

CONFIDENTIAL

DISCOVERER RESEARCH

SUBSATELLITE

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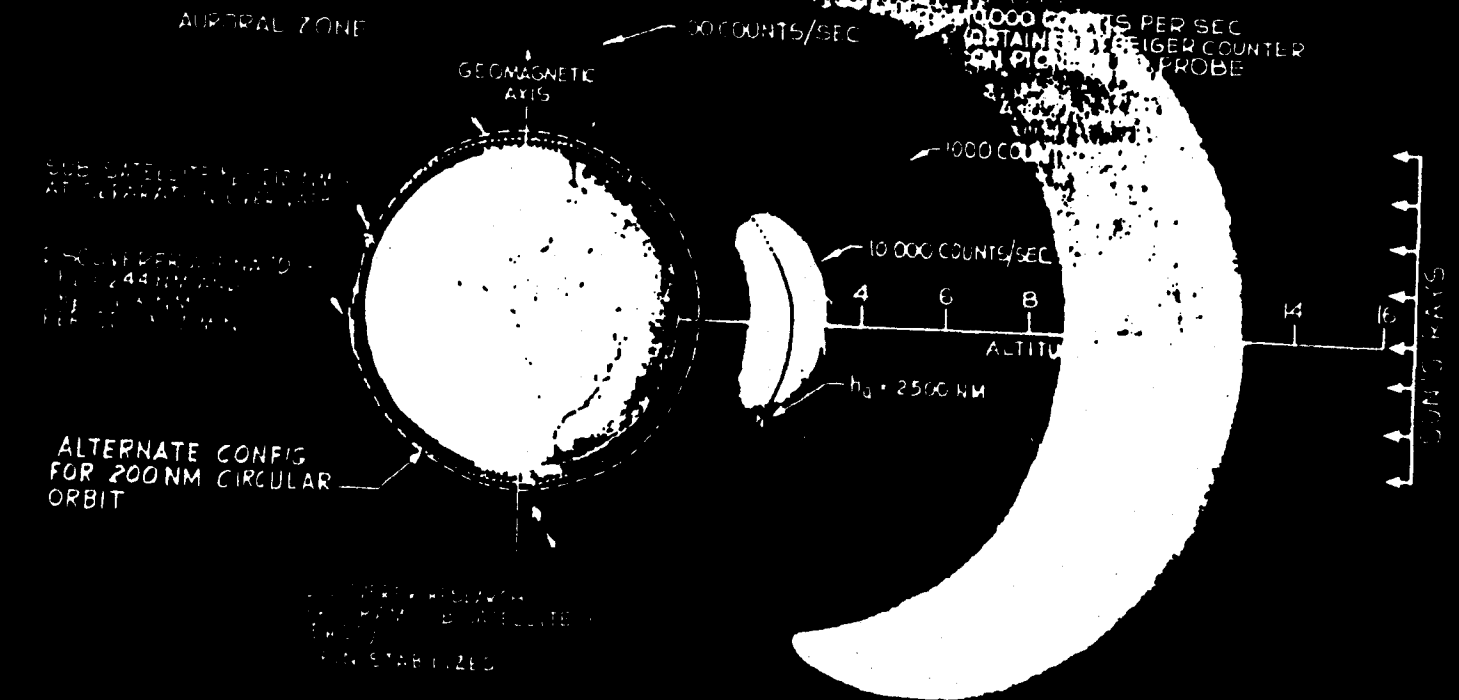
In Accordance with E.O. 12958

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DISCOVERER RESEARCH PROGRAM

SUBSATELLITE FLT CHARACTERISTICS



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DISCOVERER RESEARCH PROGRAM

SUBSATELLITE

- TO PROVIDE A VEHICLE
 1. CAPABLE OF INCREASED ORBIT RANGES
 2. WITH EXTENDED ACTIVE LIFE (2 TO 6 MONTHS)
 3. TO CARRY A WIDE VARIETY OF RESEARCH EXPERIMENTS

- SUBSATELLITE CONFIGURED TO FIT ON AGENA D AFT RACK.
- THE SUBSATELLITE PROPULSION UNIT MAY BE VARIED TO ACHIEVE DIFFERENT ORBITS.
- BASIC STRUCTURE AND ELECTRONIC EQUIPMENT SUITABLE TO ACCOMMODATE RESEARCH EXPERIMENTS.
- ELECTRIC POWER MAY BE BATTERIES AND/OR SOLAR CELLS.

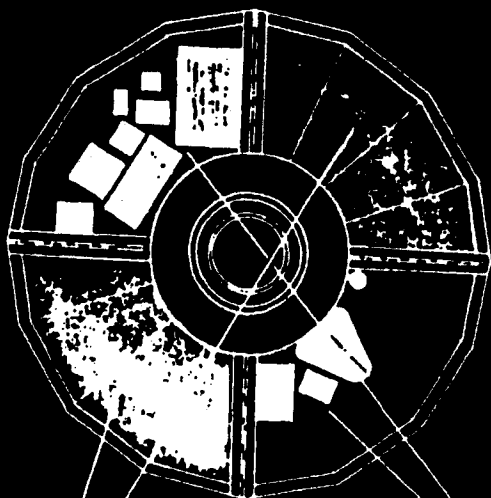
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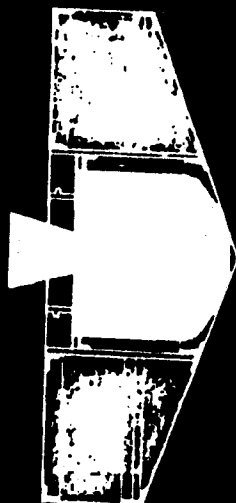
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SUBSATELLITE DETAILS

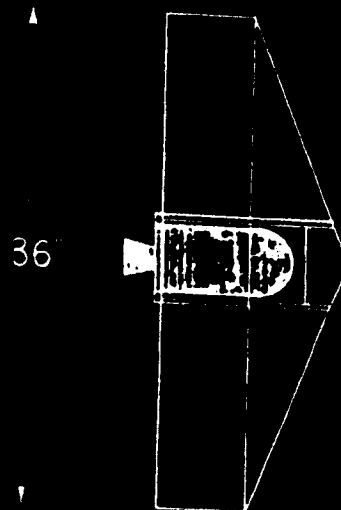


BASIC EQUIPMENT

AVAILABLE SPACE FOR
RESEARCH EXPERIMENTS



- TE 316 ROCKET
- 2000 NM APOGEE
(FOR 225 LBS)
- PAYLOAD SENSOR
VOLUME = 3000 CU IN



- ALTERNATE CONFIGURATION
- TE 344 ROCKET
 - 200 NM CIRCULARIZED
ORBIT
 - PAYLOAD SENSOR
VOLUME = 3750 CU IN

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LAUNCHING OF SUB-SATELLITE

DIRECTION OF FLT

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SUB-SATELLITE

- LAUNCH PACK
- ANTENNA
- STOWED POSITION
- SOLAR CELLS
- RESEARCH INSTRUMENTS
- ONE OF TWO SPIN NOZZLES

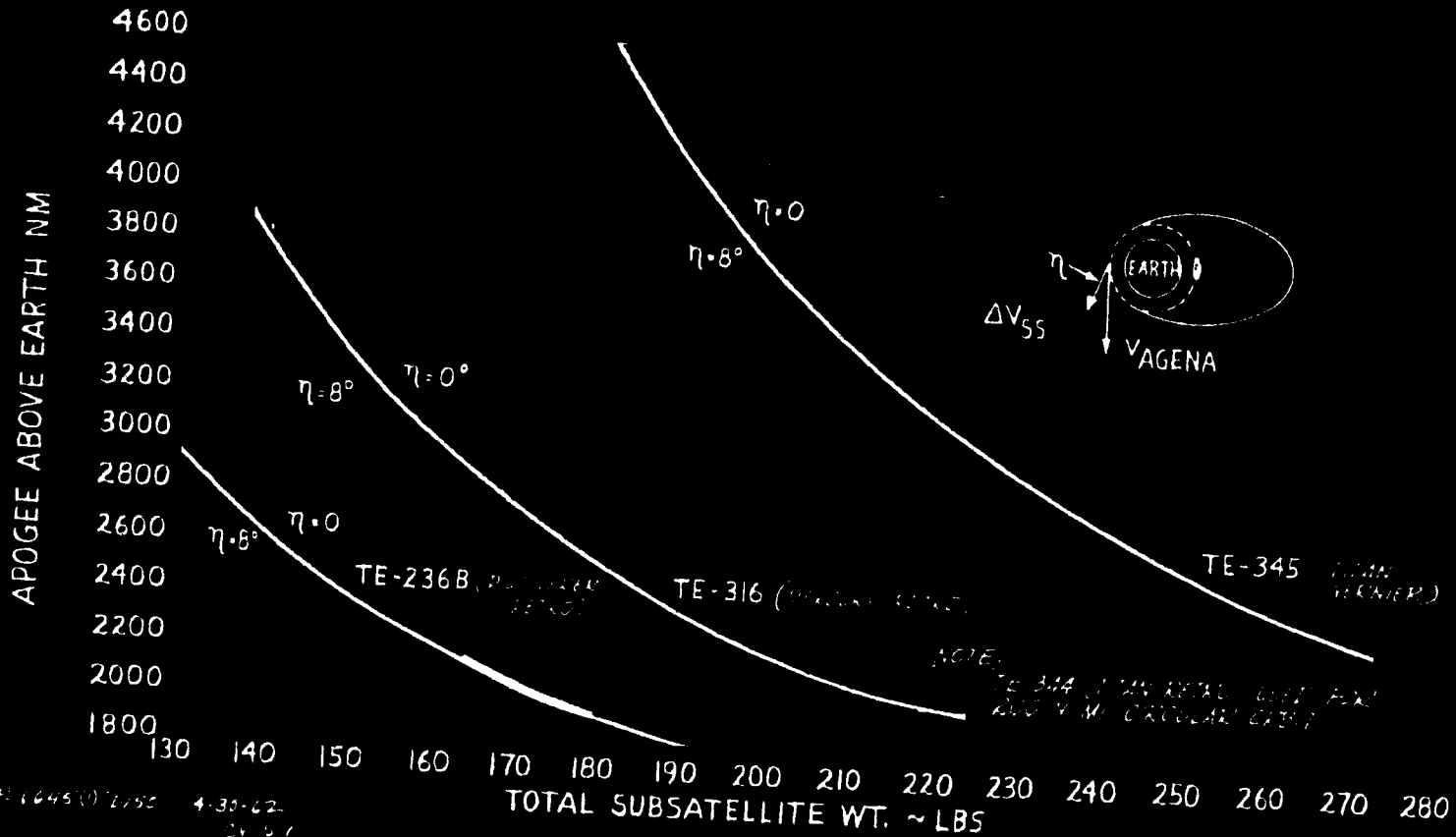
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SUBSATELLITE WT. VS APOGEE



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SUBSATELLITE EQUIPMENT & WEIGHT SUMMARY

| DESCRIPTION | WEIGHT LBS | | | |
|---|-------------|---------|--------|-------------|
| | TE 344 | TE 236B | TE-316 | TE-345 |
| BASIC VEHICLE | | | | |
| STRUCTURE | | | | |
| SPIN SYSTEM | 12.0 | | | |
| BATTERY & CHARGER | 3.0 | | | |
| SOLAR CELL ASSEMBLY | 19.0 | | | |
| ANTENNA & COUPLER | 5.0 | | | |
| TIMER | 4.5 | | | |
| COMMAND & SQUIB PROGRAMMERS | 1.2 | | | |
| COMMUTATORS (2 REQUIRED) | 3.0 | | | |
| TRANSMITTERS (2) | 3.2 | | | |
| • MOD AMPLIFIER | 2.0 | | | |
| • VCO (4 REQUIRED) | 1.1 | | | |
| • TRAY ASSEMBLY | 1.2 | | | |
| • DC-DC CONVERTER | 1.2 | | | |
| COMMAND RECEIVER / DECODER | 4.0 | | | |
| TAPE RECORDERS (2) | 13.0 | | | |
| ACCELEROMETER | 6.6 | | | |
| CONNECTORS & WIRING | 7.0 | | | |
| SUBTOTAL | 78.2 | | | |
| BOOST ROCKET (INCL HEATER BLANKET) | 8.0 | | | |
| EXPERIMENT PAYLOAD | 127.8 | 60.0 | 68.8 | 86.0 |
| SUBSATELLITE | | 75.8 | 67.0 | 49.8 |
| AGENA EQUIPMENT & STRUCTURE (LAUNCHER, UMBILICAL, BAROMETRIC SWITCH) | | | | 21.0 |
| TOTAL SYSTEM WEIGHT | | | | 11.0 |
| | | | | 225.0 |

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2500 N.M. ~ SUBSATELLITE POWER SUMMARY

| DESCRIPTION | POWER (WATT) | DUTY CYCLE* (PERCENT) | W-HR* ORBIT |
|---------------------------------|-----------------|--------------------------|----------------|
| COMMAND RECEIVER | 0.35 | 100 | 0.81 |
| TAPE RECORDER | 4.0 | 100 | 9.20 |
| T/M TRANSMITTER | 13.0 | 10 | 4.14 |
| DC-DC CONVERTER | | | |
| MOD AMPLIFIER | | | |
| VCO (4 UNITS) @ 30 MA | 3.36 | 10 | .77 |
| COMMUTATOR (2 UNITS) @ 1.6 W | 3.0 | 100 | 8.26 |
| TIME REFERENCE GENERATOR | 0.5 | 100 | 1.15 |
| COMMAND & SQUIB PROGRAMMER | 1.5 | 10 | 0.35 |
| RESEARCH INST | 13.0 | 100 | 29.90 |
| TIMER | 1.5 | 10 | .35 |
| TOTAL | ≈ 46 | | ≈ 55 |

* OPERATIONAL DUTY CYCLE BASED ON 2.3 HRS PER ORBIT,
AVERAGE POWER OF 15 WATTS FOR SOLAR CELLS, AND A
1.75 AMP-HR NI-CAD BATTERY IS AS FOLLOWS:

2.3 HRS/ORBIT - ON
FOUR ORBITS - OFF

* ORBIT - 137 MIN. = 2.3 HRS

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SUB-SATELLITE COMMAND LINK CALCULATION

| | GAINS | LOSSES |
|------------------------------|---------|---------|
| TRANSMISSION SYSTEM | | |
| R.F. POWER 1000 WATTS | + 30 db | |
| ANTENNA GAIN | + 10 db | |
| RANGE 5000 N M (SLANT RANGE) | | -154 db |
| RECEIVING SYSTEM | | |
| RECEIVER SENSITIVITY | +132 db | |
| ANTENNA GAIN | | -3 db |
| FADE LOSS | | -3 db |
| POLARIZATION LOSS | | -3 db |
| TOTALS | +172 db | -163 db |

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SUB SATELLITE TELEMETRY LINK CALCULATION

| | GAINS | LOSSES |
|-----------------------------|--------|--------|
| TRANSMISSION SYSTEM: | | |
| R.F. POWER 2 WATTS | | |
| ANTENNA GAIN | +8dB | |
| RANGE 5000 NM (SLANT RANGE) | | -3dB |
| | | -157dB |
| RECEIVING SYSTEM: | | |
| RECEIVER SENSITIVITY | -129dB | |
| ANTENNA GAIN TEL-16 | +28dB | |
| FADE LOSS | | +3dB |
| POLARIZATION LOSS | | +3dB |
| <hr/> | | |
| TOTALS | +70dB | -166dB |

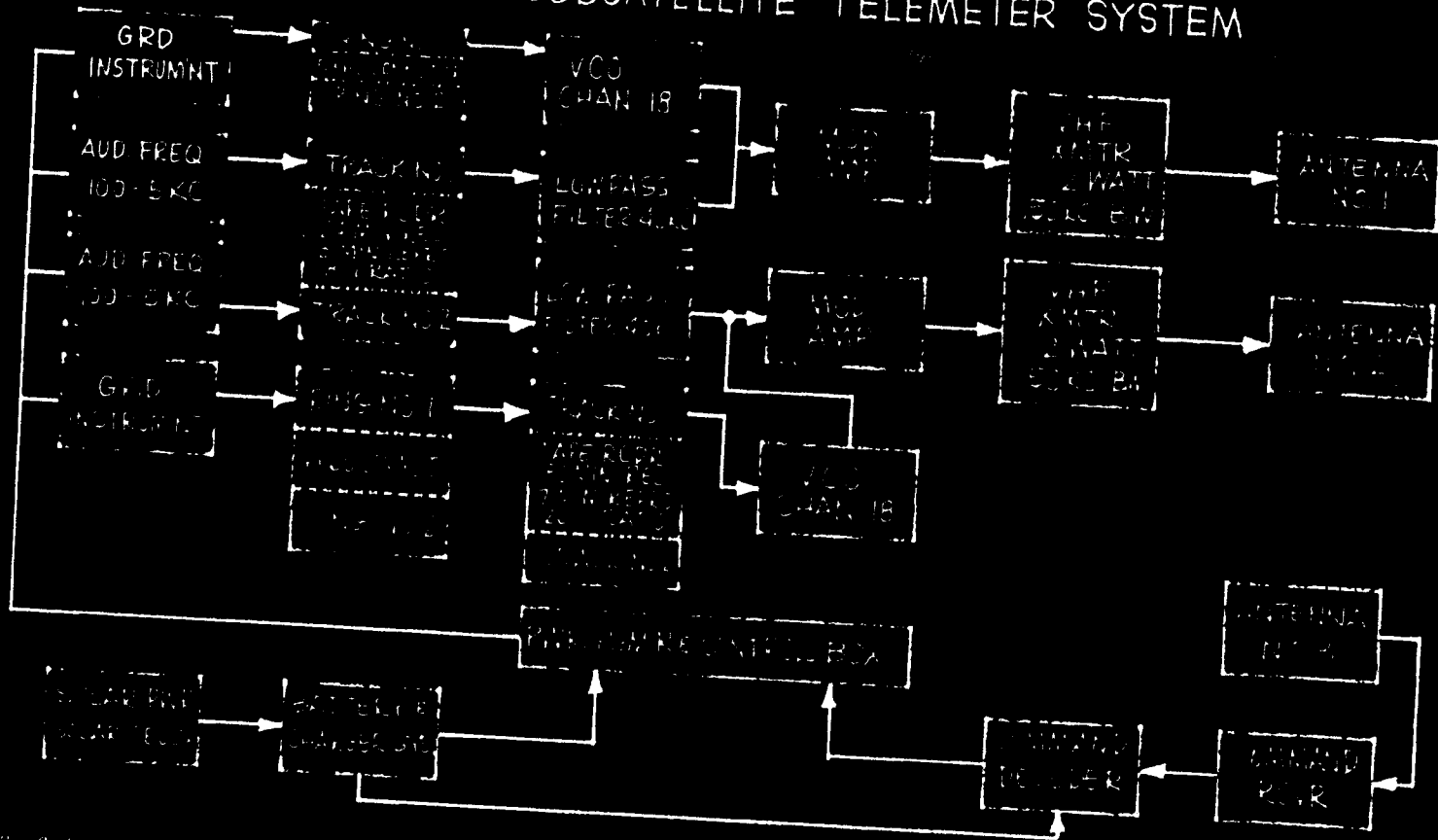
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200 N. MI ~ SUBSATELLITE TELEMETER SYSTEM

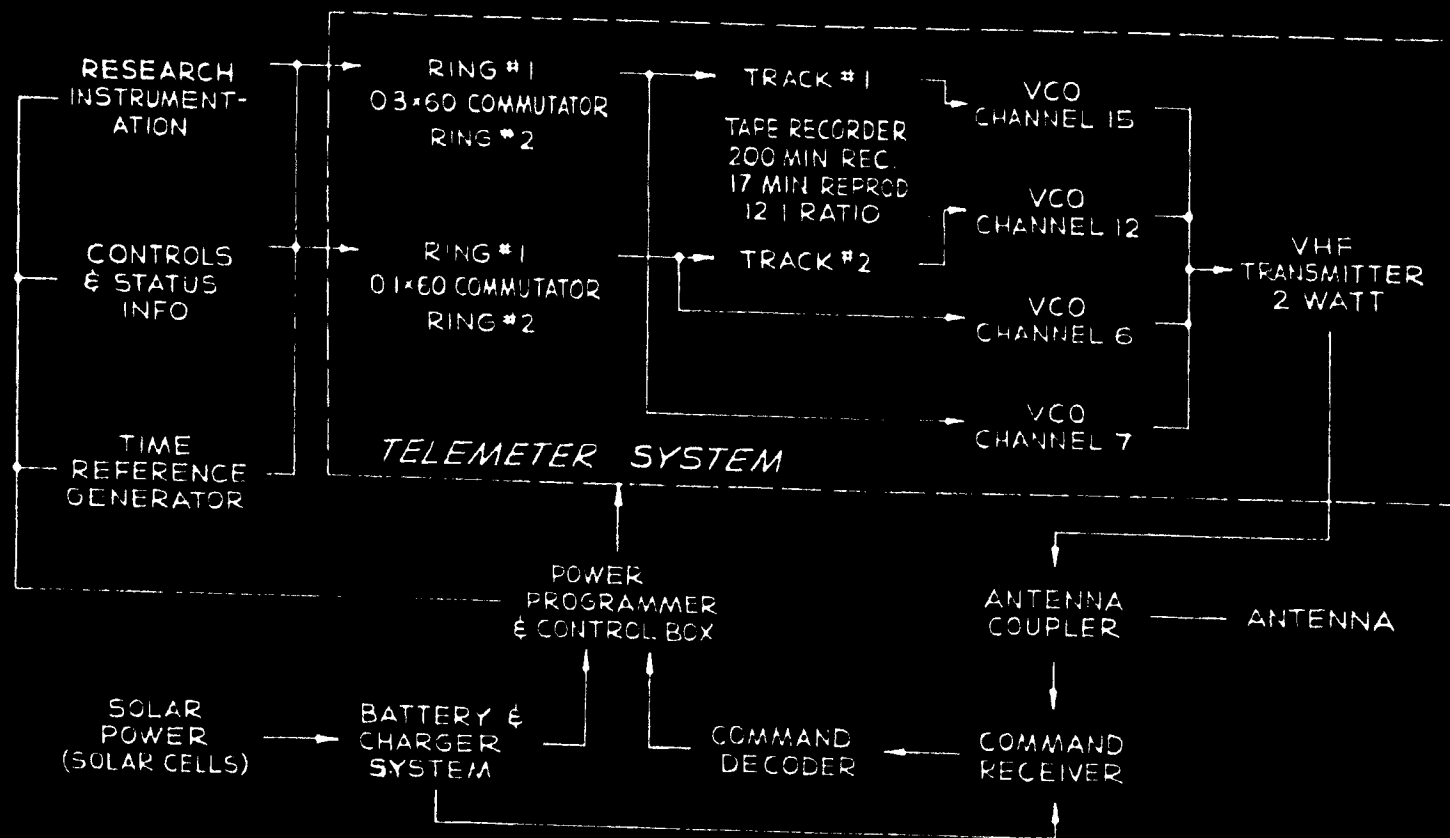


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2500 N M SUBSATELLITE SYSTEM



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SUBSATELLITE TRACKING

- ① "SPADATS" FOR PRIMARY EPHEMERIS DATA
 - ② DELETES NEED FOR TRACKING BEACON
 - ③ MUCH MORE ACCURATE & RELIABLE THAN ANGLES ONLY

- ② SATELLITE TEST CENTER GENERATES ACQUISITION MESSAGES
 - ③ ACQUISITION MESSAGES TO HAWAII & VANDENBERG, NTS TRACKING STATIONS

- ③ HAWAII & VANDENBERG FOR COMMAND & TELEMETRY DATA READOUT
 - ④ NO ADDITIONAL MAJOR C & C EQUIPMENTS REQUIRED
 - ⑤ NO ADDITIONAL COMMAND OR READOUT STATIONS REQUIRED

NEW BOSTON TRACKING STATION USED IN SUPPORT OF ABOVE FOR 200 N. MI. CIRCULAR ORBIT

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SUBSATELLITE COST & PERFORMANCE COMPARISON

| DESCRIPTION | BLUE SCOUT | DISCOVERER RESEARCH SUBSATELLITE |
|---|---------------------|----------------------------------|
| ● COST | | |
| ○ BOOSTER & GUIDANCE | \$ 855,000 | \$ 0 |
| ○ SATELLITE VEHICLE (INCL. PAYLOAD INTEGRATION, TELEMETRY, BATTERIES) | 310,000 | 310,000 |
| ○ LAUNCH | GFE | 0 |
| ○ TRACKING | GFE | GFE |
| ○ TOTAL COST EACH FLIGHT | <u>\$ 1,165,000</u> | <u>\$ 310,000</u> |
| ● PERFORMANCE (300 NM CIRCULAR ORBIT) | | |
| ○ INCLINATION ANGLE | 70°-105° | 70°-105° |
| ○ ORBITING WEIGHT | 160 LBS | 225 LBS |
| ○ VEHICLE ACTIVE LIFE | 1 MONTH | 2 - 6 MONTHS |
| ● COST PER LB IN ORBIT | \$7,300 | \$ 1,380 |

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SUBSATELLITE SYSTEM RELIABILITY

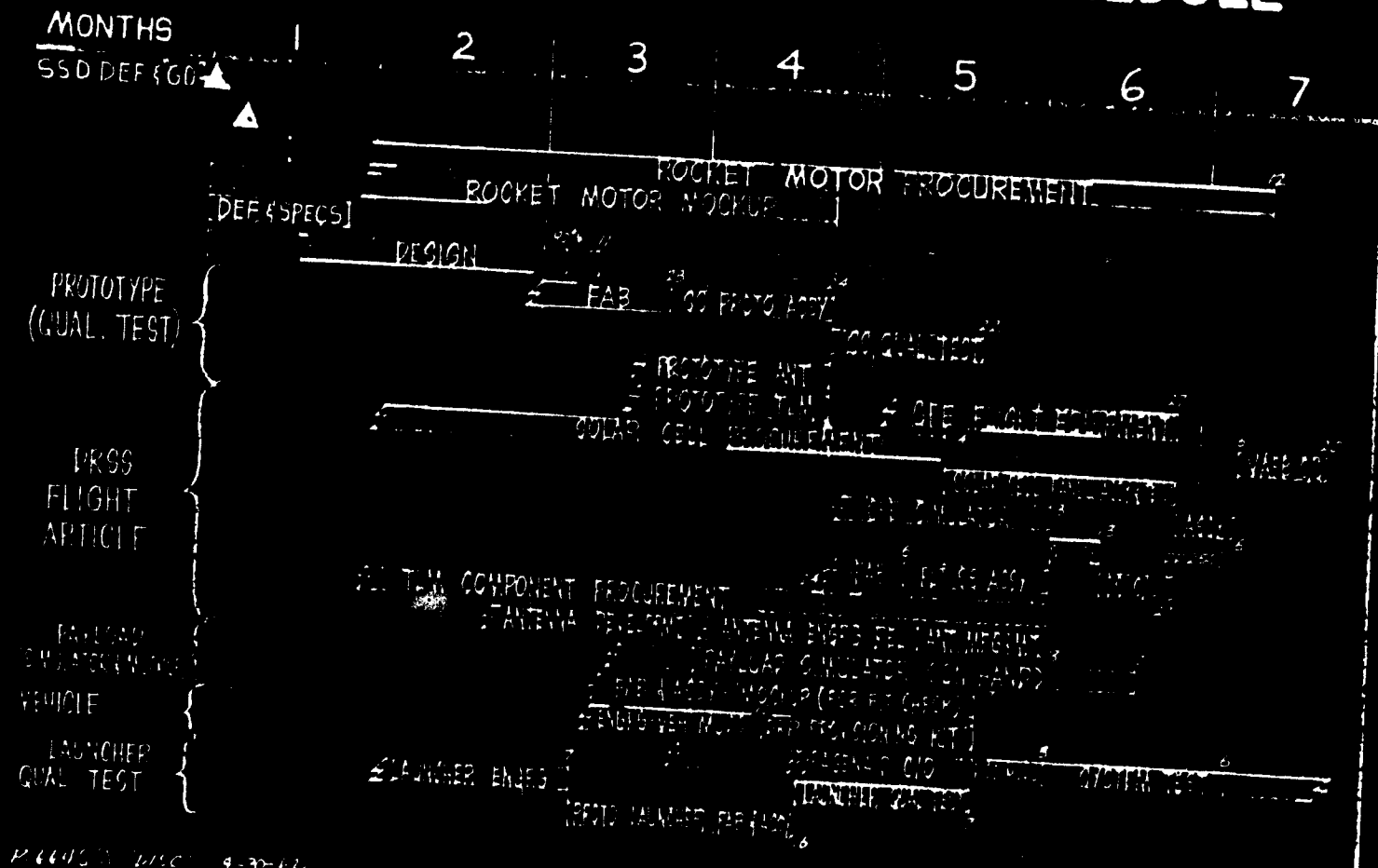
| | |
|----------------------------|--------------|
| ROCKET MOTOR & SPIN SYSTEM | 0.990 |
| LAUNCHER MECHANISM | 0.999 |
| COMMAND SYSTEM | 0.971 |
| TELEMETRY SYSTEM | 0.940 |
| POWER SYSTEM | <u>0.942</u> |
| OVERALL SYSTEM | 0.850 |

FIGURE 1-4-1

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DRP SUBSATELLITE PROGRAM SCHEDULE



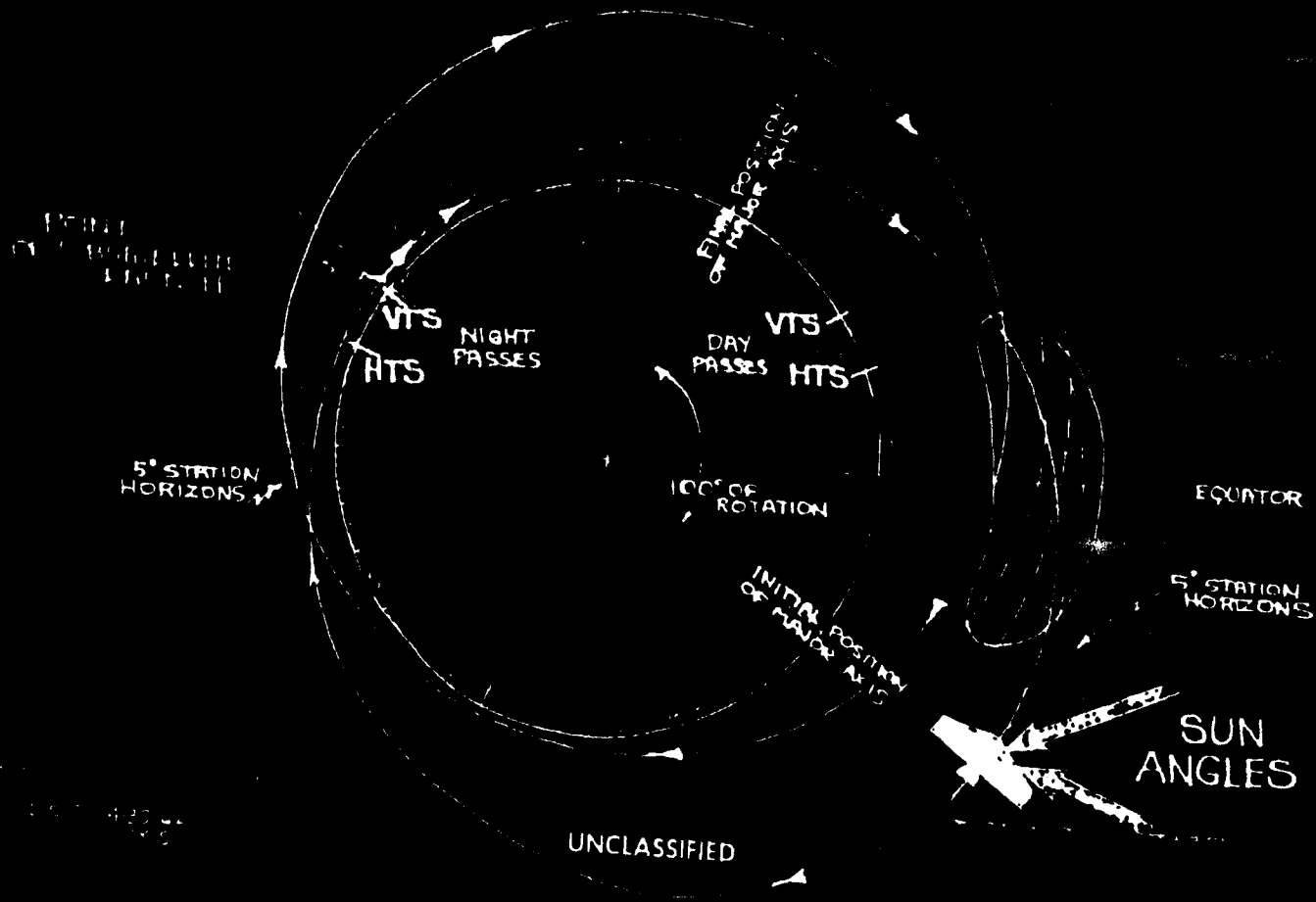
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SUBSATELLITE APOGEE ROTATION

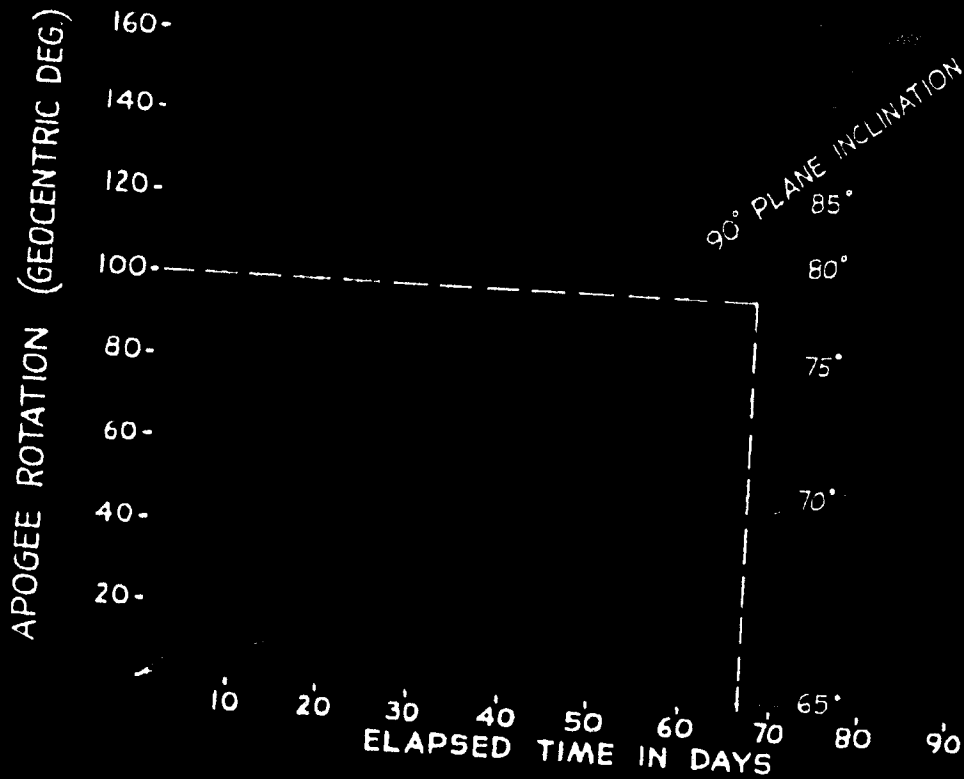


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SUBSATELLITE APOGEE ROTATION VS ELAPSED TIME



NOTE :
APOGEE = 2500 N.M.

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DISCOVERER RESEARCH SUBSATELLITE

SYSTEM RELIABILITY

| DESCRIPTION | (4) DUTY CYCLE (PERCENT) | (1) LIFE (PERCENT PROBABILITY OF SURVIVAL) | (2) MEANTIME TO FAILURE (HOURS) | COMPONENT RELIABILITY (R) |
|---|--------------------------------|---|--|---------------------------------|
| COMMAND SYSTEM RECEIVER DECODER | 100 100 | 99.9 % FOR 100 HOURS 99.9 % FOR 100 HOURS | 10.5 10.5 | 0.985 (3) 0.985 (3) |
| TELEMETRY SYSTEM TRANSMITTER DC-DC CONVERTER | 10 10 | MINIMUM OF 10000 HOURS (75 % FOR 10000 HOURS) | 2.0×10^4 1.92×10^5 | 0.999 0.999 |
| VCO COMMUTATOR (SWITCH TYPE) | 10 100 | 95 % FOR 2000 HOURS 95 % FOR 1000 HOURS | 3.84×10^4 1.92×10^4 | 0.999 0.990 |
| TAPE RECORDER TIME REF GEN | 100 100 | 95 % FOR 200 HOURS 98 % FOR 2000 HOURS | 3.84×10^3 3.36×10^4 | 0.954 0.998 |
| POWER SYSTEM SOLAR CELLS BATTERY POWER PROGRAMMER & CONTROL | 100 100 100 | 95 % FOR 1440 HOURS (ESTIMATED) 95 % FOR 15000 HOURS 95 % FOR 20000 HOURS | 2.81×10^4 2.25×10^5 3.84×10^5 | 0.950 0.994 0.999 |
| | | OVERALL SYSTEM RELIABILITY = 0.800 | | 0.942 |

- NOTE: 1 PER INDIVIDUAL SPECIFICATIONS
 2 ASSUME EXPONENTIAL DENSITY FUNCTION $R = e^{-t/\lambda}$
 3 LIFE TEST ON SIMILAR EQUIPMENT CONDUCTED AT GEORGE C. MARSHALL SPACE FLIGHT CENTER - TOTAL NUMBER OF INTERROGATION CYCLES COMPLETED CORRESPONDS TO MAXIMUM INTERROGATION FOR 25 YEARS
 4 ASSUMED - ACTIVE LIFE OF SUBSATELLITE OF 60 DAYS (3 HOURS OF OPERATION PER DAY)

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