

# ME9000

Equipping with QPSK & ASK



ME9000 is based on ARIB STD-T75 and ARIB TR-T16. Moreover, it is equipped with QPSK and ASK modulations and supports Profile 9 to 12. ME9000 is a necessary inspection system by all means in the production line and the development phase of OBE.

A low-priced system can be achieved because the method of selecting the necessary ones from among abundant options and constructing the system is adopted.

## Features

- ① ME9000 system is based on ARIB STD-T75 and ARIB TR-T16.
- ② ME9000 system is equipped with two modulations of ASK and QPSK.
- ③ ME9000 system supports Profile 9 to 12 in ARIB STD-T75. It is especially important for OBE equipped with both of ASK and QPSK modulation to be able to be tested on the condition of Profile 11.
- ④ Basic operation test, Dynamic motion test and Wireless system test can be performed.
- ⑤ Modulation factor (ASK), modulation accuracy (QPSK), receiving sensitivity and opening eye ratio (ASK) measurement can be performed in wireless system test besides seven test items (excluding "signal transmission speed") relating to the technical regulations conformity certification stipulated in the radio law.
- ⑥ PC software MAS960 is used to control this ME9000 system.
- ⑦ The amplitude level calibration and the self-check of a system can be performed.

## Test item

The arbitrary items from ① to ⑦ in the table below can be selected, and they can be brought together as one system. For instance, ① and ② are selected in the initial development phase and ①, ②, ③ and ⑦ are selected in the production line. The test can be done by both of the air connection and the coaxial connection. In the test by the air connection, the shield box ME8661A equipped with a transmission antenna and a receiving antenna is needed. Moreover, the personal computer and the PC software MAS960 are necessary at all the test items.

Test item		Contents
① Basic operation test	Protocol test	<ul style="list-style-type: none"> <li>• Communication</li> <li>• Execute &lt;2-1-1&gt; to &lt;2-1-22&gt; of ARIB TR-T16</li> </ul>
	profile test	<ul style="list-style-type: none"> <li>• Execute profile 9 to 12</li> </ul>
② Dynamic motion test		<ul style="list-style-type: none"> <li>• Execute &lt;2-2-1&gt; to &lt;2-2-3&gt; of ARIB TR-T16</li> <li>• MAT800 and average power meter are used.</li> </ul>
③ Wireless system test (items relating to TRCC)	Antenna power	<ul style="list-style-type: none"> <li>• Measured by spectrum analyzer.</li> <li>• The carrier frequency is measured by a frequency counter function of spectrum analyzer.</li> <li>• The signal transmission rate can not be measured.</li> <li>• The calibration is done by MAT800 and average power meter.</li> </ul>
	Carrier frequency	
	Occupied bandwidth	
	Carrier off leakage power	
	Adjacent channel power	
	Spurious radiation strength	
	Radio wave strength emitted subordenately	
Wireless system test (items relating to TRCC)	④ Modulation factor	<ul style="list-style-type: none"> <li>• Only ASK.</li> <li>• MMD850 and digital oscilloscope are used.</li> </ul>
	⑤ Modulation accuracy	<ul style="list-style-type: none"> <li>• Only QPSK.</li> <li>• Spectrum analyzer with modulation accuracy measurement function is used.</li> </ul>
	⑥ Receiving sensitivity	<ul style="list-style-type: none"> <li>• Through the sequence in which ME9010 transmits FCMC and receives ACTC correctly, the minimum transmission level is measured.</li> <li>• MAT800 and average power meter are used.</li> </ul>
	⑦ Opening eye ratio	<ul style="list-style-type: none"> <li>• Only ASK.</li> <li>• MMD850 and digital oscilloscope are used.</li> </ul>

### Note

※ TRCC : Technical Regulations Coformity certification

※ ME8661A : Shield box, with transmission/receiving or reference antenna

URL: <http://www.micronix-jp.com/english/Products/Electromagnetic%20anechoic%20box/me8661A/me8661A.html>

MAT800 : Fast programmable attenuator

URL: <http://www.micronix-jp.com/english/Products/Microwave%20series/MAT800/mat800.html>

MMD850 : Microwave AM detector

URL: <http://www.micronix-jp.com/english/Products/Microwave%20series/mmd850/mmd850.html>

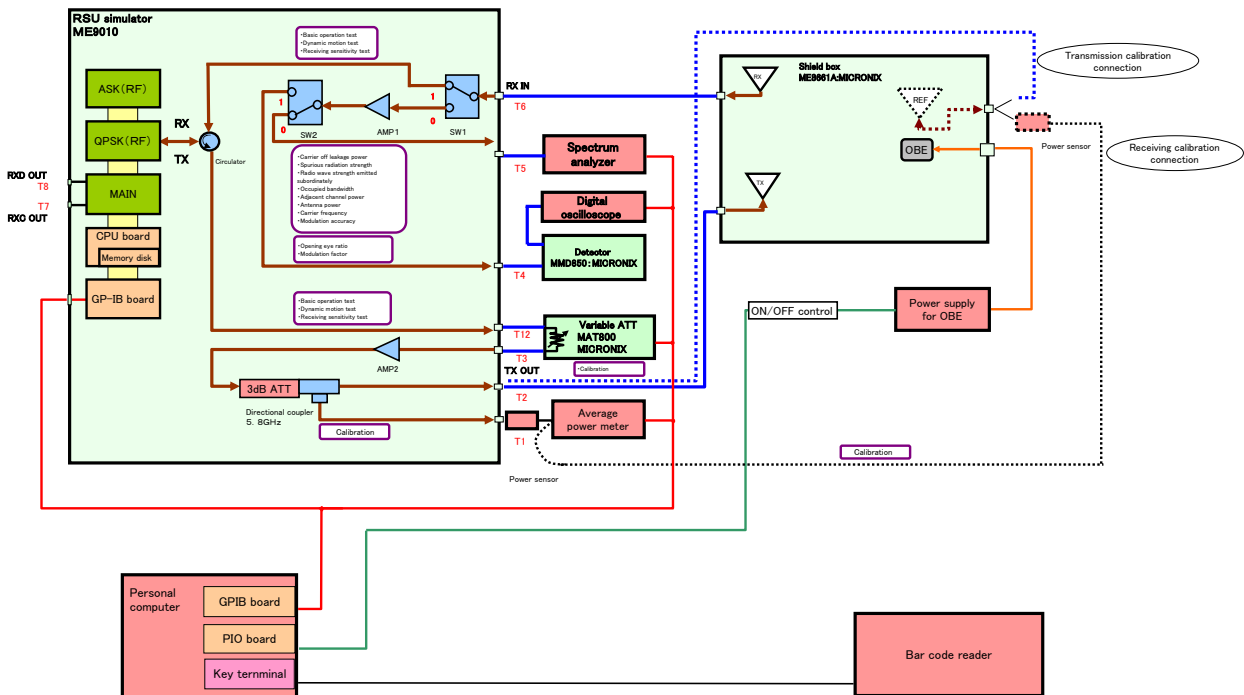
The contents about the communication profile of the profile test are shown in the table below. It is important for OBE equipped with both of ASK and QPSK modulation to be able to be tested on the condition of Profile 11 at the basic operation test. ME9000 system can perform this Profile 11.

Profile number		9	10	11	12
Modulation form	FCMC/ACTC	ASK	ASK	ASK	QPSK
	MDC/ACKC	ASK	ASK	QPSK	QPSK
Channel location		2	7	7	7

## Explanation of system

The figure below shows the block diagram in which all the equipment necessary in the air connection are included so that all the test items can be performed. The control of equipment such as ME9010 and a spectrum analyzer and the display of the measurement result are executed with PC software MAS960. In addition, the calibration and the self-check of the system can be done. Refer to "ETC/DSRC RSU simulator ME9010" for details of ME9010.

Moreover, it is possible to display the administrative information recorded in the bar code sticking to PCB or equipment in the same screen as the measurement result by connecting the bar-code reader with the key terminal of a personal computer.

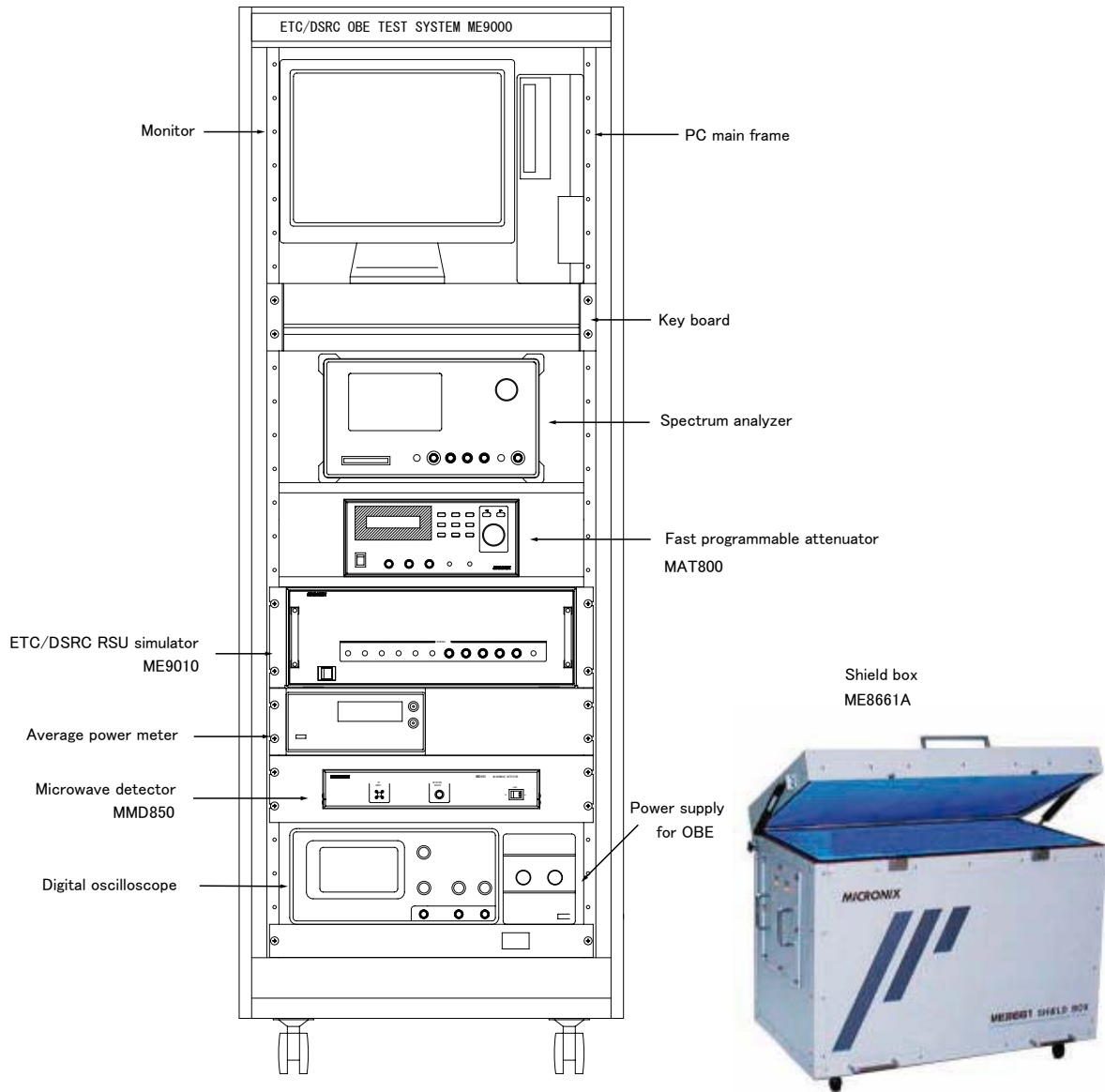


By the way, the shield box ME8661A is necessary when testing by the air connection. The ME8661A is equipped with the receiving antenna (RX) and the transmission antenna (TX), and the reference antenna (REF) is separately prepared for the calibration of the system. Only in the spurious radiation strength measurement and the radio wave strength emitted subordnately measurement of the wireless system test, the spiral antenna having a wide frequency bandwidth is necessary for a receiving antenna and a reference antenna. The frequency bandwidth is 2 to 18GHz in this case. Ofcourse, in the coaxial connection, the measured frequency range is from 500MHz to 18GHz to correspond with the performance of ME9010.

In the tests except two measurement items described above, or in other words, in the wireless system test except these two measurement items, the basic operation test and the dynamic motion test, the patch antenna are used for a receiving antenna, a transmission antenna and a reference antenna.

ME9010 and the external equipment are controlled by the GP-IB interface. Therefore, it is necessary to install the GP-IB board in the personal computer. However, only ON/OFF control of the power supply for OBE is done by the PIO board installed in the personal computer.

The figure below indicates the appearance in which all of equipment shown in the block diagram are mounted on the 1500mm rack. However, the bar code reader is excluded. The rack is an option.



## Calibration of system

It is necessary to calibrate the level of system, in the dynamic motion test, the receiving sensitivity test and the wireless system test (antenna power, spurious radiation strength and radio wave strength emitted subordinately). The average power meter is used for the calibration.

### 1) Calibration of receiving system

This is a calibration for the dynamic motion test and the receiving sensitivity test. The reference antenna is put on the same position as the front face of OBE (equipment under test) in the shield box ME8661A, and the average power meter is connected to its output. The CW "1" signal in ASK mode or all "1" signal of base band data in QPSK mode is output from ME9010. The carrier frequency is 5.795GHz. Under above conditions, MAT800 is adjusted to the attenuation value in which the power in front face of the reference antenna becomes -40dBmeirp, in short the reading value of the average power meter becomes the equivalent value, and then that value is stored. This is a reference value in which the power in front face of OBE becomes -40dBmeirp. By the way, the above-mentioned equivalent value of the average power meter is decided because the gain data of the reference antenna and the loss data of the coaxial cable are attached.

$$\text{Equivalent value (dBm)} = -40 + (\text{Reference antenna gain}) - (\text{Coaxial cable loss})$$

Afterward, the average power meter is connected with the T1 connector, and the reading value of the meter at this time is stored. This value is used for the self-check.

The patch antennas are used for transmission (TX), receiving (RX) and reference (REF) antennas.

### 2) Calibration of transmission system

This is a calibration for the antenna power, the spurious radiation strength and the radio wave strength emitted subordinately in the wireless system test (items relating to TRCC).

#### 2-1) Calibration of antenna power measurement

The reference antenna is put on the same position as the calibration of receiving system, and its output is connected with TX OUT (T2 connector) of ME9010. The average power meter is connected with T1 connector of ME9010. The output signal of ME9010 is same as the calibration of receiving system. Under above conditions, MAT800 is adjusted to the attenuation value in which the power in front face of the reference antenna becomes +10dBmeirp, in short the reading value of the average power meter becomes the equivalent value, and then the measured level of the spectrum analyzer at this time is stored. This stored value is a reference value in which the power in front face of OBE becomes +10dBmeirp. By the way, the above-mentioned equivalent value of the average power meter is decided because the gain data of the reference antenna, the loss data of the coaxial cable and the insertion loss data of the directional coupler are attached.

The patch antennas are used for transmission (TX), receiving (RX) and reference (REF) antennas.

#### 2-2) Calibration of spurious radiation strength and radio wave strength emitted subordinately measurement

The wideband spiral antenna is used for a receiving antenna (RX) and a reference antenna (REF) because the measured frequency bandwidth is 18GHz. The connection of the equipment and the calibration method & procedure at 5.795GHz reference point are entirely same as the antenna power measurement.

In this calibration, the frequency characteristics of the system is taken into account. The frequency characteristics data is installed into PC software MAS960 when shipped. The measured value is calibrated based on the reference level at 5.795GHz and the frequency characteristics data.

The measured frequency bandwidth is from 2 to 18 GHz.

## Self-check

The self-check is effective only to the calibration of receiving system.

### 1) Procedure of self-check

(Procedure 1) [Setting of test information] is selected from the menu screen of PC software MAS960.

(Procedure 2) [Self-check] is selected from [Setting of test information] screen.

(Procedure 3) The self-check begins when [Start (S)] is clicked.

(Procedure 4) Self-check result : [Measurement end Judgement : OK] or [OOO - × × dBmeirp ERROR]

(Procedure 5) The self-check is finished when [End (ESC)] is clicked.

### 2) Contents of self-check

#### ① Confirmation of -40dBmeirp

MAT800 is set to the attenuation value which is stored at the calibration of receiving system, and ME9010 outputs the calibration signal. The power measurement with the average power meter is repeated ten times, and then it is confirmed whether the difference between the mean value and the value stored at the calibration is within  $\pm 1.5\text{dB}$ .

#### ② Confirmation of -60dBmeirp

The attenuation of MAT800 is lowered 20dB from the state of ①. The power measurement with the average power meter is repeated ten times, and then it is confirmed whether the difference between the mean value and "the value stored at

① -20(dB)" is within  $\pm 2.3\text{dB}$ .

#### ③ Confirmation of -80dBmeirp

The attenuation of MAT800 is lowered 20dB from the state of ②. The power measurement with the average power meter is repeated ten times, and then it is confirmed whether the difference between the mean value and "the value stored at

① -40(dB)" is within  $\pm 2.5\text{dB}$ .

#### ※ Calibration signal

- |   |         |   |
|---|---------|---|
| { | At ASK  | : CW "1" signal, in short non modulation. |
|   | At QPSK | : All "1" signal of base band data.       |

The examples of the screen of PC software MAS960 are shown as follows.

① Setting of parameters of basic operation test

The parameters related to basic operation test are set.

② Setting of test information

The information necessary for the calibration of system and the self-check is set.

### ③ Main screen for basic operation test

No	試験項目	単試験	総合試験開始	結果
1	ACTC送信の確認	実行	○	OK
2	ACTC送信停止の確認-最大送信回数による停止	実行	○	OK
3	ACTC送信停止の確認-ACPIIによる停止	実行	○	OK
4	ACTC送信停止の確認-FCMC登録による停止	実行	○	OK
5	AIDIによるアプリケーションの確認	実行	○	OK
6	BSTの受信	実行	○	OK
7	VSTの送信	実行	○	OK
8	通信プロファイルの確認	実行	○	OK
9	終了手順1	実行	○	OK
10	終了手順2	実行	○	OK
11	データの送受信	実行	○	OK
12	データの送受信-連続	実行	○	OK
13	データの送受信-重複リジェクト機能	実行	○	OK
14	データの送受信-OBE再送信機能	実行	○	OK
15	データの送受信-OBE再送信要求機能	実行	○	OK
16	WONC送信機能	実行	○	OK
17	ぶくそう情報STAIによるACTCの制御	実行	○	OK
18	データの送受信-データの分割、組立て処理	実行	○	—
19	終了手順3	実行	○	OK
20	リリースタイマ無効の制御	実行	○	OK
21	グループ同報の確認	実行	○	NG
22	一斉同報の確認	実行	○	NG

The single test is a mode that executes only one item of 22 items. When “Execute” of each test item arranged in the row of “Single test” is clicked, only the test item clicked is executed and the result is displayed.

Regarding the overall test, either of ○ mark (execute test) or × mark (not execute test) is selected in each test item, and then only the items with ○ mark are tested and the results are displayed when “Overall test start” or “Test start (T)” is clicked.

### ④ Inspection data of basic operation test

試験項目	値	B	D	H
ACTC Uw2(Uw2A)	7cd2			
ACTC FID	01			
ACTC LID	71563412			
ACTC LRI	10			
ACTC CRC	c3d5			
周波数決定回数	4			
ACTC POS 1	4			
ACTC POS 2	1			
ACTC POS 3	3			
ACTC POS 4	2			
ACTC POS 5	1			
ACTC POS 6	4			
ACTC POS 7	1			
ACTC POS 8	0			
ACTC POS 9	5			
ACTC POS10	0			

The inspection data corresponding to each test item is displayed. B, D and H displayed at the right of the screen mean binary, decimal and hexadecimal number respectively.

The screen above shows the inspection data of the test number <2-1-1>(confirmation of ACTC transmission) as an example.



### ⑤ Main screen for dynamic motion test

【1】試験項目						TEST01			総合試験開始			【2】オフセット [dB]	
No	試験項目	測定回数	単試験	結果									
1	通常走行試験-理想パターン-OBE最大入力	100	実行	○	OK								0.00
2	通常走行試験-理想パターン-OBE最小入力	100	実行	○	OK								
3	通常走行試験-実パターンA	100	実行	○	OK								
4	通常走行試験-実パターンB	100	実行	×	---								
5	通常走行試験-隣接車線走行パターン	100	実行	○	OK								
6	通常走行試験-シャドウイングパターン	100	実行	○	OK								
7	低速走行試験-理想パターン-OBE最大入力	100	実行	○	OK								
8	低速走行試験-理想パターン-OBE最小入力	100	実行	○	OK								
9	低速走行試験-実パターンA	100	実行	○	OK								
10	低速走行試験-実パターンB	100	実行	×	---								
11	低速走行試験-隣接車線走行パターン	100	実行	○	OK								
12	低速走行試験-シャドウイングパターン	100	実行	○	OK								
13	高速走行試験-理想パターン-OBE最大入力	100	実行	○	OK								
14	高速走行試験-理想パターン-OBE最小入力	100	実行	○	OK								
15	高速走行試験-実パターンA	100	実行	○	OK								
16	高速走行試験-実パターンB	100	実行	×	---								
17	高速走行試験-隣接車線走行パターン	100	実行	○	OK								
18	高速走行試験-シャドウイングパターン	100	実行	○	NG								

【3】プロファイル周期 [s]	
通常時	1.0000
低速時	2.0000
高速時	1.0000

【4】リレースタイム値	
通常時	0.8 s
低速時	2.0 s
高速時	0.8 s

The single test and the overall test can be done as well as the basic operation test. Moreover, the number of measurement can be set, and the result is displayed as "OK" when all the measurement operate correctly.

### ⑥ Inspection data of dynamic motion test

試験項目	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	10	21	10	41	10	61	10	81	10											
2	10	22	10	42	10	62	10	82	10											
3	10	23	10	43	10	63	10	83	10											
4	10	24	10	44	10	64	10	84	10											
5	10	25	10	45	10	65	10	85	10											
6	10	26	10	46	10	66	10	86	10											
7	10	27	10	47	10	67	10	87	9											
8	10	28	10	48	10	68	10	88	8											
9	10	29	10	49	10	69	9	89	10											
10	10	30	10	50	9	70	8	90	10											
11	10	31	10	51	8	71	10	91	10											
12	10	32	9	52	10	72	10	92	10											
13	10	33	8	53	10	73	10	93	10											
14	8	34	10	54	10	74	10	94	10											
15	10	35	10	55	10	75	10	95	10											
16	10	36	10	56	10	76	10	96	10											
17	10	37	10	57	10	77	10	97	10											
18	10	38	10	58	10	78	10	98	10											
19	10	39	10	59	10	79	10	99	10											
20	10	40	10	60	10	80	10	100	10											

--- : 試験未実行  
 0 : 未測定  
 1 : FCMS出力OK  
 2 : ACTC検込みOK  
 3 : BST出力OK  
 4 : VST検込みOK  
 5 (-) : セットリストOK  
 6 (-) : セットリストOK  
 7 (-) : ケットリストOK  
 8 (-) : ケットリストOK  
 9 (8) : リレース出力OK  
 10(6) : WCNST検込みOK

※10未満はNG判定(申告AIDが0)  
 ※6未満はNG判定(申告AIDが0以外)

The number of "1 to 100" which is displayed on the screen above shows the order of the measurement. "1" shows the first measurement. The test items of "1 to 10" which are displayed at the right side of the screen are executed in turn. It is shown that all the test items operated correctly if the inspection data is "10". For instance, if the inspection data is eight, it is confirmed that all the test items up to eighth item operated correctly, in short the problem occurred in the ninth item.