TDC 4100

1.0 GB

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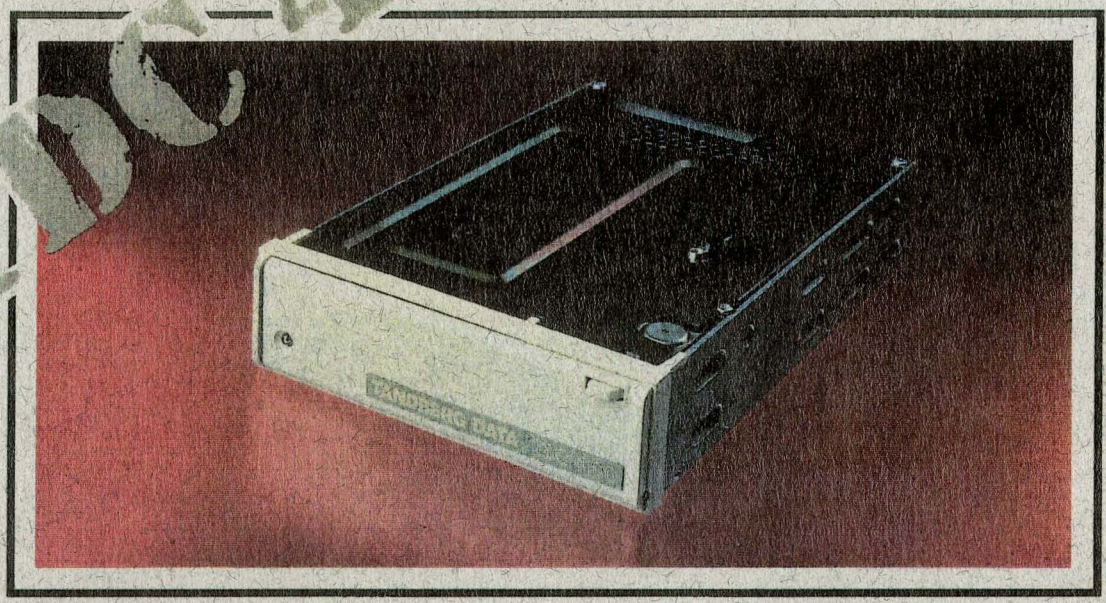

TDC 4100 SERIES

MAINTENANCE MANUAL

TANDBERG DATA

TDC 4100 SERIES
MAINTENANCE MANUAL

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6009	42 21 24	TDC 4100 Series Reference Manual
6046	42 30 40	TDC 4100 SCSI-1 Interface - Functional Specifications
6047	42 30 42	TDC 4100 SCSI-2 Interface - Functional Specifications

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1. Read This First

This manual is intended for service technicians who have attended a Tandberg Data service course on TDC 4100 Series drives.

The TDC 4100 Series Drive handles different tape formats according to the table below:

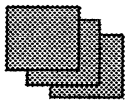
QIC-1000 - 30 tracks
QIC-525 - 26 tracks
QIC-150 - 18 tracks
QIC-120 - 15 tracks
QIC-24 - 9-tracks

Tape Format	Capacity	Write	Read
QIC-1000	1.0 GByte	Yes	Yes
QIC-525	525 MByte	Yes	Yes
QIC-150	155 MByte	Yes	Yes
QIC-120	125 MByte	Yes	Yes
QIC-24	60 MByte	No	Yes

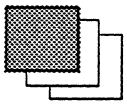
To avoid duplication and to save space, we have omitted in this manual such descriptions of the Drive that are given in the *TDC 4100 Series Reference Manual*. We therefore strongly recommend that the reference manual is considered a part of the maintenance manual, and that you use it as a source of details that the maintenance manual does not supply.

Three main parts

This manual can be regarded as divided into three main parts.

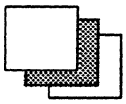


Part One



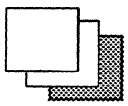
The first part (Chapters 1, 2, and 3) gives a general description of the Drive. It comprises an illustrated description, an interconnection diagram and block diagrams.

Part Two



The second part (Chapters 4 and 5) contains some schematics, mnemonics lists and component location drawings of the two printed circuit boards (Mainboard and Sensor Board).

Part Three



The third part (Chapters 6, 7, 8, 9 and 10) contains a troubleshooting guide, explains the Drive's resident selftests, how to replace all mechanical assemblies and the extensive adjustment procedures. Furthermore you will find an illustrated spare module list.

Contact our local representative or our Sales Department if you have any questions regarding service courses or additional documentation. Refer also to the back of this publication.

1.1. Updating/Backdating

The updating routine for this manual is based on the distribution of ECNs (Engineering Change Notices). The ECNs describe changes in hardware and firmware from the time of the first release of the product.

NOTE:
If you want updating/backdating for your maintenance manual, please contact your local Tandberg Data representative or subsidiary company for ECN dispatch.

2. A Short Description of the Drive

2.1. Illustrated Description

The Tandberg Data TDC 4100 Series Drives are streaming 1/4" tape-cartridge drives.

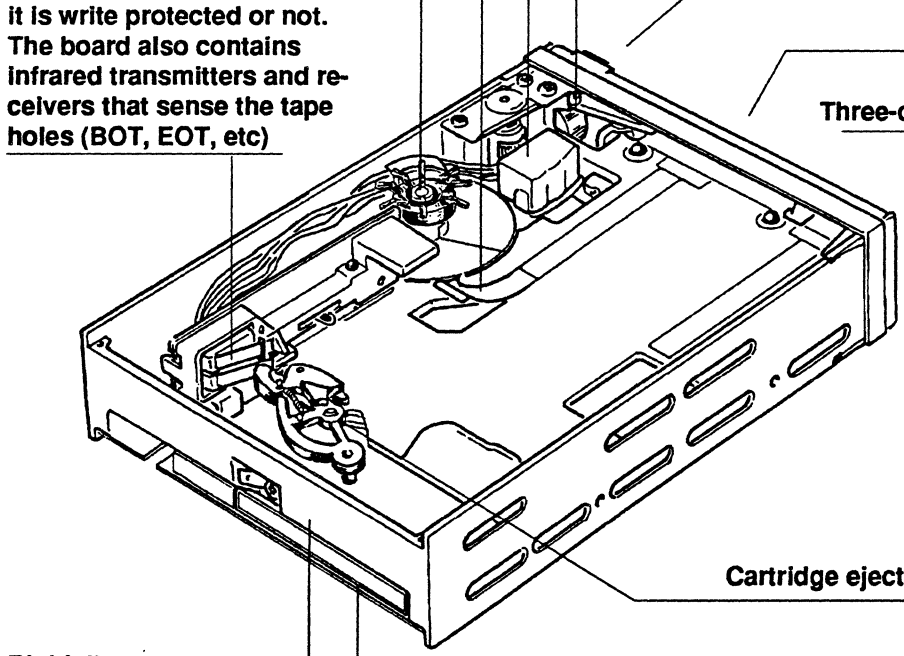


Figure 2.1 Illustrated description of the TDC 4100 Series Drive. The Drive shown without top cover.

2.2. Interconnection Diagram

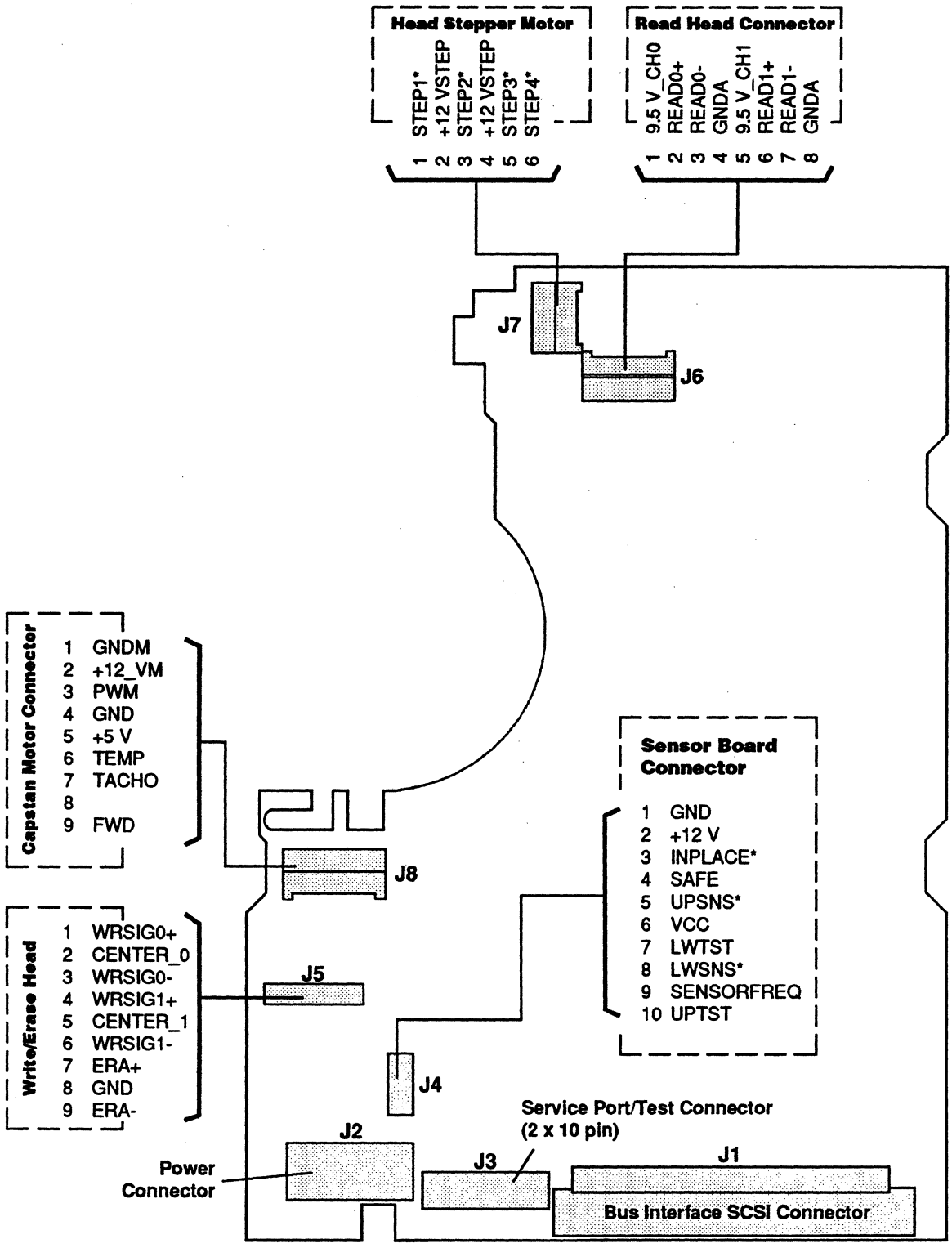


Figure 2.2 Interconnection Diagram

3. Block Diagrams

3.1. Overall Block Diagram

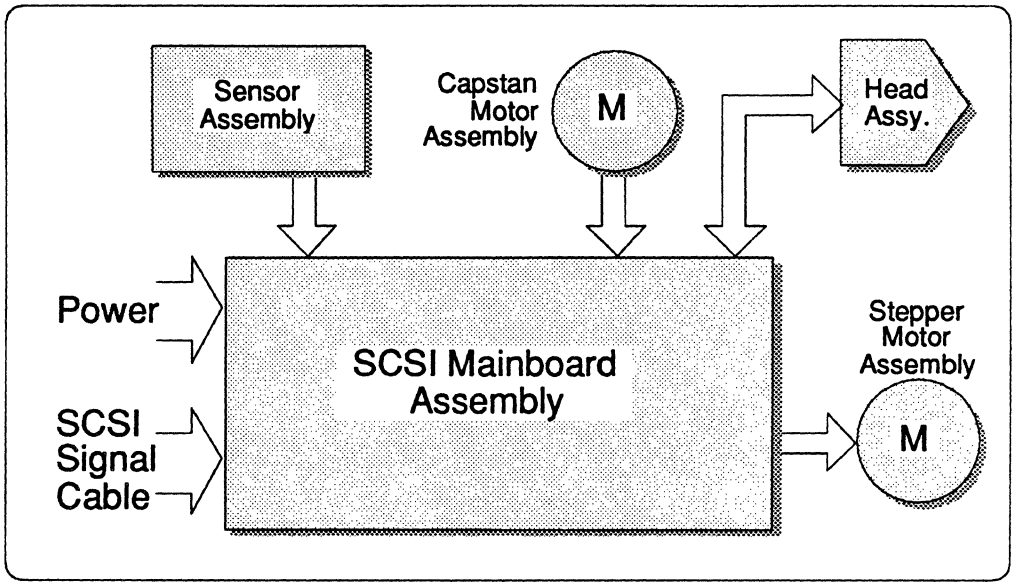


Figure 3.1 Overall Block Diagram

Sensor Assembly
The following sensors are located on the Sensor Board (see the interconnection diagram, Section 2.2):

- ***SAFE:*** A microswitch operated by the write protect switch on the tape cartridge. Prevents writing when the cartridge is write protected.
- ***IN PLACE/DOOR CLOSED:*** A microswitch operated by the tape cartridge. Prevents operation when the door is not closed or when no cartridge is inserted.
- ***LP/BOT/EOT/EW:*** Opto-electronic sensors that detect holes in the upper and lower half of the tape. The sequence of pulses from the two sensors allow the control logic to determine whether a BOT- (Beginning Of Tape), an EOT- (End Of Tape), an LP- (Load Point) or an EW- (Early Warning) situation has been detected.

Capstan Motor Assembly
The capstan motor with its built-in tacho sensor provides the tape motion required for the various operating modes: Read/Write, Wind/Rewind. The capstan motor is a DC operated brushless motor.

Head Assembly

The read/write and erase functions are combined in one common head. The erase section is active over the full width of the tape and thus erases all tracks in one operation. The read/write sections are active only for one track at a time. Since a read check is always carried out after the writing of each block of data, the head has one section for forward tape motion and one section for reverse tape motion. Track locations on the tape are illustrated in the *TDC 4100 Series Reference Manual*, Section 3.6.2.

SCSI Mainboard Assembly

See separate block diagram, Section 3.2.

High-resolution stepper mechanism

Stepper Motor Assembly

The Stepper Motor is a part of the head motion system which ensures that reading or writing takes place on the exact track.

The high-resolution stepper mechanism has 5 micrometers per step. The head motion is controlled by the microprocessor which allows high accuracy dynamic head positioning. A detailed description of the principles for the track position algorithm is given in the *TDC 4100 Series Reference Manual*, Section 2.3.

3.2. SCSI Mainboard Block Diagram

Detailed descriptions of the separate blocks are found in Chapter 4 - Section 4.1.

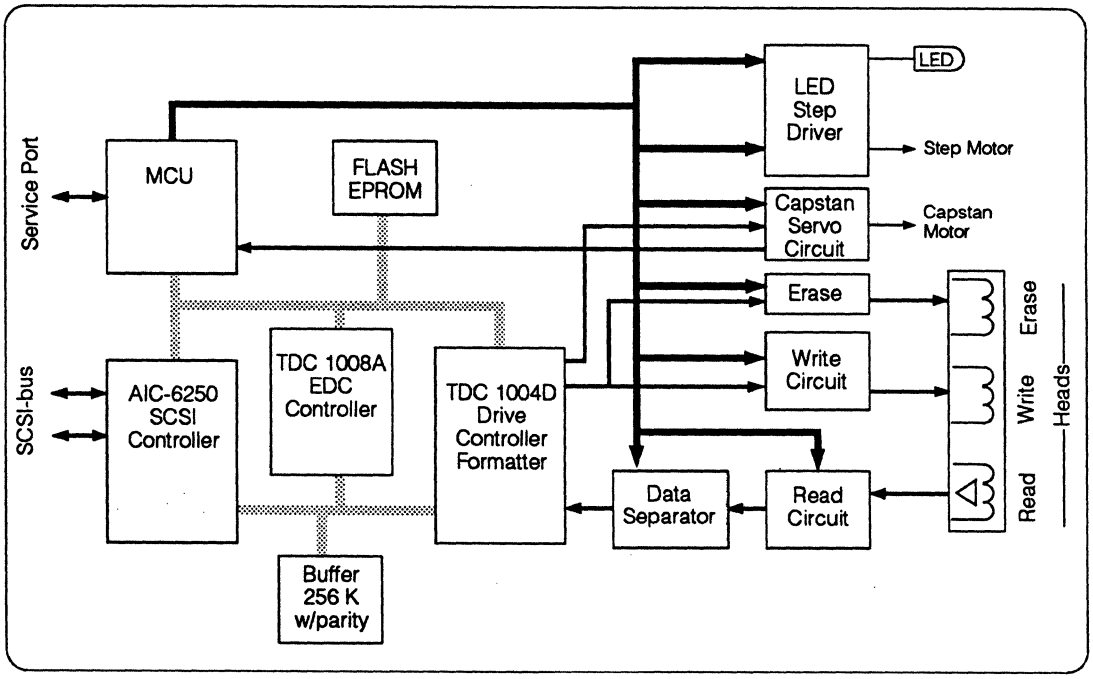


Figure 3.2 TDC 4100 Series Drive Block Diagram

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4. The SCSI Mainboard

The following description handles the current revision of the SCSI Mainboard. For further updating see the ECN routine (Chapter 1).

4.1. Description/Schematic Diagrams

The TDC 4100 SCSI Mainboard

consists of

- **the Digital Block** - Section 4.2

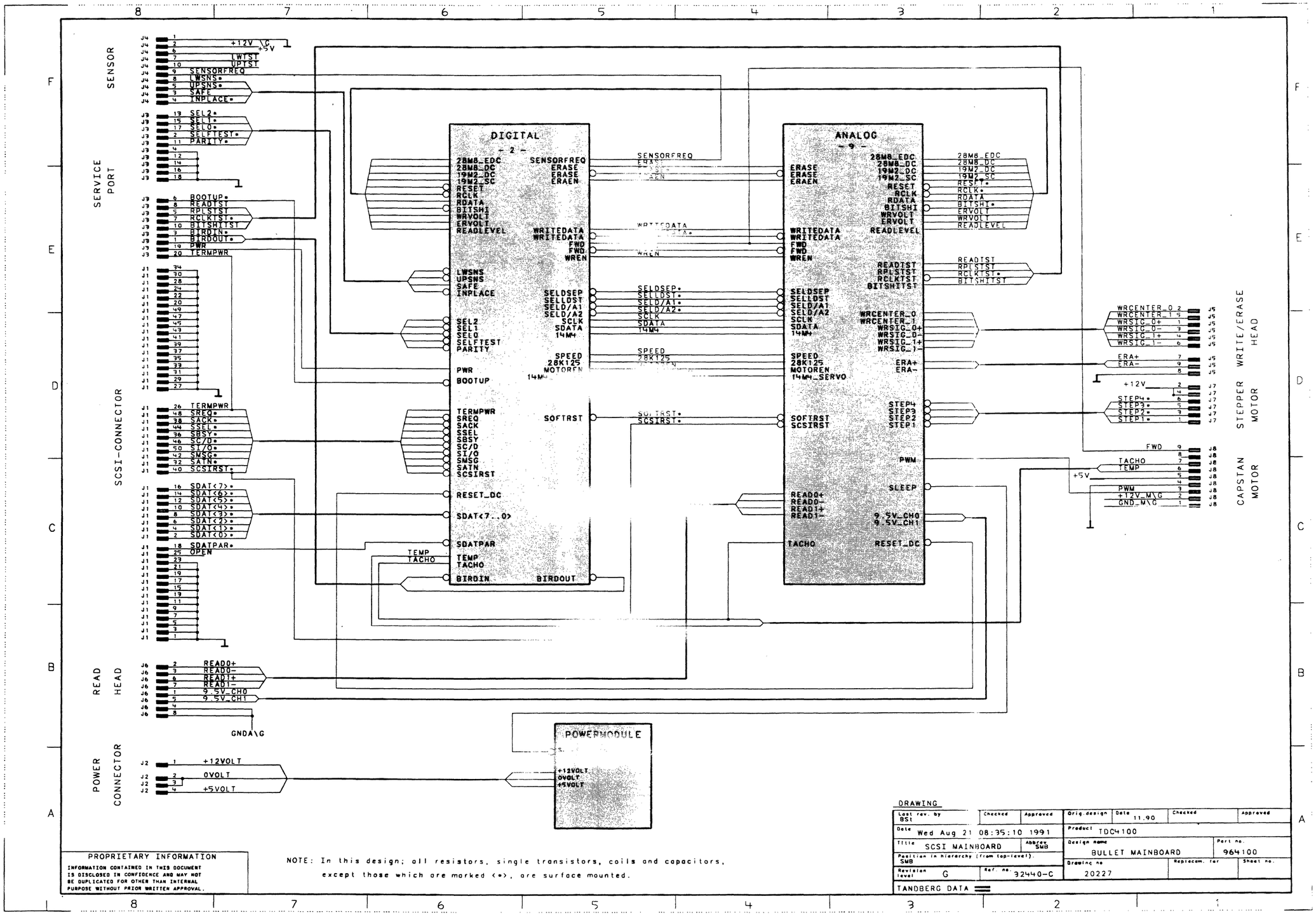
and

- **the Analog Block** - Section 4.3

4.2. The Digital Block

The Digital Block consists of two parts:

- **the Computer Unit**
- **the Formatter**



PROPRIETARY INFORMATION

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NOTE: In this design; all resistors, single transistors, coils and capacitors, except those which are marked (*), are surface mounted.

DRAWING

Last rev. by BSt		Checked	Approved	Orig.design	Date 11.90	Checked	Approved
Date Wed Aug 21 08:35:10 1991				Product TDC4100			
Title SCSI MAINBOARD	Abbrev. SMB			Design name BULLET MAINBOARD		Part no. 964100	
Position in hierarchy (from top-level) SMB				Drawing no 20227		Replacem. for	Sheet no.
Revision level G	Ref. no. 32440-C						

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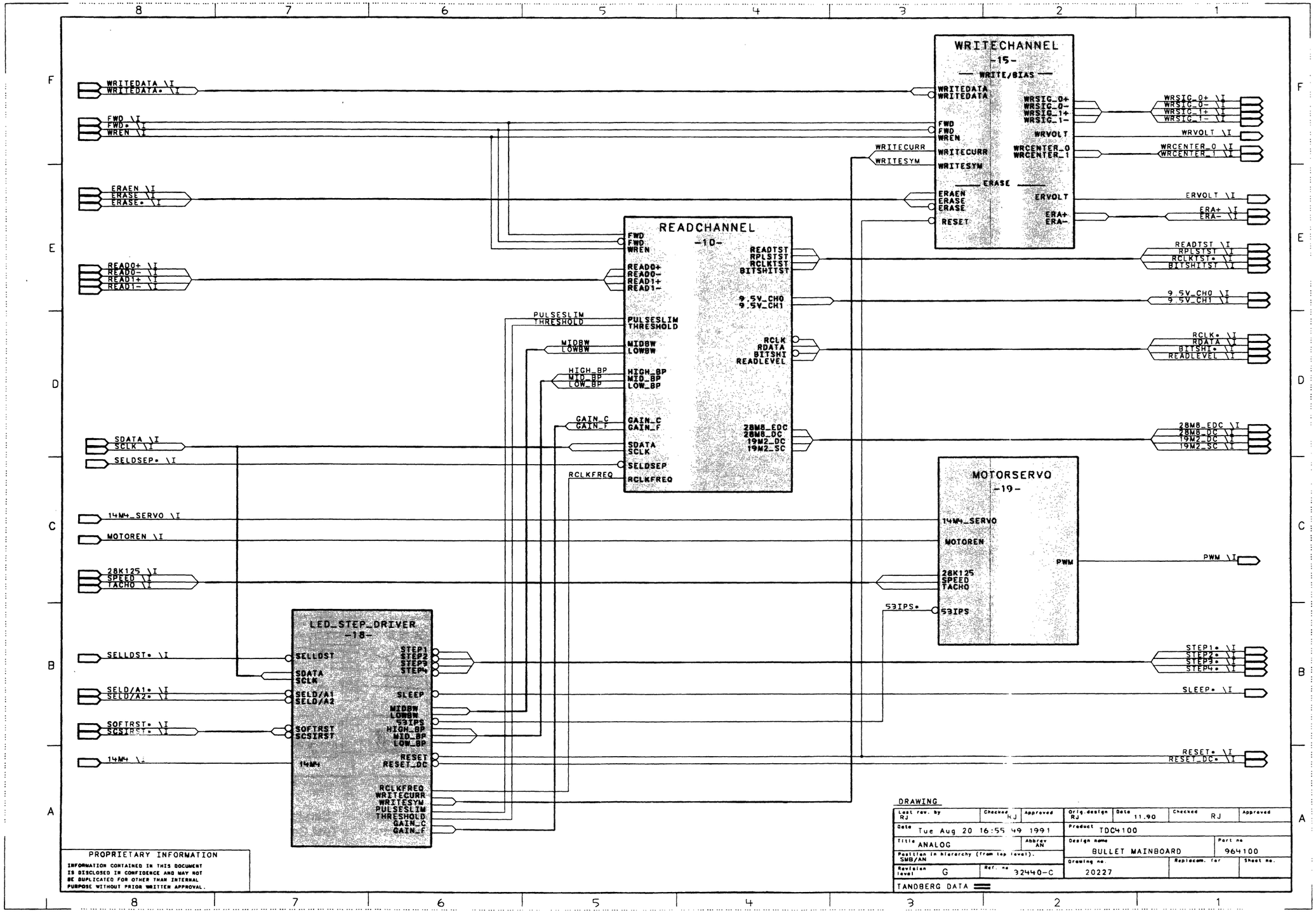
4.3. The Analog Block

The Read Channel (– 10 –)
The Read Channel receives a low level signal from the pre-amplifier inside the head. This signal is amplified, filtered, and converted into digital serial data.

The Write Channel (– 15 –)
The Write Channel receives digital write signals, and converts these into write current for the write head. The Write Channel block also contains the Erase Circuit.

The LED Step Driver (– 18 –)
The LED Step Driver consists of a LED and step motor driver circuit, an output latch for controlling analog functions, several D/A converters and the Reset Circuit.

The Motorservo (– 19 –)
The Motorservo controls the capstan motor speed according to a digital reference.


WRITECHANNEL
-15-
WRITE/BIAS
WRITEDATA
WRITEDATA
FWD
FWD
WREN
WRITECURR
WRITESYM
ERASE
ERAEN
ERASE
ERASE
RESET
WRSIG_0+
WRSIG_0-
WRSIG_1+
WRSIG_1-
WRVOLT
WRCENTER_0
WRCENTER_1
ERVOLT
ERA+
ERA-
READCHANNEL
-10-
FWD
FWD
WREN
READ0+
READ0-
READ1+
READ1-
PULSESLIM
THRESHOLD
MIDBW
LOWBW
HIGH_BP
MID_BP
LOW_BP
GAIN_C
GAIN_F
SDATA
SCLK
SELDSEP
RCLKFREQ
READTST
RPLSTST
RCLKTST
BITSHITST
9.5V_CH0
9.5V_CH1
RCLK
RDATA
BITSHI
READLEVEL
28M8_EDC
28M8_DC
19M2_DC
19M2_SC
MOTORSERVO
-19-
14M4_SERVO
MOTOREN
28K125
SPEED
TACHO
53IPS
PWM
LED_STEP_DRIVER
-18-
SELLOST
SDATA
SCLK
SELD/A1
SELD/A2
SOFTRST
SCSIRST
14M4
STEP1
STEP2
STEP3
STEP4
SLEEP
MIDBW
LOWBW
53IPS
HIGH_BP
MID_BP
LOW_BP
RESET
RESET_DC
RCLKFREQ
WRITECURR
WRITESYM
PULSESLIM
THRESHOLD
GAIN_C
GAIN_F
WRITEDATA \I
WRITEDATA• \I
FWD \I
FWD• \I
WREN \I
ERAEN \I
ERASE \I
ERASE• \I
READ0+ \I
READ0- \I
READ1+ \I
READ1- \I
SDATA \I
SCLK \I
SELDSEP• \I
14M4_SERVO \I
MOTOREN \I
28K125 \I
SPEED \I
TACHO \I
SELLOST• \I
SELD/A1• \I
SELD/A2• \I
SOFTRST• \I
SCSIRST• \I
14M4 \I
WRSIG_0+ \I
WRSIG_0- \I
WRSIG_1+ \I
WRSIG_1- \I
WRVOLT \I
WRCENTER_0 \I
WRCENTER_1 \I
ERVOLT \I
ERA+ \I
ERA- \I
READTST \I
RPLSTST \I
RCLKTST• \I
BITSHITST \I
9.5V_CH0 \I
9.5V_CH1 \I
RCLK• \I
RDATA \I
BITSHI• \I
READLEVEL \I
28M8_EDC \I
28M8_DC \I
19M2_DC \I
19M2_SC \I
PWM \I
53IPS•
STEP1• \I
STEP2• \I
STEP3• \I
STEP4• \I
SLEEP• \I
RESET• \I
RESET_DC• \I
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Product TDC4100
Design name BULLET MAINBOARD
Part no 964100
Drawing no. 20227
Replacem. for
Sheet no.
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4.4. SCSI Mainboard Component Location

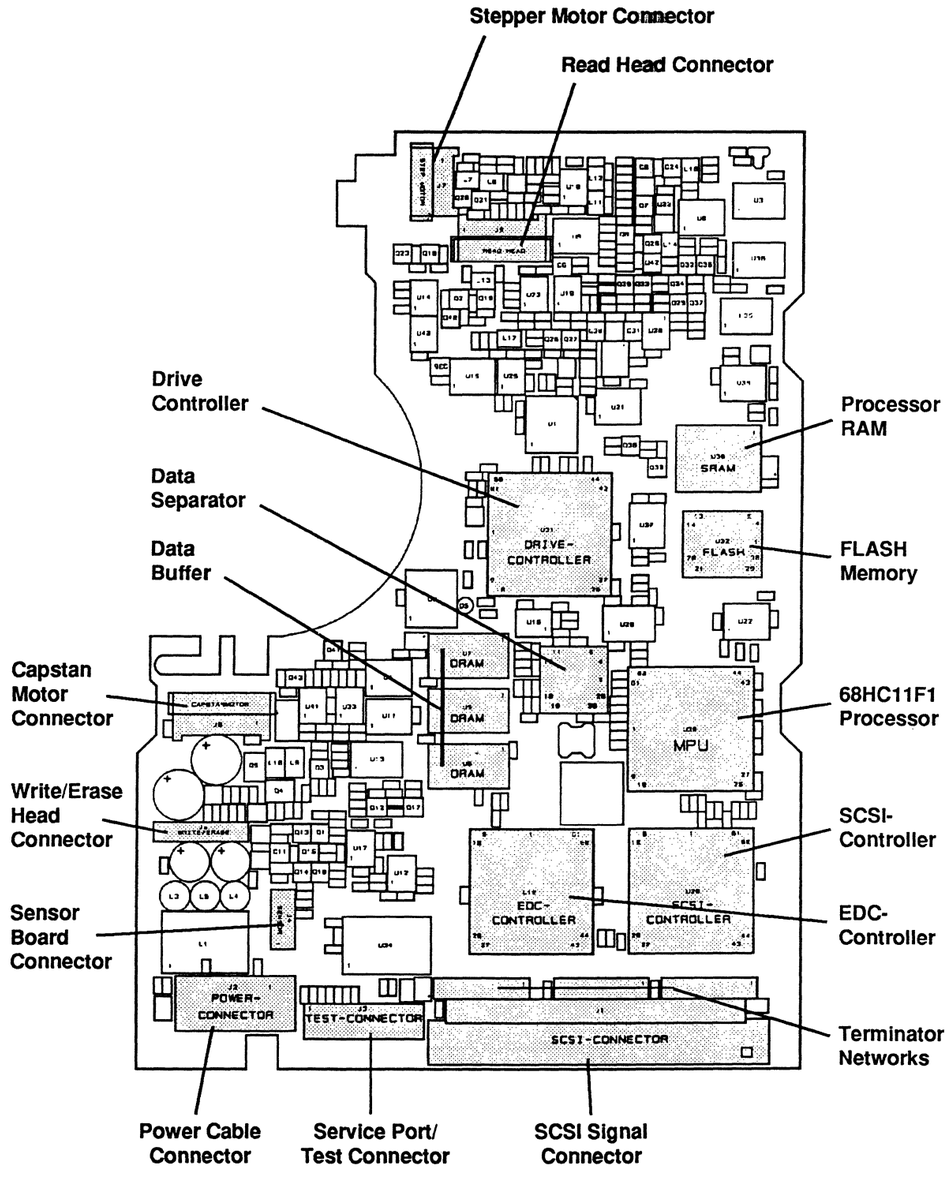


Figure 4.1 SCSI Mainboard Component Location

4.5. SCSI Mainboard Mnemonics List

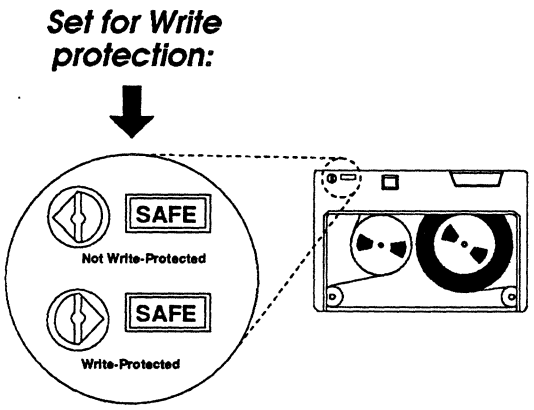
Mnemonic	Function
+12VOLT	2 V input to drive
+12VSLEEP	DC voltage derived from +12V global. For the Read channel.
+12V_M	12 V supply to capstan motor
+5VOLT	5V input to drive
+5VREG	Regulated 5 V derived from +8VREG
+8VREG	Regulated 8 V derived from +12 V global
0VOLT	0 V (ground) input to drive
14M4_SERVO	Clock signal to servo motor
28K125	28K125 clock signal input to capstan motor PWM
28M8_DC	28M8 clock signal input to Formatter. Derived from 28M8.
28M8_EDC	28M8 clock signal input to EDC Controller. Derived from 28M8.
53IPS*	Signal used to control the capstan motor servo
9.5V_CH0	Power supply to preamplifier (in-head) for CH0 (fwd)
9.5V_CH1	Power supply to preamplifier (in-head) for CH1 (rev)
BIRDIN*	Serial input line from the service port
BIRDOUT*	Serial output line to the service port
BITSHITST*	Bitshift detector output from Data Separator. Output to test port.
BOOTUP*	Service port line for reprogram FLASH memory
CENTER_0	See WR_CENTER_0
CENTER_1	See WR_CENTER_1
ERA+	Connection to erase coil
ERA-	Connection to erase coil
ERAEN	Signal that controls the power supply of the erase circuit
ERASE	Signal that toggles the erase coil current (9.6 MHz). Low when erase is not on. Complementary to ERASE*.
ERASE*	Signal that toggles the erase coil current (9.6 MHz).
ERVOLT	Erase circuit fault monitoring voltage. Input to A/D of MPU.
FWD	Selects read and write channels, and capstan motor direction
FWD*	Selects read and write channels
GAIN_C	Sets the read channel gain (coarse). Output from D/A
GAIN_F	Sets the read channel gain (fine). Output from D/A
HIGH_BP	Signal that selects a bandpass filter at 1.2 MHz in the read level detector (also gives 20 dB extra gain).
INPLACE*	Signal from a mechanical microswitch when a cartridge is inserted
LOWBW	Signal that selects the lowest read channel bandwidth (for QIC-120/150 and QIC-24)
LOW_BP	Signal that selects a bandpass filter at 0.48 MHz in the read level detector (also gives 20 dB extra gain)
LWSNS*	Output from the sensor circuit. Gives a burst of pulses when a lower tape hole is detected.
LWTST	Sensor circuit test point. Used for calibrating the lower sensor
MIDBW	Signal that selects the middle read channel bandwidth (for QIC-1000 53 ips and QIC-525)
MID_BP	Signal that selects a bandpass filter at 0.6 MHz in the read level detector (also gives 20 dB extra gain)
MOTOREN	Enables the PWM signal to the capstan motor Output Enable stroke to the memory chips
PARITY*	Input from the service port to enable the Drive for parity checking on the SCSI-bus
PORTSEL*	Selects the TDC1009-chip (Service port)
PULSESLIM	Sets the read channel pulse slimming. Output from D/A.
PWM	Pulse width modulator output. To capstan motor.

Mnemonic	Function
PWR	5 V supply to SCSI bus termination network
RCLK*	Recovered read channel clock. Generated by the Data Separator VCO. Used to clock the recovered data into the Drive Controller.
RCLKTST*	Test signal derived from RCLK*. Output to test port.
RDATA	Recovered read channel data. Output from the Data Separator. Clocked into the Drive Controller by RCLK*.
READ0+	Connection to read head CH0 (fwd). From preamplifier (in-head).
READ0-	Connection to read head CH0 (fwd). From preamplifier (in-head).
READ1+	Connection to read head CH1 (rev). From preamplifier (in-head).
READ1-	Connection to read head CH1 (rev). From preamplifier (in-head).
READTST	Test signal for the read channel analog signal at comparator and detector input. Output to test port.
RESET*	Resets the Drive
RPLSTST	Test signal from the Data Separator. A read pulse (RPLS) is given for each qualified zero crossing. Output to test port.
SACK*	SCSI control signal
SAFE	Signal preventing erase and write operation of write protected cartridges. Output from sensor circuit.
SATN*	SCSI control signal
SBSY*	SCSI control signal
SC/D*	SCSI control signal
SCLK	SPI bus clock signal
SCSIRST*	Reset input from the SCSI-bus
SDAT<7..0>*	SCSI data bus
SDATA	SPI-bus serial data
SDATPAR*	SCSI parity signal
SEL0*	SCSI device address used to determine the SCSI-device address and to execute the proper selftest
SEL1*	SCSI device address used to determine the SCSI-device address and to execute the proper selftest
SEL2*	SCSI device address used to determine the SCSI-device address and to execute the proper selftest
SELD/A1*	SPI-bus select line for D/A converter 1
SELD/A2*	SPI-bus select line for D/A converter 2
SELDSEP*	SPI-bus select line for Data Separator
SELFTEST*	Activates the internal selftest of the device
SELLDST*	SPI-bus select line for LED/step driver
SENSORFREQ	Clocking signal that controls the current in the LED of the Tape Hole Sensor. Frequency is 28.125 kHz, duty cycle 25 %.
SI/O*	SCSI control signal
SLEEP*	When Drive not active. Circuits not requiring power are deactivated.
SMSG*	SCSI control signal
SPEED	Generates speed reference. Duty cycle selectable in 1/256 steps. The signal is a PWM controlled 28.125 kHz signal.
SREQ*	SCSI control signal
SSEL*	SCSI control signal
STEP1*	Step motor connection
STEP2*	Step motor connection
STEP3*	Step motor connection
STEP4*	Step motor connection
TACHO	Contains motor speed information. Derived from the Hall IC outputs of the capstan motor.
TEMP	Signal goes high if motor temperature reaches a critical value
TERMPWR	Connection of 5 V external power to the termination network

Mnemonic	Function
THRESHOLD	Sets the qualification comparator threshold. Output from D/A.
UPSNS*	Output from the sensor circuit. Gives a burst of pulses when an upper tape hole is detected.
UPTST	Sensor circuit test point. Used for calibrating the upper sensor.
WRCENTER_0	Connection to center tap of the write coil for CH0 (fwd)
WRCENTER_1	Connection to center tap of the write coil for CH1 (rev)
WREN	Signal setting the modules for write operation
WRITECURR	Sets the write current. Output from D/A.
WRITEDATA	Signal that toggles the write current. Low when not writing. Complementary to WRITEDATA*.
WRITEDATA*	Signal that toggles the write current. Low when not writing.
WRITESYM	Set the write current symmetry. Output from D/A.
WRSIG0+	Same as WRSIG_0+
WRSIG0-	Same as WRSIG_0-
WRSIG1+	Same as WRSIG_1+
WRSIG1-	Same as WRSIG_1-
WRSIG_0+	Write coil connection CH0 (fwd)
WRSIG_0-	Write coil connection CH0 (fwd)
WRSIG_1+	Write coil connection CH1 (rev)
WRSIG_1-	Write coil connection CH1 (rev)
WRVOLT	Write circuit fault monitoring voltage. Input to A/D of MPU.

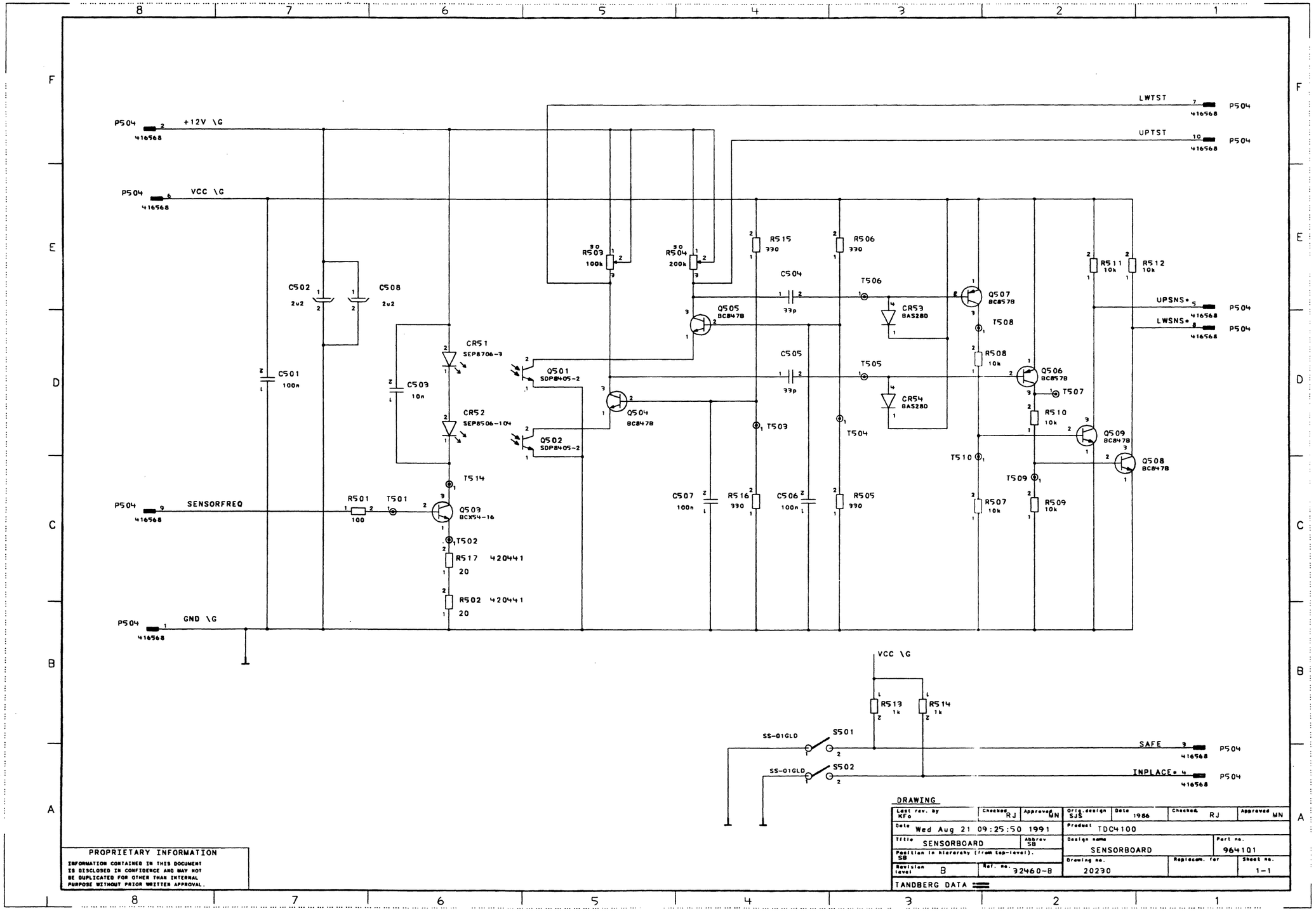
5. The Sensor Board

5.1. Description/Schematic Diagram



- **SAFE is true when the tape cartridge in the TDC 4100 Series Drive is set for write protection (S501 open).**
- **Switch S502 confirms the presence of a cartridge in the Drive by generating the INPLACE* signal (S502 closed).**

Light from the two light-emitting diodes CR51 and CR52 activates the corresponding photo transistors Q501 and Q502 when a hole in the tape opens the light path. Q501 will detect a hole in the upper part of the tape that results in UPSNS* being generated. LWSNS* is generated in the same way when Q502 detects a hole in the lower half of the tape. These signals are analyzed by the processor on the Mainboard in order to determine the position of the tape.


P504 +12V \G
P504 VCC \G
P504 SENSORFREQ
P504 GND \G
LWTST
UPTST
UPSNS*
LWSNS*
SAFE
INPLACE*
C501 100n
C502 2u2
C508 2u2
C503 10n
C504 33p
C505 33p
C507 100n
C506 100n
R503 100k
R504 200k
R515 330
R506 330
R516 330
R505 330
R501 100
R517 20
R502 20
R511 10k
R512 10k
R508 10k
R510 10k
R507 10k
R509 10k
R513 1k
R514 1k
CR51 SEP8706-3
CR52 SEP8506-104
CR53 BAS28D
CR54 BAS28D
Q501 SDP8405-2
Q502 SDP8405-2
Q503 BCX54-16
Q504 BC847B
Q505 BC847B
Q506 BC857B
Q507 BC857B
Q508 BC847B
Q509 BC847B
T501
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S501 SS-01GLD
S502 SS-01GLD
416568
PROPRIETARY INFORMATION
INFORMATION CONTAINED IN THIS DOCUMENT IS DISCLOSED IN CONFIDENCE AND MAY NOT BE DUPLICATED FOR OTHER THAN INTERNAL PURPOSE WITHOUT PRIOR WRITTEN APPROVAL.
DRAWING
Last rev. by KFo
Checked RJ
Approved MN
Orig.design SJS
Date 1986
Checked RJ
Approved MN
Date Wed Aug 21 09:25:50 1991
Product TDC4100
Title SENSORBOARD
Abbrev SB
Design name SENSORBOARD
Part no. 964101
Position in hierarchy (from top-level). SB
Revision level B
Ref. no. 32460-8
Drawing no. 20230
Replacem. for
Sheet no. 1-1
TANDBERG DATA

5.2. Sensor Board Component Location

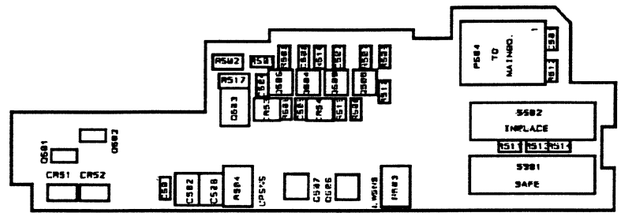


Figure 5.1 Layout of Sensor Board Assembly

5.3. Sensor Board Mnemonics List

Mnemonic	Function
SENSORFREQ	Sensor frequency
GND	Ground
INPLACE*	Cartridge in place
LWSNS*	Lower sensor
SAFE	Cartridge write protected
LWTEST	Used when adjusting the sensors
UPTEST	Used when adjusting the sensors
UPSNS*	Upper sensor
VCC	+ 5 V to Sensor Board
+12V	+12 V to Sensor Board

6. Troubleshooting

6.1. General

This troubleshooting guide does not provide complete fault diagnostics, but is meant to be a guidance to locate faulty modules.

Tools needed for troubleshooting are the same as in Section 9.1. *Tools for Adjustment.*
In most cases the TDC 4100 BirdTalk will provide the best support when locating defects.

A description of the different signals is found in Section 4.5. *SCSI Mainboard Mnemonics List.*

In this guide, the error conditions are divided into the following six groups:

① Dead drive/unable to communicate/failing power-up
② Read errors
③ Write errors/Erase errors
④ Sensor Board related errors
⑤ Capstan Motor related errors
⑥ Stepper Motor related errors

6.2. Error Conditions

6.2.1. Dead Drive/Unable to Communicate/Failing Power-up

Cause of failure: SCSI Mainboard

6.2.2. Read Errors

Probable cause of failure: SCSI Mainboard or Magnetic Head

IMPORTANT!
Signal conditions are based on using TDC 4100 BirdTalk.
Writing high density pattern QIC-1000 at 53 ips!

Important signals:

Signal	Reading Forwards	Reading Reverse	Testpoint
RDATA	+5 V DC *)	+5 V DC *)	T329
READTST	2 V p-p 1.2 MHz sinewave	2 V p-p 1.2 MHz sinewave	Service port
RPLSTST	TTL 2400 KHz	TTL 2400 KHz	Service port
RCLKTST	TTL 2400 KHz	TTL 2400 KHz	Service port

Outputs from the Read Head:

Signal	Reading Forwards	Reading Reverse	Testpoint
READ0+	30 mV p-p 9 V offset	**)	J6-2
READ0-	30 mV p-p 9 V offset	**)	J6-3
READ1+	**)	30 mV p-p 9 V offset	J6-6
READ1-	**)	30 mV p-p 9 V offset	J6-7

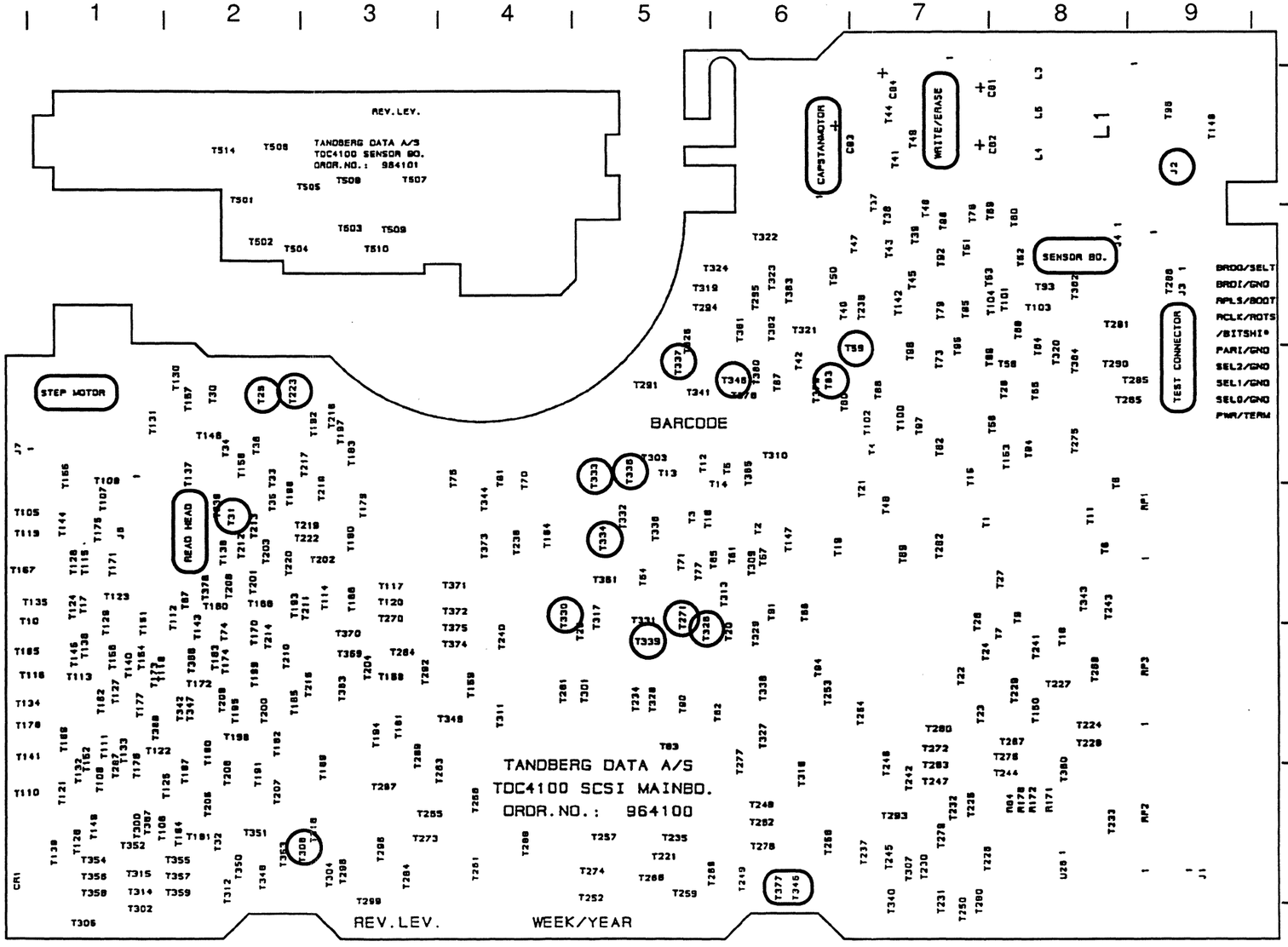
Inputs to the Read Head:

Signal	Reading Forwards	Reading Reverse	Testpoint
9.5V_CH0	10 V DC	0 V DC	J6-1
9.5V_CH1	0 V DC	10V DC	J6-5

NOTE *):
TTL pulses when using anything else than high density pattern, e.g. 60H or 29H.

NOTE **):
READ0+ and READ1+ are connected together at J6 on the Mainboard.
READ0- and READ1- are connected together at J6 on the Mainboard.
Signal amplitude in forward direction measured with ERASE turned OFF.

Mainboard Testpoint	Location	Signal Name
T29	2C	+8VREG\G
T31	2D	+12VSLEEP\G
T59	7C	WRITEDATA
T63	6C	WRITEDATA*
T223	2C	+5VREG\G
T271	5E	19M2
T308	3F	RESET*\I
T326	5E	28M8
T330	4E	RDATA
T333	5C	ERASE
T334	5D	ERASE*
T335	5C	14M4_SERVO
T337	5C	28K125
T339	5E	SPEED
T345	6F	MOTOREN
T346	6C	WREN
T377	6F	ERAEN
J2-1	9A	+12VOLT
J2-2,3	Power Connector	0VOLT
J2-4		+5VOLT
J5-1	7A	WRSIG0+
J5-2	Write/Erase Head Connector	WRCENTER_0
J5-3		WRSIG0-
J5-4		WRSIG1+
J5-5		WRCENTER_1
J5-6		WRSIG1-
J5-7		ERA+
J5-9		ERA-
J6-1	2D	9.5V_CH0
J6-2	Read Head Connector	READ0+
J6-3		READ0-
J6-5		9.5V_CH1
J6-6		READ1+
J6-7		READ1-
J7-1	1C	STEP1*
J7-2	Head Stepper Motor Connector	+12V
J7-3		STEP2*
J7-4		+12V
J7-5		STEP3*
J7-6		STEP4*
J8-2	6A	+12V_MG
J8-3	Capstan Motor Connector	PWM
J8-5		+5V
J8-6		TEMP
J8-7		TACHO
READTST	9B-C	READTST
RPLSTST	Test Connector/ Service Port	RPLSTST
RCLKTST		RCLKTST



Sensor Board Testpoint	Location	Signal Name
J4-2	8B	+12V\G
J4-3	Sensor Board Connector	INPLACE*
J4-4		SAFE
J4-5		UPSNS*
J4-6		+5V
J4-8		LWSNS*
J4-9		SENSORFREQ

TANDBERG DATA A/S
TDC 4100 SCSI MAINBD./SENSOR BD.
COMPONENT MARK SOLDER SIDE
DRAWING NO.: 11240-D (32440-D/32460-C)
TDCHRISTIAN 21.8.91

6.2.3. Write Errors/Erase Errors

Probable cause of failure: SCSI Mainboard or Magnetic Head

IMPORTANT!
Signal conditions are based on using TDC 4100 BirdTalk.
Writing high density pattern QIC-1000 at 53 ips!

Important Write signals:

Signal	Writing Forwards	Writing Reverse	Testpoint
WREN	High	Low	T346
WRITEDATA	TTL 1200 KHz	TTL 1200 KHz	T59
WRITEDATA*	TTL 1200 KHz	TTL 1200 KHz	T63
WRVOLT	See table below	See table below	

Inputs to the Write Head:

Signal	Writing Forwards	Writing Reverse	Testpoint
WRSIG0+	1200 KHz 12 V DC	0 V DC	J5-1
WRSIG0-	1200 KHz 12 V DC	0 V DC	J5-3
WRSIG1+	0 V DC	1200 KHz 12 V DC	J5-4
WRSIG1-	0 V DC	1200 KHz 12 V DC	J5-6
WRCENTER_0	12 V DC	0 V DC	J5-2
WRCENTER_1	0 V DC	12 V DC	J5-5

Important Erase signals:

Signal	Erasing	Not Erasing	Testpoint
ERAEN	High	Low	T377
ERASE	9.6 MHZ TTL	0 V DC	T333
ERASE*	9.6 MHZ TTL	0 V DC	T334
ERVOLT	See table below	See table below	

Inputs to the Erase Head:

Signal	Erasing	Not Erasing	Testpoint
ERA+	9.6 MHz 28 V p-p	Approx. 4.6 V DC	J5-7
ERA-	9.6 MHz 28 V p-p	Approx. 4.6 V DC	J5-9

WRVOLT and ERVOLT are values that are visible in TDC 4100 BirdTalk under Drive Adjust as AD write level and AD erase level.

Typical values are:

Write ON:	AD write level:	70 -> 145
Write OFF:	AD write level:	< 40
Erase ON:	AD erase level:	200 -> 255 - typical value: 255
Erase OFF:	AD erase level:	89 -> 161

NOTE:
Because the Drive performs Read-After-Write, Write errors can be caused from failures in Read Channel module.

6.2.4. Sensor Board Related Errors

Probable cause of failure: SCSI Mainboard or Sensor Board

Inputs to the Sensor Board:

Signal	Lower Hole Active	Upper Hole Active	Testpoint
+5 V	+5 V DC	+5 V DC	J4-6
+12 V\G	+12 V DC	+12 V DC	J4-2
SENSORFREQ	28.125 KHz	28.125 KHz	J4-9

Outputs from the Sensor Board:

Signal	Lower Hole Active	Upper Hole Active	Testpoint
UPSNS*	0 V DC	28.125 KHz TTL	J4-5
LWSNS*	28.125 KHz TTL	0 V DC	J4-8
UPTST	12 V DC	12 µs ± 2 *)	J4-10
LWTST	12 µs ± 2 *)	12 V DC	J4-7
SAFE	Low when the cartridge is write protected		J4-3
INPLACE*	Low when the cartridge is present in the Drive		J4-4

NOTE *):
See figure in Section 9.3. *Sensor Sensitivity Adjustment.*

Fold Out

6.2.5. Capstan Motor Related Errors

Probable cause of failure: SCSI Mainboard or Capstan Motor

Important Capstan Motor signals:

Signal	Motor Running	Motor Not Running	Testpoint
MOTOREN	High	Low	T345
14M4_SERVO	14.4 MHz TTL	14.4 MHz TTL	T335
28K125	28.125 KHz TTL	28.125 KHz TTL	T337
SPEED	28.125 KHz TTL *)	28.125 KHz TTL	T339

Inputs to the Capstan Motor:

Signal	Motor Running	Motor Not Running	Testpoint
+12V_M\G	+12 V DC	+12 V DC	J8-2
+5 V	+ 5 V DC	+5 V DC	J8-5
PWM	28.125 KHz TTL *)	0 V DC	J8-3

Outputs from the Capstan Motor:

Signal	Motor Running	Motor Not Running	Testpoint
TEMP	< 1.75 V	< 1.75 V	J8-6
TACHO	TTL frequency dependent of motor speed	0 V DC	J8-7

NOTE *):
Duty cycle dependent of motor speed.

6.2.6. Stepper Motor Related Errors

Probable cause of failure: SCSI Mainboard or Stepper Motor

Important Stepper Motor signals:

Signal	Stepping	Not Stepping	Testpoint
+12V	+12 V DC	+12 V DC	J7-2
+12V	+12 V DC	+12 V DC	J7-4
STEP1*	Pulses, 50-100 Hz 15 V p-p	+12 V DC	J7-1
STEP2*	Pulses, 50-100 Hz 15 V p-p	+12 V DC	J7-3
STEP3*	Pulses, 50-100 Hz 15 V p-p	+12 V DC	J7-5
STEP4*	Pulses, 50-100 Hz 15 V p-p	+12 V DC	J7-6

6.2.7. Important Voltages and Frequencies

Signal	Testpoint
+12VSLEEP\G	T31
+8VREG\G	T29
+5VREG\G	T223
+5VOLT	J2-4
+12VOLT	J2-1
0VOLT	J2-2,3
28M8	T326
19M2	T271
RESET*\I	T308

7. Maintenance

7.1. Service Philosophy

It is assumed that no major repair on the TDC 4100 Series Drive will be be performed in the field. The first task there will be to find out if the fault is in the system or in the Drive itself.

Changing of modules or components will always involve some adjustments and is therefore easier to perform at the service center.

7.2. Selftests

The processor in the TDC 4100 Series Drive adds up to a lot of intelligence. We have used this opportunity to build in selftesting and adjustment possibilities.

Three different types of selftest procedures can be executed:

- **The Power-Up Selftest**
- **The Manually Activated Selftest**
- **The Host Activated Selftest**

The selftests are described extensively in the *TDC 4100 Series Reference Manual.*

7.3. Power-Up Selftest

Each time the power is turned on, the Drive will go through a power-up selftest routine before it will be accessible to the Host system. This test will check most of the digital hardware.

7.4. The Manually Activated Selftests

These selftests are invoked by using the straps located at the rear of the Drive.

① **Production BURN-IN Test. (For internal use only!)**
This test is used in the production in order to exercise the hardware during the Burn-In period for the Mainboard. The test will discover most errors in the digital hardware.

② **Selftest 2**
First the Selftest 1 (see section 7.2) is run.
Next test is a Write/Read test. Two tracks are written in files of 50 frames (1400 512-byte blocks). Between each file the tape stops and backspaces before a new file is appended. Data Append is included to test the Erase circuitry.

③ **Wind/Rewind Test**
This test will do a continuous Wind and Rewind between BOT and EOT with head movement until power is turned OFF.

④ **Erase FWD/REV Test**
This test will run the tape continuously forward and reverse between BOT and EOT with the Erase current ON in both directions until power is turned OFF.

⑤ **Write + Erase FWD/REV Test**
This test will run the tape continuously forward and reverse between BOT and EOT with the Write and Erase currents ON in both directions until power is turned OFF.

7.4.1. How to Activate the Selftests Manually

The Drive has several test functions that easily can be started by setting up a specific code on the select straps (SEL0 - SEL2), and by grounding the TEST-pin during drive power-up. The coding is as follows:

TEST	SEL 2	SEL 1	SEL 0	Meaning
CLOSED	OPEN	OPEN	OPEN	Drive without Sensor Board: Burn-In Test Complete Drive: Run-In Test
CLOSED	OPEN	OPEN	CLOSED	Selftest 2
CLOSED	OPEN	CLOSED	OPEN	Reserved
CLOSED	OPEN	CLOSED	CLOSED	Reserved
CLOSED	CLOSED	OPEN	OPEN	Reserved
CLOSED	CLOSED	OPEN	CLOSED	Erase FWD/REV Test
CLOSED	CLOSED	CLOSED	OPEN	Write + Erase FWD/REV Test
CLOSED	CLOSED	CLOSED	CLOSED	Wind/Rewind Test

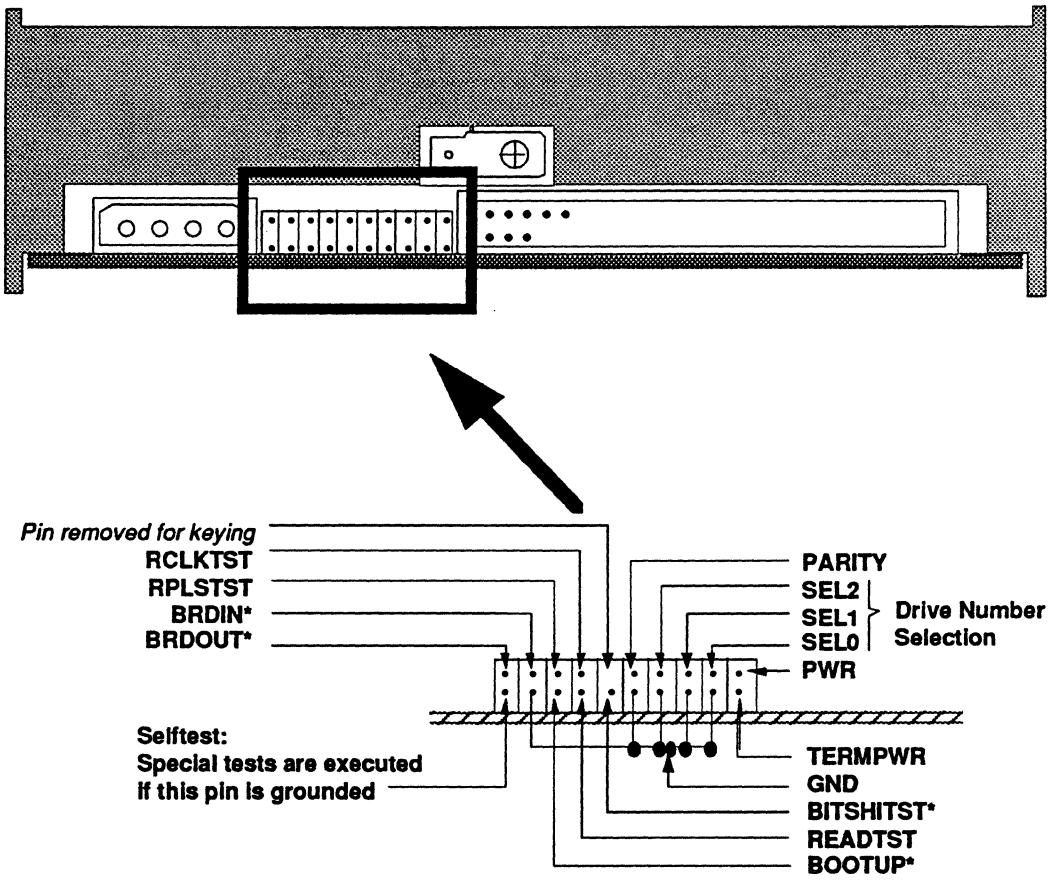


Figure 7.1 Rear view of a TDC 4100 Series Drive showing the Test Connector / Service Port

7.5. The Host Activated Selftests

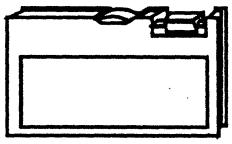
Selftest 1 and Selftest 2 may be activated from the Host side by asserting the Send Diagnostics command via the SCSI-bus.

NOTE: Selftest 1 activated from the Host will take about 1 sec. Selftest 2 will first run Selftest 1 and then the read/write test.

7.6. Head Cleaning

Optimal recording- and readback performance of valuable data requires proper head cleaning at frequent intervals.

Recommended equipment for head cleaning is:



The Tandberg Data ***1/4" Cleaning Cartridge Kit.*** (See Figure 7.2)

Tandberg Data ordering number 96 66 04

Contact your local Tandberg Data representative for order information.

CAUTION!
Use no sharp objects when cleaning the head!
Even small scratches may damage the head permanently!

The cleaning interval depends on three main factors:

① How much the Drive is used
② The quality of the tape
③ The quality of the environment

However, the following can be used as a recommended guideline

Usage	Clean
Eight hours a day	Daily
Daily	Weekly
Weekly	Monthly

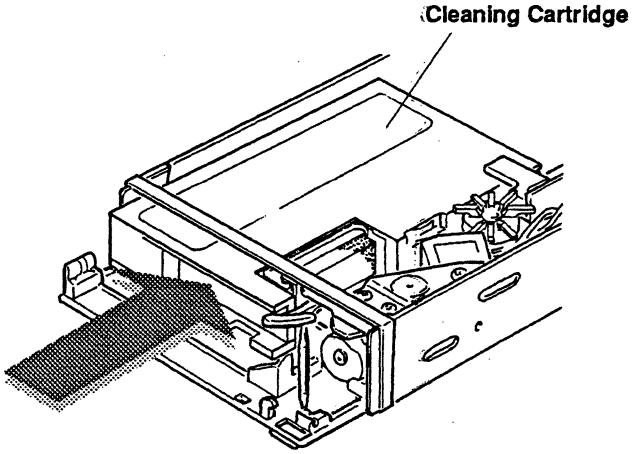


Figure 7.2 Head cleaning using the Cleaning Cartridge Kit

NOTE:
Always clean the head immediately after using a new cartridge. And remember, it is better to clean too often than too seldom!

7.7. Tools for Adjustment

All adjustments on TDC 4100 Series Drives can be done automatically or manually by means of a PC and the TDC 4100 BirdTalk.

The Drive can also be tested via the SCSI-bus by means of the "TDC 4100 SCSI Test System" PC-package.

The Test System

The complete test system, ordering no. 96 41 09, contains:

- **TDC 4100 SCSI Test Software**
- **TDC 4100 BirdTalk**
- **RS-232 Interface (for the BIRD-channel)**
- **SCSI Test Interface**
- **Manual describing the system**
- **Service Port Connection Board**

The results from the automatic adjustments, stored in the EEPROM, can be verified from the Drive Adjust Menu in the TDC 4100 Bird-Talk.

7.8. Necessary Hand Tools

The list below shows the hand tools that are required to replace and adjust the spare modules of the Drive.

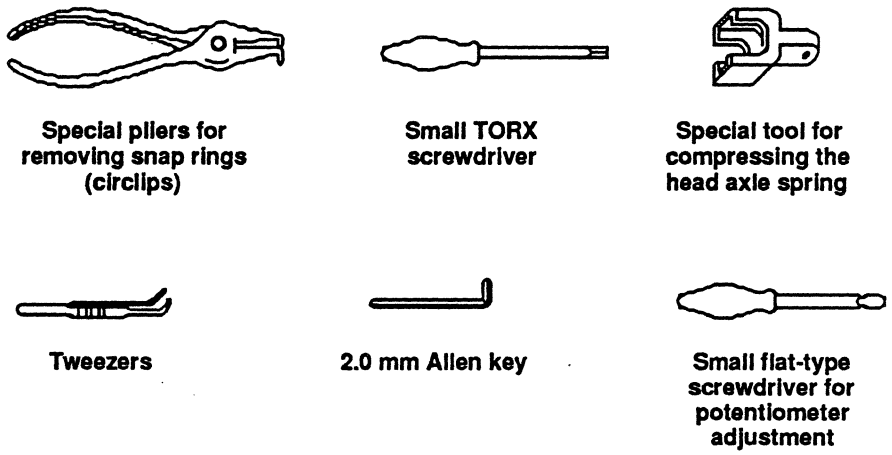


Figure 7.3 Hand Tools

7.9. Diagnostic Tools

To locate faults on the printed circuit boards, you will need an oscilloscope and a digital multimeter.
Three different test/service boards are available from our service department:

① A serial communication board for adjusting and exercise of the Drive.

Tandberg Data ordering number 96 60 22

② A test board with LEDs that monitor the SCSI-bus control lines. The board is connected between the TDC 4100 and the Host's signal cable.
This test board is very useful for host software development.

Tandberg Data ordering number 96 60 05

③ A service board for connecting an oscilloscope to the BITSHIFT, RDTST and RDCLK signals along with GND.

Tandberg Data ordering number 96 80 32

④ A TDC XXXX service board

Tandberg Data ordering number 96 41 08

7.10. Adjustments (See also Chapter 9)

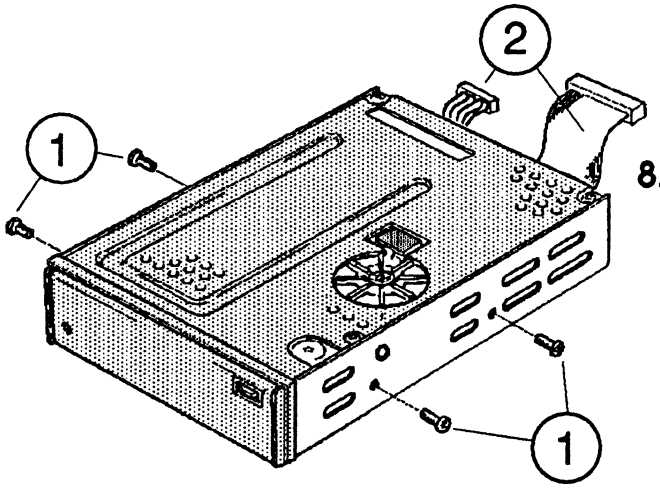
The table below shows the various adjustments of the Drive, their corresponding potentiometers and testpoints.

Adjustment	Potentiometer, test pin
SENSOR	R503 Sense Controller, pin 7 R504 Sense Controller, pin 10

8. How to Change the Different Modules

Important Antistatic Precautions

Always consider the danger of destruction caused by electrostatic discharge when handling this product!
Dis-assembling/assembling should only be performed within a static-free area, always using correctly antistatic prepared desk-tops, tools and armlinks!
Violating these rules may introduce immediate or resting breakdown of vital electronic parts!

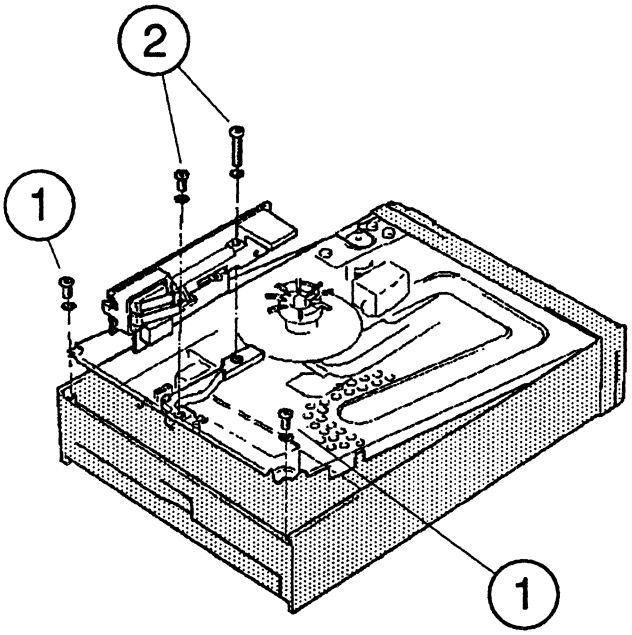


8.1. Removing the Drive

① Remove the four mounting screws from the Drive.

② Unplug the signal and power cables.

NOTE:
Some of the module exchanges require subsequent mechanical or electrical adjustments. All adjustments are described in detail in Chapter 9.



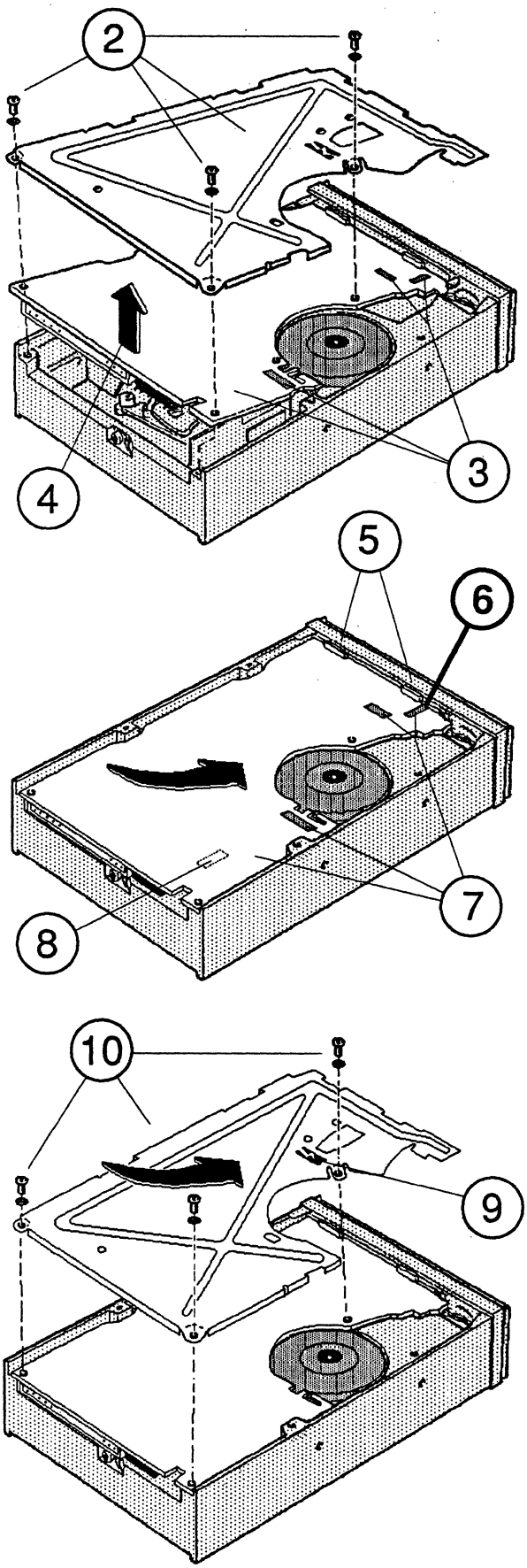
8.2. Changing the Sensor Board

① Remove the two screws and lift off the top cover.

Don't lose the serrated washers!

② Remove the two screws in the Sensor Board holder. Pull the board straight out of the Mainboard plug.

③ Check that the two sensors work properly. It may be necessary to readjust R503 and R504. See Section 9.3.



8.3. Changing the SCSI Mainboard

① Remove the top cover.
See Section 8.2 step 1.

② Remove the 3 screws that secure the metal cover and the Mainboard and remove the metal cover.

③ Disconnect the cables for the Read/Write/Erase-Head, the Capstan Motor and the Stepper Motor.

④ Lift the Mainboard out carefully.

Replacing the SCSI Mainboard

⑤ Place the board edge under the two knobs on the casting and ease into place as indicated by the arrow.

⑥ **Avoid getting the Stepper Motor/Read Head cables caught between the board edge and the casting!**

⑦ Plug in the Read/Write/Erase-Head, Capstan Motor and Stepper Motor cables.

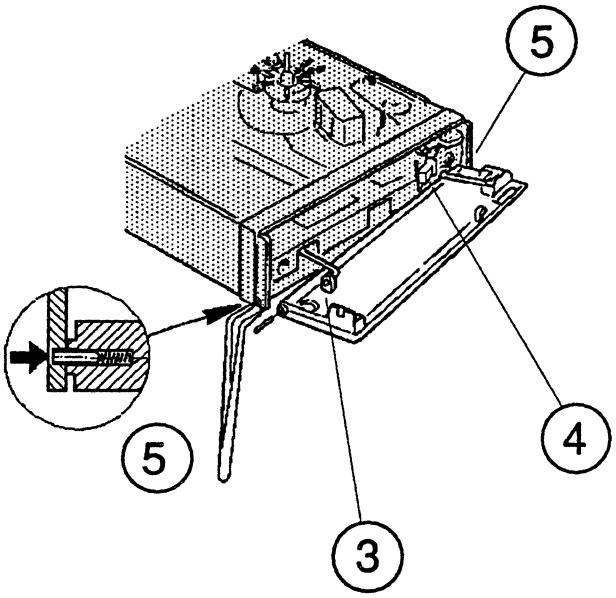
⑧ Make sure that the Sensor Board engages properly in the Mainboard socket.

⑨ Replace the metal cover as indicated by the arrow - making sure that the Read Head cable is held in place by the indented cable clamp.

⑩ Replace the 3 screws.

NOTE:
If a new SCSI Mainboard has been installed, adjust the Drive according to Chapter 9. Adjustments.

8.4. Changing the Stepper Motor



① Remove the top cover.
See Section 8.2.

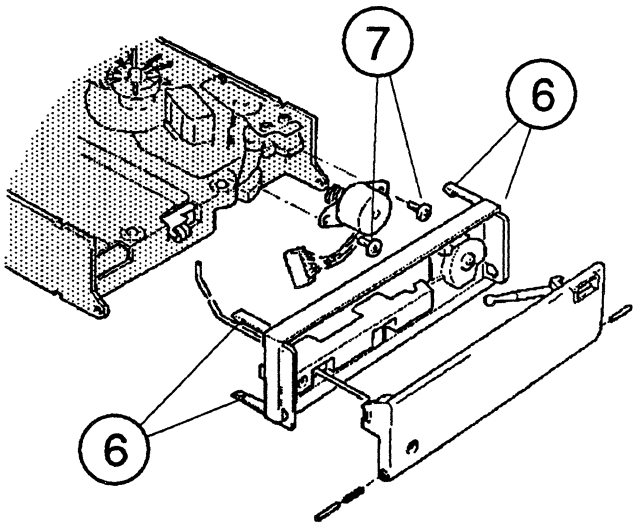
② Remove the Mainboard.
See Section 8.3.

③ Remove the snap-ring from the push/pull-rod.

④ Hold the cartridge locking arm and pull the ball joint out of its socket.

⑤ Push in the spring-loaded axle at the near end- and the pin at the far end of the door with tweezers and remove the door.

Take care NOT to lose the springs and axles!

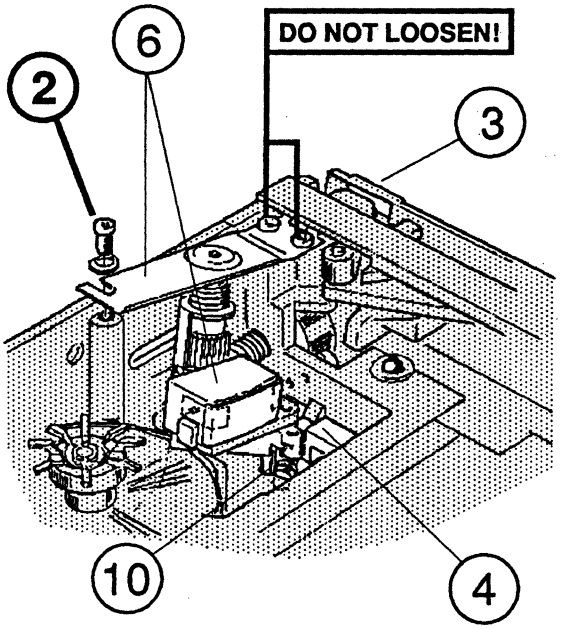


⑥ Disengage the 4 hooks to remove the front frame.

⑦ Loosen the 2 screws and pull out the motor.

NOTE:
Check that the door moves freely when all the parts have been re-assembled.

⑧ Adjust the Head top-stop.



8.5. Changing the Head Assembly

① Remove the Mainboard.
See Section 8.3 steps 1 - 4.

② **Remove ONLY ONE screw from the spring plate. Take care, DO NOT LOOSEN the indicated screws!**

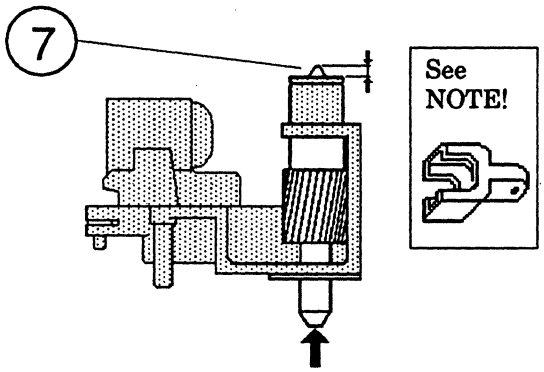
③ Open the door slightly.

④ Bend the arm down and bring the platform pin out of the hole in the arm.

⑤ Close the door.

⑥ While bending the leaf spring up, lift and pull out the head assembly. Slight force may be necessary.

IMPORTANT!
DO NOT DAMAGE THE NEW HEAD FRONT! KEEP WELL PROTECTED!

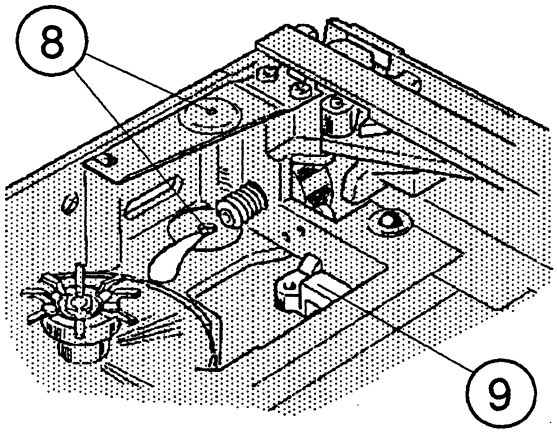


Replacing the Head Assembly

⑦ Press vertical axle upwards and turn the "worm-wheel" until only the conical part of the axle is visible on top.

⑧ Compress the head-axle spring with the tweezers (see NOTE) and wriggle assembly back in place, top of axle first into hole in spring plate, then into hole in casting!

NOTE:
A specially designed tool is available for compressing the head-axle spring.



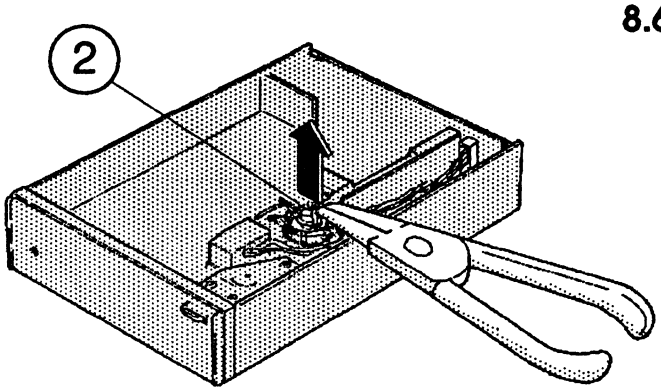
⑨ Replace the arm on the head platform pin.

⑩ Replace spring, washer and screw ② and the cable connectors.

⑪ Replace the Mainboard.

⑫ Degausse and clean the Head.

⑬ Adjust the Write Current, Write Current Balance, Read Gain and the Head top-stop.



8.6. Changing the Capstan Wheel

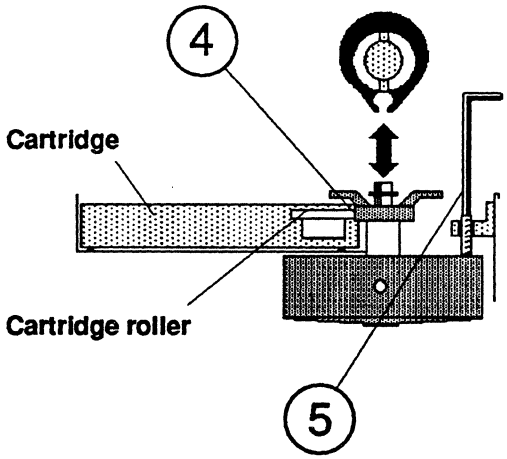
① Remove the top cover. See Section 8.2.

② Remove the snap-ring **(do NOT overstress the ring)** and pull the capstan wheel straight up.

③ Replace the capstan wheel.

④ Insert a tape cartridge, and using snap-ring pliers as shown at ②, loosen and move the capstan wheel so that it covers the cartridge roller ④ and then allow the snap-ring to tighten.

Observe the correct snap-ring positioning!



8.7. Changing the Capstan Motor

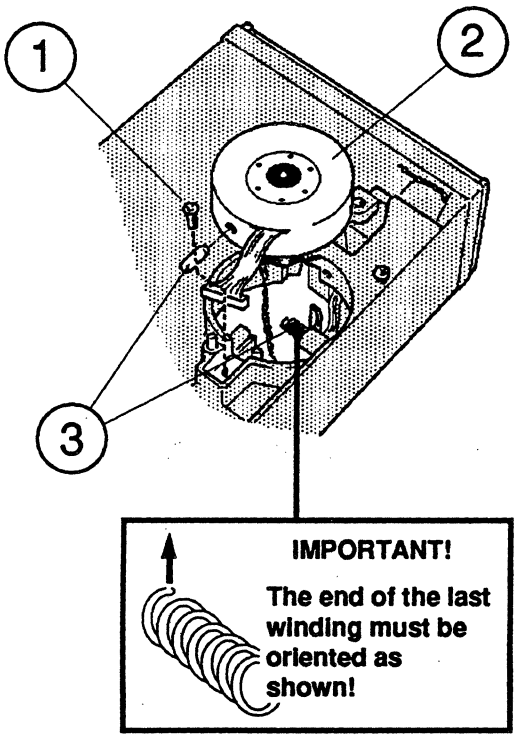
① Remove the screw that holds the axle.

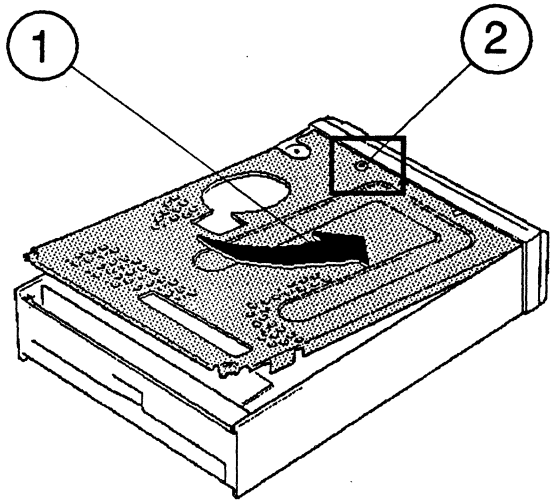
② Pull the motor carefully out.

③ When replacing the motor, make certain that the pivot ball enters its recess. Ensure also that the spring pressing against the motor-hub stays in place and that the end of the last winding is correctly oriented. **See detail!**

④ Check that the motor tilts easily with no axial play in the pivot bearing.

⑤ If a new motor is installed, turn the set screw (use the 2.0 mm Allen key) clockwise until the capstan wheel lifts from the cartridge roller. Then turn 1/2-turn back.

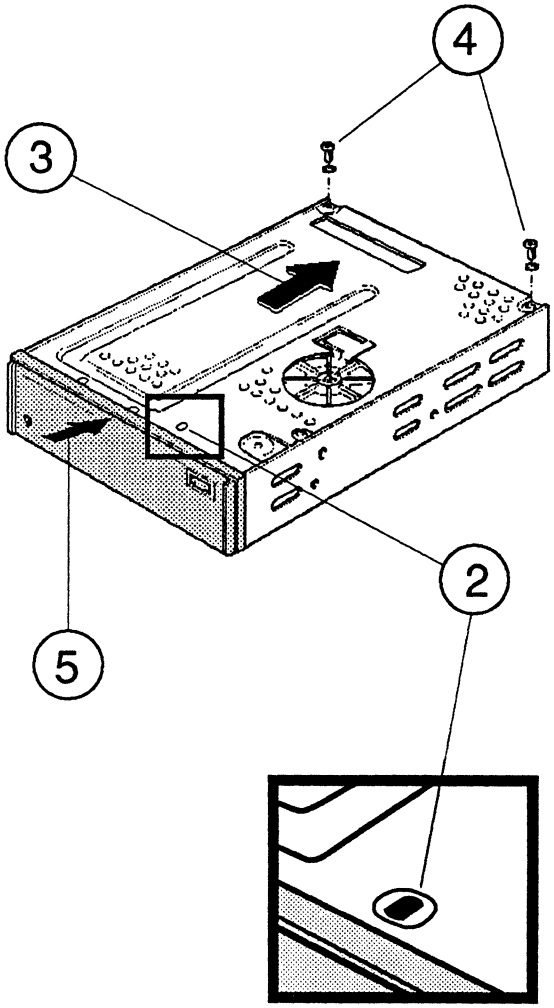




8.8. Replacing the Top Cover

① Replace the top cover in the indicated direction.

② Make sure that the tab enters the hole properly. (See also detail below).



③ When the cover is in place, push it back until the tab protrudes the cover, see detail at ②.

④ Hold the cover firmly and replace the two screws.

Remember the serrated washers!

⑤ Check that the tab can move freely in the hole at ② by pressing carefully on the front frame as indicated.

8.9. Firmware (FLASH Memory) Upgrading

8.9.1. Program and Files Needed

To perform a firmware FLASH-memory upgrade, the following software is necessary:

- TDC 4100 SCSI Test Program (BST)

To perform a FLASH-memory upgrade, the following file is needed:

- x x . BIN (fw file)

Example: *"SCSI fw". BIN*

8.9.2. Upgrade Execution

① Insert cartridge (*not required*)

② Connect the SCSI power cable and attach power to the Drive.

③ Write "BST" to start the program.

④ New Drive – ND

⑤ Single Command – SC

⑥ Request Sense – RS

⑦ Write Buffer – WB
- Mode 5
- filename x x . BIN

NOTE: Verbose Mode can also be used, giving more information during upgrade execution. When the upgrading is finalized, the Drive will do a reset and the upgrading is finished.

8.9.3. Firmware Upgrade Using a Firmware Tape

<To Be Supplied>

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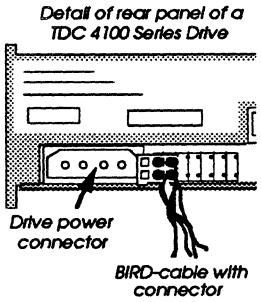
9. Adjustments

9.1. Tools for Adjustment

The BIRD-Channel



All adjustments, except adjustments for the Sensor Board, will be done automatically. For failure analysis the Drive can also be adjusted manually.

The adjustment software used for both automatic and manual adjustments is the "TDC 4100 BirdTalk".

The complete test system, ordering no. 96 41 09, contains:

- **SCSI Test Software**
- **TDC 4100 BirdTalk**
- **RS-232 Interface (for the BIRD-channel)**
- **SCSI Test Interface**
- **Service Port Connection Board**
- **User Manual describing the system**

For adjusting the SCSI Mainboard, no other tools are needed.
An oscilloscope is needed for adjusting the Sensor Board.

9.2. Service Port Details

Figure 9.1 shows the various monitoring and test pins on the test connector/service port located at the rear of the Drive.

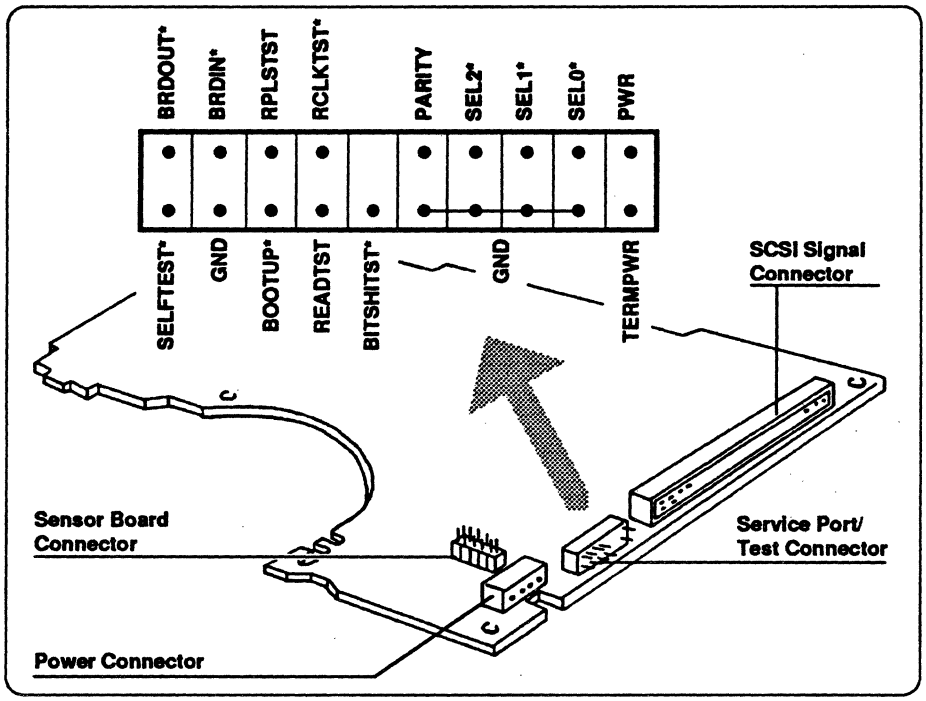


Figure 9.1 Location of Testpoints / Detail of Service Port

9.3. Sensor Sensitivity Adjustment

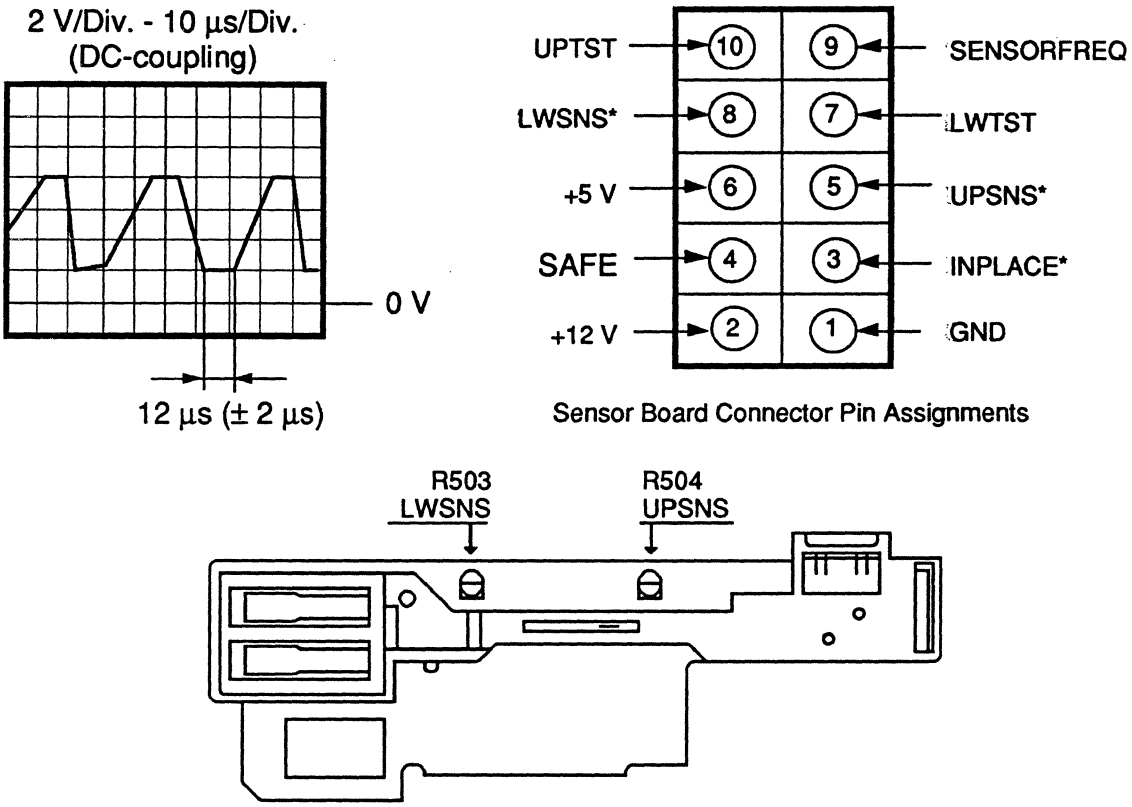


Figure 9.2 Sensor Sensitivity Adjustment

① Set the oscilloscope to 2 V/Div.

② Connect ground to the Service Port Connector Board.

③ Connect the probe to pin 7 on the Sensor Board.

④ Insert a DC9100 cartridge and locate the lower BOT-hole in front of the sensor by turning the capstan wheel.

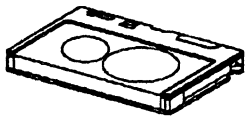
⑤ Turn the capstan wheel so that you obtain maximum clipping of the signal.
Maximum clipping should be 12 µs ± 2 µs. See figure above.
Adjust with potentiometer R503 if necessary.

⑥ Move the probe to pin 10.

⑦ Locate the upper LP (Load Point)-hole in front of the sensor by turning the capstan wheel.

⑧ Turn the capstan wheel so that you obtain maximum clipping of the signal.
Adjust with potentiometer R504 if necessary.

9.4. Automatic Adjustment and Tests



Use a certified DC9100 cartridge ...

To start the automatic adjustment and test procedure, enter the "Drive Adjust" - menu in the "TDC 4100 BirdTalk" program (BBT).

When performing automatic adjustments, a certified DC9100 tape cartridge must be used.

The Write Current, Write Symmetry, Read Gain, Read Channel Pulse Slimming and the Read Clock Center Frequency will be automatically adjusted for all tape and format combinations.

The program will also perform a test of the Drive. All parameters such as signal-to-noise ratio, erase performance, bitshift performance etc., will be checked to be inside their specifications. In addition a Read and Write test will be performed.

9.5. Manual Adjustment with BirdTalk

Manual adjustments must only be performed for failure analysis. The limits given in the following are approximates and *not* meant for final adjustments. The manual adjustments can be performed by entering the "Drive Adjust" - menu in the TDC 4100 BirdTalk program.
To toggle between the format and tape combinations,
use the

INS-key

9.5.1. Adjustment of Write Current and Write Symmetry

When adjusting for QIC-1000 tape format, use a **DC9100** cartridge.
When adjusting the other format and tape combinations, a **DC6525** cartridge must be used.

The adjustment procedure must be performed in both directions.

Write Current adjustment

① Connect the oscilloscope to READTST (see Figure 9.1)

② Select *high density* pattern using *Alt F8*

③ Before the adjustment starts, set the Write Symmetry to 32

③ Adjust the Write Current (I_W) (see Figure 9.3) to maximum output or to $I_W = 63$, then reduce the Write Current until the output has dropped 5 %. This current is defined as I_{WREF}.
Then set the Write Current to:

$I_{WREF} \bullet 1.15$ for the QIC-1000 format

and to:

$I_{WREF} \bullet 1.3$ for the other formats

I_{WREF} must be found separately for the QIC-1000, QIC-525 and the QIC-150/120 formats.

Write Symmetry adjustment

① Select 60H data pattern using *Alt F8*

② Adjust the Write Symmetry until the Read output is symmetrical (see Figure 9.4). Both the "zero line distance" and the signal peak values shall be symmetrical.

9.5.2. Read Gain Adjustment

When adjusting for QIC-1000 tape format, use a **DC9100** cartridge. When adjusting the other format and tape combinations, a **DC6525** cartridge must be used.

The adjustment procedure must be performed in both directions.

① Select *high density* pattern using *Alt F8*

② Adjust the Read Gain with "Gain_Coarse" and "Gain_Fine" until the Read output is:

2 V p-p for the QIC-1000/525/150/120 and QIC-24-DC6150 formats

2.8 V p-p for the QIC-24-DC300XLP tape format combination

9.5.3. Read Channel Pulse Slimming Adjustment

This adjustment is performed in the QIC-1000 and QIC-525 format. For the other tape formats the Pulse Slimming can be set to 0 (zero).

The adjustment shall be performed for both directions.

① Select 60H data pattern using *Alt F8*

② Adjust the Pulse Slimming until the distance ***d*** - see Figure 9.5 - between the two ones (in 01100) of the data pattern is 525 ns for QIC-1000/53 ips, QIC-525 and 350 ns for QIC-1000/80 ips.

9.5.4. Read Clock Center Frequency Adjustment

This adjustment is not dependant upon direction and is done for both directions simultaneously.

The RCLK frequency can either be monitored at the RCLK freq. readout in BBT or by using an external frequency counter connected to the RCLKTST*-pin on the service port/test connector at the rear of the Drive.

① Adjust the frequency according to the specifications below:

2.4 MHz ± 100 kHz for QIC-1000/53 ips
3.6 MHz ± 100 kHz for QIC-1000/80 ips
2.4 MHz ± 100 kHz for QIC-525
1.2 MHz ± 50 kHz for QIC-150/120
960 kHz ± 50 kHz for QIC-24

Write Current Adjustment
Typical oscilloscope-image

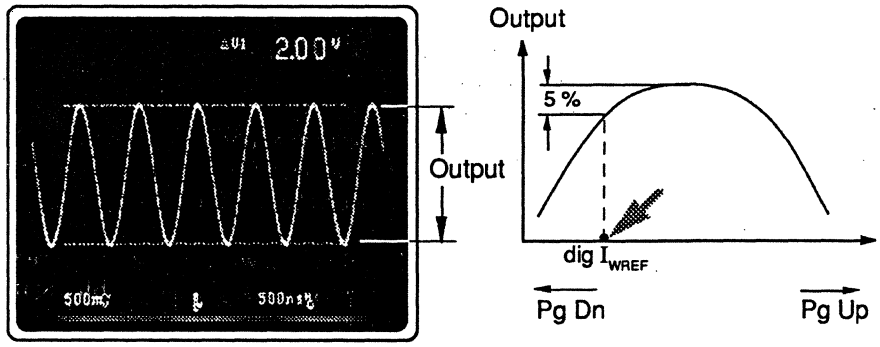


Figure 9.3 Write Current Adjustment

Write Symmetry Adjustment
Typical oscilloscope-image

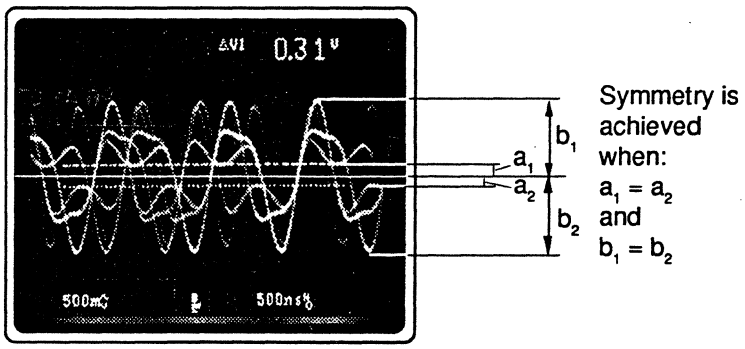


Figure 9.4 Write Symmetry Adjustment

Pulse Slimming Adjustment
Typical oscilloscope-image

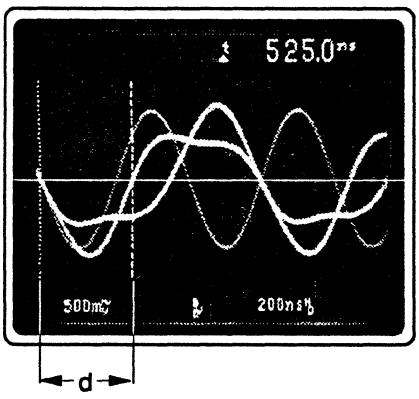


Figure 9.5 Read Channel Pulse Slimming Adjustment

10. Spare Module List

Only complete spare modules (assemblies) are shown in this illustration. Complete parts lists for each printed circuit board are included in the individual descriptions of each board.

A comprehensive list, with prices, of spare mechanical and electrical parts, and some accessories, is available from your local Tandberg Data representative.

When ordering, please specify order number and the full name of the required part.

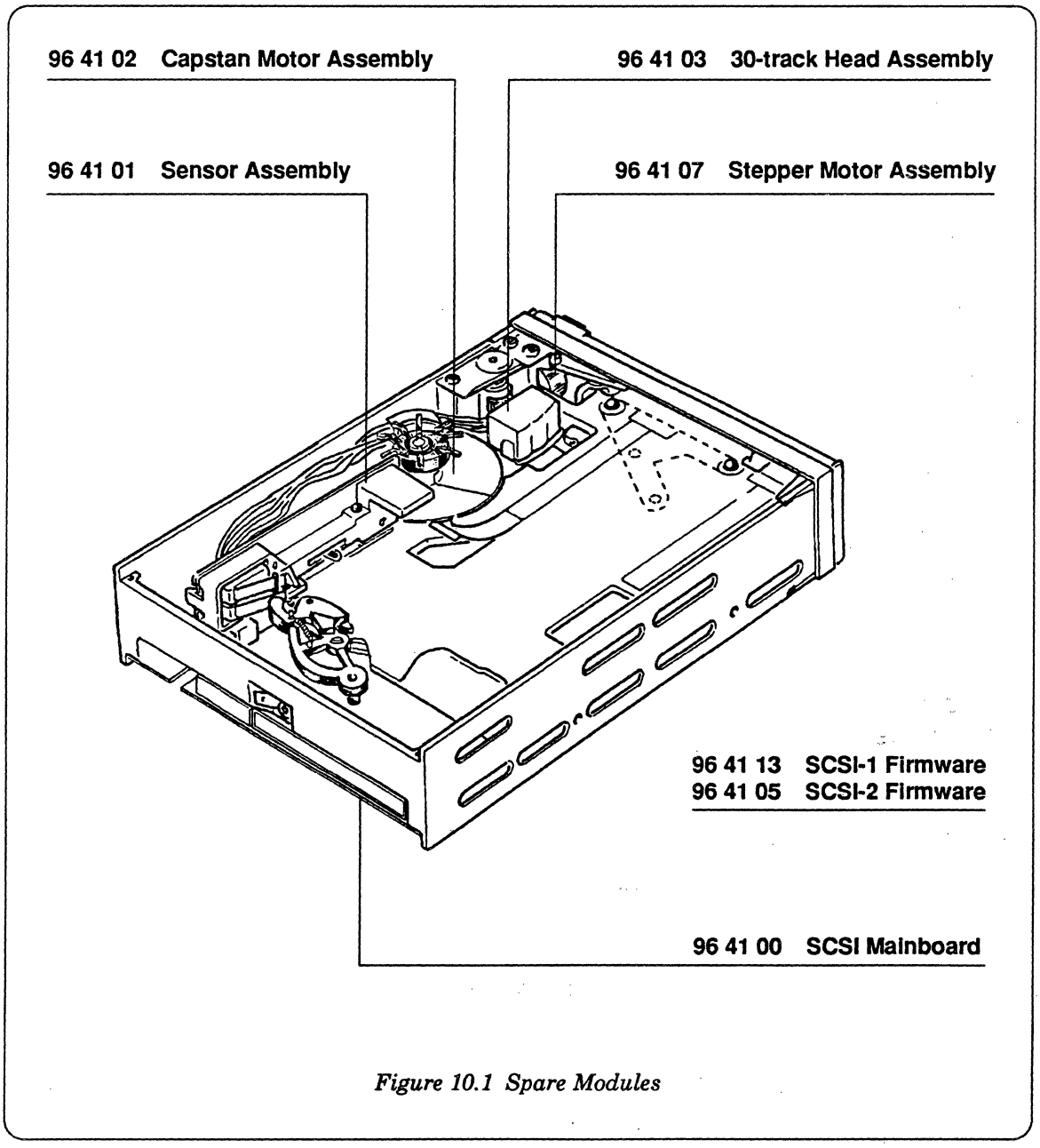


Figure 10.1 Spare Modules

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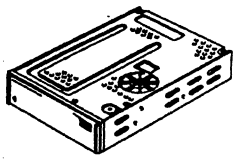

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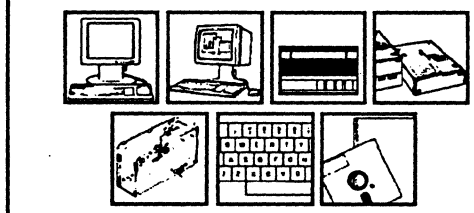
Refer to the last page of this publication for addresses and telephone numbers.



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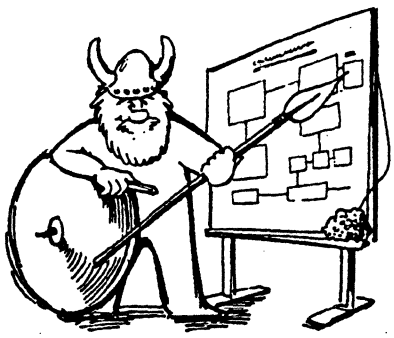

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