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NMX910 Technical Notes
OEM Interface Guide

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Approvals

Issue	Technical Approval	Project Approval
1.4	Mike Hamilton	Noel Diviney

Record of Issue(s)

Issue	Issued by	Date	Nature of Amendment(s)
1.0	AH	19.05.98	Draft release
1.1	AH	3.07.98	Revised for BBR605 / RF400302
1.2	AH	10.07.98	❑ Signal naming convention changed to improve meaning ❑ Document rearranged to improve readability ❑ LED pins described ❑ Design notes updated
1.3	AH	29.07.98	Added section – Special Notes
1.4	BH	18.11.98	Revised for related Mobitex document references RF Power vs Vrad issues
1.5	BH	12.01.99	Revised For NMX900 Preliminary Issue
1.6	BH	03.05.1999	Marketing Name Change to identify Production Release Added power requirements template Added discussion of Human Exposure to Radiofrequency Electromagnetic Fields

Contents

1 Introduction

The NMX910 Radio Packet Modem provides access to MOBITEX networks using a standard serial communications interface and is designed for integration into OEM type products (the **OEM Device**).

OEM designers are primarily interested in the electrical and functional characteristics of the NMX from a “black-box” frame of reference. To this end, the NMX can be considered as a device with two ports; the **External Interface** and the **Antenna Port**.

The **Antenna Port** provides the RF interface between the NMX radio and an external antenna. The **External Interface** provides all external control signals, data communications and power supply lines to the NMX through a predefined connector at the **OEM Device** (see section 3 below).

When considering the integration of the NMX910 into an OEM design the designer should provide for the following:

- EIA-232 serial communications port 7bit, Even Parity, 1 Stop bit (ie. **TXD**, **RXD**, **DTR** etc.) for the MASC interface.
- Logic power supply (**VLOG**, VLOG)
- Radio power supply (**VRAD**, +6.5V to +7.5V)
- *(Optional)* Power control (**PWR**)
- *(Optional)* Mode control (**MODE**)

This technical brief documents the behaviour and control of the **External Interface** to enable OEM designers to correctly and efficiently interface with the NMX.

The content of this document is valid for Nomadic Communications NMX910 MOBITEX Radio Modem model BBR606/RF900304, firmware versions greater than 1.38

1.1 Scope

- Certification issues, compliance with certain standards etc, are beyond the scope of this document.
- All data in this document was derived from experimental results using a randomly selected NMX910 modem from certified production stock.
- Characteristics should be applied assuming natural variance of product.
- No consideration is given to the operation of the MASC interface with respect to the command language.

2 Special Notes

- Permanent damage can occur to the NMX910 if operated without a properly connected 50-ohm antenna and cable (eg. RG-58). Care should be taken to ensure that the antenna and cable are correctly matched to the NMX910.

- NMX910 must be properly registered with the approved MOBITEX Network Operator in the country of intended operation before use. Care should be taken not to operate an unregistered NMX910.

- When power is applied to the NMX910 power pins it will enter **POWER-OFF MODE** (see section 4 below) waiting to sense a “power on request” via the correct assertion of either the **MODE** or **DTR** pins (see section 3 below).

- When operated for the first time, via the correct assertion of either the **MODE** or **DTR** pin (see section 3 below), the NMX910 may take several minutes as it attempts to become BORN on its registered MOBITEX Network. Once BORN, the NMX910 will automatically enter **MOBITEX BATTERY SAVE MODE** (see section 4 below) and is ready for use. Operation to the EXPRESS MODE is achieved by using the relevant MASC command, or via the external interface input line described in Section 3.

- NMX910 should always be operated as described in this document, special attention should be given to power handling detailed in section 4.1

3 External Interface

The following table outlines the electrical configuration of the NMX910 (Model BBR606-RF900303) at the **External Interface** connector.

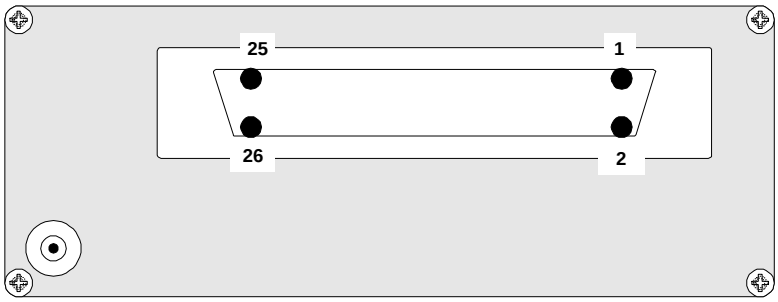
Connector is a 26 pin Molex 52629-2611 to mate with Molex 52660-2611

Pin#	Name	Req'd	Type	Description
1-3	VRAD	Yes[1]	Power	Radio power supply[3]
4-7,18	GND	Yes[1]	Power	Common return[3]
8	VLOG	Yes[1]	Power	Logic power supply
9	MODE	-	Input	Mode change request. The NMX toggles between EXPRESS and BATTERY mode when this pin is held logic high for a minimum of 1000ms
10	MAN-ON	-	Input	Power on/off request. The NMX toggles between POWR-ON and POWER-OFF modes when this pin is held logic high for a minimum of 1500ms.
11-14	NC	-	Output	LED status (LED3 – LED0)
15-17	NC	-	-	Do not connect
19	RI	-	Output	Not internally used[2]
20	DTR	Yes[1]	Input	Power on request. The NMX will enter power-on mode when this pin is driven from low to high (positive edge) in power-off mode.
21	CTS	-	-	Not internally used, follows RTS[2]
22	RXD	Yes[1]	Output	Serial data from NMX
23	RTS	-	-	Not internally used, follows CTS[2]
24	TXD	Yes[1]	Input	Serial data to NMX
25	DSR	-	Output	Not internally used, follows DTR[2]
26	DCD	-	Output	Not internally used, follows DTR[2]

[1] Required to successfully interface to NMX

[2] These signals are provided for EIA-232 compatibility only, the minimum requirement for a serial interface with the NMX is TXD, RXD, DTR and GND.

[3] All pins in these groups should be connected to provide the required current handling capability.



External Interface Connector Pin Outs

Antenna Connector, MCX Female

3.1 LED Configuration

LED signals are driven from TTL compatible output with series 2K resistor. LED driver circuitry must be used if external LED's are required.

Pin#	Name	Description
14	LED0	POWER-ON MODE indicator
13	LED1	Network contact indicator
12	LED2	Transmit indicator
11	LED3	EXPRESS MODE indicator

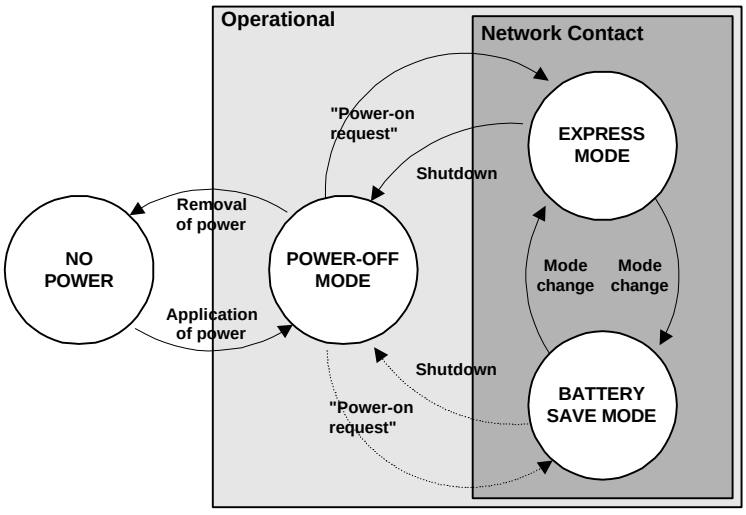
4 Modes of Operation

The NMX910 is a microprocessor controlled, hybrid electronic device with special requirements for power quality and application. The NMX is designed to operate with power applied to the **External Interface** at all times, and provides the ability to power itself on and off under software and hardware control. Because of the nature of radio transmissions, and the MOBITEX network, the NMX needs to be able to control its own powering down to ensure that certain time–critical processes are completed and the system is left in a known state. If possible, OEM designers should provide for this behaviour by powering the NMX from a constant power source, or the same source as the OEM equipment.

IMPORTANT!
Care should be taken not to remove power from the External Interface without properly shutting down the NMX910 via the MASC FO command or asserting the MAN-ON pin. For further information see section "Power Sequencing"

If power is removed from the **External Interface**, without correctly shutting down the NMX, the MOBITEX network and NMX will be left in an unknown state. This state is recoverable, however the sudden loss of power could result in data loss or data corruption. This section outlines the procedures necessary to properly power and control the NMX910.

The following diagram outlines the relationship between the three power modes and the mechanisms for changing between them.



The NMX operates in one of three distinct power modes while power is applied to the **External Interface**; **POWER-OFF MODE**, **BATTERY SAVE MODE** and **EXPRESS MODE**. To provide control over the operational state, and power consumption of the NMX, the OEM can change between these modes by issuing certain MASC commands and/or electrically activating one of three input pins; **MODE**, **MAN-ON** and **DTR** on the **External Interface**.

- **POWER-OFF MODE** – this mode is selected when the NMX is not required to communicate with the MOBITEX network to send and/or receive messages, or the NMX is to have its power disconnected. Power consumption is reduced to a minimum in this mode by switching off most internal devices, including the microprocessor and MASC interface. The NMX is waiting to sense a "power on request" via the correct assertion of either the **MODE** or **DTR** pin (see section 3 above). Either of these two events will cause the NMX to enter its last known operational state (ie. either **EXPRESS** or **BATTERY SAVE MODE**, whichever mode was active when **POWER-OFF MODE** was entered.)

- **EXPRESS MODE** – in this mode the NMX is fully operational and can communicate with the MASC interface. Radio conditions permitting, the NMX will logon and register with the MOBITEX network and is able to send and/or receive messages. The NMX will enter **BATTERY SAVE MODE** when either the **MODE** pin is correctly asserted (see section 3 above) or the MASC FY command is issued. Alternatively, the NMX will return to **POWER-OFF MODE** by correctly asserting the **MAN-ON** pin or issuing the MASC FO command. This is the factory default operational mode for the NMX910.

- **BATTERY SAVE MODE** - this mode is functionally similar to **EXPRESS MODE** except that the Radio Module runs on a 10% duty cycle to reduce the average power consumption.

4.1 Application of power

Electrical power must be applied to the NMX via the **VRAD** and **VLOG** pins of the **External Interface**. The NMX will power-up, run internal diagnostics and then enter **POWER-OFF MODE**. The designer should allow at least 2 seconds between the application of power and the first attempt to communicate with the NMX to change out of **POWER-OFF MODE**.

4.2 Network Contact

Once power has been applied according to Section 3.1 the NMX can be brought into Network Contact (ie. either **EXPRESS** or **BATTERY MODE**) using one of the following "power on request" mechanisms:

1. **MAN-ON** pin is asserted for at least 1500ms *OR*

2. **DTR** pin is toggled from low to high

The NMX will issue a MASC B frame to initialise the MASC interface, and begin MOBITEX network roaming and logon. From this point on the MASC interface is active and controls the behaviour of the NMX.

NOTE: Application of MAN-ON for duration less than 1000ms will initiate internal diagnostics and return to POWER-OFF MODE.

4.3 Mode Change

The NMX can toggle between **EXPRESS MODE** and **BATTERY SAVE MODE** while in network contact using one of the following mechanisms:

1. **MODE** pin is asserted for at least 1000ms *OR*

2. MASC FY command is issued.

The NMX will contact the network to toggle modes, this operation involves packet transmission and can take up to two seconds.

4.4 Shutdown

The NMX can be placed back into **POWER-OFF MODE** using one of the following “power off request” mechanisms:

1. **MAN-ON** pin is asserted for at least 1500ms *OR*

2. MASC FO command is issued.

The NMX will terminate MOBITEX network activities, logoff the network, issue the MASC FO reply and shut down power to internal devices to enter **POWER-OFF MODE**. The NMX can toggle between **EXPRESS/BATTERY SAVE MODE** and **POWER-OFF MODE** by repeating sections 4.2 and 4.3.

4.5 Removal of power

The NMX controls the internal distribution of power from the VRAD and VLOG pins using digitally controllable switches and regulators. While there is no mechanism for completely disconnecting power from the NMX without externally removing the power source from the interface, the NMX can enter a very low power state (**POWER-OFF MODE**) under direct control. It is preferable to use this low power mode rather than disconnecting power from the **External Interface**.

If power must be removed from the **External Interface** the following procedure should be followed to ensure data integrity and network compatibility:

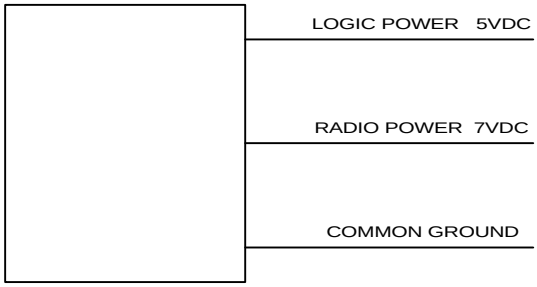
1. Shut down NMX via the MASC FO command or by asserting the **MAN-ON** pin for at least 1500ms according to section 4.4

2. Wait for MASC FO response from the NMX to indicate that it has shut down.

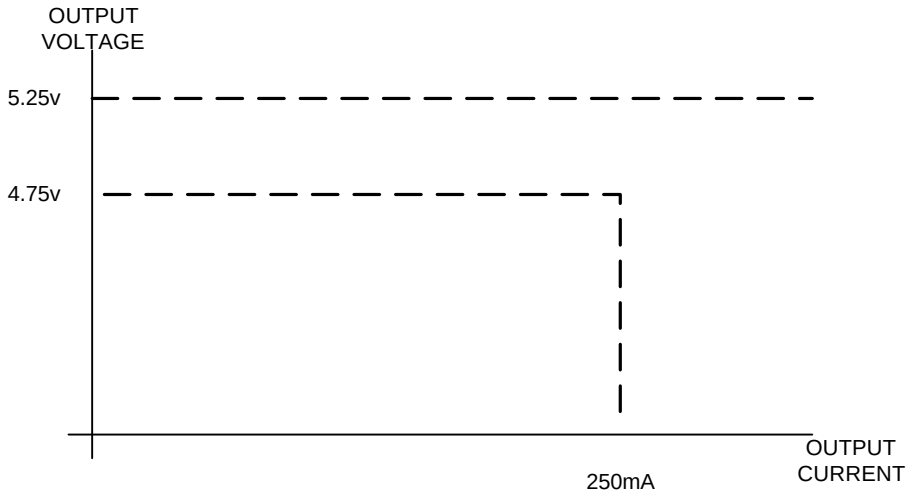
3. Remove electrical power from the interface

Following this procedure will ensure that the network is properly notified and no data loss or data corruption can occur.

5 NMX910 RECOMMENDED POWER SUPPLY REQUIREMENTS

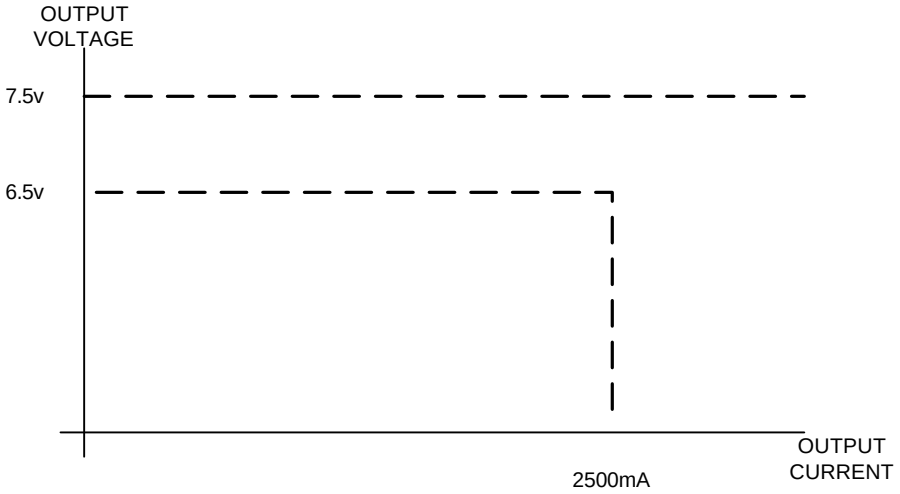


The logic power supply should meet the following output requirements:-



The output voltage must stay within these limits for any transient load change greater than 10uS.

The radio power supply should meet the following requirements



The output voltage must stay within these limits for any transient load change greater than 10uS.

6 Human Exposure to Radiofrequency Electromagnetic Fields

The FCC has set limits for the safe exposure to RF emissions due to wireless transmitters. The FCC guidelines differentiate between classes of transmitting devices according to their proximity to exposed persons. Compliance with the FCC guidelines must be demonstrated at a system level, and depends on factors such as antenna design gain and position, transmission profile (duty cycle and packet size), proximity to operators and proximity to general population and uncontrolled conditions.

Generally, if the completed system is hand held, or body worn, or is capable of being operated in theses modes, then RF evaluation must be based on the specific absorption rate (SAR). SAR testing must be done by a certified laboratory, and involves the measurement of field strengths within human body models and liquids with similar characteristics to human tissue.

If it is not possible for the final system to be used handheld, or body worn, and the antenna will, by design, be located more than 20 cm from human bodies, then human exposure to RF emissions may be evaluated with respect to Maximum Permissible Exposure limits. MPE can be evaluated by calculation, taking into account transmitter power, transmission duty cycle and packet size, antenna characteristics and minimum distance from antenna to possible human exposure.

The MPE limits for General Population/Uncontrolled exposure are frequency related, and for a Mobitex modem operating in the 900 MHz band, the limit is 0.6 mW/cm^2 averaged over 30 minutes. The following example calculates MPE for an application that is required to transmit 200 x 200 byte packets over an 8 hour period. Included in the calculation is the system service transmissions required on the Mobitex network (Ack packet and Access Request).

		Unit
Output Power	2.5	W
Distance	20	cm
Antenna Aperature Factor	1.46	
Tx Preamble	15	ms
Tx Data Rate	8000	bps
Packet Overhead	19	Bytes
Packet Size	200	Bytes
Ack Packet (Downlink)	55	ms
Access Request (Uplink)	55	ms
Number of Packets per day (8 hrs)	200	
Field Intensity at stated distance at point of maximum power	7.261E-01	mw/cm2
Tx Time	344	ms
Total Tx over 1 day	68800	ms
Average Exposure over 30 minutes	0.0520404	mw/cm^2/30min

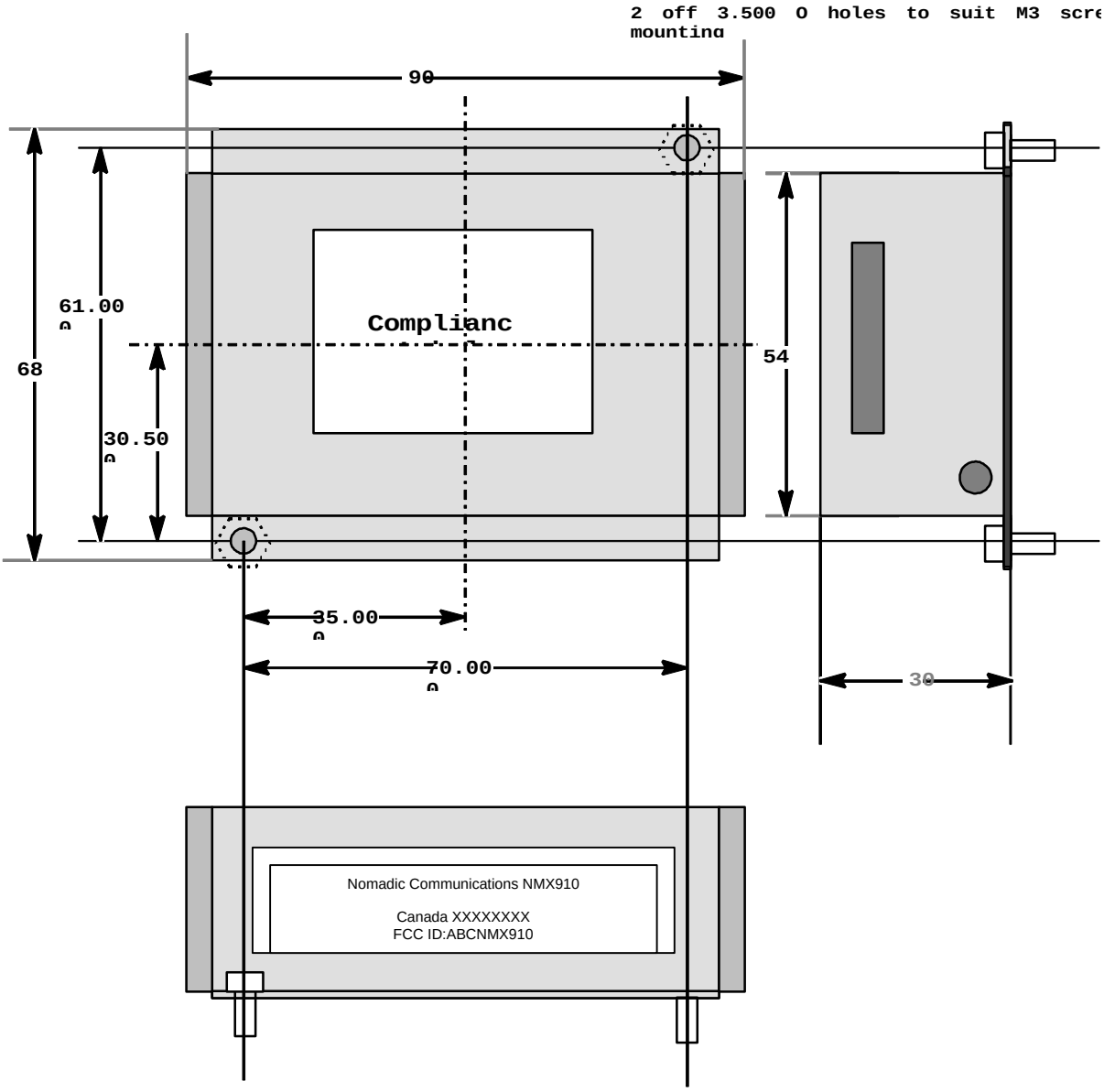
A full discussion of Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields is published by the FCC in OET Bulletin 65 and supplements. These documents are available from the FCC www site http://www.fcc.gov/oet .

7 Housing Dimensions

The OEM designer should ensure that:

1. There is sufficient space around the case to achieve required ventilation.
2. Adequate space is allowed for the fitting and removal of external connectors.

All Dimensions in Millimetres



8 Technical Specifications

Disclaimer

Any and all specifications are subject to change by Nomadic Communications Pty Ltd without notice except to the appropriate spectrum management authorities. The information in this specification is deemed reliable at the time of printing. Nomadic Communications does not assume responsibility for any errors that may appear in this specification nor any omissions that may have occurred at the time of printing. Interested parties must therefore reply on their own enquires. Nomadic Communications does not assume liability arising from the application or use of any information contained in this document or the product referred to by this document. Mobitex® is a registered trademark of Telia AB, Sweden.

Overview

The NMX910 is a 900MHz Mobitex® Radio Packet Modem designed for integration into third party OEM equipment. The NMX910 consists of two small PCB's connected via a flexible printed circuit and housed in an EMI shielded enclosure with MCX antenna connector and single power and data connector. Integration of the NMX910 into existing and new designs is simplified by the use of a single 26-pin Molex® connector for data, control and power.

Key Features

- Compatible with 900MHz Mobitex® networks in USA, Canada and South Korea.
- Low power consumption for prolonged battery life.
- Flexible packaging configurations with optional connector styles and casing options.
- Certified MIS conformance (excluding voice features)
- Rugged design suited to handheld, mobile and fixed base installations.
- 2W nominal power transmitter for effective indoor and fringe area use.
- Four-level automatic attenuation for matched transmission performance in strong signal strength conditions.
- Ability to sustain maximum transmission power output over the useable supply voltage range and operating temperature range.
- High tolerance to EMI produced by close proximity electronics, or coupled through signalling interface.
- Special composite plastic components with better than 90dB EMI shielding.

Approvals

Mobitex® compliant to MOA corrigendum issue 4

Radio Transceiver Specification

General	Dual conversion receiver, directly modulated transmitter utilising common antenna and solid state transmit/receive RF switch.
Modulation Technique	NRZ GMSK (BT=0.3)
Transmitter Frequency Range	895 – 905 MHz (800 channels)
Receive Frequency Range	931 – 941 MHz (800 channels)
Channel Spacing	12.5 kHz
Frequency Accuracy	±1.2 kHz over full operating temperature range
Receiver Sensitivity	-114 dBm (1 kHz @ +/- 1.5 kHz deviation over 0.3 to 3.4 kHz bandwidth)
	-116 dBm (1 kHz @ +/- 2 kHz deviation over 0.3 to 3.4 kHz bandwidth)
Transmitter Power (typical)	2 W @ 6.5 – 7.5 VDC into matched 50Ω antenna load at 20°C
Transmitter Power Control	4 level transmit power control (0, -6dB, -12dB and –18dB)
Antenna Cable Connector	MCX Female

Environmental Specification

Operating Temperature	-10°C to +50°C
Storage Temperature	-35°C to +80°C
Cooling Method	Convection and thermal conduction of an enclosed environment
Operating Humidity	5% to 95% non-condensing relative humidity at +50°C for at least 8 hours

Physical Specification

Overall dimensions	89mm x 68mm x 29.5mm (standard enclosure)
Weight	138g including standard enclosure
Mounting Method	Fastened though holes (M3 at 2 positions)
Housing	Conductive “Alodyne” aluminium body with metal impregnated end-caps
Grounding	Continuous-edge direct coupling with standard enclosure

Logic Power Requirements

Supply Voltage	Regulated 5VDC ±5%
Supply Ripple	Less than 50mV rms
Express and Battery Mode	410mW (typical) @ 5.0VDC
Power-off Mode	225mW (typical) @ 5.0VDC

Radio Power Requirements

Supply Voltage	7.0 VDC (6.5 – 7.5 VDC typical)
Supply Ripple	Less than 35mV rms
All modes – Transmitting high power	7800 mW (typical) @ 7.0 VDC into matched 50Ω antenna at 20°C
Express Mode – Receiving	510 mW (typical) @ 7.0 VDC into matched 50Ω antenna at 20°C
Battery Saving Mode – Receiving	260 mW (typical) @ 7.0 VDC into matched 50Ω antenna at 20°C

Device Interface

Connector	26 pin Molex 52629-2611 to mate with Molex 52660-2611
Data link protocol	Mobitex® Asynchronous Communications Protocol (MASC1)
Data port	RS-232 9-wire interface
Data rate	1200 – 9600bps, 7Bits Even Parity, 1 Stop Bit