# I. INTRODUCTION

This manual covers the **IMPRESSION, EXPRESSION** and **CONCEPT500** consoles. Since all three consoles share the same basic hardware, the following terminology is used to distinguish them:

- All circuit boards and schematics are labeled "EXPN-4xx"; these are the part numbers found on the silk screen of each ciruit board. Discussions in which there are no differences between console hardware will reference the circuit board as "**EXPN-4xx**".

- Each circuit board is manufactured as either an **IMPRESSION, EXPRESSION,** or **CONCEPT** part; the serial number tag on each board identifies which console family it belongs to. Discussions specific to a particular console will reference the part as "***IMPN-4XX***", "***EXPN-4XX***" or "***CNCP-4XX***".

- The discussions that follow will refer to **EXPRESSION** and **EXPN-4XX**; where **IMPRESSION** and **CONCEPT 500** differences exist, a separate section is included.

- The circuit board number designations are:
  - -430: Main Processor Board
  - -431: Face Panel Processor Board
  - -432: Submaster Circuit Board
  - -433: Slave Processor Expansion Circuit Board

- Signal lines are printed in bold underline: "**ACK1**"
- Active low signals are identified by asterisks: "**ACK2***".
- Component parts and U numbers are printed in bold: "**U2 (74LS374)**".
- Revision A and B circuit board silk screens use I-numbers (**I35**), revision C circuit boards use U-numbers (**U35**); the component numbers are the same on all circuit boards. This manual refers to all circuit components by U-numbers.

This manual covers features supported by software version 1.51; earlier software versions do not support some of the features described, and future software releases will provide capabilities not described herein. Addendums covering changes and improvements are available upon request.

## A. PRODUCT DESCRIPTION

The **IMPRESSION, EXPRESSION** and **CONCEPT500** lighting control consoles constitute a family of products based upon similar core hardware. The consoles differ primarily in standard and optional features:

### IMPRESSION:

**STANDARD FEATURES:**

- 150 Control Channels controlling up to 512 dimmers
- 24 Programmable Submasters with Bump Switches
  (12 additive, 12 additive or inhibitive)
- 2 Autofader pairs, a Grand Master fader, and a Fader Wheel
- Progamming, execution and display functions accessable via keypads
- Show memory is retained in non-volatile memory and on a built in 3.5" floppy disk
- DMX512 digital dimmer outputs
- Serial and parallel printer support
- Monochrome monitor

**INTERNAL OPTIONS:**

- 192 Analog Wire-per-Dimmer Outputs (expandable in groups of 96)
- 384 Analog Multiplex Dimmer Outputs (expandable in groups of 192)
- 150 Manual Inputs (expandable in groups of 32)
- Colortran D-192, AVAB digital ouputs
- Real-Time Clock

**EXTERNAL OPTIONS:**

- RGB Color monitor (works in addition to the monochrome RS-170 video output)
- Hand Held Remote Focus Unit
- Remote Go capabilities (opto-isolated)
- **MIDI** support
- MS-DOS disk translation and editing (**"ETCEDIT"**)
- External RS-232 console control (**Serial Button Protocol**)
- Redundant Tracking

# I. INTRODUCTION

## A. PRODUCT DESCRIPTION

**EXPRESSION** adds the following over **IMPRESSION:**

**STANDARD FEATURES:**

- 250 Control Channels
- Programmable Macro keys (up to 125)
- Subroutines and Effects
- Color RGB monitor

**INTERNAL OPTIONS:**

- 192 Manual Inputs (expandable in groups of 32)
- 1024 DMX digital dimmer outputs

**EXTERNAL OPTIONS:**

- Monochrome RS-170 monitor (works in addition to the RGB color video output)
- Remote Go capabilities (opto-isolated), assignable to macros
- Designer's Work Sheet
- External keyboard
- External trackball

**CONCEPT500** adds the following over **EXPRESSION:**

**STANDARD FEATURES:**

- 500 Control Channels controlling up to 1500 dimmers
- Dual screen video output
- (2) Color RGB monitors

**INTERNAL OPTIONS:**

- Analog outputs are not available as an internal option on **CONCEPT500**

**EXTERNAL OPTIONS:**

- Monochrome composite RS-170 monitors (work in addition to the RGB color video output)
- Analog Wire per Dimmer outputs (expandable in blocks of 96 up to 1500 dimmer outputs)

# II. BASIC SYSTEM HARDWARE

## A. OVERVIEW

The **EXPRESSION LIGHTING CONTROL SYSTEM** incorporates two Processor-based circuit boards, a Submaster circuit board, a Power Supply, a Disk Drive, and a Fader Wheel, all housed in a single package.

Provisions are made within this package to house all the option cards, and rear panel cut-outs are present for all standard features and options.

### 1. MECHANICAL

The **EXPRESSION** basic configuration is designed for ease of access for service and assembly, and is highly integrated with circuit board design and rear panel access. The back panel features a removable Plexiglass window for access to the configuration dipswitches and indicator LEDs.

The basic structure consists of a Bottom Tray with back panel, and a hinged Face Panel assembly.

The Bottom Tray contains the main Processor card (**EXPN-430**), the power supply, all rear panel connectors and cut-outs, and mounting hardware for optional input and output cards.

The Face Panel assembly contains the Face Panel Processor board (**EXPN-431**), the Submaster board (**EXPN-432**), the Fader Wheel, the Disk Drive, and the Power and Record Lock Out switches.

These two halves of the structure are hinge attached at the rear knobs, which act as bearings for the hinge. The front knobs are threaded and act as securing bolts.

To open the console, unscrew the front knobs about a quarter of an inch (they are both normally threaded), and lift up at the front. The Face Panel assembly will now open to a vertical position.

**WARNING:** the Face Panel is heavier than the Bottom Tray, so precautions must be taken to prevent the console from tipping over backwards when open. This may be accomplished by providing a cushioned back drop, or by wooden sticks used either as hood props or hinge catches.

## 2. ELECTRICAL

### a) AC Power

AC POWER is routed from the rear panel power input connector and EMI/RF/SURGE PROTECTOR through a 5 AMP fuse to the power keyswitch in the Face Panel. The keyswitch switches the hot line to the rear panel AC accessory outlet and the DC power supply. AC (earth) ground is tied directly to the console sheet metal for operator safety.

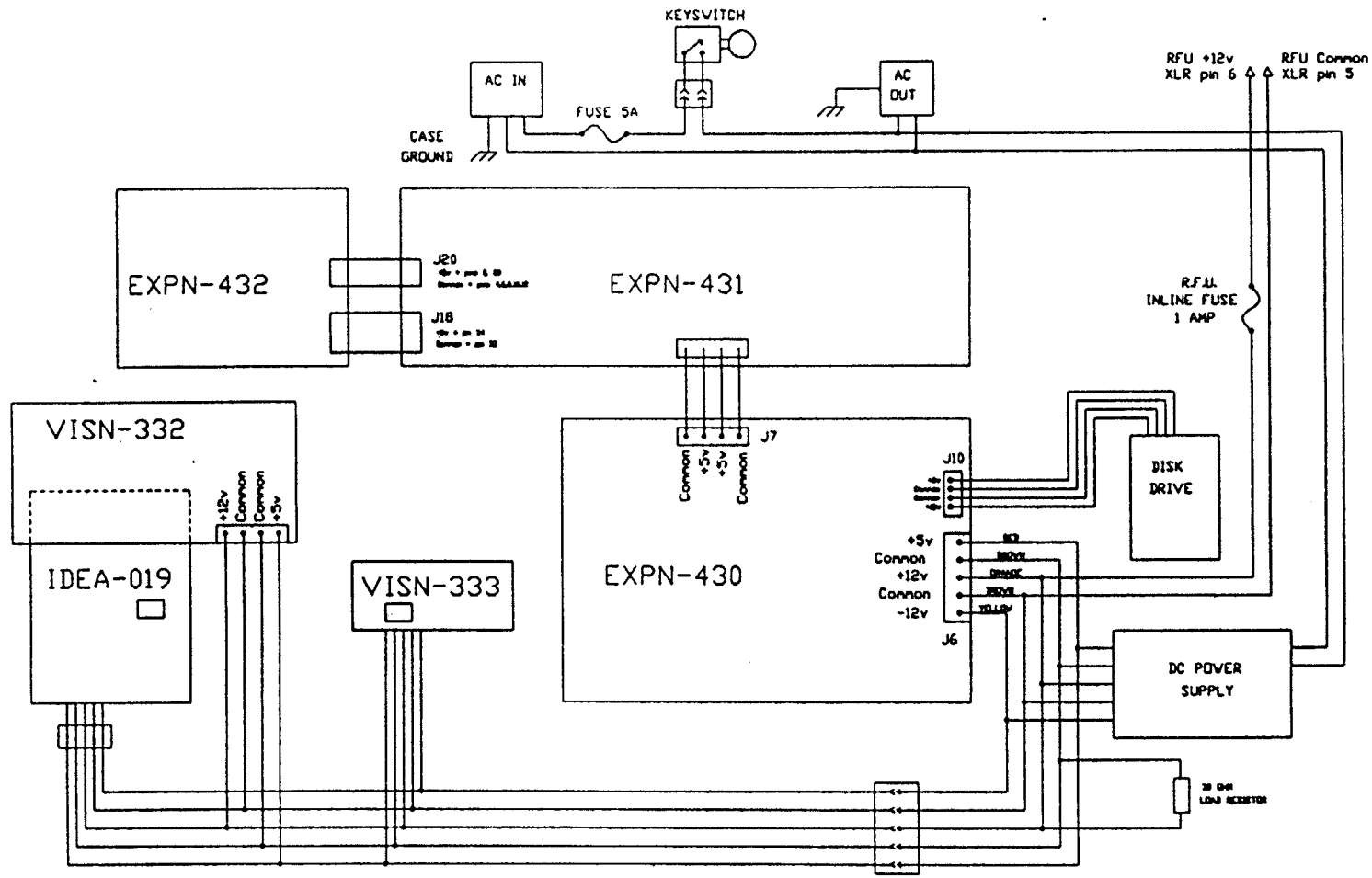
**NOTE** that for 220 VAC applications the DC power supply must be jumpered appropriately, and that the rear panel switched accessory outlet will be a 220 VAC outlet.

### b) DC Power

The DC power supply used is a 40 Watt Switching power supply with +5/+12/-12 volt outputs, and can be jumpered for 220 VAC/50-60 HZ operation.

**WARNING: The Power Supply has high voltages present on some of its heat sinks. Under no circumstance should anyone work inside the console without taking the proper precautions: disconnect the AC power or cover the power supply.**

The DC power is routed through the **EXPN-430** Main Processor Board to the Face Panel Assembly and the Disk Drive. Power for the optional output and readback cards is supplied by a power loom extension (supplied with the option cards) which plugs into a receptacle built into the standard base system power loom. Note that the console sheet metal is earth grounded, and that DC common floats. **(Consoles manufactured after December 1988 have DC common tied to earth ground.)**




+5 VDC = RED

+12 VDC = ORANGE

-12 VDC = YELLOW

Common = BROWN

| | |
|---|---|
| IMPRESSION, EXPRESSION AC/DC POWER | |
| ELECTRONIC THEATRE CONTROLS 6-30-88 | PAGE 1 OF 1 |

## 3. ELECTRONIC

The main electronic components of the **EXPRESSION** system are the **EXPN-430** Main Processor Board, the **EXPN-431** Face Panel Processor Board, and the **EXPN-432** Submaster Circuit Board. The functions are distributed as follows:

**EXPN-430 MAIN PROCESSOR BOARD**

- Main program execution
- Show programming calculations
- System configuration control
- Dimmer calculations
- Floppy Disk control
- Video output
- Digital dimmer outputs (RS-422)
- Remote Focus communications (RS-422)
- Printer interface
- MIDI input connector (feeds to Face Panel)
- Non-volatile show and configuration memory
- Face Panel communication and control (RS-422)

**EXPN-431 FACE PANEL BOARD**

- Face Panel program execution
- Face Panel keyboard control and interpretation (including Bump switches)
- LED control
- Fader Analog to Digital conversion (including Submaster faders)
- Fader Wheel interface
- Record lockout interface
- Expansion bus for optional output and readback cards
- Opto-isolated Remote Switch interface
- Communication with **EXPN-430** Main Processor board
- MIDI processing

**EXPN-432 SUBMASTER CIRCUIT BOARD**

- Submaster slide pots
- Submaster bump switches
- LED driver for bump switches

In general terms, the **EXPN-430** Main Processor Board controls all output operations and calculations, while the **EXPN-431** Face Panel board interprets operator actions (switches and faders) and communicates these actions to the Main Processor Board. In addition, the Face Panel Processor Board receives dimmer and LED status information from the Main Processor Board and sends this on to the optional output and readback cards.

# B. EXPN-430 MAIN PROCESSOR BOARD

## 1. GENERAL

The **EXPN-430** Main Processor Board contains two processors linked in Master/Slave fashion, where the MASTER CPU (a HITACHI HD64180) controls main program execution, Floppy Disk, Video, Printer and system communications, and the SLAVE CPU (a TEXAS INSTRUMENTS TMS 32020) calculates dimmer levels and generates the digital dimmer outputs. The breakdown of major circuit elements is as follows:

| Circuit Element | IC name | IC#s | Function |
|---|---|---|---|
| **MAIN CPU** | HD 64180 | 1 | Main program, Face Panel, RFU & RS-232 serial ports |
| Dynamic RAM (256K) | 4256 | 33-40 | Operating memory |
| Static RAM (256K) | 20256 | 10, 14-18 | Non-volatile memory |
| Eproms (256K) | 27256 | 2-9 | Program code |
| Floppy Disk control | FDC 9266 | 44 | Floppy Disk control |
| Video | HD 6845 | 57 | CRT controller |
| Video memory (2K) | 2064 | 65 | Video static ram |
| RS-422 Drivers | UA 9638 | 12, 22 | Face Panel, RFU |
| RS-422 Receivers | UA 9637 | 21 | Face Panel, RFU |
| **SLAVE CPU** | TMS 32020 | 80 | Slave program |
| Slave Static RAM | 20256 | 85 | Slave memory |
| Slave Eproms | 27128 | 1, 82 | Slave program code |
| RS-422 drivers | SN 75176 | 13, 93 | Digital data&clocks |

## 2. MECHANICAL

The **EXPN-430** Main Processor Board is mounted to the bottom tray on 1/4" X 6-32 hex standoffs and secured with 5/16" X 6-32 nylon nuts. Additionally, two 3/16"X 6-32 screws are used to anchor the circuit board at the rear near the BNC video connector and the DIP switches. Finally, the Video and Printer ports are right angle board mount connectors which are secured to the back panel with 5/16" X 4-40 female screw locks.

**Removal** of the **EXPN-430** Main Processor board is accomplished by disconnecting all ribbon and power cables, removing all screws and nuts and lifting the board up and forward out of the bottom tray.

**NOTE:** All connectors are polarized, and each connector is unique to aid in assembly. Notice, however, that since it is possible to install the Floppy Disk power connector mis-aligned, care should be taken when re-inserting it.

**NOTE: This circuit board contains many static-sensitive components; care must be taken to avoid damage.**

## 3. MAIN CPU

The HITACHI HD64180 CPU **(U1)** is a Z80 code-compatible processor which features a 1 Megabyte physical address space, 10 MHZ operating frequency, built in memory management, two asynchronous serial communication channels, and a clocked serial I/O port.

The main time base for the HD64180 is provided by an external 18.432 MHZ crystal **(Y4)**, which is halved internally to provide the main system clock of 9.216 MHZ.

A **TI TL7705** voltage reference **(U30)** is used to detect low voltage conditions and pulls the **RESET*** line low when Vcc falls below 4.6 volts for durations longer than 500 MSEC.

Channel 0 of the Asynchronous Serial Communication Interface (ASCI) drives the RS-232 serial printer port, channel 1 of the ASCI drives the RS-422 Remote Focus serial port, and the Clocke Serial I/O port (CSIO) is used for clocked RS-422 communication with the **EXPN-431** Face Panel processor board.

All DATA BUS lines and ADDRESS LINES A0 - A15 are directly buffered, while ADDRESS LINES A16-A19 are used to access Video, Slave and Expansion Port addresses.

## 4. MEMORY

The memory elements on the **EXPN-430** are distributed as follows:

| Type | IC#s | Part Name | Function |
|---|---|---|---|
| **MASTER:** | | | |
| EPROM (256K) | 2-9 | 27256 (32Kx8) | Main Program Code |
| Dynamic RAM (256K) | 33-40 | 4256-120 (256Kx1) | Program Execution |
| Static RAM (256K) | 10, 14-18 | 20256 (32Kx8) | Cue Memory |
| Static RAM (8K) | 65 | 2064 (8Kx8) | Video Memory |
| **SLAVE:** | | | |
| EPROM (32K) | 81,82 | 27128 (16Kx8) | Slave Program Code |
| Static RAM (32K) | 82 | 20256 (32kx8) | Slave Memory |

All main memory is accessable through the Master processor's bus, the Video memory is accessed through the controller, and the SLAVE STATIC MEMORY is accessable to both the MASTER and SLAVE processors.

### a) EPROMS

The main program code is stored in 8-27256 (32KX8) EPROMS. They are labeled with the software version number (eg, "V1.44") and the EPROM number. The EPROMs are numbered 1 through 8, left to right **(U2.. U9)**. These EPROMs are programmed at the factory and are thouroughly tested in circuit to verify their contents. (See Appendices for software upgrade instructions.)

The contents of these EPROMS are accessable to the MASTER HD64180 processor through ADDRESS BUS BUFFERS **U27** and **U31** and DATA BUS BUFFER **U29** (all **74LS245**s). Individual EPROMs are selected one at a time by **U11** (a **74LS138**), which is driven by ADDRESS LINES A15-A19 and the buffered and inverted **MEMORY ENABLE (ME*)** line from the processor.

JUMPERS E and F are used to route either A14 or +5V to PIN 27 of the EPROM #1 socket (U2). This allows the use of either 16KBYTE 27128 or 32KBYTE 27256 EPROMs. Install F for a 27128, E for a 27256.

JUMPERS G and H provide the same selection for the remaining EPROM sockets (U3..U9). Install G for 27128s, H for 27256s.

JUMPER I is for routing the processor **WRITE** line to sockets U3..U9 so that STATIC RAM ICs could be used instead of EPROMS; this option has not been utilitized. EPROM installation requires that JUMPER I not be installed.

JUMPERS J and K are used in conjunction with JUMPER I for installing STATIC RAM ICs instead of EPROMs. These select either +5V or A14 to be routed to pin 1 of sockets U3..U9. EPROM installation requires that JUMPER J is installed.

In normal operation, EPROM **#1** contains the boot loader and self-test code. The processor operates directly out of this EPROM until the self-tests are completed, at which point either the Stage screen or a "BACK UP MEMORY ERROR" message is displayed. After this the code in the remaining EPROMs is copied into DYNAMIC RAM for faster execution and main program execution begins.

**b) DRAM**

The DYNAMIC RAM consists of 8-256KX1 120NSEC DRAMs **(U33..U40)**. This memory is used for program code execution and support (look-up tables, etc). All translation from the internal Z80 16 bit address bus (64KBYTE) to the HD64180's 20 bit address bus (1 MBYTE) is internal to the HD64180; this leaves only the memory mapping to be implemented in hardware. This is implemented in U20, U46, U47, U45 and U44, which control access to the DRAM depending on whether the CPU is asserting a **REFRESH** or memory access. Three **74LS157** multiplexers are used to clock the valid addresses from either the upper or lower half of the address bus into the DRAMs.

Notice that all DRAMs are socketed for ease of replacement (120 NSEC or better parts are required). The self-tests that are run after the system boots are fairly exhaustive and will identify memory ICs by silkscreen number if a failure has been detected. It is strongly recommended that the self-tests not be defeated except for shop test and maintenance.

**c) Static RAM**

This memory is used to hold all Cue, Patch, Setup options, and necessary support information from the current Show. This Show information will be retained in memory for 7 days minimum. Should the need arise to clear this memory COMPLETELY,a **DEEP CLEAR** operation may be executed by holding down the 7,8 and 9 Submaster Bump switches and cycling the power. These switches must be held down at the point where the self-tests are completed and the main processor reads the switches. Note that this procedure will clear ALL show memory, including Patch, Dimmer, and system options (eg, Customized Channels, Default Full levels and Fade times).

The STATIC RAM consists of 6-32KX8 100 NSEC non-volatile STATIC RAM ICs **(U10, U14..U16)**. They are accessed directly through the buffered ADDRESS (A0..A14) and DATA BUSSES in combination with the **READ** and **WRITE** lines (also buffered). The non-volatile (power-off memory retention) capability of these SRAMS is implemented with two 1-FARAD capacitors **(C17, C18)** and a network of resistors, diodes and 2N3906 transistors **(Q2..Q7)**. In normal operation **U19 (74LS138)** selects which one of the eight SRAMs is being addressed, and these CHIP ENABLE lines are fed directly through **Q2..Q7** (which are turned on) to the SRAMs. When power is shut off, **Q1** is turned off, which then turns off **Q2..Q7** with the result that all the CE* (CHIP ENABLE) lines are pulled HI by **R31**. When the CHIP ENABLES are pulled HI, the SRAMs are put in power standby mode. The 1 Farad capacitor pair then maintains the power supply current/voltage to the SRAMs. **Schottky Diode D6** is used to block current flow from the 1 Farad capacitors to the main +5V bus, and the tantalum capacitor C1 smooths out transitions between power states.

**IMPRESSION**: only 4-32KX8 STATIC RAMs are used; U15 and U16 on the ***IMPN-430*** processor board are not installed.

Note that JUMPER D connects the capacitor back-up power to the SRAMs. Removal of JUMPER D and installation of JUMPER C will force all the SRAMs to lose their contents at power down. This procedure is recommended only for troubleshooting, as the **DEEP CLEAR** operation will force a memory write of the proper default values into all SRAM locations.

## 5. SLAVE PROCESSOR, DIGITAL OUTPUTS

The SLAVE PROCESSOR CPU is a Texas Instruments TMS32020 DIGITAL SIGNAL PROCESSOR, which is a 16 bit reduced instruction set processor with built in memory and serial ports. It is used to handle the real-time calculation of digital dimmer output levels and to generate the serial clock and data signals which are fed to RS-485 drivers to send information to digital dimmers.

The Slave circuit consists of the TMS32020, a 32KX8 STATIC RAM, two 16KX8 EPROMs which hold the TMS32020s program code, main CPU time base and serial output crystals, RS485 drivers, and TTL buffers to mediate communication between the Slave circuit and the main processor.

**a) Memory**

The Slave circuit's external RAM is a single **32Kx8 SRAM (U85)**, which is used to share dimmer information with the MASTER HD64180 CPU. This SRAM is accessable to the HD64180 when it asserts the **SLAVE MEMORY** line which puts the TMS32020's data, address and control lines in a high impedance state. This then gates open all the **74LS245** buffers **(U86, U87, U89)** for **READ** and **WRITE** operations into the SRAM.

The SLAVE EPROMs are accessable only to the TMS32020, and are arranged in MSB/LSB fashion to accomodate the TMS32020's 16 bit data path. Most of the code is loaded from the EPROMS into the TMS32020 at boot; the EPROMs are only occasionally accessed after that.

Sockets **U83** and **U84** are for future expansion.

**b) Digital Dimmer Outputs**

The Digital Dimmer Outputs are generated by the TMS32020's serial output port using the clock provided by **crystal Y1** and **divider U79 (74LS393**, divide by 16). The clock signal is also routed directly to a **SN75157** RS-485 driver **(U13)** for synchronous dimmer protocols (LMI digital).

The dimmer outputs are generated by the TMS32020 at pins 28 **(BREAK character)** and 32 **(DATA)**. These signals are then ANDed by **U45** and routed to another RS-485 driver **(U93, an SN75157)**.

Note that **Y1** sets the BAUD RATE for the dimmer outputs, and that the Slave software determines the actual output protocol. Y1 = 4.00 MHZ generates 250 KBAUD for the DMX standard, Y1 = 2.4576 MHZ generates 153.6 KBAUD for the COLORTRAN D-192 standard; the two protocols are the same except for baud rate.

## 6. COMMUNICATIONS: Face Panel, RFU, Printers

All communications other than the Digital Dimmer Outputs are handled by the internal serial communication sections of the HD64180 main CPU on the **EXPN-430**. In all cases the serial information is buffered by RS-422 recievers and transmitters, which are socketed for ease of replacement.

**a) Face Panel Communications**

The **EXPN-430** Main Processor Board shares three basic types of information with the **EXPN-431** Face Panel Processor Board:

1) Switch closure activity
2) LED information
3) dimmer/channel information to and from the optional analog input and output cards.

This information is communicated over a high speed synchronous serial link between the **EXPN-430** and **EXPN-431** CPUs (both HITACHI HD64180s). With the exception of the RS-422 converters, all the hardware for this serial link resides within the two HD64180s and therefore protocol and clock signals are functions of the software installed.

The HD64180's CLOCKED SERIAL I/O PORT is used at both ends of this serial link. The signals and pin assignments are as follows:

**MAIN PROCESSOR TO FACE PANEL SERIAL COMMUNICATIONS**

| EXPN-430 | | | | | INTER- | EXPN-431 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | HD64180 | | DRIVER# & PINS | | CONNECT | DRIVER# & PINS | | HD64180 | |
| FUNCTION | SIGNAL | PIN# | INPUT | OUTPUT | WIRE# | INPUT | OUTPUT | SIGNAL | PIN# |
| Data OUT | TXS | 55 | U22.3 | U22.5,6 | 1,2 | U22.5,6 | U22.3 | RXS | 56 |
| Data IN | RXS | 56 | U21.7,8 | U21.2 | 5,6 | U23.2 | U23.7,8 | TXS | 55 |
| Clock OUT | CKS | 57 | U12.3 | U12.6,5 | 11,10 | U22.7,8 | U22.2 | CKS | 55 |
| Rx Flag | | | U55.12 | | 8 | | | RTS0 | 45 |
| Tx Flag | | | U55.13 | | 9 | | U6.19 | | |

The RECEIVE and TRANSMIT **FLAG** signals are handshaking lines. The **Rx FLAG** is the **RTS0* (Request to Send)** line from the **EXPN-431** FACE PANEL's processor; it is asserted LO to indicate that the FACE PANEL processor is ready to receive data. The **Tx (Transmit) FLAG** is generated by the FACE PANEL processor through **I6 (a 74LS374 octal flip-flop)**; it goes HI to indicate that the FACE PANEL processor is ready to Send data. Both the **Rx** and **Tx FLAGs** are read by the **EXPN-430** MAIN PROCESSOR through **U55 (a 74LS251 8-input multiplexer)** as part of the same circuit used to read DIPSWITCH 2.

**b) Remote Focus Unit (RFU)**

The optional REMOTE FOCUS UNIT plugs into the RFU connector on the back panel of the **EXPRESSION** console which in turn is wired to **J5** on the **EXPN-430** MAIN PROCESSOR board. The back panel connector is a 6 PIN FEMALE XLR which carries power (+12 VOLTS and COMMON) and the TRANSMIT and RECEIVE DATA pairs (RS-422). The Data transmitted to the RFU is generated by the main processor's Asynchronous Serial Communication Interface (ASCI) CHANNEL 0 (TXA1) at **U1 pin 51**. Crystal **Y2 (2.5MHz)** generates the clock for the 38.4 KBAUD serial channel. A **UA9638 RS-422 driver (U22)** is used to send the data to the RFU. The data from the RFU is routed to a **UA9637 RS-422 receiver (U21)** which converts the complementary RS-422 signals to TTL levels. The received data is then routed directly to the HD64180's ASCI RECEIVE DATA pin **(RXA1, U1 pin 53)**.

Power for the REMOTE FOCUS UNIT is provided by the console power supply. Console common and +12 volts (nominal) are routed to the RFU on the same cable as the Data pairs. The RFU +12 volt pin on the back panel connector is fused with a 1 AMP fuse in an inline fuse holder inside the console. The +12V provides sufficient headroom for the voltage drop between the console and the RFU. The nominal +12 volts is dropped to approximately 9 volts by series diodes inside the RFU and then fed to a 7805 voltage regulator to power the RFU. In cases of cable runs longer than 250 feet it may be necessary to bypass one or more of these diodes to maintain the minimum input voltage of 7 volts to the 7805 regulator. A good rule of thumb is to bypass one diode for each 200 feet of cable beyond 250 feet.

The pinout of the RFU connector on the back panel of the **EXPRESSION** is:

**CONSOLE REMOTE FOCUS UNIT PINOUT (6 pin FEMALE XLR)**

1. Data (+) OUT (Console to RFU)
2. Data (-) OUT (Console to RFU)
3. Data (+) IN (RFU to Console)
4. Data (-) IN (RFU to Console)
5. Console DC Common
6. +12 volt DC (nominal)

**c) Printers**

The **EXPRESSION** console supports both Serial and Parallel printers. The configuration dipswitches (see Dipswitch setting chart; also included in the back of every console's Operator's Manual) are used to tell the Main Processor at turn on whether a serial or parallel printer will be used. The types of connectors used (female DB-9 serial or female DB-25 parallel) and the pinouts for each are consistent with IBM AT-style serial and parallel ports. In most cases a printer that has been connected to an IBM AT or equivalent will work without modification. Connector pinouts and common interface cable wiring are provided in the appendix.

**PARALLEL PRINTER:** The parallel printer connector is **J1** on the **EXPN-430** Main Processor Board. It is a right angle circuit board mount **DB-25** which is accessable through a cut-out in the **EXPRESSION** back panel.

The parallel interface consists of a **74LS374 octal flip-flop** which clocks the data out to printer when the **PRINTER STROBE*** line **(U28 pin 13)** is LO. A **74LS74 flip-flop (U26)** generates a **STRB** output which signals the printer that valid data is on the printer bus. The printer responds by pulling the **ACKnowledge** line LO to indicate that data has been received and that the printer is ready for the next byte. The **ACK** line also toggles the output of the **74LS74 flip flop (U26)** which is connected to the **INT0*** interrupt line of the HD64180 CPU. This signals the

CPU to send the next byte to the printer port. If the **ACK*** line is not toggled, the CPU will detect no response on the **INT0*** line and will therefore conclude that the printer is not responding.

SERIAL PRINTER: The serial printer interface signals are generated directly by the HD64180 CPU's ASIC channel 0. The two output signals (**RTS0*** and **TXA0**) are sent to a **LM1488 RS-232** driver to provide **Data Out** and **RTS (Ready to Send)** for the printer. Two RS-232 inputs are provided; **Data In** is used with factory development systems and the REDUNDANT TRACKING Option, and **CTS (Clear to Send)** is used to indicate that the printer is ready to receive more data. The **CTS** signal is an active HI input (**CTS** must be HI for the console to send data). The input signals are buffered by a **LM1489 RS-232** receiver and sent to the CPU's **RXA0** and **CTS0*** inputs respectively.

## 7. VIDEO

The video circuit provides simultaneous digital color RGB and monochrome analog composite RS-170 outputs. Dipswitch settings provide for selecting between Color/Monochrome and 50/60 HZ refresh rates. The Monochrome switch setting will provide half-intensity instead of greyscale monochrome; this provides a brighter display on the composite monitor and displays purple and white characters on a color RGB monitor.

The screen displays 34 lines of 80 characters, where each character cell is 7 pixels wide by 9 pixels high. This yields a horizontal sync rate of 18.36 KHZ, which is sufficiently different from the IBM CGA and EGA color RGB standards to require re-adjustment of some RGB monitors to display the entire screen. For this reason it is recommended that a high quality "multi-sync" type of monitor be used, as they will automatically adjust their scan rates. The pinout of the DB-9 color RGB connector is the same as the IBM CGA standard. Any high quality RS-170 compatible monochrome monitor with a 20 KHZ horizontal bandwidth and horizontal sync and centering controls will work with the monochrome output.

The video output of the **EXPN-430** is controlled by a Hitachi **HD 68A45** CRT controller which provides the CRT sync signals and the refresh addresses for the video RAM. The HD6845 is connected directly to the data bus for initialization, and is controlled by the CPU's **WRITE** and **ENABLE** lines. The memory mapped **CRTC SELECT*** is the chip select line and the **RS** input to the **HD6845 (A0)** selects between address and data registers.

**MA0..MA10** are the address outputs for the current character in display memory, and **RA0..RA3** provide the raster address within each row of characters. The characters to be displayed are stored in the **8Kx8 Static RAM (U65)**; this memory is accessed by either the **HD6845** for display refresh or by the CPU for altering the display. Access to the VIDEO RAM is controlled by **U77 (74LS74)** and **U78 (74LS32)**; **VRAM*** is asserted by the CPU for access to the video memory, and **WAIT C*** is generated to delay access until the end of the next refresh cycle. **U62 (74LS373)** is used to latch data into the video RAM and **U63 (74LS373)** latches data to be read by the CPU. **(U58..U60)** switch the video RAM addresses between the CPU address bus and the **HD6845's** refresh address outputs.

The **Character Generator EPROM (U64)** contains the dot patterns for each character. **A4..A9** are the ASCII code for the character to be displayed, **A0..A3** are the raster address within the character to display. The ASCII code for the character to be displayed is latched into the character generator by **U66 (74LS374)**, and the raster address is provided by the **HD6845**. The video shift register **U67 (74LS166)** converts the dot inputs from the character generator into a serial bit stream for the CRT display.

The dual-port RAM **(U68, a 74LS670)** contains the color lookup table used to select the color attributes of the pixel to be displayed. The color attributes and the serial pixel stream are combined at **U70 (74LS158)** and presented to **U74 (74LS367)** along with the sync information from the **HD6845** to drive the RGB digital outputs. The monochrome output is generated by the DAC composed of **(R14..R19)** which combines the sync and color signals to drive the emitter follower Q8 that drives the 75 ohm video output.

## 8. FLOPPY DISK

The Floppy Disk Drive used in the **EXPRESSION** is an **NEC FD1037** 3.5" drive capable of storing up to 1 MBYTE to disk. As implemented in **EXPRESSION**, double-sided double-density 720K disks are required. The disk format is compatible with the MS-DOS standard, but the show information is not directly accessable from MS-DOS. Each disk holds two 400 cue shows (one per side) and show information is upward compatible with **EXPRESSION** and **CONCEPT500** disks. The disks may be write-protected by sliding the small plastic tab at the front of the disk open.

The disk controller used on the **EXPN-430** processor board is an **FD9266**. It provides bi-directional data bus access and is controlled by the CPU's **RD***, **WR***. **FD SELECT*** is the memory mapped chip select line, **FD DMACK***, **TEND1*** and **DREQ1*** are arbitration lines for access to the **HD64180** CPU'S DMA memory transfer functions. The **INT** ouput of the **FDC9266** is inverted to drive the CPU's **INT2*** interrupt input. The **FDC9266** requires a 8 MHZ clock which is provided by crystal **Y5**. **Jumpers LMNOPQ** are used to set the write precompensation **(install M,O,P for normal operation)**.

## 9. MIDI

The **MIDI** inputs and outputs (**J13** and **J14** respectively) are routed directly from the back panel connector to the Face Panel interconnect socket. The **EXPN-431** Face Panel processor controls all **MIDI** access through it's software controlled serial interface (ASIC CHANNEL 0). The **MIDI** inputs are opto-isolated by **I42**, a **HP 2602** differential line receiver.

As of this writing (v1.51) the **MIDI** feature has not been implemented. If you have suggestions or applications for MIDI interfacing, please call us for more information.

**NOTE: EXPN-430** circuit board Revisions A,B and C have incorrect **MIDI** connector pinouts. Either an adaptor cable or circuit board modifications will be required when the **MIDI** feature is implemented.

## 10. KEYBOARD

The **EXPN-430** board has a rear panel socket **(J2)** for an external IBM PC style keyboard. This will accept PC, AT or enhanced (101 key) keyboards.

The keyboard signals are routed directly from this connector to the **EXPN-431** Face Panel processor board. The serial keyboard data **(KDATA, pin 13)** and clock **(KCLK, pin 12)** are synchronized and clocked onto the Face Panel CPU's data bus by **I29 (74LS595)** and **I30 (74LS74)** when the **KEYBOARD SELECT*** line is **LO**. When a keyboard clock is present an interrupt is generated and routed to the HD64180's **INT2*** input.

As of this writing (v1.51) the keyboard interface has not been included in software.

**NOTE: EXPN-430** circuit board Revisions A,B and C have incorrect keyboard connector pinouts. Either an adaptor cable or circuit board modifications will be required when the keyboard feature is implemented.

## 11. EXPANSION

The 50 pin Expansion Bus Connector on the **EXPN-430** main processor board **(J16)** is provided for future expansion options.

**CONCEPT500:** The Expansion Bus is used to support the **EXPN-433 Slave Expansion Card** (see section **II-E** for description).

## 12. DIPSWITCHES, LEDS

The **EXPN-430** contains 5 status **LEDs** which are under software control **(D1..D5)**. These LEDs are visible through the window in the back of the console. In normal operation they will be flickering rapidly in succession. If Face Panel communications are halted, the flicker rate will slow down to a strobe like appearance. During the self-tests at power up one **LED** will light up as each test is successfully completed. Each **LED** has it's own IO port address.

Two sets of Dipswitches **(SW1, SW2)** are provided for setting configuration options. They are accessable through the removable window in the back panel. When viewed from the back, Switch group A is on the left and the individual switches are numbered 1 through 8 left to right.

The switch settings are read once by the CPU after the boot tests are completed and the results are displayed at the bottom of the boot screen. The interpretation of the switch settings is a function of the the main program code version so it's important to refer to the **DIPSWITCH SETTINGs sheet** (which indicates which software version it applies to) to determine proper configuration. The console is shipped with all configuration switches set properly (unless specified otherwise, the console is shipped with the serial printer selected). The switches are read by **U54** and **U55 (74LS251 8 input multiplexers)**. Their base address is determined by **(A0..A2)** and their port address is a function of the chip select lines **JUMPER1* (SW1)** and **JUMPER2* (SW2)** generated by **U28**. The data value of each switch section is then placed on D0.

# C. EXPN-431 FACE PANEL PROCESSOR BOARD

## 1. GENERAL

The **EXPN-431** Face Panel Processor board contains a single **HD64180 CPU**, which monitors switch, fader and wheel status. Additionally, the built in serial ports of the **HD64180** are used for communication with the **EXPN-430** processor board and for the MIDI and PC keyboard options. Finally the CPU converts serial dimmer information from the **EXPN-430** main processor board and generates the parallel digital expansion bus **('Mythical' Bus)** which provides control and information for the analog readback and output cards.

The major circuit elements are:

**EXPN-431 CIRCUIT ELEMENTS**

| Circuit Element | IC name | IC#s | Function |
|---|---|---|---|
| CPU | HD64180 | 18 | Face Panel program; EXPN-430, MIDI and keyboard serial communications |
| Static RAM (8K) | 2064 | 19 | Face Panel operating memory |
| EPROM (16K) | 27128A | 20 | Face Panel program code |
| A-D Converter | MAX 150 | 5 | Fader Analog to Digital converter |
| Multiplexers | CD4051 | 1..4 | Fader analog multiplexers |
| Op-amp | LM393 | 15 | Fader Wheel interface |
| LED drivers | ICM7218 | 17,9 | Switch & Bargraph LEDs |
| Opto-isolator | HP2602 | 32..39 | Remote switch inputs (8) |
| Opto-isolator | HP2602 | 42 | MIDI input |
| Serial converter | 74LS595 | 29 | PC keyboard input |

## 2. MECHANICAL

The **EXPN-431** Face Panel board is mounted to the face panel sheet metal on 1/4" hex standoffs and secured with 20 1/4"X6-32 screws with **fiber washers under the screws.** The fiber washers provide mechanical and electrical protection in addition to functioning as lock washers.

The Autofader and Grand Master slide pots are mounted to the PCB with screws and each is connected to the PCB with 3 pin Panduit connectors. The Fader Wheel is permanently mounted to the face panel, and signals are routed from it to the **EXPN-431** on a 4 pin Panduit connector.

The Submasters and Bump Switches reside on a separate circuit board (**EXPN-432**), and the slide pot voltages, LED data, and Bump Switch signals are routed to the **EXPN-431** board by 3-34 conductor ribbon cables (1 each).

To remove the Face Panel board:

- Disconnect the AC line cord from the console
- Remove the Grand Master and Autofader slide pot knobs
- Disconnect the ribbon cable to the **EXPN-430** Main Board
- Disconnect the ribbon cables to the **EXPN-432** Submaster Board
- Disconnect the Power, Fader Wheel and Record Lock-out connectors
- Disconnect the Mythical Bus ribbon cable, if installed
- Remove the screws and washers, starting at the outside and leaving the middle one until last
- Be careful to account for all screws removed (20)

## 3. CPU

The **HD64180** is the same type as the one used on the **EXPN-430** Main Processor Board; it's clock frequency is provided by an **18.432 MHz crystal (Y1)** (divided by two), which is the same clock frequency as the main board CPU. The **HD64180**'s Clocked Serial I/O **(CSIO)** port is used to communicate with the **EXPN-430** Main Processor Board (see discussion under **EXPN-430** Communications). The HD64180's Aysnchronous Communication Interface **(ASCI)** channels are used for **MIDI** communication (CHANNEL 0, I18 PINS 48 AND 49), while the **Clear to Send** (CTS0*) and **Data Carrier Detect** (DCD0*) inputs for the ASCI channel 0 are used for the low frequency signals from the Fader Wheel interface circuit.

**Interrupt 0** (INT0*, **I18 pin 10**) is used to flag Fader Wheel activity, INT1* (**I18 pin 11**) is used to flag A-D converter action, and INT2* (**I18 pin 12**) flags PC Keyboard input.

The DATA and ADDRESS buses for the MYTHICAL BUS are driven by a **74LS245 (I28)** and two **74LS367s (I26 and 27)**, respectively. Two **74LS138** decoders **(I24, I25)** generate the control lines for the switch and fader scanning and the **LED** drivers; **I25** also generates the select lines for the analog option cards and the PC keyboard.

## 4. MEMORY

The **EXPN-431** Face Panel Board contains only two memory elements; a **16Kbyte EPROM** and a **16Kx8 Static RAM**. The **27128A EPROM (I20)** contains the Face Panel CPU's program code; the CPU operates directly out of this EPROM. **Jumpers J3** and **J4** determine whether a 27128 (16KX8) or a 27256 (32KX8) EPROM is installed. Install **J3** for a 27256, **J4** for a 27128. All production face panels use a 27128A.

The **16Kx8 Static RAM** is used for type-ahead buffering and program support (look-up tables, etc). The Face Panel buffers up to 16 keystrokes. **Jumpers J1** and **J2** select between a 32KX8 and a 16KX8 SRAM. Install **J1** for 16KX8, **J2** for a 32KX8. All production face panels use a 16KX8 SRAM.

## 5. SWITCHES AND LEDS

The main Face Panel switches are read in standard matrix fashion, where the columns of the 8X9 switch matrix are strobed by address lines A0..A2 and control lines **KEYBRD SCAN A*** and **KEYBRD SCAN B*** through two **74LS156** dual 1 of 4 decoders **(I4 and I6)**. The data represented by switch closures is gated back onto the data bus by a **74LS373 octal latch (I13)** controlled by the ANDed **SCAN A** and **B** lines. Note that the **RECORD LOCK-OUT** Keyswitch and the opto-isolated Remote Switch inputs are included in the 8X9 switch matrix.

**IMPRESSION:** the Macro and Effects rows of switches are not installed on the ***IMPN-431*** Face Panel circuit board.

The Submaster Bump Switches are not matrixed; each Bump Switch has it's own line back to the **EXPN-431** Face Panel from the **EXPN-431** Submaster Board (**J19** on the **EXPN-431**). The bump switches are NORMALLY CLOSED (NC) switches, tied HI (+5 VOLTS). When a switch is pressed, the line to **J19** on the **EXPN-431** is pulled LO by the **1Kohm SIPs (R2..R4)**. This voltage is then latched onto the data bus by one of three **74LS373 octal latches (I10..I12)**. The latches are strobed by the the three control lines **BUMP SWITCH A**, **B**, and **C**. Note that since all the Bump Switches are Normally Closed HI, the ribbon cable to the **EXPN-431** Face Panel must be connected in order to troubleshoot, since the pull down resistors are on this board.

The switch **LEDs** are under software control of the **EXPN-431** CPU; **LED** status information is brought in from the **EXPN-430** Main Processor Board. Two **ICM7218 LED drivers (I7, I9)** are used to select which **LEDs** are illuminated in the switch and bargraph **LED** matrices. The data is presented to the **ICM7218s** directly from the buffered data bus, and clocked into the **7218s** by the two control lines **7218 A*** and **7218 B*** in conjunction with address line **A0**.

The Bump Switch **LEDs** are driven in the same manner, except that the **7218 LED driver** and LED matrix is located on the **EXPN-432** Submaster Board. The data and control lines are routed to Submaster Board over a 20-conductor ribbon cable which plugs into **J20** on the **EXPN-431** board.

## 6. FADERS

Slide pot voltages (including Submasters) are de-multiplexed by four **CD4051s (I1..I4)**, buffered by an **LM358 op-amp (I43)** and converted one fader at a time by the **MAX150 ADC (I5)**. The **POT SCAN*** line and data bus select which slide pot will be converted **(I6, a 74LS374)**, and the **ADC***, **RD*** and **WR*** control lines determine ADC timing. The ADC circuit includes two trim adjust pots (**R29-left-zero adjust** ; and **R30-right-full scale adjust**). The zero adjust pot should be trimmed for 0 volts at **MAX150 (I5) pin 11**. The Full Scale adjust should be trimmed for approximately 2.5V at **MAX150 (I5) pin 12** and then fine tuned to read 100% at full and 50% at mid-travel. This adjustment must be made with the submaster circuit board connected to the face panel board.

## 7. FADER WHEEL

The Fader Wheel is a stepper motor used in reverse; it generates voltage pulses which are a function of the direction and rate of rotation of the wheel. The quad differential outputs of the motor are filtered and buffered by a **LM393 dual op-amp (I15)** and routed to the CPU's **CTS0*** and **DCD0*** serial port inputs for processing. A **74LS74 flip-flop (I41)** generates an interrupt **(INT0*)** to indicate wheel activity.

## 8. MYTHICAL BUS

A parallel buffered system bus called the **"Mythical Bus" (J17)** is used to distribute control and dimmer level information to the optional analog input and output cards (**VISN-332** analog input card, **IDEA-019** analog output card, and **VISN-333** analog multiplex AMX output card). This bus supports two each of either input or output cards (only one type of output - analog or AMX - may be used at a time).

The dimmer level and control status (what type of cards are installed - determined by the dipswitch setting) information is generated by the **EXPN-430** Main Processor Board and sent to the **EXPN-431** Face Panel Board over the serial interconnect. The face panel CPU then converts this information to parallel TTL signals which are then buffered and routed to the 34 pin mythical bus connector on the face panel **(J17)**. (See discussion of option card installation in **Section III.**)

## 9. REMOTE SWITCH CIRCUIT

The Remote Switch input option is implemented with **HP2602** opto-isolators **(I32..I39)**. A 5 volt pulse (current limited to 10-50 milliamps) of 100 MSEC minimum duration presented across the inputs **(IN+, IN-)** of any one of the the **HP2602s** will activate the switch function assigned to that remote function. The remote switch inputs are connected to the **EXPN-431** Face Panel board at **J21**, a 16 conductor ribbon cable header. The default switch assignment and pin-outs for these remote inputs is:

**REMOTE SWITCH INPUT WIRING**

| Input # | Function | IC# | J21 #s |
|---|---|---|---|
| 1 | AB HOLD | 32 | 1(-),2(+) |
| 2 | AB GO | 33 | 3,4 |
| 3 | AB CLEAR | 34 | 5,6 |
| 4 | CUE | 35 | 7,8 |
| 5 | nc | 36 | 9,10 |
| 6 | nc | 37 | 11,12 |
| 7 | nc | 38 | 13,14 |
| 8 | "1" | 39 | 15,16 |

The Remote Switch Input is a dealer-installed option; it requires installation of the **HP2602** opto-isolators and wiring. Production consoles specified without this option do not have the **HP2602s** installed. (See Addendum for specifications.)

# D. EXPN-432 SUBMASTER BOARD

## 1. GENERAL

The **EXPN-432** Submaster Board contains the Submaster faders, the Submaster Bump Switches, and the LED driver for the 24 Bump Switch indicators and 12 Inhibitive Bump Switch indicators. Three ribbon cables are used to route the fader level, switch status, and LED data to and from the **EXPN-431** Face Panel processor board. **J1** (34 conductors) carries the bumpswitch voltages, **J2** (34 conductors) carries the Submaster fader voltage levels, and **J3** (20 conductors) carries the data for the LED driver from the face panel processor board. The pinouts for these are as follows:

### EXPN-432 SUBMASTER BOARD INTERCONNECT CABLE PINOUTS

**BUMPSWITCHES: EXPN-432 J1 to EXPN-431 J19**

| Signal | Wire# | Signal | Wire# | Signal | Wire# |
|---|---|---|---|---|---|
| BSW1 | 1 | BSW9 | 9 | BSW17 | 17 |
| BSW2 | 2 | BSW10 | 10 | BSW18 | 18 |
| BSW3 | 3 | BSW11 | 11 | BSW19 | 19 |
| BSW4 | 4 | BSW12 | 12 | BSW20 | 20 |
| BSW5 | 5 | BSW13 | 13 | BSW21 | 21 |
| BSW6 | 6 | BSW14 | 14 | BSW22 | 22 |
| BSW7 | 7 | BSW15 | 15 | BSW23 | 23 |
| BSW8 | 8 | BSW16 | 16 | BSW24 | 24 |
| | | | | nc | 25..32 |
| | | | | Common | 33,34 |

**FADER LEVELS: EXPN-432 J2 to EXPN-431 J18**

| Signal | Wire# | Signal | Wire# | Signal | Wire# |
|---|---|---|---|---|---|
| SUB1 | 1 | SUB9 | 9 | SUB17 | 17 |
| SUB2 | 2 | SUB10 | 10 | SUB18 | 18 |
| SUB3 | 3 | SUB11 | 11 | SUB19 | 19 |
| SUB4 | 4 | SUB12 | 12 | SUB20 | 20 |
| SUB5 | 5 | SUB13 | 13 | SUB21 | 21 |
| SUB6 | 6 | SUB14 | 14 | SUB22 | 22 |
| SUB7 | 7 | SUB15 | 15 | SUB23 | 23 |
| SUB8 | 8 | SUB16 | 16 | SUB24 | 24 |
| | | | | nc | 25..32 |
| | | | | Common | 33 |
| | | | | +5V | 34 |

**BUMPSWITCH LEDS: EXPN-432 J3 to EXPN-431 J20**

| Signal | Wire# | Signal | Wire# |
|---|---|---|---|
| Mode* | 1 | +5V | 2 |
| 7218WR* | 3 | Common | 4 |
| D7 | 5 | Common | 6 |
| D6 | 7 | Common | 8 |
| D5 | 9 | Common | 10 |
| D4 | 11 | Common | 12 |
| D3 | 13 | nc | 14 |
| D2 | 15 | nc | 16 |
| D1 | 17 | nc | 18 |
| D0 | 19 | +5V | 20 |

## 2. MECHANICAL

The **EXPN-432** Submaster Board is mounted with 1/4"X6-32 screws with fiber washers. Low profile 10KOHM slide pots are mounted directly to the circuit board. Bump switches 1 through 12 have a single LED to indicate RECORDED; Bump switches 13 through 24 have two LEDs each - the red one indicates an Inhibitive submaster.

To remove the the submaster circuit board, remove all submaster slide pot knobs. **WARNING: Exercise great care in removing these knobs, as excessive force will break the slide pot!** Remove by moving knob to center position and gently prying up with a small screwdriver (place a piece of cardboard under knob to protect face panel). Then disconnect all ribbon cables, remove all screws and drop out. Be sure to keep track of all screws and fiber washers.

## 3. BUMP SWITCH CIRCUIT

The bump switches use the NC position of the switch so that normally 5V is present on each switch line (switches are not matrixed). When the switch is pressed the signal is pulled to common by a resistor on the **EXPN-431** Face Panel Board. (See discussion under **EXPN-431** "Switches and LEDs".)

## 4. FADER CIRCUIT

The slide pot wiper voltage is routed directly to the ribbon cable through a series 1KOHM SIP resistor. The 5 volts for the slide pots is also supplied through the ribbon cable from the **EXPN-431** face panel board. (See discussion of ADC circuit under **EXPN-431** "FADERS".)

# E. EXPN-433 SLAVE EXPANSION CARD (CONCEPT 500 ONLY)

## 1. GENERAL

The **EXPN-433** Slave Expansion Card is used only with the **CONCEPT500**; it's purpose is to calculate and drive DMX dimmer outputs 513 through 1500, and to generate a second video output (RGB and RS-170 monochrome).

## 2. MECHANICAL

The ***EXPN-433*** mounts in the bottom tray of the **CONCEPT500** console just to the left of the ***CNCP-430*** Main Processor Card. It is connected to the ***CNCP-430*** by a 50 conductor ribbon cable (see discussion under **EXPN-430**) and is mounted on four 6-32X1/4" hex standoffs. In addition, there are two 4-40X3/16 female screw locks which retain the DB-9 RGB color video connector in the back panel.

The DMX digital dimmer outputs are routed to the back panel XLR connectors by way of a 10-conductor ribbon cable which plugs into **J4**.

## 3. DC POWER

DC power is provided to the ***CNCP-433*** by way of a separate wiring harness from the power supply; it plugs into the board's main power connector **J1** and bridges over to the **CNCP-430** expansion power connector; this assures even voltages across all four circuit boards.

## 4. CPU

The CNCP-433 contains a single **TMS 32020** Digital Signal Processor chip (identical to the slave processor CPU on the ***CNCP-430*** Main Processor board); it functions in much the same fashion except for the following features:

- there are two 32KX8 STATIC RAMs **(U30 and U31)**, required to support nearly a thousand dimmer outputs.
- the Data, Address and Control information is provided by the MASTER HD64180 CPU on the ***CNCP-430*** Main Processor board through the Slave Expansion connector.
- the digital dimmer outputs are generated by a **MC68661 UART (U44)** which receives it's data and control information from the **TMS 32020**.

## 5. MEMORY

There are three groups of memory on the ***CNCP-433***:

**Cue Memory:** the four **32Kx8 Static RAMs (U32..U35)** provide the additional memory required for 500 channel operation. This memory is a simple extension of the Static Ram on the ***CNCP-430*** Main Processor Board and operates in exactly the same manner, with the exception that the data bus is buffered by an additional **74LS245 buffer (U28)**. Access to this memory is controlled by the **HD64180** processor on the ***CNCP-430*** processor board. Back-up power for these Static RAMs is provided by a **1-Farad capacitor (C6)** and a network of transistors and resistors; it operates in exactly the same manner as the back-up power circuit on the **EXPN-430**.

**Slave Processor Memory:** as in the **EXPN-430** slave circuit, the **TMS32020's** data bus is broken into MOST SIGNIFICANT BIT **(MSB)** and LEAST SIGNIFICANT BIT **(LSB)** paths. Each half contains an **EPROM (U36, U37)**, a **32Kx8 Static RAM (U30, U31)**, and a socket for an additional **8Kx8 Static RAM (U5 and U6**, currently not installed). This memory is used in exactly the same fashion as that on the **EXPN-430.**

**NOTE:** each slave circuit in the **CONCEPT500** uses 2-27128A EPROMs; they are labeled **430 Slave MSB** and **LSB** (for installation on the ***CNCP-430*** **Main Processor Board**) and **433 Slave MSB** and **LSB** (for installation on the ***CNCP-433*** **Slave Expansion Card**). These EPROMs form a set and are not interchangeable with each other or with those of the **EXPRESSION** or **IMPRESSION.**

**Video Memory:** is provided by a **2Kx8 Static RAM (U4).**

## 6. DIGITAL OUTPUTS

The **CONCEPT500** console provides for up to 1500 DMX512 digital dimmer outputs; dimmer outputs 1-512 are generated on the ***CNCP-430*** **Main Processor** Board exactly as they are in **EXPRESSION** and **IMPRESSION.** Dimmer outputs 513-1500 are generated on the ***CNCP-433*** by the **TMS32020** in the following way: dimmer outputs 513-1024 are created directly by the **TMS32020** at pins **28 (break)** and **32 (data)**, ANDed by **U52 (74LS00)**, and presented to the input of **U39 (SN75176)**, a RS-422 driver. (This part of the circuit is also identical to that of the **EXPN-430.**)

Dimmer outputs 1025-1500 are calculated by the **TMS32020**, which then transfers the information over its data bus to the **MC68661 UART**, which then serializes the data and presents it to **U41 (SN75176)**, another RS-422 driver. Note that provisions are made for synchronous (clocked) digital outputs by way of **U40** and **U42** (the remaining SN75176 RS-422 drivers), however these are presently not used.

Each output group is provided with its own crystal time-base, jumper selectable between 4.00 MHZ (DMX) and 2.4576 MHZ (D-192). **Y1** and **Y2** provide the clock for the internal serial output of the **TMS32020** (dimmer outputs 513-1024), with jumpers **C** and **D** selecting between DMX and D-192, respectively. Similarly, crystals **Y4** and **Y5** provide the clock for the **MC68661 UART** (dimmer outputs 1025-1500) and are selected by jumpers **I** and **J** (DMX and D-192 respectively).

## 7. VIDEO

The video circuit on the ***CNCP-433*** is identical to the circuit on the **EXPN-430**; it provides simultaneous TTL RGB color and RS-170 monochrome 75 ohm video outputs. Please refer to section **B-7** for operational details.

## 8. LEDs

The LEDs on the ***CNCP-433*** are under software control; at present they have the following use:

D1- indicates communication with the CNCP-430 Main Processor Board.
D2- indicates TMS32020 code execution (on the CNCP-433).
D3- indicates DMX #2 (dimmers 513-1024) operation.
D4- indicates DMX #3 (dimmers 1025-1500) operation.
D5-D8 are not utilized.

# III. OPTIONAL SYSTEM HARDWARE

## A. OVERVIEW

The **EXPRESSION** system optional hardware provides for up to:

- 192 Manual Readback channels
  (**IMPRESSION** supports up to 150 Readback channels)

- 192 Analog Wire-per-dimmer outputs
  (**EXPRESSION** and **IMPRESSION** only)

- 384 Analog Multiplex (AMX/CD80/SCI) dimmer outputs (**EXPRESSION** and **IMPRESSION** only)

These inputs and outputs are implemented with factory or dealer installed circuit boards which mount in the bottom tray to the left of the processor board. The output signals from these option cards are routed to the cutouts in the back panel, which provide for all output configurations. (No sheet metal modification is required.)

Additional optional hardware includes a Handheld **Remote Focus Unit (RFU)** which plugs directly into an XLR connector on the back of all consoles (see **Section B-6; EXPN-430** Communications), and a **Real Time Clock**, which consists of a **SmartWatch socket** installed underneath the STATIC RAM **(U10)** on the **EXPN-430** main processor card. The **Real Time Clock (RTC)** requires software that supports the SmartWatch circuit (to be released November 1988).

## OPTIONAL READBACK AND ANALOG DIMMER OUTPUT CARDS:

The Readback and Dimmer Output cards consist of the following:

### MANUAL READBACK:

**VISN-332** Manual Input Card

- Up to (2) **VISN-332** Manual Input Cards may be installed.
- # of Manual Inputs is expandable in groups of 32. (ie; 32, 64, 96, 128, 160 or 192 Manual inputs; 150 maximum in **IMPRESSION**)
- Manual input cards coexist with all types of digital and analog outputs.
- Readback voltage range is 0-24 volts DC.
- Input cards are mounted on standoffs in the bottom tray; input connectors mount directly to the rear sheet metal of the console.
- Input connectors are male Centronics D36 style (32 inputs per connector).
- Power is supplied by a power loom extension.
- Data signals are supplied by 34 conductor ribbon cable (Mythical Bus) from **EXPN-431** Face Panel Board.

### ANALOG WIRE-PER-DIMMER OUTPUTS:

**IDEA-019** 96 Analog Wire-per-Dimmer output card

- Up to (2) **IDEA-019** output cards may be installed for a total of 192 outputs (**IMPRESSION, EXPRESSION** only).
- Standard output voltage is 0-11 volts DC.
- Optional power supply provides for up to 28 volt DC outputs.
- Analog output cards are mounted side-by-side on standoffs in the bottom tray.
- Outputs are routed from cards to back panel cut-outs by ribbon cables.
- Outputs are female Centronics D36 style connectors (32 outputs per connector).
- Power is supplied by a power loom extension.
- Data signals are supplied by 20 conductor ribbon cable (Mythical Bus) from **EXPN-431** Face Panel Board.

OVERVIEW

**ANALOG MULTIPLEX DIMMER OUTPUTS (AMX192, SCI, CD80):**

**VISN-333** 192 Analog Multiplex output card

- Up to (2) **VISN-333** output cards may be installed, for a total maximum of 384 AMX outputs (**IMPRESSION, EXPRESSION** only.
- Outputs are configured as two AMX192 outputs.
- Outputs are carried by ribbon cable from the **VISN-333** card to back panel cutouts for 4-pin male XLR style connectors.
- Female XLR and "mini-Switchcraft" output connectors are optional via adaptor cables.
- Analog Multiplex cards are installed on standoffs in the bottom tray.
- Power is supplied by a power loom extension.
- Data signals are supplied by 20 conductor ribbon cable (Mythical Bus) from **EXPN-431** Face Panel Board.

Note that although Analog Wire-per-Dimmer and Analog Multiplex outputs cannot be used simultaneously, both types of cards may be installed; the output type to be used is determined by the dipswitch settings.

The maximum number of **option cards** would be:

- 192 Manual Inputs (two **VISN-332** input cards)
  (**IMPRESSION:** 150 maximum)

- 96 wire-per-dimmer Outputs (one **IDEA-019** output card)
  (**IMPRESSION, EXPRESSION** only)

- 384 Analog Multiplex Outputs (two **VISN-333** output cards)
  (**IMPRESSION, EXPRESSION** only)

See Appendix B (Mythical Bus Cable Wiring) for details on wiring.

## B. IDEA-019 ANALOG WIRE PER DIMMER OUTPUT CARD

# IDEA-019 Analog Output Board
# Technical Manual
# rev. 10/23/85

## I. General

### A. Overview

The IDEA-019 is a 96 dimmer analog output board used in the Idea and Vision systems. Outputs are adjustable (both zero and full scale voltages).

### B. Specifications

#### 1. CPU interface

The CPU interface connector (J4) is compatible with the IDEA-120 and VISN-330 CPU boards. Other devices may be used to drive the IDEA-019 provided the restrictions outlined in the Programming section are met.

There are some errors in the IDEA-120 and VISN-330 interfaces to this card; see Appendix A. for further information.

#### 2. Analog outputs

The IDEA-019 has 96 analog outputs which can provide up to 0-28 VDC out with eight bit resolution. The maximum output voltage depends on the power supply voltage. With a 12V supply, the outputs can supply up to 0-10V. With a 30V supply, the range is 0-28V.

Negative output voltages are not available.

The pinout of the dimmer output connectors is shown in figure 1.

There are three connectors; each has 32 outputs. J1 is outputs 1-32, J2 is outputs 33-64 and J3 is outputs 65-96.

| output | pin | | output |
|---|---|---|---|
| 1 | 1 | 2 | 19 |
| 2 | 3 | 4 | 20 |
| 3 | 5 | 6 | 21 |
| 4 | 7 | 8 | 22 |
| 5 | 9 | 10 | 23 |
| 6 | 11 | 12 | 24 |
| 7 | 13 | 14 | 25 |
| 8 | 15 | 16 | 26 |
| 9 | 17 | 18 | 27 |
| 10 | 19 | 20 | 28 |
| 11 | 21 | 22 | 29 |
| 12 | 23 | 24 | 30 |
| 13 | 25 | 26 | 31 |
| 14 | 27 | 28 | 32 |
| 15 | 29 | 30 | GND |
| 16 | 31 | 32 | GND |
| 17 | 33 | 34 | GND |
| 18 | 35 | 36 | GND |
| GND | 37 | 38 | GND |
| GND | 39 | 40 | GND |

FIGURE 1.
J1, J2, J3 -- OUTPUT CONNECTOR PINOUT

## II. Circuit description

### A. CPU interface

#### 1. Description

The IDEA-019 is connected to the CPU board (IDEA-120 or VISN-330) via a 20 conductor ribbon cable connector [J4]. On J4, there are seven address lines, eight data lines, and two control lines.

The IDEA-019 is addressed as 96 consecutive I/O addresses by the CPU. To set an output level, the CPU writes a data byte to the appropriate port.

#### 2. Operation

There are two control signals on J4, designated WR* and DAC*. The card is selected whenever they are both low. The data and address are latched on the rising edge of WR* or DAC*.

#### 3. CPU Connector schedule

The pinout of J4 is shown in figure 2. NOTE: this pinout is different than that shown on the schematic (rev 5/22/84) and is also different than the pinout of the interface connectors on the

IDEA-120 and VISN-330 CPU boards. The differences are corrected for in the Idea and Vision software at the moment.

| PIN | SIGNAL | DESCRIPTION | |
|---|---|---|---|
| 1 | SD4 | data bit 4 | (active low) |
| 2 | SD0 | data bit 0 | (active low) |
| 3 | SD7 | data bit 7 | (active low) |
| 4 | SD1 | data bit 1 | (active low) |
| 5 | SD6 | data bit 6 | (active low) |
| 6 | SD2 | data bit 2 | (active low) |
| 7 | SD5 | data bit 5 | (active low) |
| 8 | SD3 | data bit 3 | (active low) |
| 9 | no connection | | |
| 10 | SA6 | address bit 6 | |
| 11 | SA5 | address bit 5 | |
| 12 | SA4 | address bit 4 | |
| 13 | SA3 | address bit 3 | |
| 14 | SA0 | address bit 0 | |
| 15 | SA1 | address bit 1 | |
| 16 | SA2 | address bit 2 | |
| 17 | DAC* | card select | (active low) |
| 18 | WR* | write strobe | (active low) |

FIGURE 2.
J4 -- CPU INTERFACE PINOUT

4. Connection to Vision systems:

One or two IDEA-019 cards can be connected to the VISN-330 as follows:

Card#1 (dimmers 1-96):
J4 connects to pins 1-20 of J4 on the VISN-330 CPU board

Card#2 (dimmers 97-192):
J4 pin 17 connects to pin 21 of J4 on the VISN-330.

All other pins connect to the corresponding pins of J4 on the VISN-330.

5. Connection to Idea systems:

J4 on the IDEA-019 connects directly to J3 on the IDEA-120 CPU.

B. Channel decoding

The seven address bits from the CPU are latched in an 8-bit latch (U43, 74LS374). The latched addresses are used to select one of 96 channels as follows:

Bits 0,1,2 are shifted to 0..12V levels by U39 (7406) and drive the three address inputs of each of the output multiplexers (U1-U12, CD4051).

Bits 3,4,5 select one of the 12 outputs of U37 or U41 (74LS145's). U41 is used as a one-of-eight decoder; U37 as a one-of-four decoder. Together, U37 and U41 enable one of the 12 output multiplexers.

Bit 6 enables either U41 or U37.

The enable signal for the selected multiplexer is delayed by a one-shot (U46, 74121) to allow the output from the DAC to settle.

C. DAC

The AD7520 D/A converter (U40) is a ten bit DAC of which only the upper eight bits are used.

A 3.6V reference voltage is provided to the DAC by zener diode D97. R63 adjusts the full-scale output voltage by raising or lowering the reference voltage.

The DAC output is buffered and amplified by U42 (TL094). R62 adjusts the zero output.

D. Multiplexers

The DAC level is routed to one of the 96 output circuits by 12 CD4051 analog multiplexers (U1-U12).

E. Sample/Hold and Output amplifiers

Each output has a sample/hold capacitor (C1-C96) which stores the output voltage between refresh cycles. The capacitor voltage is amplified by a gain of about 2.2 by an op-amp (U13-U36, TL094 or LM324).

The outputs are coupled through diodes for "pile-on" applications. There is a 100K resistor to ground on each output to ensure that the output will swing to ground when driving high impedance loads.

## III. Power Supply Inputs & Output Voltage Ranges

The IDEA-019 requires +5V and +12V for operation. If output voltages above 10V are required, then an additional power supply voltage is required. The supplimentary supply must be at least 2V above the maximum required output voltage.

The pinout of the power supply connector J5 is shown in figure 3. As viewed from the component side of he board:

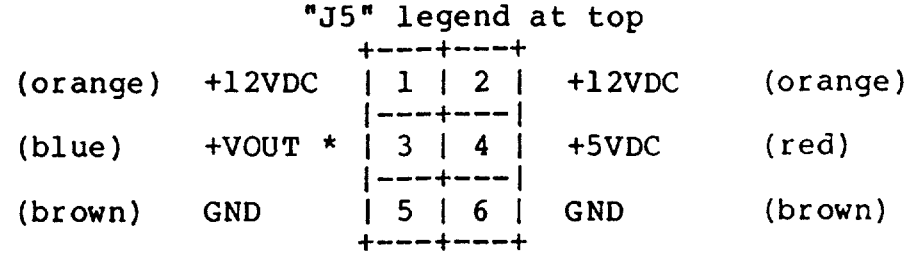



FIGURE 3.
POWER SUPPLY CONNECTOR PINOUT

* VOUT is the power supply for the output buffers. Normally, it is connected to +12 for 0-10V outputs. For 0-24V outputs, cut jumpers J6 and J7 and connect VOUT to +28-+30V.

## IV. Programming

### A. General

The IDEA-019 appears as 96 write-only I/O ports to the CPU. The output data is 0..255 decimal, where 0 is the HIGHEST level and 255 is the LOWEST level.

There should be a delay of about 100 uS between channels for the Sample/Hold circuit to settle.

All of the outputs should be updated at least twice a second to avoid drift.

### B. Idea interface

In the Idea system, the IDEA-019 is adressed at ports 80H-DFH.

There are a couple of errors in the interface on the IDEA-120 CPU board which complicate things:

1) The data bus is flopped end-for-end. This means that the least significant bit (D0) on the Idea CPU is connected to the most significand bit (D7) of the IDEA-019. This must be corrected for in software.

2) A0 and A2 are reversed on the IDEA-120 interface. This must also be corrected for.

C. Vision interface

In the Vision system, one or two IDEA-019 boards can be used. Both boards are in I/O page 2.

The first board is mapped at ports 00H-5FH.

The second board is mapped at ports 80H-DFH.

There is one error in the interface on the VISN-330: address bits A0 and A2 are swapped and must be corrected in software.

V. Adjustment

There are two adjustments on the IDEA-019:

R62 adjusts the ZERO voltage

R63 adjusts the FULL SCALE voltage

The adjustment procedure is as follows:

1) Connect a voltmeter or oscilloscope to one of the outputs.

2) Program an output for full scale. Adjust R63 for the desired full-scale voltage.

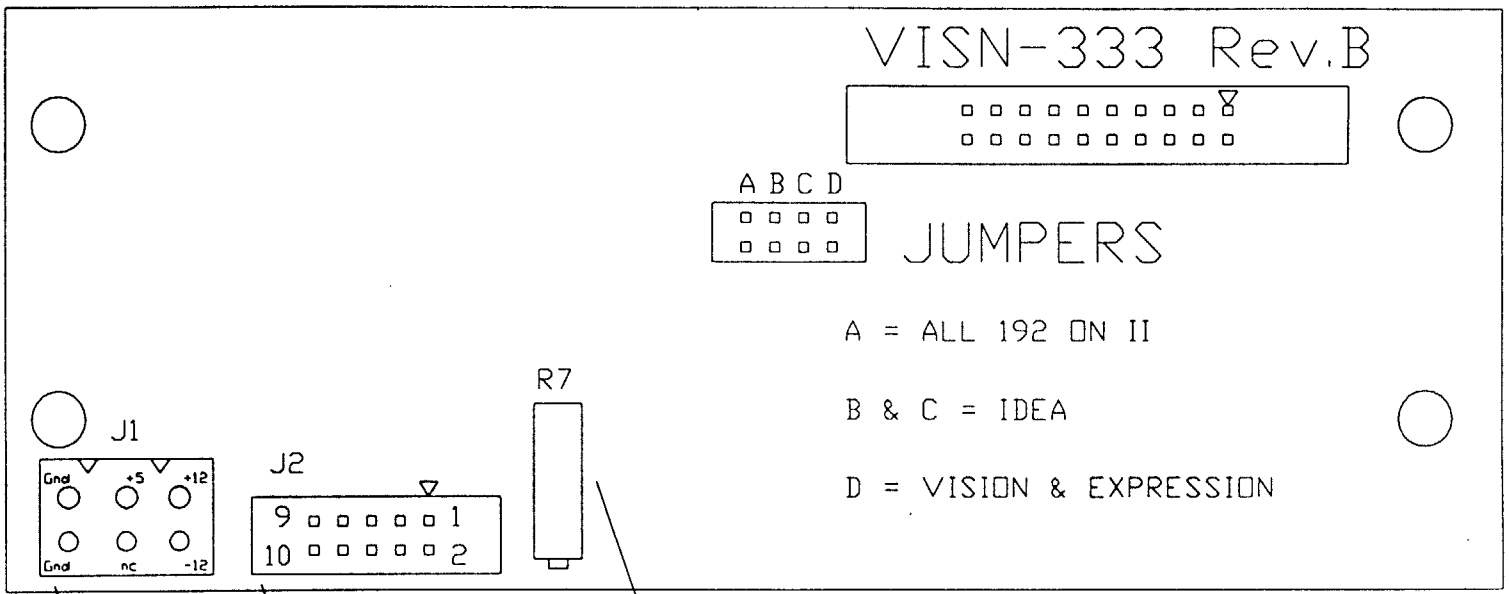
3) Program the output to zero. Adjust R62 for the desired zero voltage. When adjusting for 0 V, turn R62 down until the output is at 0V, then turn it back up until the output just begins to move upwards.

Repeat steps 2 and 3 three or four times until the desired accuracy is achieved.

Check the output voltage at 25%, 50%, and 75% of full scale. The voltage should be within 5% of the true value over the entire range.

# C. VISN-333 ANALOG MULTIPLEX OUTPUT CARD

# MYTHICAL BUS




1 = CLOCK I (+) [BRN]
2 = CLOCK I (-) [RED]
3 = DATA I [OR]
4,8 = Gnd
5 = CLOCK II (+) [GRN]
6 = CLOCK II (-) [BLU]
7 = DATA II [VIOL]
9,10 = nc

| STRAND PINOUT | USITT AMX-192 PINOUT |
|---|---|
| 1 - CLOCK (-) | 1 - COMMON |
| 2 - COMMON | 2 - CLOCK (+) |
| 3 - CLOCK (+) | 3 - ANALOG DATA |
| 4 - ANALOG DATA | 4 - CLOCK (-) |

VISN-333 REV. B AMX/CD80 OUTPUT CARD

ELECTRONIC THEATRE CONTROLS 12/20/88

# D. VISN-332 MANUAL INPUT CARD

# VISN-332 Analog Input Board
# Technical Manual
# rev. 1/16/86

## I. General

### A. Overview

The VISN-332 is an analog input board used in the Vision system. It accepts up to 96 DC or pulse-width modulated (PWM) inputs and digitizes them. The input range (both zero and full-scale) is adjustable.

There are 3 versions of this card. The VISN-332-32 has 32 inputs, the VISN-332-64 has 64 inputs, and the VISN-332-96 has 96 inputs.

### B. Specifications

#### 1. CPU interface

The CPU interface connector (J2 or J3) is compatible with the 'mythical bus' interface on the VISN-330 CPU. This interface is electrically similar to a subset of the STD bus.

#### 2. Analog inputs

The analog inputs on the VISN-332 can accept up to 0-24V DC inputs. Each input has a filter circuit which allows use with an AC input signal such as the PWM output of a manual lighting control console. The lowest frequency component of an AC input signal should be 200Hz or greater.

Negative input voltages cannot be used.

The pinout of the input connectors is shown in Figure 1.

There are one, two or three connectors, depending on the number of inputs. Each connector has 32 inputs.

On the VISN-332-64, J6 is for inputs 1-32 and J7 is for inputs 33-64.

On the VISN-332-96: J5 is for inputs 1-32; J6 is for inputs 33-64 and J7 is for inputs 65-96.

| | | | |
|---|---|---|---|
| input 1 | pin 1 | 2 pin | input 19 |
| 2 | 3 | 4 | 20 |
| 3 | 5 | 6 | 21 |
| 4 | 7 | 8 | 22 |
| 5 | 9 | 10 | 23 |
| 6 | 11 | 12 | 24 |
| 7 | 13 | 14 | 25 |
| 8 | 15 | 16 | 26 |
| 9 | 17 | 18 | 27 |
| 10 | 19 | 20 | 28 |
| 11 | 21 | 22 | 29 |
| 12 | 23 | 24 | 30 |
| 13 | 25 | 26 | 31 |
| 14 | 27 | 28 | 32 |
| 15 | 29 | 30 | GND |
| 16 | 31 | 32 | GND |
| 17 | 33 | 34 | GND |
| 18 | 35 | 36 | GND |
| GND | 37 | 38 | GND |
| GND | 39 | 40 | GND |

FIGURE 1.
J5, J6, J7 -- INPUT CONNECTOR PINOUT

## II. Circuit Description

### A. Overview

The VISN-332 is divided into three sections, each to service 32 inputs. The three sections are electrically separate and identical. U6 and U7 form an address decoder to select one of the three sections.

Each section contains an ADC and a one-of-32 multiplexer to select one of its 32 inputs. A 'write' operation will select one of the 32 inputs in each section and start conversion on all 3 ADC's simultaneously. A 'read' operation will read the data from one of the three ADCs, depending on the address which is read.

### B. CPU interface

#### 1. Description

The VISN-332 is connected to the CPU board (VISN-330) via a 34 conductor ribbon cable connector (the "mythical bus" -- J2 or J3). On the mythical bus, there are are eight data lines, eight address lines, and several control lines.

The data lines are connected directly to the three ADC-0804 ADC's and to two 74LS174 address latches. Three address lines (A0..A2) and the card select signal (RDBIO*, pin 22) are used for address decoding. The upper five address lines (A3..A7) are not used.

## 2. Operation

The RDBIO* (ReaDBack I/O) signal indicates when an I/O operation to the VISN-332 is to take place. If the operation is a WRITE, the low 5 data bits are latched into the 74LS174's (U4, U8, U15) in each section to select one of the 32 inputs. A WRITE operation will also start conversion on all 3 ADC's.

If the operation is a READ, data from one of the 3 ADC's (selected by the low 3 address bits) will be gated onto the data bus.

3. CPU connector schedule

| PIN | SIGNAL DESCRIPTION | |
|---|---|---|
| 1 | SD4 data bit 4 | |
| 2 | SD0 data bit 0 | |
| 3 | SD7 data bit 7 | |
| 4 | SD1 data bit 1 | |
| 5 | SD6 data bit 6 | |
| 6 | SD2 data bit 2 | |
| 7 | SD5 data bit 5 | |
| 8 | SD3 data bit 3 | |
| 9 | no connection | |
| 10 | no connection | |
| 11 | no connection | |
| 12 | no connection | |
| 13 | no connection | |
| 14 | SA0 address bit 0 | |
| 15 | SA1 address bit 1 | |
| 16 | SA2 address bit 2 | |
| 17 | no connection | |
| 18 | no connection | |
| 19 | no connection | |
| 20 | no connection | |
| 21 | no connection | |
| 22 | RDBIO* | (active low card select) |
| 23 | no connection | |
| 24 | no connection | |
| 25 | no connection | |
| 26 | no connection | |
| 27 | no connection | |
| 28 | no connection | |
| 29 | no connection | |
| 30 | no connection | |
| 31 | GND | |
| 32 | GND | |
| 33 | GND | |
| 34 | GND | |

FIGURE 2.
J4 -- CPU INTERFACE PINOUT

4. Connection to the Vision system

The VISN-332 is connected to the VISN-330 CPU board via a 34 conductor ribbon cable. The cable can be plugged into either J2 or J3 on the VISN-332. The other end of the cable connects to J4 on the VISN-330 CPU board.

Only one VISN-332 can be connected to the system. One or two IDEA-019 output cards can also be connected on the same ribbon cable (see the IDEA-019 technical manual)

C. Input Signal Conditioning

Each input of the VISN-332 has a low-pass active filter circuit with a cutoff frequency of about 50 Hz. This filter serves two functions: (1) it filters out high frequency noise on the inputs; (2) it allows the use of the VISN-332 with the pulse-width modulated outputs of some manual lighting consoles.

The input voltage is divided by two by two 47K resistors to allow up to 24VDC input signals.

D. Multiplexers

In each section, the 32 input filters feed four 8 input multiplexers (CD4051s). The 4051's select one of the 32 inputs and route the input signal to the ADC via an amplifier.

E. Channel Decoding

The 74LS145 (U5, U9, U15) is a one-of-four decoder which selects one of the four 4051's. The inputs to this chip are the latched data bits D3, D4 and D5 from the 74LS174. D3 and D4 select one of four 4051's. D5 disables all the 4051's when it is a '1'.

The lower 3 data bits (D0, D1 and D2) drive the address inputs of all the 4051's in parallel via a 7407 open-collector driver (U3, U10).

F. Amplifier for Full Scale Adjustment

The input signal selected by the 4051's is fed to the ADC via an amplifier (TL004: U2, U13). The input signal is divided by two by two 10K resistors and then fed to a variable gain amplifier. The output of the amplifier is then divided by two again and then fed to the input of the ADC.

This allows the full-scale input to be adjusted. The amplifier gain is normally adjusted to provide a 0-5V input signal to the ADC.

G. Analog to Digital Converter

The ADC is an ADC0804. This is an 8 bit successive approximation converter with differential inputs. The conversion time of this ADC is approximately 100 uS.

The ADC is designed to connect directly to a microprocessor bus as an I/O device. The WRITE* input (pin 3) is an active-low input which starts conversion. The READ* input (pin 2) is an active-low input which gates the output data onto the system data bus.

The positive analog input (pin 6) is the conditioned input signal (see section F.) The negative analog input (pin 7) is connected to a trim pot to allow adjustment of the zero level.

The 2.5V reference voltage required by the ADC is provided to pin 9 by an AD580 voltage reference IC.

## III. Programming

### A. I/O addresses

The VISN-332 input card responds to 4 I/O port addresses. These addresses appear on I/O page 2 of the VISN-330 CPU. (see the VISN-330 programmer's guide for more information.)

| ADDRESS | FUNCTION |
|---|---|
| 00H | set address, start conversion<br>data = channel number within group (0..31) |
| 03H | read data from first group |
| 04H | read data from second group |
| 06H | read data from third group |

FIGURE 3. I/O ADDRESSES

### B. Detailed programming information

After selecting a new channel, the software must delay about 10 uS or more for the multiplexer to settle, and then select the channel again to start the ADC.

The procedure is as follows:

1) write channel number (0..31) to port 00

2) delay about 10 uS

3) write channel number to port 00 again

4) delay about 200 uS for the ADC conversion

5) read data:

for group 1 (inputs 1-32), read port 03H
for group 2 (inputs 33-64), read port 04H
for group 3 (inputs 65-96), read port 06H

Note that you can read the data from all three groups after performing steps 1 thru 4. Thus, reading all 96 inputs requires only 32 conversion cycles or about 6.4 mS.

## IV. Adjustment

The VISN-332 has 2 adjustments on each section: a full scale adjustment (R2, R22, R23) and a zero adjustment (R1, R20, R21).

The adjustment procedure is as follows:

NOTE: each group of 32 inputs has separate adjustments. Adjust each group separately and then compare them to make sure the groups match each other.

Connect the VISN-332 to a functioning Vision console and power-up the console. Do not connect anything to the VISN-332 inputs.

Turn the zero adjust pot fully counter-clockwise. The channel levels should be mostly 01's and 02's. Turn the pot slowly clockwise until all the levels disappear.

Apply 10VDC to one or more of the inputs in the group under test. Adjust the full scale pot until the display just shows 'FF'.

# IV. APPENDICES

# SOFTWARE RELEASE

Product Line: Expression/Impression/Concept-500/Insight

Description: Main/Expansion Memory version 2.05.
Slave version 2.05 (Expression/Impression/Insight, only)

Effective Date: 06/15/92

The following information outlines the Version 2.05 Main software release for ETC Expression Line consoles. This release includes all new Main and Expansion memory code for all four console configurations, as well as new slave code for all but the Concept-500. This version uses the latest current releases of Face panel software (2.07 Expn/Impn/Cncp, 2.04 Inst).

## Console Versions

Main Expression/Impression/Insight/Concept-500 -

Main Code Version - 2.05
Expansion Memory - 2.05 (PGX1 U28)
- 2.05 (PGX2 U29)

Slave Expression/Impression/Insight -

Slave Code Version - 2.05

Concept-500 -

Slave Code Version - 2.02.

Face panel Expression/Impression/Concept-500 -

Face Panel - 2.07A (A or B for ARRI as required)

Insight -

Face Panel - 2.04A.

## Operational Notes

1 - Boot screen displays a version message for the Main, Slave, and Face panel code. The version message for the Slave will indicate which Slave processor is present by preceding the version number with either a "C" for TMS320C25, or "V" for TMS32020.

2 - The Long Boot includes EPROM Checksum tests which, in the event of an error, will prompt the operator before continuing with the boot.

3 - All consoles shipped with version 2.05 should have dipswitch B6 set in the up position. This enables the Face Panel time-out message.

## Issues Resolved

The following is a list of problems that are now fixed in this release.

1) Reading an Expression disk into an Insight console killed subroutines.

2) Effect Ripple steps flashed to full before fading out.

23) Modular RTB System problems:

a) A "B" CPU that has taken control (tracking link broken) would loose all pot and submaster bump control whenever a Digitizer is active.

b) Consoles could get out of sync during disk operations if disk errors occurred on the B CPU and the error clearing syntax wasn't followed (e.g pressing Enter in place of Clear). This has been fixed except for those cases where a Macro is used to perform some disk operation followed by other button hits.

c) The FLASH key didn't function or track properly. It is not allowed to be programmed into Macros or DWS regions.

d) Submaster Bump button hits could get out of sync on the B CPU causing some submasters to be locked on or the wrong submaster to come up. This was most noticeable with submasters programmed with infinite wait times.

e) When simultaneously moving multiple submasters, the B CPU would only display the movement of the first submaster in the group. The others would update to the correct values after the submaster movement stopped.

f) The "RFU ON" prompt would appear on the B CPU screen when the RFU was turned on and then would stay locked on even after the RFU was turned off. This now functions the same as the "DWS ON" message, which is not displayed on the B CPU until control is passed to it.

Outstanding Problems

1) On modular RTB consoles, rate changes followed immediately by rapid button hits will not properly track to the "B" CPU; the button hit steps on the rate info in transit.

2) Plugging in the Alphanumeric keyboard while the console is powered up can cause odd behavior. The keyboard should always be plugged in before the console is turned on.

Things to Remember

1) The GROUP AT syntax experiences rounding errors at 47, 37 and 15%. In these cases the next lower number will be displayed (e.g Group-At-47 yields 46%). This is also true with the "+" and "-" keys with the syntax "GROUP AT + (or -)" will skip over the above values and repeat the next lowest value. This is a known problem that can't be improved.

2) With tracking consoles, there is a delay in response of the slave console. The delay is more noticeable on heavily loaded consoles and on Concept-500.

3) Levels set by the submasters are 256 values and are output that way. However, the recorded values are stored as 100 values, and if recalled as a submaster, the output values may be off by 1 (2 or 3 Hex values).

4) F1/F2/F3 Digitizer select keys do not track.

5) GROUP-AT-WHEEL syntax will blank the level value from the upper keyboard window. FF or 00 will flash if over/under range conditions exist. This was intended as no rational/sensible value exits to display.

6) The Wheel is still active while running Macros and can cause odd behavior if moved.

7) Decimal cue numbers can not be used with MIDI.

SOFTWARE ANOMALY REPORT

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**DATE:** 11/12/90 **FOR INHOUSE USE ONLY** **NUMBER:** 6

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**PRODUCT:** MicroVision

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**SOFTWARE VERSION(S):** 1.10, 1.11

---

**CUSTOM FEATURES/OPTIONS:** N.A.

---

**DESCRIPTION:**

There is a problem where selecting multiple channels using [AND] followed by [REL] to cancel the operation, will leave the console in a mode where the next numeric entry will also select the channels previously selected.

For example:

- Press [CHAN] [1] [AND] [2] [AND] [3] [AND] [4] [AND] [5] [AND] [6].
- Set to a level using the wheel.
- Press [REL] followed by [9].

Notice that any of the previously selected channels that were followed by [AND] are now selected again (1 through 5). It is not necessary to set levels in the above example; selecting the channels is enough to cause the problem. If [CHAN] is pressed before entering a new number, or if the previous channel selection sequence was terminated using [AT] or [FULL], this problem doesn't occur.

---

**SUGGESTED WORK AROUND:**

Although this effect doesn't cause any serious problems in the console, the user should avoid the channel selection syntax [AND] [REL] [n] by terminating the previous channel selection with [AT] level command, or by beginning a new channel select sequence using [CHAN].

---

**CORRECTIVE ACTION:**

To be determined - should be fixed in the next release version.

---

**CODE AFFECTED:**

Main Code

---

**SOFTWARE RELEASE**

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**Product Line:** Expression/Impression/Concept-500/Insight
**Description:** Slave Code version 1.82
**Effective Date:** June 7, 1990

---

Slave Code Version 1.82 corrects two problems found in earlier code and incorporates a new feature involving the DMX outputs.

Corrections:

PATCH Bug - Patching Dimmers to channel Zero would cause the profile and level parameters of any following dimmers to be proportionally offset. Example: Setting Dimmer 20 to profile 6 at 55% and then patching Dimmer 11 through 15 to channel Zero will offset the profile/level assignment of dimmer 20 to dimmer 25. It is important to note that only the effect of the profile/level is shifted and that softpatch looks normal.

BACK Bug - When running a console with one SRAM in the Slave circuit, the Autofader BACK operation would not fade completely to zero, leaving "01" in all of the channels moving to zero. This was traced to a problem in the routines that control ALLFADEs which are used in the BACK operation and also exhibit the "01" problem.

New Feature:

The Slave code now waits until after the console has completed the boot sequence before turning on the DMX outputs. The DMX signal becomes valid within 1 second after the Boot screen redraws to the initial Stage screen.

---

**Instructions:**

1. All consoles shipped after the effective date must use Slave Code version 1.82.

2. Retrofit consoles in the field as required by ETC service policy.

**Console software version:**

EXPN/IMPN - Main Code - 1.80 or 1.80A
**Slave Code - 1.82**
Face Panel - 1.80

CNCP-500 - Main Code - 1.80 or 1.80A
**Slave Code - 1.82 (for 430 and 433)**
Face Panel - 1.80

INST - Main Code - 1.80 or 1.80A
**Slave Code - 1.82**
Face Panel - 1.80

**Limitations:** See Version 1.80 Releases.

**Operational changes:** See Version 1.80 Releases.

# BETA SOFTWARE RELEASE

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**Product Line:** Insight

**Description:** Main/Slave/Face Panel Beta Version 1.76A.

**Effective Date:** 02/19/90

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The following information details the Version 1.76A software release for ETC Insight consoles. Release 1.76A is the Beta version of 1.80 software.

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**Instructions:**

1 - Only those Insight consoles participating in the customer Beta test program are to receive Version 1.76A. Participation in this program shall be authorized by Field Service/Support.

2 - All consoles shipped with version 1.76A should have dipswitch B6 set in the on (or up) position. This enables the Face Panel time-out message.

3 - Consult the Version 1.76/1.80 User Manual for dipswitch settings and console operation information.

4 - Face Panel version 1.76A is compatible with the Rev.B INST-531 as well as older 531s using the 439 add-on Fader wheel circuit.

---

**Console Versions:**

Insight -

| | |
|---|---|
| Main Code Version | - 1.76A |
| Slave Code Version | - 1.76A |
| Face Panel Version | - 1.76A |

---

NOTES:

1 - Boot screen version messages indicate "1.76" with no "A". The version message for the Slave will indicate which Slave processor is present by preceding the version number with either a "C" for TMS320C25, or "V" for TMS32020.

2 - Redundant Tracking now requires that both consoles be powered up simultaneously.

3 - The Long Boot includes EPROM Checksum tests which, in the event of an error, will prompt the operator before continuing with the boot.

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INSIGHT 1.76A BETA RELEASE
(Continued)

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Bugs yet unresolved:

1 - The "DEFAULT DIMMER PROFILES" option only works with dimmers numbers equal to channel numbers. (Example: Console configured for 50 channels, 200 dimmers and default softpatch. Default profile option will only reset dimmers 1 through 50).

2 - Clearing links to Macros can not be done directly with [LINK] [CLEAR] command sequence. Required sequence is [LINK] [CUE] [CLEAR].

3 - Using the "+" key while linking cue or macro numbers does not work properly.

4 - Writing Macros using "Macrowait" will sometimes overwrite part of the message in the keypad prompt window (upper right screen). This is most noticeable when working with three digit Macros.

# BETA SOFTWARE RELEASE

---

**Product Line:** Expression/Impression

**Description:** Main/Face Panel 1.76B. Slave 1.76C Beta Versions.

**Effective Date:** 02/23/90

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The following information details the Version 1.76 software release for ETC Expression and Impression consoles. Release 1.76 is the Beta version of 1.80 software.

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**Instructions:**

1 - Only those EXPN/IMPN consoles participating in the customer Beta test program are to receive Version 1.76. Participation in this program shall be authorized by Field Service/Support.

2 - All consoles shipped with version 1.76 should have dipswitch B6 set in the on (or up) position. This enables the Face Panel time-out message.

3 - Consult the Version 1.76/1.80 User Manual for dipswitch settings and console operation information.

4 - Face Panel version 1.76C is compatible with the Rev.D EXPN-431 as well as older 431s using the 439 add-on Fader wheel circuit.

---

**Console Versions:**

Expression/Impression -

| | |
|---|---|
| Main Code Version | - 1.76B |
| Slave Code Version | - 1.76C |
| Face Panel Version | - 1.76B |

---

NOTES:

1 - Boot screen version messages indicate "1.76" with no succeeding letter. The version message for the Slave will indicate which Slave processor is present by preceding the version number with either a "C" for TMS320C25, or "V" for TMS32020.

2 - Redundant Tracking now requires that both consoles be powered up simultaneously.

3 - The Long Boot includes EPROM Checksum tests which, in the event of an error, will prompt the operator before continuing with the boot.

4 - Impression consoles will require the installation of all six SRAM (U10,U14-18) on the 430 board. This release will cancel step 1 of ECO # EXPN-430-0203, which removes two of the SRAM from the standard EXPN-430.

5 - The following Face Panel keys have changed function with this release:

| | | |
|---|---|---|
| AUTO-LOAD | changed to | PAGE |
| DELAY | changed to | EXCEPT |
| COPY | changed to | AUTO-LOAD |
| Impression only | | |
| EXPAND | changes to | AUTO-LOAD |

EXPN/IMPN 1.76 BETA RELEASE
(Continued)

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Bugs yet unresolved:

1 - The "DEFAULT DIMMER PROFILES" option only works with dimmers numbers equal to channel numbers. (Example: Console configured for 50 channels, 200 dimmers and default softpatch. Default profile option will only reset dimmers 1 through 50).

2 - Using the "+" key while linking cue or macro numbers does not work properly.

3 - Using "+" and "-" keys with the GROUP function does not work while running a Linked series of cues or chase.

4 - Writing Macros using "Macrowait" will sometimes overwrite part of the message in the keypad prompt window (upper right screen). This is most noticeable when working with three digit Macros.

5 - Using the "Print Macros" and "Print Regions" options on consoles with Expansion Memory will print erroneous Macro numbers above Macro 255.

**SOFTWARE RELEASE - DEALER NOTICE**

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**Product Line:** Expression/Impression

**Description:** Main Code Version 1.68A.

**Effective Date:** 12/6/89

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The following information details the Version 1.68A software release for ETC Expression and Impression consoles. **Version 1.68A supercedes version 1.68.**

Version 1.68A includes:

- Corrections for three serious problems found in Version 1.64.
- Added and/or enhanced console features.

These items as well as a list of additional bugs yet unresolved in 1.68A are described in detail below.

Version 1.68 slave provides for the use of either slave processor and can determine which is present at system boot. The boot screen will display "SLAVE 1.68" if the processor is the TMS32020 or "SLAVE C1.68" if the TMS320C25 is in use.

**Version 1.68A is not intended for use in Concept-500.**

---

**Instructions:**

1 - All Expression/Impression consoles shipped after the effective date must use the console versions shown below.

2 - Expression/Impression consoles already in the field should be upgraded at the discretion of field service.

3 - All consoles shipped with version 1.68A should have dipswitch B6 set in the on (or up) position. This enables the Face Panel time-out message.

4 - Consult the Version 1.64 User Manual for dipswitch settings and console operation information.

5 - Face Panel version 1.18 is compatible with 1.68A and allows use of the Rev.D and later EXPN-431 as well as older 431s using the 439 add-on Fader wheel circuit.

---

**Console Versions:**

Expression/Impression -

| | | |
|---|---|---|
| Main Code Version | - 1.68A | |
| Slave Code Version | - 1.68 | |
| Face Panel Version | - 1.17 | - for use with standard Fader Wheel circuit on 431 Rev. A through D. |
| Face Panel Version | - 1.18 | - Compatible with all 431 revs and Fader Wheel circuits. |

Concept-500 - Not supported by 1.68A.

---

**Operational changes:**

Dipswitch B6 controls the Face Panel time-out display. Setting B6 "ON" enables the message and setting B6 "off" inhibits it. The dipswitch is read every time an error condition is detected rather than at system boot. If B6 is on, any fades running at the time the message is displayed will pause until it is acknowledged by hitting "Clear". At this point the fades will resume.

* Infinite Submaster wait times are supported. Activate by pressing "-" from a "MAN" wait time or "+" from a wait time of "99.59".

* CLEAR-SUB and ON-SUB in Macros are supported. Activate by holding the desired sub bump and pressing "CLEAR" for "CLEAR-SUB" or "ENTER" for "ON-SUB" (while Macro editing).

* See INSIGHT manual for further information.

Macro Editing has been improved. Terminating a Macro line with a Macro number or by "ENTER MACRO" will advance the pointer to the next Macro. If more than 32 entries are made in sequence, the console will display the following message:

"MAX SEQUENCE LENGTH (32) REACHED< SEQUENCE TERMINATED AND SAVED."
"PRESS `ENTER' TO CONTINUE"

Macro editing will be inhibited until you acknowledge this message. If you insert commands in an existing Macro and exceed the maximum limit, commands will scroll off the end of the line.

---

**Bugs fixed in 1.68A:**

1 - Two related problems with the RFU were uncovered in 1.64 code. The first was that power cycling the RFU would cause the console to crash. Most of the time, the Slave and Main processors would get out of sync, sending the console into "slow" mode. The Dimmer outputs would also drop off or go out of control. Other time the console would just lock up. In either case a reboot was required to restore proper console operation. The second problem involved power cycling the console with the RFU turned on. In this case the RFU would no longer be recognized by the console. This was usually corrected by power cycling the RFU.

2 - The Button sequence [STAGE][EXPAND][CHAN][#][EXPAND] would crash the unexpanded displays of Stage, Blind, and Fader mode. The characters of the channel and level portion of these display modes would contain garbage, while the rest of the display (ie. Cue line, Cue sheet, Submaster status) was correct. Redrawing the unexpanded display by pressing the mode button twice ("Stage" "Stage" for example) would correct the problem.

3 - In Stage, Blind, or Fader display mode, redrawing to the second display page clears the Cue sheet information. To restore it, you must press the appropriate display mode button. In Stage, pressing [CUE][n] also restores the Cue sheet.

Bugs yet unresolved:

- If a console has Readback cards and it's dipswitch settings are incorrect, levels from the Readback cards can appear on screen, even if the channels they are assigned to are configured out. This occurs when the dipswitch settings are set lower than the real number of inputs.

- Slave Code bug - ETC Digital outputs do not work on consoles with 2nd SRAM installed in slave circuit. (NOTE: This is a problem in the Slavecode and is for informational purposes only).

- [Flash][+] Bug - Hitting [Flash][+] repeatedly very fast occasionally leaves full level up. These can only be cleared when (any) captured channels are brought up and then released.

- Macro w/Record Lock-Out - The console behaves unpredictably when macros containing record commands are executed with Record lock-out enabled.

- Second "Flash" bug - Select some channels, press FLASH two or three times rapidly. Levels go to full or 00 and hold there.

- The PATCH, RECORD, and EXPAND help messages contain the following errors:

  PATCH - Needs [AT] between the last enter and the level of 80 given in the example.

  RECORD - States "RECORD" is required in softpatch.

  EXPAND - Message is appropriate for the Concept-500 dual monitor setup but not for EXPN/IMPN.

- Can't unpatch a dimmer at full. Level block shows that it is at full but the outputs only respond to levels 00 - 99.

- Effects mode - Entering decimal fractions in the time column using the arrow keys will only work once. After that the decimal point isn't recognized until; 1- you leave and return to the time column using arrow keys, 2- clear the value pointed to before entering a new value, 3- or by pressing TIME followed by a new value.

- Group Message problem - After performing a usual group sequence like [GROUP][#][AT][level] the operator is prompted with the Group mode select message which leads one to believe that Group mode is still active. Entering a numeric value at this point puts you into channel mode. This operation is intended to work this way but the message should be changed to indicate the proper mode.

- Set Grand Master to any level < 100%. Capture some channels at full. Roll the Wheel up or press [at][+] and observe that the GM % is applied a second time. The level block in the upper right of the display shows the correct level.

- While in Expand display mode, returning from a disk read causes the Expand LED to go out even though the mode is still active. Disk Write, Verify, and Format do not cause this.

- There are complaints that the Help message for Wheel flashes by too fast due to sensitivity of wheel.

- There are complaints that the Wheel is read as button hits at awkward times. Some examples given are: during Macro execution, during disk operations such as Verify show ,and anywhere "Hit any key" is used.

- While programming Regions with the Digitizer, pressing Setup when "Outline Region" prompt is on screen crashes the console.

- Problem with unpredictable console behavior if Macros M1-M5 are activated while set up to call other unprogrammed Macros.

- There are complaints that using Help with loaded submasters will cause their levels to flash on stage. [HELP][SUB][SUB]. Timed submasters don't do this.

- Problem in Track Sheet - Selected cues on page two (any Chan) respond incorrectly. Rolling the Wheel up advances the levels but some "blink" to full immediately. (See ER #44)

- Adjusting captured channels with the "+" and "-" keys causes problems. Try [CHAN][AT][+][+][+][+].... a few times and then try [AT][-]. The level will flip back to zero.

- In fader display, with Mode AB or CD (mode 1 or 2) selected and a chase running, the level (A fader) has no effect on screen. Fader display is otherwise accurate. Mode 3 (both faders) works fine.

- Macro LEDs M1 - M* will stay on even though the macro has been cleared. Programming a new macro will clear the LEDs of the unused macros.

- The console will not let you record the changes to an inhibitive submaster if you have deleted a channel(s). Adding channels to an inhibitive submaster works fine.

- If the HELP button is pressed repeatedly and quickly, the graphic boarder around the message is sometimes blanked out.

- Unpatching dimmers with Cues running in the autofaders may cause odd console behavior resulting in flickering dimmers, Cues running backwards or out of sequence (chase) and large gaps in dimmer response.

- Submaster wait times programmed greater than 45 minutes will not run any longer than 45 minutes. Wait times less than 45 minutes will run on time.

- When patching, the dimmer highlight and dimmer button LED go out while the console waits for the level data.

- If you try changing the RTC setting with the Record Lock-out enabled, the warning message over writes part of the screen and is not centered in the display box.

- Plusfades in subroutines don't pile on to other cues in that subroutine. The action appears as a crossfade. If levels are on stage from another source, the Plusfade works.

# IV. APPENDICES



## A. CONNECTOR PINOUT SCHEDULES

# 1.MAIN PROCESSOR BOARD CONNECTOR PINOUTS

(IMPN-430, EXPN-430 and CNCP-430)

## J1: PARALLEL PRINTER CONNECTOR - FEMALE DB-25

| | |
|---|---|
| 1 | STRB* |
| 2 | D0 |
| 3 | D1 |
| 4 | D2 |
| 5 | D3 |
| 6 | D4 |
| 7 | D5 |
| 8 | D6 |
| 9 | D7 |
| 10 | ACK |
| 11..17 | nc |
| 18..25 | Common |

## J2: KEYBOARD INTERFACE - FEMALE 5 PIN DIN

| | | |
|---|---|---|
| 1 | KCLK | (NOTE: this is not a standard pinout) |
| 2 | KDATA | |
| 3 | RESET | |
| 4 | Common | |
| 5 | +5 VDC | |

# IV. APPENDICES



## J3: FACE PANEL INTERFACE - 16 PIN RIBBON CABLE SOCKET

| | | |
|---|---|---|
| 1 | DATA (+) OUT | RS-422 |
| 2 | DATA (-) OUT | RS-422 |
| 3 | MIDI OUT | From Face Panel |
| 4 | MIDI IN (+) | To Face Panel (From Back Panel Connector J13) |
| 5 | DATA (-) IN | RS-422 |
| 6 | DATA (+) IN | RS-422 |
| 7 | MIDI IN (-) | To Face Panel (From Back Panel Connector J13) |
| 8 | Rx FLAG | Face Panel Handshaking line |
| 9 | Tx FLAG | Face Panel Handshaking line |
| 10 | CLOCK (-) IN | RS-422 |
| 11 | CLOCK (+) IN | RS-422 |
| 12 | KCLOCK | Keyboard clock (from Back Panel Connector J2) |
| 13 | KDATA | Keyboard data (from Back Panel Connector J2) |
| 14 | RESET | Face Panel RESET line for Keyboard |
| 15 | Common | |
| 16 | +5 VDC | |

## J4: SERIAL PRINTER INTERFACE - MALE DB-9

| | | |
|---|---|---|
| 1 | nc | |
| 2 | Data In | (For Factory Use & Redundant Tracking) |
| 3 | Data Out | |
| 4 | DTR | Data Terminal Ready (= +12 VDC) |
| 5 | Common | |
| 6 | NC | |
| 7 | RTS | Ready to Send |
| 9 | CTS | Clear to Send (HI to send printer data) |

# IV. APPENDICES



## J5: SERIAL COMMUNICATIONS - 10 PIN RIBBON HEADER

| | | |
|---|---|---|
| 1 | Common | |
| 2 | DIMMER TRANSMIT DATA (-) | (RS-485) |
| 3 | DIMMER TRANSMIT DATA (+) | (RS-485) |
| 4 | DIMMER TRANSMIT CLOCK (+) | (RS-485) |
| 5 | DIMMER TRANSMIT CLOCK (-) | (RS-485) |
| 6 | Common | |
| 7 | RFU TRANSMIT DATA (+) | (RS-422) |
| 8 | RFU TRANSMIT DATA (-) | (RS-422) |
| 9 | RFU RECEIVE DATA (+) | (RS-422) |
| 10 | RFU RECEIVE DATA (-) | (RS-422) |

## J6: ETC DC POWER - MALE AMPHENOL 5 PIN

| | | |
|---|---|---|
| 1 | + 5 VDC | (RED) |
| 2 | Common | (BROWN) |
| 3 | +12 VDC | (ORANGE) |
| 4 | Common | (BROWN) |
| 5 | -12 VDC | (YELLOW) |

## J7: FACE PANEL POWER - 4 PIN MOLEX

| | |
|---|---|
| 1 | Common |
| 2 | +5 VDC |
| 3 | +5 VDC |
| 4 | Common |

## J9: FLOPPY DISK DRIVE INTERFACE - 34 CONDUCTOR RIBBON HEADER

| | | | |
|---|---|---|---|
| 1 | Common | 2 | nc |
| 3 | Common | 4 | HEAD LOAD* |
| 5 | Common | 6 | DRIVE 3* |
| 7 | Common | 8 | INDEX* |
| 9 | Common | 10 | DRIVE 0* |
| 11 | Common | 12 | DRIVE 1* |
| 13 | Common | 14 | DRIVE 2* |
| 15 | Common | 16 | MOTOR ON* |
| 17 | Common | 18 | DIRECTION |
| 19 | Common | 20 | STEP |
| 21 | Common | 22 | WRITE DATA* |
| 23 | Common | 24 | WRITE GATE* |
| 25 | Common | 26 | TRACK 0* |
| 27 | Common | 28 | FILE PROTECT* |
| 29 | Common | 30 | READ DATA* |
| 31 | Common | 32 | HEAD SELECT |
| 33 | Common | 34 | READY* |

## J10: FLOPPY DISK DRIVE POWER - 4 PIN MOLEX

| | | |
|---|---|---|
| 1 | +12 VDC | (ORANGE) |
| 2 | Common | (BROWN) |
| 3 | Common | (BROWN) |
| 4 | +5 VDC | (RED) |

## J11: MONOCHROME RS-170 COMPOSITE VIDEO - BNC

CENTER - VIDEO
SHIELD - Common

## J12: COLOR RGB VIDEO - MALE DB-9

| | |
|---|---|
| 1 | Common |
| 2 | Common |
| 3 | RED |
| 4 | GREEN |
| 5 | BLUE |
| 6 | INTENSITY |
| 7 | nc |
| 8 | HSYNC |
| 9 | VSYNC |

# IV. APPENDICES



## J13: MIDI INPUT - FEMALE 5 PIN DIN

| | |
|---|---|
| 1 | nc |
| 2 | Common |
| 3 | nc |
| 4 | IN (-) |
| 5 | IN (+) |

(NOTE: this is not standard MIDI pinout)

## J14: MIDI OUTPUT - FEMALE 5 PIN DIN

| | |
|---|---|
| 1 | nc |
| 2 | Common |
| 3 | nc |
| 4 | MIDI OUT |
| 5 | nc |

(NOTE: this is not standard MIDI pinout)

## J16: EXPANSION BUS CONNECTOR - 50 PIN RIBBON SOCKET

| | | | |
|---|---|---|---|
| 1 | Common | 2 | Common |
| 3 | +5 VDC | 4 | MEMORY 10 |
| 5 | MEMORY 9 | 6 | IOE* |
| 7 | U19p9 | 8 | U19p7 |
| 9 | RD* | 10 | WR* |
| 11 | RESET* | 12 | E |
| 13 | Common | 14 | Common |
| 15 | D0 | 16 | D1 |
| 17 | D2 | 18 | D3 |
| 19 | D4 | 20 | D5 |
| 21 | D6 | 22 | D7 |
| 23 | Common | 24 | Common |
| 25 | A7 | 26 | A6 |
| 27 | A5 | 28 | A4 |
| 29 | A3 | 30 | A2 |
| 31 | A1 | 32 | A0 |
| 33 | Common | 34 | Common |
| 35 | A15 | 36 | A14 |
| 37 | A13 | 38 | A12 |
| 39 | A11 | 40 | A10 |
| 41 | A9 | 42 | A8 |
| 43 | Common | 44 | Common |
| 45 | BIO* | 46 | WAIT B* |
| 47 | +5 VDC | 48 | CLOCK |
| 49 | Common | 50 | Common |

# 2. FACE PANEL PROCESSOR BOARD CONNECTOR PINOUTS

(IMPN-431, EXPN-431 and CNCP-431)

## J9: RECORD KEYSWITCH CONNECTOR - 2 pin PANDUIT

(Solder Side)
1. To Record Lock-out keyswitch
2. To Record Lock-out Keyswitch

(RECORD functions locked out when pins 1 & 2 are shorted)

## J10,11,12,13,14: GRAND MASTER,A,B,C,D FADERS - 3 PIN PANDUIT

(Solder side)
1. +5VDC
2. WIPER
3. Common

## J15: FADER WHEEL CONNECTOR - 4 PIN PANDUIT

(Solder Side)
1. YELLOW
2. WHITE
3. BLUE
4. RED

## J16: FACE PANEL POWER - 4 PIN PANDUIT

(Solder Side)
1. Common
2. +5 VDC
3. +5 VDC
4. Common

## J17: MYTHICAL BUS - 34 CONDUCTOR RIBBON HEADER

(Solder Side)

| | | | |
|---|---|---|---|
| 1. | D4 | 2. | D0 |
| 3. | D7 | 4. | D1 |
| 5. | D6 | 6. | D2 |
| 7. | D5 | 8. | D3 |
| 9. | nc | 10. | A6 |
| 11. | A5 | 12. | A4 |
| 13. | A3 | 14. | A2 |
| 15. | A1 | 16. | A0 |
| 17. | CARD1* | 18. | WR* |
| 19. | nc | 20. | RDBIO2* |
| 21. | CARD2* | 22. | RDBIO1* |
| 23. | CLOCK* | 24. | RESET* |
| 25. | RD* | 26. | A7 |
| 27. | nc | 28. | nc |
| 29. | nc | 30. | nc |
| 31. | Common | 32. | Common |
| 33. | Common | 34. | Common |

## J18: SUBMASTER FADER LEVELS - 34 CONDUCTOR RIBBON HEADER

(Solder Side)
(Same as Submaster Board J2)

| | | | |
|---|---|---|---|
| 1. | SUBMASTER 1 | 18. | SUBMASTER 18 |
| 2. | SUBMASTER 2 | 19. | SUBMASTER 19 |
| 3. | SUBMASTER 3 | 20. | SUBMASTER 20 |
| 4. | SUBMASTER 4 | 21. | SUBMASTER 21 |
| 5. | SUBMASTER 5 | 22. | SUBMASTER 22 |
| 6. | SUBMASTER 6 | 23. | SUBMASTER 23 |
| 7. | SUBMASTER 7 | 24. | SUBMASTER 24 |
| 8. | SUBMASTER 8 | 25. | nc |
| 9. | SUBMASTER 9 | 26. | nc |
| 10. | SUBMASTER 10 | 27. | nc |
| 11. | SUBMASTER 11 | 28. | nc |
| 12. | SUBMASTER 12 | 29. | nc |
| 13. | SUBMASTER 13 | 30. | nc |
| 14. | SUBMASTER 14 | 31. | nc |
| 15. | SUBMASTER 15 | 32. | nc |
| 16. | SUBMASTER 16 | 33. | Common |
| 17. | SUBMASTER 17 | 34. | +5 VDC |

## J19: BUMPSWITCHES - 34 CONDUCTOR RIBBON HEADER

(Solder Side)
(Same as Submaster Board J1)

| | | | |
|---|---|---|---|
| 1. | BUMPSWITCH 1 | 18. | BUMPSWITCH 18 |
| 2. | BUMPSWITCH 2 | 19. | BUMPSWITCH 19 |
| 3. | BUMPSWITCH 3 | 20. | BUMPSWITCH 20 |
| 4. | BUMPSWITCH 4 | 21. | BUMPSWITCH 21 |
| 5. | BUMPSWITCH 5 | 22. | BUMPSWITCH 22 |
| 6. | BUMPSWITCH 6 | 23. | BUMPSWITCH 23 |
| 7. | BUMPSWITCH 7 | 24. | BUMPSWITCH 24 |
| 8. | BUMPSWITCH 8 | 25. | nc |
| 9. | BUMPSWITCH 9 | 26. | nc |
| 10. | BUMPSWITCH 10 | 27. | nc |
| 11. | BUMPSWITCH 11 | 28. | nc |
| 12. | BUMPSWITCH 12 | 29. | nc |
| 13. | BUMPSWITCH 13 | 30. | nc |
| 14. | BUMPSWITCH 14 | 31. | nc |
| 15. | BUMPSWITCH 15 | 32. | nc |
| 16. | BUMPSWITCH 16 | 33. | Common |
| 17. | BUMPSWITCH 17 | 34. | Common |

## J20: BUMPSWITCH LEDS - 20 CONDUCTOR RIBBON HEADER

(Solder Side)
(Same as Submaster Board JJ3)

| | | | |
|---|---|---|---|
| 1. | MODE* | 11. | D4 |
| 2. | +5 VDC | 12. | Common |
| 3. | 7218WR* | 13. | D3 |
| 4. | Common | 14. | nc |
| 5. | D7 | 15. | D2 |
| 6. | Common | 16. | nc |
| 7. | D6 | 17. | D1 |
| 8. | Common | 18. | nc |
| 9. | D5 | 19. | D0 |
| 10. | Common | 20. | +5 VDC |

## J21: REMOTE GO INPUTS - 26 CONDUCTOR RIBBON HEADER

| (Solder Side) | | | | | |
|---|---|---|---|---|---|
| 1. | IN 1 (-) | (AB HOLD) | 9. | IN 5 (-) | nc |
| 2. | IN 1 (+) | | 10. | IN 5 (+) | |
| 3. | IN 2 (-) | (AB GO) | 11. | IN 6 (-) | nc |
| 4. | IN 2 (+) | | 12. | IN 6 (+) | |
| 5. | IN 3 (-) | (AB CLEAR) | 13. | IN 7 (-) | nc |
| 6. | IN 3 (+) | | 14. | IN 7 (+) | |
| 7. | IN 4 (-) | (CUE) | 15. | IN 8 (-) | "1" |
| 8. | IN 4 (+) | | 16. | IN 8 (+) | |

# 3. SLAVE EXPANSION BOARD CONNECTOR PINOUTS

(CNCP-433)

## J1: DC POWER - 6 PIN PANDUIT

| | |
|---|---|
| 1 | +5V |
| 2 | +5V |
| 3 | Common |
| 4 | Common |
| 5 | +12V |
| 6 | -12V |

## J2: MONOCHROME RS-170 COMPOSITE VIDEO - BNC

| | |
|---|---|
| CENTER | VIDEO |
| SHIELD | Common |

## J3: COLOR RGB VIDEO - MALE DB-9

| | |
|---|---|
| 1 | Common |
| 2 | Common |
| 3 | RED |
| 4 | GREEN |
| 5 | BLUE |
| 6 | INTENSITY |
| 7 | nc |
| 8 | HSYNC |
| 9 | VSYNC |

## J4: DIGITAL DIMMER OUTPUTS - 10 CONDUCTOR RIBBON HEADER

| | |
|---|---|
| 1 | Common |
| 2 | DIMMER TRANSMIT DATA (-) (Dimmers 513-1024) |
| 3 | DIMMER TRANSMIT DATA (+) |
| 4 | DIMMER TRANSMIT CLOCK (+) |
| 5 | DIMMER TRANSMIT CLOCK (-) |
| 6 | Common |
| 7 | DIMMER TRANSMIT DATA (-) (Dimmers 1025-1500) |
| 8 | DIMMER TRANSMIT DATA (+) |
| 9 | DIMMER TRANSMIT CLOCK (+) |
| 10 | DIMMER TRANSMIT CLOCK (-) |

## J5: COLOR RGB VIDEO - 10 CONDUCTOR RIBBON HEADER

| | |
|---|---|
| 1 | Common |
| 2 | RED |
| 3 | GREEN |
| 4 | BLUE |
| 5 | VSYNC |
| 6 | HSYNC |
| 7 | Common |
| 8 | COMPOSITE MONOCHROME |

## J6: EXPANSION BUS CONNECTOR - 50 PIN RIBBON CABLE

| | | | |
|---|---|---|---|
| 1 | Common | 2 | Common |
| 3 | +5 VDC | 4 | MEMORY 10 |
| 5 | MEMORY 9 | 6 | IOE* |
| 7 | U19p9 | 8 | U19p7 |
| 9 | RD* | 10 | WR* |
| 11 | RESET* | 12 | E |
| 13 | Common | 14 | Common |
| 15 | D0 | 16 | D1 |
| 17 | D2 | 18 | D3 |
| 19 | D4 | 20 | D5 |
| 21 | D6 | 22 | D7 |
| 23 | Common | 24 | Common |
| 25 | A7 | 26 | A6 |
| 27 | A5 | 28 | A4 |
| 29 | A3 | 30 | A2 |
| 31 | A1 | 32 | A0 |
| 33 | Common | 34 | Common |
| 35 | A15 | 36 | A14 |
| 37 | A13 | 38 | A12 |
| 39 | A11 | 40 | A10 |
| 41 | A9 | 42 | A8 |
| 43 | Common | 44 | Common |
| 45 | BIO* | 46 | WAIT B* |
| 47 | +5 VDC | 48 | CLOCK |
| 49 | Common | 50 | Common |

# C. PRINTER INFORMATION

# EXPRESSION PRINTER CONNECTIONS

## SERIAL PRINTER ADAPTER:

| EXPN DB9 | DB25 |
|---|---|
| 1 (nc) | nc |
| 2 (Data In) | 2 |
| 3 (Data Out) | 3 |
| 4 (DTR +12v) | nc |
| 5 (Gnd) | 7 |
| 6 (nc) | nc |
| 7 (nc) | nc |
| 8 (CTS) | 20 |
| 9 (nc) | nc |

PROTOCOL:

- 1200 BAUD
- 8 Data bits
- 2 Stop bits
- No parity

(CTS HI for console to send)

## PARALLEL PRINTER:

Recommended cable for Expression parallel printer:

Radio Shack #26-223 (12') or 26-227 (6')

| D36 (Printer) | DB25 (Expression) |
|---|---|
| 1-12 | 1-12 (pin to pin) |
| 13-17 NC | |
| 18 | 13 |
| 19-22 NC | |
| 23 | 18 |
| 24 | 19 |
| 25 | 20 |
| 26 | 21 |
| 27 | 22 |
| 28 | 23 |
| 29 | 24 |
| 30 | 25 |
| 31 NC | |
| 32 | 15 |
| 33 | 16 |
| 34-36 NC | |

# D. VIDEO MONITOR INFORMATION

# EXPRESSION & VISION VIDEO MONITOR SPECIFICATIONS

COLOR RGB MONITOR:

**EXPRESSION DISPLAY**: 80 X 34 CHARACTERS
**VISION DISPLAY**: 80 X 24 CHARACTERS

**PINOUT**: IBM CGA COMPATIBLE

| Pin # | Signal |
|---|---|
| 1 | Ground |
| 2 | Ground |
| 3 | Red |
| 4 | Green |
| 5 | Blue |
| 6 | Intensity |
| 7 | nc |
| 8 | Horizontal Sync |
| 9 | Vertical Sync |

**EXPRESSION HORIZONTAL SCAN FREQUENCY**: 18.04 Khertz
(Note: this is a non-standard scan frequency, and is significantly higher than the CGA standard. It is recommended that only high quality EGA compatible or "multi-synchronous" type monitors be used.

**VISION HORIZONTAL SCAN FREQUENCY**: 12.9 Khertz (VISION)

**RECOMMENDED MONITOR**: NEC MULTISYNC II

**ALTERNATIVE MONITORS** tested by ETC:
SONY 1302 Multiscan (13")
PRINCETON HX12 Ultrascan (12")

MONOCHROME MONITOR:

**EXPRESSION DISPLAY**: 80X34 CHARACTERS
**VISION DISPLAY**: 80X24 CHARACTERS

**SIGNAL**: MONOCHROME RS-170 75 OHM COAXIAL

**EXPRESSION HORIZONTAL SCAN FREQUENCY**: 18.04 Khertz
**VISION HORIZONTAL SCAN FREQUENCY**: 12.9 Khertz

**RECOMMENDED MONITOR**: AMDEK 300A Amber or CASPER Green screen

# E. STANDARD OUTPUT CONNECTOR WIRING

# CONSOLE CONNECTORS AND STANDARD PINOUTS

## VISION, IMPRESSION, EXPRESSION, CONCEPT

### DIGITAL DIMMER OUTPUTS

Connector: 5 pin XLR Female
Pinout:
1 - Common
2 - Data (-) (DMX 512, ETC/LMI, D-192)
3 - Data (+)
4 - Clock (+) (ETC/LMI only)
5 - Clock (-)

### ANALOG WIRE-PER-DIMMER OUTPUTS

Connector: Centronics D-36 Female
Pinout:
1 - 32 = Dimmers 1 - 32
33- 36 = Common

### AMX-192 ANALOG MULTIPLEX DIMMER OUTPUTS (CD80, SCI)

Connector: 4 pin XLR Male
Pinout:
1 - Common
2 - Clock (+)
3 - Analog Data
4 - Clock (-)

### ANALOG WIRE-PER-DIMMER INPUTS

Connector: Centronics D-36 Male
Pinout:
1 - 32 = Channels 1-32
33- 36 = Common

### REMOTE FOCUS UNIT

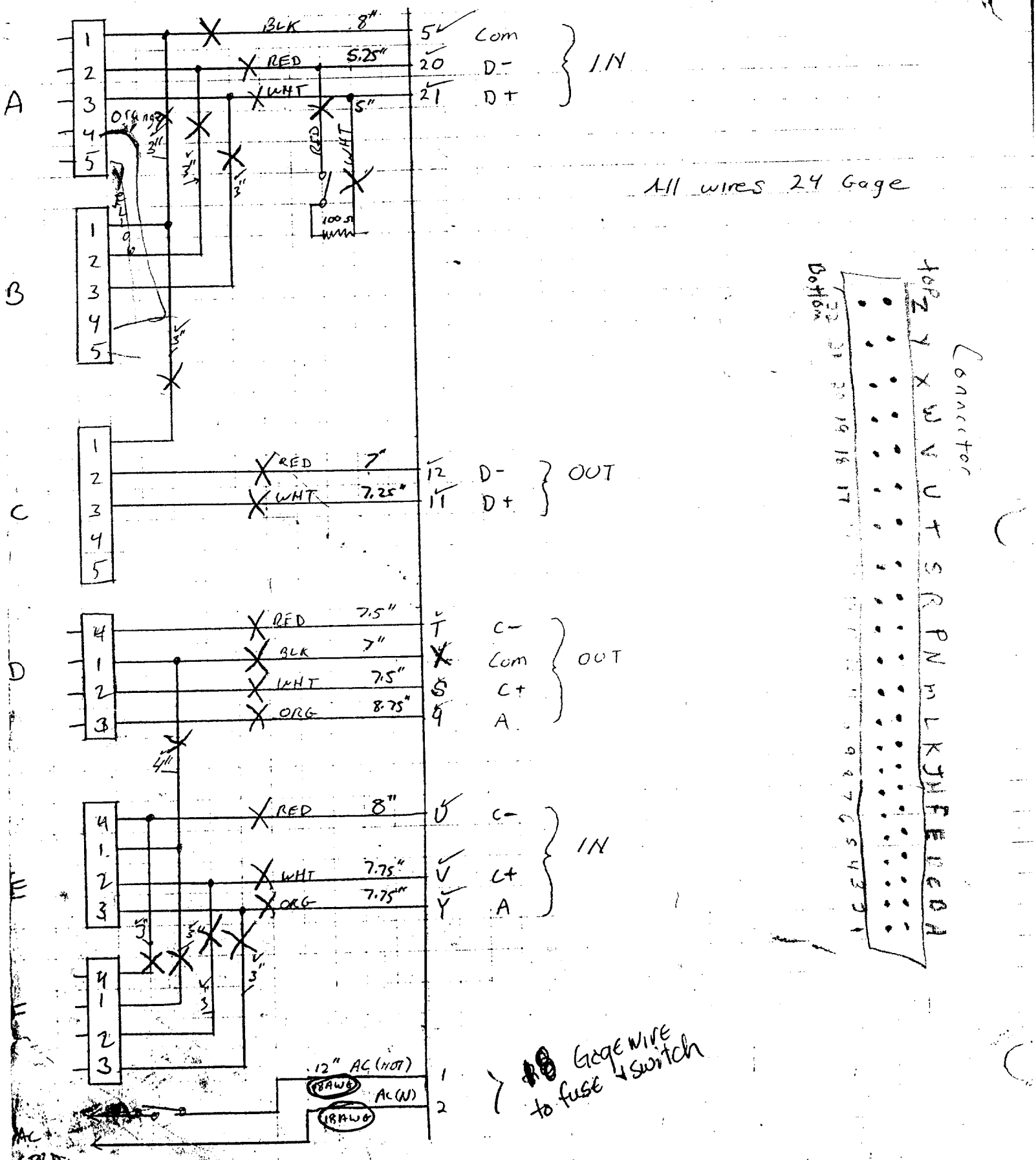
Connector: 6 pin XLR Female
Pinout:
1 - Data (+) (Transmit to RFU)
2 - Data (-)
3 - Data (+) (Transmit from RFU)
4 - Data (-)
5 - Common
6 - +12 VDC

### REMOTE GO INPUTS

Connector: Male XLR
Pinouts: number of pins and pin assignment as specified by purchaser.
Up to 5 Remote inputs are available on one XLR.
Larger numbers of remotes will use other connector types.

RD-2212 Rev B WRF 1-15-90

Revised Assy Pinout WHL 11-8-90



# G. OPTION SELECTOR & DIPSWITCH SETTINGS

# EXPRESSION/IMPRESSION DIPSWITCH SETTINGS April 21, 1989

## Software v1.64

Switches are read once when the console is turned on.
There are 2 sets of 8 switches, from left to right A1-A8 and B1-B8 (as viewed from the back).

Up is "on" ("1") and down is "off" ("0").

**PLEASE NOTE: DIPSWITCH B8 MUST BE OFF OR THE SYSTEM WILL NOT BOOT.**

| | A3 | A4 | A5 | A6 | A7 | A8 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | B8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ETC Messages | .0 | | | | | | | | | | | | | |
| ARRI Messages | .1 | | | | | | | | | | | | | |
| 60 Hz CRT | | .0 | | | | | | | | | | | | |
| 50 Hz CRT | | .1 | | | | | | | | | | | | |

| Manual Readback | A6 | A7 | A8 |
|---|---|---|---|
| None | .0 | 0 | 0 |
| 32 Channels | .0 | 0 | 1 |
| 64 Channels | .0 | 1 | 0 |
| 96 Channels | .0 | 1 | 1 |
| 192 Channels | .1 | 0 | 0 |

| Analog Dimmer Outputs | B1 | B2 |
|---|---|---|
| 96 Analog Wire per Dimmer Outputs | .0 | 0 |
| 192 Analog Wire per Dimmer Outputs | .0 | 1 |
| 192 AMX192 Analog Multiplex Outputs | .1 | 0 |
| 384 AMX192 Analog Multiplex Outputs | .1 | 1 |

| Digital Outputs | B3 |
|---|---|
| DMX512 Digital Output | .0 |
| ETC/LMI Digital Output | .1 |

Colortran D192 Digital Output:

Rev A-C Processor Boards: Install 2.4576 MHz crystal at Y2, set switch to DMX

Rev D Processor Boards: Remove jumper R, install jumper S, set switch to DMX

| Redundant Tracking (set Printer to Parallel) | B4 | B5 |
|---|---|---|
| Redundant Tracking ON | .1 | |
| Redundant Tracking OFF | .0 | |
| Master Console Redundant Tracking | | .0 |
| Slave Console Redundant Tracking | | .1 |

| Face Panel Diagnostics | B6 |
|---|---|
| Enabled (operator announcement appears if timeout occurs) | .1 |
| Disabled | .0 |

| MIDI Interface | B7 |
|---|---|
| MIDI Disabled | .0 |
| MIDI Enabled | .1 |

**WARNING: Enabling MIDI when the Option is not installed will result in unpredictable console behavior!**

# EXPRESSION DIPSWITCH SETTINGS (Software v1.51) July 30, 1988

REVISED

Switches must be set at the time the machine is turned on, as they are read during the boot procedure. There are 2 sets of 8 switches, from left to right A1-A8 and B1-B8 (as viewed from the back). Up is "on" (denoted by "1") and down is "off" (denoted by "0").

**PLEASE NOTE: DIPSWITCH B8 MUST BE OFF OR THE SYSTEM WILL NOT BOOT.**

A1 - not used

A2 - not used

A3 - 0 = ETC messages 1 = ARRI messages

A4 - 0 = 60 MHz CRT 1 = 50 Hz CRT

A5 - 0 = Color Monitor 1 = Monochrome Monitor

A6 A7 A8 = Sets number of readback channels

| | | | |
|---|---|---|---|
| 0 | 0 | 0 | = no manual readback |
| 0 | 0 | 1 | = 32 manual readback |
| 0 | 1 | 0 | = 64 manual readback |
| 0 | 1 | 1 | = 96 manual readback |
| 1 | 0 | 0 | = 192 manual readback |

---

B1 - 0 = 0-10v Analog 1 = SCI/AMX Analog

B2 - 0 = 96 Analog 0-10/ 192 SCI/AMX 1 = 192 Analog 0-10/ 384 SCI/AMX

B3 - 0 = DMX Digital 1 = ETC Digital

(For Colortran D-192 Digital Set Dip Switch for DMX and install a 2.4576 Mhz crystal at Y1 on the EXPN-430 processor board.)

B4 - 0 = Normal use 1 = Redundant Tracking Consoles

B5 - 0 = Master Console 1 = Slave Console (Redundant Tracking)

B6 - 0 = Serial Printer 1 = Parallel Printer (Must be up for Redundant Tracking)

B7 - 0 = Full Boot Test 1 = Skip Boot Test

B8 - 0 = Factory Use 1 = Factory Use

# I. SOFTWARE RELEASES

# EXPRESSION/IMPRESSION/CONCEPT500 SOFTWARE RELEASE v1.64

MAIN CODE : 1.64
SLAVE CODE : 1.64 (CONCEPT500 1.65)
FACE PANEL : 1.17
DATE : 4/19/89

## FEATURES:

- **REAL TIME CLOCK** option with Date and Time stamping of show disks
- **SERIAL BUTTON PROTOCOL** option
- **MIDI** option available
- **MACRO** access from RFU (uses M*) (Expression, Concept 500 only)
- New IS/ONE Digitizer model implemented (Designers Worksheet Option)
- Queries Face Panel and Slave for software version #
- **MACRO EDITING** capability (EXPRESSION, CONCEPT500 ONLY)
- Opto-isolated **REMOTE INPUT OPTION** assigned to Macros #118-125
  (EXPRESSION and CONCEPT500 ONLY)
- LINK/DELAY locked out in Effects/Subroutines
  (EXPRESSION, CONCEPT500)
- Printer and Monitor type, Fast/Slow boot settings in SETUP menu (SYSTEM SETTINGS)
- **DISK VERIFY** function and improved checksum testing
- Disk format is now the same as MS-DOS disks; show disks may be formatted on a PC
  with a 720K disk drive (show disks are NOT readable by MS-DOS)
- **MEMORY SELF TESTS** on power up - hold down submaster bumpswitches:
  DRAM TEST = 13,14,15
  SRAM TEST = 22,23,24
  DEEP CLEAR = 7,8,9
- DEEP CLEAR is also available from within SETUP menu
- **UNPATCH DIMMER** from STAGE mode for focus
- Face Panel timeout messages (dipswitch selectable) and boot testing
- Improved operator prompts and error messages
- Improved fade output (400 part resolution)

## PROBLEMS FIXED:

- Disk actions cannot halt system
- Dimmer output glitches eliminated
- Operational consistency improved
- Disk format and read reliability improved

## APPLICATION NOTES FOR USERS UPGRADING FROM 1.51:

- **Some SETUP Menu numbers have changed. Any v1.51 Macros that use SETUP functions may need to be edited.**
- **Arrow keys are now used as editing keys and cannot be used in new macros.**
  v1.51 Macros that use the arrow keys should work properly. (Expression, Concept only).
- v1.64 is forward compatable: 1.51 shows will in general run properly in a 1.64 console.
  However, backwards compatability is **not** assured: v1.64 shows **will not run properly** in a v1.51 console.
- **DISK VERIFY** will work **only** on disks formatted and recorded with v1.64; to VERIFY a 1.51 disk, read the show in and record out to a newly formatted disk.

- It is recommended that pre-1.64 disks be read into the console and then written back out to a new disk formatted with v1.64 and VERIFIED (see above).

ELECTRONIC THEATRE CONTROLS

March 6, 1989

# EXPRESSION / IMPRESSION / CONCEPT 500

# VERSION 1.64 SOFTWARE UPGRADE INSTRUCTIONS

The upgrade to software version 1.64 consists of:

- Removal of old software eproms (including face panel).
- Installation of new eproms.
- Installation of additional memory chip (Concept 500 only).
- Moving jumper "P" to "Q" on the **EXPN-430** main processor board. (A jumper clip is supplied with the upgrade kit.)

**TO UPGRADE FROM VERSION 1.51 TO VERSION 1.64:**

1. On the Expression Processor Board (marked **EXPN-430**, see drawing):
   - Remove Eproms labeled ***v1.51 #1 - 8*** at U2 thru U7.
   - Remove Eproms labeled ***Slave MSB*** (U82) and ***Slave LSB*** (U81).
   - Install new Eproms Labeled ***v1.64 #s 1 - 8*** at U2 thru U9.
   - Install new Eproms Labeled ***SLAVE MSB*** (U82) and ***SLAVE LSB*** (U81).
   - Locate Jumper P at right rear corner of EXPN-430 Processor board; it is part of a row of jumpers labeled LMNOPQ. Remove jumper or wire-wrap from "P" and install at "Q". (Rev.A to Rev.C boards)
     (On Rev.D boards jumper P is hardwired with a trace: cut this trace and install a jumper at "Q".)
   - CONCEPT500: on the EXPN-433 expansion card, remove the ***433 Slave MSB*** and ***LSB*** EPROMs and install the new ones (LSB U36, MSB U37).
   - CONCEPT500: on the EXPN-430 processor card, install the 32Kx8 SRAM at U83.

   **Verify that all chips are fully inserted and that there are no pins bent under.**

2. On the Face Panel circuit board (marked **EXPN-431**):
   - This **DOES NOT** require removal of submaster circuit board.
   - Remove Face Panel (See Face Panel Removal Procedures).
   - Remove Face Panel Eprom I20.
   - Install new Face Panel Eprom labeled ***v1.17***
   - Re-assemble Face Panel.

3. Power up:
   - Verify that all connectors have been properly re-attached.
   - While holding down the 7,8,9 Bump Switches, power up the console (this clears the memory).
   - Verify that system boots and runs.
   - Cycle power on the console and watch the boot tests to verify that all tests pass; and that the console boots normally and displays an empty stage display with no channel levels or cues.
   - Load a show from a version 1.51 disk, cycle power, and verify that memory has been retained. (Note: Some v1.51 disks may not be readable with the new software; we recommend that you test several disks. Contact ETC if problems occur.)
   - Load a show from a version 1.64 disk, cycle power, and verify that memory has been retained.

## EXPRESSION/IMPRESSION FACE PANEL CIRCUIT BOARD REMOVAL PROCEDURES

Some software upgrades require replacing the EPROM in the EXPN-431 Face Panel Processor Board.

The following notes should be taken into account before attempting removal of this circuit board:

1) When in the open position, the console is likely to tip over, especially when removing the face panel board.
Prevent this by leaning it up against something or setting a heavy object in the bottom tray.

2) The Face Panel circuit board is secured either by nylon nuts or by 6-32x3/16 screws with fiber washers.To prevent damaged or shorted traces, the following applies:
If NYLON NUTS are used, care should be taken to avoid damaging traces on the circuit board with a nutdriver.
If SCREWS and FIBER WASHERS are used it essential that all the fiber washers are re-installed: these protect the traces and insulate them from the metal screw head.

# EXPRESSION/IMPRESSION SLAVE EPROM REPLACEMENT PROCEDURES

Some software upgrades require replacing the slave processor EPROMS on the console's main processor board.

The main processor board lies in the bottom tray of the console and is labeled "EXPN-430".

The slave processor EPROMs are located in the left front corner of the processor board and are installed in the the sockets labeled "U81" and "U82" on the circuit board silkscreen.

The EPROMs are labeled LSB and MSB; LSB installs in U81 and MSB installs in U82.

Note the orientation of the old EPROMs (notch towards the right) and remove them.

Install the new EPROMs in their respective sockets and check carefully that there are no pins bent under and the EPROMs sit squarely in the socket.

## SOFTWARE RELEASE

---

**Product Line:** Expression/Impression/Concept-500/Insight

**Description:** Slave Code version 1.81

**Effective Date:** May 3, 1990

---

Slave Code version 1.81 solves the timing sensitivity problems involving the TMS32020 processor. This sensitivity varies from chip to chip and had become a more critical when the code was adjusted to use both the TMS32020 and TMS320C25. Random loss of the DMX512 signal at power-up or during console operation was a common symptom of this problem.

All console slave code versions are being updated to 1.81.

---

**Instructions:**

1. All consoles shipped after the effective date must use Slave Code version 1.81.

2. Retrofit consoles in the field as required by ETC service policy.

**Console software version:**

EXPN/IMPN - Main Code - 1.80 or 1.80A
**Slave Code - 1.81**
Face Panel - 1.80

CNCP-500 - Main Code - 1.80 or 1.80A
**Slave Code - 1.81 (for 430 and 433)**
Face Panel - 1.80

INST - Main Code - 1.80 or 1.80A
**Slave Code - 1.81**
Face Panel - 1.80

**Limitations:** See Version 1.80 Releases.

**Operational changes:** See Version 1.80 Releases.

**SOFTWARE RELEASE**

---

**Product Line:** Expression/Impression/Concept-500/Insight

**Description:** Main Code Version 1.80A

**Effective Date:** May 3, 1990

---

Main Code version 1.80A corrects the composite video line tearing problem encountered with the newer Princeton MAX-15 monitors. The changes required to implement this fix involve only the #1 and #5 Main Code EPROMs (U2 and U6) and will be implemented as shown below. These EPROMs will be released as specially marked parts with the intent that they be used to replace the standard EPROMs in 1.80 Main Code sets.

1.80A Implementation:

- The Expression, Impression, and Concept all share the "EXPN #1" EPROM.
- Insight requires the use of a separate "INST #1" EPROM.
- The "#5" EPROM is cross-compatible with all console types.

---

**Instructions:**

1. The EPROMs containing the 1.80A changes will be labeled as shown:

| | | |
|---|---|---|
| **V1.80 A**<br>**EXPN #1**<br>**ETC/LMI** | **V1.80 A**<br>**INST #1**<br>**ETC/LMI** | **V1.80 A**<br>**#5**<br>**ETC/LMI** |

2. Retrofit consoles in the field as required by ETC Service policy.

**Console Software Versions:**

EXPN/IMPN/CNCP - **Main Code - 1.80 with 1.80A EXPN #1 and #5 EPROMS.**

Slave Code - 1.80 or 1.81
Face Panel - 1.80

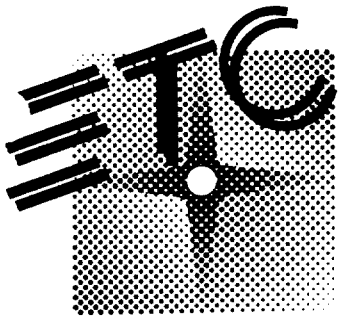
Insight - **Main Code - 1.80 with 1.80A INST #1 and #5 EPROMs.**

Slave Code - 1.80 or 1.81
Face Panel - 1.80

**Limitations:** See Version 1.80 Releases.

**Operational changes:** See Version 1.80 Releases.

# J. ADDENDA



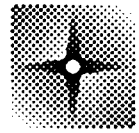
# ETC
# CONSOLE-DRIVER PROTOCOL™

The **ETC Console-Driver Protocol** allows a host device (for example, a laptop computer or PC) to send operational commands to an ETC IMPRESSION™, EXPRESSION™, or CONCEPT-500™ lighting control console. Using the protocol, the host device can, in effect, push all the buttons on the console's face panel.

Commands are sent via a standard RS-232 serial link connecting the host's serial port with the RS-232 port on the back of the console. All you need is a standard cable.

A sample program (with source code, written in BASIC) is provided to show you how to program your host device to send command sequences to a console. You are welcome to modify the sample program as needed to suit your application.

Electronic Theatre Controls, Inc. • 3002 W Beltline Hwy. • Middleton, WI 53562 • 608/831-4116 • 608/836-1736 (Fax)



# ETC Console-Driver Protocol Definition

Electronic Theatre Controls, Inc.

Version 1.4
Revised February 23, 1989

## Introduction

The ETC Console-Driver Protocol provides a means by which a host device (e.g. a microcomputer) can send operational commands to an ETC Impression, Expression, or Concept/500 lighting control console.

Communication is bidirectional, via an RS-232 serial link at 9600 bps, with 8 data bits, 1 stop bit, no parity. The host device uses a distinct serial port for each console slaved to it.

Communication is packet-oriented, with each packet consisting of a list of up to 32 opcodes followed by a termination code. Certain opcodes require one or more arguments -- such arguments follow immediately after the opcode.

In what follows, **word** refers to a 2-byte integer value. Word values are transmitted **least significant byte first**.

## Escape Sequences

It is desirable to reserve a particular byte value to use as a terminator code marking the end of a packet. Alternatively, one could include a byte count in each packet, but under such a scheme if a byte count is garbled or lost the receiver may never get back in sync with the host.

Each packet is terminated with a byte value of 255 (decimal). To distinguish between a terminator and other occurrences of 255 in the packet data, escape sequences are employed in the standard manner.

That is, an escape character (byte) is defined; it is 27 (decimal). Each non-terminator instance of 255 in a packet is preceded by an escape character. Likewise, each non-escape byte value of 27 in a packet is preceded by an escape character.

Escape characters are inserted into the packet as needed by the sending device when a packet is transmitted and are stripped out by the receiving device when the packet is received.

## Host-to-Console Operational Opcodes

Up to 32 opcodes may be sent in a packet. The opcodes are word values, as are their arguments, if any.

Many of the opcodes correspond simply to buttons on the face panel of the lighting control console. For that reason, they often will be referred to as "buttons" in this document.

The following opcodes have no arguments:

| Opcode | Definition |
|---|---|
| 1 | Up Arrow |
| 2 | Left Arrow |
| 3 | SETUP |
| 4 | COPY |
| 5 | PATCH |
| 6 | STYLE |
| 7 | TRACK SHEET |
| 8 | CUE SELECT |
| 9 | FADER |
| 10 | STEP |
| 11 | EXPAND |
| 12 | Right Arrow |
| 13 | BLACK OUT |
| 14 | Down Arrow |
| 15 | MINUS SUB |
| 18 | HOLD A/B |
| 20 | HOLD C/D |
| 21 | REC |
| 22 | GO A/B |
| 23 | LINK |
| 24 | TRACK |
| 25 | GO C/D |
| 26 | M1 |
| 27 | M2 |
| 28 | M3 |
| 29 | M4 |
| 30 | M5 |
| 33 | REL |
| 34 | DELAY |
| 35 | SOLO |
| 36 | TIME |
| 37 | DIM |
| 38 | TYPE |
| 39 | AUTO LOAD |
| 40 | SUB |
| 41 | CUE |
| 42 | 7 |
| 43 | BLIND |
| 44 | 8 |

| | |
|---|---|
| 45 | STAGE |
| 46 | 4 |
| 47 | CHAN |
| 48 | 5 |
| 49 | GRP |
| 50 | 1 |
| 51 | AT |
| 52 | 2 |
| 53 | FULL |
| 54 | 0 |
| 55 | CLEAR |
| 56 | - |
| 57 | ENTER |
| 58 | + |
| 59 | AND |
| 60 | . |
| 61 | THRU |
| 62 | 3 |
| 63 | 9 |
| 64 | 6 |
| 65-88 | Submaster Bump buttons, submasters 1-24, respectively |
| 89 | M* |
| 90 | MACRO WAIT |
| 91 | ENTER MACRO |
| 93 | CLEAR A/B |
| 94 | CLEAR C/D |
| 95 | BACK |
| 100 | FLASH |
| 104 | HELP |
| 105 | Clear the system |

The following opcodes have 1 argument:

| **Opcode** | **Definition** |
|---|---|
| 131-154 | Pot levels for submasters 1-24, respectively |
| 157 | Grandmaster pot level |
| 161-164 | A,B,C,D fader levels, respectively |
| 165 | A/B fader levels (i.e. sets A & B faders to same level) |
| 166 | C/D fader levels (i.e. sets C & D faders to same level) |
| 170 | Fader wheel |

For the submasters, grandmaster, and faders, the argument is a value in the range 0-100 specifying the pot level.

For the fader wheel, the argument is a value in the range -100 to +100 specifying a number of "ticks", where a "tick" is the smallest wheel movement detectable, analogous to a "mickey" in mouse parlance.

## Terminator

As noted above, each packet is terminated by a byte value equal to 255 decimal.

## Sample Packet

The following stream of bytes (decimal) sent host-to-console starts CUE 25 on the A/B fader, triggers Macro 2, moves the fader wheel -1 ticks, and sets the Grandmaster to 50%:

41 0 52 0 48 0 22 0 27 27 0 170 0 27 255 27 255 157 0 50 0 255

Note particularly the use of escape sequences.

### Host-to-Console Status Request Opcode

The following opcode allows the host to request status information from the console.

| Opcode | Definition |
|---|---|
| 1000 | Status Request (no arguments) |

The console replies with a Status Message (see below). One special limitation applies to opcode 1000:

**A packet containing opcode 1000 is not permitted to contain any other opcodes.**

### Console-to-Host Opcode

| Opcode | Definition |
|---|---|
| 1001 | Status Message (1 argument)<br>The status message is sent in response to opcode 1000. It is also sent whenever the console error status changes.<br><br>Argument: 16 1-bit condition flags; flag=1 means the specified condition has occurred.<br><br>Bit 0 - battery memory error<br>Bit 1 - disk error<br>Bit 2 - printer error<br>Bit 3 - communications buffer overflow |

Bit 4 - host must wait for XON before
resuming transmission
Bits 5-16 - reserved for future use

## Miscellaneous Comments

Opcodes not defined above are reserved for future expansion.

The console face panel ordinarily remains "live" while the protocol is in use. If buttons transmitted from the host device and buttons sent from the console's face panel are interleaved, the operational results will be unpredictable. This problem is alleviated partially by the following stipulation: **Console software gives a higher priority to buttons transmitted from a host device.** This means that a sequence of buttons sent in a single packet will necessarily be serviced sequentially.

Note, however, that there is nothing to prevent a sequence of buttons entered at the face panel from being interrupted by buttons sent from the host device. It is the responsibility of the user to ensure that this does not interfere with the operation of the console. This may be done by carefully partitioning operational tasks between the face panel and the host device, or by restricting use of the face panel to operational phases during which the host device is known to be inactive.

The ability to set pot levels is included for possible future use. **Under current implementations of the console software, pot levels transmitted from the host device will be ignored.** Fader wheel movements, however, **will** be processed by the console.

## XON/XOFF Pacing

The console uses XON/XOFF codes to pace transmissions from the host. The host does not pace the console. XON's and XOFF's from the host are harmless, but they are ignored by the console.

If the console's input buffer becomes nearly full, the console sends an XOFF byte to the host. The XOFF byte value is 19 decimal. It is sent as a single byte, not as a packet with opcode and terminator. The console sends an additional XOFF for each byte received until the host stops transmitting.

When the console has bailed most of its buffer, it sends an XON byte to the host. The XON byte value is 17 decimal. Like the XOFF, the XON is sent as a single byte, not as a packet with opcode and terminator.

The host stops transmitting when it receives an XOFF. It resumes trans-mitting when it receives an XON. If no XON is sent within a reasonable time period, the host should send a Status Request message. Then if the host does not receive a Status Message in reply within a few seconds, it may assume communications with the console have been disrupted. That is, the console guarantees that Status Request replies will be sent promptly even if the console is in the midst of doing something else.

A minimal implementation of host software may ignore XON/XOFF pacing provided the host adheres to the following three requirements:

- First, the host must not send packets so quickly that the console cannot keep up. (To get a sense of how fast is too fast, see the DEMO program, described below).

- Second, the host must not send packets while the console is busy doing a disk operation. In particular, this means that a command that initiates a disk operation must be the last (or only) command in its packet.

- Third, the host must delay at least a tenth of a second after sending a command that causes the console to switch screen modes. Such commands include: STAGE, BLIND, FADER, TRACK SHEET, PATCH, SETUP, and EXPAND. In particular, it follows that any such command must be the last (or only) command in its packet.

## Latency

A packet is not serviced until its terminator word has been received. This introduces a slight delay (roughly N millisecs., where N is the number of bytes in the packet) before the first opcode in the packet can be serviced by the console in the best case.

Worse cases are possible. The console may already be servicing another button which must complete before the packet's opcodes can be serviced. Most buttons take only about .05 secs. to complete, but some -- disk and printer operations being the worst case -- take longer.

Since buttons received from the host are given priority, at most one button must be serviced before the next button from the host is attended to. This means that host-transmitted buttons will ordinarily receive prompt service. If large numbers of buttons are sent by the host in rapid succession, how-ever, buttons sent later will have to wait their turn. This means that the host may want to prioritize among the various operations it transmits.

## Setting Up the Console

To use the Console-Driver Protocol with your Impression, Expression, or Concept/500 lighting console, your console must have software release 1.60 or later.

Connect the Console-Driver Protocol cable between the serial port on your host device and the serial printer port on the back of your console.

In the **System Settings** menu on your lighting console, select the "Serial/Parallel Printer" entry and set your console for a parallel printer. This allows the Console-Driver Protocol to use the serial port.

Having selected the parallel printer, turn your console's power off and back on to reboot it. When the console completes the boot sequence it is ready to receive Console-Driver Protocol commands.

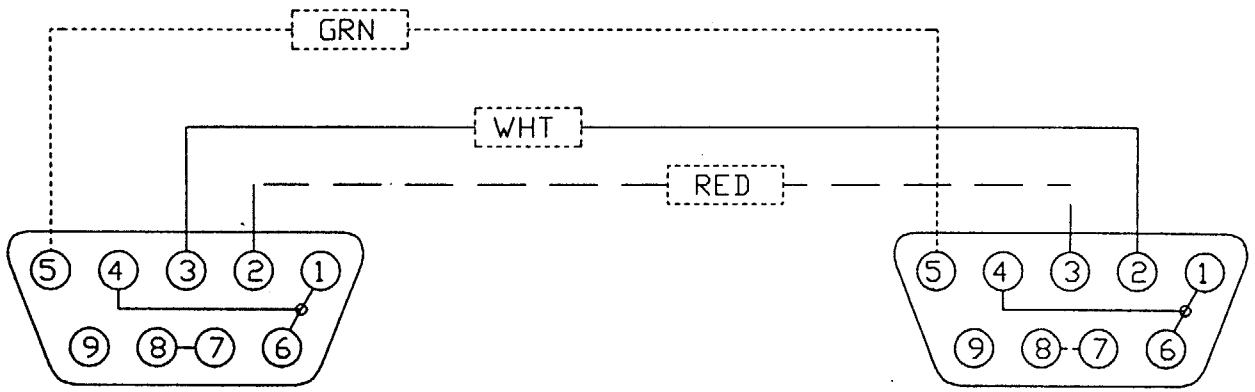
## Using the DEMO Program

A demonstration program with source code, written in BASIC, is provided. The source code file includes explanatory notes at the beginning of the file. Please consult the source code file.

Note that the DEMO program lets you resend a particular packet a number of times in rapid succession and will beep, if requested, each time it receives an XOFF or XON from the console. You can use this feature to get a sense of how rapidly you can send commands to the console without causing it to generate XOFF/XON codes. This should be helpful to users who want to implement host software in a minimal way that ignores XOFF/XON codes from the console.

BELDON 9503 CABLE

6 FEET




DB-9 FEMALE
W/ STRAIN RELIEF

DB-9 FEMALE
W/ STRAIN RELIEF

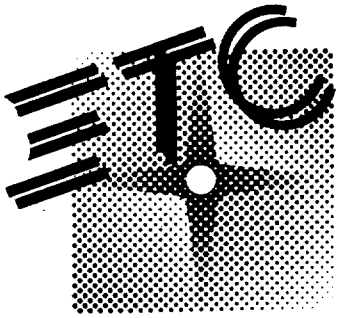
PINOUT:

| | | | |
|---|---|---|---|
| 2 | | 2 | Data In |
| 3 | | 3 | Data Out |
| 5 | —— | 5 | Gnd |
| 1,4&6 | nc | 1,4&6 | Console +12v |
| 7&8 | nc | 7&8 | RTS&CTS |

INSTALLATION:

- Cable is connected to "Serial Printer" connector on console.
- Connectors are wired for PC AT style serial ports.

| | |
|---|---|
| SERIAL BUTTON PROTOCOL<br>INTERCONNECT CABLE<br>ELECTRONIC THEATRE CONTROLS 10-10-88 | EXPN-481<br><br>PAGE 1 OF 1 |



# ETC
# DESIGNER'S WORKSHEET™

## Using the ETC DESIGNER'S WORKSHEET™

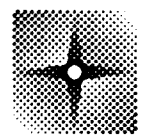
The ETC DESIGNER'S WORKSHEET™ employs a 12" by 12" data tablet with stylus. A printed overlay sheet is placed under the plastic cover sheet of the data tablet. This printed overlay divides the data tablet area roughly in half. One half comprises a replica of the console face panel, the other half is a workspace to be programmed by the user.

The face panel portion of the tablet is used just like the actual face panel of the console. It contains all the buttons and slide pots of the face panel, and the wheel. The user touches the various buttons, etc., with the stylus on the tablet, just as he/she would press the corresponding button with his/her finger on the face panel.

The user-programmable portion of the tablet is called the Designer's Workspace. Within it, the user can define up to 125 regions of arbitrary size and shape. For each such region, the user defines a sequence of up to 32 face-panel-button presses. Thereafter, when the user touches the data tablet stylus to any point within a defined region, the button presses associated with the region are executed sequentially just as if the buttons in question were actually pressed on the face panel in rapid succession. In other words, each region provides a "macro" of button presses.

Typically, the user starts by drawing the regions with pen or pencil on the printed overlay. He/she then activates an operational mode called "Edit Designer's Workspace". In this mode, a region is defined by tracing its outline with the data tablet's stylus. The associated sequence of button presses is defined by touching the stylus to the buttons in question, in sequence. In this process, the user also selects a number for each region. Region numbers are in the range 1 thru 125.

Electronic Theatre Controls, Inc. • 3002 W Beltline Hwy. • Middleton, WI 53562 • 608/831-4116 • 608/836-1736 (Fax)



After the user exits "Edit Designer's Workspace" mode, touching the stylus to a defined region causes the associated macro of button presses to be executed. Each such macro can also be executed from the face panel via the Macro buttons. The various macro buttons are labeled M1, M2, M3, M4, M5, and M*. The first five buttons activate macros 1-5; the M* button is used to activate macros 6-125. To execute the macro for region 25, for example, the user presses the M* button, the 2 button, and the 5 button, and the Enter Macro button.

The user is free to define the regions in any way he/she likes. He/she may, for example, draw a picture of the stage and outline regions corresponding to various groups of lights on stage. Or, the regions may be more "abstract" entities that have nothing to do with any spatial layout. There might, for example, be several columns of circles each one of which represents a particular song in a band's playlist.


Mini DIN

RS-232

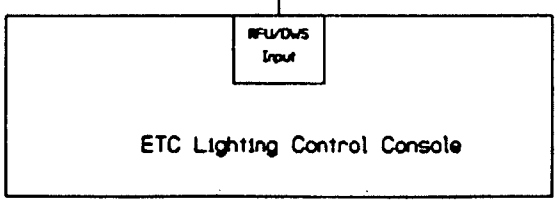
DB-25

RS-422 to RS-232 Converter

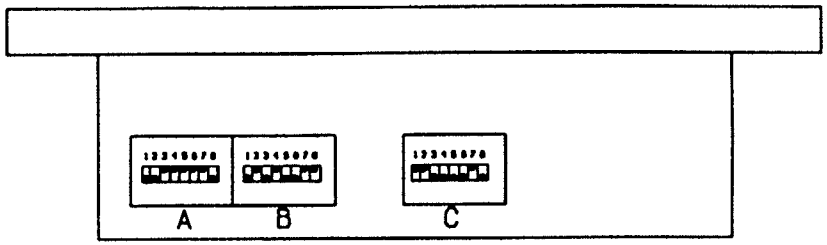
DB-25

RS-422

XLR 6 Pin Male




DWS (Rear View)




Factory Dipswitch Settings

- o RS-422 Converter is powered by console +12v.
- o Cable runs longer than 50' must use RS-422 cable (Belden 9830 or equivalent)
- o Cable runs longer than 200' may require local power source for RS-422 converter. Contact Dealer or Factory for details.

ETC DESIGNER'S WORKSHEET

CABLING & DIPSWITCH SETTINGS 5/11/89

# MIDI OPERATION FOR:
# EXPRESSION
# IMPRESSION
# CONCEPT500 LIGHTING CONTROL CONSOLES

by Electronic Theatre Controls

3/9/89

## I. Introduction.

This document is an Operational/Technical specification for the use of MIDI(Musical Instrument Digital Interface) with the Expression line of lighting control consoles from ETC. The operation of the light board with the MIDI protocol as well as the technical aspects of the implementation will be discussed.

We welcome any suggestions and/or comments from our users. Your feedback will help us to make a better product. Please do not hesitate to contact us at:

Electronic Theatre Controls
3002 W. Beltline Hwy.
Middleton, WI 53562
(608)831-4116 (608)836-1736 Fax

## II. Operations.

This section will help the user to connect their MIDI equipment to the Expression and explain how to operate the light board through the MIDI protocol.

1) Hooking It Up.

The Expression may be connected to any MIDI equipment using a standard MIDI cable. At this point the software (v1.17 Face Panel) only allows the Expression the receive MIDI commands so only one cable is needed. On the back of the console are three round 5-pin DIN type connectors labeled MIDI IN, MIDI OUT, and KEYBOARD. DO NOT plug the MIDI cable into the keyboard connector. This connector is for future use with a computer type ASCII keyboard and may damage any MIDI equipment plugged into it. Since the console is only receiving MIDI data the cable should be plugged into the MIDI IN connector. On newer systems the option has been included to jumper the MIDI OUT connector as a MIDI THRU port. Please contact ETC for more information on this configuration.

2) Configuring the Expression.

Once the cable has been connected the light board must be configured to operate in the MIDI mode. Since MIDI is an optional feature on ETC lighting control consoles please make sure this option is installed on your console before continuing. If you have any questions about this please contact your dealer or ETC directly.

Before the console is powered up the dipswitch B7 must be turned on. During boot the console recognizes this as meaning MIDI is enabled and a message to this effect will appear on the boot screen. Once the console has booted the MIDI Channel must also be set. This can be done in the sub-menu System Settings under the Setup menu. Function number 11 is labeled "Select MIDI Channel ". If this function is selected without dipswitch B7 on the message "Optional feature not installed" will appear. Selecting MIDI Channel 0 will also disable the MIDI operation.

The console operates at all times in MIDI Mode 3 or Omni=off/Poly. This means it will only receive MIDI commands on the user selected channel. Using the "Select MIDI Channel" function in the light board allows the user to specify that channel. The Expression will ignore all MIDI commands on channels other than the specified one so be sure your MIDI gear is set to the matching channel. The console will remember the selected MIDI channel the next time it is powered up.

3) MIDI Operations.

There are three basic functions of the Expression that can be accessed through the MIDI protocol. These functions are the operation of the submaster bump buttons, running cues in the faders and controlling macros.

The submaster bump buttons are mapped directly to MIDI note messages using Note On and Note Off commands. These MIDI note messages correspond to keys on a piano style keyboard. Submaster bump button #1 equals Middle C on a keyboard or note #60 in the MIDI scheme. The subsequent submaster bump buttons a numbered sequentially so the 24 buttons cover a full two octaves of the keyboard starting at Middle C. The submaster bump buttons may be programmed with levels or timed fades from the console and activated through MIDI in exactly the same way as they are activated from the console. During MIDI operation the bump buttons on the console are still active and can be used concurrently with MIDI applications.

The execution of cues can also be controlled through the MIDI protocol. The MIDI Program Change or Patch Change is used to access cues 1-127 in the AB fader pair. If the MIDI message for Patch Change #1 is sent the light board will execute cue #1 in the AB fader pair. Sending Patch Change #0 will cause the next cue to be run in the AB fader. It is equivalent to pushing the AB-GO button on the console.

To execute cues 128 and above MIDI Controller Change messages are used. The Expression uses Controller #70 to execute cues 128 to 255 on the AB fader pair. For example, to run cue #128 on the AB fader the MIDI Controller #70 message is sent with a parameter of #0. Each controller number allows the user to execute 128 different cues, subsequent controller numbers are used to execute cues up to 999. (Note: although cues may be numbered up to 999 there are only 400 separate programmable cues in the Expression system). The CD fader pair is operated through other controller numbers. Please see the Appendix for a list of these controller numbers. There is no provision for accessing cues with decimal point numbers (i.e. cue 101.5) except through the sequential cue operation (Patch Change #0 is the same as "GO-AB" and executes the next cue).

The use of Macros on the Expression can also be controlled through MIDI. Up to 125 Macros with 32 button hits each can be programmed into the console. These macros can now be accessed through the MIDI protocol starting with Controller #85. The table in the Appendix holds a list of the Controller numbers needed to access all the macros. Macro numbers above 125 are included for future expansion.

The MIDI implementation of these three functions allow the MIDI user to access a useful subset of the lightboard capabilities. Any suggestions and/or comments about the MIDI operation of the Expression light board are welcome.

## III. Implementation.

This section will give an overview of the hardware and software used to implement MIDI on the Expression line of lighting control consoles.

1). The Hardware.

The hardware for the MIDI interface is very simple to allow for inexpensive implementation. The two 5-pin DIN connectors reside on the main CPU board (EXPN-430) but the signals are routed directly to the face panel processor (EXPN-431). The face panel use a HD64180 as its microprocessor. This processor is a hardware superset of the Z80 and is also code compatible with the Z80 so all the MIDI software in the Expression was written in Z80 assembly language. The HD64180 has two internal serial ports so the MIDI signals are sent and received directly by the microprocessor. The transmitted serial signal is buffered by two inverters and the received serial signal is opto-isolated by a HP6N138 as per the MIDI specifications. The latest circuit board revisions (Rev. C for the 431) allow the MIDI OUT port to be jumpered as a MIDI THRU connector. The present version of software does not utilize the MIDI OUT port. Future software versions will allow the user send out MIDI commands from the light board.

2). The Software.

The MIDI software runs primarily in the face panel processor which consists of the HD64180 with the code in 16k of EPROM and 8K of SRAM for data storage. The is written entirely in Z80 assemble language. Besides taking care of the MIDI protocol the face panel processor scans the buttons, reads the slide pots, updates the face panel LEDs and controls the analog output and readback cards.

The MIDI software is set up on an interrupt driven structure that collects the received MIDI messages. The processor's internal serial port causes an interrupt when a byte has been received. The interrupt handler checks to see if it is a known command (in the present software Note On, Note Off, Patch Change and Controller Change are known commands). The software will only acknowledge a command if it is sent along the proper MIDI channel. If the command is not recognized it is ignored along with its subsequent data bytes. If the command is recognized then it is stored in a 1k circular buffer along with its data bytes. Ignoring unacceptable commands keeps the buffer from becoming too full. All system realtime messages will also be ignored.

The commands are then processed out of this buffer by a non-interrupt routine in the normal program cycle. The routine checks the MIDI command to make sure it is a recognized command and that it specifies the correct MIDI channel for which the light board is set. Once the command is verified as correct the matching data bytes are read out of the buffer to complete the MIDI message. The program then jumps to separate subroutines to process each command.

If a Note On message is received the software checks to see if the note number is in range. If the note number falls in the two octave range starting at Middle C (note #60) then the routine sends a message to the main processor that the bumpbutton has been pressed. If a Note Off message or a Note On message with a velocity of zero is received the software tells the main processor that the bump button is no longer being pressed. The main processor interprets these messages from the MIDI software in exactly the same way as actual bump button presses. The MIDI implementation also allows for the All Notes Off command. This command causes all the bump buttons to be cleared when it is received.

Patch Change and Controller Change messages are used to execute Cues and Macros respectively. In the normal operation of the light board Cues or Macros are started through a sequence of button hits. When the MIDI software receives the correct Patch or Program change message it mimics these button hits by sending the same button codes to the main processor. The main processor cannot distinguish between the actual button hits and the simulated button hits from the MIDI software so it executes a Cue or Macro in the normal fashion.

The tables in the following Appendix give a complete listing of the present MIDI implementation in the Expression line of lighting control consoles from Electronic Theatre Controls. Since MIDI is a very new protocol and its use in lighting control systems is even more recent there is very little consensus on the correct way to incorporate MIDI into lighting control. At ETC we are trying to develop what you, the user, need to operate a flexible and powerful system. Therefore, we welcome any feedback that will help us to make our product better. Please feel free to contact us with any comments and/or suggestions.

# MIDI FOR THE EXPRESSION LIGHTING CONTROL CONSOLE

3/9/89

## APPENDIX A

## I. MIDI Message Formats (all numbers in Hex).

A. NOTE OFF - <Note Off><Key Number><Note Off Velocity>

8n kk vv - 8 = Note Off status
n = MIDI Channel Number (0-F)
kk= key number (0-7F)
vv= Note Off velocity (0-7F)

B. Note On - <Note On><Key Number><Note On Velocity>

9n kk vv - 9 = Note On Status
n = MIDI Channel Number (0-F)
kk= key number (0-7F)
vv= Note On velocity (0-7F)
[00 = Note Off]

C. Control Change - <Control Change><Control Number>
<Control Value>

Bn kk vv - B = Control Change Status
n = MIDI Channel Number
kk= control number (0-79)
vv= control value (0-7F)

D. Program Change - <Program Change><Program Number>

Cn kk - C = Program(patch) change status
n = MIDI channel number (0-F)
kk= Program number (0-7F)

# MIDI FOR THE EXPRESSION LIGHTING CONTROL CONSOLE

3/9/89

## APPENDIX B

### I. Cue Execution AB Fader Pair.

| | | |
|---|---|---|
| Program Change 0 | - | "GO-AB" (Execute Next Cue in AB Fader Pair) |
| Program Change 1-127 | - | "Cues 1-127 GO-AB" |
| Controller Change 70 Parameters 0-127 | - | "Cues 128-255 GO-AB" |
| Controller Change 71 Parameters 0-127 | - | "Cues 256-383 GO-AB" |
| Controller Change 72 Parameters 0-127 | - | "Cues 384-511 GO-AB" |
| Controller Change 73 Parameters 0-127 | - | "Cues 512-639 GO-AB" |
| Controller Change 74 Parameters 0-127 | - | "Cues 640-767 GO-AB" |
| Controller Change 75 Parameters 0-127 | - | "Cues 768-895 GO-AB" |
| Controller Change 76 Parameters 0-127 | - | "Cues 896-999 GO-AB" |

### II. Cue Execution CD Fader Pair.

| | | |
|---|---|---|
| Controller Change 77 Parameter 0 | - | "GO-CD" (Execute Next Cue in CD Fader Pair) |
| Controller Change 77 Parameters 1-127 | - | "Cues 1-127 GO-CD" |
| Controller Change 78 Parameters 0-127 | - | "Cues 128-255 GO-CD" |
| Controller Change 79 Parameters 0-127 | - | "Cues 256-383 GO-CD" |
| Controller Change 80 Parameters 0-127 | - | "Cues 384-511 GO-CD" |
| Controller Change 81 Parameters 0-127 | - | "Cues 512-639 GO-CD" |
| Controller Change 82 Parameters 0-127 | - | "Cues 640-767 GO-CD" |
| Controller Change 83 Parameters 0-127 | - | "Cues 768-895 GO-CD" |
| Controller Change 84 Parameters 0-127 | - | "Cues 896-999 GO-CD" |

# MIDI FOR THE EXPRESSION LIGHTING CONTROL CONSOLE

3/9/89

## APPENDIX C

## I. Macro Execution (EXPRESSION, CONCEPT500 only)

Controller Change 85 - "M* 1-127 MACRO ENTER"
Parameters 1-127

Controller Change 86 - "M* 128-255 MACRO ENTER"
Parameters 0-127

Controller Change 87 - "M* 256-383 MACRO ENTER"
Parameters 0-127

Controller Change 88 - "M* 384-511 MACRO ENTER"
Parameters 1-127

Controller Change 89 - "M* 512-693 MACRO ENTER"
Parameters 1-127

Controller Change 90 - "M* 640-767 MACRO ENTER"
Parameters 1-127

Controller Change 91 - "M* 768-895 MACRO ENTER"
Parameters 1-127

# IMPRESSION
# OPTOISOLATED REMOTE INPUT OPTION

The IMPRESSION console supports 8 switch-closure style remote inputs which are assigned to the Autofader GO, HOLD and CLEAR buttons, and the CUE and "1" buttons.

The Remote Inputs are accessable through a female DB25 connector mounted on the rear panel of the console. This connector provides 8 pairs of input contacts and 4 contacts each for +5v DC output and DC Common (also earth ground).

A momentary 5 volt pulse presented to the (+,-) inputs will activate the switch assigned to it.

The pinout of the back panel DB25 is:

| Function | DB25 Pin #s | Function |
|---|---|---|
| Input 1(-) | 1 | AB HOLD |
| Input 1(+) | 14 | |
| Input 2(-) | 2 | AB GO |
| Input 2(+) | 15 | |
| Input 3(-) | 3 | AB CLEAR |
| Input 3(+) | 16 | |
| Input 4(-) | 4 | CUE |
| Input 4(+) | 17 | |
| Input 5(-) | 5 | CD HOLD |
| Input 5(+) | 18 | |
| Input 6(-) | 6 | CD GO |
| Input 6(+) | 19 | |
| Input 7(-) | 7 | CD CLEAR |
| Input 7(+) | 20 | |
| Input 8(-) | 8 | "1" |
| Input 8(+) | 21 | |
| n.c. | 9 | |
| DC Common | 10,11,22,23 | |
| +5 VDC | 12,13,24,25 (Fused 1/2 Amp) | |

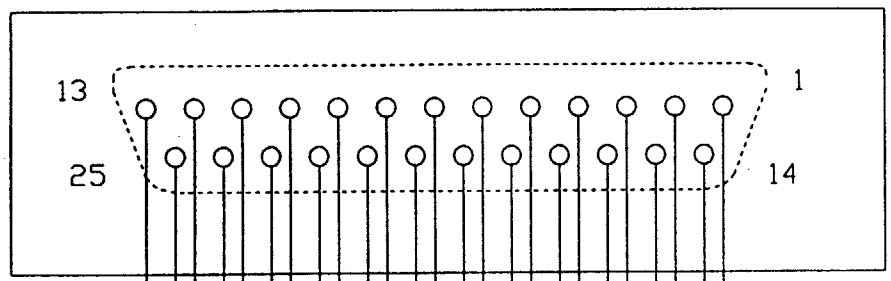
Note that this pinout is designed for use with a 3M 3634-1000 Male DB25 connector (ribbon cable).

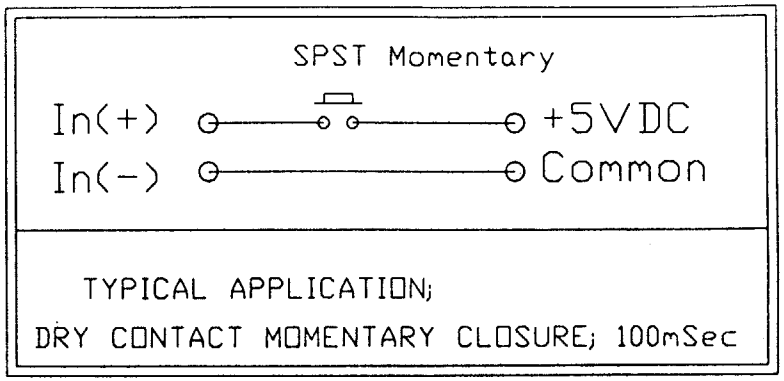
The Remote Switch input option is implemented with HP2602 opto-isolators mounted in the Face Panel circuit board.

As installed at the factory, the option provides proper current limiting for 5 volt inputs with 470 Ohm current limiting resistors built into the (+) inputs. Higher input voltages will require additional series resistance to limit maximum input current to 50 milliAmps or less.

| The operating limits of the HP2602 opto-isolator are: | Max | Min |
|---|---|---|
| Input current (high level) | 60mA | 6.3mA |
| High level enable voltage | 2.0V | 5.0 V |

# REMOTE INPUTS




(-) (+) AB HOLD
(-) (+) AB GO
(-) (+) AB CLEAR
(-) (+) CUE
(-) (+) CD HOLD
(-) (+) CD GO
(-) (+) CD CLEAR
(-) (+) "1"
no connect
DC Common
Console +5v DC (Fused)

| | |
|---|---|
| IMPRESSION OPTO-ISOLATED REMOTE GO<br>BACK PANEL DB-25F PINOUT<br>ELECTRONIC THEATRE CONTROLS | 3-7-89<br><br>PAGE 1 OF 1 |

# EXPRESSION / CONCEPT500
# OPTOISOLATED REMOTE INPUT OPTION

The EXPRESSION and CONCEPT500 consoles support 8 switch-closure style remote inputs which are assigned to the Macro numbers 118 to 125 (M*118 to M*125).

The Remote Inputs are accessable through a female DB25 connector mounted on the rear panel of the console. This connector provides 8 pairs of input contacts and 4 contacts each for +5v DC output and DC Common (also earth ground).

A momentary 5 volt pulse presented to the (+,-) inputs will activate the Macro assigned to it.

The pinout of the back panel DB25 is:

| Function | DB25 Pin #s | Macro Number |
|---|---|---|
| Input 1(-) | 1 | M*118 |
| Input 1(+) | 14 | |
| Input 2(-) | 2 | M*119 |
| Input 2(+) | 15 | |
| Input 3(-) | 3 | M*120 |
| Input 3(+) | 16 | |
| Input 4(-) | 4 | M*121 |
| Input 4(+) | 17 | |
| Input 5(-) | 5 | M*122 |
| Input 5(+) | 18 | |
| Input 6(-) | 6 | M*123 |
| Input 6(+) | 19 | |
| Input 7(-) | 7 | M*124 |
| Input 7(+) | 20 | |
| Input 8(-) | 8 | M*125 |
| Input 8(+) | 21 | |
| n.c. | 9 | |
| DC Common | 10,11,22,23 | |
| +5V DC | 12,13,24,25 (Fused 1/2 Amp) | |

Note that this pinout is designed for use with a 3M 3634-1000 Male DB25 connector (ribbon cable).

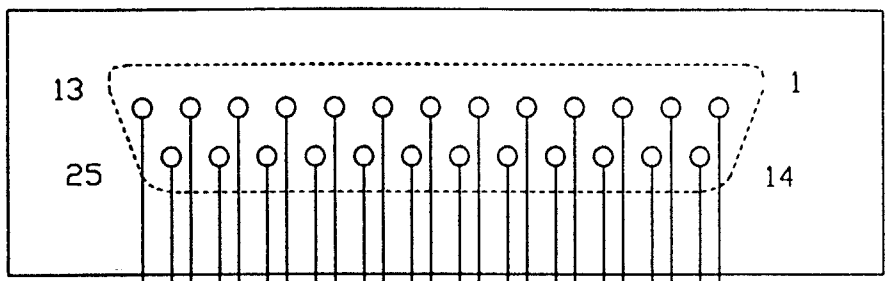
The Remote Switch input option is implemented with HP2602 opto-isolators mounted in the Face Panel circuit board.

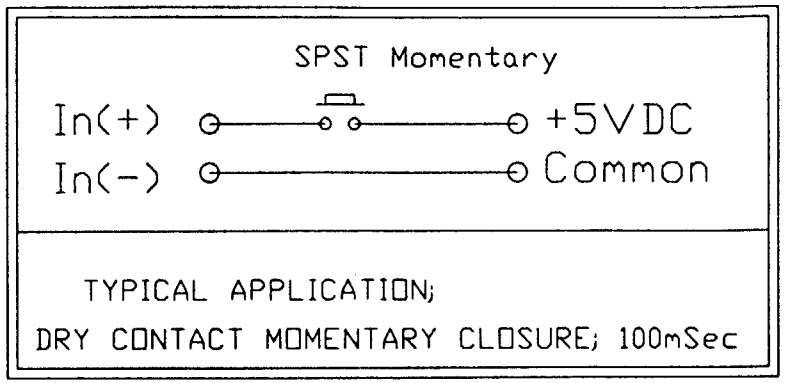
As installed at the factory, the option provides proper current limiting for 5 volt inputs with 470 Ohm current limiting resistors built into the (+) inputs. Higher input voltages will require additional series resistance to limit maximum input current to 50 milliAmps or less.

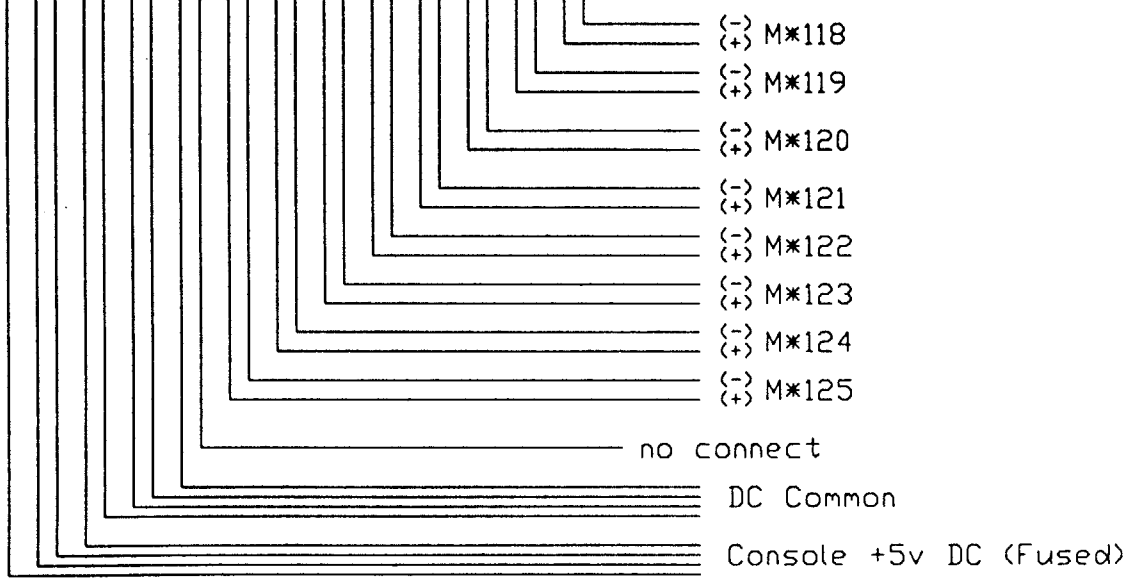
| The operating limits of the HP2602 opto-isolator are: | Max | Min |
|---|---|---|
| Input current (high level) | 60mA | 6.3mA |
| High level enable voltage | 2.0V | 5.0 V |

(Revised April 18, 1989)

# REMOTE INPUTS

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|---|---|
| EXPN/CNCP OPTO-ISOLATED REMOTE INPUTS<br>BACK PANEL DB-25F PINOUT<br>ELECTRONIC THEATRE CONTROLS | 3-7-89<br><br>PAGE 1 OF 1 |

## Description of RAM Tests

The RAM tests are fairly simple. They are intended to detect hard errors only. Transient errors and errors involving subtle interactions among a number of memory cells are not likely to be detected.

Tests 1-12 do the following:

- write a constant to each location in a 32K page
- delay for 1 second without accessing RAM (to test refresh)
- read back the contents of the page comparing against the constant that was written into it

The constants used are as follows:

| Test | Constant (in binary) |
|---|---|
| 1 | 00000000 |
| 2 | 00000001 |
| 3 | 00000010 |
| 4 | 00000100 |
| 5 | 00001000 |
| 6 | 00010000 |
| 7 | 00100000 |
| 8 | 01000000 |
| 9 | 10000000 |
| 10 | 01010101 |
| 11 | 10101010 |
| 12 | 11111111 |

Test 13 writes bytes 00000000 and 11111111, alternately, through a 32K page, then reads the page back, checking against the pattern that was written.

Test 14 writes and reads a series of "ripple" patterns. An initial value is written in the first location of the page. The value is then rotated one bit, and the resulting value is written in the second location. That value is rotated and written in the third location, etc. After the entire 32K page has been written in this way, the page is read back and checked against what was written.

For example, an initial value of 00001111 would produce the following pattern:

00001111 00011110 00111100 01111000
11110000 11100001 11000011 10000111
00001111 etc.

14 different ripple patterns are used, in succession, corresponding to the following initial values:

```
00000001
11111110
00000011
11111100
00000111
11111000
00001111
11110000
00011111
11100000
00111111
11000000
01111111
10000000
```

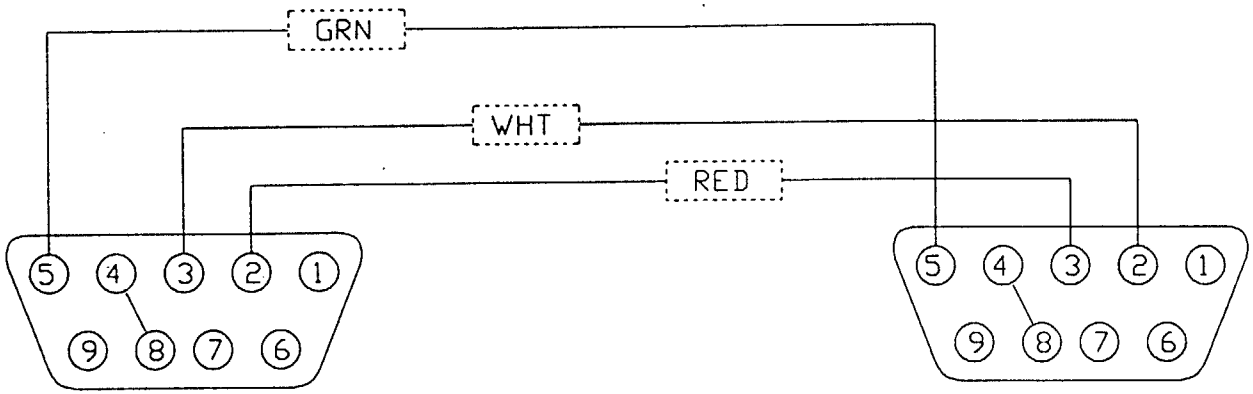
Test 15 uses a pseudo-random number generator to fill a 32K page with a pseudo-random sequence of values, then reads the page back, checking against the pattern that was written.

Test 16 is an addressing cross-check. It takes a long time to run, so is executed on every 10th pass only. The entire page is cleared. Then 11111111 is written in the first location only. The entire page is read back to make sure that only that location was actually written. The same process is repeated for the second location, then the third, etc.

Note: While the tests are running, the LEDs on the main processor board show the number, in binary, of the test currently in progress.

BELDON 9503 CABLE

6 FEET




DB-9 FEMALE
W/ STRAIN RELIEF

DB-9 FEMALE
W/ STRAIN RELIEF

PINOUT:

2 —— 3

3 —— 2

5 —— 5

4&8 nc 4&8

* Pins 4&8 tied together at each end but not connected thru cable.

INSTALLATION:

- Cable is connected to 'Serial Printer' connector on each console.
- Cable is symmetrical, ie; it doesn't matter which end is connected to which console.

| | |
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| REDUNDANT TRACKING CONSOLE<br>SERIAL INTERCONNECT CABLE<br>ELECTRONIC THEATRE CONTROLS 4-10-88 | DWG 88-103<br>PAGE 1 OF 1 |