AMPEX

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HBR-3000i

High Bit Rate Digital Recorder/Reproducer With ECC

System Manual

ISSUED 15 SEPTEMBER 1983

Note: Asterisk denotes pages affected by latest change.

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INTRODUCTION

This manual is part of a set which covers the Ampex HBR-3000i high-bit-rate digital recorder/reproducer system with error-correction code (ECC). Incorporated in the same volume with this manual are manuals on tape-transport adjustment, signal-electronics adjustment, and tape-transport maintenance. In a separate volume are contained separate manuals on the elements of the signal electronics, including the printed wiring board assemblies (PWBA's) and the bays and housings that house them.

This manual includes installation, operation, and maintenance instructions for the system, plus descriptions of the system, and instructions on how to set up the signal electronics for different signal-handling configurations.

SECTION 1

EQUIPMENT IDENTIFICATION

1-1. GENERAL

The Ampex HBR-3000i is a magnetic tape recorder/reproducer system for the storage and retrieval of high-bit-rate digital data, featuring a relatively low-overhead error correction system for optimum bit-error rate (BER). In applications where maximum data storage is required, the error correction function can be disabled, thus lowering system overhead by eliminating parity channels. Both 28- and 14-channel versions of the system are standard. See figures 1-1 and 1-2. A large variety of standard and custom signal system configurations are available for either parallel or serial data input at a wide range of data rates. Refer to tables 1-1 (standard equipment) and 1-2 (custom equipment, if applicable) for the configuration of your system. The signal-system configuration is to a considerable extent determined by programming that can be readily changed. Refer to section 8 of this manual for details.

Serial data can be distributed onto multiple channels (through serial-to-parallel conversion) and reassembled for serial output during playback. The number of serial streams that can be accommodated is determined by the rate of the serial data and the number of tracks available for the divided-down parallel streams, as related to the maximum per-channel rate of the recorder, and the selected bit-packing density. Depending on the input formatter (serial-to-parallel converter) used, a single stream of serial data as high as 30 Mb/s can be accommodated, on either a 14-track or 28-track recorder, or a 6-bit serial word of as high as 20 Mw/s can be recorded on a 28-channel recorder.

Parallel channels can be recorded without division, within the per-channel data rate of the recorder. (A word-serial system requires a minor, plug-change reconfiguration to operate as a parallel system. For a bit-serial system, parallel operation is switch-selectable. Up to 13 such channels without error-correction, or 12 channels with can be accepted by a 14-channel recorder, and up to 26 without or 24 with by a 28-channel recorder.

Through the use of an optional ECL input/output formatter bay, a serial stream of up to 100 megabits per second (Mb/s) can be recorded and reproduced.

Refer to section 4 of this manual for system descriptions.

1-2. PHYSICAL CONFIGURATIONS

Systems are supplied in one or two rack cabinets, as required. A 14 channel system is normally housed in one cabinet, and a 28-channel system in two. (See figures 1-1 and 1-2.) All cabinets are nominally 70 inches high, 23 inches wide, and 31 inches deep.They can be mounted on dollies (optional) designed to allow the cabinet and dolly to pass through a standard 80-inch-high doorway.

1-3. SYSTEM COMPONENTS

An HBR-3000i system is made up of a tape transport (which includes a rack cabinet), a mode-select bay (MSB), and signal electronics contained in bays and housings, as described in paragraph 1-6, below. (See figures 1-3 through 1-6.)

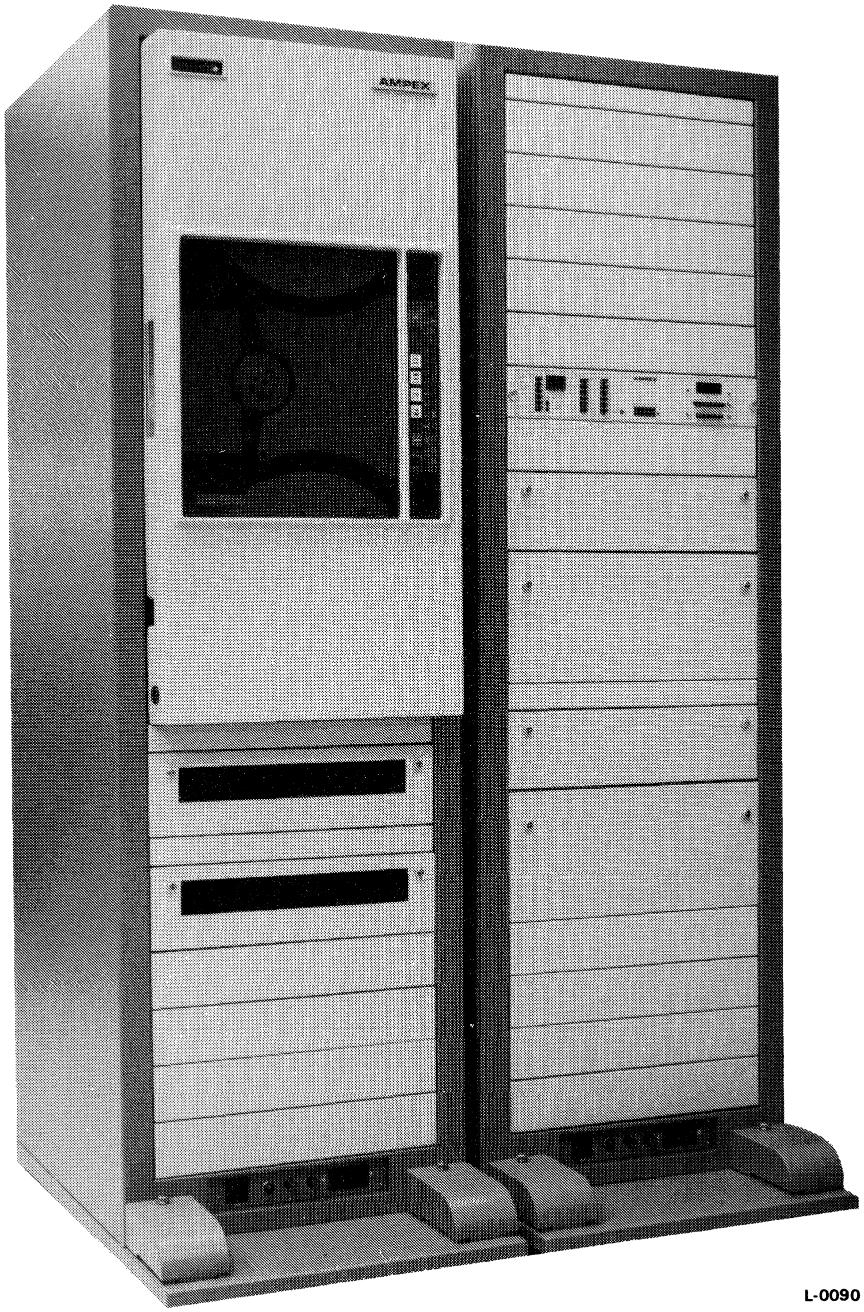

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Figure 1-1. Typical 28-Track System (on Optional Dolly)

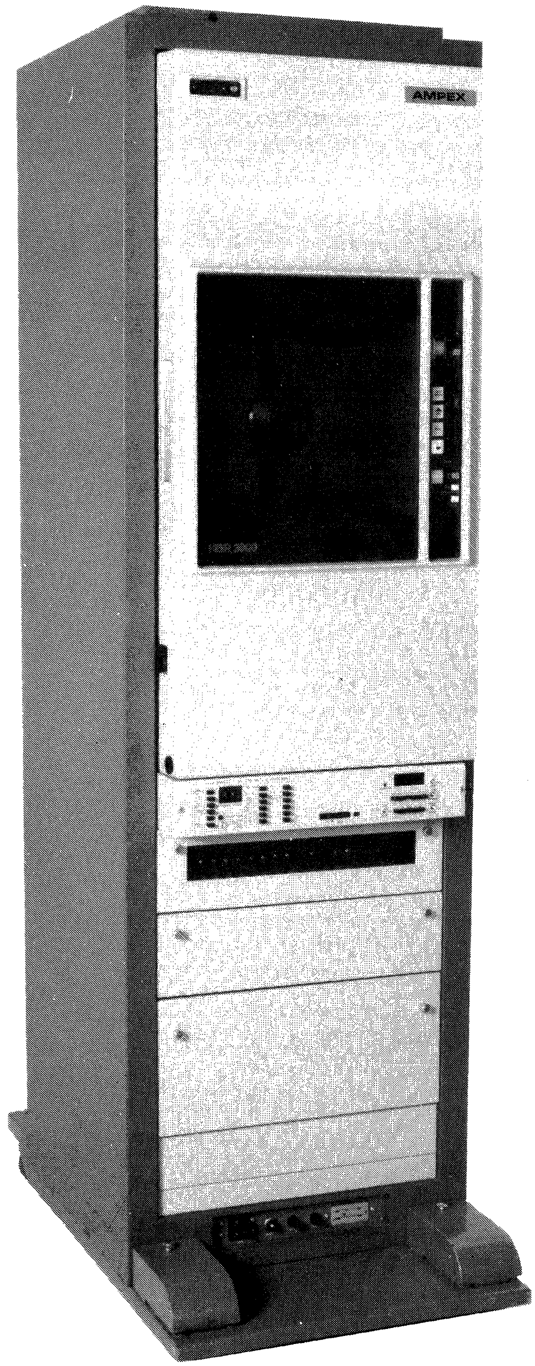

Figure 1-2. Typical 14-Track System (on Optional Dolly)

Table 1-1. HBR-3000i Standard System Configuration for

Sales Order ____________________

☐ Custom (If checked, see table 1-2 for custom features)
Signal Format (standard) ☐ Parallel: ____________ channels ☐ Word serial: ______ ______-bit word(s), each ÷ to ______ tracks ☐ Bit serial: ______ stream(s) ÷ to ______ tracks (each)
Density/Rate/Speed Packing density ________________ kb/in. Data rate ________________ Mb/s Tape speed ________________ IPS
Auxiliary Tracks BAY A ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ Analog ☐ Digital BAY B ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ Analog ☐ Digital
Error Correction ☐ ECC ☐ No ECC

1-4. Tape Transport

The tape transport is the HBR-3000i laboratory instrumentation tape transport, configured to handle 1-inch-wide magnetic tape on precision reels up to 16 inches in diameter. The record/reproduce tape-speed range is from 150 to 1-7/8 inches per second (IPS) (electronics limit 64:1 or 1:64 speed ratio), forward or reverse. Fast modes, both forward and reverse, move the tape at 240 IPS.

The transport provides servo control of the tape reels and the capstan. The capstan servo is controlled by a data-clock, and is continuously variable. This means that tape speed is data-rate controlled to produce constant packing density on the tape. The tape speed switches on the transport control panel are selectors for certain elements in the signal electronics. The indicated tape speeds on the control panel are only nominal, being set to the placarded speed nearest the actual tape speed. (If the actual tape speed is midway between two pla-

Table 1-2. Custom Features of the HBR-3000i on

Sales Order ______________________

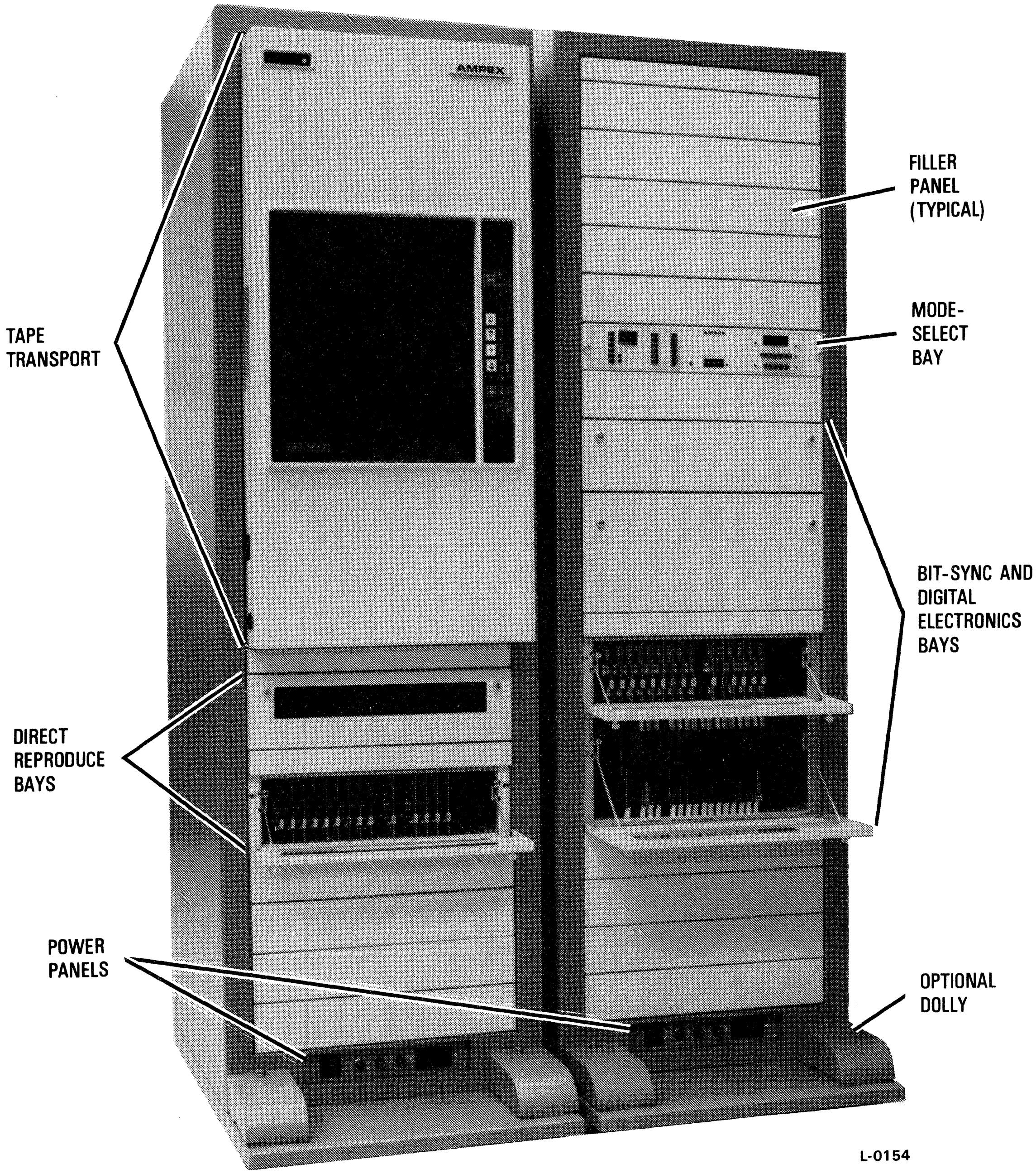

Figure 1-3. HBR-3000i Principal Assemblies

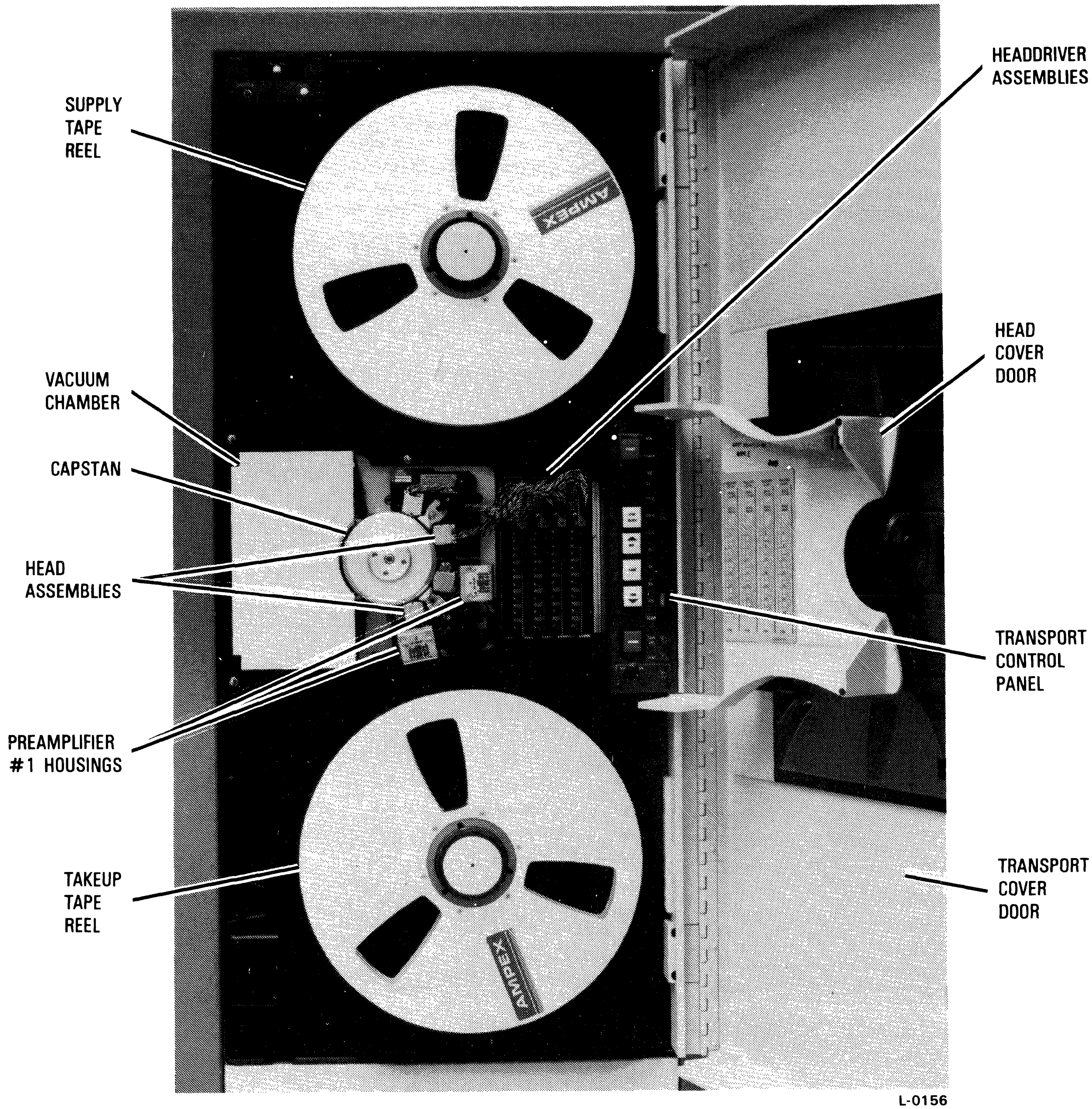

Figure 1-4. Tape Transport Front View

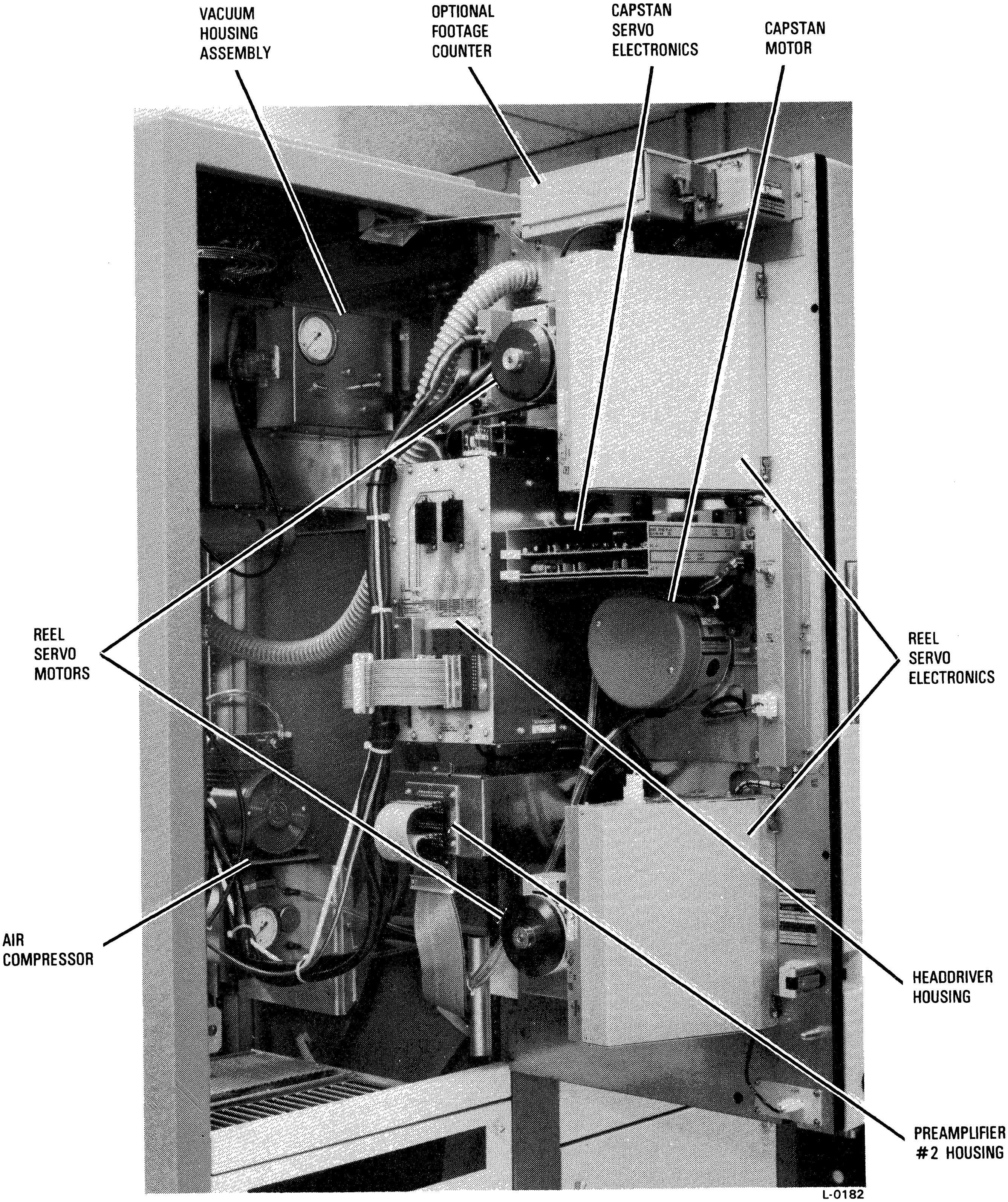

Figure 1-5. Transport Interior Assemblies

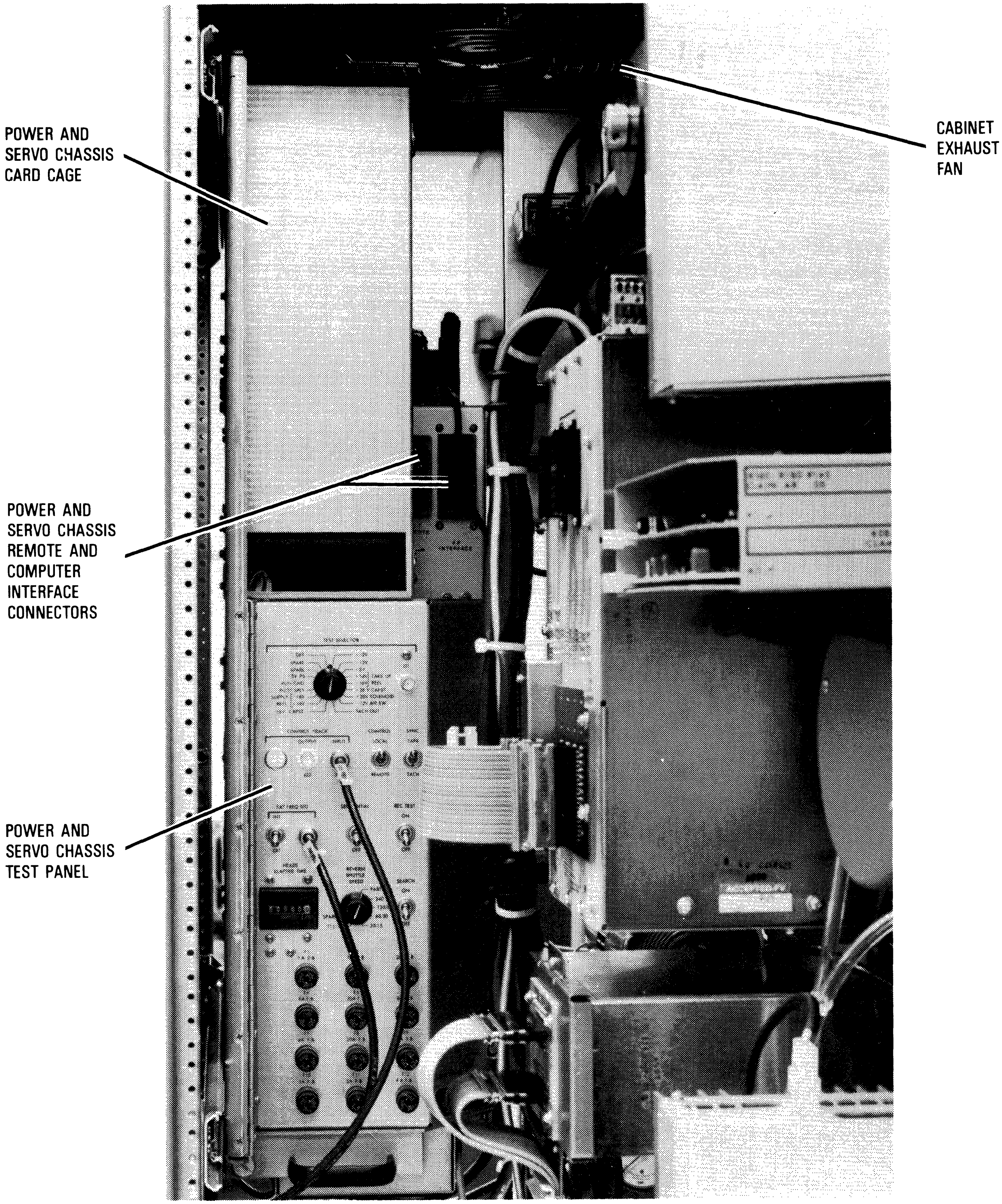

Figure 1-6. Transport Power and Servo Chassis

carded speeds, the next higher setting is usually used.) The transport employs air-bearing tape guides near the heads, and a vacuum chamber as part of the tension-control system. Details on the transport are given in this manual (section 3, operation, section 4, system description), in the tape transport adjustment manual, and in the tape transport maintenance manual.

1-5. Mode Select Bay (MSB)

The MSB is mounted either directly below the transport, or in the adjacent rack at a height convenient for operation of the controls. Mode selection includes operating, test, and monitor functions. Built-in test equipment (BITE) provides a frequency synthesizer, a test word generator, and an error detector and display. Further details of the MSB are contained in this manual (section 3, operation), in the signal electronics adjustment manual, and in the signal electronics maintenance manual.

1-6. Signal Electronics

The signal electronics of the HBR-3000i are contained in three types of bays and three types of housings:

a. One or two digital process bay(s) (DPB's)

b. A headdriver housing

c. Two types of preamplifier housings (one is part of the associated reproduce head assembly)

d. One or two reproduce bay(s) (REP bays)

e. One or two bit-sync/decoder bay(s) (BSB's)

In 28-channel systems, two bays of each type are used. They differ slightly in configuration, one being designated an "A" bay and the other a "B" bay. One bay of each type (in the "A" configuration) is used in 14-channel systems. The same number of the housings is used in all systems: two preamplifier number 1 housings, one each preamplifier number 2 and headdriver housings.

1-7. Digital Process Bay. The DPB contains record-signal printed wiring board assemblies (PWBA's) that accept incoming NRZ-L data and clock and process them for recording on tape in M^2 code, in analog form. These electronics also process the clock for controlling the capstan speed. The bay also contains reproduce-signal PWBA's that process the data from tape for output in its original (NRZ-L) form.

In addition, record and reproduce processing for both deskewing and error correction take place in this bay.

1-8. Headdriver Housing. The headdriver housing contains headdriver PWBA's that amplify analog signals representing the digital data to a level to drive the magnetic record heads. The headdriver housing is located in an opening in the transport adjacent to the head assemblies.

1-9. Preamplifier Housings. The preamplifier housings house preamplifier no.1 and preamplifier no.2 PWBA's which are portions of the same preamplifier circuit. The preamplifier no.1 circuits are mounted on the associated head assembly itself in order to minimize noise pickup. Their outputs are connected to the preamplifier no. 2 circuits in their housing which is mounted just below the headdriver housing.

1-10. Reproduce Bay. The outputs of the preamplifiers are coupled to the REP bay. In this bay, direct reproduce amplifiers amplify and equalize the reproduced analog signals to compensate for the low level, phase and frequency response which are inherent in magnetic tape reproducing.

1-11. Bit-Sync/Decoder Bay. The BSB houses bit-sync/decoder PWBA's (bit-sync's), and a master control PWBA. The bit-sync's receive the analog signal from the reproduce amplifiers, return them to digital format, decode the M^2 back to NRZ-L and reconstruct a clock precisely related to the data in each track. The outputs of the bit-sync's are sent to the DPB for deskewing, error correction, and parallel-to-serial conversion, if required. The master control PWBA controls the frequencies of voltage-controlled oscillators on the bit-syncs.

1-12. OPTIONS

Following are brief descriptions of a few of the optional accessories for the HBR-3000i.

1-13. Serial Data Converter Bay

With the use of an optional serial-data converter bay (ECL logic), a serial data stream as high as 100 Mb/s can be recorded and reproduced on a 28-channel system, or a 50 Mb/s stream on a 14-channel system.

1-14. Sequential Recording

Two recorders can be connected for sequential operation by the addition of one optional sequential cable. In this arrangement, when the first machine nears the end of a reel of tape in record mode, it automatically starts the second machine in record mode. An overlap of data is recorded until the first machine reaches the end of tape. If the first machine is reloaded while the second is recording, etc., recording can be continuous for any length of time.

1-15. Other Optional Accessories

Other standard optional accessories include remote controls (with and without a footage counter), computer interfaces (including an IEEE-488 bus interface and TTL level interfaces), voice monitors, etc. Consult the accessories manual, or your Ampex representative for details.

1-16. RELATED MANUALS

Included in this volume, in addition to this system manual, are adjustment manuals for the tape transport and the signal electronics, and a tape transport maintenance manual. Contained in a separate volume are a set of individual manuals on the signal electronics assemblies, including the bays that house them. Also included in the manual set is an accessories manual, in its own binder, covering the available accessories for the HBR-3000i.

SECTION 2

INSTALLATION

2-1. GENERAL

This section contains installation information including unpacking requirements, siting requirements, physical and electrical characteristics, and connector and cabling information.

2-2. UNPACKING REQUIREMENTS

Ampex recorder/reproducers are prepared for shipment using various packing and packaging methods. The method selected for a given shipment depends on the mode of transportation, destination, and contractual requirements.

WARNING

RACK-MOUNTED RECORDER/REPRODUCERS WITH TAPE TRANSPORTS INSTALLED HIGH IN THE RACK ARE VERY TOP-HEAVY. TO PREVENT INJURY TO PERSONNEL, OR DAMAGE TO THE EQUIPMENT, EXERCISE EXTREME CARE DURING UNPACKING AND HANDLING. AVOID TIPPING RACKS. DO NOT EXTEND THE TRANSPORT OR OTHER ASSEMBLIES UNTIL THE RACK IS BOLTED DOWN OR SECURED TO AN APPROVED DOLLY.

Magnetic tape recorder/reproducers are precision instruments, and adequate care must be employed during unpacking and handling to ensure proper operation of the equipment and to prevent equipment damage.

After unpacking a recorder make sure that any protective padding, blocks, and tie-downs used inside the equipment rack for shipment are removed. Inspect the equipment carefully for shipping damage, and if any is found, notify both the shipping carrier and the local Ampex representative.

2-3. SITING

Install the HBR-3000i in a location that provides a level, firm surface, free of vibration, and where ambient temperature and humidity fluctuations are as small as possible. In addition, the environmental atmosphere should contain neither excessive dust, nor corrosive fumes such as those found near storage batteries. (For high density digital systems such as the HBR-3000i, all possible exclusion of dust is of extreme importance.) Further, do not locate a magnetic tape recorder/reproducer or store magnetic tape in areas containing strong magnetic fields. These can cause deterioration or erasure of data (high frequencies in particular) on magnetic tape. They can also cause harmful magnetization of the head assemblies and tape guides on the tape recorder itself.

For installation and maintenance purposes, it is recommended that a minimum clear aisle space of 3 feet in front and 2 feet in back of the equipment be provided. See figure 2-1 for the rack cabinet dimensions. A free flow of air through the top of the rack must be maintained to prevent components from overheating. A rack fan assembly exhausts air through the top of the cabinet. Louvers in the lower part of the cabinet back door allow intake of air. A fan bay is located above each bit-sync bay (BSB), and a fan is included in the headdriver housing.

2-4. PHYSICAL AND ELECTRICAL CHARACTERISTICS

Physical characteristics of HBR-3000i systems, pertaining to locating equipment and putting it into service, are included in table 2-1 and figure 2-1. Electrical characteristics are also given in table 2-1.

2-5. CONNECTORS AND CABLING

The following paragraphs give information for interconnecting the cabinets in a two-cabinet system, and I/O connections for all standard systems.

2-6. 28-Channel Interconnect

If the system being installed is 14-track (i.e., all contained in a single-rack cabinet), this material does not apply.

The 28-track system is contained in two rack cabinets which must be located side by side. Conventionally, the rack containing the transport is on the left; however, this is not required. The following description is based on the conventional configuration with parenthetical notes for the reverse configuration.

The interconnections between the racks are made with cables which exit from the rear of the racks, by means of couplers. See figure 2-2.

NOTE

The cabinet rear doors may be removed for easier access during cabling and reinstalled at the end of the procedure.

a. After siting the equipment, locate the cables in the bottom rear of the electronics cabinet. There should be four 20-conductor coaxial ribbon cables, one 40-conductor flat ribbon cable, one 10-conductor flat ribbon cable, and two RG-type coaxial cables.

b. Feed the cables out through the rear doorway of the cabinet for easy access to the connectors.

c. Locate the cables in the lower rear of the transport cabinet (there are not any RG-type cables) and feed them out through the slots in the rear edge of the cabinet nearest the electronics cabinet.

d. Feed them into the electronics cabinet through the adjacent slots (see figure 2-2). Then feed them out the rear doorway of the electronics cabinet. They are to be coupled as shown in figure 2-3.

e. Locate the couplers (five 1257073 and one 1257093) in the loose parts shipped with the equipment.

Table 2-1. Installation Characteristics

CHARACTERISTIC	14-CHANNEL	28-CHANNEL
SIZE	(See figure 2-1)	(See figure 2-1 — double width)
WEIGHT (approximate)	660 lbs	640 transport cabinet 400 electronics cabinet 1040 lbs total
POWER CONSUMPTION without serial data converter bay	1400 VA	1900 VA
POWER CONSUMPTION with serial data converter bay	1500 VA	2000 VA
DOMESTIC U.S. INPUT POWER	115 VAC, 47 to 63 Hz	
DOMESTIC U.S. POWER CONNECTORS	J501 (Power chassis, ref.): Ampex 145-640, Hubbell 2615 Mating connectors: Ampex 145-637, Hubbell 2613	
INTERNATIONAL POWER INPUT*	220 VAC, 47-63 Hz	
INTERNATIONAL POWER CONNECTORS	J501 (Power chassis, ref.): Ampex 145636, Hubbell 2625 Mating connector: Ampex 145-638, Hubbell 2623	

* An international power converter kit may be installed at the factory or in the field.

f. Locate cable X29 DPB(B) XJ6 HD DRVR, coming from the transport cabinet. Connect it to one of the couplers (1257073), with pin 1 (there should be a white stripe on the connector body) next to the PIN 1 – UP end of the coupler. See figure 2-4A.

g. Locate the cable with the same label coming from the electronics cabinet. Plug it into the other side of the coupler with pin 1 next to the PIN 1 – DWN end of the coupler. If this was done correctly, the pin-1 (white-stripe) end of each cable connector is near the same end of the coupler; however, the white stripe on one connector (PIN 1 UP) should be visible, on the other it should not. (See figure 2-4B for a typical completed connection).

h. Repeat steps *f* and *g* for the following pairs of cables:

   1. X22 REP(B) XJ19 B-S(B)

   2. X29 DPB(A) XJ5 HD DRVR

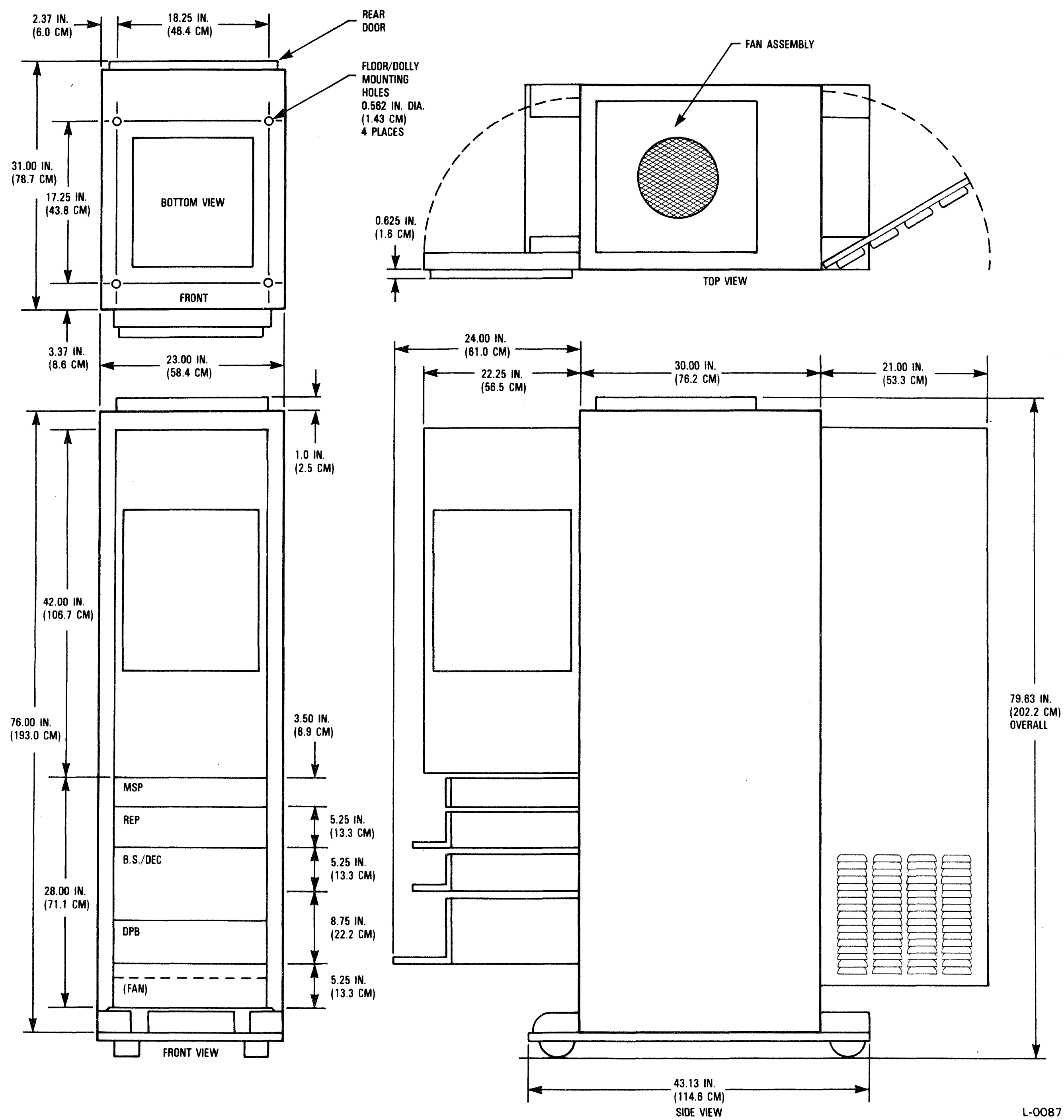

Figure 2-1. Installation Dimensions

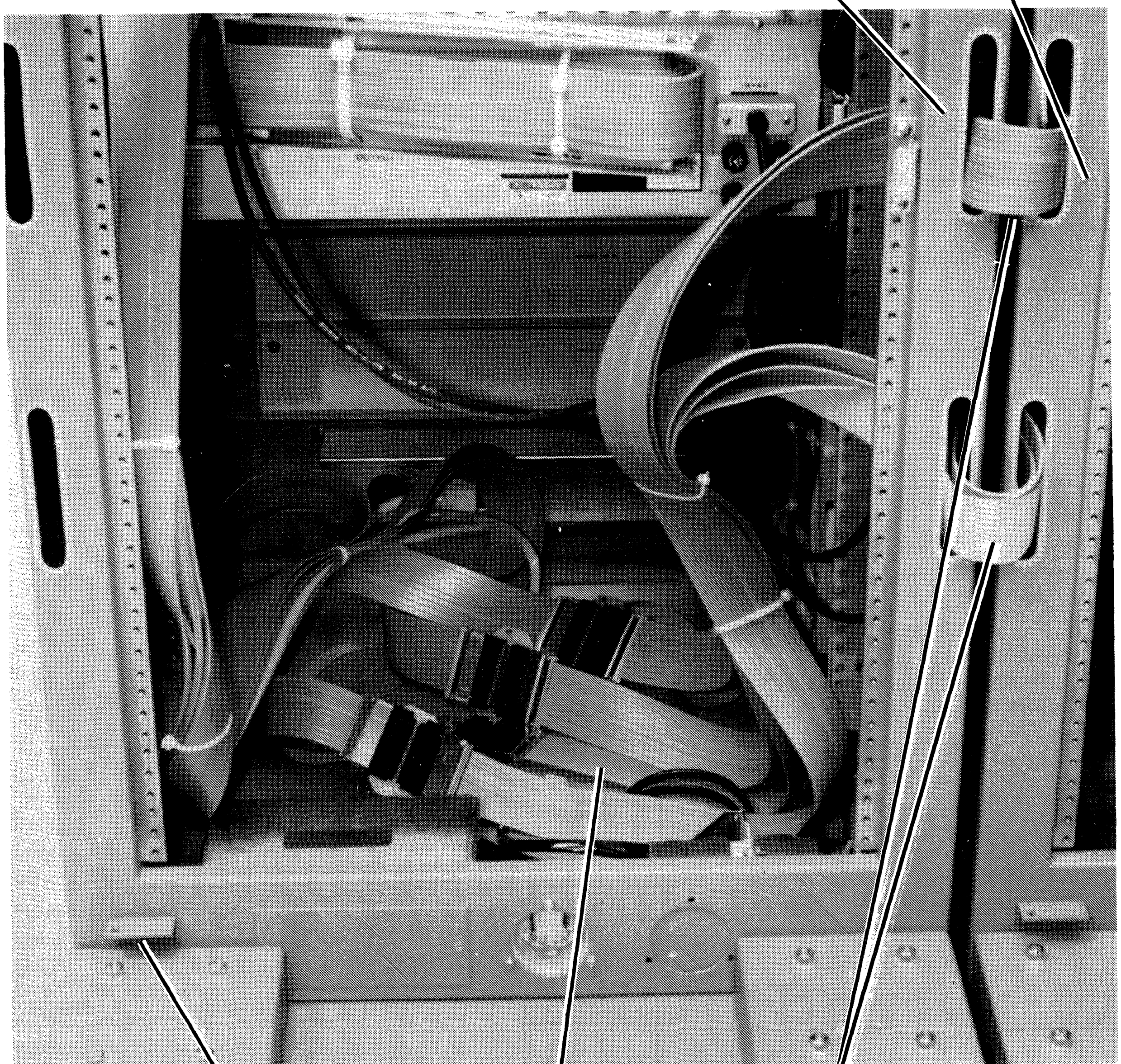

Figure 2-2. Inter-Rack Cabling in Place

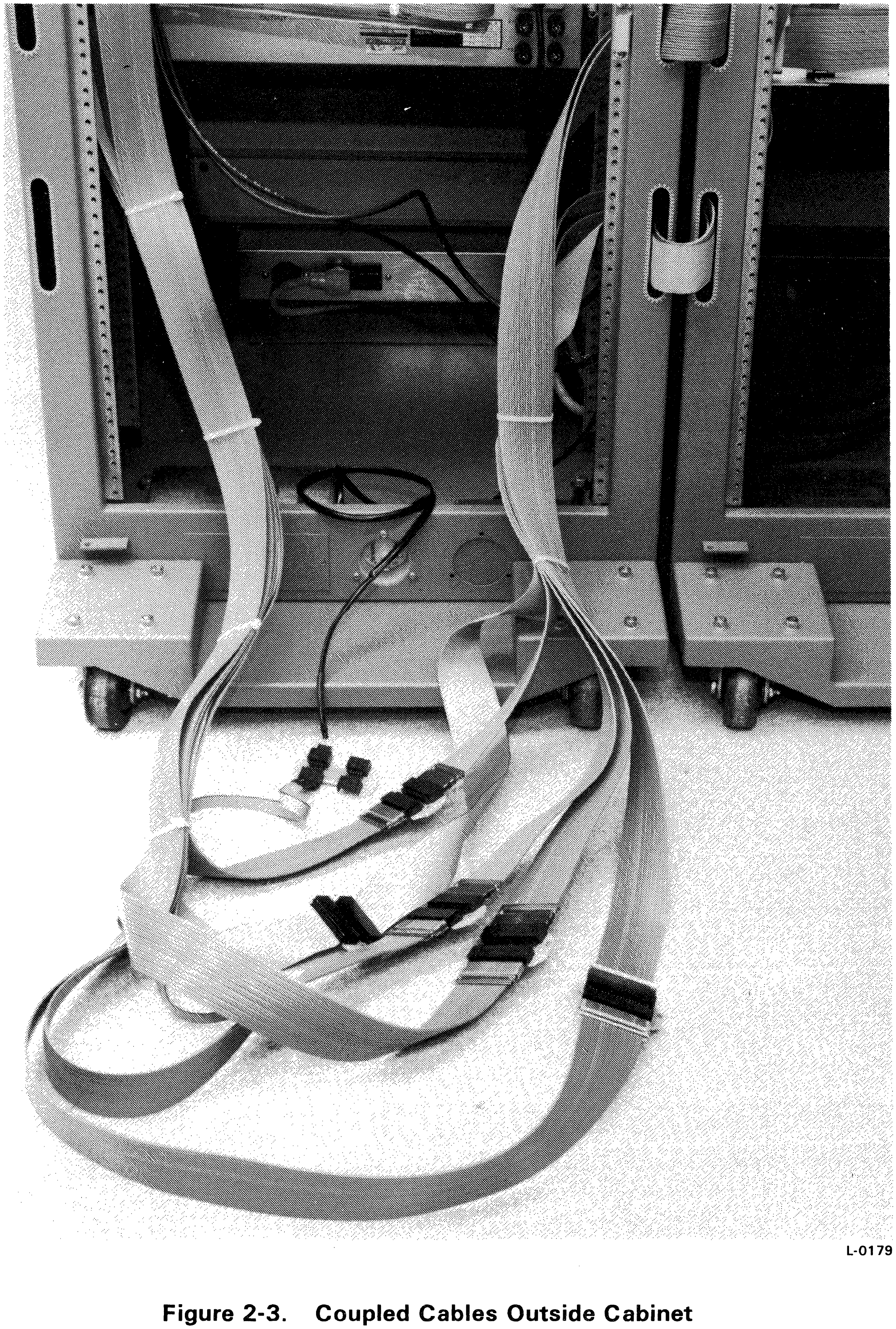
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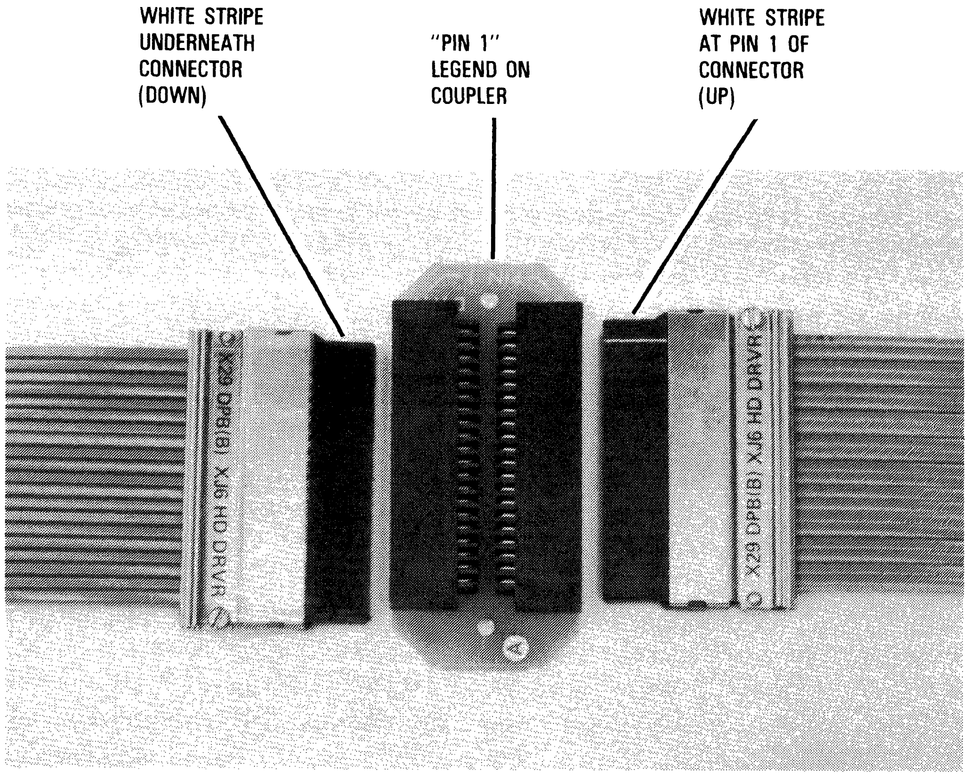
Figure 2-3. Coupled Cables Outside Cabinet



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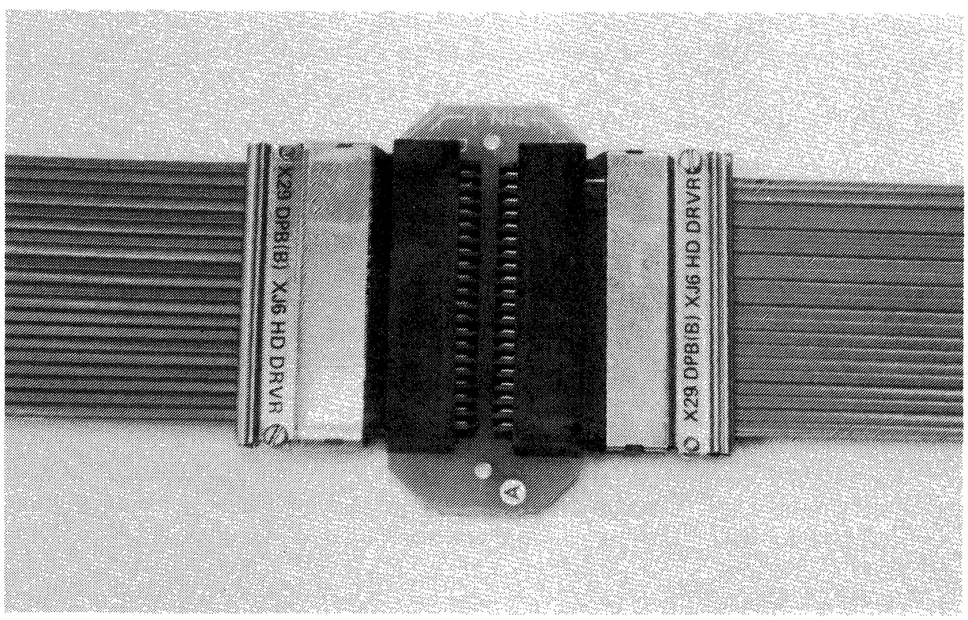
A. CABLE CONNECTORS AND COUPLER BEFORE CONNECTION



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B. CABLE CONNECTORS AND COUPLER CONNECTED

Figure 2-4. Typical Coupler Connection

3. X22 REP(A) XJ19 B-S(A)

i. Locate the 40-conductor ribbon cables from each cabinet and connect them together, using the last 40-pin coupler with pin 1 of each cable at the same end of the coupler. Pin 1 is designated by the red stripe on one edge of the cable.

j. Locate the 10-conductor ribbon cables from each of the cabinets and connect them, using one pair of the connectors on the dual 10-pin coupler (1257093), with pin 1 at the same end of the coupler. The other half of this coupler is not used.

k. Feed the two RG-type coax cables into the transport cabinet through one of the slots in the rear edge of the cabinet. Route them up the side of the cabinet (behind the slides for the reproduce bays) where the power cables are located. Bring them out over the top of the upper reproduce bay and connect them to J23 and J24 on the front of the transport power and servo chassis. Access for this last step is from the front of the transport cabinet after releasing the transport and swinging it out.

2-7. Data/Clock I/O

User data and clock interface is at the rear of the digital process bay (DPB). See figures 2-5 and 2-6 along with the following discussion. The connections are different depending on the system configuration; use the description which applies to the correct system configuration. If this is initial installation, see the configuration sheet in section 1 of this manual. If the configuration has been changed, use the description which applies to the new configuration.

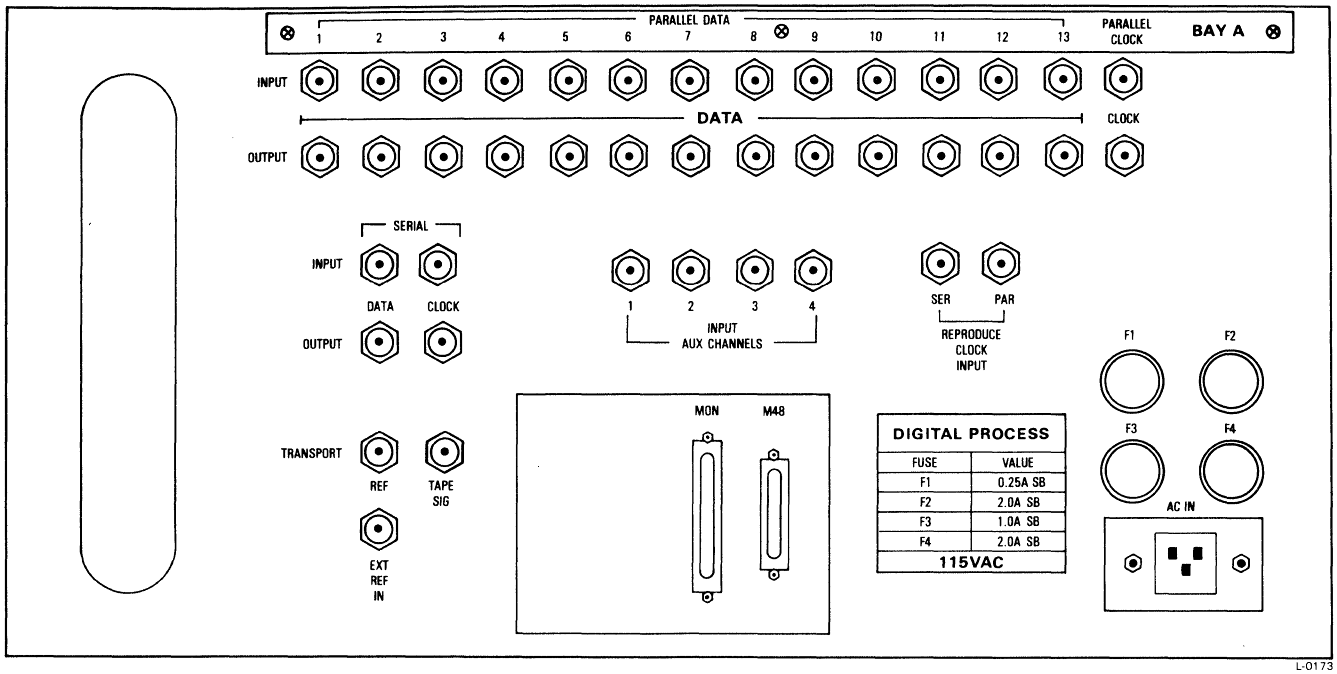
2-8. Parallel System. The parallel system is similar to the word-serial system in interface, and care should be taken to ensure that the proper configuration is installed. If there is any doubt, refer to section 8 of this manual, on how to configure a system.

The top two rows of BNC connectors in each DPB are the I/O connections for this configuration. As shown in figure 2-4, they are labeled PARALLEL DATA 1 to 13 and PARALLEL CLOCK BAY A (also PARALLEL DATA 14 to 26 and PARALLEL CLOCK BAY B in a 28-track system). The actual number of parallel channels to be recorded is determined by the user requirements. In 28-track systems, DPB A and DPB B must each have a PARALLEL CLOCK signal of identical rate and phase.

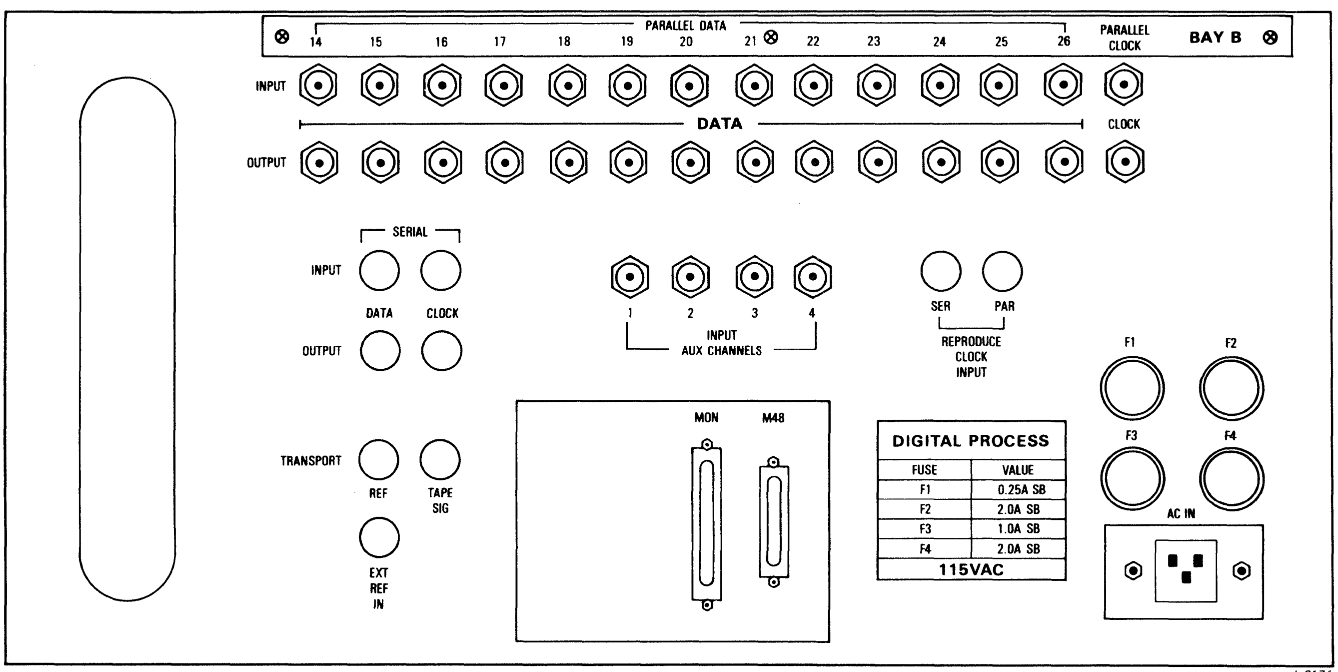
a. ECC system. For the ECC configuration, up to 12 parallel inputs can be connected in each of the bays (for a total of 24 inputs to a parallel system). Channels 1 thru 13 are in DPB A and channels 14 thru 26 are in DPB B. Channels 12 and 25 or 13 and 26 are used by the ECC electronics and when thus used are unavailable for user application. Channels 12 and 25 are normally used by the ECC electronics for parity channels and channels 13 and 26 are available as either uncorrected parallel data channels or auxiliary analog data channels (depending on programming in the DPB). If channel 12 (and/or 25) is used as a corrected data channel, the parity is moved to channel 13 (and/or 26) and these channels are unavailable for data inputs.

b. Non-ECC system. For non-ECC systems, up to 13 inputs are available in each of the DPB's: channels 1 thru 13 in DPB A, and channels 14 thru 26 in DPB B.

c. Parallel clock. The parallel clock input on the right end of the top row is the record clock input. If the system is to use an external clock for reproduce reference, it must be connected to the PAR REPRODUCE CLOCK INPUT connector.

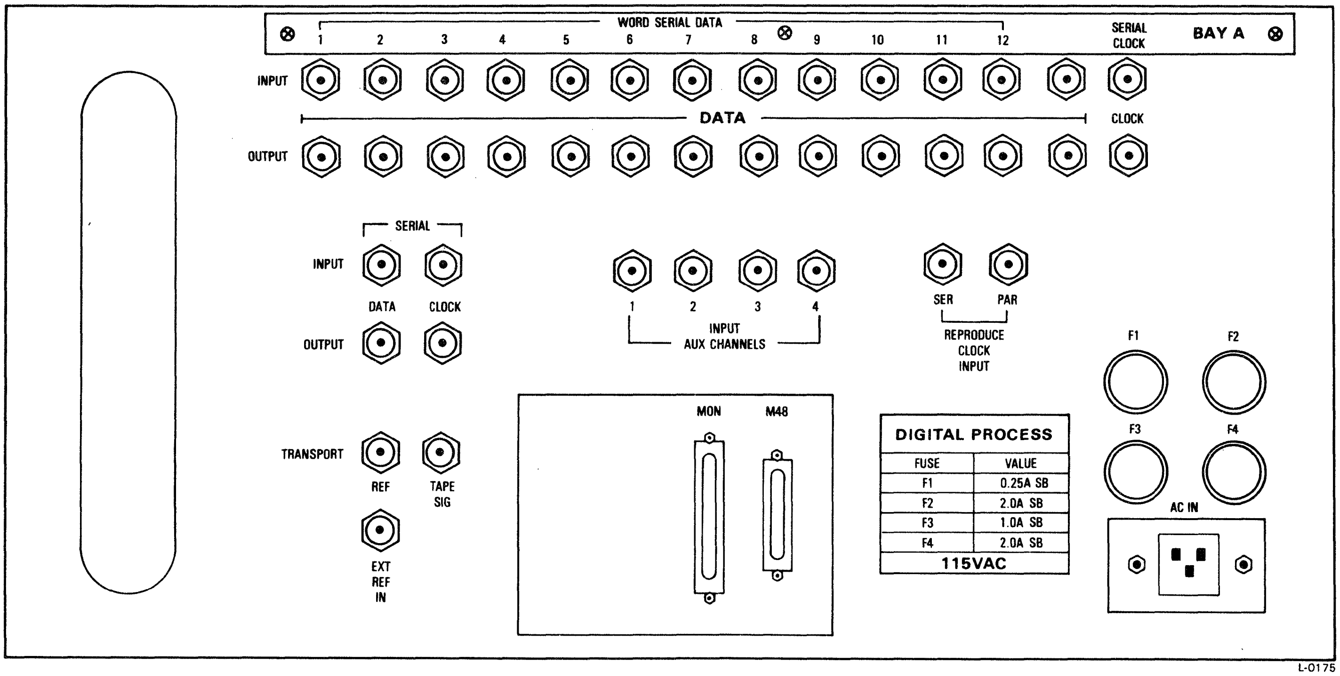


BAY A, ALL SYSTEMS

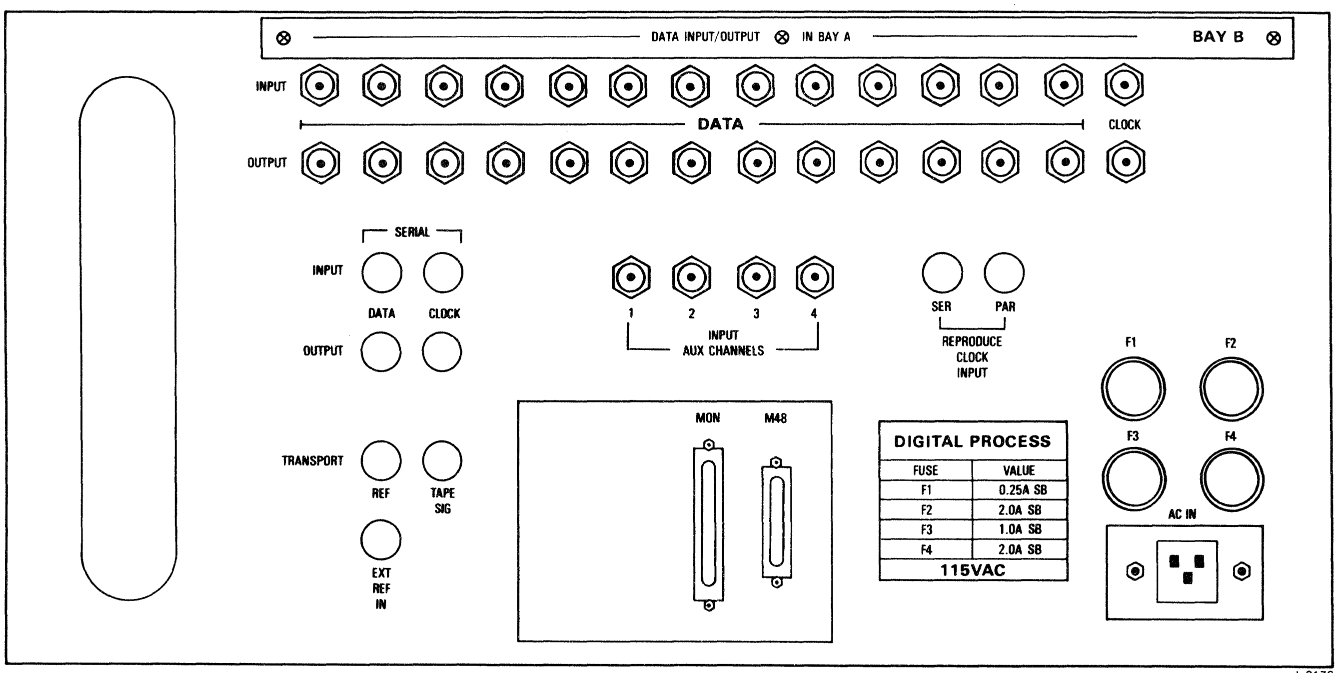


BAY B, 28-CHANNEL SYSTEMS

Figure 2-5. Bit-Serial and Parallel System DPB Rear Panels



BAY A, ALL SYSTEMS



BAY B, 28-CHANNEL SYSTEMS

Figure 2-6. Word-Serial System DPB Rear Panels

Table 2-2. Parallel Interface

CONNECTOR	LEVEL	NOTES
INPUT PARALLEL DATA	LSTTL	75Ω to ground
INPUT PARALLEL CLOCK	LSTTL	75Ω to ground
PAR REPRODUCE CLOCK INPUT	LSTTL	75Ω to ground
OUTPUT PARALLEL DATA	STTL	74S37 with 10Ω series resistor
OUTPUT PARALLEL CLOCK	STTL	74S37 with 10Ω series resistor

See table 2-2 for the electrical interface to these connections.

2-9. Word-Serial System. The word-serial system is similar to the parallel system and care should be taken to be sure which configuration is installed. If there is any doubt, refer to section 8 of this manual, on how to configure a system.

The top two rows of BNC connectors in DPB A are the I/O connectors for this configuration. See figure 2-6. They are labeled WORD SERIAL DATA 1 to 12 and SERIAL CLOCK. The top two rows of BNC connectors in DPB B are not functional in this configuration and should be labeled DATA INPUT/OUTPUT IN BAY A.

The maximum number of active inputs is determined by the user configuration (i.e., up to 12 inputs divided by 2, or up to 8 inputs divided by 3, or up to 6 inputs divided by 4). The unused inputs are terminated and may be left connected if variable configurations are used. The configuration as originally supplied can be found at the beginning of this manual. See section 8 of this manual for configuration changes.

The serial clock input adjacent to the word serial data input connectors is the record mode clock. If an external reproduce reference is required, it must be connected to the SER REPRODUCE CLOCK INPUT.

Table 2-3 gives the electrical interface requirements.

2-10. Bit-Serial System. From the rear of the DPB, the bit-serial system appears the same as a parallel system. See figure 2-5. However, the I/O connections are *not* made on the upper rows of BNC connectors. The I/O connections are the four BNC connectors in the left center position of the DPB. If an external reproduce reference is to be used, it should be connected to the SER REPRODUCE CLOCK INPUT. See table 2-4 for the electrical interface requirements.

2-11. Auxiliary Direct I/O. Provisions for up to four auxiliary channels per DPB are provided (three if ECC is used). Signals in these channels pass only through the direct (analog) electronics. The inputs are located on the rear of the DPB and the outputs are on the rear of the bit-sync bay (BSB). They are labeled INPUT and OUTPUT AUX CHANNELS 1, 2, 3, 4, respectively. In a 28-track system, they are associated with the appropriate DPB and BSB as A1, A2, A3, A4 and B1, B2, B3, B4. See table 2-5 for a description of the electrical interface. (Original configuration of your system is given in table 1-1. Configuration changes are covered in section 8.)

Table 2-3. Word Serial Interface

CONNECTOR	LEVEL	NOTES
INPUT WORD SERIAL DATA	LSTTL	75Ω to ground
INPUT WORD SERIAL CLOCK	LSTTL	75Ω to ground 1 kΩ to +5 V
SER REPRODUCE CLOCK INPUT	STTL	75Ω to ground
OUTPUT WORD SERIAL DATA	STTL	74S37
OUTPUT WORD SERIAL CLOCK	STTL	74S37

Table 2-4. Bit-Serial Interface

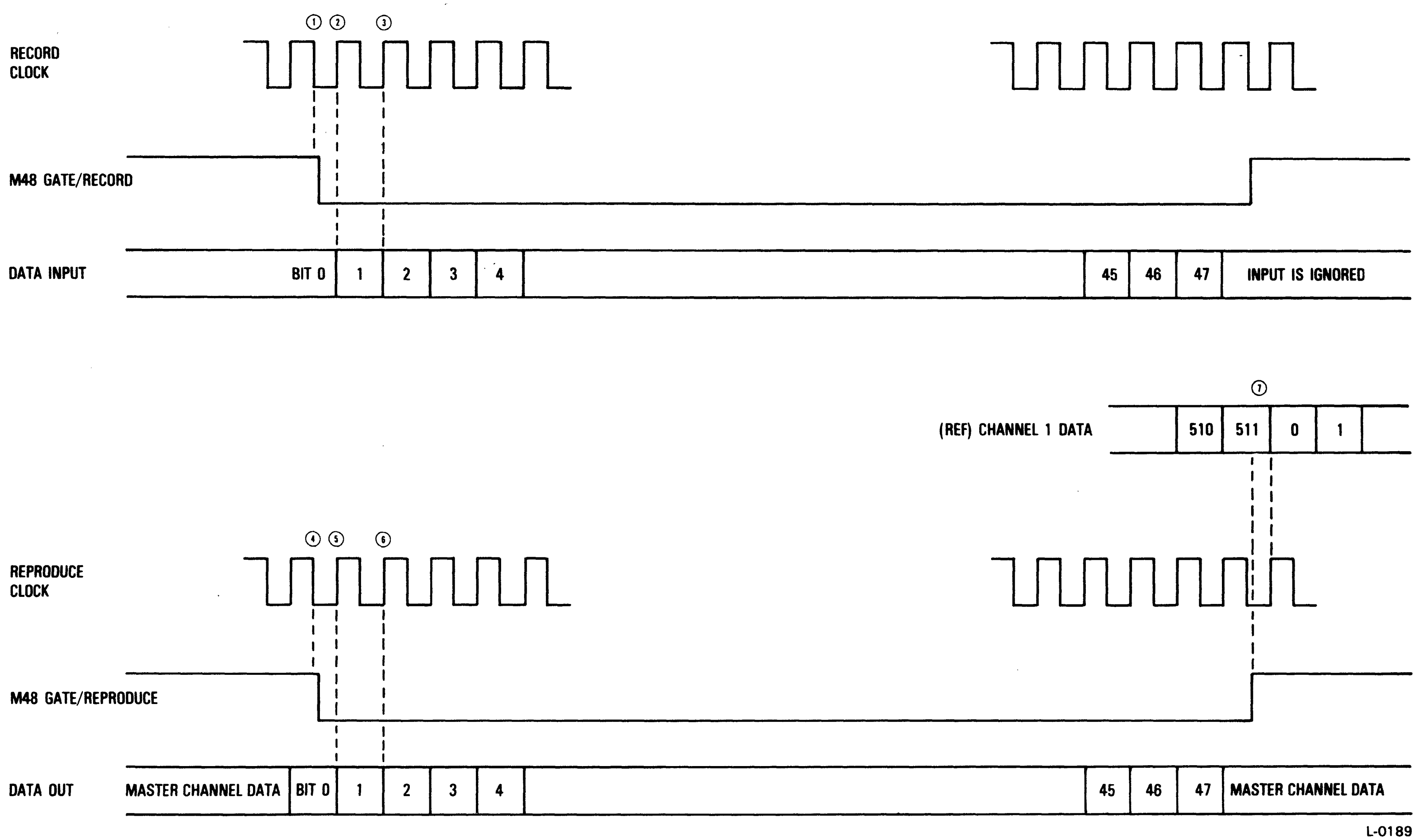
CONNECTOR	LEVEL	NOTES
INPUT SERIAL DATA	STTL	75Ω to ground
INPUT SERIAL CLOCK	STTL	75Ω to ground
SER REPRODUCE CLOCK INPUT	STTL	75Ω to ground
OUTPUT SERIAL DATA	STTL	74S140
OUTPUT SERIAL CLOCK	STTL	74S140

Table 2-5. Auxiliary Channel Interface

CONNECTOR	LEVEL	NOTES
INPUT AUX CHANNELS	0.5-2 V RMS	75Ω
OUTPUT AUX CHANNELS	0.5-2 V RMS	75Ω AC coupled

2-12. M48 I/O. The M48 I/O connections are made on a single multipin connector (25-pin D-subminiature type). See table 2-6 for pin assignments and electrical interface requirements, and figure 2-7 for signal timing requirements.

2-13. Monitor Connections. The monitor connections are made on a single multipin connector (37-pin D-subminiature type). The electrical interface requirements are as shown in table 2-7.



①④ M48 GATE TRANSITION IS TIMED TO BUT SLIGHTLY DELAYED (≈20 NS) FROM NEGATIVE TRANSITION OF CLOCK.

② FIRST M48 DATA BIT (BIT 0) WILL BE CLOCKED INTO SYSTEM ON FIRST POSITIVE CLOCK EDGE FOLLOWING GATE TRANSITION.

③ SUCCESSIVE BITS ARE CLOCKED INTO SYSTEM ON POSITIVE CLOCK EDGES.

⑤ FIRST REPRODUCE M48 DATA BIT (BIT 0) WILL BE VALID AT GATE TRANSITION AND UNTIL APPROXIMATELY 20 NS AFTER FIRST SUBSEQUENT POSITIVE CLOCK EDGE.

⑥ SUBSEQUENT DATA BITS ARE VALID FOR ONE CLOCK CYCLE.

⑦ FOR REFERENCE CHANNEL 1 DATA OUTPUT STARTS BIT 0 (FIRST DATA BIT) AT FIRST POSITIVE CLOCK TRANSITION FOLLOWING TRAILING EDGE OF M48 GATE.

Figure 2-7. M48 Timing

Table 2-6. M48 Interface

SIGNAL	PIN NO. DIFFERENTIAL		LEVEL	NOTES
	+	–		
Record gate output	1	14	TTL	9638
Record clock output	2	15	TTL	9638
Data input	3	16	TTL	
Reproduce gate output	4	17	TTL	9638
Reproduce clock output	5	18	TTL	9638
Data output	6	19	TTL	9638
System ground	13			

2-14. Tape Transport Interface

Refer to table 2-8. The EXT REF IN connector (on the power-and-servo chassis test panel of the tape transport) is provided for external input of an IRIG reference signal for tape speed control when operating in non-HBR mode at nonstandard speeds. The other two transport interface connectors provide the transport with its capstan reference for HBR use (REF) and its "tape" signal (TAPE SIG) for speed-error correction while reproducing data.

2-15. Mode Select Bay Interface

The rear panel of the mode select bay (MSB) has provisions for a variety of synchronization and data connections to the user. They are primarily intended as test mode connections, but in some instances they may be operationally useful. Refer to figure 2-8 and table 2-9.

The DSKW SYNC OUTPUT provides a means of synchronizing test equipment to the master-channel sync-word position. It is a negative-going pulse, one parallel clock cycle wide, occurring during the first bit following the master channel sync word.

The GEN and READ SYNC outputs provide a means of synchronizing to the internal data generator and reader respectively. The generator output is a negative-going pulse. The read sync pulse is positive-going. Both pulses are one data bit wide, occurring at the beginning of the data pattern selected (511 or 2047 pseudo-random or fixed word).

The EXT OSC input is selected by the INT/EXT OSC pushbutton on the BITE panel. It allows an external clock source to be used in place of the built-in frequency synthesizer. If necessary, the symmetry of this clock signal can be adjusted on the clock divider PWBA of the MSB. Refer to the MSB manual in the signal electronics volume.

Table 2-7. **Monitor (MON) Output Interface**

SIGNAL	PIN NO.	LEVEL	DEVICE	NOTES
Flag monitor 1	1	LSTTL	74LS04	1 = flag
Flag monitor 2	20	LSTTL	74LS04	1 = flag
Flag monitor 3	2	LSTTL	74LS04	1 = flag
Flag monitor 4	21	LSTTL	74LS04	1 = flag
Flag monitor 5	3	LSTTL	74LS04	1 = flag
Flag monitor 6	22	LSTTL	74LS04	1 = flag
Flag monitor 7	4	LSTTL	74LS04	1 = flag
Flag monitor M	23	LSTTL	74LS04	1 = flag
Flag monitor 8	5	LSTTL	74LS04	1 = flag
Flag monitor 9	24	LSTTL	74LS04	1 = flag
Flag monitor 10	6	LSTTL	74LS04	1 = flag
Flag monitor 11	25	LSTTL	74LS04	1 = flag
Flag monitor 12	7	LSTTL	74LS04	1 = flag
Flag monitor 13	26	LSTTL	74LS04	1 = flag
Flag 1 monitor	8	OCTTL	7407 (4.7 K pullup)	0 = flag
Flag 2 monitor	27	OCTTL	7407 (4.7 K pullup)	0 = flag
Parity retest	9	STTL	74S280	1 = error
Parity sum	28	LSTTL	74LS00	1 = error
CSDB	10	LSTTL	74LS04	
Parity clock	29	STTL	74S37	
Bit-sync lock	11	STTL	74S04	0 = locked
System ground	19			

Table 2-8. Transport Interface

TRANSPORT CONNECTOR	LEVEL	NOTES
EXT REF IN	0.5-5 V RMS	1 kΩ, AC-coupled, for external capstan control.
REF (J24)	TTL	Internally derived capstan reference signal from TRANSPORT REF on DPBA.
TAPE SIG (J23)	TTL	Master-channel bit-sync clock processed for use as "tape" signal. From TRANSPORT TAPE SIG on DPBA.

Table 2-9. MSB Interface

CONNECTOR	LEVEL	SOURCE/LOAD	NOTES
INT CLK OUTPUT	STTL	74S140	
EXT DATA INPUT	STTL	75Ω (ground)	1 load
EXT CLOCK INPUT	STTL	75Ω (ground)	1 load
EXT DATA OUTPUT	STTL	74S140	
EXT CLOCK OUTPUT	STTL	74S140	
SYNC GEN OUTPUT	STTL	74S37	
SYNC READ OUTPUT	STTL	74S37	
SYNC DSKW OUTPUT	STTL	74S37	
EXT OSC INPUT	0.5-2 V RMS	75Ω	AC coupled
TEST DATA OUTPUT	STTL	74S140	
TEST CLOCK OUTPUT	STTL	74S140	
TEST ERR OUTPUT	STTL	74S86	

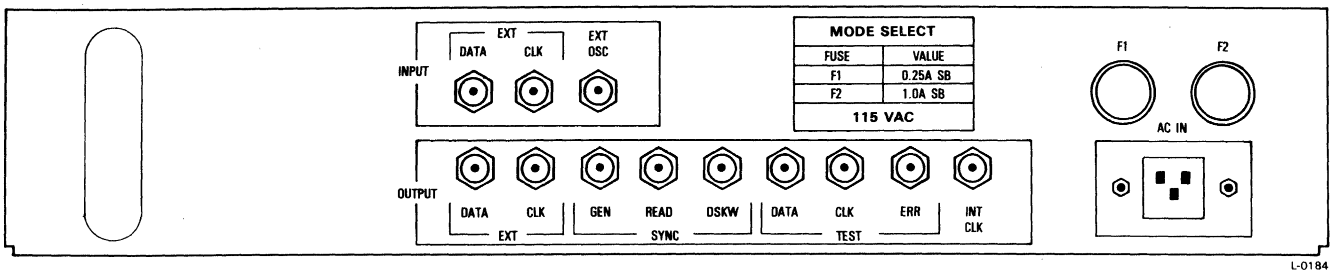


Figure 2-8. MSB Rear Panel

The external word (EXT DATA) input and output are provided for connection of external test equipment (i.e., random or special pattern generator/reader) through the system without disturbing the normal input connections. They are selected by the INT/EXT WORD pushbutton on the BITE panel.

The EXT CLK OUTPUT provides a TTL clock at the same rate as the BITE system is operating. That is, it is the synthesizer clock (or EXT OSC input) divided by the clock divider PWBA, which is the frequency being used to generate the test data.

The TEST DATA OUTPUT and TEST CLK OUTPUT provide the user with the output of the internal data generator. This can be fed to the normal inputs of the system to evaluate the system in normal mode. The output can be read by an external reader, by the internal reader in reproduce test mode, or by the internal reader in normal reproduce mode via the EXT DATA and EXT CLK inputs.

The TEST ERR OUTPUT is a TTL pulse for each error detected by the internal reader.

2-16. BENCHMARK TAPE

It is good practice to make a benchmark test tape as soon as your system is installed and operating. Record this tape in the parallel mode (even for systems normally used in the serial mode) using the packing density, number of channels, etc., as are usual for your application. Record a pseudo-random test word for the entire length of a reel of tape, half without and half with an inserted sync word. Play the tape back and verify that all channels are operating satisfactorily. Mark the reel with the particulars of the recording (bit-rate, packing density, channel assignment, etc.). Store the tape in a vault or other safe place. This benchmark tape verifies system operation and can be a valuable tool for use in maintenance and troubleshooting (although it cannot be used to reverify bit-error-rate).

To make a benchmark tape, proceed as follows:

a. Load a fully degaussed reel of properly cleaned tape (refer to section 5 of this manual for tape care information).

b. Set all the MSB BITE switches to the *out* position. This provides a 511-bit pseudo-random word with the display set to accumulate errors.

c. Set the frequency synthesizer to the equivalent of 120 IPS per-channel rate.

d. Set the other MSB switches *out* except set the NORMAL/TEST, SYNC INHIBIT, DESKEW/BIT SYNC, and the SERIAL PARALLEL SWITCHES *in*. This sets BITE test data the same on all channels in parallel without sync insertion.

e. Record the first half of the reel of tape with the above conditions.

f. Record the last half of the reel of tape with the sync word inserted. To do this, set the SYNC INHIBIT and DESKEW/BIT SYNC switches to the *out* position. All other conditions are the same.

g. In the reproduce mode, observe the output of all channels to verify operation. On the last half of the tape, the master and slave master channel are not accessible with the channel select thumbwheel switches.

2-17. CONFIGURATION SWITCHES

Switches on the PWBA's are used to configure the HBR-3000i and are normally set at the factory. For the use of these switches in programming system configuration, refer to section 8 of this manual.

SECTION 3

OPERATION

3-1. GENERAL

This section contains instructions for the operation (including preoperation) of HBR-3000i recorder/reproducers. The section covers the following topics:

a. Controls and indicators

b. Preoperation

c. Operation

To ensure good results, the preoperational procedures should be carefully followed before operating the recorder.

3-2. CONTROLS AND INDICATORS

HBR-3000i recorder/reproducers are operated from four separate panels (see associated figures and tables 3-1 through 3-4):

a. An AC power panel located at the bottom front of the rack cabinet. It controls AC power to the rack. (Each rack has its own independent power input.)

b. A control panel mounted on the right front of the tape transport. It controls tape movement, record/reproduce modes. It also controls reproduce equalization and bit-sync rate via speed-select switches.

c. A test panel (part of the power and servo chassis) mounted on the inside of the rack cabinet behind the tape transport. In addition to test functions, this panel selects remote, sequential, and search functions for those systems so equipped. (The INT/EXT switch is bypassed and has no function on HBR-3000i's.)

d. A mode select panel, the front panel of the mode select bay (MSB), is located just below the transport on 14-track systems and adjacent to the transport on 28-track systems. These controls select the signal electronics mode of operation and provide monitoring and test functions.

3-3. Power Panel Control, Indicator, and Fuses

The components on the power panel are shown in figure 3-1. Their types and functions are described in table 3-1. Detailed information on the power panel (part of the power chassis assembly), is to be found in the HBR-3000i tape transport maintenance manual.

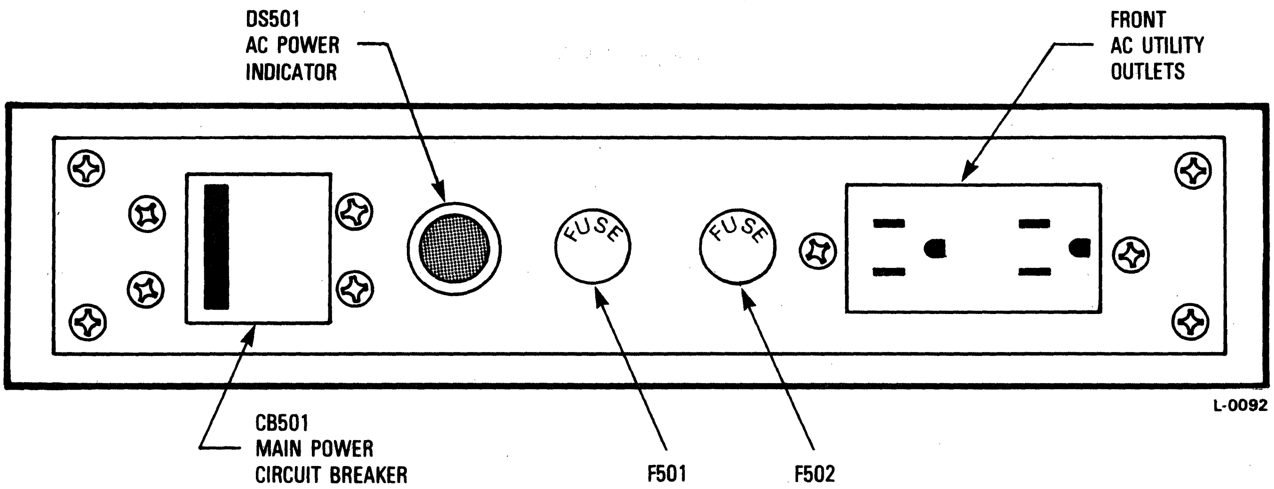


Figure 3-1. Power Panel Control and Indicator

Table 3-1. Power Panel Control, Indicator, and Fuse Functions

SCHEMATIC REF	CONTROL OR INDICATOR	TYPE	FUNCTION
CB501	Main Power	Circuit breaker	Applies AC power to the power and servo chassis, the +30 V pilot power supply, the power supplies in the electronics trays*, and the convenience strip and outlets in the rack cabinet.
DS501	AC Power	Lamp (Red)	Indicates that AC power is applied as described for circuit breaker CB501 above.
F501	Fuse	Fast Blo 10 A, 250 V	Provides overload protection for the rear (inside cabinet) AC outlet.
F502	Fuse	Fast Blo 10 A, 250 V	Provides overload protection for the front AC outlet. (The front outlet is not switched by the circuit breaker CB501.)

* This immediately applies power to the digital, bit-sync, and analog reproduce electronics, and makes power available to the filter PWBA for record mode. CB501 should be set to OFF before inserting or removing signal electronics printed wiring assemblies (PWA's).

3-4. Control Unit Controls and Indicators

The controls and indicators on the control unit are shown in figure 3-2. Their type and functions are described in table 3-2. Detailed information on the control unit is to be found in the HBR-3000i tape transport maintenance manual.

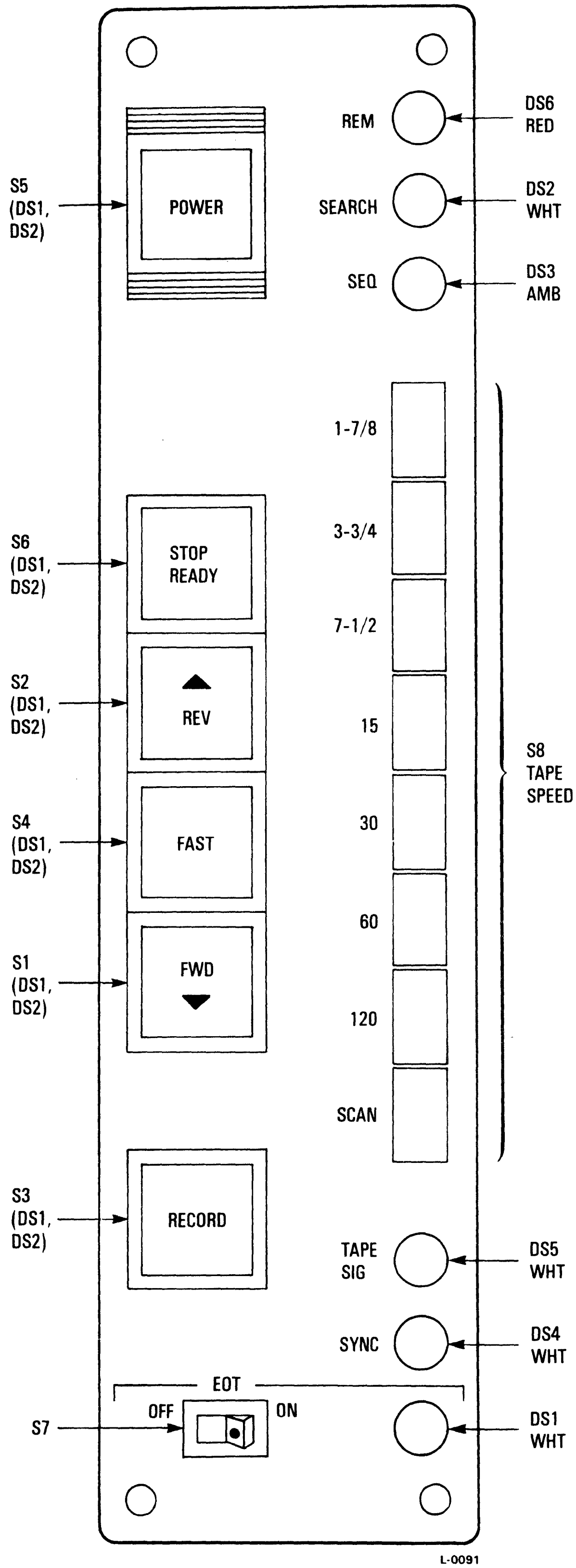


Figure 3-2. Control Unit Controls and Indicators

Table 3-2. Control Unit Controls and Indicators

SCHEMATIC REF	CONTROL OR INDICATOR	TYPE	FUNCTION
S5 DS1 DS2	POWER (transport)	Lighted push on/ push off pushbutton (green) Lamps	When the POWER pushbutton is initially pressed, power is applied to the tape transport, the power and servo unit, the vacuum blower, and the compressor. The footage counter (if fitted) also comes on. The POWER pushbutton is back-lit. If tape is threaded, and loops properly in the vacuum chamber, the STOP/READY pushbutton is back-lit. When the button is pressed a second time, it removes the power from these units. (Does not control signal-electronics power.)
S1 DS1 DS2	FWD (Forward)	Lighted pushbutton (white) Lamps	When the FWD pushbutton is pressed, it places the tape transport in the forward mode, and the FWD pushbutton is back-lit. In this mode, the tape moves from the upper reel to the lower reel. When correct tape speed is reached, the SYNC light also comes on.
S4 DS1 DS2	FAST	Lighted pushbutton (white) Lamps	When the FAST pushbutton is pressed simultaneously with the FWD pushbutton, it places the tape transport in the fast-forward mode and the FAST and FWD pushbuttons are back-lit. When it is pressed simultaneously with the REV pushbutton, it places the tape transport in the fast-reverse mode and the FAST and REV pushbuttons are back-lit.
S2 DS1 DS2	REV (Reverse)	Lighted pushbutton (white) Lamps	When the REV pushbutton is pressed, it places the tape transport in the reverse mode, and the REV pushbutton is back-lit. In this mode, the tape moves from the lower reel to the upper reel. When correct tape speed is reached, the SYNC light also comes on.
S6 DS1 DS2	STOP/READY	Lighted pushbutton (white) Lamps	When the STOP/READY pushbutton is pressed, tape movement stops, and the pushbutton is back-lit. When the STOP/READY pushbutton is lit, it indicates that the tape transport is in the ready mode; that is: a. Tape is positioned in the vacuum chamber, and adequate vacuum is present. b. The control logic and reel servo circuits are activated.

Table 3-2. **Control Unit Controls and Indicators (Cont)**

SCHEMATIC REF	CONTROL OR INDICATOR	TYPE	FUNCTION
S6 (Cont)			c. The brake solenoid is actuated, releasing the brakes.
S3 DS1 DS2	RECORD	Lighted pushbutton (red) Lamps	When the RECORD pushbutton is pressed simultaneously with either the FWD or REV pushbutton, the transport is placed in the record mode. The FWD or REV and the RECORD pushbuttons are lit. When the REC TEST switch on the power and servo chassis test panel is set to ON, the STOP/READY and RECORD pushbuttons are back-lit. In this condition, the tape may not be moved, but the record electronics in the transport are energized. This allows record electronics testing without moving tape. (See E-E mode in table 3-4.)
S7 DS1	EOT	Rocker switch Lamp (white)	When the EOT rocker switch is set to the ON position, it places the end-of-tape sensors in the circuit. The EOT indicator lights. Tape motion stops just prior to depletion of tape on either reel. When set to OFF, the end-of-tape sensors are disabled and the indicator light is off. Tape runs completely off the reel before the transport stops.
DS5	TAPE SIG indicator	Lamp (white)	When TAPE SIG indicator is lit, it indicates that the capstan servo is in tape mode and sufficient signal is being recovered from tape.
DS4	SYNC indicator	Lamp (white)	When the SYNC indicator is lit, it indicates that the capstan speed is synchronized with the appropriate reference frequency. When the SYNC lamp alone is lit, the capstan servo is synchronized with the tachometer and reference signals. When the SYNC and TAPE SIG indicators are on, the capstan servo is synchronized with the master bit-sync (tape) and reference signals.
DS3	SEQ indicator	Lamp (amber)	When the SEQ indicator is lit, it indicates that the SEQUENTIAL switch on the power and servo chassis test panel is set at ON, and therefore that the transport is ready to send or accept a sequential record command.
DS2	SEARCH indicator	Lamp (white)	When the SEARCH indicator is lit, it indicates that the SEARCH switch on the power and servo chassis test panel is set at ON.

Table 3-2. **Control Unit Controls and Indicators (Cont)**

SCHE-MATIC REF	CONTROL OR INDICATOR	TYPE	FUNCTION
DS6	REMOTE indicator	Lamp (red)	When the REMOTE indicator is lit, it indicates that the control switch on the power and servo chassis test panel is set at REMOTE and a remote control assembly is connected to the system. The POWER pushbutton on the transport is off, the STOP/READY light is on (if tape is properly threaded) and control of the transport modes of operation can be made from the remote control unit only.
S8	Tape speed visual indicator	8-position interlocked pushbuttons*	Permits selection of equalizers and timing units relating to one of seven indicated tape speeds: 1-7/8, 3-3/4, 7-1/2, 15, 30, 60, or 120 IPS. (The SCAN pushbutton selects the same equalizers and timing units as the 120 IPS pushbutton.) (If the HBR/IRIG pushbutton of the mode select bay [figure/table 3-4] is set to IRIG, these buttons select the indicated tape speeds. If in TEST mode, they select a division of the test clock frequency to determine tape speed.)

* Mechanically interlocked so that any individual pushbutton, when pressed, cancels the selection of any other.

3-5. Power and Servo Chassis Test Panel Controls and Indicators

The controls and indicators on the power and servo chassis test panel are shown in figure 3-3. Their types and functions are described in table 3-3. Detailed information on the power and servo chassis is to be found in the HBR-3000i tape transport maintenance manual.

3-6. MSB Diagnostic/Mode Select Controls and Indicators

The DIAGNOSTIC/MODE SELECT controls and indicators of the MSB are shown in figure 3-4 and described in table 3-4. Detailed information on the MSB is to be found in the HBR-3000i signal electronics manual. The use of the built-in test equipment (BITE) is covered in this manual, in section 5, and in the signal electronics adjustment manual.

3-7. PREOPERATION

Prior to using the system, the following information should be carefully noted, and all preoperational procedures should be performed.

3-8. Preventive Maintenance

Determine that the recorder is within the preventive maintenance schedule as described in section 5.

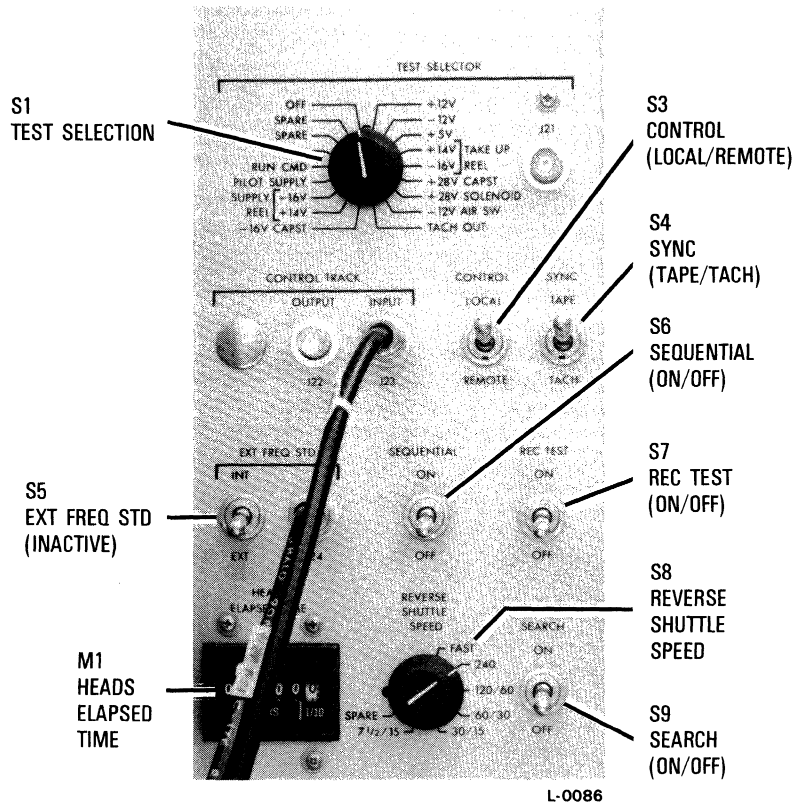


Figure 3-3. Transport Power and Servo Chassis Test Panel

3-9. Tape Selection for Recording Data

Select a reel of tape that has been bulk-erased. When recording new data, bulk-erasure of the tape will help to ensure optimum performance. The recommended tape for HBR-3000i systems is Ampex 799. In order to maintain the best bit-error rate (BER), the tape must be clean. For recommendations on cleaning tape, see section 5 of this manual.

3-10. Tape Handling

In addition to bulk degaussing and cleaning, the handling, care, and storage of magnetic tape is crucial to the success and longevity of high density digital recordings. The following conditions and practices will all contribute to the quality and durability of HBR recordings.

- Do not smoke or eat in the same room in which the recorder or exposed tape is located.

- Keep bands on the reels when they are not on the recorder. *Never* use any type of adhesive tape to hold the end of a roll of tape down.

- Keep reels in their boxes, standing vertically on a shelf. Never stack reels on their sides.

- Clip off damaged ends of tape.

Table 3-3. **Power and Servo Chassis Test Panel Controls and Indicators**

SCHE-MATIC REF	CONTROL OR INDICATOR	TYPE	FUNCTION
S1	TEST SELECTION	Rotary switch	Used to check the equipment for the presence of proper voltages and signals as placarded.
S3	CONTROL (LOCAL/REMOTE)	Toggle switch	When set at LOCAL, permits operation of the equipment exclusively from the control unit on the tape transport. When set at REMOTE, permits operation of the equipment exclusively from a remote control unit connected through a cable to REMOTE CONTROL receptacle J7 on the power and servo chassis.
S4	SYNC (TAPE/TACH)	Toggle switch	When set at TAPE, selects the master bit-sync clock as the capstan servo input. When set at TACH, selects the capstan tachometer signal as the capstan servo input. If the TAPE (bit-sync clock) signal disappears, the system automatically switches to TACH, regardless of the position of S4.
S5	EXT FREQ STD (INT/EXT)	Toggle switch	Inactive. This function is performed by the BIT RATE/EXT switch on the mode select panel.
S6	SEQUENTIAL (ON/OFF)	Toggle switch	When set to ON, permits the recorder to operate sequentially with another HBR-3000i via the sequential cable. When set at OFF, the equipment operates as an independent recorder/reproducer.
S7	REC TEST (ON/OFF)	Toggle switch	When set to ON, disables all tape motion modes, but enables the record electronics. This permits checking and setting up the record system without moving tape. When set to OFF, enables the normal operating modes.
S8	REVERSE SHUTTLE SPEED	7-position rotary	Permits selection of a reverse shuttle speed when the transport is in the shuttle mode. The SHUTTLE switch and the REV. SHUTTLE SPEED switch on the optional footage counter at the top of the tape transport must be set to *on*. (The REV. SHUTTLE SPEED SWITCH is located on the rear of the footage counter assembly, on the back of the transport.)
S9	SEARCH (ON/OFF)	Toggle switch	When set to ON, lights the SEARCH indicator on the control unit. If a search-control unit (SCU) is connected to the FR-3030, it also permits the SCU to control the operation of the FR-3030.

Table 3-3. **Power and Servo Chassis Test Panel Controls and Indicators (Cont)**

SCHEMATIC REF	CONTROL OR INDICATOR	TYPE	FUNCTION
M1	HEAD ELAPSED TIME	Meter	Indicates cumulative time of tape motion past the heads (run time).

- Handle reels of tape by their hubs *only*.
- Keep fingers off the tape pack.
- Keep the transport cover door closed except when loading and unloading tape.
- Watch for transport abnormalities:
  a. Roller guides not turning freely.
  b. Tracking problems, tape curl.
  c. Guide and chamber wear.
  d. Excessive tension.
- Keep the tape path clean.
- Watch for magnetized heads.
- Watch for and replace damaged reel flanges.
- Wherever possible, use an airconditioning system equipped with electrostatic filters.
- Periodically damp-wipe all dust-collecting surfaces.
- The best environment for tape use has a temperature of 60° to 80°F and relative humidity of 40% to 50%.
- The "ideal" environment for archival tape storage has a temperature of 65°F and a relative humidity of 40%.
- Before reproducing a tape that has been exposed to a severe environment, allow it to normalize for 16 to 24 hours.

3-11. Tape Reel Installation

Tape reels should be installed with the transport power off. As much as possible, handle tape reels by the hubs. Place a full reel of tape on one holddown of the tape transport and an empty reel on the other. For

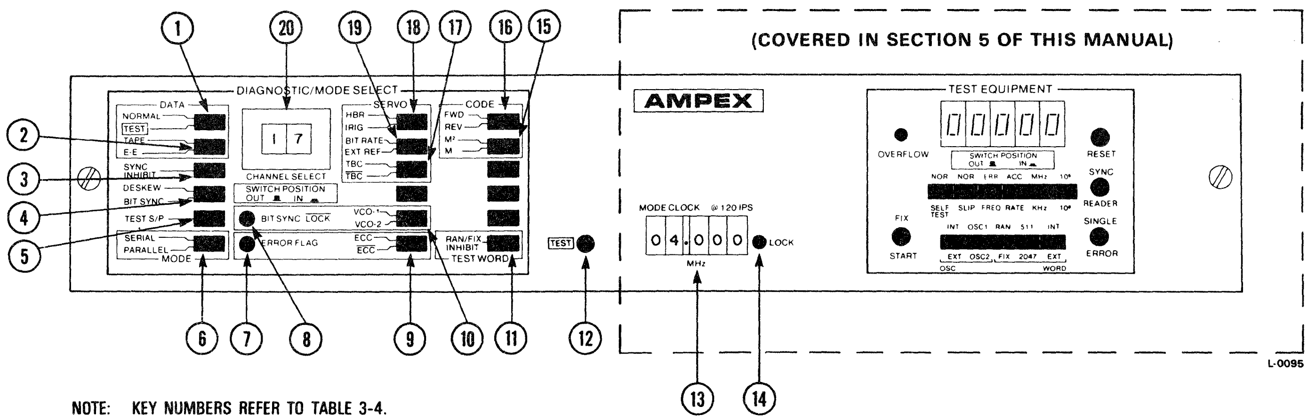


Figure 3-4. Mode Select Bay DIAGNOSTIC/MODE SELECT Controls and Indicators

forward operation, the supply reel (the full reel) is on the upper reel holddown and the takeup reel (the empty reel) on the lower holddown. (For reverse operation, simply reverse the reel positions.) A tape reel is installed as follows:

a. If necessary, turn the reel holddown knob counterclockwise to allow a reel to fit over it.

b. Seat the reel firmly against the flange of the reel holddown.

c. Tighten the holddown knob by turning it clockwise until the reel is firmly held in place.

3-12. Tape Threading

The tape threading path is shown in figure 3-5. The procedure for threading the tape is as follows:

NOTE

For proper recording and reproducing, the tape must be threaded with the oxide surface facing the headstack.

a. Open the transport cover door and grasp the vacuum-chamber cover by its right edge. Swing it out, away from the vacuum chambers.

b. Swing the head cover out as far as it will go, uncovering the heads.

c. Pull a length of tape from the upper reel and position it past the upper idler roller, down between the glass plate and the upper guide pin.

d. Thread the tape *loosely* in the area of the heads, capstan, and air guides, as shown in figure 3-5. *Do not force* the tape in between the capstan and heads or tape-edge damage may result. To seat the tape correctly and to remove any tape loops, rotate the capstan slowly in a clockwise direction while pulling the free end of the tape lightly.

Table 3-4. Mode Select Bay DIAGNOSTIC/MODE SELECT Controls and Indicators

KEY NO.*	SCHEMATIC REF	CONTROL OR INDICATOR	TYPE	POSITION	FUNCTION
1	S1	NORMAL (black) $\boxed{\text{TEST}}$ (red) (This switch is always active and must be *out* for recording user data)	Push-push switch	NORMAL (*out*)	Selects external data and clock inputs for recording.
				$\boxed{\text{TEST}}$ (*in*)	Selects test data and clock inputs from the word generator in the BITE.
2	S2	TAPE (black) E-E (red)	Push-push switch	TAPE (*out*)	Routes signals to and from tape in normal record/reproduce paths.
				E-E (*in*)	Routes signals from record to reproduce electronics, bypassing the tape, for testing and calibration.
3	S3	SYNC INHIBIT (red) (test mode only)	Push-push switch	— — — (*out*)	Diagnostic switch — disabled when the system is not in the test mode.
				SYNC INHIBIT (*in*)	Inhibits sync word insertion on all channels.
4	S4	DESKEW (black) BIT SYNC (red)	Push-push switch	DESKEW (*out*)	Permits reading reproduced (or E-E) data directly from the deskew electronics.
				BIT SYNC (*in*)	Permits reading reproduced (or E-E) data directly from the bit-syncs with S3 *in*.
5	S5	TEST S/P (red) (diagnostic only)	Push-push switch	TEST S/P (*in*)	Routes test signal through S/P converter for test purposes. Active in test mode only.
6	S6	SERIAL (black) PARALLEL (red)	Push-push switch	SERIAL (*out*)	Routes signal(s) from serial input(s) on digital process bay rear panel to signal electronics.
				PARALLEL (*in*)	Routes signals from parallel inputs on digital process bay rear panel to signal electronics.
7	DS2	ERROR FLAG indicator (ECC mode only)	Red LED	N/A	Indicates that multi-track errors are being detected and no error correction is being made.
8	DS1	BIT SYNC $\overline{\text{LOCK}}$ indicator	Red LED	N/A	Indicates that any bit-sync other than the master channel is out of sync.

* Figure 3-4

Table 3-4. Mode Select Bay DIAGNOSTIC/MODE SELECT Controls and Indicators (Cont)

KEY NO.*	SCHE-MATIC REF	CONTROL OR INDICATOR	TYPE	POSITION	FUNCTION
9	S12	ECC (black) $\overline{\text{ECC}}$ (red) (ECC systems only)	Push-push switch	ECC (*out*)	Enables error-correction process.
				$\overline{\text{ECC}}$ (*in*)	Disables error-correction process.
10	S11	VC01 (black) VC02 (red) (Disabled in E-E mode; use switch on master control PWBA in bit-sync bay)	Push-push switch	VC01 (*out*)	Selects VC01 on bit-sync PWBA's — normally adjusted for primary bit rate.
				VC02 (*in*)	Selects VC02 — normally adjusted for alternate bit rate.
11	S18	RAN/FIX INHIBIT (red) (test mode only)	Push-push switch	— — — (*out*)	Inactive in *normal* mode, or when in *out* position.
				RAN/FIX INHIBIT (*in*)	Inhibits test-word data from BITE. (For record and bias level adjustments.)
12	DS3	$\boxed{\text{TEST}}$ indicator	Red LED	N/A	Warns that system is in test mode and user inputs will not be recorded.
13	S19	MODE CLOCK @ 120 IPS	5-Section thumb-wheel switch	Each position of each segment displays a numeral	Selects frequency of mode clock generated by the frequency synthesizer in the MSB and used to determine tape speed. Also used in generating test clock.
14	DS2	LOCK	Green LED	N/A	Indicates frequency synthesizer circuit is locked at selected frequency.
15	S14	M^2 (black) M (red)	Push-push switch	M^2 (*out*)	Selects M^2 code for recording and reproducing — normal mode of operation.
				M (*in*)	Selects Miller code for compatibility with systems/tapes using Miller code.
16	S13	FWD (black) REV (red)	Push-push switch	FWD (*out*)	Normal conditions for forward reproduction of tapes.
				REV (*in*)	Switches bit-syncs, reproduce amps, and deskew logic to read tapes in reverse.
17	S9	TBC $\overline{\text{TBC}}$ (used for test only)	Push-push switch	TBC	Permits time-base correction of data (in reproduce mode).
				$\overline{\text{TBC}}$	Disables time-base correction (reproduce mode).

* Figure 3-4

Table 3-4. Mode Select Bay DIAGNOSTIC/MODE SELECT Controls and Indicators (Cont)

KEY NO.*	SCHE-MATIC REF	CONTROL OR INDICATOR	TYPE	POSITION	FUNCTION
18	S7	HBR (black) IRIG (red)	Push-push switch	HBR (*out*)	Selects bit-rate clock as capstan speed reference for normal HBR operation.
				IRIG (*in*)	Selects internal reference for IRIG fixed-speed selection at the transport control panel.
19	S8	BIT RATE (black) EXT REF (red) (Selects record mode capstan ref)	Push-push switch	BIT RATE (*out*)	Data (bit-rate) clock used to control servo in record mode — produces constant packing density over the range of bit-rates.
				EXT REF (*in*)	For nonconstant packing density recording — gives tape speed independent of data rate.
20	S19	CHANNEL SELECT (normally used in test mode, but always active)	Two-digit thumb-wheel switch	Each position of each segment displays a numeral	Selects channel output for calibration or diagnosis. In parallel, selects parallel channel output. In word-serial, selects word-serial channel output. No action in bit-serial mode.

* Figure 3-4

e. Insert the tape between the glass plate and the lower guide pin. Pull the tape past the lower idler roller.

f. Hold the end of the tape to the lower reel hub through one of the reel-flange slots. Wind the remaining tape counterclockwise onto the lower reel.

g. Leave a loop of tape in each of the vacuum chambers. Close the vacuum cover over the vacuum chambers and the head cover over the head assembly. Use care not to pinch the wires protruding from the headstacks when closing the head cover.

WARNING

TO AVOID POSSIBLE INJURY, NEVER TRY TO STOP A SPINNING REEL BY HAND. TURN POWER OFF AND THE REEL WILL COAST TO A STOP.

h. Apply power to the transport (see paragraph 3-24). (The reels may move abruptly as the tape is positioned in the vacuum chambers.) See that tape is drawn into the vacuum chambers and

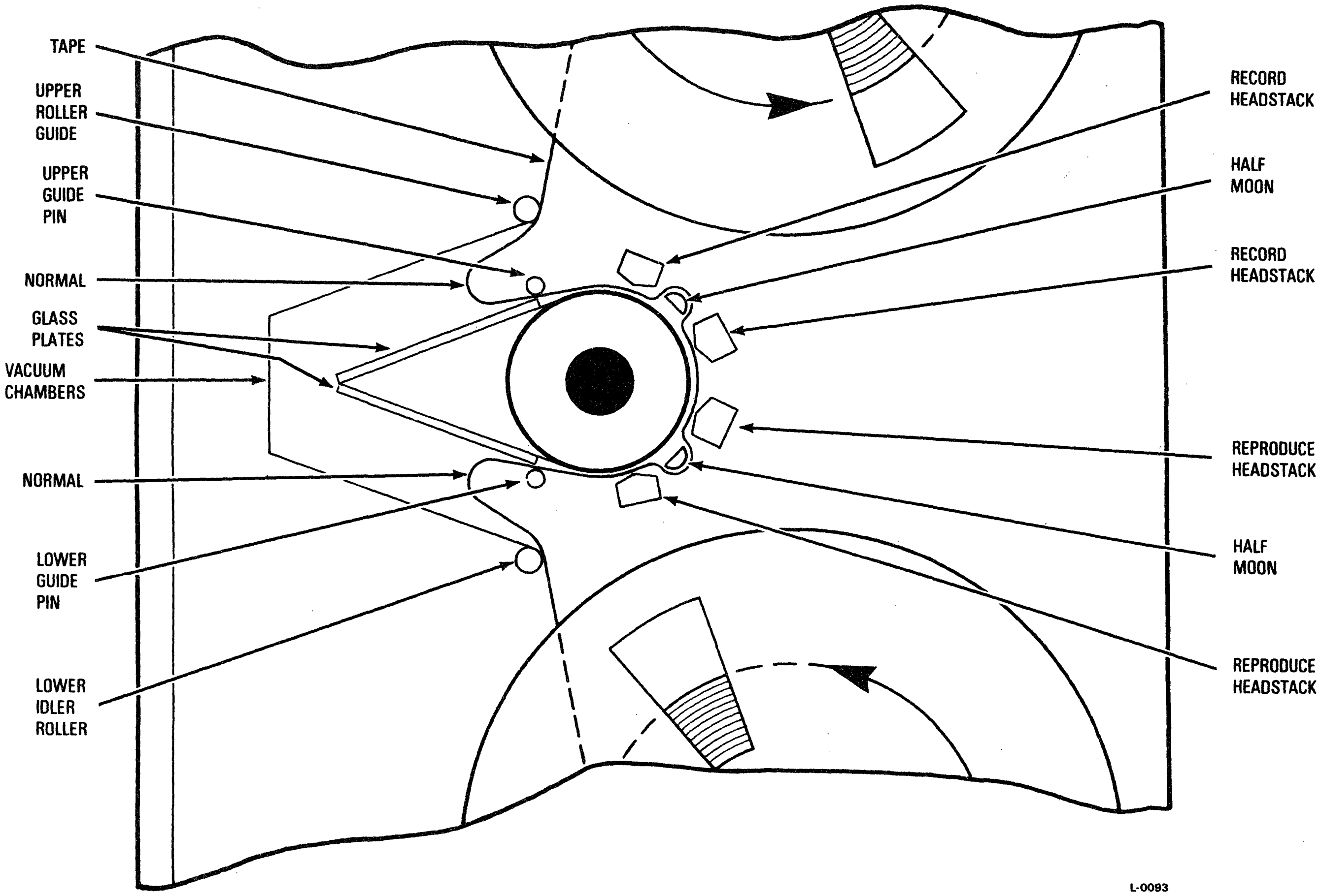


Figure 3-5. Tape Threading Path

remains properly threaded in the rest of the tape path. This completes threading. When the tape is properly loaded, the STOP/READY indicator lights.

3-13. Initial Settings

The following initial control settings should be confirmed.

3-14. Test Panel. For normal, local operation of the recorder, set the power and servo chassis test panel switches to the following positions:

SWITCH	POSITION
CONTROL	LOCAL
SEQUENTIAL	OFF
REC TEST	OFF
SEARCH	OFF
EXT FREQ STD	(inactive)
SYNC	TAPE

3-15. Control Unit. On the control unit, set the EOT switch to ON. (Note that when the tape is stopped by the EOT circuits, it is not necessary to turn the EOT switch off to run the tape off the reel. Simply press the transport pushbutton that will move the tape in the desired direction — with or without FAST.)

3-16. Relay Buffer. Switch S1, "A" Speed Line Selection, on the relay buffer PWBA (P106 in the power and servo chassis card cage) must be set to the 120 position. (For normal operation, the switch is set to this position and left. If it is in the wrong position, incorrect equalizers on the reproduce amplifiers and bit-sync timing units on the bit-sync/decoder PWBA's are selected by the speed switches.)

3-17. MSB. On the left-hand end of the MSB front panel the following operating control settings should be made.

3-18. NORMAL/TEST SWITCH. The NORMAL/TEST switch is set to the NORMAL (out) position for recording and reproduction of data. This inhibits the test functions, except as follows:

a. The TAPE/EE switch can be used during recording to bypass the recording process for monitoring without interrupting the recording process. This switch must be in the TAPE position to reproduce data from tape.

b. The SERIAL/PARALLEL switch is active during recording and reproduction of data, and must be set to match the input data format.

3-19. ECC/$\overline{\text{ECC}}$ SWITCH. This switch must be set to the correct position:

a. The ECC position enables generating and recording CRC and parity data in the record mode, and using this information to perform error-correction on the reproduced data.

b. The $\overline{\text{ECC}}$ position disables the error correction functions.

3-20. SERVO SWITCHES. The normal servo reference is derived from the data clock for recording, with these switches set to HBR and BIT RATE. The IRIG or EXT REF positions are used only in special applications or for troubleshooting.

3-21. CODE SWITCHES. M^2 and FWD are the normal settings of these switches and produces M^2 encoding, which is the optimum for the system. The M (Miller) position allows recordings to be made that are compatible with older systems using only Miller code. (Refer to section 8 for compatibility with non-standard formats.)

3-22. VCO1/VCO2 SWITCH. This switch allows selection of one of two bit-sync VCO's which may have been set for different bit rates. VCO2 is not needed if bit rates are binarily related. (This affects E-E and reproduce modes only.)

3-23. Power Application

To apply power to the tape transport, turn main AC power circuit breaker CB501 to ON. The cooling fans should come on and the signal electronics should be energized.

Red AC power indicator DS501 should be on. Press the transport POWER pushbutton. The lamps behind the POWER pushbutton should light and the sound of the air compressor and vacuum blower coming up to speed should be audible. The brake solenoids should activate and tape should be pulled into each vacuum chamber. The STOP/READY lamp should light, indicating that the system is in a *ready* state.

3-24. OPERATION

The recorder can be operated in any of the standard modes by pressing the appropriate pushbutton(s) on the control unit. These modes are record, forward, and reverse. Additionally, when the FAST pushbutton is pressed simultaneously with either the FORWARD or REVERSE pushbutton, the fast forward or fast reverse mode is selected. The following optional modes are also available: search, sequential, and shuttle. These modes are selected by toggle switches on the power and servo chassis test panel. (If the equipment fails to operate properly in any of these modes, troubleshooting in accordance with section 5 of this manual should be performed.)

3-25. Operating Procedure for Recording

The following is a typical step-by-step operating procedure for recording data. For operating controls and threading details, see the previous discussions in this section.

a. Turn rack AC power *on*; transport power *off*.

b. Load a degaussed reel of tape on the transport upper hub (supply reel) and an empty reel on the lower hub (takeup reel).

c. Thread the tape.

d. Turn on transport power and verify that the STOP/READY light is *on*.

e. Select the nominal tape speed. Note that the green window is visible in the pushbutton next to the selected speed.

f. Verify that the EOT switch is in the ON position.

g. Set the MSB switches. Normal positon for all switches is *out* for serial input systems. For parallel input systems, the SERIAL/PARALLEL switch must be *in*. (See paragraphs 3-17 to 3-22.)

h. To initiate recording, press and release the transport RECORD and FWD pushbuttons at the same time.

i. Monitor the LED indicators on the front of the reproduce PWBA's to verify recording.

j. To end recording, press the STOP pushbutton to stop tape motion, or FAST and REV to rewind.

k. Mark the tape reel with bit-packing density, nominal tape speed, data clock rate, format (i.e., ECC/NON-ECC, aux channels, etc.), and any other pertinent information.

3-26. Operating Procedure for Reproducing

The following is a typical step-by-step operating procedure for reproducing recorded data.

a. Load and thread a recorded tape. (See paragraphs 3-11 and 3-12.)

b. At the transport control panel, select the nominal tape speed. If in doubt, refer to section 8 of this manual to determine this tape speed setting from data bit rate packing density and parallel clock rate.

c. Verify that the EOT switch is set to the ON position.

d. Set the MSB switches. Normal position for all switches is *out* for serial input systems. For parallel input systems, the SERIAL/PARALLEL switch must be *in*. Tapes recorded to older standards may require some alternate switch settings.

e. Verify that the correct (SER or PAR) REPRODUCE CLOCK INPUT is connected on the DPB.

f. Select VC01 or VC02 according to the data rate.

g. To initiate data reproduction, press the FWD pushbutton on the transport. When the TAPE and SYNC lights are both *on*, the system is reproducing data.

h. Press the STOP pushbutton to halt tape motion, or both FAST and REV pushbuttons for rewind.

3-27. Fast Mode Operation

The fast modes are used to move tape quickly from one reel to the other. To initiate fast forward or fast reverse (either when the transport is stopped or while it is in the record or reproduce mode), simultaneously press the two appropriate pushbuttons (i.e., FAST and FWD or FAST and REV). The transport will then proceed into the selected mode. If there is a direction change, the transport will first stop and then proceed into the selected mode.

3-28. Search Mode Operation

The search mode requires the attachment of an optional time-code generator with a tape control unit to the equipment. This mode is similar to the reproduce mode, except the speed of tape movement is controlled by the time-code generator. The SEARCH switch on the inner test panel must be set to ON, which will cause the SEARCH indicator on the control unit to light. The search mode is initiated by pressing the FWD pushbutton.

3-29. Sequential Operation

Sequential operation involves the use of two recorder/reproducers. One is initially operated in the forward record mode, while the other is in the stop/ready mode. To link the two recorders for sequential operation, a cable must be connected from SEQUENTIAL receptacle J3 on one recorder to the equivalent receptacle on the other recorder, and the SEQUENTIAL switch on the power and servo chassis test panel of each recorder must be set to ON.

When the first recorder nears the end of its tape supply in the forward record mode, the second recorder is automatically started in the forward record mode. The first recorder continues to record until the end-of-tape is reached. If the first recorder is reloaded while the second is operating, the sequence can be extended indefinitely.

3-30. End-of-Tape Switch During Sequential Operation

The EOT switch on the control unit may be set to OFF when operating in the sequential mode. This provides a maximum of redundantly recorded data because the end-of-tape sensors are disabled, which permits data to be recorded until the tape runs off the reel. Setting the EOT switch to OFF in no way affects the sequential sensor.

When the EOT switch is set to ON and tape movement stops as a result of the end-of-tape sensor action, there is no need to set the switch to OFF in order to move tape off the reel. Press the pushbutton(s) that will wind the tape onto the desired reel.

3-31. Shuttle Mode

The shuttle mode, which is an automatic cycling operation, shuttles the tape between preselected points on the tape in reproduce mode only. The shuttle mode requires the use of a footage counter. (For a detailed breakdown of the footage counter, see the FR-3000 series accessories manual.) To operate the recorder/reproducer in the shuttle mode, proceed as follows:

a. Place the recorder/reproducer in the fast foward mode and move the tape to a point where the cycling operation is to start.

b. Press the RESET (zero set) switch on the footage counter. This will place the footage counter to 00000 count.

c. Move the tape to a position where the cycling operation is to end.

d. Press the LIMIT SET switch on the footage counter to mark the end of the shuttle distance. (Another version of the footage counter has a digital thumbwheel switch to set the end of shuttle point in feet.)

e. Select the desired forward tape speed on the control unit.

f. If the desired reverse shuttle speed is the same as the forward speed, set the SPEED SWITCH at the rear of the footage counter to OFF. Then place the SHUTTLE switch on the front of the footage counter in the *on* position (downward) and proceed to step *h*.

g. If the desired reverse shuttle speed is different from the forward speed, then set the REVERSE SHUTTLE SPEED switch on the inner test panel to the desired reverse shuttle speed. Set the SPEED SWITCH at the rear of the footage counter assembly to the REV. SHUTTLE (*up*) position. Proceed to step *h*.

h. Press the REV pushbutton on the control unit. The tape will automatically shuttle between the two preselected points on the tape.

i. To terminate the shuttle operation, press the STOP/READY pushbutton on the control unit, set the SHUTTLE switch on the footage counter to the *off* position, and set the SPEED SWITCH at rear of footage counter assembly to the OFF position.

3-32. Remote and Computer Control

The following two paragraphs cover remote control and computer control. One or the other of these optional capabilities can be implemented in any system, but not both.

3-33. Remote Control. Remote operation is selected by setting the CONTROL switch on the inner test panel to REMOTE. Connect a cable from the remote control unit to the REMOTE receptacle (J7) on the power and servo chassis behind the tape transport. When a remote control unit is connected to J7 through a cable and the CONTROL switch is set to REMOTE, the REM indicator on the tape transport control unit should light.

All of the tape transport functions that are normally controlled from the tape transport control unit can now be exclusively controlled from the remote control unit.

3-34. Computer Control. If the system is equipped for computer control (TTL interface PWBA, IEEE-488 bus interface PWBA, etc., installed, plus internal interfacing), the cable from the computer must be connected to power and servo chassis connector J8.

3-35. TAPE REMOVAL

Following the recording or reproducing of data, rewind the tape onto the upper reel. When the end-of-tape sensors stop the tape, press the FAST and REV pushbuttons so that the tape completely rewinds onto the upper reel. Remove the reel of tape by turning the reel holddown knob counterclockwise until the reel is released.

SECTION 4

FUNCTIONAL DESCRIPTION

4-1. GENERAL

The Ampex HBR-3000i recorder/reproducer is a laboratory-quality, high-bit-rate (HBR) digital record/reproduce system. It uses magnetic tape to store digital data at high bit rates and high packing densities. Bit rates as high as 30 MHz and packing densities as high as 33.3 kb/in/track are standard. The HBR-3000i reproduces the recorded data with a minimum bit-error-rate (BER) through the use of an orthogonal error-correction system employing an error-correction code (ECC) and a parity channel or channels (refer to paragraphs 4-6 and 4-11). A large variety of data rates and formats is accepted by the system. Readily performed system programming allows adapting the recorder to the format and bit rate of the incoming data. This includes selecting the track distribution, the packing density, and the tape speeds. The record tape speed is derived from the data rate and the selected density. The reproduce tape speed may differ from the record speed by a factor as great as 64 for time expansion or compression. Instructions for programming the system are included in section 8 of this manual.

System options include a 100 Mb/s ECL serial data converter bay (input/output formatter — covered in a separate manual), IEEE-488 bus interface, and many more. See the FR-3000 series accessories manual and your local Ampex representative for further details on the available accessories.

The simplified system description below is followed by a more detailed system description. Hardware descriptions of the various elements of the system in still greater detail are contained in the tape transport and signal electronics maintenance manuals.

4-2. SIMPLIFIED SYSTEM DESCRIPTION

The following simplified system description leaves out a great many details of the system in order to give an overall, or conceptual, idea of the recorder/reproducer system. Refer to figure 4-1 (block diagram). For physical location of the transport and bays referred to below, see figures 1-1 through 1-5, in section 1 of this manual. Since channels of the same type are essentially the same, the following descriptions are in terms of one channel of each type. Synchronous digital channels are referred to as data channels. Non-synchronous channels (analog or digital) are classified as auxiliary channels (see paragraph 4-13). A digital data channel of the basic (error-correcting) system is described first, then the differences with error correction removed. An auxiliary channel is described, then the calibration and self-test capabilities.

4-3. System Control

Main power on/off control is available at the power chassis assembly located at the lower front of each rack.

Record/reproduce modes, tape motion direction, fast winding of the tape, end of tape, tape shuttling, are controlled at the transport control panel. In the HBR digital application, the existing speed-selection pushbuttons do not affect tape speed, but are used to select certain elements in the reproduce electronics, as described further on in this section, and in section 8. Some secondary controls for the transport are located on a test panel on the power and servo chassis behind the transport.

Except for record/reproduce modes, the signal system is primarily controlled from the front panel of the mode select bay (MSB). Some further transport control is also performed at this panel.

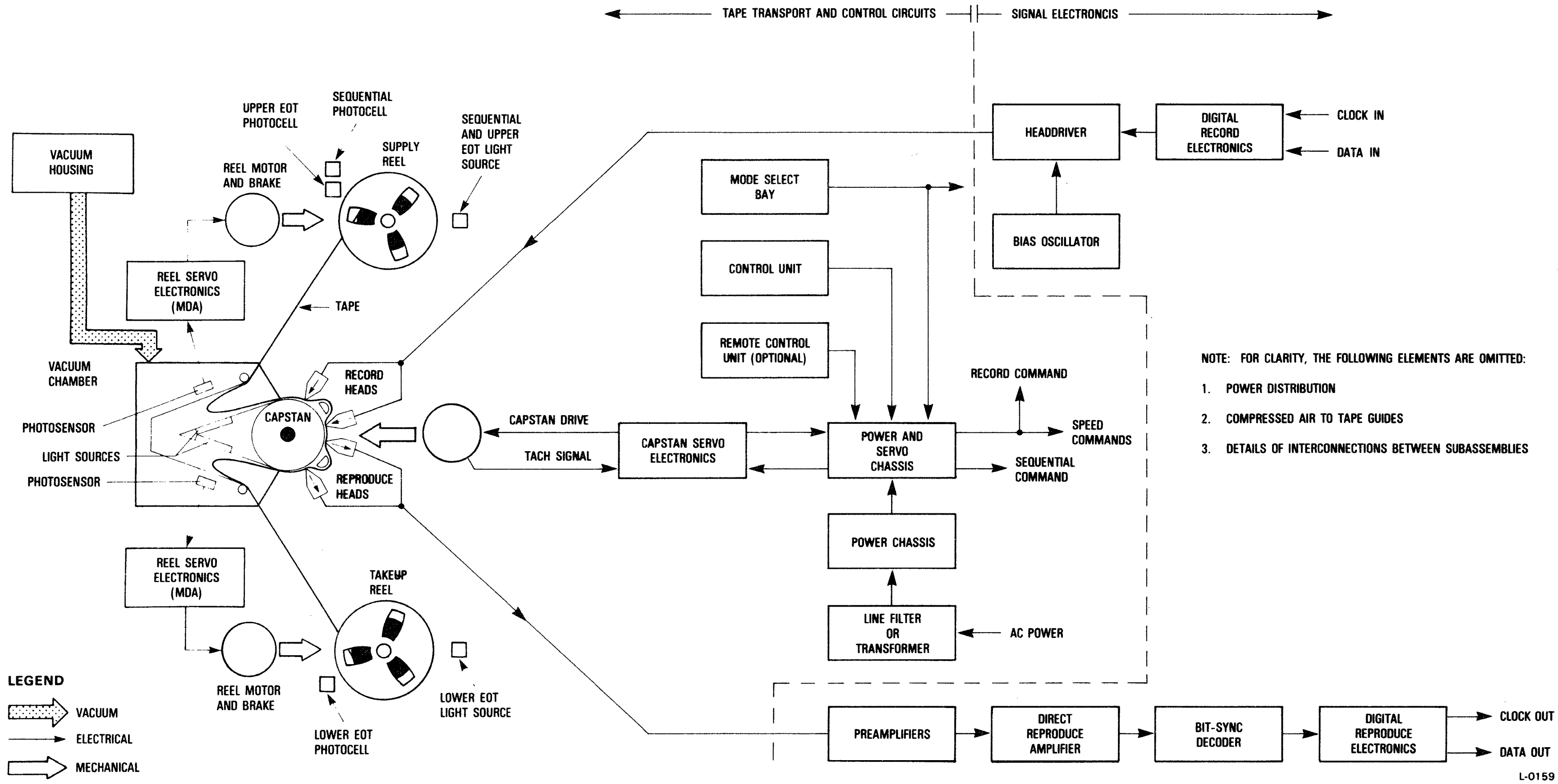


Figure 4-1. HBR-3000i System Block Diagram

4-4. Tape Transport

The HBR-3000i tape transport is a precision, reel-to-reel, laboratory instrumentation tape transport. It handles 1-inch-wide magnetic tape on reels up to 16 inches in diameter, and provides continuously variable record/reproduce tape speeds from 1-7/8 to 150 inches per second (IPS), forward and reverse. It also moves tape both forward and reverse at a tape speed of 240 IPS for fast winding or scanning.

4-5. Digital Channel Record Electronics

The HBR-3000i receives high-bit-rate NRZ-L digital inputs in one of three basic formats. (Numerous variations as to number of tracks, packing density, etc., are possible within the basic formats.)

a. Serial stream

b. Serial word

c. Parallel

Serial stream inputs usually consist of a high bit-rate data signal with a clock. (The data bit-rate is 30 Mb/s maximum, or 100 Mb/s with optional ECL input/output serial data converter bay). Because of the per-track bandwidth limit of the tape recorder, any stream above 5 Mb/s must be divided into lower rate streams (serial-to-parallel conversion) until the bit rate delivered to the record heads is 5 Mb/s or lower. The input data may be divided by any integer from 2 to 12.

Serial word inputs consist of one or more words with the bits of each word in parallel. If the words are received at a rate higher than 5 Mb/s, each bit stream must be divided into multiple streams to bring them below the 5 Mb/s limit. This is performed by a serial-to-parallel converter with 12 channels and programmable division by 2, 3, or 4.

Parallel inputs are synchronous, separate streams, 5 Mb/s or lower in rate.

The digital channel record electronics which process the inputs include both digital and analog circuits.

4-6. Digital Record Electronics. Referring to figure 4-1, the data and clock normally received by the HBR-3000i are in NRZ-L code. They are applied to the digital record electronics in the digital process bay (DPB) where:

- Serial or parallel input mode is selected.

- As required, serial-to-parallel conversion is performed. This conversion (÷N) is programmed to produce the required number of parallel data channels and a clock at the parallel rate. Further division of the clock (÷X) is programmed to create a capstan reference signal. This reference is at a frequency which produces the tape speed that provides the selected packing density.

- The signals pass through a calibrator card (cal #1) used in system calibration and test.

- Following this, a 32-bit block is removed from each data channel. These blocks are recorded in a master channel (one for each 13 digital data channels). A 16-bit sync word is inserted into the later 16-bit spaces of the blocks. The sync frame length is 512 bits, and within each frame of the master channel, there is space for 48 bits of user data (called M48 data). A parity channel (normally one for each DPB) is also generated from a programmed number of tracks (those included in error-correction). When ECC is disabled, a 32-bit sync word is inserted into the block removed from each channel.

- Next, a 16-bit cyclic redundancy check (CRC) word is generated and inserted into the first 16 bits of the 32-bit block. The CRC is not used if ECC is disabled.

- The data is encoded from NRZ-L to M^2. This process eliminates the separate clock signal. (It is reconstructed during reproduction of the signals from tape). Using M^2 code for recording eliminates the need for DC response.

- The signal is filtered to remove high-order harmonics and passed to the analog record electronics.

4-7. Analog Record Electronics. The analog record electronics consist of a headdriver circuit, mounted near the heads, which processes the signal to drive a magnetic record head for constant-flux recording. The headdriver also mixes the data signals with a high-frequency (13.6 MHz) bias signal which is used to linearize the recording process. A bias oscillator, mounted in the headdriver housing, generates the bias signal.

4-8. Digital Channel Reproduce Electronics

When recorded signals are reproduced (downstream from the recording as it is being made, or at a later time) tape is moved past the reproduce heads and a very low-level signal is induced in the heads. This signal is processed by analog, bit-sync, and digital electronics.

4-9. Analog Reproduce Electronics. The low-level reproduce head signal is amplified by the analog reproduce electronics which consist of:

- A two-section preamplifier circuit mounted near the heads. The first section is located on the head assembly, the second section is located behind the tape transport in a separate housing. The preamplifier circuit increases the signal level close to the heads to avoid noise pickup.

- A direct reproduce amplifier, housed in a reproduce bay (REP bay), which provides amplitude equalization and phase correction.

4-10. Bit-Sync/Decoder Electronics. The output of the direct reproduce amplifier is applied to a bit-synchronizer/decoder circuit (bit-sync/decoder, or bit-sync), housed in a bit-sync bay (BSB).

- The bit-sync circuit returns the signal to digital form, recovers the clock information and outputs a clock signal. This clock signal (or its derivative) is used to clock the data through subsequent decoding to NRZ-L (in the decoder portion of the bit-sync/decoder) and into the digital reproduce electronics. The master-channel bit-sync clock is also processed and used to control the capstan during reproduction of data in a manner similar to the use of the "tape," or control-track, signal in an analog recorder.

- A master-control PWBA in the BSB makes it possible to adjust voltage controlled oscillators (VCO's) on all the bit-syncs at once.

4-11. Digital Reproduce Electronics. The digital reproduce signal electronics (in the DPB) consist of:

- A second calibrator PWBA (cal #2) used in system calibration and testing.

- A deskew circuit for each channel including the master channel that deskews the data.

- An error detector and delay that checks the data and CRC words for errors and delays the data by 512 bits. This PWBA also enables the transfer of the 48-bit blocks of user (M48) data from the recorder/reproducer to registers in user equipment.

- An error-corrector and data reinserter which corrects errors, channel by channel, using the parity channel(s), and reinserts the data from the master channel into the individual data channels. In parallel systems, the output of this circuit is the output of the system.

- In serial systems, the output of the error-corrector circuits is passed to a parallel-to-serial converter which returns the data to its original (input) format. In that case, the output of the parallel-to-serial converter is the system output.

- An auto channel select PWBA. This circuit decodes information inserted into the master channel during recording, and automatically selects the channel(s) which are included in the ECC process. This selection can be manually made by switch settings on the error corrector PWBA.

4-12. Non-ECC Mode

The system may be used without error-correction. This cancels the need for parity channels. Thus, any channels used for parity in error-correction operation may be reassigned to data recording. The CRC insertion is disabled and a 32-bit sync word is used. Non-ECC operation is selected with a switch on the front panel of the MSB.

4-13. Auxiliary Channel

As many as four auxiliary channels are available per each 14 tracks. An auxiliary channel is a non-synchronous digital or analog channel commonly used for voice logging or for a time-code signal. Auxiliary channels use only the analog electronics. The input is made directly to the filter PWBA. The output of an auxiliary channel is the output of the direct reproduce amplifier, available at a connector on the back panel of the BSB. In ECC mode, only three auxiliary channels are available.

4-14. Test Mode

The test mode is entered by pressing the NORMAL/TEST pushbutton on the MSB panel to the *in* position. In this mode, the data and clock are derived from the BITE in the MSB. Test signals are substituted for user signals, and signals from the reproduce side are fed back to the MSB for determining error rates or frequency.

4-15. DETAILED SYSTEM DESCRIPTION

The following paragraphs contain detailed descriptions of the HBR-3000i system. It is presented in the same order as the preceding simplified description: system control, tape transport, signal electronics (except no further coverage of auxiliary channels is given), and test mode. The signal electronics descriptions are in the order of signal flow from input to output. Detailed descriptions of the individual elements that make up the system are contained in separate manuals.

4-16. System Control

The HBR-3000i is controlled from four locations: the power chassis assembly, the transport control panel, the power and servo chassis test panel, and the MSB front panel.

4-17. Power Control. Main power control is applied through the power chassis assembly at the bottom of each rack. Power is conducted into the cabinet by way of connector J503 at the bottom rear of the rack. (A mating connector is supplied with the system, to allow cable fabrication to the required length. Refer to section 2 of this manual.) J503 is part of either a line filter assembly (115 V systems) or an international power transformer assembly (220 V systems). The power is cabled from the filter or transformer assembly to the power chassis assembly which includes main-power circuit breaker CB501. The breaker is accessible on the front panel of the power chassis assembly.

When power is connected, the front utility outlets are powered. When CB501 is set to its ON position, power is applied to the outlets from which the signal electronics bays are supplied. This powers up the electronics bay power supplies. Power is also supplied to the transport POWER switch, which controls power to all the assemblies that make up the transport. The main-power-on condition is indicated by the lighting of DS501 on the front panel of the power chassis assembly. The front panel also carries fuses which protect the outlets.

4-18. Tape Transport Control. Different phases of tape transport control are initiated from three of the four system control centers.

4-19. TRANSPORT CONTROL UNIT. The primary functions of the tape transport are controlled from the panel of the transport control unit on the right-hand side of the tape transport (seen from the front). The switches on this panel act with control logic on plug-in PWBA's in the power and servo chassis to control transport modes. These include transport power on/off, reverse and forward tape motion (reproduce modes), record mode, and fast tape winding.

Switches on the transport control panel are used to select equalizers in the direct reproduce amplifiers, and timing units in the bit-sync/decoders. (These switches are marked with *nominal* tape speeds, but do not control actual tape speed.) The end-of-tape function is controlled from here, and its status indicated by a light. When it is *on*, tape is stopped slightly before it runs off the reel which is supplying tape. Other indicators on this panel signal the status of remote control (REM), search mode (SEARCH), sequential mode (SEQ), tape signal presence (TAPE SIG) for capstan control, and capstan synchronization (SYNC).

4-20. POWER AND SERVO CHASSIS TEST PANEL. Behind the tape transport mechanism, accessible when the transport is extended on its hinges, is the power and servo chassis. On the front of the chassis is a test panel which mounts further transport controls. These include:

- The CONTROL switch which allows selection of control from the local panel or an (optional) remote unit.
- The SYNC switch, which is left in the TAPE position for normal HBR use.
- The SEQUENTIAL switch used in sequential operation as described in paragraphs 1-14, 3-29, and 3-30 of this manual.
- The REC TEST switch which allows turning the record electronics on without moving tape for test and alignment purposes.

- The SEARCH switch which allows selection of a search mode when accessory time-code generator and search control units are connected.

- The REVERSE SHUTTLE SPEED switch which allows selection of a reverse speed different from the forward speed in shuttle mode. (Shuttle mode is controlled by an optional footage counter assembly. The mode consists of continuous passes back and forth over a selected section of a reel of tape for analysis. Shuttle mode is further described in paragraph 3-31 of this manual and the accessory manual coverage of footage counters.)

- The EXT FREQ STD switch which is inactive in HBR use.

- The TEST SELECTOR switch which applies voltages from various points in the transport to a test connector for maintenance purposes.

4-21. MSB TRANSPORT CONTROL. In the group of controls titled DIAGNOSTIC/MODE SELECT on the front panel of the MSB, is a sub-group titled SERVO. These switches perform control over the capstan servo, as follows:

- The HBR/IRIG switch selects whether the transport responds to the external capstan servo references (HBR) to make continuously variable tape speed possible for constant bit-packing density on the tape, or to internal references that produce the standard, fixed IRIG tape speeds (those assigned to the tape speed switches on the transport control panel).

- The BIT RATE/EXT REF switch selects the bit-rate clock (data clock) as the capstan servo reference, for constant packing density, or an external reference (EXT REF) independent of bit-rate for non-constant packing density.

- The TBC/$\overline{\text{TBC}}$ switch selects or disables time-base correction of data during reproduction.

4-22. Signal System Control. Aside from the control performed by the transport (i.e., record/reproduce modes, and selection of elements in the reproduce electronics, described above), signal system control is performed by the MSB. Normal operating control and selections of normal or test functions are performed by the switches in the group titled DIAGNOSTIC/MODE SELECT. These switches act through the PWBA's in the DPB, particularly the cal #1 board. They provide selection between different operating modes (e.g., parallel or serial inputs), or between normal operating modes and test (diagnostic) modes (e.g.,normal operating mode or a test mode in which normal user data is not recorded, and data and clock signals are provided by the MSB). The functions of these switches are covered in section 3, table 3-4, and their use in procedures is included in sections 3 and 5 of this manual. Details of the entire MSB are given in the MSB manual in the signal electronics volume.

4-23. BITE Control. The BITE circuits are contained on five PWBA's, in a card cage that is part of the MSB. Controls and indicators extend through the front of the panel for access. For additional information on the MSB, including BITE power supplies and MSB control cluster, schematics, parts lists, etc., see the signal electronics volume.

A simplified block diagram of the BITE is shown in figure 4-2. The BITE electronics form a self-contained system for performance testing. The BITE also provides word-synchronizing signals to an oscilloscope for signal electronics adjustments and troubleshooting. If additional test words (bit patterns) are desired, an external test word generator and analyzer can be substituted for the BITE electronics.

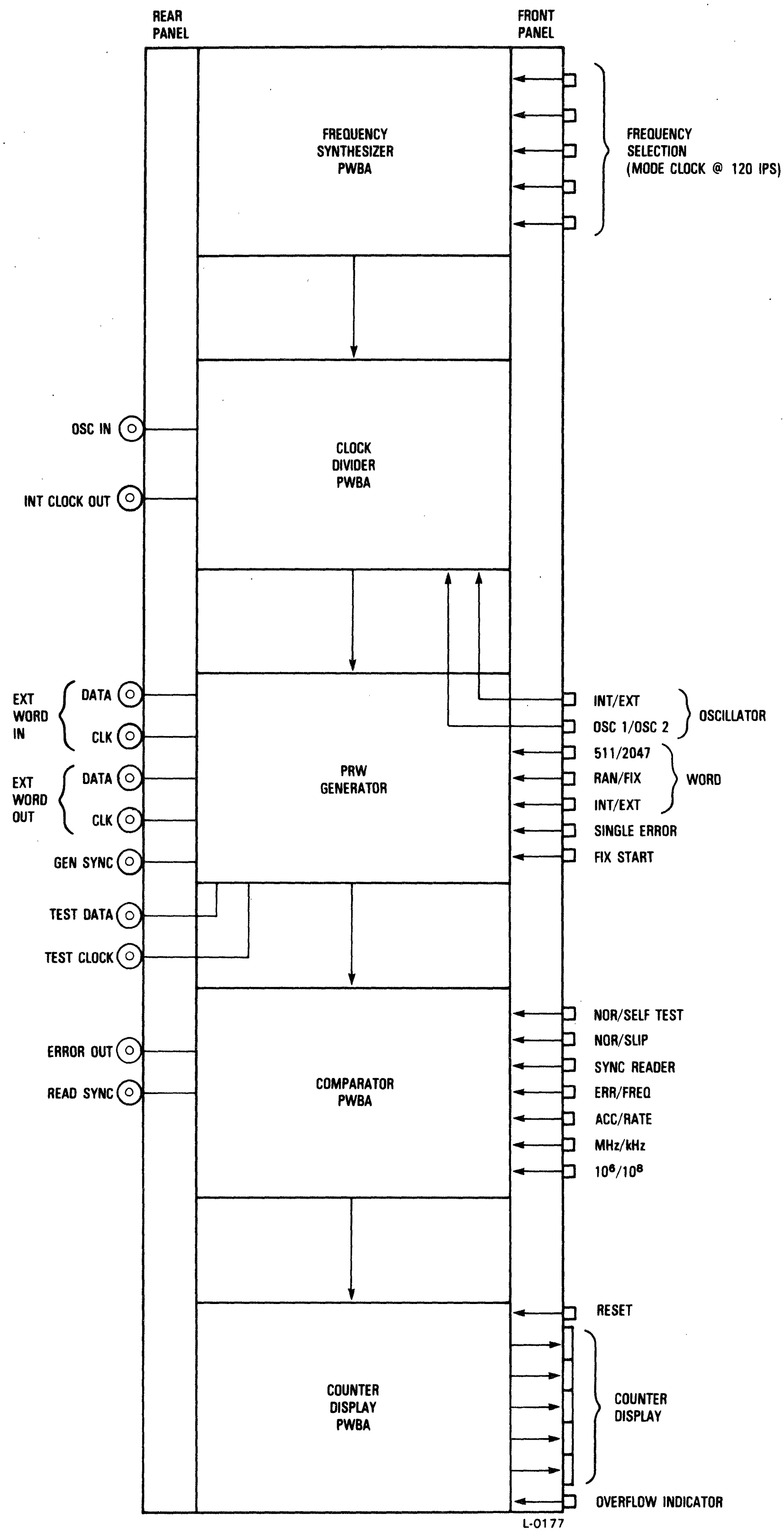


Figure 4-2. BITE Control Block Diagram

The BITE circuits include a frequency synthesizer PWBA, a clock divider PWBA, a pseudo-random word (PRW) generator PWBA, a comparator (reader) PWBA, and a counter display (numeric LED) PWBA. The purpose of the BITE group is to:

a. Select a test data rate

b. Generate a test word

c. Detect errors (if any) in the test word

d. Display the results

4-24. SELECTION OF THE TEST DATA RATE. The test data rate (clock frequency) is determined by the oscillator frequency input to the clock divider PWBA and division performed by the clock divider circuits. The most common selection is to use the frequency synthesizer PWBA as the oscillator input and the frequency select 1 of the clock divider PWBA for division. The following paragraph describes this.

Switches on the frequency synthesizer PWBA control a VCO in the range of 2 MHz to 52 MHz. These switches are accessible at the front panel of the bay (MODE CLOCK @ 120 IPS). A crystal oscillator is used as a reference for a phase-locked loop to ensure a stable and precise frequency. This becomes the internal source for the frequency select 1 on the clock divider PWBA. The frequency select 1 is enabled by the OSC1 switch on the word generator PWBA. Frequency division is controlled by the rate divider circuits which are, in turn, controlled by the speed lines from the tape transport. This division is determined by the transport speed selection switches in binary steps of 1, 2, 4, 8, 16, 32, or 64. Divide-by-1 corresponds to 120 IPS, and divide-by-64 corresponds to 1-7/8 IPS.

Alternative selection of the test data rate includes using an external oscillator and/or the frequency select 2. The frequency select 2 is enabled by the OSC2 switch, and switches on the clock divider PWBA may be set up for various fixed divisions.

4-25. GENERATING A TEST WORD. The pseudo-random word (PRW) generator PWBA produces one of three bit-patterns as determined by front panel switch settings. These bit patterns (called words) can be a fixed 10-bit word, a 511-bit PRW, or a 2047-bit PRW. If other bit patterns are required, an externally generated word and associated comparator can be selected by a front panel switch.

The fixed word requires synchronizing by pressing the FIX START pushbutton. The fixed word is most useful when displayed on an oscilloscope as an aid to troubleshooting circuits on a PWBA. A sync pulse (rear panel GEN SYNC connector) is generated for the selected word for oscilloscope synchronization. A switch that introduces single errors into the output word for a confidence check is provided.

4-26. DETECTING ERRORS. The comparator PWBA (J5) contains logic capable of comparing a word generated by the PRW generator PWBA (J6) with the bit pattern after processing, and detecting errors on a bit-by-bit basis. Pushbuttons located on the PRW generator PWBA (FIX/RAN and 511/2047) select the logic circuits used. Errors may be detected in either the NOR (normal) or SLIP mode as follows:

a. In the NOR mode, the incoming 511/2047 PRW is circulated through shift registers in a modulo-2 configuration with the same pattern as the generator. Thus each bit is compared three times, and a single actual error in theincoming data produces an error count of three. (An exception to this occurs when there is a coincidence of two errors in such relationship that they are compared and appear to be correct bits.)

b. In the NOR mode, an incoming fixed word is circulated through registers where the input is compared to the output. (The bit at the output is compared to the equivalent bit in the following word.) In this case, each error tends to be counted. twice, producing an error count of two for every error in the data.

c. In the SLIP mode, the incoming 511/2047 PRW is compared to data from a generator which is synchronized to the input data. It shows one count for one actual error. In this mode, if the clock slips (i.e., synchronization is lost), the comparator generates continuous errors until the SYNC READER pushbutton is pressed to resynchronize the reader. The SLIP mode is the most acurate method of error measurement. The fixed word is not used in the SLIP mode.

If EXT word mode is selected, the data (and clock) are routed to/from rear panel connectors, and the BITE electronics are bypassed.

4-27. DISPLAYING THE RESULTS. The counter display PWBA provides readout for clock frequency or bit errors. In the self-test mode and counter (CTR) mode, the output frequency of the synthesizer PWBA is displayed. The bit-sync/decoder clock channel displayed is determined by the channel selected with the thumbwheel switch in the DIAGNOSTIC/MODE SELECT control cluster. Error rates from the comparator PWBA can be in either the accumulate mode or the rate mode. In the accumulate mode, errors are accumulated until the RESET switch is pressed. In the rate mode, either 10^6 or 10^8 may be selected to show the errors for the indicated number of bits. In rate mode this is automatic.

4-28. Tape Transport

The tape transport must move tape across the record and reproduce heads at a linear velocity determined by programmed division of the data-rate clock, with the least amount of disturbance to the tape motion. It must also provide some means of tape storage (in this case, the co-planar reels). It must have the speed range to allow the combinations of data-rates and packing densities called for by the system.

To this end, the HBR-3000i tape transport is designed so that the tape speed and tension are very cisely controlled by servos. The record/reproduce speed range is 1-7/8 to 150 IPS, with fast wind speed of 240 IPS, in either direction. Tape tension, end-of-tape, and broken tape are automatically sensed. Sequential and remote control are available as options.

In order to meet these requirements, the HBR-3000i tape handling mechanism is built on a baseplate subassembly which gives a rigid, precise reference to the various other subassemblies in proper relationships. The most critical subassemblies (capstan, head assemblies, and vacuum chambers) are mounted on a precision plate which is part of the capstan assembly. This, in turn, mounts on the back of the transport baseplate. The tape handling components project forward through a hole in the baseplate.

4-29. **Control Logic.** The functions of the tape transport, as well as some of the functions of the associated signal electronics, are controlled by logic circuits contained in the power and servo chassis. These circuits are controlled in turn by signals or switch closures from a control unit which mounts in an opening in the baseplate so that a control panel (or cluster) is accessible from the front of the transport.

The control logic also receives end-of-tape (stop) signals from two photosensors, one associated with each tape reel. When sequential operation is selected, and the end of the tape is approached, a similar photosensor generates a signal which can be used to start a second recorder. The sequential signal is also generated if power fails or tape breaks in the first recorder. The control logic also receives broken-tape or missing-tape signals from the vacuum system, and shuttle-control signals from an optional footage counter assembly when it is installed and shuttle mode is selected.

4-30. Reel Control. The tape reels are controlled by reel motors which mount on the back of the baseplate. The shafts of these motors project through holes in the baseplate. On the shafts are mounted reel hold-downs that secure the reels while they are in use. Included in the reel servos is a vacuum chamber assembly which is divided into two sections, each of which maintains a loop of tape. These loops are forced into the chamber by ambient air moving in to fill a vacuum which is generated by a blower in the vacuum housing assembly behind the transport.

Light sources and photosensors within the vacuum chamber sense the positions of the loops, and generate control signals that are used to adjust the position of the reel motors to keep the loop-lengths correct. This action results in servo control of tape tension in all modes of operation and in the tape being wound on and off the reels as required. The vacuum chamber also acts to isolate (buffer) the capstan/head area from tape-tension disturbances.

4-31. Capstan Control. Refer to figures 4-2 and 4-4. The tape is moved, and therefore its speed is controlled, by a capstan. In operation, the tape is wrapped in contact with 110° of an elastomer-surfaced puck which is 1 foot in circumference. The puck is turned by a motor which is part of a closed-loop servo. The functioning of the servo is based on a crystal-oscillator reference signal. When tape is being moved, the reference signal is compared to a signal representing either capstan speed or tape speed. Differences between the reference signal and the comparison signal are used to form an error signal which controls power from the power and servo chassis to the motor. This results in a high degree of speed-error correction.

In the recording mode, the parallel clock from the cal No. 1 PWBA is applied to the serial-to-parallel converter PWBA for division to the servo reference frequency. The clock is first divided by *N* (number of channels), and then divided by *X* (density) for comparison to the tachometer output. The record command holds the machine in this tachometer mode.

When the system is in the scan or fast modes, the transport is also held in the tachometer mode. In addition, circuits on the HBR servo interface PWBA in the power and servo chassis select the internal reference in place of the bit-rate clock when in the scan or fast modes. For other than the record, scan, or fast modes, a three-position switch on the servo interface PWBA selects the bit-rate clock or internal reference as follows:

a. REV (down) position: When the transport is in the forward mode, the bit-rate clock is selected for TBC (time base correction), and when in the reverse mode, the internal clock is selected so that the transport operates at normal speed selection (1-7/8 to 120 IPS).

b. FWD (up) position: The action is the reverse of *a* above.

c. Center position: Used in some custom configurations. The internal clock is not selected by the forward or reverse modes. (The system must be equalized for forward and reverse.)

In the reproduce mode, the reproduce reference clock (REPRODUCE CLOCK INPUT on the back panel of the DPB, SER or PAR according to the system configuration) is selected as the source of the capstan servo reference. During normal reproduction of the tape signals, this clock is divided by *N*, and then routed to the master deskew PWBA where it is divided to become the Qx clock. Also on the same PWBA, the data clock from the master channel bit-sync/decoder PWBA is divided to the same nominal frequency for the Qt tape signal. This division is selected at the factory for the best performance; usually, it is divide-by-8. At start-up, the tach is used and compared to the output of the divide-by-X circuit. Once both the capstan servo and bit-sync are phase-locked, these signals (Qx and Qt) are selected and compared for time-base stabilized reproduction.

4-32. Power Supplies and Regulators. The power and servo chassis includes the power supplies and a power regulator assembly required for operation of the tape transport. The main power supply (a multiple output supply) provides power which drives the capstan and reel motors and releases the reel brakes.

The ±18 V power from the main power supply is also processed by a ±12 V regulator assembly which includes a +5 V regulator section. This assembly provides the power to operate the logic circuits which control the transport. The ±12 V regulator (as well as the logic circuits) are plug-in printed wiring assemblies (PWBA's) which mount in the power and servo chassis card cage.

4-33. Record Signal Processing

A block diagram of the record section of the HBR-3000i is shown in figure 4-3.

4-34. Serial-to-Parallel Converter PWBA. Incoming data is applied to a serial-to-parallel converter printed wiring board assembly (PWBA) which divides the serial data stream(s) into the necessary number of channels. The serial-stream assembly can be programmed (÷N) for any number of output channels from 2 to 12. The serial word assembly can be programmed for ÷2, ÷3, or ÷4 to produce 2, 3, or 4 record channels for each bit of the incoming word, up to a total of 12 record channels for each DPB in the system. The signals at this point are still in NRZ-L form.

This processing includes dividing the serial record clock or reproduce XTAL clock down to the bit rate for the parallel channels. This division (÷N) is set by switches on the circuit board. The resulting divide-by-N clock is further divided by *X* in circuits that produce a frequency for the capstan servo reference. The divide-by-X clock is also set by switches on the circuit board, and the switches are set to produce the chosen bit-packing density on tape. The output signals from the serial-to-parallel converter are connected to the parallel or serial select PWBA.

4-35. Parallel or Serial Select PWBA. The parallel or serial select PWBA consists of solid-state digital switching as required to select either parallel outputs from the serial-to-parallel converter for serial systems, or external parallel inputs for parallel systems. The PWBA accommodates up to 13 parallel channels. The PWBA is controlled from the mode select panel (parallel or serial switch).

4-36. Calibrator No. 1 PWBA. The calibrator No. 1 (cal #1) PWBA works in conjunction with the calibrator No. 2 (cal #2) PWBA (on the reproduce side of the system) and the mode select panel switches. It routes data and clock selection required for system testing, adjustments, and troubleshooting.

4-37. Sync Inserter PWBA. The data is then processed by a sync inserter PWBA in order to insert a sync word for deskewing the reproduced data. A check word is also inserted into the same 32-bit window as the sync word. The sync inserter inserts a 32-bit sync window, with a sync word in the last 16 bits, into each of the parallel data channels, in turn, every 512 bits. The first 16 bits are subsequently used for the check word. The data bits displaced by the sync window are inserted into the master channel (transferred from each data channel in sequence). Table 4-1 shows the sync-word pattern developed in this manner. For testing purposes, sync insertion can be inhibited, thus allowing bit-rate error testing of each channel on an individual basis. Refer to the signal electronics adjustment manual for testing details.

The sync inserter also acts on the data to generate an even parity channel, which is used in error correction. In 28-channel systems, two such channels are normally generated, one in each DPB. The parity channel in the A bay is in channel 12 or 13 and the one in the B bay in channel 25 or 26, as determined by the system programming. If data requirements make it necessary, a 28-channel system may operate on only one parity channel by combining the parity sums of the two bays. This results in lower overhead, but also in a lessening in the degree of error correction.

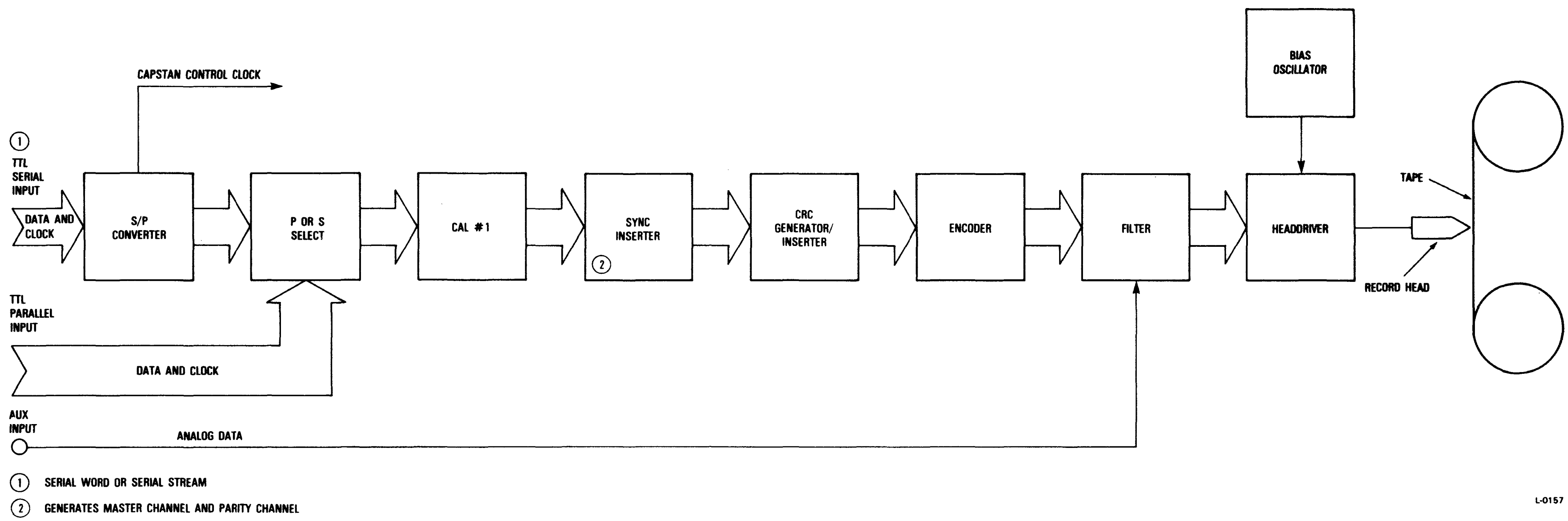


Figure 4-3. HBR-3000i Record System Block Diagram

Table 4-1. Typical Sync-Word Distribution (512-Bit Sync-to-Sync, 12 Data Channels Plus Master Channel and Parity Channel)

CHANNEL	SYNC-WINDOW BIT NUMBERS AND SOURCE OF DATA IN MASTER CHANNEL															
	1-32	33-64	65-96	97-128	129-160	161-192	193-224	225-256	257-288	289-320	321-352	353-384	385-416	417-448	449-480	481-512
DATA 1	NOTE (1) S	NOTE (1) D →														→ D
DATA 2	D	S	D →													→ D
DATA 3	D	D	S	D →												→ D
DATA 4	D →		→ D	S	D →											→ D
DATA 5	D →			→ D	S	D →										→ D
DATA 6	D →				→ D	S	D →									→ D
MASTER (DATA FROM CHANNEL NO.)	1	2	3	4	5	6	S	7	8	9	10	11	12	13	NOTE (3)	
DATA 7	D →						→ D	S	D →							→ D
DATA 8	D →							→ D	S	D →						→ D
DATA 9	D →								→ D	S	D →					→ D
DATA 10	D →									→ D	S	D →				→ D
DATA 11	D →										→ D	S	D →			→ D
DATA 12/PARITY NOTE (4)	D →											→ D	S	D →		→ D
DATA 13/PARITY NOTE (4)	D →												→ D	S	D	D

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NOTES:

(1) S = sync window, D = data. A 32-bit sync window with a sync word in the last 16 bits is inserted. Then the CRC is inserted into the first 16 bits in channels included in error correction.

(2) If any channels are unused, or contain unsynchronized data, no sync word is recorded on the tape. Nonsignificant signals are recorded on the master track during the periods that would normally be used for data transfer from these channels.

(3) Bits 449-512 on the master channel are used for auto-channel-select data and M48 (user) data.

(4) Parity may be recorded in channel 12 or 13, depending on configuration.

At the end of each sync cycle, the last two windows (for channels 14 and 15 in the master channel(s)) are not used for sync purposes. Part of this space is used to record 16 bits of internally generated information used in the auto-channel select function (described below in paragraph 4-52). The remaining 48 bit spaces are used (if desired) for the previously mentioned M48 data. The user can insert up to 48 bits of serial data for each 512-bit sync cycle. In the 28-track systems, both the master and slave master channels can accept M48 data.

4-38. CRC Generator/Inserter PWBA. The function of this PWBA is to and generate a 16-bit, binary cyclic redundancy check (CRC) word. The circuit operates on the 480 bits of data between sync windows to generate the CRC which is then inserted into the first 16 bits of the sync window of each channel.

4-39. Encoder PWBA. The encoder PWBA encodes the output of the CRC generator PWBA, including the master channel(s) and partiy channel(s). It uses a common clock for all channels. Up to fourteen channels can be encoded by this circuit board. Encoding can be either M^2 or Miller as selected at the mode select panel. Each channel has a normal output and a calibrate (cal) output for electronics-to-electronics (E-E) mode tests. (E-E mode bypasses analog electronics, head, and tape.) The E-E output is inhibited unless E-E is selected, and the normal output is inhibited except in record mode.

4-40. Filter PWBA. The encoded signals and auxiliary channels, if any are included, are next processed through passive filters on the filter PWBA. A low-pass filter for each channel removes harmonics from the signals to prevent possible intermodulation distortion between data and the high-frequency bias in the headdriver PWBA's.

4-41. Headdriver PWBA. The headdriver housing is mounted on the back of the transport baseplate assembly. This housing can be equipped with up to four 7-channel headdriver PWBA's that plug in from the front of the transport. The signals applied to the record headdriver PWBA from the filter PWBA are mixed with 13.6 MHz bias. The outputs of these assemblies drive the record heads.

4-42. Reproduce Signal Processing

Figure 4-4 is a block diagram of the reproduce section of the HBR-3000i. For systems having more than 14 tracks, two BSB's, two REP bays, and two DPB's are required.

4-43. Reproduce Head Preamplifiers. When data is being reproduced, it is detected by magnetic reproduce heads. The low-level signals induced in the reproduce heads are processed by two preamplifier circuits. Preamplifier number 1 assemblies are mounted on the reproduce head assemblies. They convert the head signals from tape to a differential output to the preamplifier number 2 assemblies, to minimize noise pickup. The preamplifier number 2 assemblies are mounted in a housing on the back of the transport. They complete a 40 dB amplification of the head signals and convert them to single-ended outputs which are cabled to the reproduce amplifiers.

4-44. Direct Reproduce Amplifier PWBA. In the direct reproduce amplifiers, the signals are further amplified and are equalized for best frequency response. Optimum equalization is different at different tape speeds, so the direct reproduce amplifier has equalizers for seven speeds, covering the range from 1-7/8 to 120 IPS (nominal). The correct equalizer for any tape speed in the range is selected by the speed select pushbutton. Phase correction is also applied.

4-45. Bit-Sync/Decoder PWBA. The equalized signals from the outputs of the reproduce amplifiers are cabled to the bit-sync/decoder PWBA's in the BSB. These assemblies have three purposes:

a. To amplitude-limit the signals from the reproduce amplifiers

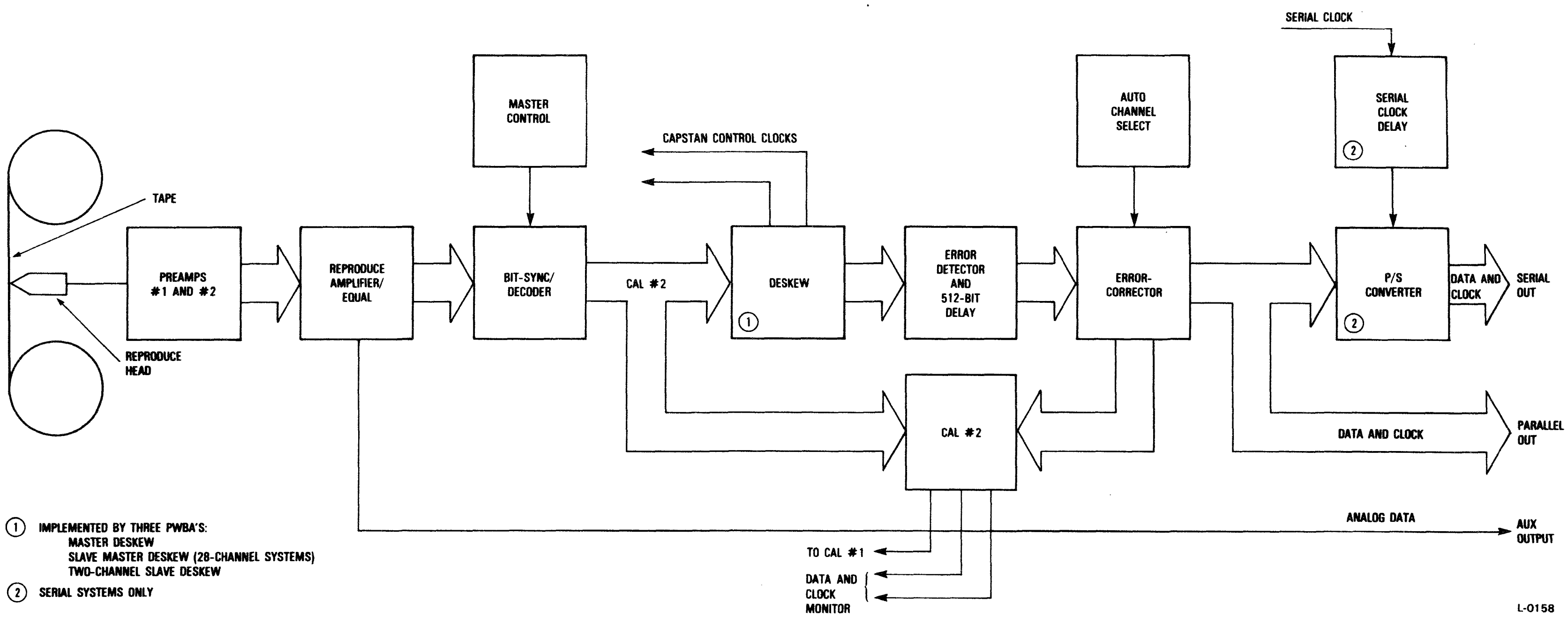


Figure 4-4. HBR-3000i Reproduce System Block Diagram

b. To recover a clock from each channel of reproduce data

c. To decode reproduce data (i.e., from M^2 to NRZ-L)

The reproduced signal from the direct reproduce PWBA's is passed through limiter circuits which include threshold adjustments. Clock recovery is accomplished by phase-locking a VCO to the incoming data transitions.

The resulting clock is used in the decoding circuitry to decode the incoming encoded data to NRZ-L. The clock and NRZ-L data are output to the deskew circuitry.

4-46. Speed Encoder PWBA. This PWBA (not a plug-in) is mounted on the rear of the bay interconnect panel. The speed encoder circuit converts the speed select line made at the transport control panel into a binary-coded-decimal (BCD) word that selects equalization in the reproduce amplifiers and dividers in the code clock generator of the bit-synchronizers.

4-47. Master Control PWBA. The master control assembly supplies two DC voltages and VCO select logic to each bit-sync/decoder assembly. The two voltages, one fixed, one adjustable, are used to set all VCO's to the correct static-center frequency. In the E-E mode, a pushbutton on the master control PWBA selects VCO1 or VCO2, as required, for adjustment. In all other modes, the VCO1/VCO2 selection is made on the MSB.

4-48. Cal #2 PWBA. The calibrator number 2 (cal #2) board works in conjuction with cal #1, described above, in testing the signal electronics system. Its function is to select the reproduce channel programmed by the MSB CHANNEL SELECT switch and send it to the cal No. 1 PWBA.

4-49. Deskew PWBA. The outputs of the bit-sync/decoders (data and clock) are cabled to the deskew electronics in the DPB. The deskew electronics consist of one master deskew assembly, plus slave deskew assemblies for the associated data channels. The slave deskew assemblies include two channels each: one deskew circuit for an odd channel, and one for an even channel. The master channel provides clocks to control the deskew process in the slave assemblies. The deskew electronics realign the data, bit by bit, before error detection and correction take place. The master deskew PWBA also includes circuits which divide the master-channel bit-sync clock and the parallel clock to form a reference and comparison signal for the capstan servo. On 28-track systems, a slave master deskew PWBA is used in the second DPB to perform the same functions as the master deskew PWBA, but is synchronized with the master deskew PWBA, and does not include the capstan reference generation circuitry.

4-50. 512-Bit Delay and Error Detector PWBA. To permit the correction of errors, the data is delayed for 512-bit periods (i.e., until after error detection). The actual error detection makes use of the CRC inserted in the first 16 bits of the sync window to detect if an error occurred within the previous 480-bit data block. Detected errors are used to generate flags for each channel, one of which is used by the error corrector and one of which is used as a monitor signal. The M48 data is made available for transfer into user registers by circuits on the 512-bit delay PWBA.

4-51. Error Corrector/Data Reinsertion PWBA. The error corrector/data reinsertion PWBA (error corrector) has four main functions:

- To determine if one and only one track has error(s) on it.
- To correct the error(s), if they are present.

- To recombine the data from the master channel with the appropriate data channels.

- To output parallel data.

Channel selection for error correction can be made either by the DIP switches on the front of the PWBA or by the auto-channel-select PWBA. The auto-channel-select board can select automatic or manual mode. In automatic mode the DIP switches are disabled, and the format read from the tape is used to select the active ECC channels. The error correction circuit does a parity check of all the ECC data channels, portions of the master channel and the parity channel. If no error exists, as determined by the flags, no further action is taken. If only one channel has an error, its data is corrected. If two or more channels have errors, correction is inhibited during the time the detected flags overlap.

Parallel data outputs are taken from this PWBA. In a parallel system, these outputs are interfaced to external equipment. In serial systems, they are sent on to the parallel-to-serial converter.

4-52. Auto Channel Selector PWBA. The auto channel selector contains logic for decoding the channel-select information inserted in the first half of the channel 14 sync window in the master channel during recording. When this PWBA is included and is in auto mode, it uses this information to generate signals which drive the channel-select circuits on the error-corrector PWBA. A series of LED's on the front edge of the card indicate the channels which are selected for error correction.

4-53. Parallel-to-Serial Converter PWBA. In serial systems, the parallel-to-serial converter PWBA reassembles the data into its original serial form. The divide-by-N switches on the serial-to-parallel PWBA determine the number of channels reassembled. The serial clock from the serial-to-parallel PWBA, suitably delayed, is used to clock the serial data and becomes the output clock. Parallel systems do not use this PWBA, as parallel outputs are taken directly from the error corrector PWBA's.

4-54. Serial Clock Delay PWBA. This PWBA includes delay circuits that delay the serial clock to bring it into alignment with the parallel clock (which is delayed by processing) for use in the serial-to-parallel converter.

4-55. ECC and Non-ECC Operation

As stated earlier in this section, if non-ECC operation is selected at the MSB, ECC parity tracks may be used for data recording. In this mode, the system operates as a non-ECC system, including use of a 32-bit sync word. This makes error-correction impossible, and is not normally used except in cases where the use of the parity track(s) for data is mandatory. No other advantage accrues from non-ECC operation. Previously recorded non-ECC tapes may be played back with the system in either ECC or non-ECC mode. Tape interchangeability is as follows:

a. Tapes recorded in ECC format are playable with error correction in the forward direction only, and in the reverse direction without error correction on ECC equipped systems.

b. Tapes recorded in the ECC format are playable on non-ECC systems only in the forward direction (without error correction).

c. Non-ECC systems equipped with ECC type deskews can play ECC format tapes in both forward and reverse directions (without error correction).

d. ECC systems are capable of playing non-ECC format tapes in the forward direction.

4-56. Test Mode

When test mode is selected (by use of the NORMAL/TEST switch of the MSB), signals from the MSB are substituted for user inputs. In conjunction with other switches on the MSB panel, this function can be used to test various sections of the signal system. Electronics-to-electronics (E-E) mode can be used to bypass the tape in order to assist in isolating faults. The following are some of the tests that can be performed:

- BITE self-test
- E-E tests
  - Encode/decode
  - Sync-insertion/deskew
  - Serial-to-parallel, parallel-to-serial
- Reproduce (analog) test
- Record (analog) test

Instructions for performing the above listed tests are included in section 5 of this manual.

SECTION 5

MAINTENANCE

5-1. GENERAL

This section covers preventive maintenance, troubleshooting, and removal and installation of signal electronics subassemblies. Maintenance of the tape transport, including removal and installation of subassemblies, is covered in the HBR-3000i tape transport maintenance manual. Tape transport adjustments are covered in the separate tape transport adjustment manual. Signal electronics adjustments are covered in the signal electronics adjustment manual. When adjustments to the system are made, always be sure the transport is correctly adjusted before adjusting the signal electronics.

5-2. TOOLS AND MATERIALS REQUIRED

The tools, materials, and test equipment required to perform the preventive maintenance detailed in this section are listed in tables 5-1 and 5-2.

5-3. PREVENTIVE MAINTENANCE

Preventive maintenance is intended to maintain optimum performance and minimize corrective maintenance by means of routine inspection, cleaning, and head degaussing at suitable intervals.

5-4. Maintenance Schedule

Depending upon the type and quantity of tape used, or total operating time, the required amount of cleaning varies. When a tape transport is operated in a dusty environment, more frequent cleaning is required. Aligning of signal electronics, including cleaning of the heads, should only be done after a series of performance checks have been made and indicate the need. Each time the tape is threaded, the surface of the heads, capstan, and guides should be examined for oxide or dust deposits. An increase in signal dropouts may be an indication that the heads need cleaning (paragraph 5-8). Loss of high-frequency response and increase in second-harmonic distortion or noise may be indications that the heads need degaussing (paragraph 5-12). Table 5-3 lists the recommended preventive maintenance tasks and their frequency.

5-5. Head Retraction and Reseating

For cleaning the capstan, and cleaning and degaussing the heads, the head assemblies must be retracted from the capstan. The head assemblies, including the quick-release clamping levers, are shown in figure 5-1. When the quick-release clamping lever is released, the head assembly must be free to slide away from the capstan. When the lever is returned to its clamping position, the mechanism must hold the head assembly securely to the transport precision plate without distorting the clamping mechanism threads or the precision plate. This condition is roughly definable as "at or just slightly above the minimum force required to hold the head assembly securely in place." If any difficulty is encountered with head retraction or reseating, or if a new head assembly is installed, the clamping tension must be adjusted as described in the tape transport maintenance manual.

Table 5-1. Tools and Materials Required for Preventive Maintenance

TOOL OR MATERIAL	IDENTIFICATION OR TYPE
Head cleaner fluid	Ampex 087-007
Toothbrush	Any ordinary soft toothbrush
Clean, lint-free cloth	N/A
Cotton swab	Ampex 650-080 or equivalent
Cleaning agent	Isopropyl alcohol; Denatured alcohol; Tex-Pads (91%); Freon TF (Ampex 050-104); Freon TP35
Head degausser	Ampex HD-16 (1815050-010)
Vacuum cleaner	Any commercial unit
Airguide cleaner	Ampex 1208604-02

Table 5-2. Test Equipment for Troubleshooting*

ITEM	TYPE	CHARACTERISTICS
Oscilloscope	Tektronics model 7704A with 7A26 and 7B71 plug-in units or equivalent	Time base and reading accuracy should be sufficient to avoid degrading the measurement of the equiment performance.
Digital voltmeter	Fluke 8000A or equivalent	Accuracy within 0.01%.

* This equipment is in addition to the built-in test equipment (BITE) of the mode select bay.

To retract and reseat the head assemblies, proceed as follows:

a. Remove the tape from the head assemblies.

b. Raise the clamping lever and move it completely (≈180°) to the released position (figure 5-1).

c. Using *only the round knob as a handle,* retract the head assembly by sliding it to the right.

d. To reseat the head assembly, reverse the above procedure.

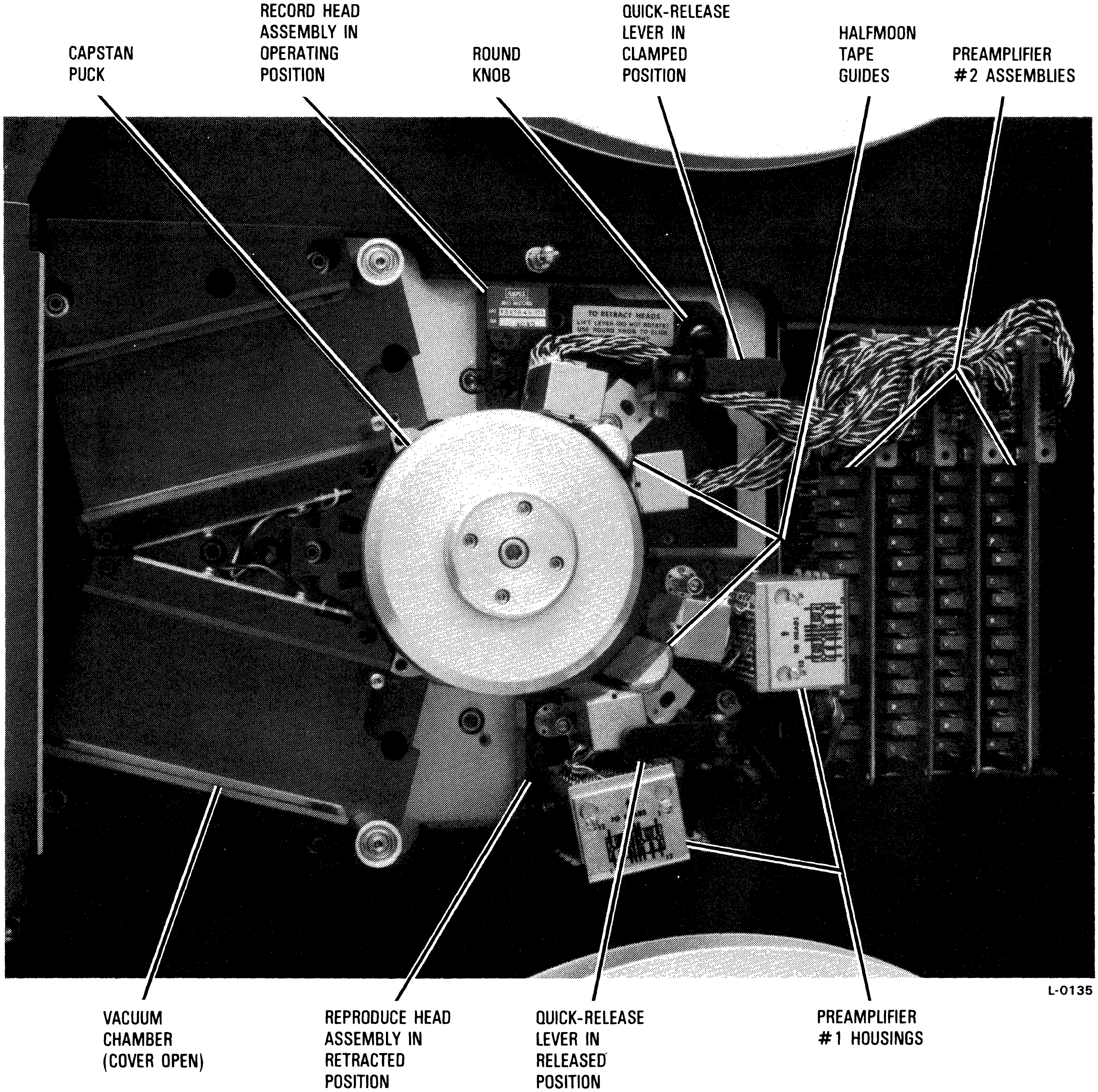


Figure 5-1. Head and Capstan Area Cleaning

5-6. Transport General Cleaning

Clean all dust and loose foreign material from the transport. A clean, lint-free cloth, dipped into alcohol may be used for this purpose. Use a vacuum cleaner to remove dust from otherwise inaccessible areas. Do not blow air into the transport; it may force dust into the bearings or other moving parts.

5-7. Capstan Cleaning

WARNING

TO AVOID PERSONAL INJURY, OR DAMAGE TO THE EQUIPMENT, ONLY THE CLEANING AGENTS LISTED IN TABLE 5-1 SHOULD BE USED. DO NOT USE CLEANING AGENTS SUCH AS MEK, TRICHLOROETHYLENE, OR HEAD CLEANER. DUE TO THE HYGROSCOPIC NATURE OF THECAPSTAN ELASTOMER, SOAP AND WATER SHOULD NOT BE USED. REGARDLESS OF THE CLEANING AGENT USED, THE CAPSTAN SHOULD NEVER BE SATURATED — IT SHOULD BE CLEANED WITH AN APPLICATOR THAT HAS BEEN LIGHTLY MOISTENED WITH THE CLEANING AGENT.

To clean the capstan, proceed as follows:

a. Retract the head assemblies as detailed above in paragraph 5-5.

b. Clean the capstan puck with a lint-free cloth or cotton swab *lightly* moistened with an approved cleaning agent (listed in table 5-1). This can be done by holding the cloth or swab against the capstan surface while turning the capstan slowly by hand. Remove all traces of foreign matter. Pay particular attention to cleaning the grooves in the elastomer surface of the capstan puck. This can be accomplished by lightly brushing the capstan surface with a very fine nylon or bristle brush (toothbrush). (Bristles should not be so hard as to damage the elastomer surface.) Care should be taken to prevent the cleaning agent from entering the area behind the capstan puck. Excessive liquid in this area could damage the optics assembly located there.

5-8. Head Cleaning

With the head assemblies retracted, clean the heads as follows:

CAUTION

USE ONLY APPROVED HEAD CLEANER, AMPEX PART NO. 087-007. OTHER CHEMICALS OR SOLVENTS MAY DAMAGE THE HEAD ASSEMBLIES.

Table 5-3. Preventive Maintenance Schedule

TASK	FREQUENCY OF PERFORMANCE	PARAGRAPH
Capstan cleaning	Preceding each data recording, or at least once every 8 hours of operation.	5-7
Head cleaning	Preceding each pass of a full reel of tape during recording or when degradation of signal occurs during reproduction.	5-8
Tape cleaning	Before each recording or reproduction for which minimum BER is required.	5-9
Head degaussing	When the performance checks or adjustment procedure indicate the necessity.	5-12
Halfmoon guide cleaning	Quarterly, or as necessary when they become dirty.	5-10
Vacuum chamber and tape guide cleaning	As necessary, when they become dirty. Generally speaking it is recommended that these items be checked preceding each data recording, and cleaned if found to be dirty.	5-11
Vacuum plenum chamber filter cleaning	Semiannually or when it becomes dirty. When tape that sheds heavily is used, the vacuum plenum chamber filter can become dirty in a short period of time.	Tape transport maintenance manual
Air compressor filter replacement	Semiannually or when they become dirty.	Tape transport maintenance manual

a. Moisten a cotton-tipped swab with approved head cleaner (Ampex 087-007) and carefully wipe the heads (with a scrubbing motion) so that all oxide, lubricant, and foreign matter are removed.

b. Repeat the scrubbing action with a clean swab for final cleaning.

c. If degaussing is not required, return the heads to their operational position following the procedure in paragraph 5-5.

5-9. Tape Cleaning

In high-density digital recording, cleanliness of the tape is of paramount importance. As a minimum, great care should be taken to store and use the tape and recorder in the cleanest possible environment. It can be of considerable help in obtaining the most consistently good results to clean the tape whenever minimum BER is required. Commercial tape cleaners that perform such cleaning are available, and should be operated according to their manufacturer's instructions. If degaussing is required, degauss the tape before cleaning it.

For further information on tape handling and care, refer to paragraph 3-10 in section 3 of this manual.

5-10. Halfmoon Guide Cleaning

To clean the halfmoon air guide (see figure 5-1 for location), proceed as follows:

a. Using a lint-free cloth or cotton-tipped swab moistened in head cleaner (Ampex 087-007), clean the exposed surfaces of the air guide with a scrubbing motion. Pay particular attention to the air slots.

b. Use the airguide cleaner (Ampex 1208604-02) to clean the airguide holes.

c. Repeat the scrubbing action with a clean cloth or swab for final cleaning. Remove all traces of oxide.

5-11. Vacuum Chamber and Tape Guide Cleaning

CAUTION

TO AVOID PERSONAL INJURY, OR DAMAGE TO THE EQUIPMENT, ONLY THE CLEANING AGENTS LISTED IN TABLE 5-1 SHOULD BE USED. DO NOT USE DANGEROUS SOLVENTS SUCH AS MEK, TRICHLOROETHYLENE, ETC.

To clean the vacuum chamber and tape guides, proceed as follows:

a. Open the vacuum chamber cover to gain access to the chambers.

b. Lightly moisten a lint-free cloth or cotton-tipped swab with an approved cleaning agent (listed in table 5-1). Clean the tape guide rollers, the interior of the vacuum chamber, including the glass surfaces, and the inside of the cover. Be sure to remove all dirt and oxide. Use care not to let the cleaning agent get into the ball bearings of the outer roller guides.

c. When all surfaces are completely dry, close the vacuum chamber cover.

5-12. Head Degaussing

With all tape removed, and the head assemblies retracted (paragraph 5-5), proceed with the degaussing as indicated below:

a. Turn off the transport power.

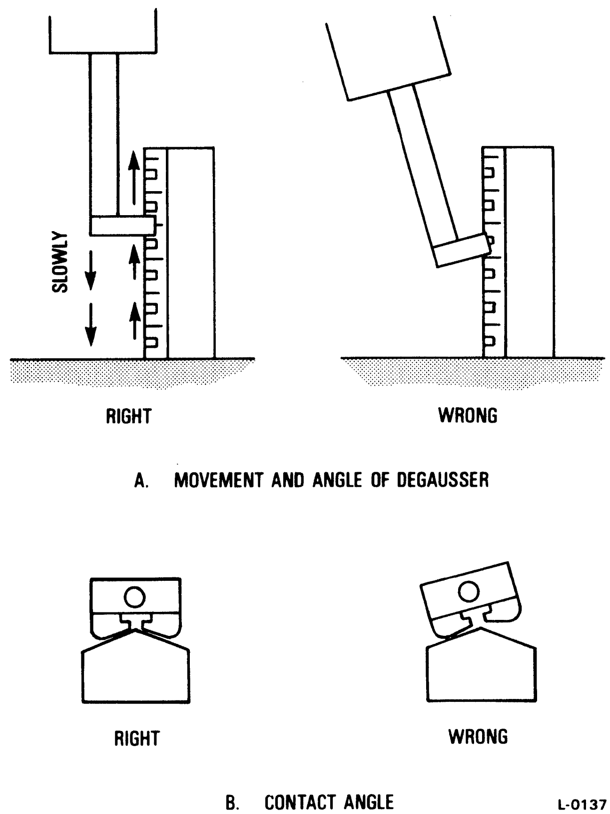


Figure 5-2. Head Degaussing

CAUTION

KEEP THE DEGAUSSER AWAY FROM THE HEAD ASSEMBLY AND OTHER TAPE-HANDLING COMPONENTS WHILE CONNECTING OR DISCONNECTING POWER. THE INITIAL AND FINAL SURGES OF CURRENT PRODUCE STRONG FIELDS THAT CAN MAGNETIZE THE ASSEMBLIES. KEEP THE DEGAUSSER AWAY FROM THE MAGNETIC TAPE THROUGHOUT THE PROCEDURE.

b. Connect an Ampex Model HD-16 degausser (1815050-01) to a 117 VAC, 50/60 Hz outlet at the foot of the transport rack. Do not connect or disconnect the degausser when it is within three feet of the transport or tape.

c. Carefully and slowly place the degausser pole tips in light contact with the head as shown in figure 5-2. Keep the pole tips parallel to the head surface and move the degausser slowly and steadily all the way inward along the head center line (this should take approximately 15 seconds). Reverse the direction of the degausser movement and bring it slowly and steadily outward along the center line. Continue slow outward motion until the degausser is well away from the heads.

d. Repeat the procedure with the other head stacks.

e. After degaussing, the heads should be returned to their operating position (paragraph 5-5).

5-13. Other Routine Maintenance

This completes system preventive maintenance. However, there are separate preventive maintenance procedures for the tape transport which must be followed if optimum performance is to be maintained. Refer to the tape transport maintenance manual if there is any doubt that transport maintenance is up to date.

5-14. TROUBLESHOOTING

The following paragraphs give troubleshooting information for the HBR-3000i system with references to other parts of this manual and supporting manuals as needed for isolating and repairing faults. The location of troubleshooting information is as follows:

a. This section is divided into power failure, initial checks, and signal electronics problems.

b. Section 6 of this manual includes information on racks and cables not covered elsewhere.

c. The HBR-3000i signal electronics manual contains descriptions and complete schematics and parts lists for the signal electronics and for the BITE electronics of the mode-select bay (MSB).

d. The HBR-3000i signal electronics adjustment manual contains complete adjustment procedures for all the signal electronics, including identification of all adjustment and test points.

e. The HBR-3000i tape transport maintenance manual and the HBR-3000i tape transport adjustment manual both provide maintenance information for the tape transport, including reel servos, capstan servo, and air and vacuum systems.

5-15. Power Failure

Table 5-4 lists the circuit breaker and fuses for the rack and signal electronics. Tape transport circuit breaker and fuses are listed in the HBR-3000i tape transport maintenance manual.

5-16. Initial Checks

Often the first indication of a malfunction is an increase in the bit error rate (BER). The following steps should be considered before beginning troubleshooting.

a. Verify correct operating procedure. Check all switch settings on the mode select panel, transport control panel, and any internal switches which may have been changed.

b. Run performance tests to verify that a failure exists.

c. Be sure the system (including the tape transport) is properly adjusted.

d. For fault isolation in the signal system, refer to paragraph 5-17 and following.

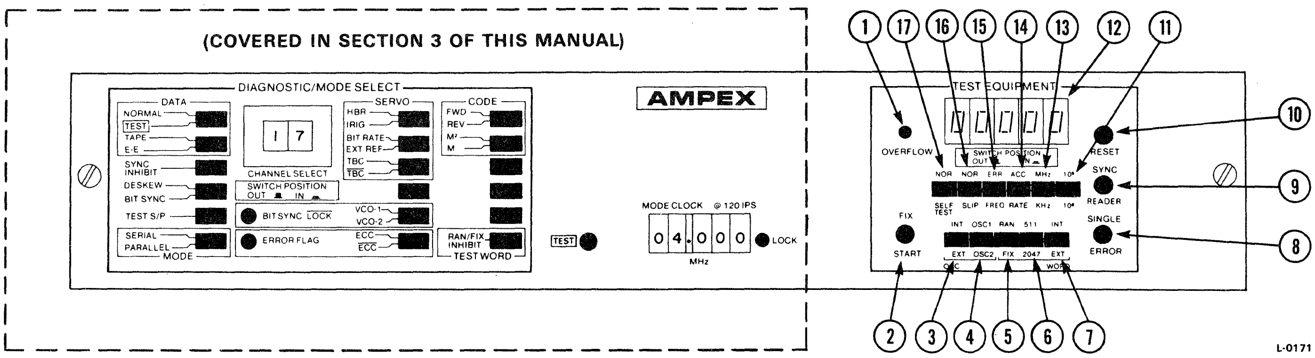
Table 5-4. HBR-3000i Circuit Breaker and Fuses*

ITEM	LOCATION	REFERENCE	AMPS	SPEED	CIRCUIT
1	Power chassis panel	CB501	25	— — —	Two-pole main-power circuit breaker. All loads within the transport, plus utility outlets.
2	Power chassis panel	F501	10	Fast blow	AC outlets panel. Supplies cabinet fan and headdriver housing.
3	Power chassis panel	F502	10	Fast blow	AC outlets front panel.
4	Mode select panel	F1	0.25	Slow blow	Primary power −5.2 VDC supply.
5	Mode select panel	F2	1	Slow blow	Primary power +5 VDC supply.
6	Bit sync bay	F1	3	Fast blow	Primary power +5 VDC supply.
7	Bit sync bay	F2	2	Fast blow	Primary power −5 VDC supply.
8	Reproduce bay	F1	4	Slow blow	Primary power ±12 VDC supply.
9	Reproduce bay	F2	0.5	Slow blow	Pirmary power +5 VDC supply.
10	Digital process bay	F1	0.25	Slow blow	Primary power −5 VDC supply.
11	Digital process bay	F2	2	Slow blow	Primary power +5 VDC supply.
12	Digital process bay	F3	1	Slow blow	Primary power +12 VDC supply.
13	Digital process bay	F4	2	Slow blow	Primary power +5 VDC supply.
14	Headdriver housing	F1	2	Slow blow	Primary power. Headdriver and pre-amplifier power supplies.
15	Headdriver housing	F2	4	Fast blow	Power supply for bias oscillator and selective record relays (+24V, +18V).
16	Preamp #2 housing	F1	0.25	Fast blow	+12 V power for preamp #1's.

* All fuses are 1/4" x 1-1/4" tubular.

5-17. Troubleshooting Using BITE

The following procedures are designed to isolate a signal electronics malfunction to a PWBA or other replaceable assembly, using the BITE in the MSB. Before using these procedures, verify correct operation of AC power, DC power supplies, and transport servos. The following tests are given for a serial 14-channel system. Only slight modification is necessary for parallel or 28-channel systems; i.e., parallel systems do not have the serial-to-parallel or parallel-to-serial functions, and the tests can be skipped.



NOTE: KEY NUMBERS REFER TO TABLE 5-5.

Figure 5-3. TEST EQUIPMENT Controls and Indicators

Figure 5-3 and table 5-5 identify and describe the TEST EQUIPMENT controls and indicators of the MSB. The DIAGNOSTIC/MODE SELECT controls and indicators (at the lefthand end of the front panel) are described in figure 3-4 and table 3-4 in section 3 of this manual.

In order to proceed in a systematic sequence, perform the tests in the following order. Tests shown in paragraphs *b* through *e* require successful completion of the previous tests.

a. BITE self-test: verifies BITE electronics.

b. E-E group A tests: tests encode/decode functions.

c. E-E group B tests: tests sync insertion/deskew functions.

d. E-E group C tests: tests serial-to-parallel/parallel-to-serial functions.

e. Reproduce mode tests: tests analog reproduce system.

f. Record mode tests: tests analog record system.

When a malfunction is traced to a particular channel and function, an oscilloscope can be used to isolate the problem to a replaceable unit.

5-18. Description of Troubleshooting Block Diagram. Figure 5-4 is a troubleshooting block diagram for the HBR-3000i system. The approximate areas under test in the group A, B, and C tests are shown by different types of shading.

NOTE

Once a fault is isolated, refer to the appropriate schematics in the signal-electronics volume for the relationship of test circuits to normal signal and clock circuits. Locating failures of test circuit IC switches, gates, or isolation resistors must be considered as part of troubleshooting.

Table 5-5. Mode Select Bay TEST EQUIPMENT Controls and Indicators

KEY NO.*	SCHEMATIC REF	CONTROL OR INDICATOR	TYPE	POSITION	FUNCTION
1	DS6 Counter display	OVERFLOW	LED	N/A	Indicates overflow of digital display unit.
2	S3 PRW generator	FIX START	Momentary pushbutton switch	N/A	Starts the fixed-word test pattern.
3	S2E PRW generator	OSC: INT (black) EXT (red)	Push-push switch	INT (*out*)	Selects the internal frequency synthesizer to generate the test clock frequency.
				EXT (*in*)	Selects rear panel connector EXT OSC INPUT for test clock.
4	S2D PRW generator	OSC: OSC 1 (black) OSC 2 (red)	Push-push switch	OSC 1 (*out*)	Allows the division of the fundamental clock frequency to be controlled by the seven-line speed-selector or BCD encoder S4 on the clock divider PWBA.
				OSC 2 (*in*)	Allows the division of an external oscillator signal to be controlled by BCD encoder S5.
5	S2C PRW generator	WORD: RAN (black) FIX (red)	Push-push switch	RAN (*out*)	Sets the test generator as a pseudorandom word generator.
				FIX (*in*)	Sets the test generator to output a 10-bit repeating pattern: 1101000000.
6	S2B PWR generator	WORD: 511 (black) 2047 (red)	Push-push switch	511 (*out*)	Selects a pseudo-random word length of 511 bits.
				2047 (*in*)	Selects a pseudo-random word length of 2047 bits.
7	S2A PRW generator	WORD: INT (black) EXT (red)	Push-push switch	INT (*out*	Selects the internal pseudo-random generator as the test source.
				EXT (*in*)	Selects an external generator as the test source.

* Figure 5-3

Table 5-5. Mode Select Bay TEST EQUIPMENT Controls and Indicators (Cont)

KEY NO.*	SCHEMATIC REF	CONTROL OR INDICATOR	TYPE	POSITION	FUNCTION
8	S1 PRW generator	SINGLE ERROR	Momentary pushbutton switch	N/A	Initiates a single error for test purposes. Counts as three in normal mode with random word. Counts as two in normal mode with fixed word. Counts as one in slip mode with random word.
9	S1 Comparator	SYNC READER	Momentary pushbutton switch	N/A	Resynchronizes the pseudo-random reader/comparator in the slip mode.
10	S1 Counter display	RESET	Momentary pushbutton switch	N/A	Resets the digital display to zero.
11	S2A Comparator	10^6 (black) 10^8 (red)	Push-push switch	10^6 (*out*) 10^8 (*in*)	Selects range for error-rate mode (key no. 14).
12	DS1 thru DS5 Counter display	Five-digit readout	Red LED	N/A	Displays error count (ERR) or frequency (FREQ).
13	S2B Comparator	MHz (black) kHz (red)	Push-push switch	MHz (*out*) kHz (*in*)	Selects range for frequency (FREQ) mode.
14	S2C Comparator	ACC (black) RATE (red)	Push-push switch	ACC (*out*)	Causes total error count to be accumulated.
				RATE (*in*)	Causes rate of errors per 10^6 or 10^8 (key no. 11) to be displayed.
15	S2D Comparator	ERR (black) FREQ (red)	Push-push switch	ERR (*out*)	Puts the display into the error mode, counting errors.
				FREQ (*in*)	Puts the display into frequency mode, showing the frequency of the clock applied to the comparator.

* Figure 5-3

Table 5-5. Mode Select Bay TEST EQUIPMENT Controls and Indicators (Cont)

KEY NO.*	SCHEMATIC REF	CONTROL OR INDICATOR	TYPE	POSITION	FUNCTION
16	S2E Comparator	NOR (black) SLIP (red)	Push-push switch	NOR (*out*)	Causes the comparator to resynchronize every word automatically. A single error in a random word counts as three, and in a fixed word, counts as two.
				SLIP (*in*)	Causes the comparator to indicate continuous errors if a bit-slip occurs. It must be resynchronized with the SYNC READER pushbutton. Any single error counts as one (pseudo-random word only).
17	S2F Comparator	NOR (black) SELF TEST (red)	Push-push switch	NOR (*out*)	Routes data and clock to the comparator from the test output of the calibrator #1 PWBA.
				SELF TEST (*in*)	Routes data and clock from inside the BITE.

Figure 5-3

Referring to figure 5-4, note that all test signals pass through the CAL #1 PWBA for all groups, and group B tests pass through the CAL #2 PWBA. All test signals also pass through the sync inserter and CRC generator PWBAs; but, for the group A tests, the sync and ECC functions are inhibited.

5-19. BITE Self-Test. This is a confidence test to verify that the BITE electronics are working. Proceed as follows:

a. Set NOR/SELF TEST *in*.

b. Set RAN/FIX *in*.

c. Reset the display.

d. Press the SINGLE ERROR pushbutton several times.

e. Verify two error counts on the display for each error.

f. If a problem is encountered, see the MSB manual in the signal electronics volume.

g. Set NOR/SELF TEST *out*.

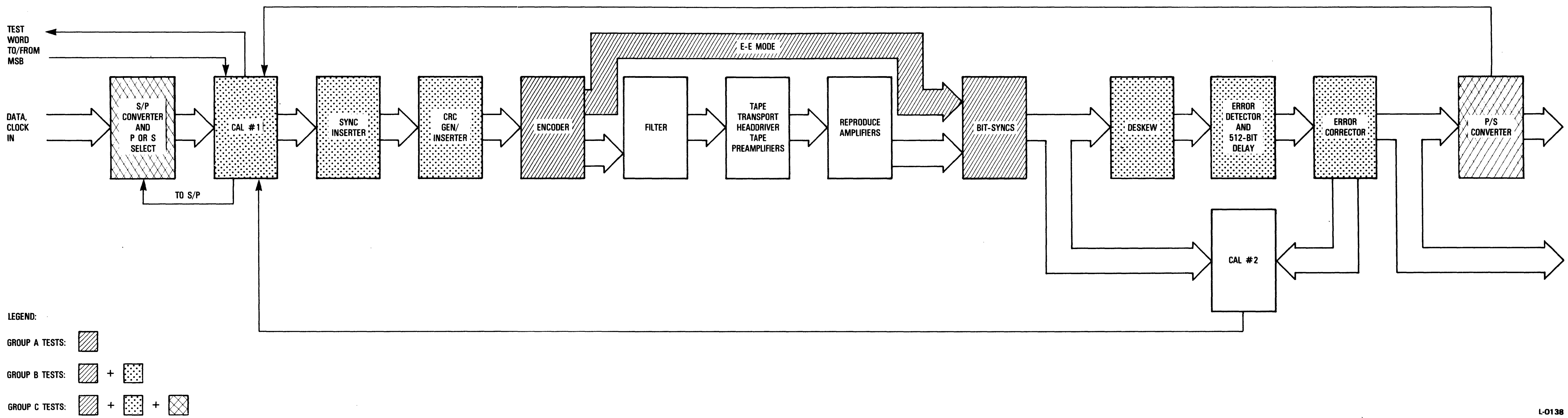


Figure 5-4. Troubleshooting Block Diagram

5-20. Group A Tests E-E. These tests verify the operation of the encode and decode functions without sync insertion and deskew. For this test, all channels, including the master channel, have the same data. Proceed as follows:

a. On the MSB, set all diagnostic and BITE switches *out*, except the following:

   1. NORMAL/TEST *in*

   2. TAPE/E-E *in*

   3. SYNC INHIBIT *in*

   4. DESKEW/BIT SYNC *in*

   5. ECC/$\overline{\text{ECC}}$ *in*

   6. SERIAL/PARALLEL (bottom diagnostic pushbutton) *in*

b. Set the frequency synthesizer to the parallel channel rate (i.e., the serial rate divided by the number of channels).

c. Set the CHANNEL SELECT switch to 00 (master channel) and press the SINGLE ERROR switch several times. Verify the display reads three counts for each error introduced.

d. Set the CHANNEL SELECT switch for each channel in sequence while repeating the previous step. (Channel-select 29 is the slave-master channel.)

e. If all channels are OK, go to the next test.

f. If a channel is bad, use an oscilloscope to verify the data (at that channel) at the output of the sync inserter PWBA (test points are on the block diagram). Sync the oscilloscope using GEN SYNC which is located on the MSB rear panel.

g. If the sync inserter outputs are OK, move the oscilloscope probe to the test points on the encoder PWBA and repeat the tests for all channels.

h. If the encoder outputs are OK, move the oscilloscope probe to the data/clock test point on the bit-sync/decoder PWBA and repeat the tests for all channels.

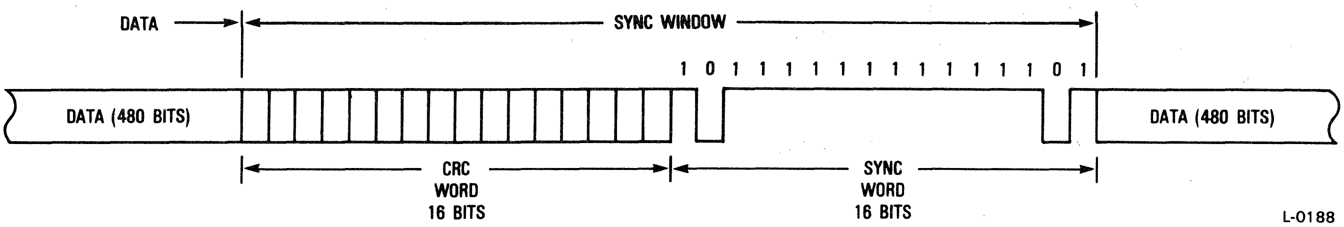
i. Replace any faulty PWBA, signal trace, and repeat the tests.

5-21. Group B Tests E-E. These tests verify the operation of the sync inserter and deskew functions. The master channel is operating and is automatically tested as part of these tests. It cannot be tested individually. Proceed as follows:

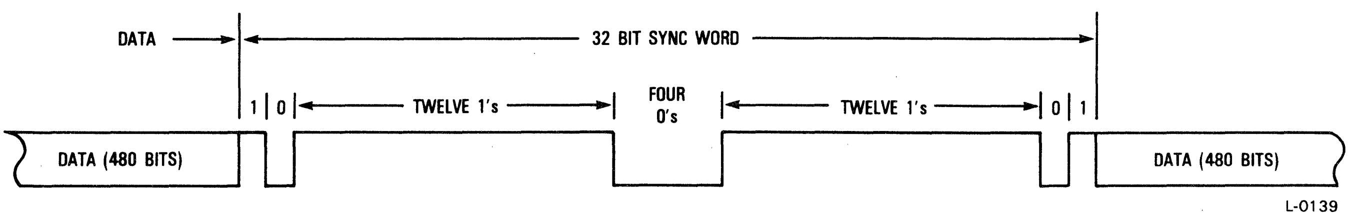
a. All switches remain as in the previous test, except:

   1. SYNC INHIBIT *out*

   2. DESKEW/BIT SYNC *out*



A. SYNC WORD WITH ECC



B. SYNC WORD WITHOUT ECC

Figure 5-5. Sync Words

b. Set the CHANNEL SELECT switch to 01 and press the SINGLE ERROR switch several times. Verify the display reads three counts for each error introduced.

c. Repeat the previous step for all digital channels equipped.

d. If all channels are OK, go to the next test.

e. If a channel is bad, use an oscilloscope (with TP18 on sync inserter PWBA for sync) to verify the sync word format and position is correct at the output of the sync inserter PWBA. See figure 5-5. Verify that the data is present.

f. If the output of the sync inserters is OK, move the oscilloscope probe to the output test points of the 2-channel slave deskew PWBA's. (Same sync as step *e*.) Verify that TP2 and TP4 show data plus sync, and that TP8 and TP9 show data only.

g. Replace any faulty PWBA and repeat the tests.

h. Place the ECC/$\overline{\text{ECC}}$ switch in the *out* (ECC) position and repeat steps *b* through *g*. Note that the parity channel(s) operate during these tests and are automatically tested. They cannot be individually tested. (If there is doubt as to which channels contain the parity, refer to section 8 of this manual.)

5-22. Group C Tests E-E. These tests verify the operation of the serial-to-parallel and parallel-to-serial versions, and may be run either with or without ECC. (Refer to note for systems having multiple serial input/output.) Proceed as follows:

NOTE

Systems having multiple serial input/output use the CHANNEL SELECT switch to select the serial channel under test. The settings of the CHANNEL SELECT switch depend on the system configuration. Repeat the procedure for each serial channel.

a. Set the frequency synthesizer to the serial rate.

b. Set the S/P pushbutton *in*.

c. Set the SERIAL/PARALLEL (bottom diagnostic) pushbutton *out*.

d. Press the SINGLE ERROR pushbutton several times and verify the display reads the correct number of errors.

e. If OK, go to the next test.

f. If a fault is detected, use an oscilloscope to verify the data at the output TP's of the parallel-or-serial-select PWBA. Use GEN SYNC for oscilloscope sync.

g. If a fault is found, replace the parallel-or-serial-select PWBA. If errors persist, replace the serial-to-parallel PWBA with one having the same configuration switch settings (divide-by-N and divide-by-X).

5-23. Reproduce Mode Tests. Complete all E-E mode tests prior to starting the following tests. These tests verify the operation of the reproduce analog electronics of the HBR-3000i system. It requires the use of a bench-mark tape (one recorded previously on the system when operating normally). Preferably, the locations of any repeatable gross errors (indicating tape defects) have been logged. Proceed as follows:

a. Load the bench-mark tape on the transport. (Use the recorded section without sync insertion.)

b. Set the following switches as indicated:

   1. NORMAL/TEST *in*

   2. DESKEW/BIT SYNC *in*

   3. TAPE/E-E *out*

   4. ACC/RATE *in*

   5. $10^6/10^8$ according to system requirements

c. Set the BITE to match the recorded word length.

d. Set all other switches *out*.

e. Verify that the reproduce clock (REPRODUCE CLOCK INPUT) is at the same rate used to make the bench-mark tape, and that the density switches (divide-by-X) are set to match the tape density (refer to the serial-to-parallel converter PWBA schematic for settings).

f. Start the tape transport and verify that the transport tape-sync light indicates sync and tape lock.

g. Observe the reproduce PWBA indicators and verify that they are normal.

h. Observe the BIT SYNC $\overline{\text{LOCK}}$ indicator on the MSB and verify it is *not* lit. This indicates all bit-syncs (except the master channel) are phase-locked.

i. Starting with the master channel (CHANNEL SELECT switch set to 00), check the error rate (BER) in each channel.

j. If all channels are within acceptable limits, go to the next test.

k. If a channel is outside the limits, use an oscilloscope to verify the data output of the associated reproduce amplfier PWBA. Use internal oscilloscope sync with the trigger set to approximately 0 DC level. If the eye pattern is bad, replace the reproduce amplifier PWBA with a good one. Repeat the tests.

l. If replacing the reproduce amplifier PWBA does not correct the fault, trial replacement of preamplifier no. 1 and/or no. 2 is indicated.

m. If replacement of the preamplifiers does not provide a solution, the problem may be the reproduce head. This is likely only if the head is near the end of its life. If the reproduce head still has considerable life left, the problem is more likely to be in the wiring or connectors.

5-24. **Record Mode Tests.** These tests verify the operation of the entire analog electronics of the HBR-3000i system. It is recommended that a known good tape (preferably with the locations of any known defects logged) be used for the following tests. Proceed as follows:

a. Degauss and load the reel of tape on the transport.

b. Set the following switches as indicated:

1. NORMAL/TEST *in*
2. SYNC INHIBIT *in*
3. DESKEW/BIT SYNC *in*
4. TAPE/E-E *out*
5. ACC/RATE *in*
6. $10^6/10^8$ according to system requirements

c. Set the frequency synthesizer for the parallel rate.

d. Place the transport in the forward recording mode.

e. Set the CHANNEL SWITCH to 00 (master channel) and observe any errors on the display. Repeat for all channels.

f. If a channel is bad, use an oscilloscope to verify the data at that channel on the filter PWBA. For filter PWBA's having level adjustments, the output level should be about 0.5 V P-P; or for those systems having the level adjustments on the headdriver PWBA's, the filter PWBA output level should be about 1.7 V P-P. Replace the filter PWBA, if necessary.

g. If the filter PWBA is OK, the problem lies with the record headdriver PWBA or the record heads. Verify that the green bias indicators on the headdriver PWBA's are *on*. If a bias indicator is *out*, replace the headdriver PWBA. Be sure to readjust bias and record level for all channels on a headdriver PWBA after replacement.

h. Use point-to-point signal-tracing if the fault has not been corrected.

5-25. Auxiliary Channel Performance Checks

5-26. Test Equipment Setup. The test setup for the electronics performance checks is shown in figure 5-6. The test equipment listed below is identified in greater detail in table 5-1.

a. AC EVM (electronic voltmeter)

b. Sine-wave oscillator

c. Oscilloscope

d. Bandpass filter

e. Wave analyzer

f. 75 Ω Load(s)

5-27. Definitions. Definitions of the terms *operating input level* and *standard output level* are as follows:

a. Operating Input Level. Commonly 1 V RMS, but any selected data input level to a record amplifier (within the limits given in the system specifications) is known as the *operating input level* for the channel in which the amplifier is used.

b. Standard Output Level. The reproduce output level control is normally adjusted to produce an output signal amplitude of 1 V RMS, as measured across the proper terminating impedance, when reproducing a signal recorded at *normal record level.* This output level is referred to as the *standard output level.* (Amplitudes other than 1 V RMS may be used, but degradation in signal-to-noise ratio or distortion may result.)

5-28. Confidence Check of Wideband Direct Signal Electronics. Using the direct record/reproduce system test setup (figure 5-6), the operator can perform a confidence check of the signal electronics by the following procedure:

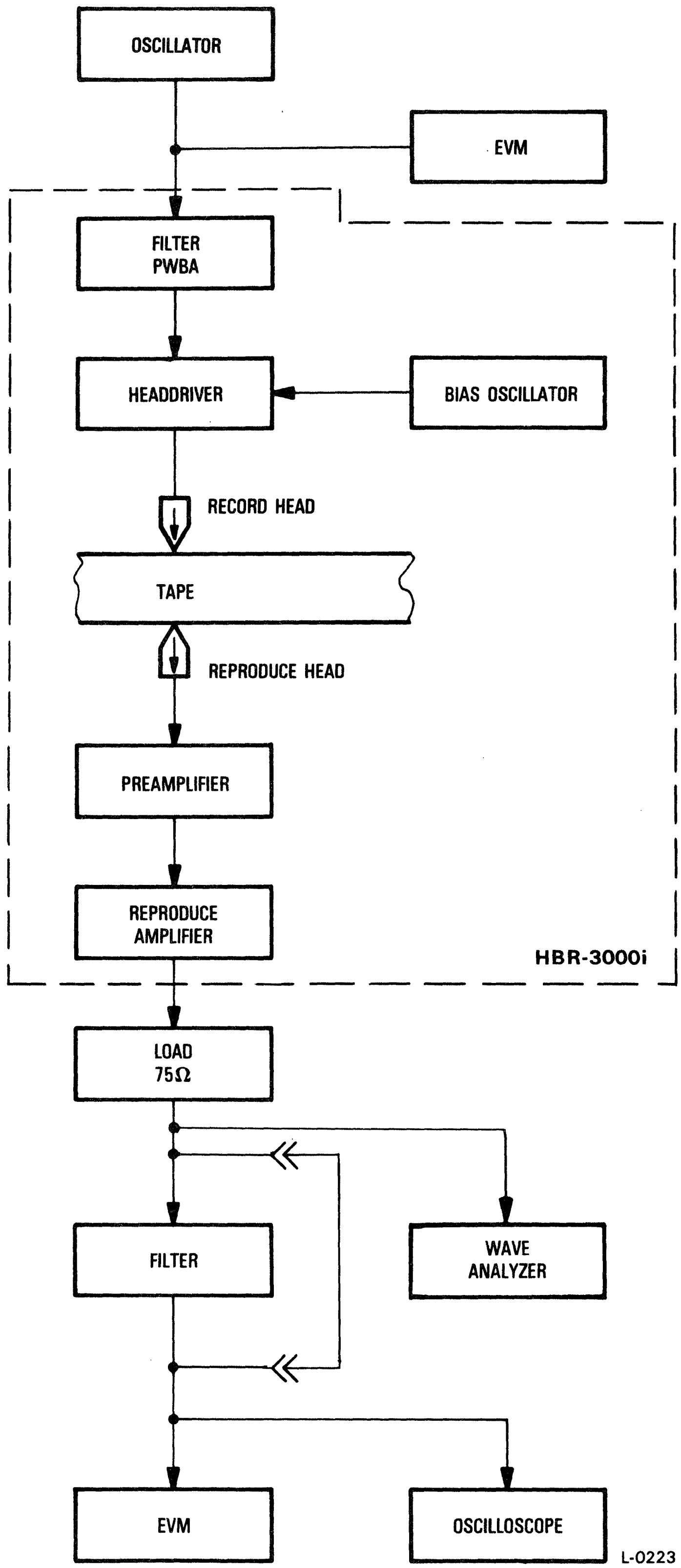


Figure 5-6. Auxiliary Channel Test Setup

Table 5-6. Auxiliary Channel Frequencies

SPEED IPS	LOW BANDEDGE	UPPER BANDEDGE	RECORD LEVEL-SET AND REPRO REF FREQ
120	400 Hz	2 MHz	200 kHz
60	400 Hz	1 MHz	100 kHz
30	400 Hz	500 kHz	50 kHz
5	400 Hz	250 kHz	25.0 kHz
7-1/2	400 Hz	125 kHz	12.5 kHz
3-3/4	400 Hz	62.5 kHz	6.25 kHz
1-7/8	400 Hz	31.25 kHz	3.1 kHz

a. Determine the record-level-set frequency for the tape speed to be checked (see table 5-6). Apply a signal of this frequency, at the *operating input level*, to the input receptacle for the auxiliary channel to be checked on the rear panel of the digital process bay (DPB).

b. Connect an oscilloscope to the output receptacle of that same channel (rear panel of the bit-sync bay). (Terminate the output with a 75 Ω load.) The bandpass filter should be jumpered out of the circuit.

c. Select IRIG on the MSB front panel.

d. Initiate the forward record mode at the tape speed to be checked.

e. The oscilloscope should display a *standard output level* (1 V RMS) (2.8 V P-P) reproduction of the frequency recorded.

If the check indicates that adjustment of the signal electronics is needed, follow the adjustment procedures in signal electronics adjustment manual.

5-29. Direct Frequency Response Check. The purpose of this check is to verify the system frequency response across the passband. To check frequency response, proceed as follows:

a. Connect the oscillator to the input jack of the channel to be checked (rear of the DPB).

b. Select IRIG (mode select panel) and the highest tape speed to be checked (transport control panel).

c. Set the oscillator to the (0.1 upper bandedge frequency) record-level-set frequency at the *operating input level*. (Refer to table 5-6.)

d. Check that the bandpass filter is out of the circuit.

e. Initiate the forward record mode. Set the reproduce output level control for a 1 V RMS output.

f. Sweep the oscillator through a frequency range from the low bandedge to the upper bandedge and check that amplitude deviations fall within the specified range.

g. Repeat steps *a* through *f* for all remaining channels and at any other tape speeds for which frequency response checks are required.

If, at the completion of the frequency response check, deviations outside the spread are present, a complete readjustment may be necessary (refer to the signal electronics adjustment manual). If the response is within the spread, the equipment is aligned and a signal-to-noise ratio check may be carried out.

5-30. Direct Signal-to-Noise Ratio Check. To check the signal-to-noise ratio of the auxiliary channel, perform the preceding frequency response check, then proceed as follows:

a. Set up the test equipment as shown in figure 5-6. Connect it to the channel to be checked with the bandpass filter in the circuit.

b. Set the filter for a frequency range to pass a band of frequencies from the low to the upper bandedge for the tape speed being checked. See table 5-6.

c. With IRIG selected, switch to the tape speed being checked and to the forward record mode.

d. Set the oscillator to the *operating input level* at the record-level-set frequency and note the reproduce output level.

e. Disconnect the oscillator and substitute a short circuit at the input.

f. Observe and note the reproduce output level with the true-RMS EVM (electronic voltmeter).

g. Determine the difference in dB between the reading obtained in step *d* and the reading obtained in step *f*. This is the signal-to-noise ratio.

h. Repeat steps *b* through *g* for the remaining channels and other tape speeds.

i. If, at the completion of the signal-to-noise ratio check, the signal-to-noise ratio does not meet published specifications, a complete realignment (readjustment) may be necessary (refer to the signal electronics adjustment manual.

5-31. Second Order Harmonic Distortion Check. In order to ensure that the heads are not gaussed (magnetized), check the second order harmonic content of a reproduced test signal as follows:

a. Set up the test equipment as shown in figure 5-6, with the filter jumpered out of the circuit. The EVM at the output is not required. Set the oscillator for the normal *operating input level* of the channel to be checked, and at a frequency two times the record-level-set frequency.

b. With fully degaussed tape installed, operate the recorder in record mode at the tape speed being checked.

c. Tune the wave analyzer to the signal being reproduced. Set the reference adjustment of the wave analyzer for a reference level.

d. Leave the analyzer tuned to two times the record level set frequency. Tune the oscillator to the record level set frequency, maintaining the level established in step *a.* Increase the input sensitivity of the wave analyzer (utilizing the step attentuator only), and fine-tune the oscillator until the wave analyzer is reading the second harmonic of the reproduced record level set frequency oscillator signal.

e. The reading is the second-order harmonic in dB. If the reading is not within specification, refer to the alignment procedures in the signal electronics adjustment manual. Magnetized heads can seriously degrade the second harmonic reading. (See paragraph 5-12 for a degaussing procedure.)

f. Repeat steps *a* through *e* for any remaining auxiliary channel(s).

5-32. REMOVAL AND INSTALLATION

This section gives the procedures for field removal and installation of components located within bays, housings, etc., for which removal procedures are not self-evident. Such items include power supplies, power supply regulators, headdriver PWBA's, preamplifier no. 1 PWBA's, preamplifier no. 2 PWBA's, and various connectors associated with these items.

The removal and installation procedures for components which are part of the tape transport are covered in the HBR-3000i tape transport maintenance manual. Note that if the vacuum chamber assembly is removed and reinstalled, or if it is removed and replaced with a new one, a careful tape-tracking check should be performed. (Refer to the tape transport maintenance manual.) Also, observe reproduced signals for amplitude instability which may reveal tracking problems. If there is indication of tape-tracking problems after replacement of the vacuum chamber assembly, remove it and assure that no foreign matter is causing misorientation of the assembly. It must be scrupulously clean before reinstallation.

5-33. Signal Electronics Bay Removal and Installation

Refer to figure 5-7. To remove an electronics bay from the rack cabinet, proceed as follows:

a. Extend the bay. For the mode select panel, loosen the two captive thumb screws. For other bays, drop the front panel to expose the rack retainer screws and remove them.

b. Remove the top mesh cover from the rear half of the bay. There is one retainer screw on each side.

c. Remove the ribbon cable clamp(s) on the right-hand side toward the rear. (Tape the cables together to facilitate reassembly.)

d. Disconnect the ribbon cables from the interconnect PWBA and pull them through the slot in the rear panel of the bay. To do this, it is necessary to partially disassemble the cable support bracket attached to the rear of the bay.

   1. Slide the bay out far enough for access to the two cross-recessed screws that hold the clamp to the rear of the bay.

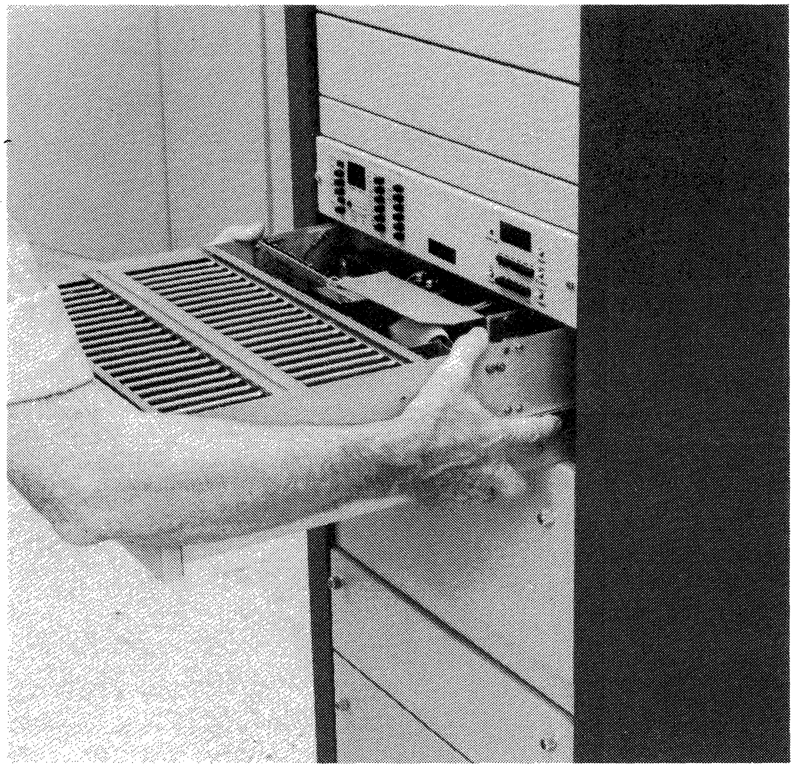


Figure 5-7. Bay Removal

2. Remove the screws to separate the clamp from the bay.

3. To provide sufficient maneuverability for removing the cables, as necessary, cut the cable ties which hold the cables in the support bracket.

e. Disconnect the rear panel connectors including the power cable.

f. Extend the bay to locking position. Press the slide release catches on each side and slide the bay out of the rack.

g. Replacement of the signal electronics bays is the reverse of removal. Refer to section 2 and drawings 1280195 or 1280196 in section 6 of this manual for locations of ribbon connectors and other cabling.

5-34. Headdriver PWBA Removal and Installation

To remove a headdriver PWBA, proceed as follows:

a. Tag and disconnect the head cables. Two 4-40 screws hold each of the head connectors to the front of the headdrivers.

b. Remove the 4-40 card retention screw from each headdriver PWBA. These screws are marked *A* in figure 5-8.

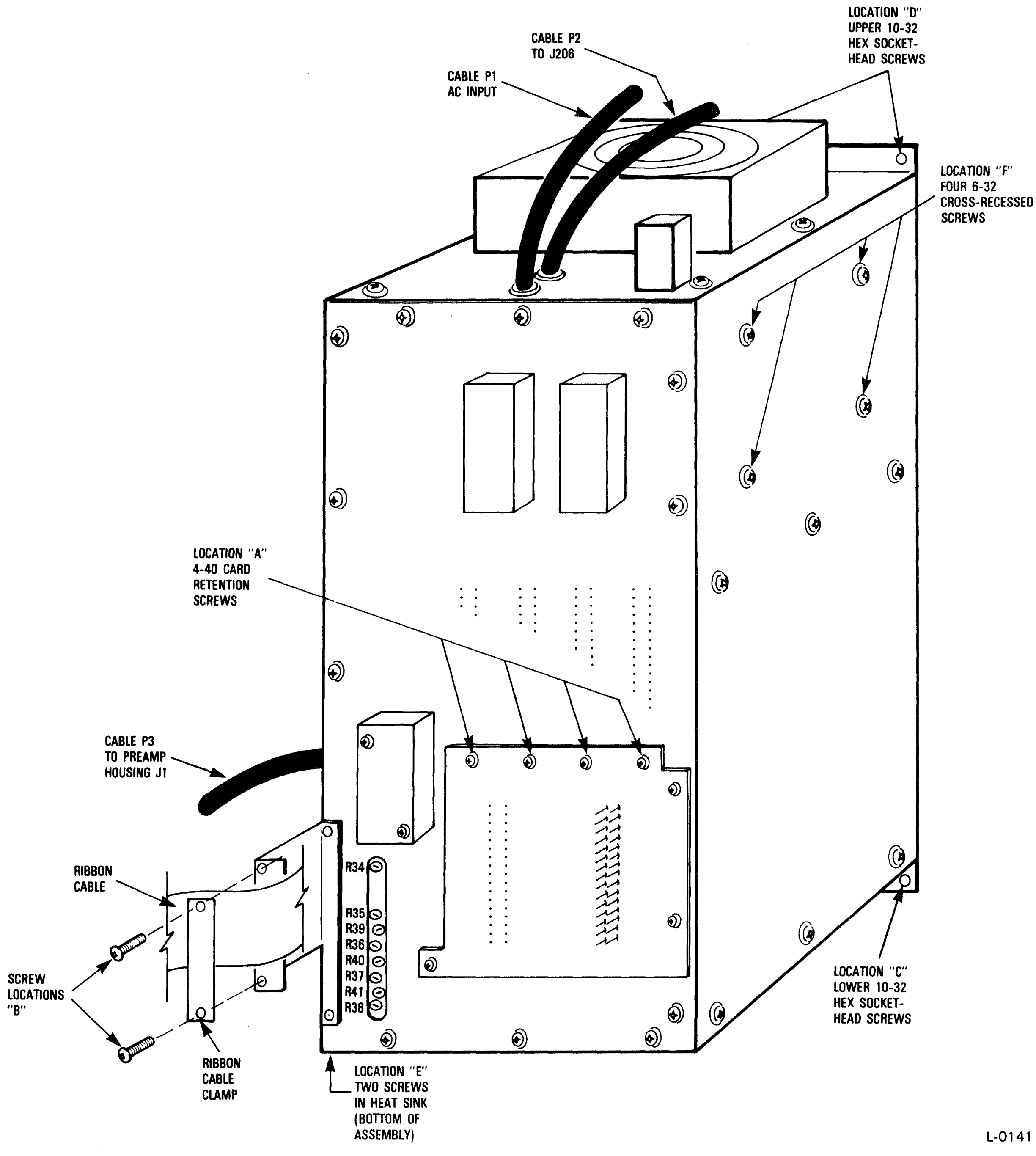


Figure 5-8. Headdriver Housing Removal

c. The headdriver PWBA's can now be removed from the front of the headdriver housing.

d. Install the headdriver PWBA's and connect the cables in the reverse of the order given above.

5-35. Headdriver Housing Removal and Installation

In order to service or replace internal components of the headdriver, it is necessary to remove the housing from the transport baseplate. For details on component replacement, see the headdriver housing manual in the signal electronics volume.

Refer to figure 5-8. To remove the headdriver housing assembly from the transport baseplate, proceed as follows:

a. Remove the two screws, *B*, holding the ribbon cable clamp.

b. Disconnect ribbon cable J5 (and J6, if used).

c. Disconnect cable P3 from the preamplifier No. 2 housing.

d. Disconnect cable P2 from J206.

e. Unplug AC power cable P1 from the AC outlet.

f. Remove the headdriver cards as given above under paragraph 5-23.

g. Remove the cables and the cable clamps at the rear left-hand side of the headdriver housing. Cut tie wraps to free the AC power cable.

h. Remove the two lower hex-socket-head screws *C* which hold the headdriver housing to the transport baseplate.

CAUTION

SUPPORT THE HEADDRIVER HOUSING DURING REMOVAL, AS THE UNIT CONTAINS HEAVY POWER TRANSFORMERS. THE ASSISTANCE OF A SECOND PERSON IS RECOMMENDED.

i. While supporting the headdriver housing, remove the two upper hex-socket-head screws *D*.

j. Place the headdriver housing assembly face down on a clean surface (rear panel connector board upward).

k. To install the headdriver housing, reverse the above procedure.

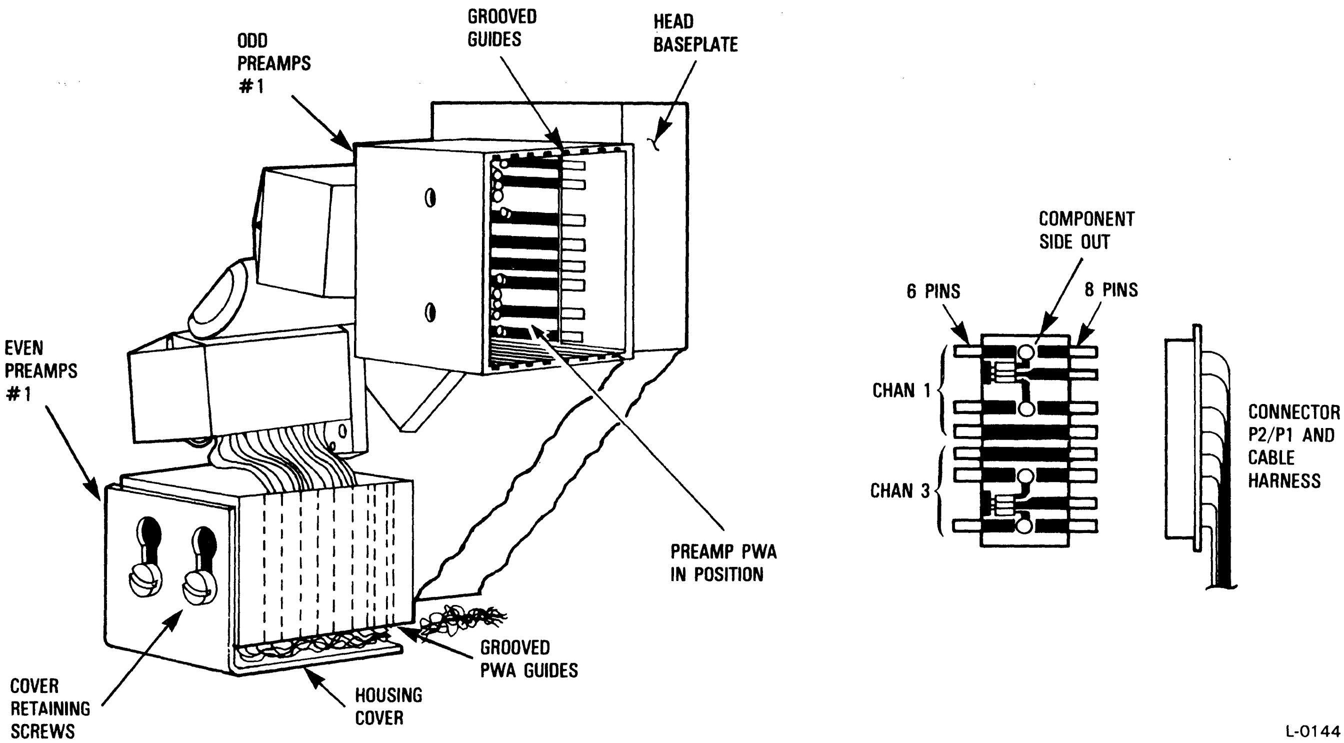


Figure 5-9. Preamplifier No. 1 Housing

5-36. Preamplifier No. 1 PWBA Removal and Installation

Care should be taken when dealing with the head or preamplifier no. 1 area. Be sure that any tools used are not magnetized.

To remove and replace preamplifier no. 1 PWBA's, refer to figure 5-9 and proceed as follows:

a. Loosen the two cover retaining screws holding the preamplifier no. 1 housing cover and remove it.

b. Carefully pull the preamplifier harness assembly (for the preamplifiers to be removed) out of the preamplifier no. 1 housing. (The preamplifier no. 1 PWBA's associated with the connectors should come out with them. If they do not, use extreme care in removing them from the housing.)

c. Insert the preamplifier PWBA's into the preamplifier no. 1 housing guides, with the six-pin side facing in. Do not use excessive force. If resistance is met while plugging a preamplifier PWBA into the connectors of the housing, remove the preamplifier and check to see if any of the pins are bent. If so, straighten them and reinsert the preamplifiers carefully into the housing.

d. Connect the harness assembly to the exposed eight-pin edges of the preamplifiers.

e. Install the preamplifier no. 1 housing cover plate.

5-37. Preamplifier No. 2 PWBA Removal and Installation

In order to remove the preamplifier no. 2 PWBA's from their housings, it is necessary to remove the cover plate from the housing. To remove a preamplifier no. 2, proceed as follows:

a. Unplug the ribbon connector(s).

b. Remove the two 2-56 cross-recessed screws which hold the preamplifier housing cover plate to the housing.

c. Pull the cover away from the housing. (This should disconnect the connections to the preamplifier PWBA's. The preamplifiers should be left in their guides in the housing assembly.)

d. Pull out the required preamplifier no. 2 PWBA from the housing.

e. For installation, reverse the above procedure.

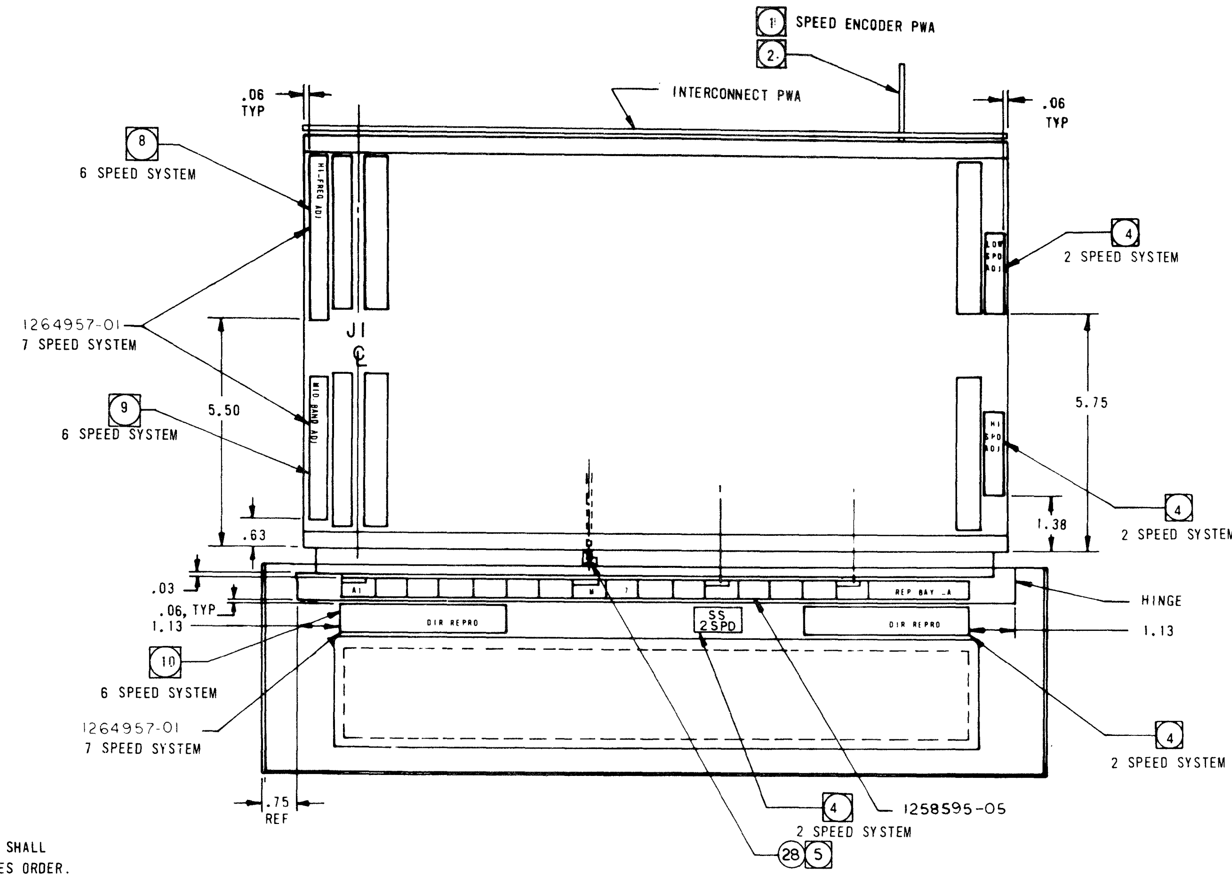
SECTION 6

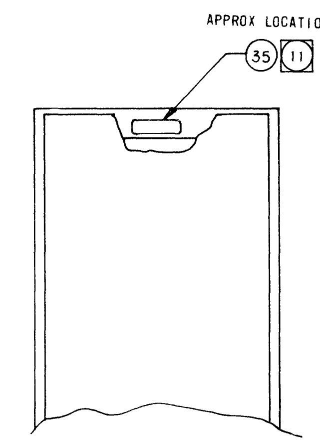
SYSTEM ASSEMBLY

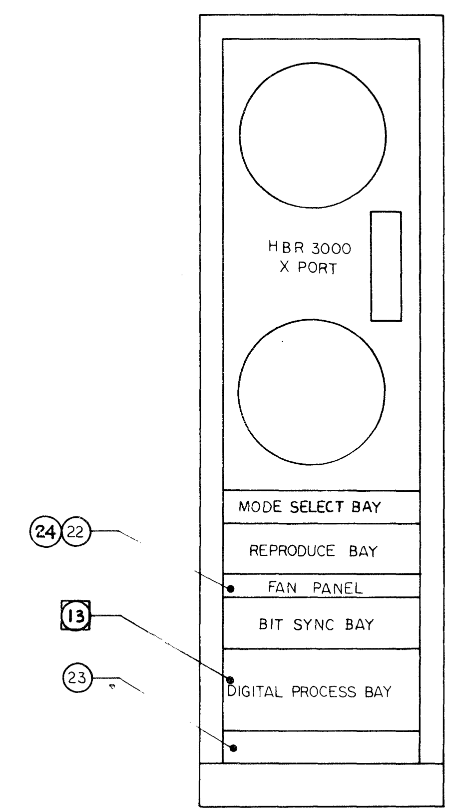
This section contains system assembly information. Table 6-1 lists the drawings which give this information.

Table 6-1. List of Drawings

LTR	ZONE	DESCRIPTION	DFT	CHK	ENGRG
A	–	PRODUCTION RELEASE	8-19-83	8-19-83	



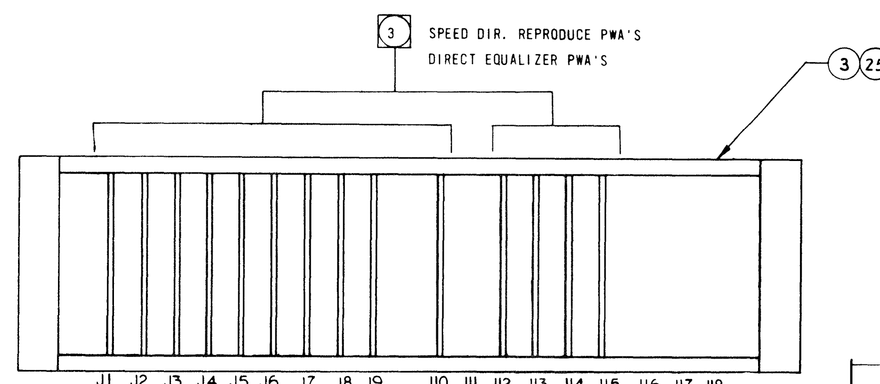




SYSTEM CONFIGURATION 15

NOTES: UNLESS OTHERWISE SPECIFIED, THE FOLLOWING INSTRUCTION SHALL BE PERFORMED AT FINAL SYSTEMS TEST AS DIRECTED BY SALES ORDER.

1. INSTALL JUMPER E22-E23.
2. REMOVE JUMPER E20-E21 WHEN 2 SPEED SYSTEM IS PROVIDED.
3. PWA'S TO BE PROVIDED AS DIRECTED BY SALES ORDER.
4. APPLY LABELS (1262515) WHEN 2 SPEED SYSTEM IS PROVIDED.
5. APPLY APPROPRIATE BAY LABELS; CHANNEL MARKERS AND COLORED MODULE MARKERS TO PWA HANDLES. COLORED MARKERS ARE FOR CHANNELS A1, A2, M, MC, S/M. & SS: NUMERICAL MARKERS ARE FOR ALL CHANNELS. COLORED MARKERS ON PWA HANDLES ARE TO CORRESPOND TO COLORS ON THE PANEL LABEL (ITEM 28).
6.
7.
8. APPLY LABEL (1262517) "MID-BAND ADJ" AT THIS LOCATION FOR 6 SPEED SYSTEM.
9. APPLY LABEL (1262517) "HI-FREQ ADJ" AT THIS LOCATION FOR 6 SPEED SYSTEM.
10. APPLY LABEL (1262517) "DIR. REPRO 6 SPEED" FOR 6 SPEED SYSTEM.
11. MARK MODEL, SYSTEM, SERIAL NO'S & ELECTRICAL DATA PER MIL-STD-130.
12. APPLY LABEL 1259155-01 WHEN BIT SYNC PWA 1803081-XX IS USED.
13. SEE SHEET 3 TABLE I FOR DIGITAL PROCESS BAY INTERNAL CABLING INSTRUCTIONS. NOTE: THIS CABLING MUST BE ACCOMPLISHED PRIOR TO INSTALLING ANY CABLES PROVIDED IN THE SYSTEM INSTALLATION CABLE SET (ITEM 14) 1280195.
14. ITEMS NOTED IN PL ARE USED FOR MOUNTING BAY SLIDES TO CABINET.
15. CABLING TO BE PER SYSTEM INSTALLATION CABLE SET (ITEM 17) 1280195-01.



REPRODUCE (A) BAY
FRONT VIEW OF BAY ASSY
(FRONT PANEL NOT SHOWN)

SEE SEPARATE PARTS LIST

NEXT ASSY	USED ON
1270356	HBR-3000

APPLICATION

UNLESS OTHERWISE SPECIFIED

DO NOT SCALE THIS PRINT

MATERIAL

FINISH

H. Dao 8/01/83

AMPEX
HEADQUARTERS
Redwood City,
California 94063

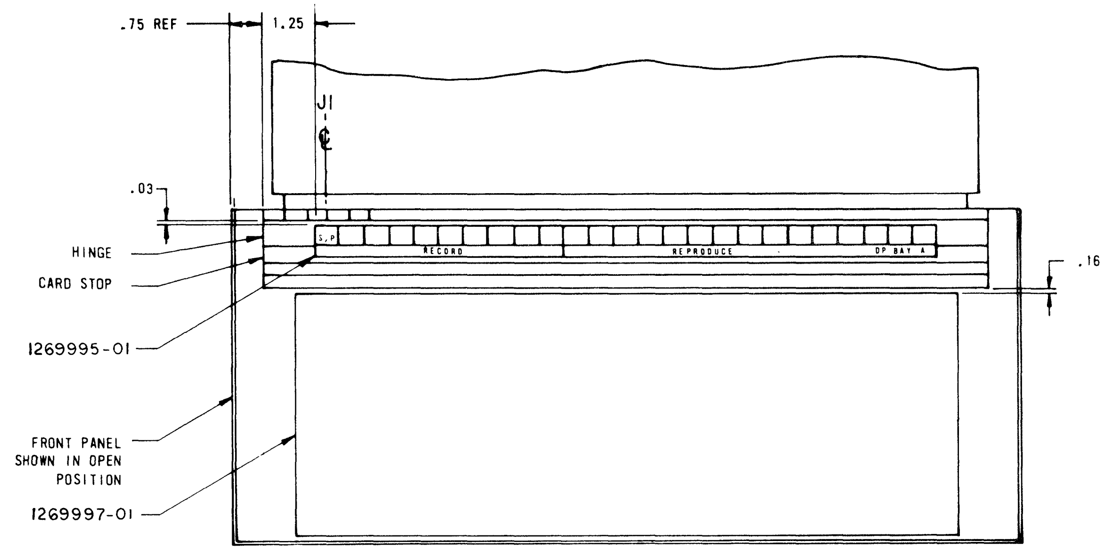
HBR-3000i 14CH SYSTEM

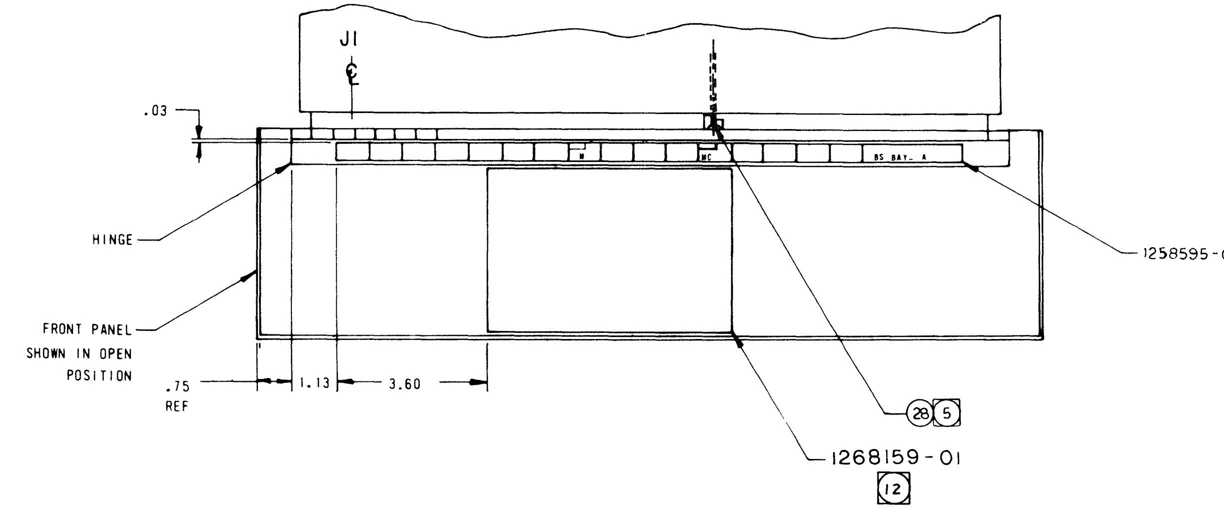
D 92739 1280215 -01

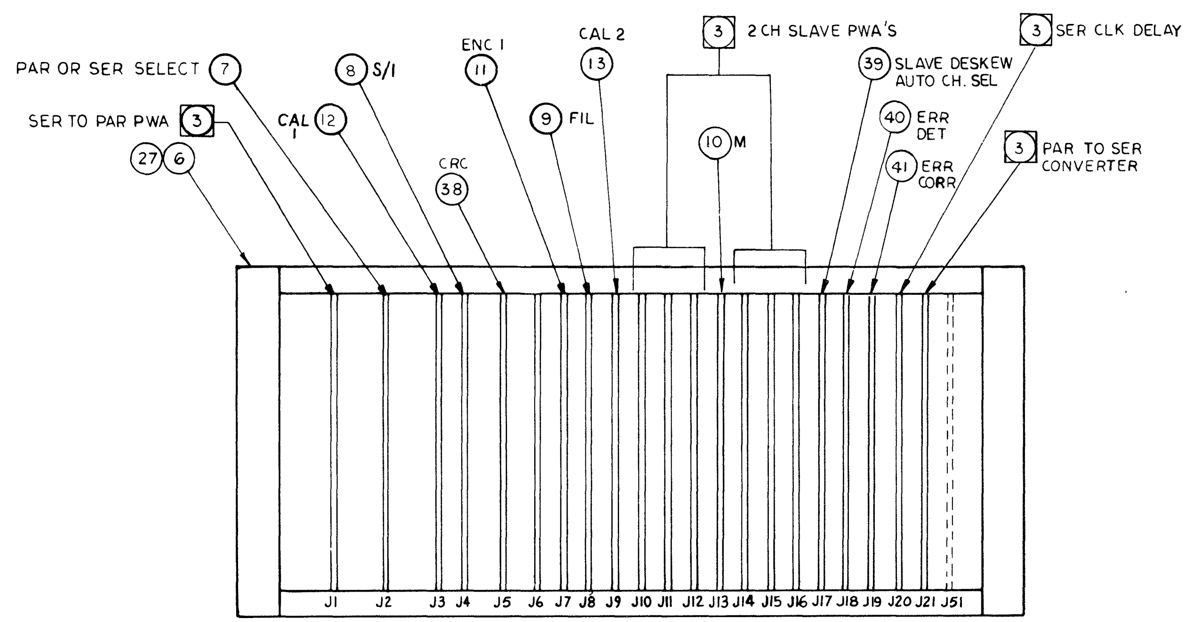
SHEET 1 OF 3

1280215-01

LTR	ZONE	REVISIONS DESCRIPTION	DFT	CHK	ENGRG
A	–	SEE SHEET ONE	—	—	—

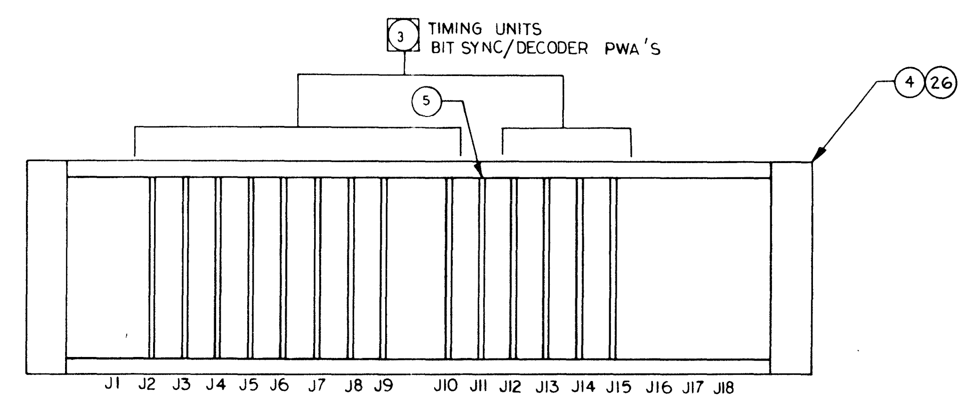






DIGITAL PROCESS (A) BAY

FRONT VIEW OF BAY ASSY
(FRONT PANEL NOT SHOWN)



BIT SYNC (A) BAY

FRONT VIEW OF BAY ASSY
(FRONT PANEL NOT SHOWN)

1280215-01

SIZE	CODE IDENT NO	
D	92739	1280215 - 01
SCALE —		SHEET 2 OF 3

UC 3504A (Rev Aug 67) Printed in U.S.A.

1280215-01

REVISIONS					
LTR	ZONE	DESCRIPTION	SIGNATURE AND DATE DFT	CHK	ENGRG
A	-	SEE SHEET ONE	—	—	—

TABLE 1 INSTALL PUSH-ON CABLE ASSY'S ON INTERCONNECT PWA AS FOLLOWS

(REF) CABLE ASSY REQD (PART OF BAY ASSY)	FUNCTION	CONDUCTOR	FROM	SYSTEM TYPE PER SALES ORDER (CODE GROUP) SERIAL STREAM/PRL WORD (D-05,D-06) TO	SERIAL WORD (D-07) TO
1267868-01	SER TEST DATA	CENTER SHIELD	J3 PIN 34 J3 PIN 94	J46 PIN 2 * J46 PIN 22	J21 PIN 41 J21 PIN 101
1264959-02 1264959-02	MASTER DIST CLOCK MASTER PARA CLOCK	JUMPER JUMPER	J20 PIN 40 J20 PIN 36	J20 PIN 42 (D-06 REMOVE) J20 PIN 38 (D-06 REMOVE)	REMOVE JUMPER REMOVE JUMPER
1257425-06	SERIAL DATA INPUT	CENTER SHIELD	REAR PANEL SER DATA INPUT	J43 PIN 9 J43 PIN 27	DISCONNECT PUSH ONS AND TIE BACK
1257425-06	SERIAL CLOCK INPUT	CENTER SHIELD	REAR PANEL SER CLK INPUT	J43 PIN 16 J43 PIN 37	DISCONNECT PUSH ONS AND TIE BACK
1257425-01	SERIAL DATA OUTPUT	CENTER SHIELD	REAR PANEL SER DATA OUTPUT	J46 PIN 7 J46 PIN 26	DISCONNECT PUSH ONS AND TIE BACK
1257425-01	SERIAL CLOCK OUTPUT	CENTER SHIELD	REAR PANEL SER CLK OUTPUT	J46 PIN 8 J46 PIN 29	DISCONNECT PUSH ONS AND TIE BACK
1267825-04	DATA CH1 THRU CH13 AND PARA CLOCK INPUTS	—	REAR PANEL, DATA 1-13, CLK INPUT	J38	J43
1267825-03	DATA CH1 THRU CH13 AND PARA CLOCK OUTPUTS	—	REAR PANEL, DATA 1-13, CLK OUTPUT	J25 *	J46

* AS PREVIOUSLY CONNECTED IN BAY ASSY

1280215-01

SIZE	CODE IDENT NO	
D	92739	1280215-01
SCALE —		SHEET 3 OF 3

PARTS LIST	AMPEX	DATA SYSTEMS DIVISION 401 BROADWAY REDWOOD CITY, CALIF. 94063	CODE IDENT 92739	ASSY DWG. SIZE D	PL 1 2 8 0 2 1 5 - 0 1 SHEET 1 OF 3	REV A

REVISIONS

LTR	DESCRIPTION	APP'D	DATE	SIGNATURES		DATE
A	PROD RELEASE	Jaa	8-1983	DRAWN	Lee Sweet	7-11-83
				CHECKED	WJ Slamka	7-19-83
				ENGRG		
				ENGRG	J. Mulcahey	8-5-83
				MANAGER	A. Vella	5 Aug. 83

CONTRACT NUMBER

MODEL: HBR-3000i

NEXT ASSEMBLY: 1270356

DRAWING TITLE: HBR-3000i 14 CH SYSTEM

ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	-01	-02	-03	-04	-05	-06	-07	-08
1													
2		1254678	01	PWA, PRE-AMP NO. 1		8							
3		1270379	01	REPRODUCE BAY ASSY		1							
4		1270377	01	BIT SYNC BAY ASSY, (A) BAY		1							
5		1256003	02	PWA, MASTER CONTROL		1							
6		1267037	01	DIGITAL PROCESS BAY ASSY, (A) BAY		1							
7		1256343	03	PWA, PARALLEL OR SERIAL SELECT		1							
8		1261623	04	PWA, SYNC INSERTER		1							
9		1261763	06	PWA, FILTER		1							
10		1261793	02	PWA, MASTER DESKEW		1							
11		1259673	01	PWA, ENCODER NO. 1		1							
12		1803073	04	PWA, CALIBRATOR NO. 1		1							
13		1803077	01	PWA, CALIBRATOR NO. 2		1							
14		1280195	01	SYSTEM INST. CABLE SET		1							
15		1258207	02	HOUSING ASSY, PRE AMP NO. 2		1							
16		1259503	01	PWA, HEAD DRIVER		2							
17		1258377	03	HEAD DRIVER HOUSING ASSY, 13.6 MHZ		1							
18		1802846	06	PWA, PRE AMP NO. 2		2							
19		1261479	01	RECORD HEAD ASSY		1							
20		1261485	01	REPRO HEAD ASSY		1							

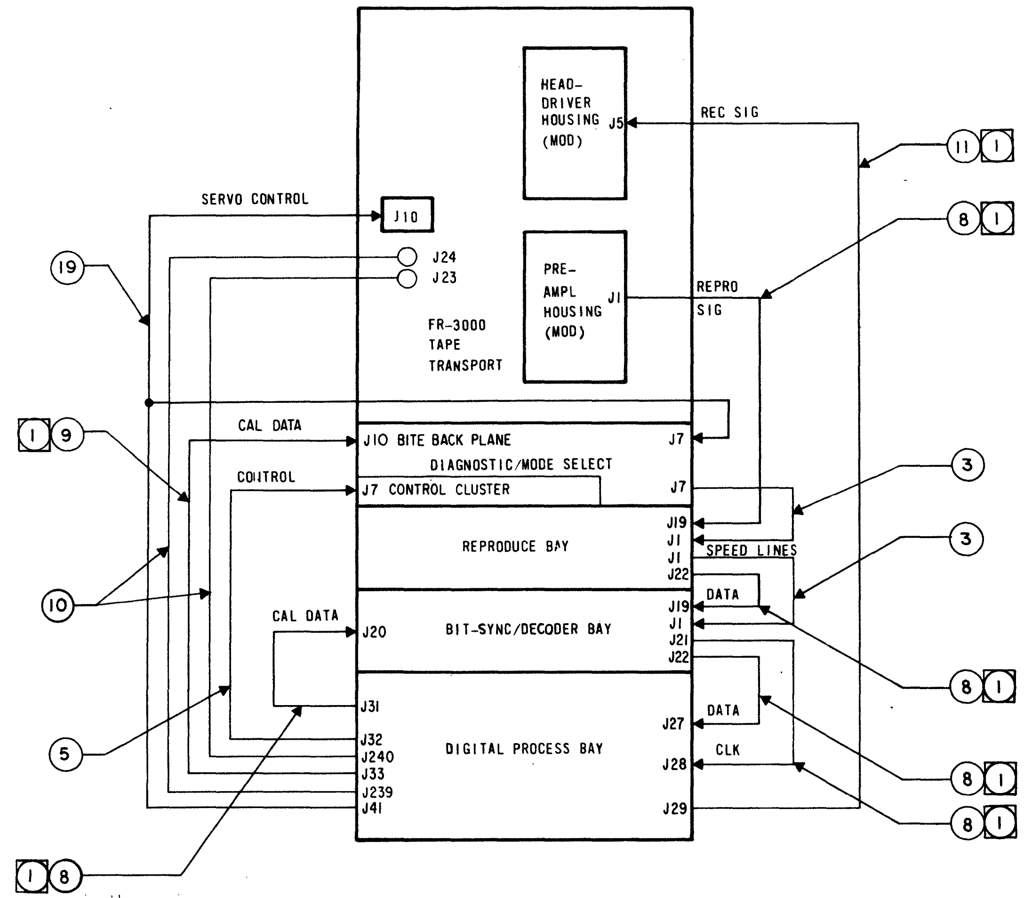
PARTS LIST	AMPEX	DATA SYSTEMS DIVISION	CODE IDENT 92739	PL 1 2 8 0 2 1 5 - 0 1 SHEET 2 OF	REV A

ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	-01	-02	-03	-04	-05	-06	-07	-08
21		1802821	08	TAPE SECT ASSY		1							
22		1261968	01	FILLER PANEL		1							
23		1261968	02	FILLER PANEL		1							
24		1812528	01	FAN ASSY		1							
25		1270378	01	REPRODUCE BAY, SUB-ASSY		1							
26		1270376	01	BIT SYNC BAY, SUB-ASSY		1							
27		1270419	01	DIGITAL PROCESS BAY, SUB-ASSY		1							
28		1280385	01	LABEL KIT, 14 CH ELECTRONICS/BAYS		1							
29													
30		1280217	01	MANUAL, ECC ELECT.		1							
31		1262015	02	MANUAL, OPER. HBR-3000		1							
32		1802854	03	MANUAL, MAINT. FR-3000		1							
33		1263576	01	MANUAL, ACC. FR-3000		1							
34		1262016	01	MANUAL, DIG. HBR		1							
35		1251520	01	NAMEPLATE, SYSTEM IDENT.		1							
36		750-354		TAPE, 799, 1 X 14		1							
37		102-034		REEL, EMPTY, 1 X 14		1							
38		1261713	02	CRC GENERATOR		1							
39		1262013	02	AUTO CH SELECT		1							
40		1261633	04	ERROR DETECTOR		1							
41		1261903	02	ERROR CORRECTOR		1							
42													
43													
44													
45													

PARTS LIST	AMPEX	DATA SYSTEMS DIVISION	CODE IDENT 92739	PL 1280215-01 SHEET 3 OF 3	REV A

ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	-01	-02	-03	-04	-05	-06	-07	-08
46		1267305	01	CLAMPING STRIP, SLIDE BRKT	14	16							
47		470-035		SCR, 10-32 x .31 SCH	14	32							
48		502-005		WSHR, #10, SLK	14	32							

A	–	PROD RELEASE	8-19-83



NOTES:

1. PRIOR TO CABLE INSTALLATION, INSTALL APPROPRIATE LABEL ON BODY OF CONNECTOR AT EACH END OF CABLE: J29 DPB / REC OUT

"J" NUMBER LOCATION FUNCTION

☒ SEE SEPARATE PARTS LIST

05	04	03	02	01	ITEM NO	PART NUMBER	EQUIVALENT VENDOR OR MIL PART NUMBER (REF ONLY)	DESCRIPTION	FMC	LONG LEAD ITEM
QUANTITY PER UNIT										

ASSY CONTROL NO

PARTS LIST

NEXT ASSY	USED ON
1270356	HBR 3000

CAT ITEM | NEXT ASSY | USED ON | IN | MF | PR CODE

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES

TOL 2 PLC 3 PLC ANG

REMOVE BURRS AND SHARP EDGES YES NO

DO NOT SCALE THIS PRINT

MATERIAL

FINISH

DRAWN BY 8/2/83

CHK BY

DFT APPD

ENGRG APPD

AUTH BY

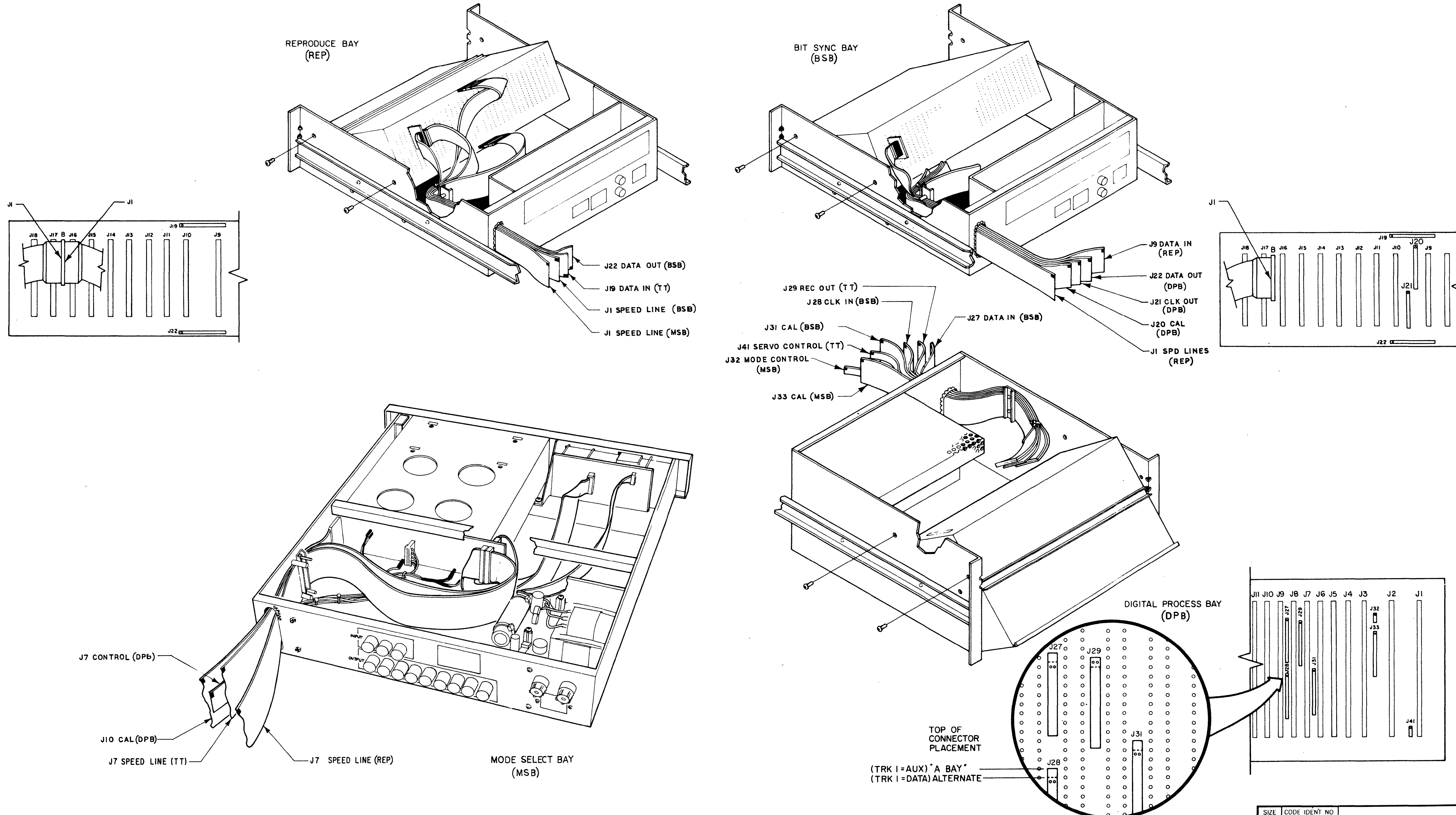
AMPEX HEADQUARTERS Redwood City, California 94063

SYSTEM INSTALLATION/ CABLE SET (14 CH) HBR-3000i

SIZE D CODE IDENT NO 92739 1280195-01

SCALE SHEET 1 OF 3

REVISIONS					
LTR	ZONE	DESCRIPTION	SIGNATURE AND DATE DFT	CHK	ENGRG
A	—	SEE SHEET ONE			

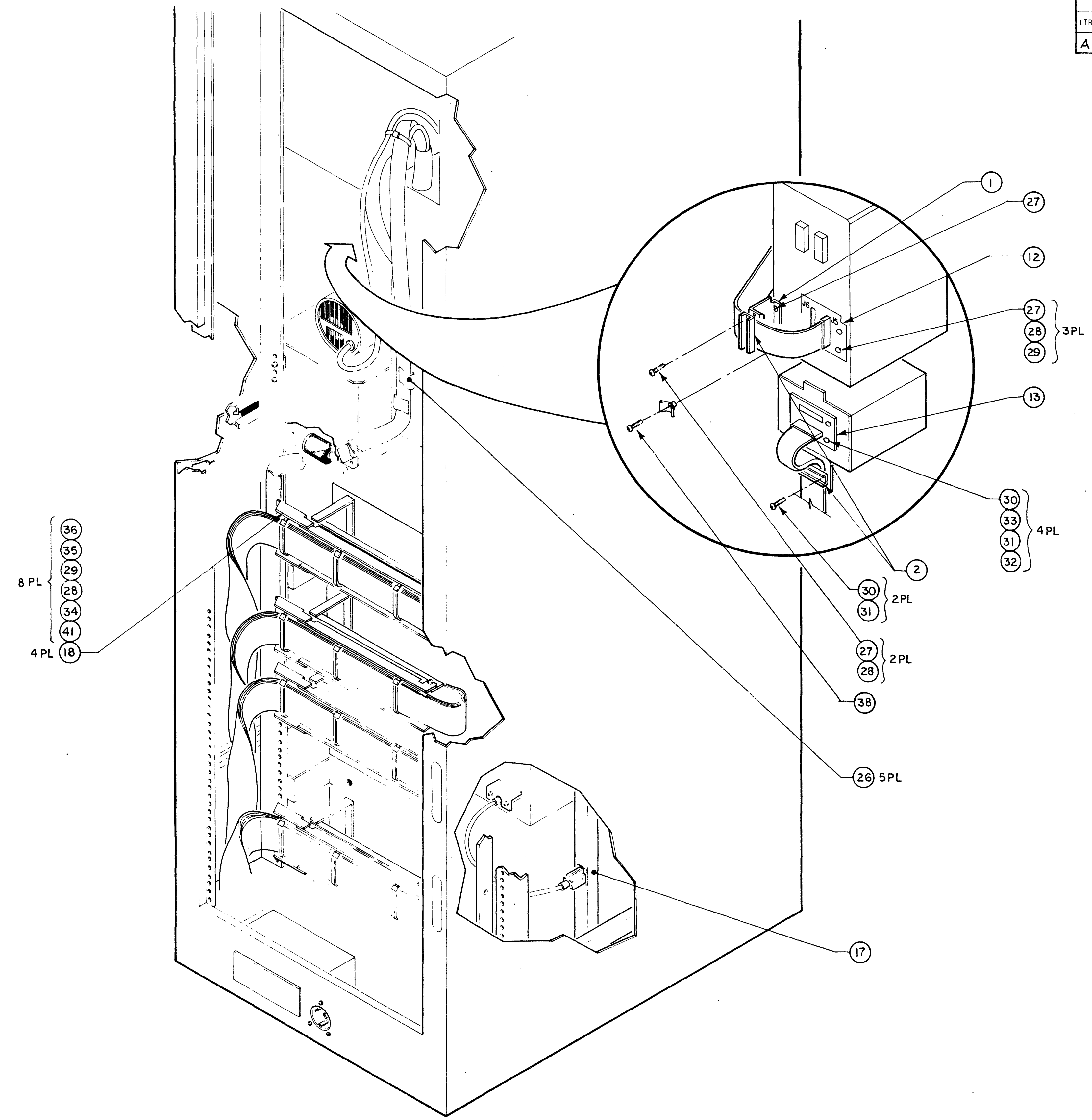


SIZE	CODE IDENT NO	
D	92739	1280195 -01
SCALE 1/4		SHEET 2 OF 3

UC-3504A (Rev Aug 67) Printed in U.S.A.

1280195-01

REVISIONS					
LTR	ZONE	DESCRIPTION	SIGNATURE AND DATE DFT	CHK	ENGRG
A	-	SEE SHEET ONE	—	—	—



SIZE	CODE IDENT NO	
D	92739	1280195-01
SCALE —		SHEET 3 OF 3

UC 3504A (Rev Aug 67) Printed in U.S.A.

PARTS LIST	AMPEX	DATA SYSTEMS DIVISION 401 BROADWAY REDWOOD CITY, CALIF. 94063	CODE IDENT 92739	ASSY DWG. SIZE D	PL 1280195-01 SHEET 1 OF 2	REV A

REVISIONS

LTR	DESCRIPTION	APPD	DATE
A	PROD RLSE		

SIGNATURES		DATE
DRAWN	Lee Sweet	7-28-83
CHECKED	DJ Slamka	8-5-83
ENGRG		
ENGRG	J Uihar	8-5-83
MANAGER	J.A. Vitts	5A-?

CONTRACT NUMBER	MODEL	NEXT ASSEMBLY
	HBR-3000 i	1270356

DRAWING TITLE

SYSTEM INSTALLATION/CABLE SET (14 CH)
HBR-3000i

ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	-01	-02	-03	-04	-05	-06	-07	-08
1	C	1257039	01	BRACKET, CABLING SUPPORT		1							
2	B	1257068	01	HOLD DOWN, CABLE		2							
3	B	1257495	03	CABLE ASSY, RIBBON 40 POS 8 FT.		2							
4													
5	B	1257496	04	CABLE ASSY, RIBBON 10 POS 11.5 FT.		1							
6													
7													
8	C	1261047	07	CABLE ASSY, 20 POS COAX 9 FT.		5							
9	C	1261047	08	CABLE ASSY, 20 POS COAX 9.5 FT.		1							
10	C	1258085	13	CABLE BNC 10 FT.		2							
11	C	1261047	09	CABLE ASSY, 20 POS COAX 10.0 FT.		1							
12	D	1255604	01	HEAD DRIVER ADAPTER		1							
13	D	1255606	01	PREAMP #2 ADAPTER		1							
14	C	1238324	03	LABEL, HEAD DRIVER CONTROLS		1							
15	C	1258465	02	LABEL SET, CABLE		1							
16	B	1267669	01	KIT, CABLE LABELS		1							
17	C	1259798	01	KIT, MULT, OUTLET STRIP		1							
18	D	1264075	01	FLAT CABLE CHANNEL ASSY		4							
19	C	1269209	02	CABLE, HBR CONTROL		1							
20													

PARTS LIST	AMPEX	DATA SYSTEMS DIVISION	CODE IDENT 92739	PL 1280195-01 SHEET 2 OF 2	REV A

ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	-01	-02	-03	-04	-05	-06	-07	-08
21		302-568		CLAMP, FL CABLE .25 HG		4							
22		302-560		PAD, FOAM .50 HG		4							
23		302-335		STRAP, CABLE .095 x 4.00 LG		10							
24		302-366		STRAP, CABLE .30 x 15.00 LG		20							
25		302-388		STRAP, CABLE .19 x 6.75 LG		10							
26		302-523		CLAMP,CABLE		5							
27		471-071		SCR, 6-32 x .50 PNH		6							
28		501-009		WSHR #6 FL		13							
29		502-003		WSHR #6 S LK		11							
30		471-062		SCR, 4-40 x 1/2 PNH		6							
31		501-008		WSHR #4 FL		6							
32		503-316		WSHR #4 FIBER		4							
33		493-005		NUT,4-40 HEX W/LK		4							
34		471-087		SCR, 10-32 x 3/8 PNH		8							
35		501-070		WSHR #10 FL		8							
36		502-005		WSHR #10 S LK		8							
37		302-356		MTG PLATE, CABLE STRAP		1							
38		471-072		SCR, 6-32 x 5/8 PNH		1							
39		496-005		NUT, 6-32 HEX W/LK		1							
40		600-117		SLVG, SHRINK BLK 2.00/1.00 DIA		1.5'							
41		471-067		SCR, 6-32 x 1/4 PNH		8							

PARTS LIST	AMPEX	DATA SYSTEMS DIVISION 401 BROADWAY REDWOOD CITY, CALIF. 94063	CODE IDENT 92739	ASSY DWG. SIZE —	PL 1280385-01 SHEET 1 OF 1	REV A

REVISIONS

LTR	DESCRIPTION	APPD	DATE
A	PROD REL	[illegible]	8 31 83

SIGNATURES		DATE
DRAWN	[illegible]	8-3-83
CHECKED	WQ Slamka	8/5/83
ENGRG		
ENGRG	[illegible]	8 5 83
MANAGER	H. A. Miller	5 Aug 83

CONTRACT NUMBER:

MODEL: HBR 3000 i

NEXT ASSEMBLY: 1280215

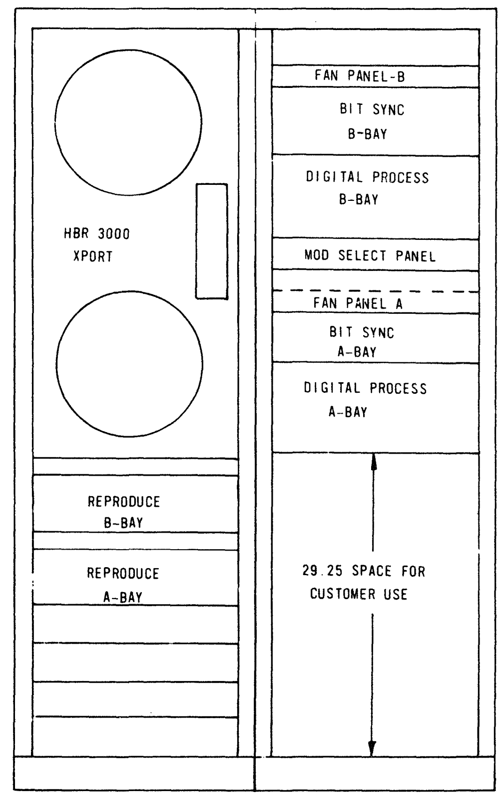
DRAWING TITLE: LABEL KIT, 14 CH ECC ELECTRONICS/BAYS

ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	-01	-02	-03	-04	-05	-06	-07	-08
1		1258595	05	LABEL, 14 TRACK REPRO BAY		1							
2		1258595	06	LABEL, 14 TRACK BIT SYNC BAY		1							
3		1264957	01	LABEL, ADJ AND TP REPRO BAY		1							
4		1268159	01	LABEL, ADJ AND TP BIT SYNC BAY		1							
5		1269995	01	LABEL, DP BAY-A		1							
6		1269997	01	LABEL, ADJ AND TP DP BAY		1							
7		1258677	01	CHANNEL MARKERS 1-14		2							
8		1258775	01	MODULE COLOR MARKER MAG		2							
9		1258775	02	MODULE COLOR MARKER BLU		1							
10		1258775	03	MODULE COLOR MARKER BLK		1							

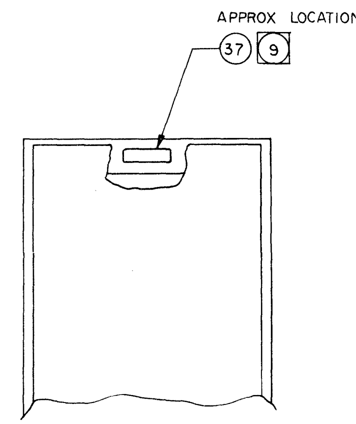
1280216-01 DISTR CODE: AH

REVISIONS

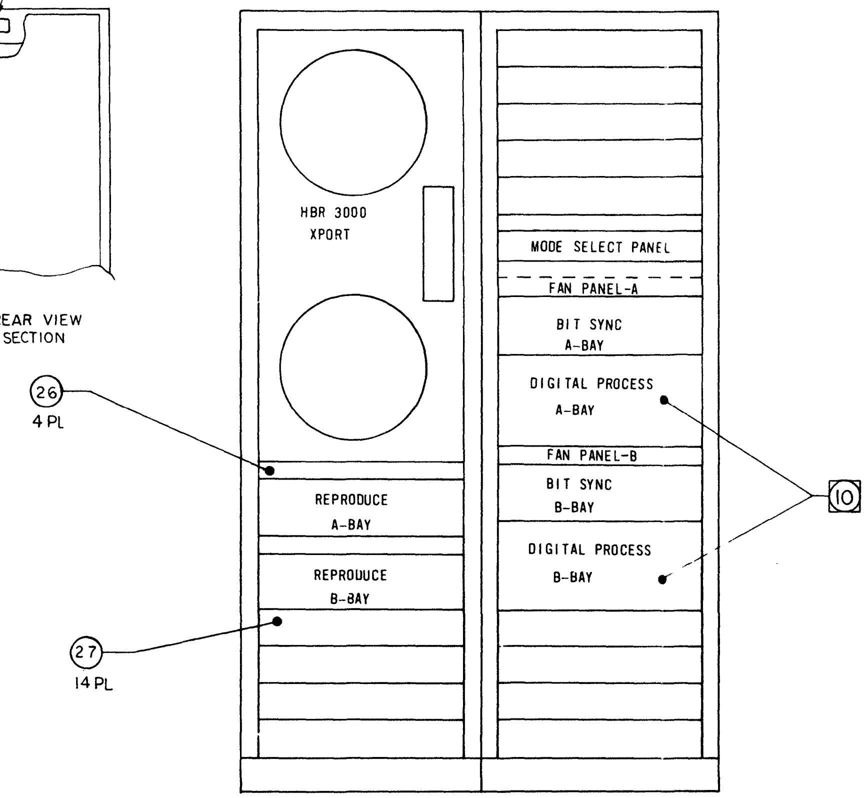
LTR	ZONE	DESCRIPTION	DFT	CHK	ENGRG
A	-	PRODUCTION RELEASE	8-19-83		



ALTERNATE SYSTEM CONFIGURATION



PARTIAL REAR VIEW OF TAPE SECTION



STANDARD SYSTEM CONFIGURATION 13

NOTES: UNLESS OTHERWISE SPECIFIED, THE FOLLOWING INSTRUCTION SHALL BE PERFORMED AT FINAL SYSTEMS TEST AS DIRECTED BY SALES ORDER.

1. INSTALL JUMPER E22-E23.
2. REMOVE JUMPER E20-E21 WHEN 2 SPEED SYSTEM IS PROVIDED.
3. PWA'S TO BE PROVIDED AS DIRECTED BY SALES ORDER.
4. APPLY LABELS (1262515) WHEN 2 SPEED SYSTEM IS PROVIDED.
5. APPLY APPROPRIATE BAY LABELS; CHANNEL MARKERS AND COLORED MODULE MARKERS TO PWA HANDLES. COLORED MARKERS ARE FOR CHANNELS A1, A2, M, MC, S M, & SS; NUMERICAL MARKERS ARE FOR ALL CHANNELS. COLORED MARKERS ON PWA HANDLES ARE TO CORRESPOND TO COLORS ON THE PANEL LABEL (ITEM 28).
6. APPLY LABEL (1262517) "MID-BAND ADJ" AT THIS LOCATION FOR 6 SPEED SYSTEM.
7. APPLY LABEL (1262517) "HI-FREQ ADJ" AT THIS LOCATION FOR 6 SPEED SYSTEM.
8. APPLY LABEL (1262517) "DIR. REPRO 6 SPEED" FOR 6 SPEED SYSTEM.
9. MARK MODEL, SYSTEM, SERIAL NO'S & ELECTRICAL DATA PER MIL-STD-130.
10. SEE SHEET 5 TABLE I FOR DIGITAL PROCESS BAY INTERNAL CABLING INSTRUCTIONS. NOTE THIS CABLING MUST BE ACCOMPLISHED PRIOR TO INSTALLING ANY CABLES PROVIDED IN THE SYSTEM INSTALLATION CABLE SET (ITEM 17) 1280196-01.
11. APPLY LABEL 1259155-01 WHEN BIT SYNC PWA 1803081-XX IS USED.
12. ITEMS NOTED IN PL ARE USED FOR MOUNTING BAY SLIDES TO CABINET.
13. CABLING TO BE PER SYSTEM INSTALLATION CABLE SET (ITEM 14) 1280196-01.

☒ SEE SEPARATE PARTS LIST

-01 | PART NUMBER | DESCRIPTION

QUANTITY PER VERSION — PARTS LIST

NEXT ASSY	USED ON
1270355	HBR-...

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES
TOL: .03
REMOVE BURRS AND SHARP EDGES
DO NOT SCALE THIS PRINT
MATERIAL
FINISH

	SIGNATURE	DATE
DRAWN BY	H. Dao	7/28/83
CHK BY		
DFT APPD		
ENGRG APPD		
AUTH BY		

AMPEX HEADQUARTERS Redwood City, California 94063

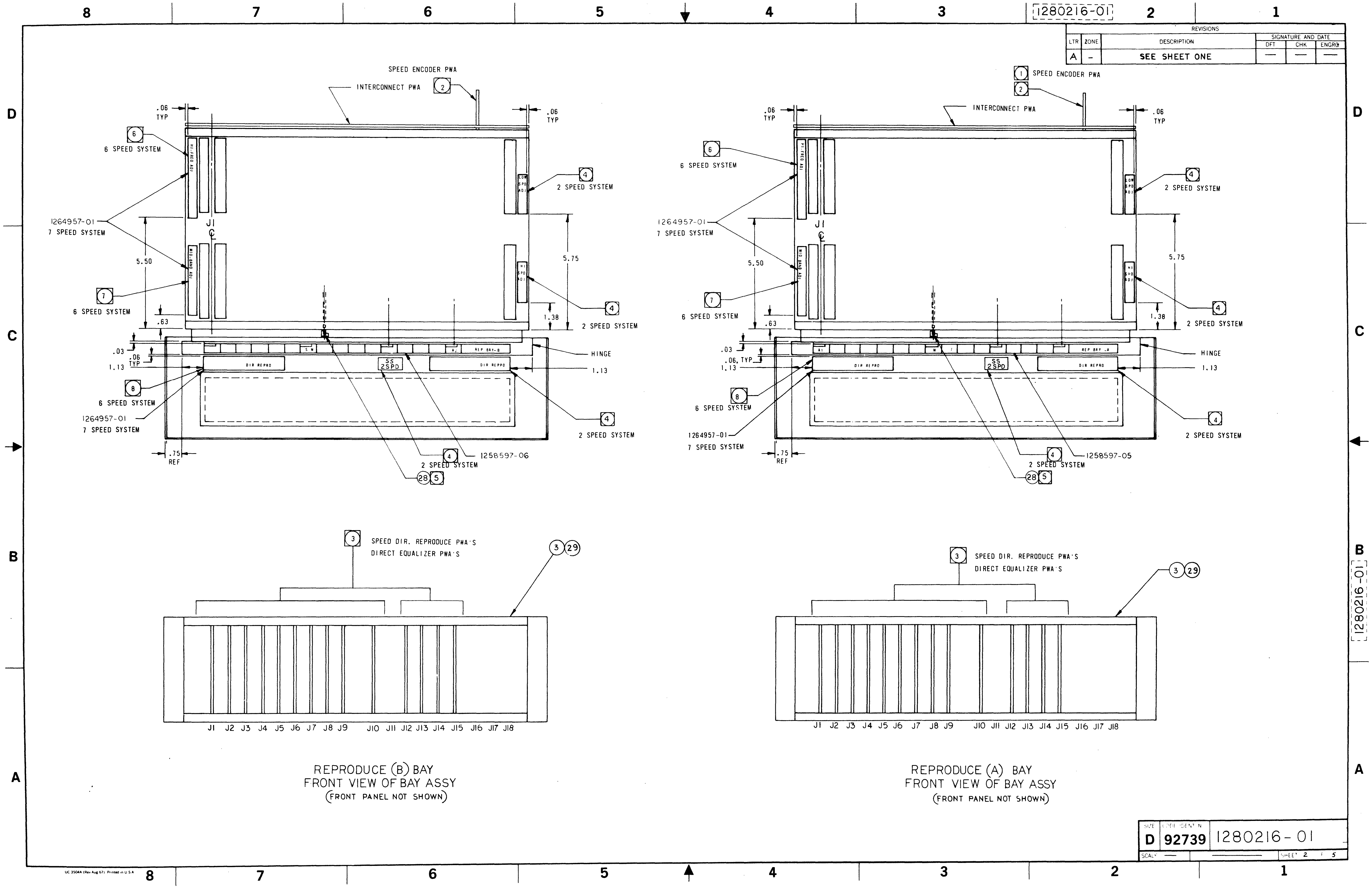
HBR-3000i 28CH SYSTEM

SIZE D | CODE IDENT NO 92739 | 1280216-01

SCALE — SHEET 1 OF 5

UC-3504 (Rev Aug 67) Printed in U S A

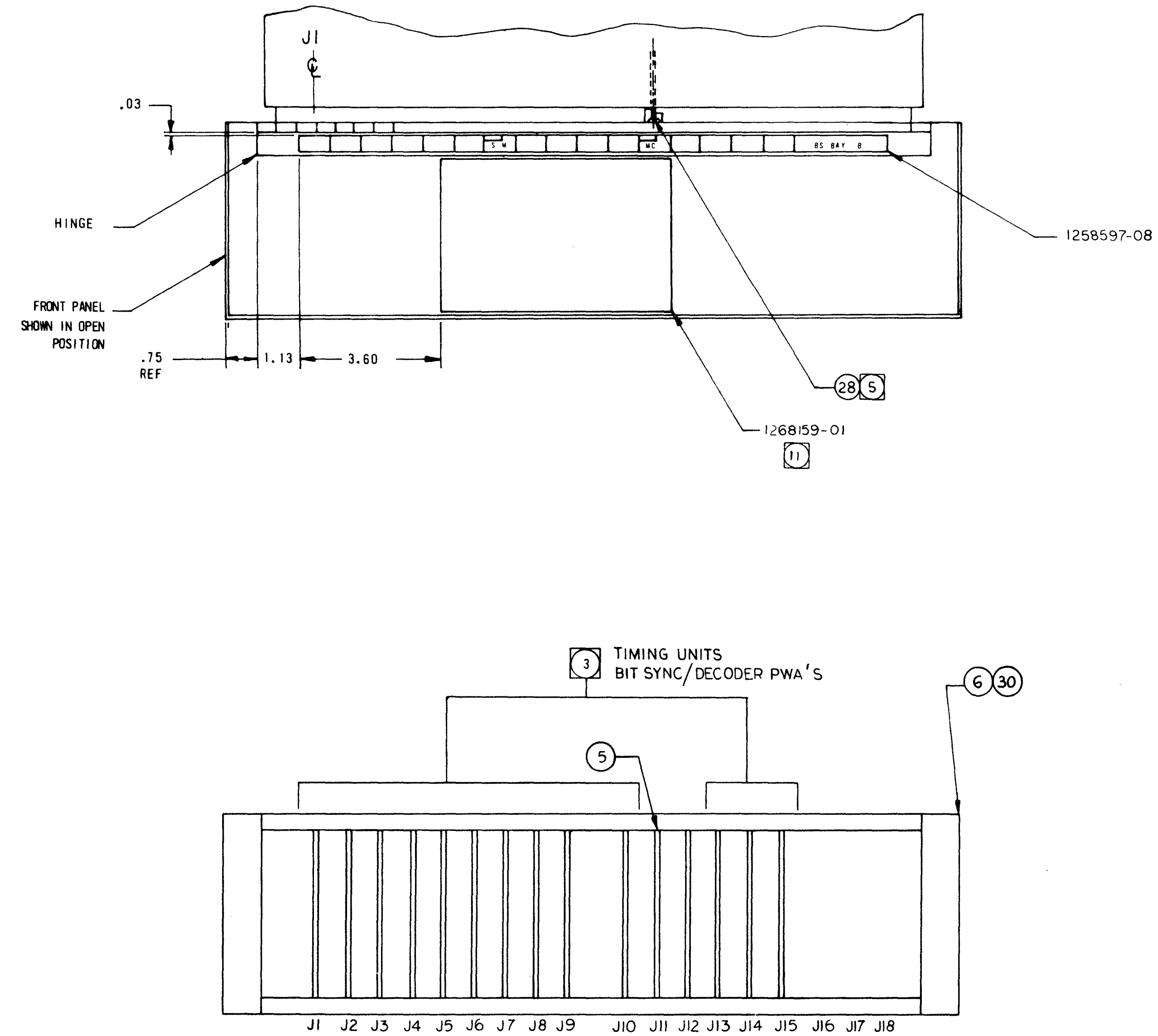
6-21/6-22
1280065



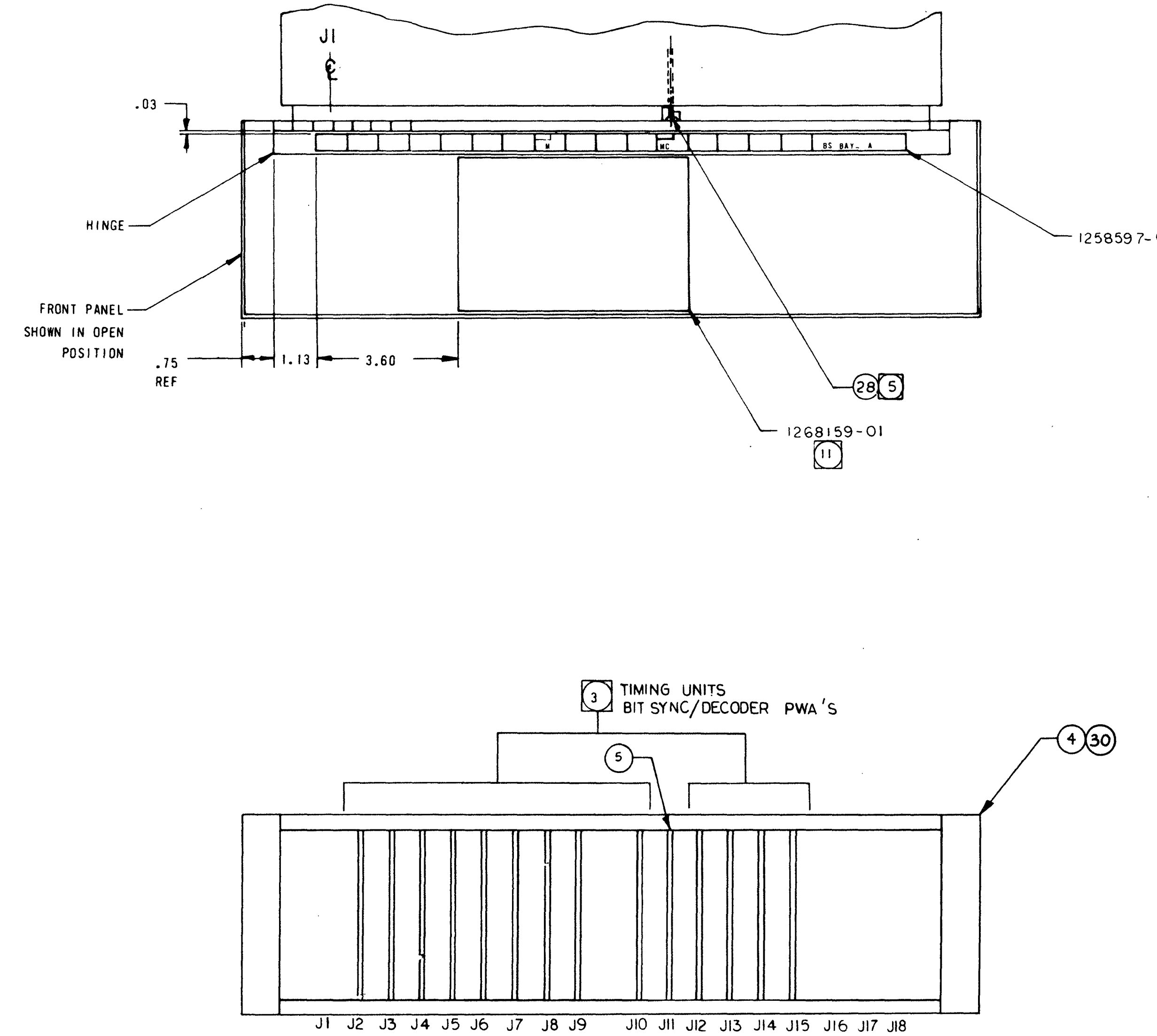
6-23/6-24
1280065

1280216-01

LTR	ZONE	DESCRIPTION	DFT	CHK	ENGRG
A	—	SEE SHEET ONE	—	—	—



BIT SYNC (B) BAY
FRONT VIEW OF BAY ASSY
(FRONT PANEL NOT SHOWN)

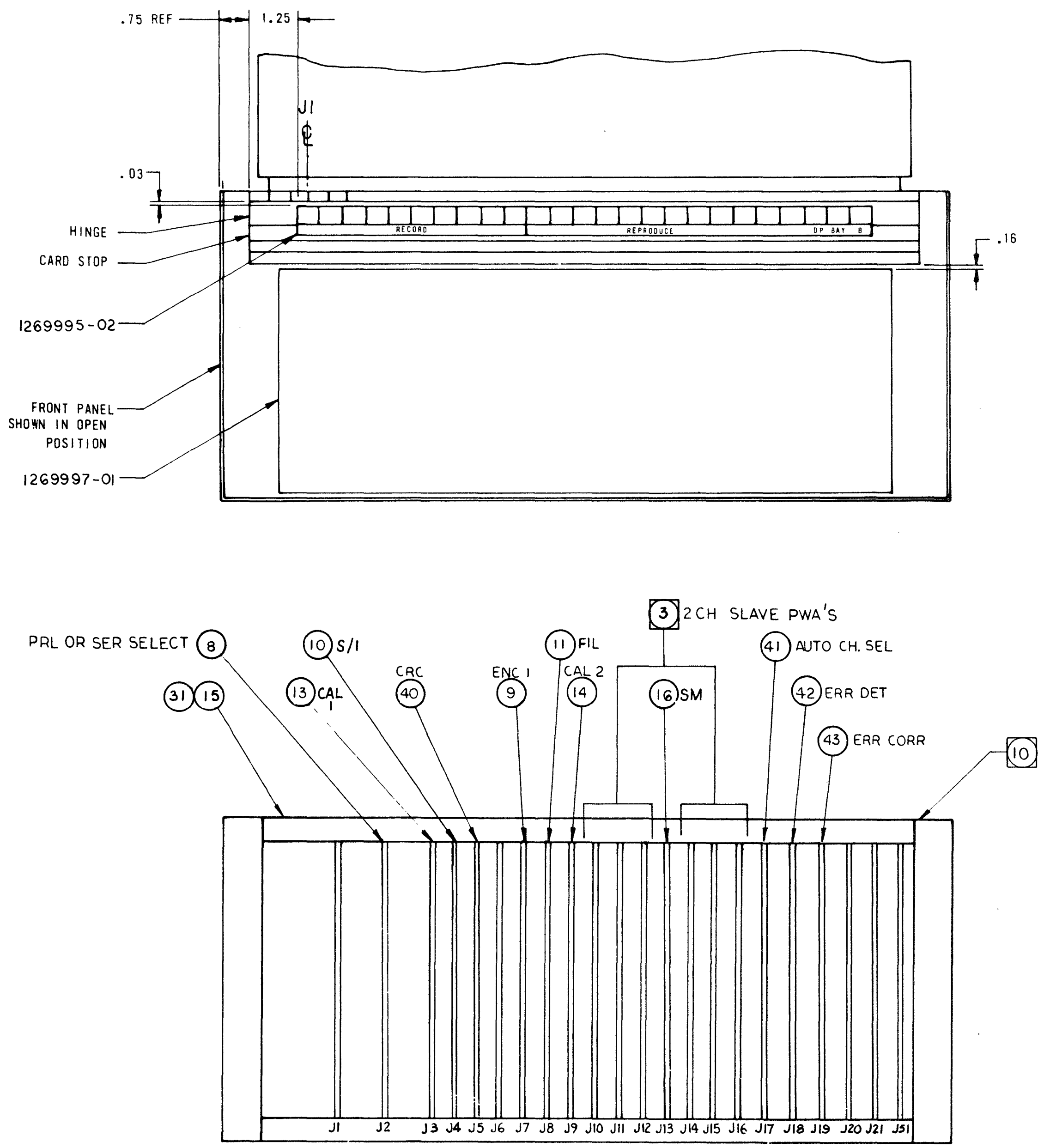


BIT SYNC (A) BAY
FRONT VIEW OF BAY ASSY
(FRONT PANEL NOT SHOWN)

SIZE	CODE IDENT NO.	
D	92739	1280216-01
SCALE —		SHEET 3 OF 5

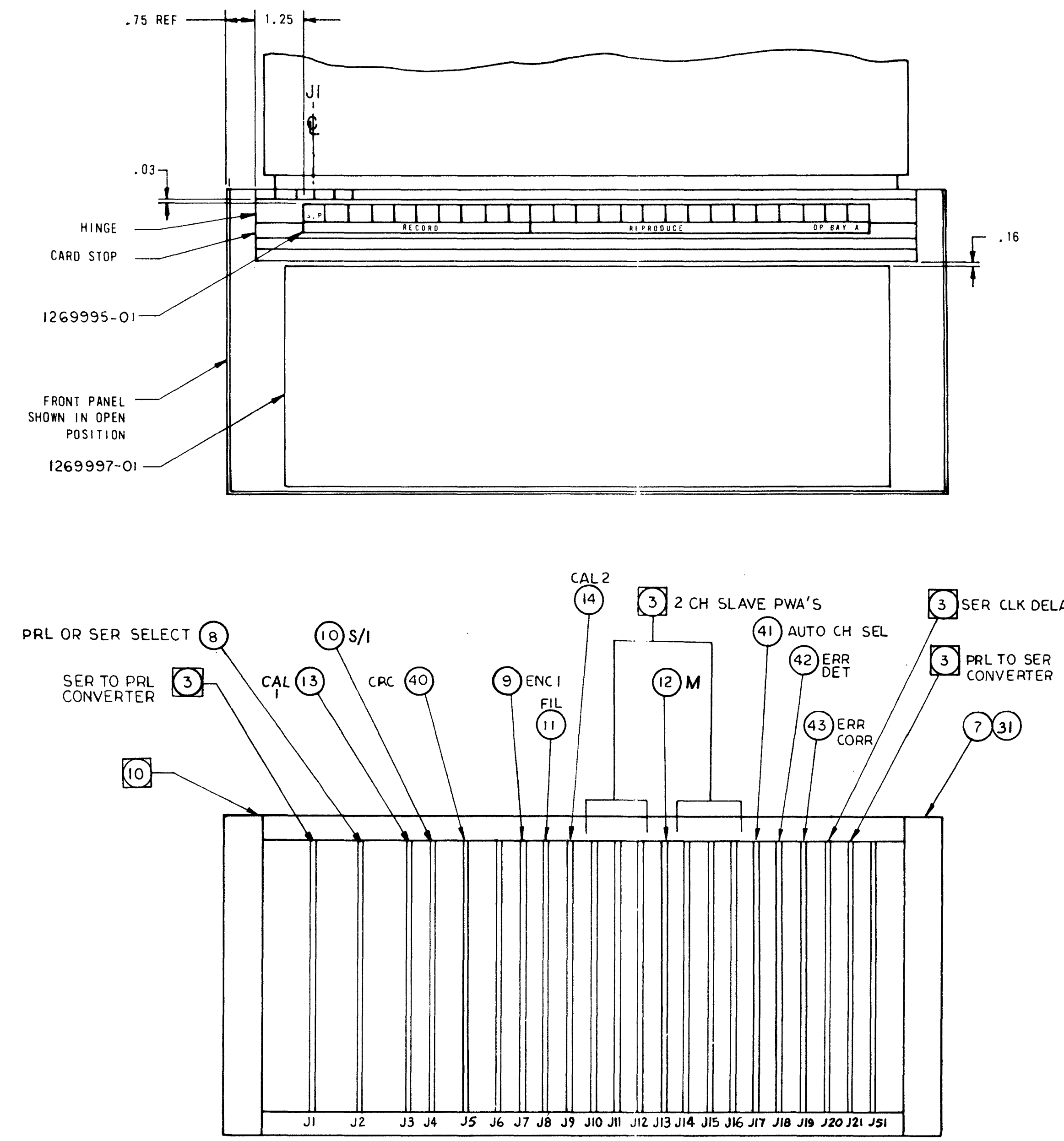
1280216-01

REVISIONS					
LTR	ZONE	DESCRIPTION	SIGNATURE AND DATE DFT	CHK	ENGRG
A	–	SEE SHEET ONE	—	—	—



DIGITAL PROCESS (B) BAY

FRONT VIEW OF BAY ASSY
(FRONT PANEL NOT SHOWN)



DIGITAL PROCESS (A) BAY

FRONT VIEW OF BAY ASSY
(FRONT PANEL NOT SHOWN)

SIZE	CODE IDENT NO	
D	92739	1280216-01
SCALE —		SHEET 4 OF 5

1280216-01

REVISIONS					
LTR	ZONE	DESCRIPTION	SIGNATURE AND DATE DFT	CHK	ENGRG
A	–	SEE SHEET ONE	—	—	—

TABLE 1. INSTALL PUSH-ON CABLE ASSY'S ON INTERCONNECT PWA AS FOLLOWS.

(REF) CABLE ASSY REQD (PART OF BAY ASSY)	FUNCTION	CONDUCTOR	FROM	SYSTEM TYPE PER SALES ORDER (CODE GROUP): SERIAL STREAM/PRL WORD (D-01) TO	SYSTEM TYPE PER SALES ORDER (CODE GROUP): SERIAL WORD (D-04) TO	BAY
1267868-01	SER TEST DATA	CENTER SHIELD	J3 PIN 34 J3 PIN 94	J46 PIN 2 * J46 PIN 22	J21 PIN 41 J21 PIN 101	A
1264959-02 1264959-02	MASTER DIST CLOCK MASTER PARA CLOCK	JUMPER JUMPER	J20 PIN 40 J20 PIN 36	J20 PIN 42 J20 PIN 38	REMOVE JUMPER REMOVE JUMPER	A
1257425-06	SERIAL DATA INPUT	CENTER SHIELD	REAR PANEL SER DATA INPUT	J43 PIN 9 J43 PIN 27	DISCONNECT PUSH ONS AND TIE BACK	A
1257425-06	SERIAL CLOCK INPUT	CENTER SHIELD	REAR PANEL SER CLK INPUT	J43 PIN 16 J43 PIN 37	DISCONNECT PUSH ONS AND TIE BACK	A
1257425-01	SERIAL DATA OUTPUT	CENTER SHIELD	REAR PANEL SER DATA OUTPUT	J46 PIN 7 J46 PIN 26	DISCONNECT PUSH ONS AND TIE BACK	A
1257425-01	SERIAL CLOCK OUTPUT	CENTER SHIELD	REAR PANEL SER CLK OUTPUT	J46 PIN 8 J46 PIN 29	DISCONNECT PUSH ONS AND TIE BACK	A
1267825-04	DATA CH1 THRU CH13 AND PARA CLOCK INPUTS	——	REAR PANEL, DATA 1-13, CLK INPUT	J38	J43	A
1267825-03	DATA CH1 THRU CH13 AND PARA CLOCK OUTPUTS	——	REAR PANEL, DATA 1-13, CLK OUTPUT	J25	J46	A
1267825-04	DATA CH14 THRU CH26 AND PARA CLOCK INPUTS	——	REAR PANEL, DATA 14-26, CLK INPUT	J38	J38	B
1267825-03	DATA CH14 THRU CH26 AND PARA CLOCK OUTPUTS	——	REAR PANEL, DATA 14-26,CLK OUTPUT	J25 *	J46	B

* AS PREVIOUSLY CONNECTED IN BAY ASSY

SIZE	CODE IDENT NO	
D	92739	1280216 - 01
SCALE —		SHEET 5 OF 5

PARTS LIST	AMPEX	DATA SYSTEMS DIVISION	401 BROADWAY REDWOOD CITY, CALIF. 94063	CODE IDENT 92739	ASSY DWG. SIZE D	PL 1 2 8 0 2 1 6 - 0 1 SHEET 1 OF 3	REV A

REVISIONS

LTR	DESCRIPTION	APPD	DATE	SIGNATURES		DATE	CONTRACT NUMBER	MODEL	NEXT ASSEMBLY
A	PROD RLSE		8-19-83	DRAWN		7-11-83		HBR-3000i	1270355
				CHECKED	W J Slamka	7-19-83	DRAWING TITLE		
				ENGRG			HBR-3000i 28 CH SYSTEM		
				ENGRG		8-5-83			
				MANAGER		5/4/83			

ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	-01	-02	-03	-04	-05	-06	-07	-08
1													
2		1254678	01	PWA, PRE-AMP #1		16							
3		1270379	01	REPRODUCE BAY ASSY		2							
4		1270377	01	BIT SYNC BAY ASSY, (A) BAY		1							
5		1256003	02	PWA, MASTER CONTROL		2							
6		1270377	02	BIT SYNC BAY ASSY, (B) BAY		1							
7		1267037	01	DIGITAL PROCESS BAY ASSY, (A) BAY		1							
8		1256343	03	PWA, PARALLEL OR SERIAL SELECT		2							
9		1259673	01	PWA, ENCODER NO. 1		2							
10		1261623	04	PWA, SYNC INSERTER		2							
11		1261763	06	PWA, FILTER		2							
12		1261793	02	PWA, MASTER DESKEW		1							
13		1803073	04	PWA, CALIBRATOR NO. 1		2							
14		1803077	01	PWA, CALIBRATOR NO. 2		2							
15		1267037	02	DIGITAL PROCESS BAY ASSY, (B) BAY		1							
16		1261863	02	PWA, SLAVE MASTER DESKEW		1							
17		1280196	01	SYSTEM INST. CABLE SET		1							
18		1258207	01	HOUSING ASSY, PREAMP NO. 2		1							
19		1259503	01	PWA, HEAD DRIVER		4							
20		1258377	03	HEAD DRIVER HOUSING ASSY, 13.6 MHZ		1							

PARTS LIST	AMPEX	DATA SYSTEMS DIVISION	CODE IDENT 92739	PL 1 2 8 0 2 1 6 - 0 1 SHEET 2 OF	REV A

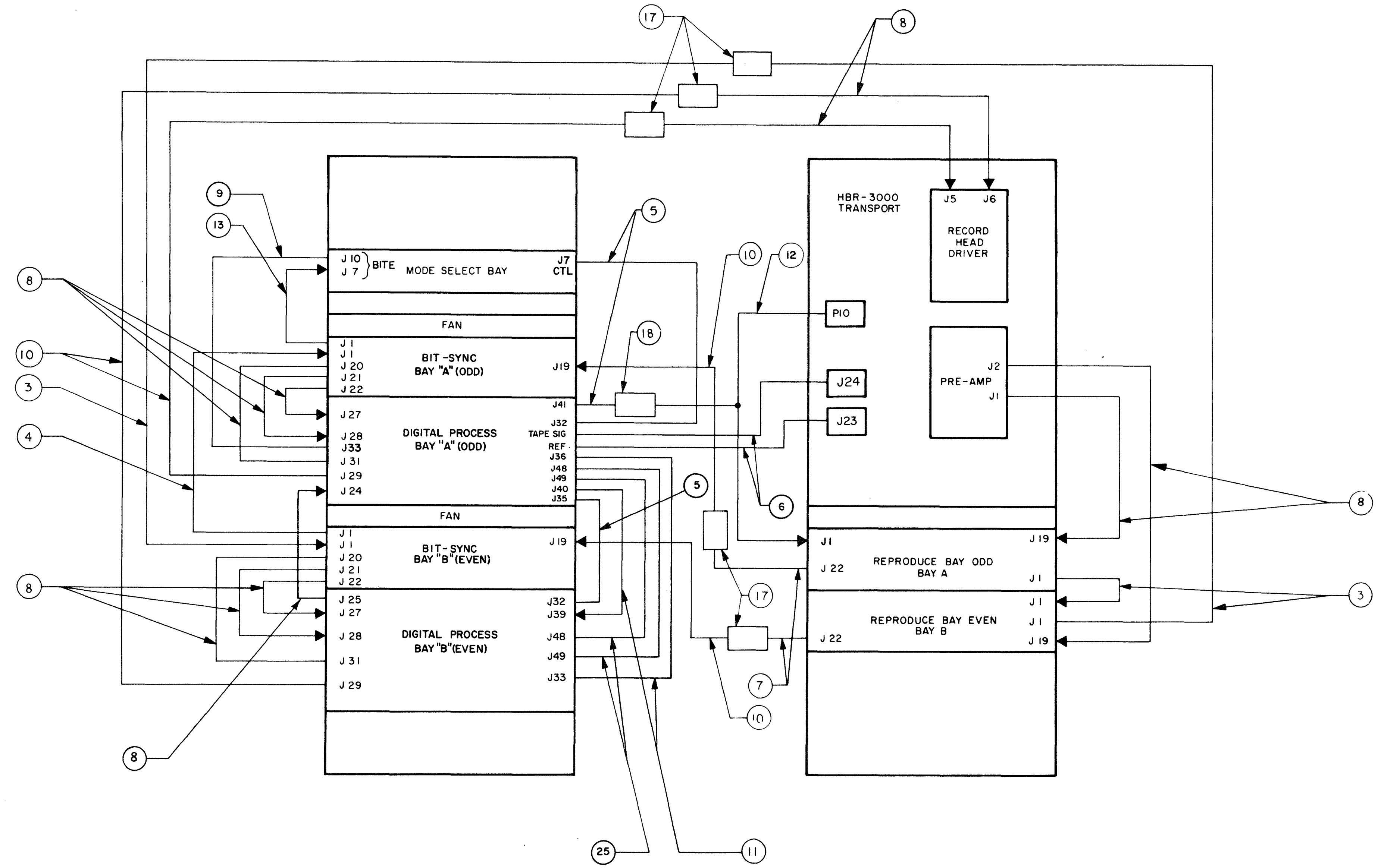
ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	-01	-02	-03	-04	-05	-06	-07	-08
21		1802846	06	PWA, REPRO PRE-AMP NO. 2		4							
22		1261845	01	RECORD HEAD ASSY		1							
23		1261846	01	REPRO HEAD ASSY		1							
24		1802821	08	TAPE SECT ASSY		1							
25		1812528	01	FAN ASSY		2							
26		1261968	01	FILLER PANEL		4							
27		1261968	02	FILLER PANEL		14							
28		1280386	01	LABEL KIT, 28 CH ELECTRONICS/BAY		1							
29		1270378	01	REPRODUCE BAY, SUB-ASSY		2							
30		1270376	01	BIT SYNC BAY, SUB-ASSY		2							
31		1270419	01	DIGITAL PROCESS BAY, SUB-ASSY		2							
32		1280217	01	MANUAL, ECC ELECT.		1							
33		1262015	02	MANUAL, OPER HBR-3000		1							
34		1802854	03	MANUAL, MAINT FR-3000		1							
35		1263576	01	MANUAL, ACC. FR-3000		1							
36		1262016	01	MANUAL, DIG-HBR		1							
37		1251520	01	NAMEPLATE, SYSTEM IDENT.		1							
38		750-354		TAPE, 799, 1 X 14		1							
39		102-034		REEL, EMPTY, 1 X 14		1							
40		1261713	02	CRC GENERATOR		2							
41		1262013	02	AUTO CHANNEL SELECT		2							
42		1261633	04	ERROR DETECTOR		2							
43		1261903	02	ERROR CORRECTOR		2							
44													
45													

PARTS LIST	AMPEX	DATA SYSTEMS DIVISION	CODE IDENT 92739	PL 1280216-01 SHEET 3 OF 3	REV A

ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	QUANTITY REQUIRED PER ASSEMBLY -01	-02	-03	-04	-05	-06	-07	-08
46		1267305	01	CLAMPING STRIP, SLIDE BRKT	12	28							
47		470-035		SCR, 10-32 x .31 SCH	12	56							
48		502-005		WSHR, #10, SLK	12	56							

1280196-01 DISTR CODE: AH

A	—	PRODUCTION RELEASE	8-19-83	



CABLING DIAGRAM

	1280216	HBR 3000		
CAT ITEM	NEXT ASSY	USED ON	IN MF PR	CODE
APPLICATION				

PARTS LIST

UNLESS OTHERWISE SPECIFIED

REMOVE BURRS AND SHARP EDGES

DO NOT SCALE THIS PRINT

MATERIAL

FINISH

SIGNATURE		DATE
DRAWN BY	K. Kraus	6/17/83
CHK BY		6/26/83
DFT APPD		
ENGRG APPD		
AUTH BY		

AMPEX HEADQUARTERS Redwood City, California 94063

SYSTEM INSTALLATION CABLE SET HBR 3000i (28 TR)

SIZE D | CODE IDENT NO 92739 | 1280196-01

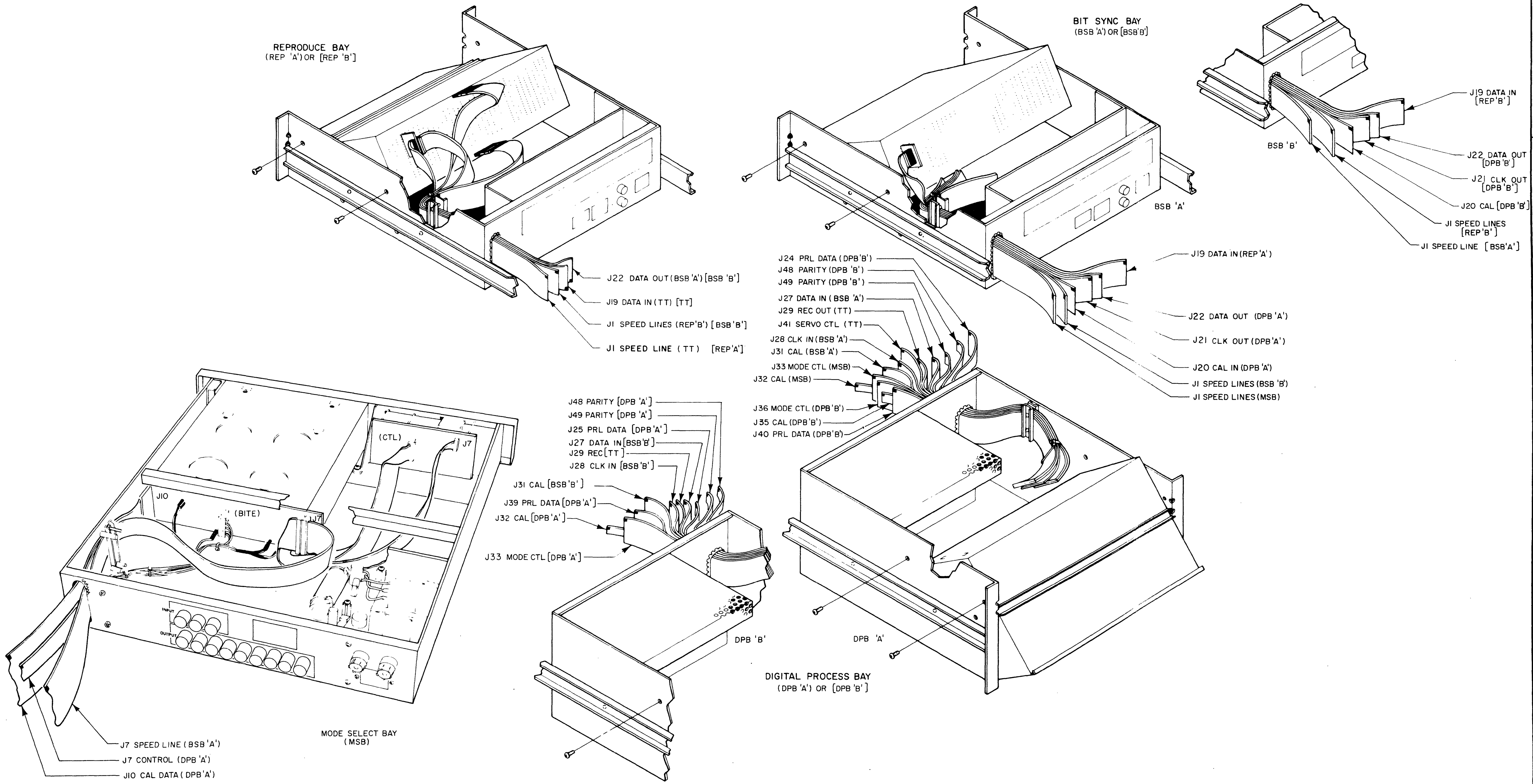
SCALE — SHEET 1 OF 4

1280196-01

1280196-01

REVISIONS

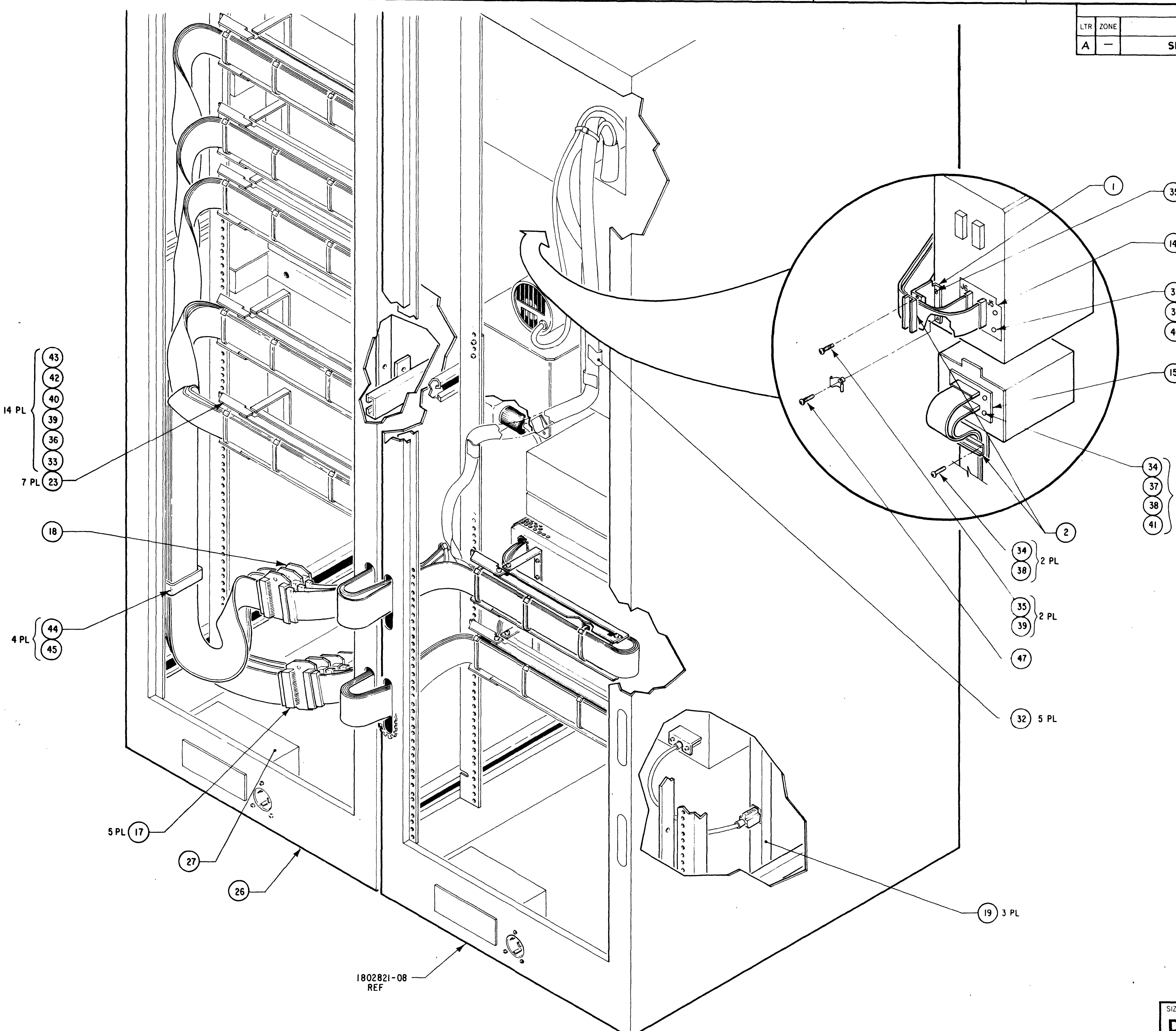
LTR	ZONE	DESCRIPTION	DFT	CHK	ENGRG
A	—	SEE SHEET ONE			



SIZE	CODE IDENT NO	
D	92739	1280196-01
SCALE 1/4		SHEET 2 OF 4

UC-3504A (Rev Aug 67) Printed in U.S.A.

REVISIONS					
LTR	ZONE	DESCRIPTION	SIGNATURE AND DATE DFT	CHK	ENGRG
A	—	SEE SHEET ONE			



SIZE	CODE IDENT NO	
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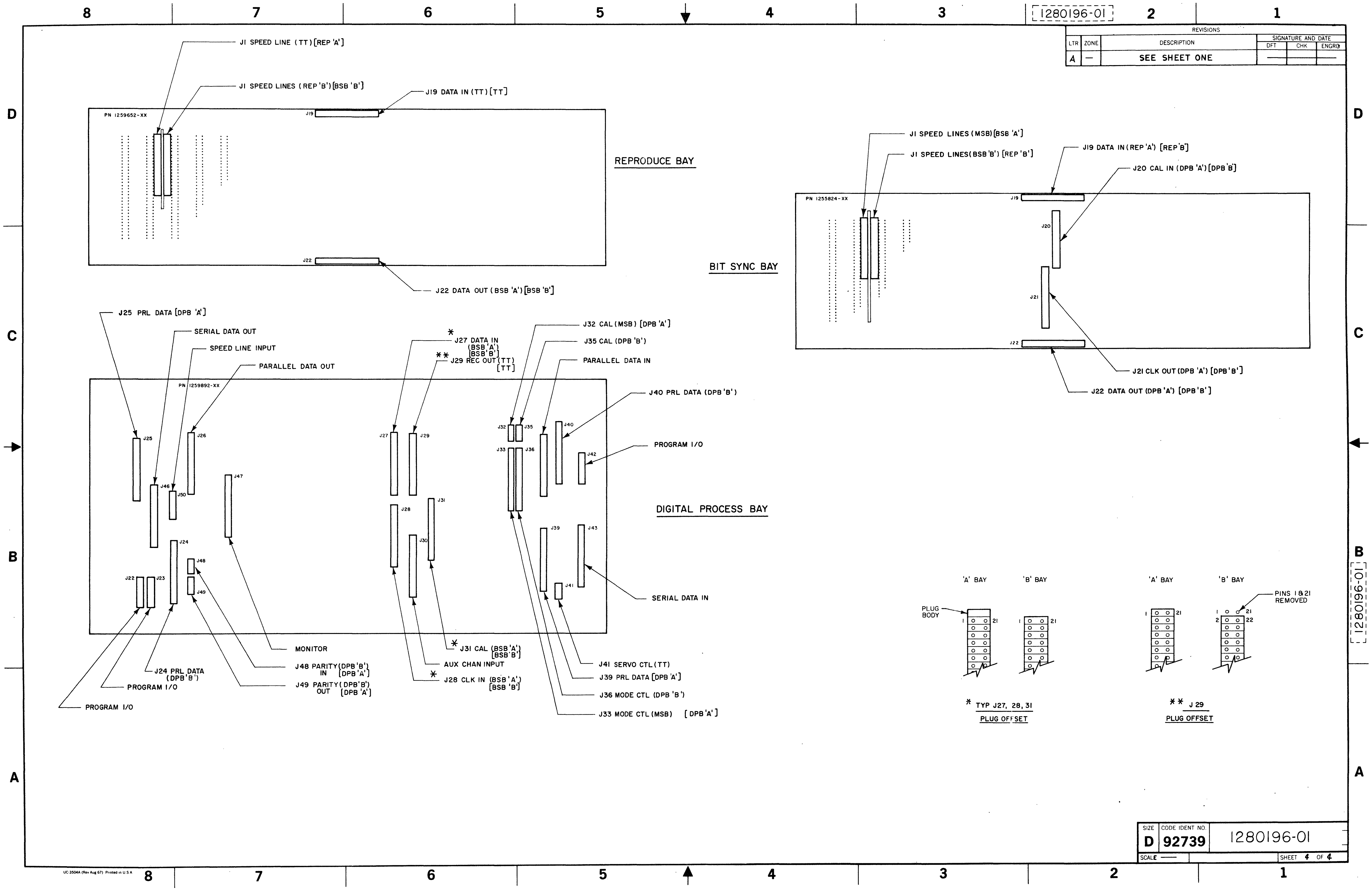
SCALE 1:1		SHEET 3 OF 4

UC 3504A (Rev Aug 67) Printed in U.S.A.


1280196-01
REVISIONS
LTR | ZONE | DESCRIPTION | SIGNATURE AND DATE DFT CHK ENGRG
A | — | SEE SHEET ONE
J1 SPEED LINE (TT) [REP 'A']
J1 SPEED LINES (REP 'B') [BSB 'B']
J19 DATA IN (TT) [TT]
PN 1259652-XX
J19
J22
REPRODUCE BAY
J22 DATA OUT (BSB 'A') [BSB 'B']
J1 SPEED LINES (MSB) [BSB 'A']
J1 SPEED LINES (BSB 'B') [REP 'B']
J19 DATA IN (REP 'A') [REP 'B']
J20 CAL IN (DPB 'A') [DPB 'B']
PN 1255824-XX
J20
J21
BIT SYNC BAY
J21 CLK OUT (DPB 'A') [DPB 'B']
J22 DATA OUT (DPB 'A') [DPB 'B']
J25 PRL DATA [DPB 'A']
SERIAL DATA OUT
SPEED LINE INPUT
PARALLEL DATA OUT
* J27 DATA IN (BSB 'A') [BSB 'B']
** J29 REC OUT (TT) [TT]
J32 CAL (MSB) [DPB 'A']
J35 CAL (DPB 'B')
PARALLEL DATA IN
J40 PRL DATA (DPB 'B')
PROGRAM I/O
PN 1259892-XX
J25 J26 J46 J50 J47 J24 J48 J49 J22 J23
J27 J29 J28 J31 J30
J32 J35 J33 J36 J40 J42 J39 J43 J41
DIGITAL PROCESS BAY
SERIAL DATA IN
MONITOR
J48 PARITY IN (DPB 'B') [DPB 'A']
J49 PARITY OUT (DPB 'B') [DPB 'A']
J24 PRL DATA (DPB 'B')
PROGRAM I/O
PROGRAM I/O
* J31 CAL (BSB 'A') [BSB 'B']
AUX CHAN INPUT
* J28 CLK IN (BSB 'A') [BSB 'B']
J41 SERVO CTL (TT)
J39 PRL DATA [DPB 'A']
J36 MODE CTL (DPB 'B')
J33 MODE CTL (MSB) [DPB 'A']
'A' BAY
'B' BAY
PLUG BODY
1 21
* TYP J27, 28, 31
PLUG OFFSET
'A' BAY
'B' BAY
PINS 1 & 21 REMOVED
1 21
2 22
** J29
PLUG OFFSET
SIZE D
CODE IDENT NO. 92739
1280196-01
SCALE —
SHEET 4 OF 4
UC 3504A (Rev Aug 67) Printed in U.S.A.

PARTS LIST	AMPEX	DATA SYSTEMS DIVISION 401 BROADWAY REDWOOD CITY, CALIF. 94063	CODE IDENT 92739	ASSY DWG. SIZE D	PL 1280196-01 SHEET 1 OF 3	REV A

LTR	DESCRIPTION	APPD	DATE	SIGNATURES		DATE
A	PRE-PROD RLSE			DRAWN	Ole Sweet	6-6-83
				CHECKED	WJ Slamka	6/6/83
				ENGRG		6 JUN 83
				ENGRG		6 JUN 83
				MANAGER	A. Vitter	13 June 83

CONTRACT NUMBER:
MODEL: HBR-3000 i
NEXT ASSEMBLY: 1270355
DRAWING TITLE: SYSTEM INSTALLATION/CABLE SET (28 TRK) HBR-3000i

ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	-01	-02	-03	-04	-05	-06	-07	-08
1	C	1257039	01	BRACKET, CABLING SUPPORT		1							
2	B	1257068	01	HOLD DOWN, CABLE		2							
3	B	1257495	03	CABLE ASSY, RIBBON 40 POS 8 FT		3							
4	B	1257495	04	CABLE ASSY, RIBBON 40 POS 9.5 FT		1							
5	B	1257496	04	CABLE ASSY, RIBBON 10 POS 11.5 FT		3							
6	C	1258085	15	CABLE ASSY, (75Ω), INTERCONN. SIGNAL		2							
7	C	1261047	05	CABLE, COAX ASSY 20 POS 8 FT		2							
8	C	1261047	07	CABLE, COAX ASSY 20 POS 9 FT		11							
9	C	1261047	08	CABLE, COAX ASSY 20 POS 9.5 FT		1							
10	C	1261047	09	CABLE, COAX ASSY 20 POS 10 FT		4							
11	C	1261047	10	CABLE, COAX ASSY 20 POS 10.5 FT		2							
12	C	1269209	02	CABLE, HBR CONTROL		1							
13	B	1257495	06	CABLE ASSY, RIBBON 40 POS 8.5 FT		1							
14	D	1255604	02	HEAD DRIVER ADAPTER		1							
15	D	1255606	02	PREAMP #2 ADAPTER		1							
16													
17	C	1257073	01	COUPLER RIBBON CABLE		5							
18	C	1257093	01	COUPLER RIBBON CABLE		1							
19	C	1259798	01	KIT, MULT. OUTLET STRIP		3							
20	B	1267669	01	KIT, CABLE LABELS		1							

PARTS LIST	AMPEX	DATA SYSTEMS DIVISION	CODE IDENT 92739	PL 1280196-01 SHEET 2 OF 3	REV 2

ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	-01	-02	-03	-04	-05	-06	-07	-08
21	C	1238324	02	LABEL, HEAD DRV		1							
22	C	1258465	02	LABEL SET, CABLE		1							
23	D	1264075	01	FLAT CABLE CHANNEL ASSY		6							
24	D	1264075	02	FLAT CABLE CHANNEL ASSY		1							
25	C	1280136	01	CABLE, RIBBON, 10 POS		2							
26	D	1262249	03	CABINET ASSY		1							
27	D	1802939	01	LINE FILTER		1							
28													
29		302-335		STRAP, CABLE .095 x 4.00 LG		10							
30		302-366		STRAP, CABLE .30 x 15.00 LG		40							
31		302-388		STRAP, CABLE .19 x 6.75 LG		20							
32		302-523		CLAMP, CABLE		5							
33		471-078		SCR, 10-32 x 3/8 PNH		14							
34		471-062		SCR, 4-40 x 3/8 PNH		6							
35		471-071		SCR, 6-32 x 1/2 PNH		6							
36		471-067		SCR, 6-32 x 1/4 PNH		14							
37		493-005		NUT 4-40 HEX W/LK		4							
38		501-008		WSHR #4 FL		6							
39		501-009		WSHR #6 FL		19							
40		502-003		WSHR #6 S LK		17							
41		503-316		WSHR #4 FIBER		6							
42		501-070		WSHR #10 FL		14							
43		502-005		WSHR #10 S LK		14							
44		302-557		CLAMP, CABLE		4							
45		302-560		PAD, FOAM		4							

PARTS LIST	AMPEX	DATA SYSTEMS DIVISION	CODE IDENT 92739	PL 1280196-01 SHEET 3 OF 3	REV 2

ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	QUANTITY REQUIRED PER ASSEMBLY -01	-02	-03	-04	-05	-06	-07	-08
46		302-356		CLAMP, CABLE		1							
47		471-072		SCR, 6-32 x 5/8 PNH		1							
48		496-005		NUT, 6-32 HEX W/LK		1							
49		600-117		SLVG, SHRINK, BLK		1.5'							

PARTS LIST	AMPEX	DATA SYSTEMS DIVISION, 401 BROADWAY, REDWOOD CITY, CALIF. 94063	CODE IDENT 92739	ASSY DWG. SIZE —	PL 1280386-01 SHEET 1 OF 1	REV A

REVISIONS

LTR	DESCRIPTION	APPD	DATE
A	PROD REL	[illegible]	8/3/83

SIGNATURES		DATE
DRAWN	[illegible]	[illegible]
CHECKED	[illegible]	8/5/83
ENGRG		
ENGRG	[illegible]	8.5.83
MANAGER	[illegible]	[illegible] 83

CONTRACT NUMBER

MODEL: HBR 3000 i

NEXT ASSEMBLY: 1280216

DRAWING TITLE: LABEL KIT, 28 CH ECC ELECTRONICS/BAYS

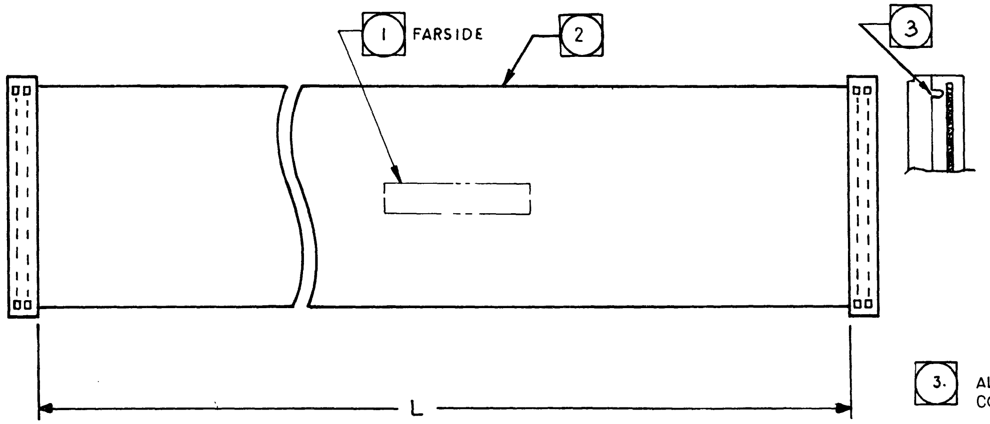
ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	-01	-02	-03	-04	-05	-06	-07	-08
1		1258597	05	LABEL, 28 TRACK REPRO (A) BAY		1							
2		1258597	06	LABEL, 28 TRACK REPRO (B) BAY		1							
3		1258597	07	LABEL, 28 TRACK BIT SYNC (A) BAY		1							
4		1258597	08	LABEL, 28 TRACK BIT SYNC (B) BAY		1							
5		1264957	01	LABEL, ADJ AND TP REPRO BAY		2							
6		1268159	01	LABEL, ADJ AND TP BIT SYNC BAY		2							
7		1269995	01	LABEL, DP BAY-A		1							
8		1269995	02	LABEL, DP BAY-B		1							
9		1269997	01	LABEL, ADJ AND TP DP BAY		2							
10		1258677	01	CHANNEL MARKERS 1-14		2							
11		1258677	02	CHANNEL MARKERS 15-28		2							
12		1258775	01	MODULE COLOR MARKER MAG		4							
13		1258775	02	MODULE COLOR MARKER BLU		2							
14		1258775	03	MODULE COLOR MARKER BLK		2							

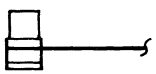
(Columns -01 through -08: QUANTITY REQUIRED PER ASSEMBLY)

1257495-XX

DISTR CODE: AE

REVISIONS				
LTR	DESCRIPTION	SIGNATURE AND DATE DFT	CHK	ENGRG
A	PROD RELEASE	8/18/77		MLB
B	REV PER ECN 29844	H. Dao 6-23-81	6-30-81	7-2-81
C	ADDED-05 & -06 PER ECN 30592	H. Dao 4-27-82	5-14-82	6-9-82
D	ADDED-07 PER ECN 30785	RA 8-6-82	8-13-82	J Barker 11-1-82
E	REV PER ECN 31212-1 (B)	H. Dao 12/20/82	WJS	D Burr 3-30-83
E1	REV PER ECN 31691-2 (B)	H. Dao 3/16/83	WJS 3-16-83	J Barker 3-31-83





3. ALIGN NOTCH END OF CONNECTOR WITH COLOR CODED WIRE, TWO PLACES.

2. COLOR CODED WIRE THIS SIDE OF ASSY.

1. MARK ASSY NO, AND REVISION AT APPROX. CENTER OF CABLE, COLOR BLACK.

1257495-XX
E

NOTES: UNLESS OTHERWISE SPECIFIED

VERSION TABLE

ASSY NO.	L (LENGTH)
1257495-01	72.0 ± 1.0
1257495-02	90.0 ± 1.0
1257495-03	96.0 ± 1.0
1257495-04	114.0 ± 1.0
1257495-05	120.0 ± 1.0
1257495-06	102.0 ± 1.0
1257495-07	360.0 ± 1.0

SEE SEPARATE PARTS LIST

-05	-04	-03	-02	-01	ITEM NO.	PART NUMBER	EQUIVALENT VENDOR OR MIL. PART NUMBER (REF ONLY)	DESCRIPTION	FMC	LONG LEAD ITEM
QUANTITY PER UNIT										
ASSY CONTROL NO					PARTS LIST					

CAT. ITEM	NEXT ASSY	USED ON	IN	MF CODE	PR
	1258155	HBR-3000			
	1258156	HBR-3000			
APPLICATION					

NOTICE

THIS DRAWING SHALL NOT BE DUPLICATED USED FOR ANY PURPOSE OTHER THAN THAT FOR WHICH PROVIDED OR DISCLOSED IN WHOLE OR IN PART WITHOUT THE WRITTEN CONSENT OF AMPEX CORPORATION PROVIDED HOWEVER THAT IF THIS DRAWING IS SPECIFIED TO BE DELIVERED TO THE GOVERNMENT OR TO A GOVERNMENT CONTRACT OR PURSUANT TO A GOVERNMENT PRIME OR SUBCONTRACT THE GOVERNMENT MAY MAKE SUCH USE OF THIS DRAWING AS IS PERMITTED BY THE APPLICABLE DATA CLAUSE SET FORTH IN SUCH CONTRACT OR SUBCONTRACT

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES

TOL: 2 PLC | 3 PLC | ANG

REMOVE BURRS AND SHARP EDGES YES ☐ NO ☐

DO NOT SCALE THIS PRINT

MATERIAL

FINISH

	SIGNATURE	DATE
DRAWN BY		8/18/77
CHK BY		
DFT APPD		
ENGRG APPD		8-22-77
AUTH BY		8-22-77

AMPEX

HEADQUARTERS
Redwood City,
California 94063

CABLE ASSY, RIBBON 40 POS

SIZE B | CODE IDENT NO 92739 | 1257495-XX

SCALE —— | SHEET 1 OF 1

UC-3502.03 (6-73) PRINTED IN U.S.A.

6-45/6-46
1280065

PARTS LIST	AMPEX	DATA PRODUCTS DIVISION	401 BROADWAY REDWOOD CITY, CALIF. 94063	ASSY DWG SIZE B	PL 1257495-XX SHEET 1 OF 1	REV E_1

REVISIONS

LTR	DESCRIPTION	APPD	DATE
A	PRODUCTION RELEASF	[signature]	
E	REV PER ECN 31212-1	[signature]	3-30-83
E_1	REV PER ECN 31691-2	[signature]	5-31-83

SIGNATURES		DATE
DRAWN	[signature]	[illegible]
CHECKED		
ENGRG		
ENGRG	[signature]	8-22-77
MANAGER		

~~CODE IDENT~~	CODE IDENT	CONTRACT NUMBER	NEXT ASSEMBLY
~~09150~~	92739		1257485-01

DRAWING TITLE

CABLE ASSY, RIBBON 40 POS

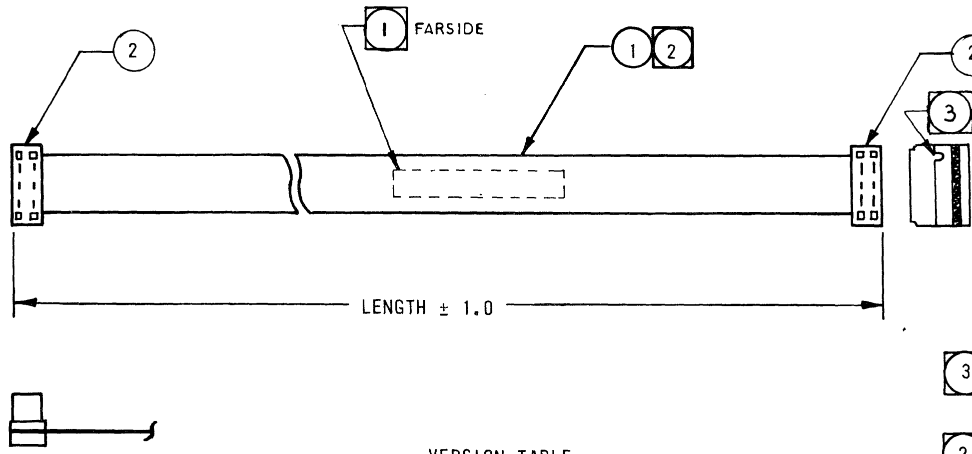
HBR - 3000

ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	QUANTITY REQUIRED PER ASSEMBLY -01	-02	-03	-04	-05	-06	-07	-08
1		616-623		CABLE, RIBBON 40 COND, 28 AWG		6.0'	7.5'	8.0'	9.5'	10.0'	8.5'	30.0'	
2		140-168		CONNECTOR, DUAL 20 POS		2	2	2	2	2	2	2	

1257496 - XX

DISTR CODE: AE

REVISIONS		SIGNATURE AND DATE		
LTR	DESCRIPTION	DFT	CHK	ENGRG
A	PROD. RELEASE	9-10-79		
A_1	REV PER ECR 28402	E.O.M. 11-6-79	H.J. 11-13-79	J Barker 12-3-79
B	ADDED-04 PER ECN 29936	H. Dao 7-31-81	7-28-81	B Dahl 7-31-81
C	ADDED -05 PER ECN 30578	H. Dao 4-23-82	5-5-82	H Dahl
D	REV PER ECN 31212 - 2 (B)	H. Dao 3/18/83	WJS 5-23-83	3-30-83
D_1	REV PER ECN 31691-1(B)	H. Dao 5/9/83	WJS 5-16-83	J Barker 5-31-83



VERSION TABLE

PART NUMBER	LENGTH
1257496-01	96.0
1257496-02	126.0
1257496-03	108.0
1257496-04	138.0
1257496-05	150.0

3. ALIGN NOTCH END OF CONNECTOR WITH COLOR CODED WIRE, TWO PLACES.

2. COLOR CODED WIRE THIS SIDE OF ASSY.

1. MARK ASSY NO. AND REVISION AT APPROX. CENTER OF CABLE, COLOR BLACK.

1257496-XX
D

NOTES: UNLESS OTHERWISE SPECIFIED

SEE SEPARATE PARTS LIST

-05	-04	-03	-02	01	ITEM NO.	PART NUMBER	EQUIVALENT VENDOR OR MIL PART NUMBER (REF ONLY)	DESCRIPTION	FMC	LONG LEAD ITEM
QUANTITY PER UNIT										
					PARTS LIST					
ASSY CONTROL NO										

CAT. ITEM	NEXT ASSY	USED ON	IN	MF CODE	PR
	1258156				
	1258155				
	1257485-01	HBR 3000			
APPLICATION					

NOTICE

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UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES

TOL ±		2 PLC	3 PLC		ANG

REMOVE BURRS AND SHARP EDGES YES ☐ NO ☐
DO NOT SCALE THIS PRINT

	SIGNATURE	DATE
DRAWN BY		9/5/79
CHK BY		
DFT APPD		
ENGRG APPD		
AUTH BY		9/14/79

MATERIAL

FINISH

AMPEX

HEADQUARTERS
Redwood City,
California 94063

CABLE ASSY,
RIBBON 10 POS

SIZE B | CODE IDENT N 92739 | 1257496 -XX

SCALE —— | —— | SHEET 1 OF 1

UC-3502.03 (6-73) PRINTED IN U.S.A.

6-49/6-50
1280065

PARTS LIST	AMPEX	DATA PRODUCTS DIVISION	401 BROADWAY REDWOOD CITY, CALIF. 94063	ASSY DWG SIZE B	PL 1257496-XX SHEET 1 OF 1	REV D1

REVISIONS

LTR	DESCRIPTION	APPD	DATE	SIGNATURES		DATE
A	PROD. RELEASE		9/14/79	DRAWN		9/14/79
D1	REV PER ECN 31691-1		5-31-83	CHECKED		
				ENGRG		
				ENGRG		8-27
				MANAGER		9/14/79

~~CODE IDENT 09150~~	CODE IDENT 92739	CONTRACT NUMBER	NEXT ASSEMBLY 1257485-01

DRAWING TITLE

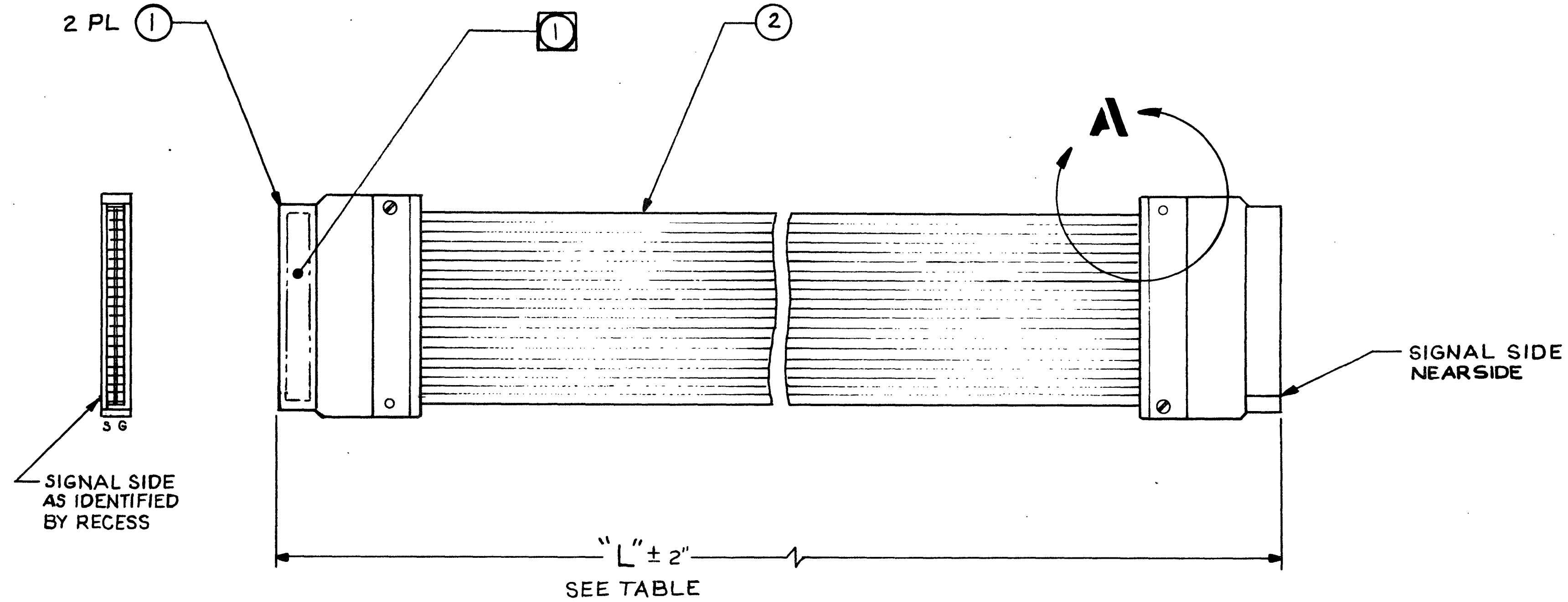
CABLE ASSY,
RIBBON 10 POS
HBR-3000

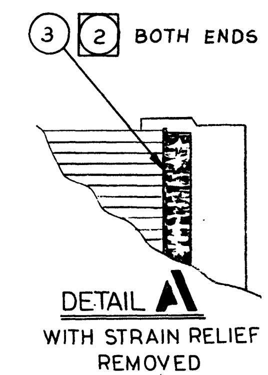
ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	-01	-02	-03	-04	-05	-06	-07	-08
1		616-653		CABLE, RIBBON 10 COND 28 AWG		8'	10.5'	9'	11.5'	12.5'			
2		140-167		CONNECTOR, DUAL 5 POS		2	2	2	2	2			

QUANTITY REQUIRED PER ASSEMBLY

1261047-XX | DISTR CODE: AE

REVISIONS					
LTR	ZONE	DESCRIPTION	SIGNATURE AND DATE DFT	CHK	ENGRG
A	—	PRODUCTION RELEASE	3-2-79	J Barker 2-22-80	2-22-80
B	—	REV PER ECN 30228	11-3-81	11-3-81	11-10-81





2. APPLY ADHESIVE ITEM 3 TO SHIELD AND DRAIN WIRES BEFORE INSTALLING CONN. STRAIN RELIEFS.

1. MARK PART NUMBER AND REVISION IN .12 HIGH VERTICAL GOTHIC LETTERING WITH PERMANENT INK WHERE SHOWN PER MIL-STD-130.

1261047-XX
B

NOTES: UNLESS OTHERWISE SPECIFIED

VERSION TABLE

ASSY NO.	DIM "L"	SAME AS
1261047-01	6.0 FT	636-022
-02	6.5 FT	
-03	7.0 FT	
-04	7.5 FT	
-05	8.0 FT	636-023
-06	8.5 FT	
-07	9.0 FT	
-08	9.5 FT	
-09	10.0 FT	
-10	10.5 FT	
-11	11.0 FT	
-12	11.5 FT	
1261047 -13	12.0 FT	

QTY	ITEM NO.	PART NUMBER		DESCRIPTION	
AR	3	018-539	——	ADHESIVE, BONDING	LOCTITE #420
AR	2	636-037	——	CA, RIBBON, COAX. 20 COND.	
2	1	140-259	——	CONN, S16, 20 COND.	
ALL	ITEM NO.	PART NUMBER		DESCRIPTION	

QUANTITY PER VERSION

PARTS LIST

NEXT ASSY	USED ON
1258156	HBR
1258155	HBR

APPLICATION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES.
TOL ± | 2 PLC | 3 PLC | ANG
REMOVE BURRS AND SHARP EDGES YES ☐ NO ☐
DO NOT SCALE THIS PRINT

MATERIAL:
FINISH:

	SIGNATURE	DATE
DRAWN BY	R Moreno	3-2-79
CHK BY		
DFT APPD		
ENGRG APPD		6-3-79
AUTH BY		

AMPEX — HEADQUARTERS Redwood City, California 94063

CABLE, COAX ASSY, 20 COND

SIZE C | CODE IDENT NO. 92739 | 1261047-XX

SCALE 1/1 | SHEET 1 OF 1

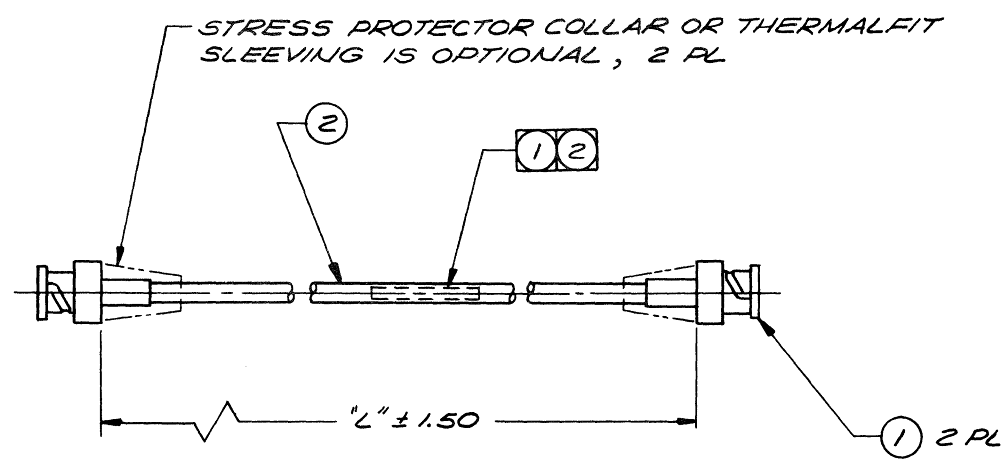
UC-3503 (Rev Aug 67) Printed in U.S.A.

6-53/6-54
1280065

1258085-XX DISTR CODE: AE

REVISIONS

LTR	ZONE	DESCRIPTION	DFT	CHK	ENGRG
A	–	PRODUCTION RELEASE	6 JUN 78	6/8/78	6-8-78
B	–	REVISED PER ECN 27202	7-18-78	7/21/78	7-25-78
B1	–	ADDED -16 THRU -19 PER ECR 27972	DW 6-6-79	6/11/79	6-13-79



VERSION TABLE			
ASSY NO.	"L" DIM	ASSY NO.	"L" DIM
1258085-01	18.00	1258085-16	180.00
1258085-02	16.00	1258085-17	228.00
1258085-03	24.00	1258085-18	252.00
1258085-04	30.00	1258085-19	300.00
1258085-05	48.00		
1258085-06	60.00		
1258085-07	70.00		
1258085-08	80.00		
1258085-09	90.00		
1258085-10	100.00		
1258085-11	12.00		
1258085-12	108.00		
1258085-13	120.00		
1258085-14	144.00		
1258085-15	168.00		

2. ASSY NO. IS PER VERSION TABLE.

1. MARK ASSY NO. AND REV IN .12 HIGH VERTICAL GOTHIC LETTERING WITH PERMANENT WHITE INK PER MIL-STD-130.

ASSY 1258085-XX
B

NOTES: UNLESS OTHERWISE SPECIFIED

1258085-XX

PARTS LIST

QTY (ALL)	ITEM NO.	PART NUMBER	DESCRIPTION
AR	2	616-677	CABLE, COAX, RG59B/U 75 OHM
2	1	140-242	CONN, BNC

QUANTITY PER VERSION

NEXT ASSY	USED ON
GEN.	HBR

APPLICATION

NOTICE

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UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES.
TOL ± | 2 PLC | 3 PLC | ANG
REMOVE BURRS AND SHARP EDGES ~~YES~~ NO
DO NOT SCALE THIS PRINT

MATERIAL: SEE PL
FINISH:

	SIGNATURE	DATE
DRAWN BY		6 JUN 78
CHK BY		6/8/78
DFT APPD		
ENGRG APPD		6-8-78
AUTH BY		6-8-78

AMPEX HEADQUARTERS Redwood City, California 94063

CABLE ASSY, (75 Ω) INTERCONNECTING SIGNAL BNC-BNC

SIZE C | CODE IDENT NO. 92739 | 1258085-XX

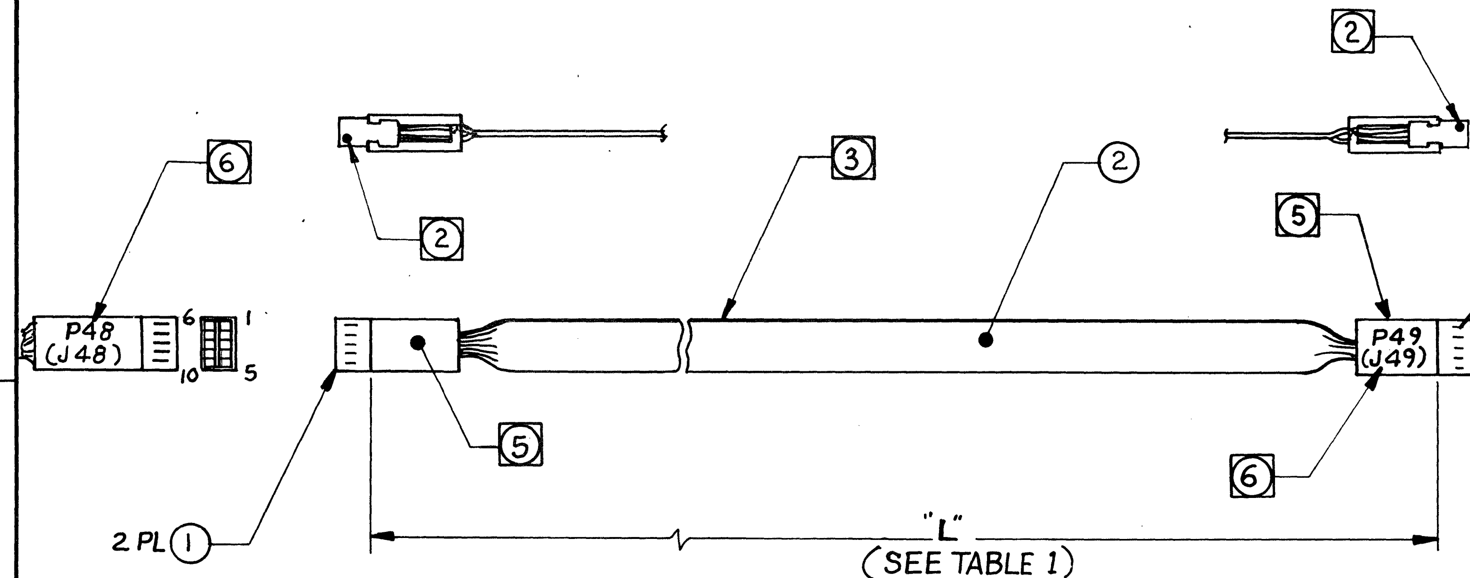
SCALE 1/1 | SHEET 1 OF 1

UC-3503 (Rev Aug 67) Printed in U.S.A.

6-55/6-56
1280065

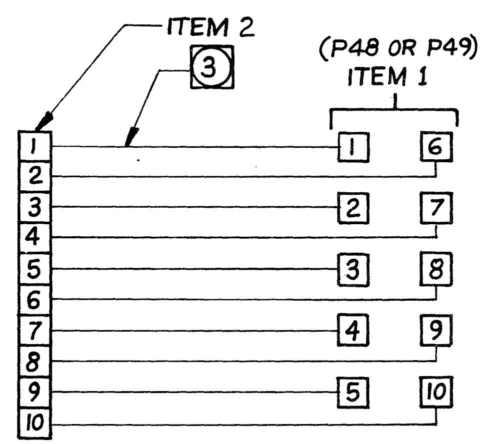
2 | 1280136-XX | DISTR CODE:

REVISIONS					
LTR	ZONE	DESCRIPTION	SIGNATURE AND DATE DFT	CHK	ENGRG
1	–	PRE-PRODUCTION RELEASE			



NOTES: UNLESS OTHERWISE SPECIFIED.

1. IDENTIFY PART WITH PART NUMBER AND REVISION BY TAGGING OR MARKING CONTAINER PER MIL-STD-130. 1280136-XX / 1
2. BEFORE WIRING, REMOVE VENDOR'S PIN NUMBER DESIGNATION. IDENTIFY PIN 1 WITH A WHITE DOT AS SHOWN.
3. COLOR CODED WIRE THIS SIDE OF ASSY.
4. SEPARATE CONDUCTORS OF ITEM 2 TO 1.50 INCHES FROM END AND TERMINATE AS SHOWN.
5. FOLD CABLE, ITEM 2, AS NECESSARY TO FIT COVER OF ITEM 1 OPENING.
6. MARK REF DES "P48" "(J48)" AND "P49" "(J49)" ON SIDE OF ITEM 1 AS SHOWN; COLOR IS WHITE.



WIRING DIAGRAM
4

TABLE 1	
ASSY NO.	LENGTH "L"
1280136-01	138.00±1.00
1280136-02	84.00±1.00

-02	-01	ITEM NO	PART NUMBER		DESCRIPTION
7.0'	11.5'	2	616-653	———	CABLE, RIBBON, 28 AWG, 10 COND
2	2	1	140-717	AMP-102397-3	CONN, DUAL, 5 POS

QUANTITY PER VERSION — PARTS LIST

NEXT ASSY	USED ON
1270089	AHBR 1700
1280186	HBR 3000

APPLICATION

NOTICE

THIS DRAWING SHALL NOT BE DUPLICATED, USED FOR ANY PURPOSE OTHER THAN THAT FOR WHICH PROVIDED OR DISCLOSED, IN WHOLE OR IN PART, WITHOUT THE WRITTEN CONSENT OF AMPEX CORPORATION. PROVIDED, HOWEVER, THAT IF THIS DRAWING IS SPECIFIED TO BE DELIVERED TO THE GOVERNMENT, OR TO A GOVERNMENT CONTRACTOR, PURSUANT TO A GOVERNMENT PRIME OR SUBCONTRACT, THE GOVERNMENT MAY MAKE SUCH USE OF THIS DRAWING AS IS PERMITTED BY THE APPLICABLE "DATA" CLAUSE SET FORTH IN SUCH CONTRACT OR SUBCONTRACT.

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES

TOL ±	2 PLC	3 PLC		ANG
—	—	—	—	—

REMOVE BURRS AND SHARP EDGES YES ☐ NO ☐

DO NOT SCALE THIS PRINT

MATERIAL:

FINISH:

	SIGNATURE	DATE
DRAWN BY		5-10-83
CHK BY		
DFT APPD	B. Carmer	5-31-83
ENGRG APPD		
AUTH BY		

AMPEX — HEADQUARTERS, Redwood City, California 94063

CABLE ASSEMBLY, RIBBON 10 POS

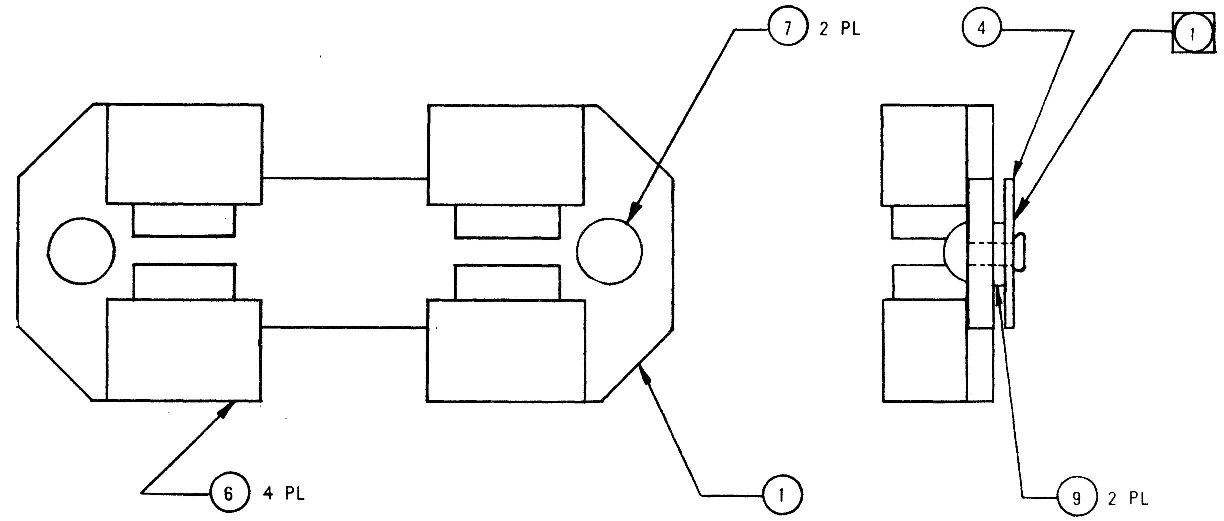
SIZE	CODE IDENT NO	
C	92739	1280136-XX

SCALE 1/1 — SHEET 1 OF 1

UC-3503 (Rev Aug 67) Printed in U.S.A.

1257093-01 | DISTR CODE: AG

LTR		DESCRIPTION			
A	—	PROD RLSE	R 9/12/79		



1257093-01

1 MARK PART NUMBER AND REVISION IN .12 HIGH VERTICAL GOTHIC LETTERING WITH PERMANENT INK WHERE SHOWN PER MIL-STD-130. 1257093-01 A

NOTES: UNLESS OTHERWISE SPECIFIED.

■ PARTS LIST

QUANTITY PER VERSION

1258156	HBR
NEXT ASSY	USED ON
APPLICATION	

NOTICE

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UNLESS OTHERWISE SPECIFIED

REMOVE BURRS AND SHARP EDGES

DO NOT SCALE THIS PRINT

MATERIAL

FINISH

DRAWN 4/22/78
26 JUN 78
9/12/79

AMPEX HEADQUARTERS Redwood City, California 94063

PRINTED WIRING BD ASSY, RIBBON CABLE COUPLER, 4 CONNECTORS

C 92739 1257093-01

SCALE 2/1 SHEET 1 OF 1

UC-3503 (Rev Aug 67) Printed in U.S.A.

PARTS LIST | **AMPEX** | **DATA PRODUCTS DIVISION**

401 BROADWAY
REDWOOD CITY,
CALIF 94063

ASSY DWG SIZE: C

PL 1257093-01 SHEET 1 OF 1 — REV A

REVISIONS

LTR	DESCRIPTION	APPD	DATE
A	PROD. RELEASE	[signature]	9/14/79

SIGNATURES		DATE
DRAWN	[signature]	6/23/78
CHECKED	[signature]	26 JUN 78
ENGRG		
ENGRG	[signature]	10/31/78
MANAGER	[signature]	9/14/79

CODE IDENT	CONTRACT NUMBER	NEXT ASSEMBLY
92739	HBR	1258156

DRAWING TITLE

PRINTED WIRING BD ASSY,
RIBBON CABLE COUPLER,
4 CONNECTORS

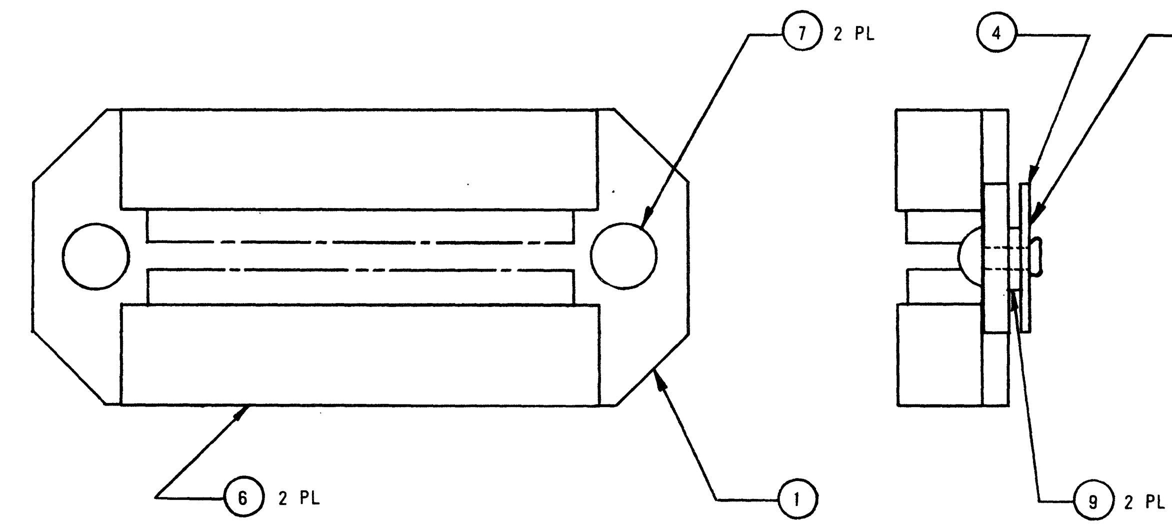
ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	-01	-02	-03	-04	-05	-06	-07	-08
1	C	1257072	01	PWB , RIBBON CABLE COUPLER		1							
2													
3													
4	C	1258747	01	INSULATOR, RBN CABLE COUPLER		1							
5													
6		135-068		HEADER ASSY, 10 POSTS, RIGHT ANGLE		4							
7		460-149		RIVET, TUBULAR, OVAL HD .089 X .22 LG		2							
8													
9		501-008		WASHER, FLAT, NO. 4		2							

(QUANTITY REQUIRED PER ASSEMBLY: -01 through -08)

1257073-01 DISTR CODE: AG

REVISIONS

LTR	ZONE	DESCRIPTION	DFT	CHK	ENGRG
A	—	PROD RLSE	9/12/79		



1257073-01

1 MARK PART NUMBER AND REVISION IN .12 HIGH VERTICAL GOTHIC LETTERING WITH PERMANENT INK WHERE SHOWN PER MIL-STD-130.

1257073-01
A

NOTES: UNLESS OTHERWISE SPECIFIED.

■ PARTS LIST

QUANTITY PER VERSION	ITEM NO	PART NUMBER	DESCRIPTION

PARTS LIST

NEXT ASSY	USED ON
1258156	HBR

APPLICATION

NOTICE

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UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES

TOL	2 PLC	3 PLC	ANG
±			

REMOVE BURRS AND SHARP EDGES YES ☐ NO ☐

DO NOT SCALE THIS PRINT

MATERIAL:

FINISH:

	SIGNATURE	DATE
DRAWN BY	[signature]	6/22/78
CHK BY	[signature]	26 JUN 78
DFT APPD		
ENGRG APPD		
AUTH BY	[signature]	9/4/79

AMPEX HEADQUARTERS Redwood City, California 94063

PRINTED WIRING BD ASSY, RIBBON CABLE COUPLER, 2 CONNECTORS

SIZE C CODE IDENT NO 92739 1257073-01

SCALE 2/1 SHEET 1 OF 1

UC-3503 (Rev Aug 67) Printed in U.S.A.

6-63/6-64
1280065

PARTS LIST	AMPEX	DATA PRODUCTS DIVISION	401 BROADWAY REDWOOD CITY, CALIF. 94063	ASSY DWG SIZE C	PL 1257073-01 SHEET 1 OF 1	REV A

REVISIONS

LTR	DESCRIPTION	APPD	DATE
A	PROD RELEASE		

SIGNATURES		DATE
DRAWN	D. [illegible]	6/23/78
CHECKED	[illegible]	26 JUN 78
ENGRG		
ENGRG	[illegible]	10-31-78
MANAGER		

CODE IDENT	CONTRACT NUMBER	NEXT ASSEMBLY
92739	HBR	1258156

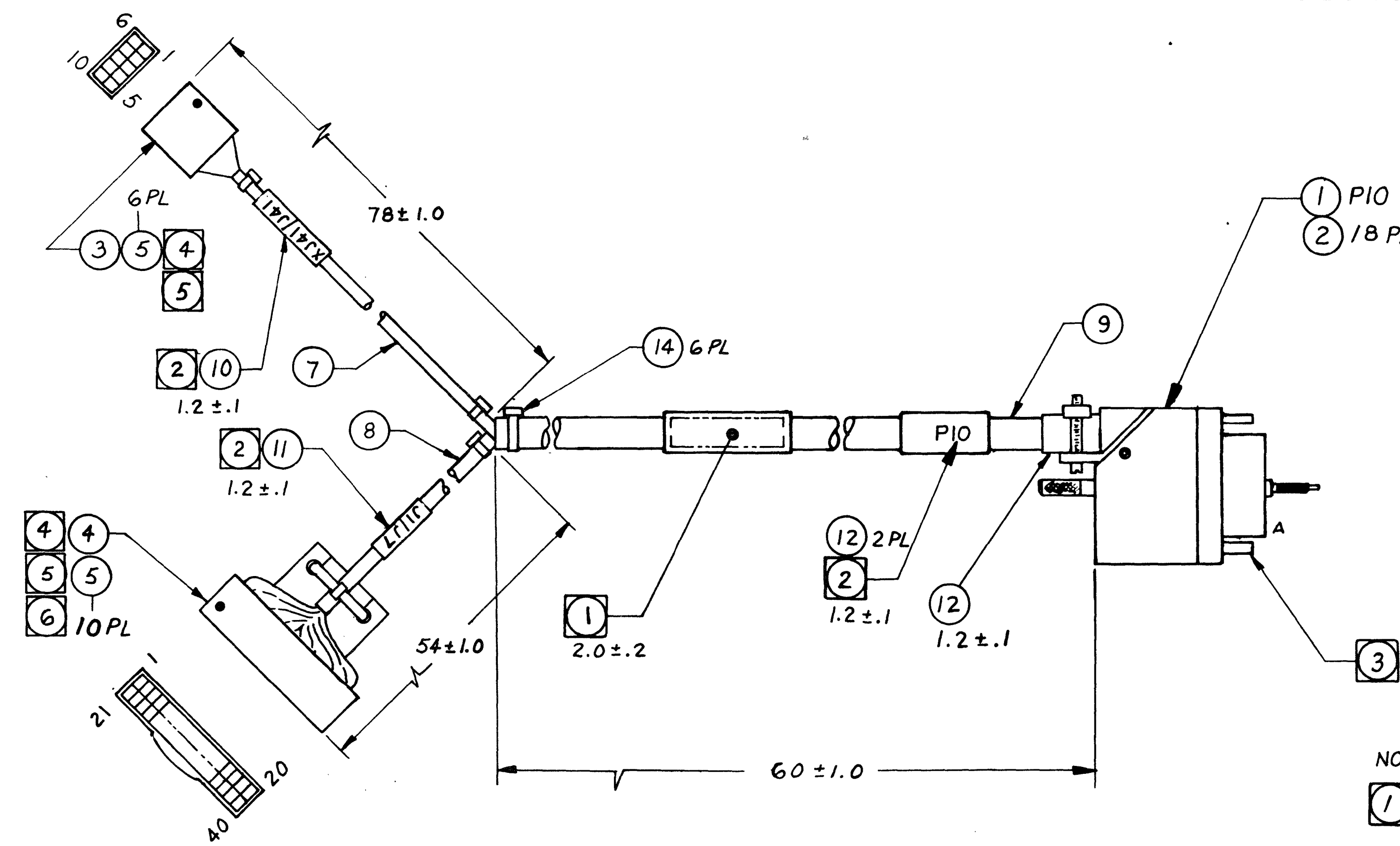
DRAWING TITLE

PRINTED WIRING BD ASSY,
RIBBON CABLE COUPLER ,
2 CONNECTORS

ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	-01	-02	-03	-04	-05	-06	-07	-08
						QUANTITY REQUIRED PER ASSEMBLY							
1	C	1257072	01	PWB , RIBBON CABLE COUPLER		1							
2													
3													
4	C	1258747	01	INSULATOR, RBN CABLE COUPLER		1							
5													
6		135-071		HEADER ASSY, 40 POSTS, RIGHT ANGLE		2							
7		460-149		RIVET, TUBULAR, OVAL HD .089 x .22 LG		2							
8													
9		501-008		WASHER, FLAT, NO. 4		2							

1269209-XX   DISTR CODE: AE

LTR	ZONE	DESCRIPTION	DFT		
A	–	REV PER ECR 31601 PROD RELEASE (B)			
B	–	ADDED -02 PER ECN 31887 (B)			



NOTES: UNLESS OTHERWISE SPECIFIED.

1. MARK ASSY NUMBER AND REVISION IN .12 HIGH VERTICAL GOTHIC LETTERING WITH PERMANENT WHITE INK WHERE SHOWN PER MIL-STD-130. ASSY 1269209-XX B
2. MARK REF DES'S "J1/J7", "J41" AND "P10" ON ITEMS 10,11&12 AS SHOWN.
3. LOCATE LARGE GUIDE PIN OF CONNECTOR AT PIN A END AND ORIENT BOTH GUIDE PINS OF P10 TO POSITION 4.
4. MARK KEYING DOT ON CONNECTOR HOUSINGS ADJACENT TO PIN 1 USING PERMANENT WHITE PAINT. DOT TO BE APPROX .06 TO .12 DIA.
5. INSERT CRIMPED CONTACTS (ITEM 5) ORIENTED WITH LOCKING TABS TOWARDS OUTSIDE WALL OF CONNECTOR HOUSINGS.
6. ORIENT CABLE STRAP (ITEM 14) WITH LOCKING DEVICE ON CABLE SIDE OF CONNECTOR HOUSING (ITEM 4) AS SHOWN.

VERSION TABLE

ASSY NUMBER	DESCRIPTION
1269209-01	NON-ECC SYSTEMS
1269209-02	ECC SYSTEMS

SEE SEPARATE PARTS AND WIRE LIST

QUANTITY PER VERSION	ITEM NO	PART NUMBER	DESCRIPTION

PARTS LIST

NEXT ASSY	USED ON
1280195	HBR-3000
1280196	↑
1258156	↓
1258155	HBR-3000

APPLICATION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES
TOL | 2 PLC | 3 PLC | ANG
REMOVE BURRS AND SHARP EDGES YES NO
DO NOT SCALE THIS PRINT

MATERIAL:
FINISH:

	SIGNATURE	DATE
DRAWN BY	H. Dao	8/6/82
CHK BY		
DFT APPD		
ENGRG APPD		
AUTH BY		

AMPEX HEADQUARTERS Redwood City, California 94063

CABLE ASSEMBLY
HBR CONTROL (P10)

SIZE C | CODE IDENT NO 92739 | 1269209-XX

SCALE NONE | SHEET 1 OF 1

UC 3503 (Rev Aug 67) Printed in U.S.A.

PARTS LIST	AMPEX	DATA SYSTEMS DIVISION, 401 BROADWAY REDWOOD CITY, CALIF. 94063	CODE IDENT 92739	ASSY DWG. SIZE C	PL 1269209-XX SHEET 1 OF 2.	REV B

REVISIONS

LTR	DESCRIPTION	APPD	DATE	SIGNATURES		DATE
A	REV PER ECR 31601 PROD REL (B)		4-20-83	DRAWN		
B	ADDED -02 ECN 31887		8-31-83	CHECKED		
				ENGRG		10/4/82
				ENGRG		10 15 82
				MANAGER		10 Oct 82

CONTRACT NUMBER:

MODEL: HBR 3000

NEXT ASSEMBLY: "SEE DWG"

DRAWING TITLE: CABLE ASSEMBLY HBR CONTROL (P10)

ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	-01	-02	-03	-04	-05	-06	-07	-08
1		166-290		CONN, PLUG, RECT, 56 POS	P10	1	1						
2		169-872		CONN, CONTACT, HERMAPHRODITE	REF: P10	18	18						
3		177-146		CONN, PLUG, DUAL 5 POS	J41	1	1						
4		177-150		CONN, PLUG, DUAL 20 POS	J1/J7	1	1						
5		177-147		CONN, CONTACT, SOCKET, 24-20 AWG	REF: J1/J7, J41	16	16						
6													
7		600-009		SLVG, .208 I.D., FLEX, BLK		6.5'	6.5'						
8		600-007		SLVG, .263 I.D., FLEX, BLK		4.5'	4.5'						
9		600-052		SLVG, .375 I.D., FLEX, BLK		5.0'	5.0'						
10		600-092		SLVG, .250 I.D., SHK, BLK		0.2'	0.2'						
11		600-093		SLVG, .375 I.D., SHK, BLK		0.2'	0.2'						
12		600-097		SLVG, .750 I.D., SHK, BLK		0.5'	0.5'						
13													
14		302-587		STRAP, CABLE, NYLON, BLK		5	5						
15													
16		611-256		WIRE, STRD, INSUL, 20 AWG, BLK		9.7'	9.7'						
17		617-053		WIRE, STRD, INSUL, 20 AWG, GRN		9.7'	9.7'						
18		617-056		WIRE, STRD, INSUL, 20 AWG, W/BLK		9.7'	9.7'						
19		617-057		WIRE, STRD, INSUL, 20 AWG, W/BRN		9.7'	9.7'						
20		617-058		WIRE, STRD, INSUL, 20 AWG, W/RED		9.7'	9.7'						

PARTS LIST	AMPEX	DATA SYSTEMS DIVISION	CODE IDENT 92739	PL 1269209-XX SHEET 2 OF 2	REV B

ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	-01	-02	-03	-04	-05	-06	-07	-08
21		617-059		WIRE, STRD, INSUL, 20 AWG, W/ORG		9.7'	9.7'						
22		617-060		WIRE, STRD, INSUL, 20 AWG, W/YEL		9.7'	9.7'						
23		617-061		WIRE, STRD, INSUL, 20 AWG, W/GRN		9.7'	9.7'						
24		617-062		WIRE, STRD, INSUL, 20 AWG, W/BLU		9.7'	9.7'						
25		617-063		WIRE, STRD, INSUL, 20 AWG, W/VIO		9.7'	9.7'						
26		614-847		WIRE, STRD, INSUL, 24 AWG, W/BRN		11.7'	11.7'						
27		614-848		WIRE, STRD, INSUL, 24 AWG, W/RED		11.7'	11.7'						
28		614-849		WIRE, STRD, INSUL, 24 AWG, W/ORG		11.7'	11.7'						
29		614-874		WIRE, STRD, INSUL, 24 AWG, W/YEL		11.7'	11.7'						
30		611-504		WIRE, STRD, INSUL, 24 AWG, W/GRN		11.7'	11.7'						
31		614-875		WIRE, STRD, INSUL, 24 AWG, W/BLU		11.7'	11.7'						
32		614-876		WIRE, STRD, INSUL, 24 AWG, W/VIO		0.2'	0.2'						
33		1269209	01	WIRE LIST		REF	-						
34		1269209	02	WIRE LIST		-	REF						

WIRE LIST	AMPEX	DATA SYSTEMS DIVISION 401 BROADWAY REDWOOD CITY, CALIF. 94063	CODE IDENT 92739	ASSY DWG. SIZE C	WL 1269209-02 SHEET 1 OF 1	REV B

REVISIONS

LTR	DESCRIPTION	APPD	DATE
A	REV PER ECR 31601 PROD REL (B)	[illegible]	4/18/83 4-20-83
B	REV PER ECN 31887	[illegible]	8-31-83

SIGNATURES		DATE
DRAWN	[illegible]	10/14/82
CHECKED		
ENGRG	[illegible]	10/14/82
ENGRG	[illegible]	10 OCT 82
MANAGER	[illegible]	10 OCT 82

CONTRACT NUMBER

MODEL: HBR 3000

NEXT ASSEMBLY: SEE DWG

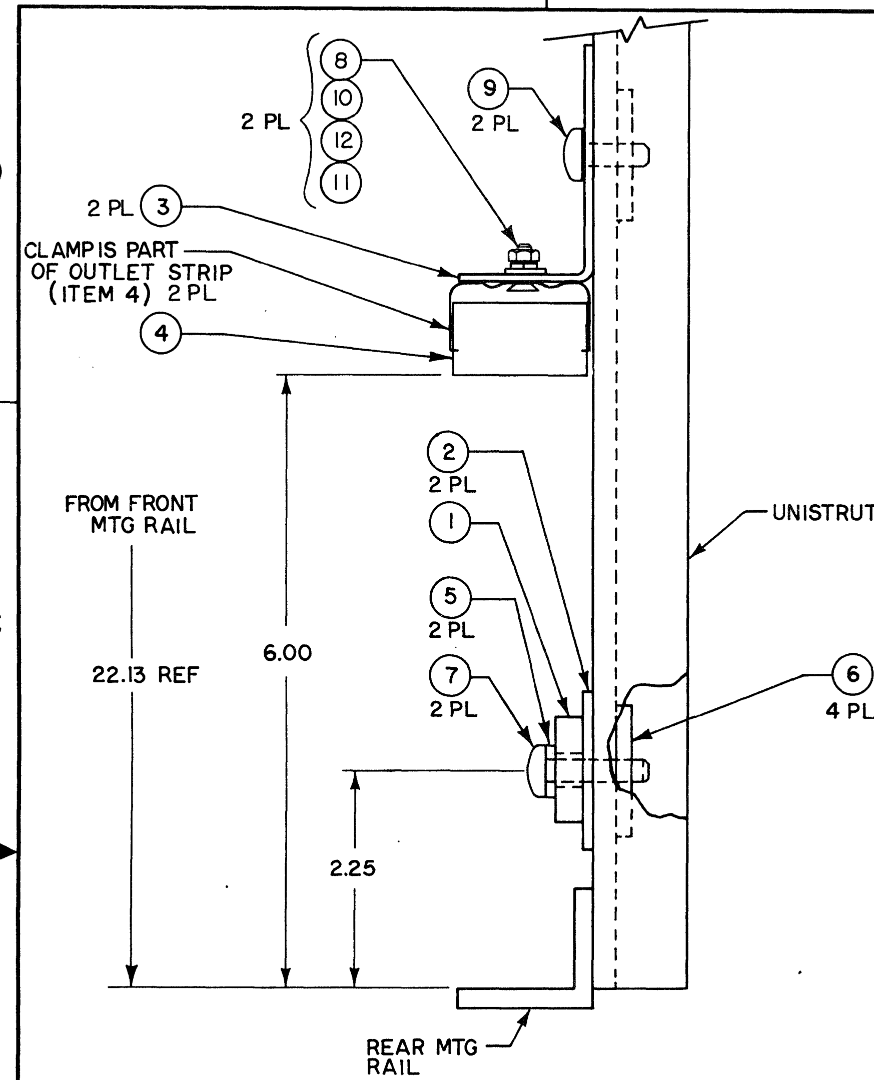
DRAWING TITLE: CABLE ASSEMBLY HBR CONTROL (P10)

BM # 1269209-02

WIRE NO.	GAUGE/ DESC	LGTH INCH	FROM REF DESIG TERMINAL	FROM PROCESS	FROM STA	TO STA	TO PROCESS	TO REF DESIG TERMINAL	REMARKS	BM ITEM NO. FROM	BM ITEM NO. WIRE	BM ITEM NO. TO
1	20/5	116	P10-F	CRIMP			CRIMP	J1/J7-1	+5V	2	17	5
2	20/0	116	H					J1/J7-20	+5V COM		16	
3	20/97	116	L					J1/J7-2	SP. LINE A		25	
4	24/94	140	M					XJ41/J41-4	REC CMD OUT		29	
5	20/95	116	P					J1/J7-4	SP. LINE C		23	
6	96		R					3	SP. LINE B		24	
7	90		S					12	COM		18	
8	93		U					6	SP. LINE E		21	
9	94		V					5	D		22	
10	91		W					8	G		19	
11	20/92	116	X					J1/J7-7	SP. LINE F		20	
12	24/93	140	Y					XJ41/J41-3	REF HBR/INT		28	
13	91		Z					1	DATA VALID S.		26	
14	92		$\overline{A}$					2	DTLC		27	
15	95		$\overline{T}$					5	BIT SYNC LK		30	
16	96	140	CC					XJ41/J41-7	TBC/$\overline{TBC}$		31	
17	24/97	2	P10-MM	CRIMP			CRIMP	P10-NN	REF HBR/INT OUT	2	32	5

1259798-01 DISTR CODE: AH

REVISIONS					
LTR	ZONE	DESCRIPTION	SIGNATURE AND DATE DFT	CHK	ENGRG
A	—	PROD RELEASE	K. Kra 9-25-79	J. Barker 10-10-79	10-11-79



NOTES:

1. IDENTIFY KIT WITH KIT NUMBER AND REVISION BY TAGGING OR MARKING CONTAINER PER MIL-STD-130.

1259798-01
A

·05	·04	·03	·02	·01	ITEM NO.	PART NUMBER	EQUIVALENT VENDOR OR MIL PART NUMBER (REF ONLY)	DESCRIPTION	FMC	LONG LEAD ITEM
QUANTITY PER UNIT										
ASSY CONTROL NO.					PARTS LIST					

CAT. ITEM	NEXT ASSY	USED ON	IN	MF	PR CODE
	1258155	HBR			
	1258156	HBR			
APPLICATION					

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UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES.
TOL ± | 2 PLC .13 | 3 PLC —
REMOVE BURRS AND SHARP EDGES YES ☐ NO ☐
DO NOT SCALE THIS PRINT
MATERIAL:
FINISH:

SIGNATURE		DATE
DRAWN BY	K. Kra	9-25-79
CHK BY	J. Barker	10-10-79
DFT APPD		
ENGRG APPD		10-11-79
AUTH BY		

AMPEX
HEADQUARTERS
Redwood City,
California 94063

KIT, MULT OUTLET STRIP

SIZE C | CODE IDENT NO. 92739 | 1259798-01
SCALE 1:1 | SHEET 1 OF 1

UC-3503.03 (4-71) PRINTED IN U.S.A.

6-71/6-72
1280065

PARTS LIST	AMPEX	DATA SYSTEMS DIVISION 401 BROADWAY REDWOOD CITY, CALIF. 94063	CODE IDENT 92739	ASSY DWG. SIZE C	PL 1259798-01 SHEET 1 OF 1	REV A

REVISIONS

LTR	DESCRIPTION	APPD	DATE	SIGNATURES	DATE
A	PROD RELEASE	MO	10-10-79	DRAWN D. Jorgensen	9/25/79
				CHECKED J. Barker	10-10-79
				ENGRG D. Dare	10/10/79
				ENGRG	
				MANAGER	

CONTRACT NUMBER

MODEL: HBR

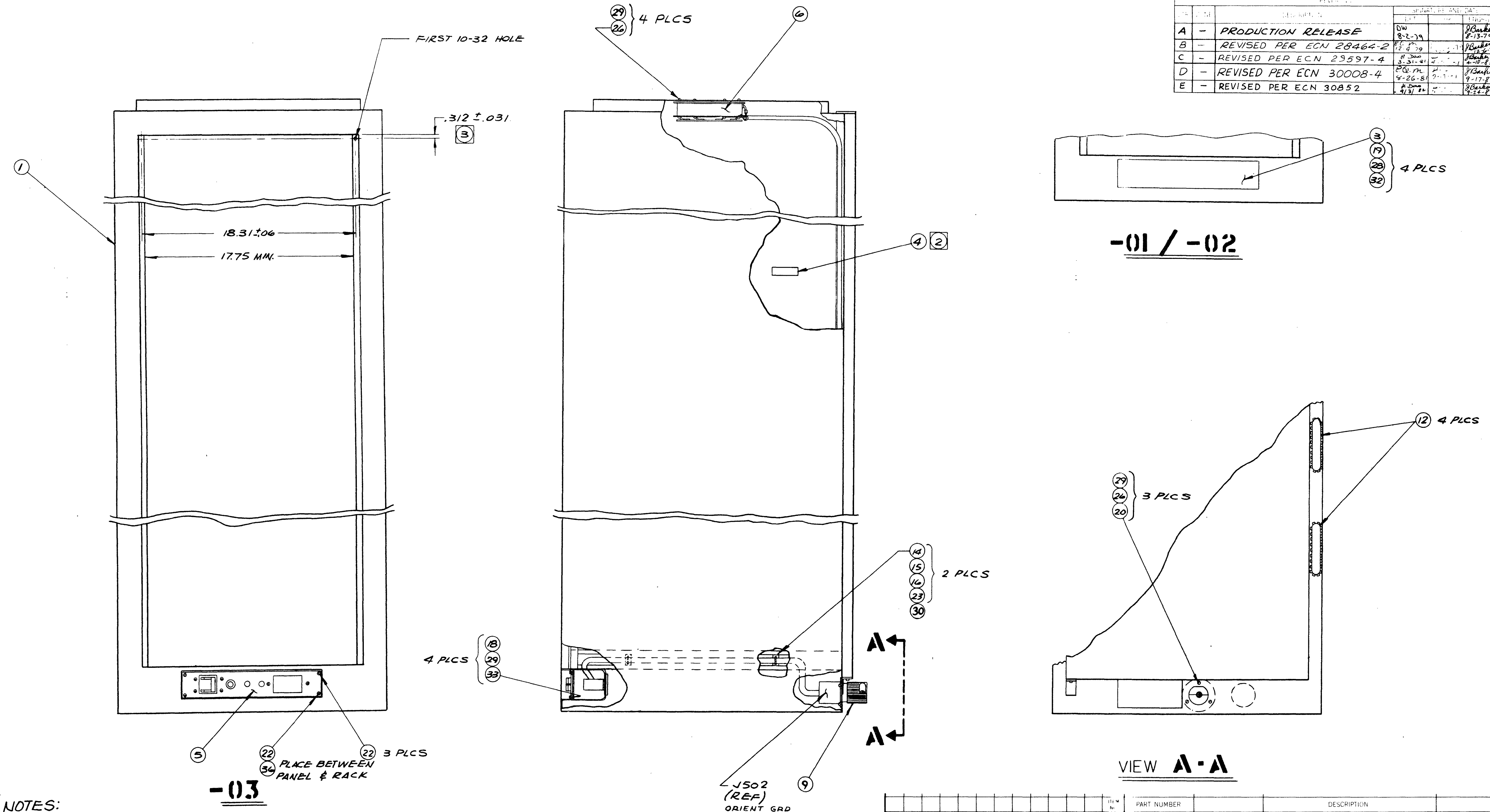
NEXT ASSEMBLY: 1258155, 1258156

DRAWING TITLE: KIT, MULT OUTLET STRIP

ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	-01	-02	-03	-04	-05	-06	-07	-08
						QUANTITY REQUIRED PER ASSEMBLY							
1	B	1256939	01	BAR, BUS		1							
2	B	1256947	01	INSULATOR, DELRIN		2							
3	B	1259479	01	BRACKET, OUTLET STRIP		2							
4		145-696		OUTLET STRIP, MULT		1							
5		265-097		BUSHING, SLEEVE .312 OD		2							
6		310-169		NUT, UNISTRUT		4							
7		471-149		SCR, 1/4-20 x .875 LG PNH		2							
8		471-336		SCR, 6-32 x .375 LG 82° FH		2							
9		472-487		SCR, 1/4-20 x .500 LG PNH		2							
10		492-009		NUT, HEX #6		2							
11		501-009		WASHER, PLAIN #6		2							
12		502-003		WASHER, LOCK, HELICAL #6		2							

DISTR CODE: AC

LTR	ZONE	DESCRIPTION	DFT		ENGRG
A	–	PRODUCTION RELEASE	DW 8-2-79		JBarker 8-13-79
B	–	REVISED PER ECN 28464-2	12-4-79		JBarker 12-6-79
C	–	REVISED PER ECN 29597-4	3-31-81		JBarker 4-10-81
D	–	REVISED PER ECN 30008-4	8-26-81		JBarker 9-17-81
E	–	REVISED PER ECN 30852	9/3/82		JBarker 9-24-82



NOTES:

1. CATALOG NUMBER IS PER VERSION TABLE.
2. MARK ITEM 4 WITH CATALOG NUMBER AND REVISION LETTER AND MOUNT APPROX WHERE SHOWN.
3. ADJUST FRONT AND REAR RAILS TO DIMENSIONS SHOWN.
4. ITEM 16 IS SUPPLIED WITH ITEM 1.
5. SIMILAR TO DRAWING 1259387-XX.

VERSION TABLE

CAT NUMBER	FEATURES: FAN ASSY	FEATURES: PWR CHASSIS	DISPOSITION
1262249-01	NO	NO	ACTIVE
1262249-02	YES	NO	ACTIVE
1262249-03	YES	YES	ACTIVE

QUANTITY PER VERSION | ITEM NO | PART NUMBER | DESCRIPTION

PARTS LIST

CAT	HBR 3000
NEXT ASSY	USED ON

APPLICATION

NOTICE

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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES.

TOL | 2 PLC | 3 PLC | ANG

REMOVE BURRS AND SHARP EDGES YES ☐ NO ☐

DO NOT SCALE THIS PRINT

MATERIAL:

FINISH:

	SIGNATURE	DATE
DRAWN BY	DWilliams	Aug 2 79
CHK BY		
DFT APPD		
ENGRG APPD	JBarker	8-13-79
AUTH BY		

AMPEX

HEADQUARTERS Redwood City, California 94063

CABINET ASSY, EQUIPMENT (30" DEEP)

SIZE D | CODE IDENT NO 92739 | 1262249-XX

SCALE: 1/4 | SHEET 1 OF 1

UC 3504 (Rev Aug 67) Printed in U.S.A.

6-75/6-76
1280065

PARTS LIST	AMPEX	DATA PRODUCTS DIVISION	401 BROADWAY REDWOOD CITY, CALIF. 94063	ASSY DWG SIZE D	PL 1262249-XX SHEET 1 OF 2	REV E

REVISIONS

LTR	DESCRIPTION	APPD	DATE	SIGNATURES		DATE
A	PROD RELEASE DW 8-3-79	J Barker	8-13-79	DRAWN	D Williams	8-3-79
B	REV PER ECN 28464-2	J Barker	4-3	CHECKED		
C	REV PER ECN 29597-4	J Barker	2-3-81	ENGRG	J Barker	8-13-79
D	REV PER ECN 30008-4	J Barker	4-17-81	ENGRG	[illegible]	8-14-79
E	REV PER ECN 30852	J Barker	4-3 82	MANAGER		

CODE IDENT ~~09150~~ | CODE IDENT 92739 | CONTRACT NUMBER ——— | NEXT ASSEMBLY CAT.

DRAWING TITLE: CABINET ASSY, EQUIPMENT (30"DEEP)

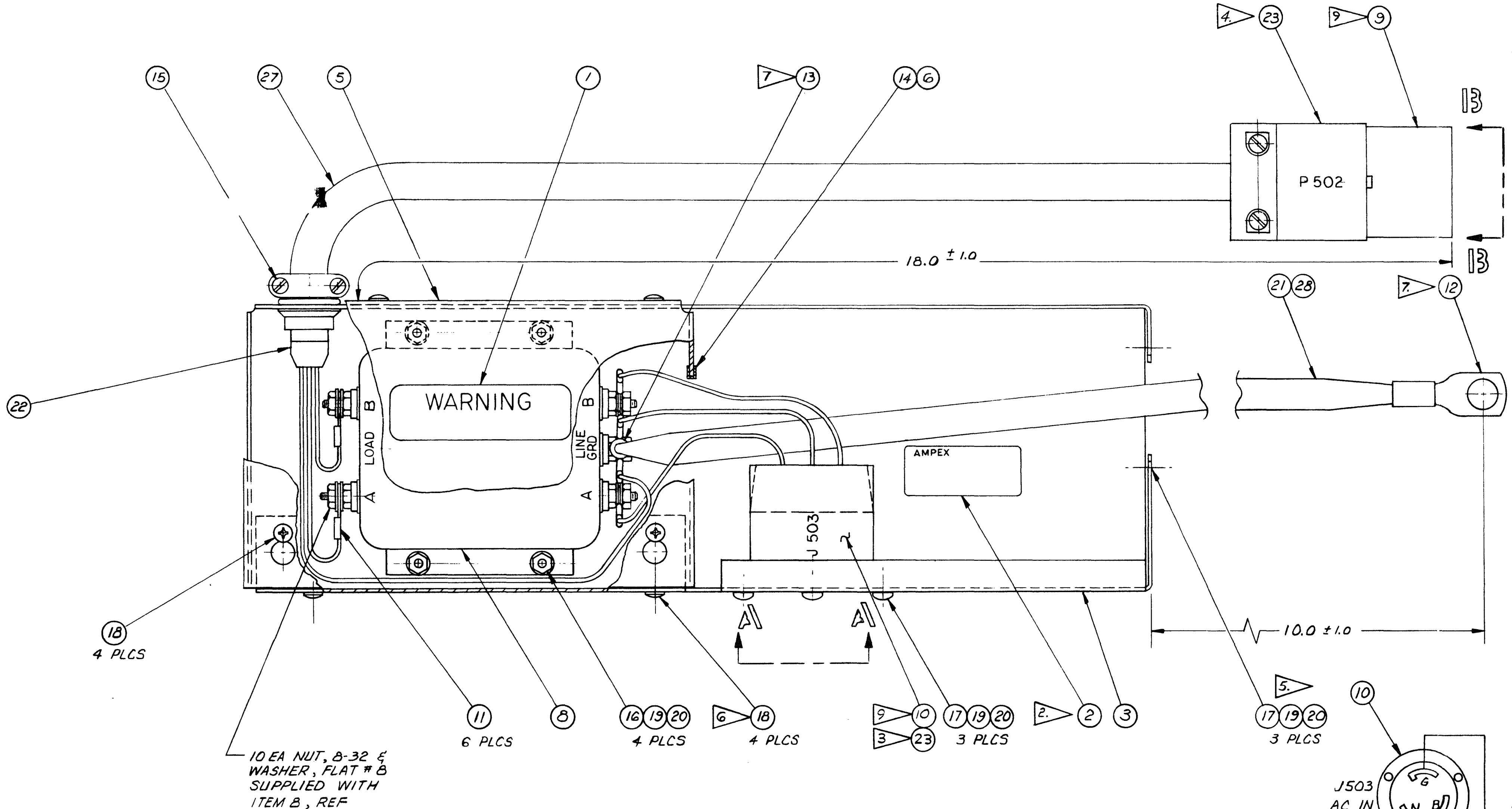
ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	-01	-02	-03	-04	-05	-06	-07	-08
1	D	1261849	01	RACK		1	1	1					
2													
3	C	1248622	04	PANEL		1	1	-					
4	C	1251523	01	NAMEPLATE, IDENT		1	1	1					
5	D	1254747	01	POWER CHASSIS ASSY		-	-	1					
6	D	1262679	01	FAN ASSY		-	1	1					
7													
8													
9		145-637		CONN, PLUG, AC, 3 SOC		-	-	1					
10													
11													
12		260-052		GROMMET, NYLON CATERPILLAR		4.0'	4.0'	4.0'					
13													
14		302-356		MTG PLATE, CABLE STRAP		-	-	2					
15		302-366		CABLE TIE		-	-	2					
16		310-169		NUT, CHANNEL, SPRING, 1/4-20	4	-	-	2					
17													
18		470-019		SCR, 6-32 x 7/16, SCH, CAD 2		-	-	4					
19		471-062		SCR, 4-40 x 3/8, PNH, CAD 2		4	4	-					
20		471-069		SCR, 6-32 x 3/8, PNH, CAD 2		-	-	3					

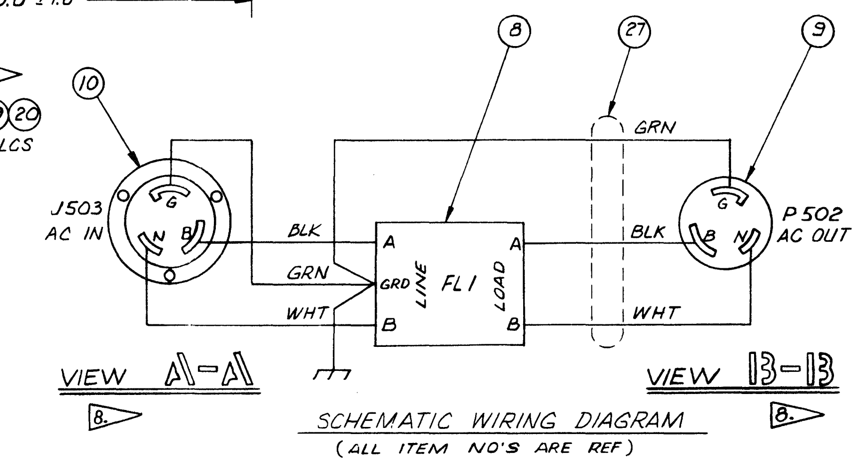
PARTS LIST	AMPEX	DATA PRODUCTS DIVISION	CODE IDENT ~~09150~~	CODE IDENT 92739	PL 1262249-XX X X SHEET 2 OF 2	REV E

ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	-01	-02	-03	-04	-05	-06	-07	-08
21													
22		471-606		SCR, 6-32 x 1/4, TRH, SST		-	-	4					
23		472-487		SCR, 1/4-20 x 1/2, PNH, CAD 2		-	-	2					
24													
25													
26		496-005		NUT, 6-32, HEX, CAD 2		-	4	7					
27													
28		501-008		WSHR #4 FL, CAD 2		4	4	-					
29		501-009		WSHR #6 FL, CAD 2		-	4	11					
30		502-633		WSHR, .312 I.D. x 1.50 OD FL		-	-	2					
31													
32		502-002		WSHR #4 LK, SPR		4	4	-					
33		502-003		WSHR #6 LK, SPR		-	-	4					
34													
35													
36		502-014		WSHR #6 LK, EXT		-	-	1					

DISTR CODE: AC

LTR	ZONE	DESCRIPTION	DFT	CHK	ENGRG
—	—	LIMITED PRODUCTION	B. D. 10-13-75	JB 10-14-75	J Barker 10-15-75
—	—	PRODUCTION RELEASE	2/5/76	J Barker 2-5-76	BC 2-5-76
A	—	REVISED PER ECN 27237	8-22-78	[illegible]	J Barker 8-25-78
B	—	REV PER ECN 27589	1-18-79	1-19-79	J Barker 2-15-79
B1	—	REVISED PER ECR 28605	2-7-80	2-26-80	J Barker 3-17-80
C	—	REV PER ECN 29883	H. Dao 7-1-81	7-8-81	J Barker 7-8-81
D	—	REV PER ECN 31572 (B)	H. Dao 4/19/83	5-12-83	5-6-83





SCHEMATIC WIRING DIAGRAM
(ALL ITEM NO'S ARE REF)

NOTES:

1. CATALOG NUMBER IS 1802939-01.
2. MARK ITEM 2 WITH CATALOG NUMBER AND SERIAL NUMBER PER MIL-STD-130.
3. CUT 2.0 LONG PIECE OF SLEEVING, ITEM 23, MARK "J503" AND SHRINK IN PLACE OVER ITEM 10.
4. CUT 2.0 LONG PIECE OF SLEEVING, ITEM 23, MARK "P502" AND SHRINK IN PLACE OVER ITEM 9.
5. THIS HARDWARE USED AT SYSTEM INSTALLATION TO SECURE CONNECTOR J502.
6. THIS HARDWARE USED AT INSTALLATION.
7. CRIMP AND SOLDER-FILL TERMINAL LUGS (ITEMS 12 & 13). INSULATING SLEEVE MAY BE REMOVED.
8. CONNECTOR IDENTIFICATION:
   G = GROUND LUG
   N = NICKEL LUG
   B = BRASS LUG
9. REMOVE INSULATION FROM WIRE (APPROX .6 INCH) PER STRIP GAUGE LOCATED ON CLEAR PLASTIC CASE OF CONNECTORS, ITEMS 9 & 10.

SEE SEPARATE LM

-05	-04	-03	-02	-01	ITEM NO.	PART NUMBER	EQUIVALENT VENDOR OR MIL PART NUMBER (REF ONLY)	DESCRIPTION	FMC	LONG LEAD ITEM
QUANTITY PER UNIT										
ASSY CONTROL NO.								PARTS LIST		

CAT. ITEM	NEXT ASSY	USED ON	IN	MF	PR
	CAT	HBR-3000			
—	CAT	FR-3000			

APPLICATION

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UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES.

TOL ±		2 PLC	3 PLC		ANG
	—	—	—	—	-

REMOVE BURRS AND SHARP EDGES ~~YES~~ ☐ ~~NO~~ ☐

DO NOT SCALE THIS PRINT

MATERIAL:

FINISH:

	SIGNATURE	DATE
DRAWN BY	B. DUARTE	10-13-75
CHK BY	J Barker	10-14-75
DFT APPD	—	—
ENGRG APPD	J Barker	10-15-75
AUTH BY		

AMPEX HEADQUARTERS Redwood City, California 94063

LINE FILTER ASSY

SIZE D | CODE IDENT NO. 92739 | 1802939

SCALE 1/1 | SHEET 1 OF 1

UC-3504.03 (3-74) PRINTED IN U.S.A.

6-79/6-80
1280065

AMPEX	Ampex Corporation REDWOOD CITY, CALIFORNIA	LIST OF MATERIALS	LM-1802939 SHEET 1 OF 2	D

CODE IDENT NO. 92739

TITLE LINE FILTER ASSEMBLY

REVISIONS

LTR	DESCRIPTION	DATE	APPROVED
—	LIMITED PRODUCTION	10-15-75	J Barker
–	PRODUCTION RELEASE	2/5/76	2-5-76
A	REV PER ECN 27237		J Barker
B	REV PER ECN 27589	2-15-79	J Barker
B1	REVISED PER ECR 28605	2-26-80	J Barker
C	REV PER ECN 29883	7-8-81	J Barker
D	REV PER ECN 31572 (B)	5-6-83	[illegible]

CAT. ITEM	NEXT ASSY	USED ON	IN	MF	PR
	CAT	HBR-3000			
—	CAT.	FR-3000			

APPLICATION

	SIGNATURE	DATE
DRAWN BY	G. Sullivan	10/3/75
CHECKED BY	J Barker	10/6/75
ENGR APPD	J Barker	10-15-75
APPD BY	[illegible]	10-15-75

ITEM NO.	AMPEX PART NO.	LONG LEAD ITEM	PART DESCRIPTION	REF DESIG	EQUIVALENT VENDOR OR MIL PART NUMBER (REF ONLY)	FMC	QUANTITY PER UNIT -01	-02	-03	-04	-05
1	1213679-01		LABEL, VOLTAGE WARNING				1				
2	1251522-01		LABEL, IDENTIFICATION				1				
3	1255244-01		CHASSIS				1				
4	1255245		INSTALLATION INSTRUCTIONS				REF				
5	1255251-01		COVER				1				
6	018-026		ADHESIVE, RUBBER		GOODYEAR PLIOBOND 20		A/R				
7											
8	052-211		FILTER, RF INTERFACE	FL1	CORCOM: 20R6		1				
9	145-637		CONN, PWR, PLUG, FEM CONT.	P502	HUBBELL: 2613		1				
10	145-640		CONN, PWR, RECPT, MALE CONT	J503	HUBBELL: 2615		1				
11	172-218		TERMINAL LUG, CRIMP, RING TONGUE #8 STUD				6				
12	172-255		TERMINAL LUG, CRIMP, RING TONGUE 1/2 ID				1				
13	172-278		TERMINAL LUG, CRIMP, RING TONGUE, #10 STUD				1				
14	260-062		GROMMET, NYLON, CATERPILLAR				0.5'				
15	302-104		CLAMP, CABLE, CONN				1				
16	471-069		SCREW, PAN HD, XREC, 6-32 X .375 LG				4				
17	471-070		SCREW, PAN HD, XREC, 6-32 X .438 LG				6				
18	471-606		SCREW, TRUSS HD, XREC, 6-32 X .250 LG				8				
19	496-005		NUT, HEX, CAPTIVE WASHER, 6-32				10				
20	501-009		WASHER, PLAIN #6				10				
21	600-095		SLEEVING, SHRINK, .500/.250 ID				2.0'				
22	600-097		SLEEVING, SHRINK, .750/.375 ID				0.2'				
23	600-117		SLEEVING, SHRINK, 2.0/1.0 ID				0.5'				
24	611-158		WIRE, STR, INS, #14 AWG, BLK				1.0'				
25	611-160		WIRE, STR, INS, #14 AWG, WHT				1.0'				
26	611-498		WIRE, STR, INS, #14 AWG, GRN				1.0'				
27	616-032		CABLE, 3 COND, #14 AWG				3.0'				
28	615-029		WIRE, BRAID, TUBULAR .375 ID				2.0'				

AMPEX	Ampex Corporation REDWOOD CITY, CALIFORNIA	CODE IDENT NO. 92739	WIRE ROUTING LIST	1802939 SHEET 2 OF 2	REV. D

WIRE NO	GAUGE/ COND.	FROM			TO			REMARKS	LM ITEM NUMBER		
		STA	REF DES.	TERM	STA	REF DES.	TERM				01
1	14/0		J503	B		FL1 LINE	A				24
2	14/9		J503	N			B				25
3	14/5		J503	G			GRD				26
4	BRAID		—	ITEM 12			GRD	GROUNDING STRAP			28
5	14/5		P502	G		LINE	GRD				
6	14/0		P502	B		LOAD	A				27
7	14/9		P502	N		FL1 LOAD	B				

1255604-XX | DISTR CODE: AG

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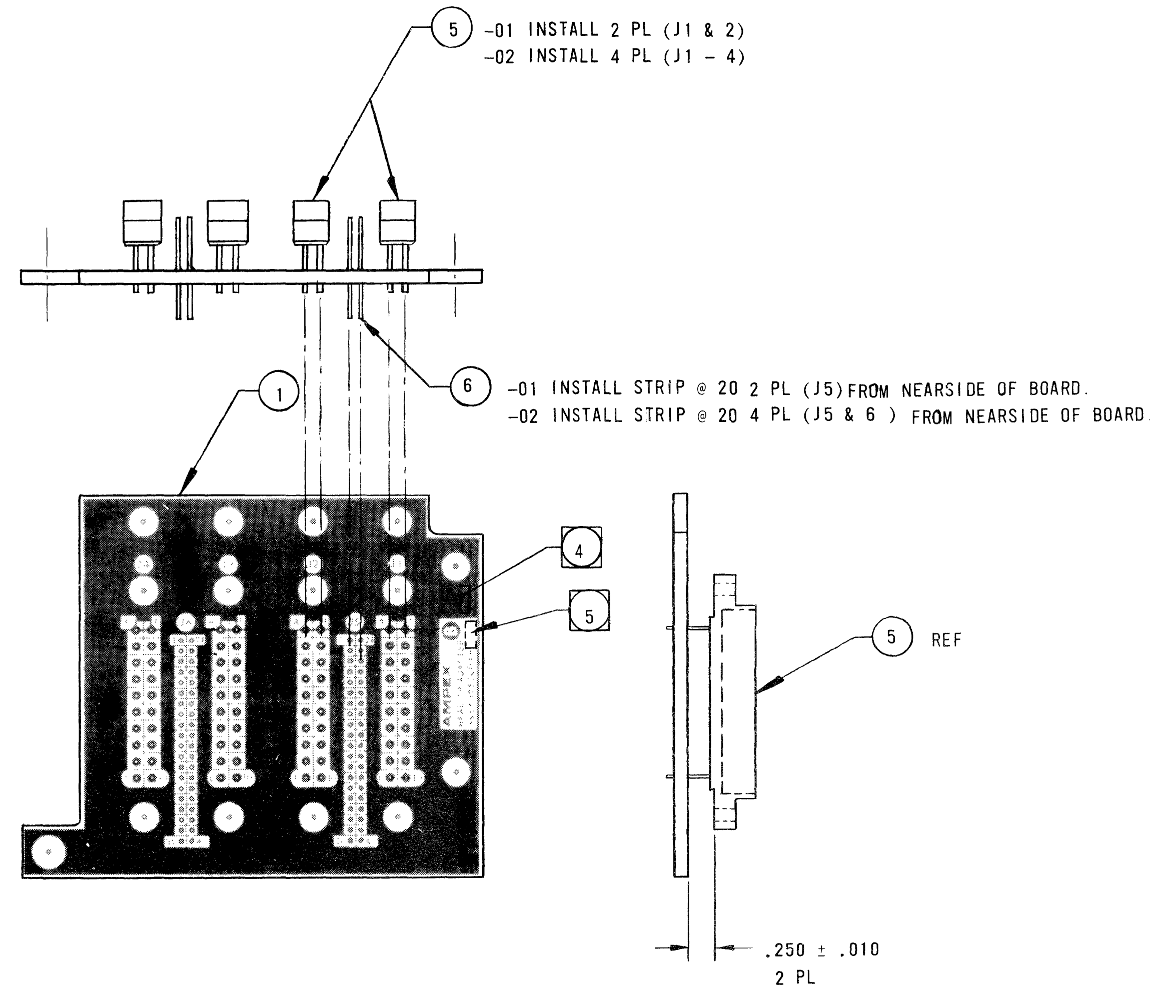
REVISIONS

LTR	ZONE	DESCRIPTION	DFT	CHK	ENGRG
B1	—	PRODUCTION RELEASE		29JUL78	7-27-78
C	—	REV PER ECN 28672	3-16-80	3-19-80	4-1-80
D	—	REV PER ECN 29471	02-23-80	2/25/81	3-17-81



5. MARK ASSY DASH NO. WHERE SHOWN.

4. MARK ASSEMBLY REVISION LEVEL.

3. ASSEMBLE PER AMPEX STANDARDS.

2. REFERENCE SCHEMATIC 1257447-XX.

1. LOCATE COMPONENTS BY MATCHING REFERENCE DESIGNATIONS IN PL.

NOTES: UNLESS OTHERWISE SPECIFIED

VERSION TABLE

ASSEMBLY	DESCRIPTION
1255604-01	14 TRACK SYSTEM
1255604-02	28 TRACK SYSTEM

NEXT ASSY	USED ON
1812755	HBR

APPLICATION

	SIGNATURE	DATE
DRAWN BY		8-5-77
CHK BY		10-10-77
DFT APPD	—	—
ENGRG APPD		
AUTH BY		7-27-78

AMPEX | DATA PRODUCTS DIVISION

PRINTED WIRING BD ASSY, HEAD DR ADAPTER

SIZE C | CODE IDENT NO. 92739 | 1255604-XX

SCALE 1 X 1 | SHEET 1 OF 1

FORM 2

6-83/6-84
1280065

PARTS LIST | **AMPEX** | **DATA PRODUCTS DIVISION**

401 BROADWAY REDWOOD CITY, CALIF. 94063

ASSY DWG SIZE: C

PL 1255604-XX

SHEET 1 OF 1

REV: D

REVISIONS			
LTR	DESCRIPTION	APPD	DATE
B1	PROD RELEASE	[illegible]	1-27-78
C	REV PER ECN 28672	J Baker	3-19-80
D	REV PER ECN 29471	J Baker	2/25/81

SIGNATURES		DATE
DRAWN	E. Williams	10/5/77
CHECKED	J Koopman	10-10-77
ENGRG	[illegible]	
ENGRG	[illegible]	5/16/78
MANAGER		

CODE IDENT: 09150 | CODE IDENT: 92739 | CONTRACT NUMBER: HBR | NEXT ASSEMBLY: 1812755

DRAWING TITLE: PRINTED WIRING BD ASSY, HEAD DR ADAPTER

ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	-01	-02	-03	-04	-05	-06	-07	-08
1	C	1255603	01	PRINTED WIRING BD		1	1						
2													
3	D	1257447	XX	SCHEMATIC DIAGRAM		REF	REF						
4													
5		140-166		CONN, RCPT, 20 PIN	J1,2	2	-						
5		140-166		CONN, RCPT, 20 PIN	J1-4	-	4						
6		187-326		POST STRIP, 20 PIN	J5	2	-						
6		187-326		POST STRIP, 20 PIN	J5,6	-	4						

6-85/6-86
1280065

1255606-XX DISTR CODE: AG

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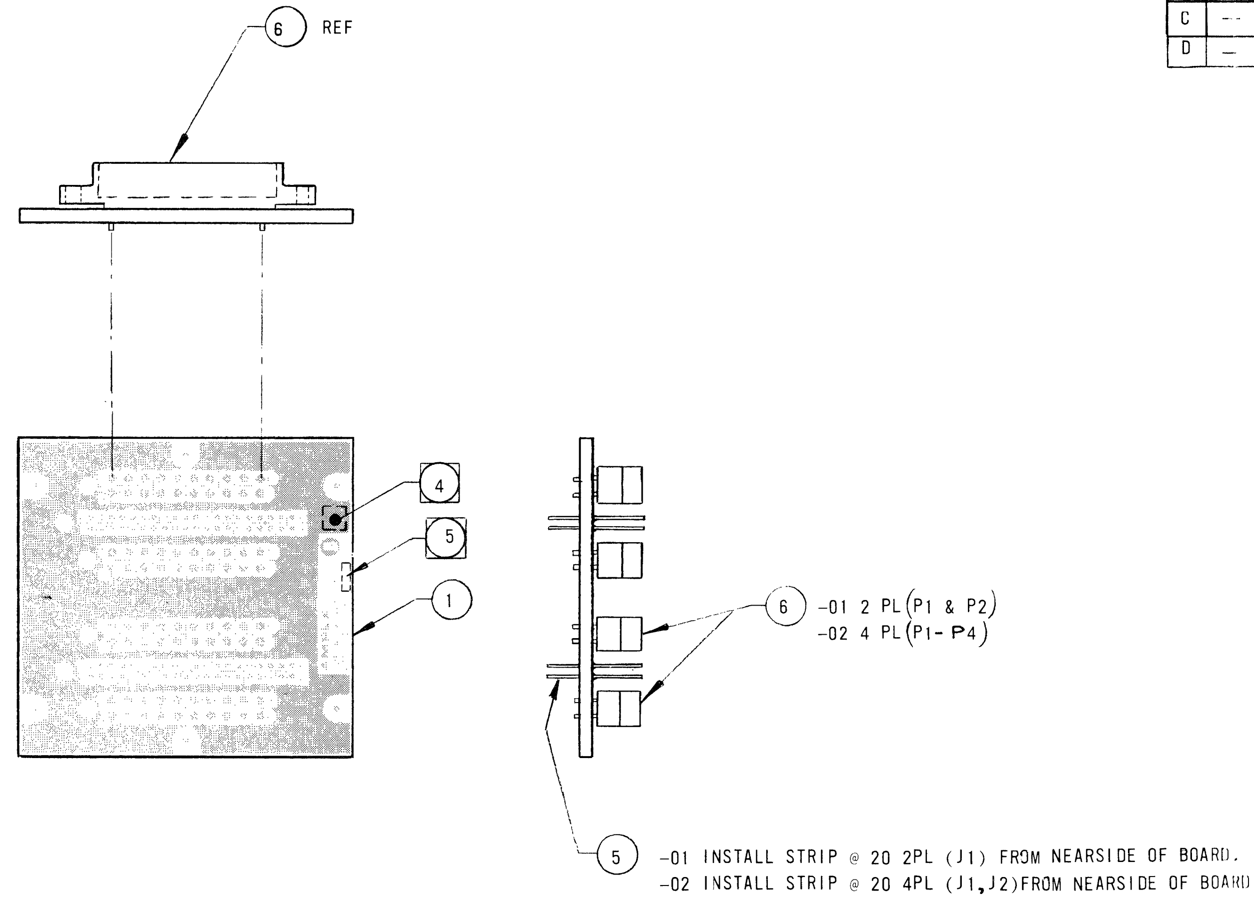
REVISIONS

LTR	ZONE	DESCRIPTION	DFT	CHK	ENGRG
B_1	–	PRODUCTION RELEASE			
C	--	REV PER ECN 28673	3-19-80	3-19-80	4-1-80
D	–	REV PER ECN 29472	2-24-80		3-17-81



5. MARK APPROPRIATE DASH NO. (PER TABLE) APPROX. WHERE SHOWN PER MIL-STD-130.
4. MARK ASSEMBLY REVISION LEVEL.
3. ASSEMBLE PER AMPEX STANDARDS.
2. REFERENCE SCHEMATIC 1257478-01.
1. LOCATE COMPONENTS BY MATCHING REFERENCE DESIGNATIONS IN PL.

NOTES: UNLESS OTHERWISE SPECIFIED

VERSION TABLE	
VERSION	DESCRIPTION
-01	14 TRACK SYSTEM
-02	28 TRACK SYSTEM

NEXT ASSY	USED ON
1812755	HBR

APPLICATION

SIGNATURE		DATE
DRAWN BY		8-5-77
CHK BY		7-27-78
DFT APPD		
ENGRG APPD		
AUTH BY		7-27-78

AMPEX DATA PRODUCTS DIVISION

PRINTED WIRING BD ASSY,

PREAMP ADAPTER NO. 2

SIZE C CODE IDENT NO. 92739 1255606-XX

SCALE 1 X 1 SHEET 1 OF 1

FORM 2

6-87/6-88
1280065

PARTS LIST	AMPEX	DATA PRODUCTS DIVISION	401 BROADWAY REDWOOD CITY, CALIF. 94063	ASSY DWG SIZE C	PL 1255606-XX SHEET 1 OF 1	REV D

REVISIONS

LTR	DESCRIPTION	APPD	DATE
B	PROD RELEASE		7-27-78
C	REV PER ECN 28673		3-19-80
D	REV PER ECN 29472		2/18/81

SIGNATURES		DATE
DRAWN		5/16/78
CHECKED	FO	7-27-78
ENGRG		
ENGRG		5/16/78
MANAGER		

CODE IDENT	CODE IDENT	CONTRACT NUMBER	NEXT ASSEMBLY
09150	92739	HBR	1812755

DRAWING TITLE

PRINTED WIRING BD,
PREAMP ADAPTER No. 2

ITEM NO	DWG SIZE	PART/DRAWING NUMBER	-XX	DESCRIPTION	REFERENCE	-01	-02	-03	-04	-05	-06	-07	-08
1	C	1255605	01	PWB		1	1						
2													
3	D	1257478	01	SCHEMATIC DIAGRAM		REF	REF						
4													
5		187-326		POST STRIP, FEED THRU 20 PIN	-01 J1 -02 J1, J2	2	4						
6		140-166		CONN, DUAL, 10 PIN	-01 P1, P2 -02 P1-4	2	4						
7													

(QUANTITY REQUIRED PER ASSEMBLY: columns -01 to -08)

6-89/6-90
1280065

SECTION 7

SCHEMATIC DIAGRAMS

There are no schematics, as such, for the HBR-3000i system. Cabling information is contained in sections 2 and 6 of this manual. Refer to the tape transport manual for tape transport schematics, and to the signal electronics volume for signal electronics schematics.

SECTION 8

CONFIGURING A SYSTEM

8-1. GENERAL

Configuring an HBR-3000i involves several processes which are all interrelated. It may be necessary to try a configuration on paper and then change it several times before arriving at a final working configuration which meets the data input requirements while staying within the available storage capabilities of the HBR-3000i. This section contains descriptive information on configuration selection in the first paragraphs, and then the actual programming information in later paragraphs. If the configuration has already been determined, it is only necessary to read the paragraphs on programming. (Paragraph 8-12, on.)

The necessary information to determine a configuration is:

a. Number of inputs

b. Input data rate

c. Minimum record time needed

d. Reproduce data rate (if different than record rate)

e. Number of auxiliary channels (channels not using an input clock)

The functions to be programmed in the system are as follows:

a. Selection of serial or parallel data inputs

b. Division ratio of serial input data

c. Packing density

d. Use of error correction

8-2. PLANNING A CONFIGURATION

8-3. System Size

The first decision to be made is whether to use a parallel or a serial system. This depends on the number and bit-rate of synchronous digital inputs and number of available tracks in the system. There are two system sizes, 14-track and 28-track. Immediately below, the differences between the 14- and 28-track versions are described. Then, programming requirements are discussed in detail, generally in terms of the 28-track system. Conversion of this coverage to apply to a 14-track machine is easily made, keeping in mind the differences described below.

Channel and track assignments are shown in figure 8-1.

Formats A, B, and C, shown in the figure are not restrictive, as the subsequent programming information makes clear, but they are the commonest formats, comprising a large majority of the systems shipped from the factory. They serve to demonstrate the principle inherent in the digital processing logic that the least-significant information is automatically placed on the tracks at the edges of the tape (1 and 28 or 1 and 14). (This is because the edge tracks are the most subject to error.) Thus, auxiliary channels first, and parity channels second, are routed to the edge tracks.

In either size system there are overhead channels necessary for system operation. The master channel in both versions and the slave-master channel in the 28-track system. This leaves either 26 or 13 channels available. If error correction (ECC) is to be used, additional overhead channel(s) are required. Normally this is one overhead (parity) channel per 12 data channels, which leaves either 24 or 12 data channels available. There is a configuration (format C in figure 8-1) in the 28-channel system which uses only one parity channel for 24 data channels. This leaves 24 data and 1 auxiliary channels available, at the expense of less error correction. In the following discussion, an error-correction system with two parity channels is described. The option of one-channel parity is discussed in the paragraph (8-7) on auxiliary channel selection.

8-4. Serial or Parallel Selection

The selection of a parallel or serial system is dependent upon the number of inputs, their bit-rate, and the record time needed. (See figure 8-1 for channel and track assignments.) For more than 12 data inputs, a parallel system must be used. For less than that number, the inputs may be divided by a serial-to-parallel converter into an integral number of parallel channels in the system. In a word-serial system, the division ratio is 2, 3, or 4; i.e., up to 12 channels can be divided by 2, up to 8 can be divided by 3, and up to 6 can be divided by 4. In a bit-serial system, a single input can be divided by an integer from 2 to 12 as long as the maximum serial input rate of 30 Mbits per second is not exceeded. For data rates above this, it is necessary to use the (optional) serial data converter bay, which is installed separately in the system.

It should be noted that the two types of serial system (word-serial and bit-serial) are not program-interchangeable. Different serial-to-parallel and parallel-to-serial converters are required, and interconnections within the DPB must be changed to convert from one to the other. Details of these interconnection changes are given on system drawings 1280216 (28-channel) and 1280215 (14-channel) in section 6 of this manual. The converter PWBA's are:

	Serial-to-Parallel	**Parallel-to-Serial**
Bit-serial	1803072	1803075
Word serial	1258523	1258513

The record time is affected by the data rate and the use of serial-to-parallel conversion, in that increasing the number of channels used per input (the division ratio) increases the record time proportionately. That is, if some number of inputs is recorded in a divide-by-four configuration, the record speed is one-fourth that required for recording the same inputs in parallel directly, at the same linear packing density. Thus the record time is four times as long. The record time is also affected by the response required for auxiliary channels, and the ratio of record-to-reproduce speed required if the data is to be played back at higher or lower speeds to compress or expand the data.

USER DATA 1 (NUMBERING IS ARBITRARY) TYPICAL FORMATS A	B	C	NON ECC	RECORDER CHANNEL	SELECTED BY MSB THUMB-WHEEL SETTING	TAPE TRACK 28 TR	14 TR
				DIGITAL PROCESS BAY A			
1	1	1	1	1	01	3	2
2	2	2	2	2	02	5	3
3	3	3	3	3	03	7	4
4	4	4	4	4	04	9	5
5	5	5	5	5	05	11	6
6	6	6	6	6	06	13	7
			2	M (MASTER)	00	15	8
7	7	7	7	7	07	17	9
8	8	8	8	8	08	19	10
9	9	9	9	9	09	21	11
10	10	10	10	10	10	23	12
11	11	11	11	11	11	25	13
3 P	12	12	12	12	12	27	14
4 A	P	P	13	13	13	1	1
				DIGITAL PROCESS BAY B			
12	13	13	14	14	14	2	
13	14	14	15	15	15	4	
14	15	15	16	16	16	6	
15	16	16	17	17	17	8	
16	17	17	18	18	18	10	
17	18	18	19	19	19	12	
				SM (SLAVE MASTER)	29	14	
18	19	19	20	20	20	16	
19	20	20	21	21	21	18	
20	21	21	22	22	22	20	
21	22	22	23	23	23	22	
22	23	23	24	24	24	24	
P	24	24	25	25	25	26	
A	P	A	26	26	26	28	

L-0186

NOTES:

1. MAY BE THE OUTPUT OF S/P CONVERTER
2. ▨ = MASTER CHANNEL
3. P = ECC PARITY DATA
4. A = AUX DATA

Notes 2 and 3: INTERNALLY GENERATED OVERHEAD FUNCTIONS: DO NOT HAVE SYSTEM INPUTS OR OUTPUTS

Figure 8-1. Track/Channel Assignments

Since the serial and parallel systems are related, it is usually necessary to select a trial division ratio for the serial system and see if the result is workable in a parallel configuration. If difficulty is encountered, a different division ratio is used and the process repeated until a configuration is established which meets all the requirements. (Paragraphs 8-9 through 8-11 give certain limits which must be included in the determination of "workability.")

8-5. Serial System. Select a division ratio which uses as many of the available 24 channels as possible. That is, if there are seven inputs, select divide-by-three, which will use 21 data channels. Divide the data rate by that same number (e.g., if the data rate is 12 Mbits/second, divide that by 3, which yields 4.0 Mbits/second/channel). If the resulting data rate is greater than 5.0 Mbits/second/channel, it is beyond the limit of the HBR-3000i and it is necessary to divide by a larger number (four) which, for the example of seven inputs, results in 28 data channels. The system provides a maximum of 24 channels (with ECC) and 26 channels (without ECC), so the number of inputs must be reduced (unless the data rate can be reduced).

Limits on selection of serial systems are:

a. Multiple inputs can be divided by only 2, 3, or 4.

b. Single inputs can be divided by any integer from 2 to 12.

c. Maximum single input rate is 30 Mbits/second.

d. Maximum per-channel rate after division is 5.0 Mbits/second.

e. Maximum number of channels after division is:

1. 24 with ECC

2. 26 without ECC

8-6. Parallel System. The selection of a parallel system involves a different set of parameters than serial selection. These will determine the record mode tape speed, based on the per-channel data rate and the density to be used. The relationship is quite simple. The parallel data rate (in kilobits/second) divided by the density (in kilobits/inch) results in the tape speed. It can also be used in reverse if the tape speed (record time) is a limiting factor. The density is not continuously variable, however, so if the tape speed is the limiting factor, the next higher density must be selected. This results in slightly slower speed and slightly longer record time.

The available densities are from 16.6 kbits/in. to 33.3 kbits/in. as follows:

a. 16.6 kbits/in.

b. 20.0 kbits/in.

c. 23.3 kbits/in.

d. 26.6 kbits/in.

e. 30.0 kbits/in.

f. 33.3 kbits/in.

The basic tradeoff in density selection is the reproduce error rate. As the density is increased, the error rate increases, but due to the randomness of magnetic tape construction, there is no formula for this. Should the calculation yield a density higher than 33.3 kbits/in., it is possible to run at 36.6 kbits/in., 40.0 kbits/in., and 43.3 kbits/in.; however, operation at these densities is not recommended, as the error rate becomes very dependent on each roll of tape and is likely to be too inconsistent for normal use. Also, error correction is less effective, as the error distribution tends toward single-bit errors. Should the calculation yield a density lower than 16.6 kbits/in., it indicates low tape usage and the speed should be decreased by using a higher packing density. Below 20 kbits/in. there is no real improvement in error rate.

8-7. Auxiliary Channels

Auxiliary channels are defined as channels that are not synchronous with the parallel data channels. They may be analog signals such as voice annotation, time code, or multiplexed combinations of signals. They may alternately be self-clocking digital signals. Custom modifications to the system can allow them to be clocked digital signals also. In any case, they are handled by bypassing the synchronous portions of the system. The auxiliary channel input(s) are in the DPB's where the signal(s) are fed directly to the record filter and amplifier sections of the system. The output(s) are in the BSB's where the signal is taken at the input of the appropriate bit-sync channel. (This corresponds to the output of the direct reproduce amplifier.) Selection of auxiliary channels is by jumpers on a PWBA; and it is advisable to verify complete system operation whenever configuration changes are made, to be sure that selection of the auxiliary channels has not turned off any of the data or ECC channels.

There are a maximum of four auxiliary channels in a 14-track system, and a maximum of eight in a 28-track system. In the ECC system, one of these channels is used for ECC information (the parity channel); thus there are only three auxiliary channels available in the 14-track version and six in the 28-track version. It is possible to get seven in the 28-track system by using the one-parity-channel version of the ECC system.

The number of auxiliary channels subtracts directly from the number of parallel channels available for the synchronous data. For example, in a 28-track system with two-parity-channel ECC, there are 24 data channels available without any auxiliary channels. If three auxiliary channels are required, there are only 21 data channels available. One common version of the system is eight parallel inputs, which are divided by three, to make 24 data channels. In the two-parity-channel system, this leaves no auxiliary channels. Thus, the one-parity-channel system is available to make room for one auxiliary channel at a slightly reduced level of error correction.

Selection of the track location of the auxiliary channels must be done with care. If channels 12 and 25 in a 28-track system do not have parallel data on them, they are the ECC parity channels and they *must not* be used as auxiliary channels. If channels 12 and 25 in a 28-track system do have parallel data on them, the ECC parity channels are 13 and 26, and they *must not* be used as auxiliary channels. For the one-parity-channel system, channel 26 is not used for ECC, so it becomes the auxiliary channel if so programmed.

8-8. Summary

To summarize, the steps necessary to configure a system are as follows:

a. Determine system size (14- or 28-track).

b. Subtract overhead channels.

   1. 1 or 2 master channels

   2. 1 or 2 ECC channels

c. Subtract auxiliary channels.

d. This leaves the number of parallel data channels available.

e. Decide on parallel or serial system.

1. If data rate exceeds 5.0 Mbits/second, a serial system is mandatory.

2. If serial, continue at step *f*.

3. If parallel, skip to step *g*.

f. Select a division ratio that utilizes most of the parallel channels.

1. Compute per-channel data rate (if this exceeds 5.0 Mbits/second, it is necessary to divide by a larger number).

2. It may be necessary at this point to replace one or more auxiliary channels with parallel digital channels.

g. Select density or record time needed and compute speed.

1. Parallel data rate (kbits/second) = density (kbits/inch) X tape speed (inch/second).

2. Select the next higher available density if density was computed.

3. If density exceeds 33.3 kbits/inch, it is necessary to make a judgement as to the importance of record time or error rate.

h. Before the above calculations are final, the limitations given below must be taken into account.

8-9. Record/Reproduce Tape-Speed Limits. The system is limited to a maximum tape speed of approximately 150 IPS and a minimum speed of approximately 1-7/8 IPS. If the reproduce speed is to be different than the record speed, these limits must be observed. For instance, if the record speed calculates out to 35 IPS, and a 32-to-1 speed reduction is needed in reproduce, this would mean a reproduce speed of 1.09 IPS, which is too low. Either the record speed must be increased, or the reduction ratio reduced. The maximum speed ratio is 64:1 (down) or 1:64 (up), limited by the signal electronics.

8-10. Reproduce Amplifier Limits. The reproduce amplifier used in this system has certain limits on the range of adjustments when operating at non-IRIG tape speeds. Figure 8-2 shows the relationship of density to reproduce speed for a typical reproduce amplifier. If the reproduce speed falls into one of the shaded areas, it is very difficult to get optimum equalization. It is advisable to select a slightly different speed if at all possible.

8-11. Bit-Sync Timing Unit Limitations. Plug-in timing units determine the data rate ranges of the VCO's in the bit-sync/decoder PWBA's. Figure 8-3 shows the ranges of the various versions of timing unit 1256919 used with the HBR-3000i. The figure shows the data rate ranges in Mb/s at 120 IPS speed selection. (Refer to paragraph 8-21 for further information on timing unit selection.) If the units in place at the time of a configuration change are not correct for the data rates required, they must be replaced with ones that are. If two nonbinary related data rates are required, the timing unit for the primary data rate is normally installed in VCO 1 and the unit for the secondary data rate in VCO 2.

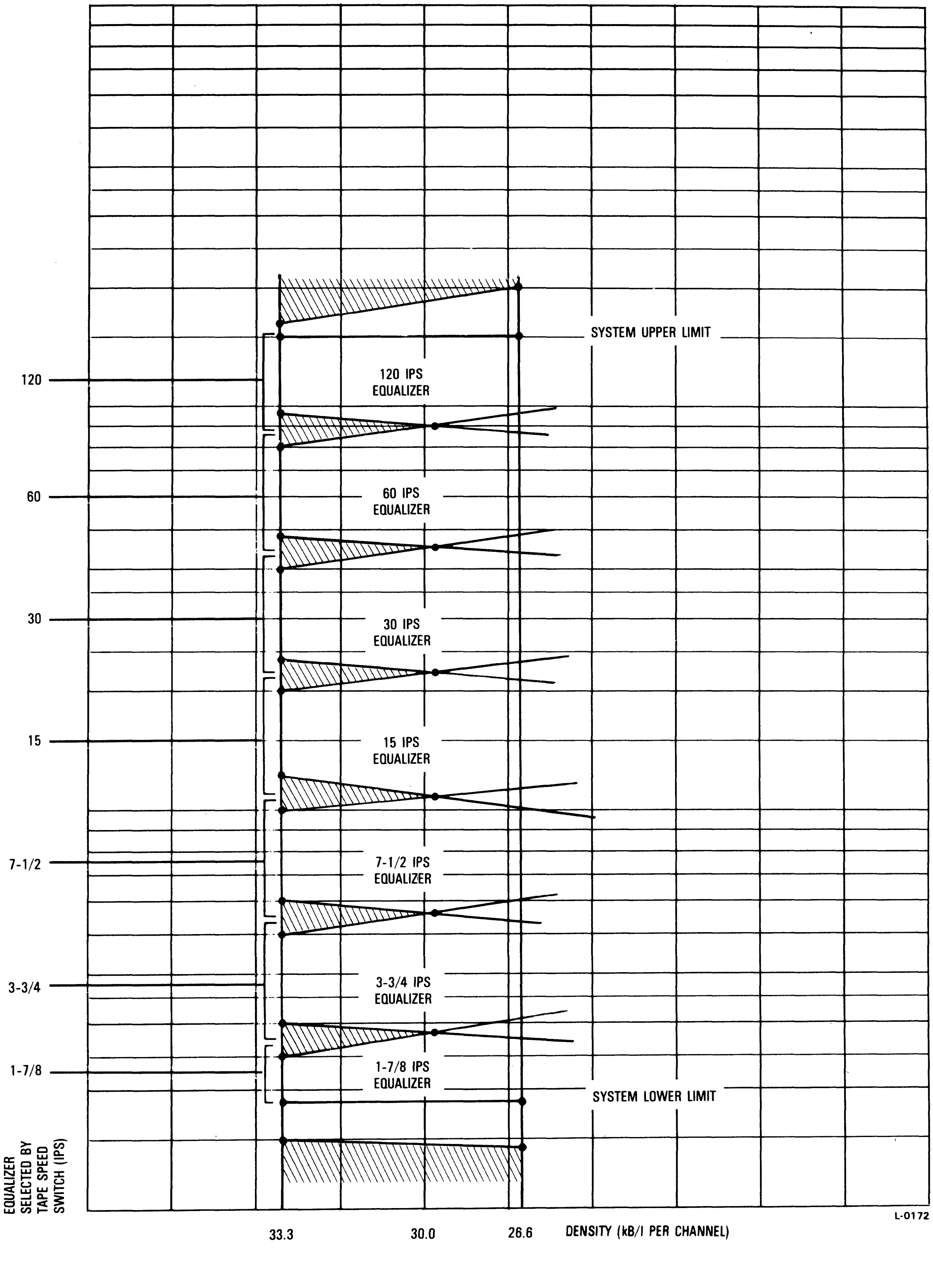


Figure 8-2. Equalizer Ranges

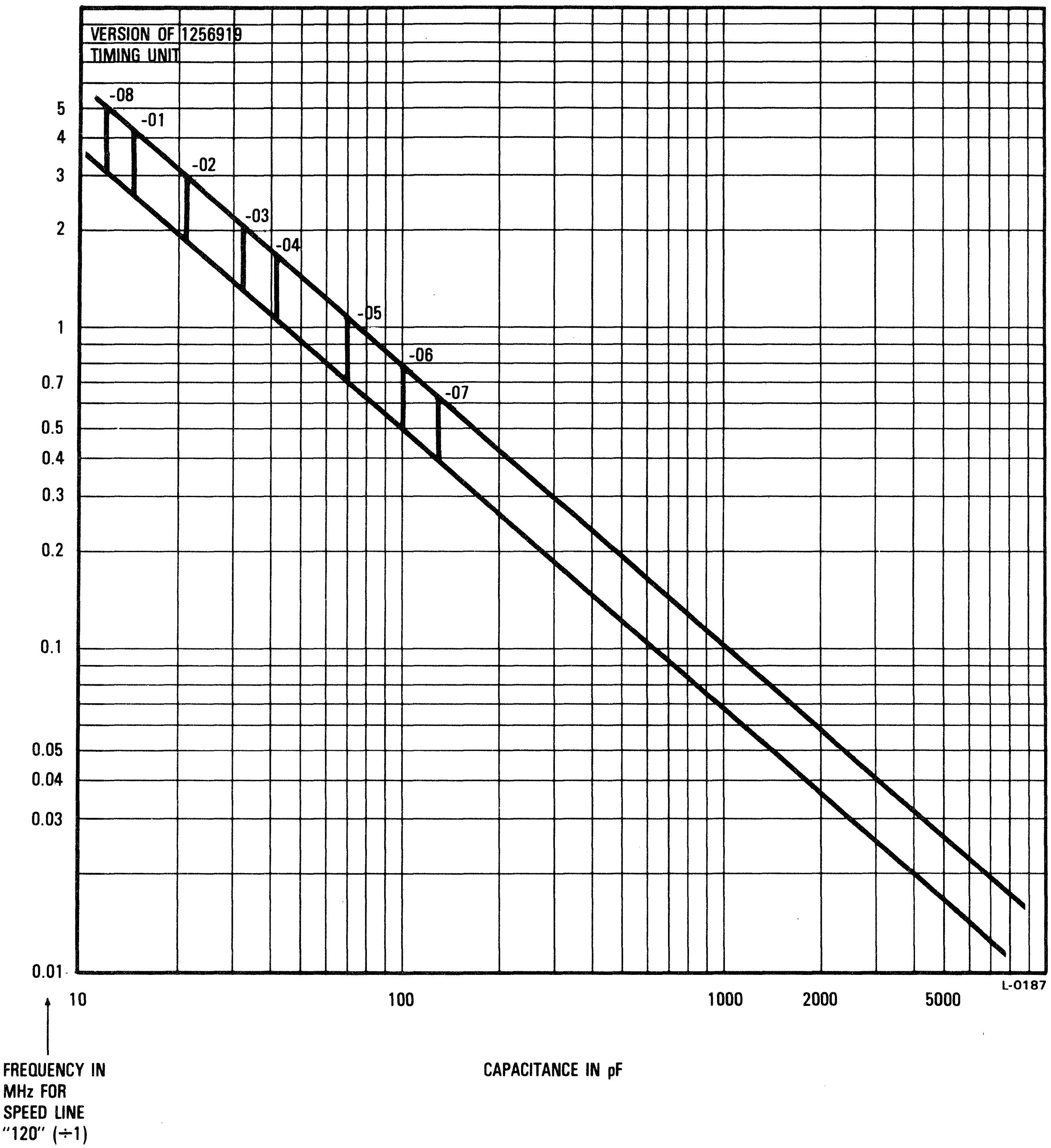


Figure 8-3. Timing Unit Selection Ranges

Table 8-1. Bit-Serial Programming

DIVISION RATIO	S1-1	S1-2	S1-3	S1-4	S1-5	S1-6	S1-7
2	0	1	1	1	1	1	1
3	1	0	1	1	1	1	0
4	0	0	1	1	1	1	0
5	1	1	0	1	1	1	0
6	0	1	0	1	1	1	0
7	1	0	0	1	1	0	1
8	0	0	0	1	1	0	1
9	1	1	1	0	1	0	1
10	0	1	1	0	1	0	1
11	1	0	1	0	1	0	0
12	0	0	1	0	1	0	0

8-12. PROGRAMMING A CONFIGURATION

After determining the configuration to be used, it is necessary to program the various functions into the system. The following descriptions give the location and selections necessary for each step.

8-13. Serial-to-Parallel and Parallel-to-Serial

If the data rate or division ratio is changed, it may be necessary to readjust the serial clock delay. (Refer to the signal electronics adjustment manual.)

8-14. Bit-Serial. The bit-serial division ratio is programmed on the serial-to-parallel converter PWBA (P/N 1803072-XX) located in the left-most slot of the DPB. Programming is done with the DIP switch S1 as shown in table 8-1, where a "1" means the switch is OPEN and a "0" means the switch is *closed*. Note that S1-8 is not used. Also note that any switch numbers on the switch itself are superseded by any differing numbers silk-screened on the board adjacent to the switch.

The parallel-to-serial PWBA (P/N 1803075-XX) also has programming switches on it. Since the program lines from the serial-to-parallel PWBA are connected to the parallel-to-serial PWBA, be sure that the switches on the parallel-to-serial PWBA are left in the OPEN position.

Table 8-2. Word-Serial Programming, Serial-to-Parallel Converter

DIVISION RATIO	S1-B	S1-C	S1-D
2	0	1	1
3	1	0	1
4	1	1	0

Table 8-3. Density Programming, Serial-to-Parallel Converter

DENSITY (kBITS/IN.)	S2-1 OR S2-A	S2-2 OR S2-B	S2-3 OR S2-C	S2-4 OR S2-D
16.6	1	1	0	1
20.0	0	1	0	1
23.3	1	0	0	1
26.6	0	0	0	1
30.0	1	1	1	0
33.3	0	1	1	0
36.6	1	0	1	0
40.0	0	0	1	0
43.3	1	1	0	0

8-15. Word-Serial. The word-serial division ratio is programmed on the serial-to-parallel converter PWBA (P/N 1258513-XX) located in the left-most slot of the DPB. Programming is done with the DIP switch S1 as shown in table 8-2, where a "1" means the switch is OPEN and a "0" means the switch is *closed*. Note that S1-A is not used.

The parallel-to-serial PWBA (P/N 1258156-XX) also has programming switches on it. Since the program lines from the serial-to-parallel PWBA are connected to the parallel-to-serial PWBA, be sure that the switches on the parallel-to-serial PWBA are left in the OPEN position.

8-16. Density Selection. Selection of the record density is also made on the serial-to-parallel converter PWBA. Table 8-3 gives the switch positions where a "1" means OPEN and a "0" means *closed*.

8-17. Transport Reference Selection

Selection of the division ratio for the reproduce reference and tape frequencies is made on the master deskew PWBA. For packing densities of 26.6 kb/in. and higher, divide-by-8 should be used, and for 23.3 kb/in. and lower, divide-by-4 should be used. For low-speed-only systems, lower division ratios may be appropriate.

See table 8-4 for the programming switch positions. A "1" means OPEN and a "0" means *closed*.

8-18. ECC Channel Selection

8-19. Record Format. The selection of which channels are to be included in the error-correction format is made on the front of the sync-inserter PWBA(s) (P/N 1261623-XX): one in a 14-track system and two in a 28-track system. See table 8-5 for a summary of the switch functions. The channels to be included are selected by closing the appropriate switch where channel 1 or 14 is the switch in position 1, and channel 12 or 25 is the switch in position 12. Note that the ECC (parity) channel is automatically on channel 12 unless channel 12 is selected as a data channel. If channel 12 is selected, the ECC (parity) channel is automatically moved to channel 13.

The switch in position 13 selects the one-parity-channel configuration when in the *closed* position. The switches in positions 14 and 15 are not used.

The switch in position 16 controls whether ECC is used or not. It is normally left OPEN, which enables the ECC/$\overline{\text{ECC}}$ switch on the MSB. If ECC is turned off at either of the sync inserters, it is off throughout the system and the MSB switch has no function.

8-20. Reproduce Format. Selection of the reproduce format *must* match the format recorded on the tape. The selection is made manually on the error corrector PWBA (P/N 1261903-XX) see table 8-5, or automatically by the auto-channel-select PWBA (P/N 1262013-XX). The selection made on the sync inserter is *not* connected to the error corrector, so the selection must be repeated. The switches are the same as the sync inserter in that OPEN is *off* and *closed* is *on*, channel 1 is at the top and channel 12 is the 12th switch. In the auto-select mode, the channel select switches are inoperative and may be left in either position. The auto-channel-select only selects the channels; the following switches must be manually selected:

a. The 13th switch selects the one-parity-channel format when *closed*. If this format is selected, it is also necessary to select the DPB (A or B) in which this card is installed. This is done with the 15th switch, where OPEN means the A bay and *closed* means the B bay. The 14th switch is not used.

b. The bottom switch controls the reproduce ECC function. Reproduce error correction may be turned off (switch *closed*) to test the ECC electronics while a recording is being made, without affecting the recording.

8-21. Bit-Sync/Decoder Programming and Timing Unit Determination. Certain programming must be performed (or verified) on the bit-sync/decoder PWBA, and the correct timing unit(s) for the data rates to be used must be determined. These requirements are covered below.

8-22. PROGRAMMING. For normal system operation with M^2, the bit-sync/decoder PWBA is programmed with a jumper from E1 to E3, and switches S1-1 through S1-4 *open*. For special codes and conditions, reprogramming can be performed as indicated in tables 8-6 and 8-7.

Table 8-4. Transport Reference Select, Master Deskew

DIVIDE BY	S1-A	S1-B
4	0	0
8	1	0
16	0	1
32	1	1

Table 8-5. ECC Programming

SWITCH	SWITCH POSITION	SYNC INSERTER FUNCTION	ERROR CORRECTOR FUNCTION	NOTES
S1-8	1	Channel 1 select	Channel 1 select	OPEN = *off*
S1-7	2	Channel 2 select	Channel 2 select	OPEN = *off*
S1-6	3	Channel 3 select	Channel 3 select	OPEN = *off*
S1-5	4	Channel 4 select	Channel 4 select	OPEN = *off*
S1-4	5	Channel 5 select	Channel 5 select	OPEN = *off*
S1-3	6	Channel 6 select	Channel 6 select	OPEN = *off*
S1-2	7	Channel 7 select	Channel 7 select	OPEN = *off*
S1-1	8	Channel 8 select	Channel 8 select	OPEN = *off*
S2-8	9	Channel 9 select	Channel 9 select	OPEN = *off*
S2-7	10	Channel 10 select	Channel 10 select	OPEN = *off*
S2-6	11	Channel 11 select	Channel 11 select	OPEN = *off*
S2-5	12	Channel 12 select	Channel 12 select	OPEN = *off*
S2-4	13	Two/one parity	Two/one parity	OPEN = two
S2-3	14	Not used	Not used	
S2-2	15	Not used	A/B bay	OPEN = A
S2-1	16	Record ECC *on/off*	Reproduce ECC *on/off*	OPEN = *on*

Table 8-6. Jumper Programming of Bit-Sync Decoder PWBA 1261253

JUMPER	FUNCTION
E1 to E3	Normal input polarity
E2 to E3	Inverted input polarity
E15 to E16	If no DC restorer on PWA
E13 to E14	Provides external (remote) bi-ϕ/M^2 control (if used)
E5 to E6, E8 to E9, E11 to E12	For NRZ incoming data (bypasses decoder on bit-sync and gives clock output)
E5 to E4, E8 to E7, E11 to E10	For non-NRZ incoming data (normal operation)

Table 8-7. Switch S1 Programming of Bit-Sync Decoder PWBA

SWITCH	FUNCTION	POSITION
S1-1	DC restorer on	Open
	DC restorer off	Closed
S1-2	Not used	
S1-3	Bi-ϕ polarity inverted	Open
	Bi-ϕ polarity normal	Closed
S1-4	Miller, M^2, NRZ	Open
	Bi-ϕ, normal, or inverted	Closed

8-23. TIMING UNIT DETERMINATION. A single timing unit is used for all binarily related transport speeds. If the data rate for 120 IPS transport speed-select is known, determine the timing unit directly from figure 8-3. If the 120 IPS transport speed-select is not used (lower data rates), determine the 120 IPS data rate equivalent of the actual data rate and use that to determine the timing unit from figure 8-3. For example:

a. Assume 30 IPS transport speed-select (as determined by equalizer selection per paragraph 8-8), and a parallel data rate of 0.975 Mb/s.

b. Divide 120 by 30 to determine the binary relationship.

120/30 @ 4

c. Multiply the parallel data rate by the binary relationship to get the equivalent 120 IPS data rate.

$$0.975 \times 4 = 3.9 \text{ Mb/s}$$

d. Determine the timing unit for 3.9 Mb/s from figure 8-3. This would be the -01 unit.

If a second speed (or set of speeds), not binarily related to the first, is to be used, a timing unit for VCO2 must be determined. Use the same method.

8-24. AUXILIARY CHANNEL PROGRAMMING

Auxiliary channels are selected by means of jumpers on the line driver/filter PWBA (P/N 1261763) located in the DPB. The auxiliary channels are designated as A1, A2, A3, A4 (in DPB A and bit-sync bay [BSB] A of a 14-track system) and B1, B2, B3, B4 (in DPB B bit-sync bay [BSB] B of a 28-track system).

While selection of auxiliary channels is made with a simple change of jumpers, you must be careful not to remove data channels that are needed in the system. For instance, for ECC, a parity channel is on data channel 12 or 13 (another is on channel 25 or 26 in a 28-track system) and the parity channel(s) must be recorded for error correction to take place. Thus only three auxiliary channels are available in each DPB of an ECC system. Be sure to determine the system data-channel configuration before selecting auxiliary channels, and remember that channel 12 (and 25) are parity channel(s), unless they are selected as data channels, in which case channels 13 (and 26) become the parity channel(s). For a one-parity-channel system, the parity is in channel 12 or 13.

Table 8-8 gives the relationship of data (or parity) and auxiliary channels to tape tracks and the jumper positions.

Auxiliary channel inputs are on the rear of their respective DPB's. Auxiliary channel outputs are located on the rear of their respective BSB's.

8-25. SYSTEM CALIBRATION

After a system is reconfigured, or if the 120 IPS equivalent data rate is changed, certain adjustments may be required. Such adjustments as encoder symmetry, record and bias levels, reproduce amplifier equalization, bit-sync VCO frequency, and serial clock delay may be required. Refer to the signal electronics adjustment manual for details.

Table 8-8. Auxiliary Channel Programming

AUXILIARY CHANNEL	DATA CHANNEL	TAPE TRACK		JUMPER	
		28-TRACK	14-TRACK	DATA	AUXILIARY
A1	13 (P)	1	1	E14-E12	E14-E15
A2	12 (P)	13	14	E8-E7	E8-E9
A3	11	12	13	E6-E5	E6-E4
A4	10	9	12	E1-E3	E1-E2
B1	26 (P)	28	—	E14-E12	E14-E15
B2	25 (P)	26	—	E8-E7	E8-E9
B3	24	24	—	E6-E5	E6-E4
B4	23	22	—	E1-E3	E1-E2