40468A, 40559A

MOS Silicon Transistors

N-Channel Depletion Types

For RF Amplifier and Mixer Applications in FM and AM/FM Receivers

RCA-40468A and 40559A are silicon insulated-gate field-effect transistors of the n-channel depletion type utilizing the MOS* construction. They are intended primarily for use as the rf amplifier and mixer, respectively, in FM receivers covering the 88 to 108 MHz band, but can be used for general amplifier applications at frequencies up to 125 MHz. For circuit design and typical performance data refer to RCA Application Note AN3535 "An FM Tuner Using Single-Gate MOS Field-Effect Transistors as RF Amplifier and Mixer".

The wide dynamic range of these transistors reduces cross-modulation effects in AM receivers and minimizes the generation of spurious responses in FM receivers.

Operating as a neutralized amplifier at 100 MHz, the 3A can provide a power gain of 17 dB (typ.). A r gain of 14 dB (typ.) can be realized without neutralization.

* Metal-Oxide-Semiconductor.

Performance Features:

- **reduced spurious responses in FM tuners**
- **reverse bias on substrate improves linearity**
- **reduced cross-modulation effects in AM receivers**

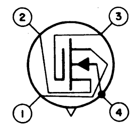
Maximum Ratings, *Absolute-Maximum Values at T_A = 25°C:*

DRAIN-TO-SOURCE VOLTAGE, V_{DS}	+20	V
DRAIN-TO-GATE VOLTAGE, V_{DG}	+20	V
GATE-TO-SOURCE VOLTAGE, V_{GS}:		
CONTINUOUS (dc)	+1, -8	V
PEAK ac	±15	V
DRAIN CURRENT, I_D	25	mA
TRANSISTOR DISSIPATION:		
At ambient temperatures up to 25°C	330	mW
At ambient temperatures above 25°C	derate at 2.2 mW/°C	
AMBIENT TEMPERATURE RANGE:		
Storage	-65 to +175	°C
Operating	-65 to +175	°C
LEAD TEMPERATURE (During Soldering):		
At distances not closer than 1/32 inch to seating surface for 10 seconds maximum	265	°C

Device Features:

- **high forward transconductance - - gfs = 7500 μmho typ. for 40468A**
- **low feedback capacitance - - c_{rss} = 0.35 pF max. for 40468A; 0.38 pF max. for 40559A**
- **high useful power gains - - neutralized - 17 dB typ. unneutralized - 14 dB typ.**
- **hermetically sealed in TO-72 metal package**

TERMINAL DIAGRAM



LEAD 1 - DRAIN
LEAD 2 - SOURCE
LEAD 3 - INSULATED GATE
LEAD 4 - BULK (SUBSTRATE) AND CASE

ELECTRICAL CHARACTERISTICS, at T_A = 25°C
With Bulk (Substrate) Connected to Source Unless Otherwise Specified

Characteristics	Symbols	TEST CONDITIONS: Frequency f (MHz)	DC Drain-to-Source V_{DS} (V)	DC Drain Current I_D (mA)	LIMITS RCA-40468A RF Amplifier Min.	Typ.	Max.	RCA-40559A Mixer Min.	Typ.	Max.	Units
Drain-to-Source Cutoff Current	$I_{D(off)}$	-	12	V_{GS} = -8V	-	-	100	-	-	500	μA
Gate Leakage Current	I_{GSS}	-	0	V_{GS} = -8V	-	-	1	-	-	1	nA
		-	0	V_{GS} = +1V	-	-	1	-	-	1	nA
Zero-Bias Drain Current	I_{DSS}	-	15	V_{GS} = 0	5	15	30	5	15	30	mA
Small-Signal, Short-Circuit Forward Transconductance	g_{fs}	1 kHz	15	5	-	7500	-	-	-	-	μmho
Small-Signal, Short-Circuit Reverse-Transfer Capacitance (Drain-to-Gate)	C_{rss}	1	15	5	-	0.25	0.35	-	0.25	0.38	pF
Input Capacitance	C_{iss}	1	15	5	-	5.5	-	-	5.5	-	pF
Admittance	-	RF / Mixer		RF / Mixer	-			-			-
Input Admittance	Y_{is}	100 MHz	15	5 / 3	0.155 + j 3.45			0.14 + j 3.38			mmho
Forward Transfer Admittance	Y_{fs}	100 MHz	15	5 / 3	7.4 + j 0.9			-			mmho
Output Admittance	Y_{os}	100 MHz / 10.7 MHz	15	5 / 3	0.21 + j 0.9			0.076 + j 0.153			mmho
Forward Conversion Transconductance	$g_{fs(c)}$	1 kHz	15	3	-	-	-	-	2800*	-	μmho
Maximum Available Power Gain	MAG	100	15	5	-	26	-	-	-	-	dB
Maximum Usable Power Gain (Unneutralized)	MUG	100	15	5	-	14	-	-	-	-	dB
Maximum Usable Power Gain (Neutralized)	MUG	100	15	5	14	17	-	-	-	-	dB
Maximum Available Conversion Gain	MAG_C	f_{in} = 100, f_{out} = 10.7	15	3	-	-	-	-	22	-	dB
Noise Figure	NF	100	15	5	-	3.5	5	-	-	-	dB

* Bulk (Substrate)-to-Source Volts (V_{BS}) = -3.

For characteristics curves, refer to types 3N128 and 3N143.

40600, 40601, 40602

SILICON DUAL INSULATED-GATE FIELD-EFFECT TRANSISTORS

N-Channel Depletion Types
For VHF TV Receiver Applications

RCA 40600, 40601, and 40602 are n-channel depletion type, dual-insulated-gate, field-effect transistors utilizing the MOS construction. These devices have characteristics which make them highly desirable for rf-amplifier applications (40600), mixer applications (40601), and first-if-amplifier applications (40602) in vhf TV receivers and other types of commercial equipment operating at frequencies up to approximately 250 MHz.

These transistors feature a series arrangement of two separate channels, each channel having an independent control gate. In amplifier applications the 40600 and 40602 with their wide dynamic range provide substantially better cross-modulation performance than is obtainable with bipolar or single-gate field-effect transistors. In mixer applications the 40601 provides excellent isolation between the oscillator and rf signals because each of the two signal frequencies being mixed has its own control element. The wide dynamic range of the 40601 minimizes cross-modulation which is generally encountered in mixer stages.

Provision of two insulated gates also results in extremely low feedback capacitances (0.02 pF typ.), a feature which enables the 40600 and 40602 to provide high maximum useable power gains in unneutralized circuits – for example, 20 dB at 200 MHz typ. for the 40600, and 35 dB typ. at 44 MHz for the 40602. The gain of the rf and if stages can be controlled by applying agc voltage to gate No.2 and agc delay is easily obtained. Virtually no agc power is required for full gain reduction.

Types 40600, 40601, and 40602 are hermetically sealed in metal JEDEC TO-72 packages.

APPLICATIONS

- **VHF TV Receiver**
  - **40600 for rf amplifier applications**
  - **40601 for mixer applications**
  - **40602 for first-if-amplifier applications**

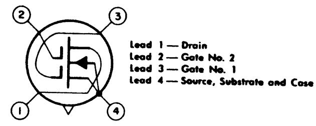
PERFORMANCE FEATURES

- **superior cross-modulation performance and greater dynamic range than bipolar and single-gate field-effect transistors**
- **permits use of vacuum-tube biasing techniques**
- **excellent thermal stability**

DEVICE FEATURES

- **extremely low feedback capacitance** C_{rss} = 0.02 pF typ.
- **high power gain**
  - MUG_u = 20 dB typ. for 40600
  - MAG = 35 dB typ. for 40602
  - MAG_c = 14 dB typ. for 40601

TERMINAL DIAGRAM



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

DRAIN-TO-SOURCE VOLTAGE, V_{DS}	0 to +20	V
GATE No.1-TO-SOURCE VOLTAGE, V_{G1S}:		
Continuous (dc)	+1 to -8	V
Peak ac	+20 to -8	V
GATE No.2-TO-SOURCE VOLTAGE, V_{G2S}:		
Continuous (dc)	-8 to 40% of V_{DS}	V
Peak ac	-8 to +20	V
DRAIN-TO-GATE VOLTAGE, V_{DG1} or V_{DG2}	+20	V
DRAIN CURRENT, I_D (Pulsed):		
Pulse duration $\leq$ 20 ms, duty factor $\leq$ 0.15	50	mA
TRANSISTOR DISSIPATION, P_T:		
At ambient temperatures up to 25°C	400	mW
At ambient temperatures above 25°C	derate linearly at 2.67 mW/°C	
AMBIENT TEMPERATURE RANGE:		
Storage and Operating	-65 to +175	°C
LEAD TEMPERATURE (During soldering):		
At distances $\geq$ 1/32" from seating surface for 10 seconds max.	265	°C

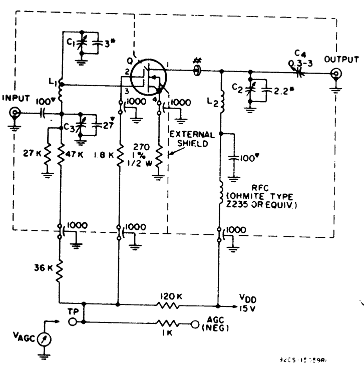
ELECTRICAL CHARACTERISTICS, at T_A = 25°C

CHARACTERISTICS	SYMBOLS	TEST CONDITIONS	LIMITS 40600, 40601, 40602 Min.	Typ.	Max.	UNITS
Gate No.1-to-Source Cutoff Voltage	$V_{G1S(off)}$	V_{DS} = +15V, I_D = 200 μA, V_{G2S} = +4V	-	-2	-	V
Gate No.2-to-Source Cutoff Voltage	$V_{G2S(off)}$	V_{DS} = +15V, I_D = 200 μA, V_{G1S} = 0	-	-2	-	V
Gate No.1 Leakage Current	I_{G1SS}	V_{G1S} = -20V, V_{G2S} = 0, V_{DS} = 0	-	-	1	nA
Gate No.2 Leakage Current	I_{G2SS}	V_{G2S} = -20V, V_{G1S} = 0, V_{DS} = 0	-	-	1	nA
Drain Current	I_{DSS}	V_{DS} = +13V, V_{G1S} = 0, V_{G2S} = +4V	-	18	-	mA
Forward Transconductance	g_{fs}	V_{DS} = +13V, I_D = 10 mA, V_{G2S} = +4V, f = 1 kHz	-	10000	-	μmho

TYPICAL PERFORMANCE CHARACTERISTICS, at T_A = 25°C

CHARACTERISTICS	SYMBOLS	40600 RF AMPLIFIER f = 200 MHz	40602 IF AMPLIFIER f = 44 MHz	40601 MIXER f = 200 MHz	UNITS
		V_{G1S} is adjusted for I_D = 10 mA, Gate No.2 at AC ground potential, V_{DS} = 13V, V_{G2S} = +4V		Local-oscillator injection Voltage on Gate No.2 = 750 mV, V_{DS} = 15V, V_{G2S} = +0.6V, V_{G1S} = 0.75V	
Small-Signal, Short Circuit Reverse-Transfer Capacitance (Drain-to-Gate No.1) at f = 1 MHz	C_{rss}	0.02 typ. 0.03 max.	0.02 typ. 0.03 max.	0.02 typ. 0.03 max.	pF
Output Capacitance	C_{oss}	2.2	2.2	2.2 at f = 44 MHz	pF
Input Capacitance	C_{iss}	5.5	5.5	5.5	pF
Input Resistance	r_{iss}	1.2	10	1.2	kΩ
Output Resistance	r_{oss}	2.8	12	12 at f = 44 MHz	kΩ
Magnitude of Forward Transadmittance	$\lvert Y_{fs} \rvert$	11000	11000	2700*	μmho
Phase Angle of Forward Transadmittance	$\angle\theta$	-46	-11	-	degrees
Maximum Available Power Gain	MAG	20	35	14**	dB
Maximum Usable Power Gain (Unneutralized)	MUG_u	20▲	1 Stage 28, 2 Stages 26, 3 Stages 24	-, -, -	dB, dB, dB
Power Gain See Fig.1 for measurement circuit	G_{PS}	17.5	-	-	dB
Noise Figure	NF	5 max.	-	-	dB

* Magnitude of forward conversion transadmittance ** Maximum available conversion gain ▲ Limited by practical design considerations



* Tubular ceramic.

▼ Disk ceramic.

\# Ferrite bead (½ used); Indiana General No. H1742C-(A-147) or F1157-1-H, or equivalent.

C_1, C_2: 1.5-5 pF variable air capacitor: E. F. Johnson Type 160-10?, or equivalent.

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

C_4: 0.3-3 pF piston-type variable air capacitor: Roanwell Type MH-13, or equivalent.

L_1: 5 turns silver-plated 0.02" thick, 0.07"- 0.08" wide copper ribbon. Internal diameter of winding = 0.25"; winding length approx. 0.65". Tapped at 1-1/2 turns from C_1 end of winding.

L_2: Same as L_1 except winding length approx. 0.7"; no tap.

Fig.1 - 200 MHz Power Gain and Noise Figure Test Circuit for 40600 and 40602

For characteristics curves, refer to type 3N140.

SILICON DUAL INSULATED-GATE FIELD-EFFECT TRANSISTORS

N-Channel Depletion Types
For FM Tuner Applications

RCA 40603 and 40604 are n-channel silicon, depletion type, dual insulated-gate, field-effect transistors utilizing the MOS construction.

These devices have exceptional characteristics for rf-amplifier (40603) and mixer applications (40604) in FM tuners and other commercial equipment operating at frequencies up to approximately 150 MHz. These transistors feature a series arrangement of two separate channels, each channel having an independent control gate. For amplifier applications the 40603 with its wide dynamic range provides substantially better cross-modulation performance and relative freedom from spurious responses than is obtainable with bipolar or single-gate field-effect transistors. The mixing function performed by the 40604 is unique in that the signal applied to gate No.2 is used to modulate the input-gate (gate No.1) sfer characteristic. This technique is superior to ventional "square law" mixing, which can only be accomplished in the non-linear region of the device transfer characteristic.

Because of the low feedback capacitance (0.02 typ. pF) the 40603 can provide a power gain of 25 dB (typ.) at 100 MHz in an unneutralized amplifier circuit.

The gain of the rf stage can be controlled by applying agc voltage to gate No.2. Virtually no agc power is required for full gain reduction.

The 40603 and 40604 are hermetically sealed in JEDEC TO-72 packages.

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

DRAIN-TO-SOURCE VOLTAGE, V_{DS}	0 to +20	V
GATE No.1-TO-SOURCE VOLTAGE, V_{G1S}:		
Continuous (dc)	-8 to +1	V
Peak ac	-8 to +20	V
GATE No.2-TO-SOURCE VOLTAGE, V_{G2S}:		
Continuous (dc)	-8 to 40% of V_{DS}	V
Peak ac	-8 to +20	V
DRAIN-TO-GATE VOLTAGE, V_{DG1} or V_{DG2}	+20	V
DRAIN CURRENT, I_D (Pulsed):		
Pulse duration $\leq$ 20 ms, duty factor $\leq$ 0.15	50	mA
TRANSISTOR DISSIPATION, P_T:		
At ambient temperatures up to 25°C	400	mW
At ambient temperatures above 25°C	derate linearly at 2.67 mW/°C	
AMBIENT TEMPERATURE RANGE:		
Storage and Operating	-65 to +175	°C
LEAD TEMPERATURE (During soldering):		
At distances $\geq$ 1/32" from seating surface for 10 seconds max.	265	°C

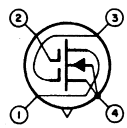
PERFORMANCE FEATURES

- **large dynamic range permits large-signal handling before overload**
- **dual gates allow product mixing with extremely low harmonic generation**
- **greatly reduces spurious responses in FM receivers**
- **permits use of vacuum-tube biasing techniques**
- **excellent thermal stability**
- **superior cross-modulation performance and greater dynamic range than bipolar and single-gate field-effect transistors**

DEVICE FEATURES

- **extremely low feedback capacitance** C_{rss} = 0.02 pF typ.
- **high unneutralized RF power gain** MUG = 25 dB (typ.) for 40603
- **low noise figure** NF = 2.5 dB typ. for 40603

TERMINAL DIAGRAM



Lead 1 — Drain
Lead 2 — Gate No. 2
Lead 3 — Gate No. 1
Lead 4 — Source, Substrate and Case

ELECTRICAL CHARACTERISTICS, at T_A = 25°C

CHARACTERISTICS	SYMBOLS	TEST CONDITIONS	LIMITS				UNITS
			40603 RF AMPLIFIER		40604 MIXER		
			Typ.	Max.	Typ.	Max.	
Gate No.1-to-Source Cutoff Voltage	$V_{G1S(off)}$	V_{DS} = +15 V, I_D = 200 μA, V_{G2S} = +4 V	-2	--	-2	--	V
Gate No.2-to-Source Cutoff Voltage	$V_{G2S(off)}$	V_{DS} = +15 V, I_D = 200 μA, V_{G1S} = 0	-2	--	-2	--	V
Gate No.1 Leakage Current	I_{G1SS}	V_{G1S} = -20 V, V_{G2S} = 0, V_{DS} = 0	--	1	--	1	nA
Gate No.2 Leakage Current	I_{G2SS}	V_{G2S} = -20 V, V_{G1S} = 0, V_{DS} = 0	--	1	--	1	nA
Zero-Bias-Voltage Drain Current	I_{DSS}	V_{G2S} = +4 V, V_{G1S} = 0, V_{DS} = +13 V	18	--	18	--	mA
Small-Signal, Short-Circuit Reverse-Transfer Capacitance (Drain-to-Gate-No.1)	C_{rss}	V_{DS} = +13 V, I_D = 10 mA, f = 1 MHz, V_{G2S} = +4 V	0.02	0.03	0.02	0.03	pF
Input Capacitance	C_{iss}	V_{DS} = +13 V, I_D = 10 mA, V_{G2S} = +4 V, f = 1 MHz	5.5	--	5.5	--	pF
Output Capacitance	C_{oss}	V_{DS} = +13 V, I_D = 10 mA, V_{G2S} = +4 V, f = 100 MHz	2.1	--	2.3	--	pF
Input Resistance	r_{is}	V_{DS} = +13 V, I_D = 10 mA, V_{G2S} = +4 V, f = 100 MHz	3.5	--	3.5	--	kΩ
Output Resistance	r_{os}	V_{DS} = +13 V, I_D = 10 mA, V_{G2S} = +4 V; f = 100 MHz	4	--	--	--	kΩ
		f = 10.7 MHz	--	--	20	--	kΩ
Forward Transconductance	g_{fs}	V_{DS} = +13 V, I_D = 10 mA, V_{G2S} = +4 V, f = 1 kHz	10,000	--	2800*	--	μmho
Maximum Available Power Gain	MAG	V_{DS} = +13 V, I_D = 10 mA, V_{G2S} = +4 V, f = 100 MHz, f_{out} for 40604 (mixer) = 10.7 MHz	26	--	21	--	dB
Maximum Usable Power Gain (Unneutralized)	MUG		25▲	.	--	--	dB
Noise Figure	NF		2.5	--	--	--	dB

* conversion transconductance
▲ or limited [illegible] design considerations

For characteristics curves, refer to type 3N140.

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

APPLICATIONS

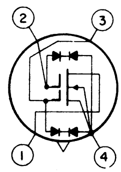
- RF amplifier, mixer, and IF amplifier in military, industrial, and consumer communications equipment
- aircraft and marine vehicular receivers
- CATV and MATV equipment
- telemetry and multiplex equipment

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 requirea
- 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



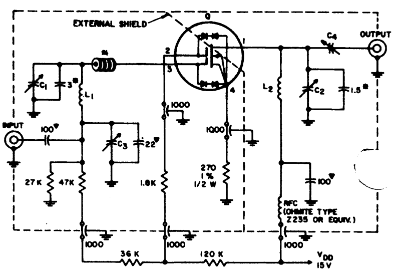
TERMINAL DIAGRAM

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

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

CHARACTERISTICS	SYMBOLS	TEST CONDITIONS	LIMITS Min.	Typ.	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	$\|Y_{fs}\|$		–	12,000	–	μmho
Phase Angle of Forward Trans-admittance	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.



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

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.

Silicon Dual-Insulated-Gate Field-Effect Transistor

N-Channel Depletion Type

With Integrated Gate-Protection Circuits

For RF Amplifier Applications up to 250 MHz

RCA-40819 is an n-channel silicon, depletion type, dual insulated-gate field-effect transistor (FET).

The excellent overall performance characteristics of the RCA-40819 make it useful for a wide variety of rf-amplifier applications at frequencies up to 250 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 40819 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 reduces local oscillator feedthrough to the antenna – features of special importance in rf and if amplifiers.

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 and protect the gates against damage in all normal handling and usage.

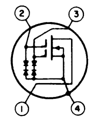
The back-to-back diode configuration permits the 40819 to retain the wide input signal dynamic range inherent in the MOSFET. In addition, the low junction capacitance of these diodes adds little to the total capacitance shunting the signal gate.

The 25-volt drain-to-source rating permits the use of higher voltage power supplies.

The 40819 is hermetically sealed in the metal JEDEC TO-72 package.

TERMINAL DIAGRAM

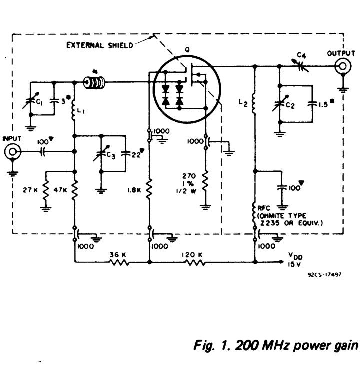
LEAD 1 - DRAIN
LEAD 2 - GATE No.2
LEAD 3 - GATE No.1
LEAD 4 - SOURCE, SUBSTRATE, AND CASE



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

CHARACTERISTICS	SYMBOLS	TEST CONDITIONS	LIMITS Min.	Typ.	Max.	UNITS
Ga... .1-to-Source Cutoff Voltage	$V_{G1S(off)}$	V_{DS} = +15 V, I_D = 200 µA, V_{G2S} = +4 V	–	–2	–4	V
Gate-No.2-to-Source Cutoff Voltage	$V_{G2S(off)}$	V_{DS} = +15 V, I_D = 200 µA, V_{G1S} = 0	–	–2	–4	V
Gate-No.1-Leakage Current	I_{G1SS}	V_{G1S} = ± 6 V, V_{DS} = 0, V_{G2S} = 0	–	–	50	nA
Gate-No.2-Leakage Current	I_{G2SS}	V_{G2S} = ± 6 V, V_{DS} = 0, V_{G1S} = 0	–	–	50	nA
Zero-Bias Drain Current	I_{DSS}	V_{DS} = + 15 V, V_{G2S} = +4 V, V_{G1S} = 0	5	15	35	mA
Forward Transconductance (Gate-No.1-to-Drain)	g_{fs}	V_{DS} = +15 V, I_D = 10 mA, V_{G2S} = +4 V, f = 1 kHz	–	12,000	–	µmho
Small-Signal, Short-Circuit Input Capacitance†	C_{iss}	V_{DS} = +15 V, I_D = 10 mA, V_{G2S} = +4 V, f = 1 MHz	–	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	–	pF
Power Gain (see Fig. 1)	G_{PS}	V_{DS} = +15 V, I_D = 10 mA, V_{G2S} = +4 V, 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	$\|Y_{fs}\|$		–	12,000	–	µmho
Phase Angle of Forward Transadmittance	θ		–	–35	–	degrees
Input Resistance	r_{iss}		–	1	–	kΩ
O... Resistance	r_{oss}		–	2.8	–	kΩ
P... ve Diode Knee Voltage	V_{knee}	I_{diode} (reverse) = ± 100 µA	–	±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.



#Ferrite bead (4); Pyroferric Co. "Carbonyl J" 0.09 in OD; 0.03 in ID; 0.063 in thickness.

Q = 40673
▼ Disc ceramic.
* Tubular ceramic.

All resistors in ohms
All capacitors in pF

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: 4-1/2 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.

Device Features

- back-to-back diodes protect each gate against handling and in-circuit transients
- 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
- low gate leakage currents: I_{G1SS} & I_{G2SS} = 50 nA at T_A = 25° C
- increased drain-to-source voltage rating: V_{DS} = –0.2 to +25 V

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
- virtually no agc power required
- greatly reduces spurious responses in FM receivers
- dual gate permits simplified AGC circuitry

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

Absolute Maximum Values, at T_A = 25°C:

Drain-to-Source Voltage, V_{DS}	–0.2 to +25	V
Gate Terminal Current, I_{G1S} or I_{G2S}	±100	µA
Drain-to-Gate Voltage, V_{DG1} or V_{DG2}	+31	V
Drain Current, I_D	50	mA
Transistor Dissipation, P_T:		
At T_A up to 25°C	330	mW
At T_A above 25°C	derate linearly 2.2 mW/°C	
Ambient Temperature Range:		
Operating and Storage	–65 to +175	°C
Lead Temperature (During Soldering):		
At distances 1/32 in from seating surface for 10 s max.	265	°C

Maximum Ratings

Continuous Working Voltage#, at T_A = 25°C:

Gate No.1-to-Source Voltage, V_{G1S}	–6 to +3	V
Gate No.2-to-Source Voltage, V_{G2S}	–6 to +6 or 40% of V_{DS} (whichever value is less)	V
Drain-to-Gate Voltage, V_{DG1} or V_{DG2}	+25	V

Continuous Working Voltage Ratings must be observed to maintain device characteristics. These ratings are based on long-term continuous voltage operation but may be exceeded for short durations (e.g. testing of device characteristics), provided the absolute Maximum Ratings are not exceeded.

40820, 40821

Silicon Dual-Insulated-Gate Field-Effect Transistors

N-Channel Depletion Types

With Integrated Gate-Protection Circuits
For VHF-TV Tuner Applications

40820 – RF Amplifier **40821 – Mixer**

Device Features

- **back-to-back diodes protect each gate against handling and in-circuit transients**
- **high forward transconductance: g_{fs} = 12,000 μmho (typ.)**
- **high unneutralized RF power gain: G_{ps} = 17 dB (typ.) at 200 MHz (40820)**
- **low VHF noise figure: 3.5 dB (typ.) at 200 MHz (40820)**
- **low gate leakage currents: I_{G1SS} & I_{G2SS} = 50 nA**

RCA-40820 and 40821 are n-channel silicon, depletion type, dual-insulated-gate, MOS▲ field-effect transistors for RF amplifier (40820) and mixer (40821) applications in VHF-TV receivers and other commercial equipment operating at frequencies up to 250 MHz.

These devices designed for VHF performance, provide excellent power gain, low-noise figures and have wide dynamic range. The dual-gate feature offers good cross-modulation performance over the AGC range and reduces feedback capacitance by shielding Gate No. 1 from the drain. The very low feedback capacitance also eliminates the need for circuit neutralization and reduces local oscillator feed-through to the antenna.

Virtually no AGC power is required because of the high gate input resistance of the MOS FET types. Automatic AGC delay can be achieved with a very slight change in the input impedance by the application of AGC voltage to Gate No. 2.

▲ Metal-Oxide-Semiconductor.

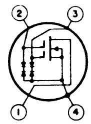
Performance Features

- **superior cross-modulation performance and greater dynamic range than bipolar or single-gate FET s**
- **wide dynamic range permits large-signal handling before overload**
- **virtually no agc power required**
- **dual gate permits simplified AGC circuitry**

The dual-gate arrangement also makes it possible to isolate the local oscillator signal from the incoming signal by applying each signal to a separate gate.

Integral back-to-back diodes protect the gates against damage in normal handling and usage by limiting transient voltages that exceed ±10 volts. The 40820 and 40821 are hermetically sealed in metal JEDEC TO-72 packages.

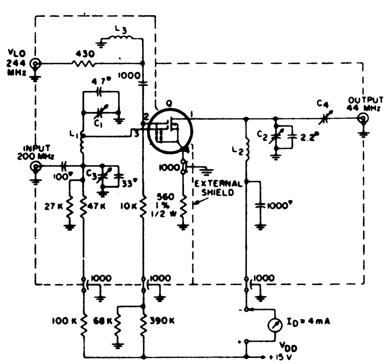
TERMINAL DIAGRAM



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

Maximum Ratings	40820	40821	
Continuous Working Voltage#, at T_A = 25°C:			
Gate No. 1-to-Source Voltage, V_{G1S}	–6 to +3	–4.5 to +3	V
Gate No. 2-to-Source Voltage, V_{G2S}	-6 to +6 or 40% of V_{DS} (whichever value is less)	-4.5 to +4.5 or -4.5 to 40% of V_{DS} (whichever value is less)	V
Drain-to-Gate Voltage, V_{DG1} or V_{DG2}	+20	+20	V
Absolute Maximum Values, at T_A = 25°C:			
Drain-to-Source Voltage, V_{DS}	–0.2 to +20	–0.2 to +20	V
Gate Terminal Current, I_{G1S} or I_{G2S}	±100	±100	μA
Drain-to-Gate Voltage, V_{DG1} or V_{DG2}	+26	+24.5	V
Drain Current, I_D	50	50	mA
Transistor Dissipation:			
At T_A up to 25°C	330	330	mW
At T_A above 25°C	derate linearly 2.2 mW/°C		
Ambient Temperature Range:			
Operating and Storage	–65 to +175	–65 to +175	°C
Lead Temperature (During Soldering):			
At distances 1/32 in from seating surface for 10 s max.	265	265	°C

Continuous Working Voltage Ratings must be observed to maintain device characteristics. These ratings are based on long-term continuous voltage operation but may be exceeded for short durations (e.g. testing of device characteristics), provided the Absolute Maximum Ratings are not exceeded.



92CS-17466

Q = 40821
▼Disc. ceramic.
* Tubular ceramic.
All resistors in ohms
All capacitors in pF

C_1, 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: 0.9–7 pF compression-type capacitor: ARCO 400 or equivalent.

L_1: 5 turns silver-plated 0.02" thick, 0.07"–0.08" wide copper ribbon. Internal diameter of winding = 0.25"; winding length approx. 0.65". Tapped at 1-1/2 turns from C_1 end of winding.

L_2: Ohmite Z-235 RF choke or equivalent

L_3: J. W. Miller Co. #4580 0.1 μH RF choke or equivalent.

Note: If 50Ω meter is used in place of sweep detector, a low pass filter must be provided to eliminate local oscillator voltage from load.

Fig.1 – Conversion power gain test circuit for type 40821.

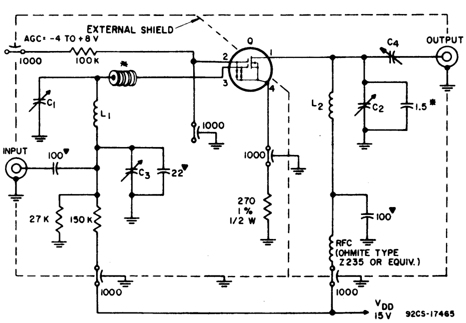
For characteristics curves, refer to type 3N187.

ELECTRICAL CHARACTERISTICS at T_A = 25°C

CHARACTERISTICS	SYMBOLS	TEST CONDITIONS		LIMITS 40820 Min.	Typ.	Max.	LIMITS 40821 Min.	Typ.	Max.	UNITS
Gate No. 1 to Source Cutoff Voltage	$V_{G1S(off)}$	V_{DS} = +15V, I_D = 200μA, V_{G2S} = +4V		–	-1	-3	–	-1	-3	V
Gate No. 2 to Source Cutoff Voltage	$V_{G2S(off)}$	V_{DS} = +15V, I_D = 200μA, V_{G1S} = 0		–	-1	-3	–	-1	-3	V
Gate-to-Source Forward Breakdown Voltage: Gate No. 1	$V_{(BR)G1SSF}$	I_{G1SSF}, I_{G2SSF} 100 μA	V_{G2S} V_{DS} 0	–	9	–	–	11	–	V
Gate No. 2	$V_{(BR)G2SSF}$		V_{G1S} V_{DS} 0	–	9	–	–	11	–	V
Gate-to-Source Reverse Breakdown Voltage: Gate No. 1	$V_{(BR)G1SSR}$	I_{G1SSR}, I_{G2SSR} 100 μA	V_{G2S} V_{DS} 0	–	9	–	–	11	–	V
Gate No. 2	$V_{(BR)G2SSR}$		V_{G1S} V_{DS} 0	–	9	–	–	11	–	V
Gate No. 1 Terminal Forward Current	I_{G1SSF}	V_{DS} V_{G2S} 0	V_{G1S} 6 V	–	–	50	–	–	–	nA
			V_{G1S} 4.5 V	–	–	–	–	–	50	nA
Gate No. 1 Terminal Reverse Current	I_{G1SSR}	V_{DS} V_{G2S} 0	V_{G1S} 6 V	–	–	50		–	–	nA
			V_{G1S} 4.5 V	–	–	–		–	50	nA
Gate No. 2 Terminal Forward Current	I_{G2SSF}	V_{DS} V_{G1S} 0	V_{G2S} 6 V	–	–	50	–	–	–	nA
			V_{G2S} 4.5 V	–	–	–	–		50	nA
Gate No. 2 Terminal Reverse Current	I_{G2SSR}	V_{DS} V_{G1S} 0	V_{G2S} -6 V		–	50	–	–	–	nA
			V_{G2S} 4.5 V	–	–	–	–	–	50	nA
Zero-Bias Drain Current	I_{DS}	V_{DS} +15 V, V_{G1S} 0, V_{G2S} +4 V		0.5	8	15	0.5	8	20	mA
Forward Transconductance (Gate No. 1-to-Drain)	g_{fs}	V_{DS} +15 V, I_D 10 mA, V_{G2S} +4 V	f 1 kHz	–	12000	–	–	12000	–	μmho
Small-Signal, Short-Circuit Input Capacitance♦	C_{iss}		f 1 MHz		6	8.5	–	6	9	pF
Small-Signal, Short-Circuit, Reverse Transfer Capacitance (Drain-to-Gate No. 1)♠	C_{rss}			0.005	0.02	0.03	0.005	0.02	0.04	pF
Small-Signal, Short-Circuit Output Capacitance	C_{oss}			–	2	–	–	2	–	pF
Power Gain (see Fig. 6)	G_{PS}		f 200 MHz	14	17	–	–	–	–	dB
Noise Figure (see Fig. 6)	NF			–	4.5	6	–	–	–	dB
Conversion Gain	$G_{PS(C)}$		f 200/44 MHz	–	–	–	11	–	–	dB

♦ Capacitance between Gate No. 1 and all other terminals.

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



*Ferrite bead (4); Pyroferric Co. "Carbonyl J" 0.09 in OD; 0.03 in ID; 0.063 in thickness.

Q = 40820

▾ Disc ceramic.

* Tubular ceramic.

All resistors in ohms

All capacitors in pF

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: 4-1/2 turns silver-plated 0.02 in thick, 0.085-0.095 in wide, 5/16-in; ID Coil ≈ 0.90 in. long.

Fig.2 – 200 MHz power gain and noise figure test circuit for type 40820.

Table 1 – y parameters vs. frequency

CHARACTERISTICS	SYMBOL	FREQUENCY (MHz) 50	100	200	250	UNITS
Y Parameters						
Input Conductance	g_{is}	0.08	0.33	1.0	1.6	mmho
Input Susceptance	b_{is}	1.8	3.6	7.5	9.8	mmho
Magnitude Forward Transadmittance	$\lvert y_{fs}\rvert$	12	12	12	12.3	mmho
Angle of Forward Transadmittance	$\angle y_{fs}$	-2	-13	-35	-45	degrees
Output Conductance	g_{os}	0.10	0.18	0.36	0.42	mmho
Output Susceptance	b_{os}	0.5	1.0	2.0	2.6	mmho
Magnitude of Reverse Transadmittance	$\lvert y_{rs}\rvert$	8	12	25	40	μmho
Angle of Reverse Transadmittance	$\angle y_{rs}$	-88	-73	-25	-10	degrees

40822-40823

Silicon Dual-Insulated-Gate Field-Effect Transistors

N-Channel Depletion Types

With Integrated Gate-Protection Circuits

For FM Tuner Applications

40822 – RF Amplifier 40823 – Mixer

RCA-40822 and 40823 are n-channel silicon, depletion type, dual-insulated-gate, field-effect transistors for RF amplifier (40822) and mixer (40823) applications in FM receivers and other commercial equipment operating at frequencies up to 150 MHz.

These devices designed for VHF performance, provide excellent power gain, low-noise figures and have wide dynamic range. The dual-gate feature offers good cross-modulation performance over the AGC range and reduces feedback capacitance by shielding Gate No. 1 from the drain. The very low feedback capacitance also eliminates the need for circuit neutralization and reduces local oscillator feed-through to the antenna.

Virtually no power is required in AGC utilizing the 40822 and 40823. In addition, these devices minimize input impedance variations and automatically achieve AGC delay when AGC is applied to Gate No. 2. The dual-gate arrangement also makes it possible to isolate the local oscillator signal from the incoming signal by applying each signal to a specific gate.

Back-to-back diodes, diffused directly into the MOS pellet, protect the gates against damage in normal handling and usage by limiting transient voltages that exceed +10 volts. The 40822 and 40823 are hermetically sealed in metal JEDEC TO-72 packages.

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
- virtually no agc power required
- greatly reduces spurious responses in FM receivers
- dual gate permits simplified AGC circuitry

Device Features

- back-to-back diodes protect each gate against handling and in-circuit transients
- high forward transconductance: g_{fs} = 12,000 μmho (typ.)
- high unneutralized RF power gain: G_{ps} = 24 dB (typ.) at 100 MHz (40822)
- low VHF noise figure: 2 dB (typ.) at 100 MHz (40822)
- low gate leakage currents: I_{G1SS} & I_{G2SS} = 50 nA at T_A = 25°C

Maximum Ratings

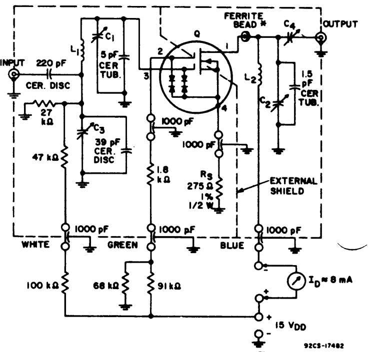
	40822	40823	
Continuous Working Voltage#, at T_A = 25°C:			
Gate No. 1-to-Source Voltage, V_{G1S}	–6 to +3	–4.5 to +3	V
Gate No. 2-to-Source Voltage, V_{G2S}	-6 to +6 or 40% of V_{DS} (whichever value is less)	-4.5 to +4.5 or 40% of V_{DS} (whichever value is less)	V
Drain-to-Gate Voltage, V_{DG1} or V_{DG2}	+20	+20	V
Absolute Maximum Values, at T_A = 25°C:			
Drain-to-Source Voltage, V_{DS}	–0.2 to +18	–0.2 to +18	V
Gate Terminal Current, I_{G1S} or I_{G2S}	±100	±100	μA
Drain-to-Gate Voltage, V_{DG1} or V_{DG2}	+24	+22.5	V
Drain Current, I_D	50	50	mA
Transistor Dissipation:			
At T_A up to 25°C	330	330	mW
At T_A above 25°C	derate linearly 2.2 mW/°C		
Ambient Temperature Range:			
Operating and Storage	–65 to +175	–65 to +175	°C
Lead Temperature (During Soldering):			
At distances 1/32 in from seating surface for 10 s max.	265	265	°C

Continuous Working Voltage Ratings must be observed to maintain device characteristics. These ratings are based on long-term continuous voltage operation but may be exceeded for short durations (e.g. testing of device characteristics), provided the Absolute Maximum Ratings are not exceeded.

CHARACTERISTICS	SYMBOLS	TEST CONDITIONS		LIMITS 40822 Min.	40822 Typ.	40822 Max.	40823 Min.	40823 Typ.	40823 Max.	UNITS
Gate No. 1-to-Source Cutoff Voltage	$V_{G1S(off)}$	V_{DS}= +15V, I_D=200μA, V_{G2S}= +4V		–	–2	–4	–	–2	–4	V
Gate No. 2-to-Source Cutoff Voltage	$V_{G2S(off)}$	V_{DS}= +15V, I_D=200μA, V_{G1S}=0		–	–2	–4	–	–2	–4	V
Gate-to-Source Forward Breakdown Voltage: Gate No. 1	$V_{(BR)G1SSF}$	I_{G1SSF} = I_{G2SSF} = 100 μA	V_{G2S} = V_{DS} = 0	–	9	–	–	11	–	V
Gate No. 2	$V_{(BR)G2SSF}$		V_{G1S} = V_{DS} = 0	–	9	–	–	11	–	V
Gate-to-Source Reverse Breakdown Voltage: Gate No. 1	$V_{(BR)G1SSR}$	I_{G1SSR} = I_{G2SSR} = 100 μA	V_{G2S} = V_{DS} = 0	–	9	–	–	11	–	V
Gate No. 2	$V_{(BR)G2SSR}$		V_{G1S} = V_{DS} = 0	–	9	–	–	11	–	V
Gate No. 1-Terminal Forward Current	I_{G1SSF}	V_{DS} = V_{G2S} = 0	V_{G1S} = 6 V	–	–	50	–	–	–	nA
			V_{G1S} = 4.5 V	–	–	–	–	–	50	nA
Gate No. 1-Terminal Reverse Current	I_{G1SSR}	V_{DS} = V_{G2S} = 0	V_{G1S} = –6 V	–	–	50	–	–	–	nA
			V_{G1S} = –4.5 V	–	–	–	–	–	50	nA
Gate No. 2-Terminal Forward Current	I_{G2SSF}	V_{DS} = V_{G1S} = 0	V_{G2S} = 6 V	–	–	50	–	–	–	nA
			V_{G2S} = 4.5 V	–	–	–	–	–	50	nA
Gate No. 2-Terminal Reverse Current	I_{G2SSR}	V_{DS} = V_{G1S} = 0	V_{G2S} = -6 V	–	–	50	–	–	–	nA
			V_{G2S} = –4.5 V	–	–	–	–	–	50	nA
Zero-Bias Drain Current	I_{DS}	V_{DS} = +15 V, V_{G1S} = 0, V_{G2S} = +4 V		5	15	30	5	15	35	mA
Forward Transconductance (Gate No. 1-to-Drain)	g_{fs}	V_{DS} = +15 V, I_D = 10 mA, V_{G2S} = +4 V	f = 1 kHz	–	12000	–	–	12000	–	μmho
Small-Signal, Short-Circuit Input Capacitance †	C_{iss}		f = 1 MHz	–	6.5	9.5	–	6.5	10	pF
Small-Signal, Short-Circuit, Reverse Transfer Capacitance (Drain-to-Gate-No. 1)♠	C_{rss}			0.005	0.020	0.030	0.005	0.025	0.045	pF
Small-Signal, Short-Circuit Output Capacitance	C_{oss}			–	2	–	–	2	–	pF
Power Gain (see Fig. 5)	G_{PS}		f = 100 MHz	19	24	–	–	–	–	dB
Noise Figure (see Fig. 5)	NF			–	2	3.5	–	–	–	dB
Conversion Gain	$G_{PS(C)}$		f = 100 to 10.7 MHz	–	–	–	14	18	–	dB

† Capacitance between Gate No. 1 and all other terminals.

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



1.3-5 pF variable air capacitor: E.F. Johnson Type 160-102 or equivalent.

2.7-19.6 pF variable air capacitor: E.F. Johnson Type 160-110 or equivalent.

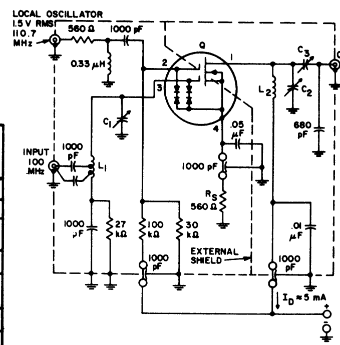
80 pF max. compression-type capacitor: Arco 405 or equivalent

8 turns No. 22 wire on 1/4" diameter air core. One turn spacing between windings. Tapped at one turn from low end.

37 turns No. 34 wire on 3/16" diameter air core. Unloaded Q = 63

40823.

Fig.1 - 100/10.7-MHz conversion power gain test circuit for type 40823.



C1:

C2:

C3:

L1:

Q:

C_1,C_2: 1.3-5.4 pF variable air capacitor

C_3: 1-10 pF variable air capacitor, piston type: Johanson Co., No. 4335

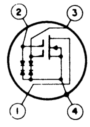
C_4: 1-15 pF variable air capacitor, precision piston type: Roanwell Corp. SG11129/AG

L_1,L_2: 0.22 μH RF choke (7T): Miller, No. 4584

*Ferramic toroid (1/2 used): Indiana General, No. CF101-(0-6)

Fig.2 - 100-MHz power gain and noise figure test circuit for type 40822.

TERMINAL DIAGRAM



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

For characteristics curves, refer to type 3N187.

40841

Silicon Dual-Insulated Gate Field-Effect Transistor

N-Channel Depletion Type

With Integrated Gate-Protection Circuits

General-Purpose Economy Type for Applications from DC to 500 MHz

RCA-40841 is an n-channel silicon, depletion type, dual-insulated gate, field-effect transistor intended for general-purpose applications from DC to frequencies up to 500 MHz.

This MOS/FET provides excellent power gain, linear-circuit operation and has a wide dynamic operating range. Its square-law characteristics result in low cross-modulation performance over the AGC range. Its dual-gate construction reduces feedback capacitance by shielding Gate No. 1 from the drain, and makes it possible to isolate the local oscillator signal from the incoming signal bv applying the two signals to separate gates. The very low feedback capacitance of this device eliminates the need for neutralization in circuits using the dual-gate configuration. Use of the device in the RF input stage of a receiver reduces local oscillator feed-through to the antenna. The 40841 requires negligible AGC power, vides automatic delay when AGC is applied to Gate No. id exhibits slight input impedance variations during AGC nctioning. The device has exceptionally high input impedance, an attribute for timing-circuit design.

Back-to-back diodes are fabricated on the same monolithic silicon pellet as the MOS/FET to protect the gates against damage due to electrostatic charges frequently encountered during normal handling. These back-to-back diodes also function as "transient trappers" by limiting in-circuit transient voltages that exceed ±10 volts.

Maximum ratings and electrical characteristics are included in the data for operation of the 40841 as the equivalent of a single-gate device. For single-gate operation, connect Gate No. 1 (Term. 2) to Gate No. 2 (Term. 3), as shown in the Terminal Diagrams on Page 2. The 40841 MOS/FET is hermetically sealed in the metal JEDEC TO-72 package.

Device Features:

- **back-to-back diodes protect gate insulation against damage due to static changes frequently encountered during handling**
- **high forward transconductance: g_{fs} = 12,000 µmho (typ.)**
- **high power gain: G_{ps} = 32 dB (typ.) at 44 MHz**
- **gate leakage currents: I_{G1SS} and I_{G2SS} = 60 nA (max.) at T_A = 25°C**
- **high input impedance**
- **excellent thermal stability**

Performance Features:

- **superior cross-modulation performance and greater dynamic range than bipolar and junction-gate FETs**
- **wide dynamic range permits large-signal handling before overloading**
- **virtually no agc power required**
- **greatly reduced spurious responses in AM and FM receivers**
- **dual-gate configuration permits simplified AGC circuitry**
- **operates at frequencies to 500 MHz without neutralization in circuits utilizing the dual-gate configuration**
- **operates up to UHF with low-noise performance**

The following dual-gate MOS/FET types are specified for applications requiring premimum-grade performance: 3N200, 3N187, 40673, 40819, 40820, 40821, 40822, and 40823.

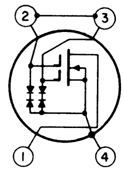
Detailed information, utilizing RCA dual-gate protected MOS/FETs in RF applications, is given in the following RCA Application Notes: AN-4431 "RF Applications of the Dual-Gate MOS/FET up to 500 MHz" and AN-4018 "Design of Gate-Protected MOS Field-Effect Transistors".

Applications:

- **DC amplifiers**
- **RF amplifiers**
- **mixers**
- **IF amplifiers**
- **video amplifiers**
- **differential amplifiers**
- **frequency multipliers**
- **phase splitters**
- **industrial timers — long time delays**
- **thyristor trigger circuits**
- **choppers**
- **voltage-controlled attenuators**
- **constant-current source**
- **voltage regulators**
- **telemetry & multiplex**
- **servo amplifiers**
- **proximity switches**

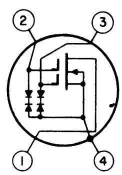
TERMINAL DIAGRAMS

SINGLE-GATE CONFIGURATION



LEAD 1–DRAIN
LEADS–2 AND 3–GATE
LEAD 4–SOURCE, SUBSTRATE AND CASE

DUAL-GATE CONFIGURATION



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

Maximum Ratings

Absolute Maximum Values, at T_A = 25°C:	Dual-Gate Configuration	Single-Gate Configuration	
Drain-to-Source Voltage, V_{DS}	–0.2 to +18	–0.2 to +18	V
Gate Terminal Current, I_{G1S} or I_{G2S}	±100	–	µA
Gate Terminal Current, I_{GS}	–	±100	µA
Drain-to-Gate Voltage, V_{DG1} or V_{DG2}	+24	–	V
Drain-to-Gate Voltage, V_{DG}	–	+24	V
Drain Current, I_D	50	50	mA
Transistor Dissipation:			
At T_A up to 25°C	330	330	mW
At T_A above 25°C	derate linearly 2.2 mW/°C		
Ambient Temperature Range:			
Operating and Storage	–65 to +175	–65 to +175	°C
Lead Temperature (During Soldering):			
At distances 1/32 in from seating surface for 10 s max.	265	265	°C
Continuous Working Voltage#, at T_A = 25°C:			
Gate No. 1-to-Source Voltage, V_{G1S}	–4.5 to +3	–	V
Gate No. 2-to-Source Voltage, V_{G2S}	-4.5 to +4.5 or 40% of V_{DS} (whichever value is less)	–	V
Gate-to-Source Voltage, V_{GS}	–	–4.5 to +3	V
Drain-to-Gate Voltage, V_{DG1} or V_{DG2}	+20	–	V
Drain-to-Gate Voltage, V_{DG}	–	+20	V

#Continuous Working Voltage Ratings must be observed to maintain device characteristics. These ratings are based on long-term continuous voltage operation but may be exceeded for short durations (e.g. testing of device characteristics), provided the Absolute Maximum Ratings are not exceeded.

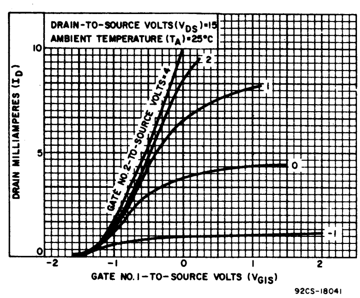


Fig.1–I_D vs. V_{G1S}.

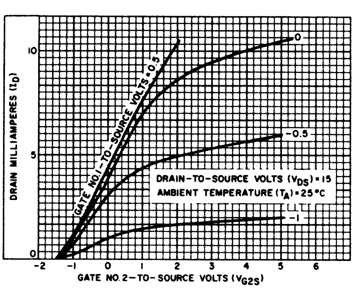


Fig.2–I_D vs. V_{G2S}.

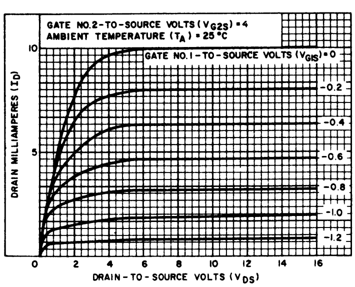


Fig.3–I_D vs. V_{DS}.

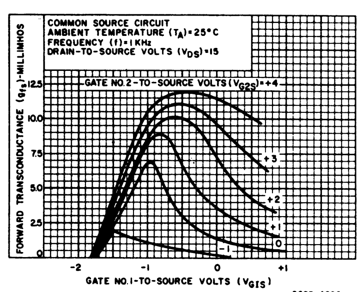


Fig.4–g_{fs} vs. V_{G1S}.

40841

ELECTRICAL CHARACTERISTICS at $T_A = 25^oC$

CHARACTERISTICS	SYMBOLS	TEST CONDITIONS	LIMITS CONFIGURATION DUAL-GATE MIN.	DUAL-GATE TYP.	DUAL-GATE MAX.	SINGLE-GATE MIN.	SINGLE-GATE TYP.	SINGLE-GATE MAX.	UNITS
Gate-to-Source Cutoff Voltage:									
Dual-Gate (No. 1)	$V_{G1S(off)}$	V_{DS} = +15V, I_D = 200μA, V_{G2S} = +4V	–	–2	–	–	–	–	V
Dual-Gate (No. 2)	$V_{G2S(off)}$	V_{DS} = +15V, I_D = 200μA, V_{G1S} = 0	–	–2	–	–	–	–	V
Single Gate	$V_{GS(off)}$	V_{DS} = +15V, I_D = 200μA	–	–	–	–	–1.6	–	V
Gate-to-Source Forward Breakdown Voltage:									
Dual-Gate (No. 1)	$V_{(BR)G1SSF}$	I_{G1SSF} = I_{G2SSF} = 100μA, V_{G2S} = V_{DS} = 0	–	9	–	–	–	–	V
Dual-Gate (No. 2)	$V_{(BR)G2SSF}$	I_{G1SSF} = I_{G2SSF} = 100μA, V_{G1S} = V_{DS} = 0	–	9	–	–	–	–	V
Single-Gate	$V_{(BR)GSSF}$	I_{GSSF} = 100μA, V_{DS} = 0	–	–	–	–	9	–	V
Gate-to-Source Reverse Breakdown Voltage:									
Dual-Gate (No. 1)	$V_{(BR)G1SSR}$	I_{G1SSR} = I_{G2SSR} = 100μA, V_{G2S} = V_{DS} = 0	–	9	–	–	–	–	V
Dual-Gate (No. 2)	$V_{(BR)G2SSR}$	I_{G1SSR} = I_{G2SSR} = 100μA, V_{G1S} = V_{DS} = 0	–	9	–	–	–	–	V
Single-Gate	$V_{(BR)GSSR}$	I_{GSSR} = 100μA, V_{DS} = 0	–	–	–	–	9	–	V
Gate Terminal Forward Current:									
Dual-Gate (No. 1)	I_{G1SSF}	V_{DS} = V_{G2S} = 0, V_{G1S} = 6 V	–	–	60	–	–	–	nA
Dual Gate (No. 2)	I_{G2SSF}	V_{DS} = V_{G1S} = 0, V_{G2S} = 6 V	–	–	60	–	–	–	nA
Single-Gate	I_{GSSF}	V_{DS} = 0, V_{GS} = 6 V	–	–	–	–	–	120	nA
Gate Terminal Reverse Current:									
Dual-Gate (No. 1)	I_{G1SSR}	V_{DS} = V_{G2S} = 0, V_{G1S} = –6 V	–	–	60	–	–	–	nA
Dual-Gate (No. 2)	I_{G2SSR}	V_{DS} = V_{G1S} = 0, V_{G2S} = –6 V	–	–	60	–	–	–	nA
Single-Gate	I_{GSSR}	V_{DS} = 0, V_{GS} = –6 V	–	–	–	–	–	120	nA
Zero-Bias Drain Current:									
Dual-Gate	I_{DS}	V_{DS} = +15 V, V_{G1S} = 0, V_{G2S} = +4 V	–	10	–	–	–	–	mA
Single-Gate	I_{DSS}	V_{DS} = +15 V, V_{GS} = 0	–	–	–	–	3.7	–	mA
Forward Transconductance (Gate-to-Drain)									
Dual-Gate	g_{fs}	V_{DS} = +15 V, I_D = 10 mA [Dual-Gate only V_{G2S} = +4 V]; 1 kHz	–	12000	–	–	–	–	μmho
Single-Gate	g_{fs}	1 kHz	–	–	–	–	7000	–	μmho
Small-Signal, Short-Circuit Input Capacitance†	C_{iss}	f = 1 MHz	–	6.5	–	–	11	–	pF
Small-Signal, Short-Circuit, Reverse Transfer Capacitance (Drain-to-Gate-No. 1)♠	C_{rss}	f = 1 MHz	–	0.02	–	–	0.54	–	pF
Small-Signal, Short-Circuit Output Capacitance	C_{oss}	f = 1 MHz	–	2	–	–	2	–	pF
Audio Spot Noise Figure*									
Dual-Gate	NF	f = 1 kHz	–	0.46	–	–	–	–	dB
Single-Gate	NF	f = 1 kHz	–	–	–	–	0.29	–	dB
Power Gain	G_{ps}	44 MHz	–	32	–	–	–	–	dB
Conversion Gain	$G_{ps(C)}$	44 MHz	–	24	–	–	–	–	dB

† Capacitance between Gate No. 1 and all other terminals (Dual-Gate), Gate and all other terminals (Single-Gate)

♠ Three-terminal measurement with Gate No. 2 and Source returned to guard terminal (Dual-Gate)

* Noise Figure = $10 \log_{10}\left[1 + \frac{e_n^2}{4\,KT\,BW\,R_g}\right]$ where $K = 1.38 \times 10^{-23}$; T = Temperature in °Kelvin; BW = Bandwidth in Hz; R_g = Generator resistance

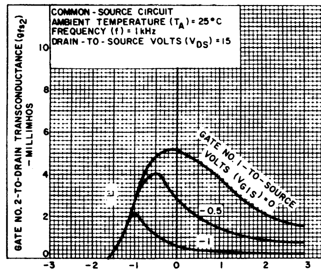


Fig.5—g_{fs2} vs. V_{G2S}.

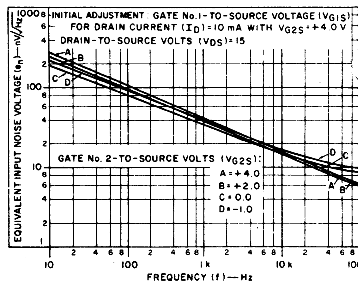


Fig.6—e_n vs. f.

TYPICAL CHARACTERISTICS FOR 40841 IN SINGLE-GATE CONFIGURATION

(Terminals 2 and 3 tied together to comprise effective single-gate)

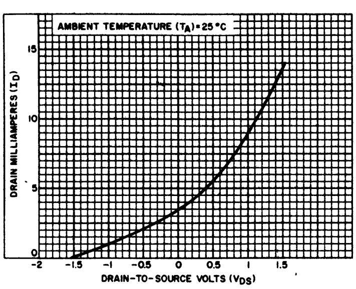


Fig.7—I_D vs. V_{DS}.

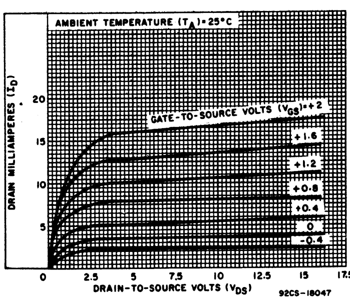


Fig.8—I_D vs. V_{DS}.

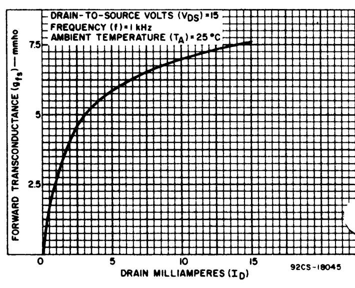


Fig.9—g_{fs} vs. I_D.

TYPICAL CHARACTERISTICS FOR 40841 IN SINGLE-GATE & DUAL-GATE CONFIGURATION

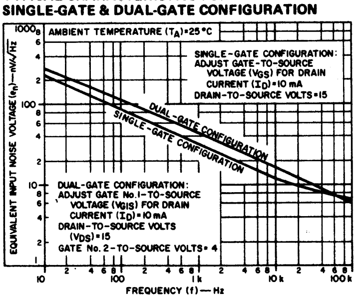


Fig.10—e_n vs. f.

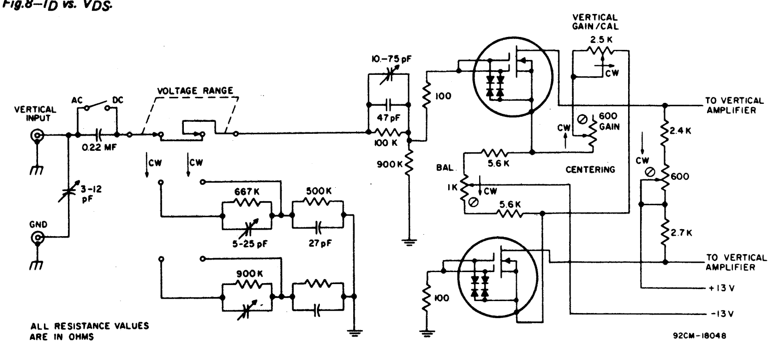
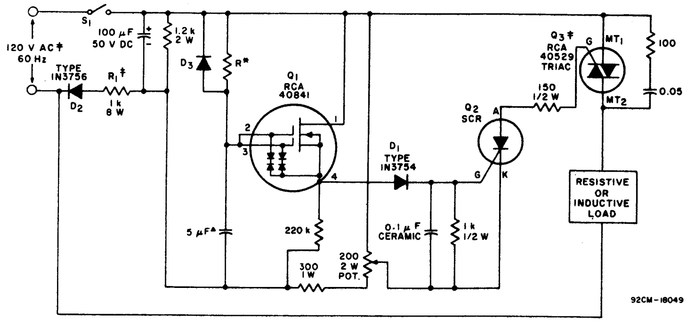


Fig.11—Typical differential amplifier utilizing the 40841 in the vertical input stage of a solid-state oscilloscope.

SOLID-STATE TIMER FOR INDUSTRIAL APPLICATIONS



▲ Cornell-Dubilier Electronics–Type MMW or equivalent.
* R controls duration of time delay. At R = 60 MΩ up to 5-minute delay (IRC resistor, Type CGH or equivalent)
‡ This circuit can also be used at supply voltages of 240 V AC and 24V AC (60Hz) by changing the values of R1 and Q3.

TIMING CIRCUIT CHARACTERISTICS

T_A = −25°C to +60°C
Accuracy: ±10% (over temperature)
Repeatability: ±3% (at 25°C)
Reset Time: Less than 150 ms

Q2: V_{DRM} = 60V
I_{GT} = 200µA
I_T = 0.8A

D3: I_R = 1 nA
V_R = 60V

Fig.12–Typical timing circuit utilizing the 40841 in a single-gate configuration.