SPECIAL EVENTS CONTROL SYSTEM
EPCOT CENTER
June 18, 1981

Section 16903

Consultant's Report

EPCOT CENTER

FUTURE WORLD AND WORLD SHOWCASE

SPECIAL EVENTS CONTROL SYSTEM

Construction Documentation

Presented June 18, 1981

By

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1.0 GENERAL

1.1 Objective

The Special Events Control System in EPCOT Center will be responsible for the control and monitoring of all Live Show Production Facilities throughout Future World and World Showcase.

1.2 System Description

1.2.1 System Overview

The SECS is a computerized data aquisition and process control system. A computer in EPCOT Central manages all aspects of the system. The schedule of events entered from the event scheduling terminal as well as lighting and audio cues created at the cue editing console are stored on the computer's disk. During an Entertainment event cues are sent from the EPCOT Central Computer to Remote Interface Cabinets (RICs) located in the Electronic Equipment Rooms in every Pavilion and in Communicore. Each RIC directly controls lighting, audio and special functions in its Pavilion's zone.

The RICs are also responsible for monitoring lighting contactors, lift contactors, key-switches and other status indicators and sending this information back to the EPCOT Central Computer. The interconnect between EPCOT Central and the RICs is a high-speed, multidrop data line provided by Vista United Telecommunications.

A Back-up Computer at EPCOT Central will maintain copies of cues and schedules in case of a Main Computer failure. This Back-up Computer will provide an alternate path for EPCOT Central to RIC communication and will also serve as a software development system (See Figure 1).

1.2.2 System Components

The Operator's Console at EPCOT Central will have four CRT displays: the System Maintenance Console, the Color Graphics Console, the Cue Editing Console and the Owner-provided Audio Monitoring Console. A data entry keyboard and three touch screens will allow the operator to control the system.

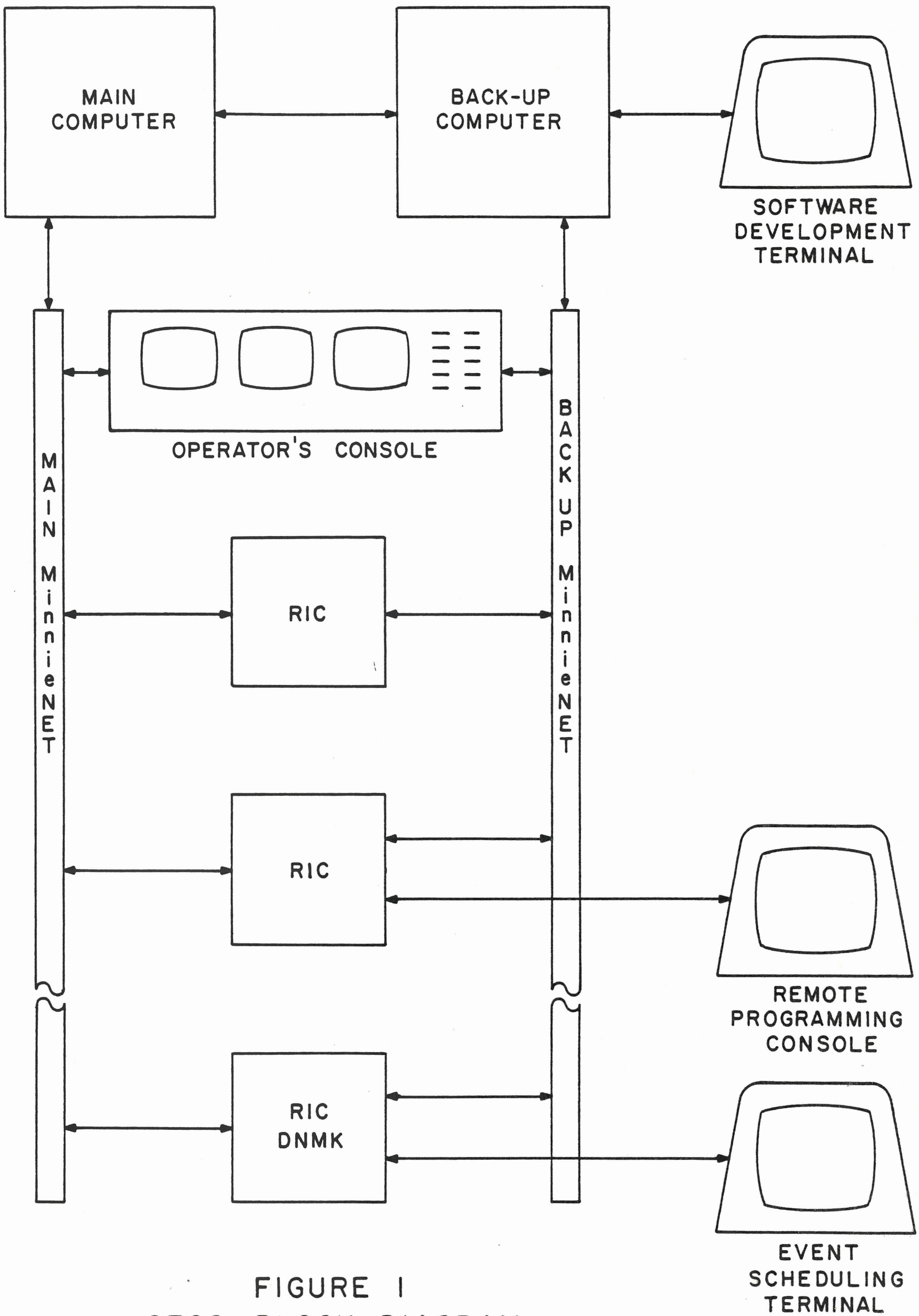


FIGURE 1
SECS BLOCK DIAGRAM

The Main Computer at EPCOT Central will be a 16-bit minicomputer with 20 megabytes of disk storage for program, schedule and cue storage. A character printer will be used to produce status reports, daily logs and cue listings.

The Back-up Computer at EPCOT Central will be a 16-bit minicomputer similar to the Main Computer but without a printer.

A RIC will consist of a single 19 inch RETMA cabinet with an eight bit microprocessor system, EPROM program memory, optically isolated digital inputs and outputs and other special purpose I/O functions.

1.3 Functional Requirements

1.3.1 Scope

Initially the SECS will serve twenty-two zones using ten Remote Interface Cabinets. As Entertainment facilities are added the SECS may be expanded to provide a Remote Interface Cabinet for each zone.

1.3.2 Digital Controls

A typical zone will require ten digital channels for the control of non-dimmed lighting and lighting lifts with some zones requiring as many as twenty four digital channels.

The SECS must be capable of executing cues to these channels with an overall latency less than 0.1 second.

1.3.3 Analog Controls

The SECS must be capable of recording control signals from lighting control boards and reproducing these control signals when required. The system must update these analog outputs at a minimum rate of 16 Hz to prevent flicker on dimmed lighting channels. Initially two pavilions will have this facility; one with 24 channels the other with 48 channels. The SECS should have the capacity for expansion so that any zone could support up to 96 analog channels.

1.3.4 Radio ID Receivers (Owner Provided)

A typical zone will have three radio ID receivers with some zones having up to five. These receivers will monitor the progress of parade components. The SECS will read out ID messages from these receivers.

1.3.5 Audio Tape Synchronization

The SECS will generate start signals and read timing cues from 31 audio tape machines. The SECS will also read a parallel encoded SMPTE time code. The maximum latency associated with these functions will be 0.5 second.

1.3.6 Audio Routing Equipment (Owner Provided)

All audio signals will be routed through an Audio Routing Switcher in Communicore and then through Audio Processing Cabinets in each zone. The SECS will provide serial control messages for these units. The maximum latency associated with these functions will be 0.5 second.

1.3.7 Park Function Controller (Owner Provided)

Facility lighting will be controlled by the Park Function Controller. The SECS will provide serial control messages for this unit. The maximum latency associated with this function will be 0.5 seconds.

2.0 PRODUCT SPECIFICATIONS

2.1 SECS Computers

2.1.1 SECS Computers Overview

The SECS vendor will supply the Central Site (EPCOT Central) computer equipment that implements the functions described in sections 1.2, 4.1 and Appendix 1 of this document.

2.1.2 SECS Computer Components

The SECS Central Site computer equipment will consist of two complete, functional systems referred to as the 'Main Computer' and the 'Back-up Computer'. The Main Computer will contain the following components:

- 16 bit Central Processor with power fail restart
- 20 Mbyte System Disk Storage including minimum 5 Mbyte removeable media
- 128 Kbytes Memory
- Real time clock
- CRT Terminal
- Character Printer
- Interprocessor link
- MinnieNET interface
- All necessary peripheral controllers and supplementary computer cards
- All requisite power supplies
- A.C. power distribution for all units
- Enclosures, wiring and cables for all units
- Single 19 inch RETMA cabinet

The Back-up Computer will contain the following components:

- 16 bit Central Processor identical to Main Computer's
- 20 Mbyte Sytem Disk Storage identical to Main Computer's
- 128 Kbytes Memory identical to Main Computer's
- Real time clock
- CRT Display terminal identical to Main Computer's
- Interprocessor link
- MinnieNET interface

- All necessary peripheral controllers and supplementary computer cards
- All requisite power supplies
- A.C. power distribution for all units
- Enclosure, wiring and cables for all units
- Single 19 inch RETMA cabinet identical to Main Computer's

2.1.3 Computer System Configuration

The Main and Back-up Computers will be capable of exchanging data via a high-speed interprocessor link.

The Main and Back-up Computers will each be connected to multi-drop, serial data lines for communication with the RICs and the Operator's Console (See MinnieNET Interconnect Drawing SECS-152905).

2.1.4 Detailed Component Specifications

A) Computer terminals

- CRT terminal with keyboard and numeric keypad
- 96 character ASCII
- EIA RS232 interface
- Data rate 9600 baud

B) Character Printer

- Impact Printer
- 150 CPS minimum print speed
- 96 char. ASCII

C) Interprocessor Link

- DMA or I/O processor transfer
- Supported under operating system as a system device
- 50K 16-bit words/second transfer rate

D) MinnieNET interface

- DMA or I/O processor transfer
- RS422 serial line interface

- Data rate = 128 Kbaud
- HDLC protocol including error detection, message formatting etc. implemented in hardware (See Appendix 5)
- Compatible with Vista United Telecommunications interconnect (See Appendix 2 section 2.2)

2.2 SECS Operator's Console

2.2.1 Console Overview

The SECS Operator's Console at EPCOT Central is the primary human interface to the SECS. The Console enclosure will be supplied by the Owner. All SECS equipment in the Console except the keyboard will be RETMA rack mountable.

2.2.2 Console Components

The Console will have the following components:

- Cue Editing Station
- System Maintenance Station
- Color Graphics Station
- Audio Monitoring Station (equipment Owner provided)
- Voice Communications Station (equipment Owner provided)
- Dual 8" Flexible Disk Drive
- 8 bit microprocessor system
- MinnieNet interfaces
- Power supplies
- All input and output wiring
- Connector panel

All owner furnished console equipment will be installed by the SECS vendor.

2.2.3 Detailed Component Specifications

A) 8 bit microprocessor system

The microprocessor system will consist of a cabinet mounted STD-Z80 bus card cage housing the CPU, EPROM program memory, RAM memory and interface cards. The system will meet or exceed the following specifications:

- Z80 CPU
- 4 MHz clock frequency
- 24 Kbytes EPROM memory w/ cycle time < 500 ns.
- 32 Kbytes RAM memory w/ cycle time < 500 ns.
- Serial interfaces - three (3) independent cards providing five ports for MinnieNET, the Cue Editing Station, the System Maintenance Station and the Color Graphics Station:
    - two (2) ports on seperate cards must be MinnieNET compatible (See Appendix 2 section 2.2)
    - three (3) ports must be ISC/Carroll color display compatible, ie.;
        - 9600 Baud
        - Asynchronous
        - RS422
- Digital Inputs

  Digital inputs to detect switch closures on the Remote Reset Panel and read the keyboard on the Cue Editing Station.

    - 32 lines available for Reset Switches
    - 8-bit parallel port for keyboard with keypress strobe
    - Inputs TTL compatible
- Digital Outputs

  Digital Outputs to drive backlight LEDs on the Remote Reset Panel.

    - Outputs for 32 illuminated switches/indicators
    - Output electrical requirements: 60 mA @ 5 VDC

- Console MPU Reset Input

  - Activated by contact closure
  - Generates Console CPU reset
  - Reset switch shall be on the Remote Reset Panel on the Console.

B) Cue Editing Station

The Console will contain an ISC color terminal with a Carroll touchscreen and alphanumeric keyboard for the purpose of entering and editing cues for the system (see Appendix 1).

1) Color Display

- 19 inch diagonal Color CRT Monitor
- 80 character x 24 line display
- character graphics
- 19 inch RETMA mounting enclosure
- Carroll touchscreen

2) Alphanumeric Keyboard

- ISC-100879
- 96 character ASCII
- 8-bit parallel interface with keypress strobe
- TTL compatible

The Color display and touchscreen unit is being manufactured to Owner specifications by Carroll Manufacturing.

C) System Maintenance Station

The System Maintenance Station on the Console shall contain an ISC color display with a Carroll touchscreen to monitor the status of components in the system (see Appendix 1 Section 5), and a Remote Reset Panel to reset the processors in the RICs and Console.

1) System Status Display

- 19 inch diagonal Color CRT monitor
- 80 character x 24 line display

- character graphics
- 19 inch RETMA mounting enclosure
- Carroll touchscreen

2) Remote Reset Panel

- 24 remote reset outputs
- Reset Enable switch
- 25 Switch illumination controlled by Console MPU
- 24 Switch outputs to Elco Connector
- 24 Switch inputs to console MPU

The Color display and touchscreen unit is being manufactured to Owner specifications by Carroll Manufacturing.

D) Color Graphics Station

A central feature of the control console is a color graphics station. This station will provide the console operator with a means of extracting information on the system's status and performance. In addition, color graphics will contribute to the entertainment aspect of the control console.

- 19 inch diagonal Color CRT monitor
- 80 character x 24 line display
- character graphics
- 19 inch RETMA mounting enclosure
- Carroll touchscreen

This unit is being manufactured to Owner specifications by Carroll Manufacturing.

E) Dual 8" Flexible Disk Drive

The console will contain a Dual 8" Flexible Disk Drive for storing and loading cue files:

- Single Sided
- Single Density
- IBM Soft Sectored

F) MinnieNET Interfaces

The Console will have a rear panel mounted Elco 8016 - 056 receptacle with both the Main and the Back-up MinnieNET lines and the remote reset lines brought from the microprocessor card cage to this connector. The communications signals on this connector will be compatible with the Vista United Telecommunications interconnect. (See Appendix 2 section 2.2)

G) Power Supplies

1) General

- Rack mounted chassis with:
  - Front panel volt and amp meters
  - Front panel power switch

  - Overvolt protection
  - 0.1% Load regulation
  - 0.1% Line regulation
  - Output current rating 50% greater than maximum load current

2) Specific Requirements

- One (1) 5 VDC @ 20 A Supply
- One (1) +12 VDC @ 7 A Supply
- One (1) -12 VDC @ 7 A Supply

2.3 Remote Interface Cabinets (RICs) - Facility

2.3.1 Overview

The Remote Interface Cabinets (RICs) provide the majority of the input, output and remote monitoring functions for the Special Events Control System. There will be one RIC located in the Electronic Equipment Room of each of the pavilions in World Showcase as well as two in Communicore. From a system architecture point of view, the RICs are nodes on MinnieNET and are each comprised of an 8-bit microprocessor system which contains the necessary interface components for each application (See Figure 2).

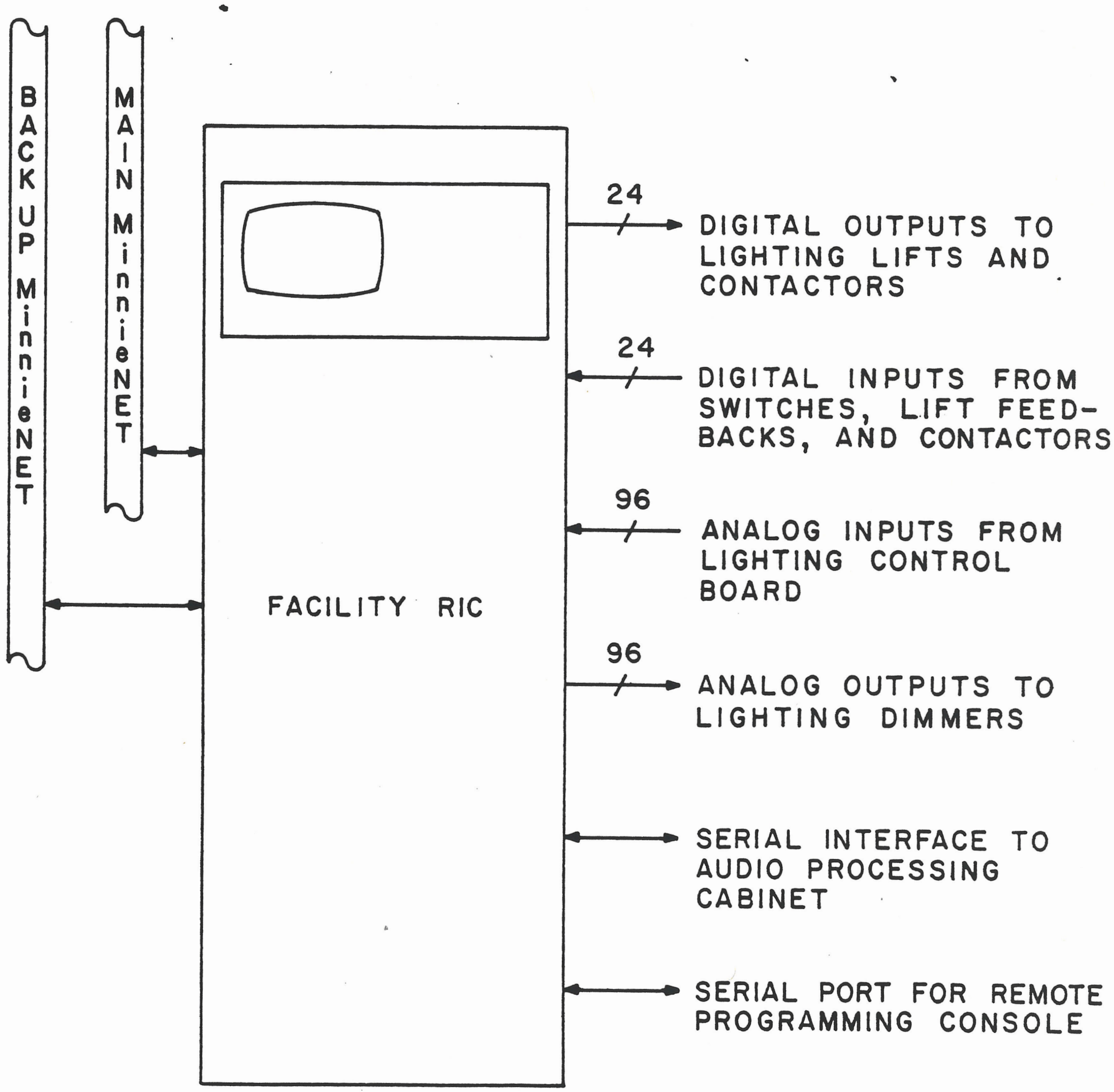


FIGURE 2
FACILITY RIC

2.3.2 Components

Each RIC will be housed in a 19 inch RETMA cabinet containing the following components:

- 8-bit microprocessor system
- MinnieNET interfaces
- Optically isolated digital inputs
- Optically isolated 48 VDC outputs
- Analog outputs (Where needed)
- Analog inputs (Where needed)
- Local Status Display CRT
- Manual reset switch
- Remote reset input
- ID receivers (Owner Provided)
- EIA serial interfaces
- Remote Programming Console Interface
- Power supplies
- Connector Panels
- All necessary intra-cabinet wiring
- All input and output cables as specified

2.3.3 Detailed Component Specifications

A) 8-bit Microprocessor System

The microprocessor system will consist of a rack mounted STD-Z80 bus card cage housing the CPU, EPROM program memory, RAM memory and interface cards. The system will meet or exceed the following specifications:

- Z80 CPU

- 4 MHz clock frequency

- 24 Kbytes EPROM memory w/ cycle time < 500 ns.

- 32 Kbytes RAM memory w/ cycle time < 500 ns.

- 24 output bits per digital output card

- 24 input bits per digital input card

- Digital inputs and outputs compatible with OPTO22 series PB and Motorola series MS optical isolators

- 24 analog output channels per analog output card with each channel providing (See Drawings SECS-152964 and SECS-152980):

  8-bit resolution
  0-10 VDC range @ 3ma.
  Diode outputs to permit output pile-on

- 24 analog input channels per analog input card with each channel providing (See Drawings SECS-152964 and SECS-152980):

  8-bit resolution
  0-10 VDC range
  100 V input overvolt protection

- CRT controller providing:

  RS170 composite video output
  96 character ASCII
  Limited graphics
  24 line x 80 column display format
  5x7 pixel character format

- Synchronous serial interfaces - two (2) independent cards per RIC for MinnieNET interfaces:

  EIA RS422 interface
  HDLC protocol implemented in hardware
  128 Kbaud data rate
  MinnieNET compatible

- Asynchronous serial interfaces for communication with the Audio Processing Cabinets:

  One card per RIC
  EIA RS232 interface
  Minimum two (2) interfaces per card
  9600 Baud
  Data and Ground only

- One slot for each Owner provided Radio ID Receiver interface card. One card interfaces two receivers.

B) MinnieNET Interfaces

The EPCOT Central RIC will have a rear panel mounted Elco 8016-056 receptacle with both the Main and the Back-up MinnieNET lines and the remote interface lines brought from the microprocessor card cage to this connector. The communications signals on this connector will be compatible with the circuits provided by Vista United Telecommunications (See Appendix 2 section 2.2)

C) Digital Inputs

Each RIC will have sufficient digital inputs to read all contactor closures, lift-position indicators, etc. as required in the area served by that RIC (See Figure 3).

- Up to 24 inputs per RIC
- Optical isolation on all inputs
- 2500 V RMS input isolation
- Rear panel Elco interconnect
- Individual input status monitor LED

D) Digital Outputs

Each RIC will have sufficient digital outputs to control all lighting contactors, lift actuators, etc. as required in the area served by that RIC (See Figure 4).

- Up to 24 outputs per RIC
- Output Voltage = 48 VDC
- Output Current = 200 ma.
- Off state leakage = 1 ma. Max
- Optical isolation on all outputs
- 2500 V RMS isolation on all outputs
- On and Off times = 1 msec. Max
- Rear panel Elco interconnect
- Individual output status monitor LED

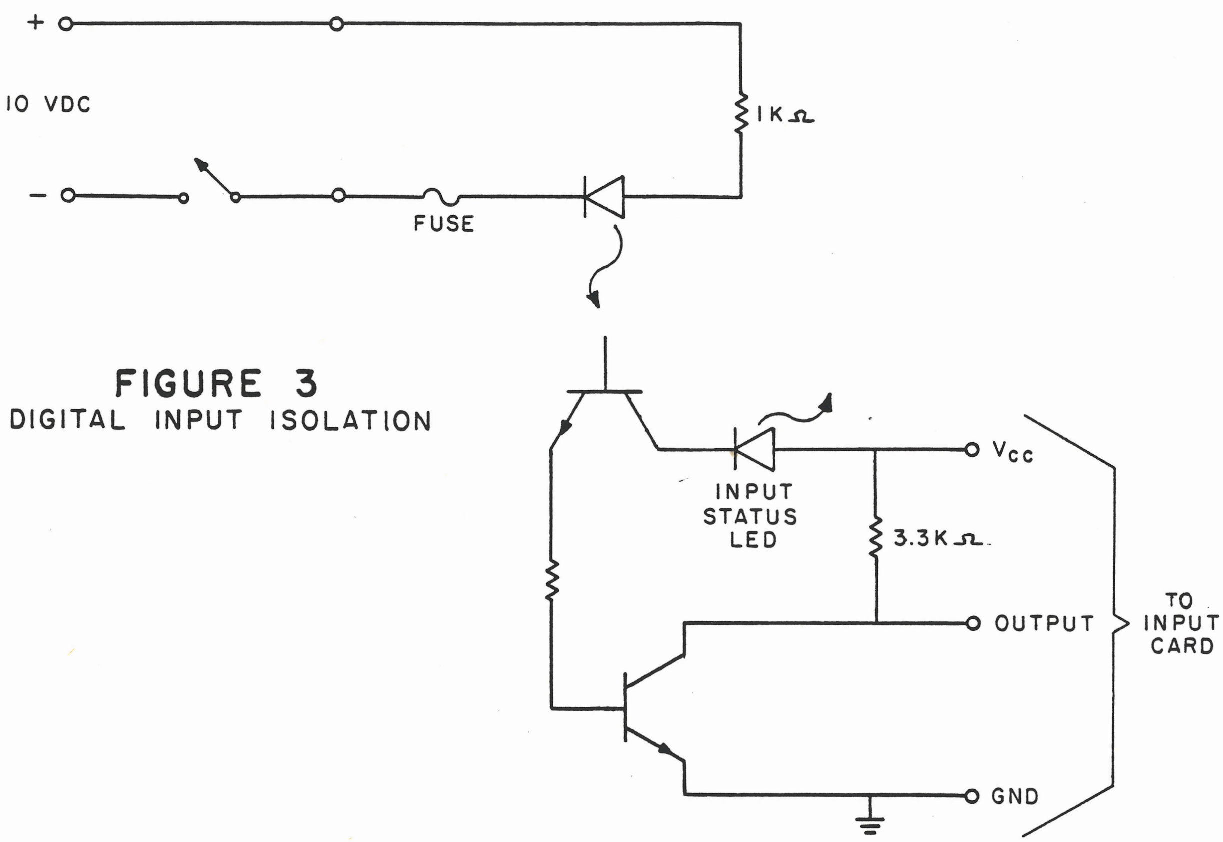
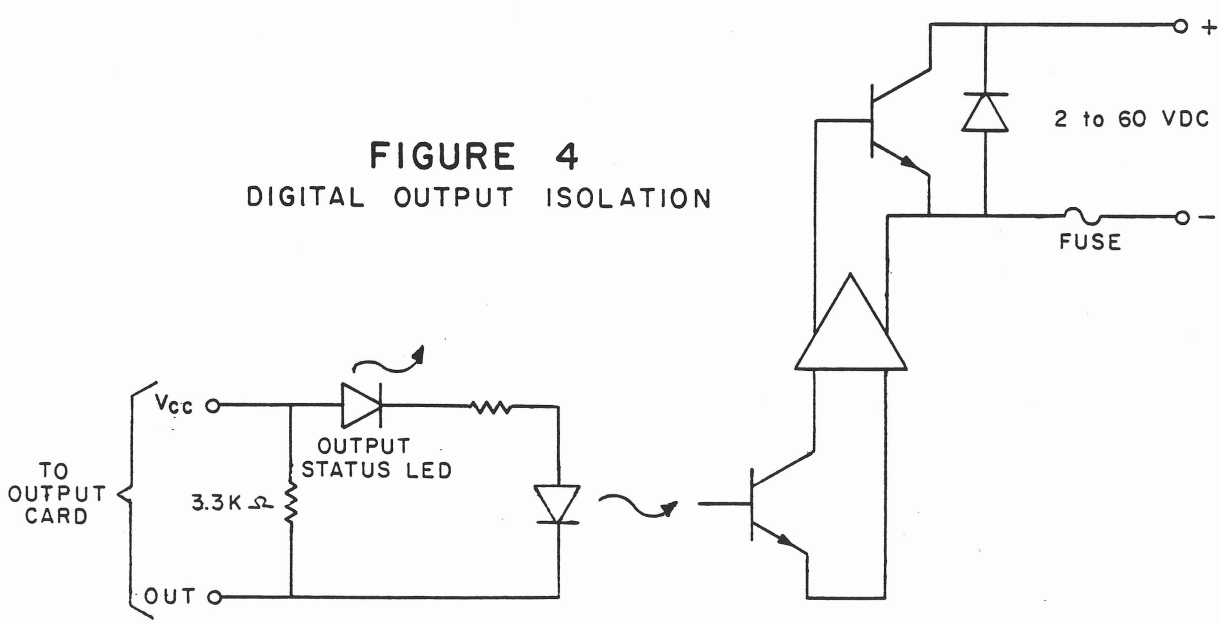


FIGURE 3
DIGITAL INPUT ISOLATION

FIGURE 4
DIGITAL OUTPUT ISOLATION



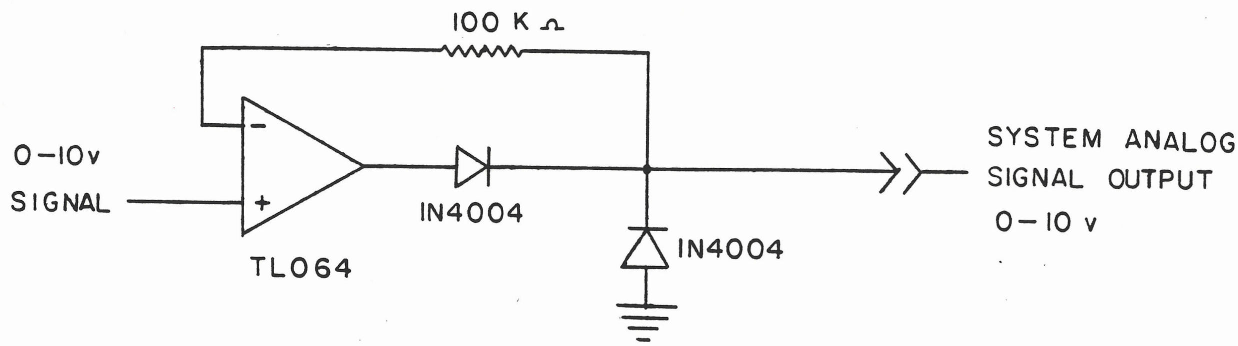


FIGURE 5

TYPICAL ANALOG OUTPUT SCHEMATIC

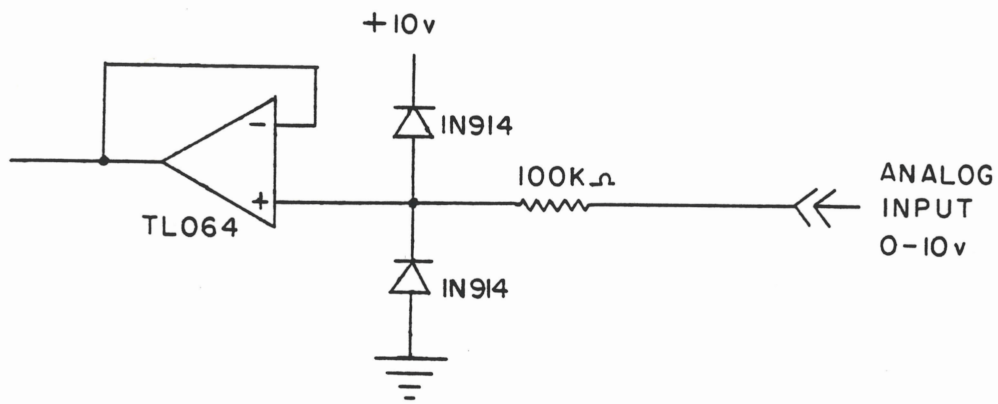


FIGURE 6

TYPICAL ANALOG INPUT SCHEMATIC

E) Analog Inputs

Each RIC will have sufficient analog inputs to record cues from local show lighting consoles where required (See Figure 6 and Drawing SECS-152995).

- 8-bit resolution
- 0-10 VDC input voltage range
- Up to 72 inputs per RIC
- Rear panel Elco interconnect
- 100 K ohm input impedance min.
- 100 V input protection

F) Analog Outputs

Each RIC will have sufficient analog outputs to control required interior and exterior stage lighting in the area served by that RIC (See figure 5 and Drawing SECS-152996).

- Up to 72 outputs per RIC
- 8-bit resolution
- 0-10 VDC output voltage range
- Output current = 3 ma. min.
- Rear panel Elco interconnect
- Diode outputs to permit output pile-on
- Protection from positive transients of 100 V and negative currents up to 1 A.

G) Local Status Display CRT

- RS170 composite video input
- 10 inch diagonal screen
- 8.75 inch high front panel rack mount
- Controls accessible from the front of the RIC

H) Manual Reset Switch

- Generates RIC CPU reset
- Accessible from the front of the RIC
- keyswitch, all RICs alike

I) Remote Reset Input

- Activated by contact closure
- Generates CPU reset

- Circuits provided on MinnieNET Elco connector (See Appendix 2 section 2.2.4)

J) Radio ID Receivers (Owner Provided)

- Up to five (5) receivers per RIC (See Appendix 2)

K) RS232 Serial Interfaces

- One (1) RS232 interface per RIC required for Audio Processing Cabinet
- Rear panel DB25S connector interconnect
- 9600 Baud

L) Remote Programming Console Interface

- Asynchronous
- RS422
- 9600 Baud
- Rear panel Elco 8016-020 interconnect
- Intercom line for Entertainment Communications 3-wire pass thru to Owner provided voice communications system on Elco 8016-020

M) Power Supplies

1) General

- Rack mounted chassis with:

  Front panel volt and amp meters
  Front panel power switch

- Overvolt protection
- 0.1% Load regulation
- 0.1% Line regulation
- Ambient operating temperature -10 to +50 deg C
- Output current rating 50% greater than maximum load current

2) Specific Requirements

- One (1) 48 VDC @ 5 A Supply per RIC
- One (1) 5 VDC @ 20 A Supply per RIC
- One (1) +12 VDC @ 7 A Supply per RIC
- One (1) -12 VDC @ 7 A Supply per RIC

N) Cabinet Wiring

All card cage inputs and outputs shall be wired to rear panel connectors (See Drawings SECS-152943, 955, 965, 969, 973, 977, 981, 985, 989, 993, 997, 998).

2.3.4 RIC Data Communication

The Facility RICs will communicate with the MinnieNET and with the Owner provided Audio Processing Cabinets (See Appendix 2 section 2.0).

2.4 Remote Interface Cabinet - EPCOT Central

2.4.1 Overview

The EPCOT Central RIC serves functions unlike those of the Facility RICs. This RIC does not control any lighting, lighting lifts or audio processing cabinets. It has no float I.D. receivers and no analog I/O. However, the EPCOT Central RIC is responsible for several functions not required on any other RICs. These are (See Figure 7):

- Generating Tape Start Signals
- Reading Tone Decoder Signals from Audio Tape Reproducers
- Reading SMPTE Time Codes from a Tape Reproducer
- Communication with the Park Function Controller
- Control of the Audio Routing Switcher

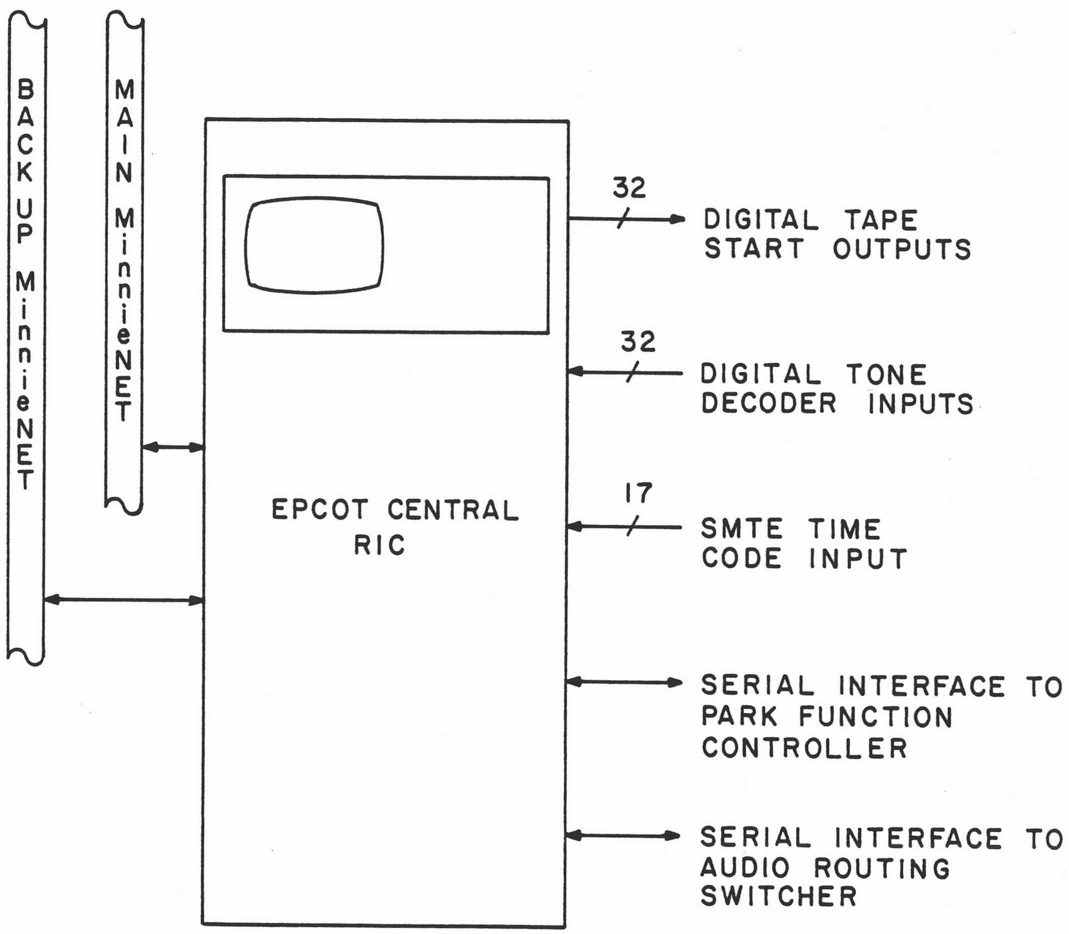


FIGURE 7
EPCOT CENTRAL RIC

2.4.2 Components

The EPCOT Central RIC will be housed in the rear of the SECS Operator's Console. It will be mounted in a 19 inch RETMA rack and will contain the following components:

- 8-bit microprocessor system
- MinnieNET interfaces
- Optically isolated digital inputs
- Optically isolated digital outputs
- Local Status Display CRT
- Manual Reset Switch
- Remote Reset Input
- Power Supplies
- Connector Panel
- All necesary intra-cabinet wiring
- All input and output cables as specified

2.4.3 Detailed Component Specifications

A) 8-bit Microprocessor System

The microprocessor system will consist of a rack mounted STD-Z80 bus card cage housing the CPU, EPROM program memory, RAM memory and interface cards. The system will meet or exceed the following specifications:

- Z80 CPU

- 4 MHz clock frequency

- 24 Kbytes EPROM memory w/ cycle time < 500 ns.

- 32 Kbytes RAM memory w/ cycle time < 500 ns.

- 24 output bits per digital output card

- 24 input bits per digital input card

- Digital inputs and outputs compatible with OPTO22 series PB and Motorola series MS optical isolators

- CRT controller providing:

  RS170 composite video output
  96 character ASCII
  Limited graphics
  Display hold switch input
  24 line x 80 column display format
  5x7 pixel character format

- Synchronous serial interfaces - two (2) independent cards for MinnieNET interfaces each providing:

  EIA RS422 interface
  HDLC protocol implemented in hardware
  128 Kbaud data rate
  MinnieNET compatible

- Asynchronous serial interfaces - two (2) ports for communication with the Park Function Controller and the Audio Routing Switcher:

  EIA RS232 interface
  Minimum two (2) interfaces per card
  9600 Baud

B) MinnieNET Interfaces

The EPCOT Central RIC will have a rear panel mounted Elco 8016-056 receptacle with both the Main and the Back-up MinnieNET lines and the remote reset lines brought from the microprocessor card cage to this connector. The communications signals on this connector will be compatible with the circuits provided by Vista United Telecommunications (See Appendix 2 section 2.2)

C) Digital Inputs

The EPCOT Central RIC will have sufficient digital inputs to read the tone decoder signals and SMPTE time codes from the audio tape reproducers.

- 32 switch closures from tone decoders for synchronization with audio sources
- 16 bit parallel TTL input with 24 Hz strobe for SMPTE time code
- Optical isolation on all switch inputs
- 2500 V RMS input isolation
- Rear panel Elco interconnect
- Individual input status monitor LEDs

D) Digital Outputs

The EPCOT Central RIC will have sufficient digital outputs to produce 32 tape start signals.

- Contact closure or Solid State equivalent
- 26 VDC @ 50 ma.
- Optical isolation on all outputs
- 2500 V RMS isolation on all outputs
- Rear panel Elco interconnect
- Individual output status monitor LEDs

E) Local Status Display CRT

- RS170 composite video input
- 10 inch diagonal screen
- 8.75 inch high front panel rack mount
- Control accessible from the front of the RIC

F) Manual Reset Switch

- Generates RIC CPU reset
- Accessible from the front of the RIC

G) Remote Reset Input

- Activated by contact closure
- Generates CPU reset
- Circuits provided on MinnieNET Elco connector (See Appendix 2 section 2.2.4)

H) RS232 Serial Interfaces

- Two (2) RS232 interfaces for interface to the Park Function Conroller and Audio Routing Switcher (both Owner provided)
- Rear panel DB25S connector interconnect
- 9600 Baud
- Data and Ground only

I) Power Supplies

1) General

- Rack mounted chassis with:

  Front panel volt and amp meters
  Front panel power switch

- Overvolt protection
- 0.1% Load regulation
- 0.1% Line regulation
- Ambient operating temperature -10 to +50 deg C
- Output current rating 50% greater than maximum load current

2) Specific Requirements

- One (1) 5 VDC @ 20 A Supply per RIC
- One (1) +12 VDC @ 7 A Supply per RIC
- One (1) -12 VDC @ 7 A Supply per RIC

J) Cabinet Wiring

All card cage inputs and outputs shall be wired to rear panel connectors (See Drawings SECS-152947 and SECS-152948).

2.5 Remote Programming Console

The Remote Programming Console will allow Entertainment personnel to perform cue editing functions from locations on the parade route. The Owner will provide parade route connection points and cabling to each RIC along the route. The Remote Console will resemble the Cue Editing Station on the Operator's Console and will function in a similar way.

- ISC 8001I Color Graphics Terminal
  - 19 inch diagonal CRT
  - Extended keyboard with 16 function keys
  - 480 x 384 graphics resolution
  - 96 character ASCII
  - 9600 Baud

- RS232 Interface

- RS422 long lines adapter

2.6 Remote Terminals

2.6.1 Event Scheduling Terminal

The Event Scheduling Terminal will allow Entertainment personnel to create, modify and examine the schedule of entertainment events. It will also provide the means for examining the system log and exchanging messages with other EPCOT terminals.

- Monochromatic CRT Terminal
- 96 character ASCII
- 9600 Baud
- RS232 Interface

The Owner will provide a telecommunication line for this terminal with RS232 interfaces at the terminal's location and in the Denmark Pavilion's Electrical Equipment Room. The terminal will be interfaced to the Denmark RIC (DNMK-EPRC1).

2.6.2 Software Development Terminal

The Software Development Terminal will allow computer programmers to create and modify SECS software. The terminal will be interfaced to the Back-up Computer and will be operational whenever the Back-up Computer is running.

- Identical to Event Scheduling Terminal

The Owner will provide a telecommunications line for this terminal with RS232 interfaces at the terminal's location and in EPCOT Central.

2.7 Software

2.7.1 SECS Operating Software

A) Overview

The SECS vendor must supply all Main and Back-up Computer and RIC software necessary to implement the functions described in sections 1.1, 4.1 and Appendix 5.1 of this document.

This software will be written in a high-level language such as ANSI Fortran IV or Compiled BASIC. Assembly code will be used only for time-critical routines.

B) Main Computer Software

1) General

The Main Computer software must perform the following functions:

- SECS software storage, on-line and off-line
- Event cue storage on-line and off-line
- Cue editing
- MinnieNET control
- Event control
- Process operator commands
- Maintain system status information
- Update status displays
- Generate printed logs
- Execute SECS diagnostics
- Interact with the Back-up Computer to maintain current cue files and system schedule and status back-ups

The Main Computer software will manage its various functions with a multi-tasking approach. In its role as MinnieNET controller the Main computer continuously polls all RICs and the operator's console. Any change in system status such as a contactor closure, real-time clock update, operator command, etc. is communicated to the Main computer. The Main computer uses this information to maintain system status tables and it uses these tables to determine what actions such as cue execution, status display update, cue file manipulation, etc. to take.

This software will be supplied with:

- machine readable source code
- complete source code listings
- complete link maps
- complete operator's manual
- complete software description including flowcharts for all program modules, operational descriptions for all modules and definitions for all variables and

arrays.

2) Tasks

The tasks executed by the Main Computer are as follows:

a) MinnieNET Manager - Real-time task responsible for polling RICs, transferring RIC status and cue information and transferring operator's console status and command information. The MinnieNET Manager will consist of two parts: a message scheduler and an I/O handler.

b) Event Execution Manager - Real-time task responsible for issuing cue commands for events in progress. The Event Execution Manager will issue commands to the MinnieNET Manager.

c) Schedule Manager - Maintains the current event schedule and active event cue lists.

d) Status Update Manager - Maintains current status tables.

e) Operator Command Processor - Receives operator commands, interprets commands and issues commands to the Event Editor, Schedule Manager, Status Update Controller and SECS Diagnostic Manager.

f) Event Editor - Creates, modifies, and deletes event files.

g) Back-up Manager - Transfers updated event files, current event schedules and status tables to the Back-up Computer. Transfers MinnieNET messages via the Back-up MinnieNET in the event of a Main MinnieNET failure.

h) SECS Diagnostic Manager - Executes SECS diagnostic programs and generates maintenance reports.

C) Back-up Computer Software

1) General

The Back-up Computer must perform the following functions:

- Maintain copies of all current event files
- Maintain a copy of the current event schedule
- Maintain a copy of the current status tables
- Support the Back-up Minnie-Net

- Take over SECS control in the event of a Main Computer failure
- Provide a facility for interactive program development and maintenance

This software will be supplied with:

- Machine readable sorce code
- Complete source code listings
- Complete link maps
- Complete operator's manual
- Complete software description including flowcharts for all program modules, operational descriptions for all modules and definitions for all variables and arrays.

2) Tasks

The Back-up Computer performs its functions with a dual-task scheme:

a) Back-up Handler - Real-time task responsible for handling interrupts from the Main Computer via the interproccesor link. This is the high priority task.

b) Software Development Task - Any system utility, text editor or language processor.

D) RIC Software/Firmware

1) General

The RIC software is responsible for generating the appropriate control signals in response to command messages from the Main Computer. The RIC software is also responsible for reading inputs and sending status messages in response to requests from the Main Computer.

- Software resides in industry standard 2716 or 2732 EPROMS
- Identical in all RICs (except EPCOT Central)
- High level language software (Compiled BASIC or Fortran)
- Self configuring software automatically accounts for added I/O

This software will be supplied with:

- Machine readable sorce code
- Complete source code listings
- Complete link maps
- Complete operator's manual
- Complete software description including flowcharts for all program modules, operational descriptions for all modules and definitions for all variables and arrays.

2) Stand-Alone Features: Self Diagnosis

- A minimal system consisting of one (1) CPU card and one (1) CRT driver card will be sufficient to generate system diagnostic displays on the CRT.
- As additional cards are added the local Status Display will reflect the status of each card
- Simple stand-alone test can be performed on each RIC which will have results displayed on the Local Status Display:

  Individually activated contactor inputs
  Serial line loopback test

3) Local Status Display

- Cycles through displays of diagnostic reports, system output status, etc.
- System message displayed at top of CRT
- Pavilion name is displayed on CRT when MinnieNET link is established (assigned by EPCOT Central)
- Time of day is displayed on CRT as updated by EPCOT Central

2.7.2 Systems and Utilities Software

The Vendor will supply system and utility software for the Main and Back-up Computers on appropriate media with all necessary software licenses. This software will include :

- Single-user, multi-tasking operating system with device handlers for system terminals, disk drives, clock and other system resources. The operating system must support on-line applications and interactive program development.
- Interactive text editor
- File management utility
- Device directory utility
- Assembler
- High Level Language Compiler such as Fortran or BASIC
- Linker
- On-line program debugging utility
- BASIC interpreter
- Hardware diagnostics for CPU, memory, computer cards and all peripherals

NOTE: The owner may have some of the above software products or licenses already. The vendor should not supply duplicate products unless required by the license agreement.

2.8 Warranties

The vendor shall furnish a warranty covering the SECS hardware and software that is in effect for one year from the date of installation of the system. The warranty shall state all conditions under which the warranty is valid.

2.9 Proprietary Agreements

The vendor shall furnish a proprietary agreement that states that all SECS software supplied by the vendor shall be the property of the Owner.

3.0 Execution

3.1 Submittals/Documentation

The SECS vendor must supply complete documentation for the hardware and software of the Main and Back-up Computers including:

- Owner's/Operator's manuals for all system components
- Engineering drawings, schematics and hardware descriptions for all system components
- User's manuals for all system software, utilities and language processors
- Any handbooks, references or user's guides that facilitate program development or system operation
- Software documentation as described in section 2.7

3.2 Factory Testing

The Vendor shall schedule an Equipment Review prior to June 30th of 1982. During this review the Vendor will demonstrate an operational subset of the SECS consisting of the Main Computer, the Operator's Console and a Remote Interface Cabinet. Representatives of the Owner will be present at the Equipment Review.

3.3 Installation

The Owner will ship the Operator's Console, Audio Monitoring Station, Voice Communication Station and Radio ID Receivers to the Vendor so that the Vendor may install the Audio Monitoring Station and Voice Communication Station in the Operator's Console and install the Radio ID Receivers in the RICs.

The Vendor will subsequently ship all equipment to the Owner for storage.

Final Installation will be performed by the Owner's electrical contractors.

3.4 Final Testing

The Vendor will complete on-site testing and demonstrate the complete system for the Owner by August 31, 1982.

4.0 Operation

4.1 SECS Equipment

4.1.1 Operator's Console

The Operator's Console at EPCOT Central requires the performance of the following specialized functions:

- Cues are entered and edited from the Cue Editing Console. Data entry can be performed by keyboard and/or menu selection on the touchscreen. The operational procedures for these functions are given in detail in Appendix 1, The Operation Manual (section 1 - Entering Cues).

  Additional functions performed on this terminal include (all operational procedures are listed in the specified section of the Operation Manual, Appendix 1):

  SCHEDULING EVENTS (Section 2)
  THE SYSTEM LOG (Section 3)
  SYSTEM STATUS DISPLAYS (Section 4)
  PRINTING FUNCTIONS (Section 6)
  FLEXIBLE DISK STORAGE (Section 7)
  SEND MESSAGES (Section 9)

- Monitoring of the SECS entertainment events on the Color Graphics Terminal, which provides graphics enhanced event status displays and color-coded System Log displays. The displays and Log formats may be chosen by menu selection on the touchscreen as described in the Operation Manual, Appendix 1 (sections 3 and 4).

  Messages received from other SECS terminals are displayed on this terminal. (See Appendix 1, section 8.)

- Monitoring Park outputs, detecting hardware malfuctions, resetting RIC microprocessors, and effecting direct I/O modification on the System Maintenance Console. The various maintenance routines may be chosen from the menu by touchscreen selection. The Maintenance operations are given in section 5 of the Operation Manual, Appendix 1.

Renaming and reconfiguring System Components procedures may also be performed on this terminal (as well as on the Software Development Terminal). These procedures, which are performed by software maintenance personnel rather than the Console operator, are described in section 9 of the Operation Manual, Appendix 1.

4.1.2 SECS Computers

The SECS Computers will normally require minimal operational procedures. The SECS System will generally be running twenty-four hours a day; however, occasionally it may be necessary for an operator to power-up and reboot the System. Additional tasks involve changing cartridge disks and installing paper in the character printer.

4.1.3 Remote Programming Console

The Remote Programming Console allows the performance of cue editing and executing functions at remote sites in the Park. All modes describes in section 1 of the Operation Manual, (see Appendix 1), specifically:

CREATE EVENT
VIEW EVENT
EDIT EVENT
EXECUTE
CANCEL EVENT
DELETE EVENT and
HELP,

are available on this terminal, as well as SEND MESSAGE (see section 8 of Appendix 1).

The procedures for cue editing on the Remote Programming Console are identical to those for cue editing on the Main Operator's Console. Information entered and edited from the same manner as information from the central console. Menu selection is accomplished by use of a keyboard on the Remote Programming Console.

4.1.4 Event Scheduling Terminal

Maintaining SECS entertainment schedules may be done from the Event Scheduling Terminal. Event schedules may be created up to four weeks in advance; they may be viewed or edited at any time by the Entertainment personnel.

In addition, this terminal allows the System Log to be viewed, so that the daily progress of events may be monitored.

The operation of this terminal proceeds as described in the Operation Manual. (See appendix 1.) The available modes include VIEW SCHEDULE, EDIT SCHEDULE, VIEW LOG and SEND MESSAGE. Menu selection is performed by keyboard entry.

4.1.5 Software Development Terminal

The Back-up Computer at EPCOT Central will use a foreground/background or multi-tasking operating system. The functions associated with SECS back-up will run in the foreground leaving the background free for program development. A video terminal will be available at all times for SECS software modification or new program development. System Development Programmers will be able to run any system utility, text editor or language processor from this terminal.

4.2 Operations Support

4.2.1 Support Personnel and Training

The Vendor will assist the Owner in determining the skills required of SECS personnel and in determining the training required for SECS personnel. A representative of the Vendor will be on-site for a period of one month after the system is operational to help personnel become competent in SECS operation.

4.2.2 Maintenance

The Vendor will furnish a list of recommended spares, tools and instruments for system maintenance with current pricing.

OPERATION MANUAL

PREFACE

This Operation Manual is meant to be a guide to the SECS vendor in the development of the operating software for the System. The vendor understands that special cases may arise during program development which would require modification of the descriptions contained herein. In addition, the Owner may require changes to the functional requirements during development.

APPENDIX 1. OPERATION MANUAL

TABLE OF CONTENTS

INTRODUCTION

The major operations of the SECS System are controlled by the console buttons. Each button corresponds to a different mode of operation, and when a button is depressed, a new set of displays, particular to the button, appears on the terminal concerned.

Operation within a mode proceeds through menu selection. The menus which appear when a specific mode is selected are the same for each terminal, whether a terminal has a touchscreen, keyboard, or both.

Some of the terminals have specialized uses and, therefore, do not have access to all of the modes discussed in this manual.

SECTION 1. ENTERING CUES

1.1. CREATE EVENT

Each event is a named file on the SECS Main CPU disk(s). The CREATE EVENT button causes a new event name to be listed in the event directory. An event name may be up to 25 characters long, including blanks.

Each version of an event keeps two dates in its file: 1) the date that the event was initially created (creation date), and 2) the date that the specific version was created (revision date). Both dates are displayed in the VIEW EVENT and EDIT EVENT modes.

When the CREATE EVENT mode is entered the operator is asked to type the new event name on the keyboard, and then press ENTER. At this point the EDIT EVENT mode is automatically entered so that cues can be entered in the new event. If the operator does not wish to write the cues at this time, EDIT EVENT mode can be terminated, but the name of the new event and the creation date (which will be the current date) remain in the directory for future use.

1.2. VIEW EVENT

The VIEW EVENT button allows the operator to look at the cues recorded for an event. No editing may be done in this mode, and entering this mode does not cause a new version to be created.

When the VIEW EVENT button is pressed, the CRT lists all the events in the event directory. If the directory of events is too long to fit on one page of the CRT, the screen can be scrolled until the desired event appears. Scrolling is accomplished by pressing the screen scrolling buttons on either the keyboard or on the touchscreen.

The operator may select from the menu any version of an event to view. Menu selection can be done by 1) touchscreen, 2) typing the event number listed on the menu, or 3) typing the first few characters of the event name, and a space.

After the event is selected, the cue sequence appears on the CRT. Cues which have been recorded for Transmitter # / Receiver # combinations can be viewed by selecting XMTR/RCVR from the menu, and then entering the specific transmitter number and receiver number, as requested by the CRT.

If an event which is in progress is viewed on a color terminal, the executed cues appear in a color different from that of the unexecuted cues.

1.3. EDIT EVENT

1. INTRODUCTION

When the EDIT EVENT button is pressed, the operator may select any version of an event, as in VIEW EVENT. (See section 1.2.) A new version of the event is created and the current date becomes the revision date. The System automatically keeps the ten most recent versions of an event, and deletes older versions. Old versions of events may be saved by copying into new files (see section 1.3.7.), or onto flexible disks (see section 7.). If more than one version is created in one day, the revision date will have a suffix number, (e.g., 3/15/82 -1, 3/15/82 -2, etc. with the suffix #1 being the oldest version).

If EDIT EVENT mode is terminated before any cues have been changed, a new version is not saved, and all previous versions remain unaltered.

A single event may not be edited simultaneously from two different terminals, and an event may not be deleted if it is being edited on another terminal.

2. COMPOSING A SEQUENCE OF CUES

A sequence of cues may affect any light or audio channel in the Park, it may be of any length, and it may require several different inputs in order to execute various cues within the sequence. After an event has been selected for editing, the sequence appears on the CRT as follows (see figure 1):

- The cues appear as a series of numbered lines of English-like text; to the right is a menu of editing options which changes according to the cue being edited.
- Each line contains a command or "cue" and one or more parameters which specify fade times, channel numbers, key-switch inputs, etc., (e.g., LIGHTS UP CHANNEL 18 THROUGH 28 TO 75%).
- Some sections of the text can be boxed off from the main body of the sequence. These boxes are executed separately from the rest of the sequence; for example, they can be triggered by an external switch input or time of day.
- Pavilion and Input/Output channels can be displayed and referred to by names, numbers, or both, and can be selected either by touchscreen or by keyboard.
- A sequence of cues may become so long that it no longer fits on a single page of the CRT. In this case, the text appears as a single large sheet, or "scroll," of paper which can be moved up and down on the CRT by pressing the scrolling buttons on either the touchscreen or keyboard. This allows any portion of any sequence to be accessed for editing.
- The righthand side of the CRT contains a menu which changes as different pieces of information are entered into the cue. When a cue is being inserted, the menu contains a list of possible cues: LIGHTS UP, LIGHTS DOWN, WAIT, etc. After the cue is specified, the menu automatically switches to the options available for any additional information required by the selected cue, (e.g., pavilion names/numbers, light channel names/numbers).

EDITING : SIDEWALK CAFE SHOW CREATED: 10-07-82
LOCATION: FRANCE REVISED: 10-31-82

1. WAIT 15:00 FOR FRAN [06] INPUT 11 [COURTYRD KEY]
2. IF AFTER 15:00 EVENT TIME
3. SEND MESSAGE ** NO INPUT FOR SIDEWALK CAFE SHOW **
4. END EVENT
5. NOTE: BEGINNING ACT ON STAGE......KILL BGM AND START INTRODUCTION TAPE
6. SOUND DOWN FRAN [06] SRC 0 [BGM] ZN 6 IN 00:10
7. START TAPE 2 [FR CAFE INTR]
8. SOUND UP FRAN [06] SRC 2 ZN 6 TO 60% IN 00:15
9. LIGHTS UP FRAN [06] CHAN 5 [CRTYD STG L]
10. THROUGH CHAN 10 [CRTYD STG R]
11.
12. WAIT FOR FRAN [06] INPUT 11 [COURTYRD KEY]

SELECT CUE
1. LIGHTS UP
2. LIGHTS DOWN
3. SOUND UP
4. SOUND DOWN
5. START TAPE
6. WAIT
7. TRIGGER
8. IF
9. ETA NEXT RCVR
10. SEND MESSAGE
11. DIMMER LEVELS

SCROLL ENTER MENU

FIGURE 1. EDITING A CUE SEQUENCE

The operator has chosen the "INSERT LINE" command, which causes the menu of cues to be displayed. When a cue is selected, it is written on the blank line and a new menu appears which contains the new editing choices.

If the cue sequence is scrolled, the cues on the following pages would appear. NOTE the correspondence between the cursor position in the cue and the menu selections available.

```
EDITING : SIDEWALK CAFE SHOW          CREATED: 10-07-82
LOCATION: FRANCE                      REVISED: 10-31-82

13.  NOTE:  WHEN INTRODUCTION IS OVER, KILL STAGE                   SELECT PAVILION
     LIGHTS AND START SIDE SHOWS
14.  SOUND DOWN   FRAN  SRC  2   ZN  6                               1. AFRI  13.
                  [06]
15.  LIGHTS DOWN  FRAN       CHAN  5                                 2. AMER  14.
                  [06]       [CRTYD STG L]
16.  THROUGH                 CHAN 10                                 3. CANA  15.
                             [CRTYRD STG R]
17.  START TAPE 4                                                    4. CMSW  16.
                [CAFE SIDES]
18.  SOUND UP     FRAN  SRC  4   ZN  6  TO  60%   IN 00:05           5. CNTL  17.
                  [06]
19.  TRIGGER ON   FRAN       INPUT 12                                6. FRAN  18.
                  [06]       [REAR CRTYD]
20.  NOTE:  CUES FOR JUGGLERS....THIS SEQUENCE IS OPTIONAL           7. GERM  19.

21.  LIGHTS UP    FRAN       CHAN 18        TO  50%                  8. ITLY  20.
                  [06]       [REAR FLDS]
22.  AND                     CHAN 42                                 9. JPAN  21.
                             [CRTYD SPOT 7]
23.  WAIT        00:20                                              10. MEXI  22.

24.  LIGHTS UP    FRAN       CHAN 43                                11. MORO  23.
                  [06]       [CRTYD SPOT 8]
25.  WAIT        01:25                                              12. UKNG  24.

   ↑ SCROLL ↑           ↓ SCROLL ↓           ENTER
```

```
EDITING : SIDEWALK CAFE SHOW          CREATED: 10-07-82
LOCATION: FRANCE                      REVISED: 10-31-82

26.  LIGHTS UP     FRAN     CHAN 41                          SELECT COMMAND
                   [06]     [CRTYD SPOT 6]
27.  NOTE:  END ACT WHEN 15 SECOND WARNING CUE BEGINS

28.  WAIT FOR      FRAN     INPUT 12                         1.  INSERT CUE
                   [06]     [REAR CRTYD]
29.  LIGHTS DOWN   FRAN     CHAN 18              IN 00:15    2.  DELETE CUE
                   [06]     [REAR FLDS]
30.  AND                    CHAN 41                          3.  MOVE CUE
                            [CRTYD SPOT 6]
31.  THROUGH                CHAN 43                          4.  COPY CUES
                            [CRTYD SPOT 8]
32.  NOTE:  CUES FOR MIMES (5 MINUTE ACT) IN FRONT           5.  DELETE  END
            COURTYARD                                            TRIGGER BOX
33.  LIGHTS UP     FRAN     CHAN 16     TO  65%  IN 00:05
                   [06]     [F. CRTYD LC]
34.  WAIT         01:45

35.  LIGHTS UP     FRAN     CHAN 36
                   [06]     [CRTYD SPOT 1]
36.  WAIT         01:35

37.  LIGHTS DOWN   FRAN     CHAN 36
                   [06]     [CRTYD SPOT 1]

   ↑ SCROLL ↑          ↓ SCROLL ↓          ENTER
```

```
EDITING : SIDEWALK CAFE SHOW          CREATED: 10-07-82
LOCATION: FRANCE                      REVISED: 10-31-82

38.  LIGHTS UP     FRAN   CHAN 37                          SELECT  LIGHT
                   [06]   [CRTYD SPOT 2]                      CHANNEL
39.  WAIT         01:20
                                                           NON-DIMMED [10]
40.  NOTE:  SOUND CUE TO TELL SIDE SHOWS THAT THEY HAVE
            15 SECONDS LEFT                                 5. CRTYD STG L
41.  SOUND DOWN    FRAN  SRC  4   ZN  6
                   [06]                                     6. CRTYD STG LF
42.  START TAPE    3
                   [INTERLUDE]                              7. CRTYD STG LR
43.  SOUND UP      FRAN  SRC  3   ZN  6  TO  60%
                   [06]                                     8. CRTYD STG RR
44.  LIGHTS DOWN   FRAN    CHAN 16      TO  10%   IN 00:10
                   [06]    [F. CRTYD LC]                    9. CRTYD STG RF
45.  AND                   CHAN 37
                           [CRTYD SPOT 2]                  10. CRTYD STG R
46.  NOTE:  GRAND FINALE ON STAGE BEGINS
                                                              DIMMED  [35]
47.  START TAPE   5
                 [CAFE FINALE]                             11. BLUE WASH #1
48.  SOUND DOWN    FRAN  SRC  3   ZN  6
                   [06]                                    12. BLUE WASH #2
49.  SOUND UP      FRAN  SRC  5   ZN  6  TO  60%  IN 00:05
                                                           13. MAGENTA #4

  ↑ SCROLL ↑      ↓ SCROLL ↓      ENTER      MENU ↑   MENU ↓
```

```
EDITING : SIDEWALK CAFE SHOW          CREATED: 10-07-82
LOCATION: FRANCE                      REVISED: 10-31-82

50.  LIGHTS UP    FRAN     CHAN  5                              SELECT IF
                  [06]     [CRTYD STG L]                        CONDITION
51.  THROUGH               CHAN 10
                           [CRTYD STG R]
52.  WAIT        10:00                                       1. BEFORE TIME
                                                                  OF DAY
53.  IF           FRAN     INPUT  9                          2. AFTER  TIME
                  [06]     [STG FOOT SW]                          OF DAY
54.  NOTE:  ENCORE PERFORMANCE..RESTART TAPE IF FOOTSWITCH   3. INPUT
            IS BEING PRESSED
55.  START TAPE  5                                           4. BEFORE EVENT
                 [CAFE FINALE]                                      TIME
56.  WAIT       03:00                                        5. AFTER  EVENT
                                                                    TIME
57.  NOTE:  EVENT OVER...CLEAN UP AND GO HOME                6. BEFORE XMTR/
                                                                 RCVR TIME
58.  LIGHTS DOWN  FRAN     CHAN  5                           7. AFTER  XMTR/
                  [06]     [CRTYD STG L]                         RCVR TIME
59.  THROUGH               CHAN 10                           8. BEFORE SMPTE
                           [CRTYD STG R]                            TIME
60.  SOUND DOWN   FRAN  SRC  5   ZN  6          IN 00:30     9. AFTER  SMPTE
                  [06]                                              TIME
61.  SOUND UP     FRAN  SRC  0   ZN  6          IN 00:30
                  [06]
62.  END EVENT

   [↑ SCROLL ↑]                  [ENTER]
```

- In cases where the menu is too long to fit on one page of the CRT, MENU UP and MENU DOWN buttons appear on the CRT. Scrolling the menu may be accomplished by touching one of these buttons on the touchscreen, or by typing the first few characters (i.e., M U or M D) on the keyboard.

- Cue sequences which require a radio transmission identification at a specific antenna are recorded separately by selecting the XMTR/RCVR menu option. Each Transmitter # / Receiver # combination specifies a different cue sequence which appears on the CRT as a separate page of text.

3. REVISING A SEQUENCE OF CUES

To edit an existing sequence of cues, the cursor must be moved to the part of the cue which is to be changed. This is accomplished by pressing the UP, DOWN, LEFT or RIGHT cursor control buttons on the keyboard. Alternatively, if the terminal is equipped with a touchscreen, the cursor may be moved by simply touching the relevant part of the cue on the CRT. The menu then displays the changes that can be made. For example, if the cursor is moved to the 39 in the cue

<u>LIGHTS</u> <u>UP</u>	FRAN	CHAN 39	TO 45%,
	[06]	[BLUE #1]	

the menu display lists all dimmable light channels in the specified pavilion. A new light channel number can then be entered from either the menu or the keypad. Depressing the ENTER button causes the data entry cursor to move to the next piece of information for the cue, in this case the 45% dimmer level.

4. INSERTING A CUE

Inserting a cue can be accomplished through either the keyboard, or the touchscreen, or both. In each case the line which will contain the new cue is inserted on the line immediately below the current position of the cursor.

- Entering a cue with the touchscreen is initiated by touching the INSERT CUE entry on the menu. This causes a new, blank line to appear in the cue sequence and a menu of possible cues to be printed. Touching one of the cues on the menu causes the selected cue to be printed on the line. The cursor is then automatically moved to the first piece of information required by the cue, and a new menu appears to select that piece of information.

  This process is repeated until all of the required information has been entered .

  Numerical information is entered with the touchscreen via special numerical menus, which are similar to a calculator keypad. Information entered with the numerical menu is treated identically to the information entered with the keyboard, and keyboard data entries can be interspersed with touchscreen entries.

- Entering a cue with the keyboard is accomplished by typing the first few characters of each desired menu entry. As soon as enough characters are typed for the program to recognize which menu item is being selected, typing a space will cause the program to fill in the rest of the entry. For example, the cue line

<u>LIGHTS</u> <u>UP</u>	FRAN	CHAN 6	TO	75%
	[06]	[FOOTLIGHTS]		

  could be entered by typing

  L U F 6 TO 75.

  In this example, pavilion 6 was specified by name (F), but could just as well have been specified by typing its number (6).

  Since the possible menu entries will always be displayed on the CRT, it will be easy to enter cues accurately. However, if the operator misspells a menu entry, all misspelt characters will be ignored by the program.

  If the operator wishes to go back and retype the last few entries, he may move the cursor back and then reenter the correct information.

5. DESCRIPTION OF CUES

Cues which can be entered into SECS cue sequences are listed below. A typical example of each type of cue is given, followed by an explanation. The notation (Optional) at the right denotes data which need not be included in the cue entry.

```
LIGHTS UP   FRAN        CHAN  24
            [06]
AND                     CHAN  30                            (Optional)

THROUGH                 CHAN  36  TO  65%   IN 00:25        (Optional)
```

This command turns on a light or group of lights in a given pavilion. After the LIGHTS UP cue is selected, the pavilion is selected from a menu of pavilion names/numbers. The first channel is then selected from a list of channels available at that pavilion (the menu includes user-defined names for any or all of the channels). Additional channels can be selected by hitting the AND and THROUGH menu entries. The THROUGH command selects a block of channels starting with the last selected channel and continuing to the channel number specified for THROUGH, which may be a bigger or smaller number than the channel number previously specified.

If any of the selected channels are dimmed channels, one can specify the final light intensity (in %) and the fade time (in minutes:seconds). If all of the selected channels are non-dimmed, this menu entry does not appear and the fade % and time cannot be entered. If the % and fade time are not specified, they are assumed to be 100% and 00:00, respectively.

```
LIGHTS DOWN   FRAN      CHAN  14
              [06]
AND                     CHAN  30                            (Optional)

THROUGH                 CHAN  32           IN 22:00         (Optional)
```

This cue is similar to the LIGHTS UP cue except that if no fade % is specified, the level is assumed to be 0%.

```
SOUND UP    GERM    SRC 13   ZN
            [07]
THROUGH                      ZN  05                         (Optional)

AND                          ZN 03  TO  65%  IN 00:30       (Optional)
```

This causes the SECS System to send a request to the audio system to patch the proper audio source to the desired zone, and perform the fade. No more than two Entertainment sources can be patched into any audio zone at any one time. If an audio source is requested to be patched into a zone which already has two programs assigned to it, the source which has been patched in the longest is disconnected to make room for the new audio source.

If the audio level and fade time are not specified, they are assumed to be 100% and 00:00, respectively.

SOUND DOWN	JPAN [09]	SRC 12	ZN 0		
AND			ZN 09		(Optional)
THROUGH			ZN 12	IN 00:15	(Optional)

This is similar to the SOUND UP command except that if no audio fade % is specified, it is assumed to be 0%.

START TAPE 6
[EVNT ANNCMNT]

This cue causes the SECS processor in Communicore to emit a 1/4 second "start" pulse to one of the tape machines. The audio output from the tape is then synchronized to the cue sequence.

WAIT 02:35

This is the simplest form of the WAIT command, which causes the execution of this cue sequence to be delayed for the specified time. Cues following the WAIT command will be executed when the delay time has expired.

WAIT FOR	FRAN [06]	INPUT 21 [COURTYRD KEY]

This causes cue execution to wait until the given input is received. Typical inputs used here would be safety interlocks on hydraulically operated lighting booms, tone decoder switch closure inputs for tapes, remote control key-switch or pushbutton inputs.

Two WAIT commands can be combined to give

WAIT	12:00	FOR	FRAN [06]	INPUT 6 [BACKSTAGE KY]

In this case, the program will "give up" and proceed with the cue if no input has been received after 12 minutes are up.

<u>WAIT</u> <u>FOR</u> 22:00 <u>HRS</u> (in hours:minutes)

This provides a means of delaying part of a cue sequence until a specific time of day. If it is already later in the day than the specified time, this cue will be ignored. For the purposes of the SECS event cues, the clock "rolls over" at 4:00 AM so that 1:00 HRS is considered "later" than 22:00 HRS.

<u>WAIT</u> <u>FOR</u> <u>EVENT</u> <u>TIME</u> 23:30 (in minutes:seconds)

This provides a means of delaying until a specific time relative to the start of the event. Thus if the event time is moved or the event gets underway a bit late, the cue timing relationships can be preserved.

<u>WAIT</u> <u>FOR</u> <u>XMTR</u> 15 / <u>RCVR</u> 21 <u>TIME</u> 00:30 (in min:sec)

This is similar to the above WAIT command except that the specified time is relative to the start time of the cue sequence of a specific Transmitter # / Receiver # combination.

<u>WAIT</u> <u>FOR</u> 4.02 <u>ON</u> <u>SMPTE</u> <u>TRACK</u> #5

This provides a means of syncronizing a cue sequence to a specific position on a tape SMPTE time track.

<u>TRIGGER</u> <u>ON</u> CANA [03] <u>INPUT</u> 7 [CNTL BOOTH]

This box may contain any number of cues, (e.g., LIGHTS UP, LIGHTS DOWN, etc.).

A TRIGGER box consists of a trigger condition for which to wait, and a box of cues to be executed once the condition is met. In general, any condition that can be used in the WAIT FOR command can also be used in the TRIGGER command, (e.g., time of day, key-switch inputs, etc.).

The sequencing of cues inside a trigger box proceeds completely independently of the sequencing of the cues outside the box. Thus, when a trigger box is encountered, the box is "activated" and the cue sequencing jumps past the trigger box and continues to execute cues outside the box. The activated trigger box then waits for its condition to be met. If and when it is met, the cues inside the box will be executed. These cues can include normal cues, WAITs, IFs, and other trigger boxes. Other examples of trigger boxes are:

<u>TRIGGER</u> <u>ON</u> 00:50 (in min:sec)

TRIGGER ON 10:35 HRS (in hrs:min)

TRIGGER ON EVENT TIME 11:25 (in min:sec)

TRIGGER ON XMTR 12 / RCVR 03 TIME 2:25 (in min:sec)

TRIGGER ON 4.40 ON SMPTE TRACK 03

SEND MESSAGE ** LAST CUE EXECUTED IN BASTILLE DAY **

This cue prints a message on the CRT when the cue is executed. The message is entered into the cue from the cue editing keyboard.

NOTE ** Now turn on the lights one by one for the band leader's entrance **

This cue does nothing, but it permits the cue writer to enter explanatory notes and comments about what the cues are doing. The NOTE also appears when the cue sequence is listed on the printer.

E.T.A. NEXT RCVR 2:15 (in minutes:seconds)

This cue specifies the time at which a radio transmitter can be expected to arrive at the next receiver antenna. If the time between Radio ID "hits" is longer than the specified time, an error message will appear on the CRT.

IF AFTER 22:30 HRS (in hrs:min)

(This box may contain any number or type of cues)

An IF box consists of an IF clause and a box containing conditional cues. If the clause is true when the box is encountered, the cues inside the box will be executed; if the clause is false, the box will be skipped. This is unlike the TRIGGER box which continues waiting for its condition to be met. The IF statement provides a means of writing cues which will do different things depending on circumstances, (e.g., a pageant cue may activate the lights only if the time is after 8:00 PM).

Other examples of IF boxes are:

```
IF BEFORE     22:00   HRS   (in hrs:min)
```

```
IF AFTER      EVENT TIME   4:20   ( in min:sec)
```

```
IF AFTER   XMTR 06 / RCVR 10   TIME 00:01 (in min:sec)
```

```
IF            MEXI          INPUT 15
              [10]          [LIGHT LIFT 6]
```

```
IF BEFORE     00.05         ON SMPTE TRACK 03
```

```
     DIMMER LEVELS    UKNG      CRASSFADE IN   00:25
                      [12]
     Channel:  0 0 0 0 0 0 0 0 0   1 1 1 1 1 1 1 1 1 1   2 2 2 2 2
               1 2 3 4 5 6 7 8 9   0 1 2 3 4 5 6 7 8 9   0 1 2 3 4

     Level:    1 0 0 0 1 0 0 0 0   0 0 1 0 0 0 0 1 0 0   0 0 0 0 0
               0 2 4 8 0 6 3 1 2   7 4 0 1 2 6 3 0 3 3   6 4 6 8 3
               0 4 7 5 0 5 4 1 3   6 1 0 0 0 3 4 0 2 5   5 2 3 1 7
```

This cue provides a means of controlling the dimmers in a pavilion which are normally under the control of a lighting control board. The DIMMER LEVEL cue is entered into the cue sequence when the dimmers are set to the correct levels. After the pavilion is specified, the dimmer output levels are recorded directly from the dimmer control lines of the lighting control board in that pavilion.

In addition, a fade time is entered, so that when the cue is executed, the dimmers crossfade to the dimmer levels in the amount of time specified.

The DIMMER LEVELS cue provides a backup capability to the lighting control board, or it can be combined with other WAIT, IF, and TRIGGER cues to provide a fully automatic lighting sequence.

The dimmer levels that have been recorded may be edited by re-recording the entire group of dimmers using the DIMMER LEVELS cue, or by changing selected dimmers using the LIGHTS ON and LIGHTS OFF cues.

<u>LIFT UP</u>	ITLY [08]	#3
<u>LIFT DOWN</u>	FRAN [06]	#1

These cues may be used to raise and lower lighting lifts in the Park. Each lift has a switch closure verification input which will cause a System error message if the input is not received within 45 seconds of the time that the LIFT UP cue was executed. If desired, the lift verification input can also be tested, using IF or WAIT cues, so that special action can be taken if the lift fails.

<u>END EVENT</u>

This cue may be used to cause an event to terminate, regardless of whether all cues in the event have been executed. It may appear at the end of a cue sequence, or it may be used inside an IF or TRIGGER box, such that if/when the condition is met, the event is ended.

The END EVENT cue need not be used in events which have uncertain endpoints, (e.g., a parade in which the floats could get out of order).

6. MOVE CUE

Cues may be moved within a cue sequence without retyping, by using the MOVE CUE option. After selecting the MOVE CUE command on the menu, the operator enters the line number of the cue which is to be moved. The selected cue is then highlighted on the CRT, and the operator is asked to move the cursor to the line where the cue should be inserted. (The cursor can be placed between cues on the CRT.) Pressing ENTER causes the moved cue to be written into the text, and all of the following cues are automatically shifted downwards.

To move cues using a touchscreen terminal, the operator selects the MOVE CUE command, then simply "picks up" a line by touching it, and "deposits" it by touching the place in the text where the cue should be inserted. A large number of lines can be moved quickly and easily in this way.

7. COPY CUES

Cues may be copied from a cue sequence by selecting the COPY CUES option from the menu while in cue editing mode. The operator is asked to select the line numbers of the cues he wishes to copy and, as they are chosen, the information appears on the CRT to verify that the correct cues have been entered, e.g.,

COPYING CUES:	5
AND	3
AND	12
THROUGH	10

The cues are copied in the order that they are typed. If a wrong cue is selected, the cursor may be moved back to the error, and the line number can be re-selected.

The operator may select ALL from the menu to copy an entire cue sequence; if there are multiple cue sequences in the event, he may select ENTIRE EVENT to copy all of the sequences.

When all of the cues are selected, the operator presses ENTER and he is then asked to select the event in which the copied lines are to be inserted. Cues may be copied into any version of an existing event, a new version of an existing event, or a new event which can be created by the copy.

If the cues are inserted in an existing version, the text of the version appears on the CRT, and the operator sets the cursor to the place in the text where the lines should be inserted. Pressing ENTER causes the cues to be copied, and the cues are automatically renumbered in that event.

The CRT then returns to the original file, which remains unaltered, for additional editing.

8. DELETE CUE

Cues may be deleted from a cue sequence by selecting the DELETE CUE command from the menu. The operator is asked to set the cursor on the line to be deleted. On a touchscreen this may be done by touching the line to be deleted, which is then highlighted to verify that the correct line was touched. Pressing ENTER causes the cue to be deleted from the text, and all the cues following the deleted line are automatically shifted upwards.

9. ABORT

If the operator selects a wrong command, (e.g., DELETE CUE instead of INSERT CUE, or MOVE CUE instead of COPY CUES), he may select the ABORT option, which causes the menu to return to the command selection list, and allows the operator to re-select.

1.4. EVENT EXECUTION

1. EVENT ACTIVATION

When an event is activated, the cues of the selected event are moved from the hard disk to the processor memory so that they may be executed. There are two ways to activate an event:

1) through event scheduling, whereby the activation occurs automatically when the scheduled time is reached, or

2) manually, by pressing the EXECUTE button. (See MANUAL EXECUTION, section 1.4.3.)

If the first cue of an activated event is a WAIT cue, (typically a WAIT FOR KEY-SWITCH INPUT), the lighting and sound outputs to the Park remain unaffected until the designated input is received.

2. EVENT DEACTIVATION

An event can be deactivated in one of the following ways:

1) The operator cancels the event at the console after activation has taken place. If no lighting or sound cues have been executed, the cancelled event has no effect on the outputs to the Park. If cues have started execution, the audio channels will do a 20-second fade to the background music, but the light channels will stay at their current states until the operator changes them at the console or until another event occurs in that zone.

2) When all cues of an event have been executed the event will deactivate automatically.

3) If an event in progress has no cues which are being executed, but still has an unexecuted cue, (e.g., a TRIGGER box which did not receive its input, or a specific Transmitter # / Receiver # which was missed), the processor will "give up" after 30 minutes and deactivate the event. The status of the event is changed to INCOMPLETE and an error message appears on the CRT, which includes the list of light or sound channels which were not returned to "normal."

   This does not apply to a WAIT command, (e.g., WAIT FOR 30:05), which is considered to be a cue, and is in execution for the entire WAIT period.

4) If an event is restarted, the original occurrence of the event is immediately deactivated, and the restarted event begins execution. The light channels remain as they were when the cancellation occurred, until affected by the restarted event. The sound channels begin a 20-second fade to the background music, but this may be interrupted by the restarted event as cues are executed.

5) When an END EVENT cue is executed in a cue sequence, the event will be deactivated. A message will appear on the CRT if any of the Park outputs are not returned to "normal" when the event is deactivated.

3. MANUAL EXECUTION

At any time, the operator can execute an event, or any portion of an event by pressing the EXECUTE button on the console. When this button is pressed, the event name and version may be selected, and its cue sequence appears on the CRT. Any of the following commands are available in this mode:

- The operator may select the ACTIVATE EVENT command from the menu which loads the event from the hard disk and prepares to execute the cue sequence. This is identical to event activation through event scheduling. (See section 1.4.1.)

  If the activated event is scheduled to occur later in the day, the operator is asked if this execution should replace the next occurrence. If YES, then the status of that occurrence of the event is changed to CANCELLED. The manual execution and the cancellation are both recorded on the System Log.

- If an event has Transmitter # / Receiver # cue sequences recorded, XMTR/RCVR may be selected from the menu, which allows selection and execution of a specific Radio ID sequence.

- By selecting EXECUTE CUE from the menu, any cues in the sequence may be executed, in any order, any number of times. This command allows the operator to enter the line numbers of the cues he wishes to execute. The chosen lines appear on the CRT for verification, and when ENTER is pressed, the cues are executed. For example, the operator may specify:

```
EXECUTE   CUES     2
       THROUGH    12
           AND    22
       THROUGH    26
```

If the cues to be executed contain WAIT or TRIGGER cues, the processor waits for these conditions to be satisfied, just as in event execution through event scheduling.

Similarly, an IF box is evaluated, and executed or skipped, depending on whether the IF condition is TRUE or FALSE when the IF cue is encountered.

However, any WAIT, TRIGGER or IF condition may be by-passed by executing the cues following the WAIT, TRIGGER or IF statement. For example, in the following TRIGGER box,

```
5. TRIGGER ON     FRAN     INPUT 6
                  [06]     [COURTYRD KEY]
6. LIGHTS UP      FRAN     CHAN  24
                  [06]     [PINK SPOT]
7. WAIT          00:15

8. LIGHTS DOWN    FRAN     CHAN  24
                  [06]     [PINK SPOT]
```

the cues on lines 6 through 8 may be specified to be executed, whether or not input 6 is received.

- If an event has a variable endpoint through the use of TRIGGER and/or IF boxes which depend on various inputs, the operator may specify END as the last cue to execute, (e.g., EXECUTE LINES 2 THROUGH END). Execution of the cues proceeds until there are no more cues to execute, as in the case of non-manual event execution.

On color terminals, the cues listed on the CRT change colors upon execution. Execution continues until all of the selected cues have been completed, whether the operator leaves EXECUTE mode, or selects another sequence or event to execute.

4. CONFLICTING CUES

The large number of cues which can be written and rapidly executed on the SECS System makes it possible for two cues to be executed which give conflicting instructions to a lighting or sound channel. For example, the cue sequence for one transmitter/receiver combination could start to bring a lighting channel up in a 30-second fade, and another radio cue sequence could come along 10 seconds later and request the light to be taken immediately to 85%. In cases of conflicting commands to the hardware, the last command given is the one which is obeyed. Cues which take time to execute, (e.g., fades), will not necessarily be completed if a conflicting cue is received before they have time to be completed.

1.5. CANCEL EVENT

Any event which appears on the current daily schedule, or any event currently being executed (manually or automatically), may be cancelled from the Cue Editing Console. This is accomplished by pressing the CANCEL EVENT button on the console. When this mode is entered, the operator is asked to select the event to be cancelled. If there are several occurrences of the event scheduled, or if the event is currently being executed but has other occurrences on the schedule, the CRT will indicate the possibilities for cancellation, and the operator may select any or all of the choices listed.

If the event is in progress at the time that the event is cancelled, the audio channels will perform a 20-second fade to the background music, but the light channels will remain as they are when the cancellation occurs. A message appears on the CRT to alert the operator that the light channels may need to be returned to their "normal" states.

1.6. DELETE EVENT

When the DELETE EVENT button is pressed, the names of all the events currently in the directory are listed. The operator chooses the event to be deleted, and then must verify the choice by typing YES or NO. A YES response erases all versions of the selected event from the hard disk of the System. This information is not recoverable unless it has first been saved on a flexible disk (see section 7.), or a spare disk pack.

This command is useful for getting rid of obsolete events or sample events that were used for demonstrations. It is also used to erase seasonal events from the directory after they have been copied onto flexible disks.

It is not necessary to delete unwanted versions of events because back versions are eventually deleted as they are replaced by newly edited versions. (See section 1.3.1.)

1.7. HELP BUTTON

Each of the console CRTs has a dedicated HELP button which causes the contents of the CRT display to be momentarily replaced by an explanation of the current display mode and the options available to the console operator. When applicable, the HELP information is keyed to the position of the cursor at the time the HELP button is pressed. The explanatory message remains on the CRT for as long as the HELP button is depressed, and the CRT returns to normal as soon as the button is released.

SECTION 2. SCHEDULING EVENTS

2.1. VIEW SCHEDULE

1. INTRODUCTION

The VIEW SCHEDULE button will cause the daily schedule to be displayed. Future schedules may be viewed by selecting the menu entry for the date desired. No editing can be done in VIEW SCHEDULE mode.

The schedule display shows the name of each event scheduled to take place on that date, the time of day for which it is scheduled, the location of the event (if the event is a pageant, the entrance point is entered as the location), the current status of the event and the next scheduled occurrence of that event. The status of the events will be changing throughout the day as events are executed. (See figure 2.)

2. STATUS DESCRIPTIONS

An event may have any of the following status entries:

SCHEDULED - Event is programmed and it appears on the schedule. Activation will occur at the scheduled time.

IN PROGRESS (__:__ A) - Event was activated automatically at the time given in parentheses, and is currently being executed.

IN PROGRESS (__:__ M) - Event was activated manually at the time given in parentheses, and is currently being executed.

COMPLETE (__:__) - Event was executed and finished at the time given in parentheses.

INCOMPLETE (__:__) - Event was partially executed, and deactivated at the time given in parentheses.

NOT PROGRAMMED - Event is listed in the schedule but the event directory has no such event on file. The event will be ignored if it has not been programmed by the scheduled time.

EVENT SCHEDULE FOR: 3/15/83

TIME	EVENT	LOCATION	STATUS	NEXT SHOW
10:00	MEXICAN HOLIDAY	MEXICO	COMPLETE (10:32)	03-16-83
10:45	ORANGE FESTIVAL	AMERICA	INCOMPLETE (11:45)	12:45
12:15	GERMAN BEER FESTIVAL	GERMANY	CANCELLED (10:45)	18:15
12:45	ORANGE FESTIVAL	AMERICA	SCHEDULED	03-16-83
13:00	JAPANESE TEA CEREMONY	JAPAN	IN PROGRESS (12:55 M)	16:00
13:30	SIDEWALK CAFE SHOW	FRANCE	IN PROGRESS (13:30 A)	14:30
14:30	SIDEWALK CAFE SHOW	FRANCE	SCHEDULED	15:30
15:30	SIDEWALK CAFE SHOW	FRANCE	SCHEDULED	03-16-83
16:00	JAPANESE TEA CEREMONY	JAPAN	SCHEDULED	19:00
17:00	NORTHERN NEIGHBORS	CANADA	SCHEDULED	03-16-83
18:15	GERMAN BEER FESTIVAL	GERMANY	SCHEDULED	03-16-83
19:00	JAPANESE TEA CEREMONY	JAPAN	SCHEDULED	03-16-83
19:30	CANDLELIGHT PARADE	E.ENTR	SCHEDULED	03-22-83
20:30	ITALIAN THEATRE	ITALY	NOT PROGRAMMED	
21:00	DIXIELAND JAZZ	E.RSTRT	SCHEDULED	03/16/83

FIGURE 2. VIEW SCHEDULE MODE

CANCELLED (__:__) - Event was cancelled today at the time given in parentheses. (Event may be rescheduled for a different time.)

2.2. EDIT SCHEDULE

1. INTRODUCTION

Schedules may be written up to four weeks in advance, and each is deleted when its date has passed. When the EDIT SCHEDULE button on the console is pressed, the CRT displays all of the dates for which a schedule may be edited. The operator may select a date by touchscreen or by keyboard, which causes the schedule (if any) for that date to appear. The display includes a menu of commands at the right-hand side of the CRT.

The procedure for editing schedules is very similar to that for editing cues:

- The cursor can be moved either by cursor control buttons on the keyboard, or by touching the touchscreen at the desired location.

- Scrolling the screen is accomplished by scrolling buttons either on the touchscreen or on the keyboard.

- Menu selection on the touchscreen is performed simply by touching the menu entry. Menu selection on the keyboard may be done either by typing the line number of the menu entry, or by typing enough characters of the entry for the program to recognize which is to be selected.

- If the menu is too long to fit on one page of the CRT, menu scrolling buttons appear on the CRT.

2. ENTER EVENT ONTO SCHEDULE

To enter an event onto a schedule, the INSERT EVENT command is selected from the menu, and the operator is asked to enter the time for which the event is to be scheduled. When the time is entered, a blank line will automatically appear in the correct place in the schedule, and all subsequent events that are listed are moved down one line.

When this is completed, the name of the event is entered. The location, current status, and next scheduled occurrence of the event are entered automatically from the event file. (See STATUS DESCRIPTIONS, section 2.1.2.) If the event has not yet been programmed, the location column will be left blank, and the status will be listed as NOT PROGRAMMED.

An event which takes place more than once a day must have a separate entry on the schedule for each occurrence.

3. REVISE SCHEDULE

The scheduled time of an event may be changed at any time until that event is activated. This is done by moving the cursor to the time entry which is to be changed, and entering the correct time. The event is automatically moved into the correct place on the schedule so that the chronological order is maintained.

If the event has already been activated, a time change must be performed by cancelling the activated event, and inserting a new entry on the schedule. (See CANCEL EVENT, section 1.5.)

4. DELETE AN ENTRY FROM THE SCHEDULE

An event may be deleted from the schedule at any time until the day for which the schedule was written. The DELETE ENTRY command is selected from the menu, and the operator is asked to move the cursor to the line which is to be deleted. The chosen line is then highlighted for verification, and is deleted when ENTER is pressed.

On the day that an event is scheduled to take place, it may not be deleted, but must be cancelled. (See section 1.5.) This will leave a cancelled entry visible on the event schedule.

5. COPY SCHEDULE

Any line or lines may be copied from one schedule to another. After selecting the COPY SCHEDULE menu command, the operator enters the line numbers of the events which are to be copied onto another schedule. For example, the following may be entered:

```
COPYING SCHEDULE LINES:   3
                    AND   6
                    AND  10
                THROUGH  15
```

The lines may be entered in any order. They will be put into chronological order automatically when they are inserted into another schedule.

If a wrong line number is entered, it may be corrected by moving the cursor back to the error and retyping the line number.

If the entire schedule is to be copied, ALL may be selected instead of entering the line numbers.

When ENTER is pressed, the menu will allow selection of the date for which the copied lines are to be scheduled. Selecting the date will initiate the copy, and then return to the command menu for additional schedule editing.

6. ABORT

The ABORT command may be selected from the menu whenever the operator has selected the wrong command, (e.g., DELETE EVENT instead of INSERT EVENT). ABORT causes the menu to return to the command list so that the operator may re-select.

SECTION 3. THE SYSTEM LOG

3.1. INTRODUCTION

The System Log is a disk file on the SECS Main Computer which contains a listing, by real time, of all hardware and software actions which took place on the SECS System in the recent past. It appears to the various SECS consoles as a sheet of paper which can be scrolled to earlier or later times by pressing the scrolling buttons. This mode is entered by pressing the VIEW LOG button on the console.

Several System Log display modes are available to "filter out" all Log entries which are not of immediate interest to the operator. For example, one can display only Log entries which have to do with EVENT SCHEDULING AND TIMING, or those dealing with HARDWARE FAILURES, or by applying more than one filter, one can select Log entries dealing with RADIO ID TRIGGERS in BASTILLE DAY PAGEANT in UNITED KINGDOM RIC.

In order to keep the System Log to a manageable size, Log entries are deleted after a reasonable period of time. For example, Log reports on successful hardware diagnostics are deleted within 2 days, whereas Log entries dealing with event starting and finishing times, or System down-time remain in the Log for a week. At any point, Log entries may be saved on flexible disks. (See section 7.)

To speed the process of setting the display filters, a set of standard display filters will be provided to access the System Log in commonly used formats; e.g., an ENTERTAINMENT SCHEDULING FORMAT which filters out most hardware entries, and a MAINTENANCE DIRECTOR'S FORMAT which filters out everything except hardware messages. (See figure 3.)

3.2. CONTENTS OF THE SYSTEM LOG

The types of entries contained in the System Log are listed below. The time in brackets which follows each of the entries below indicates how long the information is maintained in the Log before deletion.

EVENT SCHEDULED TIMES [1 Week] - contains the names of the events and their scheduled times.

SYSTEM LOG
JULY 14,1983 ENTERTAINMENT FORMAT

09:35	EVENT START:	MEXICAN HOLIDAY	LOCATION: MEXICO 13 cues
09:51	CUE EDITING SESSION:	BASTILLE DAY	REVISION: 7/14/83-1 7 cues changed
09:56	EVENT END:	MEXICAN HOLIDAY	
10:45	EVENT START	ORANGE FESTIVAL	
11:22	SCHEDULE CHANGES:	BASTILLE DAY BASTILLE DAY	13:30 SCHEDULED 14:00 CANCELLED
11:25	EVENT START:	BANJO PARADE (manual)	LOCATION: S.E. ENTRANCE (3 Radio ID cues)
11:45	EVENT END:	ORANGE FESTIVAL	INCOMPLETE: xmtr 6 / rcvr 9 xmtr 6 / rcvr 10 xmtr 6 / rcvr 11 xmtr 6 / rcvr 12
11:47	DIRECT I/O MODIFICATION	PAVILION: AMER	LIGHT CHANNELS: 16,17,18 37,38
12:25	EVENT END:	BANJO PARADE	
12:28	CUE EDITING:	BASTILLE DAY	REVISION: 7/14/83-2
13:30	EVENT START:	BASTILLE DAY	LOCATION: FRANCE (41 Radio ID Cues)

↓[SCROLL FOR ADDITIONAL LOG ENTRIES]↓

FIGURE 3. VIEWING THE SYSTEM LOG:
ENTERTAINMENT DIRECTOR'S FORMAT

EVENT ACTIVATION TIME [1 Week] - contains the names of the events and the time each event was activated, as well as whether the event was activated manually or via EVENT SCHEDULE.

FIRST CUE TIME [1 Week] - contains the time of the first key-switch input, radio ID trigger, light fade or sound fade of the event. This indicates the time that the event actually got underway.

CUE SEQUENCE TIMES FOR ALL SEQUENCES IN EVENT [2 DAYS] - This permits careful examination of cue timing relationships and Radio ID System performance. Cue sequences initiated via Radio ID have a Log entry containing radio signal strength and signal duration as reported from the RIC, for use in diagnosing weak transmitters and/or receivers.

CUE EXECUTION TIMES [2 Days] - contains the execution times for all cues in all cue sequences executed by the SECS System. Provides verification of cue execution timing.

RIC INPUT STATUS CHANGES [2 Days] - contains the time of key-switch closures, tape tone decoders, etc., which trigger cues.

EVENT TERMINATION TIME [1 Week] - contains the time that the last cue of each event was executed, or status information if event was cancelled.

RIC DIAGNOSTICS [2 Days if no errors, 1 week if errors are logged] - contains any errors reported by each of the RICs.

CHANGES IN SYSTEM CONFIGURATION [1 Week] - installation of new RIC equipment and maintenance downtime will be logged.

3.3. ACCESSING THE SYSTEM LOG

There are several filters available for retrieving various portions of the System Log. They include the following:

1. EVENT FILTER.

Any of the events which occurred in the time period covered may be selected as a filter to isolate log entries dealing with SECS performance in that event.

2. RIC (Pavilion) FILTER.

Any RIC or group of RICs may be selected as a filter to isolate log entries dealing with operations of the specified RIC(s).

3. HARDWARE FILTERS.

These are a series of ON/OFF display options for log entries which deal with hardware conditions in the SECS System.

- Hardware diagnostic reports from the routines which are continually performing System checks.
- Hardware diagnostics which report recoverable System errors (serial link failures, memory diagnostic checks, etc.).
- Hardware diagnostics which report unrecoverable System errors (RIC processor failures, audio box failures, etc.).
- RIC input status changes - any RIC input bit can be used as an input filter to monitor the performance of that input.
- RIC input status changes which trigger cues.
- RIC output status commands - any software request to change the status of an RIC output.
- RIC verification response for output status change.
- Changes in System configuration and down-time reports.
- SECS backup CPU offline time for software modification.

4. SOFTWARE FILTERS.

The following software System Log entries can be selectively displayed:

- Times of scheduled events.
- Actual times of event starts.
- Time of first cue in events.
- Times of all cues in events.
- Times of Transmitter / Receiver starts in events.
- Times of all trigger boxes in events.
- Times of last cue in events.
- Times of event cancellations.
- Times of all front panel button hits.
- Times of all event editing sessions.
- Times of all event schedule edits.

5. DATE FILTER.

Any date or dates which reside in the System Log may be specified as a filter.

3.4. FORMATS FOR VIEWING SYSTEM LOG ENTRIES

Each viewing format specifies a complete set of viewing filters, so that the System Log may be rapidly viewed without setting each filter individually.

PAST EVENT SCHEDULE FORMAT - This format displays only Log entries describing the schedule of past events and the time at which they actually took place, in a format similar to the EVENT SCHEDULE display.

ENTERTAINMENT DIRECTOR'S FORMAT - This is an expanded form of the PAST EVENT SCHEDULE Log display. It includes more details on each event which took place, as well as information on event editing sessions and System reconfiguration notes, etc.

SYSTEM PERFORMANCE SUMMARY FORMAT - This format displays a brief statistical summary of the number of events run, the number cancelled, down-time of System components, performance of the Radio ID System, etc.

FATAL SYSTEM ERROR LOG - This format displays all non-recoverable System errors, i.e., errors which result in down-time to Park function outputs.

SYSTEM CONFIGURATION CHANGES FORMAT - This format displays all logged changes in the System configuration, as well as whether the System was reconfigured for maintenance or upgrading, or because of automatic switching to backup devices due to a fault condition. All logged edits of the System Name Table are displayed.

CUSTOM FORMATS A AND B - Two independent sets of operator adjustable display filters are provided. The display filter options can be adjusted at the right of the Log display. The display filter setups are remembered when the display mode is switched, so that an operator can return to a custom format and have the Log displayed with the same set of filters.

SECTION 4. SYSTEM STATUS DISPLAYS

4.1. INTRODUCTION

The System Status displays are a set of standard display modes which are used to monitor the status of events in the Park.

The System Status displays are totally passive, i.e., they cannot modify event cues, schedules, or affect outputs to the Park.

4.2. PARK EVENT STATUS

This display, which is map-like in appearance, is a general overview of the Park, which allows the operator to see how the events are progressing. It is divided into zones, which correspond to the RICs in the Park. Each zone has one or more of the following entries, which indicate the status of the events in that zone:

P	- Event is in progress.
X	- Event has completed execution after automatic activation.
M	- Event has completed execution after manual activation.
$\boxed{P}$	- A cue sequence, triggered by a Radio ID "hit," is in progress. Detailed information on each Transmitter # / Receiver # combination is available in the Local Event Status display. (See section 4.3.)
$\boxed{X}$	- A XMTR/RCVR cue sequence was completed after the Radio ID trigger.
$\boxed{M}$	- A XMTR/RCVR cue sequence was completed after manual execution.
I	- Event has been deactivated with an unexecuted cue. (See EVENT DEACTIVATION, section 1.4.2.)
[BLANK]	- No event is currently taking place in this zone.

Each entry in a zone is color-coded by event on color terminals. The list of currently active events, and the color-key is available on the menu at the right-hand side on the display.

An event remains on the Park Status display for five minutes after it is deactivated. If information concerning an event is needed after this time, the System Log can retrieve any information required.

4.3. LOCAL EVENT STATUS

This display provides detailed information on the status of a selected event. When this display mode is initiated, the operator chooses from a menu of scheduled events. Events which have been activated are highlighted on the menu. When an event has been selected, the CRT displays (see figure 4):

- Schedule information for the event.
- A summary of cues and cue sequences recorded for the event.
- A summary of cues and cue sequences already executed for the event.
- A summary of Park outputs (sound, lights, etc.) which the event currently controls.
- Timing information on the event.
- Number of XMTR/RCVR cue sequences recorded for the event.

For events which have cue sequences recorded on the Radio ID System, an additional display may be selected, which contains a grid of all Transmitter # / Receiver # combinations. Each of the combinations has one of the following grid entries:

$\boxed{}$ - A cue sequence has been recorded but has not yet been executed.

$\boxed{P}$ - The cue sequence is in progress.

$\boxed{X}$ - The cue sequence has completed execution after the Radio ID trigger.

VIEWING STATUS OF:
BASTILLE DAY PARADE CREATED: 01-15-82
LOCATION: SW ENTRANCE REVISED: 01-31-82

EVENT SCHEDULE TIME:	2:00 PM
# OF CUES RECORDED:	31 Cues
# OF XMTR/RCVR CUES RECORDED:	151 XMTR/RCVR Cues
# OF CUES EXECUTED:	16 Cues
# OF XMTR/RCVR CUES EXECUTED:	56 Cues
# OF XMTR/RCVR SEQS EXECUTED:	5 Sequences
EVENT ACTIVATION TIME:	2:00 PM [Automatic]
FIRST CUE TIME:	2:03 PM [SW ENTRANCE #6]

XMTR/RCVR TIMES:

XMTR #	RCVR #	TIME
1	1	2:03
1	2	2:05
2	1	2:07
1	3	2:07
2	2	2:08

CURRENTLY CONTROLLED OUTPUTS:

PAVILION	LIGHT CHANNELS
AFRI	2,3,4,6,16,31
AMER	20,22,23,26
CANA	15,17,18

SOURCE	AUDIO ZONE
5	1
13	2
6	3

MENU SELECTIONS

1. VIEW XMTR/RCVR STATUS
2. VIEW STATUS OF ANOTHER EVENT
3. VIEW PAVILION STATUS
4. VIEW PARK STATUS

FIGURE 4. VIEWING THE EVENT STATUS DISPLAY.

M - The cue sequence has completed execution after manual initiation.

[BLANK] - No cue sequence has been recorded for this combination.

The cue execution data remain on the Local Status displays for five minutes after the event has been deactivated. After that time, the displays are "reset" for the next occurrence of the event. However, any of this information can be retrieved from the System Log using the PAST EVENT Format. (See section 3.4.)

4.4. PAVILION STATUS

After menu selection of a given pavilion (RIC), the CRT displays the status of all events which are active or scheduled in the pavilion. Information is color-coded by event on color terminals. This status display includes:

- A grid display indicating which events use specific light and sound channels in that pavilion. This display is useful when programming events, so that conflicting cues to the hardware may be avoided.

- A grid display indicating which events (if any) are currently controlling specific light and sound channels in the pavilion.

- Grid displays representing the status of I/O channels in the RIC.

- Configuration information and down-time summary for the RIC.

SECTION 5. SYSTEM MAINTENANCE

5.1. INTRODUCTION

The System Maintenance console provides hardware-oriented displays and I/O modification commands. During normal operation of the SECS console this will be used as a passive monitor of the Park function outputs; however, it provides for rapid fault isolation and correction when necessary.

The various System Maintenance modes are entered via menu selection on the touchscreen.

5.2. REMOTE PROCESSOR RESETS

These backlit pushbuttons provide a hardware reset command to each of the RIC microprocessors. The backlighting of the pushbuttons is under control of the SECS Console microprocessor, which causes the button to flash whenever an RIC fails to respond to commands from the main processor. When this happens, the console operator has two options:

1) Reset the RIC processor. This is performed by simultaneously pressing the RIC RESET ENABLE switch and the (blinking) RIC reset button. If the processor has "crashed" but can be successfully reset, this will cause a momentary (~1 second) dip in the sound, lighting, etc., as the processor returns the lights to the power-up condition and waits for updated information from the SECS Main CPU.

2) If the Park outputs are at acceptable levels even though the RIC CPU has "crashed," it may be desirable to wait some period of time before resetting the RIC processor.

5.3. SYSTEM CHECKOUT AND MAINTENANCE ROUTINES

System checkout and maintenance routines can be initiated from the System Maintenance console by selecting the SYSTEM CHECKOUT menu entry. These are divided into two classes:

1. PASSIVE MAINTENANCE/ CHECKOUT ROUTINES

These routines do not affect the Park outputs. They can be executed by the console operator at any time, and include:

- CONSOLE LAMP TEST. This routine turns on all console lamps, individually and in groups, without otherwise affecting console operation.

- INTENSIVE EXERCISE OF AN INDIVIDUAL SERIAL LINE. This mode is useful for rapidly evaluating the error rate of any serial link in MinnieNET, and includes a real-time display of the GO / NO GO status of the link, which will be useful when the System is powered up.

- SWITCH TO BACKUP. Any of the redundant elements in MinnieNET (backup CPUs, serial links, etc.) can be switched to backup, even if the main unit is still functioning properly. (This switchover takes place automatically whenever a fault is detected in the primary device.)

- LOCAL STATUS DISPLAY MIMIC. This enables the operator to view the contents of the status display of any RIC on the MinnieNET System.

2 . ACTIVE MAINTENANCE / CHECKOUT ROUTINES

These routines do affect the Park outputs. They include:

- LIGHTING CHECKOUT ROUTINES. These do simple lighting sequences, chases and fades in the lighting outputs of a given pavilion.

- SOUND SYSTEM CHECKOUT. These routines methodically test audio crosspoints by sequentially patching all possible audio sources into each zone, while allowing the console operator to monitor the high-level outputs at each zone.

5.4. DIRECT I/O MODIFICATION

From time to time it may be required to effect direct modifications to the System outputs. This may be performed, for example, during System checkout or in "cleaning up" after an event which was cancelled while it was in progress. (See section 1.5.)

To perform this function, DIRECT I/O is selected on the System Maintenance menu, followed by the selection of the subsystem (sound, lights, Radio ID, etc.), or pavilion in which the modifications are needed. If a subsystem (e.g., lighting) is selected, the display mode is a grid of (lighting) channel numbers organized by pavilion. If a specific pavilion is selected, grids representing all subsystems in the pavilion appear. Channels which are currently in use appear on the grids as non-blank entries. A channel or group of channels is then selected for modification.

- If the entry is a non-dimmed lighting channel, selecting the channel number on the touchscreen will cause the entry to toggle from ON to OFF, and vice versa.

- If the entry is a dimmed lighting channel, the menu displays bar graphs and digital values representing

  1) the current value of the channel;

  2) the desired new value of the channel; and

  3) the crossfade time.

The operator sets 2) and 3) and selects the menu entry, CROSSFADE GO. The new value and crossfade time do not change when a new channel is selected, so that the same crossfade can be rapidly performed on a large number of channels.

- If an audio channel is selected for direct modification, the menu displays the status of that audio channel, including:

  1) The name of the audio channel (obtained from the Configuration Table - see section 9).

  2) The names of all source inputs currently connected in the zone.

  3) The % of full volume for each source.

  4) The event which is responsible for the audio channel being active.

  5) The new % and fade time desired for the channel. These can be adjusted by the operator to select the audio crossfade desired.

6) A similar entry for a new audio source which the operator may wish to fade up in the zone.

7) An AUDIO CROSSFADE GO command which performs the crossfade after the operator has set up the new information.

8) A CROSSFADE TO BGM which returns the audio channel to the background music in 20 seconds.

- If an input channel is selected for direct modification, the menu allows selections which can, through software, "force" an input either ON or OFF. This can be done on a momentary basis (e.g., simulating a tape track switch closure input or a Radio ID hit) or on a semi-permanent basis (e.g., forcing a key-switch ON or a radio receiver OFF). Any inputs which are being forced on or off are displayed as such on all relevant status displays.

SECTION 6. PRINT FUNCTIONS

6.1. AUTOMATIC DAILY REPORTS

Several daily reports are printed automatically every morning on the SECS Operator's Console printer. These reports include:

- The event schedule for the day.

- Any hardware errors reported on the previous day.

- The event scheduling and timing information from the previous day. This report includes the times for which the events were scheduled, the activation times and whether the events were activated manually or automatically, first cue times, and event termination times.

- Two operator adjustable custom reports which can be set to retrieve any information contained on the SECS System Log. The Log filters are set via menu selection. (See section 3.) The filter setups are remembered, so that they need not be reset every morning.

6.2. PRINT OPTIONS

Information that can be displayed on any one of the CRTs can be printed. To do this, the operator must first enter the mode on the CRT that will display the desired information, (e.g., VIEW SCHEDULE, VIEW LOG, VIEW STATUS, etc.), so that the information to be printed appears on the screen. At this point the operator presses the PRINT button on the console, and the CRT menu will ask which CRT has the information to be printed. By selecting the correct CRT, by touchscreen or by keyboard, printing will begin. If the information to be printed does not appear on a single page of the CRT, as in the case of the System Log, the operator may scroll the screen down to the end of the data to be printed while the printer is still in operation.

SECTION 7. FLEXIBLE DISK STORAGE

7.1. SAVING EVENTS ON FLEXIBLE DISKS

Any event in the event directory may be saved on a flexible disk. This is done by putting a disk into the Console Disk Drive, and pressing the TO DISK button on the cue editing console. When the SAVE EVENT command is selected from the menu, all of the event names in the directory are displayed, and an event can be selected. The operator may choose any or all of the versions of an event. When this is completed, the event is copied onto the disk.

Saving an event on a flexible disk does not affect the event in the event directory. It will remain on the hard disk of the System until deleted by the operator.

7.2. READING EVENTS FROM FLEXIBLE DISKS

Any event which has been stored on a flexible disk may be read into the event directory at any time. To do this, the disk containing the event is put into the Console Disk Drive, and the FROM DISK button on the cue editing console is depressed. The names of the files on the disk will appear on the CRT, and an event name may be selected. This causes all versions of the event to be copied into the event directory.

The file on the flexible disk remains unaffected by the copy procedure, and may be read from the disk whenever necessary.

The event that was read from the flexible disk remains in the event directory until deleted by the operator.

7.3. SAVING THE SYSTEM LOG ON FLEXIBLE DISKS

Any portion of the System Log may be saved on a flexible disk. When a disk is inserted into the Console Disk Drive, and the TO DISK button is depressed, the operator selects the SAVE LOG command from the menu. The CRT asks for the date of the Log to be saved, and allows the operator to select any or all of the Formats and/or filters. When the portion of the Log has been specified, the copy to the disk occurs. The Log in the hard disk of the System remains unaffected, and will be deleted as specified in section 3.2.

7.4. READING THE SYSTEM LOG FROM FLEXIBLE DISKS

When a disk is inserted into the Console Disk Drive, and the FROM DISK console button is depressed, the CRT displays the names of all the files on the flexible disk. The System Log files are kept by date, and by selecting a Log date, the entire Log which was saved for that date is read into the System Log. The Log file on the flexible disk remains unaffected, and may be read from the disk at any time.

The Log file that was read from the flexible disk will be deleted automatically at the end of the day.

SECTION 8. SENDING MESSAGES

Messages may be sent from one terminal to another in the SECS System by depressing the SEND MESSAGE button. Terminals which have this capability include all RIC terminals, the Remote Programming Console, the Event Scheduling Terminal, the Cue Editing Terminal on the Main Operator's Console, and the SMACS System Console.

After the message is typed on the keyboard, any or all of the terminals may be chosen, by menu selection, to receive the message.

The message remains on the CRT until acknowledged by an operator. All messages are recorded in the System Log.

SECTION 9. RENAMING AND RECONFIGURING SYSTEM COMPONENTS

The names which appear on CRT references to pavilions (RICs), lighting channels, key-switch inputs, radio antennas, and other System I/Os are obtained from the Configuration Table which resides on the SECS System disks. Information in this file also determines the nominal number and type of each component in the SECS System. In addition to being useful for constructing CRT menus with the correct number of entries, this file enables the diagnostic routines to determine the difference between components which are failing diagnostic routines and those which are not installed.

This file must be edited whenever the SECS System is reconfigured. This is considered to be software maintenance, and would not normally be done by the SECS System Console operator. The procedure is as follows:

1) Select the CONFIGURATION TABLE display mode on the System Maintenance CRT. The Configuration Table will appear as a scrolled sheet on the left side of the CRT, and an editing menu will appear on the right.

2) The Configuration Table appears on the System Maintenance CRT in outline form, with one major entry per RIC. The outline can be scrolled up or down on the CRT by selecting the scrolling entries on the touchscreen. The line chosen on the touchscreen is highlighted for editing, and a menu at the right indicates which editing functions may be performed on that line. (See figure 5.)

EDITING SYSTEM CONFIGURATION TABLE

RIC #6

A. NAME: Germany

B. SERIAL COMMUNICATION LINKS:

C. DIMMED LIGHTING CHANNELS: Total of: 16

1. CHANNEL 1

   NAME: Courtyard area lighting

2. CHANNEL 2

   NAME: Courtyard blue wash #1

3. CHANNEL 3

   NAME: none, displayed as "Ch. 3"

4. CHANNEL 4

   NAME: Courtyard Spot #1

5. CHANNEL 5

   NAME: Courtyard Spot #2

↓ [SCROLL FOR ADDITIONAL TABLE ENTRIES] ↓

SELECT # OF DIMMED LIGHTING CHANNELS

1	2	3
4	5	6
7	8	9
	0	

ENTER NUMBER THEN PRESS 'ENTER'

FIGURE 5.

OWNER PROVIDED EQUIPMENT

Owner Provided Equipment

Table of Contents

OWNER PROVIDED EQUIPMENT

Section 1.0

Site Environmental Conditions

Site Environmental Conditions

1) EPCOT Central

- Temperature 72° F ± 2°
- Humidity 50% ± 5%
- Dedicated HVAC
- 12" Raised Floor
- Fire Protection by ionization detection, dry pipe and Halon gas

2) Electronic Equipment Rooms (RIC locations)

- (Similar to EPCOT Central)
- No Raised Floor

OWNER PROVIDED EQUIPMENT

Section 2.0

Data Communications

Data Communications

1.0 Vendor Supplied Lines

The SECS will communicate with two Owner provided systems;

- Park Function Controller
- Audio Processing Equipment

For the purpose of interfacing to SECS the Park Function Controller appears as a single unit in Communicore while the Audio Processing Equipment consists of an Audio Routing Switcher in Communicore and an Audio Processing Cabinet in each pavilion's electronic equipment room.

The interface to each of these units is by direct connection to RICs utilizing the WED protocol which features:
(See Appendix 4)

- 9600 Baud
- EIA RS232 standard
- DB25S connector
- Data and ground only (2,3 and 7)
- Printable ASCII codes

2.0 Owner Provided Lines

2.1 General

The Owner will provide data communications facilities for the SECS from the Vista United Telecommunications VistaNET. These facilities will provide the SECS the means for transferring data between the EPCOT Central Computers, the SECS Console, the RICs and the remote terminals. In addition to data commmunications the facilities provided by the VistaNET will allow the SECS console to generate contact closures at the RICs for the purpose of resetting the RIC microprocessors. The VistaNET lines are fibre optic cables; however this is transparent to the user who will access them with the interfaces described below.

2.2 MinnieNET

2.2.1 Overview

The EPCOT Central Computers, the SECS console and the RICs (Remote Interface Cabinets located in Communicore and World Showcase electronic equipment rooms) will be linked by a pair of multidrop lines referred to as the "MinnieNET".

MinnieNET features:

- Two independent lines: Main Bus and Back-up Bus
- Single Elco 8016-056 connector
- HDLC Synchronous protocol
- 128K bits/sec
- EIA RS422 standard interface
- Fault protection
- Transparent to user

2.2.2 Configuration

The Main Bus will connect the Main SECS Computer with the SECS Operator's Console and all the RICs. The Back-up Bus will connect the Back-up Computer with the SECS Operator's Console and all the RICs. During normal operation SECS data will be transferred via the Main Bus. In the event of a failure on the Main Bus or a failure of the Main Computer data will be transferred via the Back-up Bus. A high speed interprocessor link will allow the Back-up Computer to maintain copies of SECS files, schedules and status tables.

2.2.3 Electrical Specifications

A) MinnieNET Signals

Each MinnieNET line will contain five signals:

- Ground
- Received Data
- Receiver Signal Element Timing
- Transmitted Data
- Transmitter Signal Element Timing

These signals are similar to the EIA RS449 Data Transmission Configuration Type DT with the exception that Receive Timing and Send Timing are not provided on independent lines.

In the definitions that follow the term "DCE" means the owner provided Data Communications Equipment and the term "DTE" means the vendor provided SECS equipment.

B) Signal Definitions

1) Signal Ground

A direct connection to circuit ground.

2) Received Data

Direction: from DCE

The data signals generated by the DCE, in response to data channel line signals received from a remote data station, are transferred on this circuit to the DTE. This circuit shall be held in the binary ONE (marking) condition at all times when data is not present.

3) Receiver Signal Timing Element

Direction: from DCE

Signals on this circuit provide the DTE with receive signal element timing information. The transition from ON to OFF shall nominally indicate the center of each signal element on the Received Data circuit.

This circuit shall also provide the the DTE with transmit signal element timing information. The DTE shall provide a data signal on the Transmitted Data circuit in which the transitions between signal elements nominally occur at the time of the transitions from OFF to ON of the signal on the Receiver Signal Timing Element circuit.

4) Transmitted Data

Direction: to DCE

The data signals originated by the DTE, to be transmitted via the data channel to all remote stations on the line, are transferred on this circuit to the DCE.

The DTE shall hold this circuit in the binary ONE (marking) condition when data is not present.

5) Transmitter Signal Timing Element

Direction: to DCE

Signals on this circuit provide the DCE with transmit signal element timing information. The ON to OFF transition shall nominally indicate the center of each signal element on the Transmitted Data circuit.

C) Signal Electrical Standard

All signals described in section 2.2.3 above shall comply with EIA RS422.

2.2.4 Mechanical Specifications

The MinnieNET circuits will be provided on an Elco 8016-056 Receptacle in the electrical equipment rooms at Communicore and in the pavilions of World Showcase. The necesary cables will be Owner provided unless otherwise specified (See Drawing SECS-152905).

2.2.5 Message Format

MinnieNET data transfers will use the HDLC frame protocol which features (See Appendix 5):

- frame synchronization
- destination addressing
- CRC error detection

2.2.6 Remote Terminal Lines

The owner will provide lines for interfacing the SECS computers in EPCOT Central to two data terminals. These will be used for the Software Development Terminal and the Event Scheduling Terminal.

- EIA RS232 Interface
- DB25S connector
- 9600 Baud
- Transparent to user

2.2.7 Remote Resets

The owner will provide lines allowing the SECS Console in EPCOT Central to reset the RICs.

- Switch closure or 12-48VDC control signal inputs
- Switch closure or 12-48VDC outputs
- Transparent to user

The Remote Reset signals will be available on the MinnieNET Elco connectors.

OWNER PROVIDED EQUIPMENT

Section 3.0

SECS Console Mechanical Specifications

OWNER PROVIDED EQUIPMENT

Section 4.0

Audio Monitoring Console

OWNER PROVIDED EQUIPMENT

Section 5.0

Voice Communications

OWNER PROVIDED EQUIPMENT

Section 6.0

Radio ID Transmitters and Receivers

EPCOT SECS ID TELEMETRY SYSTEM FUNCTIONAL SPECIFICATION

TABLE OF CONTENTS

1.0 OBJECTIVE

The objective of the system is to identify a number of independent, portable radio transmitters by their presence over buried antennas. Each transmitter will broadcast a thumbwheel-selectable ID code which will be received and transferred to an STD-Z80 Bus microprocessor system.

2.0 SYSTEM SPECIFICATIONS

2.1 Transmission Distance: Approximately 5 feet

2.2 Operating Frequency: VHF Hi-Band. Exact frequency to be determined by customer.

2.3 Overall Requirements

Each transmitter shall reliably communicate its ID while passing within five (5) feet of a buried antenna for a minimum of two (2) seconds, without interference from other transmitters operating on the same frequency at a minimum distance of fifty (50) feet away and without causing interference to other buried antennas a minimum of one hundred (100) feet away.

The following specification applies at a transmission distance of 5 feet or less, for all combinations of transmitters and receivers in the system, for all orientations of transmitting and receiving antennas, and with all interfering transmitters at a minumum distance of 50 feet:

Error Rate: ID Telemetry system shall have an error rate less than 0.001/bit.

3.0 TRANSMITTER SPECIFICATIONS

3.1 FCC approved

3.2 Power Requirements: Operation for eight (8) hours minimum with internal, rechargeable battery. Protected against accidental reversal of polarity and input power voltage transients ± 25V.

3.3 Mechanical Specifications

The Vendor shall offer the transmitter in two packages. One will be a belt-pack and the other will be designed for mounting on a small vehicle. The units must meet the following specifications:

Maximum size: 1" x 3" x 6"

Maximum weight: 2 lbs.

The Vendor may, at his option, construct the unit in two packages provided that the packages are attached, necesary cables are supplied and the total size and weight does not excede the maximum specified.

The Vendor should attempt to make the package as small as possible.

3.4 Thumbwheel Switches: Two-digit BCD coded, gold-plated contacts. Provided with protective cover to prevent accidental modification.

3.5 On/Off control: covered to prevent accidental actuation.

3.6 The circuit must automatically recover from all undefined logic states caused by electrical noise, abnormal power supply cycling, etc.

3.7 Transmitter Antennas: Shall be removable from transmitter package and may be mounted up to ten feet from the transmitter.

3.8 Transmitter Environmental Conditions: The transmitters must operate out of doors in Florida and may be exposed to rain and extreme temperature and humidity.

4.0 RECEIVER SPECIFICATIONS

4.1 Power: 110 VAC 60 Hz 50 W. maximum

4.2 Receiver Antennas: Shall be designed to be buried in the roadway and connected to receiver by a length of low-loss heliax cable not to exceed 800 feet. Installed by Owner.

4.3 Cables and Connectors

UHF: S029 for antenna. Owner will install antenna and provide cabling and connectors between antenna and receiver. Antenna cable will be low-loss foam dielectric heliax cable, Andrew type FHJ1-50, or equivalent.

Microprocessor interface: The Vendor shall provide a six foot ribbon cable with self-locking headers to connect the Radio ID Receivers with the STD Z-80 Bus interface card.

4.4 Front Panel Controls and Indicators

The receivers will have the following front panel controls and indicators:

AC ON/OFF switch.
AC monitor lamp or LED.
Squelch control with monitor LED.

4.5 Mechanical Specifications: The receivers shall be designed for mounting in a standard 19 inch RETMA rack with two receivers mounted side by side in 3.5 inches of rack space.

4.6 STD-Z80 Bus Interface: The Vendor will provide an STD-Z80 Bus card to interface the Radio ID Receivers to the Owner's microprocessor system. The card shall employ a Mostek SIO or similar chip to receive the demodulated signal. The demodulator circuit may be on this card or in the receiver package.

5.0 DOCUMENTATION

5.1 The Vendor shall submit two copies each of complete system schematics.

5.2 The Vendor shall submit two copies of manuals for complete operation and maintenance.

5.3 The Vendor shall submit a list of recommended spares with current pricing.

6.0 SYSTEM CHECKOUT

The Vendor or his authorized representative shall make personnel that are thoroughly familiar with the system available for on-site (EPCOT Center, Lake Buena Vista, Florida) consultation and assistance during a two week system checkout period. All costs of time, travel, food, lodging and other incidentals shall be borne by the Vendor.

7.0 WARRANTY

The Vendor shall furnish a warranty covering all products that is valid for one year beginning on the conclusion of the two week system checkout. The warranty shall state all conditions for which it is valid.

EPCOT SECS RADIO ID SYSTEM SPECIFICATION

TABLE OF CONTENTS

1.0 OBJECTIVE

The objective of the system is to identify a number of independent, portable radio transmitters by their presence over buried antennas. Each transmitter will broadcast a thumbwheel-selectable ID code which will be received and transferred to an STD-Z80 Bus microprocessor system.

2.0 SYSTEM SPECIFICATIONS

2.1 Transmission Distance: Approximately 5 feet

2.2 Operating Frequency: VHF Hi-Band. Exact frequency to be determined by customer.

2.3 Transmitted Signal: Audio FSK signal tone between 2kHz and 3kHz.

2.4 Operating Conditions: Each transmitter shall reliably communicate its ID while passing within five (5) feet of a buried antenna for a minimum of two (2) seconds, without interference from other transmitters operating on the same frequency at a minimum distance of fifty (50) feet away and without causing interference to other buried antennas a minimum of one-hundred (100) feet away.

2.5 The following specifications apply at a transmission distance of 5 feet or less, for all combinations of transmitters and receivers in the system, for all orientations of transmitting and receiving antennas, and with all interfering transmitters at a minumum distance of 50 feet:

Distortion: 5% maximum, 2kHz to 3kHz.

Signal to noise: 20 db or better.

Squelch gate reliably ON: duty cycle greater than 95%.

Error Rate: ID modulator/demodulator system shall have an error rate less than 0.001/bit when coupled through an audio channel with signal to noise 10 db or better.

3.0 TRANSMITTER SPECIFICATIONS

3.1 FCC approved

3.2 Power Requirements: Operation for eight (8) hours minimum with internal, rechargeable battery or from external 12 VDC ±3 VDC source. Protected against accidental reversal of polarity and input power voltage transients ± 25V.

3.3 ID Modulation Signal

3.3.1 Signal: 0.5V peak-to-peak FSK audio tone. Frequencies are Bell 101/113 compatible (mark=2255 Hz; space=2025 Hz) to permit standard modem equipment to receive signal tones. Audio output must be filtered to remove frequency components above 10 kHz. Output Impedance: 1k Ohm maximum.

3.3.2 Format: Serial asynchronous multibyte data transmission to encode thumbwheel settings.

3.3.3 Data Rate: 300 baud

3.3.4 Redundancy Check: 2 byte CRC or similar redundancy check on each transmission sequence. May be performed in microprocessor software.

3.4 Mechanical Specifications

The Vendor shall offer the transmitter in two packages. One will be a belt-pack and the other will be designed for mounting on a small vehicle. The units must meet the following specifications:

Maximum size: 1" x 3" x 6"

Maximum weight: 2 lbs.

The Vendor may, at his option, construct the unit in two packages provided that the packages are attached, necesary cables are supplied and the total size and weight does not excede the maximum specified.

The Vendor should attempt to make the package as small as possible.

3.5 Thumbwheel Switches: Two-digit BCD coded, gold-plated contacts. Provided with protective cover to prevent accidental modification.

3.6 On/Off control: covered to prevent accidental actuation.

3.7 The circuit must automatically recover from all undefined logic states caused by electrical noise, abnormal power supply cycling, etc.

3.8 Transmitter Antennas: Shall be removable from transmitter package and may be mounted up to ten feet from the transmitter.

3.9 Transmitter Environmental Conditions: The transmitters must operate out of doors in Florida and may be exposed to rain and extreme temperatures and humidity.

4.0 RECEIVER SPECIFICATIONS

4.1 Power: 110 VAC 60 Hz 50 W. maximum

4.2 RF Sensitivity: 1 microvolt for 30 db quieting.

4.3 Squelch

Audio shall be gated by a squelch or similar "carrier detect" signal with the following properties:

Response Time: 0.5 seconds maximum. Whenever all transmitters are at a distance of 50 feet or more from antenna, the audio tone shall be at a level at least 40 db below nominal level, except for periods not to exceed 0.25 seconds. This specification shall be met at the same level of squelch used to meet section 2.5.

4.4 Receiver Antennas: Shall be designed to be buried in the roadway and connected to receiver by a length of low-loss heliax cable not to exceed 800 feet. Installed by Owner.

4.5 Cables and Connectors

UHF: S029 for antenna. Owner will install antenna and provide cabling and connectors between antenna and receiver. Antenna cable will be low-loss foam dielectric heliax cable, Andrew type FHJ1-50, or equivalent. Microprocessor interface: The Vendor shall provide a six foot ribbon cable with self-locking headers to connect the Radio ID Receivers with the STD Z-80 Bus interface card.

4.6 Front Panel Controls and Indicators

The receivers will have the following front panel controls and indicators:

AC ON/OFF switch.
AC monitor lamp or LED.
Squelch control with monitor LED.

4.7 Mechanical Specifications: The receivers shall be designed for mounting in a standard 19 inch RETMA rack with two receivers mounted side by side in 3.5 inches of rack space.

4.8 STD-Z80 Bus Interface: The Vendor will provide STD-Z80 Bus cards to interface the Radio ID Receivers to the Owner's microprocessor system. The card shall employ a Mostek SIO or similar chip to receive the demodulated signal. The demodulator circuit may be on this card or in the receiver package. Each card will interface at least two receivers.

4.9 Receiver Environmental Conditions

Temperature: 72° F $\pm$ 2° F
Humidity: 50% $\pm$ 5%

5.0 DOCUMENTATION

5.1 The Vendor shall submit two copies each of complete system schematics.

5.2 The Vendor shall submit two copies of manuals for complete operation and maintenance.

5.3 The Vendor shall submit a list of recommended spares with current pricing.

6.0 SYSTEM CHECKOUT

The Vendor or his authorized representative shall make personnel that are thoroughly familiar with the system available for on-site (EPCOT Center, Lake Buena Vista, Florida) consultation and assistance during a two week system checkout period. All costs of time, travel, food, lodging and other incidentals shall be borne by the Vendor.

7.0 WARRANTY

The Vendor shall furnish a warranty covering all products that is valid for one year beginning on the conclusion of the two week system checkout. The warranty shall state all conditions for which it is valid.

OWNER PROVIDED EQUIPMENT

Section 7.0

Park Function Controller

OWNER PROVIDED EQUIPMENT

Section 8.0

Audio Routing Switcher

OWNER PROVIDED EQUIPMENT

Section 9.0

Audio Processing Cabinet

SECS DATA COMMUNICATIONS

(See Appendix 2 section 2.0)

WED COMMUNICATIONS PROTOCOL

5.2 Message Format And Protocol

5.2.1 General

To ensure communications integrity among SMACS components and other systems over serial asynchronous lines, the message handshaking protocol will be as defined in this section. Message sequences will consist of an "Instigation Message", from the instigator (Master) of the message sequence, and a "Response Message" from the recipient (slave), back to the instigator, as shown below.

MASTER   SLAVE

INSTIGATION ——————>

<—————— RESPONSE

To aid in system debugging, communications checkout and monitoring, and in simulation of systems components, messages will consist of printable ASCII characters (7 bits plus parity). Any numeric data included will be in a suitable format using printable characters. Table 5-1 defines those ASCII characters regarded as printable, forming the communications character set. Carriage return (CR) and feedline (LF) are regarded as printable.

TABLE 5-1
ASCII CHARACTER SET

HEX VALUE WITHOUT PARITY	CHARACTER	HEX VALUE WITHOUT PARITY	CHARACTER	HEX VALUE WITHOUT PARITY	CHARACTER
2Ø	SP (space)	4Ø	@	6Ø	` (grave)
21	!	41	A	61	a
22	"	42	B	62	b
23	#	43	C	63	c
24	$	44	D	64	d
25	%	45	E	65	e
26	&	46	F	66	f
27	´ (acute)	47	G	67	g
28	(	48	H	68	h
29	)	49	I	69	i
2A	*	4A	J	6A	j
2B	+	4B	K	6B	k
2C	' (apostrophe)	4C	L	6C	l
2D	- (hyphen)	4D	M	6D	m
2E	.	4E	N	6E	n
2F	/	4F	O	6F	o
3Ø	Ø	5Ø	P	7Ø	p
31	1	51	Q	71	q
32	2	52	R	72	r
33	3	53	S	73	s
34	4	54	T	74	t
35	5	55	U	75	u
36	6	56	V	76	v
37	7	57	W	77	w
38	8	58	X	78	x
39	9	59	Y	79	y
3A	:	5A	Z	7A	z
3B	;	5B	[	7B	{ (l.brace)
3C	<	5C	\ (backslant)	7C	|
3D	=	5D	]	7D	} (r.brace)
3E	>	5E	^ (caret)	7E	~ (tilde)
3F	?	5F	_ (underline)	7F	(not used)
/ØA	(Line Feed) LF	/ØD	(Carriage Return)		

The following six characters from the above set are reserved as communications control characters: { | } ~ CR LF

By utilizing a protocol that comprises only printable ASCII characters, a standard ASCII CRT may be used for checking out system communications without having to resort to datascopes, line analyzers, or other specialized equipment. Any communications line can be monitored by simple parallel connection to an ASCII CRT.

The protocol defined in this section is to be used both for point-to-point and multi-drop lines.

5.2.2 Message Formats

All messages (Instigation and Response) will be framed by Start-of-Message (SOM) and End-of-Message (EOM) characters.

A. Instigation Messages <IM>

<IM> :: = <SOM> <MASTER> <SLAVE> <SEQUENCE #> <CODE>

<DATA> <CHECKSUM> <EOM>

Where:

<SOM> :: = {

<MASTER> :: = Identification of master component. This is any character in the character set except the control characters CR, LF, or SP (space), providing unique identification for up to 90 components (see Table 5-2 in Section 5.2.4).

<SLAVE> :: = Identification of Slave Component (see Table 5-2 in Section 5.2.4).

<Sequence #> :: = An incrementing sequence number, cycling through all characters in the character set except the control characters and SP (space). This allows for the detection of duplicate messages, loss of messages, etc. Thus, the <Sequence #> will continuously cycle from ! (hex 21) through z (hex 7A).

<Code> :: = A code (or command) defining the actions to be taken by the receiver as a result of receiving the message. May be any character in the character set except the control characters or SP (space), allowing for up to 90 possible codes. (See Table 5-3 in Section 5.2.5).

<Data> :: = Optional (depending upon the <Code>), up to 72 data characters from the character set (except control characters).

<Checksum> :: = Checksum character (see Section 5.2.3.B.).

<EOM> :: = CR or LF

B. Response Messages

Three types of Response Messages <RM> may be generated by a slave.

<RM> :: = <ACK> | <NAK> | <DAK>

1. Acknowledge Response Message <ACK>

<ACK> :: = <SOM> <Sequence #> <EOM>

Where:

<SOM> :: = }

<Sequence #> :: = <Sequence #> from the instigation message for which this is the response. See <IM> definition, Section 5.2.2.A.

<EOM> :: = CR or LF

This response indicates that the slave has correctly received the <IM> of <Sequence #>.

2. Negative Acknowledge Response Message <NAK>

<NAK> :: = <SOM> <EOM>

Where:

<SOM> :: = ~

<EOM> :: = CR or LF

This response indicates that the slave did not correctly receive an <IM> due to:

- check sum error
- character parity error
- basic communications receive error

3. Data Acknowledge Response Message <DAK>

<DAK> :: = <SOM> <Sequence #> <Code> <Data> <Checksum> <EOM>

Where:

<SOM> :: = |

<Sequence #> :: = <Sequence #> from the <IM> for which this is a response.

<Code> :: = See <IM> definition

<Data> :: = See <IM> definition, up to 72 characters.

<Checksum> :: = Checksum character (see Section 5.2.3.B).

<EOM> :: = CR or LF

This response is similar to the <ACK> response except that as well as acknowledging correct reception of the <IM>, returned data is included. A major reason for providing the capability of <DAK> messages is to reduce communication time on multi-drop (or polled) lines. Without a <DAK> capability a message sequence between a multi-drop line-master (not message sequence Master) and a line-slave would be as follows:

<IM> request for data ——>	Total 4 Messages
<—— <ACK>	
<—— <IM> with requested data	
<ACK> ——>	

By providing <DAK> capabilities the communications overhead is reduced and the sequence becomes:

<IM> request for data ——>	Total 2 Messages
<—— <DAK> with requested data	

If for some reason the <DAK> is not received properly, the instigator will simply re-issue the <IM> requesting data. Repeated failures will be acted upon as appropriate by each using system.

5.2.3 Error Detection And Recovery

In order to be able to detect and recover from errors in communications message sequences, the following techniques will be employed:

A. <u>Character Parity</u>

Each character sent in a message will contain a parity bit, following the conventions for ASCII coded characters. Odd parity will be used in the SMACS system.

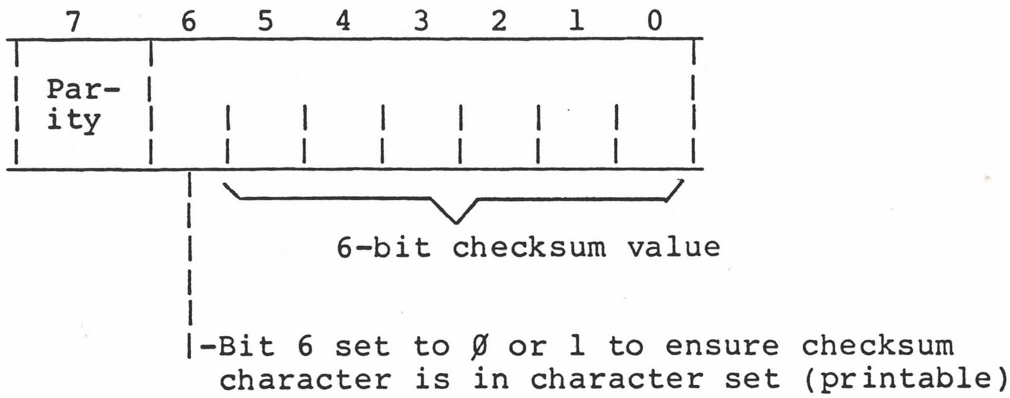
```
     ______________________________________________________________
    |        |    |    |    |    |    |    |    |    |           |
    | Stop   | P  | 6  | 5  | 4  | 3  | 2  | 1  | Ø  | Start     |
    | Bit    |    |    |    |    |    |    |    |    | Bit       |
    |________|____|____|____|____|____|____|____|____|___________|
             |    \__________________  _________________/
             |     MSB               \/              LSB
             |                       |
Parity bit __|                       |     7-bit ASCII character code
                                     |__   in range SP (hex 20)
                                           through ~ (hex 7E)
```

B. <u>Checksum</u>

All messages which contain <Code> or <Data> characters will include a <Checksum> character, which may be any character in the character set except CR or LF.

1. Calculation

All 7-bit ASCII characters (excluding the parity bit) following the <SOM>, up to but not including the <checksum> will be summed to form an eight-bit summation. The two high order bits of the summation (bits 6 and 7) will be added to the low order 6 bits (bits 0 through 5) to produce a 6-bit sum. This 6-bit sum will be negated (two's complement) to produce the low order 6 bits (checksum value) of the checksum. Bit 6 of the check sum will be set to 1 unless all low order 6-bits are 1, when it will be set to Ø. See diagram below.

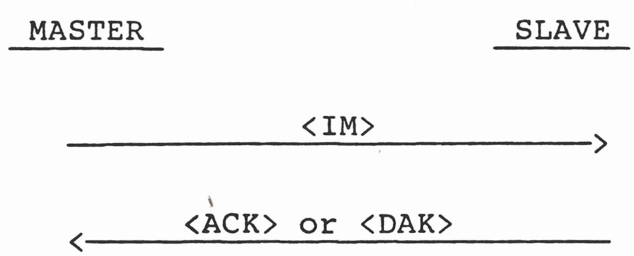


2. Checking

All 7-bit ASCII characters following <SOM>, up to but not including the <Checksum> will be summed to form an 8-bit summation. The two high order bits of the summation will be added to the low order 6 bits to form a 6-bit sum. This 6-bit sum will be added to the 6 low order bits of the <checksum> to produce a 6-bit value that must be zero. Although not the most sophisticated or easy method, this does provide a reasonable degree of confidence for all 7-bits of the ASCII characters.

C. <u>Message Hand Shaking And Message Retransmission</u>

All message sequences will consist of instigation messages and responses. An error-free sequence would be as follows:



If for some reason the slave detects an error in a received <IM>, (parity or checksum error) it will respond with a <NAK> indicating bad reception. The master will then retransmit the <IM>, as shown below.

MASTER		SLAVE
	<IM> -->	Slave detects error in <IM>,
Master receives <NAK>	<-- <NAK>	and responds with <NAK>
and retransmits <IM>	<IM> -->	Slave receives <IM> correctly
	<-- <ACK> or <DAK>	

Retransmission is ONLY performed by a communications sequence Master, and only <IM>'s. Retransmission of an <IM> will be performed a specific number of times before the Master terminates the message sequence and reports the communications error. Retransmission will be performed upon:

- reception of a <NAK> to an <IM>
- time-out waiting for a response from slave.

D. Sequence Number

The sequence number allows the disregarding of duplicate messages and the detection of lost messages. If a received <IM> contains the same <Sequence #> as the last <IM> received, then the <IM> has been retransmitted due to the failure of the slave's <ACK> to reach the Master correctly, as shown below.

MASTER		SLAVE
Master sends <IM> correctly with <Sequence #>=10	<IM, #10> -->	Slave receives <IM> correctly, sets last good sequence # to 10,
Master fails to receive good <ACK> from slave	| <-- <ACK,#10>	and responds with <ACK>
and retransmits	<IM,#10> -->	Slave receives <IM> with same sequence # as last good <IM>,

MASTER		SLAVE
Master receives <ACK> and proceeds to next message if any	<—— <ACK,#10> ——	and simply responds with <ACK>, ignoring second <IM>

If a slave receives an <IM> that is out of sequence, the <IM> will be <ACK>'ed correctly, but the <IM> at the slave will be marked as being received out of sequence. (Attempts to secure retransmission of lost <IM>'s are not as yet defined.)

5.2.4 Unit Identification

Table 5-2 following defines the ASCII codes assigned for unit identification.

5.2.5 Code Definition

Table 5-3 following defines the action or command codes.

5.3 Reports And Logs

(To be supplied)

5.4 Operation And Interaction

(To be supplied)

TABLE 5-2
UNIT ID ASSIGNMENTS FOR
COMM. PROTOCOL INSTIGATION MESSAGES
(MASTER & SLAVE IDENTIFICATION)

HEX VALUE WITHOUT PARITY	CHARACTER	EQUIP. ITEM	EQUIP. TITLE: EPCOT/T-D/L
2Ø	SP (space)	(Not Used)	
21	!	Eclipse (Camp)	CNTL-AP01/CENT-AP01
22	"	Monitor Concentrator	CNTL-MC01/CENT-MC01
23	#	Central Monitor Cabinet #1	CNTL-MR01/CENT-MR01
24	$	Central Monitor Cabinet #2	CNTL-MR01/-
25	%	Park Function Controller	CNTL-FPF1/-
26	&	Tape Start Cabinet #1	CNTL-TS01/CENT-TS01
27	´ (acute)	Tape Start Cabinet #2	CNTL-TS02
28	(	Tape Start Cabinet #3	CNTL-TS03
29	)	CRT #1	CNTL-OCC1/CENT-OCC1
2A	*	CRT #2	CNTL-OCC2
2B	+		
2C	' (apostrophe)		
2D	- (hyphen)		
2E	.		
2F	/		
3Ø	Ø	Ride Control System #1	TRAN-RCC1/SMAL-RCC1
31	1	Ride Control System #2	LAND-RCC1/PRID-RCC1
32	2	Ride Control System #3	SSEP-RCC1/PRID-RCC2
33	3	Ride Control System #4	FPRO-RCC1/SPAM-RCC1
34	4	Ride Control System #5	SEAS-RCC1/SPAM-RCC2
35	5	Ride Control System #6	MEXI-RCC1
36	6	Ride Control System #7	ENRG-RCC1
37	7	Ride Control System #8	ENRG-RCC2
38	8	Ride Control System #9	IMAG-RCC1
39	9		
3A	:		
3B	;		
3C	<		
3D	=		
3E	>		
3F	?		

TABLE 5-2
(CONT'D)

HEX VALUE WITHOUT PARITY	CHARACTER	EQUIP. ITEM: EPCOT/T-D/L	EQUIP. TITLE: EPCOT/T-D/L
4Ø	@	Monitor Cabinet #1/#1	TRAN-MR01/SMAL-MR01
41	A	Monitor Cabinet #2/#2	LAND-MR01/PRID-MR01
42	B	Monitor Cabinet #3/-	SSEP-MR01/-
43	C	Monitor Cabinet #4/#3	FPRO-MR01/SPAM-MR01
44	D	Monitor Cabinet #5/-	SEAS-MR01/-
45	E	Monitor Cabinet #6/#4	MEXI-MR01/TIKI-MR01
46	F	Monitor Cabinet #7/#5	ENRG-MR01/BONE-MR01
47	G	Monitor Cabinet - /#6	- /BTWO-MR01
48	H	Monitor Cabinet #8/#7	IMAG-MR01/MEET-MR01
49	I	Monitor Cabinet #9/#8	IMAG-MR02/MICK-MR01
4A	J	Monitor Cabinet #10/#9	AMER-MR01/HMAN-MR01
4B	K	Monitor Cabinet #11/#10	AMER-MR02/AMES-MR01
4C	L	Monitor Cabinet #12/#11	CANA-MR01/JNGL-MR01
4D	M	Monitor Cabinet #13/#12	FRAN-MR01/CIVI-MR01
4E	N	Monitor Cabinet #14/#13	GERM-MR01/SNOW-MR01
4F	O	Monitor Cabinet #15	ITLY-MR01
5Ø	P	Monitor Cabinet #16	JPAN-MR01
51	Q	Monitor Cabinet #17	UKNG-MR01
52	R	Monitor Cabinet #18	DNMK-MR01
53	S	Monitor Cabinet #19	AFRI-MR01
54	T	Monitor Cabinet #20	CHNA-MR01
55	U	Monitor Cabinet #21	CMNE-MR01
56	V	Monitor Cabinet #22	CMSE-MR02
57	W	Monitor Cabinet #23	CMSW-MR03
58	X	Monitor Cabinet #24	CMNW-MR04
59	Y	TBD	
5A	Z	TBD	
5B	[	TBD	
5C	\ (backslant)	TBD	
5D	]	TBD	
5E	^ (caret)	TBD	
5F	_ (underline)	TBD	

TABLE 5-2
(CONT'D)

HEX VALUE WITHOUT PARITY	CHARACTER	EQUIP. ITEM: EPCOT/T-D/L	EQUIP. TITLE: EPCOT/T-D/L
6Ø	\` (grave)	SCU #1/- :TRAN/-	CNTL-AS02/-
61	a	SCU #2/#1:LAND/PRID	CNTL-AS03/CENT-AS45
62	b	SCU #3/- :SSEP/-	CNTL-AS04/-
63	c	SCU #4/- :FPRO/-	CNTL-AS07/-
64	d	SCU #5/- :SEAS/-	CNTL-AS08/-
65	e	SCU #6/#2:MEXI/TIKI	CNTL-AS17/CENT-AS47
66	f	SCU #7/#3:ENRG/BONE	CNTL-AS01/CENT-AS01
67	g	SCU - /#4:- /BTWO	- /CENT-AS02
68	h	SCU #8/#5:IMAG/MEET	CNTL-AS06/CENT-AS22
69	i	SCU - /#6:- /MICK	- /CENT-AS04
6A	j	SCU #9/#7:AMER/HMAN	CNTL-AS11/CENT-AS46
6B	k	SCU - /#8:- /AMES	- /CENT-AS05
6C	l		
6D	m		
6E	n		
6F	o		
7Ø	p		
71	q		
72	r		
73	s		
74	t		
75	u		
76	v		
77	w	SEC	CNTL-ECC1
78	x	AM & CS	CNTL-FAM1
79	y	CEMS	CNRG-FCC1
7A	z	IIN	CNTL-IIN1
7B thru 7E	-- Not Used	(Protocol Control Characters)	

TABLE 5-3

ACTION/COMMAND CODES FOR USE IN INSTIGATION/RESPONSE MESSAGES

HEX VALUE WITHOUT PARITY	CHARACTER	DEFINITION	REMARKS
20	SP (space)	(Not Used)	
21	!	Time-of-day follows	Time-of-day contained in data block
22	"	My current operating mode	Operating mode contained in data block (unsolicited)
23	#	My current show ID and rev. level	Information contained in data block (unsolicited)
24	$	Test data follows	Data contained in data block
25	%	Enter mode "M"	"M" contained in data block
26	&	Start sequence "S"	"S" contained in data block
27	´ (acute)	Stop sequence "S"	"S" contained in data block
28	(	Activate point(s)/function(s)	Defined in data block
29	)	De-activate point(s)/function(s)	Defined in data block
2A	*	Event for log only	Defined in data block
2B	=	Event for log and report-emergency	Defined in data block
2C	' (apost.)	Event for log and report-urgent	Defined in data block
2D	- (hyphen)	Change to frame rate "FR"	Defined in data block
2E	.	Display the following data	Defined in data block
2F	/	Suspend communications	
30	0	Resume communications	
31	1	Error	Defined in data block
32	2	Failure	Defined in data block
33	3	START	Yourself, or subordinate unit defined in data block
34	4	STOP	Yourself, or subordinate unit defined in data block
35	5	RESET	Yourself, or subordinate unit defined in data block
36	6	PAUSE	Yourself, or subordinate unit defined in data block
37	7	HOLD	Yourself, or subordinate unit defined in data block
38	8	101	Yourself, or subordinate unit defined in data block
39	9	Go to "safe" state	Yourself, or subordinate unit defined in data block
3A	:	Respond with current operating mode	Yourself, or subordinate unit defined in data block
3B	;	Respond with Show ID and rev. level	Yourself, or subordinate unit defined in data block
3C	<	Respond with current frame count	Yourself, or subordinate unit defined in data block
3D	=	Respond with unit status	Yourself, or subordinate unit defined in data block
3E	>	Respond with data	Defined in data block
3F	?	Respond with status of point(s)	Defined in data block

NOTE: When responding to 3A through 3F above, slaves will use the same message codes as in the request.

TABLE 5-3
(CONT'D)

HEX VALUE WITHOUT PARITY	CHARACTER	DEFINITION	REMARKS
4Ø	@	Start scan of point(s)	Defined in data block
41	A	Stop scan of point(s)	Defined in data block
42	B	102	Yourself, or subordinate unit defined in data bloc
43	C	Tape Start	Which tape defined in data block
44	D	Event for log and report-maint. request	Defined in data block
45	E	Event for log and report-status info.	Defined in data block
46	F		
47	G		
48	H		
49	I		
4A	J		
4B	K		
4C	L		
4D	M		
4E	N		
4F	O		
5Ø	P		
51	Q		
52	R		
53	S		
54	T		
55	U		
56	V		
57	W		
58	X		
59	Y		
5A	Z		
5B	[		
5C	\ (backslant)		
5D	]		
5E	^ (caret)		
5F	_ (underline)		

ıBLE 5-3
(CONT'D)

HEX VALUE WITHOUT PARITY	CHARACTER	DEFINITION	REMARKS
6Ø	\ (grave)		
61	a		
62	b		
63	c		
64	d		
65	e		
66	f		
67	g		
68	h		
69	i		
6A	j		
6B	k		
6C	l		
6D	m		
6E	n		
6F	o		
7Ø	p		
71	q		
72	r		
73	s		
74	t		
75	u		
76	v		
77	w		
78	x		
79	y		
7A	z		
7B through 7E	-- Not Used	(Protocol Control Characters)	

HDLC COMMUNICATIONS PROTOCOL

Data communication – High-level data link control procedures – Frame structure

0 INTRODUCTION

This document is one of a series of International Standards, to be used for implementation of various applications with synchronous transmission facilities.

1 SCOPE AND FIELD OF APPLICATION

This International Standard defines in detail the frame structure for data communication systems using bit-oriented high-level data link control (HDLC) procedures. It defines the relative positions of the various components of the basic frame and the bit combination for the frame delimiting sequence (Flag). The bit escaping mechanism which is used to achieve bit pattern independence within the frame is also defined. The document also specifies the frame checking sequence (FCS). No details of the address or control field allocations are included, other than address extension outlined in clause 4.

2 FRAME STRUCTURE

In HDLC, all transmissions are in frames, and each frame conforms to the following format :

Flag	Address	Control	Information	FCS	Flag
01111110	8 bits	8 bits	*	16 bits	01111110

* An unspecified number of bits which in some cases may be a multiple of a particular character size, for example an octet.

where

Flag = flag sequence

Address = secondary station address field

Control = control field

Information = information field

FCS = frame checking sequence

Frames containing only supervisory control sequences form a special case where there is no information field. The format for these frames shall be :

Flag	Address	Control	FCS	Flag
01111110	8 bits	8 bits	16 bits	01111110

3 ELEMENTS OF THE FRAME

3.1 Flag sequence

All frames shall start and end with the flag sequence. All stations which are attached to the data link shall continuously hunt for this sequence. Thus, the flag is used for frame synchronization. A single flag may be used as both the closing flag for one frame and the opening flag for the next frame.

3.2 Address field

The address shall in all cases identify the secondary or secondaries which are involved in the particular frame interchange.

3.3 Control field

The control field contains commands or responses, and sequence numbers. The control field shall be used by the primary to command the addressed secondary to perform a particular operation. It shall be used by the secondary to respond to the primary.

3.4 Information field

Information may be any sequence of bits. In most cases it will be linked to a convenient character structure, for example octets, but if required, it may be an unspecified number of bits and unrelated to a character structure.

3.5 Transparency

The transmitter shall examine the frame content between the two flag sequences including the address, control and FCS sequences and shall insert a "0" bit after all sequences of 5 contiguous "1" bits (including the last 5 bits of the FCS) to ensure that a flag sequence is not simulated. The receiver shall examine the frame content and shall discard any "0" bit which directly follows 5 contiguous "1" bits.

3.6 Frame checking sequence (FCS)

The FCS shall be a 16-bit sequence. It shall be the ones complement of the sum (modulo 2) of :

1) the remainder of x^k $(x^{15} + x^{14} + x^{13} + \ldots + x^2 + x + 1)$ divided (modulo 2) by the generator polynomial $x^{16} + x^{12} + x^5 + 1$, where k is the number of bits in the frame existing between, but not including, the final bit of the opening flag and the first bit of the FCS, excluding bits inserted for transparency, and

2) the remainder after multiplication by x^{16} and then division (modulo 2) by the generator polynomial $x^{16} + x^{12} + x^5 + 1$ of the content of the frame, existing between, but not including, the final bit of the opening flag and the first bit of the FCS, excluding bits inserted
430 for transparency.

As a typical implementation, at the transmitter, the initial remainder of the division is preset to all ones and is then modified by division by the generator polynomial (as described above) on the Address, Control and Information fields; the ones complement of the resulting remainder is transmitted as the 16-bit FCS sequence.

At the receiver, the initial remainder is preset to all ones and the serial incoming protected bits and the FCS when divided by the generator polynomial will result in a remainder of 0001110100001111 (x^{15} through x^0, respectively) in the absence of transmission errors.

NOTES

1 If future applications show that a higher degree of protection is needed, the number of bits of the FCS shall be increased by octets.

2 See the annex for explanatory notes on implementation of the FCS.

3.7 Order of bit transmission

Addresses, commands, responses, and sequence numbers shall be transmitted low-order bit first (for example the first bit of the sequence number that is transmitted shall have the weight 2^0).

The order of transmitting bits within the information field is not specified by this International Standard.

The FCS shall be transmitted to the line commencing with the coefficient of the highest term.

3.8 Inter-frame time fill

Inter-frame time fill shall be accomplished by transmitting either contiguous flags or a minimum of seven contiguous "1" bits or a combination of both.

A selection of the inter-frame time fill methods depends on systems requirement.

3.9 Invalid frame

An invalid frame is defined as one that is not properly bounded by two flags or one which is too short (for example shorter than 32 bits between flags). Invalid frames shall be ignored. Thus, a frame which ends with an all "1" bit sequence equal to or greater than seven bits in duration shall be ignored.

As an example, one method of aborting a frame would be to transmit 8 contiguous "1" bits.

4 EXTENSIONS

4.1 Extended address field

Normally a single octet address shall be used and all 256 combinations shall be available.

However, by prior agreement the address range can be extended by reserving the first transmitted bit (low order) of each address octet which would then be set to binary zero to indicate that the following octet is an extension of the basic address. The format of the extended octet(s) shall be the same as that of the basic octet. Thus, the address field may be recursively extended.

When extensions are used, the presence of a binary "1" in the first transmitted bit of the basic address octet signals that only one address octet is being used. The use of address extension thus restricts the range of single octet addresses to 128.

4.2 Extended control field

The control field may be extended by one or more octets. The extension method and the bit patterns for the commands and responses will be defined in a separate International Standard.

ANNEX

EXPLANATORY NOTES ON IMPLEMENTATION OF THE FRAME CHECKING SEQUENCE

(Not part of the standard)

In order to permit the use of existing devices that are arranged to use a zero preset register, the following implementation may be used.

At the transmitter, generate the FCS sequence in the following manner while transmitting the elements of the frame unaltered onto the line :

a) preset the FCS register to zeros;

b) invert the first 16 bits (following the opening flag) before shifting into the FCS register;

c) shift the remaining fields of the frame into the FCS register uninverted;

d) invert the contents of the FCS register (remainder) and shift onto the line as the FCS sequence.

At the receiver, operate the FCS checking register in the following manner while receiving (and storing) unaltered the elements of the frame as-received from the line :

a) preset the FCS register to zeros;

b) invert the first 16 bits (following the opening flag) before shifting them into the FCS checking register;

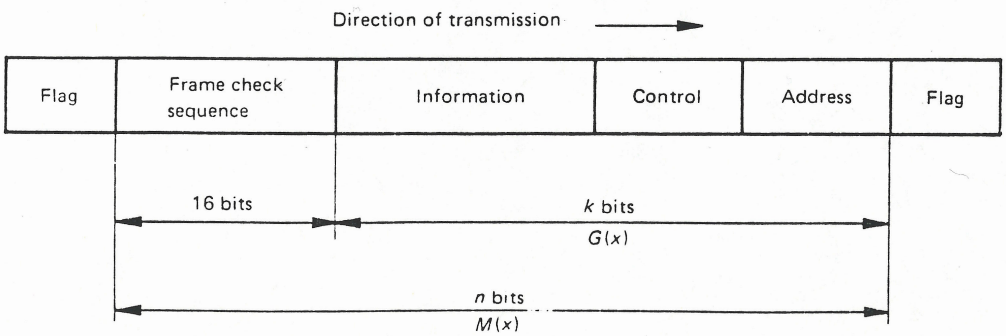
c) shift the remaining elements of the frame, up to the beginning of the FCS, into the checking register uninverted;

d) invert the FCS sequence before shifting into the checking register. In the absence of errors, the FCS register will contain all zeros after the FCS is shifted in.

In the above, inversion of the first 16 bits is equivalent to a ones preset and inversion of the FCS at the receiver causes the registers to go to the all zeros state.

The transmitter or the receiver can independently use the ones preset or the first 16-bit inversion. Also, the receiver can choose not to invert the FCS, in which case it must check for the unique non-zero remainder specified in 3.6.

It must be realized that inversion of the FCS by the receiver requires a 16-bit storage delay before shifting message bits into the register. The receiver cannot anticipate the beginning of the FCS. Such storage, however, will normally take place naturally as the FCS checking function will need to differentiate the FCS from data anyway, and it will thus withhold 16 bits from the next function at all times.



The procedure for using the FCS assumes the following :

1) The k bits of data which are being checked by the FCS can be represented by a polynomial $G(x)$.

Example : $G(x) = x^5 + x^3 + 1$ represents 101001.

2) The Address field, Control field and Information field (if it exists in the message) are represented by the polynomial $G(x)$.

3) For the purpose of generating the FCS, the first bit following the opening flag is the most significant bit of $G(x)$ regardless of the actual representation of the Address, Control and Information fields.

4) There exists a generator polynomial $P(x)$ of degree 16, having the form $P(x) = x^{16} + x^{12} + x^5 + 1$.

The FCS is defined as a ones complement of a remainder, $R(x)$, obtained from the modulo 2 division of

$$x^{16}G(x) + x^k (x^{15} + x^{14} + x^{13} + x^{12} + x^{11} + x^{10} + x^9 + x^8 + x^7 + x^6 + x^5 + x^4 + x^3 + x^2 + x^1 + 1)$$

by the generator polynomial $P(x)$.

$\overline{\text{FCS}}$

$$\frac{x^{16}G(x) + x^k (x^{15} + x^{14} + \ldots + x + 1)}{P(x)} = Q(x) + \frac{R(x)}{P(x)}$$

The multiplication of $G(x)$ by x^{16} corresponds to shifting the message $G(x)$ 16 places and thus providing the space of 16 bits for the FCS.

The addition of x^k $(x^{15} + x^{14} + \ldots + x + 1)$ to $x^{16}G(x)$ (equivalent to inverting the first 16 bits of $x^{16}G(x)$) corresponds to initializing the initial remainder to a value of all "ones". This addition is provided for the purpose of protection against the obliteration of leading flags, which may be non-detectable if the initial remainder is zero. The complementing of $R(x)$, by the
432 transmitter, at the completion of the division ensures that the received, error-free message will result in a unique, non-zero remainder at the receiver. The non-zero remainder provides protection against potential non-detectability of the obliteration of trailing flags.

At the transmitter the FCS is added to the $x^{16}G(x)$ and results in the total message $M(x)$ of length n, where $M(x) = x^{16}G(x) + \text{FCS}$.

At the receiver, the incoming $M(x)$ is multiplied by x^{16}, added to x^n $(x^{15} + x^{14} + \ldots + x + 1)$ and divided by $P(x)$.

$$\frac{x^{16} [x^{16}G(x) + \text{FCS}] + x^n (x^{15} + x^{14} + \ldots + x + 1)}{P(x)} = Qr(x) + \frac{Rr(x)}{P(x)}$$

If the transmission is error free, the remainder $Rr(x)$ will be "ØØØ111Ø1ØØØØ1111" (x^{15} through x^0).

$Rr(x)$ is the remainder of the division : $\dfrac{x^{16}L(x)}{P(x)}$

where $L(x) = x^{15} + x^{14} + \ldots + x + 1$. This can be shown by establishing that all other terms of the numerator of the receiver division are divisible by $P(x)$.

Note that FCS $= \overline{R(x)} = L(x) + R(x)$. (Adding $L(x)$ without carry to a polynomial of its same length is equivalent to a bit-by-bit inversion of the polynomial.)

The equation above, for the FCS receiver residual, is used in the following to show that inverting the FCS at the receiver returns the checking register to zero. This equation is

$$\frac{x^{16}L(x)}{P(x)} = Q(x) + \frac{Rr(x)}{P(x)}$$

where $L(x)$ is as before and $Rr(x)$ is the residual contents of the FCS register.

If another $x^{16}L(x)$ is added to the above numerator, the result is

$$\frac{x^{16}L(x) + x^{16}L(x)}{P(x)} = 0$$

Physically, this second $x^{16}L(x)$ quantity is added to the bit stream by inverting the FCS.

STD BUS SPECIFICATIONS

STD BUS
Specification and Practice

Contents

SECTION 1
STD BUS Specification

Introduction

The STD BUS standardizes the physical and electrical aspects of modular 8-bit microprocessor card systems. It provides a dedicated and orderly interconnection scheme (Fig. 1-1). The standardized pinout and 56-pin connector lend themselves to a bussed motherboard that permits any card to work in any slot.

The STD BUS is dedicated to internal communications. All other interconnections are made via suitable connectors at the I/O interface card edge. The concept gives an orderly signal flow across the cards. Peripheral and I/O devices can be connected to the system, according to their own unique connector and cabling requirements.

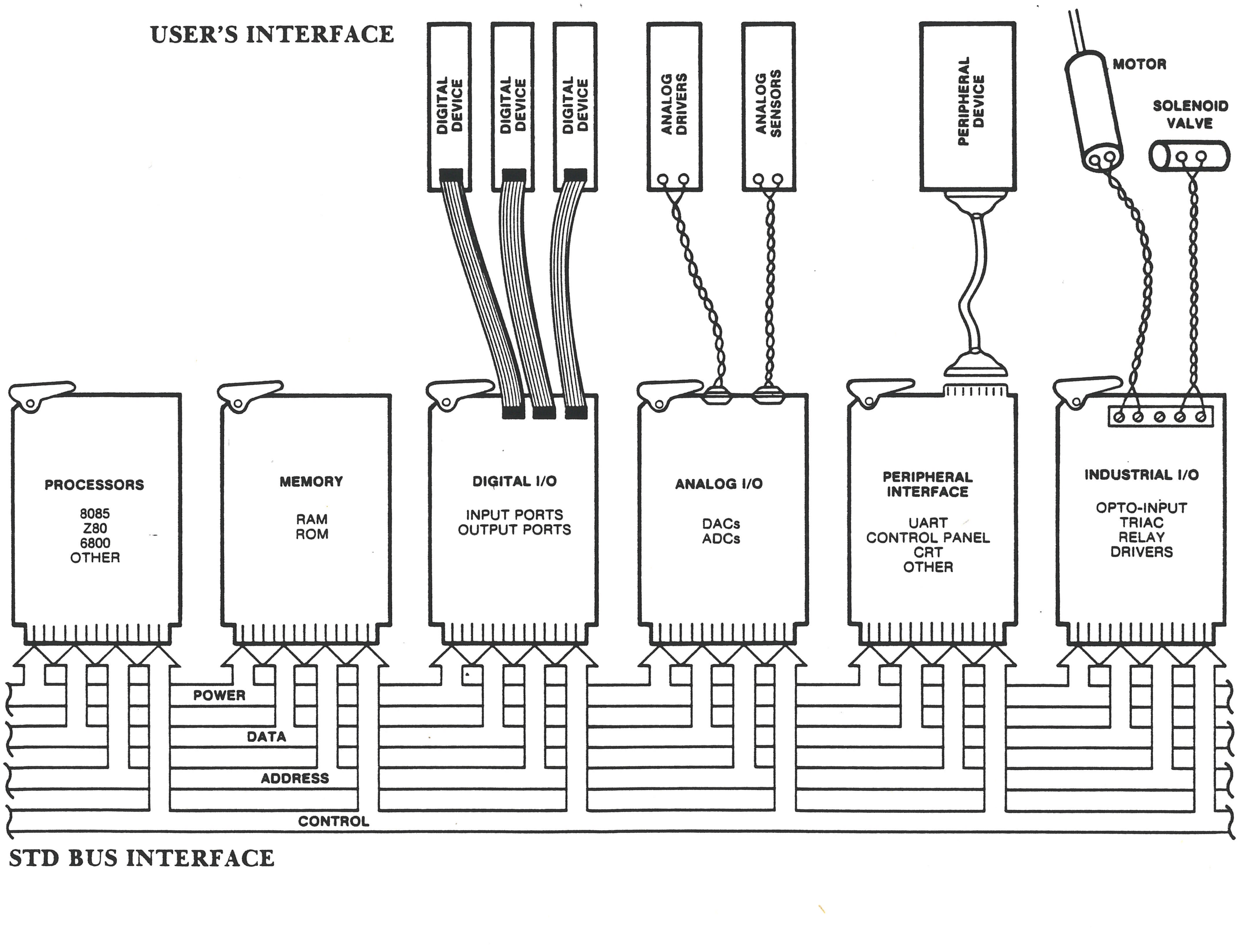


Figure 1-1. STD BUS Implementation.

Organization and Functional Specifications (with pin definitions)

The STD BUS pinout is organized into four functional groups:

- Dual Power Busses: Pins 1-6 and 53-56
- Data Bus: Pins 7-14
- Address Bus: Pins 15-30
- Control Bus: Pins 31-52

The organization and pinouts are shown in Table 1-1. This table lists the mnemonic function and signal flow direction (referenced to the processor card in control of the BUS) for each pin of the STD BUS. The STD BUS is further defined as requiring a 56-pin (dual 28) card edge connector, with 0.125-in. pin centers. Connectors are on a spacing interval of 0.5-in. centers minimum, and they accept the standard 4.5 x 6.5 x 0.062-in. card.

Table 1-1. STD BUS Pinouts with Signal Flow Referenced to the Processor Card.

	COMPONENT SIDE				CIRCUIT SIDE			
	PIN	MNEMONIC	SIGNAL FLOW	DESCRIPTION	PIN	MNEMONIC	SIGNAL FLOW	DESCRIPTION
LOGIC POWER BUS	1	+5VDC	In	Logic Power (bussed)	2	+5VDC	In	Logic Power (bussed)
	3	GND	In	Logic Ground (bussed)	4	GND	In	Logic Ground (bussed)
	5	VBB #1	In	Logic Bias #1 (-5V)	6	VBB #2	In	Logic Bias #2 (-5V)
DATA BUS	7	D3	In/Out	Low-Order Data Bus	8	D7	In/Out	High-Order Data Bus
	9	D2	In/Out	Low-Order Data Bus	10	D6	In/Out	High-Order Data Bus
	11	D1	In/Out	Low-Order Data Bus	12	D5	In/Out	High-Order Data Bus
	13	D0	In/Out	Low-Order Data Bus	14	D4	In/Out	High-Order Data Bus
ADDRESS BUS	15	A7	Out	Low-Order Address Bus	16	A15	Out	High-Order Address Bus
	17	A6	Out	Low-Order Address Bus	18	A14	Out	High-Order Address Bus
	19	A5	Out	Low-Order Address Bus	20	A13	Out	High-Order Address Bus
	21	A4	Out	Low-Order Address Bus	22	A12	Out	High-Order Address Bus
	23	A3	Out	Low-Order Address Bus	24	A11	Out	High-Order Address Bus
	25	A2	Out	Low-Order Address Bus	26	A10	Out	High-Order Address Bus
	27	A1	Out	Low-Order Address Bus	28	A9	Out	High-Order Address Bus
	29	A0	Out	Low-Order Address Bus	30	A8	Out	High-Order Address Bus
CONTROL BUS	31	WR*	Out	Write to Memory or I/O	32	RD*	Out	Read Memory or I/O
	33	IORQ*	Out	I/O Address Select	34	MEMRQ*	Out	Memory Address Select
	35	IOEXP	In/Out	I/O Expansion	36	MEMEX	In/Out	Memory Expansion
	37	REFRESH*	Out	Refresh Timing	38	MCSYNC*	Out	CPU Machine Cycle Sync.
	39	STATUS 1*	Out	CPU Status	40	STATUS 0*	Out	CPU Status
	41	BUSAK*	Out	Bus Acknowledge	42	BUSRQ*	In	Bus Request
	43	INTAK*	Out	Interrupt Acknowledge	44	INTRQ*	In	Interrupt Request
	45	WAITRQ*	In	Wait Request	46	NMIRQ*	In	Nonmaskable Interrupt
	47	SYSRESET*	Out	System Reset	48	PBRESET*	In	Push-Button Reset
	49	CLOCK*	Out	Clock from Processor	50	CNTRL*	In	AUX Timing
	51	PCO	Out	Priority Chain Out	52	PCI	In	Priority Chain In
AUXILIARY POWER BUS	53	AUX GND	In	AUX Ground (bussed)	54	AUXGND	In	AUX Ground (bussed)
	55	AUX +V	In	AUX Positive (+12V DC)	56	AUX -V	In	AUX Negative (-12V DC)

*Low-level active indicator

Dual Power Busses (Pins 1-6 and 53-56). The dual power busses accommodate logic and analog power distribution. As many as five separate power supplies can be used with two separate ground returns as shown.

PIN	DESCRIPTION	COMMENTS
1 & 2	Logic Power	Logic Power Source (+5V DC)
3 & 4	Logic Ground	Logic Power Return Bus
5	Logic Bias Voltage	Low-current Logic Supply #1 (-5V)
6	Logic Bias Voltage	Low-current Logic Supply #2 (-5V)
53 & 54	Auxiliary Ground	Auxiliary Power Return Bus
55	Auxiliary Positive	Positive DC Supply (+12V)
56	Auxiliary Negative	Negative DC Supply (-12V)

Data Bus (Pins 7-14). The data bus is an 8-bit, bidirectional, 3-state bus. (Bidirectional means signals may flow either into or out of any card on the bus.) Direction of data is normally controlled by the processor card via the control bus. The data direction is normally affected by such signals as read (RD*), write (WR*), and interrupt acknowledge (INTAK*.)

The data bus uses high-level active logic. All cards are required to release the bus to a high-impedance state when not in use. The processor card releases the data bus in response to bus request (BUSRQ*) input from an alternate system controller, as in DMA transfers.

Address Bus (Pins 15-30). The address bus is a 16-bit, 3-state, high-level active bus. Normally, the address originates at the processor card. The card releases the address bus in response to a BUSRQ* input from an alternate controller.

The address bus provides 16 address lines for decoding by either memory or I/O. Memory request (MEMRQ*) and I/O request (IORQ*) control lines distinguish between the two operations. The particular microprocessor that you use determines the number of address lines and how they are applied.

Example:

PROCESSOR	NO. OF MEM ADR. LINES	ADDRESS LINES DURING REFRESH	NO. OF I/O ADDRESS LINES	
			I/O MAPPED I/O	MEMORY MAPPED I/O
8080	16	—	Lower 8	16
8085	16	—	Lower 8	16
Z80	16	Lower 7	Lower 8	16
6800	16	—	—	16
6809	16	—	—	16
6502	16	—	—	16
NSC800	16	Lower 7	Lower 8	16

Control Bus (Pins 31-52). The control bus determines the flexibility of the STD BUS. Signal lines are grouped into five separate areas: memory and I/O control, peripheral timing, clock and reset, interrupt and bus control, and serial priority chain.

Memory and I/O Control lines provide the signals for fundamental memory and I/O operations. Simple applications may only require the following six control signals:

- WR*—Write to memory or I/O (3-state, active-low), pin 31.

  This signal indicates that the BUS holds valid data to be written in the addressed memory or output device. WR* is the clock pulse, which writes data to memory or output port latches. The signal originates from the processor, which also provides the output data on the BUS.

- RD*—Read from memory or I/O (3-state, active-low), pin 32.

  This signal indicates that the processor or other bus-controlling device needs to read data from memory or from an I/O device. The selected I/O device or memory utilizes this signal to gate data onto the BUS. RD* originates from the processor, which accepts the data from the BUS.

- IORQ*—I/O address select (3-state, active-low), pin 33.

  This signal indicates that the address lines hold a valid I/O address for an I/O read or write. It is used on the I/O cards and is gated with either RD* or WR* to designate I/O operations.

- MEMRQ*—Memory address select (3-state, active-low), pin 34.

  This signal indicates that the address bus holds a valid address for memory read or memory write operations. It is used on memory cards and is gated with either RD* or WR* to designate memory operations.

- IOEXP—I/O expansion (high expand, low enable), pin 35.

  This signal expands or enables I/O port addressing. An active-low enables primary I/O operations. An example of its use is to allow common address decoding in memory-mapped I/O operations. Simple systems can generally strap this signal to ground.

- MEMEX—Memory expansion (high expand, low enable), pin 36.

  This signal expands or enables memory addressing. An active-low enables the primary system memory. MEMEX allows memory overlay such as that found in bootstrap operations. A control card may switch out the primary system memory to make use of an alternate memory. Simple systems can generally strap this signal to ground.

Peripheral Timing Control lines provide control signals that enable the use of the STD BUS with microprocessors that service their own peripheral devices. The STD BUS is intended to service any 8-bit microprocessor. Most peripheral devices work only with the microprocessor they are designed for. Four control lines of the STD BUS are designated for peripheral timing. They are defined specifically for each type of microprocessor, so that it can best serve its own peripheral devices. In this way, the STD BUS is not limited to only one processor.

- REFRESH*—(3-state, active-low), pin 37.

  This signal refreshes dynamic memory. It may be generated on the processor card or on a separate control card. The nature and timing of the signal may be a function of the memory device or of the microprocessor. In systems without refresh, this signal can be any specialized memory control signal. Simple systems with static memory may disregard REFRESH*.

- MCSYNC*—Machine cycle sync (3-state, active-low), pin 38.

  This signal occurs once during each machine cycle of the processor. (Machine cycle is defined as the sequence that involves addressing, data transfer, and execution.) MCSYNC* defines the beginning of the machine cycle. The exact nature and timing of this signal are processor-dependent. MCSYNC* keeps specialized peripheral devices synchronized with the processor's operation. It can also be used for controlling a bus analyzer, which can analyze bus operations cycle-by-cycle.

- STATUS 1*—Status control line 1 (3-state, active-low), pin 39.

  This signal provides secondary timing for peripheral devices. When available, STATUS 1* is considered as a signal for identifying instruction fetch.

- STATUS 0*—Status control line 0 (3-state, active-low), pin 40.

  This signal provides additional timing for peripheral devices.

Table 1-2 defines the peripheral timing-control lines for various 8-bit microprocessors. The designated pins are also being defined for other microprocessors.

Table 1-2. Peripheral Timing-Control Lines for Various 8-Bit Microprocessors.

	REFRESH* PIN 37	MCSYNC* PIN 38	STATUS 1* PIN 39	STATUS 0* PIN 40
8080	—	SYNC*	M1*	—
8085	—	ALE*	S1*	SO*
NSC800	REFRESH*	ALE*	S1*	SO*
8088	—	ALE*	DT/R*	SSO*
Z80	REFRESH*	(RD*+WR*+INTAK*)	M1*	—
6800	—	Ø2*	VMA*	R/W*
6809	—	EOUT* (Ø2*)	—	R/W*
6809E	—	EOUT* (Ø2*)	LIC*	R/W*
6502	—	Ø2*	SYNC*	R/W*

*	Low-level active
—	Not used
R/W*	Read high, write low
DT/R*	Data transmit high, receive low

Interrupt and bus control lines allow the implementation of such bus control schemes as direct memory access, multiprocessing, single stepping, slow memory, power-fail-restart, and a variety of interrupt methods. The STD BUS includes provision for a serial priority chain. Parallel priority schemes can also be implemented.

- BUSAK*—Bus acknowledge (active-low), pin 41.

  This signal indicates that the bus is available for use by a requesting controller. The controlling processor responds to a BUSRQ* by releasing the BUS and giving an acknowledge signal on the BUSAK* line. BUSAK* occurs at the completion of the current machine cycle.

- BUSRQ*—Bus request (active-low, open collector), pin 42.

  This signal causes the controlling processor to suspend operations on the STD BUS by releasing all 3-state STD BUS lines for use by another processor. The STD BUS is released when the current machine cycle has been completed. BUSRQ* is used in applications requiring direct memory access (DMA). In complex systems, it can be an input, or an output, or it can be bidirectional, depending on the supporting hardware.

- INTAK*—Interrupt acknowledge (active-low), pin 43.

  This signal tells the interrupting device that the processor card is ready to respond to the interrupt. For vectored interrupts, the interrupting device places the vector address on the data bus during INTAK*. This signal can be combined with a priority signal, if multiple controllers need bus access. INTAK* is not used in nonvectored interrupt schemes.

- INTRQ*—Interrupt request (active-low, open collector), pin 44.

  This processor-card input signal conditionally interrupts the program. It is masked and ignored by the processor, unless deliberately enabled by a program instruction. If the processor accepts the interrupt, it usually acknowledges by dropping INTAK* (pin 43). Other actions depend on the specific type of processor, the interrupt-related program instructions, and the hardware support of the interrupt mechanism.

- WAITRQ*—Wait request (active-low, open collector), pin 45.

  This input signal to the processor suspends operations as long as it remains low. Normally, the processor holds in a state that maintains a valid address on the address bus. WAITRQ* can be used to insert wait states in the processor cycle. Examples of its use include slow-memory operations and single stepping.

- NMIRQ*—Nonmaskable interrupt (active-low, open collector), pin 46.

  This signal is a processor-card interrupt input of the highest priority. It should be used for critical processor signalling, e.g., power-fail indications.

Clock and reset lines provide the STD BUS with basic clock timing and reset capability.

- SYSRESET*—System reset (active-low), pin 47.

  This signal is an output from the system reset circuit, which is triggered by power-on detection, or by the push-button reset. The system reset bus line should be applied to all bus cards that have latch circuits requiring initialization.

- PBRESET*—Push-button reset (active-low), pin 48.

  This signal is an input line to the system reset circuit.

- CLOCK*—Clock from processor, pin 49.

  This signal is a buffered, processor clock signal, for use in system synchronization or as a general clock source.

- CNTRL*—Control, pin 50.

  This signal is an auxiliary circuit for special clock timing. It may be a multiple of the processor clock signal, a real-time clock signal, or an external input to the processor.

Serial priority chain lines are provided for interrupt or bus control. Two bus pins are allocated to the chain, which requires logic on the card to implement the priority function. Cards not needing the chain must jumper PCI to PCO on the card, if they are to be used in a serial priority scheme.

- PCO—Priority chain out, pin 51.

  This signal is sent to the PCI input of the next lower card in priority. A card that needs priority should hold PCO low.

- PCI—Priority chain in, pin 52.

  This signal is provided directly from the PCO of the next higher card in priority. A high level on PCI gives priority to the card sensing the PCI input.

Electrical Specifications

Absolute Maximum Ratings. The maximum ratings for the STD BUS card edge connector pins, which are listed below, are not recommended operating conditions. Above these values, damage to card components is possible. The specific voltage at which damage occurs is component-dependent.

PARAMETER	LIMIT	REFERENCE
Positive voltage applied to logic input or disabled 3-state output	+5.5V	GND pins 3, 4
Negative DC voltage applied to a logic input or disabled 3-state output	-0.4V	

Note: Unless otherwise specified, the removal of circuit cards that are compatible with the STD BUS, or the removal of their component parts from sockets, is not recommended while operating voltages are applied.

Power Bus Voltage Tolerances. STD BUS cards normally require +5V for logic operations. Other operating voltages may be needed, according to individual card function and device types. The table below shows the STD BUS power busses and voltage values. Note that these voltage values are specified at the card pins, not at the backplane traces.

CARD PIN	SUPPLY VOLTAGE	TOLERANCE	REFERENCE
1, 2	VCC (+5V)	±0.25V	GND pins 3, 4
5	VBB #1 (-5V)	±0.25V	GND pins 3, 4
6	VBB #2 (-5V)	±0.25V	GND pins 3, 4
55	AUX +V (+12V)	±0.5V	AUX GND pins 53, 54
56	AUX -V (-12V)	±0.5V	AUX GND pins 53, 54

Logic Signal Characteristics. The STD BUS is designed for compatibility with industry-standard TTL logic. The following specifications apply over the specified temperature range for the STD BUS.

STD BUS CARD PARAMETER	TEST CONDITIONS		MIN	MAX	UNITS
VOH (high-state output voltage)	VCC=MIN	IOH=-15 mA	2.4	—	V
VOL (low-state output voltage)	VCC=MIN	IOL=24mA	—	0.5	V
VIH (high-state input voltage)			2.0	—	V
VIL (low-state input voltage)			—	0.8	V
tR, tF (rise time, fall time)			4	100	NS

Mechanical Specifications

The circuit card size and outline of the STD BUS are defined in Table 1-3 and Figures 1-2 and 1-3. The dimensions exclude the card ejector and I/O interface connections.

Table 1-3. STD BUS Card Dimensions.

STD CARD DIMENSIONS	INCHES		MILLIMETERS	
	NOMINAL	TOLERANCE	NOMINAL	TOLERANCE
Card Length	6.500	±0.025	165.10	±0.64
Card Height	4.500	+0.005, -0.025	114.30	+0.13, -0.64
Plated Board Thickness	0.062	±0.003	1.58	±0.08
Card Spacing	0.500	MIN	12.70	MIN

Minimum card spacing requires a consideration for component height, lead protrusion, and card clearance, in addition to the board thickness. Table 1-4 lists recommended dimensions for these parameters; however, trade-offs can be made between component height and lead protrusion. Cards not meeting these requirements may need multiple card slot positions.

Table 1-4. STD BUS Profile Dimensions for Minimum Spacing.

RECOMMENDED DIMENSIONS FOR MINIMUM CARD SPACING	INCHES		MILLIMETERS	
	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM
Component Height	0.375	—	9.52	—
Component Lead Protrusion ⚠1	0.040	—	1.02	—
Adjacent Card Clearance	—	0.010	—	0.25

⚠1 The card ejector occupies the top 1.4-in. (35.6 mm) of the card and protrudes 0.1-in. (2.54 mm) on each side of the card.

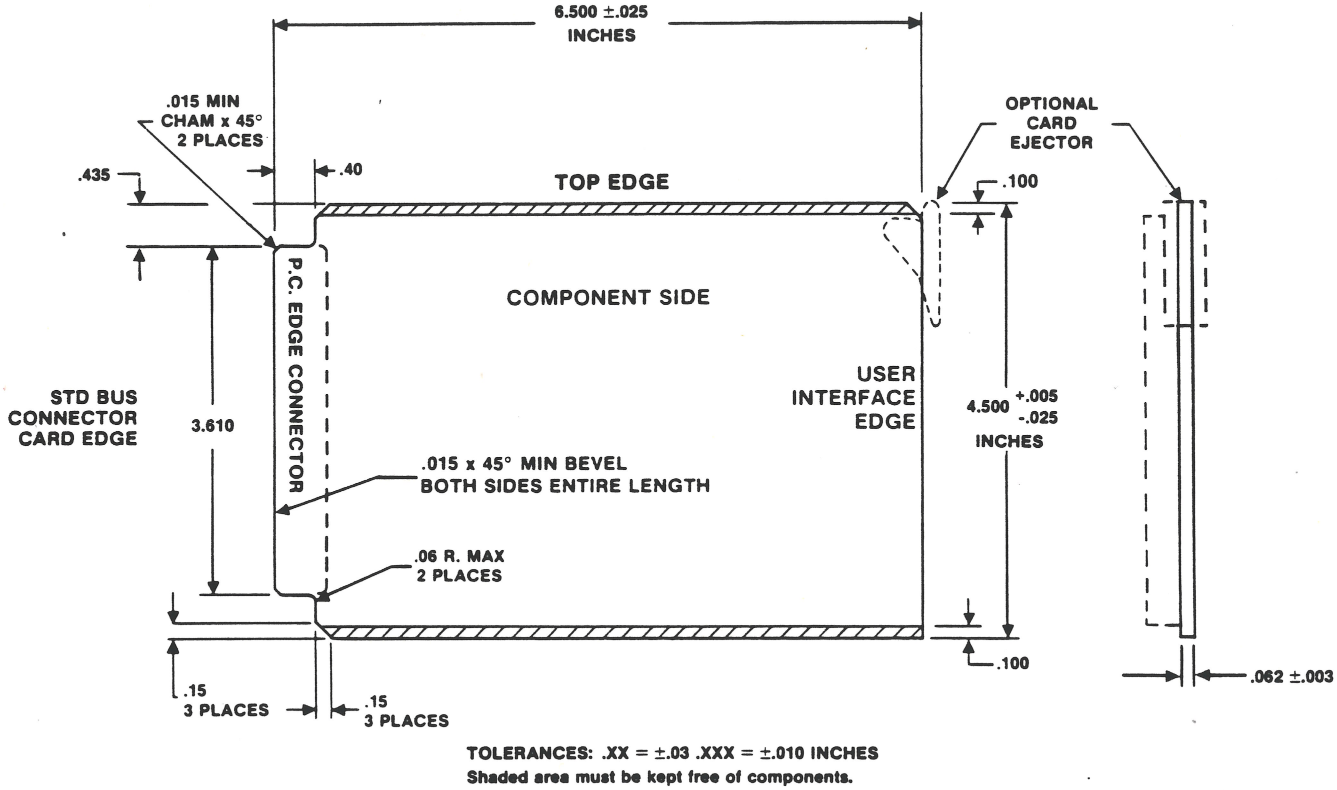


Figure 1-2. STD BUS Card Outline.

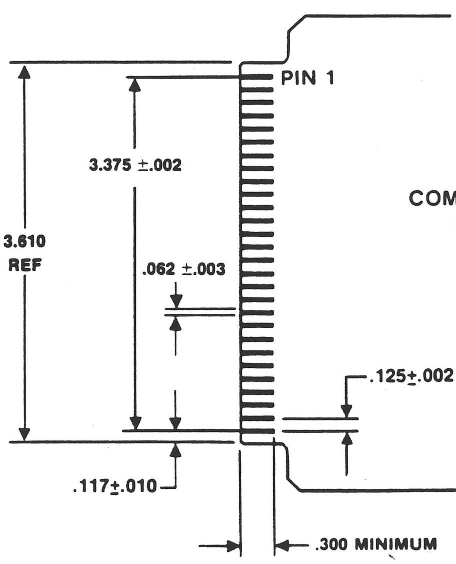


Figure 1-3. STD BUS Edge Card Finger Design.

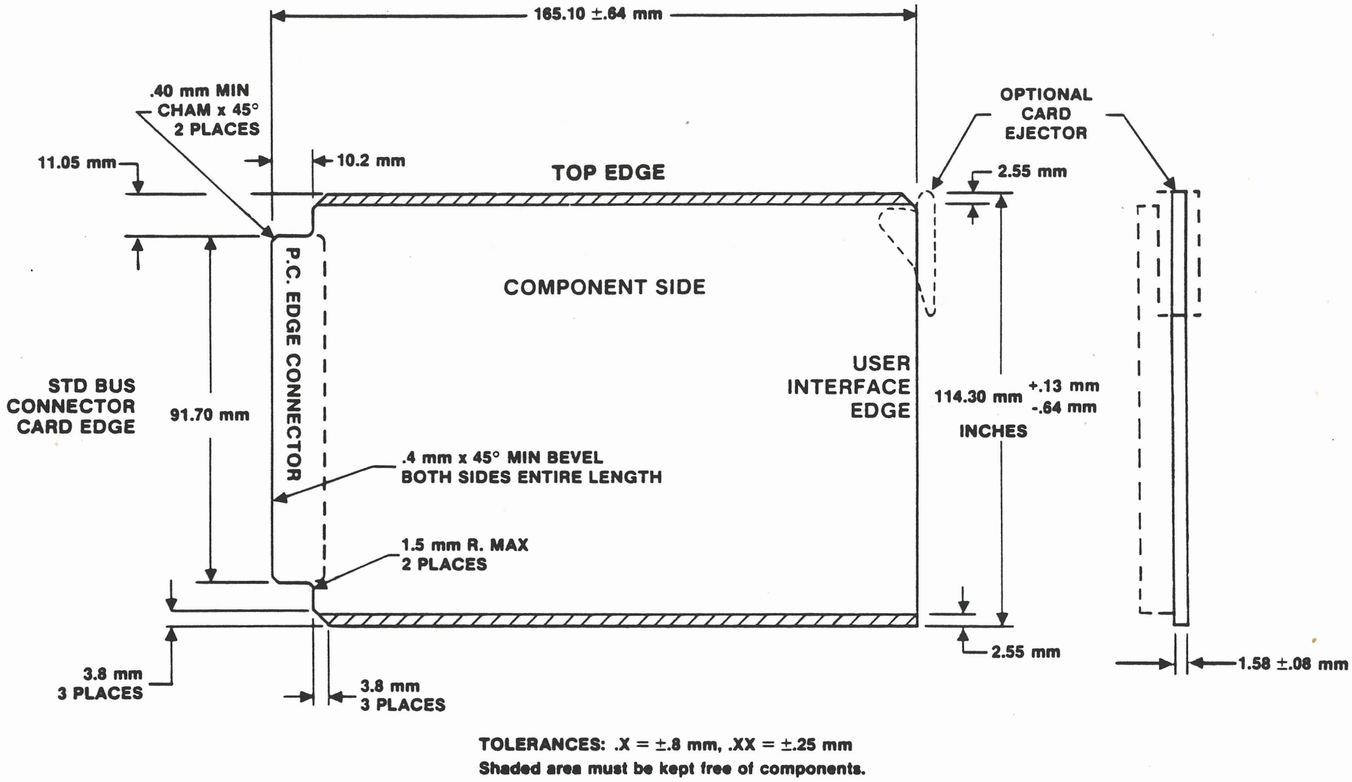


Figure 1-4. STD BUS Card Outline - Metric.

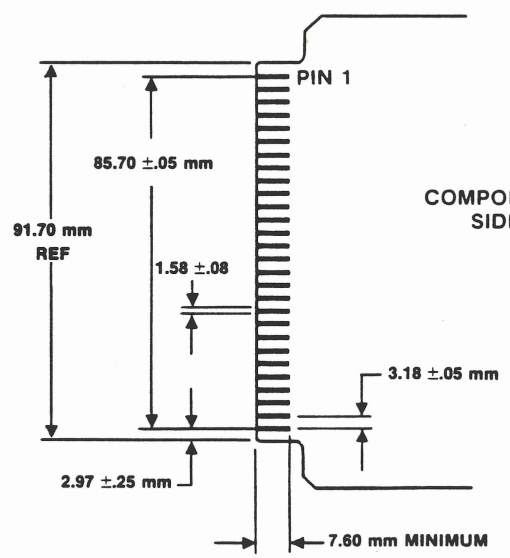


Figure 1-5. STD BUS Edge Card Finger Design - Metric.

SECTION 2
STD BUS Practice

The industry-based STD Manufacturers Group meets regularly to review concerns regarding the STD BUS. It has resolved the following recommended practice for the design of STD BUS cards. The STD Practice is supplemental to the STD Specification and is to be applied at the discretion of the user. The current STD Practice relates to:

- Compatibility designation
- Bus timing
- Parallel priority interrupt
- Card keying for polarity
- Open collector bus signals

Compatibility Designation

STD BUS cards that use peripheral chips usually depend on specific timing signals from the processor. This dependency prevents peripheral cards from being used interchangeably with cards from other families.

The STD Practice for designating compatibility is to label cards that are processor-timing-dependent, with reference to the CPU device: STD-Z80, STD-8085, STD-6800, etc.

Bus Timing

Card designers require bus timing definitions to insure compatibility. The recommended STD Practice for cards that source the bus control signals is for each card to specify the waveforms and timing information. Bus timing is further defined in the STD-Z80 and STD-8085 specifications.

Parallel Priority Interrupt

The STD BUS provides signal lines for interrupt requests and bus requests. In systems with only a single interrupting device or a single alternate controller, these lines are sufficient to allow direct implementation. But in systems with multiple interrupting devices or multiple bus controllers, a priority scheme is necessary. The STD BUS is designed to handle either serial priority or parallel priority schemes.

Serial Priority. The STD BUS includes a priority-chain bus signal for serial priority schemes. Serial priority, using PCI and PCO signals, requires that each peripheral needing priority must have logic on the card to service the request, as shown in Figure 2-1. This scheme is practical with peripheral devices designed to service a serial priority chain such as the Z80 family of devices.

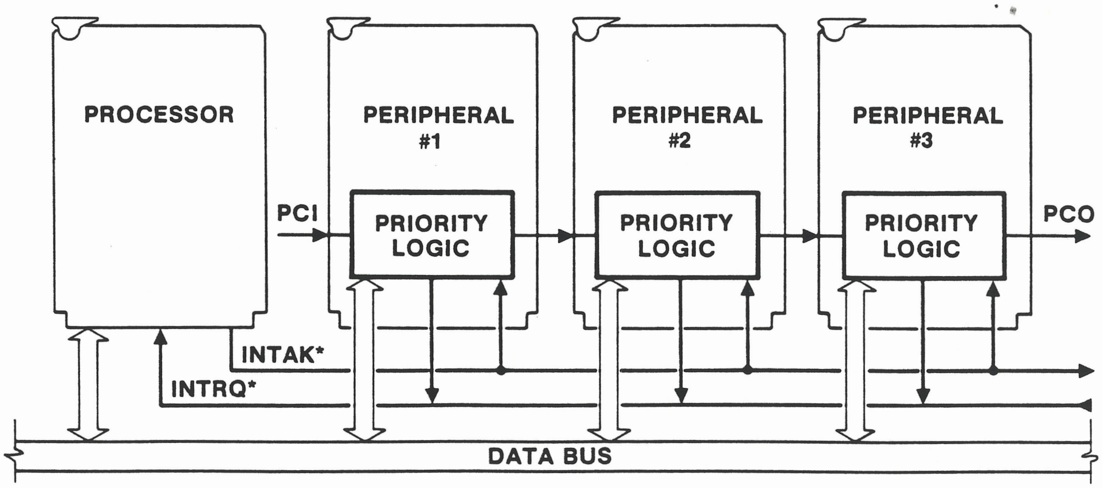


Figure 2-1. Serial Priority Interrupt Scheme.

Parallel Priority. A parallel priority scheme can be implemented on the STD BUS, so that the priority logic rides on a separate card and not on each peripheral card. The parallel priority card is a modular function that can be tailored to individual processor requirements. This scheme allows peripheral cards to be processor-independent. It requires that the individual requests and acknowledges be made from the user edge of the card, as shown in Figure 2-2.

Note that a difference exists between an interrupt priority encoder and a bus priority decoder. The interrupt encoder doesn t need to send an acknowledge back to the requesting peripheral. The processor simply begins to service the interrupting device through normal bus operations. A bus priority decoder must decode the acknowledge back to the requesting peripheral, so that it knows when to take control of the bus.

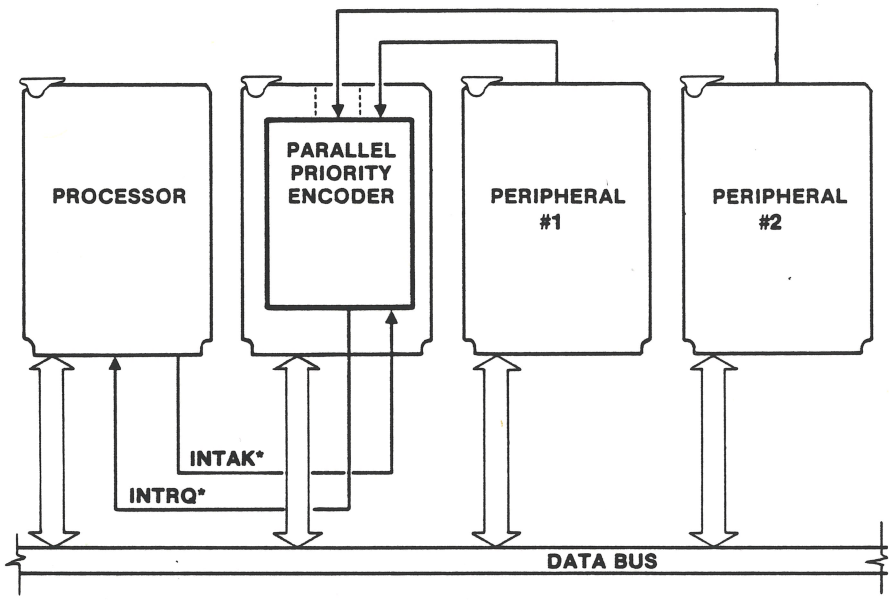


Figure 2-2. Parallel Priority Interrupt Scheme.

STD Practice for Parallel Priority Interrupt. Cards designed to work with the parallel priority scheme require circuit connections at the user interface edge of the card. The STD Practice for compatibility is:

Mechanical:

- Two connections for each request channel: a request signal and a ground signal.
- Connector layout for priority encoder cards as shown in Figure 2-3. The ground pins are the top row and the request pins are the bottom row.
- Connector pins are 0.025-in. square posts or equivalent.
- Requesting cards provide the cable and mating connector. This practice doesn't define the method for fastening the cable to the requesting card. The cable end at the requesting card may be permanently wired or connected via any desired connector means.
- Mating cables can be twisted pairs or flat cable.
- Mating connectors are two pins per channel, in any size from single (2-pin) channel to multiple channel.

Electrical:

- Low-level active signal.
- LSTTL logic levels.
- Drive sink capability of 16mA at 0.4V minimum.
- Open-collector driver with 10K pullup minimum.
- Load on encoder input: 4 LSTTL loads in parallel with 4.7K pullup resistor.

Pullup resistors on the encoder card inputs are recommended to disable the request if no connection is made. Open-collector drivers on requesting cards are recommended, to allow wire-ORing of multiple requests on a single channel. This scheme is useful for low-level requests and requires the processor to poll to identify the requester.

The implementation of the parallel priority interrupt on the STD BUS is shown in Figure 2-4.

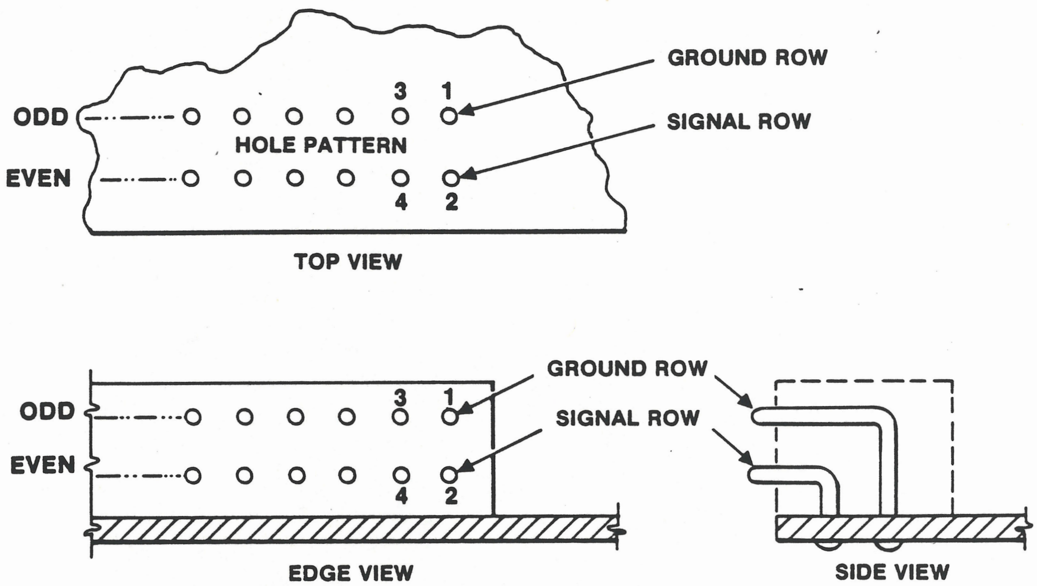


Figure 2-3. Recommended Connector Arrangement for Priority Encoder Cards.

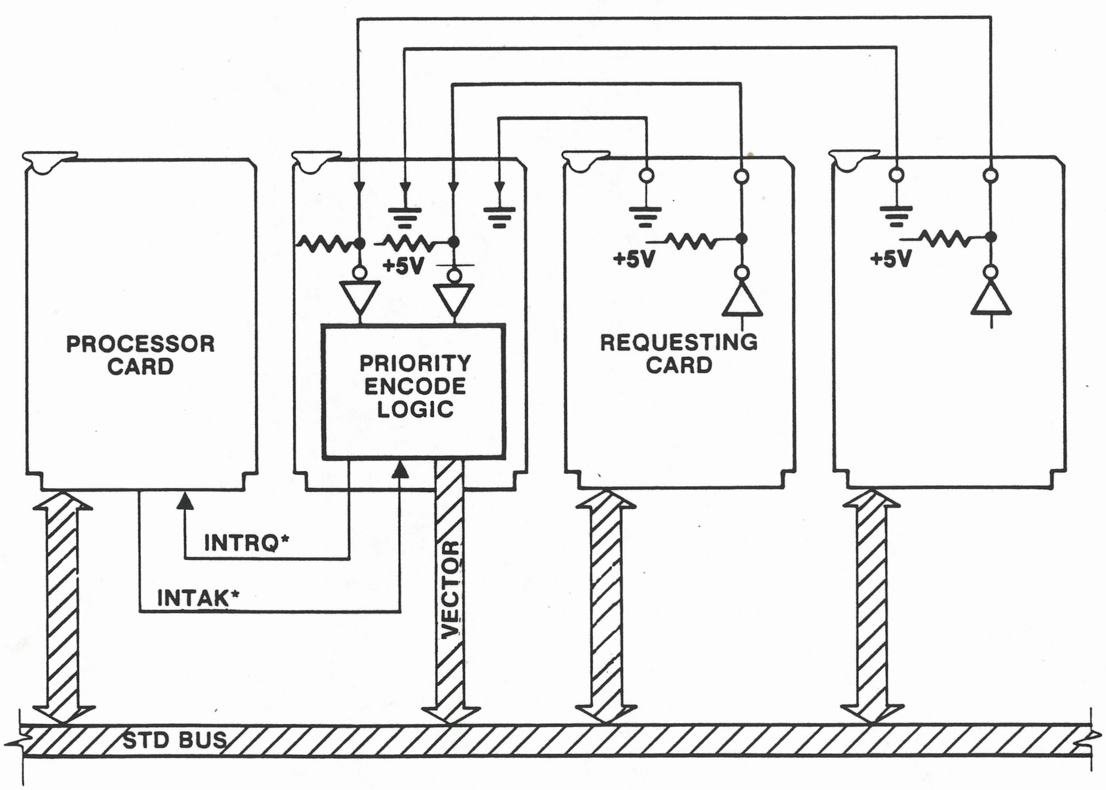


Figure 2-4. Recommended Implementation of Parallel Priority Interrupt on the STD BUS.

Card Keying for Polarity

Upside-down card insertion can be prevented with a single, offset key slot. The slot is located between pins 25 and 27, and between 26 and 28, for cards keyed for polarity (Fig. 2-5).

Cards keyed for **position** must not use the slot between pins 27 and 29 or between 28 and 30, as this would invalidate the polarity keying.

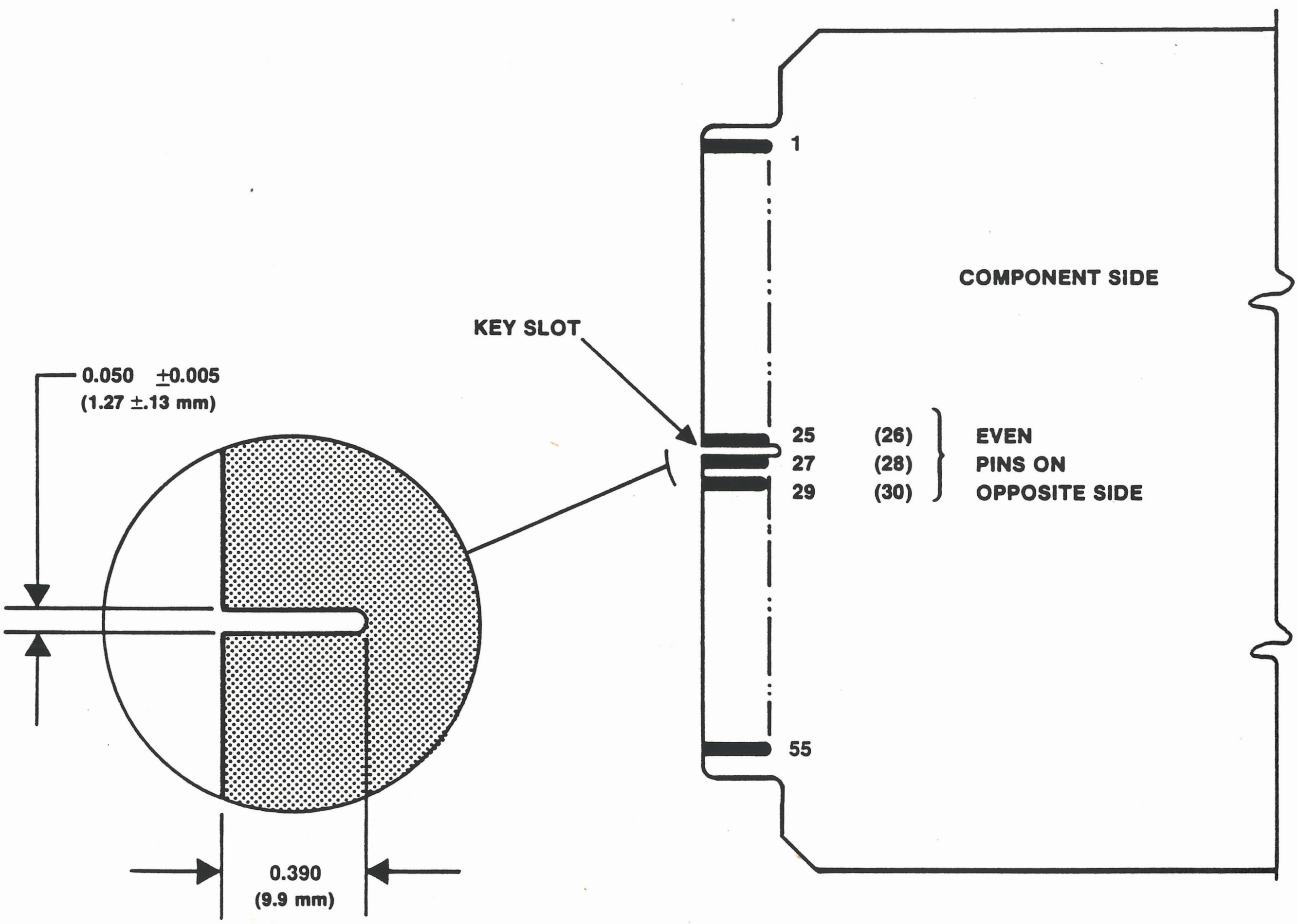


Figure 2-5. Recommended Key Slot Placement and Dimensions for Cards Keyed for Polarity on the STD BUS.

Open-Collector Bus Signals

Bus control inputs to the processor card are often wire-OR connected, which requires open-collector drivers. It is recommended, as STD Practice, that the following signals be open-collector on any source card and pulled-up on any destination card:

- BUSRQ* —Pin 42
- INTRQ* —Pin 44
- WAITRQ* —Pin 45
- NMIRQ* —Pin 46
- SYSRESET* —PIN 47
- PBRESET* —PIN 48

Also, it is recommended that these lines be specified as follows:

- Low-level active signal
- LSTTL logic levels
- Driver sink capability of 16mA at 0.4V
- Open-collector driver with 10K pullup
- Destination load pullup of 4.7K

HARDWARE MODIFICATIONS

Hardware Modifications

1) The ISC-8001I terminal used for the Remote Programming Console (CNTL-EPOC2) must contain an RS422 long lines adapter. This adapter must be installed between the terminal's RS232 port and the Elco 8016-020 receptacle. This connector is to be mounted on the rear of the terminal.

2) The Mostek MDX-SIO card must be modified to allow the Receive Clock to be used as the Transmitter Timing Element (See Appendix 2 section 2.0 "Data Communications", section 2.2.3-B-3 "Receiver Signal Timing Elememt"). The Transmit Clock printed circuit trace must be cut and the Receive Clock signal must be jumpered to the MK3884 Transmit Clock input.

3) The Mostek MDX-PIO card must be modified when used to drive the Console's Remote Reset Switch backlights. The I/O drivers must be replaced with high current drivers to provide the 60 ma. LED current.

GLOSSARY

Glossary

Audio Processing Cabinet - An Owner provided piece of equipment located in the Electronic Equipment Room of each Pavilion and Communicore. The Audio Processing Cabinet routes selected inputs to audio amplifiers. The inputs to the Audio Processing Cabinet come from the Audio Routing Switcher in Communicore. The SECS provides RS232 control signals for the Audio Processing Cabinets.

Audio Routing Equipment - Owner provided equipment including the Audio Processing Cabinet and the Audio Routing Switcher.

Audio Routing Switcher - An Owner provided piece of equipment located in the Communicore Electronic Equipment Room. The Audio Routing Switcher routes inputs from tape reproducers and live audio sources to the Audio Processing Cabinets. The SECS provides RS232 control signals for the Audio Routing Switcher.

Communicore - A building in Future World where EPCOT Central is located.

Cue - A signal prompting the beginning of some action such as the turning on of stage lighting or the fading of an audio source.

EPCOT Center - "Experimental, Prototype Community of Tomorrow"; a theme park presently under construction by Walt Disney World.

EPCOT Central - The control center for EPCOT Center. The SECS Computers and Operator's Console are located in EPCOT Central.

Future World - A portion of EPCOT Center containing Communicore, Spaceship Earth futuristic attractions.

Lighting Contactor - A double-pole relay controlling power to lighting and providing verification of closure.

Lighting Lift - A mechanical device for raising lighting fixtures.

MinnieNET - The portion of VistaNET responsible for carrying information between the SECS Computers and the RICs.

Park Function Controller - An Owner provided piece of equipment responsible for controlling worklights and walkway and facade lights. The SECS provides RS232 control signals for this unit.

RIC - Remote Interface Cabinet

Remote Interface Cabinet - Any of several SECS equipment cabinets responsible for Entertainment facility control and monitoring.

SECS - Special Events Control System

SMPTE - Society of Motion Picture Technicians and Engineers.

SMPTE Time Code - A 16-bit parallel code from a tape reproducer or film projector encoding HOURS:MINUTES:SECONDS:FRAMES. The code is updated 24 times per second and is accompanied by a strobe signal.

Special Events Control System - A computerized data aquisition and process control system responsible for managing live show production facilities throughout EPCOT Center.

Tape Reproducer - An audio source, either cartridge tape loop or multitrack, reel-to-reel tape.

Tone Decoder Signal - A switch closure generated by a tape reproducer in response to timing signals recorded on the tape. The Tone Decoder allows cues to be synchronized with the audio source.

VistaNET - The Owner provided telecommunications network serving EPCOT Center. Under construction by Vista United Telecommunications.

World Showcase - A portion of EPCOT Center containing International Pavilions.