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AEC-BOX-30/30G/31/32
SERIAL TIME CODE DATA INSERTERS
INSTRUCTION MANUAL

ADRIENNE ELECTRONICS
CORPORATION

AEC-BOX-30: Serial LTC Reader Data Inserter

AEC-BOX-30G: Serial LTC Reader/Generator Data Inserter

AEC-BOX-31: Serial VITC Reader Data Inserter

AEC-BOX-32: Serial LTC/VITC Reader Data Inserter

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*** FCC NOTICE ***

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, could cause harmful interference to radio communications. Operation of this equipment in a residential area may cause harmful interference, in which case the user will be required to correct the interference at his or her own expense.

*** COPYRIGHT NOTICES ***

Also, due to copyright restrictions, we cannot provide you with the serial protocol used by your particular VTR. Such information must be obtained from the VTR manufacturer.

*** TRADEMARK NOTICES ***

TABLE OF CONTENTS

INTRODUCTION

Adrienne Electronics Corporation (AEC) developed the AEC-BOX-30 series of serial time code data inserters for "Sony protocol" VTR's in order to provide a low cost way of adding time code capabilities to these VTR's.

The serial protocol used, with 38400 baud, 8 data bits, and ODD parity, is the same as that used on Sony Betacam and U-matic broadcast quality VTR's. This protocol is used by VTR's from many other manufacturers as well. Due to copyright restrictions, we cannot provide you with a description of this protocol. If needed, order a description from the manufacturer of your VTR.

These boxes work equally well with SMPTE (30fps) and EBU (25fps) time codes, in both the forward and reverse tape directions.

NOMENCLATURE

The term "AEC-BOX-30" will be used in this manual to refer to all members of the AEC-BOX-30 family. Where not obvious, differences in behavior between the various boxes will be pointed out.

The word "controller" will be used to refer to whatever device is sending commands to the AEC-BOX-30.

GETTING STARTED QUICKLY

If you want to use your AEC-BOX-30 right away, without reading the whole manual, just do the following:

1) Plug the AC power cord into a suitable voltage AC outlet.
2) Connect the appropriate LTC/VITC signals up to the box.
3) Use ESbus (RS422) cables to connect the AEC-BOX-30 to the VTR, and to the VTR controller, as indicated on the box.

The LED will blink off briefly every second if no time code is being read. Serial communications errors (including no response from the VTR) cause the LED to blink OFF for one half second per occurrence. If something doesn't work, you will have to carefully read the "INSTALLATION" section of this manual.

AEC-BOX-30 SPECIFICATIONS

LTC READER:	
Input Impedance	10kohms typical
Input Level	100mVpp to 10Vpp
DC on Input	+1V maximum
Speed Range (2)	1/10x to 50x (w.r.t. play speed)
Tape Direction	Forward or Reverse
Bits Read	ALL time, user, and embedded bits.
Time Code Standard	Both SMPTE and EBU, without modification.
VITC READER (AND VIDEO SYNC INPUT):	
Impedance	6kohms typical (Hi-Z)
Input Level	0.8Vpp to 2.2Vpp (1Vpp nominal)
Looping Response	+0.1db maximum, 0-5MHz
Video Frequency	Must be within 5% of nominal frequency.
Speed Range (3)	-1x to STILL to +3x (w.r.t. play speed)
Tape Direction	Forward or Reverse
Bits Read	ALL time, user, and embedded bits.
Time Code Standard	SMPTE/EBU determined by VTR's ID code.
LTC GENERATOR:	
Output Level	1Vpp typical
Output Impedance	100ohms typical
DC on Output	+50mV maximum
Freerun Error	+0.2% maximum
Phasing Error	+20us maximum w.r.t. NTSC/PAL specs
Bits Written	ALL time, user, and embedded bits.
Time Code Standard	SMPTE/EBU determined by VTR's ID code
MISCELLANEOUS:	
Box Dimensions (4)	16cm wide x 5cm high x 21cm long
Box Weight	0.7kg
Power Consumption	6W
Temperature Range	0 to 50 degrees Centigrade
Relative Humidity	Up to 95%, noncondensing

Notes:
(1) All specifications are subject to change without notice.
(2) LTC signals below play speed are often too distorted to read.
    Varies with tape format, tape machine, etc..
(3) Highly VTR dependent. Some are better, some are worse.
(4) Allow at least 6cm in rear for cables and connectors.
(5) See also "VTR, TAPE, AND TIME CODE REQUIREMENTS" (page 23).

Throughout the following discussion you may want to refer to the AEC-BOX-30 schematics which are in the back of this manual. If your box has been customized in any way for your application, or if some features are not installed in your box, then the descriptions below (obviously) may not be entirely accurate.

The power supply primary side comprises power transformer T1 and thermal "fuse" device F1. Of special note is the fact that this "fuse" does not burn out. If it trips, turn the power off for one minute to let it cool/reset, then turn the power back on.

The power supply secondary side starts with full wave rectifiers DB1 and DB2, plus large filter capacitors C72, C73, C82, and C83. The resulting unregulated DC supplies are then passed through voltage regulators U70(+5V), U72(+12V), and U73(-12V).

The LTC input at RCA jack J1 first goes through a differential amplifier centered about U10A. Note that the outer conductor on the RCA jack is normally grounded, but may be converted to a true differential input by cutting jumper X3. See the INSTALLATION section for details. The output of the differential amplifier is AC coupled to eliminate DC offsets, then is fed into the window comparator made up of quad comparator U9 and surrounding components. This comparator automatically senses the incoming signal level and adjusts itself as needed to recover the LTC transition data even from very poor quality input signals. The complementary outputs of the window comparator go directly to proprietary LTC reader chip U2.

The video/VITC input signal first passes through 3-pole low pass filter R17,C44,L1,C45, then is buffered by U8A. Transistor Q5 is turned on by each sync tip, and thus generates horizontal sync pulses which are fed to U4 pin 1. Low pass filter RN10B,C40 only exceeds the threshold of comparator U6B during vertical reset pulses. The vertical sync output of U6B then goes to U4 pin 2. OTA U11A is strobed ON during the back porch of each video line, and forces the voltage on C42 to track the blanking level of the incoming video signal. OTA U11C is strobed ON during each sync tip, and together with the blanking voltage from U11A generates a +40IRE voltage on C41. Comparator U6A then compares the VITC input pulses with the +40IRE level, and its digital logic output then goes to proprietary VITC reader chip U3.

The LTC output pulses are created directly by microcomputer U4. OTA U11C switches current into and out of C21, with the amplitude limited by zener diodes D8 and D9. This circuit forms the proper LTC waveform, with flat tops and sloped edges, per SMPTE/EBU specifications. Buffer amplifier U10A then drives RCA jack J2 through R18 and R19 to create the proper output level and impedance.

Microcomputer U4, together with address latch U51 and EPROM U1, form a completely self contained (but miniature) computer system. DIP switch SW1 allows easy modification of box operating modes, edit offsets, VITC line numbers, and other features. "Watch dog" timer U5 resets the microcomputer chip, and thus the entire box, if the supply voltage drops too low or if the software crashes for some reason.

Serial EEPROM U54 stores box setup data for at least 10 years without the use of any batteries. EEPROM data can be modified at any time, as needed, via DIP switch programming (see page 12).

Serial data from Dual UART (DUART) U52 is translated to RS232 levels by U7, and is translated to RS422 levels by U14. U14 also translates received RS232 and RS422 data for use by DUART U52. Nine pin "D" connector J3 contains the RS232 and RS422 transmit and receive data lines which go to the VTR controller. Nine pin "D" connector J4 contains the RS232 and RS422 transmit and receive data lines which go to the VTR being controlled.

Note that even though AEC-BOX-30's normally use only the RS422 data lines, the RS232 data lines were included to allow control of the AEC-BOX-30 (and thus the VTR) using standard personal computer RS232 ports. We also envision adapting these boxes to RS232 controlled VTR's in the future.

AC INPUT VOLTAGE RANGE SELECTION

Normally all AEC-BOX's are shipped with the transformer primary wired for 100-130VAC. Your box will bear a special marking if it has been wired for 200-260VAC instead. For your own safety, PLEASE do not proceed unless the line cord has been unplugged! Just turning off a power switch somewhere is not sufficient!

*** WARNING ***

NEVER OPEN UP THE BOX unless the line cord has been unplugged from its AC power source! To do otherwise risks damage to your AEC-BOX, and could even KILL you! We cannot assume responsibility for such careless behavior.

Box Cover Removal:
First you must UNPLUG the AC power cord, remove all other cables, then remove the bottom cover as follows:

1) Use a small (#1) Phillips screwdriver to remove the two small black screws which are on each side of the box.
2) Slide off the front and back black plastic bezels.
3) Turn the box over, then lift off the BOTTOM cover.

Note that you are now exposing yourself to a severe (FATAL) shock hazard if the box is still plugged in to an AC power source!

Voltage Strap Modification for 200-260VAC:
In the area underneath power transformer T1, you will find four large holes in a row, with "115V" and "230V" markings adjacent. Using sharp nosed cutters, or some other appropriate tool, cut out at least 2mm of the narrow trace next to each of the "115V" markings. Then solder a short wire between the two holes closest to the "230V" marking, being careful not to poke the ends of the wire too far into the holes (could damage power transformer T1). Also make sure that the wire you added is flush with the bottom of the board, and will not even come close to touching to bottom of the box.

Voltage Strap Modification for 100-130VAC:
In the area underneath power transformer T1, you will find four large holes in a row, with "115V" and "230V" markings adjacent. Remove the wire between the two holes closest to the "230V" marking. Then solder a short wire between each pair of holes closest to the "115V" markings, being careful not to poke the ends of the wire too far into the holes (could damage power transformer T1). Also make sure that the two wires you added are flush with the bottom of the board, and will not even come close to touching to bottom of the box.

AC POWER INPUT VOLTAGE RANGE SELECTION
(continued)

Box Cover Replacement:
Basically, just follow the earlier instructions in reverse order (power to the box must be OFF):

1) Put the bottom cover back in place.
2) Slide a black plastic bezel onto each end of the unit. The box looks better if the two small molding marks are facing towards the bottom of the unit.
3) Reattach the bezels to the chassis with the four small black screws you removed earlier. Be careful not to strip the threads in the aluminum side extrusions!

Label The Line Cord:
Attach a small label to the plug end of the line cord, so that the next person to use this AEC-BOX will know what AC power input voltage range it expects to see.

Test Your Work:
BEFORE connecting any cables to the box, plug it in to the appropriate AC power source and make sure it works (no smoke).

INSTALLING YOUR OWN AC POWER LINE PLUG

If the plug on the end of the AC line cord is not suitable, you can cut it off and put on your own. Where possible, please wire the new plug as follows:

1) Green = Ground (Chassis)
2) Blue = Neutral
3) Brown = Hot

In no case should the green wire be connected to anything but ground! Use a continuity tester to verify that the ground lug on your new power cord is connected directly to the AEC-BOX chassis.

LTC INPUT CONNECTION (for AEC-BOX-30/30G/32 only):
RCA jack J1 is the high impedance (20kohm) LTC input connector. It is usually fed by the LTC output signal from the VTR, but may also be fed by one of the audio outputs in some cases, provided that the audio track has an LTC signal on it.

As shipped from the factory, this RCA jack's outer conductor is connected to frame ground (the box chassis) via shunt X3 (next to J1). You may remove X3 in order to get a true differential LTC input, provided that the common mode voltage (usually 50/60Hz hum) is less than 2Vrms. In this configuration, you may also want to wrap electrical tape around the outside of the RCA input plug so that its outer conductor cannot short to the rear panel inadvertently.

VITC INPUT CONNECTION (for AEC-BOX-31/32 only):
The two "VITC IN" BNC connectors are hard wired together. The video output signal from the VTR should be looped through the AEC-BOX so that the VITC signal can be read from it. The high impedance input circuitry will load the video signal very little (see specifications). The nominal video input level is 1Vpp, but the input amplifiers will adjust themselves to other input levels, including the unterminated input condition. For best results, this video signal should be properly terminated.

SYNC INPUT CONNECTION (for AEC-BOX-30G only):
The two "SYNC IN" BNC connectors are hard wired together. The "VIDEO IN" signal going to the VTR should first be looped through the AEC-BOX-30G so that the box and VTR will always be "in sync" with each other. Alternatively, some other video sync reference signal may be used, so long as it is properly aligned with the video input to the VTR. This ensures that the box's LTC output will be properly aligned with the video signal going into the VTR. The AEC-BOX-30G's high impedance sync input circuitry will load your video signal very little (see specifications).

LTC OUTPUT CONNECTION (for AEC-BOX-30G only):
RCA jack J2 is the 100 ohm (low impedance) LTC output connector. It is usually connected to the LTC input on the VTR, but may also be connected to one of the VTR's audio inputs. The RCA jack's outer conductor is connected directly to frame ground.

SERIAL CONNECTION "TO VTR":
This 9-pin D connector has the same pinout as is found on most VTR controllers. Thus a standard 9-pin cable with no crossed lines will make the proper connection to the VTR. If you are making your own cable, the following chart indicates the pinout of this connector:

Pin #	Function
1	Chassis GND
2	RX422-/RX232
3	TX422+
4	Transmit GND
5	TX232
6	Receive GND
7	RX422+
8	TX422-
9	Chassis GND

Notes:
1) Tiny pin numbers are molded into the connector face.
   Be careful not to be "off by one".
2) The RS422 pinout is that of an ESbus CONTROLLER.

SERIAL CONNECTION "TO CONTROLLER":
This 9-pin D connector has the same RS422 pinout as is found on the VTR itself. Thus a standard 9-pin RS422 cable with no crossed lines will make the proper connection to an RS422 type controller. If you are using an RS232 type controller, such as an IBM PC type computer, note that a NONSTANDARD RS232 cable is required. If you are making your own cable, the following chart indicates the pinout of this connector:

Pin #	Function
1	Chassis GND
2	TX422-
3	RX422+
4	Receive GND
5	TX232
6	Transmit GND
7	TX422+
8	RX422-/RX232
9	Chassis GND

Notes:
1) Tiny pin numbers are molded into the connector face.
   Be careful not to be "off by one".
2) The RS422 pinout is that of an ESbus TRIBUTARY.

DIP SWITCH AND EEPROM PROGRAMMING

Via DIP switch SW1, you can alter several box operating modes and parameters, as described in the following sections. All changes made to the EEPROM can be considered permanent, since it is supposed to retain its data for 10 years, even when the power is off. Since each AEC-BOX-30 is set up with the proper default values at the factory, in most cases you will not need to make any changes.

Box Cover Removal:
First you must UNPLUG the AC power cord, remove all other cables, then remove the top cover as follows:

1) Use a small (#1) Phillips screwdriver to remove the two small black screws which are on each side of the box.
2) Slide off the front and back black plastic bezels.
3) Lift off the top cover.

Note that the bottom cover will fall off easily at this point, exposing you to a severe (FATAL) shock hazard if the box is still plugged in to an AC power source!

*** WARNING ***

NEVER OPEN UP THE BOX unless the line cord has been unplugged from its AC power source! To do otherwise risks damage to your AEC-BOX, and could even KILL you! We cannot assume responsibility for such careless behavior.

Changing DIP Switch (SW1) Settings:
Note that the switches are numbered 1 through 8. Also note the small "1" and "0" numbers down on the PCB next to both ends of SW1. To set a switch to be a "1", simply press down on the "1" (OPEN) end of that switch. Conversely, to set a switch to be a "0", simply press down on the "0" end of that switch. All done!

In the paragraphs which follow, you are often asked to turn on the box power for three seconds while the top cover is off. This operation should only be performed when:

1) No tools or fingers are inside or otherwise near the box.
2) The box is nested properly inside the bottom cover.
3) The operator is being VERY careful.

Please do be careful, as we don't want to lose you as a customer.

Note that switches 1-3 (or 1-4) often determine which EEPROM register is to be programmed with the data indicated by the other switches. Thus if you change ANY switches while power to the box is on, you will probably reprogram parts of the EEPROM in undesired ways. If you accidentally do this, or if the box is behaving strangely, you may want to completely reinitialize the EEPROM. This latter process is described fully on page 15.

DIP SWITCH AND EEPROM PROGRAMMING
(continued)

*** NOTICE ***

Changing DIP switches while the power to the box is on will usually result in undesirable data being entered into the EEPROM, with indeterminate box operation results!

Normal Operations:
In most cases, DIP switch segments 1-8 will all be "0" during normal box operations. This is the factory default setting:
1) Set switches 1-4 to "0000", respectively.
2) Turn on the power. The box should be operating normally.

Special Instructions for JVC CR-850U and Similar VTR's:
These VTR's have a serial protocol which is somewhat different from that found in standard Sony VTR's. The AEC-BOX-30 automatically detects the presence of the JVC VTR's, then does protocol translation as needed (if switch 7 is in the factory default "0" position) so that the controller thinks it is talking to a true Sony protocol device having a BVU-850 ID code.

In some cases (notably with Calaway edit controllers) we have found it necessary to disable our protocol translation software so that our box looks like a true JVC VTR. Just set switch 7 to "1" if you need to do this.

Setting VITC Line #1:
The following steps can be taken to load into the EEPROM the first line number to be used when reading VITC:
1) Set switches 1-3 to "100", respectively.
2) Set switches 4-8 to the binary equivalent of the desired line number (0-31). Note that 10000b = 16d, 01110b = 14d, etc.. For example, setting switches 4-8 to "10000" selects line 16. Refer to "VITC READER OPERATIONS" for which number to use.
3) Turn on power, wait three seconds, turn off power.
4) Restore switches 1-8 to their normal operating positions.

Setting VITC Line #2:
Same as for line 1, but set switches 1-3 to "010" instead.

Setting the Edit Offsets:
If the controller sends the PREVIEW, AUTO EDIT, or REVIEW commands to the AEC-BOX-30, you can specify how many frames prior to the edit IN/OUT points the AEC-BOX-30 will send the EDIT ON/OFF commands to the VTR. Most controllers issue EDIT ON/OFF commands directly to the VTR, and no AEC-BOX-30 adjustments are needed. Otherwise you may need to:

1) Set switches 1-3 to "001", respectively.
2) Set switches 6-8 to the binary equivalent of the number of whole frames offset that you desire (0-7). Default is 2.
3) Set switch 5 to "1" for an additional half frame offset. For example, set switches 5-8 to "1011" for 3.5 frames offset.
4) Set switch 4 to "1" for an additional quarter frame offset.
5) Turn on power, wait three seconds, turn off power.
6) Restore switches 1-8 to their normal operating positions.

Setting the FFWD/REWD Search Offset:
Whenever the AEC-BOX-30 starts a search, it puts the VTR into the FFWD or REWD mode if the VTR is "far away" from the destination. Normally this "FFWD/REWD search offset" is set to 2 minutes, so that if the tape is within 2 minutes of its destination, FFWD/REWD will not be used. You can select your own offset as follows (00000 => FFWD/REWD will never be used for searches):

1) Set switches 1-3 to "110", respectively.
2) Set switches 4-8 to the binary equivalent of the number of minutes offset that you desire (1-31). Use "00101" for 5, etc.
3) Turn on power, wait three seconds, turn off power.
4) Restore switches 1-8 to their normal operating positions.

Selecting a New VTR Identification Code:
If absolutely necessary, it is possible to program a new VTR ID code into your AEC-BOX-30, using four different DIP switch settings and power on/off cycles. First figure out which VTR model you need to emulate, then contact us for details on how to do it (give us a while to look up the proper codes). These ID codes do not affect the operation of the AEC-BOX-30 in any way, except when asked "who are you" by the controller.

DIP SWITCH AND EEPROM PROGRAMMING
(continued)

Reading EEPROM Registers:
If necessary for diagnostic purposes, we may ask you to use this setting, which blinks the LED in a manner which allows us to figure out what data is currently in the EEPROM:

1) Set switches 1-4 to "1110", respectively.
2) Set switches 5-8 to the binary equivalent of the EEPROM register to be viewed (0-15). Use "0011" for 3, and so forth.
3) Turn on the power, and describe to us the LED blink pattern.
4) When finished, turn off the power, then restore switches 1-8 to their normal operating positions.

Other Diagnostic Modes:

1) Set switches 1-4 to "0001", respectively.
2) Set switches 5-8 to whatever we suggest.
3) Turn on the power, and describe to us exactly what happens to the VTR. Normally it will begin a series of tests which repeat until you turn the power off.
4) Note that while in any of these diagnostic modes, the LED on the front of the AEC-BOX-30 will blink ON about twice per second (a "heartbeat" indication).
5) When finished, turn off the power, then restore switches 1-8 to their normal operating positions.
6) Do not "experiment" with these diagnostic modes. Some of them will record and edit holes into your video tape.

Reinitializing the EEPROM:
If the box is behaving strangely, or if you suspect that you altered a register you weren't supposed to, you may want to reload the EEPROM with all of the default settings:

1) Set switches 1-4 to "1111", respectively.
2) Turn on power, wait three seconds, turn off power.
3) Restore switches 1-8 to their normal operating positions.

Box Cover Replacement:
Basically, just follow the earlier instructions in reverse order (power to the box must be OFF):

1) Put the top cover back in place.
2) Slide a black plastic bezel onto each end of the unit. The box looks better if the two small molding marks are facing towards the bottom of the unit.
3) Reattach the bezels to the chassis with the four small black screws you removed earlier. Be careful not to strip the threads in the aluminum side extrusions!

LTC READER OPERATIONS

The AEC-BOX-30 and AEC-BOX-32 have an LTC reader which uses a proprietary chip to read the LTC input signal present at the "LTC IN" RCA jack. The reader will properly read both SMPTE and EBU LTC signals in both the forward and reverse directions, with LTC input signal levels ranging from 100mVpp to 10Vpp, and at tape speeds from 1/10x to 50x play speed.

If the LTC input signal is severely distorted, as is often the case when tape machines are played back at speeds below 1/2x, the reader may not be able to decode the LTC signal without errors. The lowest useable speed is highly dependent on the tape and tape machine that you are using, so you'll just have to use trial and error to find out what the minimum useable speed is. Even a single bit error out of the 80 in each LTC frame is enough to invalidate the entire frame.

If LTC read errors are detected, the VTR's control track counter ("Timer 1") will be used to adjust the previous LTC count as needed to keep it approximately correct. When jogging or shuttling at very low speeds, where LTC cannot be read, the control track pulses will be used exclusively. The resulting "interpolated LTC" data will be corrected as soon as a valid LTC frame is read.

LTC GENERATOR OPERATIONS

This page only applies if you have purchased the AEC-BOX-30G.

The LTC output signal is generated directly by the microcomputer chip. See the "HARDWARE DESCRIPTION" section for details.

The starting generator time, user, and embedded bits are normally taken from the last good LTC reader data. Some edit controllers allow you to preset the generator time and user bit data yourself. The AEC-BOX-30G cannot be used as a standalone LTC generator - a "Sony Protocol" edit controller is always required.

The LTC generator is activated only by a RECORD, ASSEMBLE EDIT, or INSERT EDIT (with LTC channel selected) command from the controller. Directly pressing the RECORD button on your VTR, for instance, will not activate the AEC-BOX-30G's LTC generator.

While running, the generator automatically updates its count every LTC frame. The current generator time can be read out via the serial port, just like the LTC reader data normally is.

The LTC generator automatically aligns itself (synchronizes) with the "VIDEO SYNC" input if present. Otherwise the generator will "freerun", using an imperfect internal timebase, which over the course of an hour can lead to time code errors of several seconds. For this reason we strongly recommend that you loop the video input signal going to your VTR through the AEC-BOX-30G, so that the two will always be "in sync" with each other.

If the video sync input disappears, or if any video sync errors are detected, the LTC generator will "coast" as long as necessary, automatically incrementing the time count every frame. When (if) the video sync input reappears, the LTC generator will smoothly realign itself with the video sync input within 1 second.

The AEC-BOX-30G does not have the ability to detect color subcarrier phase, so the LTC generator cannot properly color frame or color lock the LTC output.

VITC READER OPERATIONS

The AEC-BOX-31 and AEC-BOX-32 have a VITC reader which uses a proprietary chip to read VITC from the video signal present at the "VITC IN" BNC's. The VITC reader also filters out noise, and includes automatic level sensing circuits to compensate for input levels other than the nominal 1Vpp.

The VITC signal is usually present on two nonadjacent lines (for redundancy) in each vertical interval. Lines 10-20 are normally used with NTSC, and lines 6-22 are normally used with PAL. The box automatically selects SMPTE/NTSC or EBU/PAL based on the ID code returned by the VTR during box initializations. Thus no setup work is required of you for the two different standards.

The two VITC line numbers to be used are stored in the EEPROM. You can change these numbers at any time via DIP switch programming (see page 12).

The factory default setting of "0" for both lines tells the VITC reader to read the first two lines which it thinks have VITC on them. If other signals are present in the vertical interval, such as teletext or a second set of VITC lines, it may get confused. In this case, you may want to specify which line numbers to use (via DIP switch programming). For NTSC, lines 10-25 are accepted. For PAL, lines 6-25 are accepted. The second line number should always be greater than or equal to the first line number. The box will force the numbers to be valid if you choose something which it can't understand.

If a nonstandard vertical sync pulse is detected, which is the case with some VTR's at anything other than play speed, the VITC reader will be unable to properly count video lines. In this case, the VITC reader will read the first two lines it finds (if any) which have VITC on them, regardless of your EEPROM settings.

It is also important to note that those VTR's which generate nonstandard vertical sync pulses often obliterate whatever is on NTSC lines 10-12. PAL machines undoubtedly do similar things. Thus if you are using these type VTR's, and if you have a choice, it is best to place VITC on some of the higher numbered lines.

The ability to read VITC at other than play speed is highly machine dependent. With some tape machines we have been able to read VITC at up to +10 times play speed. Other tape machines destroy or distort the VITC waveforms at some speeds, yet work fine at both higher and lower speeds. Experimentation on your part is usually in order. We'd like to hear about your findings.

VITC READER OPERATIONS
(continued)

The VITC reader always uses the data read from the first VITC line, if it is OK. Otherwise it will use the data read from the second VITC line, if that is OK. If both lines are bad, the data is ignored.

If VITC read errors are detected, the VTR's control track counter ("Timer 1") will be used to adjust the previous VITC count as needed to keep it approximately correct. When shuttling at high tape speeds, where VITC cannot be read, the control track pulses will be used exclusively. The resulting "interpolated VITC" data will be corrected as soon as a valid VITC frame is read.

VITC read errors are a fact of life, even with good tape machines. The CRC byte in each VITC word provides fairly good error detection capability, but does not eliminate 100% of bad data. So, in addition to the CRC check, our software checks the data in each VITC frame, and discards it (up to three times) if it appears to be radically different from the previous VITC frame.

AUTO LTC/VITC READER OPERATIONS

This section only applies to the AEC-BOX-32, which can read both LTC and VITC simultaneously.

Make sure you have read both the LTC READER OPERATIONS and VITC READER OPERATIONS sections of this manual first.

The AEC-BOX-32 selects either LTC or VITC, then stays with that signal until it goes bad, whereupon it tries the other. If both signals are bad, the box will continuously switch back and forth between the two until it finds a good one. Time delays are built in so that this mode switching will not occur if just a few frames are unreadable.

As with the LTC and VITC reader cases, whenever the AEC-BOX-32's currently selected reader detects bad (or missing) time code, the VTR's control track counter will be used to modify the LTC/VITC data and keep it up to date.

AEC-BOX-30 LED OPERATIONS

The so called "POWER" LED on the front of the box behaves in a variety of ways so that you can have some clues as to what is (or is not) going on inside the box.

When power is first turned on, a hardware reset circuit forces the LED to blink ON for a short (barely noticeable) time. If this fails to happen, there is something seriously wrong with the power supply or LED. Check the TROUBLESHOOTING section on page 21 for details.

If the LED blinks on initially, but then fails to come on any more, there must be some kind of serious hardware/software problem. Again, check the TROUBLESHOOTING section on page 21 for details.

If the LED blinks OFF occasionally (or constantly), the box is working OK, but it is indicating that there is something unusual with the time code and/or serial data signals which are coming into the box.

The most serious problems, which blink the LED off for about 500ms per occurrence, are any serial data reception errors. These may include random communication errors (like parity or framing errors), no response from the VTR, or protocol errors.

The other possible problems are LTC/VITC read errors. If both signals are missing or unreadable for one full second, the LED will blink off for about 50ms (a very short period). The LED will then continue to blink once per second until at least one of the time code inputs is restored.

For the AEC-BOX-30G, the LED will also blink off for about 50ms (a very short period) if the video sync input is missing while in a record or edit mode (whenever the LTC generator is active).

Note that no matter how many errors are detected, the LED will always come on at least once per second. This way you will know that the power supply is OK.

If the "POWER" LED stays on all the time, everything must be running perfectly, and you can go read something else.

AEC-BOX-30 TROUBLESHOOTING GUIDE

This guide lists anticipated problems and their solutions. If you really get stuck, call our Service Department.

Problem #1: Power LED does not blink ON when power is applied:
Solutions :
a) Check for presence of external AC power source.
b) Make sure AC voltage agrees with box wiring.
c) Turn OFF for 1 minute, then turn back on. Thermal "fuse" will then be cooled and reset.
d) Fix broken LED wiring.
e) Return AEC-BOX for power supply repairs.

Problem #2: Power LED blinks ON initially, then stays off:
Solutions :
a) Return AEC-BOX for repairs.

Problem #3: Power LED blinks OFF during operations:
Solutions :
a) See the LED OPERATIONS section of this manual. Something is wrong with LTC/VITC input signals, or there are communication problems.

Problem #4: AEC-BOX-30 indicates no connection to the VTR:
Solutions :
a) Turn on power to the VTR.
b) Enable the VTR's serial remote control port.
c) Check the cable for shorts, opens, crossed wires.
d) Check box and/or cables by installing TX/RX line shorts, then turn on the box. LED will flash quickly if this loopback test is OK.

Problem #5: AEC-BOX-30 is not talking to the controller:
Solutions :
a) Turn on power to the box (check LED).
b) Check the cable for shorts, opens, crossed wires.
c) Make sure controller UART parameters (38400 baud, eight data bits, ODD parity) are set properly.
d) Connect controller directly to VTR and see if the problem goes away (checks controller and cable).

Problem #6: Messages from AEC-BOX-30 are incomplete:
Solutions :
a) The controller must be able to receive ALL bytes in a message without any OVERRUN errors, even if interrupts occur during reception. Change interrupt priorities, disable some, etc.
b) Inspect the cable for intermittent problems.

Problem #7: Some time code counts are missing:
Solutions :
a) Poll the box more frequently so you don't miss any. At high tape speeds, may be impossible.
b) SMPTE drop frame counting eliminates some counts.
c) Use a higher quality tape and/or VTR which does not have any dropouts, bit errors, etc..

Problem #8: Edits do not happen in exactly the right place:
Solutions :
a) Adjust edit offsets via DIP switch programming (see page 12).

WARRANTY REGISTRATION

We no longer have a formal warranty registration procedure, but do like to keep in touch with our end users. If you did not purchase this product directly from us, please copy the User Feedback Request form in the back of this manual, fill it out, then fax or mail it back to us. This way we will know who and where you are and be able to provide you with the following:

1) product upgrade and and bug reports,
2) manual updates and application notes,
3) safety/recall notices, and
4) better service in many other ways.

OUR WARRANTY

For the first two years following the shipment of an AEC product, we will repair or replace, at our option, any such product which is found to be inoperative due to defects in materials or workmanship. Not covered is damage due to unusual electrical and/or physical abuse. Altered hardware, software, labels, or other identifying marks may also void the warranty.

GENERAL GUIDELINES

Before sending a product back to us for service, please do the following (we've found over 90% of returned items work fine):

1) Check the "Troubleshooting Guide" in this manual.
2) Call our Service Department for assistance if needed.
3) Obtain our current return address, and possibly an RMA number, before shipping anything back to us.
4) Package the unit carefully before shipping it (it's yours).

WARRANTY SERVICE PROCEDURES

All you have to do is call our Service Department and describe the nature of the problem. We will attempt to fix it over the phone, but if that doesn't work we will give you an RMA number and you can ship the defective product back to us. We will repair or replace the product and return it to you as soon as possible.

OUT-OF-WARRANTY SERVICE PROCEDURES

If the two year warranty period has expired, or if the product has been altered or damaged, we will repair the product for a charge to be agreed upon before the repairs are begun. Call our Service Department for assistance. We have the test equipment, parts, and experience to quickly find and fix any problems.

VTR, TAPE, AND TIME CODE REQUIREMENTS

The following are required in order for the AEC-BOX-30 family of serial data inserters to operate properly:

1) A proper installation of AC power, all cables, the VTR, etc..

2) DIP switches set properly (use factory defaults if needed).

3) Time code must be present and of good quality.

4) Time codes must be sequential (no jumping around) in order for searches, prerolls, auto edits, etc. to work properly.

5) For searches and prerolls, it is always assumed that the destination time code is within 11 hours of the current time.

6) LTC frames must be aligned closely with their associated video frames (a tolerance of +1/4 field is permitted).

7) If both LTC and VITC are being used, they must agree exactly with each other at all times.

NUMBER SYSTEM CONVERSION TABLE

This chart will help you make conversions between the various numbering systems which are used in this manual.

Hexadecimal	(MSB) Binary (LSB)	Decimal	BCD
0	0 0 0 0	0	0
1	0 0 0 1	1	1
2	0 0 1 0	2	2
3	0 0 1 1	3	3
4	0 1 0 0	4	4
5	0 1 0 1	5	5
6	0 1 1 0	6	6
7	0 1 1 1	7	7
8	1 0 0 0	8	8
9	1 0 0 1	9	9
A	1 0 1 0	10	invalid
B	1 0 1 1	11	invalid
C	1 1 0 0	12	invalid
D	1 1 0 1	13	invalid
E	1 1 1 0	14	invalid
F	1 1 1 1	15	invalid
(base 16)	(base 2)	(base 10)	

(BCD is an abbreviation for "Binary Coded Decimal")

PACKED BCD NUMBERS

A "packed BCD" byte contains two BCD digits in an 8-bit byte. Bits 7-4 (upper nibble) contain the upper BCD digit, and bits 3-0 (lower nibble) contain the lower BCD digit.

For example, incrementing BINARY 09h leaves you with 0Ah, but incrementing PACKED BCD 09h leaves you with 10h. A packed BCD number such as 0Ah would be invalid, because "A" is not a valid BCD digit.

Here is one more example, showing the packed BCD format as used for time bits I/O. The 30 second (half minute) mark would be read (or written) as a 30h byte, even though 30 decimal is the same as binary 1Eh.