DATA MONITOR

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ABSTRACT

When a decoder does not function after it is installed, the problem may be the insertion of the data into the global cycle, the software, the encoder, or the distribution system. The decoder itself may be faulty, despite what testing indicates. Finding the problem can be difficult; it is made easier with test equipment, such as a data monitor. The data monitor deciphers incoming data and provides a readout. This includes general and box-specific data. By keying in an address, the operator can determine the authorization for the box with that address. The unit can flag changes in authorization and indicate which bits were changed. It can determine the length of the global cycle and count down the expected time until it is next addressed. It indicates whether there is a market number matches and whether it is authorized to decode. It flags parity errors. It also provides information about the signal itself, such as modulation depth, signal strength, absence of video, sync suppression level, and video inversion status.

THE NEED

It can be very frustrating when a decoder, once installed, does not function properly. Even more frustrating, in many cases, is the attempt to pinpoint the source of the problem. Potential sources are numerous. The data for the box may have been incorrectly inserted into the global data base. There may be a problem with computer hardware or software. Encoding hardware sometimes breaks down or drifts out of alignment. The distribution system is rarely perfect. There will always be some percentage of decoders that will pass factory and incoming inspection tests and still fail in the home.

Any instrument that will help the operator and his equipment supplier localize the problem is very useful. One such instrument is a data monitor. This is an instrument that receives, decodes and displays various data.

Two types of data are of concern: general data and box-specific data. General data are meant for every decoder in the system. Included are:

- o Tier or tag level for the channel tuned, if a premium channel.
- o System market code.
- o Shift in data position, if used to indicate audio scrambling, stereo, type of scrambling, etc.
- o Scrambling parameters, such as video inversion.

The data monitor is designed to emulate the data reception of a normal decoder. The operator can key in the market and address numbers that would reside in a PROM in a decoder. With this capability, the unit can receive and decode box-specific data meant only for it. These data include:

- o Box address.
- o Authorization

Data-related items that can be useful include:

- o Presence or absnece of data.
- o Failures of error-detection bits.
- o Pauses in the global cycle.
- o Length of the global cycle.

General information about the signals can also be very valuable. Although not specifically related to data content, certain parameters have a definite effect on the recoverability of data. Among them:

- o Signal strength.
- o Modulation depth.
- o Sync suppression level.

GENERAL CIRCUIT ORGANIZATION

The general organization of the data monitor circuits is illustrated in Figure 1.

Two RF inputs on A and B cables are applied to an RF switch. Under control of a microcom-

puter in the tuner control, the switch selects an input and feeds it to the tuner. The tuner includes a voltage-controlled-oscillator; the tuning voltage is derived from the filtered output from the tuner control microcomputer. The tuner output is demodulated and the baseband signal is applied to a data receptor board. Data, contained in the vertical blanking interval, are stripped from the signal and fed in bytes to an 8051 microcomputer. The microcomputer accepts keypad entries and drives seven digits of 7-segment display for alphanumeric indication of address, tier level, etc.; it also drives the authorization and decoder and encoder status displays. The 8051 microcomputer determines when channel changes have been requested through the keypad entries and sends appropriate commands to the tuner control microcomputer to effect the changes. Channel number display is controlled by the tuner control microcomputer. Bargraph displays that do not involve data (signal strength, depth of modulation and sync suppression level) are driven by signal sampling circuits. The baseband output, possibly scrambled, is buffered as video out. An alternate-field data trigger is developed for convenience of analysis with an oscilloscope.

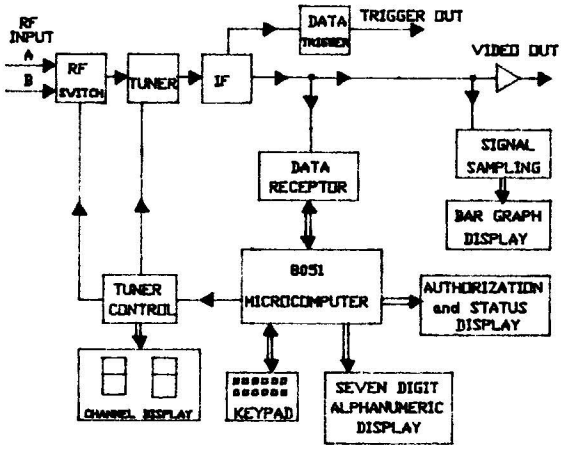

Figure 1 Data Monitor Organization

OPERATION

A data monitor in use is shown in Figure 2. The keys, displays and input and output ports are seen here.

The tuner is controlled through the Channel Up, Channel Down, Enter, Favorite Channel (FC), Clear Entry (CE), A/B select, and 0-9 keys. A channel is accessed by keying in the channel number, then Enter, or by channel scan. If the operator wishes to monitor a small number of channels on a regular basis, the FC and CE keys are used to program those channels as favorite. A scan operation then results in stopping only on those programmed channels. The tuning microcomputer tunes the new channel and drives the channel number and A/B display. In our example, the unit is tuned to Channel 10.

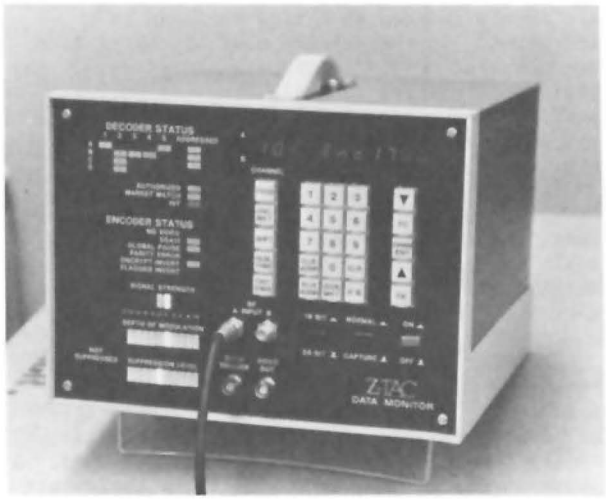

Figure 2 Data Monitor in Operation

Other keys allow the user to select the data to be shown in the seven-digit display. The display shows data keyed in from the front panel, such as decoder address and decoder market code. The Decoder Address and Market Code keys also serve to allow the operator to change those numbers through entry from the numeric keys. The display can also show data derived from the incoming signal, including encoder market code as shown in Figure 2, tier level, and lines of data shift, if data shifting is used as an indicator.

The unit measures the time between successive data transmissions for its address and displays the time as global time. Knowing the length of the global, it counts down the time until the expected time when it will next be addressed; this is displayed as countdown.

The Clear switch clears the seven-digit display and the authorization memory. The Clear Address switch turns off the Addressed indicators. The remaining switches are the power switch, a switch for selecting 18 or 20-bit addressing mode, and a switch permitting selection of normal and capture modes.

When the unit detects data sent to the address that had been specified, it stores the data in an authorization memory organized as four words (A-D) of five bits (1-5) each. These are displayed on 20 LED's in the Decoder Status area. In our figure, the box is authorized for A-1, A-5, B-2, B-3, B-4, C-2, and D-2. Receipt of data meant for this box also lights the hit LED for 1/2 second and lights the addressed LED ('s) corresponding to the words that were received. The Addressed LED corresponding to the last word received flashes. The others, if lit, are

steady. For a word that has not been written since the Clear Address key was pushed, the LED is off.

In the normal mode, the authorization data are merely updated each time the unit is addressed. In the capture mode, incoming data are compared to the previously-stored data. Any difference results in a flashing LED corresponding to the bit that is different. The on/off duty cycle indicates the present value of the bit.

Other Decoder Status indicators are Authorized, which tells whether the decoder is authorized for the incoming channel, and Market Match, which tells whether encoder and decoder market codes are the same.

Encoder Status indicators give information about the incoming signal. Video dropout is detected by loss of vertical sync and is signalled by a No Video LED. Existence of data, indicative of a premium channel is displayed. A pause in the global, detected if the parity bit doesn't change for a considerable length of time, is also indicated. The Parity Error LED lights for 1/2 second when the parity bit is incorrect. The Invert LED's tell whether the signal is indicated to be inverted or not.

The IF AGC Voltage drives the Signal Strength bar graph. The bargraph is comprised of ten LED's and is connected so that, normally, one LED is lighted. Internal adjustments allow the bar graph to be linearized and calibrated. In Figure 2, the incoming signal is about -1 dbmv.

Similar circuits drive the Depth of Modulation bargraph. This, too, normally has one lighted LED. The two green indicators in the center, when either is lit, show the modulation depth to be within acceptable limits. A Suppression Level bar graph, also connected so that only one LED is normally lighted, verifies that sync suppression is at the proper level. A Not Suppressed LED lights when sync is not suppressed. In Figure 2, depth of modulation and suppression level are both within acceptable limits.

USAGE

With familiarity, the operator will invent many useful ways to employ this instrument. Some of these might be the following:

If the Parity Error LED flashes, it probably indicates degraded data reception, possibly because of low signal. The Signal Strength indicator and the Market Match indicators would be useful in making this determination.

An inordinately long global cycle or global pause could indicate computer problems. Changes in the authorization data, with the unit in the capture mode, could also indicate computer error.

If a decoder refuses to work properly, even when all the indicators suggest that it should, one should tend to distrust the decoder.

CONCLUSION

The unit described in this paper is clearly dedicated for baseband systems from a specific supplier. The general approach and most of the parameters monitored would be pertinent for other baseband systems and for RF systems as well. The main difference would be in the circuitry and software used to extract the various bits of information.

With normal factory constraints (i.e. low cost, few adjustments, minimal alignment time) removed for data monitors, it should not be difficult for all hardware suppliers to provide this invaluable diagnostic tool for their customers.