DISK PACK INITIALIZATION

Initializing a Disk Pack is the process of formatting and certifying all of the tracks on the recording surfaces within the pack. This process insures that a disk pack is magnetically and mechanically suitable for use and provides the necessary operating information such as: Header Addresses, Record Zero (RØ), etc.

This issue of COMPUTER TALK will briefly describe the physical construction of a disk pack, the recording technique used, and the function of the initialization routine.

PHYSICAL DESCRIPTION

A typical disk pack is composed of a stack of individual recording disks which are secured into a cylindrical unit. Each disk is approximately 14 inches in diameter and consists of a precision aluminum substrate coated on both sides with a magnetic material. Each disk has two useable recording surfaces except for the outside of the top and the bottom disks, each of which have one recording surface covered by a mechanical element of the pack.

During data recording each surface is magnetically recorded in concentric paths called "tracks." The number of tracks per surface varies with the particular type of drive being used. For simplicity, a typical IBM 2311, Model 1, usage will be used as a basic reference.

In this typical configuration, each recording surface has 203 tracks. The primary data tracks, numbered 0 to 199, are those used to store data for future recall. The alternate tracks, numbered 200, 201, and 202 are reserved to record data which cannot be successfully recorded on primary data tracks. The recorded tracks which lie within a single vertical cylindrical plane comprise a cylinder. Thus, within the typical configuration there are 200 primary data cylinders and 3 alternate cylinders.

The disk drive unit contains the read/write heads and the necessary electronics to drive the disk pack and syn-

chronize it to the remaining system components. The read/write heads are mounted in a single access system with one head for each recording surface. Each head is supported by a very thin film of air (called an air bearing) between the head and the disk surface. Ideally, the heads should never touch the magnetic surface; but head-to-disk contact always occurs during the load cycles and occasionally during operation. If this contact is severe, the results could cause disk or head damage. The heads, moving as a unit, select the desired cylinder position within the pack. By selecting a particular cylinder and switching to an individual read/write head, every track within the disk pack is directly accessible. The intersection of a particular head with a given cylinder is referred to as a "Track." Therefore, each track has its own unique address which corresponds to its cylinder and head location.

INITIALIZATION PROCESS

The preparation of a disk pack for individual usage is accomplished during initialization. The initialization process consists of two related procedures, those of certification and formatting. During certification each track is magnetically checked for data errors. Establishing the format involves recording appropriate control informa-

tion on each track which insures system and pack compatibility.

CERTIFICATION

Certification of a disk pack involves the recording of data patterns on each track. The retrieval of the data patterns during playback is monitored and verified to insure reliable system operation.

Basically there are two types of errors which may appear during certification: *Dropouts* and *Dropins*. Neither error, however, is distinguishable from the other as to the overall effect during the initialization process. A *Dropout* is a reduction in the playback signal amplitude below a specific level. A typical cause of a dropout is a non-magnetic asperity in the coating. This condition can cause the loss of one or more recorded bits of data. Figure 1 shows an example of signal loss created by a dropout.
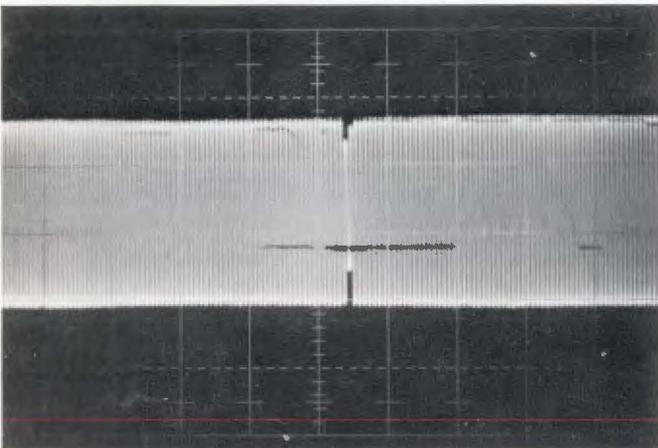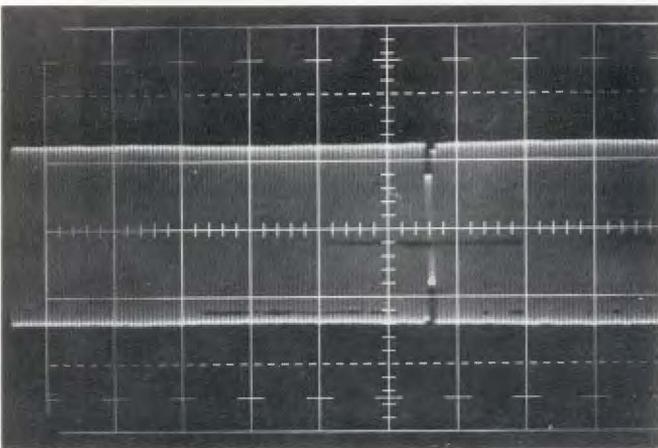
FIGURE 1. DROPOUT ERROR

A *Dropin* (extra pulse) is an increase in playback signal amplitude above a specific level. This error condition can create a playback of more bits than were actually recorded. A dropin may be caused by an abrupt irregularity in the disk surface. This irregularity in the disk surface effectively changes the magnetic interface between the head and the coating, producing a spurious signal. The closer the head flies to the disk surface, resulting in an oversensitive playback condition, the greater the susceptibility to dropin errors. Figure 2 shows a typical example of the extra pulse.
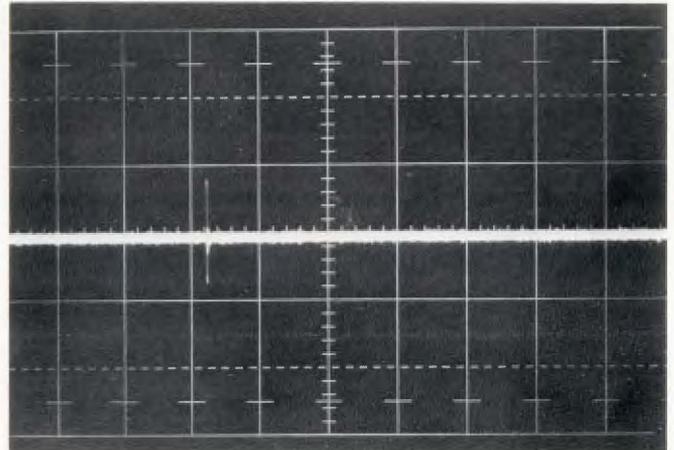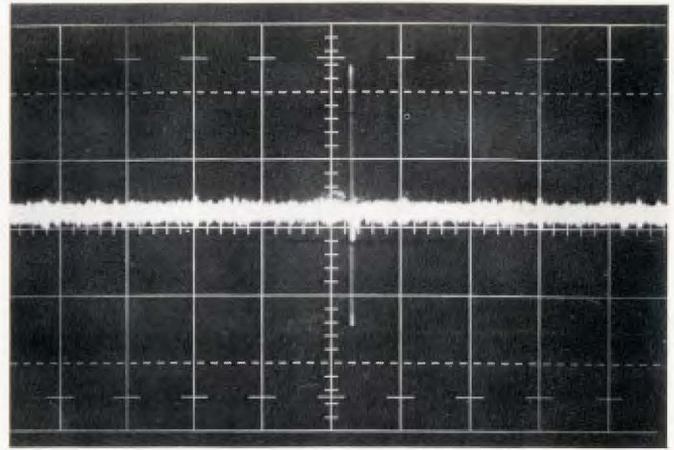
FIGURE 2. DROPIN ERROR

During certification any primary data track found to be defective is magnetically identified (flagged), and an alternate track is assigned to take its place. For this reason the alternate tracks are certified first. If an alternate track is found to be defective, it is flagged and may not be used. After all the alternate tracks are certified, the primary data tracks are then certified to establish the presence of any errors. A completely error-free disk pack is one in which all the primary data and alternate tracks are free of error-producing flaws.

FORMAT

A disk pack format is primarily a track identification system which is required to access the track on command. Each track is formatted with a Home Address and Track Descriptor Record.

The Home Address occupies the first seven bytes on every track. It contains information to indicate the track's condition, identification as to whether it is a primary data track or an alternate, and that particular track's location in terms of its cylinder and head number (track address).

The Track Descriptor Record (RØ) is the first data record on each track. On a primary data track it contains the "Record ID" (Address) of the last physical record on that track. The data area within RØ indicates the number of remaining recordable bytes on the track. If the track is flagged, or known to have an error, the data

area contains the address of the alternate track which was assigned to replace it. Because the functions performed by the Home Address and the Track Descriptor Record (RØ) are essential for proper access, these areas must be error-free and remain so for the life of the pack.

IMPORTANCE OF CERTIFICATION

Harsh or improper handling, such as dropping the pack, may disturb the critical position of the individual disks in relation to each other and to the pack centerline. This type of damage will create a condition in which the disk drive will not be able to properly index to the recorded format areas on the disk surface.

Occasionally a disk drive system, with its ultra-sensitive electronic equipment, may be over-sensitive of pack performance. This condition may create an excessive number of errors within a disk pack which would otherwise be considered normal and serviceable in similar drives. The initialization process allows a determination of the degree of compatibility which exists between the disk drives and the packs which form a part of any data processing system.

SUMMARY

The process of initialization involves certifying each track on every disk within a disk pack to determine if any flaws are present which could produce errors during normal operation. Also, the process formats each track with system control information, namely Home Address and Track Descriptor Record. The entire initialization process allows the user to check the condition of the pack and determine its compatibility with his equipment and its suitability for the intended use.

If at any time additional information on this topic is desired, it is available by simply writing to:

> Product Communications
> Magnetic Products Division
> 3M Company
> 3M Center
> St. Paul, Minnesota 55101

Additional copies of this paper are available from your 3M representative, or by writing to the address above.

Magnetic Products Division 3M COMPANY