The MRFIC Line

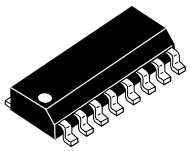
900 MHz GaAs Two-Stage Driver Amplifier

MRFIC0904

900 MHz GaAs TWO STAGE DRIVER AMP INTEGRATED CIRCUIT

The MRFIC0904 is an integrated driver amplifier designed for class A/B operation in the 800 MHz to 1 GHz frequency range. The design utilizes Motorola's Advanced GaAs FET process (MAFET) to yield superior performance and efficiency in a cost effective monolithic device. Off–chip output matching provides maximum flexibility in design. Applications for the MRFIC0904 include GSM, AMPS, and ISM band transmitters.

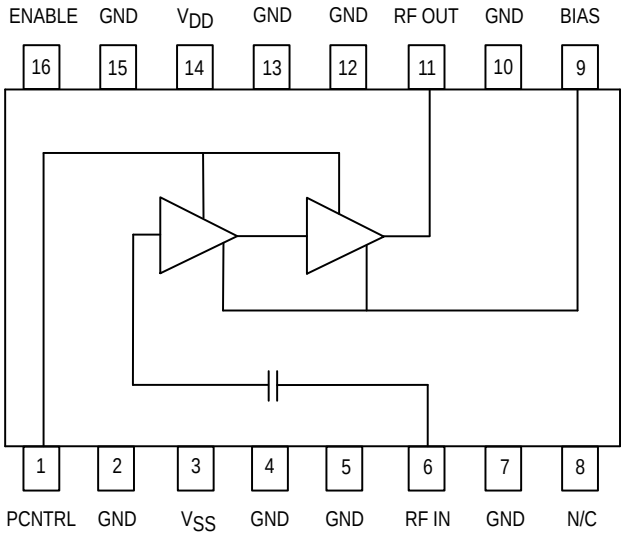
- GSM Ramping/Gain Control of 45 dB with Power Control Function (PCNTRL)
- Class 4 P_{out} (1 dB Gain Compression) = 26 dBm @ 4.8 V (Typical)
- Class 4 Supply Current (1 dB) = 120 mA @ 4.8 V (Typical)
- Class 5 P_{out} (1 dB Gain Compression) = 24 dBm 3.6 V (Typical)
- Class 5 Supply Current (1 dB) = 120 mA @ 3.6 V (Typical)
- Low Cost Surface Mount Plastic Package
- Available in Tape and Reel by Adding R2 Suffix to Part Number. R2 Suffix = 2,500 Units per 16 mm, 13 inch Reel.
- Device Marking = M0904



CASE 751B–05 (SO–16)

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Limit	Unit
Supply Voltage	V_{DD} V_{SS}	6.0 –3	Vdc
Power Control Voltage	PCNTRL	V_{DD}	Vdc
Enable Voltage	ENABLE	V_{DD}	Vdc
Input Power	P_{in}	5	dBm
Operating Ambient Temperature	T_A	– 35 to +85	°C
Storage Temperature	T_{stg}	–65 to +150	°C



Pin Connections and Functional Block Diagram

MOTOROLA

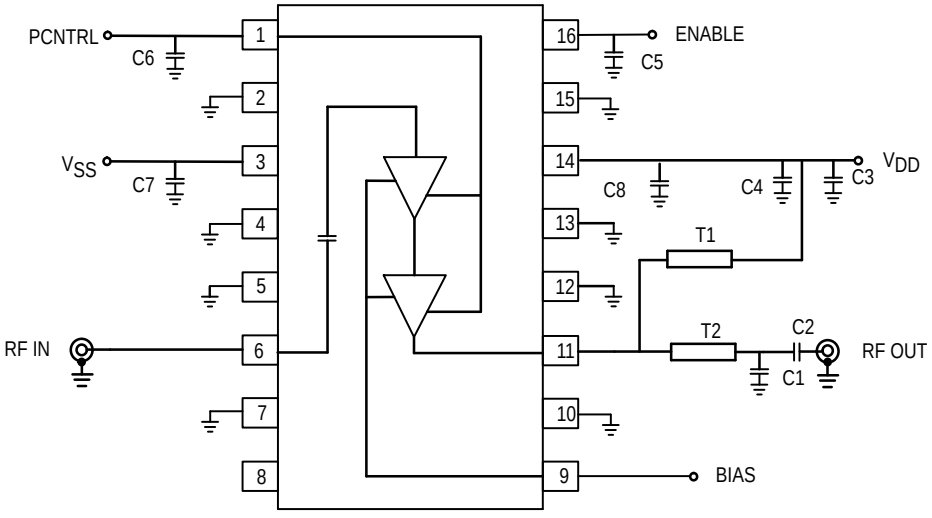
RECOMMENDED OPERATING RANGES (T_A = 25°C unless otherwise noted)

Parameter	Symbol	Value	Unit
Supply Voltage	V_{DD} V_{SS}	2.7 to 5.0 –2.75 to –2.25	Vdc
Bias Voltage Range	BIAS	0 to 1.0	Vdc
Power Control Voltage Range	PCNTRL	0 to 3.0	Vdc
Enable Voltage ON State	ENABLE	2.5	Vdc
Enable Voltage OFF State	ENABLE	0.5	Vdc
RF Frequency	f	800 to 1000	MHz

ELECTRICAL CHARACTERISTICS (V_{DD} = 3.6 V, V_{SS} = –2.5 V, BIAS = 0.0 V, PCNTRL = 3.0 V, ENABLE = 3.0 V, P_{in} = –2 dBm, f = 900 MHz, Z_O = 50 Ω, T_A = 25°C unless otherwise noted)

Characteristic	Min	Typ	Max	Unit
Supply Current I_{DD} I_{SS}	 — —	 120 1.0	 160 1.75	mA
Standby Current: Off–mode (ENABLE = 0 V) I_{DD} I_{SS}	 — —	 50 60	 130 360	μA
Output Power	22.5	24	—	dBm
Output Power at 1 dB Gain Compression	—	24.5	—	dBm
Input Return Loss	—	14	—	dB
PCNTRL Current	—	200	—	μA
ENABLE Current	—	200	—	μA
Gain Control Range	—	45	—	dB
Enable/Control Input 3 dB Bandwidth	—	1	—	MHz

(1) All electrical Characteristics are measured in test circuit schematic as shown in Figure 1.



C1 – 2.7 pF
C2, C4, C8 – 100 pF
C3 – 1 μF
C5, C6 – 10 pF
C7 – 1000 pF
T1 – 90° @ 900 MHz, Z_0 = 100 Ω
T2 – 9° @ 900 MHz, Z_0 = 50 Ω
BOARD MATERIAL = FR4

Figure 1. Applications Circuit Configuration

TYPICAL CHARACTERISTICS

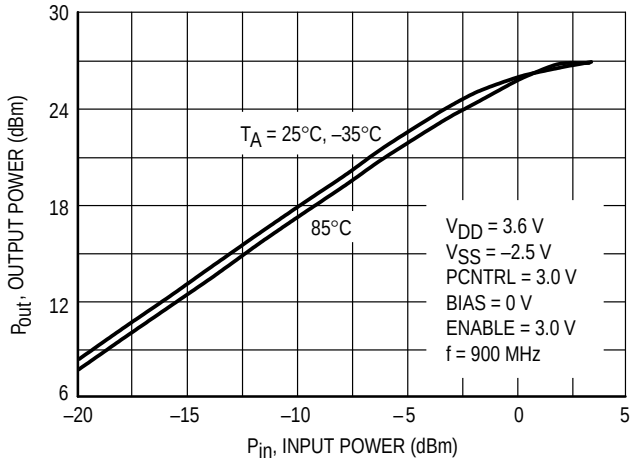


Figure 2. Output Power versus Input Power

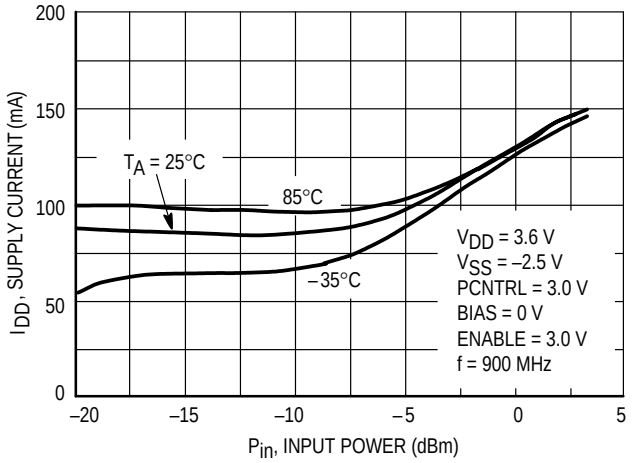


Figure 3. Supply Current versus Input Power

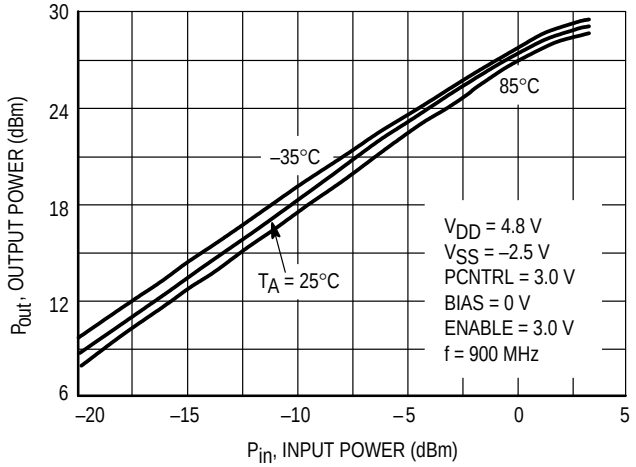


Figure 4. Output Power versus Input Power

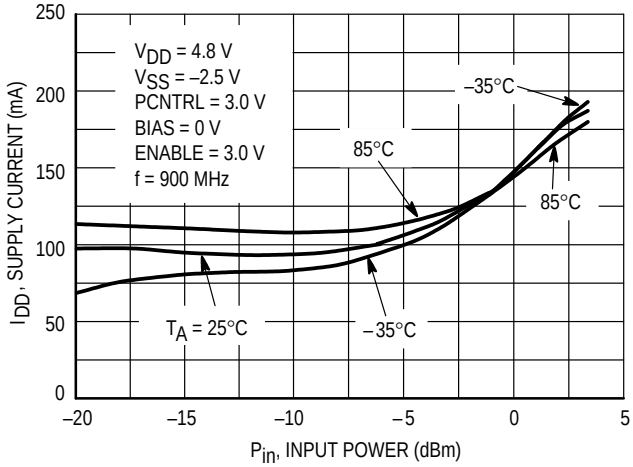


Figure 5. Supply Current versus Input Power

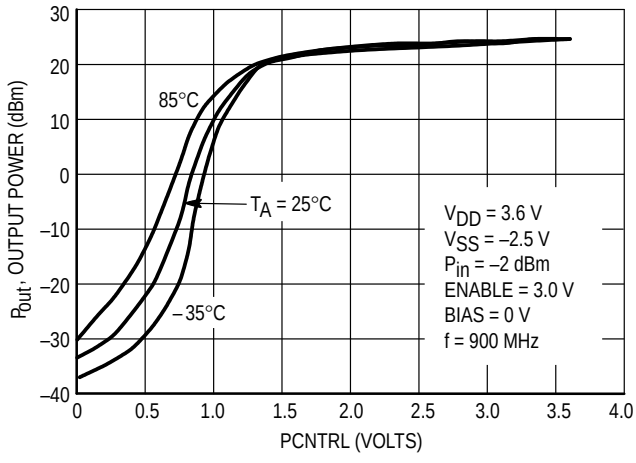


Figure 6. Output Power versus PCNTRL

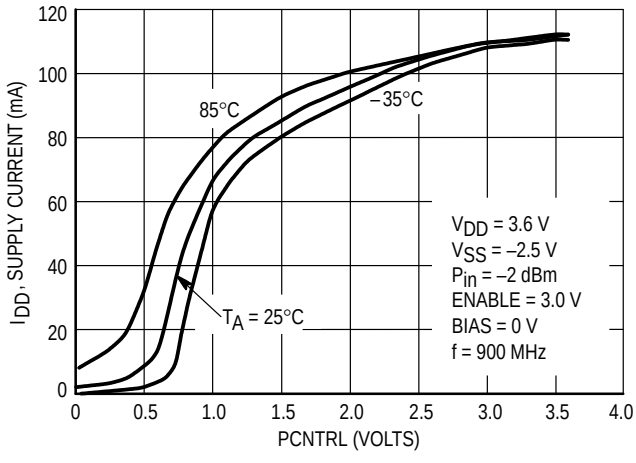


Figure 7. Supply Current versus PCNTRL

TYPICAL CHARACTERISTICS

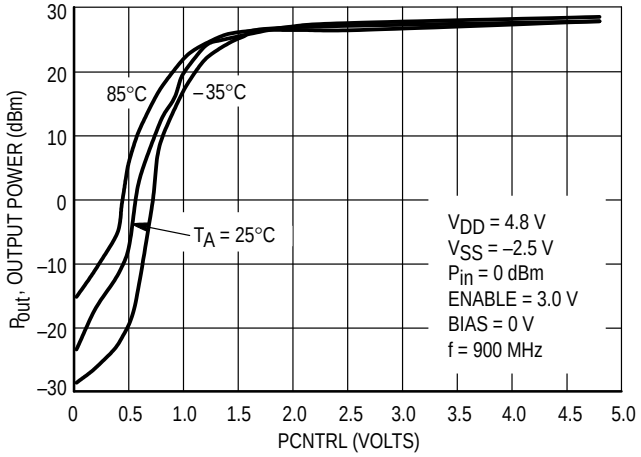


Figure 8. Output Power versus PCNTRL

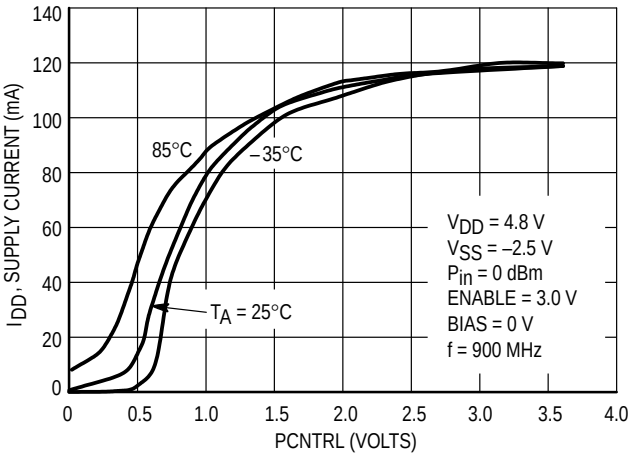


Figure 9. Supply Current versus PCNTRL

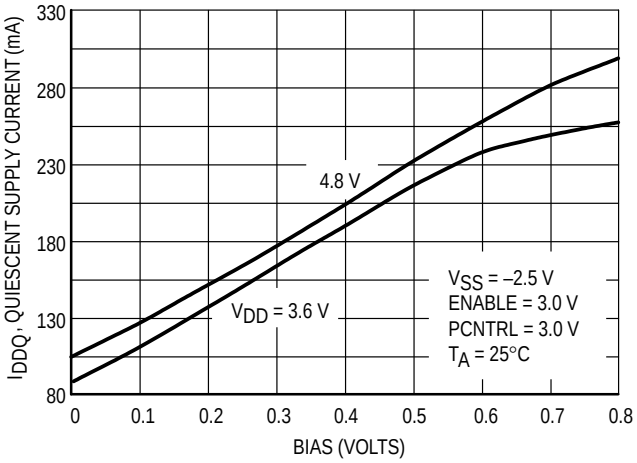


Figure 10. Quiescent Supply Current versus BIAS

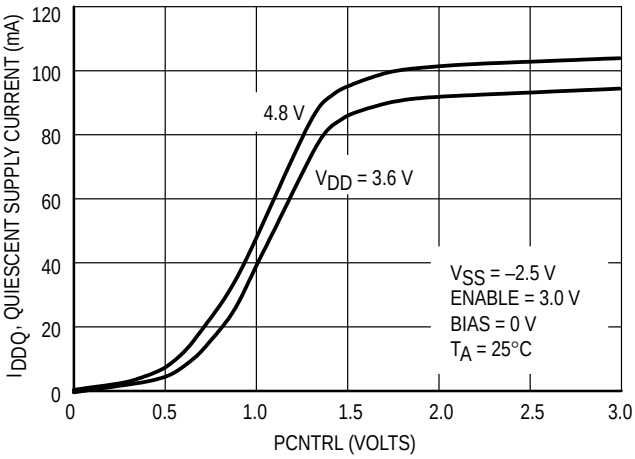


Figure 11. Quiescent Supply Current versus PCNTRL

Table 1. Scattering Parameters
(V_{DD} = 3.6 V, V_{SS} = –2.5 V, BIAS = 0.0 V, PCNTRL, ENABLE = 3 V, 50 Ω System)

f	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	$\|S_{11}\|$	∠ϕ	$\|S_{21}\|$	∠ϕ	$\|S_{12}\|$	∠ϕ	$\|S_{22}\|$	∠ϕ
500	0.922	–40.93	12.201	–76.39	0.002	72.64	0.276	166.48
550	0.887	–52.05	16.242	–98.58	0.002	62.03	0.276	169.80
600	0.826	–65.21	21.133	–116.66	0.003	44.52	0.297	175.47
650	0.698	–81.22	28.039	–140.66	0.004	26.65	0.342	173.06
700	0.419	–99.95	33.973	174.46	0.004	6.35	0.360	169.94
750	0.206	–106.43	32.195	145.72	0.006	–9.10	0.393	163.65
800	0.073	–56.19	31.685	121.12	0.006	–31.13	0.392	154.83
850	0.146	–4.45	29.419	85.45	0.006	–47.59	0.351	146.93
900	0.170	–1.59	25.996	64.50	0.006	–61.44	0.305	145.90
950	0.183	10.82	24.115	45.18	0.007	–80.54	0.276	152.91
1000	0.232	27.47	22.091	16.72	0.007	–107.22	0.287	162.87
1050	0.302	34.19	19.995	–5.08	0.007	–116.06	0.310	167.00
1100	0.395	34.85	17.411	–26.64	0.006	–125.77	0.337	170.51
1150	0.522	29.21	14.15	–52.28	0.006	–146.60	0.380	169.57
1200	0.607	23.25	11.961	–71.38	0.005	–154.46	0.403	167.34
1250	0.675	17.30	9.76	–88.04	0.005	–177.16	0.419	163.73
1300	0.743	9.17	7.951	–108.01	0.004	160.61	0.436	159.33

Table 2. Scattering Parameters
(V_{DD} = 4.8 V, V_{SS} = –2.5 V, BIAS = 0.0 V, PCNTRL, ENABLE = 3 V, 50 Ω System)

f	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	$\|S_{11}\|$	∠ϕ	$\|S_{21}\|$	∠ϕ	$\|S_{12}\|$	∠ϕ	$\|S_{22}\|$	∠ϕ
500	0.910	–41.17	12.58	–78.69	0.0012	65.66	0.228	168.72
550	0.873	–51.75	17.09	–99.91	0.0024	43.49	0.232	172.87
600	0.807	–64.98	22.33	–118.28	0.0032	48.13	0.252	177.75
650	0.671	–81.03	29.24	–142.97	0.0041	17.29	0.293	174.31
700	0.409	–100.12	35.95	172.30	0.0040	–10.22	0.326	172.83
750	0.200	–104.83	34.04	143.18	0.0055	–14.65	0.349	164.57
800	0.080	–53.72	33.08	118.78	0.0056	–28.05	0.345	156.12
850	0.142	–6.52	30.64	83.58	0.0057	–45.38	0.307	147.87
900	0.165	0.32	27.22	62.36	0.0065	–62.81	0.248	146.40
850	0.187	14.68	24.95	41.95	0.0066	–86.95	0.226	146.72
1000	0.252	28.28	22.30	14.13	0.0062	–100.71	0.257	167.95
1050	0.323	32.92	20.06	–7.52	0.0057	–113.16	0.279	172.05
1100	0.409	32.35	17.37	–28.14	0.0049	–121.71	0.310	173.62
1150	0.527	26.77	14.03	–53.24	0.0051	–152.49	0.349	171.86
1200	0.606	21.18	11.89	–71.66	0.0051	–159.64	0.365	169.36
1250	0.669	15.59	9.74	–87.41	0.0043	–155.55	0.381	163.46
1300	0.735	8.10	7.96	–107.51	0.0039	171.99	0.397	161.81

APPLICATIONS INFORMATION

DESIGN PHILOSOPHY

The MRFIC0904 is a versatile driver amplifier designed to operate in the 800 MHz to 1 GHz frequency range for cellular phone and Industrial, Scientific, and Medical (ISM) applications. The amplifier is designed using depletion mode GaAs MESFETs to perform at high efficiency at battery voltages of 3.6 and 4.8 Volts. While designed as a driver amplifier for a discrete transistor final stage, the device can act as a power amplifier for lower power systems such as ISM applications in telemetry and cordless telephones.

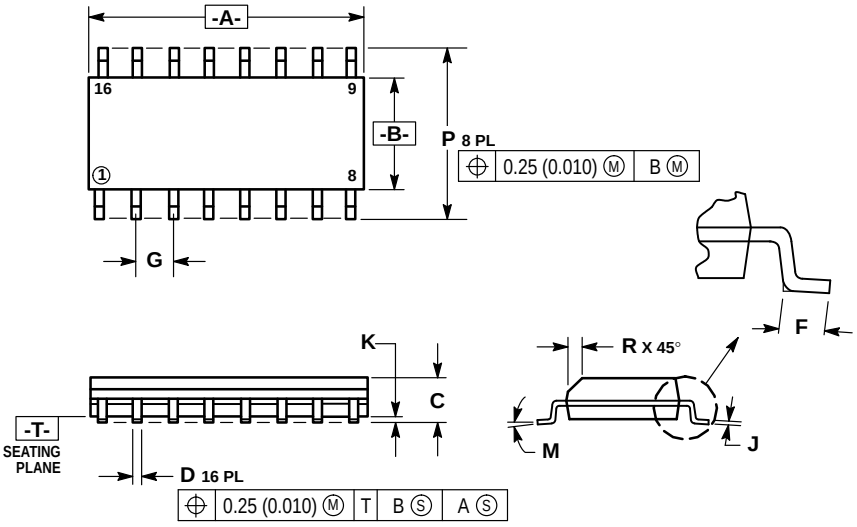
THEORY OF OPERATION

The MRFIC0904 has various control features making it versatile and applicable to both linear and saturated applications. The BIAS pin allows the setting of drain quiescent current. For non–linear applications such as GSM cellular, the pin can be grounded. For better gain and linearity, a positive voltage up to about 0.6 Volts can be applied. The PCNTRL pin allows the control of the output power over a wide dynamic range with low AM to AM distortion such as is required in GSM and other cellular systems. As shown in Figures 6 through 9, PCNTRL affects both the output power and the drain current thus maintaining good efficiency over a range of output power. The ENABLE pin is used to control the on–off state of the device and is useful as a reduced current standby control. A logic high signal of more than 2.5 Volts turns the device on. A logic low signal of less than 0.5 Volts reduces total supply current to typically less than 200 μA.

EVALUATION BOARDS

Evaluation boards are available for RF Monolithic Integrated Circuits by adding a “TF” suffix to the device type. For a complete list of currently available boards and ones in development for newly introduced poduct, please contact your local Motorola Distributor or Sales Office.

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	9.80	10.00	0.386	0.393
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

CASE 751B-05
ISSUE J

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