Multiple-Mission Open-Loop Receiver

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Existing Block III open-loop receivers are being modified to provide multiple-mission capability at S-band. These modifications provide greater flexibility in the selection of the receiver data bandwidth and the synchronizing signal frequency for analog recording and digital data processing. The basic receiver design and the modifications required for multiple-mission capability are described in this article.

I. Introduction

Before the Mariner Mars 1971 (MM'71) mission, occultation measurements of doppler frequency perturbations caused by planet atmospheres were made using R&D open-loop receiver equipment (Ref. 1). For the MM'71 mission, operational open-loop receivers were installed at DSSs 14, 41, and 62 (the receivers at DSSs 41 and 62 being subsequently moved to DSSs 43 and 63). The design of these receivers was based on available Block III modules and was tailored to the requirements of the MM'71 mission. To handle the open-loop doppler measurements during occultation for immediate missions such as Pioneer 10 and Mariner Venus–Mercury 1973 (MVM 73), as well as later missions, these receivers are being modified to provide multiple–mission capability.

II. Receiver Design

The open-loop receiver utilized available Block III receiver modules through the final mixer (Fig. 1a). A video processor was added to generate the synchronizing tone and combine it with the signal for real-time digital processing or analog recording. The design limited the receiver to two operating bandwidths, as determined by the selection of one of the two filters in the 10-MHz filter module.

The filters were chosen to provide adequate bandwidth for the doppler frequency excursions of the MM'71 mission (Table 1). During operation, the frequency of the local oscillator synthesizer is selected so that the incoming signal is within this filter bandwidth.

In addition to the open-loop receiver filter bandwidth, the synchronizing tones have also been determined by the requirements of MM'71. Fig. 2 shows the relationship between the receiver bandwidth and the selection of the synchronizing tone frequency. For MM'71, the synchronizing tones were selected to be at least twice the data bandwidth to provide an adequate sampling rate for digital data processing.

III. Multiple-Mission Modifications

The two characteristics of the open-loop receiver that are peculiar to the MM'71 mission are the bandpass filters and the synchronizing tone. To provide multiple–mission operation, the receiver must have the capability of conveniently changing these parameters. This has been accomplished in the following ways:

(1) Receiver bandwidth: The filters will no longer be wired into the module assembly. They are being designed with coaxial connectors and located in a drawer assembly to make it convenient to change them, if it is so required (Fig. 2). In addition, the drawer assembly will be capable of containing four such filters of different bandwidths. The desired filter of the four can then be selected from a front panel control.

(2) Synchronizing tone: A synthesizer is being used to provide full flexibility for selection of the frequency of the synchronizing tone.

IV. Concluding Remarks

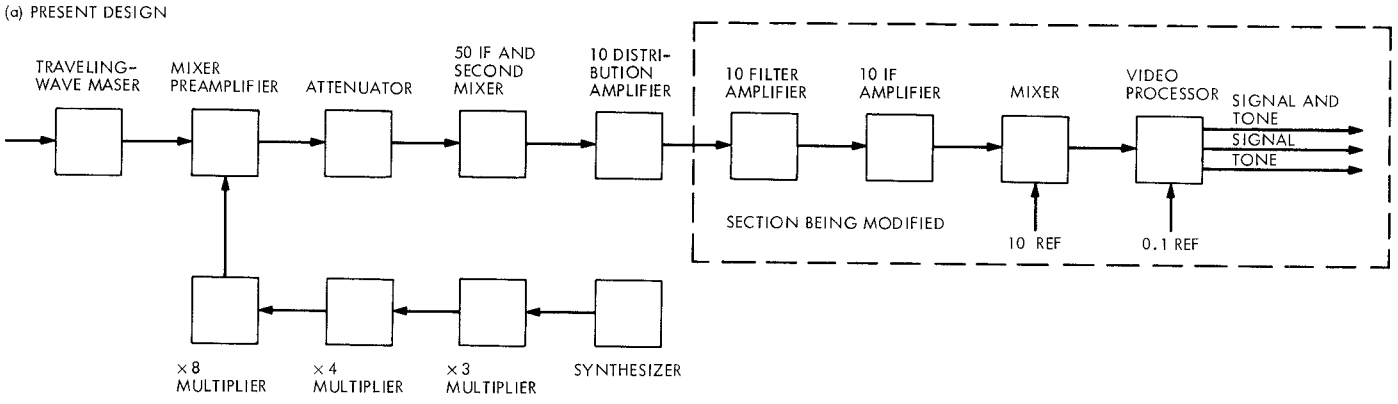
These modifications are being incorporated into the four existing Block III open-loop receivers to support initially the Pioneer 10 Jupiter flyby. Since DSSs 14 and 43 both view the occultation, the receiver from DSS 63 is being relocated to DSS 43 to function as a backup system. For the MVM 73 occultations, the two receivers at DSS 43 will also function as prime and backup at S-band. However, at DSS 14 one receiver is being used at S-band and the other at X-band. The modifications to provide X-band capability are discussed in Ref. 2.

References

1. Seidel, B., and Nixon, D. L., "Ground Instrumentation for the Mariner VI and VII Occultation Experiment," in *The Deep Space Network for the Period January 1 to February 28, 1970*, Space Programs Summary 37-62, Vol. II, pp. 94–97. Jet Propulsion Laboratory, Pasadena, Calif., Mar. 31, 1970.
2. Donnelly, H., "S/X-Band Open-Loop Receivers," in *The Deep Space Network Progress Report for March and April 1973*, Technical Report 32-1526, Vol. XV (this issue). Jet Propulsion Laboratory, Pasadena, Calif., June 15, 1973.

Table 1. Open-loop receiver bandwidths

Filter	Bandwidth, kHz	Synchronization tone frequency, kHz	Mission
		Present design	
1	10.250	30	MM'71
2	15.250	40	MM'71
		Multiple-mission design	
1	4.463	Synthesizer selection	MVM 73 (S or X)
2	16.363	Synthesizer selection	MVM 73 (S or X)
3	70.000	Synthesizer selection	MVM 73 (X) Pioneer 10
4	Blank	–	–



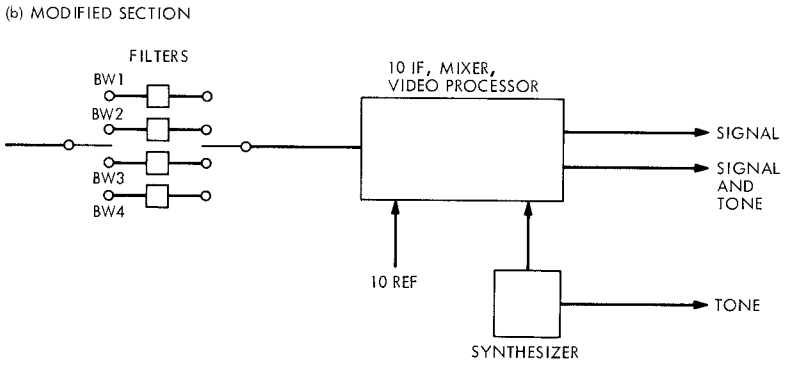


Fig. 1. Block III open-loop receiver

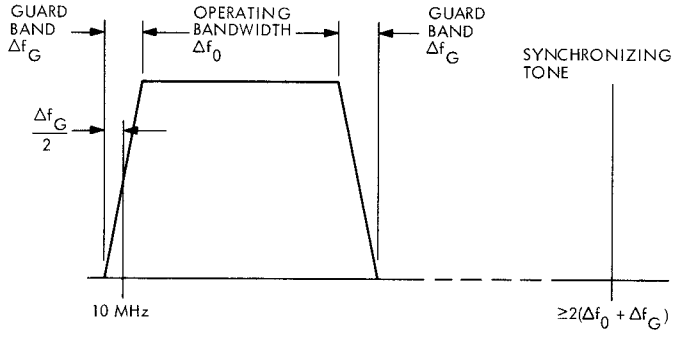


Fig. 2. Filter/tone characteristics