C1 SATELLITE

PAYLOAD INFORMATION

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YOUR EYE IN THE SKY

1.0 Introduction

A SATELLITE FLEET TO BE PROUD OF

WITH OVER 25 YEARS OF EXPERIENCE, OPTUS IS A LEADER IN SATELLITE COMMUNICATIONS WITHIN AUSTRALIA. OVER THAT TIME WE'VE SUCCESSFULLY LAUNCHED NINE OPTUS OWNED SATELLITES AND OPERATED THIRTEEN SPACECRAFT.

THAT'S A CUMULATIVE TOTAL OF NEARLY 120 SPACECRAFT YEARS, CONSISTING OF 92 YEARS OF FULL STATION KEPT OPERATIONS AND 25 YEARS OF EXPERIENCE IN SATELLITE SERVICES.

What we manage

We look after an Australian domestic satellite system that provides coverage over continental Australia, Tasmania, and New Zealand. This also includes parts of Papua New Guinea, Norfolk Island, Lord Howe Island, Cocos Island, Christmas Island, McMurdo Sound, East Asia and Hawaii. Services are currently provided in Ku and L band.

The Optus satellite fleet consists of the B3, C1, D1, D2 and D3 satellites.

What's in this book?

It only includes information about our C1 satellite's commercial payload. It describes the satellite and its general performance characteristics which are based on in orbit measurement results. It's to help give you an indication of the C1 satellite service capabilities.

The C1 is a hybrid commercial/military communications satellite which was procured in partnership with the Australian Defence Forces. The commercial payload operates in the Ku band with coverage for Australia, New Zealand, East Asia and Hawaii.

C1 SATELLITE PAYLOAD INFORMATION

1.1 Satellite System Management

All Optus satellites are operated within parameters which are dependent on the satellite performance capability and the requirements of the communication services. The specific nature and application of the technical requirements is dependent on many factors such as the service technology, the amount of satellite capacity used and the transponder in which the service is operated. All these factors are interdependent and need to be managed to ensure the quality of all services is preserved over the life of the satellite. As the owner, operator and manager of the satellite system, Optus controls the performance of all satellite services and is responsible for determining transponder allocations and setting operating characteristics that meet the requirements of each user, while ensuring minimal interference to other services.

Satellite system management is not a simple task and in some cases Optus may need to apply special conditions to a service that will ensure the performance integrity of the satellite system is preserved.

2.0 THE OPTUS C1 SATELLITE

2.1 Satellite Summary

The C1 Satellite was manufactured under contract to Mitsubishi Electric Corporation who sub-contracted Space Systems Loral for the design and manufacture of the space platform or “spacecraft bus”.

A diagram of the C1 satellite in the deployed configuration is shown in **Figure 2.1.**

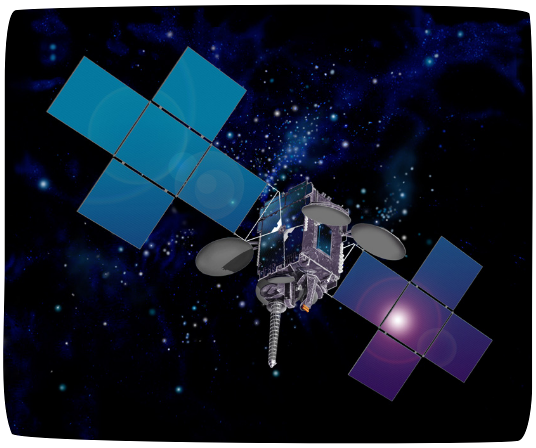


FIGURE 2.1 OPTUS C1 SATELLITE

C1 SATELLITE PAYLOAD INFORMATION

The C1 satellite consists of a space platform or “spacecraft bus” which provides various support systems that are required to control and maintain the satellite in orbit and operate the on-board communications system. The reliability of the platform itself is designed to be extremely high, and extensive protection from platform failures is provided by built-in redundancy and by extensive emergency operating procedures which have been developed to counter any foreseeable on-station emergency situation. The platform includes the power supply (solar cells and battery) which have been designed with an adequate margin for successful in-orbit operation extending well beyond the satellite design life.

The C1 satellite commercial payload comprises a Ku Band repeater designed to provide Fixed Satellite Services (FSS) to Australia and other specific locations in South East Asia, Asia and the Pacific. A total of twenty-four active linearised transponders are provided. Four beams are possible via the C1 satellite providing connectivity to the National Australia A (NA), National Australia B (NB), National Australia and New Zealand (NANZ) and East Asia (EA). The East Asia beam is steerable within limits set by regulatory considerations and the mechanical limitations of the satellite. These beams operate in orthogonal polarisations and each uplink beam operates in the polarisation orthogonal to its corresponding downlink beam.

Telemetry and control of the spacecraft is provided by Optus Satellite Operations staff from Sydney Satellite Facility at Belrose, with back up from Perth Satellite Facility at Lockridge.

The main characteristics of the Optus C1 satellite are listed in **Table 2.1** below.

	C1 Satellite
Physical Structure	Rectangular Prism body with solar wings
Dimensions	26 metres across extended solar panels
Dry Weight	1980 kg
Stabilisation Method	3 Axis Body Stabilised
Solar Power Capacity	10000 watts (at end of life) total C1 capacity.
Battery Capacity	Full operation during eclipse
Geostationary Life	15 years
Inclined Life Extension	5yrs (nominal)
Number of Transponders	24 Ku-Band
Transponder Power	110 watts saturated RF power per transponder
Transponder Bandwidth	8 Transponders 36 MHz Australia or Australia plus NZ 2 Transponders 72 MHz Australia or Australia plus NZ 4 Transponders 72MHz EA only 2 Transponders 36 MHz Aust or EA switchable-Splitcast capable. Note 1 1 Transponder 72 MHz Aust or EA switchable-Splitcast capable. Note 1 6 Transponders 36 MHz Aust only-Simulcast capable. Note 1 1 Transponder 72 MHz Aust only-Simulcast capable. Note 1 **Note 1:** See **Section 3.3.3** for information re special connectivity applications related to EA beam services
Communications payloads	Ku-Band communications UPC Beacon (Ku-Band)

TABLE 2.1 C1 SATELLITE SUMMARY

C1 SATELLITE PAYLOAD INFORMATION

2.2 Commercial Communications Payload Overview

A simplified block diagram of the communications payload is shown in **Figure 2.2.**

The Ku-band payload is divided into two repeaters called A and B. The A repeater consists of ten transponders which are switchable between National Australia A and National Australia plus NZ beams. The B repeater consists of a total of fourteen transponders which are switchable to provide access from/to National Australia B and East Asia beams. The transponders receive and transmit on orthogonal linear polarisations. Satellite transponders 1 to 10 are identified as repeater A and receive on horizontal polarisation and transmit on vertical polarisation. Transponders 11 to 20 and 21 to 24 are identified as repeater B and receive on vertical polarisation and transmit on horizontal polarisation.

The Ku-band payload can be conveniently divided into six sections described below:

i) Receive and Transmit Antennas

The receive and transmit antennas consist of four shaped surface reflectors, illuminated with separate feed antennas and sub-reflectors mounted on the spacecraft body. These provide highly shaped uplink and downlink beams: 4 receive and 4 transmit beams

ii) Receivers

The receiver section contains four receivers in a 4-for-2 redundancy ring for each repeater. The receivers amplify the entire 500MHz spectrum and translate it by 1748MHz from the 14GHz band to the 12GHz band.

iii) Input Hybrids

The receivers are followed by the 1:4 input hybrids. One hybrid is provided for each receive beam. The hybrids divide the received signal for presentation to the input multiplexers

iv) Input Multiplexers (IMUX)

The hybrids are followed by the input multiplexers (IMUX). These are filter banks which divide or “channelise” the receive band into a number of Ku-band channels. In the A repeater ten Ku-Band channels are derived. In the B repeater fourteen Ku-Band channels are derived. The latter can operate as straight channels or are able to be operated in simulcast or splitcast mode. Splitcasting of transponders 11-13 can be provided between National B and East Asia beams. Simulcast operation requires the utilisation of the Simulcast Divider/Combiner section. See **Section 3.3.3** for information on operation under Splitcast and Simulcast modes.

v) Simulcast Divider/Combiner Section

Outputs from the input multiplexers for transponders 14-20 and 21-24 are able to be rearranged via dividers, combiners and switches to allow simulcasting of these eleven B repeater transponders. Simulcasting refers to National Australia B and East Asia beams. See **Section 3.3.3** for information on operation under Simulcast mode.

vi) Channel Amplifiers

Each channel amplifier section consists of a Channel Control Unit (CCU) followed by a Travelling Wave Tube Amplifier (TWTA). The CCU controls the transponder gain setting and is discussed in **Section 3.5**.

All transponders have the same saturated RF power output – 110W.

The channel amplifiers are connected on the input and output via separate redundancy rings for each repeater. On the A repeater two rings provide 12-for-10 redundancy. On the B repeater a separate two rings provide 16-for-14 redundancy.

vii) Transmit beam switch matrices (TSM)

Following the channel amplifiers are the transmit beam switch matrices (TSM). These are configured under ground command to select a particular transmit beam on a particular transponder.

viii) Output Multiplexers (OMUX)

All transponders switched to a given transmit beam are recombined into a 500MHz spectrum in an output multiplexer (OMUX) bank before being fed to the transmit antenna. An OMUX bank is provided for each downlink beam. The OMUX banks provide channel filtering plus harmonic filters to absorb and reject TWTA harmonics.

C1 SATELLITE PAYLOAD INFORMATION

Communications Payload (Ku-Band)

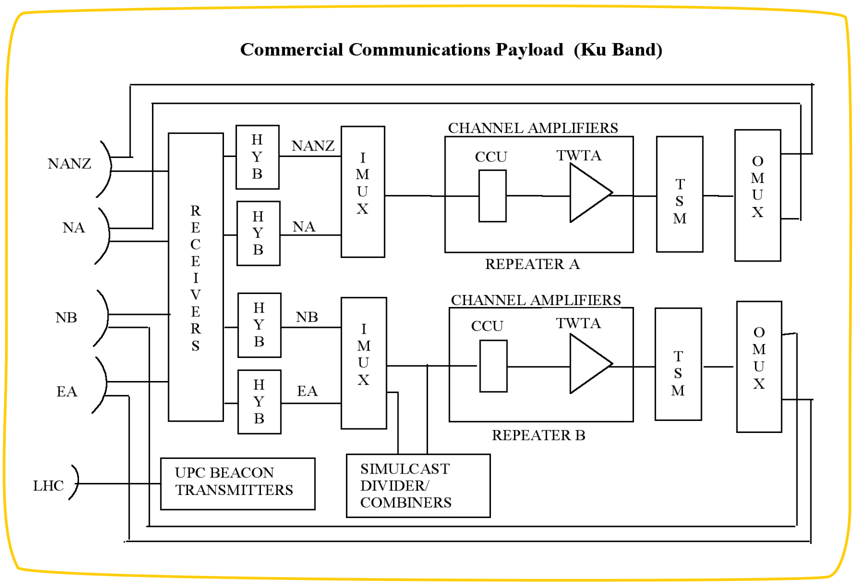


FIGURE 2.2 C1 SATELLITE COMMERCIAL COMMUNICATIONS PAYLOAD BLOCK DIAGRAM

2.3 Satellite Orbital Positions

The Optus C1 satellite is located at 156° East. During the lifetime of the satellite it could be moved to an alternate location involving the necessary regulatory considerations should the needs of the business dictate.

2.4 Station Keeping Performance

A satellite in a "geostationary" orbit will gradually change its orbit position primarily due to the combined gravitational effects of the sun, moon and earth. Optus employs two forms of station-keeping to maintain the nominal satellite position. These are Geostationary and Inclined Orbit operation.

The C1 satellite operates in geostationary mode. During the normal lifetime the C1 satellite will be maintained in orbit with a tolerance of ±0.07° in latitude and longitude about the sub-satellite point. (The sub-satellite point is the point on the earth's surface directly below the nominal satellite position.) Earth station antennas of up to about 7m in diameter accessing the Optus Ku-band frequencies of 14/12GHz generally do not require tracking capability.

3.0 KU-BAND COMMUNICATIONS PAYLOAD

The Optus C1 satellite can provide twenty-four active 14/12 GHz transponders operating in a dual polarisation frequency re-use scheme with ten transponders on one polarisation and fourteen on the other.

3.1 Frequency Plan

The C1 satellite will receive and transmit at the following Ku-Band frequencies:

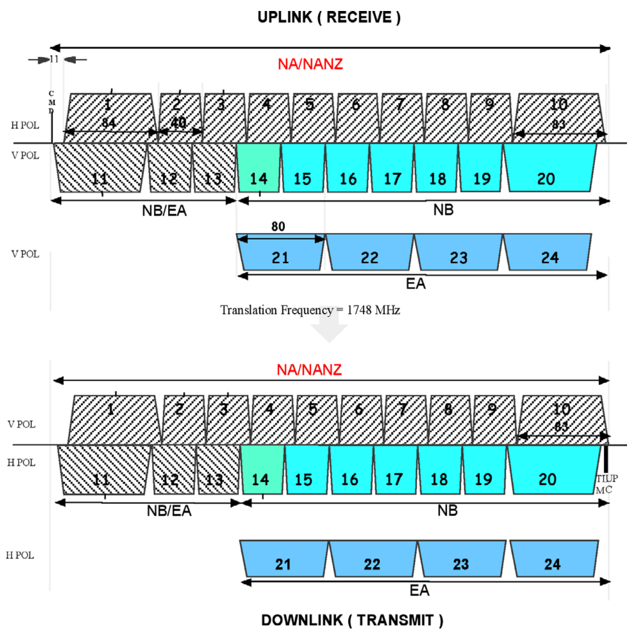
Receive	14,000-14,500 MHz	(14.00-14.50 GHz)
Transmit	12,250-12,750 MHz	(12.25-12.75 GHz)

The transponder channel plan is shown in **Figure 3.1.**

C1 SATELLITE PAYLOAD INFORMATION

The frequency plan uses the following spacing of transponder centre frequencies.

Separation between transponder centre frequencies:	
Adjacent 36MHz transponders	40 MHz
Adjacent 36MHz and 72MHz transponders	62 MHz
Adjacent 72MHz transponders – channels 21-23	80 MHz
Adjacent 72MHz transponders – channel 23 and 24	82 MHz
Frequency Offset (Repeater A to Repeater B)	9 MHz



Uplink channel	Centre frequency	Downlink channel	Centre frequency
1	14053.00	1	12305.00
2	14115.00	2	12367.00
3	14155.00	3	12407.00
4	14195.00	4	12447.00
5	14235.00	5	12487.00
6	14275.00	6	12527.00
7	14315.00	7	12567.00
8	14355.00	8	12607.00
9	14395.00	9	12647.00
10	14457.00	10	12709.00
11	14044.00	11	12296.00
12	14106.00	12	12358.00
13	14146.00	13	12398.00
14	14186.00	14	12438.00
15	14226.00	15	12478.00
16	14266.00	16	12518.00
17	14306.00	17	12558.00
18	14346.00	18	12598.00
19	14386.00	19	12638.00
20	14448.00	20	12700.00
TLM1			12747.75
TLM2			12748.75
UPC			12750.00
21	14206.00	21	12458.00
22	14286.00	22	12538.00
23	14366.00	23	12618.00
24	14448.00	24	12700.00

FIGURE 3.1 SATELLITE FREQUENCY, POLARISATION AND CONNECTIVITY

C1 SATELLITE PAYLOAD INFORMATION

3.2 Frequency Translation Characteristics

Satellite frequency translation characteristics for the Ku band communications payload, including expected stability performance, are as follows:

C1 Satellite Parameter	Performance Measure
Translation Frequency	1,748 MHz
Short-term Drift	±2 kHz/month
Long-Term Drift (over satellite life)	±20 kHz

TABLE 3.1 KU-BAND TRANSLATION FREQUENCY CHARACTERISTICS

3.3 Satellite Beam Information

Each Optus satellite has several receive and transmit beams on both horizontal and vertical polarisation.

Receive and transmit connectivity may be configured by ground command from the Optus Satellite Control Centre to match system operational requirements as they evolve throughout the life of each satellite.

3.3.1 Receive Beams

The receive beams for the C1 satellite are as follows:

Transponders	C1 Satellite Receive Beams
Transponders 1-10	Switchable NA or NANZ
Transponders 11-13	Switchable NB or EA
Transponders 14-20	NB
Transponders 21-24	EA

TABLE 3.2 C1 SATELLITE RECEIVE BEAMS

3.3.2 Transmit Beams

The transmit beams for the C1 satellite are as follows:

Transponders	C1 Satellite Receive Beams
Transponders 1-10	Switchable NA or NANZ
Transponders 11-13	Switchable NB or EA or both
Transponders 14-20	NB
Transponders 21-24	EA

TABLE 3.3 C1 SATELLITE TRANSMIT BEAMS

C1 SATELLITE PAYLOAD INFORMATION

3.3.3 Transponder and Beam Connectivity

Transponder connectivity may be configured by ground command from the Optus Satellite Control Centre to match system operational requirements as they evolve throughout the life of each satellite.

The connectivity available on the C1 satellite is shown in **Table 3.4** below.

Transponder Number	Receive Beam					Transmit Beam				
	NA (H)	NB (V)	NANZ (H)	EA (V)	EA (V)	NA (V)	NB (H)	NANZ (V)	EA (H)	EA (H)
Standard Mode Note 1										
1	S		S			S		S		
2	S		S			S		S		
3	S		S			S		S		
4	S		S			S		S		
5	S		S			S		S		
6	S		S			S		S		
7	S		S			S		S		
8	S		S			S		S		
9	S		S			S		S		
10	S		S			S		S		
11		S		S			S		S	
12		S		S			S		S	
13		S		S			S		S	
14		X					X			
15		X					X			
16		X					X			
17		X					X			
18		X					X			
19		X					X			
20		X					X			
21					X					X
22					X					X
23					X					X
24					X					X
Simulcast Mode Note 1										
14		14					14			21
15		15					15			21
16		16					16			22
17		17					17			22
18		18					18			23
19		19					19			23
20		20					20			24
Splitcast Mode Note 2										
11		11					11		11	
12		12					12		12	
13		13					13		13	
11				11			11		11	
12				12			12		12	
13				13			13		13	

TABLE 3.4 TRANSPONDER AND BEAM CONNECTIVITY

(Each transponder may be switched to one of the beams as shown).

Legend of abbreviations:

NA National Beam, repeater A

NB National Beam, repeater B

EA East Asia Beam

NANZ National Australia plus New Zealand Beam

S Switchable between beams marked with S for respective transponder

X Dedicated beam

C1 SATELLITE PAYLOAD INFORMATION

Table 3.4 Notes:

1. Each of transponders 21-24 is able to operate in standard mode or simulcast mode. Refer **Section 3.3.3.1.** In standard mode these transponders operate as dedicated transponders. In simulcast mode, the transponder numbers occupied by the simulcast mode uplink and downlink are separately listed. Each of the NB transponders 14-20 is independently switchable into simulcast mode.

2. Each of the NB transponders 11-13 is able to operate in standard mode or splitcast mode. Refer **Section 3.3.3.2.** In standard mode these transponders operate as transponders independently switchable between NB or EA beams. In splitcast mode each transponder can be independently switched to both NB and EA beams simultaneously. In splitcast mode the nominal EIRP at edge of coverage for both beams are approximately equal.

3.3.3.1 Simulcast Modes

Simulcast describes the configuration where uplinks from the NB service area are downlinked simultaneously into the NB service area and the EA service area via their own TWTAs. In this mode, there is no loss of total EIRP into each service area.

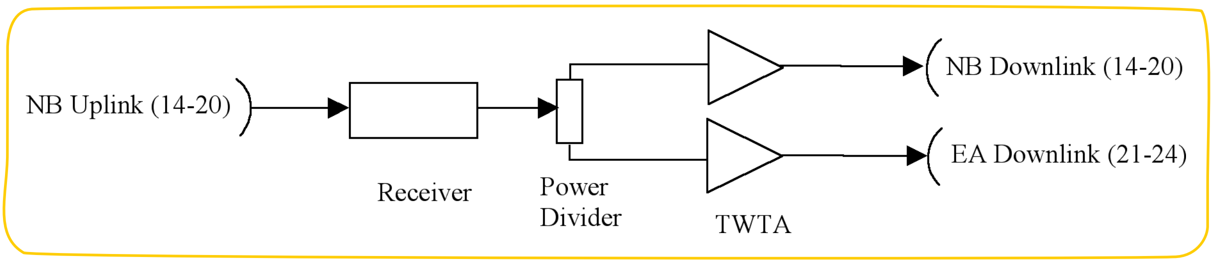


FIGURE 3.2 – SIMULCAST CONFIGURATION

In Standard mode, NB transponders 14 to 20 have uplinks and downlinks in the NB service area only.

Similarly, EA transponders 21 to 24 have uplinks and downlinks in the EA service area only.

In Simulcast mode, the uplinks for up to 2 adjacent NB transponders are simultaneously downlinked via the corresponding 2 NB TWTAs as well as via a single EA TWTA whose bandwidth overlaps the consecutive bandwidths of the 2 NB transponders.

Uplinks in each of NB transponders 14 to 20 can be simultaneously downlinked via both the corresponding NB and EA transponders on an individual basis. However the corresponding unused portion of transponders 21 to 24 cannot be used for an EA uplink.

For example: A 36Mhz wide uplink carrier into the NB receive beam for transponder 14 can be routed simultaneously into the NB transmit beam as well as the lower 36MHz of transponder 21 into the EA beam. As a result, the upper 36MHz of transponder 21 will now transmit into the EA beam any uplink carrier coming into the NB receive beam for transponder 15.

In this case the two carriers in transponder 21 are required to be backed off appropriately to reduce interference with each other and overdriving of the transponder. The same situation applies with transponders 16/17 and 18/19 operating in simulcast mode with transponders 22 and 23 respectively. Transponders 20 and 24 operate in simulcast mode in a one for one configuration as they are both 72MHz transponders.

Simulcast is available for uplinking from Australia and downlinking into Australia and Asia only.

C1 SATELLITE PAYLOAD INFORMATION

3.3.3.2 Splitcast

Splitcast describes the configuration where uplinks from either the NB service area or the EA service area are downlinked simultaneously into both the NB and EA service areas via a single TWTA on a predefined power split between the two service areas. In this mode, the EIRP into each service area is reduced by the power share ratio.

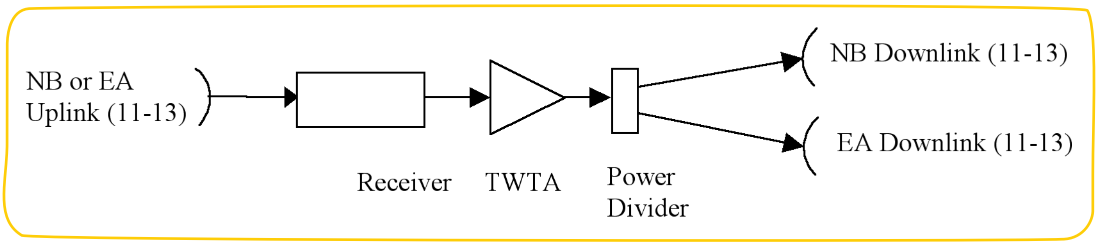


FIGURE 3.2 – SIMULCAST CONFIGURATION

3.4 Satellite Beam Performance Levels

Contour maps of satellite beam performance, in terms of G/T and EIRP, are provided in **Attachment 1**.

Service designs based on satellite beam performances need to include allowances for the normal performance variations to be expected between different satellite transponders over the operating life of the satellites. To assist design engineers in taking these effects into account, Optus has established a number of "Beam Performance Levels" which include different assumptions about satellite performance. The most important of these is the "General Design Level" which is the only beam performance level for which information is provided in this guide.

3.4.1 General Design Level

The General Design Level (GDL) of beam performance represents the best estimate by Optus of the worst-case performance through to end-of-life for any satellite transponder switched to a particular beam. It allows for all possible cases of service restoration or transponder reallocation, and Optus recommends that it be used for the design of satellite systems to ensure that they will work on any satellite transponder through to end-of-life. In particular the General Design Level of beam performance is recommended for the sizing of earth station antennas and High Power Amplifiers (HPAs) on the uplink, and the calculation of earth station receive G/Ts on the downlink.

The contour maps in **Attachment 1** show the General Design Level of beam performance at the time of publication of this guide for the C1 satellite operating in geostationary orbit.

3.4.2 Specific Performance Levels

Beam performance specific to a given transponder on a given satellite in a given orbit position at a given time will be provided by Optus to customers on request. Optus does not recommend that specific performance levels be used to design systems or size earth stations.

Optus will only contract to a Warranted Performance Level which makes allowances for all possible cases of service restoration or transponder reallocation.

3.5 Transponder Gain Control

Each satellite transponder contains a Channel Control Unit (see **section 2.2**) which provides a means of controlling the transponder gain. This gives the transponder a range of operating C/T values to suit the characteristics of the systems operating on it at a given time. The C/T (called "C-to-T") is the uplink saturated carrier-to-noise-temperature ratio and is a fundamental design parameter of a satellite transponder. It is related to the SFD and G/T by the following equation:

$$C/T = SFD + G/T + 10\log10(\lambda^2/4\pi)$$

- where -

C/T = Saturated carrier-to-noise-temperature ratio (dBW/K)C/T

SFD = Saturated flux density (dBW/m^2)

G/T = Satellite receive gain-to-noise-temperature ratio (dB/K)C/T

$\lambda^2/4\pi$ = Isotropic area conversion factor (m^2)

C1 SATELLITE PAYLOAD INFORMATION

Note that for a given transponder gain setting the C/T is fixed, meaning that the sum (SFD + G/T) is also fixed, i.e. the SFD and G/T vary in inverse proportion over the satellite receive beam pattern

On the C1 satellite two methods are used to provide transponder gain control for a range of C/Ts. Fixed Gain Mode (FGM) and Variable Gain Mode (VGM) are selectable by ground command in accordance with the following specifications.

3.5.1 Fixed Gain Mode (FGM)

FGM corresponds to traditional gain-step control in which a variable step-attenuator is switched under ground command to one of a number of settings or “gain steps”.

The C1 satellite has seven gain steps (called 1 to 7) in 2dB increments, covering a nominal uplink saturated C/T range of -123 to -135 dBW/K. In the fixed gain mode, when the spacecraft is illuminated by a single carrier at transponder centre frequency and at a level required for single carrier saturation, the receive carrier-to-noise temperature ratio (C/T) at the receiver input to each transponder is as specified in **Table 3.5**.

Transponder Gain Step	Nominal C/T (dBW/K)
1 (Low)	-123
2	-125
3	-127
4	-129
5	-131
6	-133
7 (High)	-135

TABLE 3.5 SATURATED C/T SPECIFICATION AT 14250MHZ

Each transponder is provided with independent ground commandable gain adjustment capability to facilitate selection on any transponder gain step as indicated in **Table 3.5.**

The C/T required for transponder saturation at any selected gain step does not vary by more than +1dB over any 24 hour period, and +2dB over the spacecraft service life.

3.5.2 Variable Gain Mode (VGM)

VGM provides a form of automatic gain control. Under VGM a feedback-loop maintains a constant input drive level to the transponder TWTA over an uplink C/T range of -123 to -143 dBW/K. This compensates for uplink fading at the cost of gradually degrading the uplink C/N.

When the spacecraft is illuminated by a single carrier or multiple carriers within the transponder usable bandwidth, at a level required to produce a total receive carrier-to-noise temperature ratio (C/T) in the range –123 dBW/K to –143 dBW/K, the transponder operating point is maintained at a total input back-off, selectable by ground command for each transponder, of -1,0,1,2,3,4,5 or 6 dB relative to that required for single carrier saturation.

VGM operates on the total transponder power and is therefore intended for either single-carrier operation, or for multiple carriers where all carriers are uplinked from the same location and therefore undergo an uplink fade at the same time. VGM may be used with uplink power control if desired to extend the range of uplink fade compensation.

OPTUS yes

C1 SATELLITE PAYLOAD INFORMATION

3.6 Amplitude Transfer Characteristics.

Representative AM/AM transfer characteristics for the TWTAs used in the C1 satellite is shown in **Figure 3.4.** This shows the transfer curves for single carrier. The X axis defines the Input Backoff (IBO) relative to TWTA saturation for the carrier whilst the Y axis defines the Output Backoff (OBO) for the carrier.

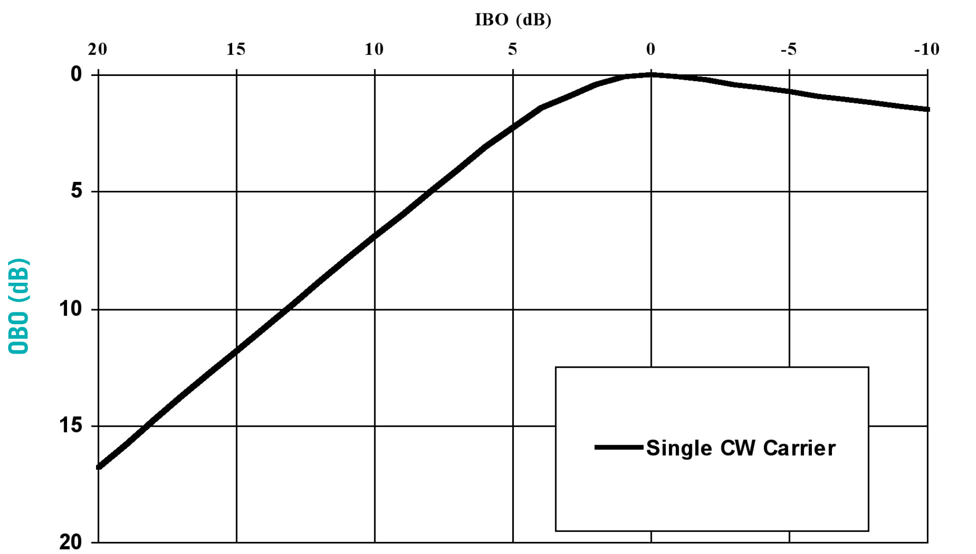


FIGURE 3.4 TYPICAL C1 SATELLITE AMPLITUDE TRANSFER CHARACTERISTIC

Figure 3.5 shows the normalised TWTA gain of a typical C1 satellite transponder as a function of Input Backoff (IBO) for a single carrier. The X axis defines the Input Backoff (IBO) relative to TWTA saturation for the carrier whilst the Y axis defines the carrier gain of the transponder.

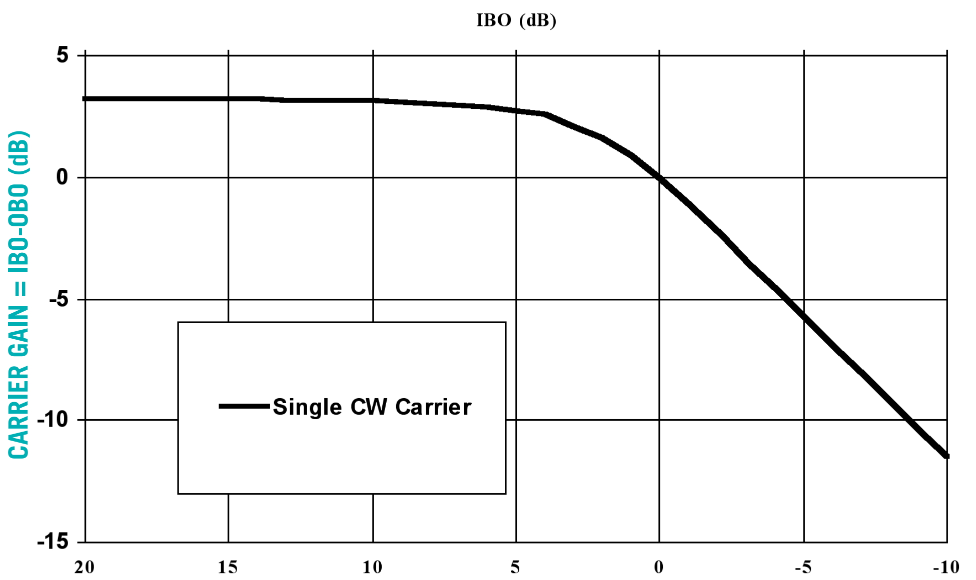


FIGURE 3.5 TYPICAL C1 SATELLITE TRANSPONDER GAIN CHARACTERISTIC

C1 SATELLITE PAYLOAD INFORMATION

3.7 Satellite Cross Polarisation Discrimination

Cross polarisation performance of the orthogonally polarised repeater A and repeater B, for the satellite receive beam, will equal or exceed the following performance levels as indicated in **Table 3.6.**

Cross-polarisation performance of the satellite link can be expected to degrade during rain storms and under other adverse weather conditions.

Beam	Cross Pol Discrimination over 100% Coverage Area
NA Beam	27dB
NB Beam	27dB
NANZ Beam	27dB
EA Beam	27dB

TABLE 3.6 C1 SATELLITE CROSS POLARISATION DISCRIMINATION

3.8 C1 and D3 Satellite NZ Co Polarisation Isolation

The D3 satellite is collocated with C1 at 156°E. D3 carries a back-up payload for the FSS NZ payload on D1 (refer to the D Series Satellite Payload Information document). The typical Co Polarisation isolation performance between the D3 FNZB beam and the C1 NB beam over New Zealand is given in Table 3.7. Customers intending to use the D3 NZ FSS payload should contact Optus for more accurate information for specific transponders.

Location	Receive Co Pol Isolation (dB)	Transmit Co Pol Isolation (dB)
Minimum	13	17
Typical	15-20	20-25*
Auckland	19	23
Wellington	17	23
Christchurch	18	22

TABLE 3.7 D3/C1 SATELLITE RECEIVE NZ CO POLARISATION ISOLATION

***Note:** Generally the transmit Co Pol Isolation is in the range 20-25dB with the exception of the North East tip of the North Island where it drops to 17dB.

C1 SATELLITE PAYLOAD INFORMATION

4.0 SATELLITE BEACONS

All Optus satellites transmit beacon signals which are used by Optus to monitor the condition of the spacecraft and which may be used by customer earth stations for antenna tracking and uplink power control (UPC). The UPC beacon is appropriate for tracking by customer earth stations.

4.1 Telemetry Beacons

The C1 satellite transmits two telemetry beacons. These beacons are transmitted in Right Hand Circular polarisation via the Omni antenna for transfer orbit activities and in Horizontal polarisation for on station service over the C1 satellite service area. The Beacon frequencies are 12747.75MHz and 12748.75MHz. **Table 4.1** indicates specifications of the Telemetry beacons.

Telemetry Beacons	
Frequency	12,747.75 MHz
Frequency	12,748.75 MHz
Frequency Stability	±12KHz over any 24 hour period
	± 100KHz over the spacecraft lifetime.
Polarisation	Right Hand Circular – Transfer Orbit activity Horizontal – On Station
EIRP at Perth	20.5dBW on station
EIRP at Sydney	22dBW on station

TABLE 4.1 C1 SATELLITE TELEMETRY BEACONS

C1 SATELLITE PAYLOAD INFORMATION

4.2 Uplink Power Control Beacon

The C1 satellite carries an uplink power control beacon which is used for tracking and Uplink Power Control (UPC). This beacon is radiated in Left Hand Circular Polarisation over the C1 satellite service area. The beacon frequency is 12750MHz. The frequency stability of the UPC beacon is as specified in **table 4.1.** Within the service area, the received EIRP level of the UPC beacon is at least 9.5dBW measured within a 1KHz bandwidth centred on the beacon centre frequency. The level received will be 3dB lower when received with a linear feed on either polarisation.

UPC Beacon	
Frequency	12,750 MHz
Frequency Stability	± 13KHz over any 24 hour period
	± 20KHz over any 1 month period
	± 130KHz over the spacecraft lifetime
Polarisation	Left Hand Circular
EIRP across Service Area	>9.5dBW throughout service area
EIRP at Sydney	11.95dBW worst case

TABLE 4.2 C1 SATELLITE UPC BEACON

5.0 UPLINK POWER CONTROL OPERATION

Customers may use uplink power control systems (UPC) to compensate for uplink rain attenuation. Since a malfunctioning UPC system can interfere with other services and even damage a satellite TWTA, UPC systems must be approved by Optus before use and are strictly limited in the amount of uplink compensation permitted. Details of the amount of UPC permitted under various operating conditions may be obtained from Optus.

UPC systems use the attenuation measured on a downlink beacon to compensate for attenuation on the uplink. However attenuation is frequency-dependent and a scaling factor needs to be applied to determine the correct uplink compensation. At 14/12GHz Optus recommends a scaling factor of 1.3.

OPTUS yes

C1 SATELLITE PAYLOAD INFORMATION

ATTACHMENT 1

Satellite Beam Contours for the Ku-Band Communications Payload

The contour diagrams in **Attachment 1** show the General Design Levels of G/T (dB/K) and Saturated EIRP (dBW) for the Optus C1 satellite at an orbit position of 156°E. Refer to **Section 3.4** of this document for an explanation of General Design Levels.

Contour diagrams **Figures A1-1 to A1-12** are provided for the following beams: NA (Australia and Hawaii coverage), NB, NANZ, and EA (East Asia and Hawaii coverage). Note that the EA beam contours are for the nominal beam position (see below).

Alternate EA Beam Coverage

The EA beam is steerable within strict limitations owing to regulatory constraints and the mechanical limits on the spacecraft pointing system. An alternate position is shown in Fig A1-13 & A1-14. Note that any steering of the EA beam away from the nominal position moves the Hawaii spot off Hawaii, so that it's no longer usable. The EA beam coverage always applies to all four EA beam transponders. Specific enquiries for EA beam operation will be considered on a case by case basis.

Contracted performance will need to be marginally lower than that specified in this document to allow for individual transponder differences, TWT redundancy and different orbital locations.

C1 SATELLITE PAYLOAD INFORMATION

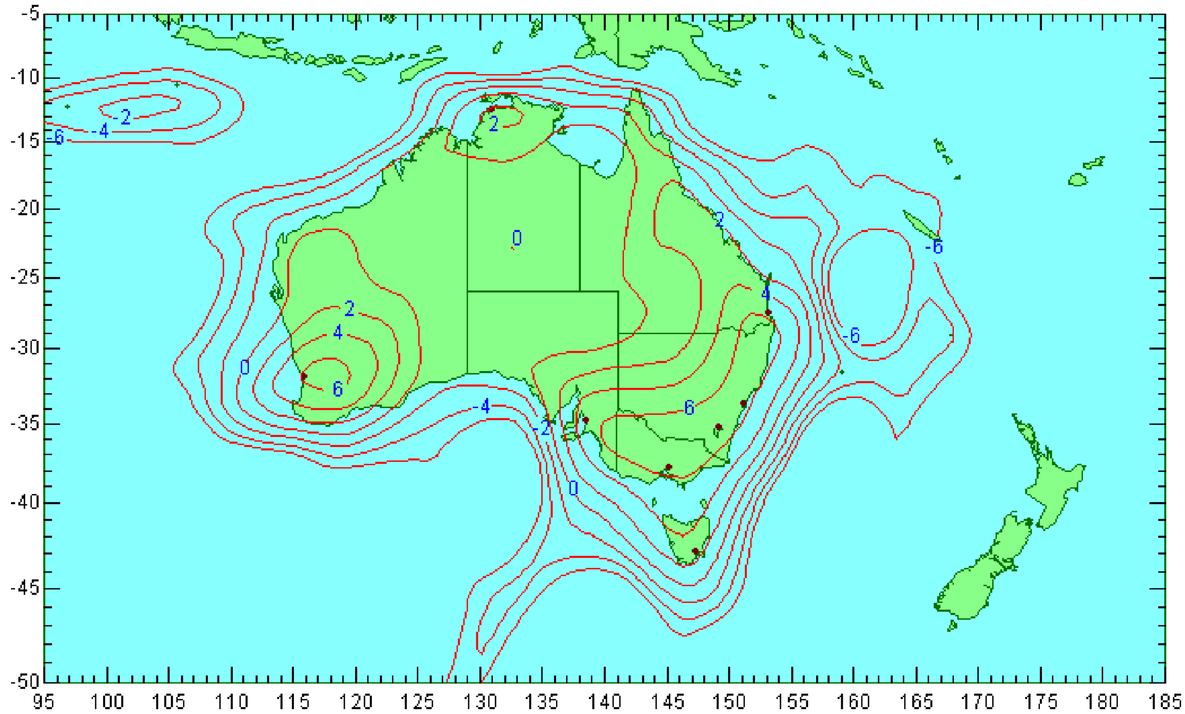


FIGURE A1-1 – NA BEAM RECEIVE GAIN ON TEMPERATURE (G/T)

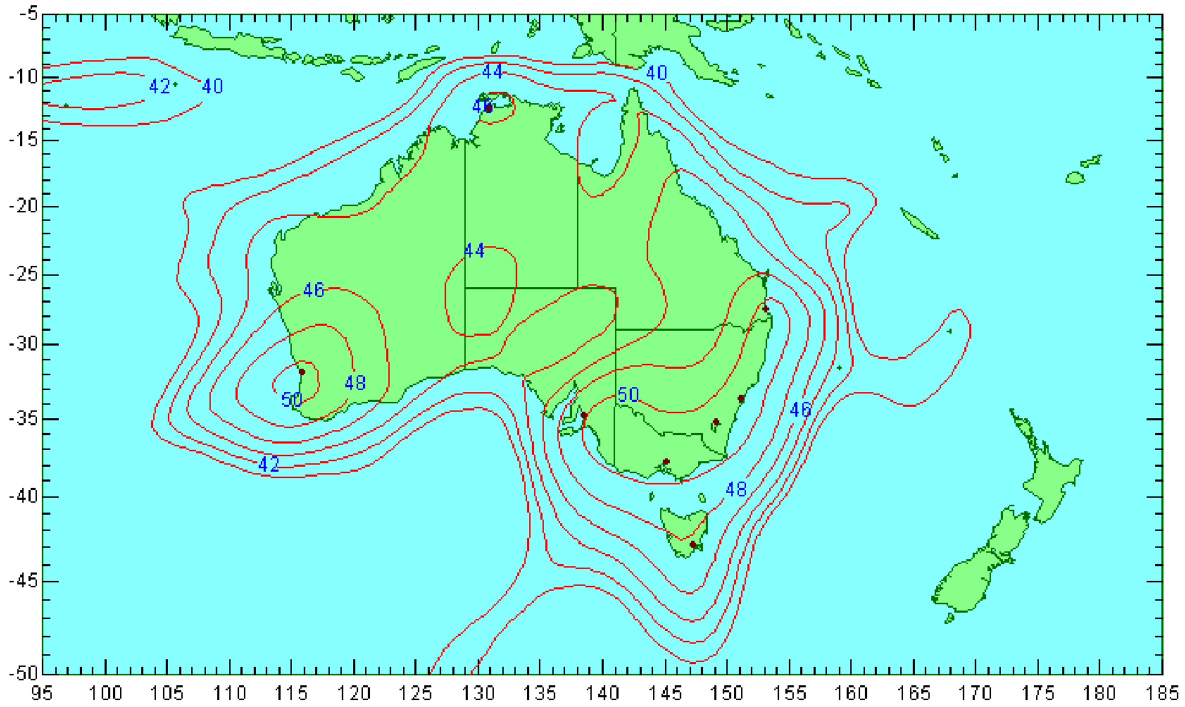


FIGURE A1-2 – NA BEAM EFFECTIVE ISOTROPIC RADIATED POWER (EIRP)

C1 SATELLITE PAYLOAD INFORMATION

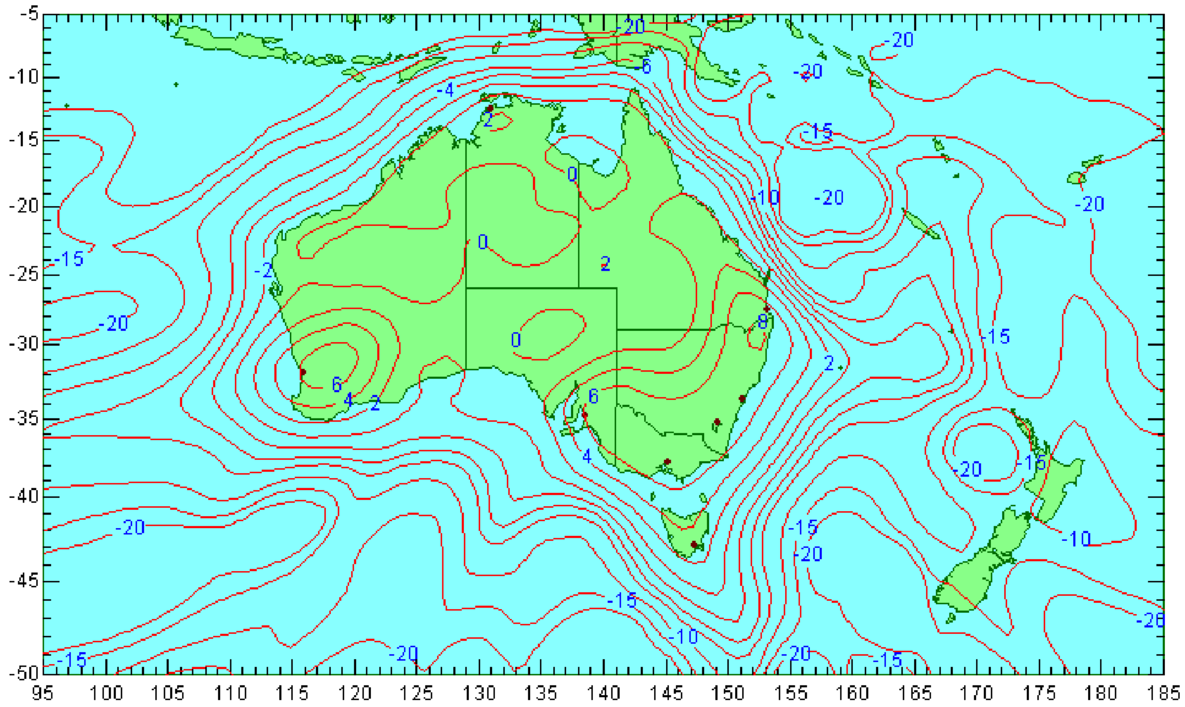


FIGURE A1-3 – NB BEAM RECEIVE GAIN ON TEMPERATURE (G/T)

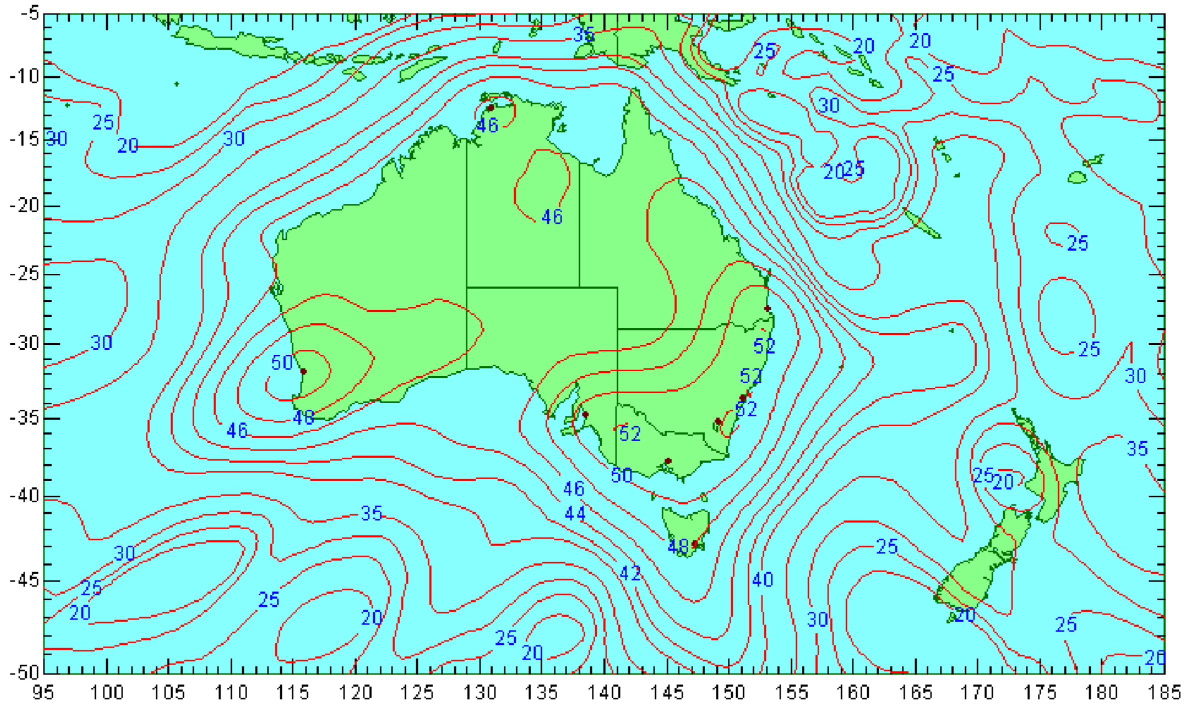


FIGURE A1-4 – NB BEAM EFFECTIVE ISOTROPIC RADIATED POWER (EIRP)

C1 SATELLITE PAYLOAD INFORMATION

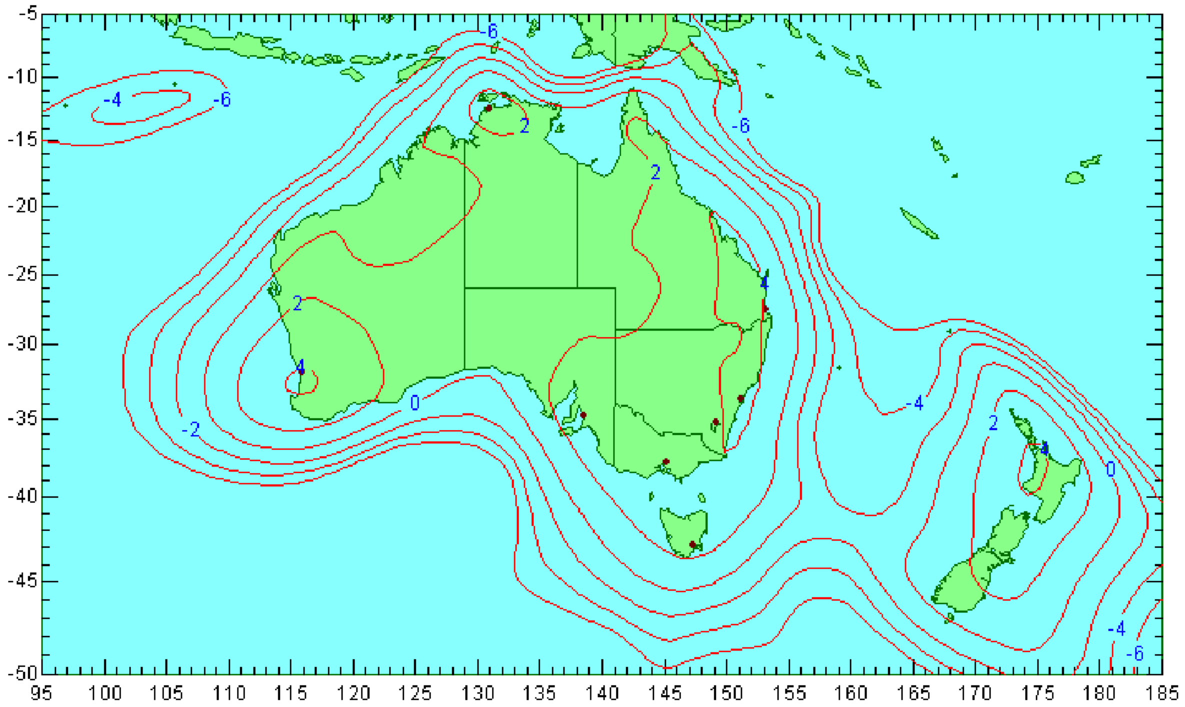


FIGURE A1-5 – NANZ BEAM RECEIVE GAIN ON TEMPERATURE (G/T)

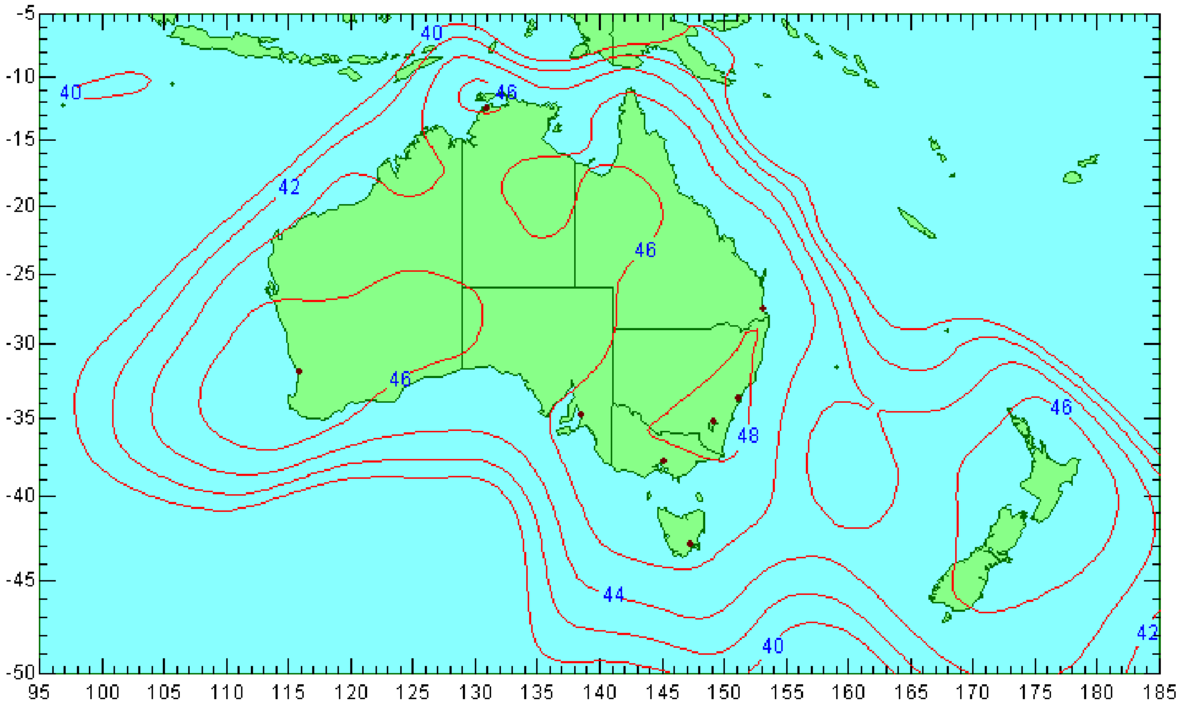


FIGURE A1-6 – NANZ BEAM EFFECTIVE ISOTROPIC RADIATED POWER (EIRP)

C1 SATELLITE PAYLOAD INFORMATION

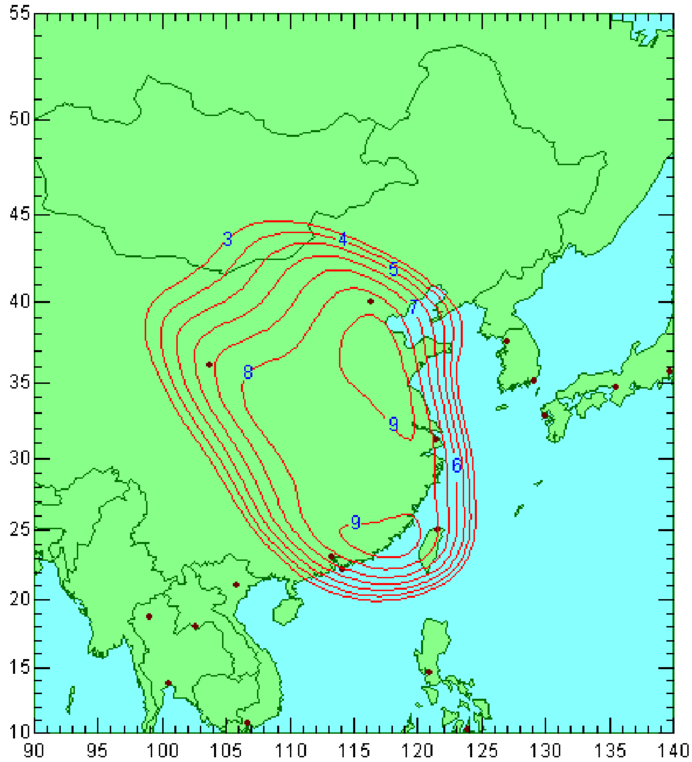


FIGURE A1-7 – EA BEAM EAST ASIA NOMINAL POSITION RECEIVE GAIN ON TEMPERATURE (G/T)

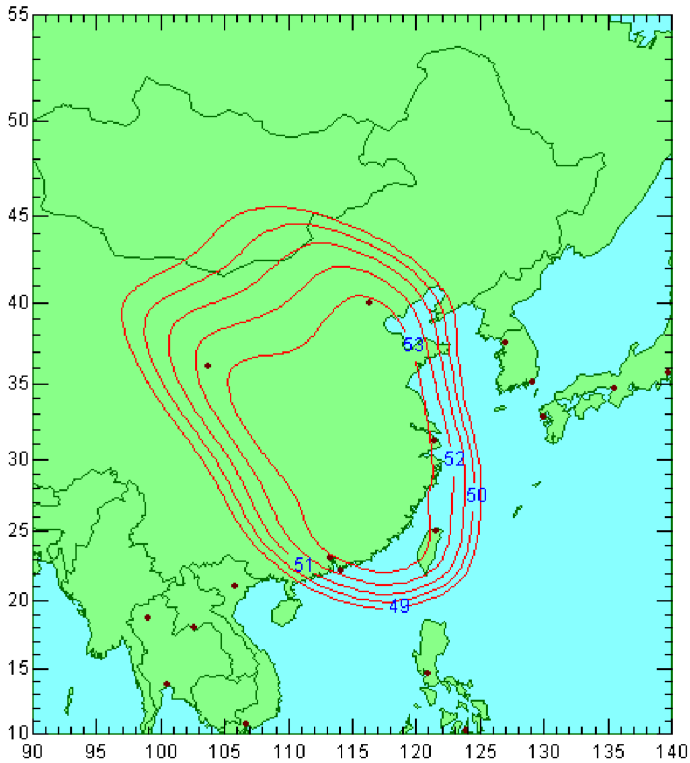


FIGURE A1-8 – EA BEAM EAST ASIA NOMINAL POSITION EFFECTIVE ISOTROPIC RADIATED POWER (EIRP)

C1 SATELLITE PAYLOAD INFORMATION

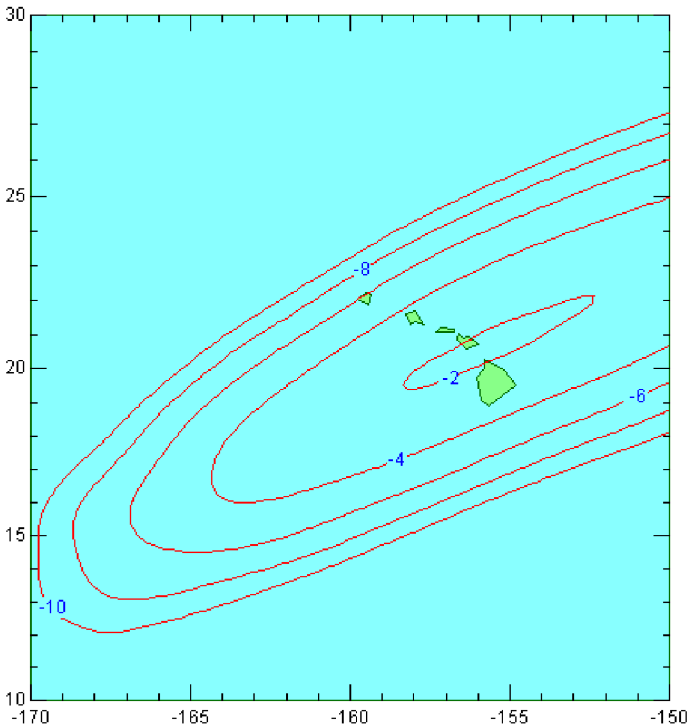


FIGURE A1-9 – NA BEAM HAWAII SPOT RECEIVE GAIN ON TEMPERATURE (G/T)

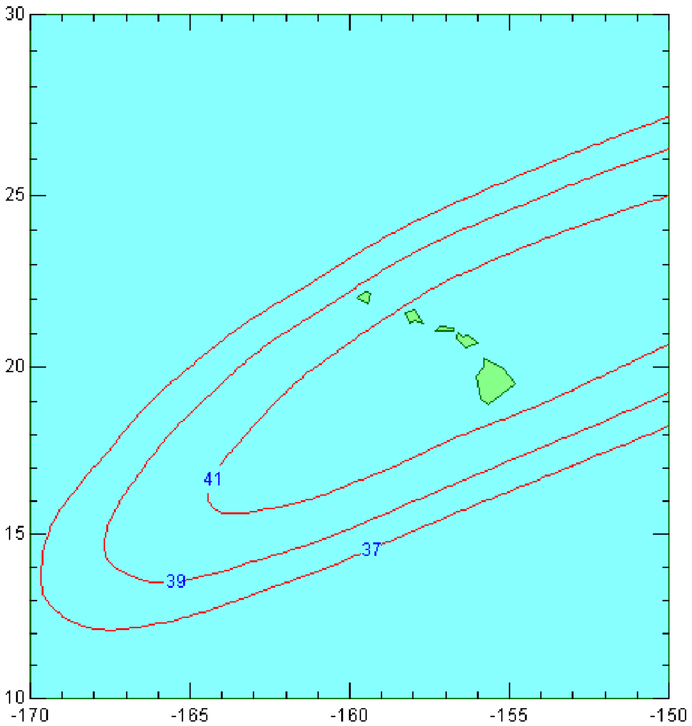


FIGURE A1-10 – NA BEAM HAWAII SPOT EFFECTIVE ISOTROPIC RADIATED POWER (EIRP)

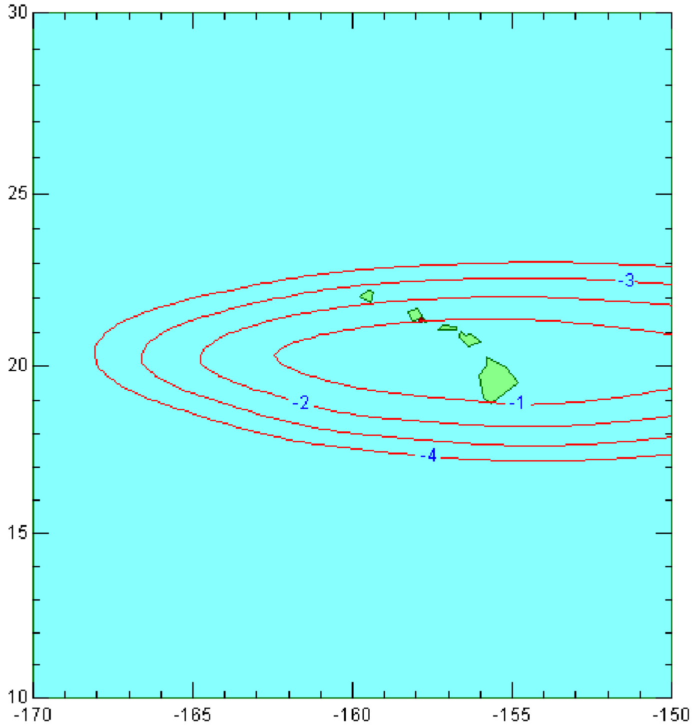


FIGURE A1-11 – EA BEAM HAWAII SPOT NOMINAL POSITION RECEIVE GAIN ON TEMPERATURE (G/T)

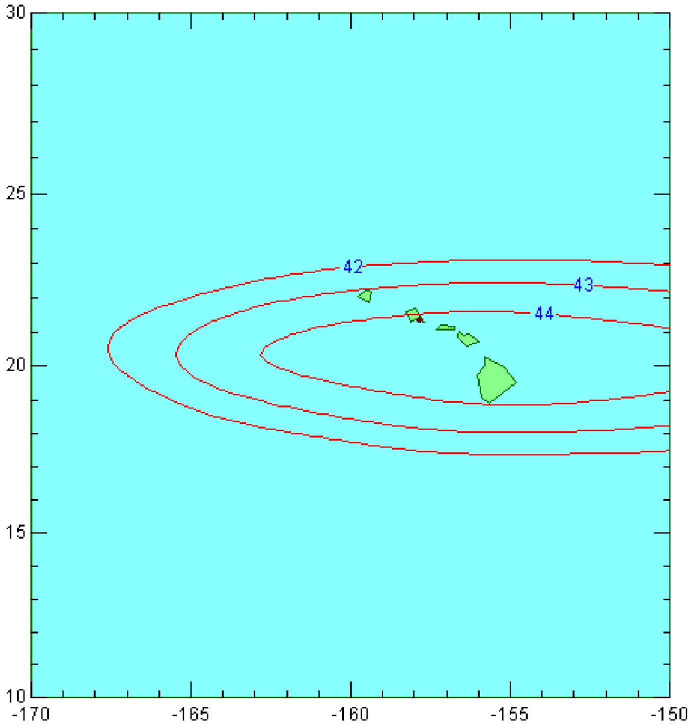


FIGURE A1-12 – EA BEAM HAWAII SPOT NOMINAL POSITION EFFECTIVE ISOTROPIC RADIATED POWER (EIRP)

C1 SATELLITE PAYLOAD INFORMATION

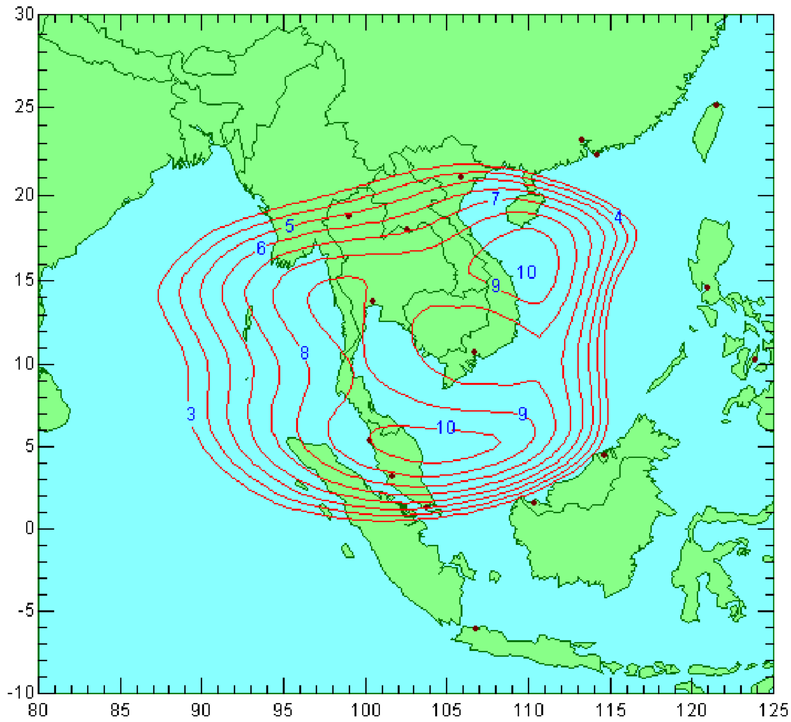


FIGURE A1-13 – EA BEAM ALTERNATE POSITION RECEIVE GAIN ON TEMPERATURE (G/T)

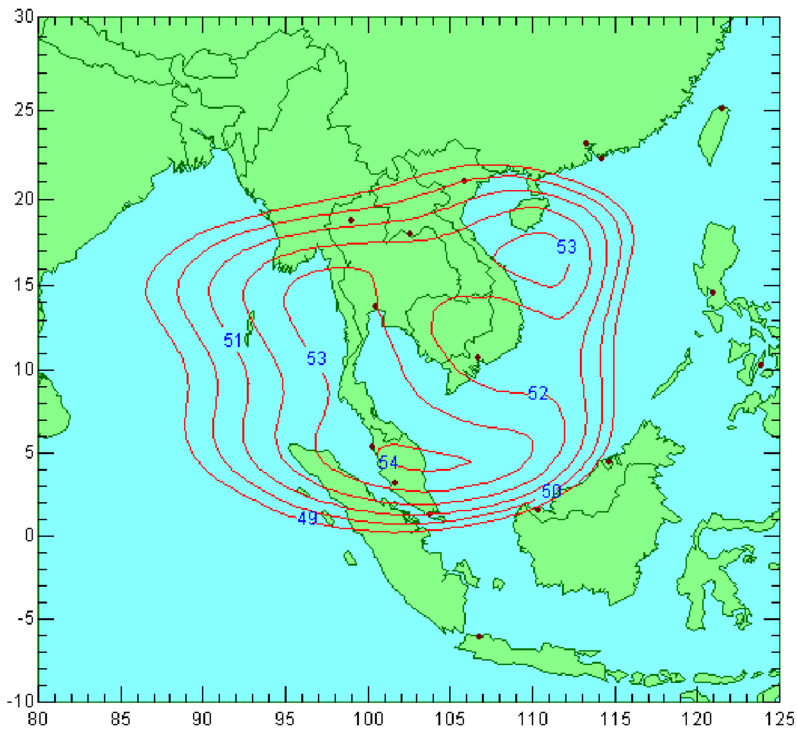


FIGURE A1-14 – EA BEAM ALTERNATE POSITION EFFECTIVE ISOTROPIC RADIATED POWER (EIRP)

NETWORKS MADE EASY-PEASY

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The information contained in this document is based on the tested performance of the C1 satellite.

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OPTUS yes