

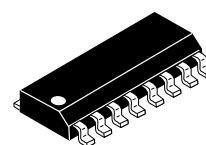
The MRFIC Line 900 MHz Driver and Ramp

The MRFIC2004 is an integrated Driver and Ramp designed for transmitters operating in the 800 MHz to 1.0 GHz frequency range. The Ramp is an integrator which can be used for burst control for TDD/TDMA systems. The Driver uses a cascode configuration for high gain and reverse isolation. A power down control is provided to minimize current drain with minimum recovery/turn-on time. Also, an on-board inverter is included to provide complementary control for an antenna switch, such as the MRFIC2003. The design utilizes Motorola's advanced MOSAIC 3 silicon bipolar RF process to yield superior performance in a cost effective monolithic device. Applications for the MRFIC2004 include CT1 and CT2 cordless telephones, GSM, remote controls, video and audio short range links, low cost cellular radios, and ISM band transmitters.

- Small Signal Gain = 21.5 dB (Typ)
- Small Signal Gain Control = 34 dB (Typ)
- P_o 1.0 dB = -1.0 dBm (Typ)
- On Board Ramp for Burst Control
- Power Down Supply Current = 0.7 mA (Typ)
- Low Operating Supply Voltage (2.7 to 4.0 Volts)
- Input/Output VSWR Insensitive to Gain Control
- Order MRFIC2004R2 for Tape and Reel.
R2 Suffix = 2,500 Units per 16 mm, 13 inch Reel.
- Device Marking = M2004

MRFIC2004

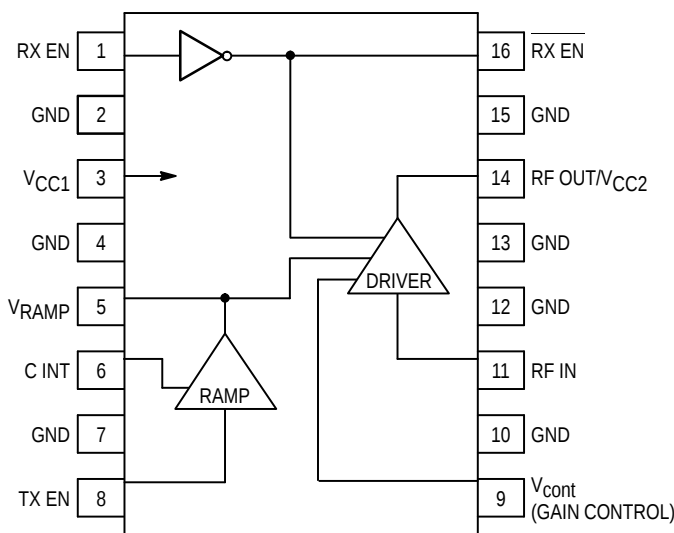
**900 MHz DRIVER
& RAMP
SILICON MONOLITHIC
INTEGRATED CIRCUIT**



**CASE 751B-05
(SO-16)**

ABSOLUTE MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Rating	Symbol	Value	Unit
Supply Voltages	V_{CC1}	4.5	Vdc
	V_{CC2}	6.0	Vdc
Control Voltages	RXEN, TXEN, V_{cont}	6.0	Vdc
Input Power, RF IN Port	P_{RF}	+10	dBm
Operating Ambient Temperature	T_A	-35 to +85	$^\circ\text{C}$
Storage Temperature	T_{stg}	-65 to +150	$^\circ\text{C}$



Pin Connections and Functional Block Diagram

RECOMMENDED OPERATING RANGES

Parameter	Symbol	Value	Unit
Supply Voltage Ranges	V_{CC1} , V_{CC2}	2.7 to 4.0	Vdc
Control Voltage Ranges	TX EN, RX EN, V_{cont}	0 to V_{CC1}	Vdc
Frequency Range	f	800 to 1000	MHz

ELECTRICAL CHARACTERISTICS (V_{CC1} , $V_{CC2} = 3.0$ V, $C_{INT} = 2.0$ nF, $T_A = 25^\circ\text{C}$, $f = 900$ MHz, $V_{CONT} = 1.3$ V)

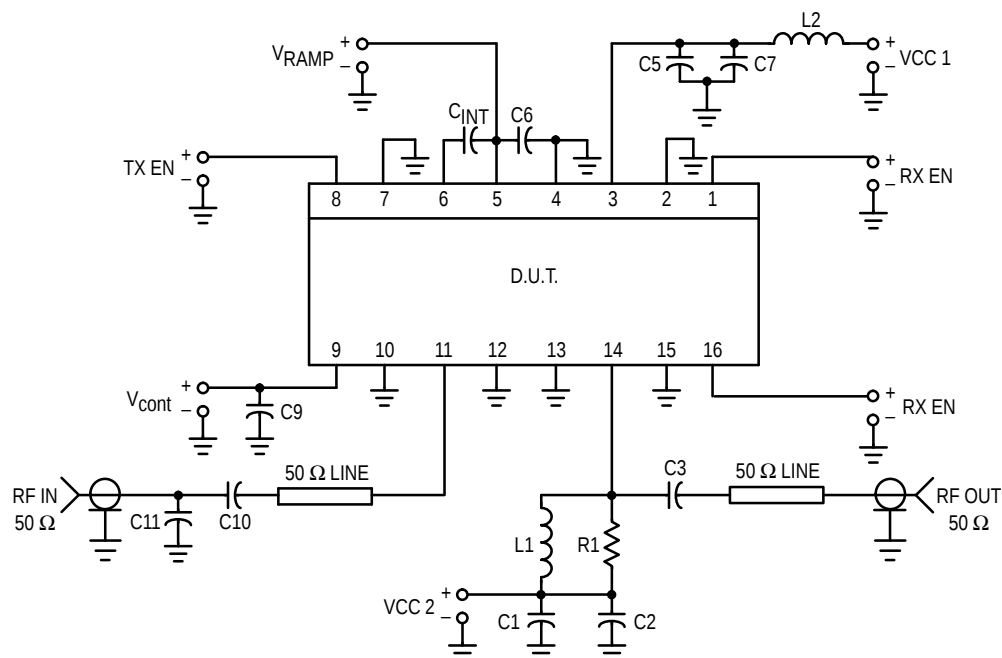
Characteristics (1)	Min	Typ	Max	Unit
Supply Current, TX EN High, RX EN Low	—	11	13	mA
Supply Current, TX EN Low, RX EN High	—	0.7	1.5	mA
Driver Characteristics (1)				
Gain (Small Signal)	19	21.5	24	dB
Gain Control (Small Signal)	—	34	—	dB
Power Out @ 1.0 dB Gain Compression	-4.0	-1.0	—	dBm
Third Order Intercept Point (out)	—	+7.5	—	dBm
Reverse Isolation	—	32	—	dB
Ramp Characteristics (1)				
Ramp Up Delay Time	—	4.0	—	μs
Rise Time	—	18	—	
Total Time	—	22	—	
Ramp Down Delay Time	—	4.0	—	μs
Fall Time	—	18	—	
Total Time	—	22	—	

LOGIC LEVELS ($V_{CC1} = 2.7$ to 4.0 V, $T_A = 25^\circ\text{C}$)

RX EN & TX EN Input Voltage	Min	Typ	Max	Unit
High	$V_{CC1} - 0.8$	—	—	V
Low	—	—	0.8	
RX EN Output Voltage				
High	$V_{CC1} - 0.2$	—	—	V
Low	—	—	0.2	

NOTE:

1. All electrical characteristics measured in test circuit schematic shown in Figure 1 below.



- C1, C7, C9 — 1000 pF Chip Capacitor
 C2, C5, C6, C10 — 100 pF Chip Capacitor
 C3 — 1.6 pF Chip Capacitor
 C_{INT} — 2000 pF Chip Capacitor
 C11 — 6.2 pF Chip Capacitor
 L1 — 4.7 nH Chip Inductor
 L2 — 150 nH Chip Inductor
 R1 — 330 Ω Chip Resistor
 RF Connectors — SMA Type
 Board Material — Epoxy/Glass $\epsilon_r = 4.5$,
 Dielectric Thickness = 0.014" (0.36 mm)

Figure 1. Typical Biasing Configuration

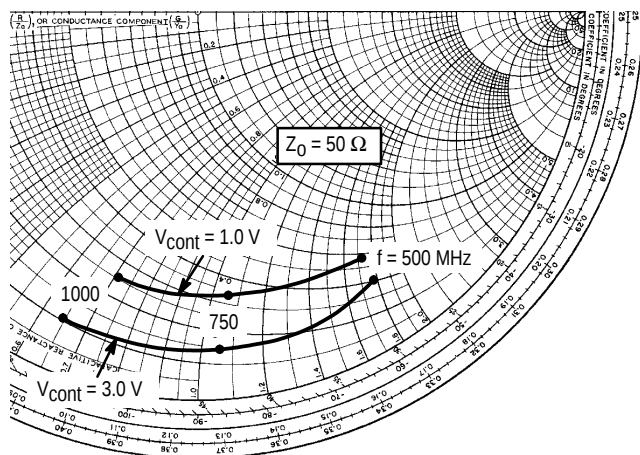


Figure 2. S_{11} versus Frequency versus V_{cont}

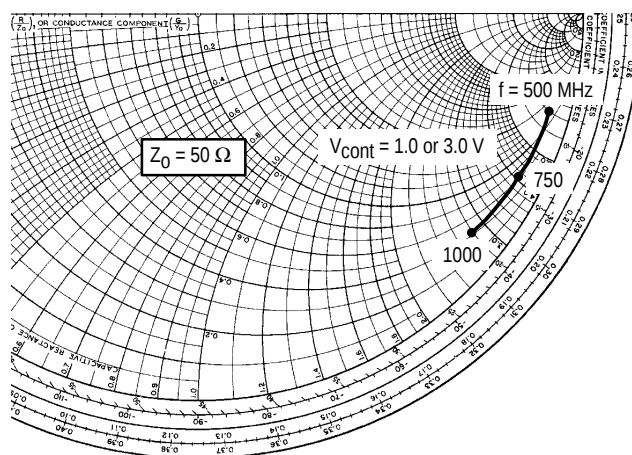


Figure 3. S_{22} versus Frequency

V_{cont}	f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
		$ S_{11} $	$\angle\phi$	$ S_{21} $	$\angle\phi$	$ S_{12} $	$\angle\phi$	$ S_{22} $	$\angle\phi$
1.0	100	0.85	-11.3	10.48	171.5	0.0002	142.7	0.99	-2.9
	300	0.83	-32.8	10.33	156.3	0.0020	129.0	0.99	-7.3
	500	0.79	-56.9	10.15	140.5	0.0030	130.6	0.98	-15.9
	550	0.79	-62.5	10.04	135.9	0.0030	132.6	0.98	-17.9
	600	0.78	-68.5	9.85	130.2	0.0040	133.3	0.98	-20.0
	650	0.77	-74	9.47	126.9	0.0040	135.9	0.98	-22.3
	700	0.76	-79	9.23	123.6	0.0050	137.2	0.98	-24.7
	750	0.76	-84.4	9.02	119.4	0.0050	138.1	0.97	-27.0
	800	0.75	-89.6	8.69	113.8	0.0060	139.7	0.97	-29.3
	850	0.74	-94.5	8.33	110.8	0.0070	140.3	0.97	-31.4
	900	0.73	-99.1	8.13	108.9	0.0080	141.2	0.96	-33.2
	950	0.73	-102	7.98	105.4	0.0090	138.3	0.96	-36.3

	1000	0.72	-106.9	7.70	101.0	0.0100	133.7	0.95	-38.4
1.9	100	0.85	-11.3	0.53	-173.5	0.0002	104.3	0.99	-2.9
	300	0.86	-33.5	0.69	-169.7	0.0009	118.7	0.98	-8.7
	500	0.87	-59.3	0.89	-179.5	0.0010	134.3	0.98	-15.5
	550	0.87	-65.7	0.96	175.1	0.0020	136.3	0.98	-17.5
	600	0.88	-73.1	1.02	169.9	0.0020	138.9	0.97	-19.6
	650	0.88	-78.7	1.04	167.3	0.0020	142.6	0.97	-21.8
	700	0.88	-84.7	1.07	165.0	0.0030	147.8	0.97	-24.1
	750	0.89	-90.7	1.14	161.5	0.0030	153.4	0.96	-26.4
	800	0.89	-98.2	1.17	155.8	0.0040	161.0	0.96	-28.8
	850	0.88	-104.6	1.22	151.2	0.0050	161.8	0.96	-30.7
	900	0.87	-110.1	1.24	144.6	0.0060	162.7	0.95	32.8
	950	0.86	-114.6	1.26	139.9	0.0070	160.3	0.95	-35.1
	1000	0.85	-118.8	1.27	134.1	0.0080	158.2	0.94	-37.2
3.0	100	0.85	-10.9	0.003	-85.9	0.0001	115.0	0.99	-2.8
	300	0.86	-31.9	0.014	-78.8	0.0006	121.0	0.99	-8.5
	500	0.87	-56.9	0.032	-61.1	0.0010	128.0	0.98	-15.1
	550	0.88	-62.4	0.038	-65.8	0.0010	136.2	0.98	-17.0
	600	0.89	-69.4	0.048	-68.3	0.0010	140.0	0.98	-19.2
	650	0.90	-75.1	0.058	-75.1	0.0020	145.1	0.98	-21.3
	700	0.90	-81.3	0.069	-82.4	0.0020	150.8	0.97	-23.6
	750	0.91	-87.3	0.081	-89.4	0.0020	156.8	0.97	-25.8
	800	0.91	-93.8	0.092	-113.4	0.0030	160.3	0.97	-28.1
	850	0.92	-100.7	0.092	-121.8	0.0040	163.3	0.96	-30.1
	900	0.91	-106.8	0.089	-128.2	0.0050	163.3	0.96	-32.3
	950	0.90	-111.4	0.083	-137.1	0.0060	155.2	0.95	-34.5
	1000	0.89	-115.2	0.077	-151.9	0.0060	150.0	0.95	-36.6

Table 1. Small Signal Deembedded S Parameters

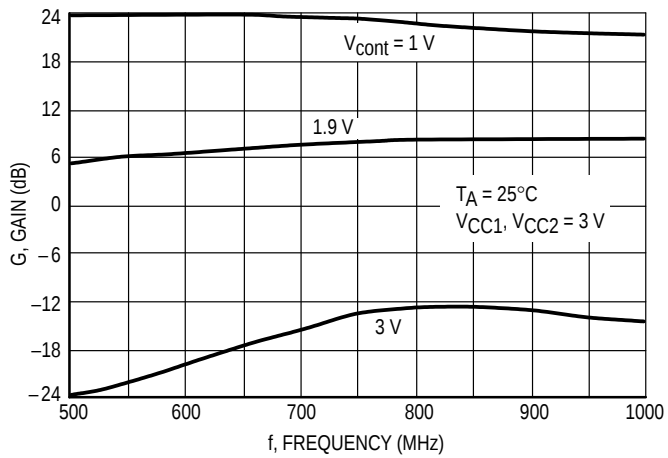


Figure 4. Small Signal Gain versus Frequency

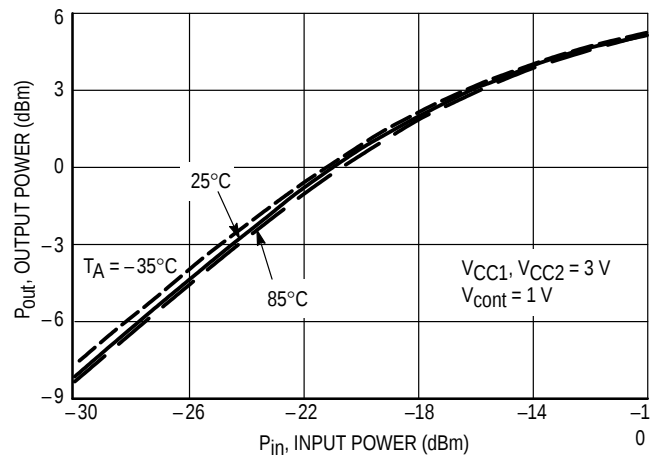


Figure 5. Output Power versus Input Power

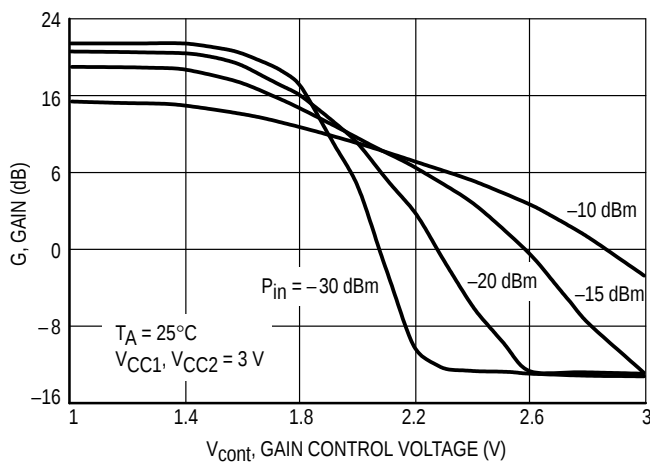


Figure 6. Driver Gain versus Gain Control Voltage

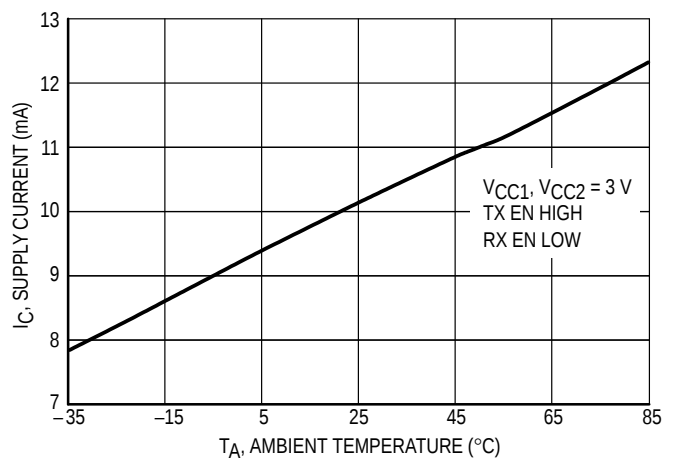


Figure 7. Supply Current versus Ambient Temperature

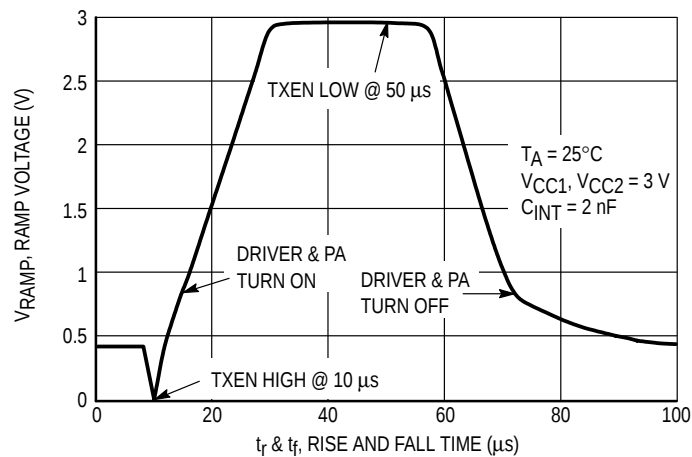


Figure 8. Ramp Voltage versus Rise & Fall Time

DESIGN PHILOSOPHY

The MRFIC2004 was designed as a support IC for a CT2 chip-set. The other chips making up the chip-set are the MRFIC2001 downconverter, the MRFIC2002 transmit mixer, the MRFIC2003 antenna switch and the MRFIC2006 PA. A complete CT2 front-end solution requires a ramp for burst control, an inverter for complementary antenna switch control and gain control (or an attenuator) for the transmitter low power mode. In order to keep the other chips in the chip-set relatively general purpose, yet provide the system designer with an easily controlled solution, these functions were combined with a driver amplifier into one IC, the MRFIC2004.

THEORY OF OPERATION

The driver is a cascode design that exits the IC open-collector. Impedance matching must be done externally. Since the output requires a bias inductor and DC blocking capacitor, the output can be matched with these two elements. To keep the driver unconditionally stable, it is recommended that a 300–400 ohm resistor be placed in parallel with the bias inductor as close to the IC as possible. Since the output impedance of the driver by itself is very high, the resistor sets the output impedance. The input can be matched with a series inductor followed by a shunt capacitor. Alternatively, a series transmission line followed by a shunt capacitor can be used. A DC block is also required on the input.

Gain control is provided to meet the CT2 low power mode requirement. The CT2 Common Air Interface specification requires the transmitter to be capable of dropping the output power by 16 ± 4.0 dB. Although the driver has 34 dB of small signal gain control, it can be reduced by ad-

ding a resistor in series with the gain control pin. The value of the resistor depends on the logic levels being used and the amount of gain compression after the driver. Also, the amount of gain control is a function of the driver input power level. The input power should be kept less than –10 dBm to allow for sufficient gain control to achieve the low power mode. The gain control can also be used for PA output power trimming. However, this is not an efficient method.

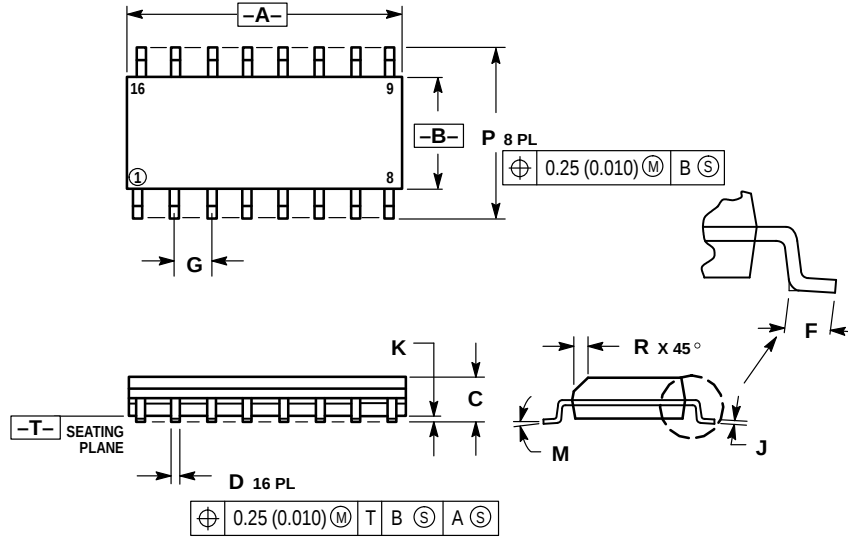
The ramp is an integrator which is used to slow down the driver and PA turn-on and turn-off times to reduce AM splatter. By applying a pulse waveform to the input, a linear ramp waveform is created at the output which is then applied to the current mirrors of the driver and PA. An external integrating capacitor is used so that the rise/fall time can be programmed externally. A minimum value of 2.0–2.4 nF is needed to meet the CT2 Common Air Interface splatter specification. For non-TDD/TDMA systems the ramp reverts to an enable/disable function.

The inverter is CMOS/TTL compatible and was included to provide complementary control for an antenna switch such as the MRFIC2003. By applying the receiver enable control line, RXEN, to the inverter the inverse RXEN will be created. RXEN and RXEN can then be used to control the MRFIC2003 antenna switch.

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 product, 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.

DIM	MILLIMETERS		INCHES	
	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
E	0.40	1.25	0.016	0.049
F	1.27 BSC		0.050 BSC	
G	0.19	0.25	0.008	0.009
H	0.10	0.25	0.004	0.009
I	0°	7°	0°	7°
J	5.80	6.20	0.229	0.244
K	0.25	0.50	0.010	0.019

CASE 751B-05 ISSUE J

Motorola reserves the right to make changes without further notice to any products herein. Motorola makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Motorola assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters which may be provided in Motorola data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. Motorola does not convey any license under its patent rights nor the rights of others. Motorola products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Motorola product could create a situation where personal injury or death may occur. Should Buyer purchase or use Motorola products for any such unintended or unauthorized application, Buyer shall indemnify and hold Motorola and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Motorola was negligent regarding the design or manufacture of the part. Motorola and  are registered trademarks of Motorola, Inc. Motorola, Inc. is an Equal Opportunity/Affirmative Action Employer.

Mfax is a trademark of Motorola, Inc.

How to reach us:

USA/EUROPE/Locations Not Listed: Motorola Literature Distribution;
P.O. Box 5405, Denver, Colorado 80217. 303-675-2140 or 1-800-441-2447

JAPAN: Nippon Motorola Ltd.: SPD, Strategic Planning Office, 4-32-1,
Nishi-Gotanda, Shinagawa-ku, Tokyo 141, Japan. 81-3-5487-8488

Mfax™: RMFAX0@email.sps.mot.com – TOUCHTONE 602-244-6609
– US & Canada ONLY 1-800-774-1848

ASIA/PACIFIC: Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park,
51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852-26629298

INTERNET: <http://motorola.com/sps>





Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный)

Факс: 8 (812) 320-02-42

Электронная почта: org@eplast1.ru

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.