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**X3, Information Processing Systems**

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**Reply to:** J. Lohmeyer

To: Membership of X3T9.2

From: L. Lamers

Subject: Correction Package for SCSI-2

This package contains the correction pages for SCSI-2 rev 10k.

1) The first four pages replace everything up to the table of contents. The 10L pages contain a list of corrections and a list of errata.

2) Replace the Foreword and Introduction with the new version supplied.

3) Replace the pages in 10k with the pages supplied for the body of the document.

Please note that the page numbers were kept the same for the update package. However if you get a wholly new 10L the page numbers may not be identical due to the regeneration process.

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# WORKING DRAFT

# X3T9.2 Project 375D

Revision 10L
7-SEP-93

# Information technology - Small Computer System Interface - 2

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## ABSTRACT

The SCSI protocol is designed to provide an efficient peer-to-peer I/O bus with up to 16 devices, including one or more hosts. Data may be transferred asynchronously at rates that only depend on device implementation and cable length. Synchronous data transfers are supported at rates up to 10 mega-transfers per second. With the 32-bit wide data transfer option, data rates of up to 40 megabytes per second are possible.

SCSI-2 includes command sets for magnetic and optical disks, tapes, printers, processors, CD-ROMs, scanners, medium changers, and communications devices.

## PATENT STATEMENT

The developers of this standard have requested that holder's of patents that may be required for the implementation of the standard, disclose such patents to the publisher. However neither the developers nor the publisher have undertaken a patent search in order to identify which if any patents may apply to this standard.

No position is taken with respect to the validity of any claim or any patent rights that may have been disclosed. Details of submitted statements may be obtained from the publisher concerning any statement of patents and willingness to grant a license under these rights on reasonable and nondiscriminatory terms and conditions to applicants desiring to obtain such a license.

**Document Status**

The following are the changes from revision 10k to 10l.

1. Page 3, clause 3, move the sentence beginning "For the purposes" after the title to subclause 3.1.

2. Pages 3 to 5, clause 3, definitions should not begin with phrases such as "This term refers to" etc.

3. Page 8, clause 5, remove the full stop after the clause number.

4. Page 8, subclause 5.2.1, line 1, replace "meters" with "m".

5. In the Introduction, item c) under the list of new low-level requirements should read: "The arbitration delay was increased from 2.2 to 2.4 us"

6. In 4.1 Overview, the last line of the fifth paragraph should read: "are contending and can be completed in less than 10 us."

7. In 8.3.3.2 Disconnect-reconnect page, there are three occurrences of 100 ms being substituted for 100 microsecond. These should all be changed to 100 us. The corrected lines should read: "The bus inactivity limit field indicates the maximum time in 100 us ...". "The disconnect time limit field indicates the minimum time in 100 us ...". "The connect time limit field indicates the maximum time in 100 us ..."

8. In 9.3.3.2 Flexible disk page, the paragraph describing the drive step rate should begin: "The drive step rate field specifies the step rate in units of 100 us."

9. In 12.2.2, paragraph 7, the reference is to Table 65, not 8.2.14.1.

10. The Foreword and Introduction clauses were modified to correctly reflect the ANSI/ISO style.

11. Updated the Vendor ID list in Annex E.

## X3T9.2/375R revision 10L

### ERRATA

The following errors have been reported. Due to the constraints of the standards process these errors cannot be corrected within the body of the document. The X3T9.2 committee plans to issue errata to correct these items.

1. An error exists in Table 161. The Head load bit pattern should be P011 not P000.

# Foreword

This Small Computer System Interface -2 standard is designed to provide an efficient peer-to-peer I/O bus with up to 16 devices, including one or more hosts. Data may be transferred asynchronously at rates that only depend on device implementation and cable length. Synchronous data transfers are supported at rates up to 10 mega-transfers per second. With the 32-bit wide data transfer option, data rates of up to 40 megabytes per second are possible. This standard includes command sets for magnetic and optical disks, tapes, printers, processors, CD-ROMs, scanners, medium changers, and communications devices.

## Introduction

This part of ANSI X3.131-199x replaces ANSI X3.131-1986 *Small Computer System Interface*.

The clauses contain material as described below.

Clause 1 describes the scope.

Clause 2 lists the normative references.

Clause 3 provides a glossary common to the whole document.

Clause 4 provides descriptions and conventions.

Clause 5 describes the physical characteristics.

Clause 6 describes the logical characteristics of the interface.

Clause 7 describes the SCSI command and status structure.

Clause 8 specifies those commands that have a consistent meaning for all device types.

Clause 9 specifies commands for direct-access devices.

Clause 10 specifies commands for sequential-access devices.

Clause 11 specifies commands for printer devices.

Clause 12 specifies commands for processor devices.

Clause 13 specifies commands for write-once devices.

Clause 14 specifies commands for CD-ROM devices.

Clause 15 specifies commands for scanner devices.

Clause 16 specifies commands for optical memory devices.

Clause 17 specifies commands for medium changer devices.

Clause 18 specifies commands for communications devices.

Annex A illustrates SCSI signal sequence.

Annex B illustrates fast SCSI skew time.

Annex C describes other SCSI standardization activities.

Annex D contains SCSI-2 additional sense codes and operation codes in numeric order.

Annex E contains the list of SCSI-2 vendor identifications.

The SCSI protocol is designed to provide an efficient peer-to-peer I/O bus with up to 16 devices, including one or more hosts. Data may be transferred asynchronously at rates that only depend on device implementation and cable length. Synchronous data transfers are supported at rates up to 10 mega-transfers per second. With the 32-bit wide data transfer option, data rates of up to 40 megabytes per second are possible.

SCSI-2 includes command sets for magnetic and optical disks, tapes, printers, processors, CD-ROMs, scanners, medium changers, and communications devices.

In 1985, when the first SCSI standard was being finalized several manufacturers wanted to increase the mandatory requirements of SCSI and to define further features for direct-access devices. Rather than delay the SCSI standard, formed an ad hoc group was formed to develop a working paper that was eventually called the Common Command Set (CCS). Many disk products were designed using this working paper.

In parallel with the development of the CCS working paper, work began on an enhanced SCSI standard which was named SCSI-2. SCSI-2 included the results of the CCS working paper and extended them to all device types. It also added caching commands, performance enhancement features, and other worthwhile functions. While SCSI-2 has gone well beyond the original SCSI standard (now referred to as SCSI-1), it retains a high degree of compatibility with SCSI-1 devices.

SCSI-2 has evolved significantly from SCSI-1 with the new document nearly three times larger. Most of the changes are additions, but several obsolete options were removed:

a) Single initiator option
b) Non-arbitrating systems option
c) The SCSI-1 alternative 1 shielded connector
d) Non-extended sense data option
e) Reservation queuing option
f) The read-only device command set.

There are several new low-level requirements:

a) Parity is now required
b) Initiators are required to provide terminator power
c) The arbitration delay was increased from 2.2 to 2.4 $\mu$s
d) Message support is now required.

Several low-level options were added:

a) Wide SCSI (up to 32 bits wide using a second cable)
b) Fast SCSI (synchronous data transfers of up to 10 mega-transfers per second)
c) Command queuing (up to 256 commands per initiator per logical unit)
d) High-density connector alternatives were added
e) Asynchronous event notification
f) Extended contingent allegiance.

New command sets were added including:

a) CD-ROM (replaces read-only device)
b) Scanner device
c) Optical memory device (provides for write-once, read-only, and erasable media)
d) Medium changer device
e) Communications device

All command sets were enhanced:

a) Device models were added
b) Extended sense was expanded
c) The INQUIRY data was expanded
d) The MODE SELECT and MODE SENSE commands were paged for all device types

# 4 General

## 4.1 Overview

SCSI is a local I/O bus that can be operated over a wide range of data rates. The primary objective of the interface is to provide host computers with device independence within a class of devices. Thus, different disk drives, tape drives, printers, optical media drives, and other devices can be added to the host computers without requiring modifications to generic system hardware or software. Provision is made for the addition of special features and functions through the use of vendor unique fields and codes. Reserved fields and codes are provided for future standardization.

A second key objective of SCSI-2 is to provide compatibility with those SCSI-1 devices that support bus parity and that meet conformance level 2 of SCSI-1. While some previously vendor unique commands and parameters have been defined by the SCSI-2 standard, devices meeting SCSI-1 and SCSI-2 can co-exist on the same bus. It is intended that those operating systems providing support for both command sets be able to operate in environments mixing SCSI-1 and SCSI-2 devices. Properly conforming SCSI-1 devices, both initiators and targets, should respond in an acceptable manner to reject SCSI-2 protocol extensions. All SCSI-2 protocol extensions are designed to be permissive of such rejections and to allow the SCSI-1 device to continue operation without requiring the use of the extension.

A third key objective of SCSI-2 is to move device-dependent intelligence out to the SCSI-2 devices. The command set definitions allow a sophisticated operating system to obtain all required initialization information from the attached SCSI-2 devices. The formalized sequence of requests identify the type of attached SCSI-2 device, the characteristics of the device, and all the changeable parameters supported by the device. Further requests can determine the readiness of the device to operate, the types of media supported by the device, and all other pertinent system information. Those parameters not required by the operating system for operation, initialization, or system tuning are not exposed to the SCSI-2 interface, but are managed by the SCSI-2 device itself.

The interface uses logical rather than physical addressing for all data blocks. For direct-access devices, each logical unit may be interrogated to determine how many blocks it contains. A logical unit may coincide with all or part of a peripheral device.

The interface protocol includes provision for the connection of multiple initiators (SCSI devices capable of initiating an operation) and multiple targets (SCSI devices capable of responding to a request to perform an operation). Distributed arbitration (i.e. bus-contention logic) is built into the architecture of SCSI. A priority system awards interface control to the highest priority SCSI device that is contending for use of the bus. The time to complete arbitration is independent of the number of devices that are contending and can be completed in less than 10 $\mu$s.

There are two electrical alternatives: single-ended and differential. Single-ended and differential devices are electrically incompatible and can not be mixed on the same physical bus.

Provision is made for cable lengths up to 25 m using differential drivers and receivers. A single-ended driver and receiver configuration is defined for cable lengths of up to 6 m and is primarily intended for applications within a cabinet.

Arbitration is defined to permit multiple initiators and to permit concurrent I/O operations. All SCSI devices are required to be capable of operating with the defined asynchronous transfer protocol. In addition, an optional synchronous transfer protocol is defined. A message protocol for control of the interface is also specified. In most cases, messages are not directly apparent to the host computer software.

Commands are classified as mandatory, optional, or vendor-specific. SCSI devices are required to implement all mandatory commands defined for the appropriate device type and may implement other commands as well. SCSI devices contain commands that facilitate the writing of self-configuring software drivers that can discover all necessary attributes without prior knowledge of specific peripheral characteristics (such as storage capacity). Many commands

also implement a very large logical block address space ($2^{32}$ blocks), although some commands implement a somewhat smaller logical block address space ($2^{21}$ blocks).

Starting with clause 8 and for each clause on a specific device type, the clause is constructed of at least four subclauses. The first subclause is the model for the device type. The model establishes the framework for interpreting the commands for the device type. The attributes and capabilities of the device type are discussed and examples are given. The second subclause defines the commands applicable to the device type. The third subclause defines the parameters applicable to the device type. These are the diagnostic parameters, log parameters, mode parameters and vital product data parameters that are transmitted as part of the appropriate commands. Most of the parameters are formatted into pages. The fourth subclause gives the definition of terms that apply specifically to that device type.

Starting with clause 9 the commands in each of these clauses are unique to the device type, or they have interpretations, fields, or features that are specific for the device type. Thus, for example, although the WRITE command is used for several device types, it has a somewhat different form for each type, with different parameters and meanings. Therefore, it is specified separately for each device type.

## 4.2 Conventions

Certain words and terms used in this International Standard have a specific meaning beyond the normal English meaning. These words and terms are defined either in clause 3 or in the text where they first appear. Names of signals, phases, messages, commands, statuses, sense keys, additional sense codes, and additional sense code qualifiers are in all uppercase (e.g. REQUEST SENSE). Lower case is used for words having the normal English meaning.

Fields containing only one bit are usually referred to as the name bit instead of the name field.

Numbers that are not immediately followed by lower-case b or h are decimal values.

Numbers immediately followed by lower-case b (xxb) are binary values.

Numbers immediately followed by lower-case h (xxh) are hexadecimal values.

### 8.3.3.2 Disconnect-reconnect page

The disconnect-reconnect page (see table 98) provides the initiator the means to tune the performance of the SCSI bus.

**Table 98 - Disconnect-reconnect page**

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | PS | Reserved | Page code (02h) | | | | | |
| 1 | Page length (0Eh) | | | | | | | |
| 2 | Buffer full ratio | | | | | | | |
| 3 | Buffer empty ratio | | | | | | | |
| 4 | (MSB) | Bus inactivity limit | | | | | | |
| 5 | | | | | | | | (LSB) |
| 6 | (MSB) | Disconnect time limit | | | | | | |
| 7 | | | | | | | | (LSB) |
| 8 | (MSB) | Connect time limit | | | | | | |
| 9 | | | | | | | | (LSB) |
| 10 | (MSB) | Maximum burst size | | | | | | |
| 11 | | | | | | | | (LSB) |
| 12 | Reserved | | | | | | DTDC | |
| 13 | Reserved | | | | | | | |
| 14 | Reserved | | | | | | | |
| 15 | Reserved | | | | | | | |

The buffer full ratio field indicates to the target, on read operations, how full the buffer should be prior to attempting a reselection. Targets that do not implement the requested ratio should round down to the nearest implemented ratio as defined in 7.5.4.

The buffer empty ratio field indicates to the target, on write operations, how empty the buffer should be prior to attempting a reselection. Targets that do not implement the requested ratio should round down to the nearest implemented ratio as defined in 7.5.4.

The buffer full and buffer empty ratios are numerators of a fractional multiplier that has 256 as its denominator. A value of zero indicates that the target determines when to initiate reselection consistent with the disconnect time limit parameter. These parameters are advisory to the target.

NOTE 101 As an example, consider a target with ten 512-byte buffers and a specified buffer full ratio of 3Fh. The formula is: INTEGER((ratio/256)*number of buffers). Thus INTEGER((3Fh/256)*10) = 2. The target should attempt to reselect the initiator on read operations whenever two or more buffers are full.

The bus inactivity limit field indicates the maximum time in 100 $\mu$s increments that the target is permitted to assert the BSY signal without a REQ/ACK handshake. If the bus inactivity limit is exceeded the target shall attempt to disconnect if the initiator has granted the disconnect privilege (see 6.6.7) and it is not restricted by DTDC. This value may be rounded as defined in 7.5.4. A value of zero indicates that there is no bus inactivity limit.

The disconnect time limit field indicates the minimum time in 100 μs increments that the target shall wait after releasing the SCSI bus before attempting reselection. This value may be rounded as defined in 7.5.4. A value of zero indicates that there is no disconnect time limit.

The connect time limit field indicates the maximum time in 100 μs increments that the target is allowed to use the SCSI bus before disconnecting, if the initiator has granted the disconnect privilege (see 6.6.7) and it is not restricted by DTDC. This value may be rounded as defined in 7.5.4. A value of zero indicates that there is no connect time limit.

The maximum burst size field indicates the maximum amount of data that the target shall transfer during a data phase before disconnecting if the initiator has granted the disconnect privilege. This value is expressed in increments of 512 bytes (e.g. a value of one means 512 bytes, two means 1024 bytes, etc.). A value of zero indicates there is no limit on the amount of data transferred per connection.

The data transfer disconnect control (DTDC) field (see table 99) defines further restrictions on when a disconnect is permitted.

**Table 99 - Data transfer disconnect control**

| DTDC | Description |
|---|---|
| 00b | Data transfer disconnect control is not used. Disconnect is controlled by the other fields in this page. |
| 01b | A target shall not attempt to disconnect once the data transfer of a command has started until all data the command is to transfer has been transferred. The connect time limit and bus inactivity limit are ignored during the data transfer. |
| 10b | Reserved |
| 11b | A target shall not attempt to disconnect once the data transfer of a command has started, until the command is complete. The connect time limit and bus inactivity limit are ignored once data transfer has started. |

If DTDC is non-zero and the maximum burst size is non-zero, the target shall return CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST and the additional sense code set to ILLEGAL FIELD IN PARAMETER LIST.

The parameters savable (PS) bit is only used with the MODE SENSE command. This bit is reserved with the MODE SELECT command. A PS bit of one indicates that the target is capable of saving the page in a non-volatile vendor-specific location.

NOTE 125 This page is mainly intended for defining parameters of flexible disk drives, but may be used for other devices, if applicable.

The transfer rate indicates the data rate of the peripheral device. See table 159 for examples of common transfer rates.

**Table 159 - Examples of transfer rates**

| Value | Transfer rate |
|---|---|
| 00FAh | 250 kbit/s transfer rate |
| 012Ch | 300 kbit/s transfer rate |
| 01F4h | 500 kbit/s tranfer rate |
| 03E8h | 1 mbit/s transfer rate |
| 07D0h | 2 mbit/s transfer rate |
| 1388h | 5 mbit/s transfer rate |

The number of heads field specifies the number of heads used for reading and writing data on the medium. Heads used exclusively for servo information are excluded.

The sectors per track field specifies the number of sectors per revolution per head.

The data bytes per sector field specifies the number of bytes of data per sector that an initiator can read or write.

The number of cylinders field specifies the number of cylinders used for data storage.

The starting cylinder for write precompensation field specifies the cylinder at which write precompensation is to begin. Cylinders are numbered starting with zero. If the starting cylinder for write precompensation is equal to the value in the number of cylinders field, write precompensation shall be disabled by the target.

The starting cylinder for reduced write current field specifies cylinder at which write current is reduced. Cylinders are numbered starting with zero. If the starting cylinder for reduced write current is equal to the value in the number of cylinders field, reduced write current shall be disabled by the target.

The drive step rate field specifies the step rate in units of 100 $\mu$s. This value may be rounded as defined in 7.5.4. A value of zero requests the target to set its default value.

The drive step pulse width field specifies the width of the step pulse in microseconds. This value may be rounded as defined in 7.5.4. A value of zero requests the target to set its default value.

The head settle delay field specifies the head settle time in units of 100 $\mu$s. This value may be rounded as defined in 7.5.4. A value of zero requests the target to set its default value.

If a true ready signal is not available, the motor on delay field specifies in tenths of a second the time that the target shall wait before attempting to access the medium after the motor on signal is asserted. If a true ready signal is available, the motor on delay field specifies in tenths of a second the time that the target shall wait for drive ready status before aborting an attempt to access the medium. This value may be rounded as defined in 7.5.4.

The motor off delay field specifies in tenths of a second the time that the target shall wait before releasing the motor on signal after an idle condition exists. A value of FFh indicates that the motor on signal shall not be released. The START STOP UNIT command is not affected by this parameter. This value may be rounded as defined in 7.5.4.

### 12.2.2 SEND command

The SEND command (see table 231) requests that the target transfer data from the initiator.

**Table 231 - SEND command**

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation code (0Ah) | | | | | | | |
| 1 | Logical unit number | | | Reserved | | | | AEN |
| 2 | (MSB) | | | | | | | |
| 3 | Transfer length | | | | | | | |
| 4 | | | | | | | | (LSB) |
| 5 | Control | | | | | | | |

An asynchronous event notification (AEN) bit of one indicates that the data to be transferred conforms to AEN data format as defined in table 232. A SEND command with an AEN bit of one shall be only issued to logical unit zero.

**Table 232 - SEND command - AEN data format**

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Reserved | | LUNTAR | Reserved | | LUNTRN | | |
| 1 | Reserved | | | | | | | |
| 2 | Reserved | | | | | | | |
| 3 | Reserved | | | | | | | |
| 4 | Sense data byte (0) | | | | | | | |
| n+4 | Sense data byte (n) | | | | | | | |

An AEN bit of zero indicates that the data to be transferred are vendor-specific.

The transfer length specifies the length in bytes of data that shall be sent during the DATA OUT phase. A transfer length of zero indicates that no data shall be sent. This condition shall not be considered an error.

A logical unit target (LUNTAR) bit of zero specifies that the asynchronous event occurred on a logical unit. A LUNTAR bit of one specifies that the asynchronous event occurred on a target routine.

If the LUNTAR bit is zero, the logical unit number target routine number (LUNTRN) field specifies the logical unit on which the asynchronous event occurred. If the LUNTAR bit is one, the LUNTRN field specifies on the routine on which the asynchronous event occurred.

The sense data bytes are defined in table 65.

# Annex E
(informative)

## Vendor identification

This annex contains the list of SCSI-2 vendor identifications (see table E.1) as of the date of this document. The purpose of this list is to help avoid redundant usage of vendor identifications. Task Group X3T9.2 of Accredited Standards Committee X3 maintains an informal list of vendor identifications currently in use. Please contact the chairman of X3T9.2 prior to using a new vendor identification to avoid conflicts.

**Table E.1 - Vendor identification list**

| ID | Organization |
|---|---|
| 3M | 3M Company |
| ACL | Automated Cartridge Librarys, Inc. |
| ADAPTEC | Adaptec |
| ADSI | Adaptive Data Systems, Inc. (a Western Digital subsidiary) |
| AMCODYNE | Amcodyne |
| ANAMATIC | Anamartic Limited (England) |
| ANCOT | ANCOT Corp. |
| ANRITSU | Anritsu Corporation |
| APPLE | Apple Computer, Inc. |
| ARCHIVE | Archive |
| ASACA | ASACA Corporation |
| ASPEN | Aspen Peripherals |
| AST | AST Research |
| ASTK | Alcatel STK A/S |
| AT&T | AT&T |
| ATARI | Atari Corporation |
| ATTO | ATTO Technology Inc. |
| ATX | Alphatronix |
| AVR | Advanced Vision Research |
| BALLARD | Ballard Synergy Corp. |
| BERGSWD | Berg Software Design |
| BEZIER | Bezier Systems, Inc. |
| BULL | Bull Peripherals Corp. |
| CalComp | CalComp, A Lockheed Company |
| CALIPER | Caliper (California Peripheral Corp.) |
| CAST | Advanced Storage Tech |
| CDC | Control Data or MPI |
| CDP | Columbia Data Products |
| CHEROKEE | Cherokee Data Systems |
| CHINON | Chinon |
| CIE&YED | YE Data, C.Itoh Electric Corp. |
| CIPHER | Cipher Data Products |

**Table E.1 - (continued)**

| ID | Organization |
|---|---|
| Ciprico | Ciprico, Inc. |
| CMD | CMD Technology |
| CNGR SFW | Congruent Software, Inc. |
| COGITO | Cogito |
| COMPORT | Comport Corp. |
| COMPSIG | Computer Signal Corporation |
| CONNER | Conner Peripherals |
| CPU TECH | CPU Technology, Inc |
| CREO | CREO Products Inc. |
| CROSFLD | Crosfield Electronics |
| CSM, INC | Computer SM, Inc. |
| CYGNET | Cygnet Systems, Inc. |
| DATABOOK | Databook, Inc. |
| DATACOPY | Datacopy Corp. |
| DATAPT | Datapoint Corp. |
| DEC | Digital Equipment |
| DELPHI | Delphi Data Div. of Sparks Industries, Inc. |
| DENON | Denon/Nippon Columbia |
| DEST | DEST Corp. |
| DGC | Data General Corp. |
| DIGIDATA | Digi-Data Corporation |
| DILOG | Distributed Logic Corp. |
| DISC | Document Imaging Systems Corp. |
| DPT | Distributed Processing Technology |
| DSM | Deterner Steuerungs- und Maschinenbau GmbH & Co. |
| DTC QUME | Data Technology Qume |
| DXIMAGIN | DX Imaging |
| EMULEX | Emulex |
| EPSON | Epson |
| EXABYTE | Exabyte Corp. |
| FILENET | FileNet Corp. |
| FUJI | Fuji Electric Co., Ltd. (Japan) |
| FUJITSU | Fujitsu |
| FUTURED | Future Domain Corp. |
| Gen_Dyn | General Dynamics |
| GIGATAPE | GIGATAPE GmbH |
| GIGATRND | GigaTrend Incorporated |
| Goidelic | Goidelic Precision, Inc. |
| GOULD | Gould |
| HITACHI | Hitachi America Ltd or Nissei Sangyo America Ltd |
| HONEYWEL | Honeywell Inc. |
| HP | Hewlett Packard |
| IBM | International Business Machines |
| ICL | ICL |
| IDE | International Data Engineering, Inc. |
| IGR | Intergraph Corp. |
| IMPLTD | Integrated Micro Products Ltd. |
| IMPRIMIS | Imprimis Technology Inc. |
| INSITE | Insite Peripherals |
| IOC | I/O Concepts, Inc. |
| IOMEGA | Iomega |

**Table E.1 - (continued)**

| ID | Organization |
|---|---|
| ISi | Information Storage inc. |
| ITC | International Tapetronics Corporation |
| JVC | JVC Information Products Co. |
| KENNEDY | Kennedy Company |
| KODAK | Eastman Kodak |
| KONAN | Konan |
| KONICA | Konica Japan |
| LAPINE | Lapine Technology |
| LASERDRV | LaserDrive Limited |
| LASERGR | Lasergraphics, Inc. |
| LMS | Laser Magnetic Storage International Company |
| MATSHITA | Matsushita |
| MAXTOR | Maxtor Corp. |
| MaxOptix | Maxoptix Corp. |
| MDI | Micro Design International, Inc. |
| MELA | Mitsubishi Electronics America |
| MELCO | Mitsubishi Electric (Japan) |
| MEMREL | Memrel Corporation |
| MEMTECH | MemTech Technology |
| MICROBTX | Microbotics Inc. |
| MICROP | Micropolis |
| MICROTEK | Microtek Storage Corp |
| MINSCRIB | Miniscribe |
| MITSUMI | MITSUMI Electric Co., Ltd. |
| MOTOROLA | Motorola |
| MST | Morning Star Technologies, Inc. |
| NAI | North Atlantic Industries |
| NatInst | National Instruments |
| NatSemi | National Semiconductor Corp. |
| NCL | NCL America |
| NCR | NCR Corporation |
| NEC | NEC |
| NISCA | NISCA Inc. |
| NKK | NKK Corp. |
| NT | Northern Telecom |
| OCE | Oce Graphics |
| OMI | Optical Media International |
| OMNIS | OMNIS Company (FRANCE) |
| OPTIMEM | Cipher/Optimem |
| OPTOTECH | Optotech |
| ORCA | Orca Technology |
| OSI | Optical Storage International |
| OTL | OTL Engineering |
| PASCOsci | Pasco Scientific |
| PERTEC | Pertec Peripherals Corporation |
| PFTI | Performance Technology Inc. |
| PIONEER | Pioneer Electronic Corp. |
| PRAIRIE | PrairieTek |
| PRESOFT | PreSoft Architects |
| PRESTON | Preston Scientific |
| PRIAM | Priam |
| PRIMAGFX | Primagraphics Ltd |

**Table E.1 - (concluded)**

| ID | Organization |
|---|---|
| PTI | Peripheral Technology Inc. |
| QUALSTAR | Qualstar |
| QUANTEL | Quantel Ltd. |
| QUANTUM | Quantum Corp. |
| R-BYTE | R-Byte Inc. |
| RACALREC | Racal Recorders |
| RADSTONE | Radstone Technology |
| RGI | Raster Graphics, Inc. |
| RICOH | Ricoh |
| RODIME | Rodime |
| RTI | Reference Technology |
| SANKYO | Sankyo Seiki |
| SANYO | SANYO Electric Co., Ltd. |
| SCREEN | Dainippon Screen Mfg. Co., Ltd. |
| SEAGATE | Seagate |
| SEQUOIA | Sequoia Advanced Technologies, Inc. |
| Shinko | Shinko Electric Co., Ltd. |
| SIEMENS | Siemens |
| SII | Seiko Instruments Inc. |
| SMS | Scientific Micro Systems/OMTI |
| SNYSIDE | Sunnyside Computing Inc. |
| SONIC | Sonic Solutions |
| SONY | Sony Corporation Japan |
| SPECTRA | Spectra Logic, a Division of Western Automation Labs, Inc. |
| SPERRY | Sperry (now Unisys Corp.) |
| STK | Storage Technology Corporation |
| SUMITOMO | Sumitomo Electric Industries, Ltd. |
| SUN | Sun Microsystems, Inc. |
| SyQuest | SyQuest Technology, Inc. |
| SYSGEN | Sysgen |
| T-MITTON | Transmitton England |
| TALARIS | Talaris Systems, Inc. |
| TALLGRAS | Tallgrass Technologies |
| TANDBERG | Tandberg Data A/S |
| TANDON | Tandon |
| TEAC | TEAC Japan |
| TECOLOTE | Techolote Designs |
| TEGRA | Tegra Varityper |
| Tek | Tektronix |
| TI-DSG | Texas Instruments |
| TOSHIBA | Toshiba Japan |
| ULTRA | UltraStor Corporation |
| UNISYS | Unisys |
| USDC | US Design Corp. |
| VERBATIM | Verbatim Corporation |
| VRC | Vermont Research Corp. |
| WangDAT | WangDAT |
| WANGTEK | Wangtek |
| WDIGTL | Western Digital |
| WEARNES | Wearnes Technology Corporation |
| XEBEC | Xebec Corporation |