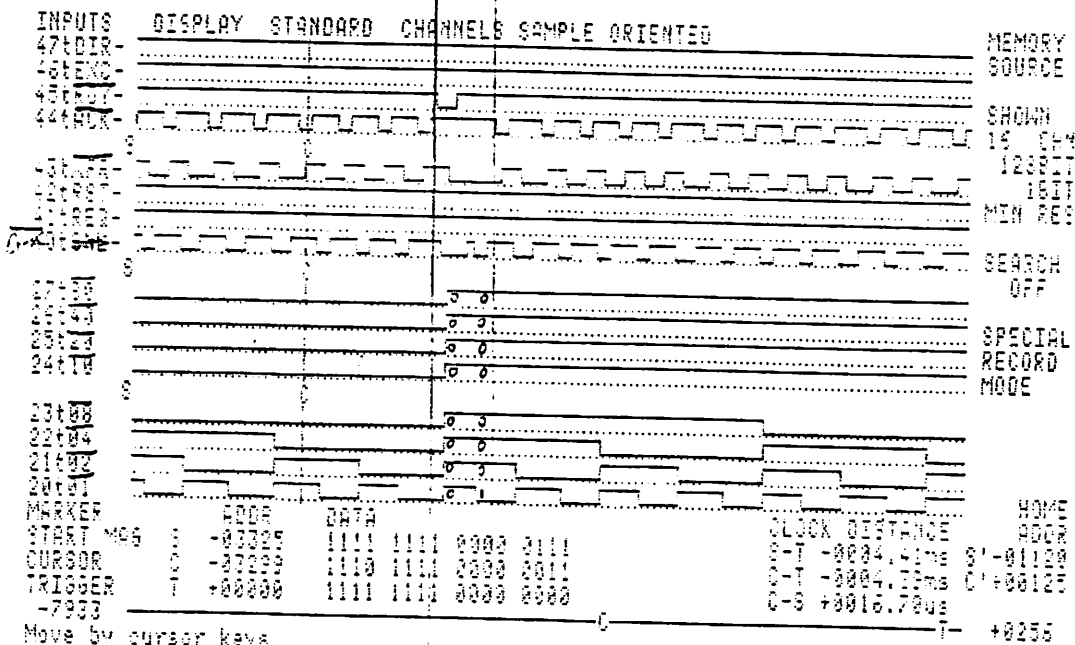


All signals from TEAC DIC-02 interface except pin 15 of DACK3 -- from 957 DMA chip.

ready

Drive accepts first byte (leading edge of ACK)
 one XFER one ACK
 TWO DACK3
 Data has gone from 00 to 01 shortly after falling edge of DACK3



Tape Streamer Commands

- ' 0 - Rewind
- ' 1 - Erase
- ' 2 - Retension tape
- ' 3 - Wang Mode

- ' 4 - Seek Block
- ' 5 - Seek Directory Block
- ' 6 - Seek End of Data
- ' 7 - Restore Sectors

- ' 8 - Read Block
- ' 9 - Reread Block
- ' 10 - Read File Mark
- ' 11 - Read N File Marks

- ' 12 - /Dxf Status
- ' 13 - Tape Drive status
- ' 14 - Extended status
- ' 15 - MENU

- ' 16 -
- ' 17 -
- ' 18 -
- ' 19 - Industry Mode

- ' 20 - Select Drive
- ' 21 - Select Drive with Lock
- ' 22 -
- ' 23 - Backup

- ' 24 - Write Block
- ' 25 -
- ' 26 - Write File Mark
- ' 27 -

- ' 28 -
- ' 29 - Release Tape Buffer
- ' 30 -
- ' 31 - Command String

DS \$GIO tape streamer commands

16 DS status
30 Rewind
31 Erase
32 Retension tape
33 Backup sectors
34 Write file mark
35 Restore sectors
36 Read file mark
37 Read status
38 Select Wang Mode
39 Set industry mode
3A
3B Read N file marks
3C
3D
3E Read extended status
3F seek block

46 Select drive with lock
47
48 write block
49
4A Read block
4B release tape
4C reread block

\$GIO break down

0600 Orhh .Store Immediate hh in Register r
0700 Orhh .Store Immediate hh in Register r
70A0
68D0 68hh .WR,OBS/Imm,W5,CPB,IBS, Verify, Set CC if VFY bit set
7040
682E 68hh .WR,OBS/Imm,W5,CPB,IBS, Verify, Set CC if VFY bit set
6831 68hh .WR,OBS/Imm,W5,CPB,IBS, Verify, Set CC if VFY bit set
8B67 8Brr .WR,CPB,IBS,SAVE, Verify/Ind, Set CC if VFY bit set
4000 40hh .WR,OBS/Imm
8706 870r .WR,CPB,IBS.Save

Tape Streamer Commands

- ' 5 - Seek Directory Block
- ' 7 - Restore Sectors
- ' 9 - Reread Block
- ' 12 - /Dxf Status
- ' 23 - Backup
- ' 29 - Release Tape Buffer

From Product Specification manual	Subroutine in TAPECMD1.
15.1 Select drive lock	' 21 - Select Drive with Lock
Op. 11 (SDL) - Illegal command if not issued at BOT.	
15.2 Select drive (w/o lock)	' 20 - Select Drive
Op. 01 (SD) - Illegal command if not issued at BOT.	
15.3 Position to BOT (Rewind)	' 0 - Rewind
Op. 21 (BOT) - Flush write buffers to media and then go to BOT.	
15.4 Erase entire tape	' 1 - Erase
Op. 22 (ERA) - Illegal command if drive not ready	
	not positioned at BOM.
15.5 Prewind (Retension)	' 2 - Retension tape
Op. 24 (PRW) - Illegal command if drive not ready.	
15.6 Write (with erase)	' 24 - Write Block
Op. 40 (WRT) -	
15.7 Write w/o erase	
Op. 42 (WRTE) -	
15.8 Seek end of recorded data	' 6 - Seek End of Data
Op. A3 (SEOD) -	
15.9 Write file mark	' 26 - Write File Mark
Op. 60 (WFM) -	
15.10 Read file mark	' 10 - Read File Mark
Op. A0 (RFM) -	
15.11 Read n file marks	' 11 - Read N File Marks
Op. Bn (RFM)n-	
15.12 Read	' 8 - Read Block
Op. 80 (RD) -	
15.13 Read status	' 13 - Tape Drive status
Op. C0 (RSTU) -	
15.14 Read extended status	' 14 - Extended status
Op. C8 (ESTU) -	
15.15 Select format	' 3 - Wang Mode
	' 19 - Industry Mode
Op. Fn (FMT) -	
15.16 Locate block (n)	' 4 - Seek Block
Op. AD (LBM) - (operates in Wang mode only).	

Problems with 150MB drive, tests run in 4th floor lab using DS Prom R01.

Program "TAPECMD1"
. Backup to disk does not work on 150 MB drive.

Program "DS.TST01"
. Program fails on write of blocks to cassette.
Failure is a \$GIO hang requiring CS Reset on (Blk# * 128)-1 block.
This is when DS buffer is dumped to cassette.
WRITE PASS with ** Block 0000xxxx Pass **

Suggested additional commands from Ed:
View status and read of extended status bytes 0.

- . Two new DS Op codes
- 1) Write OP code to tape drive with no return expected.
- 2) Write OP code to tape drive with 6 byte return expected.
- 3) View existing status command would show read following exception
return 6 byte status,
return 1 byte count,
reset count to 00.
- . Option to view status lines. *ref page 30 D/CAS Product Spec*
- ** DS Prom reads status anytime exception is set.

Additional observations:

1. Initial tape cassette interaction.
Forced rewind does too much as potentially wears out the drive.

DS Prom requires REWIND before any other action which does the following:

- 1) Reset (drive sets exception)
- 2) Read status --- wait for ready
- 3) Rewind --- wait for ready
- 4) Set Wang mode --- wait for ready

Ed claims it should:

Test bits exception and ready.

- | | | |
|---------------|---------------------------------|--------------------|
| If neither | 1) Reset (drive sets exception) | |
| If exception | 2) Read status | --- wait for ready |
| If ready only | 3) Rewind | --- wait for ready |
| | 4) Set Wang mode | --- wait for ready |

Status read:

Extended status read.

2. Status reads are of types.

Forced rewind does too much as potentially wears out the drive.

1-10 コマンド

コマンドはすべて 1 バイトで構成されている。コマンドコードを表 108 に示す。

MT-2ST/45DF コマンドコード

番号	コマンド名	略称	コマンドコード									
			7	6	5	4	3	2	1	0		
S 1	Select Drive	SD	0	0	0	0	0	0	0	0	1	
S 2	Select Drive Lock Cassette	SDL	0	0	0	1	0	0	0	0	1	
	3	Read Status	RSTU	1	1	0	0	0	0	0	0	
S 4	Position to BOT	BOT	0	0	1	0	0	0	0	0	1	
S 5	Erase the Entire Tape	ERA	0	0	1	0	0	0	0	1	0	
S 6	Prewind Cassette	PRW	0	0	1	0	0	0	1	0	0	
	7	Write	WRT	0	1	0	0	0	0	0	0	
	8	Read	RD	1	0	0	0	0	0	0	0	
S 9	Write Filemark	WFM	0	1	1	0	0	0	0	0	0	
S 10	Read Filemark	RFM	1	0	1	0	0	0	0	0	0	
	11	Write without Underruns	WUNR	0	1	0	0	0	0	0	0	1
	12	Read Extended Status	ESTU	1	1	0	0	1	0	0	0	
* 13	Select Nth Track	STR(N)	1	0	0	1	X	X	X	X	X	
S 14	Seek EOD	SEOD	1	0	1	0	0	0	0	1	1	
	15	Read N Filemarks	RFM(N)	1	0	1	1	X	X	X	X	
	16	Write without Erase	ERTE	0	1	0	0	0	0	1	0	
* 17	Write without Underruns and Erase	WUNE	0	1	0	0	0	0	0	1	1	
S 18	Write Filemark without Erase	WFME	0	1	1	0	0	0	1	0		
S 19	TEST (0 ~ F)	TEST0~TESTF	1	1	0	1	X	X	X	X	*1	

EST ESTA ~ F CX
 STM STM FX

備考 (1) *1 は MT-2ST のメンテナンス用コマンドである。内容については別途定める。

(表 108) コマンドコード表

SELECT FORMAT X	SFX	FX
SELECT FORMAT 1	SF1	F1
LOCATE	LCA	AD XX XX XX XX

Partition BLOCK ADDRESS

REV.	
LEN	
承認	
検閲	
提出	

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図番番号	
A	
	頁
	途中

TEAC		45DW vs N55W		2/5
No.	ITEM	MT-2ST/45DW	MT-2ST/N55W (仮称)	
1	WRITE WITHOUT UNDERRUN COMMAND (OP CODE = 41H)	Y.	N.	
2	WRITE WITHOUT UNDERRUN WITHOUT ERASE COMMAND (OP CODE = 43H)	Y.	N.	
3	COMMAND (OP CODE = C8H)	Y. ESTU	Y. ESTA	
4	" (" C9H)	N.	Y. ESTB	
5	" (" CBH)	N.	Y. ESTC	
6	" (" CCH)	N.	Y. ESTD	
7	" (" CDH)	N.	Y. ESTE	
8	" (" F3H)	N.	Y. STM	
9	" (" CFH)	N.	Y. MC	
10	Extended Status Byte 0	Identity Code (02H)	bit7: Physical Tape Format 0: 9 Track Format 1: 17 Track Format bit6~0: Identity Code (07H)	
11	" Byte 1 (FAULT STATUS)	bit7: FSB 6: ROM FAULT 5: RAM FAULT 4: BUF FAULT 3: STALL 2: BOT/EOT 1: DRIVE FAULT 0: 0	bit7: FSB 6: Res. 5: Res. 4: Res. 3: STALL 2: BOT/EOT 1: Res. 0: 0	
12	" Byte 2	bit7: MODE bit6~2: Res. bit1~0: Selected Drive	bit7: MODE bit6~5: Res. bit4~0: Current Track Number	
13	" Byte 3	bit7~4: Current Track Number bit3~0: Current Block Address (MSB)	bit7~4: Res. bit3~0: Current Block Address (MSB)	
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3. ステータス N55, N55W

Name Byte	STU	ESTA (C8)	ESTB (C9)	ESTC (CB)
0	STATUS BYTE 0	IDENTITY CODE	ERROR BLOCK COUNTER (MSB)	TRACK 0 DATA ERROR COUNTER
1	STATUS BYTE 1	FAULT STATUS	" (LSB)	TRACK 1 "
2	DATA ERROR COUNTER (MSB)	CURRENT TRACK NUMBER	TAPE POSITION COUNTER (MSB)	TRACK 2 "
3	" (LSB)	CURRENT BLOCK ADDRESS (MSB)	" (LSB)	TRACK 3 "
4	UNDERRUN/OVERRUN COUNTER (MSB)	"	CORRECTED ERROR BLOCK COUNTER (MSB)	TRACK 4 "
5	" (LSB)	" (LSB)	" (LSB)	TRACK 5 "

Name Byte	ESTD (C)	ESTE (CD)
0	TRACK 6 DATA ERROR COUNTER	TRACK 12 DATA ERROR COUNTER
1	TRACK 7 "	TRACK 13 "
2	TRACK 8 "	TRACK 14 "
3	TRACK 9 "	TRACK 15 "
4	TRACK 10 "	TRACK 16 "
5	TRACK 11 "	RES.

注1 ESTA BYTE の内容は通常時とテストモード時で異なる。

bit	7	6	5	4	3	2	1	0
通常時	PTF	IDENTITY CODE						
テストモード時	CLD	WRP	X	RUN	X	X	X	X

PTF (Physical Tape Format) 0 : 9 Track Tape Format
 1 : 12 Track Tape Format


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承認

担当

T A B L E o f C O N T E N T S

SECTION	SUBJECT	PAGE	SECTION	SUBJECT	PAGE
1.0	Scope - - - - -	4	9.0	Operational Characteristics - - -	7
2.0	Applicable Documents - - -	4	9.1	Tape Speed	
3.0	Standards Compliance - - -	4	9.2	Long term Speed Variation	
4.0	Physical Description - - -	4	9.3	Instantaneous Speed Variation	
4.1	Dimensions		9.4	Average Data Transfer Rate	
4.2	Mounting		9.5	Block Length	
4.3	Orientation		9.6	Buffers	
4.4	Color		9.7	Retry Count RECORDING	
4.5	Weight		9.8	Retry Count READING	
5.0	Power - - - - -	5	9.9	Repositioning Time	
5.1	REGULATION		9.10	Rewind Time	
5.2	Connector (Drive)		10.0	Recording Geometry - - - - -	7
5.3	Connector (Mating)		10.1	Encoding Method	
5.4	Cable		10.2	Physical Form	
5.5	Frame Ground Connections		10.3	Area & Sequence	
6.0	Environmental - - - - -	6	10.4	Track Locations	
6.1	Ambient temperature		10.5	Number of Tracks	
6.2	Temperature gradient		10.6	Track Pitch	
6.3	Relative Humidity		10.7	Track Width	
6.4	Vibration		11.0	Recording Format - - - - -	8
6.5	Shock		11.1	Reference Burst	
7.0	Reliability - - - - -	6	11.2	Block Format	
7.1	MTBF		11.3	Preamble & Postamble	
7.2	MTTR		11.4	Block Sync. Byte	
7.3	Component Design Life		11.5	Data Field	9
7.4	Head wear		11.6	Block Address	
7.5	Preventative Maintenance		11.7	CRC	
7.6	Error Rate		11.8	USER DATA BLOCKS	10
8.0	Shipping and Packaging - - -	7	11.9	FILE MARK BLOCKS	
8.1	Transportation Performance		11.10	Control Blocks	
8.2	Packaging Performance		11.11	END of RECORDED DATA	
8.3	Test Requirements		12.0	Error Management (write)- - -	11
			13.0	Error Management (Read) - - -	11

 WANG LABORATORIES, INC.	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER	
	CHK	DATE		191 - 3190	
	APPR	DATE		2 of 47	
	APPR	DATE			

PRODUCT SPECIFICATION 191-3190
CASSETTE TAPE (D/CAS)


WANG P/N 725-1481

~~Ed W. ...~~ EDITOR
~~...~~ TASK ENGINEERING
~~...~~ PROJECT MANAGER
~~...~~ ENGINEERING MANAGER
~~...~~ MARKETING

SHEET NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
REV. LEVEL																													
SHEET NO.	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58
REV. LEVEL																													
SHEET NO.	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
REV. LEVEL																													
SHEET NO.	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116
REV. LEVEL																													
SHEET NO.	117	118	119	120																									
REV. LEVEL																													

BY _____
DATE _____

REVISION	ORIGINAL RELEASE:	
REV.	A	

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	W/L NUMBER 191 - 3190
	CHK	DATE		
	APPR	DATE		1 of 47
	APPR	DATE		

T A B L E of C O N T E N T S

T A B L E S (appendix A)


SECTION	SUBJECT	PAGE
14.0	Signal Interface - - - -	12
14.1	Circuits Input / Output	
14.2	Electrical Characteristics	
14.3	Connector	
14.4	Cable	
14.5	Signal Definitions	13
14.6	Timing	15

SECTION	SUBJECT	PAGE
A.1	Exception Status Byte summary	27
A.2	GCR Conversion Codes	28
A.3	Command Summary	29
A.4	Signal Cable Pin Assignments	30
A.5	Test (n) (manufacturing use only)	31

F I G U R E S (appendix B)

SECTION	SUBJECT	PAGE
15.0	Commands - - - - -	
15.1	Select Drive Lock	16
15.2	Select Drive	16
15.3	Position to BOT	17
15.4	Erase	17
15.5	Prewind	18
15.6	Write	19
15.7	Write without Erase	20
15.8	Seek end of Recorded Data	20
15.9	Write File Mark	21
15.10	Read File Mark	21
15.11	Read (n) Filemarks	21
15.12	Read	22
15.13	Read Status	23
15.14	Read Extended Status	24
15.15	Select Format	25
15.16	Locate Block (n)	26

SECTION	SUBJECT	PAGE
B - 1	RSTU, ESTU Command Timing	32
B - 2	RESET Timing	33
B - 3	SD, SDL Command Timing	34
B - 4	BOT, ERA, PRW, Command Timing	35
B - 5	WRT, WRTE, RD, Command Timing	36
B - 6	Write Data transfer Timing	37
B - 7	Read Data transfer Timing	38
B - 8	WFM Command Timing	39
B - 9	RFM, RFM(n), SEOD Timing	40
B - 10	Driver / Receiver Circuits	41
B - 11	DC Power Connections	42
B - 12	DC Power Loading	42
B - 13	Signal Connector	43
B - 14	Track Recording Geometry	44
B - 15	Track Locations	45
B - 16	Track Sequence (9 track)	46
B - 17	Track Sequence (WANG FORMAT)	46
B - 18	EXTERNAL VIEWS	47

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER	
	CHK	DATE		191 - 3190	
	APPR	DATE		3 of 47	REV.
	APPR	DATE		A	

1.0 Scope:

The purpose of this document is to describe the specifications of a specific product. Although this device is implemented via the generic interface known as QIC-02, this specification, will treat each item on a device basis. Additional information is included with respect to applications, although out of context for a product specification it is intended for clarity, in application and design.

For reference, the Cassette devices evolved through a standard known as D/CAS, (Data Cassette Interchange), which is a sister to the QIC-02 interface.

All commands, features, protocol, and timing, specified herein are MANDATORY. Any reference to optional, preferred, or not recommended are for applications of the product, with respect future interface compatibility and performance.

2.0 Applicable Documents

Shipping Specification	10-521	Revision A.
Electrostatic Discharge (ESD)	10-630	Revision -.
Shock and Vibration Test Procedure	191-2505	Revision A.
Environmental Specification Mechanical	10-708	Revision 4.

3.0 Standards Compliance

This product as received by Wang Laboratories Inc. must conform to the general, physical, electrical, and safety requirements, of the following organizations:

- UL Underwriters Laboratories
- CSA Canadian Standards Association

Further when this device is installed in a Wang computer or word processing system, shall not, in itself, due to faulty design or assembly, prevent Wang from gaining EMI, RFI compliance of said system, as specified under FCC docket 20780/FCC 80-148. Part 15.
Further this product must perform, to this specification, in all Wang Systems without exception.

4.0 Physical Description

This device is categorized in general as a "Half High 5 1/4 inch" form factor. It shall conform to the specific dimensions specified herein.

4.1	Dimensions	(also refer to figure B.18)
	Height	41.3 +/- 0.5 mm (1.626 +/- 0.020 inches)
	Width	146 +/- 0.5 mm (5.750 +/- 0.020 inches)
	Depth	203 +/- 1.0 mm (8.000 +/- 0.040 inches) (Excluding External Interface connector projection.)

4.2 Mounting


The drive may be affixed using the mounting holes on the sides and bottom, reference figure B-18.

4.3 Orientation

The Drive may be mounted in either of two (2) orientations, with the front bezel at right angle to a horizontal plain:

- a Ejection button on the right hand side
- b Ejection button on the top

The drive may be mounted as specified above with a declination angle of 15 degrees maximum, such that the front panel is at an equal or higher elevation than the rear of the unit.

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER	
	CHK	DATE		191 - 3190	
	APPR	DATE		4 of 47	REV.
	APPR	DATE			

4.4 Color

The front bezel and all of it's exposed parts, with the cassette removed shall be BLACK (Munsell N1)
 The front panel indicator shall be RED (when illuminated).

4.5 Weight 1.2 kg Approximately

5.0 Power

5.1 REGULATION

The drive shall be independant of power sequencing, in any order, without damage to data recorded on the medium. The drive shall conform to this specification under the following power input conditions:

Nominal (Volts)	Regulation	Ripple ¹	Current ²
+ 5.0	+/- 5%	100 mV	1.1 Amp Max.
+12.0	+/- 5%	200 mV	1.6 Amp Max.

- notes: 1. Ripple includes spike noise.
 2. Maximum current is source impedance dependent (reference figure B-12)

5.2 Connector (Drive) Amp part number 172349-1 or equivalent
 A 4 pin inline keyed connector with pins labled 1 thru 4 shall be mounted to the drive per figure (B-12).


5.3 Connector (Mating)
 Housing Amp part number 1-480424-0 or equivalent
 Contacts Amp part number 60619-1 or equivalent

5.4 Cable

The cable guage and length are to be selected with regard to the maximum power consumption, and the required regulation. reference section 14.1 and figure B-12.
 The pin assignments are as follows: (PIN 1 +12 V), (PIN 4 +5V) (PINS 2 & 3 0V DC-GROUND)

5.5 Frame Ground Connections

Isolation method Disconnect jumper W1 (0 ohm resistor), mounted on the the drive PCB (with power connector). It is visible on the top of the drive, at the edge of the PCB next to the cassette.
 Insulation resistance (after isolation) greater than 5 M ohms, measured at 100 Volts.

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	W/L NUMBER	
	CHK	DATE		191 - 3190	REV.
	APPR	DATE		5 of 47	A
	APPR	DATE			


6.0 Environmental

The operating environmental conditions specified herein are with Natural Air Convection Cooling.

- 6.1 Ambient temperature (Media dependant)
 - Operating + 5 - +45 deg. C
 - Nonoperating -25 - +60 deg. C
- 6.2 Temperature gradient
 - Operating 15 deg. C per hour (Non Condensing)
 - Nonoperating 30 deg. C per hour (Non Condensing)
- 6.3 Relative Humidity
 - Operating 20% - 80 % (Non Condensing Max. Wet Bulb 26 deg. C)
 - Nonoperating 10% - 90 % (Non Condensing)
- 6.4 Vibration Tested per Wang Specification (reference section 2.0)
 - Operating 0.2 G 5 - 50 Hz.
 - Nonoperating 2.0 G 5 - 50 Hz.
- 6.5 Shock Tested per Wang Specification (reference section 2.0)
 - Operating 5.0 G 10 mS.
 - Nonoperating 40.0 G 10 mS.

7.0 Reliability

- 7.1 MTBF 8000 Hours Minimum (Operating with TAPE MOTION)
- 7.2 MTTR 30 Minutes Maximum (Field replaceable unit)
- 7.3 Component Design Life 5 years (except for head wear)
- 7.4 Head wear -- Hours minimum TO BE SPECIFIED
- 7.5 Preventative Maintenance Head Cleaning (monthly) or 200 (BOT to EOT to BOT) motions.
- 7.6 Error Rate
 - a. Soft 10^{-8} bits Read
 - b. Hard 10^{-10} bits Read

 WANG LABORATORIES, INC.	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER		
	CHK	DATE		191 - 3190		
	APPR	DATE		6 of 47	REV.	
	APPR	DATE			A	

8.0 Shipping and Packaging

8.1 Transportation Performance

The level of packaging required at the individual unit level shall be to (as accelerated in test reference below) protect the product when it is transported by motor freight (other than air suspension).

Rail, parcel post, express type service, loose ocean freight or ocean containers in which freight is moved or added during transshipment

8.2 Packaging Performance

Packaged product shall be subjected to applicable test per Wang Standard SPI 10-521 "Shipping Container Performance Test" for individual unit packages.

At completion of tests, unit shall show no signs of mechanical damage nor shall the operational performance be impaired.

Allignment or adjustment of operator accessible controls may be employed.

8.3 Test Requirements

Prior to the acceptance of vendor packaging, a representative, functional product and package shall be subjected to the tests specified.

This testing may be performed by Wang Laboratories R&D package engineering, an approved independant package testing laboratory or other laboratory acceptable to Wang Laboratories Inc.


The report of these tests will, in addition to the information called in SPI 10-521 rev. A, contain engineering drawings of the package tested so that they may be used to determine continuing compliance with performance requirements of this test standard. Should a change in package design be made, retesting and recertification are required.

9.0 Operational Characteristics

9.1	Tape Speed	90 ips nominal
9.2	Long term Speed Variation	4% max.
9.3	Instantaneous Speed Variation	4% max.
9.4	Average Data Transfer Rate	86.3 k Bytes per second (Reference only)
9.5	Block Length	512 Bytes (fixed)
9.6	Buffers	3 at (512 Bytes each)
9.7	Retry Count RECORDING	16 Maximum
9.8	Retry Count READING	16 Maximum
9.9	Repositioning Time	1 Second Approximate (media defect dependant)
9.10	Rewind Time	70 Second Approximate. (Media length and current position dependant)

10.0 Recording Geometry

10.1	Method	GCR 4/5 conversion (0-2 RLL Code) reference table A.2
10.2	Recording Form	Single track serpentine serial
10.2	Area & Sequence	Reference figure B.14 - B.16
10.2	Track Locations	Reference figure B.15
10.3	Number of Tracks	9 total Reference Select Format command 15.15
10.4	Track Pitch	0.406 mm (nominal)
10.5	Track Width	
	a. Write	0.279 +/- 0.013 mm
	b. Read	0.203 +/- 0.013 mm

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER	
	CHK	DATE		191 - 3190	
	APPR	DATE		7 of 47	REV.
	APPR	DATE			

11.0 Recording Format

The Recording format describes the longitudinal parcing of all the information recorded on the medium, it includes a detailed description of all fields within each of the types of blocks used.

Default mode:

Records in a single partition D/CAS standard format employing the three types of recorded blocks: DATA BLOCKS, FILEMARK BLOCKS, AND CONTROL BLOCKS.

Wang Mode:

Records in a two partition format employing the two types of recorded blocks: USER DATA BLOCKS, FILEMARK BLOCKS. The CONTROL BLOCKS have been omitted to allow the functional application of "Locate Block N" command. as these blocks are recorded without the knowledge of the user, and would displace the numbering sequence, in an unpredictable manner.

11.1 Reference Burst (reference figure B-14)

A 10,000. frpi pattern, recorded at the beginning of TRACK 0, and extends from a point within 381 mm of the BOT Clear Leader to a point within 12 mm prior to, or 101 mm after the BOT HOLE.

11.2 Block Format

The Block Format specifies the structure for all recorded blocks. all fields specified in bytes are converted into 10 bit GCR Patterns, according to TABLE A-2.

! Preamble !	! Block Sync. !	! DATA FIELD !	! Block Address !	! CRC !	! Postamble !
! (1 Byte) !	! (1 Byte) !	! (512 Bytes) !	! (4 Bytes) !	! (2 Bytes) !	!


The individual fields are described in the succeeding sections.

11.3 Preamble and Postamble

A pattern recorded at a fixed frequency (10,000. frpi) over fixed or variable lengths for the purpose maintaining read circuit synchronization between blocks. The lengths are normally kept to a minimum during streaming, and are extended to account for head spacing and velocity changes associated with re-positioning, caused by underruns, and track (direction) changes.

The lengths of and conditions under, which the various Preamble & Postambles are implemented, is tabulated as follows:

! Type	!field length in flux reversals!			! Condition when invoked
	! Minimum	! Nominal	! Maximum	
! Normal Preamble	! 120 !	! 140 !	! 300 !	! All blocks (written normally)
! Elongated Preamble	! 3,500 !	! 5,000 !	! 7,000 !	! First Block after repositioning
! Long Preamble	! 15,000 !	! 25,000 !	! 30,000 !	! First Block on each track
! Normal Postamble	! 5 !	! 10 !	! 20 !	! All blocks (written normally)
! Elongated Postamble	! 3,500 !	! 5,000 !	! 7,000 !	! REWRITTEN Block (media defect)
!	!	!	!	! or Buffer Underrun or End of Track

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLNUMBER		
	CHK	DATE		191 - 3190		
	APPR	DATE		8 of 47	REV.	
	APPR	DATE			A	

11.0 Recording Format (continued)

11.4 Block Sync. Byte

A Unique 10 Bit pattern, (GCR Byte) following a preamble and preceding a Data Field. In purpose this allows the data separator to synchronize at the beginning of a Data Block. It has the following GCR bit pattern, is never transmitted over the BUSS and has no equivalent in 8 bit BUSS pattern.

```

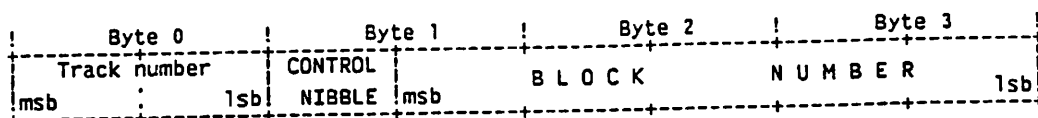
+-----+
! 1 1 1 1 1 0 0 1 1 1 !
+-----+
  
```

11.5 Data Field

This field will always contain 512 Bytes of data converted to and from GCR patterns per table A-2. As mentioned earlier this field may contain three types of data: "User Data", "File Mark Data" and "Control Information".

11.6 Block Address

This field contains; a unique address for each block on the medium, the track number where that block resides, and the "Control Nibble". The format is described as follows:



Track number Indicates the track in which the relevant block is written.

Control Nibble Identifies the Block Type:

The type of data contained in any given block is determined by the data itself, in conjunction with a "Control Nibble", located within the "Block Address Field". This qualification is summarized as follows:

Block Type	Data Field content (512 Byte)	Control Nibble contents	
		HEX	GCR Pattern
Control	any data pattern	1	1 1 1 0 1
File Mark	GCR Bytes 0 0 1 0 1 0 0 1 0 1	0	1 1 0 0 1
User Data	U S E R D A T A	0	1 1 0 0 1


Block Number

A sequence of consecutive numbers starting from 1, which number each block on medium, including DATA BLOCKS, FILEMARK BLOCKS, AND CONTROL BLOCKS. This is a physical block number, which the drive translate from the Logical Block Number specified in the LOCATE COMMAND (reference section 15.12)

11.7 CRC

The Cyclic Redundancy Check (CRC), is a check sum of two bytes, or 20 GCR bits. The checking process covers the Data Bytes (512) and the Block Address bytes (4).

The generation polynomial is $x^{16} + x^{12} + x^5 + 1$ (initial value: all bits 1).

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER	
	CHK	DATE		191 - 3190	
	APPR	DATE		9 of 47	
	APPR	DATE		REV.	

11.0 Recording Format (continued)

11.8 USER DATA BLOCKS

These blocks contain the recorded user data, in 512 byte blocks, and are consecutively numbered from the beginning of a partition.

11.9 FILE MARK BLOCKS

The format of a filemark block is identical to a data block, with one exception; the entire 512 Byte Data Field is filled with a [00101 00101] GCR pattern. (note: these blocks are included within the Logical Block addressing scheme.

11.10 Control Blocks

A Control Block is identified on medium by the "Control Nibble" value of 11101 GCR, or 0001 Hex, as described in (section 11.6). The information contained in the data field is not accessible to the Host, it is used by the drive as a repositioning mark following Write underruns.

CONTROL BLOCK data Field (contents)


BYTE	7	6	5	4	3	2	1	0
00	DRIVE TYPE				[04]			
01	CONTROL BLOCK TYPE				[20]			
02 thru 0F	+	+	RESERVED		[0]	+	+	
10 thru 1F	+	+	UNDEFINED			+	+	
1FF	REWRITE				COUNT			

note: values in [] are default values in Hex.

Rewrite Count Specifies the rewrite count for the last block recorded; value 0 thru 10 Hex.

11.11 END of RECORDED DATA

This condition is defined as: any Valid Block followed by 45 inches of erased tape.

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER		
	CHK	DATE		191 - 3190		
	APPR	DATE		10 of 47	REV.	
	APPR	DATE				

12.0 Error Management (Write)

The testing all written data employs a read after write verification, using a separate read head immediately following the write head. This verification is a byte image compare, including the CRC.

With a spacing of 0.15 inches between the write and read heads, and a block length of approximately 0.55 inches, there are two geometric patterns that can exist during error detection.

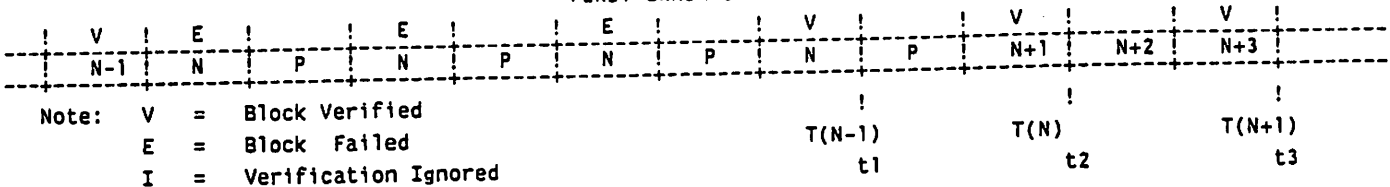
First, an error in the current block being written and second, an error in the preceding block.

In the first condition, the current block is completed followed by that block re-written. Further medium defects are anticipated to cover one or more block lengths, and for this reason the drive will switch postamble lengths, in order to avoid, re-writing consecutive block pairs.

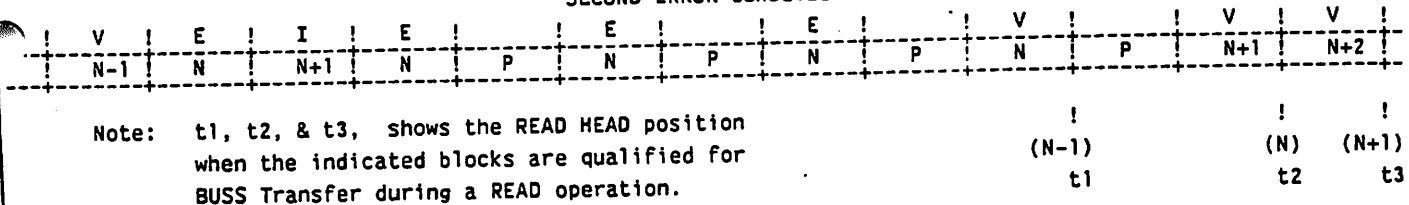
In the second condition the writing of the current block is completed, but verification is omitted, as re-writing that block is necessary to maintain sequential order of all validated blocks.

All defective blocks are re-written up to 16 times prior to reporting a HARD Write Error.

FIRST ERROR CONDITION



SECOND ERROR CONDITION



13.0 Error Management (Read)


The drive checks CRC, Block Address, and control fields. This includes a read ahead process, and automatic track / direction changes when necessary.

A block is qualified for transfer to the Host when:

- a. The current block and it's subsequent block have been CRC verified. (reference TABLE A- __)
- b. Current block is CRC verified followed by a validated FILE MARK BLOCK.
- c. Current block is CRC verified followed by END OF RECORDED DATA detection.

Soft read errors are defined as any block failing the above qualification. Automatic retries (up to 16) are performed prior to reporting a hard error.

Included within the 16 retry algorithm are fractional track offsets, in both directions. When a successful offset is found it becomes the new track center for the remainder of the media, or until subsequent read errors lead to a new offset. This process is limited to reads and a total of four offsets, two in each direction, about the initial center.

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER		
	CHK	DATE		191 - 3190		
	APPR	DATE		11 of 47	REV.	
	APPR	DATE			A	

14.0 Signal Interface

14.1 Circuits Input/output

Receivers Type: TTL 74LS14 or equivalent
Termination Split 220/330 ohm 5% (non removable)

Drivers Type: TTL 74ALS240-1 or equivalent
Termination none

Bidirectional Type: Wire or'e Driver and receiver as specified above
Termination Split 220/330 ohm 5% (non removable)

The terminators are connected as follows: 220 ohm to +5 VCC and 330 to 5 volt ground.

14.2 Electrical Characteristics

The following levels and ratings, apply at the drive end of the interface cable.


INPUT LEVEL	Low	(TRUE)	0.5 V Maximum
	High	(FALSE)	2.0 V Minimum to 5.25 Maximum
	LOAD		-0.4 mA (excluding terminator)
OUTPUT LEVEL	Low	(TRUE)	0.5 V Maximum
	High	(FALSE)	2.4 V Minimum to 5.25 Maximum
	Sink Current		Capable of driving up to 48 mA. (excluding the bidirectional terminator)

14.3 Connector

The drive is supplied with a 50 pin edge card connector, with a key slot located between pins 4 & 6. (reference figure B-13)

14.4 Cable

Twisted pair or ribbon type 3M part number 3415-0001 or equivalent
Maximum length 3 meters.

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER		
	CHK	DATE		191 - 3190		
	APPR	DATE		12 of 47	REV.	
	APPR	DATE				

14.0 Signal Interface (continued)

14.5 Signal Definitions

This section describes the Input / Output Control Signals. All signals are true "ACTIVE LOW".

RESET (RST) Type: Unidirectional Direction: Host to Target

Resets the drive to an INITIALIZED condition equal to a power on reset.

- a. Resets: ACKNOWLEDGE, READY and DIRECTION.
- b. Sets: EXCEPTION
- c. Terminates: all commands.

ONLINE (ONL) Type: Unidirectional Direction: Host to Target

Used by the Host to set and or hold a DRIVE ONLINE.

Industry Mode: ONLINE must remain active during all WRITE or READ operations. Dropping ONLINE at the completion of an operation will:

- WRITE: Flush the buffers to medium, WRITE a FILEMARK, Rewind to BOT.
- READ: Rewind to BOT.

WANG Mode: ONLINE must remain active during any WRITE or READ operation which begins at BOT. Dropping ONLINE at the completion of an operation will: have no affect on current media position or buffer pointers. Subsequent READ CONTINUE, or WRITE operations are NOT dependent upon ONLINE being ACTIVE.

Write buffers are flushed by issuing a REWIND Command, or issuing a WRITE FILEMARK Command.


In either case the Host allegiance to error reporting, is OPEN until the medium successfully reaches BOT.

REQUEST (REQ) Type: Unidirectional Direction: Host to Target

Controls the transfer of Commands to the target, or Status from the target, in a handshake control with the READY (RDY) line.

Qualification: Ready (RDY) must be true for command transfer.
EXCEPTION (EXC) true Read Status must be transferred.

Exclusion: When EXCEPTION (EXC) is True all commands apart from READ STATUS are rejected.

 WANG LABORATORIES, INC.	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER	
	CHK	DATE		191 - 3190	
	APPR	DATE		13 of 47	
	APPR	DATE			

14.0 Signal Interface (continued)

14.5 Signal Definitions (continued)

READY (RDY) Type: Unidirectional Direction: Target to Host


- a. Controls the transfer of Commands to the target, or Status from the target, in a handshake control with REQUEST (REQ) line.
- b. Informs the Host that one of the following commands have been completed.

REWIND
 ERASE TAPE (The entire tape)
 PREWIND
 SELECT Nth TRACK (This command may not exist)
 WRITE FILEMARK
 WRITE FILEMARK without ERASE

- c. Informs the Host that a 512 Byte DATA BLOCK was transferred to or from the Target Buffers. At this point Data transfer may continue or a New command issued.

WRITE
 WRITE (w/o ERASE)
 READ

Exclusion: When EXCEPTION (EXC) is True all commands apart from READ STATUS are rejected.

 WANG LABORATORIES, INC.	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER		
	CHK	DATE		191 - 3190		
	APPR	DATE		14 of 47	REV.	
	APPR	DATE		A		

14.0 Signal Interface (continued)

14.5 Signal Definitions (continued)

TRANSFER (XFR) Type: Unidirectional Direction: Host to Target

Controls the transfer of WRITE and READ DATA to and from the target, in a handshake control with the ACKNOWLEDGE (ACK) line.
 During a WRITE operation it indicates that the host has data setup on the bus.
 During a READ operation it indicates that the host has removed data from the bus.

ACKNOWLEDGE (ACK) Type: Unidirectional Direction: Target to HOST

Controls the transfer of WRITE and READ DATA to and from the target, in a handshake control with the TRANSFER (XFR) line.
 During a READ operation it indicates that the drive has data is setup on the bus.
 During a WRITE operation it indicates that the drive has removed data from the bus.

EXCEPTION (EXC) Type: Unidirectional Direction: Target to HOST

A request from the Drive that a status is pending.
 This signal is reset by a READ STATUS command, all other commands will be rejected.

DIRECTION (DIR) Type: Unidirectional Direction: Target to HOST

Informs the Host as to the valid direction of data over the buss, per the states as described:
 True: STATUS and READ data can be transfered to the HOST.
 False: COMMAND and WRITE data can be transfered to the DRIVE.


DATA BUS Bit 7-0 (HB7 - HB0) Type: Bidirectional

A common bus for READ, WRITE, STATUS, and COMMAND data. HB7 is the Most Significant Bit (MSB), and HB0 is the Least Significant Bit (LSB).

BUS PARITY (HBP) Type: Bidirectional

Parity is ODD.
 The drive ALWAYS generates PARITY, for STATUS and READ DATA.
 The drive TEST PARITY, for COMMAND and WRITE DATA, only if TP7 and TP8 are shorted together, else it will ignore PARITY.

14.6 Timing All timing is specified within figures B-1 thru B-9, located in appendix B.

 WANG LABORATORIES, INC.	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WJ NUMBER		
	CHK	DATE		191 - 3190		
	APPR	DATE		15 of 47	REV.	
	APPR	DATE			A	

15.1 OP CODE 11 Select Drive (lock) Mnemonic SDL

This command enables the front panel light circuit, such that the light will be ON when ever a CASSETTE is in place. This state will remain TRUE until either an SD command, or a drive RESET is issued.

COMMAND FORMAT: Single byte OP Code.

BYTE	7	6	5	4	3	2	1	0
00	0	0	0	1	0	0	0	1

RETURNED STATUS: Illegal command if not issued at BOT.

POWER UP DEFAULT: SD mode.

INTERFACE TIMING: Standard single byte command (per Appendix A, Figure ____.)

15.2 OP CODE 01 Select Drive (without lock) Mnemonic SD

This command turns OFF the condition set by the SDL command.

COMMAND FORMAT: Single byte OP Code.

BYTE	7	6	5	4	3	2	1	0
00	0	0	0	0	0	0	0	1

RETURNED STATUS: Illegal command if not issued at BOT.

POWER UP DEFAULT: SD mode.

INTERFACE TIMING: Standard single byte command (per Appendix A, Figure ____.)

NOTE: A drive set in the SD (or default) MODE will turn on the front panel lamp during all operations, which cause actual tape motion. Reading operations which are successful through buffer transfers, without tape motion will NOT illuminate the front panel light. This is also true for redundant BOT operations.

The OP codes and Mnemonics are carried over from an interface option which is NOT supported in this product.

DWN	DATE
CHK	DATE
APPR	DATE
APPR	DATE

15.3

OP CODE 21 Rewind (to BOT) Mnemonic BOT

This command moves the tape from current position to the physical beginning of tape and the logical beginning of track zero (0). If following a WRITE operation all filled buffers will be flushed to medium prior to rewinding the medium.

COMMAND FORMAT: Single byte OP Code.

BYTE	7	6	5	4	3	2	1	0
00	0	0	1	0	0	0	0	1

RETURNED STATUS: Illegal command if drive not "READY".
Appropriate Write status if buffers contained valid information from a previous WRITE operation.

POWER UP DEFAULT: NO Affect.

INTERFACE TIMING: Standard single byte command (per Appendix A, Figure ____.)

NOTE: The host has an alligence to WRITE error status for several seconds after issuing this command. It has an extended alligence for media damage, until command completion, (at BEGINNING OF MEDIUM), drive "READY", and no "EXCEPTION".

15.4

OP CODE 22 Erase (entire tape) Mnemonic ERA

This command erases the entire tape, from BOM, including all tracks and partitions. It may be issued from any point on the medium, with a prerequisite of drive "READY".

COMMAND FORMAT: Single byte OP Code.


BYTE	7	6	5	4	3	2	1	0
00	0	0	1	0	0	0	1	0

RETURNED STATUS: Illegal command if Tape not at BOM & "READY".
Command complete drive "READY". Successful Status "BCM" 00 88 Hex in status bytes 0 & 1 respectively.

POWER UP DEFAULT: NO Affect.

INTERFACE TIMING: Standard single byte command (per Appendix A, Figure ____.)

NOTE: The host has an extended alligence for media damage, until command completion, (at BEGINNING OF MEDIUM), drive "READY", and no "EXCEPTION".

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLNUMBER		
	CHK	DATE		191 - 3190		
	APPR	DATE		17 of 47	REV.	
	APPR	DATE				

15.5 OP CODE 24 Prewind (retension) Mnemonic PRW

This command moves the tape from current position to the physical end of medium and back to the physical beginning of medium or logical beginning of track zero (0).

COMMAND FORMAT: Single byte OP Code.

BYTE	7	6	5	4	3	2	1	0
00	0	0	1	0	0	0	0	1


RETURNED STATUS: Illegal command if drive not "READY".
Appropriate Write status if buffers contained valid information from a previous WRITE operation.

POWER UP DEFAULT: NO Affect.

INTERFACE TIMING: Standard single byte command (per Appendix A, Figure ____.)

NOTE: The host has an extended alligence for media damage, until command completion, (at BEGINNING OF MEDIUM), drive "READY", and no "EXCEPTION".

This commands prime purpose is to prepare a medium for write and read operations. It will help to remove the affects from intermittent motions, and long term storage, both of which can cause abnormal speed variations.

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER	
	CHK	DATE		191 - 3190	
	APPR	DATE		REV.	
	APPR	DATE		18 of 47	

15.6 OP CODE 40 Write Command (with erase) Mnemonic WRT

This command Writes from current position on the medium. The single byte OP Code is transferred via a REQUEST / READY handshake, and followed by data transfer via Transfer (XFER) / Acknowledge (ACK) handshake. The prerequisites are: Drive "READY", "ONLINE" true.

COMMAND FORMAT: Single byte OP Code.

BYTE	7	6	5	4	3	2	1	0
00	0	1	0	0	0	0	0	0

RETURNED STATUS: The "EXCEPTION" line set if mandatory status is pending. Directional or inquiry status may be accessed any time following "READY" true. The Drive will make the appropriate changes in control lines and complete the status transfer prepared for another WRITE operation or valid command. It is possible to collect STATUS or EXTENDED STATUS, while the drive is recording the current buffers on medium. Approximately 18 mS is available if all three (3) buffers are full. To avoid a soft or hard underuns the host must complete the READ STATUS, and issue the next WRITE transfer of 1 Block minimum, prior to the last buffer being transferred to medium.

POWER UP DEFAULT: Will cause the drive to WRITE in the Industry standard (9 track) Mode.
 Will cause the drive to WRITE from Beginning of Medium (BOM).

CARTRIDGE INSERTION: Will cause the drive to WRITE in the Previously SET Mode.
 Will cause the drive to WRITE from Beginning of Medium (BOM).


ERASE FUNCTION: The erase head will be ON while writing on track zero (0). Any partial track writes (less than 5 Megabytes approximately from 30M) will result in a minimum of 45 inches of erase media following the last block recorded.

INTERFACE TIMING: per Appendix A, Figure ____.

SUCCESSFUL COMPLETION: The completion of modulo 512 byte transfers, and a returned "READY" status from the drive.

UNDERUN: Any time the host fails to keep up with with the Drive and all 3 buffers of (512 bytes) have been transferred to medium the drive stop and reposition the medium in preparation to continue the transfer. Following an underun the next two (2) blocks transferred to buffers, without tape motion. A third block transfer will trigger tape motion, and begin the transfer to medium when the next logical block on medium is located.

- NOTE: 1. It is the host responsibility to track partial blocks, via the READY signal.
 2. The DATA ERROR & UNDERRUN COUNTERS, are useful mechanisms to monitor the host performance as well as the media quality. Caution both counters are reset by: Reading Status via RSTU command.

 WANG LABORATORIES, INC.	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER	
	CHK	DATE		191 - 3190	
	APPR	DATE		19 of 47	REV.
	APPR	DATE		A	

15.7 OP CODE 42 Write Command (WITHOUT ERASE) Mnemonic WRTE

This command is identical to the "Write command OP Code 40 with the following difference.
The erase head is TURNED OFF on all tracks.

It's singular intention is to allow recording on a partitioned medium, with out erasing information within an adjacent partition.

APPLICATION NOTE: This command is to be used in the following manner:

1. Prior to Writing from BOM (partition 0), tke entire tape is to be erased.
2. The drive is to be set in the "WANG MODE".
3. WRITE and WRITE appends may be performed within either partition, and in any order. Refer to "LOCATE" and "SEEK END OF RECORDED DATA" commands.

15.8 OP CODE A3 Seek end of Recorded Data Mnemonic SEOD

This command searches tape tape from current position for the "End of Recorded Medium". When found "EXCEPTION" goes true. and the status read, will indicate current track, block and Physical end of media if true. On a full tape (9 tracks recorded) without FILEMARKS will take in excess of 10 minutes.

COMMAND FORMAT: The single byte OP Code is transfered via a REQUEST / READY handshake.
The prerequisites are: Drive "READY", "ONLINE" true.

APPLICATION NOTE: All data blocks encountered during this process are (CRC) Cyclic Redundancy Checked, standard read retries are performed as well as soft error logging and Hard error reporting.



DWN	DATE
CHK	DATE
APPR	DATE

TITLE
PRODUCT SPECIFICATION
CASSETTE TAPE (D/CAS)

WLNUMBER	REV.
191 - 3190	
20 of 47	

15.9 OP CODE 60 Write FILEMARK Command Mnemonic WFM

This command Writes from current logical position on the medium. All buffers holding data from a previous write operation are recorded on medium prior to recording the FILEMARK BLOCK.

COMMAND FORMAT: The single byte OP Code is transferred via a REQUEST / READY handshake.
The prerequisites are: Drive "READY", "ONLINE" true.

ERASE FUNCTION: The erase head will be ON while writing a FILEMARK on track zero (0). Any partial track writes (less than 5 Megabytes approximately from BOM) will result in a minimum of 45 inches of erase media following the last block recorded.

APPLICATION NOTE:

1. Do NOT use WRITE FILEMARKS in the WANG MODE.
2. This command has been included to allow downward compability to older architectural, recording techniques.
3. Each filemark written occupies approximately the same space as four (4) data blocks written in a streaming mode.

15.10 OP CODE A0 Read FILEMARK Command Mnemonic RFM

This command searches tape from current position searching for the first occurrence of a FILEMARK. If one is found "EXCEPTION" goes true, and the filemark bit is set in status byte 0. If no FILEMARK is found the process will be terminated by the detection of END of RECORDED DATA (35 inches of erased tape), or PHYSICAL END of MEDIA (clear leader at the end of last track), which ever comes first. On a full tape (9 tracks recorded) without FILEMARKS will take in excess of 10 minutes.

COMMAND FORMAT: The single byte OP Code is transferred via a REQUEST / READY handshake.
The prerequisites are: Drive "READY", "ONLINE" true.

APPLICATION NOTE: All data blocks encountered during this process are (CRC) Cyclic Redundancy Checked, standard read retries are performed as well as soft error logging and Hard error reporting.

15.11 OP CODE Bn Read "N" FILEMARKS Mnemonic RFM(N)

This command is identical to the READ FILEMARK COMMAND with the following difference.

The OP Code has a total 16 values B0 through BF hexadecimal, specifying the number of filemarks to be spaced over. The OP Code value B0 specifies 16 decimal FILEMARKS. All data blocks encountered during this search are CRC verified.



DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER 191 - 3190	
CHK	DATE			REV.
APPR	DATE		21 of 47	A
APPR	DATE			

15.12

OP CODE

80

Read Command

Mnemonic RD

This command Reads from current position on the medium. The single byte OP Code is transferred via a REQUEST / READY handshake, and followed by data transfer via Transfer (XFER) / Acknowledge (ACK) handshake. The prerequisites are: Drive "READY", "ONLINE" true.

COMMAND FORMAT: Single byte OP Code.

BYTE	7	6	5	4	3	2	1	0
00	1	0	0	0	0	0	0	0

RETURNED STATUS: The "EXCEPTION" line set if mandatory status is pending. Directional or inquiry status may be accessed any time following "READY" true. The Drive will make the appropriate changes in control lines and complete the status transfer prepared for another WRITE operation or valid command. It is possible to collect STATUS or EXTENDED STATUS, while the drive is reading into the current buffers from medium. Approximately 18 mS is available if all three (3) buffers are full. To avoid hard underruns the host must complete the READ STATUS, and issue the next READ transfer of 1 Block minimum, prior to the last buffer being filled from a medium transfer.

POWER UP DEFAULT: Will cause the drive to READ in the Industry standard (9 track) Mode.
Will cause the drive to READ from Beginning of Medium (BOM).


CARTRIDGE INSERTION: Will cause the drive to READ in the Previously SET Mode.
Will cause the drive to READ from Beginning of Medium (BOM).

INTERFACE TIMING: per Appendix A, Figure ____.

SUCCESSFUL COMPLETION: The completion of modulo 512 byte transfers, and a returned "READY" status from the drive.

OVERUN: Any time the host fails to keep up with with the Drive and all 3 buffers of (512 bytes) have been filled the drive stop and reposition the medium in preparation to continue the transfer. Following an overrun the next two (2) blocks transferred will come from buffers, without tape motion. A third block transfer will trigger tape motion, and begin to fill the buffers when the next logical block on medium is located.

- NOTE:
1. It is the host responsibility to track partial blocks, via the READY signal.
 2. The DATA ERROR & UNDERRUN COUNTERS, are useful mechanisms to monitor the host performance as well as the media quality. Caution both counters are reset by: Reading Status via RSTU command.

 WANG LABORATORIES, INC.	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	W/L NUMBER 191 - 3190	
	CHK	DATE		22 of 47	REV. ↑
	APPR	DATE			
	APPR	DATE			

15.13

OP CODE CO Read Status Command Mnemonic RSTU

This command requests 6 bytes of status from the drive. Transferred via a REQUEST / READY handshake.

COMMAND FORMAT: Single byte OP Code.

BYTE	7	6	5	4	3	2	1	0
00	1	1	0	0	0	0	0	0

*filler block
formed*

RETURNED STATUS:

*SD
SI*

BYTE	7	6	5	4	3	2	1	0
00	ST0	CNI	USL	WRP	EOM	UDA	BNL	FIL
01	ST1	ILL	NDT	MBD	BOM	BPE	RES	POR
02	DATA ERROR COUNTER (MSB)							
03	DATA ERROR COUNTER (LSB)							
04	UNDERRUN COUNTER (MSB)							
05	UNDERRUN COUNTER (LSB)							

POWER UP DEFAULT:

INTERFACE TIMING: per Appendix A, Figure ____.

Exception Status: Two byte field with bit weighted status information, per table A - 1.

- | | | | |
|-----|---|-----|--|
| ST0 | A status bit is set in byte 0 | ST1 | A status bit is set in byte 1 |
| CNI | Cassette not in Place | ILL | Illegal Command. |
| USL | Unselected Drive | NDT | No data detected |
| WRP | Write Protected (Cassette). | MBD | Marginal Block Detected |
| EOM | End of Media (End of current Partition). | BOM | Beginning of Media |
| UDA | Unrecoverable Data Error | BPE | Buss Parity Error |
| BNL | Bad Block Not Located | RES | THIS BIT IS RESERVED ALWAYS ZERO. |
| FIL | File Mark Detected | POR | (POWER ON) or (RESET SIGNAL) occurred. |

DATA ERROR COUNTER: RESET by Reading Status via RSTU command.

An unsigned 16 bit value containing the total number error blocks, resulting from any READ or WRITE operation. This count is incremented by 1 for each error as defined:

Write: Any block rewritten up to 15 times, will increment by that number.

Read: Any read retry up to 15 times, will increment by that number.

UNDERRUN COUNTER: RESET by Reading Status via RSTU command.

An unsigned 16 bit value containing the total number of underruns / overruns, resulting from any READ or WRITE operation. This count is incremented by 1 for each condition as defined:

Write: Any time the host fails to keep up with with the Drive and all filled buffers (512 bytes) have been written and verified on medium.

Read: Any time the host fails to keep up with with the Drive and all available buffers (512 bytes) have been filled.

NOTE: It is the host responsibility to track partial blocks, via the READY signal.

WANG LABORATORIES, INC.	DWN	DATE	TITLE	WLNUMBER	
	CHK	DATE	PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS)	191 - 3190	
	APPR	DATE	P/N 725 - 1481	23 of 47	REV. A
	APPR	DATE			

15.14 Read Extended Status Command Mnemonic ESTU OP CODE C8

This command requests 6 bytes of status from the drive. Transferred via a REQUEST/READY handshake.

COMMAND FORMAT: Single byte OP Code.

BYTE	7	6	5	4	3	2	1	0
00	1	1	0	0	1	0	0	0

RETURNED STATUS:

BYTE	7	6	5	4	3	2	1	0
00	Identity Code							
01	FSB	ROM	RAM	BUF	STL	BOT	DRV	0
02	MODE	RESERVED (0)				Selected Drive		
03	Track Number				Current Block address (MSB)			
04	Current Block Address							
05	Current Block Address (LSB)							

POWER UP DEFAULT A number of "self Tests" are executed at the POWER UP, or after a drive RESET SIGNAL (PIN32).

INTERFACE TIMING: per Figure B ____.

Identity Code: One byte Reserved field value (2).

Fault Status: Byte 01: All values and the associated EXCEPTION "signal", may ONLY be reset by issuing a Drive RESET via the RESET Signal. Pin 32. Reading Status or Extended Status will NOT clear these bits, or the associated EXCEPTION "signal".


- FSB One or more bits set in Fault Status Byte.
- ROM Drive detected ROM fault, after POWER-UP or after a RESET.
- RAM Drive detected RAM fault, after POWER-UP or after a RESET.
- BUF Drive detected BUFFER fault, after POWER-UP or after a RESET.
- STL STALL, Tape did not move, after motion command issued to drive.
- BOT Drive failed to detect; EOT, BOT, or Clear Leader.
- DRV DRIVE FAULT, detected by the drive, and may be be inclusive or exclusive with other bits.

Mode Status: Byte 02: All values may be reset by issuing a Drive RESET via the RESET Signal Pin 32.

- MODE: Operational Mode of the Drive:
 - 0 Industry Mode (power up Default)
 - 1 Wang Mode (Partitioned Recording) ref Select Format Command (section 15.14).
- RESERVED: Five Bit field fixed value (0).
- Selected Drive: Fixed value (1).

Track Number: Bits 7 and 4 correspond to msb and lsb respectively.

Current Block Address: A 20 Bit field, where (Byte 3, Bit 3) and (Byte 5, Bit 0), correspond to msb and lsb respectively.

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER	
	CHK	DATE		191 - 3190	
	APPR	DATE		24 of 47	
	APPR	DATE		REV.	A

15.15 Select Format Command

Mnemonic FMT OP CODE Fn

This command allows the host to select the recording format modes. This command will only be accepted (valid) with tape rewound to BOT Track 0, or "NO CASSETTE in the drive".

Industry Mode: Records all information per the D/CAS-12 standard which is as described within this specification, with the following exceptions:

1. Exclusion of "LOCATE BLOCK n" command.
2. All recording is in a single partition 9 track mode.
3. When "ONLINE" signal is dropped (false), the drive will flush the data buffer, "WRITE a FILEMARK", and rewind to Beginning of tape (BOT).
4. When "ONLINE" signal is dropped (false), following a "WRITE a FILEMARK" Command, the drive will rewind to Beginning of tape (BOT).

Wang Format Mode: There are modifications to the CONTROL AND DATA BLOCK STRUCTURES, to allow the implementation of "LOCATE BLOCK" command, and partitioned media features. There is also a modification to the "ONLINE PROTOCOL" to enable multi tasking operations.

1. All recording is in a two partition mode, refer to the "LOCATE COMMAND".
3. When "ONLINE" signal is dropped (false) following a:
 - WRITE OPERATION: The drive will flush the WRITE BUFFER to medium and maintain the current LOGICAL POSITION on tape, allowing the host to process error status for the current transfer. Subsequent WRITE operation(s) will Append at the End of recorded Medium.
 - READ OPERATION; The drive will maintain current logical position, for subsequent valid read, write or position commands.

COMMAND FORMAT: Single byte OP code Fn, with the value of n used to select the following modes:

BYTE	7	6	5	4	3	2	1	0
00	1	1	1	1	0	0	0	FMT


FORMAT MODES: FMT Value of 0 will select Industry recording mode.
 Value of 1 will select WANG FORMAT RECORDING MODE.
 The drive will remain in the selected mode until reselected or a power up reset occurs.
 The drive will perform all subsequent commands in the selected state.
 The current mode may be detected via EXTENDED STATUS "MODE" bit. ref (section 15.13).

POWER UP DEFAULT MODE: Shall be Industry RECORDING Mode.

STATUS RETURNED: Successful: Command completion will return with drive Ready.
 Un-successful: Any conflicts which occur between the drive and media format will result in an EXCEPTION set and return status:

Conflict State	Results	STATUS BYTES	
		Byte 0	Byte 1
Tape not at BOT	"Illegal Command not at BOT"	xxxx 0000	1100 0000
Read	"Read Abort"	100x 0100	1000 1000
Locate	"Read Abort"	100x 0100	1000 1000
Seek end of Data	"Read Abort"	100x 0100	1000 1000
NO Cassette	"No Cassette"	110x 0000	0000 0000

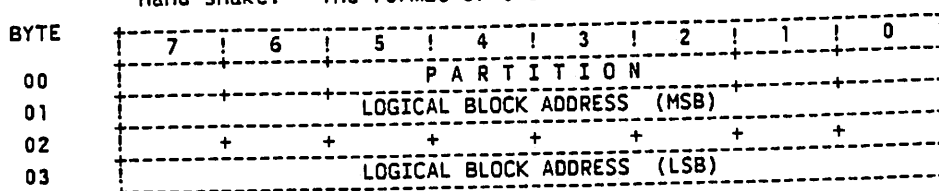
NOTE: "x" may be 0 or 1 value.

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER		
	CHK	DATE		191 - 3190		
	APPR	DATE		25 of 47	REV.	
	APPR	DATE				

15.16 Locate command Mnemonic LBN OP CODE AD Functional in the Wang Mode ONLY.

This command allows the host to position the medium to any specified logical block, which exists within a contiguous string starting from the beginning of any partition. Upon successful completion the next block to be read will be that LOGICAL block. The block is located by a series of successive approximations, in such a manner as to minimize the random block access time.

COMMAND FORMAT: Single byte opcode AD followed by a four (4) byte ADDRESS BLOCK, using a REQUEST/READY hand shake. The format of the ADDRESS BLOCK is described as follows:



PARTITION: An 8 Bit field specifying the track group (partition) to be selected, prior to searching for the logical block specified, by the LOGICAL BLOCK FIELD. Partition (0) will select tracks 0 through 7. Partition (1) will select track 9.

LOGICAL BLOCK ADDRESS: A 24 Bit field specifying the ADDRESS of the LOGICAL BLOCK to be LOCATED. The first Logical Block in any partition is 0_H in order to maintain interchangeability with future interfaces.

RANGE of ADDRESSABLE BLOCKS: 00 00 00 H - FF FF FF H Media dependent.


Status Returned:

Successful command will return with drive READY.
 Un-successful command will return with EXCEPTION and the appropriate bits set in the status bytes:

Results	STATUS BYTES	
	Byte 0	Byte 1
"Read Abort"	100x 0100	1000 1000

APPLICATION NOTES:

1. PREREQUISITE to the successful use of this command: a means to assure that the logical target block exists within a contiguous string of blocks starting from BOT of the specified partition. This may be accomplished by:
 - a. Erasing the entire tape prior to the first recording on the media.
 - b. All WRITES from BOT, or WRITE APPENDS (from end of recorded data) with "WRITE without ERASE", OP Code 42h.
 - c. NO FILEMARKS are recorded on the media.
 - d. The host does NOT ACCESS a block outside the range of a contiguous string within a specified partition.
2. WRITE APPEND A write append operation requires the medium to be logically positioned immediately after the last recorded block within a partition. This may be accomplished by:
 - a. LOCATING a block at or near the end of recorded media, followed by a SEEK END OF DATA (SEOD Hex A3) Command. A return status of (88 00 H) in Status Bytes 0 & 1 will qualify a write append.
 - b. Issuing a SEEK END OF DATA (SEOD Hex A3) from any valid position within the partition, with the returned of (88 00 H). This method can take up to 8 minutes to process.

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	W/LI NUMBER	
	CHK	DATE		191 - 3190	
	APPR	DATE		26 of 47	
	APPR	DATE		REV.	A

Exception Status Byte Summary

STATUS BYTE 0								STATUS BYTE 1								DESCRIPTION
ST0	CNI	USL	WRP	EOM	UDA	BNL	FIL	ST1	ILL	NDT	MBD	BOM	BPE	0	POR	
1	1		X													NO Cassette
1	1		1													NO Drive
1			1					X				X				Write Protected
1				1												End of Media
1			X		1			1				1				Read or Write Abort
1			X	X	1	1	1									Read Error, Filler Block XFERED.
1			X		1	1		1		1						Read Error No Data
1			X	1	1	1		1		1						Read Error No Data & EOM
1			X	X			1									File Mark detected
X	X	X	X					1	1			X				Illegal Command
X	X	X	X					1	1							Illegal Command (tape not @ BOT)
X	X	X	X					1				X			1	Power ON / RESET
1			X					1			1					Marginal Block Detected
X	X	X	X					1				X	1			Bus Parity Error

Note: All BLANK BIT fields are zero (0) filled.
The value "X" may be zero or one.

BIT DEFINITIONS

BIT	STATE	BIT	STATE
ST0	A status bit is set in byte 0	ST1	A status bit is set in byte 1
CNI	Cassette not in Place	ILL	Illegal Command.
USL	Unselected Drive	NDT	No data detected
WRP	Write Protected (Cassette).	MBD	Marginal Block Detected
EOM	End of Media (Physical end of current Partition).	BOM	Beginning of Media
UDA	Unrecoverable Data Error	BPE	Buss Parity Error
BNL	Bad Block Not Located	0	THIS BIT IS RESERVED ALWAYS ZERO.
FIL	File Mark Detected	POR	(POWER ON) or (RESET SIGNAL) occurred.

TABLE - A1

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER	
	CHK	DATE		191 - 3190	
	APPR	DATE			REV.
	APPR	DATE		27 of 47	A

Group Code Recording CONVERSION TABLE

Host Buss data					RECORDED DATA (on tape)					
B3	B2	B1	B0	Hex Value	G4	G3	G2	G1	G0	Hex Value
B7	B6	B5	B4							
				0	1	1			1	19
			1	1	1	1			1	1B
		1		2	1			1		12
		1	1	3	1			1	1	13
	1			4	1	1	1		1	1D
	1		1	5	1		1		1	15
	1	1		6	1		1	1		16
	1	1	1	7	1		1	1	1	17
1				8	1	1			1	1A
1			1	9		1			1	09
1		1		A		1		1		0A
1		1	1	B		1		1	1	0B
1	1			C	1	1	1	1		1E
1	1		1	D		1	1		1	0D
1	1	1		E		1	1	1		0E
1	1	1	1	F		1	1	1	1	0F

TABLE A-2

All data is converted on a nibble bound according to table A-2. Please note that all zeros within the binary portion of the table have been omitted for readability.

This recording scheme is one of the common Group Code Recording (GCR) techniques use in the industry and is referred to as the 5 bit to 4 bit conversion, or 0 - 2 Run Length Limited (RLL) code. Recording in this method using 5 bits per nibble allows half the absolute binary combinations to be discarded. The combinations chosen for recording are those which yield the minimum bit shift, and thus increase the reliability.

The (5 - 4) conversion relates to the range in number of bits recorded on the medium versus those transferred over the BUSS, for a given "nibble".

The (0 - 2) RLL description relates to the number of consecutive zeros recorded on medium, within any string of bytes or nibbles.

A deviation to the above is the unique synchronization "Data Block Marker" [11111 00111], which precedes all recorded data fields, and the "Filemark Data Pattern" [00101 00101], which fills the data field in a filemark block.

In the application used, they do not violate the above rules, as the data block marker is always 10 bits and bounded by 1's, and the filemark pattern is always 10 bits, preceded by a "Data Block Marker".



DWN	DATE
CHK	DATE
APPR	DATE
	DATE

TITLE
PRODUCT SPECIFICATION
CASSETTE TAPE (D/CAS)

WJNUMBER	REV.
191 - 3190	
28 of 47	A

COMMAND SUMMARY

OP CODE		CASSETTE	Commands not listed in this table will be rejected by the DRIVE.
HEX	Mnemonic	(D/CAS)	COMMENTS
01	SD	Select Drive	
11	SDL	Select Drive (LOCK)	Lights the Led on the front of the Drive.
21	BOT	Position to BOT	
22	ERA	Erase (entire tape)	
24	PRW	Prewind (tension)	Tape motion CP-EOT-BOT.
40	WRT	Write	
42	WRTE	Write without ERASE	REQUIRED BRIDGE TO PARTITIONED TAPE.
80	RD	Read	
A3	SEOD	Seek EOD (End of DATA)	ON CURRENT PARTITION
C0	RSTU	Read Status	
C8	ESTU	Read Extended Status	
AD	LBN	Locate Block (n)	4 byte parameter command for compatibility to SCSI "LOCATE".
60	WFM	Write FILE MARK	INCOMPAITBLE with SCSI ENHANCED commands.
A0	RFM	Read FILE MARK	do
Bn	RFM(N)	Read (n) File Marks	do
----- WANG PROPRIETARY COPYWRITE COMMANDS -----			
Fn	FMT	Select Format	Required for WANG software protection and improved performance. Unit powers up in DESELECTED MODE.
			F0 Standard 9 track format.
			F1 Wang Partition format.
----- Vendor Unique Commands -----			
Dn	TEST(n)	TEST n = (0 - F)	TEST may be useful for repair diagnostic functions.

TABLE - A3

WANG LABORATORIES, INC.	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER 191 - 3190	
	CHK	DATE		29 of 47	REV. A
	APPR	DATE			
	APPR	DATE			


Pin Number		SIGNAL NAME	MNEMONIC	SOURCE
GND	Signal			
01	02			
03	04			
05	06			
07	08			
09	10	HOST BUSS (ODD PARITY)	HB-P	
11	12	HOST BUSS BIT-7 (MSB)	HB-7	
13	14	HOST BUSS BIT-6	HB-6	
15	16	HOST BUSS BIT-5	HB-5	
17	18	HOST BUSS BIT-4	HB-4	Bi-directional
09	20	HOST BUSS BIT-3	HB-3	
21	22	HOST BUSS BIT-2	HB-2	
23	24	HOST BUSS BIT-1	HB-1	
25	26	HOST BUSS BIT-0 (LSB)	HB-0	
27	28	ONLINE	ONL	
29	30	REQUEST	REQ	HOST
31	32	RESET	RST	
33	34	TRANSFER	XFR	
35	36	ACKNOWLEDGE	ACK	
37	38	READY	RDY	DRIVE
39	40	EXCEPTION	EXC	
41	42	DIRECTION (RENAMED I/O)	DIR	
43	44			
45	46			
47	48			
49	50			

I/φ

Signal Cable Pin Assignments

TABLE - A4

DIRECTION ACTIVE LOW () READ INPUT

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER 191 - 3190		
	CHK	DATE		30 of 47	REV.	
	APPR	DATE				
	APPR	DATE				


THESE COMMANDS ARE MAINTENANCE USE ONLY

NORMAL RECORDED INFORMATION MAY BE (D E S T R O Y E D)

COMMAND	COMMAND NAME	Description
! TEST ! OP Code!		
! 0 ! D20	! Stop	! Terminates tests 1, 2, 3, 6, 7, 8
! 1 ! D1	! Write 1F	! Writes 3333 frpi in the recording direction of the current track.!
! 2 ! D2	! Write 1.5F	! Writes 5000 frpi in the recording direction of the current track.!
! 3 ! D3	! Write 3F	! Writes 10000 frpi in the recording direction of the current track.!
! 4 ! D4	! Select Track 0	! Selects track 0
! 5 ! D5	! Select next track	! Increments the track to the next LOGICAL TRACK NUMBER. ! (Track position can be monitored via EXTENDED STATUS)
! 6 ! D6	! Go Forward	! Moves thke tape in the forward direction (toward physical EOT) ! Tape motion stops when on clear leader.
! 7 ! D7	! Go Reverse	! Moves the tape in the reverse direction (toward physical BOT) ! Tape motion stops when on clear leader.
! 8 ! D8	! Sensor test	! Moves the tape forward from the current position 100 inches ! if hole detected, the tape is moved +/- 50 inches about the hole.! ! if hole not detected tape is moved +/- 100 inches about the hole.!
! 9 ! D9	! Write Error Skip	! Using this OP Code in a write command operation will cause the ! drive to disregard all read after write errors. <i>6.04</i>
! A ! DA	! Read Error Retry	! Using this Op code in a read operation will cause the drive to ! stop logically before any defective block, Allowing user ! controlled retries on defective blocks. (Caution: verify that ! dummy data is transfered to the host when read errors occure)

Maintenance Command Table

TABLE - A5

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER		
	CHK	DATE		191 - 3190		
	APPR	DATE		31 of 47	REV.	
	APPR	DATE			A	

Sym- bol	Min	Max	Unit
T1	0		μ S
T2	10		μ S
T3	20	500	μ S
T4	0		
T5	0		
T6	20	100	μ S
T7	20		μ S
T8		1	μ S
T9	0		
T10	20		μ S
T11	0		
T12	0		
T15	500		μ S
T18		1	μ S
T20	20	500	μ S
T51		150	μ S

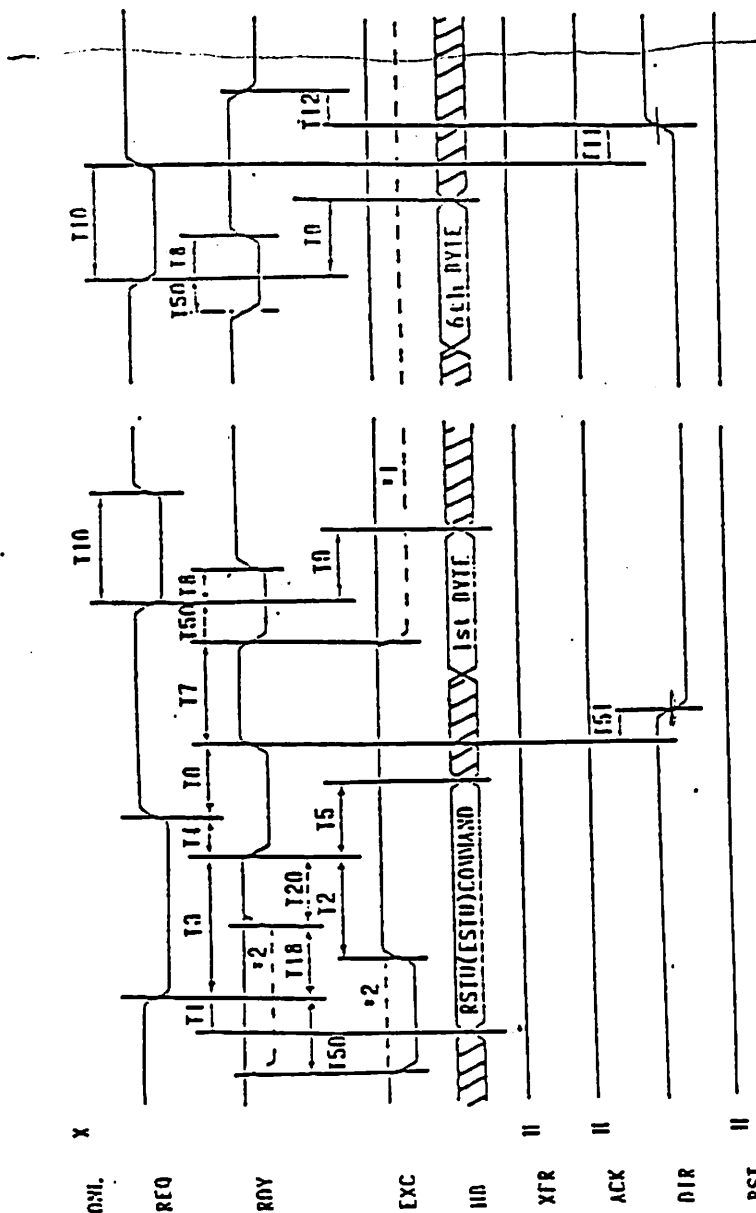
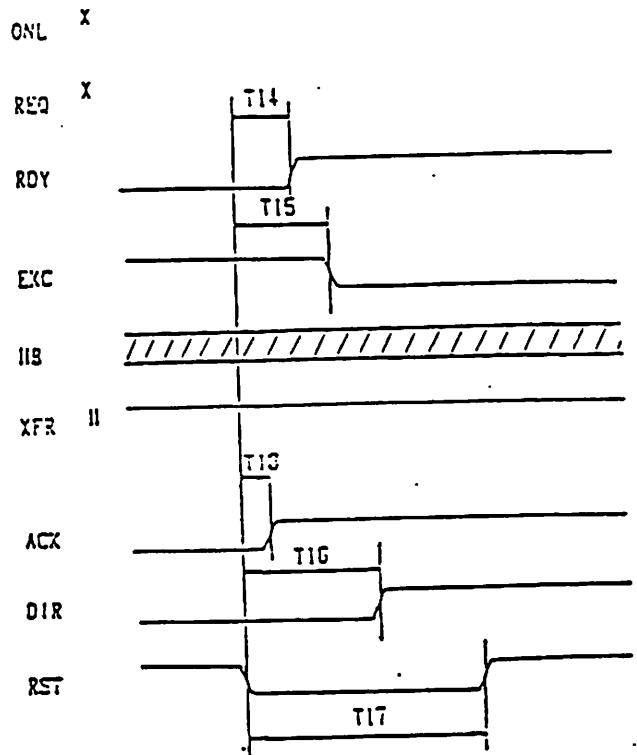


FIGURE B - 1
RSTU, ESTU, EXC Command Timing

- Note 1 (1) The dotted line #1 indicates the EXC signal output timing in the case where a BUS PARITY error has occurred under RSTU or ESTU command. In this case, the following status information is not transferred.
- (2) The dotted line #2 indicates the timing in the case where RSTU or ESTU command is input when a RDY signal is output.

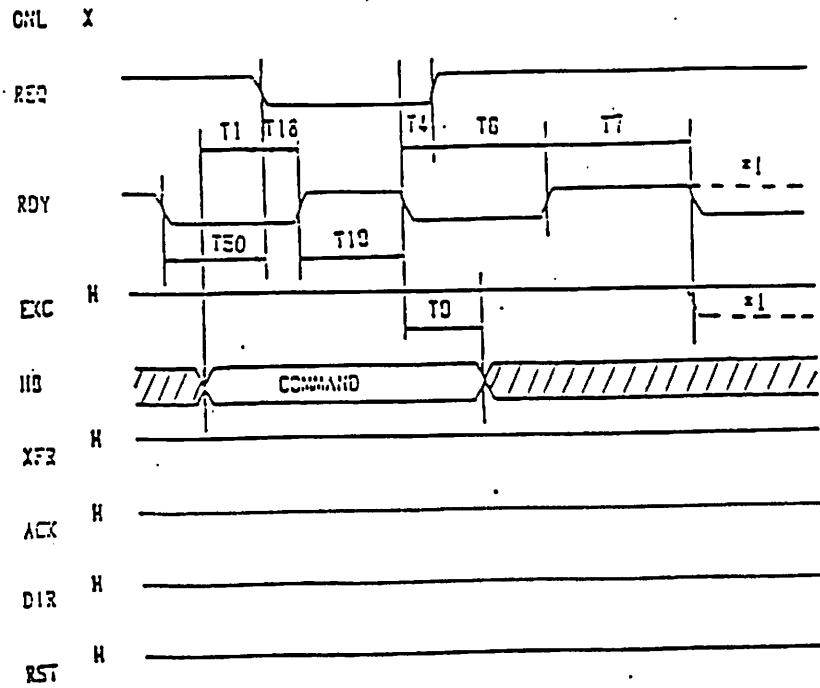
	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	W/L NUMBER	
	CHK	DATE		191 - 3190	
	APPR	DATE		32 of 47	
	APPR	DATE			



Symbol	MIN	MAX	units
T13		1	μS
T14		1	μS
T15		3	μS
T16		3	μS
T17	25		μS

FIGURE B - 2
RESET Timing

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	W/L NUMBER 191 - 3190		
	CHK	DATE		33 of 47	REV. A	
	APPR	DATE				
	APPR	DATE				

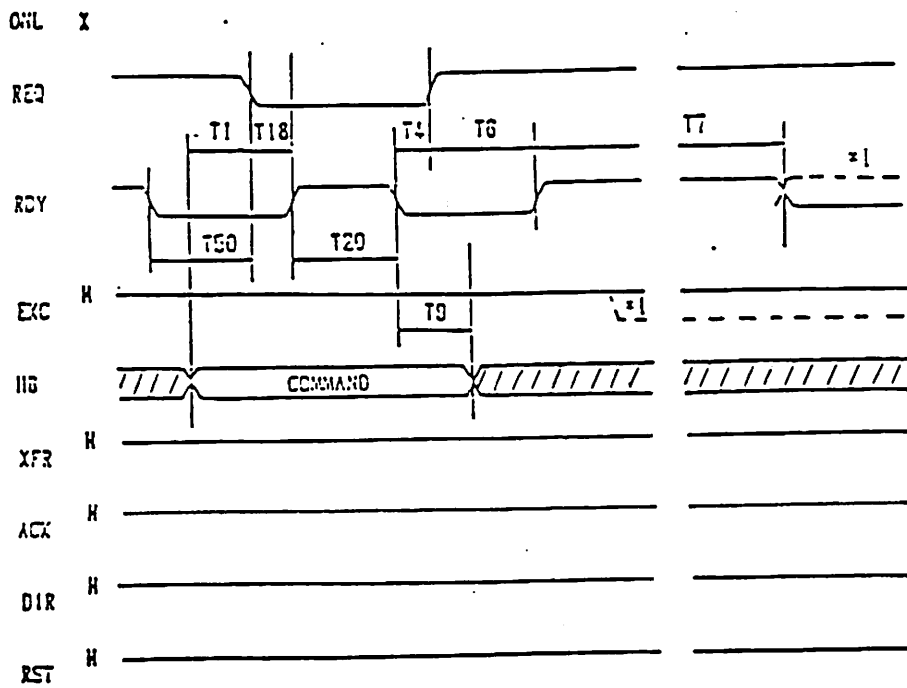


Symbol	MIN	NCM	MAX	Unit
T1	0			
T18			1	μS
T19	50	500		μS
T4	0			
T9	0			
T6	20		100	μS
T7	20			μS
T50	500			nS

Note : The dotted line *1 indicates the EXC signal output timing in the case where a command is rejected at the command receiving time.

FIGURE B - 3
SD, SDL Command Timing

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLNUMBER		
	CHK	DATE		191 - 3190		
	APPR	DATE		34 of 47	REV.	
	APPR	DATE			A	

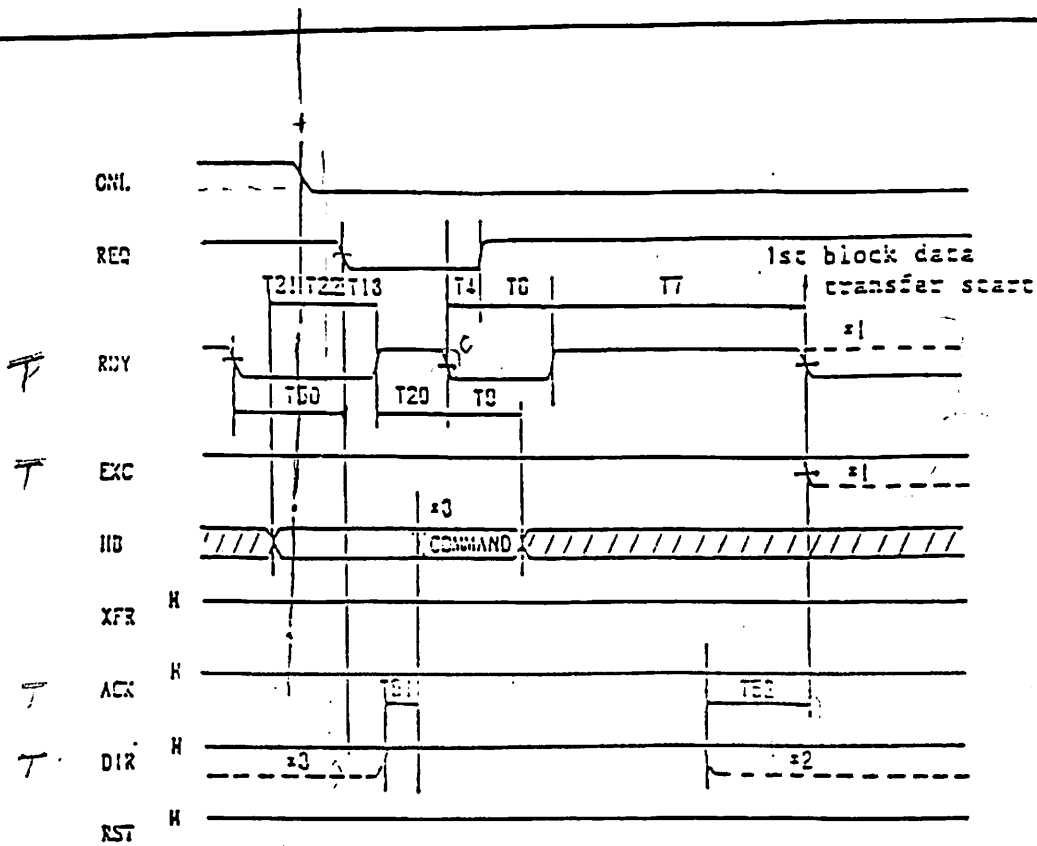


Symbol	MIN	NOM	MAX	units
T1	0			
T18			1	μS
T20	20	500		μS
T4	0			
T9	0			
T6	20		100	μS
T7	20			μS
T50	500			nS

Note : The dotted line *1 indicates the EIC signal output timing in the case where a command is rejected at the command receiving time.

FIGURE B - 4
BOT, ERA, PRW, Command Timing

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER	
	CHK	DATE		191 - 3190	
	APPR	DATE		35 of 47	REV.
	APPR	DATE			A



Symbol	MIN	NOM	MAX	Units
T21	0			
T22	0			
T16			1	μS
T20	20	500		μS
T4	0			
T9	0			
T6	20		100	μS
T7	20			μS
T50	500			nS
T31	0		3	μS
T32	0			

Note :

- (1) The dotted line #1 indicates the EXC signal output timing in the case where a command is rejected at the command receiving time.
- (2) The dotted line #2 is valid only under RD command.
- (3) The dotted line #3 indicates the command input timing in the case where command is input during read operation.

FIGURE B - 5
WRT, WRTE, RD, Command Timing

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER	
	CHK	DATE		191 - 3190	
	APPR	DATE		36 of 47	REV. A
	APPR	DATE			

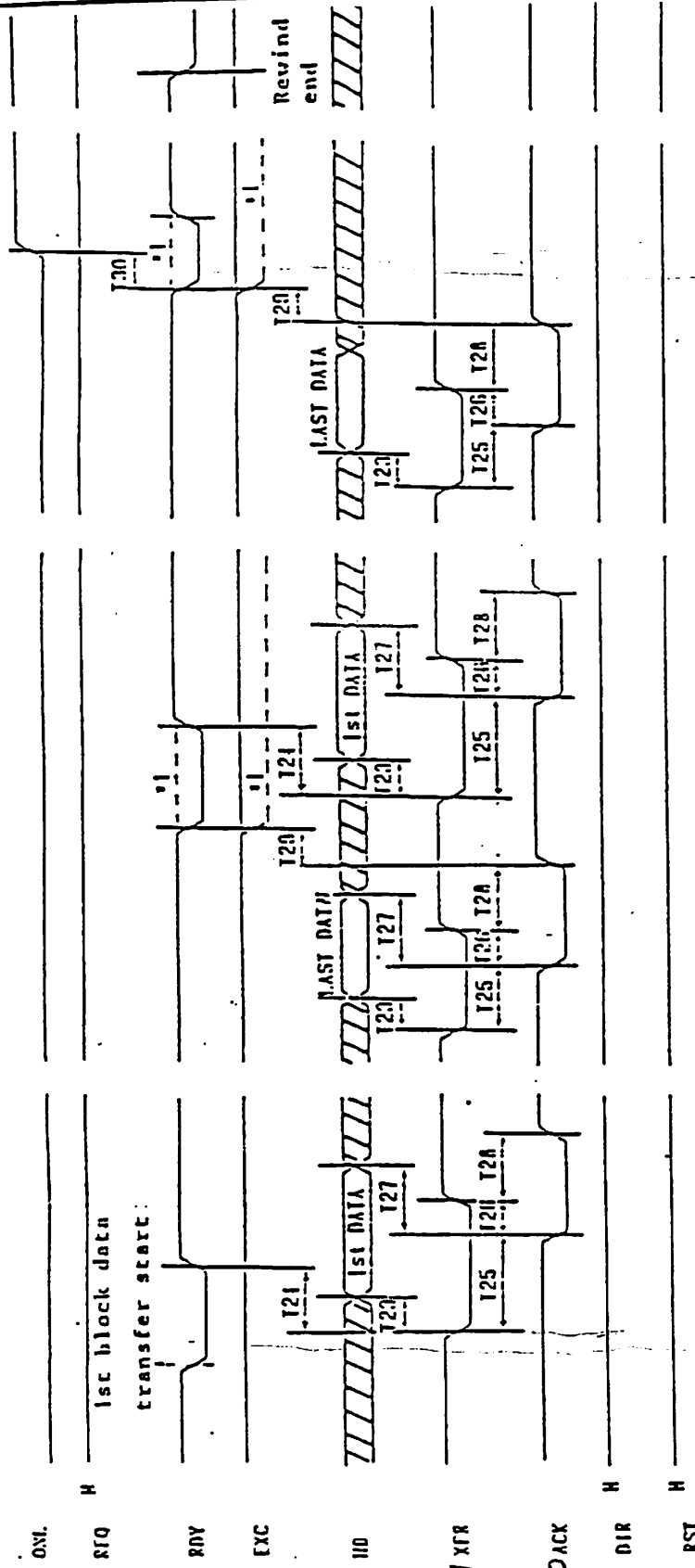


FIGURE B - 6
Write Data transfer Timing

Sym- bol	MIN	MAX	Unit
T24	0	3	μS
T29	100		μS
T30	0		μS

Sym- bol	MIN	MAX	unit
T20		10	ns
T21		1	μs
T25	0.5	100	μs
T26	0		μs
T27	0		μs

Note :

The dotted line #1 indicates the EXC signal output timing in the case where a BUS PARITY error has occurred during data transfer.

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER	
	CHK	DATE		191 - 3190	
	APPR	DATE		37 of 47	REV.
	APPR	DATE		A	

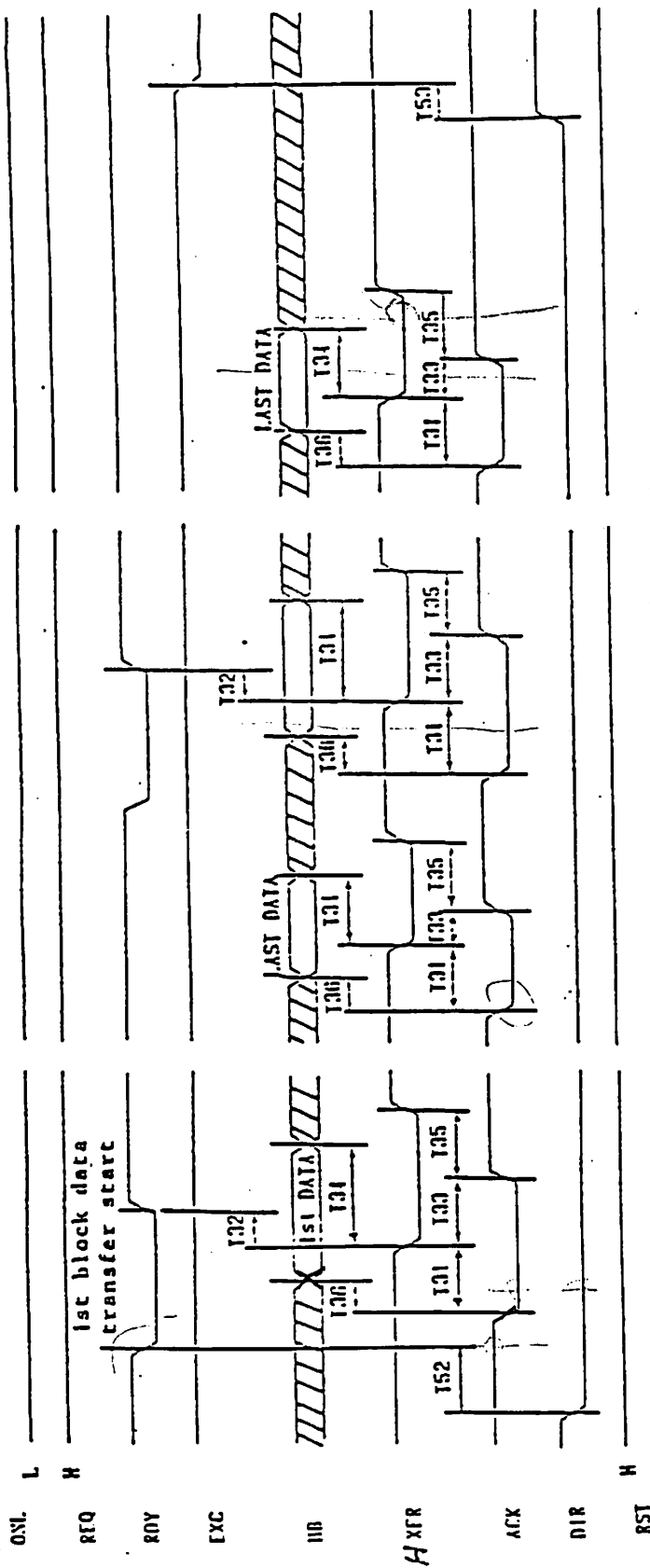


FIGURE B - 7
Read Data transfer Timing

Symbol	MIN	MAX	Unit
T31	0		
T35	0		
T52	0		
T53	0		

Symbol	MIN	MAX	Unit
T30		10	ns
T31	0		
T32		1	μs
T33	0.5	3	μs

*

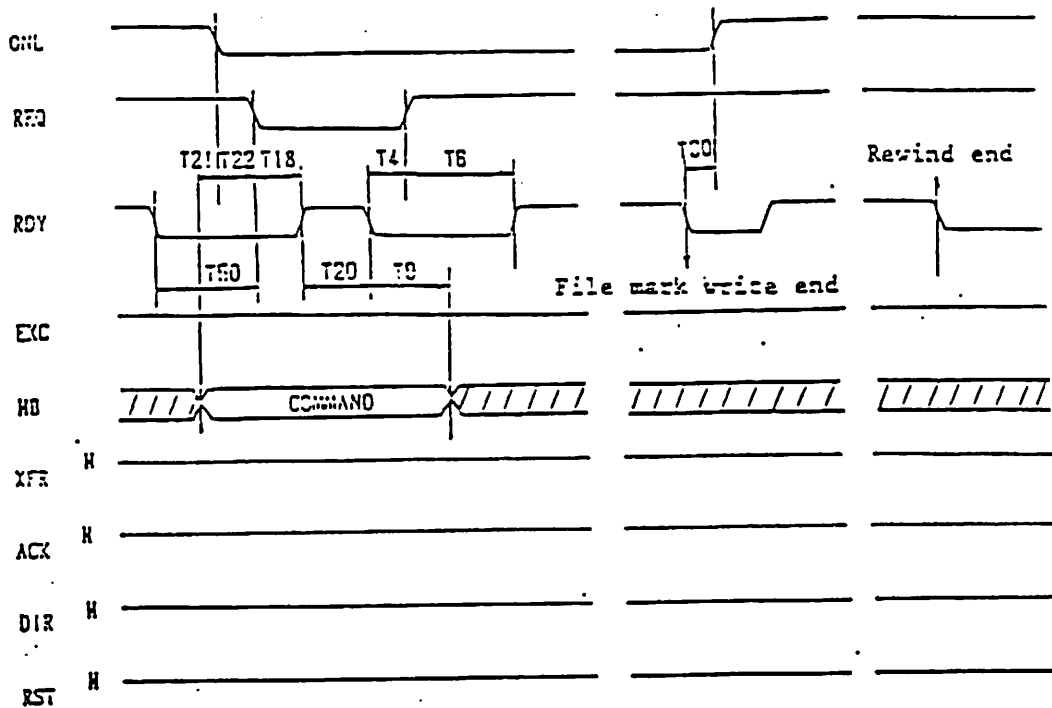
~~Handwritten signature or mark~~

WANG
LABORATORIES, INC.

DWN	DATE
CHK	DATE
APPR	DATE
APPR	DATE

TITLE
PRODUCT SPECIFICATION
CASSETTE TAPE (D/CAS)
P/N 725 - 1481

WLNUMBER 191 - 3190	
38 of 47	REV. A



Symbol	MIN	NOM	MAX	units
T2!	0			
T22	0			
T18			1	μS
T20	20	500		μS
T4	0			
T9	0			
T6	20		100	μS
T30	0			
T50	500			nS

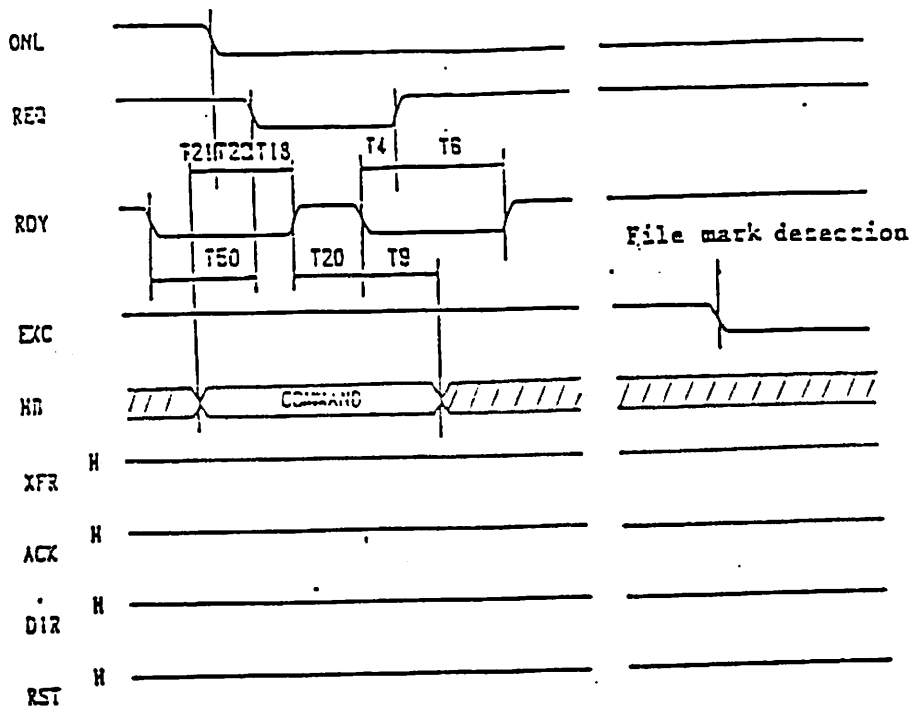
FIGURE B - 8
WFM Command Timing

WANG
LABORATORIES, INC.

DWN	DATE
CHK	DATE
APPR	DATE
APPR	DATE

TITLE	PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS)
P/N	725 - 1481

WLI NUMBER	191 - 3190
REV.	A
39 of 47	



Sym- bol	MIN	NOM	MAX	Units
T21	0			
T22	0			
T18			1	μS
T20	20	500		μS
T4	0			
T9	0			
T6	20		100	μS
T50	500			nS

FIGURE B - 9
RFM, RFM(n), SEOD Command Timing

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER	
	CHK	DATE		191 - 3190	
	APPR	DATE		40 of 47	REV. A
	APPR	DATE			

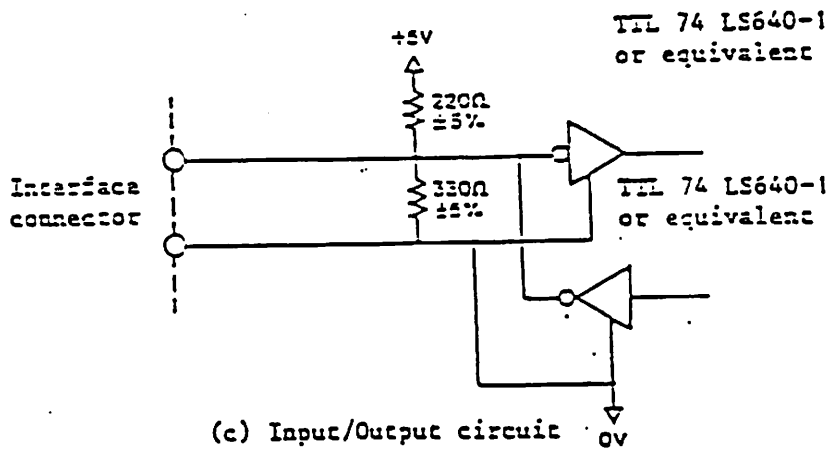
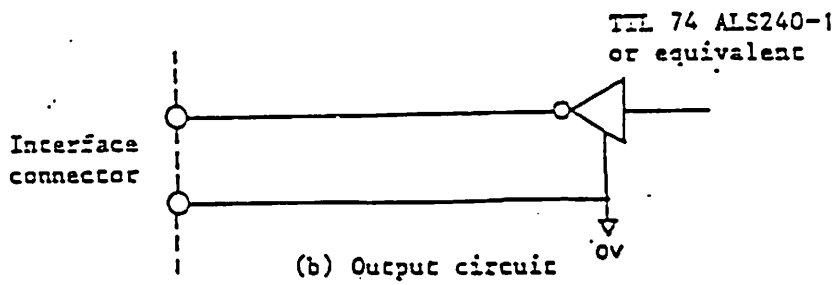
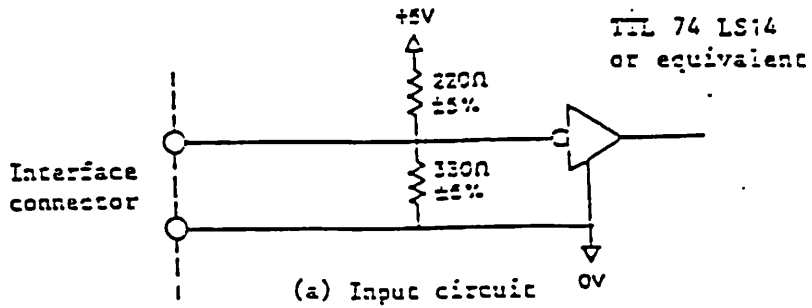
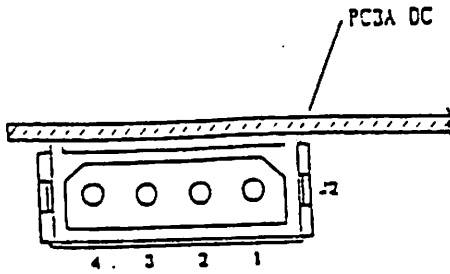


FIGURE B - 10
Driver / Receiver Circuits

DWN	DATE
CHK	DATE
APPR	DATE
APPR	DATE

TITLE	WLNUMBER
PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS)	191 - 3190
P/N 725 - 1481	REV. A

41 of 47	REV. A
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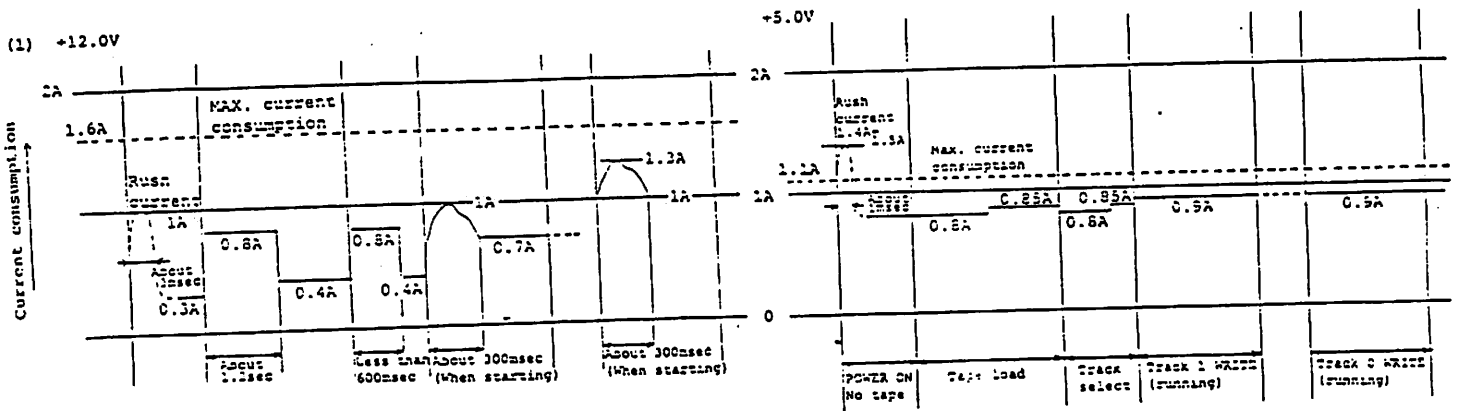


Pin number	Voltage
1	DC + 12V
2	0V
3	0V
4	DC + 5V

Power connector pin number table

Power connector pin arrangement

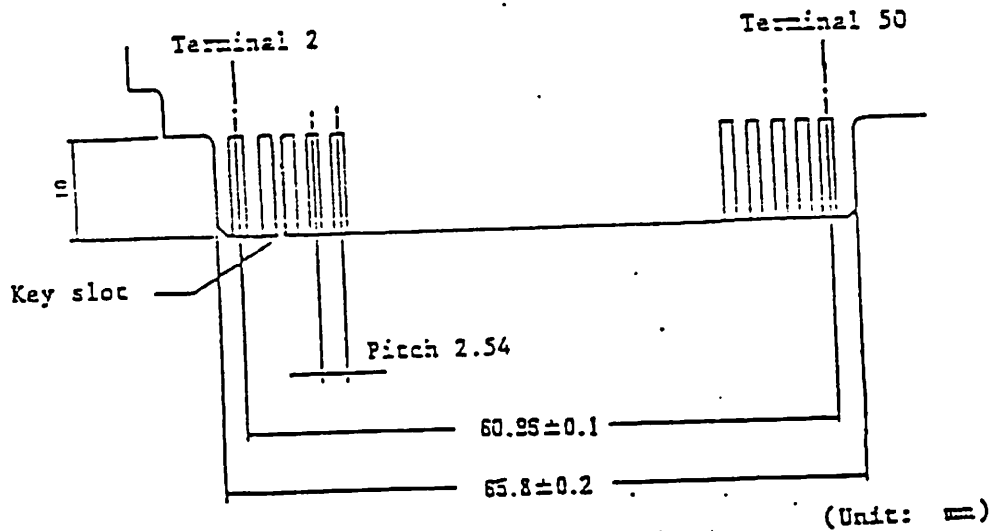
FIGURE B - 11
DC Power Connections



Note: (1) Values shown above are representative values at normal temperatures.

FIGURE B - 12
DC Current Loading

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER	
	CHK	DATE		191 - 3190	
	APPR	DATE		42 of 47	
	APPR	DATE		REV.	



Note : (1) The above illustration is a view from the parts face side of the controller PCB.

(2) The thickness of the PCB is nominally 1.6 mm.

FIGURE B - 12
Signal Connector

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	W/L NUMBER		
	CHK	DATE		191 - 3190		
	APPR	DATE		43 of 47	REV.	
	APPR	DATE			A	

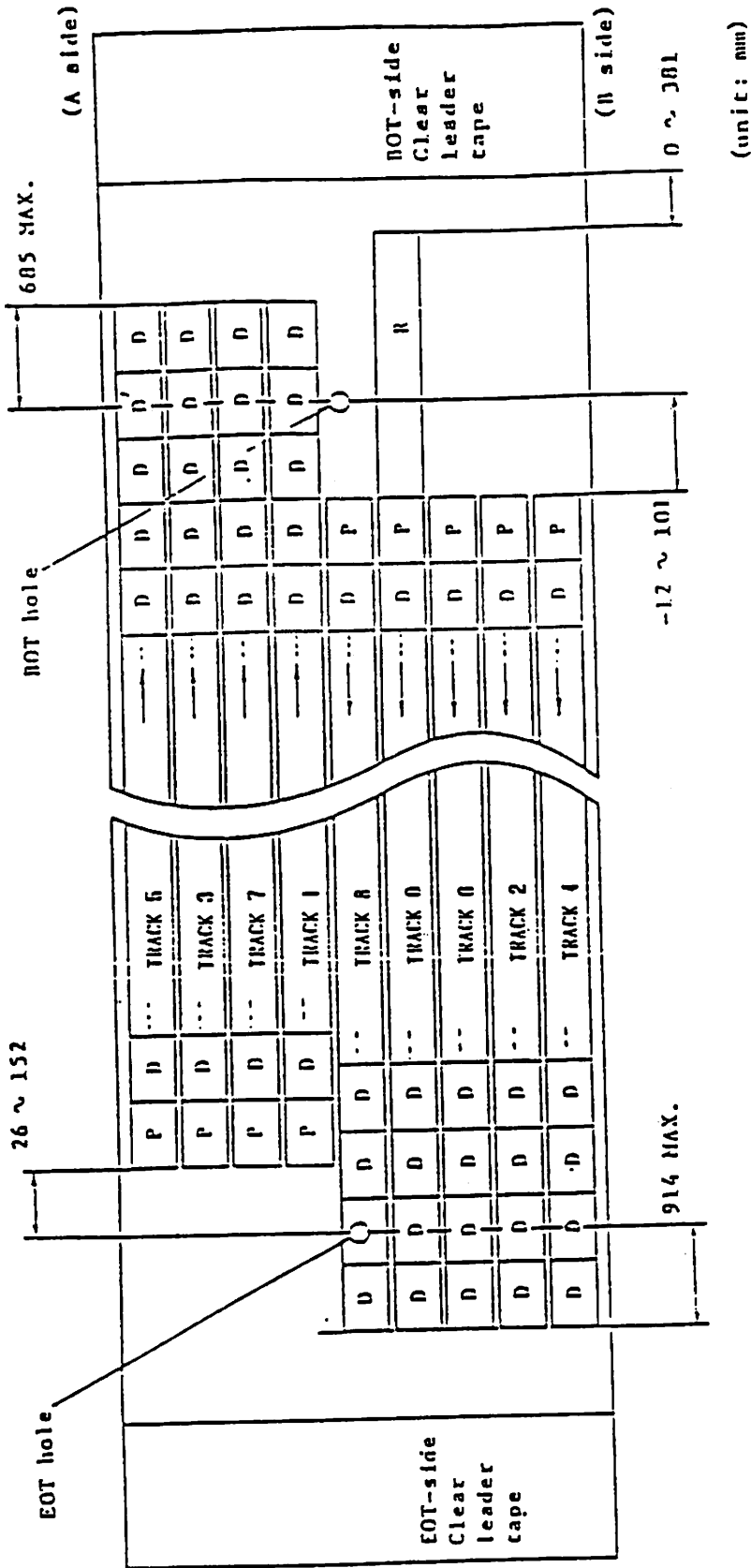


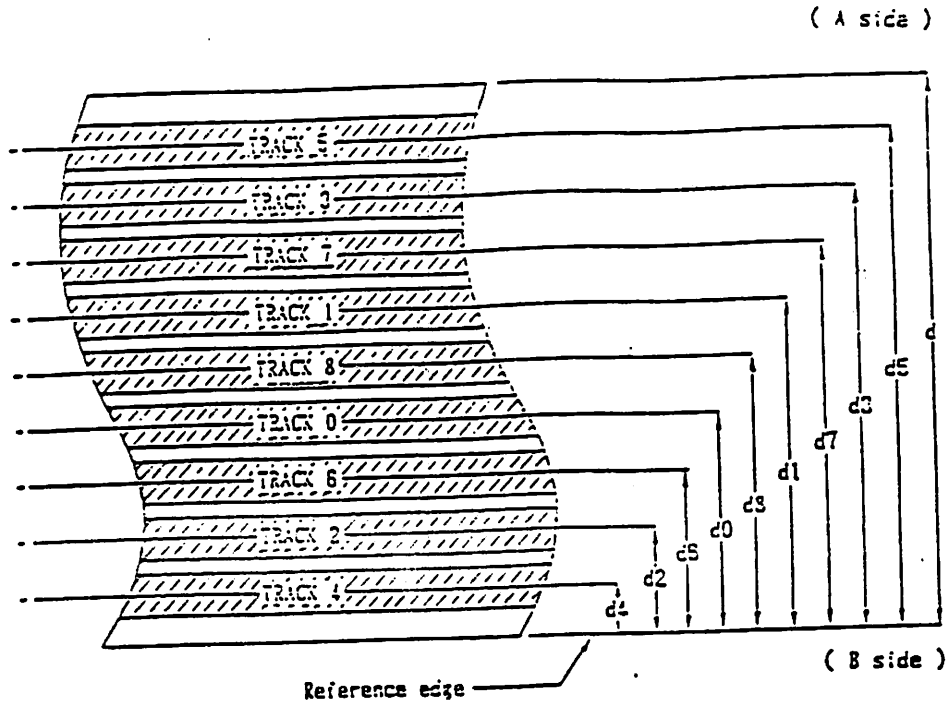
FIGURE B - 13
Track Recording Geometry

- Notes:
- (1) This figure is as viewed from the magnetic face side of the tape.
 - (2) The arrow indicates the recording direction of the relevant track. The recording sequence of data tracks is TRACK 0, TRACK 1,....., and TRACK 7. TRACK 8 is independently controlled as the directory track.
 - (3) R, P and D represent the reference burst, long preamble, and data block, respectively (refer to item 1-0-3 "Data Format").

DWN	DATE
CHK	DATE
APPR	DATE
APPR	DATE

TITLE
PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS)
P/N 725 - 1481

W/LNUMBER	REV.
191 - 3190	A
44 of 47	



$d_0 = 1.489 \pm 0.05$	$d_5 = 3.531 \pm 0.05$
$d_1 = 2.311 \pm 0.05$	$d_6 = 1.082 \pm 0.05$
$d_2 = 0.588 \pm 0.05$	$d_7 = 2.718 \pm 0.05$
$d_3 = 2.124 \pm 0.05$	$d_8 = 1.905 \pm 0.05$
$d_4 = 0.279 \pm 0.05$	$d = 2.785 \pm 0.013$

(unit : mm)

Note : The above illustration is a view from the magnetic face side.

FIGURE B - 14
Track Locations

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER		
	CHK	DATE		191 - 3190		
	APPR	DATE		45 of 47	REV.	
	APPR	DATE			A	

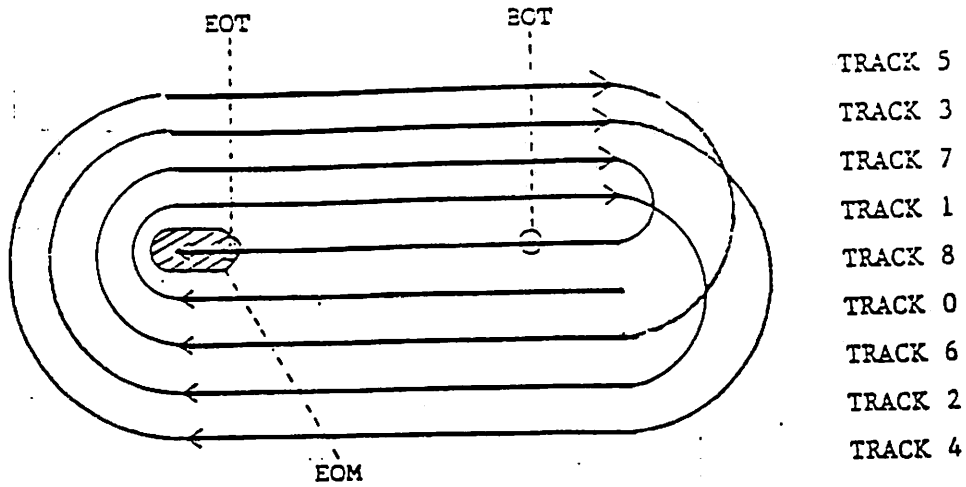


FIGURE B - 15
Track Sequence (Single Partition)

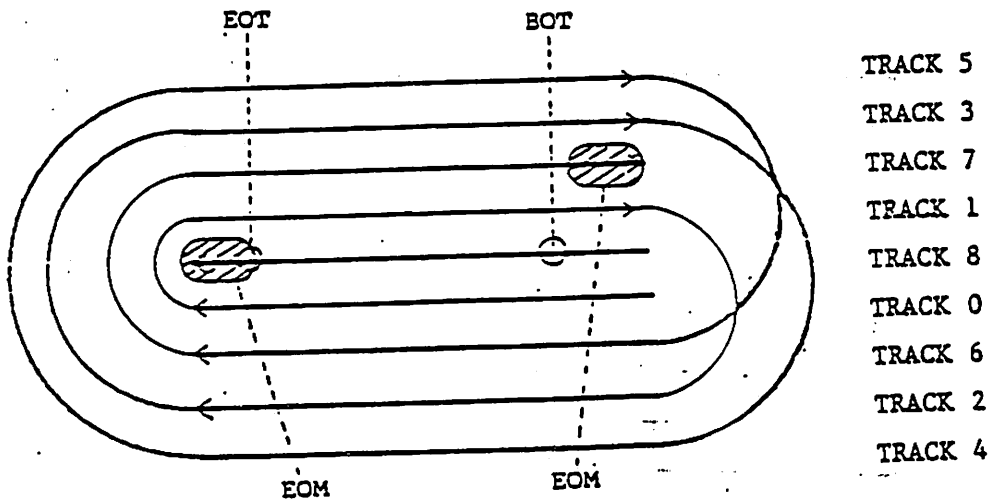
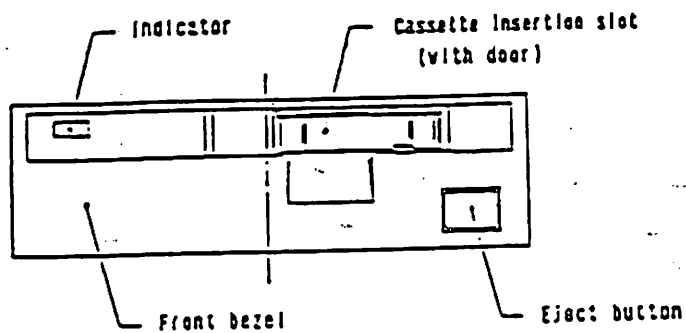
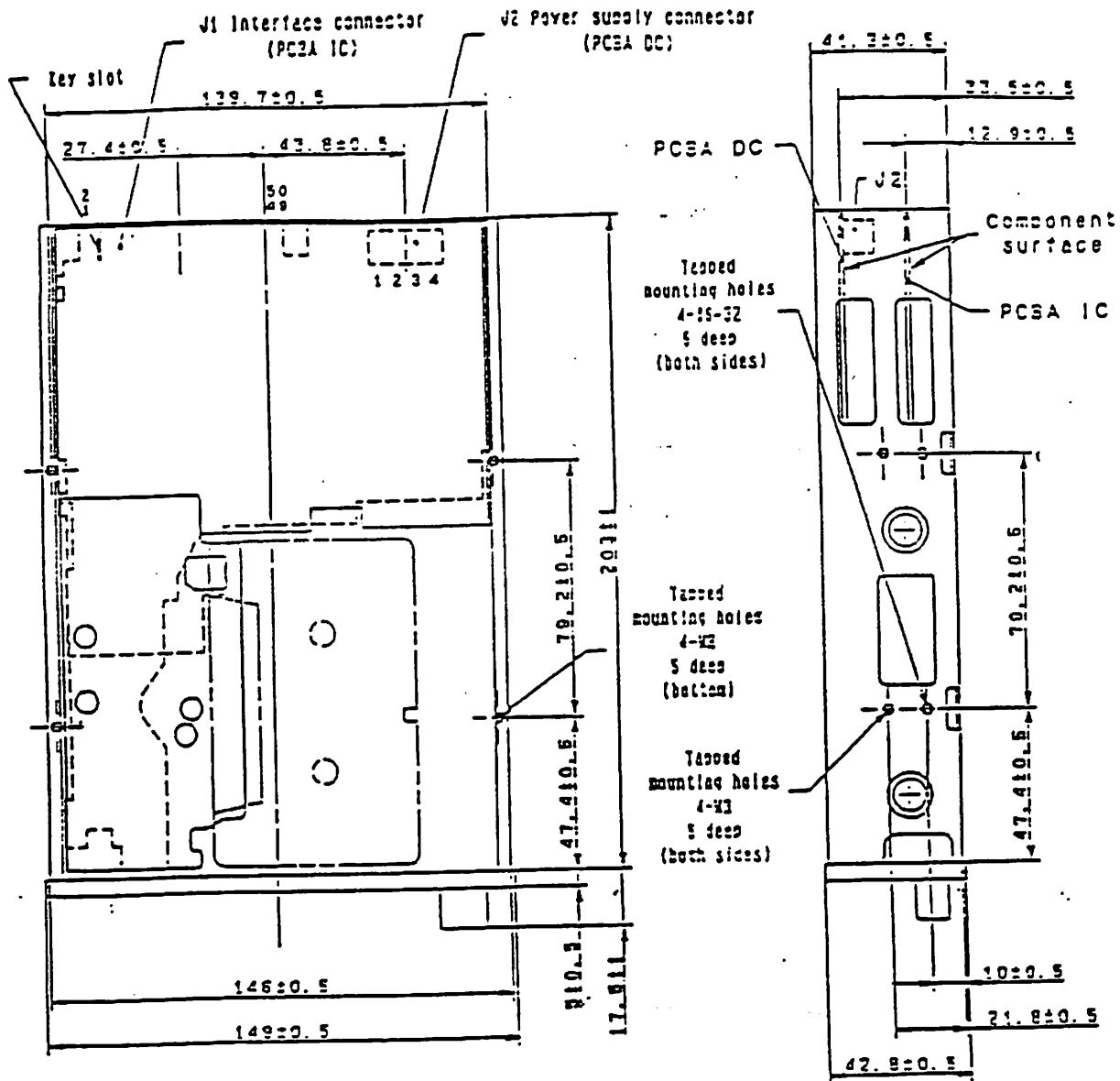


FIGURE B - 16
Track Sequence (Dual Partition)
WANG FORMAT MODE

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	APPR	DATE		46 of 47	REV.
	APPR	DATE			A



(Unit :mm)

FIGURE B - 18
EXTERNAL VIEWS

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER	
	CHK	DATE		191 - 3190	
	APPR	DATE		47 of 47	REV.
	APPR	DATE			A

REVISIONS

REV.	DATE	DESCRIPTION


DATE

Approved Vendor List

The following vendor is approved by _____

Teac Corporation of America Model Number MT-2ST / 45DW

Wang P/N 725-1481

	DWN	DATE	TITLE PRODUCT SPECIFICATION CASSETTE TAPE (D/CAS) P/N 725 - 1481	WLI NUMBER	
	CHK	DATE		191 - 3190	
	APPR	DATE			REV.
	APPR	DATE			