Wideband Distribution Amplifier for Coherent Reference Generator

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A wideband (0.1 to 100 MHz) frequency distribution module has been designed to have high output-to-output isolation, low phase shift with temperature, no RF tuning, and internal means to detect module performance that can be monitored by a computer.

I. Introduction

The DSN Mark III development plan is placing more stringent specifications on the Deep Space Stations' frequency standard distribution systems to have rigid control over phase shift and output-to-output isolation. The subsystems are further required to provide internal means of monitoring their performance and produce an indication compatible with computer interface.

II. Amplifier Development

A development program was initiated to create such an amplifier module for the coherent reference generator since no commercial amplifier exists that provides the following: (1) 12 outputs isolated from each other by 70 dB at 100 MHz, (2) a frequency range of 0.1 to 100 MHz, (3) less than 2 deg phase shift over a temperature change of 0 to 50° centigrade, and (4) a computer-level output of module quality.

Figure 1 is a block diagram of the basic amplifier. A wideband power amplifier drives a passive power divider and the 12 output isolation amplifiers. The high output-to-output isolation was achieved by using the 30-dB minimum isolation of the power divider and the reverse isolation of the output isolation amplifiers.

Two mechanical designs were attempted during the development. The first (Fig. 2) used the machined compartment technique and semirigid coax; the second (Fig. 3) used stripline transmission and flexible coax techniques. The difference in isolation measured over frequency range is shown in Table 1.

The final production module will be as shown in Fig. 3. This method meets the original design requirements, provides a high control over reproducibility, and is less costly to produce. The module quality monitor circuit shown in Fig. 1 uses hot carrier diodes to detect the power level at the input and at the 12 outputs, which are sampled by a multiplexer whose output goes to a comparator. The detected input power signal goes to a separate comparator. The detected input and multiplexer output signals are compared in a gate. If the input is out of its specified limits, the gate is *off* and the module indicates that it is operational. If the input is within its specified limits, and one of the outputs drops out of its preset limits, an external system detector latches until the problem is solved.

III. Planned Production and Installation

The wideband amplifier has passed the prototype stage and a contract has been issued for a production run. These modules will be evaluated for uniformity of performance and will be installed in the engineering prototype of the coherent reference generator.

Table 1. Performance data for wideband distribution amplifier

Parameter	Design goal	Compartmentized module (Fig. 2)	Printed circuit stripline module (Fig. 3)
Phase stability, <2 deg, at temperature of 0 to 50° C	<2	<1.5	<1.5
Output-to-output isolation, dB, at			
10 MHz	≥ 80	103	87
25 MHz	≥ 80	96	81
50 MHz	≥ 80	90	79
100 MHz	≥ 70	80	71
Harmonic distortion, %	≤ 5	<3	≤ 3
Nonharmonically related spurious output, dB	-70	-70	-70

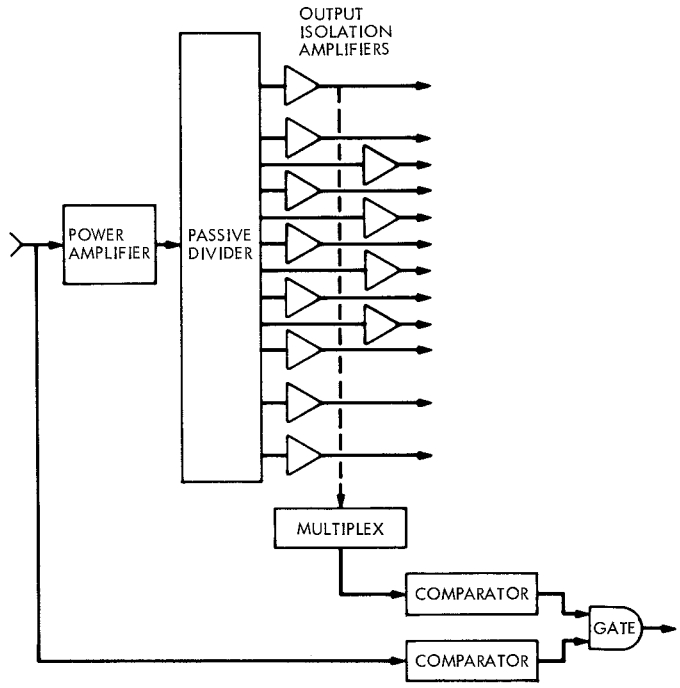

Fig. 1. Coherent reference generator wideband distribution amplifier

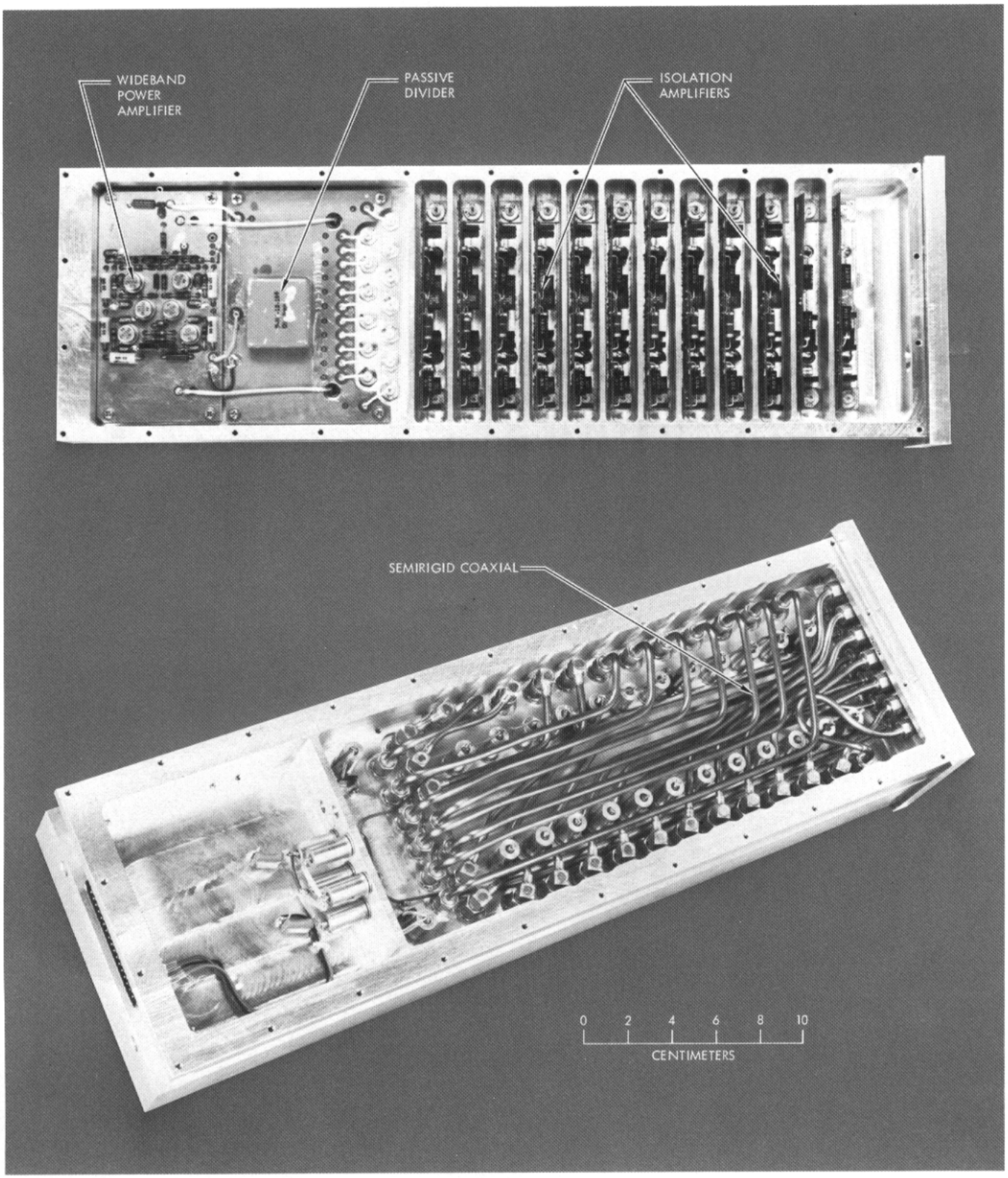

Fig. 2. Mechanical details of machined wideband distribution amplifier

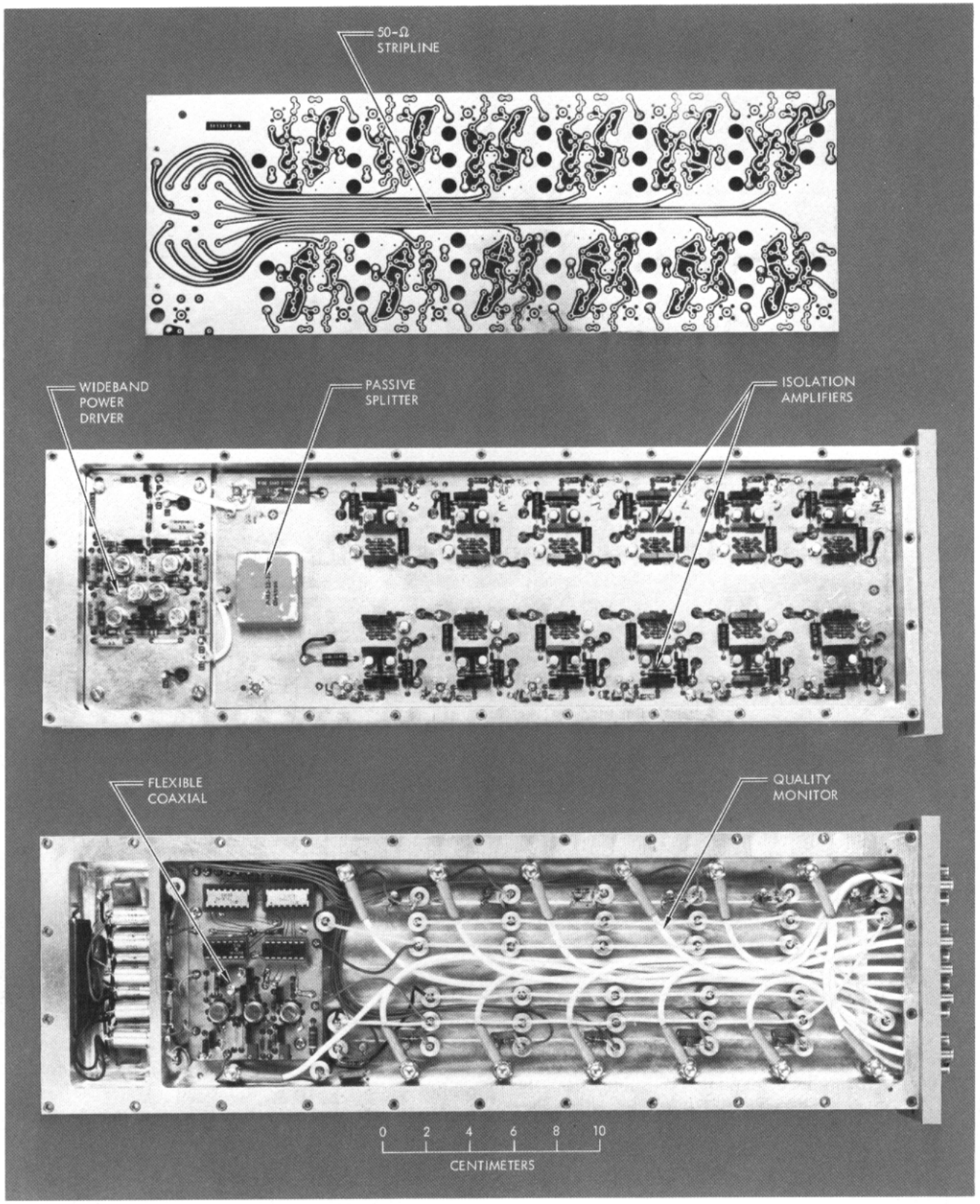

Fig. 3. Mechanical details of stripline wideband distribution amplifier