IR Remote Control Codes (2)

Part 2

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In this second and concluding instalment we look at the structure of the infra-red remote control code systems proposed by Denon, NEC, Motorola, Samsung and Daewoo, as well as a format which is generally referred to as 'Japanese Code'.

Correction to Part 1 (March 2001)

In last month's instalment, the illustrations with the RECS80 format description show the Daewoo format. The correct drawings are shown below.

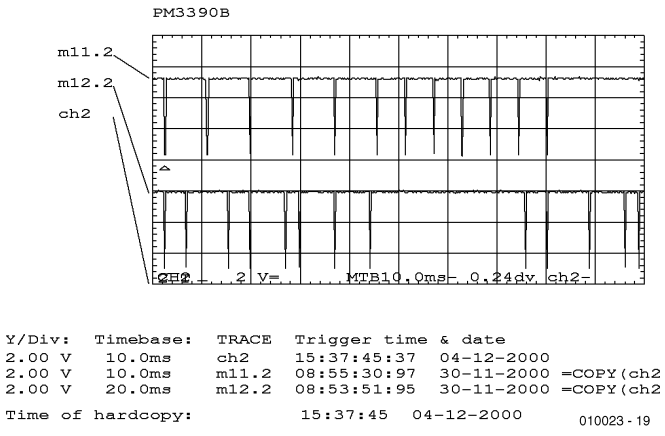

Figure 5. RECS80 code at the output of the TFMS5360 receiver IC.

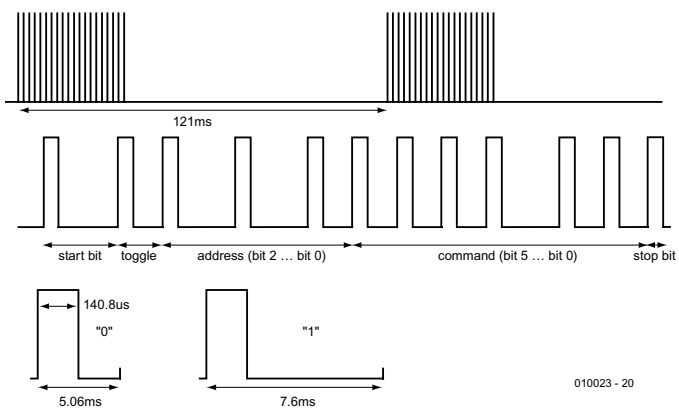

Figure 6. RECS80 code message format

Denon Code

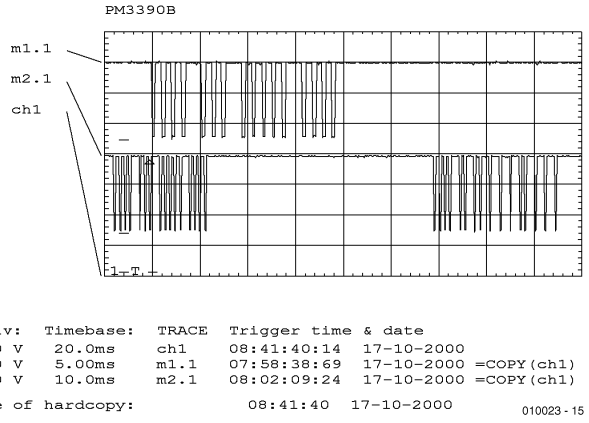

Figure 7. Denon code at the output of the TFMS5360 receiver IC (CD Player)

A Denon coded message consists of 15 information bits. The first five bits are the equipment address field while the remaining ten bits contain the command.
The modulation frequency is 32 kHz and the bit coding is:

1: 275 µs mark, 1900 µs space
0: 275 µs mark, 775 µs space

To reduce the effects of interference the message is sent twice, the second time 65 ms after the first. During the second time the command field bits are inverted. The receiver will only accept commands when the second message is identical to the first after the command field bits are inverted. The address field is always sent uninverted. Bit 16 is a stop bit.

There are currently no dedicated chips to implement this code. Transmitters and receivers can be built from mask programmable micro controllers e.g. the Mitsubishi M50560.

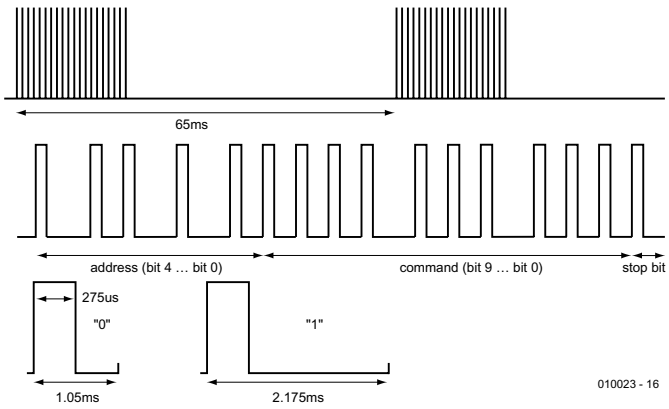

Figure 8. Denon code message format

NEC Code

The NEC code operates with a carrier frequency of 38 kHz and uses pulse position modulation (PPM). Transmission begins with a 9 ms long start bit, followed by a 4.5 ms space. The message information is contained in the following 32 bits which consists of a 16 bit manufacturer field and a 16 bit command field. The 8 bit wide data is sent twice, the second time inverted. A complete message is 67.5 ms long. Each bit is sent using the following format:
1: 0.56 ms Pulse, 1.69 ms space
0: 0.56 ms Pulse, 0.565 ms space
A new message is sent 108 ms after the start of the preceding message. A special current saving feature is implemented if a key is held down on the controller. In this case the message consists of a 9 ms start bit followed by a 2.25 ms space and a 0.56 ms pulse.

Sanyo supply ICs that generate codes using this format but have a 13 bit manufacturers code.

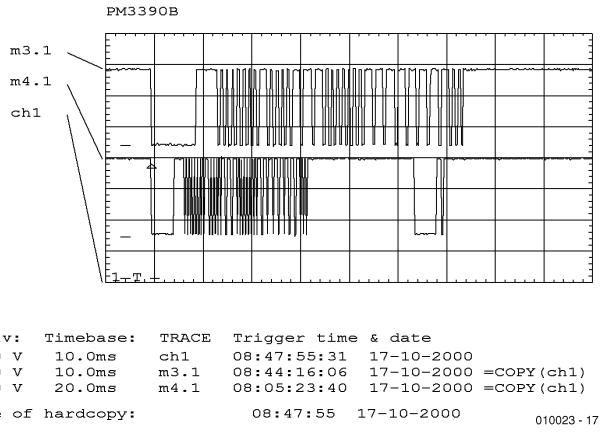

Figure 9. NEC code at the output of the TFMS5360 receiver IC

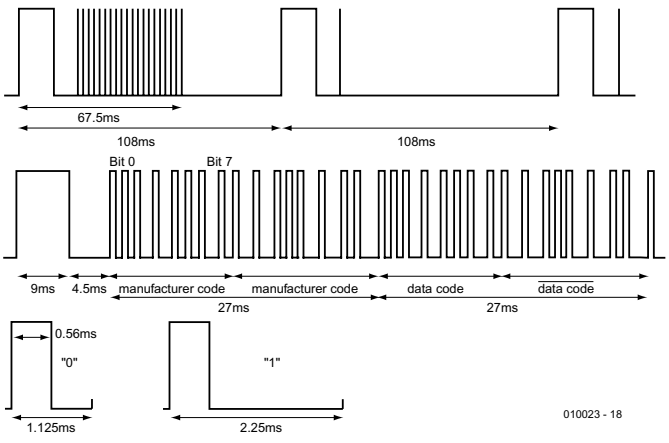

Figure 10. NEC code message format

Typical transmitter ICs remote controls:
PTPT2221, PT2222 (Princeton)

uPD6120, uPD6121 (NEC)
LC7461M, LC7462M (Sanyo)

Motorola Code

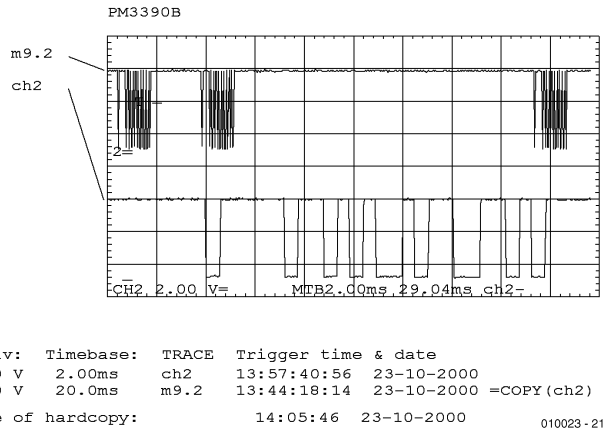

Figure 11. Motorola code at the output of the TFMS5360 receiver IC.

The Motorola code consists of a 9 bit data word. Biphase modulation is used similar to the RC5 standard but with Motorola a '0' is represented by a 512 µs pause followed by a 512 µs long high and a '1' is represented by a 512 µs high followed by a 512 µs long pause. This is opposite to the data representation found in the RC5 code. A 32 KHz carrier frequency is used.

A typical telegram has a message start header consisting of nine consecutive '1's followed by the key code of the pressed key (repeated for as long as the key is pressed) and ended by sending nine consecutive '1's. A brief key press at the controller will cause three messages to be transmitted.

Each message consists of a pre-bit, a pre-bit-pause, a start-bit and nine data bits. The pre-bit and the start-bit are always a logical 1. The pre-bit is used by the receiver to set the AGC gain level of the IR receiver.

The IC MC144105 chip is typically used to implement a remote control system using the Motorola code.

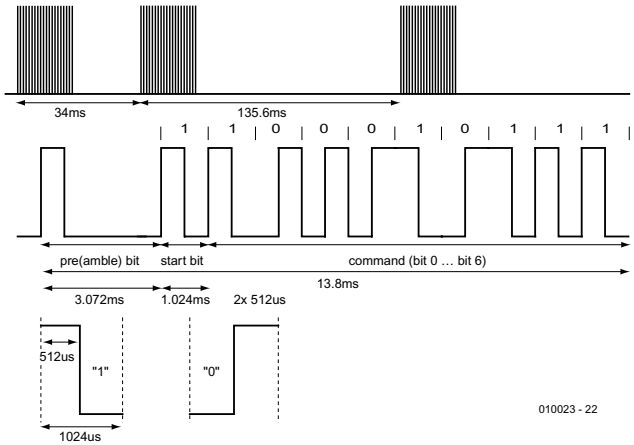

Figure 12. Motorola code message format.

Japanese Code

Similar to the way in which the RC5 code has been standardised in Europe, the Japanese Association for Electric Home Appliances has produced a standard for IR control. This system is called (uninspiringly) the 'recommended standard for infrared remote controls'.

The code is used by a number of manufacturers and has a message length of 48 Bits split into the following fields:

Manufacturers Code (16 bit)
These 16 Bits comprise the unique code for each manufacturer and are registered by the standards organisation. This code is programmed into the IC mask.

Parity Code (4 bit)
These four bits detect data corruption in the message.

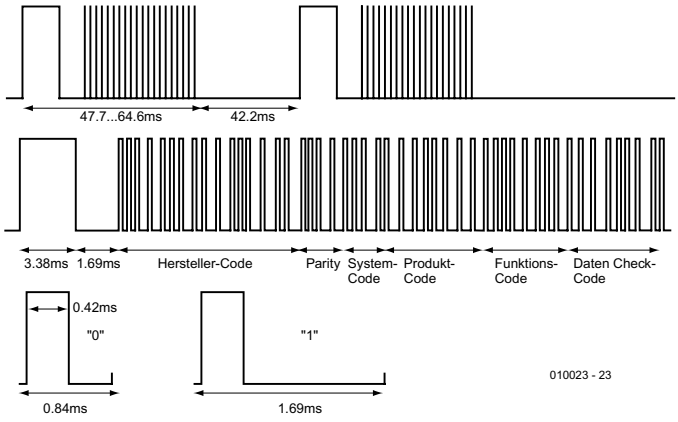

Figure 13. Japanese code message format.

System Code (4 bit)
The four system code bits are pre-programmed into the IC during manufacture.

Product Code (8 bit)
The 8 Bit Product code is made up of two mask programmed bits and 6 user wired bits. The six hardwired bits determine the equipment address.

Functions Code (8 bit)
The 8 bit function code is the value of the key pressed.

Data check code (8 bit)
These eight bits are used to detect data corruption. The system, product and function codes are passed through an algorithm to generate this check code.

A digital zero is represented by a '1' of 0.42 ms followed by a '0' of 1.27 ms. A digital one is represented by a '1' of 0.42 ms followed by a '0' of 0.42 ms.

Sanyo produce the LC7465M this device interfaces to a keypad and sends IR messages using this format.

SAMSUNG Code

The Samsung code consists of a start bit followed by a 12 Bit manufacturers code and an 8 bit command code. The message is always sent a minimum of twice.

A digital zero is represented by a '1' of 0.56 ms followed by a '0' of 0.56 ms. A digital one is represented by a '1' of 0.56 ms followed by a '0' of 1.69 ms. A continuous key press will cause the message to be repeated every 60 mS. The carrier frequency used for this code is 38 kHz.

There are no dedicated transmitter IC's for the Samsung system. A microcontroller is generally used to generate the code e.g. the data sheet of the KS51840 from Samsung gives an application for remote control use.

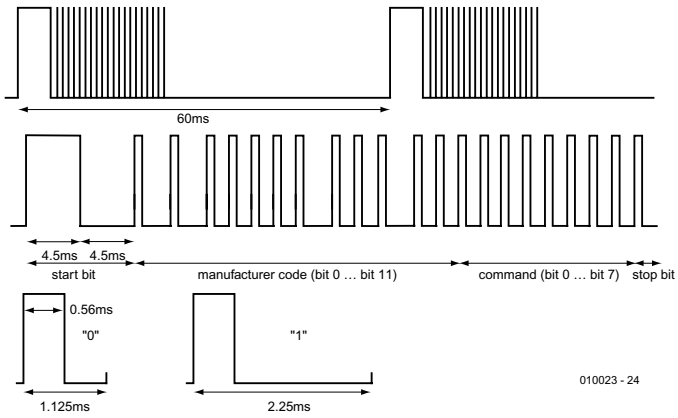

Figure 14. Samsung code message format.

Daewoo Code

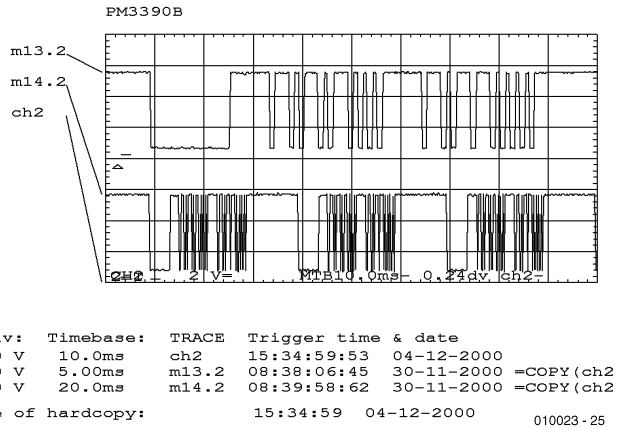

Figure 15. Daewoo code at the output of the TFMS5360 receiver IC

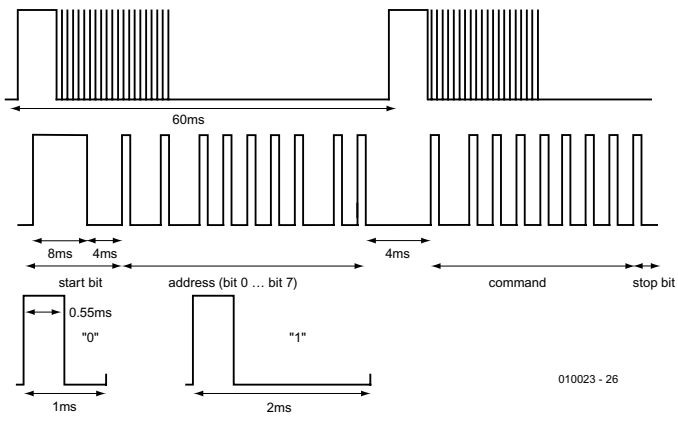

Figure 16. Daewoo code message format.

A digital zero is represented by a '1' of 0.55 ms followed by a '0' of 0.45 ms. A digital one is represented by a '1' of 0.55 ms followed by a '0' of 1.45 ms. This uses a carrier frequency of 38 kHz. A 4 ms space separates the address field from the command field.

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