# THEORY OF OPERATION

The Heathkit Model GDA-19-1 Digital Transmitter produces a pulse modulated, crystal-controlled, RF carrier. The unique method of modulation permits remote control of five separate devices when the Transmitter is used with a Digital Receiver and Servo Units. An understanding of the modulation principles used in this Transmitter will help you to understand the Operation and Circuit Description. You may find it helpful to refer to the Block Diagram in Figure 6-2 as you read the following paragraphs.

Waveform A in Figure 6-1 shows a frame of six pulses that is repeated every 16,000 microseconds in a continuous train. Each pulse in the frame is 350 microseconds wide, and all pulses in a frame except the first one normally start 1500 microseconds after the start of the previous pulse.

The time interval between the first pulse in one frame and the first pulse in the next frame is always 16,000 microseconds and cannot be changed. This is called "fixed frame rate". The time interval between any two successive pulses within a frame can be increased or decreased as much as 500 microseconds. It is this variable width between individual pulses that is used to position the servo motors. One of these variable width segments is used to control each servo.

The long space between the last pulse in a frame and the first pulse in the next frame is called the sync pause. This locks the receiver's decoder circuit in synchronization with the transmitted signal. When one of the control

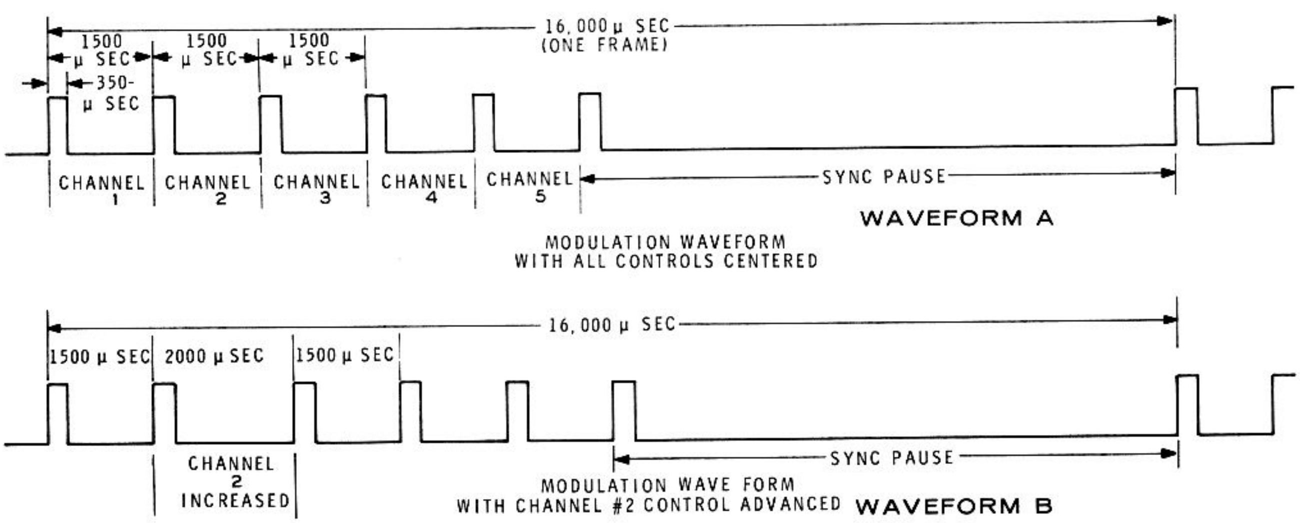


Figure 6-1

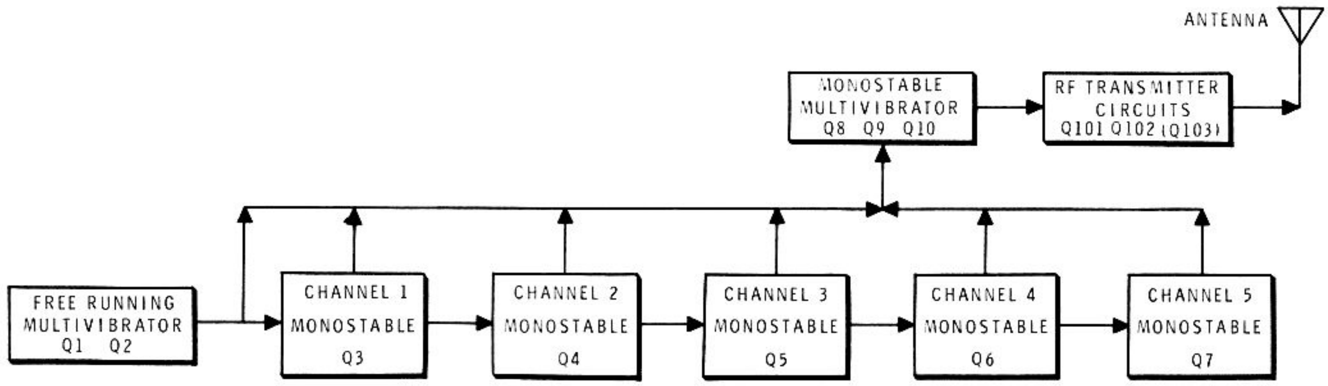


Figure 6-2

sticks is moved, that channel's time interval is changed. Waveform B of Figure 6-1 shows the relative position of the pulses when the Channel #2 control stick is moved to increase its time interval. The other channels are not affected, although the sync pause time is shortened by the amount of channel 2 increase.

The frame waveform modulates the RF carrier as shown in Figure 6-3. That is, the carrier is turned off during the 350 microsecond pulses, but is on at all other times. This form of modulation reduces the possibility of the Receiver circuits being triggered by interference, which would cause the servo units to operate erratically.

The Receiver circuits receive, amplify, and detect this RF carrier to reproduce the pulse modulation waveform. The pulses are then shaped for proper triggering of the decoder circuits that control the servo units. The decoder circuits are reset in synchronism with the transmitter signal by the long sync pause. The first pulse then starts a new pulse frame and begins passing a pulse to the channel #1 servo unit.

The time interval between the start of the first and the start of the second trigger pulse determines the length of the pulse that is sent to the channel #1 servo unit for positioning.

The decoder passes the second pulse to the channel #2 servo unit, and the next pulse to the channel #3 servo unit, etc. Therefore, each servo unit receives one pulse from each frame, or one pulse every 16,000 microseconds, and the length of the pulse determines the position of the Servo.

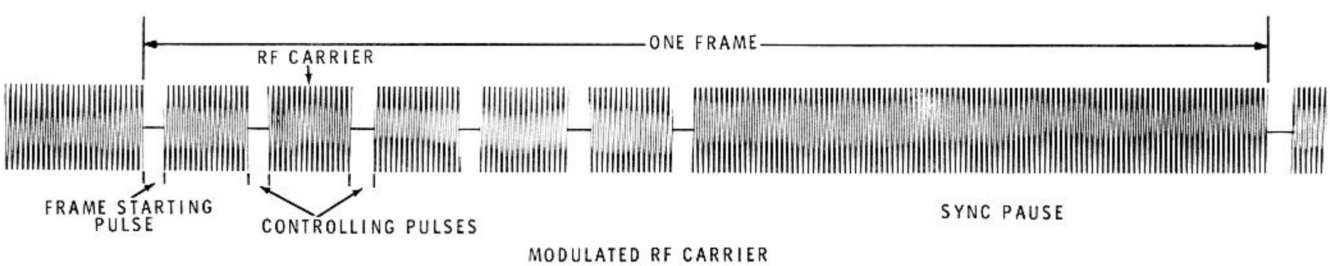


Figure 6-3