	U305	U306
13	SWITCH	t_d	Turn-ON Delay Time		20		25		25		V_{DD}	-10 V	-6 V	-6 V
14	SWITCH	t_r	Rise Time		15		25		35		V_{GG}	20 V	12 V	8 V
15	SWITCH	t_{off}	Turn-OFF Delay Time		10		15		20		R_L	430 Ω	910 Ω	2 kΩ
16	SWITCH	t_f	Fall Time		25		40		60		R_G	100 Ω	220 Ω	390 Ω
											$I_{D(on)}$	-15 mA	-7 mA	-3 mA

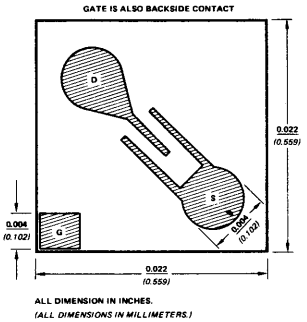
*Due to symmetrical geometry these units may be operated with source and drain leads interchanged.



PS

INPUT PULSE
RISE TIME < 1 ns
FALL TIME < 1 ns
PULSE WIDTH 100 ns
REPETITION RATE 1 MHz

SAMPLING SCOPE
RISE TIME 0.4 ns
INPUT RESISTANCE 10 MΩ
INPUT CAPACITANCE 1.5 pF



N-CHANNEL DEPLETION MODE SILICON JUNCTION FIELD-EFFECT TRANSISTOR

APPLICATIONS

- **Low Power General Purpose Amplifiers where a Combination of Low Gate Leakage and Noise Voltage are Required**

PRINCIPAL DEVICES

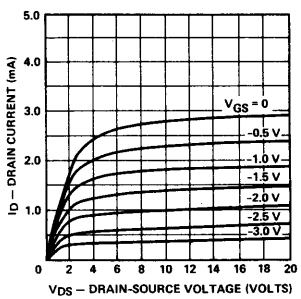
2N3066-71 2N3089-89A
2N3365-67 2N3452-57
2N5647-49

PACKAGE TYPES

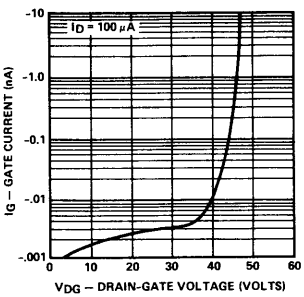
TO-18 TO-72

PERFORMANCE CURVES (25°C unless otherwise noted)

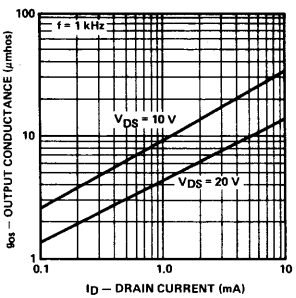
Output Characteristic



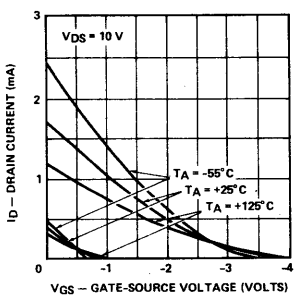
Gate Operating Current vs Drain-Gate Voltage



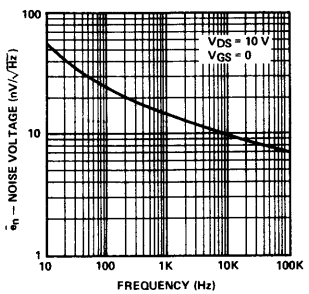
Common-Source Output Conductance vs Drain Current



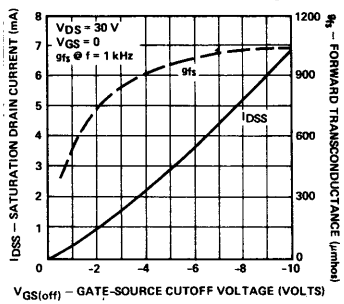
Transfer Characteristics



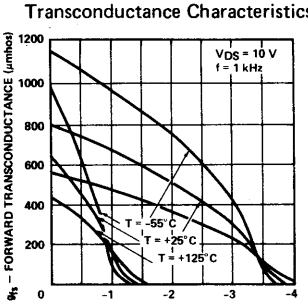
Equivalent Input Noise Voltage vs Frequency



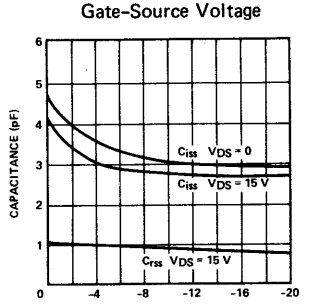
Drain Current & Transconductance vs Gate-Source Cutoff Voltage



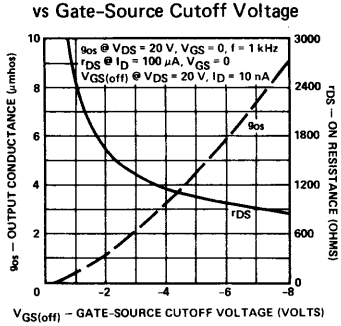
Transconductance Characteristics

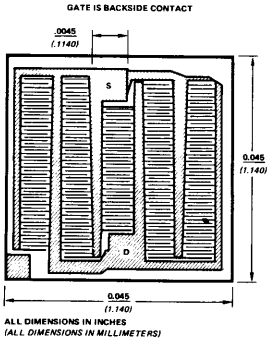


Common-Source Capacitance vs Gate-Source Voltage



ON Resistance & Output Conductance vs Gate-Source Cutoff Voltage





N-CHANNEL DEPLETION MODE JUNCTION FIELD-EFFECT TRANSISTOR

APPLICATIONS

- Ultra Low ON Resistance Switches
- High Gain Audio or Power Amplifiers

PRINCIPAL DEVICES

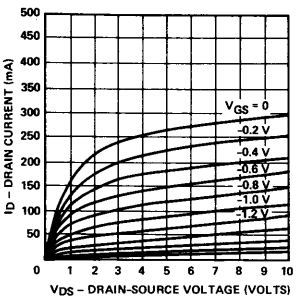
U290-91, E105-07

PACKAGE TYPES

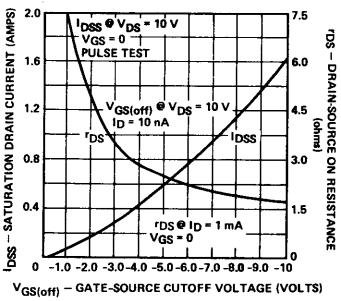
TO-39, TO-52, TO-106

PERFORMANCE CURVES (25°C unless otherwise noted)

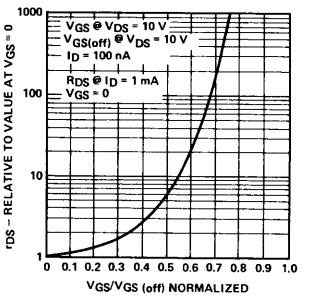
Output Characteristic



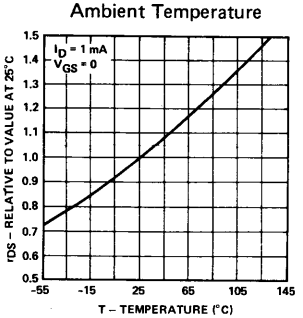
Saturation Drain Current and Drain-Source 'ON' Resistance vs Gate-Source Cutoff Voltage



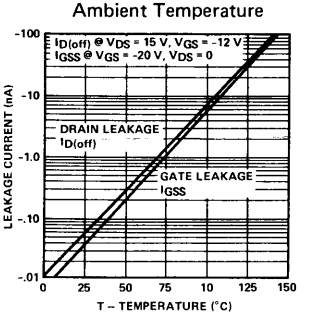
Drain-Source 'ON' Resistance vs Gate-Source Voltage



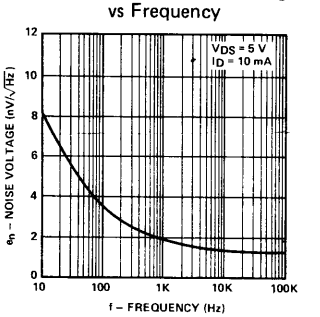
Drain-Source 'ON' Resistance vs Ambient Temperature



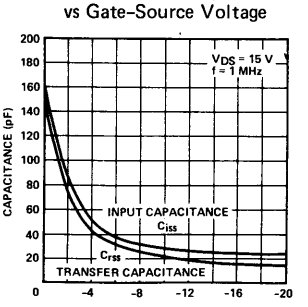
Leakage Currents vs Ambient Temperature

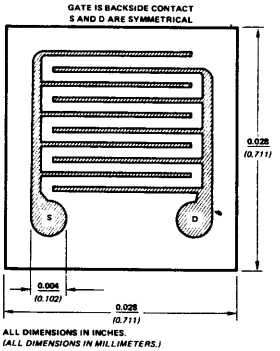


Equivalent Input Noise Voltage vs vs Frequency



Common-Source Capacitance vs Gate-Source Voltage





P-CHANNEL DEPLETION MODE SILICON JUNCTION FIELD-EFFECT TRANSISTOR

APPLICATIONS

- High g_{fs} and Low Noise (10 to 40 nV at 1 kHz) Suitable for General Purpose Amplifiers
- High g_{fs}, Low ON Resistance and Capacitance and Low Switching Aperture Times Allows Operation in Analog Switching Applications

PRINCIPAL DEVICES

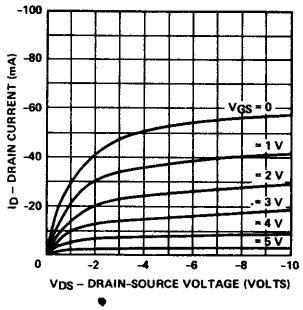
2N5114-16, U300-01, U304-06, E174-6, E270-1

PACKAGE TYPES:

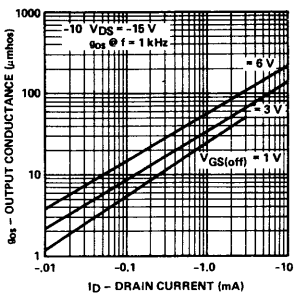
TO-18, TO106

PERFORMANCE CURVES (25°C unless otherwise noted)

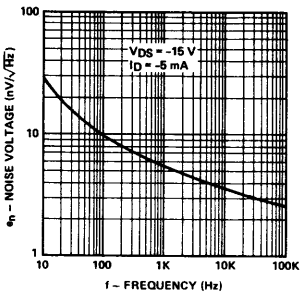
Output Characteristic



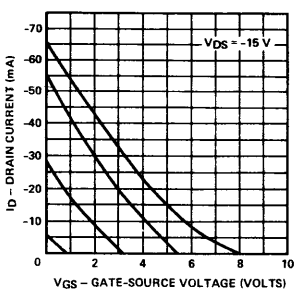
Common-Source Output Conductance vs Drain Current



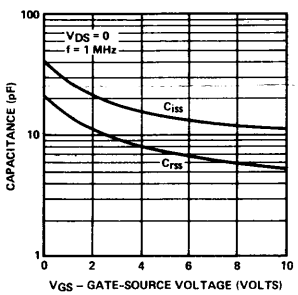
Equivalent Input Noise Voltage vs Frequency



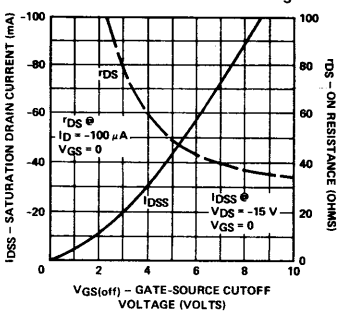
Transfer Characteristics



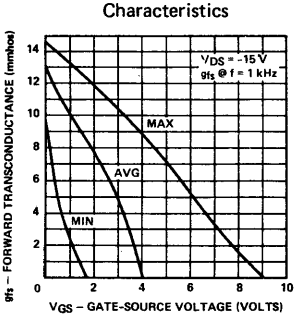
Common-Source Capacitance vs Gate-Source Voltage



Saturation Drain Current and Drain-Source ON Resistance vs. Gate-Source Cutoff Voltage



Transconductance Characteristics



Gate Operating Current vs Drain-Gate Voltage