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GEOLOGICAL SURVEY
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HARDWARE INTERFACE BETWEEN CONTROLLING COMPUTER AND BELL & HOWELL 3700B TAPE DRIVE USED IN FM PLAYBACK SYSTEM

BY

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This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards.

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INTRODUCTION

The U.S.Geological Survey's Hawaiian Volcano Observatory (HVO) uses magnetic tape as a medium to save analog seismic information. A Bell & Howell 3700B 1" tape drive is used to save these analog frequency modulated (FM) signals. In the past a Data General "ECLIPSE" computer was used for playback and analysis of these data. HVO presently uses a Digital Equipment Corporation (DEC) 11/750 computer with a Tustin analog to digital converter with special software to process seismic signals in real time. The Bell & Howell tape drive is still used as a backup to the real time system. The "Eclipse" is no longer used and a new control system utilizing a "Leading Edge" computer has replaced the Eclipse to control the playback of the Bell & Howell (see photographs on page P1,P2). The following report describes the hardware interconnections between the Leading Edge and other equipment for proper FM playback control. This report is intended as an aid in troubleshooting, repair, and modification to circuitry in the FM playback control system. For anyone interested, there is enough information to reproduce this interface system.

FM PLAYBACK INTERFACE FLOW DIAGRAM

(INTFL)

Figure INTFL (pg.F1) is the block diagram of the FM playback interface system. All of the hardware for the interface is mounted in a 30" high standard 19" roll around cabinet. The diagram can be broken down into 3 main zones: on the left, the Leading Edge (IBM XT clone) computer; the middle, in the dashed box are the Hex Buffers (HEXBF),terminal Blocks (TBXX'S), and Pass Select Control (PASSEL); on the right, the Bell & Howell VR 3700B tape drive, Hex Footage Counter, Datum Model 9210 Time Code Translator, and Pass Select Circuitry. The Hex Buffers, Terminal Blocks, and Pass Select Control are mounted on the Back Plane. The Back Plane is mounted on the back of the FM Playback Control System cabinet. The boxes on the right are purposely tied together to indicate the following: The Hex footage Counter is located inside the Bell & Howell cabinet, and the Time Code Translator and Pass Select Circuitry are mounted in the same instrument rack. The middle zone is the actual "interface" (BPLANE). On this panel signals from the Leading Edge are hard-wired to the various equipment on the right.

Commands from the Leading Edge are expressed as arrows away from its box and data read as arrows toward its box. There are two types of commands, as seen on the diagram: one going through the Hex Buffers before going to the terminal blocks, and the other going directly to the terminal blocks.

The purpose of the Hex buffers is to boost the current sinking capability of those command lines that need them. (See the Hex Buffer section for more information.) There are a total of 18 command lines. 16 are for the Bell & Howell, all of which are buffered. The two that do not go to the Hex Buffers are routed to the Pass Select Control (PASSEL) board where they are buffered through the 7445 BCD to decimal decoder. After traveling through either the Hex Buffers or Pass Select Control all of the command signals go to the Terminal Blocks (TBXX'S) (See Back Plane section for details). From the TBXX'S the command signals go to the Bell & Howell and Pass Select Circuitry shown. These are shown as arrows into the appropriate box.

Signals that are read by the Leading Edge are generated on the right of the diagram. These signals come from the Bell & Howell, Hex Footage Counter, and Time Code Translator. All of these signals are wired directly to the TBXX'S and are indicated on the diagram is arrows away from these boxes. From the TBXX'S the signals are wired to the Leading Edge. (See Back Plane section for details).

At the heart of the interface system is the Back Plane (BPLANE) where all signals to and from the control computer and the equipment are interconnected.

Although there are other elements in the complete FM playback system, they are beyond the scope of this document. The Bell & Howell, and the Datum Time Code Translator come with ample documentation from the manufacturers.

The Hex Footage Counter and Pass Select Circuitry were designed in 1977 at the U.S.Geological Survey in Menlo Park, Ca. Most of people involved are gone and information is sketchy.

BACK PLANE

(BPLANE)

The back plane (BPLANE) is a 19" panel mounted on the back of the FM playback control system cabinet (see fig BPLANE,pg.F2). This panel is used as the physical interconnection point between the "Leading Edge" computer and the other equipment (see fig. INTFL).The BPLANE also serves as a ground plane for noise suppression. This figure shows the location and appropriate nomenclature for the various connectors,terminal blocks, and circuits that are mounted on the BPLANE. This figure in conjunction with the figures TBA1-TBA4 and TBB1-TBB3 provide information on terminal block pin assignments. The figures TBA1-TBB4 and TBB1-TBB3 correspond to the terminal blocks as labelled on the BPLANE.

Two Qua Tech Inc. PXB-721 parallel expansion boards are used as the input and output ports of the Leading Edge computer. Ribbon cables are used to connect the expansion boards to the Back Plane.

See PXB-721 port assignment section for the complete listing of port assignments. The connectors A1-A3 correspond to H1-H3 (see Qua Tech documentation) of card 1 and B1-B3 correspond to H1-H3 of card 2. Each of the connectors has 3 ports, A,B,and C each port comprises 8 bits, 0-7. 10K pull down resistors are added to unused bits of ports that are read by the Leading Edge. This is to reduce the noise picked up on the unused bits, which during testing was found to be significant (see also fig. BPGND). Each bit is uniquely identified by pin number,card number,port letter, and bit number. As an example on terminal block TBA2, (refer to figure TBA2), the alphanumeric series, 34/A2PB7 refers to connector pin 34 of connector A2 (A is card 1, 2 is for H2) port B (PB) bit 7 (7). When referring to the PXB-721 ports, the previous alphanumeric definition will be used.

TBA1

This terminal block (figure TBA1,pg.F3) is used to tie into the remote control lines of the Bell & Howell tape drive. The signals are derived from the PXB-721 (see HEXBF section) then go to the hex buffer drivers and are sent to the Bell & Howell through this terminal block. The voltage logic here is negative logic, active lows, 0 volts = logical "1".

Also shown are the 10K pull up resistors to the +5 volt power supply (mounted on the back plane cabinet). The color codes under ALPHA CABLE refer to the individual wires within the one cable that goes to the Bell & Howell.

TBA2

Signals on this terminal block (see Fig.TBA2,pg.F4) come from the Bell & Howell tape drive and serve as status indicators of the various speed and modes of the Bell & Howell. The logic used here is positive +5 volt = logical "1". Other information from left to right on the figure TBA2 are port assignments, color code of the wire connecting the pin# of the connector/bit to the terminal block, the electrical function of the line, terminal block pin number and finally the color of the wire within the one Alpha cable that goes from the terminal block to the Bell & Howell tape drive.

TBA3

This terminal block (fig.TBA3,pg.F5) routes the Hex Footage Counter High Order Bits via ribbon cables from the Bell & Howell tape drive to the PXB-721. The footage counter was designed in Menlo Park. Other information from left to right on the figure TBA3 are, port assignments, color code of the wire connecting the pin# of the connector/bit to the terminal block, the electrical function of the line in this case the hexadecimal weights of the digits, terminal block pin number which is the same as the ribbon cable conductor numbers.

TBA4

The first four positions on this terminal block (fig.TBA4,pg.F6) are the Low Order Bits of the Hex Footage Counter described in TBA3. Position number 5 is the READY status from the Bell & Howell. The last eleven positions are not used. Other information from left to right on the figure TBA4 are, port assignments, color code of the wire connecting the pin# of the connector/bit to the terminal block, the electrical function of the line, terminal block pin number. The first four positions use a ribbon cable with conductors numbered the same as the terminal block numbers. The fifth position is a wire within the Alpha cable to the Bell & Howell. This terminal block concludes the assignments for PXB-721 card number 1.

TBB1 &TBB2

This terminal block (figs.TBB1,TBB2;pg.F7,F8) routes Time Code Translator signals to PXB-721 card number 2. The signals are positive logic, binary coded decimal digits. Other information on the figure TBA4 are, from left to right, port assignments, color code of the wire connecting the pin# of the connector/bit to the terminal block, the electrical function of the line, terminal block pin number, and finally color codes of the wires with the Alpha cable to the Time Code Translator.

TBB3

The first 8 position of this terminal block (fig.TBB3,pg.F9) complete the signals from the Time Code Translator as described above under TBB2 & TBB3. Positions 9,10 are for the control signals to the Pass Select Control (input to PASSEL) circuit. Position 11,12 are not used. Positions 13,14,15, and 16 are the pass select control numbers (output of PASSEL circuit).

The cable information is as follows: The first 8 positions are color coded wires within the Alpha cable that goes to the Time Code Translator. Positions 9,10 are a separate twisted pair that goes to the input of the PASSEL circuit. The last 4 positions are color codes for the two pair Belden cable that goes to the Pass Select Circuit. This terminal block completes the signal assignments to PXB-721 card number 2.

TBB4

This terminal block is not used.

BACK PLANE GROUNDING

(BPGND)

Figure BPGND (pg.F10) shows the schematic drawing of the grounding pathways of the various equipment in the FM playback control system. The pieces of equipment are grounded so that signals are in a single ended mode. This is done to help reduce the ground looping problem which can generate unwanted and unpredictable noise.

Each piece of equipment shown is grounded to the computer room power distribution unit ground (PDU). The PDU is an isolation transformer and circuit breaker box combination that distributes power from the uninterruptable power source.

There is an area within the PDU that ties all of the AC power neutral and grounds together. This tie point is used as the low side for all of the signals of the FM playback control system. Since all low sides are connected through the PDU, only high side connections are made via the cables. Shields of cables are terminated only at one end of the run. As to which end of the cable shield is grounded, see figure BPGND. (Shielded cables are indicated by circles around lines with arrows at both ends) As a general rule, the cable shield is terminated at the end that is generating the signal. The Leading Edge computer's low side is grounded to the chassis, so to avoid creating a ground loop, a rubber mat is placed between the Leading Edge and the interface cabinet (The Leading Edge sits on top of the cabinet).

This process of identifying grounding pathways and carefully planning their connection reduces the chance of creating ground loops. A ground loop is a condition where any ground or low side signal or shield has more than one path to the same ground or the condition that a low side cable or shield has a path to 2 or more different grounds. An example would be if a length of shielded cable were laid out on the ground from point A to point B, A and B not at the same point. If both ends of the shield were grounded to their earth grounds, a ground loop would be created.

The grounding scheme incorporates all of the equipment that is controlled or from which data are read. Grounds and shields are connected to provide shielding from noise sources and at the same time designed to minimize ground loops.

5 Volt Supply

The 5 volts supply is used to power the Pass Select Control (PASSEL) circuit board, the Hex Buffer (HEXBF) circuit board and all pull up resistors mounted on the Back Plane (BPLANE). The 5 volts supply is mounted on the back of the FM playback control system cabinet.

HEX BUFFERS

(HEXBF)

The control signals for the Bell & Howell 3700B (B&H) tape drive are derived from the Qua Tech, PXB-721 parallel expansion board. This board is capable of driving one TTL load. However the inputs of the remote control unit for the B&H recorder have higher current requirements. Current buffers are installed to provide the necessary current and voltage levels for proper control of the tape drive.

Figure HEXBF (pg.F11) shows the three 7417 hex buffers that are installed to provide drives to the 16 control lines to the B&H remote control box. The two unused gates are tied high on the inputs to reduce noise pickup. The diagram shows the two types of control inputs of the Bell & Howell.

Both control inputs have 7404 hex inverting gates. The differences are as follows. The control inputs that determine tape speeds and the search (SRCH) function are all controlled by a level, that is they require a steady low or "0" voltage to be activated. These inputs have 1K pull up resistors to +5 volts. It is because of these resistors that the 7417's are installed. With the 1K's, and assuming a .8 volt low level, the current that needs to be sunk is 4.2mA. The PXB-721 can only sink about 1.6 mA. The 7417 can safely sink a maximum of 40 mA.

The second type of control inputs are on the "mode" inputs, the STOP,record (REC) etc. (see HEXBF fig) they are activated by pulsing the lines with a momentary low or "0" voltage. Although these inputs do not have pull up resistors the 7417's are installed to provide a lower output impedance to help reduce the noise pick up. 10K pull up resistors are installed on the back plane on all of the input control lines to make sure that all controls are held high during power up and before program control takes over. The 10K's are also needed on the control lines that do not have the 1K pull up resistors to provide the collector resistor for proper 7417 operation.

The hex buffer board is located on the Back Plane inside of the interface cabinet. The IC's are mounted on a separate board on stand offs (see BPLANE fig., pg.F2) The buffers provide both current drive and provide the proper voltage levels for controlling the Bell & Howell 3700B playback tape drive.

PASS SELECT CONTROL CIRCUIT

(PASSEL)

This circuit was designed in Menlo Park for the original Eclipse based FM playback system. It is still used with the Leading Edge based system and its function is to provide control signals to the Pass Select Circuitry that ultimately determine which stations are being digitized.

The input to the PASSEL (see fig. PASSEL,pg.F12) is from the PXB-721 (see fig. TBB3). The input is positive logic. The PXB-721 supplies the proper coding to the 7445 to activate one of the outputs. Outputs 0,1,2,3 correspond pass select lines 1,2,3,4. The output is negative logic and the 10K pull up resistors are needed for proper operation (open collector). The output signals are sent to the Pass Select Circuitry via the 2 pair Belden cable.

PXB-721 PORT ASSIGNMENTS

The following is the list of signal assignments to the parallel expansion boards of the FM Playback Control System. The boards are PBX-721's, made by Qua Tech, Inc. There are two boards and each board has 3 interface chips (1,2,3). Each interface has it's own output connector so there are 3 per board.

There are 34-conductor ribbon cables with connectors that are used to hook up the PXB-721 ports to the interface back plane. 10K pull down resistors are added to the unused bits of INPUT ports to reduce noise pick up. To differentiate between the boards, one board's output chips/connectors are labelled A1,A2,A3, the other B1,B2,B3. Each chip/connector has 3 output ports labelled PA,PB,PC, each port is made up of 8 bits that are numbered 0 through 7. To identify a specific bit, use the following example.

If it is desired to assign a signal to card A1 (chip 1), and use port PB, bit 7, the label for that bit would be A1PB7 with the appropriate signal assignment. The previous port assignment nomenclature is used through-out the rest of this section.

A1PA0	FF (Fast Forward)	OUTPUT - B/H CONTROL
A1PA1	RF (Run Forward)	"
A1PA2	RR (Run Reverse)	"
A1PA3	FR (Fast Reverse)	"
A1PA4	REC (Record - not used here)	"
A1PA5	STOP (Stop)	"
A1PA6	SRCH (not used)	"
A1PA7	Not Connected	
A1PB0	1-7/8 ips	OUTPUT - B/H CONTROL
A1PB1	3-3/4 ips	"
A1PB2	7-1/2 ips	"
A1PB3	15 ips	"
A1PB4	30 ips	"
A1PB5	60 ips	"
A1PB6	120 ips	"
A1PB7	240 ips	"
A1PC0	15/16ip	OUTPUT - B/H CONTROL
A1PC1	NOT CONNECTED	
A1PC2	NOT CONNECTED	
A1PC3	NOT CONNECTED	
A1PC4	NOT CONNECTED	
A1PC5	NOT CONNECTED	
A1PC6	NOT CONNECTED	
A1PC7	NOT CONNECTED	
A2PA0	FF (Fast Forward)	INPUT - B/H TAPE STATUS
A2PA1	RF (Run Forward)	"
A2PA2	RR (Run Reverse)	"
A2PA3	FR (Fast Reverse)	"
A2PA4	REC (Record not used here)	"
A2PA5	STOP (Stop)	"
A2PA6	SRCH (not used)	"
A2PA7	15/16 ips	"

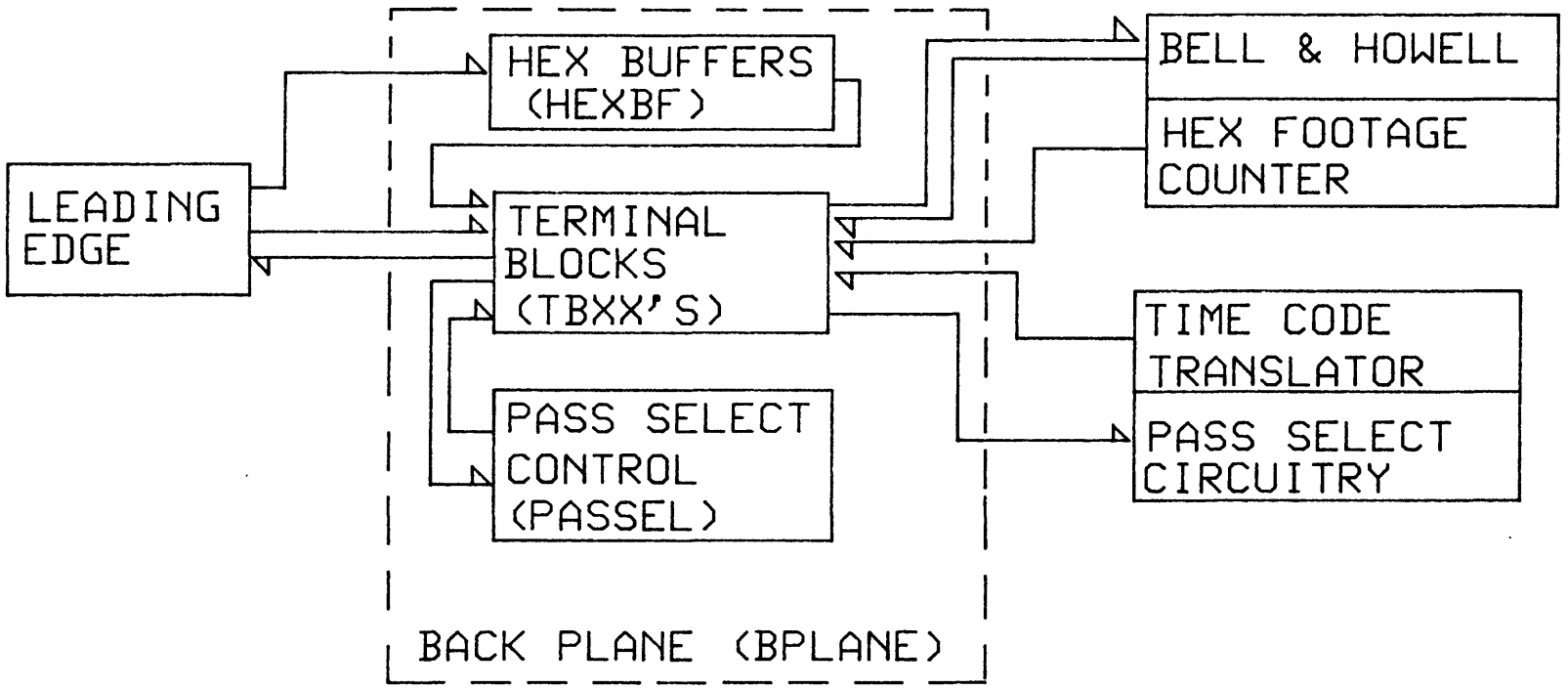
A2PB0	1-7/8 ips	INPUT - B/H TAPE STATUS
A2PB1	3-3/4 ips	"
A2PB2	7-1/2 ips	"
A2PB3	15 ips	"
A2PB4	30 ips	"
A2PB5	60 ips	"
A2PB6	120 ips	"
A2PB7	240 ips	"
A2PC0	READY	INPUT - B/H TAPE STATUS
A2PC1	NOT USED	PULLED DOWN 10K (INPUT)
A2PC2	"	"
A2PC3	"	"
A2PC4	"	"
A2PC5	"	"
A2PC6	"	"
A2PC7	"	"
A3PA0	1 of XXXHX	HEX FOOTAGE COUNTER
A3PA1	2 "	"
A3PA2	4 "	"
A3PA3	8 "	"
A3PA4	1 of XXHXX	"
A3PA5	2 "	"
A3PA6	4 "	"
A3PA7	8 "	"
A3PB0	1 of XHXXX	HEX FOOTAGE COUNTER
A3PB1	2 "	"
A3PB2	4 "	"
A3PB3	8 "	"
A3PB4	1 of HXXXX	"
A3PB5	2 "	"
A3PB6	4 "	"
A3PB7	8 "	"
A3PC0	1 of XXXXH	HEX FOOTAGE COUNTER
A3PC1	2 "	"
A3PC2	4 "	"
A3PC3	8 "	"
A3PC4	NOT USED	PULLED DOWN 10K (INPUT)
A3PC5	"	"
A3PC6	"	"
A3PC7	"	"

B1PA0	BIT 1	OUTPUT TO PASS SELECT
B1PA1	BIT 2	"
B1PA2	NOT CONNECTED	
B1PA3	"	
B1PA4	"	
B1PA5	"	
B1PA6	"	
B1PA7	"	
B2PA0	UH1 TCT units of hours	IN FROM TIME CODE TRANSLATOR
B2PA1	UH2 "	"
B2PA1	UH4 "	"
B2PA3	UH8 "	"
B2PA4	TH1 TCT tens of hours	"
B2PA5	TH2 "	"
B2PA6	UD1 TCT units of days	"
B2PA7	UD2 "	"
B2PB0	UD4 "	"
B2PB1	UD8 "	"
B2PB2	TD1 TCT tens of days	"
B2PB3	TD2 "	"
B2PB4	TD4 "	"
B2PB5	TD8 "	"
B2PB6	HD1 TCT hundreds of days	IN FROM TIME CODE TRANSLATOR
B2PB7	HD2 "	"
B3PA0	US1 TCT units of seconds	"
B3PA1	US2 "	"
B3PA2	US4 "	"
B3PA3	US8 "	"
B3PA4	TS1 TCT tens of seconds	"
B3PA5	TS2 "	"
B3PA6	TS4 "	"
B3PA7	UM1 TCT units of minutes	"
B3PB0	UM2 "	"
B3PB1	UM4 "	"
B3PB2	UM8 "	"
B3PB3	TM1 TCT tens of minutes	"
B3PB4	TM2 "	"
B3PB5	TM4 "	"
B3PB6	SYNCH	"
B3PB7	SAMP	"

B3PC0	hs1	TCI	hundreds of seconds	IN FROM TIME CODE TRANSLATOR
B3PC1	hs2	"		"
B3PC2	hs4	"		"
B3PC3	hs8	"		"
B3PC4	ts1	TCI	tenths of seconds	"
B3PC5	ts2	"		"
B3PC6	ts4	"		"
B3PC7	ts8	"		"

INTFL

FM PLAYBACK INTERFACE FLOW DIAGRAM



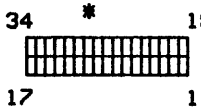
DESIGNED/DRAWN	FM PLAYBACK INTERFACE FLOW DIAGRAM
KHONMA 4/20/88	

F1

BPLANE

CARD 1&2:PXB-721
PARALLEL EXPANSION
QUA TECH, INC.

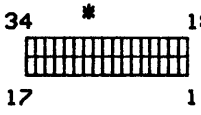
* 10K PULL DOWN RESISTORS ADDED ON BITS OF UNUSED BYTES THAT ARE READ.



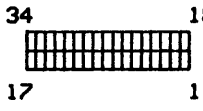
A3 — CONNECTS TO CARD 1 H3

B3 — CONNECTS TO CARD 2 H3

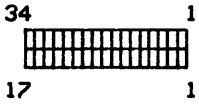
PASS SELECT CONTROL CIRCUIT (PASSEL)



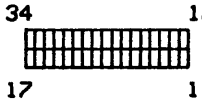
A2 — CARD 1 H2



B2 — CARD 2 H2



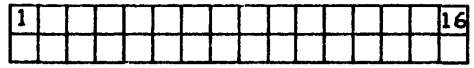
A1 — CARD 1 H1



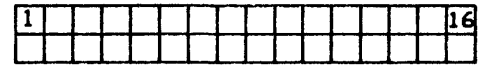
B1 — CARD 2 H1

MOUNTED ON BACKSIDE OF BACKPLANE

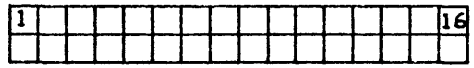
HEX BUFFERS (HEXBF)



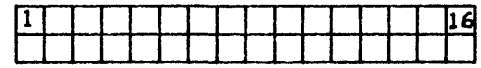
TBA1



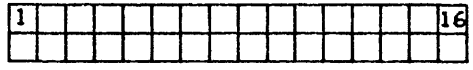
TBB1



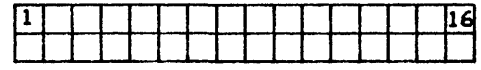
TBA2



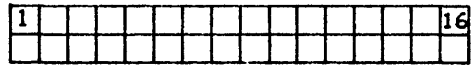
TBB2



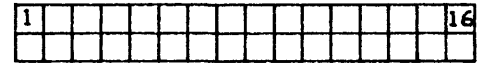
TBA3



TBB3



TBA4



TBB4

BACKPLANE LAYOUT OF CONNECTORS AND TERMINAL BLOCKS

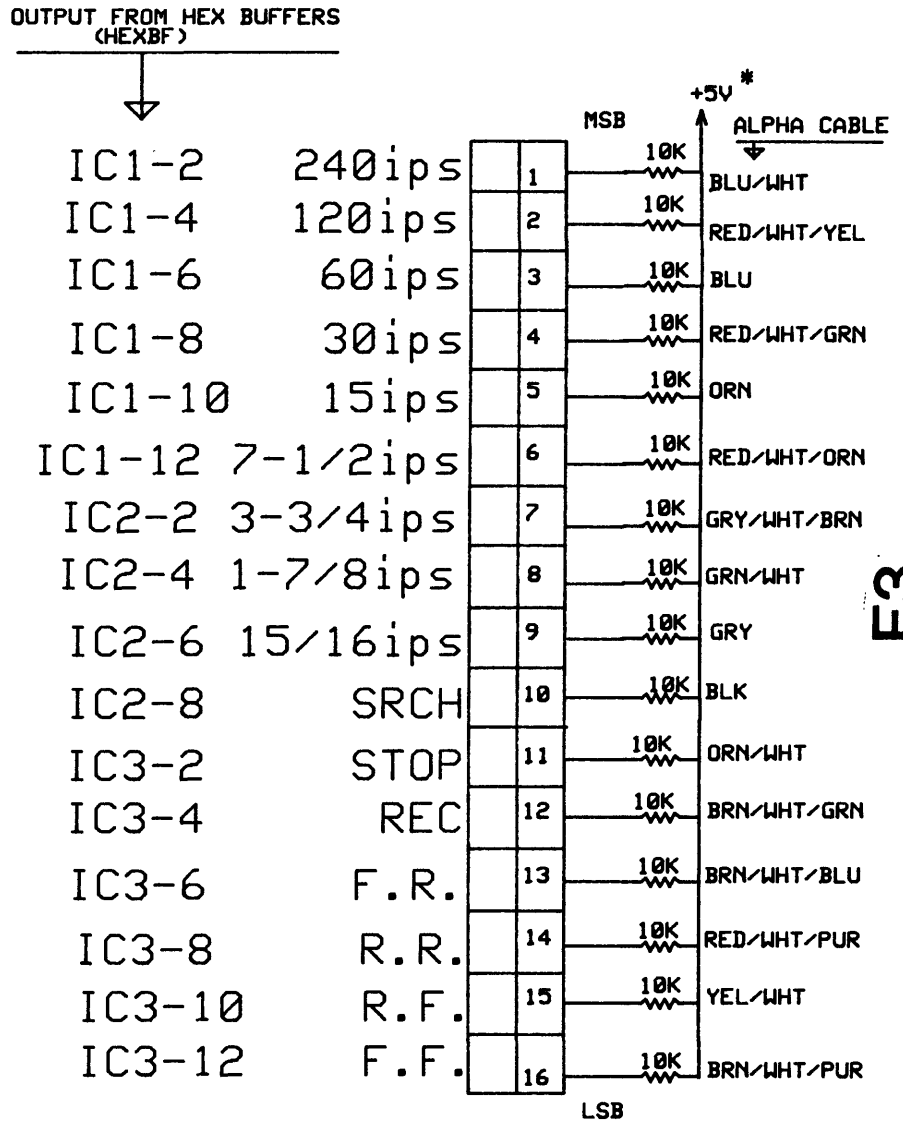
CONNECTORS: A(#) to B(#)
TERMINAL BLOCKS: TB(##)

F2

TBA1

OUTPUT TO BELL & HOWELL
USES NEGATIVE LOGIC; ACTIVE
LOWS. 0volts = "1"

OUTPUT
BELL & HOWELL
CONTROL



*5 VOLTS SUPPLY MOUNTED ABOVE BACK PLANE (BPLANE)

F3

23

TBA2

INPUT STATUS FROM BELL & HOWELL IS POSITIVE LOGIC; +5volts="1"

INPUT
BELL & HOWELL
TAPE STATUS

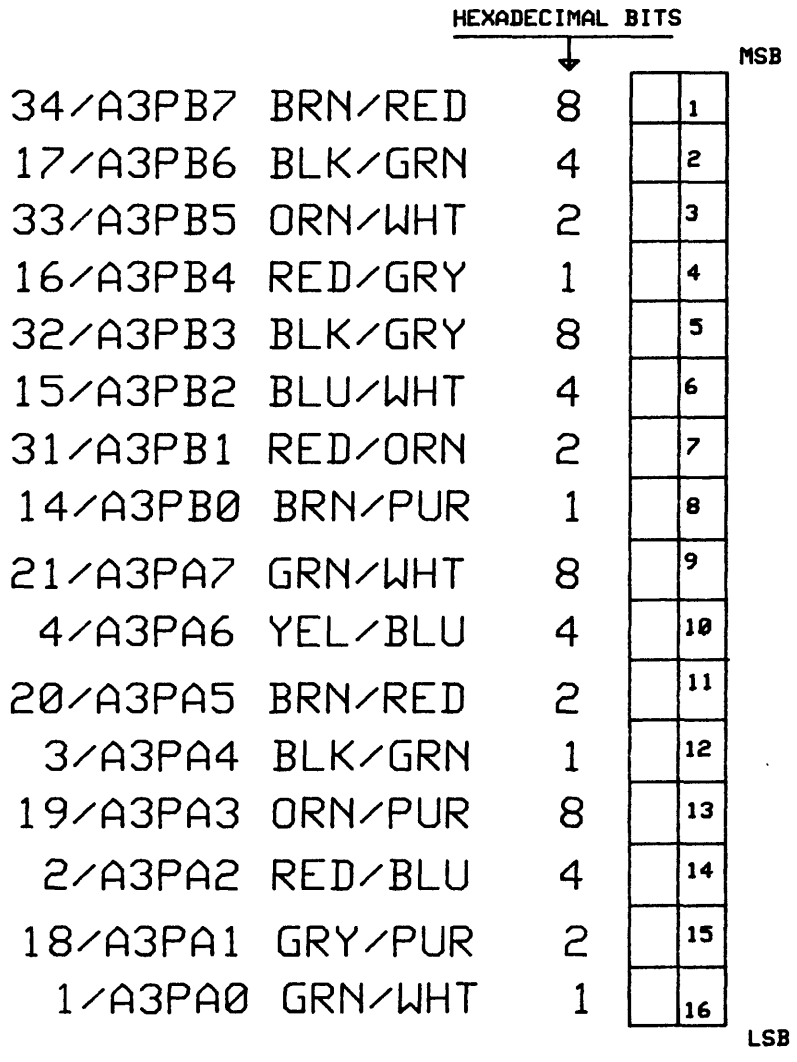
34/A2PB7	PUR/BRN	240ips	1	GRY/WHT	MSB
17/A2PB6	BRN/BLK	120ips	2	BRN/WHT	
33/A2PB5	BLU/YEL	60ips	3	PUR/WHT	
16/A2PB4	BLU/BRN	30ips	4	BRN/WHT/YEL	
32/A2PB3	GRN/BLK	15ips	5	YEL	
15/A2PB2	PUR/BLU	7-1/2ips	6	WHT	
31/A2PB1	GRY/RED	3-3/4ips	7	BRN	
14/A2PB0	YEL/BRN	1-7/8ips	8	RED	
21/A2PA7	WHT/BLU	15/16ips	9	GRN	
4/A2PA6	GRN/YEL	SRCH	10	PUR	
20/A2PA5	PUR/BRN	STOP	11	BLK/WHT/YEL	
3/A2PA4	BRN/BLK	REC	12	ORN/WHT/BLU	
19/A2PA3	GRN/YEL	F.R.	13	ORN/WHT/YEL	
2/A2PA2	ORN/RED	R.R.	14	RED/WHT/GRY	
18/A2PA1	GRY/BLK	R.F.	15	BLK/WHT/BRN	
1/A2PA0	PUR/GRN	F.F.	16	BLK/WHT/BLU	LSB

ALPHA CABLE

F4

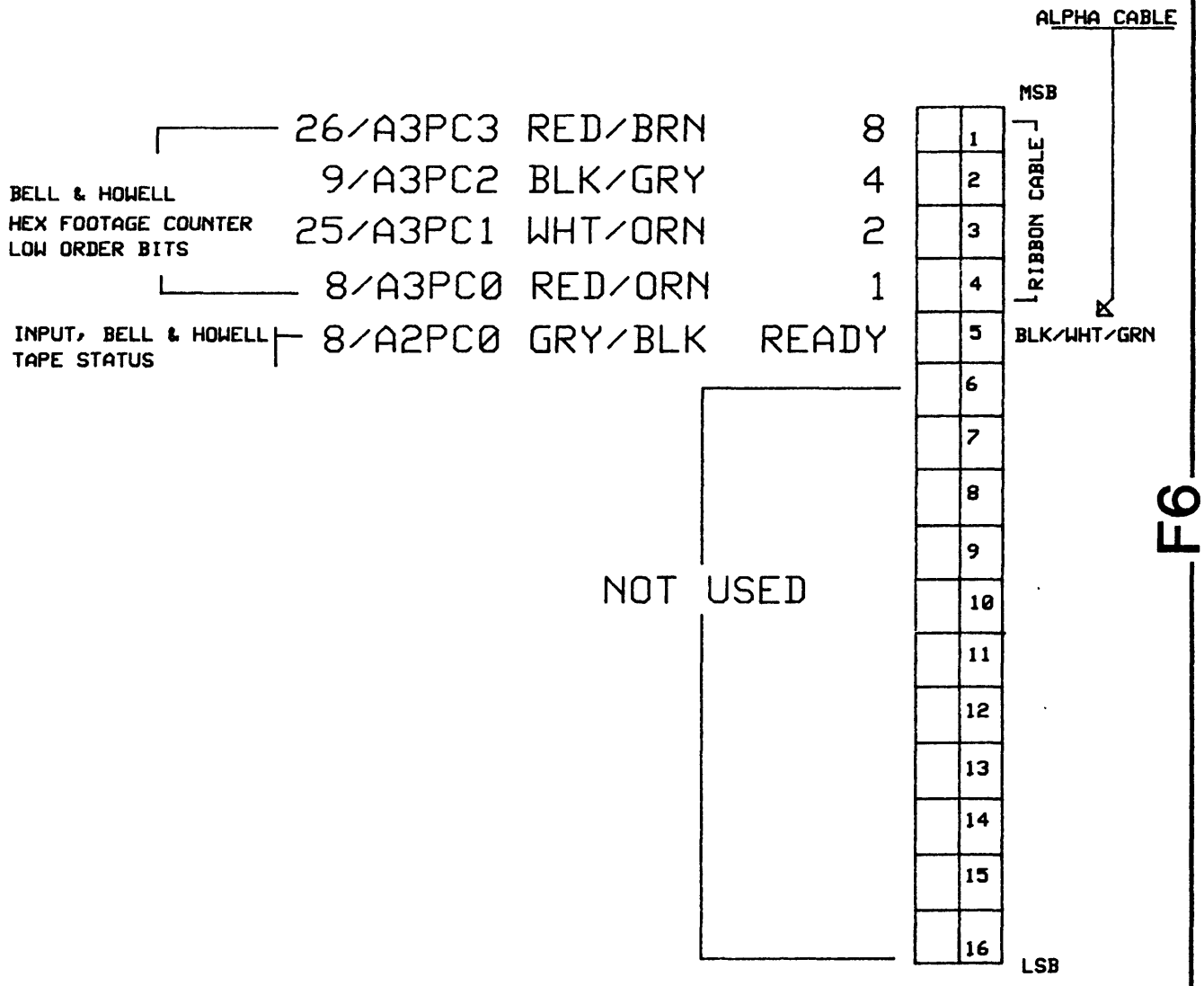
TBA3

HEX FOOTAGE
COUNTER
HIGH ORDER BITS

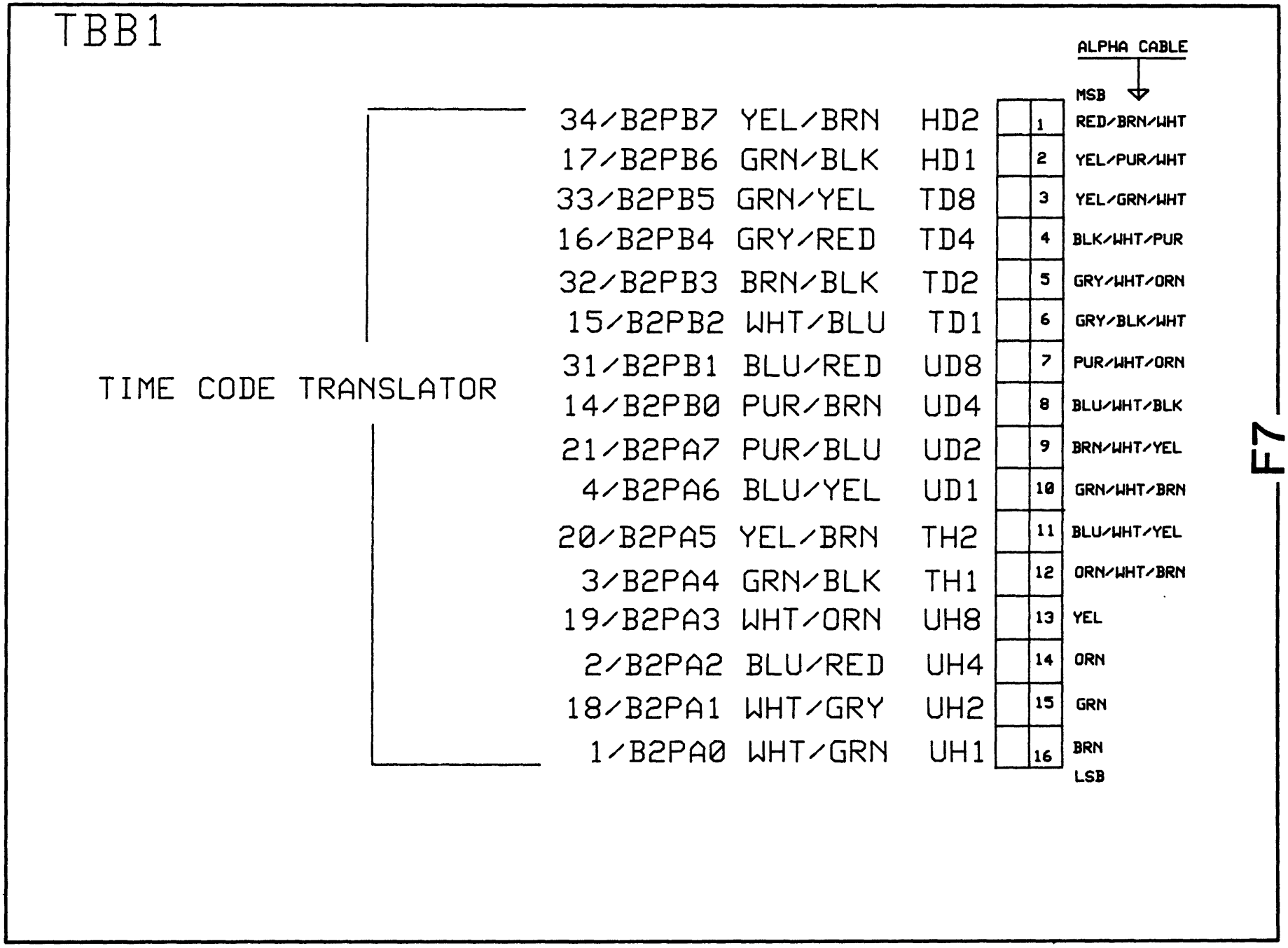


F5

TBA4


ALPHA CABLE
MSB
26/A3PC3 RED/BRN 8
9/A3PC2 BLK/GRY 4
25/A3PC1 WHT/ORN 2
8/A3PC0 RED/ORN 1
8/A2PC0 GRY/BLK READY
BELL & HOWELL
HEX FOOTAGE COUNTER
LOW ORDER BITS
INPUT, BELL & HOWELL
TAPE STATUS
RIBBON CABLE
BLK/WHT/GRN
NOT USED
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
LSB

F6


TBB1
TIME CODE TRANSLATOR
34/B2PB7 YEL/BRN HD2
17/B2PB6 GRN/BLK HD1
33/B2PB5 GRN/YEL TD8
16/B2PB4 GRY/RED TD4
32/B2PB3 BRN/BLK TD2
15/B2PB2 WHT/BLU TD1
31/B2PB1 BLU/RED UD8
14/B2PB0 PUR/BRN UD4
21/B2PA7 PUR/BLU UD2
4/B2PA6 BLU/YEL UD1
20/B2PA5 YEL/BRN TH2
3/B2PA4 GRN/BLK TH1
19/B2PA3 WHT/ORN UH8
2/B2PA2 BLU/RED UH4
18/B2PA1 WHT/GRY UH2
1/B2PA0 WHT/GRN UH1
ALPHA CABLE
MSB
1 RED/BRN/WHT
2 YEL/PUR/WHT
3 YEL/GRN/WHT
4 BLK/WHT/PUR
5 GRY/WHT/ORN
6 GRY/BLK/WHT
7 PUR/WHT/ORN
8 BLU/WHT/BLK
9 BRN/WHT/YEL
10 GRN/WHT/BRN
11 BLU/WHT/YEL
12 ORN/WHT/BRN
13 YEL
14 ORN
15 GRN
16 BRN
LSB
F7

TBB2

TIME CODE TRANSLATOR

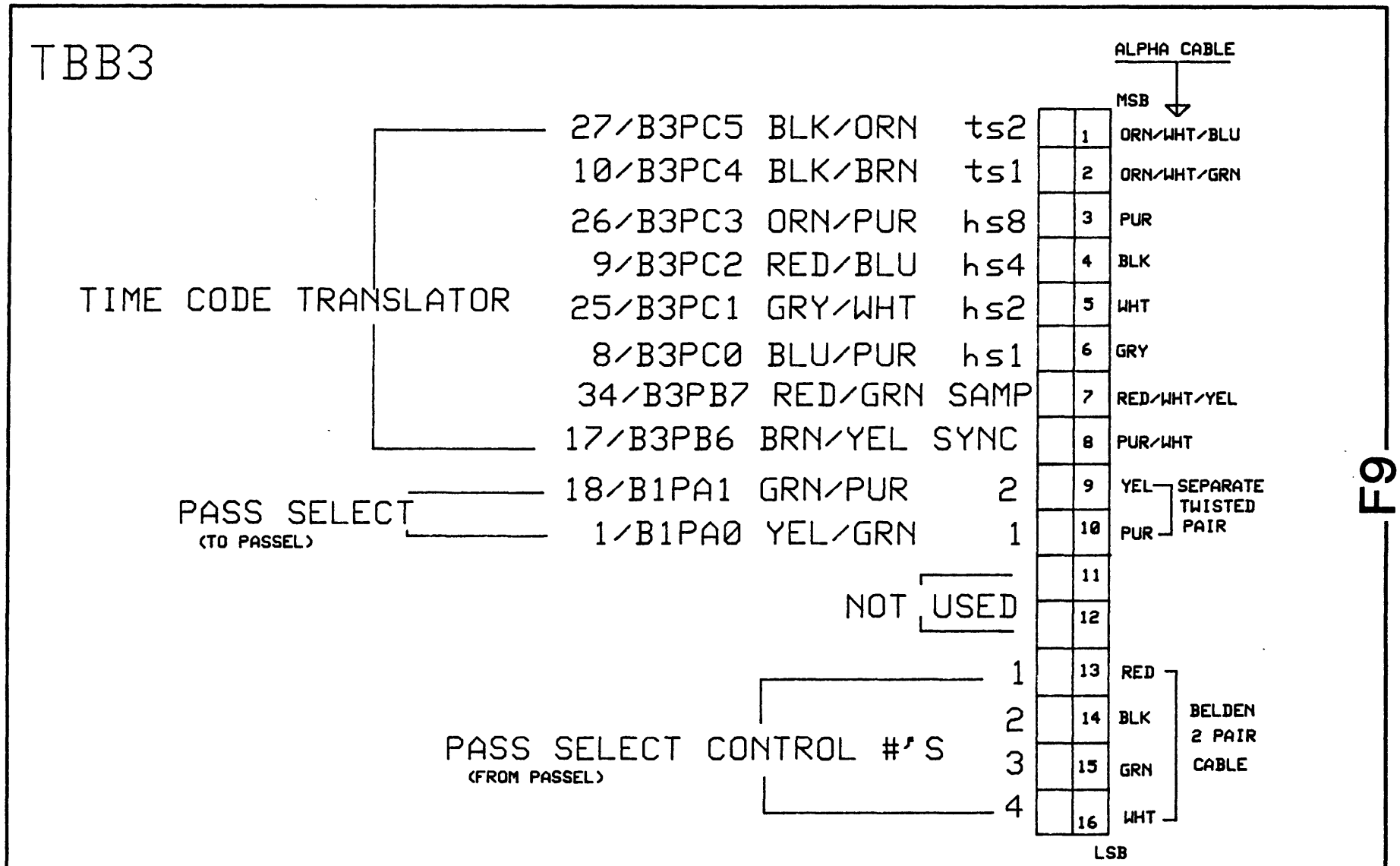
33/B3PB5	BRN/PUR	TM4		1	ORN/WHT
16/B3PB4	GRY/BLK	TM2		2	YEL/WHT
32/B3PB3	YEL/BLU	TM1		3	RED/WHT
15/B3PB2	ORN/RED	UM8		4	BLU
31/B3PB1	BLK/GRN	UM4		5	BRN/WHT/BLU
14/B3PB0	WHT/GRN	UM2		6	RED
21/B3PA7	RED/GRY	UM1		7	GRN/WHT
4/B3PA6	RED/BRN	TS4		8	RED/WHT/GRN
20/B3PA5	BLU/WHT	TS2		9	BLK/WHT/BRN
3/B3PA4	WHT/ORN	TS1		10	RED/WHT/BLU
19/B3PA3	BRN/PUR	US8		11	RED/WHT/PUR
2/B3PA2	GRY/BLK	US4		12	RED/WHT/BLK
18/B3PA1	YEL/GRN	US2		13	RED/WHT/GRY
1/B3PA0	GRN/BRN	US1		14	ORN/WHT/YEL
28/B3PC7	BLK/GRY	ts8		15	BLK/WHT/GRN
11/B3PC6	GRY/YEL	ts4		16	BLK/WHT/YEL

ALPHA CABLE

MSB

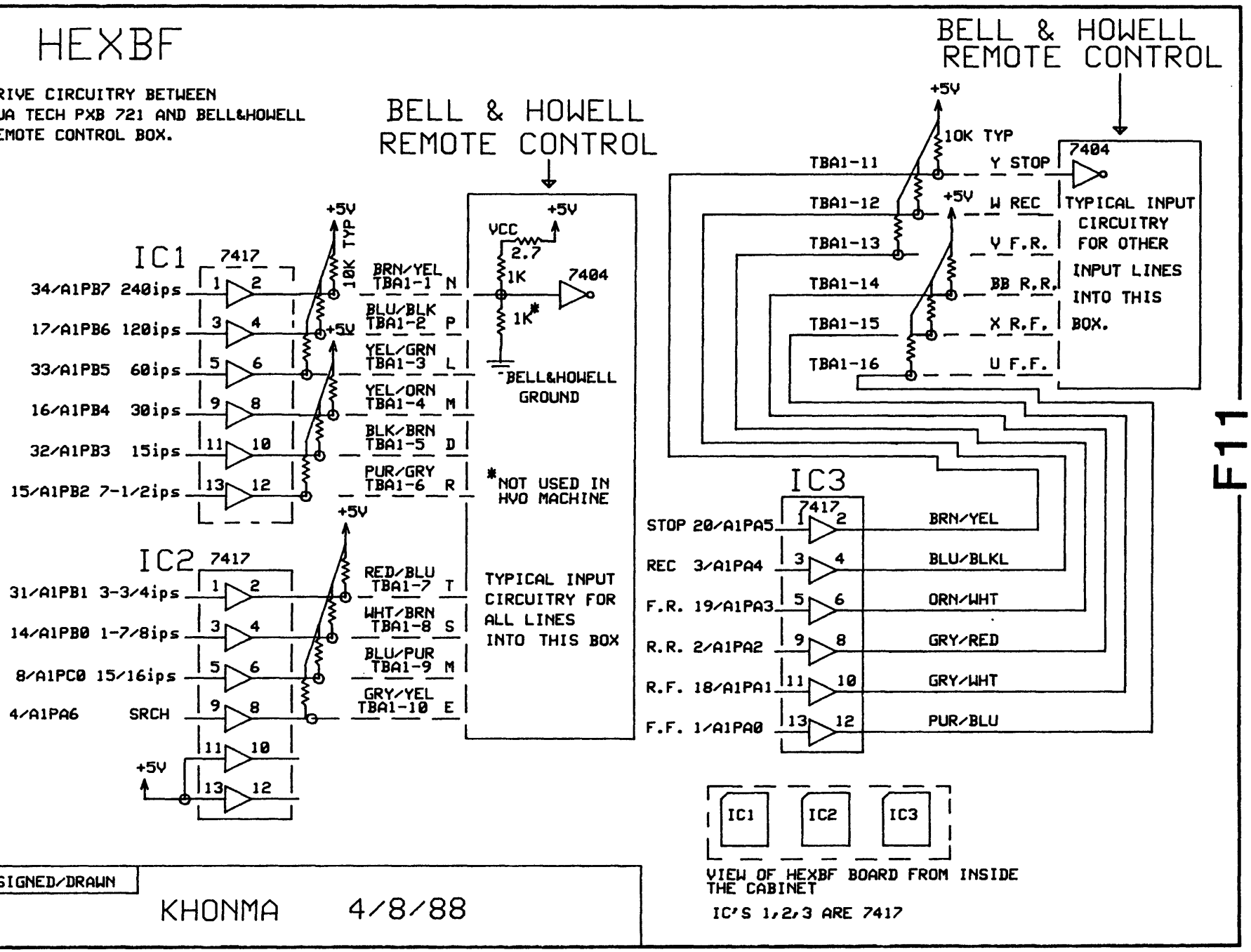
LSB

F8


TBB3
ALPHA CABLE
MSB
TIME CODE TRANSLATOR
27/B3PC5 BLK/ORN ts2
10/B3PC4 BLK/BRN ts1
26/B3PC3 ORN/PUR hs8
9/B3PC2 RED/BLU hs4
25/B3PC1 GRY/WHT hs2
8/B3PC0 BLU/PUR hs1
34/B3PB7 RED/GRN SAMP
17/B3PB6 BRN/YEL SYNC
PASS SELECT
(TO PASSEL)
18/B1PA1 GRN/PUR 2
1/B1PA0 YEL/GRN 1
NOT USED
PASS SELECT CONTROL #'S
(FROM PASSEL)
1
2
3
4
1 ORN/WHT/BLU
2 ORN/WHT/GRN
3 PUR
4 BLK
5 WHT
6 GRY
7 RED/WHT/YEL
8 PUR/WHT
9 YEL
10 PUR
SEPARATE TWISTED PAIR
11
12
13 RED
14 BLK
15 GRN
16 WHT
BELDEN 2 PAIR CABLE
LSB
F9
TBB4 : ALL OF THIS TERMINAL BLOCK NOT USED
DESIGNED/DRAWN
KHONMA 4/13/88

HEXBF

DRIVE CIRCUITRY BETWEEN
QUA TECH PXB 721 AND BELL&HOWELL
REMOTE CONTROL BOX.

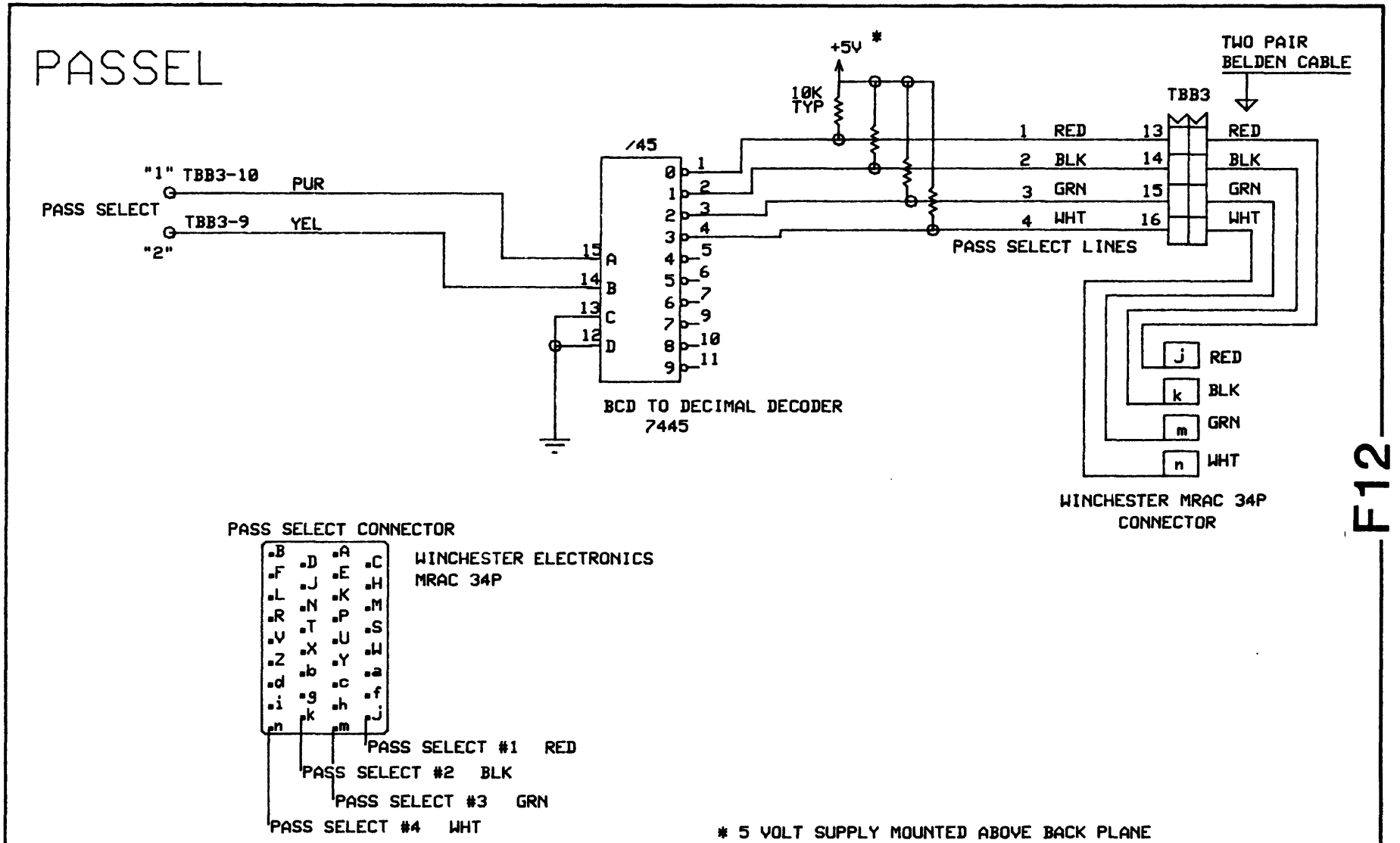


VIEW OF HEXBF BOARD FROM INSIDE THE CABINET

IC'S 1,2,3 ARE 7417

DESIGNED/DRAWN	
KHONMA	4/8/88

F11



F12

SYSTEM	DRAWN/TECH REVIEW
FM PLAYBACK	K HONMA 3/11/88
	SUB-SYSTEM
	PASS SELECT CONTROL CIRCUIT (ON BACK PLANE)

FRONT VIEW OF THE LEADING EDGE COMPUTER AND THE FM PLAYBACK CONTROL CABINET

REAR VIEW OF THE LEADING EDGE COMPUTER AND THE FM PLAYBACK CONTROL CABINET

CLOSE UP OF REAR OF FM PLAYBACK CONTROL CABINET
WITH RIBBON CABLES

CLOSE-UP OF REAR OF FM PLAYBACK CONTROL CABINET
WITHOUT RIBBON CABLES