40673

SILICON DUAL INSULATED-GATE FIELD-EFFECT TRANSISTOR
N-Channel Depletion Type With Integrated Gate-Protection Circuits
For RF Amplifier Applications up to 400 MHz

RCA-40673 is an n-channel silicon, depletion type, dual insulated-gate field-effect transistor.

Special back-to-back diodes are diffused directly into the MOS* pellet and are electrically connected between each insulated gate and the FET's source. The diodes effectively bypass any voltage transients which exceed approximately ±10 volts. This protects the gates against damage in all normal handling and usage.

A feature of the back-to-back diode configuration is that it allows the 40673 to retain the wide input signal dynamic range inherent in the MOSFET. In addition, the low junction capacitance of these diodes adds little to the total capacitance shunting the signal gate.

The excellent overall performance characteristics of the RCA-40673 make it useful for a wide variety of rf-amplifier applications at frequencies up to 400 MHz. The two serially-connected channels with independent control gates make possible a greater dynamic range and lower cross-modulation than is normally achieved using devices having only a single control element.

The two gate arrangement of the 40673 also makes possible a desirable reduction in feedback capacitance by operating in the common-source configuration and ac-grounding Gate No. 2. The reduced capacitance allows operation at maximum gain *without neutralization;* and, of special importance in rf-amplifiers, it reduces local oscillator feedthrough to the antenna.

The 40673 is hermetically sealed in the metal JEDEC TO-72 package.

*Metal-Oxide-Semiconductor.

Maximum Ratings, *Absolute-Maximum Values, at T_A = 25°C*

DRAIN-TO-SOURCE VOLTAGE, V_{DS}	-0.2 to +20	V
GATE No.1-TO-SOURCE VOLTAGE, V_{G1S}:		
Continuous (dc)	-6 to +1	V
Peak ac	-6 to +6	V
GATE No.2-TO-SOURCE VOLTAGE, V_{G2S}:		
Continuous (dc)	-6 to 30% of V_{DS}	V
Peak ac	-6 to +6	V
DRAIN-TO-GATE VOLTAGE, V_{DG1} OR V_{DG2}	+20	V
DRAIN CURRENT, I_D	50	mA
TRANSISTOR DISSIPATION, P_T:		
At ambient temperatures up to 25°C	330	mW
At ambient temperatures above 25°C	derate linearly at 2.2 mW/°C	
AMBIENT TEMPERATURE RANGE:		
Storage and Operating	-65 to +175	°C
LEAD TEMPERATURE (During soldering):		
At distances ≥1/32 inch from seating surface for 10 seconds max.	265	°C

ELECTRICAL CHARACTERISTICS, at T_A = 25°C unless otherwise specified

CHARACTERISTICS	SYMBOLS	TEST CONDITIONS	LIMITS Min.	LIMITS Typ.	LIMITS Max.	UNITS
Gate-No.1-to-Source Cutoff Voltage	$V_{G1S(off)}$	V_{DS} = +15V, I_D = 200μA, V_{G2S} = +4V	–	–2	–4	V
Gate-No.2-to-Source Cutoff Voltage	$V_{G2S(off)}$	V_{DS} = +15V, I_D = 200μA, V_{G1S} = 0	–	–2	–4	V
Gate-No.1-Leakage Current	I_{G1SS}	V_{G1S} = +1 or–6 V, V_{DS} = 0, V_{G2S} = 0	–	–	50	nA
Gate-No.2-Leakage Current	I_{G2SS}	V_{G2S} = ±6V, V_{DS} = 0, V_{G1S} = 0	–	–	50	nA
Zero-Bias Drain Current	I_{DSS}	V_{DS} = +15V, V_{G2S} = +4V, V_{G1S} = 0	5	15	35	mA
Forward Transconductance (Gate-No.1-to-Drain)	g_{fs}	V_{DS} = +15V, I_D = 10mA, V_{G2S} = +4V, f = 1kHz	–	12,000	–	μmho
Small-Signal, Short-Circuit Input Capacitance †	C_{iss}	V_{DS} = +15V, I_D = 10mA, V_{G2S} = +4V, f=1MHz	–	6	–	pF
Small-Signal, Short-Circuit, Reverse Transfer Capacitance (Drain-to-Gate No.1) ♦	C_{rss}		0.005	0.02	0.03	pF
Small-Signal, Short-Circuit Output Capacitance	C_{oss}		–	2.0	–	pF
Power Gain (see Fig. 1)	G_{PS}	V_{DS} = +15V, I_D = 10mA, V_{G2S} = +4V, f = 200 MHz	14	18	–	dB
Maximum Available Power Gain	MAG		–	20	–	dB
Maximum Usable Power Gain (unneutralized)	MUG		–	20*	–	dB
Noise Figure (see Fig. 1)	NF		–	3.5	6.0	dB
Magnitude of Forward Transadmittance	$\lvert Y_{fs} \rvert$		–	12,000	–	μmho
Phase Angle of Forward Transadmittance	θ		–	–35	–	degrees
Input Resistance	r_{iss}		–	1.0	–	kΩ
Output Resistance	r_{oss}		–	2.8	–	kΩ
Protective Diode Knee Voltage	V_{knee}	$I_{DIODE(REVERSE)}$=±100μA	–	±10	–	V

*Limited only by practical design considerations.

†Capacitance between Gate No. 1 and all other terminals

♦Three-terminal measurement with Gate No. 2 and Source returned to guard terminal.

APPLICATIONS

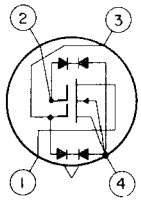
- RF amplifier, mixer, and IF amplifier in military, industrial, and consumer communications equipment
- aircraft and marine vehicular receivers
- CATV and MATV equipment
- telemetry and multiplex equipment

PERFORMANCE FEATURES

- superior cross-modulation performance and greater dynamic range than bipolar or single-gate FET s
- wide dynamic range permits large-signal handling before overload
- dual-gate permits simplified agc circuitry
- virtually no agc power required
- greatly reduces spurious responses in fm receivers
- permits use of vacuum-tube biasing techniques
- excellent thermal stability

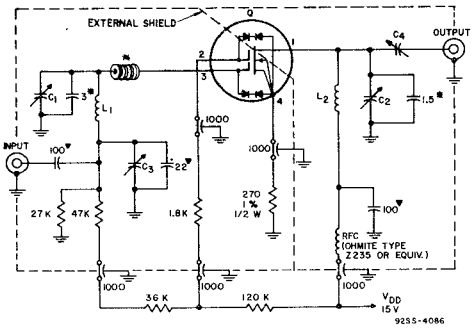
DEVICE FEATURES

- back-to-back diodes protect each gate against handling and in-circuit transients
- low gate leakage currents —— I_{G1SS} & I_{G2SS} = 20 nA(max.) at T_A = 25°C
- high forward transconductance —— g_{fs} = 12,000 μmho (typ.)
- high unneutralized RF power gain —— G_{ps} = 18 dB(typ.) at 200 MHz
- low VHF noise figure —— 3.5 dB(typ.) at 200 MHz



TERMINAL DIAGRAM

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



#Ferrite bead (4); Pyroferric Co. "Carbonyl J" 0.09 in. OD; 0.03 in. ID; 0.063 in. thickness.
All resistors in ohms
All capacitors in pF
Q = 40673
▼ Disc ceramic.
*Tubular ceramic.

C_1: 1.8 – 8.7 pF variable air capacitor: E.F. Johnson Type 160-104, or equivalent.

C_2: 1.5 – 5 pF variable air capacitor: E.F. Johnson Type 160-102, or equivalent.

C_3: 1 – 10 pF piston-type variable air capacitor: JFD Type VAM-010; Johanson Type 4335, or equivalent.

C_4: 0.8 – 4.5 pF piston type variable air capacitor: Erie 560-013 or equivalent.

L_1: 4 turns silver-plated 0.02-in. thick, 0.075-0.085-in. wide, copper ribbon. Internal diameter of winding = 0.25 in, winding length approx. 0.80 in.

L_2: 4½ turns silver-plated 0.02-in. thick, 0.085-0.095-in. wide, 5/16-in. ID. Coil ≈ .90 in. long.

Fig. 1. 200-MHz Power gain and noise-figure test circuit

For characteristics curves, refer to type 3N187.