Anritsu envision : ensure

TETRA
Rx Test Solution

Vector Signal Generator MG3710A
Vector Signal Generator MS2830A-020/021

Reference Specifications

ETSI EN 300 394-1 V3.3.1(2015-04) / Part1: Radio

ETSI TS 100 392-2 V3.6.1(2013-05) / Part2: Air Interface

May. 2016

[Anritsu] TETRA Rx Test Solution

For Rx Evaluation

Output multi-signals with one unit!

Vector Signal Generator
MG3710A

Single		**Single** memory in **one** RF port **Normal**	Test Signal T1
Dual		**Dual** memory in one RF port * **+ Opt-048**	Test Signal T1 + Test Signal T2
Triple		Dual memory + **two** RF ports * **+ Opt-062 (2.7 GHz)**	Test Signal T1 + Test Signal T2 + Test Signal T3



***Combination of Baseband Signal option**: (Two internal ARB memories)
Selects two waveform patterns per RF output for setting mutual frequency offset, level offset, delay time, etc., to output two signals from one RF port.
Frequency (recommended range: ±60 MHz) and level (CN: ±80 dB) can also be set at the screen.

[Anritsu] TETRA Rx Test Solution

Note: For details, refer to the TETRA standard.

TETRA	Receiver test items	Signal Generator		
EN 300 394		Wanted Signal	Unwanted Signal	
7.2.2 9.2	Nominal error rates	T1 (Static, Fading)	---	---
7.2.3 9.3	Reference sensitivity performance	T1 (Static, Fading)	---	---
7.2.4 9.4	Reference interference performance	T1 (Fading)	T2 (Interference)	---
7.2.5 9.5	Blocking characteristics	T1 (Static)	---	T3 (Interference)
7.2.6 9.6	Spurious response rejection	T1 (Static)	---	T3 (Interference)
7.2.7 9.7	Intermodulation response rejection	T1 (Static)	T2 (Interference)	T3 (Interference

T1: Test signal T1 (TETRA wanted signal, phase modulation)

T2: Test signal T2 (TETRA interferer)

T3: Test signal T3 (unmodulated interferer)

BER (Bit Error Rate) measurement is supported by the BER Measurement function of the Vector Signal Generator. MER (Message Error Rate) measurement is not supported.

Fading: User can create Fading pattern by using Fading IQproducer (Option).

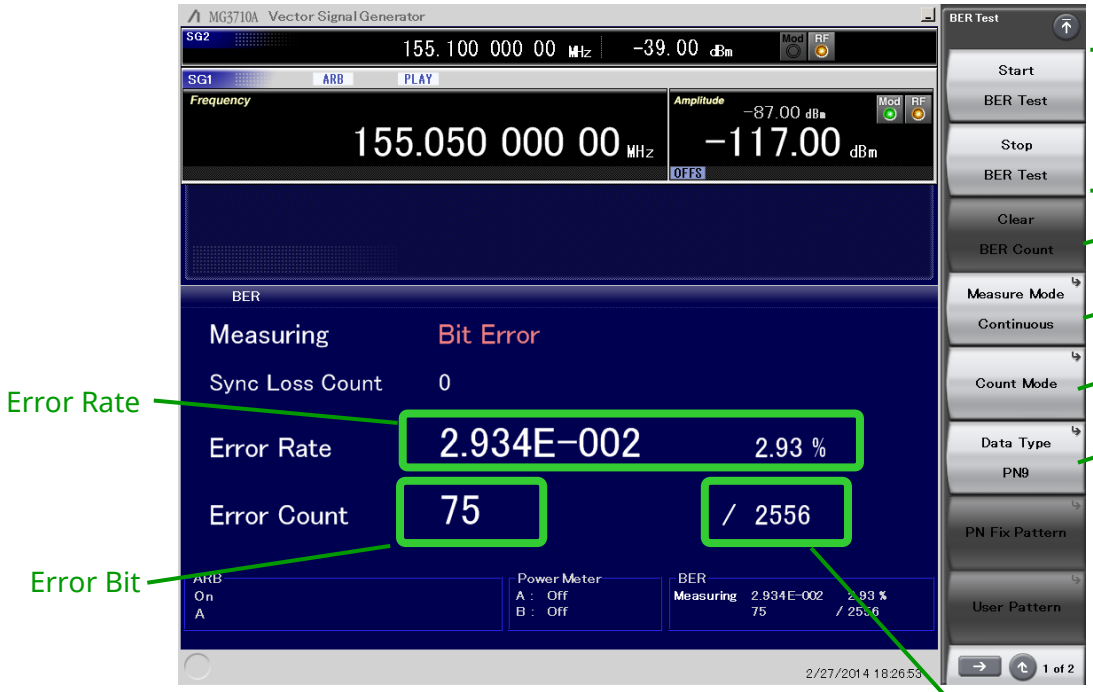
Vector Signal Generator
MG3710A

One RF port — Single, Dual

Two RF ports — Dual or Triple

[Anritsu] TETRA Rx Test Solution

Built-in BER Measurement Function (Opt-021)



Error Rate

Error Bit

Measurement Bit

BER Test Start or Stop

Clears measurement result

Measure Mode

Count Mode

Data Type
PN9/11/15/20/23, ALL1, ALL0, Alternate (0101...), User Data, PN9fix/11fix/15fix/20fix/23fix

BER Measurement Example

Measure Mode

Single: Measures selected data patterns until result reaches specified number of bits or specified number of error bits

Continuous: Repeats single measurements (default)

Endless: Measures data until result reaches upper limit of measurement count bit

Count Mode

Data: Specifies number of measurement bits (default) Error: Specifies number of measurement error bits

[Anritsu] TETRA Rx Test Solution

Test Signals

Measures transmitter and receiver

(Specified by EN 300 394 5.3 Radio Test Signals)

Note: For details, refer to the TETRA standard.

<table>
<tr><th>Test Signals</th><th colspan="3">Contents</th></tr>
<tr><td>T1</td><td>The T1 signal sequence shall comply with the TETRA air interface multiframe, frame and slot/burst/sub burst structure and is the wanted signal transmitted by the test system during frames 1 to 17 in all receiver tests. The modulation type shall be π/4-DQPSK or π/8-D8PSK (where supported). The information transmitted by the test system in frame 18 of T1 is used for test control purposes.</td><td>MS Testing</td><td>Frame 18
<table><tr><th>Burst type</th><th>Block 1</th><th>Block 2</th><th>Broadcast Block</th></tr><tr><td>synchronization</td><td>BSCH</td><td>BNCH/T</td><td>AACH</td></tr></table>Frame 1~17
<table><tr><th>Channel type</th><th>Burst type</th><th>Block 1</th><th>Block 2</th><th>Broadcast Block</th></tr><tr><td>0</td><td>normal</td><td colspan="2">TCH/7,2</td><td>AACH</td></tr><tr><td>1</td><td>normal</td><td colspan="2">TCH/7,2</td><td>AACH</td></tr><tr><td>2</td><td>normal</td><td colspan="2">SCH/F</td><td>AACH</td></tr><tr><td>3</td><td>synchronization</td><td>BSCH</td><td>SCH/HD</td><td>AACH</td></tr><tr><td>4</td><td>normal</td><td colspan="2">TCH/2,4, N = 1</td><td>AACH</td></tr></table>(1)</td></tr>
<tr><td></td><td></td><td>BS Testing</td><td>Frame18
<table><tr><th>Channel type</th><th>Burst type</th><th>Block 1</th><th>Block 2</th></tr><tr><td>8</td><td>normal</td><td colspan="2">SCH/F</td></tr></table>Frame 1~17
<table><tr><th>Channel type</th><th>Burst type</th><th>Block 1 / Sub slot 1</th><th>Block 2 / Sub slot 2</th></tr><tr><td>7</td><td>normal</td><td colspan="2">TCH/7,2</td></tr><tr><td>8</td><td>normal</td><td colspan="2">SCH/F</td></tr><tr><td>9</td><td>normal</td><td>STCH</td><td>STCH</td></tr><tr><td>10</td><td>normal</td><td colspan="2">TCH/2,4, N = 1</td></tr><tr><td>11</td><td>control</td><td>SCH/HU</td><td>SCH/HU</td></tr></table>(2)</td></tr>
<tr><td>T2</td><td colspan="3">The phase modulated test signal T2 is a π/4-DQPSK modulated continuous radio signal following the structure of TETRA signals, but with all modulating bits (including training sequences) derived directly from pseudo random bit sequence</td></tr>
<tr><td>T3</td><td colspan="3">Test signal T3 is an unmodulated continuous sinusoidal radio signal. T3 is used as an unwanted (unmodulated) signal.</td></tr>
<tr><td>T4(3)</td><td colspan="3">unsupported.</td></tr>
</table>

(1)(2)(3)
Anritsu is now discussing to Implement the Tetra Release 2 about modulation type π/8-D8PSK and QAM.

Receiver Performance Measurement Methods

Nominal error rates

Note: For details, refer to the TETRA standard.

Measures the receiver performance under nominal channel conditions.

The Vector SG is supported as an MG2830A option.

The MS2830A is recommended when only "Reference Sensitivity" is included in the manufacturing Rx test.

Receiver under Test

T1

Wanted Signal (Static/TU50)

(BER Opt)

Data/Clock

Fading IQproducer:
"Fading (Rayleigh)" pattern created by Fading IQproducer.
This is supported only by the MG3710A.

Fading conditions
- Rayleigh fading
- Moving speed 50 km/h

Limits
for MS/BS receiver, class A

Test Type	Channel type	Logical channel	Propagation condition	Signal level (dBm)	Interferer level (dBm)	Spec. BER or MER %	Test limit BER or MER %	Minimum sample size
Nominal error	1	TCH/7,2	TU50	-85		**0,4**	**0,448**	3 600 000
Nominal error	1	TCH/7,2	STAT	-20		**0,1**	**0,122**	170 000

Nominal channel conditions are defined as a received signal level ≥ -85 dBm with no interference under both static and fading conditions

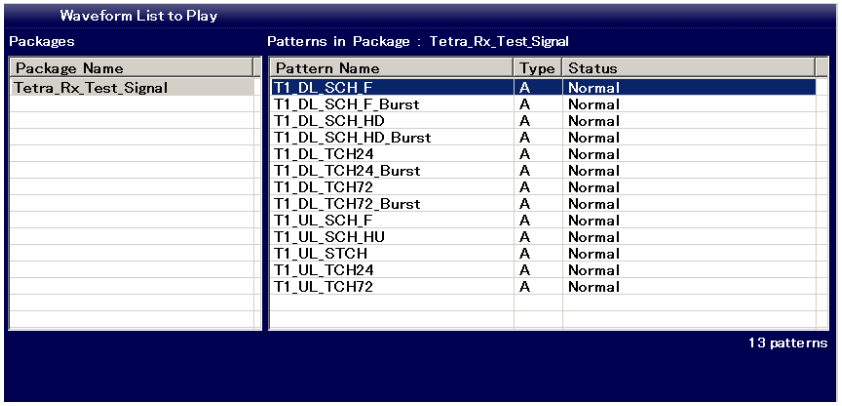
Receiver Performance Measurement Methods

Nominal error rates (Static)

Note: For details, refer to the TETRA standard.

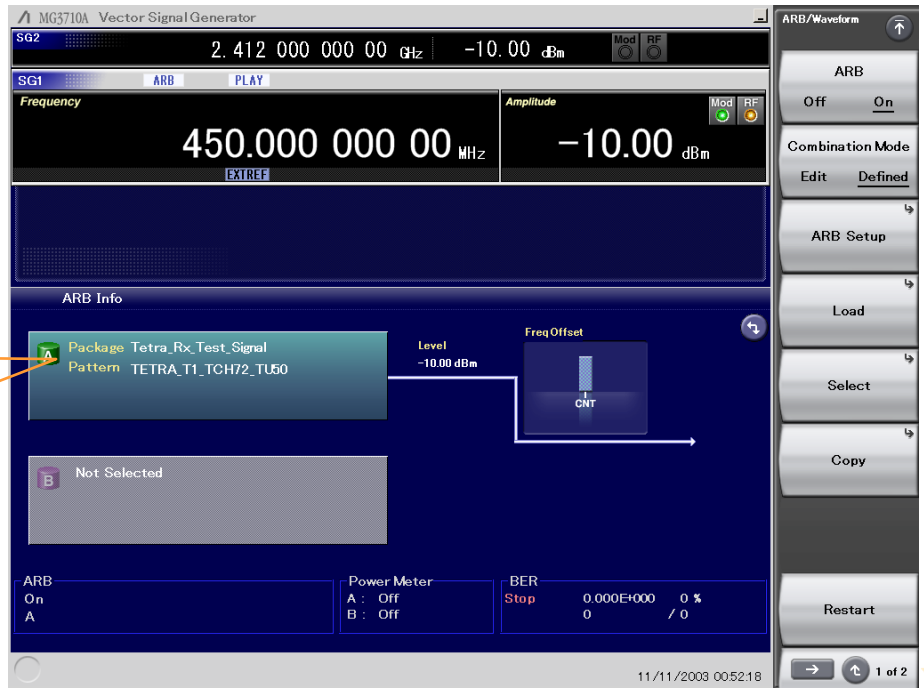
Wanted Signal (Static)

Choose TETRA signal you want from the list.



Receiver Performance Measurement Methods

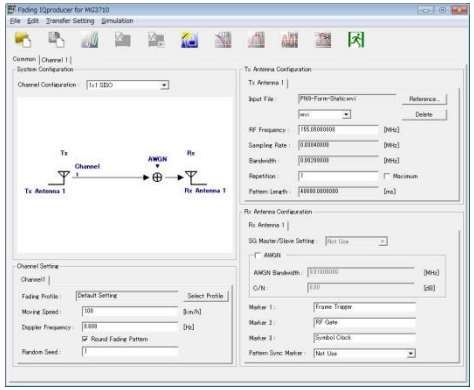
Nominal error rates (TU50)



Wanted Signal (Faded)

Load to Memory

User creates Fading pattern using Fading IQproducer



Load to Fading IQproducer

Standard Modulation State

Fading IQproducer:
"Fading (Flat/Rayleigh)" pattern created by Fading IQproducer.
This is supported only by the MG3710A.

Receiver Performance Measurement Methods

Reference sensitivity performance

Note: For details, refer to the TETRA standard.

The minimum required reference sensitivity performance is specified for V+D equipment according to test condition, logical channel, propagation condition, BS transmission mode, the receiver class, modulation type and channel bandwidth.

T1

Wanted Signal (Static/TU50)

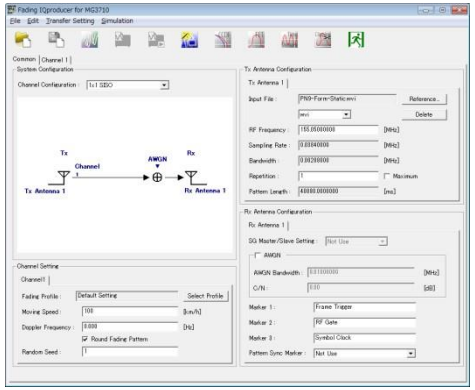
Receiver under Test

(BER Opt)

Data/Clock

Fading IQproducer:
"Fading (Rayleigh)" pattern created by Fading IQproducer.
This is supported only by the MG3710A.

User creates Fading pattern using Fading IQproducer



Fading conditions

TU50
- Rayleigh fading
- Relative delay 5 us
- Average relative power -22.3dB
- Moving speed 50 km/h

HT200
- Rayleigh fading
- Relative delay 15 us
- Average relative power -8.6 dB
- Moving Speed 200 km/h

Standard Modulation State

Load to Fading IQproducer

Receiver Performance Measurement Methods

Reference sensitivity performance

Note: For details, refer to the TETRA standard.

Limits

MS receiver minimum reference sensitivity

Test Type	Channel type	Logical channel	Propagation condition	Signal level (dBm)	Interferer level (dBm)	Spec. BER or MER %	Test limit BER or MER %	Minimum sample size
Sensitivity	2	SCH/F	TU50	-103 (-97)		8	8,96	6 600
Sensitivity	2	AACH	TU50	-103 (-97)		10	11,2	6 600
Sensitivity	3	BSCH	HT200	-103		11	12,32	4 800
Sensitivity	3	SCH/HD	HT200	-103		11	12,32	4 800
Sensitivity	4	AACH	HT200	-103		17	19,04	3 000
Sensitivity	4	TCH/2,4 N = 1	HT200	-103		**1,1**	**1,232**	1 290 000

BS receiver minimum reference sensitivity

Test type	Channel type	Logical channel	Propagation condition	Signal level (dBm)	Interferer level (dBm)	Spec. BER or MER %	Test limit BER or MER %	Minimum sample size
Sensitivity	8	SCH/F	TU50	-106 (-100)		11	12,32	6 600
Sensitivity	9	STCH	TU50	-106		9	10,08	6 600
Sensitivity	10	TCH/2,4 N = 1	HT200	-106		**1,3**	**1,456**	45 000
Sensitivity	11	SCH/HU	HT200	-106		9,5	10,64	5 000

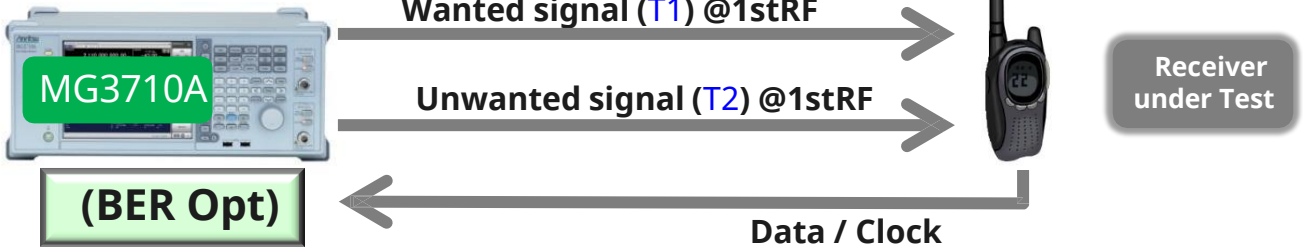
Receiver Performance Measurement Methods

Reference interference performance

Notes: For details, refer to the TETRA standard.

The minimum required reference interference performance (for co-channel C/Ic or adjacent channel C/Ia) is specified for V+D equipment with phase modulation according to test condition, channel type, propagation condition and the receiver class of the equipment.

Dual Memory:
One RF port has two memories. Two signals are output at one RF port. The Frequency and Level can be set. This is supported only by the MG3710A.



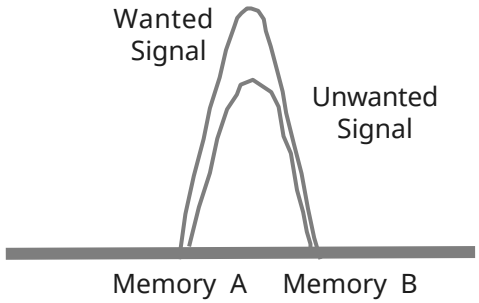
For Co-channel

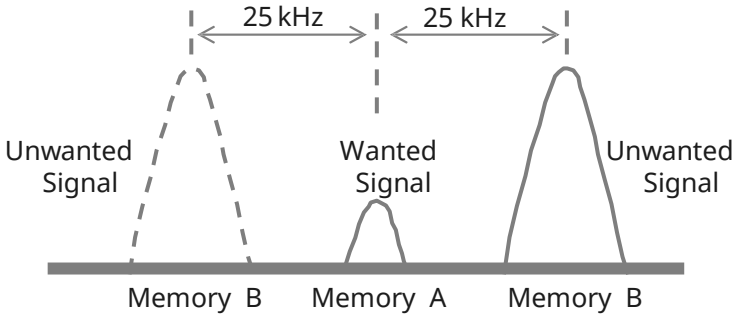
- RF1 = Wanted signal (T1)
- RF2 = Unwanted signal (T2)
  Level: 19 dB below RF1
  Frequency: [RF1 Freq]

For Adjacent channel

- RF1 = Wanted signal (T1)
- RF2 = Unwanted signal (T2)
  Level: 40 dB or 45 dB(1) above RF1
  Frequency: [RF1 Freq ± 25 kHz]

(1) Only for BS in adjacent channel interference below 700 MHz



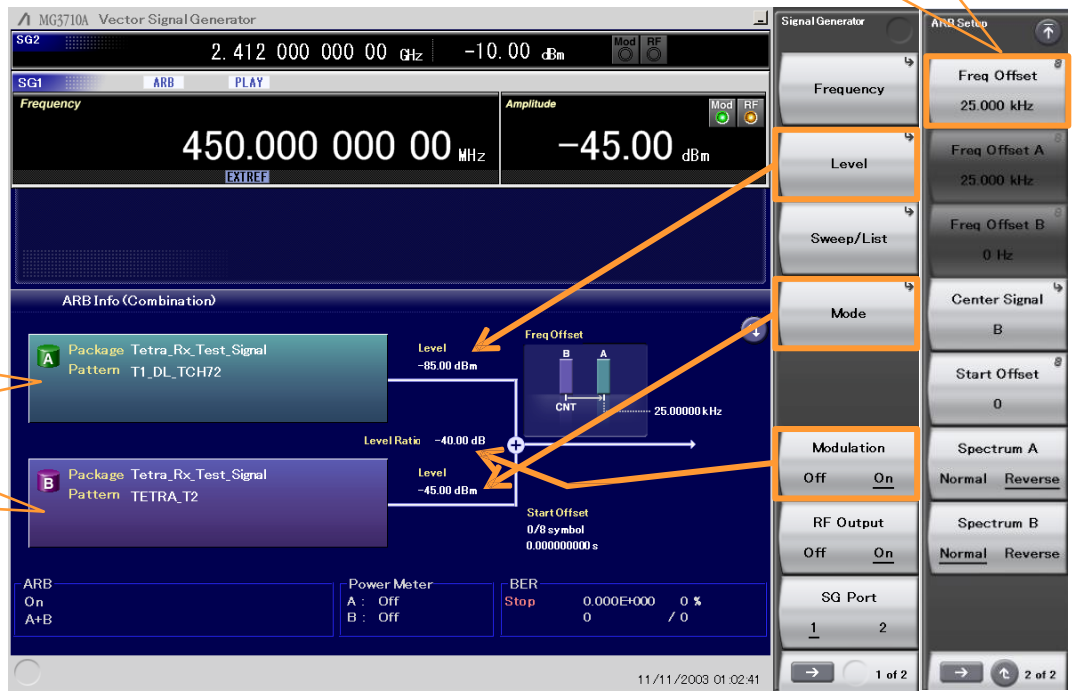


Receiver Performance Measurement Methods

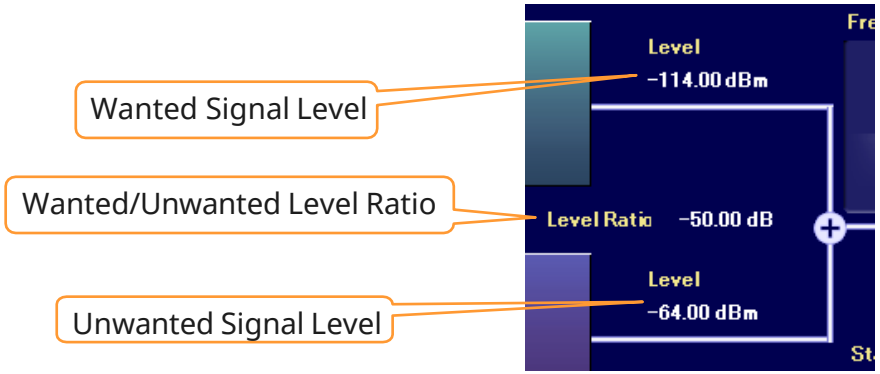
Reference interference performance

Merit of Dual Memory:

- **Two signals of "Wanted signal" and "Unwanted signal" are output by one RF port.**
- **Both Level and C/N set for each level**
- **Frequency offset set by direct input.**



For Co-channel
Frequency Offset = 0 Hz
For Adjacent channel
Frequency Offset = ± 25 kHz



Receiver Performance Measurement Methods

Reference interference performance

Notes: For details, refer to the TETRA standard.

Limits

For MS receiver

Test Type	Channel type	Logical channel	Propagation condition	Signal level (dBm)	Interferer level (dBm)	Spec. BER or MER %	Test limit BER or MER %	Minimum sample size
Co-channel interference	2	SCH/F	HT200	-85	-104	9,2	10,304	7 000
Adjacent channel interference	2	SCH/F	TU50	-100 (-94)	-60 (-64)	6,5	7,280	8 000

For BS receiver

Test type	Channel type	Logical channel	Propagation condition	Signal level (dBm)	Interferer level (dBm)	Spec. BER or MER %	Test limit BER or MER %	Minimum sample size
Co-channel interference	8	SCH/F	HT200	-85	-104	9,2	10,30	7 000
Adjacent channel interference	8	SCH/F	TU50	-103 (-97)	-58 (-62) (see note)	6	6,72	9 000

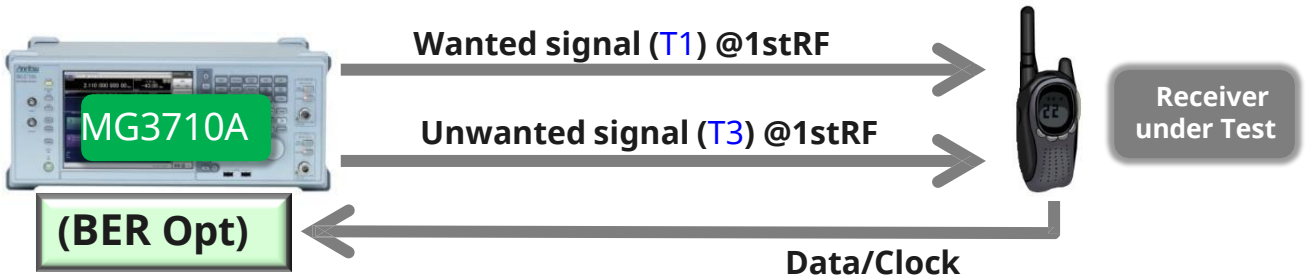
Receiver Performance Measurement Methods

Blocking characteristics

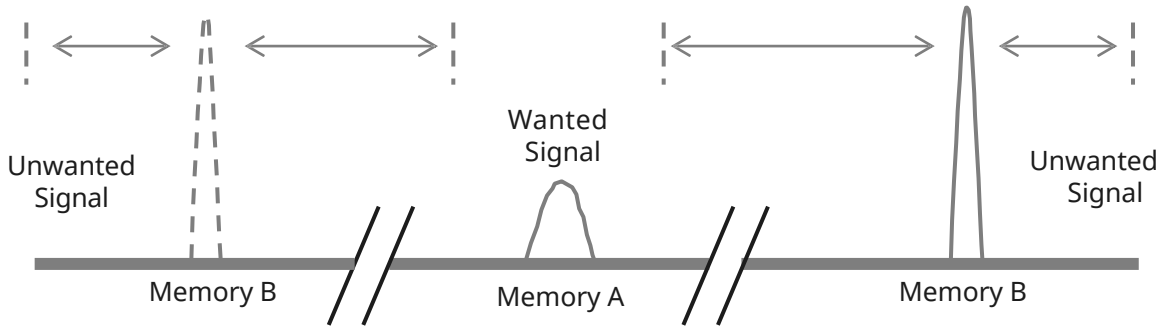
Note: For details, refer to the TETRA standard.

Measures the capability of the receiver to receive a modulated wanted input signal in the presence of an unwanted unmodulated input signal on frequencies other than those of the spurious responses or the adjacent channels, without this unwanted input signal causing a degradation of the performance of the receiver beyond a specified limit.

Two RF Ports:
The MG3710A supports two RF ports in one unit, cutting equipment costs.



•RF1 = Wanted signal (T1)
•RF2 = Unwanted signal (T3)
Level: -25 dBm
Frequency: [RF1 Freq±1 MHz, ±2 MHz, ±5 MHz and ±10 MHz]



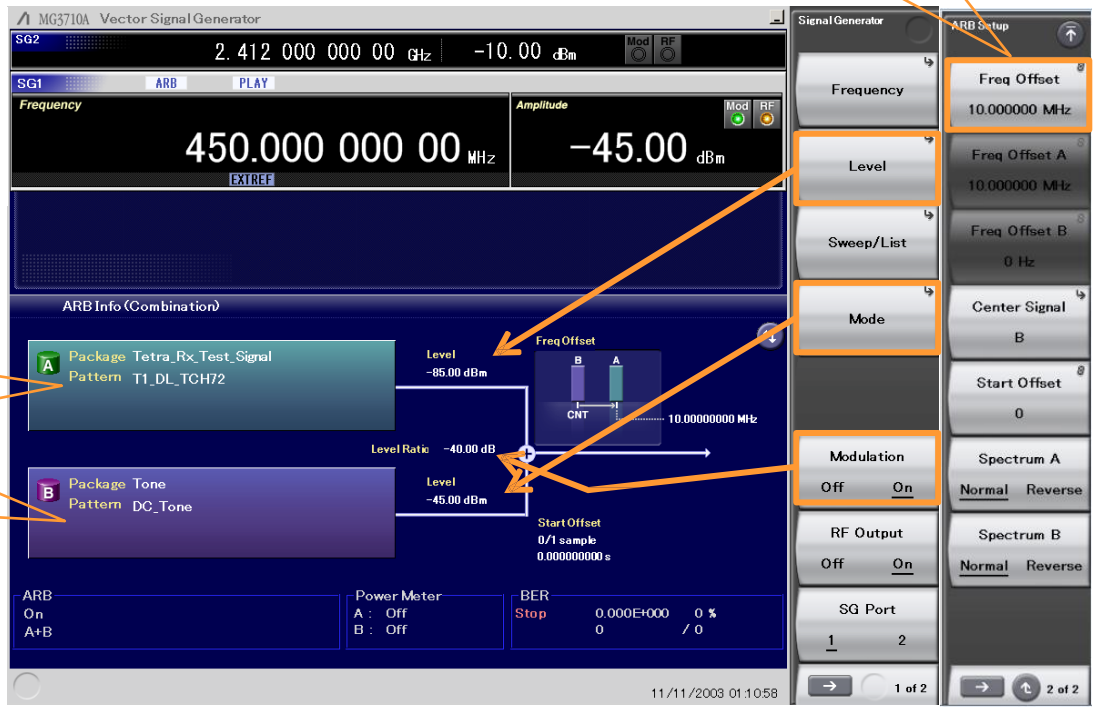
Receiver Performance Measurement Methods

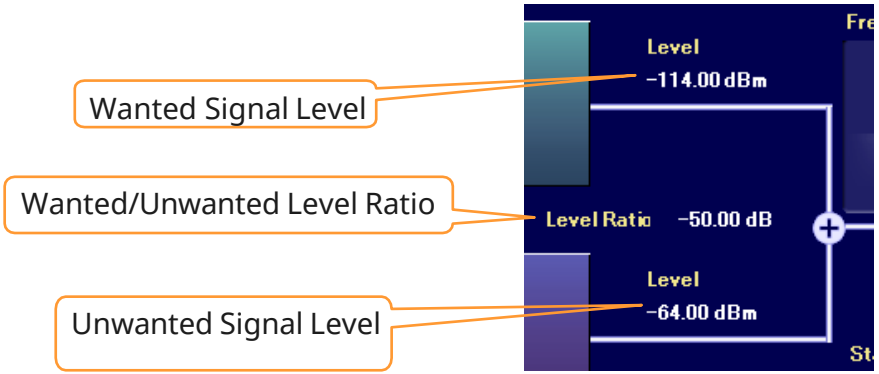
Blocking characteristics

Merit of Dual Memory:

- **Two signals of "Wanted signal" and "Unwanted signal" are output by one RF port.**
- **Both Level and C/N set for each level**
- **Frequency offset set by direct input.**

Frequency Offset = ±1 MHz, ±2 MHz, ±5 MHz and ±10 MHz





Blocking characteristics

Note: For details, refer to the TETRA standard.

Limits

For MS receiver

Test Type	Channel type	Logical channel	Propagation condition	Signal level (dBm)	Interferer level (dBm)	Spec. BER or MER %	Test limit BER or MER %	Minimum sample size
Blocking	1	TCH/7,2	STAT	-109	-25	**3,5**	**4,270**	5 000

For BS receiver

Test type	Channel type	Logical channel	Propagation condition	Signal level (dBm)	Interferer level (dBm)	Spec. BER or MER %	Test limit BER or MER %	Minimum sample size
Blocking	7	TCH/7,2	STAT	-112	-25	**3,0**	**3,66**	5 800

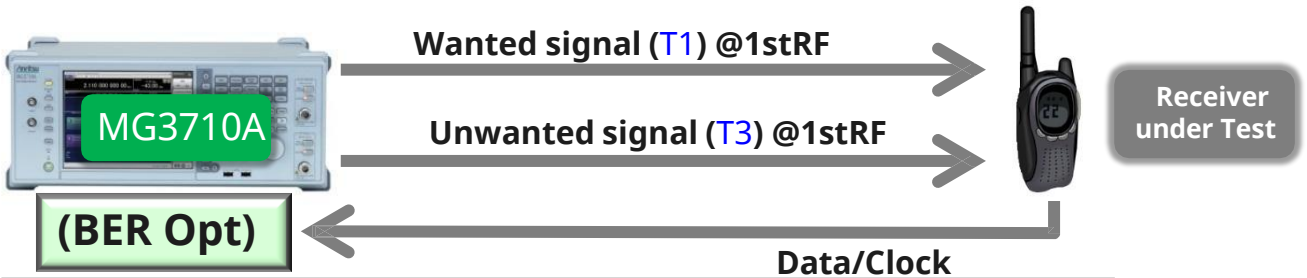
Receiver Performance Measurement Methods

Spurious response rejection

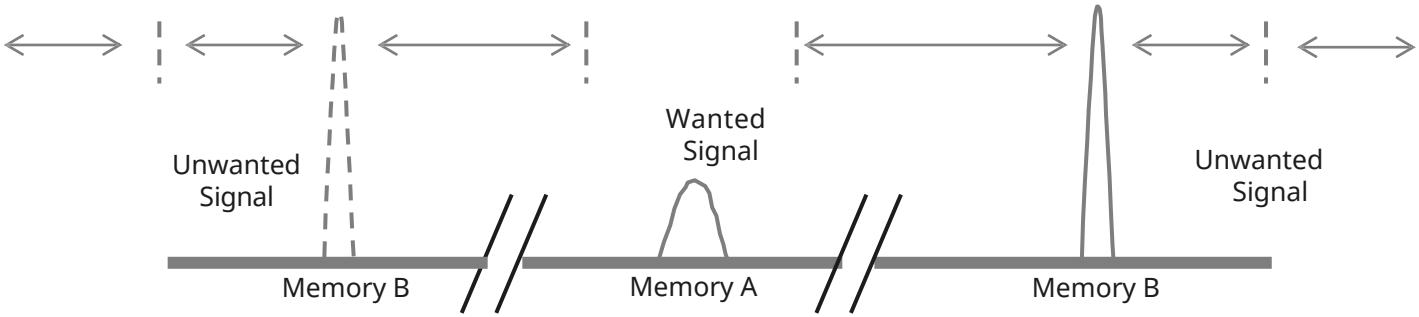
Note: For details, refer to the TETRA standard.

Measures the capability of a receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted unmodulated signal at any other frequency at which a response is obtained.

Two RF Ports:
The MG3710A supports two RF ports in one unit, cutting equipment costs.



- RF1 = Wanted signal (T1)
- RF2 = Unwanted signal (T3)
  Level: -45 dBm
  Frequency: $f_{lo} - \sum_{i=1}^{n} f_{ij} - sr/2 \le f_I \le f_{lo} + \sum_{i=1}^{n} f_{ij} + sr/2$

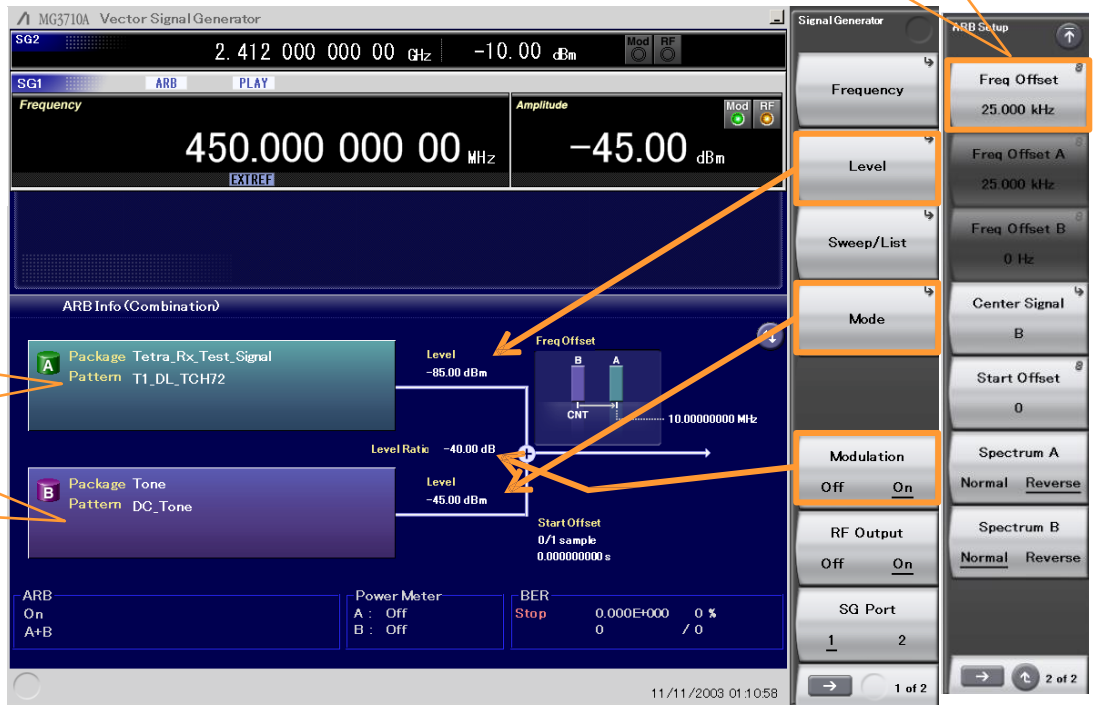


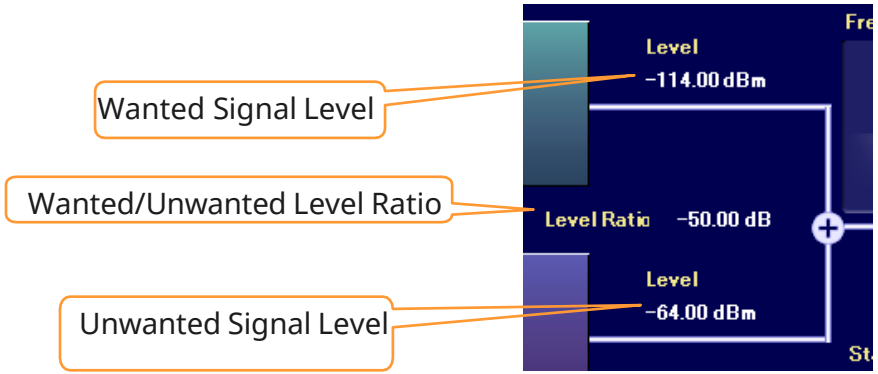
Receiver Performance Measurement Methods

Spurious response rejection

Merit of Dual Memory:

- Two signals of "Wanted signal" and "Unwanted signal" are output by one RF port.
- Both Level and C/N set for each level
- Frequency offset set by direct input.





Spurious response rejection

Note: For details, refer to the TETRA standard.

Limits

For MS receiver

Test Type	Channel type	Logical channel	Propagation condition	Signal level (dBm)	Interferer level (dBm)	Spec. BER or MER %	Test limit BER or MER %	Minimum sample size
Spurious response	1	TCH/7,2	STAT	-109	-45	**3,5**	**4,270**	5 000

For BS receiver

Test type	Channel type	Logical channel	Propagation condition	Signal level (dBm)	Interferer level (dBm)	Spec. BER or MER %	Test limit BER or MER %	Minimum sample size
Spurious response	7	TCH/7,2	STAT	-112	-45	**3,0**	**3,66**	5 800

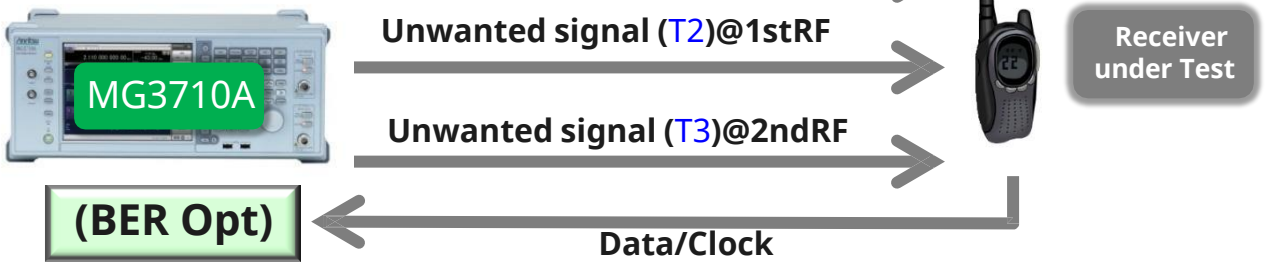
Receiver Performance Measurement Methods

Intermodulation response rejection

Note: For details, refer to the TETRA standard.

Measures the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of two or more unwanted signals with a specific frequency relationship to the wanted signal frequency.

Dual Memory:
One RF port has two memories. Two signals are output by one RF port. The Frequency, Level and Delay-Time can be set. This is supported only by the MG3710A.

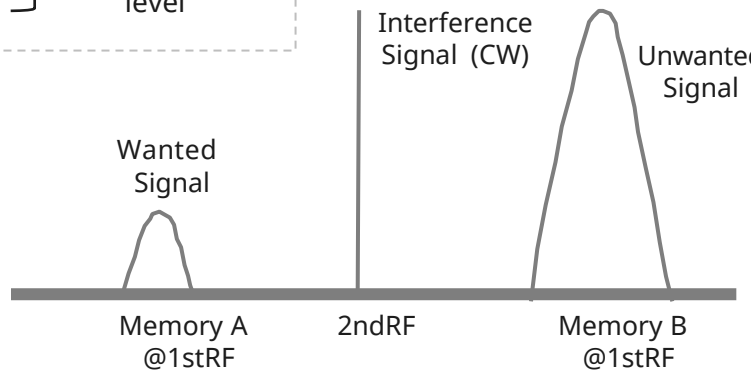


Two RF Ports:
The MG3710A supports two RF ports in one unit, cutting equipment costs.

RF1 = Wanted signal (T1)

RF2 = Unwanted signal (T2)
Frequency: [RF1 Freq] ± [400 kHz]
RF3 = Unwanted signal (T3)
Frequency: [RF1 Freq] ± [200 kHz]

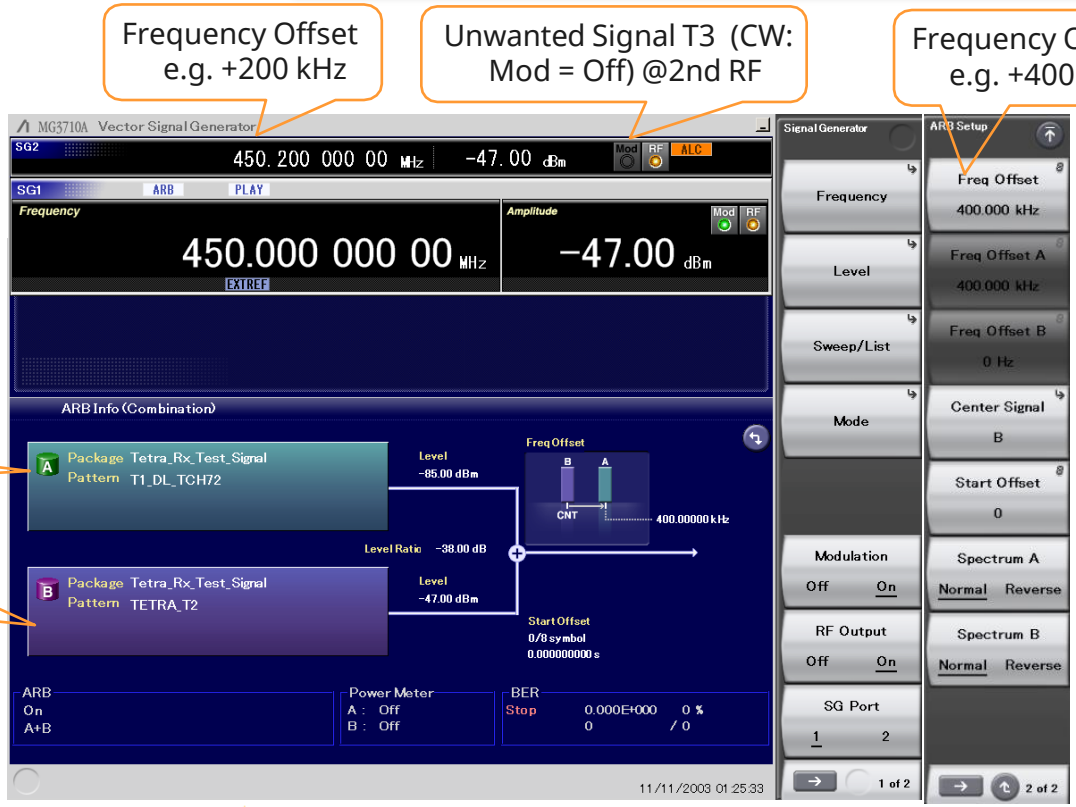
} Same level



Receiver Performance Measurement Methods

Intermodulation response rejection

Note: For details, refer to the TETRA standard.



Merit of Dual Memory:

- **Two signals of "Wanted signal" and "Unwanted signal" are output by one RF port.**
- **Both Level and C/N set for each level**
- **Frequency offset set by direct input.**

Two RF Ports:
The MG3710A supports two RF ports in one unit, cutting equipment costs.

***Combination of Baseband Signal option** (Two internal ARB memories) :

Frequency (recommended range: ±60 MHz) and **level (CN: ±80 dB)** can also be set at the screen.

Receiver Performance Measurement Methods

Intermodulation response rejection

Note: For details, refer to the TETRA standard.

Limits

For MS receiver

Test Type	Channel type	Logical channel	Propagation condition	Signal level (dBm)	Interferer level (dBm)	Spec. BER or MER %	Test limit BER or MER %	Minimum sample size
Inter-modulation	1	TCH/7,2	STAT	-109	-47	**3,5**	**4,270**	5 000

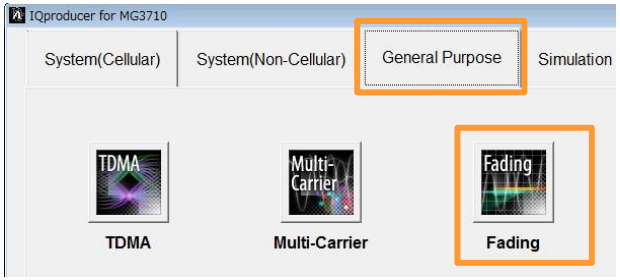
For BS receiver

Test type	Channel type	Logical channel	Propagation condition	Signal level (dBm)	Interferer level (dBm)	Spec. BER or MER %	Test limit BER or MER %	Minimum sample size
Inter-modulation	7	TCH/7,2	STAT	-112	-47	**3,0**	**3,66**	5 800

[Appendix] How to Create Faded Pattern 1/2

Start Fading IQproducer

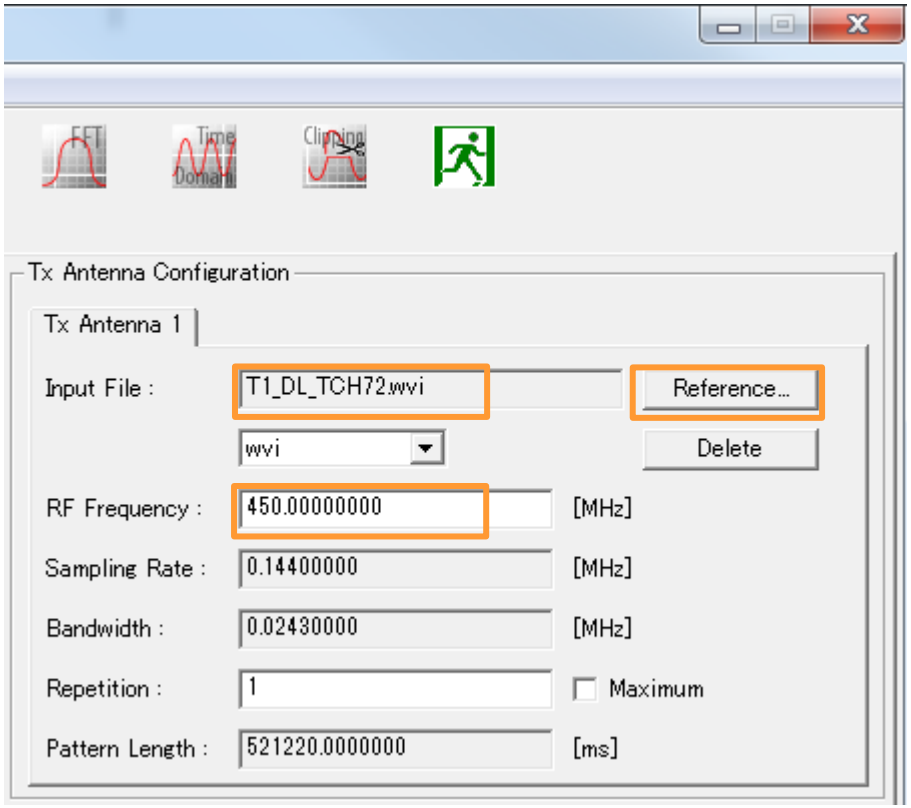
[IQpro]
Click [General Purpose] tab. Click [Fading] icon.



Set Fading Parameter (TxAntenna Configuration)

Click [Reference].
Select [T1_DL_TCH72] .
(C:¥Anritsu¥MG3710A¥User Data¥Waveform ¥TETRA) on MG3710A HDD
Set RF Frequency (e.g. : 450 MHz)

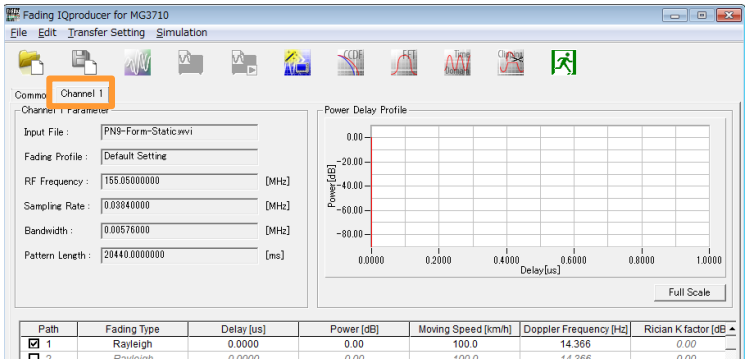
Create different patterns for each evaluated frequency

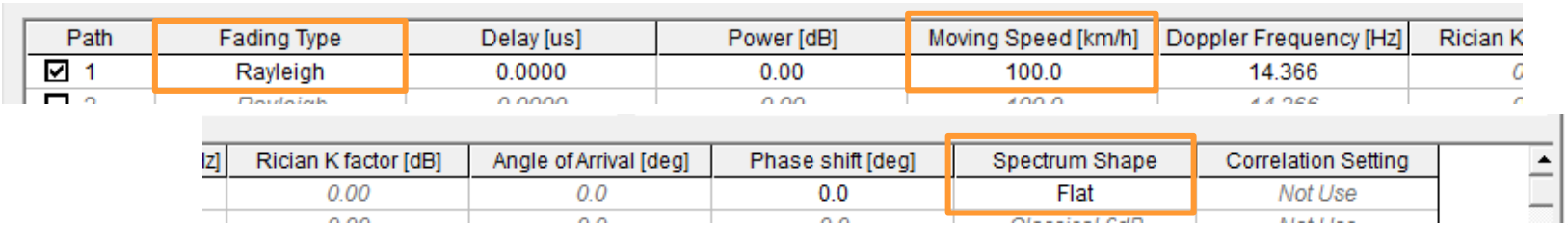


[Appendix] How to Create Faded Pattern 2/2

Set Fading Parameter (Channel condition)

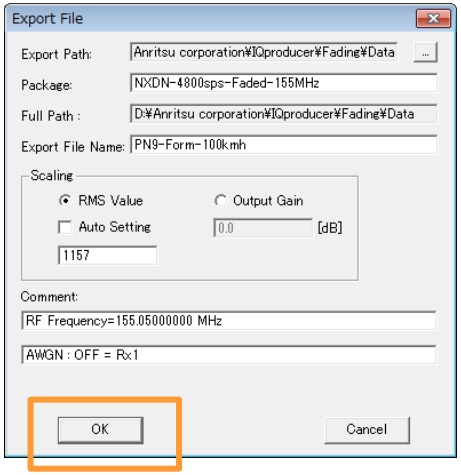
Click [Channel 1] tab.
Set [Fading Type] = Rayleigh.
Set [Moving Speed] = 50 km/h or 200 km/h.





Create Pattern (Calculation)

Click [Calculation].



Input [Package] name.
(e.g. : TETRA) Input [Pattern] name.
(e.g. : T1-DL-TCH72-TU50) Click [OK].

Appendix

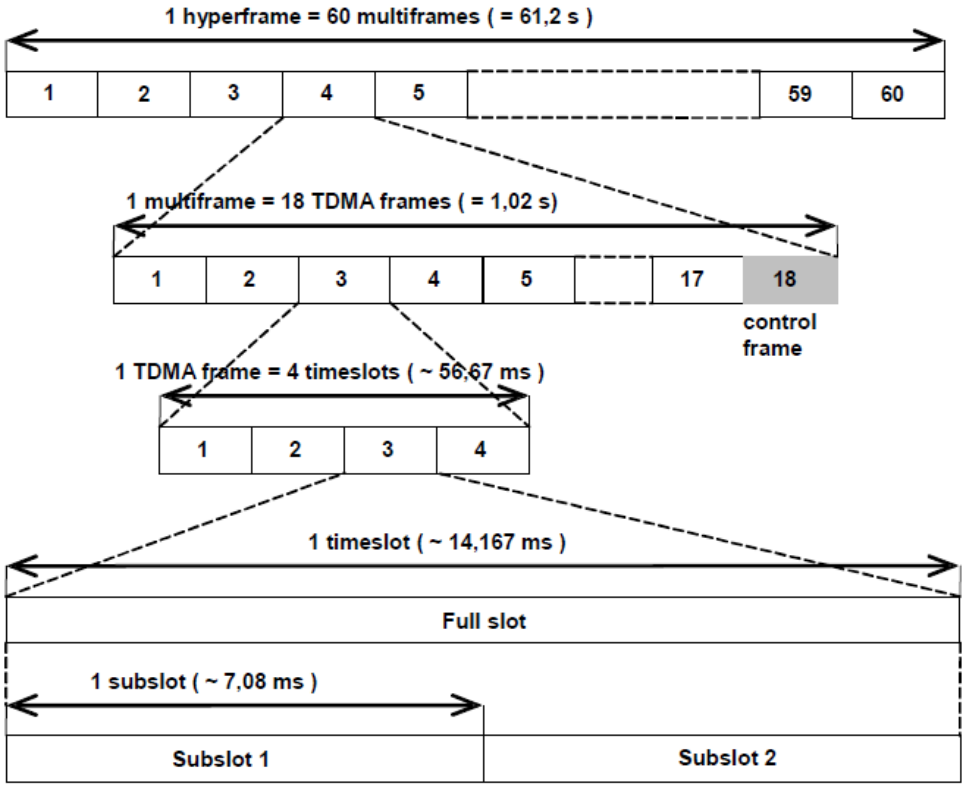
TETRA PHY Specifications

Transmitter Performance Measurement Methods

TS100 392-2

Note: For details, refer to the TETRA standard.

4.5.2 Hyperframes, multiframes and frames



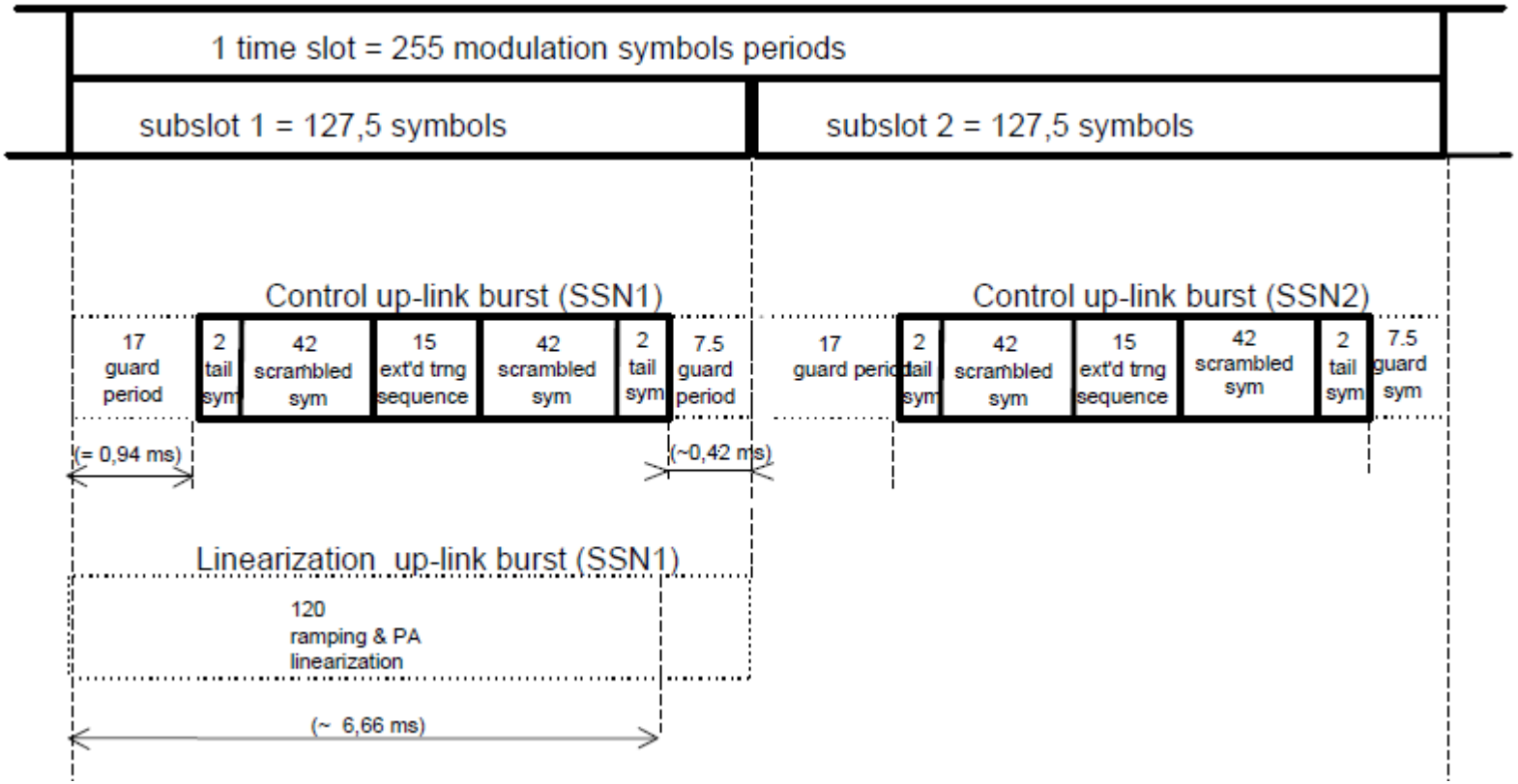
	Number of symbols	
	Phase modulation	QAM
Slot	255	34
Subslot	127,5	17

Transmitter Performance Measurement Methods

TS100 392-2

Note: For details, refer to the TETRA standard.

9.4.4 Type of bursts for phase modulation

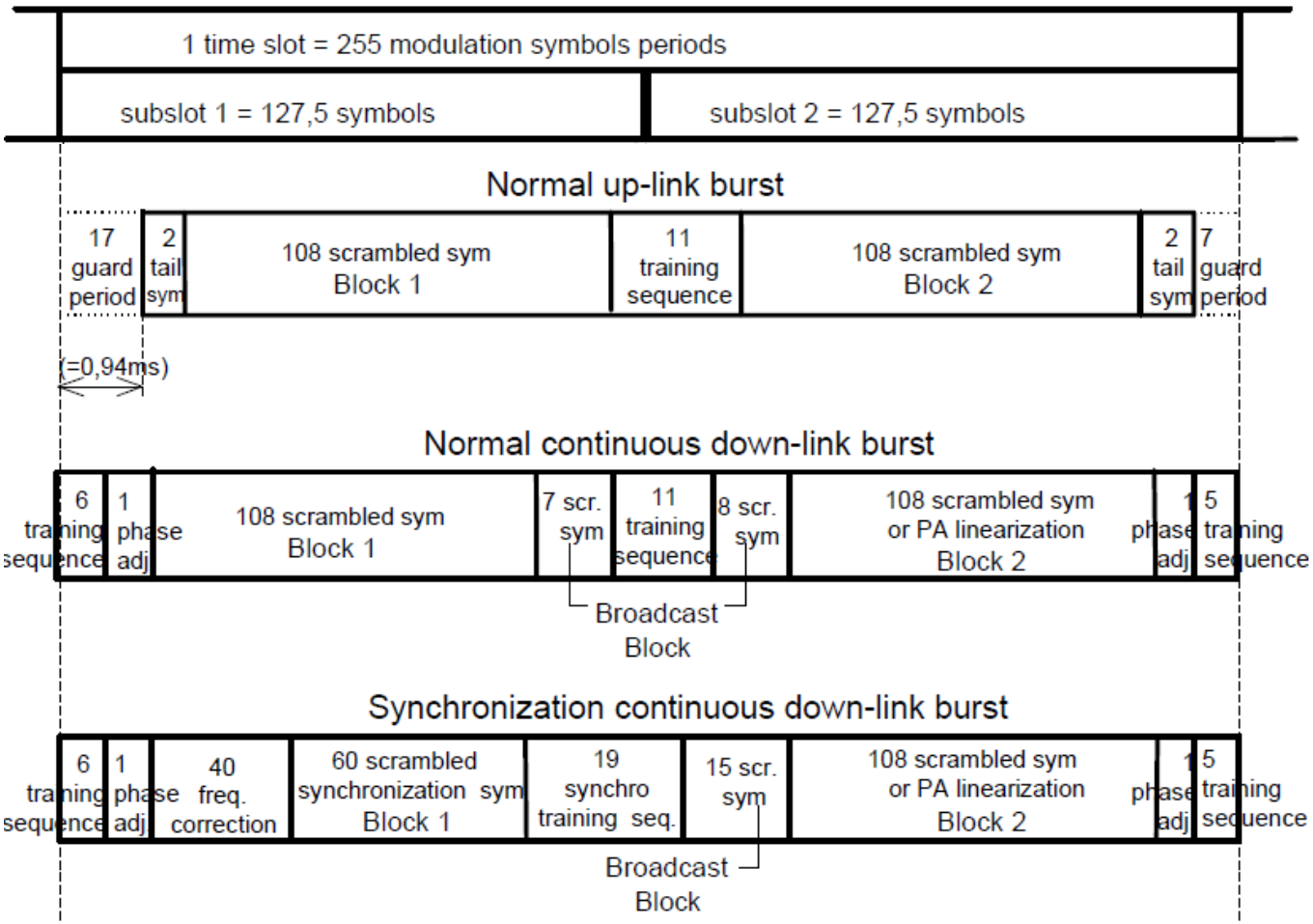


Transmitter Performance Measurement Methods

TS100 392-2

Note: For details, refer to the TETRA standard.

9.4.4 Type of bursts for phase modulation

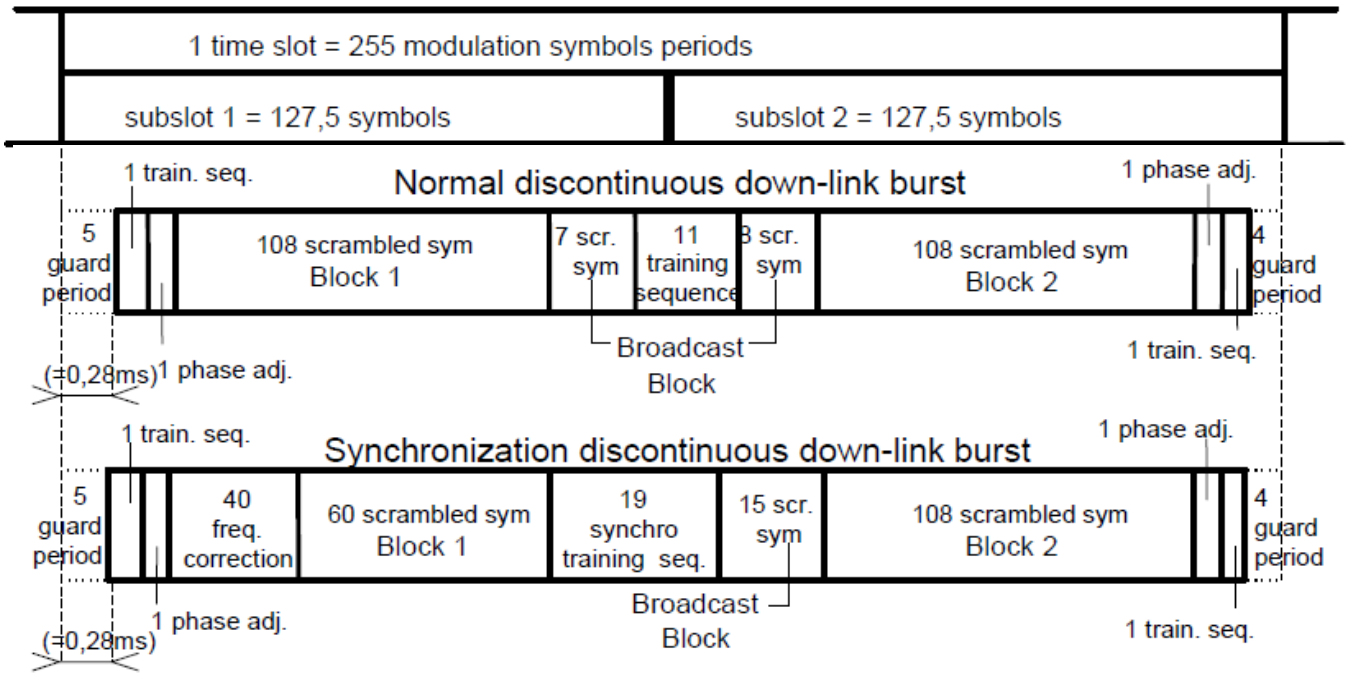


Transmitter Performance Measurement Methods

TS100 392-2

Note: For details, refer to the TETRA standard.

9.4.4 Type of bursts for phase modulation



Transmitter Performance Measurement Methods

TS100 392-2

Note: For details, refer to the TETRA standard.

Table 1: Summary of logical channels characteristics.

Logical Channel	Direction	Physical resource	Category	Evaluated performance
AACH	Downlink	30 initial bits of downlink timeslot	Signalling	MER
SCH/HD, BNCH and STCH	Downlink	Half slot	Signalling	MER
SCH/HU	Uplink	Half slot	Signalling	MER
BSCH	Downlink	Full slot	Signalling	MER
SCH/F	Uplink / Downlink	Full slot	Signalling	MER
TCH/S	Uplink / Downlink	Full slot	Traffic (Speech)	MER, residual BER
TCH/7,2	Uplink / Downlink	Full slot	Traffic (Data)	BER
TCH/4,8 (N=1, 4, 8)	Uplink / Downlink	Full slot	Traffic (Data)	BER
TCH/2,4 (N=1, 4, 8)	Uplink / Downlink	Full slot	Traffic (Data)	BER

The π/4-DQPSK normal training sequence 1 shall be:

$$(n1, n2, \ldots, n22) = (1,1,\ 0,1,\ 0,0,\ 0,0,\ 1,1,\ 1,0,\ 1,0,\ 0,1,\ 1,1,\ 0,1,\ 0,0)$$

The π/4-DQPSK normal training sequence 2 shall be:

$$(p1, p2, \ldots, p22) = (0,1,\ 1,1,\ 1,0,\ 1,0,\ 0,1,\ 0,0,\ 0,0,\ 1,1,\ 0,1,\ 1,1,\ 1,0)$$

The π/4-DQPSK normal training sequence 3 shall be:

$$(q1, q2, \ldots, q22) = (1,0,\ 1,1,\ 0,1,\ 1,1,\ 0,0,\ 0,0,\ 0,1,\ 1,0,\ 1,0,\ 1,1,\ 0,1)$$

The extended training sequence for π/4-DQPSK shall be:

$$(x1, x2, \ldots, x30) = (1,0,\ 0,1,\ 1,1,\ 0,1,\ 0,0,\ 0,0,\ 1,1,\ 1,0,\ 1,0,\ 0,1,\ 1,1,\ 0,1,\ 0,0,\ 0,0,\ 1,1)$$

The synchronization training sequence shall be:

$$(y1, y2, \ldots, y38) = (1,1,\ 0,0,\ 0,0,\ 0,1,\ 1,0,\ 0,1,\ 1,1,\ 0,0,\ 1,1,\ 1,0,\ 1,0,\ 0,1,\ 1,1,\ 0,0,\ 0,0,\ 0,1,\ 1,0,\ 0,1,\ 1,1)$$

The contents of the π/4-DQPSK tail bit field shall be:

$$(t1, t2, t3, t4) = (1,\ 1,\ 0,\ 0)$$

The frequency correction field shall contain 80 bits:

$$(f1, f2, \ldots\ldots, f8) = (1,\ 1,\ \ldots.,\ 1)$$

$$(f9, f10, \ldots., f72) = (0,\ 0,\ \ldots.,\ 0)$$

$$(f73, f74, \ldots, f80) = (1,\ 1,\ \ldots.,\ 1)$$

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