Pertec 9-Track Tape Interface

Information courtesty of John Wilson

Electrical

The interface uses two 50 conductor (ribbon) cables, **P1** and **P2**. All odd-numbered conductors are grounded, with the exception of conductors 1 and 3 on **P2**.

All signal levels are TTL (5 volt). Drivers are open-collector and must be capable of sinking 36 mA. The last device on each end of any cable should be terminated on all receive lines with 220 ohms to +5 volts and 330 ohms to ground.*(Note: I suspect that 220 ohm to 1K ohm to +5 will suffice on short (less than 1 meter cable runs.)*

All signals are active-low.

Signal Definitions

In the following, the source (driver) of the signal is signified by either **Drive** for the tape drive or **Host** for the host (controller). Note also, that the bit ordering is IBM-style. That is, bit 0 is the**most** significant bit in a byte and bit 7 is the **least**significant bit position. **Don't let this trip you up!**

P1 Connections

P1 Pin	Signal Name	Asserted by	Description
2	IFBY	Drive	Forrmatter busy—Set by trailing edge of **IGO**, clears when command finished (but you can send a new command as soon as **IDBY** clears)
4	ILWD	Host	Last word—Used to tell drive that this is the last word (byte) to be written in this record, Must be asserted at least 300 nsec. before trailing edge of final **IWSTR** pulse.
6	IW4	Host	Write data bit 4
8	IGO	Host	Initiate command—Pulsed low for at least 1µsec. to start command execution. The formatter address lines must be stable throughout the pulse and until **IFBY** drops.
10	IW0	Host	Write data bit 0 (*MSB!*)
12	IW1	Host	Write data bit 1
14	ISGL	Drive	Selected drive fault on some drives; NC on others. If used, it is cleared by de-asserting, then re-asserting **IFEN**.
16	ILOL	Host	Load on-line—Pulsing this line at least 1µsec. begins the tape load sequence on many drives.
18	IREV	Host	Reverse—When asserted, indicates operation is to be performed in the reverse direction.
20	IREW	Host	Rewind—A pulse of at least 1 µn;sec. starts the tape rewind sequence. Completion is signalled by **IRWD** and **IRDY** being asserted by the drive.
22	IWP	Host	Write parity. This is (almost always) odd parity computed over **IW0–IW7** and on some drives is ignored and computed by the formatter.
24	IW7	Host	Write data bit 7 (*LSB!*)
26	IW3	Host	Write data bit 3
28	IW6	Host	Write data bit 6
30	IW2	Host	Write data bit 2
32	IW5	Host	Write data bit 5
34	IWRT	Host	Write—When asserted with **IGO** begins a write sequence.
36	IRTH2	Host	Write density select 2—On some drives, this signal, along with **IRTH1** is used to select the drive write density. If it is implemented, it is valid only at BOT and must be asserted with **IGO** during the first write sequence.

38	IEDIT	Host	Edit—Not implmented on all drives. See notes in the next section for details on its application.
40	IERASE	Host	Erase—When asserted with **IWRT** and **IGO**, causes tape to be erased, usually for a predetermined length. Usually used to recover from write errors or provide extra space for mode changes (i.e. Read after write).
42	IWFM	Host	Write filemark&mash;When asserted with **IWRT**, writes a filemark.
44	IRTH1	Host	Write density control—See **IRTH2**, pin 36.
46	ITAD0	Host	Transport address bit 0 (MSB!)—Used to address multiple drives on a single controller.
48	IR2	Drive	Read data bit 2
50	IR3	Drive	Read data bit 3
All odd	Gnd	–	Signal ground.

P2 Connections

P2 Pin	Signal Name	Asserted by	Description
1	IRP	Drive	Read data parity (odd) *This is not a ground pin!*
2	IR0	Drive	Read data bit 0 (*MSB!*)
3	IR1	Drive	Read data bit 1 *This is not a ground pin!*
4	ILDP	Drive	Load point—Asserted whenever the tape is at the load point (or might as well be, as far as the controller needs to know -- there may be hidden repositioning)
6	IR4	Drive	Read data bit 4
8	IR7	Drive	Read data bit 7 (*LSB!*)
10	IR6	Drive	Read data bit 6
12	IHER	Drive	Hard error—Pulsed during **IDBY** when a hard data error (or illegal character in the IRG) is seen. Note that most modern formatters correct this error automatically.
14	IFMK	Drive	File mark—Pulsed during **IDBY** when a tape mark is seen. Note that you have to catch this as it goes by!
16	IDENT	Drive	Identification—Asserted while drive is actually reading the PE ID burst, dropped the rest of the time so it's up to the controller to catch it and remember.
18	IFEN	Host	Formatter enable—This signal should normally be asserted all the time. If dropped for a minimum of 2 µsec., aborts any comman that asserts **IDBY** (I/O, skip, but not rewind or unload).
20	IR5	Drive	Read data bit 5
22	IEOT	Drive	End of tape—Asserted whenever the tape is past the EOT marker, clears when the tape is backspaced past it.
24	IRWU	Host	Rewind and unload—A pulse of at least 1 µsec. initiates a rewind-with-unload and sets drive off-line. Some drives require that **IREW** is also asserted.
26	INRZ	Drive	NRZI mode—Signals 800 BPI mode on some drives.
28	IRDY	Drive	Ready—Signals that tape is fully loaded, on-line and not rewinding. This must be asserted by the drive before it will accept any command.
30	IRWD	Drive	Rewinding—This is asserted by the drive while the tape is rewinding.
32	IFPT	Drive	File protect—This signal is asserted continuously when the tape is not write-enabled (i.e. no ring present).
34	IRSTR	Drive	

			Read strobe—Pulses low for at least 200 nsec. when data on **IR0-IR7** and **IRP** are stable before leading edge; typically held for 200 nsec., but this is not a requirement. Note that data is made available–there is no check made to ensure that the host has picked it up.
36	IWSTR	Drive	Write strobe—Pulses low for at least 200 nsec. when the drive is ready to accept data. This is roughly similar to an "Acknowledge" signal after data has been received. The next data byte can be presented immediately.
38	IDBY	Drive	Data busy—This signal is asserted during I/O phase of read or write commands. It generally lags a few milliseconds after the drive asserts **IFBY**.
40	ISPEED	Drive	High-speed—This signal is asserted when commands are executing in high-speed mode; that is, when the drive is not operating in start-stop mode.
42	ICER	Drive	Corrected error—This signal is pulsed during **IDBY** when a single-track dropout is successfully corrected using the parity information.
44	IONL	Drive	Online—Asserted when the drive is online; clears within 1 µsec. of being taken offline.
46	ITAD1	Host	Transport address bit 1 (*LSB!*)
48	IFAD	Host	Formatter address
50	IHISP	Host	High speed select—When asserted 1 µsec. before and then with **IGO** (de-asserted any time after the trailing edge of **IGO** selects high-speed (streaming) mode.
5-49 odd	Gnd	–	Signal ground.

Usage

Commands are started by setting up the **IREV**, **IWRT**,**IWFM**, **IEDIT**, and **IERASE** signals and then pulsing**IGO**. Various combinations of these signals are possible to get vendor-specific commands.

The basic ones are:

Read

Assert **IGO**. The drive reads data and presents data at**IR0**–**IR7**, strobing each byte with **IRSTR**. No check is made for data received by the host; it's simply shoveled out by the drive until the end-of-block or error. **ICER** and **IHER** signal soft and hard errors, respectively and **IFMK** will indicate a filemark. Observe that these signals are just pulses that accompany each data byte—they do *not* latch.

Read Reverse

Assert **IGO** while asserting **IREV**. Operates the same as a forward read, but data is presented in reverse order.

Write

Assert **IWRT** while asserting **IGO**. As the formatter accepts each byte of data, it signals with the **IWSTR** strobe. Again, no check is made to see if the data presented at **IW0**-**IW7** and **IWP** is valid--the host must present data and parity prior to the assertion by the drive of **IWSTR**. When the last byte in a block is presented for writing, the host must assert **ILWD**.

Write Filemark

Assert **IWRT** and **IWFM** while asserting **IGO**. One filemark will be written.

Erase

Assert **IWRT**, **IWFM** and **IERASE** while asserting **IGO**. This command erases a few inches of tape, usually as part of a write error recovery sequence.

Skip Block Forward

Assert **IERASE** with **IGO**. This functions similarly to a read but with no data transfer.

Skip Block Reverse

Assert **IERASE** and **IREV** with **IGO**. This is similar to a read reverse operation, but with no data transfer.

Search Filemark Forward

Assert **IWFM** and **IERASE** with **IGO**. This causes the drive to skip forward to the next filemark or EOT. The tape is left positioned after the filemark

Search Filemark Reverse

Assert **IWFM**, **IREV** and **IERASE** with **IGO**. This causes the drive to skip backward to the preceding filemark or BOT. The tape is left positioned before the filemark

Miscellany

On some drives, **IEDIT** modifies reverse reads and forward writes so that a record can be replaced. Asserting **IEDIT** while doing a reverse read causes the drive to move further back into the IRG preceding the record being spaced over. Asserting **IEDIT** while writing tells the drive to modify the write current turn-off to avoid a glitch.

Streamers have a drive-dependent "reinstruct time" which is the size of the time window after completion of a command during which you can issue a new command without the drive having to reposition. If you fail to make this window, then the drive stops and backspaces a few records to get a running start at the next record. This can waste a lot of time and movement. Asserting **IHISP** needlessly will probably result in operations taking longer if succeeding operations cannot be issued in time, so care must be used in attempting to use the "high speed" mode of operation.

As regards transfer speeds, a good rule of thumb is that an interface should be designed to provide or receive data at least at 1MB/second. Observe that there's no handshaking for data transfers, so it's incumbent on the controller to satisfy all timing requirements.

Glossary

Here are a few terms used in this discussion:

BOT or "beginning of tape". This is not the physical start of a tape, but rather the point after the beginning where a reflective foil tape marker has been applied. All tape before this is classified as "leader".

EOT or "end of tape". This is not the physical end of the tape, but rather a point somewhere before the physical end where a reflective foil marker has been placed. As a rule of thumb, it's safe to write at least one short record past the EOT marker.

Filemark is a reserved bit pattern used to delimit files on a tape. Most drives can scan a tape in either forward or reverse directions at high speed to locate a filemark. Some system software uses two or three consecutive filemarks to provide extra levels of delineation.

Write enable or "write ring" is a plastic ring that fits into a groove in the back of a reel of tape to tell the drive that it's safe to write to the tape. "No ring, no write" is an old data processing rule.

Formatter is a intermediate interface between the drive and the controller that provides buffering and error correction facilities for a drive or group of drives. One formatter can service several drives. It's also possible to interface a drive to more than one formatter.

Parity is used for error control on tape drives. One bit in a nine-bit frame is reserved for parity and some tape formats also append a longitudinal parity frame at the end of a block, so that single errors can be corrected. In 9-track tapes, the number of bits in a frame must be odd. Some 7 track tape formats allowed for even parity as long as no all-zero frames are written.

Chuck Guzis, Sydex, Inc.
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