REVISION PAGE

1. This page records a running history of all changes to this procedure.
2. Rev. A is used to identify the first issue. Subsequent changes to the procedure are identified with letters in the revision column.
3. Description column should include brief before/after details of each change and the page number involved.
4. Every page in this procedure must have, in order, the drawing number, latest revision letter and page # of # located in the page footer.

Rev.	PCO No.	Page No. Affected	Description of Change	Engineer	Date
A			AS ISSUED	L. Fries	11-30-90
B	2-21684	All	Complete Rewrite	D. Montgomery	01-20-94
C	2-22408	10,19-22	Corrected Osc. # on pg.10. Added pages 19-22.	D. Montgomery	11-27-95
D	2-22774	Sections 12,13,14,15	updated specs. for -60158/60159/60160; added 10811-60164	D. Montgomery	10-16-96
E	2-23023	17,25	Added 10811-60260	D. Montgomery	05-01-97
F	2-23915	15	Updated index.	D. Montgomery	06-10-99
G	2-24149	15,16	Updated index.	D. Montgomery	10-26-99
H	2-24428	Section 11	Add Phase Noise Specs for 10811-60219	D. Montgomery	07-17-00

Document Owner: PFS Production Manager or Designate

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Performance Specifications for HP 10811D/E Family Crystal Oscillators

1 10811D/E Crystal Oscillators

The performance specifications in section 1 also apply to the following options and subassemblies:

10811-60120	10811D Replacement
10811-69120	10811D "Blue Stripe" Replacement
10811-60126	10811E Replacement
10811-69126	10811E "Blue Stripe" Replacement
10811E Option H40	
10811-60132	10811E Option H40 Replacement
10811-69132	10811E Option H40 "Blue Stripe" Replacement

1.1 Output Signal

1.1.1 Frequency: 10.000000 MHz.

1.1.2 Voltage: .55V ± .05V rms into 50 Ω

1.1.3 Harmonic Distortion: < -25 dBc.

1.1.4 Spurious Phase Modulation: < -100 dBc (discrete sidebands 10 Hz to 25 kHz).

1.2 Frequency Adjustment

1.2.1 Coarse Tuning Range: > ± $1x10^{-6}$ (± 10 Hz).

1.2.2 Electronic Frequency Control (EFC): ≥ $1x10^{-7}$ (1 Hz) total for control. range of -5V to +5V

1.3 Frequency Stability

1.3.1 Long Term Stability (Aging Rate):

Aging rate (long term frequency stability is defined as the absolute value (magnitude) of the fractional frequency change with time. An observation time sufficiently long to reduce the effects of random noise to an insignificant value is implied. Frequency changes due to environmental effects must be considered separately.

1.3.1.1 < 5×10^{-10} / day after 24 hour warm up when:

1.3.1.1.1 oscillator off time was less than 24 hours and

1.3.1.1.2 oscillator aging rate was < 5×10^{-10} / day prior to turn off.

1.3.1.2 < 5×10^{-10} / day in less than 30 days of continous operation for off time of greater than 24 hours.

1.3.1.3 < 1×10^{-7} / year for continous operation (Typical 1×10^{-8} / year after 1 year)

1.4 Time Domain Stability

Time domain stability ($\sigma_y(\tau)$) is defined as the two sample deviation of fractional fluctuations due to random noise in the oscillator. The measurement bandwidth is 100 kHz. See NBS Monograph 140 for measurement details.

Averaging Time (seconds) τ	Stability $\sigma_y(\tau)$
.001	< 1.5×10^{-10}
.01	< 1.5×10^{-11}
.1	< 5.0×10^{-12}
1	< 5.0×10^{-12}
10	< 5.0×10^{-12}
100	< 1.0×10^{-11}
(Typical)1000	< 1.0×10^{-11}

1.5 Frequency Domain Stability (Phase Noise)

Frequency domain stability is defined as the single sideband noise to signal ratio per Hertz of bandwidth (a power spectral density). This ratio is analogous to a sprectrum analyzer display of the carrier versus either phase modulation sideband. See NBS Monograph 140 for measurement details.

Offset from Signal (Hz)	Phase Noise (dBc)
1	< -100
10	< -130
100	< -150
1000	< -157
10000	< -160

1.6 Warm Up

1.6.1 $< 5 \times 10^{-9}$ of final value 10 minutes after turn on when:

1.6.1.1 oscillator is operated in a 25° C environment with 20 Vdc oven supply voltage,

1.6.1.2 oscillator off time was less than 24 hours,

1.6.1.3 oscillator aging rate was $< 5 \times 10^{-10}$ / day prior to turn off..

1.6.1.4 Final value is defined as oscillator frequency 24 hours after turn on.

1.7 Environmental Sensitivity

1.7.1 Temperature

1.7.1.1 Frequency Change: $< 4.5 \times 10^{-9}$ from 0° C to +71°C.

1.7.1.2 Operating Range: 0° C to +71°C.

1.7.1.3 Storage Range: -55° C to +85°C.

1.7.2 Load: $< 5 \times 10^{-10}$ for $\pm$ 10% change in 50 Ω load on output.

1.7.3 Power Supply

1.7.3.1 Oscillator Supply: $< 2 \times 10^{-10}$ for 1% change.

1.7.3.2 Oven Supply: $< 2.5 \times 10^{-10}$ ($< 1 \times 10^{-10}$ typical) for 10% change.

1.7.4 Gravitational Field: $< 4 \times 10^{-9}$ for 2g static shift (180° change in position).

1.7.5 Magnetic Field: Sidebands < -90 dBc for .1 mTesla (1 Gauss) field at 100 Hz

1.7.6 Humidity (typical): $< 1 \times 10^{-9}$ for 95% relative humidity at 40° C.

1.7.7 Shock (survival): 30 g, 11 ms, 1/2 sinwave.

1.7.8 Altitude (typical): $< 2 \times 10^{-9}$ for 0 to 50,000 ft.

1.8 Power Requirements

1.8.1 Oscillator Circuit:

1.8.1.1 11.0 to 13.5 Vdc.

1.8.1.2 30 mA typical, 40 mA.

1.8.1.3 < 100 μV ripple and noise

1.8.2 Oven Circuit:

1.8.2.1 20 to 30 Vdc

1.8.2.2 480 mA at 20 V to 720 mA at 30V max.(turn on load is constant and 42 Ω minimum)

1.8.2.3 Steady state power drops to approximately 2 W at 25° C in still air at 20 V.

2 10811D/E Option 001

The performance specifications in section 2 also apply to the following subassemblies:

10811-60121	10811D Option 001 Replacement
10811-60127	10811E Option 001 Replacement

The performance specifications for the 10811D/E Option 001 are the same as the 10811D/E with the following exceptions:

2.1 Aging Rate:

Aging rate (long term frequency stability is defined as the absolute value (magnitude) of the fractional frequency change with time. An observation time sufficiently long to reduce the effects of random noise to an insignificant value is implied. Frequency changes due to environmental effects must be considered separately.

2.1.0.1 $< 1 \times 10^{-10}$ / day after 24 hour warm up when:

2.1.0.1.1 oscillator off time was less than 24 hours and

2.1.0.1.2 oscillator aging rate was $< 1 \times 10^{-10}$ / day prior to turn off.

2.1.0.2 $< 1 \times 10^{-10}$ / day in less than 30 days of continous operation for off time of greater than 24 hours.

2.1.1 $< 3.6 \times 10^{-7}$ / year for continous operation.

3 10811D/E Option 002

The performance specifications in section 3 also apply to the following subassemblies:

10811-60122	10811D Option 002 Replacement
10811-60128	10811E Option 002 Replacement

The performance specifications for the 10811D/E Option 002 are the same as the 10811D/E with the following exceptions:

3.1 Frequency Domain Stability (Phase Noise)

Frequency domain stability is defined as the single sideband noise to signal ratio per Hertz of bandwidth (a power spectral density). This ratio is analogous to a sprectrum analyzer display of the carrier versus either phase modulation sideband. See NBS Monograph 140 for measurement details

.

Offset from Signal (Hz)	Phase Noise (dBc)
1	< -103
10	< -133
100	< -153
1000	< -162
10000	< -162

4 10811D/E Option 003

The performance specifications in section 4 also apply to the following subassemblies

10811-60123	10811D Option 003 Replacement
10811-60129	10811E Option 003 Replacement

The performance specifications for the 10811D/E Option 003 are the same as the 10811D/E with the following exceptions:

4.1 Aging Rate:

Aging rate (long term frequency stability is defined as the absolute value (magnitude) of the fractional frequency change with time. An observation time sufficiently long to reduce the effects of random noise to an insignificant value is implied. Frequency changes due to environmental effects must be considered separately.

4.1.0.1 $< 1 \times 10^{-10}$ / day after 24 hour warm up when:

4.1.0.1.1 oscillator off time was less than 24 hours and

4.1.0.1.2 oscillator aging rate was $< 1 \times 10^{-10}$ / day prior to turn off.

4.1.0.2 $< 1 \times 10^{-10}$ / day in less than 30 days of continous operation for off time of greater than 24 hours.

4.1.0.3 $< 3.6 \times 10^{-7}$ / year for continous operation.

4.2 Frequency Domain Stability (Phase Noise)

Frequency domain stability is defined as the single sideband noise to signal ratio per Hertz of bandwidth (a power spectral density). This ratio is analogous to a sprectrum analyzer display of the carrier versus either phase modulation sideband. See NBS Monograph 140 for measurement details

Offset from Signal (Hz)	Phase Noise (dBc)
1	< -103
10	< -133
100	< -153
1000	< -162
10000	< -162

5 10811D/E Option 100

The performance specifications in section 5 also apply to the following subassemblies:

10811-60125	10811D Option 100 Replacement
10811-60131	10811E Option 100 Replacement
10811E Option H41	
10811-60133	10811E Option H41 Replacement
10811-69133	10811E Option H41 "Blue Stripe" Replacement

The performance specifications for the 10811D/E Option H41 are the same as the 10811D/E with the following exceptions

5.1 Frequency Adjustment

5.1.1 Coarse Tuning Range: > $\pm$ 8 x 10^{-7} ($\pm$ 8 Hz).

5.1.2 Electronic Frequency Control (EFC): Not Specified

5.2 Frequency Stability

5.2.1 Long Term Stability (Aging Rate):

Aging rate (long term frequency stability is defined as the absolute value (magnitude) of the fractional frequency change with time. An observation time sufficiently long to reduce the effects of random noise to an insignificant value is implied. Frequency changes due to environmental effects must be considered separately.

5.2.1.1 < 1.5 x 10^{-9} / day after 24 hour warm up when:

5.2.1.1.1 oscillator off time was less than 24 hours and

5.2.1.1.2 oscillator aging rate was < 1.5 x 10^{-9} / day prior to turn off.

5.2.1.2 < 1.5 x 10^{-9} / day in less than 30 days of continous operation for off time of greater than 24 hours.

5.2.1.3 < 5.5 x 10^{-7} / year for continous operation.

5.3 Time Domain Stability

Time domain stability ($\sigma_y(\tau)$) is defined as the two sample deviation of fractional fluctuations due to random noise in the oscillator. The measurement bandwidth is 100 kHz. See NBS Monograph 140 for measurement details
.

Averaging Time (seconds) τ	Stability $\sigma_y(\tau)$
.001	Not Specified
.01	Not Specified
.1	Not Specified
1	$< 1.0 \times 10^{-11}$
10	Not Specified
100	Not Specified
1,000	Not Specified

5.4 Frequency Domain Stability (Phase Noise)

Frequency domain stability is defined as the single sideband noise to signal ratio per Hertz of bandwidth (a power spectral density). This ratio is analogous to a sprectrum analyzer display of the carrier versus either phase modulation sideband. See NBS Monograph 140 for measurement details.

Offset from Signal (Hz)	Phase Noise (dBc)
1	Not Specified
10	Not Specified
100	Not Specified
1000	< -155
10000	Not Specified

5.5 Warm Up

5.5.1 $< 6 \times 10^{-9}$ of final value 10 minutes after turn on when:

5.5.1.1 oscillator is operated in a 25° C environment with 20 Vdc oven supply voltage,

5.5.1.2 oscillator off time was less than 24 hours,

5.5.1.3 oscillator aging rate was $< 1.5 \times 10^{-9}$ / day prior to turn off.

5.5.1.4 Final value is defined as oscillator frequency 24 hours after turn on.

5.6 Temperature

5.6.1 Frequency Change: $< 7 \times 10^{-9}$ from 0° C to +71°C.

5.7 Power Supply

5.7.1 Oscillator Supply: < 1×10^{-8} for 1% change.

5.7.2 Oven Supply: < 1×10^{-9} for 10% change.

5.8 Gravitational Field

Not Specified

5.9 Magnetic Field

Not Specfied

6 10811-60111

The performance specifications in section 6 also apply to the following subassemblies:

10811-69001	10811-60111 "Blue Stripe" Replacement

The performance specifications for the 10811-60111 are the same as the 10811D/E with the following exceptions:

6.1 Time Domain Stability

Time domain stability ($\sigma_y(\tau)$) is defined as the two sample deviation of fractional fluctuations due to random noise in the oscillator. The measurement bandwidth is 100 kHz. See NBS Monograph 140 for measurement details.

Averaging Time (seconds) τ	Stability $\sigma_y(\tau)$
.001	Not Specified
.01	Not Specified
.1	Not Specified
1	$< 1.0 \times 10^{-11}$
10	Not Specified
100	Not Specified
1,000	Not Specified

6.2 Frequency Domain Stability (Phase Noise)

Not Specified.

6.3 Gravitational Field

Not Specified

6.4 Magnetic Field

Not Specified

7 10811-60109

The performance specifications for the 10811-60109 are the same as the 10811D/E with the following exceptions:

7.1 Time Domain Stability

Time domain stability ($\sigma_y(\tau)$) is defined as the two sample deviation of fractional fluctuations due to random noise in the oscillator. The measurement bandwidth is 100 kHz. See NBS Monograph 140 for measurement details.

Averaging Time (seconds) τ	Stability $\sigma_y(\tau)$
.001	$< 1.5 \times 10^{-10}$
.01	$< 1.5 \times 10^{-11}$
.1	$< 5.0 \times 10^{-12}$
1	$< 2.5 \times 10^{-12}$
10	$< 5.0 \times 10^{-12}$
100	$< 1.0 \times 10^{-11}$
1,000	$< 1.0 \times 10^{-11}$

7.2 Frequency Domain Stability (Phase Noise)

Frequency domain stability is defined as the single sideband noise to signal ratio per Hertz of bandwidth (a power spectral density). This ratio is analogous to a sprectrum analyzer display of the carrier versus either phase modulation sideband. See NBS Monograph 140 for measurement details

.

Offset from Signal (Hz)	Phase Noise (dBc)
1	< -95
10	< -120
100	< -140
1000	< -157
10000	< -160

8 10811-60209

The performance specifications for the 10811-60209 are the same as the 10811D/E with the following exceptions:

8.1 Time Domain Stability

Time domain stability ($\sigma_y(\tau)$) is defined as the two sample deviation of fractional fluctuations due to random noise in the oscillator. The measurement bandwidth is 100 kHz. See NBS Monograph 140 for measurement details.

Averaging Time (seconds) τ	Stability $\sigma_y(\tau)$
.001	Not Specified
.01	Not Specified
.1	Not Specified
1	$< 1.0 \times 10^{-11}$
10	Not Specified
100	Not Specified
1,000	Not Specified

8.2 Frequency Domain Stability (Phase Noise)

Frequency domain stability is defined as the single sideband noise to signal ratio per Hertz of bandwidth (a power spectral density). This ratio is analogous to a sprectrum analyzer display of the carrier versus either phase modulation sideband. See NBS Monograph 140 for measurement details.

Offset from Signal (Hz)	Phase Noise (dBc)
1	< -103
10	< -133
100	< -153
1000	< -162
10000	< -162

8.3 Temperature

8.3.1 Frequency Change: $\leq 7.0 \times 10^{-9}$ from 0° C to +71°C.

8.4 Gravitational Field

8.4.1 Not Specified

8.5 Magnetic Field

8.5.1 Not Specified

9 10811-60211

The performance specifications in section 9 also apply to the following subassemblies:

10811-60260	10811-60160 with improved aging

The performance specifications for the 10811-60211 are the same as the 10811D/E with the following exceptions:

9.1 Time Domain Stability

Time domain stability ($\sigma_y(\tau)$) is defined as the two sample deviation of fractional fluctuations due to random noise in the oscillator. The measurement bandwidth is 100 kHz. See NBS Monograph 140 for measurement details

Averaging Time (seconds) τ	Stability $\sigma_y(\tau)$
.001	Not Specified
.01	Not Specified
.1	Not Specified
1	$< 1.0 \times 10^{-11}$
10	Not Specified
100	Not Specified
1,000	Not Specified

9.2 Frequency Domain Stability (Phase Noise)

9.2.1 Not Specified

9.3 Aging Rate:

Aging rate (long term frequency stability is defined as the absolute value (magnitude) of the fractional frequency change with time. An observation time sufficiently long to reduce the effects of random noise to an insignificant value is implied. Frequency changes due to environmental effects must be considered separately.

9.3.0.1 $< 1 \times 10^{-10}$ / day after 24 hour warm up when:

9.3.0.1.1 oscillator off time was less than 24 hours and

9.3.0.1.2 oscillator aging rate was $< 1 \times 10^{-10}$ / day prior to turn off.

9.3.0.2 $< 1 \times 10^{-10}$ / day in less than 30 days of continous operation for off time of greater than 24 hours.

9.3.0.3 $< 3.6 \times 10^{-7}$ / year for continous operation.

10 10811-60102

The performance specifications for the 10811-60102 are the same as the 10811D/E with the following exceptions:

10.1 Temperature

10.1.1 Frequency Change: $< 7.0 \times 10^{-9}$ from 0° C to +71°C

11 05071-60219

The performance specifications in section 11 also apply to the following options and subassemblies:

05071-69219	05071-60219 "Blue Stripe" Replacement

The performance specifications for the 05071-60219 are the same as the 10811D/E with the following exceptions:

11.1 Frequency Adjustment

11.1.1 Coarse Tuning Range: > ± 5×10^{-7} (± 5 Hz).

11.1.2 Electronic Frequency Control (EFC): [3] ± 2.5×10^{-7} (± 2.5 Hz) for control. range of -5V to +5V

11.2 Time Domain Stability

Time domain stability (s_y (t)) is defined as the two sample deviation of fractional fluctuations due to random noise in the oscillator. The measurement bandwidth is 100 kHz. See NBS Monograph 140 for measurement details.

Averaging Time (seconds) t	Stability s_y (t)
.001	< 1.5×10^{-10}
.01	< 1.5×10^{-11}
.1	< 4.5×10^{-12}
1	< 2.5×10^{-12}
10	< 5.0×10^{-12}
100	< 1.0×10^{-11}
(Typical)1000	< 1.0×10^{-11}

11.3 Frequency Domain Stability (Phase Noise)

Frequency domain stability is defined as the single sideband noise to signal ratio per Hertz of bandwidth (a power spectral density). This ratio is analogous to a sprectrum analyzer display of the carrier versus either phase modulation sideband. See NBS Monograph 140 for measurement details.

Offset from Signal (Hz)	Phase Noise (dBc)
1	< -100
10	< -137
100	< -150
1000	< -155
10000	< -155

12 10811-60158

The performance specifications in section 12 also apply to the following options and subassemblies:

10811-60159	10811-60158 with shock mount studs

The performance specifications for the 10811-60158/60159 are the same as the 10811D/E with the following exceptions:

12.1 Frequency Adjustment

12.1.1 Coarse Tuning Range: > ± $5x10^{-7}$ (± 5 Hz).

12.1.2 Electronic Frequency Control (EFC): > ± $2.0x10^{-7}$ (± 2.5 Hz) for control. range of -5V to +5V

12.2 Frequency Stability

12.2.1 Long Term Stability (Aging Rate):

Aging rate (long term frequency stability is defined as the absolute value (magnitude) of the fractional frequency change with time. An observation time sufficiently long to reduce the effects of random noise to an insignificant value is implied. Frequency changes due to environmental effects must be considered separately.

12.2.1.1 < 2.5×10^{-10} / day after 24 hour warm up when:

12.2.1.1.1 oscillator off time was less than 24 hours and

12.2.1.1.2 oscillator aging rate was <2.5×10^{-10} / day prior to turn off.

12.2.1.2 < 2.5×10^{-10} / day in less than 30 days of continous operation for off time of greater than 24 hours.

12.2.1.3 < 1×10^{-7} / year for continous operation (Typical 1×10^{-8} / year after 1 year)

12.3 Time Domain Stability

Time domain stability ($\sigma_y(\tau)$) is defined as the two sample deviation of fractional fluctuations due to random noise in the oscillator. The measurement bandwidth is 100 kHz. See NBS Monograph 140 for measurement details.

Averaging Time (seconds) τ	Stability $\sigma_y(\tau)$
.001	$< 1.5 \times 10^{-10}$
.01	$< 1.5 \times 10^{-11}$
.1	$< 5.0 \times 10^{-12}$
1	$< 9.8 \times 10^{-13}$
10	$< 5.0 \times 10^{-12}$
100	$< 1.0 \times 10^{-11}$
(Typical)1000	$< 1.0 \times 10^{-11}$

12.4 Frequency Domain Stability (Phase Noise)

Frequency domain stability is defined as the single sideband noise to signal ratio per Hertz of bandwidth (a power spectral density). This ratio is analogous to a sprectrum analyzer display of the carrier versus either phase modulation sideband. See NBS Monograph 140 for measurement details.

Offset from Signal (Hz)	Phase Noise (dBc)
1	< -95
10	< -125
100	< -135
1000	< -145
10000	< -150

12.5 Environmental Sensitivity

12.5.1 Gravitational Sensitivity: Not Specified

12.6 Power Requirements

12.6.1 Oven Circuit:

12.6.1.1 12 to 30 Vdc

12.6.1.2 11 W max.at turn on

12.6.1.3 Steady state power drops to approximately 2 W at 25° C in still air at 20 V.

13 10811-60160

The performance specifications in section 13 also apply to the following options and subassemblies:

The performance specifications for the 10811-60160 are the same as the 10811-60111 with the following exceptions:

13.1 Frequency Adjustment

13.1.1 Coarse Tuning Range: > ± $5x10^{-7}$ (± 5 Hz).

13.1.2 Electronic Frequency Control (EFC): > ± $2.0x10^{-7}$ (± 2.5 Hz) for control. range of -5V to +5V

13.2 Power Requirements

13.2.1 Oven Circuit:

13.2.1.1 12 to 30 Vdc

13.2.1.2 11 W max.at turn on

13.2.1.3 Steady state power drops to approximately 2 W at 25° C in still air at 20 V.

14 10811-60164

The performance specifications in section 6 also apply to the following subassemblies:

The performance specifications for the 10811-60164 are the same as the 10811D/E with the following exceptions:

14.1 Output Signal

14.1.1 Harmonic Distortion: Not Specified

14.1.2 Spurious Phase Modulation: Not Specified

14.2 Frequency Adjustment

14.2.1 Coarse Tuning Range: $> \pm 5 \times 10^{-7}$ ($\pm$ 5 Hz).

14.2.2 Electronic Frequency Control (EFC): $> \pm 2.0 \times 10^{-7}$ ($\pm$ 2.5 Hz) for control. range of -5V to +5V

14.3 Frequency Stability

14.3.1 Long Term Stability (Aging Rate):

Aging rate (long term frequency stability is defined as the absolute value (magnitude) of the fractional frequency change with time. An observation time sufficiently long to reduce the effects of random noise to an insignificant value is implied. Frequency changes due to environmental effects must be considered separately.

14.3.1.1 $< 1 \times 10^{-8}$ / day

14.4 Time Domain Stability

Not Specified

14.5 Frequency Domain Stability (Phase Noise)

Not Specified.

14.6 Warm Up

Not Specified

14.7 Environmental Sensitivity

Not Specified

14.8 Power Requirements

14.8.1 Oven Circuit:

14.8.1.1 12 to 30 Vdc

14.8.1.2 11 W max.at turn on

14.8.1.3 Steady state power drops to approximately 2 W at 25° C in still air at 20 V.

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