

32MHZ CRYSTAL OSCILLATOR OSCILLATION MARGIN STUDY

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COMPANY CONFIDENTIAL



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Candidates around a 10 Oscillation Margin

- Two good configurations are preferred:
 - 6pF Crystal EVK / ISEL=5 and R= 510 Ohm
 - 6pF Crystal EVK / ISEL=6 and 560 Ohm

Their frequency accuracies at ambient temperature are compliant with BLE and 15.4 standards

Results for 6pF (@CDAC=0x00h)

EVK	Xtal Cap	Series resistor	ISEL	Osc. Margin	✓	/	✗	32MHz accuracy (ppm) @ ISEL=0x05h
KW45	6pF	470	0 to 4				✗	
KW45	6pF	470	5 to 15	8,9	✓			
KW45	6pF	510	0 to 4				✗	
KW45	6pF	510	5 to 15	9,5	✓			-4,6 ppm
KW45	6pF	560	0 to 5				✗	
KW45	6pF	560	6 to 15	10,3	✓			+2,3 ppm
KW45	6pF	620	0 to 5				✗	
KW45	6pF	620	6 to 15	11,3	✓			+3,3 ppm
KW45	6pF	680	0 to 7				✗	
KW45	6pF	680	8 to 15	12,3	✓			

Conclusion after verification on the 8pF Crystal EVK

- The oscillation margin has been increased under certain conditions below.
- For instance, based on tables on next slides 4 and 6, if we want an oscillation margin at 10.3, the 32MHz frequency error and the configuration will be :
 - +10 ppm @25°C with CDAC = 0x05h and ISEL = 0x07h minimum,
 - +6 ppm @25°C with CDAC = 0x0Ah and ISEL = 0x09h minimum,
 - +3 ppm @25C with CDAC = 0x0Dh and ISEL = 0x09h minimum,
 - +2 ppm @25C with CDAC = 0x0Eh and ISEL = 0x0Ah minimum,
 - +1 ppm @25C with CDAC = 0x0Fh and ISEL = 0x0Bh minimum.

Recheck on the 8pF Crystal EVK - 1/3

For $R=0 \Omega$, the best CDAC for 0ppm

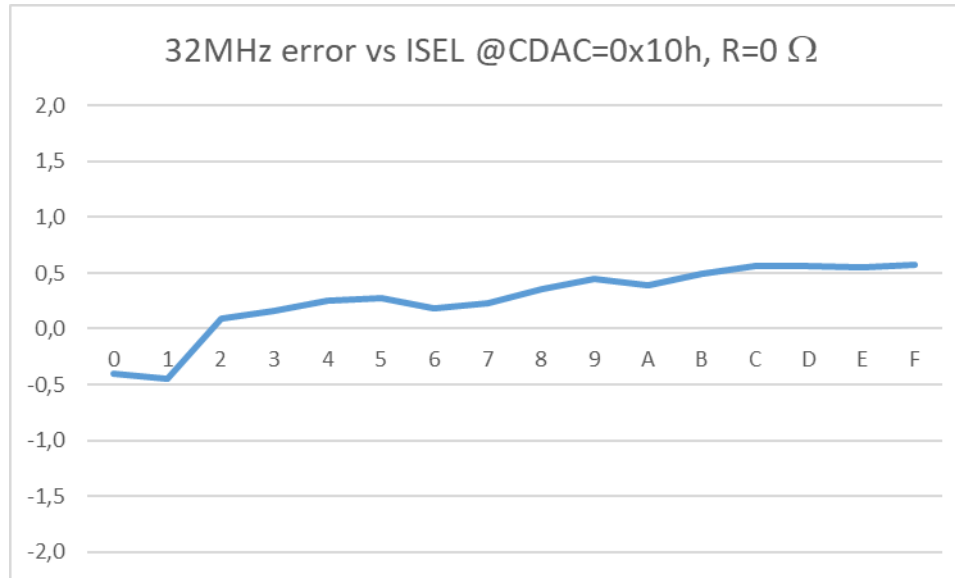
→ CDAC=0X10h

→ Freq= 32,0000020 MHz (+0.06 ppm)

CDAC	freq	ppm
0	32,0005201	16,25
1	32,0004833	15,10
2	32,0004584	14,32
3	32,0004219	13,18
4	32,0003753	11,73
5	32,0003405	10,64
6	32,0003069	9,59
7	32,0002757	8,62
8	32,0002470	7,72
9	32,0002162	6,76
A	32,0001831	5,72
B	32,0001508	4,71
C	32,0001239	3,87
D	32,0000943	2,95
E	32,0000638	1,99
F	32,0000365	1,14
10	32,0000020	0,06

Recheck on the 8pF Crystal EVK - 2/3

For this CDAC=0X10h and R=0 Ω , check of freq vs ISEL:



ISEL	Freq (MHz)	ppm
0	31.9999873	-0,4
1	31.9999856	-0,5
2	32.0000030	0,1
3	32.0000053	0,2
4	32.0000079	0,2
5	32.0000088	0,3
6	32.0000059	0,2
7	32.0000072	0,2
8	32.0000114	0,4
9	32.0000144	0,4
A	32.0000126	0,4
B	32.0000159	0,5
C	32.0000179	0,6
D	32.0000181	0,6
E	32.0000175	0,5
F	32.0000182	0,6

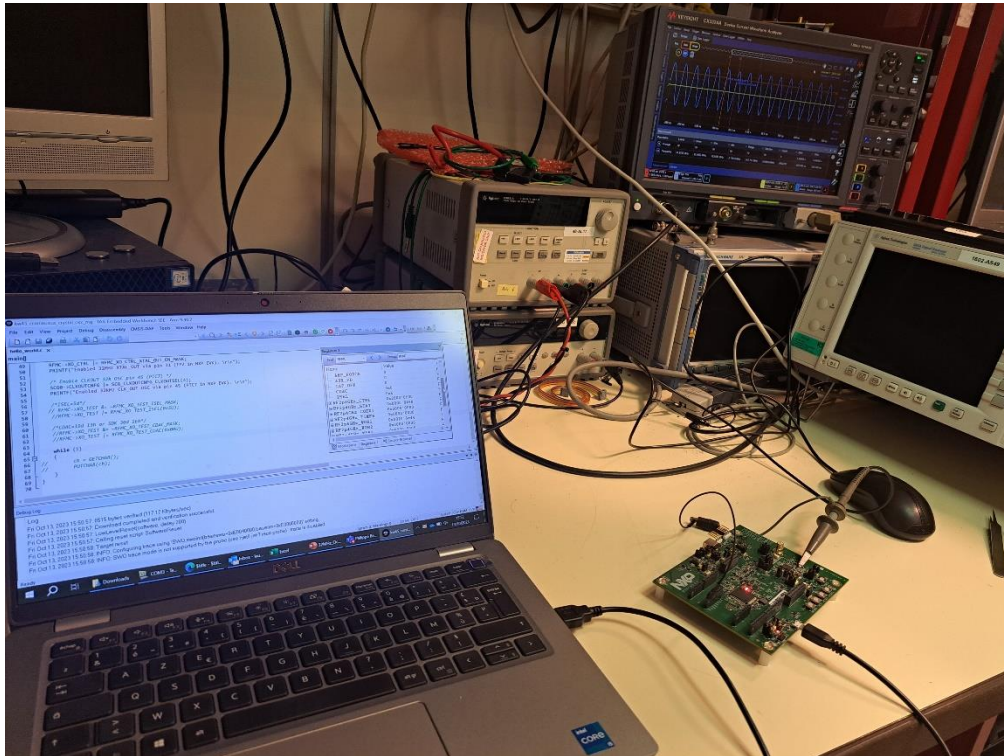
Recheck on the 8pF Crystal EVK - 3/3

R changes from 0 to 560 Ω

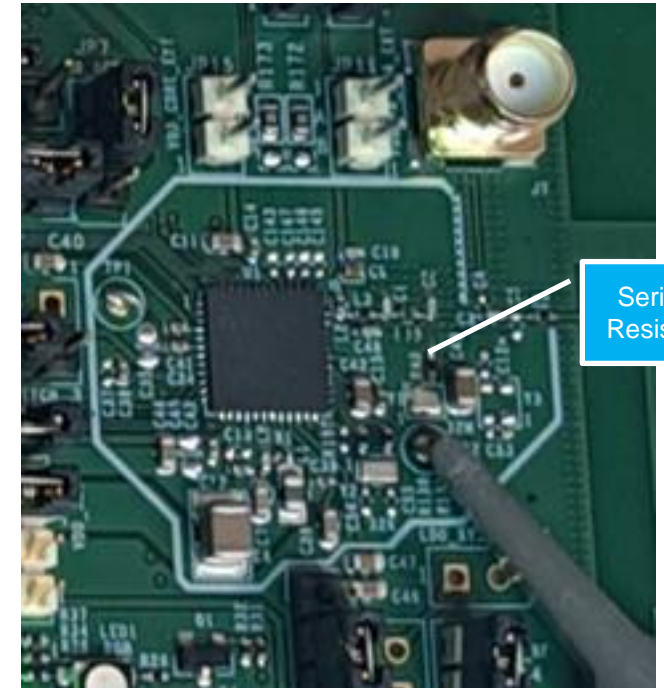
Confirmation of the CDAC and ISEL when there is the 32MHz oscillation

R= 560 Ω		ISEL										
		5	6	7	8	9	A	B	C	D	E	F
CDAC	0	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
	1	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
	2		ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
	3		ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
	4			ok	ok	ok	ok	ok	ok	ok	ok	ok
	5			ok	ok	ok	ok	ok	ok	ok	ok	ok
	6			ok	ok	ok	ok	ok	ok	ok	ok	ok
	7			ok	ok	ok	ok	ok	ok	ok	ok	ok
	8			ok	ok	ok	ok	ok	ok	ok	ok	ok
	9				ok	ok	ok	ok	ok	ok	ok	ok
	A					ok	ok	ok	ok	ok	ok	ok
	B					ok	ok	ok	ok	ok	ok	ok
	C					ok	ok	ok	ok	ok	ok	ok
	D					ok	ok	ok	ok	ok	ok	ok
	E						ok	ok	ok	ok	ok	ok
	F							ok	ok	ok	ok	ok
	10							ok	ok	ok	ok	ok
	11								ok	ok	ok	ok
12								ok	ok	ok	ok	
13								ok	ok	ok	ok	
14									ok	ok	ok	
15										ok	ok	
16										ok	ok	
17											ok	

Test set up and versions



SCH-50555 REV D
700-50555 REV X5



Equipment: Keysight CX3322A + Scope probe
Agilent MXA N9020A + High frequency probe
+ with a modified SW* allowing CDAC register update at Xtal initialization (near startup slot)

(*): 'hello_world' application with the 32MHz signal output to a test point



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