

A HYBRID APPROACH TO A UNIVERSAL IR TRANSMITTER

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ABSTRACT

A multibrand IR transmitter is generally one of two types. One type has a stored library of codes. To program a transmitter, the user selects code sets from the library. The library unit lacks versatility, reproducing only the code sets included in the library. A learning unit can be taught any code set by exposing it, one key at a time, to IR streams from a host transmitter. It can replicate any transmitter, but the learning process is cumbersome and time-consuming.

A hybrid of the two can have both the programming ease of the library unit and the versatility of the learning unit. One such hybrid is disclosed herein. Along with the method for combining the two techniques, a discussion of additional desirable features is also included.

HISTORIC PERSPECTIVE

Library Units

Of the numerous remote control transmitters capable of controlling devices from different manufacturers, several use the library technique. The code formats for a number of different devices are stored in a library and some means is used to

specify which code is the appropriate one for the TV receiver, which for the VCR, and so on. In an earlier paper (Ref. 1), some of the different ways to specify the code were examined. The convenience of programming a library unit is further enhanced in that the operation does not require possession of the transmitter that originally was supplied with a device.

Although the library of codes in this type of transmitter may be extensive, it is still finite. A particular code set may be missing from the library because it was unknown during the development, because it was introduced at a later date, or because it represented a small market share. A device requiring that code set, then, cannot be operated by that library unit. Further, the library units typically contain the codes for TVs, VCRs, and cable decoders, but the codes for video disc players, audio equipment, satellite receivers, teletext decoders, and such, are intentionally omitted. Clearly, a library unit is not universal; this is its main shortcoming.

Learning Units

Learning transmitters sample IR emissions from the host transmitter that originally came with a device, pair each IR command with a corresponding key and, generally, a particular mode,

and store the information in memory. Subsequently, the device can reproduce any command it has learned. The only limitation is the resolution needed, but this has not been a problem with existing units. Thus, this type of transmitter is universal and not subject to the restrictions noted for the library units. Its principal fault is the learning process itself. These units learn the code sets one key at a time, a distinct annoyance if one is training the device to replicate several dozen commands. The annoyance of the training process is exacerbated if it must be repeated when a battery is changed, particularly if one of the host transmitters has been misplaced.

A HYBRID APPROACH

Overview

When the two methods are combined to eliminate the shortcomings of each, a great improvement results. The hybrid of the two has an extensive library of codes and a convenient selection means so that most programming can be done conveniently and quickly. To accommodate new or altered codes, more devices to be controlled, or even key rearrangement, the transmitter has the capability of learning one or more codes from a host transmitter. These codes can be activated by auxiliary keys or, where appropriate, they can replace functions that

were originally programmed from a library.

Selector Switch

The unit has a three-position mode selector switch with TV, VCR, and CATV positions (Fig. 1). In

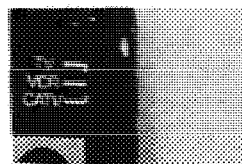


Figure 1. Selector Switch

operation, the function transmitted when a key is pressed is determined by the switch setting. As with the transmitter of the previously referenced paper, features are incorporated to minimize the need to move the selector switch. In normal usage:

1. Three separate power keys control the corresponding device regardless of the selector switch setting.
2. For all switch positions, the Volume Up, Volume Down, and Mute keys control the cable box or the TV set as determined during the programming operation.
3. The keys uniquely assigned to the VCR, e.g. Fast Forward, operate the VCR with any setting of the selector switch.

The selector switch labels are for programming

convenience only; they do not define restrictions on the unit. Thus, for example, a user might program VCR channel select functions to be active when the selector switch is in the CATV position. This could be advantageous in a lashup where the decoder decodes one channel while the VCR records another. Although there are obvious practical considerations, the user has complete freedom to program any command for any device to be responsive to any key at any selector switch setting.

Keyboard and Displays

The keyboard (Fig. 2) has 42 keys. The Erase and Learn keys are used only for programming and do not produce IR emission when pushed. Because these keys must be activated in any process involving programming the unit, raised bumps below the keys are provided to prevent the user from accidentally depressing either.

The upper 28 keys are labelled for the functions most commonly needed for operating TV, VCRs, and cable boxes. These keys will most commonly be programmed by code selection from the library.

Three rows of unlabelled keys can control up to 36 functions by use of the selector switch. Some of these keys may be programmed from a library, but in many cases, the user will use the learning

mode to program the keys to add controls for units other than TVs, VCRs, and cable boxes.



Figure 2. Keyboard

Two LEDs, designated "Teach" and "Learn," serve to prompt the user during a programming operation. Lighting separately or in combination, they signal that the unit is in the programming mode, that an error has been made, that the unit is ready

to learn a function, or that a function has been learned.

A writable overlay (Fig. 3) is furnished to allow the user to label the 12 keys.

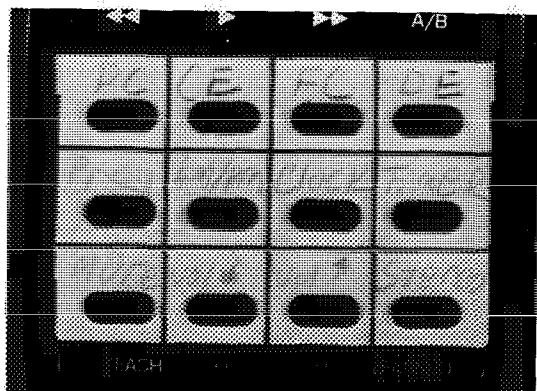


Figure 3. Overlay

PROGRAMMING THE UNIT

Mode Establishment

From the normal operational mode, the unit is switched to the library programming mode by pressing the Learn key for about three seconds. The LEDs flash alternately to indicate the mode.

While in the library programming mode, keying 9-9-9-Enter selects the learning mode. The Teach LED lights to signal entry into the mode and to prompt the user to proceed to the next operation. Entry into the learning mode from the library programming mode is a reminder to the user that programming from the library is always done before head-to-head programming, for a reason to be explained later.

To exit either programming mode, press Learn until both LEDs are off. The device automatically reverts from the library programming mode to the normal usage mode if there is no programming activity during any 50 second time span.

Library Programming

While in the library programming mode, the device can be block-programmed from a library that includes 41 different TV code sets, 39 for VCRs, and 50 for cable boxes. This is easily done by keying in a three-digit number and Enter. The number starts with 1 for TVs, 2 for VCRs, and 3 for cable boxes. Consequently, the position of the selector switch during library programming is immaterial. The unit responds to a library entry by lighting the Learned LED.

If a library entry is made, it overwrites whatever was previously in the memory for that type of unit. If a TV code, for example, is entered, it writes or overwrites the part of memory controlled by the TV position of the selector switch, regardless of the previous contents of the memory. It is for this reason that key-by-key programming in the learning mode must occur after all library programming has been done.

Although the labelled keys define the most common functions for different units,

some labelled functions are not needed for certain devices while other devices, particularly cable boxes, require functions not included in the labelled keys. In the former case, library programming blanks the memory for any unneeded function and there is no IR emission if the user pushes that key. In the latter case, all known commands are programmed by a library entry using the unlabelled keys, if necessary. The instruction manual defines any programming of unlabelled keys corresponding to each code set from the library. The user transcribes this to the writable overlay.

Learning Programming

To teach the unit a command from another transmitter, the user selects the learning mode as previously explained. The selector switch is set to the desired position and the learning transmitter and host transmitter are butted together. The user responds to the Teach LED by pressing the key on the host transmitter for the function to be learned and the key on the learning unit that is to control that particular function. Under normal conditions, only one attempt will be needed for each key and the Learned LED will light to indicate acceptance of the function. If the unit requires a second pass, it lights the Teach LED rather than the Learned LED. In

either case, after the function has been learned and the user so informed, the Teach LED lights to prompt that the device is ready to learn the next function.

Multiple-Level Programming

For a given key, there are three possible commands that can be transmitted, corresponding to the three positions of the selector switch. When a command is stored during either type of programming, it is always assigned to a selector switch setting. As noted, this is determined by the prefix for library programming or by the switch setting during learning mode programming. Under certain conditions, a command may be assigned to one or both of the other two switch positions.

1. Programming a unit from the library assigns functions of certain keys for all selector switch settings. These include eight keys, including Power, dedicated to VCRs and the Power keys for TV and CATV. This is a convenient method for making these keys independent of the selector switch.
2. Programming a TV or cable box from the library establishes the volume control functions (Up, Down, Mute) in all three positions regardless of previous contents. This allows those keys to operate independ-

ently of selector switch position. It also permits the choice of having volume control functions operate the TV or cable box; whichever of the two was programmed last will respond to the volume control keys.

3. During learning mode programming, a function is assigned to the selector switch position and to either or both of the other two positions for which there had been no previous assignment. This is a convenient technique for making the unlabelled keys responsive independent of the selector switch position.

Master Clear

Under certain circumstances, it may be expedient to de-program the entire memory. This is done by holding down the Erase and Learn keys for several seconds. The Learned LED lights to signal completion.

Individual Clear

The memory for a particular key can be cleared by pressing that key and Clear for three seconds. The Learned LED indicates completion of the activity.

Number of Functions

To minimize the amount of memory needed for storing the functions, the library of codes is in lookup tables in

program memory of the micro-computer. The designation of which codes have been selected from the library takes up a small amount of space in external non-volatile memory. The remainder of that memory is used for storing the learned functions. Although data compression is used, there is still a limit to the number of functions that can be stored in the available memory. The number is related to the complexity of the individual commands being stored. It is estimated that the unit will accommodate about 80 average commands in addition to those programmed from the library. The absolute maximum number of commands is 120, derived from 40 keys and a three-position selector switch.

Should the device use up all available memory during programming, both LEDs light to signal an error. At this point, the user must pick and choose the functions which are of most value and can use individual key clearance to re-program the transmitter.

PROGRAMMED OPTIONS

The transmitter has several programmable options:

1. When the transmitter turns on a cable box, it also sends commands to tune the TV to a programmed channel, generally Ch. 3. The user can program any channel up to Ch. 9 or can disable this feature.

2. When the VCR is commanded to play, the TV is tuned to a programmed channel. This too is user programmable and can be any single digit channel or can be disabled.
3. When the cable box is turned on, it is automatically tuned to a programmed channel. Programming of any turn-on channel up to 99 and installation of the option is done in the factory and cannot be changed by the user.

ELECTRICAL

A combined circuit/block diagram for the transmitter is

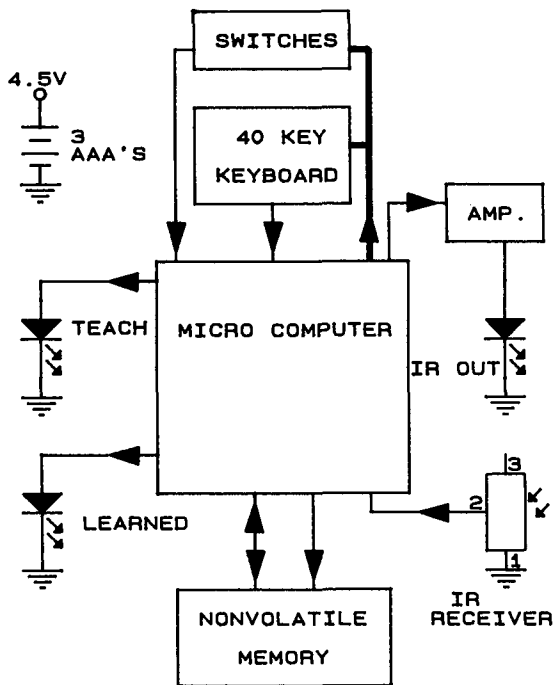


Figure 4. Circuit

shown in Fig. 4. The 40 keys that produce IR emissions comprise the keyboard block. The Learn and Erase keys and various other programming options are part of the switches block. The heart of the system is an 8-bit micro-computer. It drives the Teach and Learned LEDs and the IR LED through a buffer. An IR receiver passes along the IR signals from host transmitters.

The designation of which codes have been selected and the definitions of the functions which have been learned are stored in external non-volatile memory. The added premium for the non-volatile memory is a worthwhile trade-off to guarantee the user will not have to re-program the transmitter following a battery change.

MECHANICAL

A survey of various other units on the market makes it clear that manageable physical size is of considerable importance. By eliminating the library programming switches and compressing the keyboard, this transmitter has been made smaller than the device disclosed in the previously-referenced paper. Fig. 5 is a graphic illustration of the size of the transmitter. In view of the features incorporated into the device, particularly the large number of keys, the size of the unit is quite reasonable.



Figure 5. The Transmitter

SUMMARY

As described herein, a very user friendly universal IR transmitter can include the following characteristics:

1. Easy block programming from a library.
2. Convenience of learning from another transmitter.
3. Easy programming to make some of the keys independent of the selector switch.
4. Complete user control of key allocation.
5. Convenient designation of user-programmed keys.
6. Easy to understand prompting.
7. Sufficient memory for a great number of learned functions.
8. No loss of memory with battery change.
9. Programmable macro-instructions for tuning options.
10. Reasonable size.

References:

1987 NCTA TECHNICAL PAPERS, "Multi-Control Remote Transmitters," Richard G. Merrell, p. 213-216