

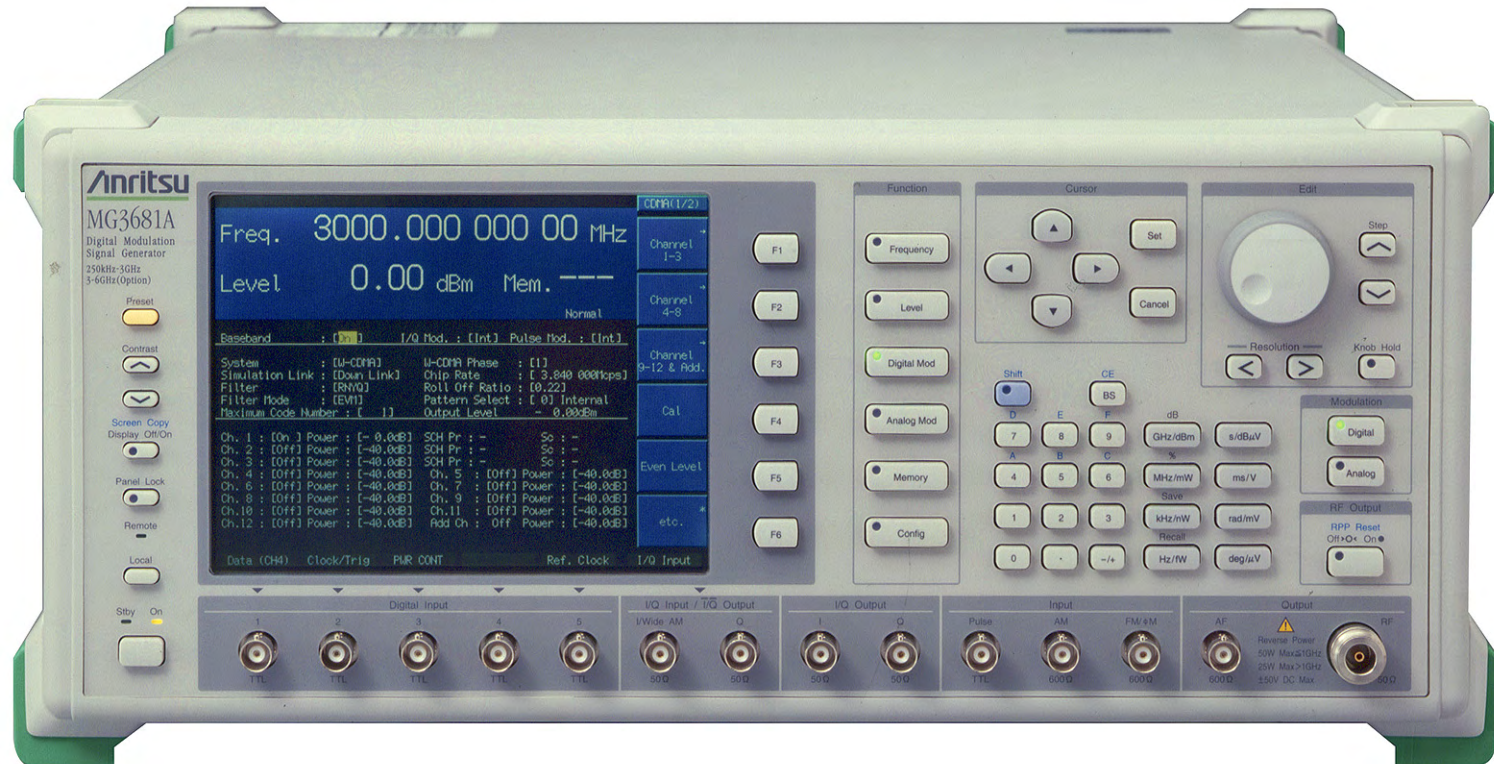
MG3681A

Digital Modulation Signal Generator

MG3681A






Digital Modulation Signal Generator

Product Introduction



Anritsu Corporation
December 2009 Ver 10.0




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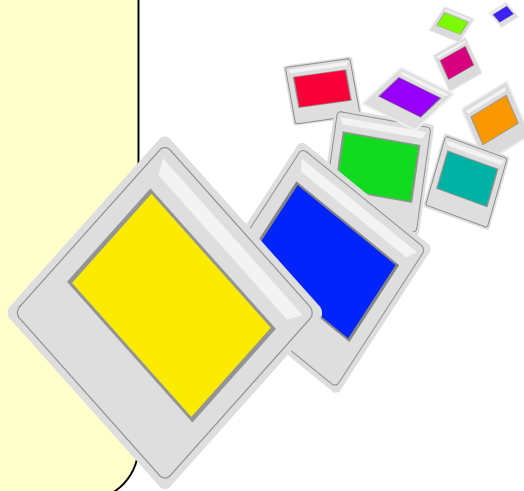
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Product outline

- **Product outline**
- Feature
- Application
- Option

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For evaluating Base station, Mobile phone and Components for high-speed and wideband digital mobile communications systems

The digital mobile communications systems are evolved to higher speed and wider band.

- » The interference to other systems of adjacent frequency band and the adjacent channel of the same system is minimized, and the modulation type with efficient transmission is adopted, in order to communicate at higher speed in the limited frequency resources.



- **This signal generator that performed excellent adjacent channel leakage power ratio, wideband/high-accuracy vector modulation and various basebands is utilizable for the evaluation of high-speed digital mobile communications equipment and components in future.**

For evaluating Base station, Mobile phone and Components for high-speed and wideband digital mobile communications systems

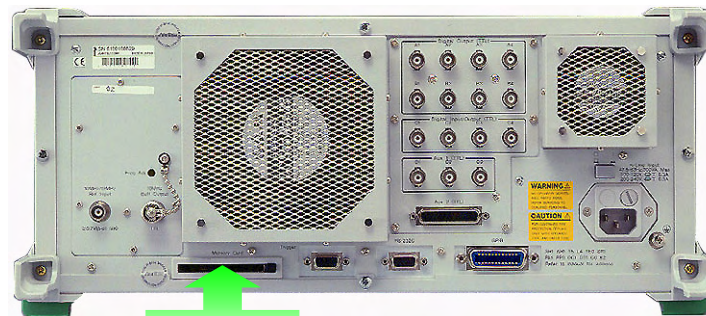
- **The sensitivity(demodulation) test of base station and mobile phone receivers needs to be evaluated by wanted signal generator. Also, the receiver interference test needs to be evaluated by interference signal generator and wanted signal generator.**
- **Path characteristics and distortion of the components such as power amplifier, RF module and baseband need to be evaluated by signal generator and signal analyzer.**



Almighty support to 3G mobile communications systems (Product concept)

- **Excellent expandible platform**

- » Various modulation signals and AWGN are outputted by installing required expansion unit for baseband.
- » Due to the main logic circuit of expansion unit which consists of reconfigurable FPGA (Field Programmable Gate Array), users can upgrade easily by downloading the firmware including FPGA circuit data and DSP (Digital Signal Processor) program in the expansion unit.



PC Card



CompactFlash™

Almighty support to 3G mobile communications systems (Product concept)

- **Successor of MG3670 series Signal Generator for second generation mobile communications systems**

- » 4/5 downsizing
- » 20% cost down

MG3681A (250k~3GHz)

Digital and Analog modulation
30MHz wideband vector modulation

MG3670 series (300k~2.75GHz)

Released in 1993, greatly contributed to the digitizing of mobile communication systems

MG3641/42A (125k~2.08GHz)

Analog systems

1G

Digital systems

2G

High-speed data communication systems

3G

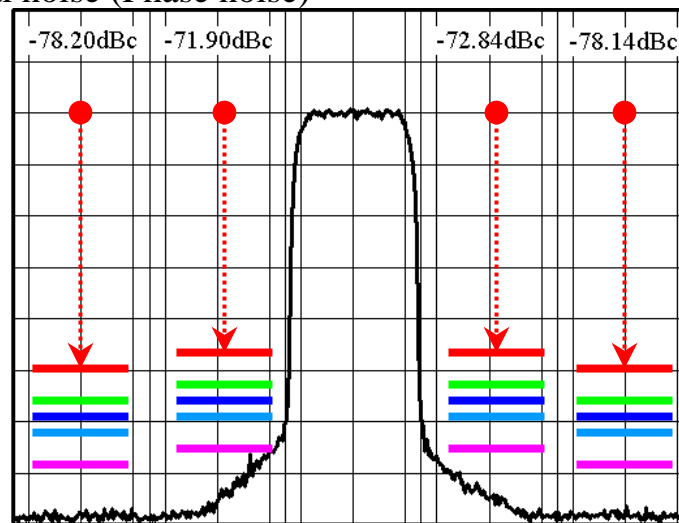


Excellent analog basic performance (Product concept)

Adjacent Channel Leakage Power Ratio

In W-CDMA system, the adjacent channel leakage power ratio must be minimized in order to reduce the interference to adjacent PHS system. Extremely low adjacent channel leakage power ratio is required especially for TX power amplifier of BTS. The measurement of adjacent channel leakage power ratio of TX power amplifier requires excellent adjacent channel leakage power ratio of signal source.

- -68 dBc/3.84MHz typ. : 5MHz offset
 - Due to Intermodulation distortion
- -75 dBc/3.84MHz typ. : 10MHz offset
 - Due to Residual noise (Phase noise)



BS ACLR minimum requirement
BS ACLR manufacture target (e.g. -6 dB)
TX amplifier minimum requirement (e.g. -9 dB)
TX amplifier manufacture target (e.g. -12 dB)
Signal source minimum requirement (e.g. -16 dB)

Excellent analog basic performance (Product concept)

- **Output level resolution**

- 0.01 dB : at all level range

Useful for fine level adjustment in components test and level calibration by power meter.



Level -143.00 dBm

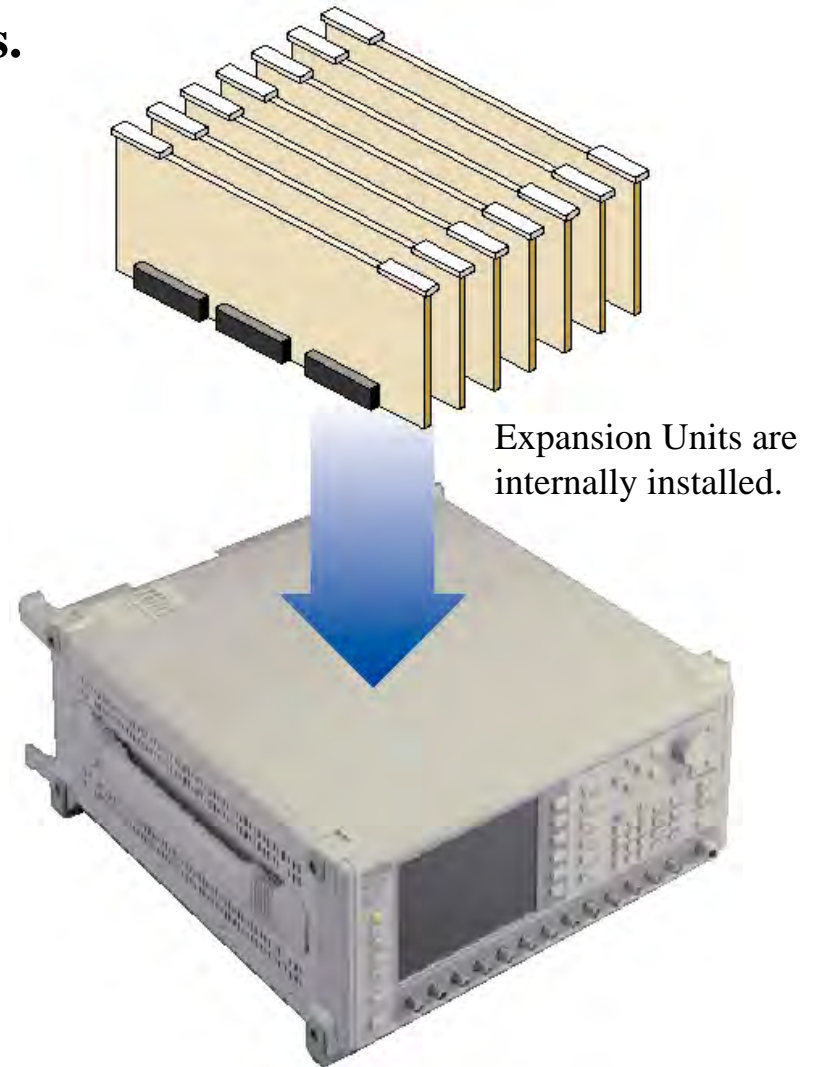


Various expansion unit



















The Platform with Excellent Expandability

Expansion Units is installable up to seven slots.

Expansion unit	Software
MU368010A TDMA Modulation Unit	MX368011A PDC Software
	MX368012A GSM Device Test Software
MU368040A CDMA Modulation Unit	MX368041B W-CDMA Software
	MX368042A IS-95 Device Test Software
MU368030A Universal Modulation Unit	MX368031A Device Test Signal Generation Software
	MX368033A CDMA2000 1xEV-DO Signal Generation Software
	MX368034A PDC Packet Software
	MX368035A PHS Generation Software
MU368060A AWGN Unit	



Expansion Unit and Software

Communication system	Software  CompactFlash™	Expansion unit
W-CDMA / 3GPP(FDD)	MX368041B W-CDMA Software 	   MU368040A CDMA Modulation Unit
cdmaOne	MX368042A IS-95 Device Test Software 	
PDC	MX368011A PDC Software 	   MU368010A TDMA Modulation Unit
GSM	MX368012A GSM Device Test Software 	
CDMA2000 1xEV-DO ^{*1} , CDMA2000 1X ^{*2} GSM/EDGE ^{*3} , PDC ^{*3} , PHS ^{*3} , NADC ^{*3}	MX368031A Device Test Signal Generation Software 	   MU368030A Universal Modulation Unit
CDMA2000 1xEV-DO	MX368033A CDMA2000 1xEV-DO Signal Generation Software 	
PDC Packet	MX368034A PDC Packet Software 	
PHS	MX368035A PHS Signal Generation Software 	

*1: Only 16QAM modulation is available in Forward, 8PSK and QPSK modulations are not available.

Neither Forward or Reverse is utilizable for receiver sensitivity test as coding format is not performed.

*2: Reverse is utilizable for receiver sensitivity test (RC1 & 3) in BS manufacturing as coding format is performed.

Forward is not utilizable for receiver sensitivity test as coding format is not performed.

*3: Continuous modulation signal based on the communication system.

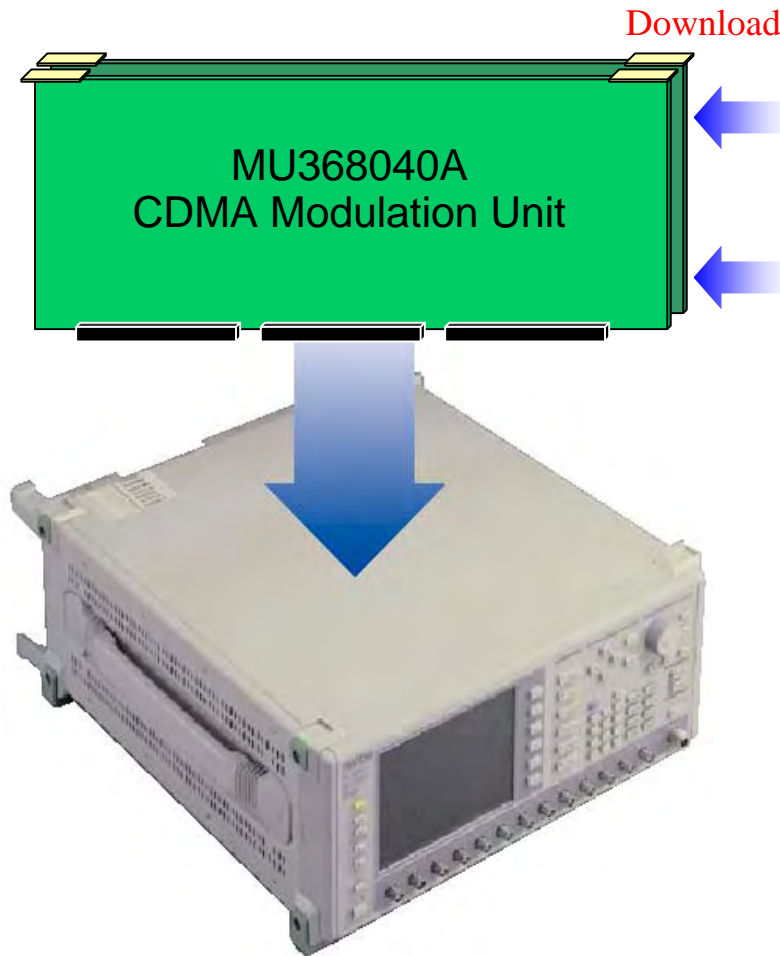
The software is provided pre-installed in the expansion unit. Also, a PC memory card is provided for backup.

The software changes instantly by selecting the installed software.

At the software for the MU368030A, the signal format to output is selectable by downloading signal pattern files included in the software from a PC memory card to the waveform memory of the MU368030A Universal Modulation Unit.

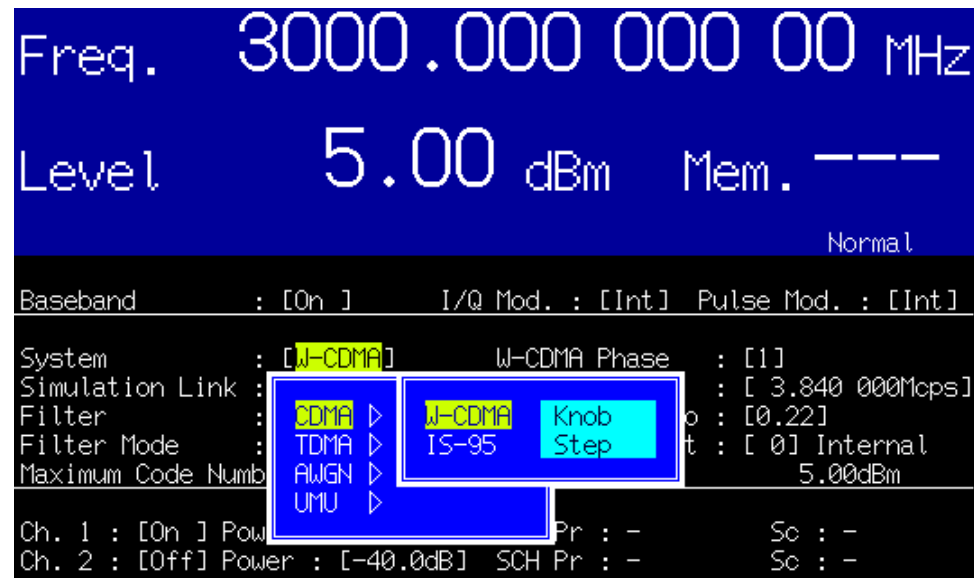
MU368040A CDMA Modulation Unit

Dual output Baseband generator for Real time output and Waveform memory output



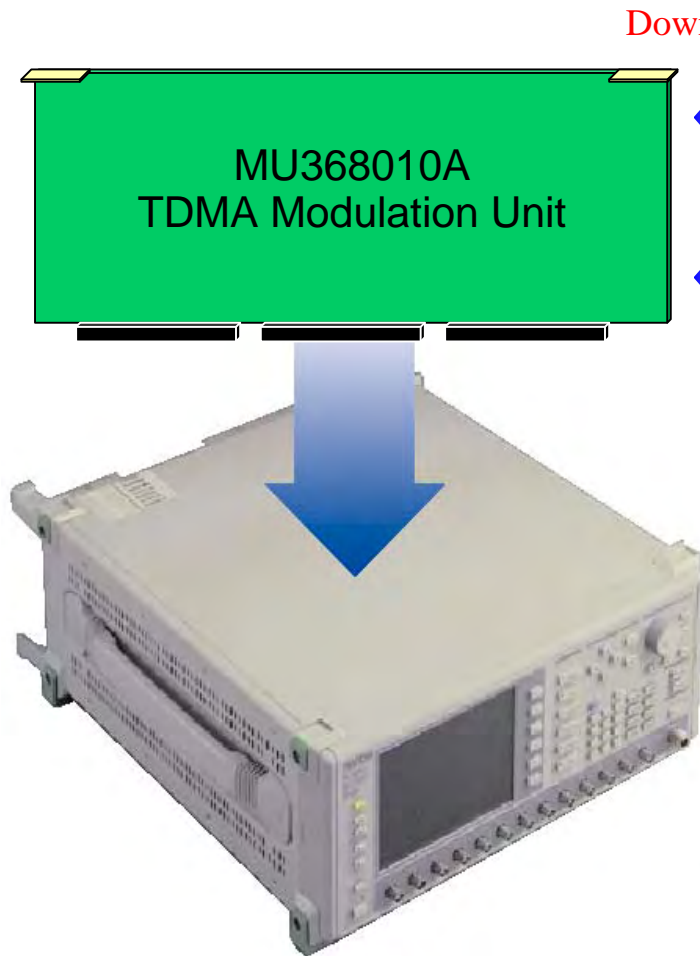
MX368041B
W-CDMA Software

MX368042A
IS-95 Device Test Software



MU368010A TDMA Modulation Unit

Baseband generator for Real time output

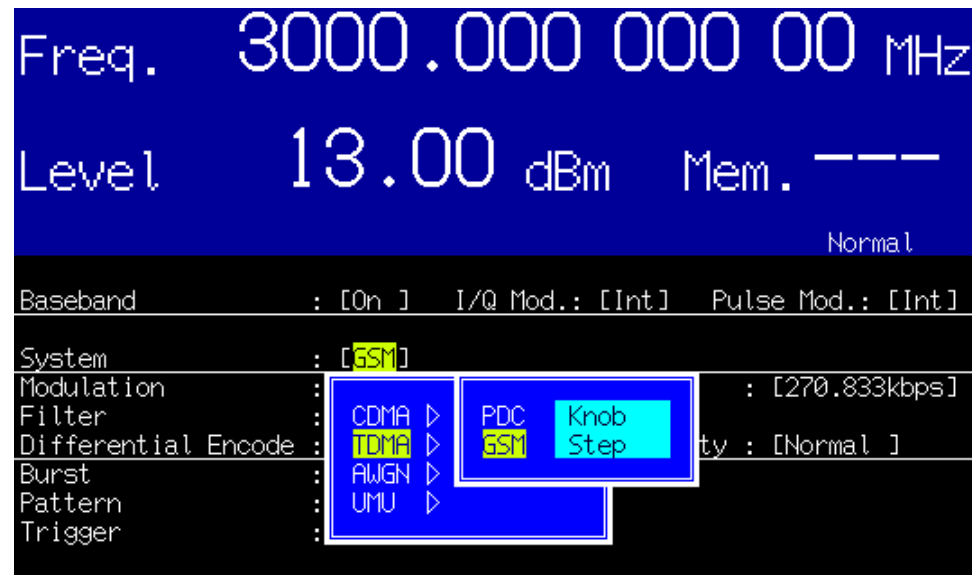


Download



MX368011A
PDC Software

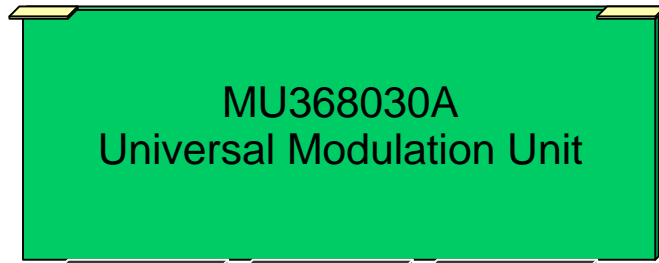
MX368012A
GSM Device Test Software



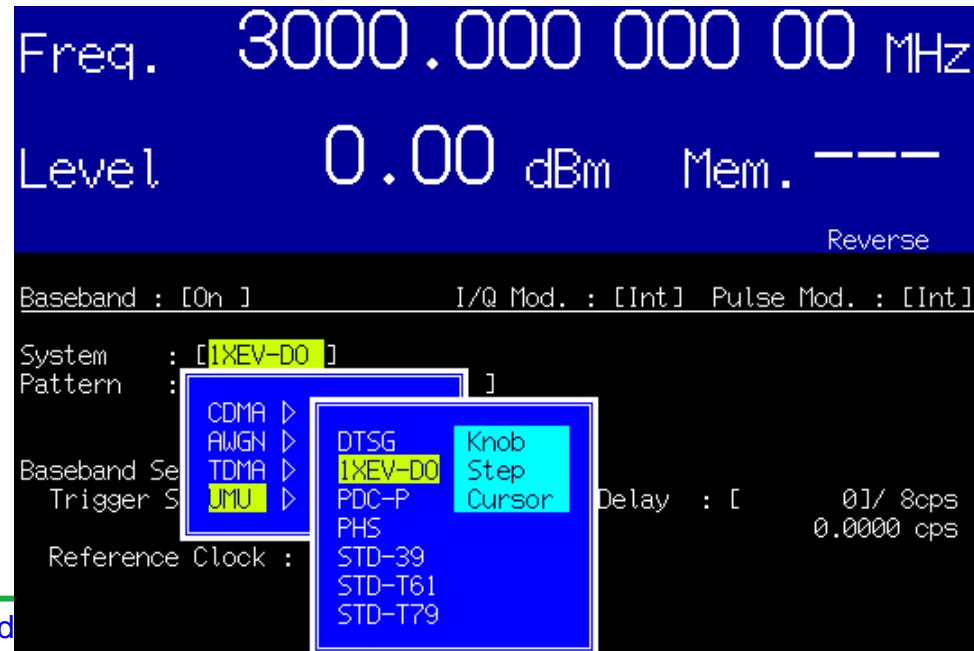
MU368030A Universal Modulation Unit

Baseband generator for Waveform memory output

Download

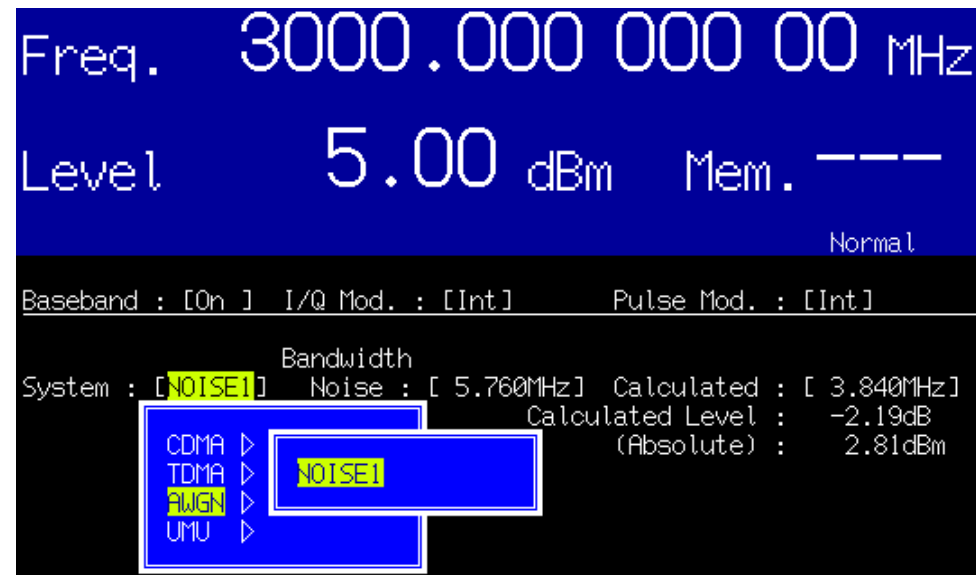
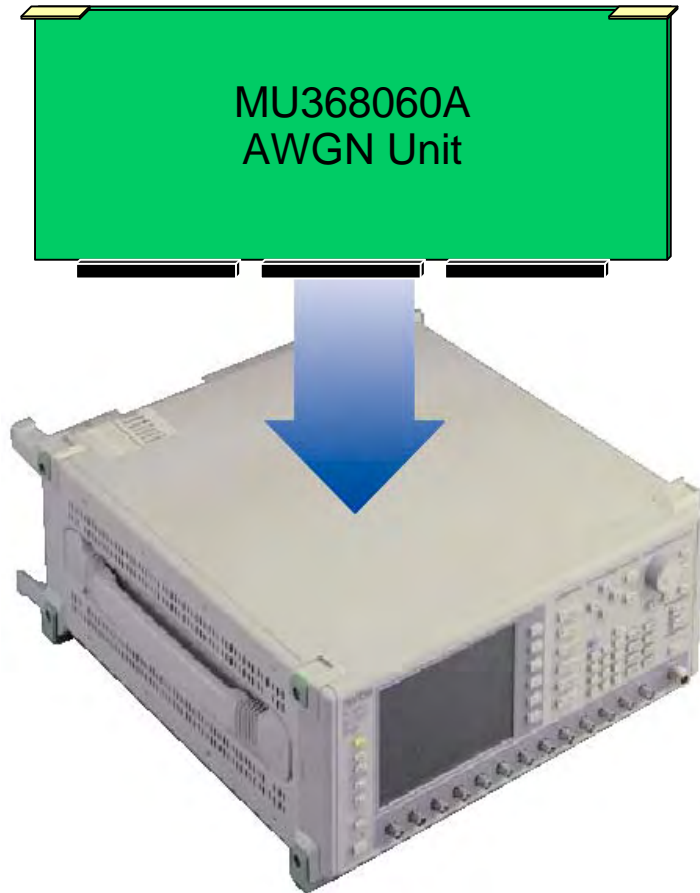


- MX368031A Device Test Signal Generation Software
- MX368033A CDMA2000 1xEV-DO Signal Generation Software
- MX368034A PDC Packet Software
- MX368035A PHS Signal Generation Software



MU368060A AWGN Unit

AWGN source for Real time output



MU368040A + MX368041A + MU368060A

W-CDMA and AWGN mixing output

MU368060A
AWGN Unit

Download

MU368040A
CDMA Modulation Unit

MX368041B
W-CDMA Software



Freq. 3000.000 000 00 MHz
Level 5.00 dBm Mem. ---
Normal

Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]

System : [W-CDMA] W-CDMA Phase : [1]
Simulation Link : [] Power : [3.840 000Mops]
Filter : [] Power : [0.22]
Filter Mode : [] Power : [18] ULRMC12k
Maximum Code Num : [] Power : 5.00dBm

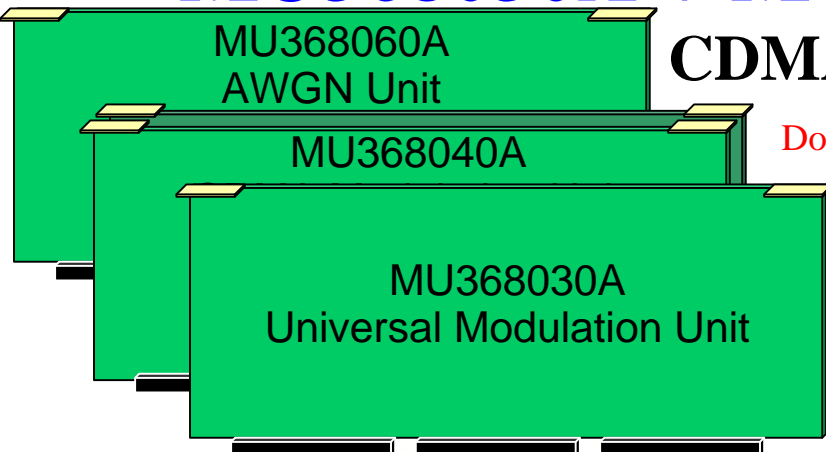
Ch. 1 : [On] Power : [-40.0dB]
Ch. 2 : [Off] Power : [-40.0dB]
Ch. 3 : [Off] Power : [-40.0dB]
Ch. 4 : [On] Power : [-1.9dB] Ch. 5 : [Off] Power : [-40.0dB]
Ch. 6 : [Off] Power : [-40.0dB] Ch. 7 : [Off] Power : [-40.0dB]
Ch. 8 : [Off] Power : [-40.0dB] Ch. 9 : [Off] Power : [-40.0dB]
Ch.10 : [Off] Power : [-40.0dB] Ch.11 : [Off] Power : [-40.0dB]
Ch.12 : [Off] Power : [-40.0dB] Add.Ch. : [Off] Power : [-40.0dB]

AWGN : [On] C/N : [-20.0dB] Wanted -18.5dBm Noise 1.5dBm

CDMA > W-CDMA Knob
TDMA > IS-95 Step
AWGN >
UMU >

MU368030A + MU368040A + MU368060A

CDMA2000 and AWGN mixing output



Download



- MX368031A
Device Test Signal Generation Software
- MX368033A
CDMA2000 1xEV-DO Signal Generation Software



Freq. 3000.000 000 00 MHz

Level 0.00 dBm Mem. ---

Reverse

Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]

System : [1xEV-DO]

Pattern : []

Baseband Se []

Trigger S []

Reference Clock : []

Noise Setup

AWGN : [On] C/N : [-30.0dB] Wanted: -33.44dBm Noise: -3.44dBm

Noise Bandwidth : [CalcBW x2] Calculated Bandwidth : 1.230MHz

CDMA > DTSG Knob

AWGN > 1xEV-DO Step

TDMA > PDC-P Cursor

JMU > PHS

STD-39

STD-T61

STD-T79

Delay : [] 0]/ 8cps

0.0000 cps

Slide

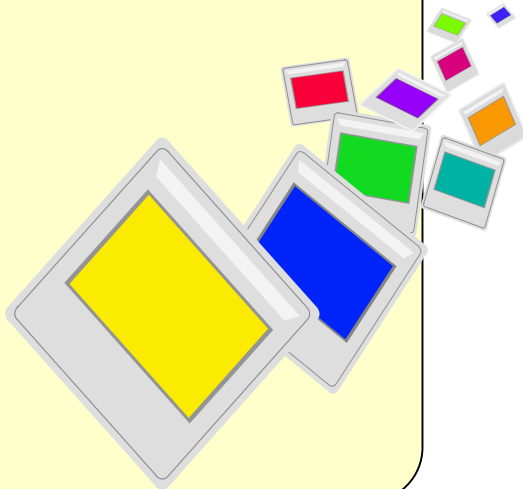
MG3681A-E-I-1












Discover What's Possible™



Feature

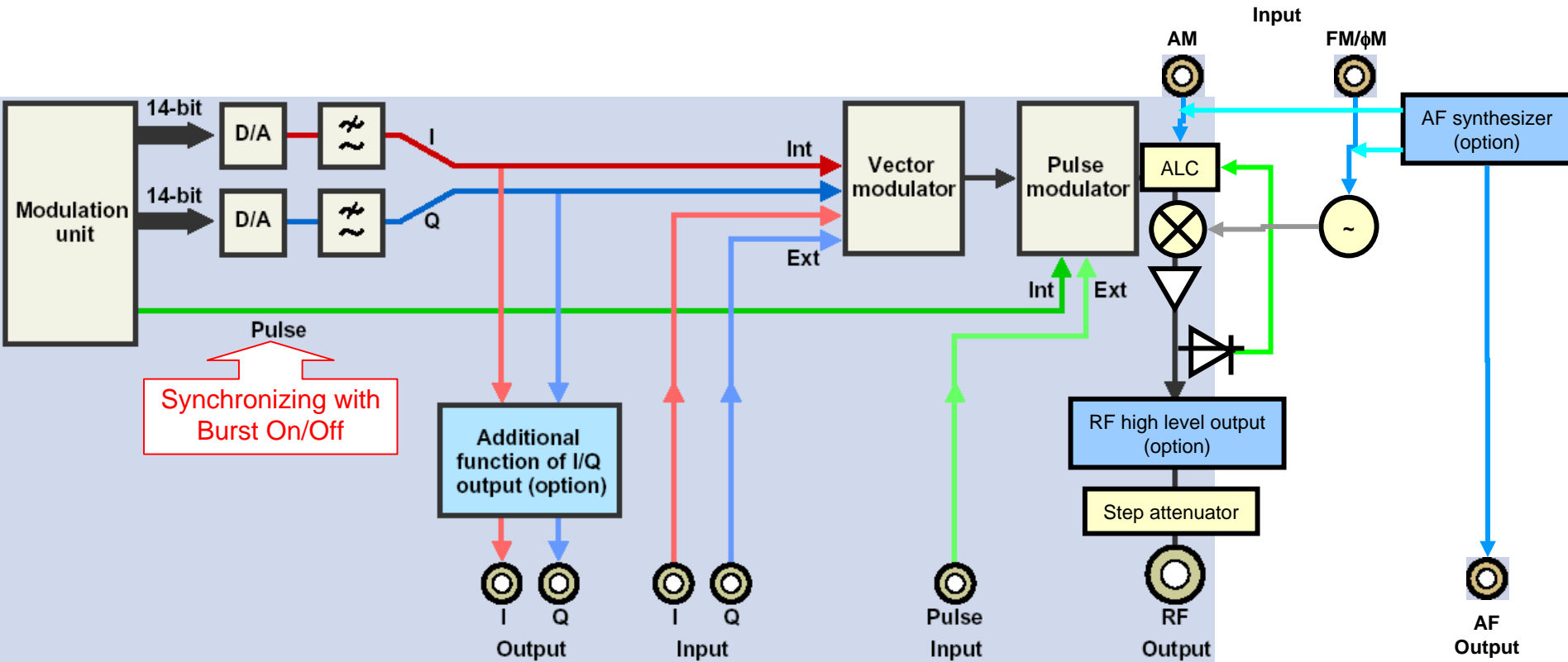
- Product outline
- **Feature**
- Application
- Option



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MG3681A Block diagram



Connectivity

Front panel

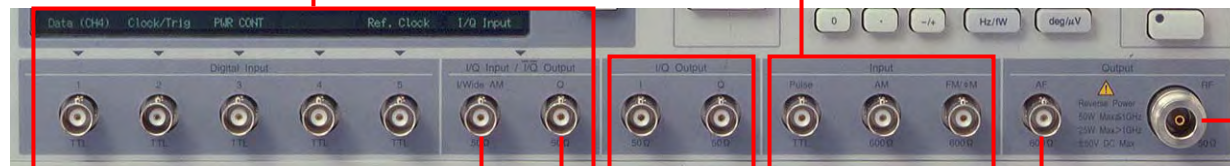
- Display functions according to the used software and settings

```
System      : [W-CDMA]      W-CDMA Phase : [1]      Channel 9-12 & Add.
Simulation Link : [Down Link]  Chip Rate   : [ 3.840 000]Mpsps
Filter       : [RNYQ]         Roll Off Ratio : [0.22]
Filter Mode  : [EVM]         Pattern Select : [ 3] BS164_8
Maximum Code Number : [ 68]    Output Level  : 5.03dBm

Ch. 1 : [0n ] Power : [-10.0dB] SCH Pr : [-13.0dB] Sc : [-13.0dB]
Ch. 2 : [0ff] Power : [- 9.5dB] SCH Pr : [-12.5dB] Sc : [-12.5dB]
Ch. 3 : [0ff] Power : [- 9.5dB] SCH Pr : [-12.5dB] Sc : [-12.5dB]
Ch. 4 : [0n ] Power : [-18.0dB] Ch. 5 : [0n ] Power : [-18.0dB]
Ch. 6 : [0ff] Power : [- 9.5dB] Ch. 7 : [0ff] Power : [- 9.5dB]
Ch. 8 : [0ff] Power : [- 9.5dB] Ch. 9 : [0ff] Power : [- 9.5dB]
Ch.10 : [0ff] Power : [-40.0dB] Ch.11 : [0ff] Power : [-40.0dB]
Ch.12 : [0n ] Power : [-10.0dB] Add Ch : 0n Power : [- 1.1dB]

[Data (CH4)] [Clock/Trig] [PWR CONT] [Ref. Clock] [I/Q Input]
```

- External modulation Input
 - » Pulse, AM, FM, ϕ M



- External I/Q Input
- Differential I/Q Output (Option)

- I/Q Output

- AF Output

- RF Output

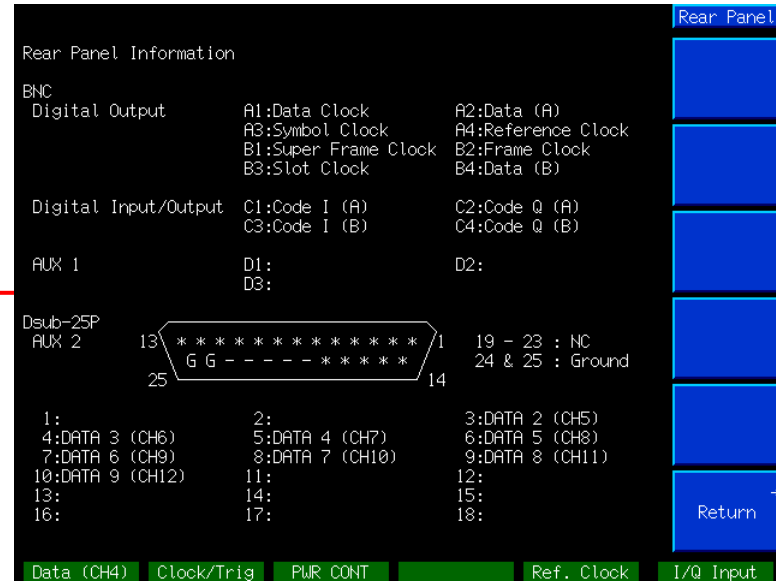
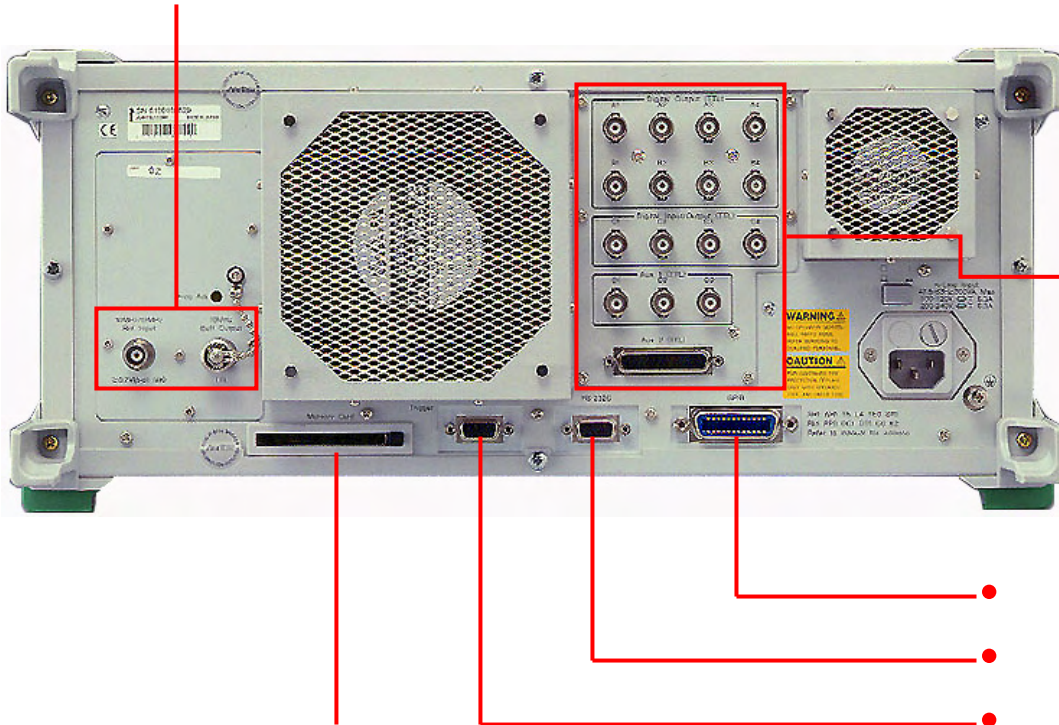
Connectivity

Rear panel

- **External timebase reference clock**

 - » 10MHz/13MHz

- **Display functions according to the used software and settings**



 - **GPIB remote control**

 - **RS-232C remote control**

 - **Trigger remote control**

 - » Frequency, Output level, Parameter memory (BPM number) Up/Down, RF output On/Off

Excellent level accuracy signal

For outputting with precise level

- **High-stability ALC**(Automatic Level Control) **circuit**

Detectable at vector modulation (internal/external modulation) also

- » The temperature stability of ALC circuit is almost decided by temperature response of detector. The temperature response of detector has been improved by heating the detection diode with heater circuit in low temperature, which is due to the big influence of detection voltage drift especially in low temperature.

- **High-accuracy and high-reliability step attenuator**

- » Mechanical attenuator with excellent attenuation accuracy, small path loss and no signal distortion.

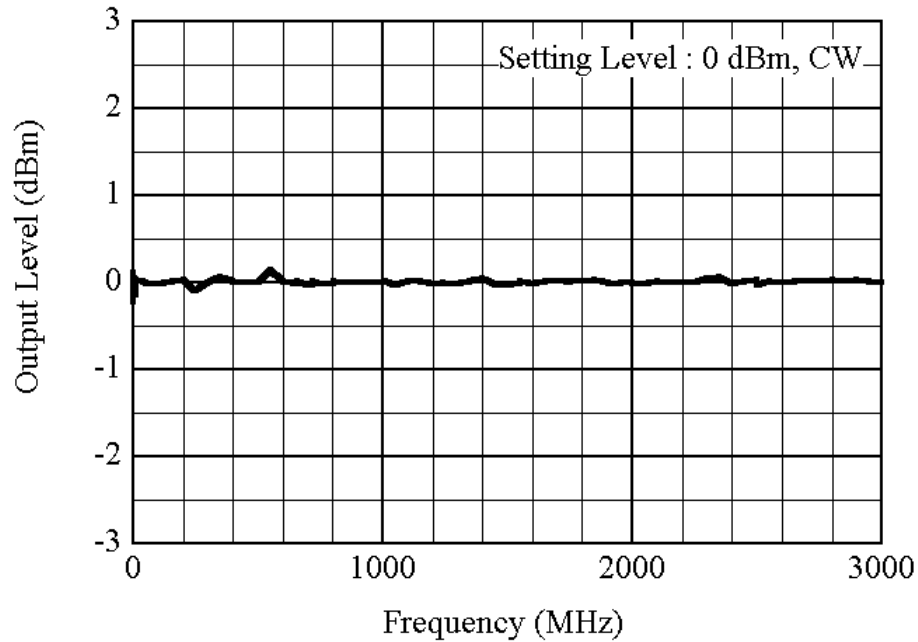
- 1dB step, up to 140dB attenuation

- **Per-unit correction**

- » Frequency response, linearity error of ALC circuit and attenuation error of step attenuator are measured by the power meter and calibration receiver, then the data is inputted to correction table.

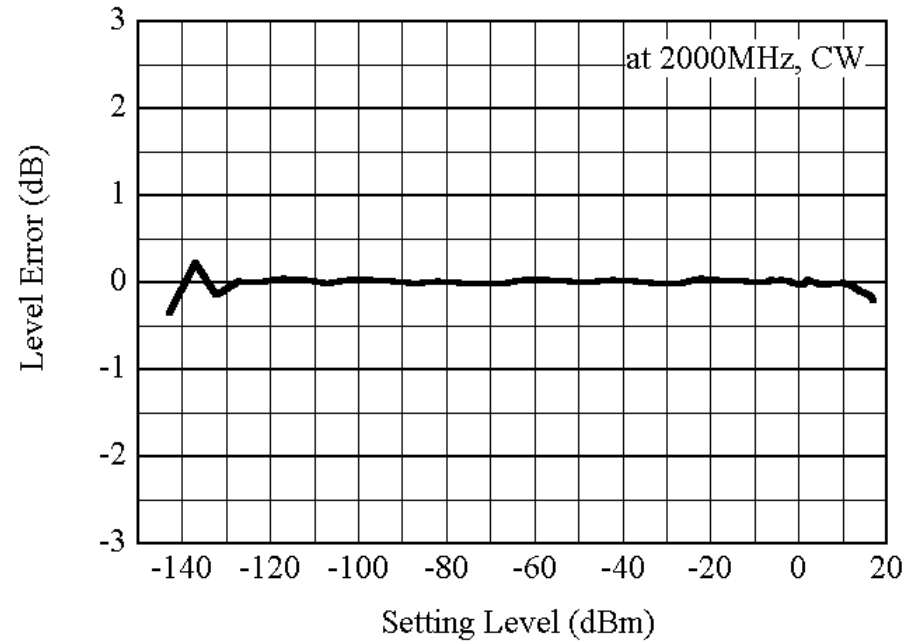
Typical level accuracy

- **Frequency response**



» $\leq \pm 0.2$ dB

- **Linearity**

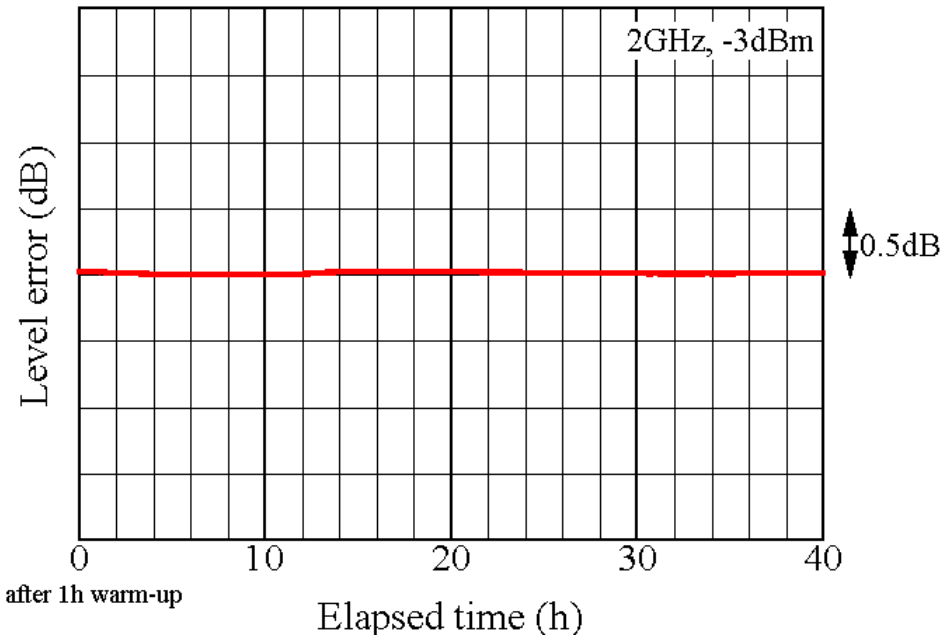


» $\leq \pm 0.1$ dB (-127 ~ +13 dBm)

Typical level stability

- **Aging**

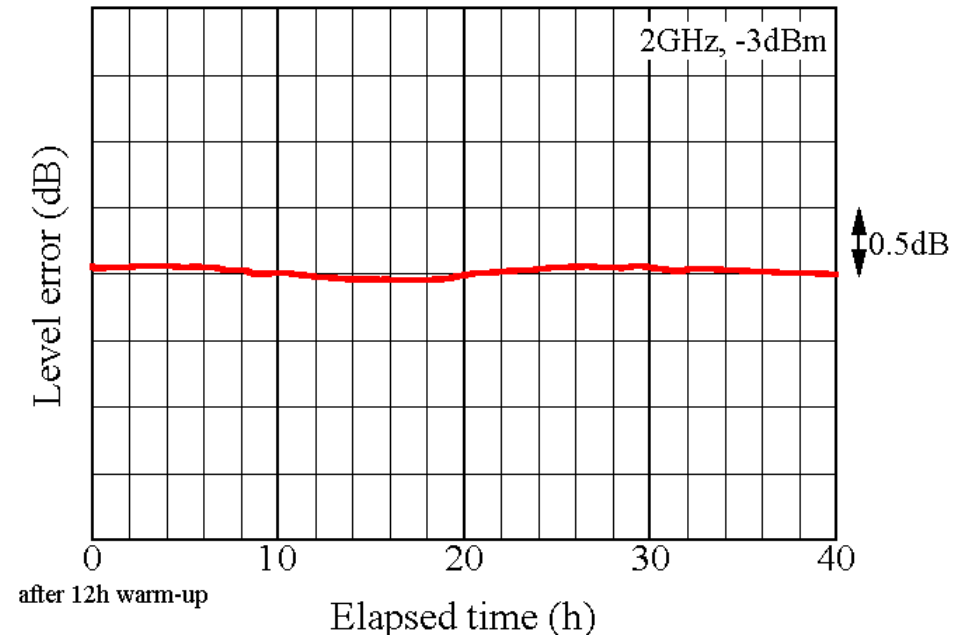
- » CW, ALC on (default setting)



- » Almost no variation

- **Aging**

- » CW, ALC off



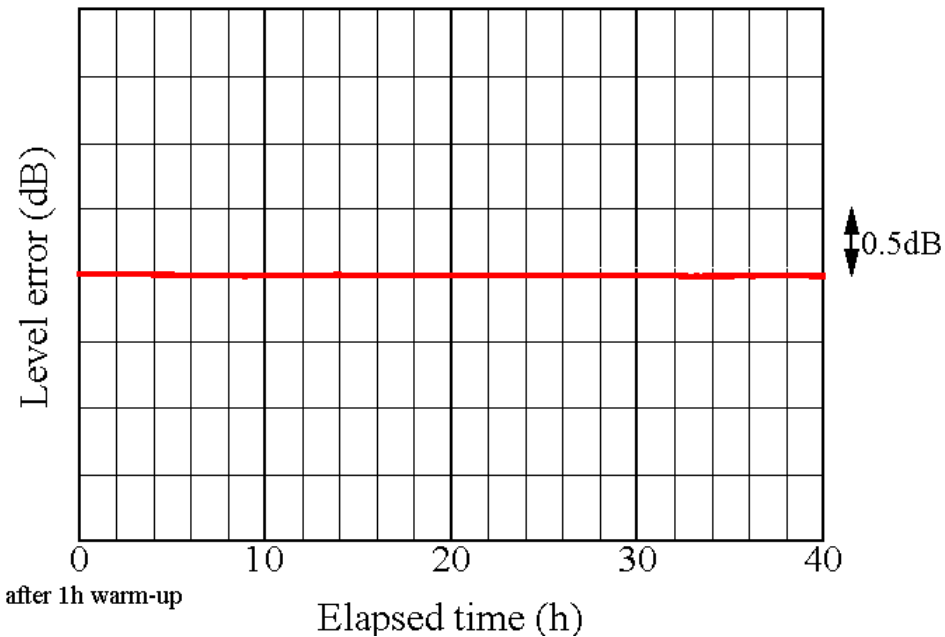
- » $\leq \pm 0.1$ dB

- at ALC off

- High-speed level switching

Typical level stability

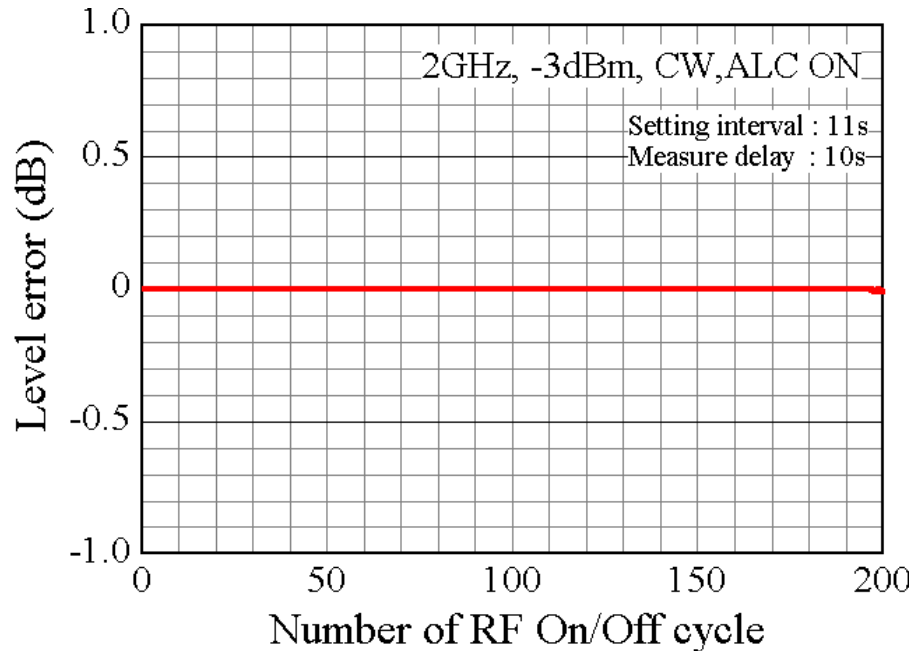
- **Aging**
 - » W-CDMA modulation, ALC on



- » Almost no variation (same as CW)

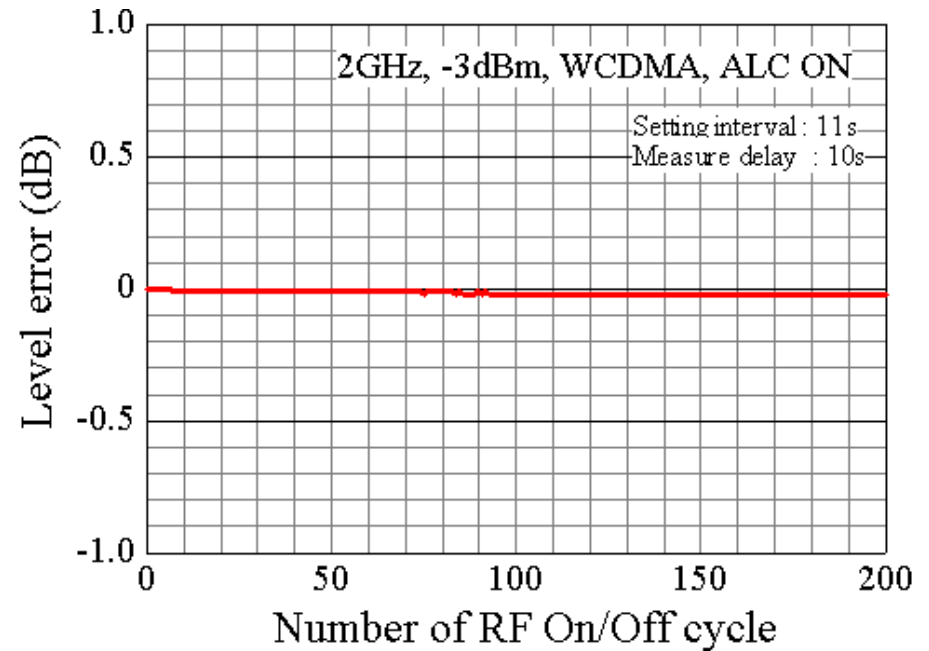
Typical level repeatability

- **RF off → on ([on] off [on] off ...)**
 - » CW



- » Almost no variation

- **RF off → on ([on] off [on] off ...)**
 - » W-CDMA modulation

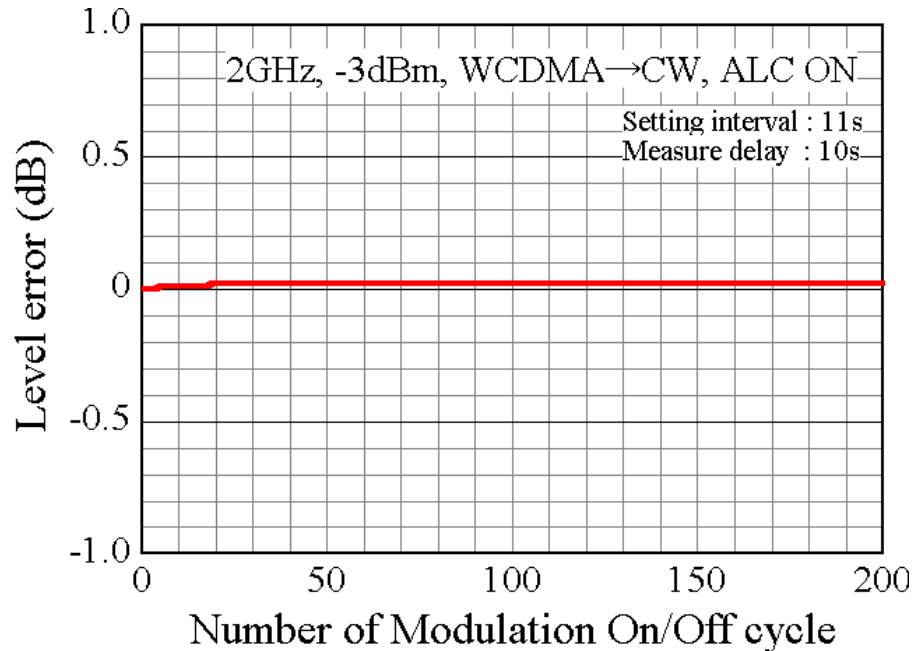


- » ≤ 0.02 dB

1st measurement level = reference(0 dB)

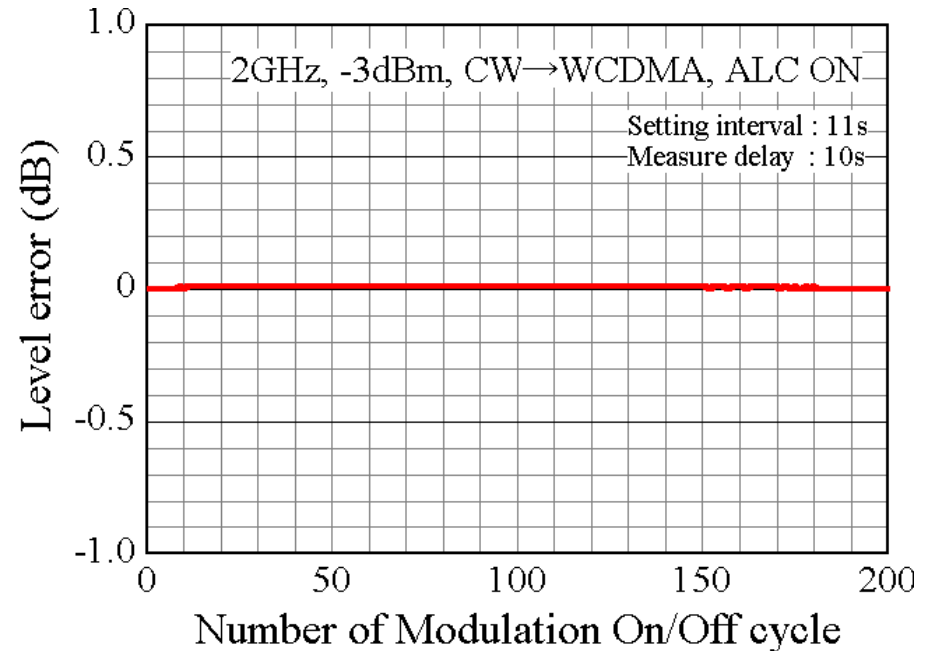
Typical level repeatability

- **Modulation on → off**
([off^(CW)] on^(W-CDMA) [off] on ...)



» ≤ 0.02 dB

- **Modulation off → on**
([on^(W-CDMA)] off^(CW) [on] off ...)



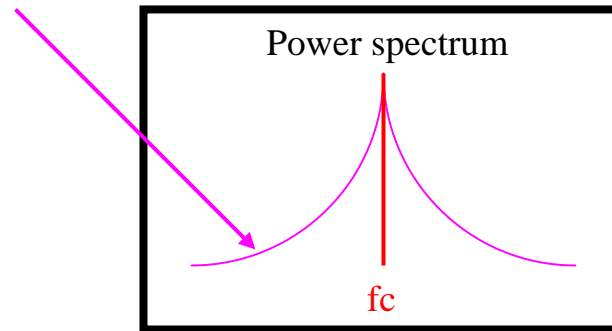
» ≤ 0.02 dB

1st measurement level = reference(0 dB)

Excellent signal Purity

Alternate adjacent channel leakage power ratio is mainly due to phase noise.

- » Phase noise [dBc/Hz]



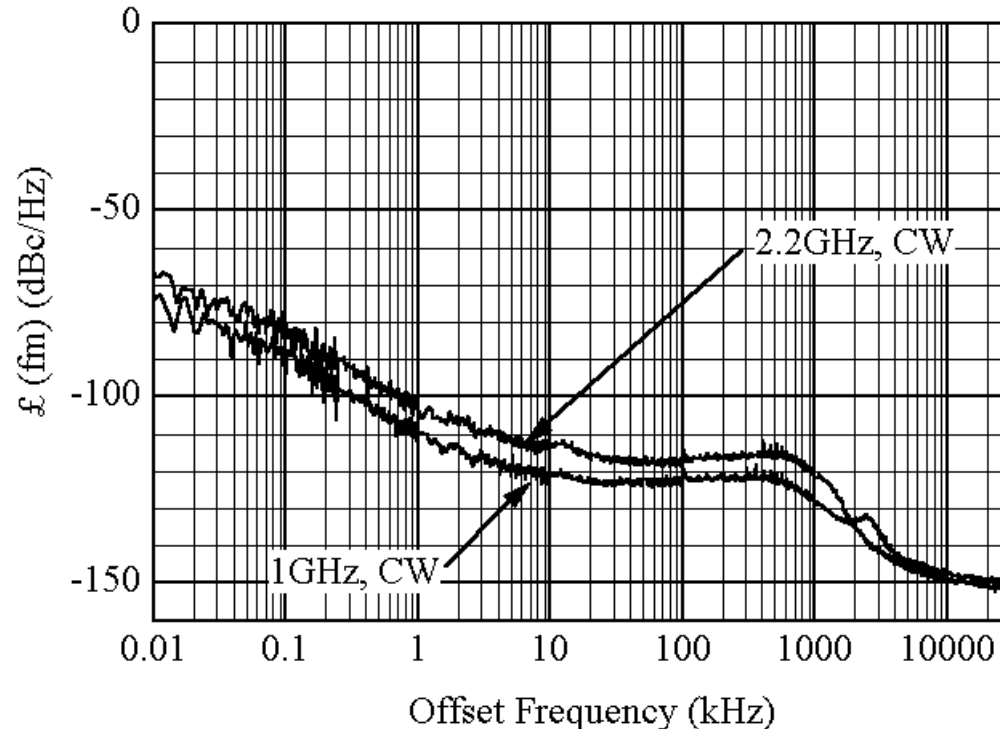
For attenuating the residual noise

- **Optimization of level diagram and components**
 - » Circuit has been simplified to minimize the influence of non-linear components.
 - » High-speed 14 bit D/A converter has been adopted, and the quantization noise leading to the residual noise has been reduced.
 - » The smoothing filter which set the cutoff frequency according to the modulation band has been passed, and out-band spurious and noise have been eliminated.

SSB (Single Side Band) phase noise

Noise of wide-band modulation signal for 3G has been lowered.

- C/N characteristic of excellent purity VCO has been applied.
 - » Alternate adjacent channel leakage power ratio is excellent.
 - -145 dBc/Hz typ. : 5MHz offset
 - -150 dBc/Hz typ. : 20MHz offset



Changing Phase noise

The compression of phase noise is changed by switching the loop characteristic of PLL synthesizer circuit. Thus noise of narrow band modulation signal for 2G can be lowered also.

» PLL Mode: Normal

The phase noise up to 100 kHz offset is improved.

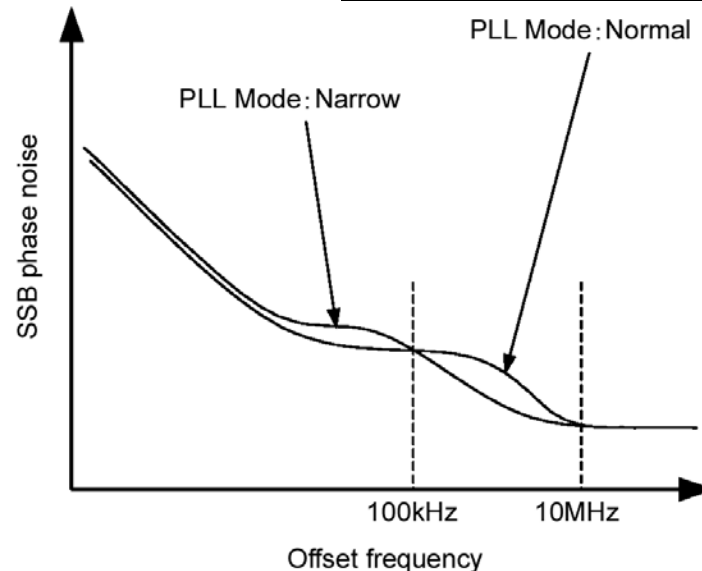
» PLL Mode: Narrow

The phase noise of 100 k to 10 MHz offset is improved.

Changing by the communication system is useful.

e.g.

- W-CDMA: Normal
- CDMA2000: Narrow
- GSM/EDGE: Narrow
- PHS : Narrow
- PDC : Normal
- NADC(IS-136): Normal

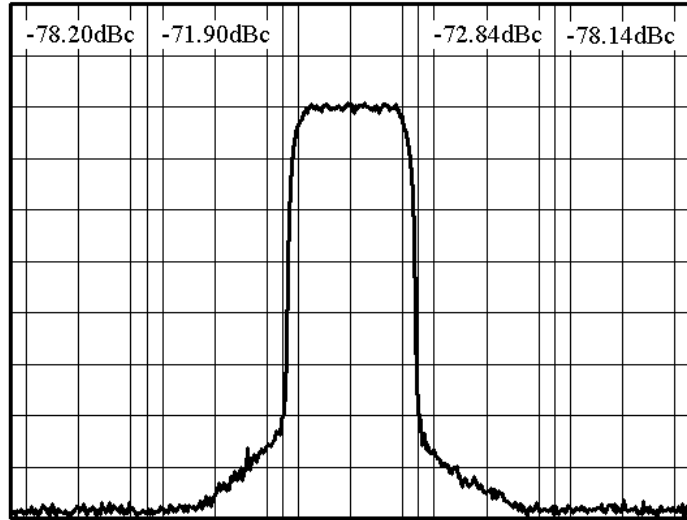


Adjacent channel leakage power ratio

W-CDMA, ≤ -3 dBm ($\leq +5$ dBm at installing Option42)

Adjacent channel leakage power ratio was achieved at top level.

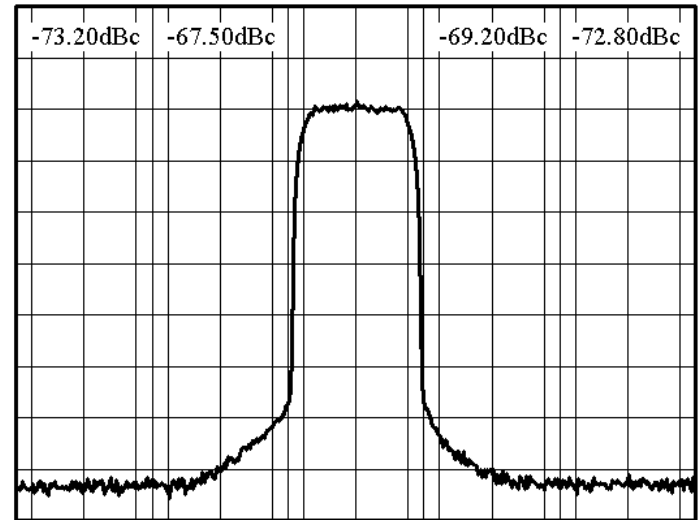
10dB/ RBW 30kHz VBW 30kHz SWT 70ms DET RMS



CENTER 2.14GHz SPAN 25MHz

Frequency 2.140GHz
Output Level -3dBm
Pattern 1 code PN9

10dB/ RBW 30kHz VBW 30kHz SWT 70ms DET RMS



CENTER 2.14GHz SPAN 25MHz

Frequency 2.14GHz
Output Level -3dBm
Pattern 3G TS25.141 V3.5.0 (2001-03) 6.2.1.1.1

Test Model 1 = P-CCPCH+SCH+P-CPICH+PICH+S-CCPCH+DPCH x 16codes

CDMA(1/2)			
Freq. 2140.000 000 00 MHz			
Level - 3.00 dBm Mem. ---			
Normal			
Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]			
System : [W-CDMA]		W-CDMA Phase : [1]	
Simulation Link : [Down Link]		Chip Rate : [3.840 000] Mcps	
Filter : [RNF0]		Roll Off Ratio : [0.22]	
Filter Mode : [ACP]		Pattern Select : [0] Internal	
Maximum Code Number : [1]		Output Level : - 3.00dBm	
Ch. 1 : [On] Power : [- 0.0dB]	SCH Pr : -	Sc : -	
Ch. 2 : [Off] Power : [-40.0dB]	SCH Pr : -	Sc : -	
Ch. 3 : [Off] Power : [-40.0dB]	SCH Pr : -	Sc : -	
Ch. 4 : [Off] Power : [-40.0dB]	Ch. 5 : [Off] Power : [-40.0dB]		
Ch. 6 : [Off] Power : [-40.0dB]	Ch. 7 : [Off] Power : [-40.0dB]		
Ch. 8 : [Off] Power : [-40.0dB]	Ch. 9 : [Off] Power : [-40.0dB]		
Ch. 10 : [Off] Power : [-40.0dB]	Ch. 11 : [Off] Power : [-40.0dB]		
Ch. 12 : [Off] Power : [-40.0dB]	Add Ch : Off Power : [-40.0dB]		

CDMA(1/2)			
Freq. 2140.000 000 00 MHz			
Level - 3.00 dBm Mem. ---			
D Warning Normal			
Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]			
System : [W-CDMA]		W-CDMA Phase : [1]	
Simulation Link : [Down Link]		Chip Rate : [3.840 000] Mcps	
Filter : [RNF0]		Roll Off Ratio : [0.22]	
Filter Mode : [ACP]		Pattern Select : [1] BS116.8	
Maximum Code Number : [20]		Output Level : - 2.97dBm	
Ch. 1 : [On] Power : [-10.0dB]	SCH Pr : [-13.0dB]	Sc : [-13.0dB]	
Ch. 2 : [Off] Power : [-40.0dB]	SCH Pr : [-40.0dB]	Sc : [-40.0dB]	
Ch. 3 : [Off] Power : [-40.0dB]	SCH Pr : [-40.0dB]	Sc : [-40.0dB]	
Ch. 4 : [On] Power : [-18.0dB]	Ch. 5 : [On] Power : [-18.0dB]		
Ch. 6 : [Off] Power : [-40.0dB]	Ch. 7 : [Off] Power : [-40.0dB]		
Ch. 8 : [Off] Power : [-40.0dB]	Ch. 9 : [Off] Power : [-40.0dB]		
Ch. 10 : [Off] Power : [-40.0dB]	Ch. 11 : [Off] Power : [-40.0dB]		
Ch. 12 : [On] Power : [-10.0dB]	Add Ch : On Power : [- 1.1dB]		

Slide 32

G3681A-E-

Adjacent channel leakage power ratio

IS-95, ≤ -1 dBm ($\leq +7$ dBm at installing Option42)

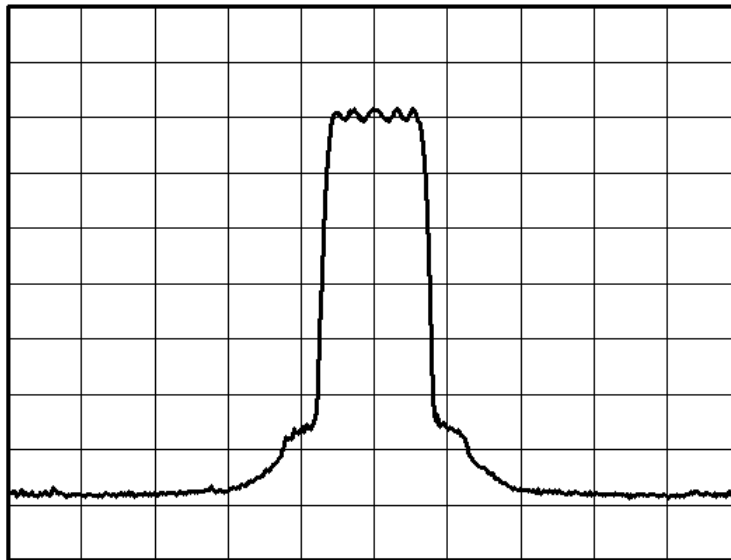
Forward

9 channels	64 channels
- ≤ -63 dBc	≤ -63 dBc
- ≤ -69 dBc	≤ -68 dBc
- ≤ -77 dBc	≤ -75 dBc

Reverse

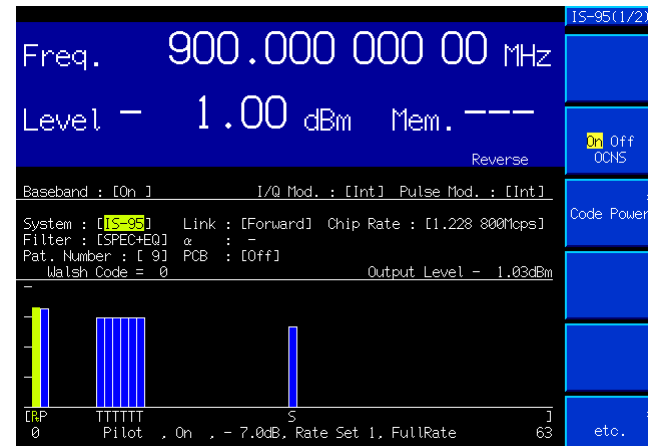
full rate	
≤ -65 dBc/30kHz	: 0.885 ~ 1.25 MHz offset
≤ -70 dBc/30kHz	: 1.25 ~ 1.98 MHz offset
≤ -77 dBc/30kHz	: 1.98 ~ 5 MHz offset

10dB/ RBW 30kHz VBW 100Hz SWT 8.4s DET POS



CENTER 900MHz SPAN 10MHz

Frequency 900MHz
 Output Level 0dBm
 Pattern Base Station Test Model, Nominal



Adjacent channel leakage power ratio

CDMA2000 1X (RC1-2), ≤ 0 dBm ($\leq +8$ dBm at installing Option42)

CDMA2000 1X (RC3-5), ≤ -3 dBm ($\leq +5$ dBm at installing Option42)

Forward

RC1 & 2

- ≤ -62 dBc
- ≤ -67 dBc
- ≤ -77 dBc

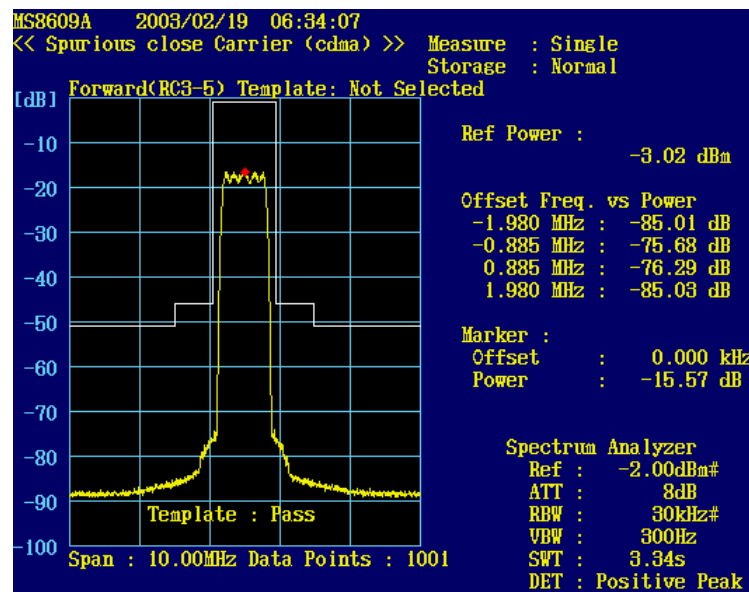
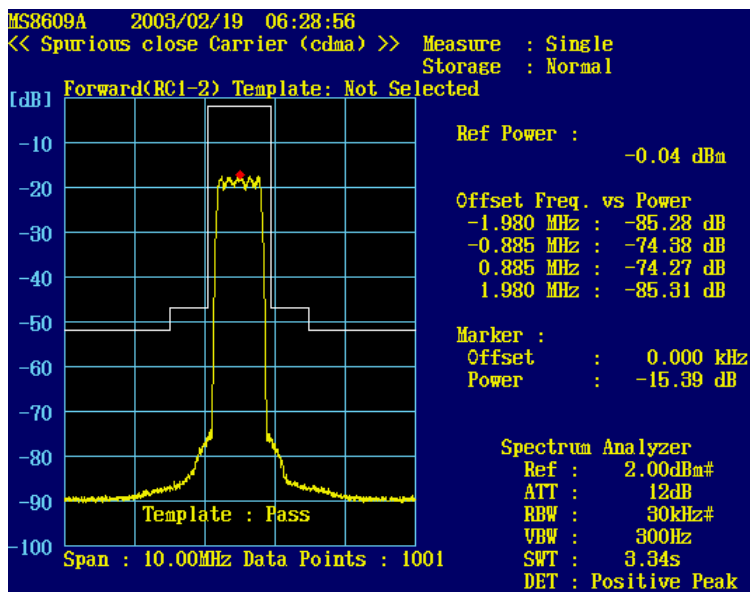
RC3 ~ 5

- ≤ -62 dBc/30kHz
- ≤ -70 dBc/30kHz
- ≤ -77 dBc/30kHz

Reverse

RC1 & 3

- ≤ -62 dBc/30kHz : 0.885 ~ 1.98 MHz offset
- ≤ -70 dBc/30kHz : 1.98 ~ 2.5 MHz offset
- ≤ -77 dBc/30kHz : 2.5 ~ 5 MHz offset



Discover W

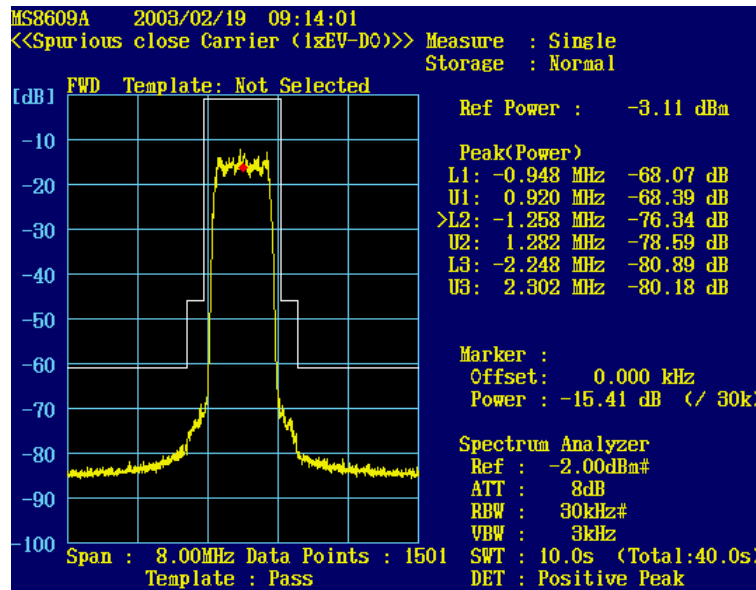
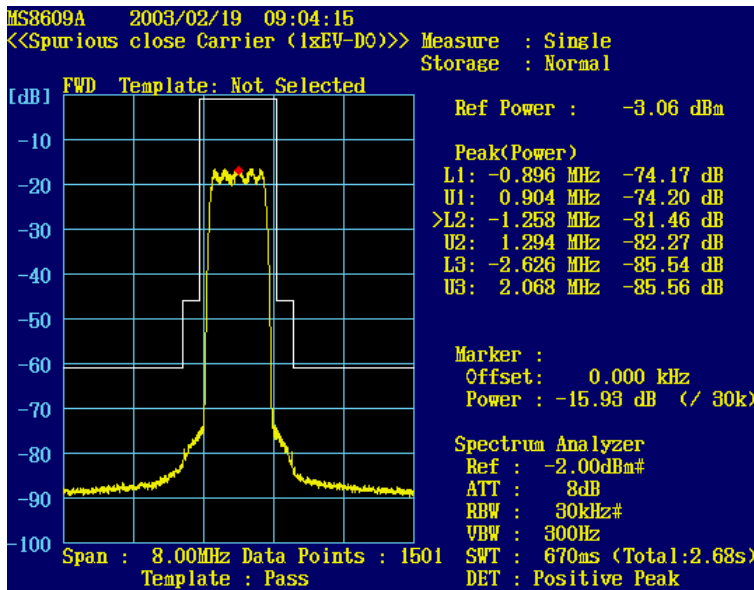
Freq. 900.000 000 00 MHz
 Level 0.00 dBm Mem. ---
 Reverse
 Baseband: [On] I/Q Mod.: [Int] Pulse Mod.: [Int]
 System : [DTSG]
 Pattern : [9:1xRTTrc1-2_FL0]
 Baseband Setup
 Trigger Source : [Int] Trigger Delay : [01/ 8cps
 0.0000 cps
 Reference Clock : [Int]

Freq. 900.000 000 00 MHz
 Level - 3.00 dBm Mem. ---
 Reverse
 Baseband: [On] I/Q Mod.: [Int] Pulse Mod.: [Int]
 System : [DTSG]
 Pattern : [10:1xRTTrc3-5_FL0]
 Baseband Setup
 Trigger Source : [Int] Trigger Delay : [01/ 8cps
 0.0000 cps
 Reference Clock : [Int]

Adjacent channel leakage power ratio

CDMA2000 1xEV-DO, ≤ -3 dBm ($\leq +5$ dBm at installing Option42)

- ≤ -65 dBc/30kHz : 0.885 ~ 1.98 MHz offset
- ≤ -70 dBc/30kHz : 1.98 ~ 2.5 MHz offset
- ≤ -77 dBc/30kHz : 2.5 ~ 5 MHz offset



1xEV-DO

Freq. 900.000 000 00 MHz

Level - 3.00 dBm Mem. ---

Reverse

Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]

System : [1xEV-DO]
 Pattern : [I1:FWD_2457.6kbps.1]

Baseband Setup
 Trigger Source : [Int] Trigger Delay : [0]/ 8cps
 Reference Clock : [Int] 0.0000 cps

Wave Data Restart

Wave Data

1xEV-DO

Freq. 900.000 000 00 MHz

Level - 3.00 dBm Mem. ---

Reverse

Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]

System : [1xEV-DO]
 Pattern : [I2:FWD_Idle_Slot]

Baseband Setup
 Trigger Source : [Int] Trigger Delay : [0]/ 8cps
 Reference Clock : [Int] 0.0000 cps

Wave Data Restart

Wave Data

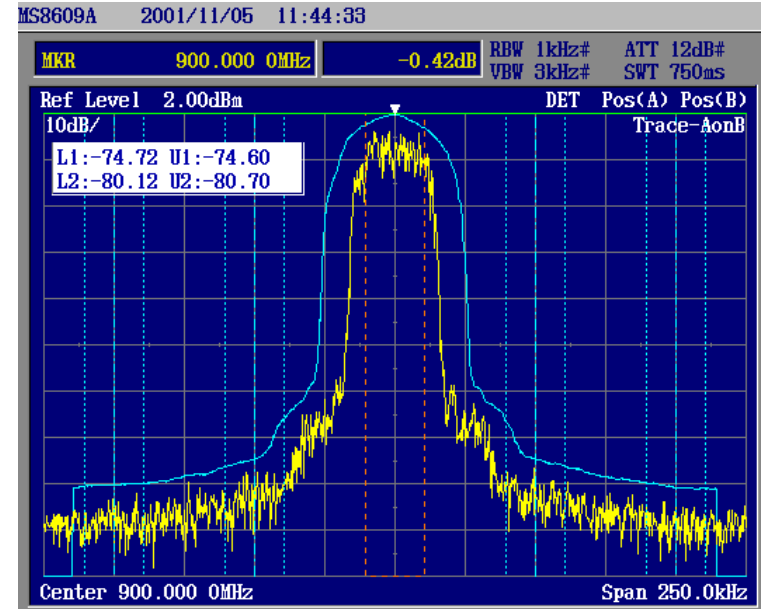
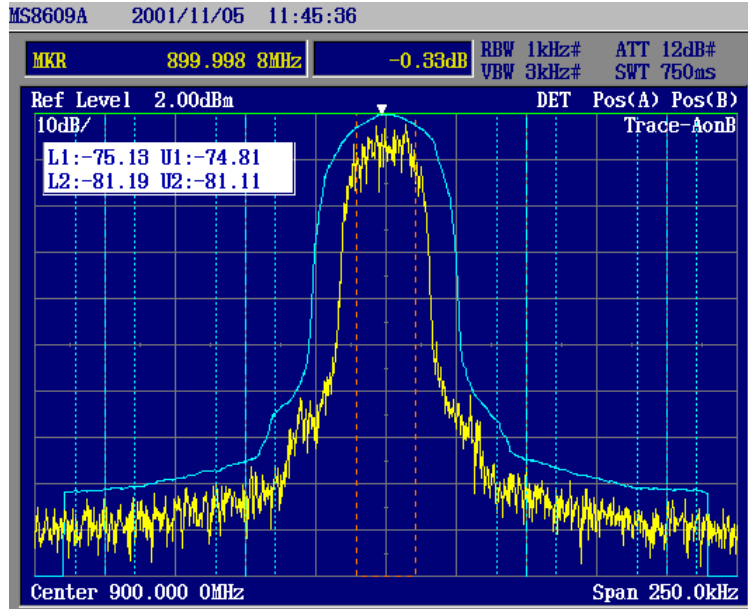
Adjacent channel leakage power ratio PDC, $\leq +5$ dBm

MX368011A

- ≤ -64 dBc/21kHz
- ≤ -68 dBc/21kHz

MX368031A

- ≤ -63 dBc/21kHz : 50 kHz offset
- ≤ -67 dBc/21kHz : 100 kHz offset



Freq. 900.000 000 00 MHz

Level 5.00 dBm Mem. ---

Normal

Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]

System : [PDC]

Modulation : [Q/4 DQPSK] Bit Rate : [42.0kbps]

Filter : [RNYQ] α :[0.50] Phase Encode : [Normal]

Slot Rate : [Fullrate]

Burst : [Off]

Pattern : [PN9]

Digital Mod

Freq. 900.000 000 00 MHz

Level 5.00 dBm Mem. ---

Normal

Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]

System : [DTSG]

Pattern : [2:P1/4QPSK_PDC]

Baseband Setup

Trigger Source : [Int] Trigger Delay : [01/16sps
0.0000 sps]

Reference Clock : [Int]

DTSG

Slide 36

MG3681A-E-I-1

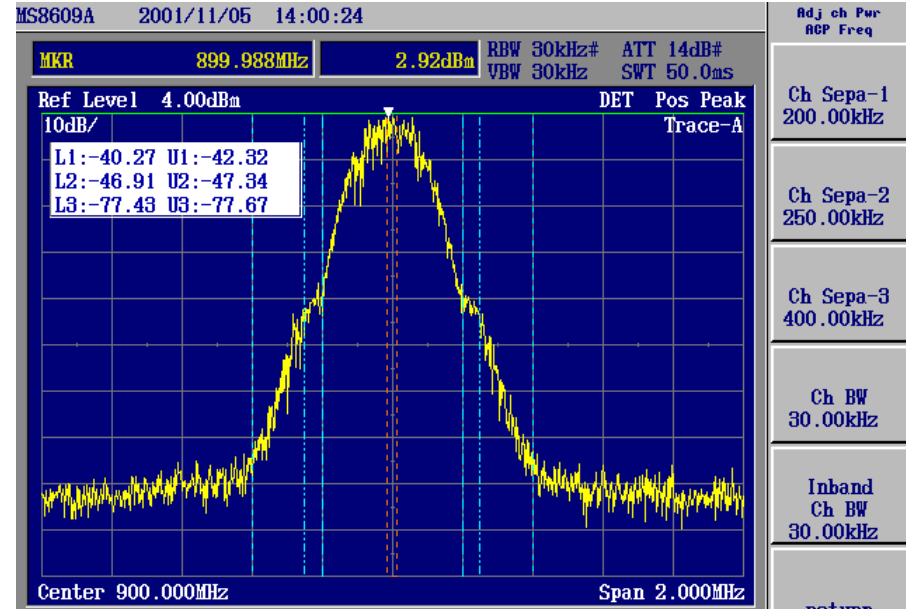
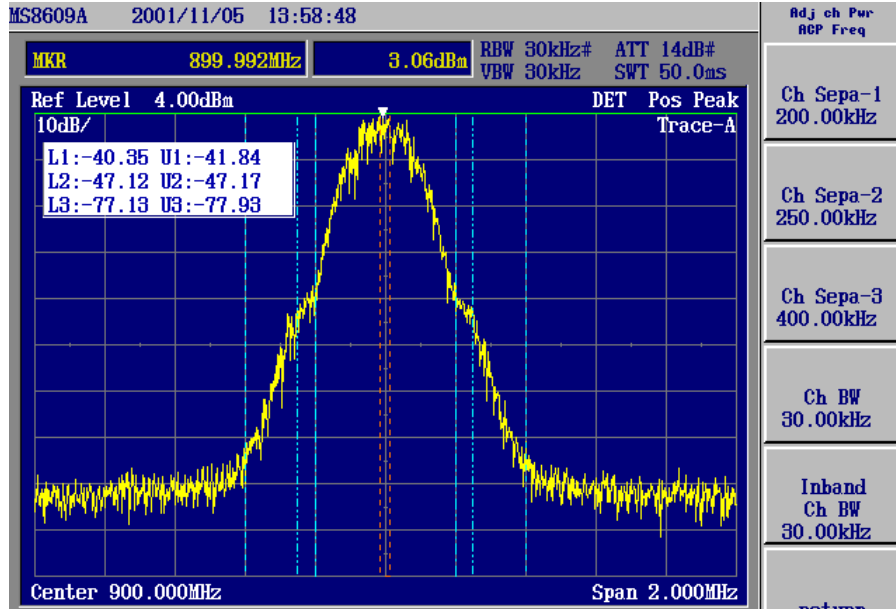
Adjacent channel leakage power ratio GSM/EDGE(GMSK), $\leq +5$ dBm

MX368012A

- ≤ -35 dBc/30kHz
- ≤ -66 dBc/30kHz

MX368031A

- ≤ -35 dBc/30kHz : 200 kHz offset
- ≤ -66 dBc/30kHz : 400 kHz offset



Freq. 900.000 000 00 MHz

Level 5.00 dBm Mem. ---

Normal

Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]

System : [GSM]

Modulation : GMSK Bit Rate : [270.833kbps]

Filter : BbT=[0.30]

Differential Encode : [On] Phase Polarity : [Normal]

Burst : [Off]

Pattern : [PN9]

Digital Mod

Freq. 900.000 000 00 MHz

Level 5.00 dBm Mem. ---

Normal

Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]

System : [DTSS]

Pattern : [1:GSM/GMSK]

Baseband Setup

Trigger Source : [Int] Trigger Delay : [01/24sps

Reference Clock : [Int] 0.0000 sps

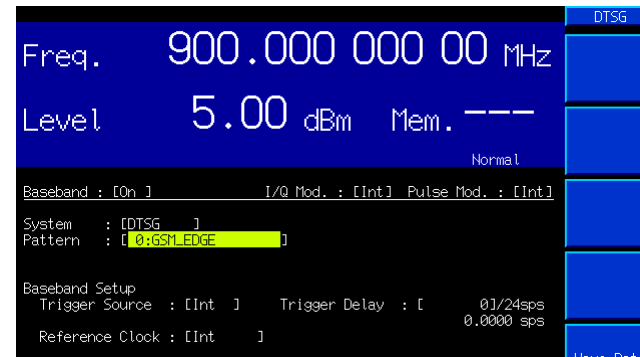
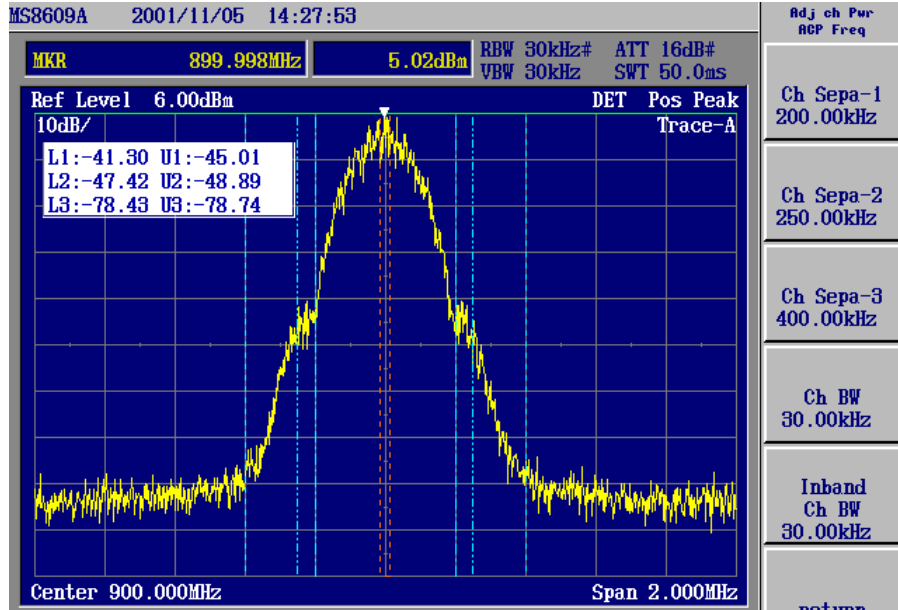
DTSS

Slide 37

MG3681A-E-I-1

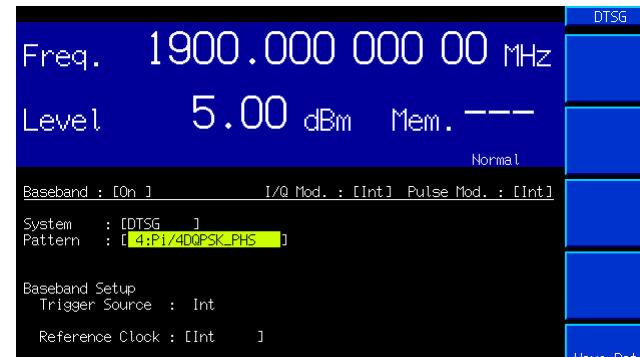
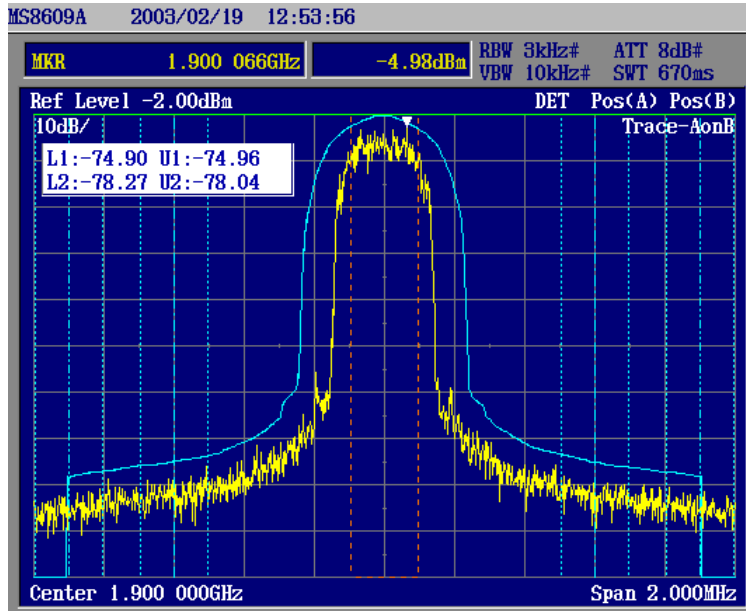
Adjacent channel leakage power ratio GSM/EDGE(8PSK), $\leq +5$ dBm

- ≤ -38 dBc/30kHz : 200 kHz offset
- ≤ -67 dBc/30kHz : 400 kHz offset



Adjacent channel leakage power ratio PHS, $\leq +5$ dBm

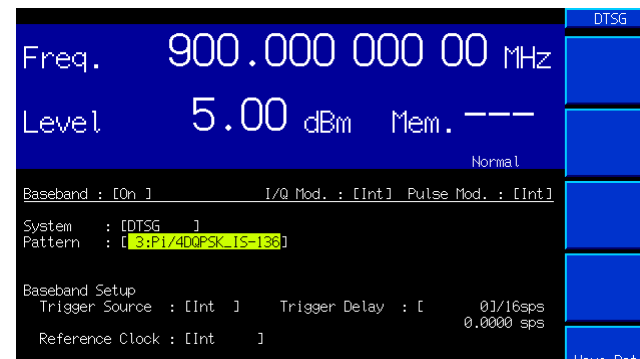
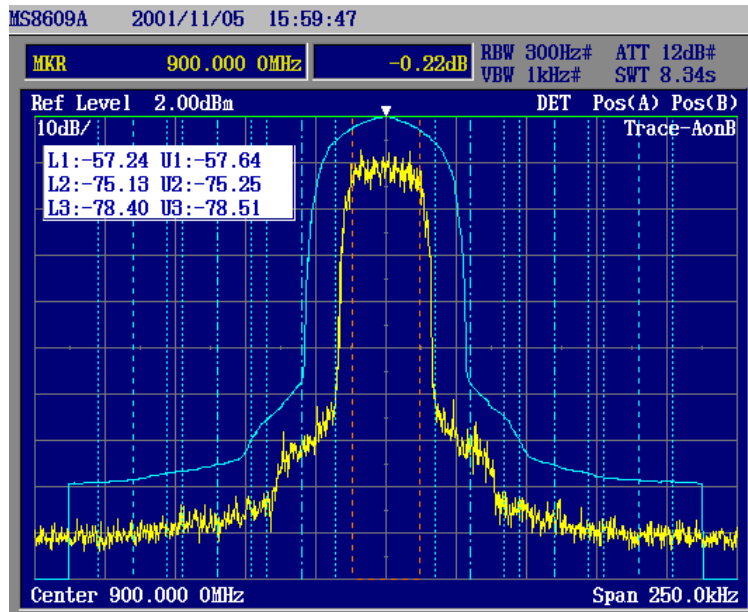
- ≤ -66 dBc/192kHz : 600 kHz offset
- ≤ -69 dBc/192kHz : 900 kHz offset



Adjacent channel leakage power ratio

NADC(IS-136), $\leq +5$ dBm

- ≤ -42 dBc/24.3kHz : 30 kHz offset
- ≤ -64 dBc/24.3kHz : 60 kHz offset
- ≤ -64 dBc/24.3kHz : 90 kHz offset

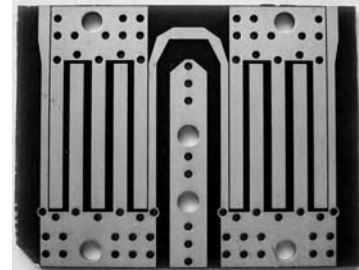
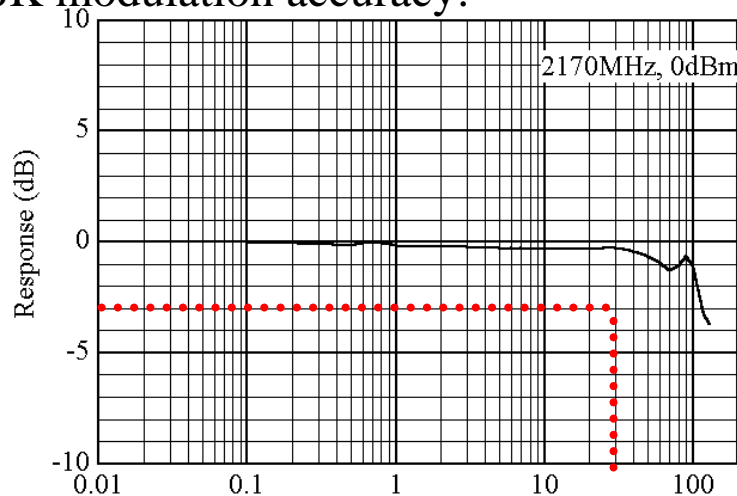


Wide-band and Excellent accuracy vector modulation

The filter group according to the output frequency is switched in RF circuit to attenuate the spurious close to carrier.

This filter group is the inter-digital band pass filter which can configure multi-stages in small area to satisfy out-band attenuation characteristic to eliminate the spurious in near-band, frequency response of vector modulation, pass band amplitude and group delay characteristic not to deteriorate vector modulation accuracy.

- » Vector modulation frequency response (3 dB bandwidth): ≥ 30 MHz
- » 3.84 Msps QPSK modulation accuracy: ≤ 2.5 % (rms)



Modulation Frequency (MHz)

Slide 41

MG3681A-E-I-1

Discover What's Possible™

Anritsu



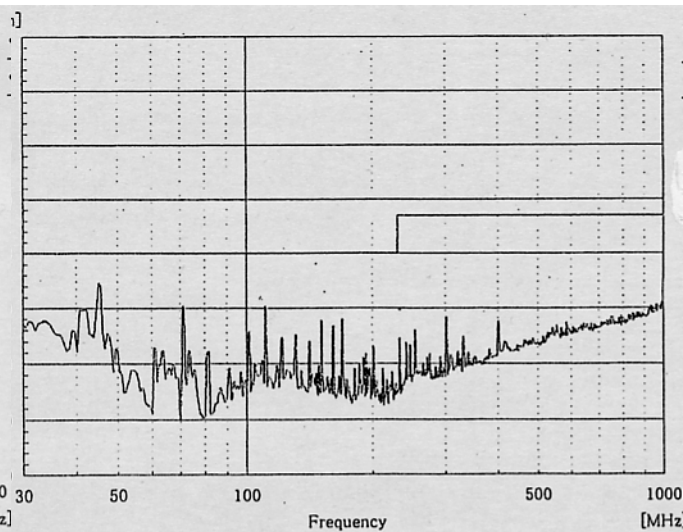
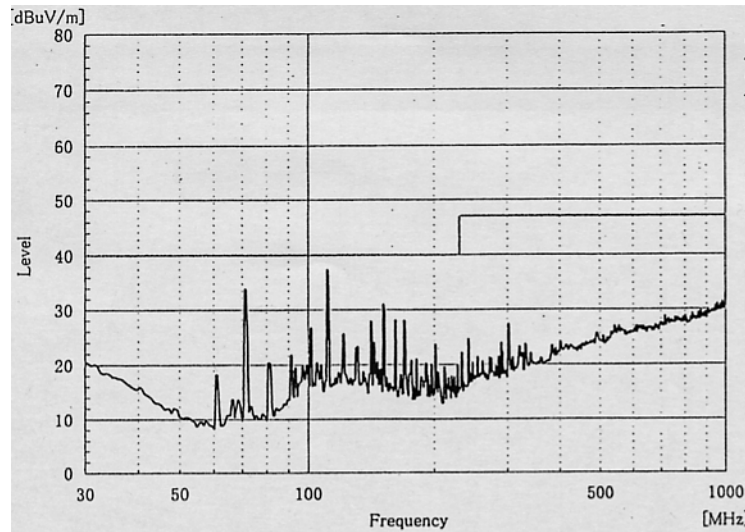
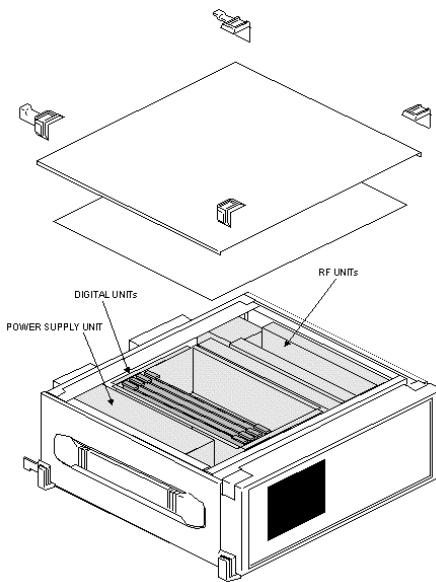
Leakage emissions policy

The shield of signal generator is important in minimizing the signal generator's leakage emissions which interfere to the receiver in receiver sensitivity test at low level.

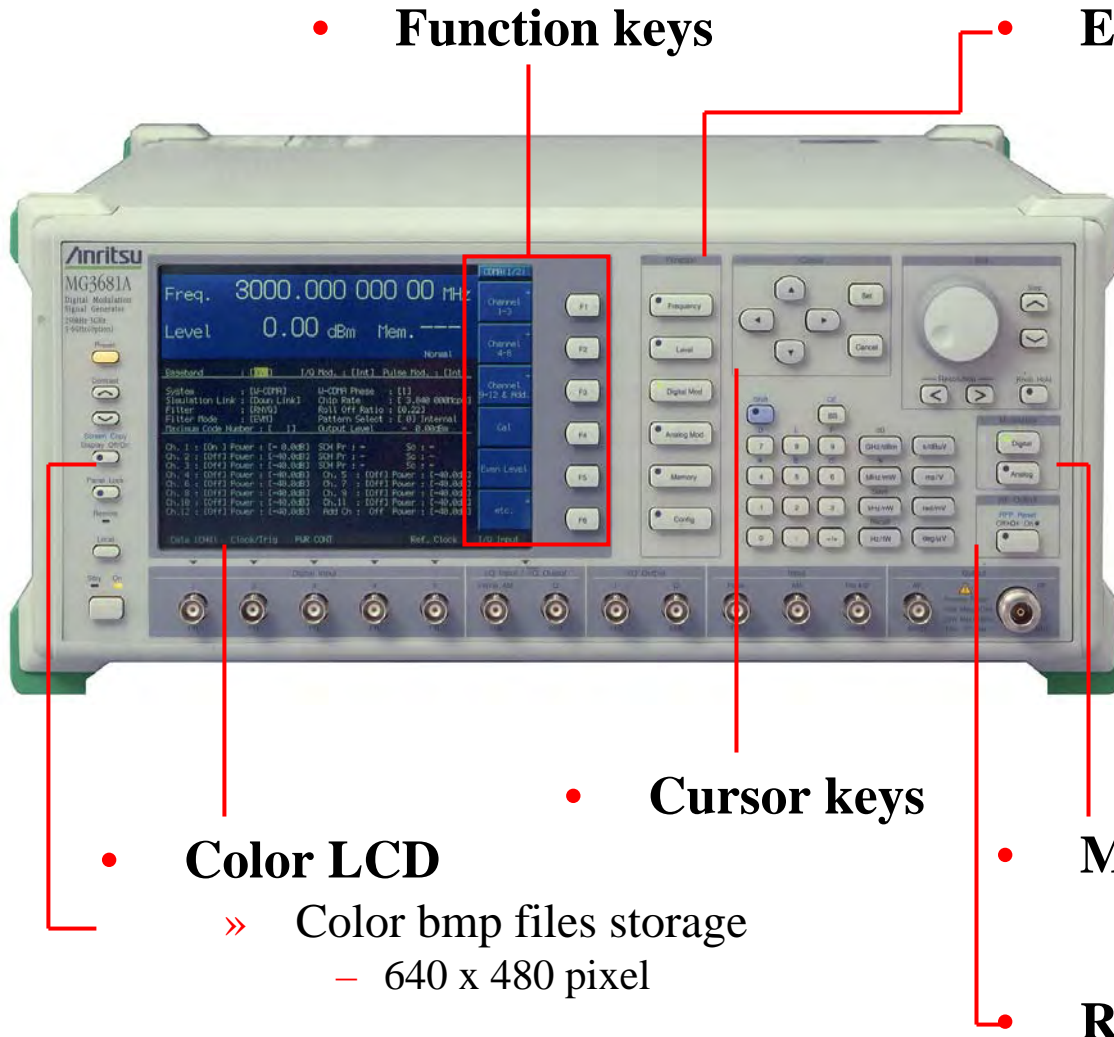
- » Mainframe cabinet has been structured with double shields.
- » The circuit units installed in mainframe have been mounted in the shield case, respectively.
- » Shield net has been equipped to display.
- » PC memory card interface has been equipped to rear panel.

Horizontal

Vertical



Operability



Editing keys

- » Frequency
- » Output level
- » Modulation parameters (Baseband)
 - Digital
 - Analog
- » Internal memory administration
 - Saving/Recall the setting situation
- » System setting

Main settings

- Screen saver ⇒ Power-saving
- Remote control
- Version information
- Operation time/count check

Modulation On/Off

- Digital
- Analog

RF output On/Off

Color LCD

- » Color bmp files storage
 - 640 x 480 pixel

Cursor keys

Operability

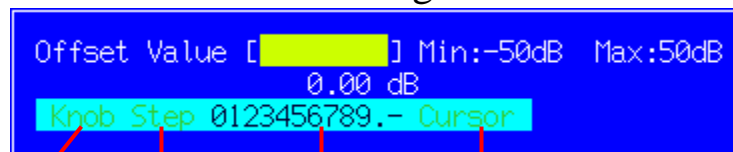
- **Panel key layout and role**

- » Operability has been improved by panel layout considering smooth operation flow of [Selecting functions] → [Moving cursor] → [Editing(input/select)] → [Setting]

- **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, in order to enable the operation without confusion.

- Example of Level Offset setting



Rotary knob , Step keys, ten keys, Cursor keys

Operability

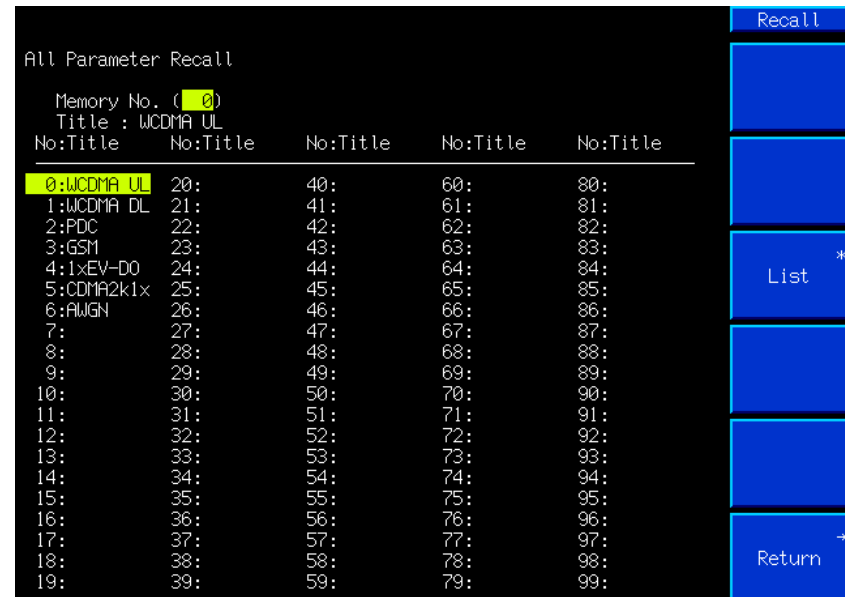
- **Modulation On/Off**

- Digital: Vector modulation, Pulse modulation
- Analog: AM, FM, ϕ M
 - Internal analog modulation with AF signals of sine, triangular, square and sawtooth wave is possible at installing Option21 AF Synthesizer.
- » These modulations are switched On or Off by one touch.
- » The combination of digital modulation and analog modulation can achieve external ALC function by AM, also it is useful for the simulation of amplitude variation by AM and frequency variation by FM.

Operability

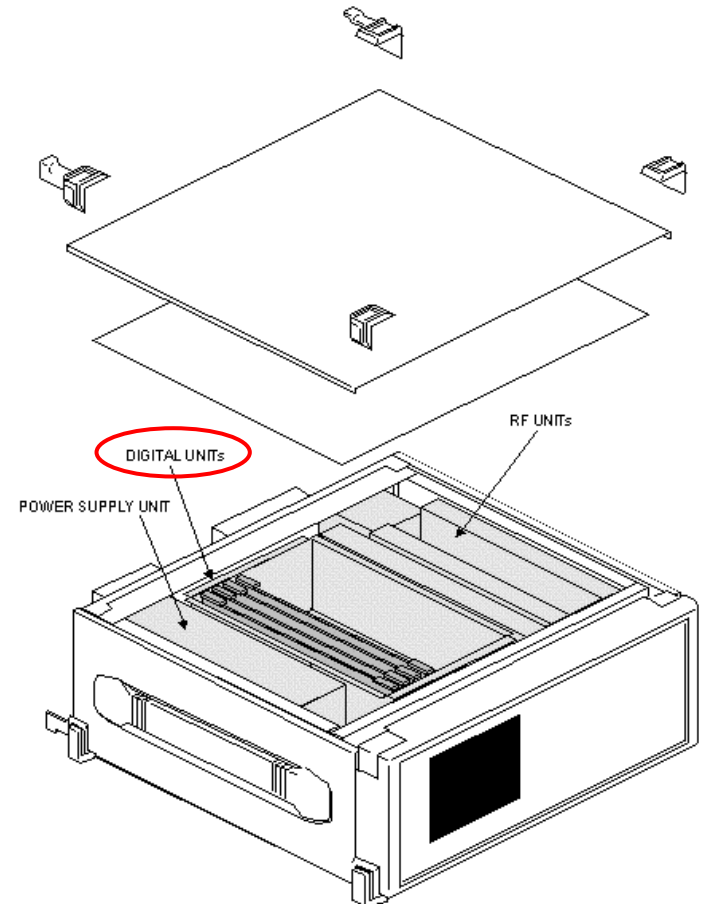
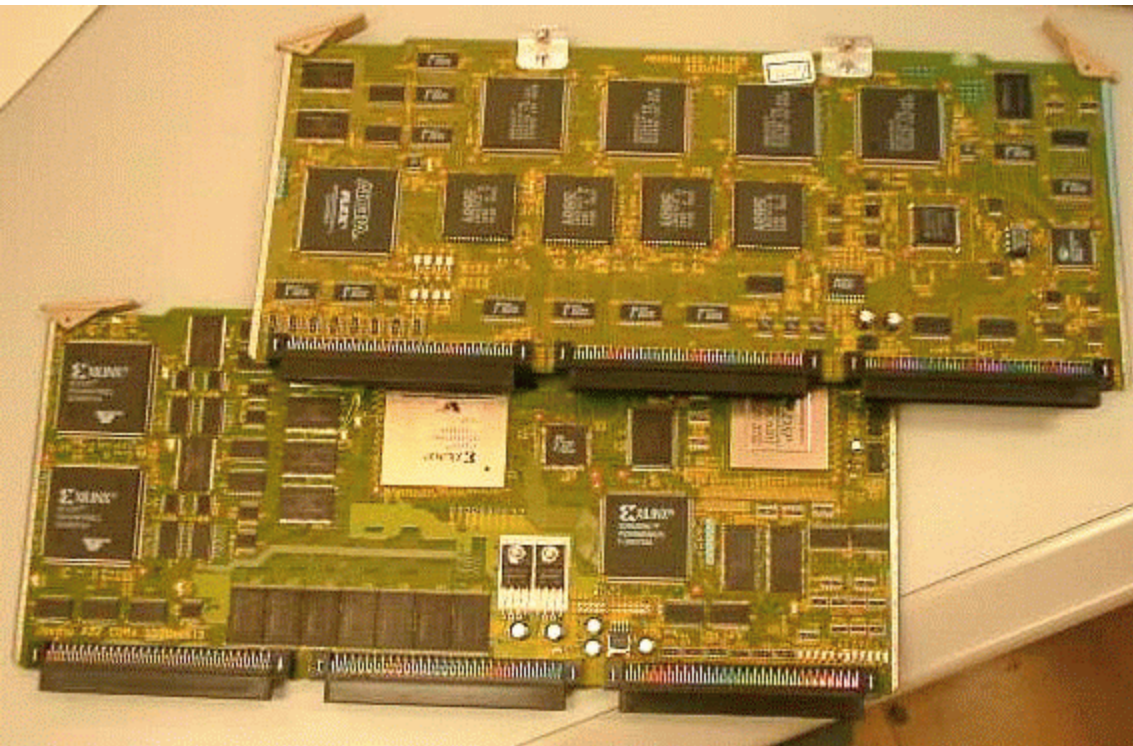
- **Internal memory administration**

- » **Basic Parameter Memory (BPM)**
 - 512 types of frequency and output level are savable.
 - Sweepable continuous recall and high-speed recall by external trigger signal are performable.
- » **All Parameter Memory (APM)**
 - all settings including the modulation parameter setting of baseband in addition to frequency and output level are savable.
 - 100 types of settings are savable regardless of the quantity of installed expansion units.
 - Max. 8 characters can be inputted each title for easy confirmation.
- » **Memory Export/Import**
 - It is useful for copying to other MG3681A and backup of memory, because BPM and APM can be save in PC memory card and recalled from PC memory card.



Expansion unit

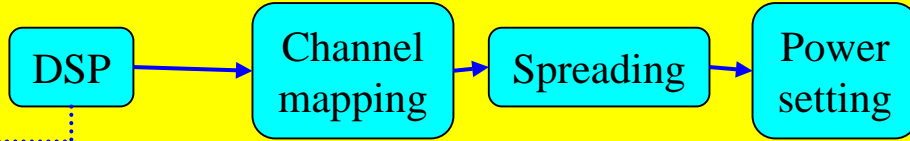
- **Expansion unit is the digital board to generate digital I/Q signal of baseband.**
 - » Digital I/Q signal is converted to analog I/Q signal by D/A converter.



MU368040A CDMA Modulation Unit

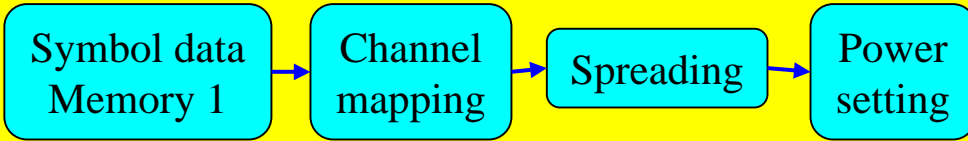
Block diagram

DSP real time Generator

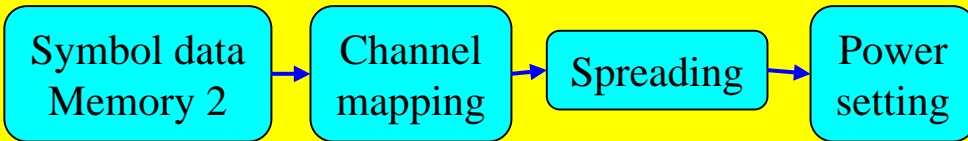


CH1~3 or ~4

Symbol data Generator

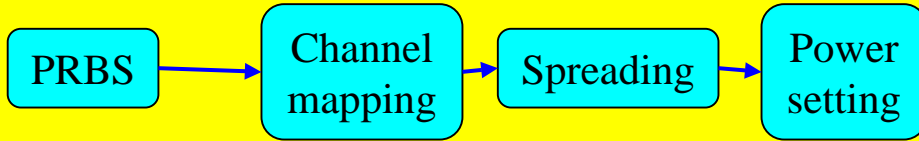


CH4



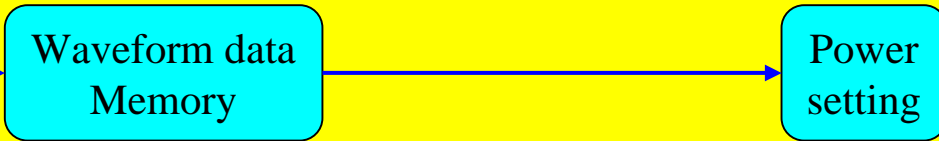
CH5

PRBS coding Generator

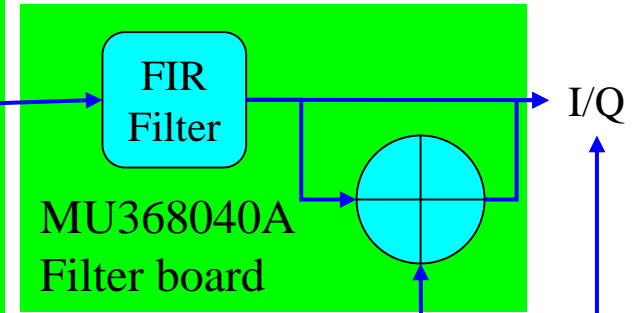
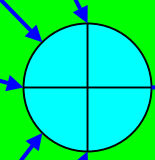


CH6~12

Arbitrary Waveform Generator

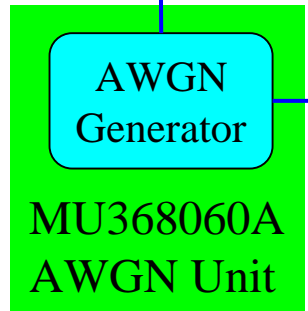


Add.CH



MU368040A
Filter board

I/Q



MU368060A
AWGN Unit

MU368040A CDMA board

MU368040A CDMA Modulation Unit

- **DSP real time Generator**

- » Mapping physical layer data achieved real-time coding by DSP to physical channel

- **Symbol data Generator**

- » For the channels which require power/burst control per symbol such as W-CDMA DL-DPCH and PRACH
- » Symbol signal pattern files of physical layer before spreading
 - Downloading from PC memory card to internal memory
 - Internal memory capacity CH4: 4Mbit, CH5: 4Mbit
 - W-CDMA Downlink ≤ 512 ksymbol e.g. DL-DPCH 30ksps: 1747 frame
 - W-CDMA Uplink ≤ 1 Msymbol

- **PRBS coding Generator**

- » Mapping PRBS(Pseudo-random Binary Sequence) data to physical channel

- **Arbitrary Waveform Generator**

- » For multiple channels such as W-CDMA DPCH and OCNS
- » Signal pattern files of physical layer before FIR filtering (before over sampling)
 - *W-CDMA over sampling rate: 8×3.84 Mcps = 30.72 MHz
 - Downloading from PC memory card to internal memory
 - Internal memory capacity 512 ksamples/channel (2 Mbyte)
 - W-CDMA 3.84 Mcps ≤ 13 frame (130 ms)

MU368040A CDMA Modulation Unit

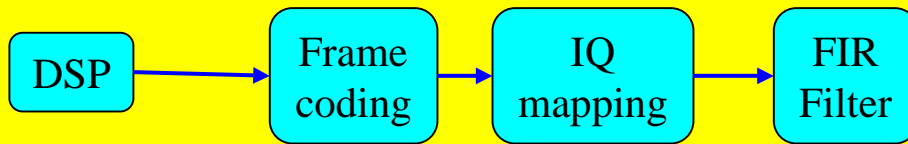
- **Firmware configuration for flexible system support**

- » Low-rate signal processor before spreading switches 2 methods according to the usage.
 - Real-time coding method by DSP
 - Memory method for downloading by cycle output of external created data pattern
- » Signal processor from high-speed spreading to FIR filtering has been adopted high accumulation FPGA of 1M gates for flexible system support.
- » These DSP programs, Signal pattern files for downloading and FPGA configuration data can be rewritten from PC memory card.
- » FIR filter which requires high-speed processing has adopted the dedicated IC, as there is not the necessity for functional change.

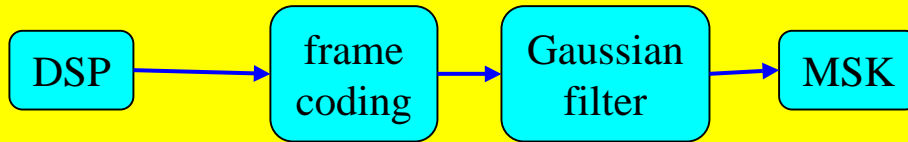
- **High-speed data transmission**

- High-speed signal processing ability is required for baseband as W-CDMA specifies high-speed data communication up to 384kbps in moving state and up to 2Mbps in static state.
- » Max. 1600MIPS of high-performance DSP has been adopted for real-time coding. It enables the real-time channel coding up to 384kbps.

$\pi/4$ DQPSK (PDC)



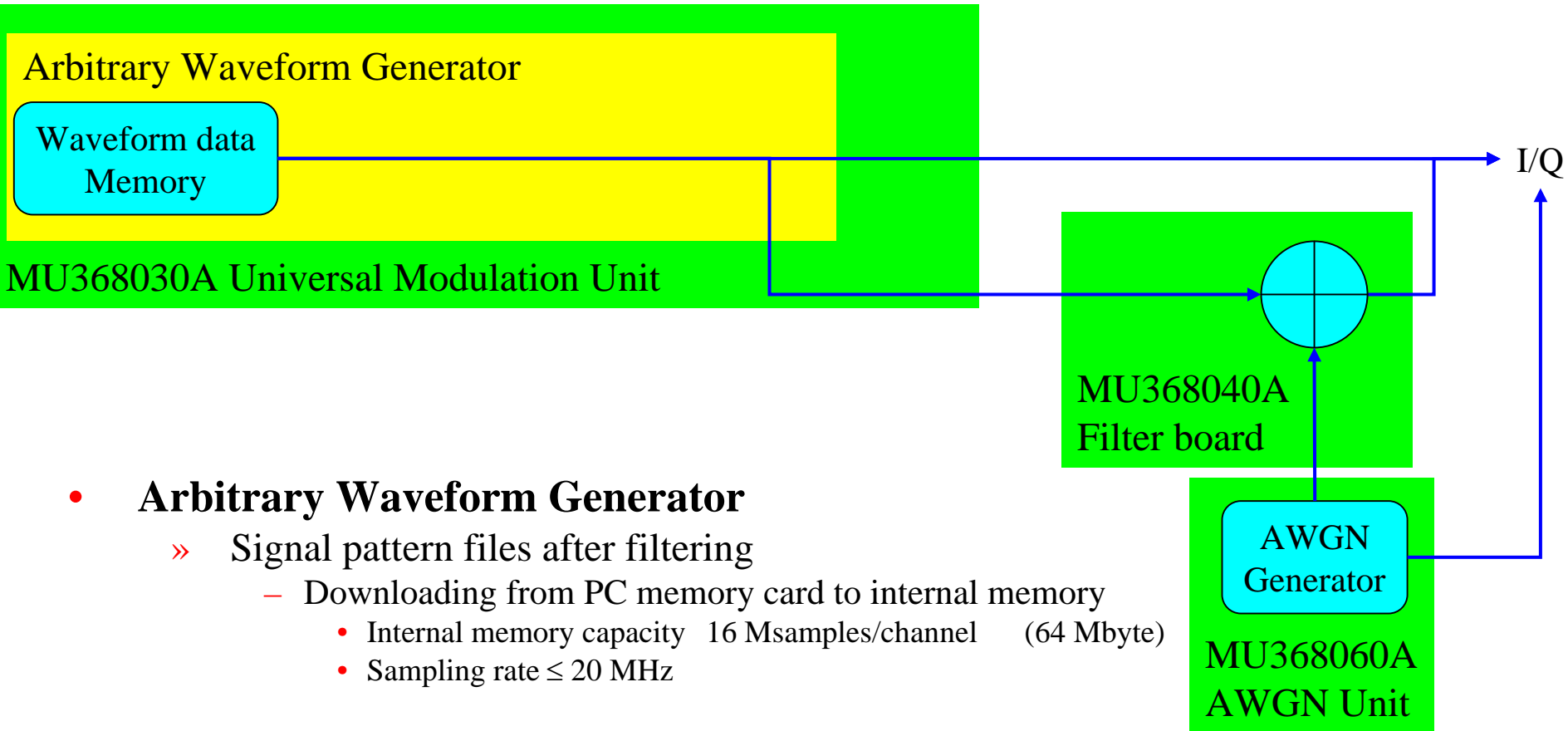
GMSK (GSM)



I/Q

MU368010A TDMA Unit

MU368030A Universal Modulation Unit Block diagram



- **Arbitrary Waveform Generator**
 - » Signal pattern files after filtering
 - Downloading from PC memory card to internal memory
 - Internal memory capacity 16 Msamples/channel (64 Mbyte)
 - Sampling rate ≤ 20 MHz



Software

•	MX368041B	W-CDMA Software	54	▶
	–	MX368041B-11 HSDPA Signal Pattern	56	▶
	–	MX368141A HSDPA IQ producer	73	▶
•	MX368042A	IS-95 Device Test Software	77	▶
•	MX368011A	PDC Software	84	▶
•	MX368012A	GSM Device Test Software	92	▶
•	MX368031A	Device Test Signal Generation Software	102	▶
•	MX368033A	CDMA2000 1xEV-DO Signal Generation Software	111	▶
	»	MX368133A CDMA2000 1xEV-DO IQproducer™	120	▶
•	MX368034A	PDC Packet Software	126	▶
•	MX368035A	PHS Signal Generation Software	133	▶
•	MU368060A	AWGN	141	▶



MX368041B W-CDMA Software



- **Downlink/Uplink W-CDMA test signals for 3GPP(FDD) standard can be outputted by installing the MX368041B W-CDMA Software in the MU368040A CDMA Modulation Unit.**
- **In R&D/production process of components, base stations (BS) and user equipment (UE), the functions to support various applications are provided as the signal source for components, the wanted signal source and the interfering signal source for receiver test.**

CDMA(1/2)		CDMA(1/2)	
Freq. 2112.500 000 00 MHz		Freq. 1922.500 000 00 MHz	
Level 0.00 dBm Mem. ---		Level 0.00 dBm Mem. ---	
D Warning Normal		Normal	
Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]		Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]	
System : [W-CDMA] W-CDMA Phase : [1]		System : [W-CDMA] W-CDMA Phase : [1]	
Simulation Link : [Down Link] Chip Rate : [3.840 000Mcps]		Simulation Link : [Up Link] Chip Rate : [3.840 000Mcps]	
Filter : [RNYQ] Roll Off Ratio : [0.22]		Filter : [RNYQ] Roll Off Ratio : [0.22]	
Filter Mode : [EVM] Pattern Select : [1] BS116_8		Filter Mode : [EVM] Pattern Select : [18] ULRMC12k	
Maximum Code Number : [20] Output Level 0.03dBm		Maximum Code Number : [2] Output Level - 0.03dBm	
Ch. 1 : [On] Power : [-10.0dB] SCH Pr : [-13.0dB] Sc : [-13.0dB]		Ch. 1 : [On] Power : [- 4.6dB]	
Ch. 2 : [Off] Power : [-40.0dB] SCH Pr : [-40.0dB] Sc : [-40.0dB]		Ch. 2 : [Off] Power : [-40.0dB]	
Ch. 3 : [Off] Power : [-40.0dB] SCH Pr : [-40.0dB] Sc : [-40.0dB]		Ch. 3 : [Off] Power : [-40.0dB]	
Ch. 4 : [On] Power : [-18.0dB] Ch. 5 : [On] Power : [-18.0dB]		Ch. 4 : [On] Power : [- 1.9dB] Ch. 5 : [Off] Power : [-40.0dB]	
Ch. 6 : [Off] Power : [-40.0dB] Ch. 7 : [Off] Power : [-40.0dB]		Ch. 6 : [Off] Power : [-40.0dB] Ch. 7 : [Off] Power : [-40.0dB]	
Ch. 8 : [Off] Power : [-40.0dB] Ch. 9 : [Off] Power : [-40.0dB]		Ch. 8 : [Off] Power : [-40.0dB] Ch. 9 : [Off] Power : [-40.0dB]	
Ch.10 : [Off] Power : [-40.0dB] Ch.11 : [Off] Power : [-40.0dB]		Ch.10 : [Off] Power : [-40.0dB] Ch.11 : [Off] Power : [-40.0dB]	
Ch.12 : [On] Power : [-10.0dB] Add Ch : On Power : [- 1.1dB]		Ch.12 : [Off] Power : [-40.0dB] Add Ch : Off Power : [-40.0dB]	
AWGN : [Off] C/N :		AWGN : [Off] C/N : Wanted - Noise -	
Data (CH4) Clock/Trig PWR CONT Ref. Clock I/Q Input		Data (CH4) Clock/Trig PWR CONT Ref. Clock I/Q Input	

Support of test signal format

- Just to select the signal patterns for TS 25.141 and TS 34.121 test specifications without setting complicated parameters of 3GPP!

Simple operation

- **Quick support** is provided by updating the signal pattern files saved from PC memory card to internal memory and DSP program for real-time coding.

» Supporting 3GPP update and special signal patterns

- “Product Introduction MX368041A/B Update News” is provided.

Version-up History, How to check Version, How to upgrade, File configuration in PC memory card,

Signal pattern List

Pattern
Internal
1:BS11657
2:BS13257
3:BS16457
4:BS257
5:BS31657
6:BS33257
7:BS457
8:D32T18s0
9:D32T28s0
10:D32T38s0
11:D32T48s0
12:D4MR18s0
13:D4MR28s0
14:D4MR38s0
15:D1SDN8s0
16:DL_C31
17:DL_INTR
18:ULRMC12k
19:ULRMC144
20:ULRMC384
21:ULRMC64k
22:UL_AMR#1
23:UL_AMR#2
24:UL_AMR#3
25:UL_ISDN
26:
27:
28:
29:
30:
31:
32:

Total Share : Symbol = 22 Wave = 45

Selecting Signal pattern in internal memory

Pattern Contents (No.11:D32T48s0)
 Channel combination : TS25.101 V3.8.0 Annex C3.2
 for Performance requirement
 Demodulation of DCH TEST4 (BLER=10⁻²)

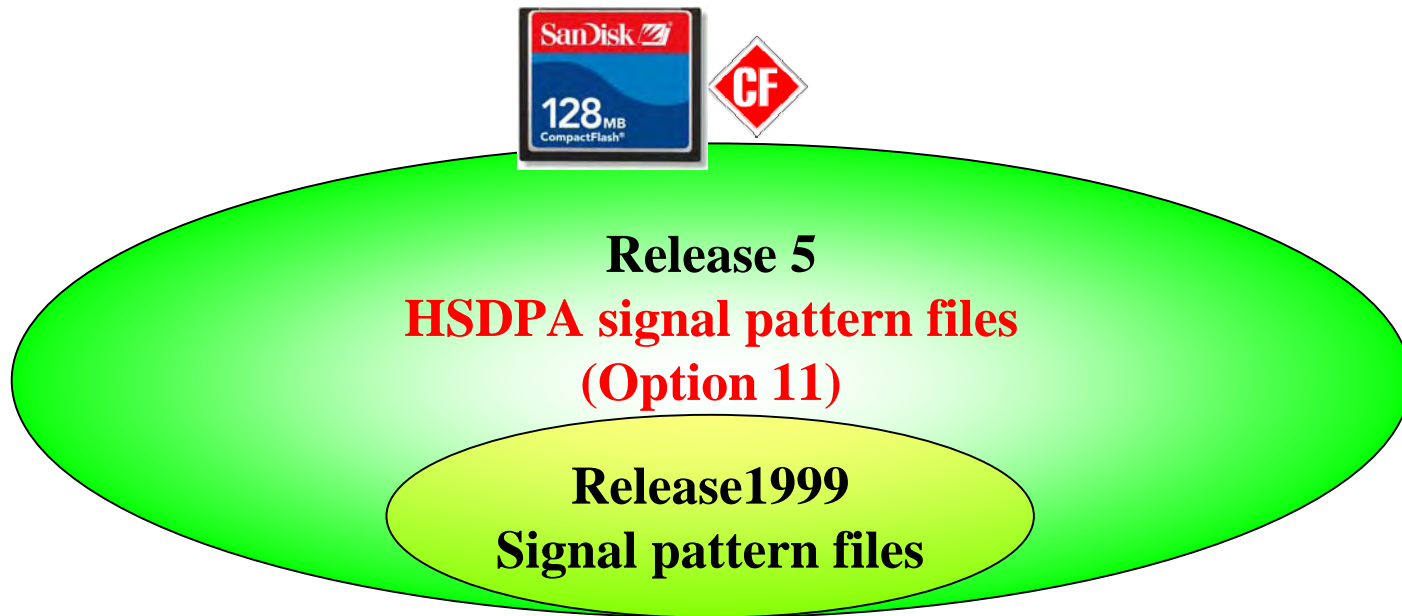
Channel	Modulation
ch1	P-CPDCH + P/S-SCH
ch4	DL-DPDCH (480 kbps)
5:BS	3G TS25.211 V3.7.0, TS25.212,213 v3.6.0
6:BS	3G TS25.101 v3.7.0 Annex A.3.4
7:BS	DL reference measurement channel 384 kbps
8:D3	ch5 : PICH
9:D3	ch6 : CPICH
10:D3	ch2-3, ch7-12: OFF
Add ch:	OCNS (TS25.101 V3.8.0 table C.6)
Total	Scrambling code number = 00h

Confirming of Signal pattern contents

Pattern files of test signal format

MX368041B-11 (Option) HSDPA Signal Pattern

- » This package added the signal pattern file specified in Release5 to Release1999 signal pattern file of an appendix in MX368041B.



Signal patterns For evaluating components in BS transmitter

Test item	Channel combination	Parameter	Pat. name	Added by option11
TS25.141 6.1.1 Transmitter Test Models	TS25.141 6.1.1.1 Test Model 1	16 DPCH	BS11657	B11657d
			BS116571	B11657d2
			BS116572	
			BS116573	
		32 DPCH	BS13257	B13257d
			BS132571	B13257d2
			BS132572	
			BS132573	
		64 DPCH	BS16457	B16457d
			BS164571	B16457d2
			BS164572	
			BS164573	
TS25.141 6.1.1.2 Test Model 2	-	-	BS257	
			BS2571	
			BS2572	
			BS2573	
TS25.141 6.1.1.3 Test Model 3		16 DPCH	BS31657	
			BS316571	
			BS316572	
			BS316573	
		32 DPCH	BS33257	
			BS332571	
			BS332572	
			BS332573	
TS25.141 6.1.1.4 Test Model 4	-	-	BS457	
			BS4571	
			BS4572	
			BS4573	
TS25.141 6.1.1.4A Test Model 5	2 HS-PDSCH + 6 DPCH		BS5_257	B5_257d
			BS5_2571	B5_257d2
			BS5_2572	
			BS5_2573	
	4 HS-PDSCH + 14 DPCH		BS5_457	B5_457d
			BS5_4571	B5_457d2
			BS5_4572	
			BS5_4573	
	8 HS-PDSCH + 30 DPCH		BS5_857	B5_857d
			BS5_8571	B5_857d2
			BS5_8572	
			BS5_8573	

» Test Models

- 6.1.1.1
Test Model 1 Multi-carrier
(2 carriers)

2 carriers

*****d: for lower freq.
*****d2: for higher freq.

- 6.1.1.4A
Test Model 5 (HSDPA)
 - Multi-carrier (2 carriers)

Signal patterns For receiver and performance testing for BS

Test item	Channel combination	Parameter	Patt. name	Added by option 11	
TS25.141	TS25.141 Annex A.1	TS25.141 Annex A.2	ULRMC12k		
7 Receiver characteristics		TS25.141 Annex A.3	ULRMC64k		
8 Performance requirement		TS25.141 Annex A.4	ULRMC144		
		TS25.141 Annex A.5	ULRMC384		
8.8.1 RACH preamble	TS25.211 5.2.2.1	TS25.213 4.3.3		PRE	
8.8.3 RACH message		TS25.141 Annex A.7		R168	R360
8.9.3 CPCH message	TS25.211 5.2.2.2	TS25.141 Annex A.8		C168	C360
8.10 SSdT	TS25.141 Annex A.1	TS25.141 Annex A.2		SSDTa	SSDTb
-	TS25.104 Annex A.1	TR25.944 4.1.2.2.1.1 DCCH 4.1.2.2.1.2 AMR TFCS#1 4.1.2.2.2.2	UL_AMR#1		
		TR25.944 4.1.2.2.1.1 DCCH 4.1.2.2.1.2 AMR TFCS#2 4.1.2.2.2.2	UL_AMR#2		
		TR25.944 4.1.2.2.1.1 DCCH 4.1.2.2.1.2 AMR TFCS#3 4.1.2.2.2.2	UL_AMR#3		
		TR25.944 4.1.2.2.1.1 DCCH 4.1.2.2.1.6 ISDN 4.1.2.2.2.2	UL_ISDN		

- 8.8 RACH performance

- 8.8.1 RACH preamble detection in static propagation conditions
- 8.8.2 RACH preamble detection in multipath fading case 3
- 8.8.3 Demodulation of RACH message in static propagation conditions
- 8.8.4 Demodulation of RACH message in multipath fading case 3

- 8.9 CPCH Performance

- 8.9.3 Demodulation of CPCH message in static propagation conditions
- 8.9.4 Demodulation of CPCH message in multipath fading case 3

- 8.10 Site Selection Diversity Transmission (SSdT) Mode

Signal patterns For receiver and performance testing for UE

Test item	Channel combination	Parameter	Patt. name	Added by option11				
TS25.101	TS25.101 Annex C.3.1	TS25.101 Annex A.3.1	DL_C31					
7 Receiver characteristics 8 Performance requirement	TS25.101 Annex C.3.2		D32T18s0 D32T18s8 D32T18s9					
		TS25.101 Annex A.3.2	D32T28s0 D32T28s8 D32T28s9					
		TS25.101 Annex A.3.3	D32T38s0 D32T38s8 D32T38s9					
		TS25.101 Annex A.3.4	D32T48s0 D32T48s8 D32T48s9					
	TS25.101 Annex C.4		DL_INTR					
8.3 in multi-path (Case7) Test21~25	TS25.101 Annex C.3.5	TS25.101 Annex A.4A	4Ps0 4Ps8 4Ps9					
8.6.1 open-loop transmit diversity	TS25.101 Annex C.3.3	TS25.101 Annex A.3.1	OTD1s0 OTD1s8 OTD1s9	OTD2s0 OTD2s8 OTD2s9				
8.9 Downlink compressed mode	TS25.101 Annex C.3.2	TS25.101 Annex A.5	DCP11540 DCP11548 DCP11549	DCP12540 DCP12548 DCP12549	DCP21540 DCP21548 DCP21549	DCP22540 DCP22548 DCP22549	DCP23540 DCP23548 DCP23549	
8.10 BTFD		TS25.101 Annex A.4	BTFD1s0 BTFD1s8 BTFD1s9	BTFD2s0 BTFD2s8 BTFD2s9	BTFD3s0 BTFD3s8 BTFD3s9			
8.12 PCH		TS25.101 Annex A.6	PCHs0 PCHs8 PCHs9					
7.4.2 Maximum input level HS-PDSCH 9 Performance requirement (HSDPA)	TS25.101 Annex C.5.1 Table C.8	TS25.101 Annex A.7.1	F1P0s0 F1A0s0 F2P0s0 F2A0s0 F3P0s0 F3A0s0 F4P0s0 F5P0s0					
	TS25.101 Annex C.3.2	TR25.944 4.1.1.3.1.1 DCCH 4.1.1.3.1.2 AMR TFCS#1 4.1.1.3.2.2	DAMR18s0 DAMR18s8 DAMR18s9					
		TR25.944 4.1.1.3.1.1 DCCH 4.1.1.3.1.2 AMR TFCS#2 4.1.1.3.2.2	DAMR28s0 DAMR28s8 DAMR28s9					
		TR25.944 4.1.1.3.1.1 DCCH 4.1.1.3.1.2 AMR TFCS#3 4.1.1.3.2.2	DAMR38s0 DAMR38s8 DAMR38s9					
		TR25.944 4.1.1.3.1.1 DCCH 4.1.1.3.1.6 ISDN 4.1.1.3.2.5	DISDN8s0 DISDN8s8 DISDN8s9					

8.3

Demodulation of DCH in multi-path fading propagation conditions

- (Case 7) Test 21~25

8.6

Demodulation of DCH in downlink Transmit diversity modes

- 8.6.1

Demodulation of DCH in open-loop Transmit diversity mode

8.9

Downlink compressed mode

8.10

Blind transport format detection (BTFD)

8.12

Demodulation of Paging Channel (PCH)

7.4

Maximum input level

- 7.4.2 HS-PDSCH for 16QAM

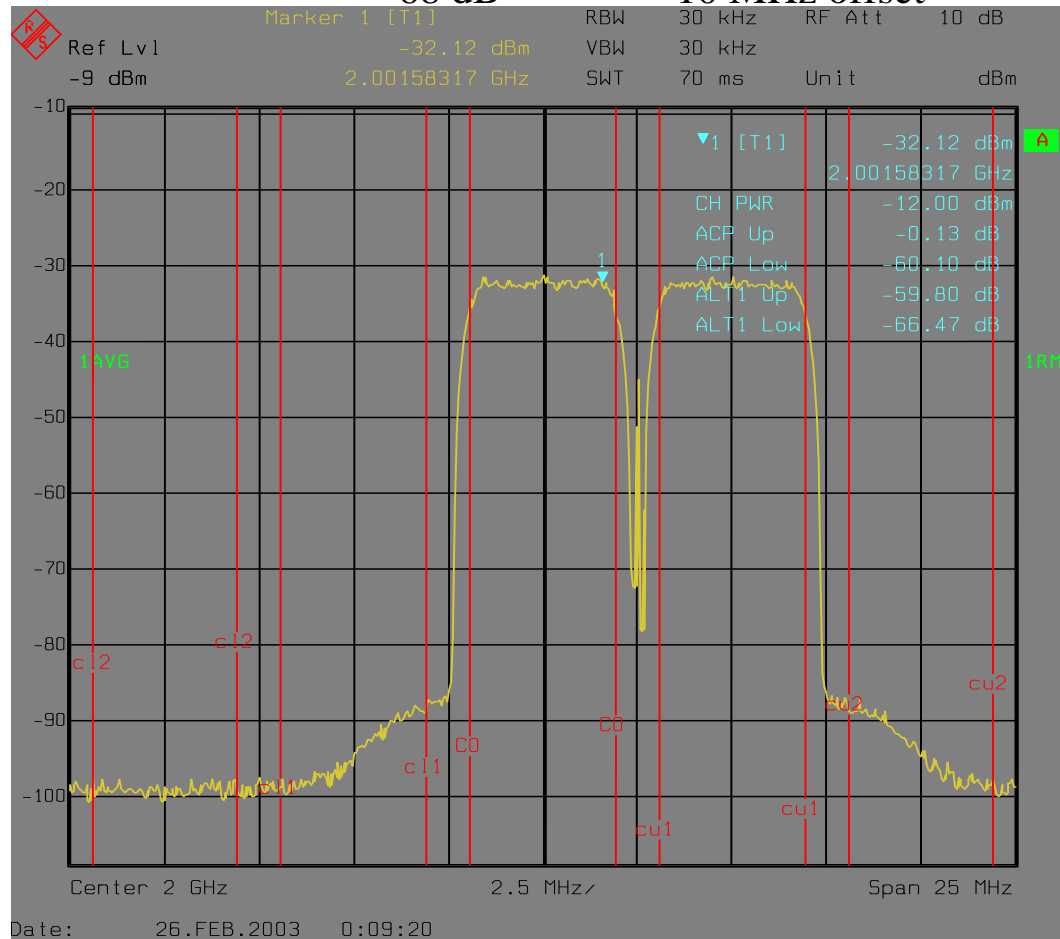
9

Performance requirement (HSDPA)

Multi-carrier typical ACLR

- **Test Model 1: 64 DPCH, ≤ -8 dBm**

- -60 dB 5 MHz offset
- -68 dB 10 MHz offset



```
MS8609A 2003/05/28 04:00:46
<< Modulation Analysis (W-CDMA) >>
```

Measure	: Single
Storage	: Normal
Trace	: Non
Frequency	
Carrier Frequency	: 2 137.500 000 2 MHz
Carrier Frequency Error	: 0.000 2 kHz
	: 0.000 ppm
Waveform Quality	
Waveform Quality Factor	: 0.99926
Modulation	
RMS EVM	: 2.70 % (rms)
Peak EVM	: 7.15 %
Phase Error	: 1.09 deg. (rms)
Magnitude Error	: 1.92 % (rms)
Origin Offset	: -74.61 dB
Power	
Filtered Power	: -11.14 dBm
SCH(Total)	: -12.97 dB
P-SCH	: -16.07 dB
S-SCH	: -15.89 dB
Scramble Code Number	: 00000

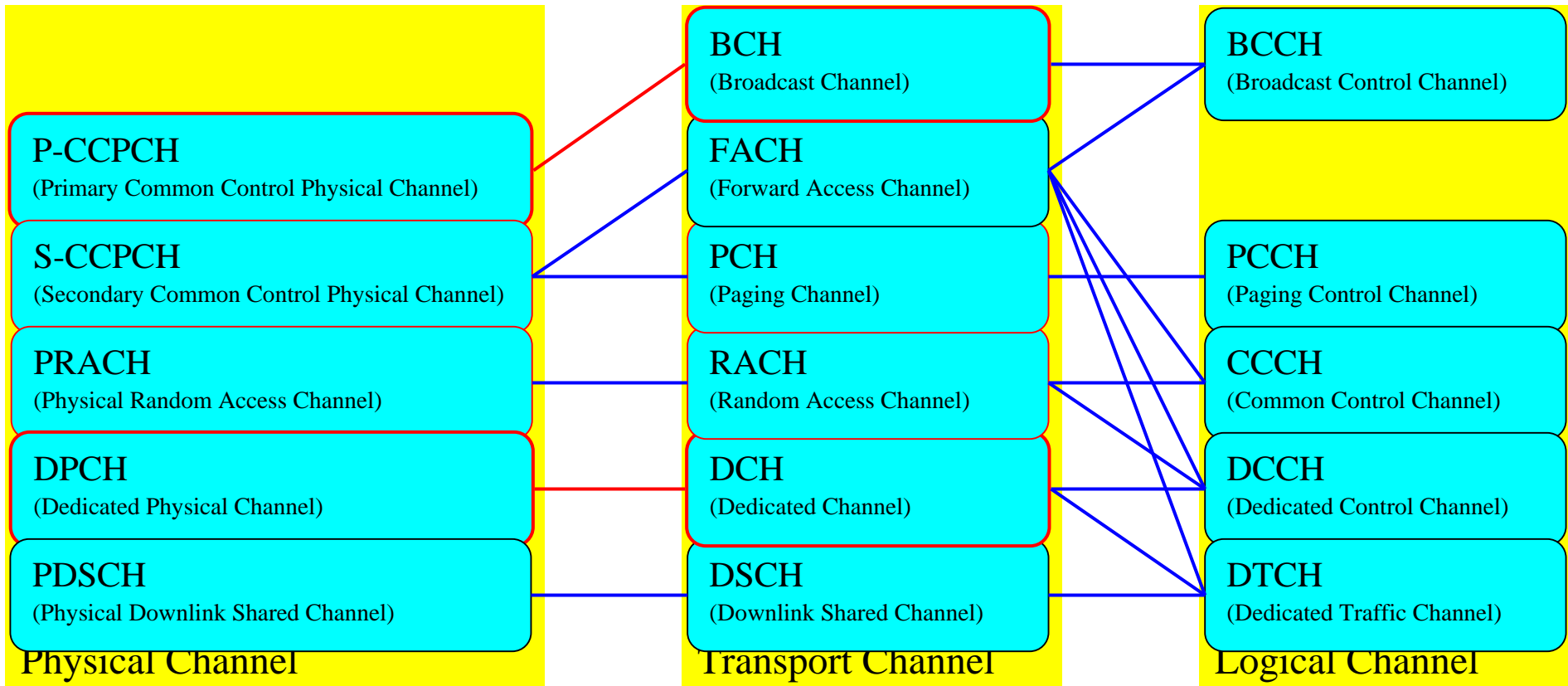
Real-time generation of test signal format

- **Simple editing on display**

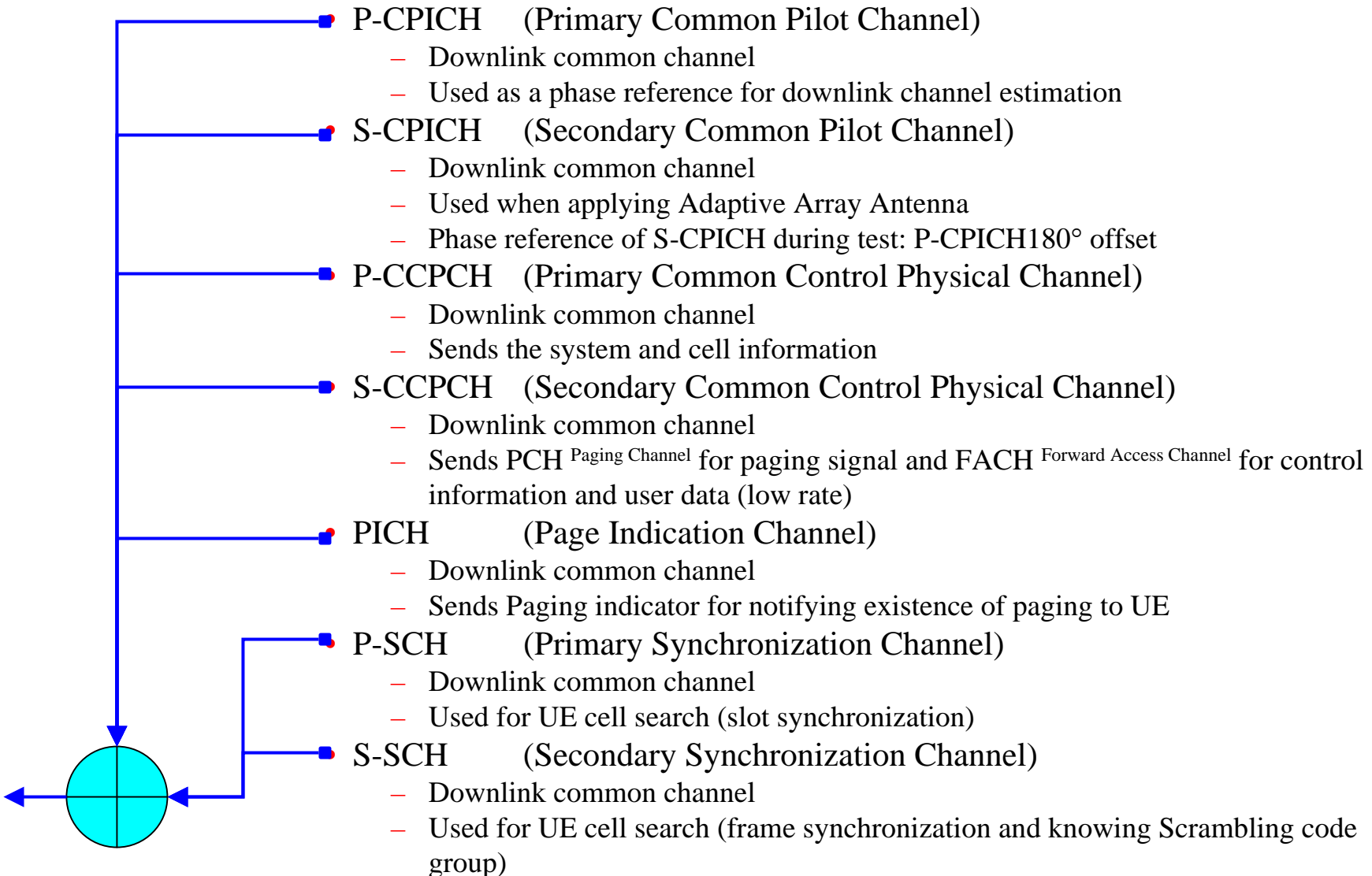
Supporting various test cases

- » Parameters for 5 types of physical channels and 2 types of transport channels

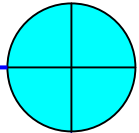
For reference) Mapping relations among main physical channels, transport channels and logical channels



Main physical channels for test



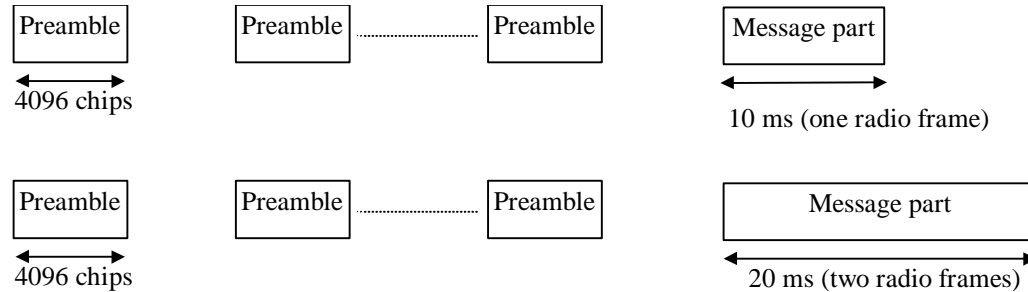
Main physical channels for test



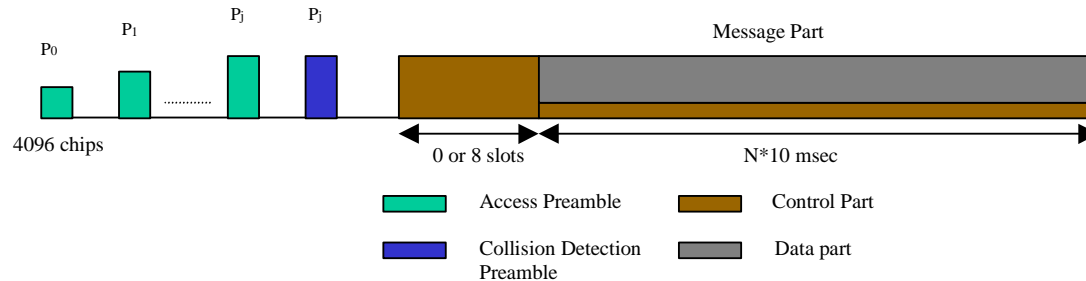
- **DPCH** (Dedicated Physical Channel)
 - Allocated to each UE
 - Downlink: Time multiplexing of DPDCH (Dedicated Physical Data Channel) and DPCCH (Dedicated Physical Control Channel) in time slot
 - Uplink: I/Q multiplexing of DPDCH, DPCCH and HS-DPCCH (Dedicated Physical Control Channel (uplink) for HSDPA)
- **HS-SCCH** (Shared Control Channel for HS-DSCH (High Speed Downlink Shared Channel))
 - Downlink common channel for HSDPA
 - Maximum of 4 channels per HS-SCCH set
 - Used for HS-PDSCH allocation
- **HS-PDSCH** (High Speed Physical Downlink Shared Channel)
 - Downlink common channel for HSDPA
 - Sends HS-DSCH for packet data
 - Slot format #0: QPSK, 1#: 16QAM
- **OCNS** (Orthogonal Channel Noise Simulator)
 - Interfering channel to simulate other users channels on downlink

Main physical channels for test

- PRACH (Physical Random Access Channel)
 - Uplink common channel
 - Sends RACH for control information and user data (low rate)



- PCPCH (Physical Common Packet Channel)
 - Uplink common channel
 - Sends CPCH for user packet data (high rate)



Real-time generation of Downlink physical channel

- » P-CCPCH (CH1~3)
 - BCH transport channel mapping
 - SCH TSTD: On, Off
 - TSTD
 - Time Switched TX Diversity
 - Open loop mode
 - Switching TX antenna (SCH) per slot
- » CPICH (CH1~3)
 - Antenna: 1,2
 - For TX diversity
 - STTD encoding (Antenna: 2)
 - STTD
 - Space Time Block Coding Based Transmit Antenna Diversity
 - Open loop mode
 - Controlling Symbol patterns on antenna2 side
- » DPCH (CH4)
 - DCH transport channel mapping
 - Slot format: #0 to #15
 - TPC: TPC command of 4 frames (60 slots) cycle
 - TPC
 - Transmit Power Control
 - Closed loop power control
 - * Inner loop power control
 - Controlling to equalize with target SIR
 - * Outer loop power control
 - Correcting target SIR to equalize with target BER/BLER

Physical channel : P-CCPCH

SCH	Data
2	18

Data : [SCH]
 SCH TSTD : [Off]
 Antenna : [1]

Data (CH4) Clock/Trig PWR CONT Ref. Clock I/Q Input

PhCH Edit
TrCH Edit
Return

Physical channel : DL-DPCH

Data 1	TPC	TFCI	Data 2	Pilot
(6)	(2)	(2)	(22)	(8)

Slot Format : [1]
 Data : [DCH]
 TPC : [5555 5555 5555 5555]_H
 TFCI : [000]_H
 Antenna : [1]
 DPCH/DPDCH Power Ratio : [0.0]dB
 BER : -

Data (CH4) Clock/Trig PWR CONT Ref. Clock I/Q Input

PhCH Edit
TrCH Edit
Return

Real-time generation of Uplink physical channel

- » DPCCH (CH1~3)
 - Slot format: #0, #2, #5
 - TPC: TPC command of 4 frames (60 slots) cycle
 - TPC
 - Transmit Power Control
 - Closed loop power control
 - * Inner loop power control
Controlling to equalize with target SIR
 - * Outer loop power control
Correcting target SIR to equalize with target BER/BLER

- » DPDCH (CH4)
 - DCH transport channel mapping

Physical channel : UL-DPCCH

Pilot	TFCI	FBI	TPC
(6)	(2)	(0)	(2)

Slot Format : #0
TFCI : [000]H
FBI : -
TPC : [555 5555 5555 5555]H

Physical channel : UL-DPDCH

Data (40)

Slot Format : #2
Data : [DCH]
BER : -

Screen Copy Completed

Real-time generation of Downlink transport channel

» BCH (P-CCPCH data)

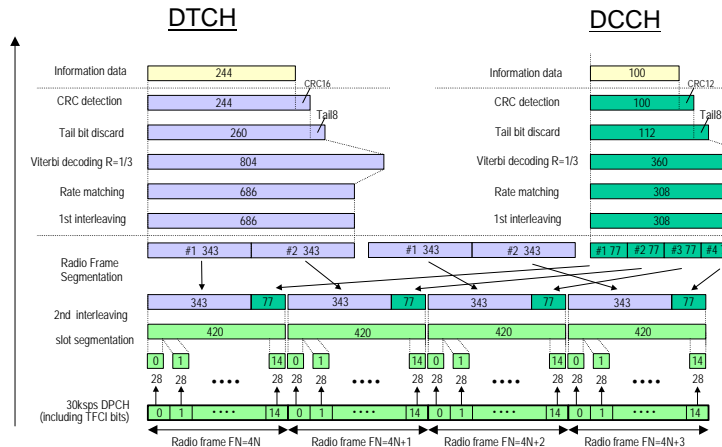
- 3GPP TS 25.944

Transport block size	246
CRC	16 bits
Coding	CC, coding rate = 1/2
TTI	20 ms
The number of codes	1
SF	256

» DCH (DPCH data)

- 3GPP TS 25.101

Parameter	TrCH1	TrCH2
	DTCH	DCCH
Transport Channel Number	1	2
Transport Block Size	244	100
Transport Block Set Size	244	100
Transmission Time Interval	20 ms	40 ms
Type of Error Protection	Convolution Coding	Convolution Coding
Coding Rate	1/3	1/3
Rate Matching attribute	256	256
Size of CRC	16	12
Position of TrCH in radio frame	fixed	fixed



- BER, BLER

- Generating the error
- 0 to 10 %, 0.1 % resolution

TrCH Edit

Transport Channel : BCH

SFN	Control	BCH	CRC	Tail
(11)	(20)	(215)	16	8

TTI : 20ms
 Coding : CC_1/2
 BCH Data : [PN9]
 SFN : [11]bit
 Control : [20]bit
 SFN Initial : [0000]H
 Control Data : [0000 7000]H

Return

Data (CH4)
Clock/Trig
PWR CONT
Ref. Clock
I/Q Input

TrCH Edit

Transport Channel : DCH

SF 128 Slot Format : #11
 TrCH No. [2] DTX : [Fix]

	TrCH1	TrCH2	TrCH3	TrCH4
Data	[PN9]	[PN9]	-	-
TTI	[20]ms	[40]ms	-	-
Max.TrBk Size	[244]bit	[100]bit	-	-
TrBk Size	[244]bit	[100]bit	-	-
TrBk Set No.	TrBk X [1]	TrBk X [1]	-	-
CRC	[16]bit	[12]bit	-	-
Tail	1 X 8bit	1 X 8bit	-	-
Coder	[CC_1/3]	[CC_1/3]	-	-
Termination	0 X 12bit	0 X 12bit	-	-
RM attribute	[256]	[256]	-	-
Rept/Punc	-118bit	-52bit	-	-
BER	[0.01%]	[0.01%]	-	-
BLER	[0.01%]	[0.01%]	-	-

Return

Data (CH4)
Clock/Trig
PWR CONT
Ref. Clock
I/Q Input

Real-time generation of Uplink transport channel

- » DCH (DPDCH data)
 - 3GPP TS 25.101

Parameters	TrCH1	TrCH2
	DTCH	DCCH
Transport Channel Number	1	2
Transport Block Size	244	100
Transport Block Set Size	244	100
Transmission Time Interval	20 ms	40 ms
Type of Error Protection	Convolution Coding	Convolution Coding
Coding Rate	1/3	1/3
Rate Matching attribute	256	256
Size of CRC	16	12

Transport Channel : DCH TrCH Edit

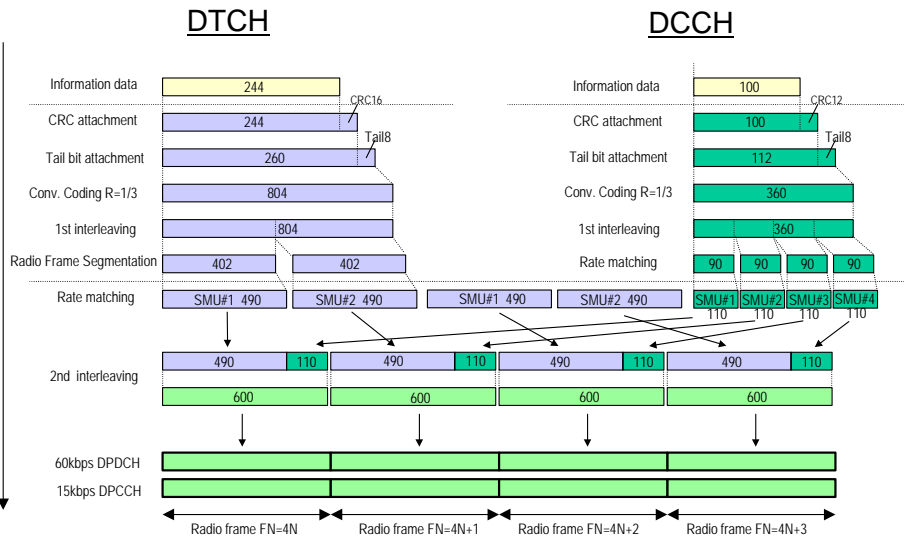
SF 64 Slot Format : #2

TrCH No. [2]

	TrCH1	TrCH2	TrCH3	TrCH4
Data	[PN9]	[PN9]	-	-
TTI	[20]ms	[40]ms	-	-
Max.TrBk Size	-	-	-	-
TrBk Size	[244]bit	[100]bit	-	-
TrBk Set No.	TrBk X [1]	TrBk X [1]	-	-
CRC	[16]bit	[12]bit	-	-
Tail	1 X 8bit	1 X 8bit	-	-
Coder	[CC_1/3]	[CC_1/3]	-	-
Termination	0 X 12bit	0 X 12bit	-	-
RM attribute	[256]	[256]	-	-
Rept./Punc	88bit	20bit	-	-
BER	[0.0]%	[0.0]%	-	-
BLER	[0.0]%	[0.0]%	-	-

Data (CH4)
Clock/Trig
PWR CONT
Ref. Clock
I/Q Input

Return →



- BER, BLER
 - Generating the error
 - 0 to 10 %, 0.1 % resolution

Power control function

Operation check of closed loop power control is performable.

- The slot power of each channel is programmable up to 64 slot cycle by editing on display.
 - » Editing the slot power for each channel of CH4~12
 - -40 to 0 dB (reference: channel power), 1 dB resolution
- The slot power of each channel is controlled up/down by external control trigger input.
 - » Controlling the slot power of specified channel among CH4~12
 - Up & Down in 1, 2 or 3 dB

e.g.) TPC bit

External control trigger TTL

Power Control Program Edit

Edit Channel : [4] Ext Power Control Step Size : [1dB]
Edit Slot : [32] Power Control Program : [Int]
Power Control Cycle Number : [32]

Slot : [0n] Power : [- 0dB]

Slot	Power	Slot	Power	Slot	Power	Slot	Power
1:0n	- 1dB	17:0n	-15dB	33:0ff	- 0dB	49:0ff	- 0dB
2:0n	- 2dB	18:0n	-14dB	34:0ff	- 0dB	50:0ff	- 0dB
3:0n	- 3dB	19:0n	-13dB	35:0ff	- 0dB	51:0ff	- 0dB
4:0n	- 4dB	20:0n	-12dB	36:0ff	- 0dB	52:0ff	- 0dB
5:0n	- 5dB	21:0n	-11dB	37:0ff	- 0dB	53:0ff	- 0dB
6:0n	- 6dB	22:0n	-10dB	38:0ff	- 0dB	54:0ff	- 0dB
7:0n	- 7dB	23:0n	- 9dB	39:0ff	- 0dB	55:0ff	- 0dB
8:0n	- 8dB	24:0n	- 8dB	40:0ff	- 0dB	56:0ff	- 0dB
9:0n	- 9dB	25:0n	- 7dB	41:0ff	- 0dB	57:0ff	- 0dB
10:0n	-10dB	26:0n	- 6dB	42:0ff	- 0dB	58:0ff	- 0dB
11:0n	-11dB	27:0n	- 5dB	43:0ff	- 0dB	59:0ff	- 0dB
12:0n	-12dB	28:0n	- 4dB	44:0ff	- 0dB	60:0ff	- 0dB
13:0n	-13dB	29:0n	- 3dB	45:0ff	- 0dB	61:0ff	- 0dB
14:0n	-14dB	30:0n	- 2dB	46:0ff	- 0dB	62:0ff	- 0dB
15:0n	-15dB	31:0n	- 1dB	47:0ff	- 0dB	63:0ff	- 0dB
16:0n	-16dB	32:0n	- 0dB	48:0ff	- 0dB	64:0ff	- 0dB

Pwr. Cont. [Ext]

Return

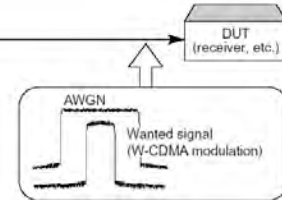
Data (CH4) Clock/Trig PWR CONT Ref. Clock I/Q Input

AWGN mixing

Single unit is performable dynamic range test of BS receiver.

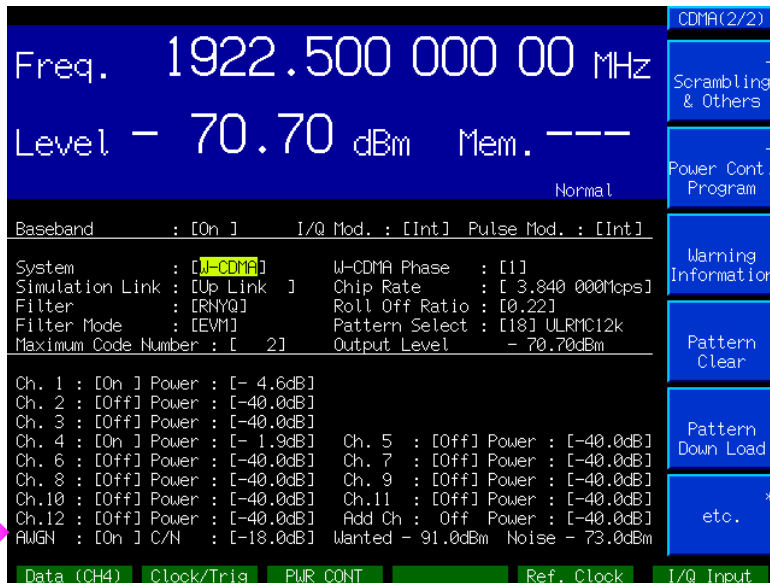
- **Mixing AWGN to Uplink wanted signal**
 - AWGN: Additive White Gaussian Noise
- **High-accuracy and high-stability C/N**
 - » -30 to -20 dB, 0.2 dB resolution
 - 19.9 to -8 dB, 0.1 dB resolution

Signal generator for wanted signal and AWGN



- **Selecting AWGN bandwidth**

- » $1.5 \times 3.84\text{MHz}(\text{Chip rate}) = 5.76\text{ MHz}$
- » $2 \times 3.84\text{MHz}(\text{Chip rate}) = 7.68\text{ MHz}$



» Front panel

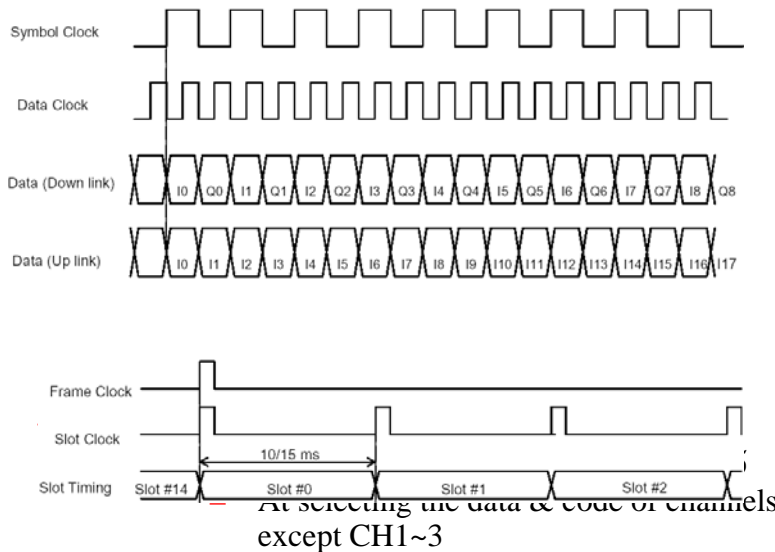
- Data (CH4)
 - Symbol data
- Clock/Trig
 - Synchronization of external frame clock
 - Frame trigger or start trigger is selectable
 - Used at BS receiver test
- PWR CONT
 - Refer to “Power Control Function” on previous pages
- Ref. Clock
 - Synchronization of external baseband reference clock
 - 1×, 2×, 4× chip rate is selectable
 - Used at start trigger
 - External reference clock input on rear panel (10/13MHz) is also available



Auxiliary signal

» Rear panel

- Data (A),(B), Code I/Q (A),(B)
 - Data & code of CH1~12 are selectable
 - Data: The data before spreading(Symbol) or after spreading(Chip) is selectable
- At CH1~3
 - (A) Data & code of P-CCPCH and P-SCH
 - (B) Data & code of P-CCPCH and S-SCH
- Reference Clock
 - Baseband reference clock
 - 1x, 2x, 4x, 8x chip rate is selectable
- Symbol Clock, Data Clock



At selecting the data & code of channels except CH1~3

Output

Rear Panel

Rear Panel Information

BNC		
Digital Output	A1:Data Clock A3:Symbol Clock B1:Super Frame Clock B3:Slot Clock	A2:Data (A) A4:Reference Clock B2:Frame Clock B4:Data (B)
Digital Input/Output	C1:Code I (A) C3:Code I (B)	C2:Code Q (A) C4:Code Q (B)
AUX 1	D1: D3:	D2:
Dsub-25P AUX 2	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 13 ***** 1 G G - - - - * * * * * 25 14 </div>	19 - 23 : NC 24 & 25 : Ground
1:	2:	3:DATA 2 (CH5)
4:DATA 3 (CH6)	5:DATA 4 (CH7)	6:DATA 5 (CH8)
7:DATA 6 (CH9)	8:DATA 7 (CH10)	9:DATA 8 (CH11)
10:DATA 9 (CH12)	11:	12:
13:	14:	15:
16:	17:	18:

Data (CH4)
Clock/Trig
PWR CONT
Ref. Clock
I/Q Input

Rear Panel

Rear Panel Information

BNC		
Digital Output	A1:Data Clock A3:Symbol Clock B1:Super Frame Clock B3:Slot Clock	A2:Data (A) A4:Reference Clock B2:Frame Clock B4:Data (B)
Digital Input/Output	C1:Code I (A) C3:Burst Gate (CH4)	C2:Code Q (A) C4:Burst Gate (CH5)
AUX 1	D1: D3:	D2:
Dsub-25P AUX 2	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 13 ***** 1 G G - - - - * * * * * 25 14 </div>	19 - 23 : NC 24 & 25 : Ground
1:	2:	3:DATA 2 (CH5)
4:DATA 3 (CH6)	5:DATA 4 (CH7)	6:DATA 5 (CH8)
7:DATA 6 (CH9)	8:DATA 7 (CH10)	9:DATA 8 (CH11)
10:DATA 9 (CH12)	11:	12:
13:	14:	15:
16:	17:	18:

Data (CH4)
Clock/Trig
PWR CONT
Ref. Clock
I/Q Input

MX368141A HSDPA IQproducer™

- MX368141A HSDPA IQproducer™ is the PC application software that generates 3GPP HSDPA compliant signal patterns outputted from MG3681A Digital Modulation Signal Generator.
- MG3681A Digital Modulation Signal Generator that has MU368040A CDMA MODULATION UNIT and MX368041B W-CDMA Software is required for the use of generated signal patterns.
- Since multiple pattern files that are generated can be downloaded into MG3681A mainframe, users can switch over signal patterns easily by selecting them.



PC

MX368141A
HSDPA IQproducer™



Memory card



MG3681A
Digital Modulation Signal Generator
+ MU368040A
CDMA Modulation Unit
+ MX368041B
W-CDMA Software

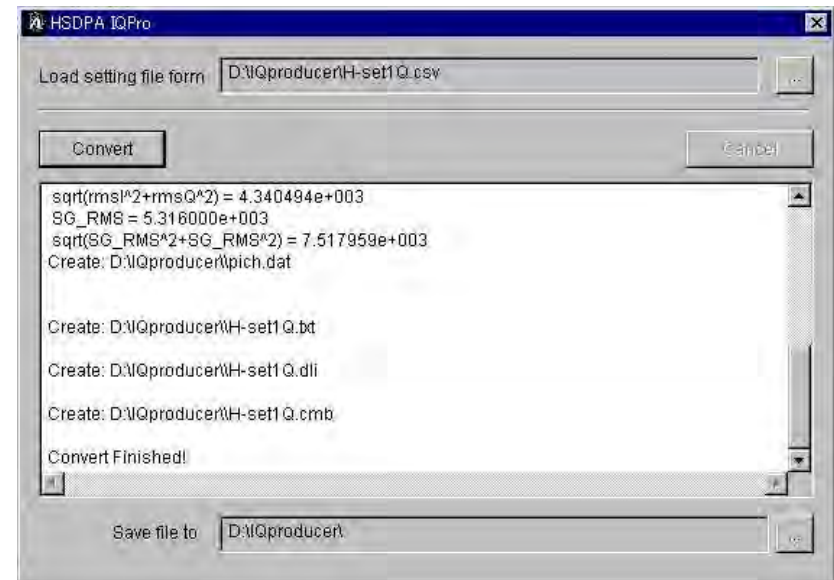
Easy to generate signal patterns with the setting file included

- With the MX368141A HSDPA IQproducer™, users can generate signal patterns by editing a setting file (csv format) that determines HSDPA-system signal patterns with Excel program and converting the edited setting file.
- With the setting file of standard signal patterns (Fixed Reference Channel*) included in the software, users can generate signal patterns easily only by editing the parameter they wish to change.

The screenshot shows an Excel spreadsheet with the following data:

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	#Downlink Physical Channels connection set-up												
2	#3GPP TS 25.101 V5.9.0 C5.1 Table C.8-Downlink physical channels for HSDPA receiver testing for Single Link performance												
3	SIB_LINK	ON											
4	CPICH	ON	-10.1										
5	P_CCPCH	ON	-10.1										
6	PICH	ON	-10.1	127									
7	DLDPCH	ON	-10.1	127	RMC12.2kbps								
8	OCNS	ON											
9	DL_ScramblingCode		8191										
10													
11	HS-SCCH	ON	-10.1	127	Coded	FFFF		1	5	0		0	0
12	HS-SCCH2	OFF	-10.1	127	Coded	FFFF		6	10	0		0	0
13	HS-SCCH3	OFF	-10.1	127	Coded	FFFF		9	3	0		0	0
14	HS-SCCH4	OFF	-10.1	127	Coded	FFFF		12	3	0		0	0
15	HS-PDSCH1	ON	-10.1	HS-PDSCH	PR96x	FFFF	Correct	1				800	
16	HS-PDSCH2	OFF	-10.1	HS-PDSCH	PR96x	FFFF	Correct	1				800	
17	HS-PDSCH3	OFF	-10.1	HS-PDSCH	PR96x	FFFF	Correct	1				800	
18	HS-PDSCH4	OFF	-10.1	HS-PDSCH	PR96x	FFFF	Correct	1				800	
19	HARQprocess1	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000
20	HARQprocess2	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000
21	HARQprocess3	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000
22	HARQprocess4	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000
23	FrameCycle	12											

MX368141A HSDPA IQproducer™
setting file edit screen



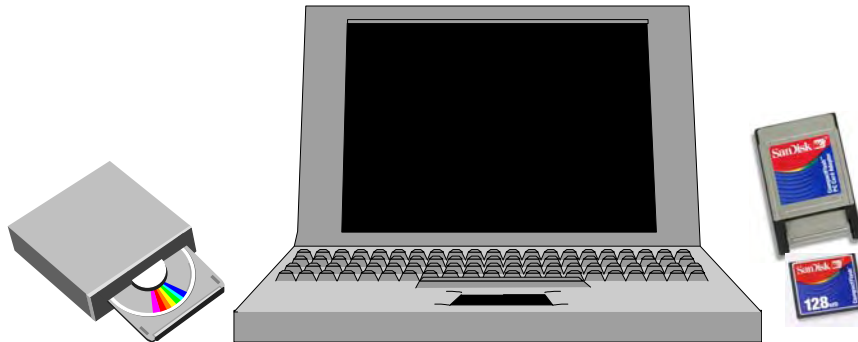
MX368141A HSDPA IQproducer™
setting file convert screen

Operating environment

Personal computer

- **OS:** Windows 2000/XP
- **CPU:** Pentium 300MHz or faster
- **Memory size:** $\geq 128\text{MB}$
- **HDD:** Occupation $\leq 200\text{MB}$
- **Display:** 800×600 pixels or more
- **Peripheral equipment :**

It be possible to read CD-R.
It be possible to save in Compact-Flash (PC card adapter is required for download to MG3681A)



Comparison of MX368141A HSDPA IQproducer and MX368041A-11 HSDPA signal pattern

The functional difference about HSDPA

Model - Baseband - Software - HSDPA application software	MG3681A - MU368040A - MX368041A/B - MX368141A	MG3681A - MU368040A - MX368041A/B - MX368041A/B-11
Type of software	IQproducer * Change of a parameter is possible.	Signal pattern * Change of a parameter is impossible.
Component test for Down-Link of HSDPA	No	Yes (Supports test model 5)
Component test for Up-Link of HSDPA	Yes (Supports HS-DPCCH)	No
Supports HSDPA channels	HS-PDSCH HS-SCCH HS-DPCCH	HS-PDSCH HS-SCCH

MX368141A can change a parameter and supports HS-DPCCH of HSDPA Uplink.

MX368040A-11 support "Test Model 5" of the component test of HSDPA Downlink.

MX368042A IS-95 Device Test Software



- Forward/Reverse cdmaOne test signals for IS-95A/B(3GPP2 C.S0002 RC1 & 2) standard can be outputted by installing the MX368042A IS-95 Device Test Software in the MU368040A CDMA Modulation Unit.
- In R&D/production process of components, base stations (BS) and mobile stations (MS), the functions to support various applications are provided as the signal source for components and the interfering signal source for receiver test.



Generation of test signal format

- Test Mode 1 & 2 signals in IS-97A/B(3GPP2 C.S0010 RC1 & 2) test specifications can be **simply set** without setting complicated parameters of IS-95A/B(3GPP2 C.S0002 RC1 & 2).



Caution

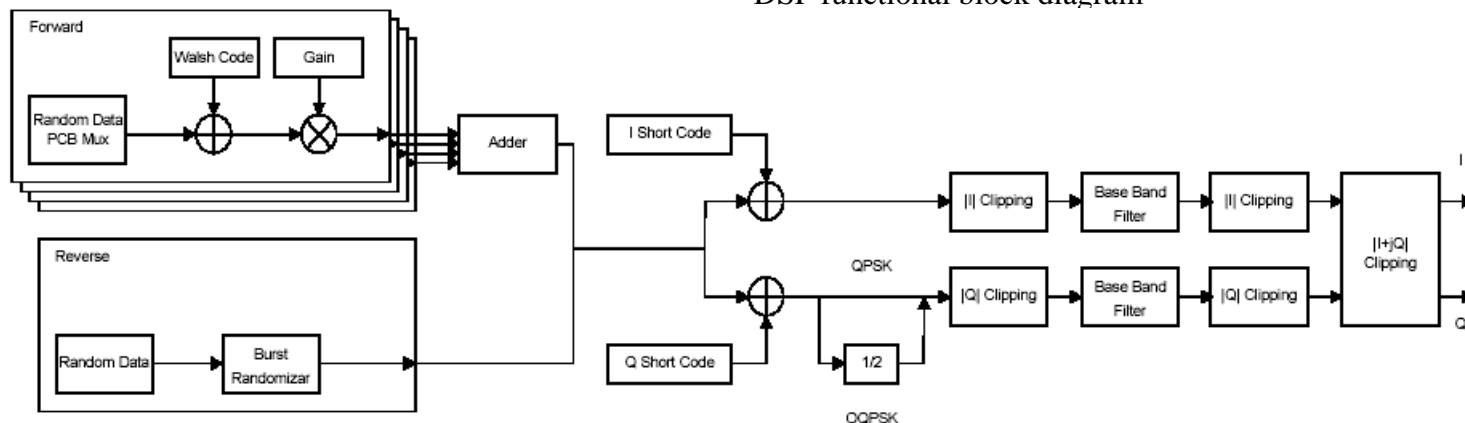
- » Channel coding is not supported
(FER Frame Error Rate test is not performable)

Table 6.5.2-1. Base Station Test Model, Nominal for Main Path

Channel Type	Number of Channels	Fraction of Power (linear)	Fraction of Power (dB)	Comments
Forward Pilot	1	0.2000	-7.0	Code channel W_0^{128}
Sync	1	0.0471	-13.3	Code channel W_{32}^{64} ; always 1/8 rate
Paging	1	0.1882	-7.3	Code channel W_1^{64} ; full rate only
Traffic	6	0.09412	-10.3	Variable code channel assignments; full rate only

- DSP stores the I/Q mapping data of 98304 chip (4 frames) /4× over sampling in Waveform data Memory according to the parameter set on display.

DSP functional block diagram



Generation of test signal format

Simple editing on display

Support various test cases

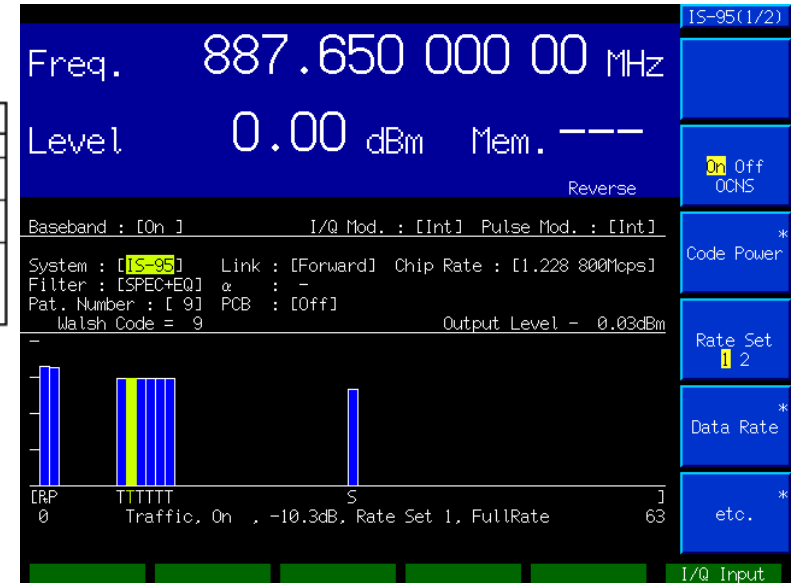
Channel Type	Walsh Code	Function
Pilot	0	Symbol Data is "0".
Sync	32	Symbol Data is Random. Symbol Rate is 4.8 kbps.
Paging	1 to 7	Symbol Data is Random. Symbol Rate is 19.2 kbps.
Traffic	8 to 31, 33 to 63	Symbol Data is Random. Symbol Rate is 19.2 kbps. Settings of Data Rate and Rate Set are enabled. Setting PCB to On allows PCB bit to be inserted.

Forward

- » Multiple channels
 - 1 to 64
- » Per Walsh code (0 to 63)
 - On, Off, OCNS
 - Code Domain Power
 - -40 to 0 dB, 0.1 dB resolution
- » Traffic channels
 - Rate set
 - 1 (RC1), 2 (RC2)
 - Data rate
 - Full, Half, Quarter, Eighth
 - 9.6, 4.8, 2.4, 1.2 kbps (Rate set 1)
 - 14.4, 7.2, 3.6, 1.8 kbps (Rate set 2)

Reverse

- Data rate
 - Full, Half, Quarter, Eighth
 - 9.6, 4.8, 2.4, 1.2 kbps (Rate set 1)



Peak Clipping of test signal

Clipping

Freq. 887.650 000 00 MHz

Level 0.00 dBm Mem. ---

Reverse

Baseband : [0n] I/Q Mod. : [Int] Pulse Mod. : [Int]

System : [IS-95] Link : [Forward] Chip Rate : [1.228 800]kpsps
 Filter : [SPEC+EQ] α : -
 Pat. Number : [9] PCB : [Off]
 Walsh Code = 9 Output Level = 0.03dBm

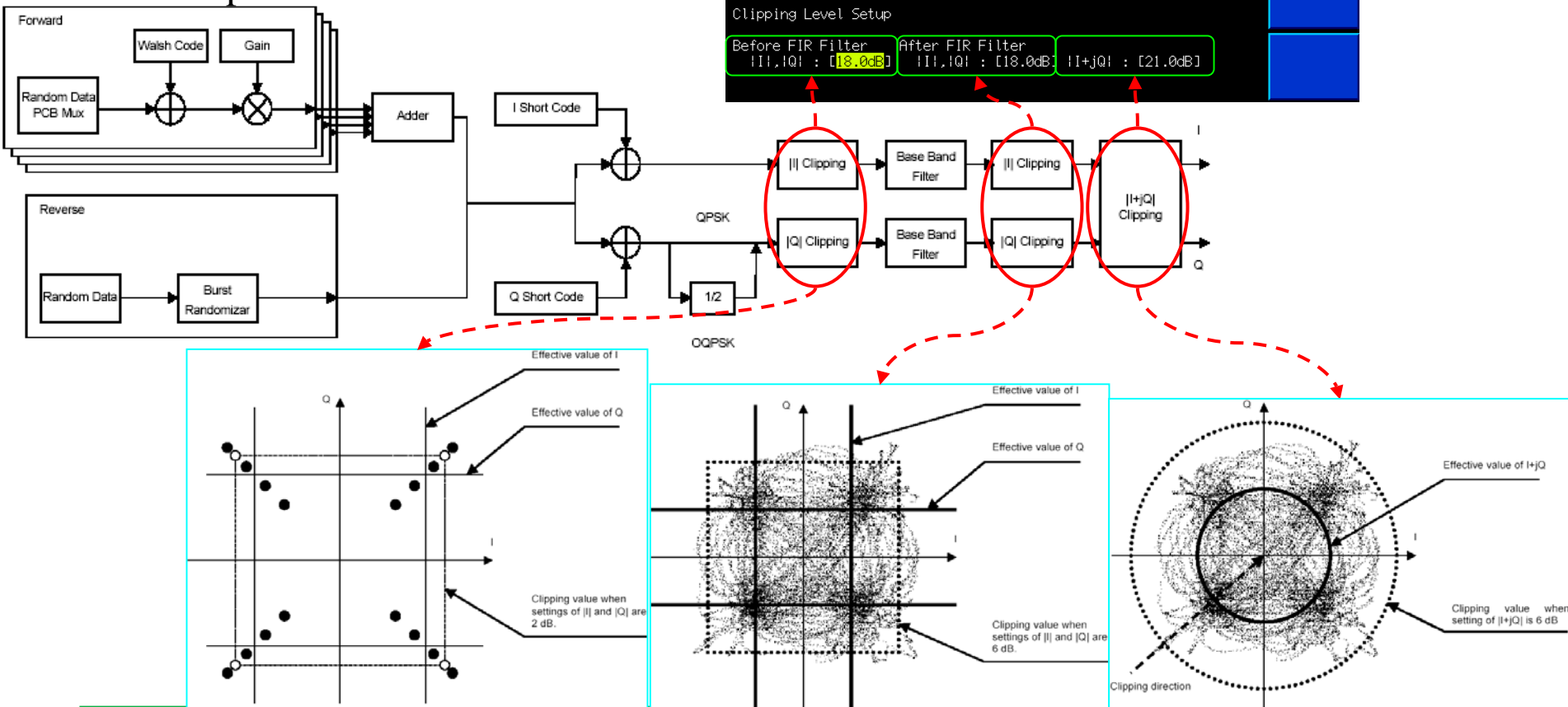
Clipping Level Setup

Before FIR Filter After FIR Filter

$|I|, |Q|$: [18.0dB] $|I|, |Q|$: [18.0dB] $|I+jQ|$: [21.0dB]

Useful for the evaluation of crest factor(CCDF) at components

» Limiting the peak level of I/Q amplitude



Peak Clipping of test signal

- **Clipping before FIR filtering**
 - » ACLR of output signals is not deteriorated because of no distortion caused by clipping.
 - Extreme clipping deteriorates waveform quality.
 - » FIR filtering may cause the peak exceeding limited level. Large peak is caused especially at few multiplex number.
- **Clipping after FIR filtering**
 - » Clipping causes distortion and deteriorates the ACLR of output signals.
- **Scalar clipping**
 - » Limiting I or Q amplitude level
- **Vector clipping**
 - » Limiting RMS $\sqrt{I^2+Q^2}$ level

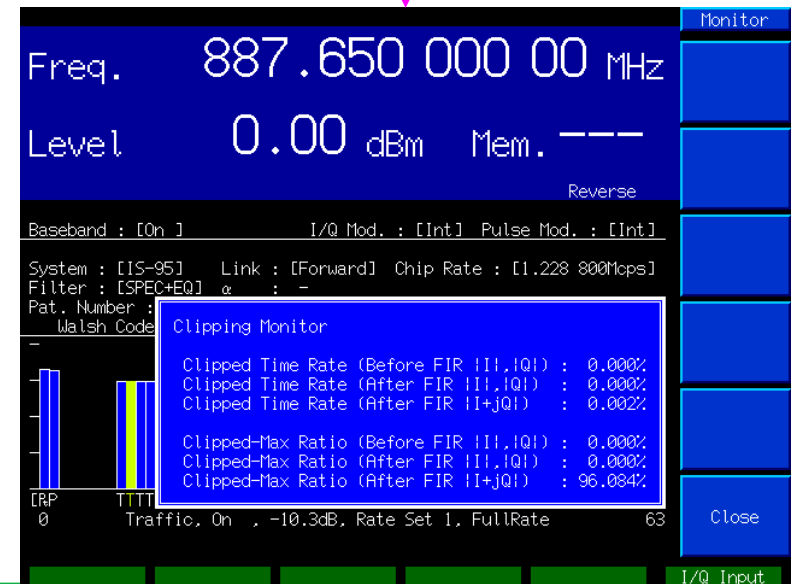
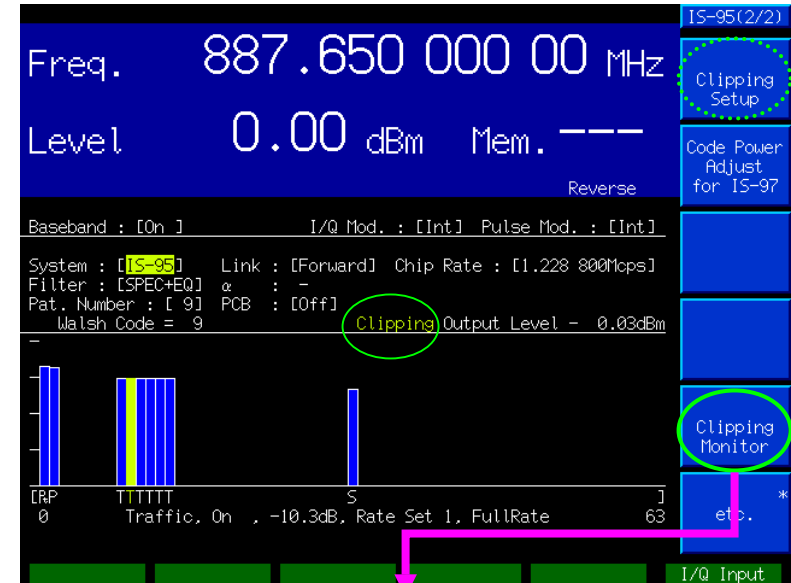
Peak Clipping Monitor of test signal

- **“Clipping” is indicated when vector amplitude is attenuated by Clipping**

- » Selectable “Clipping Monitor”

- **Checking Attenuated time and vector amplitude**

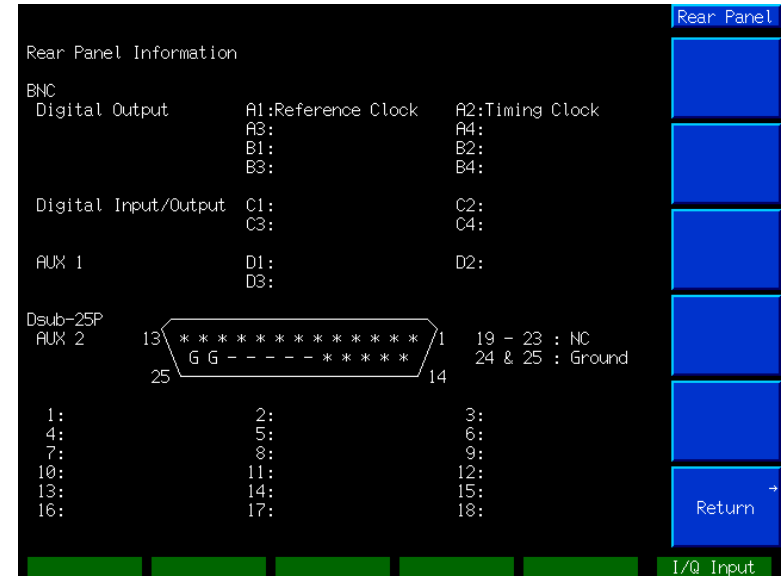
- » Clipped Time Rate
 - Percentage of attenuated sampling point
- » Clipped Max Ratio
 - Attenuation percentage of max. vector amplitude
 - 100% indicates the vector amplitude without attenuation



Auxiliary signal

Output

- » Rear panel
 - Reference Clock
 - Baseband reference clock
 - Chip rate
 - Timing Clock
 - 20ms, 26.7ms, 80ms, 2sec is selectable



MX368011A PDC Software

- **Downlink/Uplink PDC test signals (TCH, VOX) for RCR STD-27 standard can be outputted by installing the MX368011A PDC Software in the MU368010A TDMA Modulation Unit.**
- **In R&D/production process of components, base stations (BS) and mobile stations (MS), the functions to support various applications are provided as the signal source for components, the wanted signal source and the interfering signal source for receiver test.**

The image displays two side-by-side screenshots of the MX368011A PDC Software interface. Both screens show the same top-level settings: Freq. 800.000 000 00 MHz, Level 5.00 dBm, and Mem. ---. The left screen is labeled 'Full rate' and shows a 'Pattern Edit' menu with 'UP TCH' selected for Slot 0. The right screen is labeled 'Half rate' and shows a 'Pattern Edit' menu with 'DOWN TCH' selected for Slots 0 through 5. Both screens also display system parameters such as Modulation (π/4 DQPSK), Bit Rate (42.0kbps), and Filter (RNYQ α=[0.50]).

Emulation of MG3670 series

MG3670 series/MG3660A

- MG0301C $\pi/4$ DQPSK Modulation Unit
- MG0303B Burst Function Unit

Equal functions

- Display
- Remote control

A screenshot of the MG3670 series signal generator's display. The screen is divided into several sections. At the top, it shows 'Freq. 800.000 000 00 MHz' and 'Level 5.00 dBm Mem. ---'. Below this, it indicates 'Normal' mode. The main section shows various settings: 'Baseband : [On] I/Q Mod.: [Int] Pulse Mod.: [Int]', 'System : [PDC]', 'Modulation : $\pi/4$ DQPSK Bit Rate : [42.0kbps]', 'Filter : [RNYQ] α =[0.50] Phase Encode : [Normal]', 'Slot Rate : [Halfrate]', 'Burst : [On]', and 'Pattern : [DN TCH ALL]'. A small pop-up menu is visible over the 'Pattern' setting, showing options: 'DEVICE', 'UP TCH', 'UP TCH ALL', 'UP VOX', 'DN TCH', and 'DN TCH ALL'. The 'UP TCH ALL' and 'DN TCH ALL' options are highlighted in cyan. At the bottom of the screen, there are several status indicators: 'Data', 'Symbol Clock', 'Burst Gate', 'Burst Trig', 'Data Clock', and 'I/Q Input'. The bottom of the screen also shows 'Slot 0 S' and 'Slot 4 Slot 5' with corresponding 'DOWN TCH' indicators.

Real-time generation of test signal format

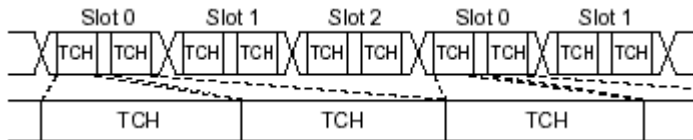
- **Simple editing on display**

Support various test cases

- » Full rate/Half rate
- » Slot On/Off
- » Parameter

- **PRBS data of TCH**

- » Continuous in the same slot
- » Phase is shifted per slot
 - When invalid slot is received, PRBS data becomes discontinuous and detectable by BER test



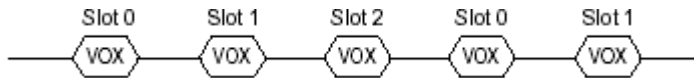
The top screenshot shows the 'DOWN TCH' pattern configuration. The frequency is 800.000 000 00 MHz, and the level is 5.00 dBm. The system is PDC, and the pattern is DN TCH ALL. The configuration is for Slot 0, with parameters: R=4, P=2, TCH=112, SW=20, CC=8, SF=1, SACCH=21, TCH=112. The parameters are: Scramble: [0h], Scramble Code: [000]h, TCH: [PN9], SW: [87A4B]h, CC: [00]h, SACCH: [00000]h. The parameters are: R: 0h, P: 2h, SF: 0h.

The bottom screenshot shows the 'UP TCH' pattern configuration. The frequency is 800.000 000 00 MHz, and the level is 5.00 dBm. The system is PDC, and the pattern is UP TCH. The configuration is for Slot 0, with parameters: R=4, P=2, TCH=112, SW=20, CC=8, SF=1, SACCH=15, TCH=112, G=6. The parameters are: Scramble: [0h], Scramble Code: [000]h, TCH: [PN9], SW: [785B4]h, CC: [00]h, SACCH: [00000]h. The parameters are: R: 0h, P: 2h, SF: 0h, G: 0h.

Real-time generation of test signal format

- **VOX (Voice Operated Transmission)**

- » Controlling to transmit voice signal in voice period and not to transmit voice signal in voiceless period for power saving of MS.



- **Interfering signal for receiver test**

The top screenshot shows the 'PatternEdit' screen. The frequency is set to 800.000 000 00 MHz and the level to 5.00 dBm. The system is 'PDC' and the pattern is 'UP VOX'. A diagram shows a sequence of slots: Slot 0 (VOX), Slot 1 (VOX), Slot 2 (UP TCH), Slot 3 (UP TCH), Slot 4, and Slot 5. Below this, a table shows parameters for Slot 0:

G	R	P	SW	CC	SF	SACCH	G
108	4	6	20	8	1	15	118

Additional parameters for Slot 0 are listed below the table:

- Scramble : [0h](SF,SACCH) G : 0h
- Scramble Code : [000]h R : 0h
- SW : [785B4]h P : 26h
- CC : [00]h SF : 0h
- SACCH : [0000]h

The bottom screenshot shows the 'Digital Mod' screen with the same frequency and level settings. The system is 'PDC'. The modulation is $\pi/4$ DQPSK, the filter is RNYQ with $\alpha=[0.50]$, and the slot rate is 'Fullrate'. Other parameters include Baseband: [0h], I/Q Mod.: [Int], Pulse Mod.: [Int], Modulation: $\pi/4$ DQPSK, Bit Rate: [42.0kbps], Filter: RNYQ $\alpha=[0.50]$, Phase Encode: [Normal], Slot Rate: [Fullrate], Burst: [Off], and Pattern: [PN15].

Pattern memory (MU368010A internal memory)

- Parameter settings up to 100 types on Pattern Edit screen can be saved.
- Title up to 8 characters can be inputted for easy confirmation.
 - » Saved parameter setting window

Edit Pattern Save/Delete
Memory No. (0)
Title : DN TCH

No:Title	No:Title	No:Title	No:Title	No:Title
0: DN TCH	20:	40:	60:	80:
1:	21:	41:	61:	81:
2:	22:	42:	62:	82:
3:	23:	43:	63:	83:
4:	24:	44:	64:	84:
5:	25:	45:	65:	85:
6:	26:	46:	66:	86:
7:	27:	47:	67:	87:
8:	28:	48:	68:	88:
9:	29:	49:	69:	89:
10:	30:	50:	70:	90:
11:	31:	51:	71:	91:
12:	32:	52:	72:	92:
13:	33:	53:	73:	93:
14:	34:	54:	74:	94:
15:	35:	55:	75:	95:
16:	36:	56:	76:	96:
17:	37:	57:	77:	97:
18:	38:	58:	78:	98:
19:	39:	59:	79:	99:

Save/Delete
Title *
Delete
Delete All
Return

Data Symbol Clock Burst Gate Burst Trig Data Clock I/Q Input

Edit Pattern List
Memory No. (0)

Title : DN TCH (1/3)

Slot 0 : DOWN TCH

R	P	TCH	SW	CC	SF	SACCH	TCH
4	2	112	20	8	1	21	112
Scramble : On (TCH,SF,SACCH)						SACCH : 000000H	
Scramble Code : 000H						R : 0H	
TCH : PN9						P : 2H	
SW : 87A4BH						SF : 0H	
CC : 00H							

11: 31: 51: 71: 91:
12: 32: 52: 72: 92:
13: 33: 53: 73: 93:
14: 34: 54: 74: 94:
15: 35: 55: 75: 95:
16: 36: 56: 76: 96:
17: 37: 57: 77: 97:
18: 38: 58: 78: 98:
19: 39: 59: 79: 99:

List
Next Slot

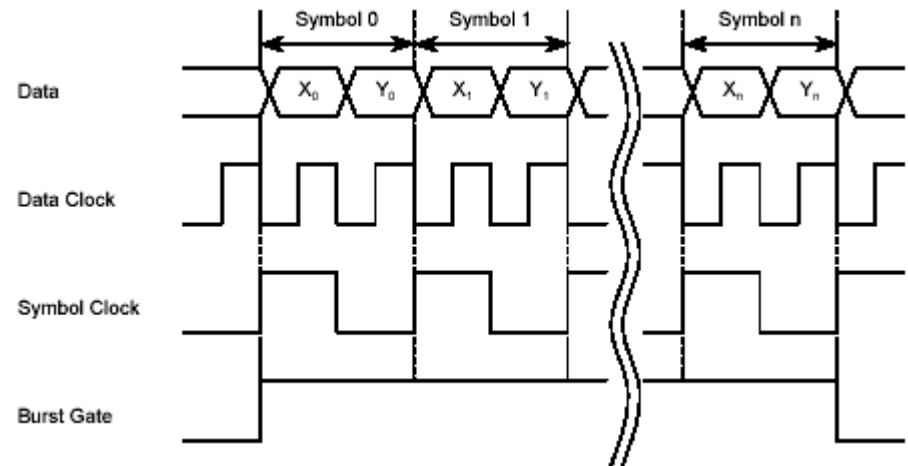
Data Symbol Clock Burst Gate Burst Trig Data Clock I/Q Input

External data input

$\pi/4$ DQPSK modulation signal of arbitrary frame format can be outputted by utilizing the pulse pattern generator.



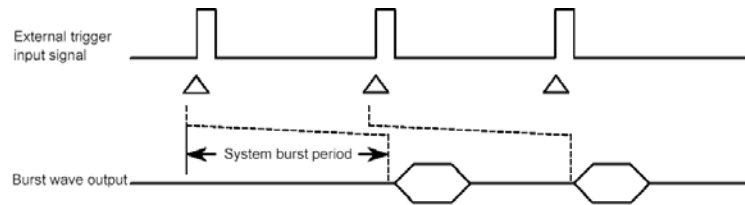
Base Band Setup	
Data	: [Ext]
Data Clock	: [Ext]
Ext Mod Input	
Data	: [Positive]
Data Clock	: [Rise]
Symbol Clock	: [Rise]
Burst Gate	: [Positive]
Ext Mod Output	
Data	: [Positive]
Data Clock	: [Rise]
Symbol Clock	: [Rise]
Burst Gate	: [Positive]
Burst Trigger Input	: [Rise]
Burst Trigger Output	: [Rise]
Pattern Sync Output	: [PN Clock]



Auxiliary signal Input

» Front panel

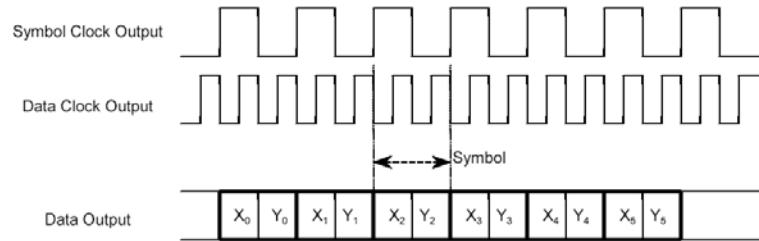
- Data, Symbol Clock, Burst Gate, Data Clock
 - Refer to “External Data Input” on previous pages
- Burst Trig
 - Synchronization of external burst trigger
 - Used at BS receiver test



Auxiliary signal

» Rear panel

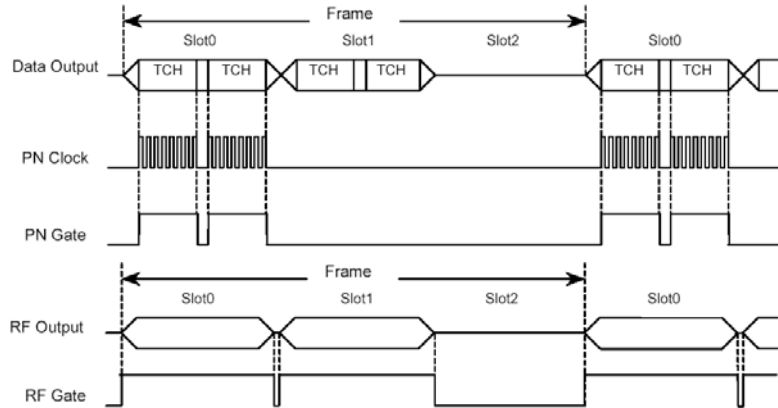
- Data, Data Clock, Symbol Clock



- Pattern Sync

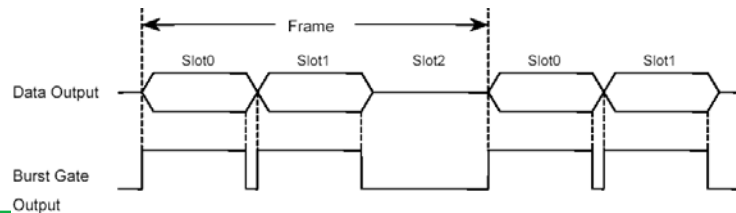
- PN Clock, PN Gate, RF Gate is selectable

- at Burst On



Control signal of internal pulse modulator

- Burst Gate



Output

- Burst Trigger

- Full/Half rate: 20 / 40 ms clock

Rear Panel

Rear Panel Information

BNC	A1:Data Clock	A2:Data
Digital Output	A3:Symbol Clock	A4:Burst Gate
	B1:Burst Trigger	B2:Pattern Sync
	B3:	B4:

Digital Input/Output	C1:	C2:
	C3:	C4:

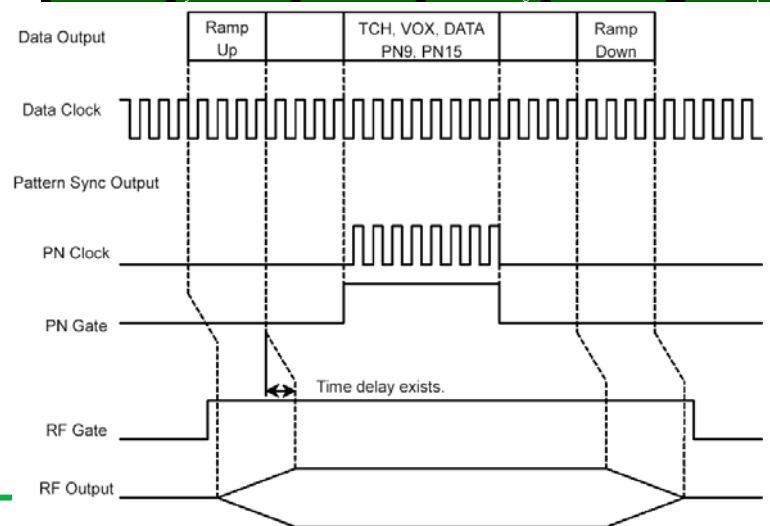
AUX 1	D1:	D2:
	D3:	

Dsub-25P
AUX 2

13	*****	1	19 - 23 : NC
	G G - - - - -		24 & 25 : Ground
25		14	

1 :	2 :	3 :
4 :	5 :	6 :
7 :	8 :	9 :
10 :	11 :	12 :
13 :	14 :	15 :
16 :	17 :	18 :

Data Symbol Clock Burst Gate Burst Trig Data Clock I/Q Input



MX368012A GSM Device Test Software



- **Downlink/Uplink GSM test signals (NB Normal Burst, AB Access Burst) for 3GPP TS (GSM) 05.01 standard can be outputted by installing the MX368012A GSM Device Test Software in the MU368010A TDMA Modulation Unit.**
- **In R&D/production process of components, base stations (BS) and mobile stations (MS), the functions to support various applications are provided as the signal source for components and the interfering signal source for receiver test.**

The image displays two side-by-side screenshots of the MX368012A GSM Device Test Software interface. Both screens show the same configuration for frequency (900.000 000 00 MHz) and level (5.00 dBm). The left screen is labeled 'NB' (Normal Burst) and shows a burst pattern of 8 'NORM' slots. The right screen is labeled 'AB' (Access Burst) and shows a 'RACH' slot. The interface includes a 'Digital Mod' header, a 'Pattern Edit' button, and a status bar at the bottom with 'Data', 'Symbol Clock', 'Burst Gate', 'Burst Trig', 'Data Clock', and 'I/Q' indicators.

Emulation of MG3670 series

MG3670 series/MG3660A

- **MG0302A GMSK Modulation Unit**
- **MG0303B Burst Function Unit**

Equal functions

- **Display**
- **Remote control**

Additional function

- **RACH format**
 - » Access Burst



The screenshot shows the signal generator's menu interface. The top section displays the frequency as 900.000 000 00 MHz and the level as 5.00 dBm. Below this, a table of settings is shown:

Baseband	: [On]	I/Q Mod.:	[Int]	Pulse Mod.:	[Int]
System	: [GSM]				
Modulation	: GMSK	Bit Rate	: [270.833kbps]		
Filter	: BbT=[0.30]				
Differential Encode	: [On]	Phase Polarity	: [Normal]		
Burst	: [On]				
Pattern	: [TCH_ALL]				
Trigger	:				

A context menu is open over the 'TCH_ALL' pattern setting, showing options: DEVICE (Knob), TCH (Step), TCH_ALL (Cursor), and RACH. Below the menu, a waveform diagram shows a sequence of slots (Slot0 to Slot7) with 'NORM' labels. At the bottom, a status bar includes 'Data', 'Symbol Clock', 'Burst Gate', 'Burst Trig', 'Data Clock', and 'I/Q Input'.

Real-time generation of test signal format

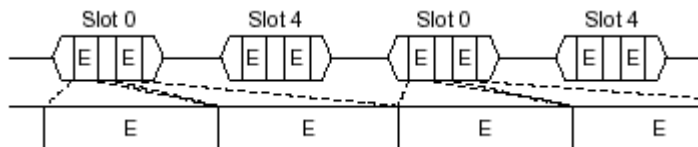
- **Simple editing on display**

Support various test cases

- » Slot On/Off
- » Slot level
 - -20 to 0 dB, 0.1 dB resolution
- » Differential Encode
 - Differential encoding in 3GPP TS (GSM) 05.04
- » Parameter

- **PRBS data of E(Encrypted bits)**

- » Continuous in the same slot
- » Phase is shifted per slot
 - When invalid slot is received, PRBS data becomes discontinuous and detectable by BER test



The top screenshot shows the 'TCH ALL' pattern configuration. The frequency is 900.000 000 00 MHz and the level is 5.00 dBm. The system is GSM and the pattern is TCH ALL. The slot configuration shows Slot 0 selected, with Slot Level set to [- 0.0dB]. The parameters for Slot 0 are: T: 3, E: 58, TS: 26, E: 58, T: 3, G: 8.25. The parameters for the entire pattern are: E: [PN9], TS: [0970897]H, T: 0H, G: FFH.

The bottom screenshot shows the 'RACH' pattern configuration. The frequency is 900.000 000 00 MHz and the level is 5.00 dBm. The system is GSM and the pattern is RACH. The slot configuration shows Slot 0 selected, with Slot Level set to [- 0.0dB]. The parameters for Slot 0 are: Ta: 8, TS: 41, E: 36, T: 3, G: 68, 25. The parameters for the entire pattern are: Ta: [3A]H, E: [PN9], TS: 096FF335478H, T: 0H, G: FFFFFFFFFFFFFFFFH.

Real-time generation of test signal format

- **Interfering signal for receiver test**

The screenshot displays a control interface for a test signal generator. The main display area has a dark blue background with white text. At the top right, there is a label 'Digital Mod'. The primary parameters shown are:

- Freq. 900.000 000 00 MHz
- Level 5.00 dBm Mem. ---

Below these, the word 'Normal' is centered. A series of settings follows, each on a new line:

- Baseband : [On] I/Q Mod.: [Int] Pulse Mod.: [Int]
- System : [FSK]
- Modulation : GMSK Bit Rate : [270.833kbps]
- Filter : BbT=[0.30]
- Differential Encode : [On] Phase Polarity : [Normal]
- Burst : [off]
- Pattern : [PN15]

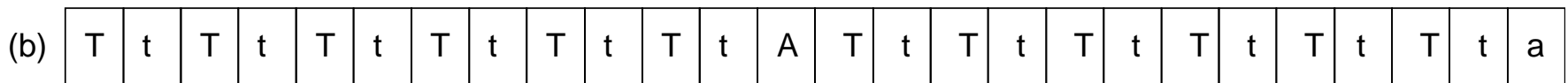
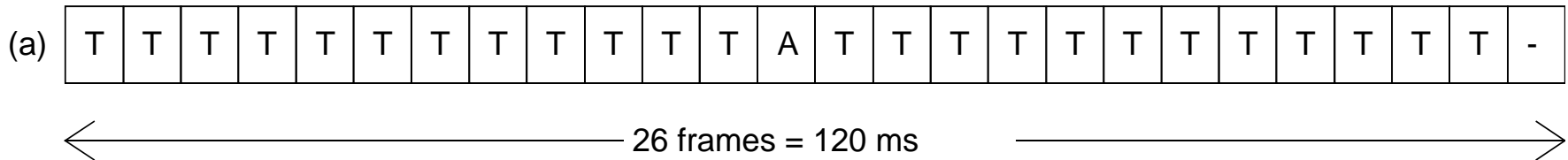
At the bottom of the interface, there is a row of seven green buttons with white text: Data, Symbol Clock, Burst Gate, Burst Trig, Data Clock, and I/Q Input.

Channel coding of test signal format



Caution

- » 3GPP TS (GSM) 05.03 Channel Coding is not supported.
 - Traffic Channels (TCH)
 - TCH/FS (Speech channel at full rate)
 - TCH/EFS (Speech channel at enhanced full rate)
 - Control Channels
 - SACCH (Slow associated control channel)
 - RACH (Random access channel)
 - Packet Switched Channels
 - PDTCH (Packet data traffic channel)
- » Multiframe format is not supported.



(a) case of one full rate TCH

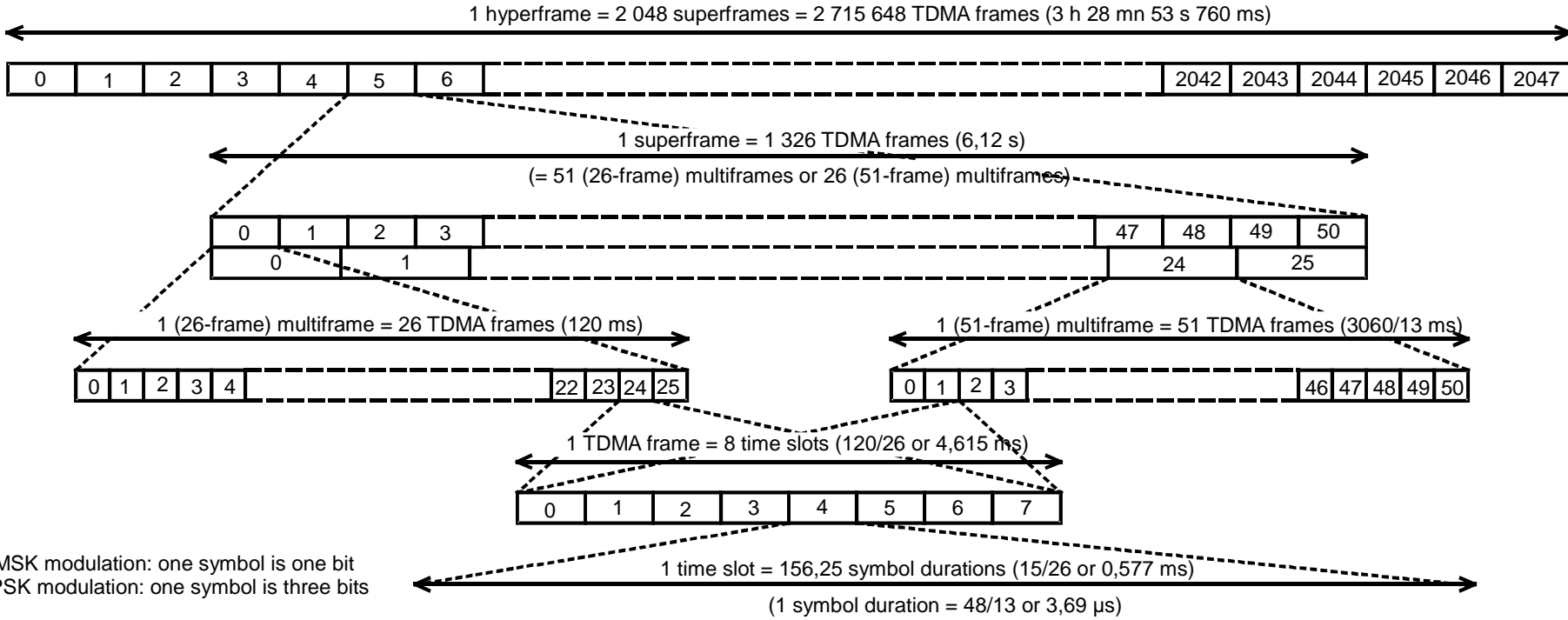
T, t: TDMA frame for TCH

-: idle TDMA frame

(b) case of two half rate TCHs

A, a: TDMA frame for SACCH/T

Time slot configuration in 3GPP TS 05.01



NOTE: GMSK modulation: one symbol is one bit
 8PSK modulation: one symbol is three bits

(TB: Tail bits - GP: Guard period)

Normal burst (NB) <i>The number shown are in symbols</i>	TB 3	Encrypted bits 58	Training sequence 26	Encrypted bits 58	TB 3	GP 8,25	
Frequency correction burst (FB)	TB 3	Fixed bits 142				TB 3	GP 8,25
Synchronization burst (SB)	TB 3	Encrypted bits 39	Synchronization sequence 64	Encrypted bits 39	TB 3	GP 8,25	
Access burst (AB)	TB 8	Synchronization sequence 41	Encrypted bits 36	TB 3	GP 68,25		

Pattern memory (MU368010A internal memory)

- Parameter settings up to 100 types on Pattern Edit screen can be saved.
- Title up to 8 characters can be inputted for easy confirmation.
 - » Saved parameter setting window

Edit Pattern Save/Delete
Memory No. (0)
Title : TCH ALL

No:Title	No:Title	No:Title	No:Title	No:Title
0: TCH ALL	20:	40:	60:	80:
1:	21:	41:	61:	81:
2:	22:	42:	62:	82:
3:	23:	43:	63:	83:
4:	24:	44:	64:	84:
5:	25:	45:	65:	85:
6:	26:	46:	66:	86:
7:	27:	47:	67:	87:
8:	28:	48:	68:	88:
9:	29:	49:	69:	89:
10:	30:	50:	70:	90:
11:	31:	51:	71:	91:
12:	32:	52:	72:	92:
13:	33:	53:	73:	93:
14:	34:	54:	74:	94:
15:	35:	55:	75:	95:
16:	36:	56:	76:	96:
17:	37:	57:	77:	97:
18:	38:	58:	78:	98:
19:	39:	59:	79:	99:

Save/Delete
Title *
Delete
Delete All
Return

Edit Pattern List
Memory No. (0)

Title : TCH ALL (1/8)

Slot 0 : NORMAL Slot Level : - 0.0dB

T	E	TS	E	T	G
3	58	26	58	3	8.25
E : PN9			T : 0H		
TS : 0970897H			G : FFH		

11: 31: 51: 71: 91:
12: 32: 52: 72: 92:
13: 33: 53: 73: 93:
14: 34: 54: 74: 94:
15: 35: 55: 75: 95:
16: 36: 56: 76: 96:
17: 37: 57: 77: 97:
18: 38: 58: 78: 98:
19: 39: 59: 79: 99:

List
Next Slot

External data input

GMSK modulation signal of arbitrary frame format can be outputted by utilizing the pulse pattern generator.

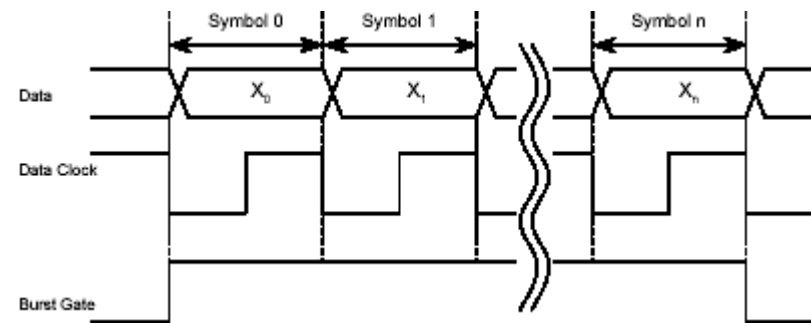


```
Base Band Setup
Data : [Ext.]
Data Clock : [Ext.]

Ext Mod Input
Data : [Positive]
Data Clock : [Rise]
Symbol Clock : [Rise]
Burst Gate : [Positive]

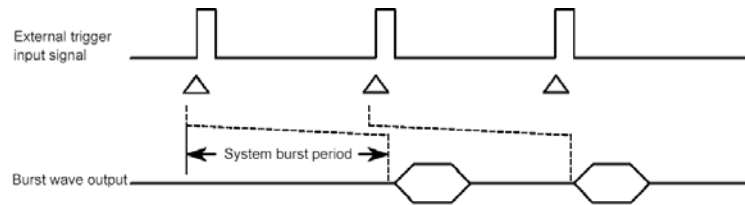
Ext Mod Output
Data : [Positive]
Data Clock : [Rise]
Symbol Clock : [Rise]
Burst Gate : [Positive]

Burst Trigger Input : [Rise]
Burst Trigger Output : [Rise]
Pattern Sync Output : [PN Clock]
```



» Front panel

- Data, Burst Gate, Data Clock
 - Refer to “External Data Input” on previous pages
- Symbol Clock
 - Same as Data Clock
- Burst Trig
 - Synchronization of external burst trigger
 - Used at BS receiver test



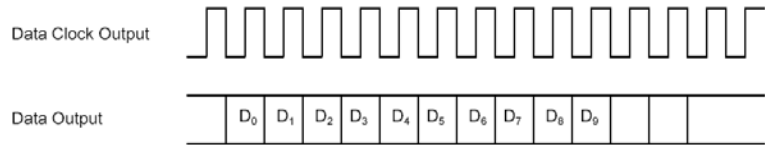
Auxiliary signal

Output

» Rear panel

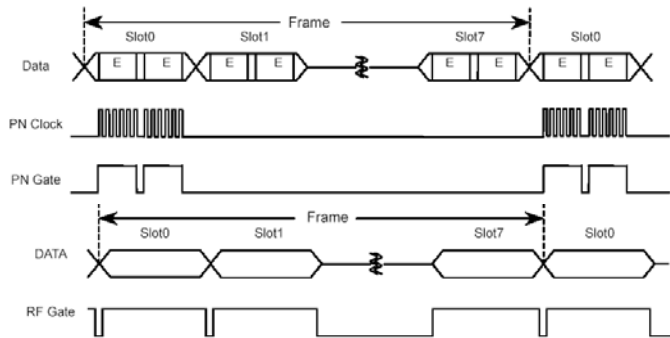
- Data, Data Clock

- Symbol Clock is the same as Data Clock



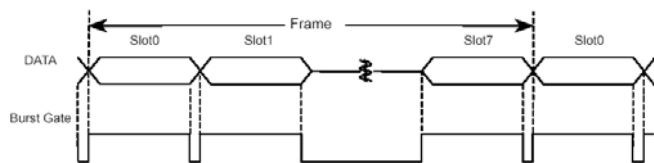
- Pattern Sync

- PN Clock, PN Gate, RF Gate is selectable
- at Burst On



Control signal of internal pulse modulator

- Burst Gate



- Burst Trigger

- 4.615 ms clock

Rear Panel

Rear Panel Information

BNC	A1:Data Clock	A2:Data
Digital Output	A3:Symbol Clock	A4:Burst Gate
	B1:Burst Trigger	B2:Pattern Sync
	B3:	B4:

Digital Input/Output	C1:	C2:
	C3:	C4:

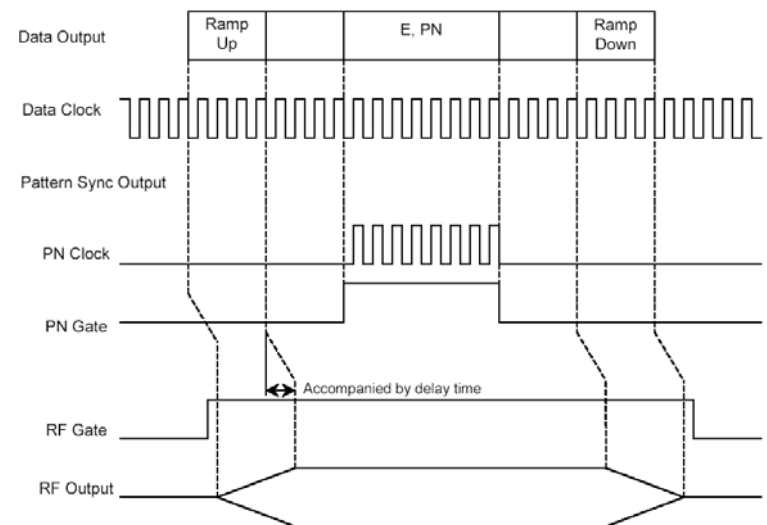
AUX 1	D1:	D2:
	D3:	

Dsub-25P

AUX 2	13	*****	1	19 - 23 : NC
	G	G	14	24 & 25 : Ground
	25	-----		

1:	2:	3:
4:	5:	6:
7:	8:	9:
10:	11:	12:
13:	14:	15:
16:	17:	18:

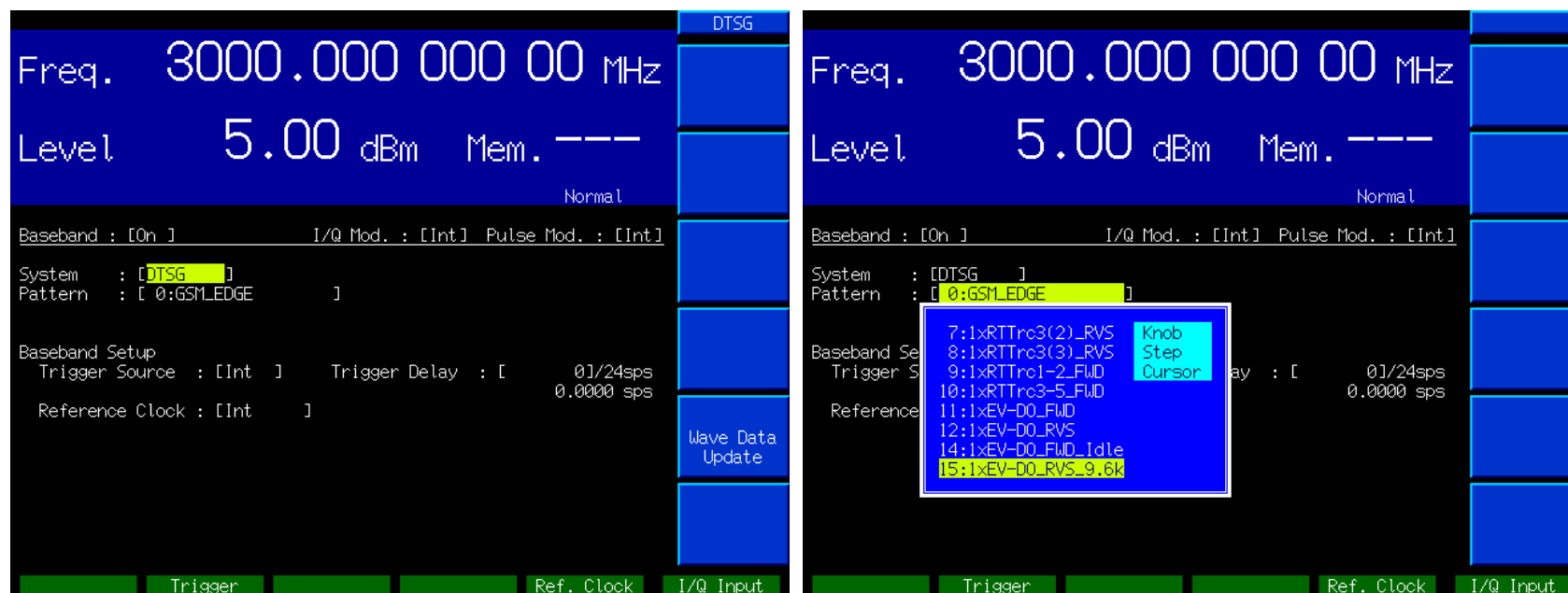
Data Symbol Clock Burst Gate Burst Trig Data Clock I/Q Input



MX368031A Device Test Signal Generation Software



- The test signals for worldwide main communications systems can be outputted by installing the MX368031A Device Test Signal Generation Software in the MU368030A Universal Modulation Unit.
- In production process of components, the function is provided as the signal source for components.
- In production process of CDMA2000 1X BS, the function is provided as the wanted signal source for receiver test.
- In R&D/production process of CDMA2000 1X MS, CDMA2000 1xEV-DO AN Access Network and AT Access Terminal, the function is provided as the interfering signal source for receiver test.



Support of test signal format

- **Just to select the signal patterns saved in large-capacity waveform memory without setting complicated parameters of communication systems!** **Simple operation**
- **High-speed change among TDMA 5 signal patterns and CDMA2000 10 signal patterns < 1 sec**
 - » TDMA: GSM/EDGE (2), PDC, IS-136, PHS
 - » CDMA2000: CDMA2000 1X (5), 1xEV-DO (4)
- **Quick support is provided by updating the signal pattern files saved from PC memory card to internal memory.**
 - IQ signal pattern file is downloaded to MG3681A via PC memory card (CompactFlash).
 - The I/Q mapping data of over sampling is stored in Waveform data Memory.

Signal patterns

TDMA

Frame coding -not supported

	Modulation	Modulation data, Parameter
» GSM/EDGE:	8PSK GMSK	PN9 cont. modulation, Linearized Gaussian, 270.833ksps PN9 cont. modulation, Gaussian (Bbt: 0.3), 270.833ksps
» PDC:	$\pi/4$ DQPSK	PN9 cont. modulation, Root Nyquist (α : 0.5), 21ksps
» NADC(IS-136):	$\pi/4$ DQPSK	PN9 cont. modulation, Root Nyquist (α : 0.35), 24.3ksps
» PHS:	$\pi/4$ DQPSK	PN9 cont. modulation, Root Nyquist (α : 0.5), 192ksps

CDMA2000 1X

» Reverse:	Channel coding -supported (Utilizable for FER test of BS)	
– RC1:	BPSK→OQPSK	Traffic(TCH)
– RC3 (1):	BPSK→HPSK	Fundamental(FCH) + Pilot(PICH)
– RC3 (2):	BPSK→HPSK	Fundamental(FCH) + Supplemental(SCH) + Pilot(PICH)
– RC3 (3):	BPSK→HPSK	Dedicated Control(DCCH) + Pilot(PICH)
» Forward:	Channel coding -not supported	
– RC1-2:	BPSK→QPSK	Pilot(PICH) + SYNC + Paging(PCH) + Traffic(TCH)x6
– RC3-5:	BPSK/QPSK→QPSK	Pilot(PICH) + SYNC + Paging(PCH) + Traffic(TCH)x6

CDMA2000 1xEV-DO

Channel coding -not supported

» Forward:		
– Active Slot:	BPSK/16QAM→QPSK	Pilot(PICH) + MAC + Data
– Idle Slot:	BPSK→QPSK	Pilot(PICH) + MAC
» Reverse:	BPSK→HPSK	Pilot(PICH) + DRC + ACK + Data
– 9.6 kbps:	DRCChannelGain 3 dB, ACKChannelGain 3 dB, DataChannelGain 3.75 dB	
– 153.6 kbps:	DRCChannelGain 3 dB, ACKChannelGain 3 dB, DataChannelGain 18.5 dB	

MX368031A

» PDC

```
Baseband : [0n ] I/Q Mod. : [Int] Pulse Mod. : [Int]
System : [DTSG ]
Pattern : [ 2:Pi/4DQPSK_PDC ]

Baseband Setup
Trigger Source : [Int ] Trigger Delay : [ 01/16sps
0.0000 sps
Reference Clock : [Int ]
```

» GSM

```
Baseband : [0n ] I/Q Mod. : [Int] Pulse Mod. : [Int]
System : [DTSG ]
Pattern : [ 1:GSM_GMSK ]

Baseband Setup
Trigger Source : [Int ] Trigger Delay : [ 01/24sps
0.0000 sps
Reference Clock : [Int ]
```

» PHS

```
Baseband : [0n ] I/Q Mod. : [Int] Pulse Mod. : [Int]
System : [DTSG ]
Pattern : [ 4:Pi/4DQPSK_PHS ]

Baseband Setup
Trigger Source : Int
Reference Clock : [Int ]
```

» MX368011A (PDC)

```
Baseband : [0n ] I/Q Mod. : [Int] Pulse Mod. : [Int]
System : [PDC]
Modulation : [π/4 DQPSK Bit Rate : [42.0kbps]
Filter : [RNYQ] α=[0.50] Phase Encode : [Normal ]
Slot Rate : [Fullrate]
Burst : [Off]
Pattern : [PN9 ]
```

» MX368012A (GSM)

```
Baseband : [0n ] I/Q Mod. : [Int] Pulse Mod. : [Int]
System : [GSM]
Modulation : [GMSK Bit Rate : [270.833kbps]
Filter : [BbT=[0.30]
Differential Encode : [On ] Phase Polarity : [Normal ]
Burst : [Off]
Pattern : [PN9 ]
```

» MX368035A (PHS)

```
Baseband : [0n ] I/Q Mod. : [Int] Pulse Mod. : [Int]
System : [PHS ]
Pattern : [ 3:CONPN9 ]

Baseband Setup
Trigger Source : Int
Reference Clock : [Int ]
```



CDMA2000 1X Identical signal patterns

MX368031A

- » CDMA2000 1X
- Forward RC1-2

```
Baseband : [On ]           I/Q Mod. : [Int] Pulse Mod. : [Int]
System   : [DSSS ]
Pattern  : [9:1xRTTnc1-2_Fwd]

Baseband Setup
Trigger Source : [Int ]   Trigger Delay : [ 0]/ 8cps
Reference Clock : [Int ]   0.0000 cps
```



- » MX368042A (IS-95)

```
Baseband : [On ]           I/Q Mod. : [Int] Pulse Mod. : [Int]
System   : [IS-95]         Link : [Forward] Chip Rate : [1.228 800Mops]
Filter   : [SPEC+EQ]      α : -
Pat. Number : [ 9] PCB : [0ff]
Walsh Code = 0           Output Level = 1.03dBm

[P] TTTTTT S
0 Pilot , On , - 7.0dB, Rate Set 1, FullRate 63
```

CDMA2000 1xEV-DO MX368031A

Identical signal patterns

» CDMA2000 1xEV-DO

- Forward Active Slot

```
Baseband : [0n ] I/Q Mod. : [Int] Pulse Mod. : [Int]
System : [DTSG ]
Pattern : [1:1xEV-DO_FWD ]

Baseband Setup
Trigger Source : [Int ] Trigger Delay : [ 0]/ 8cps
0.0000 cps
Reference Clock : [Int ]
```

» MX368033A (1xEV-DO)

```
Baseband : [0n ] I/Q Mod. : [Int] Pulse Mod. : [Int]
System : [1xEV-DO ]
Pattern : [4:FWD_2457.6_I_MR ]

Baseband Setup
Trigger Source : [Int ] Trigger Delay : [ 0]/ 8cps
0.0000 cps
Reference Clock : [Int ]
```

- Forward Idle Slot

```
Baseband : [0n ] I/Q Mod. : [Int] Pulse Mod. : [Int]
System : [DTSG ]
Pattern : [14:1xEV-DO_FWD_Idle]

Baseband Setup
Trigger Source : [Int ] Trigger Delay : [ 0]/ 8cps
0.0000 cps
Reference Clock : [Int ]
```

```
Baseband : [0n ] I/Q Mod. : [Int] Pulse Mod. : [Int]
System : [1xEV-DO ]
Pattern : [9:1xEV-DO_Idl_MRxI]

Baseband Setup
Trigger Source : [Int ] Trigger Delay : [ 0]/ 8cps
0.0000 cps
Reference Clock : [Int ]
```

- Reverse 9.6 kbps

```
Baseband : [0n ] I/Q Mod. : [Int] Pulse Mod. : [Int]
System : [DTSG ]
Pattern : [15:1xEV-DO_RVS_9.6k]

Baseband Setup
Trigger Source : [Int ] Trigger Delay : [ 0]/ 8cps
0.0000 cps
Reference Clock : [Int ]
```

```
Baseband : [0n ] I/Q Mod. : [Int] Pulse Mod. : [Int]
System : [1xEV-DO ]
Pattern : [1:RVS_9.6kbps ]

Baseband Setup
Trigger Source : [Int ] Trigger Delay : [ 0]/ 8cps
0.0000 cps
Reference Clock : [Int ]
```

- Reverse 153.6 kbps

```
Baseband : [0n ] I/Q Mod. : [Int] Pulse Mod. : [Int]
System : [DTSG ]
Pattern : [12:1xEV-DO_RVS ]

Baseband Setup
Trigger Source : [Int ] Trigger Delay : [ 0]/ 8cps
0.0000 cps
Reference Clock : [Int ]
```

```
Baseband : [0n ] I/Q Mod. : [Int] Pulse Mod. : [Int]
System : [1xEV-DO ]
Pattern : [10:RVS_153.6kbps ]

Baseband Setup
Trigger Source : [Int ] Trigger Delay : [ 0]/ 8cps
0.0000 cps
Reference Clock : [Int ]
```

Slide 107

MG3681A-E-I-1

Auxiliary signal Input

» Front panel

– Trigger

- Available at CDMA2000 1X Reverse signal
- Synchronization of external frame clock
- Frame trigger or start trigger is selectable
 - Used at BS receiver test

– Ref. Clock

- Available at CDMA2000 signal
 - Synchronization of external baseband reference clock
 - $8 \times$ chip rate ($8 \times 1228.4 \text{ kcps} = 9830.4 \text{ kHz}$)
 - Used at start trigger
- External reference clock input on rear panel (10/13MHz) is also available

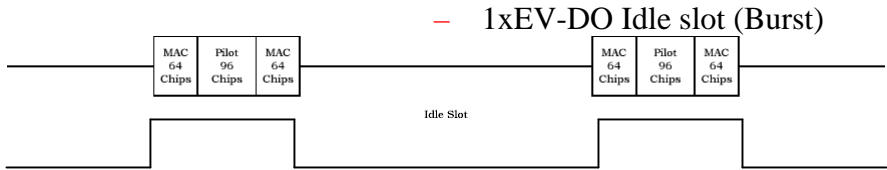


Auxiliary signal

Output

» Rear panel

- RF Gate



Control signal of internal pulse modulator

- Sampling Clock
 - Available at CDMA2000 signal
 - Baseband reference clock
 - 8× chip rate
(8× 1228.4 kcps = 9830.4 kHz)

Rear Panel

Rear Panel Information

BNC		
Digital Output	A1: RF Gate	A2: Frame Trigger
	A3: RF Gate	B2: Sequence Pulse
	B1: Sampling Clock	B4: Sequence Pulse
	B3:	
Digital Input/Output		
	C1:	C2:
	C3:	C4:
AUX 1		
	D1:	D2:
	D3:	
Dsub-25P		
AUX 2	13: *****	19 - 23 : NC
	14: G G - - - - -	24 & 25 : Ground
	25: *****	
	14:	

1:	2:	3:
4:	5:	6:
7:	8:	9:
10:	11:	12:
13:	14:	15:
16:	17:	18:

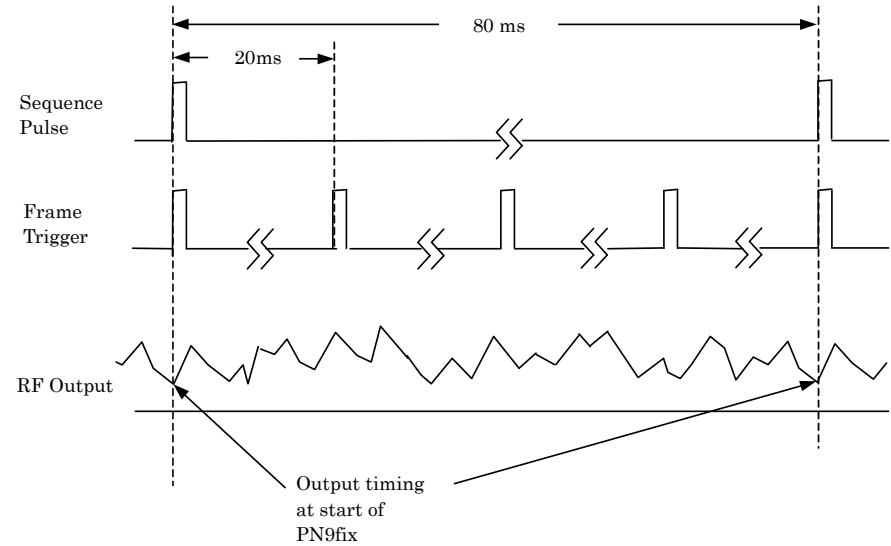
Trigger	Ref. Clock	I/Q Input
---------	------------	-----------

Return

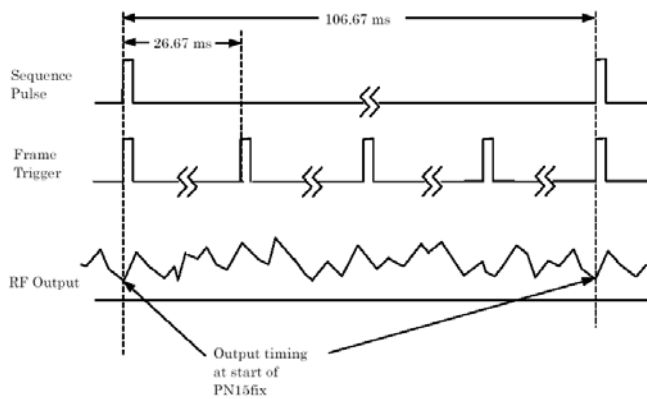
Auxiliary signal

Output

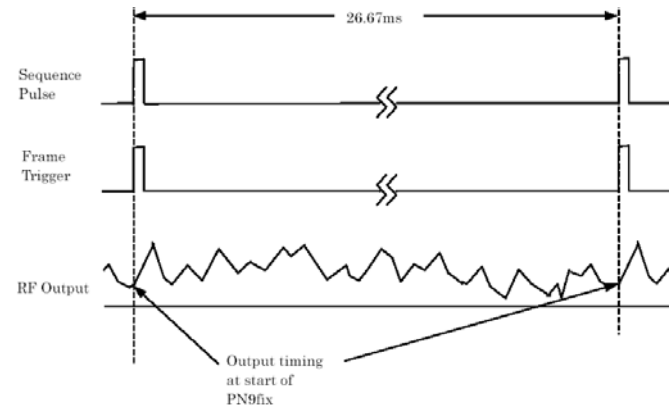
- » Rear panel
 - Frame Trigger, Sequence Pulse
 - CDMA2000 1X



- 1xEV-DO (Active/Idle)



- 1xEV-DO Reverse



MX368033A CDMA2000 1xEV-DO Signal Generation Software



- **Forward/Reverse CDMA2000 1xEV-DO test signals for 3GPP2 C.S0024 standard can be outputted by installing the MX368033A CDMA2000 1xEV-DO Signal Generation Software in the MU368030A Universal Modulation Unit.**
- **In R&D/production process of components, AN ^{Access Network} and AT ^{Access Terminal}, the functions to support various applications are provided as the signal source for components and the wanted signal source for receiver test.**

The image displays two screenshots of the MX368033A software interface, showing the configuration for 1xEV-DO signal generation. Both screenshots show the same main parameters: Freq. 900.000 000 00 MHz, Level - 3.00 dBm, Mem. ---, and Reverse mode. The Baseband is set to [0n], I/Q Mod. to [Int], and Pulse Mod. to [Int].

Left Screenshot (1xEV-DO):

- System : [1xEV-DO]
- Pattern : [0:FWD_38.4_16_MR]
- Baseband Setup: Trigger Source : [Int], Trigger Delay : [0]/ 80ps, 0.0000 cps
- Reference Clock : [Int]
- Noise Setup: Noise : [Off], Noise Bandwidth : [x2], C/N : [0.0dB], Calculated Bandwidth : 1,230.000kHz, Calc Noise Power : ---, Wanted Signal Power : ---

Right Screenshot (1xEV-DO):

- System : [1xEV-DO]
- Pattern : [0:FWD_38.4_16_MR]
- Baseband Setup: Trigger Source : [Int], Trigger Delay : [0]/ 80ps, 0.0000 cps
- Reference Clock : [Int]
- Noise Setup: Noise : [Off], Noise Bandwidth : [x2], C/N : [0.0dB], Calculated Bandwidth : 1,230.000kHz, Calc Noise Power : ---, Wanted Signal Power : ---

A list of rates is displayed in the center of the right screenshot, with a 'Knob Step Cursor' overlay highlighting the '23:RVS_153.6kbps_RT' rate:

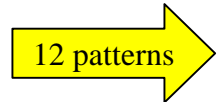
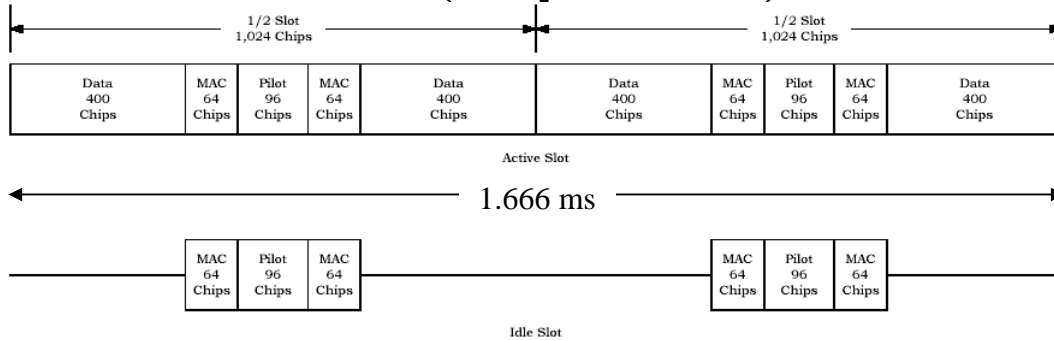
- 15:RVS_38.4kbps
- 16:RVS_76.8kbps
- 17:RVS_153.6kbps
- 19:RVS_9.6kbps_RT
- 20:RVS_19.2kbps_RT
- 21:RVS_38.4kbps_RT
- 22:RVS_76.8kbps_RT
- 23:RVS_153.6kbps_RT

Support of test signal format

- **Receiver test (PER ^{Packet Error Rate}) for 3GPP2 C.S0032 (Sector) and C.S0033 (AT) test specifications is performable due to the Coding format (Frame/Slot structuring, CRC addition, turbo coding, interleave) based on 3GPP2 C.S0024.**
- **Just to select the signal patterns saved in large-capacity waveform memory without setting complicated parameters of 3GPP2! **Simple operation****
- **High-speed change among Forward 13 data rate signal patterns (with Idle Slot) and Reverse 5 data rate signal patterns < 1 sec**
- **Supporting multi-carrier up to 8×**
- **Quick support is provided by updating the signal pattern files saved from PC memory card to internal memory.**
 - IQ signal pattern file is downloaded to MG3681A via PC memory card (CompactFlash).
 - The I/Q mapping data of 8× over sampling is stored in Waveform data Memory.
 - 16× over sampling at multi-carrier

Signal patterns

- Forward (13 patterns)**



- Reverse (10 patterns)**

- » for receiver test of Sector
- » for transmitter test of AT

Data Rate (kbps)	9.6	19.2	38.4	76.8	153.6
Reverse Rate Index	1	2	3	4	5
Code Rate	1/4	1/4	1/4	1/4	1/2
Bits per Physical Layer Packet	256	512	1,024	2,048	4,096
Number of Turbo Encoder Input Symbols	250	506	1,018	2,042	4,090
Turbo Encoder Code Rate	1/4	1/4	1/4	1/4	1/2
Encoder Output Block Length (Code Symbols)	1,024	2,048	4,096	8,192	8,192

de 113

MG3681A-E-I-1

Data Rate (kbps)	Number of Values per Physical Layer Packet				
	Slots	Bits	Code Rate	Modulation Type	TDM Chips (Preamble, Pilot, MAC, Data)
38.4	16	1,024	1/5	QPSK	1,024 3,072 4,096 24,576
76.8	8	1,024	1/5	QPSK	512 1,536 2,048 12,288
153.6	4	1,024	1/5	QPSK	256 768 1,024 6,144
307.2	2	1,024	1/5	QPSK	128 384 512 3,072
614.4	1	1,024	1/3	QPSK	64 192 256 1,536
307.2	4	2,048	1/3	QPSK	128 768 1,024 6,272
614.4	2	2,048	1/3	QPSK	64 384 512 3,136
1,228.8	1	2,048	1/3	QPSK	64 192 256 1,536
921.6	2	3,072	1/3	8-PSK	64 384 512 3,136
1,843.2	1	3,072	1/3	8-PSK	64 192 256 1,536
1,228.8	2	4,096	1/3	16-QAM	64 384 512 3,136
2,457.6	1	4,096	1/3	16-QAM	64 192 256 1,536

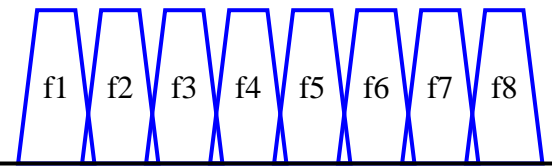
Disco

INRISU

Multi-carrier

Multi-carrier are stored in PC memory card as sample signal patterns.

- Forward Active Slot multi-carrier (8×, 4×, 3×, 2×, 1×)
- Forward Idle Slot multi-carrier (8×, 4×, 3×, 2×, 1×)
 - Frequency offset: 1.25 MHz
 - Pilot Channel:
 - PN Offset Index = 0 (f1), 1 (f2), 2 (f3), 3 (f4), 4 (f5), 5 (f6), 6 (f7), 7 (f8)
 - MAC Channel:
 - MACIndex = RA, 13 RPC Channel



- RABit = 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 (f1)
- RPCBit = 4, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30 (f2)
- Frame length: 4, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43 (f3)
- Active Slot 4, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56 (f4)
- Traffic Channel: 4, 57, 58, 59, 60, 61, 62, 63, 5, 6, 7, 8, 9, 10 (f5)
- Data Rate: 4, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23 (f6)
- Preamble: 4, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36 (f7)
- Modulation: 4, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49 (f8)

Multi-carrier select

Freq. 900.000 000 00 MHz
 Level - 3.00 dBm Mem. ---
 Reverse

Baseband : [0n] I/Q Mod. : [Int] Pulse Mod. : [Int]

System : [1xEV-DO]
 Pattern : [0:FWD_38.4_16_MR]

Baseband Setup
 Trigger Source : [Int] Trigger Delay : [0]/ 8cps
 0.0000 cps

Reference Clock : [Int]

Noise Setup
 Noise : [Off] Noise Bandwidth : [x2]
 C/N : [0.0dB] Calculated Bandwidth : 1,230.000kHz
 Calc Noise Power : --- Wanted Signal Power : ---

1xEV-DO
 Wave Data Restart
 Wave Data Download

Trigger Ref. Clock I/Q Input

Freq. 900.000 000 00 MHz
 Level - 3.00 dBm Mem. ---
 Reverse

Baseband : [0n] I/Q Mod. : [Int] Pulse Mod. : [Int]

System : [1xEV-DO]
 Pattern : [1:1xEV-DO_FWD_MRx4]

Baseband Setup
 Trigger Source : [Int] Trigger Delay : [0]/ 16cps
 0.0000 cps

Reference Clock : [Int]

1xEV-DO
 Wave Data Restart
 Wave Data Download

0:1xEV-DO_FWD_MRx8 Knob Step
 1:1xEV-DO_FWD_MRx4 Knob Step
 2:1xEV-DO_FWD_MRx3 Cursor
 3:1xEV-DO_FWD_MRx2
 4:FWD_2457.6_1_MR
 5:1xEV-DO_Idl_MRx8
 6:1xEV-DO_Idl_MRx4
 7:1xEV-DO_Idl_MRx3

Forward Active slot

Downloading the signal pattern file from PC memory card

Freq. 900.000 000 00 MHz
 Level - 3.00 dBm Mem. ---
 Reverse

Baseband : [0n] I/Q Mod. : [Int] Pulse Mod. : [Int]

System : [1xEV-DO]
 Pattern : [1:RVS_9.6kbps]

Baseband Setup
 Trigger Source : [Int] Trigger Delay : [0]/ 8cps
 0.0000 cps

Reference Clock : [Int]

Noise Setup

4:FWD_2457.6_1_MR Knob Step
 5:1xEV-DO_Idl_MRx8 Knob Step
 6:1xEV-DO_Idl_MRx4 Cursor
 7:1xEV-DO_Idl_MRx3
 8:1xEV-DO_Idl_MRx2
 9:1xEV-DO_Idl_MRx1
 10:RVS_153.6kbps
 11:RVS_9.6kbps

Reverse (appendix)

Freq. 900.000 000 00 MHz
 Level - 3.00 dBm Mem. ---
 Reverse

Baseband : [0n] I/Q Mod. : [Int] Pulse Mod. : [Int]

System : [1xEV-DO]
 Pattern : [6:1xEV-DO_Idl_MRx4]

Baseband Setup
 Trigger Source : [Int] Trigger Delay : [0]/ 16cps
 0.0000 cps

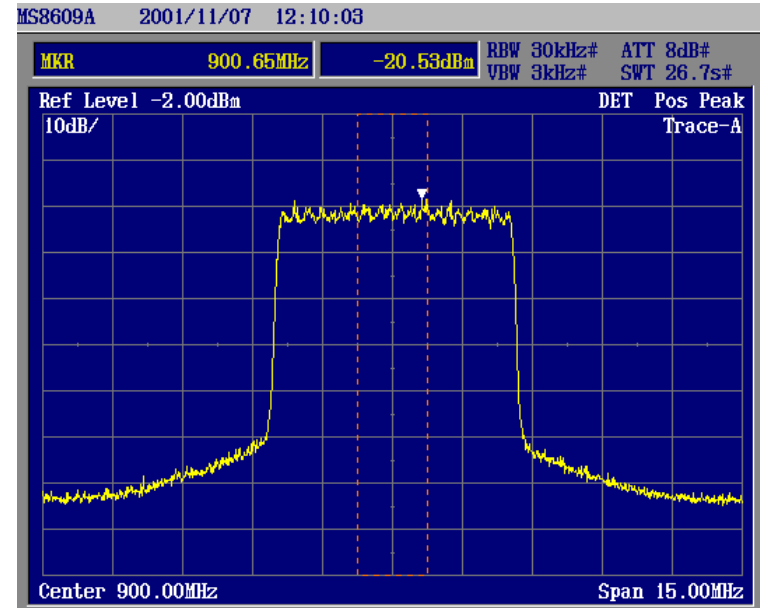
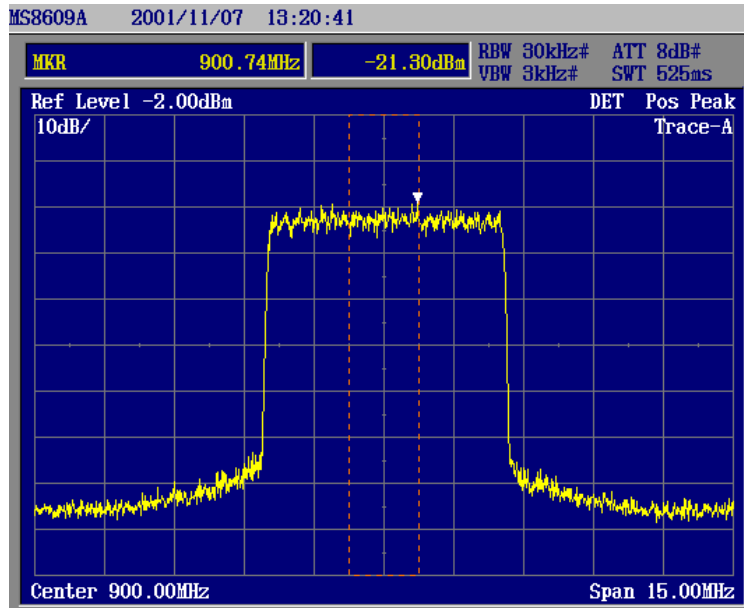
Reference Clock : [Int]

Noise Setup

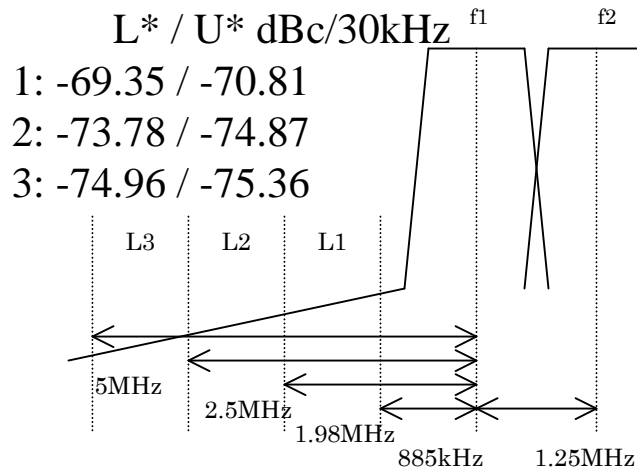
2:1xEV-DO_FWD_MRx3 Knob Step
 3:1xEV-DO_FWD_MRx2 Knob Step
 4:FWD_2457.6_1_MR Knob Step
 5:1xEV-DO_Idl_MRx8 Knob Step
 6:1xEV-DO_Idl_MRx4 Knob Step
 7:1xEV-DO_Idl_MRx3 Knob Step
 8:1xEV-DO_Idl_MRx2 Knob Step
 9:1xEV-DO_Idl_MRx1 Knob Step

Forward Idle slot

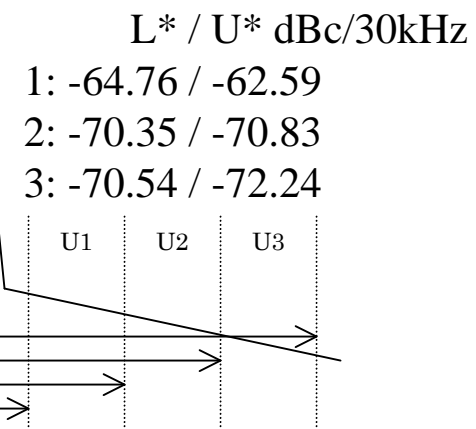
4 carriers Spurious Emissions (typ.)



Forward Active Slot



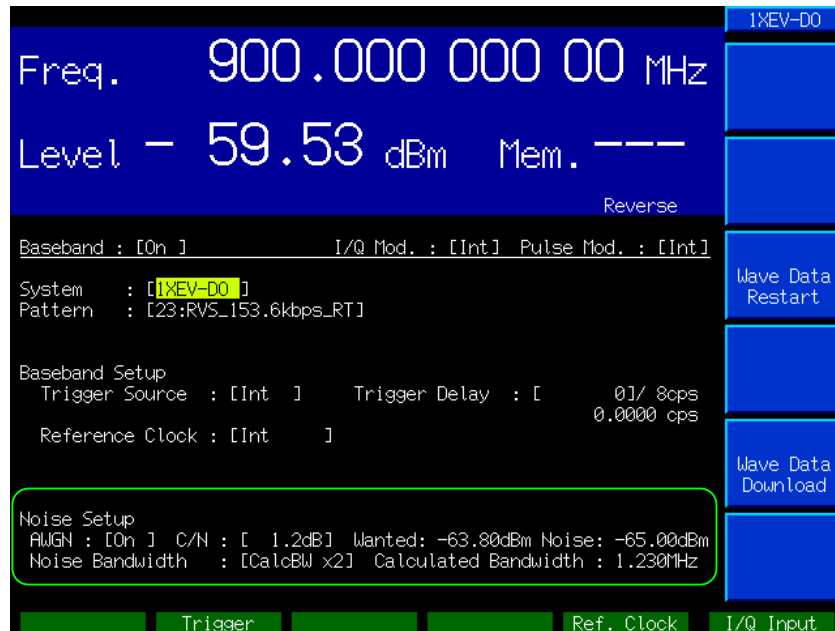
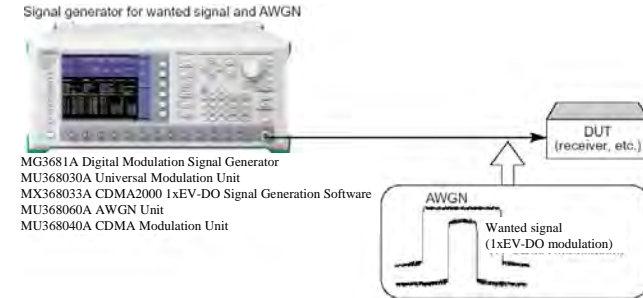
Forward Idle Slot



AWGN mixing

Single unit is performable dynamic range test of BS receiver.

- **Mixing AWGN to CDMA2000 wanted signal**
- **High-accuracy and high-stability C/N**
 - » -30 ~ -30 dB, 0.1 dB resolution



- **Selecting AWGN bandwidth**

- » $2 \times 1.23\text{MHz} = 2.46\text{ MHz}$
- » $3 \times 1.23\text{MHz} = 3.69\text{ MHz}$
- » $4 \times 1.23\text{MHz} = 4.92\text{ MHz}$

» Front panel

– Trigger

- Synchronization of external frame clock
- Frame trigger or start trigger is selectable
 - Used at Sector receiver test

– Ref. Clock

- Available at single carrier
 - Synchronization of external baseband reference clock
 - $8 \times$ chip rate ($8 \times 1228.4 \text{ kcps} = 9830.4 \text{ kHz}$)
 - Used at start trigger
- External reference clock input on rear panel (10/13MHz) is also available



Auxiliary signal

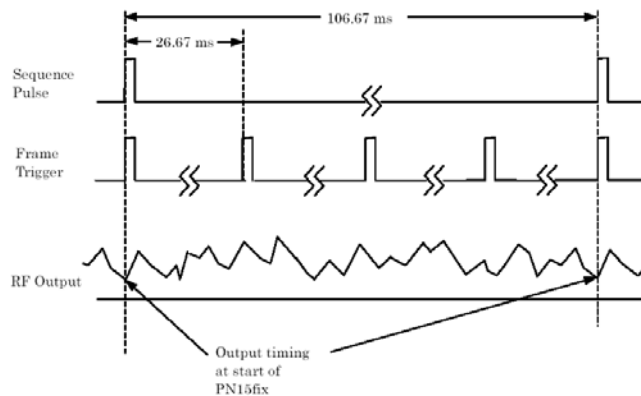
Output

- » Rear panel
 - RF Gate



Control signal of internal pulse modulator

- 8x Chip Clock
 - Available at single carrier
 - Baseband reference clock
 - 8x chip rate
($8 \times 1228.4 \text{ kcps} = 9830.4 \text{ kHz}$)
- Frame Trigger, Sequence Pulse
 - Forward (Active/Idle)



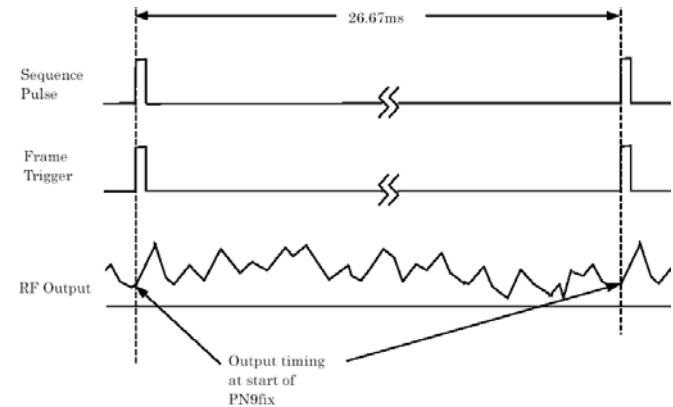
Rear Panel

Rear Panel Information

BNC		
Digital Output	A1: RF Gate (M.P. 4) A2: RF Gate (M.P. 2)	
	A3: RF Gate (M.P. 2) A4: Frame Trigger	
	B1: 8x Chip Clock B2: Sequence Pulse	
	B3: B4:	
Digital Input/Output		
C1:	C2:	
C3:	C4:	
AUX 1		
D1:	D2:	
D3:		
Dsub-25P		
AUX 2	13: ***** 1 19 - 23 : NC	
	25: G G - - - - - ***** 14 24 & 25 : Ground	
1:	2:	3:
4:	5:	6:
7:	8:	9:
10:	11:	12:
13:	14:	15:
16:	17:	18:

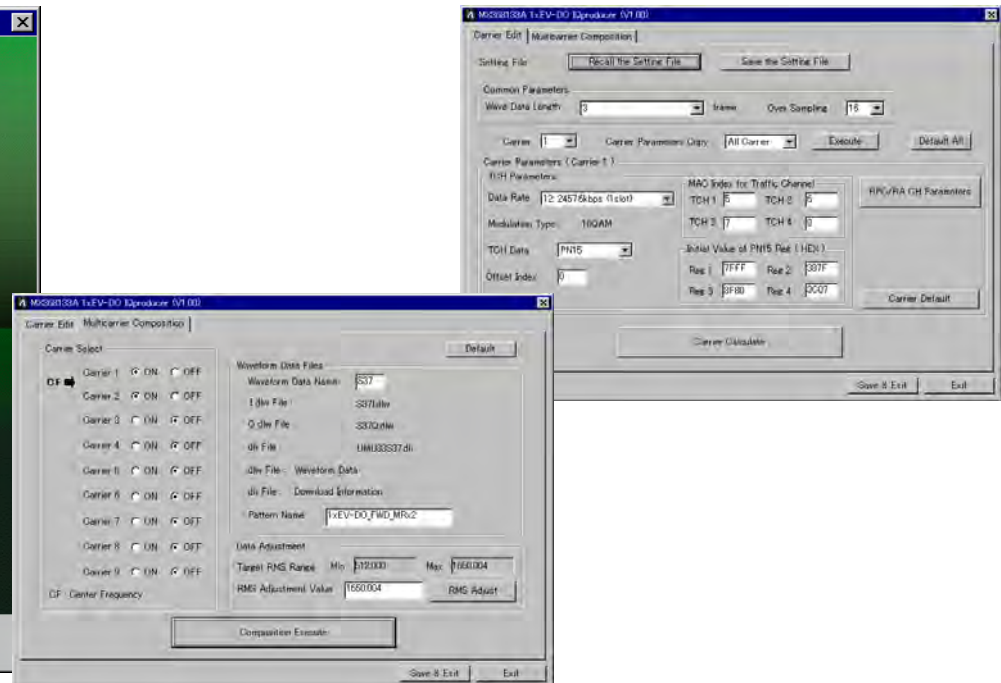
Trigger
Ref. Clock
I/Q Input

- Reverse



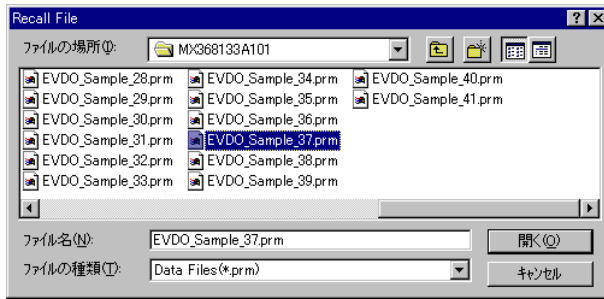
MX368133A CDMA2000 1xEV-DO IQproducer™

- It is Windows application software which upgrades the functioning of MX368033A installed in the MG3681A.
- The IQ mapping data file for signal patterns, which are generated by MU368030A Universal Modulation Unit incorporated in the MG3681A is created.
- In R&D process of components, AN and AT, the functions to perform various evaluation of power amplifier and demodulation test are supported.



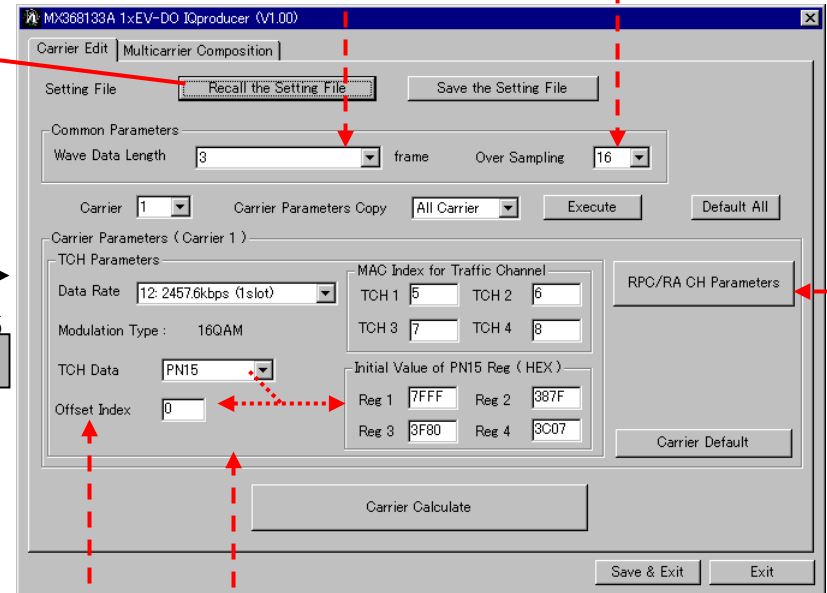
Reference setting files for easy setup

- Since the reference setting files for signal patterns of standard MX368033A is recorded, a signal pattern can be created easily only by editing a parameter changing.



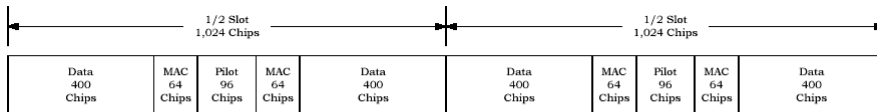
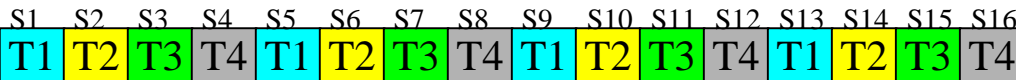
× 26.66...ms

× 1.23 MHz(Chip rate)

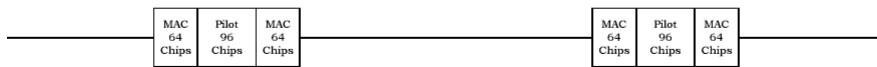


PN Offset Index

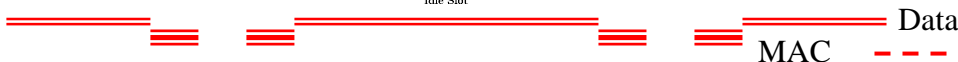
← Forward Traffic Channel frame (26.66... ms) →



Active Slot



Idle Slot



MAC

Slide 121

MG3681A-E-I-1

Editing of various MAC channels

- Able to edit parameters for each frame and slot
- Multiplex of RA channels and RPC channels

Random bits

Carrier 1 RPC/RA CH Parameters

Frame 1 Slot 1 RPC/RA Parameters Copy All Frame Execute

RPC/RA CH Parameters

MAC Index 4 RA Bit 0 CH Power -12.041 dB ON OFF

5-14 15-24 25-34 35-44 45-54 55-63

MAC Index 5 RPC Bit 0 CH Power -11.420 dB ON OFF

MAC Index 6 RPC Bit 0 CH Power -11.420 dB ON OFF

MAC Index 7 RPC Bit 0 CH Power -11.420 dB ON OFF

MAC Index 8 RPC Bit 0 CH Power -11.420 dB ON OFF

MAC Index 9 RPC Bit 0 CH Power -11.420 dB ON OFF

MAC Index 10 RPC Bit 1 CH Power -11.420 dB ON OFF

MAC Index 11 RPC Bit 0 CH Power -11.420 dB ON OFF

MAC Index 12 RPC Bit 0 CH Power -11.420 dB ON OFF

MAC Index 13 RPC Bit 1 CH Power -11.420 dB ON OFF

MAC Index 14 RPC Bit 0 CH Power -11.420 dB ON OFF

Group Edit

RPC/RA Bit ON/OFF

Channel Power -All MACCH Value Set

Normalizing RACH:RPCCHs= 1 / 16 : 15/16 Normalize

Carrier 1 RPC/RA CH Parameters

Frame 1 Slot 1 RPC/RA Parameters Copy All Frame Execute

RPC/RA CH Parameters

MAC Index 4 RA Bit 0 CH Power -12.041 dB ON OFF

5-14 15-24 25-34 35-44 45-54 55-63

MAC Index 15 RPC Bit 0 CH Power -11.420 dB ON OFF

MAC Index 16 RPC Bit 1 CH Power -11.420 dB ON OFF

MAC Index 17 RPC Bit 0 CH Power -11.420 dB ON OFF

MAC Index 18 RPC Bit 0 CH Power -11.420 dB ON OFF

MAC Index 19 RPC Bit 1 CH Power -11.420 dB ON OFF

MAC Index 20 RPC Bit 0 CH Power -11.420 dB ON OFF

MAC Index 21 RPC Bit 1 CH Power -11.420 dB ON OFF

MAC Index 22 RPC Bit 0 CH Power -11.420 dB ON OFF

MAC Index 23 RPC Bit 0 CH Power -11.420 dB ON OFF

MAC Index 24 RPC Bit 1 CH Power -11.420 dB ON OFF

Group Edit

RPC/RA Bit ON/OFF

Channel Power -All MACCH Value Set

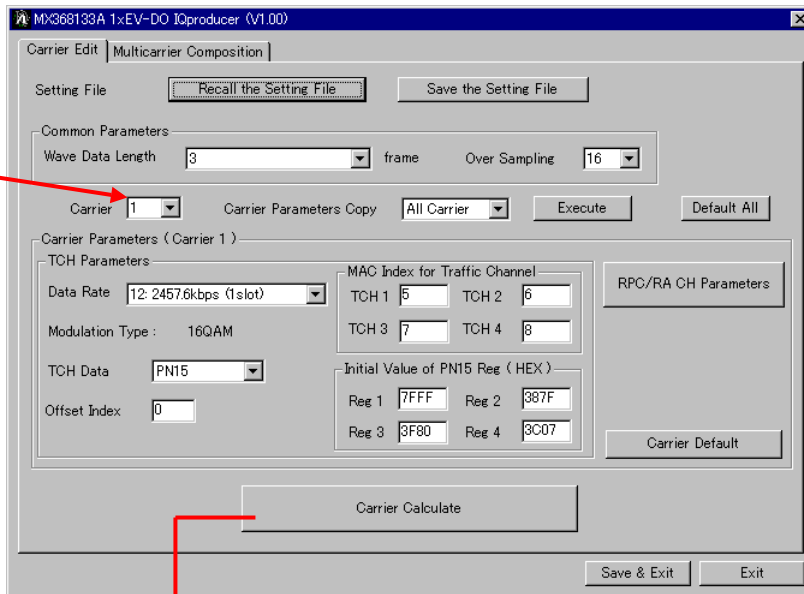
Normalizing RACH:RPCCHs= 1 / 16 : 15/16 Normalize

MACIndex	MAC Channel Use
0 and 1	Not Used
2	Not Used
3	Not Used
4	RA Channel
5-63	Available for RPC Channel and DRLOCK Channel Transmissions

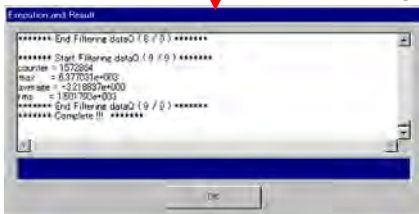
Creating Forward multi-carrier

- Able to edit parameters for each carrier

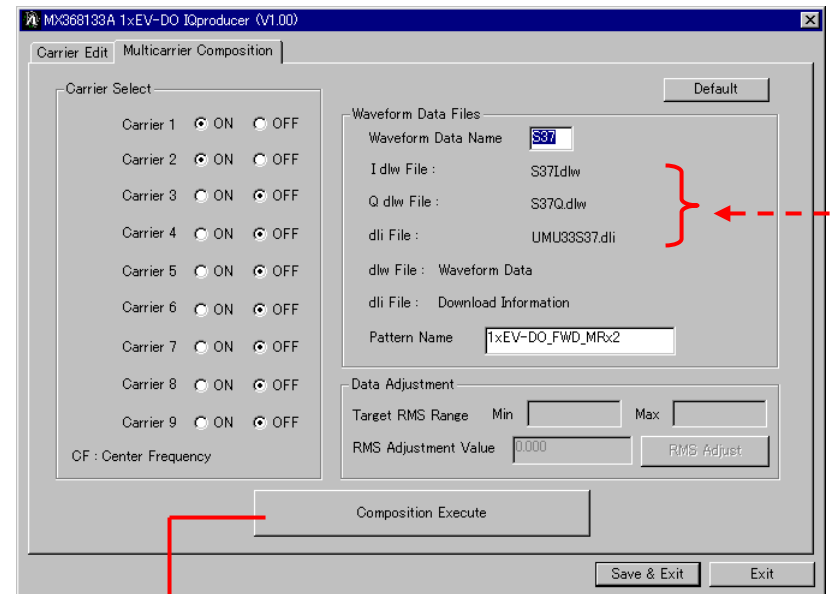
» 1 ~ 9



calculating the IQ mapping data



- Up to 9 carriers
» 1.25MHz offset

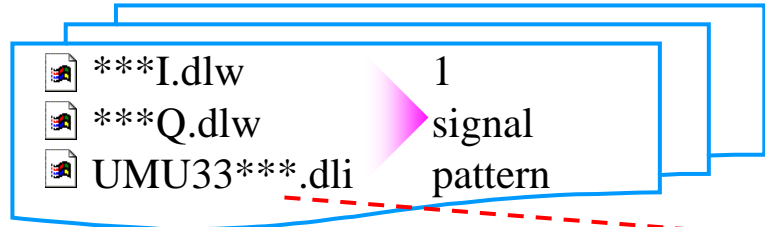


creating 3 files

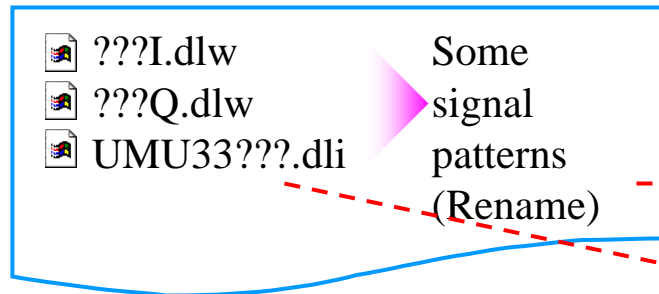
- I data
- Q data
- Configuration file for download

Signal pattern combiner

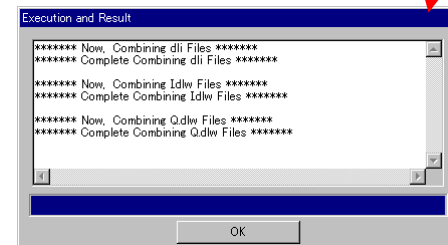
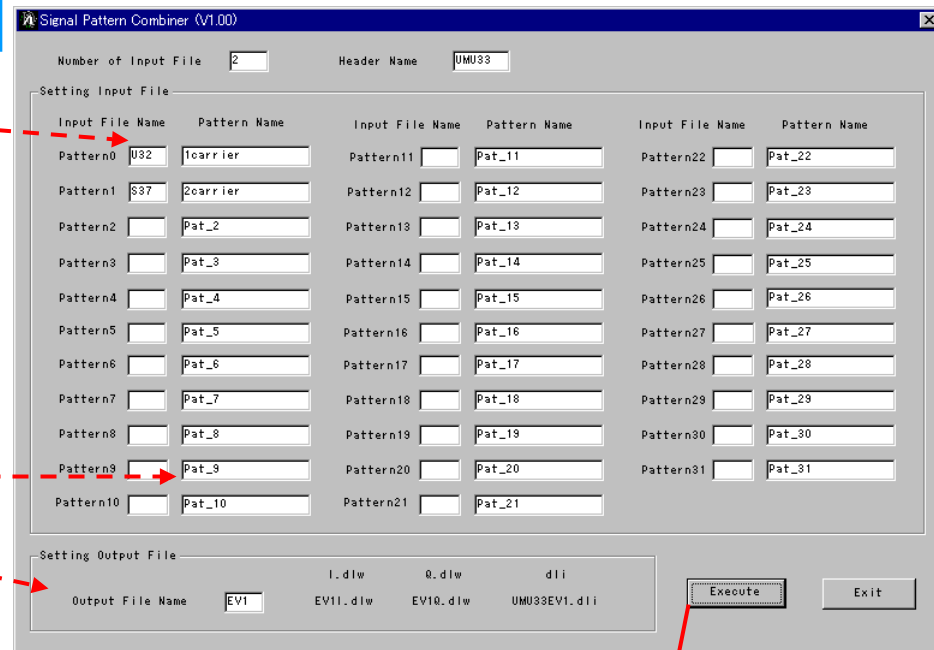
Created signal pattern files



Combined signal pattern file



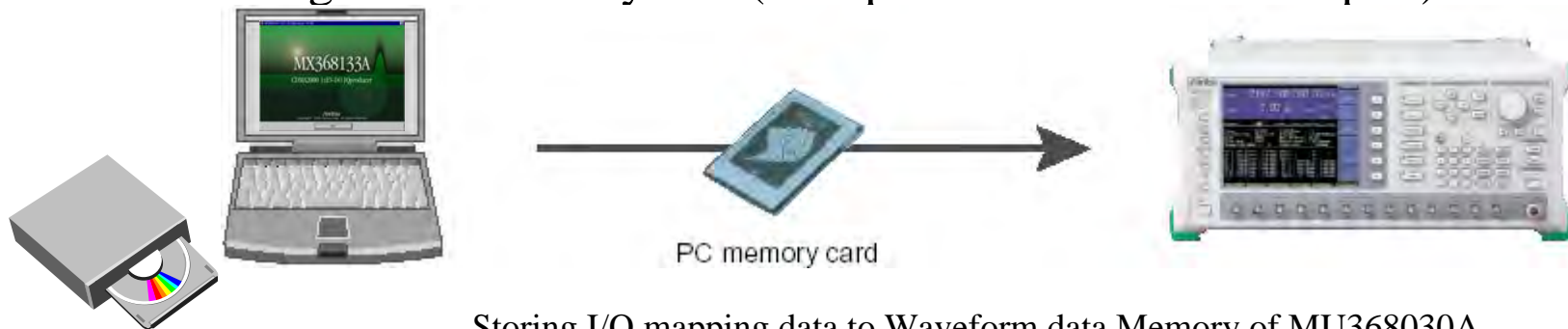
- **Performable high-speed change of signal pattern**



Operating requirements

Personal computer

- **OS:** Windows 2000, XP recommendation
- **CPU:** $\geq 300\text{MHz}$
- **Memory:** $\geq 128\text{MB}$ recommendation
- **HDD:** $\leq 512\text{MB}$ Occupied
- **Display:** $\geq 800 \times 600$ pixel
- **Peripheral equipment:**
 - Reading CD-R
 - Saving to PC memory card (CompactFlash+PC card adapter)



– Storing I/Q mapping data to Waveform data Memory of MU368030A

MX368034A PDC Packet Software

- Downlink/Uplink PDC user packet channel (UPCH) test signals for RCR STD-27 standard can be outputted by installing the MX368034A PDC Packet Software in the MU368030A Universal Modulation Unit.
- In R&D/production process of components, base stations (BS) and mobile stations (MS), the functions to support various applications are provided as the signal source for components and the wanted signal source for receiver test.



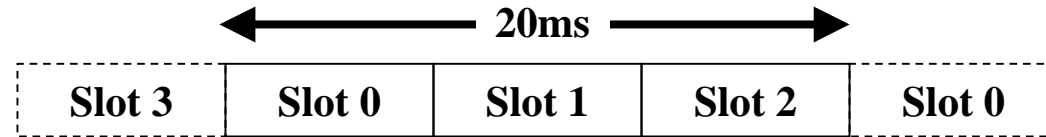
Support of test signal format

- **Packet (Downlink up to 28.8 kbps) receiver test (BER) for BS/MS is performable due to the Frame/Slot format based on RCR STD-27.**
- **Just to select the signal patterns saved in large-capacity waveform memory without setting complicated parameters of RCR STD-27! Simple operation**
- **Changing among Downlink 3 data rate signal patterns and Uplink 1 data rate signal pattern (approx. 10 min)**
- **UPCH \Leftrightarrow TCH (MX368011A) High-speed change < 10 sec**
- **Quick support is provided by updating the waveform data saved from PC memory card to internal memory.**
 - IQ signal pattern file is downloaded to MG3681A via PC memory card (CompactFlash).
 - The I/Q mapping data of 16 \times over sampling is stored in Waveform data Memory.

Signal patterns

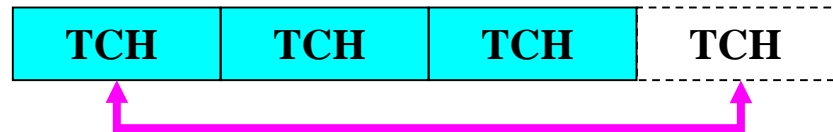
frame configuration

- Physical channel for packet communication (UPCH)



Patterns

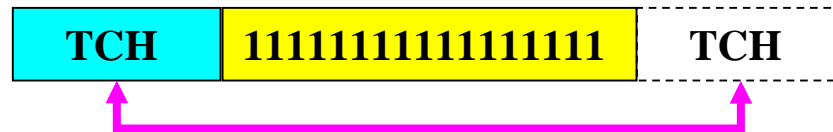
- » Downlink 3 slots



- » Downlink 2 slots



- » Downlink 1 slot



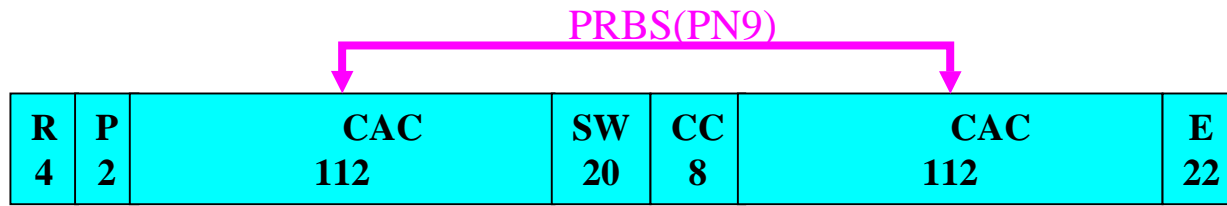
PRBS(PN9) in the same slot

- » Uplink 1 slot



- Super-frame is not supported

- **Downlink physical channel for packet communication (UPCH)**
 - » 280 bit
 - Scrambling Off

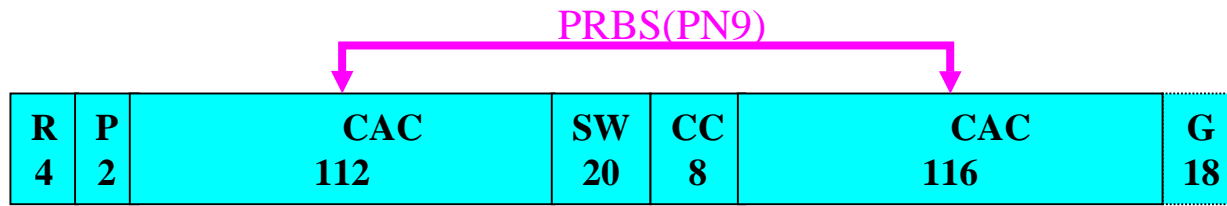


- » R Guard time for burst transient response 0000
- » P Preamble 10
- » SW Synchronous word
 - Slot 0: S1(87A4B)
 - Slot 1: S2(9D236)
 - Slot 2: S3(81D75)
- » CC Color code 00000000
- » E Collision control bit

Signal patterns

slot configuration

- **Uplink physical channel for packet communication (UPCH)**
 - » 280 bit
 - Scrambling Off



- » R Guard time for burst transient response 0000
- » P Preamble 10
- » SW Synchronous word
 - Slot 0: S1'(785B4)
- » CC Color code 00000000
- » G Guard time

» Front panel

– Trigger

- Synchronization of external frame clock
- Frame trigger or start trigger is selectable
 - Used at BS receiver test

– Ref. Clock

- Synchronization of external baseband reference clock
- $16\times$ symbol rate ($16\times 21 \text{ ksps} = 336 \text{ kHz}$)
 - Used at start triggerExternal reference clock input on rear panel (10/13MHz) is also available



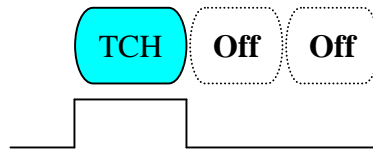
Auxiliary signal

Output

» Rear panel

- RF Gate

- Uplink (Burst)



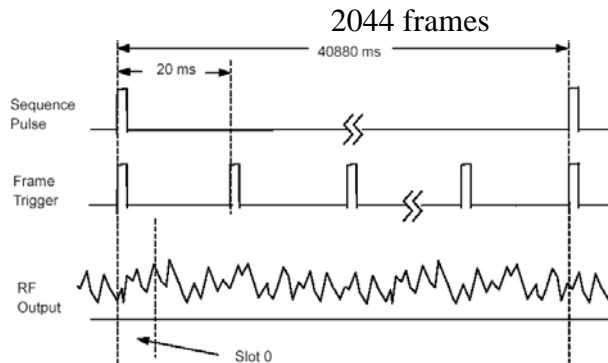
Control signal of internal pulse modulator

- 16x Symbol Clock

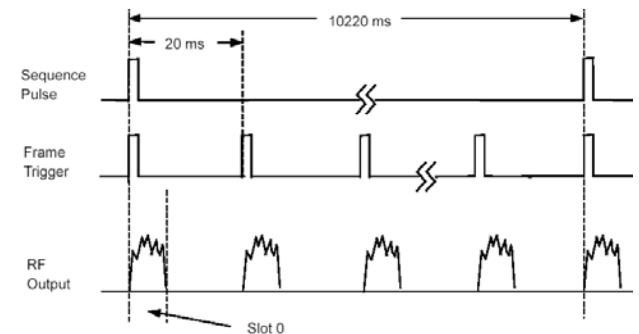
- Baseband reference clock
 - 16x symbol rate
(16x 21 ksps = 336 kHz)

- Frame Trigger, Sequence Pulse

- Downlink



- Uplink 511 frames



Rear Panel

Rear Panel Information

BNC	
Digital Output	A1: RF Gate (M.P. 4) A2: RF Gate (M.P. 2) A4: Frame Trigger B1: 16x Symbol Clock B2: Sequence Pulse B3: B4:
Digital Input/Output	C1: C2: C3: C4:
AUX 1	D1: D2: D3:
Dsub-25P AUX 2	13: ***** 1 19 - 23 : NC G G - - - - - * * * * * 24 & 25 : Ground 25 14

1:	2:	3:
4:	5:	6:
7:	8:	9:
10:	11:	12:
13:	14:	15:
16:	17:	18:

Trigger
Ref. Clock
I/Q Input

MX368035A PHS Signal Generation Software



- Downlink/Uplink PHS test signals (TCH) for RCR STD-28 standard can be outputted by installing the MX368035A PHS Signal Generation Software in the MU368030A Universal Modulation Unit.
- In R&D/**production** process of components, CS and PS, the functions to support various applications are provided as the signal source for components, the wanted signal source and the interfering signal source for receiver test.



Support of test signal format

- Receiver test (BER) for CS/PS test specifications is performable due to the $\pi/4$ DQPSK Frame/Slot format based on RCR STD-28 Version 4.0.
- Just to select the signal patterns saved in large-capacity waveform memory without setting complicated parameters of RCR STD-28!

Simple operation

- High-speed change the signal patterns < 1 sec
- Continuous modulated signal patterns for Advanced PHS on RCR STD-28 Version 4.0 are appended as sample file.

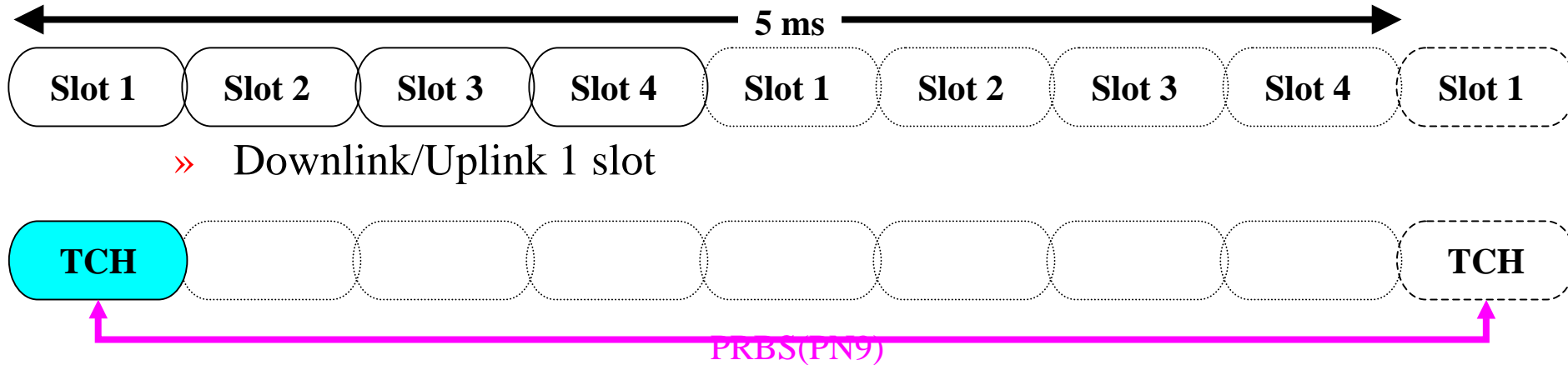
	16QAM	8PSK	QPSK	BPSK	kHzBW	ksps	α
– 1x:	PN9/15	PN9/15	PN9/15	PN9/15	: 288	192	0.5
– 3x:	PN9/15	PN9/15	PN9/15	PN9/15	: 884	640	0.38

- Quick support is provided by updating the signal pattern files saved from PC memory card to internal memory.
 - IQ signal pattern file is downloaded to MG3681A via PC memory card (CompactFlash).
 - The I/Q mapping data of 20× over sampling is stored in Waveform data Memory.

Signal patterns

frame configuration

- $\pi/4$ DQPSK Traffic channel (TCH)

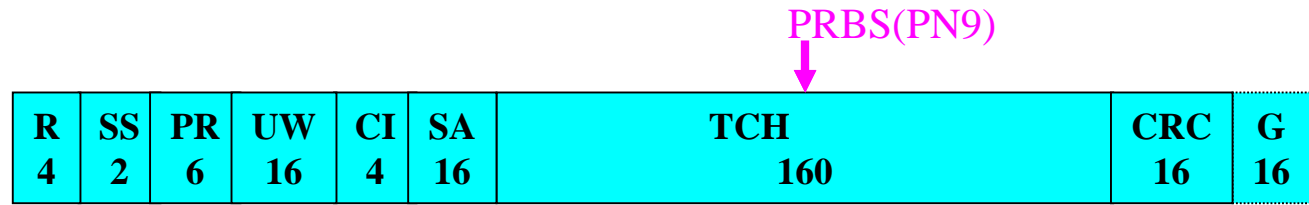


- Super-frame is not supported
 - for the wanted signal source for receiver test

- $\pi/4$ DQPSK **PN9 continuous modulation**
 - for the signal source for components
- $\pi/4$ DQPSK **PN15 continuous modulation**
 - for the interfering signal source for receiver test

- **$\pi/4$ DQPSK Traffic channel (TCH)**

- » 240 bit, 625 ms
 - Scrambling Off



- » R Ramp time for transient response
- » SS Start symbol 10
- » PR Preamble 011001
- » UW Unique word
 - Uplink: E149
 - Downlink: 3D4C
- » CI Channel identifier 0000 (TCH)
- » SA SACCH All “0”
- » G Guard time

Continuous modulated signal patterns select

Freq. 1900.000 000 00 MHz
Level 5.00 dBm Mem. ---
Normal

Baseband : [0n] I/Q Mod. : [Int] Pulse Mod. : [Int]

System : [PHS]
Pattern : [0:DWLINK]

Baseband Setup
Trigger Source : [Int] Trigger Delay : [0]/20sps
Reference Clock : [Int] 0.0000 sps

Wave Data Download

Trigger Ref. Clock I/Q Input

PHS

Wave Data Restart

UMU35SEC0.DLI Knob Step
UMU35PHS.DLI Knob Step

A pink arrow points from the 'Wave Data Download' button to the right-hand screenshot.

Freq. 1900.000 000 00 MHz
Level 0.00 dBm Mem. ---
Normal

Baseband : [0n] I/Q Mod. : [Int] Pulse Mod. : [Int]

System : [PHS]
Pattern : [0:1x2p9]

Baseband Setup
Trigger Source : [Int] Trigger Delay : [0]/20sps
Reference Clock : [Int] 0.0000 sps

0:1x2p9 Knob Step
1:1x4p9 Knob Step
2:1x8p9 Knob Step
3:1x16p9 Knob Step
4:3x2p9 Knob Step
5:3x4p9 Knob Step
6:3x8p9 Knob Step
7:3x16p9 Knob Step

Downloading the signal pattern file from PC memory card

Freq. 1900.000 000 00 MHz
Level 0.00 dBm Mem. ---
Normal

Baseband : [0n] I/Q Mod. : [Int] Pulse Mod. : [Int]

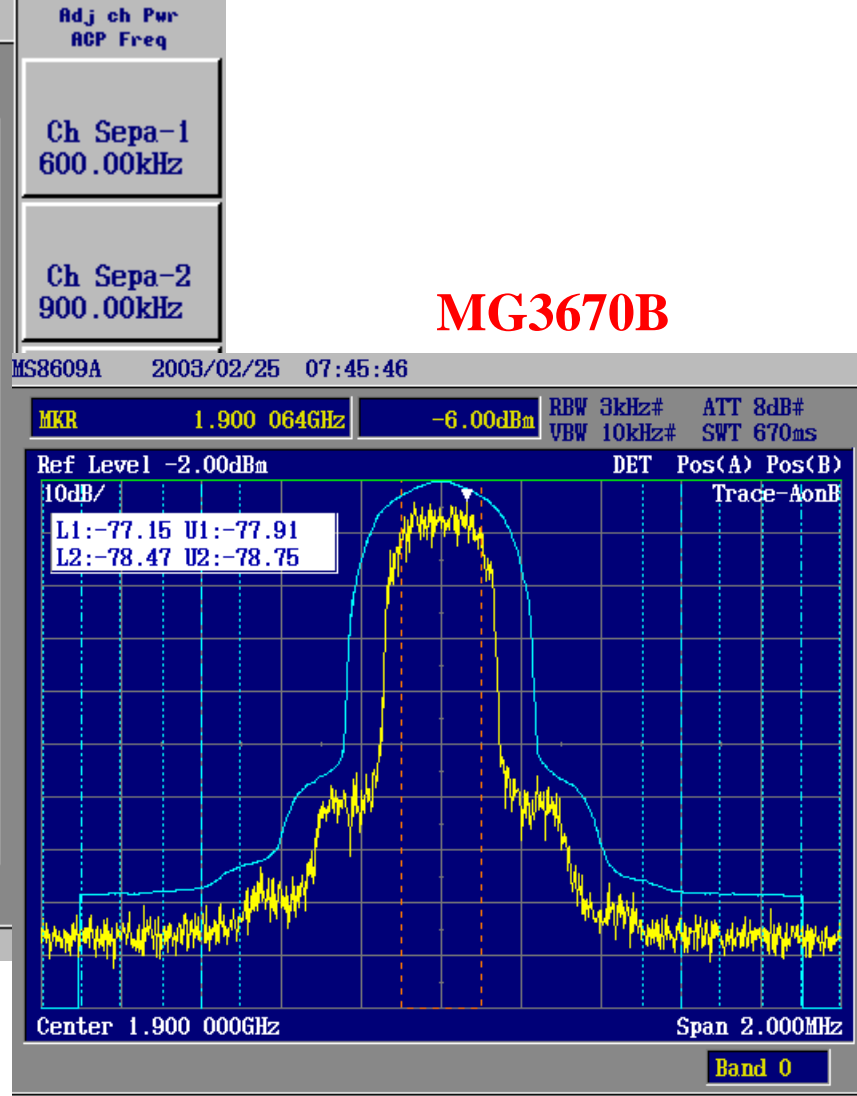
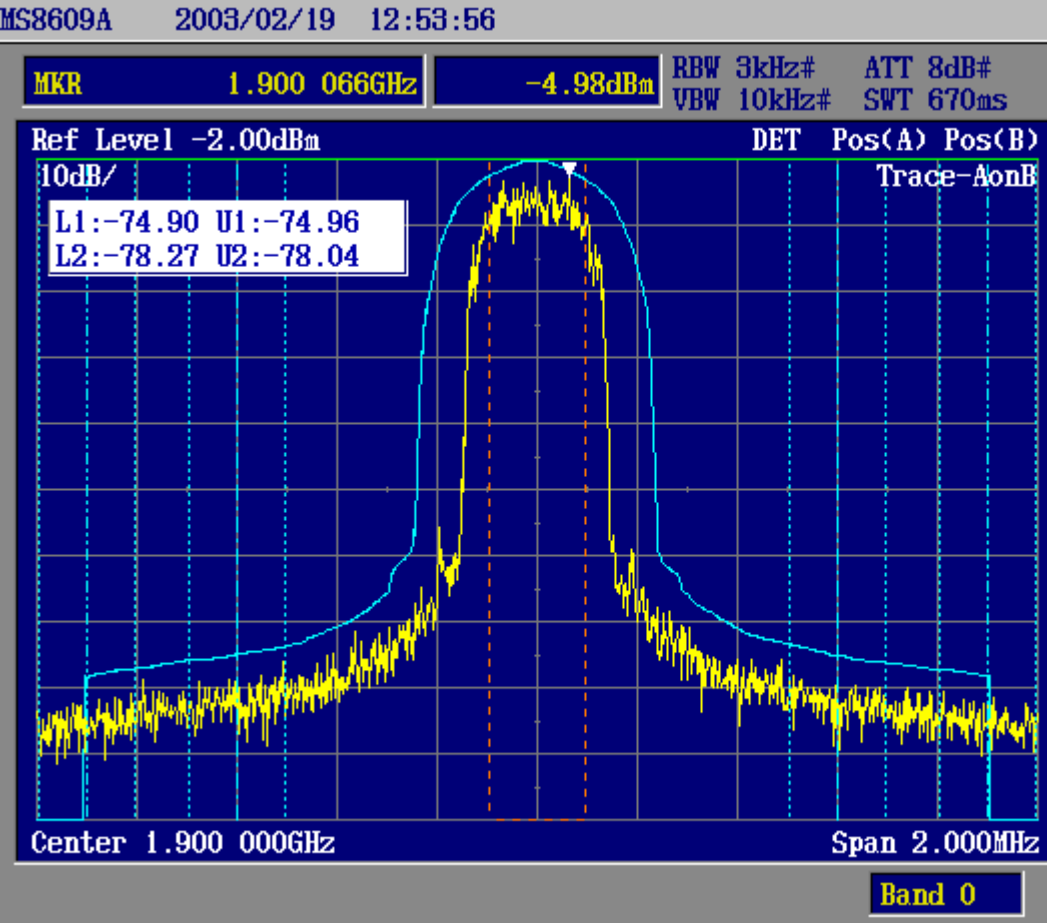
System : [PHS]
Pattern : [0:1x2p9]

Baseband Setup
Trigger Source : [Int] Trigger Delay : [0]/20sps
Reference Clock : [Int] 0.0000 sps

8:1x2p15 Knob Step
9:1x4p15 Knob Step
10:1x8p15 Knob Step
11:1x16p15 Knob Step
12:3x2p15 Knob Step
13:3x4p15 Knob Step
14:3x8p15 Knob Step
15:3x16p15 Knob Step

Contrast of typical ACLR

$\leq +5$ dBm, Continuous modulation



» Front panel

– Trigger

- Synchronization of external frame clock
- Frame trigger or start trigger is selectable
 - Used at CS receiver test

– Ref. Clock

- Synchronization of external baseband reference clock
- $20\times$ symbol rate ($20\times 192\text{ ksps} = 3,840\text{ kHz}$)
 - Used at start triggerExternal reference clock input on rear panel (10/13MHz) is also available

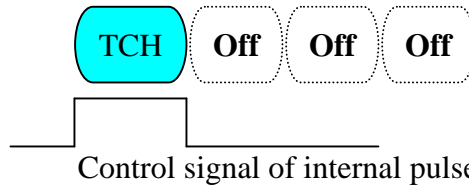


Auxiliary signal

Output

» Rear panel

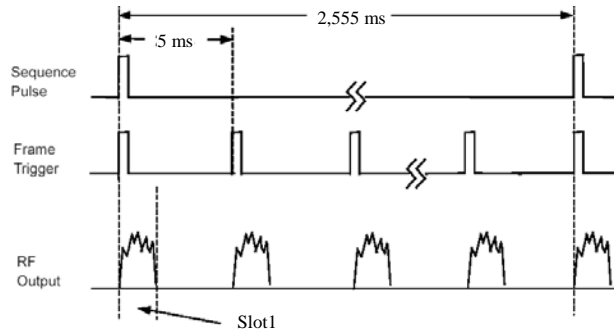
- RF Gate



- Sampling Clock

- Baseband reference clock
 - 20x symbol rate
(20x 192 ksps = 3,840 kHz)

- Frame Trigger, Sequence Pulse
511 frames



Rear Panel

Rear Panel Information

BNC	Digital Output	A1: RF Gate A3: RF Gate B1: Sampling Clock B3:	A2: A4:Frame Trigger B2:Sequence Pulse B4:
Digital Input/Output	AUX 1	C1: C3:	C2: C4: D1: D2: D3:
Dsub-25P AUX 2	<div style="border: 1px solid white; padding: 2px; display: inline-block;"> 13 ***** 1 G G - - - - * * * * * 25 14 </div>		19 - 23 : NC 24 & 25 : Ground

1:	2:	3:
4:	5:	6:
7:	8:	9:
10:	11:	12:
13:	14:	15:
16:	17:	18:

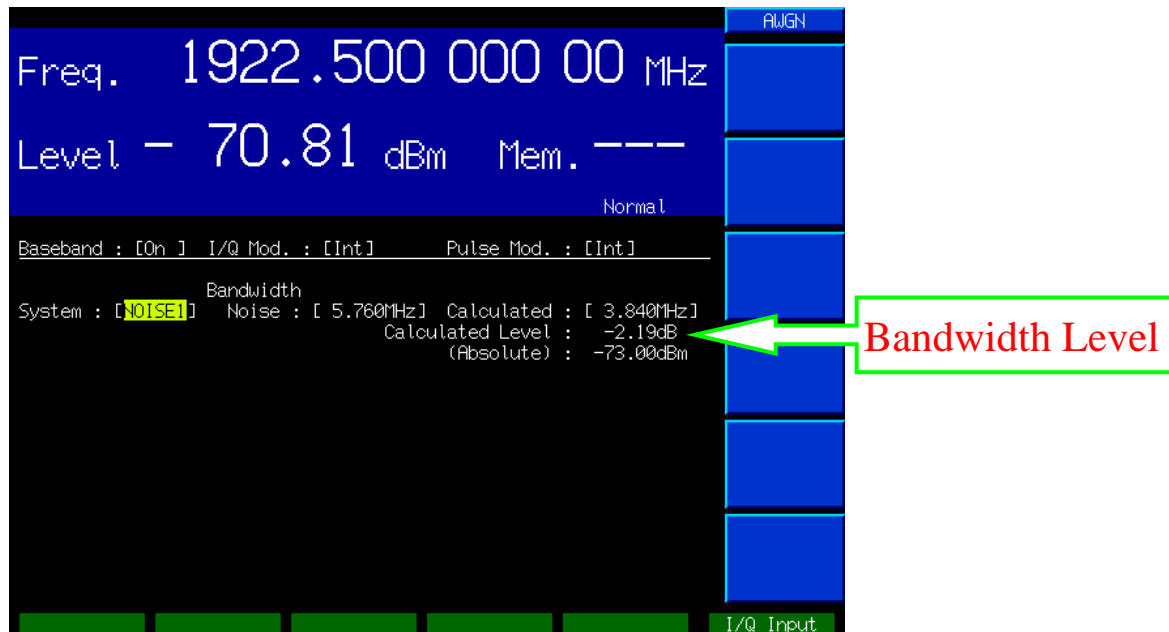
Trigger
Ref. Clock
I/Q Input

Return

MU368060A AWGN



- **AWGN for 3GPP(FDD/TDD) and 3GPP2(CDMA2000) standards can be outputted at real time by installing the MU368060A AWGN Unit in the MG3681A Digital Modulation Signal Generator.**
- **In R&D/production process of base stations(BS) and user equipment(UE), the function is provided as the AWGN source for receiver test.**



AWGN test support

- **3GPP(FDD)**

- » At mounting MX368041B W-CDMA Software installed in MU368040A CDMA Modulation Unit together...

Single unit is performable

- Wanted signal source (W-CDMA modulation)
- Interfering signal source (W-CDMA modulation, CW)
- AWGN source

change < 10 sec

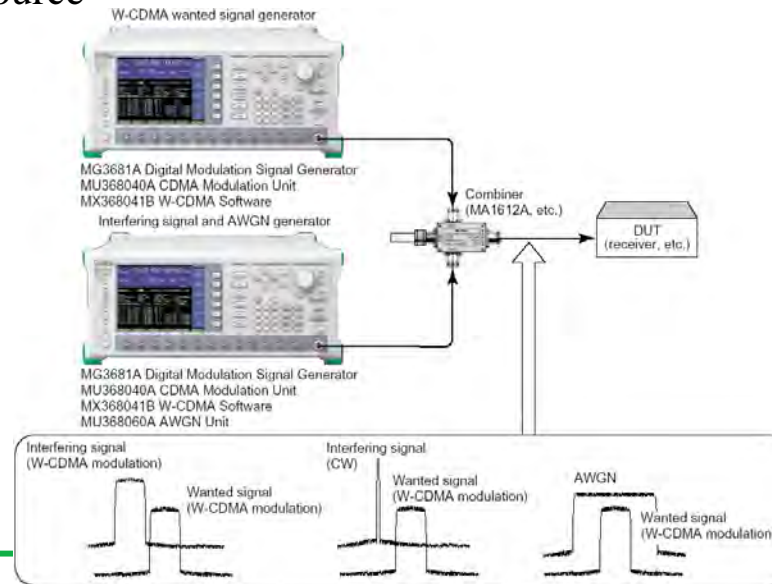
- **3GPP2(CDMA2000)**

- » At mounting MX368033A CDMA2000 1xEV-DO Signal Generation Software installed in MU368030A Universal Modulation Unit together...

Single unit is performable

- Wanted signal source (CDMA2000 1xEV-DO modulation)
- Interfering signal source (CDMA2000 modulation, CW)
- AWGN source

change < 10 sec



MG3681A-E-I-1

Ioc bandwidth level

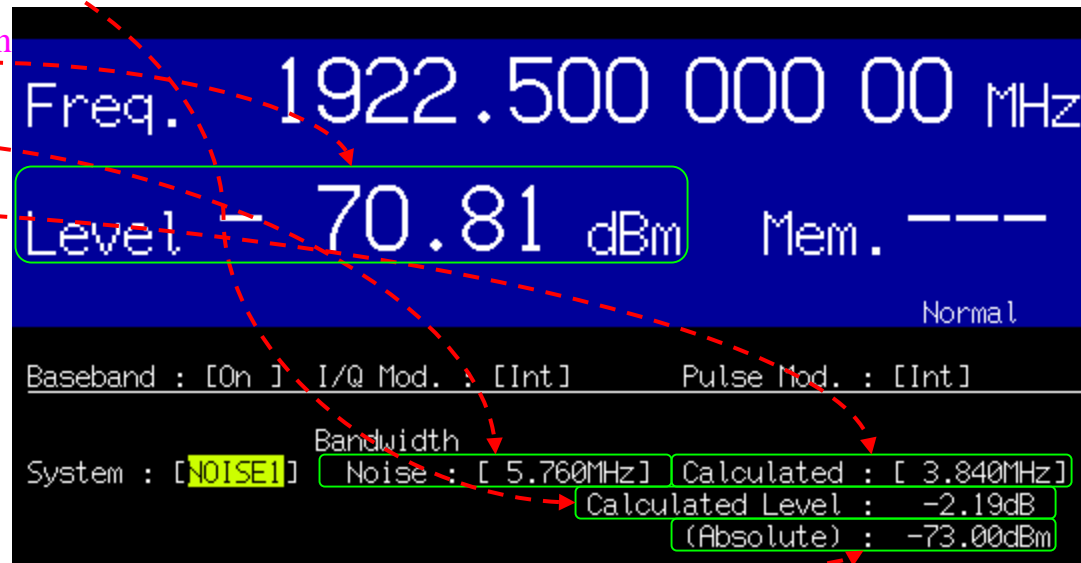
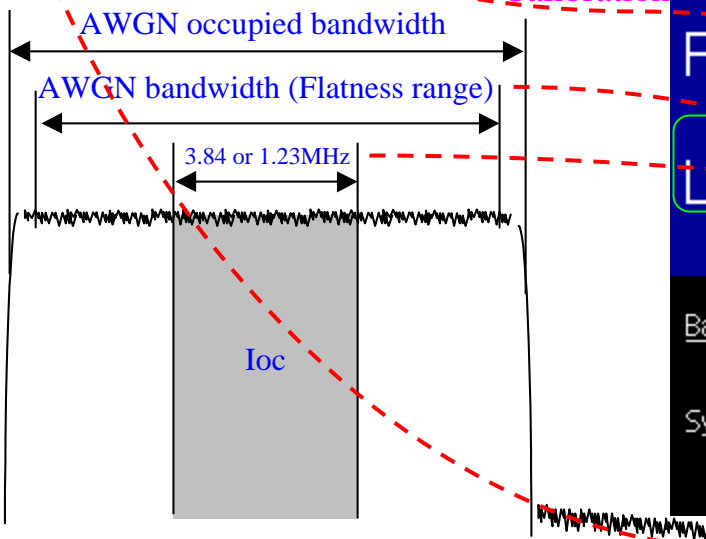
Ioc [dBm] = AWGN level of 3.84MHz(3GPP) or 1.23MHz(3GPP2) bandwidth

To measure for high-accuracy

- » By spectrum analyzer
 - Measuring total level (Pt)[dBm]
 - Measuring 3.84MHz or 1.23MHz bandwidth level (Pb)[dBm]
- » By power meter
 - Measuring total level (Pm)[dBm]
- » $Ioc = Pm + (Pb - Pt)$








Measuring per frequency

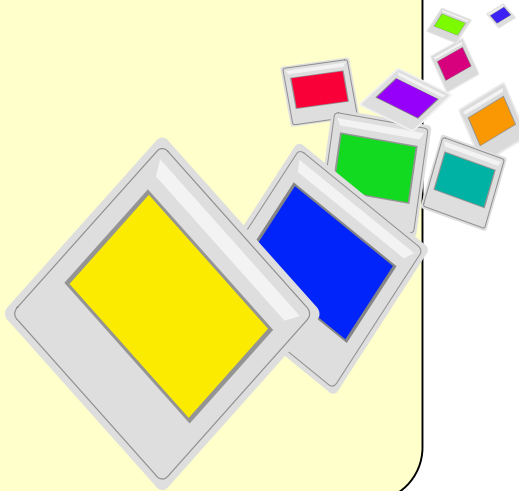
Spectrum analyzer needlessness (accuracy $\leq \pm 0.6$ dB)



Application

- Product outline
- Feature
- **Application**
- Option

- **3GPP**
 - » W-CDMA 3GPP(FDD) 145 
 - » GSM/EDGE 186 
- **3GPP2**
 - » CDMA2000 1xEV-DO 188 
 - » CDMA2000 1X 211 
- **ARIB**
 - » PHS 226 
 - » PDC 235 
- **TIA**
 - » NADC 246 



- 6 Transmitter
- 7 Receiver
- 8 Performance requirement

Section	Test	Wanted signal generator	Interfering signal generator	CW generator	AWGN generator	Others	
6.4	Output power dynamics	MG3681A +MU368040A +MX368041B				Code domain analyzer	
6.4.2	Power control steps						
6.4.3	Power control dynamic range						
6.6	Transmit intermodulation		MG3681A +MU368040A +MX368041B (+MG3681A-42)			Spectrum analyzer Circulator	
7.2	Reference sensitivity level	MG3681A +MU368040A +MX368041B				MP1201C BERT MA1612A 3GHz Combiner	
7.3	Dynamic range				+MU368060A		
7.4	Adjacent Channel Selectivity (ACS)		MG3681A +MU368040A +MX368041B				
7.5	Blocking characteristics		MG3681A +MU368040A +MX368041B	MG3692A 20GHz or MG3642A 2.08GHz			
7.6	Intermodulation characteristics		(+MU368010A) (+MX368012A)				
7.8	Verification of the internal BER calculation						
8.2	Demodulation in static propagation conditions				+MU368060A		
8.3	Demodulation of DCH in multipath fading conditions						
8.4	Demodulation of DCH in moving propagation conditions				MG3681A +MU368060A		Fading simulator
8.5	Demodulation of DCH in birth/death propagation conditions						
8.6	Verification of the internal BLER calculation						
8.8	RACH performance				(MG3681A) +MU368060A (Fading simulator)		
8.8.1	RACH preamble detection in static propagation conditions						
8.8.2	RACH preamble detection in multipath fading case 3						
8.8.3	Demodulation of RACH message in static propagation conditions						
8.8.4	Demodulation of RACH message in multipath fading case 3						
8.9	CPCH performance						
8.9.3	Demodulation of RACH message in static propagation conditions						
8.9.4	Demodulation of RACH message in multipath fading case 3						
8.10	Site Selection Diversity Transmission (SSDT) Mode				+MU368060A		

Transmitter test

Connection example

Wanted signal generator
MG3681A
+MU368040A+MX368041B



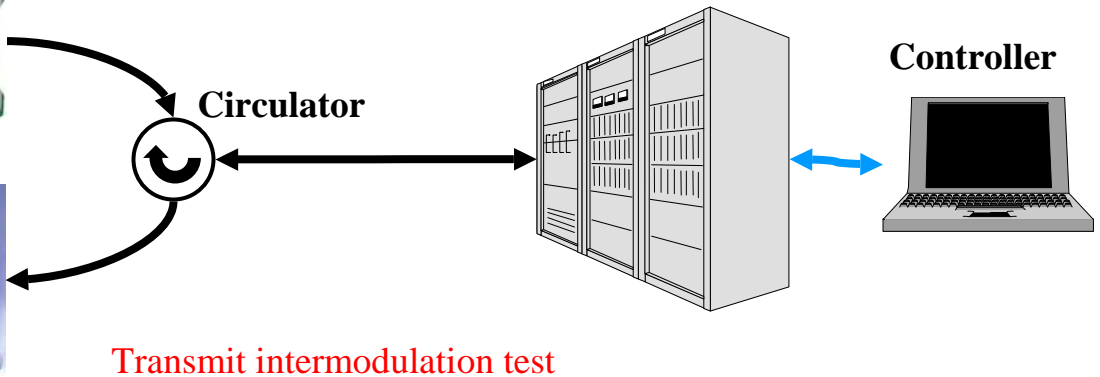
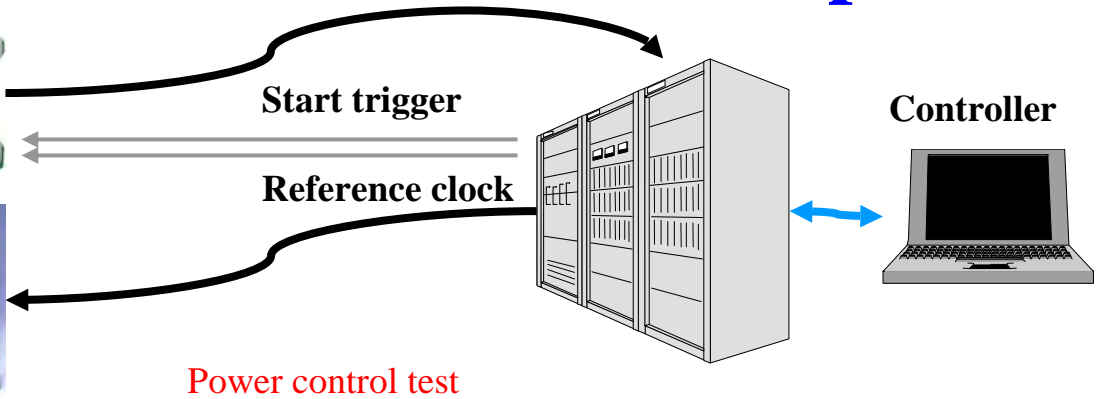
Code domain analyzer
MS8608A/8609A
+MX860801B/860901B



Interfering signal generator
MG3681A
+MU368040A+MX368041B
(+MG3681A-42)



Spectrum analyzer
MS8608A/8609A
+MX860801B/860901B



– Controller

- Launches the Inner loop power control in the possible state by FTM^{Factory Test Mode} control.
- Launches in the transmitting state by FTM^{Factory Test Mode} control.

Receiver test Connection example

Interfering signal generator

CW generator

(AWGN generator)

MG3681A

+MU368040A+MX368041B

(+MU368010A+MX368012A)

(+MU368060A)



Wanted signal generator

(+ AWGN generator)

MG3681A

+MU368040A+MX368041B

(+MU368060A)



CW generator

(MG3692A)



Combiner

(MA1612A)



Start trigger

Reference clock

**Demodulated
(DTCH) data**

Clock



Controller

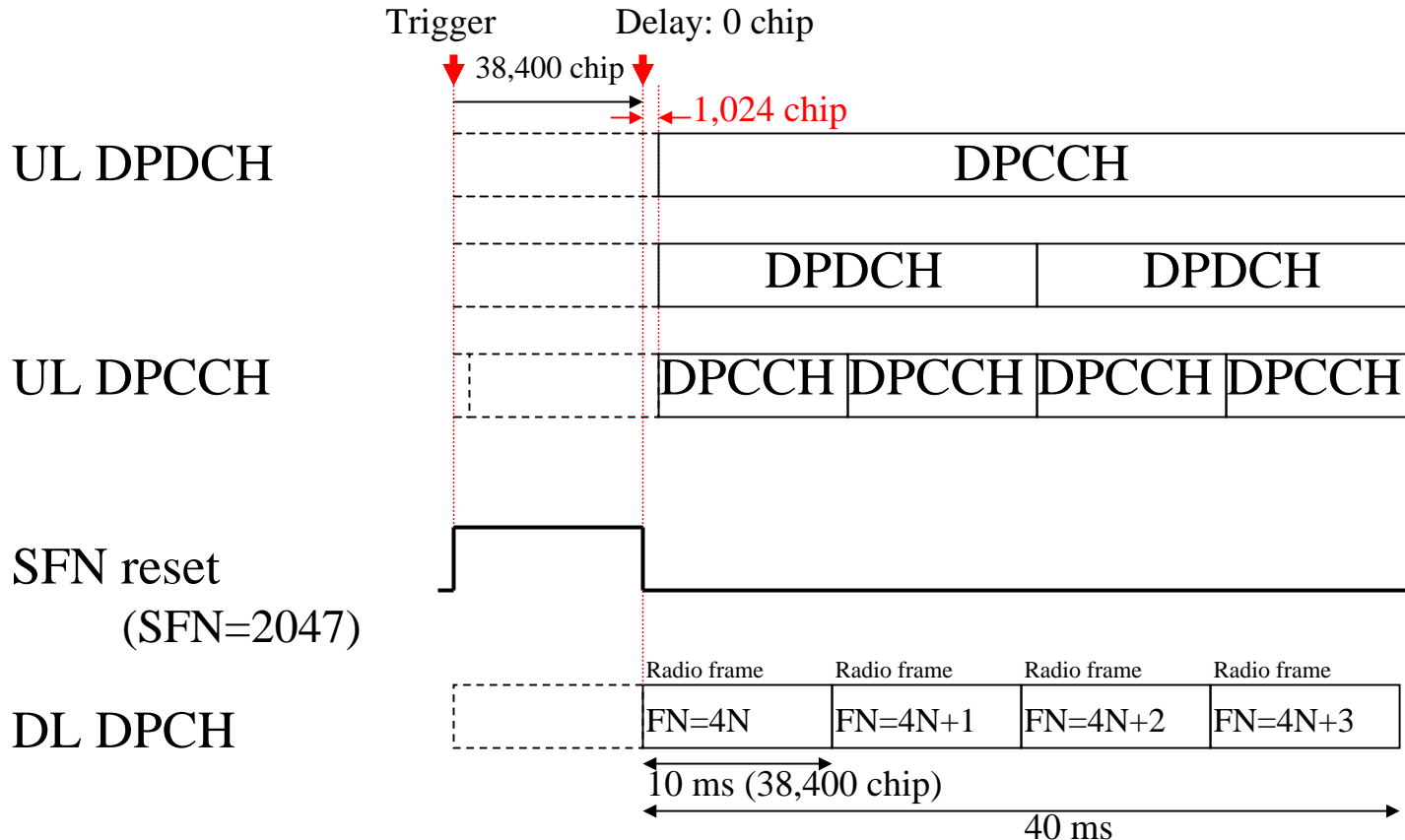


- Start trigger
 - Front panel [Clock/Trig] Input
 - 40 ms × n clock
 - e.g. SFN reset timing of Downlink BCH \emptyset (2044 frame × 10 ms), BFN timing(4096 frame × 10 ms)
- Reference clock
 - Apply only one
 - Front panel [Ref. Clock] Input
 - 3.84 MHz, 2 × 3.84 MHz (7.68 MHz), 4 × 3.84 MHz (15.36 MHz)
 - Rear panel [10MHz/13MHz Ref] Input
 - 10 MHz, 13 MHz
- Controller
 - Launches UL RMC in the receivable state by FTM Factory Test Mode control.
 - Checks the CRC per demodulated transport block (DTCH) and calculates the BLER.

Timing synchronization Setup example

- **Start trigger delay**

- » Set the timing to which BS can receive UL RMC



Timing sync. Setup example

- **Setting External Start trigger**

- » Captures/ Synchronizes the Trigger only once

- **Reference clock:**

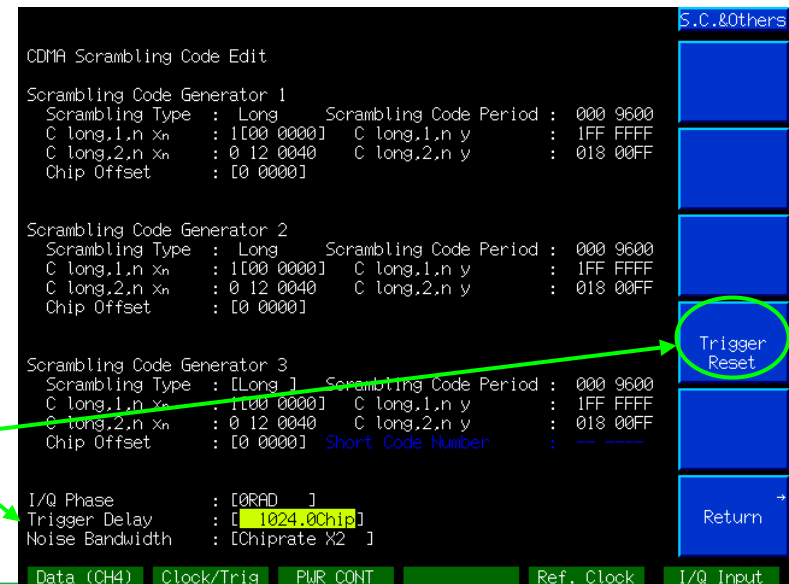
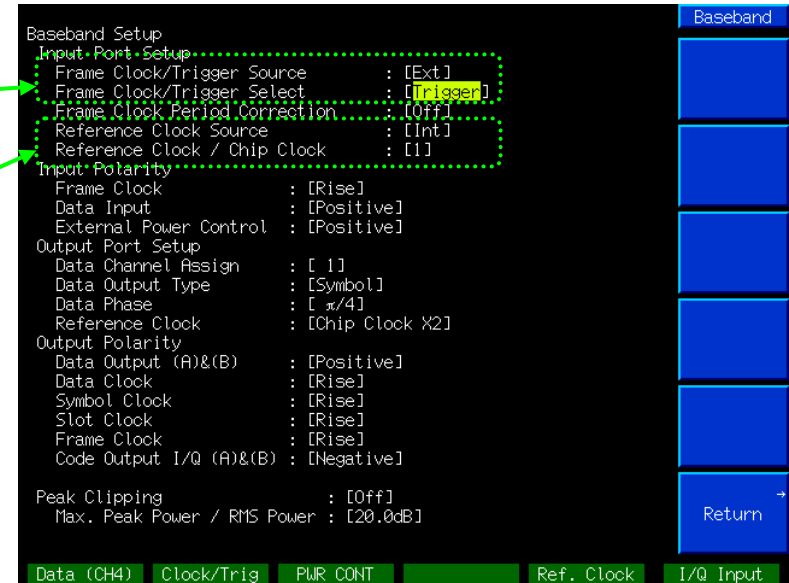
- » [Ref. Clock] Input applicable case
 - Reference Clock Source : [Ext]
 - Reference Clock / Chip Clock:
 - [1] at 3.84 MHz
 - [2] at 2× 3.84 MHz
 - [4] at 4× 3.84 MHz

- » [10MHz/13MHz Ref] Input applicable case
 - Reference Clock Source : [Int]

- **Start trigger delay**

- » -38,353.5 ~ +65,536 chip
1/2 chip resolution

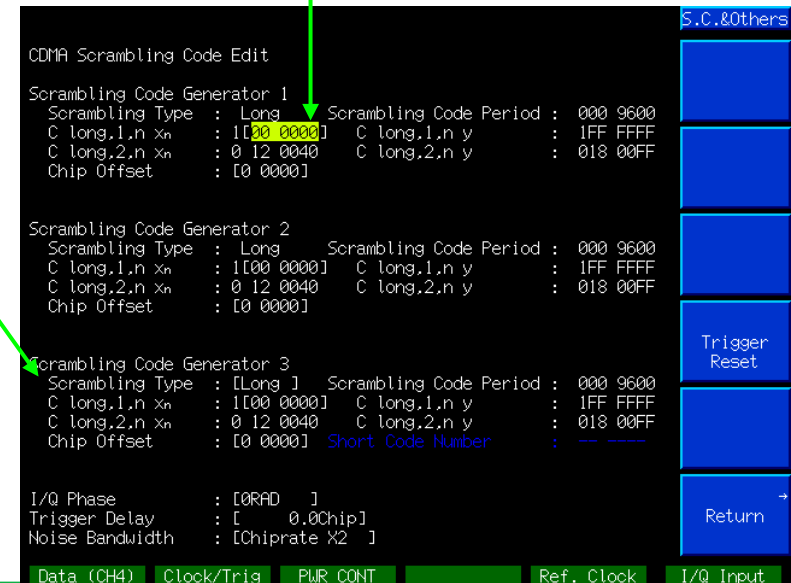
- **Trigger recapture/ synchronization**



Scrambling code sync.

Setup example

- **Long scrambling code**
 - » 38,400 chip (10 ms) length
 - Created from two (x_n, y) binary m-sequences of 25 bit length
 - » Applies HPSK modulation at spreading
 - HPSK: QPSK modulation and $\pi/2$ BPSK modulation alternate per chip timing.
 - Crest factor is lowered without shifting the phase by 180° .
- **Set $x_n(23) \sim x_n(0)$ receivable by BS in hexadecimal**
 - » $C_{\text{long},2,n}$ shifts $C_{\text{long},1,n}$ by 16,777,232 chip
- **Short scrambling code**
 - » To mitigate the reception processing of BS when applying interference canceler
 - » 256 chip length



Wanted signal generator Setup example

- **UL RMC 12.2 kbps**
 - **UL RMC 64 kbps**
 - **UL RMC 144 kbps**
 - **UL RMC 384 kbps**
- **Generating the error 1% in DTCH**
- » Verification of the internal BER/BLER calculation test

Transport Channel : DCH

SF 64 Slot Format : #2
TrCH No. [2]

	TrCH1	TrCH2	TrCH3	TrCH4
Data	[PN9]	[PN9]	-	-
TTI	[20]ms	[40]ms	-	-
Max.TrBk Size	-	-	-	-
TrBk Size	[244]bit	[100]bit	-	-
TrBk Set No.	TrBk X [1]	TrBk X [1]	-	-
CRC	[16]bit	[12]bit	-	-
Tail	1 X 8bit	1 X 8bit	-	-
Coder	[CC_1/3]	[CC_1/3]	-	-
Termination	0 X 12bit	0 X 12bit	-	-
RM attribute	[256]	[256]	-	-
Rept./Punc	88bit	20bit	-	-
BER	[1.01%]	[0.01%]	-	-
BLER	[1.01%]	[0.01%]	-	-

Buttons: Apply, Cancel, Return

Freq. 1922.500 000 00 MHz
Level 0.00 dBm Mem. ---

Normal

Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]

System : [W-CDMA] W-CDMA Phase : [1]
Simulation Link : [Up Link] Chip Rate : [3.840 000]Mps
Filter : [RNT0] Roll Off Ratio : [0.22]
Filter Mode : [EVM] Pattern Select : [18] ULRMC12k
Maximum Code Number : [2] Output Level - 0.03dBm

Ch. 1 : [On] Power : [- 4.6dB]
Ch. 2 : [Off] Power : [-40.0dB]
Ch. 3 : [Off] Power : [-40.0dB]
Ch. 4 : [On] Power : [- 1.9dB] Ch. 5 : [Off] Power : [-40.0dB]
Ch. 6 : [Off] Power : [-40.0dB] Ch. 7 : [Off] Power : [-40.0dB]
Ch. 8 : [Off] Power : [-40.0dB] Ch. 9 : [Off] Power : [-40.0dB]
Ch.10 : [Off] Power : [-40.0dB] Ch.11 : [Off] Power : [-40.0dB]
Ch.12 : [Off] Power : [-40.0dB] Add Ch : Off Power : [-40.0dB]
AWGN : [Off] C/N : Wanted - Noise -

Buttons: Cal, Even Level, etc.*

Freq. 1922.500 000 00 MHz
Level - 3.00 dBm Mem. ---

Normal

Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]

Internal	11:ULRMC64k	22:
1:C168	12:UL_AMR#1	23:
2:C360	13:UL_AMR#2	24:
3:PRE	14:UL_AMR#3	25:
4:R168	15:UL_ISDN	26:
5:R360	16:	27:
6:SSDTa	17:	28:
7:SSDTb	18:	29:
8:ULRMC12k	19:	30:
9:ULRMC144	20:	31:
10:ULRMC384	21:	32:

Total Share : Symbol = 3 Wave = 40

AWGN : [Off] C/N : Wanted - Noise -

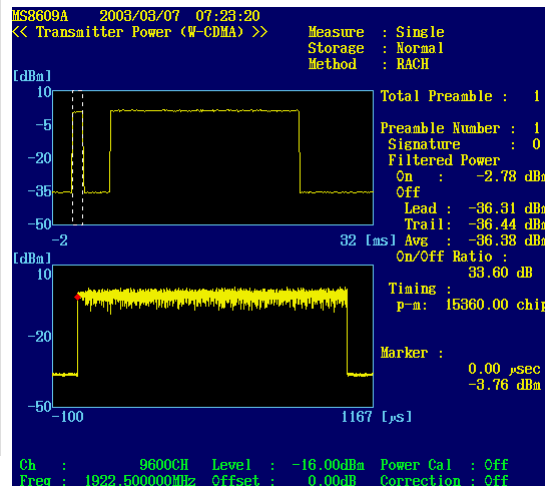
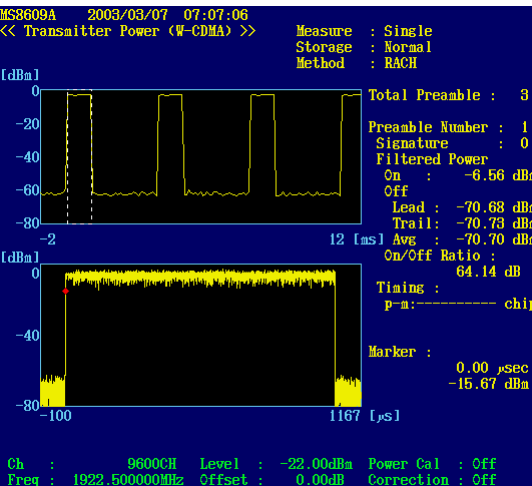
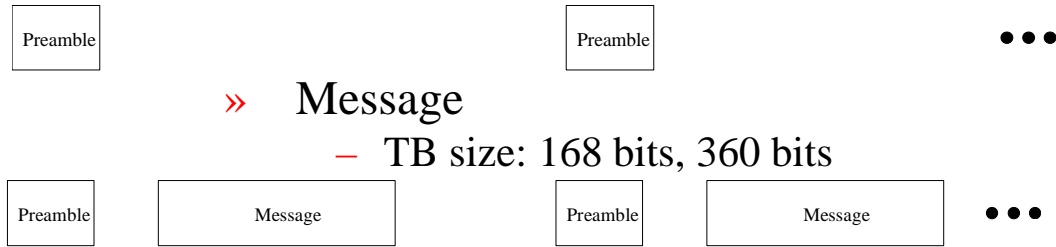
Wanted signal generator Setup example

- UL RMC RACH**

- » Preamble

- » Message

- TB size: 168 bits, 360 bits



- UL RMC CPCH**

- TB size: 168 bits, 360 bits



Wanted signal generator Setup example

- **UL RMC 12.2 kbps**
 - » **SSDT test**
 - Cell ID transmitted by UE: A, B

The screenshot shows a signal generator configuration interface. At the top, the frequency is set to 1922.500 000 00 MHz and the level is -3.00 dBm. Below this, a table lists various parameters and their values. A red dashed box highlights the '8:ULRMC12k' entry. To the right of the table, there are several numerical values and labels, including 'Knob Step Cursor' and 'ULRMC12k - 3.03dBm'. At the bottom, there are several status indicators and labels like 'Data (CH4)', 'Clock/Trig', 'PWR CONT', 'Ref. Clock', and 'I/Q Input'.

Internal	11:ULRMC64k	22:	Knob	[1]
1:C168	12:UL_AMR#1	23:	Step	[3.840 000Mbps]
2:C360	13:UL_AMR#2	24:	Cursor	[0.22]
3:PRE	14:UL_AMR#3	25:		[8] ULRMC12k
4:R168	15:UL_ISDN	26:		- 3.03dBm
5:R360	16:	27:		
6:SSDTa	17:	28:		ower : [-40.0dB]
7:SSDTb	18:	29:		ower : [-40.0dB]
8:ULRMC12k	19:	30:		ower : [-40.0dB]
9:ULRMC144	20:	31:		ower : [-40.0dB]
10:ULRMC384	21:	32:		

Total Share : Symbol = 3 Wave = 40

AWGN : [Off] C/N : Wanted - Noise -

Data (CH4) Clock/Trig PWR CONT Ref. Clock I/Q Input

Wanted signal generator Setup example

- **Set TPC command for Inner loop power control**
 - » 60 TPC command (60 slots) cycle
 - Power control steps test
 - Transmitter power control step tolerance
 - [555 5555 5555 5555] _H
0101 0101 ... 0101
 - Transmitter aggregated power control step range
 - [003 FF00 3FF0 03FF] _H
0000 0000 0011 1111 1111
0000 ... 1111
 - Power control dynamic range test
 - [000 0000 3FFF FFFF] _H
0000 ... 0011 ... 1111
(0^{30bits} | 30bits)

Physical channel : UL-DPCCH

Pilot	TFCI	FBI	TPC
(6)	(2)	(0)	(2)

Slot Format : [0] (highlighted)
TFCI : [000] _H
FBI : -
TPC : [555 5555 5555 5555] _H

Buttons: PhCH Edit, Return

Bottom bar: Data (CH4), Clock/Trig, PWR CONT, Ref. Clock, I/Q Input

Interfering signal generator

Setup example

- **W-CDMA**

- » UL RMC 64 kbps
- » Set the scrambling code different from wanted signal
 - [00 0010]
 - in case of Wanted signal: [00 0000]

- » ACP priority filter

Freq. 1922.500 000 00 MHz
 Level - 52.00 dBm Mem. ---
 Normal
 Baseband : [0n] I/Q Mod. : [Int] Pulse Mod. : [Int]
 System : [W-CDMA] W-CDMA Phase : [1]
 Simulation Link : [Up Link] Chip Rate : [3.840 000Mps]
 Filter : [RNYQ] Roll Off Ratio : [0.22]
 Filter Mode : [ACP] Pattern Select : [0] Internal
 Maximum Code Number : [1] Output Level - 52.00dBm
 Ch. 1 : [0n] Power : [- 0.0dB]
 Ch. 2 : [0ff] Power : [-40.0dB]
 Ch. 3 : [0ff] Power : [-40.0dB]
 Ch. 4 : [0ff] Power : [- 3.1dB]
 Ch. 5 : [0ff] Power : [-40.0dB]
 Ch. 6 : [0ff] Power : [-40.0dB]
 Ch. 7 : [0ff] Power : [-40.0dB]
 Ch. 8 : [0ff] Power : [-40.0dB]
 Ch. 9 : [0ff] Power : [-40.0dB]
 Ch.10 : [0ff] Power : [-40.0dB]
 Ch.11 : [0ff] Power : [-40.0dB]
 Ch.12 : [0ff] Power : [-40.0dB]
 Add Ch : Off Power : [-40.0dB]
 AWGN : [0ff] C/N : [-20.0dB] Wanted - Noise -

Freq. 1922.500 000 00 MHz
 Level - 3.00 dBm Mem. ---
 Normal
 Baseband : [0n] I/Q Mod. : [Int] Pulse Mod. : [Int]
 Internal 11:ULRMC64k 22: Knob
 1:C168 12:UL_AMR#1 23: Step
 2:C360 13:UL_AMR#2 24: Cursor
 3:PRE 14:UL_AMR#3 25:
 4:R168 15:UL_ISDN 26:
 5:R360 16: 27:
 6:SSDTa 17: 28:
 7:SSDTb 18: 29:
 8:ULRMC12k 19: 30:
 9:ULRMC144 20: 31:
 10:ULRMC384 21: 32:
 Total Share : Symbol = 3 Wave = 40
 AWGN : [0ff] C/N : Wanted - Noise -
 Data (CH4) Clock/Trig PWR CONT Ref. Clock I/Q Input

CDMA Scrambling Code Edit
 Scrambling Code Generator 1
 Scrambling Type : Long Scrambling Code Period : 000 9600
 C long,1,n x_n : 1[00 0000] C long,1,n y : 1FF FFFF
 C long,2,n x_n : 0 12 0040 C long,2,n y : 018 00FF
 Chip Offset : [0 0000]
 Scrambling Code Generator 2
 Scrambling Type : Long Scrambling Code Period : 000 9600
 C long,1,n x_n : 1[00 0000] C long,1,n y : 1FF FFFF
 C long,2,n x_n : 0 12 0040 C long,2,n y : 018 00FF
 Chip Offset : [0 0000]
 Scrambling Code Generator 3
 Scrambling Type : [Long] Scrambling Code Period : 000 9600
 C long,1,n x_n : 1[00 0000] C long,1,n y : 1FF FFFF
 C long,2,n x_n : 0 12 0040 C long,2,n y : 018 00FF
 Chip Offset : [0 0000] Short Code Number :
 I/Q Phase : [0RAD]
 Trigger Delay : [0.0Chip]
 Noise Bandwidth : [Chiprate X2]
 Data (CH4) Clock/Trig PWR CONT Ref. Clock I/Q Input

Interfering signal generator

Setup example

- **Test Model 1**
 - » Transmit intermodulation test
 - » ACP priority filter
- **GMSK modulation**
 - » Blocking characteristics, Intermodulation characteristics test

Frequency: 2112.500 000 00 MHz
Level: 8.00 dBm Mem. ---
Warning: Normal

Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]

Internal	11:BS31657	22:	Knob
1:BS11657d	12:BS33257	23:	Step
2:BS13257d	13:BS457	24:	Cursor
3:BS16457d	14:BS5_257	25:	
4:BS_257d	15:BS5_457	26:	
5:BS_457d	16:BS5_857	27:	
6:BS_857d	17:	28:	
7:BS11657	18:	29:	
8:BS13257	19:	30:	
9:BS16457	20:	31:	
10:BS257	21:	32:	

Total Share : Symbol = 12 Wave = 87

Parameters:
[1] [3.840 000Mpps]
[0.221]
[0] BS16457
- 7.97dBm
1 Sc : [-13.0dB]
1 Sc : [-12.5dB]
1 Sc : [-12.5dB]
Power : [-18.0dB]
Power : [- 9.5dB]
Power : [- 9.5dB]
Power : [-40.0dB]
Power : [- 1.1dB]

Frequency: 900.000 000 00 MHz
Level: 5.00 dBm Mem. ---
Warning: Normal

Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]

System : [SS1]
Modulation : GMSK Bit Rate : [270.833kbps]
Filter : BbT=[0.30]
Differential Encode : [On] Phase Polarity : [Normal]
Burst : [off]
Pattern : [PN15]

Buttons: Data (CH4) Clock/Trig PWR CONT Ref. Clock I/Q Input

AWGN generator

Setup example

• AWGN mixing

» C/N = Wanted signal/AWGN

- Dynamic range test
 - C/N: [-16.8dB]
 - Wanted -89.8dBm Noise -73.0dBm
- Demodulation in static propagation conditions test
 - C/N: [-19.5dB]
 - Wanted -103.5dBm Noise -84.0dBm
 - $(R_b: 12.2 \text{ kbps}, E_b/N_o: 5.5 \text{ dB})$
 - $= 10 \log_{10}(R_b/3.84 \times 10^6) + E_b/N_o$

12.2 kbps:	<u>-24.98</u>
64 kbps:	<u>-17.78</u>
144 kbps:	<u>-14.26</u>
384 kbps:	<u>-10</u>

• AWGN source

» $I_{oc} =$
 Total level
 + Bandwidth level

Scrambling Code Generator 3
 Scrambling Type : [Long] Scrambling Code Period : 000 9600
 C long,1,n x_n : 1[00 0000] C long,1,n y : 1FF FFFF
 C long,2,n x_n : 0 12 0040 C long,2,n y : 018 00FF
 Chip Offset : [0 0000] Short Code Number : _____

I/Q Phase : [Knob Step]
 Trigger Delay : _____
 Noise Bandwidth : [Chiprate X1.5]

Data (CH4) Clock/Trig PWR CONT Ref. Clock

Level - 70.70 dBm Mem. ---

Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]

System : [W-CDMA] W-CDMA Phase : [1]
 Simulation Link : [Up Link] Chip Rate : [3.840 000Mps]
 Filter : [RNYQ] Roll Off Ratio : [0.22]
 Filter Mode : [EVM] Pattern Select : [18] ULRMC12k
 Maximum Code Number : [2] Output Level : - 70.70dBm

Ch. 1 : [On] Power : [- 4.6dB]
 Ch. 2 : [Off] Power : [-40.0dB]
 Ch. 3 : [Off] Power : [-40.0dB]
 Ch. 4 : [On] Power : [- 1.9dB]
 Ch. 5 : [Off] Power : [-40.0dB]
 Ch. 6 : [Off] Power : [-40.0dB]
 Ch. 7 : [Off] Power : [-40.0dB]
 Ch. 8 : [Off] Power : [-40.0dB]
 Ch. 9 : [Off] Power : [-40.0dB]
 Ch.10 : [Off] Power : [-40.0dB]
 Ch.11 : [Off] Power : [-40.0dB]
 Ch.12 : [Off] Power : [-40.0dB]
 Add Ch : Off Power : [-40.0dB]
 AWGN : [On] C/N : [-18.0dB] Wanted - 91.0dBm Noise - 73.0dBm

Data (CH4) Clock/Trig PWR CONT Ref. Clock I/Q Input

Freq. 1922.500 000 00 MHz

Level - 70.81 dBm Mem. ---

Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]

Bandwidth

System : [NOISE] Noise : [5.760MHz] Calculated : [3.840MHz]
 Calculated Level : -2.19dB
 (Absolute) : -73.00dBm

W-CDMA 3GPP(FDD) UE testing

3GPP TS 25.101 (Release 5)

- 6 Transmitter
- 7 Receiver

* TS 34.121 (Release 5)

- * 5 Transmitter
- * 6 Receiver

Section	Test	Wanted signal generator	Interfering signal generator	CW generator	AWGN generator	Others
6.4	Output power dynamics					(Slot) Pwr meter Circulator
6.4.2	Inner loop power control in the uplink					
6.4.3	Minimum output power					
7.3	Reference sensitivity level					
7.4	Maximum input level					MP1201C BERT
7.4.1	DPCH					
7.4.2	HS-PDSCH for 16QAM					
7.5	Adjacent Channel Selectivity (ACS)		MG3681A +MU368040A +MX368041B	MG3681A +MU368040A +MX368041B		
7.6	Blocking characteristics		MG3681A +MU368040A +MX368041B +(MU368010A) +(MX368012A)	MG3692A 20GHz or MG3633A 2.7GHz		MA1612A 3GHz Combiner
7.7	Spurious response					
7.8	Intermodulation characteristics		MG3681A +MU368040A +MX368041B			

W-CDMA 3GPP(FDD) UE testing

3GPP TS 25.101 (Release 5)

* TS 34.121 (Release 5)

8 Performance requirement

* 7 Performance requirements

9 Performance requirement (HSDPA)

Section	Test	Wanted signal generator	Interfering signal generator	CW generator	AWGN generator	Others	
8.2	Demodulation in static propagation conditions	MG3681A +MU368040A +MX368041B			MG3681A +MU368060A		
8.2.3	Demodulation in Dedicated Channel (DCH)						
8.3	Demodulation of DCH in multi-path fading propagation conditions						
8.4	Demodulation of DCH in moving propagation conditions						
8.5	Demodulation of DCH in birth-death propagation conditions						
8.6	Demodulation of DCH in downlink Transmit diversity modes	MG3681A x2 +MU368040A +MX368041B					Combiner
8.6.1	Demodulation of DCH in open-loop transmit diversity modes						Fading simulator
8.9	Downlink compressed mode	MG3681A +MU368040A +MX368041B					(Fading simulator)
8.10	Blind transport format detection						
8.12	Demodulation of Paging Channel						
9.2	Demodulation of HS-DSCH (FRC)	MG3681A +MU368040A +MX368041B				Combiner	
9.2.1	Single Link performance					(Fading simulator)	
9.3	Reporting of Channel Quality Indicator (CQI)						

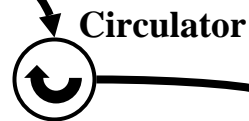
Transmitter test

Connection example

Wanted signal generator
MG3681A
+**MU368040A**+**MX368041B**



(Slot) Power meter
MS8608A/8609A
+**MX860801B/860901B**



Controller



– Controller

- Launches the Inner loop power control in the possible state by FTM^{Factory Test Mode} control.

Receiver test Connection example

Interfering signal generator

CW generator

AWGN generator

MG3681A

+MU368040A+MX368041B
(+MU368010A+MX368012A)

+MU368060A



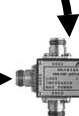
Wanted signal generator

MG3681A

+MU368040A+MX368041B
(+MX368041B-11)

CW generator
(MG3692A)

Combiner
(MA1612A)



Controller



Demodulated
(DTCH) data Clock



BERT
(MP1201C)

– Controller

- Launches DL RMC in receivable state by FTM^{Factory Test Mode} control.
- Checks the CRC per demodulated transport block (DTCH) and calculates the BLER.

Scrambling code sync.

Setup example

- **Long scrambling code**

- Created from Gold sequences of 18 bit length
- » Applies QPSK modulation at spreading

- **Set the Scrambling code receivable by UE in hexadecimal**

- » 0 ~ 3FFFF (2¹⁸-1)

- Primary scrambling code: 16 × (8 × j + k)

- Secondary scrambling code: 16 × (8 × j + k) + (1~15)

= 0 ~ 01FF0

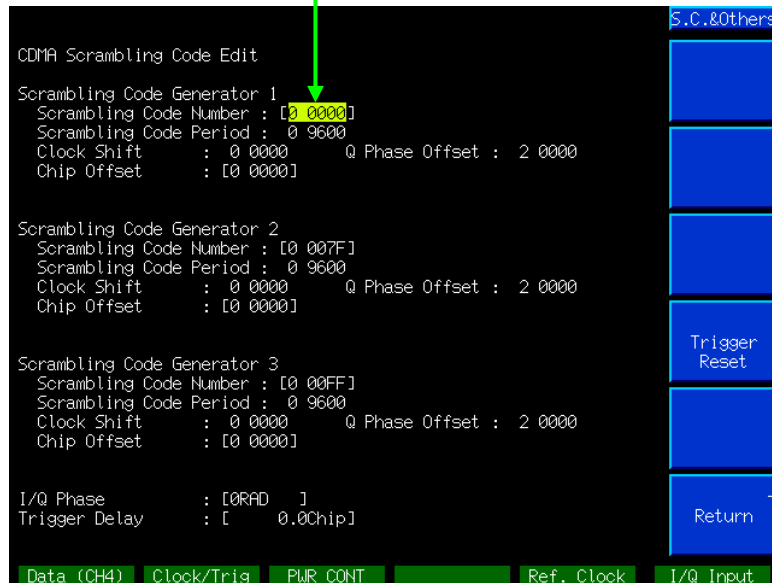
- 512 codes (i= 0 ~ 511)

- 64 Scrambling code group

j= 0 ~ 63

- 8 Primary scrambling code

k= 0 ~ 7



Applicable codes for SCH spreading modulation

- When scrambling code group (j) was changed...

Set in reference to 3GPP TS 25.213 5.2.3.2

Table 4: Allocation of SSCs for secondary SCH

- » Due to the pair with SSC Secondary Synchronisation Code allocation for S-SCH.

CDMA Channel 1-3

Channel 1 (Symbol Rate 15.00Ksps)
Channel Type : [P-CCPCH]
SF : 256 Channelization Code : [1]
Offset : [0Symbol] Scrambling Code Gen.: [1]

Channel 2 (Symbol Rate 15.00Ksps)
Channel Type : [P-CCPCH]
SF : 256 Channelization Code : [1]
Offset : [0Symbol] Scrambling Code Gen.: [1]

Channel 3 (Symbol Rate 15.00Ksps)
Channel Type : [P-CCPCH]
SF : 256 Channelization Code : [1]
Offset : [0Symbol] Scrambling Code Gen.: [1]

P-CCPCH Setup for Channel : [1]
Primary Synchronization Code : 3gpp
Secondary Synchronization Code Allocation

Slot Code	Slot Code	Slot Code	Slot Code
1 : [1]	5 : [9]	9 : [10]	13 : [15]
2 : [1]	6 : [10]	10 : [16]	14 : [7]
3 : [2]	7 : [15]	11 : [2]	15 : [16]
4 : [8]	8 : [8]	12 : [7]	

CH1 - CH3

CH1 PhCH Edit

CH2 PhCH Edit

CH3 PhCH Edit

Return

Data (CH4) Clock/Trig PWR CONT Ref. Clock I/Q Input

For reference: 3GPP TS 25.213 (Release 5) Table 4

Group 0: Default setting

Scrambling Code Group	slot number														
	#0	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14
Group 0	1	1	2	8	9	10	15	8	10	16	2	7	15	7	16
Group 1	1	1	5	16	7	3	14	16	3	10	5	12	14	12	10
Group 2	1	2	1	15	5	5	12	16	6	11	2	16	11	15	12
Group 3	1	2	3	1	8	6	5	2	5	8	4	4	6	3	7
Group 4	1	2	16	6	6	11	15	5	12	1	15	12	16	11	2
Group 5	1	3	4	7	4	1	5	5	3	6	2	8	7	6	8
Group 6	1	4	11	3	4	10	9	2	11	2	10	12	12	9	3
Group 7	1	5	6	6	14	9	10	2	13	9	2	5	14	1	13
Group 8	1	6	10	10	4	11	7	13	16	11	13	6	4	1	16
Group 9	1	6	13	2	14	2	6	5	5	13	10	9	1	14	10
Group 10	1	7	8	5	7	2	4	3	8	3	2	6	6	4	5
Group 11	1	7	10	9	16	7	9	15	1	8	16	8	15	2	2
Group 12	1	8	12	9	9	4	13	16	5	1	13	5	12	4	8
Group 13	1	8	14	10	14	1	15	15	8	5	11	4	10	5	4
Group 14	1	9	2	15	15	16	10	7	8	1	10	8	2	16	9
Group 15	1	9	15	6	16	2	13	14	10	11	7	4	5	12	3
Group 16	1	10	9	11	15	7	6	4	16	5	2	12	13	3	14
Group 17	1	11	14	4	13	2	9	10	12	16	8	5	3	15	6
Group 18	1	12	12	13	14	7	2	8	14	2	1	13	11	8	11
Group 19	1	12	15	5	4	14	3	16	7	8	6	2	10	11	13
Group 20	1	15	4	3	7	6	10	13	12	5	14	16	8	2	11
Group 21	1	16	3	12	11	9	13	5	8	2	14	7	4	10	15
Group 22	2	2	5	10	16	11	3	10	11	8	5	13	3	13	8
Group 23	2	2	12	3	15	5	8	3	5	14	12	9	8	9	14
Group 24	2	3	6	16	12	16	3	13	13	6	7	9	2	12	7
Group 25	2	3	8	2	9	15	14	3	14	9	5	5	15	8	12
Group 26	2	4	7	9	5	4	9	11	2	14	5	14	11	16	16
Group 27	2	4	13	12	12	7	15	10	5	2	15	5	13	7	4
Group 28	2	5	9	9	3	12	8	14	15	12	14	5	3	2	15
Group 29	2	5	11	7	2	11	9	4	16	7	16	9	14	14	4
Group 30	2	6	2	13	3	3	12	9	7	16	6	9	16	13	12
Group 31	2	6	9	7	7	16	13	3	12	2	13	12	9	16	6

Scrambling Code Group	slot number														
	#0	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14
Group 32	2	7	12	15	2	12	4	10	13	15	13	4	5	5	10
Group 33	2	7	14	16	5	9	2	9	16	11	11	5	7	4	14
Group 34	2	8	5	12	5	2	14	14	8	15	3	9	12	15	9
Group 35	2	9	13	4	2	13	8	11	6	4	6	8	15	15	11
Group 36	2	10	3	2	13	16	8	10	8	13	11	11	16	3	5
Group 37	2	11	15	3	11	6	14	10	15	10	6	7	7	14	3
Group 38	2	16	4	5	16	14	7	11	4	11	14	9	9	7	5
Group 39	3	3	4	6	11	12	13	6	12	14	4	5	13	5	14
Group 40	3	3	6	5	16	9	15	5	9	10	6	4	15	4	10
Group 41	3	4	5	14	4	6	12	13	5	13	6	11	11	12	14
Group 42	3	4	9	16	10	4	16	15	3	5	10	5	15	6	6
Group 43	3	4	16	10	5	10	4	9	9	16	15	6	3	5	15
Group 44	3	5	12	11	14	5	11	13	3	6	14	6	13	4	4
Group 45	3	6	4	10	6	5	9	15	4	15	5	16	16	9	10
Group 46	3	7	8	8	16	11	12	4	15	11	4	7	16	3	15
Group 47	3	7	16	11	4	15	3	15	11	12	12	4	7	8	16
Group 48	3	8	7	15	4	8	15	12	3	16	4	16	12	11	11
Group 49	3	8	15	4	16	4	8	7	7	15	12	11	3	16	12
Group 50	3	10	10	15	16	5	4	6	16	4	3	15	9	6	9
Group 51	3	13	11	5	4	12	4	11	6	6	5	3	14	13	12
Group 52	3	14	7	9	14	10	13	8	7	8	10	4	4	13	9
Group 53	5	5	8	14	16	13	6	14	13	7	8	15	6	15	7
Group 54	5	6	11	7	10	8	5	8	7	12	12	10	6	9	11
Group 55	5	6	13	8	13	5	7	7	6	16	14	15	8	16	15
Group 56	5	7	9	10	7	11	6	12	9	12	11	8	8	6	10
Group 57	5	9	6	8	10	9	8	12	5	11	10	11	12	7	7
Group 58	5	10	10	12	8	11	9	7	8	9	5	12	6	7	6
Group 59	5	10	12	6	5	12	8	9	7	6	7	8	11	11	9
Group 60	5	13	15	15	14	8	6	7	16	8	7	13	14	5	16
Group 61	9	10	13	10	11	15	15	9	16	12	14	13	16	14	11
Group 62	9	11	12	15	12	9	13	13	11	14	10	16	15	14	16
Group 63	9	12	10	15	13	14	9	14	15	11	11	13	12	16	10

Wanted signal generator Setup example

- **DL RMC 12.2 kbps**
 - » Receiver test

CDMA(1/2)

Freq. 2112.500 000 00 MHz

Level -106.70 dBm Mem. ---

D Warning Normal

Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]

System : [W-CDMA] W-CDMA Phase : [1]

Simulation Link : [Down Link] Chip Rate : [3.840 000Mpps]

Filter : [RNYQ] Roll Off Ratio : [0.22]

Filter Mode : [EW1] Pattern Select : [16] DL_C31

Maximum Code Number : [4] Output Level -106.68dBm

Ch. 1 : [On] Power : [- 5.3dB] SCH Pr : [- 8.3dB] Sc : [- 8.3dB]

Ch. 2 : [Off] Power : [-40.0dB] SCH Pr : [-40.0dB] Sc : [-40.0dB]

Ch. 3 : [Off] Power : [-40.0dB] SCH Pr : [-40.0dB] Sc : [-40.0dB]

Ch. 4 : [On] Power : [-10.3dB] Ch. 5 : [On] Power : [- 8.3dB]

Ch. 6 : [On] Power : [- 3.3dB] Ch. 7 : [Off] Power : [-40.0dB]

Ch. 8 : [Off] Power : [-40.0dB] Ch. 9 : [Off] Power : [-40.0dB]

Ch.10 : [Off] Power : [-40.0dB] Ch.11 : [Off] Power : [-40.0dB]

Ch.12 : [Off] Power : [-40.0dB] Add Ch : Off Power : [-40.0dB]

Data (CH4) Clock/Trig PWR CONT Ref. Clock I/Q Input

- **DL RMC 12.2 kbps**
 - » Maximum input level (DPCH), Performance requirement test
 - OCNS multiplexing

CDMA(1/2)

Freq. 2112.500 000 00 MHz

Level - 25.00 dBm Mem. ---

D Warning Normal

Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]

System : [W-CDMA] W-CDMA Phase : [1]

Simulation Link : [Down Link] Chip Rate : [3.840 000Mpps]

Filter : [RNYQ] Roll Off Ratio : [0.22]

Filter Mode : [EW1] Pattern Select : [3] D32T18s0

Maximum Code Number : [20] Output Level - 25.03dBm

Ch. 1 : [On] Power : [-12.0dB] SCH Pr : [-15.0dB] Sc : [-15.0dB]

Ch. 2 : [Off] Power : [-40.0dB] SCH Pr : [-40.0dB] Sc : [-40.0dB]

Ch. 3 : [Off] Power : [-40.0dB] SCH Pr : [-40.0dB] Sc : [-40.0dB]

Ch. 4 : [On] Power : [-16.6dB] Ch. 5 : [On] Power : [-15.0dB]

Ch. 6 : [On] Power : [-10.0dB] Ch. 7 : [Off] Power : [-40.0dB]

Ch. 8 : [Off] Power : [-40.0dB] Ch. 9 : [Off] Power : [-40.0dB]

Ch.10 : [Off] Power : [-40.0dB] Ch.11 : [Off] Power : [-40.0dB]

Ch.12 : [Off] Power : [-40.0dB] Add Ch : On Power : [- 1.1dB]

Data (CH4) Clock/Trig PWR CONT Ref. Clock I/Q Input

Wanted signal generator Setup example

- DL RMC 12.2 kbps
- DL RMC 64 kbps
- DL RMC 144 kbps
- DL RMC 384 kbps
 - » Performance requirement test
- DL RMC 12.2 kbps DPCCH with 4 pilot bits as phase reference
 - » Demodulation of DCH in multi-path fading propagation conditions (Case 7) Test 21~25 test



Wanted signal generator Setup example

- **DL compressed mode**

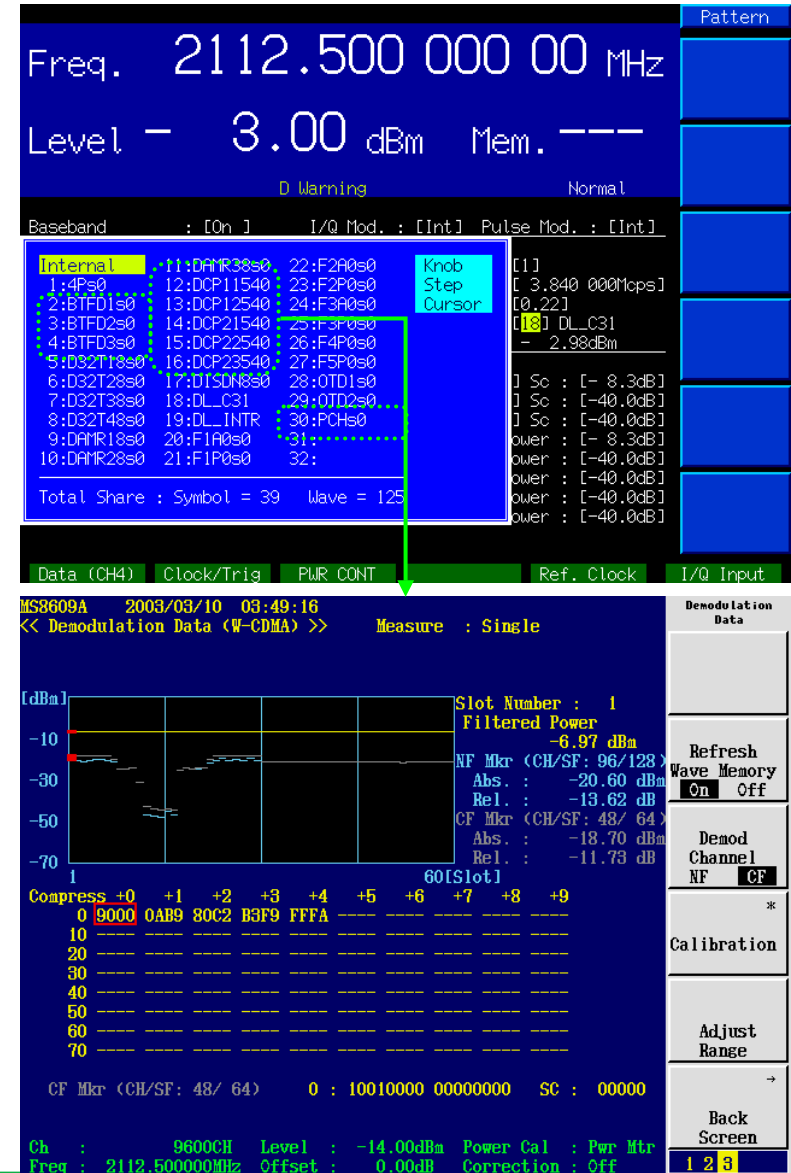
- » Downlink compressed mode test
 - Test 1,2: Reference pattern 1 Set 1
 - DL SF/2 (Spreading factor reduction)
 - Test 3,4: Reference pattern 1 Set 2
 - DL Puncturing
 - Reference pattern 2 Set 1
 - Reference pattern 2 Set 2
 - DL SF/2 (Spreading factor reduction)
 - Reference pattern 2 Set 3
 - DL Puncturing

- **DL RMC BTFD**

- » Blind transport format detection test
 - Test 1,4: 12.2 kbps (Rate 1)
 - Test 2,5: 7.95 kbps (Rate 2)
 - Test 3,6: 1.95 kbps (Rate 3)

- **DL PCH**

- » Demodulation of Paging Channel test



Interfering signal generator

Setup example

- **ACP priority filter**
 - » OCNS multiplexing

The screenshot displays the configuration for an interfering signal generator. Key parameters include:

- Freq.:** 2112.500 000 00 MHz
- Level:** -52.00 dBm
- Filter Mode:** [ACP] (highlighted with a red dashed box)
- Pattern Select:** [17] DL_INTR (highlighted with a red dashed box)
- Output Level:** -51.97dBm
- Channels:** Ch. 1: [On] Power: [-10.0dB]; Ch. 2: [Off] Power: [-40.0dB]; Ch. 3: [Off] Power: [-40.0dB]; Ch. 4: [Off] Power: [-40.0dB]; Ch. 5: [On] Power: [-15.0dB]; Ch. 6: [Off] Power: [-40.0dB]; Ch. 7: [Off] Power: [-40.0dB]; Ch. 8: [Off] Power: [-40.0dB]; Ch. 9: [Off] Power: [-40.0dB]; Ch. 10: [Off] Power: [-40.0dB]; Ch. 11: [Off] Power: [-40.0dB]; Ch. 12: [On] Power: [-10.0dB]

Navigation buttons on the right include: CDMA(1/2), Channel 1-3, Channel 4-8, Channel 9-12 & Add., Cal, Even Level, and etc.*. Bottom status bars show: Data (CH4), Clock/Trig, PWR CONT, Ref. Clock, and I/Q Input.

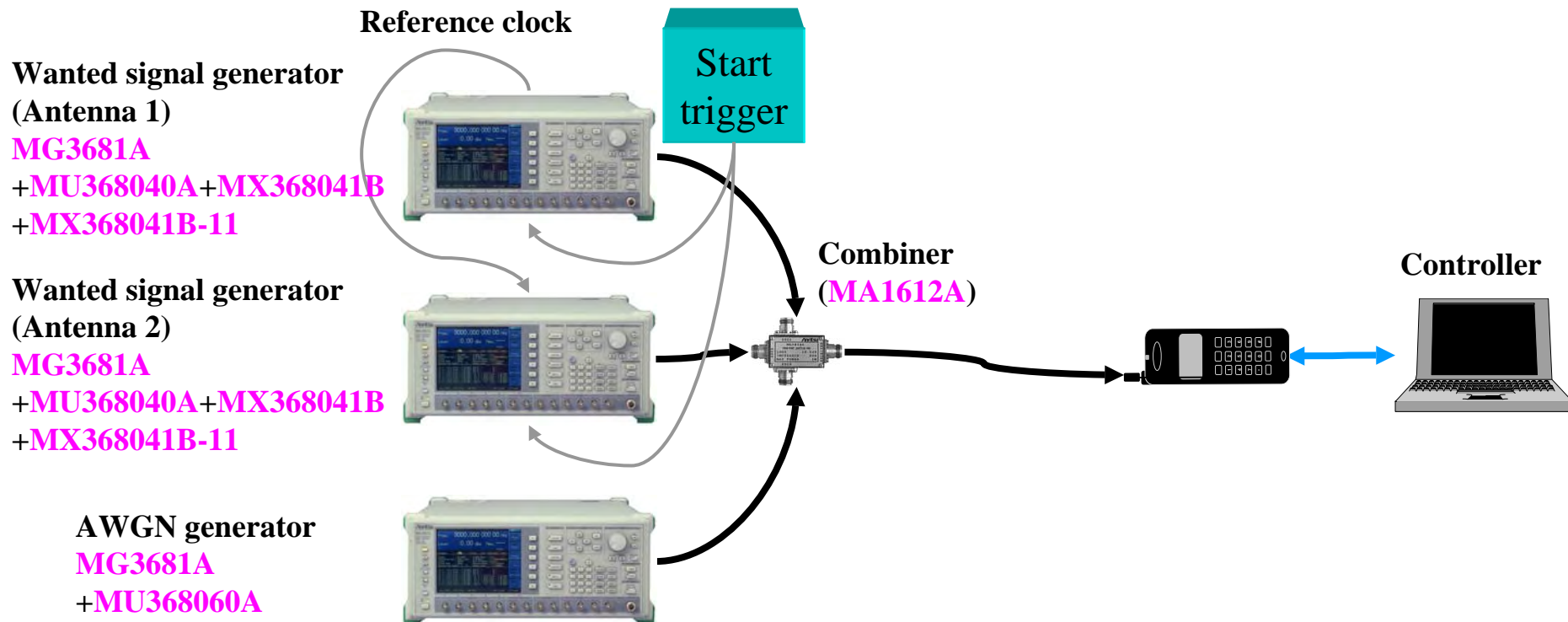
- **AWGN source**

» $I_{oc} = \text{Total level} + \text{Bandwidth level}$

The screenshot shows the configuration for an AWGN source. The frequency is set to 2112.500 000 00 MHz. The level is set to -57.81 dBm. The bandwidth is set to 5.760 MHz. The calculated level is -2.19 dB (Absolute) and -60.00 dBm. The calculated bandwidth is 3.840 MHz. The system is set to [NOISE1]. The baseband is [On], I/Q Mod. is [Int], and Pulse Mod. is [Int]. The screen is titled 'AWGN' and has a 'I/Q Input' label at the bottom right.

Parameter	Value
Freq.	2112.500 000 00 MHz
Level	-57.81 dBm
Bandwidth	5.760 MHz
Calculated Bandwidth	3.840 MHz
Calculated Level (Absolute)	-2.19 dB
Calculated Level (Absolute)	-60.00 dBm

Open-loop TX Diversity mode test Connection example



- Start trigger
 - Front panel [Clock/Trig] Input
- Reference clock
 - Rear panel [10MHz Buff] Output
 - Rear panel [10MHz/13MHz Ref] Input
- Controller
 - Launches DL RMC in receivable state by FTM^{Factory Test Mode} control.
 - Checks the CRC per demodulated transport block (DTCH) and calculates the BLER.

Wanted signal generator Setup example

- **DL RMC 12.2 kbps**
 - » Demodulation of DCH in open-loop Transmit diversity mode test
 - Antenna 1
 - Antenna 2
- **Setting External Start trigger**
 - » Captures/ Synchronizes the Trigger only once

Freq. 2112.500 000 00 MHz
 Level - 3.00 dBm Mem. ---
 D Warning Normal
 Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]

Internal	11: DAMR38s0	22: F2A0s0	Knob
1: 4Ps0	12: DCP11540	23: F2P0s0	Step
2: BTFD1s0	13: DCP12540	24: F3A0s0	Cursor
3: BTFD2s0	14: DCP21540	25: F3P0s0	
4: BTFD3s0	15: DCP22540	26: F4P0s0	
5: D32T18s0	16: DCP23540	27: F5P0s0	
6: D32T28s0	17: DISDN8s0	28: OTD1s0	
7: D32T38s0	18: DL_CS1	29: OTD2s0	
8: D32T48s0	19: DL_INTR	30: PCHs0	
9: DAMR18s0	20: F1A0s0	31:	
10: DAMR28s0	21: F1P0s0	32:	

Total Share : Symbol = 39 Wave = 125

Baseband Setup

Input Port Setup

- Frame Clock/Trigger Source : [Ext]
- Frame Clock/Trigger Select : [Trigger]
- Frame Clock Period Correction : [Off]
- Reference Clock Source : [Int]
- Reference Clock / Chip Clock : [1]

Input Polarity

- Frame Clock : [Rise]
- Data Input : [Positive]
- External Power Control : [Positive]

Output Port Setup

- Data Channel Assign : [1]
- Data Output Type : [Symbol]
- Data Phase : [$\pi/4$]
- Reference Clock : [Chip Clock X2]

Output Polarity

- Data Output (A)&(B) : [Positive]
- Data Clock : [Rise]
- Symbol Clock : [Rise]
- Slot Clock : [Rise]
- Frame Clock : [Rise]
- Code Output I/Q (A)&(B) : [Negative]

Peak Clipping : [Off]
Max. Peak Power / RMS Power : [20.0dB]

- **Trigger recapture/ synchronization**

CDMA Scrambling Code Edit

Scrambling Code Generator 1

- Scrambling Type : Long Scrambling Code Period : 000 9600
- C long,1,n x_n : 1[00 0000] C long,1,n y : 1FF FFFF
- C long,2,n x_n : 0 12 0040 C long,2,n y : 018 00FF
- Chip Offset : [0 0000]

Scrambling Code Generator 2

- Scrambling Type : Long Scrambling Code Period : 000 9600
- C long,1,n x_n : 1[00 0000] C long,1,n y : 1FF FFFF
- C long,2,n x_n : 0 12 0040 C long,2,n y : 018 00FF
- Chip Offset : [0 0000]

Scrambling Code Generator 3

- Scrambling Type : [Long] Scrambling Code Period : 000 9600
- C long,1,n x_n : 1[00 0000] C long,1,n y : 1FF FFFF
- C long,2,n x_n : 0 12 0040 C long,2,n y : 018 00FF
- Chip Offset : [0 0000] Short Code Number : [-----]

I/Q Phase : [0RAD]
Trigger Delay : [1024.0Chip]
Noise Bandwidth : [Chiprate X2]

Trigger Reset

Slide 171
MG3681A-E-I-1



Wanted signal generator Setup example

- **Set TPC command for Inner loop power control**

» 60 TPC command (60 slots) cycle

- Step A (1 dB step {0})

- [82A BE82 ABE8 2ABE]_H
1000 0010 1010 1011 1110 ...

- Step B (1 dB step {0,0,0,0,+1})

- [FFF FFFF FFFF FFFF]_H
1111 1111 1111 ...

- Step C (1 dB step {0,0,0,0,-1})

- [000 0000 0000 0000]_H
0000 0000 0000 ...

- Step D (1 dB step {+1})

- [FFF FFFF FFFF FFFF]_H
1111 1111 1111 ...

- Step E (1 dB step {-1})

- [000 0000 0000 0000]_H
0000 0000 0000 ...

- Step F (1 dB step {+1})

- [FFF FFFF FFFF FFFF]_H
1111 1111 1111 ...

- Step G (2 dB step {-1})

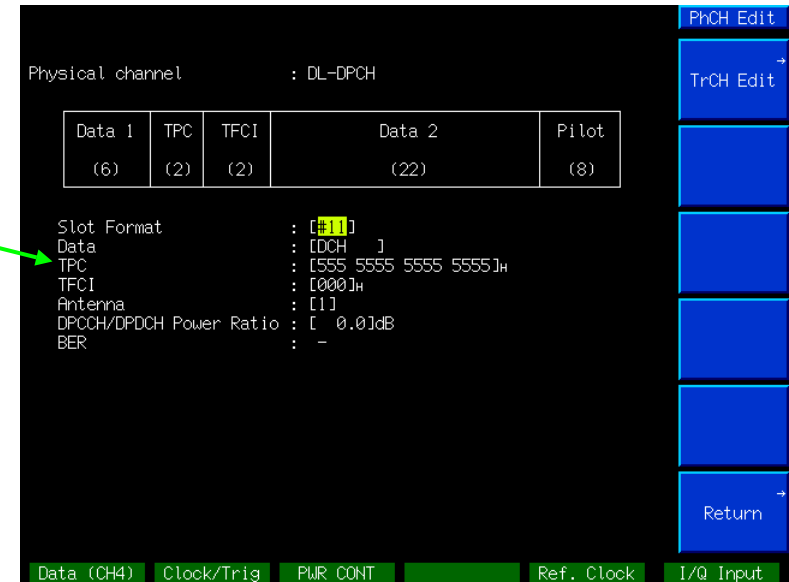
- [000 0000 0000 0000]_H
0000 0000 0000 ...

- Step F (2 dB step {+1})

- [FFF FFFF FFFF FFFF]_H
1111 1111 1111 ...

- Minimum output power test

- [000 0000 0000 0000]_H
0000 0000 0000 ...



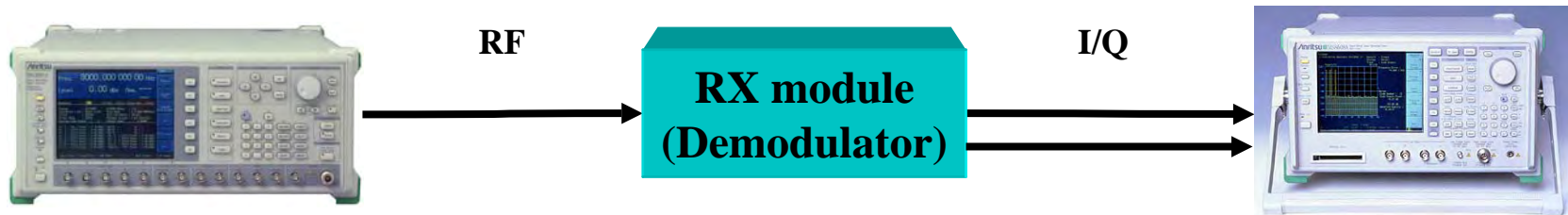
HSDPA demodulation test Connection example

Wanted signal generator

MG3681A
 +**MU368040A**+**MX368041B**
 +**MX368041B-11**

Signal analyzer

(MS8600/MS2680)

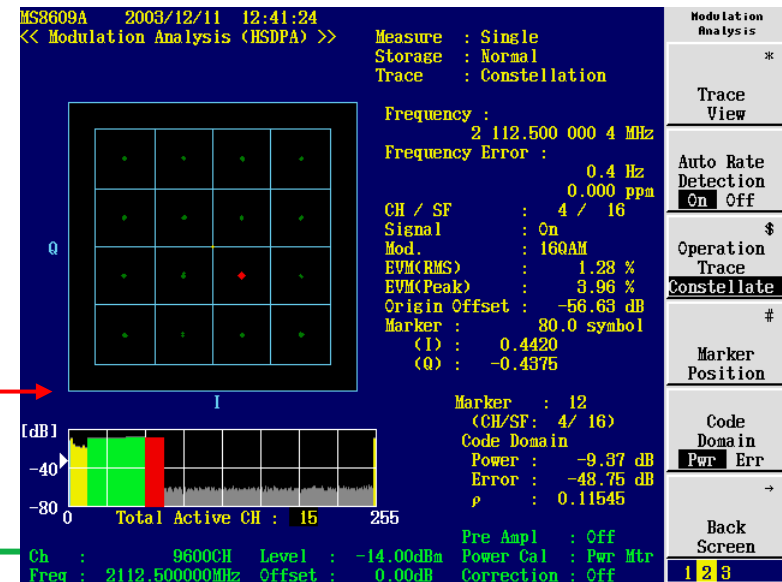


- EVM test

- HS-PDSCH, DPCH, ...

Table C.8: Downlink physical channels for HSDPA receiver testing for Single Link performance.

Physical Channel	Parameter	Value	Note
P-CPICH	P-CPICH_Ec/Ior	-10dB	
P-CCPCH	P-CCPCH_Ec/Ior	-12dB	Mean power level is shared with SCH.
SCH	SCH_Ec/Ior	-12dB	Mean power level is shared with P-CCPCH – SCH includes P- and S-SCH, with power split between both. P-SCH code is S_dl,0 as per TS25.213 S-SCH pattern is scrambling code group 0
PICH	PICH_Ec/Ior	-15dB	
DPCH	DPCH_Ec/Ior	Test-specific	12.2 kbps DL reference measurement channel as defined in Annex A.3.1
HS-SCCH_1	HS-SCCH_Ec/Ior	Test-specific	Specifies fraction of Node-B radiated power transmitted when TTI is active (i.e. due to minimum inter-TTI interval).
HS-SCCH_2	HS-SCCH_Ec/Ior	DTX'd	No signalling scheduled, or power radiated, on this HS-SCCH, but signalled to the UE as present.
HS-SCCH_3	HS-SCCH_Ec/Ior	DTX'd	As HS-SCCH_2.
HS-SCCH_4	HS-SCCH_Ec/Ior	DTX'd	As HS-SCCH_2.
HS-PDSCH	HS-PDSCH_Ec/Ior	Test-specific	.
OCNS		Necessary power so that total transmit power spectral density of Node B (Ior) adds to one	OCNS interference consists of 6 dedicated data channels as specified in table C.12.

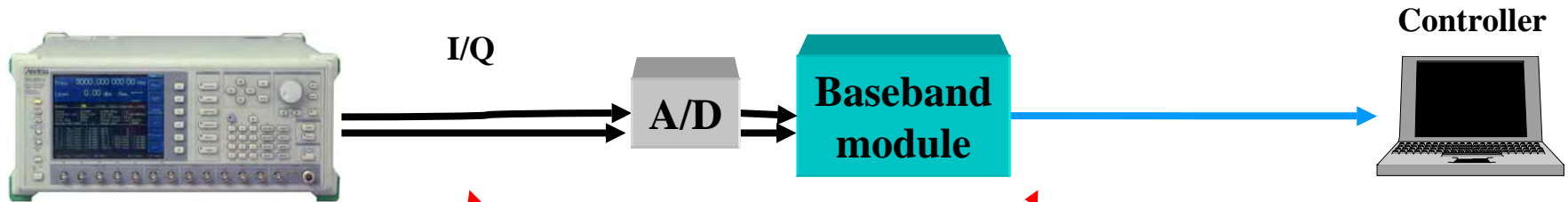


HSDPA Baseband test

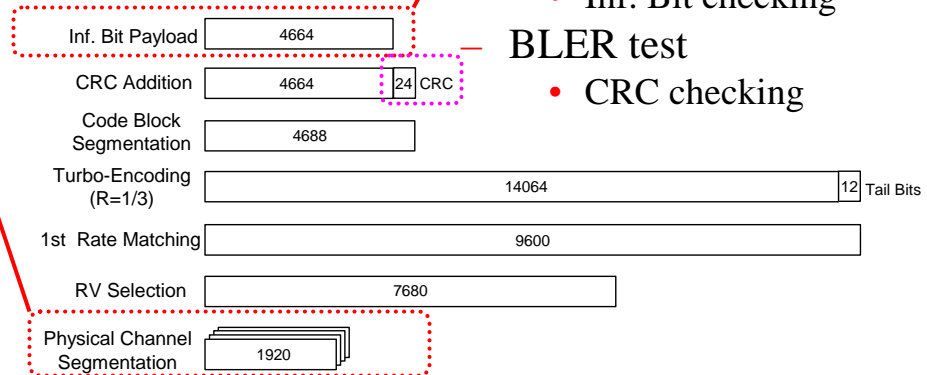
Connection example

Wanted signal generator

- MG3681A
- +MG3681A-11
- +MU368040A+MX368041B
- +MX368041B-11



- » Inf. Bit
 - PN15
 - Reset to initial value per subframe
 - All subframes are the same data



- Decoding test
 - Inf. Bit checking
- BLER test
 - CRC checking

Figure A.17: Coding rate for Fixed reference Channel H-Set 3 (16QAM)

HSDPA CQI test

Connection example

Wanted signal generator

MG3681A

+MU368040A+MX368041B

+MX368041B-11



(Terminator)
(MP752A)

(AWGN generator)

MG3681A

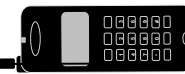
+MU368060A



(Combiner)
(MA1612A)



Controller



– Controller

- Launches DL FRC in receivable state by FTM^{Factory Test Mode} control.
- Monitors CQI^{Channel Quality Indicator} on UL HS-DPCCH and calculates BLER of DL HS-PDSCH.

Wanted signal generator Setup example

- **DL FRC**
 - » H-Set 1
 - 16QAM
 - QPSK
 - » H-Set 2
 - 16QAM
 - QPSK
 - » H-Set 3
 - 16QAM
 - QPSK
 - » H-Set 4
 - QPSK
 - » H-Set 5
 - QPSK



• **ALC Off**

Top Screenshot:

Freq. 2112.500 000 00 MHz
 Level - 3.00 dBm Mem. ---
 D Warning Normal

Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]

Internal	11:DAMR38s0	22:F2A0s0	Knob
1:4Ps0	12:DCP11540	23:F2P0s0	Step
2:BTFD1s0	13:DCP12540	24:F3A0s0	Cursor
3:BTFD2s0	14:DCP21540	25:F3P0s0	
4:BTFD3s0	15:DCP22540	26:F4P0s0	
5:D32T18s0	16:DCP23540	27:F5P0s0	
6:D32T28s0	17:D1SDN8s0	28:0TD1s0	
7:D32T38s0	18:DL_C31	29:0TD2s0	
8:D32T48s0	19:DL_INTR	30:PCHs0	
9:DAMR18s0	20:F1A0s0	31:	
10:DAMR28s0	21:F1P0s0	32:	

Total Share : Symbol = 39 Wave = 125

Data (CH4) Clock/Trig PWR CONT Ref. Clock I/Q Input

Bottom Screenshot:

Freq. 2112.500 000 00 MHz
 Level - 7.00 dBm Mem. ---
 D Warning Normal

Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]

System : [W-CDMA] W-CDMA Phase : [1]
 Simulation Link : [Down Link] Chip Rate : [3.840 000Mps]
 Filter : [RNYQ] Roll Off Ratio : [0.22]
 Filter Mode : [EVM1] Pattern Select : [24] F3A0s0
 Maximum Code Number : [44] Output Level - 7.02dBm

Ch. 1 : [On] Power : [-12.0dB]	SCH Pr : [-15.0dB]	Sc : [-15.0dB]
Ch. 2 : [On] Power : [-10.0dB]	SCH Pr : -	Sc : -
Ch. 3 : [Off] Power : [-40.0dB]	SCH Pr : -	Sc : -
Ch. 4 : [On] Power : [-10.0dB]	Ch. 5 : [On] Power : [-10.0dB]	
Ch. 6 : [On] Power : [-16.0dB]	Ch. 7 : [On] Power : [-18.0dB]	
Ch. 8 : [On] Power : [-18.0dB]	Ch. 9 : [On] Power : [-20.0dB]	
Ch.10 : [On] Power : [-17.0dB]	Ch.11 : [On] Power : [-19.0dB]	
Ch.12 : [On] Power : [-15.0dB]	Add Ch : On Power : [- 3.0dB]	

ALC On **Off**

Continuous On **Off**

Cal

etc *

Data (CH4) Clock/Trig PWR CONT Ref. Clock I/Q Input

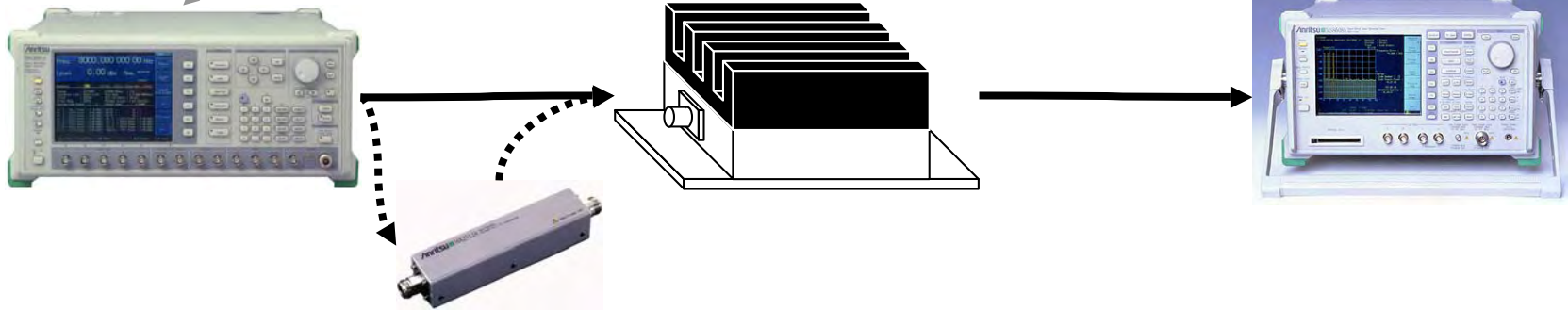
Signal source

MG3681A
+MU368040A+MX368041B

Signal analyzer

(MS8600/MS2680)

Reference clock



Spurious elimination filter

(MA2512A)

- Unwanted signals can be eliminated by connecting the filter if the spurious of signal source obstructs the evaluation.

Spurious of MG3681A

- 660 MHz (IF leakage)
- +660 MHz offset (Local leakage)
- $2 \times \text{freq.} / 3 \times \text{freq.}$ (2nd/3rd harmonics)

Downlink signal

Setup example

BS transmitter test

- **Test Model 1**
 - » Single carrier
 - » multi-carrier (2 carriers)
- **Test Model 2**
- **Test Model 3**
- **Test Model 4**
- **Test Model 5**
 - » Single carrier
 - » multi-carrier (2 carriers)
- **ACP priority filter**
 - » Spectrum emission mask
 - » ACLR
 - » Spectrum emissions

The top screenshot shows the main signal configuration screen. The frequency is set to 2112.500 000 00 MHz and the level is 8.00 dBm. A table of carrier frequencies is displayed:

Internal	11:BS31657	22:	Knob
1:BS11657d	12:BS33257	23:	Step
2:BS13257d	13:BS457	24:	Cursor
3:BS16457d	14:BS5_257	25:	
4:BS_257d	15:BS5_457	26:	
5:BS_457d	16:BS5_857	27:	
6:BS_857d	17:	28:	
7:BS11657	18:	29:	
8:BS13257	19:	30:	
9:BS16457	20:	31:	
10:BS257	21:	32:	

The bottom screenshot shows the channel configuration screen. It displays the same frequency and level. A table of channel parameters is shown:

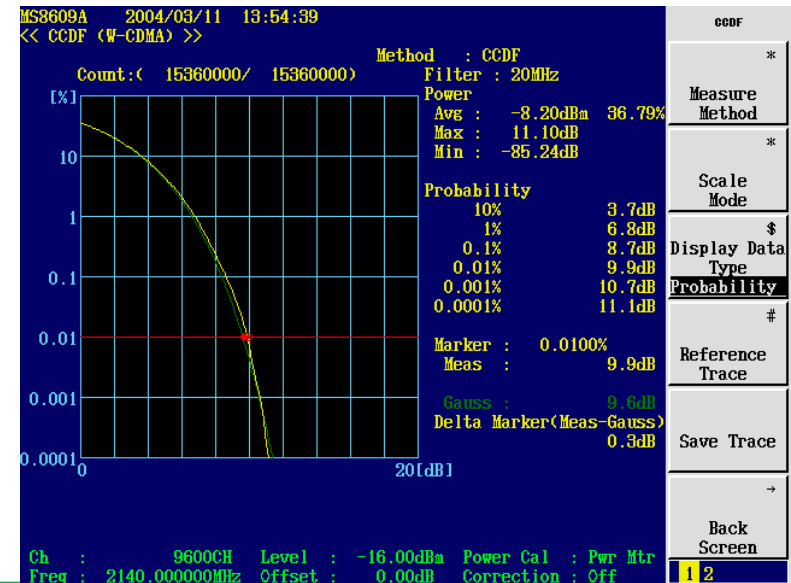
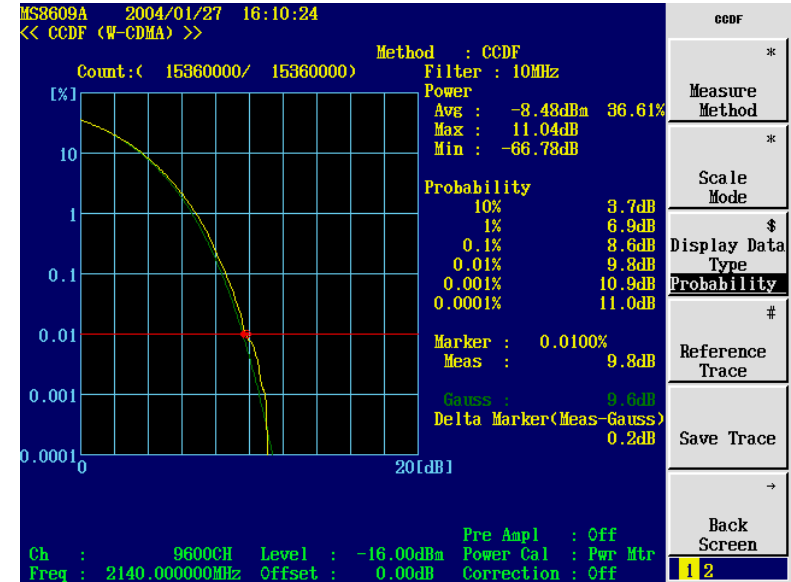
System	: [W-CDMA]	W-CDMA Phase	: [1]
Simulation Link	: [Down Link]	Chip Rate	: [3.840 000Mps]
Filter	: [RNYQ]	Roll Off Ratio	: [0.22]
Filter Mode	: [ACP]	Pattern Select	: [9] BS16457
Maximum Code Number	: [68]	Output Level	: - 7.97dBm

Below this, a list of channels is shown with their respective power levels and other parameters.

CCDF

- **Test Model 1**
 - » 64 DPCH
 - Single carrier

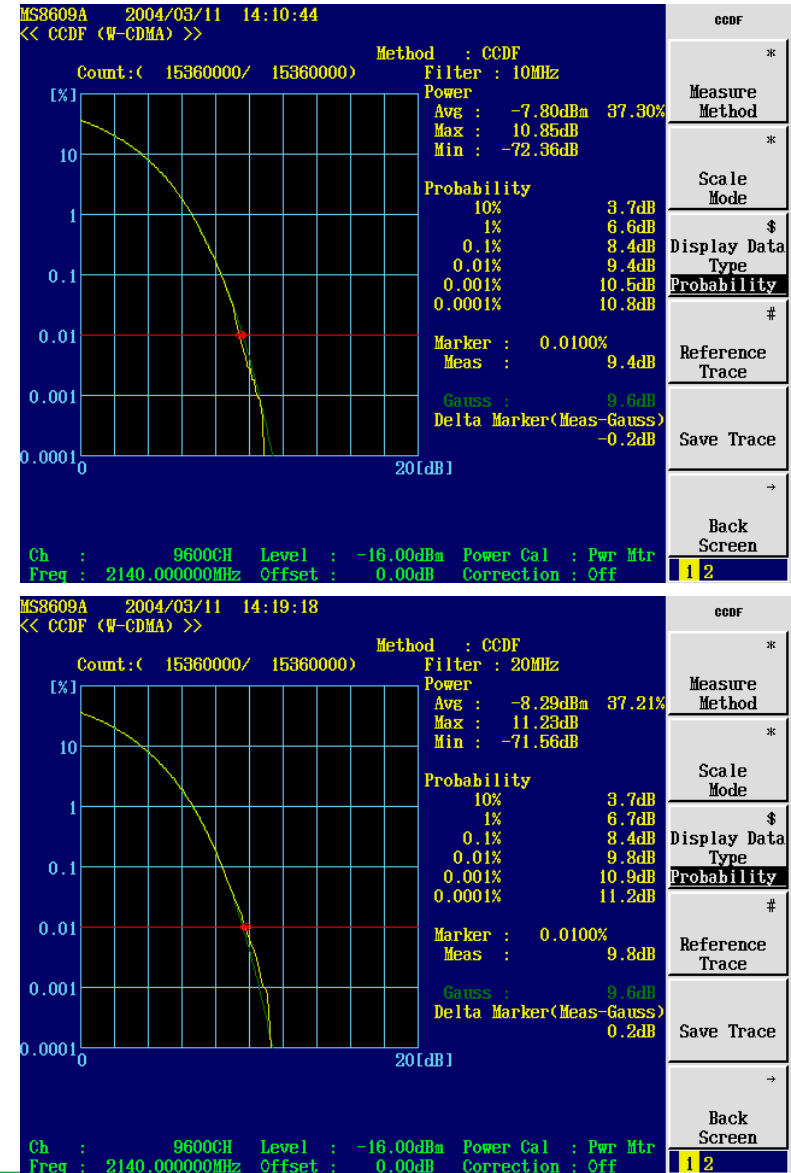
- 2 carriers



CCDF

- **Test Model 5**
 - » 30 DPCH + 8 HS-PDSCH
 - Single carrier

- 2 carriers



Downlink signal

Setup example

UE receiver test

- **DL RMC 12.2 kbps**
 - » for RX test
 - » for Performance test
- **DL RMC 64 kbps**
- **DL RMC 144 kbps**
- **DL RMC 384 kbps**

The screenshot displays a test equipment interface with the following information:

- Freq.:** 2112.500 000 00 MHz
- Level:** 3.00 dBm
- Mem.:** ---
- Warning:** D Warning (Normal)
- Baseband:** [On] | **I/Q Mod.:** [Int] | **Pulse Mod.:** [Int]
- Internal Table:**

1:4Ps0	11:DAMR38s0	22:F2A0s0
2:BTfD1s0	12:DCP11540	23:F2P0s0
3:BTfD2s0	13:DCP12540	24:F3A0s0
4:BTfD3s0	14:DCP21540	25:F3P0s0
5:D32T18s0	15:DCP22540	26:F4P0s0
6:D32T28s0	16:DCP23540	27:F5P0s0
7:D32T38s0	17:DISDN8s0	28:OTD1s0
8:D32T48s0	18:DL_C31	29:OTD2s0
9:DAMR18s0	19:DL_INTR	30:PCHs0
10:DAMR28s0	20:FIA0s0	31:
	21:FIP0s0	32:
- Knob Step Cursor** (highlighted)
- DL_C31** (selected channel):
 - Power: -2.98dBm
 - Sc: [-8.3dB]
 - Sc: [-40.0dB]
 - Sc: [-40.0dB]
 - Power: [-8.3dB]
 - Power: [-40.0dB]
 - Power: [-40.0dB]
 - Power: [-40.0dB]
- Total Share:** Symbol = 39 | Wave = 125
- Bottom Bar:** Data (CH4) | Clock/Trig | PWR CONT | Ref. Clock | I/Q Input

Uplink signal Setup example

UE transmitter test

BS receiver test

- UL RMC 12.2 kbps
- UL RMC 64 kbps
- UL RMC 144 kbps
- UL RMC 384 kbps

- **ACP priority filter**

Transmitter test

- » Spectrum emission mask
- » ACLR
- » Spectrum emissions

The top screenshot shows the main signal configuration screen. The frequency is 1922.500 000 00 MHz and the level is 3.00 dBm. A list of components is shown, with 'ULRMC12k' selected. The bottom screenshot shows a detailed view of the 'ULRMC12k' signal, with 'ACP' selected in the Filter Mode. A green arrow points from the 'ACP priority filter' section of the text to the 'ACP' selection in the screenshot.

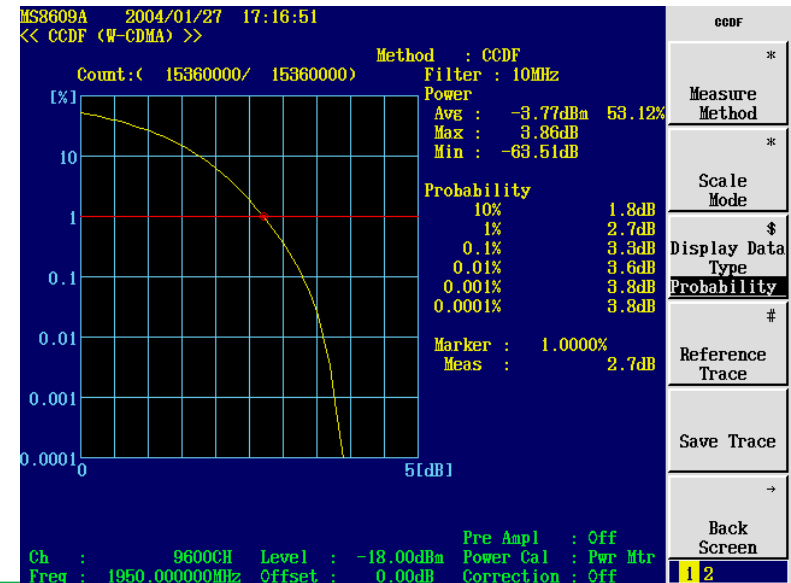
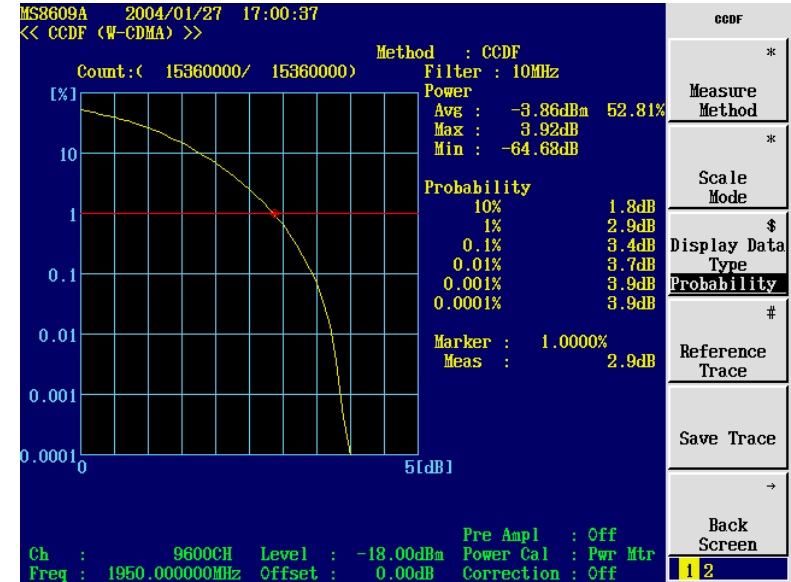
CCDF

- **UL RMC**
 » 12.2 kbps

Table A.1: Reference measurement channels for UL DCH

Parameter	DCH for DTCH / DCH for DCCH					Unit	
	12.2/2,4	64/2,4	144/2,4	384/2,4	2048/2,4		
DPDCH	Information bit rate	60/15	240/15	480/15	960/15	960/15	kbps
	Physical channel	64	16	8	4	4	kbps
	Spreading factor	22/22	19/19	8/9	-18/-17	-7/-7	%
	Repetition rate	20	40	40	40	80	ms
	Interleaving	1	1	1	1	6	
	Number of DPDCHs						
DPCCH	Dedicated pilot	6					bit/slot
	Power control	2					bit/slot
	TFCI	2					bit/slot
	FBI	0 / 2					bit/slot
	Spreading factor	256					
Power ratio of DPCCH/DPDCH		-2,69	-5,46	-9,54	-9,54	-9,54	dB
Amplitude ratio of DPCCH/DPDCH		0,7333	0,5333	0,3333	0,3333	03333	
Note: Combination of TFCI bit of 0 bit/slot and FBI bit of 2 bit /slot is applied in test of Site Selection Diversity Transmission specified in 8.10.							

- » 384 kbps



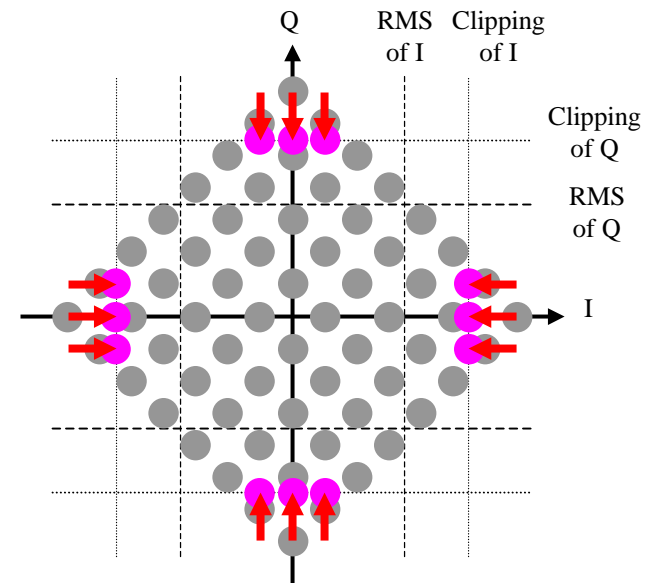
Peak Clipping of modulation signal Setup example

- **Useful for the evaluation of crest factor (CCDF)**

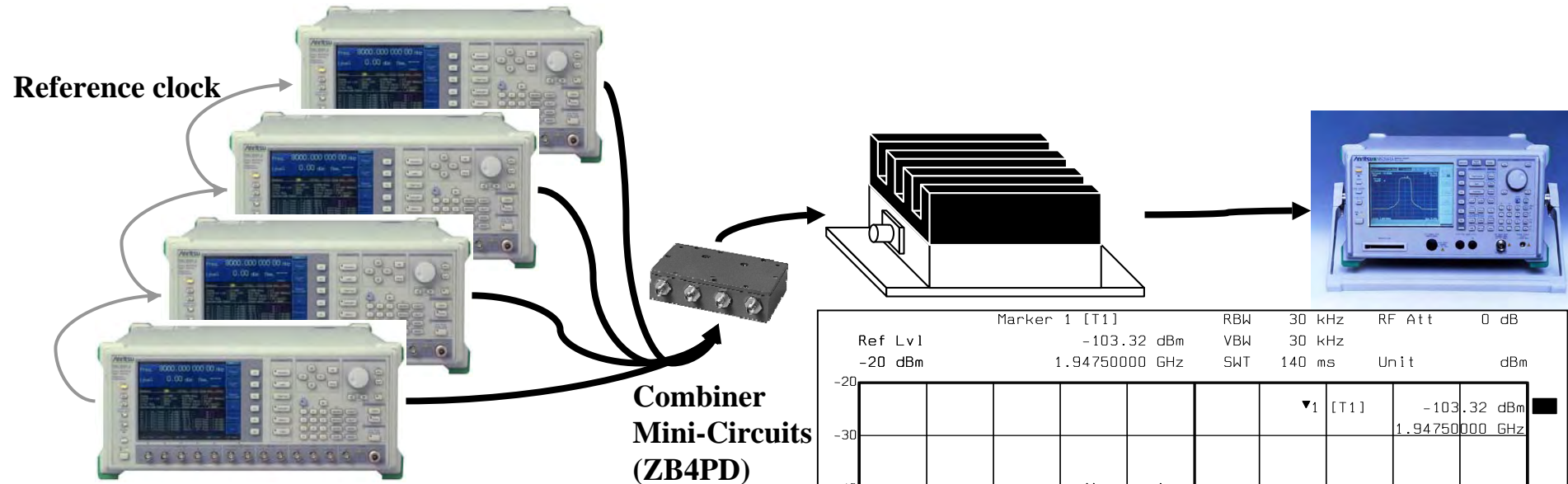
- » Limiting the peak level of I/Q amplitude before FIR filtering
 - I or Q RMS level
 - +
 - 0 ~ 20 dB, 0.1 dB resolution
 - Measure CCDF of output signal (after FIR filtering) by signal analyzer (MS8608A/09A), and adjust the level to limit.
 - ACLR of output signals is not deteriorated because of no distortion caused by clipping.
 - Extreme clipping deteriorates waveform quality.

- » Scalar clipping
 - Limiting I or Q amplitude level

```
Baseband Setup
Input Port Setup
  Frame Clock/Trigger Source : [Int]
  Frame Clock/Trigger Select : [Clock ]
  Frame Clock Period Correction : [Off]
  Reference Clock Source : [Int]
  Reference Clock / Chip Clock : [1]
Input Polarity
  Frame Clock : [Rise]
  Data Input : [Positive]
  External Power Control : [Positive]
Output Port Setup
  Data Channel Assign : [ 1]
  Data Output Type : [Symbol]
  Data Phase : [ π/4]
  Reference Clock : [Chip Clock X2]
Output Polarity
  Data Output (A)&(B) : [Positive]
  Data Clock : [Rise]
  Symbol Clock : [Rise]
  Slot Clock : [Rise]
  Frame Clock : [Rise]
  Code Output I/Q (A)&(B) : [Negative]
Peak Clipping : [On 1]
Max. Peak Power / RMS Power : [20.0dB]
```

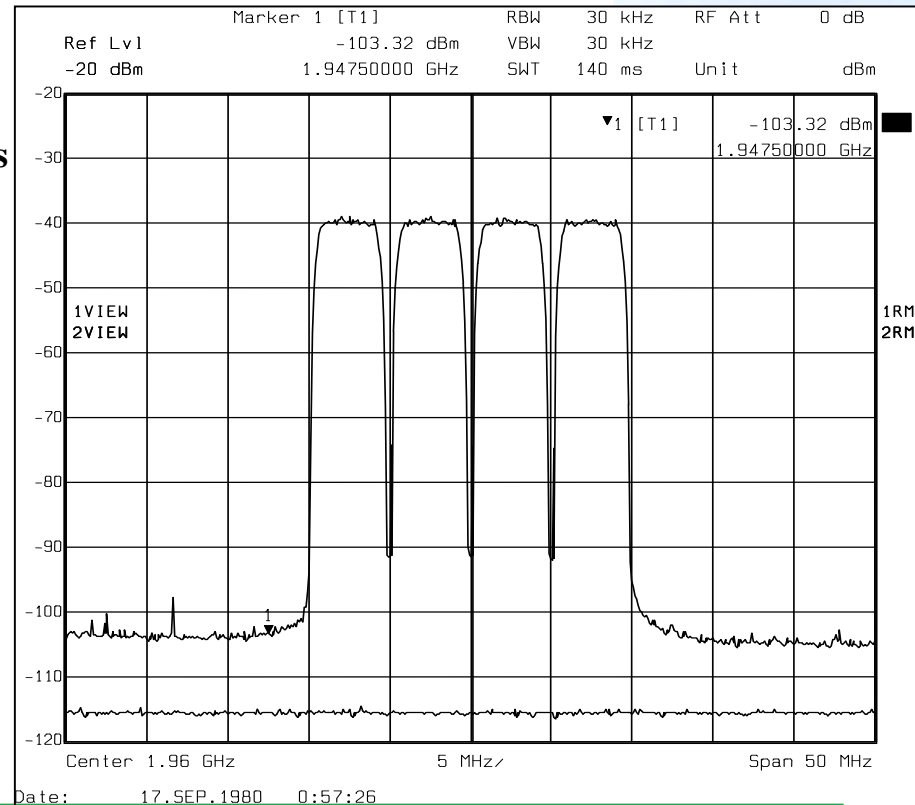


Multi-carrier signal source



- **Test model 1 (64 DPCH)**

- » Scrambling code
 - 00,10,20,30 [HEX]
- » Typical ACLR [dB/3.84MHz]
 - Lower/Upper
 - 5MHz offset: -62.6/-62.4
 - 10MHz offset: -63.3/-64.4
 - 15MHz offset: -63.2/-64.4



GSM/EDGE

RF/IF components test Connection example

Signal source

MG3681A

+MU368010A+MX368012A

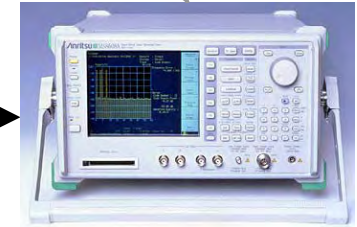
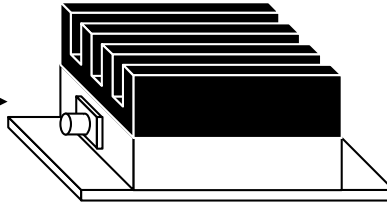
or

+MU368030A+MX368031A

Signal analyzer

(MS8600/MS2680)

Reference clock



Downlink/Uplink signal Setup example

- **MX368012A**
 - » GMSK modulation
 - Data + GP Guard period (8.25 symbol) Burst format
 - Normal burst format for TCH
 - Access burst format for RACH
 - Continuous modulation format

- **MX368031A**
 - » 8PSK modulation
 - Continuous modulation format
 - » GMSK modulation
 - Continuous modulation format

Frequency: 900.000 000 00 MHz
Level: 5.00 dBm Mem. ---
Normal

Baseband : [On] I/Q Mod.: [Int] Pulse Mod.: [Int]
System : [GSM]
Modulation : GMSK Bit Rate : [270.833kbps]
Filter : BbT=[0.30]
Differential Encode : [On] Phase Polarity : [Normal]
Burst : [On]
Pattern : [TCH_FLL]
Trigger :

Slot0 Slot1 Slot2 Slot3 Slot4 Slot5 Slot6 Slot7
NORM NORM NORM NORM NORM NORM NORM
Δ

Data Symbol Clock Burst Gate Burst Trig Data Clock I/Q Input

Control menu: DEVICE Knob, TCH Step, TCH_FLL Cursor, RACH

Frequency: 900.000 000 00 MHz
Level: 5.00 dBm Mem. ---
Normal

Baseband : [On] I/Q Mod.: [Int] Pulse Mod.: [Int]
System : [DTSS]
Pattern : [0:GSM_EDGE]

Baseband Se Trigger S Reference
0:GSM_EDGE Knob
1:GSM_GMSK Step
2:P1/4QPSK_PDC Cursor
3:P1/4QPSK_IS-136
4:P1/4QPSK_PHS
5:1xRTTtrc1_RVS
6:1xRTTtrc3(1)_RVS
7:1xRTTtrc3(2)_RVS

Trigger Ref. Clock I/Q Input



CDMA2000 1xEV-DO 3GPP2

AN Access Network testing

3GPP2 C.S0032 -0 v2.0

3.1.1 Receiver Minimum Standards

3.1.1 Transmitter Minimum Standards

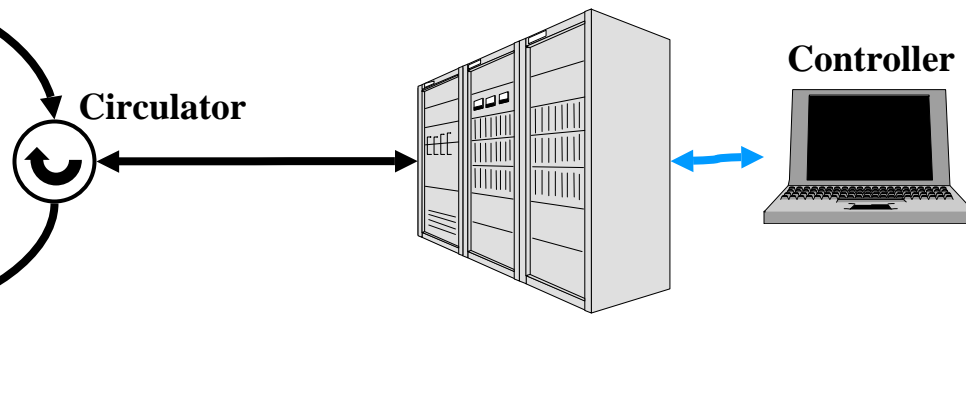
Section	Test	Wanted signal generator	Interfering signal generator	CW generator	AWGN generator	Others	
3.1.1.3.1	Data Channel Demodulation Performance (Case 1: without closed loop power control)	MG3681A +MU368030A +MX368033A			+MU368060A +MU368040A		
3.1.1.4.1	Receiver Sensitivity						
3.1.1.4.2	Receiver Dynamic Range					+MU368060A +MU368040A	
3.1.1.4.3	Single Tone Desensitization			MG3681A or 3GHz	MG3642A 2.08GHz		
3.1.1.4.4	Intermodulation Spurious Response Attenuation			MG3681A			
3.1.1.4.5	Adjacent Channel Selectivity			MG3681A +MU368030A +MX368031A			MA1612A 3GHz
3.1.1.4.6	Receiver Blocking Characteristics			MG3681A or 3GHz	MG3692A 20GHz or MG3642A 2.08GHz		Combiner
3.1.1.6	Received Signal Quality Indicator (RSQI)					+MU368060A +MU368040A	
3.1.2.4.3	Inter-Sector Transmitter Intermodulation		MG3681A +MU368030A +MX368031A (+MG3681A-42)			Spectrum analyzer Circulator	

Inter-Sector Transmitter Intermodulation test Connection example

Interfering signal generator
MG3681A
+MU368030A+MX368031A
(+MG3681A-42)



Spectrum analyzer
MS8608A/8609A
+MX860804A/860904A



- Controller
 - Launches in the transmitting state by FTM^{Factory Test Mode} control.

Receiver test Connection example

Interfering signal generator

CW generator

(AWGN generator)

MG3681A

+MU368030A+MX368031A

(+MU368060A)



Wanted signal generator

(+ AWGN generator)

MG3681A

+MU368030A+MX368033A

(+MU368060A+MU368040A)



CW generator

(MG3692A)



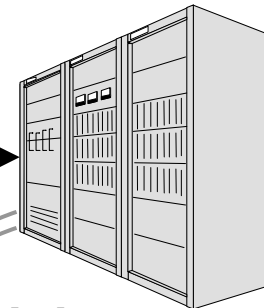
Combiner

(MA1612A)



Start trigger

Reference clock



Controller PER calculation

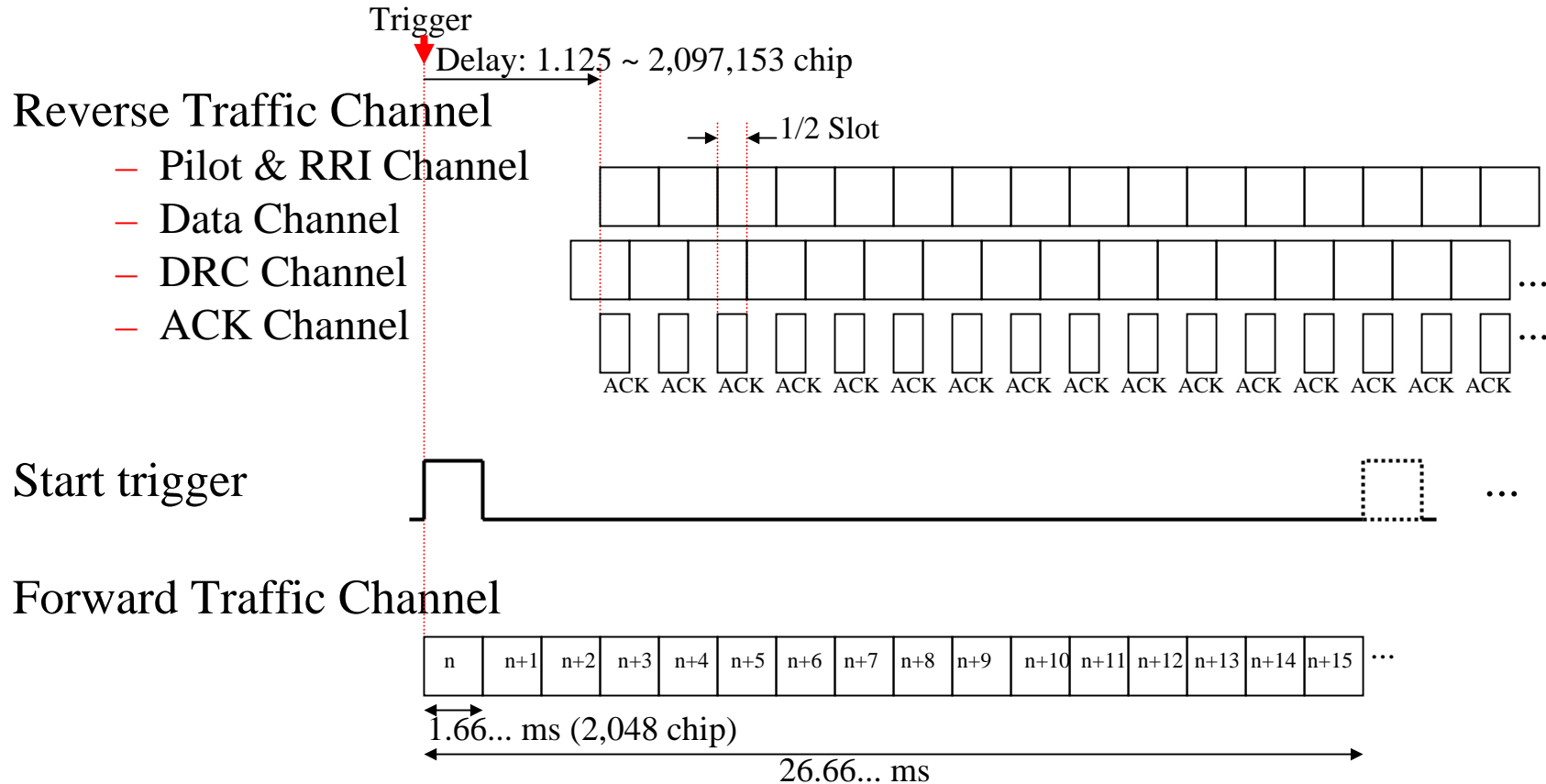


- Start trigger
 - Front panel [Trigger] Input
 - Apply only one
 - 26.66... ms clock (Short sequence rollover)
 - 426.66... ms clock (Control Channel Cycle)
 - 2 sec (Even second time mark)
- Reference clock
 - Apply only one
 - Front panel [Ref. Clock] Input
 - 8× 1.2288 MHz (9.8304 MHz)
 - Rear panel [10MHz/13MHz Ref] Input
 - 10 MHz, 13 MHz
- Controller
 - Launches Reverse Traffic channel in receivable state by FTM Factory Test Mode control.
 - Checks the CRC per demodulated Traffic channel packet and calculates the PER.

Timing synchronization Setup example

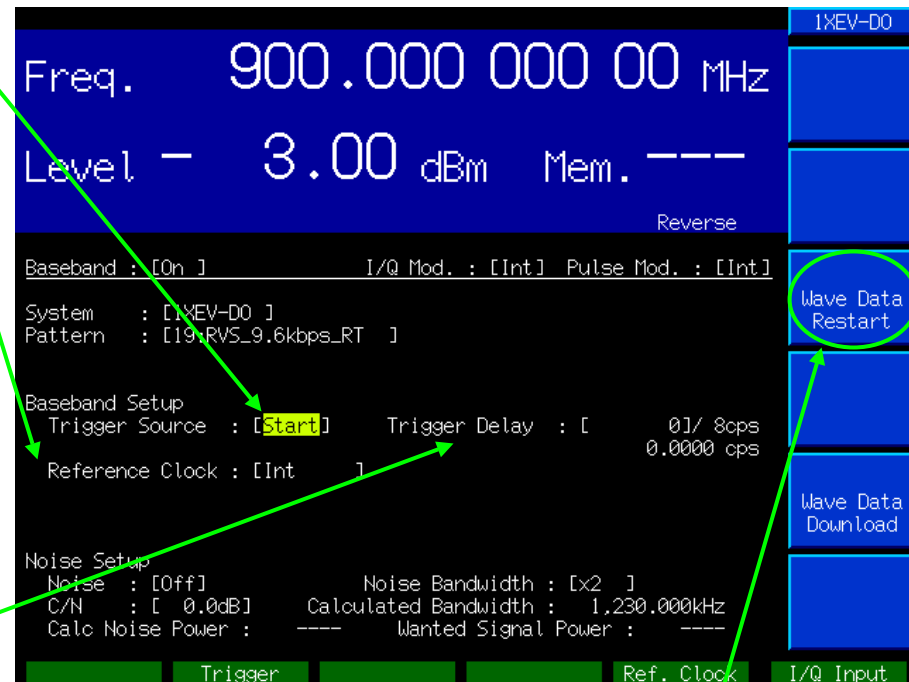
- **Start trigger delay**

- » Set the timing to which AN can receive Reverse Traffic channel



Timing sync. Setup example

- **Setting External Start trigger**
 - » Captures/ Synchronizes the Trigger only once
- **Reference clock:**
 - » [Ref. Clock] Input applicable case
 - Reference Clock : [Ext(TTL)]
 - $8 \times 1.2288 \text{ MHz}$ (9.8304 MHz)
 - » [10MHz/13MHz Ref] Input applicable case
 - Reference Clock : [Int]
- **Start trigger delay**
 - » 0 ~ 16,777,215 /8 chip
1/8 chip resolution
 - » Delay from Trigger
 - + 9/8 chip
 - 1.125 ~ 2,097,153 chip
- **Trigger recapture/ synchronization**



Long Code Mask sync.

- **Reverse Traffic Channel Long Code Mask**

- » 42-bit MI_{RTCMAC}

BIT	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
MI_{RTCMAC}	1	1	1	1	1	1	1	1	1	1	Permuted (ATI_{LCM})																															

- » 42-bit MQ_{RTCMAC}

- Derived from MI_{RTCMAC}

- $MQ_{\text{RTCMAC}}[k] = MI_{\text{RTCMAC}}[k-1]$, for $k = 1, \dots, 41$

- $MQ_{\text{RTCMAC}}[0] = MI_{\text{RTCMAC}}[0] \oplus MI_{\text{RTCMAC}}[1] \oplus MI_{\text{RTCMAC}}[2] \oplus MI_{\text{RTCMAC}}[4] \oplus MI_{\text{RTCMAC}}[5] \oplus MI_{\text{RTCMAC}}[6] \oplus MI_{\text{RTCMAC}}[9] \oplus MI_{\text{RTCMAC}}[15] \oplus MI_{\text{RTCMAC}}[16] \oplus MI_{\text{RTCMAC}}[17] \oplus MI_{\text{RTCMAC}}[18] \oplus MI_{\text{RTCMAC}}[20] \oplus MI_{\text{RTCMAC}}[21] \oplus MI_{\text{RTCMAC}}[24] \oplus MI_{\text{RTCMAC}}[25] \oplus MI_{\text{RTCMAC}}[26] \oplus MI_{\text{RTCMAC}}[30] \oplus MI_{\text{RTCMAC}}[32] \oplus MI_{\text{RTCMAC}}[34] \oplus MI_{\text{RTCMAC}}[41]$

- \oplus : XOR

- **Setting AN**

- » MI_{RTCMAC} 3FF0000000

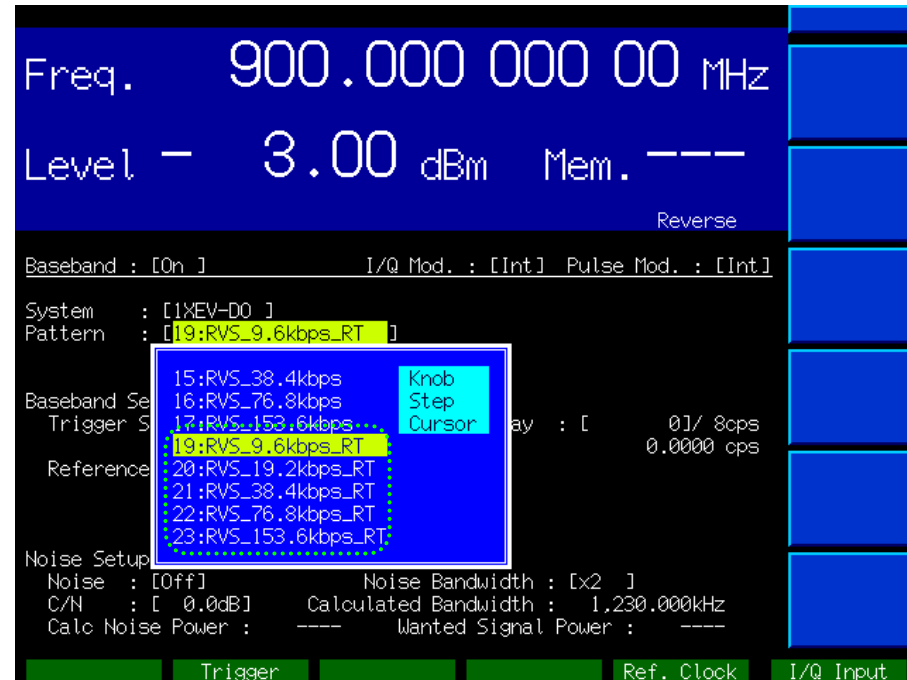
- » MQ_{RTCMAC} 3FE0000001

Wanted signal generator Setup example

- **Reverse Traffic Channel**

Data Rate

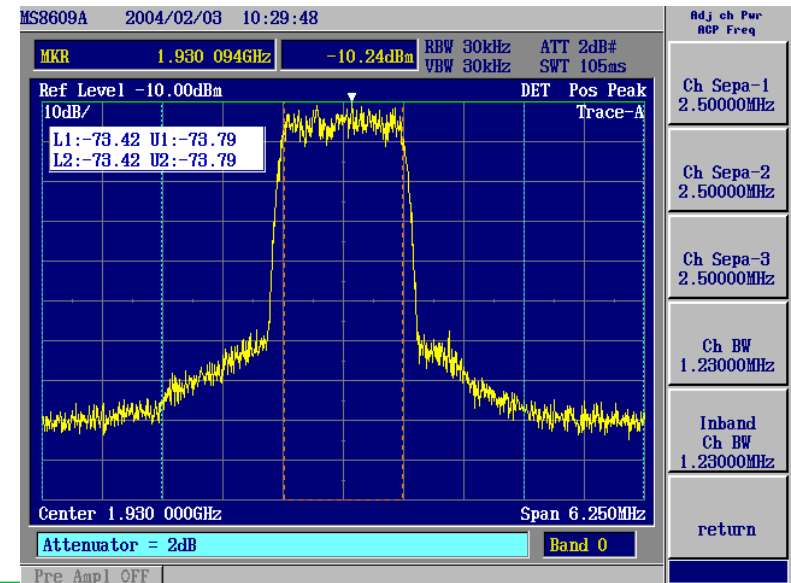
- » 9.6 kbps
- » 19.2 kbps
- » 38.4 kbps
- » 76.8 kbps
- » 153.6 kbps



Interfering signal generator

Setup example

- **HRPD signal**
 - CDMA2000 1xEV-DO Reverse Traffic Channel
 - » Adjacent Channel Selectivity test
- **Sector 2 (Interferer)**
 - » Inter-Sector Transmitter Intermodulation test



AWGN generator

Setup example

- **AWGN mixing**

- » C/N = Wanted signal/AWGN

- Dynamic range test

- C/N: [1.2dB]

- Wanted -63.8dBm Noise -65.0dBm

- RSQI test

- C/N: [1.0dB]

- Wanted -83.0dBm Noise -84.0dBm

- (Data rate:153.6 kbps,

- Data E_b/N_t : 8 dB,

- DataChannelGain: 18.5 dB)

$$\hat{I}_{oc} = \frac{E_b}{N_t} \times \frac{\text{Data rate}}{1 + \text{ChannelGain}}$$

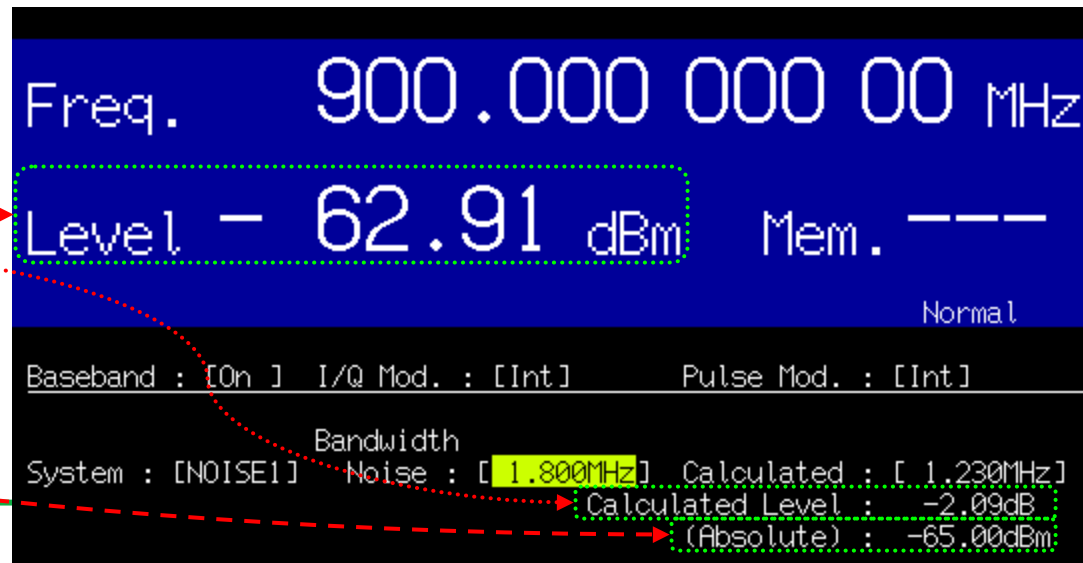
$$I_{oc} = N_t \times 1.23 \times 10^6 \times \text{ChannelGain}$$

- **AWGN source**

- » $I_{oc} =$

- » Total level

- » + Bandwidth level



CDMA2000 1xEV-DO 3GPP2 AT Access Terminal testing

3GPP2 C.S0033 -0 v2.0

3.1.1 Receiver Minimum Standards

Section	Test	Wanted signal generator	Interfering signal generator	CW generator	AWGN generator	Others
3.1.1.2.1	Demodulation of Forward Traffic Channel in AWGN	MG3681A +MU368030A +MX368033A			+MU368060A +MU368040A	
3.1.1.2.2	Demodulation of Forward Traffic Channel in Multipath Fading Channel				MG3681A +MU368060A	Channel simulator, Combiner
3.1.1.3.1	Receiver Sensitivity and Dynamic Range					
3.1.1.3.2	Single Tone Desensitization		MG3681A or 3GHz	MG3642A 2.08GHz		MA1612A 3GHz Combiner
3.1.1.3.3	Intermodulation Spurious Response Attenuation		MG3681A +MU368030A +MX368031A			
3.1.1.3.4	Adjacent Channel Selectivity					
3.1.1.4.5	Receiver Blocking Characteristics		MG3681A or 3GHz	MG3692A 20GHz or MG3642A 2.08GHz		

Receiver test Connection example

Interfering signal generator

CW generator

(AWGN generator)

MG3681A

+MU368030A+MX368031A

(+MU368060A)



Wanted signal generator

(AWGN generator)

MG3681A

+MU368030A+MX368033A

(+MU368060A+MU368040A)



CW generator

(MG3692A)



Combiner

(MA1612A)



Controller

PER calculation



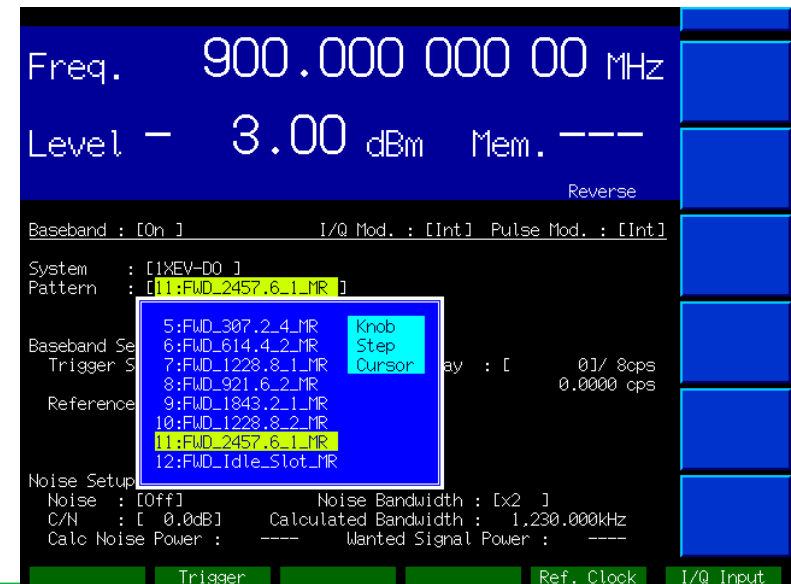
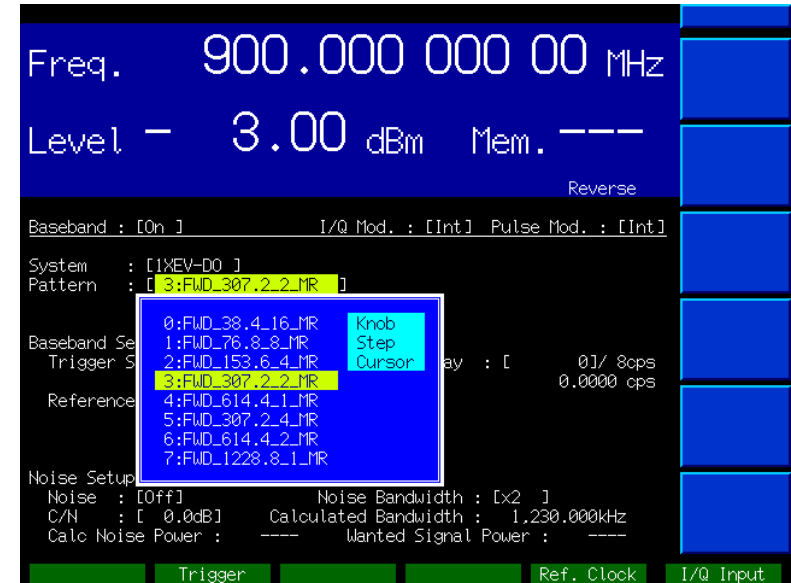
– Controller

- Launches Forward Traffic channel in receivable state by FTM^{Factory Test Mode} control.
- Checks the CRC per demodulated Traffic channel packet and calculates the PER.

Wanted signal generator Setup example

- **Forward Traffic Channel**

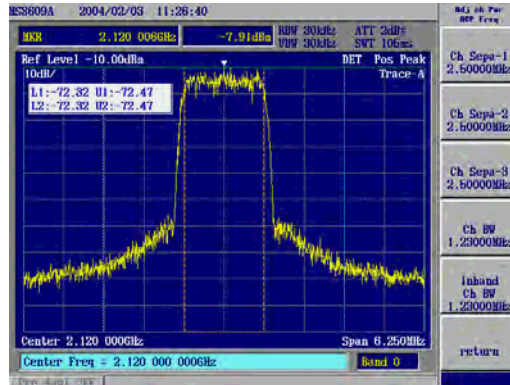
	Data Rate	Slots per Physical Layer Packet
»	38.4 kbps	16
»	76.8 kbps	8
»	153.6 kbps	4
»	307.2 kbps	2
»	614.4 kbps	1
»	307.2 kbps	4
»	614.4 kbps	2
»	1,228.8 kbps	1
»	921.6 kbps	2
»	1,843.2 kbps	1
»	1,228.8 kbps	2
»	2,457.6 kbps	1



Interfering signal generator

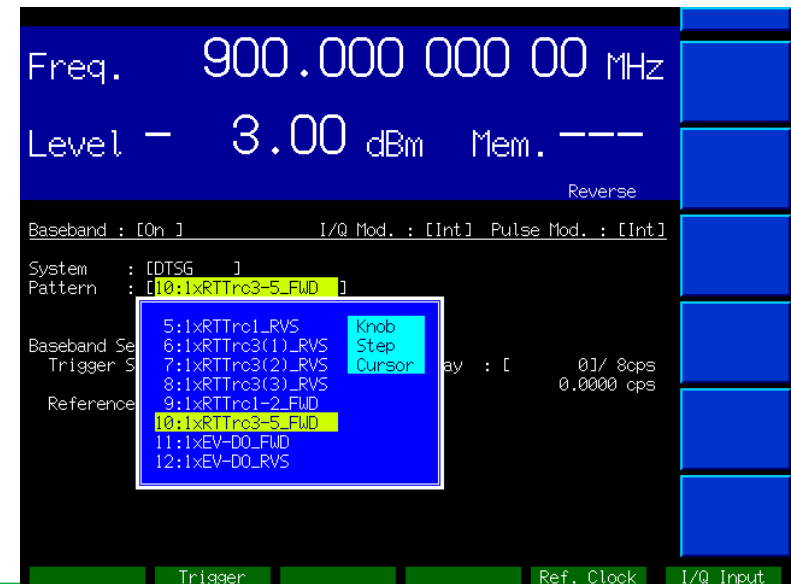
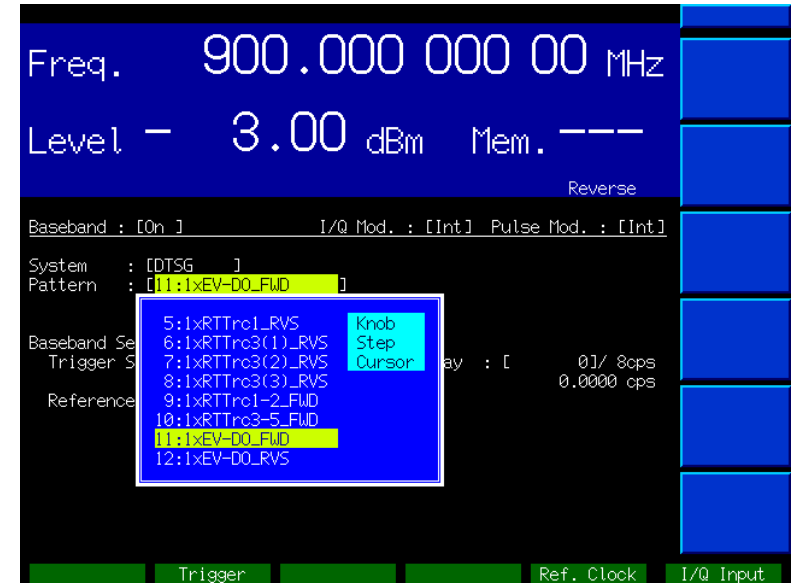
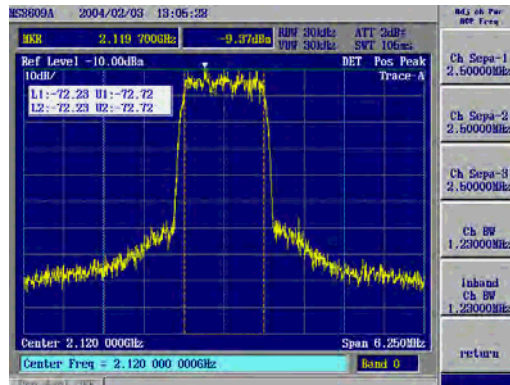
Setup example

- **HRPD signal**
 - CDMA2000 1xEV-DO Forward Traffic Channel



OR

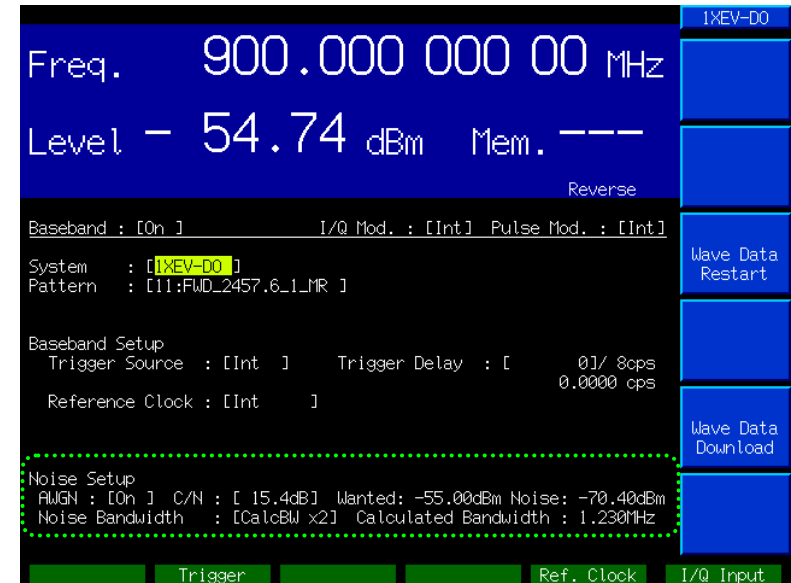
- **CDMA signal**
 - CDMA2000 1X Forward Traffic Channel



AWGN generator

Setup example

- **AWGN mixing**
 - » $C/N = \text{Wanted signal}/\text{AWGN}$
 - Demodulation of FTC in AWGN test
 - $C/N: \hat{I}_{or}/I_{oc}$

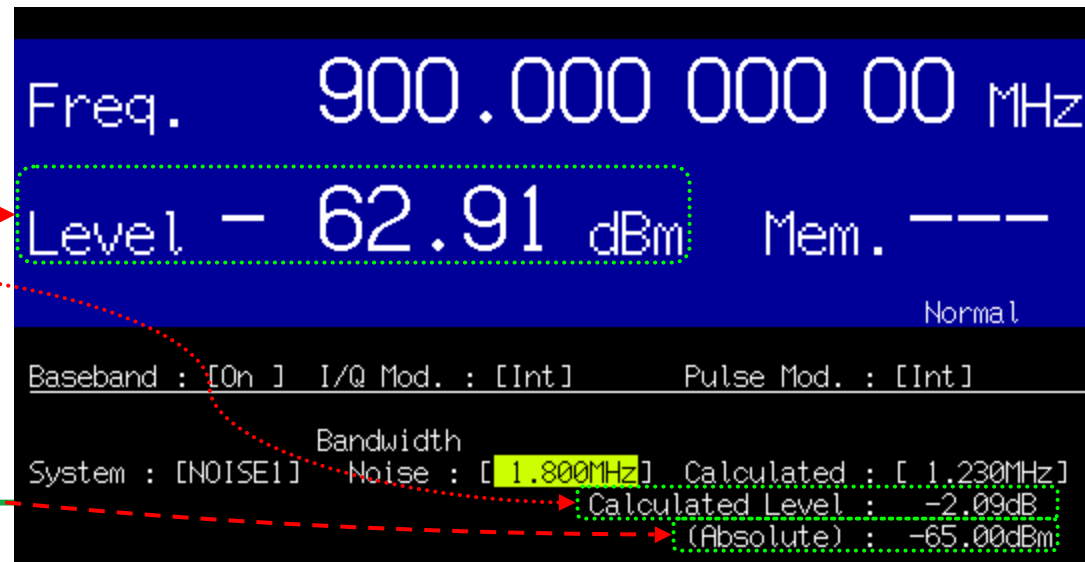


- **AWGN source**

» $I_{oc} =$

Total level

+ Bandwidth level



RF/IF components test

Connection example

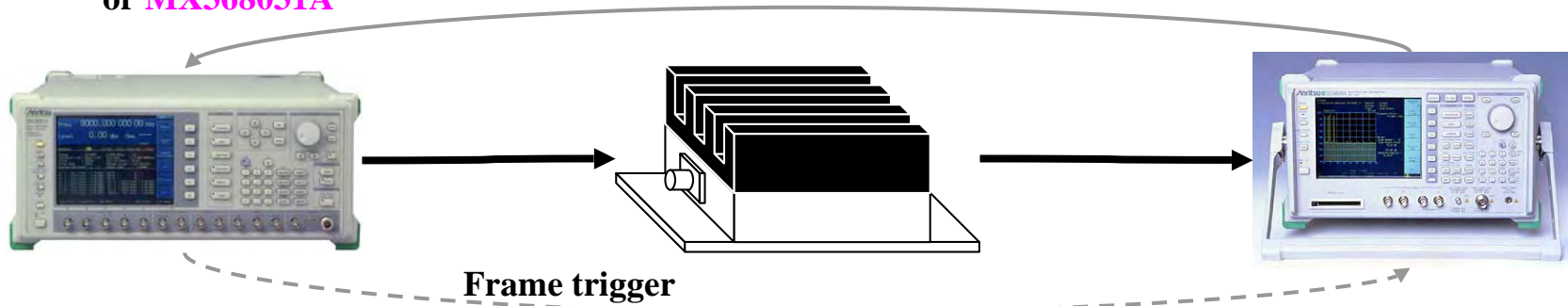
Signal source

MG3681A
 +**MU368030A**+**MX368033A**
 or **MX368031A**

Signal analyzer

(MS8600/MS2680)

Reference clock



– Frame trigger

- Required when performing modulation analysis of Reverse signal by MS8608A/8609A
 - Because, it cannot catch Pilot Channel when DataChannelGain is high.
- Rear panel A4[Frame Trigger] or B2[Sequence Pulse] Output
 - To MS8608A/8609A rear panel [Trigger] Input
 - 26.66... ms clock

Rate (kbps)	DataChannelGain (dB)
9.6	3.75
19.2	6.75
38.4	9.75
76.8	13.25
153.6	18.50

Field	Value (Decimal)
DRCLength	0 (1 slot)
DRCCChannelGain	6 (3 dB)
ACKChannelGain	6 (3 dB)

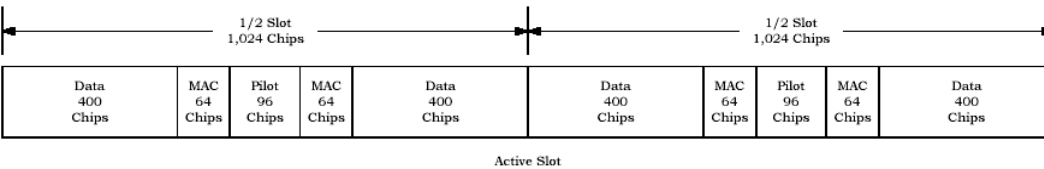
Forward signal Setup example

AN transmitter test

AT receiver test

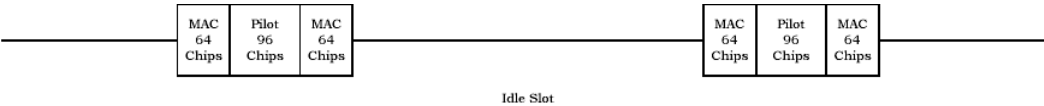
- MX368033A**

- » Active Slot: 8,4,3,2,1 carrier
 - 2,457.6 kbps, 16QAM



Active Slot

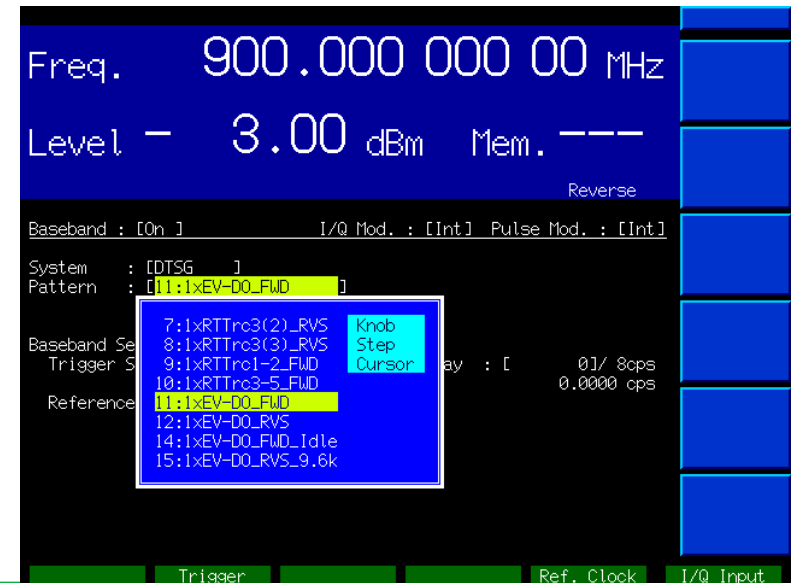
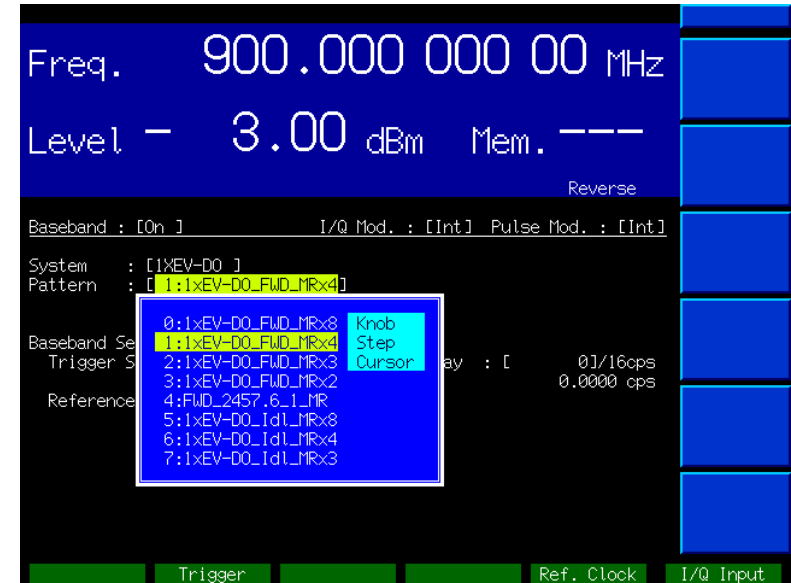
- » Idle Slot: 8,4,3,2,1 carrier
 - Burst signal



Idle Slot

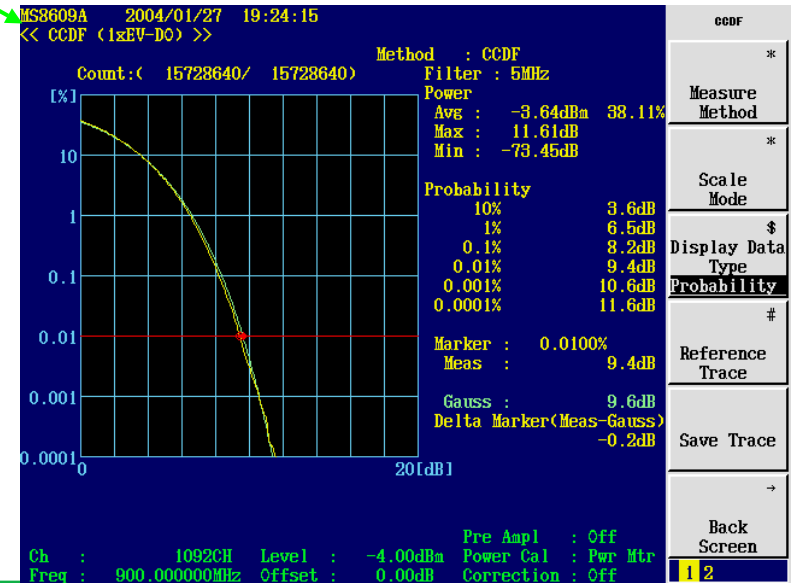
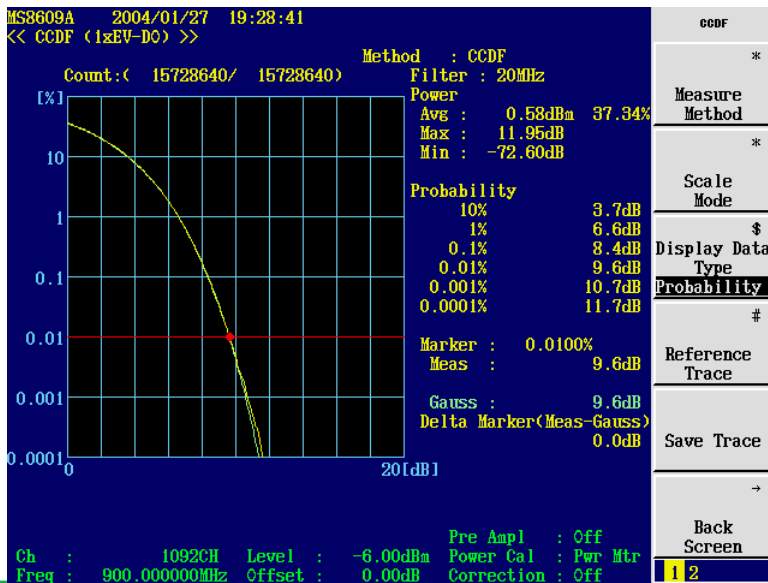
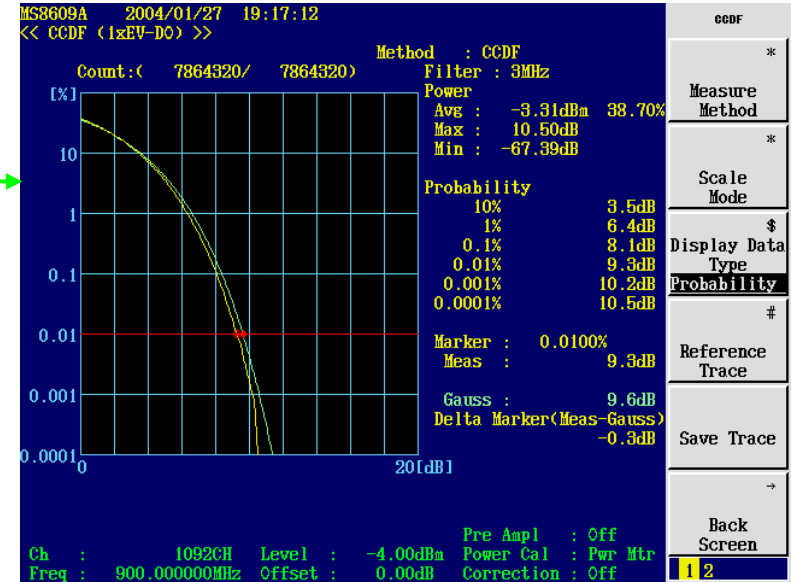
- MX368031A**

- » Active Slot: single carrier
 - 2,457.6 kbps, 16QAM
- » Idle Slot: single carrier
 - Burst signal



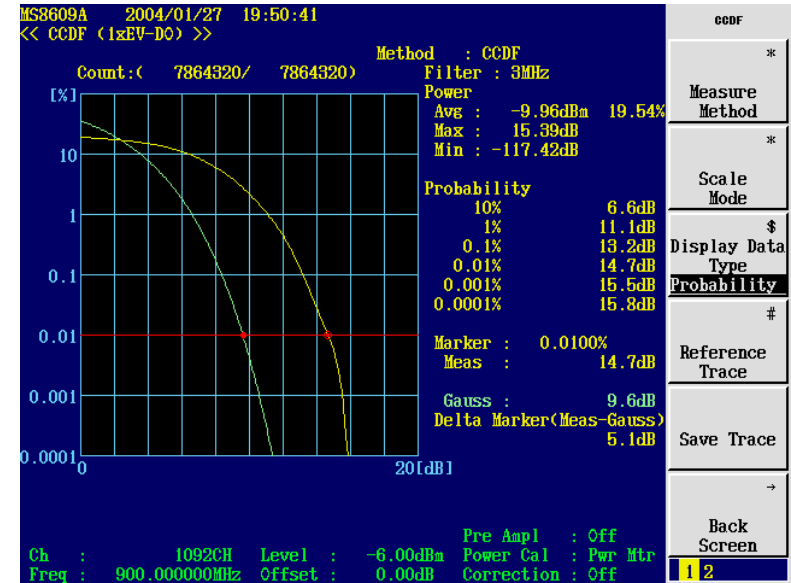
CCDF

- Active slot
 - » Single carrier
 - » 2 carriers
 - » 8 carriers



CCDF

- **Idle slot**
 - » Single carrier
 - Mean power of the ensemble average \approx Mean power of the Pilot/MAC channel ensemble average - 6.6 dB



Reverse signal Setup example

AT transmitter test

AN receiver test

- **MX368033A**
 - » 9.6 kbps
 - » 153.6 kbps
- **MX368031A**
 - » 9.6 kbps
 - » 153.6 kbps

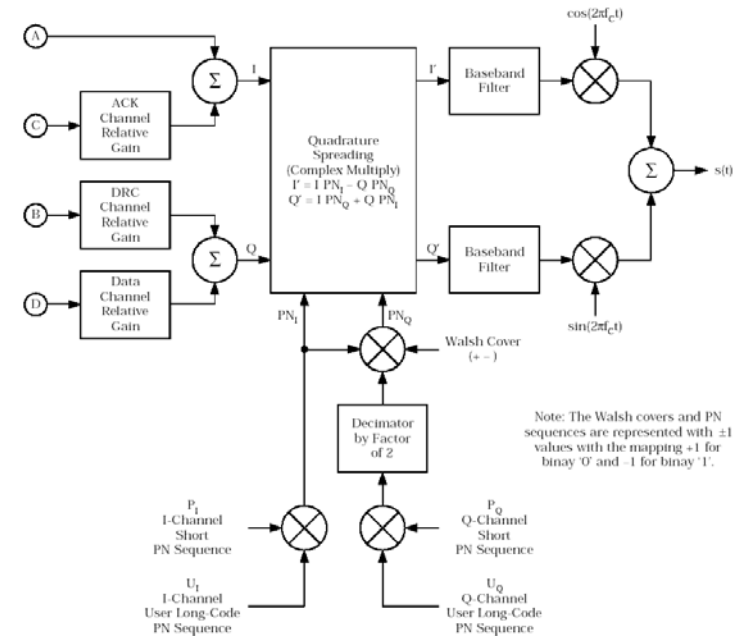
Reverse signal setup for MX368033A. The screen shows Freq. 900.000 000 00 MHz, Level - 3.00 dBm, and Mem. ---. The Baseband is [0n], I/Q Mod. is [Int], and Pulse Mod. is [Int]. The System is [1XEV-D0] and the Pattern is [13:RVS_9.6kbps]. A list of Baseband Selections is shown, with 13:RVS_9.6kbps selected. The Noise Setup shows Noise [Off], Noise Bandwidth [x2], C/N [0.0dB], and Calculated Bandwidth 1,230.000kHz.

Reverse signal setup for MX368031A. The screen shows Freq. 900.000 000 00 MHz, Level - 3.00 dBm, and Mem. ---. The Baseband is [0n], I/Q Mod. is [Int], and Pulse Mod. is [Int]. The System is [DTSG] and the Pattern is [15:1xEV-D0_RVS_9.6k]. A list of Baseband Selections is shown, with 15:1xEV-D0_RVS_9.6k selected. The Noise Setup shows Noise [Off], Noise Bandwidth [x2], C/N [0.0dB], and Calculated Bandwidth 1,228.800kHz.

Reverse signal setup for MX368031A. The screen shows Freq. 900.000 000 00 MHz, Level - 3.00 dBm, and Mem. ---. The Baseband is [0n], I/Q Mod. is [Int], and Pulse Mod. is [Int]. The System is [1XEV-D0] and the Pattern is [11:RVS_9.6kbps]. A list of Baseband Selections is shown, with 11:RVS_9.6kbps selected. The Noise Setup shows Noise [Off], Noise Bandwidth [x2], C/N [0.0dB], and Calculated Bandwidth 1,228.800kHz.

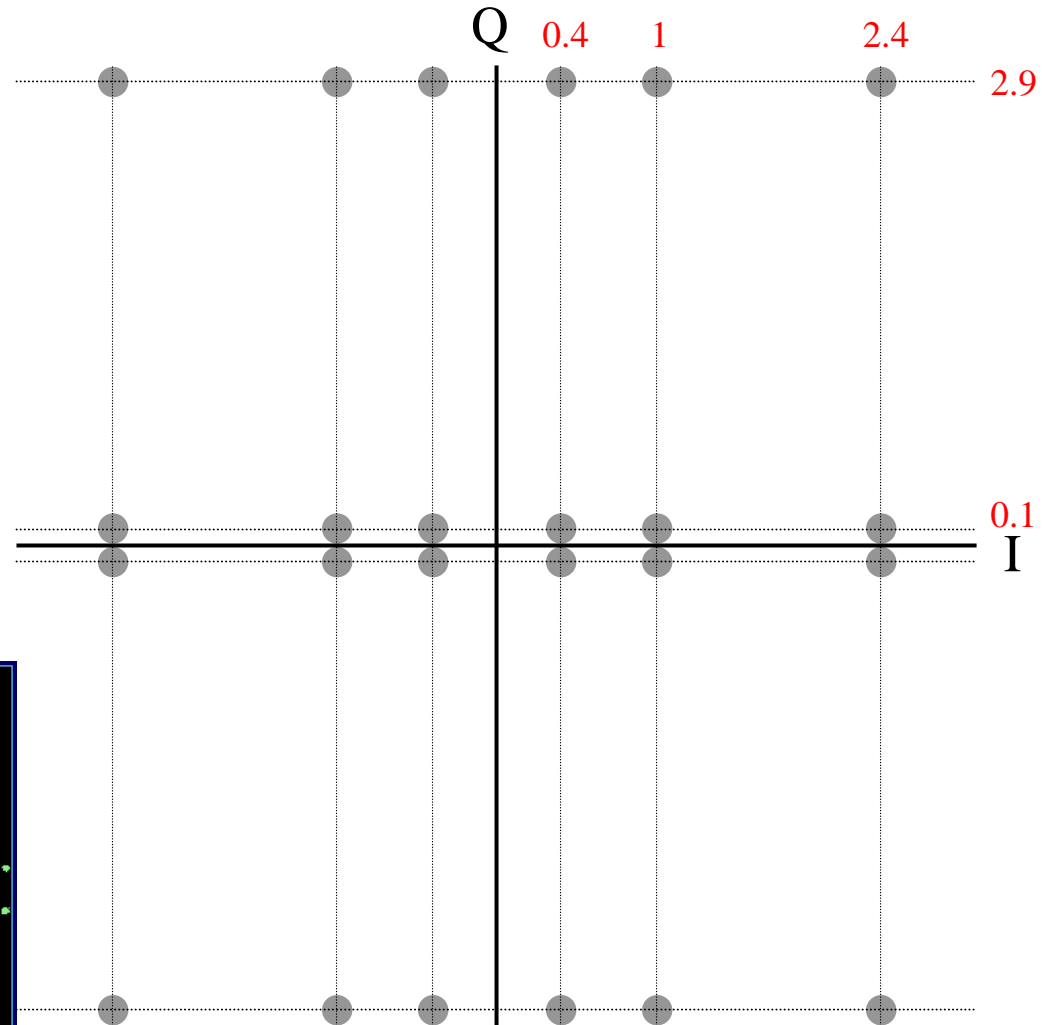
Investigation of Reverse signal (9.6 / 153.6 kbps)

- **I**
 - » Pilot Channel 0 dB
 - » ACK Channel 3 dB
- **Q**
 - » DRC Channel 3 dB
 - » Data Channel 3.75 dB (9.6 kbps)
 - 6.75 dB (19.2 kbps)
 - 9.75 dB (38.4 kbps)
 - 13.25 dB (76.8 kbps)
 - 18.5 dB (153.6 kbps)

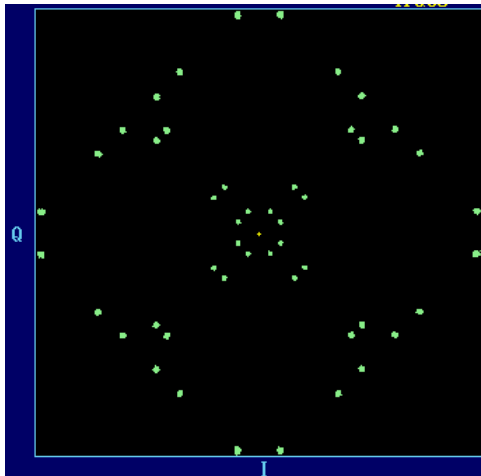


9.6 kbps Constellation

- **I**
 - » Pilot Channel 1
 - » ACK Channel ≈ 1.4
 - Half-slot transmission
- **Q**
 - » DRC Channel ≈ 1.4
 - » Data Channel ≈ 1.5

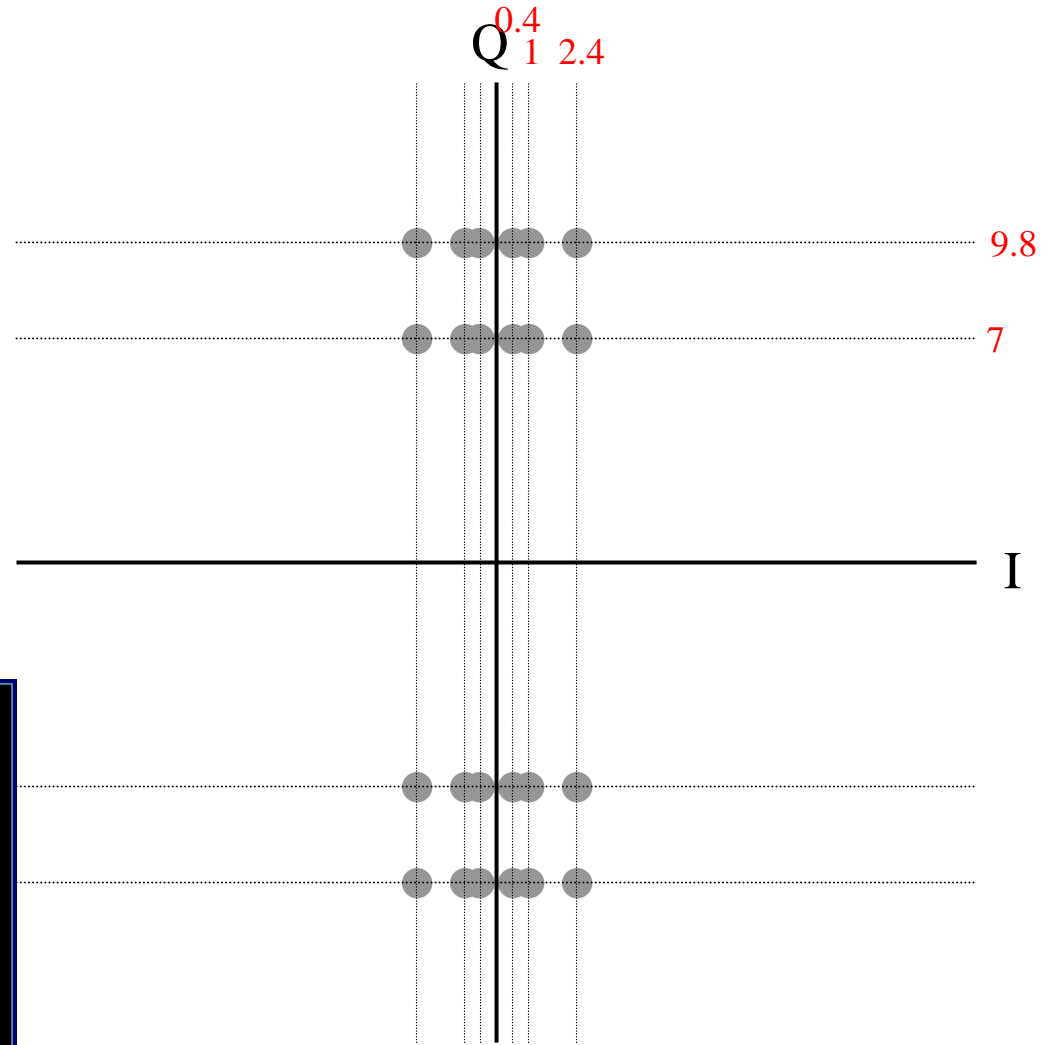


The right figure which plotted IQ inclines 45° in Spreading, and rotates 90° .

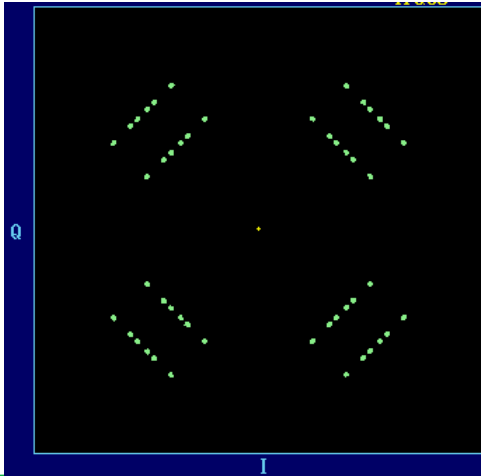


153.6 kbps Constellation

- **I**
 - » Pilot Channel 1
 - » ACK Channel ≈ 1.4
 - Half-slot transmission
- **Q**
 - » DRC Channel ≈ 1.4
 - » Data Channel ≈ 8.4



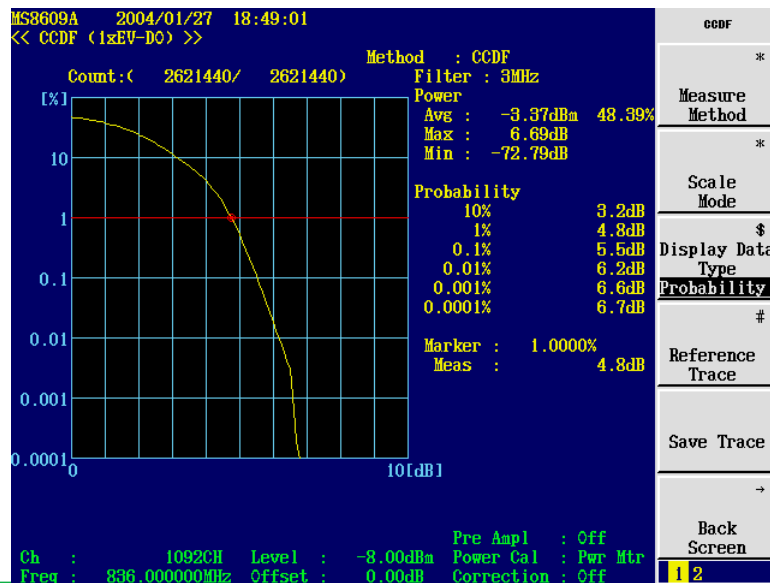
The right figure which plotted IQ inclines 45° in Spreading, and rotates 90° .



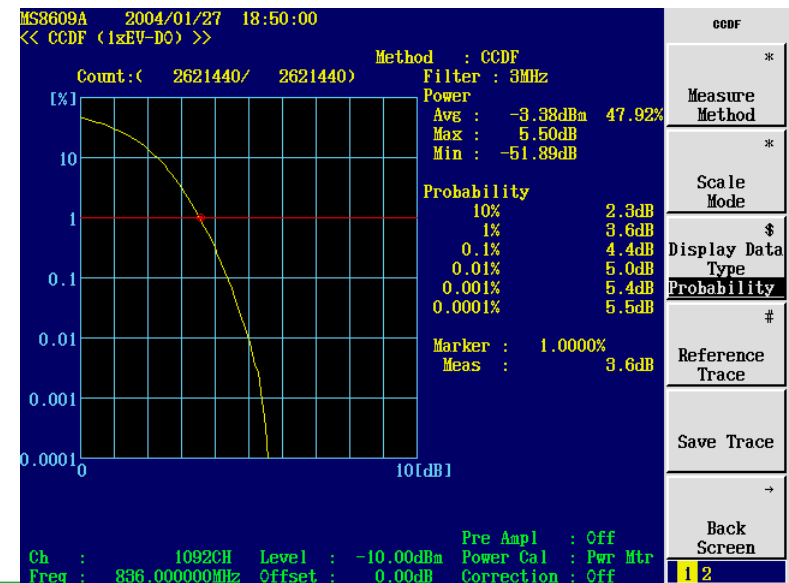
CCDF

- On the result of Constellation, 9.6 kbps side tends to generate the peak.
- Although specified that ρ test is 9.6 kbps and Spurious test is 153.6 kbps in 3GPP2, it is necessary to consider also 9.6 kbps which the peak tends to generate.

9.6 kbps



153.6 kbps



CDMA2000 1X 3GPP2 BS testing

3GPP2 C.S0010 -B v1

- 3 Receiver Minimum Standards
- 4 Transmitter Minimum Standards

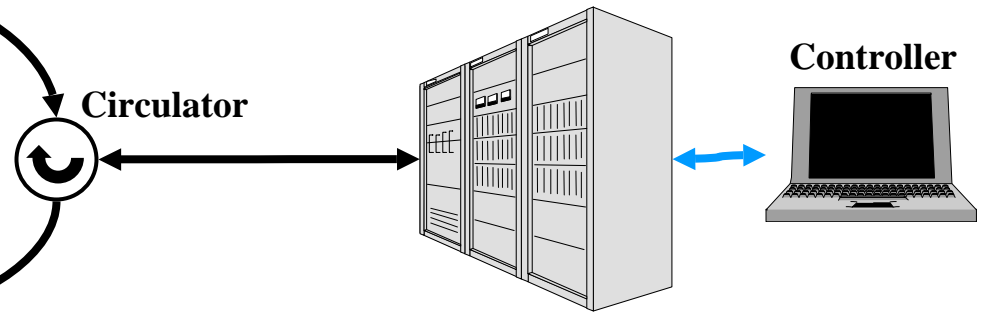
Section	Test	Wanted signal generator	Interfering signal generator	CW generator	AWGN generator	Others	
3.4 3.4.1	Reverse Traffic Channel Demodulation Performance Performance in AWGN	MG3681A +MU368030A +MX368031A			MG3681A +MU368060A	MA1612A 3GHz Combiner	
3.5.1	Receiver Sensitivity						
3.5.2	Receiver Dynamic Range					MG3681A +MU368060A	MA1612A 3GHz Combiner
3.5.3	Single Tone Desensitization			MG3681A or 3GHz	MG3642A 2.08GHz		
3.5.4	Intermodulation Spurious Response Attenuation			MG3681A			
3.5.5	Adjacent Channel Selectivity			MG3681A +MU368030A +MX368031A			
3.5.6	Receiver Blocking			MG3681A or 3GHz	MG3692A 20GHz or MG3642A 2.08GHz		
3.7	Received Signal Quality Indicator (RSQI)					MG3681A +MU368060A	
4.4.3	Inter-Base Station Transmitter Intermodulation		MG3681A +MU368030A +MX368031A (+MG3681A-42)			Spectrum analyzer Circulator	

Inter-Base Station Transmitter Intermodulation test Connection example

Interfering signal generator
MG3681A
+MU368030A+MX368031A
(+MG3681A-42)



Spectrum analyzer
MS8608A/8609A
+MX860803A/860903A



- Controller
 - Launches in the transmitting state by FTM^{Factory Test Mode} control.

Receiver test Connection example

Interfering signal generator

CW generator

AWGN generator

MG3681A

+MU368030A+MX368031A

+MU368060A



Wanted signal generator

MG3681A

+MU368030A+MX368031A



CW generator
(MG3692A)



Combiner
(MA1612A)



Start trigger

Reference clock



Controller
FER calculation



- Start trigger
 - Front panel [Trigger] Input
 - Apply only one
 - 20 ms frame clock
 - 80 ms clock (Alignment of frame clock and zero PN offset 26.67 ms clock)
 - 2 sec clock (Even second time mark)
- Reference clock
 - Apply only one
 - Front panel [Ref. Clock] Input
 - 8× 1.2288 MHz (9.8304 MHz)
 - Rear panel [10MHz/13MHz Ref] Input
 - 10 MHz, 13 MHz
- Controller
 - Launches Reverse Traffic channel in receivable state by FTM^{Factory Test Mode} control.
 - Checks the CRC per demodulated Traffic channel frame and calculates the FER.

Timing synchronization Setup example

- **Start trigger delay**

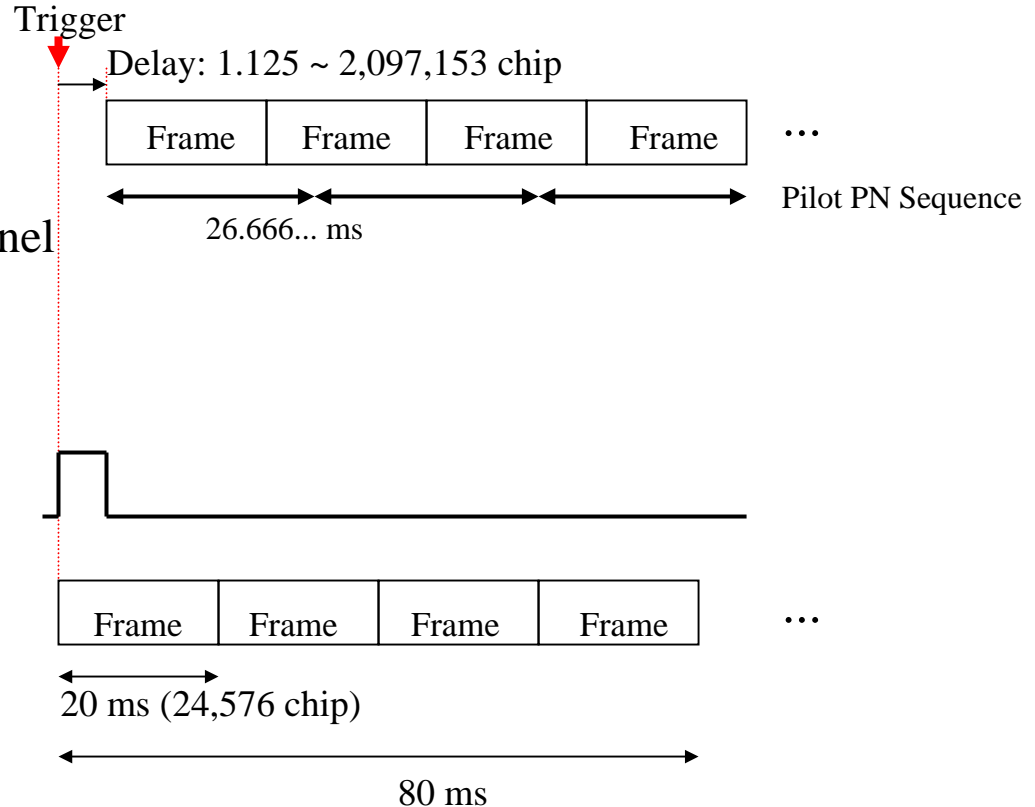
- » Set the timing to which MS can receive Reverse Traffic channel

Reverse Traffic Channel

- Pilot Channel
- Dedicated Control Channel
- Fundamental Channel
- Supplemental Channel

Start trigger

Forward Traffic Channel



Timing sync.

Setup example

- **Setting External Start trigger**

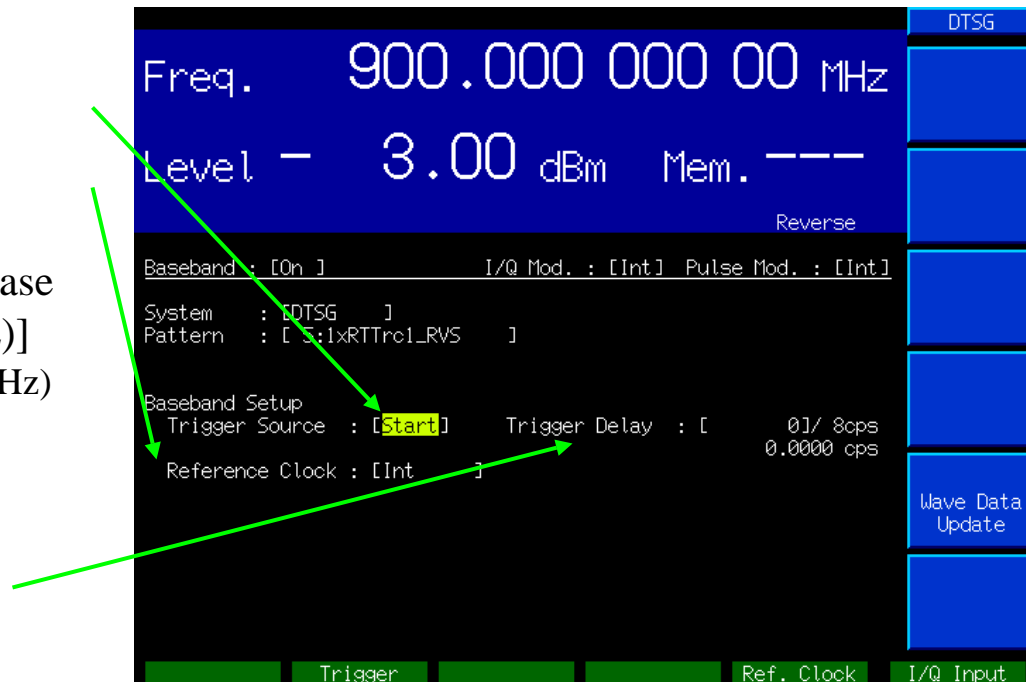
- » Captures/ Synchronizes the Trigger only once

- **Reference clock:**

- » [Ref. Clock] Input applicable case
 - Reference Clock : [Ext(TTL)]
 - 8× 1.2288 MHz (9.8304 MHz)
- » [10MHz/13MHz Ref] Input applicable case
 - Reference Clock : [Int]

- **Start trigger delay**

- » 0 ~ 16,777,215 /8 chip
1/8 chip resolution
- » Delay from Trigger
 - + 9/8 chip
 - 1.125 ~ 2,097,153 chip



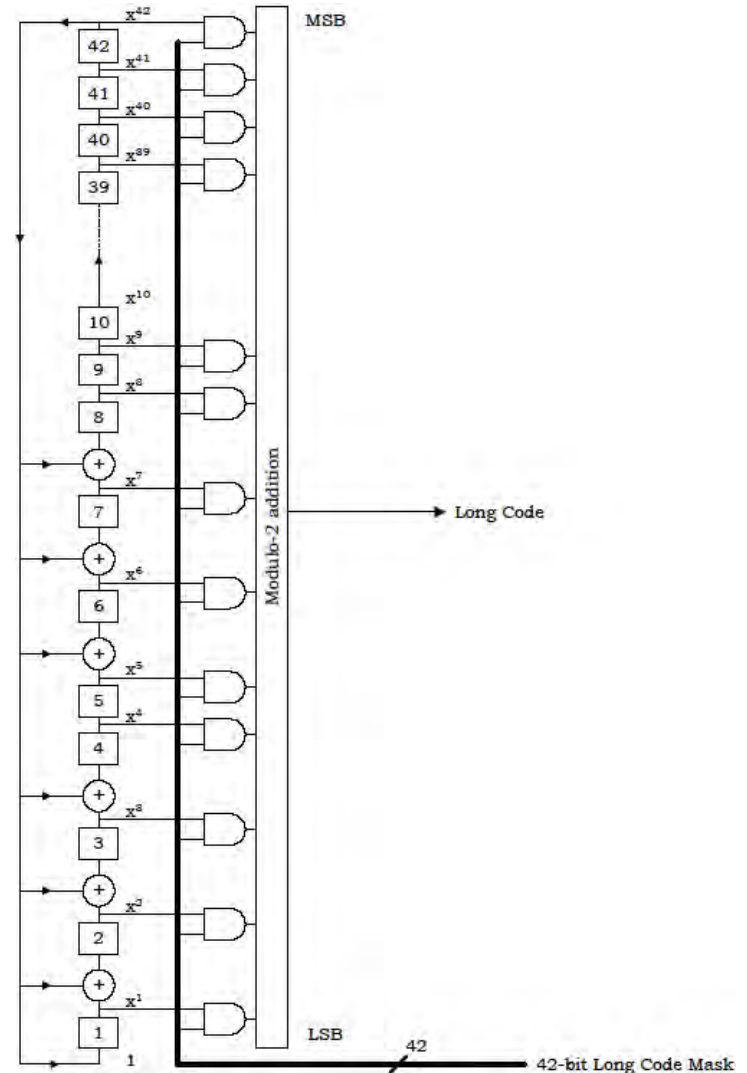
Long Code Mask sync.

- **Reverse Traffic Channel Long Code Mask**

- » 42-bit PN sequence

- **Setting BS**

- » 000000000000



Wanted signal generator Setup example

- Reverse Traffic Channel

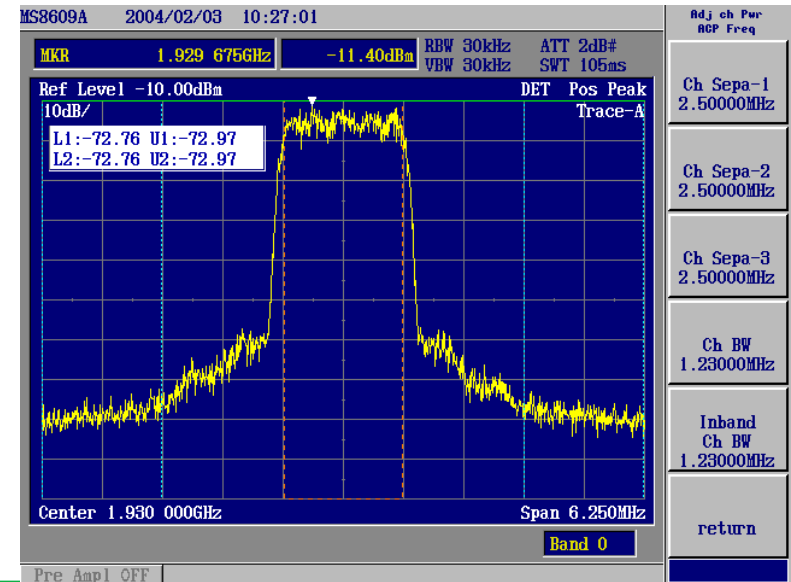
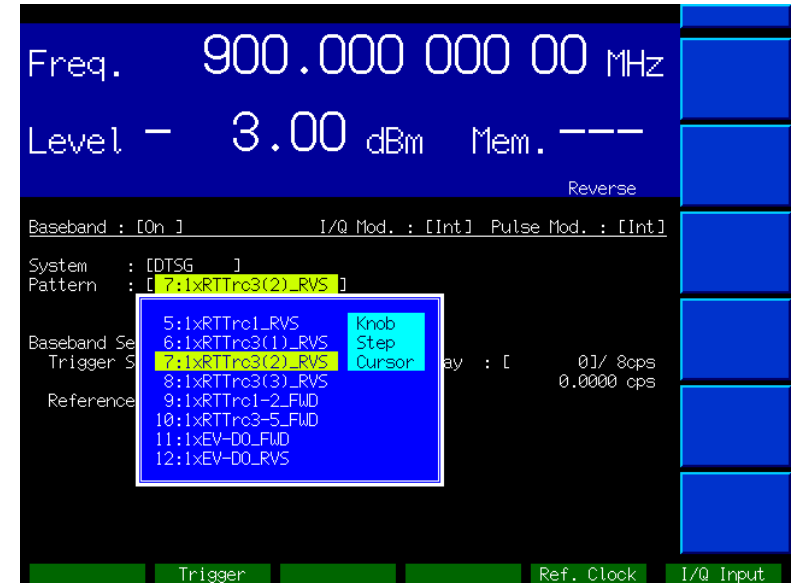
Test Mode	Forward Traffic Channel Radio Configuration	Reverse Traffic Channel Radio Configuration
1	1	1
2	2	2
3	3	3
4	4	3
5	5	4
6	6	5
7	7	5
8	8	6
9	9	6



Interfering signal generator

Setup example

- **RC 3 signal**
 - » Adjacent Channel Selectivity test
- **External Base Station**
 - » Inter-Sector Transmitter Intermodulation test



AWGN generator Setup example

- **AWGN source**

» $I_{oc} = \text{Total level} + \text{Bandwidth level}$

The screenshot shows the configuration for an AWGN source. The main display area has a blue background with white text. At the top right, it says 'AWGN'. The frequency is set to 900.000 000 00 MHz. The level is set to -62.91 dBm. The modulation is set to Normal. Below this, there are settings for Baseband, I/Q Mod., and Pulse Mod., all set to [Int]. The bandwidth section shows System: [NOISE1], Noise: [1.800MHz], Calculated: [1.230MHz], Calculated Level: [-2.09dB], and (Absolute): [-65.00dBm]. A red dashed line connects the equation above to the level and bandwidth fields. A green dashed line highlights the calculated level and absolute level values.

Parameter	Value
Freq.	900.000 000 00 MHz
Level	-62.91 dBm
Modulation	Normal
Baseband	[On]
I/Q Mod.	[Int]
Pulse Mod.	[Int]
System	[NOISE1]
Noise	[1.800MHz]
Calculated	[1.230MHz]
Calculated Level	[-2.09dB]
(Absolute)	[-65.00dBm]

RF/IF components test

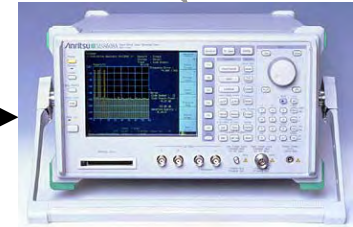
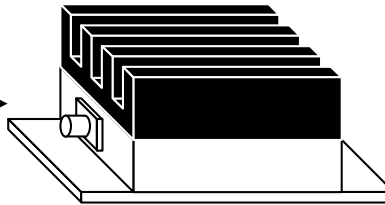
Connection example

Signal source

MG3681A
+MU368030A+MX368031A
or
+MU368040A+MX368042A

Signal analyzer
(MS8600/MS2680)

Reference clock



Forward signal Setup example

BS transmitter test

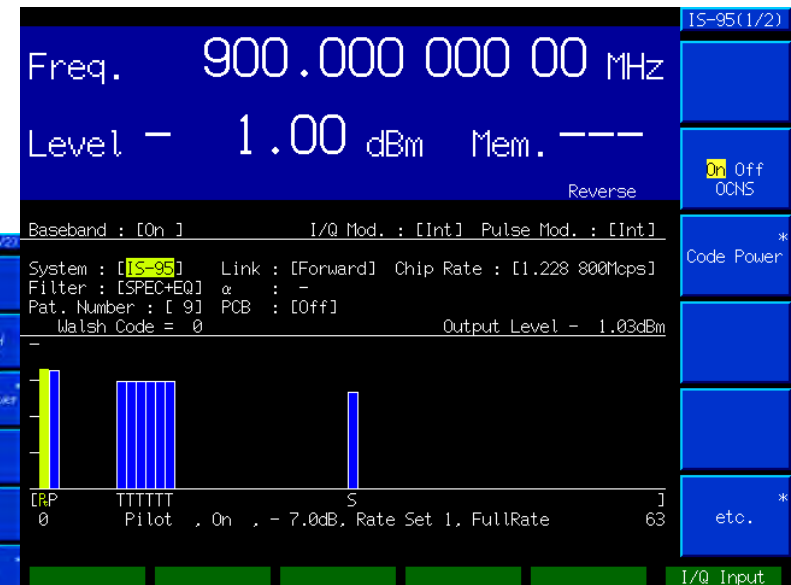
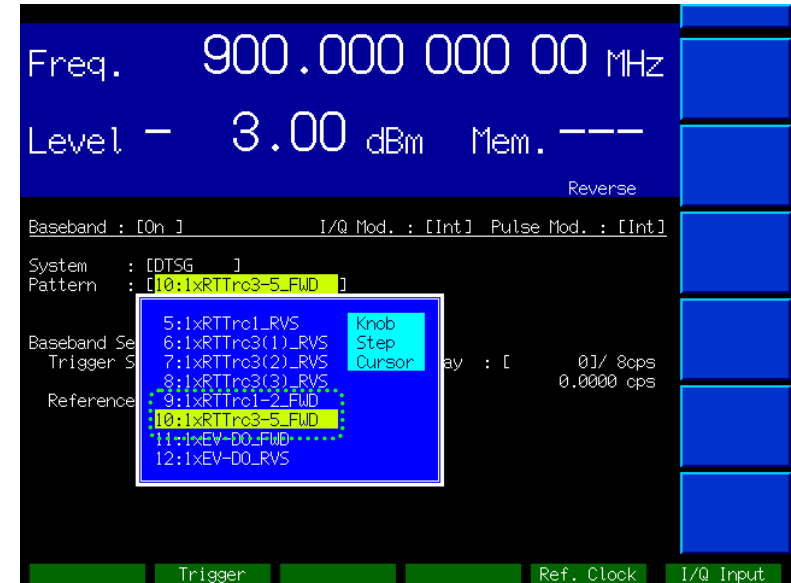
MS receiver test

- **MX368031A**
 - » RC 1/2
 - » RC 3/4/5

Table 6.5.2-3. Base Station Test Model, General

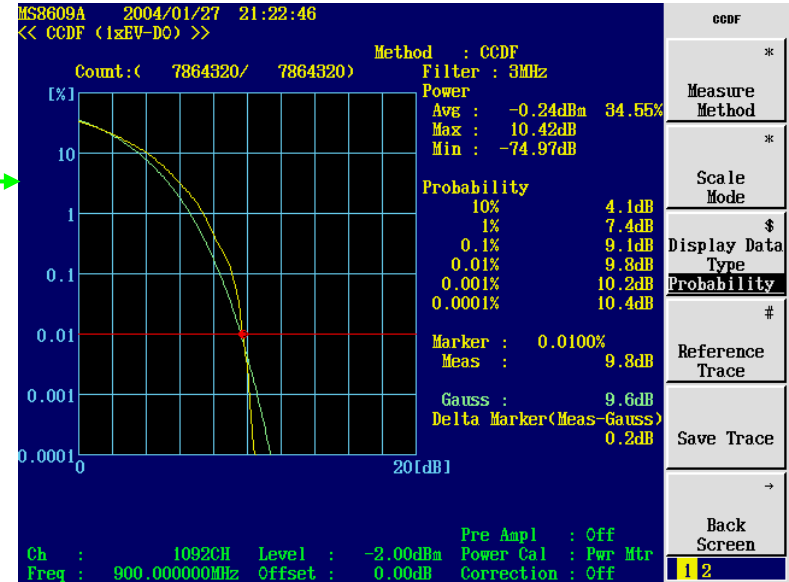
Channel Type	Relative Power
Pilot	0.2 of total power (linear)
Sync+Paging+Traffic	Remainder (0.8) of total power (linear)
Sync	3 dB less than one Fundamental Traffic Channel; always 1/8 rate
Paging	3 dB greater than one Fundamental Traffic Channel; full rate only
Traffic	Equal power in each Fundamental Traffic Channel; full rate only

- **MX368042A**
 - » RC 1
 - » RC 2

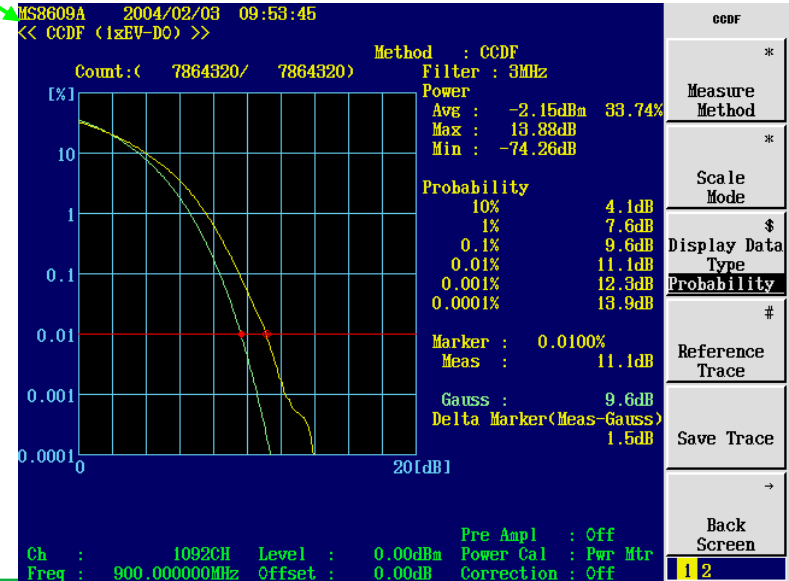
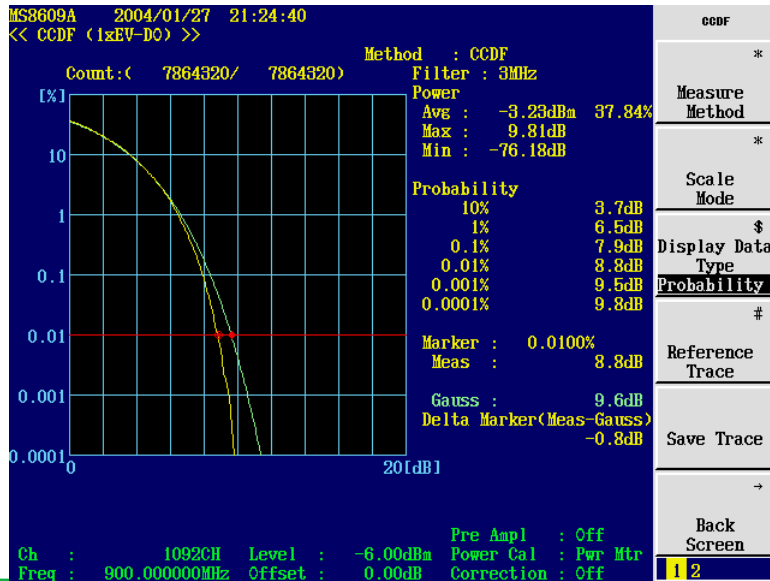


CCDF

- RC 1/2
 - » 9 channels
 - » 64 channels



- RC 3/4/5



Reverse signal Setup example

MS transmitter test

BS receiver test

- **MX368031A**
 - » RC 1
 - » RC 3
 - FCH + PICH
 - FCH + SCH + PICH
 - DCCH + PICH

- **MX368042A**
 - » RC 1

The image displays two screenshots of a software interface for reverse signal testing. The top screenshot shows a frequency of 900.000 MHz and a level of 3.00 dBm. The bottom screenshot shows a frequency of 842.650 MHz and a level of 0.00 dBm. Both screenshots show a list of reference signals and a 'Reverse' button.

Top Screenshot (900.000 MHz):

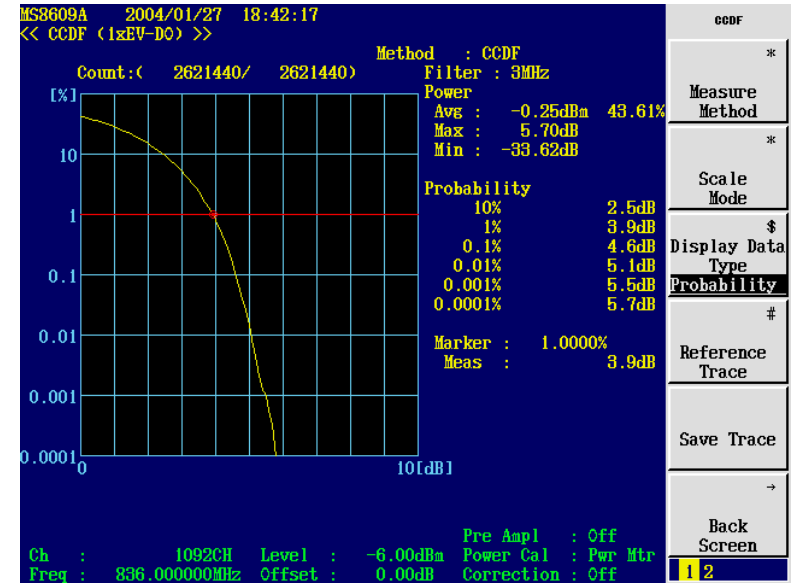
- Freq. 900.000 000 00 MHz
- Level - 3.00 dBm Mem. ---
- Reverse
- Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]
- System : [DTSG]
- Pattern : [5:1xRTTtrc1_RVS]
- Baseband Se
- Trigger S
- Reference
- Knob
- Step
- Cursor
- 0]/ 8cps
- 0.0000 cps
- Trigger
- Ref. Clock
- I/Q Input

Bottom Screenshot (842.650 MHz):

- Freq. 842.650 000 00 MHz
- Level 0.00 dBm Mem. ---
- Reverse
- Baseband : [On] I/Q Mod. : [Int] Pulse Mod. : [Int]
- System : [IS-95] Link : [Reverse] Chip Rate : [1.228 800Mbps]
- Filter : [SPEC] α : -
- Traffic, Data Rate : FullRate Output Level 0.00dBm
- Data Rate *
- etc. *
- I/Q Input

CCDF

- RC 1/2



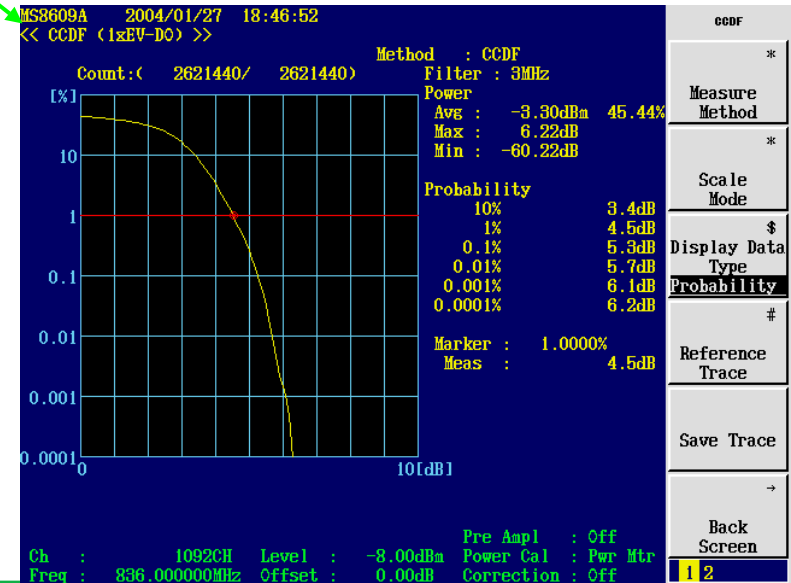
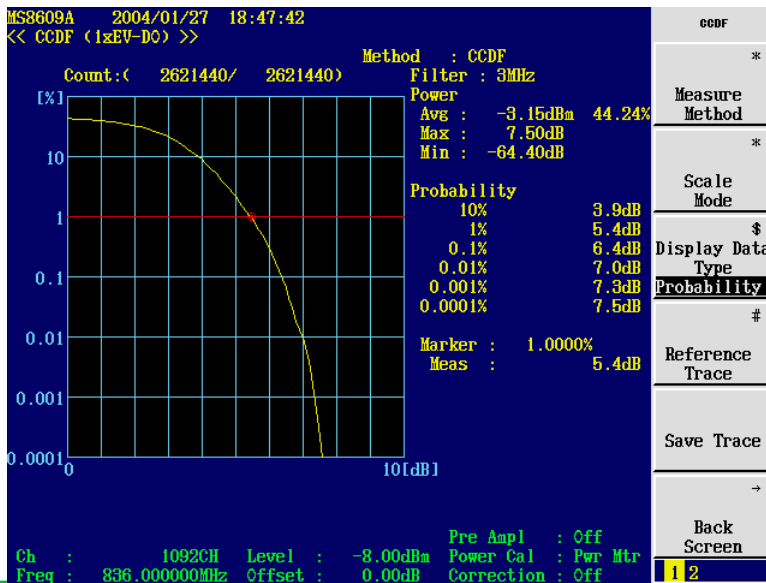
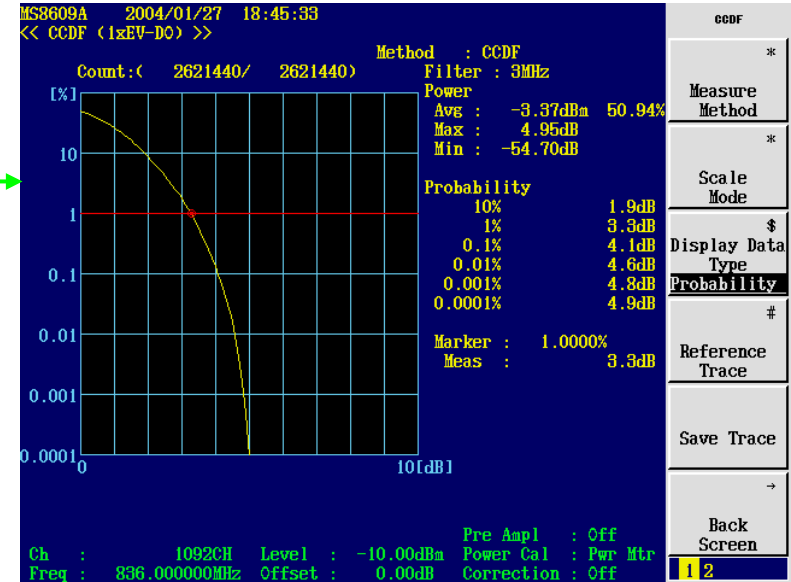
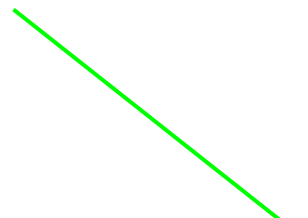
CCDF

- RC 3

- » FCH + PICH

- » FCH + SCH + PICH

- » DCCH + PICH



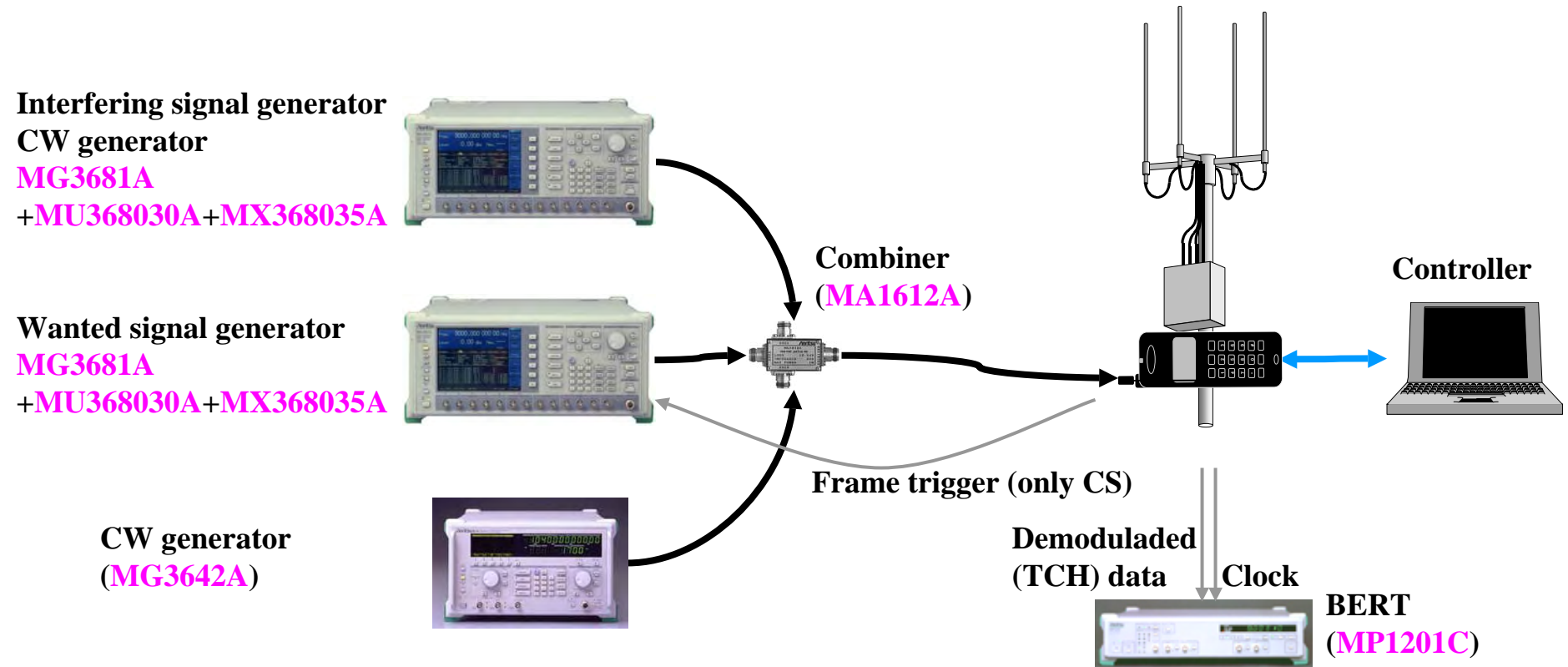
PHS RCR STD-28 CS/PS testing

RCR STD-28 V4.0

3.4.3 7.2 Receiver Test

Requirements	Meas. Methods	Test	Wanted signal generator	Interfering signal generator	CW generator	BERT	Others
3.4.3.2	7.2.1	Sensitivity	MG3681A +MU368030A +MX368035A			MP1201C	
3.4.3.4	7.2.2	Adjacent channel selectivity		MG3681A +MU368030A +MX368035A			MA1612A 3GHz
3.4.3.5	7.2.3	Intermodulation characteristics		MG3681A	MG3642A		
3.4.3.6	7.2.4	Spurious response		MG3681A or 3GHz	MG3642A 2.08GHz		
3.4.3.9	7.2.8 7.2.8.3	Receive signal strength indicator accuracy Reception level value is display					
3.4.3.10	7.2.9	Bit error rate floor characteristics					MP1201C

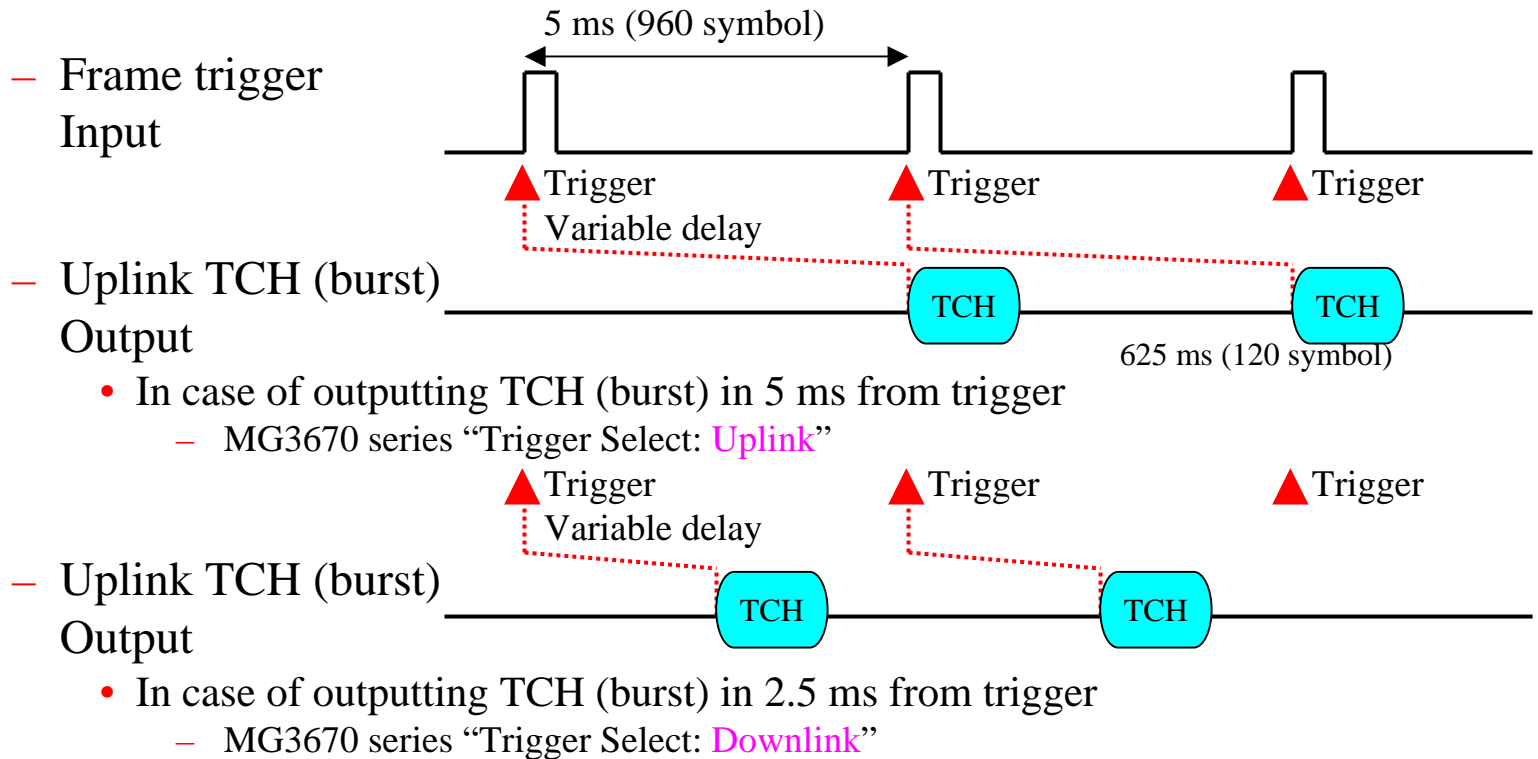
Receiver test Connection example



- Frame trigger
 - Front panel [Trigger] Input
 - 5 ms clock
- Controller
 - Launches TCH in the receivable state by FTM^{Factory Test Mode} control.

- **Frame trigger delay**

- » Set the timing to which CS can receive Uplink TCH



- **Setting External Frame trigger**
 - » Captures/ Synchronizes the Trigger of 5 ms clock
- **Reference clock:**

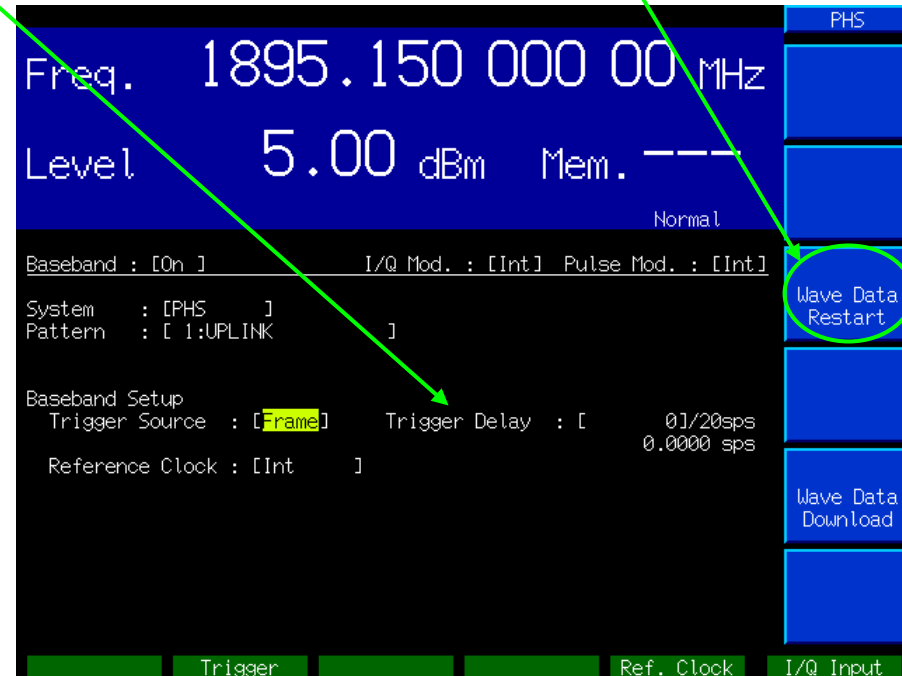
Apply to cancel the jitter of within $\pm 1/20$ symbol of synchronous errors

 - MG3670 series is the jitter within $\pm 1/16$ symbol
 - » [Ref. Clock] Input applicable case
 - Reference Clock : [Ext(TTL)]
 - 20× 192 kHz (3,840 kHz)
 - » [10MHz/13MHz Ref] Input applicable case
 - Reference Clock : [Int]



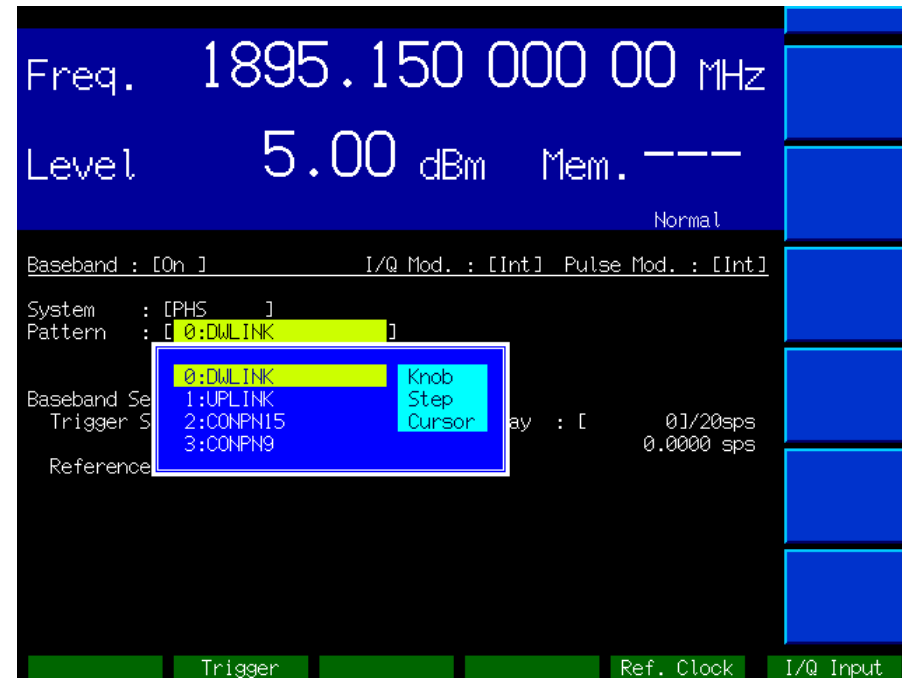
- **Frame trigger delay**
 - » 0 ~ +16,777,215 /20 symbol
1/20 symbol resolution
 - » Delay from trigger
 - + 2.55 symbol
 - 2.55 ~ 838,863.3 symbol
 - e.g.
 - » In case of outputting TCH (burst) in 5 ms from trigger
 - 19,149 /20 symbol
 - Equivalent to MG3670 series “Trigger Select: Uplink”
 - 19,171 /20 symbol
 - + 0.614 + 0.5 symbol
 - » In case of outputting TCH (burst) in 2.5 ms from trigger
 - 9,549 /20 symbol
 - Equivalent to MG3670 series “Trigger Select: Downlink”
 - 9,571 /20 symbol
 - + 0.614 + 0.5 symbol

- **Trigger recapture/ synchronization**



Wanted/Interfering signal generator Setup example

- **Wanted signal generator**
 - » CS test
 - Uplink
 - » PS test
 - Downlink
- **Interfering signal generator**
 - CONPN15



RF/IF components test

Connection example

Signal source

MG3681A

+MU368030A+MX368035A

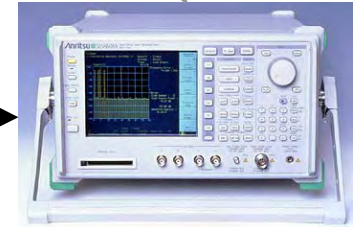
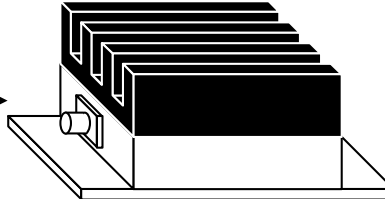
or

+MU368030A+MX368031A

Signal analyzer

(MS8600/MS2680)

Reference clock



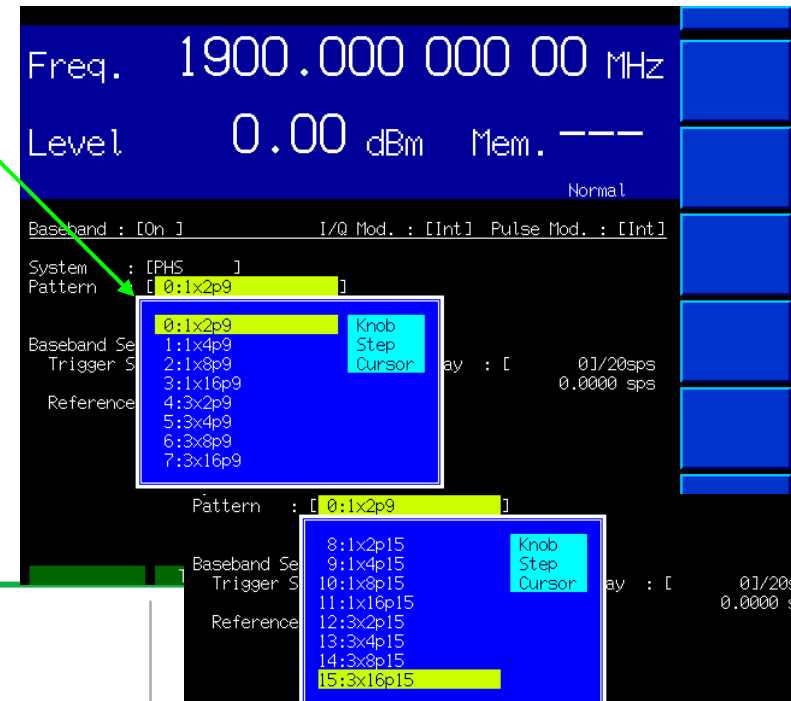
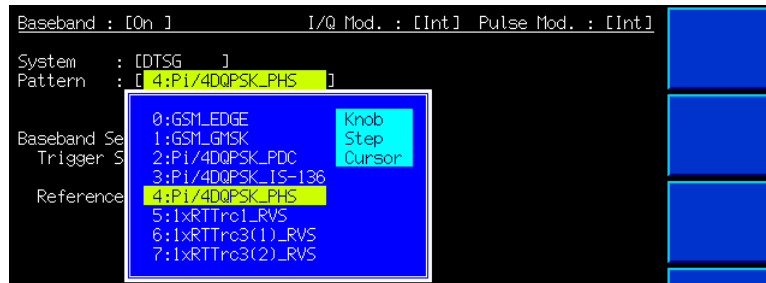
Signal Setup example

- **MX368035A**

- » $\pi/4$ DQPSK modulation
 - TCH (burst) format
 - Continuous modulation format
- » 16QAM modulation
- » 8PSK modulation
- » QPSK modulation
- » BPSK modulation
 - Continuous modulation format

- **MX368031A**

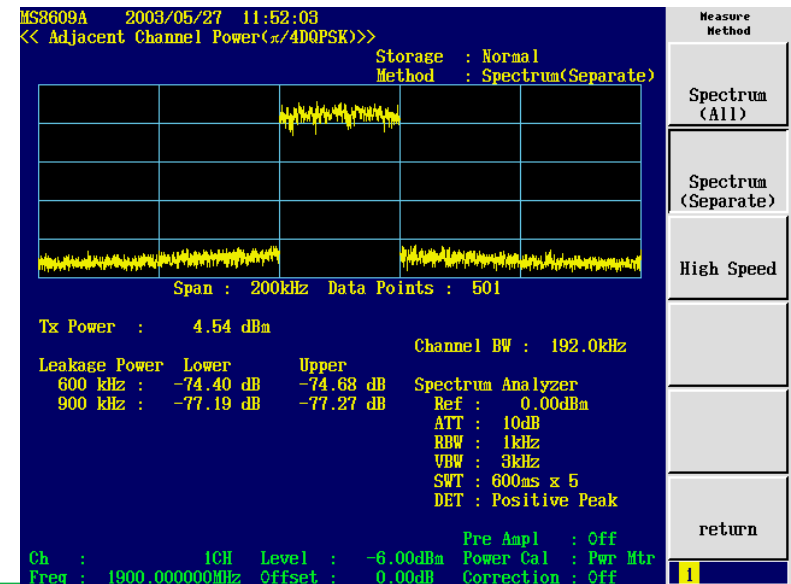
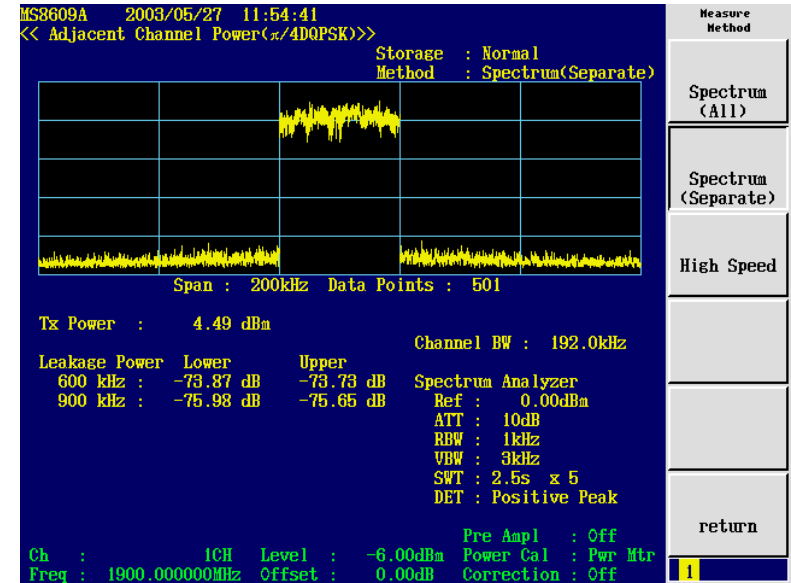
- » $\pi/4$ DQPSK modulation
 - Continuous modulation format



Contrast of typical ACLR

- **Burst (TCH) format**
 - » 600 kHz: +0.5 ~ +1 dB
 - » 900 kHz: +1 ~ +2 dB

- **Continuous modulation format**



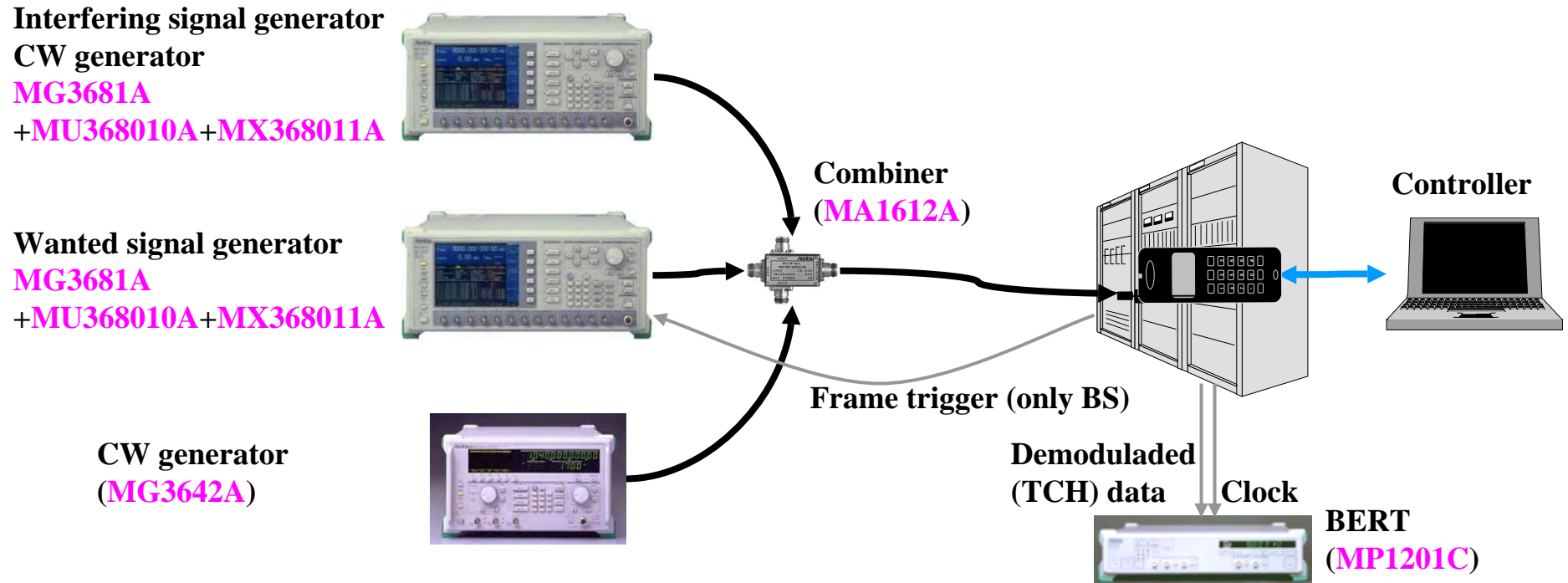
PDC RCR STD-27 BS/MS testing

RCR STD-27K

3.4.3 6.2 Receiver Test

Requirements	Meas Methods	Test	Wanted signal generator	Interfeing signal generator	CW generator	BERT	Others	
3.4.3.2	6.2.1	Sensitivity	MG3681A +MU368010A +MX368011A			MP1201C		
3.4.3.4	6.2.2	Adjacent channel selectivity		MG3681A +MU368010A +MX368011A				MA1612A 3GHz
3.4.3.5	6.2.3	Intermodulation characteristics		MG3681A	MG3642A			
3.4.3.6	6.2.4	Spurious response		MG3681A or 3GHz	MG3642A 2.08GHz			
3.4.3.8	6.2.6	Interference level (CIR)		MG3681A +MU368010A +MX368011A				
3.4.3.10	6.2.8	Reception level detection						
3.4.3.11	6.2.9	Network quality detection accuracy						MP1201C

Receiver test Connection example



- Frame trigger
 - Front panel [Burst Trig] Input
 - 20 ms clock (Full rate), 40 ms clock (Half rate)
- Controller
 - Launches TCH in the receivable state by FTM Factory Test Mode control.

- **Setting External Frame trigger**
 - » Captures/ Synchronizes the Trigger of 20 ms clock (Full rate)/ 40 ms clock (Half rate)
- **[10MHz/13MHz Ref] Input:**
Apply to cancel the jitter of within $\pm 1/16$ symbol of synchronous errors
 - MG3670 series is the jitter within $\pm 1/16$ symbol

Digital Mod

Freq. 800.000 000 00 MHz

Level 5.00 dBm Mem. ---

Normal

Baseband : [On] I/Q Mod.: [Int] Pulse Mod.: [Int]

System : [PDC]

Modulation : $\pi/4$ DQPSK Bit Rate : [42.0kbps]

Filter : [RNYQ] α =[0.50] Phase Encode : [Normal]

Slot Rate : [Fullrate]

Burst : [On]

Pattern : [UP TCH]

Trigger : [Ext]

Slot 0 Slot 1 Slot 2

UP TCH

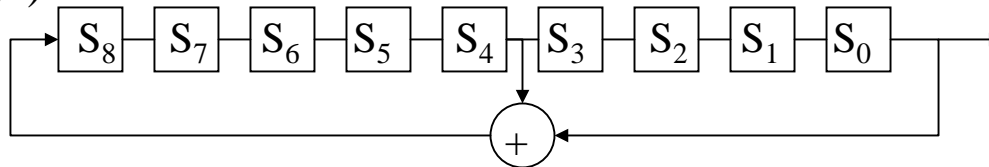
Δ Δ

Data Symbol Clock Burst Gate Burst Trig Data Clock I/Q Input

Scramble pattern sync. Setup example

- **Scramble pattern**

- » PN(9,5)



- » Register initial data($S_8 \sim S_0$) = CC

PatternEdit

Freq. 800.000 000 00 MHz

Level 5.00 dBm Mem. ---

System : PDC Pattern : UP TCH

Slot 0 Slot 1 Slot 2

UP TCH

[Slot 0] : [UP TCH]

R	P	TCH	SW	CC	SF	SACCH	TCH	G
4	2	112	20	8	1	15	112	6

Scramble : [0h](TCH,SF,SACCH) R : 0h
 Scramble Code : [000]h P : 2h
 TCH : [PN9] SF : 0h
 SW : [785B4]h G : 0h
 CC : [00]h
 SACCH : [0000]h

Data Symbol Clock Burst Gate Burst Trig Data Clock I/Q Input

PatternEdit

Freq. 800.000 000 00 MHz

Level 5.00 dBm Mem. ---

System : PDC Pattern : DN TCH ALL

Slot 0 Slot 1 Slot 2

DOWN TCH DOWN TCH DOWN TCH

[Slot 0] : [DOWN TCH]

R	P	TCH	SW	CC	SF	SACCH	TCH	G
4	2	112	20	8	1	21	112	

Scramble : [0h](TCH,SF,SACCH) R : 0h
 Scramble Code : [000]h P : 2h
 TCH : [PN9] SF : 0h
 SW : [87A4B]h
 CC : [00]h
 SACCH : [000000]h

Data Symbol Clock Burst Gate Burst Trig Data Clock I/Q Input

Wanted/Interfering signal generator Setup example

- **Wanted signal generator**

- » BS test
 - UP TCH
- » MS test
 - DN TCH ALL

Two screenshots of a signal generator interface for a 'Wanted signal generator'. The top screenshot shows the 'UP TCH' pattern in Slot 0. The bottom screenshot shows the 'UP TCH' pattern in Slot 0 and Slot 1. Both screenshots show a frequency of 800.000 000 00 MHz and a level of 5.00 dBm. The modulation is set to QPSK with a bit rate of 42.0kbps.

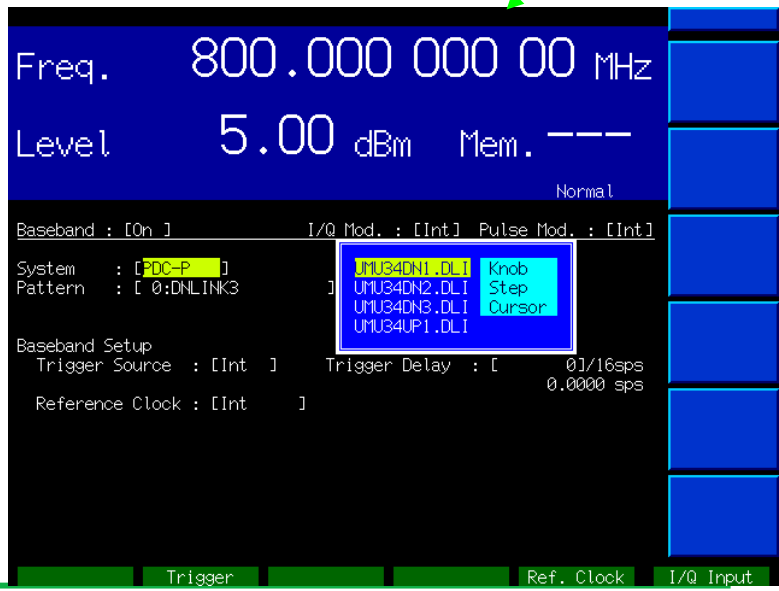
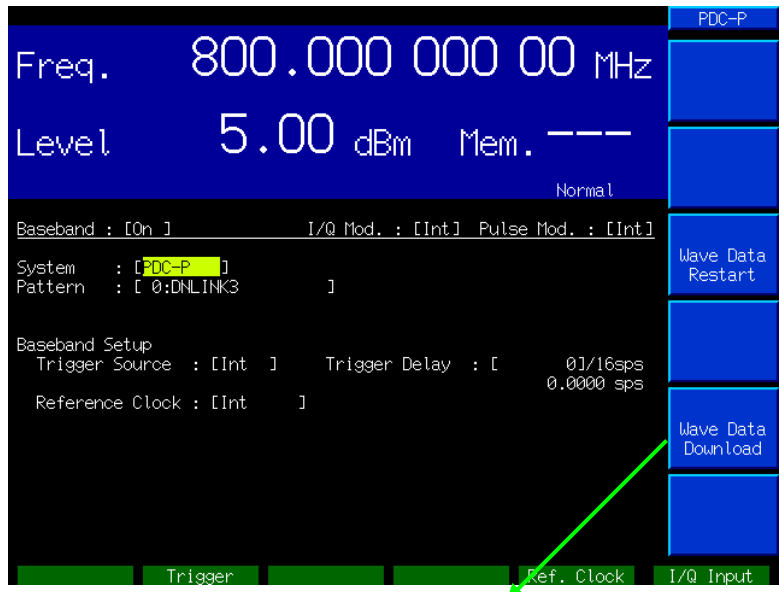
- **Interfering signal generator**

Screenshot of a signal generator interface for an 'Interfering signal generator'. The frequency is 800.000 000 00 MHz and the level is 5.00 dBm. The modulation is QPSK with a bit rate of 42.0kbps. The pattern is set to 'DN TCH ALL'.

Two screenshots of a signal generator interface for an 'Interfering signal generator'. The top screenshot shows the 'DN TCH ALL' pattern in Slot 0, Slot 1, and Slot 2. The bottom screenshot shows the 'DN TCH ALL' pattern in Slot 0, Slot 1, Slot 2, Slot 3, Slot 4, and Slot 5. Both screenshots show a frequency of 800.000 000 00 MHz and a level of 5.00 dBm. The modulation is QPSK with a bit rate of 42.0kbps.

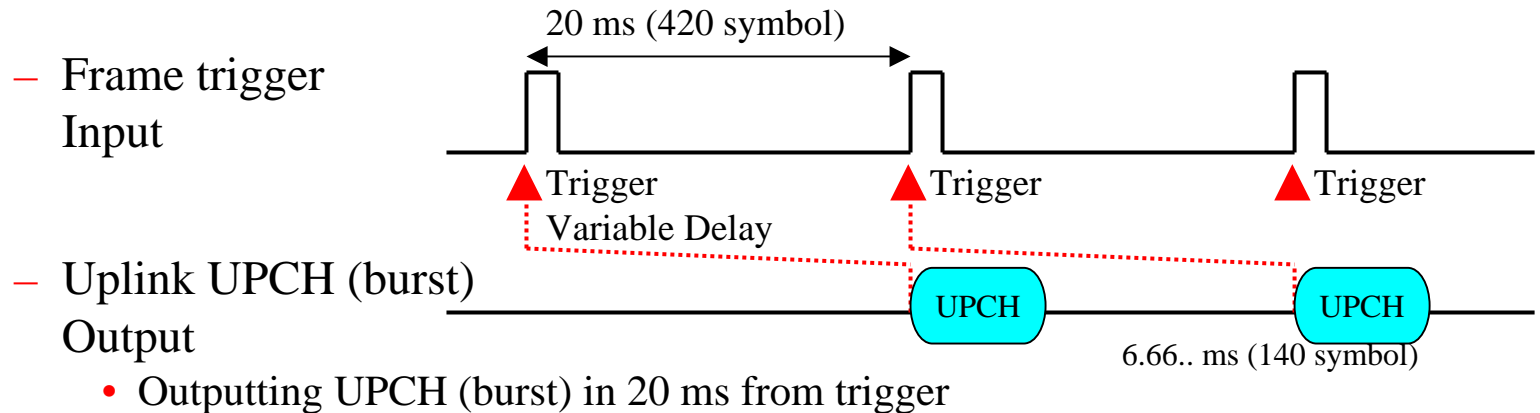
Packet communication Receiver test Setup example

- **Wanted signal generator**
MG3681A
+ MU368030A + MX368034A
 - » **BS test**
Uplink UPCH
 - UP1
 - » **MS test**
Downlink UPCH
 - DN1
 - DN2
 - DN3



- **Frame trigger delay**

- » Set the timing to which BS can receive Uplink UPCH

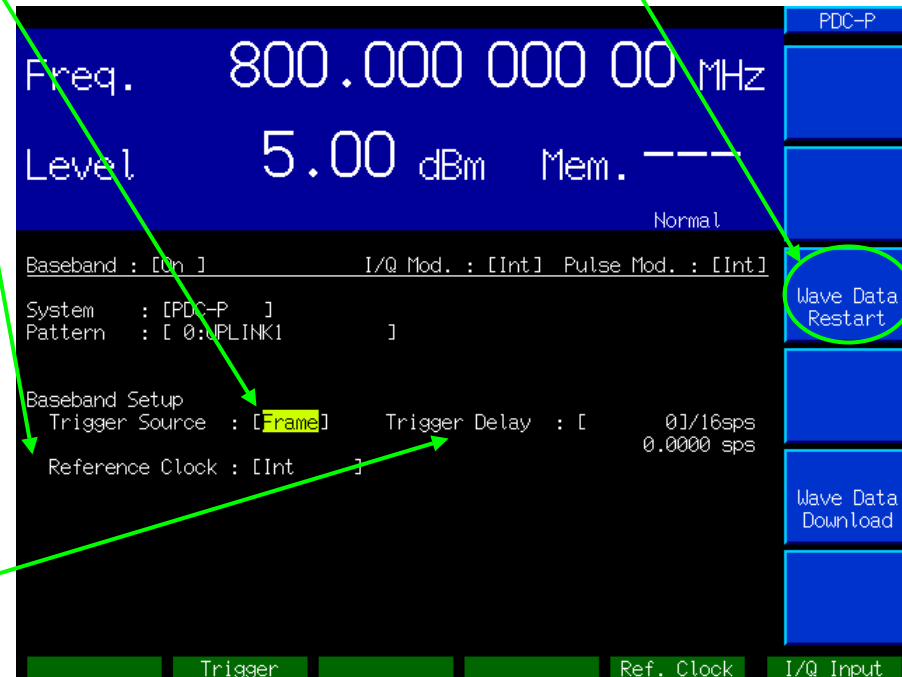


- **Setting External Frame trigger**
 - » Captures/ Synchronizes the Trigger of 20 ms clock
- **Reference clock:**

Apply to cancel the jitter of within $\pm 1/16$ symbol of synchronous errors

 - » [Ref. Clock] Input applicable case
 - Reference Clock : [Ext(TTL)]
 - 16x 21 kHz (336 kHz)
 - » [10MHz/13MHz Ref] Input applicable case
 - Reference Clock : [Int]
- **Frame trigger delay**
 - » 0 ~ +16,777,215 /16 symbol
1/16 symbol resolution
 - » Delay from trigger
+ 3.7 symbol
 - 3.7 ~ 1,048,579.6 symbol

- **Trigger recapture/ synchronization**



e.g.

- » In case of outputting UPCH (burst) in 20 ms from trigger
 - 6,661 /16 symbol

RF/IF components test

Connection example

Signal source

MG3681A

+MU368010A+MX368011A

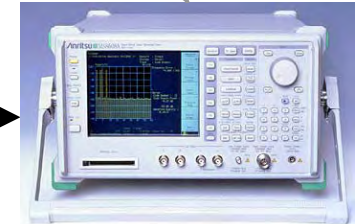
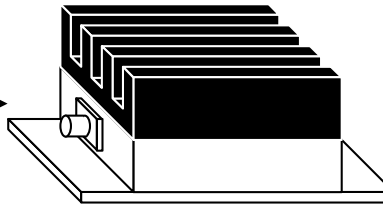
or

+MU368030A+MX368031A

Signal analyzer

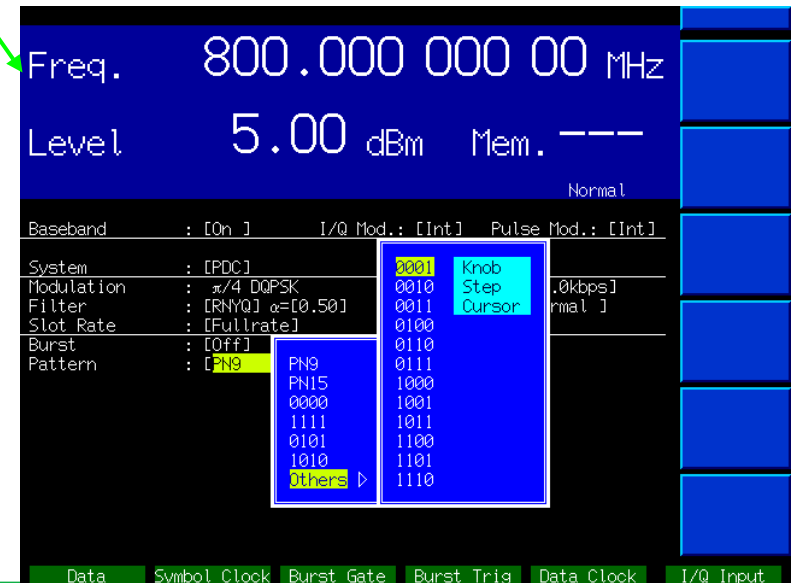
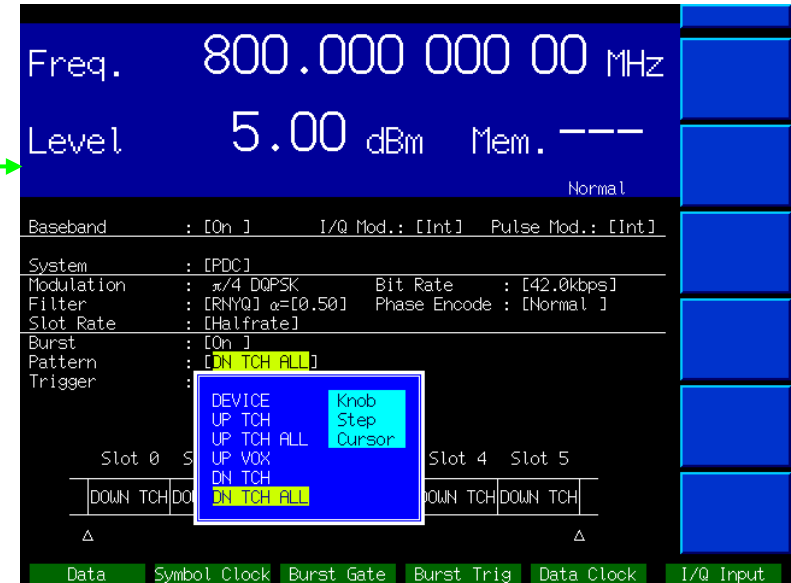
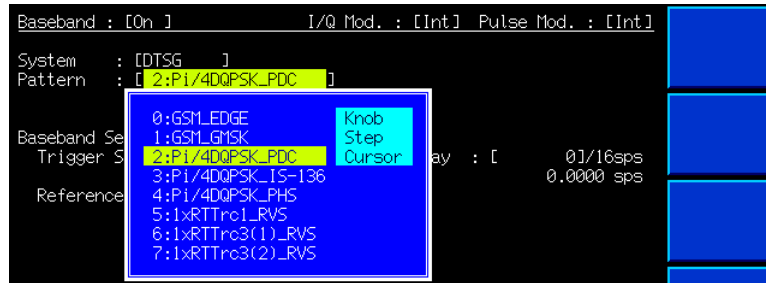
(MS8600/MS2680)

Reference clock



Signal Setup example

- **MX368011A**
 - » Burst format
 - » Continuous modulation format
- **MX368031A**
 - » Continuous modulation format

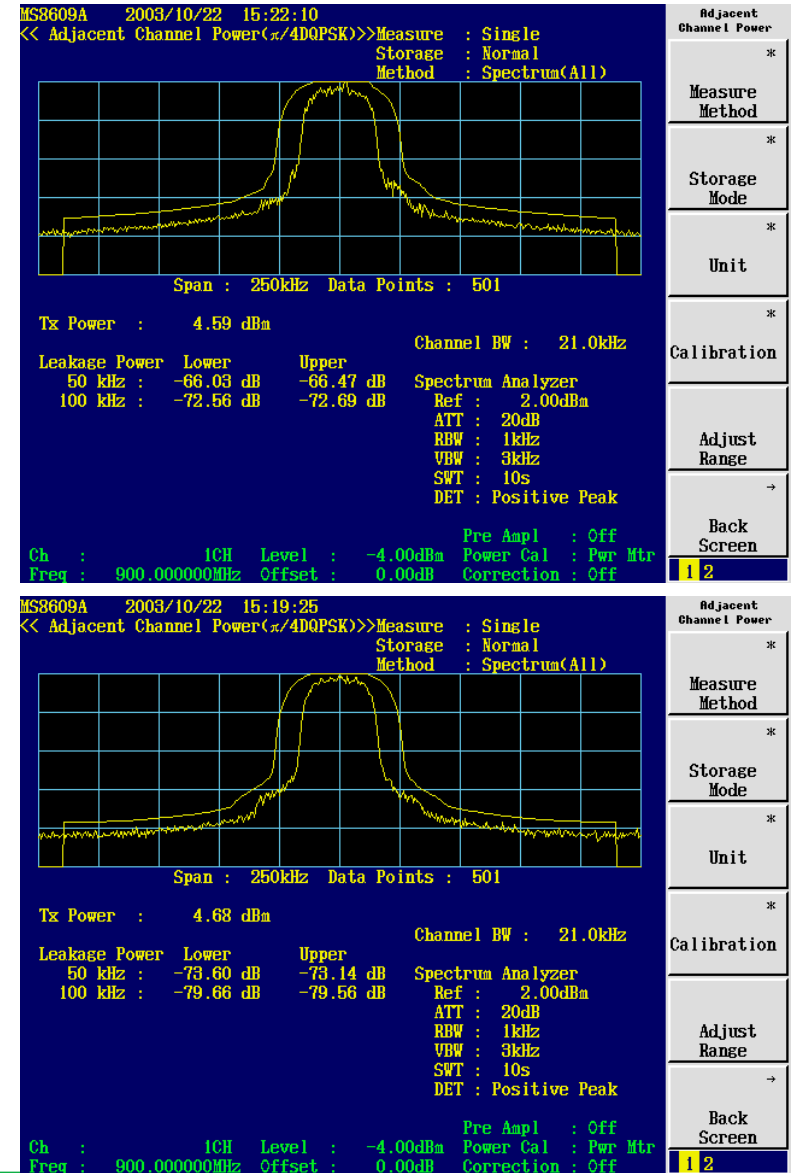


Contrast of typical ACLR

- **Burst (TCH) format**

- » 50 kHz: +7 dB
- » 100 kHz: +7 dB

- **Continuous modulation format**



RF/IF components test Connection example

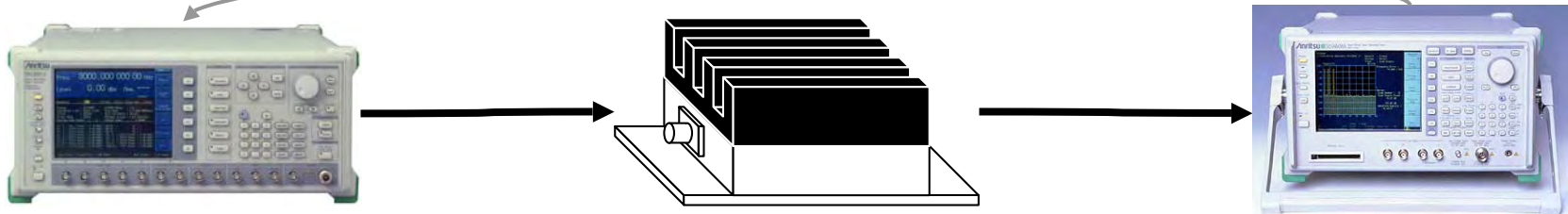
Signal source

MG3681A
+MU368030A+MX368031A

Signal analyzer

(MS8600/MS2680)

Reference clock



Signal Setup example

- **Continuous modulation format**

The screenshot displays the signal generator's configuration menu. The top section shows the frequency set to 900.000 000 00 MHz and the power level to 5.00 dBm. The modulation format is set to 3:PI/4DQPSK-IS-136. The baseband setup includes a trigger source and a reference clock. The right side of the screen features a vertical menu with options like 'DTSG' and 'Wave Data Update'.

DTSG

Freq. 900.000 000 00 MHz

Level 5.00 dBm Mem. ---

Normal

Baseband : [0n] I/Q Mod. : [Int] Pulse Mod. : [Int]

System : [DTSG]

Pattern : [3:PI/4DQPSK-IS-136]

Baseband Setup

Trigger Source : [Int] Trigger Delay : [0]/16sps
0.0000 sps

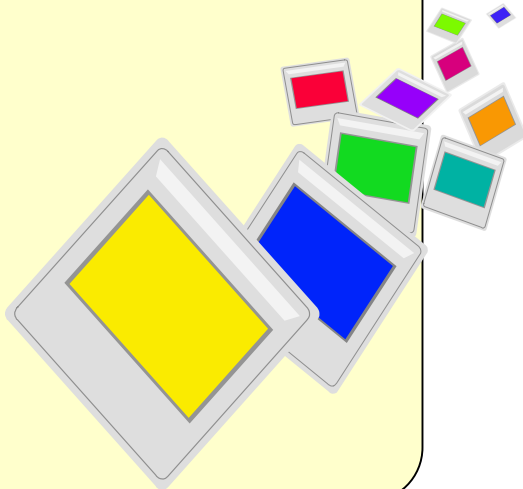
Reference Clock : [Int]

Wave Data Update

Trigger Ref. Clock I/Q Input

Option

- Product outline
- Feature
- Application
- **Option**



- **MG3681A-01, 02** 249▶
 - » Reference oscillator
- **MG3681A-11** 252▶
 - » Additional function of I/Q output
- **MG3681A-21** 256▶
 - » AF synthesizer
- **MG3681A-42** 259▶
 - » RF high level output

- **MA2512A** 264▶
 - » Band Pass Filter

- Exchangeable to long-term stable internal reference oscillator**

	Standard	MG3681A-01	MG3681A-02
Aging rate	$\pm 1 \times 10^{-6}$ /year	$\pm 5 \times 10^{-9}$ /day ($\pm 5 \times 10^{-8}$ /year)	$\pm 5 \times 10^{-10}$ /day ($\pm 2 \times 10^{-8}$ /year)
Warm-up stability		$\pm 1 \times 10^{-7}$	$\pm 1 \times 10^{-7}$
Temperature stability (0 ~ 50 °C)	$\pm 1 \times 10^{-6}$	$\pm 3 \times 10^{-8}$	$\pm 5 \times 10^{-9}$

* Warm-up stability: After 10 minute (compared to frequency after 24 hours)

- Frequency accuracy is specified by the aging rate of reference oscillator.**

» Frequency accuracy

= \pm Output frequency \times Aging rate \times Time since last calibrated

e.g. 2 GHz 1 year

= ± 2 kHz

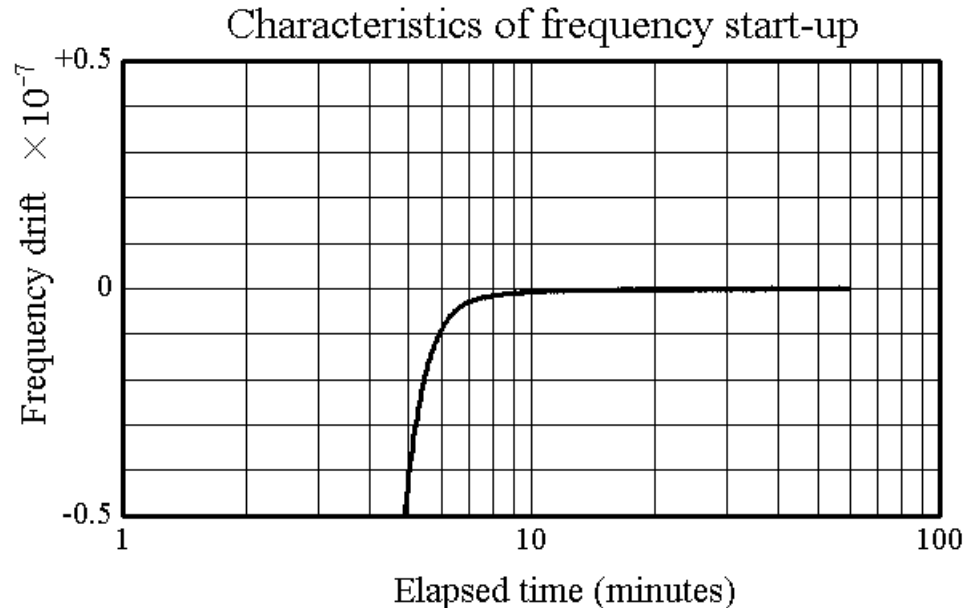
* Standard

= ± 40 Hz

* MG3681A-02

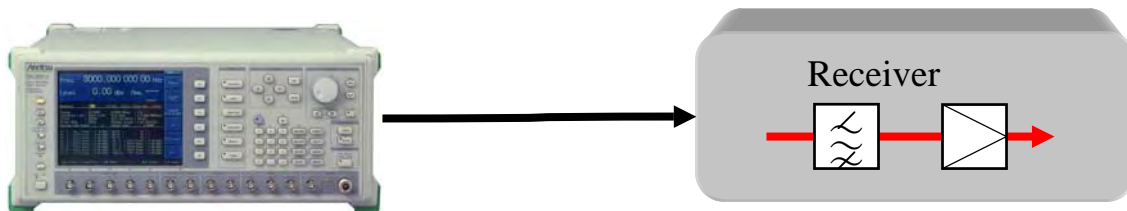
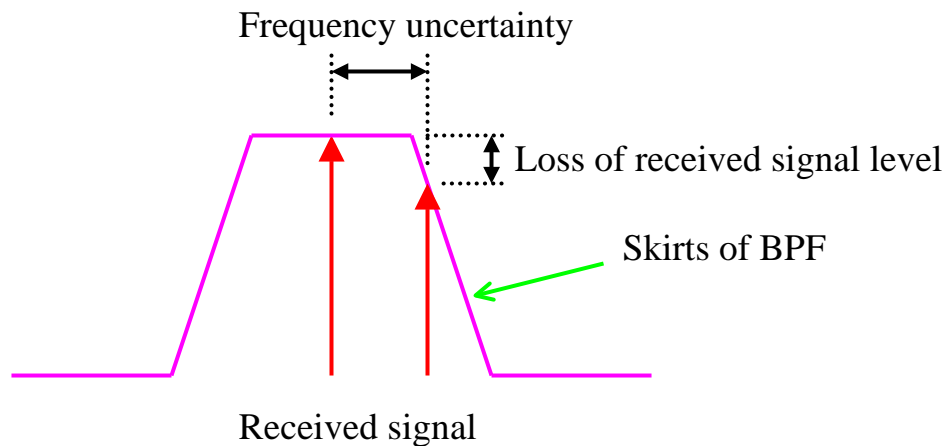
Warm-up stability

- The long-term stable internal reference oscillator of MG3681A-01 and 02 uses OCXO of the oven system which stabilizes frequency only **10 minutes** after the main power ON.
 - » Since oven is preheated in power standby state, frequency is stabilized immediately after power ON from only 10 minutes standby state.
- Standard internal reference oscillator uses TCXO with unnecessary preheating.



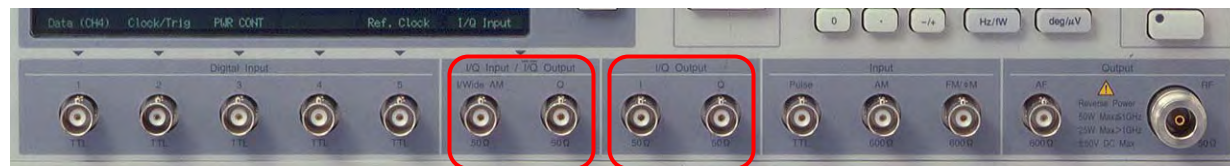
Effect of frequency accuracy on receiver sensitivity test

- **In case of more frequency uncertainty (poor frequency accuracy), receiver is tested as deteriorated sensitivity than true value.**
 - » The level of the signal is lost when the received signal is located in the skirt of BPF in a receiver by frequency uncertainty.



MG3681A-11 Additional function of I/Q output

- **Variable of voltage level of I/Q signals output, DC offset and quadrature degree**
 - » Voltage level: $\frac{80}{120} \sim 120$ % resolution 0.1 %
 - RMS level ($\sqrt{I^2+Q^2}$) is specified in each system software.
 - » DC offset: $-0.5 \sim +1.5$ V resolution 0.5 mV
 - » Quadrature degree: $-5 \sim +5$ ° resolution 0.5 °
- **Differential I/Q signals can be outputted.**
 - » \bar{I}/\bar{Q} signals which are reversal signals (amplitude is equal and polarity is reverse) of I/Q signals are outputted.



\bar{I}/\bar{Q} signals output

I/Q signals output

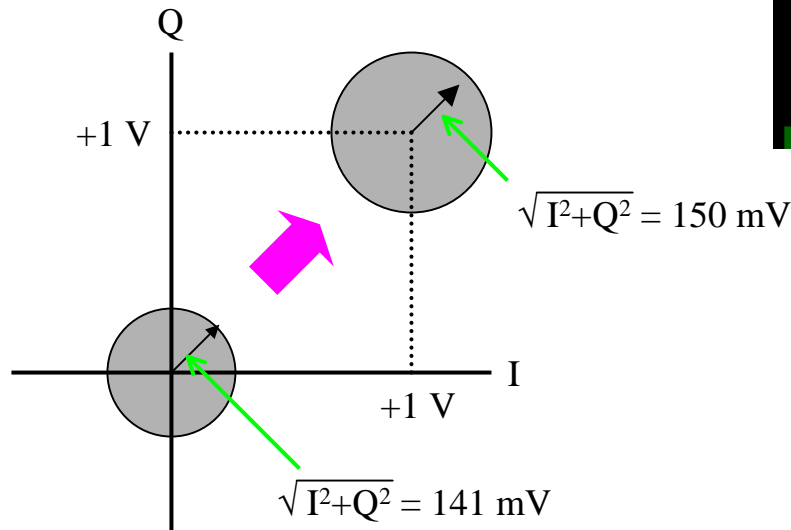
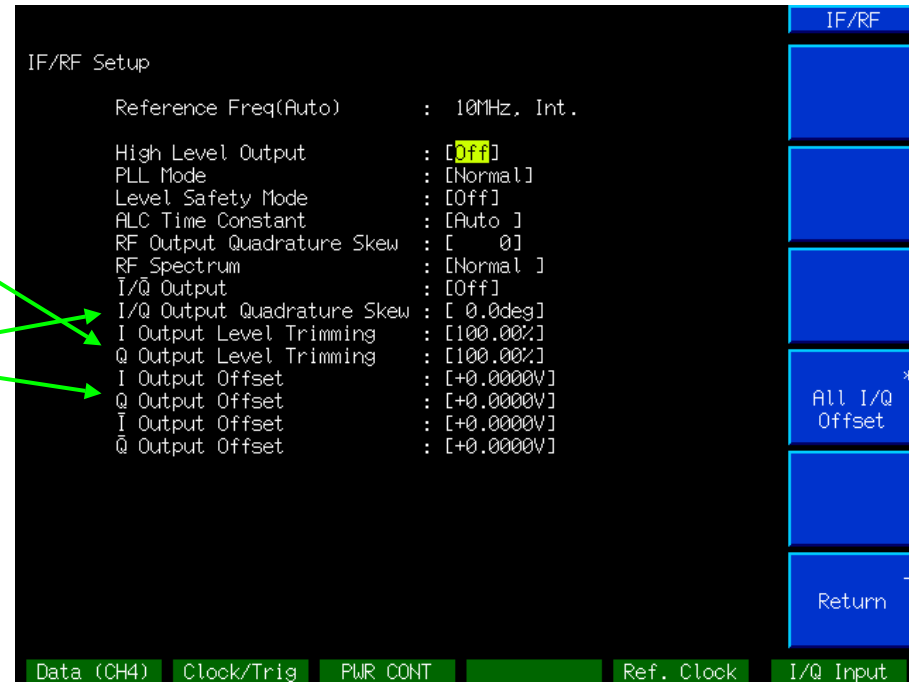
Variable application of voltage level of I/Q signals output, DC offset and quadrature degree

- **In order to test the vector modulator, the setup of vector magnitude, drive DC voltage and I/Q quadrature degree is required for the signal source.**
 - » **Vector Magnitude**
 - Voltage level is set as RMS level of the vector modulator.
 - » **Drive DC voltage**
 - In order to drive the vector modulator of the single power supply system, DC offset is set as drive voltage.
 - » **Quadrature degree**
 - In order to cancel the error of I/Q quadrature degree (90°) of the vector modulator, quadrature degree is set.

Variable of voltage level of I/Q signals output, DC offset and quadrature degree

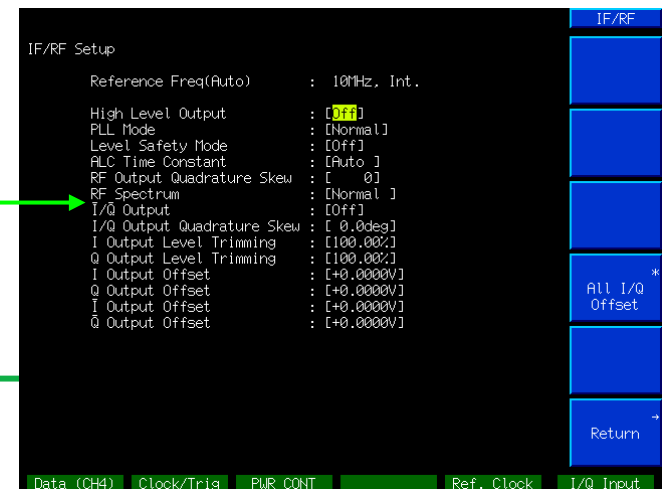
- **Setup example**

- » Voltage level
 - Specified 141 mV(rms)
→ 150 mV(rms) \approx 106 %
- » DC offset
 - +1 V
- » Quadrature degree
 - Fine tuning



Application of differential I/Q signals

- In order to test the vector modulator and baseband LSI for balanced device, the output of I, I, Q and Q balance is required for the signal source.
- In I/Q input device, the balanced input has the advantage which can reduce the amplitude error and the noise compared with I and Q unbalanced input (single end).
 - » Reduction of the amplitude error by the grand loop
 - The cause is that the ground of the signal source and the ground of the input device are not equivalent potential.
 - » Reduction of a signal line noise
 - The cause is that the environmental noise is picked up on the signal line.
- For outputting differential I/Q signals
 - » I/Q Output: [On]



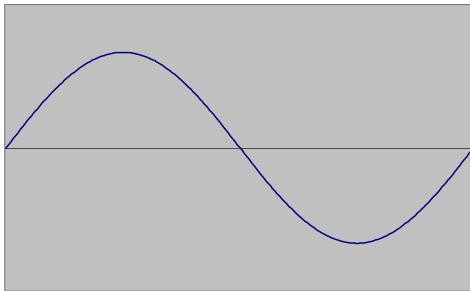
MG3681A-21 AF synthesizer

- **AF can be outputted.**



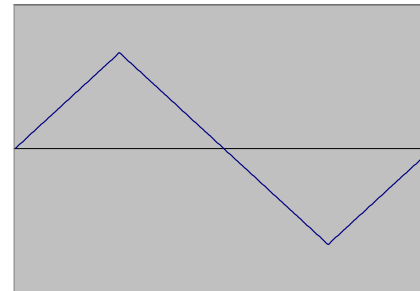
» 0.01 Hz ~ 400 kHz

Sine wave

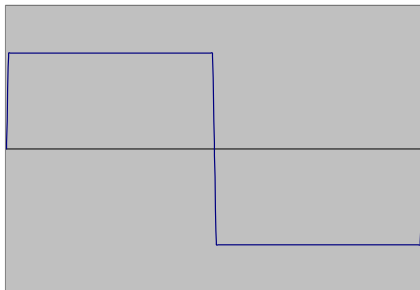


resolution 0.01 Hz

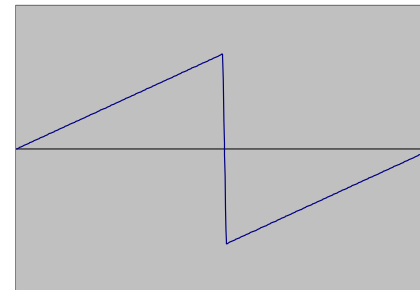
Triangle wave



Square wave



Sawtooth wave



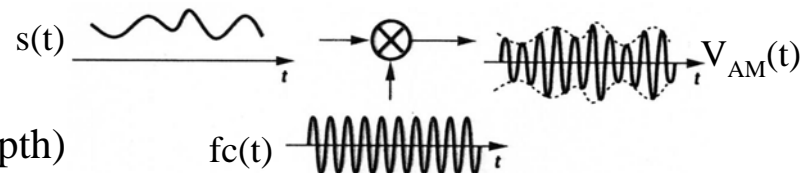
MG3681A-21 AF synthesizer

- **Internal analog modulation signal can be outputted.**

- » AM

- $V_{AM}(t) = A_c [1 + m s(t)] \cos(2\pi f_c t)$

- m: Modulation index (Modulation depth)



- » FM

- $V_{FM}(t) = A_c \cos[2\pi f_c t + m \int s(t) dt]$

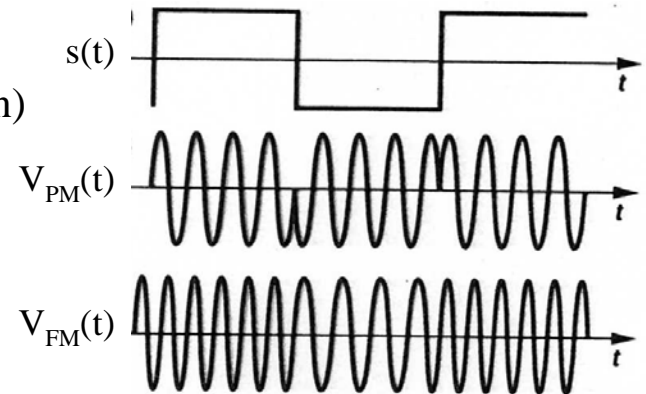
- m: Frequency modulation index (Frequency deviation)

- » ϕ M (PM)

- $V_{PM}(t) = A_c \cos[2\pi f_c t + m s(t)]$

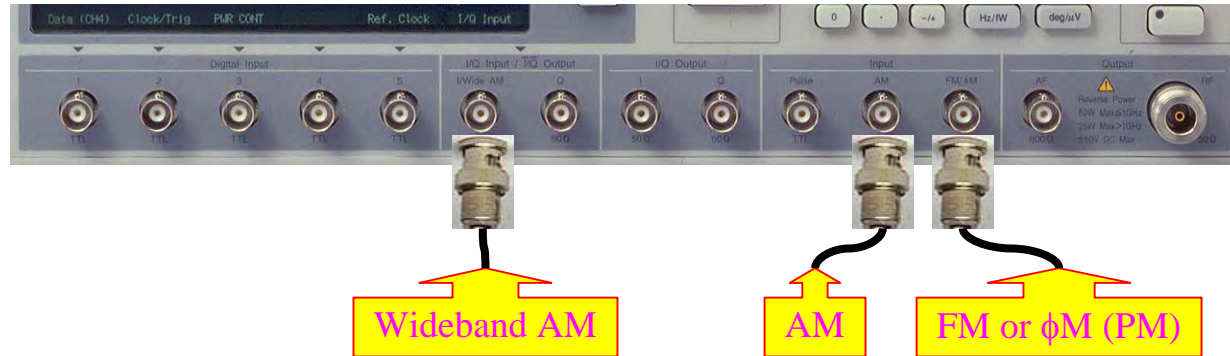
- m: Phase modulation index (Phase deviation)

- A_c : Carrier amplitude
 - $s(t)$: Modulation signal (AF)
 - f_c : Carrier frequency (RF)



External analog modulation

- **Input Modulation signal (AF).**

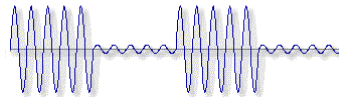


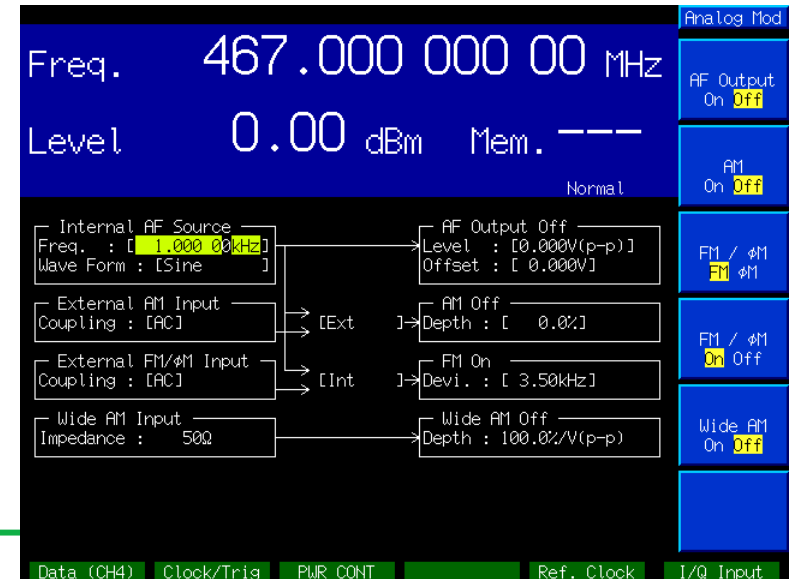
- **Wideband AM**

- » Applicable to wideband (high-speed) video modulation

- » ASK modulation is achieved by AM.

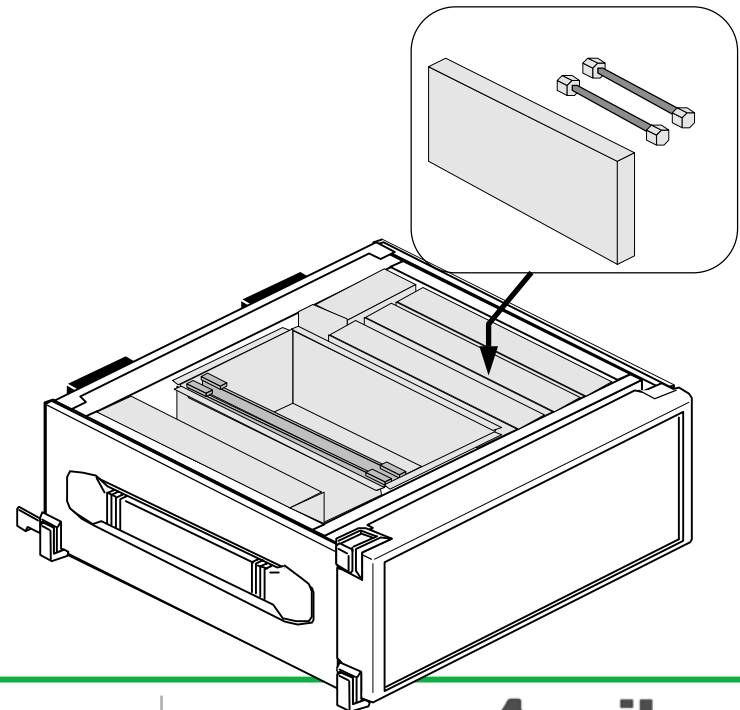
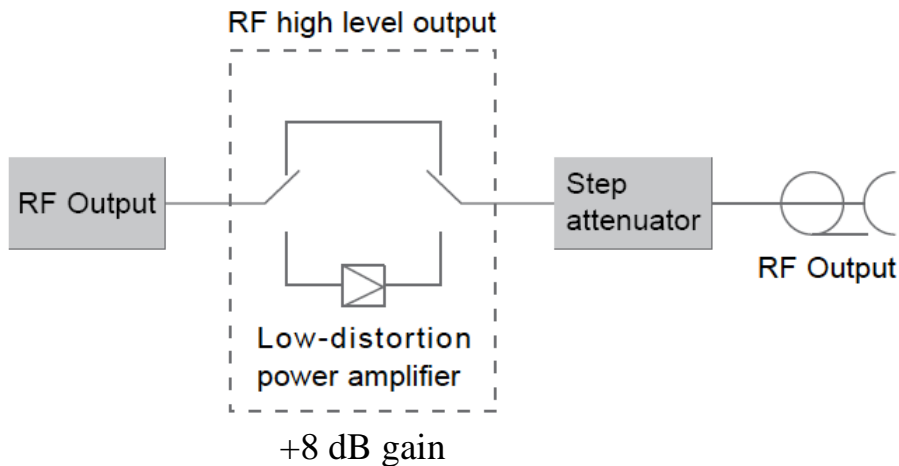
- Modulation signal 

- ASK 



MG3681A-42 RF high level output

- **RF output level range in CDMA modulation signals can be gained 8 dB without degrading the adjacent channel leakage power ratio.**
 - » at outputting 1.9 to 2.3 GHz used as the frequency band for IMT-2000 systems
 - » ACLR does not degrade up to +5 dBm in W-CDMA/CDMA2000 modulation.



Application

- Useful for signal source of power amplifier requiring a high input level

The image shows a signal generator interface. The main display shows the following settings:

- Freq. 2170.000 000 00 MHz (with a red dashed circle around the frequency value and the text "Hi-Lvl. Mode (1900-2300M)" below it)
- Level 5.00 dBm
- Mem. ---
- Normal

The bottom left of the main display shows channel status for 12 channels:

Ch. 1	: [On]	Power	: [- 0.0dB]	SCH Pr	: -	Sc	: -
Ch. 2	: [Off]	Power	: [-40.0dB]	SCH Pr	: -	Sc	: -
Ch. 3	: [Off]	Power	: [-40.0dB]	SCH Pr	: -	Sc	: -
Ch. 4	: [Off]	Power	: [-40.0dB]	Ch. 5	: [Off]	Power	: [-40.0dB]
Ch. 6	: [Off]	Power	: [-40.0dB]	Ch. 7	: [Off]	Power	: [-40.0dB]
Ch. 8	: [Off]	Power	: [-40.0dB]	Ch. 9	: [Off]	Power	: [-40.0dB]
Ch. 10	: [Off]	Power	: [-40.0dB]	Ch. 11	: [Off]	Power	: [-40.0dB]
Ch. 12	: [Off]	Power	: [-40.0dB]	Add Ch	: Off	Power	: [-40.0dB]

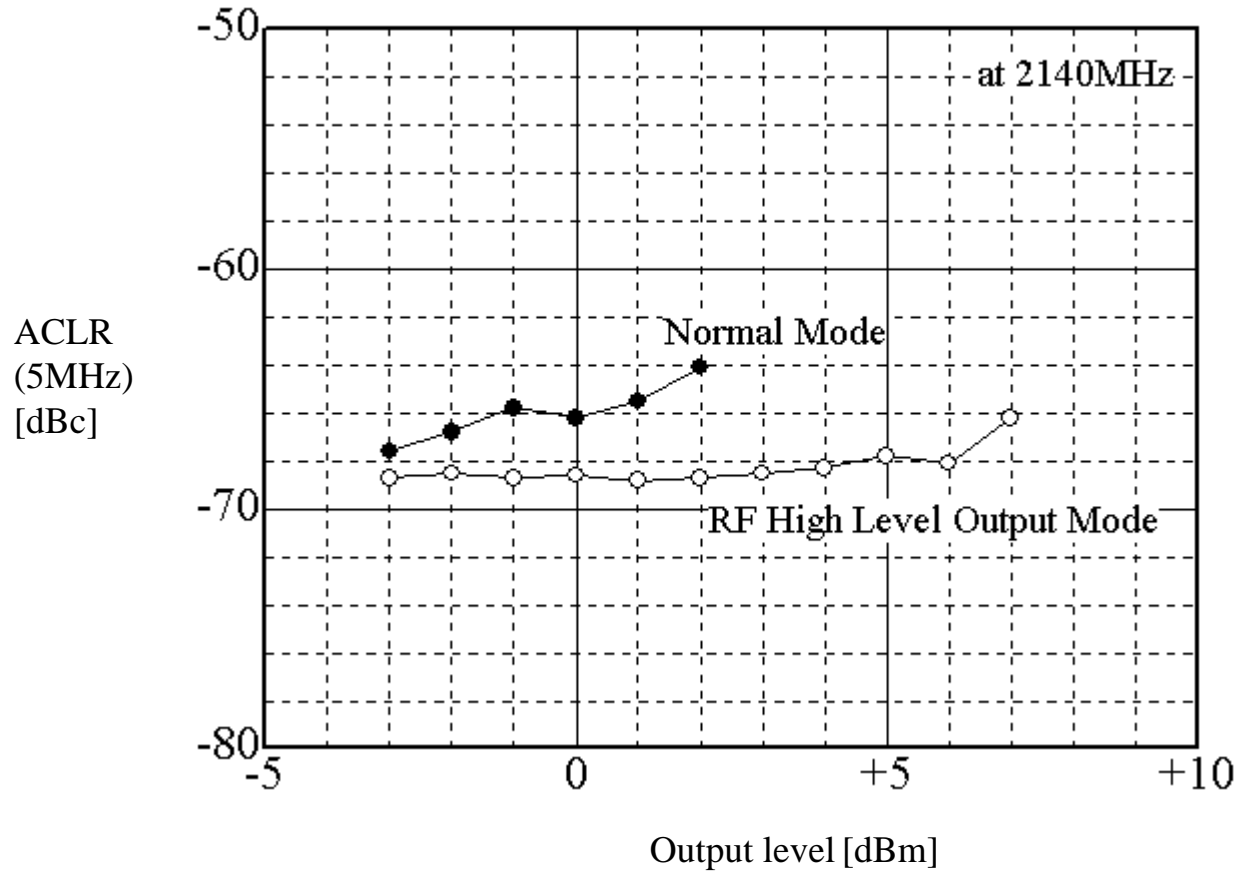
The right side of the image shows a detailed "RF/RF Setup" menu:

- Reference Freq(Auto) : 10MHz, Int.
- High Level Output : [Off]
- PLL Mode : [On] Knob
- Level Safety Mode : [Off] Step
- ALC Time Constant
- RF Output Quadrature Skew
- RF Spectrum : [Normal]
- I/Q Output : [Off]
- I/Q Output Quadrature Skew : [0.0deg]
- I Output Level Trimming : [100.00%]
- Q Output Level Trimming : [100.00%]
- I Output Offset : [+0.0000V]
- Q Output Offset : [+0.0000V]
- I Output Offset : [+0.0000V]
- Q Output Offset : [+0.0000V]

Typ. ACLR

- **W-CDMA**

- » Test Model 1: 16 DPCH



Maximum output level (1.9~2.3 GHz)

Standard

MG3681A-42

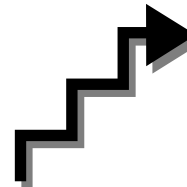
- **W-CDMA modulation**

+8 dB gain

Number of multiplex channel: dBm

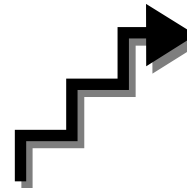
dBm

» 1~7	:	+5		+13
» 8~12	:	+4		+12
» 13~15	:	+3		+11
» 16~19	:	+2.14		+10.14
» 20~31	:	+2		+10
» 32~50	:	+1		+9
» 51~	:	0		+8



- **CDMA2000 modulation**

»		+5		+13
---	--	----	--	-----



- **CW**

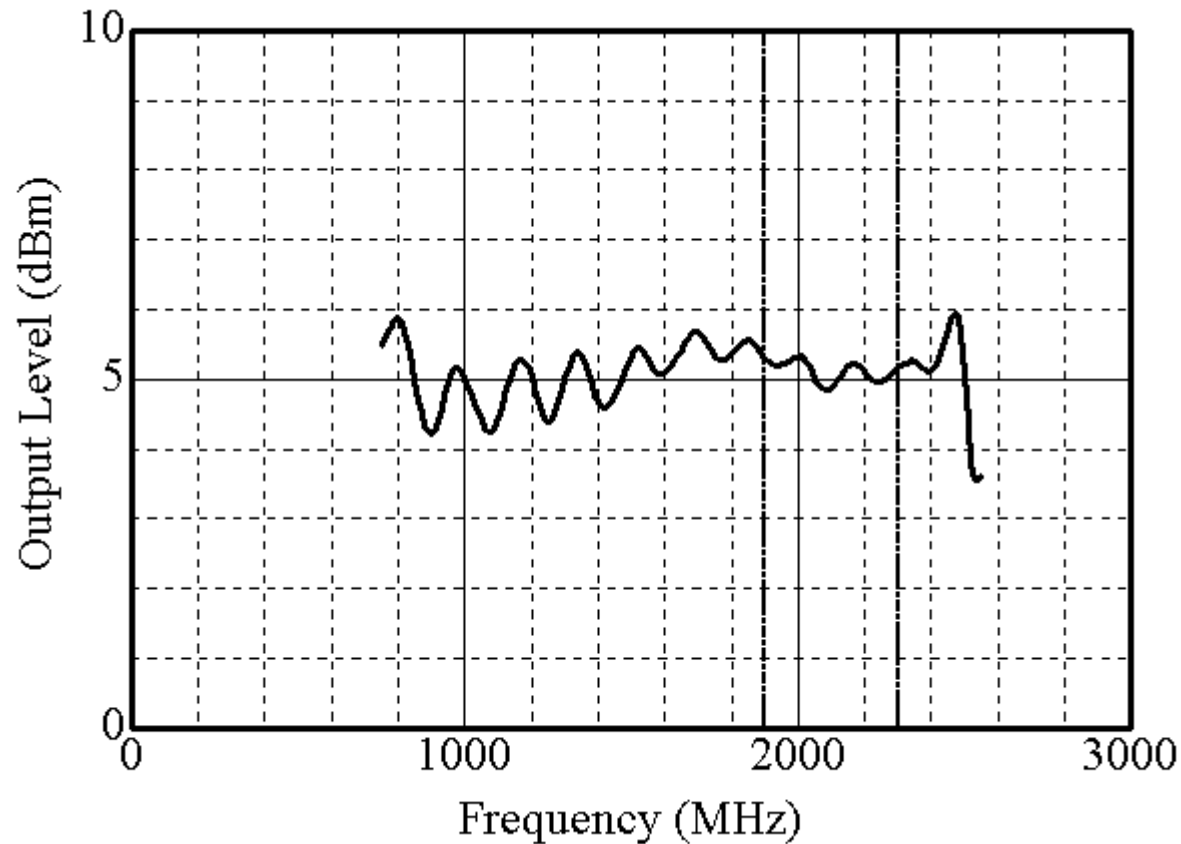
»		+17		Typ. +19 (Setting: +25)
---	--	-----	--	-------------------------

without gain



Typ. output level frequency response

- Level +5 dBm setting (CW)



MA2512A Band Pass Filter

- **The unnecessary spurious signal of a signal generator can be attenuated.**
 - » at outputting 1.92 to 2.17 GHz used as the frequency band for IMT-2000 systems
 - » Excellent amplitude ripple and group delay characteristics don't degrade modulation accuracy of the signal.



Application

- **When spurious signals hinder components evaluation**
 - » Spurious signals of MG3681A
 - 660 MHz (IF leakage)
 - +660 MHz offset (Local leakage)
 - $2 \times \text{frequency} / 3 \times \text{frequency}$ (2nd/3rd harmonics)

Signal source

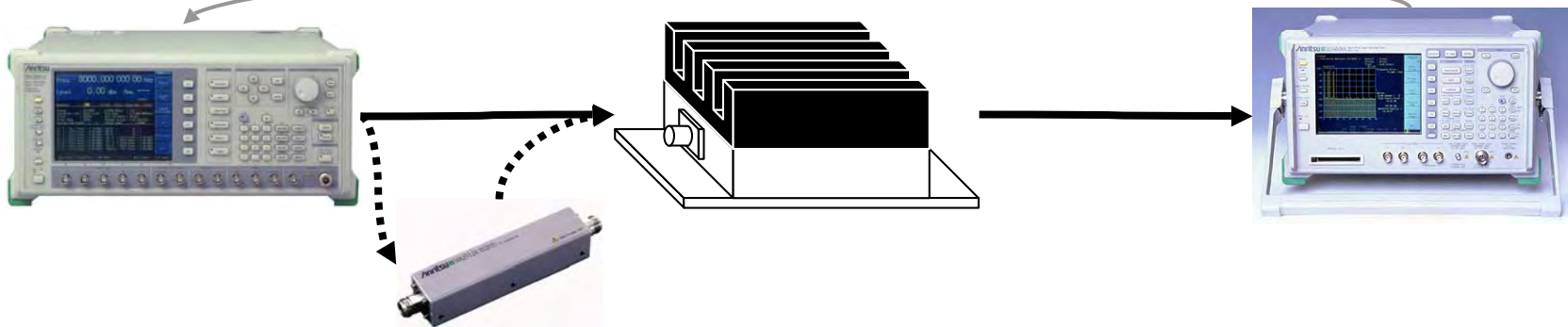
MG3681A

+MU368040A+MX368041B

Signal analyzer

(MS8600/MS2680)

Reference clock

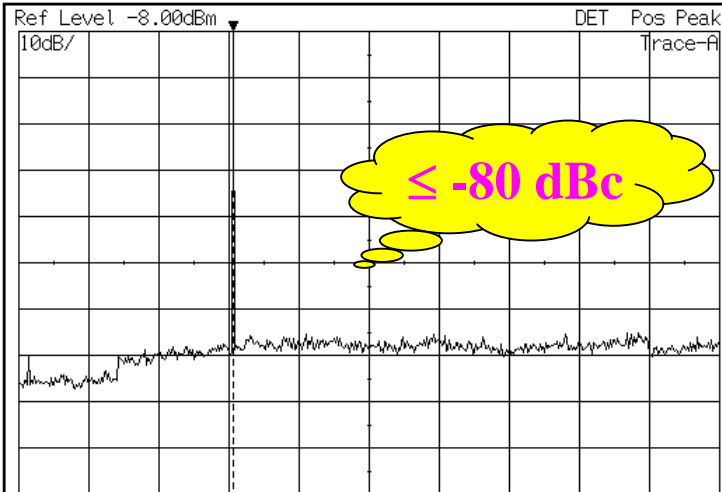


Improvement of spurious



MS8609A 2001/10/24 15:44:05

MKR 2.163GHz -7.91dBm RBW 1MHz# ATT 2dB#
VBW 1MHz SWT 90.0ms*



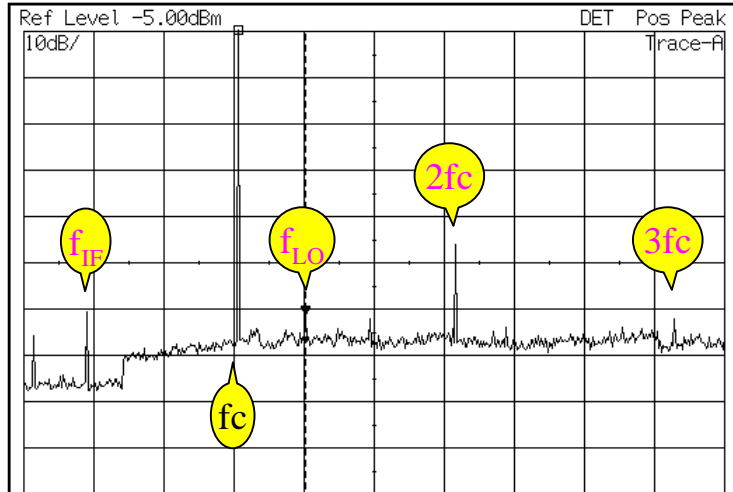
Zone Center = 2.162 820 000GHz Band 0

PeakSearch

- Peak Search
- Next Peak
- Dip Search
- Next Dip
- Resolution 5.00dB
- * Threshold

MS8609A 2001/10/24 15:37:37

Delt 669MHz -63.01dB RBW 1MHz# ATT 6dB#
VBW 1MHz SWT 90.0ms*



Zone Center = 669.120 000MHz Band 0

PeakSearch

- Peak Search
- Next Peak
- Dip Search
- Next Dip
- Resolution 5.00dB
- * Threshold

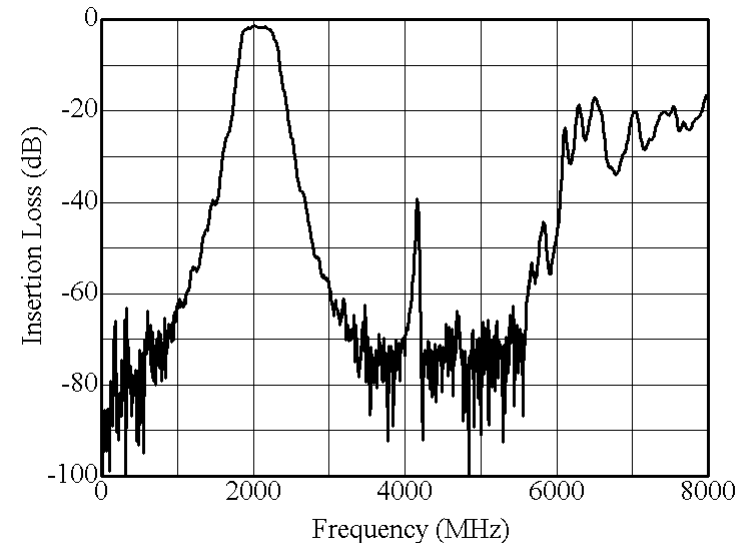
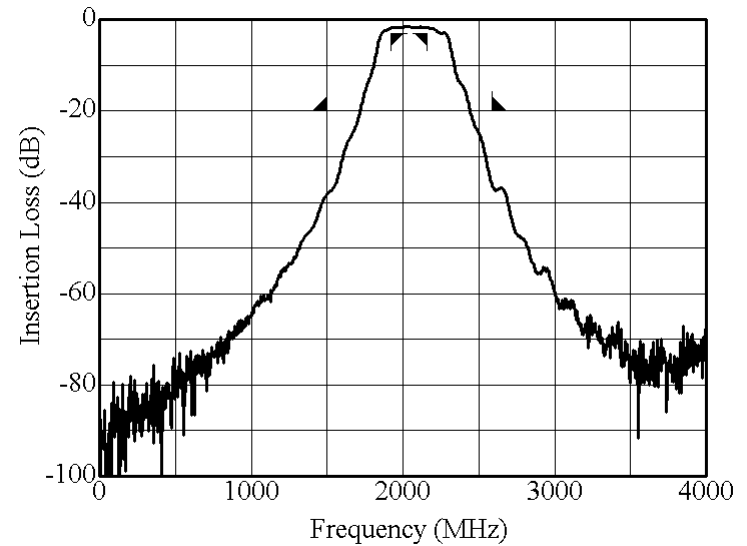
Loss frequency response

Pass band

- **1.92~2.17 GHz**
(IMT-2000 system band)
- **Insertion loss ≤ 3.5 dB**
- **Return loss ≥ 15 dB**

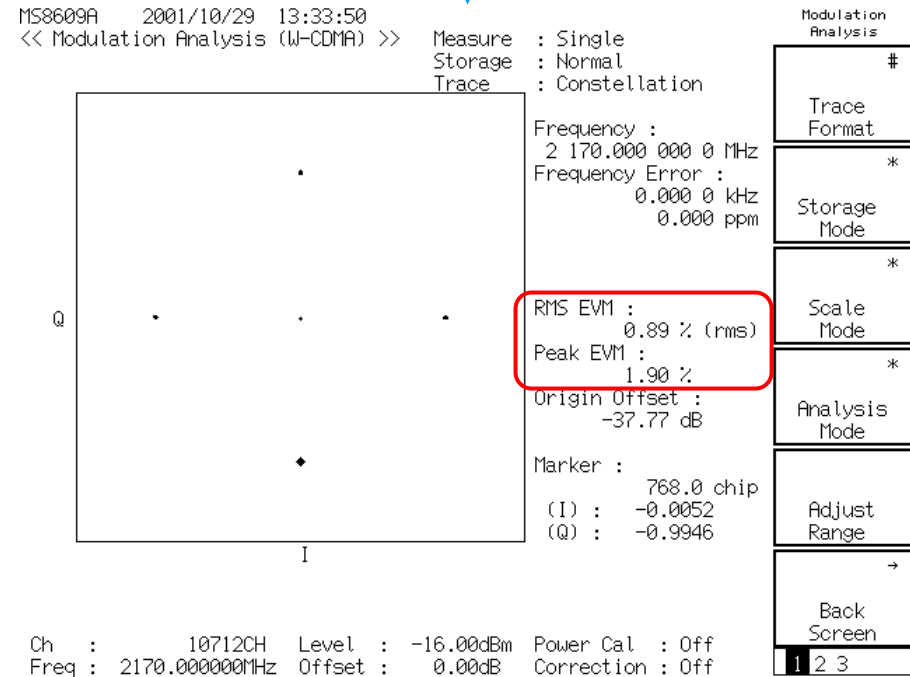
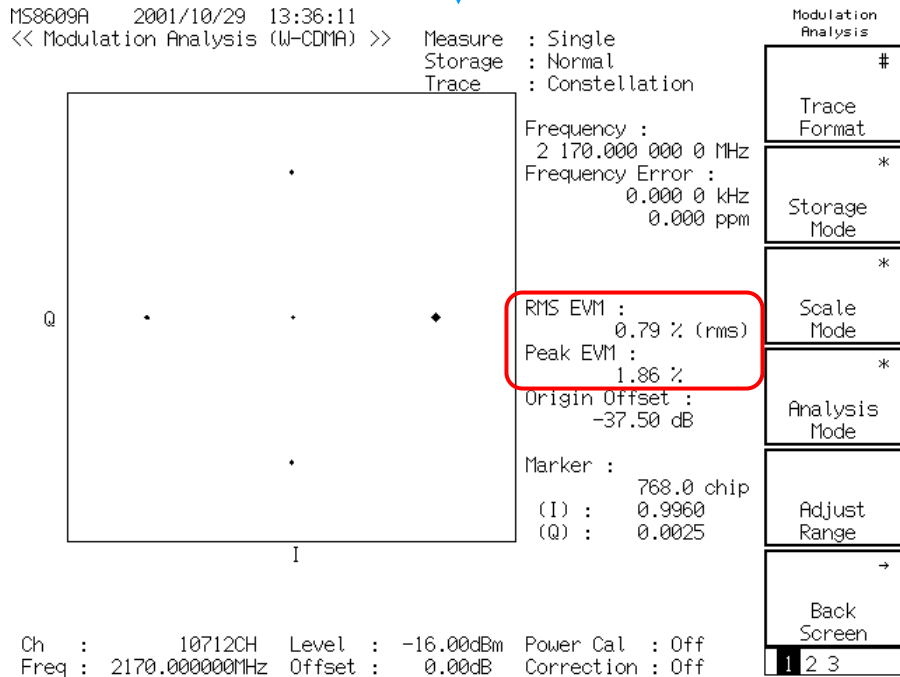
Filter band

- **DC ~ 1.5 G, 2.58 ~ 7 GHz**
- **Attenuation ≥ 20 dB (< 5 GHz)**
 ≥ 10 dB (≥ 5 GHz)



Modulation accuracy not degrading

- **Amplitude ripple**
 - » ≤ 0.2 dB
(5 MHzBW)
- **Group delay**
 - » ≤ 1 ns
(5 MHzBW)



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