

Radio Shack®

CAT. NO. 62-1376

Three Dollars and Ninety-Five Cents

**MEMORY
DATABOOK**

**NATIONAL
SEMICONDUCTOR**



This is National's 1977 Memory handbook containing information on MOS and Bipolar Memory Components, Systems, Application Notes and Support Circuits. For detailed information on Interface Circuits and other major product lines, contact a National sales office, representative, or distributor.

MOS RAMs	1
Bipolar RAMs	2
CMOS RAMs	3
MOS EPROMs	4
Bipolar PROMs	5
MOS ROMs	6
Bipolar ROMs	7
Shift Registers	8
Memory Systems	9
Interface	10
App Notes/Briefs	11

© National Semiconductor Corporation
2900 Semiconductor Drive, Santa Clara, California 95051,
(408) 737-5000/TWX (910) 339-9240
National does not assume any responsibility for use of any circuitry
described; no circuit patent licenses are implied, and National
reserves the right, at any time without notice, to change said circuitry.

Manufactured under one or more of the following U.S. patents:
3083262, 3189758, 3231797, 3303356, 3317671, 3323071,
3381071, 3408542, 3421025, 3426423, 3440498, 3518750,
3519897, 3557431, 3560765, 3566218, 3571630, 3575609,
3579059, 3593069, 3597640, 3607469, 3617859, 3631312,
3633052, 3638131, 3648071, 3651565, 3693248.

Table of Contents

Edge Index by Product Family	1
Alpha-Numerical Index	9
RAM Cross Reference Guide	13
Bipolar RAM Cross Reference Guide	14
Bipolar PROM Cross Reference Guide	15
Bipolar PROM/ROM Selection Guide	16

Section 1—MOS RAMs

MM1101, MM11011 256-Bit (256 x 1) Static	1-1
MM1101A, MM1101A1, MM1101A2 256-Bit (256 x 1) Static	1-1
MM2101, MM2101-1, MM2101-2 1024-Bit (256 x 4) Static with Separate I/O	1-5
MM2102, MM2102-1, MM2102-2 1024-Bit (1024 x 1) Static	1-8
MM2102A, MM2102AL Family 1024-Bit (1024 x 1) Static	1-12
MM2102MD, MM2102-2MD 1024-Bit (1024 x 1) Static, Military Temperature Range	1-15
MM2111, MM2111-1, MM2111-2 1024-Bit (256 x 4) Static with Common Data I/O	1-19
MM2112, MM2112-2 1024-Bit (256 x 4) Static with Common Data I/O	1-22
MM4250 256-Bit (256 x 1) Static, Military Temperature Range	1-1
MM5269 1024-Bit (256 x 4) Static with On-Chip Registers	1-26
MM4270 4096-Bit (4096 x 1) TRI-SHARE™ Port, Dynamic	1-28
MM5270 4096-Bit (4096 x 1) TRI-SHARE™ Port, Dynamic	1-33
MM5270A 4096-Bit (4096 x 1) Dynamic	1-38
MM5270-5 4096-Bit (4096 x 1) TRI-SHARE™ Port, Dynamic	1-44
MM5271 4096-Bit (4096 x 1) Fully TTL Compatible, Dynamic	1-46
MM5271A 4096-Bit (4096 x 1) TRI-SHARE™ Port, Dynamic	1-51
MM4280 4096-Bit (4096 x 1) Dynamic	1-56
MM5280 4096-Bit (4096 x 1) Dynamic	1-60
MM5280A 4096-Bit (4096 x 1) Dynamic	1-64
MM5280-5 4096-Bit (4096 x 1) Dynamic	1-70
MM5281 4096-Bit (4096 x 1) Fully TTL Compatible, Dynamic	1-72
MM5290 16,384-Bit (16,384 x 1) Dynamic	1-76

Section 2—Bipolar RAMs

DM5489/DM7489 64-Bit (16 x 4) Open-Collector	2-1
DM54LS189/DM74LS189 64-Bit (16 x 4) TRI-STATE®, Low Power Schottky	2-4
DM54S189/DM74S189 64-Bit (16 x 4) TRI-STATE® Schottky	2-7
DM54S200/DM74S200 256-Bit (256 x 1) TRI-STATE® Schottky	2-11
DM54S206/DM74S206 256-Bit (256 x 1) Open-Collector Schottky	2-15
DM54LS289/DM74LS289 64-Bit (16 x 4) Open-Collector, Low Power Schottky	2-19

Table of Contents (Continued)

Section 2—Bipolar RAMs (Continued)

DM54S289/DM74S289 64-Bit (16 x 4) Open-Collector Schottky	2-22
DM85S68 64-Bit (16 x 4) Schottky Edge-Triggered Register	2-25
DM7599/DM8599 64-Bit (16 x 4) TRI-STATE®	2-29
DM93415, DM93415A 1024-Bit (1024 x 1) TTL, Fully Decoded	2-33
DM93425, DM93425A 1024-Bit (1024 x 1) TTL, Fully Decoded	2-34

Section 3—CMOS RAMs

MM54C89/MM74C89 64-Bit (16 x 4) TRI-STATE®	3-1
MM54C200/MM74C200 256-Bit (256 x 1) TRI-STATE®	3-5
MM54C910/MM74C910 256-Bit (256 x 1) TRI-STATE®	3-8
MM54C920/MM74C920 1024-Bit (256 x 4) Static Silicon Gate	3-12
MM54C921/MM74C921 1024-Bit (256 x 4) Static Silicon Gate	3-12
MM54C929/MM74C929 1024-Bit (1024 x 1) Static Silicon Gate	3-19
MM54C930/MM74C930 1024-Bit (1024 x 1) Static Silicon Gate	3-19

Section 4—MOS EPROMs

MM1702A 2048-Bit (256 x 8) Electrically Programmable and Erasable ROM	4-1
MM2704 4096-Bit (512 x 8) UV Erasable and Electrically Programmable	4-7
MM2708 8192-Bit (1024 x 8) UV Erasable and Electrically Programmable	4-7
MM4203/MM5203 2048-Bit (256 x 8 or 512 x 4) Electrically Programmable and Erasable ROM	4-12
MM4204/MM5204 4096-Bit (512 x 8) Electrically Programmable and Erasable ROM	4-17

Section 5—Bipolar PROMs

PROM Programming Procedure	5-1
DM54S188/DM74S188 256-Bit (32 x 8) Open-Collector Schottky	5-2
DM54S287/DM74S287 1024-Bit (256 x 4) TRI-STATE® Schottky	5-4
DM54S288/DM74S288 256-Bit (32 x 8) TRI-STATE® Schottky	5-2
DM54S387/DM74S387 1024-Bit (256 x 4) Open-Collector Schottky	5-4
DM54S470/DM74S470 2048-Bit (256 x 8) Open-Collector Schottky	5-9
DM54S471/DM74S471 2048-Bit (256 x 8) TRI-STATE® Schottky	5-9
DM54S472/DM74S472 4096-Bit (512 x 8) TRI-STATE® Schottky	5-11
DM54S473/DM74S473 4096-Bit (512 x 8) Open-Collector Schottky	5-11
DM54S570/DM74S570 2048-Bit (512 x 4) Open-Collector Schottky	5-13
DM54S571/DM74S571 2048-Bit (512 x 4) TRI-STATE® Schottky	5-13
DM54S572/DM74S572 4096-Bit (1024 x 4) Open-Collector Schottky	5-18
DM54S573/DM74S573 4096-Bit (1024 x 4) TRI-STATE® Schottky	5-18
DM7577/DM8577 256-Bit (32 x 8) Open-Collector	5-20
DM7578/DM8578 256-Bit (32 x 8) TRI-STATE®	5-23
DM77S221/DM87S221 2048-Bit (256 x 8) Open-Collector Schottky with Latches	5-26
DM77S222/DM87S222 2048-Bit (256 x 8) TRI-STATE® Schottky with Latches	5-26
DM77S228/DM87S228 8192-Bit (1024 x 8) TRI-STATE® Schottky	5-28
DM77S229/DM87S229 8192-Bit (1024 x 8) Open-Collector Schottky	5-28
DM77S295/DM87S295 4096-Bit (512 x 8) Open-Collector Schottky	5-30
DM77S296/DM87S296 4096-Bit (512 x 8) TRI-STATE® Schottky	5-30

Section 6—MOS ROMs

MM1742 2048-Bit (256 x 8) Electrically Programmable	6-1
MM2316A 16,384-Bit (2048 x 8) Mask Programmable	6-12
MM4210/MM5210 1024-Bit (256 x 4) Mask Programmable	6-16
MM4211/MM5211 1024-Bit (256 x 4) Mask Programmable	6-19
MM5212 12,288-Bit (1k x 12) Mask Programmable	6-22
MM4213/MM5213 2048-Bit (256 x 8 or 512 x 4) Mask Programmable	6-24
MM4214/MM5214 4096-Bit (512 x 8) Mask Programmable	6-26
MM5215 12,288-Bit (1k x 12) Mask Programmable	6-28

Table of Contents (Continued)

Section 6—MOS ROMs (Continued)

MM4220/MM5220 1024-Bit (128 x 8 or 256 x 4) Mask Programmable	6-30
MM4220AP/MM5220AP BCDIC to ASCII Code Converter	6-34
MM4220BM/MM5220BM Sine Look-Up Table	6-36
MM4220DF/MM5220DF "Quick Brown Fox" Generator	6-40
MM4220EK/MM5220EK BCDIC to EBCDIC/ASCII to EBCDIC Code Converter	6-42
MM4220LR/MM5220LR BCDIC to ASCII-7/ASCII-7 to BCDIC Code Converter	6-45
MM4221/MM5221 1024-Bit (128 x 8 or 256 x 4) Mask Programmable	6-48
MM4221RR/MM5221RR ASCII-7 to EBCDIC Code Converter	6-52
MM4230/MM5230 2048-Bit (256 x 8 or 512 x 4) Mask Programmable	6-55
MM4230BO/MM5230BO Hollerith to ASCII Code Converter	6-59
MM4230KP/MM5230KP ASCII-7 to Selectric Code Converter	6-61
MM4231/MM5231 2048-Bit (256 x 8 or 512 x 4) Mask Programmable	6-64
MM4231CMU/MM5231CMU Hollerith to ASCII Code Converter	6-59
MM4231RP/MM5231RP EBCDIC to ASCII-7 Code Converter	6-68
MM4232/MM5232 4096-Bit (512 x 8 or 1k x 4) Mask Programmable	6-73
MM4232AEI/MM5232AEI Sine Look-Up Table	6-76
MM4232AEJ/MM5232AEJ Sine Look-Up Table	6-76
MM4232AEK/MM5232AEK Sine Look-Up Table	6-76
MM4240/MM5240 2560-Bit (64—8 x 5) Static Character Generator	6-79, 11-23
MM4240AA/MM5240AA ASCII-7 Upper Case, Horizontal Scan Character Generator	6-79, 11-22
MM4240AE/MM5240AE ASCII-7 Lower Case, Horizontal Scan Character Generator	6-79, 11-22
MM4240ABU/MM5240ABU Hollerith Character Generator	6-83, 11-23
MM4240ABZ/MM5240ABZ EBCDIC-8 Character Generator	6-85, 11-23
MM4240ACA/MM5240ACA EBCDIC Character Generator	6-86, 11-23
MM4241/MM5241 3072-Bit (64 x 6 x 8) Mask Programmable	6-87, 11-24
MM4241ABL/MM5241ABL ASCII-7 Vertical Scan Character Generator	6-87, 11-24
MM4241ABV/MM5241ABV ECMA-7 Scandinavian Vertical Scan Character Generator	6-87, 11-24
MM4241ABW/MM5241ABW ECMA-7 German Vertical Scan Character Generator	6-87, 11-24
MM4241ABX/MM5241ABX ECMA-7 European Vertical Scan Character Generator	6-87, 11-25
MM4241ABY/MM5241ABY ECMA-7 Spanish Vertical Scan Character Generator	6-87, 11-25
MM4242/MM5242 8192-Bit (1024 x 8) Mask Programmable	6-90
MM4243/MM5243 2048-Bit (256 x 8 or 512 x 4) Electrically Programmable	6-5
MM4244/MM5244 4096-Bit (512 x 8) Electrically Programmable	6-8
MM4246/MM5246 16,384-Bit (2048 x 8) Mask Programmable	6-94
MM4247/MM5247 16,384-Bit (4096 x 4) Mask Programmable	6-94
SK0003 Sine/Cosine Look-Up Table	6-114, 11-1

Section 7—Bipolar ROMs

DM5488/DM7488 256-Bit (32 x 8) Open-Collector Mask Programmable	7-1
DM54187/DM74187 1024-Bit (256 x 4) Open-Collector Mask Programmable	7-5
DM54L187A/DM74L187A 1024-Bit (256 x 4) Low Power Open-Collector Mask Programmable	7-8
DM54S187/DM74S187 1024-Bit (256 x 4) Open-Collector Schottky Mask Programmable	7-11
DM54S270/DM74S270 2048-Bit (512 x 4) Open-Collector Schottky	7-13
DM54S271/DM74S271 2048-Bit (256 x 8) Open-Collector Schottky	7-15
DM54S370/DM74S370 2048-Bit (512 x 4) TRI-STATE® Schottky	7-13
DM54S371/DM74S371 2048-Bit (256 x 8) TRI-STATE® Schottky	7-15
DM75S28/DM85S28 8192-Bit (1024 x 8) TRI-STATE® Schottky	7-17
DM75S29/DM85S29 8192-Bit (1024 x 8) Open-Collector Schottky	7-17
DM7575/DM8575 Programmable Logic Array	7-19
DM7576/DM8576 Programmable Logic Array	7-19
DM7597/DM8597 1024-Bit (256 x 4) TRI-STATE® Mask Programmable	7-26
DM75S97/DM85S97 1024-Bit (256 x 4) TRI-STATE® Schottky Mask Programmable	7-11
DM7598/DM8598 256-Bit (32 x 8) TRI-STATE® Mask Programmable	7-29
DM8678 64-Character (5 x 7 or 7 x 9) Character Generator	7-35
DM76L97/DM86L97 1024-Bit (256 x 4) TRI-STATE® Low Power Mask Programmable	7-47
DM77S201/DM87S201 2048-Bit (256 x 8) Open-Collector Schottky with Latches	7-50
DM77S202/DM87S202 2048-Bit (256 x 8) TRI-STATE® Schottky with Latches	7-50

Table of Contents (Continued)

Section 8—Shift Registers

MM1402A Quad 256-Bit Dynamic	8-1
MM1403A Dual 512-Bit Dynamic	8-1
MM1404A 1024-Bit Dynamic	8-1
MM4016/MM5016 512-Bit Dynamic	8-5
MM5024A 1024-Bit Dynamic	8-1
MM4025/MM5025 Dual 1024-Bit Dynamic	8-8
MM4026/MM5026 Dual 1024-Bit Dynamic	8-8
MM4027/MM5027 2048-Bit Dynamic	8-8
MM4052/MM5052 Dual 80-Bit Static	8-13
MM4053/MM5053 Dual 100-Bit Static	8-13
MM5054 Dual 64/72/80-Bit Static	8-16
MM4055/MM5055 Quad 128-Bit Static	8-19
MM4056/MM5056 Dual 256-Bit Static	8-19
MM4057/MM5057 512-Bit Static	8-19
MM5058 1024-Bit Static	8-24
MM5060 Dual 144-Bit Mask Programmable Static	8-27
MM5061 Quad 100-Bit Static	8-30
MM4104/MM5104 Multiple Length, Electrically Adjustable	8-33

Section 9—Memory Systems

370-Add-On Memory Systems	9-1
NS3-1 Bulk Storage Memory	9-3
NSII Memory Series	9-5
NSII/O3 Memory Card	9-6
NS21 Memory Card	9-7
NS32 Memory Card	9-8
NS400-N Series Memory Cards	9-9
NS400-C Series Memory Cards	9-10
NS3000-1 Memory Card	9-11
Memory Systems Testing	9-13

Section 10—Interface

DS0025/DS0025C 2-Phase MOS Clock Driver	10-1
DS0026 5 MHz 2-Phase MOS Clock Driver	10-2
DS0056 5 MHz 2-Phase MOS Clock Driver	10-2
DS1603/DS3603 Dual MOS Sense Amplifier	10-3
DS3604 Dual MOS Sense Amplifier	10-3
DS1605/DS3605 High Speed Hex MOS Sense Amplifier	10-4
DS1606/DS3606 High Speed Hex MOS Sense Amplifier	10-4
DS1607/DS3607 High Speed Hex MOS Sense Amplifier	10-4
DS1608/DS3608 High Speed Hex MOS Sense Amplifier	10-4
DS3625 Dual High Speed MOS Sense Amplifier	10-5
DS3629 Memory Driver with Decode Inputs	10-6
DS1640/DS3640 Quad TRI-SHARE™ MOS Driver	10-7
DS1642/DS3642 Dual Bootstrapped MOS Clock Driver	10-8
DS3643 Decoded Quad MOS Clock Driver	10-9
DS1644/DS3644 Quad MOS Clock Driver	10-10
DS1645/DS3645 Hex TRI-STATE® MOS Latch/Driver	10-11
DS1646/DS3646 6-Bit TRI-STATE® MOS Refresh Counter/Driver	10-12
DS1647/DS3647 Quad TRI-STATE® Memory I/O Register	10-13
DS1648/DS3648 TRI-STATE® MOS Multiplexer/Driver	10-14
DS1649/DS3649 Hex TRI-STATE® MOS Driver	10-15
DS3651 Quad High Speed MOS Sense Amplifier	10-16
DS3653 Quad High Speed MOS Sense Amplifier	10-16
DS1670/DS3670 Quad TRI-SHARE™ MOS Driver	10-7
DS1671/DS3671 2-Phase Bootstrapped MOS Clock Driver	10-17

Alpha-Numerical Index

DM5488/DM7488 256-Bit (32 x 8) Open-Collector Mask Programmable ROM	7-1
DM5489/DM7489 64-Bit (16 x 4) Open-Collector RAM	2-1
DM54187/DM74187 1024-Bit (256 x 4) Open-Collector Mask Programmable ROM	7-5
DM54L187A/DM74L187A 1024-Bit (256 x 4) Low Power Open-Collector Mask Programmable ROM ..	7-8
DM54S187/DM74S187 1024-Bit (256 x 4) Open-Collector Schottky Mask Programmable ROM	7-11
DM54S188/DM74S188 256-Bit (32 x 8) Open-Collector Schottky PROM	5-2
DM54LS189/DM74LS189 64-Bit (16 x 4) TRI-STATE [®] , Low Power Schottky RAM	2-4
DM54S189/DM74S189 64-Bit (16 x 4) TRI-STATE [®] Schottky RAM	2-7
DM54S200/DM74S200 256-Bit (256 x 1) TRI-STATE [®] Schottky RAM	2-11
DM54S206/DM74S206 256-Bit (256 x 1) Open-Collector Schottky RAM	2-15
DM54S270/DM74S270 2048-Bit (512 x 4) Open-Collector Schottky ROM	7-13
DM54S271/DM74S271 2048-Bit (256 x 8) Open-Collector Schottky ROM	7-15
DM54S287/DM74S287 1024-Bit (256 x 4) TRI-STATE [®] Schottky PROM	5-4
DM54S288/DM74S288 256-Bit (32 x 8) TRI-STATE [®] Schottky PROM	5-2
DM54LS289/DM74LS289 64-Bit (16 x 4) Open-Collector, Low Power Schottky RAM	2-19
DM54S289/DM74S289 64-Bit (16 x 4) Open-Collector Schottky RAM	2-22
DM54S370/DM74S370 2048-Bit (512 x 4) TRI-STATE [®] Schottky ROM	7-13
DM54S371/DM74S371 2048-Bit (256 x 8) TRI-STATE [®] Schottky ROM	7-15
DM54S387/DM74S387 1024-Bit (256 x 4) Open-Collector Schottky PROM	5-4
DM54S470/DM74S470 2048-Bit (256 x 8) Open-Collector Schottky PROM	5-9
DM54S471/DM74S471 2048-Bit (256 x 8) TRI-STATE [®] Schottky PROM	5-9
DM54S472/DM74S472 4096-Bit (512 x 8) TRI-STATE [®] Schottky PROM	5-11
DM54S473/DM74S473 4096-Bit (512 x 8) Open-Collector Schottky PROM	5-11
DM54S570/DM74S570 2048-Bit (512 x 4) Open-Collector Schottky PROM	5-13
DM54S571/DM74S571 2048-Bit (512 x 4) TRI-STATE [®] Schottky PROM	5-13
DM54S572/DM74S572 4096-Bit (1024 x 4) Open-Collector Schottky PROM	5-18
DM54S573/DM74S573 4096-Bit (1024 x 4) TRI-STATE [®] Schottky PROM	5-18
DM75S28/DM85S28 8192-Bit (1024 x 8) TRI-STATE [®] Schottky ROM	7-17
DM75S29/DM85S29 8192-Bit (1024 x 8) Open-Collector Schottky ROM	7-17
DM7575/DM8575 Programmable Logic Array	7-19
DM7576/DM8576 Programmable Logic Array	7-19
DM7577/DM8577 256-Bit (32 x 8) Open-Collector PROM	5-20
DM7578/DM8578 256-Bit (32 x 8) TRI-STATE [®] PROM	5-23
DM7597/DM8597 1024-Bit (256 x 4) TRI-STATE [®] Mask Programmable ROM	7-26
DM75S97/DM85S97 1024-Bit (256 x 4) TRI-STATE [®] Schottky Mask Programmable ROM	7-11
DM7598/DM8598 256-Bit (32 x 8) TRI-STATE [®] Mask Programmable ROM	7-29
DM7599/DM8599 64-Bit (16 x 4) TRI-STATE [®] RAM	2-29
DM8678 64-Character (5 x 7 or 7 x 9) Character Generator	7-35
DM76L97/DM86L97 1024-Bit (256 x 4) TRI-STATE [®] Low Power Mask Programmable ROM	7-47
DM77S201/DM87S201 2048-Bit (256 x 8) Open-Collector Schottky ROM with Latches	7-50
DM77S202/DM87S202 2048-Bit (256 x 8) TRI-STATE [®] Schottky ROM with Latches	7-50
DM77S221/DM87S221 2048-Bit (256 x 8) Open-Collector Schottky PROM with Latches	5-26
DM77S222/DM87S222 2048-Bit (256 x 8) TRI-STATE [®] Schottky PROM with Latches	5-26
DM77S228/DM87S228 8192-Bit (1024 x 8) TRI-STATE [®] Schottky PROM	5-28
DM77S229/DM87S229 8192-Bit (1024 x 8) Open-Collector Schottky PROM	5-28
DM77S295/DM87S295 4096-Bit (512 x 8) Open-Collector Schottky PROM	5-30

Alpha-Numerical Index (Continued)

DM77S296/DM87S296 4096-Bit (512 x 8) TRI-STATE® Schottky PROM	5-30
DM93415, DM93415A 1024-Bit (1024 x 1) TTL, Fully Decoded RAM	2-33
DM93425, DM93425A 1024-Bit (1024 x 1) TTL, Fully Decoded RAM	2-34
DS0025/DS0025C 2-Phase MOS Clock Driver	10-1
DS0026 5 MHz 2-Phase MOS Clock Driver	10-2
DS0056 5 MHz 2-Phase MOS Clock Driver	10-2
DS1603/DS3603 Dual MOS Sense Amplifier	10-3
DS3604 Dual MOS Sense Amplifier	10-3
DS1605/DS3605 High Speed Hex MOS Sense Amplifier	10-4
DS1606/DS3606 High Speed Hex MOS Sense Amplifier	10-4
DS1607/DS3607 High Speed Hex MOS Sense Amplifier	10-4
DS1608/DS3608 High Speed Hex MOS Sense Amplifier	10-4
DS3625 Dual High Speed MOS Sense Amplifier	10-5
DS3629 Memory Driver with Decode Inputs	10-6
DS1640/DS3640 Quad TRI-SHARE™ MOS Driver	10-7
DS1642/DS3642 Dual Bootstrapped MOS Clock Driver	10-8
DS3643 Decoded Quad MOS Clock Driver	10-9
DS1644/DS3644 Quad MOS Clock Driver	10-10
DS1645/DS3645 Hex TRI-STATE® MOS Latch/Driver	10-11
DS1646/DS3646 6-Bit TRI-STATE® MOS Refresh Counter/Driver	10-12
DS1647/DS3647 Quad TRI-STATE® Memory I/O Register	10-13
DS1648/DS3648 TRI-STATE® MOS Multiplexer/Driver	10-14
DS1649/DS3649 Hex TRI-STATE® MOS Driver	10-15
DS3651 Quad High Speed MOS Sense Amplifier	10-16
DS3653 Quad High Speed MOS Sense Amplifier	10-16
DS1670/DS3670 Quad TRI-SHARE™ MOS Driver	10-7
DS1671/DS3671 2-Phase Bootstrapped MOS Clock Driver	10-17
DS1672/DS3672 Dual Bootstrapped MOS Clock Driver	10-8
DS3673 Decoded Quad MOS Clock Driver	10-9
DS1674/DS3674 Quad MOS Clock Driver	10-10
DS1675/DS3675 Hex TRI-STATE® MOS Latch/Driver	10-11
DS1676/DS3676 6-Bit TRI-STATE® MOS Refresh Counter/Driver	10-12
DS1677/DS3677 Quad TRI-STATE® MOS Memory I/O Register	10-13
DS1678/DS3678 TRI-STATE® MOS Multiplexer/Driver	10-14
DS1679/DS3679 Hex TRI-STATE® MOS Driver	10-15
DS16147/DS36147 Quad TRI-STATE® MOS Memory I/O Register	10-13
DS16149/DS36149 Hex MOS Driver	10-18
DS16177/DS36177 Quad TRI-STATE® MOS Memory I/O Register	10-13
DS16179/DS36179 Hex MOS Driver	10-18
DS55107/DS75107 Dual Line Receiver	10-3
DS55108/DS75108 Dual Line Receiver	10-3
DS55109/DS75109 Dual Line Driver	10-19
DS55110/DS75110 Dual Line Driver	10-19
DS55121/DS75121 Dual Line Driver	10-20
DS55122/DS75122 Triple Line Receiver	10-21
DS75123 Dual Line Driver	10-22
DS75124 Triple Line Receiver	10-23
DS75150 Dual Line Driver	10-24
DS75154 Quad Line Receiver	10-25
DS75207 Dual Line Receiver	10-3
DS75208 Dual Line Receiver	10-3
DS75324 Memory Driver with Decode Inputs	10-26
DS55325/DS75325 Memory Driver	10-27
DS75361 Dual TTL to MOS Driver	10-28
DS75362 Dual TTL to MOS Driver	10-29
DS75364 Dual MOS Clock Driver	10-30
DS75365 Quad TTL to MOS Driver	10-31
DS7803/DS8803 2-Phase Oscillator/Clock Driver	10-32
DS7807/DS8807 2-Phase Oscillator/Clock Driver	10-33
DS8813 2-Phase Oscillator/Clock Driver	10-32

Alpha-Numerical Index (Continued)

DS8817 2-Phase Oscillator/Clock Driver	10-33
MM1101 256-Bit (256 x 1) Static RAM	1-1
MM1101A 256-Bit (256 x 1) Static RAM	1-1
MM1101A1 256-Bit (256 x 1) Static RAM	1-1
MM1101A2 256-Bit (256 x 1) Static RAM	1-1
MM11011 256-Bit (256 x 1) Static RAM	1-1
MM1402A Quad 256-Bit Dynamic Shift Register	8-1
MM1403A Dual 512-Bit Dynamic Shift Register	8-1
MM1404A 1024-Bit Dynamic Shift Register	8-1
MM1702A 2048-Bit (256 x 8) Electrically Programmable and Erasable ROM	4-1
MM1742 2048-Bit (256 x 8) Electrically Programmable ROM	6-1
MM2101 1024-Bit (256 x 4) Static RAM with Separate I/O	1-5
MM2101-1 1024-Bit (256 x 4) Static RAM with Separate I/O	1-5
MM2101-2 1024-Bit (256 x 4) Static RAM with Separate I/O	1-5
MM2102 1024-Bit (1024 x 1) Static RAM	1-8
MM2102A, MM2102AL Family 1024-Bit (1024 x 1) Static RAM	1-12
MM2102MD 1024-Bit (1024 x 1) Static RAM, Military Temperature Range	1-15
MM2102-1 1024-Bit (1024 x 1) Static RAM	1-8
MM2102-2 1024-Bit (1024 x 1) Static RAM	1-8
MM2102-2MD 1024-Bit (1024 x 1) Static RAM, Military Temperature Range	1-15
MM2111 1024-Bit (256 x 4) Static RAM with Common Data I/O	1-19
MM2111-1 1024-Bit (256 x 4) Static RAM with Common Data I/O	1-19
MM2111-2 1024-Bit (256 x 4) Static RAM with Common Data I/O	1-19
MM2112 1024-Bit (256 x 4) Static RAM with Common Data I/O	1-22
MM2112-2 1024-Bit (256 x 4) Static RAM with Common Data I/O	1-22
MM2316A 16,384-Bit (2048 x 8) Mask Programmable ROM	6-12
MM2704 4096-Bit (512 x 8) UV Erasable and Electrically Programmable ROM	4-7
MM2708 8192-Bit (1024 x 8) UV Erasable and Electrically Programmable ROM	4-7
MM4016/MM5016 512-Bit Dynamic Shift Register	8-5
MM5024A 1024-Bit Dynamic Shift Register	8-1
MM4025/MM5025 Dual 1024-Bit Dynamic Shift Register	8-8
MM4026/MM5026 Dual 1024-Bit Dynamic Shift Register	8-8
MM4027/MM5027 2048-Bit Dynamic Shift Register	8-8
MM4052/MM5052 Dual 80-Bit Static Shift Register	8-13
MM4053/MM5053 Dual 100-Bit Static Shift Register	8-13
MM5054 Dual 64/72/80-Bit Static Shift Register	8-16
MM4055/MM5055 Quad 128-Bit Static Shift Register	8-19
MM4056/MM5056 Dual 256-Bit Static Shift Register	8-19
MM4057/MM5057 512-Bit Static Shift Register	8-19
MM5058 1024-Bit Static Shift Register	8-24
MM5060 Dual 144-Bit Mask Programmable Static Shift Register	8-27
MM5061 Quad 100-Bit Static Shift Register	8-30
MM4104/MM5104 Multiple Length, Electrically Adjustable Shift Register	8-33
MM4203/MM5203 2048-Bit (256 x 8 or 512 x 4) Electrically Programmable and Erasable ROM	4-12
MM4204/MM5204 4096-Bit (512 x 8) Electrically Programmable and Erasable ROM	4-17
MM4210/MM5210 1024-Bit (256 x 4) Mask Programmable ROM	6-16
MM4211/MM5211 1024-Bit (256 x 4) Mask Programmable ROM	6-19
MM5212 12,288-Bit (1k x 12) Mask Programmable ROM	6-22
MM4213/MM5213 2048-Bit (256 x 8 or 512 x 4) Mask Programmable ROM	6-24
MM4214/MM5214 4096-Bit (512 x 8) Mask Programmable ROM	6-26
MM5215 12,288-Bit (1k x 12) Mask Programmable ROM	6-28
MM4220/MM5220 1024-Bit (128 x 8 or 256 x 4) Mask Programmable ROM	6-30
MM4220AP/MM5220AP BCDIC to ASCII Code Converter	6-34
MM4220BM/MM5220BM Sine Look-Up Table	6-36
MM4220DF/MM5220DF "Quick Brown Fox" Generator	6-40
MM4220EK/MM5220EK BCDIC to EBCDIC/ASCII to EBCDIC Code Converter	6-42
MM4220LR/MM5220LR BCDIC to ASCII-7/ASCII-7 to BCDIC Code Converter	6-45
MM4221/MM5221 1024-Bit (128 x 8 or 256 x 4) Mask Programmable ROM	6-48
MM4221RR/MM5221RR ASCII-7 to EBCDIC Code Converter	6-52
MM4230/MM5230 2048-Bit (256 x 8 or 512 x 4) Mask Programmable ROM	6-55

Alpha-Numerical Index (Continued)

MM4230BO/MM5230BO Hollerith to ASCII Code Converter	6-59
MM4230KP/MM5230KP ASCII-7 to Selectric Code Converter	6-61
MM4231/MM5231 2048-Bit (256 x 8 or 512 x 4) Mask Programmable ROM	6-64
MM4231CMU/MM5231CMU Hollerith to ASCII Code Converter	6-59
MM4231RP/MM5231RP EBCDIC to ASCII-7 Code Converter	6-68
MM4232/MM5232 4096-Bit (512 x 8 or 1k x 4) Mask Programmable ROM	6-73
MM4232AEI/MM5232AEI Sine Look-Up Table	6-76
MM4232AEJ/MM5232AEJ Sine Look-Up Table	6-76
MM4232AEK/MM5232AEK Sine Look-Up Table	6-76
MM4240/MM5240 2560-Bit (64-8 x 5) Static Character Generator	6-79, 11-23
MM4240AA/MM5240AA ASCII-7 Upper Case, Horizontal Scan Character Generator ROM	6-79, 11-22
MM4240ABU/MM5240ABU Hollerith Character Generator	6-83, 11-23
MM4240ABZ/MM5240ABZ EBCDIC-8 Character Generator	6-85, 11-23
MM4240ACA/MM5240ACA EBCDIC Character Generator	6-86, 11-23
MM4240AE/MM5240AE ASCII-7 Lower Case, Horizontal Scan Character Generator ROM	6-79, 11-22
MM4241/MM5241 3072-Bit (64 x 6 x 8) Mask Programmable ROM	6-87, 11-24
MM4241ABL/MM5241ABL ASCII-7 Vertical Scan Character Generator ROM	6-87, 11-24
MM4241ABV/MM5241ABV ECMA-7 Scandinavian Vertical Scan Character Generator ROM	6-87, 11-24
MM4241ABW/MM5241ABW ECMA-7 German Vertical Scan Character Generator ROM	6-87, 11-24
MM4241ABX/MM5241ABX ECMA-7 European Vertical Scan Character Generator ROM	6-87, 11-25
MM4241ABY/MM5241ABY ECMA-7 Spanish Vertical Scan Character Generator ROM	6-87, 11-25
MM4242/MM5242 8192-Bit (1024 x 8) Mask Programmable ROM	6-90
MM4243/MM5243 2048-Bit (256 x 8 or 512 x 4) Electrically Programmable ROM	6-5
MM4244/MM5244 4096-Bit (512 x 8) Electrically Programmable ROM	6-8
MM4246/MM5246 16,384-Bit (2048 x 8) Mask Programmable ROM	6-94
MM4247/MM5247 16,384-Bit (4096 x 4) Mask Programmable ROM	6-94
MM4250 256-Bit (256 x 1) Static RAM, Military Temperature Range	1-1
MM5269 1024-Bit (256 x 4) Static RAM with On-Chip Registers	1-26
MM4270 4096-Bit (4096 x 1) TRI-SHARE™ Port, Dynamic RAM	1-28
MM5270 4096-Bit (4096 x 1) TRI-SHARE™ Port, Dynamic RAM	1-33
MM5270A 4096-Bit (4096 x 1) Dynamic RAM	1-38
MM5270-5 4096-Bit (4096 x 1) TRI-SHARE™ Port, Dynamic RAM	1-44
MM5271 4096-Bit (4096 x 1) Fully TTL Compatible RAM	1-46
MM5271A 4096-Bit (4096 x 1) TRI-SHARE™ Port, Dynamic RAM	1-51
MM4280 4096-Bit (4096 x 1) Dynamic RAM	1-56
MM5280 4096-Bit (4096 x 1) Dynamic RAM	1-60
MM5280A 4096-Bit (4096 x 1) Dynamic RAM	1-64
MM5280-5 4096-Bit (4096 x 1) Dynamic RAM	1-70
MM5281 4096-Bit (4096 x 1) Fully TTL Compatible Dynamic RAM	1-72
MM5290 16,384-Bit (16,384 x 1) Dynamic RAM	1-76
MM54C89/MM74C89 64-Bit (16 x 4) TRI-STATE® CMOS RAM	3-1
MM54C200/MM74C200 256-Bit (256 x 1) TRI-STATE® CMOS RAM	3-5
MM54C910/MM74C910 256-Bit (256 x 1) TRI-STATE® CMOS RAM	3-8
MM54C920/MM74C920 1024-Bit (256 x 4) Static Silicon Gate RAM	3-12
MM54C921/MM74C921 1024-Bit (256 x 4) Static Silicon Gate RAM	3-12
MM54C929/MM74C929 1024-Bit (1024 x 1) Static Silicon Gate RAM	3-19
MM54C930/MM74C930 1024-Bit (1024 x 1) Static Silicon Gate RAM	3-19
NS3-1 Bulk Storage Memory	9-3
NS11 Memory Series	9-5
NS11/03 Memory Card	9-6
NS21 Memory Card	9-7
NS32 Memory Card	9-8
NS400-C Series Memory Cards	9-10
NS400-N Series Memory Cards	9-9
NS3000-1 Memory Card	9-11
SK0003 Sine/Cosine Look-Up Table	6-114, 11-1
370-Add-On Memory Systems	9-1

Bipolar RAM Cross Reference Guide

SIZE AND ORGANIZATION	OUTPUT	NATIONAL MIL/COM	AMD M = MIL C = COM	F.S.C. M = MIL C = COM	INTEL M = MIL P = COM	INTERSIL M = MIL P = COM	MMI MIL/COM	SIGNETICS S = MIL N = COM	T.I. MIL/COM
64-Bit (16 x 4)	OC	DM5489/DM7489	AM3101		3101	IM5501		8225	SN5489/7489
	TS	DM7599/DM8599							
High Speed 64-Bit (16 x 4)	OC	DM54S289/DM74S289	AM27S02	93403	3101A		5560/6560	82S25	SN54S289/74S289
	TS	DM54S189/DM74S189	AM27S03				5561/6561		SN54S189/74S189
Low Power 64-Bit (16 x 4)	OC	DM54LS289/DM74LS289	AM27LS02				L5560/L6560		
	TS	DM54LS189/DM74LS189	AM27LS03				L5561/L6561		
File Reg. (16 x 4)	TS	DM75S68/DM85S68							
256-Bit (256 x 1)	OC	DM54S206/DM74S206	AM27S01	93411 93411A	3107 3107A	IM5533A	5530/6530	82S07	SN54S301/74S301
								82S17	
1024-Bit (1024 x 1)	TS	DM54S200/DM74S200	AM27S00	93421 93421A	3106 3106A	IM5523A	5531/6531	82S06	SN54200/74200
								82S16	SN54S200/74S200
1024-Bit (1024 x 1)	OC	DM93415AM/DM93415AC		93415 93415A		IM5508 IM5508A		82S10	SN54S309/74S309
								82S11	SN54S209/74S209
	TS	DM93425AM/DM93425AC		93425 93425A			IM5518 IM5518A		

Bipolar PROM Cross Reference Guide

SIZE AND ORGANIZATION	OUTPUT	NATIONAL MIL/COM	AMD M = MIL C = COM	FAIRCHILD M = MIL C = COM	HARRIS 2 = MIL 5 = COM	INTEL M = MIL P = COM	INTERMIL M = MIL C = COM	M.M.I. MIL/COM -1 = SCHOTTKY	SIGNETICS S = MIL N = COM	T.I. MIL/COM
256-Bit (32 x 8)-16-Pin	OC	DM7577/DM8577	AM27S08		HM1-7602 HM1-8256 HM1-7603		IM5600	5330/6330	82S23	SN54188A/74188A
	TS	DM7578/DM8578	AM27S09				IM5610	5331/6331	82S123	SN54S188/74S188
1024-Bit (256 x 4)-16-Pin	OC	DM54S387/DM74S387	AM27S10	93417 93416	HM1-7610 HM1-1024A	3601-1 3601	IM5603	5300/6300	82S126	SN54S387/74S387
	TS	DM54S287/DM74S287	AM27S11	93427 93426	HM1-7611 HM1-1024	3621	IM5623	5301/6301	82S129	SN54S287/74S287
2048-Bit (512 x 4)-16-Pin	OC	DM54S570/DM74S570		93436	HM1-7620	3602	IM5604	5305/6305	82S130	
	TS	DM54S571/DM74S571		93446	HM1-7621	3622	IM5624	5306/6306	82S131	
4096-Bit (512 x 8)-24-Pin	OC	DM77S295/DM87S295		93438	HM1-7640	3604	IM5605	5340/6340	82S140	SN54S474/74S474
	TS	DM77S296/DM87S296		93448	HM1-7641	3624	IM5625	5341/6341	82S141	SN54S475/74S475
2048-Bit (256 x 8)-20-Pin	OC	DM54S470/DM74S470						5308/6308		SN54S470/74S470
	TS	DM54S471/DM74S471						5309/6309		SN54S471/74S471
4096-Bit (512 x 8)-20-Pin	OC	DM54S473/DM74S473						5348/6348		SN54S473/74S473
	TS	DM54S472/DM74S472						5349/6349		SN54S472/74S472
4096-Bit (1024 x 4)-18-Pin	OC	DM54S572/DM74S572*		93452	HM1-7642	3605	IM5606	5352/6352	82S136	
	TS	DM54S573/DM74S573*		93453	HM1-7643	3625	IM5626	5353/6353	82S137	
8192-Bit (1024 x 8)-24-Pin	OC	DM77S229/DM87S229*				3608	IM5608	5389/6380	82S180	
	TS	DM77S228/DM87S228*				3628	IM5618	5381/6381	82S181	
8192-Bit (2048 x 4)-18-Pin	OC	DM54S672/DM74S672*					IM56S01		82S184	
	TS	DM54S673/DM74S673*					IM56S11		82S185	

Note: All manufacturer's PROMs program differently.
*Future products

Bipolar PROM Cross Reference Guide

Bipolar PROM/ROM Selection Guide

TOTAL BITS	PART NUMBER		ORGANIZATION	NUMBER OF PINS	TEMPERATURE RANGE	MAXIMUM ADDRESS ACCESS (tAA)	MAXIMUM SUPPLY CURRENT (I _{CC})
	PROM	ROM					
256	DM7577	DM5488	32 x 8 OC	16	-55°C to +125°C	70	110
	DM8577	DM7488	32 x 8 OC	16	0°C to +70°C	50	110
	DM7578	DM7598	32 x 8 TS	16	-55°C to +125°C	70	110
	DM8578	DM8598	32 x 8 TS	16	0°C to +70°C	50	110
1024	DM54S387	DM54S187	256 x 4 OC	16	-55°C to +125°C	60	130
	DM74S387	DM74S187	256 x 4 OC	16	0°C to +70°C	50	130
	DM54S287	DM75S97	256 x 4 TS	16	-55°C to +125°C	60	130
	DM74S287	DM85S97	256 x 4 TS	16	0°C to +70°C	50	130
2048	DM54S570	DM54S270	512 x 4 OC	16	-55°C to +125°C	70	130
	DM74S570	DM74S270	512 x 4 OC	16	0°C to +70°C	55	130
	DM54S571	DM54S370	512 x 4 TS	16	-55°C to +125°C	70	130
	DM74S571	DM74S370	512 x 4 TS	16	0°C to +70°C	55	130
4096	DM54S572		1k x 4 OC	18	-55°C to +125°C	75	140
	DM74S572		1k x 4 OC	18	0°C to +70°C	60	140
	DM54S573		1k x 4 TS	18	-55°C to +125°C	75	140
	DM74S573		1k x 4 TS	18	0°C to +70°C	60	140
4096	DM77S295	DM77S95	512 x 8 OC	24	-55°C to +125°C	80	170
	DM87S295	DM87S95	512 x 8 OC	24	0°C to +70°C	65	170
	DM77S296	DM77S96	512 x 8 TS	24	-55°C to +125°C	80	170
	DM87S296	DM87S96	512 x 8 TS	24	0°C to +70°C	65	170
8192	DM77S229	DM75S29	1k x 8 OC	24	-55°C to +125°C	90	170
	DM87S229	DM85S29	1k x 8 OC	24	0°C to +70°C	70	170
	DM77S228	DM75S28	1k x 8 TS	24	-55°C to +125°C	90	170
	DM87S228	DM85S28	1k x 8 TS	24	0°C to +70°C	70	170
2048	DM77S221	DM77S201	256 x 8 OC	20	-55°C to +125°C	75	150
	DM87S221	DM87S201	256 x 8 OC	20	0°C to +70°C	60	150
	DM77S222	DM77S202	256 x 8 TS	20	-55°C to +125°C	75	150
	DM87S222	DM87S202	256 x 8 TS	20	0°C to +70°C	60	150
2048	DM54S470	DM54S271	256 x 8 OC	20	-55°C to +125°C	75	150
	DM74S470	DM74S271	256 x 8 OC	20	0°C to +70°C	60	150
	DM54S471	DM54S371	256 x 8 TS	20	-55°C to +125°C	75	150
	DM74S471	DM74S371	256 x 8 TS	20	0°C to +70°C	60	150
4096	DM54S473		512 x 8 OC	20	-55°C to +125°C	80	165
	DM74S473		512 x 8 OC	20	0°C to +70°C	65	165
	DM54S472		512 x 8 TS	20	-55°C to +125°C	80	165
	DM74S472		512 x 8 TS	20	0°C to +70°C	65	165

Note. All PROMS are direct equivalents to their respective ROMS.



Bipolar PROMs

PROM programming procedure

PROM programming procedure

These parts are shipped from the factory with all fuses intact. As a result, the outputs will be low (logical "0") for all addresses. In order to generate a high level on the outputs, the part must be programmed. Information on available programming equipment may be obtained from National. However, if it is desired to build your own programmer, the following conditions must be observed.

1. Programming should be attempted only at temperatures between 15°C and 30°C.
2. Addresses and chip enable pins must be driven from normal TTL logic levels during both programming and verification.
3. Programming will occur at a selected address when VCC is held at 10.5V, the appropriate output is held at 10.5V and the chip is subsequently enabled. To achieve these conditions in the appropriate sequence, the following procedure must be followed:
 - a) Select the desired word by applying a high or low level to the appropriate address inputs. Disable the chip by applying a high level to one or both enable inputs.
 - b) Increase VCC to 10.5V ±0.5V with the rate of increase being between 1.0 and 10.0V/μs. Since VCC supplies the current to program the fuse as well as the ICC of the device at programming voltage, it must be capable of supplying 400 mA at 11.0V.
 - c) Select the output where a high level is desired by raising that output voltage to 10.5V ±0.5V. Limit the rate of increase to a value between 1.0 and 10.0V/μs. This voltage change may occur simultaneously with the increase in VCC but must not precede it. It is critical that only one output at a time be programmed since the internal circuits can only supply programming current to one bit at a time. Outputs not being programmed must be left

open or tied to a high impedance source of at least 20 kΩ. (Remember that the outputs of the device are still disabled at this time because the chip enables are high.)

- d) Enable the device by taking both chip enables to a low level. This is done with a pulse of 10μs. The 10μs duration refers to the time that the circuit is enabled. Normal input levels are used and rise and fall times are not critical.
- e) Verify that the bit has been programmed by first removing the programming voltage from the output and then reducing VCC to 4.0V ±0.2V. Verification at a VCC level of 4.0V will guarantee proper output states over the VCC and temperature range of the programmed part. The chip must be enabled to sense the state of the outputs. During verification, the loading of the output must be within specified IOL and IOH limits. Steps b, c and d must be repeated 10 times or until verification that the bit has programmed.
- f) Following verification, apply five additional programming pulses to the bit being programmed. The programming procedure is now complete for the selected bit.
- g) Repeat steps a through f for each bit to be programmed to a high level. If the procedure is performed on an automatic programmer, the duty cycle of VCC at programming voltage must be limited to a maximum of 25%. This is necessary to minimize chip junction temperatures. After all selected bits are programmed, the entire contents of the memory should be verified.

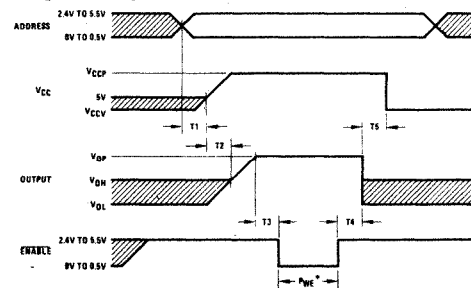
Note: Since only an enabled chip is programmed, it is possible to program these parts at the board level if all programming parameters are complied with.

5

Programming Parameters Do not test or you may program the device.

PARAMETERS		CONDITIONS	MIN	RECOMMENDED VALUE	MAX	UNITS
VCCP	Required VCC for Programming	VCC = 11V	10.0	10.5	11.0	V
ICC	ICC During Programming		600	750		mA
VOP	Required Output Voltage for Programming	VOUT = 11V	10.0	10.5	11.0	V
IOP	Output Current while Programming		20			mA
TRR	Rate of Voltage Change of VCC or Output		1.0		10.0	V/μs
PWE	Programming Pulse Width (Enabled)		9	10	11	μs
VCCV	Required VCC for Verification		3.8	4.0	4.2	V
MDC	Maximum Duty Cycle for VCC at VCCP			25	25	%

Programming Waveforms



- T1 = 100 ns min
- T2 = 5μs min (T2 may be ≥ 0 if VCCP rises at the same rate or faster than VOP)
- T3 = 100 ns min
- T4 = 100 ns min
- T5 = 100 ns min

*PWE is repeated for 5 additional pulses after verification of VOH indicates a bit has programmed



Bipolar PROMs

PRELIMINARY

DM54S188/DM74S188 open-collector 256-bit PROM DM54S288/DM74S288 TRI-STATE® 256-bit PROM

general description

These Schottky PROM memories are organized in the popular 32 words by 8 bits configuration. A memory enable input is provided to control the output states. When the enable input is in the low state, the outputs present the contents of the selected word.

If the enable input is raised to a high level, it causes all 8 outputs to go to the "OFF" or high impedance state. The memories are available in both open-collector and TRI-STATE® versions and are available as ROM's as well as PROM's.

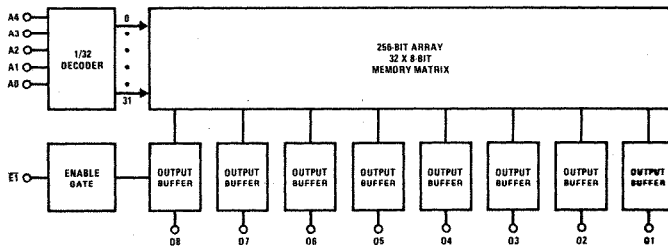
PROM's are shipped from the factory with lows in all locations. A high may be programmed into any selected location by following the programming instructions. Once programmed, it is impossible to go back to a low.

features

- Advanced titanium-tungsten (Ti-W) fuses
- Schottky-clamped for high speed
Address access—30 ns max
Enable access—20 ns max
- PNP inputs reduce input loading
- All dc and ac parameters guaranteed over temperature
- Low voltage TRI-SAFE™ programming
- Board level programming

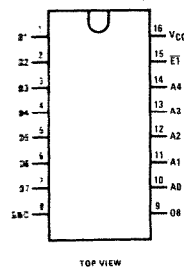
	Military	Commercial	Open-Collector	TRI-STATE	Package
DM74S188		X	X		N, J
DM74S288		X		X	N, J
DM54S188	X		X		J
DM54S288	X			X	J

block diagram

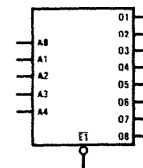


connection diagram

Dual-In-Line Package



logic symbol



absolute maximum ratings (Note 1)

Supply Voltage (Note 2)	-0.5V to +7V
Input Voltage (Note 2)	-1.2V to +5.5V
Output Voltage (Note 2)	-0.5V to +5.5V
Storage Temperature	-65°C to +150°C
Lead Temperature (Soldering, 10 seconds)	300°C

operating conditions

	MIN	MAX	UNITS
Supply Voltage (V_{CC})			
DM54S188, DM54S288	4.5	5.5	V
DM74S188, DM74S288	4.75	5.25	V
Ambient Temperature (T_A)			
DM54S188, DM54S288	-55	+125	°C
DM74S188, DM74S288	0	+70	°C
Logical "0" Input Voltage (Low)	0	0.8	V
Logical "1" Input Voltage (High)	2.0	5.5	V

dc electrical characteristics (Note 3)

PARAMETER	CONDITIONS	DM54S188, 54S288			DM74S188, 74S288			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
I_{IL}	Input Load Current, All Inputs	$V_{CC} = \text{Max}, V_{IN} = 0.45V$						μA
I_{IH}	Input Leakage Current, All Inputs	$V_{CC} = \text{Max}, V_{IN} = 2.7V$						μA
I_I	Input Leakage Current, All Inputs	$V_{CC} = \text{Max}, V_{IN} = 5.5V$						mA
V_{OL}	Low Level Output Voltage	$V_{CC} = \text{Min}, I_{OL} = 16 \text{ mA}$						V
V_{IL}	Low Level Input Voltage							V
V_{IH}	High Level Input Voltage	2.0						V
I_{CEX}	Output Leakage Current (Open-Collector Only) (Note 5)	$V_{CC} = \text{Max}, V_{CEX} = 2.4V$						μA
		$V_{CC} = \text{Max}, V_{CEX} = 5.5V$						μA
V_C	Input Clamp Voltage	$V_{CC} = \text{Min}, I_{IN} = -18 \text{ mA}$						V
C_{IN}	Input Capacitance	$V_{CC} = 5V, V_{IN} = 2V, T_A = 25^\circ C, 1 \text{ MHz}$						pF
C_O	Output Capacitance	$V_{CC} = 5V, V_O = 2V, T_A = 25^\circ C, 1 \text{ MHz, Output "OFF"}$						pF
I_{CC}	Power Supply Current	$V_{CC} = \text{Max}, \text{All Inputs Grounded, All Outputs Open}$						mA

TRI-STATE PARAMETERS

I_{SC}	Output Short Circuit Current (Note 5)	$V_O = 0V, V_{CC} = \text{Max}, \text{(Note 4)}$						mA
I_{HZ}	Output Leakage (TRI-STATE)	$V_{CC} = \text{Max}, V_O = 0.45 \text{ to } 2.4V, \text{Chip Disabled}$						μA
V_{OH}	Output Voltage High, (Note 5)	$I_{OH} = -2 \text{ mA}$						V
		$I_{OH} = -6.5 \text{ mA}$						V

ac electrical characteristics (With standard load)

PARAMETER	CONDITIONS	DM54S188, 54S288			DM74S188, 74S288			UNITS
		5V $\pm 10\%$; -55°C to +125°C			5V $\pm 5\%$; 0°C to +70°C			
		MIN	TYP	MAX	MIN	TYP	MAX	
t_{AA}	Address Access Time		22	40		22	30	ns
t_{EA}	Enable Access Time		15	30		15	20	ns
t_{ER}	Enable Recovery Time		15	30		15	20	ns

Note 1: Absolute maximum ratings are those values beyond which the device may be permanently damaged. They do not mean that the device may be operated at these values.

Note 2: These limits do not apply during programming. For the programming ratings, refer to the programming instructions.

Note 3: These limits apply over the entire operating range unless stated otherwise. All typical values are for $V_{CC} = 5V$ and $T_A = 25^\circ C$.

Note 4: During I_{SC} measurement, only one output at a time should be grounded. Permanent damage may otherwise result.

Note 5: To measure V_{OH} , I_{CEX} or I_{SC} on an unprogrammed part, apply 10.5V to either A0 (pin 10) or A4 (pin 14).

Clock Repetition Rate: The range of clock frequencies for which register operation is guaranteed.

Clock Frequency ϕ_f : The range of clock frequencies which register operation is guaranteed. Maximum clock frequencies are dependent upon minimum and maximum clock pulse width restrictions, as presented by the Guaranteed Operating Curves.

Clock Delay ϕ_d : ϕ_d is defined to be that minimum amount of time that must expire after ϕ_1 has undergone a $V_{\phi L}$ to $V_{\phi H}$ transition and the start of a ϕ_2 $V_{\phi H}$ to $V_{\phi L}$ transition. The same spacings apply, when ϕ_2 precedes ϕ_1 .

Clock Phase Delay ϕ_d , $\bar{\phi}_d$: The time between the $V_{\phi H}$ levels of ϕ_{IN} and ϕ_{OUT} . ϕ_d is the time between the trailing edge of ϕ_{IN} and the leading edge of ϕ_{OUT} . $\bar{\phi}_d$ is the time between the trailing edge of ϕ_{OUT} and the leading edge of ϕ_{IN} .

Clock Pulse Risettime, $t_{r\phi}$: The time delay between the 10% and 90% voltage points on the clock pulse as it traverses between its logic $V_{\phi L}$ and logic $V_{\phi H}$ levels.

Clock Pulse Falltime, $t_{f\phi}$: The time delay between the 10% and 90% voltage points on the clock pulse as it traverses between its logic $V_{\phi H}$ and logic $V_{\phi L}$ levels.

Clock Pulse Width, ϕ_{PW} : The duration of time that the clock pulse is greater than 1.5V.

Clock Input Levels: The voltage levels (logic $V_{\phi L}$ or $V_{\phi H}$) which the clock driver must assume to insure proper device operation.

Clock Control Setup Time, t_{cs} : The time prior to the clock Low to High transition at which the clock control must be at its desired logic level.

Clock Control Hold Time, t_{ch} : The time after the High to Low transition for which the clock control must be held at its desired logic level.

Data Setup Time, t_{ds} : The time prior to the clock High to Low transition at which the data input level must be present to guarantee being clocked into the register by that clock pulse.

Data Pulse Width, t_{dw} : The time during which the data pulse is in its V_{IH} or V_{IL} state.

Data Hold Time, t_{dh} : The time after the clock High to Low transition which the data input level must be held to guarantee being clocked into the register by that clock pulse.

Data Input Voltage Levels: The voltage levels (logic V_{IL} or V_{IH}) which the data input terminal must assume to insure proper logic inputs.

Data Output Voltage Levels: The output voltage levels (logic V_{OL} or V_{OH}) which the output will assume under normal operating conditions.

Data Input Capacitance: The capacitance between the data input terminal and ground reference measured at 1 MHz.

Output Resistance to Ground: The resistance between the output terminal and ground with the output in the logic V_{OH} state.

Partial Bit Times T_{IN} , T_{OUT} : The time between leading edges of clocks, measured at the $V_{\phi H}$ levels. T_{IN} is the time between the leading edge of ϕ_{IN} and the leading edge of ϕ_{OUT} . T_{OUT} is the time between the leading edge of ϕ_{OUT} and the leading edge of ϕ_{IN} .

Output Sink Current: The current which flows into the output terminal of the register when the output is a logical low level. Conventional current flow is assumed.

Output Source Current: The current which flows out of the output terminal of the register when the output is a logical High level. Conventional current flow is assumed.

Output Voltage Levels: The logical Low level, V_{OL} , is the more negative level. This is the state in which the output is capable of sinking current. The logical High level, V_{OH} , is the more positive level. This is the state in which the output is capable of sourcing current.

V_{GG} Current Drain: The average current flow out of the V_{GG} terminal of the package with the output open circuited.

Power Supply Voltage, V_{GG} : The negative power supply potential required for proper device operation; referenced to V_{SS} .

Power Supply Return, V_{SS} : The V_{SS} terminal is the reference point for the device. It must always be the most positive potential applied to the device.

V_{SS} Current Drain: The average current flow into the V_{SS} terminal of the package. It is equal to the sum of the I_{GG} and I_{DD} currents.

Power Supply Voltage, V_{DD} : The negative power supply potential required for proper device operation, referenced to V_{SS} .

Clock Input Voltage Levels, $V_{\phi H}$, $V_{\phi L}$: The voltage levels (logic "1" or "0") which the clock driver must assume to insure proper device operation.

Data Output Voltage Levels, V_{OH} , V_{OL} : The output voltage levels (logic "1" or "0") which the output will assume with a specified load connected between output and V_{SS} line.

Radio Shack® Books Make You an Electronics Expert

REFERENCE

- Tube Substitution Handbook.** Up-to-date DIRECT tube substitution guide includes more than 12,000 substitutions for picture tubes, radio-TV, special-purpose, foreign and domestic tubes. 96 pages. **62-2030** 1.95
- TV Tube Symptoms and Troubles.** Trouble-shooting guide shows hundreds of common problems, tells how to isolate, test and replace suspected tubes. Fully illustrated. 96 pages. **62-2033** 2.25
- Electronics Data Book.** Handy reference for electronics information — formulas, laws, math, broadcast standards, resistor and capacitor codes, symbols, more. 112 pages. **62-2040** 1.50
- Electronics Dictionary.** Very readable definitions and illustrations for more than 4800 electronics terms. 112 pages. **62-2047** 1.25
- Math for the Electronics Student.** Principles essential to acquiring a knowledge of electronics. How to solve problems in circuits, induction, capacitance, RMS, peak power, power factor, resonance. 112 pages. **62-2057** 1.50
- Fingertip Math.** Begins where your electronic calculator's manual ends. Tells how to use it for powers, roots, squares, logs, metric conversions, trig, interest — MUCH more! 264 pages. **62-2024** 1.95
- Practical Electronics, Vol. I.** Simple to understand approach to DC circuits and theory. Set up numerous experiments and gain working knowledge of electronics. 160 pages. **62-2037** 1.95

PROJECTS

- Optoelectronic Projects, Vol. I.** Thorough introduction to principles of optic electronics. Includes instructions for solar battery, power supply, digital clock and more. 95 pages. **62-2060** 1.25
- Semiconductor Projects, Vol. I.** How to construct valuable educational circuits like voltage reference source, voltage multipliers, LED flasher circuit and others. 96 pages. **62-2070** 1.25
- Transistor Projects, Vol. I.** Twelve educational projects — CB crystal, oscillator, power supplies, siren, slave flash unit, light meter, electric thermometer, electric metronome, more. 96 pages. **62-2080** 1.25
- Transistor Projects, Vol. II.** Construct interesting and useful projects, including power megaphone, light meter, electronic organ, neon lamp "idiot box," LED flasher, voltmeter. 96 pages. **62-2081** 1.25
- Transistor Projects, Vol. III.** How to build 8 exciting projects. Optoelectronic logic circuits, LED switch, battery charger, strobe unit, photorelay, burglar alarm, more. 96 pages. **62-2082** 1.25
- Integrated Circuit Projects, Vol. I.** How to build lamp driver, binary decimal decoder, digital counter, audio amp, digital oscillator, tone stepper, square-wave generator, more! Explains how integrated circuits work and how they are manufactured. 96 pages. **62-2090** 1.25
- Integrated Circuit Projects, Vol. II.** Construct a frequency-selective op-amp, audible light sensor, monostable, multivibrator, 555 IC timer, 1-watt audio amplifier. 96 pages. **62-2091** 1.25

- Integrated Circuit Projects, Vol. III.** Eight projects. Instructions and discussions on sequence generators, music machine, power supply, computer circuits, others. 96 pages. **62-2092** 1.25
- Integrated Circuit Projects, Vol. IV.** Assemble 8 types of operational amplifier experiments including op-amp meter eliminator, bridge amp, audio-filter, comparator circuit, clipping amp. 96 pages. **62-2093** 1.25
- Building Speaker Enclosures.** Get extra value by building your own speaker system — bass-reflex, infinite baffle, many more designs. 96 pages. **62-2055** 95¢
- Computer Circuits for Experimenters.** How to make and use AND, gates, OR gates, flip-flops, logic clocks, multivibrator circuits, counting circuits, more. 96 pages. **62-2058** 1.25
- Security for Your Home.** How to select the proper alarm system for your valuables. Installation, tamper-proofing, testing. 95 pages. **62-2059** 1.25

HAM-SWL-CB

- Shortwave Listener's Guide.** Lists stations by country, city, call letters, frequency, power, transmission times. With log. Get extra enjoyment from any radio equipped with shortwave bands. 128 pages. **62-2032** 2.25
- CB-HAM-SWL Log Book.** Keep an accurate record of stations heard. Tables for recording frequency, call letters, date, time. 80 pages. **62-2034** 1.75
- CB-HAM-SWL Mini-Log.** Compact, spiral-bound book keeps a permanent record of stations received. Easy to use. **62-2036** 75¢
- Citizens Band Radio.** Tells the history and many uses of CB. How to get started in CB, choose your equipment, set up and operate a station. Covers equipment and antennas, servicing, more. 96 pages. **62-2044** 95¢
- Police, Fire & Aircraft Radio.** How to enjoy real-life drama of "public service" radio. Choosing a radio and antenna. 112 pages. **62-2053** 95¢
- From 5 Watts to 1000.** A programmed course to take you from CB to Ham radio. Theory, tips to learn code, more. **62-2056** 2.95

GENERAL ELECTRONICS

- Guide to VOM's and VTVM's.** Use your meter to service radio, TV, hi-fi, Amateur and CB radios. Step-by-step directions. 112 pages. **62-2039** 1.25
- Oscilloscopes.** How to use oscilloscopes for wave-form analysis, frequency response curves, servicing. 96 pages. **62-2050** 1.25
- Introduction to Antennas.** Explains how CB, TV, radio, shortwave antennas are designed. How to choose and install the antenna best for your needs. Accessories for better reception. 128 pages. **62-2051** 1.25
- Understanding Solid-State Electronics.** Twelve lessons, self-teaching course in semiconductor theory. Prepared by Texas Instruments Learning Center. With quizzes and glossary. 242 pages. **62-2035** 1.95

Cross Reference to Integrated Circuits

RS#	NATIONAL	RS#	NATIONAL	RS#	NATIONAL
DIGITAL IC					
276-1801	SN7400	276-1828	SN74145	276-2447	4511
276-1802	SN7404	276-1829	SN74150	276-2449	4049
276-1803	SN7473	276-1831	SN74192	276-2450	4050
276-1804	SN7441	276-1832	SN74194	276-2490	4518
276-1805	SN7447	276-1833	SN74196	LINEAR IC	
276-1806	SN7475	276-1834	SN74154	276-007	LM741CN
276-1807	SN7410	276-1835	SN74LS367	276-038	LM1458N
276-1808	SN7490	276-1836	SN74LS368	276-1711	LM324N
276-1809	SN7420	CMOS			
276-1811	SN7402	276-2301	74C00	276-1712	LM339AN
276-1813	SN7476	276-2302	74C02	276-1713	LM3900N
276-1815	SN7413	276-2303	74C04	276-1721	LM567CN
276-1816	SN7448	276-2305	74C08	276-1723	LM555CN
276-1817	SN74123	276-2310	74C74	276-1724	LM566CN
276-1818	SN7474	276-2312	74C76	276-1728	LM556CN
276-1819	SN7492	276-2315	74C90	276-1731	LM386N
276-1820	SN74193	276-2321	74C192	276-1739	LM709CN
276-1821	SN7406	276-2322	74C193	276-1740	LM723CN
276-1822	SN7408	276-2401	4001	276-1741	LM741CN-14
276-1823	SN7427	276-2411	4011	SPECIAL PRODUCTS	
276-1824	SN7432	276-2413	4013	276-2501	MM2102AN-4L
276-1825	SN7451	276-2417	4017	276-2510	NSC8080A
276-1826	SN7485	276-2420	4020	277-1001	MA1012A
276-1827	SN7486	276-2427	4027	277-1003	MA1003