Polymorphic SDC and North Star SDC Compatibility

The disks written by the Polymorphic and North Star single density controllers are similar, but not identical. Both are 35 tracks, 10 hard sectors per track, and 256 bytes per sector. However, the sync byte(s), bit order, metadata, checksum calculation, and the position of the data between hard sector pulses is different.

The sync mechanism on the Poly controller is a soft implementation using the Motorola 6852 synchronous communication controller. With just some software changes, the Polymorphic controller can read and write North Star format disks. The North Star controller can write a disk in Polymorphic format, however, the North Star controller cannot read a Poly format disk.

Polymorphic Single Density Disk Format

The table below shows the sector format written by the Polymorphic hardware and software. Bytes are serialized to the disk in LSB to MSB order. Note this is the opposite direction as the North Star controller.

Time (milliseconds)	Note
0.000	Sector pulse
0.000	Start interrupt service routine
0.020	10 zero bytes (by software)
0.660	2 sync bytes (0E6h, 0E6h)
0.788	Sector number (0-9) + 80h
0.852	Track number (0-34)
0.916	256 data bytes
17.300	LSB of checksum
17.364	MSB of checksum

The checksum is iteratively computed by performing a 16 bit add, two data bytes at a time. The first byte read in each byte pair is placed in the LSB, the second byte read is placed in the MSB. The initial checksum is zero. The checksum is computed over the 256 data bytes only. Before writing to disk, the checksum is complemented (1's complement).

When reading, the Polymorphic controller does NOT suppresses sync hunt following the sector pulse. This is unlike most hard sector controllers. Instead, the Poly controller trusts the two-byte sync sequence checked by the 6852 to prevent false sync due to index alignment issues.

The Poly disk PROMs limit sync hunt to 1.33ms during reads (PROM version 8.2). Because of the way this loop exits, this timeout of 2*660us does not actually provide a +660/-660us index alignment tolerance as expected, but instead, a +660/-417us tolerance. If instead, the sync hunt timeout loop is set to 1.576ms, then a +/-660us alignment tolerance is achieved.

North Star Single Density Disk Format

The table below shows the sector format written by the North Star hardware and software. Bytes are serialized to the disk in MSB to LSB order. Note this is the opposite direction as the Polymorphic controller.

Time (milliseconds)	Note
0	Sector pulse
0	Start of 96us delay
0.096	Zero byte (by hardware)
0.160	15 zero bytes (by software)
1.120	Sync byte (0FBh)
1.184	256 data bytes
17.568	Checksum

The checksum is iteratively computed by XOR'ing the current data byte with the running checksum, then rotating that result one bit to the left. The initial checksum is zero. Checksum is computed over the 256 data bytes only.

When reading, the North Star controller suppresses sync hunt for 480us after the sector pulse. This provides +640us/-384us index alignment tolerance.

Writing Polymorphic Format using the North Star Controller

The North Star SDC can be used to write a Polymorphic compatible format as show below. Note that the bit order of all bytes must be reversed before writing to disk. The North Star controller serializes a byte from MSB to LSB, whereas the Polymorphic controller serializes a byte from LSB to MSB.

1) Wait for the WRITE status bit, then write 8 zeros
2) Write two 0E6h sync bytes (will start at about 672us)
3) Write sector number (0-9) + 80h
4) Write track number (0-35)
3) Write 256 data bytes
4) Write 16 bit checksum (LSB, then MSB)

The data written cannot be read/verified on the North Star controller because the Polymorphic sync character will not be detected by the North Star hardware.

Reading and Writing North Star Format using the Polymorphic Controller

The Polymorphic controller can read and write North Star disks as noted below. Note that the bit order of all bytes must be reversed before writing/after reading to/from disk. The North Star controller serializes a byte from MSB to LSB whereas the Polymorphic controller serializes a byte from LSB to MSB.

- Initialize the 6852 for single byte sync instead of two-byte sync and to use a sync character of 0DFh (the North Star sync of 0FBh in reverse bit order). Single byte sync is selected by initializing Control Register 3 in the 6852 with 0Eh instead of 0Ch.
- For writes, immediately upon detecting the sector pulse, write 17 zeros (one extra to account for the 96us North Star write delay) followed by the North Star sync byte, followed by the 256 byte sector, followed by the checksum (write the checksum twice since two bytes must always be written).
- For reads, after the sector pulse is detected, delay about 600us (96us+8*64us) and issue the “clear sync” command to the. This starts sync hunt half way into the 16 zero byte leader.