

3N204, 3N205, 3N206**Silicon Dual Insulated-Gate
Field-Effect Transistors**

With Integrated Gate-Protection Circuits for VHF TV
Applications

3N204 — RF Amplifier 3N205 — Mixer
3N206 — TV IF Amplifier

Features:

- Low C_{iss} — 0.03 pF max.
- High $|Y_{fs}|$ — 14 mmho typ. for 3N204 and 3N205
- Integrated gate-protection diodes

The RCA-3N204, 3N205, and 3N206 are n-channel silicon, depletion type, dual-insulated gate, field-effect transistors intended for vhf TV applications. Integrated back-to-back diodes protect the gates from excessive input voltages.

The 3N204 is intended for use in vhf rf amplifiers and delivers linear, low-noise amplification. Its extremely low feedback

capacitance allows high-gain stable operation without neutralization. The 3N205 is specified for low noise vhf mixer applications. The 3N206 is intended for use in tuned high-frequency amplifiers such as TV if strips.

Maximum Ratings, Absolute-Maximum Values at $T_A = 25^\circ$:

* DRAIN-TO-GATE No. 1 VOLTAGE.....	30 V
* DRAIN-TO-GATE No. 2 VOLTAGE.....	30 V
* DRAIN-TO-SOURCE VOLTAGE.....	25 V
* GATE No.1-TERMINAL FORWARD CURRENT [▲]	10 mA
* GATE No.2-TERMINAL FORWARD CURRENT [▲]	10 mA
* GATE No.1-TERMINAL REVERSE CURRENT.....	-10 mA
* GATE No.2-TERMINAL REVERSE CURRENT.....	-10 mA
* CONTINUOUS DRAIN CURRENT.....	50 mA
* DEVICE DISSIPATION:	
Up to $T_A = 25^\circ\text{C}$	360 mW
Above $T_A = 25^\circ\text{C}$ derate linearly.....	2.4 mW/ $^\circ\text{C}$
Up to $T_C = 25^\circ\text{C}$	1.2 W
Above $T_C = 25^\circ\text{C}$ derate linearly.....	.8 mW/ $^\circ\text{C}$
* AMBIENT TEMPERATURE RANGE:	
Operating.....	-65 to +175 $^\circ\text{C}$
Storage.....	-65 to +200 $^\circ\text{C}$
* LEAD TEMPERATURE (During Soldering):	
At distance 1/16 $\pm$ 1/32 inch (1.59 $\pm$ 0.79 mm) from case for 10 seconds max.....	+300 $^\circ\text{C}$

[▲] Forward gate-terminal current is the current into a gate terminal with a forward-gate-to-source voltage applied. This voltage is of such polarity that an increase in its magnitude causes the channel resistance to decrease.

* In accordance with JEDEC registration data format (JS-9 RDF-19B).

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ELECTRICAL CHARACTERISTICS, At $T_A = 25^\circ\text{C}$ (unless otherwise specified)

CHARACTERISTIC	TEST CONDITIONS	LIMITS		UNITS
		MIN.	MAX.	
* Drain-to-Source Breakdown Voltage, $V_{(BR)DS}$	$I_D = 10\mu\text{A}$, $V_{G1S} = V_{G2S} = -5\text{V}$	25	—	V
* Gate No.1-to-Source Forward Breakdown Voltage, $V_{(BR)G1SSF1}$	$I_{G1} = 10\text{mA}$, $V_{G2S} = V_{DS} = 0$	6	30	V
* Gate No.1-to-Source Reverse Breakdown Voltage, $V_{(BR)G1SSR1}$	$I_{G1} = -10\text{mA}$, $V_{G2S} = V_{DS} = 0$	-6	-30	V
* Gate No.2-to-Source Forward Breakdown Voltage, $V_{(BR)G2SSF1}$	$I_{G2} = 10\text{mA}$, $V_{G1S} = V_{DS} = 0$	6	30	V
* Gate No.2-to-Source Reverse Breakdown Voltage, $V_{(BR)G2SSR1}$	$I_{G2} = -10\text{mA}$, $V_{G1S} = V_{DS} = 0$	-6	-30	V
* Gate No.1-Terminal Forward Current, I_{G1SSF}	$V_{G1S} = 5\text{V}$, $V_{G2S} = V_{DS} = 0$	—	10	nA
* Gate No.1-Terminal Reverse Current, I_{G1SSR}	$V_{G1S} = -5\text{V}$, $V_{G2S} = V_{DS} = 0$	$T_A = 25^\circ\text{C}$	—	nA
		$T_A = 150^\circ\text{C}$	—	μA
* Gate No.2-Terminal Forward Current, I_{G2SSF}	$V_{G2S} = 5\text{V}$, $V_{G1S} = V_{DS} = 0$	—	10	nA
* Gate No.2-Terminal Reverse Current, I_{G2SSR}	$V_{G2S} = -5\text{V}$, $V_{G1S} = V_{DS} = 0$	$T_A = 25^\circ\text{C}$	—	nA
		$T_A = 150^\circ\text{C}$	—	μA
* Zero-Gate No.1-Voltage Drain Current, I_{DS}^2	$V_{DS} = 15\text{V}$, $V_{G1S} = 0$, $V_{G2S} = 4\text{V}$	3N204	6	30
		3N205	6	30
		3N206	3	15
* Gate No.1-to-Source Cutoff Voltage, $V_{G1S(off)}$	$V_{DS} = 15\text{V}$, $V_{G2S} = 4\text{V}$, $I_D = 20\mu\text{A}$	-0.5	-4	V
* Gate No.2-to-Source Cutoff Voltage, $V_{G2S(off)}$	$V_{DS} = 15\text{V}$, $V_{G1S} = 0$, $I_D = 20\mu\text{A}$	-0.2	-4	V
* Small-Signal Common-Source Forward Transfer Admittance, $ y_{fs} ^3$	$V_{DS} = 15\text{V}$, $V_{G1S} = 0$, $V_{G2S} = 4\text{V}$, $f = 1\text{ kHz}$	3N204	10	22
		3N205	10	22
		3N206	7	17
* Small-Signal Common-Source Reverse Transfer Capacitance, C_{rss}	$V_{DS} = 15\text{V}$, $V_{G2S} = 4\text{V}$, $I_D = 10\text{ mA}$, $f = 1\text{ MHz}$	0.005	0.03	pF

*In accordance with JEDEC registration data format (JS-9 RDF-19B).

1. All gate breakdown voltages are measured while the device is conducting rated gate current. This ensures that the gate-voltage-limiting network is functioning properly.
2. This characteristic must be measured using pulse techniques ($t_W = 300\mu\text{s}$, duty cycle $\leq 2\%$).
3. This characteristic must be measured with bias voltages applied for less than 5 seconds to avoid overheating. The signal is applied to gate No.1 with gate No.2 at ac ground.

Small-Signal MOSFETs

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OPERATING CHARACTERISTICS at $T_A = 25^\circ\text{C}$

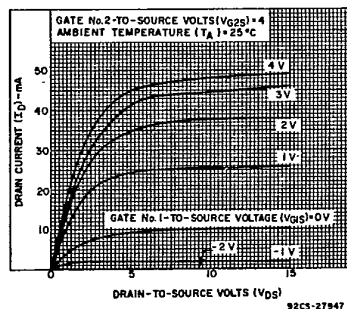
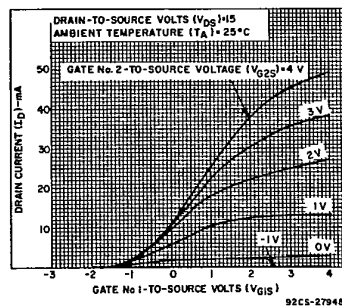
CHARACTERISTIC	TEST CONDITIONS	LIMITS			UNITS
		Min.	Typ.	Max.	
3N204					
* Common-Source Spot Noise Figure, NF	VDD=18 V, VGG=7 V, f = 200 MHz, See Fig.13	—	—	3.5	dB
* Small-Signal Common-Source Insertion Power Gain, Gps		20	—	28	dB
* Bandwidth, BW		7	—	12	MHz
* Gain-Control Gate-Supply Voltage, VGG(GC)	VDD=18 V, ΔGps=−30dB, ¹ f=200 MHz, See Fig. 13	0	—	−2	V
* Common-Source Spot Noise Figure, NF	VD=15 V, VG2S = 4 V, f = 450 MHz, ID = 10 mA, See Figs. 15 and 16	—	—	5	dB
* Small-Signal Common Source Insertion Power Gain, Gps		14	—	—	dB
3N205					
* Small-Signal Conversion Power Gain, Gps (conv)	VDD=18 V, fLO=245 MHz, ³ fRF=200 MHz, See Fig.17	17	—	28	dB
* Bandwidth, BW		4	—	7	MHz
3N206					
* Common-Source Spot Noise Figure, NF	VDD=24 V, VGG=6 V, f=45 MHz, See Fig. 14	—	—	4	dB
* Small-Signal Common-Source Insertion Power Gain, Gps		25	—	35	dB
* Bandwidth, BW		3	—	6	MHz
* Gain-Control Gate-Supply Voltage, VGG(GC)	VDD=24 V, ΔGps=−30dB, ² f=45 MHz, See Fig. 14	−1.6	—	0.6	V

*In accordance with JEDEC registration data format (JS-9 RDF-19B).

1. ΔG_{PS} is defined as the change in G_{PS} from the value at $V_{GG} = 7\text{ V}$.2. ΔG_{PS} is defined as the change in G_{PS} from the value at $V_{GG} = 6\text{ V}$.

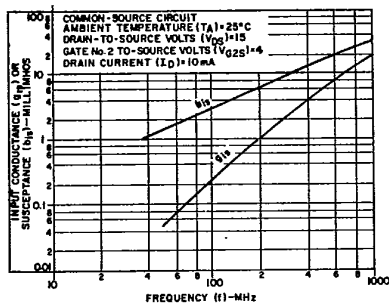
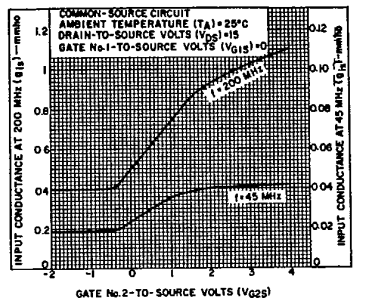
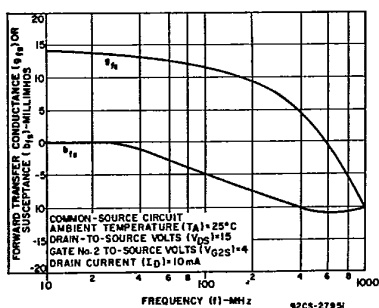
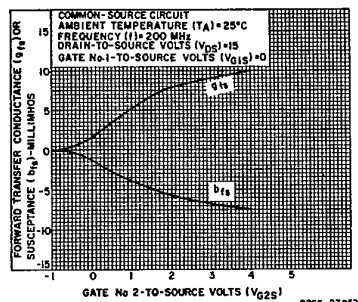
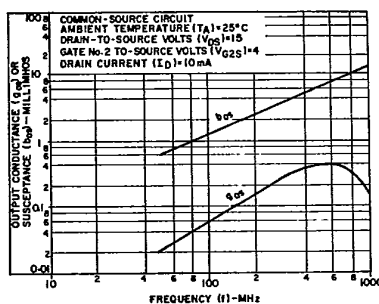
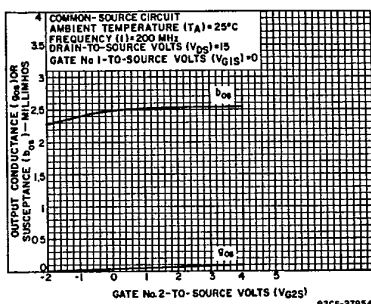
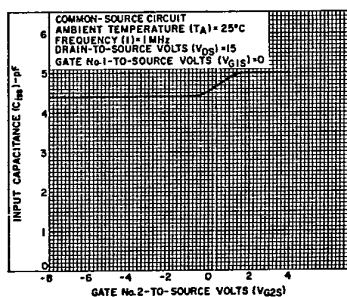
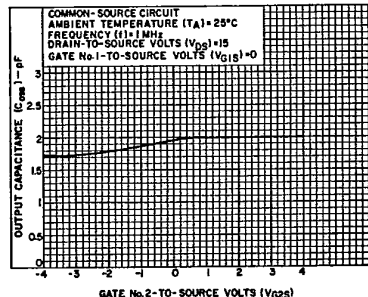
3. Amplitude at input from local oscillator is 3 V RMS.

TYPICAL CHARACTERISTICS

Fig. 1 — Drain current vs. drain-to-source volts (pulse-tested with pulse duration = 300 μs , duty cycle $\leq 2\%$).Fig. 2 — Drain current vs. gate-No. 1-to-source volts (pulse-tested with pulse duration = 300 μs , duty cycle $\leq 2\%$).

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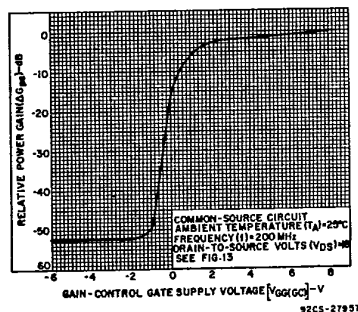
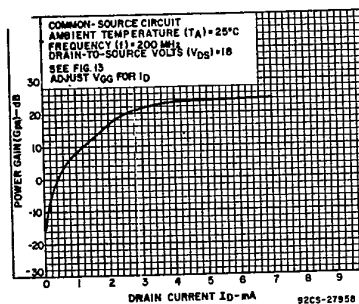
TYPICAL Y-PARAMETER CHARACTERISTICS

Fig. 3 - Y_{11} vs. f Fig. 4 - Y_{12} vs. V_{G2S} Fig. 5 - Y_{21} vs. f Fig. 6 - Y_{22} vs. V_{G2S} Fig. 7 - Y_{O1} vs. f Fig. 8 - Y_{O2} vs. V_{G2S} Fig. 9 - C_{iss} vs. V_{G2S} Fig. 10 - C_{Oss} vs. V_{G2S}

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TYPICAL OPERATING CHARACTERISTICS: FOR 3N204

Fig. 11 - ΔG_{ps} vs. $V_{GG}(GC)$ Fig. 12 - G_{ps} vs. I_D

TEST CIRCUITS

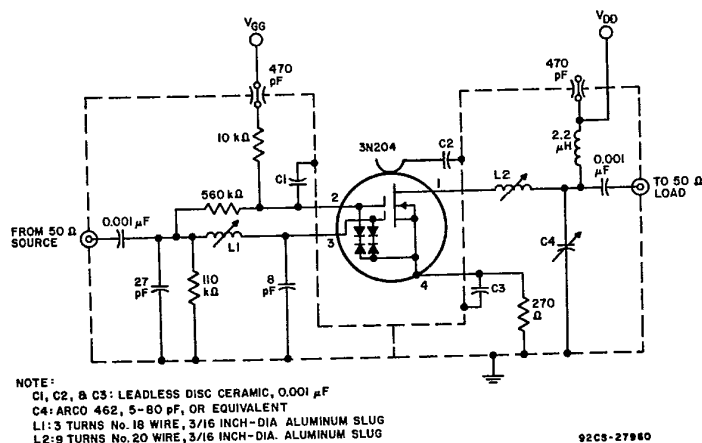


Fig. 13 - 200-MHz power gain, gain-control voltage, and noise-figure test circuit for 3N204*.

* In accordance with JEDEC registration data format (JS-9 RDF-19B).

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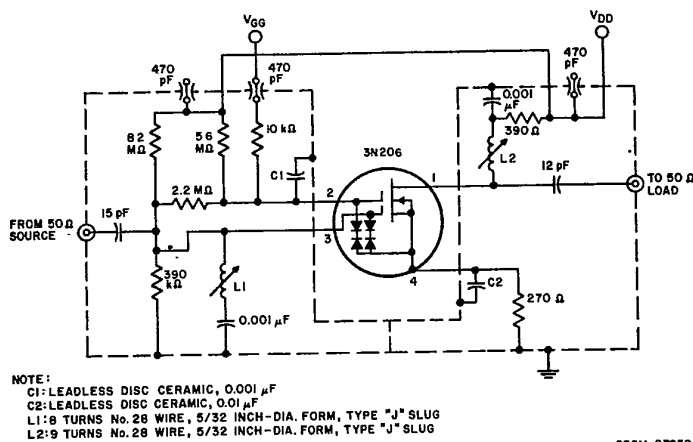


Fig. 14 — -45-MHz power-gain and noise-figure test circuit for 3N206*.
 * In accordance with JEDEC registration data format (JS-9 RDF-19B).

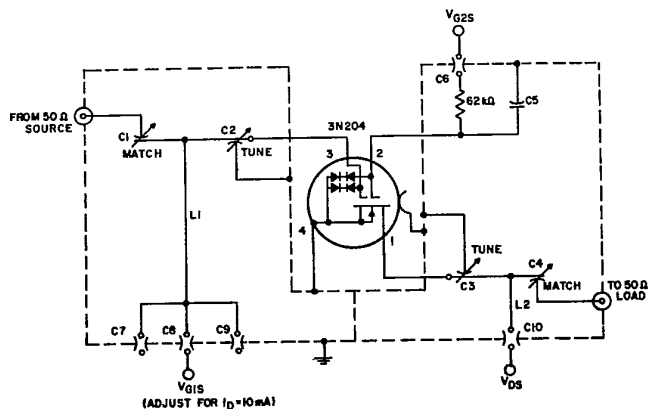
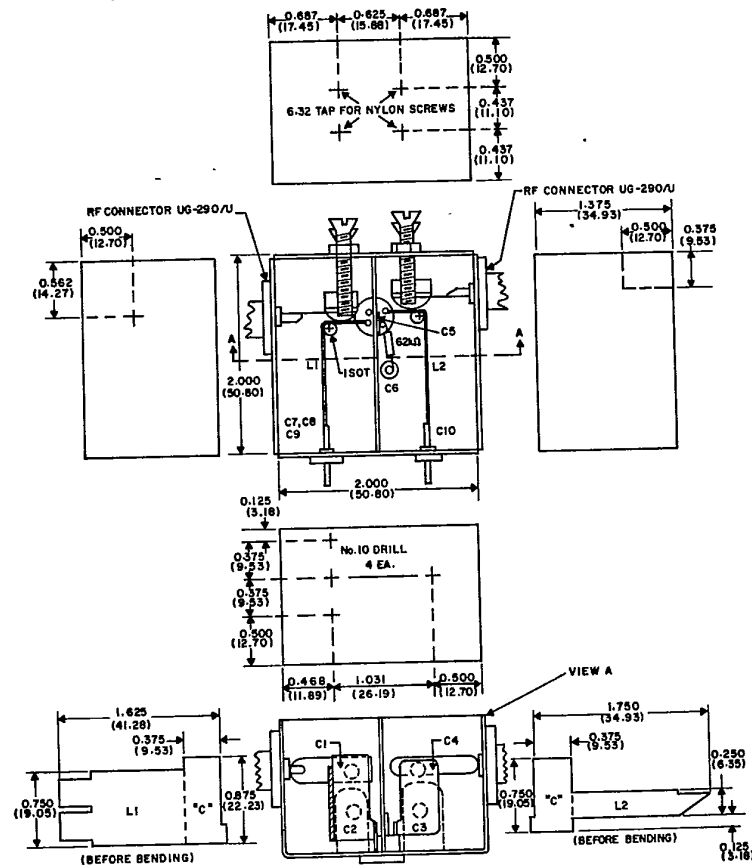


Fig. 15 — -450-MHz power-gain and noise-figure test circuit for 3N204*.
 * In accordance with JEDEC registration data format (JS-9 RDF-19B).

Small-Signal MOSFETs

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NOTES:

- Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions, as indicated.
- The removable top of test fixture is not shown.
- For clarity, the 62 k Ω resistor, the source and gate-2 socket pins, and insulating stand-off terminals (ISOT) soldered into the fold of L1 and L2 respectively for mechanical support, are not shown in view A.
- C1 and C2 (C3 and C4) consist of shim brass and the "C" portion of L1 (L2) separated by air and the mylar tape covering the "C" portion of L1 (L2).
- The four views surrounding the center view are as they would appear before the metal is bent up to form the sides.

Fig. 16 — 450 MHz power-gain and noise-figure test fixture*.

* In accordance with JEDEC registration data format (JS-9 RDF-19B).

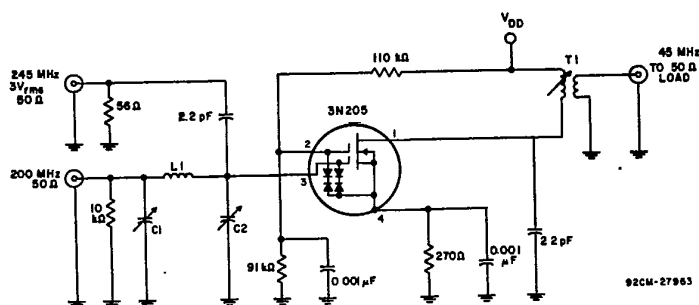
Small-Signal MOSFETs

3N204, 3N205, 3N206

01E 15026

D T-31-25

3875081 G E SOLID STATE



NOTE:

C1: ARCO 482, 5-80 pF, or EQUIVALENT
 C2: ARCO 480, 1.5-15 pF, OR EQUIVALENT
 L1: 4 TURNS No.14 WIRE, 1/4 INCH INSIDE DIA.

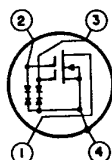
T1: PRI: 16 TURNS No.30 WIRE CLOSE WOUND
 ON 1/4 INCH DIA. FORM, TYPE "J" SLUG
 SEC: 5 TURNS No.30 WIRE CENTERED
 OVER PRIMARY

Fig. 17 - -200 MHz-to-45-MHz circuit for conversion power gain for 3N205*.

* In accordance with JEDEC registration data format (JS-9 RDF-19B).

TERMINAL DIAGRAM

Bottom View



LEAD 1 - DRAIN
 LEAD 2 - GATE No.2
 LEAD 3 - GATE No.1
 LEAD 4 - SOURCE,
 SUBSTRATE AND CASE

OPERATING CONSIDERATIONS

The flexible leads of these devices are usually soldered to the circuit elements. As is the case with any high-frequency semiconductor device, the tips of soldering irons MUST be grounded.