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Software Revision:_____

AEC-BOX-88
SIMPLE SERIAL ADAPTER FOR PARALLEL REMOTE DEVICES
INSTRUCTION MANUAL

ADRIENNE ELECTRONICS
CORPORATION

First Edition February 1997

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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.

*** TRADEMARK NOTICES ***

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INTRODUCTION

Adrienne Electronics Corporation (AEC) developed the AEC-BOX-88 in order to provide a simple and low cost way of controlling a variety of parallel remote devices via a variety of RS232/RS422 serial remote controllers. This box monitors its serial interface, sends the appropriate signals to the parallel device, and feeds the parallel device's tally outputs back to the serial controller. The AEC-BOX-88 is designed for simple machine control applications only, not for shuttling or editing.

The AEC-BOX-88 parallel control outputs are open collector, active low, capable of sinking up to 20mA, with 10kohm resistor pullups to +5V. This is sufficient for driving optoisolators, LED's, and logic gates. Basic functions such as PLAY, PAUS, STOP, FFWD, REWD, and RECD are implemented.

The parallel tally inputs are active low, with 10kohm resistor pullups to an internal +5V supply. They can be driven by relay closures, pushbuttons, open collectors, 5V logic signals, etc..

The AEC-BOX-88 can (in theory) be used to control many different parallel remote devices. Please let us know if you need something a little different, or if you come up with any ideas on how to improve the existing product. Thanks.

GETTING STARTED QUICKLY

If you want to use your AEC-BOX-88 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 37-pin "TO PARALLEL REMOTE" connector to the parallel port on the device being controlled. Refer to page 7 if you need to make your own parallel cable.
3) Use a serial data cable to connect the 9-pin RS232/RS422 "SERIAL CONTROL" connector (on the box) to your serial controller. Note that this connector has a standard 9-pin RS422 pinout, but has a NONSTANDARD RS232 PINOUT (is NOT the same as IBM PC/AT's). See page 6 if needed.

If any serial communications errors are detected, the "STATUS" LED will blink OFF periodically. If something doesn't work, you will have to carefully read the INSTALLATION, LED OPERATIONS, and/or TROUBLESHOOTING sections of this manual. Looking through this entire manual will enhance your use and enjoyment of this product, and is thus highly recommended.

AEC-BOX-88 SPECIFICATIONS

PARALLEL CONTROL OUTPUTS:

Impedance	10kohms to +5V typical
Logic LOW Level	+0.4V maximum @ -20mA
Logic HIGH Level	+4.0V minimum @ 50uA
Polarity	Active LOW
Pulse Width	50ms typical
Response Time (2)	5ms maximum

PARALLEL TALLY INPUTS:

Impedance	10kohms to +5V typical
Logic LOW Level	+0.8V maximum
Logic HIGH Level	+2.4V minimum
Polarity	Active LOW
Response Time (3)	5ms maximum

AUXILIARY +5V SUPPLY OUTPUT:

Output Voltage	+4.5V to +5.5V
Output Current	+80mA maximum (100mA current limited)

MISCELLANEOUS:

Box Dimensions (4)	16cm wide x 5cm high x 21cm long
Box Weight	1.2kg
Power Consumption	4W
Temperature Range	0 to 50 degrees Centigrade
Relative Humidity	Up to 95%, noncondensing

Notes:
(1) All specifications are subject to change without notice.
(2) Time from valid serial command to output LOW.
(3) Time from input LOW to serial status change.
(4) Allow at least 6cm front and rear for cables and connectors.

"SERIAL CONTROL" RS422 CONNECTIONS:
This 9-pin D connector has the same pinout as is found on most broadcast quality VTR's. Thus a standard 9-pin RS422 cable with no crossed lines will make the proper connection to the controller. If you are making your own RS422 cable, the following chart indicates the pinout of this connector:

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

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

"SERIAL CONTROL" RS232 CONNECTIONS:
This 9-pin D connector has a NONSTANDARD RS232 PINOUT (is NOT the same as found on IBM PC/AT's). Thus A CUSTOM RS232 CABLE IS REQUIRED to make the proper connection to a controller having a standard pinout RS232 port. We of course recommend that you purchase such a cable from us (see ordering guide in the back of this manual). If you must make your own RS232 cable, the following chart indicates the pinout of this RS232 connector:

Pin #	Function
5	Transmit Data
8	Receive Data
9	Chassis GND

Notes:
1) Tiny pin numbers are molded into the connector face.
   Be careful not to be "off by one".
2) Our transmit line should be connected to the controller's
   receive line, and vice-versa.

"TO PARALLEL REMOTE" POWER CONNECTIONS:
The 37-pin D connector contains the following power/ground pins:

Pin #	Function	Mnemonic
8	Aux +5V Supply	PWR
33	Chassis Ground	GND

"TO PARALLEL REMOTE" CONTROL OUTPUT CONNECTIONS:
The 37-pin D connector contains the following control output pins:

Pin #	Function	Mnemonic
9	-Play	PLAY
10	-Pause (Standby ON)	PAUS
11	-Stop (Standby OFF)	STOP
12	------	----
13	-Fast Forward	FFWD
14	-Rewind	REWD
25	-Eject	EJCT
26	-Record	RECD

Notes:
1) Tiny pin numbers are molded into the connector face.
   Be careful not to be "off by one".
2) All outputs are active LOW (are pulled to GND when valid).

"TO PARALLEL REMOTE" TALLY INPUT CONNECTIONS:
The 37-pin D connector contains the following tally input pins:

Pin #	Function	Mnemonic	Priority
20	-Eject	EJCT	1
21	-Record	RECD	2
6	-Rewind	REWD	3
5	-Fast Forward	FFWD	4
4	-Local (always enabled)	LOCL	-
3	-Stop (Standby OFF)	STOP	5
2	-Pause (Standby ON)	PAUS	6
1	-Play	PLAY	7

Notes:
1) Tiny pin numbers are molded into the connector face.
   Be careful not to be "off by one".
2) All inputs are active LOW (must pull to GND to activate).
3) If several inputs are LOW, the highest priority input will be
   used, and the rest will be ignored.

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 Box:
Change the markings on the rear panel as necessary to reflect the AC voltage that the box is wired to accept, so that the next person to use this AEC-BOX (possibly yourself) will know what AC power input voltage it expects to see.

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 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.

DIP SWITCH PROGRAMMING

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 the 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!

DIP Switch Functionality:

Switch	Function
8	(reserved)
7	(reserved)
6	(reserved)
5	(reserved)
4	(reserved)
3	(reserved)
2	(reserved)
1	(reserved)

These switches will be defined as the product evolves...

Factory Default Setting:
Unless you requested otherwise, the factory default setting is Sony Broadcast Protocol, with Generic Machine Control, and SW1 will normally be 00000000 for switches 8-1, respectively.

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!

Throughout the following discussion you may want to refer to the AEC-BOX-88 schematics which are in the back of this manual. If your box has been customized in any way for your application, then the descriptions below 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 3 minutes to let it cool/reset, then turn the power back on. The power supply secondary side starts with full wave rectifier DB1, plus large filter capacitors C51 and C52. The resulting unregulated DC supply is then passed through voltage regulator U21(+5V). Zener diodes D18 and D19 protect against overvoltages.

Output latch U17 drives the control output lines via open collector transistors Q26-Q33. Resistor network RN23 provides a 10kohm pullup (to +5V) for each output line. The drivers for the control output lines are specially designed to ensure that no RF emissions will creep out of the box through these lines.

Input buffer U20 is used by the microcomputer to read the status of the parallel input tally lines. These digital inputs are then debounced via software to avoid problems. Resistor network RN16 provides a 10kohm pullup (to +5V) for each input line. Resistor networks RN20 and RN21 protect U20 against transient damage.

Microcomputer U7, together with address latch U3 and EPROM U5, form a completely self contained (but miniature) computer system. DIP switch SW1 allows easy modification of box operating modes and other features. A low voltage reset circuit and a watch dog timer inside U7 improve system reliability.

Serial data from microcomputer U7 is translated to RS232 levels by U2, and is translated to RS422 levels by U1. U1 also translates received RS232 and RS422 data for use by the microcomputer. Nine pin "D" connector J1 contains the RS232 and RS422 data lines.

AEC-BOX-88 GENERAL OPERATIONS OVERVIEW

The AEC-BOX-88 waits for a message from the controller to arrive via the serial port, then pulls the appropriate control output line(s) low for a short period of time, just as if you were pushing a button on the front of the machine yourself. Control messages are buffered (up to a point) because serial commands can arrive much faster than the "buttons can be pushed" on the device being controlled. Any messages received which do not have a corresponding control output line are acknowledged but not acted upon (helps maintain compatibility with existing controllers).

The AEC-BOX-88 also continuously scans, debounces, and prioritizes the parallel tally input lines. The priorities of the various tally input lines are shown in the table on page 7. If two or more tally input lines are being held low simultaneously, only the status message associated with the highest priority tally input line is returned to the controller.

The "LOCAL" tally input line is active whenever the controlled device is in "local control only" mode. This line has no priority because it does not interfere with any of the others and because it is always enabled. For example, it is quite possible for the "LOCAL" and "REWIND" lines to be active at the same time.

The "STATUS" LED on the front of the box will blink OFF if the box feels that something abnormal is going on. See the LED OPERATIONS section on page 14 for details.

STOP/PAUSE/STILL/STANDBY NOTES

You may have already noticed that the AEC-BOX-88 provides two separate outputs for stopping the tape (other than EJECT):

1) "PAUSE (STANDBY ON)" means that the scanner is spinning, the tape tension is ON, and the video output is in playback mode. This mode is typically used just prior to entering PLAY mode, since the VTR is ready to roll immediately. This is the normal response to a "Sony Protocol STOP" (2000) command.

2) "STOP (STANDBY OFF)" means that the scanner is OFF, tape tension is OFF, and the video output is in E-E mode. Minimizes tape/head/scanner wear, but takes time to spin up. This is the normal response to a "Sony Protocol STANDBY OFF" (2004) command.

There is a LOT of variation and confusion in the industry as to how machines implement STOP, PAUSE, STILL, and STANDBY. In addition, most machines will shut themselves down automatically (to save head and tape wear) after predetermined periods of inactivity. We'll leave it up to you to select the commands which are most appropriate for your situation.

AEC-BOX-88 LED OPERATIONS

The "STATUS" 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 16 for details.

If the LED blinks on initially, but then fails to come on any more, there must be some kind of hardware/software problem. This condition usually indicates an EPROM checksum error caused by improper user modifications (contact factory).

Thereafter, if the LED blinks OFF occasionally (or constantly), the box hardware is working OK, but it is indicating that there is something unusual going on inside the box.

Serial data reception errors will cause the LED will blink off for about 500ms, after which it stays ON for at least 500ms. Continual data reception errors will thus cause the LED to toggle at a 1Hz rate. These may include setup errors (wrong baud rate, parity, etc.), random communication errors (like parity or framing errors), or protocol errors.

Diagnostic modes normally cause the LED to blink ON twice per second. This is easy to distinguish from normal operations. Some of the diagnostic modes modify this blink pattern when a particular test is OK, etc.. See page 15 for details.

Note that no matter what mode the box is in, and no matter how many errors are indicated, the LED will always come on at least once per second. This way you will know that the power supply and software are still OK.

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

AEC-BOX-88 DIAGNOSTICS

In our experience, whatever can go wrong will go wrong, so we have included several diagnostic routines to help you debug your system, cables, and to verify that our box is working properly. As mentioned on the LED OPERATIONS page, the STATUS LED normally blinks ON twice per second when the box is in any diagnostic mode. See page 10 for important DIP switch setting instructions:

Parallel Output/Input Loopback Test:
Set DIP switches 8-1 to 11111111 respectively.
Use a piece of wire to short any parallel output pin to any parallel input pin. For example, short pin 1 to pin 9 on the 37-pin "D" connector. The box LED will toggle at 8Hz (much faster than normal) if the selected output/input lines are both OK. See page 7 for a listing of all the parallel output/input pins.

Parallel Output Strobe Test (Short Version):
Set DIP switches 8-1 to 11111110 respectively.
As soon as the box has been turned on, it will pull each parallel output pin low for 50ms, with 5 seconds between tests, until each output pin has been tested (loops indefinitely). An oscilloscope is required if you want to view these pulses. You can also perform this test with the parallel cable connected, in order to see how the controlled device responds to each of the strobes. You may want to connect just one wire between the AEC-BOX-88 and the controlled device if you want to see how it responds to only one of the output pins. See page 7 for output pin assignments.

Parallel Output Strobe Test (Long Version):
Set DIP switches 8-1 to 11111100 respectively.
Same as above, except long (2000ms) pulses are used to allow checking voltage levels with voltmeters. May also be useful if your device does not respond properly to the short pulses.

RS232 Serial Loopback Test:
Set DIP switches 8-1 to 11111111 respectively.
Make sure the parallel port cable is disconnected so that it does not interfere with this test. Then use a piece of wire to short pin 5 to pin 8 on the box's 9-pin "D" connector. The box LED will toggle at 8Hz (much faster than normal) if the RS232 transmit and receive circuits are OK.

RS422 Serial Loopback Test:
Same as above, but short pin 2 to pin 8, and short pin 3 to pin 7, on the box's 9-pin "D" connector. Fast LED toggling indicates that the RS422 transmit and receive circuits are OK. If not, make sure that you are shorting the right pins to each other, as it is very easy to be "off by one".

AEC-BOX-88 TROUBLESHOOTING GUIDE

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

Problem #1: Status 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) Leave off for 3 minutes, 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: Status LED blinks ON initially, then stays off:
Solutions :
a) Put original AEC-BOX-88 EPROM back in place.
b) Return AEC-BOX for repairs.

Problem #3: Status LED blinks OFF during operations:
Solutions :
a) See the LED OPERATIONS section of this manual.

Problem #4: Box isn't controlling the device properly:
Solutions :
a) Remove and check the parallel cable wiring again.
Look for opens, shorts, wrong pins, etc..
b) Remember that control outputs are active LOW.
c) Make sure the DIP switch settings are appropriate
for the type of device being controlled.
d) Check serial cable and controller functionality.
e) Try parallel output diagnostic tests (page 15).

Problem #5: Tally status bits are incorrect:
Solutions :
a) Remove and check the tally cable wiring again.
Look for opens, shorts, wrong pins, etc..
b) Remember that tally inputs must be active LOW.
c) Make sure the DIP switch settings are appropriate
for the type of device being monitored.
d) Check to see if the controlled device is pulling
down the proper lines at the proper times.
It may be pulling down several lines at once.
e) Try parallel loopback diagnostic (see page 15).

Problem #6: Auxiliary +5V output isn't working:
Solutions :
a) Make sure power to box is on (check STATUS LED).
b) Make sure you are looking at the correct pin 8.
c) Check for overloading (is rated at 80mA maximum).
d) Remove your load, allow regulator chip to cool
for several minutes. If +5V output then works
for a few seconds before shutting down, it is
being overloaded by your circuitry.
e) Replace your load with a 62ohm 1W resistor
to ground. Should work fine (load test).

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.

SERIAL INTERFACE STANDARDS

For more information on any of these standards, contact the appropriate agency as indicated on page 19.

RS232 Standard:
Interface signals are inverted versions of the UART (TXD & RXD) signals. A valid "1" is -5V to -15V. A valid "0" is +5V to +15V. Since RS232 drivers are always on, you can't bus them together, which makes RS232 strictly a point-to-point communication link. RS232 is THE most commonly used interface in the computer industry, and is usually seen as a 25pin "D" connector on modems, terminals, serial ports (like IBM PC COM1 and COM2), and just about any type of peripheral you can think of. Cables should be limited to 30 meters max, and the data rate should be limited to 19200 baud max, in accordance with the RS232 standard. The AEC-BOX-88 does not have (and does not need) any of the handshake lines which are used by many RS232 devices.

RS422 Standard:
The RS422 transmission standard allows for cables up to 1200 meters long, and data rates up to 10Megabaud. It uses differential (2 complementary line) transmitters and receivers, which greatly reduces sensitivity to common mode noise. In addition, the transmitters can be set to a high impedance (Hi-Z) state, which in theory allows several transmitters to share a pair of data lines. However, the AEC-BOX-88 always leaves its RS422 drivers enabled, so they can only be used for point-to-point communications. For the "+" output, typical output low voltages are about 0V, and typical output high voltages are about +4V. For the "-" output, the signal polarity is reversed.

ESbus Standard:
The ESbus (EBU/SMPTE Machine Control Bus) is used in the television industry to control VTR's, routers, switchers, mixers, and other equipment. The pinout of the AEC-BOX's 9-pin "D" connector is that of an ESbus tributary. The AEC-BOX-88's standard "Sony Protocol" has some similarities with the ESbus standard (like 38400 baud), but it is not truly ESbus compatible.

WHERE/HOW TO ORDER COPIES OF STANDARDS

We suggest that you fax, call, or write the organizations below for current prices and ordering/payment procedures. Due to copyright restrictions, we cannot provide standards copies for you. It takes some of these organizations up to 2 months to respond, so plan ahead. Also, please let us know if you find anything on this page which needs updating. Thanks.

SMPTE Engineering Standards Service
595 West Hartsdale Avenue
White Plains, NY 10607
U.S.A.
Tel: +1-914-761-1100 Fax: +1-914-761-3115

1)	SMPTE 207M-1992	ESbus Electrical/Mechanical	$16.00
2)	SMPTE RP113-1992	ESbus Supervisory Protocol	$16.00
3)	SMPTE RP138-1992	ESbus Control Message Architecture	$13.00
4)	SMPTE RP139-1992	ESbus Tributary Interconnection	$16.00
5)	SMPTE RP163-1992	ESbus System Service Messages	$16.00
6)	SMPTE RP170-1993	ESbus VTR-Specific Messages	$24.00
7)	SMPTE RP172-1993	ESbus Common Messages	$18.00
8)	SMPTE 12M-1986	Time and Control Code for Television	$16.00
9)	SMPTE 262M	Data Storage & Trans. - Binary Groups	$13.00
A)	SMPTE RP159-1991	VITC and LTC Relationship	$10.00
B)	SMPTE RP164-1992	Location of VITC	$10.00

European Broadcasting Union (EBU)
Technical Department
Case Postale 67
CH-1218 Grand-Saconnex/Geneve
SWITZERLAND
Tel: +41-22-717.21.11 Fax: +41-22-717.24.81
You must order the "Annual Volume of EBU Official Technical Texts",
which (for 250 Swiss Francs) includes the following:

1) N12 Time & Control Codes for Television
2) N18 Relationship Between Time Code and PAL 8-Field Sequence
3) I29 Recording of Information in User Bits

Telecommunications Industry Association (TIA)
(formerly part of Electronic Industries Association - EIA)
2500 Wilson Blvd.
Arlington, VA 22201
U.S.A.
Tel: +1-703-907-7700 Fax: +1-703-907-7727
These standards are sold only by Global Engineering Documents:
Tel: 1-800-854-7179 Tel: +1-303-397-2573 Fax: +1-303-397-2740

1)	TIA/EIA Standard RS232-E	$49.00
2)	TIA/EIA Standard RS422-A	$51.00
3)	TIA/EIA Standard RS485	$60.00

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.