READ WRITE ANALYZER
RWA-201B

DRIVE INTEGRATION

Version 4.07

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1. GENERAL DESCRIPTION

The Guzik Read Write Analyzer RWA-201B is capable of measuring a broad range of characteristics of Head Disk Assemblies (HDA), as well as detecting various types of media defects. The tests which are performed for media and head certification equally apply to HDA certification. See the RWA-201B User's Manual for a detailed description of the tests.

Production software included with the RWA-201B allows to perform high speed HDA certification. Missing and extra pulses as well as margin errors are detected. The user can verify defects found through the analog channel by multiple write/read operations through the drive's channel (see the Digital Retry Option part of the RWA-201B User's Manual).

In order to test read-write characteristics of a Head Disk Assembly the RWA-201B must be able to write its own format and pattern onto the media. Drives with an ST-506 interface allow direct access for the write gate and write data lines from the drive interface to the input of the write circuitry. Drives with intelligent interfaces such as ESDI, SCSI and SMD control write gate and data internally.

On each track the RWA writes a single sector record. It starts with 25 bytes of preamble required for the synchronization of the data separator followed by the one bit address mark indicating the end of the preamble and the beginning of valid data. After that a two byte periodic pattern is written. The same format is expected during the read operation.

Usually the format of the signal written by an intelligent drive is different from the one described above. For this reason Guzik Technical Enterprises provides an Interface Control Board (ICB-201) which generates write gate and data signals to be connected to the write circuitry of the drive. Polarity and the driving characteristics of these signals can be controlled by jumper options on this board. External write gate disable option allows to protect a wedge servo.

Analog read data can be recovered after the drive's preamplifier through a read buffer board (B-201) and sent through the Filter Matrix (F-201) to the Read Write Analyzer (RWA-201B). Thus the characteristics of the linear signal can be measured.

Digital read data from the output of the drive's read channel are sent to the RWA-201B data separator for margin and missing pulse analysis. Bit shift characteristics of the drive's digital read data can be compared to those of the read data from the RWA's read channel.

The ability to select the interface, seek to track and select heads is provided by the RWA hardware and software.

2. HARDWARE CONFIGURATION

The following sections list the various components required to integrate drives with the RWA-201B system. Figs. 4.1 - 4.4 show the configuration of the components for each particular interface. The customer should provide a high quality low noise power supply for the drive as it affects the results of the tests performed on the drive. For example, power supplies used in IBM PC/XT's are acceptable.

2.1 ST-506

1. ST-506 control and data cables
2. Read Buffer B-201

2.2 ESDI

1. ST-506 control and data cables
2. Interface Control Board ICB-201
3. Control and data cables between ICB-201 and the drive
4. Read Buffer B-201

2.3 SCSI

1. SCSI host adapter board SMS-510 installed inside IBM PC/XT/AT
2. SCSI host adapter cable
3. ST-506 control and data cables
4. Interface Control Board ICB-201
5. Index jumper cable
5. Read Buffer B-201

2.4 SMD

1. SMD interface board 300130 installed inside RWA-201B

2. SMD control and data cables

4. Interface Control Board ICB-201

5. ST-506 control and data cables

6. Read Buffer B-201

3. INTEGRATION PROCEDURE

Integration of a drive to the RWA consists of establishing and verifying a hardware interface between the RWA and the drive under test and setting proper drive parameters in the RWA software.

The integration procedure requires some knowledge of the operation of the Read Write Analyzer RWA-201B and, in particular, the Engineering Program (T4). Please refer to the RWA-201B User's Manual.

The following provides an outline of the steps to be taken to accomplish this. As some steps are drive interface dependent, refer for details to sections for each particular drive interface:

Sec. 4.1	- ST-506
Sec. 4.2	- ESDI
Sec. 4.3	- SCSI
Sec. 4.4	- SMD

Some steps are common to all drive interfaces and are described in separate sections referred to in each such step description.

If you encounter difficulties during the integration process, review the preceding steps. If the difficulty persists, contact Guzik Technical Enterprises for assistance. Upon customer request Guzik Technical Enterprises will perform drive integration. The following materials are required:

1. The drive itself
2. Drive operating manual

3. Drive schematic
4. Layout documentation for the drive's boards

WARNING: Turn OFF the Read Write Analyzer and the drive before making any hardware connections. Performing these operations under power may severely damage the drive and/or the RWA-201B hardware.

Step 1. Connect the drive interface cables to the RWA or an appropriate host adapter.

Step 2. Provide a connection for the index signal (SCSI interface only).

Step 3. Disable erase protection (ST-506 interface only).

Step 4. Configure the RWA-201B software for the particular drive interface and verify communication (see Sec. 5).

Step 5. Connect analog read data signals to the Read Buffer B-201 (see Sec. 6).

Step 6. Attach RWA's write gate and write data signals from the Guzik Interface Control Board (ICB-201) to the corresponding inputs in the drive's write circuitry (see Sec. 7). This does not apply to ST-506 interface.

Step 7. Attach the drive's digital read data signal to the Guzik Interface Control Board (ICB-201) (see Sec. 8). This does not apply to the ST-506 interface.

Step 8. Verify the write/read ability by writing and viewing the data on an oscilloscope (see Sec. 9).

Step 9. Verify the ability to read through the digital line (see Sec. 9).

Step 10 (optional). If the drive's electronics allow to control write current by an external current or voltage source, build and attach an appropriate circuit (see Sec. 13).

4. DRIVE CONNECTION AND SOFTWARE CONFIGURATION

4.1 ST-506

ST-506 drives are attached to the RWA-201B by means of ST-506 control and ST-506 data cables (see the ST-506 Manual for line assignment and hardware handshake specifications). Fig. 4.1 is a connection diagram for ST-506 drives.

Jumpers on the drive should be configured to make the drive under test DRIVE 1 (see the ST-506 Manual). Also an interface terminating resistor pack should be installed.

An ST-506 drive normally detects the absence of write data pulses within the write gate. This is sometimes known as the erase protection feature. Since some tests such as extra pulse detection require erasure of the track, this feature must be disabled.

Some drives have a jumper or a switch which disables erase protection (see the drive's manual). For other drives erase protection can be disabled by grounding WRITE UNSAFE output of the preamplifier IC, e.g. SSI-117 (see the drive schematic or preamplifier IC manual).

See Sec. 7 for instructions on how to connect analog signals. Also see Sec. 13 for optional current control source connection.

The following parameters should be set in the System Parameters Menu.

Interface	ST-506.
ID Radius	The actual ID radius of the drive, if known. Otherwise enter 1".
Reference Radius	Same value as ID radius.
Step Size	Actual step size in μIn, if known. Otherwise 1000 μIn.
Steps per Track	1.
Step Rate	Recommended step rate for a buffered seek from the drive's manual in mSec. If not known, enter 0.01 mSec.
Maximum Track Number	The number of cylinders from the drive's manual minus one. Any positive number less than this will be valid.

Maximum Head Number	The number of read/write heads from the drive's manual minus one. Any positive number less than this will be valid.
Track to Change Current	If the drive requires external current control, this number should correspond to the track where write current is switched from inner to outer or vice versa.
Drive Number	1.

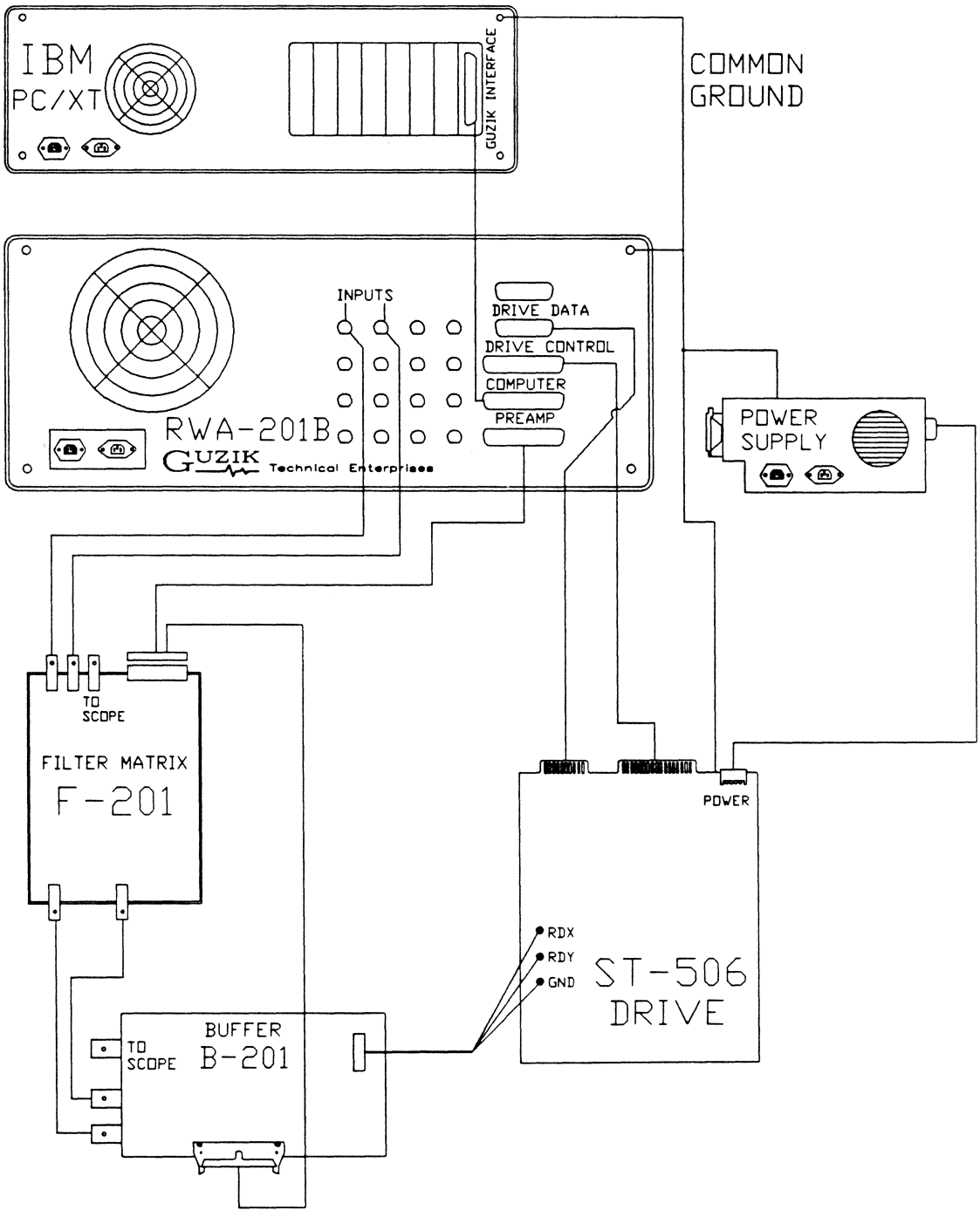

FIG. 4.1: ST-506 CONNECTION DIAGRAM

4.2 ESDI

ESDI drives are attached to the RWA-201B through the Interface Control Board ICB-201. It converts the signals coming from the RWA through the ST-506 data and control cables to those of the ESDI interface. ST-506 write gate and write data signals are not attached to the corresponding signals on the ESDI interface, but rather connected to the internal write circuitry of the drive (see Sec. 7 and Figs. 7.1 - 7.4 for connection procedure).

Digital read data are passed to the RWA-201B from the drive's read channel through the ICB-201 and the ST-506 data cables.

Jumpers on the drive should be configured to make it DRIVE 1 (see the drive's manual). Also an interface terminating resistor pack should be installed. SPINDLE MOTOR jumper or switch should be configured in such a way as to cause the drive to spin up immediately after POWER ON.

Fig. 4.2 is a configuration diagram for ESDI drives.

See Sec. 7 for instructions on how to connect analog signals. Also see Sec. 13 for optional current control source connection.

The following parameters should be set in the System Parameters Menu.

Interface	ESDI.
ID Radius	The actual ID radius of the drive, if known. Otherwise enter 1".
Reference Radius	Same value as ID radius.
Step Size	Actual step size in μIn, if known. Otherwise 1000 μIn.
Steps per Track	1.
Maximum Track Number	The number of cylinders from the drive's manual minus one. Any positive number less than this will be valid.
Maximum Head Number	The number of read/write heads from the drive's manual minus one. Any positive number less than this will be valid.
Drive Number	1.

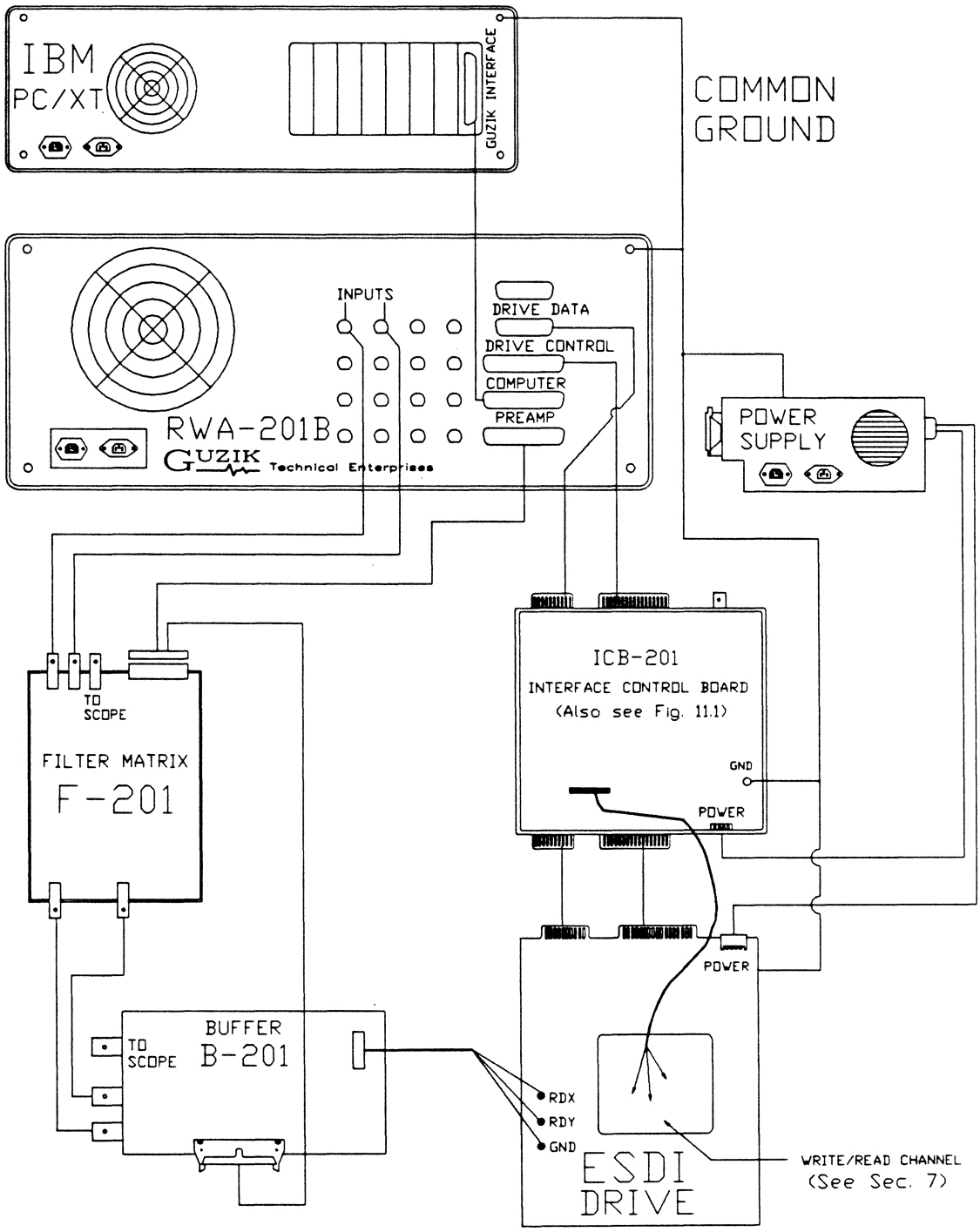

FIG. 4.2: ESDI CONNECTION DIAGRAM

4.3 SCSI

The control of SCSI drives is achieved through a host adapter OMTI-510 plugged into the IBM PC/XT/AT. All seek, head select and status request operations are performed through this adapter.

The following SCSI commands are used:

00 H - Test Unit Ready — Used to check if the drive is ready.

01 H - Rezero Unit — Used to recalibrate to track 0.

03 H - Request Sense — Four bytes of extended sense data are retrieved. Sense key (byte 2, bits 0-3) is used to retrieve current error condition which is displayed.

This command is called only if sense other than zero is detected as a result of the previous operation.

0B H - Seek Operation — This command is used to select both cylinder and head. The logical address is calculated according to the following formula (see Note below):

$$LA = (TT \cdot HC + TH) \cdot SC,$$

where LA - target logical address
TT - target physical track
TH - target physical head
HC - heads per cylinder
SC - sectors per track

As part of the command the RETRY BIT in the control byte is OFF. Under this condition the drive should not detect errors. Otherwise the drive cannot be tested.

If the drive has prerecorded logical sector reassignment information, it should be disregarded during the SEEK operation. Otherwise access to a false physical location may occur.

Write and read operations are performed via the Interface Control Board ICB-201, through which ST-506 write gate and write data signals are passed to the internal write circuitry of the drive (see Sec. 7 and Figs. 7.1 - 7.4 for connection procedure). Digital read data are

passed to the RWA-201B from the drive's read channel through the ICB-201 and the ST-506 data cable.

Index from a SCSI drive is supplied to the RWA-201B via the ICB-201B (see Fig. 4.3). The user must find the INDEX signal in the drive and connect it to the INDEX input of the ICB-201B with a jumper cable. See Sec. 11.1 for available ICB-201 configurations with respect to index polarity.

Jumpers on the drive should be configured to make it DRIVE 1 (see the drive's manual). Also an interface terminating resistor pack should be installed. SPINDLE MOTOR jumper or switch should be configured in such a way as to cause the drive to spin up immediately after POWER ON.

Fig. 4.3 is a configuration diagram for SCSI drives.

See Sec. 7 for instructions on how to connect analog signals. Also see Sec. 13 for optional current control source connection.

The following parameters should be set in the System Parameters Menu.

Interface	SCSI.

NOTE: After SCSI interface is selected, the user is faced with a menu for the purpose of specifying the maximum head number and the number of sectors per track for the drive. These numbers must be specified absolutely correctly for the particular drive under test (see the drive's manual). Failure to do so will cause incorrect conversion of physical addresses to logical addresses and consequently incorrect access to heads and tracks.

ID Radius	The actual ID radius of the drive, if known. Otherwise enter 1".
Reference Radius	Same value as ID radius.
Step Size	Actual step size in μIn, if known. Otherwise 1000 μIn.
Steps per Track	1.
Maximum Track Number	The number of cylinders from the drive's manual minus one. Any positive number less than this will be valid.
Maximum Head Number	The number of read/write heads from the drive's manual minus one. Any positive number less than this will be valid.

Drive Number 1.

The OMTI-510 host adapter should be configured to have 324 H base address. This avoids conflict with the standard hard disk controller connected to address 320 H. All other controller configuration is default.

NOTE: The OMTI-510 host adapter should NOT be placed in the slot of the IBM PC/XT that is the closest to the power supply. This slot is not compatible with the other slots.

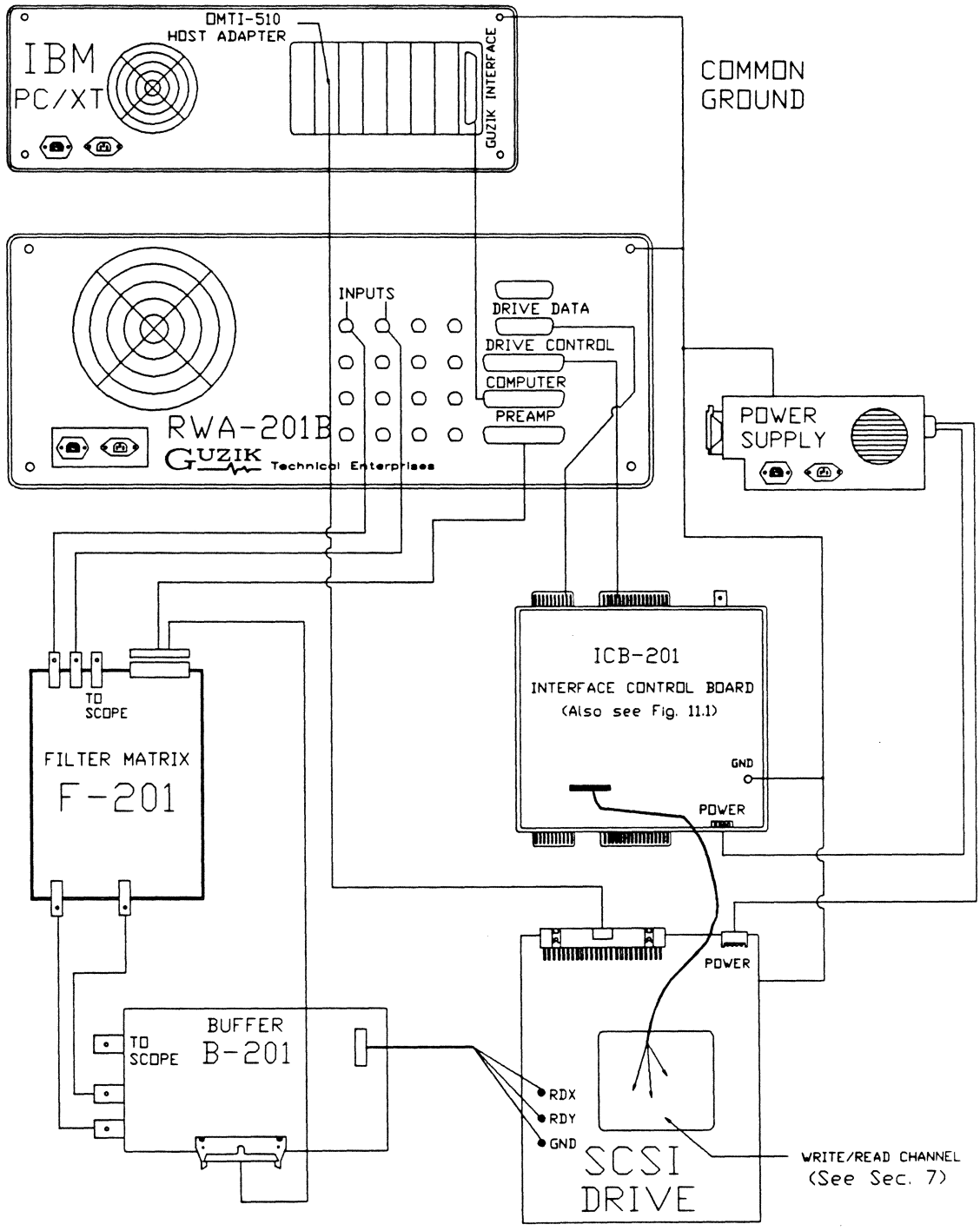

FIG. 4.3: SCSI CONNECTION DIAGRAM

4.4 SMD

The control of SMD drives is achieved through the Guzik SMD Interface Board plugged into the RWA-201B. All seek, head select and status request operations are performed through this board. Drive index is passed to the RWA-201B through the same board.

The drive is attached to the interface board by two standard SMD cables. Write and read operations are performed via the Interface Control Board ICB-201, through which ST-506 write gate and write data signals are passed to the internal write circuitry of the drive (see Sec. 7 and Figs. 7.1 - 7.4 for connection procedure). Digital read data are passed to the RWA-201B from the drive's read channel through the ICB-201 and the ST-506 data cable.

Jumpers on the drive should be configured to make it DRIVE 1 (see the drive's manual). Also an interface terminating resistor pack should be installed. SPINDLE MOTOR jumper or switch should be configured in such a way as to cause the drive to spin up immediately after POWER ON.

Fig. 4.4 is a configuration diagram for SMD drives.

See Sec. 7 for instructions on how to connect analog signals. Also see Sec. 13 for optional current control source connection.

The following parameters should be set in the System Parameters Menu.

Interface	SMD.
ID Radius	The actual ID radius of the drive, if known. Otherwise enter 1".
Reference Radius	Same value as ID radius.
Step Size	Actual step size in μIn, if known. Otherwise 1000 μIn.
Steps per Track	1.
Maximum Track Number	The number of cylinders from the drive's manual minus one. Any positive number less than this will be valid.
Maximum Head Number	The number of read/write heads from the drive's manual minus one. Any positive number less than this will be valid.
Drive Number	1.

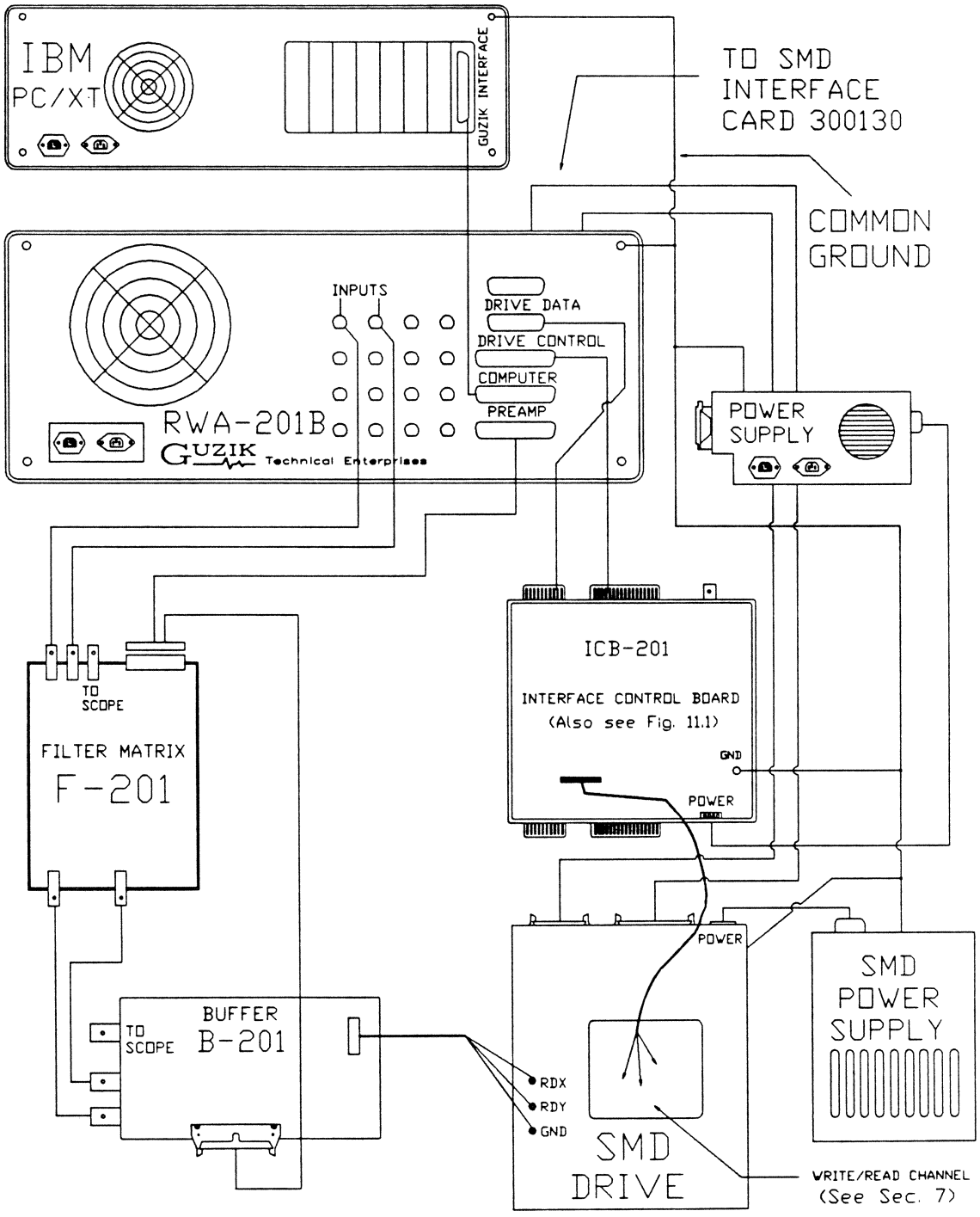

FIG. 4.4: SMD CONNECTION DIAGRAM

5. COMMUNICATION VERIFICATION

After the drive's control cables are connected, communication between the RWA-201B software and the drive should be verified. To do this turn on the drive and the Read Write Analyzer. Load the Engineering Program (T4) and configure the System Parameters Menu (F3) for the particular drive and interface as described above.

Verify the following:

1. Drive Select. Press F10. After this the rotational speed of the drive should be displayed at the lower right corner of the screen and a STOP status message at the upper left corner of the screen. The track displayed at the top should be zero.

If the rotational speed displayed by the RWA does not correspond to the drive's specification, check the index line attachment and the index signal at the output of the RWA.

If the STOP message does not appear, check that the drive number is set up correctly on the drive.

3. Seek to maximum track. Go to the Track Test Menu (F2) and select item 4 (Track Number) and enter maximum track number as specified in the System Parameters Menu. Intelligent drives such as ESDI, SCSI and SMD will issue an error condition if this track number is outside the drive's capabilities.

4. Test random seek and random head select operation. To do this go to the Surface Test Menu (F1), select SEEK as the Test Mode (item 1), RANDOM TRACK as Access Mode (item 2), RANDOM HEAD as Head Mode (item 3) and FREE RUN as Stop Mode (item 4). Start the test (item S) and let the test run for approximately one minute, then abort it (item R). The drive should emit distinctive sounds of random seek.

5. Deselect the drive (F10). Turn off the drive and the RWA-201B.

6. Save configuration. Press F7 and S.

6. ANALOG READ DATA

Analog read data are extracted through the Guzik Buffer Board B-201 from the RDX and RDY outputs of the drive's preamplifier (see Fig. 12.1). The Buffer Board has AC coupled high impedance differential inputs. A third line is provided for ground connection between the drive and the Buffer Board. The read signal is sent from the Buffer Board through the Filter Matrix F-201 to the read channel of the Read Write Analyzer for further processing. Jumpers on the Buffer Board should be configured according to Fig. 12.1.

The mounting holes of the Buffer Board are grounded. For some drives it is recommended to provide a strong ground connection between these and the ground of the drive. This can reduce possible noise. The lines connecting the RDX and RDY drive outputs to the Buffer Board inputs as well as the ground line should be as short as feasible.

The RWA's current source is provided on pin 7 of connector J2 of the Buffer Board. See Sec. 13 for optional current control for the drive.

Scope BNC connector J1 is used to observe buffered analog read signal from the drive on an oscilloscope. If the attached drive has some previously written data, the user can check these on the scope. To do this turn of the drive and the RWA-201B on, select drive (F10) and observe the read signal on the scope. Try to select various tracks and heads using items 4 and 5 in the Track Test Menu (F2) respectively.

If the drive has an ST-506 interface the user can immediately perform write verification as described in Sec. 9.

7. WRITE GATE AND DATA SIGNALS

The RWA's write gate and data signals should be applied to the drive's write circuitry. Write gate and data from RWA-201B go to the interface control board ICB-201 (see the layout and schematic of ICB-201 in Figs. 11.1, 11.2 respectively). There they are buffered and sent to pins 6 (write gate) and 5 (write data) of connector J5.

NOTE: It is crucial to select the polarity and driving characteristic options on the Interface Control Board ICB-201 to match the appropriate inputs in the drive's write circuitry (see Sec. 11). Jumpers on the Interface Control Board should be set properly BEFORE connecting the analog signals. Failure to do so may result in severe damage to various components.

Internal write gate and data signals should be disconnected from the drive's write circuitry to avoid conflict between the signals. This can be done in several ways:

1. If the write circuitry and the internal logic circuitry are on the same board and are connected by traces, then the write gate and data traces should be cut and pins installed on the write circuitry side of the traces (see Fig. 7.1).

NOTE: If the output of the internal circuit is an active low open collector, then it can be wired-OR'ed with the corresponding signal from the ICB-201. In this case no cuts are required.

2. If the write circuitry and the internal logic circuitry are on different boards connected by a cable, then a dummy cable can be inserted in such a way that all but write gate and data lines are connected. The RWA's write gate and data signals can be injected to the write circuitry side of the dummy cable (see Fig. 7.2).

3. Write gate and data lines can be designed with jumpers along them. This allows one to disconnect the drive's internal logic circuitry from the write circuitry and inject the write gate and data from the RWA-201B (see Fig. 7.3).

4. The drive can be designed with a multiplexed test connector. The external write gate and data signals and a special test mode control line can be attached to the connector so that write gate and data can be multiplexed (see Fig. 7.4).

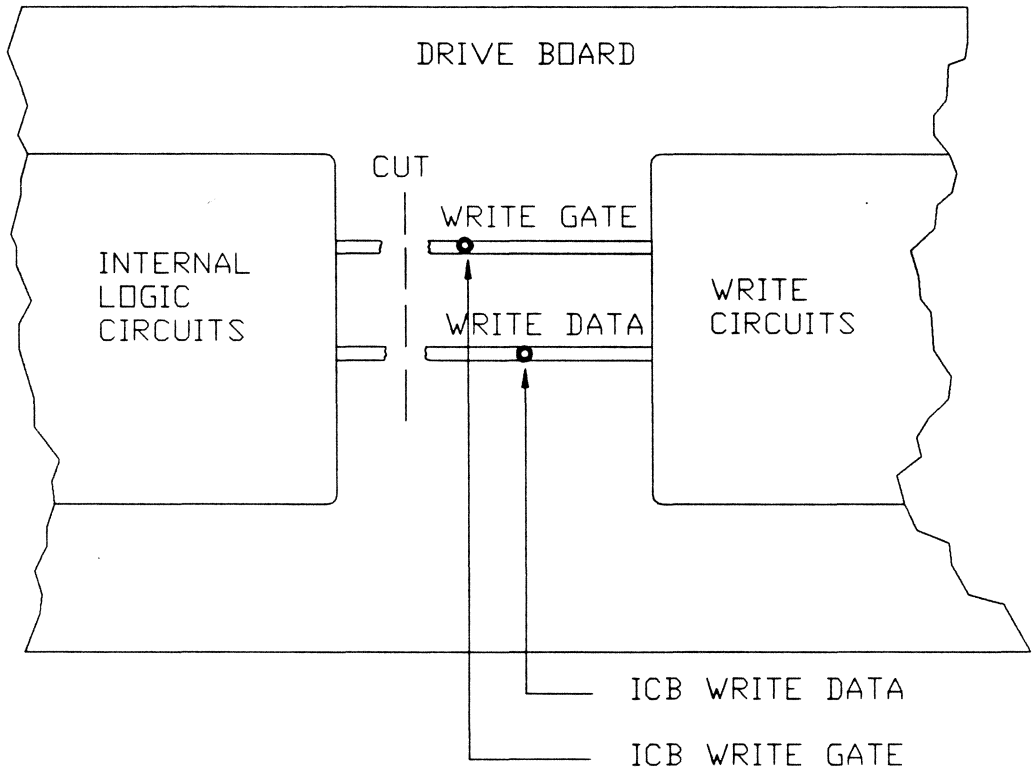

FIG. 7.1: WRITE SIGNAL CONNECTION (TRACES)

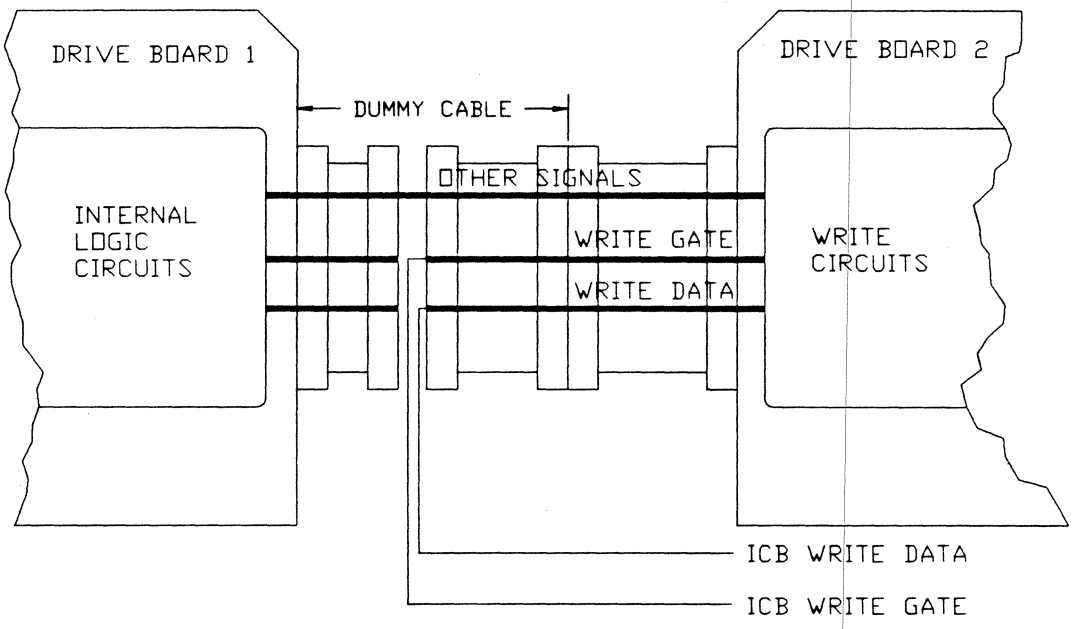

FIG. 7.2: WRITE SIGNAL CONNECTION (DUMMY CABLE)

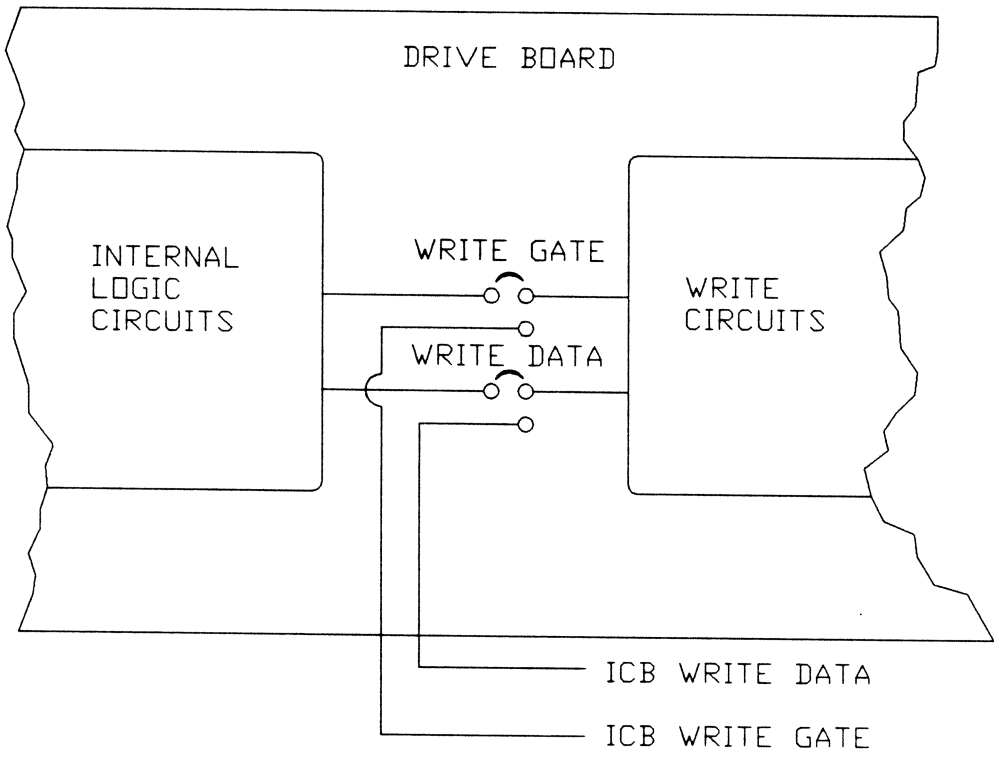

FIG. 7.3: WRITE SIGNAL CONNECTION (JUMPERS)

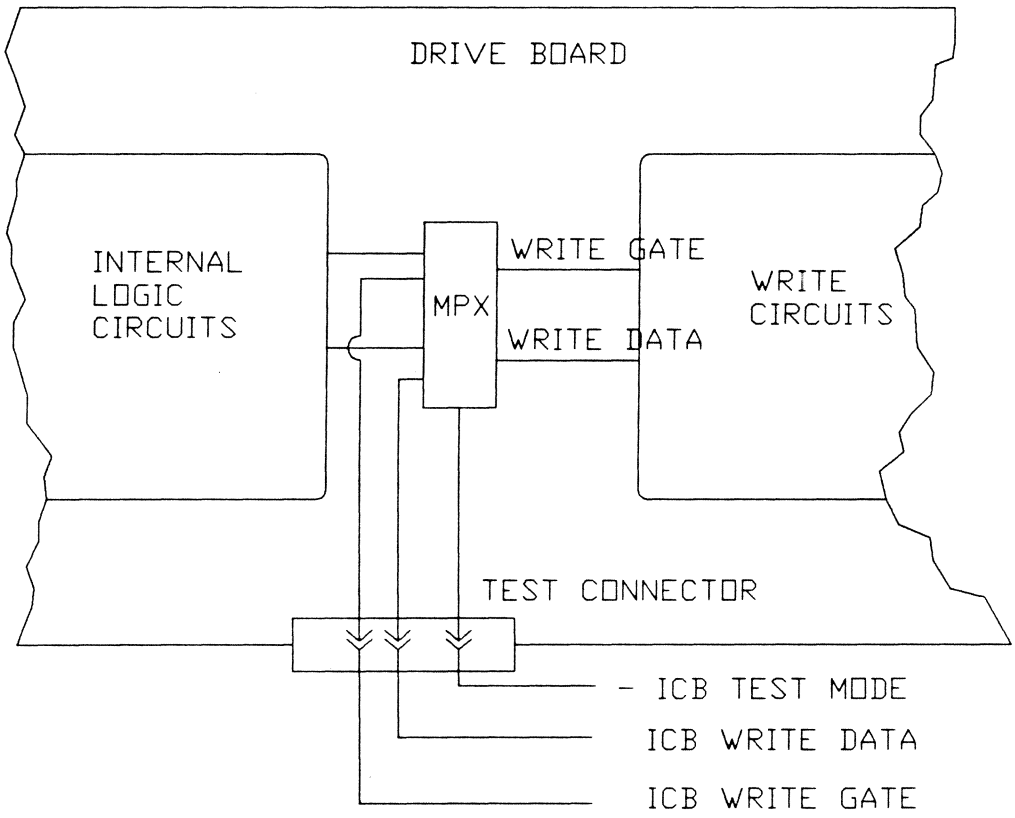

FIG. 7.4: WRITE SIGNAL CONNECTION (MULTIPLEXED)

8. DIGITAL READ DATA

Digital read data at the output of the drive's read channel are passed to the Read Write Analyzer through the Interface Control Board ICB-201. Appropriate points in the drive should be connected to the read data inputs of the ICB. See Sec. 11.4 for configuration of the receiving part of the ICB-201.

The Interface Control Board provides the option for connecting TTL data or differential ECL or TTL data inputs. These data can be used to perform Bit Shift Analysis, missing data detection and digital retry of errors through the drive's read channel.

9. WRITE/READ VERIFICATION

The purpose of the following procedure is to verify the write/read interface operation between the drive and the RWA-201B. During this procedure linear tests and digital tests, including Bit Shift Analysis, will be performed.

First, set up proper parameters in the System Parameters Menu.

Item 8 **(Clock Frequency)**	Set this to the value to the data transfer rate specified for the drive if the drive uses MFM recording scheme. See Sec. 14 for frequency selection for drives using Run Length Limited codes such as 2-7.
Item 9 **(Read Threshold)**	50%.
Item B **(Overwrite Frequency)**	Set to the center frequency of the overwrite filter installed in the Filter Matrix F-201.
Item L **(Data Source)**	Internal.
Item M **(Performance Filter)**	Filter 1
Item N **(Configuration)**	Digital and Linear
Item G **(Time Constant)**	12 μSec
Item U **(Enable Low Frequency)**	No

Turn on the Read Write Analyzer and the drive. Press F10 to select the drive and go to the Track Test Menu (F2). Use item 3 (Pattern) to select a pattern to be written and item 1 (Write, then Read) to actually write the pattern. Then visually verify the write operation by observing the read signal at the SCOPE output of the Buffer Board B-201 and the SCOPE output of the Filter Matrix F-201.

Check the ability to erase the signal on the track by using items E and R. Observe the erased signal on the scope. If the signal is not properly erased, check whether the erase protection feature of the drive is disabled.

Prior to performing further tests, the RWA-201B needs to be calibrated. To do this go to the System Calibration Menu (item E of the System Parameters Menu (F3)) and calibrate amplitude, envelope and bit shift as described in the RWA-201B User's Manual.

If the Track Average Amplitude calibration factor is displayed as asterisks, this is an indication of possible absence of analog read data at the input of the RWA read channel. Check the read signals at the differential outputs of the Buffer Board and the Filter Matrix.

Save calibration factors by pressing F7 and S. Go to the Track Test Menu (F2) and perform track analysis by running the linear test (item T). Check if the readings are reasonable. A low overwrite reading can be an indication of incorrect setting of the overwrite frequency value.

Go to the Bit Shift Analysis Menu (item 6 of the Track Test Menu (F2)), set the Sampling Level (a.k.a. Bit Shift Range) equal to 6 and select Linear Splines (this last item exists only if the BSA Interpolation Option is installed).

Write the pattern FFFF on the track (item 1 of the Track Test Menu (F2)) and perform Bit Shift Analysis (BSA Plot, item J). Check if the results look reasonable. See the RWA User's Manual for an explanation of Bit Shift Analysis.

Change the data source selection in the System Parameters Menu (F3) to EXTERNAL and repeat Bit Shift Analysis. Check if the results look reasonable. Disconnect the differential read signals RDX and RDY from the drive and generate the Bit Shift Plot again. Compare this to the previous plot. A significant difference between the two plots indicates that the RDX and RDY inputs of the Buffer Board affect the read data signal from the drive's read channel. A different buffer board may be needed (contact the factory). Another possible course of action is to attach the RDX and RDY lines to points in the drive that are buffered.

Change the data source selection back to INTERNAL, select Filter 2 (open) (item M of the System Parameters Menu (F3)) and repeat Bit Shift Analysis. Irregularity of the bottom part of Bit Shift Plot is an indication of noise at the input of the Buffer Board.

Perform the Noise Test (item N of the Track Test Menu (F2)). See if the readings for noise and crest factor appear reasonable. Typical noise readings for drives are above 25 db and the crest factor below 18%. If any of the tests produce unsatisfactory results, ground the buffer board to the drive ground.

10. DRIVE ERROR CONDITIONS AND REPORTING

10.1 ESDI

During communication with an ESDI drive the RWA software monitors the status of the COMMAND COMPLETE line. If a command is not completed within approximately 3 seconds, the following message will appear:

```
ESDI Interface Timeout
```

Before and after each command sent to the drive the ATTENTION line is polled. If ATTENTION is TRUE, REQUEST STATUS command is issued to the drive and the following message is displayed on the screen:

```
ESDI Interface Error.  STATUS = XXXXX,

   where XXXXX is a status response word represented by a decimal number.
```

After any key is pressed, CLEAR ATTENTION command is issue to the drive.

If the status response word is 256, a POWER ON RESET condition exists in the drive. In this case CLEAR ATTENTION command is issued without displaying an error message.

A common error code is:

```
32 - Invalid or unimplemented command fault
```

This occurs if the maximum track number in the System Parameters Menu (F3) exceeds the maximum allowed track number for the drive.

10.2 SCSI

After each command issued to the drive, the RWA software checks the STATUS BYTE. If the STATUS BYTE is not equal to zero, REQUEST SENSE command is issued. The first four bytes of the extended SENSE DATA are retrieved. Bits 0 - 3 of byte 2 represent the SENSE KEY.

If the SENSE KEY is equal to 6, this means that a POWER ON condition exists in the drive and no errors are reported. Otherwise the following message appears on the screen:

```
SCSI ERROR=AA 324H=BB 325H=CC CMD=XX XX XX XX XX SENSE: Y  Y  Y  Y ZZ

  where AA - STATUS BYTE (hex) detected during the last operation
        BB - hex value of register 324 H of the SCSI host adapter
        CC - hex value of register 325 H of the SCSI host adapter
        XX - last command issued to the drive (5 bytes hex)
        Y  - sense data (4 bytes decimal)
        ZZ - STATUS BYTE (decimal) detected during REQUEST SENSE.
```

If the STATUS BYTE is greater than or equal to C0H (192 decimal), there is a SCSI communication error. Depending on the value of this byte, the following messages are displayed:

```
C0 - NO SCSI HOST ADAPTER INSTALLED
C1 - SCSI COMMAND TIMEOUT
C2 - SCSI HOST ADAPTER IS BUSY
C5 - NO SCSI DRIVE ATTACHED
```

After the error message is displayed the user is prompted to press any key to continue. If a drive error other than NOT READY (SENSE KEY = 2) is detected, the RWA attempts to reset the host adapter and the drive. See SCSI Drive Manual for an explanation of other SENSE KEY values.

If NO SCSI DRIVE ATTACHED message appears after error recovery, deselect the drive (F10). Turn the drive OFF and ON, then select the drive (F10).

10.3 SMD

During SEEK and DRIVE READY VERIFICATION operations the RWA monitors the following lines and displays the following messages:

Line	Message
FAULT	SMD FAULT
SEEK ERROR	SMD SEEK ERROR
ON CYLINDER	SMD ON CYLINDER ERROR

After an error is detected the user is prompted to press any key. No error codes are retrieved.

11. INTERFACE CONTROL BOARD ICB-201

The Interface Control Board ICB-201 is designed to provide communication between the RWA and the internal circuitry of drives with intelligent interfaces.

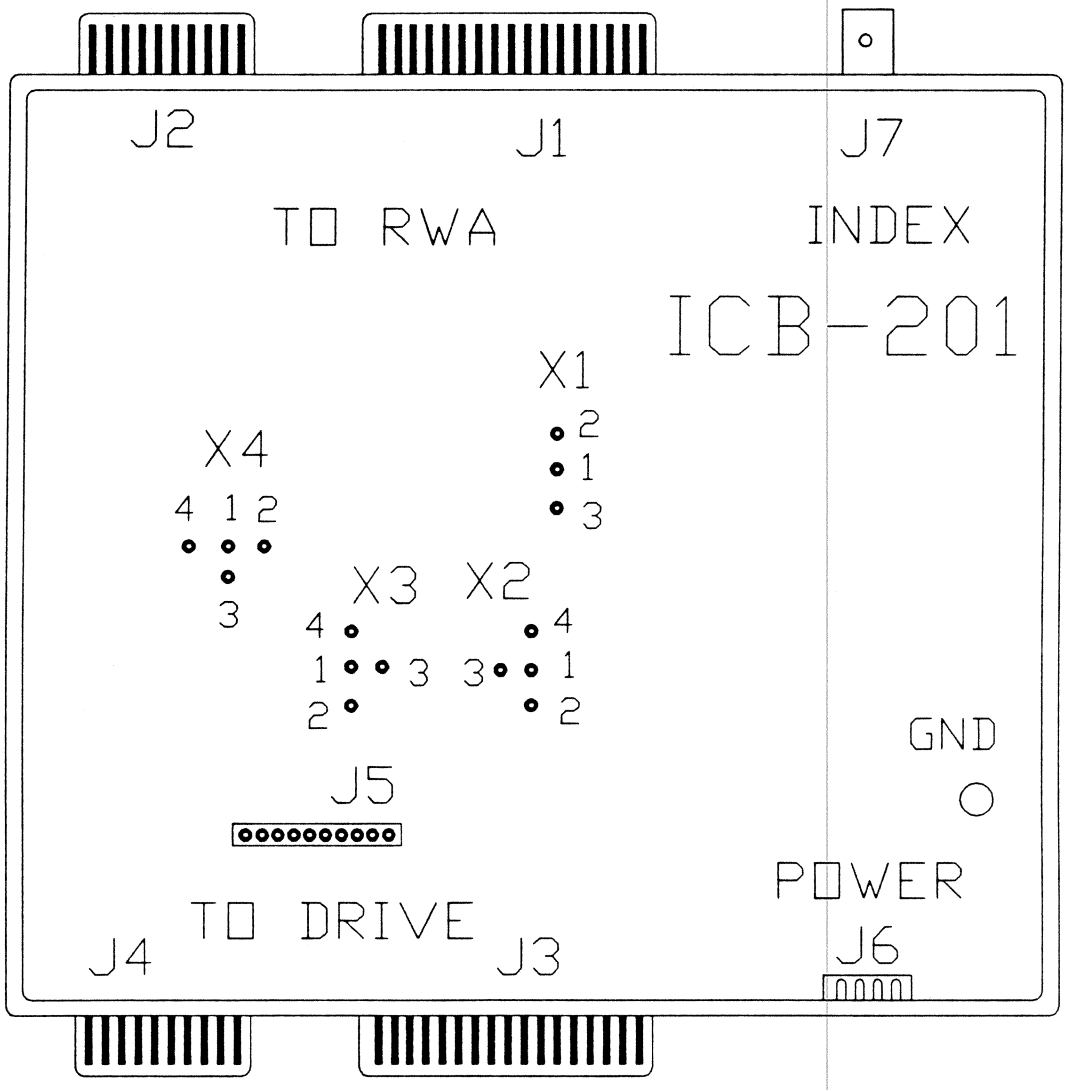

FIG. 11.1: INTERFACE CONTROL BOARD ICB-201 (LAYOUT)

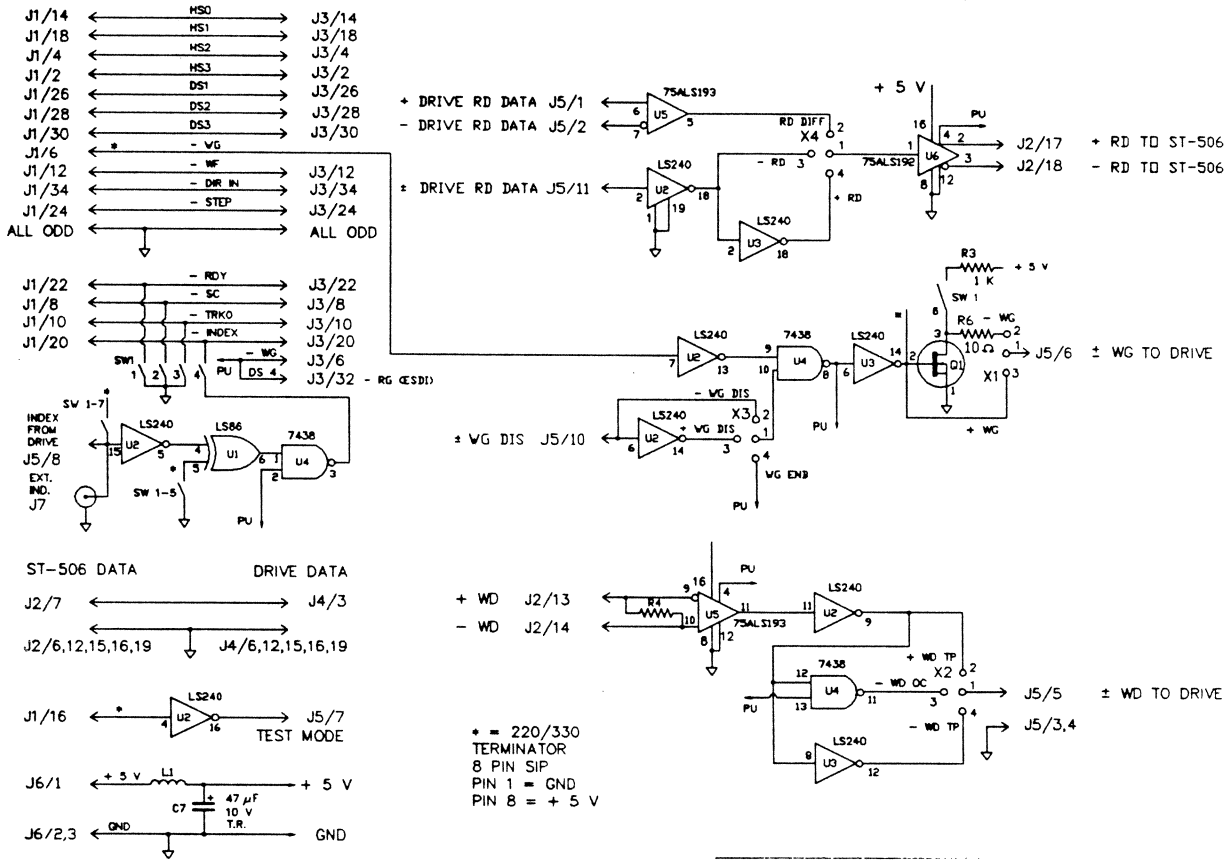

FIG. 11.2: INTERFACE CONTROL BOARD ICB-201 (SCHEMATIC)

11.1 INDEX SELECTION

The index signal from the SCSI drive is buffered and is fed through the ST-506 control cable to the RWA. Jumpers on the ICB-201 should be configured appropriately for the polarity of the drive's INDEX signal:

1. + INDEX

   SWITCH 1-5 OFF, SWITCH 1-4 ON.

2. - INDEX

   SWITCH 1-5 ON, SWITCH 1-4 ON.

External index can also be applied through the BNC connector J7. This option is especially useful for integrating a customer spinstand with manual controls (see Sec. 15.1).

NOTE: The external index BNC connector is an input, not an output.

NOTE: If neither the SCSI interface nor external index are used, SWITCH 1-4 should be OFF.

11.2 WRITE GATE SELECTION

Negative write gate comes from the RWA through the ST-506 control cable. The user can select polarity and driving characteristic options on the Interface Control Board ICB-201 before the write data are sent to the drive.

The user can select polarity and driving characteristics of these signals by means of jumpers.

The following options are available for write gate:

1. + Write Gate - totem pole output.

   SWITCH 1-6 ON, Jumper between X3-1 and X3-3.

2. - Write Gate - totem pole output.

   SWITCH 1-6 ON, Jumper between X3-1 and X3-2.

3. - Write Gate - open collector output.

   SWITCH 1-6 OFF, Jumper between X3-1 and X3-2.

11.3 WRITE DATA SELECTION

Differential write data signal comes from the RWA through the ST-506 data cable. The user can select polarity and driving characteristic options on the Interface Control Board ICB-201 before the write data are sent to the drive.

The following options are available for write data:

1. + Write Data - totem pole output.

   Jumper between X4-1 and X4-2.

2. - Write Data - totem pole output.

   Jumper between X4-1 and X4-4.

3. - Write Data - open collector output.

   Jumper between X4-1 and X4-3.

11.4 DIGITAL READ DATA SELECTION

The read data signal from the drive is converted to differential read data and is fed through the ST-506 data cable to the RWA.

The following options are available for the retrieval of digital read data from the drive's read channel:

1. + TTL Read Data

   Jumper between X1-1 and X1-4.

2. - TTL Read Data

   Jumper between X1-1 and X1-3.

3. Differential Read Data (through 26LS32 differential receiver).

   Jumper between X1-1 and X1-2.

11.5 SERVO ZONE PROTECTION

The user can provide a signal which disables the write gate during the embedded servo gap. This will protect the servo zone. The following options are available:

1. + WRITE PROTECT TTL signal from pin 10 of connector J5.

   Jumper between X2-1 and X2-3.

1. - WRITE PROTECT TTL signal from pin 10 of connector J5.

   Jumper between X2-1 and X2-2.

2. Write protection disabled.

   Jumper between X2-1 and X2-4.

11.6 MANUAL SPINSTAND CONTROLS

While integrating a manual spinstand (see Sec. 15.1) some of the lines of the ST-506 control cable should be brought to a low level. To do this turn the following switches ON:

Switch 5-1	- READY
Switch 5-2	- SEEK COMPLETE
Switch 5-3	- TRACK 0

For all other modes these switches should be OFF. See Sec. 11.1 for instructions for external index line attachment through the Interface Control Board ICB-201.

NOTE: The above switches should be OFF for drive interfaces.

12. BUFFER BOARD B-201

Buffer board B-201 is a universal read buffer used for HDA certification or with SSI-114 and SSI-104 preamplifiers. For HDA certification the buffer board B-201 should be configured in the following way (see Fig. 12.1):

1. Jumper between X1-0 and X1-1
2. Jumper between X3-0 and X3-1

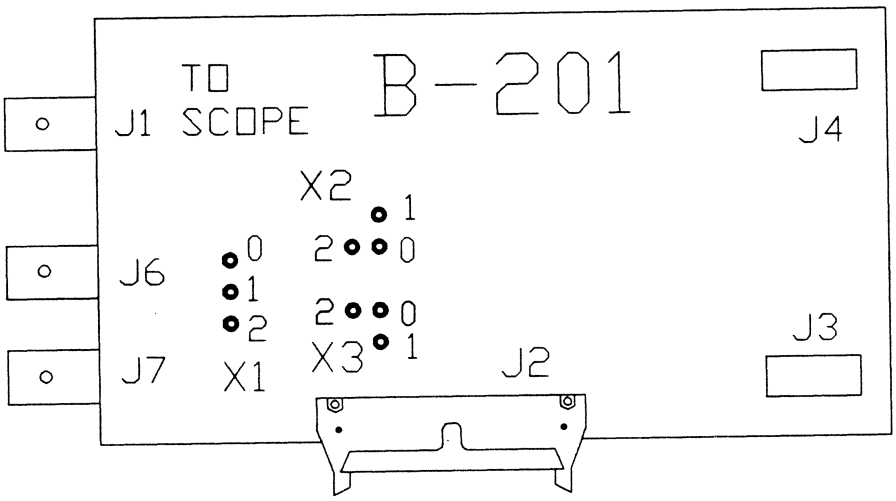

FIG. 12.1: READ BUFFER B-201

13. WRITE CURRENT CONTROL

The Read Write Analyzer RWA-201B provides a current source which is attached to pin 7 of connector J2 of the Read Buffer Board B-201. This current source can be used to control the write current in the drive under test. This can be accomplished if the drive has a test point where external current or voltage source can be applied so that the write current in the drive becomes proportional to the controlling current or voltage.

For each particular drive design, a circuit should be built to convert the RWA's output current source to a current or voltage source suitable for the drive's write current control.

Fig. 13.1 shows the schematic of a circuit which converts the RWA's current source to a voltage source. Fig. 13.2 shows the schematic of a circuit which converts the RWA's current source to a current source controlling the input of the SSI-117 preamplifier.

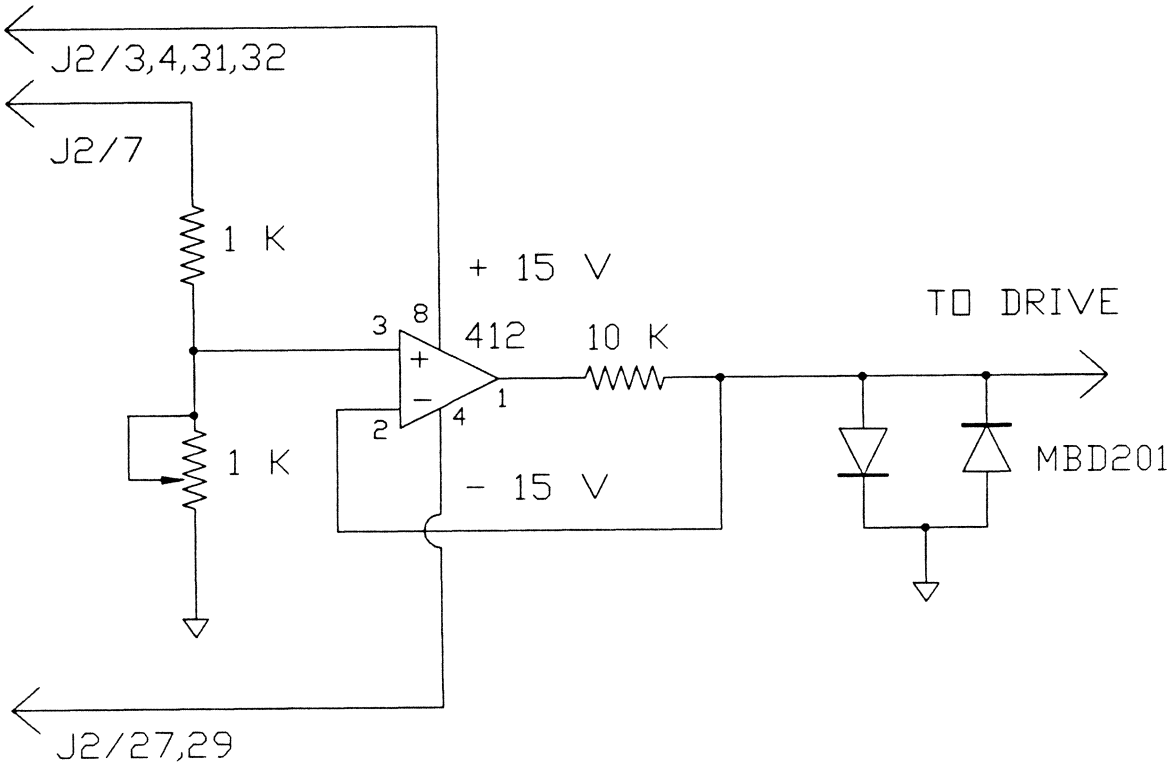

FIG. 13.1: CURRENT SOURCE CONVERTER (TO VOLTAGE)

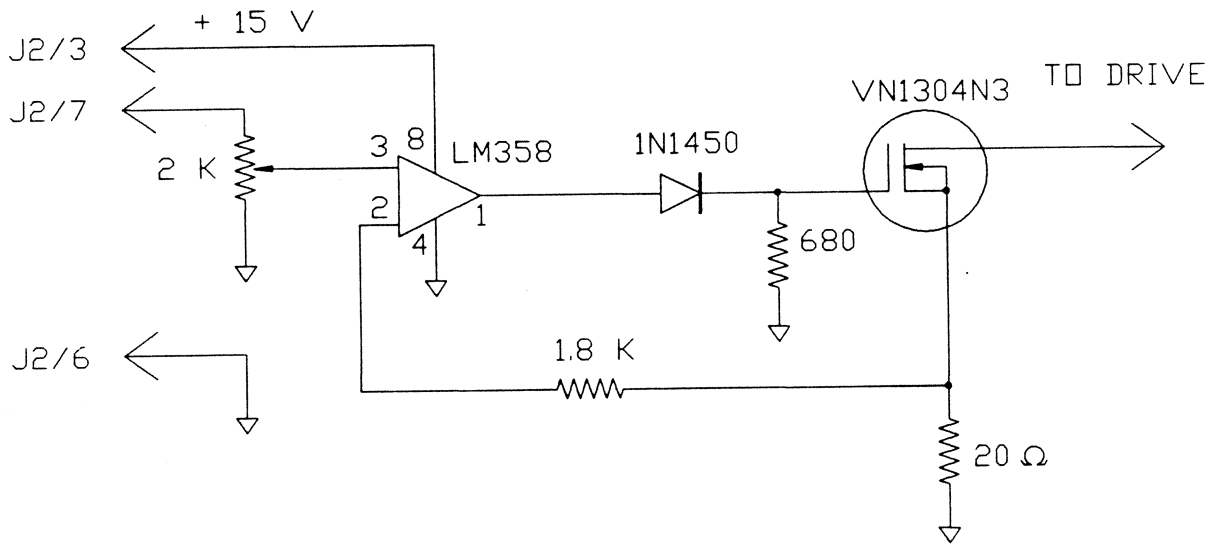

FIG. 13.2: CURRENT SOURCE CONVERTER (TO CURRENT)

14. DATA TRANSFER RATE

The RWA-201B can write any two byte repeatable MFM pattern onto recording media. The recovered signal is used for the analysis of the parametric performance of the media as well as peak shift margin testing. Worst case pattern B6D9 has been proven to show maximum bit shift for most head/media combinations. A number of new drives use RLL encoding schemes, e.g. 2-7 code, for the recording of data. The RWA-201B is effectively used to test drives with RLL encoding by using MFM patterns.

For bit shift analysis the user should set the clock rate which will produce the highest (2F) frequency of the MFM signal corresponding to the highest frequency of the RLL pattern. For example, if the drive uses the 2-7 code with a 66 nSec clock rate, the closest distance between neighboring pulses is 100 nSec and window size is ± 16 nSec. This corresponds to an MFM pattern with the clock rate of 100 nSec and margin setup to 16 nSec. This approach is effectively used by a number of drive manufacturers using RLL coding schemes for margin analysis and surface margin error detection.

While in the engineering mode, the RWA-201B can be equipped with an option to write any two byte NRZ pattern so that the ratio of the highest to the lowest frequency can be other than 2 to 1 (MFM). A bit shift plot for the resultant read signal can be obtained. For example, while in the NRZ mode, pattern CCDC will produce a signal with a 3 to 1 frequency ratio.

For amplitude, resolution and asymmetry tests as well as the overwrite test a low frequency other than half the high frequency can be selected through the software. For example, if the high frequency is set to 5.00 MHz, the low frequency can be set to 1.88 MHz which corresponds the conventional 2 to 7 recording ratio.

15. CUSTOMER SPINSTAND INTERFACE

In a number of cases a customer may have a spinstand which he may want to integrate with the RWA-201B. There are two types of spinstands: manual and automatic. In a manual spinstand the positioning of the head(s) is performed manually while in automatic spinstands a provision is made for remote positioning control. The following sections describe the specifics of integrating each type.

The jitter of the index signal from the spinstand should not exceed 10 μSec. To measure jitter synchronize an oscilloscope to the leading edge of the index pulse and observe the next index pulse's leading edge in delayed expanded mode.

The preamplifier should be mounted on the spinstand as close to the heads as feasible. It should be well grounded to the base plate of the spinstand. After the integration is done, the noise level of the system should be analyzed as described in Sec. 9. If the noise level is unacceptably high, grounding of various parts of the system should be experimented with. Bit Shift Plot obtained through the open filter (Filter 2) should be used as a way to measure the effectiveness of various grounding schemes.

Often noise is introduced by the spindle and the stepper motor drivers. Attachment of proper filters at the input and/or outputs of the drivers can significantly reduce the noise level. Contribution of the stepper motor driver to the overall noise can be estimated by turning off the stepper motor after a proper position of the head(s) is attained.

15.1 MANUAL SPINSTAND INTERFACE

To operate a manual spinstand the user should provide an index signal (once per spindle revolution) to the RWA. This can be accomplished through the external index input of the Interface Control Board ICB-201 (see Sec. 11.1). In addition the manual spinstand control switches on the ICB-201 should be turned on. This will simulate the READY condition of the ST-506 interface (see Sec. 11.6).

The System Parameters Menu should be configured in the following way:

Interface	ST-506.
ID Radius	The actual ID radius of the spinstand, if known. Otherwise enter 1".
Reference Radius	Same value as ID radius.
Step Size	1000 μIn.
Steps per Track	1.
Step Rate	0.01 mSec.
Maximum Track Number	1.
Maximum Head Number	The number of read/write heads minus one. Any number less than this will be valid.
Track to Change Current	100.
Drive Number	1.

15.2 AUTOMATIC SPINSTAND INTERFACE

Automatic spinstands should be equipped with SPINSTAND-to-RWA interface circuits emulating an ST-506 drive operation. See an ST-506 drive manual for specifications. Only the following subset of ST-506 control lines is required to support the interface:

From the RWA to the spinstand:

- DRIVE SELECT 1
- STEP
- DIRECTION IN

From the spinstand to the RWA:

- READY
- SEEK COMPLETE
- TRACK 0
- INDEX

All lines must be driven by an open collector driver 7438 and terminated on the receiving side by a 220/330 Ohm resistor pair. All the signals are active low. Only the high to low transition of the index line is significant.

The following operations must be supported:

1. Drive select.

The RWA asserts the DRIVE SELECT 1 line

Spinstand moves the head(s) to the loading zone, loads the head(s), starts the spindle motor, move the carriage to OD, asserts the following lines:

- TRACK 0
- SEEK COMPLETE
- READY

At this time index from the spinstand should provided to the RWA.

2. Seek.

The RWA asserts the DIRECTION IN line if it wants the carriage to move toward the hub and then issues a number of step pulses

corresponding to the number of steps te carriage should move. The distance between successive pulses is approximately 10 μSec.

After the spinstand detects the first step pulse it should set the - SEEK COMPLETE line false. The spinstand should count incoming step pulses. After it detects the absence of step pulses for a 100 μSec period the carriage should move to the target position determined by the direction and the number of step pulses received.

After the head(s) is settled on the target track, - SEEK COMPLETE line should be set true by the spinstand. After this the RWA can proceed with write/read operations.

3. Drive deselect.

The RWA will set the DRIVE SELECT 1 line false (high level).

The spinstand should set the - READY line false, move the head(s) to the loading zone, stop the spindle, unload the head(s) and move the carriage to HOME position.

If the spinstand detects an abnormal condition, it should perform a sequence similar to drive deselect or at least set the - READY line false. Before the - READY line can be set true again only after the spinstand state is the same as after a drive select operation.

SPINSTAND-to-RWA circuits can be implemented in a variety of ways. The following are some possibilities:

1. Hardware sequencer.

2. Spinstand onboard computer.

3. Microcomputer (e.g. IBM PC) equipped with a parallel interface ports. The computer is interfaced to the RWA through the ST-506 control cable on one hand and on the other hand communicates with the spinstand electronics.

The System Parameters Menu should be configured in the following way:

Interface	ST-506.
ID Radius	The actual ID radius of the spinstand, if known. Otherwise enter 1".
Reference Radius	Same value as ID radius.

Step Size	The distance the carriage will move in response to one step pulse from the RWA.
Steps per Track	Desirable distance between successive tracks divided by the step size (above).
Step Rate	0.01 mSec.
Maximum Track Number	The distance from ID to OD divided by the step size and divided by the number of steps per track.
Maximum Head Number	The number of read/write heads minus one. Any number less than this will be valid.
Track to Change Current	Number of the track where the inner and outer write currents are switched.
Drive Number	1.