



TEKTELIC Communications Inc.
7657 10th Street NE Calgary, Alberta
Canada, T2E 8X2

PEARL MOBILE GATEWAY

C2PCPX JUSTIFICATION

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TEKTELIC Communications Inc.
7657 10th Street NE
Calgary, AB, Canada T2E 8X2
Phone: (403) 338-6900

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1 Introduction

This document provides justification for the request for Class II Permissive Change for PCB and Part Modification (C2PCPX), for FCC ID 2ALEPT0004437, in accordance with the permissive change rules presented in KDB Publication 178919 D01 and Notification 202109-001.

1.1 Background

The Pearl Mobile Gateway, FCC ID 2ALEPT0004437, is a 12VDC powered LoRa gateway designed for IoT applications. Its intended purpose is to provide a carrier grade Gateway solution for LoRa networks. The product is designed to transmit in a North American ISM band (902-928 MHz) using DTS and FHSS modulation.

The Pearl Gen 1.5 Mobile Gateway is a redesign of Pearl Gen 1.0 Mobile Gateway to address part shortages and obsolescence. The key differences between Gen 1.5 and Gen 1.0 are summarized in the following table.

Table 1: Key Component Changes between Gen 1 and Gen 1.5 Pearl Mobile Gateway

Gen 1	Gen 1.5	Justification for C2PCPX
Oscillator was crystal-based technology.	Oscillator is MEMS-based technology. The clock frequency is kept the same.	III.D. [1] Chip replacement of oscillator can be considered Class II permissive change given no change in radio parameters, same functionality. C2PCPX. [2] Non-pin-to-pin IC substitutions permitted given fundamental frequency, maximum output power and functional specification remain unchanged.
Clock generator was SI5341A-D08092-GM.	Changed clock generator to TI CDCM6208V1HRGZR.	Q3. [3] Changes to digital circuitry in non-transmitter section of device is allowed, given the changes do not affect characteristics included in initial certification grant (frequency spectra, maximum output power)
The GPIO FPGA is from the Intel MAX 10 family, while the FE FPGA is from the Xilinx Spartan-6 LXT family.	The GPIO FPGA is now from the Lattice MachXO3LF family, while the FE FPGA is from the Xilinx Artix-7 family.	Q3. [3] Changes to digital circuitry in non-transmitter section of device is allowed, given the changes do not affect characteristics included in initial certification grant (frequency spectra, maximum output power)
The LNA used in the RF system was the NXP MML09231HT1.	The LNA used is now the Qorvo TQP3M9036.	III.F. [1] Minor circuitry for non-transmitter portions (such as receiver, peripheral circuits, or some other digital function) can be changed or depopulated, and may be approved under one FCC ID. The chip must have the same basic function as the old chip from an external perspective (internal circuitry may differ), no change in radio parameters should occur.
SPDT switch was SKY13321-360LF.	SPDT switch now RFSW8000.	III.D. [1] The substitution is pin-to-pin compatible, has the same basic function as old chip and no change in radio parameters expected.
Buck power converter was TPS53513RVET.	Buck power converter is now Maxim MAX20408AF0C.	III.D. [1] Chip replacement can be considered Class II permissive change given no change in radio parameters, same functionality.
Detector for VSWR measurements was MAX2016	Detector is now TI LMH2100	III.F. [1] Minor circuitry for non-transmitter portions (such as receiver, peripheral circuits, or some other digital function) can be changed or depopulated, and may be approved under one FCC ID. The chip must have the same basic function as the old chip from an external perspective (internal circuitry may differ), no change in radio parameters should occur.
Power supplies of note include UWE-5/15-Q12PBC, ISL80221RZ, TI LM5121.	Power supplies now substituted to RSDW40F05, NCP59771A, TPS611781 respectively.	III.F. [1] Minor circuitry for non-transmitter portions (such as receiver, peripheral circuits, or some other digital function) can be changed or depopulated, and may be approved under one FCC ID. The chip must have the same basic function as the old chip from an external perspective (internal circuitry may differ), no change in radio parameters should occur.

2 Applicable Standards

2.1 KDB 178919 D01

KDB 178919 D01 section III.D states that the substitution of an electrically identical part may be considered a Class II permissive change under the following conditions:

1. The new chip component is pin-for-pin compatible.
2. The new chip has the same basic function as the old chip, from an external perspective (internal circuitry may differ).
3. No change in radio parameters has occurred.
4. The same conditions apply when a small area (approximately the same area as the chip) of the PCB is replaced with an equivalent chip.

These conditions are met for all of the noted changes in Table 1, with the exception for the updated oscillator, which is not a pin-for-pin compatible device with the previously used component. Non-pin-for-pin compatible part modifications are accommodated by Notification 202109-001 as C2PCPX.

2.2 Notification 202109-001

Within the provisions of 47 CFR Part 2.1043, non-substantive modifications limited to the electrical/electronic components and the Printed Circuit Board (PCB) layout of a transmitter (or of the transmitter portion of the device) may be permitted as a Class II Permissive Change (for instance, to accommodate non-pin-to-pin compatible integrated circuits).

This procedure (Class II Permissive Change for PCB and Part Modification referred to as C2PCPX) is subject to PAG approval (item C2PCPX in KDB Publication 388624 D02) and may be granted under the following conditions:

1. The requirements of § 2.1043 are fulfilled, i.e., the device's block functions for the fundamental frequency, primary modulator circuit, maximum power, or field strength ratings shall remain unchanged.
2. Transmitter PCB layout and parts changes are only permitted if there is no change in identifying a device's form, functional specification, as initially granted or previously approved under a Class II permissive change.
3. PCB changes are limited to non-substantive modifications layout changes to the same size physical circuit board previously granted.
4. C2PCPX is not permitted to add, remove, augment, or change capabilities, such as transmitters, increased bandwidth, additional rule parts, bands, etc.

5. In the PAG submission for item C2PCPX, the applicant shall provide complete information on testing demonstrating that the proposed changes for fundamental emissions are unchanged within the normal, acceptable tolerances and out-of-band emissions do not exceed the appropriate limits. The PAG submission shall include all applicable test reports and internal photos.
6. The modified device shall not be marketed under the existing grant of certification before confirmation that the C2PCPX PAG is approved and granted.
7. Software Defined Radio (SDR) grants that use the C2PCPX procedure are not permitted to make subsequent Class III permissive changes.
8. The C2PCPX PAG procedure has no impact on the provisions of V) of this publication for non-SDR software-only changes; thus, adding an equipment class when related to rule changes is still permitted.
9. Class I permissive changes are not permitted under this C2PCPX procedure.

These conditions will be addressed in the remainder of this document for the updated oscillator device use in Pearl Mobile Gen 1.5 Gateway.

3 C2PCPX Justification

To process a PAG for C2PCPX, the applicant shall provide a letter in a Class II permissive change filing acknowledging compliance to the preceding items 1-9 above. The PAG KDB inquiry shall also include a clear description of the changes under consideration and comparative photos or illustrations of the device (schematics, block diagram, Gerber files, etc., or impacted areas) before and after the implemented modifications.

3.1 Oscillator Change Description

Gen 1.0 design utilized crystal-based oscillator technology, whereas the Gen 1.5 design used a MEMS based technology.

3.1.1 Gen 1.0 Oscillator

Pearl Mobile Gen 1.0 design used the MV326TCN10M voltage-controlled crystal oscillator from MtronPTI. The Tektelic part number is T0005109, and the reference designator in the design is Y20.

The fundamental frequency of the device is 10 MHz.

3.1.2 Gen 1.5 Oscillator

Pearl Mobile Gen 1.0 design used the SIT5156AI-FA033IT-10.000000Y MEMS oscillator from SiTime. The Tektelic part number is T0007459, and the reference designator in the design is Y26.

The fundamental frequency of the device is 10 MHz.

3.2 Comparative Information

3.2.1 Schematic

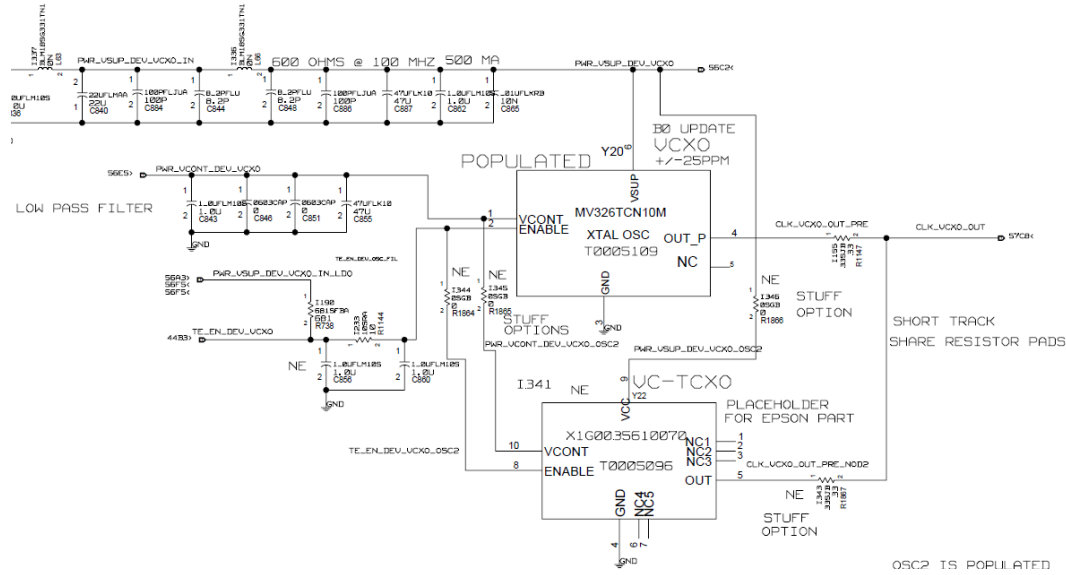


Figure 1: Gen 1.0 Oscillator Schematic

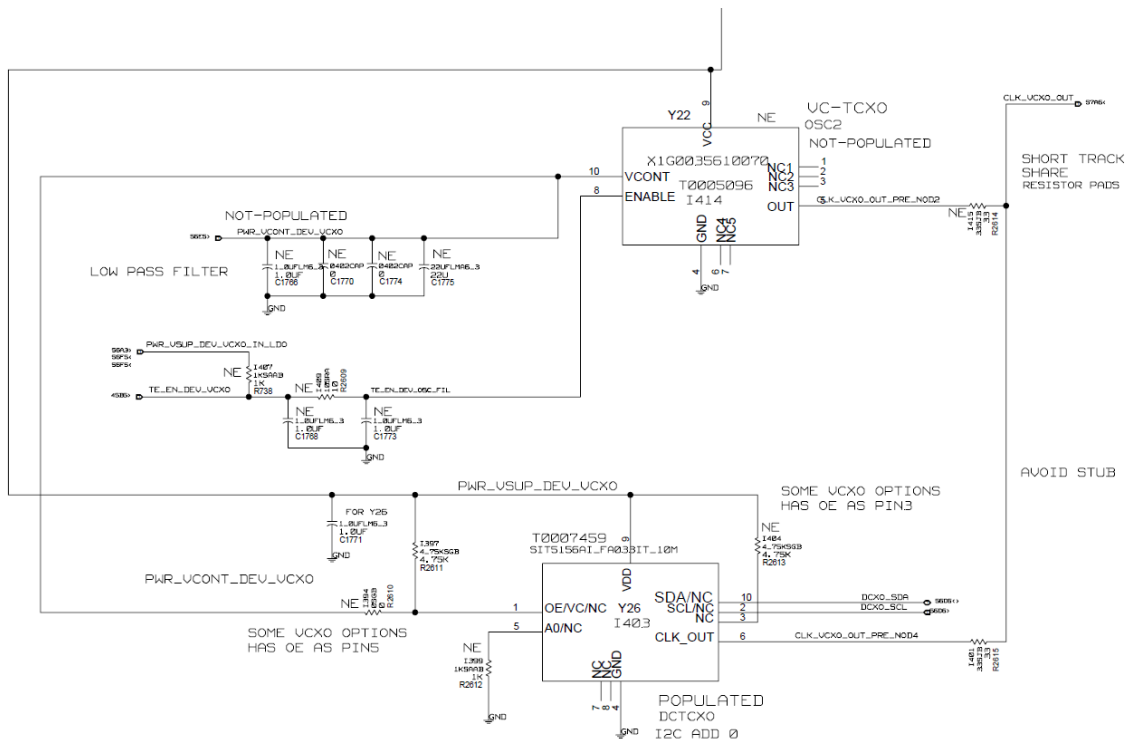


Figure 2: Gen 1.5 Oscillator Schematic

3.2.2 Pictures

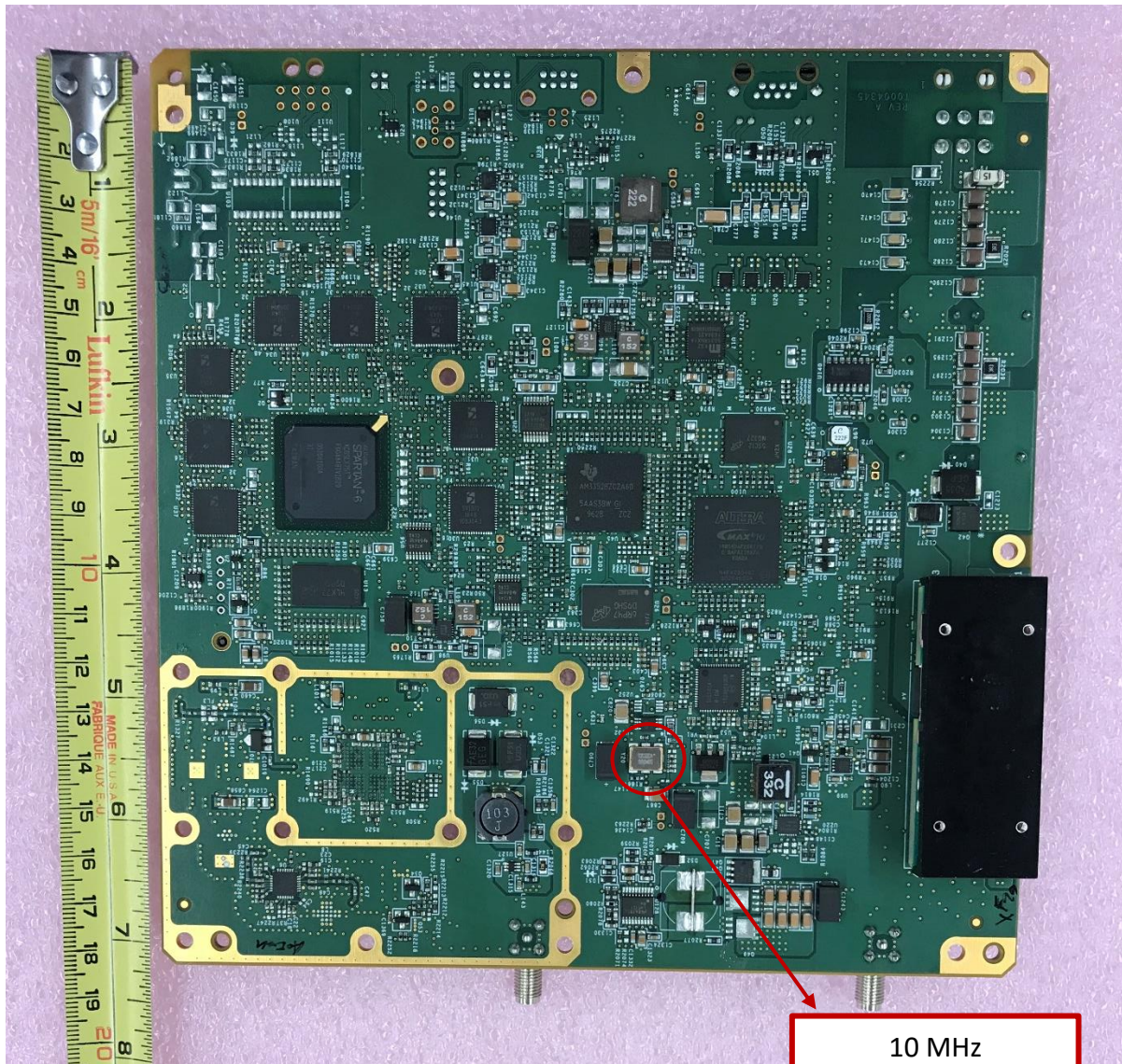


Figure 3: Gen 1.0 Pearl Mobile PCBA, secondary side

10 MHz
VCXO
MV326TCN10M
(Y20)

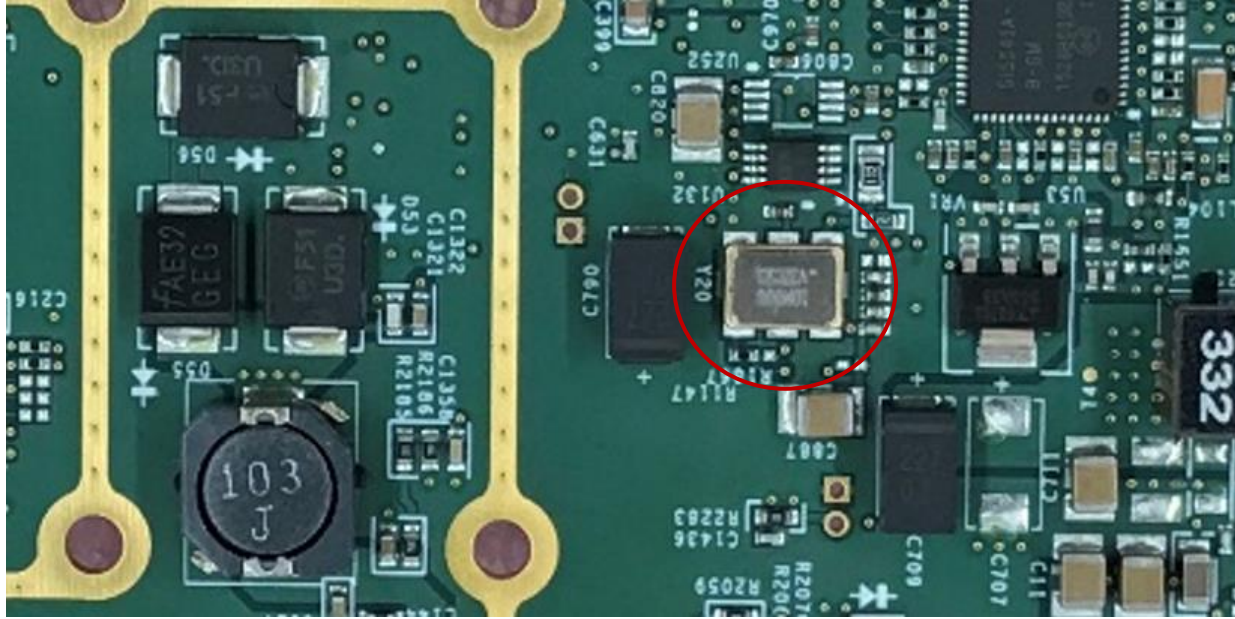


Figure 4: Gen 1.0 Pearl Mobile, 10 MHz VCXO

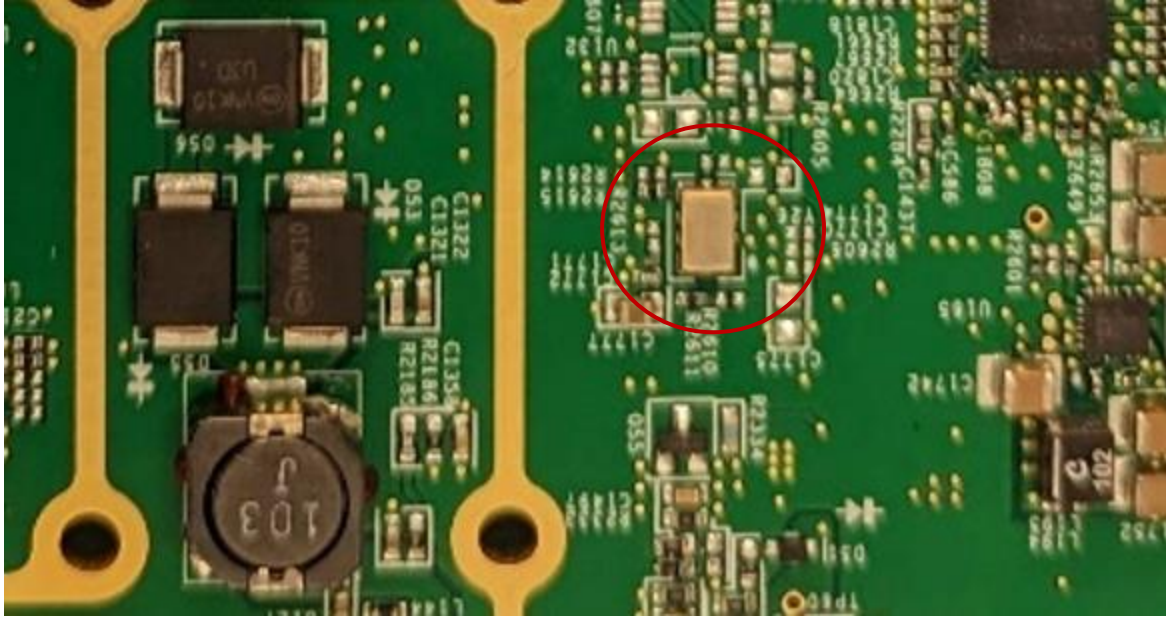
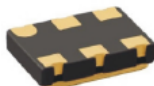


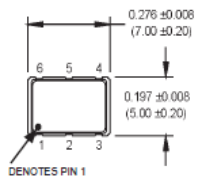
Figure 6: Gen 1.5 Pearl Mobile, 10 MHz DCTCXO

3.2.3 Specifications

MV3 & MV5 Series 5x7 mm, 3.3 or 5.0 Volt, HCMOS, VCXO



- General purpose VCXO with good performance at an affordable price



ACTUAL SIZE

All dimensions in inches (mm).

Ordering Information	
Product Series	MV3/MV5 1 3 V C N 00.0000 MHz
MV3 = 3.3 Volt	
MV5 = 5.0 Volt	
Temperature Range	1: 0°C to +70°C 2: -40°C to +85°C
6: -20°C to +70°C	
Stability	3: ±100 ppm 4: ±50 ppm
6: ±25 ppm*	8: ±20 ppm*
Output Type	V: Voltage Controlled - no tristate
	T: Voltage Controlled - tristate
Symmetry/Logic Compatibility	C: 45/55 CMOS G: 40/60 CMOS
Package/Lead Configurations	N: Leadless Ceramic
Frequency (customer specified)	

*Consult Factory for availability
M3005Sxxx & M3008Sxxx - Contact factory for datasheets.

Figure 7: Gen 1.0 Pearl Mobile Oscillator, Datasheet

Ordering Information

The part number guide illustrated below is for reference only, in which boxes identify order codes having more than one option. To customize and build an exact part number, use the [SiTime Part Number Generator](#). To validate the part number, use the [SiTime Part Number Decoder](#).

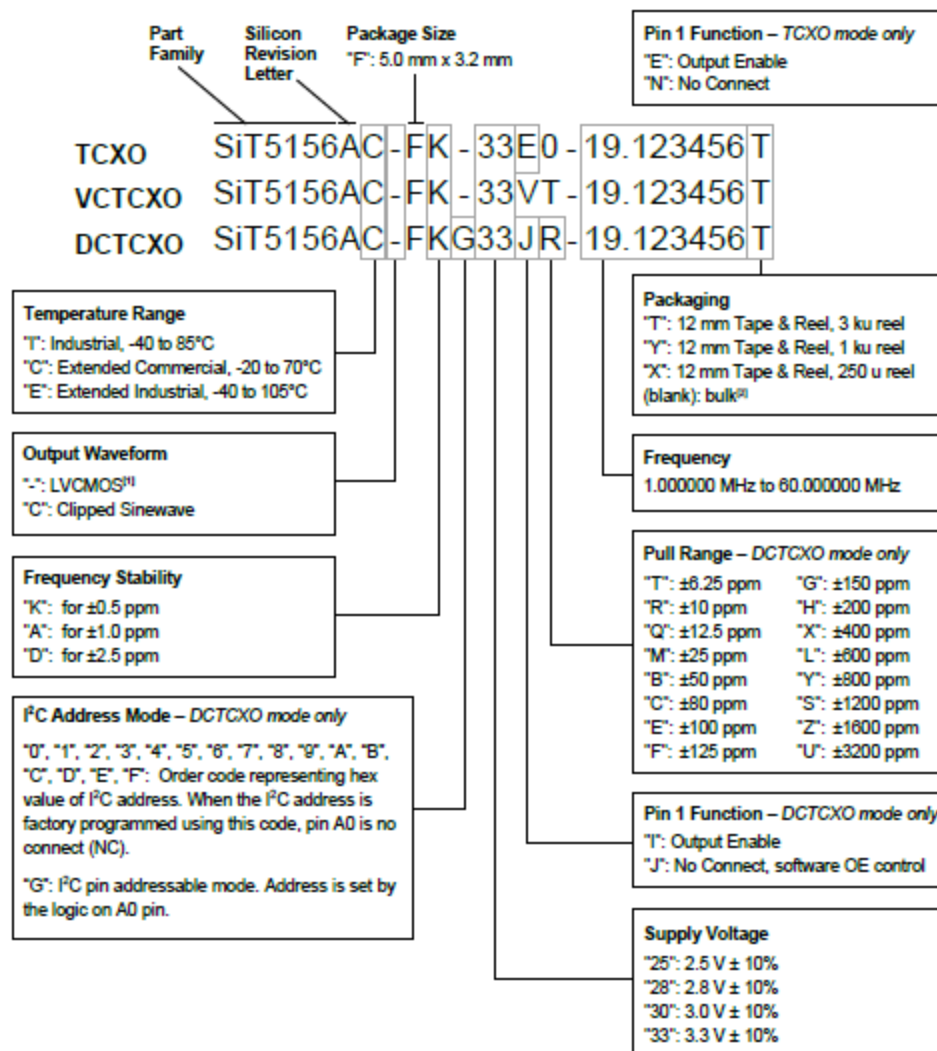


Figure 8: Gen 1.5 Pearl Mobile Oscillator, Datasheet

4 Attestation

Class II Permissive Change Request for FCC ID: 2ALEPT0004437

We, the undersigned, request a Class II Permissive Change for the Pearl Mobile Gateway, with FCC ID 2ALEPT0004437, in accordance with the permissive change rules presented in KDB Publication 178919 D01 + Notification 202109-001 (C2PCPX).

The Pearl Mobile Gateway module is a 12VDC powered LoRa gateway designed for IoT applications. Its intended purpose is to provide a carrier grade Gateway solution for LoRa networks. The product is designed to transmit in a North American ISM band (902-928 MHz) using DTS and FHSS modulation.

KDB 178919 D01 section III.D states that the substitution of an electrically identical part may be considered a Class II permissive change under the following conditions:

1. The new chip component is pin-for-pin compatible.
2. The new chip has the same basic function as the old chip, from an external perspective (internal circuitry may differ).
3. No change in radio parameters has occurred.
4. The same conditions apply when a small area (approximately the same area as the chip) of the PCB is replaced with an equivalent chip.

These conditions are met for all of the noted changes in the Table 1, with the exception of the updated oscillator, which maintains the same functional specifications, fundamental frequency and maximum output power as the previous device, but is not pin-for-pin compatible.

Non-pin-for-pin compatible part modifications are accommodated by Notification 202109-001 as C2PCPX, when the following conditions are met.

1. The requirements of § 2.1043 are fulfilled, i.e., the device's block functions for the fundamental frequency, primary modulator circuit, maximum power, or field strength ratings shall remain unchanged.
 - Pearl Mobile oscillator change does not alter the function, fundamental frequency or maximum power of the device.
2. Transmitter PCB layout and parts changes are only permitted if there is no change in identifying a device's form, functional specification, as initially granted or previously approved under a Class II permissive change.
 - Pearl Mobile oscillator change does not require any change to the device's functional specification.
3. PCB changes are limited to non-substantive modifications layout changes to the same size physical circuit board previously granted.
 - PCB changes are non-substantive; Physical size of the circuit board is unchanged.

4. C2PCPX is not permitted to add, remove, augment, or change capabilities, such as transmitters, increased bandwidth, additional rule parts, bands, etc.
 - Capabilities of the radio have not changed; there is no change to the transmitter output power, operation bandwidth or operating frequency as a result of the oscillator change.
5. In the PAG submission for item C2PCPX, the applicant shall provide complete information on testing demonstrating that the proposed changes for fundamental emissions are unchanged within the normal, acceptable tolerances and out-of-band emissions do not exceed the appropriate limits. The PAG submission shall include all applicable test reports and internal photos.
 - Test reports have been submitted demonstrating that fundamental emissions are unchanged within normal, acceptable tolerances and out-of-band emissions do not exceed the appropriate limits. The submission included applicable test reports and photos.
6. The modified device shall not be marketed under the existing grant of certification before confirmation that the C2PCPX PAG is approved and granted.
 - Understood
7. Software Defined Radio (SDR) grants that use the C2PCPX procedure are not permitted to make subsequent Class III permissive changes.
 - Understood
8. The C2PCPX PAG procedure has no impact on the provisions of V) of this publication for non-SDR software-only changes; thus, adding an equipment class when related to rule changes is still permitted.
 - Understood
9. Class I permissive changes are not permitted under this C2PCPX procedure.
 - Understood

Sincerely,



Tom Danshin, P.Eng
Manager, System Design
TEKTELIC Communications Inc.

5 Bibliography

- [1] Federal Communications Commission OET Laboratory Division, "Permissive Change Policy," October 16, 2015. [Online]. Available: <https://tinyurl.com/y6kke37n>.
- [2] Federal Communications Commission, "Notification 202109-001: Class II Permissive Change for PCB and Part Modification and PAG C2PCPX," September, 2021. [Online]. Available: <https://tinyurl.com/bpatw8wd>.
- [3] Federal Communications Commission OET Laboratory Division, "Permissive Change, Frequently-Asked Questions," October 16, 2015. [Online]. Available: <https://tinyurl.com/35n2b3r4>.
- [4] Code of Federal Regulations, "FCC Title 47, Chapter I, Subchapter A, Part 2, Subpart J, Certification § 2.1043," June 12, 2015. [Online]. Available: <https://tinyurl.com/yc6yzhbw>.