

# EMC Technologies (NZ) Ltd

Test Report No 20118 FCC  
Report date: 25 February 2002

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## **TEST REPORT**

### **Elpro 905U-K Spread Spectrum Radio Modem**

*Tested for compliance with the*

### **Code of Federal Regulations (CFR) 47**

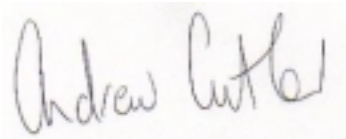
### **Part 15 – Radio Frequency Devices, Subpart C – Intentional Radiators**

### **Section 15.247 – Operation in the band 902 – 928 MHz**

*For*

### **ELPRO Technologies PTY Ltd**

This Test Report is issued with the authority of:



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**Andrew Cutler - General Manager**

Prepared by:



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**Karen Miller – Office Administrator**



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## 1. CLIENT INFORMATION

|                     |                                   |
|---------------------|-----------------------------------|
| <b>Company Name</b> | ELPRO Technologies Pty Ltd        |
| <b>Address</b>      | 9/12 Billabong Street<br>Stafford |
| <b>State</b>        | Queensland 4053                   |
| <b>Country</b>      | Australia                         |
| <b>Contact</b>      | John White                        |

## 2. DESCRIPTION OF TEST SAMPLE

|                          |                            |
|--------------------------|----------------------------|
| <b>Brand Name</b>        | ELPRO                      |
| <b>Model Number</b>      | 905U-K                     |
| <b>Product</b>           | Radio Modem                |
| <b>Manufacturer</b>      | ELPRO Technologies Pty Ltd |
| <b>Country of Origin</b> | Australia                  |
| <b>Serial Number</b>     | 0102100 9999               |
| <b>FCC ID</b>            | O9PELP905K                 |

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## 3. SUMMARY OF TEST RESULTS

Testing was carried out in accordance with the test methods defined in 47 CFR Part 15 and in particular Sections 15.203, 15.205, 15.207, 15.209 and 15.247.

| <u>CLAUSE</u> | <u>TEST PERFORMED</u>         | <u>RESULT</u> |
|---------------|-------------------------------|---------------|
| 15.203        | antenna requirement           | Complies      |
| 15.205        | operation in restricted bands | Complies      |
| 15.207        | conducted emissions           | Complies      |
| 15.209        | radiated emissions            | Complies      |
| 15.247:       |                               |               |
| (a)(1)(i)     | channel occupancy / bandwidth | Complies      |
| (b)(2)        | peak output power             | Complies      |
| (b)(4)        | radio frequency hazard        | Complies      |
| (c)           | out of band emissions         | Complies      |

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## 4. ARTICLES SUBMITTED

1 x ELPRO 905U-K Spread Spectrum Radio Modem, Sn# 0102100 9999 consisted of the following items:

- 902 – 928 MHz frequency hopping spread spectrum transmitter
- Ever Glow DDU200045 120 Vac / 20 Vdc AC Adaptor
- Antenna agencies YU800/6 Yagi antenna. Sn# 191201.
- ZCG Scalar CFD/890EL Whip antenna. Sn# 0003164.
- ZCG Scalar SG900-6 Whip antenna. Sn# 0003991.

The device has no external user controls.

Testing was carried out using software control, which allowed the following changes to be made:

- Frequency hopping in two bands: 902 – 915 MHz and 915 – 928 MHz.
- Frequency hopping using 8 different pseudo random sequences
- Changes in modulation:
  - None,
  - 115.2 kbps (bit reversals at 115200 bits per second),
  - 57.6 kbps (bit reversals at 57600 bits per second),
  - 19.2 kbps (bit reversals at 19200 bits per second).
- Single frequency operation.

The sample consisted of a transmitter only and did not include a receiver.

## 5. TEST SAMPLE DESCRIPTION

The sample tested is a frequency hopping spread spectrum transceiver, with a serial data input, with the following specifications:

### Rated Transmitter Output Power

1 watt

### Test frequencies

902 – 915 MHz

915 – 928 MHz

50 frequencies in a pseudo random sequence and a frequency spacing of 250 kHz with a one-guard frequency at the bottom and top of the frequency band, which is not used in the hop sets.

### Frequency Range

902.0 – 928.0 MHz

### Modulation Type

The following modulation type was utilised:

- Frequency Hopping Spread Spectrum.
- 115.2 kbps (bit reversals at 115200 bits per second).

### Power Supply

Ever Glow DDU200045 120 Vac / 20 Vdc AC Adaptor

### External Ports

The Radio Telemetry Module has the following ports:

- antenna port which has a reverse SMA connector (unique connector)
- Data port.

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## Spread Spectrum Radio Operation

The transceiver is controlled by a microprocessor, which performs the hopping, data transmit and data receive functions.

Eight hop sets are programmed into the microprocessors non-volatile memory at the factory. The hop set number, used by the transmitter, is programmed by the user.

One unit communicates with another unit using data packets that have a maximum size of 300ms. Each packet sent to another unit is acknowledged by the receiving unit. If an acknowledge message is not received within the timeout period then the transmitter will retry the message.

Each data packet comprises of 30ms of training data reversals and synchronization words, which allows the receiver to lock onto a valid data packet.

The hop sets used by the transceiver have been calculated using a random number generator and selected so that they are mutually orthogonal (have a very low cross correlation). Each hop set contains 50 frequencies.

The hop set is listed in memory in its random order, so that the transmitter simply uses the next value in the hop set list, when it is required to make a transmission.

So each time the transmitter wants to transmit it selects the next frequency in the hop set that it is using, programs the transceivers PLL to that frequency, starts the RF PA and then modulates the transmitter with the data required to be sent.

So each transmission is on a different frequency in the list (even retries) and hence all frequencies are used equally. The other receiving unit which acknowledges the transmission is using the same hop set, but its transmission are not synchronized (it will be in a different position in the same hop set) with the sending unit.

For example if the hop set list was 21,83,115,81,113,65,105,61 (8 channel hop set). Each of these numbers is a channel number using a spacing of 125kHz (we only use odd channel numbers because we use a 250kHz channel spacing) and starting from 902MHz.

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The sequence of transmissions would be as follows:

1<sup>st</sup> transmission ---> channel 21  
good acknowledge received <-----  
2<sup>nd</sup> transmission ---> channel 83  
bad acknowledge received <-----  
3<sup>rd</sup> transmission (retry of 2<sup>nd</sup> transmission) ----> channel 115  
good acknowledge received <-----  
4<sup>th</sup> transmission ----> channel 81  
....  
....  
....  
8<sup>th</sup> transmission ----> channel 61  
good acknowledge received <-----  
9<sup>th</sup> transmission ----> channel 21 (goes back to start of sequence)

Attached in appendix A are details of the hop sets for this transceiver.

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## 6. ATTESTATION

This report describes the tests and measurements performed for the purpose of determining compliance with the specification with the following conditions:

**The test sample was selected by the client.**

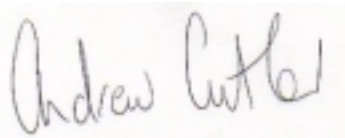
**The report relates only to the sample tested.**

**This report does not contain corrections or erasures.**

Measurement uncertainties with statistical confidence intervals of 95% are shown below test results. Both Class A and Class B uncertainties have been accounted for, as well as influence uncertainties where appropriate.

In addition this equipment has been tested in accordance with the requirements contained in the appropriate Commission regulations. To the best of my knowledge, these tests were performed using measurement procedures that are consistent with industry or Commission standards and demonstrate that the equipment complies with the appropriate standards.

I further certify that the necessary measurements were made by EMC Technologies NZ Ltd, 47 MacKelvie Street, Grey Lynn, Auckland, New Zealand.



Andrew Cutler  
General Manager  
EMC Technologies NZ Ltd

## 7. TRANSMITTER TEST RESULTS

### Section 15.203 – Antenna requirement

The antennas that attach to this system use a unique connector.

The connector used is a reverse SMA connector, which is not a standard antenna connector.

A photograph of this unique connector is contained within this report.

### Section 15.205 – Restricted bands of operation

Refer to measurements made with reference to Section 15.247 (c)

### Section 15.207 – Conducted emissions

Conducted emissions testing was carried out over the frequency range of 450 kHz to 30 MHz.

Testing was carried out at the laboratory's MacKelvie Street screened room.

The device was placed on top of the test table, which is 1m x 1.5m, 80cm above the screened room floor which acts as the horizontal ground plane. In addition the device was positioned 40cm away from the screened room wall which acts as the vertical ground plane. The artificial mains network was bonded to the screened room floor. At all times the device was kept more than 80cm from the artificial mains network.

Measurement uncertainty with a confidence interval of 95% is:

- Mains terminal tests (0.15 - 30 MHz)  $\pm 2.2$  dB

**Result:** Complies with a 8.4 dB margin at 0.454 MHz (Quasi Peak).

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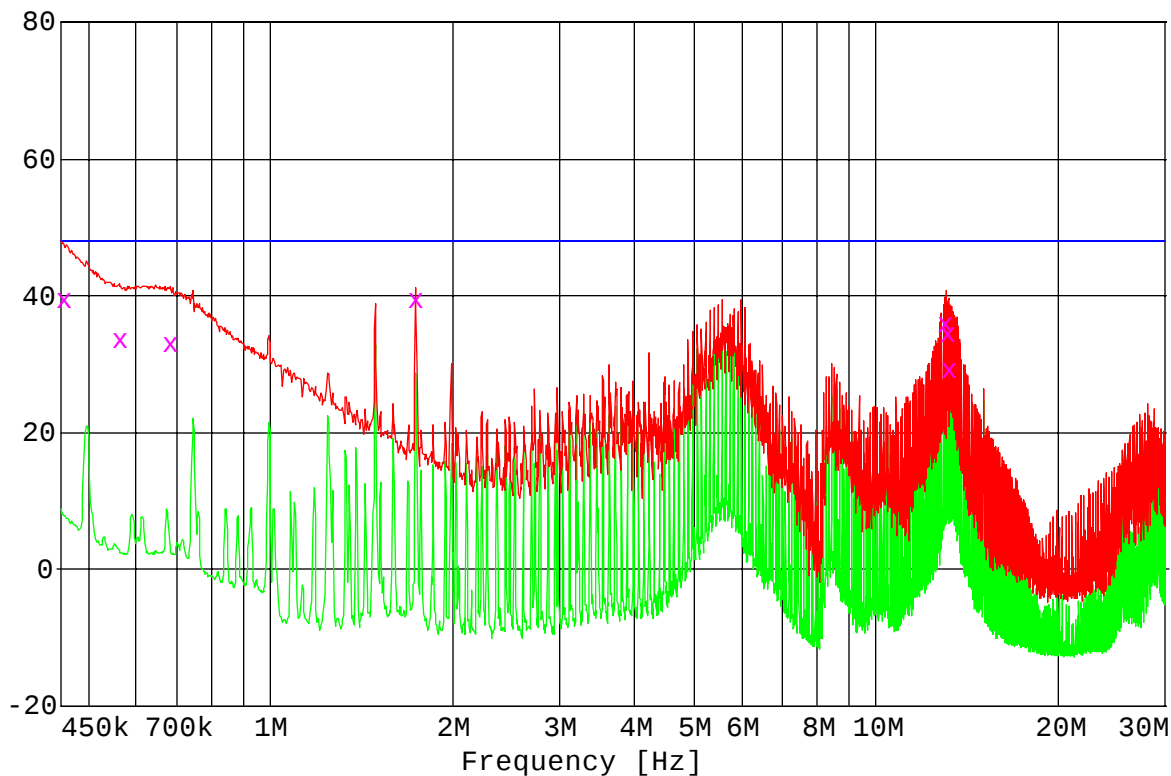
## Conducted Emissions Results

Comments:

*Device tested at 110 Vac while transmitting continuously using hop set 0.*

| KEY     |  |            |   |
|---------|--|------------|---|
| Peak    |  | Quasi Peak | X |
| Average |  | Average    | + |

Level [dB $\mu$ V]



Quasi-Peak Measurements

| Frequency<br>MHz | Level<br>dB $\mu$ V | Limit<br>dB $\mu$ V | Margin<br>dB | Exceed | Phase | Rechecks<br>dB $\mu$ V |
|------------------|---------------------|---------------------|--------------|--------|-------|------------------------|
| 0.454000         | 39.6                | 48.00               | 8.4          |        | N     | 39.0                   |
| 0.562000         | 33.6                | 48.00               | 14.3         |        | N     |                        |
| 0.684000         | 33.0                | 48.00               | 14.9         |        | N     |                        |
| 1.735000         | 39.5                | 48.00               | 8.5          |        | N     | 39.7                   |
| 12.990000        | 35.9                | 48.00               | 12.0         |        | N     |                        |
| 13.075000        | 34.5                | 48.00               | 13.4         |        | N     |                        |
| 13.160000        | 29.2                | 48.00               | 18.7         |        | L1    |                        |

Average Measurements

| Frequency<br>MHz       | Level<br>dB $\mu$ V | Limit<br>dB $\mu$ V | Margin<br>dB | Exceed | Phase | Rechecks<br>dB $\mu$ V |
|------------------------|---------------------|---------------------|--------------|--------|-------|------------------------|
| No results<br>recorded |                     |                     |              |        |       |                        |

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## Section 15.209 – Radiated emissions

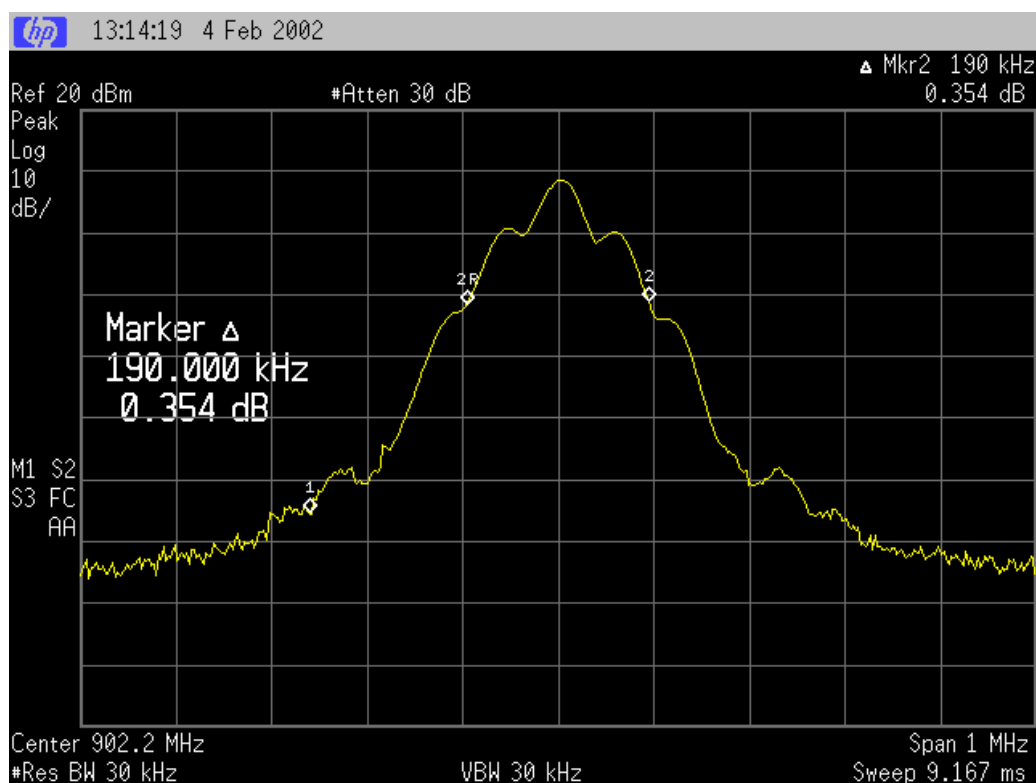
In accordance with section 15.247(c), attenuation below the general limits specified in Section 15.209(a) is not required.

However radiated emissions that fall within the restricted bands, as defined in Section 15.205(a), must comply with the radiated emission limits specified in Section 15.209(a).

## Section 15.247 (a) (1) (i) - Channel occupancy / bandwidth

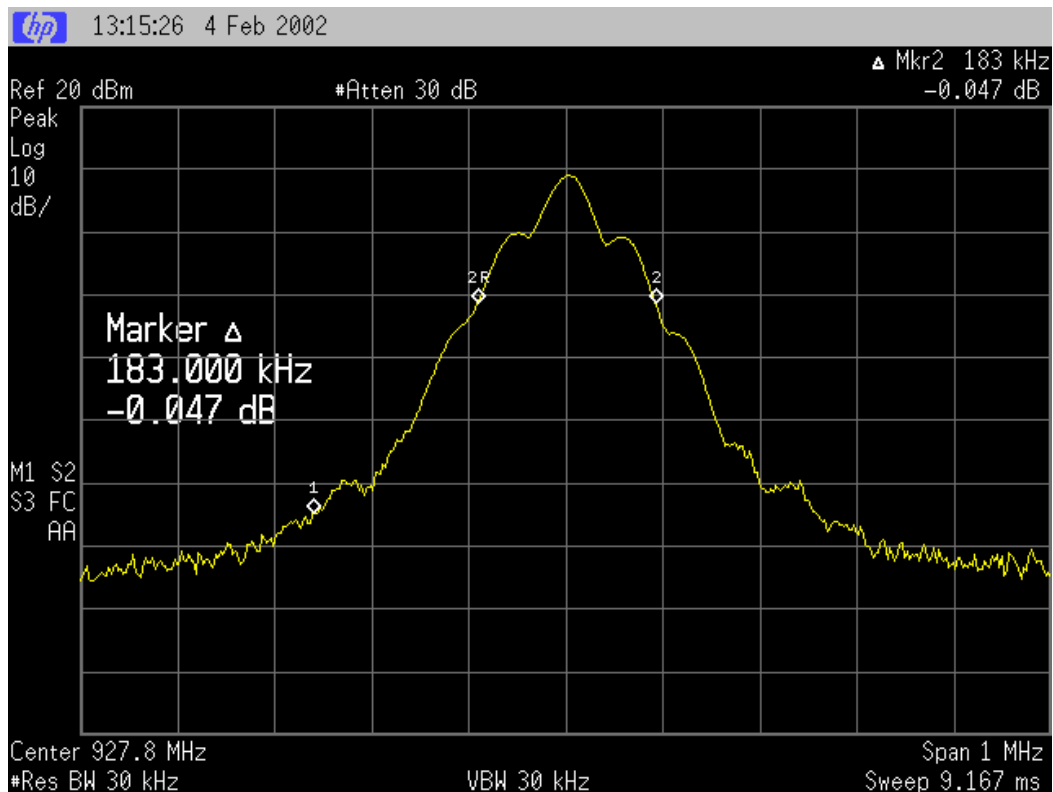
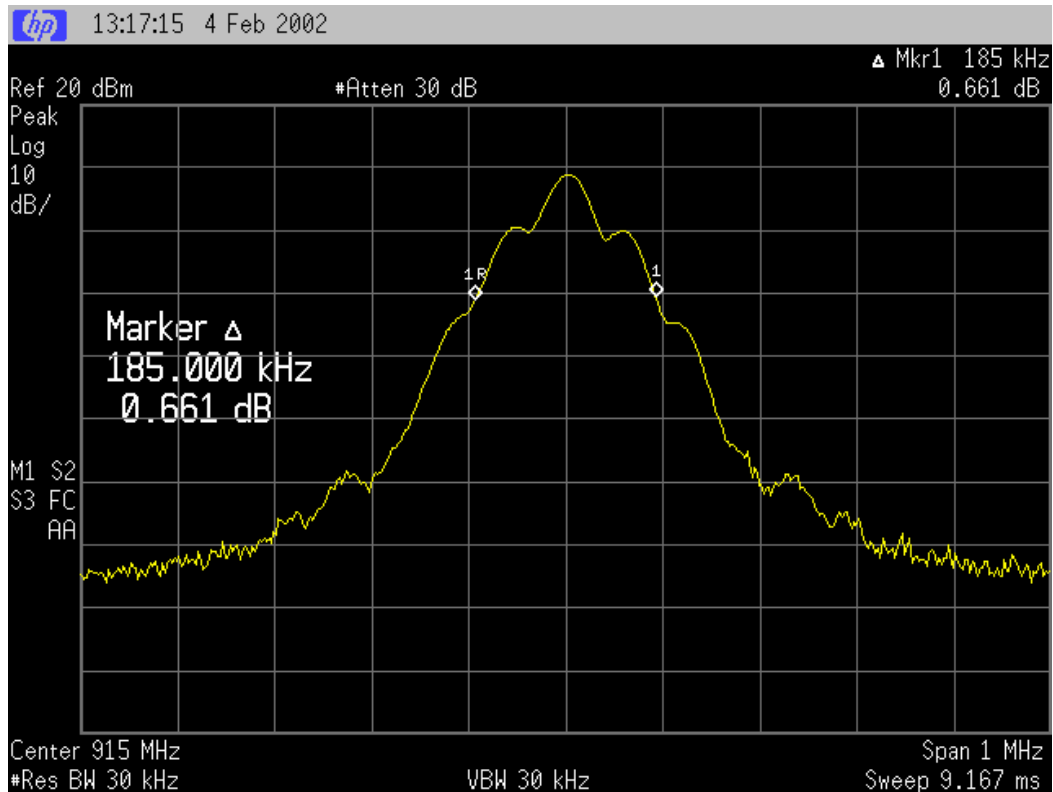
Measurements were carried out on 3 single frequencies across the operating range of the transceiver with 115.2 kbps modulation being applied.

At each frequency the 20 dB bandwidth was measured using a spectrum analyser.



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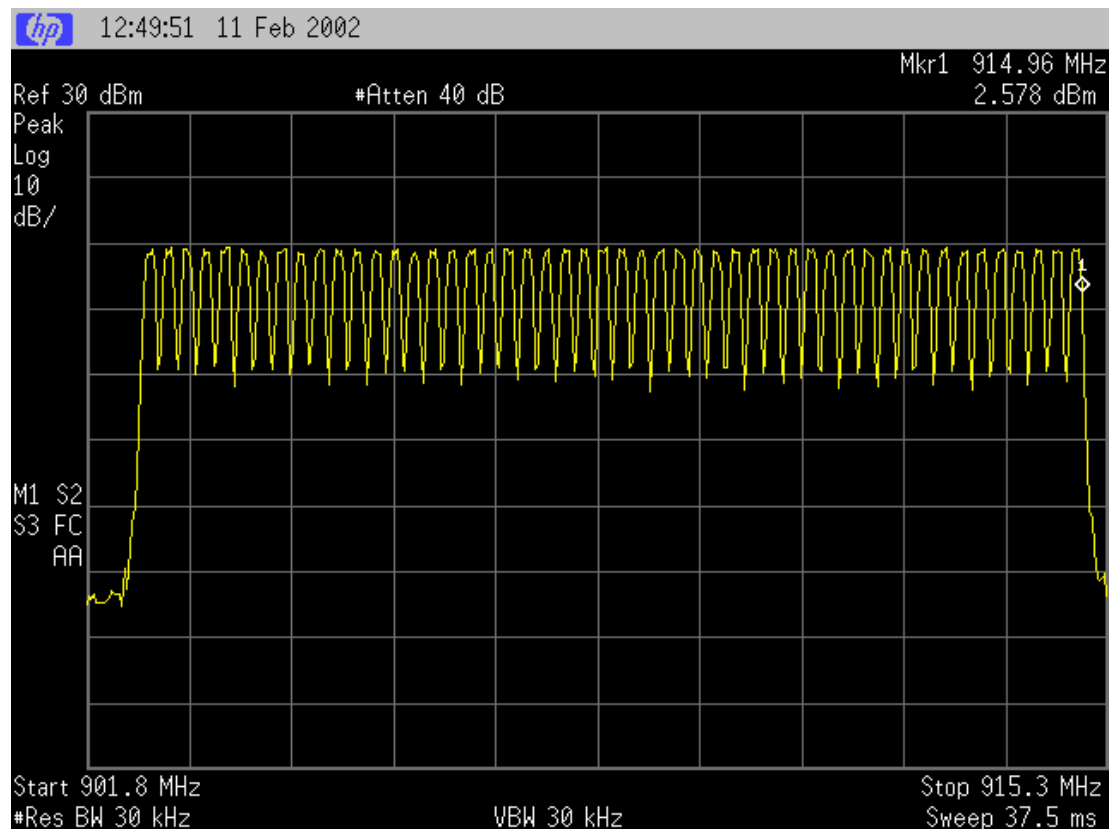
The bandwidth was observed to be:

|           |         |
|-----------|---------|
| 902.2 MHz | 190 kHz |
| 915.0 MHz | 185 kHz |
| 927.8 MHz | 183 kHz |

Testing was carried out in accordance with the less than 250 kHz requirements.

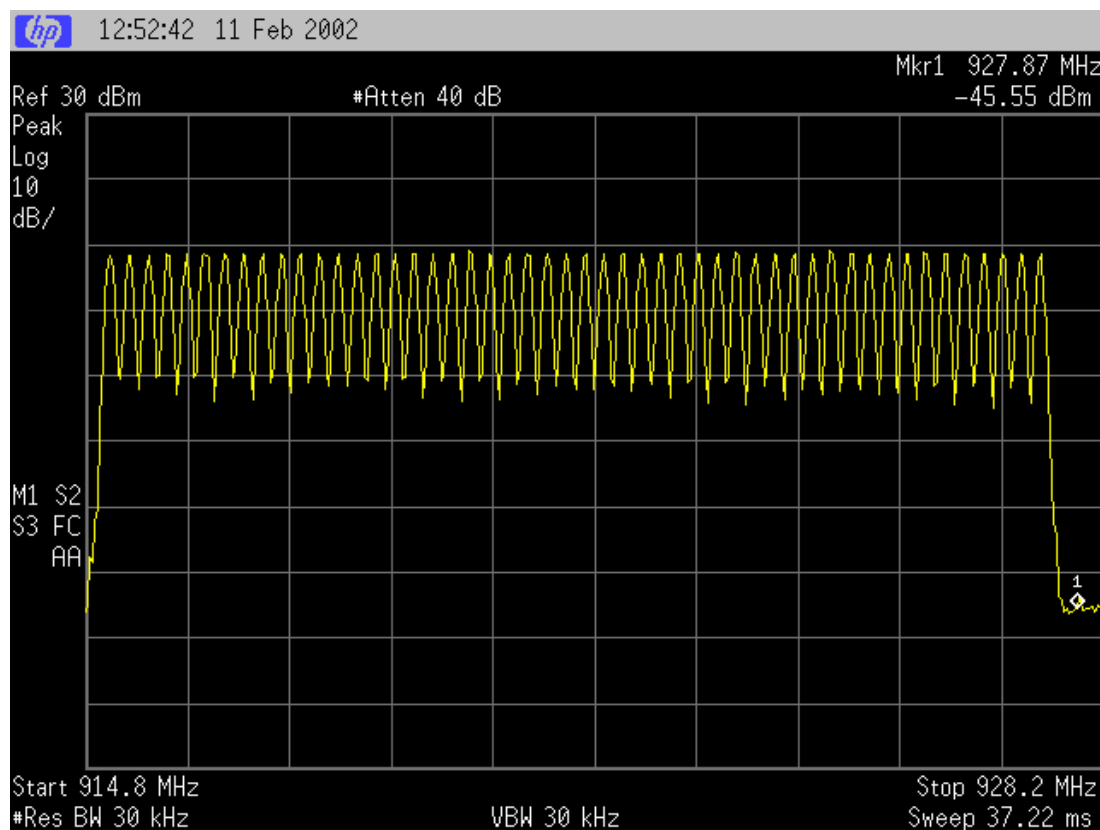
For a bandwidth of less than 250 kHz at least 50 channels should be used.

Tests were carried out between 902 – 915 MHz and 915 – 928 MHz that show that this device uses 50 channels in each of these bands.



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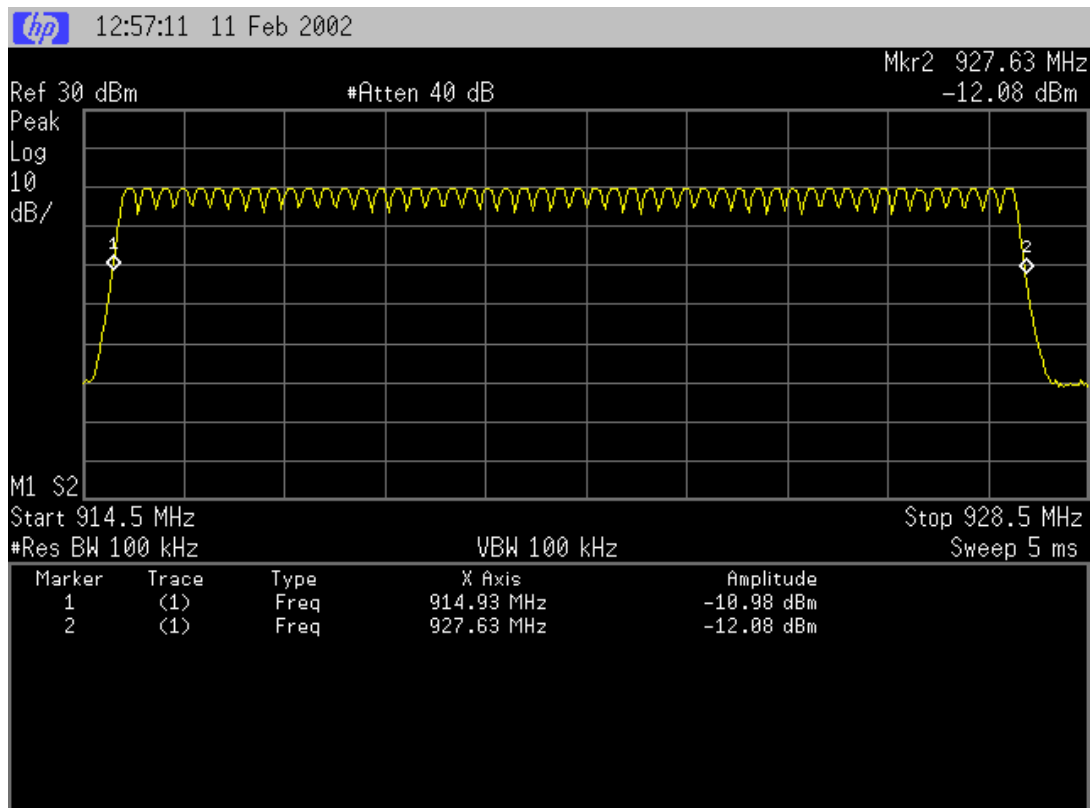
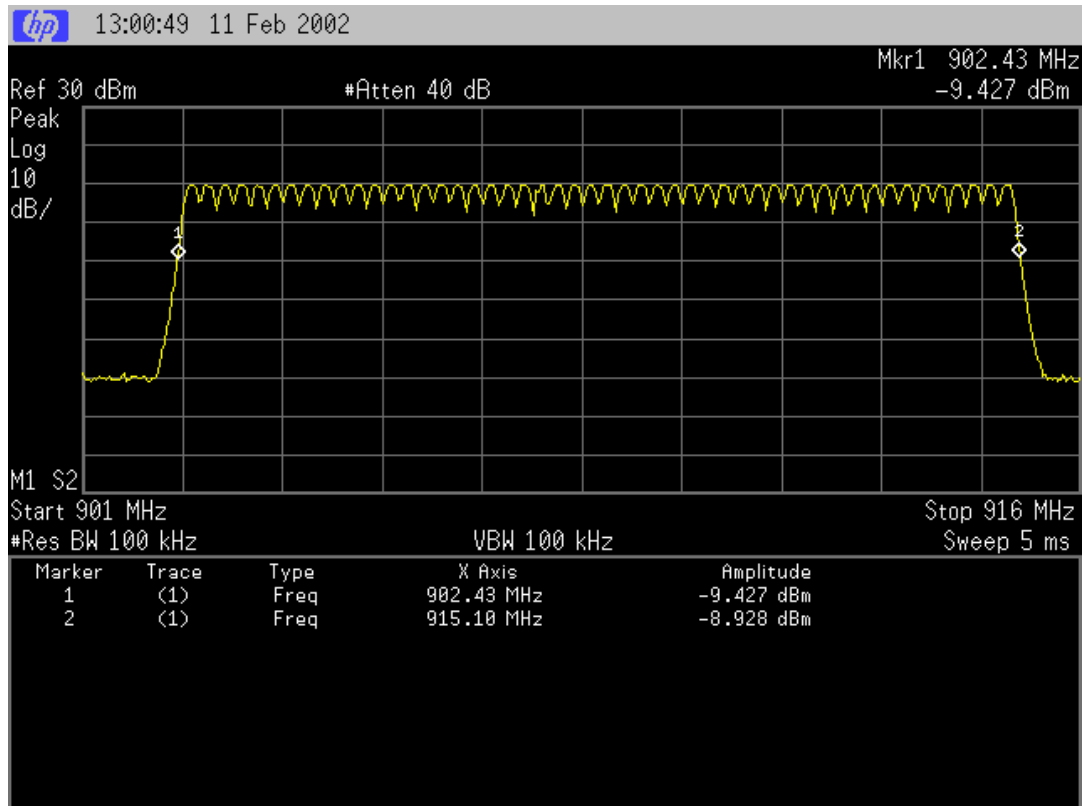
Band edge measurements were carried out to determine that the fundamental emissions from the device fell within the band edges of 902.0 – 928.0 MHz at the –20 dB emission level.

Measurements at the band edges were made using a resolution bandwidth of 100 kHz.

The fundamental emissions were observed to stay within the band 902 – 928 MHz when measurements were made at the –20 dB points.

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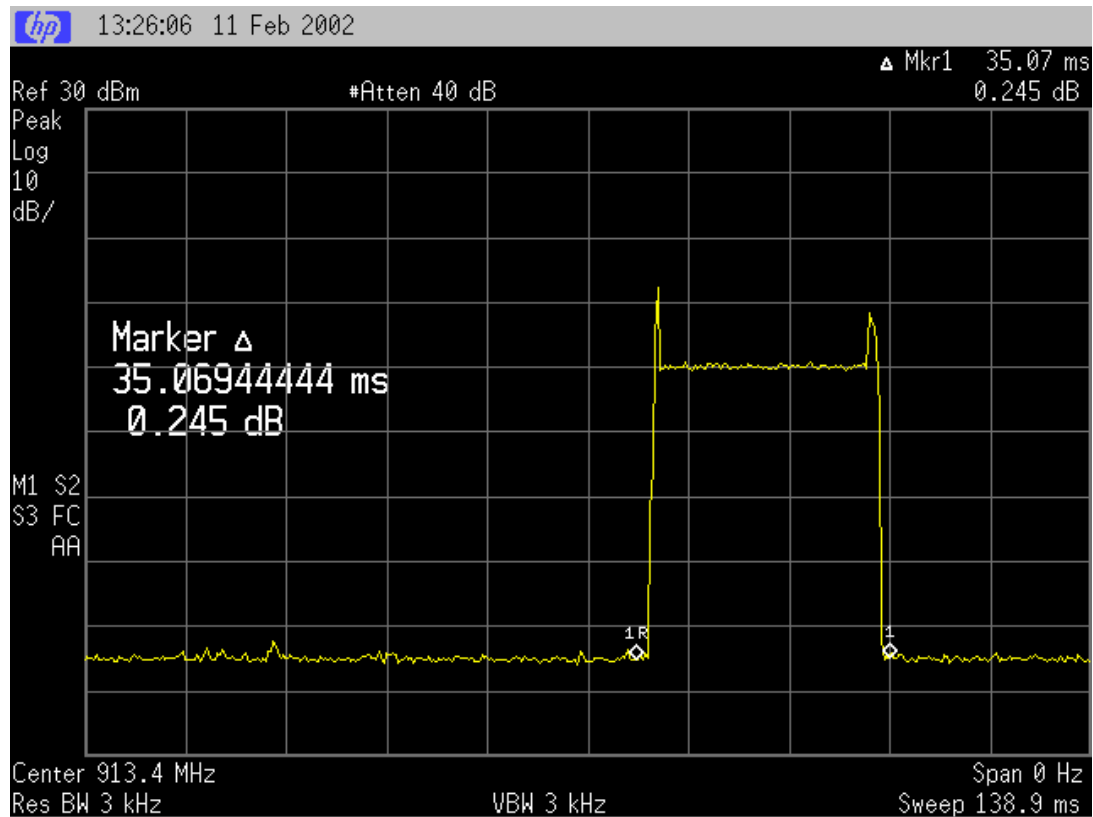
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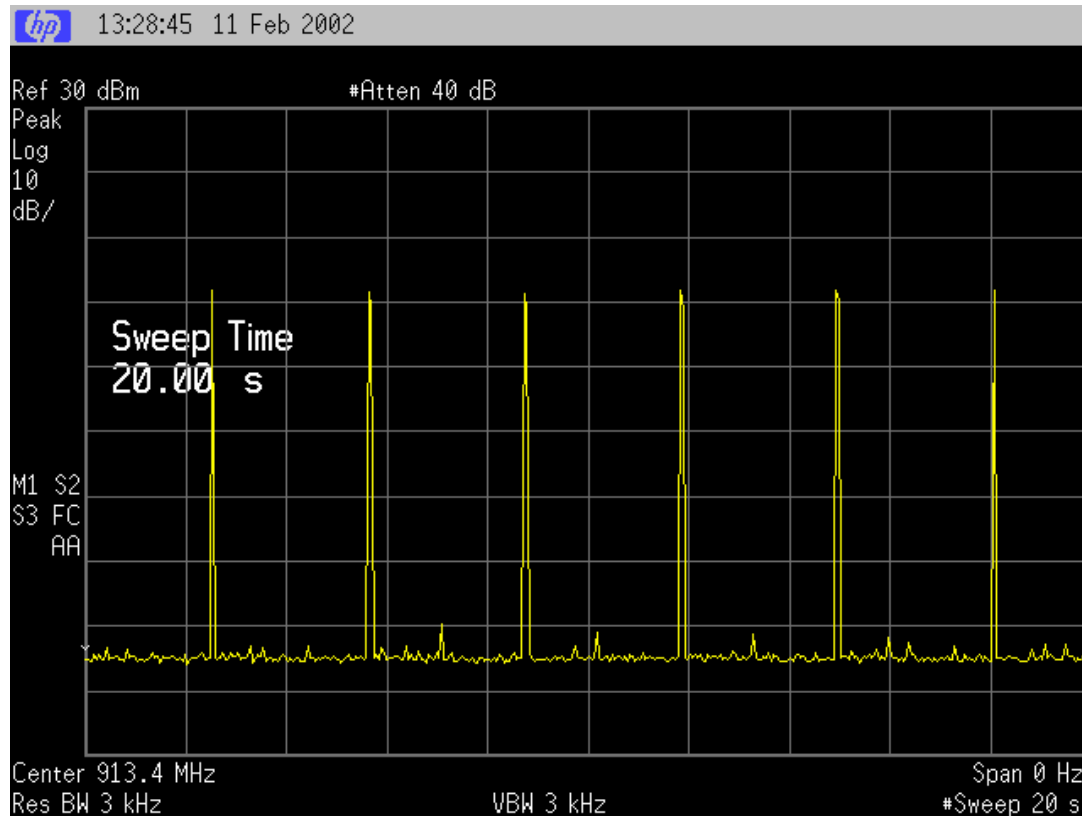
The average time occupancy on any frequency shall not exceed 400 milliseconds in any 20 second period.

Using a spectrum analyser with a 0 Hz frequency span the “on frequency time” was determined to be 35 mS.



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With the spectrum analyser still operating with a 0 Hz frequency span the transmitter was observed to be “on frequency”, on average, 6 times in any 20 second period.

Therefore  $35 \text{ mS} \times 6 \text{ times} = 210 \text{ mS}$ .

**Result:** Complies

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## Section 15.247 (b) (2) – Peak output power

Measurements were carried out at the RF output terminals of the transmitter using a 20 dB power attenuator and a spectrum analyser.

Measurements were carried out when the transmitter was not being modulated and while operating on a single frequency.

Measurements were made with the input voltage set to 110 Vac.

| RF power output<br>(Watts) |                |                |                |
|----------------------------|----------------|----------------|----------------|
| Frequency<br>(MHz)         | Level<br>(dBm) | Rated<br>(dBm) | Limit<br>(dBm) |
| 902.875                    | 29.6           | 30.0           | 30.0           |
| 915.375                    | 29.7           | 30.0           | 30.0           |
| 927.125                    | 29.7           | 30.0           | 30.0           |

Variation of the supply voltage did not vary the output power significantly.

Attached in appendix B are details of the antennas to be sold with this transmitter.

Antenna gains are as follows:

- SG900-6 collinear antenna with CC10/900 kit 5 dBi
- SG900-6 collinear antenna with CC20/900 kit 2 dBi
- YU6/900 6 element yagi with CC20/900 kit 4 dBi

The transmitter output power can remain at +30 dBm for all of the above antennas, as the gain of each antenna set up is less than 6 dBi.

### *Limits:*

The maximum peak output power for frequency hopping systems operating in the 902 – 928 MHz shall not exceed 1 watt for systems employing at least 50 channels. Antenna gains to be less than 6 dBi.

**Result:** Complies

**Measurement Uncertainty:**  $\pm 0.5$  dB

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## **Section 15.247 (b) (4) – Radio Frequency Hazard Information**

As per Section 15.247 (b) (4) spread spectrum transmitters operating in the 902 – 928 MHz band are required to be operated in a manner that ensures that the public is not exposed to RF energy levels in accordance with CFR 47, Section 1.1307(b)(1).

In accordance with this section and also Section 2.1091 this device has been defined as a mobile device whereby a distance of 20 cm can normally be maintained between the user and the device.

In accordance with Section 1.1310 the Maximum Permissible Exposure (MPE) limits for the General Population / Uncontrolled Exposure of f/1500 have been applied.

The maximum distance from the antenna at which the MPE is met or exceeded is calculated from the equation relating field strength in V/m, transmit power in watts, transmit antenna gain and separation distance in metres:

$$E, \text{ V/m} = (\sqrt{30 * P * G}) / d$$

$$\text{Power density, mW/m}^2 = E^2/3770$$

$$\begin{aligned} E \text{ for MPE: } (902/1500) &= E^2/3770 \\ E &= \sqrt{(902/1500)*3770} \\ E &= \underline{47.6 \text{ V/m}} \end{aligned}$$

This transmitter is to be sold with a variety of antennas the details of which are contained in appendix B. The SG900-6 collinear antenna when used with the CC10/900 kit has the highest gain of 5 dBi (gain = 3.2). The maximum transmitter power measured was at 29.7 dBm = 0.93 watts.

Therefore:

$$\begin{aligned} d &= \sqrt{30 * P * G} / E \\ &= \sqrt{30 * 0.93 * 3.2} / 47.6 \\ &= \underline{0.198 \text{ metres or } 19.8 \text{ cm}} \end{aligned}$$

Calculations show that this device, with the described antennas, meets the MPE requirement for mobile devices, falling below the 20 cm clearance required.

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## Section 15.247 (c) – Out of band emissions

Using a spectrum analyser and an external 20 dB attenuator the power reference level was determined to be +29.7 dBm.

Conducted measurements were carried out at the antenna port.

Measurements were made with the device operating in single frequency mode.

A check was also made with the device operating in frequency hopping mode around the frequency band of operation and at the harmonic frequencies. No significant differences were observed when compared to the levels observed when operating in single frequency mode.

**Frequency:** 925.0 MHz

| Measured Spurious Emission |                      |             |
|----------------------------|----------------------|-------------|
| Emission (MHz)             | Emission level (dBm) | Limit (dBm) |
|                            |                      |             |
| 915.0                      | -47.1                | 9.7         |
| 935.0                      | -46.6                | 9.7         |
| 957.0                      | -47.1                | 9.7         |
| 1850.0                     | -50.5                | 9.7         |
| 2775.0                     | -56.3                | 9.7         |
| 3700.0                     | -                    | 9.7         |
| 4625.0                     | -                    | 9.7         |
| 5550.0                     | -                    | 9.7         |
| 6475.0                     | -41.0                | 9.7         |
| 7400.0                     | -                    | 9.7         |
| 8325.0                     | -                    | 9.7         |
| 9250.0                     | -                    | 9.7         |

### *Limit*

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum transmitter is operating, the RF power produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power

**Result:** Complies

**Measurement Uncertainty:**  $\pm 3.3$  dB

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Radiated emission measurements were required in the restricted frequency bands as per Section 15.205 with the limits as per Section 15.209.

Measurements were carried out in frequency hopping mode below 1000 MHz and in single frequency mode (902.875 MHz) above 1000MHz.

Testing was carried out at EMC Technologies NZ Ltd Open Area Test Site, which is located at Dakota Lane, Ardmore Aerodrome, Auckland. Details of this site have been filed with the Commission, Registration Number: 90838, which was last updated on February 11, 2000.

The device was placed on the test table top which was a total of 0.8 m above the test site ground plane.

Measurements of the radiated field were made with the antenna located at a 3 m horizontal distance from the boundary of the device under test.

Measurements below 1000 MHz were made using a quasi peak detector with a bandwidth of 120 kHz.

Measurements above 1000 MHz were made using an average detector with a bandwidth of 1.0 MHz.

The device was powered at 110 Vac.

Emission levels were determined when each of the supplied antennas were attached.

When an emission is located, it is positively identified and its maximum level is found by rotating the automated turntable, and by varying the antenna height with an automated antenna tower. The emission is measured in both vertical and horizontal antenna polarisations.

The emission level is determined in field strength by taking the following into consideration:

$$\text{Level (dB}\mu\text{V/m)} = \text{Receiver Reading (dB}\mu\text{V)} + \text{Antenna Factor (dB)} + \text{Coax Loss (dB)}$$

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General emissions while operating in spread spectrum mode with the co linear whip antenna attached.

| Frequency<br>MHz | Level              |                      | Recheck<br>dBuV/m | Limit<br>dBuV/m | Margin<br>dB | Result | Worst Case<br>Antenna |
|------------------|--------------------|----------------------|-------------------|-----------------|--------------|--------|-----------------------|
|                  | Vertical<br>dBuV/m | Horizontal<br>dBuV/m |                   |                 |              |        |                       |
| 73.730           | 19.5               |                      |                   | 40.0            | -20.5        | Pass   | Vertical              |
| 109.100          | 18.1               |                      |                   | 43.5            | -25.4        | Pass   | Vertical              |
| 110.660          | 19.7               |                      |                   | 43.5            | -23.8        | Pass   | Vertical              |
| 114.798          | 19.1               |                      |                   | 43.5            | -24.4        | Pass   | Vertical              |
| 116.165          | 18.0               |                      |                   | 43.5            | -25.5        | Pass   | Vertical              |
| 122.885          |                    | 17.0                 |                   | 43.5            | -26.5        | Pass   | Horizontal            |
| 132.820          | 19.5               |                      |                   | 43.5            | -24.0        | Pass   | Vertical              |
| 149.968          | 21.6               | 18.1                 |                   | 43.5            | -21.9        | Pass   | Vertical              |
| 240.035          | 28.6               | 36.7                 | 36.7              | 46.0            | -9.3         | Pass   | Horizontal            |
| 245.773          | 24.1               | 26.9                 |                   | 46.0            | -19.1        | Pass   | Horizontal            |
| 251.918          | 34.3               | 33.6                 | 34.3              | 46.0            | -11.7        | Pass   | Vertical              |
| 258.060          |                    | 29.9                 |                   | 46.0            | -16.1        | Pass   | Horizontal            |
| 264.035          |                    | 23.2                 |                   | 46.0            | -22.8        | Pass   | Horizontal            |
| 280.018          | 23.5               |                      |                   | 46.0            | -22.5        | Pass   | Vertical              |
| 325.650          | 19.6               | 22.5                 |                   | 46.0            | -23.5        | Pass   | Horizontal            |
| 399.380          | 18.3               | 19.0                 |                   | 46.0            | -27.0        | Pass   | Horizontal            |
| 408.058          | 23.6               |                      |                   | 46.0            | -22.4        | Pass   | Vertical              |

SG900-6 collinear antenna with the CC20/900 kit

| Frequency<br>MHz | Level              |                      | Recheck<br>dBuV/m | Limit<br>dBuV/m | Margin<br>dBuV | Result | Worst Case<br>Antenna |
|------------------|--------------------|----------------------|-------------------|-----------------|----------------|--------|-----------------------|
|                  | Vertical<br>dBuV/m | Horizontal<br>dBuV/m |                   |                 |                |        |                       |
| 2708.620         | 54.0               | 46.2                 | 54.0              | 54.0            | 0.0            | Uncert | Vertical              |
| 6320.110         | 51.1               | 46.9                 |                   | 54.0            | -3.9           | Uncert | Vertical              |

As per DA 00-705 a duty cycle correction factor can be applied to the above results.

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The dwell time per channel has been measured to be 35 mS.

Correction factor =  $20\log(35 \text{ ms} / 100 \text{ ms}) = -9.1 \text{ dB}$

A -9.1 dB correction factor would give the following results:

| Frequency | Level              | Level                | Limit  | Margin | Result | Worst Case |
|-----------|--------------------|----------------------|--------|--------|--------|------------|
| MHz       | Vertical<br>dBuV/m | Correction<br>Factor | dBuV/m | dBuV/m | dB     | Antenna    |
| 2708.620  | 54.0               | -9.1                 | 44.9   | 54.0   | -9.1   | Complies   |
| 6320.110  | 51.1               | -9.1                 | 42.0   | 54.0   | -12.0  | Complies   |

YU6/900 6 element yagi with CC20/900 kit

| Frequency | Level              | Recheck              | Limit  | Margin | Result | Worst Case |
|-----------|--------------------|----------------------|--------|--------|--------|------------|
| MHz       | Vertical<br>dBuV/m | Horizontal<br>dBuV/m | dBuV/m | dBuV/m | dB     | Antenna    |
| 2708.620  | 36.8               | 45.6                 | 45.4   | 54.0   | -8.4   | Pass       |
| 5417.200  | 36.3               | 43.5                 |        | 54.0   | -10.5  | Pass       |
| 6320.110  | 39.0               | 44.4                 |        | 54.0   | -9.6   | Pass       |

## **Result:**

Complies when using the YU6/900 6 element yagi with CC20/900 kit

Complies when using the SG900-6 collinear antenna with the CC20/900 kit when the duty cycle correction factor as defined in DA 00-705 is applied.

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (30 – 10,000 MHz)  $\pm 4.1 \text{ dB}$

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## 8. TEST EQUIPMENT USED

| Instrument           | Manufacturer    | Model      | Serial #    | Asset    |
|----------------------|-----------------|------------|-------------|----------|
| Attenuator 20 dB     | Hewlett Packard | 8491B      | 22146       | E1041    |
| RF Power Meter       | Hewlett Packard | HP 436A    | 2512A22439  | E1198    |
| Spectrum Analyser    | Hewlett Packard | E 7405A    | US 39150142 | 3776     |
| Measurement Receiver | Rohde & Schwarz | ESCS 30    | 839873/1    | E1595    |
| Aerial Controller    | EMCO            | 1090       | 9112-1062   | 3710     |
| Aerial Mast          | EMCO            | 1070-1     | 9203-1661   | 3708     |
| Turntable            | EMCO            | 1080-1-2.1 | 9109-1578   | RFS 3709 |
| Biconical Antenna    | Schwarzbeck     | BBA 9106   | -           | 3612     |
| Log Periodic Antenna | Schwarzbeck     | UHALP 9107 | -           | 3702     |
| Horn Antenna         | EMCO            | 3115       | 9511-4629   | E1526    |

## 9. ACCREDITATIONS

Testing was carried out in accordance with EMC Technologies NZ Ltd registration with the Federal Communications Commission as a listed facility, Registration Number: 90838, which was updated on February 11<sup>th</sup>, 2000.

In addition testing was carried out in accordance with the terms of EMC Technologies (NZ) Ltd's International Accreditation New Zealand (IANZ) Accreditation to the New Zealand Code of Laboratory Management Practice incorporating ISO Guide 25: 1990 and ISO 9002: 1994.

All measurement equipment has been calibrated in accordance with the terms of EMC Technologies (NZ) Ltd's International Accreditation New Zealand (IANZ) Accreditation to the New Zealand Code of Laboratory Management Practice incorporating ISO Guide 25: 1990 and ISO 9002: 1994.

International Accreditation New Zealand has Mutual Recognition Arrangements for testing and calibration with 25 accreditation bodies in 21 economies. This includes NATA (Australia), UKAS (UK), SANAS (South Africa), NVLAP (USA), A2LA (USA), SWEDAC (Sweden). Further details can be supplied on request.

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## Appendix A – Hop Frequency details

### Hop set 1 – 8

|    |         |         |         |         |         |         |         |         |
|----|---------|---------|---------|---------|---------|---------|---------|---------|
| #1 | 21      | 83      | 115     | 81      | 113     | 65      | 105     | 61      |
| #2 | 21      | 83      | 115     | 67      | 107     | 77      | 47      | 97      |
| #3 | 21      | 83      | 51      | 99      | 81      | 49      | 97      | 57      |
| #4 | 21      | 113     | 105     | 103     | 61      | 119     | 69      | 111     |
| #5 | 147     | 211     | 145     | 209     | 193     | 189     | 167     | 171     |
| #6 | 121     | 183     | 151     | 191     | 155     | 219     | 207     | 163     |
| #7 | 147     | 163     | 165     | 219     | 197     | 169     | 139     | 207     |
| #8 | 147     | 211     | 171     | 121     | 197     | 127     | 159     | 217     |
|    |         |         |         |         |         |         |         |         |
| #1 | 902.625 | 910.375 | 914.375 | 910.125 | 914.125 | 908.125 | 913.125 | 907.625 |
| #2 | 902.625 | 910.375 | 914.375 | 908.375 | 913.375 | 909.625 | 905.875 | 912.125 |
| #3 | 902.625 | 910.375 | 906.375 | 912.375 | 910.125 | 906.125 | 912.125 | 907.125 |
| #4 | 902.625 | 914.125 | 913.125 | 912.875 | 907.625 | 914.875 | 908.625 | 913.875 |
| #5 | 918.375 | 926.375 | 918.125 | 926.125 | 924.125 | 923.625 | 920.875 | 921.375 |
| #6 | 915.125 | 922.875 | 918.875 | 923.875 | 919.375 | 927.375 | 925.875 | 920.375 |
| #7 | 918.375 | 920.375 | 920.625 | 927.375 | 924.625 | 921.125 | 917.375 | 925.875 |
| #8 | 918.375 | 926.375 | 921.375 | 915.125 | 924.625 | 915.875 | 919.875 | 927.125 |

### Hop set 9 – 16

|    |         |         |         |         |         |         |         |         |
|----|---------|---------|---------|---------|---------|---------|---------|---------|
| #1 | 103     | 71      | 45      | 95      | 69      | 107     | 77      | 111     |
| #2 | 69      | 43      | 31      | 89      | 117     | 75      | 111     | 65      |
| #3 | 101     | 59      | 103     | 61      | 39      | 29      | 87      | 117     |
| #4 | 65      | 93      | 71      | 45      | 117     | 109     | 73      | 95      |
| #5 | 133     | 203     | 137     | 205     | 169     | 183     | 123     | 159     |
| #6 | 177     | 147     | 133     | 181     | 149     | 173     | 145     | 189     |
| #7 | 137     | 153     | 213     | 145     | 161     | 217     | 131     | 203     |
| #8 | 131     | 175     | 133     | 203     | 193     | 135     | 153     | 163     |
|    |         |         |         |         |         |         |         |         |
| #1 | 912.875 | 908.875 | 905.625 | 911.875 | 908.625 | 913.375 | 909.625 | 913.875 |
| #2 | 908.625 | 905.375 | 903.875 | 911.125 | 914.625 | 909.375 | 913.875 | 908.125 |
| #3 | 912.625 | 907.375 | 912.875 | 907.625 | 904.875 | 903.625 | 910.875 | 914.625 |
| #4 | 908.125 | 911.625 | 908.875 | 905.625 | 914.625 | 913.625 | 909.125 | 911.875 |
| #5 | 916.625 | 925.375 | 917.125 | 925.625 | 921.125 | 922.875 | 915.375 | 919.875 |
| #6 | 922.125 | 918.375 | 916.625 | 922.625 | 918.625 | 921.625 | 918.125 | 923.625 |
| #7 | 917.125 | 919.125 | 926.625 | 918.125 | 920.125 | 927.125 | 916.375 | 925.375 |
| #8 | 916.375 | 921.875 | 916.625 | 925.375 | 924.125 | 916.875 | 919.125 | 920.375 |

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## Hop set 17 –24

|    |         |         |         |         |         |         |         |         |
|----|---------|---------|---------|---------|---------|---------|---------|---------|
| #1 | 73      | 109     | 63      | 41      | 93      | 55      | 37      | 91      |
| #2 | 105     | 81      | 113     | 73      | 109     | 63      | 41      | 29      |
| #3 | 67      | 43      | 95      | 79      | 113     | 77      | 111     | 65      |
| #4 | 57      | 91      | 55      | 37      | 75      | 47      | 33      | 85      |
| #5 | 217     | 195     | 141     | 207     | 129     | 201     | 191     | 125     |
| #6 | 199     | 159     | 193     | 213     | 205     | 203     | 161     | 139     |
| #7 | 129     | 159     | 181     | 167     | 183     | 143     | 209     | 193     |
| #8 | 219     | 149     | 179     | 187     | 189     | 125     | 199     | 169     |
|    |         |         |         |         |         |         |         |         |
| #1 | 909.125 | 913.625 | 907.875 | 905.125 | 911.625 | 906.875 | 904.625 | 911.375 |
| #2 | 913.125 | 910.125 | 914.125 | 909.125 | 913.625 | 907.875 | 905.125 | 903.625 |
| #3 | 908.375 | 905.375 | 911.875 | 909.875 | 914.125 | 909.625 | 913.875 | 908.125 |
| #4 | 907.125 | 911.375 | 906.875 | 904.625 | 909.375 | 905.875 | 904.125 | 910.625 |
| #5 | 927.125 | 924.375 | 917.625 | 925.875 | 916.125 | 925.125 | 923.875 | 915.625 |
| #6 | 924.875 | 919.875 | 924.125 | 926.625 | 925.625 | 925.375 | 920.125 | 917.375 |
| #7 | 916.125 | 919.875 | 922.625 | 920.875 | 922.875 | 917.875 | 926.125 | 924.125 |
| #8 | 927.375 | 918.625 | 922.375 | 923.375 | 923.625 | 915.625 | 924.875 | 921.125 |

## Hop set 25 – 32

|    |         |         |         |         |         |         |         |         |
|----|---------|---------|---------|---------|---------|---------|---------|---------|
| #1 | 119     | 75      | 47      | 33      | 89      | 53      | 99      | 79      |
| #2 | 87      | 53      | 35      | 27      | 23      | 85      | 51      | 99      |
| #3 | 105     | 71      | 109     | 63      | 41      | 93      | 119     | 69      |
| #4 | 81      | 97      | 101     | 77      | 107     | 63      | 41      | 87      |
| #5 | 199     | 127     | 173     | 165     | 155     | 215     | 131     | 153     |
| #6 | 129     | 185     | 179     | 175     | 197     | 201     | 171     | 169     |
| #7 | 189     | 151     | 179     | 123     | 199     | 141     | 177     | 133     |
| #8 | 165     | 183     | 167     | 139     | 177     | 155     | 215     | 195     |
|    |         |         |         |         |         |         |         |         |
| #1 | 914.875 | 909.375 | 905.875 | 904.125 | 911.125 | 906.625 | 912.375 | 909.875 |
| #2 | 910.875 | 906.625 | 904.375 | 903.375 | 902.875 | 910.625 | 906.375 | 912.375 |
| #3 | 913.125 | 908.875 | 913.625 | 907.875 | 905.125 | 911.625 | 914.875 | 908.625 |
| #4 | 910.125 | 912.125 | 912.625 | 909.625 | 913.375 | 907.875 | 905.125 | 910.875 |
| #5 | 924.875 | 915.875 | 921.625 | 920.625 | 919.375 | 926.875 | 916.375 | 919.125 |
| #6 | 916.125 | 923.125 | 922.375 | 921.875 | 924.625 | 925.125 | 921.375 | 921.125 |
| #7 | 923.625 | 918.875 | 922.375 | 915.375 | 924.875 | 917.625 | 922.125 | 916.625 |
| #8 | 920.625 | 922.875 | 920.875 | 917.375 | 922.125 | 919.375 | 926.875 | 924.375 |

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## Hop set 33 – 40

|    |         |         |         |         |         |         |         |         |
|----|---------|---------|---------|---------|---------|---------|---------|---------|
| #1 | 49      | 97      | 57      | 101     | 59      | 39      | 29      | 87      |
| #2 | 71      | 45      | 95      | 57      | 101     | 59      | 103     | 61      |
| #3 | 107     | 73      | 45      | 31      | 89      | 53      | 35      | 91      |
| #4 | 53      | 79      | 49      | 89      | 99      | 59      | 39      | 29      |
| #5 | 179     | 143     | 177     | 185     | 187     | 135     | 175     | 121     |
| #6 | 143     | 131     | 125     | 215     | 209     | 211     | 165     | 141     |
| #7 | 175     | 185     | 187     | 125     | 173     | 121     | 149     | 211     |
| #8 | 191     | 151     | 213     | 145     | 209     | 137     | 205     | 129     |
|    |         |         |         |         |         |         |         |         |
| #1 | 906.125 | 912.125 | 907.125 | 912.625 | 907.375 | 904.875 | 903.625 | 910.875 |
| #2 | 908.875 | 905.625 | 911.875 | 907.125 | 912.625 | 907.375 | 912.875 | 907.625 |
| #3 | 913.375 | 909.125 | 905.625 | 903.875 | 911.125 | 906.625 | 904.375 | 911.375 |
| #4 | 906.625 | 909.875 | 906.125 | 911.125 | 912.375 | 907.375 | 904.875 | 903.625 |
| #5 | 922.375 | 917.875 | 922.125 | 923.125 | 923.375 | 916.875 | 921.875 | 915.125 |
| #6 | 917.875 | 916.375 | 915.625 | 926.875 | 926.125 | 926.375 | 920.625 | 917.625 |
| #7 | 921.875 | 923.125 | 923.375 | 915.625 | 921.625 | 915.125 | 918.625 | 926.375 |
| #8 | 923.875 | 918.875 | 926.625 | 918.125 | 926.125 | 917.125 | 925.625 | 916.125 |

## Hop set 41 – 48

|    |         |         |         |         |         |         |         |         |
|----|---------|---------|---------|---------|---------|---------|---------|---------|
| #1 | 117     | 67      | 43      | 31      | 25      | 85      | 51      | 35      |
| #2 | 39      | 93      | 55      | 37      | 91      | 119     | 79      | 49      |
| #3 | 55      | 37      | 27      | 23      | 85      | 115     | 75      | 47      |
| #4 | 115     | 67      | 43      | 31      | 25      | 83      | 51      | 35      |
| #5 | 197     | 157     | 163     | 219     | 139     | 161     | 181     | 151     |
| #6 | 217     | 167     | 195     | 157     | 137     | 187     | 153     | 135     |
| #7 | 195     | 127     | 201     | 191     | 135     | 205     | 157     | 215     |
| #8 | 201     | 141     | 207     | 157     | 181     | 123     | 173     | 185     |
|    |         |         |         |         |         |         |         |         |
| #1 | 914.625 | 908.375 | 905.375 | 903.875 | 903.125 | 910.625 | 906.375 | 904.375 |
| #2 | 904.875 | 911.625 | 906.875 | 904.625 | 911.375 | 914.875 | 909.875 | 906.125 |
| #3 | 906.875 | 904.625 | 903.375 | 902.875 | 910.625 | 914.375 | 909.375 | 905.875 |
| #4 | 914.375 | 908.375 | 905.375 | 903.875 | 903.125 | 910.375 | 906.375 | 904.375 |
| #5 | 924.625 | 919.625 | 920.375 | 927.375 | 917.375 | 920.125 | 922.625 | 918.875 |
| #6 | 927.125 | 920.875 | 924.375 | 919.625 | 917.125 | 923.375 | 919.125 | 916.875 |
| #7 | 924.375 | 915.875 | 925.125 | 923.875 | 916.875 | 925.625 | 919.625 | 926.875 |
| #8 | 925.125 | 917.625 | 925.875 | 919.625 | 922.625 | 915.375 | 921.625 | 923.125 |

## Hop set 49 and 50

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|    |         |         |
|----|---------|---------|
| #1 | 27      | 23      |
| #2 | 33      | 25      |
| #3 | 33      | 25      |
| #4 | 27      | 23      |
| #5 | 213     | 149     |
| #6 | 127     | 123     |
| #7 | 171     | 155     |
| #8 | 143     | 161     |
|    |         |         |
| #1 | 903.375 | 902.875 |
| #2 | 904.125 | 903.125 |
| #3 | 904.125 | 903.125 |
| #4 | 903.375 | 902.875 |
| #5 | 926.625 | 918.625 |
| #6 | 915.875 | 915.375 |
| #7 | 921.375 | 919.375 |
| #8 | 917.875 | 920.125 |

Hop channel numbers are always greater than 20 and less than 220 in order to stay within the 902 to 928 MHz frequency ranges with guard bands at the band edges.

Only odd hops are used which gives a 250kHz channel plan.

Hop Frequency = 900MHz + (hop channel number x 125kHz)

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## Appendix B – Antenna Characteristics



**ELPRO Technologies**  
*The Wireless Alternative*

Accessory Data Sheet  
SG900-6

### General

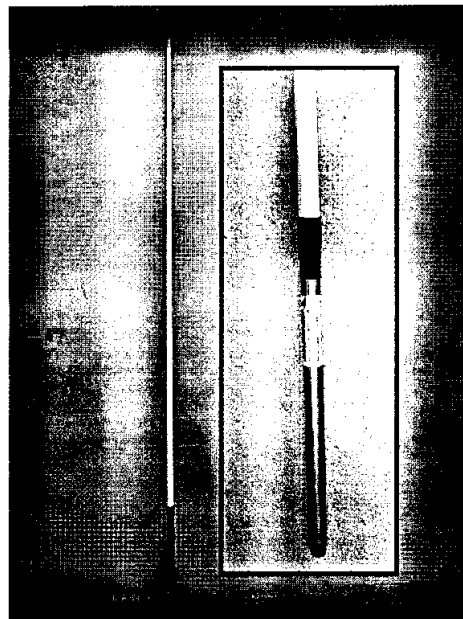
The SG900-6 collinear antenna is designed for use with the ELPRO 900 series range of telemetry products. The SG900-6 meets specific radio requirements for these products and is a slimline, lightweight antenna which is easily mounted.

The SG900-6 is fitted with a N-Type female connector. The CC10/900 and CC20/900 coaxial extender kits are suitable for use with this antenna.

The SG900-6 antenna is mounted at the base tube by U bracket (not supplied). This antenna is used when maximum range is required or as a base station antenna.

The antenna is suitable for external mounting only due to the overall length.

Mounting bracket are supplied separately with this antenna – see part # br\_collinear\_kit



### Specification

|              |                   |
|--------------|-------------------|
| Type         | Collinear         |
| Nominal gain | 8dbi              |
| Frequency    | 900 – 930 MHz     |
| Impedance    | 50 Ohms           |
| Construction | Fiberglass radome |

|           |                  |
|-----------|------------------|
| Length    | 80" / 2030mm     |
| Connector | N-Type (female)  |
| Color     | White            |
| Mounting  | 3/4" / 20mm tube |

#### Note:

Overall gain when use with CC10/900 = 5dBi

Overall gain when use with CC20/900 = 2dBi

Mounting bracket br\_collinear\_kit (not supplied)

Telemetry made easy by  
ELPRO Technologies  
9/12 Billabong Street  
Stafford QLD 4053  
Australia

[www.elprotech.com](http://www.elprotech.com)

Part No BRO\_SG9006\_V1.0

Available from:

**EMC Technologies (NZ) Ltd**

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## Accessory Data Sheet YU6/900

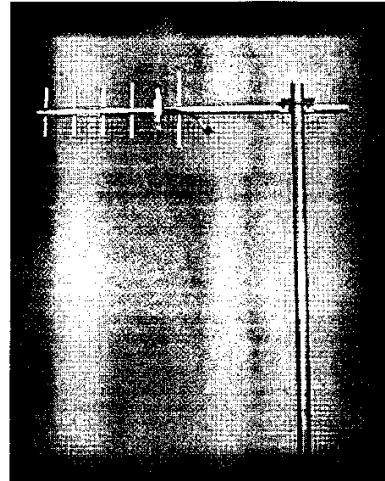
### General

The YU6/900 6 element Yagi antenna is made for use with the ELPRO 900 series telemetry products. The CC20/900 coaxial extender is suitable for use with the YU6/900

The YU6/900 is designed for pole mount and to be clear from obstructions. The narrow beamwidth and high front to back ratio is effective in reducing the affects of interference and extending radio range.

A standard female N-Type connection from a 6" / 150mm tail provides a simple connection method when using the ELPRO CC20/900 kit.

Note: Brackets are supplied separately with this antenna - see part # bracket\_yagi\_kit



YU6/900

### Specification

|                   |              |              |                      |
|-------------------|--------------|--------------|----------------------|
| Type              | Yagi         | Length       | 32" / 820mm          |
| Frequency         | 900 -930 MHz | Width        | 8" / 20mm            |
| Impedance         | 50 Ohms      | Connector    | N-Type (female)      |
| Construction      | Aluminum     | Nominal Gain | 10dBi                |
| F/B ratio dB      | 17           | Overall gain | with CC20/900 = 4dBi |
| Beamwidth 'E' Deg | 46           |              |                      |
| Beamwidth 'H' Deg | 50           |              |                      |

Telemetry made easy by  
ELPRO Technologies  
9/12 Billabong Street  
Stafford QLD 4053  
Australia

[www.elprotech.com](http://www.elprotech.com)

Part No ACC\_YU6900\_1.2

Available from:

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