O Series
User Manual

Contents

Part A – Preface

Warranty

All equipment supplied by Trio DataCom Pty Ltd is covered by warranty for faulty workmanship and parts for a period of twelve (12) months from the date of delivery to the customer. During the warranty period Trio DataCom Pty Ltd shall, at its option, repair or replace faulty parts or equipment provided the fault has not been caused by misuse, accident, deliberate damage, abnormal atmosphere, liquid immersion or lightning discharge; or where attempts have been made by unauthorised persons to repair or modify the equipment.

The warranty does not cover modifications to software. All equipment for repair under warranty must be returned freight paid to Trio DataCom Pty Ltd or to such other place as Trio DataCom Pty Ltd shall nominate. Following repair or replacement the equipment shall be returned to the customer freight forward. If it is not possible due to the nature of the equipment for it to be returned to Trio DataCom Pty Ltd, then such expenses as may be incurred by Trio DataCom Pty Ltd in servicing the equipment in situ shall be chargeable to the customer.

When equipment for repair does not qualify for repair or replacement under warranty, repairs shall be performed at the prevailing costs for parts and labour. Under no circumstances shall Trio DataCom Pty Ltd's liability extend beyond the above nor shall Trio DataCom Pty Ltd, its principals, servants or agents be liable for the consequential damages caused by the failure or malfunction of any equipment.

Important Notice

This manual covers the operation of the M Series of Digital Data Radios. Specifications described are typical only and are subject to normal manufacturing and service tolerances.

Trio DataCom Pty Ltd reserves the right to modify the equipment, its specification or this manual without prior notice, in the interest of improving performance, reliability or servicing. At the time of publication all data is correct for the operation of the equipment at the voltage and/or temperature referred to. Performance data indicates typical values related to the particular product.

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FCC Compliance Notices

FCC Part 15 Notice

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received including interference that may cause undesired operation.

This device must not be modified in any way or FCC compliance may be void.

FCC Approved Antennas

This device can only be used with Antennas listed in the Appendix of the O Series User Manual. Please Contact Trio Datacom if you need more information or would like to order an antenna.

RF Exposure

To satisfy FCC RF exposure requirements for mobile transmitting devices, a separation distance of 20 cm or more should be maintained between the antenna of this device and persons during device operation. To ensure compliance, operations at closer than this distance is not recommended. The antenna used for this transmitter must not be co-located in conjunction with any other antenna or transmitter.

MAXIMUM EIRP

FCC Regulations allow up to 36 dBm effective isotropic radiated power (EIRP). Therefore, the sum of the transmitted power (in dBm), the cabling loss and the antenna gain (in dBi) cannot exceed 36 dBm.

FCC Point to Point : More EIRP may be allowed for fixed point to point links. With the transmitter set to 27dBm, an antenna gain (subtracting cable loss) of up to 15 dBi is allowed. For antenna gains of more than 15 dBi in a fixed point to point link, the power must be backed off from 27dBm by 1dB for every 3dB the antenna gain exceeds 15dBi.

ETSI Maximum EIRP for the 2.4GHz band is +20dBm.

Australian Compliance Notices

MAXIMUM EIRP

ACMA Regulations allow up to 30 dBm (1 Watt) of effective isotropic radiated power (EIRP) in the 915MHz license free band and 36 dBm (4 Watts) of EIRP in the 2.4GHz band. Therefore, the sum of the transmitted power (in dBm), the cabling loss and the antenna gain cannot exceed the above stated EIRP limits.

Important Notices for Class I, Division 2, Groups A, B, C & D Hazardous Locations

Applies to models OM900-xxxxx-xHx(CSA Marked)

This product is available for use in Class I, Division 2, Groups A, B, C & D Hazardous Locations. Such locations are defined in Article 500 of the US National Fire Protection Association (NFPA) publication NFPA 70, otherwise known as the National Electrical Code and in Section 18 of the Canadian Standards Association C22.1 (Canadian Electrical Code).

The transceiver has been recognised for use in these hazardous locations by the Canadian Standards Association (CSA) International. CSA certification is in accordance with CSA Standard C22.2 No. 213-M1987 and UL Standard 1604 subject to the following conditions of approval:

1. This Equipment is suitable for use in class I, division 2, Groups A,B,C and D or non Hazardous locations only.

2. This module is certified as “Open type” equipment and must be used in a suitable end use enclosure.

3. The antenna, DC power and interface cables must be routed through conduit in accordance with the National Electrical Codes.

4. Installation, operation and maintenance of the radio modem should be in accordance with the radio modem’s user manual and the National Electrical Codes.

5. Tampering or replacement with non-factory components may adversely affect the safe use of the radio modem in hazardous locations and may void the approval.

6. Power supplied to this equipment must be from a CLASS 2 source (per National Electrical Code, NFPA 70, Article 725.41, and Canadian Electrical Code, C22.1, rule 16-200) or otherwise limited to the voltage levels specified for this equipment, with available current of < 5A.

7. The antenna connectors used must be secured to the module by using one of the two methods shown in this manual.

⚠ WARNING EXPLOSION HAZARD

DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN TURNED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

Electrical Ratings

5 volts @ 1.2A

3.3 volts @ 300mA

Environmental Ratings

Operating Temperature: -40 to +75 degC

Temperature code: T4

WEEE Notice (Europe)

This symbol on the product or its packaging indicates that this product must not be disposed of with other waste. Instead, it is your responsibility to dispose of your waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste equipment for recycling, please contact the dealer from whom you originally purchased the product.

Dieses Symbol auf dem Produkt oder seinem Verpacken zeigt an, daß dieses Produkt nicht mit anderer Vergeudung entledigt werden darf. Stattdessen ist es Ihre Verantwortlichkeit, sich Ihre überschüssige Ausrüstung zu entledigen, indem es rüber sie zu einem gekennzeichneten Ansammlungspunkt für die Abfallverwertung elektrische und elektronische Ausrüstung übergibt. Die unterschiedliche Ansammlung und die Wiederverwertung Ihrer überschüssigen Ausrüstung zu der Zeit der Beseitigung helfen, Naturresourcen zu konservieren und sicherzugehen, daß es in gewissem Sinne aufbereitet wird, daß menschliche Gesundheit und das Klima schützt. Zu mehr Information ungefähr, wo Sie weg von Ihrer überschüssigen Ausrüstung für die Wiederverwertung fallen können, treten Sie bitte mit dem Händler in Verbindung, von dem Sie ursprünglich das Produkt kauften.

Low Voltage Safety (Europe)

In order to comply with the R&TTE (Radio & Telecommunications Terminal Equipment) directive 1999/5/EC Article 3 (Low Voltage Directive 73/23/EEC), all radio modem installations must include an external in-line lightning arrestor or equivalent device that complies with the following specifications:

- DC Blocking Capability - 1.5kV impulse (Rise Time 10mS, Fall Time 700mS) (Repetition 10 Times) or 1.0kV rms 50Hz sine wave for 1 minute.

The OM240 has been classified as SELV throughout. All ports shall be connected to like circuits and shall not extend beyond the building boundary of the host equipment unless connected via an isolation unit compliant with the requirements of section 7 of EN60950-1.

Other Related Documentation and Products

Revision History

Issue 1	May 2007	Initial Release
Issue 2	Jun 2007	Minor FCC Modifications
Issue 3	Jul 2007	Minor FCC Modifications
Issue 4	Oct 2007	Hazardous Notices
Issue 5	Nov 2007	Updated product specifications.
Issue 6	Aug 2008	Added 2.4GHz

Part B – O Series Overview

Definition of O Series Data Radio

Trio O Series industrial strength spread spectrum data radios are the ideal solution for professional serial data communications in wireless point to point or point to multi-point SCADA and telemetry applications when the use of licensed frequencies is not possible or when data throughput requirements are greater than traditional licensed frequency equipment can achieve.

O Series systems can be rapidly deployed as permanent or temporary alternatives to costly cable based circuits. They allow complex networks with extended coverage to be implemented at minimum cost, delivering dependable communications in the most demanding environments.

O Series Product Range

The TRIO O Series comprises the OM900, which operates within the 902-928MHz license free frequency band, and the OM240 that can be configured for use in the 2.4GHz license free bands available throughout the world.

O Series – Features and Benefits

Radio

- License free communication in international 2.4GHz and 902-928 MHz ISM frequency bands
- Versions suitable for use in most parts of the world
- Robust, frequency hopping spread spectrum technology for superior interference immunity
- 900MHz - 1 Watt transmitter output power
- 2.4GHz - 500 mWatt transmitter output power
- High performance receiver
- 256kbps over the air data speed
- Supports point to point and point to multi-point operation
- User selectable master, remote and repeater operation
- Collision avoidance for simultaneous polling and spontaneous reporting

Data Modem

- Suitable for most industry standard data protocols e.g., MODBUS, DNP3, IEC870-5-101, DF1, etc.
- User configurable 1200-115,000 bps asynch RS-232/RS485 port
- Fully transparent 3 wire user interface
- Intelligent transmitter control
- Excellent BER performance
- Internal CRC and user-selectable forward error correction
- Multiple user configurable security layers including data encryption

Standard Accessories

Antennas

These antennas are for use outside North America. See Appendix for FCC approved antennas.

Part Number	Description
ANT9AL	Antenna Yagi 6 Element 9dBd Alum 850-930MHz
ANT9SS	Antenna Yagi 6 Element 9dBd S/S 850-930MHz
ANT13AL	Antenna Yagi 15 Element 13dBd Alum 850-930MHz
ANT13AL	Antenna Yagi 15 Element 13dBd S/S 850-930MHz
ANT900WHIP	Antenna Omni-Dirn Whip TNC - Demo Use 902-928MHz
ANT915OMNI	Antenna Omni-Dirn Unity Gain 902-928MHz
ANT2G4/13A	Antenna Yagi Enclosed 13dBd Gain 2.4GHz
ANT2G4/16A	Antenna Grid Reflector 16dBd Gain 2.4GHz
ANT2G4/24A	Antenna Grid Reflector 24dBd Gain 2.4GHz
ANT2G4WHIP	Antenna Omni-Dirn Whip TNC - Demo Use 2.4GHz
ANT2G4OMNI	Antenna Omni-Dirn Unity Gain 2.4GHz
ANT2G4/6OM	Antenna Omni-Dirn 6dBd Gain 2.4GHz

Note:

1. Frequencies must be specified at time of order.

Power Supplies

PS13V82A	Power Supply 13.8V 2A 240VAC
PS13V82ASW	Power Supply Switch Mode 13.8V 2A 110-240VAC

Part Number	Description

RF Cables and Accessories

RFCAB5M2	5.0m RG-213 type Antenna Feeder Cable terminated with N type Male Connectors
RFCAB10M	10.0m RG-213 type Antenna Feeder Cable terminated with N type Male Connectors
RFCAB20M4	20.0m LDF4-50 type (1/2” foam dialectric) Antenna Feeder Cable terminated with N type Male Connectors
LGHTARRST	Lightning Surge Arrestor In-line N Female to N Female DC<1000MHz
LGHTARRST2	Lightning Surge Arrestor In-line N Female to N Female 2 to 6GHz

Part C – Applications

Generic Connectivity

The O Series has been designed for SCADA and telemetry applications, and any other applications that use an ASCII communications protocol, and which connect physically using the RS-232 or RS-485 interface standard.

Any protocol that can be displayed using a PC based terminal program operating via a serial communications port is suitable for transmission by the O Series radio modems.

An ASCII protocol is any that consists of message strings formed from ASCII characters, that being defined as a 10 or 11 bit block including start and stop bits, 7 or 8 data bits and optional parity bit(s). Port set-up dialogue that includes the expressions “N,8,1”, or E,7,2” or similar indicate an ASCII protocol.

Most of the dominant telemetry industry suppliers utilise proprietary ASCII protocols, and also common “open standard” industry protocols such as DNP3, MODBUS, TCP/IP, and PPP. These are all ASCII based protocols.

Industries and Applications

The O Series products are widely used in point-to-point and point-to-multipoint (multiple access) applications for remote interconnection of PLCs, RTUs, dataloggers, and other data monitoring and control devices - including specialist utility devices (such as powerline ACRs). In addition, other applications such as area wide security and alarm systems, public information systems (traffic flow and public signage systems) and environmental monitoring systems.

Application Detail

SCADA Systems

This is where one or more centralised control sites are used to monitor and control remote field devices over wide areas. Examples include regional utilities monitoring and controlling networks over entire councils or a greater city metropolis. Industry sectors include energy utilities (gas and electricity distribution), water and waste water utilities, catchment and environment groups (rivers, dams and catchment management authorities).

Telemetry Systems

Dedicated telemetry control systems interconnecting sequential devices either where cabling is not practical or distances are considerable.

Examples include:

- ore conveyor or slurry pipeline systems
- simple water systems (pump and reservoir interlinking)
- broadcast industry (linking studio to transmitter) etc.

Information Systems

Public Information systems such as freeway vehicle flow, travel time monitoring, feedback signage, parking signage systems and meteorological stations etc.

Part D – Module Pinouts

Recommended Connections

Power Supply

Pin	Name	In/Out	Comment	Level
6	VCC	I	3.3V Supply Input 100mA	+/-5%
10	PAVCC	I	PA Supply Input 5V	+/-5%
11	GND	N/A		
12	PAVCC	I	PA Supply Input 5V	+/-5%
14	GND	N/A		

Port A (aka Port 2)

1	PORT2-TxD	I	Input for transmit for Port 2 [Port A on K-Series]	3.3V TTL
2	PORT2-RxD	O	Output for received data for Port 2 [Port A on K-Series]	3.3V TTL

Port B (aka Port 1)

29	PORT1-TxD	I	Input for transmit for Port 1 [Port B on K-Series]	3.3V TTL
30	PORT1-RxD	O	Output for received data for Port 1 [Port B on K-Series]	3.3V TTL

Systems Port

7	SysSerIn	I	Diagnostics/FDL input data or Testmode command	3.3V TTL
8	SysSerOut	O	Diagnostics/FDL output or Testmode command	3.3V TTL

LEDs

15	Tx_LED	O	Tx activity (Active Low)	3.3V TTL
17	Sync_LED	O	Masters: 100ms pulse when user data received (Active Low) Remotes/Bridges: pulsed every 1500ms for 100ms when master acquired, additional 100ms pulse when user data received (Active Low)	3.3V TTL
18	TxD_PORT1_LED	O	Pulsed for 100ms for any TxD activity for Port 1 [Port B on K-Series] (Active Low)	3.3V TTL
19	RxD_PORT1_LED	O	Pulsed for 100ms for any RxD activity for Port 1 [Port B on K-Series] (Active Low)	3.3V TTL
20	TxD_PORT2_LED	O	Pulsed for 100ms for any TxD activity for Port 2 [Port A on K-Series] (Active Low)	3.3V TTL
21	RxD_PORT2_LED	O	Pulsed for 100ms for any RxD activity Port 2 [Port A on K-Series] (Active Low)	3.3V TTL
22	Pwr_LED	O	DC power OK (Active Low)	3.3V TTL
39	NoSIG_LED	O	Masters: not activity Remotes/Bridges: pulsed every 1500ms for 100ms when master not acquired (Active Low)	3.3V TTL

Other Pins

13	Analogue RSSI	O	Synthesised average of RSSI (20dB/V absolute reference : -90dBm = 1.25v) [can also be used as a general purpose analogue output]	0-2.5v
24	PTT	I	Keys the radio at maximum TX/RX duty cycle using the current programmed channel selection and output power (Active Low). Note that while a radio is in this mode no data can be passed, the RSSI indication on other units will not respond to the radio being PTT keyed and it may block other systems.	3.3V TTL

Optional Connections

Port A (aka Port 2)

3	PORT2-CTS	O	Flow control of TxD for Port 2 [Port A on K-Series]	3.3V TTL
4	PORT2-RTS	I	Flow control of TxD for Port 2 [Port A on K-Series]	3.3V TTL
5	PORT2-DTR	I	Flow control of RxD for Port 2 [Port A on K-Series]	3.3V TTL
9	PORT2-DCD	O	Flow control of RxD for Port A	3.3V TTL

Port B (aka Port 1)

31	PORT1-RTS	I	Flow control of TxD for Port 1 [Port B on K-Series]	3.3V TTL
32	PORT1-CTS	O	Flow control of TxD for Port 1 [Port B on K-Series]	3.3V TTL
33	PORT1-DTR	I	Flow control of RxD for Primary Data Port [Port B on K-Series]	3.3V TTL
34	PORT1-DCD	O	Flow control of RxD for Port 1 [Port B on K-Series]	3.3V TTL

Other connections (Optional)

Pin	Name	In/Out	Comment	Level
16	Analogue Input	I	General purpose analogue input. 66k input resistance.	0-6v
23	nFACT/TEST-MODE	I	Reset factory defaults (Active Low on power-up)	3.3V TTL
25	TxInhibit	I	Tx inhibit for hot standby operation (Active High)	3.3V TTL
26	nSHUTDOWN_IN	I	Power down entire module (Active Low)	3.3V TTL
27	TxSync Input	I	Tx Sync input	3.3V TTL
28	TxSync Output	O	Tx Sync output	3.3V TTL
35	TWD	IO	N/C - Factory Use Only	3.3V TTL
36	TWCK	O	N/C - Factory Use Only	3.3V TTL
37	SUPPLY_MONI-TOR	I	N/C - Factory Use Only	0-3V, Hi-Z
38	SHUTDOWN_ OUT	O	N/C - Factory Use Only	3.3V TTL
40	NVRAM-WP	O	N/C - Factory Use Only	3.3V TTL

Part E – System Planning and Design

Understanding RF Path Requirements

A radio modem needs a minimum amount of received RF signal to operate reliably and provide adequate data throughput.

In most cases, spectrum regulatory authorities will also define or limit the amount of signal that can be transmitted, and the transmitted power will decay with distance and other factors, as it moves away from the transmitting antenna.

It follows, therefore, that for a given transmission level, there will be a finite distance at which a receiver can operate reliably with respect to the transmitter.

Apart from signal loss due to distance, other factors that will decay a signal include obstructions (hills, buildings, foliage), horizon (effectively the bulge between two points on the earth), and factors such as fog, heavy rain-bursts, dust storms, etc.

In order to ascertain the available RF coverage from a transmitting station, it will be necessary to consider these factors. This can be done in a number of ways, including

(a) using basic formulas to calculate the theoretically available signal - allowing only for free space loss due to distance,

(b) using sophisticated software to build earth terrain models and apply other correction factors such as earth curvature and the effects of obstructions, and

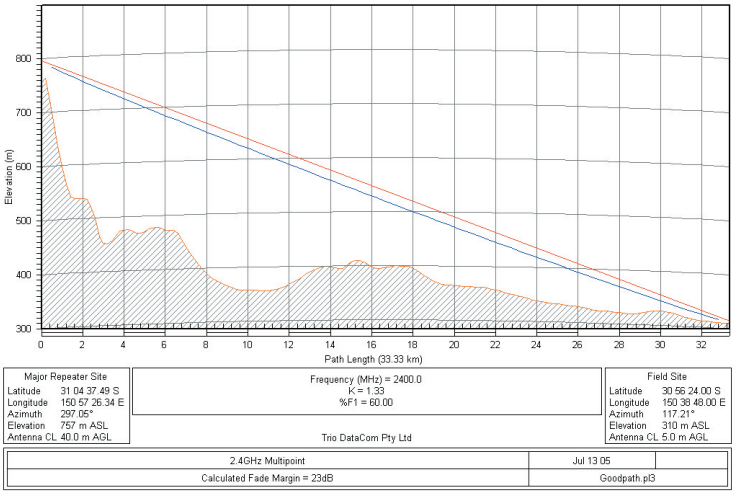
(c) by actual field strength testing.

It is good design practice to consider the results of at least two of these models to design a radio path.

Examples of Predictive Path Modelling

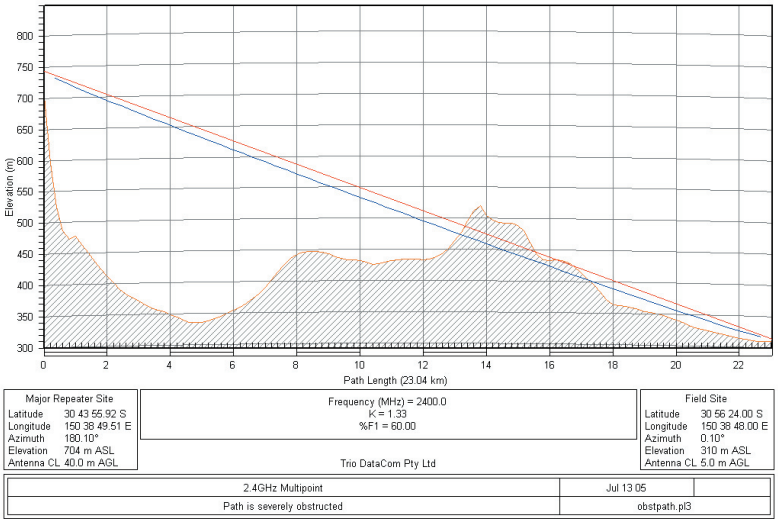
Clear line of site

Radio path with good signal levels, attenuated only by free space loss.



Obstructed Radio Path

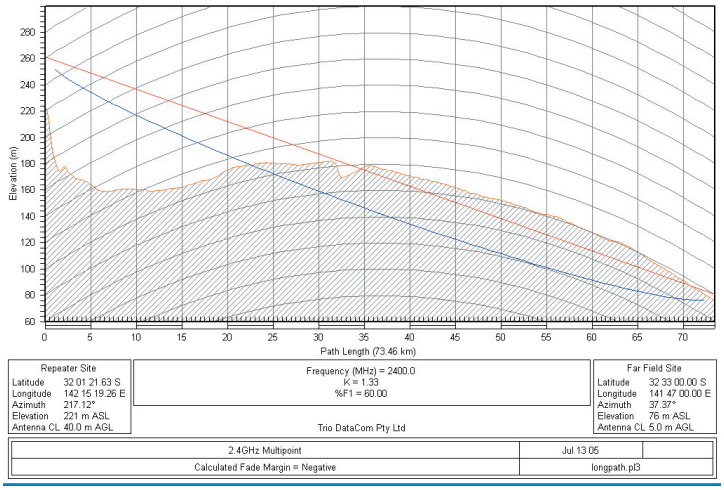
This path has an obstruction that will seriously degrade the signal arriving at the field site.



GOODPATH2400.pl4	Major Repeater Site	Field Site
Elevation (m)	756.69	309.67
Latitude	31 04 37.49 S	30 56 24.00 S
Longitude	150 57 26.34 E	150 38 48.00 E
True azimuth (°)	297.05	117.21
Vertical Angle (°)	-0.94	0.72
Antenna Model	6dB Omni	16dB Grid Reflector
Antenna Height (m)	40.00	5.00
Antenna Gain (dBi)	8.15	18.15
(dBd)	6.00	16.00
TX Line Type	LDF4-50	LDF4-50
TX Line Length (m)	40.00	5.00
TX Line Unit loss (dB /100 m)	6.79	6.79
TX Line loss (dB)	2.72	0.34
Connector loss (dB)	2.00	2.00
Frequency (MHz)	2400.00	
Polarization	Vertical	
Path Length (km)	33.33	
Free Space loss (dB)	130.53	
Diffraction loss (dB)	0.00	
Net Path loss (dB)	111.29	111.29
Radio Model	HR240	HR240
TX power (watts)	1.00	1.00
(dBm)	30.00	30.00
Effective Radiated Power (Watts)	1.34	23.23
(dBm)	31.28	43.66
RX Sensitivity (µv)	1.26	1.26
(dBm)	-105.00	-105.00
RX Signal (µv)	19.28	19.28
(dBm)	-81.29	-81.29
RX Field Strength (µv/m)	1014.39	243.90
Fade Margin (dB)	23.71	23.71
Rayleigh Fade Probability (%)	0.42	0.42
Log Normal Fade Probability (%)	3.88E-03	3.88E-03

Effect of Earth Curvature on Long Paths

This path requires greater mast height to offset the earth curvature experienced at such a distance (73km).



LONGPATH.PL3	Repeater Site	Far Field Site
Elevation (m)	221.26	75.58
Latitude	32 01 21.63 S	32 33 00.00 S
Longitude	142 15 19.26 E	141 47 00.00 E
True azimuth (°)	217.12	37.37
Vertical Angle (°)	-0.37	-0.03
Antenna Model	6dB Omni	15dB Grid Reflector
Antenna Height (m)	40.00	5.00
Antenna Gain (dBi)	8.15	17.15
(dBd)	6.00	15.00
TX Line Type	LDF4-50	LDF4-50
TX Line Length (m)	40.00	5.00
TX Line Unit loss (dB /100 m)	6.79	6.79
TX Line loss (dB)	2.72	0.34
Connector loss (dB)	2.00	2.00
Frequency (MHz)	2400.00	
Polarization	Vertical	
Path Length (km)	73.46	
Free Space loss (dB)	137.39	
Diffraction loss (dB)	34.02	
Net Path loss (dB)	153.18	153.18
Radio Model	HR240	HR240
TX power (watts)	1.00	1.00
(dBm)	30.00	30.00
Effective Radiated Power (Watts)	1.34	18.45
(dBm)	31.28	42.66
RX Sensitivity (µv)	1.26	1.26
(dBm)	-105.00	-105.00
RX Signal (µv)	0.16	0.16
(dBm)	-123.18	-123.18
RX Field Strength (µv/m)	8.16	2.20
Fade Margin (dB)	-18.18	-18.18

Location - Woodland (sigma = 6 dB)

Selecting Antennas

Antennas

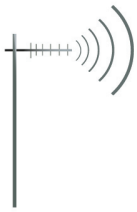
There are basically two types of antennas – omni-directional and directional.

Omnidirectional antennas are designed to radiate signal in a 360 degrees segment around the antenna. Basic short range antennas such as folded dipoles and ground independent whips are used to radiate the signal in a “ball” shaped pattern. High gain omni antennas such as the “co-linear” compress the sphere of energy into the horizontal plane, providing a relatively flat “disc” shaped pattern which goes further because all of the energy is radiated in the horizontal plane.

Directional antennas are designed to concentrate the signal into a “beam” of energy for transmission in a single direction (i.e. for point-to-point or remote to base applications).

Beamwidths vary according to the antenna type, and so can be selected to suit design requirements. The most common directional antenna is the yagi, which offers useable beam widths of 15-40 degrees. Even higher “gain” is available using parabolic “dish” type antennas such as gridpacks.

Onmi directional
360 degree signal



Directional
Concentrated beam

Antenna Gain

By compressing the transmission energy into a disc or beam, the antenna provides more energy (a stronger signal) in that direction, and thus is said to have a performance “gain” over a basic omni antenna. Gain is usually expressed in dBd, which is referenced to a standard folded dipole. Gain can also be expressed in dBi, which is referenced to a theoretical “isotropic” radiator. Either way, if you intend to send and receive signals from a single direction, there is advantage in using a directional antenna - both due to the increased signal in the wanted direction, and the relatively decreased signal in the unwanted direction (i.e. “interference rejection” properties).

Antenna Placement

When mounting the antenna, it is necessary to consider the following criteria:

The mounting structure will need to be solid enough to withstand additional loading on the antenna mount due to extreme wind, ice or snow (and in some cases, large birds).

For omni directional antennas, it is necessary to consider the effect of the mounting structure (tower mast or building) on the radiation pattern. Close in structures, particularly steel structures, can alter the radiation pattern of the antenna. Where possible, omni antennas should always be mounted on the top of the mast or pole to minimise this effect. If this is not possible, mount the antenna on a horizontal outrigger to get it at least 1-2m away from the structure. When mounting on buildings, a small mast or pole (2-4m) can significantly improve the radiation pattern by providing clearance from the building structure.

For directional antennas, it is generally only necessary to consider the structure in relation to the forward radiation pattern of the antenna, unless the structure is metallic, and of a solid nature. In this case it is also prudent to position the antenna as far away from the structure as is practical. With directional antennas, it is also necessary to ensure that the antenna cannot move in such a way that the directional beamwidth will be affected. For long yagi antennas, it is often necessary to install a fibreglass strut to stablilise the antenna under windy conditions.

Alignment of Directional Antennas

This is generally performed by altering the alignment of the antenna whilst measuring the received signal strength. If the signal is weak, it may be necessary to pre-align the antenna using a compass, GPS, visual or map guidance in order to “find” the wanted signal. Yagi antennas have a number of lower gain “lobes” centred around the primary lobe. When aligning for best signal strength, it is important to scan the antenna through at least 90 degrees, to ensure that the centre (strongest) lobe is identified.

When aligning a directional antenna, avoid placing your hands or body in the vicinity of the radiating element or the forward beam pattern, as this will affect the performance of the antenna.

RF Feeders and Protection

The antenna is connected to the radio modem by way of an RF feeder. In choosing the feeder type, one must compromise between the loss caused by the feeder, and the cost, flexibility, and bulk of lower loss feeders. To do this, it is often prudent to perform path analysis first, in order to determine how much “spare” signal can be allowed to be lost in the feeder. The feeder is also a critical part of the lightning protection system.

All elevated antennas may be exposed to induced or direct lightning strikes, and correct grounding of the feeder and mast are an essential part of this process. Gas discharge lightning arresters should also be fitted to all sites.

Note: All ETSI installations require the use of a lightning surge arrestor in order to meet EN6095.

Common Cable Types	Loss per 30.5m @ 915MHz	Loss per 30.5m @ 2.4GHz
RG213/U	7.4dB	23.6dB
FSJ1-50 (¼” superflex)	5.6dB	9.9dB
LDF4-50 (1/2” heliax)	2.2dB	2.3dB
LDF5-50 (7/8” heliax)	1.2dB	3.7dB

TX Power for Maximum EIRP (FCC)

FCC Regulations allow up to 36 dBm effective isotropic radiated power (EIRP). To calculate the maximum transmitter power you need to know the gain of the antenna being used (see the FCC Approved Antenna List Appendix) and the cabling loss. The maximum transmitter power can then be calculated using the following formula:

Maximum transmitter power (dBm) = 36dBm + cable loss (dB) – antenna gain (dBd) - 2.15.

As an example, if we choose the BMY890K yagi from the FCC Approved Antenna List which has a gain of 10dBd and we know the cable loss is 3dB then the maximum output power is:

Maximum output power (dBm) = 36 + 3 -10 - 2.15 = 26.85 dBm.

Rounded down to 26dBm. Therefore the radio TX power should be set to 26dBm.

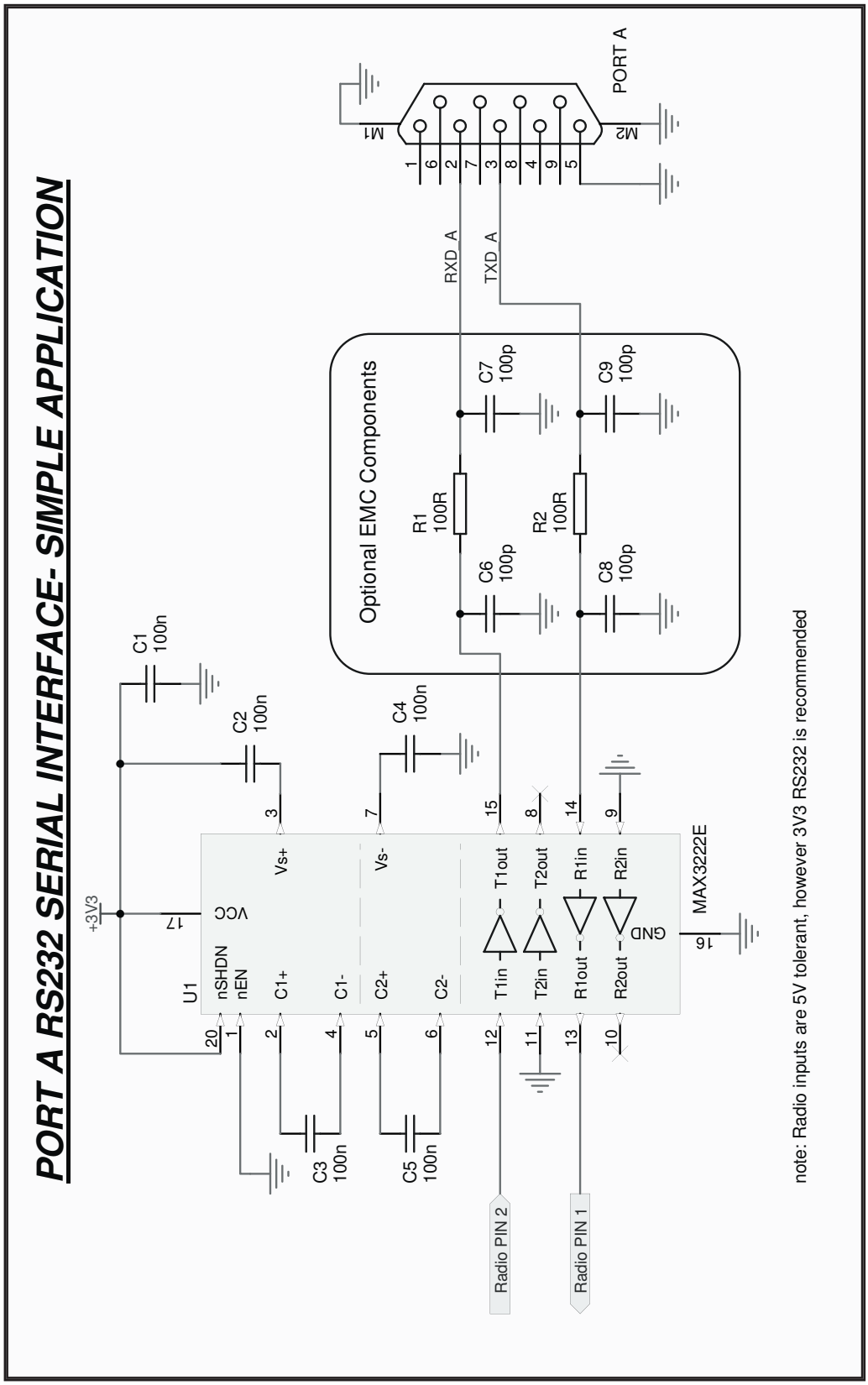
Other countries may have different EIRP limits, but the same method for calculation applies.

FCC Point to Point : More EIRP may be allowed for fixed point to point links. With the transmitter set to 27dBm, an antenna gain (subtracting cable loss) of up to 15 dBi is allowed. For antenna gains of more than 15 dBi in a fixed point to point link, the power must be backed off from 27dBm by 1dB for every 3dB the antenna gain exceeds 15dBi.

ETSI Maximum EIRP for the 2.4GHz band is +20dBm.

Part F – Suggested Interface Circuits

Port A RS232 Serial Interface



Status LEDs Interface