BURR-BROWN®

MPY634/883B SERIES

MPY634SH/883B MPY634SD/883B

REVISION A
JANUARY, 1989

Wide Bandwidth PRECISION ANALOG MULTIPLIER

FEATURES

- WIDE BANDWIDTH: 10MHz typ
- ±0.1% MAX 4-QUADRANT ERROR
- INTERNAL WIDE-BANDWIDTH OP AMP
- EASY TO USE
- MIL-STD-883 COMPLIANT

APPLICATIONS

- PRECISION ANALOG SIGNAL PROCESSING
- MODULATION AND DEMODULATION
- VOLTAGE-CONTROLLED AMPLIFIERS
- VIDEO SIGNAL PROCESSING
- VOLTAGE-CONTROLLED FILTERS AND OSCILLATORS

DESCRIPTION

The MPY634/883B is a wide bandwidth, high accuracy, four-quadrant analog multiplier. Its accurately laser-trimmed multiplier characteristics make it easy to use in a wide variety of applications with a minimum of external parts, often eliminating all external trimming. Its differential X, Y, and Z inputs allow configuration as a multiplier, squarer, divider, square-rooter, and other functions while maintaining high accuracy.

The wide bandwidth of this new design allows signal processing at IF, RF, and video frequencies. The internal output amplifier of the MPY634 reduces design complexity compared to other high frequency multipliers and balanced modulator circuits. It is capable of performing frequency mixing, balanced modulation, and demodulation with excellent carrier rejection.

An accurate internal voltage reference provides precise setting of the scale factor. The differential Z input allows user-selectable scale factors from 0.1 to 10 using external feedback resistors.

The MPY634/883B features processing that is fully compliant to the requirements of MIL-STD-883, for a Class B device. The MPY634/883B's operation is specified and tested over the Military operating temperature range of −55°C to +125°C.

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PDS-792A

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DETAILED SPECIFICATION MICROCIRCUITS, LINEAR ANALOG MULTIPLIER MONOLITHIC, SILICON

1. SCOPE

1.1 Scope. This specification covers the detail requirements for a monolithic four-quadrant precision analog multiplier.

1.2 Part Number. The complete part number is shown below.

MPY634	S	H	/883B
Basic model number	Grade (see 1.2.1)	Package (see 1.2.3)	Hi-Rel product designator (see 1.2.2)

1.2.1 Device Type. The device is a single four-quadrant analog multiplier. There is a single electrical performance grade (S grade) which features specifications and testing over the Military temperature range (−55°C to +125°C). Electrical specifications and tests are shown in Tables I and II.

1.2.2. Device Class. The device class is similar to the Class B product assurance level defined in MIL-M-38510. The Hi-Rel product designator portion of the part number distinguishes the product assurance level available as follows:

Hi-Rel Product Designator	Requirements
/883B	Standard model plus 100% MIL-STD-883 Class B screening, with 5% PDA, plus Quality Conformance Inspection (QCI) consisting of Groups A and B performed in each inspection lot, plus Groups C and D performed as required by MIL-STD-883.

1.2.3. Case Outline. Two case outlines are available.

a. The "H" package identifier is utilized to specify the 10-lead metal can TO-100, which is MIL-M-38510, Appendix C, designator A-2. Figure 1 depicts the case outline for this package type.
b. The "D" package identifier is utilized to specify the 14-pin Ceramic Side-Brazed package, which is MIL-M-38510, Appendix C, designator D-1, configuration 3. Figure 1 depicts the case outline for this package type.

1.2.4 Absolute Maximum Ratings.

Supply voltage V_{CC} to common	±20VDC
Output short circuit to ground	Continuous
Input voltage X_1, X_2, Y_1, Y_2, Z_1, and Z_2	$\pm V_{CC}$
Storage temperature range	−65°C to +150°C
Temperature (soldering 10s)	+300°C
Junction temperature	$T_J = \pm 175°C$

1.2.5 Recommended Operating Conditions.

Supply voltage $\pm V_{CC}$	±15VDC
Ambient temperature range	−55°C to +125°C

1.2.6 Power and Thermal Characteristics

Package	Case Outline	Maximum Allowable Power Dissipation	Maximum θ_{JC}
14-lead DIP	Figure 1	500mW	50°C/W
10-lead TO-100	Figure 1	500mW	60°C/W

2. APPLICABLE DOCUMENTS

2.1 Government Specification and Standard. Unless otherwise specified, the following specification and standard form a part of this specification to the extent specified herein.

SPECIFICATION
MILITARY
MIL-M-38510—Microcircuits, general specification for.

STANDARD
MILITARY
MIL-STD-883—Test methods and procedures for microcircuits.

2.2 Order of Precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 General. Burr-Brown uses production and test facilities and a quality and reliability assurance program adequate to assure successful compliance with this specification.

3.1.1 Detail Specifications. The individual item requirements are specified herein. In the event of conflicting requirements, the order of precedence will be the purchase order, this specification, and then the reference documents.

3.2 Design, Construction, and Physical Dimensions.

3.2.1 Package, Metals, and Other Materials. The packages, metal surfaces, and other materials are in accordance with MIL-M-38510.

3.2.2 Design Documentation. The design documentation is in accordance with MIL-M-38510.

3.2.3. Internal Conductors and Internal Wires. The internal conductors and internal lead wires are in accordance with MIL-M-38510.

3.2.4 Lead Material and Finish. The lead material and finish is in accordance with MIL-M-38510 and is solderable per MIL-STD-883, method 2003.

3.2.5 Die Thickness. The die thickness is in accordance with MIL-M-38510.

3.2.6 Physical Dimensions. The physical dimensions are in accordance with paragraph 1.2.3 herein and are shown in Figure 1.

3.2.7 Circuit Diagram and Terminal Connections. The simplified circuit diagram and terminal connections are shown in Figures 2 and 3.

3.2.8 Glassivation. The microcircuit die is glassivated.

3.3 Electrical Performance Characteristics. The electrical performance characteristics are specified in Table I and apply over the full operating ambient temperature range of −55°C to +125°C unless otherwise specified.

3.4 Electrical Test Requirements. Electrical test requirements are shown in Table II. The subgroups of Table I, which constitute the minimum electrical test requirements for screening, qualification, and quality conformance inspection, are specified in Table II.

3.5 Marking. Marking is in accordance with MIL-M-38510. The following marking is placed on each microcircuit as a minimum:

a. Part number (see paragraph 1.2)
b. Inspection lot identification code1/
c. Manufacturer's identification (BURR-BROWN®)
d. Manufacturer's designating symbol (CEBS)
e. Country of origin
f. Electrostatic sensitivity identifier (Δ)

3.6 Workmanship. These microcircuits are manufactured, processed, and tested in a workmanlike manner. Workmanship is in accordance with good engineering practices, workmanlike instructions, inspection and test procedures, and training, prepared in fulfillment of Burr-Brown's product assurance program.

3.6.1 Rework Provisions. Rework provisions, including rebonding for the "/883B" product designation, are in accordance with MIL-M-38510.

1/ A 4-digit code, indicating year and week of seal, and a 4- or 5-digit lot identifier are marked on each unit.

3.7 Traceability. Traceability for the "/883B" product designation is in accordance with MIL-M-38510. Each microcircuit is traceable to the production lot and to the component vendor's component lot.

3.8 Product and Process Change. Burr-Brown will not implement any major change to the design, materials, construction, or manufacturing process thay may affect the performance, quality, or interchangeability of the microcircuit without full of partial requalification.

3.9 Screening. Screening for the "/883B" Hi-Rel product designation is in accordance wtih MIL-STD-883, method 5004, Class B, and as specified herein. All microcircuits will have passed the screening requirements prior to qualification or quality conformance inspection.

T-73-29

3.10 Qualification. Qualification is not required. See paragraph 4.2 herein.

3.11 Quality Conformance Inspection. Quality Conformance Inspection (QCI) for the "/883B" product designation is in accordance with MIL-STD-883, and as specified in paragraph 4.4 herein. The microcircuit inspection lot will have passed quality conformance inspection prior to microcircuit delivery.

4. PRODUCT ASSURANCE PROVISIONS

4.1 Sampling and Inspection. Sampling and inspection procedures are in accordance with MIL-M-38510 and MIL-STD-883, method 5005.

4.2 Qualification. Qualification is not required unless specifically requried by contract or purchase order. When so required, qualification will be in accordance with the inspection routine of MIL-M-38510. The inspections to be performed are those specified herein for Groups A, B, C, and D inspections (see paragraphs 4.4.1, 4.4.2, 4.4.3, and 4.4.4 herein).

4.3 Screening. Screening for the "/883B" Hi-Rel product designation is in accordance with MIL-STD-883, method 5004, Class B, and is conducted on all devices. The following criteria apply:

a. Interim and final test parameters are specified in Table II.
b. Burn-in test (MIL-STD-883, method 1015) conditions:
   (1) Test condition B.
   (2) Test circuit is Figure 4.
   (3) $T_A = +125°C$.
   (4) Test duration is 160 hours minimum.
c. Percent Defective Allowable (PDA). The PDA, for "/883B" product designation only, is 5% and includes both parametric and catastrophic failures from Group A, Subgroup 1 test after cool-down as final electrical test in accordance with MIL-STD-883, method 5005, and with no intervening electrical measurements. If interim electrical parameter tests are performed prior to burn-in, failures resulting from preburn-in screening failures may be excluded from the PDA. If interim electrical parameter tests are omitted, all screening failures shall be included in the PDA. The verified failures of Group A, Subgroup 1 after burn-in are used to determine the Percent Defective for each manufacturing lot, and the lot is accepted or rejected based on PDA.
d. External visual inspection need not include measurement of case and lead dimensions.

4.4 Quality Conformance Inspection. Groups A and B inspections of MIL-STD-883, method 5005, Class B are performed on each inspection lot. Groups C and D inspections of MIL-STD-883, method 5005, Class B are performed as required by MIL-STD-883. A report of the most recent Group C and D inspections is available from Burr-Brown.

4.4.1 Group A Inspection. Group A inspection consists of the test subgroups and LTPD values shown in MIL-STD-883, method 5005, and as specified in Table II herein.

4.4.2 Group B Inspection. Group B inspection consists of the test subgroups and LTPD values shown in MIL-STD-883, method 5005, Class B.

4.4.3 Group C Inspection. Group C inspection consists of the subgroups and LTPD values shown in MIL-STD-883, method 5005, Class B, and as follows:

a. Operating life test (MIL-STD-883, method 1005) conditions:
   (1) Test condition B.
   (2) Test circuit is Figure 4.
   (3) $T_A = +125°C$ minimum.
   (4) Test duration is 1000 hours minimum.
b. End point electrical parameters are specified in Table II.

4.4.4 Group D Inspection. Group D inspection consists of the test subgroups and LTPD values shown in MIL-STD-883, method 5005. End point electrical parameters are specified in Table II herein.

4.4.5 Inspection of Packaging. Inspection of packaging shall be in accordance with MIL-M-38510. T-73-29

4.5 Methods of Examination and Test. Methods of examination and test are specified in the appropriate tables. Electrical test circuits are as prescribed herein or in the referenced Test Methods of MIL-STD-883.

4.5.1 Voltage and Current. All voltage values given, except the input offset voltage (or differential voltage) are referenced to the external zero reference level of the supply voltage. Currents given are conventional current and positive when flowing into the referenced terminal.

5. PACKAGING

5.1 Packaging Requirements. The requirements for packaging shall be in accordance with MIL-M-38510.

6. NOTES

6.1 Notes. The notes specified in MIL-M-38510 are applicable to this specification.

6.2. Intended Use. Microcircuits conforming to this specification are intended for use in applications where the use of screened parts is required or desirable.

6.3 Ordering Data. The contract or purchase order should specify the following:

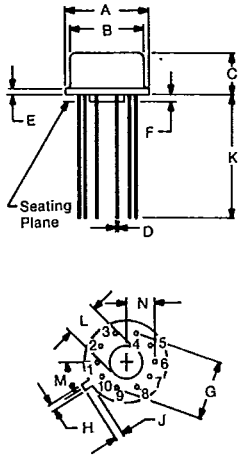
a. Complete part number (see paragraph 1.2).
b. Requirement for Certificate of Compliance, if desired.

6.4 Microcircuit Group Assignment. These microcircuits are assigned to technology Group D with a microcircuit group number of 49 as defined in MIL-M-38510, Appendix E.

6.5 Electrostatic Sensitivity. Caution—these microcircuits may be damaged by electrostatic discharge. Precautions should be observed at all times.

7. APPLICATION INFORMATION

7.1 Further Information. Further application information can be found in Burr-Brown's commercial data sheet for the MPY634.



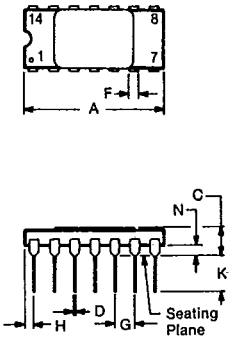
NOTE: Leads in true position within 0.01" (0.25mm) R at MMC at seating plane.

Pin numbers shown for reference only. Numbers may not be marked on package.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.335	.370	8.51	9.40
B	.305	.335	7.75	8.51
C	.165	.185	4.19	4.70
D	.016	.021	0.41	0.53
E	.010	.040	0.25	1.02
F	.010	.040	0.25	1.02
G	.230 BASIC		5.84 BASIC	
H	.028	.034	0.71	0.86
J	.029	.045	0.74	1.14
K	.500	—	12.70	—
L	.120	.160	3.05	4.06
M	36° BASIC		36° BASIC	
N	.110	.120	2.79	3.05

(a) TO-100 metal can—package ID: "H."

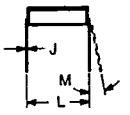
Ceramic Dual-In-Line



NOTE: Leads in true position within 0.01" (0.25mm) R at MMC at seating plane.

Pin numbers shown for reference only. Numbers may not be marked on package.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.670	.710	17.02	18.03
C	.065	.170	1.65	4.32
D	.015	.021	0.38	0.53
F	.045	.060	1.14	1.52
G	.100 BASIC		2.54 BASIC	
H	.025	.070	0.64	1.78
J	.008	.012	0.20	0.30
K	.120	.240	3.05	6.10
L	.300 BASIC		7.62 BASIC	
M	—	10°	—	10°
N	.009	.060	0.23	1.52



(b) 14-pin ceramic side braze—package ID: "D."

FIGURE 1. Case Outlines.

T-73-29

TABLE I. Electrical Performance Characteristics.

T_A = −55°C to +125°C; Supply Voltages: $\pm V_{CC}$ = ±15VDC.

CHARACTERISTICS	CONDITIONS	GROUP A SUBGROUPS	MPY634SD/883B MPY634SH/883B MIN	TYP	MAX	UNITS
MULTIPLIER PERFORMANCE						
Total Error (ET)	−10V ≤ X, Y ≤ +10V, T_A = +25°C	1	−1.0		+1.0	%FS
	−10V ≤ X, Y ≤ +10V, −55°C ≤ T_A ≤ +125°C	2, 3	−2.0		+2.0	%FS
Total Error vs. Temperature		2, 3	−0.02		+0.02	%/°C
Scale Factor Error1/	SF = 10.000V nominal			±0.25		%
Scaling Voltage Temperature Coefficient						
Supply Rejection (PSR)	$\pm V_{CC}$ = ±15V, ±1V			±0.02		%/°C
Nonlinearity: X (NL_X)	X = 20Vp-p, Y = 10V			±0.4		%FS
Y (NL_Y)	Y = 20Vp-p, X = 10V			±0.2		%FS
Feedthrough2/: X (FT_X)	Y = 0, X = 20Vp-p			±0.3		%FS
Y (FT_Y)	X = 0, Y = 20Vp-p			±0.01		%FS
Output Offset Voltage (V_{OO})	X = Y = Z = 0V, T_A = +25°C	1	−30		+30	mV
Output Offset Voltage Drift	X = Y = Z = 0V, −55°C ≤ T_A ≤ +125°C	2, 3			±500	µV/°C
DYNAMICS						
Small Signal Bandwidth	V_{OUT} = 0.1Vrms	9	6	10		MHz
1% Amplitude Error	C_{LOAD} = 100pF			50		kHz
Slew Rate	V_{OUT} = 20Vp-p			20		V/µs
Settling Time	To 1%, ΔV_O = 20V			2		µs
NOISE						
Noise Spectral Density	SF = 10V			0.8		µV/√Hz
Wideband Noise	f = 10Hz to 5MHz			1		mVrms
	f = 10Hz to 10kHz			90		µVrms
OUTPUT						
Output Voltage Swing		1, 2, 3	±11			V
Output Impedance	f ≤ 1kHz			0.1		Ω
Output Short Circuit Current (I_{OS})	−55°C ≤ T_A ≤ +125°C			30		mA
Amplifier Open Loop Gain	f = 50Hz			70		dB
INPUT AMPLIFIERS (X, Y, and Z)						
Input Voltage Range	Differential or Common-Mode Operating Differential			±10		V
Offset Voltage X, Y (V_{IOX}, V_{IOY})	T_A = +25°C	1			±20	mV
Offset Voltage X, X Drift (DV_{IOX}, DV_{IOY})	T_A = −55°C to +125°C			±100		µV/°C
Offset Voltage Z (V_{IOZ})	T_A = +25°C	1			±30	mV
Offset Voltage Z, Z Drift (DV_{IOZ})	T_A = −55°C to +125°C	2, 3			500	µV/°C
Common-Mode Rejection Ratio (CMRR)		4	60			dB
Input Bias Current (I_{IB})	X, Y, and Z Inputs	1			±2	µA
Input Offset Current (I_{IO})	X, Y, and Z Inputs	1			±2	µA
Input Differential Resistance				10		MΩ
POWER SUPPLY						
Supply Voltage ($\pm V_{CC}$)	$\pm V_{CC}$	1	±8	±15	±20	VDC
Supply Current ($\pm I_{CC}$)	Quiescent operation	1, 2, 3			±6	mA

1/ May be reduced to 3V using external resistor between $-V_S$ and SF.
2/ Irreducible component due to nonlinearity; excludes effect of offsets.

TABLE II. Electrical Test Requirements.

(The individual tests within the subgroups appear in Table I).

MODELS	MPY634SD/883B MPY634SH/883B
MIL-STD-883 TEST REQUIREMENTS	Subgroups (see Table I)
Interim electrical parameters (Pre burn-in) (method 5005)	1
Final electrical test parameters (method 5005)	1*, 2, 3, 4, 9
Group A test requirements (method 5005)	1, 2, 3, 4, 9
Group C and D end point electrical parameters (method 5005)	1

*PDA applies to Subgroup 1.

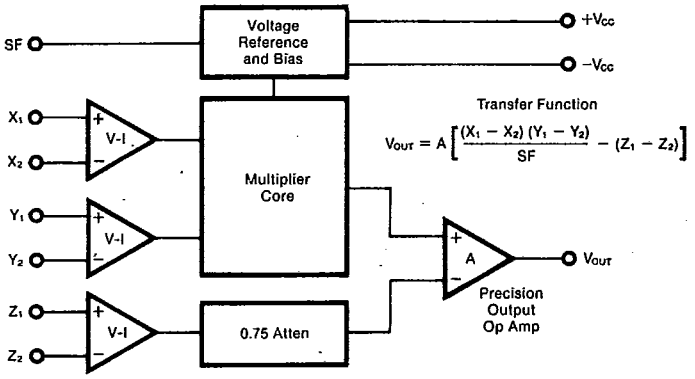
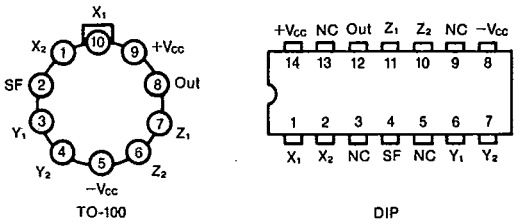


FIGURE 2. Simplified Circuit Diagram and Transfer Function.



(a) "H" Package (b) "D" Package

FIGURE 3. Terminal Connections.

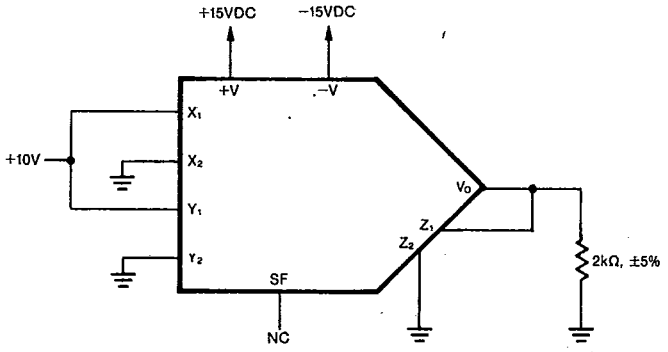


FIGURE 4. Test Circuit, Burn-in and Operating Life Test.