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APPLICATION NOTE

MG3700A

Vector Signal Generator

Waveform combining function

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MG3700A Vector Signal Generation

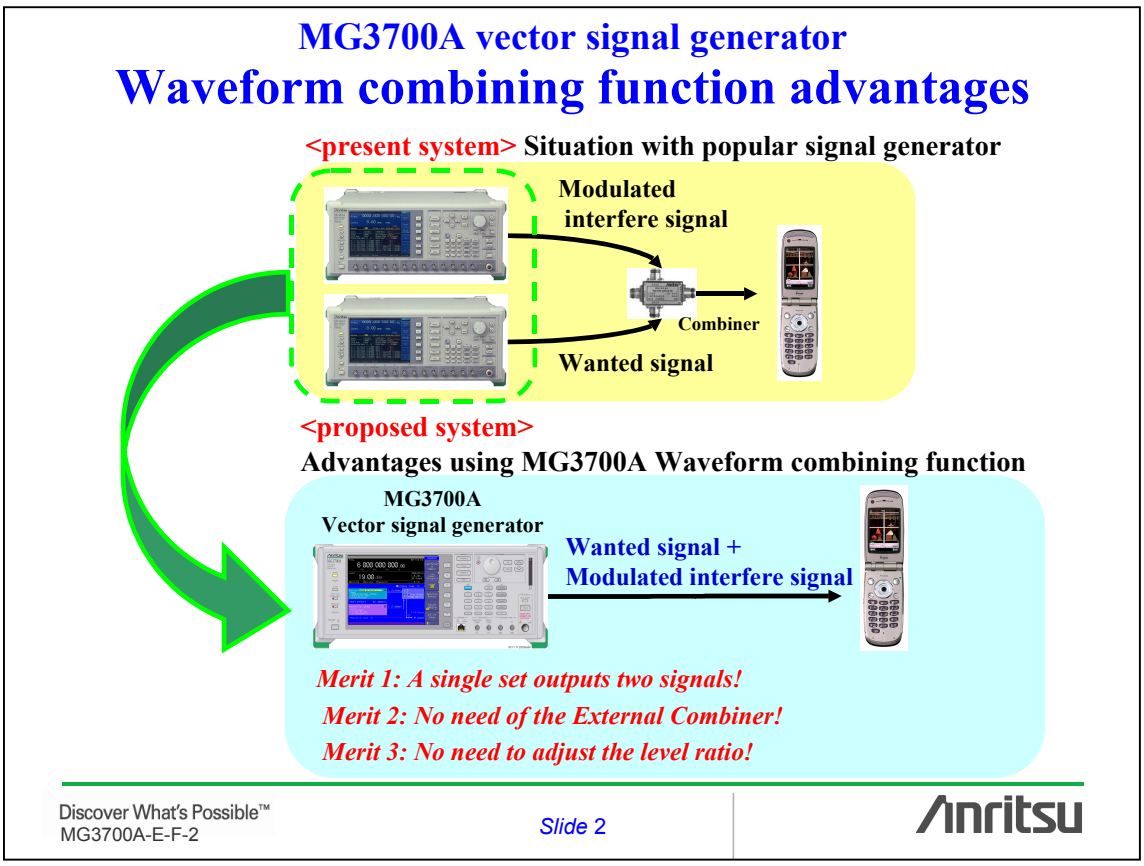
Application Note

Pre-installed Waveform combining function

ANRITSU CORPORATION

Measurement Business Center Wireless Measurement Div.

V1.0



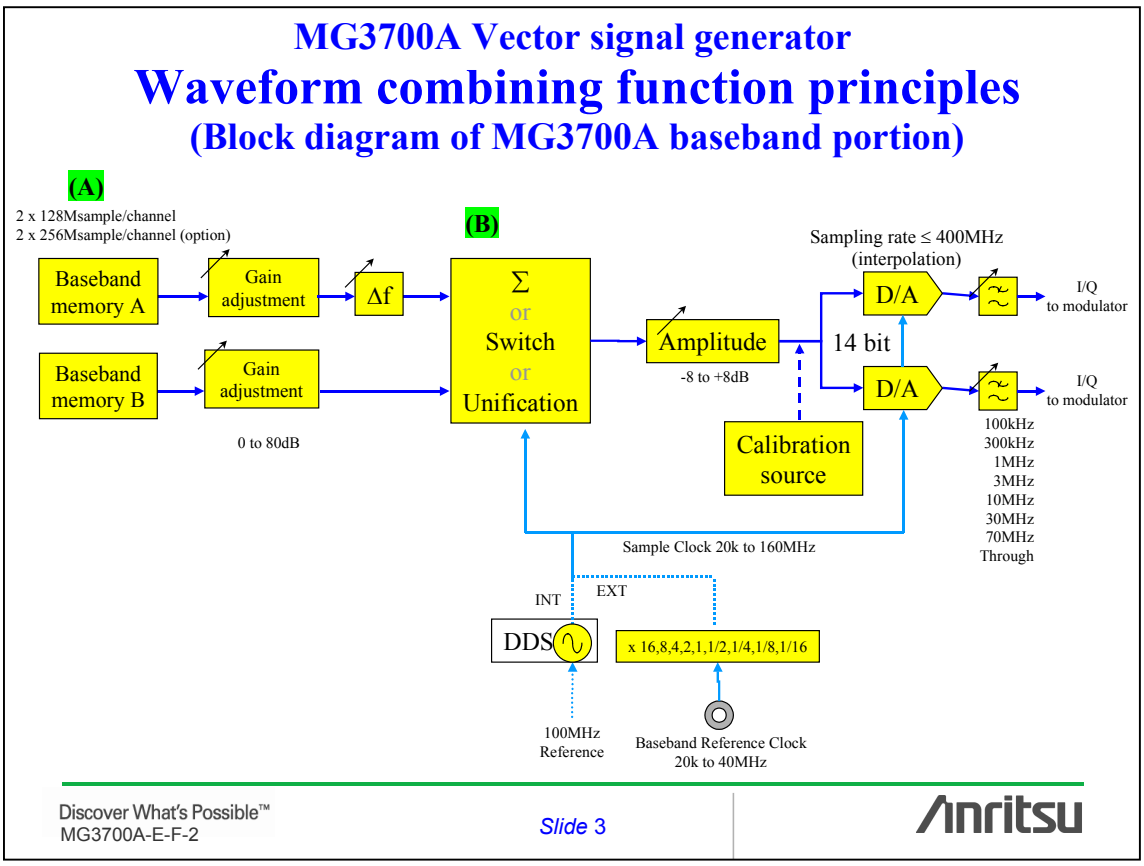
The receiver characteristic evaluation in various communication systems requires the measurement of characteristics while adding a modulated interfering signal to a wanted signal.

As you can see the diagram above, onea current signal generator can output only one signal, wanted signal, or modulated interfering signal. Therefore, two signal generators are necessary for testing [wanted signal + modulated interfere signal] as well as the Combiner that combines the two signals. In addition, a user needs to set the level ratio of a wanted signal and a modulated interfering signal.

On the contrary, as you can see the diagram below, the MG3700A Vector Signal Generator is equipped with a standard function to combine two signals and it can output both [wanted signal] and [modulated interfering signal] from a single generator. The merits are as follows.

Merit 1: A single set outputs two signals!
Merit 2: No need of the External Combiner!
Merit 3: No need to adjust the level ratio!

This function is very useful for the test of *wanted signal + modulated interfering signal of the same communication system.*



This is a block diagram of a the baseband portion of the MG3700A Vector Signal Generator. The MG3700A has two built-in baseband memories (Chart A). When the respective waveform patterns of "wanted signal" and "interfering signal" are selected for these two memories, the MG3700A can combine these waveform patterns (Chart B) and output the combined waveform pattern.

Paths are integrated into one after waveform combining and the variable width of frequency offset in waveform combining is restricted by the following formula.

$\pm(0.8 \times \text{Sampling Clock} \times 2^n - \text{Band Width})/2$

(n: The maximum integer for Sampling Clock x 2^n to be lower than 80 MHz. The integer is 0 if the Sampling Clock exceeds 20 MHz.)

As the MG3700A is able to combine two signals with two standard built-in baseband memories, a single MG3700A with its standard functions can output [wanted signal + modulated interfering signal].

Measurements of "Wanted signal + Modulated Interfering signal"

W-CDMA

DUT	Measurement Items	MG3700A
BS	ACS	√
	IM *	√
	Blocking *	√
UE	ACS	√
	IM *	√
	Blocking *	√

TD-SCDMA

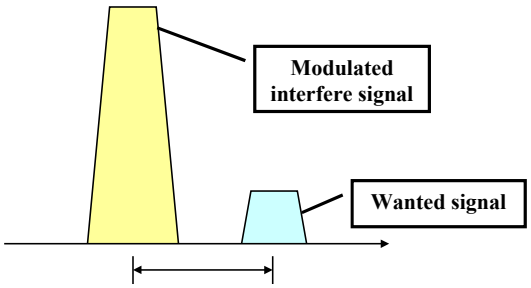
DUT	Measurement Items	MG3700A
BS	ACS	√
	IM *	√
	Blocking *	√
UE	ACS	√
	IM *	√
	Blocking *	√

ARIB STD-T61/T79/T86

DUT	Measurement Items	MG3700A
BS	ACS	√

PHS

DUT	Measurement Items	MG3700A
UE	ACS	√



*: In the measurement of IM/Blocking, the signal source of CW is needed.

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This table shows the test items of [wanted signal + modulated interfering signal] in each communication systems.
Patterns, levels and offset frequencies of a wanted signal and a modulated interfering signal are defined by respective standards.

[Waveform combining] in the table indicates that the MG3700A waveform combining function enables it to output two signals from a single generator.

Measurements of "Wanted signal + Modulated Interfering signal"

W-CDMA <Detail>

W-CDMA UE

3GPP TS25.101		Wanted Signal *2 [dBm/1.28MHz]	Interfere Signal [dBm]	Offset Frequency [MHz]
7.5	ACS	**-92.7 to -90.7**	**-52 (Mod)**	+/-5.0
7.6	Blocking	**-103.7 to -101.7 *1**	**-56 (Mod)**	+/-10.0
7.6	Blocking	**-103.7 to -101.7 *1**	**-44 (Mod)**	+/-15.0
7.8	IM	**-103.7 to -101.7 *1**	**-46 (Mod)** -46 (CW)	+/-20.0 +/-10.0

*1: It depends on operating band.
*2: All the parameteres defined using the DL reference measurement channel (12.2kbps).
==> Preinstalled waveform pattern
Wanted signal 7.5 ACS **"DL_RMC_12_2kbps_ACS"**
Wanted signal 7.6-7.8 **"DL_RMC_12_2kbps_RX"**
Interfere signal **"DL_Interfere" or "DL_Interfere_ov3"**
*3: Supurious response frequencies

W-CDMA BS

3GPP TS25.141		Wanted Signal *2 [dBm/1.28MHz]	Interfere Signal [dBm]	Offset Frequency [MHz]
7.4	ACS	**-105**	**-42 (Mod)**	+/-5.0
7.5	Blocking	**-115/-105/-101 *1**	**-40/-35/-30 (Mod)**	+/-10.0
7.6	IM	**-104**	**-48 (Mod)** -48 (CW)	+/-6.4 +/-3.2

*1: Wide area BS/ Medium Range BS/ Local area BS
*2: All the parameteres defined using theUL reference measurement channel (12.2kbps).
==> Preinstalled waveform pattern
Wanted signal **"UL_RMC_12_2kbps"**
Interfere signal **"UL_Interfere" or "UL_Interfere_ov3"**
*3: Supurious response frequencies

This table shows the test items of [wanted signal + modulated interfering signal] defined by W-CDMA standard. The levels and offset frequencies of a wanted signal/interfere signal are also described.

Blue font indicates the measurements that require [wanted signal + modulated interfering signal].
A single MG3700A can output these two signals.

Red font indicates the names of waveform patterns used as a wanted signal/interfering signal in MG3700A. W-CDMA waveform patterns can be used by the standard configuration.

Measurements of "Wanted signal + Modulated Interfering signal"

PHS <Detail>

RCR STD-28 Personal handy phone system (PHS)

RCR STD-28		Wanted Signal *1 [dBm] *3	Interfere Signal *2 [dBm] *3	Offset Frequency [MHz]
7.2.2	Adjacent Channel Selectivity	**-97.5 to -76.5**	**-47.5 to -29.5 min (Mod)**	+/- 0.6 +/- 0.9 *4
7.2.3	Intermodulation characteristics	**-97.5 to -76.5**	-53.5 to -32.5 min (CW)	+/- 0.6 & **1.2** *4 +/- 0.9 & **1.8** *5

*1: Wanted signal is a binary pseudonoise system with the cycle in 511 bits in the sign length. It is put on the information channel or all slot section. ===> Waveform pattern **"DL_TCH_Slot_1" "UL_TCH_Slot_1"**

*2: Interfere signal is a binary pseudonoise system with the cycle in 32,767 bits in the sign length.
===> Waveform pattern **"PI_4_DQPSK_PN15"**

*3: "Standard sensitivity" changes depending on the modulation method. Refer to RCR STD-28 for details.

*4: Upper: Occupied bandwidth ≤ 288kHz, Lower: Occupied bandwidth > 288kHz.

***5: A single set of MG3700A can output both "Wanted Signal" and distant "Interfere Signal". Nearby "Interfere Signal" requires the CW signal source separately. Thus, the measurement that conventionally requires three sets of MG3700A is performed only by two sets.**

This table shows the test items of [wanted signal + modulated interfering signal] defined by RCR STD-28 (PHS) standard.

Blue font indicates the measurements that require [wanted signal + modulated interfering signal].
A single of MG3700A can output these two signals.

Red font indicates the names of waveform patterns used as a wanted signal/interfere signal in MG3700A. PHS waveform patterns can be used by the standard configuration.

Measurements of "Wanted signal + Modulated Interfering signal"

TD-SCDMA <Detail>

TD-SCDMA UE

*3	Wanted Signal *2 [dBm/1.28MHz]	Interfere Signal [dBm]	Offset Frequency [MHz]	(1)	(2)
ACS	**-91**	**-54 (Mod)**	+/-1.6	6.4	7.5
Blocking	**-105**	**-61 (Mod)**	+/-3.2	6.5	7.6
Blocking	**-105**	**-49 (Mod)**	+/-4.8	6.5	7.6
IM	**-105**	**-46 (Mod)** -46 (CW)	+/-6.4 +/-3.2	6.7	7.8

*1: Supurious response frequencies
*2 All the parameteres defined using the DL reference measurement channel (12.2kbps).
==> Preinstalled waveform pattern
"rmc12_2k_ue_dl".
*3: Clause: (1) 3GPP TS34.122,
(2) 3GPP TS25.102,

TD-SCDMA BS (Wide Area)

3GPP TS25.142		Wanted Signal *2 [dBm/1.28MHz]	Interfere Signal [dBm]	Offset Frequency [MHz]
7.4	ACS	**-104**	**-55 (Mod)**	+/-1.6
7.5	Blocking	**-104**	**-40 (Mod)**	+/-3.2 min
7.5	Blocking	**-104**	-15 (CW)	*1
7.6	IM	**-104**	**-48 (Mod)** -48 (CW)	+/-6.4 +/-3.2

*1: Frequency range of interfering signal.
*2: All the parameteres defined using the UL reference measurement channel (12.2kbps).
==> Preinstalled waveform pattern
"rmc12_2k_bs_dl".

TD-SCDMA BS (Local Area)

3GPP TS25.142		Wanted Signal *2 [dBm/1.28MHz]	Interfere Signal [dBm]	Offset Frequency [MHz]
7.4	ACS	**-90**	**-41 (Mod)**	+/-1.6
7.5	Blocking	**-90**	**-30 (Mod)**	+/-3.2 min
7.5	Blocking	**-90**	-15 (CW)	*1
7.6	IM	**-90**	**-38 (Mod)** -38 (CW)	+/-6.4 +/-3.2

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This table shows the test items of [wanted signal + modulated interfering signal] defined by TD-SCDMA standard.

Blue font indicates the measurements that require [wanted signal + modulated interfering signal].
A single of MG3700A can output these two signals.

Red font indicates the names of waveform patterns used as a wanted signal/interfering signal in MG3700A. TD-SCDMA can be used by installing the optional "*MX370001A TD-SCDMA Waveform Pattern*" in the MG3700A.

Measurements of "Wanted signal + Modulated Interfering signal"

ARIB STD <Detail>

ARIB STD-T61 Narrow band digital telecommunication system (SCPC/FDMA)

ARIB STD-T61		Wanted Signal *1 [dBm]	Interfere Signal *2 [dBm]	Offset Frequency [kHz]
6.2.3	Adjacent Channel Selectivity	**-110**	**-68 min (Mod)**	+/-6.25
6.2.4	Intermodulation characteristics	**-110**	-57 min (CW) **-57 min (CW)**	+/-12.5 **+/-25.0** *3

*1: Wanted signal is a binary pseudonoise system with the cycle in 511 bits in the sign length. It is put on the traffic channel or all slot section. ==> Waveform pattern **"UpDownLink"**
*2: Interfere signal is a binary pseudonoise system with the cycle in 32,767 bits in the sign length.
==> Waveform pattern **"PN15"**

ARIB STD-T79 Digital mobile telecommunication system for local government

ARIB STD-T79		Wanted Signal *1 [dBm]	Interfere Signal *2 [dBm]	Offset Frequency [kHz]
6.2.3	Adjacent Channel Selectivity	**-104**	**-62 min (Mod)**	+/-25.0
6.2.4	Intermodulation characteristics	**-104**	-51 min (CW) **-51 min (CW)**	+/- 50.0 **+/-100.0** *3

*1: Wanted signal is a binary pseudonoise system with the cycle in 511 bits in the sign length. It is put on the traffic channel or all slot section. ==> Waveform pattern **"UpLink" "DownLink1" "DownLink4"**
*2: Interfere signal is a binary pseudonoise system with the cycle in 32,767 bits in the sign length.
==> Waveform pattern **"PN15"**

ARIB STD-T86 Regional digital simultaneous communication system

ARIB STD-T86		Wanted Signal *1 [dBm]	Interfere Signal *2 [dBm]	Offset Frequency [kHz]
6.2.3	Adjacent Channel Selectivity	**-101**	**-59 min (Mod)**	+/-15.0
6.2.4	Intermodulation characteristics	**-101**	-48 min (CW) **-48 min (CW)**	+/-30.0 **+/-60.0** *3

*1: Wanted signal is a binary pseudonoise system with the cycle in 511 bits in the sign length. It is put on the traffic channel or all slot section.
==> Waveform pattern **"Down_tch" "Down_tch_all" "Down_cch" "Up_tch" "Up_cch"**
*2: Interfere signal is a binary pseudonoise system with the cycle in 32,767 bits in the sign length.
==> Waveform pattern **"PN15"**

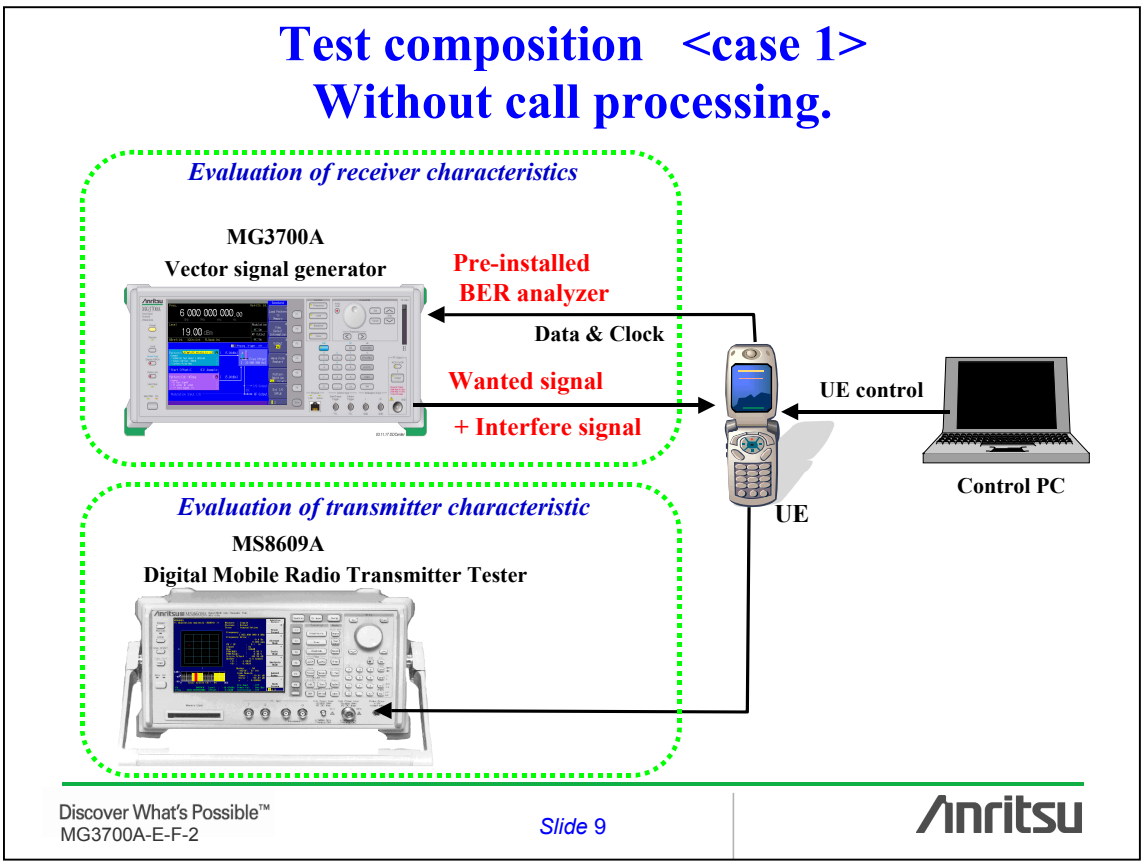
***3: A single MG3700A can output both the "Wanted Signal" and distant "Interfere Signal".**

The nearby "Interfere Signal" requires a separate CW signal source. Thus, a measurement that conventionally requires three MG3700A units is performed by only two units.

This table shows the test items of [wanted signal + modulated interfere signal] defined by ARIB STD-T61/T79/T86 standards.

Blue font indicates the measurements that require [wanted signal + modulated interfering signal].
A single MG3700A can output these two signals.

Red font indicates the names of waveform patterns used as a wanted signal/interfering signal in MG3700A. Public radio system (ARIB STD-T61/T79/T86) can be used by installing the optional *"MX370002A Public Radio System Waveform Pattern"* in the MG3700A.

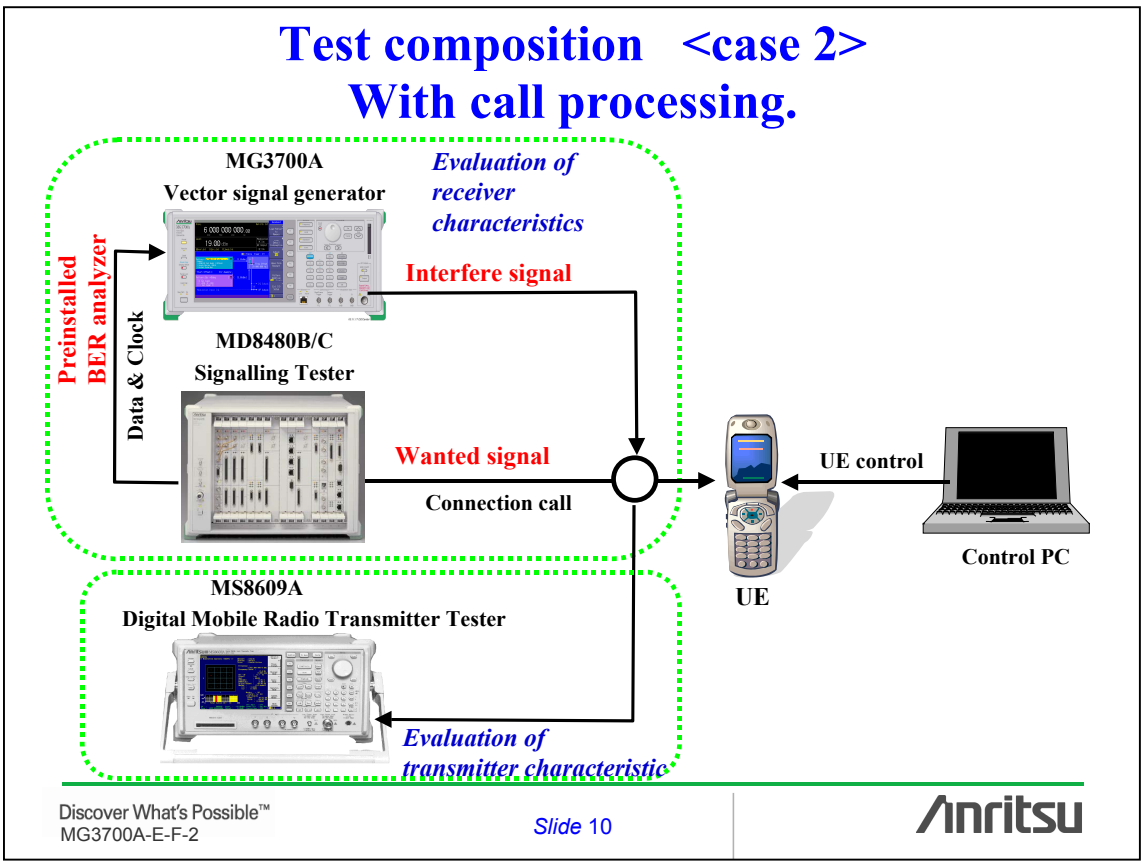


Next is about typical measurement systems utilizing various measuring instruments.
The Case 1 shows an example without call processing.

A single MG3700A can output [wanted signal + modulated interfere signal]. Furthermore, with a standard built-in [BER tester], it can be used for the receiver characteristic test.

This configuration is optimum for the RF board adjustment process in the development or manufacturing phase.

The measurement system described on the next page is required for evaluation if the loop-back mode is defined by the standard.

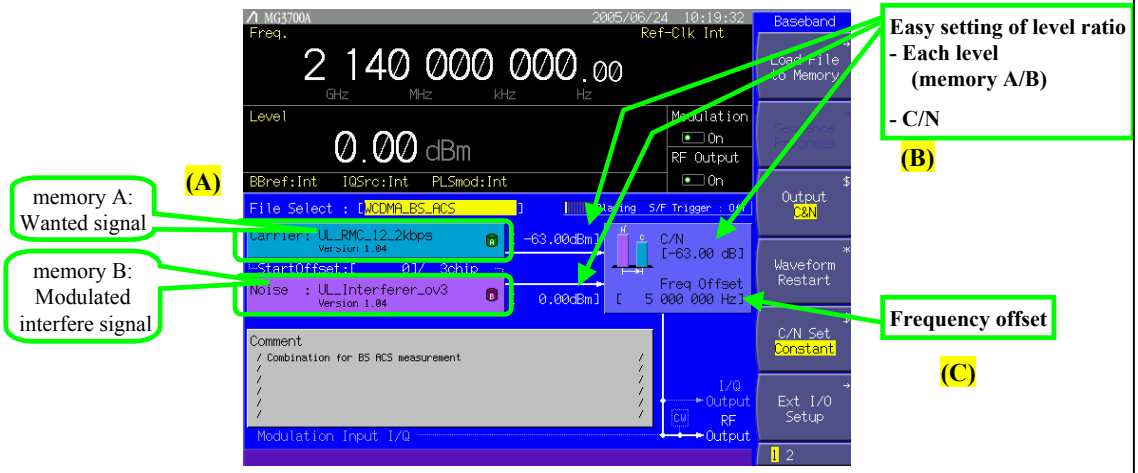


The Case 2 shows an example with call processing.

This measurement system offers the measurements by loop-back mode utilizing the MD8470A Signalling Tester.
The MS8609A evaluates transmitter characteristics and the combination of MD8470A and MG3700A evaluates receiver characteristics. In this case, the MD8470A is used as a wanted signal and the MG3700A as an interfering signal.
Also, the MD8480B/C can perform a variety of functional tests.

This configuration is optimum for RF testing and functional testing on the manufacturing line as well as in maintenance.

MG3700A Vector signal generator
What is the "Waveform combining function"?



- *Two signals of "Wanted signal＋Modulated interfere signal" are output with one SG.*
- *The level can be set with each level or C/N.*
- *The frequency offset can be set by the direct input.*

Pre-installed function

In this slide, you can see a sample screen of the waveform combining function of the MG3700A Vector Signal Generator.

The MG3700A can divide its internal memory into two; one for a wanted signal, and the other for a modulated interfering signal. (Chart A)
Two signals are combined in the internal baseband portion of MG3700A and outputted.
The levels of the two signals can be set separately or by the C/N value. (Chart B)
Also, the frequency offset of a wanted signal and a modulated interfering signal can be set on the screen. (Chart C)

Furthermore, the MG3700A is equipped with the standard [Combination function] that offers the automated setting function (Next page).

MG3700A Vector signal generator

"Combinations function"

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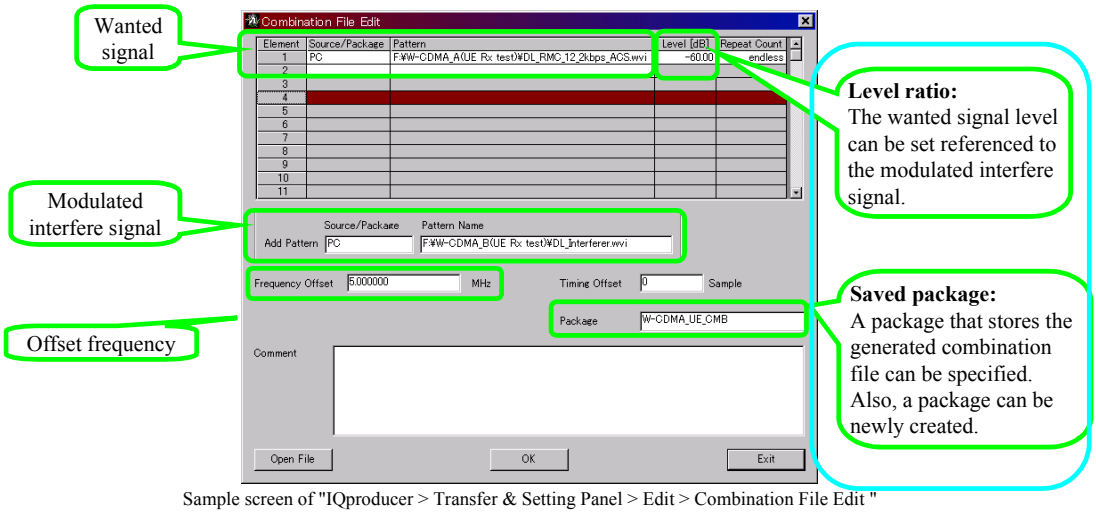
The Combination function enables automated parameter setting by only selecting a [combination file] that has parameters of [wanted signal], [modulated interfering signal], [level ratio] and [offset frequency]. After setting them automatically, a user can set these parameters individually on the screen.
Anyone can easily output a complex signal of combined waveforms by only selecting a combination file.

Also, the combination files of W-CDMA_BS, PDC and PHS are pre-installed in the HDD of the MG3700A Vector Signal Generator.

With an attached free generation tool for combination files, a user can freely generate and use the combination files (Next page).

MG3700A Vector signal generator

Combinations files are generated without charge.



Sample screen of "IQproducer > Transfer & Setting Panel > Edit > Combination File Edit "

* A combination file is useful for switching multiple waveform patterns in sequence or consolidating waveform patterns of different communication systems in one folder as well as for waveform combining. Refer to the appendix [How to create the combination file] for detail.

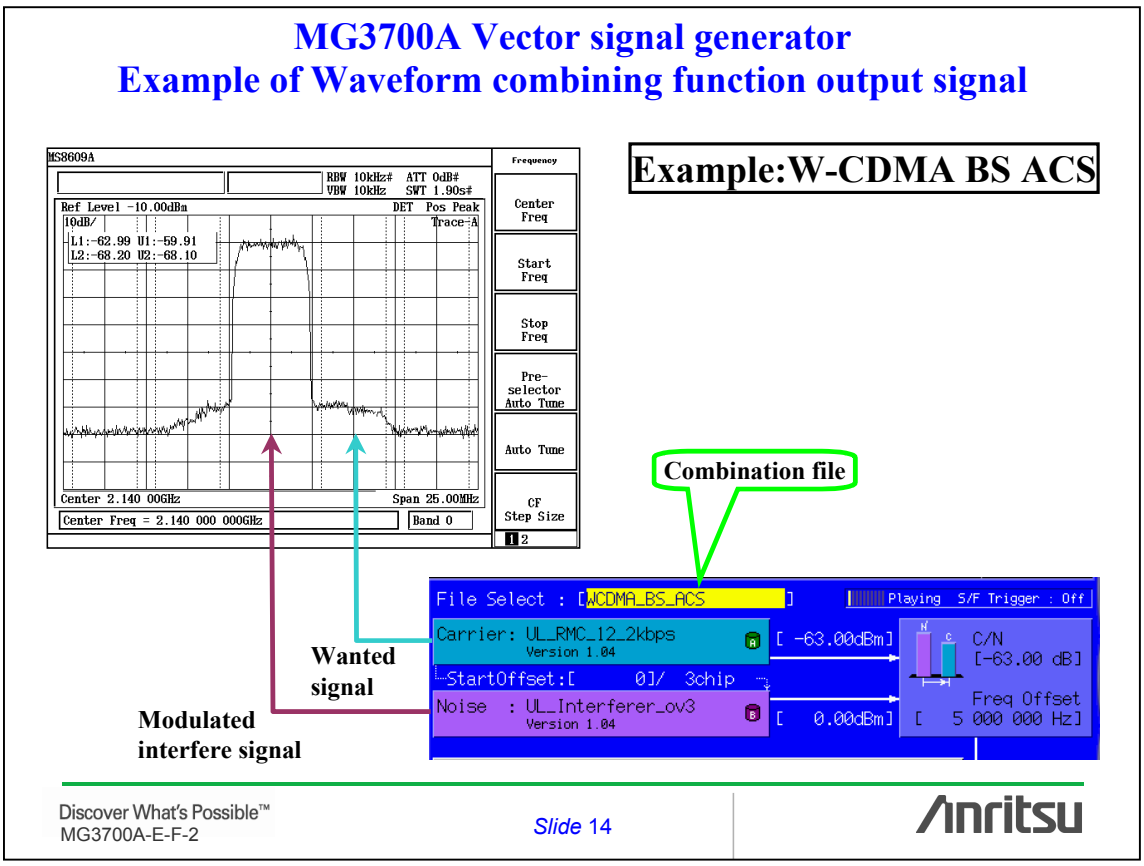
The combination file generating function is one of functions offered by “IQproducer” that is the PC software attached to MG3700A.

IQproducer > Transfer & Setting Panel
> Edit > Combination File Edit

This function is charge-free. With the very simple parameters, anyone can easily generate the combination files.

By storing it in the MG3700A’s built-in HDD, the generated combination file can be recalled from the HDD and used without a PC.

Refer to the appendix [How to create the combination file] for details.



The lower-right image shows the waveform select screen for selecting a combination file on the MG3700A Vector Signal Generator. The upper-left image shows the output waveform screen.

When a combination file named as [W-CDMA_BS_ACS] is selected in [File Select] on the waveform select screen, the intended waveform patterns are specified for Memory A&B respectively. At the same time, output levels and offset frequencies are set automatically.

MG3700A Vector signal generator
Excellent basic functions

[Mainframe] MG3700A Vector signal generator

[Pre-installed functions]

- Frequency range	**250 kHz to 3 GHz**
- Reference oscillator	**Aging rate +/- 1 x 10^{-7}/year**
- Attenuator	**Electrical, Frequency/Level setting speed 10 ms***
- Memory size	**1 GB = 256 Msamples**
- Baseband generator	**120 MHz (Using internal baseband generator)**
- Waveform combining function	
- BER analyzer	**Input bit rate 1 kbps to 20 Mbps**
- Hard disk	**40 GB preinstalled.**

[Pre-installed waveform patterns]

W-CDMA, cmda2000 1X, 1xEV-DO, GSM/EDGE, PDC, PHS, WLAN(IEEE 802.11a/b/g), *Bluetooth*®, GPS, AWGN Digital broadcast (ISDB-T/BS/CS/CATV)

*: Depends on the measurement condition.

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The MG3700A Vector Signal Generator is equipped with standard functions, performances, and waveform patterns that are necessary for a signal generator.
Furthermore, with the standard-equipped waveform combining function that is useful for receiver characteristic evaluation and additive functions such as BER tester, the MG3700A is a product with an excellent cost-performance advantage.

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