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CLASS II PERMISSIVE CHANGE REQUEST

16 March 2023

Element Materials Technology
100 Frobisher Business Park
Leigh Sinton Road
Malvern,
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WR14 1BX
UK

RE: Class II Permissive Change Request
FCC ID: 2AEHI-EP0121

To Whom It May Concern:

Please be advised that pursuant to FCC Rule 47CFR 2.1043 the manufacturer requests that the above-referenced model be approved for class II permissive change.

The reason for the class II change is that:

Due to global component shortages, Chiaro is investigating changing the main MCU component packaging for the current design on the market. We are considering a change in the IC package only and the minor layout changes required to accommodate the new footprint - however clauses in the FCC guidance state that permissive changes are possible where components are electrically Identical except in the case of entire transmitters - which would require a new FCC ID.

We are seeking guidance on if a change of the packaging of the transmitter IC would constitute "replacement of a chip that constitutes and entire transmitter"

We believe the internal silicon of the chip is identical and that only the outer packaging has changed, thus we are technically not replacing the transmitter. We also present here evidence that Radio Test Data and preliminary EMC test data has shown negligible change in RF and Electrical performance, with the new design still being within all required limits.

Table 1: Article under change

Applicant	Equipment	Product Name	FCC ID
Chiaro Technology Ltd	EP01	Elvie Pump	2AEHI-EP0121

1 Reference Documents

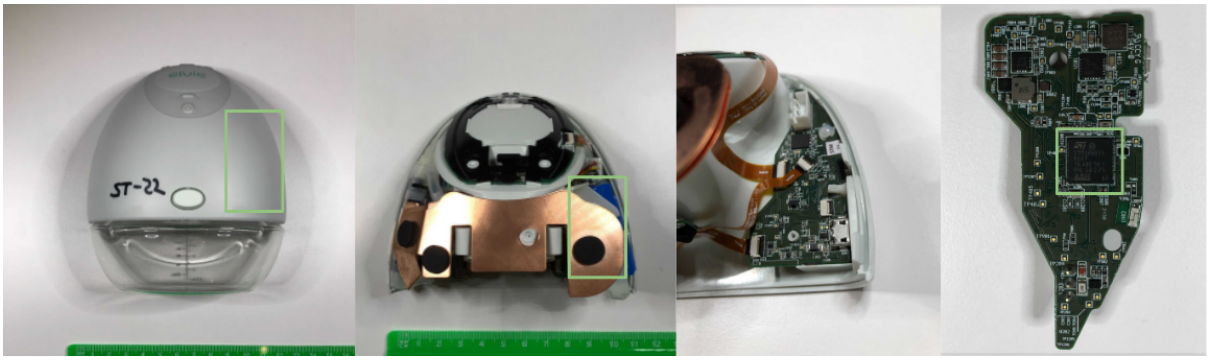
Table 2: List of documents

Document	Link
SoC manufacturer supplied BLE certificates and QDID numbers	https://www.st.com/content/ccc/resource/quality_and_reliability/quality_certificate/certification_document/group3/f2/76/41/ef/75/fd/4c/12/stm32wb55_bluetooth_certificate.pdf/files/stm32wb55_bluetooth_certificate.pdf/jcr:content/translations/en.stm32wb55_bluetooth_certificate.pdf
Datasheet for: STM32WB55xx	Datasheet - STM32WB55xx STM32WB35xx - Multiprotocol wireless 32-bit MCU Arm®-based Cortex®-M4 with FPU, Bluetooth® 5.2 and 80
FCC Permissive Change Policy 178919	https://apps.fcc.gov/kdb/GetAttachment.html?id=N0FeGuIZalHwpzYoaFJpjA%3D%3D&desc=178919%20D01%20Permissive%20Change%20Policy%20v06&tracking_number=33013

2 *Description of change*

2.1 DIFFERENCES

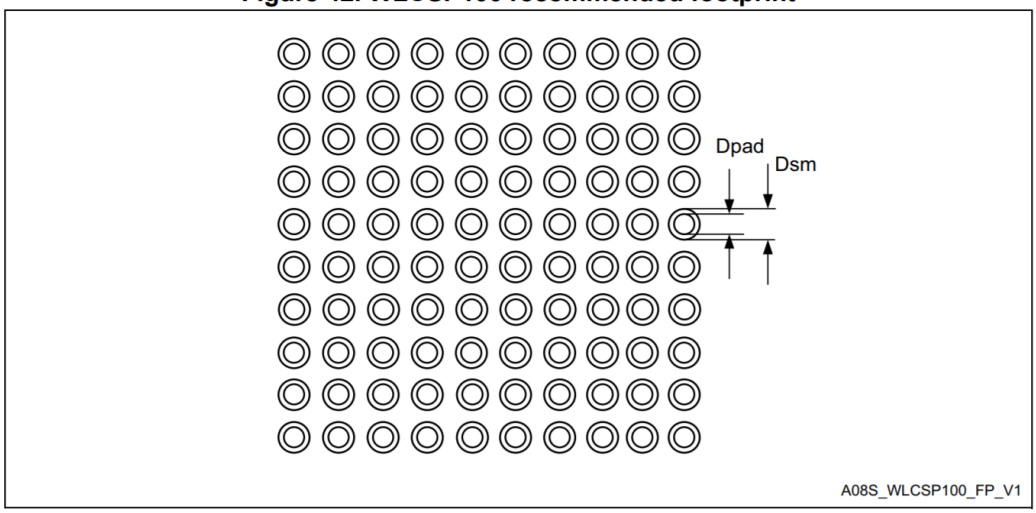
The MCU is an integrated Bluetooth Low Energy SoC that is offered in a number of different footprint options. The below picture shows the location of the MCU.



We are proposing to change the footprint from the **STM32WB55RGV6TR in a VFQFPN68 package** to an **STM32WB55VGY6TR in a WLCSP100 0.4 mm pitch package**. The internal silicon die will remain the same but in a different external package.

- There will be a slight change to the PCB layer stack to accommodate footprint change.
- The layer count remains unchanged
- The layer separation distances will be modified to accommodate a new footprint routing
- The PCB traces local to the MCU SoC will be modified to accommodate the new footprint as per the guidance images below

Figure 42. WLCSP100 recommended footprint



1. Dimensions are expressed in millimeters.

Table 103. WLCSP100 recommended PCB design rules

Dimension	Recommended values
Pitch	0.4 mm
Dpad	0.225 mm
Dsm	0.290 mm typ. (depends on the soldermask registration tolerance)
Stencil opening	0.250 mm
Stencil thickness	0.100 mm

Additionally all other critical components including the Battery and primary pumping components have not been changed, meaning that there is no other significant impact to the overall power draw or performance of the device.

2.2 SIMILARITIES

The internal silicon die (STM32WB55) is identical

The antenna is a chip antenna and will remain unchanged. The antenna feed trace will be corrected to match the original impedance specification

Clock frequency, transmission power, modulation ,data rates, frequency multiplication stages, basic modulator circuit or maximum power will remain unchanged.

2.3 PROPOSED VERIFICATION TESTING:

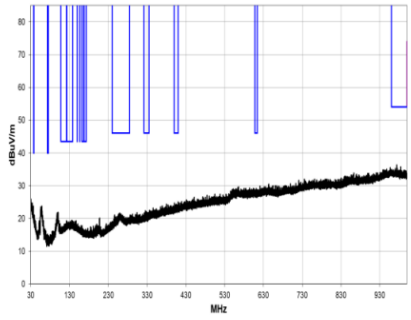
All changes will be validated by running EMC and radio pre-compliance testing to assure all radio performance is equivalent to original design and that no degradation in performance has occurred.

3 RADIO TEST RESULTS COMPARISON

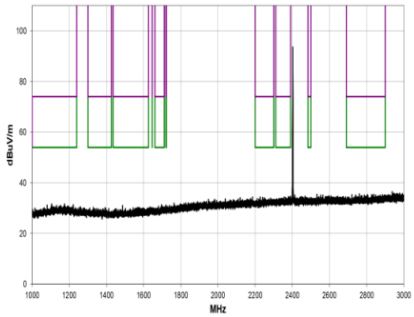
3.1 Bottom Channel Current Design

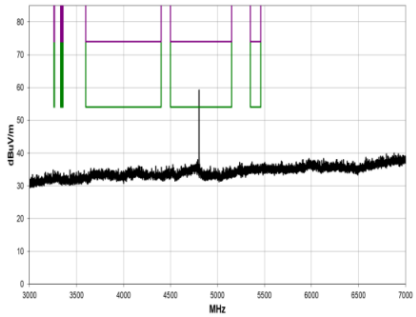
11.6 Test Results

Bottom Channel 2402 MHz



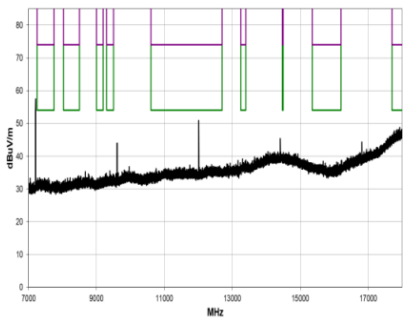
30 MHz to 1 GHz

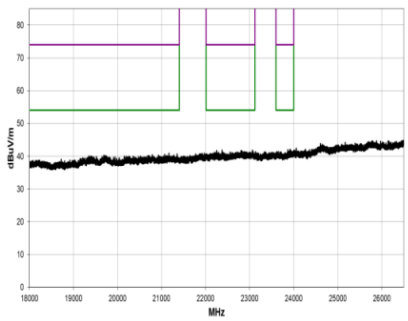




1 GHz to 3 GHz

3 GHz to 7 GHz





7 GHz to 18 GHz

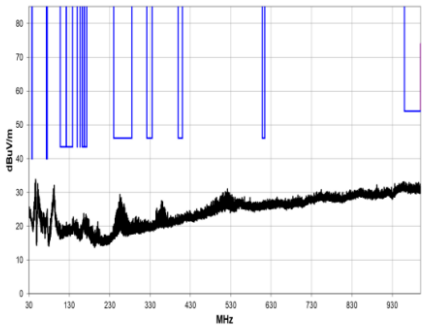
18 GHz to 26.5 GHz

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
4804.117	47.4	2.2	1.1	102.9	3.6	0.0	Horz	AV	0.0	53.2	54.0	-0.8
4804.075	45.4	2.2	1.28	240.9	3.6	0.0	Vert	AV	0.0	51.2	54.0	-2.8
4803.725	62.1	2.2	1.1	102.9		0.0	Horz	PK	0.0	64.3	74.0	-9.7
4803.583	59.5	2.2	1.28	240.9		0.0	Vert	PK	0.0	61.7	74.0	-12.3
12009.580	38.3	11.4	1.61	331.0	3.8	0.0	Vert	AV	-9.5	44.0	54.0	-10.0
12009.580	37.6	11.4	1.59	190.1	3.6	0.0	Horz	AV	-9.5	43.1	54.0	-10.9
12009.050	56.6	11.4	1.61	331.0		0.0	Vert	PK	-9.5	58.5	74.0	-15.5
12009.100	55.5	11.4	1.59	190.1		0.0	Horz	PK	-9.5	57.4	74.0	-16.6

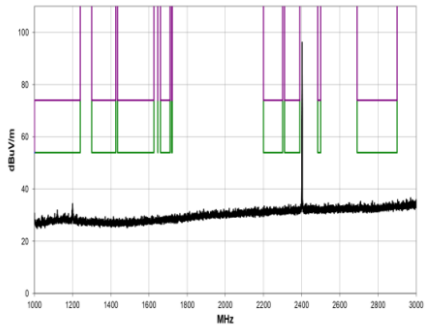
3.2 Bottom Channel New Design

11.6 Test Results

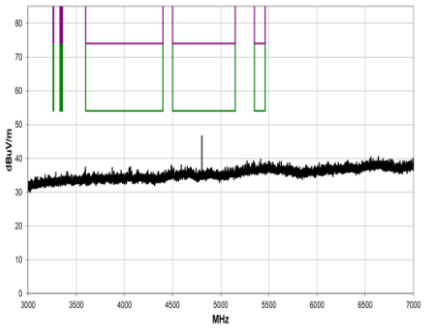
Bottom Channel: 2402 MHz



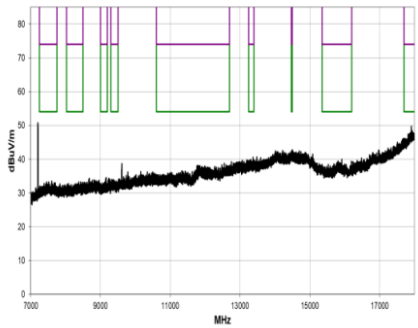
30 MHz to 1 GHz



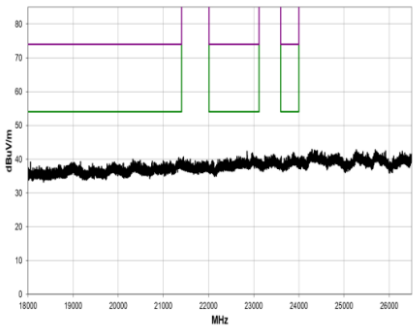
1 GHz to 3 GHz



3 GHz to 7 GHz



7 GHz to 18 GHz

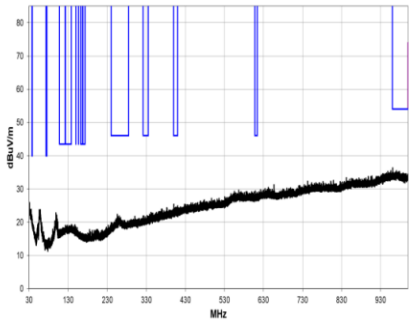


18 GHz to 26.5 GHz

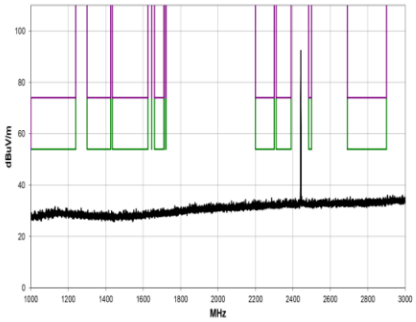
Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
4803.500	38.8	2.7	1.5	74.0	3.6	0.0	Horz	AV	0.0	45.1	54.0	-8.9
4803.567	36.4	2.7	1.5	237.0	3.6	0.0	Vert	AV	0.0	42.7	54.0	-11.3
4803.342	50.7	2.7	1.5	74.0	0.0	0.0	Horz	PK	0.0	53.4	74.0	-20.6
4803.542	48.8	2.7	1.5	237.0	0.0	0.0	Vert	PK	0.0	51.5	74.0	-22.5

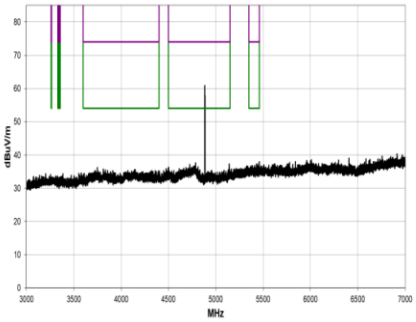
3.3 Middle Channel Current Design

Middle Channel 2442 MHz

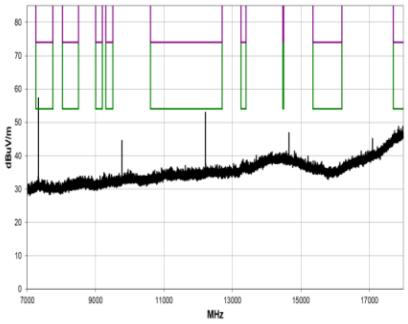


30 MHz to 1 GHz

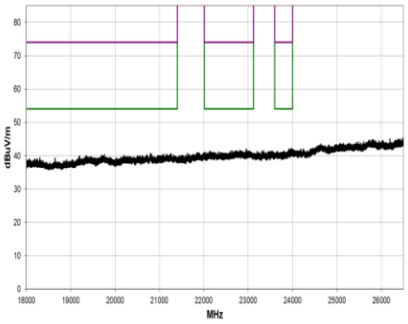




1 GHz to 3 GHz



3 GHz to 7 GHz



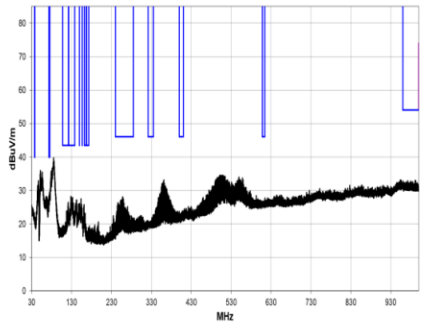
7 GHz to 18 GHz

18 GHz to 26.5 GHz

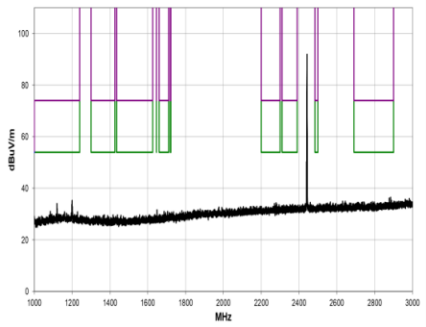
Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
4884.100	47.7	2.5	1.07	103.9	3.6	0.0	Horz	AV	0.0	53.8	54.0	-0.2
4884.100	46.1	2.5	1.55	323.0	3.6	0.0	Vert	AV	0.0	52.2	54.0	-1.8
4884.200	62.4	2.5	1.07	103.9		0.0	Horz	PK	0.0	64.9	74.0	-9.1
4884.600	60.3	2.5	1.55	323.0		0.0	Vert	PK	0.0	62.8	74.0	-11.2
7326.175	45.9	7.6	1.43	347.0	3.6	0.0	Vert	AV	-9.5	47.6	54.0	-6.4
12209.600	39.3	11.6	1.68	145.1	3.6	0.0	Horz	AV	-9.5	45.0	54.0	-9.0
7326.192	42.0	7.6	1.67	339.0	3.6	0.0	Horz	AV	-9.5	43.7	54.0	-10.3
7325.442	63.0	7.6	1.43	347.0		0.0	Vert	PK	-9.5	61.1	74.0	-12.9
12209.350	37.9	11.6	1.64	197.0	3.6	0.0	Vert	AV	-9.5	43.6	54.0	-10.4
12209.540	57.6	11.6	1.68	145.1		0.0	Horz	PK	-9.5	59.7	74.0	-14.3
12209.230	55.6	11.6	1.64	197.0		0.0	Vert	PK	-9.5	57.7	74.0	-16.3
7325.500	58.2	7.6	1.67	339.0		0.0	Horz	PK	-9.5	56.3	74.0	-17.7

3.4 Middle Channel New Design

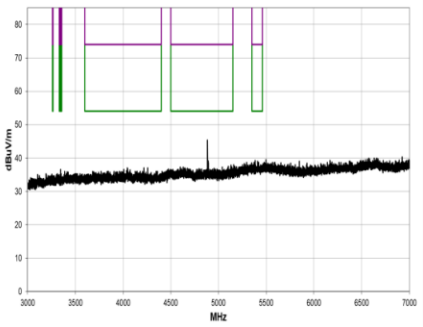
Middle Channel: 2442 MHz



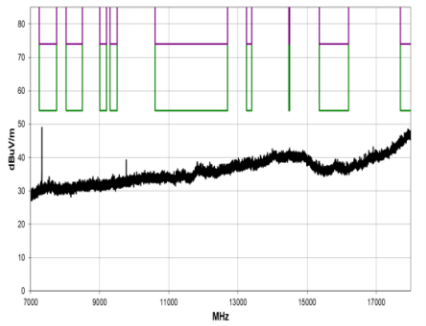
30 MHz to 1 GHz



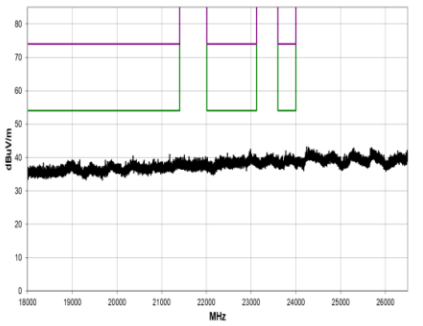
1 GHz to 3 GHz



3 GHz to 7 GHz



7 GHz to 18 GHz

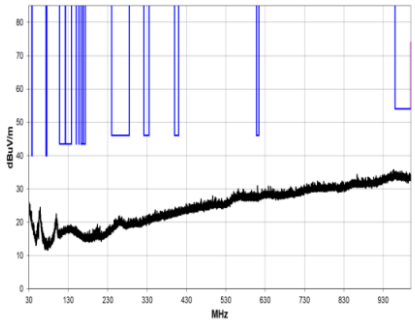


18 GHz to 26.5 GHz

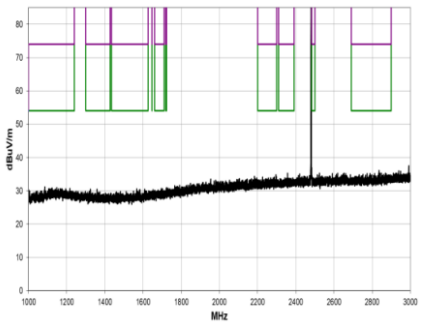
Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
4883.600	39.6	3.0	1.3	80.0	3.6	0.0	Horz	AV	0.0	46.2	54.0	-7.8
4884.500	37.6	3.0	1.4	354.0	3.6	0.0	Vert	AV	0.0	44.2	54.0	-9.8
4883.417	50.6	3.0	1.3	80.0	0.0	0.0	Horz	PK	0.0	53.6	74.0	-20.4
4884.358	50.0	3.0	1.4	354.0	0.0	0.0	Vert	PK	0.0	53.0	74.0	-21.0
7325.283	46.5	7.4	1.5	345.1	3.6	0.0	Horz	AV	-9.5	48.0	54.0	-6.0
7326.808	45.5	7.4	1.5	344.1	3.6	0.0	Vert	AV	-9.5	47.0	54.0	-7.0
7326.717	57.9	7.4	1.5	344.1	0.0	0.0	Vert	PK	-9.5	55.8	74.0	-18.2
7325.200	57.5	7.4	1.5	345.1	0.0	0.0	Horz	PK	-9.5	55.4	74.0	-18.6

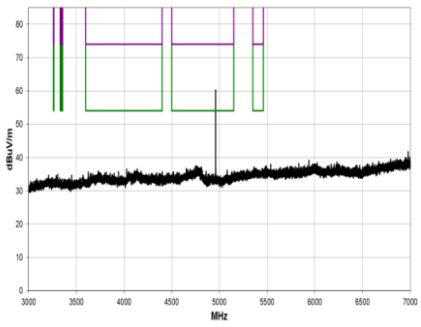
3.5 Top Channel Current Design

Top Channel 2480 MHz



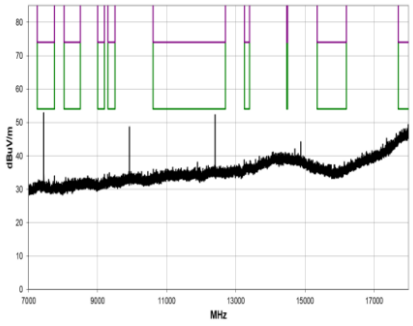
30 MHz to 1 GHz

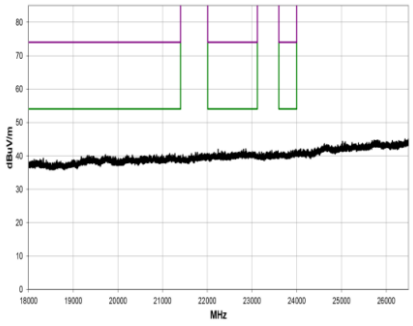




1 GHz to 3 GHz

3 GHz to 7 GHz





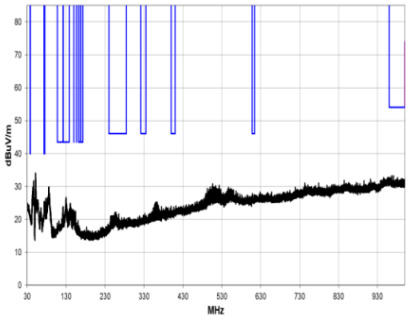
7 GHz to 18 GHz

18 GHz to 26.5 GHz

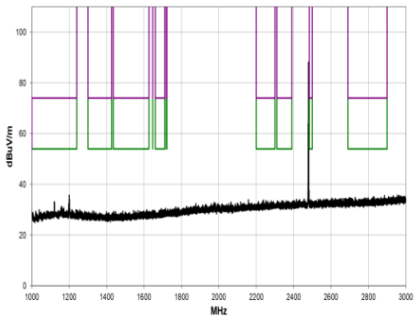
Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
4960.092	47.3	2.7	1.07	106.1	3.6	0.0	Horz	AV	0.0	53.6	54.0	-0.4
4960.117	46.7	2.7	1.81	321.1	3.6	0.0	Vert	AV	0.0	53.0	54.0	-1.0
4960.125	61.8	2.7	1.07	106.1		0.0	Horz	PK	0.0	64.5	74.0	-9.5
4959.700	61.3	2.7	1.81	321.1		0.0	Vert	PK	0.0	64.0	74.0	-10.0
7440.175	44.4	7.6	1.48	347.9	3.6	0.0	Vert	AV	-9.5	46.1	54.0	-7.9
12399.620	38.0	12.0	1.59	223.1	3.6	0.0	Horz	AV	-9.5	44.1	54.0	-9.9
7440.175	40.3	7.6	1.58	43.0	3.6	0.0	Horz	AV	-9.5	42.0	54.0	-12.0
12399.350	37.4	12.0	1.6	140.0	3.6	0.0	Vert	AV	-9.5	43.5	54.0	-10.5
7439.475	61.4	7.6	1.48	347.9		0.0	Vert	PK	-9.5	59.5	74.0	-14.5
12399.070	55.8	12.0	1.59	223.1		0.0	Horz	PK	-9.5	58.3	74.0	-15.7
12401.580	55.0	12.0	1.6	140.0		0.0	Vert	PK	-9.5	57.5	74.0	-16.5
7439.708	56.4	7.6	1.58	43.0		0.0	Horz	PK	-9.5	54.5	74.0	-19.5

3.6 Top Channel New Design

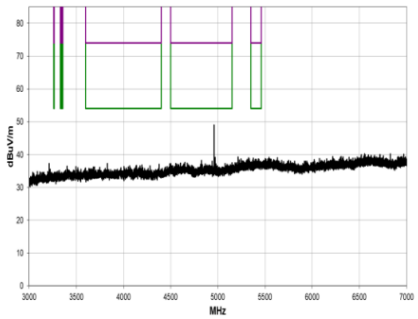
Top Channel: 2480 MHz



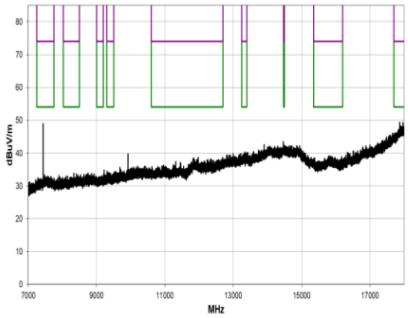
30 MHz to 1 GHz



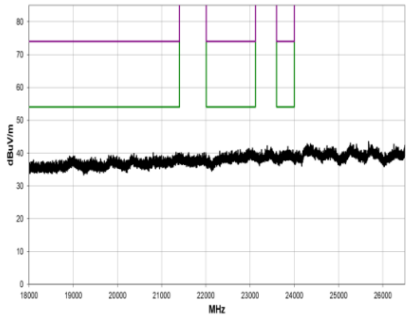
1 GHz to 3 GHz



3 GHz to 7 GHz



7 GHz to 18 GHz



18 GHz to 26.5 GHz

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
4960.483	40.4	3.2	1.5	73.1	3.6	0.0	Horz	AV	0.0	47.2	54.0	-6.8
4959.492	39.6	3.2	1.3	58.0	3.6	0.0	Vert	AV	0.0	46.4	54.0	-7.6
4960.392	52.3	3.2	1.5	73.1	0.0	0.0	Horz	PK	0.0	55.5	74.0	-18.5
4960.317	51.6	3.2	1.3	58.0	0.0	0.0	Vert	PK	0.0	54.8	74.0	-19.2
7439.258	46.9	7.4	1.5	346.0	3.6	0.0	Horz	AV	-9.5	48.4	54.0	-5.6
7439.350	46.7	7.4	1.5	348.0	3.6	0.0	Vert	AV	-9.5	48.2	54.0	-5.8
7439.258	57.9	7.4	1.5	346.0	0.0	0.0	Horz	PK	-9.5	55.8	74.0	-18.2
7439.125	57.5	7.4	1.5	348.0	0.0	0.0	Vert	PK	-9.5	55.4	74.0	-18.6

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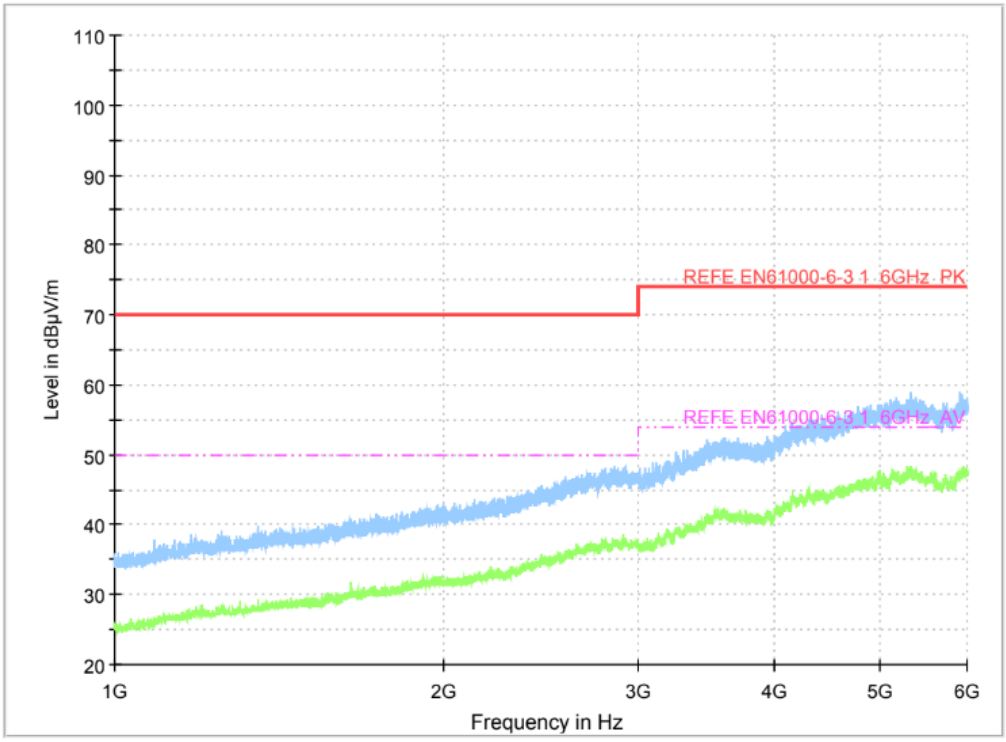
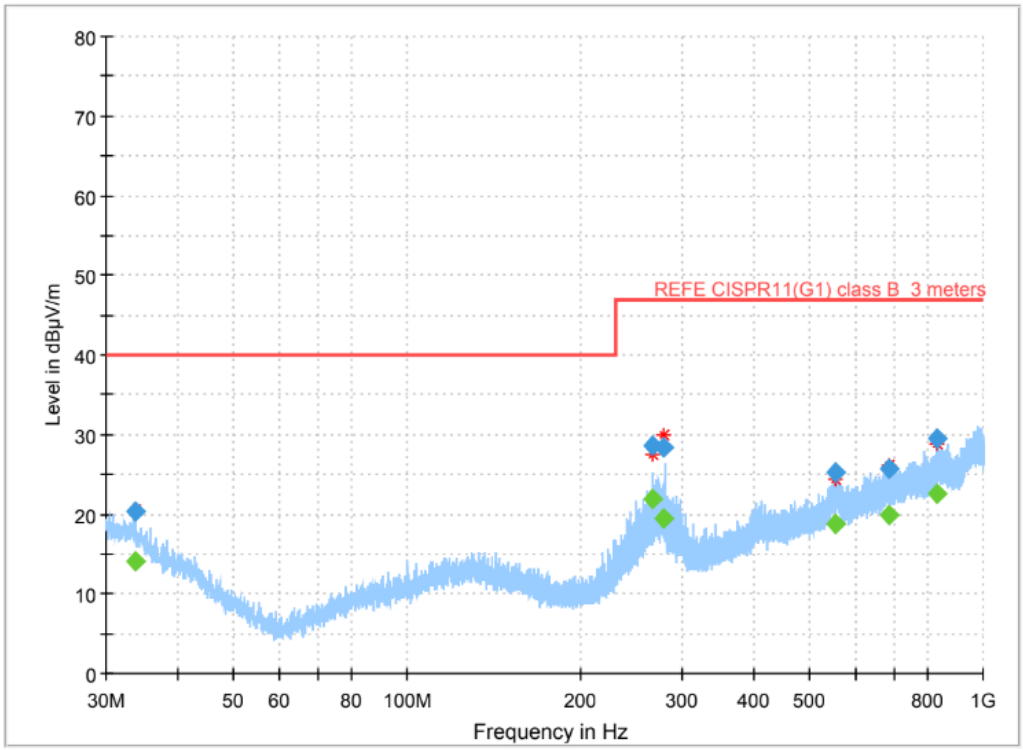
Preliminary EMC test results of the new design are also within limits

REFE Above 1G Pass 2 / 3



REFE Below 1G pass 2 / 3



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Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
33.687253	---	40.00	25.93	15000.0	120.000	132.0	H	11.0	-8.2
33.687253	20.26	40.00	19.74	15000.0	120.000	132.0	H	11.0	-8.2
266.395840	28.52	47.00	18.48	15000.0	120.000	102.0	H	218.0	-11.8
266.395840	---	47.00	25.00	15000.0	120.000	102.0	H	218.0	-11.8
279.693133	28.33	47.00	18.67	15000.0	120.000	100.0	H	181.0	-11.7
279.693133	---	47.00	27.49	15000.0	120.000	100.0	H	181.0	-11.7
555.071107	25.28	47.00	21.72	15000.0	120.000	390.0	H	-10.0	-3.5
555.071107	---	47.00	28.19	15000.0	120.000	390.0	H	-10.0	-3.5
687.341720	---	47.00	27.19	15000.0	120.000	243.0	H	51.0	-2.7
687.341720	25.62	47.00	21.38	15000.0	120.000	243.0	H	51.0	-2.7
831.569640	29.42	47.00	17.58	15000.0	120.000	124.0	V	222.0	0.2
831.569640	---	47.00	24.34	15000.0	120.000	124.0	V	222.0	0.2

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
33.687253	14.07	40.00	25.93	15000.0	120.000	132.0	H	11.0	-8.2
33.687253	---	40.00	19.74	15000.0	120.000	132.0	H	11.0	-8.2
266.395840	---	47.00	18.48	15000.0	120.000	102.0	H	218.0	-11.8
266.395840	22.00	47.00	25.00	15000.0	120.000	102.0	H	218.0	-11.8
279.693133	---	47.00	18.67	15000.0	120.000	100.0	H	181.0	-11.7
279.693133	19.51	47.00	27.49	15000.0	120.000	100.0	H	181.0	-11.7
555.071107	---	47.00	21.72	15000.0	120.000	390.0	H	-10.0	-3.5
555.071107	18.81	47.00	28.19	15000.0	120.000	390.0	H	-10.0	-3.5
687.341720	19.81	47.00	27.19	15000.0	120.000	243.0	H	51.0	-2.7
687.341720	---	47.00	21.38	15000.0	120.000	243.0	H	51.0	-2.7
831.569640	---	47.00	17.58	15000.0	120.000	124.0	V	222.0	0.2
831.569640	22.66	47.00	24.34	15000.0	120.000	124.0	V	222.0	0.2

4 CONCLUSION

Test data has shown that the change of the main MCU IC package has made negligible impact to RF performance. Radio test results shown above show minimal deviations from the original test results along with all results shown for the new design still being within the defined limits. Given that the proposed change is for an electrically identical SoC with the same internal silicon, just in a different package we believe this replacement can be described as *'variation in electrical or mechanical construction'* as described in 47 CFR 2.1043
This view is also based partly on the guidance document *'178919 D01 Permissive Change Policy v06'*. In which section III D states:
"D. Part substitution – electrically identical parts may be substituted*. An initial evaluation of test results will determine if a Class I or Class II permissive change application is required. A chip replacement of a portion of the transmitter that performs some sub-function such as an amplifier chip, oscillator chip, or frequency determining chip, may be considered a Class II permissive change under the following conditions;* ***however, replacement of a chip that constitutes a complete transmitter shall require a new grant of certification (FCC ID):***
In this instance the change is for a complete transmitter but one that is electrically identical. And given that the above testing has shown minimal deviation between the original and new design and that the new design still falls within all defined limits, we believe that the above substitution would still fall within the "Part Substitution" clause and thus would NOT require a new grant of certification.

Thank you for your attention to this matter.

Yours faithfully
Chiaro Technology Ltd

Alastair Traquair

Signature

Full Name:
Alastair Traquair