PRODUCT INTRODUCTION

MX882001A

GSM Measurement Software

ANRITSU CORPORATION

MX882001A
GSM Measurement Software
(with MT8820A, MT8820A-02, MX882001A-01/-02/-11)
Product Introduction

Ver. 4.00
Sep.2003
Wireless Measurement Div.
Measurement Business Center
Anritsu Corporation

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1.   Outline of MX882001A GSM Measurement Software

MT8820AwithMX882001A is..

the standalone measuring instrument to evaluate the main transmitter/receiver characteristics measurement of mobile phones conforming to GSM, which is most widely spread in the world.

The MT8820A hardware platform covers a frequency range of 30 MHz to 2.7 GHz.
When MX882001A GSM Measurement Software is installed, this single platform supports evaluation of all the main transmitter/receiver characteristics for GSM/GPRS terminals.
The built-in GPIB interface enables MT8820A to be integrated into automated production lines as well as to configure an automated test system for after-sales maintenance.
- **MX882001A-01 GSM Voice Codec** carry out real-time voice encoding/decoding function.
- **MX882001A-02 GSM External Packet Data** can transfer the packet data between Server PC and Client PC with GPRS UE.
- **MX882001A-11 EGPRS Measurement Software** can measure EGPRS UE of main transmitter/receiver.

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1.1 Main Specifications (MT8820A-02 with MX882001A)

Frequency/Modulation measurement	Frequency: 300 to 2200 MHz Input level: –30 to +40 dBm (average power of burst signal, MAIN connector) Measurement items: Normal burst, RACH Carrier frequency accuracy: reference oscillator accuracy + 10 Hz (at normal burst measurement) reference oscillator accuracy + 20 Hz (at RACH measurement) Residual phase error: ≤0.5°(rms), 2°(peak)
Amplitude measurement	Frequency: 300 to 2200 MHz Input level: –30 to +40 dBm (average power of burst signal, MAIN connector) Measurement items: Normal burst, RACH Measurement accuracy: ±0.5 dB (–20 to +40 dBm), ±0.7 dB (–30 to –20 dBm) *After calibration Linearity: ±0.2 dB (0 to –40 dB, ≥–30 dBm) Power measurement range at carrier off: ≥65 dB (input level: ≥–10 dBm), ≥45 dB (input level: ≥ –30 dBm)
Output RF spectrum measurement	Frequency: 300 to 2200 MHz Input level: –10 to +40 dBm (average power of burst signal, MAIN connector) Measurement item: Normal burst Measurement points: ±100 kHz, ±200 kHz, ±250 kHz, ±400 kHz, ±600 kHz, ±800 kHz, ±1000 kHz, ±1200 kHz, ±1400 kHz, ±1600 kHz, ±1800 kHz, ±2000 kHz Measurement range of modulator: ≤–55 dB (≤250 kHz offset), ≤–66 dB (≥400 kHz offset) *Average of 10-time measurement Measurement range of transient section: ≤–57 dB (≥400 kHz offset)
RF signal generator	Output frequency: 300 to 2200 MHz, in increments of 1 Hz Phase error: ≤1°(rms), 4°(peak) TCH data: PN9, PN15, ALL 0, ALL 1
Error rate measurement	Function: Error rate measurement of frame, bit and CRC Measurement items: -Loop-back data imposed on up-link TCH -Serial data inputted via Call Proc. I/O port on the rear panel -The number of blocks received from terminals imposed on up-link TCH in GPRS
Call processing	Call control: Location registration, origination, termination, disconnection from network, disconnection from UE, GPRS connection/disconnection, data transfer UE control: Output level, time slot, timing advance, loop-back On/Off GPRS test mode A, GPRS BLER
Channel coding	FS, EFS, HS0, HS1, CS-1, CS-2, CS-3, CS-4
Frequency band	GSM450, GSM480, GSM850, P-GSM, E-GSM, R-GSM, DCS1800, PCS1900

1.2 Measurement Items
1.2.1 Measurement Items for GSM

Transmitter Measurements
Output power
Power vs Time (template/mask evaluation)
Frequency error
Phase error (rms and peak)
Output spectrum

Receiver Measurements
FER/BER/CRC error rate

Call Processing
Location registration, origination, termination, communication, hand over, disconnection from UE, disconnection from network
MS report monitor (RxLev, RxQual and others)

1.2.2 Measurement Items for GPRS

Transmitter Measurements
Carrier frequency and frequency error
Phase error (rms and peak)
Burst power
Power versus time *1
Output RF spectrum due to modulation
Output RF spectrum due to switching *1
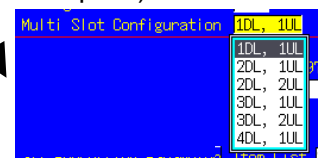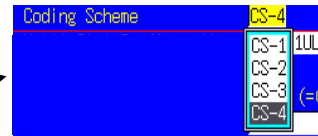***1) Measuring object is single slot which user assigns.**

Receiver Measurements
Block error rate (BLER)

Call Processing
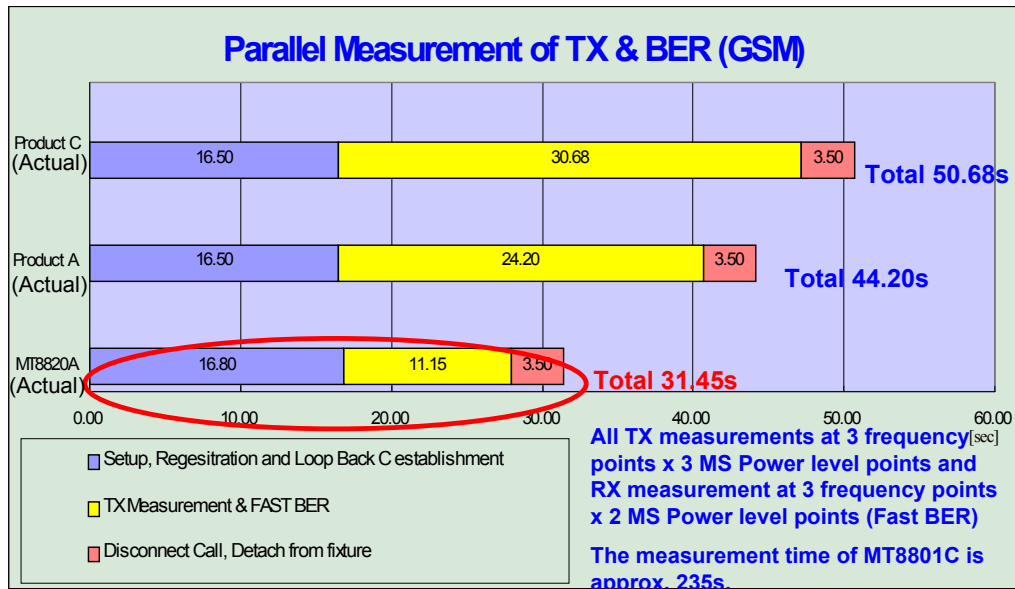Coding schemes: CS-1,CS-2,CS-3,CS-4
Multi-slot configurations: 1+1,2+1,3+1,4+1,2+2,3+2 (downlink+uplink)
Multi-slot classes supported: 1 through 6, 8 through 9
test mode A/B

GSM400/GSM850/GSM900/DCS1800/PCS1900

1.3 High Speed Measurement

GSM Measurement Time Comparison

Parallel Measurement of TX & BER (GSM)

	Setup	TX Measurement & FAST BER	Disconnect	Total
Product C (Actual)	16.50	30.68	3.50	**Total 50.68s**
Product A (Actual)	16.50	24.20	3.50	**Total 44.20s**
MT8820A (Actual)	16.80	11.15	3.50	**Total 31.45s**

0.00   10.00   20.00   30.00   40.00   50.00   60.00 [sec]

☐ Setup, Regesitration and Loop Back C establishment

☐ TX Measurement & FAST BER

☐ Disconnect Call, Detach from fixture

All TX measurements at 3 frequency points x 3 MS Power level points and RX measurement at 3 frequency points x 2 MS Power level points (Fast BER)

The measurement time of MT8801C is approx. 235s.

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1.4 Call Processing Function
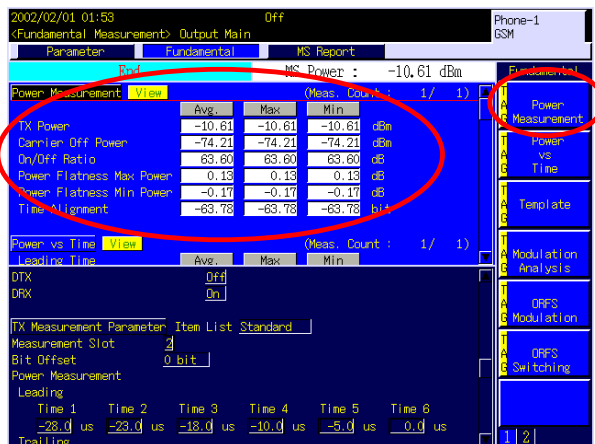
Simple Connection Test
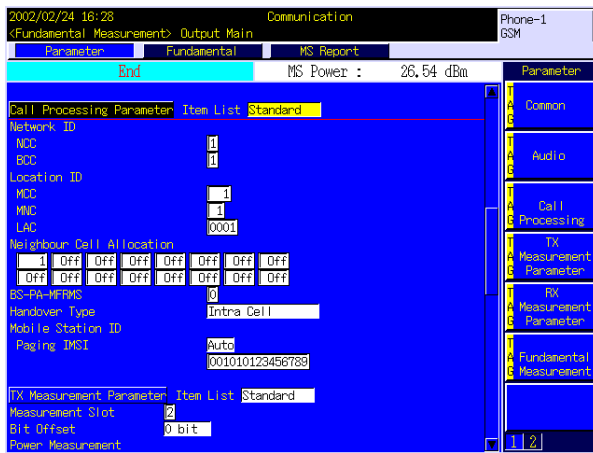
Test Items
- Location registration
- Origination
- Termination
- Terminal disconnect
- Network disconnect
- Hand over

1.5 Measurement Functions (1)
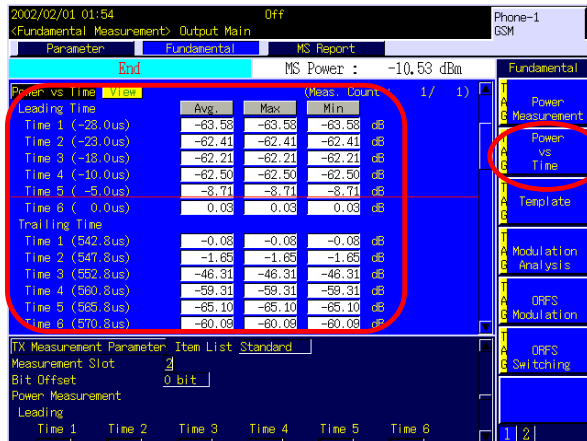
Output Power

Max./Avg./Min. values of measured result are displayed simultaneously, enabling the evaluation of UE characteristic randomness.

1.5 Measurement Functions (2)

Power vs Time

The power at 6 separate time points is measured for each burst rise/fall edge. Measurement time can be set in increments of 0.1us resolution.

1.5 Measurement Functions (3)

Rise

Fall

Burst-On Area

Entire Slot

Burst Waveform Display

Burst waveforms can be graphically displayed. Magnified display for entire slot and burst-on area as well as rise/fall area allows users to confirm at a glance whether the burst waveform is within the template of GSM standards.
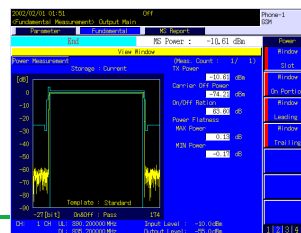
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1.5 Measurement Functions (4)

Modulation Analysis

Simultaneous measurement and display of frequency, frequency error (in kHz and ppm), phase error and peak phase error are available. Also, amplitude error at the burst-on area can be measured.
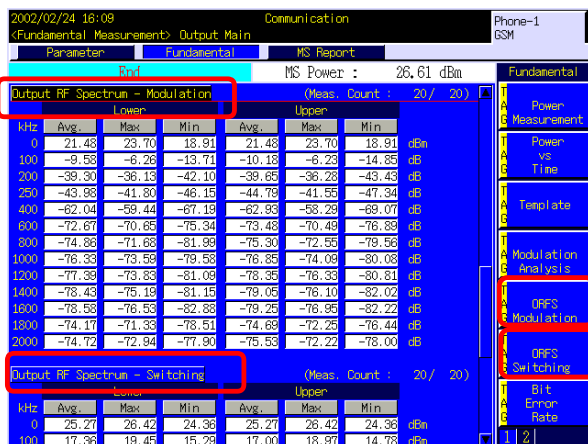
1.5 Measurement Functions (5)

Output Spectrum

Power spectrum is measured at 25 frequency points in total within the range of ±2 MHz from the carrier frequency.

"Modulation" is the spectrum resulting from modulation signal around the center of burst signal

"Switching" is the spectrum resulting from the rise/fall of burst signal

1.5 Measurement Functions (6)

Error Rate Test

The up-link RF signal, looped back from UE, is demodulated to measure frame/bit/CRC error rate with GSM UE controlled to loop-back state. These measurements can be performed in parallel with transmitter measurement by FAST BER function.
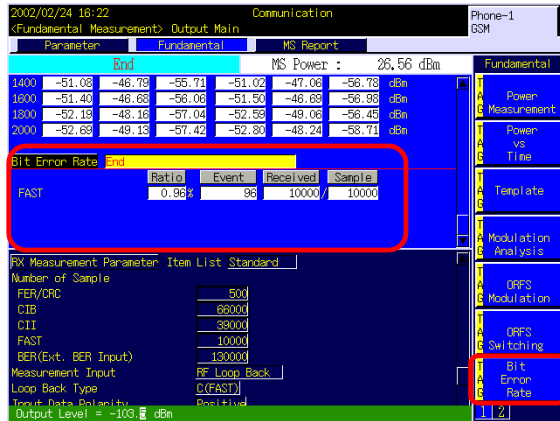
1.5 Measurement Functions (7)

MS Report Monitor
GSM terminal status can be displayed on the periodical reports from the terminal. RX Level monitoring helps users to know the received level for down-link RF signal of UE.
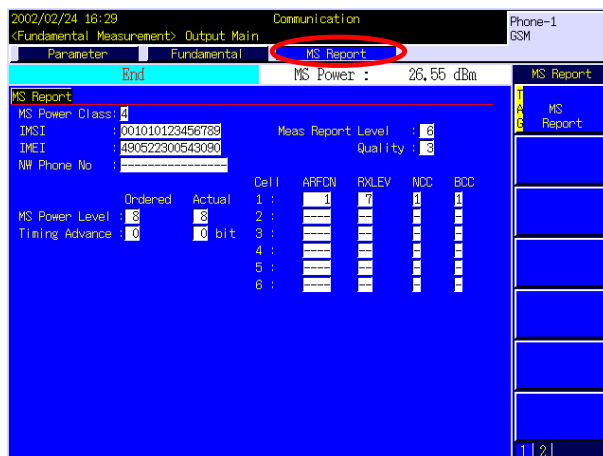
1.5 Measurement Functions (8)
GPRS Measurement Function

Measurement items are the same as that of GSM measurement.

Below is an example of BLER measurement.
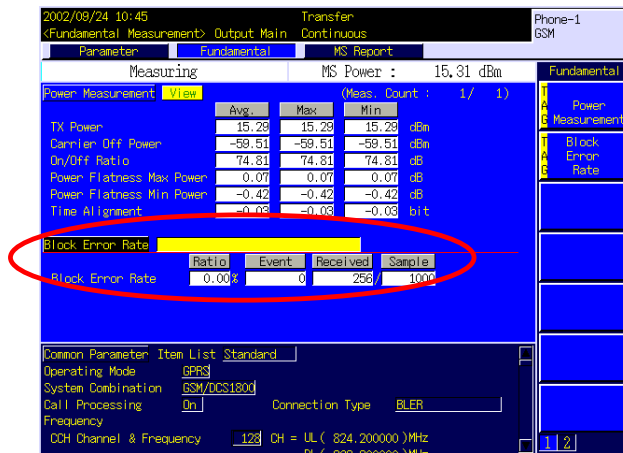
2. Outline of MX882001A-01 GSM Voice Codec

• MX882001A-01 GSM Voice Codec is the software option to add real-time voice encoding/decoding function to GSM measurement software. Live end-to-end communications test with Handset is enabled by installing MT8820A-11 Audio Board.

• As well as Handset testing, voice signal input from AF Input connector and voice signal output to AF Output connector are also supported.

• Transmission/Reception audio measurements are performable in call processing state.

2.1 Main Specifications (MT8820A-11 with MX882001A-01)

Specification of MT8820A-11 with MX882001A-01

|	
Voice codec	GSM_EFR, GSM_AMR
Codec level adjustment	Encoder input gain: -3.00 to 3.00dB, in increments of 0.01dB Handset microphone volume: 0, 1, 2, 3, 4, 5 Handset speaker volume: 0, 1, 2, 3, 4, 5
AF output	Frequency range: 30Hz to 10kHz Setting range: 0V peak to 5V peak (AF Output connector) Setting resolution: 1mV ($\leq$5V peak), 100uV ($\leq$500mV peak), 10uV ($\leq$50mV peak) Accuracy: ±0.2dB ($\geq$10mV peak, $\geq$50Hz), ±0.3dB($\geq$10mV peak, <50Hz) Waveform distortion: band$\leq$30kHz $\leq$−60dB ($\geq$500mV peak, $\leq$5kHz), $\leq$−54dB ($\geq$70mV peak) Output impedance: $\leq$1Ω Max. output current: 100mA
AF input	Frequency range: 50Hz to 10kHz Input voltage range: 1mV peak to 5V peak (AF Input connector) Max. allowable input voltage: 30V rms Input impedance: 100kΩ
Frequency measurement	Accuracy: Reference oscillator accuracy +0.5Hz
Level measurement	Accuracy: ±0.2dB ($\geq$10mV peak), ±0.4dB($\geq$1mV peak, $\geq$1kHz)
SINAD measurement	At frequency=1kHz, band$\leq$30kHz $\geq$60dB($\geq$1000mV peak), $\geq$54dB(>50mV peak), $\geq$46dB($\geq$10mV peak)
Distortion rate measurement	At frequency=1kHz, band$\leq$30kHz $\leq$-60dB($\geq$1000mV peak), $\leq$-54dB(>50mV peak), $\leq$-46dB($\geq$10mV peak)

2.2 Main Functions

Live end-to-end communications test

Connection of a handset to the RJ11 connector of MT8820A enables live end-to-end communications test between the MT8820A and MS.

RF (cable connection)

Handset
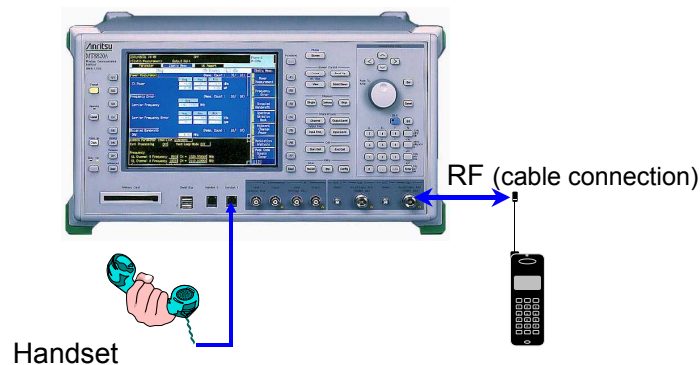
Transmission/Reception Audio Measurement Function

• The Audio Generator and Audio Meter incorporated in MT8820A perform Audio measurement of UE.

GSM: TDMA Hardware + Audio Board + GSM Software + GSM Voice Codec software option

RF

AF Input (Mod)   Speaker   Microphone

<Audio reception measurement including terminal speaker>

RF

AF Output (Demod)   Speaker   Microphone

<Audio transmission measurement including terminal microphone>

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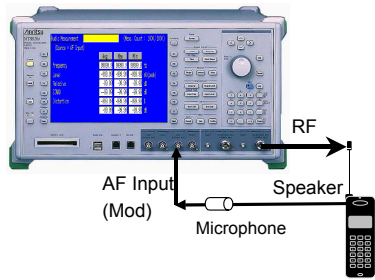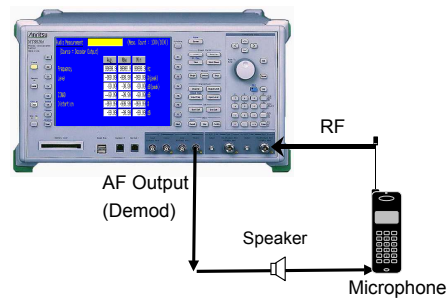
3. Outline of MX882001A-02 GSM External Packet Data

MX882001A-02 is software option to realize external data transfer function with Ethernet port.

Installation of this software and MX882001A GSM Measurement Software in the MT8820A with incorporated MT8820A-02 enables end-to-end data transfer between Server PC connected to MT8820A and GSM/GPRS terminals, and between external devices connected to MT8820A via LAN and GSM/GPRS terminals.

3.1 Main Specification (MT8820A-02 with MX882001A-02)

Specification of MT8820A-02 with MX882001A-02

Ethernet	10Base-T
Server IP Address	0.0.0.0 ～ 255.255.255.255
Client IP Address	0.0.0.0 ～ 255.255.255.255
Coding Scheme	CS-1/CS-2/CS-3/CS-4
PDTCH Data Pattern	External IP Packet

3.2 Main Functions

IP Packet Data Test

UE operates as Client PC's Modem by setting Server PC and Client PC. As shown in the connection diagram below, the operation of packet data transfer function can be tested under IP connection with UE by executing services such as FTP, HTTP, POP3 and SMTP between Client PC and Server PC.

| IP | | IP | PPP |

Server PC

Ethernet

**MT8820A
MT8820A-02
MX882001A
MX882001A-02**

Airlink

MS

Client PC
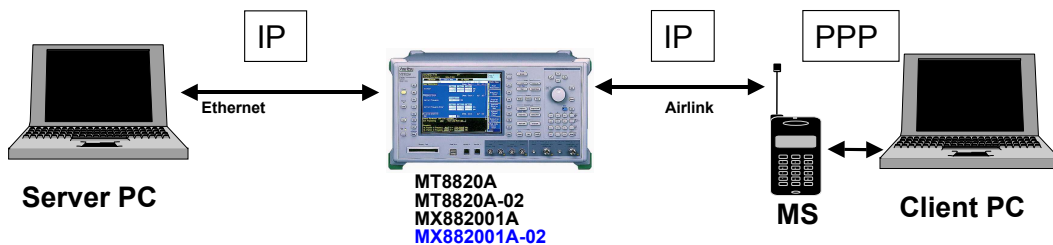
3.2 Main Functions

IP Packet Data Test via LAN

Browser operation test, Download operation test of Application Contents on MS can be tested via LAN

Server PC
IP

IP

LAN

IP

Airlink

MT8820A
MT8820A-02
MX882001A
MX882001A-02

PPP

MS

Client PC
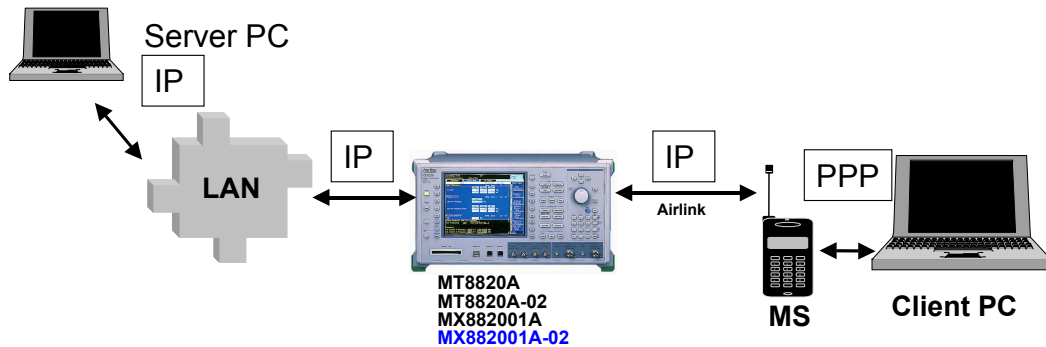
4. Outline of MX882001A-11 EGPRS Measurement Software

Utilizing an advanced high-speed measuring method and offering batch measurements to support EGPRS terminal production MX882001A-11 EGPRS Measurement Software supports transmission and reception measurements of mobile terminals conforming to EGPRS which is the advanced system of GPRS. MX882001A-11 EGPRS Measurement Software supports coding scheme of MCS1-MCS4 which uses the modulation type of GMSK and coding scheme of MCS5-MCS9 which uses the modulation type of 8PSK.

4.1 Main Specification (MT8820A-02 with MX882001A-11)
Specification of MT8820A-02 with MX882001A-11

Frequency/Modulation measurement	Frequency: 300 to 2200 MHz Input level: –30 to +40 dBm (average power of burst signal, MAIN connector) Measurement items: Normal burst, (GMSK,8PSK),RACH Carrier frequency accuracy: reference oscillator accuracy + 10 Hz (at normal burst measurement) reference oscillator accuracy + 20 Hz (at RACH measurement) Residual phase error: ≤0.5°(rms), 2°(peak) Residual EVM ≤1.5%(rms) Waveform display: Phase error vs. Bit number, Amplitude error vs. Bit number, EVM vs. Bit number
Amplitude measurement	Frequency: 300 to 2200 MHz Input level: –30 to +40 dBm (average power of burst signal, MAIN connector) Measurement items: Normal burst(GMSK,8PSK), RACH Measurement accuracy: ±0.5 dB (–20 to +40 dBm), ±0.7 dB (–30 to –20 dBm) *After calibration Linearity: ±0.2 dB (0 to –40 dB, ≥–30 dBm) Power measurement range at carrier off: ≥65 dB (input level: ≥–10 dBm), ≥45 dB (input level: ≥ –30 dBm) Burst waveform display: Rising Edge, Falling Edge, Entire Time Slot, On part
Output RF spectrum measurement	Frequency: 300 to 2200 MHz Input level: –10 to +40 dBm (average power of burst signal, MAIN connector) Measurement item: Normal burst (GMSK,8PSK) Measurement points: ±100 kHz, ±200 kHz, ±250 kHz, ±400 kHz, ±600 kHz, ±800 kHz, ±1000 kHz, ±1200 kHz, ±1400 kHz, ±1600 kHz, ±1800 kHz, ±2000 kHz Measurement range of modulator: ≤–55 dB (≤250 kHz offset), ≤–66 dB (≥400 kHz offset) *Average of 10-time measurement Measurement range of transient section: ≤–57 dB (≥400 kHz offset)
RF signal generator	Output frequency: 300 to 2200 MHz, in increments of 1 Hz Phase error (GMSK): ≤1°(rms), 4°(peak) EVM(8PSK): ≤3%(rms) Output pattern: CCH,TCH,CCH+TCH TCH data: PN9, PN15, ALL 0, ALL 1,Fixed pattern(PAT0-PAT9)
Error rate measurement	Function: Error rate measurement of bit Measurement items: -Loop-back data imposed on up-link TCH
Coding Scheme	MCS-1-MCS4(GMSK), MCS-5-MCS9(8PSK)
Puncturing Scheme	P1,P2,P3

4.2 Main Functions

Measurement Items of MX882001A-11

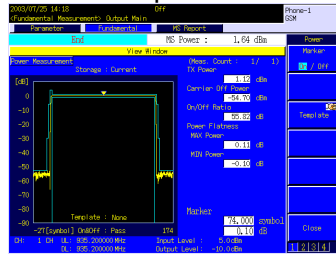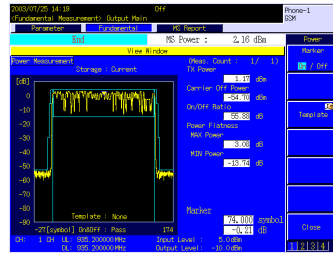|	MT8820A	
Mesurement Items	2003/09	2004/Q1
Power Measurement	X	X
Modulation Analysis (GMSK)	X	X
Modulation Analysis (8PSK)	X	X
Output RF Spectrum	X	X
Power VS Time	X	X
Bit Error Rate without Call Processing	X	X
Bit Error Rate with Call Processing	-	X
Block Error Rate	-	X
USF Block Error Rate	-	X
Test Mode A	-	X
Test Mode B	-	-
BLER Mode	-	X
SRB Loopback Mode	-	X

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4.3 Main Measurement function

Power vs. Time

Power at five measuring points for each burst rise/ fall edge
can be measured, with measuring time set in increments of
0.1 µs resolution.
Graphical display of the burst waveform is also available.
Magnified display of the entire time slot and the burst-on
area as well as the rising/falling edges enables users to confirm
at a glance whether or not the burst waveform meets the
GSM standard template.

Entire Time Slot of GMSK

Entire Time Slot of 8PSK

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5. MT8820A Application Support Table

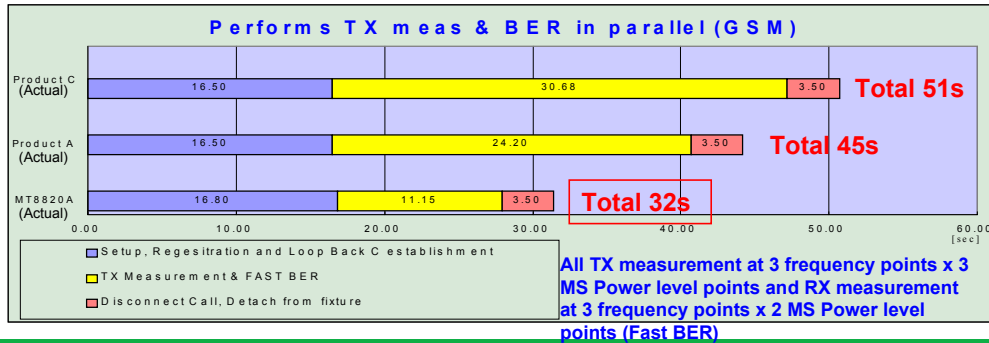| APPLICATION	W-CDMA Terminal testing	GSM/GPRS Terminal testing	GSM/GPRS/EGPRS Terminal testing	W-CDMA /GSM/GPRS Dual-mode Terminal testing	W-CDMA Terminal testing (with audio)	GSM Terminal testing (with audio)	GSM Terminal testing (Packet)	W-CDMA /GSM Dual-mode Terminal testing (with audio)
MT8820A Main Frame	√	√	√	√	√	√	√	√
MT8820A-01 W-CDMA Measurement Hardware	√			√	√			√
MT8820A-02 TDMA Measurement Hardware		√	√	√		√		√
MT8820A-11 Audio Board					√	√		√
MX882000B W-CDMA Measurement Software (requires MT8820A-01 and MX882005*A)	√			√	√			√
MX882000B-01 W-CDMA voice codec (requires MT8820A-11 and MX882000B)					√			√
MX882001A GSM Measurement Software (requires MT8820A-02)		√	√	√		√	√	√
MX882001A-01 GSM voice codec (requires MT8820A-11 and MX882001A)						√		√
MX882001A-02 GSM External packet data (requires MX882001A)							√	
MX882001A-11 EGPRS Measurement Software (requires MX882001A)			√					

√ Option required

6. Merits of Introducing MT8820A

• **Monthly production amount can be increased to 1.4 times and more of current solution by replacing the OBT in current line equipment with MT8820A.**

Throughput 1.4 times and more; [Current solution] Measurement time per unit: 25sec. Handling time: 16sec. [MT8820A] Measurement time: 12sec. *Under the almost same handling time (20sec.) →45/32= approx.1.4

• **Above throughput is achieved with higher inspection quality than current solution.**

MT8820A enables the parallel processing of all TX/RX measurements without restricting measurement items. Therefore, inspection quality can be improved without any artifice such as thinning out the measurement points for BER measurement and RF spectrum measurement which are taking most of measurement time in current solution.
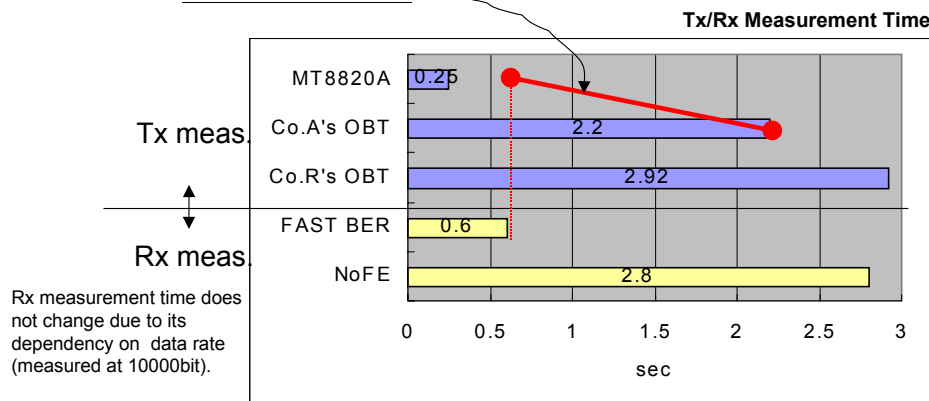

Performs TX meas & BER in parallel (GSM)

Product C (Actual)	16.50 / 30.68 / 3.50	**Total 51s**
Product A (Actual)	16.50 / 24.20 / 3.50	**Total 45s**
MT8820A (Actual)	16.80 / 11.15 / 3.50	**Total 32s**

Legend:
■ Setup, Regesitration and Loop Back C establishment
■ TX Measurement & FAST BER
■ Disconnect Call, Detach from fixture

All TX measurement at 3 frequency points x 3 MS Power level points and RX measurement at 3 frequency points x 2 MS Power level points (Fast BER)

Efficient Measurement by Tx/Rx Parallel Measurement

MT8820A is able to measure Tx and Rx in parallel. As shown in below graph, Tx measurement can be terminated during Rx measurement by using FAST BER (measurement results are the same as NoFE) for Rx measurement. As a result, the measurement time at 1 carrier, 1 MS power and 1 DL power is <u>shortened to 1/3 or less.</u>

Tx/Rx Measurement Time

Tx meas.

MT8820A	0.25
Co.A's OBT	2.2
Co.R's OBT	2.92
FAST BER	0.6
NoFE	2.8

Rx meas.

Rx measurement time does not change due to its dependency on data rate (measured at 10000bit).

RF Power, Modulation Analysis and ORFS are measured with Tx measurement condition: 1 carrier, 1 MS power, 1 DL power (AVG=20)

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6. Merits of Introducing MT8820A (continued)

GSM Phone Manufacturing Cost Comparison

		Product A	MT8820A
1	RCA GSM set price	$50,600	$52,300
2	Fixture-related cost	$15,000	$15,000
3	3-year maintenance option	$5,000	$5,000
4	3-year operation cost	$30,000	$30,000
5	Measurement time per UE (sec.)	45	32
6	Yearly quantity of UE manufactured by single RCA (260 days/year)	166857	234643
7	The quantity of RCA required (for manufacturing 1.5M sets/year)	9	7
8	Manufacturing cost for 3 years =(1+2+3+4)×7	$905,400	$716,100

GSM Phone

The use of MT8820A as production equipment is able to
reduce the cost by $189,300($905,400-$716,100) for 3 years.

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6. Merits of Introducing MT8820A (continued)

- No need of equipment replacement even for the manufacture of W-CDMA/GSM DUAL mode phone
  - MT8820A is the first to support W-CDMA measurement in the world.
  - More efficient production cost is achieved than aging equipment supporting 3G.
- Satisfactory support by 3-year/5-year warranty (optional)
  - Quick and accurate calibration and repair services are provided.

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7. Conclusion

With our Signalling & RF technologies, Anritsu provides complete support for customers' 3G business ranging from R&D through manufacturing and maintenance.

/Anritsu

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