5G NR requires new measurement techniques

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MS2090A Field Master Pro
MS2090A Field Master Pro Introduction

RF OTA Measurements required by 5G Mobile Network I&M

The first “Anritsu band” band covers FR1 and FR2 … the 2

nd up to 170 GHz …
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Target Markets

- Interference hunting and spectrum clearing networks
- Broadcast transmitter analysis
- Microwave radio links
- Spectrum & Satellite system monitoring (VISION compatible)
- 5G NR base station measurement
- 5G coverage mapping
MS2090A Field Master Pro Introduction

Frequency Models with NO GAP nor MISSES

- Ruggedized connectors protected by durable rubber overmold

<table>
<thead>
<tr>
<th>Model</th>
<th>Frequency Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS2090A-0009</td>
<td>9 GHz</td>
</tr>
<tr>
<td>MS2090A-0014</td>
<td>14 GHz</td>
</tr>
<tr>
<td>MS2090A-0020</td>
<td>20 GHz</td>
</tr>
<tr>
<td>MS2090A-0026</td>
<td>26.5 GHz</td>
</tr>
<tr>
<td>MS2090A-0032</td>
<td>32 GHz</td>
</tr>
<tr>
<td>MS2090A-0044</td>
<td>44 GHz</td>
</tr>
<tr>
<td>MS2090A-0054</td>
<td>54 GHz</td>
</tr>
</tbody>
</table>

9 kHz  10 GHz  20 GHz  30 GHz  40 GHz  50 GHz  60 GHz
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Ruggedized for extreme field use

- Rolled steel case
- Extremely solid mineral glass screen
- Real LINUX OS
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New intuitive GUI

- Multi-touch with GUI developed to Google touchscreen standard guidelines
- Pinch to zoom and expand
- Finger swipe to scan across frequency range
- Drag markers, limit lines and spectrum emission masks left and right
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Important to know - Connectivity – Hot Spot

Connectivity via
- LAN
- Hot Spot
- WiFi Access Point
- Bluetooth
- USB 3.0
- PCIe

MS2090A
Laptop PC (in Hot Spot Mode)
MS2090A Field Master Pro Introduction

Spectrum & Spectrogram with marker functionality in both domains
# MS2090A Field Master Pro Introduction

## MS2090A vs MS2720T

<table>
<thead>
<tr>
<th>Specifications</th>
<th>--</th>
<th>--</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analysis BW</td>
<td>Up to 100 MHz</td>
<td>20 MHz</td>
</tr>
<tr>
<td>Demods</td>
<td>5G, LTE-A (FDD, TDD)</td>
<td>TD-LTE, FD-LTE, GSM, other legacy</td>
</tr>
<tr>
<td>Smart measurements</td>
<td>CP, OBW, ACP, SEM</td>
<td>Field strength, channel power, OBW, ACP, emission mask, spurious, C/I, AM/FM demodulation, PIM alert</td>
</tr>
<tr>
<td>Options</td>
<td>RTSA</td>
<td>Interference analyzer, coverage mapping, EMF, NB-IoT, Neon signal mapper</td>
</tr>
<tr>
<td>Other</td>
<td>Touchscreen, ruggedized housing, WiFi / Bluetooth</td>
<td>Master software tools, sensors</td>
</tr>
<tr>
<td>Price</td>
<td>More</td>
<td>Less</td>
</tr>
</tbody>
</table>
MS2090A RTSA Operation Mode

100 MHz RTSA Capability

- 20, 50 and 100 (110) MHz HW RTSA BW
  - Wider analysis range
  - Leading Probability of Intercept on HH SPA [2 µs]
  - Lowest min detectable signal [5 ns]
  - Acquisition time between 50 ms till 5 s

- Persistence and spectrum displays to identify and track intermittent or pulsed signals

- Zero operation SPAN operation in SPA, as well as in RTSA mode
  - Zero SPAN sweep range 60 ns till 60 s
  - Zero SPAN resolution 10 ns
  - Largest Zero SPAN and RTSA RBW of 40 MHz

- FFT rate of 263,000 FFT/s (high res.) or 526,000 FFT/s (normal res.)
MS2090A RTSA Operation Mode

RTSA Example – BLUETOOTH
RF OTA Measurements
5G Mobile Wireless Technology

RF OTA Measurements required by 5G Mobile Network I&M

- RF OTA measurements
  - MS2090A Field Master Pro and
  - MS2760A Spectrum Master Ultraportable Spectrum

- Typical Measurements
  - Channel Power,
  - OccBw
  - SEM,
  - EIRP measurements
  - Modulation Quality
  - Antenna Beam qualification
  - Reference Symbol measurements
5G Mobile Wireless Technology

Carrier Frequency $3 \text{ GHz} < f \leq 6 \text{ GHz}$ with SCS 30 kHz

<table>
<thead>
<tr>
<th>Frequency</th>
<th>SCS of SSB</th>
<th>$L$ (# beams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$&lt; 3 \text{ GHz}$</td>
<td>15/30</td>
<td>4</td>
</tr>
<tr>
<td>3 to 6 GHz</td>
<td>15/30</td>
<td>8</td>
</tr>
<tr>
<td>$&gt; 6 \text{ GHz}$</td>
<td>120</td>
<td>16</td>
</tr>
<tr>
<td>$&gt; 6 \text{ GHz}$</td>
<td>240</td>
<td>64</td>
</tr>
</tbody>
</table>

Example

- $L = 8$ (# beams)
- Symbol Index set = \{4,8,16,20,32,36,44,48\}

SS Burst is a set of SS blocks (SS/PBCH block) in a half sub-frame and repeated initially every 20 ms
5G Mobile Wireless Technology

Parameter SSB-SubcarrierOffset

SSB-Offset

- Manual operation
- Automatic search function
- PCI search function

SSB Frequency Location in NSA and SA is different

Tells the starting RB location in frequency domain
5G Mobile Wireless Technology

Parameter SSB-SubcarrierOffset

- NR-ARFCN
  - New Radio Absolute Radio Frequency Channel Number
- GSCN
  - Global Synchronization Raster Channel
5G OTA Synchronization

Beam Measurements
5G OTA Synchronization Beam Measurements

Beam Detection using Primary Synchronisation Signal (PSS) demodulation

- The UE identifies the SSB within the SS Burst by using:
  - part of the time index carried by the PBCH DMRS
  - and finally selecting best SSB and beam therewith

- MS290A is measuring PSS power and sequence
5G OTA Synchronization Beam Measurements

Example – Sub 6 GHz GoB and EIRP of a real 5G NR cell
5G OTA Synchronization Beam Measurements

Measurement Point 3 – very pronounced beam
5G OTA Synchronization Beam Measurements

Measurement Point 2 – heavy traffic in cell

- EIRP:
  - Frequency: 3.593565000 GHz
  - EIRP: 34.47 dBm
  - Maximum Hold EIRP: 36.00 dBm

- Gated Sweep ON

- Input Parameters:
  - Gate Delay: 0.00 ms
  - Center Freq: 3.655050000 GHz
  - RX Antenna Gain: 6 dB
  - Path Loss: 94.61 dB
  - Gate Length: 20.00 ms
  - Channel BW: 80 MHz
  - RX Cable Loss: 0 dB
  - Distance: 351 m
5G OTA Synchronization Beam Measurements

Example – GoB 28 GHz mm-wave TRP
5G OTA Synchronization Beam Measurements

Example – Beam dominance at position 1 2 3

FR 2 max #beams 64 - sweep in two dimensions (horizontal and vertical directions)
IQ Capture & Replay
5G OTA Synchronization Beam Measurements

IQ Capturing Feature – e.g. for verification of SSB bursts

IQ_2019-Jun-24-1328-03_573759937ns_3500010000_122880000

Spectrogram

Density Spectrum

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5G NR requires new measurement techniques
5G OTA Synchronization Beam Measurements

IQ Capture & Replay

- Stream IQ data or IQ data block transfer up to 110 MHz via commodity interfaces
  - GBitLAN
  - USB 3.0
- Stream IQ data form RTSA application via PCIe Express interface into 3’rd party sinal analysis hard- and software
  - Bird Technologies
    - IQC5000B Dual-channel RF Record & Playback System
    - Spectro-X Signal Analysis Toolkit
5G beam based in- and outdoor Coverage Mapping
5G Coverage Mapping

MS2090A together with MA8100A TRX NEON Signal Tracker
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NEON Signal Tracker menu structure