This ATM provides a projection of the maximum frequency of the Flight 5 and Spare ASE grenade transmitters up to 6 years from transmitter acceptance testing. This projection is based on recent KSC test results and provides assurance that the Apollo 16 transmitters will be within specification after a possible one year lunar storage.

Prepared by: McDowell

Approved by: W. Tosh, Manager
ALSEP Experiments
The Flight 5 (S/N-20) and Flight Spare (S/N-18) live grenade launch assemblies (GLA) were functionally tested at KSC on 29-30 September, 1971. These tests represented the second check on the S/N-20 and the first on the S/N-18 since the units were delivered to KSC in December 1968. The S/N-20 unit was previously checked in November 1970 as the back up unit for the Flight 4 GLA. A portion of the GLA functional test (TCP2337036) measures the frequency of each grenade transmitter. Since all of the production flight transmitters were acceptance tested in December, 1967 and January, 1968, the measurements at KSC provide another timely and accurate check of the 3 year projected frequency drift for each transmitter established by test at the time of acceptance. The KSC measurements also provide a valid basis for revising the 3 year projection and for projecting further drift up to 6 years. ASE grenade transmitters, to be deployed on Apollo 16, will be required by specification to operate after a one year storage on the lunar surface, or up to March 1973. Therefore, it is important to establish that the 6 year projected drift will still permit the transmitter frequencies to remain within the specification frequency tolerance (30.0 ± 0.1 MHz).

During development of the transmitters at Computing Devices of Canada (CDC) a slow, upward frequency drift with time was identified. Extensive testing was conducted to determine the cause of the drifting. The results of those tests eventually led to a new flight configuration design which minimized the frequency drift. In addition, testing over a period of six months verified that a 14 day test on each transmitter was sufficient to accurately predict the drift up to 1000 days, which at that time represented a two year earth and one year lunar storage capability. A 14-day drift test was thus instituted as part of the pre-acceptance testing for all qualification and flight model transmitters. The maximum projected drift limit was set at 40 KHz, and together with an allowable characteristic frequency bandwidth (difference between maximum and minimum frequencies measured during pre-acceptance tests) of 160 KHz, established the criteria for final acceptance or rejection of a transmitter. These criteria were selected to ensure that the frequencies throughout a 3 year storage would remain within the ±100 KHz frequency tolerance. Only one of the twenty-four 'production transmitters was rejected and not delivered because it's projected 3 year frequency drift (47 KHz) exceeded the allowable 40 KHz. The results of the 14 day drift test and 3 year projection curve were included in the acceptance data package (ADP) for each transmitter delivered.
As stated earlier, tests were conducted at CDC over a period of six months to establish the validity of using a 14 day drift test to project a 3 year drift. Frequency tests were conducted on 7 flight configuration transmitters for six months and resulted in CDC stating that the results verified that the 14 day drift test was sufficient to predict 3 year frequency drift within 15 KHz to 99.73% confidence limits. Table 1 is a summarization of acceptance test data and 3 year projected drifts from CDC ADPs on eight transmitters installed in S/N's-18 and -20 GLAs. The frequency measurements made on those units at KSC are also shown. It should be noted that the actual frequency drift represented by the 4 year measurements vary from +16 KHz to -11 KHz from the maximum drift projected by the CDC 14-day drift test, thus substantiating the predicted accuracy (15 KHz) of the tests and the 3 year drift projections.

Included in this ATM are the curves (frequency drift versus time) and frequency data reproduced from the ADPs of the flight transmitters. Each curve shows a revised drift vs time projection out to 6 years and the projected maximum frequencies are shown in Table 1. The revised drift for transmitters installed in GLA's S/N-18 and -20 are based on the actual frequency drift shown by the KSC 4 year measurements on those transmitters. Using this method of revising the 3 year projections and additionally projecting to six years shows all transmitter frequency tolerances will still be well within specification.

The initial drift vs time curves, derived at CDC, assumed a linear drift and were based on the curves shown drawn through a set of measured frequency points taken within the 14 day drift test at CDC. The revised projected drift curves similarly assume a linear drift which may not be the actual case. In the case of the S/N-18 transmitters, with only one frequency check point available, (4 year measurement) the revised drift must be based on the one point. In the case of the S/N-20 transmitters, the 4 year measurement point was also used. It should be noted that the additional frequency drift determined by a curve through the 3 year and 4 year measurements adds +2 KHz, +4 KHz, +2 KHz and +3 KHz to the 6 year projected maximum frequencies for the -1, -2, -3 and -4 grenades respectively. From the above, even in the worst case, the transmitter frequencies are still well within specification.
## TABLE 1

<table>
<thead>
<tr>
<th>GLA S/N</th>
<th>Grenade S/N</th>
<th>Grenade Transmitter S/N</th>
<th>CDC ACCEPTANCE DATA</th>
<th>KSG MEASURED DATA</th>
<th>PROJECTED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Max. Freq. During Accept. Test (MHz)</td>
<td>3 Year Projected Max. Projected Freq. (MHz)</td>
<td>3 Year Measured Freq. (MHz)</td>
<td>4 Year Measured Freq. (MHz)</td>
</tr>
<tr>
<td>18</td>
<td>-1</td>
<td>8</td>
<td>30.067</td>
<td>+17</td>
<td>30.084</td>
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<td>+10</td>
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<td>24</td>
<td>30.036</td>
<td>+12</td>
<td>30.048</td>
</tr>
</tbody>
</table>

*Frequency measured in November, 1970.
ASE TRANSMITTER PROJECTED MAXIMUM FREQUENCY

GLA S/N: 18
Grenade No: -1
Transmitter S/N: 8

A. Computing Devices of Canada (CDC) Acceptance Data

Date of acceptance test 22 Dec 1967

Maximum frequency measured during pre-acceptance test 30.064 MHz
Minimum frequency measured during pre-acceptance test 29.918 MHz

Characteristic frequency bandwidth 146 KHz

Projected frequency drift (1-1000 days) +17 KHz

Maximum frequency measured during acceptance test 30.067 MHz

Projected maximum frequency at 1000 days (3 years) 30.084 MHz

B. KSC Measured Frequencies

3 year measured frequency N/A MHz

4 year measured frequency 30.083 MHz

4 year actual frequency drift +16 KHz

C. Projected Maximum Frequency

Maximum frequency at 1800 days (5 years) 30.084 MHz

Maximum frequency at 2200 days (6 years) 30.084 MHz
ASE TRANSMITTER PROJECTED MAXIMUM FREQUENCY

GLA S/N: 18
Grenade No: -2
Transmitter S/N: 15

A. Computing Devices of Canada (CDC) Acceptance Data

Date of acceptance test 3 Jan 1968

- Maximum frequency measured during pre-acceptance test 30.031 MHz
- Minimum frequency measured during pre-acceptance test 29.952 MHz
- Characteristic frequency bandwidth 79 KHz
- Projected frequency drift (1 1000 days) 49 KHz
- Maximum frequency measured during acceptance test 30.040 MHz
- Projected maximum frequency at 1000 days (3 years) 30.049 MHz

B. KSC Measured Frequencies

- 3 year measured frequency N/A MHz
- 4 year measured frequency 30.046 MHz
- 4 year actual frequency drift +6 KHz

C. Projected Maximum Frequency

- Maximum frequency at 1800 days (5 years) 30.046 MHz
- Maximum frequency at 2200 days (6 years) 30.046 MHz
Projected Freq. Drift
GLA SIN = 16
GRENAGLE = 2
Transmitter SIN = 16

Freq. Drift in KHz

CDC Projected
3yr Drift

Revised Projected
Drift

4yr Measured
Drift

No. of Days
### ASE TRANSMITTER PROJECTED MAXIMUM FREQUENCY

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
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<td>Grenade No:</td>
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<td>Transmitter S/N:</td>
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</tbody>
</table>

#### A. Computing Devices of Canada (CDC) Acceptance Data

- **Date of acceptance test**: 5 Dec 1967
- **Maximum frequency measured during pre-acceptance test**: 30.047 MHz
- **Minimum frequency measured during pre-acceptance test**: 29.942 MHz
- **Characteristic frequency bandwidth**: 105 KHz
- **Projected frequency drift (1-1000 days)**: +10 KHz
- **Maximum frequency measured during acceptance test**: 30.052 MHz
- **Projected maximum frequency at 1000 days (3 years)**: 30.062 MHz

#### B. KSC Measured Frequencies

- **3 year measured frequency**: N/A MHz
- **4 year measured frequency**: 30.060 MHz
- **4 year actual frequency drift**: +8 KHz

#### C. Projected Maximum Frequency

- **Maximum frequency at 1800 days (5 years)**: 30.060 MHz
- **Maximum frequency at 2200 days (6 years)**: 30.060 MHz
ASE TRANSMITTER PROJECTED MAXIMUM FREQUENCY

GLA S/N: 18
Grenade No: 4
Transmitter S/N: 3

A. Computing Devices of Canada (CDC) Acceptance Data

Date of acceptance test 5 Dec 1967

Maximum frequency measured during pre-acceptance test 30.025 MHz
Minimum frequency measured during pre-acceptance test 29.936 MHz

Characteristic frequency bandwidth
[Formula]

Projected frequency drift (1-1000 days)
[Formula]

Maximum frequency measured during acceptance test 30.035 MHz

Projected maximum frequency at 1000 days (3 years) 30.049 MHz

B. KSC Measured Frequencies

3 year measured frequency
N/A MHz

4 year measured frequency
30.055 MHz

4 year actual frequency drift
+20 KHz

C. Projected Maximum Frequency

Maximum frequency at 1800 days (5 years) 30.056 MHz

Maximum frequency at 2200 days (6 years) 30.056 MHz
ASE TRANSMITTER PROJECTED MAXIMUM FREQUENCY

GLA S/N: 20
Grenade No: 1
Transmitter S/N: 21

A. Computing Devices of Canada (CDC) Acceptance Data

Date of acceptance test: 30 Jan 1968
Maximum frequency measured during pre-acceptance test: 30.042 MHz
Minimum frequency measured during pre-acceptance test: 29.901 MHz
Characteristic frequency bandwidth: 141 KHz
Projected frequency drift (1-1000 days): +16 KHz
Maximum frequency measured during acceptance test: 30.055 MHz
Projected maximum frequency at 1000 days (3 years): 30.071 MHz

B. KSC Measured Frequencies

3 year measured frequency: 30.066 MHz
4 year measured frequency: 30.068 MHz
4 year actual frequency drift: +13 KHz

C. Projected Maximum Frequency

Maximum frequency at 1800 days (5 years): 30.068 MHz
Maximum frequency at 2200 days (6 years): 30.069 MHz
ASE TRANSMITTER PROJECTED MAXIMUM FREQUENCY

GLA S/N: 20
Grenade No: -2
Transmitter S/N: 19

A. Computing Devices of Canada (CDC) Acceptance Data

Date of acceptance test: 29 Jan 1968

- Maximum frequency measured during pre-acceptance test: 30.039 MHz
- Minimum frequency measured during pre-acceptance test: 29.942 MHz
- Characteristic frequency bandwidth: 97 KHz
- Projected frequency drift (1-1000 days): +13 KHz
- Maximum frequency measured during acceptance test: 30.052 MHz
- Projected maximum frequency at 1000 days (3 years): 30.065 MHz

B. KSC Measured Frequencies

- 3 year measured frequency: 30.050 MHz
- 4 year measured frequency: 30.054 MHz
- 4 year actual frequency drift: +2 KHz

C. Projected Maximum Frequency

- Maximum frequency at 1800 days (5 years): 30.054 MHz
- Maximum frequency at 2200 days (6 years): 30.054 MHz
ASE TRANSMITTER PROJECTED MAXIMUM FREQUENCY

GLA S/N: 20
Grenade No: -3
Transmitter S/N: 17

A. Computing Devices of Canada (CDC) Acceptance Data

Date of acceptance test: 29 Jan 1968

Maximum frequency measured during pre-acceptance test: 30.017 MHz
Minimum frequency measured during pre-acceptance test: 29.914 MHz
Characteristic frequency bandwidth: 103 KHz
Projected frequency drift (1000 days): +26 KHz

Maximum frequency measured during acceptance test: 30.036 MHz
Projected maximum frequency at 1000 days (3 years): 30.062 MHz

B. KSC Measured Frequencies

3 year measured frequency: 30.074 MHz
4 year measured frequency: 30.078 MHz
4 year actual frequency drift: +42 KHz

C. Projected Maximum Frequency

Maximum frequency at 1800 days (5 years): 30.079 MHz
Maximum frequency at 2200 days (6 years): 30.080 MHz
SEMILOGARITHMIC 46 6013

PROTECTED FREQ. DRIFT
GLA SIN-20
CRANE 4-3
TRANSMITTER SIN-17

Revised: PROTECTED
DRIFT

4 YR. MEASURED DRIFT
5 YR. MEASURED DRIFT
WORST CASE DRIFT

FREQ. DRIFT
1,1 MHz

No. of Days

0 1 10 100 1000 1 6 Yrs. Yrs.
ASE TRANSMITTER PROJECTED MAXIMUM FREQUENCY

GLA S/N: 20
Grenade No: -4
Transmitter S/N: 24

A. Computing Devices of Canada (CDC) Acceptance Data

Date of acceptance test 30 Jan 1968
Maximum frequency measured during pre-acceptance test 30.038 MHz
Minimum frequency measured during pre-acceptance test 29.908 MHz
Characteristic frequency bandwidth 130 KHz
Projected frequency drift (+ 1000 days) +12 KHz
Maximum frequency measured during acceptance test 30.036 MHz
Projected maximum frequency at 1000 days (3 years) 30.048 MHz

B. KSC Measured Frequencies

3 year measured frequency 30.060 MHz
4 year measured frequency 30.064 MHz
4 year actual frequency drift +28 KHz

C. Projected Maximum Frequency

Maximum frequency at 1800 days (5 years) 30.065 MHz
Maximum frequency at 2200 days (6 years) 30.066 MHz
FREQ. DRIFT IN KHz.

TRANSMITTER S/N = 24
GRADE = 4

CABE PROJECTED 3YR. DRIFT

REVISED PROJECTED DRIFT

3YR. MEASURED DRIFT

5 YRS. YRS.