

QPLL2 irradiation test: evaluation using several non-irradiated reference crystals

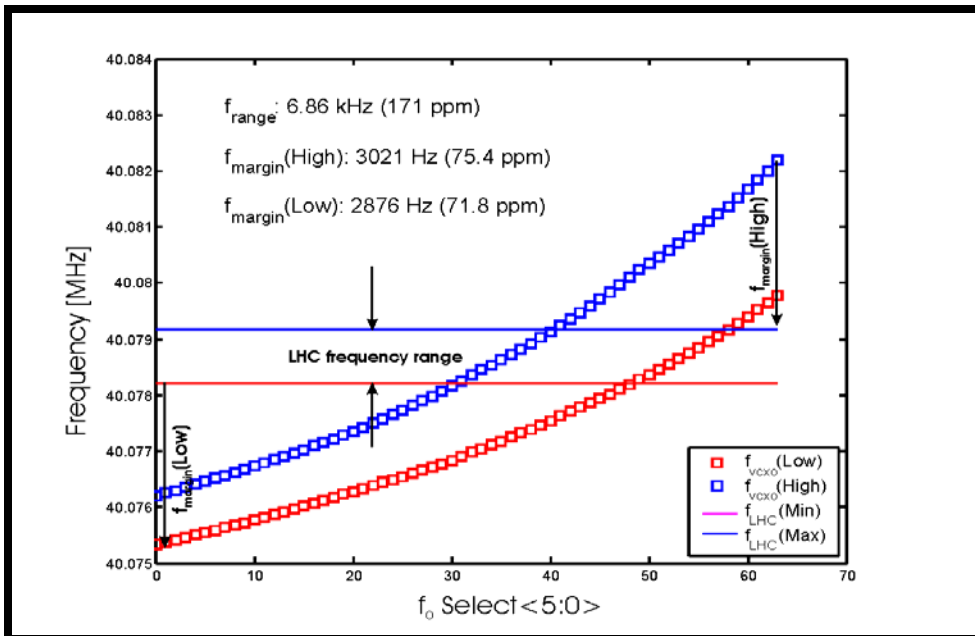
Reference crystals:

5.5 pF calibrated crystals, samples: 3, 4, 5, 6, 7, 8, 9, 10;
Lot. No.: MC168209, Xtals marked MC0350
All QPLL2: 10 Mrad (Co-60 gammas)

Test conditions:

For each chip all the crystals are used.
The frequency is measured for each value of foSelect
One measurement is made for CLKIN = 0 and another one for CLKIN = 1
f(LHC): 40078686 [Hz]

The meaning of the measurements is clarified in the figure below.



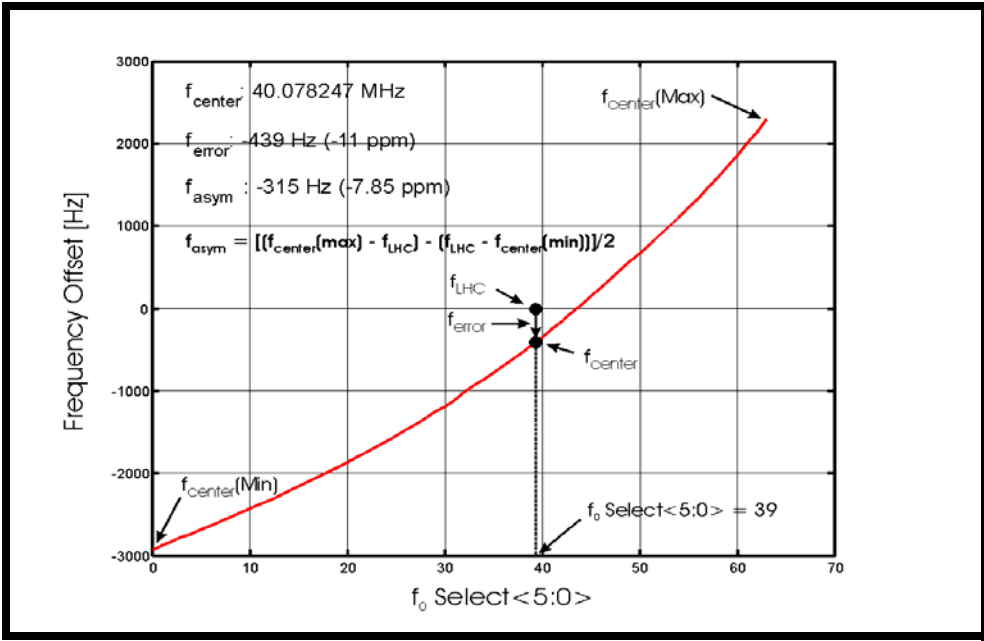
QPLL2 sample #	Crystal sample #	f range (kHz)	f range (ppm)	f marg(low) (Hz)	f marg(low) (ppm)	f marg(high) (Hz)	f marg(high) (ppm)
1	3	7.98	199	3969	99	3047	76
1	4	7.56	189	4268	106	2327	58
1	5	6.97	174	3247	81	2764	69
1	6	8.08	202	5144	128	1977	49
1	7	8.33	208	3992	100	3379	84
1	8	8.02	200	2773	69	4287	107
1	9	6.86	171	2876	72	3021	75
1	10	9.10	227	3758	94	4384	109
<>		7.86	196	3753	94	3148	79
σ		0.73	18	783	20	853	21
Min		6.86	171	2773	69	1977	49
Max		9.10	227	5144	128	4384	109

QPLL2 sample #	Crystal sample #	f range (kHz)	f range (ppm)	f marg(low) (Hz)	f marg(low) (ppm)	f marg(high) (Hz)	f marg(high) (ppm)
4	3	8.16	204	3745	93	3453	86
4	4	8.53	213	4179	104	3385	84
4	5	7.09	177	3131	78	2992	75
4	6	8.18	204	5173	129	2044	51
4	7	8.48	212	3931	98	3589	90
4	8	8.34	208	4191	105	3184	79
4	9	6.83	170	2524	63	3345	83
4	10	9.20	230	3735	93	4500	112
<>		8.10	202	3826	95	3312	83
σ		0.78	19	782	20	680	17
Min		6.83	170	2524	63	2044	51
Max		9.20	230	5173	129	4500	112

QPLL2 sample #	Crystal sample #	f range (kHz)	f range (ppm)	f marg(low) (Hz)	f marg(low) (ppm)	f marg(high) (Hz)	f marg(high) (ppm)
5	3	7.81	195	3965	99	2885	72
5	4	7.54	188	4411	110	2172	54
5	5	6.85	171	3287	82	2601	65
5	6	8.06	201	5241	131	1861	46
5	7	8.48	212	4045	101	3476	87
5	8	8.08	202	4278	107	2840	71
5	9	6.94	173	3004	75	2978	74
5	10	8.88	222	3633	91	4290	107
<>		7.83	195	3983	99	2888	72
σ		0.70	18	699	17	753	19
Min		6.85	171	3004	75	1861	46
Max		8.88	222	5241	131	4290	107

QPLL2 sample #	Crystal sample #	f range (kHz)	f range (ppm)	f marg(low) (Hz)	f marg(low) (ppm)	f marg(high) (Hz)	f marg(high) (ppm)
6	3	8.29	207	3696	92	3631	91
6	4	7.52	188	4182	104	4182	104
6	5	7.34	183	3082	77	3295	82
6	6	8.54	213	4921	123	2661	66
6	7	8.76	219	3809	95	3987	99
6	8	8.55	213	4127	103	3462	86
6	9	7.03	175	2731	68	3339	83
6	10	9.50	237	3507	88	5029	125
<>		8.19	204	3757	94	3698	92
σ		0.83	21	681	17	709	18
Min		7.03	175	2731	68	2661	66
Max		9.50	237	4921	123	5029	125

All possible combinations: QPLL-Xtal	f range (kHz)	f range (ppm)	f marg(low) (Hz)	f marg(low) (ppm)	f marg(high) (Hz)	f marg(high) (ppm)
<>	8.00	200	3830	96	3261	81
σ	0.74	18	707	18	774	19
Min	6.83	170	2524	63	1861	46
Max	9.50	237	5241	131	5029	125



QPLL2 sample #	Crystal sample #	f center (MHz)	f error (Hz)	f error (ppm)	f asym (Hz)	f asym (ppm)
1	3	40.077765	-921	-23	-851	-21
1	4	40.077345	-1340	-33	-1410	-35
1	5	40.077643	-1040	-26	-724	-18
1	6	40.077658	-2110	-53	-2060	-51
1	7	40.077881	-805	-20	-759	-19
1	8	40.077283	-1400	-35	-1250	-31
1	9	40.078247	-439	-11	-315	-8
1	10	40.078302	-384	-10	-189	-5
<>		40.077766	-1055	-26	-945	-24
σ		0.000372	564	14	611	15
Min		40.077283	-2110	-53	-2060	-51
Max		40.078302	-384	-10	-189	-5

QPLL2 sample #	Crystal sample #	f center (MHz)	f error (Hz)	f error (ppm)	f asym (Hz)	f asym (ppm)
4	3	40.077986	-700	-17	-567	-14
4	4	40.077554	-1130	-28	-1020	-25
4	5	40.077822	-843	-21	-559	-14
4	6	40.076625	-2060	-51	-2040	-51
4	7	40.078044	-642	-16	-625	-16
4	8	40.077683	-1003	-25	-999	-25
4	9	40.078511	-175	-4	-15	0
4	10	40.078402	-284	-7	-176	-4
<>		40.077828	-855	-21	-750	-19
σ		0.000587	586	15	627	16
Min		40.076625	-2060	-51	-2040	-51
Max		40.078511	-175	-4	-15	0

QPLL2 sample #	Crystal sample #	f center (MHz)	f error (Hz)	f error (ppm)	f asym (Hz)	f asym (ppm)
5	3	40.077593	-1090	-27	-942	-24
5	4	40.077254	-1430	-36	-1580	-39
5	5	40.077585	-1100	-27	-832	-21
5	6	40.076397	-2290	-57	-2190	-55
5	7	40.077413	-1270	-32	-1230	-31
5	8	40.078237	-449	-11	-407	-10
5	9	40.078237	-449	-11	-407	-10
5	10	40.078200	-486	-12	-226	-6
<>		40.077615	-1071	-27	-977	-24
σ		0.000629	629	16	669	17
Min		40.076397	-2290	-57	-2190	-55
Max		40.078237	-449	-11	-226	-6

QPLL2 sample #	Crystal sample #	f center (MHz)	f error (Hz)	f error (ppm)	f asym (Hz)	f asym (ppm)
6	3	40.078325	-361	-9	-421	-11
6	4	40.077575	-1110	-28	-1280	-32
6	5	40.078060	-626	-16	-359	-9
6	6	40.076974	-1710	-43	-1640	-41
6	7	40.078198	-488	-12	-408	-10
6	8	40.077848	-838	-21	-829	-21
6	9	40.078486	-200	-5	-86	-2
6	10	40.078716	-30	-1	-255	-6
<>		40.078023	-670	-17	-660	-16
σ		0.000554	543	14	545	14
Min		40.076974	-1710	-43	-1640	-41
Max		40.078716	-30	-1	-86	-2

All possible combinations: QPLL-Xtal	f center (MHz)	f error (Hz)	f error (ppm)	f asym (Hz)	f asym (ppm)
<>	40.077808	-913	-23	-833	-21
σ	0.000538	577	14	599	15
Min	40.076397	-2290	-57	-2190	-55
Max	40.078716	-30	-1	-15	0

QPLL2 sample #	Crystal sample #	f range (kHz)	f range (ppm)	f marg(low) (Hz)	f marg(low) (ppm)	f marg(high) (Hz)	f marg(high) (ppm)
1	3	7.98	199	3969	99	3047	76
4	3	8.16	204	3745	93	3453	86
5	3	7.81	195	3965	99	2885	72
6	3	8.29	207	3696	92	3631	91
<>		8.06	201	3844	96	3254	81
σ		0.21	5	144	4	347	9
Min		7.81	195	3696	92	2885	72
Max		8.29	207	3969	99	3631	91

QPLL2 sample #	Crystal sample #	f range (kHz)	f range (ppm)	f marg(low) (Hz)	f marg(low) (ppm)	f marg(high) (Hz)	f marg(high) (ppm)
1	4	7.56	189	4268	106	2327	58
4	4	8.53	213	4179	104	3385	84
5	4	7.54	188	4411	110	2172	54
6	4	7.52	188	4182	104	4182	104
<>		7.79	194	4260	106	3017	75
σ		0.50	12	109	3	946	24
Min		7.52	188	4179	104	2172	54
Max		8.53	213	4411	110	4182	104

QPLL2 sample #	Crystal sample #	f range (kHz)	f range (ppm)	f marg(low) (Hz)	f marg(low) (ppm)	f marg(high) (Hz)	f marg(high) (ppm)
1	5	6.97	174	3247	81	2764	69
4	5	7.09	177	3131	78	2992	75
5	5	6.85	171	3287	82	2601	65
6	5	7.34	183	3082	77	3295	82
<>		7.06	176	3187	80	2913	73
σ		0.21	5	96	2	301	8
Min		6.85	171	3082	77	2601	65
Max		7.34	183	3287	82	3295	82

QPLL2 sample #	Crystal sample #	f range (kHz)	f range (ppm)	f marg(low) (Hz)	f marg(low) (ppm)	f marg(high) (Hz)	f marg(high) (ppm)
1	6	8.08	202	5144	128	1977	49
4	6	8.18	204	5173	129	2044	51
5	6	8.06	201	5241	131	1861	46
6	6	8.54	213	4921	123	2661	66
<>		8.22	205	5120	128	2136	53
σ		0.22	6	139	3	358	9
Min		8.06	201	4921	123	1861	46
Max		8.54	213	5241	131	2661	66

QPLL2 sample #	Crystal sample #	f range (kHz)	f range (ppm)	f marg(low) (Hz)	f marg(low) (ppm)	f marg(high) (Hz)	f marg(high) (ppm)
1	7	8.33	208	3992	100	3379	84
4	7	8.48	212	3931	98	3589	90
5	7	8.48	212	4045	101	3476	87
6	7	8.76	219	3809	95	3987	99
<>		8.51	212	3944	98	3608	90
σ		0.18	4	101	3	267	7
Min		8.33	208	3809	95	3379	84
Max		8.76	219	4045	101	3987	99

QPLL2 sample #	Crystal sample #	f range (kHz)	f range (ppm)	f marg(low) (Hz)	f marg(low) (ppm)	f marg(high) (Hz)	f marg(high) (ppm)
1	8	8.02	200	2773	69	4287	107
4	8	8.34	208	4191	105	3184	79
5	8	8.08	202	4278	107	2840	71
6	8	8.55	213	4127	103	3462	86
<>		8.25	206	3842	96	3443	86
σ		0.24	6	716	18	617	15
Min		8.02	200	2773	69	2840	71
Max		8.55	213	4278	107	4287	107

QPLL2 sample #	Crystal sample #	f range (kHz)	f range (ppm)	f marg(low) (Hz)	f marg(low) (ppm)	f marg(high) (Hz)	f marg(high) (ppm)
1	9	6.86	171	2876	72	3021	75
4	9	6.83	170	2524	63	3345	83
5	9	6.94	173	3004	75	2978	74
6	9	7.03	175	2731	68	3339	83
<>		6.92	173	2784	69	3171	79
σ		0.09	2	206	5	199	5
Min		6.83	170	2524	63	2978	74
Max		7.03	175	3004	75	3345	83

QPLL2 sample #	Crystal sample #	f range (kHz)	f range (ppm)	f marg(low) (Hz)	f marg(low) (ppm)	f marg(high) (Hz)	f marg(high) (ppm)
1	10	9.10	227	3758	94	4384	109
4	10	9.20	230	3735	93	4500	112
5	10	8.88	222	3633	91	4290	107
6	10	9.50	237	3507	88	5029	125
<>		9.17	229	3658	91	4551	114
σ		0.26	6	115	3	330	8
Min		8.88	222	3507	88	4290	107
Max		9.50	237	3758	94	5029	125

QPLL2 sample #	Crystal sample #	f center (MHz)	f error (Hz)	f error (ppm)	f asym (Hz)	f asym (ppm)
1	3	40.077765	-921	-23	-851	-21
4	3	40.077986	-700	-17	-567	-14
5	3	40.077593	-1090	-27	-942	-24
6	3	40.078325	-361	-9	-421	-11
<>		40.077917	-768	-19	-695	-17
σ		0.000316	315	8	243	6
Min		40.077593	-1090	-27	-942	-24
Max		40.078325	-361	-9	-421	-11

QPLL2 sample #	Crystal sample #	f center (MHz)	f error (Hz)	f error (ppm)	f asym (Hz)	f asym (ppm)
1	4	40.077345	-1340	-33	-1410	-35
4	4	40.077554	-1130	-28	-1020	-25
5	4	40.077254	-1430	-36	-1580	-39
6	4	40.077575	-1110	-28	-1280	-32
<>		40.077432	-1253	-31	-1323	-33
σ		0.000158	158	4	236	6
Min		40.077254	-1430	-36	-1580	-39
Max		40.077575	-1110	-28	-1020	-25

QPLL2 sample #	Crystal sample #	f center (MHz)	f error (Hz)	f error (ppm)	f asym (Hz)	f asym (ppm)
1	5	40.077643	-1040	-26	-724	-18
4	5	40.077822	-843	-21	-559	-14
5	5	40.077585	-1100	-27	-832	-21
6	5	40.078060	-626	-16	-359	-9
<>		40.077778	-902	-23	-619	-15
σ		0.000214	214	5	206	5
Min		40.077585	-1100	-27	-832	-21
Max		40.078060	-626	-16	-359	-9

QPLL2 sample #	Crystal sample #	f center (MHz)	f error (Hz)	f error (ppm)	f asym (Hz)	f asym (ppm)
1	6	40.077658	-2110	-53	-2060	-51
4	6	40.076625	-2060	-51	-2040	-51
5	6	40.076397	-2290	-57	-2190	-55
6	6	40.076974	-1710	-43	-1640	-41
<>		40.076914	-2043	-51	-1983	-49
σ		0.000550	243	6	238	6
Min		40.076397	-2290	-57	-2190	-55
Max		40.077658	-1710	-43	-1640	-41

QPLL2 sample #	Crystal sample #	f center (MHz)	f error (Hz)	f error (ppm)	f asym (Hz)	f asym (ppm)
1	7	40.077881	-805	-20	-759	-19
4	7	40.078044	-642	-16	-625	-16
5	7	40.077413	-1270	-32	-1230	-31
6	7	40.078198	-488	-12	-408	-10
<>		40.077884	-801	-20	-756	-19
σ		0.000340	338	8	348	9
Min		40.077413	-1270	-32	-1230	-31
Max		40.078198	-488	-12	-408	-10

QPLL2 sample #	Crystal sample #	f center (MHz)	f error (Hz)	f error (ppm)	f asym (Hz)	f asym (ppm)
1	8	40.077283	-1400	-35	-1250	-31
4	8	40.077683	-1003	-25	-999	-25
5	8	40.078237	-449	-11	-407	-10
6	8	40.077848	-838	-21	-829	-21
<>		40.077763	-923	-23	-871	-22
σ		0.000395	394	10	355	9
Min		40.077283	-1400	-35	-1250	-31
Max		40.078237	-449	-11	-407	-10

QPLL2 sample #	Crystal sample #	f center (MHz)	f error (Hz)	f error (ppm)	f asym (Hz)	f asym (ppm)
1	9	40.078247	-439	-11	-315	-8
4	9	40.078511	-175	-4	-15	0
5	9	40.078237	-449	-11	-407	-10
6	9	40.078486	-200	-5	-86	-2
<>		40.078370	-316	-8	-206	-5
σ		0.000148	148	4	185	5
Min		40.078237	-449	-11	-407	-10
Max		40.078511	-175	-4	-15	0

QPLL2 sample #	Crystal sample #	f center (MHz)	f error (Hz)	f error (ppm)	f asym (Hz)	f asym (ppm)
1	10	40.078302	-384	-10	-189	-5
4	10	40.078402	-284	-7	-176	-4
5	10	40.078200	-486	-12	-226	-6
6	10	40.078716	-30	-1	-255	-6
<>		40.078405	-296	-7	-212	-5
σ		0.000223	196	5	36	1
Min		40.078200	-486	-12	-255	-6
Max		40.078716	-30	-1	-176	-4