

# Application Note: Antenna Installation Understanding 4G/3G Signal Data



## Introduction

For cellular M2M devices to work reliably, it is important to ensure that the connection to the cellular network is optimised, some factors to consider when judging signal conditions are:

Factor to Consider	Why
Signal Strength – RSSI for 3G and RSRP for 4G	Strength of Signal
Signal Quality – EC/n0 for 3G and RSRQ for 4G	Quality of Signal is as important as the strength
No. of Cells Available	The availability of multiple cells provides possible alternatives should failure or maintenance activity cause a cell to be unavailable

## Acceptable Signal Strength and Quality

4G/LTE RSRP	3G/UMTS RSCP	Description
< -120	< -95	Very Poor
-120 to -110	-95 to -85	Poor
-110 to -100	-85 to -75	Acceptable
-100 to -90	-75 to -60	Good
>-90	>-60	Excellent

4G/LTE RSRQ	3G/UMTS EC/n0	Description
< -18	< -10	Poor
-18 to -13	-10 to -8	Acceptable
-13 to -8	-8 to -6	Good
>-8	>-6	Excellent

The above values can be attained by issuing the AT^SMONI command to any MTX device. Note that if using MTX Tunnel firmware the serial port may not be available for AT command interface, we suggest using the USB port (drivers required) for this purpose.

If drivers are required for the USB port, go to

<https://australism2m.com.au/wp-content/uploads/2018/09/ELS61-drivers.zip>

or contact [support@australism2m.com.au](mailto:support@australism2m.com.au).

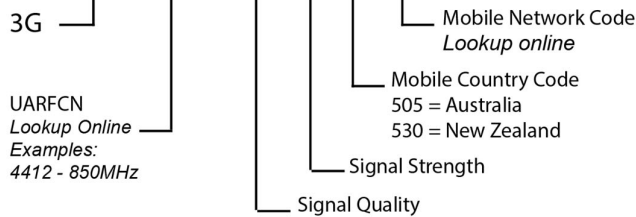
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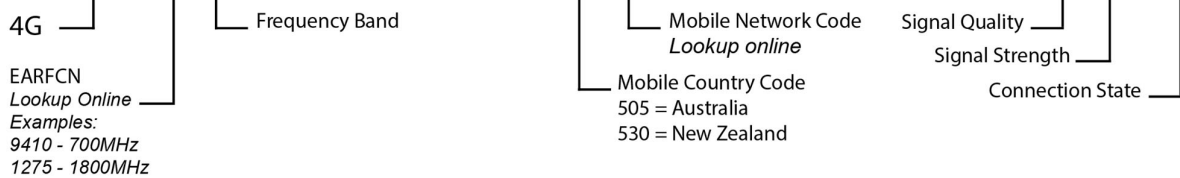


### AT^SMONI Responses

^SMONI: ACT,UARFCN,PSC,EC/n0,RSCP,MCC,MNC,LAC,cell,SQual,SRxLev,CSGid,TransportCh, SF,Slot,EC/n0,RSCP,ComMod,HSUPA,HSDPA



^SMONI: ACT,EARFCN,Band,DL bandwidth,UL bandwidth,Mode,MCC,MNC,TAC,Global Cell ID,Physical Cell ID,TX\_power,RSRP,RSRQ,Conn\_state



The figure above provides a key to some of the most important information relating to signal strength and quality as well as indicating what information EARFCN etc might be used to lookup more information on the current connection.

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### Other Commands that May be Useful

These commands can only be accessed via the USB ports, or secondary serial port if MTX Tunnel firmware is installed in the unit.

AT Command	Usage	Typical Format
AT+SMONP	See neighbour cells, note that you only see cells for the current operator and technology (3G or 4G)	4G: EARFCN1,RSRQ1,RSRP1,Srxlev1,PCI1,RSSI1 EARFCN2,RSRQ2,RSRP2,Srxlev2,PCI2,RSSI2 ... EARFCNn,RSRQn,RSRPn,Srxlevn,PCIn,RSSIn  OK
AT+CREG?	Network Registration Status	+CREG: <mode>,<regStatus>  OK <i>0 Not registered, ME is currently not searching for new operator</i> <i>1 Registered to home network</i> <i>2 Not registered, but ME is currently searching for a new operator.</i> <i>3 Registration denied</i> <i>4 Unknown (not used)</i> <i>5 Registered, roaming</i>
AT+COPS?	Operator Selection Shows currently selected operator	+COPS:<mode>[, <format>[, <opName>][, <AcT>]] OK <i>opName: Operator Name (eg Telstra, Optus, Vodafone)</i> <i>AcT: Radio access technology</i> <i>7 is 4G</i> <i>2 is 3G</i>
AT+COPS=?	Lists operators that the device can see (though it may not be able to connect to depending on SIM setup/roaming agreements)	+COPS: [list of supported (<opStatus>, long alphanumeric <opName>, short alphanumeric <opName>, numeric <opName>, <AcT>)s ] OK

### Key Factors to Consider when Mounting an Antenna

Factor to Consider	Notes
Location	Antennas should ideally be located outside any metal or dense walled (concrete, brick, rock etc.) enclosure, if possible place close to or outside a window or opening.  Higher up in/or on a building is preferable to lower levels such as basements.
Do not mount next to metal	Do not mount parallel to a metal structure, note that a concrete wall may metal reinforcing.  As a minimum place at least ¼ wavelength from any parallel structure and ideally > 1 wavelength.  For 700MHz (the worst case) this would be: Minimum 110mm, ideally > 430mm

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<p>Consider ground plane requirements</p>	<p>Refer antenna datasheets to determine which antennas are ground plane dependant or independent. A ground plane dependant antenna requires a suitable ground plane to achieve optimum performance.</p> <p>Any ground plane should be at the highest point of the structure and be at least <math>\frac{1}{4}</math> wavelength in diameter.</p> <p>For 700MHz (worst case) the ground plane should be at least 110mm in diameter.</p> <p>In a plastic enclosure a foil tape may serve as a ground plane.</p>
<p>Minimise antenna cable length</p>	<p>Antenna cable attenuates the RF signal and as such, the use of a long cable to move an antenna from a poor location to a better one may be outweighed by the cable loss.</p> <p>For example, good quality RG58 cable has a loss of approximately 0.5db per metre at 700MHz</p> <p>In some cases, it may be better to extend IO, serial or ethernet and power cables to the cellular device rather than to run a long antenna cable.</p>
<p>Placement/Spacing for Secondary or Diversity Antenna</p>	<p>MTX 4G Modems and Routers have a Main/primary and a secondary/diversity antenna, the main antenna should always be connected, and we recommend connecting the diversity antenna for optimal performance.</p> <p>Typical recommendations suggest, that the diversity antenna be placed so that it is at a distance from the main antenna, that would place it at a location that might be advantageous compared to the main antenna in relation to the signal waveform. In reality, signal reflections, and other site conditions, are likely to make the situation much more complex.</p> <p>Recommended separations of <math>\frac{1}{4}</math>, <math>\frac{1}{2}</math> or multiples of <math>\frac{1}{2}</math> wavelength, will change depending on the network frequency.</p> <p>Our recommendation is to ensure the antennas are &gt; 110mm (&gt;<math>\frac{1}{4}</math> wavelength at 700MHz) at a minimum and preferably &gt; 430mm (&gt;1 wavelength at 700MHz) apart, and to use signal data from the unit to determine final antenna positions when onsite.</p>

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### Important Mobile Bands Used in Australia

Service	Band	Frequency Band MHz	Network(s)	Uplink (MHz)	Downlink (MHz)	Supported by MTX-AUS Devices
3G	5	850	Telstra	824-849	869-894	Yes
3G	8	900	Optus, Vodafone	880-915	925-960	Yes
3G	1	2100	Telstra, Optus, Vodafone	1920-1980	2110-2170	Yes
4G	28	700	Telstra, Optus	703-748	758-803	Yes
4G	5	850	Vodafone	824-849	869-894	Yes
4G	3	1800	Telstra, Optus, Vodafone	1710-1785	1805-1880	Yes
4G	1	2100	Telstra, Optus, Vodafone	1920-1980	2110-2170	No
4G	40	2300	Optus	2300-2400	2300-2400	No
4G	7	2600	Telstra, Optus	2500-2570	2620-2690	No