UHF IRIG G DISTRIBUTION SYSTEM

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This system is designed to transfer precision time from the VAFB Master Timing System to a remote location.

Figure one is a block diagram showing the Master Timing System, the Local IRIG G System, the Transmit/Receive System and the Remote IRIG G System. Notice that the timing is transmitted to the remote site via an RF link. This method was chosen because of the rough terrain at VAFB. In other applications land lines could be used in lieu of the RF link.

The Master System is dual redundant and its time base is a pair of Cesium standards also in a dual redundant configuration. The two timing terminal generators (TTG) in the Kode Local System synchronize to the time code supplied by the Master System. Their outputs are monitored by the Fault Sense and Switching unit. This unit automatically switches to the secondary TTG if a failure is detected in the primary. The ouputs of the Fault Sense unit drive the Distribution Amplifiers that buffer the timing signals from the system to the local users and the Transmit System.

The IRIG G transmitter is a fully redundant unit which accepts the IRIG-G002 input, converts it to Bi-phase modulation, and amplifies it to a power level of 40 watts at a frequency of 1740 MHz. The transmitter system contains a separate Fault Sensing and Switch Unit which monitors critical parameters of both tranmitters and switches to the standby unit upon primary source failure. The Transmitter output feeds an omnidirectional antenna through a pressurized coaxial cable. This antenna radiates throughout the entire base as does the previously existing 100 watt IRIG A Transmitter.

At the receive sites, two 4 foot parabolic antennas aimed at both the IRIG G and IRIG A sources feed a special receiver assembly through individual pressurized coaxial cables. The receivers contain fully independent dual IRIG G receivers and one IRIG A receiver. The overall Timing Distribution reliability is assured by use of this redundant system.

The Remote Kode System also contains two TTG's. These TTGs each phase lock to the codes supplied by the RF receivers. The outputs of the TTG's are monitored by an identical Fault Sense Unit which again places the ouputs of the secondary TTG on line in the event of a failure in the primary TTG. The Distribution Amplifier furnishes buffered outputs to the remote users.

The Local and Remote Systems are identical except that the Local System does not contain the receiver chassis.

The systems are enclosed in an equipment cabinet (see figure 3) that contains a Power Control Panel, the two TTG's, the Fault Sense unit, a Signal Bypass chassis and five Distribution Amplifiers chassis.

The Power Control Panel contains the circuit breakers for the primary power and also contains two heat sensors; one for over heating and one for fire.

The TTG's are the heart of this system. They are capable of operating as stand alone time code generators. In this mode they may be preset, stopped and started and have advance/retard controls that allow them to be manually synchronized to within 50 nanoseconds. The time base is derived from an internal oven controlled quartz oscillator. The outputs of the TTG's include five IRIG time codes, four sine waves and various decade pulse rates.

In the Synchronized Generator mode the TTG's phase lock to the input time code and frequency correct the internal oscillator to match the frequency of the oscillator that is generating the input code, in this case the Cesium standards in the Master System.

The phase error between the TTG and the input code is resolved to less than 100 nanoseconds, typically 70 nanoseconds. The frequency error is resolved to 1.5 parts in 10^{10} and can handle frequency errors of greater than 1 part in 10^6. In the event of input code failure the frequency error correction is continued using the last known correction constant.

The front end of the TTG contains sophisticated error detection logic allowing it to ignore faulty code data or incorrect code formats. This logic also compensates for input signal propagation delay. The delay is user programmable in 100 nanosecond steps to a maximum of one millisecond.
(Figure 2 is a simple block of a TTG).

The Fault Sense unit monitors the outputs of each of the TTG's. TTGA is designated as the primary. Should certain of its ouputs fail, TTGB will be automatically placed on line assuming that there are no pre-existing failures in TTGB. Also once TTGB has been selected TTGA can not be returned to on line until it is determined to be error free. The criteria for auto switching include code amplitude and ratio, sine wave amplitude and input code failure. Also monitored are bit errors and phase errors between the two TTG's. These errors do not enable auto switching in this system because the lack of a third, or reference input, prevents the Fault Sense unit from determining which TTG is in error.
(Subsequent designs incorporate this feature with the third input being logically synthesized).

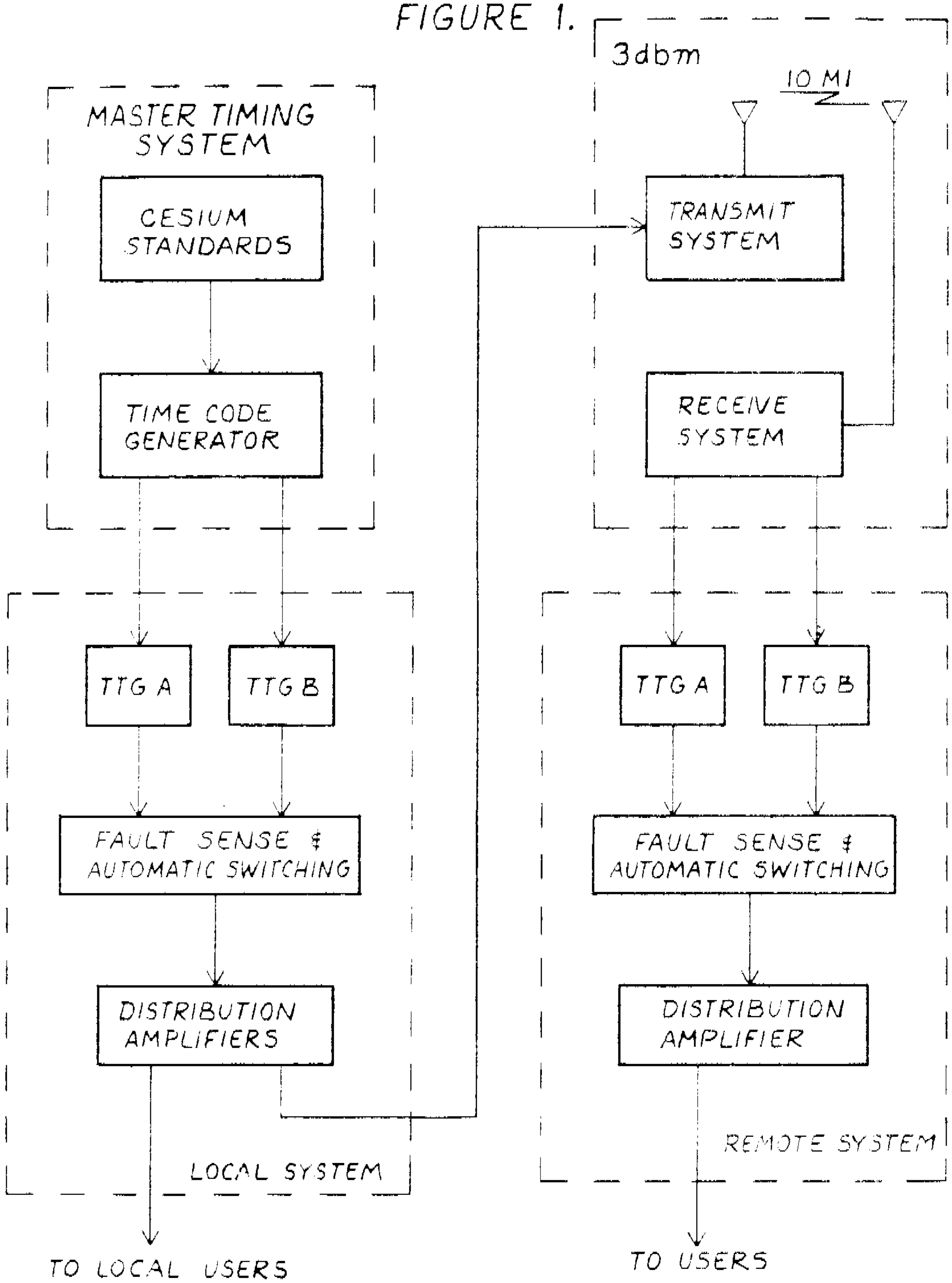
The Fault Sense unit also incorporates a very flexible self test program which allows the user to simulate any of the possible TTG failure modes. The Fault Sense unit will in every way respond to the simulated faults as if they were caused by the TTG(s). This feature allows sophisticated diagnostic testing to be run prior to times of anticipated critical timing needs.

The IRIG G System also includes a Signal Bypass chassis. This device allows the time code outputs from a user selected TTG to be applied to the Distribution Amplifier inputs. This feature allows the Fault Sense unit to be removed for maintenance and still supply timing to the users.

The remainder of the system is dedicated to the five Distribution Amplifier chassis. Each chassis will handle up to 30 channels of AC or DC amplifiers. The inputs to each amplifier are user programmable from one of five input sources. The amplifiers are wide band and will buffer any of the avialable TTG output signals. These signals range from the IRIG H time code modulating a 1KHz carrier up to a 1MHz sine wave. Each amplifier is thoroughly protected from short circuits to either ground, another amplifier, or a voltage. In the unlikely event that an amplifier is damaged, the isolation between amplifiers is such that any of the other channels will not be affected.

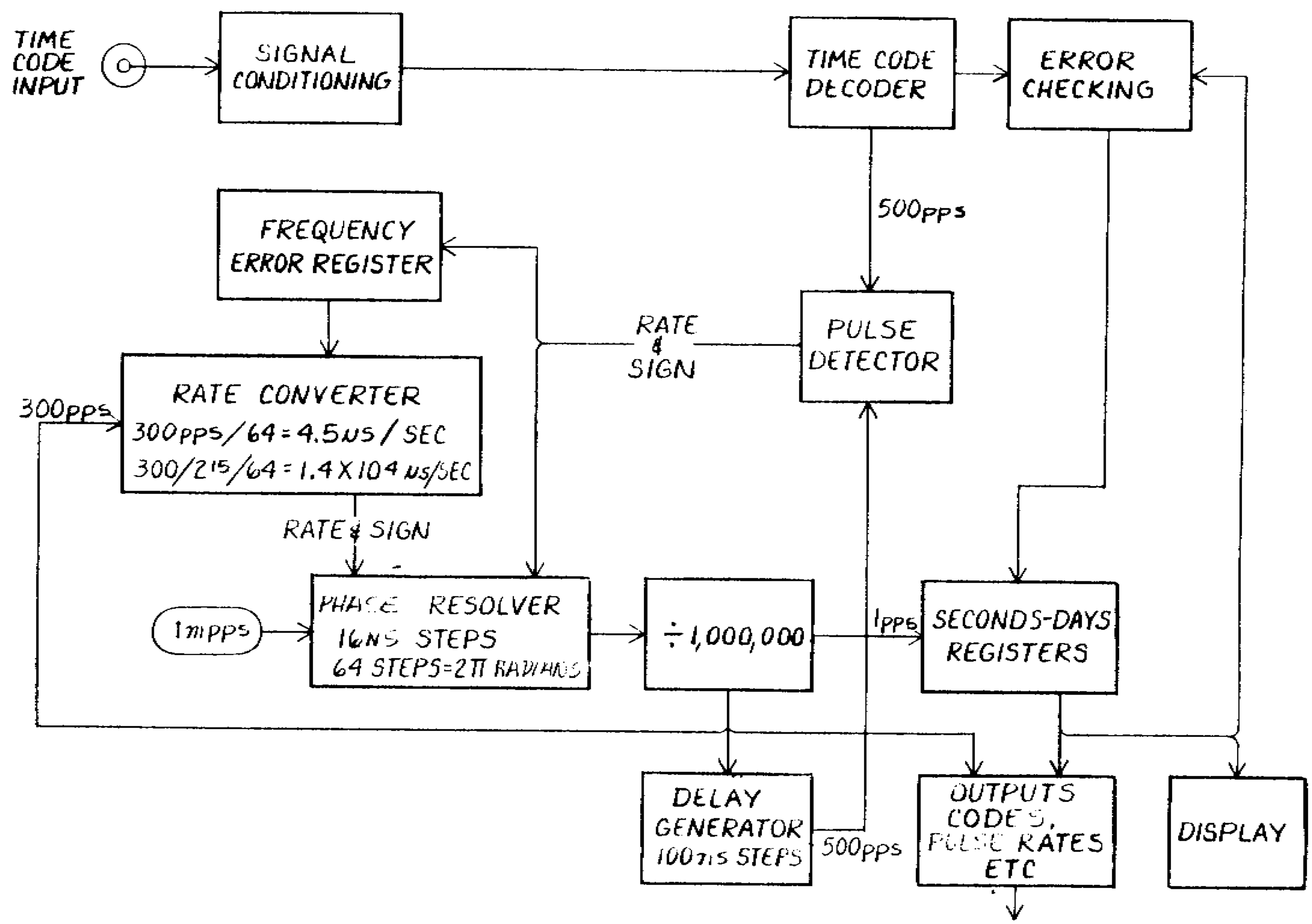
In summary these systems provide a method of transferring time derived from Cesium time standards to remote locations. The timing accuracy provided approaches the accuracy of the Cesium standard over a long period of time and also provides a wide variety of very reliable timing signals to the users.

FIGURE 1.



3dbm
10 MI
MASTER TIMING SYSTEM
CESIUM STANDARDS
TIME CODE GENERATOR
TRANSMIT SYSTEM
RECEIVE SYSTEM
TTG A
TTG B
FAULT SENSE & AUTOMATIC SWITCHING
DISTRIBUTION AMPLIFIERS
LOCAL SYSTEM
TO LOCAL USERS
TTG A
TTG B
FAULT SENSE & AUTOMATIC SWITCHING
DISTRIBUTION AMPLIFIER
REMOTE SYSTEM
TO USERS

FIGURE 2



TIME CODE INPUT
SIGNAL CONDITIONING
TIME CODE DECODER
ERROR CHECKING
500PPS
FREQUENCY ERROR REGISTER
PULSE DETECTOR
RATE & SIGN
300PPS
RATE CONVERTER
300PPS/64=4.5NS/SEC
300/2^15/64=1.4X10^4 NS/SEC
RATE & SIGN
1mPPS
PHASE RESOLVER
16NS STEPS
64 STEPS=2π RADIANS
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DISPLAY

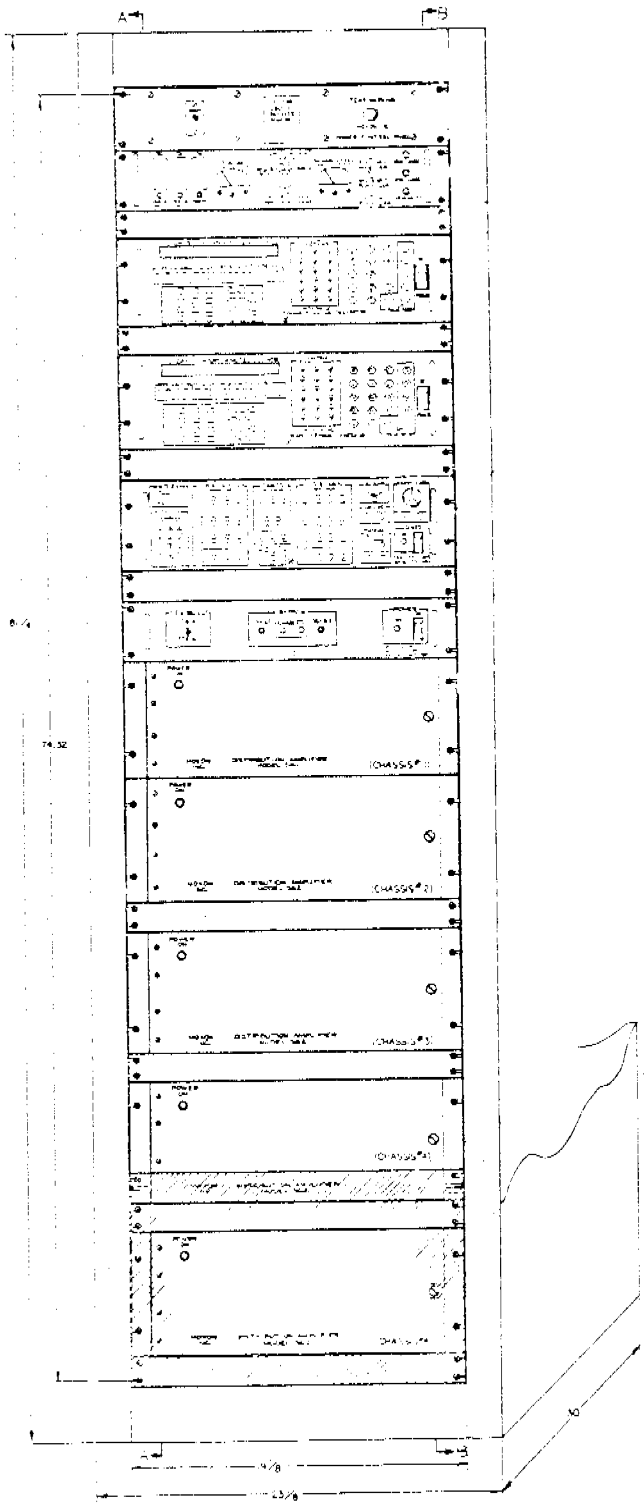

FIGURE 3

QUESTIONS AND ANSWERS

None for Paper #21.