Product Introduction

P25-Phase 2 Tx Test Solution

MS2830A
Signal Analyzer
P25-Phase 2
Tx Test Solution

P25 Phase 2 Technical Specifications
Physical Layer Protocol Specification
TIA-102.BBAB (Jul 2009)
Transceiver Performance Recommendations
TIA-102.CCBA (Oct 2011)
Transceiver Measurement Methods
TIA-102.CCAA-A (May 2011)

Note: For details, refer to the TIA-102 standard.

Version 3.00
Oct. 2014
Anritsu Corporation
**[Anritsu] P25-Phase 2 Tx Test Solution**

**Tx Evaluation**

*Multi-functions supported with one unit!*

**Unit, Module**

MS2830A
- Signal Analyzer

- **Output in Test Mode**

**MX269017A**
- Vector Modulation Analysis Software

**MX269018A**
- Analog Modulation Analysis Software

**Spectrum Analyzer**

**Frequency Counter**

**Modulation Analyzer (MX269017A)**

**FM Demodulator (MX269018A)**
### TIA-102 Transmitter test items

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<th>Signal Analyzer</th>
<th>Other</th>
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<td>CCAB</td>
<td>CCAA</td>
<td>MS2830A</td>
<td></td>
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<td>3.2.1</td>
<td>2.2.1</td>
<td>RF Output Power</td>
<td>✓</td>
</tr>
<tr>
<td>3.2.2</td>
<td>2.2.2</td>
<td>Operating Frequency Accuracy</td>
<td>✓²</td>
</tr>
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<td>✓</td>
</tr>
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<td>2.2.4</td>
<td>Acoustic Audio Performance</td>
<td>✓</td>
</tr>
<tr>
<td>3.2.5</td>
<td>2.2.5</td>
<td>Modulation Emission Spectrum</td>
<td>✓</td>
</tr>
<tr>
<td>3.2.6</td>
<td>2.2.6</td>
<td>Unwanted Emission: Radiated Spurious</td>
<td>Under investigation</td>
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<td>2.2.7</td>
<td>Unwanted Emission: Conducted Spurious</td>
<td>Under investigation</td>
</tr>
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<td>3.2.8</td>
<td>2.2.8</td>
<td>Unwanted Emission: Adjacent Channel Power Ratio</td>
<td>✓ or ✓¹</td>
</tr>
<tr>
<td>3.2.9</td>
<td>2.2.9</td>
<td>Intermodulation Attenuation (Base Station only)</td>
<td>✓</td>
</tr>
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<td>3.2.10</td>
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<td>✓</td>
</tr>
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<td>2.2.11</td>
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<td>✓</td>
</tr>
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<td>3.2.12</td>
<td>2.2.12</td>
<td>Frequency Deviation for H-CPM</td>
<td>✓²</td>
</tr>
<tr>
<td>3.2.13</td>
<td>2.2.13</td>
<td>Modulation Fidelity</td>
<td>Ongoing development</td>
</tr>
<tr>
<td>3.2.14</td>
<td>2.2.14</td>
<td>Symbol Rate Accuracy</td>
<td>✓²</td>
</tr>
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<td>3.2.15</td>
<td>2.2.15</td>
<td>H-CPM Transmitter Logical Channel Peak Adjacent Channel Power Ratio (IB only)</td>
<td>✓¹</td>
</tr>
<tr>
<td>3.2.16</td>
<td>2.2.16</td>
<td>H-CPM Transmitter Logical Channel Off Slot Power (IB only)</td>
<td>✓¹</td>
</tr>
<tr>
<td>3.2.17</td>
<td>2.2.17</td>
<td>H-CPM Transmitter Logical Channel Power Envelope (IB only)</td>
<td>✓³</td>
</tr>
<tr>
<td>3.2.18</td>
<td>2.2.18</td>
<td>H-CPM Transmitter Logical Channel Time Alignment (IB only)</td>
<td>Under investigation</td>
</tr>
</tbody>
</table>

1. Requires MS2830A-006 Analysis Bandwidth 10 MHz for Frequency vs. Time function
2. Requires MX269018A Analog Measurement Software with A0086A USB Audio
3. Requires MX269017A Vector Modulation Analysis Software with MS2830A-006

**Note:** For details, refer to the TIA-102 standard.
Transmitter Performance Measurement Methods

RF Output Power

Measures transmitter output power

Limits: (≤+20%: Specified by manufacturer)
Limits: (≤10 W for mobile or portable radios intended for public safety airborne application)

Limits: for FCC part 27.50-b (775-776/805-806 MHz) and part 90.541 (769-775/799-805 MHz)

<table>
<thead>
<tr>
<th>Station Type</th>
<th>Maximum output power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile, and Control</td>
<td>30 Watts</td>
</tr>
<tr>
<td>Portable (handheld)</td>
<td>3 Watts</td>
</tr>
</tbody>
</table>

Note: For details, refer to the TIA-102 standard.

- Measure the transmitter output power during the defined duty cycle (see CCAA 1.5.2)
- The power is measured using a gated power measurement over a 24 ms duration centered over the center of the transmit on time slot intervals.
Transmitter Performance Measurement Methods

RF Output Power

Measures transmitter output power

Burst Average Power Function [pre-installed]

Power vs. Time [Opt-006]
Burst Average Power Function

Note: For details, refer to the TIA-102 standard.
Transmitter Performance Measurement Methods

Operating Frequency Accuracy

Measures frequency of transmitter
Calculate the ppm frequency error.

Limit:

1. When AFC locked to base station
2. When AFC not locked to base station
3. Requires "External Reference Clock" or "High Stability Reference Oscillator (Opt.002)"

Example: AFC Disable

<table>
<thead>
<tr>
<th>Assigned Frequency [MHz]</th>
<th>Frequency Departure [ppm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mobile and Portable</td>
</tr>
<tr>
<td>Below 100</td>
<td>5.0</td>
</tr>
<tr>
<td>From 138 to 174</td>
<td>2.5</td>
</tr>
<tr>
<td>From 406 to 512</td>
<td>2.0</td>
</tr>
<tr>
<td>From 769 to 806</td>
<td>0.4 ¹,³/1.5 ²</td>
</tr>
<tr>
<td>From 806 to 869</td>
<td>1.5</td>
</tr>
<tr>
<td>From 896 to 941</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Note: For details, refer to the TIA-102 standard.

Example: RF Frequency

- 155.050 004 41 MHz
- 0.000 004 41 MHz
- 0.028426 ppm
- RF Power -9.79 dBm / 104.9 μW

MX269018A
Analog Modulation Analysis Software
Transmitter Performance Measurement Methods

Modulation Emission Spectrum

Measures spectrum of emitted modulation signal

Limits: FCC standard mandatory and NTIA standard recommended

**FCC Standard (47 CFR 90.210-d)**

<table>
<thead>
<tr>
<th>Displacement Frequency ($f_d$)</th>
<th>Attenuation [dB]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 kHz to 5.625 kHz</td>
<td>0.0</td>
</tr>
<tr>
<td>5.625 kHz $&lt; f_d \leq$ 12.5 kHz</td>
<td>7.27 ($f_d - 2.88$ kHz)</td>
</tr>
<tr>
<td>12.5 kHz $&lt; f_d$</td>
<td>50 + 10log$_{10}$(RFOP), or 70 whichever smaller</td>
</tr>
</tbody>
</table>

RFOP: RF Output Power in Watts

**NTIA Standard (NTIA manual part 5.3.5.2)**

<table>
<thead>
<tr>
<th>Displacement Frequency ($f_d$)</th>
<th>Attenuation [dB]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 kHz to 2.5 kHz</td>
<td>0.0</td>
</tr>
<tr>
<td>2.5 kHz $&lt; f_d \leq$ 12.5 kHz</td>
<td>7 ($f_d - 2.5$ kHz)</td>
</tr>
<tr>
<td>12.5 kHz $&lt; f_d$</td>
<td>50 + 10log$_{10}$(RFOP), or 70 whichever smaller</td>
</tr>
</tbody>
</table>

RFOP: RF Output Power in Watts

*Note: For details, refer to the TIA-102 standard.*
Transmitter Performance Measurement Methods

Modulation Emission Spectrum

Inbound Symmetrical Time Slot Standard Transmitter Test Pattern

Outbound Standard Transmitter Test Pattern

RF Signal

Spectrum Emission Mask Function [pre-installed]

Example: FCC 12.5 kHz

Transmitter under Test

Spectrum Analyzer

MS2830A
Unwanted Emission: Radiated Spurious

Measures power of spurious signals

Limits: Non-radiating load (47 CFR 2.1053 and 47 CFR 90.210-d)
- Shall be attenuated by at least $50 + 10\log(P)$ dB, or 70 dB, whichever is smaller

Limits: 700 MHz Band (47 CFR 27.53-e-8 and 47 CFR 90.543-c)
- Shall be attenuated by at least $43 + 10\log(P)$ dB below average carrier power

Limits: EIRP Emission in GNSS Band (47 CFR 27.53-f and 47 CFR 90.543-f)
- Shall be limited to $-70$ dBW/MHz equivalent isotropically radiated power (EIPR) for wideband signals, and $-80$ dBW EIRP for discrete emissions of less than 700 Hz bandwidth

Limits: Calculated EIRP Emission in GNSS Band (47 CFR 27.53-f and 47 CFR 90.543-f)
(Same as above)
Unwanted Emission: Conducted Spurious

Measures power of spurious signals

Limits: Applicable to all frequency bands below 1 GHz, excluding frequencies in 700 MHz band as specified in 47 CFR 27.53-e-8 and 47 CFR 90.543-e
Shall be attenuated by at least $50 + 10\log(P)$ dB, or 70 dB, whichever is lesser attenuation below the reference. $P$ is the average carrier power in watts.

Limits: 700 MHz Band (47 CFR 27.53-e-8 and 47 CFR 90.543-c)
Shall be attenuated by at least $43 + 10\log(P)$ dB below the reference. $P$ is the average carrier power in watts.

Check the application note
(MS2830A_EF6100.pdf)
Transmitter Performance Measurement Methods

Unwanted Emissions:
Non-Spurious Adjacent Channel Power Ratio

Measures ratio of total power of transmitter in standard transmitter test pattern to leakage power falling within bandwidth of adjacent channels.

Limits: Applicable to all frequency bands below 1 GHz excluding frequencies in 700 MHz band as specified in 47 CFR 27.53-e-6 and 47 CFR 90.543-a
Shall meet or exceed the applicable limit in following table when measured using a measurement (integration) bandwidth of 6 kHz.

<table>
<thead>
<tr>
<th>Modulation</th>
<th>Mobile</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-CPM</td>
<td>65 dB</td>
</tr>
<tr>
<td>H-DQPSK</td>
<td>67 dB</td>
</tr>
</tbody>
</table>

Note: For details, refer to the TIA-102 standard.
Transmitter Performance Measurement Methods

Unwanted Emissions:
Non-Spurious Adjacent Channel Power Ratio

Limits: 700 MHz Band (47 CFR 27.53-e-6 and 47 CFR 90.543-a)

<table>
<thead>
<tr>
<th>Offset from Center Frequency [kHz]</th>
<th>Measurement Bandwidth [kHz]</th>
<th>ACPR [dB]</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.375</td>
<td>6.25</td>
<td>40</td>
</tr>
<tr>
<td>15.625</td>
<td>6.25</td>
<td>60</td>
</tr>
<tr>
<td>21.875</td>
<td>6.25</td>
<td>60</td>
</tr>
<tr>
<td>37.5</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>62.5</td>
<td>25</td>
<td>65</td>
</tr>
<tr>
<td>87.5</td>
<td>25</td>
<td>65</td>
</tr>
<tr>
<td>150</td>
<td>100</td>
<td>65</td>
</tr>
<tr>
<td>250</td>
<td>100</td>
<td>65</td>
</tr>
<tr>
<td>350</td>
<td>100</td>
<td>65</td>
</tr>
<tr>
<td>&gt;400 kHz to 12 MHz</td>
<td>30 (s)¹</td>
<td>75²/80³</td>
</tr>
<tr>
<td>12 MHz to Paired Receiver Band</td>
<td>30 (s)¹</td>
<td>75²/80³</td>
</tr>
<tr>
<td>In Paired Rx Band</td>
<td>30 (s)¹</td>
<td>100⁴</td>
</tr>
</tbody>
</table>

1) (s) indicates that a swept measurement may be used.
   RBW <2% x Measurement Bandwidth
2) 12.5 kHz Mobile and Portable transmitter ACPR limits
3) 12.5 kHz Base transmitter ACPR limits
4) Requires “Band pass filter for Rx-band”

Note: For details, refer to the TIA-102 standard.
Transmitter Performance Measurement Methods

Unwanted Emissions: Non-Spurious Adjacent Channel Power Ratio

**Inbound Symmetrical Time Slot Standard Transmitter Test Pattern**

**Outbound Standard Transmitter Test Pattern**

**RF Signal**

**ACP Analyzer**

**MS2830A**

Adjacent Channel Power Function [pre-installed]

Ex: Applicable to all frequency bands below 1 GHz

- **Span**: 100 kHz
- **Measurement BW**: 6 kHz
- **Detection**: Sample or RMS
- **RBW**: 100 Hz
- **VBW**: RBW x10

Example: Except 700 MHz band

Burst signal (IB) is measured by a gate sweep function. However, it will take 30 seconds per once.

Note: For details, refer to the TIA-102 standard.

Example:

- **References**: dBm, dBm/Hz, dBc, dBc/Hz
- **Settings**: ATT, SM, SWT, 5.7s
- **Measurements**: dBm, dBc, dBm/Hz, dBc/Hz
- **Advanced Features**: ACP, ACP Reference, Carrier Select, In-Band Setup, Offset Setup

**Inband Standard Transmitter Test Pattern**

**Outband Standard Transmitter Test Pattern**

**Note**: For details, refer to the TIA-102 standard.
Transmitter Performance Measurement Methods

Unwanted Emissions:
Non-Spurious Adjacent Channel Power Ratio

Note: For details, refer to the TIA-102 standard.

ACP function [Opt-006]

With the signal analyzer mode (Opt-006), FFT processing is supported. Therefore one measurement will be completed in 150 ms.
Transmitter Performance Measurement Methods

Intermodulation Attenuation

Measures ability of transmitter to withstand generation of intermodulation components caused by carrier signal and interference signal input to transmitter antenna.

Limits: Shall meet or exceed 40 dB (Base Station only)

Note: For details, refer to the TIA-102 standard.

RF Signal

Transmitter under Test

Outbound Standard Transmitter Test Pattern

ATT

Directional Coupler

Interference Signal (CW)

ATT

Termination

Signal Source

Spectrum Analyzer

MS2830A

Multi-Marker Function [pre-installed]
Transmitter Performance Measurement Methods

Frequency Deviation for H-CPM (IB)

Measures frequency deviation when modulating with High and Low deviation symbols.

Set the audio bandwidth of the FM demodulator so that the high-pass corner frequency is ≤15 Hz and the low-pass corner frequency is ≥3 kHz. Turn the De-emphasis function off.

Limits:
- High deviation = 2995 Hz to 3310 Hz
- Low deviation = 998 Hz to 1104 Hz

Inbound High Deviation Test Pattern
Inbound Low Deviation Test Pattern

Example: High Deviation

Note: For details, refer to the TIA-102 standard.
Transmitter Performance Measurement Methods

Modulation Fidelity: H-CPM, H-DQPSK

Measures modulation fidelity rms.

Limits: Modulation Fidelity limits

<table>
<thead>
<tr>
<th>Radio Application</th>
<th>Mobile</th>
<th>Portable</th>
<th>Base Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class A</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Class B</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
</tr>
</tbody>
</table>

Inbound Symmetrical Time Slot Standard
Transmitter Test Pattern

Outbound Standard Transmitter Test Pattern

RF Signal

Example: Frequency Error = 1 kHz

Note: For details, refer to the TIA-102 standard.

Note: This feature is under development.
Modulation Fidelity: H-CPM, H-DQPSK

Any of seven types of numeric measurement result or two types of graphical result can be selected for display at the Custom Numeric screen. (Note: The Custom Numeric screen does not support Zoom.)

Trace: Custom Numeric

Numeric and graphical results can be checked simultaneously on four sub-screens by displaying any item from the many numeric results on the Numeric screen. Moreover, difficult-to-evaluate numeric values can be evaluated intuitively from bar graphs.
Transmitter Performance Measurement Methods

Symbol Rate Accuracy

Measures **accuracy of modulation speed** of transmitter

Limits: Shall not exceed 10 ppm

```
AF Measure Result(TX-AF)
AF Frequency  1500.000 12 Hz
Level         2.26527 kHz rms
```

```
ppm error = \left( \frac{\text{Frequency} \, \text{Hz}}{1500} - 1 \right) \times 10^6
```

*Note*) $1500 \, \text{Hz} \times 10 \, \text{ppm} = 0.015 \, \text{Hz}

Enable when “Time Range” set to “≥ 21 ms”.

[Trace] > [F2: Time Domain Setting] > [F4: Time Range]

Note: For details, refer to the TIA-102 standard.
Transmitter Performance Measurement Methods

H-CPM Transmitter Logical Channel
Peak Adjacent Channel Power Ratio (IB only)

Limit: \( P_{TX} - P_{HI} \) : 35 dB or greater
\( P_{TX} - P_{LOW} \) : 35 dB or greater

Spectrum analyzer setting
- Center Frequency: DUT ±12.5 kHz
- Span: Zero Hz
- RBW: 5 kHz (±5%)
- Filter Type: Gaussian
- Detection: Peak
- Sweep Time: 360 ms
- Trigger: Internal Magnitude
- \( P_{HI}, P_{LOW} \) : Maximum power level

Note: For details, refer to the TIA-102 standard.
Transmitter Performance Measurement Methods

H-CPM Transmitter Logical Channel
Peak Adjacent Channel Power Ratio (IB only)

Note: For details, refer to the TIA-102 standard.

Power vs. Time [Opt-006]

P_{HI} and P_{LOW} are the maximum power level.

MKR 1  209.160ms  -35.49 dBm
Transmitter Performance Measurement Methods

H-CPM Transmitter Logical Channel
Off Slot Power (IB only)

Inbound Symmetrical Time Slot Standard
Transmitter Test Pattern

Inbound Symmetrical Time Slot Standard
Transmitter Test Pattern

RF Signal, $P_{TX}$

Spectrum Analyzer

Limits: $P_{TX} - (P_{ON-REL} - P_{OFF-REL})$: Shall not exceed – 57 dBm

Spectrum analyzer setting

- Span: Zero Hz
- RBW: 100 kHz
- VBW: 100 kHz
- Sweep Speed(Time): 60 ms
- Trigger: Video, Rising Edge
- Detector: Average (sample)
- Average: Power, 10 sweeps

$P_{TX}$ = RF Output Power,
ex: 30Wmax for Mobile

(30 ms)
Transmitter Performance Measurement Methods

H-CPM Transmitter Logical Channel
Off Slot Power (IB only)

$P_{ON-REL}$ is the maximum level observed during the interval from 1 ms to 29 ms.

$P_{OFF-REL}$ is the maximum level observed during the interval from 30.2 ms to 59.8 ms.

$(P_{ON-REL} - P_{OFF-REL}) = -0.17 - (-78.32) = 78.15$ dB

Note: For details, refer to the TIA-102 standard.
Transmitter Performance Measurement Methods

H-CPM Transmitter Logical Channel Power Envelope (IB only)

Note: For details, refer to the TIA-102 standard.

Inbound Symmetrical Time Slot Standard Transmitter Test Pattern

RF Signal, $P_{TX}$

Transmitter under Test

Spectrum Analyzer

<table>
<thead>
<tr>
<th>Limits:</th>
<th>Time1 [ms]</th>
<th>Power [dBc]</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_{\text{max-on}}$</td>
<td>- 0.2 to 1.0</td>
<td>4</td>
</tr>
<tr>
<td>$P_{\text{max-ss}}$</td>
<td>1.0 to 29.0</td>
<td>1</td>
</tr>
<tr>
<td>$P_{\text{min-ss}}$</td>
<td>1.0 to 29.0</td>
<td>-3</td>
</tr>
<tr>
<td>$P_{\text{max-off}}$</td>
<td>29.0 to 30.2</td>
<td>4</td>
</tr>
</tbody>
</table>

Spectrum analyzer setting

- **Span**: Zero Hz
- **RBW**: 100 kHz
- **VBW**: 100 kHz
- **Sweep Speed(Time)**: 60 ms
- **Trigger**: Video, Rising Edge
- **Detector**: Peak

Pmax-on = $P_{\text{REF}} - P_{\text{max}(t1)}$
Pmax-ss = $P_{\text{REF}} - P_{\text{max}(t2)}$
Pmin-ss = $P_{\text{REF}} - P_{\text{min}(t2)}$
Pmax-off = $P_{\text{REF}} - P_{\text{max}(t3)}$
Transmitter Performance Measurement Methods

H-CPM Transmitter Logical Channel Power Envelope (IB only)

Note: For details, refer to the TIA-102 standard.

BW: 100.0kHz / Gaussian

<table>
<thead>
<tr>
<th>Slot</th>
<th>State</th>
<th>Avg [dBm]</th>
<th>Judge</th>
<th>Slot</th>
<th>State</th>
<th>Avg [dBm]</th>
<th>Judge</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Off</td>
<td>-85.39</td>
<td>****</td>
<td>7</td>
<td>On</td>
<td>-0.33</td>
<td>Pass</td>
</tr>
<tr>
<td>1</td>
<td>On</td>
<td>-0.33</td>
<td>Pass</td>
<td>8</td>
<td>Off</td>
<td>-85.37</td>
<td>****</td>
</tr>
<tr>
<td>2</td>
<td>Off</td>
<td>-85.49</td>
<td>****</td>
<td>9</td>
<td>On</td>
<td>-0.33</td>
<td>Pass</td>
</tr>
<tr>
<td>3</td>
<td>On</td>
<td>-0.33</td>
<td>Pass</td>
<td>10</td>
<td>Off</td>
<td>-85.37</td>
<td>****</td>
</tr>
<tr>
<td>4</td>
<td>Off</td>
<td>-85.38</td>
<td>****</td>
<td>11</td>
<td>On</td>
<td>-0.33</td>
<td>Pass</td>
</tr>
<tr>
<td>5</td>
<td>On</td>
<td>-0.33</td>
<td>Pass</td>
<td>12</td>
<td>****</td>
<td>** **</td>
<td>****</td>
</tr>
<tr>
<td>6</td>
<td>Off</td>
<td>-85.34</td>
<td>****</td>
<td>13</td>
<td>****</td>
<td>** **</td>
<td>****</td>
</tr>
</tbody>
</table>

MX269017A
Vector Modulation Analysis Software

Anritsu envision: ensure

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Two-Slot TDMA Modulation

- Uplink Modulation: H-CPM (Harmonized Continuous Phase Modulation)
- Downlink Modulation: Pi/4-DQPSK
- Data Rate: 12 kbps
- Symbol Rate: 6000 sps

Note: For details, refer to the TIA-102 standard.
Two-Slot TDMA Transmission Format

Outbound (DL) H-DQPSK
- ISCH
- Information
- Ramp 12 bits
- Pilot 8 bits

Inbound (UL) H-CPM
- ISCH
- Information
- Pilot 8 bits
- Ramp 12 bits

Outbound
- 1 2 1 2 1 1

Inbound 1

Inbound 2

Note: For details, refer to the TIA-102 standard.
### Recommended Configuration

<table>
<thead>
<tr>
<th>Model</th>
<th>Product Name</th>
<th>Recommended Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS2830A</td>
<td>Signal Analyzer</td>
<td>✓</td>
</tr>
<tr>
<td>MS2830A-040</td>
<td>3.6GHz Signal Analyzer</td>
<td>✓</td>
</tr>
<tr>
<td>MS2830A-002</td>
<td>High Stability Reference Oscillator</td>
<td>✓</td>
</tr>
<tr>
<td>MS2830A-006</td>
<td>Analysis Bandwidth 10 MHz</td>
<td>✓</td>
</tr>
<tr>
<td>MS2830A-066</td>
<td>Low Phase Noise Performance</td>
<td>✓</td>
</tr>
<tr>
<td>MX269017A</td>
<td>Vector Modulation Analysis Software</td>
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</tr>
<tr>
<td>MX269018A</td>
<td>Analog Measurement Software</td>
<td></td>
</tr>
<tr>
<td>A0086A</td>
<td>USB Audio</td>
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</table>

#### TIA-102 Receiver test items

<table>
<thead>
<tr>
<th>CAAB-C</th>
<th>CAAA-D</th>
<th>Receiver test items</th>
<th>MS2830A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Operating Frequency Accuracy</td>
<td>Basic: N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Modulation Emission Spectrum</td>
<td>Basic2: ✓, ✓</td>
</tr>
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<td></td>
<td></td>
<td>Unwanted Emission: Conducted Spurious</td>
<td>Extension: ✓</td>
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<tr>
<td></td>
<td></td>
<td>Unwanted Emission: Adjacent Channel Power Ratio</td>
<td></td>
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<td></td>
<td>Intermodulation Attenuation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Frequency Deviation for C4FM</td>
<td>Under investigation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Modulation Fidelity (C4FM, CQPSK, linear simulcast modulation)</td>
<td>Ongoing development</td>
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<tr>
<td></td>
<td></td>
<td>Modulation Fidelity (C4FM only)</td>
<td>Under investigation</td>
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<tr>
<td></td>
<td></td>
<td>Symbol Rate Accuracy</td>
<td>Basic: N/A</td>
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</tbody>
</table>

1. Requires MS2830A-006 Analysis Bandwidth 10 MHz for Frequency vs. Time function
2. Requires MX269018A Analog Measurement Software