

Safety Code 6 Compliance Analysis of NLA031

Study conducted by Eastlink, Radio Frequency Engineering Department

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Contents

Description of site	2
Summary	4
Simulation and Software.....	4
Definitions	5
Results/Analysis of Simulation	7
SC6 Controls	11
Administrative Controls	11
Appendix	12
Antenna Information	12
References	12

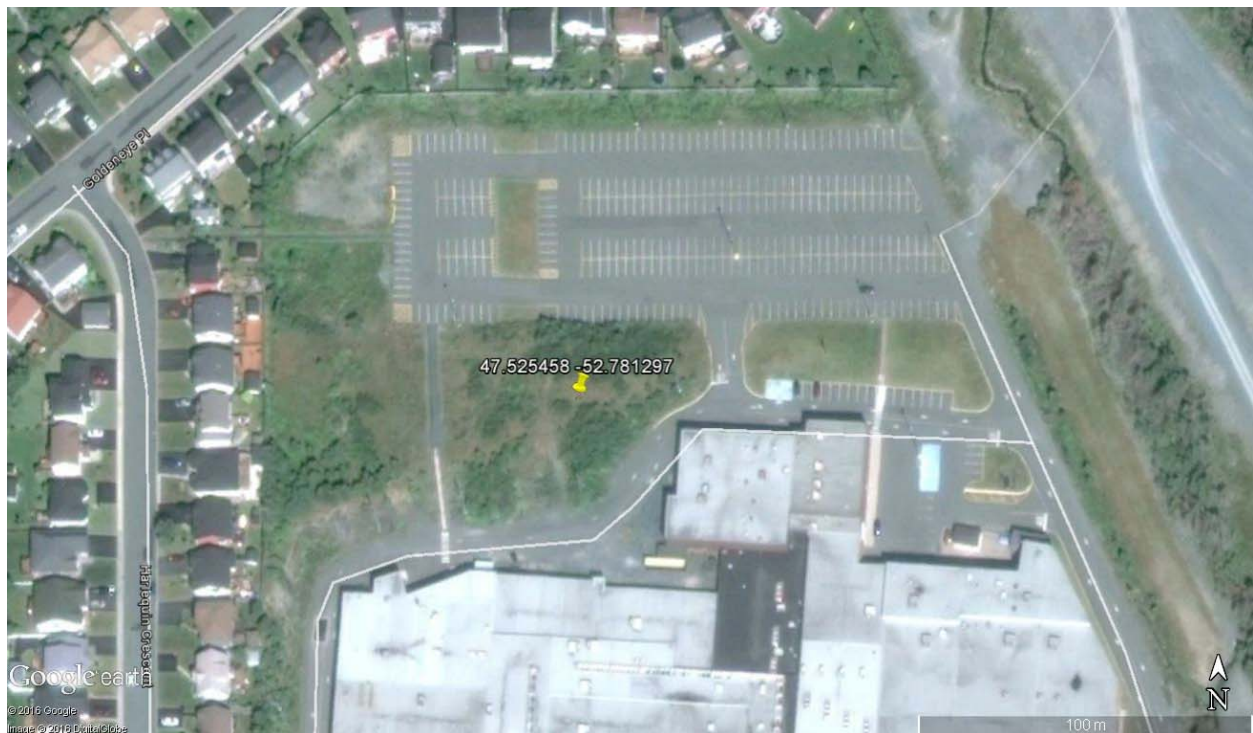
Description of site

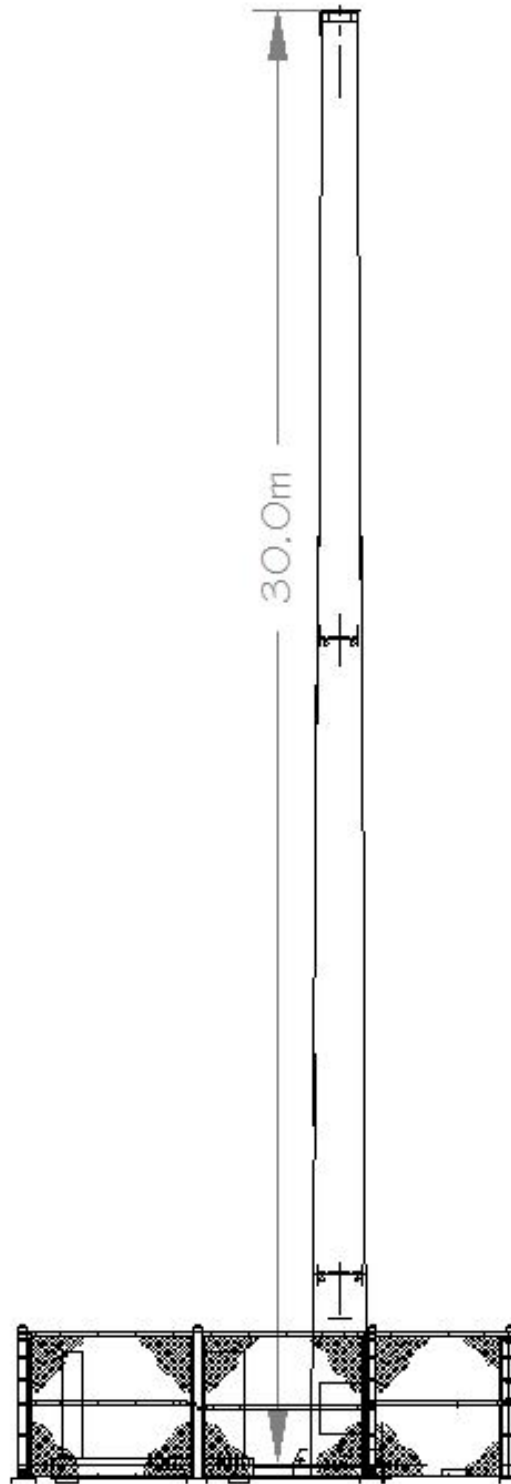
SITE TYPE: **Monopole**

SITE: **NLA031**

SITE COORDINATES: **47.525458 -52.781297**

Eastlink has proposed to install 6 antennas mounted on a monopole tower. Approx. 29 meters above ground level. No other cellular or broadcasting installations at this location.





Summary

This report assesses the Safety Code 6 (SC6) compliance of antenna radiation levels on NLA031. The concerns were tackled by conducting a simulation of a peak power scenario using IXUS electromagnetic field (EMF) Compliance Modeler software.

After modeling all the antennas on the site and running the simulation, the result analysis concluded SC6 compliance for the uncontrolled environment (general public).

In conclusion, the proposed antenna installation at NLA031 is compliant with SC6 reaching approximately 0.3% of the allowable power density levels of SC6 public limits [see exposure limit tables in appendix] with the maximum down electrical tilt of the antennas.

Simulation and Software

IXUS EMF Compliance Modeler software is used to build accurate models of sites with various architectural features. Its EMF compliance calculator can determine public and occupational non-compliance zones very accurately and display them in 3D on the model. The zones can be generated by one or many multi-band base station antennas or other antennas such as yagis and grid antennas. In addition, the software can generate environmental slices to illustrate how environmental levels of non-ionizing radiation compare to EMF general public guidelines of SC6.

For this simulation, a virtual model of NLA031 was built, all the antennas have been modeled with the specific parameters of each antenna [see “Antenna Information” in the appendix], and were placed on the tower structure with the exact offset and location. EMF zones were then calculated and environmental slices (i.e. power density levels) were placed along with a max value field point to indicate the location of the highest RF Power density level found in the simulation. Note that the antennas in the simulation are set to simulate peak input power and maximum electrical down tilt. In addition, this study only simulates the propagation of the signal in the air and does not consider the surrounding obstacles or the absorption of the signal by these obstacles and in reality the values are attenuated.

Definitions

Industry Canada's Safety Code 6

The Safety Code 6 (SC6), issued by Health Canada, (see Appendix) dictates the maximum exposure limits for two major categories of people. These categories are:

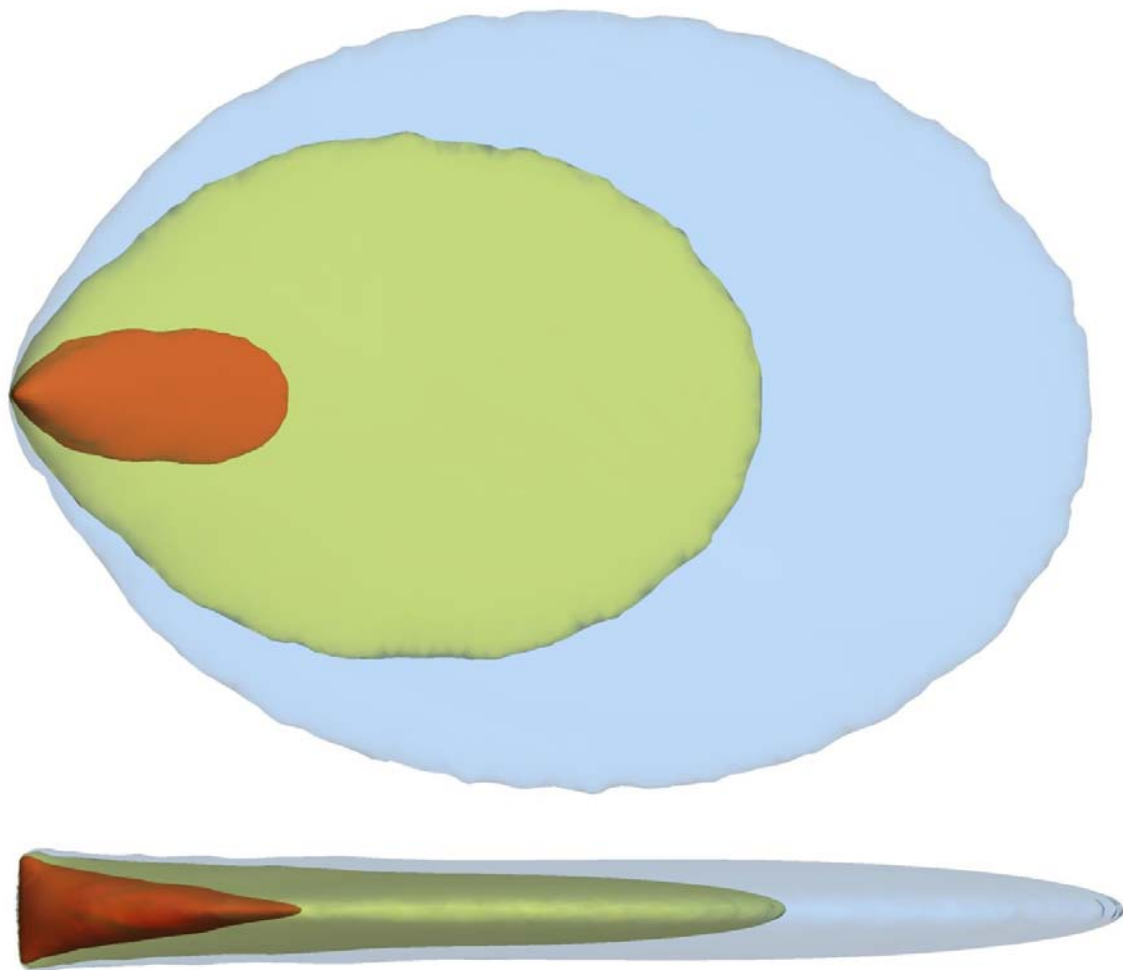
Controlled: Controlled environments are defined as those where all of the following conditions are satisfied:

- The radio-frequency (RF) field intensities in the controlled area have been adequately characterized by means of measurements, calculations or modeling.
- The exposure is incurred by persons who are aware of the potential for RF exposure and are informed of the intensity of the RF energy in their environment and,
- The exposure is incurred by persons who are aware of the potential health risks associated with RF energy exposures and whom can control their risk using mitigation strategies.

Uncontrolled environment: All situations that do not meet the specifications above are considered to be uncontrolled environments. Uncontrolled environments are defined as areas where either insufficient assessment of RF energy has been conducted or where persons who are allowed access to these areas have not received proper RF awareness training and have no means to assess or, if required, mitigate their exposure to RF energy.

Exclusion zone: Area around an antenna or where the RF power density exceeds the SC6 public guidelines (un-controlled exclusion zone) or the SC6 occupational guidelines (controlled exclusion zone)

Power Density: Level of EMF at a point in space, expressed in Watts per meter squared and presented in this report as % of uncontrolled environment limits. 100% being the maximum level a member of the general public can be exposed to under Health Canada's SC6. These limits are defined in the exposure limits table in the appendix.



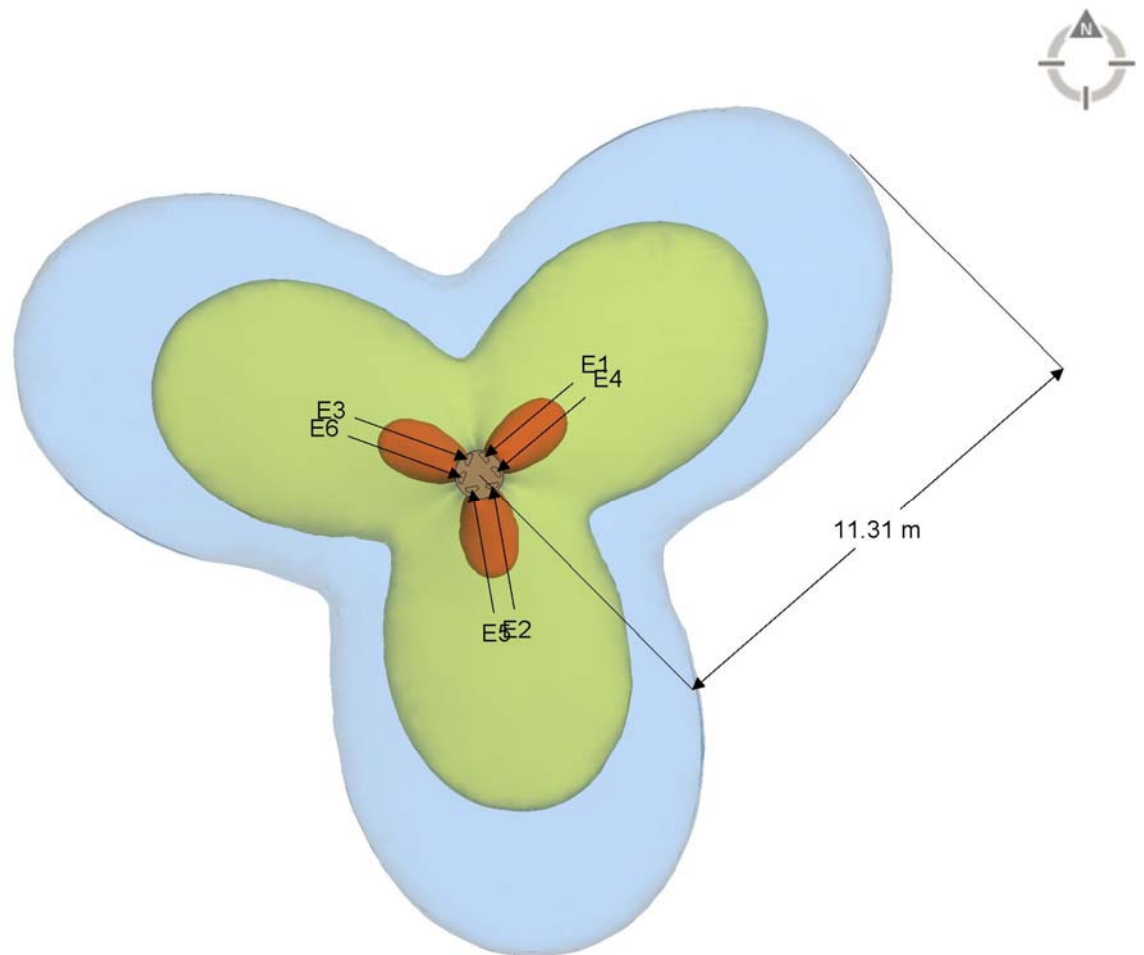
RED ZONE: 100% or above Controlled/Worker limits (5 x public limits), No access without powering down site.

YELLOW ZONE: 100% to 500% Un-Controlled/Public limits, Access RF personal only. No Access for public

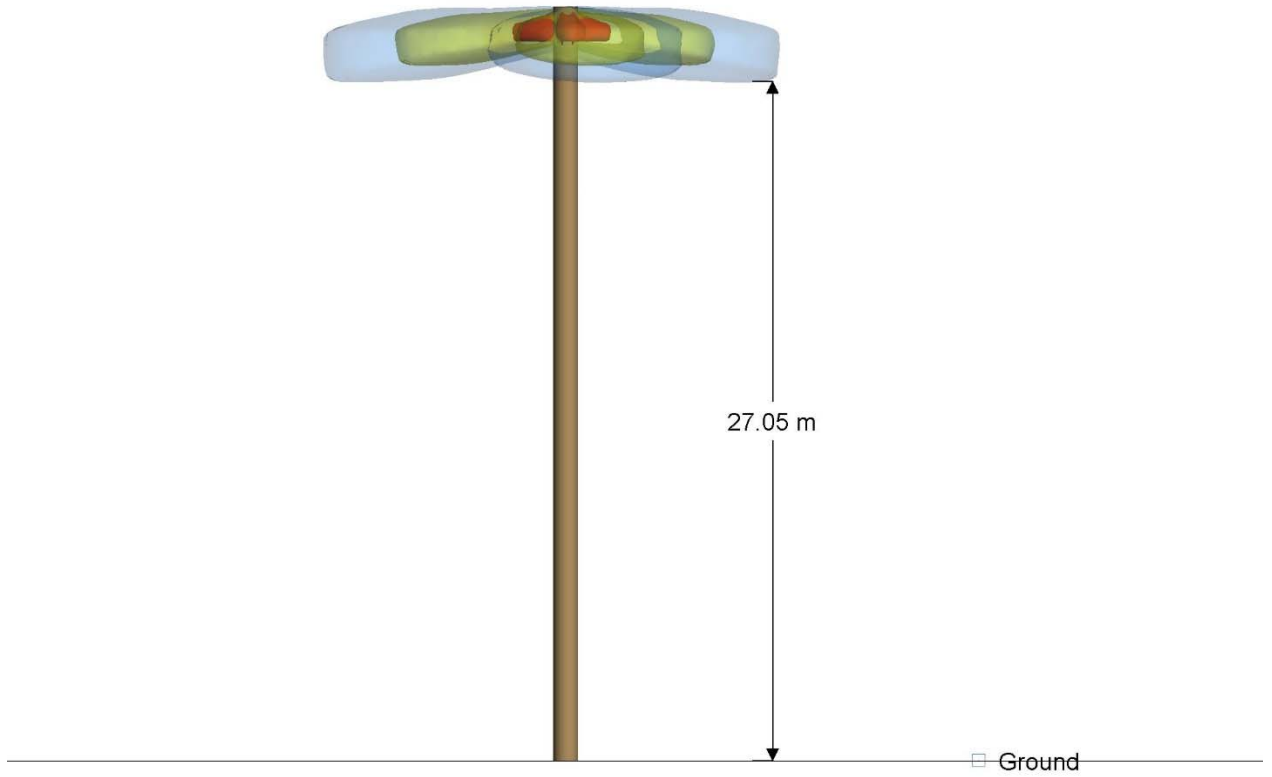
BLUE ZONE: 50% to 99% Un-Controlled limits, Public may access this area.

Results/Analysis of Simulation

The following figures illustrate the EMF exclusion zones produced by the antennas that exceed the limits of SC6. These zones are in front of the antennas roughly 27 meters above ground level. The red zone represents the controlled environment while the yellow represents the uncontrolled environment.



Top view of exclusion zones

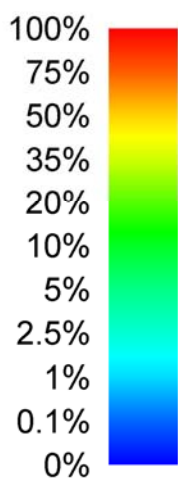


North view of exclusion zones

The following figures illustrate the power density levels observed at different heights above the ground. The Power density slice will include a Max value that indicates the location and highest power density found in the simulation at this height [2m above ground level].

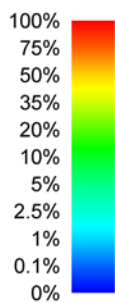
Environmental slice

% of IC Safety Code 6 Public (2015)

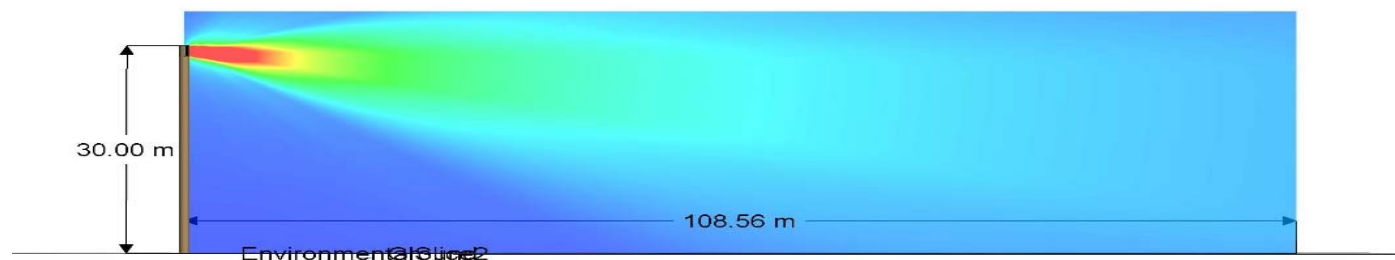




Environmental slice
% of IC Safety Code 6 Public (2015)



Power Density Levels at 2m (average human height) above ground level surrounding NLA031- Max Value 0.3% Public Limits at a distance of 108.6m from base of tower.



Cross section view of power density levels at azimuth 0 from tower structure to 108.6 meters where the highest power density was simulated at 2 meters above ground level.

SC6 Controls

Administrative Controls

No SC6 controls are required at this location.

Appendix

Antenna Information

Antenna	Antenna Model	Frequency MHz	E Tilt	Power [W]	Antenna Gain	line loss db	Antenna center height	Antenna azimuth
E1	ADU4518R9	2100	0-15	20 watts	17.2	-1	29	50
		700	0-15	20 watts	14.5	-1	29	50
E2	ADU4518R9	2100	0-15	20 watts	17.2	-1	29	50
		700	0-15	20 watts	14.5	-1	29	50
E3	ADU4518R9	2100	0-15	20 watts	17.2	-1	29	170
		700	0-15	20 watts	14.5	-1	29	170
E4	ADU4518R9	2100	0-15	20 watts	17.2	-1	29	170
		700	0-15	20 watts	14.5	-1	29	170
E5	ADU4518R7	2100	0-15	20 watts	17.2	-1	29	290
		700	0-15	20 watts	14.5	-1	29	290
E6	ADU4518R7	2100	0-15	20 watts	17.2	-1	29	290
		700	0-15	20 watts	14.5	-1	29	290

References

Limits of human exposure to radio-frequency electromagnetic fields in the frequency range from 3 kHz to 300 GHz - SC6 (2009), issued by Health Canada.

Safety Code 6 exposure limits

Table 5. Reference Levels for Electric Field Strength, Magnetic Field Strength and Power Density in Uncontrolled Environments

Frequency (MHz)	Electric Field Strength (E_{RL}), (V/m, RMS)	Magnetic Field Strength (H_{RL}), (A/m, RMS)	Power Density (S_{RL}), (W/m^2)	Reference Period (minutes)
10 - 20	27.46	0.0728	2	6
20 - 48	$58.07 / f^{0.25}$	$0.1540 / f^{0.25}$	$8.944 / f^{0.5}$	6
48 - 300	22.06	0.05852	1.291	6
300 - 6000	$3.142 f^{0.3417}$	$0.008335 f^{0.3417}$	$0.02619 f^{0.6834}$	6
6000 - 15000	51.4	0.163	10	6
15000 - 150000	51.4	0.163	10	$616000 / f^{1.2}$
150000 - 300000	$0.158 f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000 / f^{1.2}$

Frequency, f , is in MHz.

Table 6. Reference Levels for Electric Field Strength, Magnetic Field Strength and Power Density in Controlled Environments

Frequency (MHz)	Electric Field Strength (E_{RL}), (V/m, RMS)	Magnetic Field Strength (H_{RL}), (A/m, RMS)	Power Density (S_{RL}), (W/m^2)	Reference Period (minutes)
10 - 20	51.4	0.163	10	6
20 - 48	$129.8 / f^{0.25}$	$0.3444 / f^{0.25}$	$44.72 / f^{0.5}$	6
48 - 100	49.33	0.1309	6.455	6
100 - 6000	$15.50 f^{0.25}$	$0.04138 f^{0.25}$	$0.6455 f^{0.5}$	6
6000 - 15000	137	0.364	50	6
15000 - 150000	137	0.364	50	$616000 / f^{1.2}$
150000 - 300000	$0.354 f^{0.5}$	$9.40 \times 10^{-4} f^{0.5}$	$3.33 \times 10^{-4} f$	$616000 / f^{1.2}$

Frequency, f , is in MHz.