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To: T10 Technical Committee
From: William Petty, LSI Logic Corp.
Subj: Alternate Selection and Communications Protocol **(ASCP)**

Change Control

Rev.	Date	Description of Change
0	7/7/99	Initial Document
1	6/29/00	Added description for continuing from ASCP into normal SCSI selection phase. Added soft address assignment method. Specified timing values fro all TBD timings.

1 PROPOSAL SUMMARY

There is a need to communicate with “Transparent” devices residing on a SCSI bus. This includes expanders, terminators, and other possible device types. A method to allow control of these devices without requiring the consumption of a SCSI ID is herein proposed.

1.1 Primary Goals

- This alternate communications method must be transparent to all existing SCSI devices.
- It must not cause any adverse conditions or errors to occur even in expanded systems.
- It must utilize only existing SCSI signals as defined in the SPI-2 P Cable description.
- This method should not be restricted to one bus mode. I.E. Single ended.
- Each participating device should be uniquely addressable and or accept broadcast commands.
- The communications protocol should be adaptable to other devices.
- Allows soft ID assignment for Expanders.

1.2 Assumptions

- High data rates are not required. (Less than 1MB/s)
- All 16 data bits are available for use. ***Note: Not backward compatible with 8-bit systems.***
- Expanders will allow split bit-bidirectionality within the data bus. (Same as arbitration phase.)
- All participating devices of a given class should accept broadcast commands.

1.3 New Timing Definitions

- Handshake timeout delay (10 us): The minimum time the host waits for target responses.

2 PROTOCOL REQUIREMENTS

This section outlines the primary protocol requirements. Following sections explore each item in more detail.

2.1 Data Integrity

Each byte sent/received is transferred via an asynchronous fully interlocked handshake method, except in ASCP broadcast phase. A CRC byte is appended to each information packet.

2.1 Device Class segregation

- Each class of device may have a unique command structure optimized for its particular need.
- Broadcast commands may be directed to a single class of devices, or all devices.

2.2 Signal Format

The 18 SCSI data lines in conjunction with BSY and SEL are the only signals used and assigned as follows:

BIT	SP0	SD7	SD6	SD5	SD4	SD3	SD2	SD1	SD0
Function	Res	Res	Res	Res	RXER	ASEL	SEND	TSTB	HSTB

SP0, SD[7:0] bit definitions

BIT	SP1	SD15	SD14	SD13	SD12	SD11	SD10	SD9	SD8
Function	Res	Data Byte							

SP1,SD[15:8] bit definitions

3 METHOD DESCRIPTION

3.1 ASCP Selection procedure

1. The BSY and SEL pins along with SD[15:0] are used to perform a standard bus arbitration cycle as defined in the SPI-2 document.
2. Once arbitration is won, the source ID is removed for at least one bus settle delay to signify to all targets that an alternate selection may follow. SD[15:0] = 0000h. (Negated)
3. ASEL and SEND are asserted and the requested target's Class Code and ID (see 4.3) are placed on SD[15:8]. Note: ID 0Fh = Broadcast to all devices within a class, Class Code 7 = all device types.
4. After at least a deskew delay, the host asserts HSTB to strobe the ID into all target devices.
5. If this is a broadcast command, HSTB is negated after a minimum of two deskew delays has passed and, after at least one deskew delay, ASEL shall be negated. ASCP selection is assumed to be complete at this point. (Proceed to ASCP Command/Data.) Else, if this is not a broadcast command, proceed to step 6.
6. The host waits up to one handshake timeout delay for the selected target to assert TSTB.
7. Upon receipt of TSTB the host shall negate HSTB, and after at least one deskew delay, negate ASEL. The host may then proceeds to ASCP command/data phase.

Note: If any expected transition on TSTB is not detected within a handshake timeout delay for any handshake, then ASCP de-selection phase shall follow.

3.2 ASCP Command/Data Send Phase

1. The SEND bit, still asserted from the ASCP selection phase, indicates a data direction from host to target.
2. An ASCP command/data byte is placed on SD[15:8].
3. After at least a deskew delay, the HSTB bit is asserted to strobe data into the target device.
4. The host holds data valid until it detects the TSTB bit is asserted by the target or until a handshake timeout delay occurs.
5. If RXER is to be asserted by the target for this command byte, the target shall do so at least one deskew delay prior to asserting TSTB.
6. The target asserts TSTB, acknowledging the byte, and the RXER bit is captured by the host.
7. The host negates HSTB in response to observing TSTB.
8. The host waits for up to one handshake timeout delay for the target to negate TSTB to close the handshake.
9. Loop back to step 2 for more bytes.
10. After the last command byte is sent and if the next phase is Data Receive, the host shall release SD[15:8], negate the SEND bit, and wait one bus settle delay before changing any other control lines.

3.3 ASCP Data Receive Phase

Note: The roles of HSTB, TSTB, and RXER now exchange roles. (TSTB precedes HSTB.)

1. The host requests a data receive phase by negating the SEND signal following the ASCP command/data send phase and waits up to one handshake timeout delay for any target TSTB response.
2. The target device waits one bus settle delay from the negation of SEND before driving any data.
3. The target places an ASCP data byte on the SD[15:8] lines.
4. After at least a deskew delay, the target shall assert TSTB strobing the ASCP data into the host.
5. Host receipt of the ASCP data is acknowledged by asserting HSTB.
6. If RXER is to be asserted by the host for this byte, the host shall do so at least one deskew delay prior to asserting HSTB. (This indicates a host receive error has occurred.)
7. The target holds data valid until it receives HSTB from the host.
8. The host waits for up to one handshake timeout delay for the target to negate TSTB and then negates HSTB to complete the handshake.
9. Loop back to step 3 for more bytes

3.4 ASCP De-selection Phase

1. SD[15:0], SP1, and SP0 shall be release for at least one bus settle delay.
2. SEL shall be released to deselect any ASCP targets.
3. After one bus settle delay, BSY shall be released to return the SCSI bus to the bus free phase.

3.5 ASCP De-selection/Standard SCSI Phase

1. ASEL and SEND are asserted.
2. The target's Class Code and ID are set to null, (SD[15:8] negated).
3. After at least a deskew setup delay, the host asserts HSTB to clear the ID from all target devices.
4. HSTB is negated after a minimum of two deskew delays.
5. After at least one deskew delay, all ASCP control signals are negated. ASCP de-selection is assumed to be complete at this point.
6. SD[15:0], SP1, and SP0 are set to the current host ID and the desired standard SCSI target ID.
7. After a bus settle delay, the standard SCSI selection/re-selection phase may resume by releasing BSY.

3.6 ASCP Broadcast Phase

1. Following the ASCP broadcast selection phase, which does not wait for the TSTB handshake, the host waits at least a bus settle delay before changing any signals.
2. The SEND bit, still asserted from the selection phase, indicates a data direction from host to target.
3. A ASCP command/data byte is placed on SD[15:8].
4. After at least a deskew delay, the host asserts the HSTB bit to strobe the data into target devices.
5. After a minimum of two deskew delays, the host shall negate the HSTB bit and may then change the data on SD[15:8].
6. The host shall wait a minimum of two deskew delays before changing any control signals.
7. Loop back to step 3 for more bytes.

3.7 Soft ID Assignment for Expanders

1. The host shall first perform a standard SCSI bus device scan and optionally may configure each target device.
2. The Reset Device command shall be broadcast to all devices within the expander class. (001b)
3. The Assign ID command shall be broadcast to all devices within the expander class (001b) once for each possible SCSI device ID. (0 – 15)
4. On completion of sending the Assign ID command, the SEND bit and SD[15:8] shall be negated and, after at least two deskew delays, HSTB is asserted.
5. Each expander that has detected the requested ID on its far port shall read its far port SD[15:8], increment the value by one, and present that data to its near port.
6. After a bus settle delay, the host shall latch the incoming data and negate HSTB, all reporting devices shall latch their respective position (Value reported on near port) and discontinue driving SD[15:8]. (The value latched by the host is the total number of expanders in the path to the requested SCSI target.)
7. After at least one bus settle delay, the host asserts SEND and places a starting address on SD[15:8].
8. After at least a deskew delay, the host asserts the HSTB bit to strobe the new ID into target devices. (The targets new IDs are the sum of the presented address and each target's latched position.)
9. After at least two deskew delays, the host negates the HSTB and performs a de-select sequence.

Note: Once a target's ID has be captured, the target shall not respond to any further Assign ID commands until either a SCSI bus reset or Reset Device command is received.

4 Data Format of Full Handshake Signaling

4.1 Command Format

Byte	SP1	SD15	SD14	SD13	SD12	SD11	SD10	SD9	SD8
1	Res	Res			Command				
2	Res	Command Length							
3	Res	Data 1							
--	Res	--							
N	Res	Data n							
Last	Res	CRC							

Command Format

4.2 Response Format

Byte	SP1	SD15	SD14	SD13	SD12	SD11	SD10	SD9	SD8
1	Res	REJ	Length						
2	Res	Data 1							
--	Res	--							
N	Res	Data n							
Last	Res	CRC							

Response Format

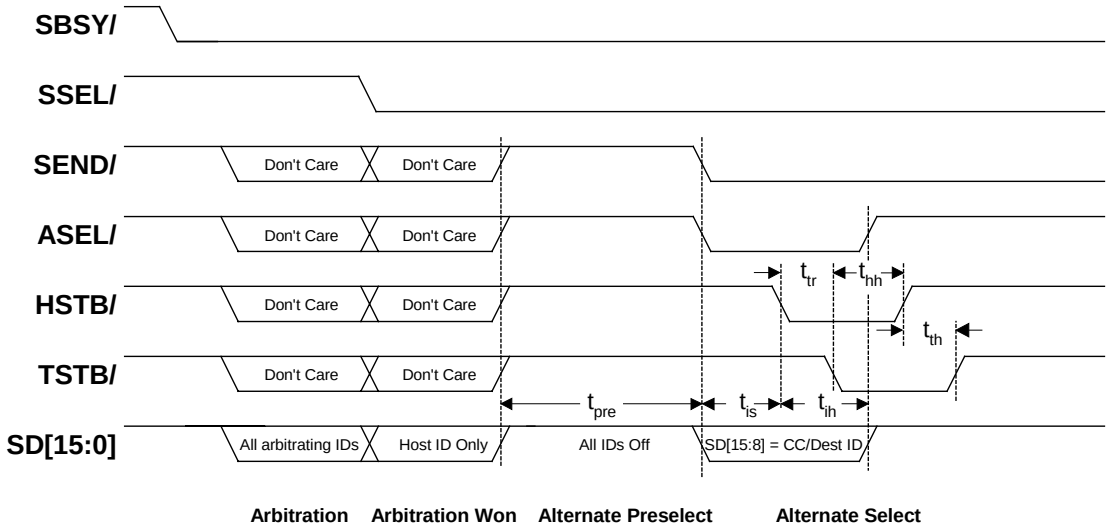
4.3 ASCP Selection Format

BIT	SP1	SD15	SD14	SD13	SD12	SD11	SD10	SD9	SD8
Function	Res	Class Code			Res	Destination ID			

SP1,SD[15:8] bit definitions

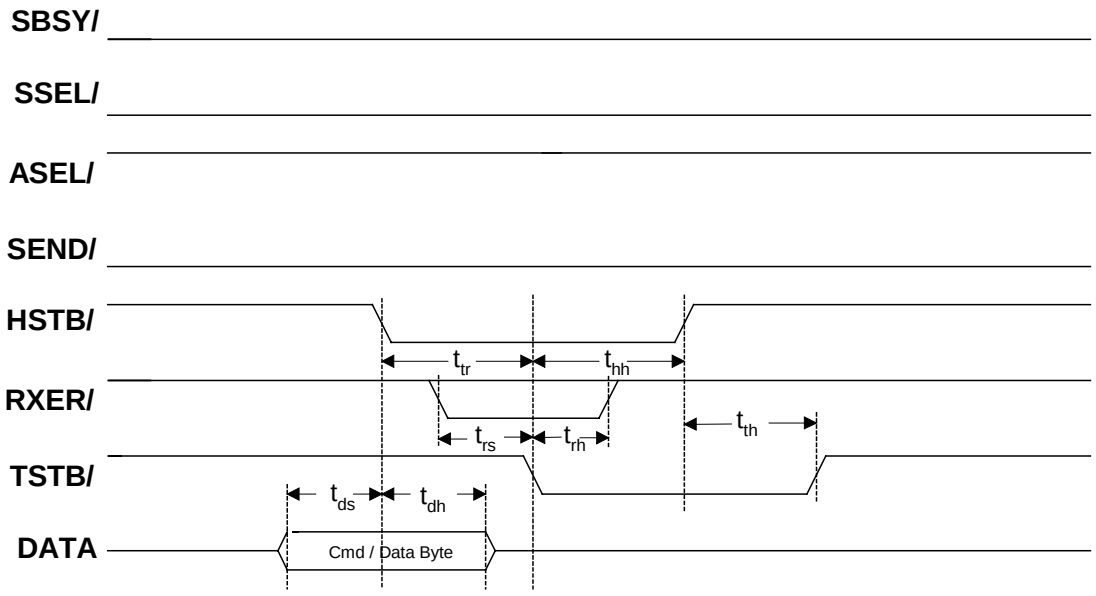
5 Full Handshake Timing Diagrams

5.1 Selection Waveform



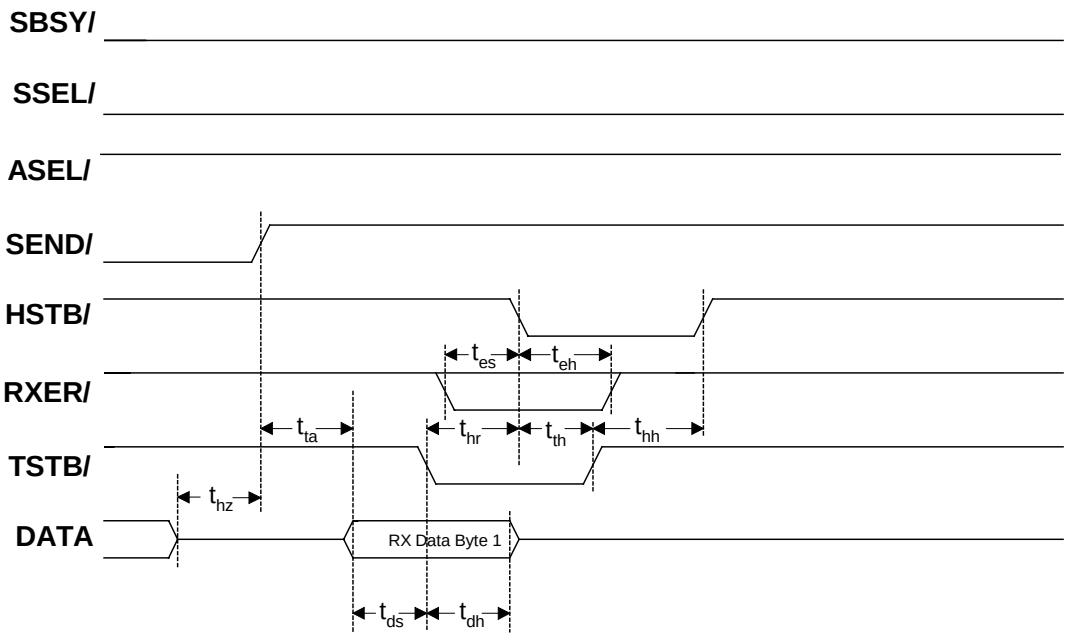
Selection Waveform

5.2 5.2 Data Send Waveform



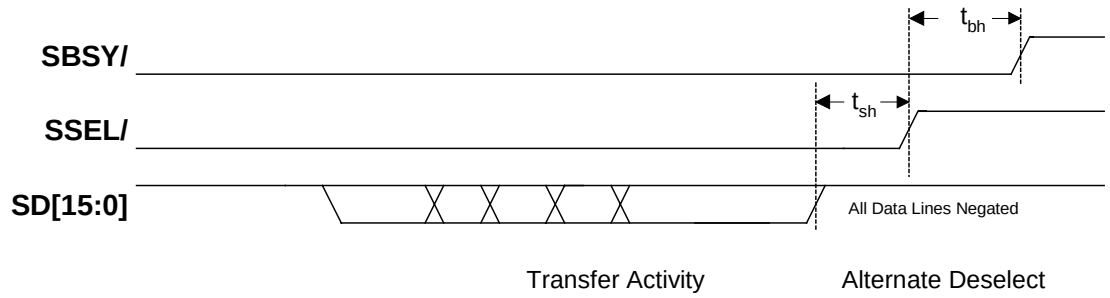
Data Send Waveform

5.3 Data Receive Waveform



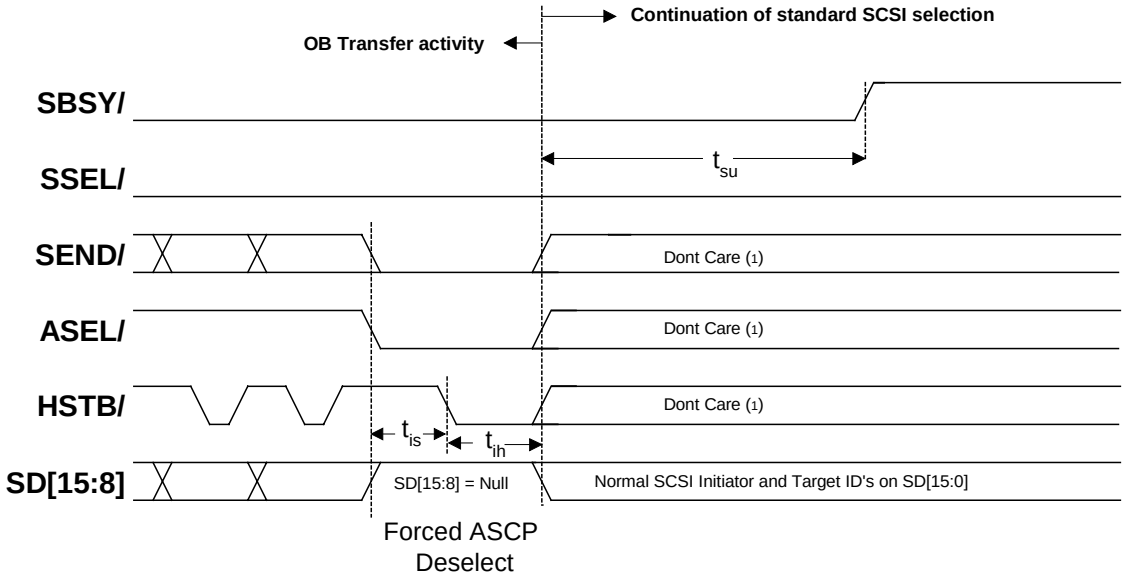
Data Receive Waveform

5.4 ASCP De-Selection Waveform



ASCP De-Selection Waveform

5.5 ASCP De-Selection/Standard SCSI Selection/Re-Selection Waveform

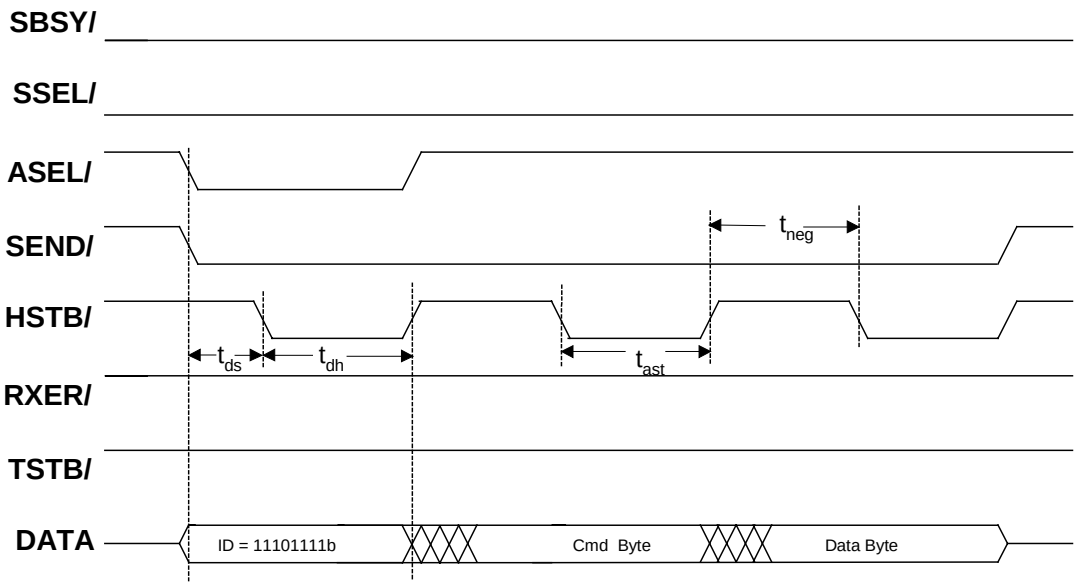


(1) No More than two of these signals should be asserted simultamiously
As per SPI-3 Specification

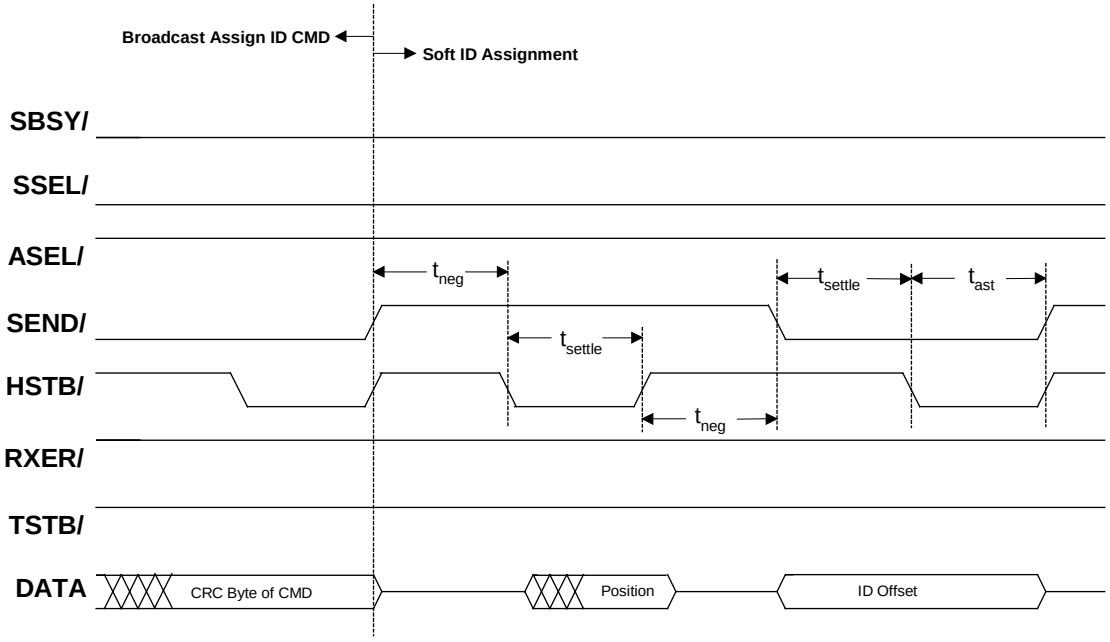
ASCP De-Selection/Standard SCSI Selection/Re-Selection Waveform

6 Broadcast Timing Diagrams

6.1 Broadcast Data Send Waveform



Broadcast Send Waveform



Soft ID Assignment Waveform

7 Field Code Definitions

7.1 Class Code

Code	Device Class
000	Reserved
001	Expanders/Repeaters
010	Standard SCSI device
011	Terminators
100 - 110	Reserved
111	All Device types

7.2 ASCP ID Codes

Code	Device Class
0000	Reserved
0001 - 1110	ASCP Target Device ID
1111	All Devices

7.3 SCSI ID Codes

Code	Device Class
0000 - 1111	ASCP Target Device ID

7.4 Commands

Code	Command
00000	Reserved
00001	Vendor Unique
00010	Identify Device
00011	Device Mode (Disable / Enable)
00100	Vendor Unique Register Write
00101	Vendor Unique Register Read
00110	Reset Device
00111	Assign ID
01000	Margin
01001-11111	Reserved

8 OPEN ISSUES

1. **Definition of 8-bit CRC.**