Product Introduction

MG3700A

Vector Signal Generator

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Anritsu Corporation

MG3700A

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Product Outline

- Product Outline
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- Options

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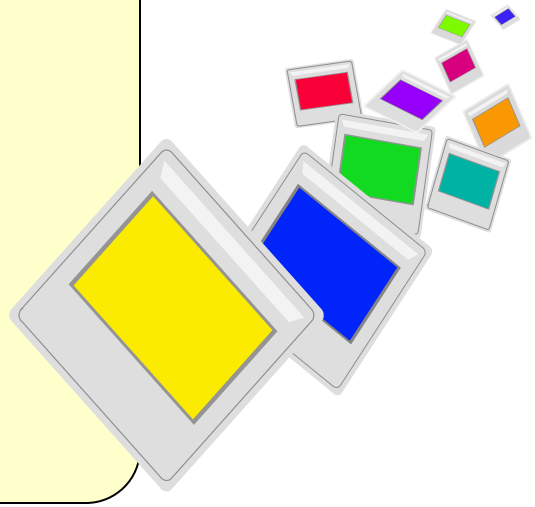


Best Value Required

Your vector signal generator requirements have never been tougher, and yet your capital equipment budget has never been tighter. You need the most value you can get in a vector signal generator. You need a vector signal generator that meets today's needs yet can be diverted to satisfy future requirements without shattering your test equipment budget. The MG3700A Vector Signal Generator delivers the best value required today at a reasonable cost:

- Adaptable to next generation markets
- Utilizable to evaluate equipment, baseband chips, and components for broadband wireless communication

Market Trends

- Mobile communication systems are evolving to higher speeds and increased wideband modulation.
  - » Cellular phones and WLANs are evolving into new wireless systems using more information.
- Broadcast and information service systems are developing toward digitization.
  - » They are changing from analog modulation to digital modulation for advanced information services and frequency-effective utilization.
- A wide variety of new wireless systems, such as last mile and personal communications (WPAN), have appeared.
  - » In order to increase cordless mobility, various new wireless systems are being introduced.

Major Vector Signal Generator Applications

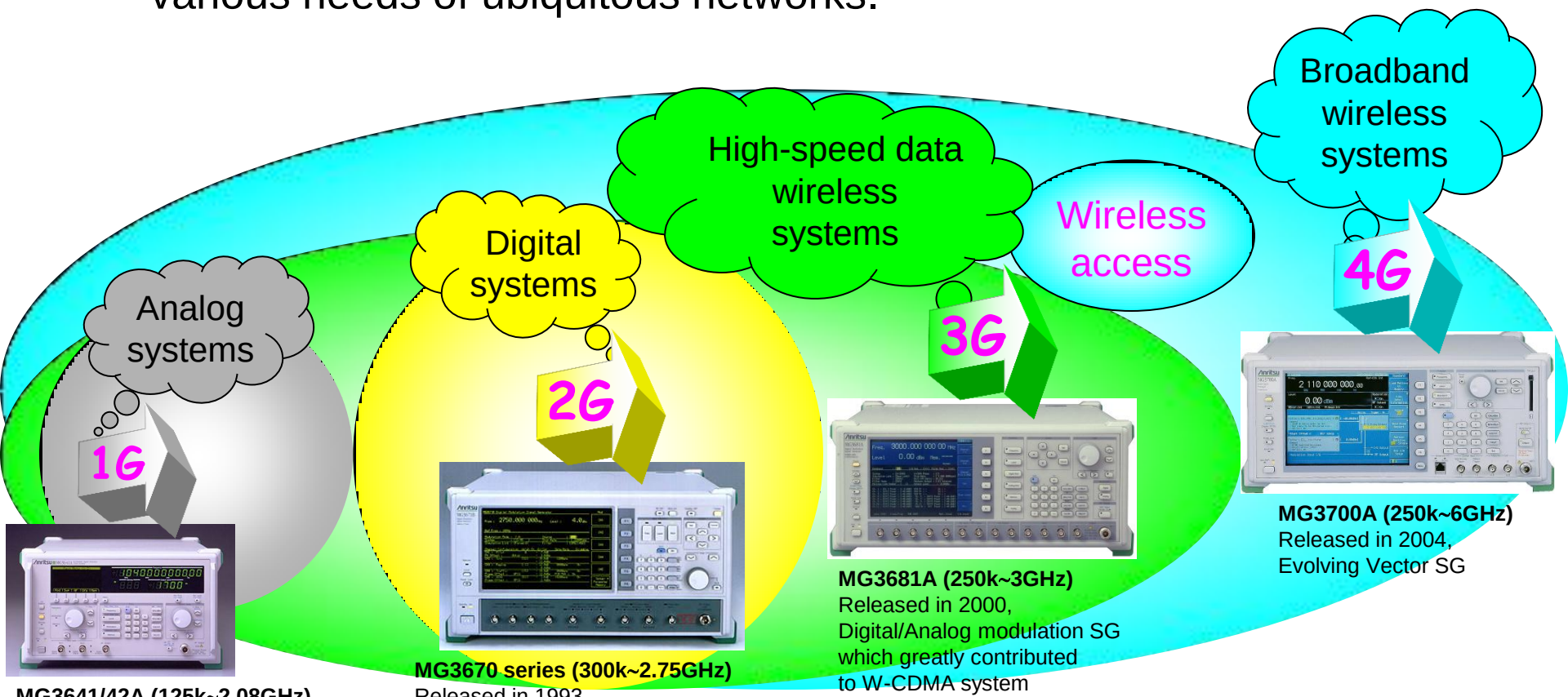
- Wanted signal source and interference signal source for receiver testing
  - » Receiver sensitivity test needs a wanted signal source. Receiver interference response test also needs interference signal sources.
- Reference signal source for evaluating components and devices
  - » For components, such as power amplifiers, filters, mixers, and modulator/demodulators, path performance and distortion (spectral regrowth) are measured using signal generators and signal analyzers.
- Reference signal source for verifying baseband chips
  - » Baseband chips are verified their decoding algorithms and processing flows in physical layer during their development phase.

Product Concept

- Wideband modulation capability adaptable up to 4G
- Includes an all-round and high-speed arbitrary waveform (ARB) I/Q baseband generator as standard equipment
- Includes baseband memory and hard disk that store large-volume baseband signal data as standard equipment
- Includes BER analyzer required for receiver sensitivity test as standard equipment
- Fast switching, high reliability, and high level accuracy for ATE
- Ethernet remote operation to make maintenance management easy
- Weight saving to increase mobility
- Ecological design

All-rounder for Ubiquitous Networks

- MG3700A is the diffusion brand with a new concept to realize the various needs of ubiquitous networks.



MG3641/42A (125k~2.08GHz)
Released in 1997,
Analog modulation SG
of reasonable economy class

MG3670 series (300k~2.75GHz)
Released in 1993,
Digital modulation SG
which greatly contributed to digitizing
of mobile communication systems

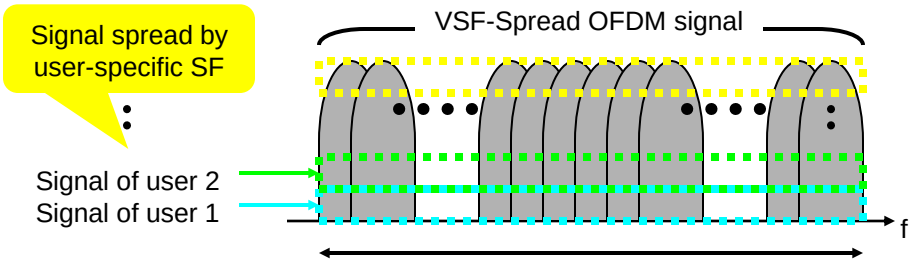
MG3681A (250k~3GHz)
Released in 2000,
Digital/Analog modulation SG
which greatly contributed
to W-CDMA system

MG3700A (250k~6GHz)
Released in 2004,
Evolving Vector SG

Wideband Modulation Capability Adaptable Up to 4G

- NTT DoCoMo started development of the next generation mobile communication system for which utilization is expected by 2010.
- High-speed packet data communications with maximum 2.5 Gbps downlink and maximum 20 Mbps uplink were achieved.

Wireless technology	Downlink	Uplink
Radio access scheme	VSF-Spread OFDM & MIMO	VSF-CDMA
Bandwidth	101.5 MHz	40 MHz
Number of sub-carrier	768 (131.836 kHz spacing)	2 (20 MHz spacing)
OFDM symbol length	9.259 ms	-
Guard interval length	1.674 ms	-
Frame length	0.5 ms	0.5 ms
Data modulation scheme	QPSK, 16QAM, 64QAM	QPSK, 16QAM, 64QAM
Channel coding (Rate)	Turbo coding (1/3 ~ 8/9)	Turbo coding (1/3 ~ 1/16)
Spreading factor	1 ~ 128	1 ~ 256

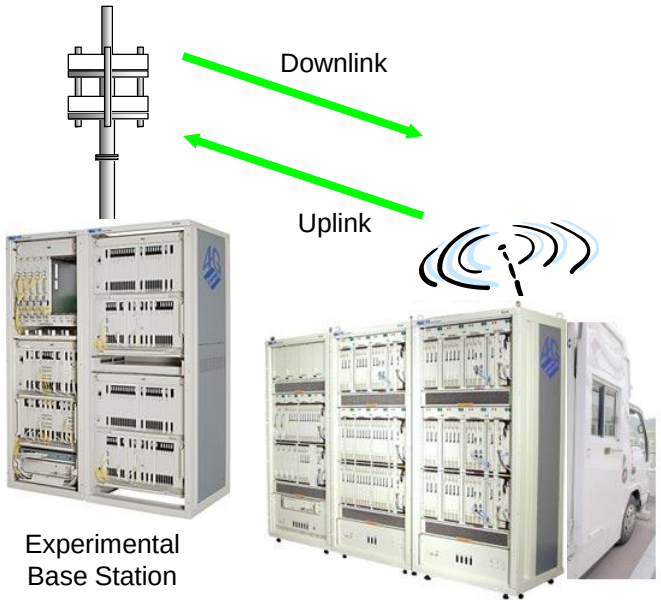


100MHz bandwidth is divided into 768 carriers, and it transmits in parallel.

VSF-Spread OFDM: Variable Spreading Factor Spread Orthogonal Frequency Division Multiplexing

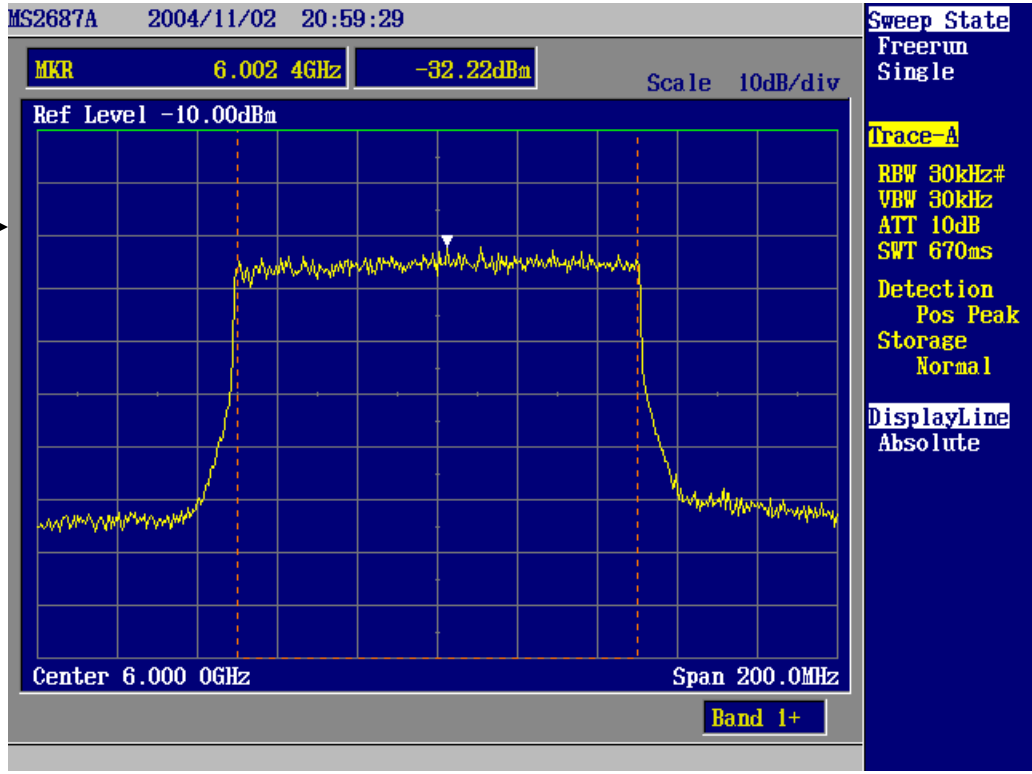
MIMO: Multiple-Input-Multiple-Output

Source: NTT DoCoMo

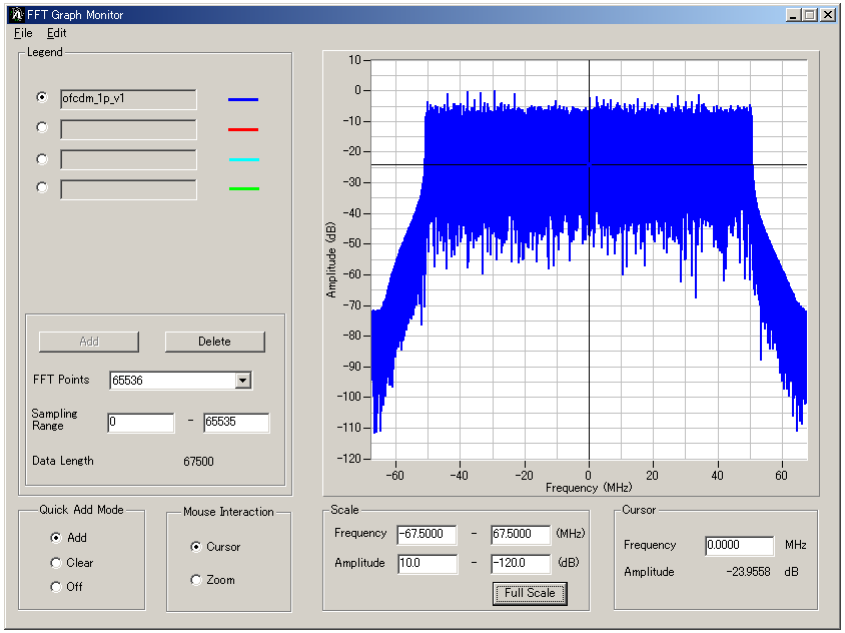


Wideband Modulation Capability Adaptable Up to 4G

- Spectrum



» Simulation using FFT



Includes an All-round and High-speed ARB I/Q Baseband Generator as Standard Equipment

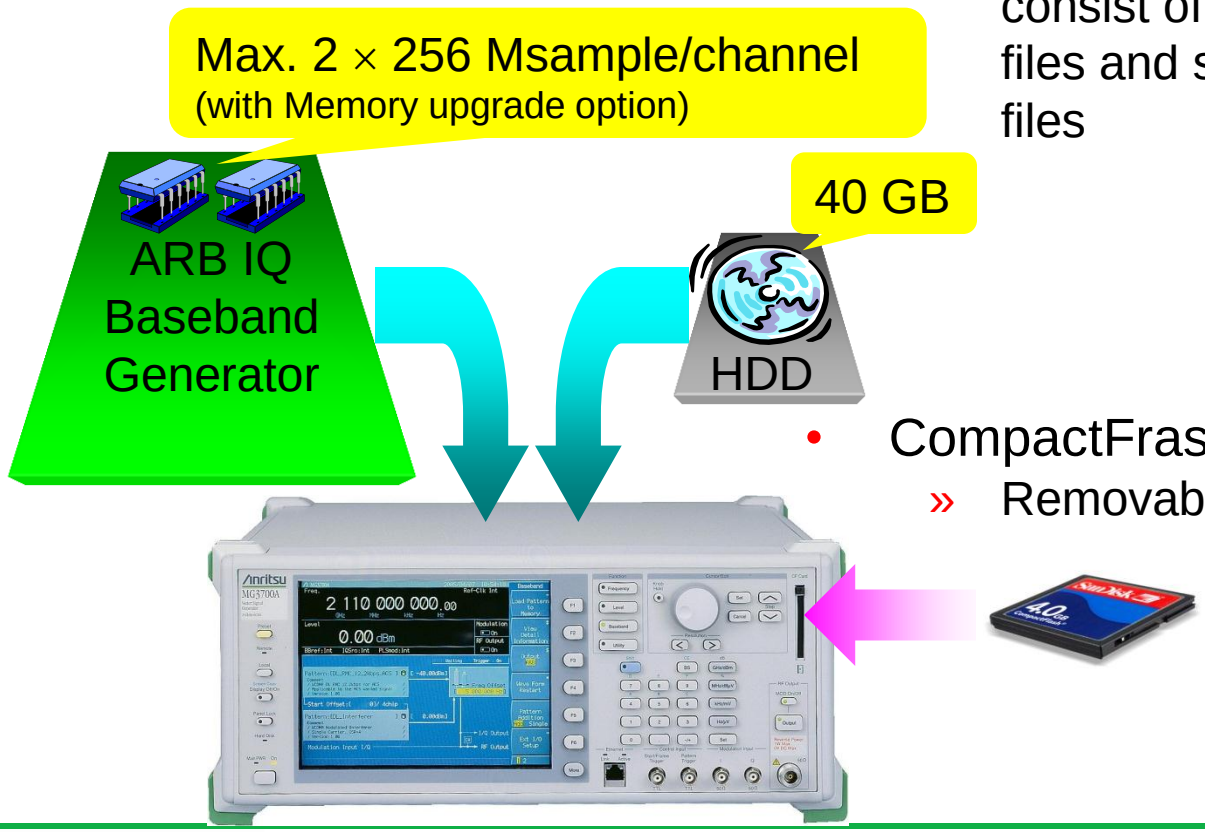
- Internal I/Q baseband generator generates the amplitude data sequence with which the baseband signals waveform of I channel (in-phase) and Q channel (quadrature-phase) were sampled. The baseband signal sample data are converted using D/A converters.
- I/Q modulation is well suited to generate digital modulation signals but may also be used to generate analog modulation signals.
- Custom I/Q sample data calculated by the PC program (algorithm) are loaded to the baseband memory, and the signal is repeatedly generated.
- Since the simulation signals can be generated arbitrarily, flexibility is very high. But the signal generating capability is limited by the baseband memory length or sample rate.

Includes Baseband Memory and Hard Disk that Store Large-volume Baseband Signal Data as Standard Equipment

- Baseband memory
  - » Memory for generating I/Q sample data

  Dual Baseband memory

- Hard disk drive (HDD)
  - » Hard disk for saving the signal pattern files which consist of I/Q sample data files and signal configuration files



- CompactFrash® (CF)
  - » Removable media

Includes BER Analyzer Required for Receiver Sensitivity Test as Standard Equipment

- Receiver sensitivity test can measure error rate specified by BER.
  - » W-CDMA, GSM, PHS, PDC etc.
- A BERT (Bit Error Rate Tester) installed as standard equipment contributes to easy receiver testing and space saving.

Fast Switching, High Reliability

- Fast testing and high reliability are critical specifications for Auto Test Equipment (ATE).
  - » Fast switching
    - – Original frequency synthesizer technique has balanced of cost and performance.
    - – Fast switching time employing an electronic step attenuator improves test throughput.
  - » High reliability
    - – MTBF has been improved employing an electronic step attenuator instead of the traditional mechanical step attenuator.
  - » Free application drivers
    - – National Instruments LabView® drivers save time and money in code generation and maintenance.
      - – The driver can be downloaded free from the Anritsu MG3700A website.

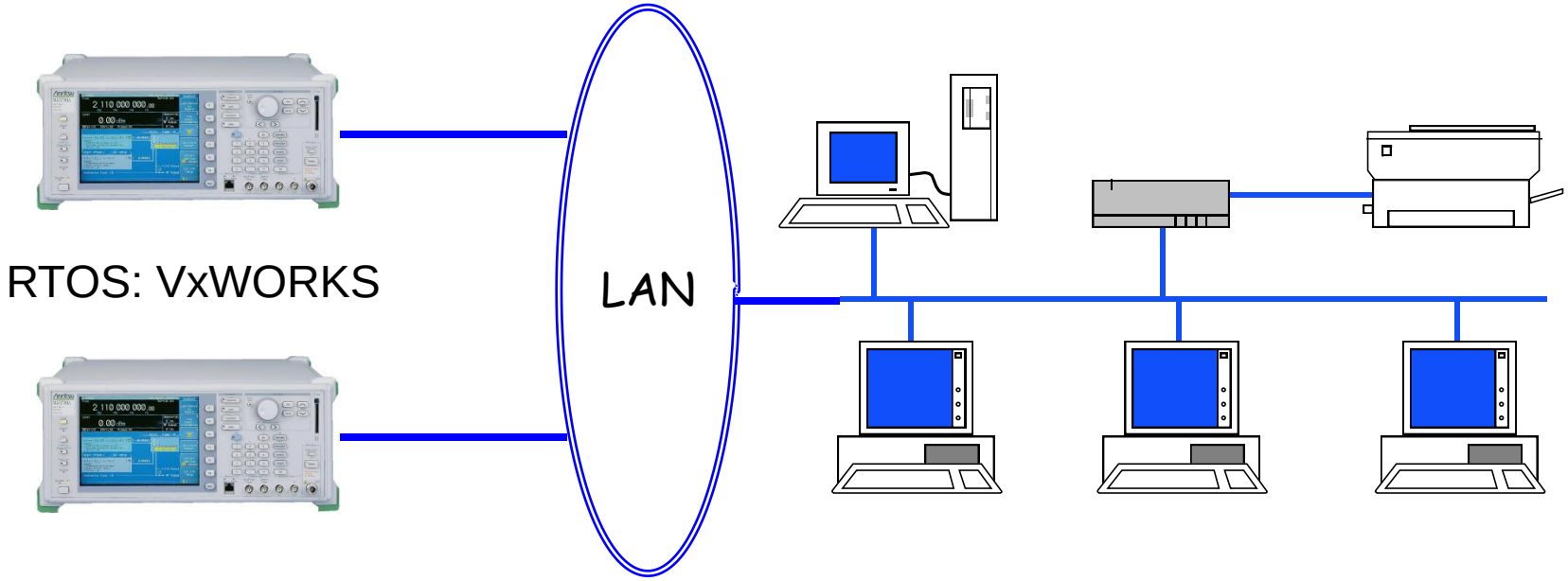
ME7856A RFIC Tester
with three MG3700As

High Level Accuracy

- Output level accuracy leading to the repeatability of measurement data is a critical specification in order to control the uncertainty of measured values.
  - Output level accuracy is derived from the uncertainty of calibrating instruments, repeatability of ALC (Automatic Level Control), repeatability of step attenuator, flatness, and impedance mismatch.
  - » The new automatic fast-acting internal calibration routine executed quickly achieves high level accuracy ±0.5 dB. * CW, 23 ±5 °C
    - Level error between I/Q modulation and CW ±0.2 dB
  - » The ability to set output level by 0.01 dB resolution in all output level ranges is useful to improve receiver test accuracy and to adjust level little by little.

Ethernet Remote Operation to Make Maintenance Management Easy

- ATE or multiple-instrument deployment can be operated efficiently by management through the network.
  - » Remote operation
    - – Ethernet control same as GPIB control (Raw Socket interface)
  - » File transfer between internal HDD and PC
    - – Transfer with FTP using the instrument accessory PC software (2 MB/s)



Weight Saving to Increase Mobility

- Weight saving increases mobility for field test usage and for shared instruments that moves frequently to installation sites.
- 10 kg lighter than traditional instruments
  - » Meets new needs

Ecological Design

Excellent Eco Product

- This symbol indicates Anritsu products with industry-leading environmental friendliness, enough transparency to disclose such information, and conformance to environment-friendly criteria uniquely set by Anritsu. Anritsu is now promoting the development of environment-friendly products which impose less burden on the environment throughout their life cycles (procurement of materials, manufacturing,distribution, use, and disposal).

- Low power consumption
  - » Energy saving: 2/3 of power consumption compared to previous type.
    - – ≤ 200 VA
- Standby power consumption virtually zero
  - » Standby state has been abolished by employing a reference oscillator with excellent start-up characteristic.
    - – “Main Power” LED lighting only
- Pb-free soldering
  - » Toxic lead substances are not used.
- Weight saving
  - » Curtails the use of raw material and improves distribution efficiency.

All-round Applications

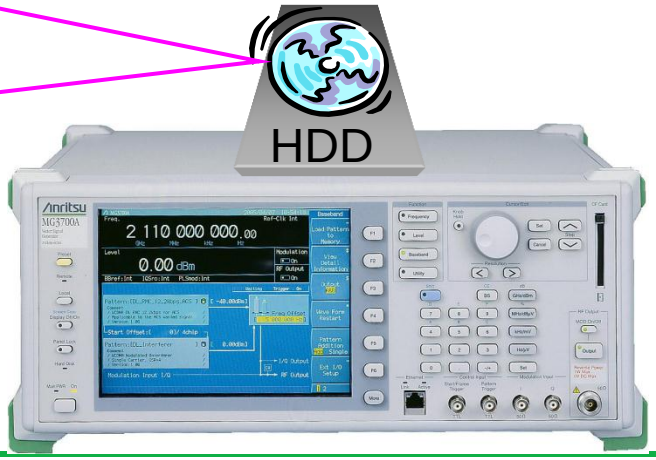
- Since standard signal pattern files for major applications are saved to the internal HDD, major signals can be generated immediately after obtaining MG3700A.

Lineup of Standard Signal Pattern files

- WLAN (IEEE802.11a/b/g)
- W-CDMA
- GSM/EDGE
- CDMA2000 1xEV-DO (Rev.0)
- CDMA2000 1X
- PHS
- PDC
- *Bluetooth*®
- GPS
- Digital Broadcast

Option

- TD-SCDMA

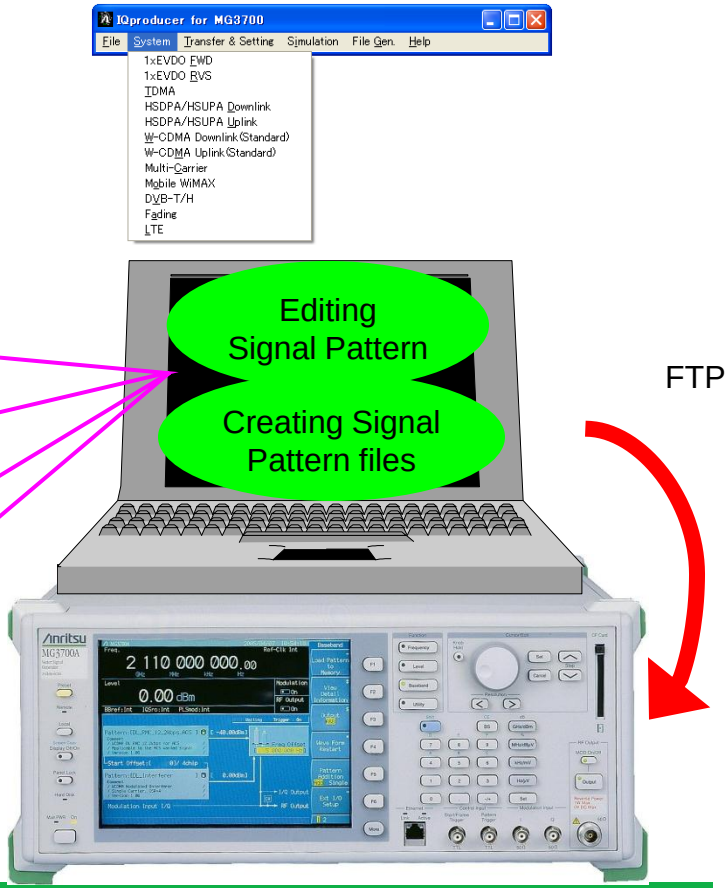


All-round Applications

- PC-based Windows simulation software "IQproducer" optimized to specific application can be provided in order to generate signal pattern files, so signal patterns can be customized.

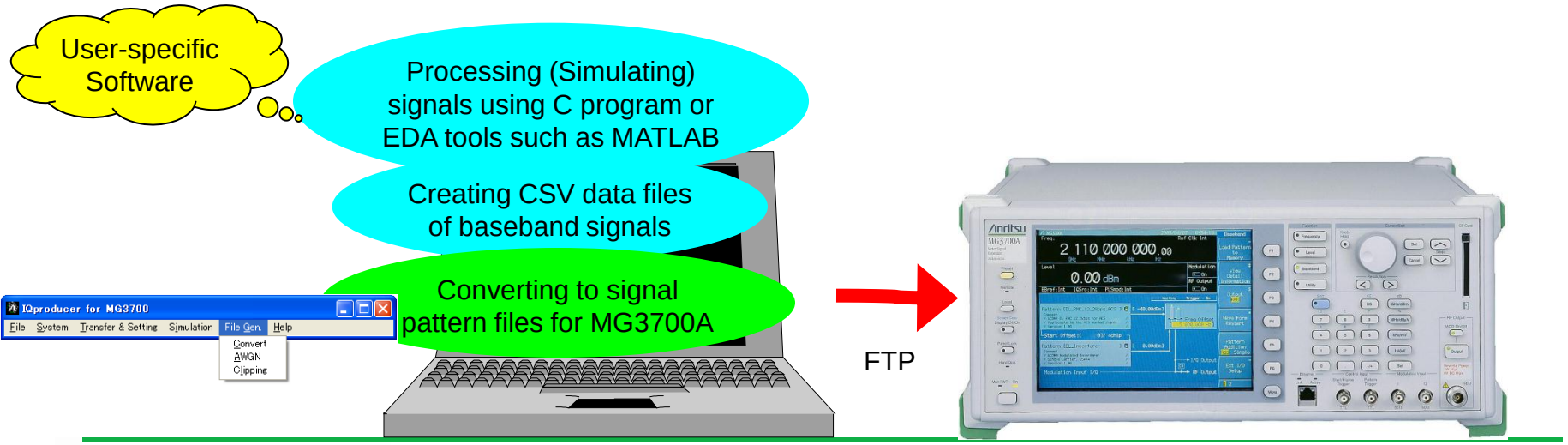
License option IQproducer
- HSPA over W-CDMA
- Universal TDMA
- CDMA2000 1xEV-DO (Rev.0)
- Multi-carrier
- Mobile WiMAX
- DVB-T/H
- NEW Fading
- NEW 3GPP LTE

No license (Standard) IQproducer
- Limited W-CDMA
- AWGN



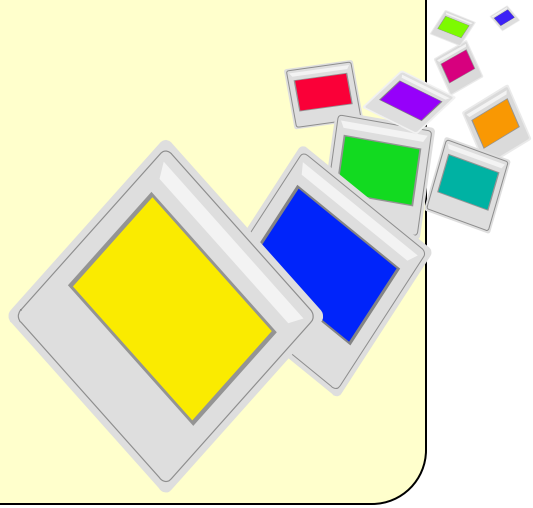
All-round Applications

- The file format conversion function of PC software "IQproducer" (MG3700A standard accessory) can convert user-signal-processed and created I/Q sample data from ASCII text CSV file to signal pattern file for MG3700A. This makes it useful for various applications.
  - » To R&D for 4G, RFID etc.



Features

- Product Outline
- Features
  - » Instrument Platform
  - » Software
- Options



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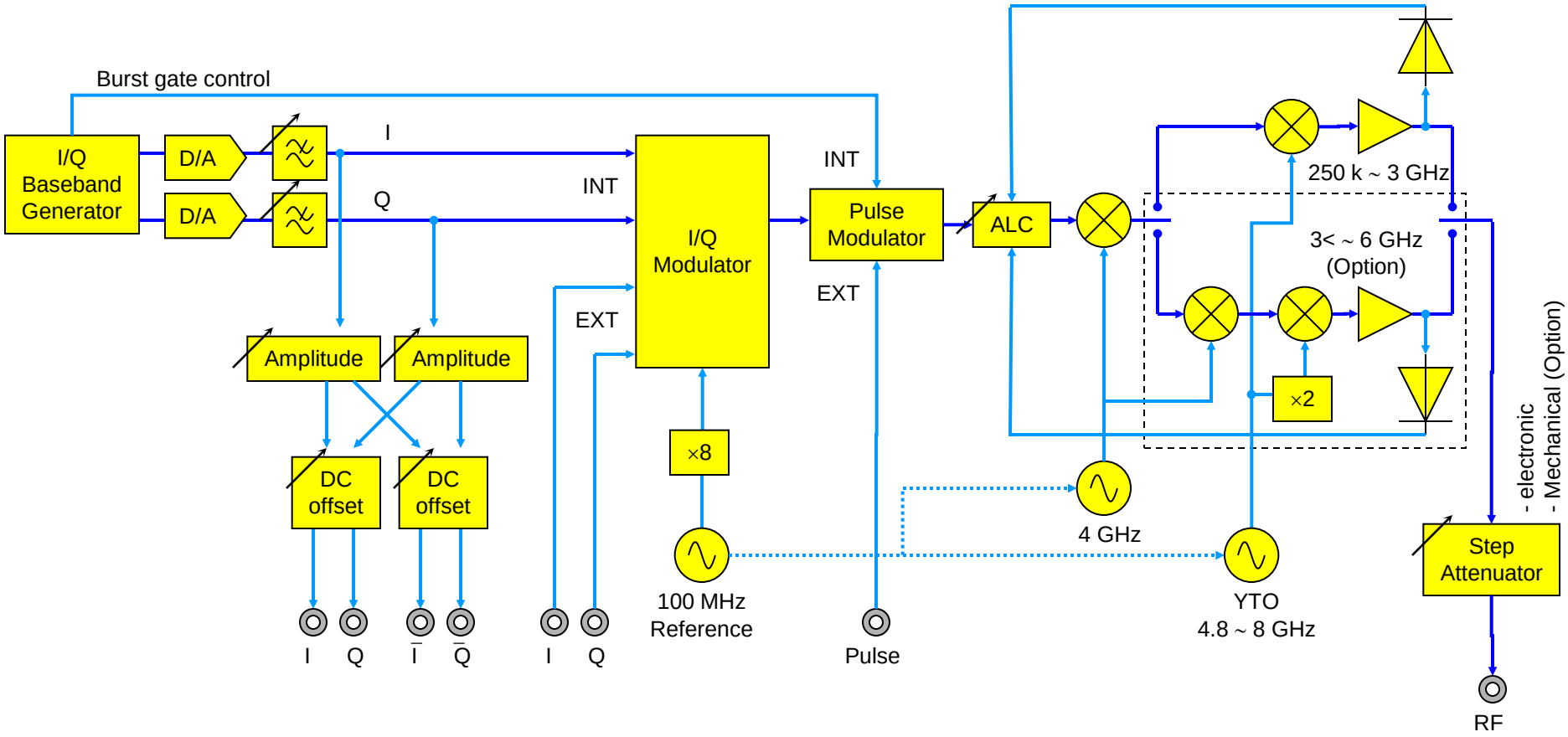
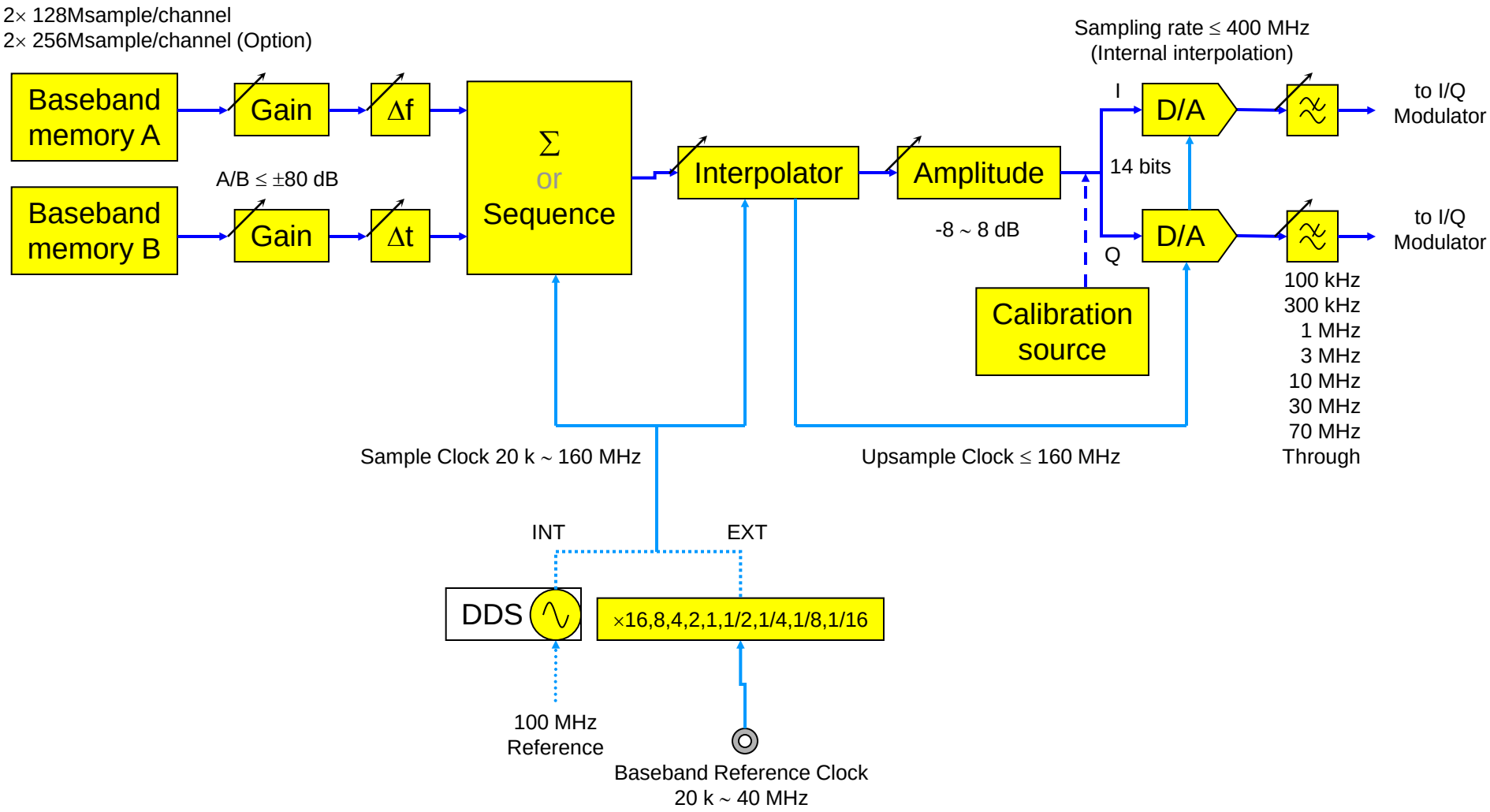
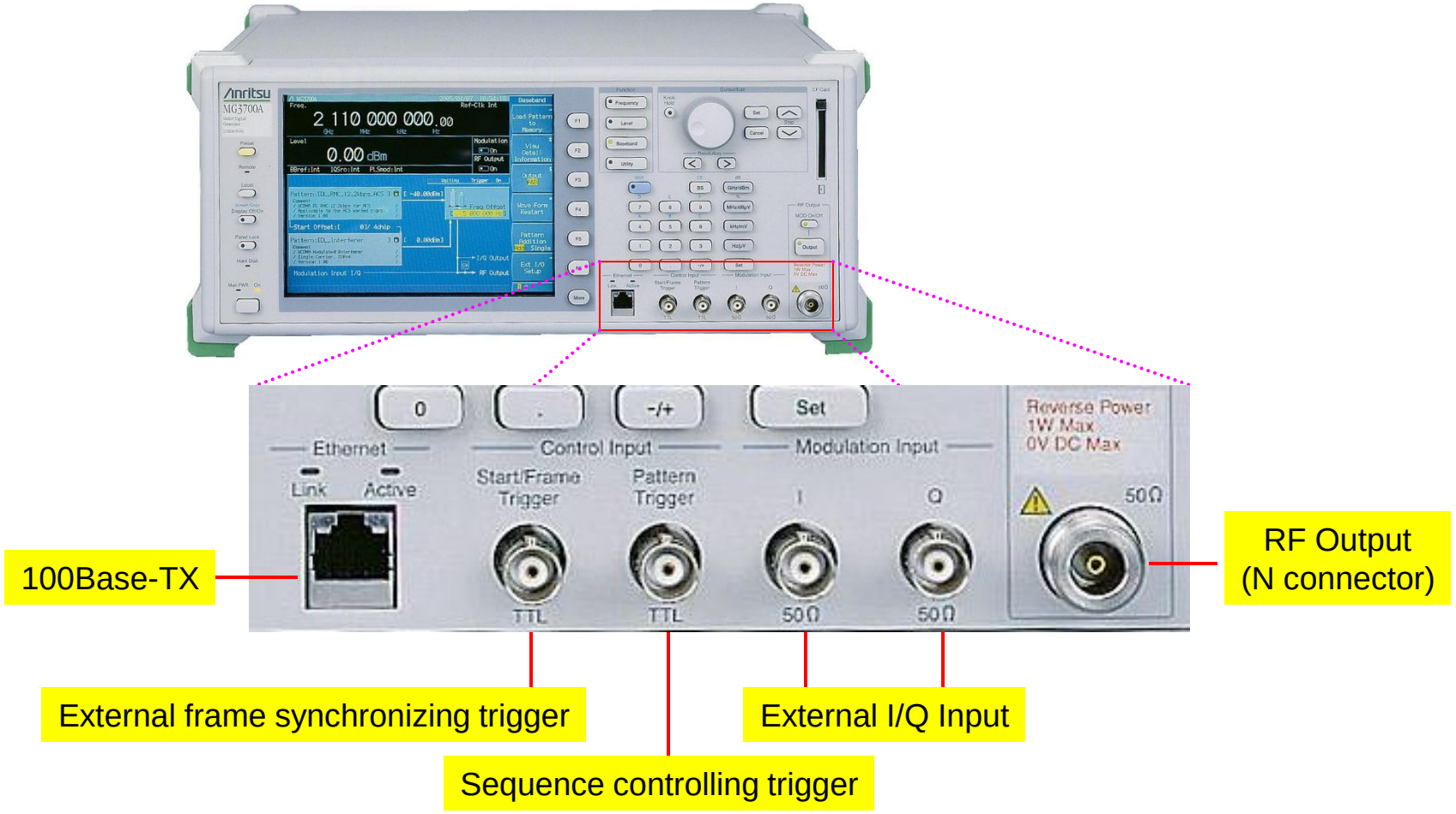
Overall Block Diagram



Baseband Block Diagram



Connectivity Front Panel



Connectivity Rear Panel

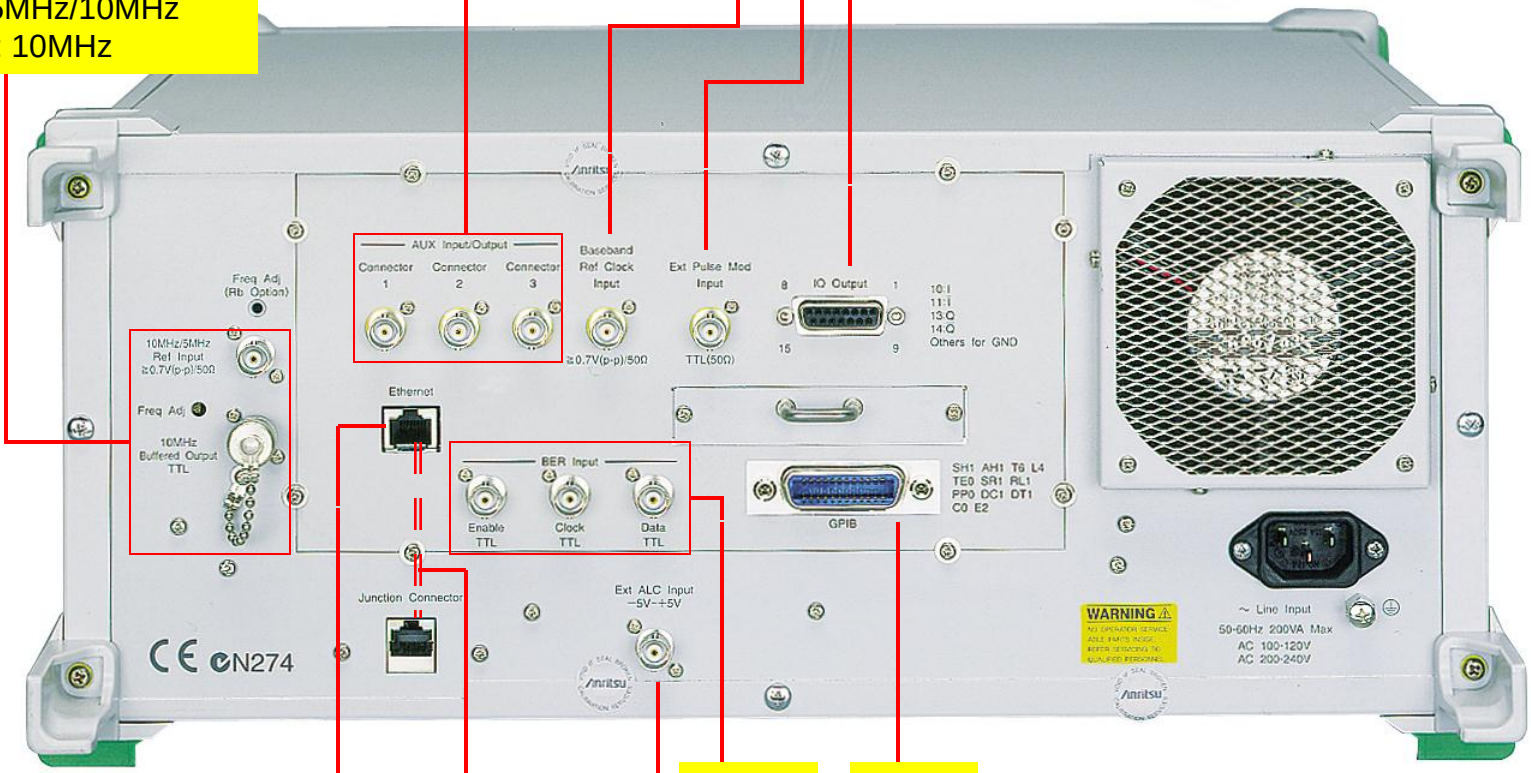
Event markers output
Trigger, Gate control, Frame synchronizing pulse marked on baseband signal data

External baseband reference input

Gate control Input for pulse modulation

Differential I/Q output

External timebase reference
Input: 5MHz/10MHz
Output: 10MHz



100Base-TX

Jumper cable for front panel connection
(Standard accessory)

BERT

GPIB

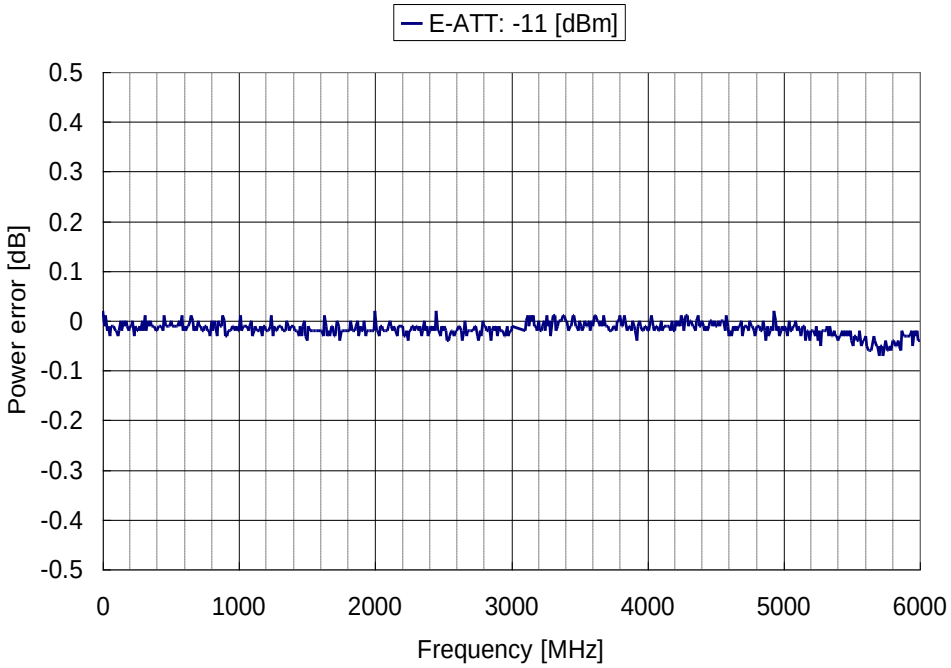
Input for leveling RF output signal externally using detector or power meter

High Level Accuracy

- Automatic internal calibration routine
  - » The reference source for internal calibration automatically calibrates at high-speed from DAC to ALC Loop.
    - – When the change of frequency, output level, and I/Q RMS level (Signal pattern selection)
      - The switching time of frequency and output level includes automatic calibration.
  - » The detector performance of ALC Loop was improved.
- Correction at high resolution per unit
  - » The frequency response, the linearity error of ALC circuitry, and the attenuation error of the step attenuator are measured using the ML2437A/38A Power Meter and the ML2530A Calibration Receiver with wide dynamic range and high linearity, and then the data is inputted to correction table.
    - – ML2530A Calibration Receiver
      - 100 k ~ 3 GHz
      - -140 ~ +20 dBm

Typical Level Accuracy

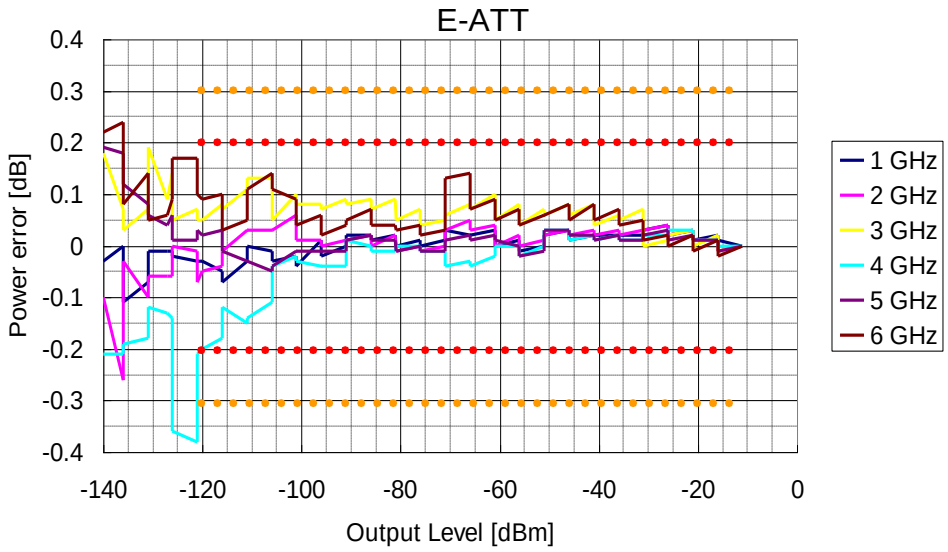
- Frequency response
  - » CW



Limits (23 ± 5 °C)

- » ±0.5 dB * 25 M ~ 3 GHz
  - – -120 ~ +6 dBm
  - – -120 ~ +10 dBm * with Option Mechanical attenuator

- Linearity
  - » CW
    - – Relative level accuracy
      Initial power -11 [dBm]

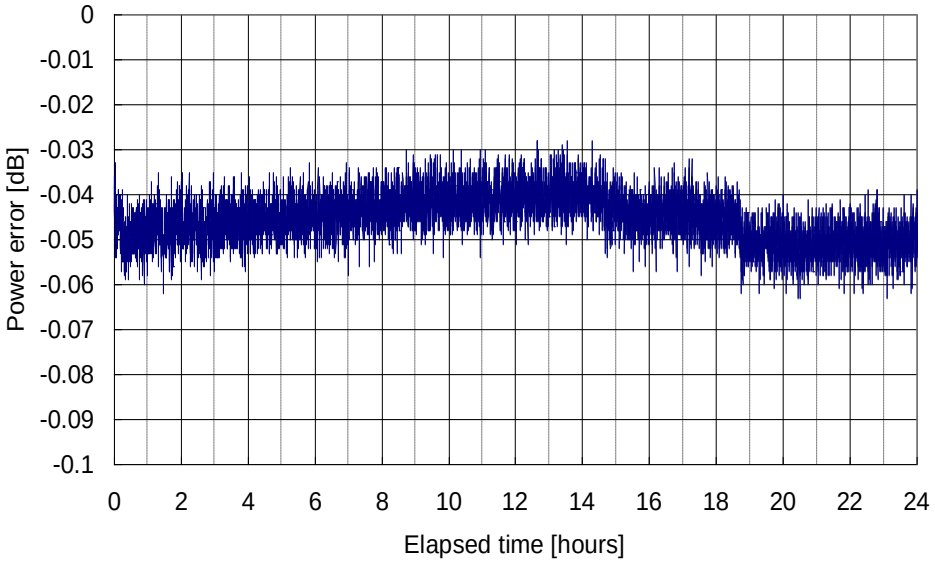


Limits (23 ± 5 °C)

- » ±0.2 dB typ. * 25 M ~ 3 GHz
- » ±0.3 dB typ. * 3 ~ 6 GHz
  - – -120 ~ -11 dBm
  - – -120 ~ -7 dBm * with Option Mechanical attenuator

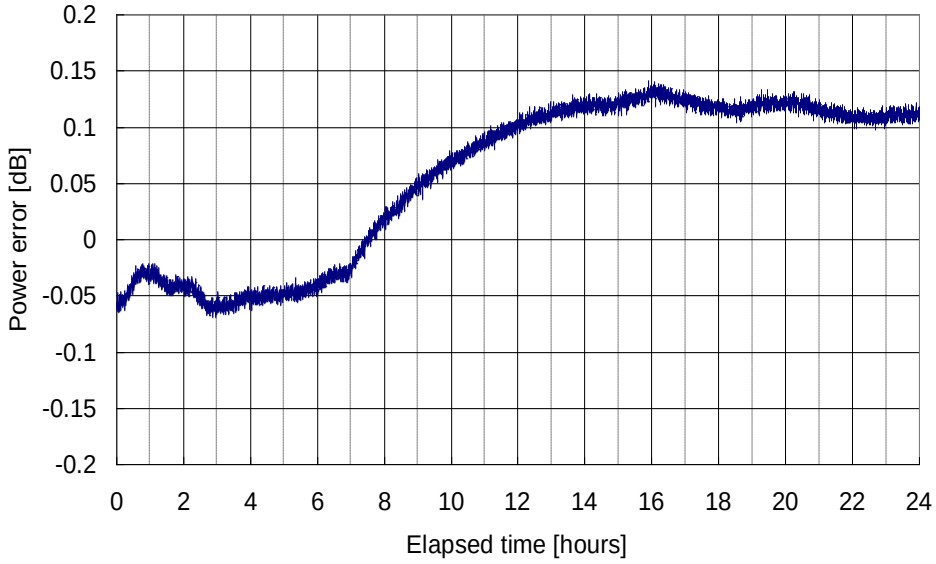
Typical Level Stability

- Aging
  - » CW (ALC: Active)
    - – 1 GHz, -11 dBm



- » Difference ≤ 0.035 dB
  -0.063 ~ -0.028 dB

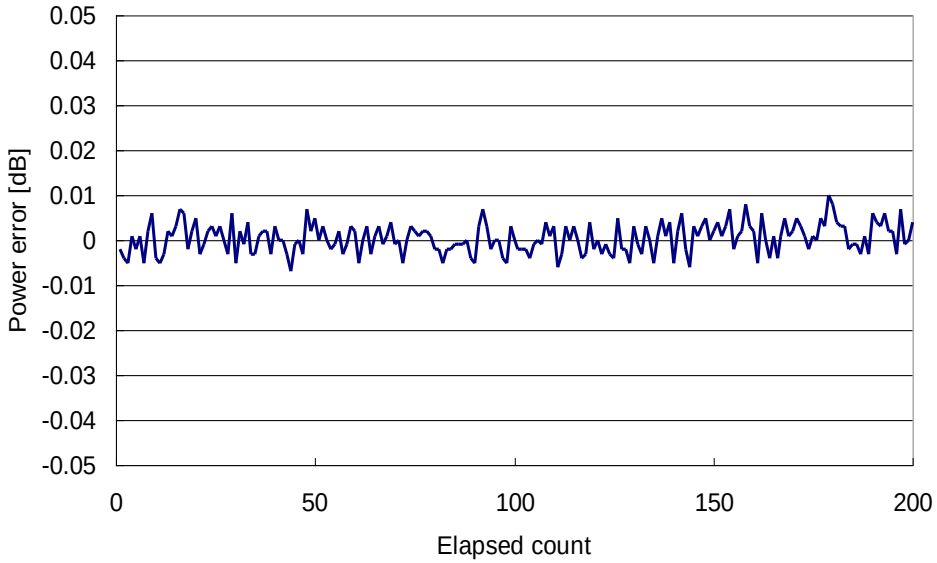
- Aging
  - » Level continuous mode, I/Q modulation (ALC: Hold)
    - – 1 GHz, -11 dBm, W-CDMA UL RMC 12.2kbps



- » Difference ≤ 0.21 dB
  -0.069 ~ 0.141 dB

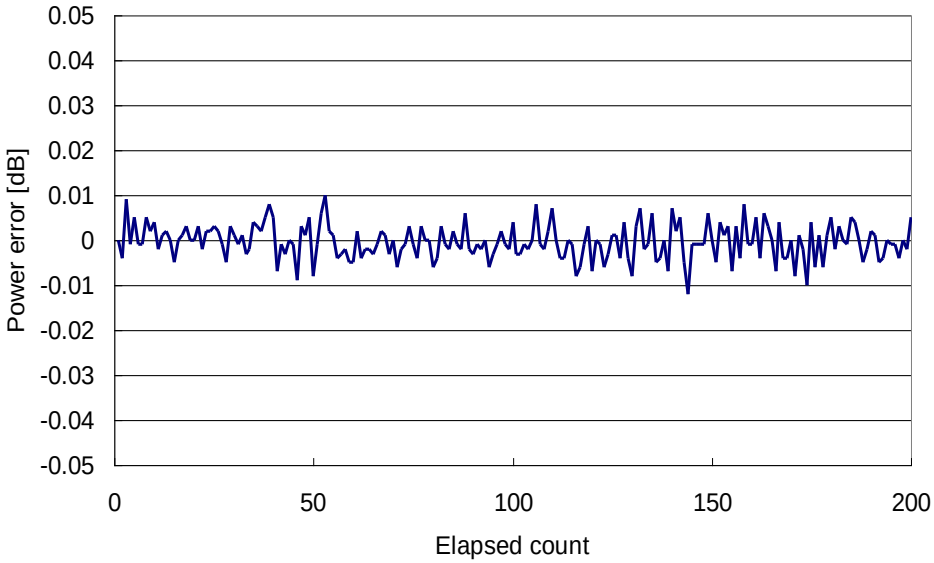
Typical Level Stability

- RF off → on (off [on] off [on] ...)
  - » CW
    - – 2 GHz, -11 dBm



- » Difference ≤ 0.017 dB
  -0.007 ~ 0.01 dB

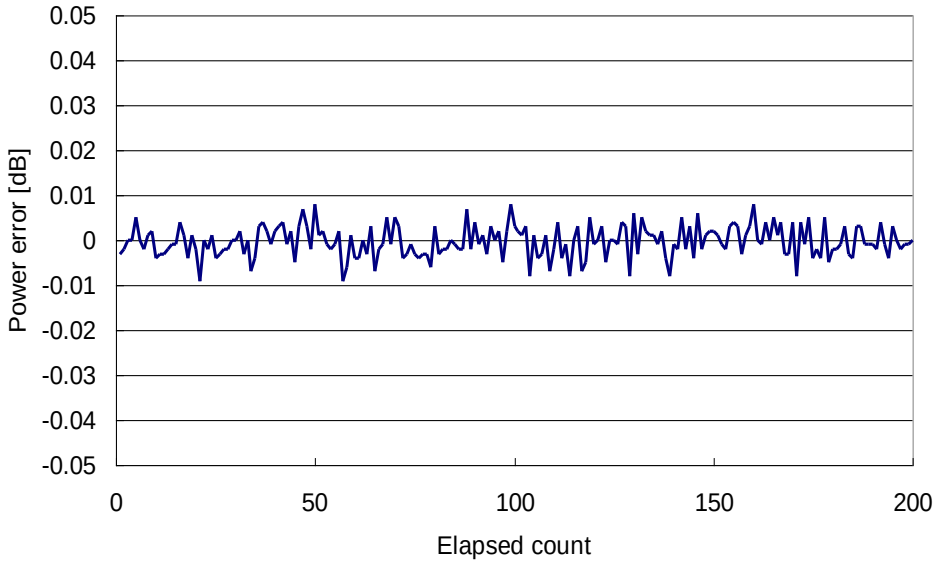
- RF off → on (off [on] off [on] ...)
  - » I/Q modulation
    - – 2 GHz, -11 dBm, W-CDMA



- » Difference ≤ 0.022 dB
  -0.012 ~ 0.01 dB

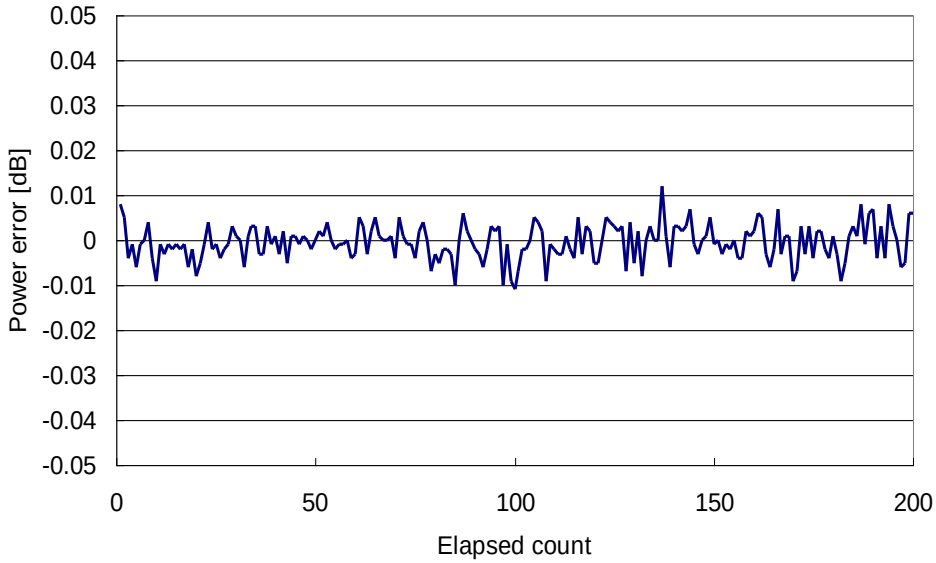
Typical Level Stability

- I/Q Modulation → CW
  (Mod on [off] on [off] ...)
  - 2 GHz, -11 dBm, W-CDMA



» Difference ≤ 0.017 dB
-0.009 ~ 0.008 dB

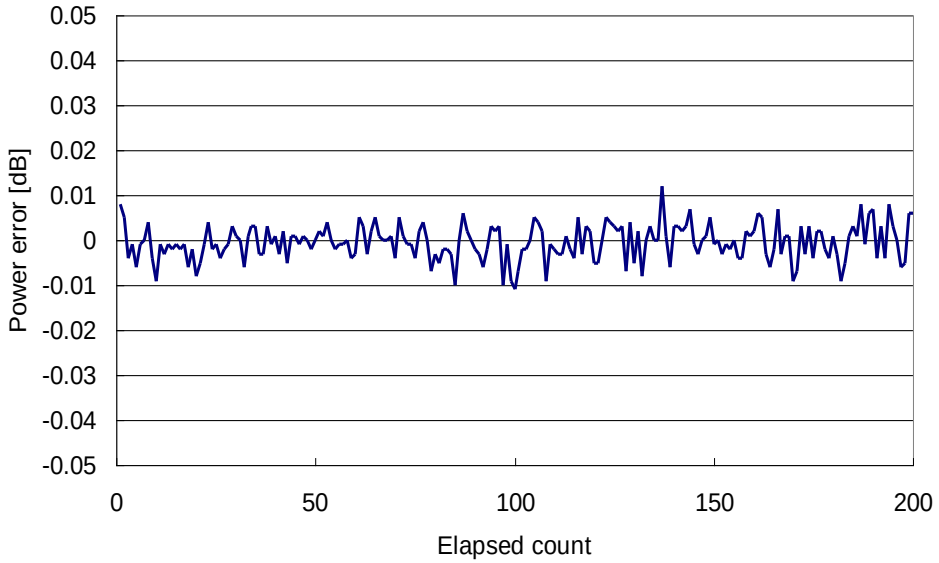
- CW → I/Q Modulation
  (Mod off [on] off [on] off ...)
  - 2 GHz, -11 dBm, W-CDMA



» Difference ≤ 0.023 dB
-0.011 ~ 0.012 dB

Typical Level Stability

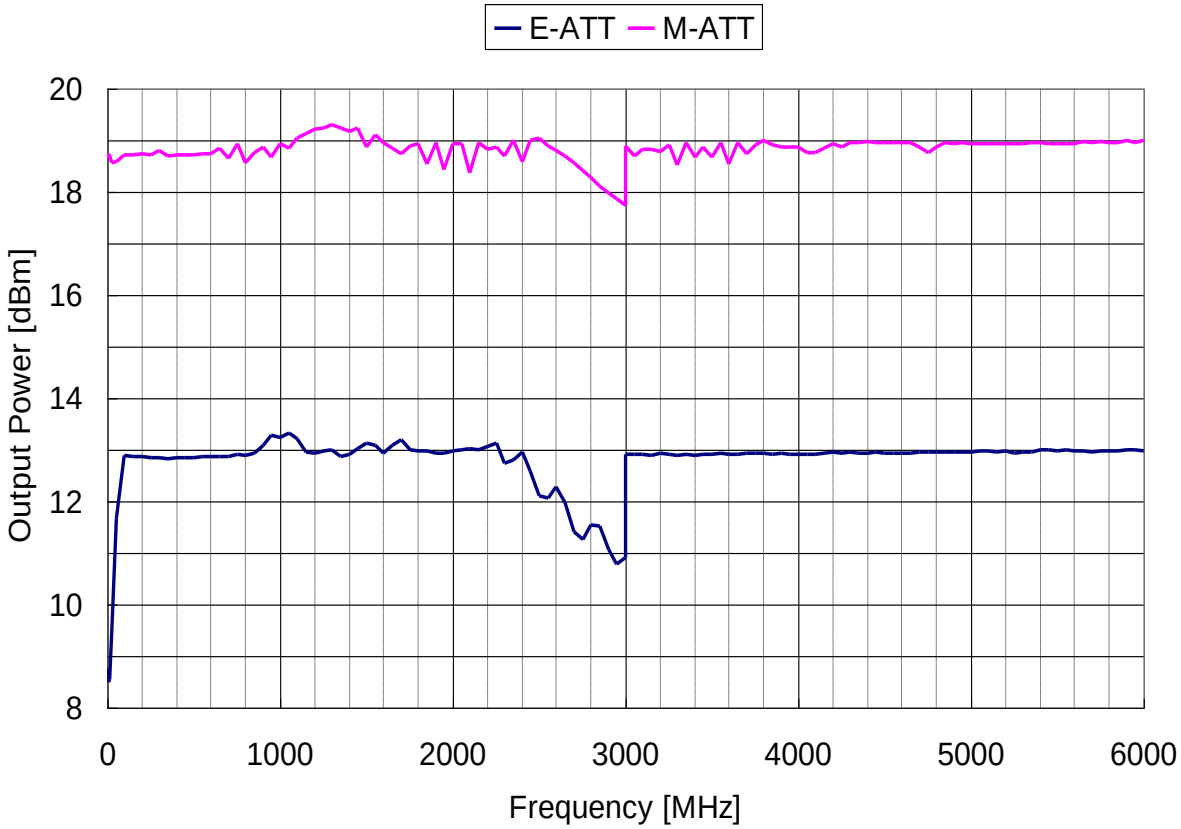
- Random level [-140 ~ -1 dBm] → -11 dBm
  (any level [-11] any level [-11] ...)
  - 2 GHz, I/Q Modulation (W-CDMA)



» Difference ≤ 0.023 dB
  -0.011 ~ 0.012 dB

Typical Maximum Available Output Level

- Electronic step attenuator (Standard): +13 dBm setting
  - E-ATT
- Mechanical step attenuator (Option): +19 dBm setting
  - M-ATT



High Spectral Purity

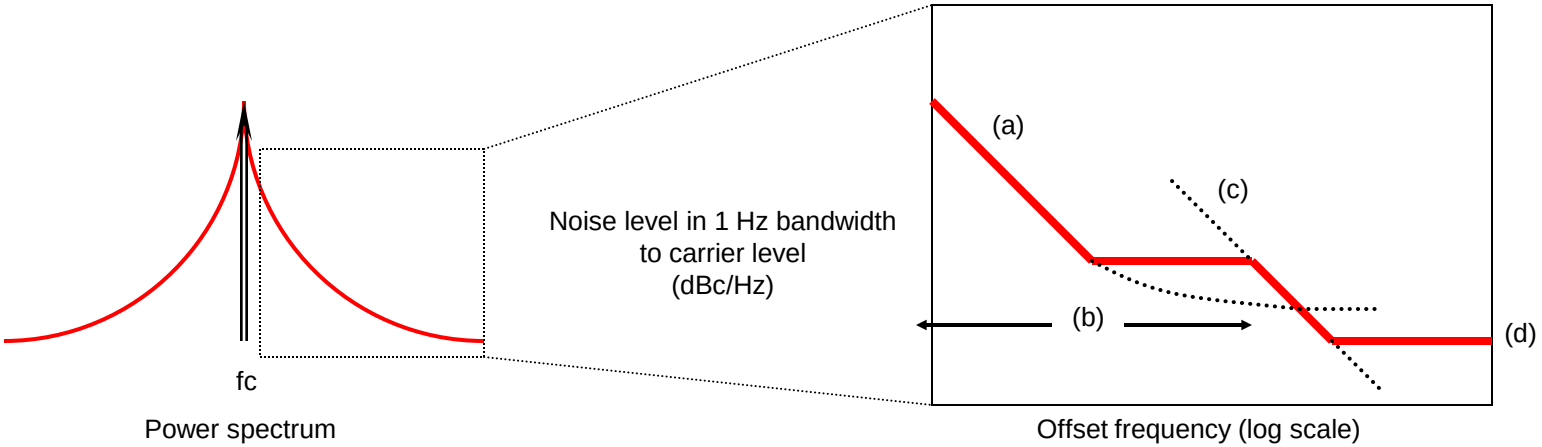
What type of specification are there for spectral purity?

- Spurious
  - » Harmonics
    - – 2 fc
    - – 3 fc
  - » Non-harmonics
    - – Local Oscillator (LO) leakage: f_{LO}
    - – Image signal: f_{img}
    - – IF signal leakage: f_{IF}
    - – Mixing signal of Harmonic IF and LO: $2 f_{IF} - f_{LO}$
  - » Sub-harmonics None
    - – 1/2 fc, 3/2 fc
  - » Power line and Fan rotation (Hum)
    - – fc ± Harmonics of AC frequency (especially 3rd order)

High Spectral Purity

What type of specification are there for spectral purity?

- SSB Single Side Band phase noise
  - » Phase noise of Reference oscillator (100 MHz) ... (a)
  - » Loop bandwidth of PLL Phase Locked Loop ... (b)
  - » Phase noise of YTO YIG Tuned Oscillator ... (c)
  - » Noise floor ... (d)

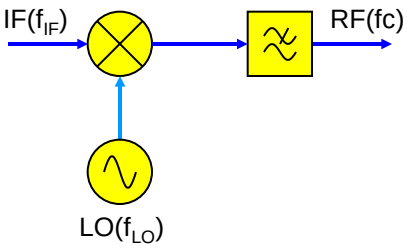


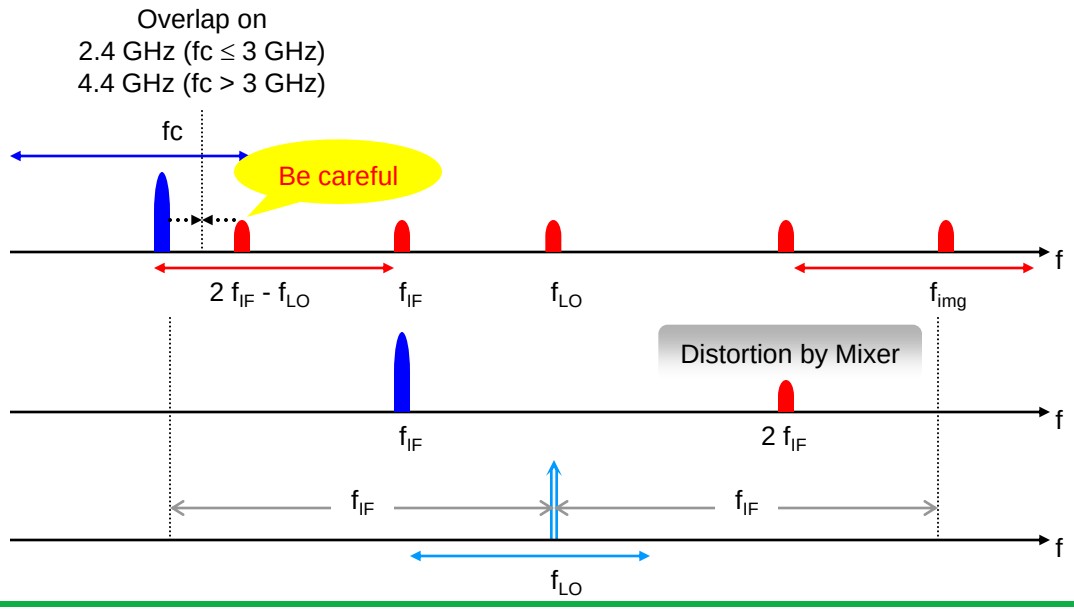
Spurious

- 4.8 - 8 GHz YTO has been employed as LO. And LO, image signal and IF leakage were placed out of the range of output frequency.

fc	LO frequency	Image frequency	IF
– 250 kHz ~ ≤ 3 GHz:	fc + 4.8 GHz	fc + 9.6 GHz	4.8 GHz
– 3 GHz < ~ 6 GHz :	fc + 8.8 GHz	fc + 17.6 GHz	8.8 GHz

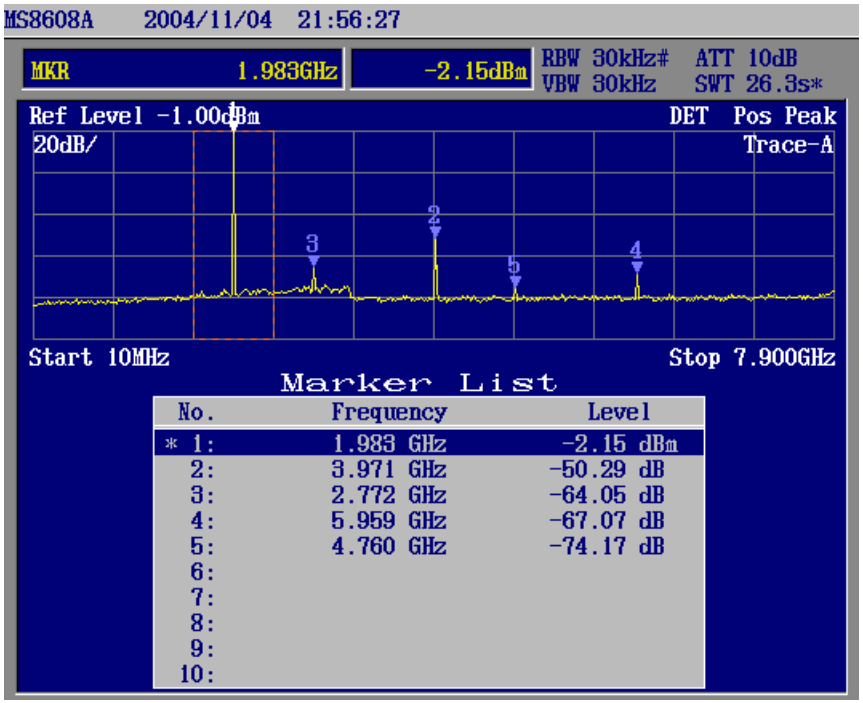
Frequency down conversion





Typical Spurious

- 2 GHz, -1 dBm
  - 2: 2 fc
  - 3: $2f_{IF} - f_{LO}$
  - 4: 3 fc
  - 5: IF



Limits (≤ -1 dBm, ≤ +3 dBm * with Option Mechanical attenuator)

- Harmonics
  - < -30 dBc
- Non-harmonics

	$2f_{IF} - f_{LO}$	Other	
–	< -50 dBc typ.	< -60 dBc	* 25 M ~ 3 GHz
–	< -40 dBc typ.	< -54 dBc	* 3< ~ 5.7 GHz
–	< -35 dBc typ.	< -54 dBc	* 5.7< ~ 6 GHz

SSB Phase Noise

In wireless communication, in order to utilize limited radio resources effectively, there is a strong phase noise requirement for signal sources.

- » Alternate channel leakage power ratio which spaces one channel from adjacent channel is caused by phase noise.

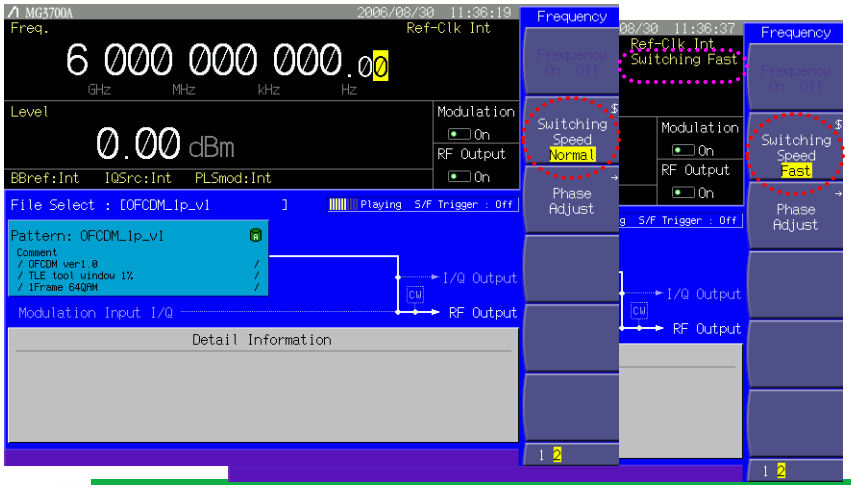
- Optimization of cost performance
  - » The balance between cost and performance was optimized, meeting present needs.
  - » A high-speed 14-bit DAC that interpolates internally to a maximum 400 MHz sampling rate has been employed, and the quantization noise leading to residual noise was reduced.
  - » A smoothing filter with variable cutoff frequency according to the modulation bandwidth eliminates alias spurious and noise.

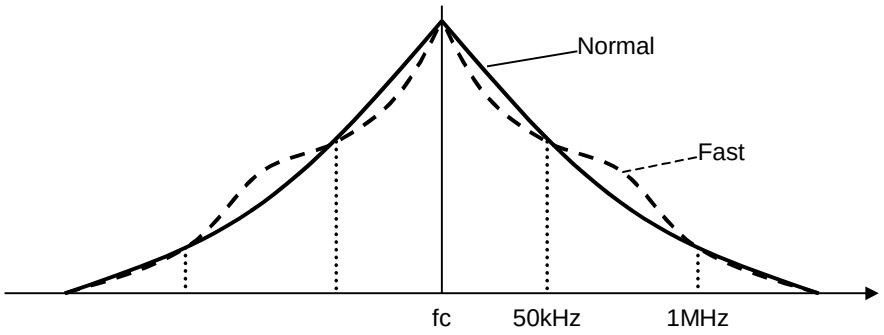
- Employed high-purity YTO
  - » Although the YTO employed as a LO is expensive, it provides all-round performance by simplifying the circuitry.

Selectable Frequency Switching Time and Phase Noise

- Frequency switching time affects the phase noise.
- The frequency switching time and phase noise profile is changed by switching the loop bandwidth of the PLL synthesizer. It is useful to select it according to the wireless system or the usage.

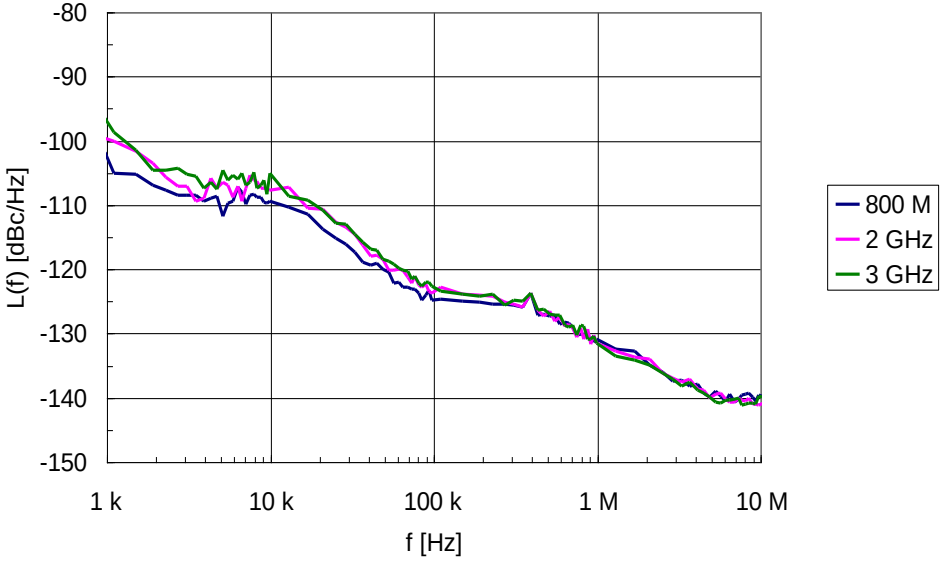
		Normal			Fast	
Frequency switching time		3 GHz non-cross		3 GHz cross	3 GHz Non-cross	3 GHz cross
		Δf < 1 GHz	Δf ≥ 1 GHz			
	Electronic attenuator	≤ 15 ms	≤ 20 ms	≤ 40 ms	≤ 10 ms	≤ 40 ms
	Mechanical attenuator	≤ 80 ms		≤ 100 ms	≤ 80 ms	≤ 100 ms
Phase noise		Lower in Offset frequency ≥ 50 kHz			Lower in Offset frequency < 50 kHz	



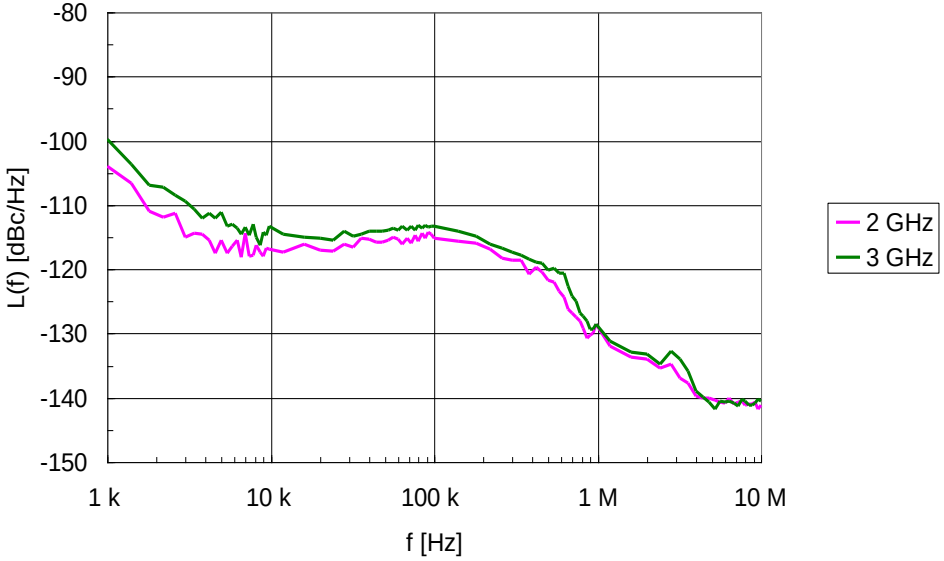


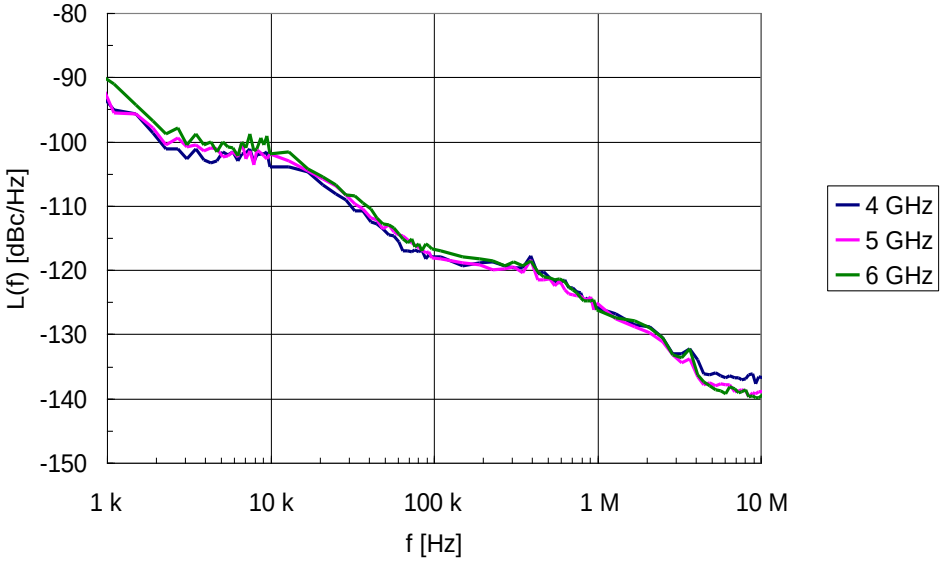
Typical Phase Noise

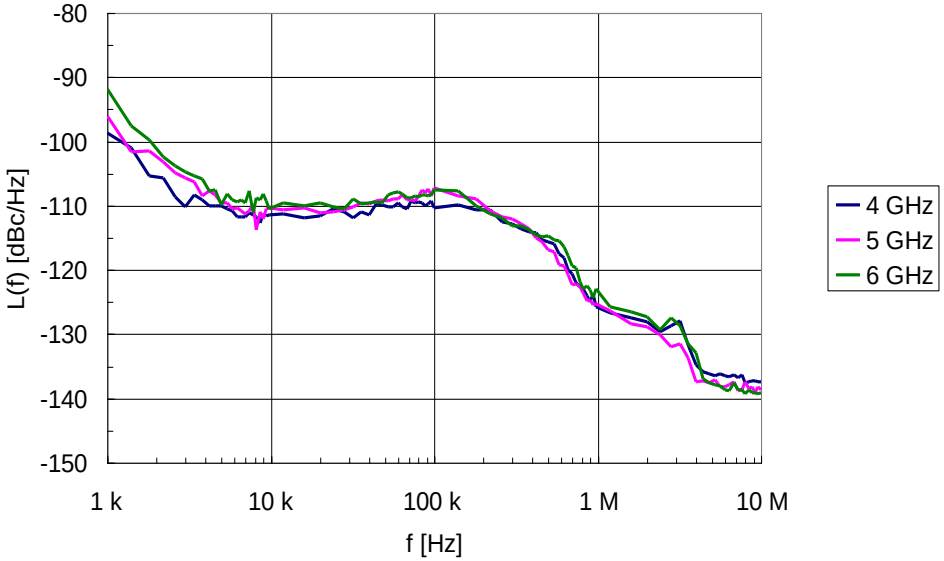
Normal



Fast







Adjacent Channel Leakage Power Ratio (ACLR)

In wireless communication, in order to utilize limited radio resources effectively, there is a strong ACLR requirement for signal sources.

- » It is a critical specification for reference signal sources evaluating transmitter components/devices and for interference signal sources testing receivers.
- » Adjacent channel leakage power ratio of modulated signals is caused by intermodulation distortion produced by nonlinear elements in signal generator.

- ACLR specification

800 ~ 1000 MHz, 1800 ~ 2400 MHz, 23 ± 5°C,
W-CDMA Downlink (Test Model 1 64 DPCH)

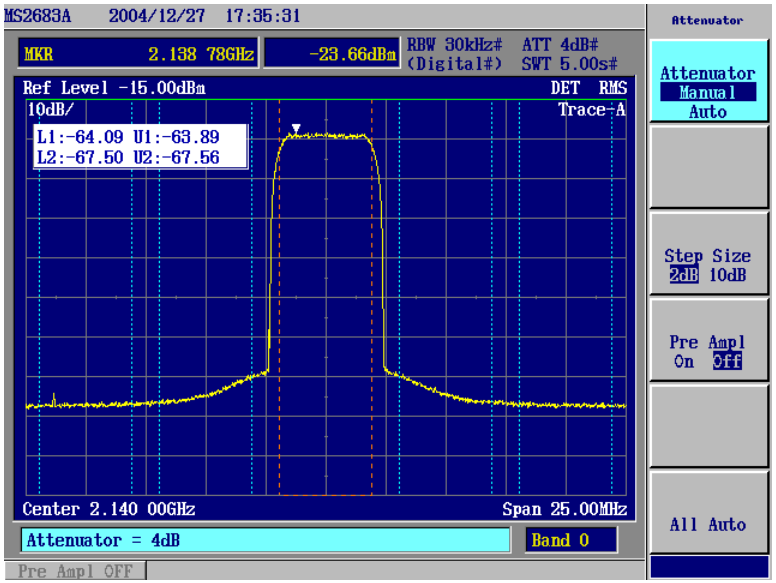
		With Option Mechanical attenuator
» 5 MHz offset:	≤ -61 dB	≤ -62 dB
• Output level	≤ -4 dBm	≤ 0 dBm
» 10 MHz offset:	≤ -66 dB typ.	≤ -67 dB typ.
• Output level	≤ -1 dBm	≤ +3 dBm

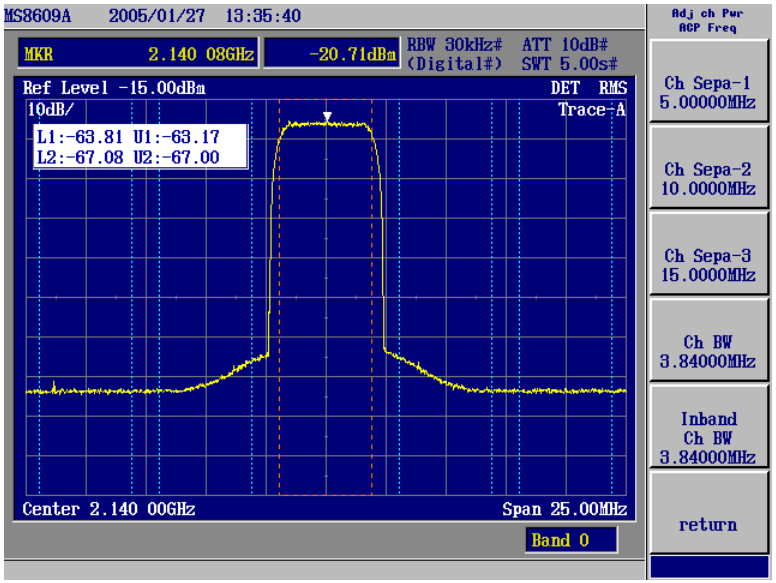
– Alternate channel leakage power ratio is caused by phase noise.

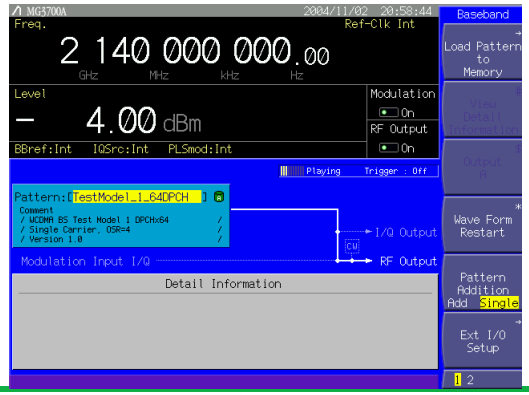
ACLR
W-CDMA, Downlink (Test Model 1 64 DPCH)

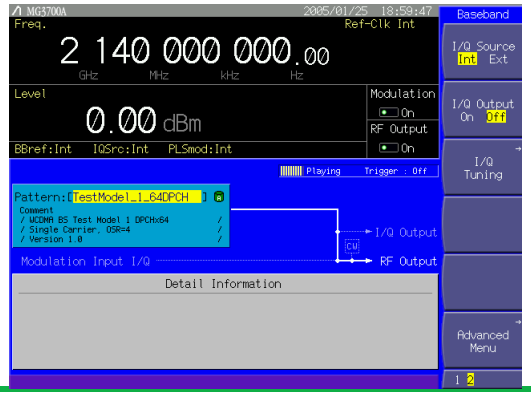
» ≤ -4 dBm

» ≤ 0 dBm * with Option Mechanical attenuator





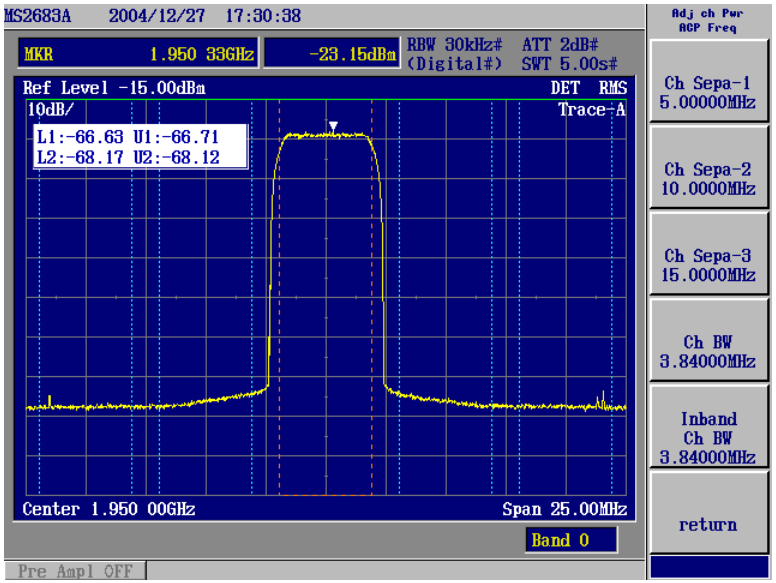


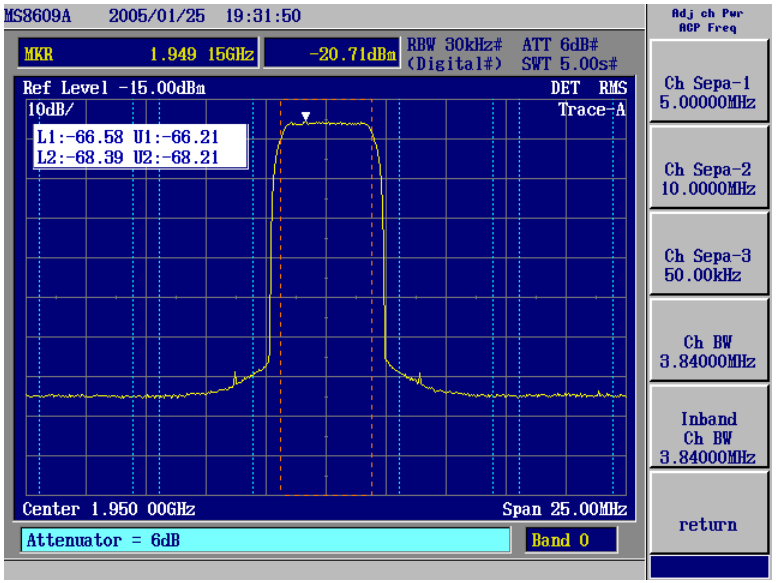


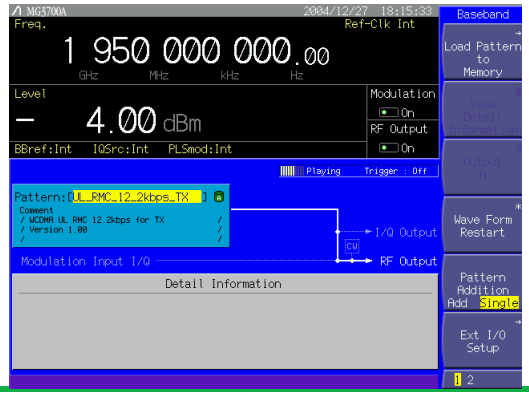
ACLR
W-CDMA, Uplink (RMC 12.2kbps)

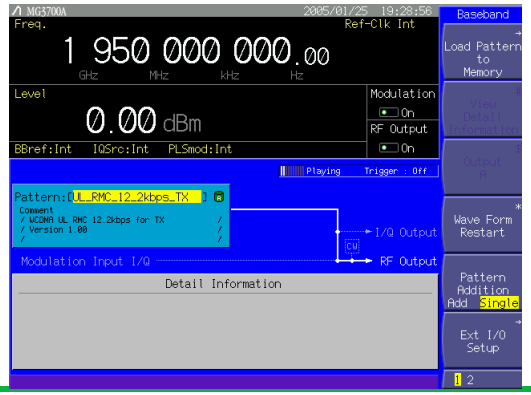
» ≤ -4 dBm

» ≤ 0 dBm * with Option Mechanical attenuator





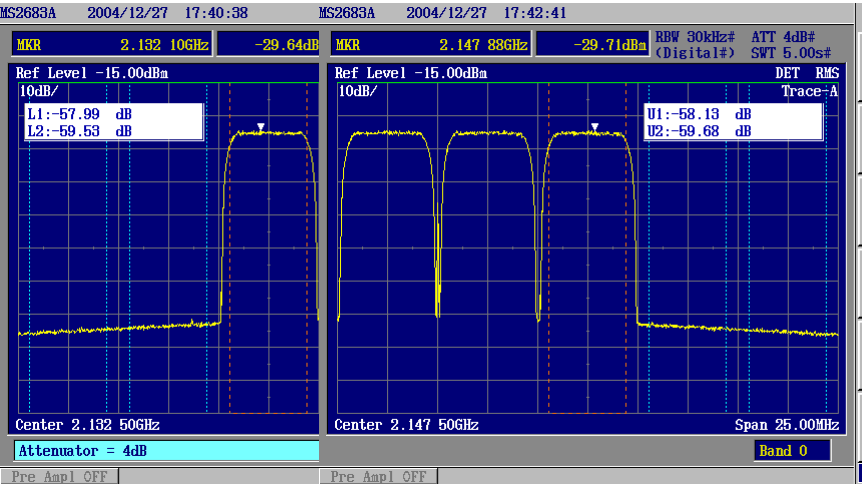


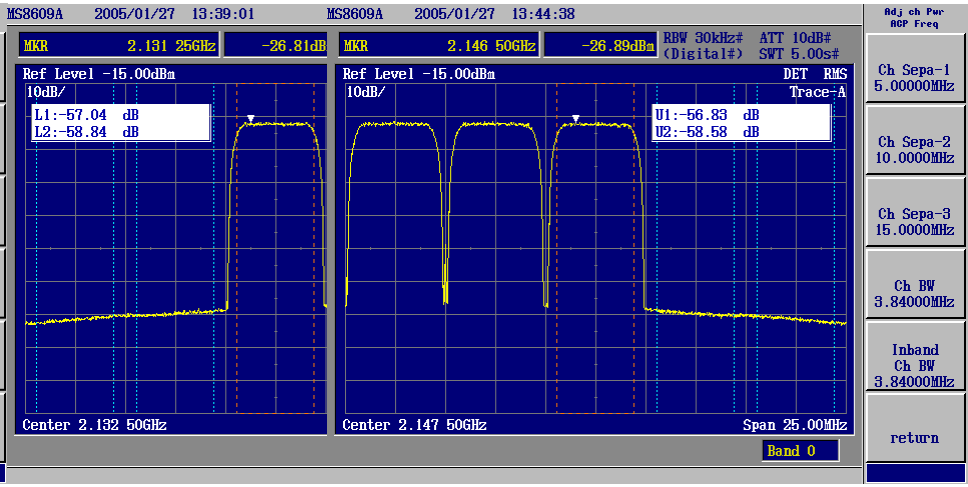


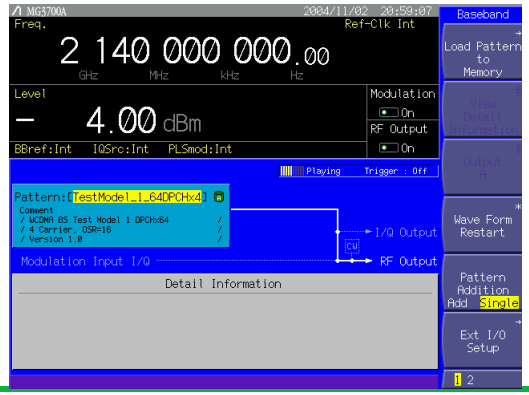
ACLR
W-CDMA, Downlink (TM1 64DPCH), 4 Carriers

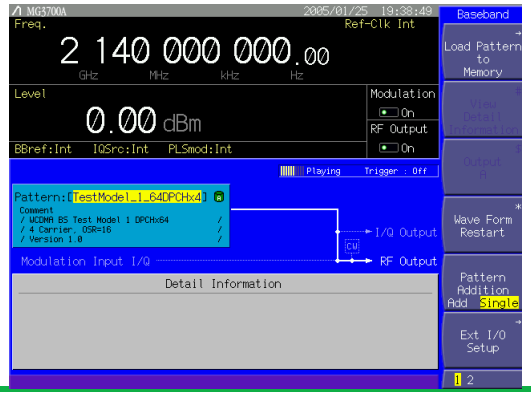
» ≤ -4 dBm

» ≤ 0 dBm * with Option Mechanical attenuator





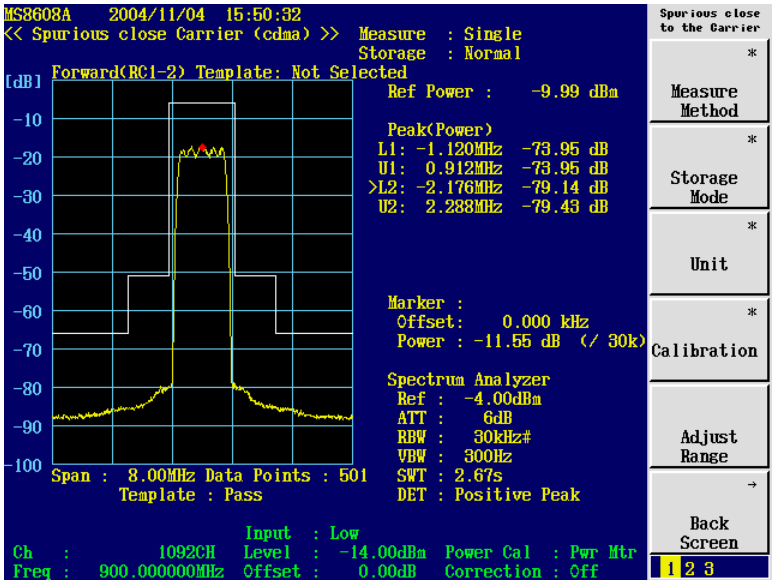


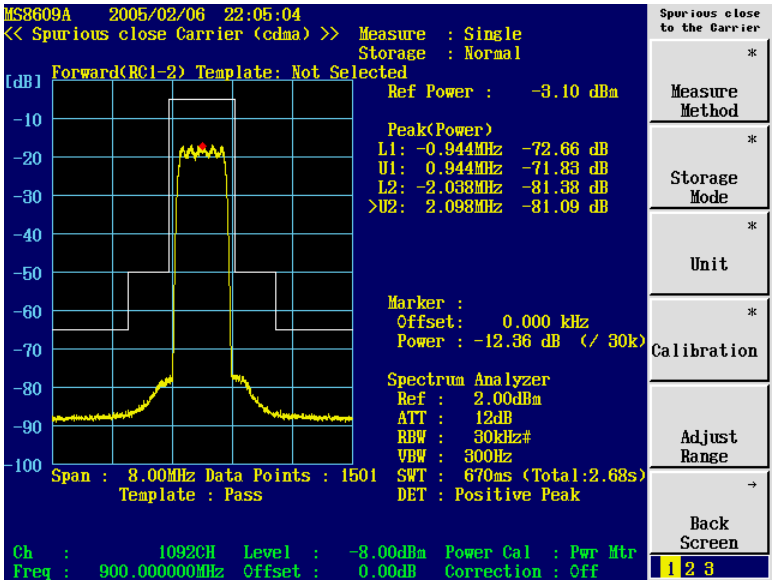


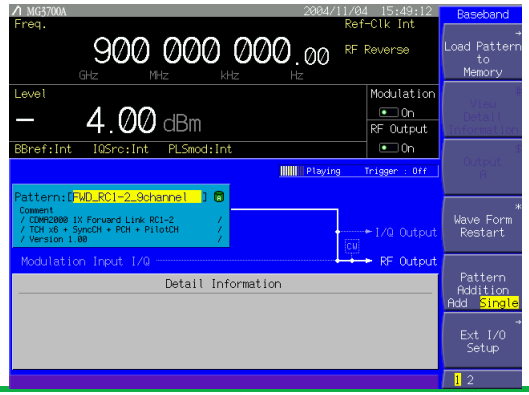
Spurious Close to Carrier
CDMA2000 1X, Forward (RC1-2)

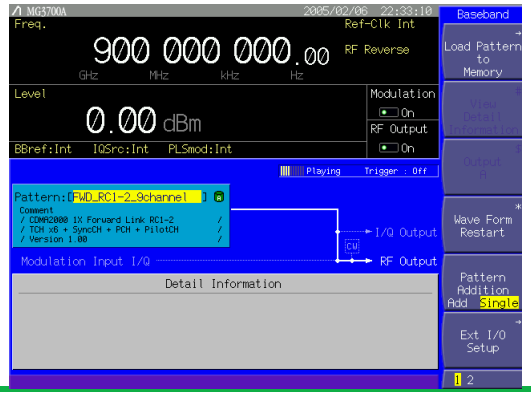
» ≤ -4 dBm

» ≤ 0 dBm * with Option Mechanical attenuator





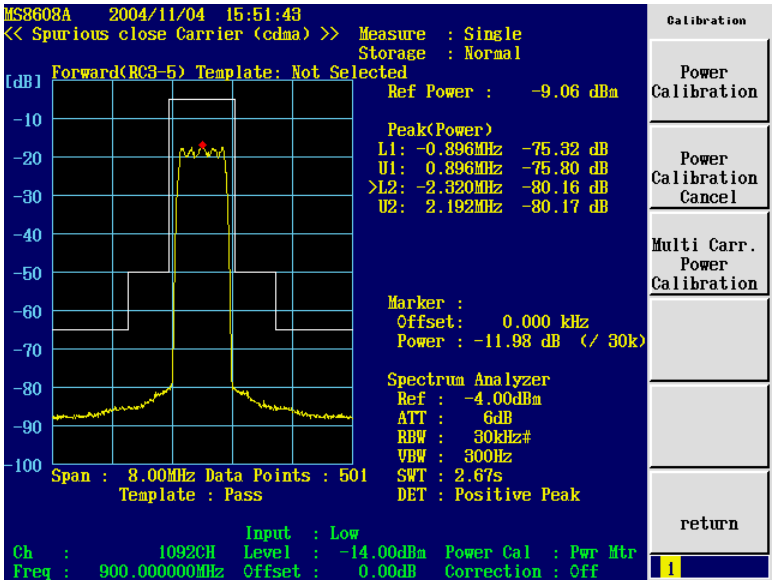


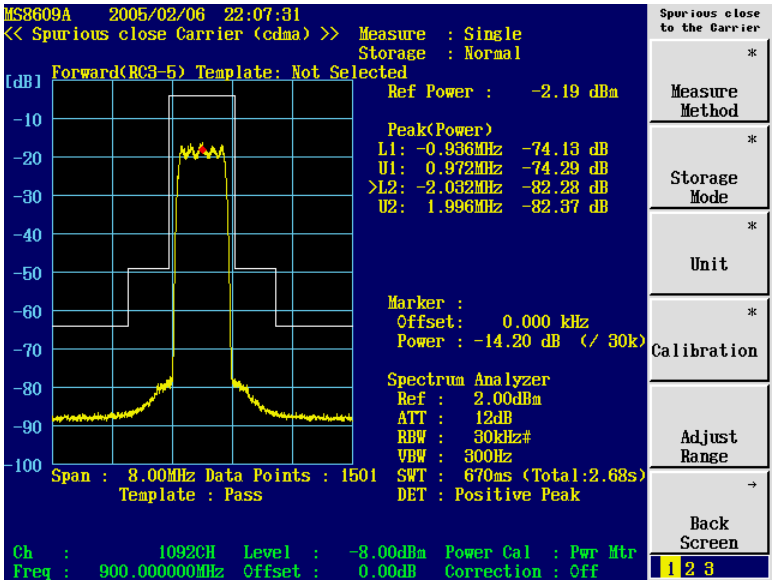


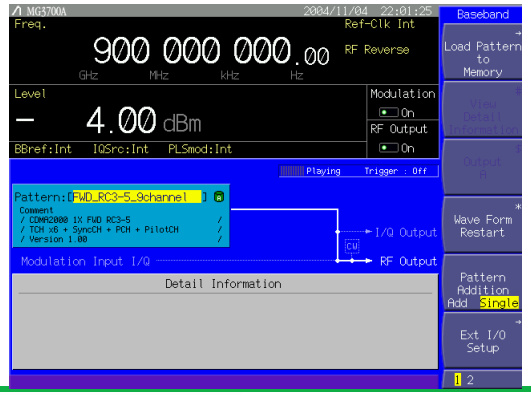
Spurious Close to Carrier
CDMA2000 1X, Forward (RC3-5)

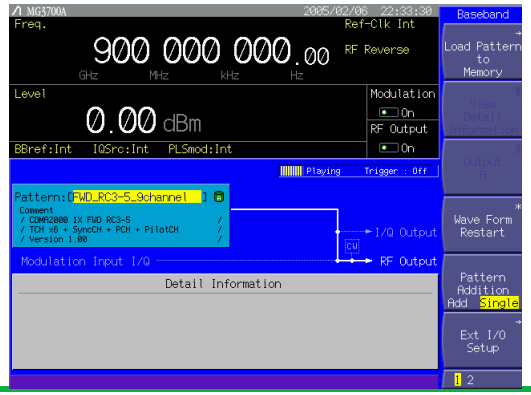
» ≤ -4 dBm

» ≤ 0 dBm * with Option Mechanical attenuator





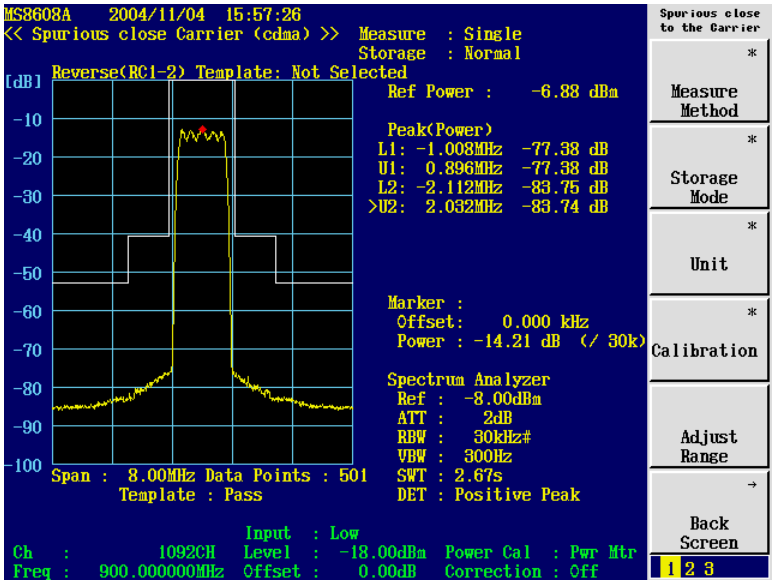


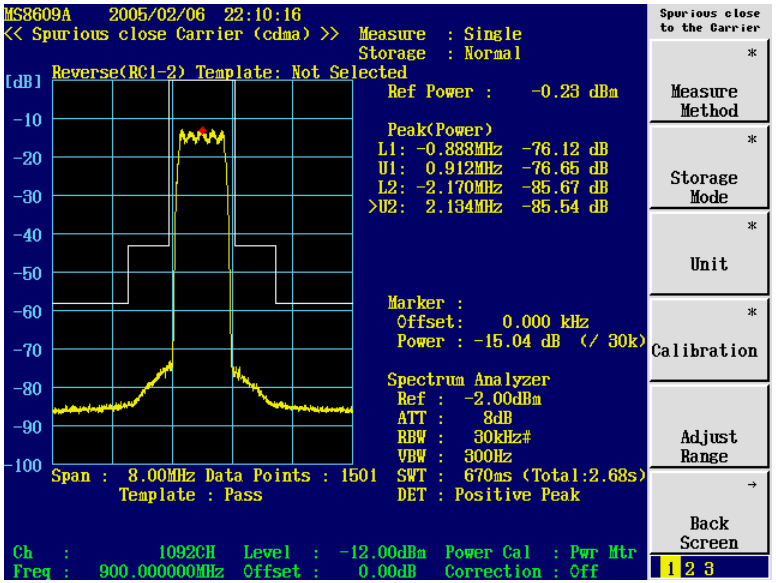


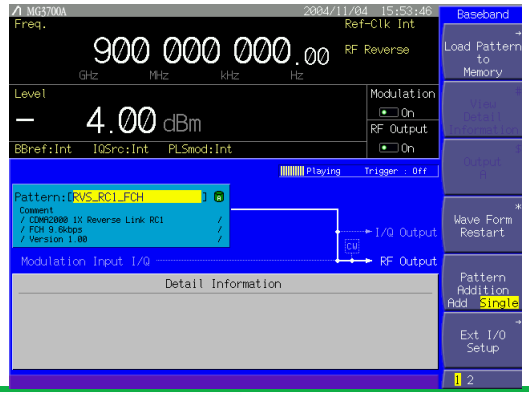
Spurious Close to Carrier
CDMA2000 1X, Reverse (RC1-2)

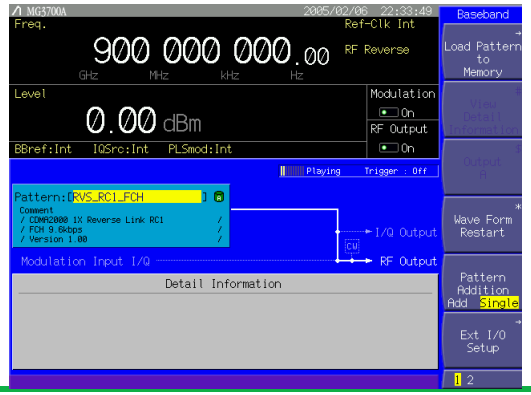
» ≤ -4 dBm

» ≤ 0 dBm * with Option Mechanical attenuator





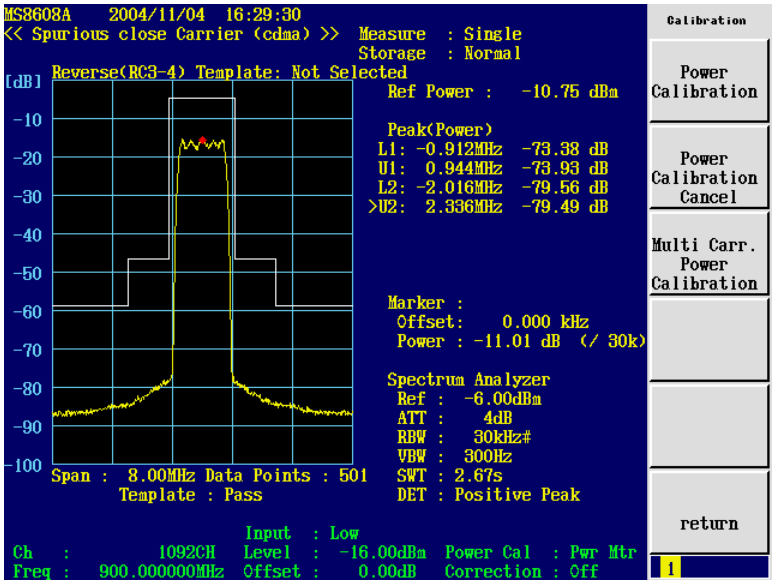


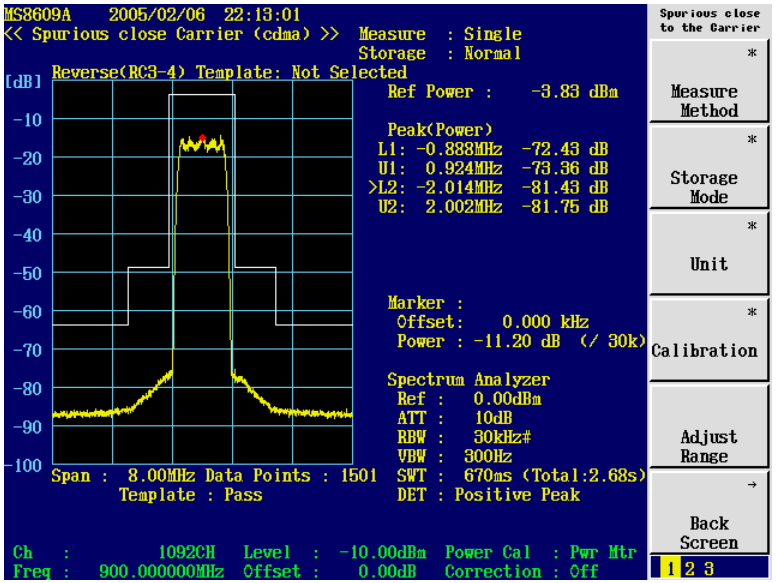


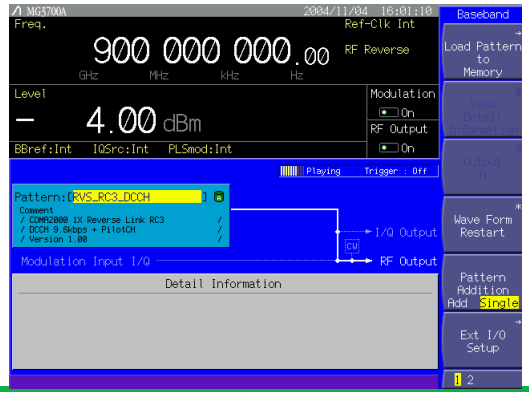
Spurious Close to Carrier
CDMA2000 1X, Reverse (RC3-4)

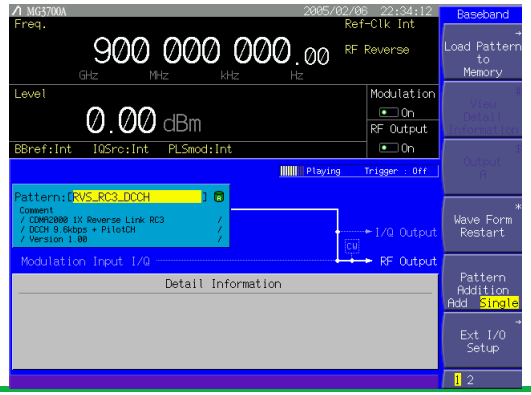
» ≤ -4 dBm

» ≤ 0 dBm * with Option Mechanical attenuator





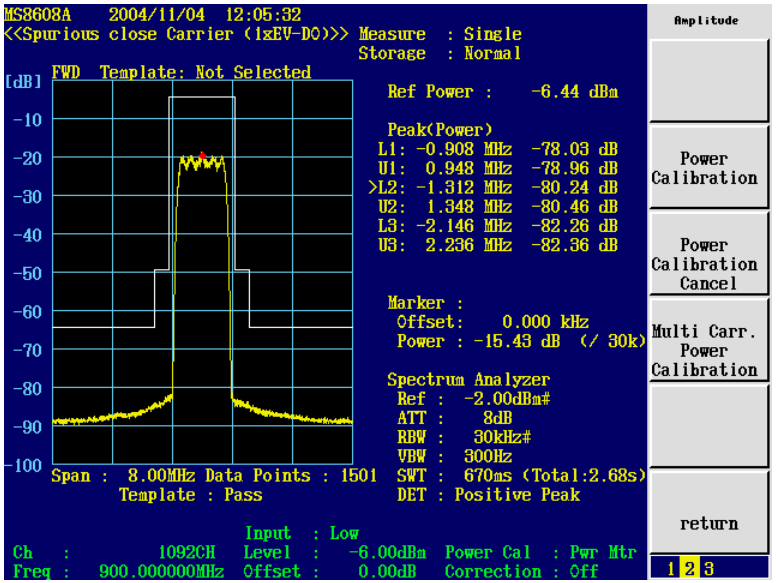


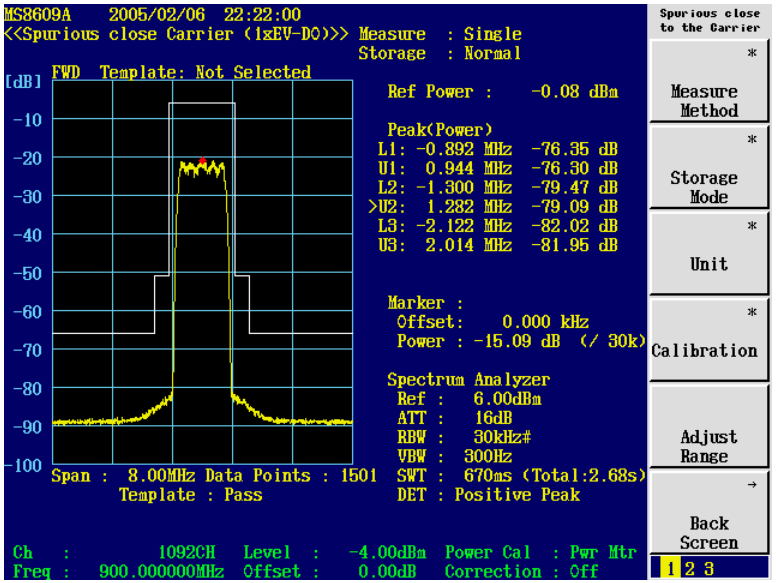


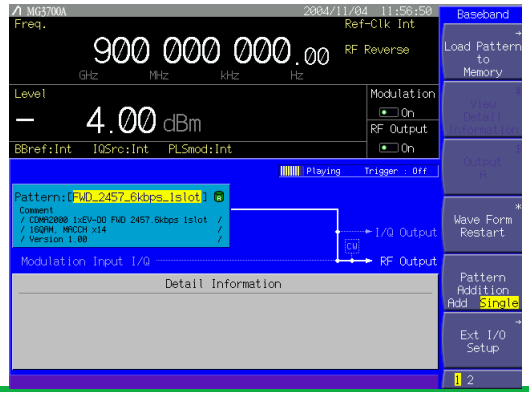
Spurious Close to Carrier
CDMA2000 1xEV-DO, Forward (Active Slot)

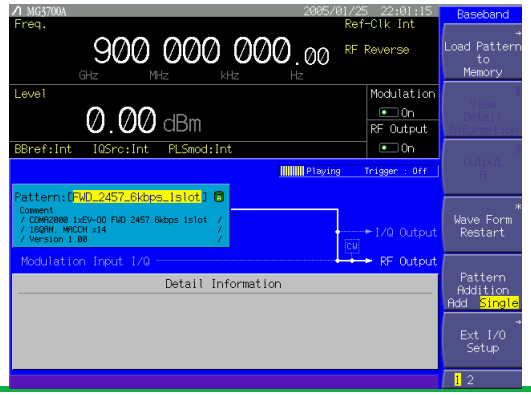
» ≤ -4 dBm

» ≤ 0 dBm * with Option Mechanical attenuator





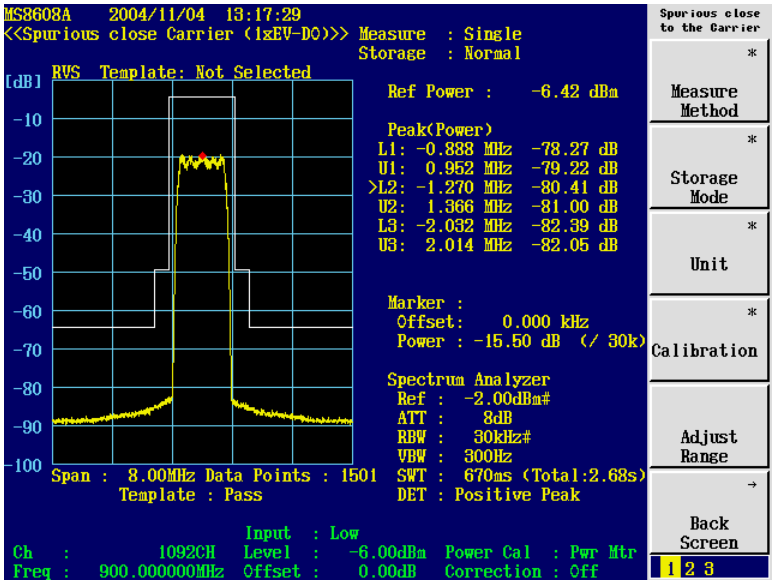


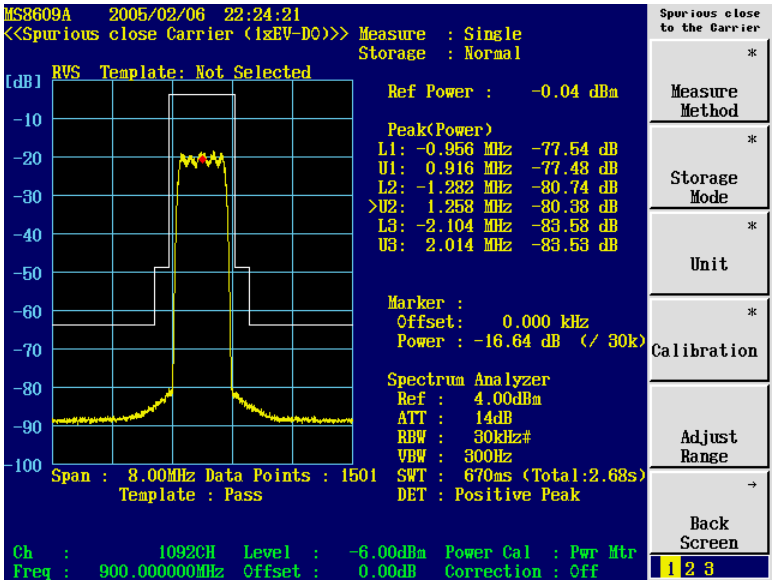


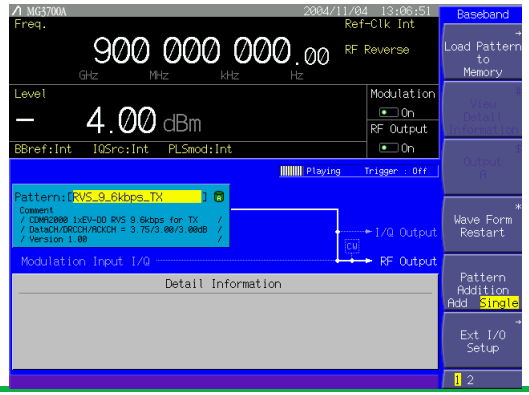
Spurious Close to Carrier
CDMA2000 1xEV-DO, Reverse

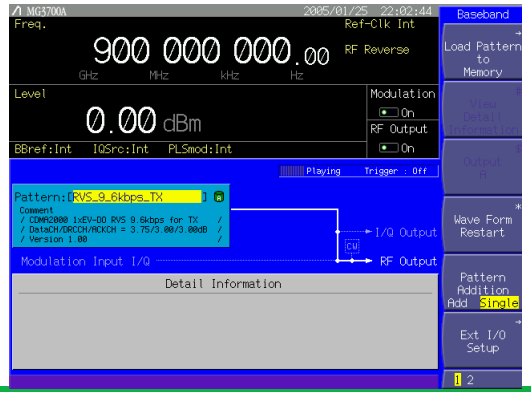
» ≤ -4 dBm

» ≤ 0 dBm * with Option Mechanical attenuator





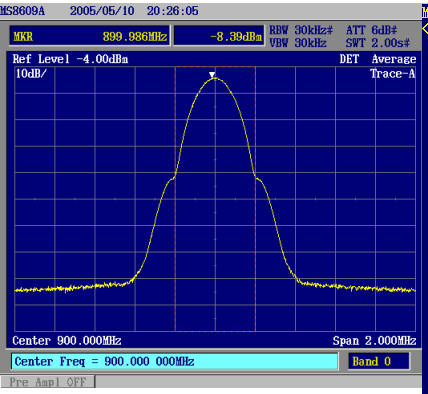


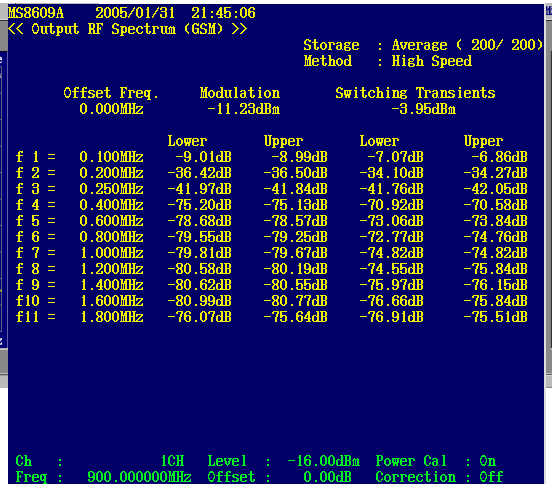


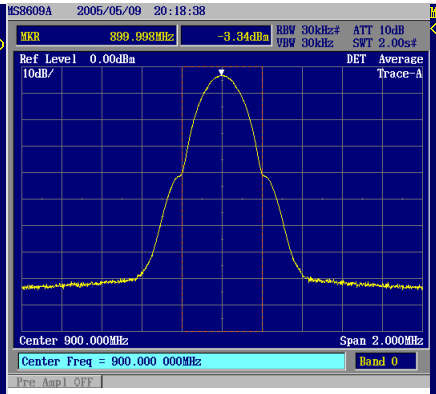
ACLR
GSM/EDGE, GMSK

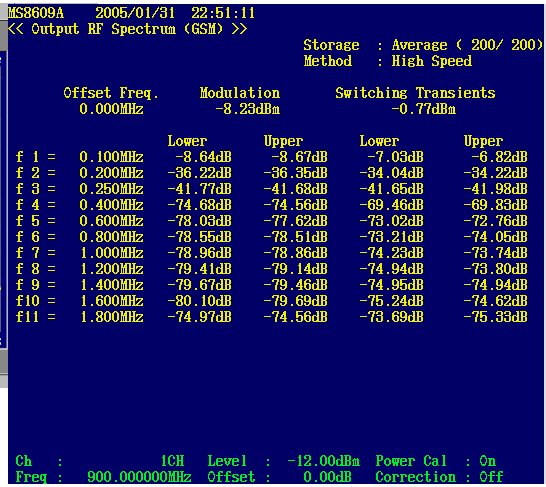
» ≤ -1 dBm

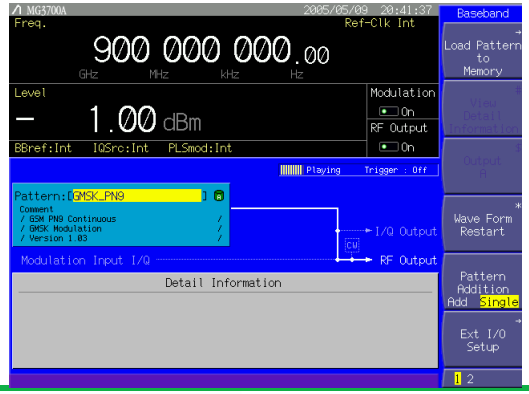
» ≤ +3 dBm * with Option Mechanical attenuator

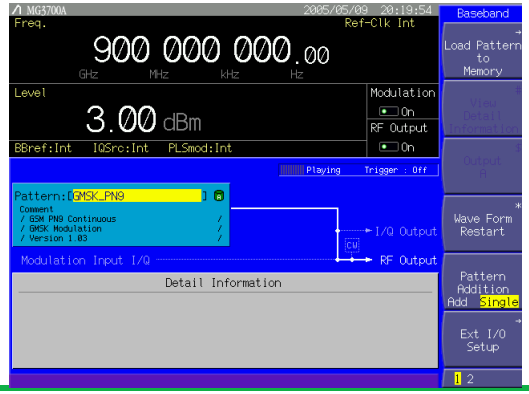








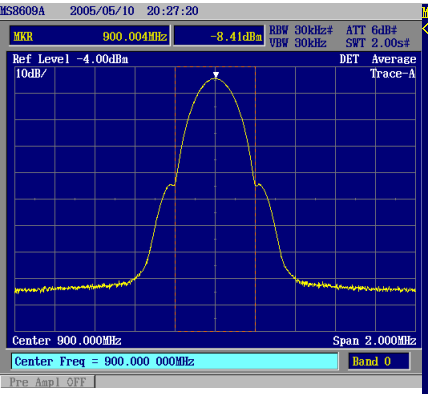


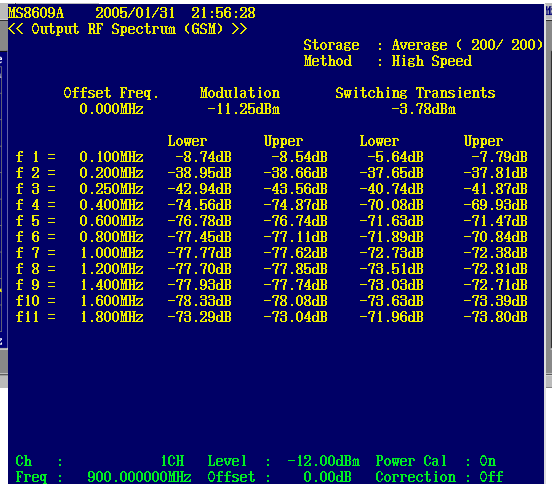


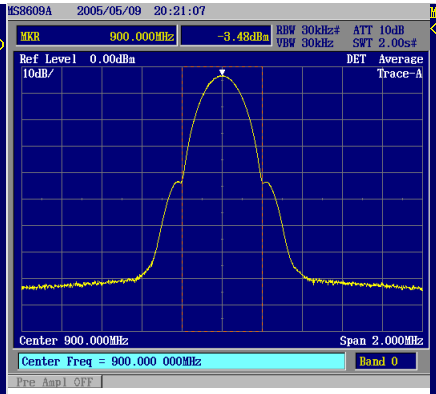
ACLR
GSM/EDGE, 8PSK

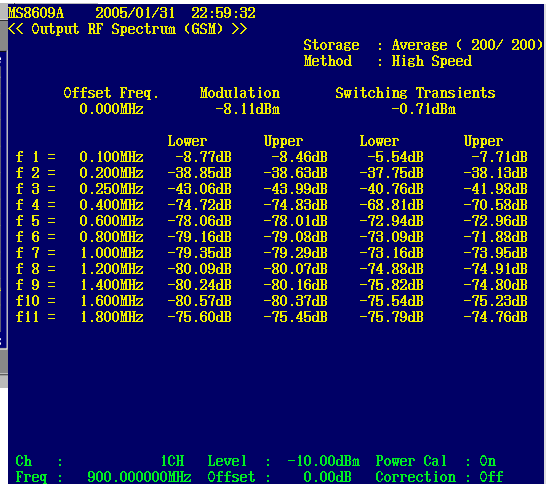
» ≤ -1 dBm

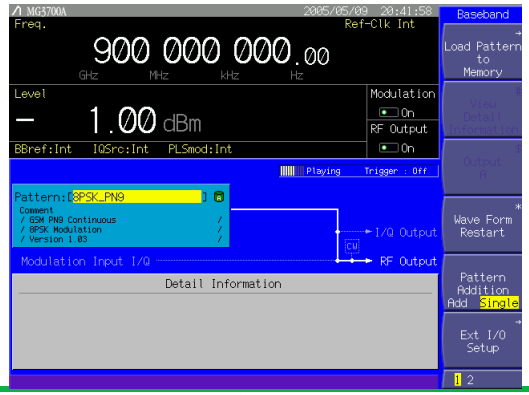
» ≤ +3 dBm * with Option Mechanical attenuator

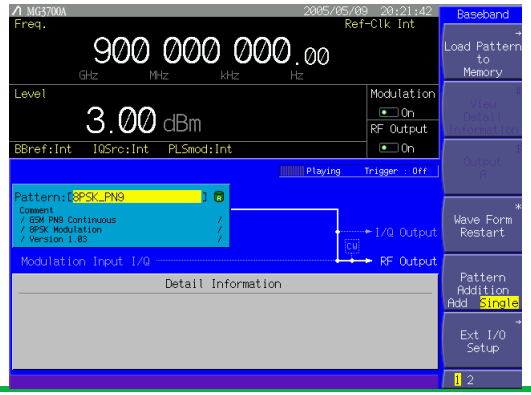








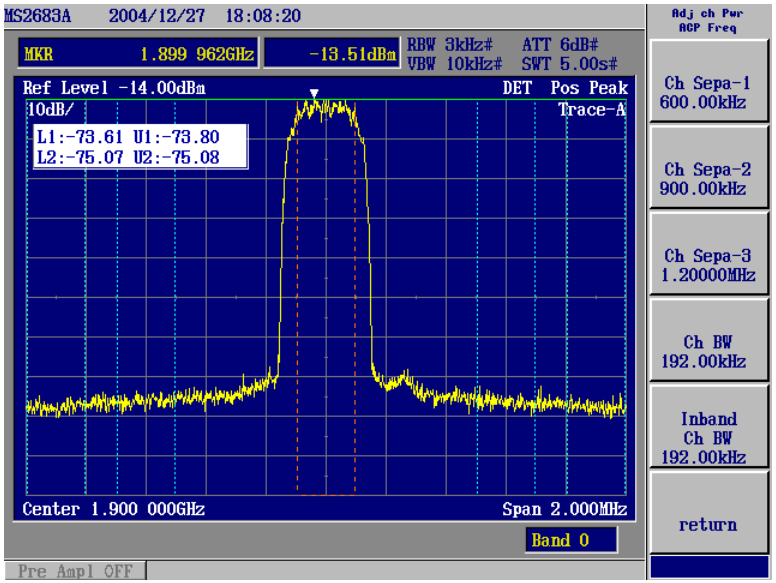


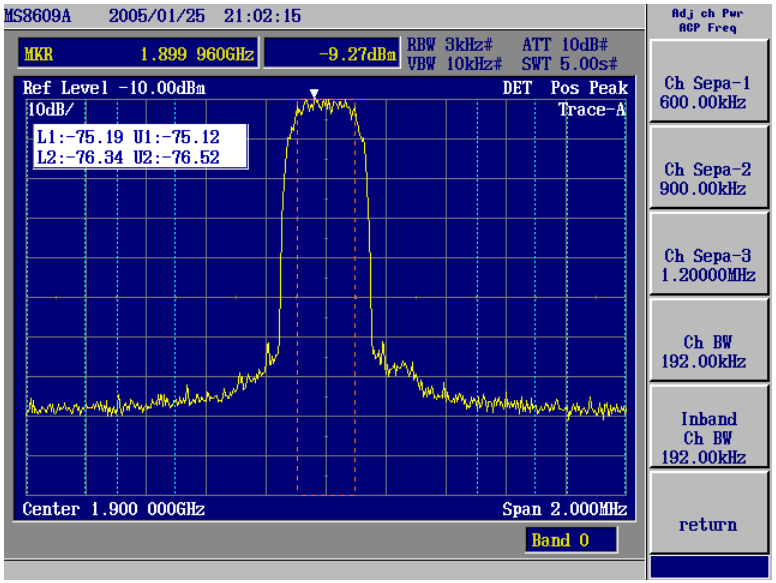


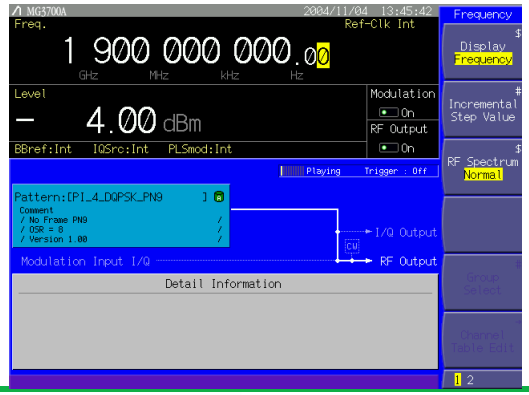
ACLR
PHS

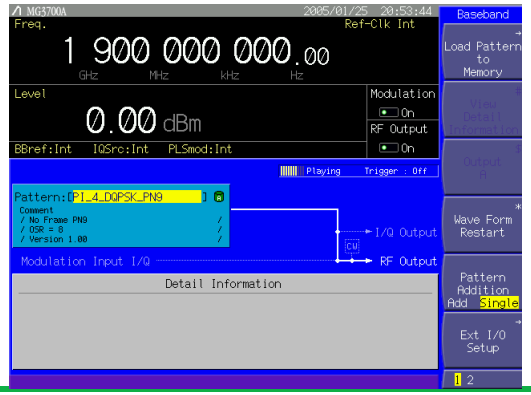
» ≤ -1 dBm

» ≤ +3 dBm * with Option Mechanical attenuator





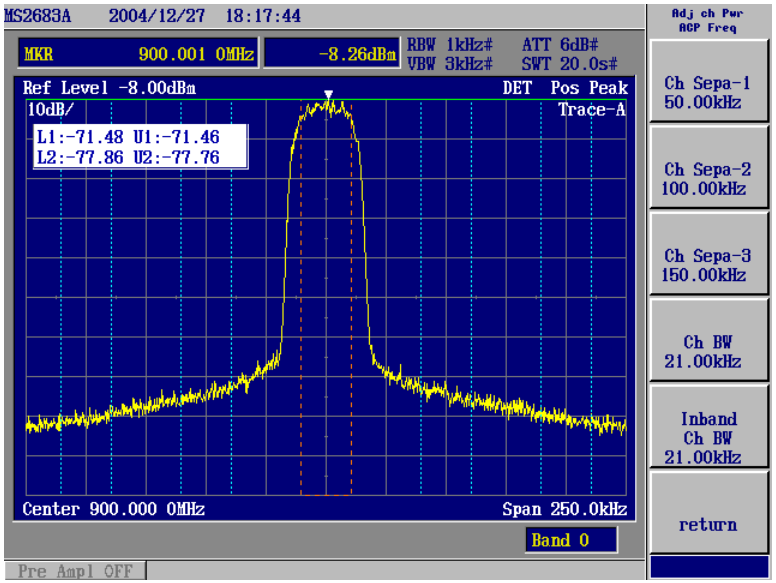


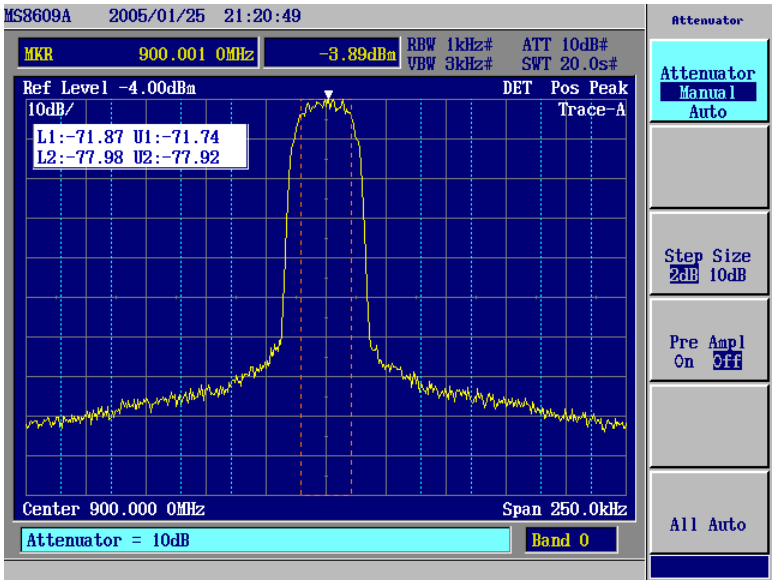


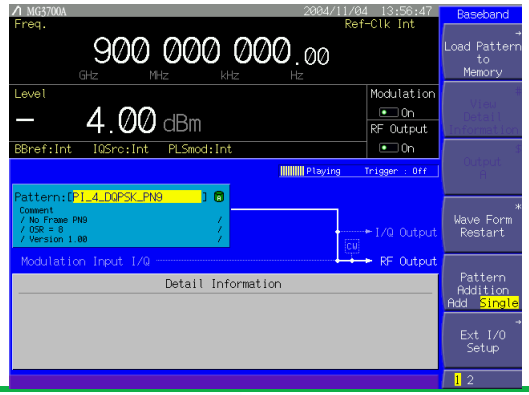
ACLR
PDC

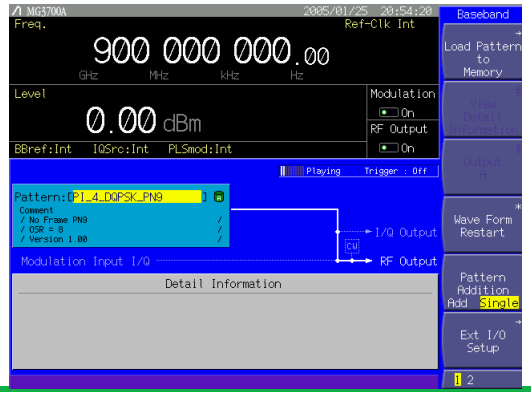
» ≤ -1 dBm

» ≤ +3 dBm * with Option Mechanical attenuator





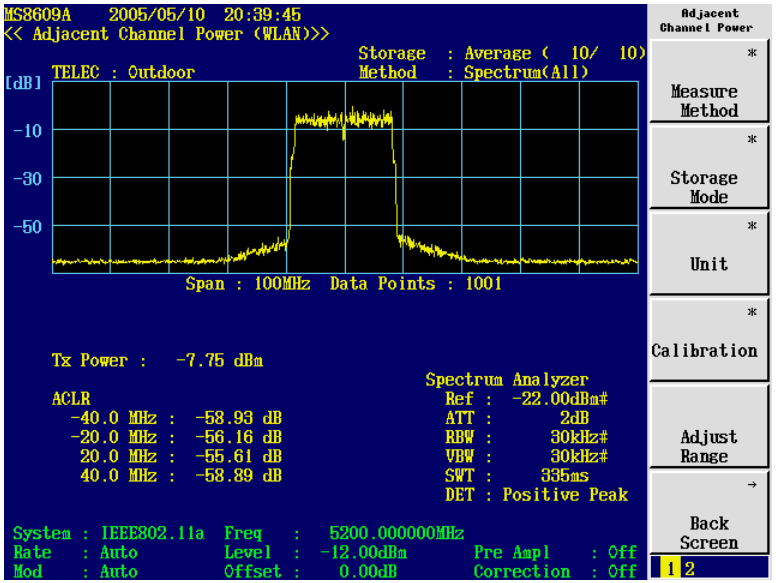


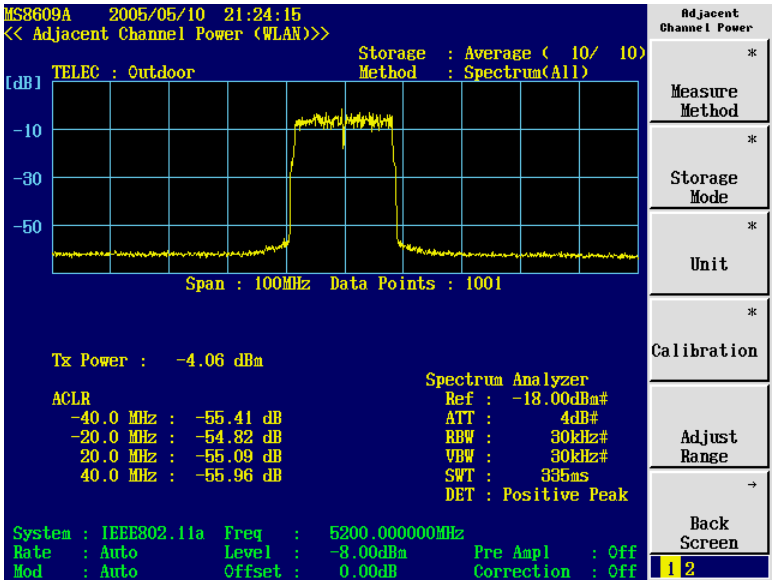


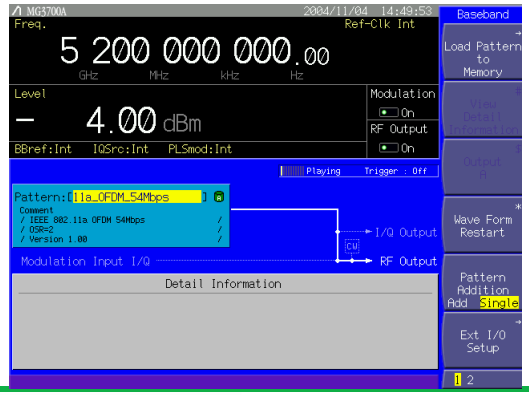
ACLR
WLAN IEEE 802.11a

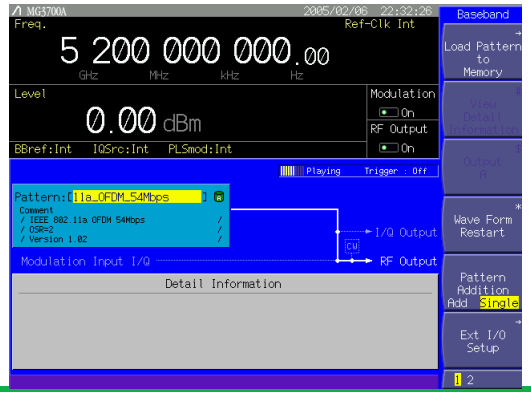
» ≤ -4 dBm

» ≤ 0 dBm * with Option Mechanical attenuator





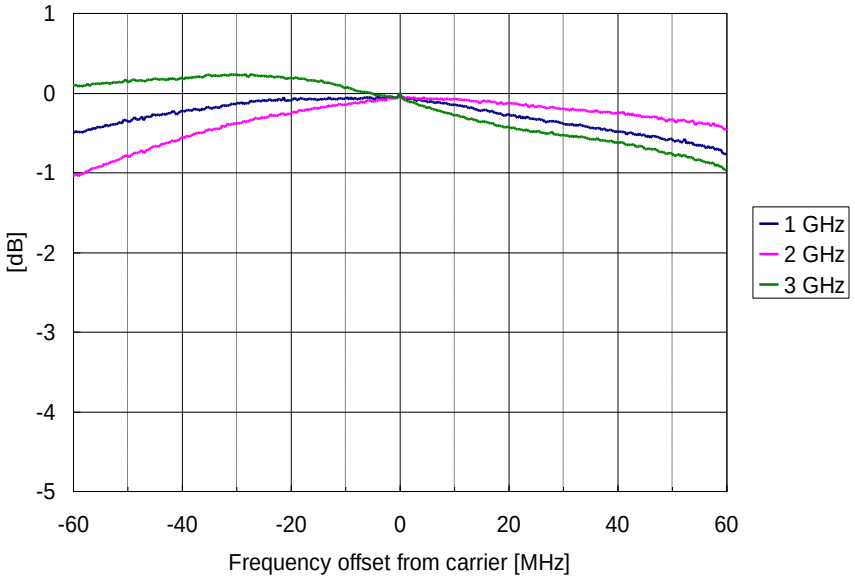


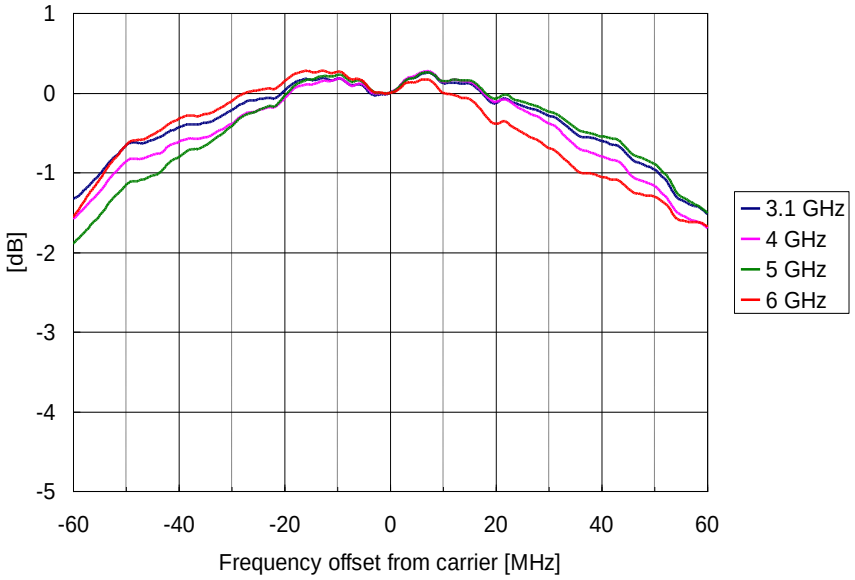


Wideband I/Q Modulation

Modulation bandwidth using internal I/Q

Bandwidth	Flatness ≤ 3 GHz	> 3 GHz
• 20 MHz (±10 MHz)	< ±0.5 dB (≥0.2 GHz)	< ±1 dB
• 120 MHz (±60 MHz)	< ±2 dB (≥1 GHz)	< ±3 dB

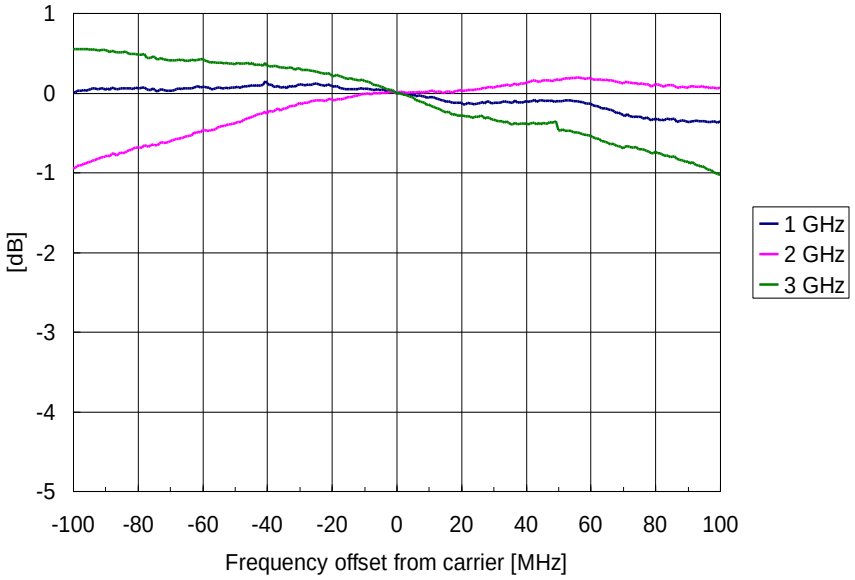


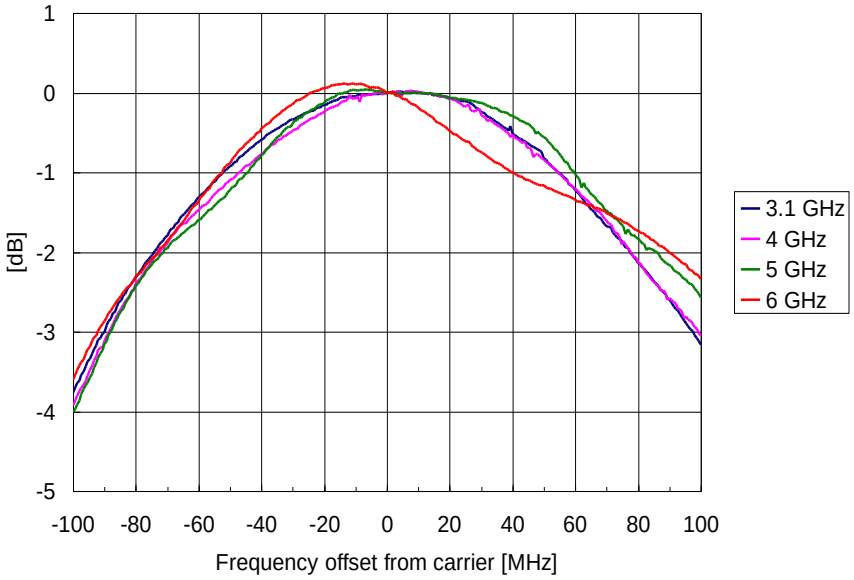


Wideband I/Q Modulation

Modulation bandwidth using external I/Q

Bandwidth	Flatness ≤ 3GHz	> 3GHz
• 20 MHz (±10 MHz)	< ±0.5 dB (≥0.2 GHz)	< ±1 dB
• 150 MHz (±75 MHz)	< ±3 dB (≥1 GHz)	< ±5 dB
• 200 MHz (±100 MHz)	< ±6 dB (≥1 GHz)	< ±9 dB

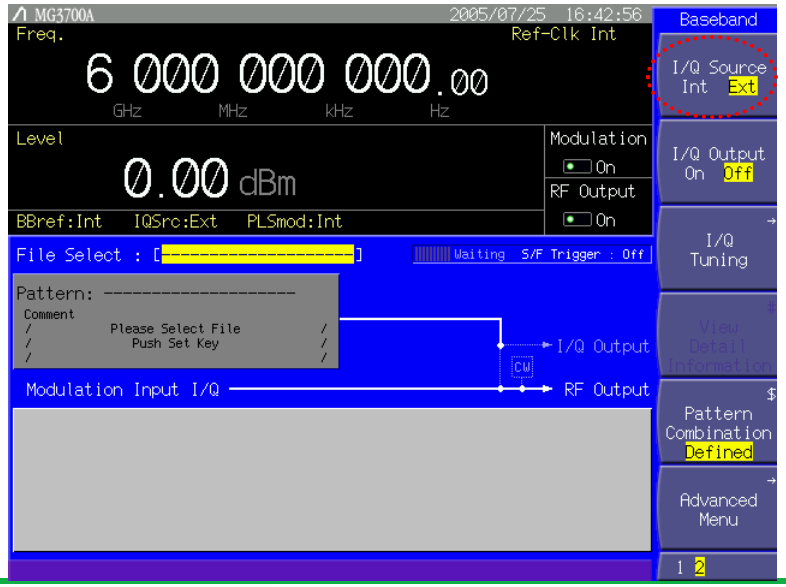




External I/Q Input

- It is possible to output RF by inputting external I/Q baseband signals.
  - » Full scale Input (Optimum level): $\sqrt{I^2+Q^2}=0.5\ Vrms$

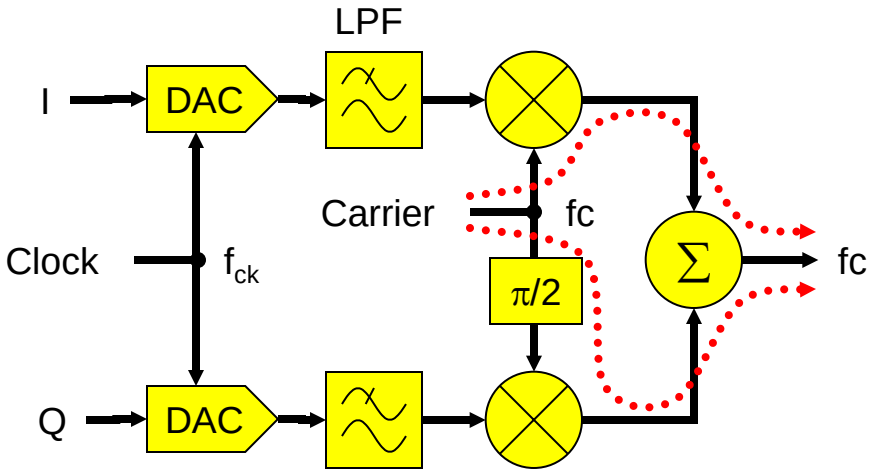
- Setting



Carrier Leakage

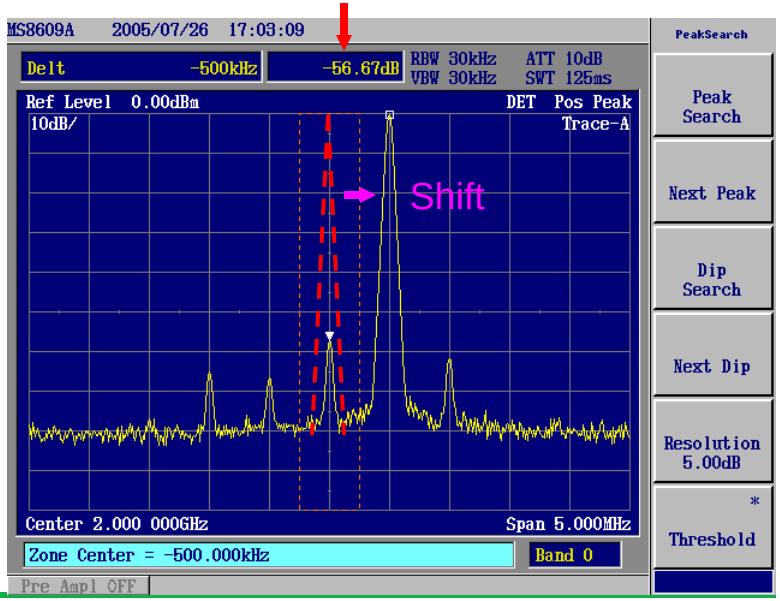
- The leakage of the carrier inputted into I/Q modulator stays in RF signal.
  - » It is quantified by origin offset of signal constellation.
  - » It deteriorates quality of the modulation and causes problems for receiver tests.

- Since the leakage adjusted to the minimum level is stable, its subsequent tune-up is unnecessary.
  - » ≤ -40 dBc



I/Q modulation Block diagram

Typical



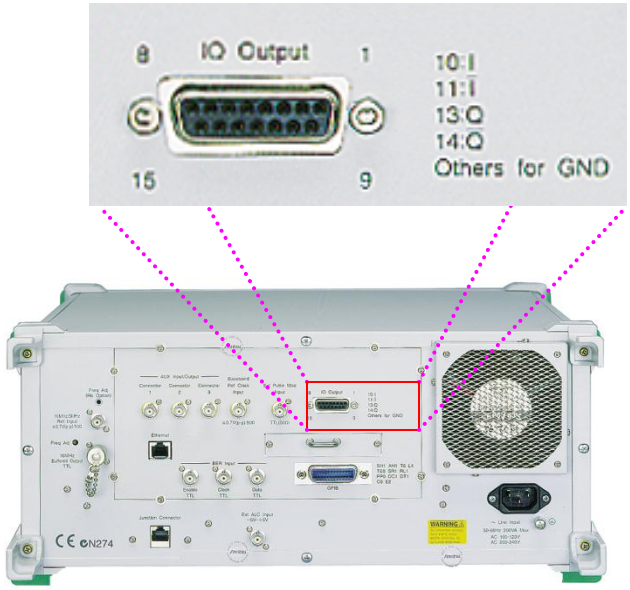
I/Q Adjustment and Differential I/Q Output

- In order to test I/Q modulators, I/Q adjustment and differential (balanced) outputs of I, $\overline{I}$, Q, $\overline{Q}$ are required for the signal source.
  - » Vector magnitude
    - – Amplitude voltage is set as RMS level of I/Q modulator.
  - » Drive DC voltage
    - – In order to drive I/Q modulator for the single power source, DC offset is set as drive voltage.

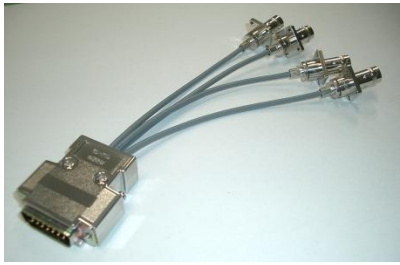
- In order to test I/Q modulators and baseband LSI for balanced devices, I, $\overline{I}$, Q, $\overline{Q}$ differential (balanced) outputs are required for the signal source.
  - » In I/Q input device, the balanced input has the advantage which can reduce the amplitude error and noise compared with I and Q unbalanced (single-ended) inputs.
    - – Reduction of amplitude error by the ground loop
      - The cause is that the grounds of signal source and input device are not equivalent potential.
    - – Reduction of signal line noise
      - The cause is that the environmental noise is picked up on the signal line.

I/Q Output

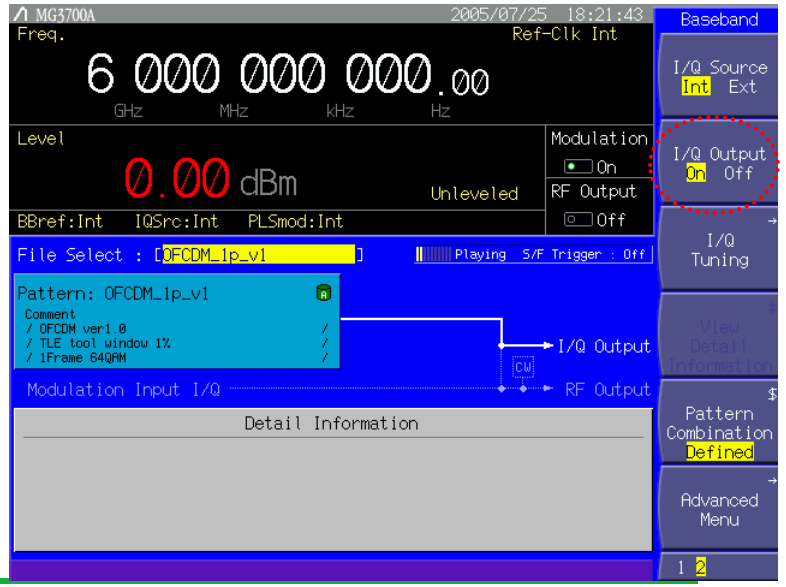
- Differential I/Q signals can be outputted.
  - » $\overline{I}$ / $\overline{Q}$ signals which are reverse signals (amplitude is equal and polarity is reverse) of I/Q signals are outputted.
    - – D-Sub 15 (Jack), 50 Ω



J1277 (Optional accessory)
D-Sub>BNC adapter

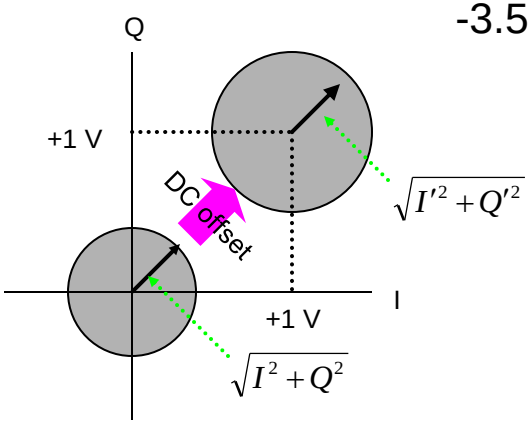


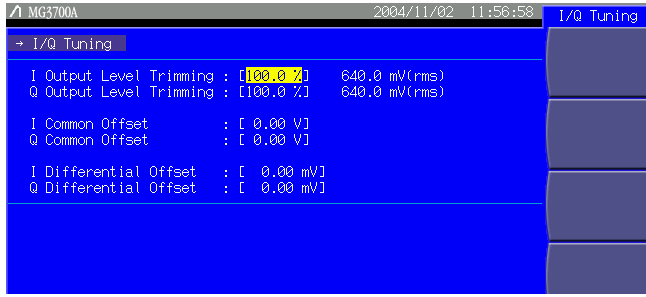
- Setting

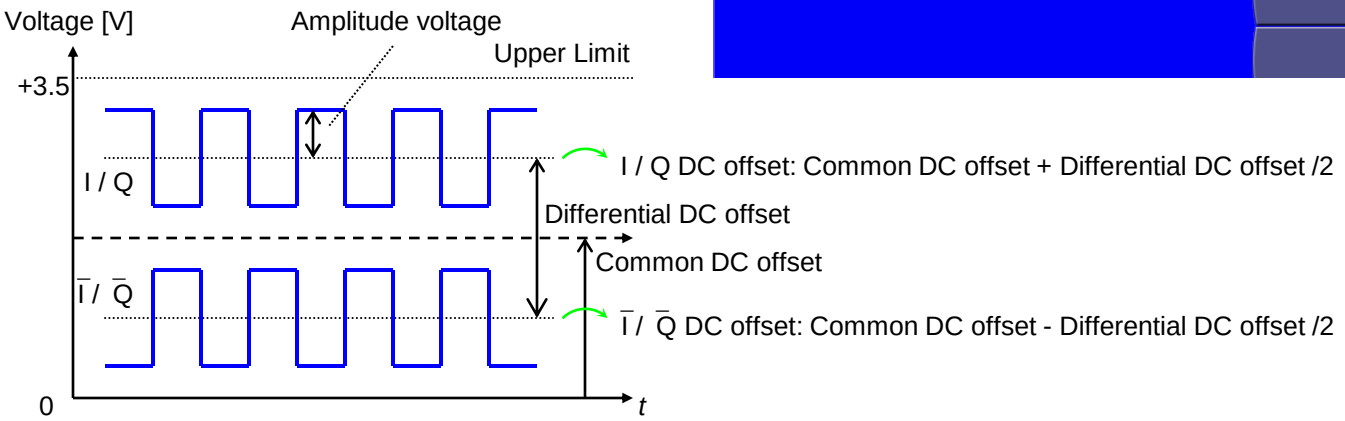


I/Q Adjustment

- Variable of amplitude voltage of I/Q signals outputs, DC offset
  - » Amplitude voltage
    - – 0 ~ 120%, Resolution 0.1%
  - » DC offset
    - – I / $\overline{I}$, Q / $\overline{Q}$ common offset: -1 ~ +3 V, Resolution 10 mV
    - – I / $\overline{I}$, Q / $\overline{Q}$ differential offset: -50 ~ +50 mV, Resolution 0.05 mV
  - » Amplitude voltage range
    - – Amplitude voltage ⊕ Common DC offset ⊕ Differential DC offset:
      -3.5 ~ +3.5 V

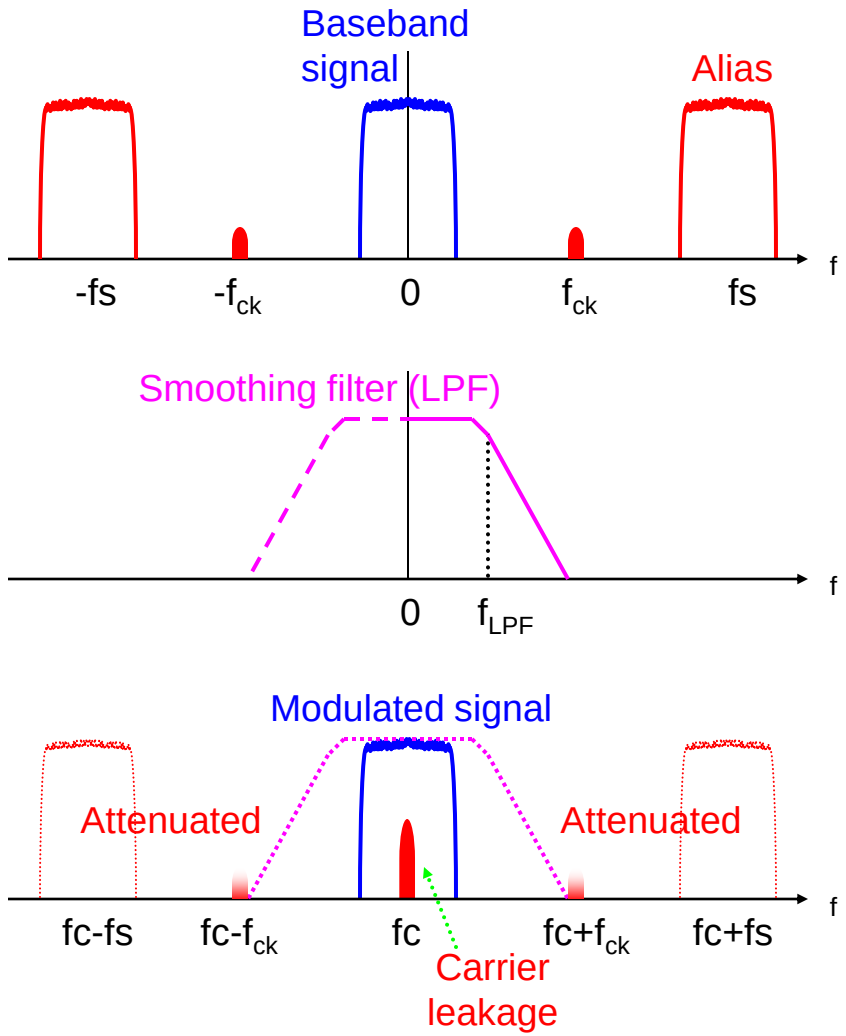






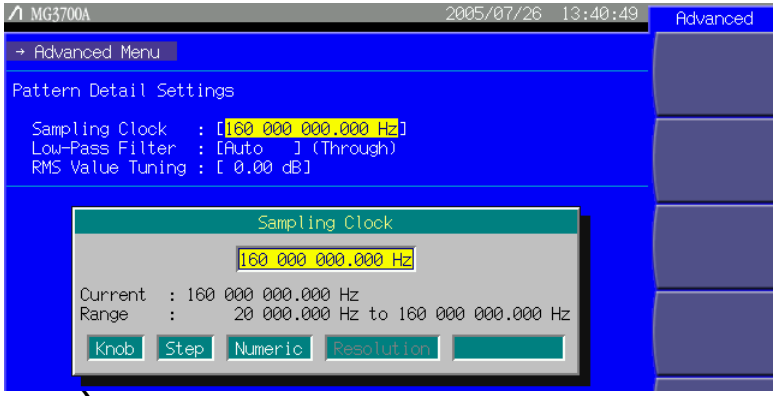
Advanced High-speed I/Q Baseband

- If the baseband sample clock (f_{ck}) and the DAC sampling rate (fs) are faster, it can generate more wideband signal.
- If the faster f_{ck} is used, the volume of sample data will be larger and the higher capacity baseband memory will be required.



Spectral mechanism of DAC → LPF → I/Q modulator (by sampling theorem)

High-speed I/Q Baseband

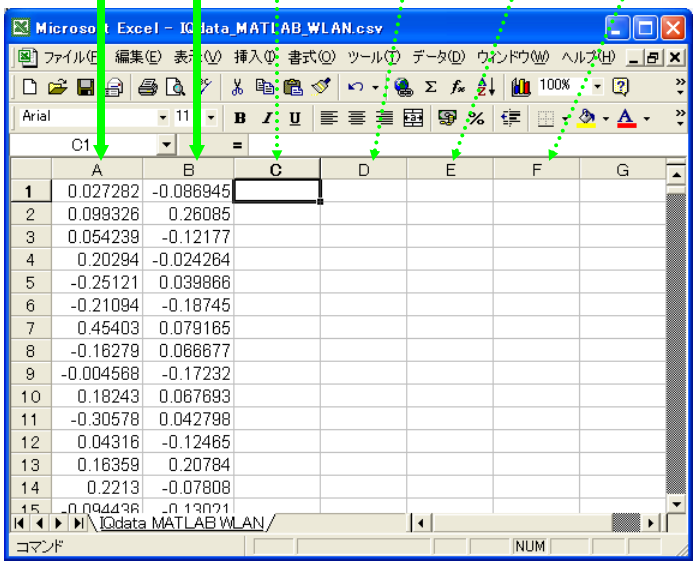


- Sample rate (Fs)
  - » 20 k ~ 160 MHz, Resolution 0.001 Hz
- Upsample clock (f_{ck})
  - » $f_{ck} = 2^n \times Fs \leq 160$ MHz (n: maximum integer)
    - – at $Fs \leq 20$ MHz
  - » Automatic interpolation
    - – Interpolator upsamples the sample clock (f_{ck}) to the maximum, and f_{ck} is further kept away from modulated signal frequency.
- DAC Sampling rate (fs)
  - » ≤ 400 MHz
    - – Since the internal interpolation DAC was employed, alias is further kept away from modulated signal frequency.
  - » Automatic interpolation fs
    - – $20 < f_{ck} \leq 50$ MHz: $8\times f_{ck}$
    - – $50 < f_{ck} \leq 100$ MHz: $4\times f_{ck}$
    - – $100 < f_{ck} \leq 160$ MHz: $2\times f_{ck}$

Dual Baseband Memory

- High-capacity baseband memory can generate high-speed signals and long term signals
  - » 2× 128 Msample/channel (1 GB)
  - » 2× 256 Msample/channel (2 GB) * with Option Memory upgrade
    - – The flash memory had been mainly employed. But since DRAM used for the main memory in PC was employed, the cost was reduced in spite of high-capacity and fast-loading.

Channel Event
I , Q (, Marker 1, Marker 2, Marker 3, RF Gate)



	A	B	C	D	E	F	G
1	0.027282	-0.086945					
2	0.099326	0.26085					
3	0.054239	-0.12177					
4	0.20294	-0.024264					
5	-0.25121	0.039866					
6	-0.21094	-0.18745					
7	0.45403	0.079165					
8	-0.16279	0.066677					
9	-0.004568	-0.17232					
10	0.18243	0.067693					
11	-0.30578	0.042798					
12	0.04316	-0.12465					
13	0.16359	0.20784					
14	0.2213	-0.07808					
15	-0.094436	-0.13021					

Sample data generates in sample time Ts=1/Fs

Maximum of
256,000,000 sample
512,000,000 sample * with Option

Dual Baseband Memory

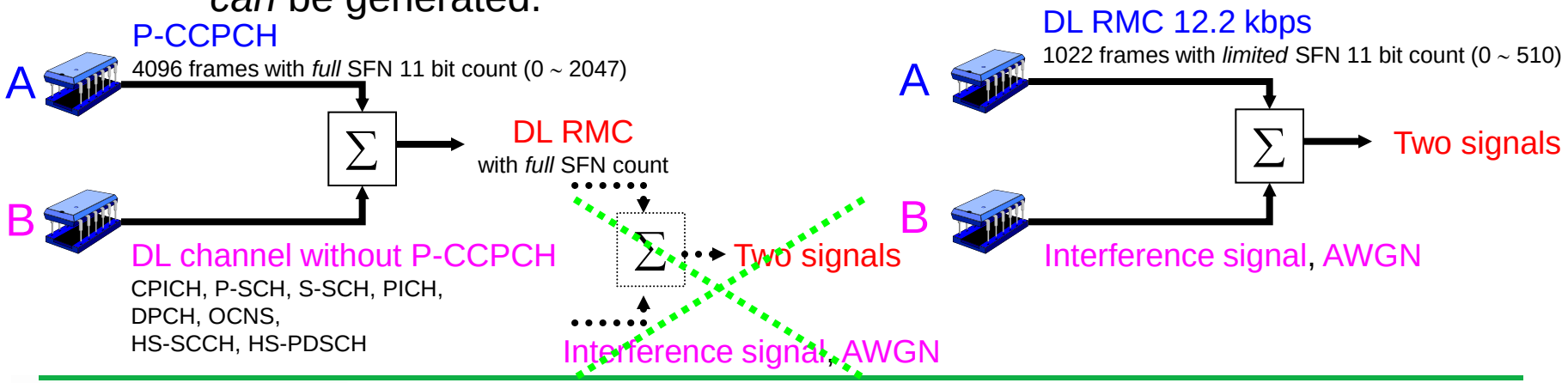
- Able to generate two signals which mixed digitally the signals of the baseband memories A and B.
  - » Two signals which mixed the signals of different sample rate (Fs) *cannot* be generated correctly.
    - – MX370104A Multi-carrier IQproducer can adjust different Fs.
      - – e.g. W-CDMA + GSM, IEEE 802.11a/g + 802.11b/g

Restriction

  - » Two signals which mixed DL RMC signal for W-CDMA UE receiver test with *full* SFN count, and interference signal or AWGN *cannot* be generated.

Restriction

  - » Two signals which mixed DL RMC 12.2 kbps signal for W-CDMA UE receiver test with *limited* SFN count, and interference signal or AWGN *can* be generated.

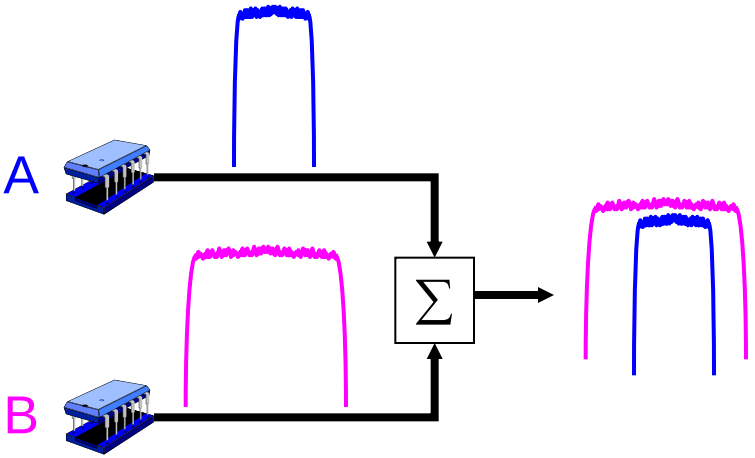


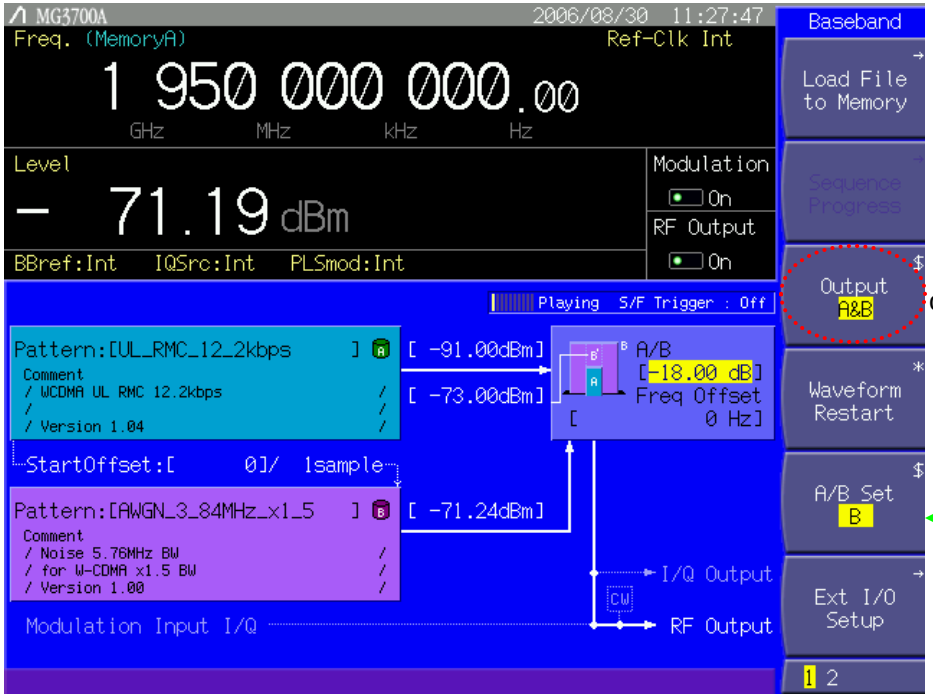
Dual Baseband Memory

- The signals output level of memories A and B can be set as [dBm] and [dB].
  - » A/B level ratio: 0 ~ ±80 dB, Resolution 0.01 dB
- Frequency offset (Δf) is available.
  - – Shift the A frequency
    - Carrier leakage stays on the B frequency.
  - » 0 ~ ±(0.8× Fs × 2^n - Bandwidth)/2
    - – at Fs ≤ 20 MHz
      - – 2^n× Fs ≤ 160 MHz (n: maximum integer)
  - » 0 ~ ±(0.8× Fs - Bandwidth)/2
    - – at Fs > 20 MHz
      - – Bandwidth: Modulation rate[cps, sps] = Fs/Oversampling ratio
      - Example of W-CDMA: ±(0.8× 4× 3.84 MHz × 2^3 - 3.84 MHz)/2 = ±47.232 MHz
  - » Resolution 1 Hz
- Timing offset (Δt) is available.
  - » 0 ~ (Total sample of A - 1) ≤ 9,999,999 , Resolution 1 sample
    - – Shift the B start timing
      - It is useful to the signals with same A and B, such as multipath and TX diversity.

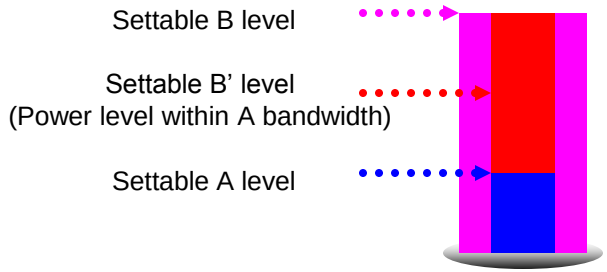
Dual Baseband Memory

- Mixing on the same frequency
  - » Wanted signal + AWGN
  - » 2-path fading
  - » TX diversity





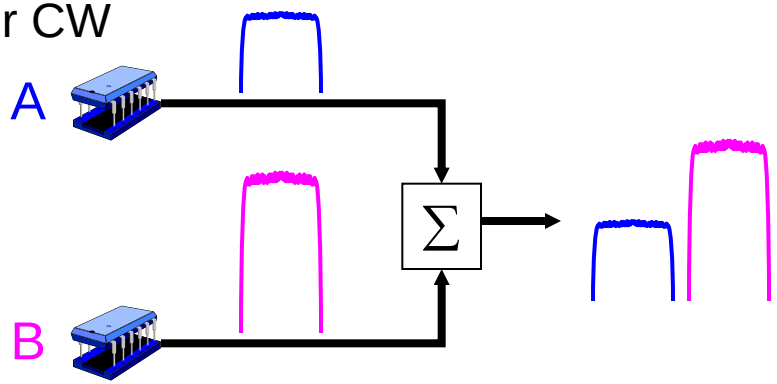
or A or B

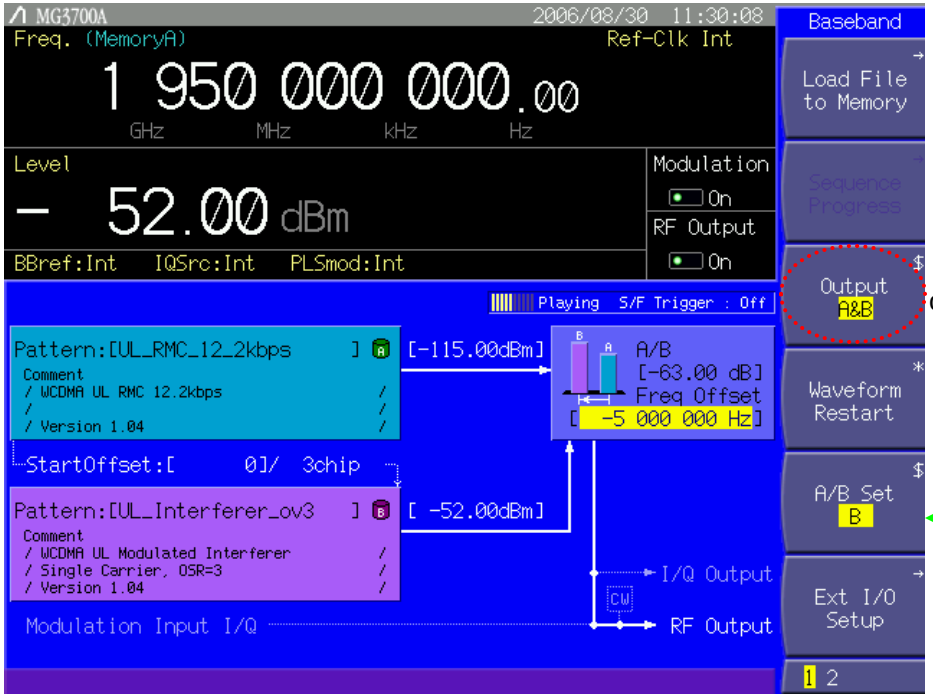


A/B Set	A level	B level	RF level
A	Variable	Static	Coupled
B	Static	Variable	Coupled
Constant	Variable	Variable	Static

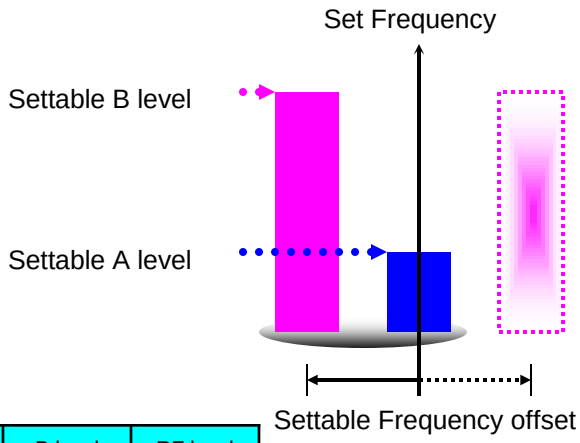
Dual Baseband Memory

- Mixing on different frequency
  - » Wanted signal + Interference signal or CW
  - » AWGN + AWGN





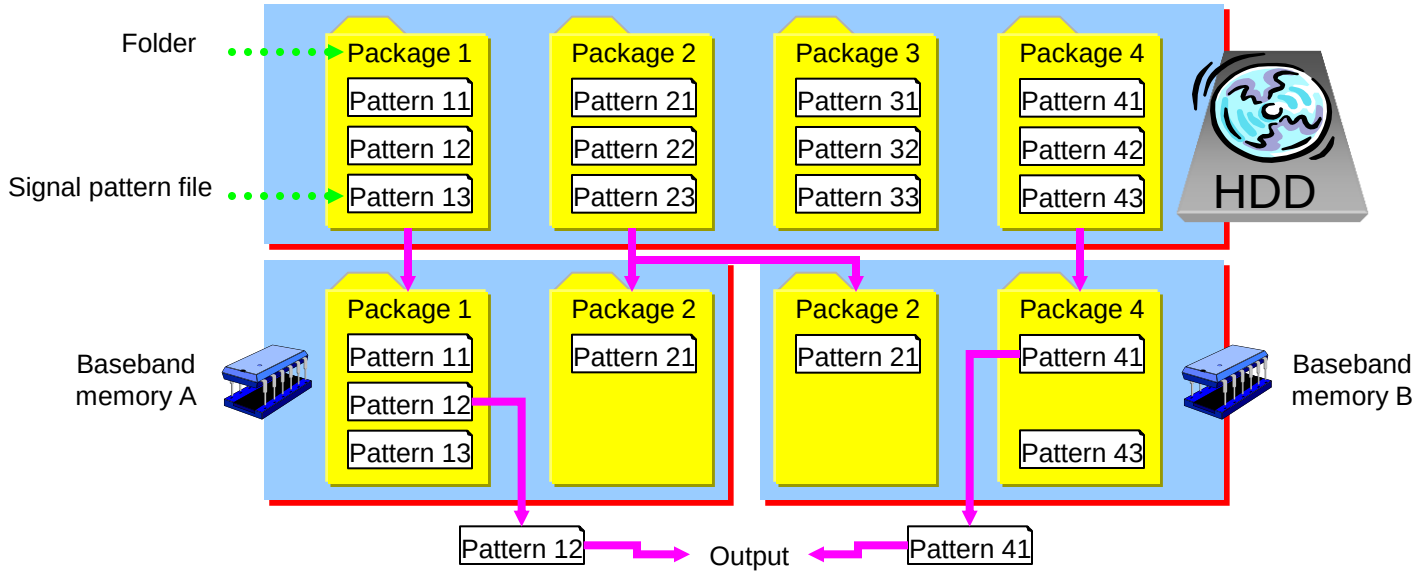
or A or B



A/B Set	A level	B level	RF level
A	Variable	Static	Coupled
B	Static	Variable	Coupled
Constant	Variable	Variable	Static

Dual Baseband Memory

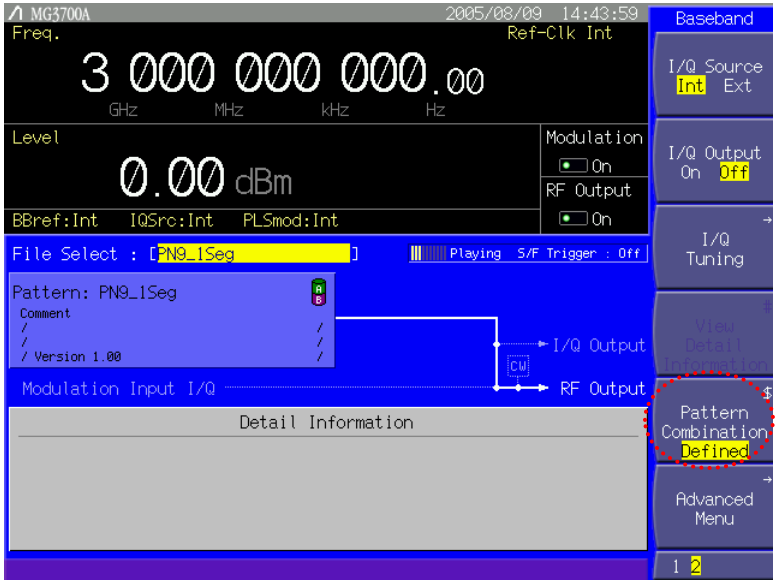
- Baseband memories A and B load the I/Q sample data in the saved signal pattern files from HDD in advance.
  - » Loading time: 14 MB/s (7 MS/s)
  - » Maximum package/baseband memory: 100
  - » Maximum pattern/package: 100
  - » Maximum pattern/baseband memory: 4,096
  - » Minimum sample/pattern: 1,000
- Baseband memories A and B output I/Q sample data of the selected signal pattern.



Dual Baseband Memory

- When outputting long term signals with larger capacity than baseband memory A, the memories of A and B are combined automatically.
  - » Simulated signal pattern of fading
  - » Real signal pattern for receiving video and voice test

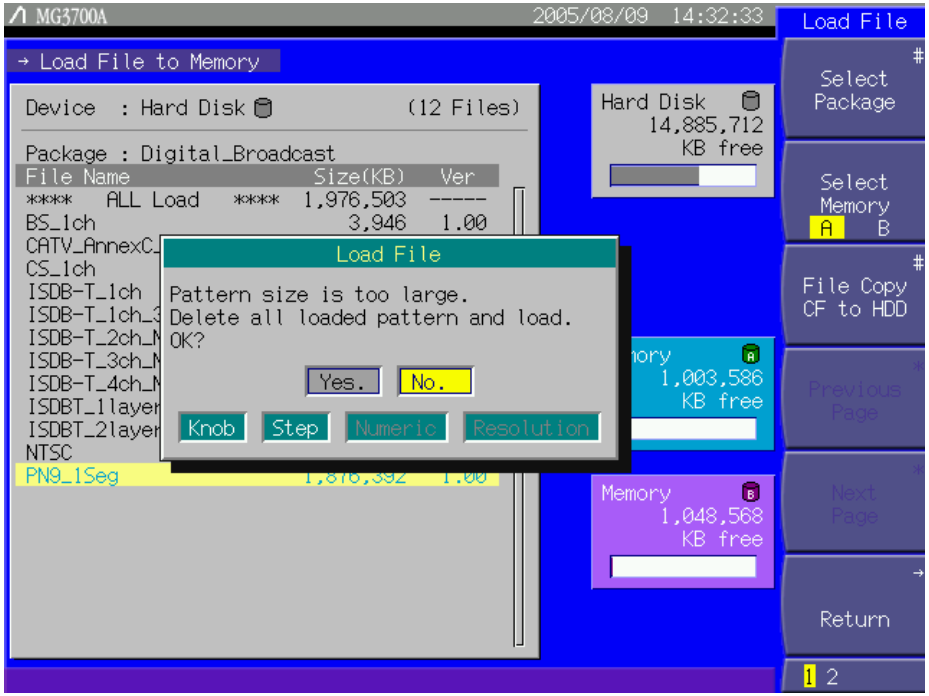
A+B



- W-CDMA 16.66 s (1,666 frame)
  33.33 s * with Memory upgrade option
  - – Sample rate (Fs): 4× 3.84 Mcps
- VSF-Spread OFDM roughly 4 s * with Memory upgrade option

Dual Baseband Memory

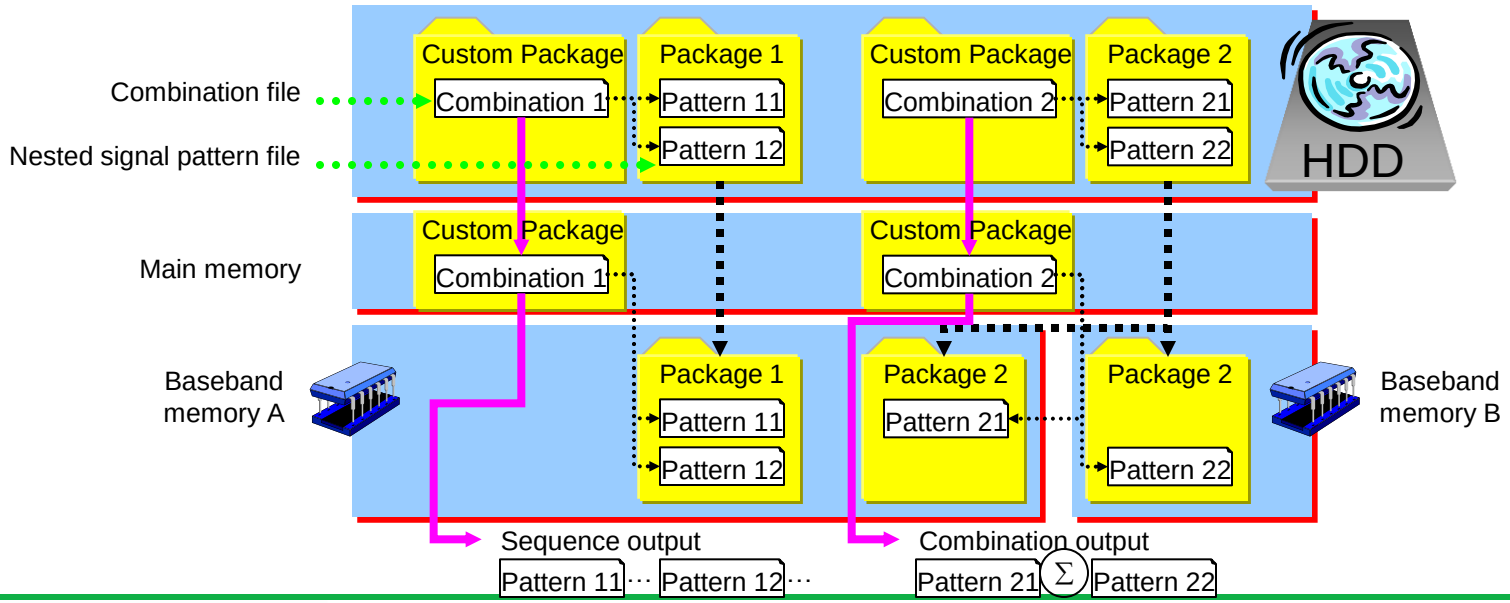
- When a long term signal is loaded to a baseband memory, all the memorized patterns are deleted.
  - » Maximum pattern/baseband memories A+B: 1
    - – The message is displayed when downloading in a baseband memory (A).



Sequence/Combination of Signal Patterns

- The signal pattern sequence can be generated.
  - » Useful to protocol emulation
  - » Available for digital sweep of output level
- Shortcut operation is served.
  - » Simplification of operation for combination output
  - » Management of utilized pattern files in custom packages

  - The combination files can be created/defined by PC software "IQ producer" (standard accessory).

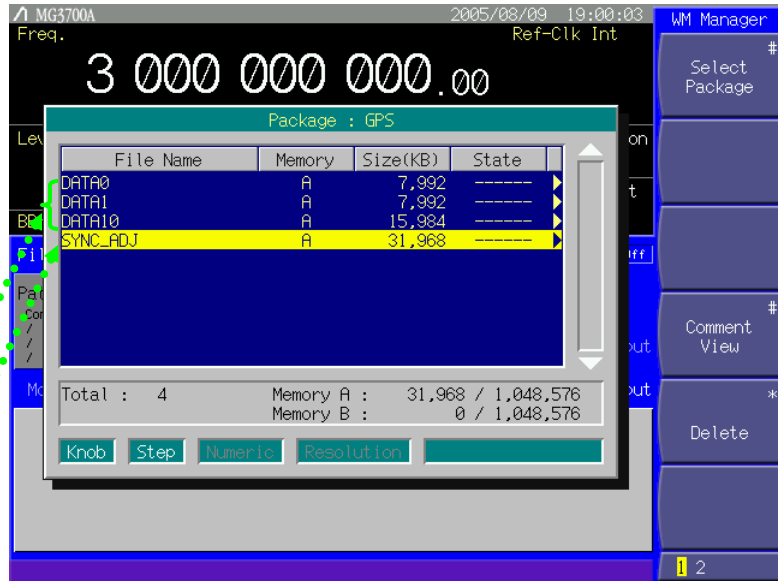


Sequence of Signal Patterns

- Example of protocol emulation
  - » Play Mode: Auto
    - – The sequence based on a scenario of the combination file works.

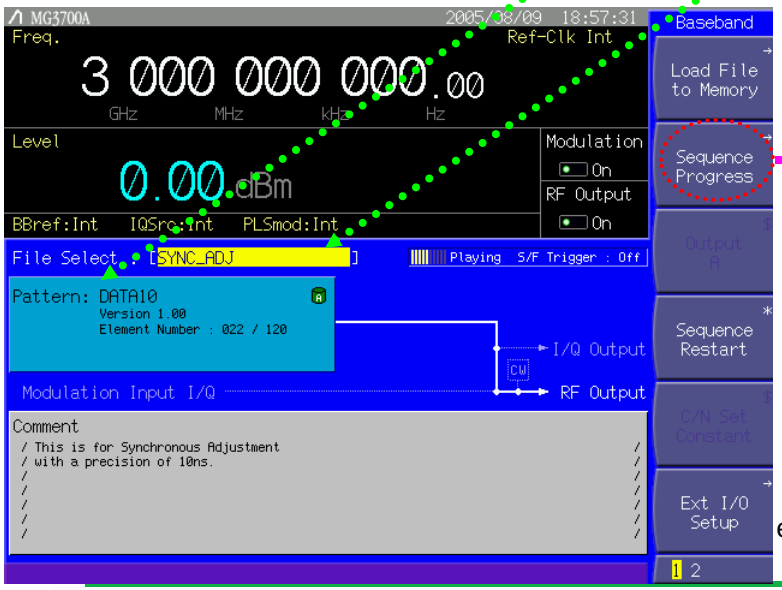
Scenario:

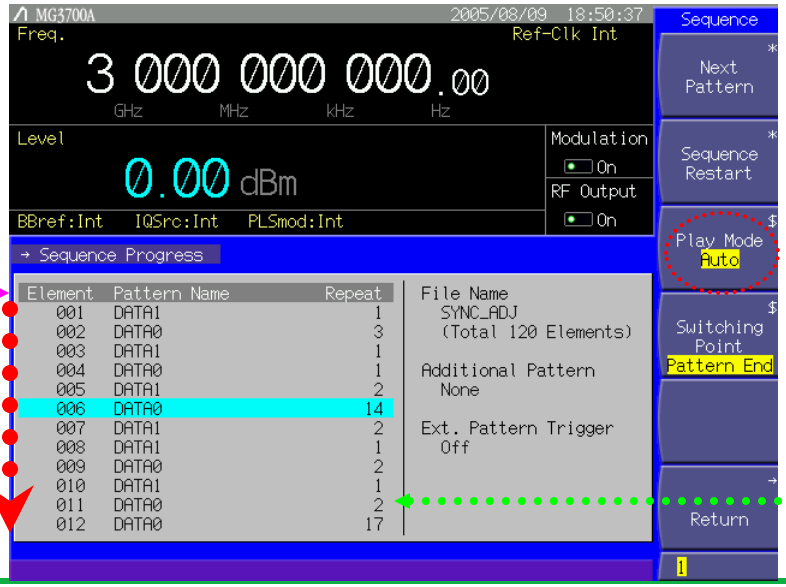
- – The repeat count and output level per element are already defined.



Nested signal pattern files

Combination file



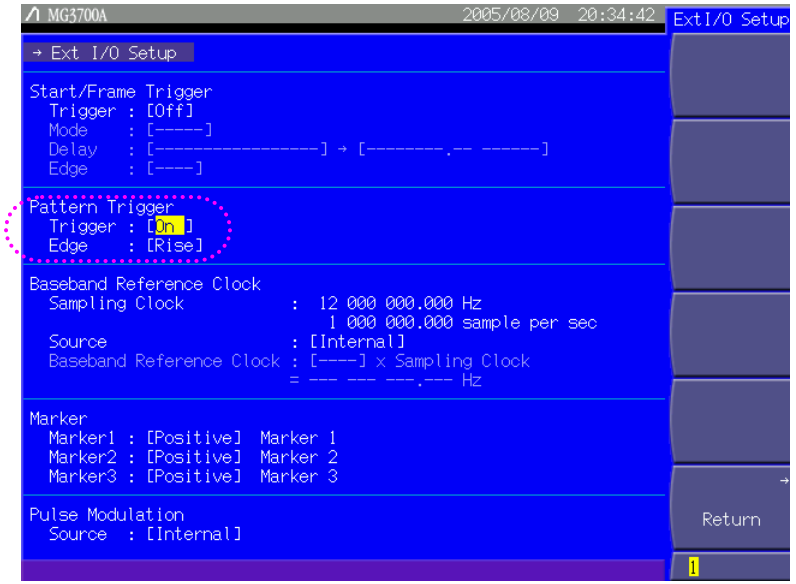


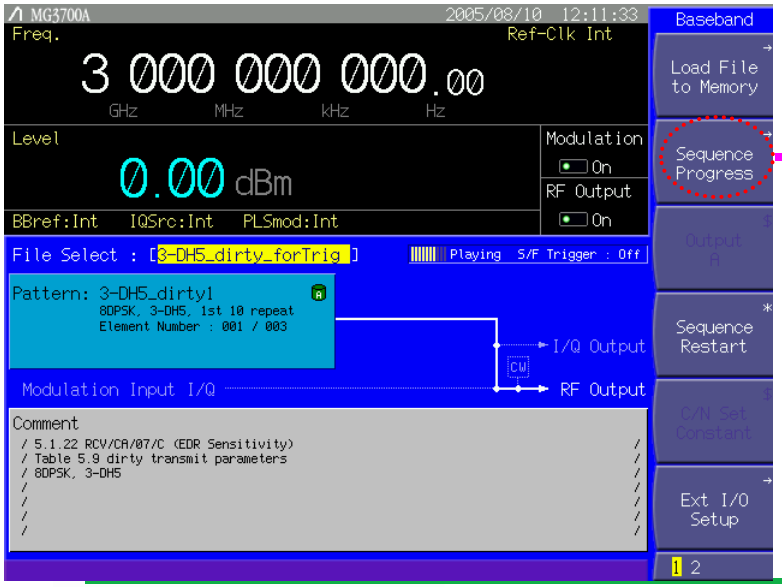
Max. element 200

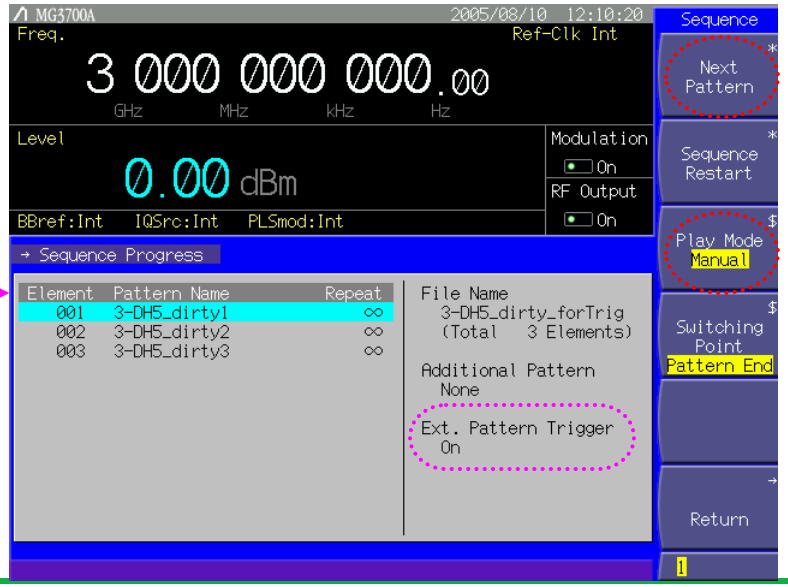
Max. element repetition 65,535

Sequence of Signal Patterns

- Example of protocol emulation
  - » Play Mode: Manual
    - – Pattern Trigger input executes Next Pattern [F1] operation.





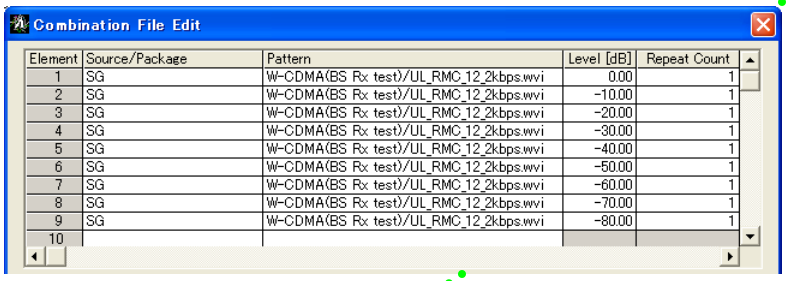


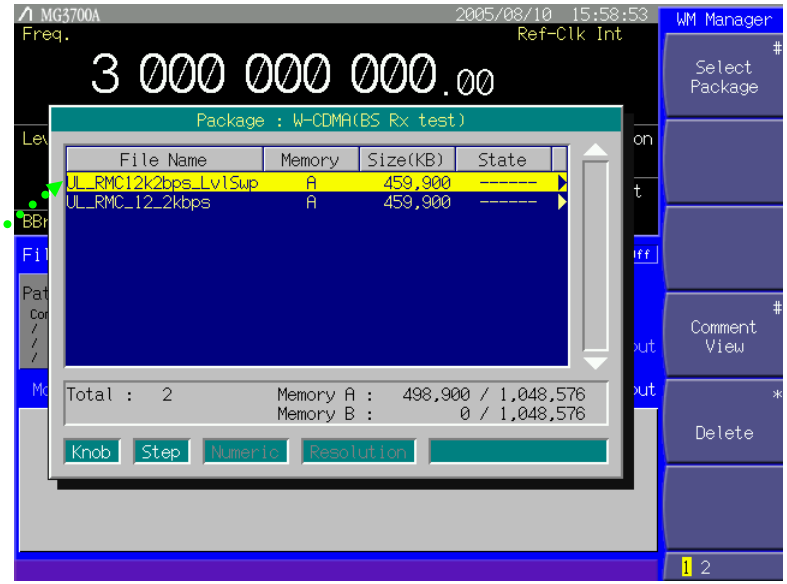
or Frame End

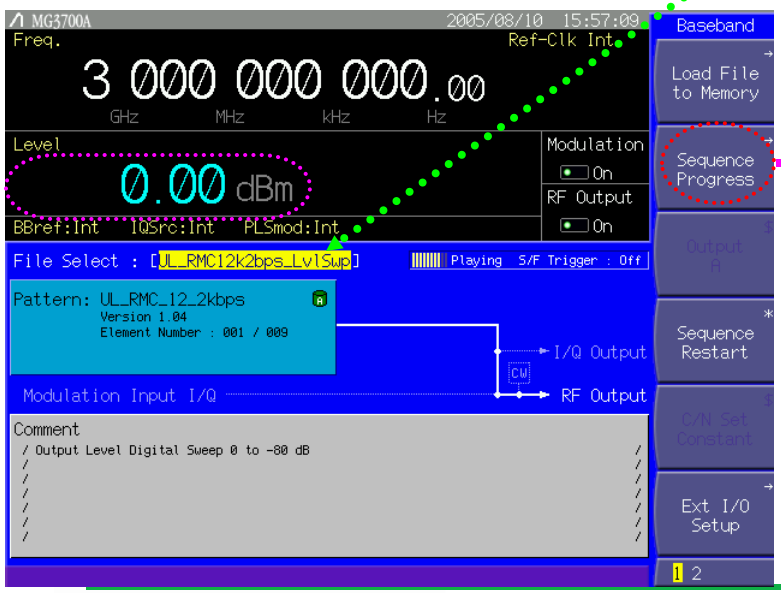
Sequence of Signal Patterns

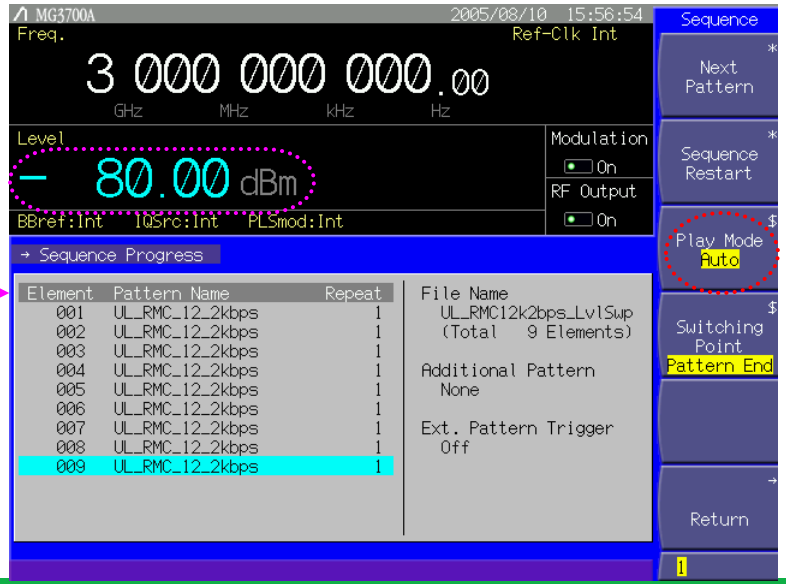
- Example of digital sweep of output level
  - » Dynamic range ≤ 80 dB

The scenario of combination file



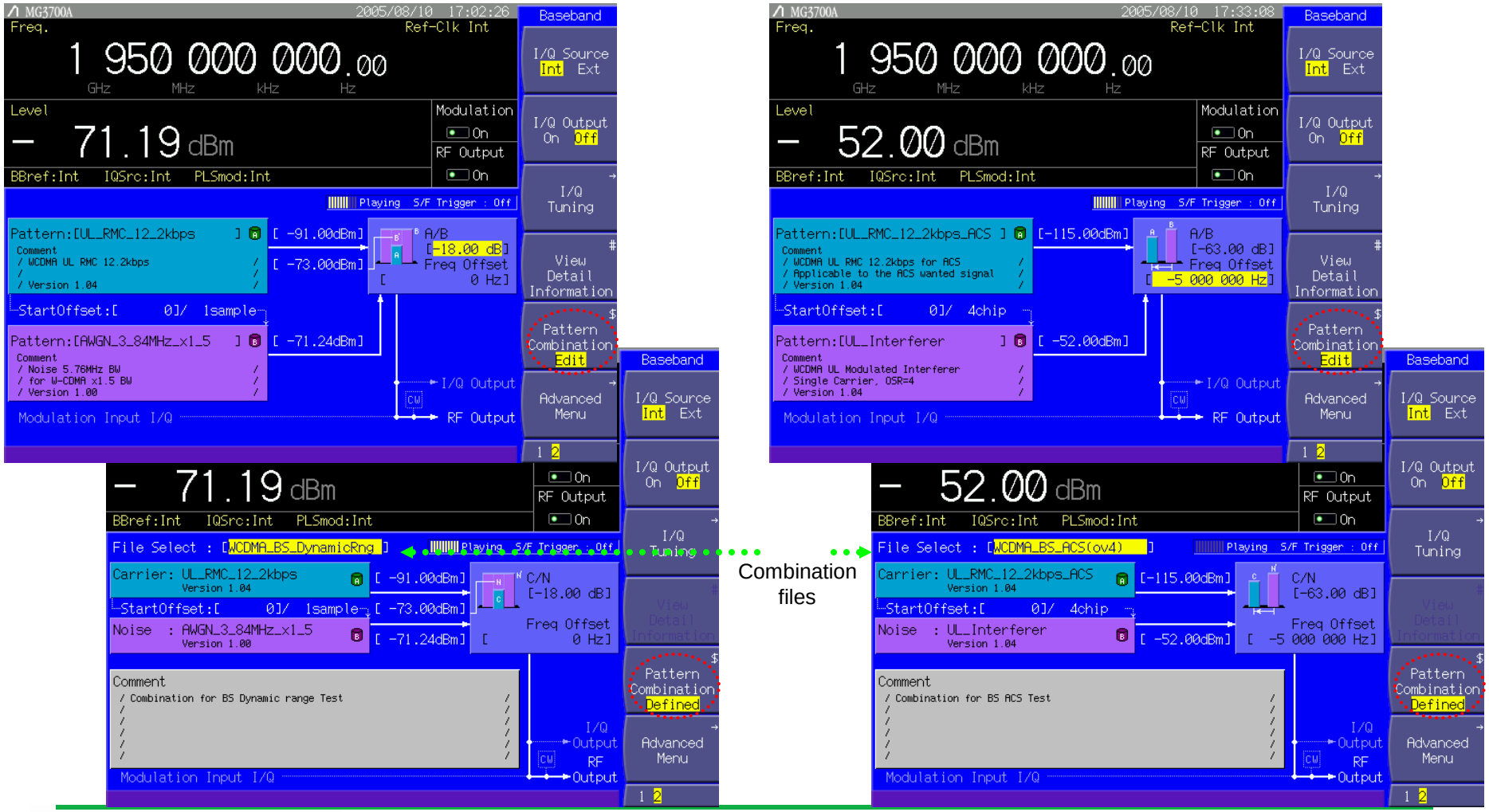






Combination of Signal Patterns

- Example of shortcut operation



Variable Smoothing Filter

- Much cutoff frequency f_{LPF} can be changed according to usage.
  - » Auto
    - – The filter is chosen according to sample rate (Fs).

f_{LPF}	Single	Dual (Used baseband memory)		
–	100 kHz	70 MHz	: 20 < Fs ≤ 312.5	kHz
–	300 kHz	70 MHz	: 0.3125 < Fs ≤ 1.25	MHz
–	1 MHz	70 MHz	: 1.25 < Fs ≤ 2.5	MHz
–	3 MHz	70 MHz	: 2.5 < Fs ≤ 5	MHz
–	10 MHz	70 MHz	: 5 < Fs ≤ 20	MHz
–	70 MHz	70 MHz	: 20 < Fs ≤ 150	MHz
–	100 MHz	100 MHz	: 150 < Fs ≤ 160	MHz

  - » 100kHz, 300kHz, 1MHz
    - – 4th-order Butterworth filter
  - » 3MHz, 10MHz, 30MHz, 70MHz, 100MHz(Through)
    - – 5th-order Butterworth filter

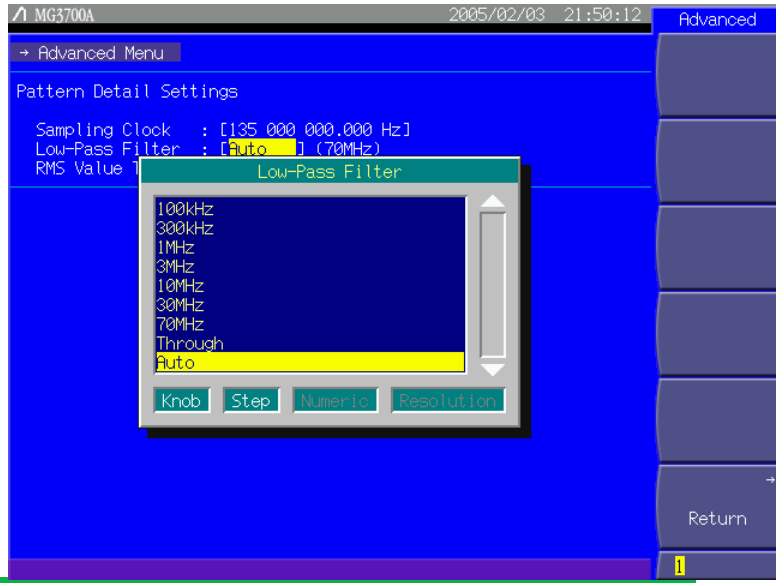
- Smoothing filter removes the aliasing noise of DAC output waveform.
  - » Smoothing filter is LPF.
  - » Aliasing noise appears as alias on the frequency domain.

Behavior of Variable Smoothing Filter

- Although the smoothing filter can be used in order to reduce the spurious and ACLR, it affects EVM.
  - » Trade-off of the performance
    - – If f_{LPF} is set lower in order to reduce ACLR, EVM performance will degrade.

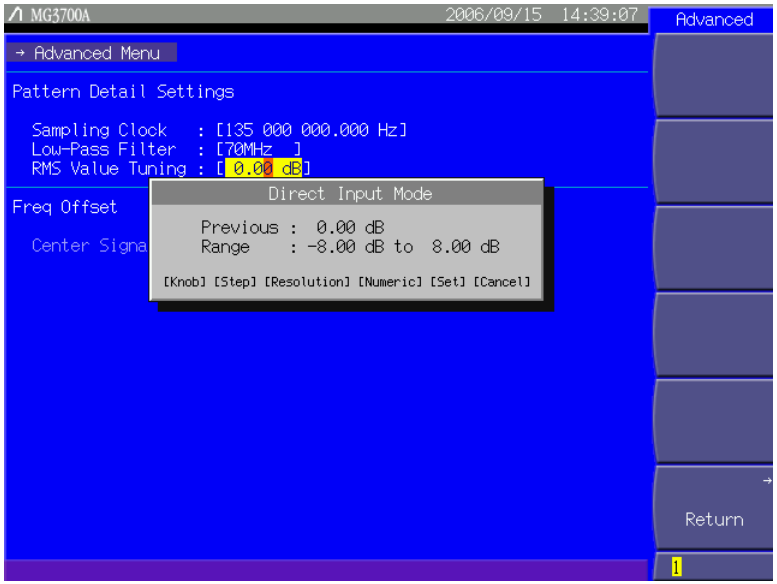
- Please select best f_{LPF} according to signal bandwidth, in the case of the signal generating that prioritizes ACLR performance.

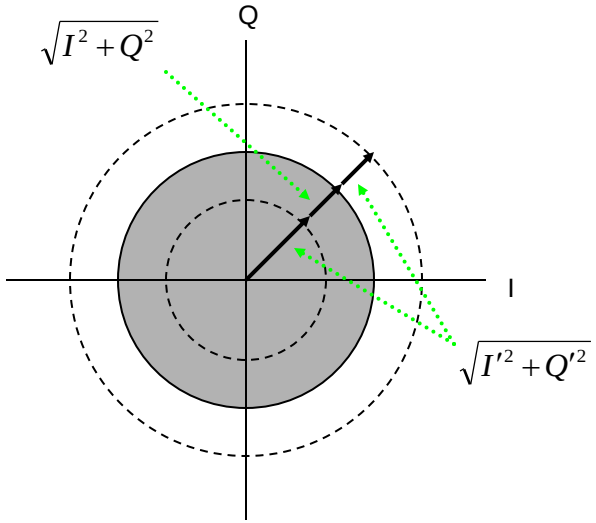
  For example
  - » W-CDMA: 3 MHz
  - » CDMA2000: 1 MHz
  - » GSM/EDGE: 300 kHz
  - » PHS: 300 kHz



Tunable Baseband Amplitude

- I/Q amplitude (RMS) of DAC output level i.e. I/Q modulator input level is tunable.
  - » $\sqrt{I^2+Q^2}$: -8 ~ +8 dB, Resolution 0.01 dB





Behavior of Tunable Baseband Amplitude

- I/Q modulator input level affects EVM, origin offset, ACLR, and noise floor.
  - » Trade-off of the performance
    - – If the level is gained in order to improve the performance of origin offset and noise floor, the spectral regrowth will be caused, and then ACLR and EVM will degrade.
- Try to decrease RMS level, in the case of the signal generating that prioritizes the adjacent channel leakage power ratio performance and intermodulation distortion performance.
- Try to increase RMS level, in the case of the signal generating that prioritizes the alternate channel leakage power ratio performance.
  - » RMS level tuning changes the performance guarantee range of the output level.
    - – If RMS level is increased, the lower limits of output level go up the increases.
      - For example 1 GHz, RMS +3 dB
        - – Upper limits of output level: +2 dBm
        - – Lower limits of output level: -140 dBm + 3 dB = -137 dBm
    - – If RMS level is decreased, the upper limits of output level go down the decreases.
      - For example 1 GHz, RMS -3 dB
        - – Upper limits of output level: +2 dBm - 3 dB = -1 dBm
        - – Lower limits of output level: -140 dBm

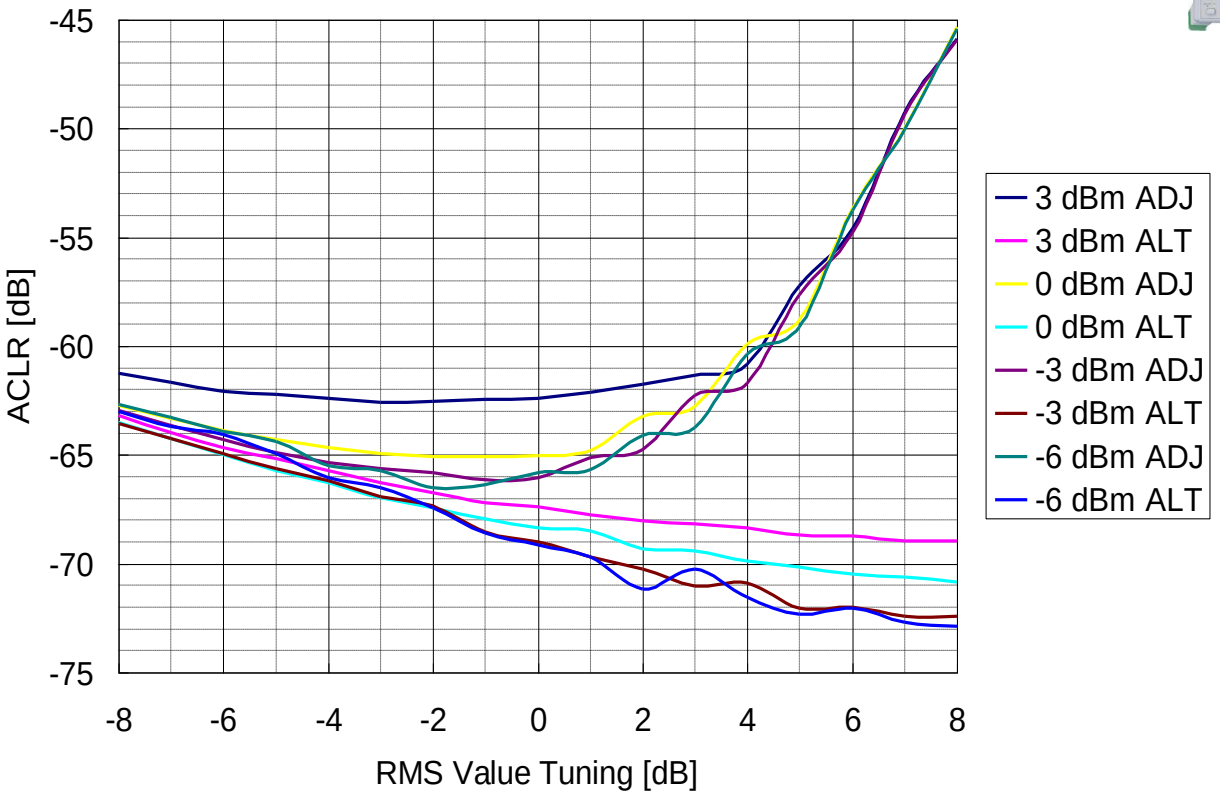
Note: RMS level is not initialized to 0 dB, even if the signal pattern is changed.

Behavior of Tunable Baseband Amplitude

Typ. ACLR of W-CDMA, Downlink Test Model 1 64 DPCH

- "Unleveled" indicates out of range for performance guarantee

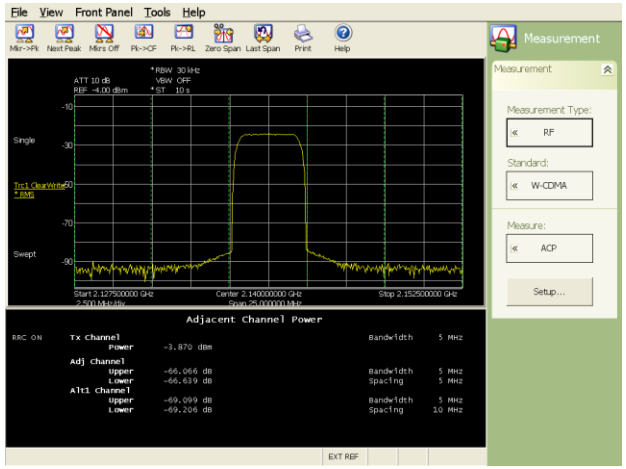
  Output level: RMS
  - +3 dBm: -2 ~ -8 dB
  - 0 dBm: -5 ~ -8 dB
  - -3 dBm: -8 dB



with Option Mechanical attenuator

2140 MHz

MS2781A Signature



BER Analyzer

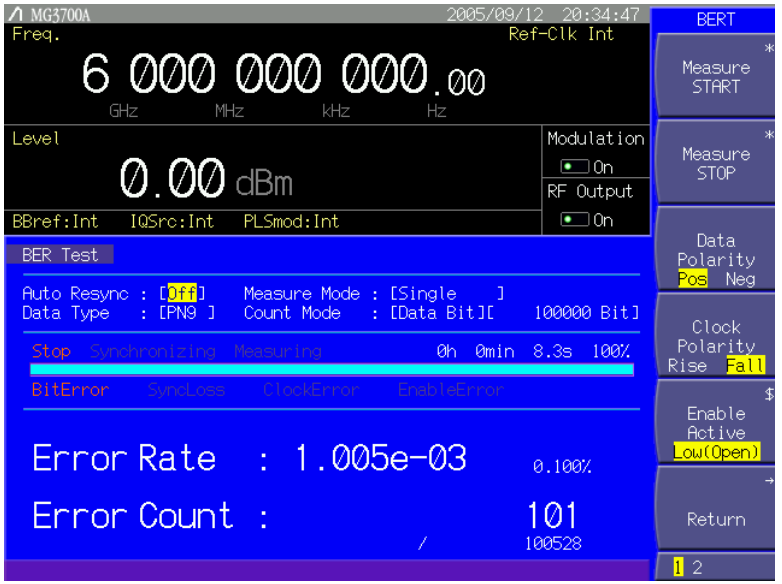
One MG3700A performs the receiver tests.

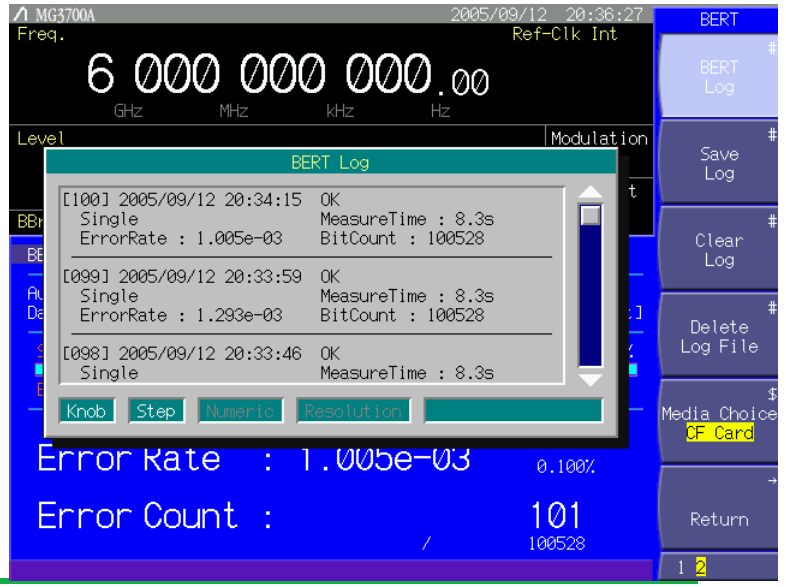
- » Until now a BER analyzer and an interference signal source in addition to the wanted signal source were required.
  - – Cost was reduced by employing LSI designed for BER analysis, and BER analyzer was included as standard equipment.

- Clock rate
  - » 1 k ~ 20 MHz * Standard
  - » 100 ~ 120 Mbps * Option
- Data pattern
  - » PN9, 11, 15, 20, 23, ALL0, ALL1, Alternate 01
  - » PN fixed pattern, Custom pattern * Option only
- Measuring bit/time (after synchronization)
  - » 1,000 ~ 4,294,967,295 (2^{23}-1) bits
  - » 0.1 ~ 359,999 s (99 h 59 m 59 s), Resolution 0.1 s * Standard only
  - » 1 ~ 2,147,483,647 (2^{31}-1) error bits * Option only

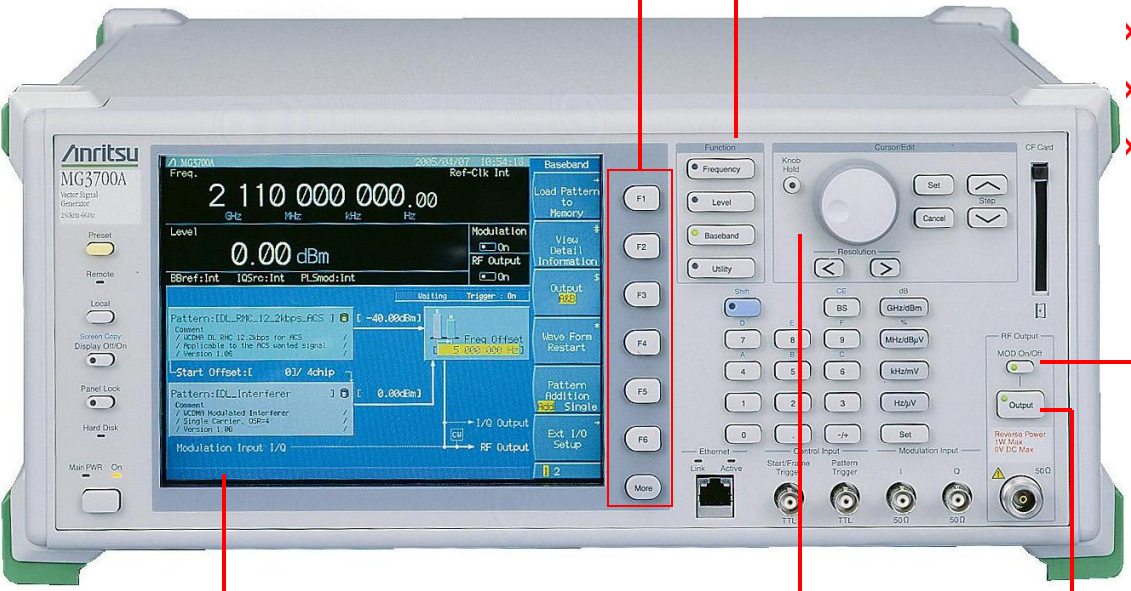
BER Analyzer

- Real-time display
  - » Elapsed time
  - » Progress rate
    - – Automatic re-synchronization (Auto Resync)
      - On: Sync Loss monitoring per 10 ms
        - – If 6 error bits in 64 bits occurs, Sync Loss will be displayed and measurement will stop.
      - Off: Sync Loss detection ignore
    - – Measure mode
      - Single, Continuous, Endless
  - » BER
    - – Floating point (×.×××e±××)
    - – Fixed point (×.××× %)
  - » Error-bit-count
  - » Bit count
- Log save
    - – Comparison with previous BER is available.
    - – Data for BER curve can be saved.
  - » Save media: HD, CF
  - » Maximum number of logs: 100





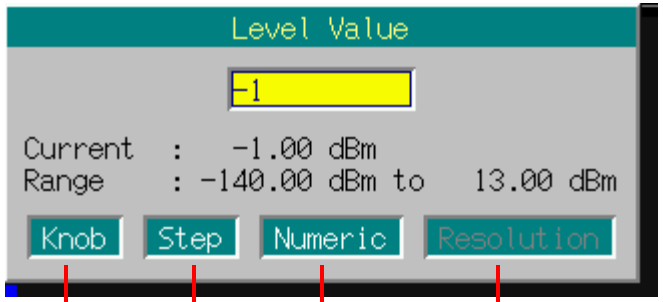
Operability



- Function keys
- Editing menu keys
  - » Frequency
  - » Output level
  - » Baseband
  - » Utility
    - – Internal memory management
      - Save/Recall the setting status
    - – BERT
    - – System
      - Remote operation interface
      - Network setting
      - Activity log
      - Configuration/Version
      - Firmware upgrade
- Cursor/Edit keys
- Large-screen color LCD
  - – 8.4 inch TFT
  - » bmp file save (HD, CF)
    - – 640 × 480 pixel
- Modulation On/Off
- RF output On/Off

Operability

- Panel key layout
  - » Operability has been improved by using the rotary knob to move the cursor, as a result of considering smooth operation flow: [Selecting function]→[Moving cursor]→[Editing(select/input)]→[Enter].
- Operation guidance display
  - » Panel operations include the parameter settings such as item selection, data input and character input. Available key types are displayed as guidance in pop-up window during parameter setting to enable operation without confusion.
    - Example of Output level setting

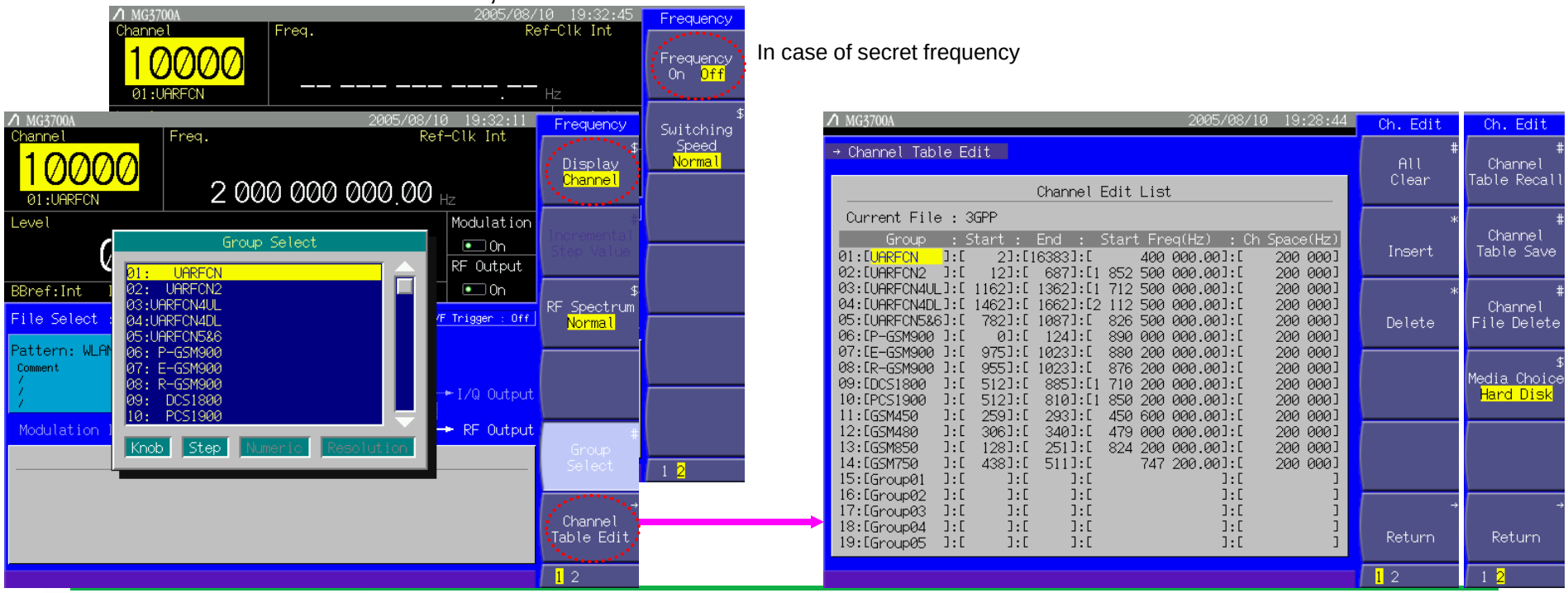


Rotary knob , Step keys, ten keys, Resolution keys

- CF slot on front panel
  - » Linking with a PC is easy in environments without a LAN by using CompactFlash® as removable media.

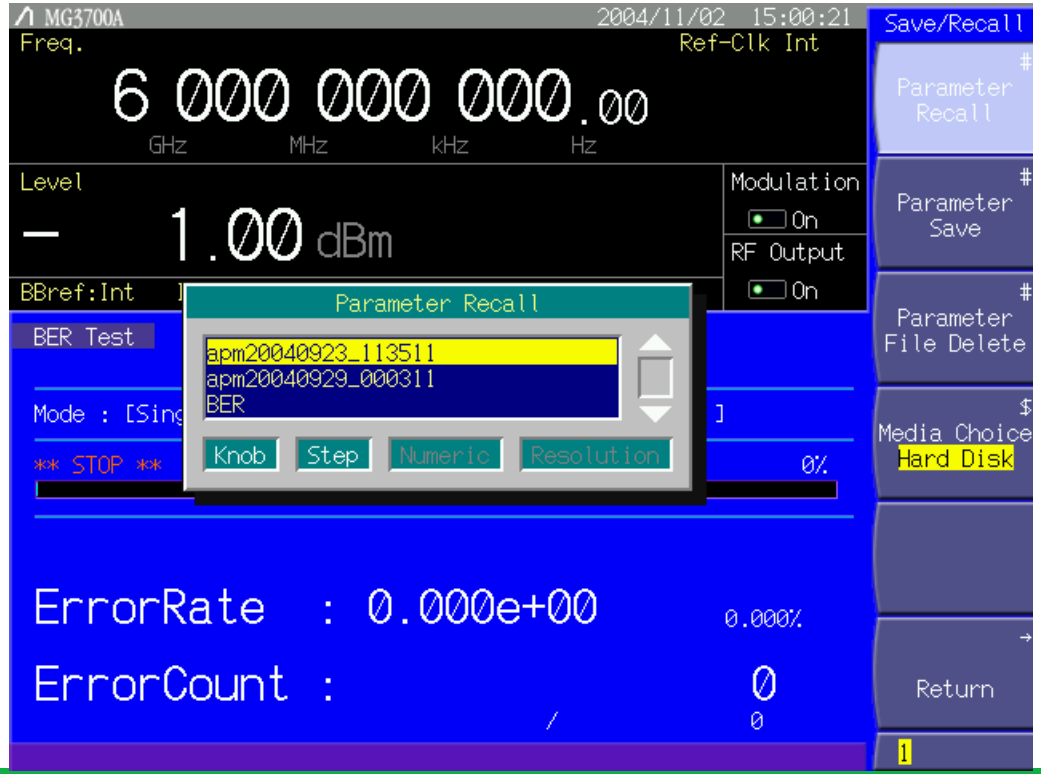
Operability

- Frequency channel setting
  - » If assignment of the channel number is defined as frequency, frequency will change only by setting the channel number.
    - – Selectable: Frequency display only, Frequency and Channel display, Channel display only
  - » The groups up to 19 are edited/saved in the channel table file.
    - – Save to HD, CF



Operability

- Internal memory management
  - » All setting parameters can be saved in up to 100 files.
    - – File name up to 30 characters can be inputted for easy confirmation.
    - – Save to HD, CF



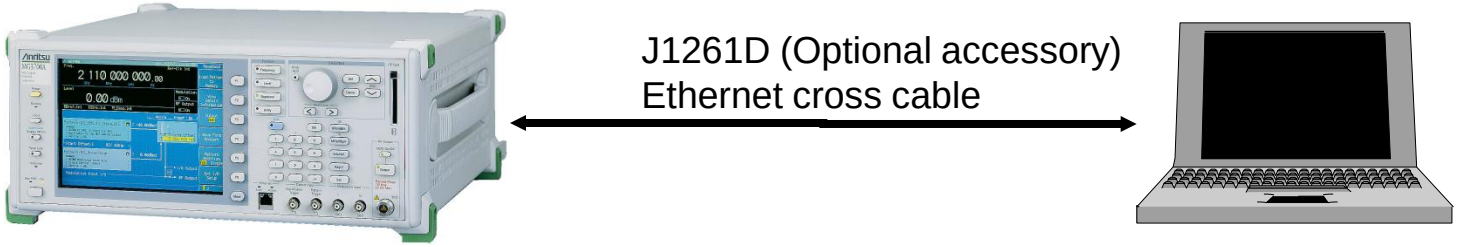
or CF

Remote Operation

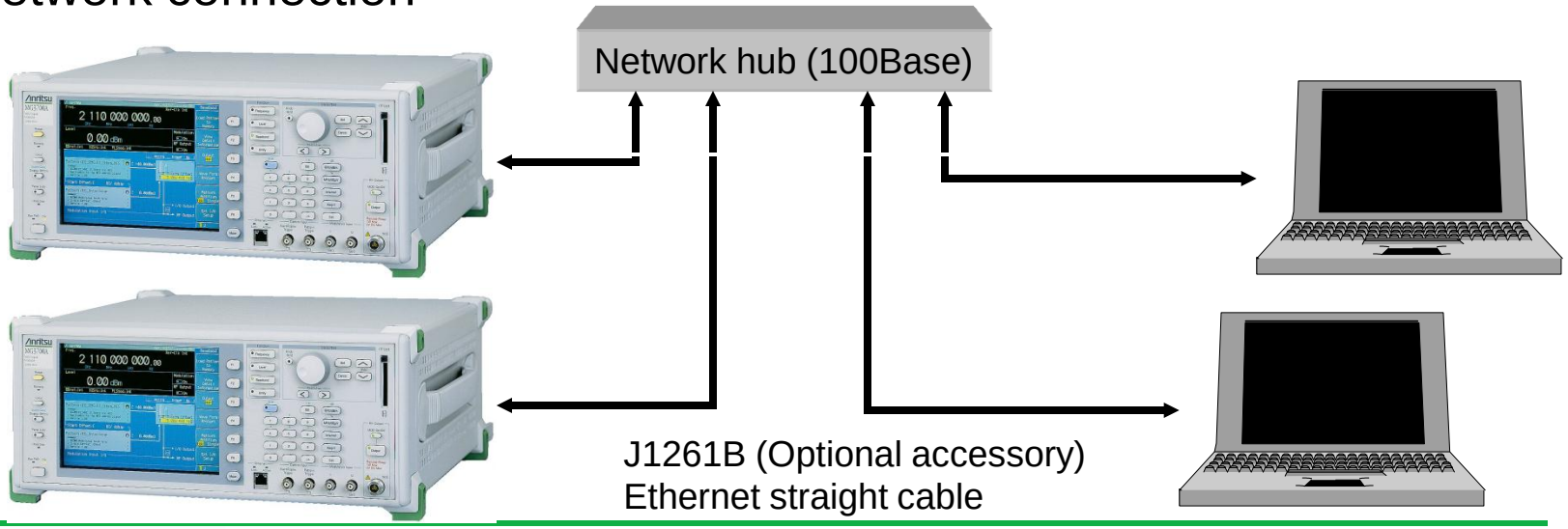
Both GPIB and Ethernet links are provided for remote interfaces.

- » 100Base-TX connectors are on the front panel and rear panel, and either can be used.

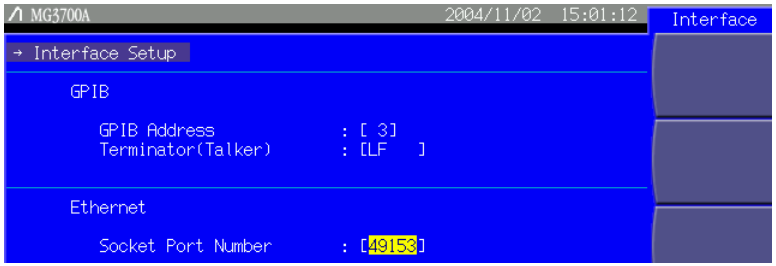
- End-to-end connection



- Network connection



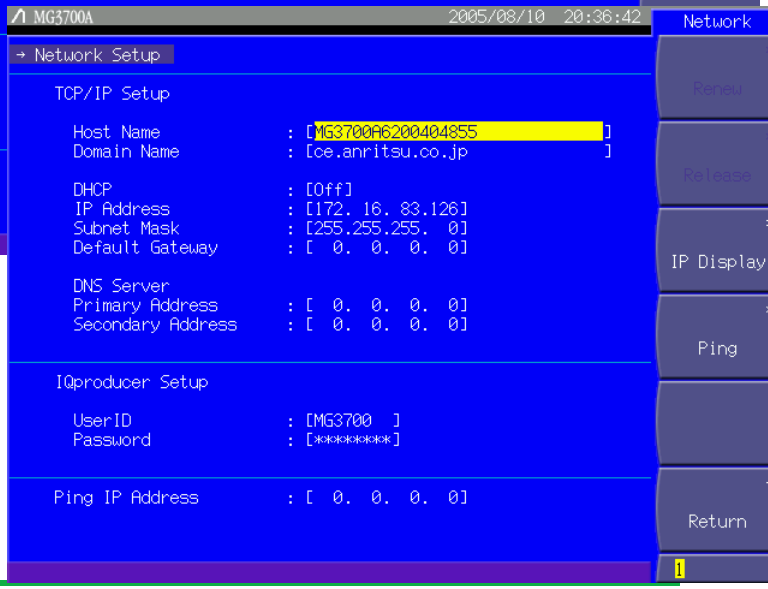
Remote Operation



Network interface settings

- Ethernet
  - » Socket Port Number: TCP/IP port number 49152 ~ 65535

- TCP/IP
  - » Host name ≤ 30 character
  - » Domain name ≤ 30 character
    assigned from DHCP server
  - » DHCP
    - – Off: IP address
      Subnet mask
      Default gateway
    - – On:
      - DNS server (DHCP use): On, Off
  - » DNS address Primary, Secondary
    at DHCP: Off or DNS server: Off
  - » Ping IP address
- FTP access key using IQproducer
  - » User ID ≤ 8 character
  - » Password ≤ 8 character

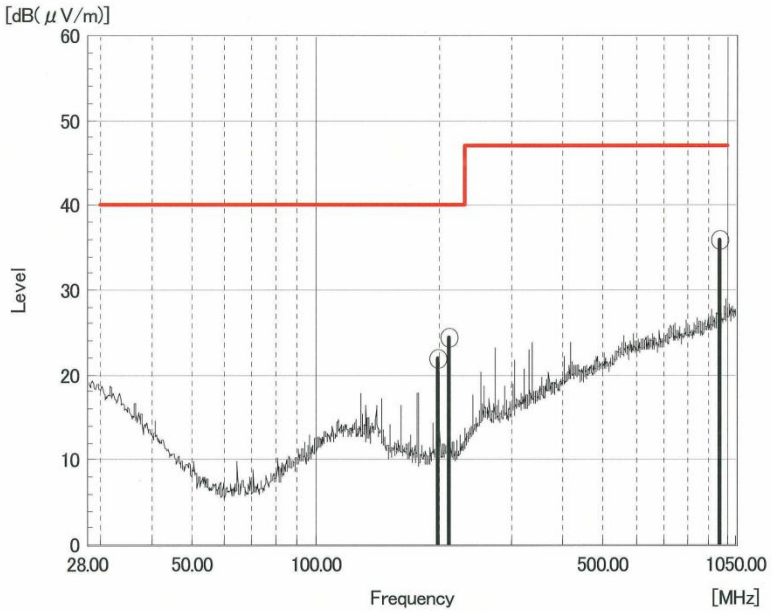


Radiated Interference Leakage

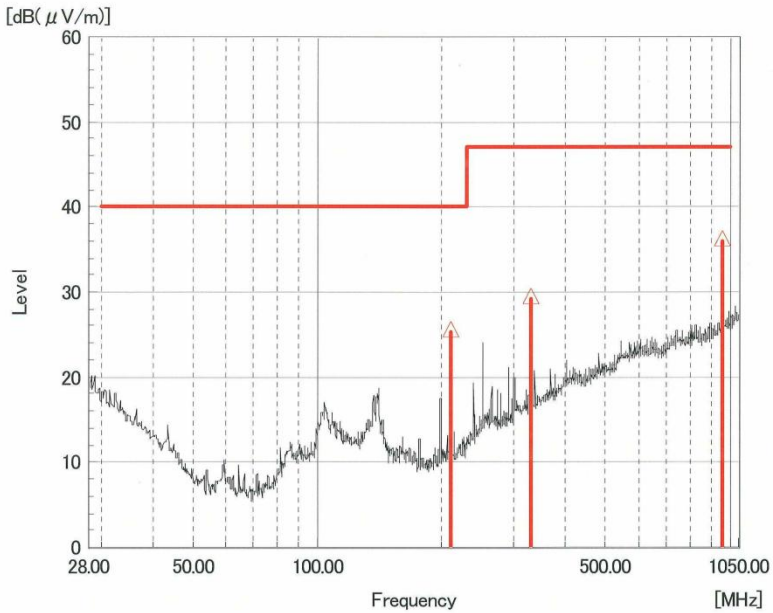
The signal generator shield is important in minimizing the signal generator's radiated interference leakage, which interferes with the receiver in low level receiver sensitivity tests.

- » Although MG3700A is lighter, the shielding performance of the circuitry units has been improved.
- » Shielding has been devised for the front panel CF port.
- » The display has been equipped with a shielding net.

Horizontal



Vertical



Maintainability

Shortening of downtime

- Exchange of internal HDD
  The signal cannot be outputted if internal HDD breaks down.
  - » If the HDD breaks down, the user can exchange it on-site via the rear panel.
    - – MTBF mean time between failures of internal HDD: 20,000 Hours
      - Periodical backup of custom files is recommended using "IQproducer" of standard accessory.
  - » If the MG3700A breaks down, the HDD for the failed MG3700A can be installed in a MG3700A loaner.
    - – Resetting is unnecessary.
  - » Confidential setting can be preserved.
    - – Pull out when shipping for repair.

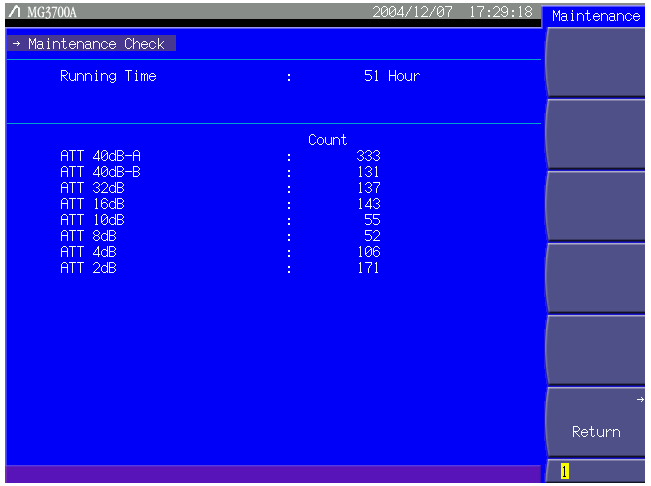
G0141(Optional accessory)
HDD ASSY assembly
- – 2.5 inch for notebook PC
- – The files at MG3700A delivery is saved.

Be careful not to damage the connection pins when inserting HDD.

Maintainability

Reliable usage for ATE

- Automatic check for useful life of mechanical step attenuator and mechanical switch
  - » Warning is released when useful life is exceeded after switching 5 million times.



- Self-check
  - » Automatic alarm at emergence of trouble
    - – Output level ALC trouble
    - – Temperature trouble (Internal temperature > 70 °C)
  - » Alarm log file
    - – It can been saved to HD or CF for troubleshooting.

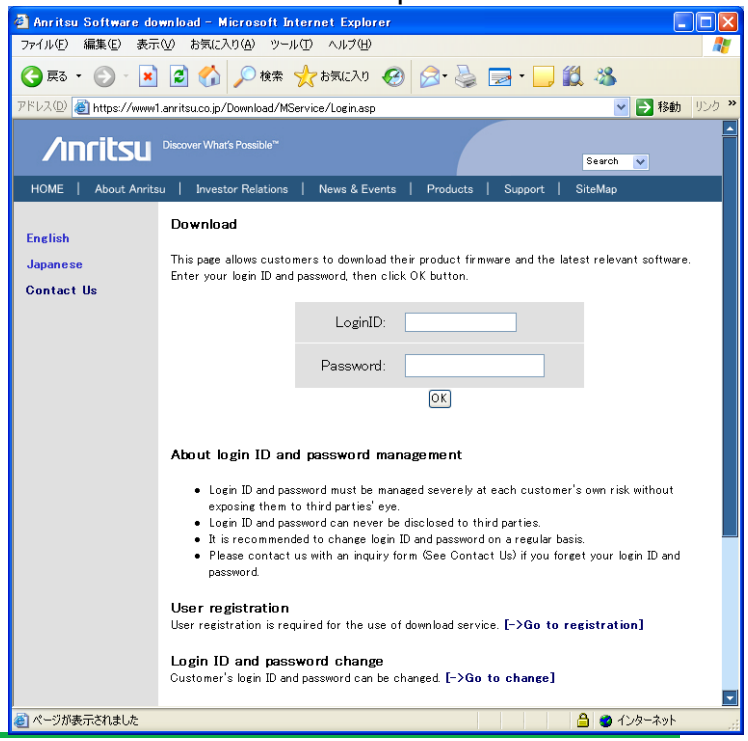
Maintainability

The users can upgrade the firmware.

- The user can visit the Anritsu "Software Download" website to download the latest firmware and operation manuals (PDF) for free.
  - User registration is required to use the download service.

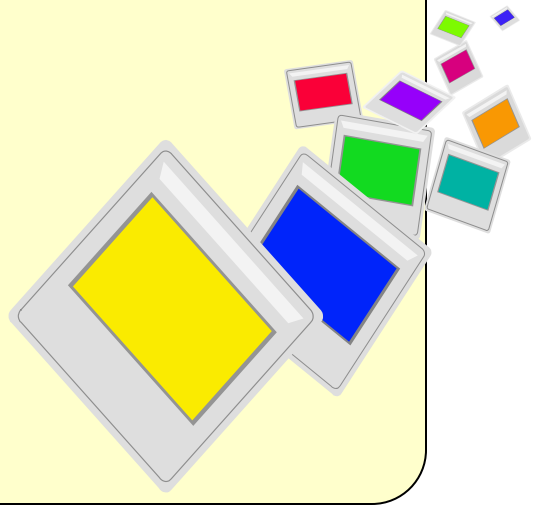
http://www.anritsu.com/

or HD



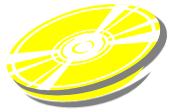
Features

- Product Outline
- Features
  - » Instrument Platform
  - » Software
- Options



- IQproducer 96
- Standard Signal Pattern Files
  Optional Signal Pattern Files 127

» IQproducer and standard signal pattern files are MG3700A standard accessory.



– IQproducer is stored in CD together with Operation Manuals (PDF).

– Standard signal pattern files are saved in HDD.

IQproducer

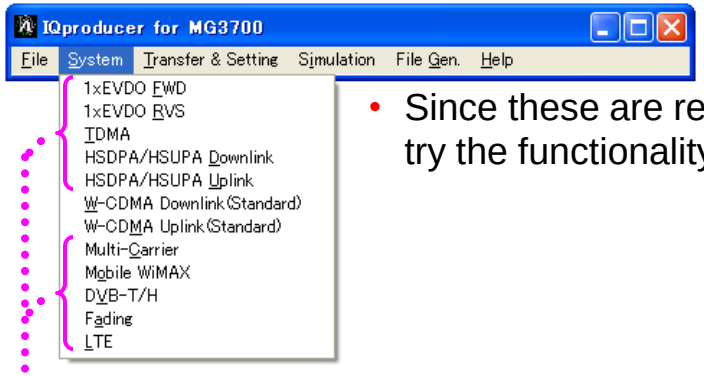
- Windows software utility operating on PC
  - » User-friendly graphical user interface (GUI)
- Creates pattern files for internal I/Q baseband generator
  - » Sets signal parameters flexibly
    - – User-friendly GUIs focused on specific signal formats
  - » Links to EDA tools
    - – Importable ASCII text CSV files of I/Q sample data to the signal pattern files for MG3700A
  - » Creates arbitrary AWGN patterns
  - » Applies peak clipping and bandlimiting filter to pattern file
  - » Edits scenario for sequence and combination of signal patterns
- Plots simulation of CCDF, FFT spectrum, and time domain
- FTP connection to MG3700A internal HDD
  - » FTP between internal HDD and PC
- Remote operation for signal generation
  - » Loads the pattern files from internal HDD to baseband memory
  - » Selects the pattern to generate

Hardware Requirements

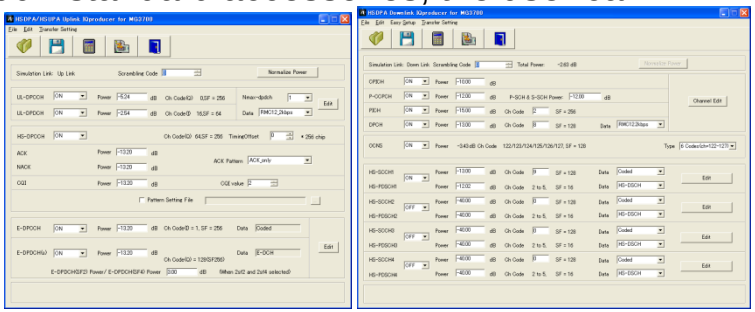
Personal computer

- OS: Windows® 2000, XP
- Memory: ≥ 512 MB recommendation
- Display: ≥ 1,024 × 768 pixel

Creates Pattern Files: Sets Signal Parameters Flexibly



- Since these are recorded on CD of MG3700A standard accessories, the user can try the functionality before purchase.

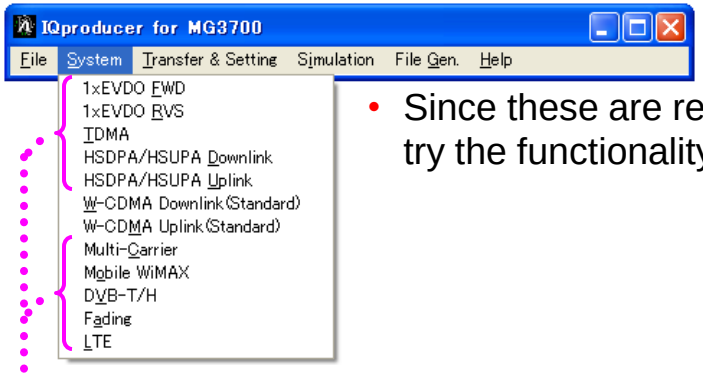


License option

- » MX370101A HSDPA/HSUPA IQproducer
  - Focuses on DL/UL RMC formats for HSPA/W-CDMA
- » MX370102A TDMA IQproducer
  - Focuses on universal TDMA formats for ASK, FSK, PSK, QAM
- » MX370103A CDMA2000 1xEV-DO IQproducer
  - Focuses on Forward/Reverse signal formats for CDMA2000 1xEV-DO (Rev.0)
- » MX370104A Multi-carrier IQproducer
  - Focuses on multi-carrier with any signal formats and Test Model formats for HSDPA/W-CDMA
- » MX370105A Mobile WiMAX IQproducer
  - Focuses on OFDMA formats for IEEE802.16e

* The other datasheets and literatures show the more information.

Creates Pattern Files: Sets Signal Parameters Flexibly



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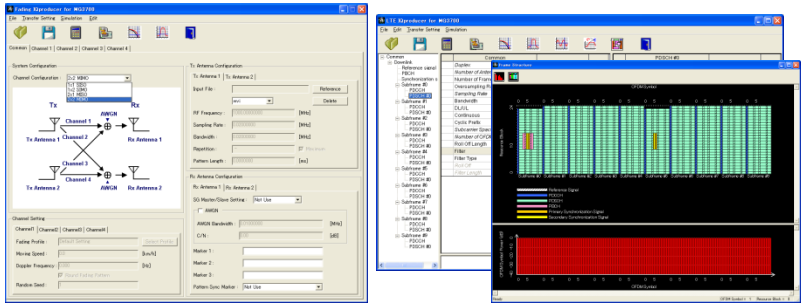


License option

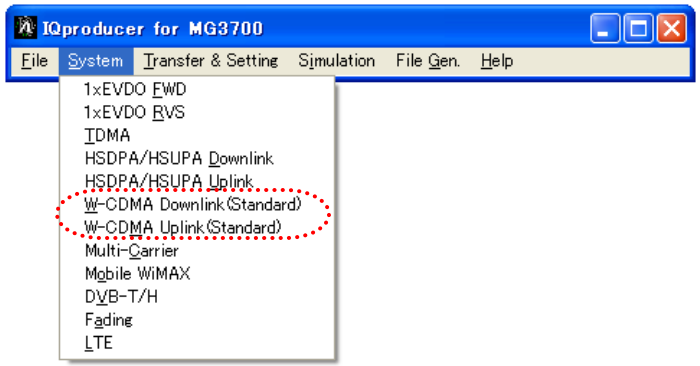
» MX370106A DVB-T/H IQproducer
- Focuses on OFDM broadcast for DVB-T/H

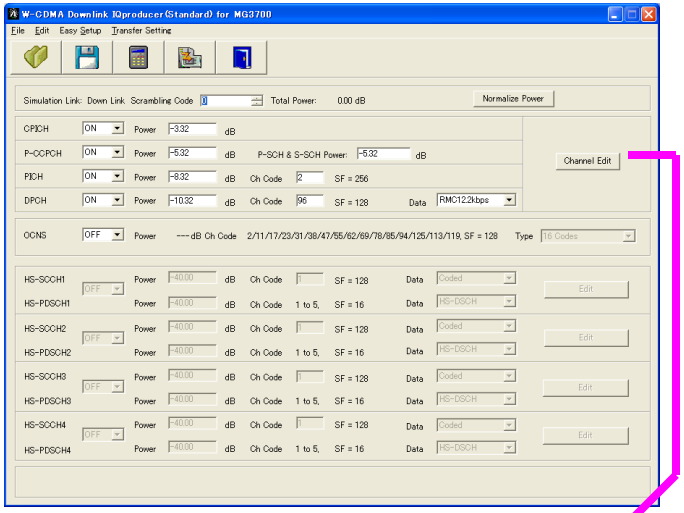
» MX370107A Fading IQproducer
- Focuses on universal fading channels containing MIMO

» MX370108A LTE IQproducer
- Focuses on DL/UL signal formats for 3GPP LTE

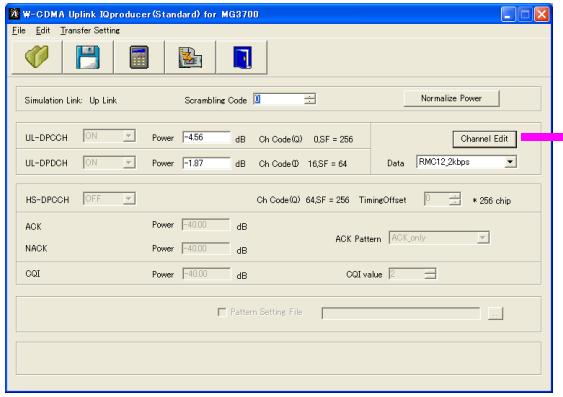
* The other datasheets and literatures show the more information.

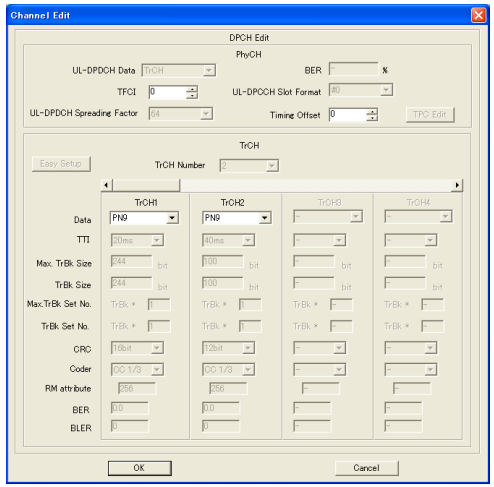
Creates Pattern Files: Sets Signal Parameters Flexibly

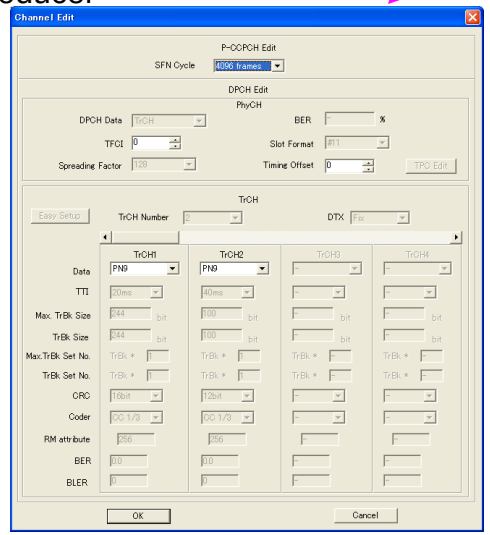




- Non-license
  - » Limited W-CDMA IQproducer
    - Focuses on DL/UL RMC formats for W-CDMA
      - Limited version for parameter editing of HSDPA/HSUPA IQproducer



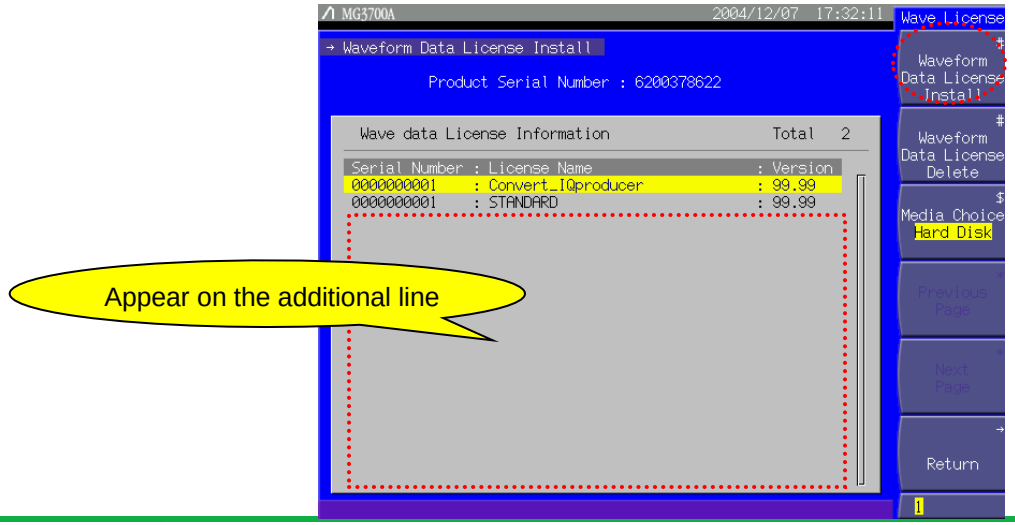




* The other datasheets and literatures show the more information.

License Key for MX3701xx IQproducer

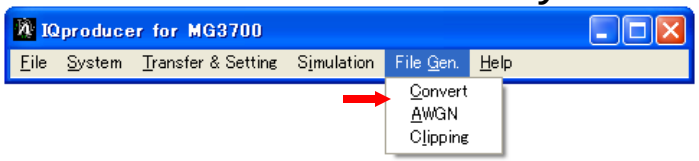
- If MX3701xx IQproducer is purchased, CD containing the license key file on MG3700A serial number will be provided.
  - » The same IQproducer as standard accessory and Operation Manual (PDF) are also contained in CD.
- In order to download the signal pattern file created using the MX3701xx IQproducer to baseband memory, installing the license key file per MG3700A is required.
  - » When MX3701xx IQproducer is purchased together with MG3700A, the license key file is already installed in MG3700A.



Creates Pattern Files: Links to EDA Tools

EDA tools such as "MATLAB" and "Microwave Office" can save IQ simulation data to ASCII text CSV files.

» It is made easy to compare simulation data and the measured data.

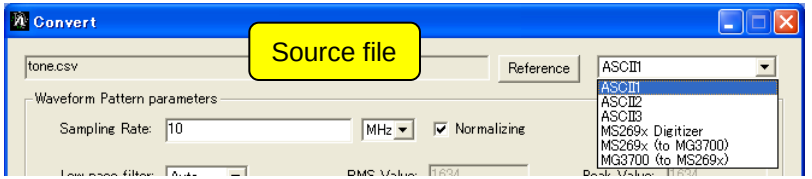


- Importable ASCII text CSV files to the signal pattern files for MG3700A
  - » ASCII text CSV files
    - – I channel data
    - – Q channel data
    - – Markers data (3 event markers and RF gate flag)

Import ⇩

- » Signal pattern files for MG3700A
  - – .wvi text file (Header file)
    - The configuration information of the signal patterns is saved.
  - – .wvd binary file (IQ sample data file)
    - The data of I channel, Q channel, markers is saved.

Convertible Files



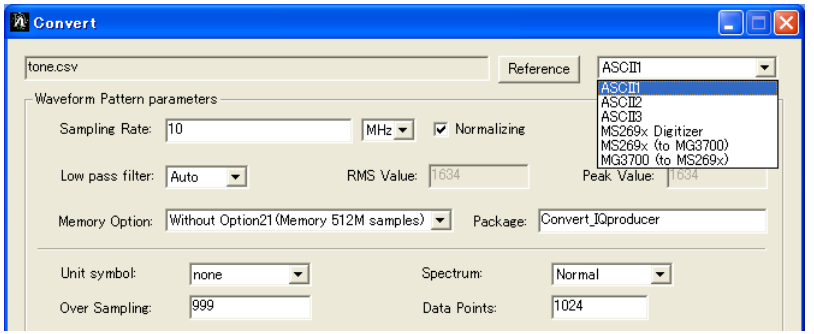
- Importable file into MG3700A
  - » ASCII text files
    - – CSV format in which data is saved to one file — ASCII1
      - I channel, Q channel, Event markers
    - – CSV format in which data is saved to two files — ASCII2
      - I channel, Q channel
    - – CSV format in which data is saved to three files — ASCII3
      - I channel, Q channel, Event markers
  - » MS2690 digitized file — MS269x Digitizer
  - » Signal pattern file for MS2690-20 (VSG) — MS269x (to MG3700)

- Exportable signal pattern files for MG3700A into MS2690-20 (VSG)
  - » Signal pattern files for MG3700A — MG3700 (to MS269x)
    - .wvi text file (Header file)

Export ⇩

  - » Signal pattern files for MS2690-20
    - .wvi text file (Header file)

Import



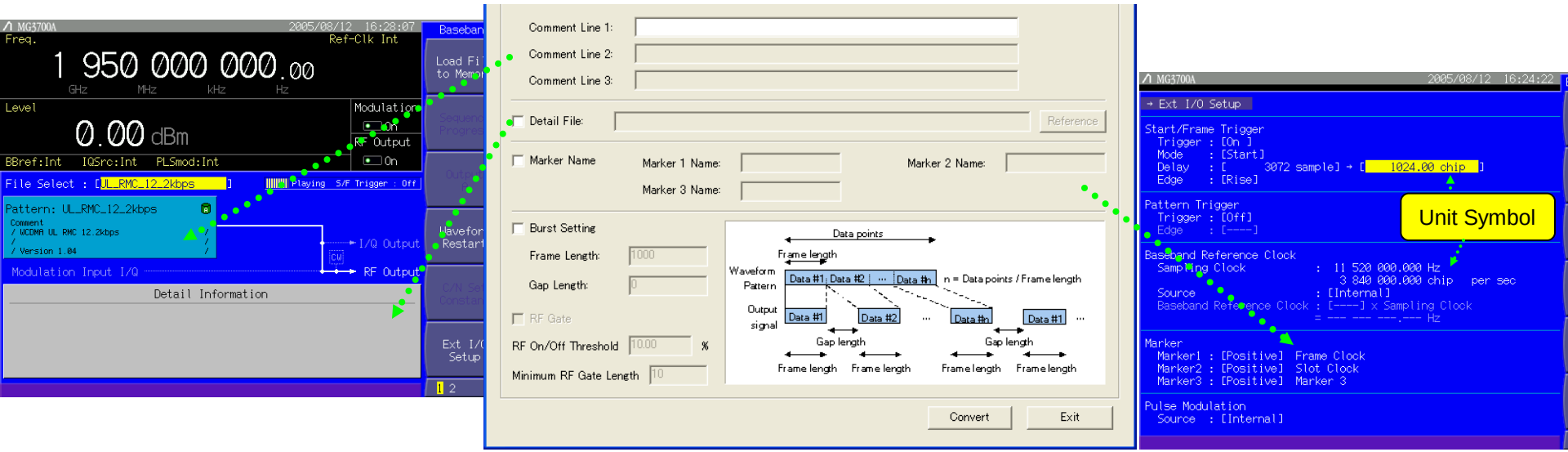
- Sampling Rate (Fs)
  - Number of I/Q waveform samples per second (expressed in Hz and equal to reciprocal of sampling interval)
- Normalizing
  - Setting RMS Value to 1634
- RMS Value
  - Tunable baseband amplitude at Normalizing Off
    - 651 ~ 1634 I/Q DAC $RMS_{I/Q}$
      - Performance guarantee is covered within RMS Value 1157 ~ 1634.
      - Set RMS Value as "1157" in the case of the signal with the higher crest factor like CDMA and OFDM.

$$RMS_{I/Q} = \sqrt{\frac{\sum_{n=1}^{N}(I_n^2 + Q_n^2)}{2N}}$$

n: Data with RF gate flag active (On)

- Low pass filter
  - Variable smoothing filter
- Over Sampling
    - 1 ~ 999 oversampling ratio (OSR) = Fs/Modulation rate (Bandwidth)
      - The more OSR, the better S/N of a signal and the wider dynamic range. (2× OSR improves S/N 3 dB.)
- Unit Symbol
  - Modulation point for Modulation rate
    - sample, symbol, chip, none

Import



Burst Setting

- Definition of frame length in use of input frame trigger
- Saving of the baseband memory in the case of a burst signal

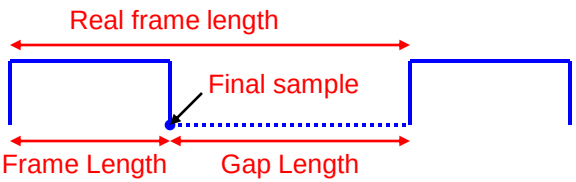
  because burst-off period doesn't need sample data.

» Frame Length

- Frame samples
  - Real frame length = Frame Length + Gap Length

» Gap Length

- Burst gap samples
  - This period holds the final sample data including event markers and RF gate flag in Frame Length.



Import

RF Gate

- This optimizes RF gate flag to scale I/Q data within burst signal for MS2690 digitized file at MS269x Digitizer.

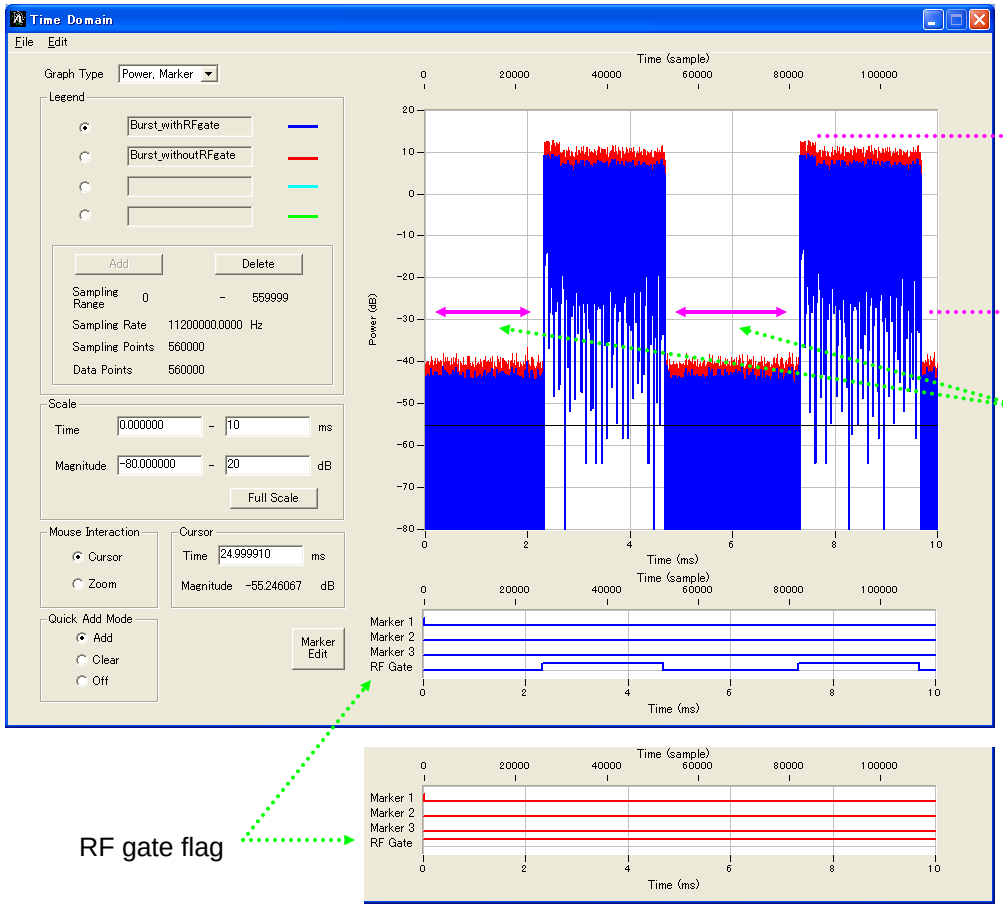
» RF On/Off Threshold

- Threshold level for automatic detection of no signal and active/inactive (On/Off) definition of RF gate flag
  - 0 ~ 100%
    - 100% reference level: Peak $\sqrt{I_n^2 + Q_n^2}$

» Minimum RF Gate Length

- Minimum consecutive samples for automatic detection of no signal and inactive (Off) definition of RF gate flag
  - 0 ~ 100000 samples

Effect of RF Gate



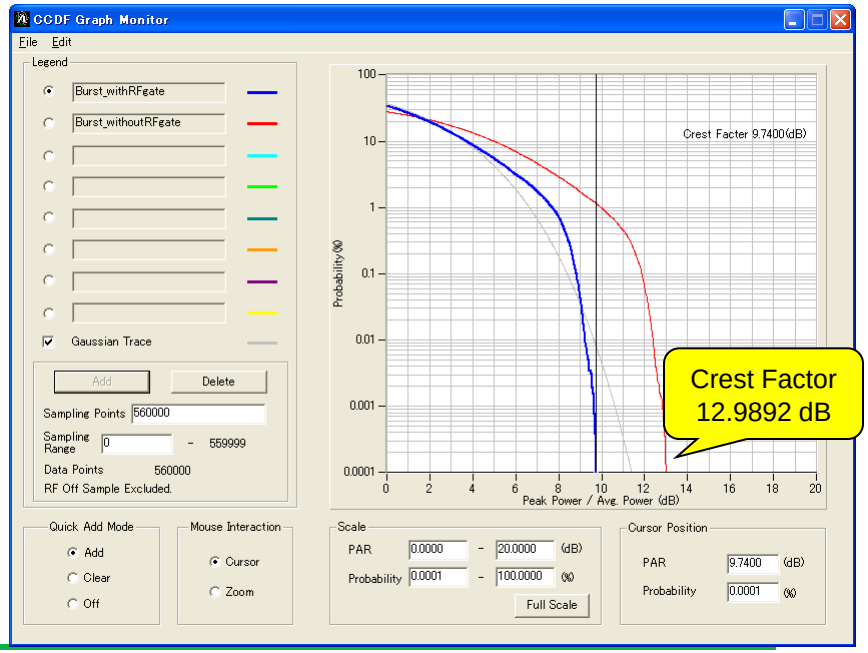
Peak level (+12.9892 dB)

RF On/Off Threshold 1% (-40 dB)

Minimum RF Gate Length ≥ 100 samples

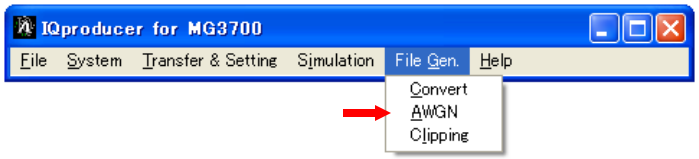
RF gate flag

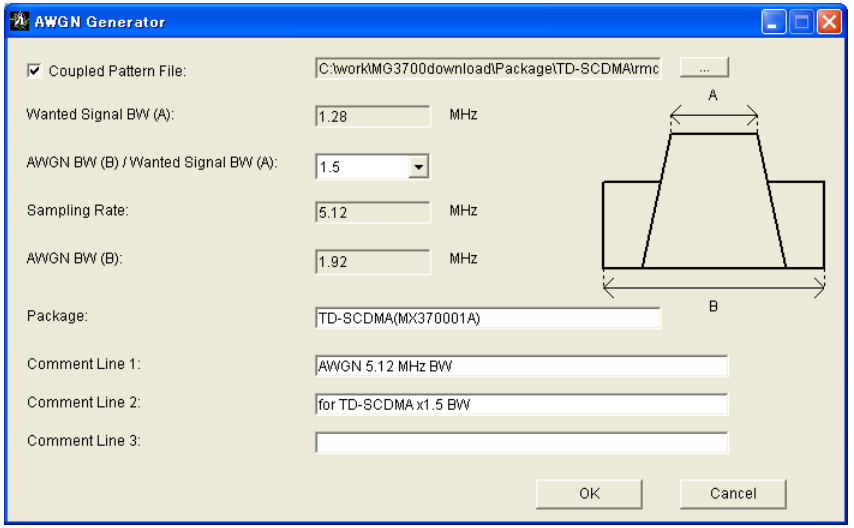
- Blue trace
  - Data with RF Gate
    - $RMS_{I/Q}$ (0 dB) is calculated from burst I/Q data.
- Red trace
  - Data without RF Gate
    - $RMS_{I/Q}$ (0 dB) is calculated from all I/Q data.



Creates Pattern Files: Creates Arbitrary AWGN Patterns

- AWGN pattern file suitable for arbitrary wireless systems can be created easily.

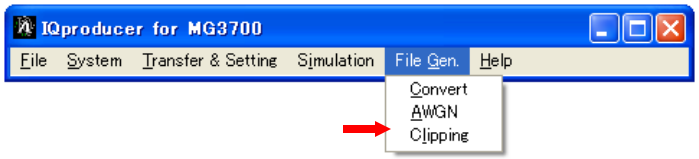


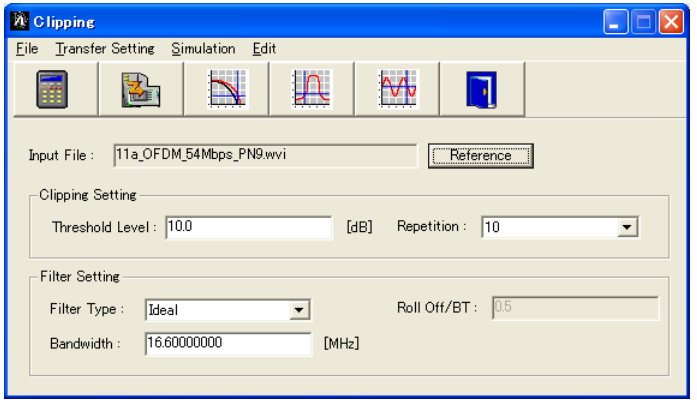


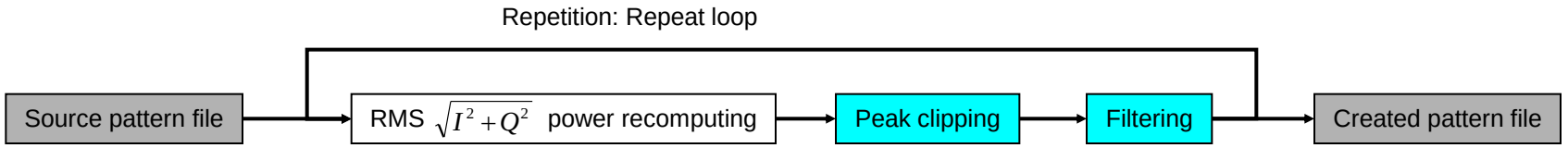
- » Coupled Patten File
  - The configuration information of the wanted signal to mix is read.
- » AWGN BW (B) / Wanted Signal BW (A)
  - 1, 1.5, 2, 2.5 ratio
- » Sampling Rate
  - Sample rate (Fs) corresponding to the wanted signal to mix
- » AWGN BW (B)
  - Calculated from Wanted Signal BW (A) and AWGN BW (B) / Wanted Signal BW (A)
    - BW (B) ≤ Fs/2 at BW (B) = 0.001 ~ 20 MHz
    - BW (B) ≤ Fs at BW (B) = 20.001 ~ 120 MHz

Creates Pattern Files: Applies Peak Clipping and Bandlimiting Filter to Pattern File

- Peak clipping affects spectral regrowth and EVM because of lower PAR.
  - It improves the spectral regrowth, but it worsens the EVM.
- Filtering affects spectrum and EVM because of spectral shaping filter on baseband.
  - It shapes up the spectrum, but it worsens the EVM.







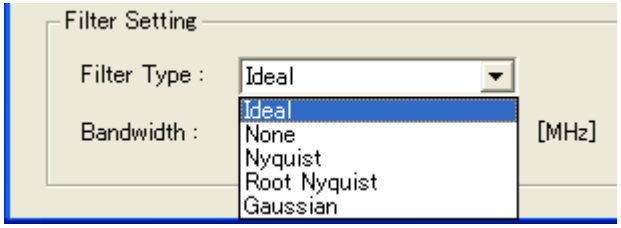
Creates Pattern Files: Applies Peak Clipping and Bandlimiting Filter to Pattern File

- Peak clipping
  - » Threshold Level
    - 0 ~ 20 dB, Resolution 0.1 dB
      - – 0 dB reference level: Recomputed RMS_{IQ} power

$$RMS_{IQ} = \sqrt{\frac{\sum_{n=1}^{N}(I_n^{\,2} + Q_n^{\,2})}{N}}$$

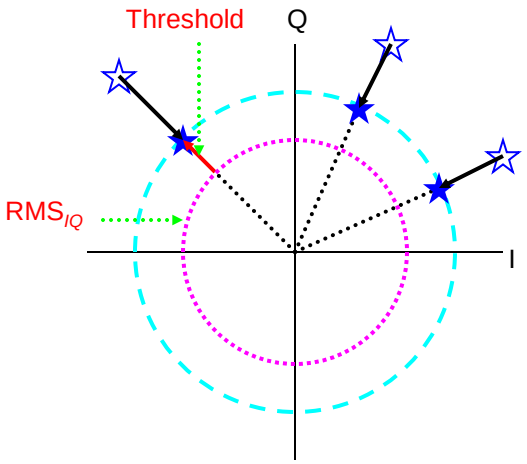
n: Data with RF gate flag active (On)

  - » Repetition
    - 0 ~ 20 repeat count
- Filtering
  - » Type



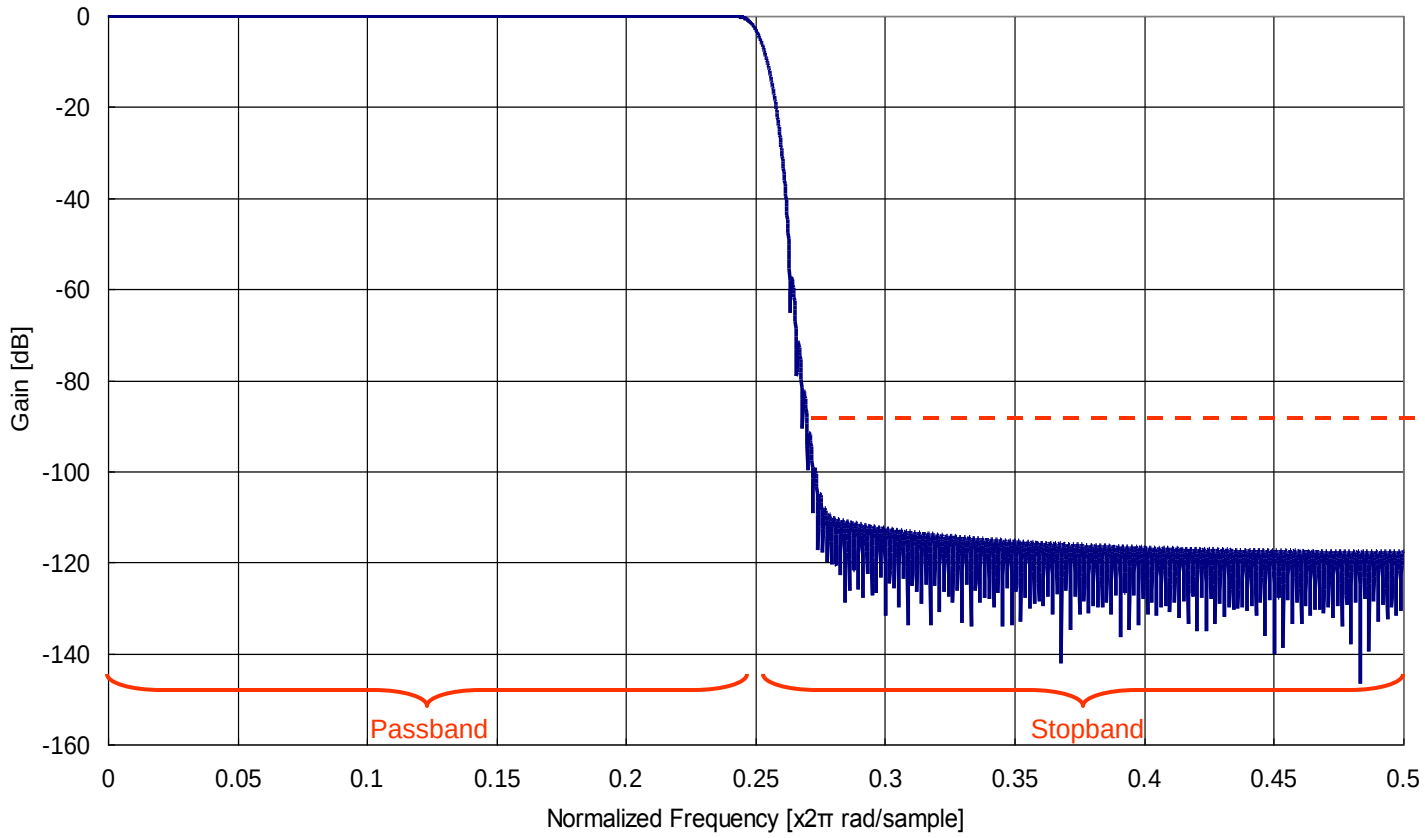
  - » Bandwidth
    - – 2× Cutoff frequency
      - Min(Sampling rate/1000, 1 kHz) ~ Sampling rate, Resolution 0.01 Hz

Vector clipping scheme



Ideal Filter

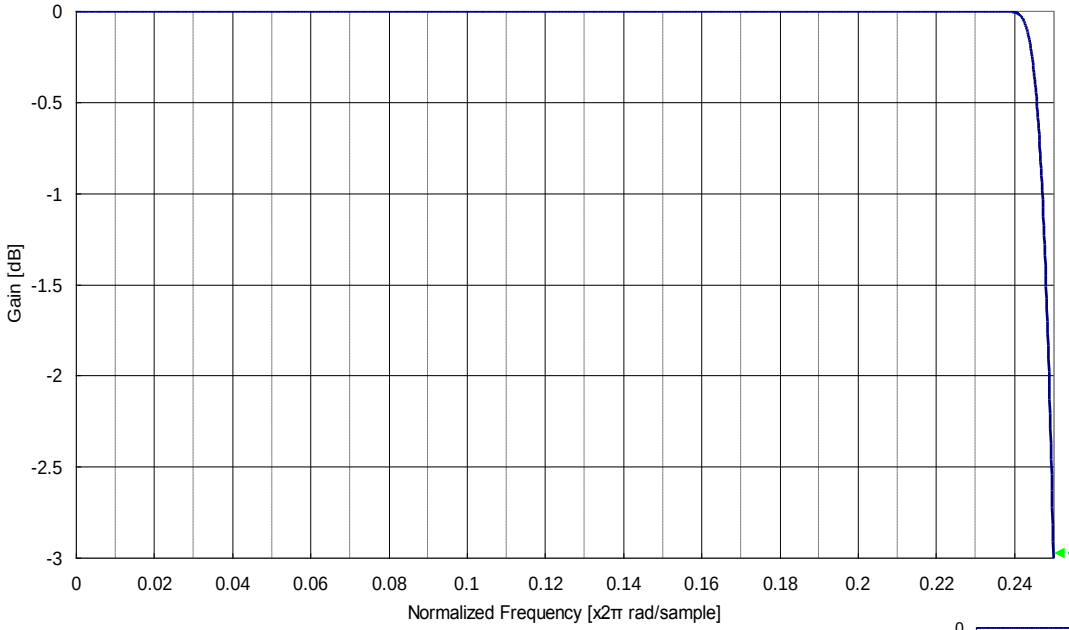
- Ideal filter is available to reduce out-of-band noises.
  - » Example of frequency response with bandwidth/sampling rate = 1/2



Frequency [Hz] = Normalized frequency * Sampling rate

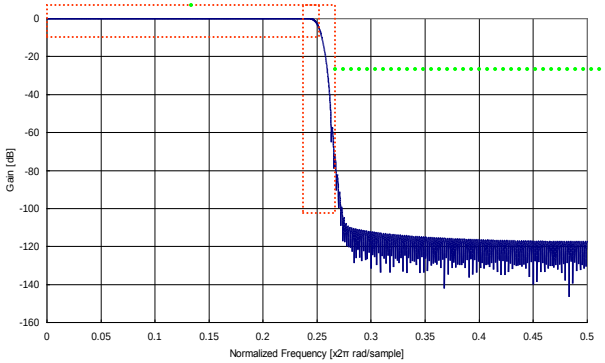
Ideal Filter

Flat 0 dB gain: 95% of bandwidth

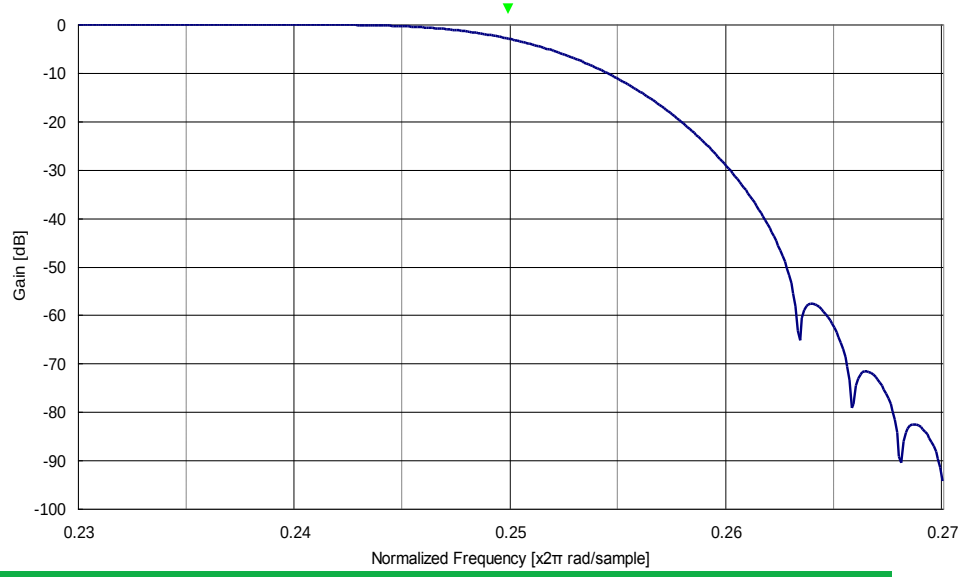


Cutoff frequency

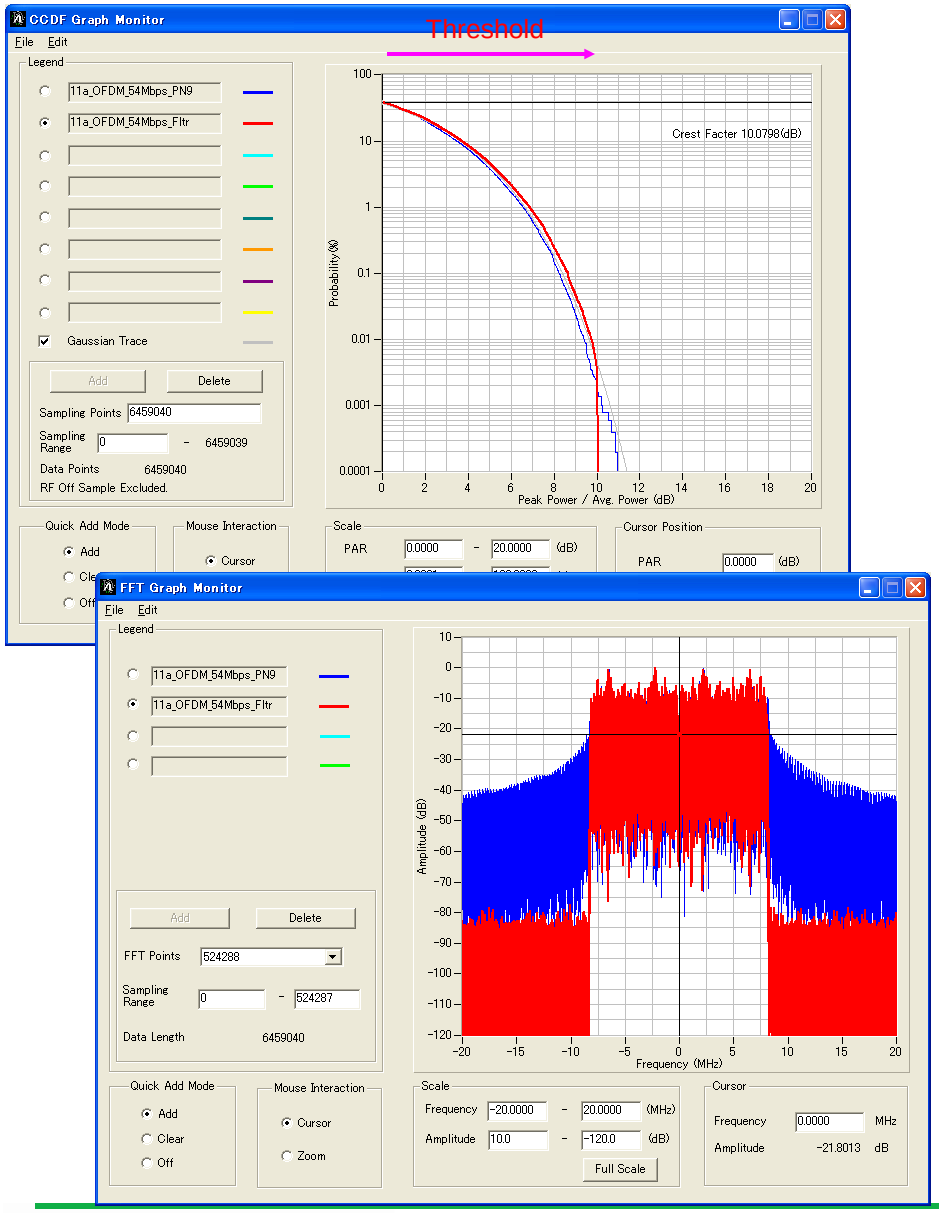
Passband zoom



Slope zoom



Effect of Peak Clipping and Filtering



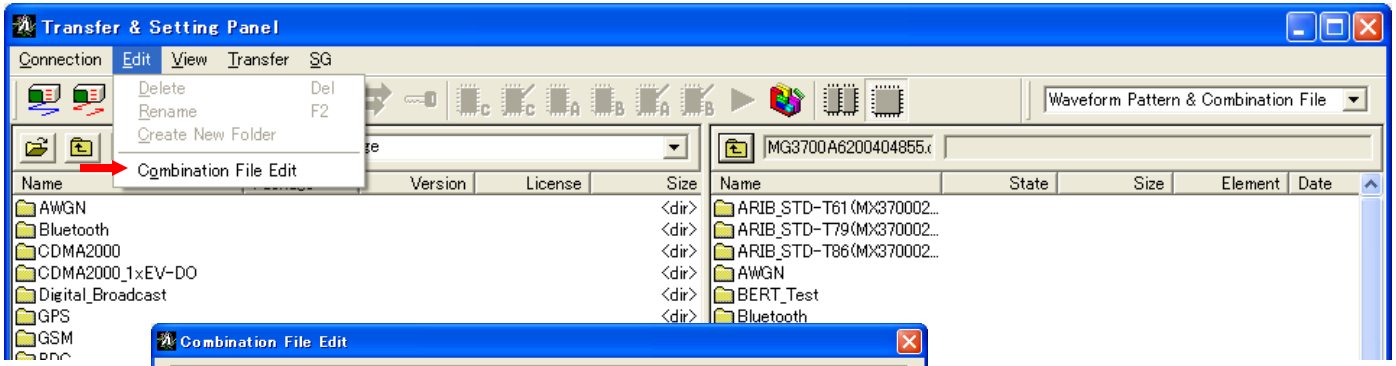
- Example of OFDM signal
  - Blue trace
    - Source data
  - Red trace
    - Data with 10 dB clipping and ideal filtering

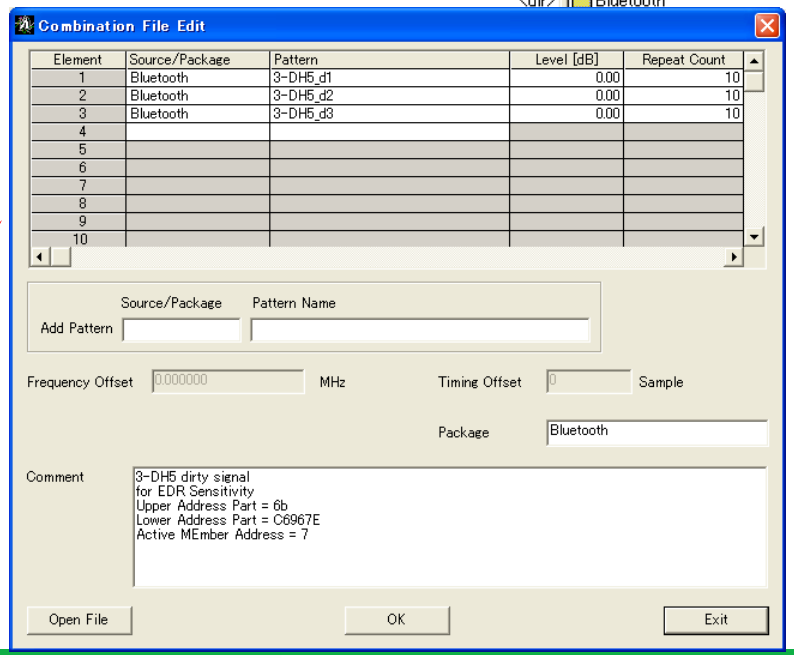
Creates Pattern Files: Edits Scenario for Sequence and Combination

» Combination file

.wvc text file

The setting status is saved.

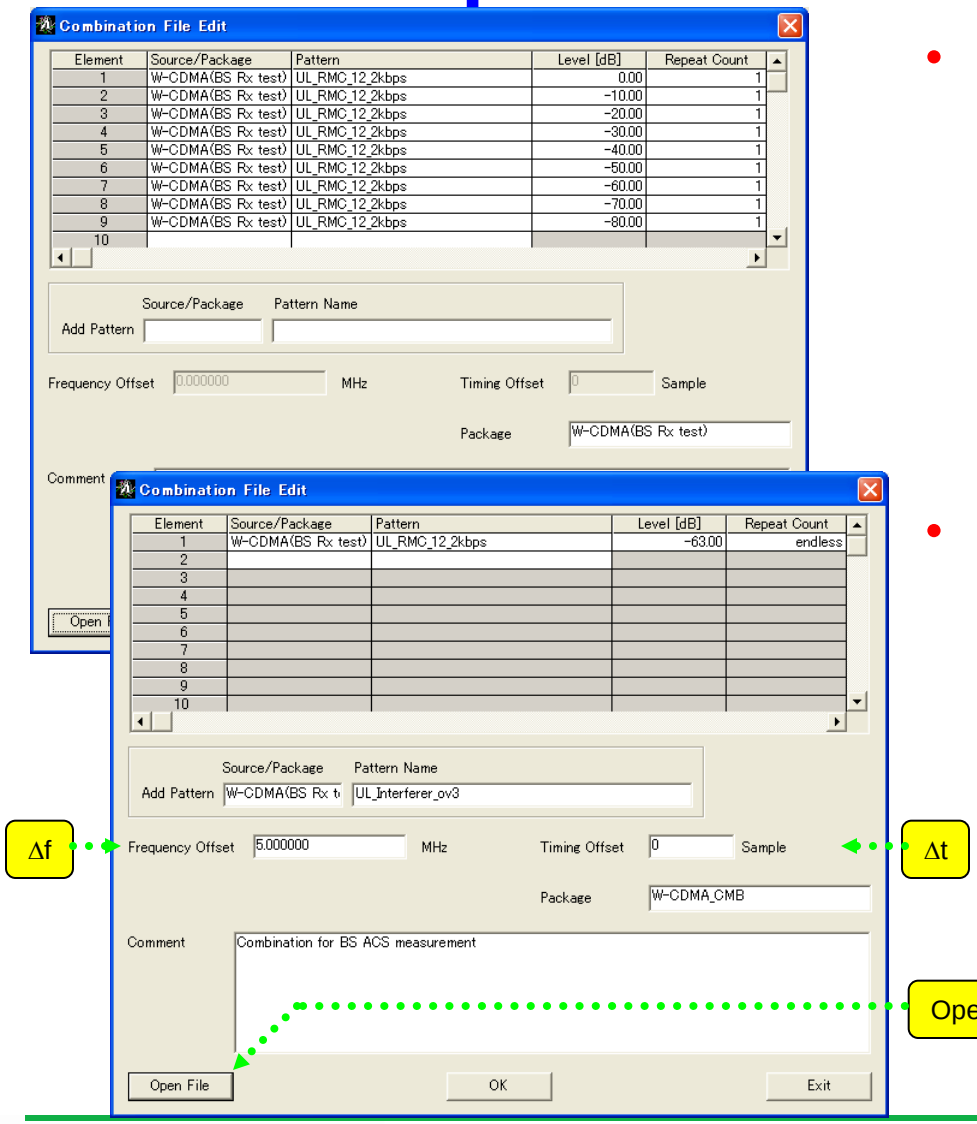




Maximum element 200

- Sequence for protocol emulation
  - » Repeat Count
    - 1 ~ 65,535 / ∞(endless)

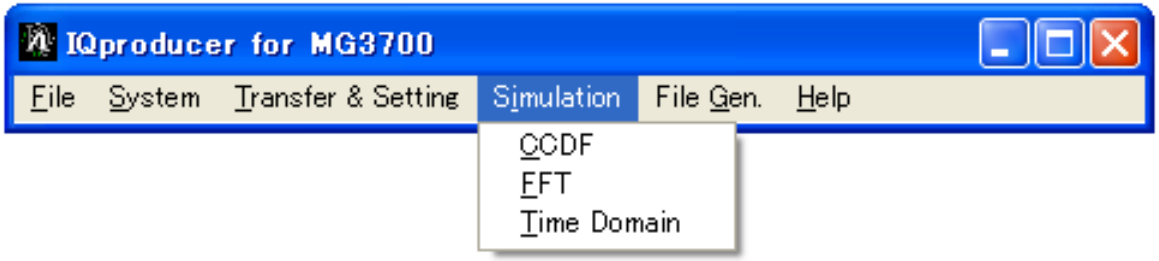
Creates Pattern Files: Edits Scenario for Sequence and Combination



- Sequence for digital sweep of output level
  - » Level
    - -80 ~ 0 dB
      - 0 dB reference level: MG3700A setting RF level

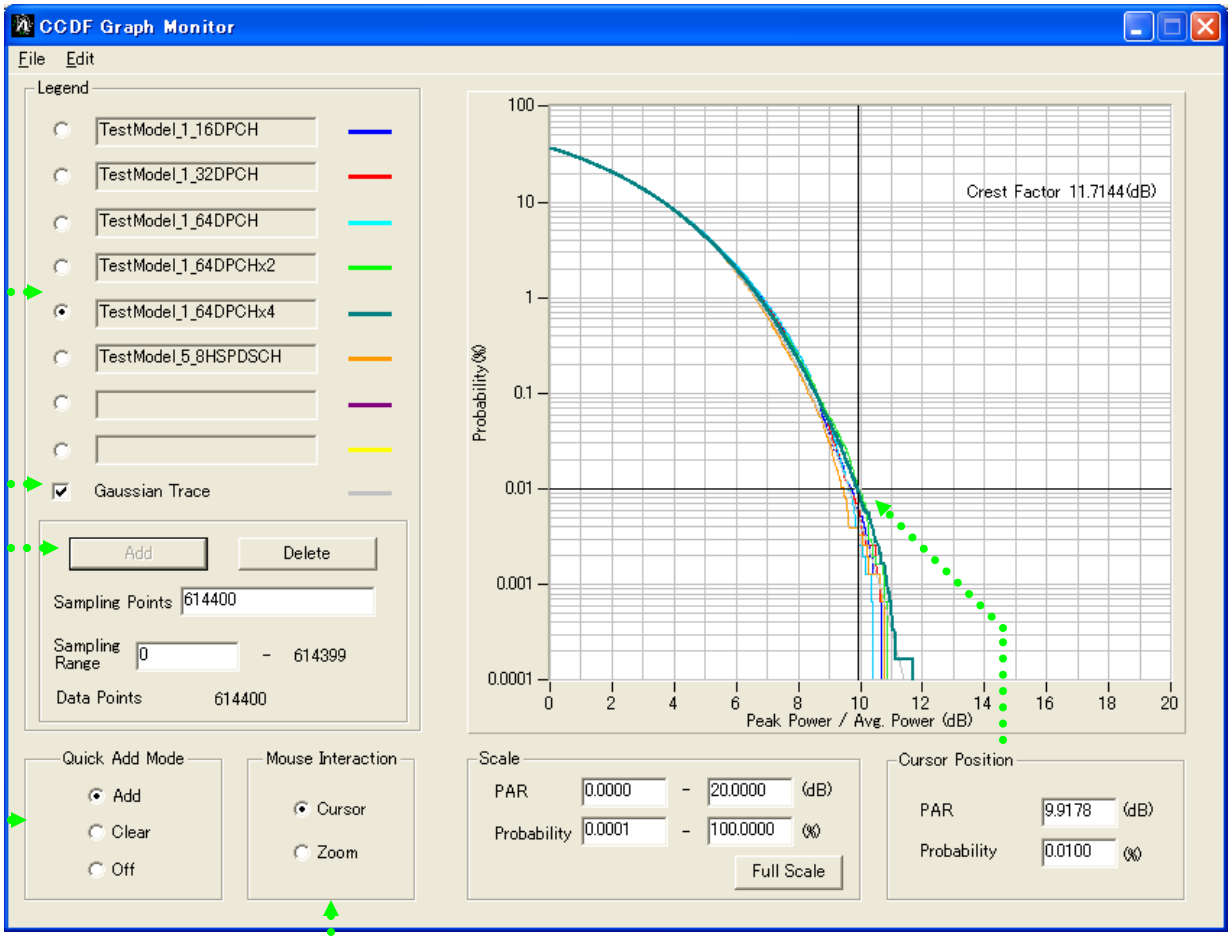
- Combination
  - » Add Pattern
    - Pattern for baseband memory B

Plots Simulation of CCDF, FFT Spectrum, Time Domain



- CCDF Complementary Cumulative Distribution Function curve
  - » Plots the cumulative distribution of instantaneous power/mean power
    - – If PAR Peak to Average power Ratio or Crest Factor of the signal is higher, the nonlinear elements will cause the spectral regrowth, and will affect ACLR.
- FFT Fast Fourier Transform Spectrum
  - » Plots the frequency spectrum
    - – Converting time-based signal into frequency domain
- Time domain
  - » Plots the I/Q waveform, markers activity and power trace into time domain
    - – Available to reconfigure markers data

CCDF



Plots the signal patterns up to 8

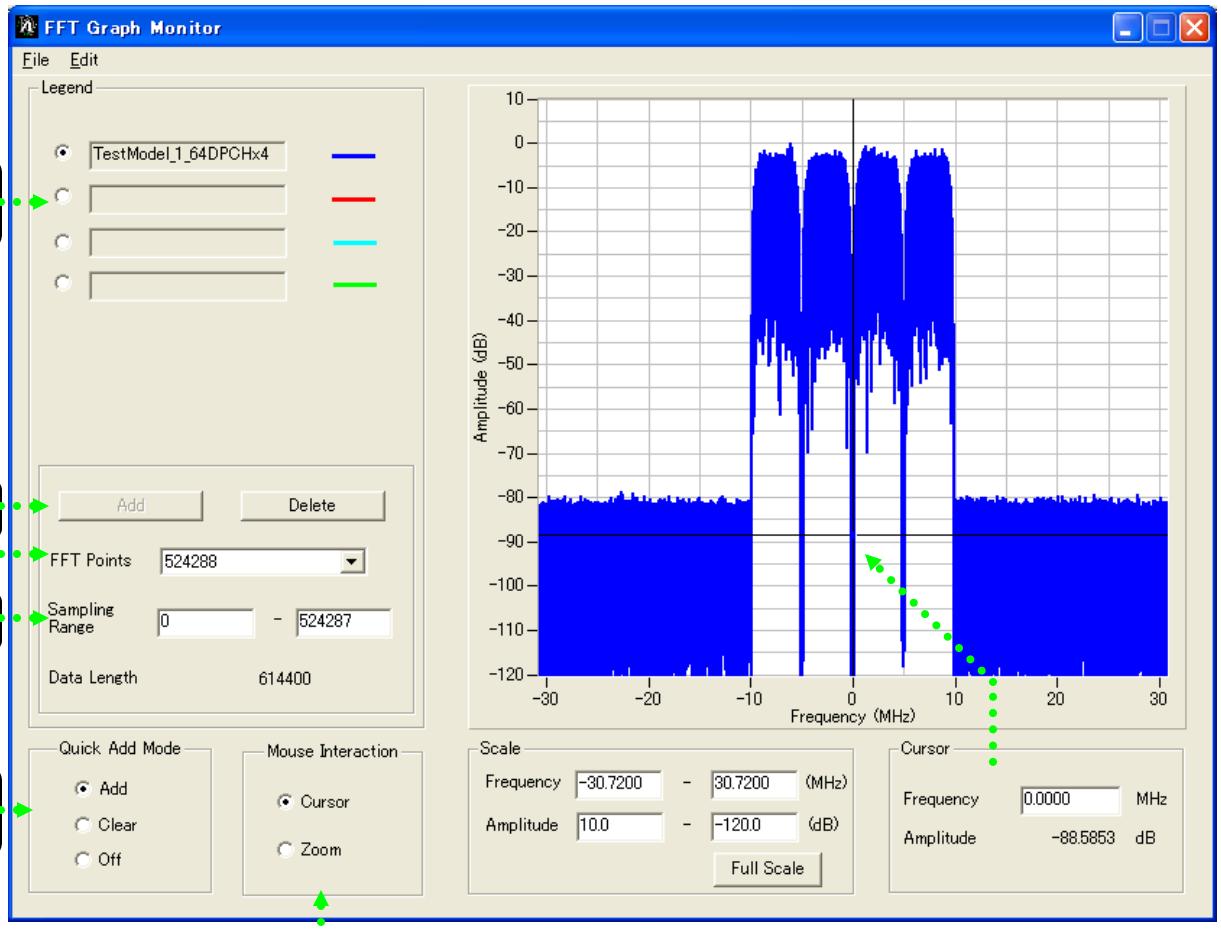
Plots the gaussian trace

Adds or deletes CCDF curve

Plots in conjunction with IQproducer under System menu

Operation of the mouse dragging on graph area
- Cursor motion
- Zoom of the scope of selection

FFT



Plots the signal patterns up to 4 on same sampling rate

Adds or deletes spectrum

Select lower value than Data Length

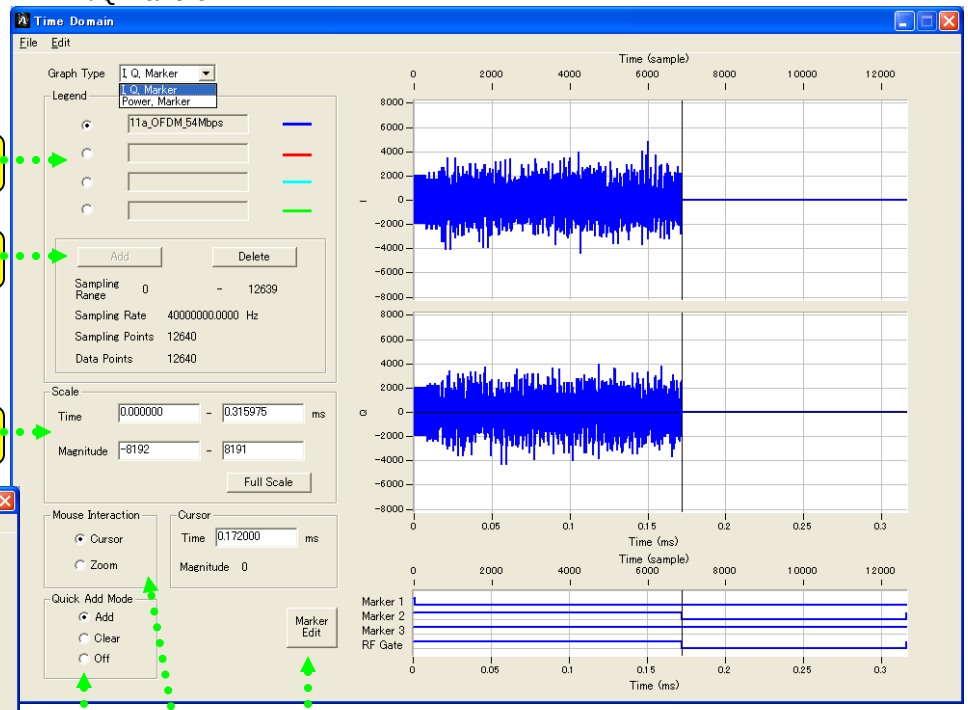
Range of the sample data to compute

Plots in conjunction with IQproducer under System menu

Operation of the mouse dragging on graph area
- Cursor motion
- Zoom of the scope of selection

Time Domain

I/Q waveform

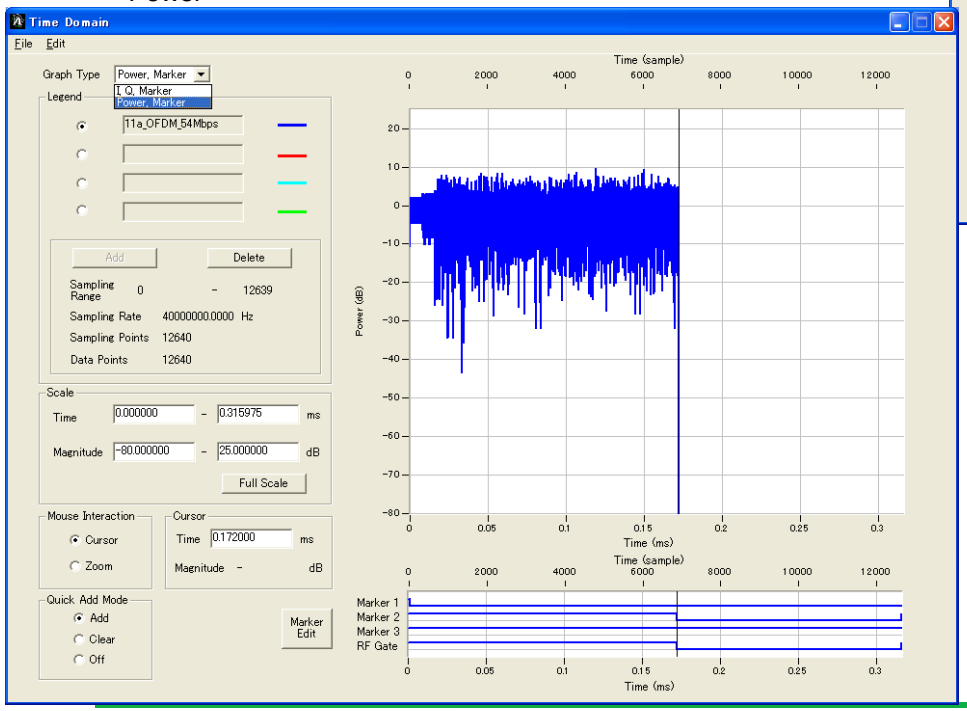


Plots the signal patterns up to 4

Adds or deletes trace

Trace range

Power

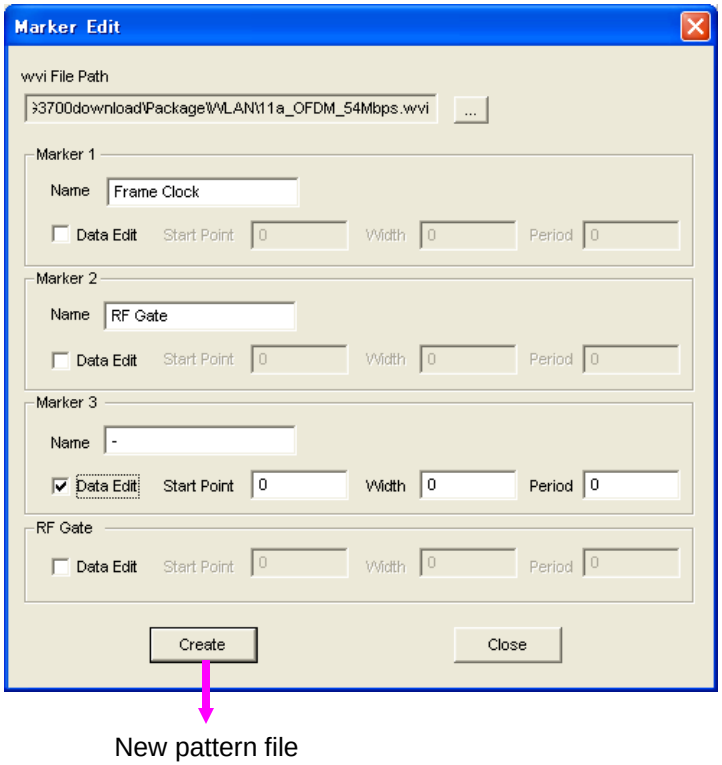


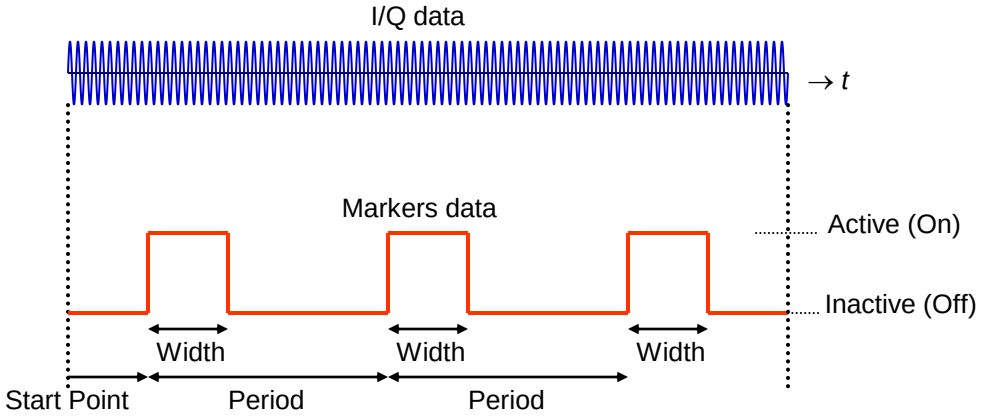
Reconfigurable markers data

Operation of the mouse dragging on graph area
- Cursor motion
- Zoom of the scope of selection

Plots in conjunction with IQproducer under System menu

Marker Edit





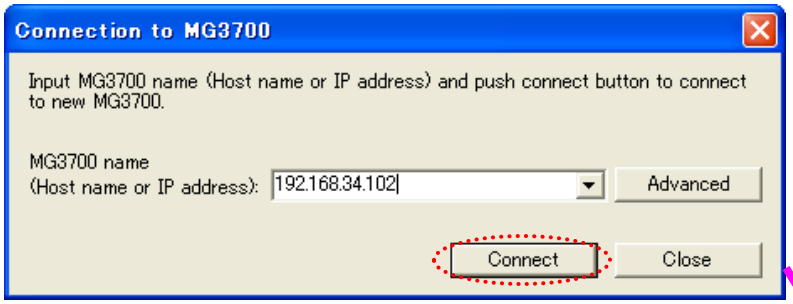
- Start Point
  - Offset inactive samples
- Width
  - Pulse width samples
- Period
  - Pulse period samples

FTP Connection to Internal HDD

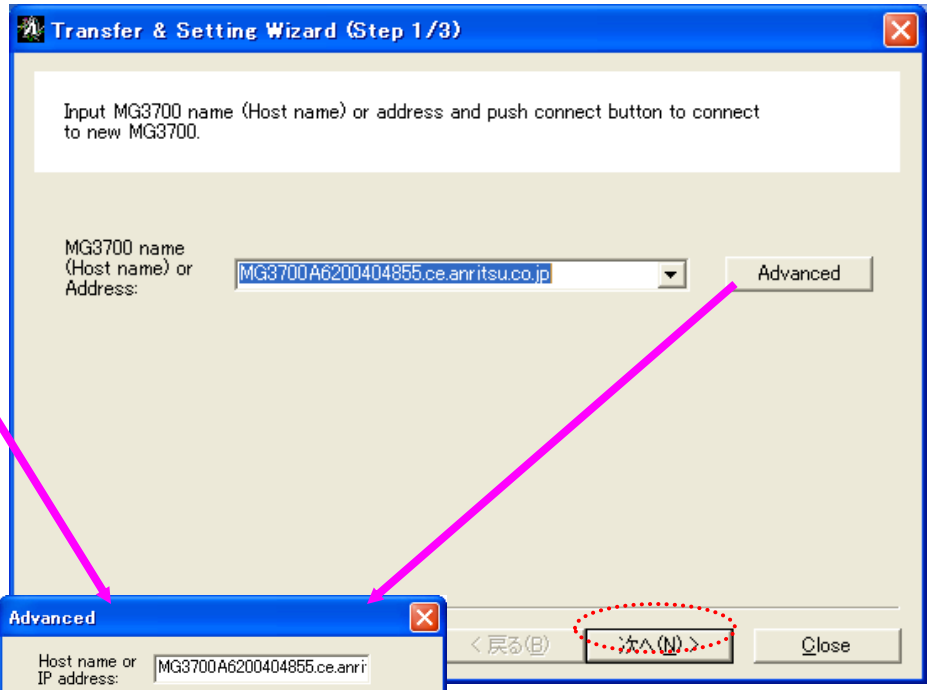
- Transfer & Setting Panel
  - » Files transfer to multi-MG3700A internal HDD, and backup of HD
    - Signal pattern files
    - Parameter files
    - Channel table files
    - BER log files
    - Alarm log files
    - Screen copy files
    - Firmware updated files
  - » Remote operation for signal generation
- Transfer & Setting Wizard
  - » Step-by-step operation for a pattern file transfer and generating
    - – Step 1: FTP connection to one MG3700A
    - – Step 2: Selection of a package for a pattern file to transfer to MG3700A internal HDD
    - – Step 3: Remote operation for selection and generation of the pattern file

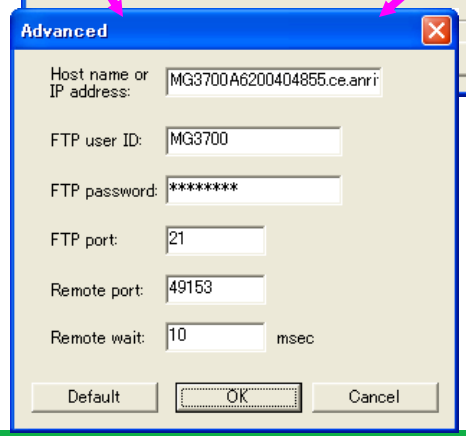
FTP Connection

- Transfer & Setting Panel



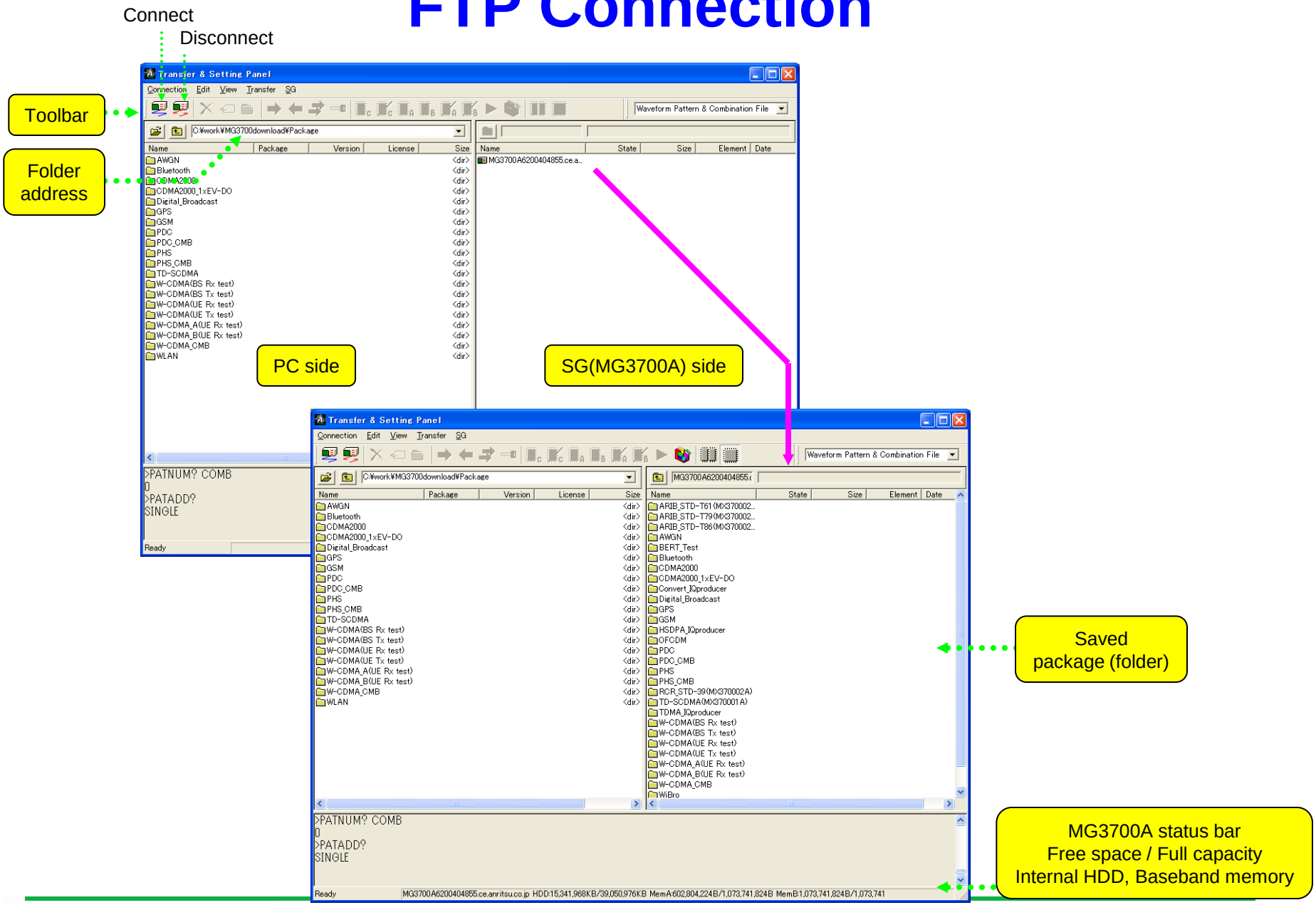
- Transfer & Setting Wizard



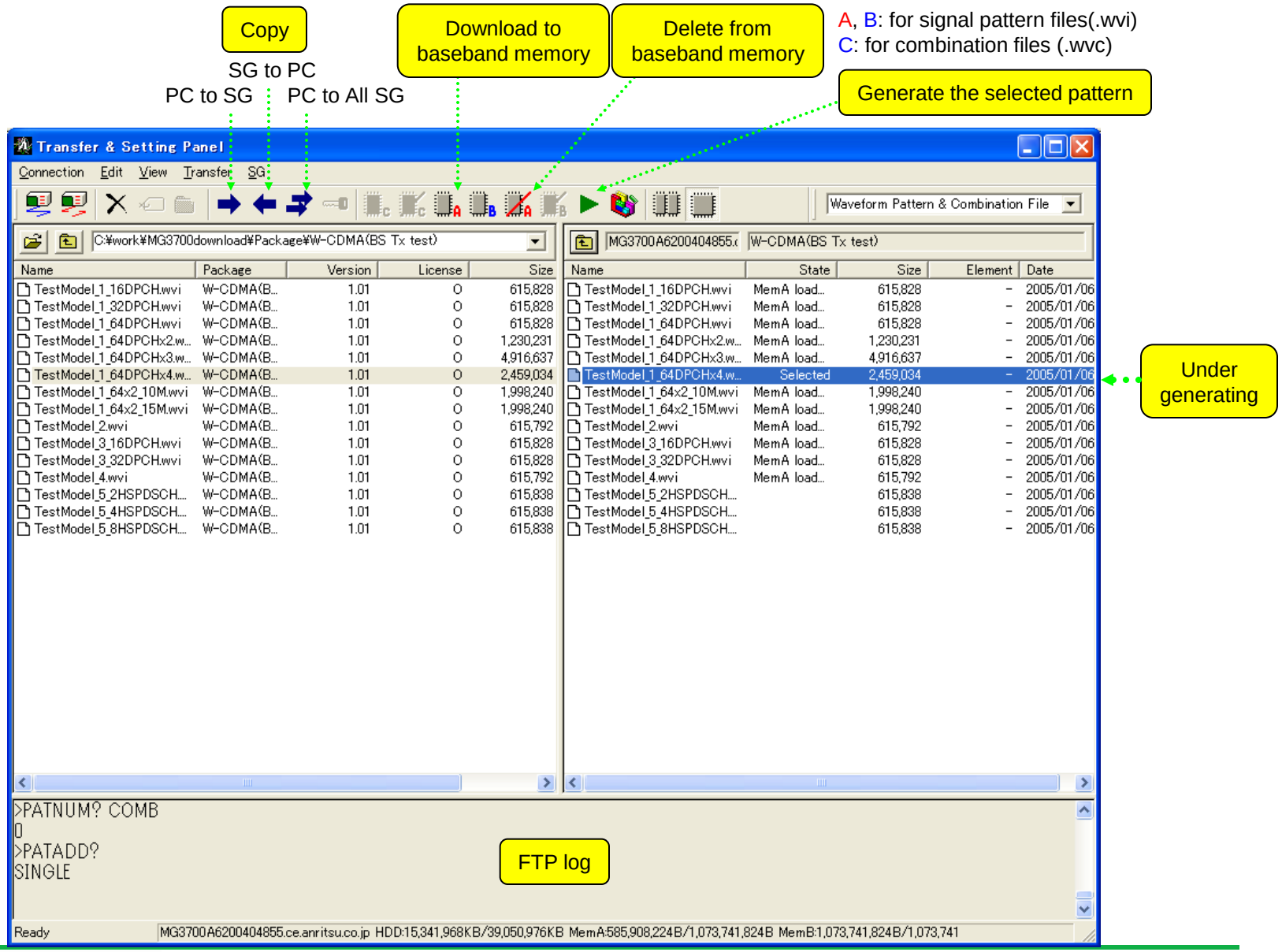


- » Server based network connection
  - – Enter the host name of MG3700A.
    - Enter the IP address of MG3700A, when the domain name is not defined.
- » End-to-end connection
  - – Enter the IP address of MG3700A.
    - PC has different IP address with MG3700A.

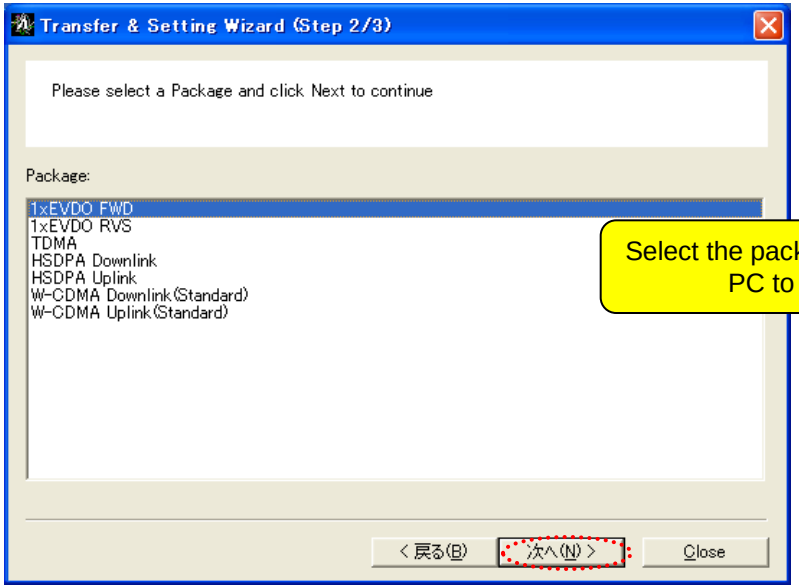
FTP Connection



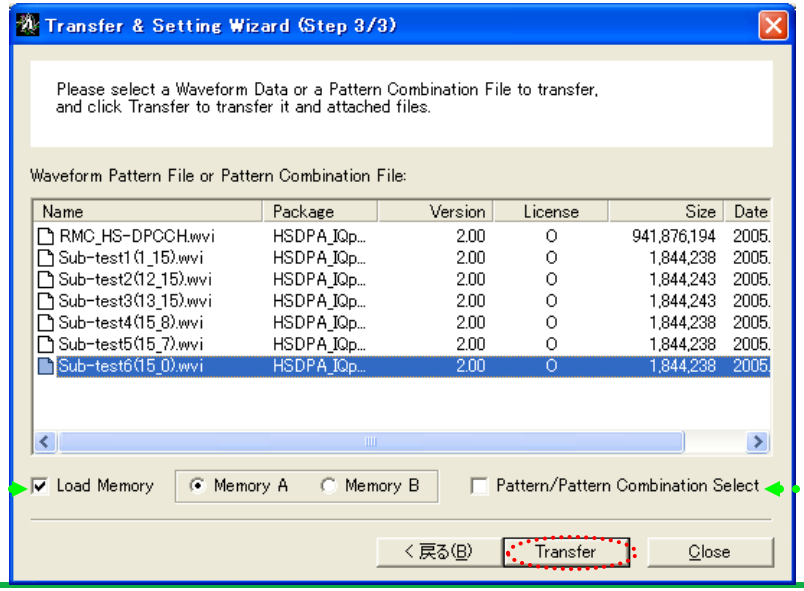
Transfer, Remote Operation



Transfer Wizard



Select the package to copy PC to SG

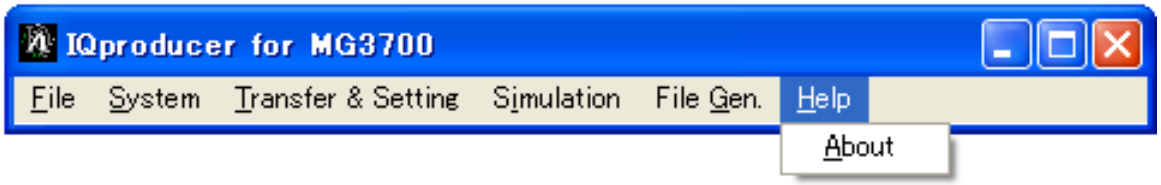


Select one pattern file to copy

Download to baseband memory

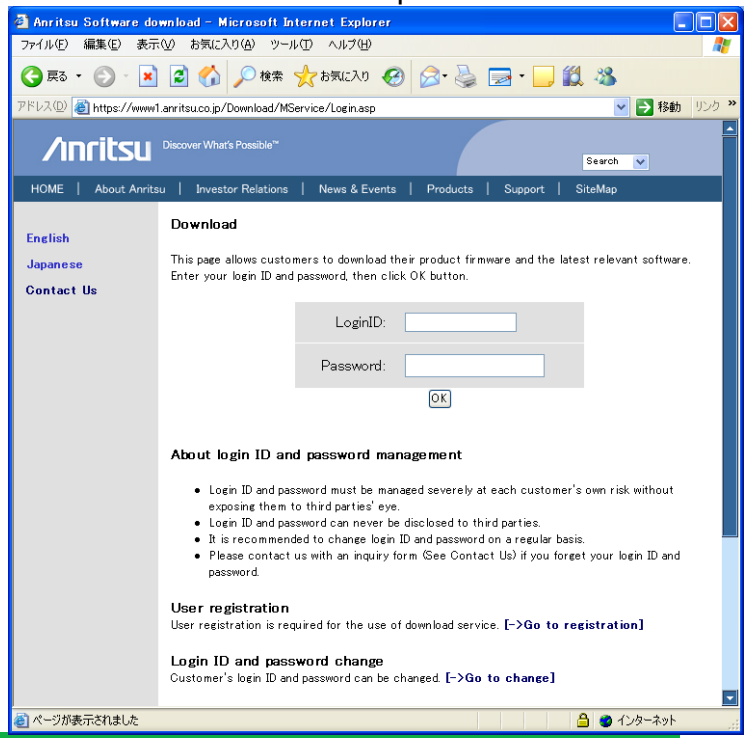
Generate the selected Pattern file

Release Version Check



- The user can visit the Anritsu "Software Download" website to download the latest IQproducer and operation manuals (PDF) for free.
  - User registration is required to use the download service.

http://www.anritsu.com/



Standard Signal Pattern Files

- Standard signal pattern files are the signal formats based on the receiver/transmitter test specifications for base stations and terminals of the major wireless systems.
- Easy operation just selects the signal pattern saved to high-capacity HDD, without setting the troublesome signal parameters for a wireless system.
- Useful for production and installation/maintenance application

Lineup

- WLAN (IEEE802.11a/b/g)
- W-CDMA
- GSM/EDGE
- CDMA2000 1xEV-DO (Rev.0)
- CDMA2000 1X
- PHS
- PDC
- *Bluetooth*®
- GPS
- Digital Broadcast (BS, CS, CATV, ISDB-T)

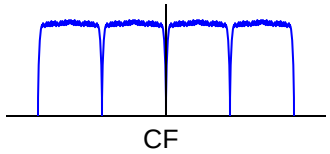
* The other datasheets show the more information.

WLAN Outline

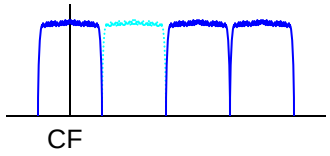
- AP/STA transmitter test
- AP/STA receiver test
  - » IEEE802.11a/g OFDM 6 ~ 54 Mbps
    - – 40 MS/s, 16.6 MHz bandwidth
  - » IEEE802.11b/g DSSS 1, 2 Mbps
    CCK 5.5, 11 Mbps
    - – 44 MS/s, 22 MHz bandwidth
  - » IEEE802.11g (Optional) DSSS-OFDM 6 ~ 54 Mbps
    - – 40 MS/s, 16.6 MHz bandwidth

W-CDMA Outline

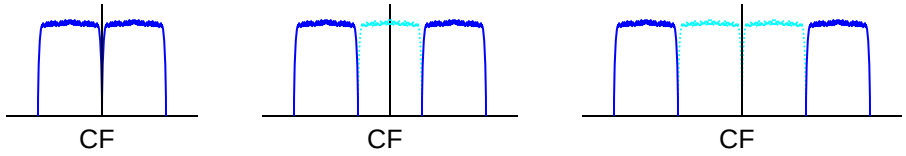
- BS transmitter test
  - » Test Model 1 ~ 5
  - » Multi-carrier
    - 4× Test Model 1 64DPCH



    - 3× Test Model 1 64DPCH



    - 2× Test Model 1 64DPCH



      - Scrambling Code 0_H, $10_H^{(+5\ MHz)}$, $20_H^{(+10\ MHz)}$, $30_H^{(+15\ MHz)}$
        - Oversampling 4× 3.84 Mcps = 15.36 MS/s

W-CDMA Outline

- BS receiver test
  - » UL RMC 12.2 ~ 384 kbps
  - » UL AMR
  - » UL ISDN
  - » UL Packet 64 kbps
    - – Scrambling Code 0_H
      - – Oversampling 3× 3.84 Mcps = 11.52 MS/s
      - – UL RMC 12.2 kbps also has Oversampling 4× 3.84 Mcps = 15.36 MS/s.
  - » UL Interferer
    - – Scrambling Code 1_H
      - – Oversampling 3× 3.84 Mcps = 11.52 MS/s
        Maximum frequency offset (Δf): ±34.944 MHz
      - – Oversampling 4× 3.84 Mcps = 15.36 MS/s
        Maximum frequency offset (Δf): ±47.232 MHz

W-CDMA Outline

- UE transmitter test
  - » UL RMC 12.2 kbps
    - – Scrambling Code 0_H
      - – Oversampling 3× 3.84 Mcps = 11.52 MS/s
- UE receiver test
  - » DL RMC 12.2 ~ 384 kbps *
  - » DL AMR *
  - » DL ISDN *
  - » DL Packet 384 kbps *
    - – Scrambling Code 80_H
  - » DL Interferer
    - – Scrambling Code 0_H
      - – Oversampling 4× 3.84 Mcps = 15.36 MS/s

*: To mix P-CCPCH (4096 frames) with *full* SFN 11 bit count (0 ~ 2047)

GSM/EDGE Outline

- BS/MS transmitter test
  - » No timeslot format PN9 (And also for interference signal)
  - » No burst format TN0

GMSK

PN 148	G 8.25

8PSK

PN 444	G 24.75

  - » No channel coding NB Normal burst TN0, TN0 ~ 7 (All slots)

GMSK

T 3	E 57	S 1	TSC 26	S 1	E 57	T 3	G 8.25

8PSK

T1 9	E 174	TSC 78	E 174	T2 9	G 24.75

- BS/MS receiver test
  - » TCH/FS Full rate Speech TCH TN0
  - » CS-1, CS-4 GPRS PDTCH TN0
  - » MCS-1, MCS-5 EGPRS PDTCH TN0
  - » MCS-9 EGPRS PDTCH TN0, TN0 ~ 3
    - – Oversampling 8× 270.833 ksps = 2,166.7 kS/s

*TN: Timeslot Number

CDMA2000 1xEV-DO Outline

- AN/AT transmitter test
- AN/AT receiver test
  - » Forward 38.4 ~ 2,457.6 kbps (Active slot), Idle slot
  - » Reverse 9.6 ~ 153.6 kbps
    - – Long Code Mask (42 bits)
      - MI: 3FF00000000H
      - MQ: 3FF00000001H
        - – Oversampling 4× 1.2288 Mcps = 4.9152 MS/s

CDMA2000 1X Outline

- BS/MS transmitter test
- BS receiver test
  - » Forward RC 1/2 (6× FCH 19.2 ksps)
    RC 3/4/5 (6× FCH 38.4 ksps)
    - – No coding
  - » Reverse RC 1 FCH 9.6 kbps
    RC 2 FCH 14.4 kbps
    RC 3 PICH + FCH 9.6 kbps
    PICH + FCH 9.6 kbps + SCH 9.6 kbps
    PICH + DCCH 9.6 kbps
    RC 4 PICH + FCH 14.4 kbps
    - – Long Code Mask (42 bits) 00000000000H
      - – Oversampling 4× 1.2288 Mcps = 4.9152 MS/s

PHS, PDC Outline

PHS

- CS/PS transmitter test
  - » No π/4DQPSK slot format PN9, All'0'
- CS/PS receiver test
  - » π/4DQPSK TCH Slot 1
  - » No π/4DQPSK slot format PN15
    - – Oversampling 8× 192 ksps = 1,536 kS/s

PDC

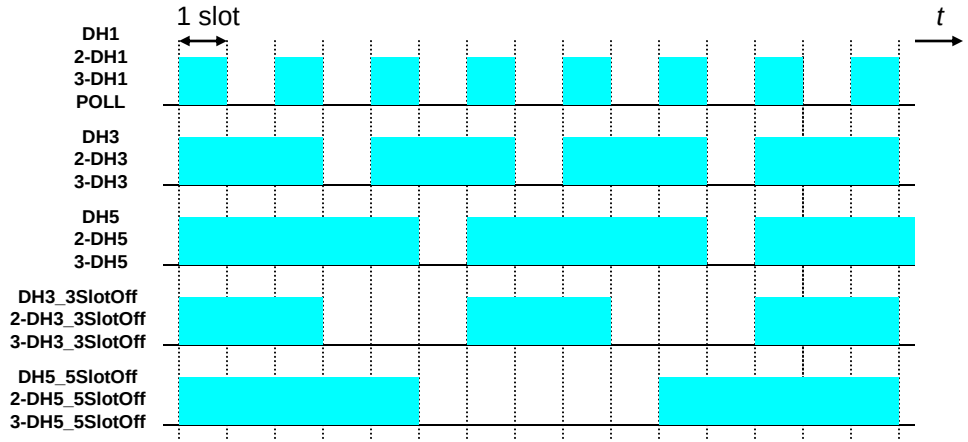
- BS/MS transmitter test
  - » No slot format PN9
- BS/MS receiver test
  - » TCH full rate Slot 0
  - » TCH half rate Slot 0
  - » PDC-P Slot 0, Slot 0/1 *Downlink, Slot 0/1/2 *Downlink
  - » No slot format PN15
    - – Oversampling 8× 21 ksps = 168 kS/s

Bluetooth® Outline

- Transmitter test
- Receiver test
  - » No packet format — PN9, PN15 — GFSK, π/4DQPSK, 8DPSK
  - » DH1, DH3, DH5 — Basic Rate — GFSK Payload
  - » 2-DH1, 2-DH3, 2-DH5 — EDR — π/4DQPSK Payload
  - » 3-DH1, 3-DH3, 3-DH5 — EDR — 8DPSK Payload
  - » POLL — System packet for functionality test
  - » 2/3-DH1/3/5 dirty signals — EDR — π/4DQPSK, 8DPSK Payload
    - – Oversampling 12× 1 Msps = 12 MS/s

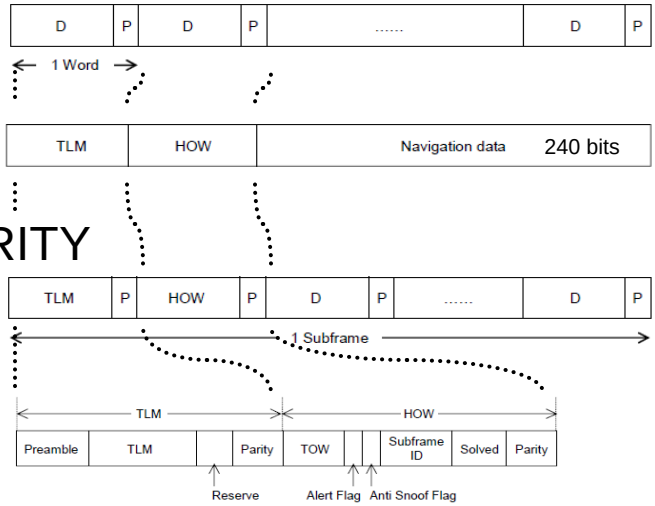
	Transmission Packets	Carrier Offset Frequency	Symbol Timing Error
1	20 Packets	0 kHz	0 ppm
2	20 Packets	+65 kHz	+20 ppm
3	20 Packets	-65 kHz	-20 ppm

Burst slots map



GPS Outline

- GPS receiver test
  - » No subframe format — PN9
  - » Subframe for parity detection — PARITY
    - – Subframe ID 1
  - » Subframe for sensitivity test — TLM
    - – Subframe ID 1
  - » Frame for sensitivity test — TLM_PARITY
    - – Subframe ID 1 ~ 5

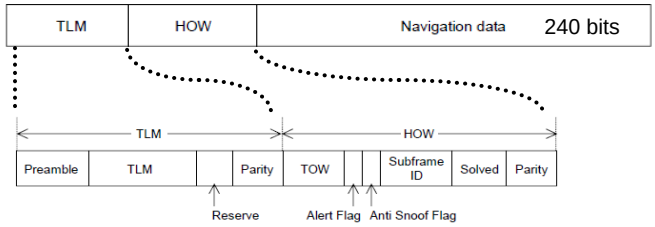


  - – Oversampling 4× 1.023 Mcps = 4.092 MS/s
    Trigger delay setting ability 244 ns ≈ 1/4.092 us

- Satellite ID 1

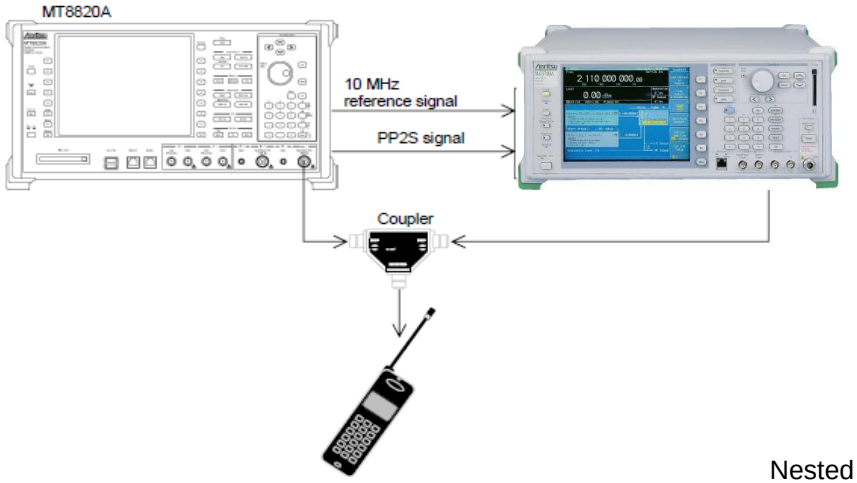
GPS Outline

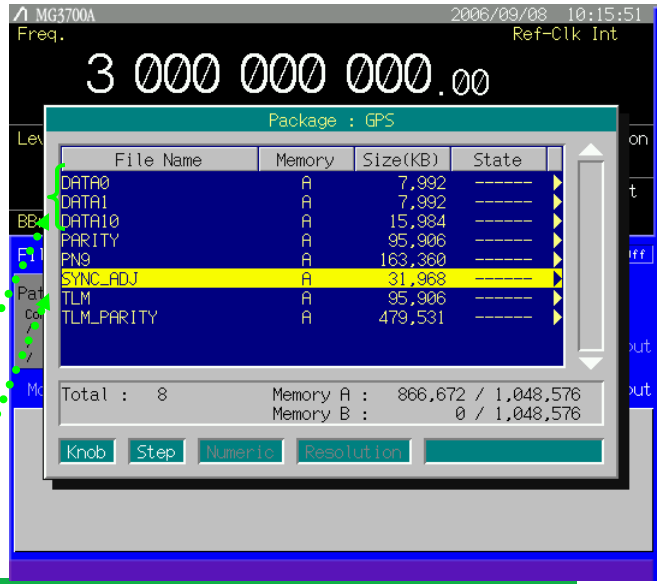
- A-GPS receiver test
  - » Subframe for time calibration SYNC_ADJ
    It is used use when synchronizing with PP2S.
    - Subframe ID 1



      - Oversampling 100× 1.023 Mcps = 102.3 MS/s
        Trigger delay setting ability 9.8 ns ≈ 1/102.3 us

        - Satellite ID 1

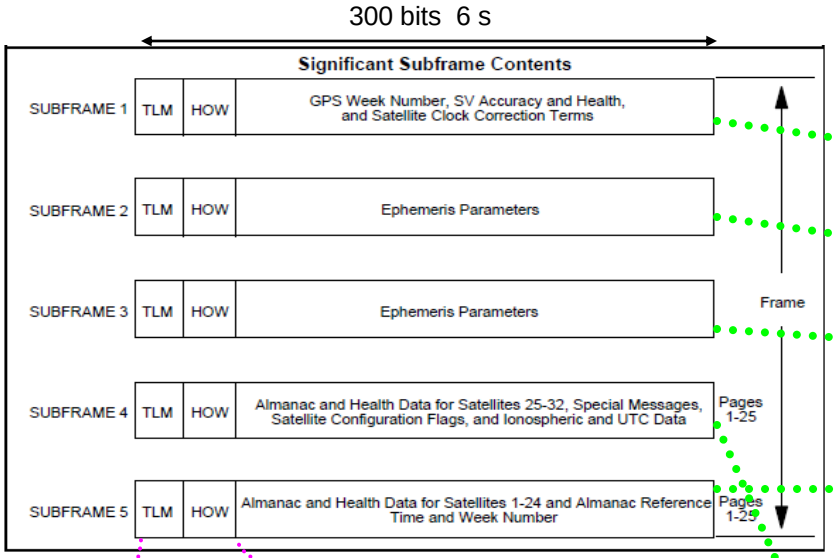


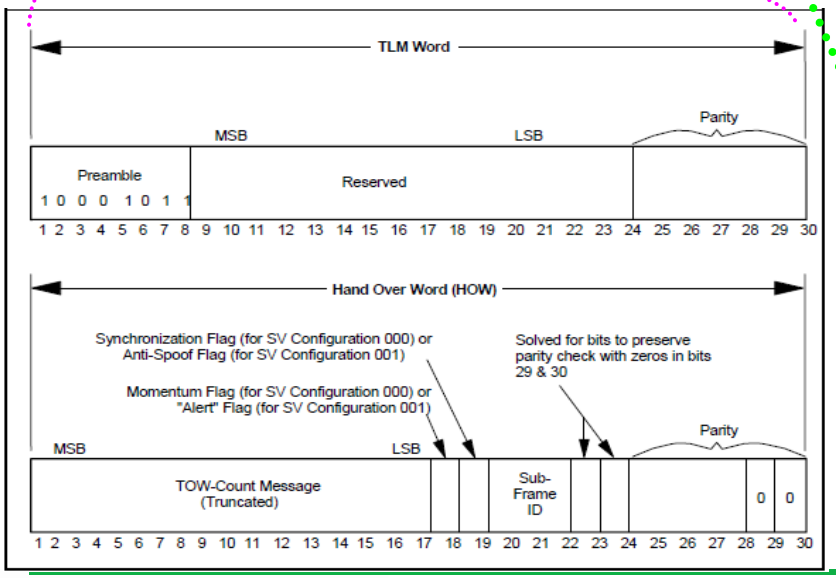


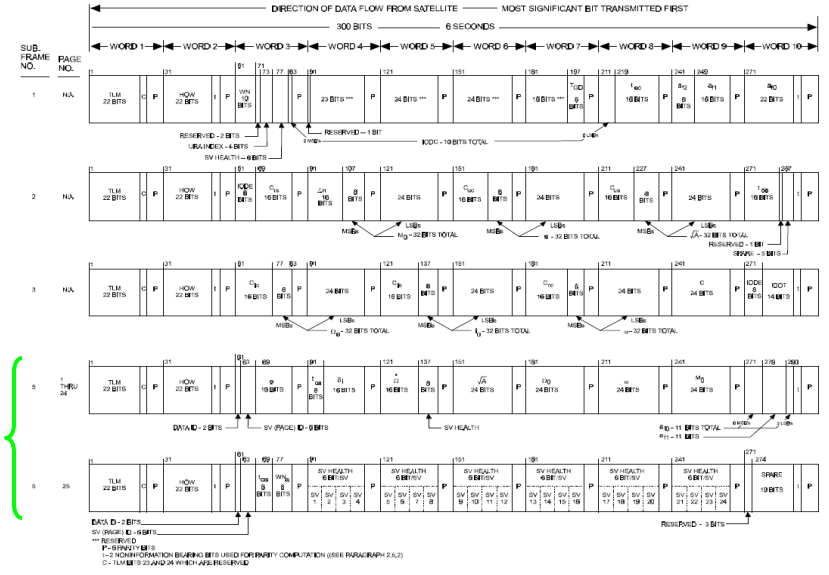
Nested signal pattern files

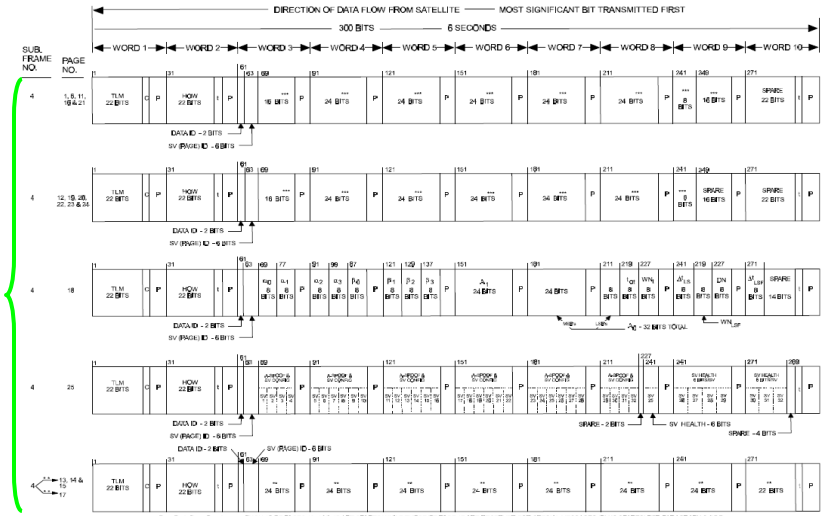
Combination file

GPS Outline


300 bits 6 s
Significant Subframe Contents
SUBFRAME 1
TLM
HOW
GPS Week Number, SV Accuracy and Health, and Satellite Clock Correction Terms
SUBFRAME 2
Ephemeris Parameters
SUBFRAME 3
Ephemeris Parameters
Frame
SUBFRAME 4
Almanac and Health Data for Satellites 25-32, Special Messages, Satellite Configuration Flags, and Ionospheric and UTC Data
Pages 1-25
SUBFRAME 5
Almanac and Health Data for Satellites 1-24 and Almanac Reference Time and Week Number
Pages 1-25


TLM Word
MSB
LSB
Parity
Preamble
1 0 0 0 1 0 1 1
Reserved
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Hand Over Word (HOW)
Synchronization Flag (for SV Configuration 000) or Anti-Spoof Flag (for SV Configuration 001)
Momentum Flag (for SV Configuration 000) or "Alert" Flag (for SV Configuration 001)
Solved for bits to preserve parity check with zeros in bits 29 & 30
MSB
LSB
Parity
TOW-Count Message (Truncated)
Sub-Frame ID
0 0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30


DIRECTION OF DATA FLOW FROM SATELLITE
MOST SIGNIFICANT BIT TRANSMITTED FIRST
300 BITS
6 SECONDS
WORD 1
WORD 2
WORD 3
WORD 4
WORD 5
WORD 6
WORD 7
WORD 8
WORD 9
WORD 10
SUB. FRAME NO.
PAGE NO.

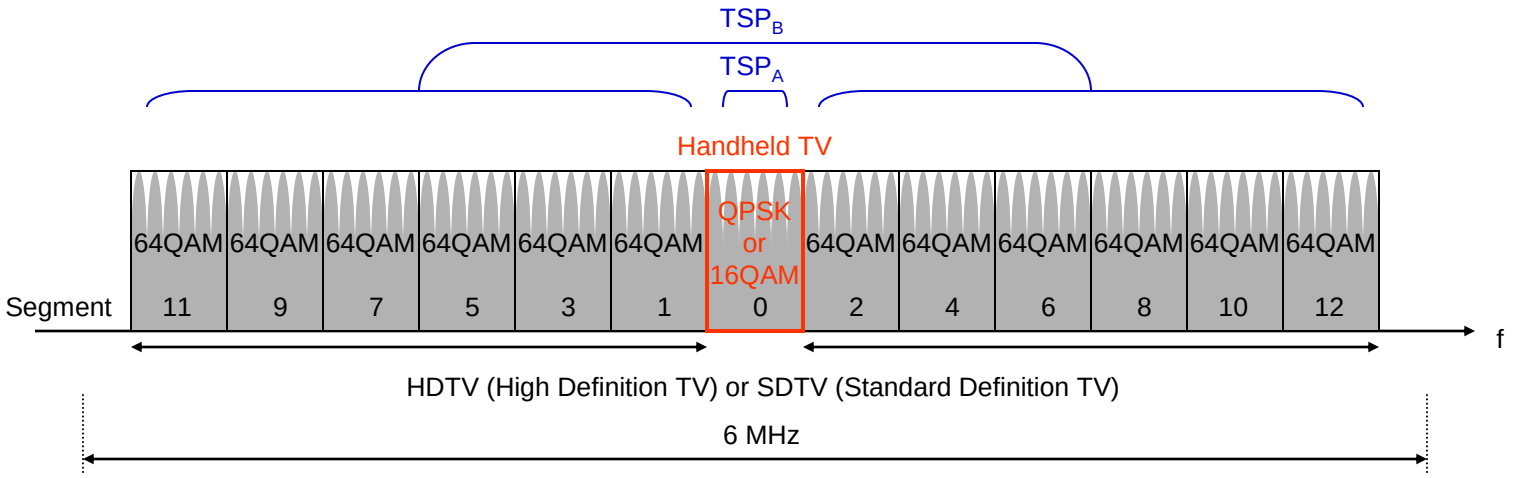

DIRECTION OF DATA FLOW FROM SATELLITE
MOST SIGNIFICANT BIT TRANSMITTED FIRST
300 BITS
6 SECONDS
WORD 1
WORD 2
WORD 3
WORD 4
WORD 5
WORD 6
WORD 7
WORD 8
WORD 9
WORD 10
SUB. FRAME NO.
PAGE NO.

Digital Broadcast Outline

- Transmitter test
  - » Digital BS (ISDB-S) QPSK Roll-off 0.35
    - – 144.3 MS/s, 34.5 MHz bandwidth
  - » Digital CS QPSK Roll-off 0.35
    - – 147.672 MS/s, 27 MHz bandwidth
  - » CATV (ITU-T J83 Annex C) 64QAM Roll-off 0.13
    - – 42.192 MS/s, 6 MHz bandwidth
  - » ISDB-T TSP_A(13 segments) 64QAM
    TSP_A(1 segment) QPSK + TSP_B(12 segments) 64QAM
    - Mode 3, GI 1/8
      - – 16.253968 254 MS/s, 5.572 MHz bandwidth

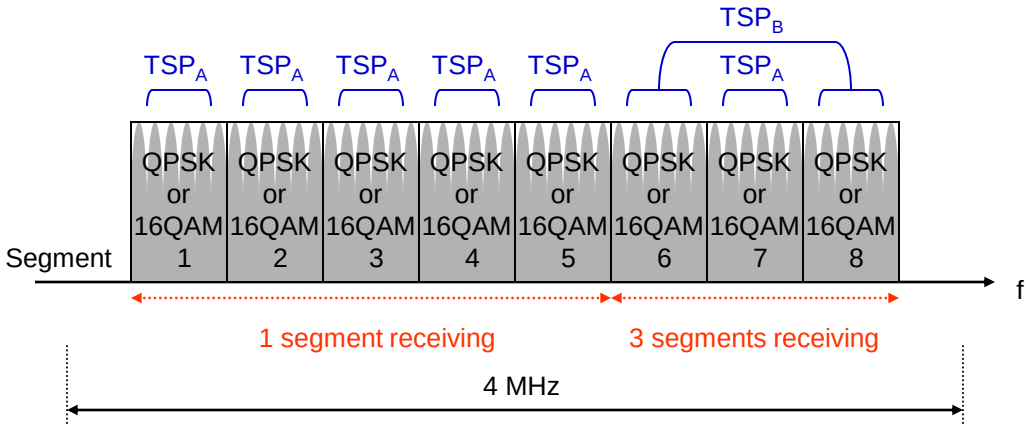
Digital Broadcast Outline

- ISDB-T receiver test
  - » TSP_A(1 segment) QPSK 2/3 + TSP_B(12 segments) 64QAM 3/4 or 7/8
    - – TSP_A/TSP_B Payload: Video + Audio
    - – 40 frames length (9.3 s)
  - » TSP_A(1 segment) QPSK 2/3 or 1/2, 16QAM 1/2 + TSP_B(12 segments) 64QAM 3/4 or 7/8
    - – TSP_A/TSP_B Payload: PN23 initialized at start of 4 frames
    - – 4 frames length (0.9 s)
      - Mode 3, GI 1/8
        - – 16.253968 254 MS/s, 5.572 MHz bandwidth



Digital Broadcast Outline

- ISDB-Tsb receiver test
  - » TSP_A(1 segment) QPSK 1/2 + TSP_B(2 segments) QPSK 1/2
    - – TSP_A/TSP_B Payload: Video + Audio
    - – 68 frames length (15.7 s)
  - » TSP_A(1 segment) QPSK 1/2 or 2/3, 16QAM 1/2 + TSP_B(2 segments) 16QAM 1/2
    - – TSP_A/TSP_B Payload: PN23 initialized at start of 4 frames
    - – 4 frames length (0.9 s)
      - Mode 3, GI 1/8
        - – 8.126984 17 MS/s, 3.429563 49 MHz bandwidth



AWGN Outline

- For W-CDMA
  - » 1.5× 3.84 MHz = 5.76 MHz bandwidth
  - » 2× 3.84 MHz = 7.68 MHz bandwidth
    - – Oversampling 3× 3.84 Mcps = 11.52 MS/s
- For CDMA2000
  - » 1.5× 1.2288 MHz = 1.8432 MHz bandwidth
  - » 2× 1.2288 MHz = 2.4576 MHz bandwidth
    - – Oversampling 4× 1.2288 Mcps = 4.9152 MS/s

Optional Signal Pattern Files

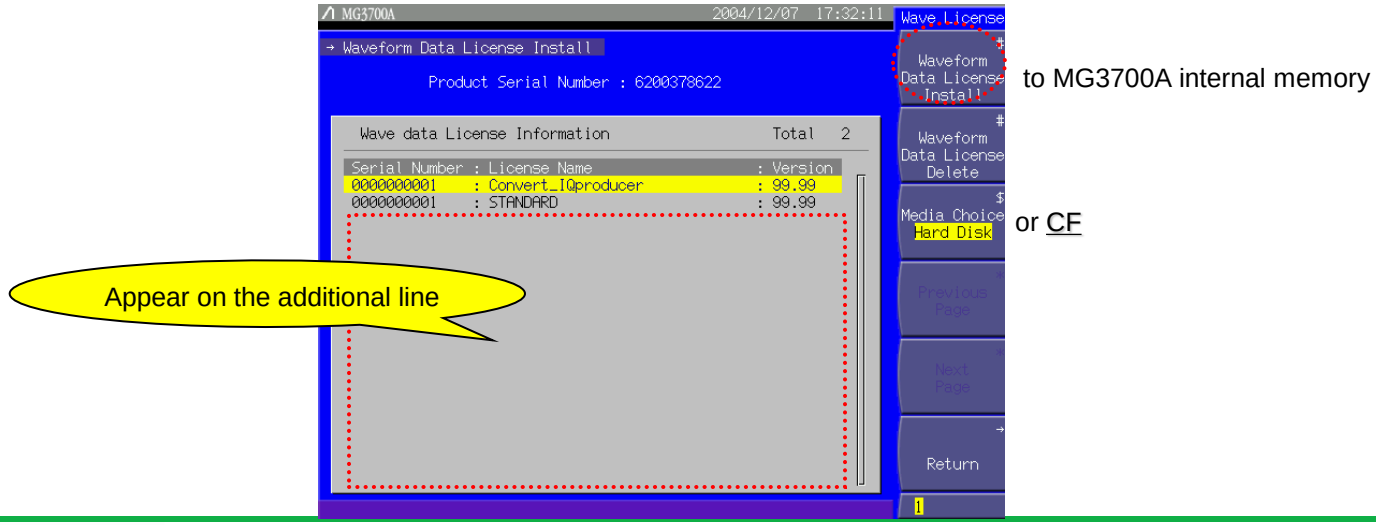
- Optional signal pattern files are the signal formats based on the receiver/transmitter test specifications for base stations and terminals of specific wireless systems.

- License option
  - » MX370001A TD-SCDMA waveform pattern
    - – DL/UL RMC of 3GPP TS 25.142/102 1.28 Mcps TDD option
      - DVD stored together with Operation Manual (PDF) is provided.

* The other datasheets show the more information.

License Key for Optional Signal Pattern Files

- If optional signal pattern files are purchased, CD (DVD) containing the license key file on MG3700A serial number will be provided.
- In order to download the optional signal pattern files to baseband memory, installing the license key file per MG3700A is required.
  - » When optional signal pattern files are purchased together with MG3700A, the license key file is already installed in MG3700A.



TD-SCDMA Outline

- BS transmitter test
  - » DL 1 DPCH, 8 DPCH, 10 DPCH, P-CCPCH
    - – Scrambling Code 0_H
- BS receiver test/ UE transmitter test
  - » UL RMC 12.2 ~ 384 kbps
    - – Scrambling Code 0_H
- UE receiver test
  - » DL RMC 12.2 ~ 384 kbps
    - – Scrambling Code 0_H

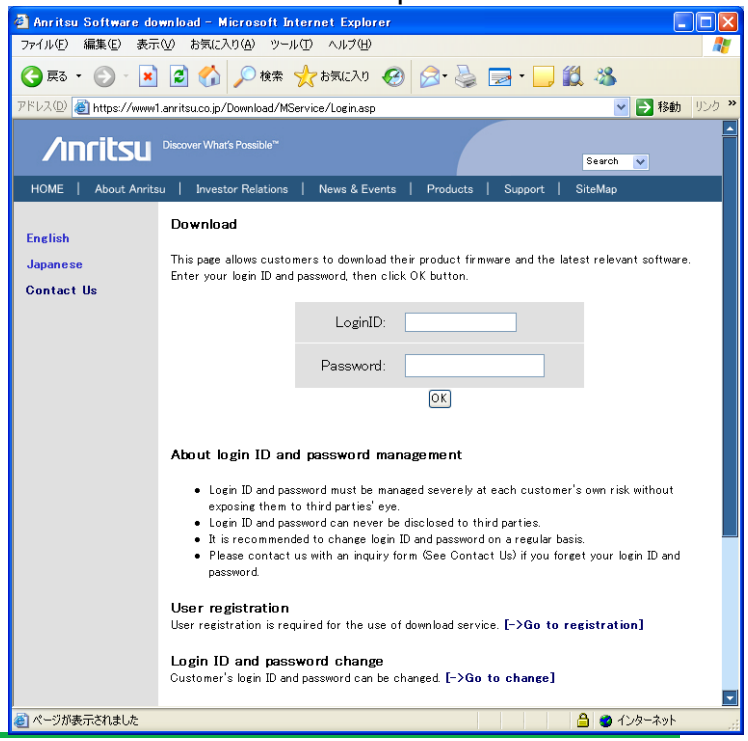
– Oversampling 4× 1.28 Mcps = 5.12 MS/s

Updated Signal Pattern Files

- The user can visit the Anritsu "Software Download" website to download the updated latest pattern files and operation manuals (PDF) for free.
  - User registration is required to use the download service.
    - The pattern files are deleted two months after an announcement due to bulk files.

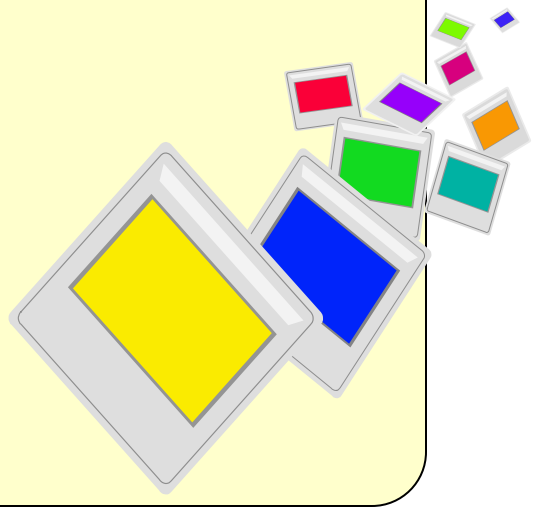
- All the latest pattern files are provided by DVD for a fee.
  - Z0777 (optional accessory)
    Standard waveform pattern upgrade kit

http://www.anritsu.com/



Option

- Product Outline
- Features
- Options



- MG3700A-002 (102) 149
  - » Mechanical Attenuator

  MG3700A- (103)
  - » Electronic Attenuator
- MG3700A-011 (111) 151
  - » Upper Frequency 6 GHz
- MG3700A-021 (121) 152
  - » ARB Memory Upgrade 512 Msample/channel
- MG3700A-031 (131) 153
  - » High-speed BER Test function

    - MG3700A-0××: Initial order
    - MG3700A-1××: Retrofit order
- Key optional accessories list 160

MG3700A-002 Mechanical Attenuator

- In order to change the RF output level widely, the step attenuator controls the output level.
- There are two types of step attenuators. An electronic attenuator is provided as standard. Please determine needs according to usage, since there are trade-off relationships regarding advantages.

  - » Electronic step attenuator Standard
    - – Switches the attenuation elements using a semiconductor switch
    - – 5 dB step, 135 dB range
    - – Advantage: high-speed, long life, no wear

    Better for ATE

  - » Mechanical step attenuator Option
    - – Switches the contacts of a multi-fixed attenuator of different values and through paths using a mechanical switch
    - – 2 dB step, 142 dB range, Switching useful life ≥ 5 million times
    - – Advantage: low loss, no variation of temperature

    Better for high power output, high C/N, field site use

Different Attenuator Specifications

<table>
<tr><th colspan="2"></th><th>Electronic attenuator</th><th>Mechanical attenuator</th><th>MG3681A Mechanical attenuator for reference</th></tr>
<tr><td>Frequency</td><td>Switching time</td><td>* Frequency switching = Normal:
≤ 15 ms (3 GHz non-cross, Δf < 1 GHz)
≤ 20 ms (3 GHz non-cross, Δf ≥ 1 GHz)
≤ 40 ms (3 GHz cross)
* Frequency switching = Fast:
≤ 10 ms (3 GHz non-cross)
≤ 40 ms (3 GHz cross)</td><td>≤ 80 ms (3 GHz non-cross)
≤ 100 ms (3 GHz cross)</td><td>≤ 20 ms</td></tr>
<tr><td rowspan="4">Output level</td><td>Settable range</td><td>-140 ~ +13 dBm</td><td>-140 ~ +19 dBm</td><td>-143 ~ +17 dBm</td></tr>
<tr><td>Accuracy</td><td>CW, 23 ±5 °C
<table><tr><th>Level (p) [dBm]</th><th colspan="3">Frequency (f) [Hz]</th></tr><tr><th></th><th>250 k ≤f < 25 M</th><th>25 M ≤f ≤3 G</th><th>3 G < f ≤6 G*</th></tr><tr><td>+3 < p ≤+6</td><td></td><td>±0.5 dB</td><td></td></tr><tr><td>−1 < p ≤+3</td><td></td><td>±0.5 dB</td><td>±0.8 dB</td></tr><tr><td>−120 ≤p ≤−1</td><td>±0.5 dB typical</td><td>±0.5 dB</td><td>±0.8 dB</td></tr><tr><td>−127 ≤p <−120</td><td></td><td>±0.7 dB</td><td>±2.5 dB typical</td></tr><tr><td>−136 ≤p <−127</td><td></td><td>±1.5 dB typical</td><td></td></tr></table></td><td>CW, 23 ±5 °C
<table><tr><th>Level (p) [dBm]</th><th colspan="3">Frequency (f) [Hz]</th></tr><tr><th></th><th>250 k ≤f < 25 M</th><th>25 M ≤f ≤3 G</th><th>3 G < f ≤6 G*</th></tr><tr><td>+7 < p ≤+10</td><td>±0.5 dB typical</td><td>±0.5 dB</td><td></td></tr><tr><td>−100 ≤p ≤+7</td><td>±0.5 dB typical</td><td>±0.5 dB</td><td>±0.8 dB</td></tr><tr><td>−120 ≤p <−100</td><td>±0.5 dB typical</td><td>±0.5 dB</td><td>±1.0 dB</td></tr><tr><td>−127 ≤p <−120</td><td></td><td>±0.7 dB</td><td>±2.5 dB typical</td></tr><tr><td>−136 ≤p <−127</td><td></td><td>±1.5 dB typical</td><td></td></tr></table></td><td>CW (0 ~ 50 °C)
<table><tr><th>Level \ Frequency</th><th>≤1 GHz</th><th>>1 GHz</th></tr><tr><td>≤+13 dBm, ≥−127 dBm</td><td>±1 dB</td><td>±2 dB</td></tr><tr><td><−127 dBm</td><td>±2 dB</td><td>±3 dB</td></tr></table></td></tr>
<tr><td>Switching time</td><td>≤ 10 ms (≥ 25 MHz)
≤ 15 ms (< 25 MHz)</td><td>≤ 80 ms</td><td>≤ 50 ms</td></tr>
<tr><td>VSWR</td><td>1.3 (≤ 3 GHz)
1.55 (> 3 GHz)</td><td>1.25 (≤ 3 GHz)
1.35 (> 3 GHz)</td><td></td></tr>
<tr><td rowspan="3">Vector mod.
I/Q mod.</td><td>W-CDMA</td><td colspan="3">Test Model 1 64DPCH</td></tr>
<tr><td>ACLR 5 MHz Offset</td><td>-61 dBc/3.84 MHz
-63 dBc/3.84 MHz typ.</td><td>-62 dBc/3.84 MHz
-64 dBc/3.84 MHz typ.</td><td>-66 dBc/3.84 MHz typ.</td></tr>
<tr><td>ACLR 10 MHz Offset</td><td>-66 dBc/3.84 MHz typ.</td><td>-67 dBc/3.84 MHz typ.</td><td>-67 dBc/3.84 MHz typ.</td></tr>
</table>

MG3700A-011 Upper Frequency 6 GHz

- Upper frequency reaches 6 GHz by mounting RF unit for 3 GHz < frequency ≤ 6 GHz

	Standard	Option
» Frequency range	250 k ~ 3 GHz	250 k ~ 6 GHz

- The frequency switch between RF unit for frequency ≤ 3 GHz and RF unit for 3 GHz < frequency ≤ 6 GHz is made using a mechanical switch.
  - » Switching useful life ≥ 5 million times

MG3700A-021 ARB Memory Upgrade

512 Msample/channel

- Upgradable baseband memory capacity
  - » Doubles the I/Q sample data sequence length
  - » Increases the loadable number of signal patterns
    - – Although the data loading speed from HDD to baseband memory is 14 MB/s, the change of the signal pattern within the memory is the instant.

Better for W-CDMA and broadcast receiver test

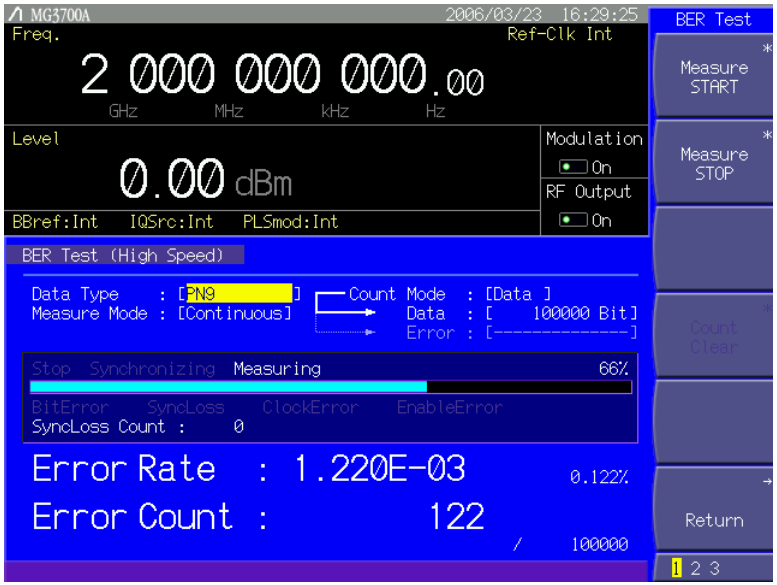
	Standard	Option	
» Memory capacity	2× 128 M (1 GB)	2× 256 M (2 GB)	sample/channel

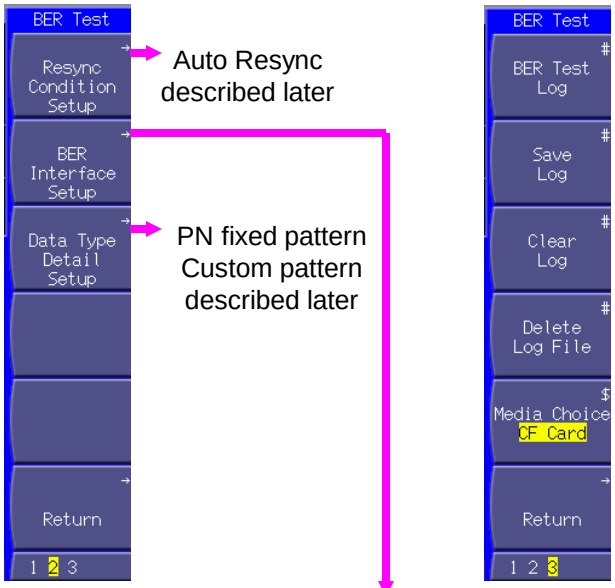
MG3700A-031 High-speed BER Test Function

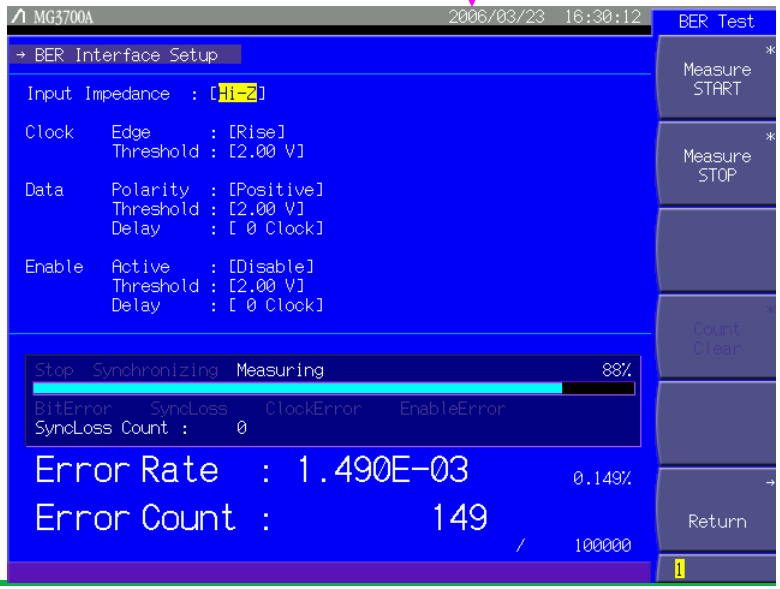
- Upgradable features by mounting PCB for Faster BER analyzer

	Standard	Option
Data rate	1 k ~ 20 Mbps	100 ~ 120 Mbps
Data pattern	PN9, 11, 15, 20, 23, ALL0, ALL1, Alternate 01	
		PN fixed pattern, Custom pattern
Measuring bit * after synchronization	1,000 ~ 4,294,967,295 (2^{23}-1)	
Measuring time * after synchronization	0.1 ~ 359,999 s (99 h 59 m 59 s) Resolution 0.1 s	
Measuring error bit * after synchronization		1 ~ 2,147,483,647 (2^{31}-1)
Automatic re-synchronization (Auto Resync)	On: Sync Loss monitoring per 10 ms	
Sync Loss behavior	Measurement stop (Sync Loss error)	Re-synchronization (Sync Loss count)
Sync Loss threshold	6 error bits 64 bits	1 ~ Error bits for half of bits 500 or 5,000 or 50,000 bits
	Off: Sync Loss detection ignore	
Input level	TTL	0 ~ 5 V
Input threshold	0.8 ~ 2.4 V for TTL	0.2 ~ 3 V Resolution 0.05 V
Input impedance	High impedance	High impedance, 50 Ω
Input timing adjustment		Data, Enable: -1 ~ +15 clock

Advanced BER Analyzer







PN Fixed Pattern

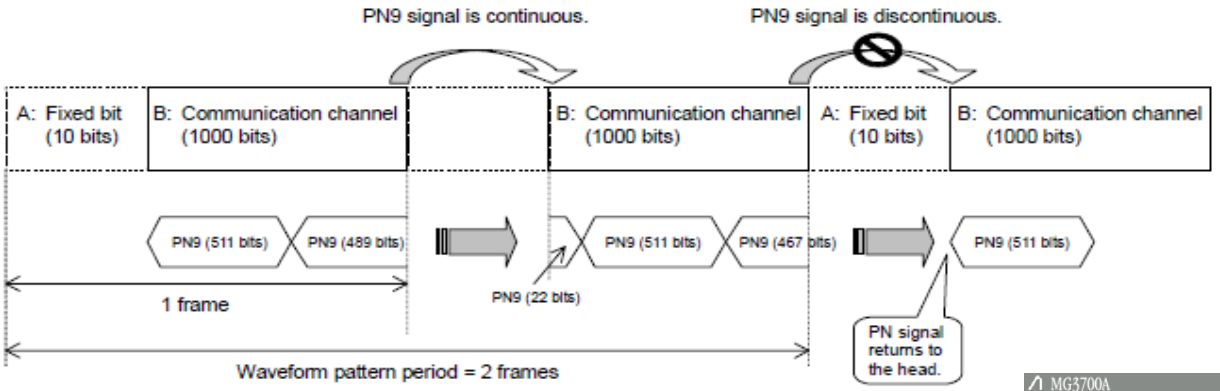
- The PN in PN sequence stands for pseudo noise, which is just another name for PRBS.
  - » PRBS: Pseudorandom binary (bit) sequence
- Pseudorandom sequences are generated using a binary shift register.
  - » PN(n) sequences are 2^n-1 bits period
    - PN9: 511 bits period
    - PN11: 2,047 bits period
    - PN15: 32,767 bits period
    - PN20: 1,048,575 bits period
    - PN23: 8,388,607 bits period

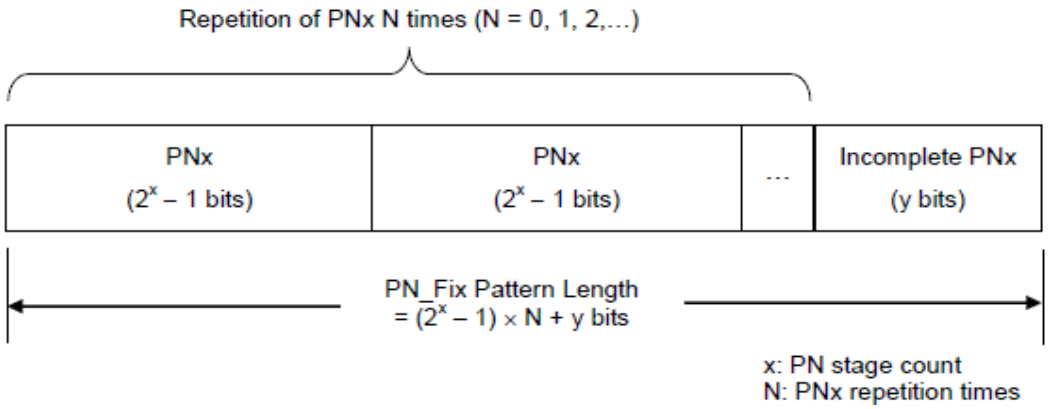
The signal pattern file created with these bits periods for BER test will be a large file.

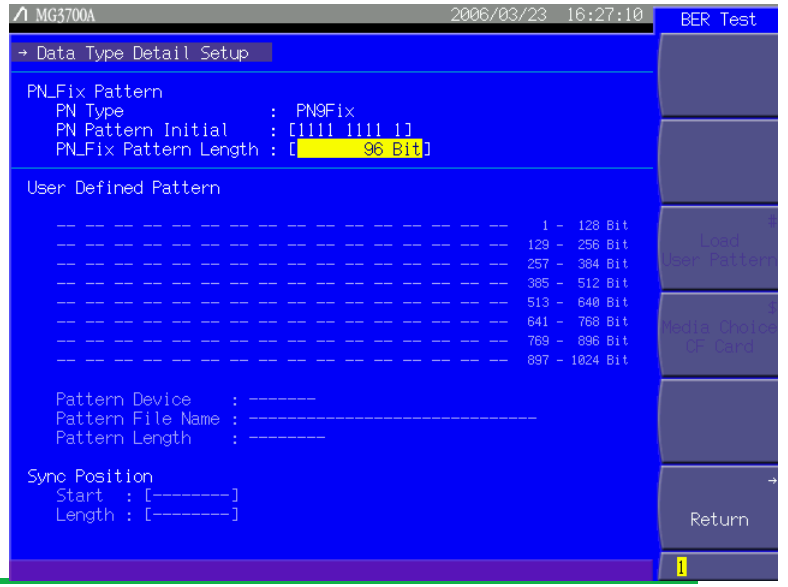
↓ In order to reduce the pattern file size

PN Fixed Pattern

- PN fixed pattern is a data pattern initialized at the start of the frame etc.

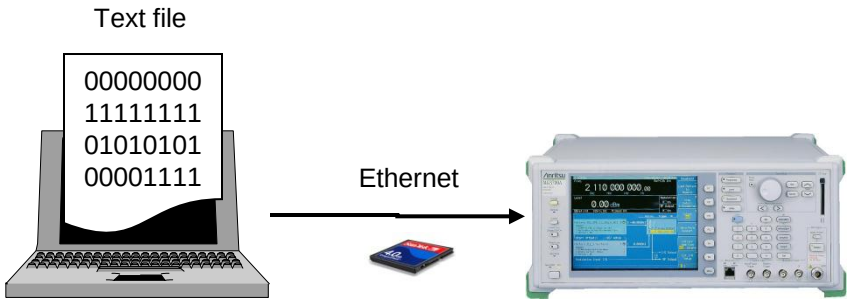


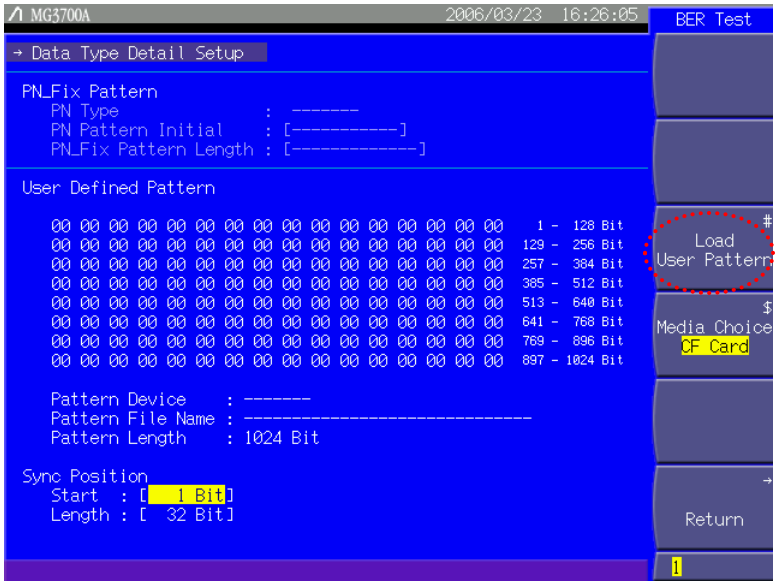




Custom Pattern

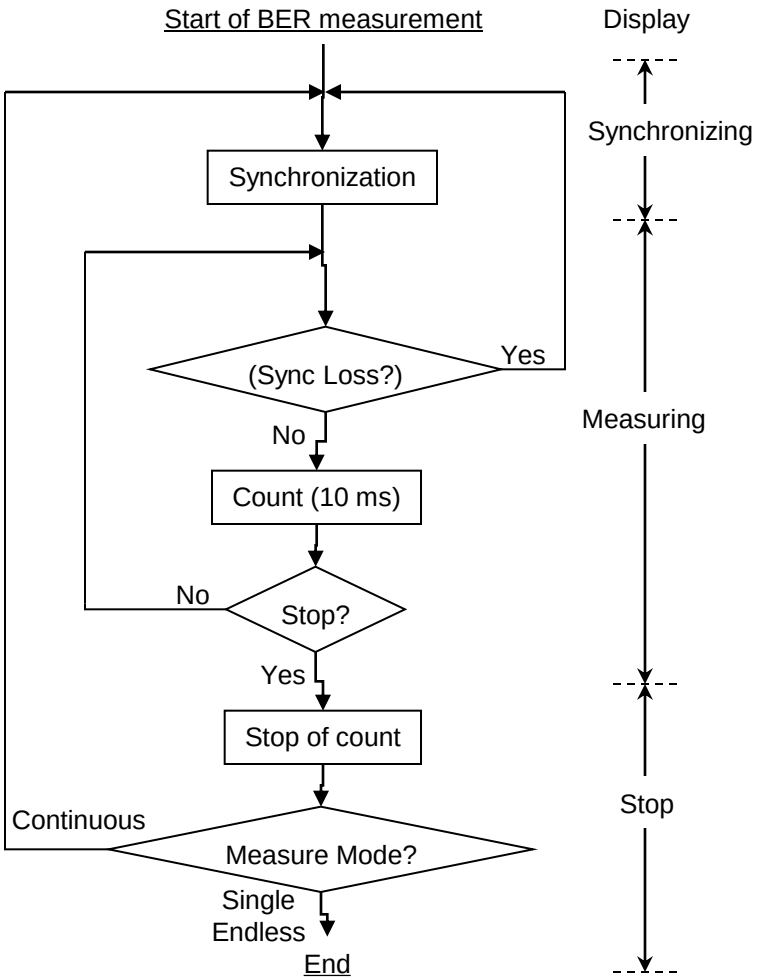
- Arbitrary data patterns can be defined on PC.
  - » 8 ~ 1,024 bits period





Automatic Re-synchronization (Auto Resync)

- On
  - » The error bits more than threshold occurred after synchronization is judged to Sync Loss, and then the data pattern is re-synchronized.
- Off
  - » Sync Loss is not detected.



Recommended setting

Error rate	Auto Resync On		Auto Resync Off
	Threshold 50/500	Threshold 200/500	
≥ 0.3 %	Not recommended	Optimum	Applicable
< 0.3 %	Optimum	Applicable	Applicable

Threshold of other models
- MP1201C
  200/512
- MD6420A default
  200/512
- MT8820A (W-CDMA)
  23/64

Synchronization

Standard

- Conditions
  - » Error-free bits detection

PN(n)	50 + n bits
ALL0, ALL1, Alternate 01	48 bits

Option

PN(n)	2 × n bits
ALL0, ALL1, Alternate 01	10 bits
PN fixed pattern	2 × n bits >> Last bit >> First n bits
Custom pattern	≥ 8 bits customer-defined

- Probability
  - » Probability that Error-free (50 + n) bits occur
  - » Probability that Error-free (2 × n) bits occur

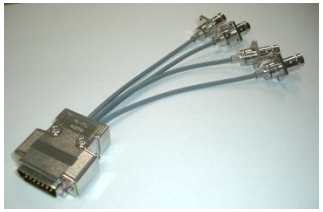
In PN(n) sequence with random error bits

Error rate	PN9	PN15	PN23
10 %	0.22 %	0.11 %	0.046 %
3 %	17.1 %	13.8 %	10.8 %
1 %	55.8 %	52 %	48 %
0.1 %	94.4 %	93.7 %	93 %

Error rate	PN9	PN15	PN23
10 %	15 %	4.2 %	0.79 %
3 %	57.8 %	40.1 %	24.6 %
1 %	83.5 %	74 %	63 %
0.1 %	98.2 %	97 %	95.5 %

Key Optional Accessories List

- Various operation manuals (booklet)
  - PDF files are stored in CDs for MG3700A standard accessories and option software.

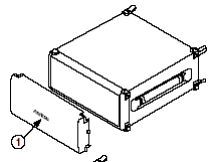


- J1277 IQ output adapter
  - D-Sub/BNC

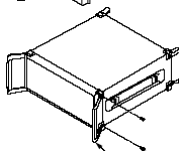
- G0141 HDD ASSY
  - for internal HDD exchange

- J1261B Ethernet cable (shield type)
  - Straight, 3 m

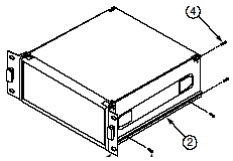
- J1261D Ethernet cable (shield type)
  - Cross, 3 m



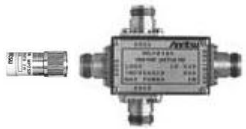
- B0329C Front cover



- B0331C Front panel handle kit



- B0333C Rack mount kit



- MA1612A Four-port junction pad
  - 5 M ~ 3 GHz
- MP752A Termination
  - DC ~ 12.4 GHz, 50 Ω

- MA2512A Band Pass Filter
  - 1.92 ~ 2.17 GHz

Anritsu

Specifications are subject to change without notice.

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