EAS Encoder/Decoder Functional Description

EASyCAP, Model EASyCAP-1

Product Detail:
FCC ID: **P4V-EASyCAP-1**
Equipment type: **EAS Encoder/Decoder**

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Related Documents: EASyCAP Functional Block Diagram

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1 GENERAL DESCRIPTION.

The Trilithic EASyCAP (Model EASyCAP-1) EAS (Emergency Alert System) Encoder/Decoder is a two-U rack mounted control center capable of performing manual or automated EAS messaging for Cable, Broadcast, and Wireline systems, in accordance with CFR 47 part 11 FCC regulations, and the EAS Cable Handbook.

The EASyCAP receives EAS messages from up to six audio sources (internal or external), decodes the FSK EAS message, and operates the target system equipment to replay the message for viewers/listeners. In addition, messages can be originated by the user via local or remote control of the EASyCAP. The EAS Audio sources for the EASyCAP include internal AM/FM/NOAA radios and external audio inputs that can be connected to any known EAS audio source. EAS Audio is decoded by the internal AFSK circuitry, it is then sorted and interpreted to determine the type of emergency or test, locations for which the emergency applies, and other information supplied in the EAS Header. If a voice message is contained in the EAS message, it is recorded for possible playback to subscribers. EAS messages then pass through a series of tests to determine if the message matches predefined, user configurable parameters. If these tests pass, EAS activation (message playback) to the system occurs. To play an EAS message to viewers/listeners, the EASyCAP activates TTLs, Contact Closures, RS-485 data commands, RS-232 data commands, and several IP based protocols, it also supplies pertinent video and re-encodes/plays the EAS FSK and recorded audio. The TTLs, Contact Closures, and serial data commands, and IP protocols activate routing equipment and end-user devices to provide the emergency audio and video to all viewers/listeners.

In addition to the EAS messaging capabilities, the EASyCAP records all received and transmitted messages in it's internal log for later retrieval.

2 INTERFACE

Front Panel Display: The display provides visual feedback to the user. The touch-screen allows for user control of the EASyCAP.

Front Panel Speaker: The speaker is used for monitoring audio inputs, to provide feedback to the user during non-messaging functions, and allows the user to hear incoming or outgoing messages during EAS activations.

Rear Panel:

Power Entry: a single phase AC Line input with ground connection, normally powered by 117 VAC 60 Hz.

COM-1, COM-2: Provide an RS-232 compliant serial data connection to provide streaming EAS information to external character generators, as well as to provide an serial input/output for the EASyCAP.

AES/EBU Inputs: provides two synchronous AES audio inputs with which a system/station may supply “normal” program audio. This audio is replaced by the EASyCAP during messaging.

AES/EBU Outputs: provides two synchronous AES Audio outputs for EAS information audio during messaging, otherwise they contains the AES/EBU Input signal from the paired AES/EBU input.

Telephone: provides a means by which emergency messages can be generated remotely. This is often used to allow emergency management personnel to access a Cable system as required by local franchise agreements.

RS-485 Data: provides a balanced serial data output to control peripheral devices during EAS messages. The EASyCAP uses a $1/8^{th}$ load RS-485 to allow connection of up to 255 external devices. RS-485 data should be terminated at the last device in the chain, using a 120 Ohm resistor.

Ethernet connections: provides multiple independent high-speed IP based data connections for command, control, configuration, monitoring, and dissemination of EAS messages.

USB Connections: provide generic high-speed data connections for future use.

Video In: a connection with which a system/station may supply “normal” program video. This video is replaced by the EASyCAP during messaging.

Video Out: provides EAS information video during messaging. This video is distributed to all program streams during messaging, otherwise it contains the Video In signal.

Contact Closures (6 total): provide a programmable contact closure output (switch) used to activate equipment to route EAS message audio and video, sound alarms, etc. during EAS activations.

General Purpose Inputs (4 total): provide a means for operators or external automation equipment to trigger or abort events (such as message retransmission) within the EASyCAP.

TTL Outputs: provide a five volt DC signal (and ground connection) used to activate EAS audio and video routing equipment. A current source is also provided.

Audio Inputs 1-6: The audio inputs provide a means for connecting up to 6 external audio sources for EAS monitoring, or for supplying audio for transmission.

Audio Outputs and Line output: provide EAS audio outputs that may be distributed for EAS messaging and monitoring.

Line Input: Provides a connection for a line-level microphone input for message origination.

Input: provides a balanced stereo audio input with which a system/station may supply “normal” program audio. This audio is replaced by the EASyCAP during messaging.

Output: provides EAS information audio during messaging, otherwise it contains the “Input” signal.

Radio Inputs 1-6: The radio inputs provide a means for connecting up to 6 external antenna’s. Each of the (up to) 6 internal radios can provide audio in lieu of the 6 audio inputs. Each radio is capable of tuning AM band, FM band, and National Weather Service band frequencies.

3 BLOCK DESCRIPTIONS

Note: Refer to the EASyCAP Functional block diagram for operational block interconnect.

- **Power Conditioning/Monitoring:** The power conditioning section(s) provide +12, -12, +8, -8, +5, -5, +3.3, +2.5, and +1.2 Volts to the EASyCAP circuitry. Power supervisor circuitry provides a system reset signal on power-loss and power-up.

- **Central Processing Unit:** The CPU circuitry consists of a modern high-power dual-core processor and support circuitry for I/O, RAM, HD Audio communication, HDD, and the external data bus communications necessary for high data rate peripheral support. The CPU performs the majority of the software operations necessary for the EASyCAP to operate.

- **Random Access Memory:** The RAM circuitry provides temporary memory storage for software and data to be acted upon by the CPU. The RAM interfaces to the CPU and DMA devices over a parallel address/data bus.

- **Solid State Drive:** The SSD is a high-capacity solid-state "hard-drive" for bulk storage of the operating system, application software, and semi-permanent data such as the EAS logs and reusable audio files. The SSD communicates to the CPU over a Serial Advanced Technology Attachment (SATA) interface.

- **Ethernet 1:** Ethernet 1 is a Gigabit Ethernet interface provided for external communication. External communications consist of a web-based GUI for configuration, control, and notification, as well as multiple protocols used to control downstream equipment during EAS messaging.

- **Ethernet 2:** Ethernet 2 is a Gigabit Ethernet interface that can be used in lieu of or in conjunction with Ethernet 1 to perform network-based communications. It is included primarily to allow the EASyCAP to access an additional network with the requirement to bridge the networks. Ethernet 2 communicates with the CPU over a single lane Peripheral Component Interconnect (PCI) Express bus.

- **Real Time Clock:** The RTC is used to maintain system time when power is removed. System time is maintained via user input or (preferably) Network Time Protocol. System Time accuracy is required for proper EAS processing since EAS messages have origination and expiration times associated with them.

- **RS-232:** The RS-232 interface circuitry provides serial data on two externally accessible RS-232C compliant ports primarily used for communicating with legacy character generators. In addition to the two externally accessible ports, a third port is used to communicate to the I/O Coprocessor which is used to control relays, I^2C devices, and other low-speed devices.

- **Graphics Adapter:** The Graphics Adapter communicates with the CPU over a high-speed bus as well as via DMA with the CPU RAM. The Graphics Adapter provides NTSC Video to a video switch for replacement of System/Station video during EAS. It also supplies video to the front-panel LCD circuitry via LVDS (Low Voltage Differential Signaling).

- **Front Panel LCD Screen:** The front panel LCD is a color graphics display that receives Video via low-voltage signaling and presents graphic information to the user. This information includes channel status, Incoming and Outgoing EAS message information, and general system health information. The Front-panel LCD screen provides the visual alerting required by FCC regulations.

- **Ethernet/MODEM/RS-485 Interface:** This interface combination communicates to the CPU via two USB bus pairs, and is used to provide an additional general-purpose Ethernet connection, a Data/Voice MODEM connection (for control and messaging via telephone), and an RS-485 data connection (for legacy character generator operation).

- **Input Output Coprocessor:** The I/O Coprocessor communicates with the CPU via a Serial RS-232 interface. It interprets software commands and reformats/routes them as necessary to it's peripheral devices. This device provides a means to separate low-speed devices from the high-speed busses of the CPU, and obviates the need for multiple interfaces to the CPU.

- **Audio Processing:** The Audio Processing circuitry is the heart of the EAS operations in the EASyCAP. It receives up to six channels of audio, and digitizes it for analyses by software. In addition, several audio outputs, both digital and analog, are created in the Audio Processing circuitry. Audio is provided to the front-panel speaker for audible alerting required by EAS regulations. The audio circuitry also contains multiplexing capability to choose from Analog Inputs or Radio Audio. Audio is transferred to and from the CPU by means of an Intel HD Audio Link bus. Audio input from the radios is via baseband signaling. Audio to the AES/EBU circuitry is via a Serial Digital signal. Multiplexing, as well as the externally accessible Balanced Stereo (EAS Audio) Switch are controlled by the CPU via I/O lines from the I/O Coprocessor.

- **AM/FM/NOAA tuners:** The radio tuners provide audio for EAS monitoring to the Audio Processing circuitry. Tuning is controlled via an I^2C interface to the I/O Coprocessor, and Received Signal Strength (RSSI) data is fed back along this interface to provide an indication of radio reception at the front-panel. Each of the (up to) six radio tuners is independently controlled. Each is capable of tuning a frequency in the AM, FM, or National Weather Service providing an appropriate antenna is connected. Antenna connections for the radio tuners are via (up to) six "F" style connectors.

- **AES/EBU Digital Audio:** The AES/EBU interface provides digital audio to external equipment without requiring translation to and from baseband signaling, which would reduce signal quality. During normal operation the AES/EBU inputs are fed to their respective outputs without modification. During EAS operation, the input signal bit-rate is detected and EAS audio is provided at the AES Out, at the same rate as the input program audio. Alternatively the AES Audio can be supplied using an internal clock and the AES inputs can be left unconnected. EAS Audio is provided on a Serial Digital interface from the Audio Processing.

- **General Purpose Outputs (Contact Closures):** The GPO Contact Closures are relay contacts used to operate external equipment during EAS operations. Signaling includes incoming message alerts, message queued alerts, outgoing audio active, and outgoing video active. The GPOs are controlled via an I^2C interface from the I/O Coprocessor.

- **General Purpose Outputs (TTLs):** The EASyCAP provides two Transistor-Transistor Logic outputs that serve the same purpose as the Contact Closure GPOs but connect to legacy routing equipment. These outputs are also controlled via I^2C from the I/O Coprocessor.

- **General Purpose Inputs (Contact Closure inputs):** Four contact-closure inputs are provided for control of the EASyCAP. These inputs may be used for purposes such as generating a Required Weekly test, Confirming a queued message, or aborting an EAS message in progress. The GPIs communicate to the CPU via I^2C from the I/O Coprocessor.

- **FAN Control:** The Fan Control circuitry (and the fans themselves) contain hardware capable of sensing temperatures inside the EASyCAP and adjusting the fan speeds based on the sensed temperature. Using dynamic fan speed extends the life of the fans, and reduces noise. The FAN controls are programmed from the CPU by means of an I^2C signal from the I/O Coprocessor, after which they can operate autonomously.

- **Front Panel Touch Screen:** The Front Panel Touch Screen is used to provide for user interaction with the EASyCAP. The interface provides analog signals to the I/O Coprocessor that vary based on the location in which the screen is touched. The I/O Coprocessor digitizes the analog signals and provides the information to the CPU. The touch screen provides for some of the user input and configuration requirements of the EAS regulations.

4 NORMAL OPERATION / IDLE

Normal (or Idle) Operation is the condition in which the EASyCAP is not actively processing an EAS message. During Normal Operation, the following operations are performed continuously:

1) Audio from the baseband audio inputs or from the radio tuners is digitized by the Audio Processing circuitry.
2) The Digitized audio is algorithmically checked by the software to detect the EAS Dual-tone or EAS FSK data (starting with the 0xAB preamble string).
3) Digitized audio is level checked and Automatic Gain is applied if necessary, either digitally or using the mixing functions of the Audio Processing circuitry.
4) System maintenance functions such as Network Time Protocol adjustments are scheduled and performed.
5) Inputs are monitored for user or automation inputs such as Required Weekly Test initiation or web-based configuration/control.
6) The display is updated with audio level or RSSI status to indicate the validity of monitoring assignments.

5 EAS RECEIVE

EAS Receive operation occurs when EAS FSK is detected on an incoming audio stream. Multiple receive operations can occur simultaneously. During a receive operation, the incoming message and associated data are stored to an internal database for retransmission.

1) Audio from the baseband audio inputs or from the radio tuners is digitized by the Audio Processing circuitry.
2) Digitized audio is level checked and Automatic Gain is applied if necessary, either digitally or using the mixing functions of the Audio Processing circuitry.
3) The Digitized audio is algorithmically checked.
    a. When FSK is detected the audio is converted into text, checked for valid EAS protocol, stored, and logged.
    b. If the FSK is valid EAS Protocol, the receive sequence continues, otherwise the FSK is ignored.
    c. When a Dual Tone is detected it is logged, and if an audio recording has started, the recording is restarted.
    d. When an EOM is detected (“NNNN”) the receive process ends.
4) Once valid EAS FSK is detected (EAS Header) and the FSK ends
    a. The Display is updated with information about the message.
    b. The incoming digitized audio is routed to the speaker as an operator alert.
    c. The incoming digitized audio is recorded and monitoring for a dual-tone or additional FSK.
    d. A timeout-timer is started (timeout is over-ridden on an EAN).
5) If a timeout occurs, message data is logged and the process resets to the idle monitoring state.
6) If an EOM is detected within the timeout window
    a. The message data is logged.
    b. The front-panel visual and aural indicators are updated.
    c. The message filtering is checked and if the message passes, it is queued for retransmission.
    d. The audio channel goes back to an idle/monitoring condition.
7) If a timeout occurs
    a. The message data is logged.
    b. The front-panel visual and aural indicators are updated.
    c. The audio channel goes back to an idle/monitoring condition.

6 EAS TRANSMIT

EAS Transmit operation occurs when a received message passes message filters, or when a message is manually queued by an operator. EAS Transmit operations are synchronous (not simultaneous). Multiple EAS messages can be queued for retransmission.

1) The message queue is checked and if a message is present, transmit processing is started.
2) The display is updated with the message information.
3) Event preferences are checked for the message and if desired, the unit awaits operator intervention (abort or continue).
    a. If the operator chooses to abort the message, the choice is logged, indicators are reset, and the transmit process ends.
    b. If the operator chooses to continue the message processing proceeds.
4) Translation Text is constructed and the video display prepped to display the text.
5) The NTSC video relay is switched to internal video, removing System/Station video.
6) Digital (Ethernet) protocol messages are constructed and sent to digital peripheral devices.
7) Serial protocol messages are constructed and sent to peripheral devices.
8) Outgoing Digital Audio is routed to audio outputs, including the front-panel speaker as an aural indicator.
9) Audio relays and soft-switches are activated to route the EAS audio to System/Station programming.
10) The video translation crawl is initiated.
11) Three bursts of FSK Audio is played (EAS Protocol FSK) with a one-second delay after each burst.
12) If a recorded voice message is present for the message, a Dual Tone is played
    a. A one-second delay is performed
13) If a recorded voice message is present for the message, it is played
    a. A one-second delay is performed
14) Three FSK End-of-Message (“NNNN”) bursts are sent with a one-second delay after each burst.
15) If the video crawl is not finished, the process waits for the crawl to end.
16) A message termination is sent over all Ethernet and Serial protocols requiring a termination.
17) Audio is switched to it’s idle, pass-through state.
18) Video is switched to it’s idle, pass-through state.
19) The message details are logged.
20) The Front panel display is reset to it’s normal, idle (monitoring) state.