Australian Government | acma

Australian
Communications
and Media Authority

www.acma.gov.au

Frequency assignment requirements for narrowband single channel two frequency point-to-point services in the VHF high and 400 MHz bands

RALI: FX 17

DATE OF EFFECT: 1 JULY 2020

Amendment history

Date	Comments
October 2001	Initial RALI
December 2019	Updates to add 50 kHz and the VHF high band. See IFC 31/2019.
July 2020	Update to remove 800/900MHz bands. See IFC 12/2020.

Suggestions for improvements to Radiocommunications Assignment and Licensing Instruction FX 17 may be addressed to:

The Manager, Spectrum Planning Section
Australian Communications and Media Authority
PO Box 78
Belconnen ACT 2616

or by email to: freqplan@acma.gov.au.

Please notify the ACMA of any inaccuracy or ambiguity found in this RALI, so that it can be investigated, and appropriate action taken.

Contents

1 Introduction

1.1 Purpose

This Radiocommunications Assignment and Licensing Instruction (RALI) provides advice on frequency assignment policy and coordination procedures for Narrowband Single Channel Two Frequency (SCTF) Fixed Point to Point (P-P) services operating in accordance with:

- the VHF High Band Plan (part of RALI MS42); and
- the 400 MHz Plan (RALI MS22).

The information in this document reflects the ACMA's statement of current policy in relation to frequency assignment requirements for narrowband SCTF services operating in the VHF High and 400 MHz bands. In making decisions, accredited frequency assigners and the ACMA's officers should take all relevant factors into account and decide each case on its merits. Issues relating to this document that appear to fall outside the enunciated policy should be referred to:

The Manager, Spectrum Planning Section
Australian Communications and Media Authority
PO Box 78
Belconnen ACT 2616

or by email to: freqplan@acma.gov.au.

2 Service description

SCTF P-P services in the VHF high and 400 MHz bands are typically used to provide simultaneous bi-directional (full duplex) narrowband communications between two fixed points. Services may use either analogue or digital modulation.

Functionally a SCTF system may be characterised as featuring:

- Line-of-site links between stations at high sites employing directional antennas;
- Full duplex operation; and
- Carriage of either:
  - Voice services; or
  - Data services.

The channelling arrangements for SCTF services are provided in the relevant band plans. The method for combining channels for 25 kHz and 50 kHz systems is detailed in Appendix A.

3 Service model

The following section presents a service model that is to be applied, with certain allowances to interservice[1] sharing, to all new frequency assignments for narrowband SCTF services operating in the VHF High and 400 MHz bands.

The model is intended to ensure a satisfactory grade of service, while still facilitating a reasonable density of co-channel services within the geographic vicinity.

The service model for SCTF services in the VHF High and 400 MHz bands is notionally characterised as a radiocommunications system where full duplex communications, meeting or exceeding a target grade of service, occur between two terminal stations utilising directional antennas over a substantially unobstructed path.

3.1 Target grade of service

The notional target grade of service for SCTF services is:

- a received signal quality of 30 dB SINAD or better for analogue services[2] for more than 90% of the time; and
- a BER of better than 10^{-6} for digital services[3] for more than 90% of the time.

Section 4 specifies planning rules intended to ensure that new SCTF services achieve at least the notional target grade of service specified in the service model.

[1] See RALI FX01 "Frequency Assignment Requirements for Narrowband Fixed and Mobile Services with Wideband Fixed Services in the 403-420 MHz Band".
[2] Refer to paragraph 2.3 of Spectrum Planning Report 3-86.
[3] Typical narrowband receivers will deliver output BERs of at least 10^{-6} at signal-to-noise ratios as low as 15 dB at the receiver input.

4 Planning rules

SCTF services in the VHF High and 400 MHz bands must comply with the following planning rules:

1. operation is limited to frequencies authorised under the appropriate frequency plan;
2. where channelling arrangements cater for 12.5 kHz, 25kHz and 50 kHz channels, 12.5 kHz channels should be used wherever operationally feasible. 25 kHz channels should only be assigned to new services operating at bit rates of at least 16 kbps. 50 kHz channels may only be assigned in low or remote density areas and for data rates exceeding 32 kbps;
3. a flat co-channel protection ratio of 30 dB applies. However, this may be reduced in some circumstances - see Section 4.2;
4. a maximum [average] transmitter output power (into the antenna) of 1 W, except for services where the link distance is less than 10 km where the maximum transmitter output power (into the antenna) shall be 100 mW; and
5. actual antenna radiation performance is to be at least equal to the following notional antenna characteristics:

- In High and Medium Spectrum Density Areas[4]:
  - in the 400 MHz band[5]: a directional antenna with a mid-band gain of least 13 dBi, a minimum front-to-back ratio of 17 dB and a maximum beam width (in E-plane) of 46°.
- Outside of High and Medium Spectrum Density Areas:
  - in the VHF High band: a directional antenna with a mid-band gain of least 7 dBi, a minimum front-to-back ratio of 12 dB and a maximum beam width (in E-plane) of 60°; and
  - in the 400 MHz band: a directional antenna with a mid-band gain of least 9 dBi, a minimum front-to-back ratio of 15 dB and a maximum beam width (in E-plane) of 47°.

4.1 Protection ratios

The service model applies a flat co-channel protection ratio[6] of 30 dB for all co-channel SCTF services, which reduces by a calculated amount for cases where a victim receiver is operating near its minimum useable sensitivity - see Section 4.2.

Due to the high level of adjacent channel isolation that is inherent to narrowband SCTF receivers, the service model only considers co-channel

[4] See ACMA's current "Apparatus Licence Fee Schedule" for definitions and maps for "High", "Medium" and "Low" Spectrum Density Areas.
[5] Consistent with Schedule 1 of *the* *Radiocommunications Licence Conditions (Fixed Licence) Determination 2015*.
[6] Protection Ratio: the minimum wanted-to-unwanted ratio that must be achieved for a successful co-ordination with a nearby service.

interference. This assumes that services will operate at no more than the EIRP limits imposed by this RALI and that isolation between channels is 50 dB or better.

The basic 30 dB co-channel protection ratio is intended to ensure that SCTF services achieve actual grades of service that are a least equal to those specified in Section 3.1.

Note: the same co-channel protection ratios apply to 12.5 kHz, 25 kHz and 50 kHz channels.

4.2 Reduced protection ratios for services operating close to minimum useable receiver sensitivity

Where a SCTF receiver is operating close to its noise limited receive threshold[7] the co-channel protection that it can be afforded is reduced. Without such reductions the effective co-channel re-use distance for adjacent services becomes unreasonably large.

Table 1 is to be used to determine the level of co-channel protection that can be afforded to a receiver operating close to its minimum useable sensitivity.

Reduced co-channel protection will apply to:

- a proposed new receiver where its own "wanted" signal will be weaker than - 99 dBm; or
- any potential victim receiver with a "wanted" signal weaker than - 99 dBm.

"Wanted" Signal Level (WL)	Co-channel protection ratio applying
WL ≥ -99 dBm	= 30 dB;
- 99 > WL > - 129 dBm	= 30 minus "X" dB; where X= (- 99 minus WL)
WL ≤ -129 dBm	No protection.

Table 1: Calculation of co-channel protection ratios applying to SCTF receivers.

[7] Limited by intrinsic system noise to around - 129 dBm in typical 25 kHz receivers.

5 Frequency assignment policy

5.1 Application of planning rules

SCTF services operating in the VHF High and 400 MHz bands are to comply with the planning rules specified in Section 4.

5.2 Channelling arrangements

Frequency assignments for SCTF services may only be made in accordance with the channelling arrangements for SCTF services made in:

- RALI MS42; and
- the 400 MHz Plan (RALI MS22).

Frequency assigners are to give full attention to the notes applying in each band plan.

5.3 Channel loading strategy for SCTF services in the VHF high and 400 MHz bands

A bottom-up vertical channel loading strategy is to be applied to all new SCTF services.

A bottom-up vertical channel loading strategy is one in which the lowest available channel must be assigned.

5.4 Inter-service co-ordination procedures

Coordination of P-P services with wideband fixed services in the 400 MHz band is addressed in RALI FX1. In any other cases, because of the diversity and complexity of sharing situations that may arise, it is not possible to provide rigorous and explicit procedures covering all inter-service coordination requirements. In these cases, coordination should be performed in accordance with good engineering practice based on fundamental interference mitigation principles.

6 Frequency coordination procedures

The following section outlines a coordination procedure for the frequency assignment of SCTF services in the VHF High and 400 MHz bands.

Note: the procedure given below only outlines the general principles that should be applied when selecting and co-ordinating frequencies. It is the responsibility of the assigner to apply sound engineering principles and take full account of all embargoes, relevant RALIs and Band Plans.

6.1 Frequency Selection

After identifying the prospective frequency range(s) that meet the basic engineering requirements for the proposed link the frequency selection process may be carried out in the following 9 general stages:

1. Obtain a current list of licensed services covering the frequency range of interest.
2. Referring to the list, perform a radial cull around the mean position (mid-point) of the proposed service. The cull is carried out in order to exclude services too far away to affect or be affected by the proposed new service. The choice of a suitable cull radius will depend on terrain and the frequency band but should not be less than 200 km.
3. Select the most appropriate site sense arrangements for the proposed service.

   Note: assigners should endeavour to follow established transmitter site sense wherever possible. This not only improves the availability of channels later, but also helps to optimise the productivity of prime sites. Rather than mixing site sense assigners should consider using an alternative frequency band. However, as a general guide when it is not possible to avoid mixing site sense, the selected transmission frequency should be at least four channels away from frequencies occupied by receivers nearby. This reduces potential intermodulation problems, which can also affect site productivity.
4. Referring to the list of current embargoes exclude any channels that cannot be used.
5. For the 400 MHz band, carry out necessary engineering assessments to exclude channels that are unavailable due to the potential for interference to wideband P-P Services - see RALI FX1.
6. Using the parameters specified in Table 2 and propagation loss determined by the use of ITU-R P.525 + P.526. The path loss may be determined by use of Table 3 to generate a list of wanted-to-unwanted ratios comparing the proposed service to each co-channel service in the cull area.

Relative angle off bore-sights	Assumed discrimination
within ±18 degrees	- 15 dB
any other angle	0 dB

Table 2: Assumed cross-polar discrimination for notional antennas.

Note: the assigner is free to select the antenna polarisation (either horizontal or vertical) that provides the best co-ordination results. However, horizontal polarisation is preferred as additional onsite isolation is then available to and from adjacent vertically polarised land mobile services.

Propagation Distance	Path Loss
0.003 to 40 km	Free space loss[8] + 10dB
> 40 km	104 + 0.55*(distance in km)

Table 3: Path loss calculations for SCTF services.

Note: Formulas are derived from the Longley Rice[9] model applied to an unobstructed line-of-sight path.

7. Exclude from the list those channels where the co-channel protection ratio required by Section 4.2 is not met. Then select the lowest available channel using the bottom-up vertical channel loading strategy described in Section 5.3.

   Note: selection of a suitable SCTF channel will require finding a pair of available duplex frequencies.

   Document the final details of the service for licensing purposes.

8. Complete licensing requirements.

   Note: antenna details must be shown on licences in cases where the authorised antenna does not meet the requirements of Schedule 1 of the *Radiocommunications Licence Conditions (Fixed Licence) Determination 2015*[10].

[8] Free Space Loss (FSL) = 32.5+ 20*Log (Distance in km) + 20*Log (Frequency in MHz).
[9] The model estimates loss to a 90% confidence level.
[10] https://www.legislation.gov.au/Details/F2018C00890

7 Local environment

There may be circumstances where the channel selected using the procedure above is not the optimal channel to be assigned due to the local environment. Examples are:

- a large mountain range offering additional propagation loss to/from a service in an adjacent area;
- a transmitter located on a site at a height much greater than the planning model assumes; or
- an anomalous propagation mode occurring due to a path over water.

Under such circumstances, propagation path loss may be determined by the use of any appropriate method described in section 4 of ITU-R P.526 (versions 4 through 14). All methods must use a 9 second digital elevation model (such as RadDEM) or better. Other methods for determining the propagation path loss may also be used pending ACMA agreement.

8 Exceptions

Exceptions to the requirements of this RALI for prospective assignments require case-by-case consideration by the Manager, Spectrum Planning Section.

A request for exemption from the requirements of this RALI would need to be accompanied by evidence to support the request.

All requests for exemptions should be submitted to freqplan@acma.gov.au.

9 RALI Authorisation

Approved 30/06/2020

Chris Worley
Manager
Spectrum Planning Section
Spectrum Planning and Engineering Branch

Communications Infrastructure Division
Australian Communications and Media Authority

Appendix A: Channelling arrangements

A.1 Preface

Each SCTF channel comprises of a pair of frequencies with a fixed frequency separation - a duplex pair. Depending on the site sense (see stage 3 of section 6.1) one end of every SCTF link must be chosen to transmit on the higher frequency of the duplex pair (i.e. to Transmit High). The related receiver at that same end receives on the lower frequency of the pair. The transmitter/receiver at the opposite end of the link operates in complement - transmitting on the lower frequency of the pair (Transmit Low) and receiving on the higher frequency. Tables A1 to A3 list the duplex pairs allocated in each band in terms of transmitter frequency. By convention, the higher duplex frequency is denoted as Transmit High and the lower duplex frequency is denoted as Transmit Low.

A.2 Combining Channels

Where two 12.5 kHz channels are being assigned contiguously, combine channels 1 and 2, 3 and 4 etc. The 25 kHz channel centre frequency should be selected as follows:

1. Calculate the centre frequency of each odd numbered channel (where n=1, 3, 5, etc.);
2. Next add 6.25 kHz to each calculated centre frequency. This yields the centre frequency of each possible 25 kHz channel; then
3. Consistent with the bottom up channel loading strategy expressed in section 5.3, use the frequency selection process outlined in section 6.1 to find the lowest available 25 kHz centre frequency.

Where four 12.5 kHz channels are being assigned contiguously (VHF High and 400 MHz bands), combine channels 1-4, 5-8 etc. The 50 kHz channel centre frequency should be selected as follows:

1. Note the centre frequency of each even numbered channel (where n=2, 6, 10, etc);
2. Add 6.25 kHz to that centre frequency. This yields the centre frequency of each possible 50 kHz channel; then
3. Consistent with the bottom up channel loading strategy expressed in section 5.3, use the frequency selection process outlined in section 6.1 to find the lowest available 50 kHz centre frequency.

Note: the same co-channel protection ratios apply to 12.5 kHz, 25 kHz and 50 kHz channels.

Channel	12.5 kHz Centre Frequency	25 kHz Centre Frequency	50 kHz Centre Frequency	12.5 kHz Centre Frequency	25 kHz Centre Frequency	50 kHz Centre Frequency
1	150.0625	150.06875	150.08125	154.6625	154.66875	154.68125
2	150.075			154.675		
3	150.0875	150.09375		154.6875	154.69375	
4	150.1			154.7		
5	150.1125	150.11875	150.13125	154.7125	154.71875	154.73125
6	150.125			154.725		
7	150.1375	150.14375		154.7375	154.74375	
8	150.15			154.75		
9	150.1625	150.16875	150.18125	154.7625	154.76875	154.78125
10	150.175			154.775		
11	150.1875	150.19375		154.7875	154.79375	
12	150.2			154.8		
13	150.2125	150.21875	150.23125	154.8125	154.81875	154.83125
14	150.225			154.825		
15	150.2375	150.24375		154.8375	154.84375	
16	150.25			154.85		
17	150.2625	150.26875	150.28125	154.8625	154.86875	154.88125
18	150.275			154.875		
19	150.2875	150.29375		154.8875	154.89375	
20	150.3			154.9		
21	150.3125	150.31875	150.33125	154.9125	154.91875	154.93125
22	150.325			154.925		
23	150.3375	150.34375		154.9375	154.94375	
24	150.35			154.95		
25	150.3625	150.36875	150.38125	154.9625	154.96875	154.98125
26	150.375			154.975		
27	150.3875	150.39375		154.9875	154.99375	
28	150.4			155		
29	150.4125	150.41875	150.43125	155.0125	155.01875	155.03125
30	150.425			155.025		
31	150.4375	150.44375		155.0375	155.04375	
32	150.45			155.05		
33	150.4625	150.46875	150.48125	155.0625	155.06875	155.08125
34	150.475			155.075		
35	150.4875	150.49375		155.0875	155.09375	
36	150.5			155.1		
37	150.5125	150.51875	150.53125	155.1125	155.11875	155.13125
38	150.525			155.125		
39	150.5375	150.54375		155.1375	155.14375	
40	150.55			155.15		

Channel	12.5 kHz Centre Frequency	25 kHz Centre Frequency	50 kHz Centre Frequency	12.5 kHz Centre Frequency	25 kHz Centre Frequency	50 kHz Centre Frequency
41	150.5625	150.56875	150.58125	155.1625	155.16875	155.18125
42	150.575			155.175		
43	150.5875	150.59375		155.1875	155.19375	
44	150.6			155.2		
45	150.6125	150.61875	150.63125	155.2125	155.21875	155.23125
46	150.625			155.225		
47	150.6375	150.64375		155.2375	155.24375	
48	150.65			155.25		
49	150.6625	150.66875	150.68125	155.2625	155.26875	155.28125
50	150.675			155.275		
51	150.6875	150.69375		155.2875	155.29375	
52	150.7			155.3		
53	150.7125	150.71875	150.73125	155.3125	155.31875	155.33125
54	150.725			155.325		
55	150.7375	150.74375		155.3375	155.34375	
56	150.75			155.35		
57	150.7625	150.76875	150.78125	155.3625	155.36875	155.38125
58	150.775			155.375		
59	150.7875	150.79375		155.3875	155.39375	
60	150.8			155.4		
61	150.8125	150.81875	150.83125	155.4125	155.41875	155.43125
62	150.825			155.425		
63	150.8375	150.84375		155.4375	155.44375	
64	150.85			155.45		
65	150.8625	150.86875	150.88125	155.4625	155.46875	155.48125
66	150.875			155.475		
67	150.8875	150.89375		155.4875	155.49375	
68	150.9			155.5		
69	150.9125	150.91875	150.93125	155.5125	155.51875	155.53125
70	150.925			155.525		
71	150.9375	150.94375		155.5375	155.54375	
72	150.95			155.55		
73	150.9625	150.96875	150.98125	155.5625	155.56875	155.58125
74	150.975			155.575		
75	150.9875	150.99375		155.5875	155.59375	
76	151			155.6		
77	151.0125	151.01875	151.03125	155.6125	155.61875	155.63125
78	151.025			155.625		
79	151.0375	151.04375		155.6375	155.64375	
80	151.05			155.65		

Channel	12.5 kHz Centre Frequency	25 kHz Centre Frequency	50 kHz Centre Frequency	12.5 kHz Centre Frequency	25 kHz Centre Frequency	50 kHz Centre Frequency
81	151.0625	151.06875	151.08125	155.6625	155.66875	155.68125
82	151.075			155.675		
83	151.0875	151.09375		155.6875	155.69375	
84	151.1			155.7		
85	151.1125	151.11875	151.13125	155.7125	155.71875	155.73125
86	151.125			155.725		
87	151.1375	151.14375		155.7375	155.74375	
88	151.15			155.75		
89	151.1625	151.16875	151.18125	155.7625	155.76875	155.78125
90	151.175			155.775		
91	151.1875	151.19375		155.7875	155.79375	
92	151.2			155.8		
93	151.2125	151.21875	151.23125	155.8125	155.81875	155.83125
94	151.225			155.825		
95	151.2375	151.24375		155.8375	155.84375	
96	151.25			155.85		
97	151.2625	151.26875	151.28125	155.8625	155.86875	155.88125
98	151.275			155.875		
99	151.2875	151.29375		155.8875	155.89375	
100	151.3			155.9		
101	151.3125	151.31875	151.33125	155.9125	155.91875	155.93125
102	151.325			155.925		
103	151.3375	151.34375		155.9375	155.94375	
104	151.35			155.95		
105	151.3625	151.36875		155.9625	155.96875	
106	151.375			155.975		
107	151.3875			155.9875		

Table A1 – VHF High Band Point-to Point Channels

Channel	12.5 kHz Centre Frequency	25 kHz Centre Frequency	50 kHz Centre Frequency	12.5 kHz Centre Frequency	25 kHz Centre Frequency	50 kHz Centre Frequency
1	403.99375	404	404.0125	413.44375	413.45	413.4625
2	404.00625			413.45625		
3	404.01875	404.025		413.46875	413.475	
4	404.03125			413.48125		
5	404.04375	404.05	404.0625	413.49375	413.5	413.5125
6	404.05625			413.50625		
7	404.06875	404.075		413.51875	413.525	
8	404.08125			413.53125		
9	404.09375	404.1	404.1125	413.54375	413.55	413.5625
10	404.10625			413.55625		
11	404.11875	404.125		413.56875	413.575	
12	404.13125			413.58125		
13	404.14375	404.15	404.1625	413.59375	413.6	413.6125
14	404.15625			413.60625		
15	404.16875	404.175		413.61875	413.625	
16	404.18125			413.63125		
17	404.19375	404.2	404.2125	413.64375	413.65	413.6625
18	404.20625			413.65625		
19	404.21875	404.225		413.66875	413.675	
20	404.23125			413.68125		
21	404.24375	404.25	404.2625	413.69375	413.7	413.7125
22	404.25625			413.70625		
23	404.26875	404.275		413.71875	413.725	
24	404.28125			413.73125		
25	404.29375	404.3	404.3125	413.74375	413.75	413.7625
26	404.30625			413.75625		
27	404.31875	404.325		413.76875	413.775	
28	404.33125			413.78125		
29	404.34375	404.35	404.3625	413.79375	413.8	413.8125
30	404.35625			413.80625		
31	404.36875	404.375		413.81875	413.825	
32	404.38125			413.83125		
33	404.39375	404.4	404.4125	413.84375	413.85	413.8625
34	404.40625			413.85625		
35	404.41875	404.425		413.86875	413.875	
36	404.43125			413.88125		
37	404.44375	404.45	404.4625	413.89375	413.9	413.9125
38	404.45625			413.90625		
39	404.46875	404.475		413.91875	413.925	
40	404.48125			413.93125		
41	404.49375	404.5	404.5125	413.94375	413.95	413.9625

42	404.50625			413.95625		
43	404.51875	404.525		413.96875	413.975	
44	404.53125			413.98125		
45	404.54375	404.55	404.5625	413.99375	414	414.0125
46	404.55625			414.00625		
47	404.56875	404.575		414.01875	414.025	
48	404.58125			414.03125		
49	404.59375	404.6	404.6125	414.04375	414.05	414.0625
50	404.60625			414.05625		
51	404.61875	404.625		414.06875	414.075	
52	404.63125			414.08125		
53	404.64375	404.65	404.6625	414.09375	414.1	414.1125
54	404.65625			414.10625		
55	404.66875	404.675		414.11875	414.125	
56	404.68125			414.13125		
57	404.69375	404.7	404.7125	414.14375	414.15	414.1625
58	404.70625			414.15625		
59	404.71875	404.725		414.16875	414.175	
60	404.73125			414.18125		
61	404.74375	404.75	404.7625	414.19375	414.2	414.2125
62	404.75625			414.20625		
63	404.76875	404.775		414.21875	414.225	
64	404.78125			414.23125		
65	404.79375	404.8	404.8125	414.24375	414.25	414.2625
66	404.80625			414.25625		
67	404.81875	404.825		414.26875	414.275	
68	404.83125			414.28125		
69	404.84375	404.85	404.8625	414.29375	414.3	414.3125
70	404.85625			414.30625		
71	404.86875	404.875		414.31875	414.325	
72	404.88125			414.33125		
73	404.89375	404.9	404.9125	414.34375	414.35	414.3625
74	404.90625			414.35625		
75	404.91875	404.925		414.36875	414.375	
76	404.93125			414.38125		
77	404.94375	404.95	404.9625	414.39375	414.4	414.4125
78	404.95625			414.40625		
79	404.96875	404.975		414.41875	414.425	
80	404.98125			414.43125		
81	404.99375	405		414.44375	414.45	
82	405.00625			414.45625		

Table A2 – 400 MHz Segments B/J Point-to Point Channels

Channel	12.5 kHz Centre Frequency	25 kHz Centre Frequency	50 kHz Centre Frequency	12.5 kHz Centre Frequency	25 kHz Centre Frequency	50 kHz Centre Frequency
1	450.49375	450.5	450.5125	459.99375	460	460.0125
2	450.50625			460.00625		
3	450.51875	450.525		460.01875	460.025	
4	450.53125			460.03125		
5	450.54375	450.55	450.5625	460.04375	460.05	460.0625
6	450.55625			460.05625		
7	450.56875	450.575		460.06875	460.075	
8	450.58125			460.08125		
9	450.59375	450.6	450.6125	460.09375	460.1	460.1125
10	450.60625			460.10625		
11	450.61875	450.625		460.11875	460.125	
12	450.63125			460.13125		
13	450.64375	450.65	450.6625	460.14375	460.15	460.1625
14	450.65625			460.15625		
15	450.66875	450.675		460.16875	460.175	
16	450.68125			460.18125		
17	450.69375	450.7	450.7125	460.19375	460.2	460.2125
18	450.70625			460.20625		
19	450.71875	450.725		460.21875	460.225	
20	450.73125			460.23125		
21	450.74375	450.75	450.7625	460.24375	460.25	460.2625
22	450.75625			460.25625		
23	450.76875	450.775		460.26875	460.275	
24	450.78125			460.28125		
25	450.79375	450.8	450.8125	460.29375	460.3	460.3125
26	450.80625			460.30625		
27	450.81875	450.825		460.31875	460.325	
28	450.83125			460.33125		
29	450.84375	450.85	450.8625	460.34375	460.35	460.3625
30	450.85625			460.35625		
31	450.86875	450.875		460.36875	460.375	
32	450.88125			460.38125		
33	450.89375	450.9	450.9125	460.39375	460.4	460.4125
34	450.90625			460.40625		
35	450.91875	450.925		460.41875	460.425	
36	450.93125			460.43125		
37	450.94375	450.95	450.9625	460.44375	460.45	460.4625
38	450.95625			460.45625		
39	450.96875	450.975		460.46875	460.475	
40	450.98125			460.48125		

41	450.99375	451	451.0125	460.49375	460.5	460.5125
42	451.00625			460.50625		
43	451.01875	451.025		460.51875	460.525	
44	451.03125			460.53125		
45	451.04375	451.05	451.0625	460.54375	460.55	460.5625
46	451.05625			460.55625		
47	451.06875	451.075		460.56875	460.575	
48	451.08125			460.58125		
49	451.09375	451.1	451.1125	460.59375	460.6	460.6125
50	451.10625			460.60625		
51	451.11875	451.125		460.61875	460.625	
52	451.13125			460.63125		
53	451.14375	451.15	451.1625	460.64375	460.65	460.6625
54	451.15625			460.65625		
55	451.16875	451.175		460.66875	460.675	
56	451.18125			460.68125		
57	451.19375	451.2	451.2125	460.69375	460.7	460.7125
58	451.20625			460.70625		
59	451.21875	451.225		460.71875	460.725	
60	451.23125			460.73125		
61	451.24375	451.25	451.2625	460.74375	460.75	460.7625
62	451.25625			460.75625		
63	451.26875	451.275		460.76875	460.775	
64	451.28125			460.78125		
65	451.29375	451.3	451.3125	460.79375	460.8	460.8125
66	451.30625			460.80625		
67	451.31875	451.325		460.81875	460.825	
68	451.33125			460.83125		
69	451.34375	451.35	451.3625	460.84375	460.85	460.8625
70	451.35625			460.85625		
71	451.36875	451.375		460.86875	460.875	
72	451.38125			460.88125		
73	451.39375	451.4	451.4125	460.89375	460.9	460.9125
74	451.40625			460.90625		
75	451.41875	451.425		460.91875	460.925	
76	451.43125			460.93125		
77	451.44375	451.45	451.4625	460.94375	460.95	460.9625
78	451.45625			460.95625		
79	451.46875	451.475		460.96875	460.975	
80	451.48125			460.98125		
81	451.49375	451.5		460.99375	461	
82	451.50625			461.00625		

Table A3 – 400 MHz Segments B/J Point-to-Point Channels