TIMATION III SATELLITE

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This satellite is the third in a series of experimental satellites designed to investigate and demonstrate the techniques of a satellite navigation system. Timation III is designed to measure the error budget for a proposed system and provide one element of a navigation demonstration experiment. Table 1 lists the principal characteristics of the three satellites and shows the progressive development of the program.

Figure 1 is a drawing of the satellite showing the basic structure. It is an octagonal donut, 48 inches across the flats and approximately 23 inches in height. The solar panels, navigation and telemetry antennas, gravity gradient booms, and solar cell experiments are clearly visible. Figure 2 lists five auxiliary experiments to be conducted with the satellite.

Time management or time transfer is a natural fallout of most navigation systems. This satellite, in view for long periods of time and covisible over intercontinental ranges, will provide an excellent time transfer capability.

A joint service flavor has been added in the form of an Air Force experiment. This consists of a pseudo-noise modulated signal near 1580 MHz. This experiment requires relatively high power compared with the power system capability and therefore must be scheduled for limited periods of time. This experiment is being conducted principally for ionospheric scintillation measurements and ILS demonstration tests.

A NASA retroreflector panel for ranging measurements provides a second joint experiment. This independent measure of range is expected to provide valuable correlation data to the navigation measurements. The expected resolution for the NASA system is 10 cm.

Several radiation dosimeters are being considered to correlate measured radiation effects on the quartz oscillator and provide dose levels and rates at this new orbit altitude. Residual radiation effects can be seen in Figure 3 which is a plot of apparent aging rate versus time for the Timation II satellite. The aging rate prior to launch was approximately $+1 pp10^{11}$ per day. During the initial orbiting period it was as high as $+3 pp10^{11}$ per day and decreasing to almost $-5 pp10^{11}$ per day. This effect has decreased to approximately $-1.4 pp10^{11}$ per day at day 1000. Transient radiation effects can be seen in Figure 4, a plot of frequency versus time for days 204 through 239 in 1972. The abrupt frequency shift is associated with a solar storm.

Test solar panels will be included to provide long-term evaluation data of several new solar cell configurations in this operating environment.

Figure 5 is a list of the primary ground stations in the orbit determining net. The satellite is always in view of at least one ground station. The satellite is observed four times daily at each station with visibility times ranging from 40 to 140 minutes.

A set of four candidate oscillators is being evaluated for this satellite. These units were manufactured by Frequency Electronics Inc. of New York. Figure 6 is a plot of fractional frequency fluctuation versus averaging time and Figure 7 is a plot of frequency versus time to show aging rates.

Table 1
Timation Satellites.

Launch Date	May 31, 1967	Sept. 30, 1969	FY 74
Altitude	500 nm	500 nm	7,500 nm
Inclination	70°	70°	145°
Weight	85 lb	125 lb	415 lb
Frequencies	400 MHz	150 & 400 MHz	335 & 1580 MHz
Max. Mod. Freq.	100 KHz	1 MHz	6.4 MHz
Memory	No	No	Yes
Osc. Stab.	$3pp10^{11}$	$1pp10^{11}$	$1\text{-}5pp10^{12}$
D.C. Power	6W	18W	90W BOL

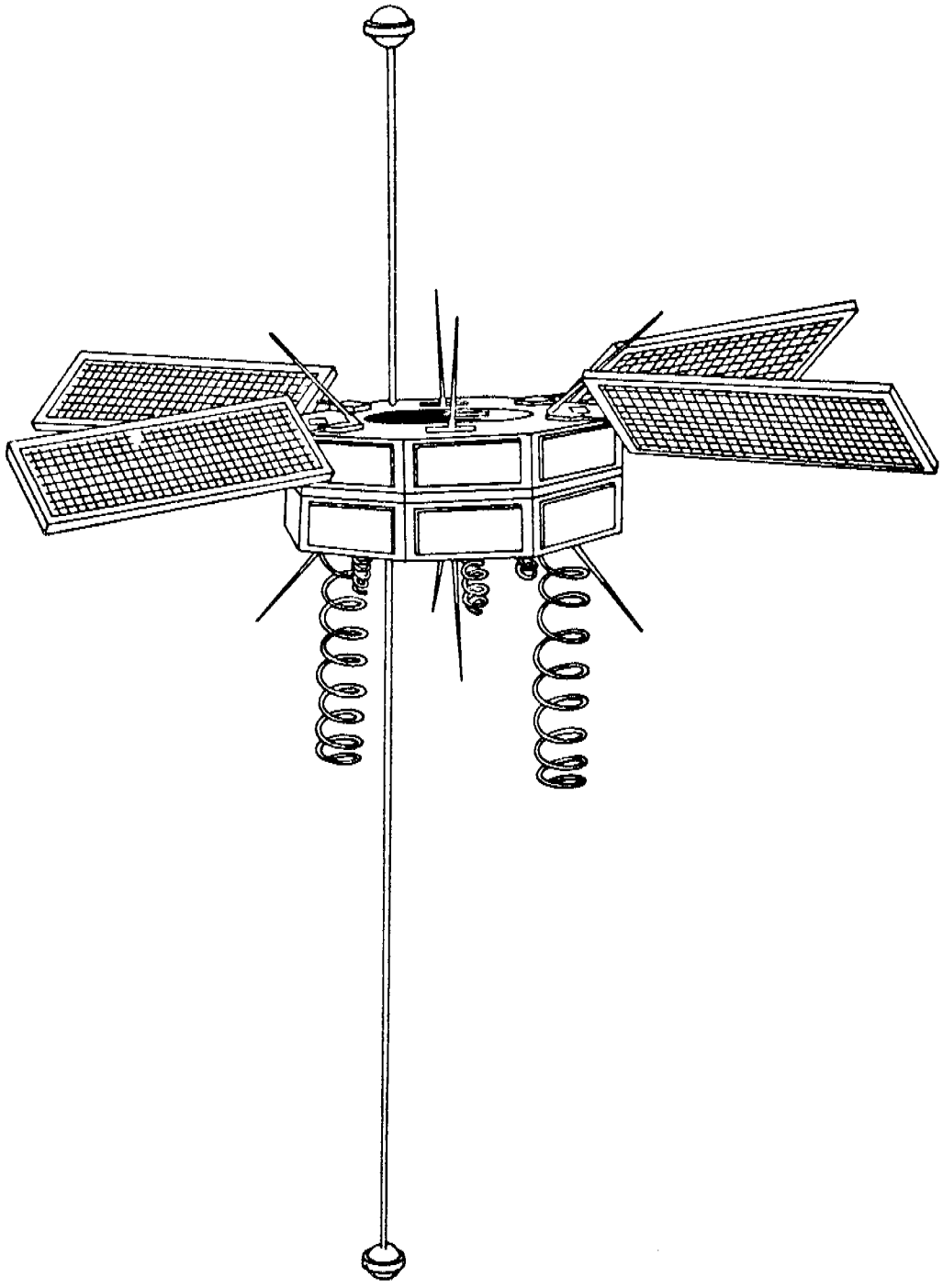

Figure 1. Drawing of Timation III.

TIME TRANSFER

PRN MODULATION (USAF)

RETROFLECTORS (NASA)

RADIATION DOSIMETERS

TEST SOLAR PANELS

Figure 2. Timation III experiments.

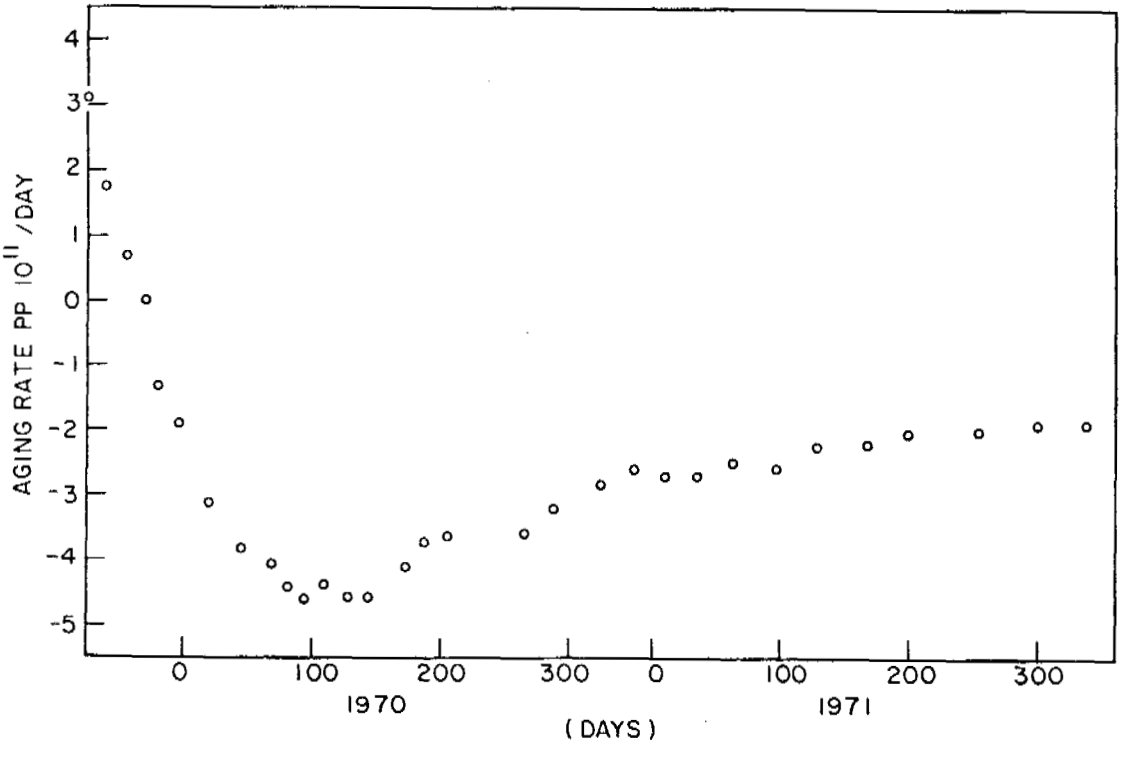

Figure 3. Apparent aging rate for Timation II.

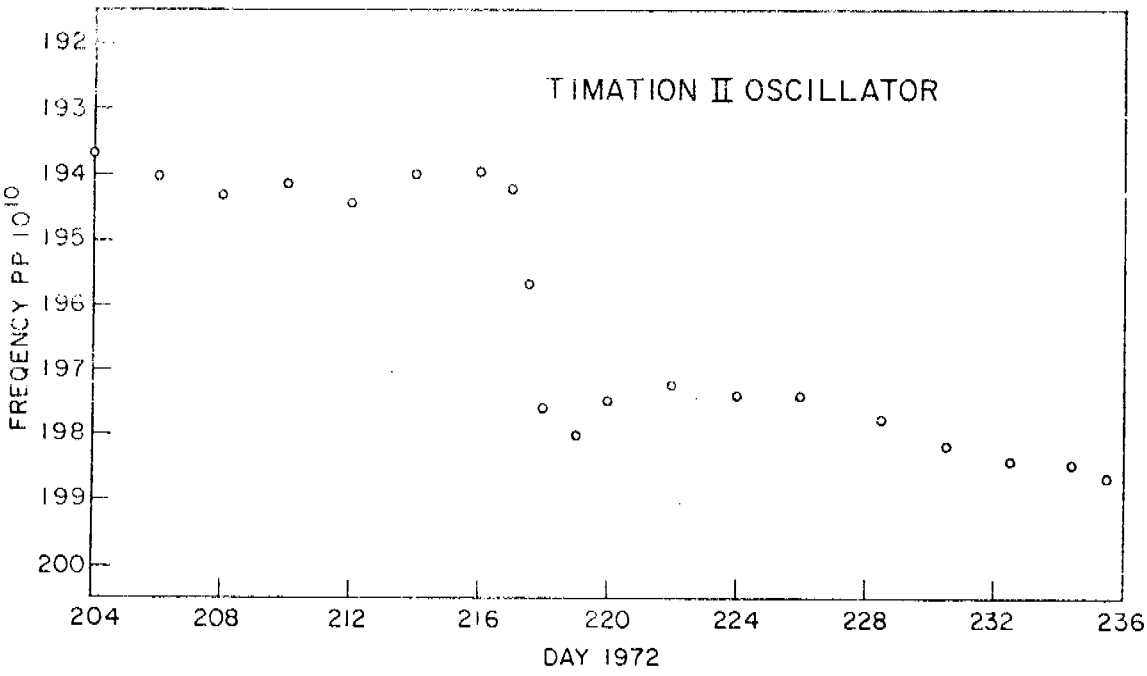

Figure 4. Transient radiation effects.

TRACKING SITES

MARYLAND

FLORIDA

SAMOA

GUAM

SEYCHELLES

Figure 5. Primary ground stations in the orbit determing network.

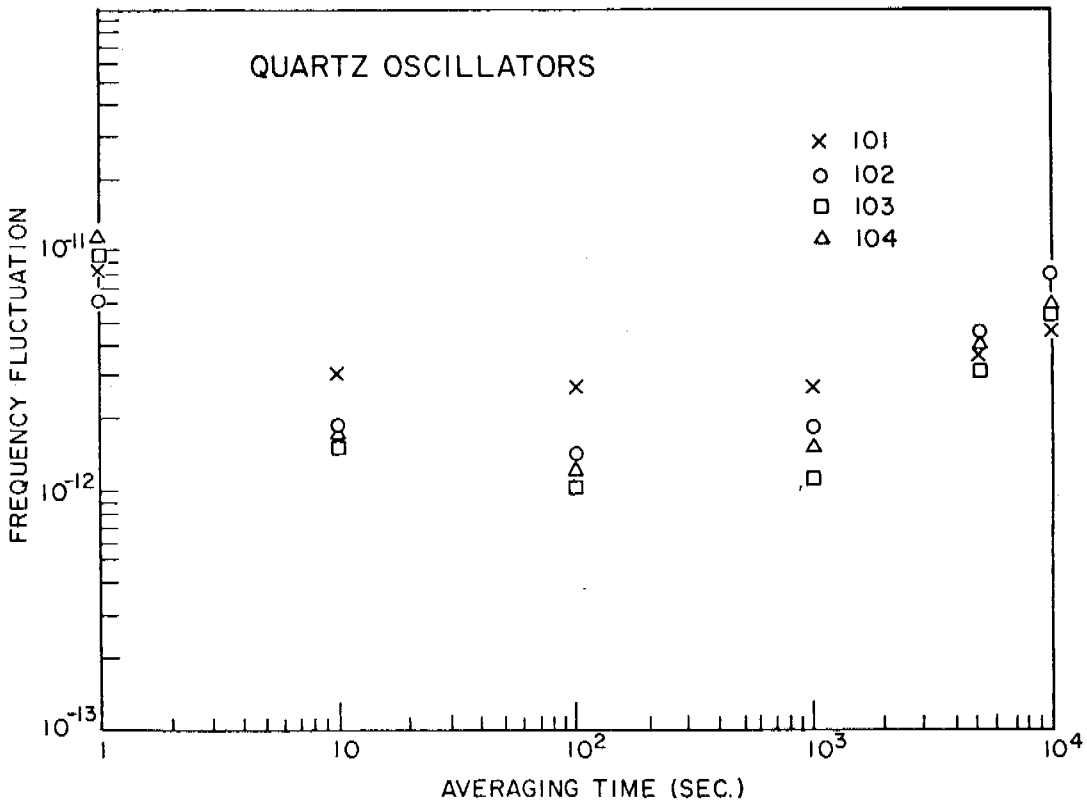

Figure 6. Fractional frequency fluctuation.

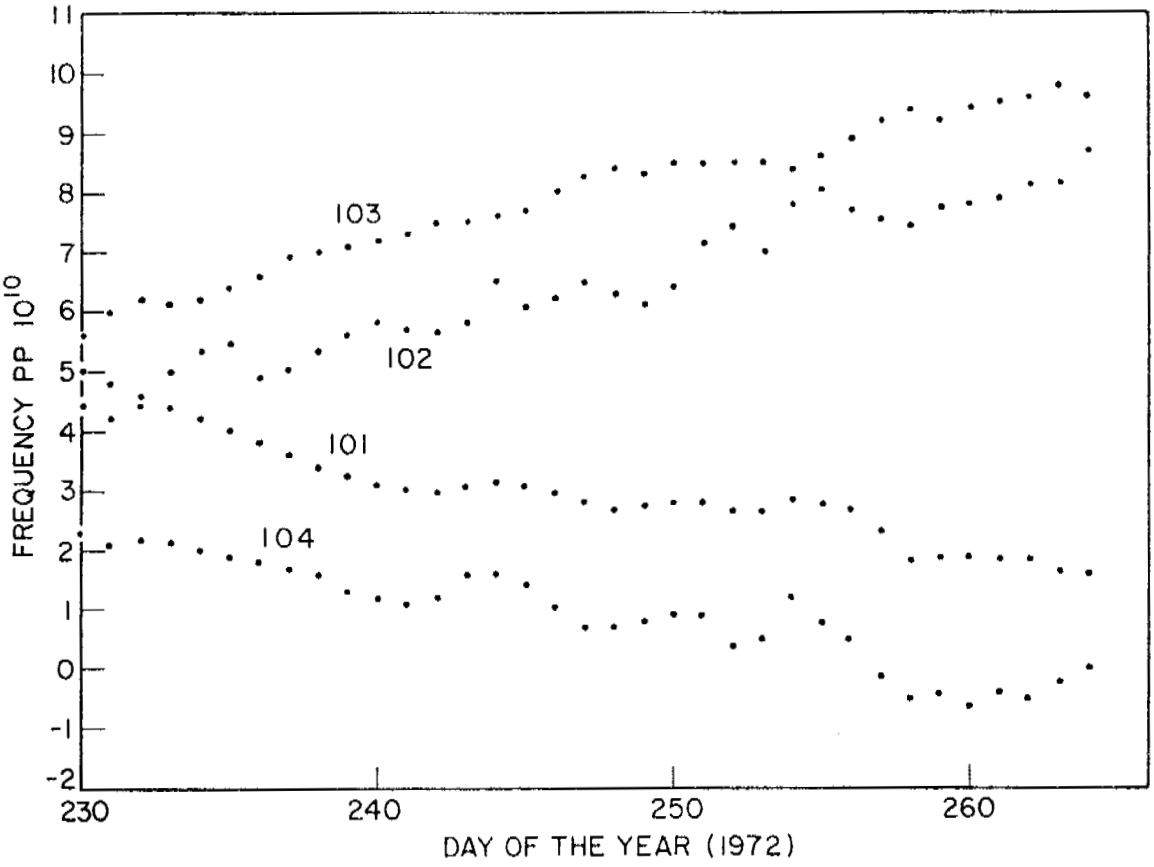

Figure 7. Oscillator aging rates.