

Measurement of Maximum Permissible Exposure

1. Foreword

In adopt with the Human Exposure IEEE C95.1, and according to the FCC 1.1310. The *Maximum Permissible Exposure (MPE)* is obligated to measure in order to prove the safety of radiation harmfulness to the human body.

The *Gain* of the antenna used is measured in an *Anechoic chamber*. The *maximum total power to the antenna* is to be recorded. By adopting the ***Friis Transmission Formula*** and the *power gain of the antenna*, we can find the distance right away from the product, where the limit of the MPE is.

2. Description of EUT

FCC ID	:	VUIWL157NMUSB
Product Name	:	WIFI module
Model Name	:	WL-157N_MUSB
Frequency Range	:	IEEE 802.11b/g/n Draft 1.0 20M: 2.412GHz ~ 2.462GHz IEEE 802.11n Draft 1.0 40M: 2.422GHz ~ 2.452GHz
Channel Spacing	:	5MHz
Support Channel	:	IEEE 802.11b/g/n Draft 1.0 20M: 11 Channels IEEE 802.11n Draft 1.0 40M: 7 Channels
Modulation Skill	:	DBPSK, DQPSK, CCK, OFDM
Power Type	:	Powered from NB PC by Mini-USB to USB cable

3. Limits for Maximum Permissible Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Time E ² , H ² or S (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	100	6
3.0-30	1842/f	4.89/f	900/f ²	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	100	30
1.34-30	824/f	2.19/f	180/f ²	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1.0	30

[The EUT is tested in transmit and receive modes and in the first, middle and the last channel separately.

The following shows only our observation have the greatest emissions.]

According to OET BULLETIN 56 Fourth Edition/August 1999, Equation for Predicting RF Fields:

Friis Transmission Formula:
$$S = \frac{PG}{4\pi R^2} = \frac{195.43 \times 1.78}{4\pi (20)^2} = 0.069 \text{ mW} / \text{cm}^2$$

Estimated safe separation:
$$R = \sqrt{\frac{PG}{4\pi}} = \sqrt{\frac{195.43 \times 1.78}{4\pi}} = 5.261 \text{ cm}$$

Note: "The safe estimated separation that the user must maintain from the antenna is at least 6.5cm"

Where: S = power density (in appropriate units, e.g. mW/cm²)

P = power input to the antenna (in appropriate units, e.g., mW)

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

The Numeric gain G of antenna with a gain specified in dB is determined by:

$$G = \text{Log}^{-1} (\text{dB antenna gain} / 10)$$

$$G = \text{Log}^{-1} (2.50 / 10) = 1.78$$

Appendix

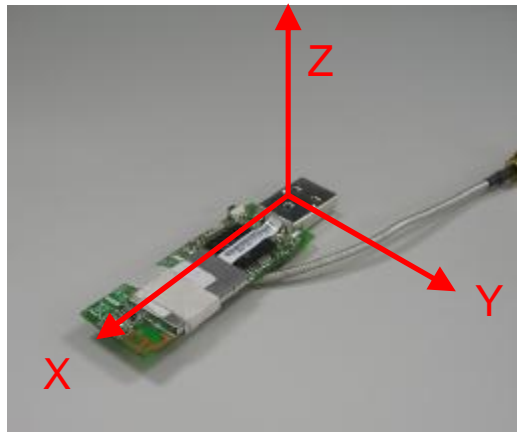
Antenna Specification (Antenna#1 Printed Antenna)

WL-157N_MUSB Antenna Specification

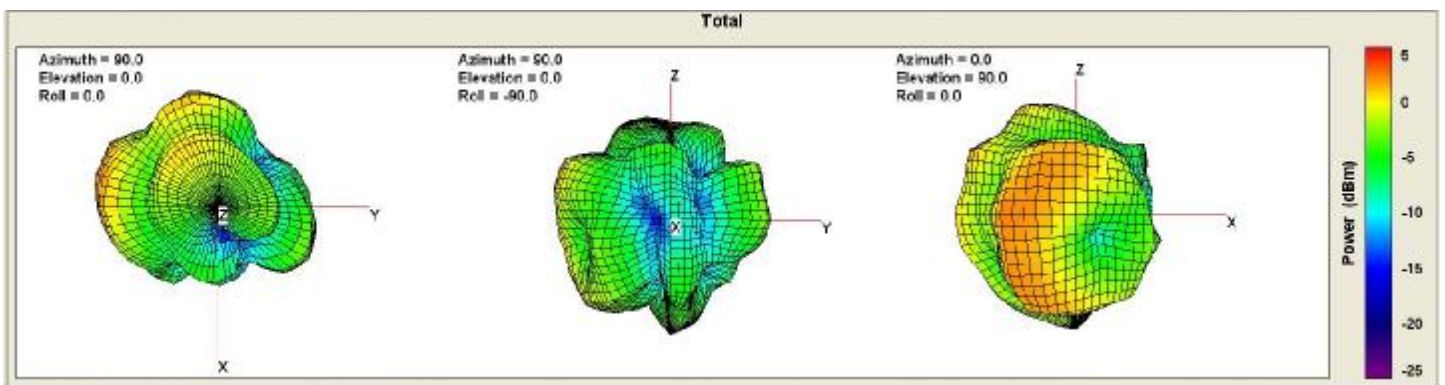
1. Antenna Specification

- | | |
|-------------------------------|---------------------------------|
| 1. Description | : 2.4GHz PIFA |
| 2. Standard | : IEEE 802.11b/g/n Wireless LAN |
| 3. Antenna Profile | : (as Drawing) |
| 4. Electrical Characteristics | |
| Operating Frequency | : 2.4~2.5GHz |
| Antenna Type | : PCB |
| Polarization Type | : Linear |
| Type of Radiation | : Semi-Omni |
| Peak Gain | : 2.3 dBi / 5.2 dBi |
| Impedance | : 50 Ohm nominal |
| V.S.W.R. | : 2.0:1 Max. |
| 6. Mechanical Characteristics | |
| Lead Length | : N/A |
| Connector | : N/A |
| 7. Raw Material | |
| Coaxial Cable | : N/A |
| Housing | : N/A |

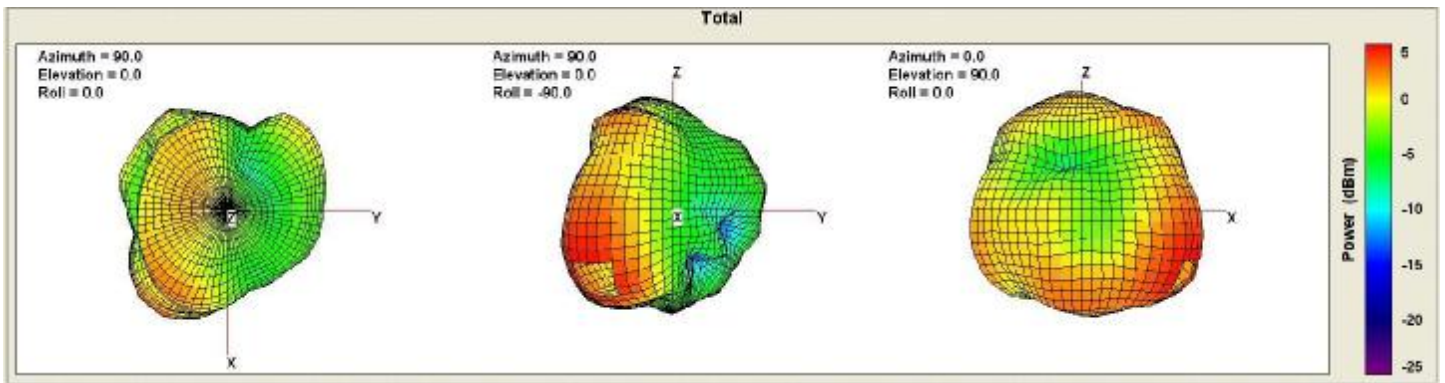
2. Radiation Pattern



Antenna 1



Antenna 2



3. Antenna Gain

Project No.	Peak Gain			Avg Gain			Efficiency (%)		
	2.40 GHz	2.45 GHz	2.50 GHz	2.40 GHz	2.45 GHz	2.50 GHz	2.40 GHz	2.45 GHz	2.50 GHz
WL-167n Main Ant.	2.32 dBi	1.08 dBi	-0.64 dBi	-3.49 dBi	-4.51 dBi	-5.85 dBi	69%	68%	65%
WL-167n Aux. Ant.	5.20 dBi	4.38 dBi	4.09 dBi	-1.15 dBi	-1.45 dBi	-1.34 dBi	73%	77%	73%

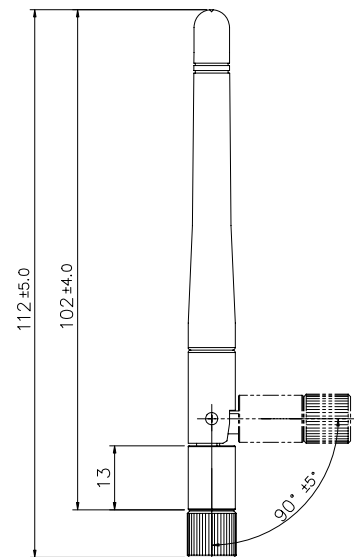
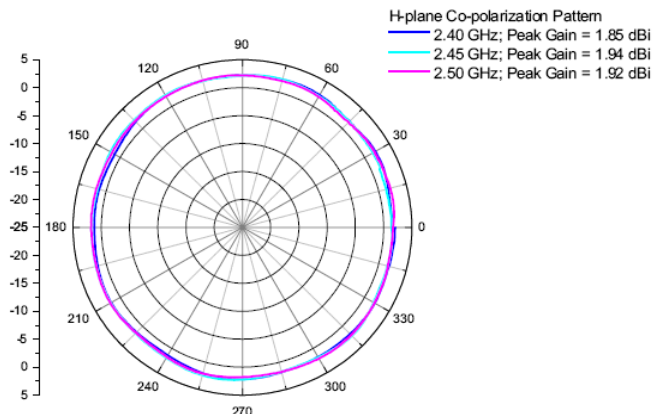
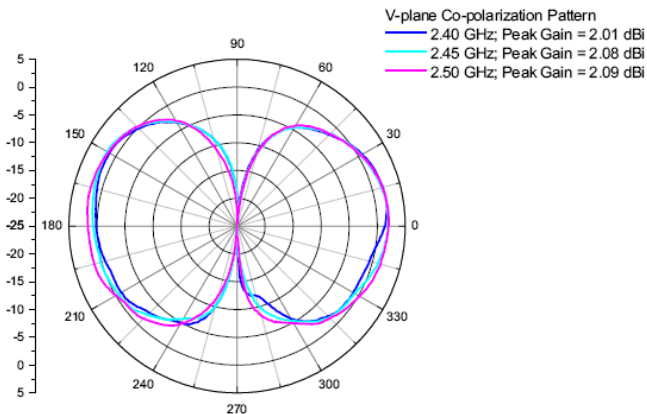
Appendix

Antenna Specification (Antenna#2 Dipole Antenna: RFA-02-C2M2-03)

RFA-02-C2M2-03

Specifications

Frequency range	2400 MHz – 2500 MHz
Antenna gain	2.5 dBi
VSWR	2.0 : 1 Max.
Polarization	Linear, vertical
Impedance	50 Ω
Temperature	- 10°C to +55°C
Connector	R SMA PLUG



Appendix

Antenna Specification (Antenna#3 Dipole Antenna: RFA-02-C2M2)

Specification

Description: Dipole antenna

Part NO.:RFA-02-C2M2

Electrical specification

- 1. Frequency range: 2400 – 2500MHz
- 2. Gain: 2.0dBi (Omni, Average gain)
- 3. VSWR: <= 2.0
- 4. Polarization: Linear, vertical
- 5. Impedance: 50 Ohm
- 6. Connector: RP-SMA plug
(Reverse Polarity meets FCC part 15. 203 Requirement)



Mechanical Testing Results

Condition : Non operating during test.

1 Endurance test result:

- 1). Number of connection/disconnection of the connector : **500 cycles**
- 2). Number of 360° rotation of the connector : **1000 cycles**

Mandatory : Guaranty of functionalities after test.

2 Resistance test result: (tests are applicable to all parts and both sides.)

2-1 Traction test result:

- 1). Traction force applied 3 times on plugs during 15 second : **1 kg**

Mandatory : No mechanical damage tolerated. Guaranty of functionalities after testing.

2-2 Bending force test result:

- 1). Number of 90° at the hinge parts and bending on one direction with 1 lbs force: **1000 cycles.**
- 2). Bending at the antenna hinge parts reversely guaranteed the quality under **1 kgw** force.

2-3 Top cover & joint Tensility test result

Test equipment: IMADA FB-50K

- A). Minimum pull test force: 8kgw
- B). Maximum pull test force: 15.5kgw
- C). Average pull test force over 10kgw

Testing items	1	2	3	4
Reference force specification	8kg ↑			
Torsion test data	15.5kg	10.5kg	12kg	15kg
Decision (Result)	OK	OK	OK	OK

Mandatory : No mechanical damage tolerated. Guaranty of functionalities after testing.

3 Environmental Testing Results

3-1 Storage test results

Condition : Non operating during test.

Cold: -40°C during 72h (IEC 68-2-1 standard Ab/Ad test)

Dry heat: +60°C during 96h (IEC 68-2-2 standard Bb/Bd test)

Humidity: +25°C at 95%R.H. during 4 days (IEC 68-2-56 standard Cb test)

Mandatory : No mechanical or visible damage tolerated. Guaranty of functionalities after test

3-2 Operation test results

Condition : Operating during test.

Cold: -10°C during 48h (IEC 68-2-1 standard Ab/Ad test)

Dry heat: +55°C during 48h (IEC 68-2-2 standard Bb/Bd test)

Composite: -10°C to +55°C 95%R.H 4 cycles(IEC 68-2-30 standard Nb test)

Mandatory : No mechanical or visible damage tolerated. Guaranty of functionalities during and after test

Appendix

Antenna Specification (Antenna#4 S SERIES Antenna)

Data Sheet

(Mechanical Use)

Product Type	WLAN Antenna
Notebook Model Number	ASUS / S SERIES
Part No. / Yageo / Aux	CAN4313 695 022501B
Part No. / ASUS / Aux	14G154011200

Yageo (Taiwan) Ltd.

16, west 3rd Street, N.E.P.Z Kaohsiung, 811 Taiwan, R.O.C

Yageo Electronics (China) Co, Ltd

No. 10, Zhu Yuan Road, Suzhou New District, Suzhou, PRC

2.45/5GHz Multi Band Antenna with Cable & Connector for IEEE802.11b, 11g, 11a, 11n, UNII	Yageo Corporation SPD		R01	Dec. 14, 07
	Datasheet Current Revision:		R02	Jan. 15, 08
	R02			
BY /	Stella Kuo	DATE /	Jan. 15, 2008	

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1. Specifications

1.1 Specifications for Antennas

Frequency Range (GHz)	2.40 ~ 2.50 for 802.11b/g/n 5.15 ~ 5.85 for 802.11a
VSWR	2.50 for 2.4GHz band For WL 2.50 for 5.0GHz band For WL
Peak Gain (dBi)	0.85 dBi for 2.4GHz band 1.50 dBi for 5.0GHz band
MiniPCI Connector	Ipex / Hirose
Impedance	50Ω
Operating Temperature	-40~90°C
Maximum Power	1W
Polarization	Linear
Radiation Pattern	Omni-directional

1.2 Antenna Dimension / Cable Length

Product	ASUS / S SERIES
Aux Antenna (LCD)	38.65*7.6*0.3 mm /265.0 mm, Color White

1.3 Packing Spec.

Product	For Example
Inner Tray	60
Carton Box	265*100

Note: Real packing will base on current project type and samples quantity to definition.



1.4 Antenna Pictures



Aux Antenna

2. Test Methodology

2.1 Test Equipment

The equipment for the antenna measurement we used is as follows.

- A. Agilent 8753ET / 8719D Network Analyzer to measure the VSWR and input impedance.
- B. Three-dimensional anechoic chamber to measure the gain
(Standard dipole and horn were used to calibrate the chamber)
- C. Digital caliper to measure the dimensions.
- D. Climatic chamber for mechanical tests.

2.2 Test Setup

2.2.1 Frequency Range

2.40 ~ 2.50GHz, 5.15 ~ 5.85GHz

2.2.2 Antenna configuration

The antenna basically has two parts; the stamping and the cable assembly with the connector on one side. The detailed drawing is attached.

2.2.3 VSWR

The VSWR is measured with Agilent 8753ET / 8719D network analyzer. All the measurements are performed with the customer provided fixture. Figure 1 shows the schematic diagram for measuring VSWR.

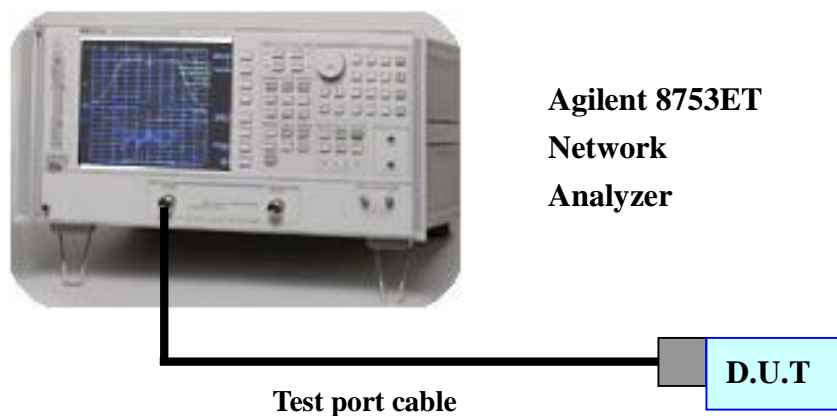


Figure 1. The schematic diagram for measuring VSWR

2.2.4 Radiation Pattern and Gain

The radiation pattern must have the omni-directional characteristic in both positions. The radiation pattern measurements are performed in the three-dimensional anechoic chamber. The chamber provides less than -30dB reflectivity from 800MHz through 8GHz. The chamber is calibrated using both standard dipole and horn antenna. The gain here is expressed as dBi that standardizes the isotropic antenna. The gain measurements are also performed in the same chamber described previously. Figure 2 shows the schematic diagram for measuring radiation pattern and gain.

2D Anechoic chamber

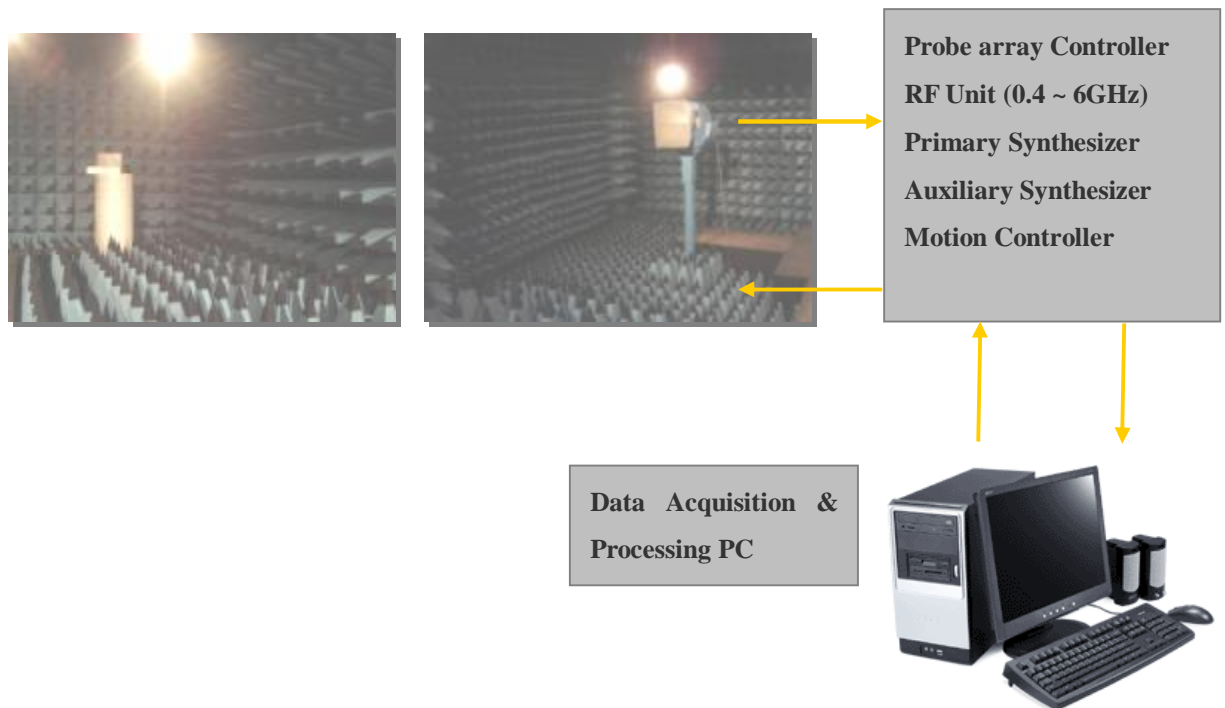
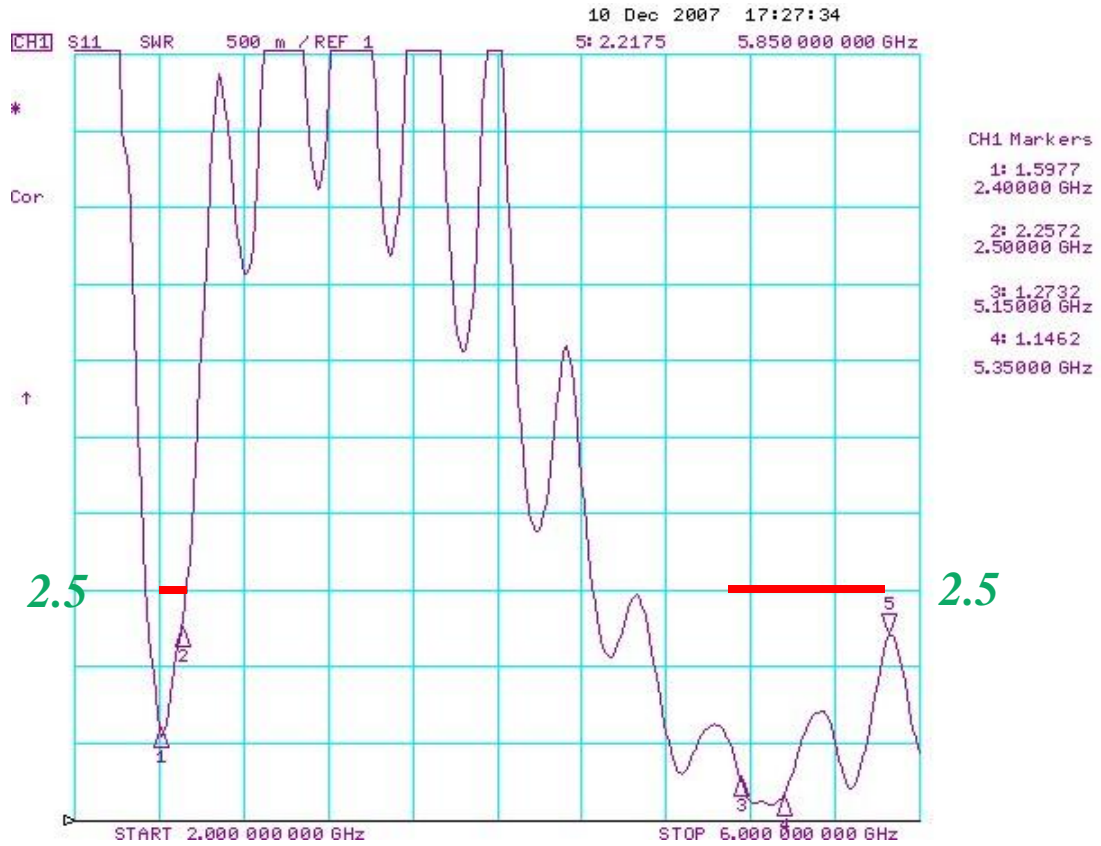


Figure 2. The schematic diagram for measuring radiation pattern and gain

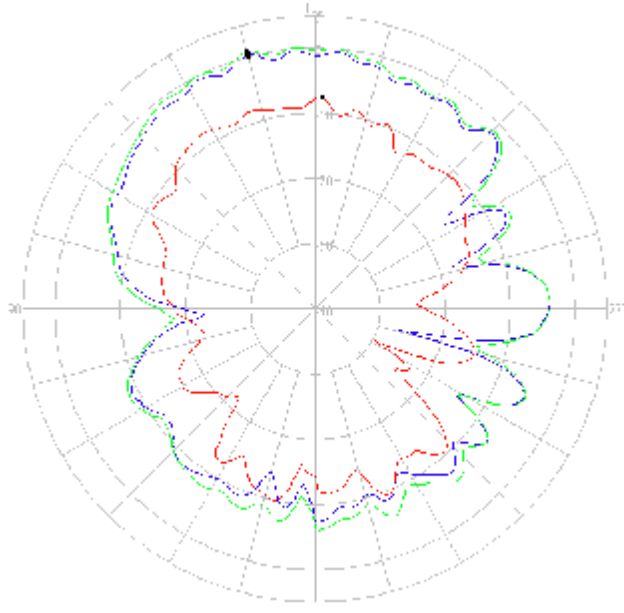
3. Performance Data

3.1 VSWR in the Fixture of Aux Antenna

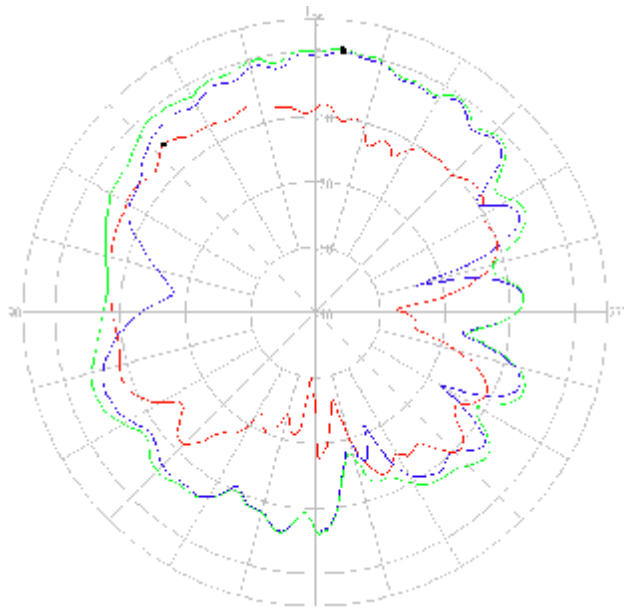


3.2 Radiation Pattern and Gain

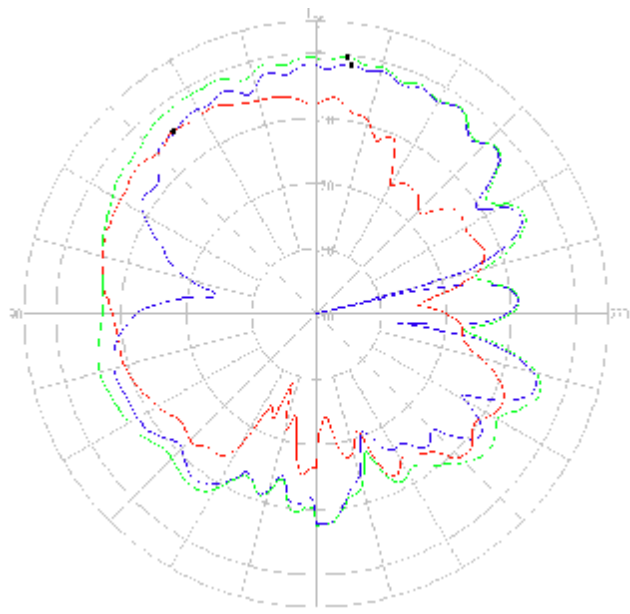
3.2.1 Low Frequency (2.40GHz~2.50GHz) / Aux Antenna



2.4GHz



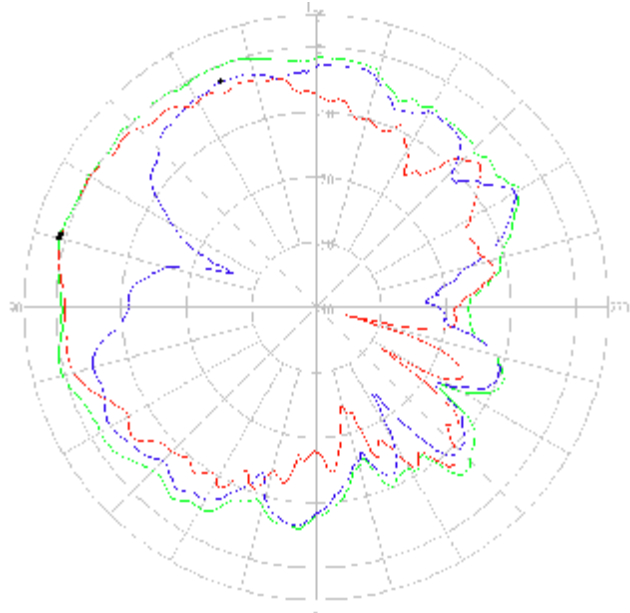
2.45GHz



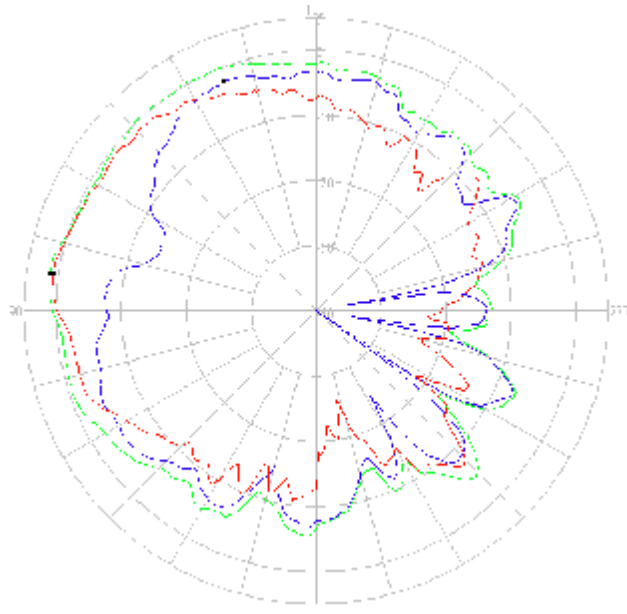
2.5GHz

- Horizontal
- Vertical
- H+V

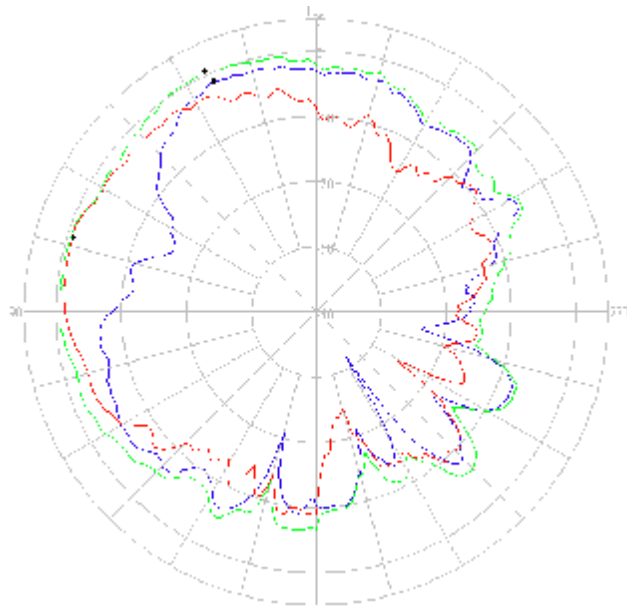
3.2.2 Middle Frequency (5.15GHz~5.35GHz) / Aux Antenna



5.15GHz



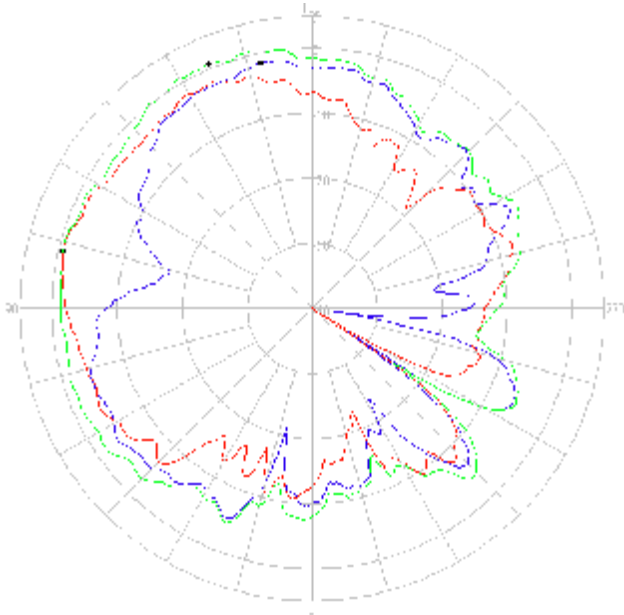
5.25GHz



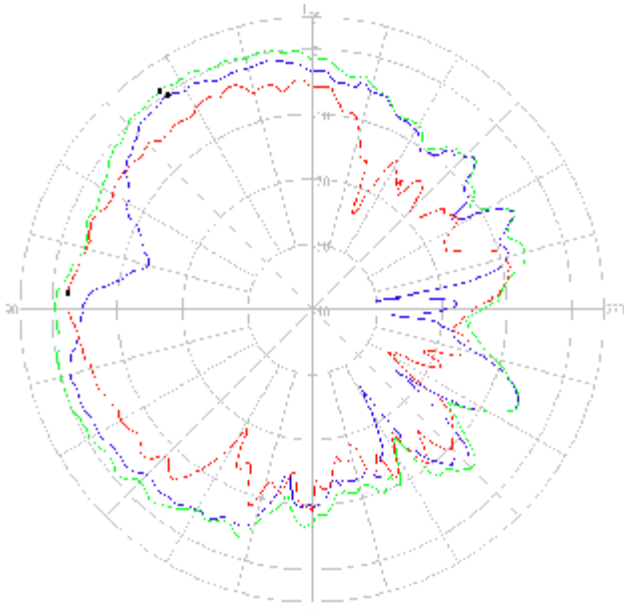
5.35GHz

-  **Horizontal**
-  **Vertical**
-  **H+V**

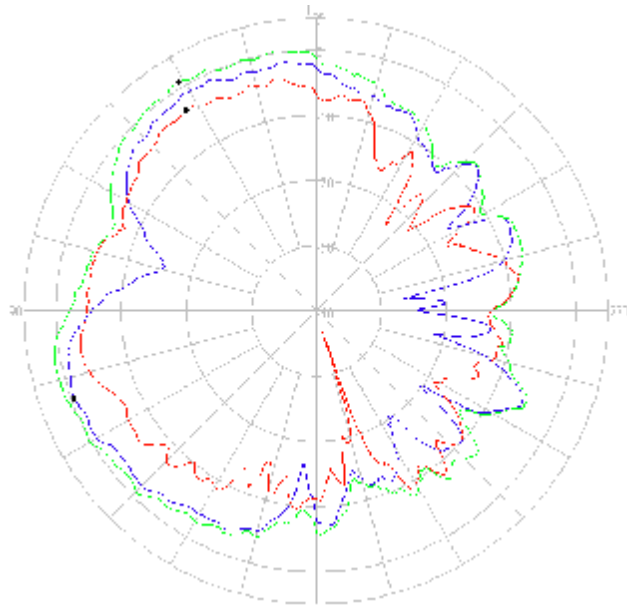
3.2.3 High Frequency (5.47GHz~5.85GHz) / Aux Antenna



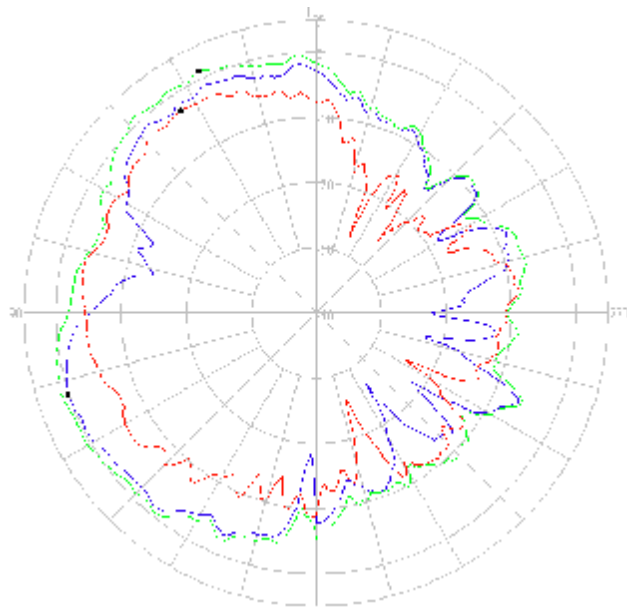
5.47GHz



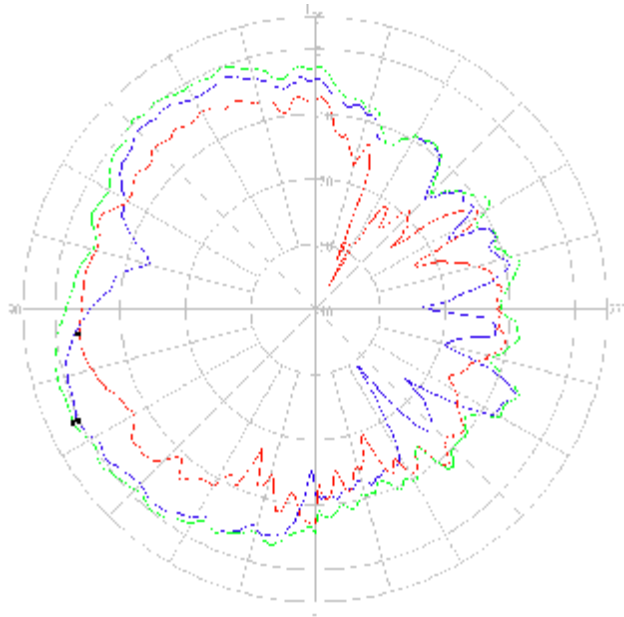
5.6GHz



5.725GHz



5.785GHz



5.85GHz

- **Horizontal**
- **Vertical**
- **H+V**

3.2.4 Average Gain (dBi) Summary

Aux Antenna Gain						
Frequency	Max Value (dBi)			Average (dBi)		
	H-pol	V-pol	Total	H-pol	V-pol	Total
2400(MHz)	0.29	-7.47	0.85	-5.35	-12.39	-4.56
2450(MHz)	0.14	-5.27	0.60	-5.47	-10.34	-4.24
2500(MHz)	-1.31	-4.32	-0.32	-6.62	-9.47	-4.81
5150(MHz)	-2.24	0.90	0.96	-6.96	-5.57	-3.20
5250(MHz)	-1.98	0.95	1.50	-7.11	-5.82	-3.41
5350(MHz)	-1.19	-0.77	0.76	-6.97	-6.61	-3.78
5470(MHz)	-1.35	-0.60	0.80	-6.73	-6.45	-3.58
5600(MHz)	-0.22	-2.31	1.04	-5.40	-7.64	-3.37
5725(MHz)	-0.39	-3.13	1.09	-5.29	-7.81	-3.36
5785(MHz)	0.19	-2.58	1.24	-5.23	-7.81	-3.32
5850(MHz)	0.30	-3.39	1.05	-5.38	-8.35	-3.60

4. Antenna Drawing



*ELECTRICAL PERFORMANCE:

1. IMPEDANCE: 50ohm
2. FREQUENCY RANGE: 2.4~2.5GHZ for 802.11bg / 5.15~5.85GHz for 802.11a
3. WORK VOLTAGE: N/A
4. DIELECTRIC WITH STANDING VOLTAGE: AC 1500V for 1MIN
5. INSULATOR RESISTANCE: 1500 MEGOHMS. MIN

5. Reliability Data For Antenna Patch (Reference To IEC)

IEC 384-10/ CECC 32 100 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.12	4(Na)	Rapid change of temperature	-40 °C (30 minutes) to +90 °C (30 minutes); 5 cycles	No visible damage Central Freq. Change ± 6%
4.14	3(Ca)	Damp heat	500 ± 12 hours at 40 °C; 90 to 95 % RH	No visible damage 2 hours recovery Central Freq. Change ± 6%
4.15		Endurance	500 ± 12 hours at 90 °C;	No visible damage 2 hours recovery Central Freq. Change ± 6%

6. Ordering Information: Yageo Ordering P/N Code

The antennas may be ordered by using the Yageo P/N ordering code. These code numbers can be determined by the following rules:

CAN4313 6 95 02 250 1B
F C M S T A P

F. Family Code

CAN43 = Antenna

C. Packing Type Code

13 = Bulk (1000 pcs)

M. Materials Code

6 = High Frequency Material

S. Size/Series Code

95 = 38.65*7.6*0.3 mm, Aux Antenna

T. Tolerance/Cable

02= Cable Aux, White

A. Working Frequency

250 = 2.45/5 GHz Dual Band

P. Packing

1B = 1000 pcs packing

7. Revision Control

Revision	Date	Content	Remark
R01	Dec. 14, 2007	New Issued, Metal Antenna	N/A.
R02	Jan. 15, 2008	Update UL Card and package description	N/A

8. UL Card

I-Pex Connector

No.2006-3
Feb/13/04

材料証明書 MATERIAL CERTIFICATE

当社製品には下記の材料が使われている事を証明致します。
WE HEREBY CERTIFY THAT THE FOLLOWING MATERIALS ARE USED IN OUR PRODUCT.

PRODUCT NAME : MHF series micro coaxial connector PLUG
P/N 20278 **1R **, 20308 **1R **, P/N 20351 **1R 37

	部品 COMPONENT	材料/MATERIAL			UL94難燃性 UL94 FLAME CLASS	UL777#No. UL FILE No.
		材質名 MATERIAL	型名 CAT No.	材料メーカー MANUFACTURER		
1	HOUSING	PBT	3116	WINTTECH POLYMER LTD.	V-0	E 213445

PRODUCT NAME : MHF series micro coaxial connector RECEPTOR
P/N 20279-001E-01, P/N 20314-001E-01

	部品 COMPONENT	材料/MATERIAL			UL94難燃性 UL94 FLAME CLASS	UL777#No. UL FILE No.
		材質名 MATERIAL	型名 CAT No.	材料メーカー MANUFACTURER		
1	HOUSING	LCP	E130i	POLYPLASTICS CO.,LTD.	V-0	E 106764

PRODUCT NAME : MHF II connector P/N 20311-**1R-**, P/N 20312-**1R-**

	部品 COMPONENT	材料/MATERIAL			UL94難燃性 UL94 FLAME CLASS	UL777#No. UL FILE No.
		材質名 MATERIAL	型名 CAT No.	材料メーカー MANUFACTURER		
1	HOUSING	LCP	A430	POLYPLASTICS CO.,LTD.	V-0	E 106764

株式会社アイベックス
I-PEX Co.,Ltd.

APPROVAL	CHECK	ORIGINATOR
T.Harada Feb/13/04		K.Obayashi Feb/13/04

FORM REV0

Nissei Cable

04-12-20:14:18 :NISSEI ELECTRIC GOLDEN TACT :053 485 8908 # 1 / 1

AVLVZ July 24, 2004
 Appliance Wiring Material - Component
NISSEI ELECTRIC CO LTD E56198
 RYUYO FACTORY 206-1 AZA-OHNISHI, MATSUMOTO IWATA-
 GUN, RYUYO-CHO, SHIZUOKA 438-0206 JAPAN

Table of Recognized Styles

Single-conductor, thermoplastic insulation.							
1164	1331	1516	1609	1727	19107	10504	10653
1180	1332	1517	1610	1827	19109	10508	10654
1198	1333	1528	1637	1828	19231	10509	10655
1199	1334	1538	1671	1829	19248	10510	10656
1212	1358	1577	1664	1847	19315	10516	10657
1213	1371	1584	1709	1943	19344	10599	10730
1226	1398	1586	1710	1948	19386	10607	10734
1227	1512	1591	1723	19590	19443	10608	10735
1330	1543	1592	1726	19886	19485	10617	10736
Multiple-conductor, thermoplastic insulation.							
2095	2384	2516	2598	2669	2843	2995	21087
2096	2385	2517	2614	2764	2854	2994	21111



8/10/2004 Underwriters Laboratories Inc. Card 1 of 3

AVLV2 July 24, 2004
 Appliance Wiring Material - Component
NISSEI ELECTRIC CO LTD E56198

Table of Recognized Styles							
2097	2386	2520	2626	2709	2876	30002	21112
2098	2387	2519	2630	2725	2934	30007	21113
2099	2388	2520	2631	2726	2935	30276	21242
2100	2440	2570	2677	2778	2936	30399	21245
2101	2462	2571	2683	2780	2937	30535	21256
2102	2463	2574	2684	2786	2938	30708	
2103	2464	2576	2685	2787	2961	30897	
2343	2490	2584	2656	2789	2969	30898	
2344	2495	2586	2660	2805	2990	30899	
2345	2501	2587	2661	2841	2991	30900	
2346	2502	2589	2662	2842	2992	30901	
Single-conductor, thermoplastic insulation.							
3068	3074	3126	3138	3243	3329	3503	3507
3069	3075	3132	3139	3301	3367	3543	3723
3070	3122	3139	3172	3305	3422	3570	3724
3071	3125	3135	3259	3318	3488	3579	3725
Single and multiple-conductor specialty items.							
5145	5187	5228	5226	5228	5230	5233	

8/10/2004 Underwriters Laboratories Inc. Card 2 of 3

AVLV2 July 24, 2004
 Appliance Wiring Material - Component
NISSEI ELECTRIC CO LTD E56198

Table of Recognized Styles						
5140	5223	5225	5227	5229	5231	5237

Marking: Company name, voltage rating, temperature rating, conductor size, conductor material if other than copper, and use.
LOOK FOR THE RECOGNITION MARK See General Information Preceding These Recognitions
 For use only with equipment where the acceptability of the combination is determined by Underwriters Laboratories Inc.

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PGGU2.MH15431

Marking and Labeling System Materials - Component

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Marking and Labeling System Materials - Component

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SONY CHEMICALS CORP
 KANUMA FACTORY
 18 SATSUKI-CHO
 KANUMA-SHI
 TOCHIGI-KEN 322-8501, JAPAN

MH15431

Pressure sensitive laminating adhesives:NP203, NP203W. For bonding aluminum (thickness.007 to 0.020 in), polycarbonate (thickness.019 to.079 in) and acrylic (thickness.019 to.079 in) to acrylonitrile butadiene styrene (ABS) plastic, maximum surface temperature 80 C (176 F), minimum temperature -40 C (-40 F). Suitable where exposed indoors to high humidity and occasional exposure to water.

NP303, NP303W. For bonding aluminum (thickness.007 to 0.020 in), polycarbonate (thickness.019 to.079 in) and acrylic (thickness.019 to.079 in) to acrylonitrile butadiene styrene (ABS) plastic, maximum surface temperature 80 C (176 F), minimum temperature -40 C (-40 F). Suitable where exposed indoors to high humidity and occasional exposure to water.

G4000, G9303S, T3500, T3500S, T3500SW, T3500W. For bonding aluminum (thickness.007 to 0.020 in), polycarbonate (thickness.019 to.079 in) and acrylic (thickness.019 to.079 in) to acrylonitrile butadiene styrene (ABS) plastic, maximum surface temperature 80 C (176 F), minimum temperature -40 C (-40 F). Suitable where exposed indoors to high humidity and occasional exposure to water.

T4000, T4000W. For bonding aluminum (thickness.007 to 0.020 in), polycarbonate (thickness.019 to.079 in) and acrylic (thickness.019 to.079 in) to acrylonitrile butadiene styrene (ABS) plastic, maximum surface temperature 80 C (176 F), minimum temperature -40 C (-40 F). Suitable where exposed indoors to high humidity and occasional exposure to water.

T4000B, T4000BW. For bonding aluminum (thickness.007 to 0.020 in), polycarbonate (thickness.019 to.079 in) and acrylic (thickness.019 to.079 in) to acrylonitrile butadiene styrene (ABS) plastic, maximum surface temperature 80 C (176 F), minimum temperature -40 C (-40 F). Suitable where exposed indoors to high humidity and occasional exposure to water.

T4500B, T4500BW. For bonding aluminum (thickness.007 to 0.020 in), polycarbonate (thickness.019 to.079 in) and acrylic (thickness.019 to.079 in) to acrylonitrile butadiene styrene (ABS) plastic, maximum surface temperature 80 C (176 F), minimum temperature -40 C (-40 F).

Suitable where exposed indoors to high humidity and occasional exposure to water.

T4700M. For bonding aluminum (thickness 0.002 to 0.032 in) to aluminum, and galvanized steel, max temperature 150 C (302 F) min temperature -40 C (-40 F); Acrylonitrile Butadiene Styrene (ABS) and Polypropylene plastics; max temperature 80 C (176 F) min temperature -40 C (-40 F); Polystyrene plastics; max temperature 60 C(140 F) min temperature -40 C (-40 F). Suitable where exposed indoors to high humidity or occasional exposure to water.

G90XX\$\$. For bonding aluminum (thickness.007 to 0.020 in), polycarbonate (thickness.019 to .079 in) and acrylic (thickness.019 to.079 in) to acrylonitrile butadiene styrene (ABS) plastic, maximum surface temperature 80 C (176 F), minimum temperature -40 C (-40 F). Suitable where exposed indoors to high humidity and occasional exposure to water.

T4700M. For bonding aluminum (thickness 0.002 to 0.032 in.) to aluminum, and galvanized steel, max temperature 150 C (302 F) min temperature -40 C (-40 F); Acrylonitrile Butadiene Styrene (ABS) and Polypropylene plastics; maximum temperature 80 C (176 F), minimum temperature -40 (-40 F); polystyrene plastics, maximum temperature 60 C (140 F), minimum temperature -40 C (-40 F). Suitable where exposed indoors to high humidity or occasional exposure to water.

T4410, T4410W, T4411, T4411W, T4900, T4900W. For bonding aluminum (thickness 0.002 to 0.032 in.) to aluminum, stainless steel, galvanized steel, alkyd enamel and porcelain, maximum temperature 150 C (302 F), minimum temperature -40 C (-40 F); polycarbonate, maximum temperature 100 C (212 F), minimum temperature -40 C (-40 F); polyphenylene oxide, nylon and ABS plastic, maximum temperature 80 C (176 F), minimum temperature 40 C (-40 F). Suitable where exposed indoors to high humidity or occasional exposure to water. Also suitable where exposed outdoors, affixed to all the surfaces mentioned above except aluminum, stainless steel, polycarbonate, polyphenylene oxide and nylon.

T4720. For bonding aluminum (thickness 0.002-0.032 inch) to aluminum and galvanized steel, maximum temperature 150 C (302 F), minimum temperature -40 C (-40 F); ABS plastic, maximum temperature 80 C (176 F), minimum temperature -40 C (-40 F) and polystyrene, maximum temperature 60 C (140 F), minimum temperature -40 C (-40 F). Suitable for indoor use where exposed to high humidity or occasional exposure to water.

T4720. For bonding aluminum (thickness 0.032 inch) to polypropylene, maximum temperature 80 C (176 F). Suitable for indoor use where exposed to high humidity or occasional exposure to water.

G91XX\$\$, for bonding aluminum thickness 0.008 thru 0.020 in., acrylic 0.020 thru 0.079 in. and polycarbonate 0.020 thru 0.079 in. to ABS plastic, maximum temperature 80 C (176 F), minimum temperature -40 C (-40 F). Suitable for indoor use where exposed to high humidity or occasional exposure to water.

"G99XX\$\$". For bonding aluminum face stock 0.007 inch - 0.020 inch thick, polycarbonate face stock 0.020 inch - 0.079 inch thick and acrylic face stock 0.020 inch - 0.079 inch thick to ABS plastic, maximum temperature 80 C (176 F), minimum temperature -40 C (-40 F). Suitable for indoor use where exposed to high humidity or occasional exposure to water.

Note:

\$\$- May be replaced by alpha characters denoting release liner type.

XX-Replaced by digits denoting product thickness.

Marking: Company name or trademark "SC" in a square and laminating adhesive designation on packaging, roll core or release liner.

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Protective Tube

YDPU2.E203950 - Tubing, Extruded Insulating - Component

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YDPU2.E203950 Tubing, Extruded Insulating - Component

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Tubing, Extruded Insulating - Component

[See General Information for Tubing, Extruded Insulating - Component](#)

SHENZHEN WOER HEAT-SHRINKABLE MATERIAL CO LTD

E203950

XINWEI INDUSTRIAL PARK, WOER MANSION
NANSHAN DISTRICT, XILI
SHENZHEN, GUANGDONG 518052 CHINA

Cat. No.	Max V	Max Temp C	Col Recognized	Max Temp Rated Oil Resistance C	VW-1 Rated #
Heat-Shrinkable Polyolefin Tubing					
RSFR-x	600	125	Black	None	Yes
RSFR-x	600	125	White	None	Yes
WKZM-x-yz	600	125	White	None	No
RSFR-H\$	600	125	All except Clear	None	No
RSFR(CB)	300	125	All except Clear	None	Yes
Not Heat-Shrinkable PTFE Tubing					
WF	600	200	Natural	None	Yes
Heat-Shrinkable Polyolefin Tubing with Meltable Liner					
SBRS	600	105	All except Clear	None	Yes
Not Heat-Shrinkable Standard Wall Silicone Tubing					
WST-600	600	150	White	None	No

x - Designated tubing expanded ID. For Black color tubing, x represents expanded ID of 2 mm - 8 mm. For White color tubing, x represents expanded ID of 1mm - 50 mm.

yz - Represents any alpha and/or numeric combination for internal client code.

- Tubing is considered to comply with the optional VW-1 flammability requirements only if it is so marked.

@ - Tubing limited to 0.7 to 15 mm internal diameters only. VW-1 rated for internal diameter sizes 6.50 - 15.00 mm only.

\$ - 125C rating restricted to 2.36 to 75.0 mm recovered ID only.

Marking: Company name or file number "E203950", catalog number, voltage rating, temperature rating in degrees C,

http://database.ul.com/cgi-bin/XYV/template...versionless&parent_id=1073806658&sequence=1 第 1 頁 / 共 2 [2007/9/26 下午 02:12:20]

YDPU2.E203950 - Tubing, Extruded Insulating - Component

inside diameter (before and after recovery), and date of manufacture shall be marked on tags attached to both ends of the tubing, on the shipping spool label or on the smallest unit container.

[Last Updated](#) on 2007-08-21

[Questions?](#)

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Data Sheet

(Mechanical Use)

Product Type	WLAN Antenna
Notebook Model Number	ASUS / S SERIES
Part No. / Yageo / Main	CAN4313 695 032501B
Part No. / ASUS / Main	14G154011000

Yageo (Taiwan) Ltd.

16, west 3rd Street, N.E.P.Z Kaohsiung, 811 Taiwan, R.O.C

Yageo Electronics (China) Co, Ltd

No. 10, Zhu Yuan Road, Suzhou New District, Suzhou, PRC

2.45/5GHz Multi Band Antenna with Cable & Connector for IEEE802.11b, 11g, 11a, 11n, UNII	Yageo Corporation SPD Datasheet Current Revision: R02		R01	Dec. 14, 07
			R02	Jan. 15, 07
BY /	Stella Kuo	DATE /	Jan. 15, 2007	

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- 7. Revision Control**

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1. Specifications

1.1 Specifications for Antennas

Frequency Range (GHz)	2.40 ~ 2.50 for 802.11b/g/n 5.15 ~ 5.85 for 802.11a
VSWR	2.50 for 2.4GHz band For WL 2.50 for 5.0GHz band For WL
Peak Gain (dBi)	1.68 dBi for 2.4GHz band 2.33 dBi for 5.0GHz band
MiniPCI Connector	Ipex / Hirose
Impedance	50Ω
Operating Temperature	-40~90°C
Maximum Power	1W
Polarization	Linear
Radiation Pattern	Omni-directional

1.2 Antenna Dimension / Cable Length

Product	ASUS / S SERIES
Main Antenna (LCD)	38.65*7.6*0.3 mm /300.0 mm, Color Black

1.3 Packing Spec.

Product	For Example
Inner Tray	60
Carton Box	265*100

Note: Real packing will base on current project type and samples quantity to definition.



1.4 Antenna Pictures



Main Antenna

2. Test Methodology

2.1 Test Equipment

The equipment for the antenna measurement we used is as follows.

- A. Agilent 8753ET / 8719D Network Analyzer to measure the VSWR and input impedance.
- B. Three-dimensional anechoic chamber to measure the gain
(Standard dipole and horn were used to calibrate the chamber)
- C. Digital caliper to measure the dimensions.
- D. Climatic chamber for mechanical tests.

2.2 Test Setup

2.2.1 Frequency Range

2.40 ~ 2.50GHz, 5.15 ~ 5.85GHz

2.2.2 Antenna configuration

The antenna basically has two parts; the stamping and the cable assembly with the connector on one side. The detailed drawing is attached.

2.2.3 VSWR

The VSWR is measured with Agilent 8753ET / 8719D network analyzer. All the measurements are performed with the customer provided fixture. Figure 1 shows the schematic diagram for measuring VSWR.

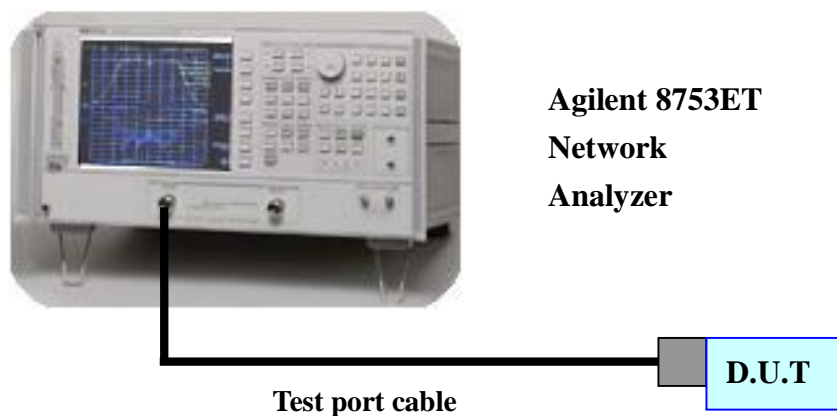


Figure 1. The schematic diagram for measuring VSWR

2.2.4 Radiation Pattern and Gain

The radiation pattern must have the omni-directional characteristic in both positions. The radiation pattern measurements are performed in the three-dimensional anechoic chamber. The chamber provides less than -30dB reflectivity from 800MHz through 8GHz. The chamber is calibrated using both standard dipole and horn antenna. The gain here is expressed as dBi that standardizes the isotropic antenna. The gain measurements are also performed in the same chamber described previously. Figure 2 shows the schematic diagram for measuring radiation pattern and gain.

2D Anechoic chamber

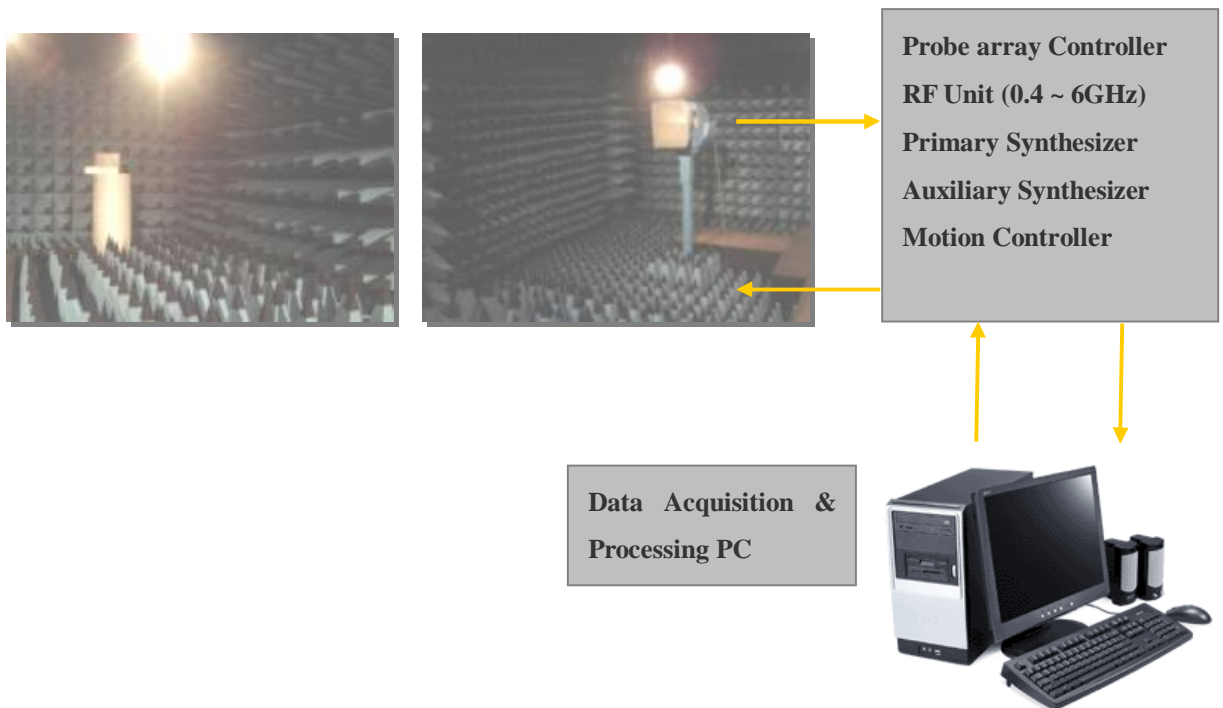
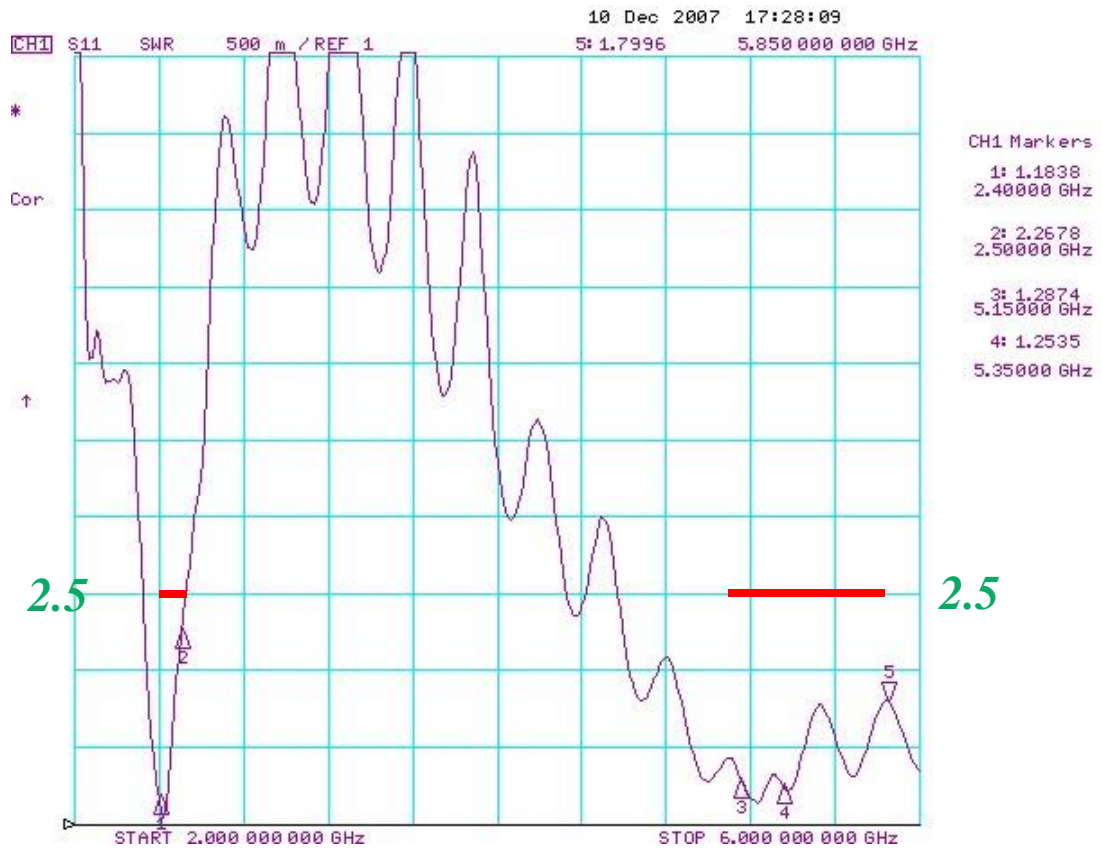


Figure 2. The schematic diagram for measuring radiation pattern and gain

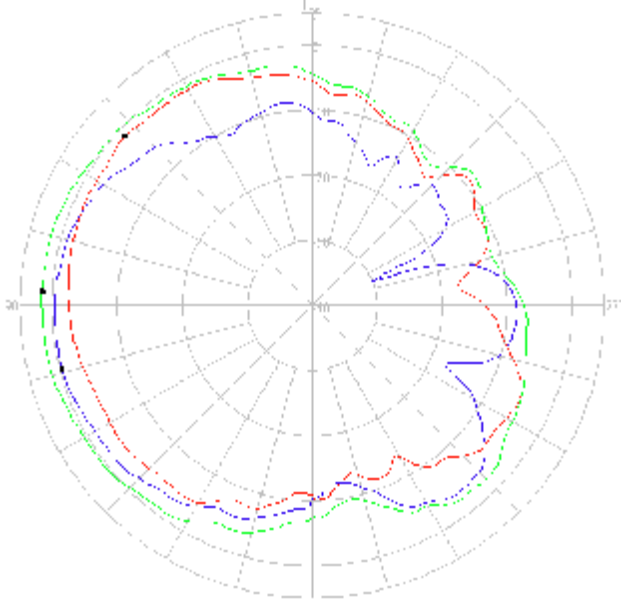
3. Performance Data

3.1 VSWR in the Fixture of Main Antenna

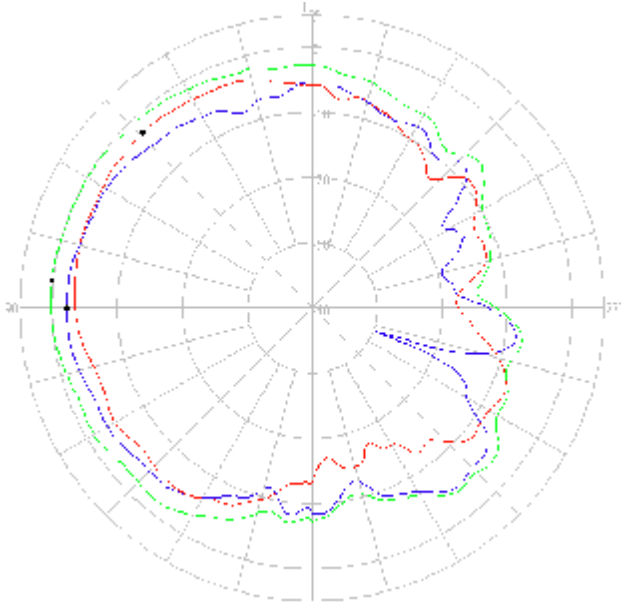


3.2 Radiation Pattern and Gain

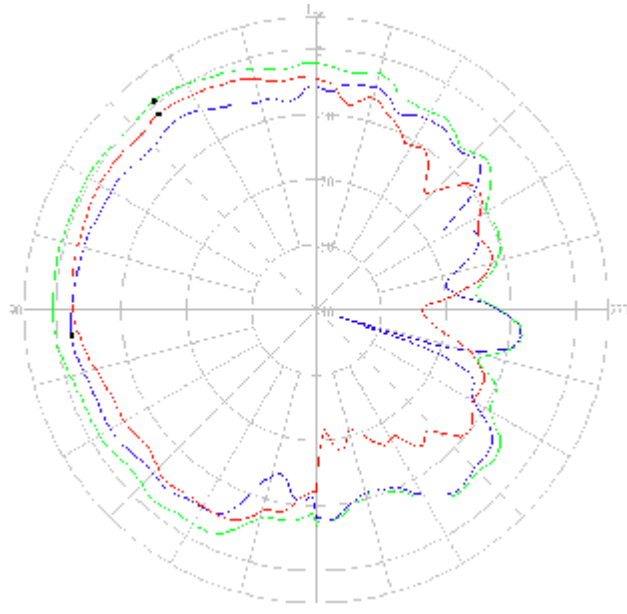
3.2.1 Low Frequency (2.40GHz~2.50GHz) / Main Antenna



2.4GHz



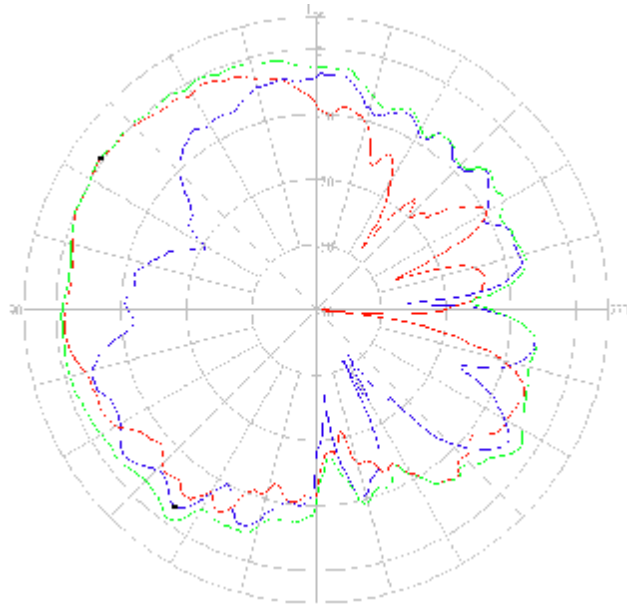
2.45GHz



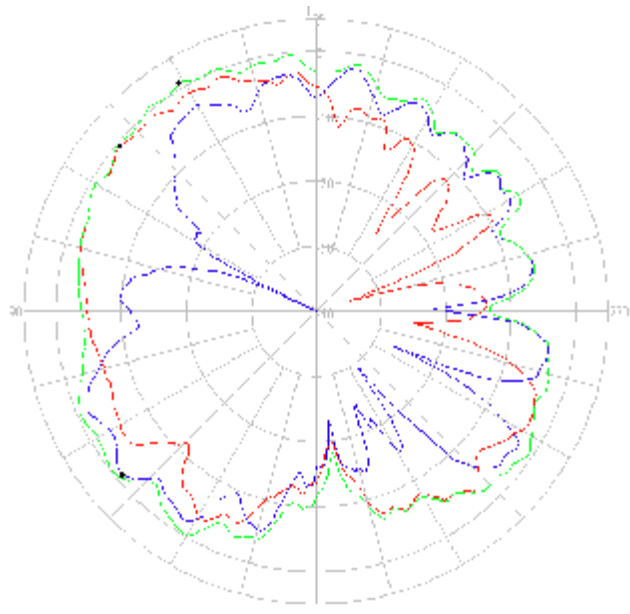
2.5GHz

- **Horizontal**
- **Vertical**
- **H+V**

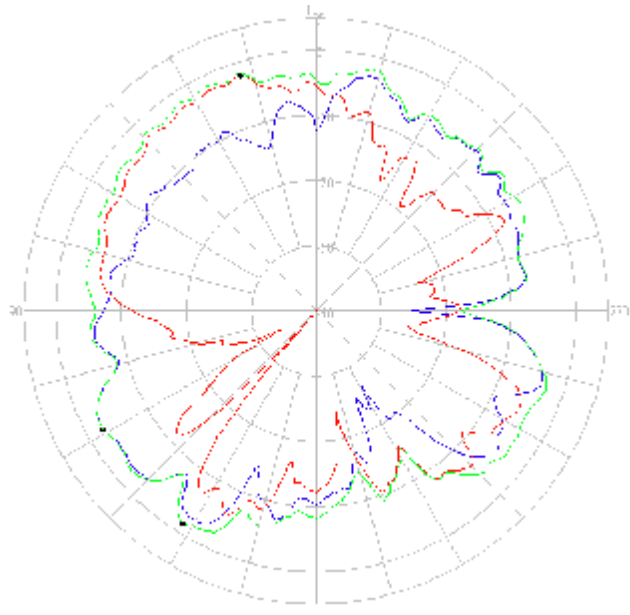
3.2.2 Middle Frequency (5.15GHz~5.35GHz) / Main Antenna






5.15GHz



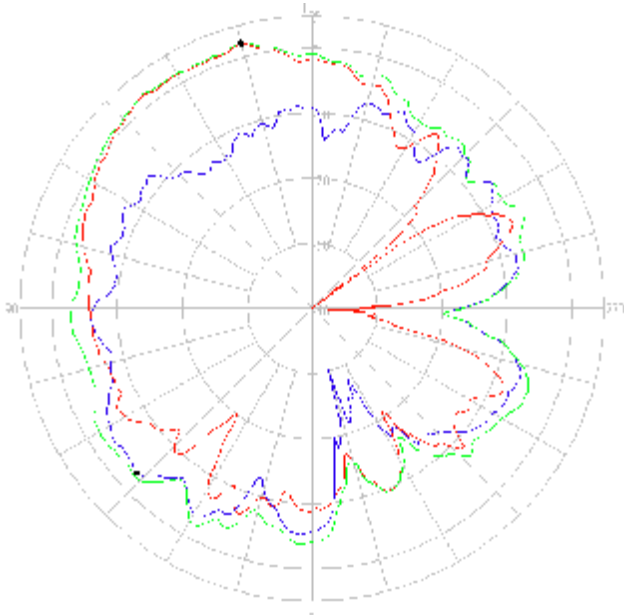
5.25GHz



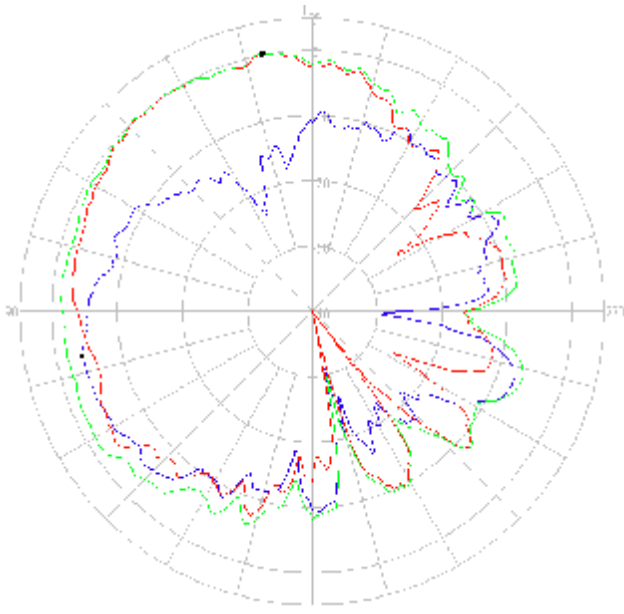
5.35GHz

-  **Horizontal**
-  **Vertical**
-  **H+V**

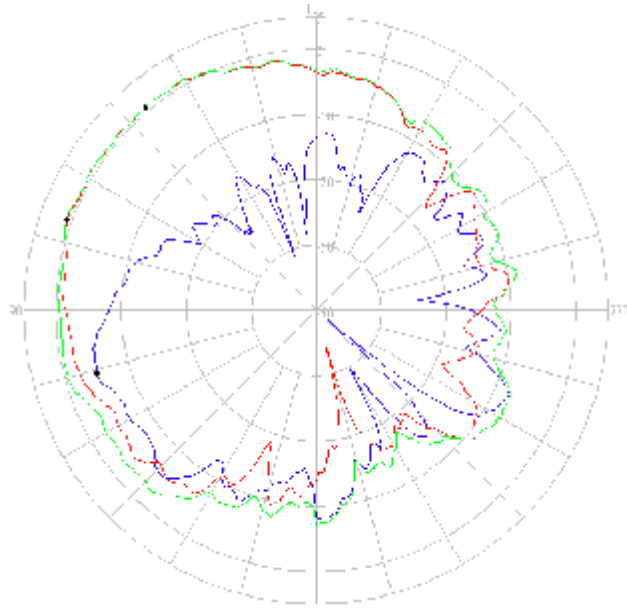
3.2.3 High Frequency (5.47GHz~5.85GHz) / Main Antenna



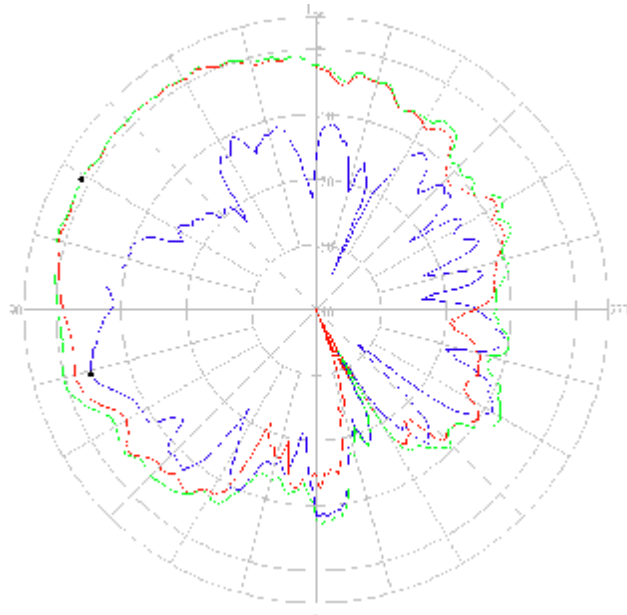
5.47GHz



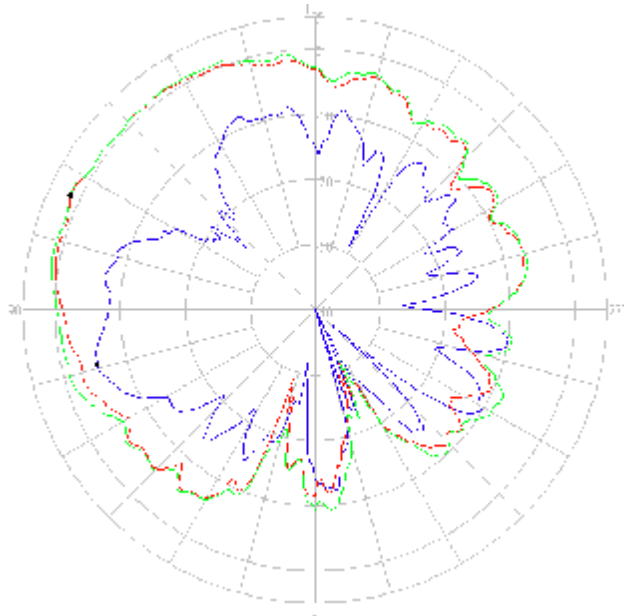
5.6GHz



5.725GHz



5.785GHz



5.85GHz

- **Horizontal**
- **Vertical**
- **H+V**

3.2.4 Average Gain (dBi) Summary

Main Antenna Gain						
Frequency	Max Value (dBi)			Average (dBi)		
	H-pol	V-pol	Total	H-pol	V-pol	Total
2400(MHz)	-0.21	-1.09	1.68	-5.34	-5.34	-2.33
2450(MHz)	-2.22	-2.45	0.30	-6.27	-6.50	-3.37
2500(MHz)	-2.10	-1.28	0.63	-5.93	-5.97	-2.94
5150(MHz)	-2.71	0.56	0.66	-7.61	-5.27	-3.27
5250(MHz)	-0.98	-0.48	1.02	-6.36	-5.54	-2.92
5350(MHz)	-2.50	-2.01	-1.39	-7.17	-8.28	-4.68
5470(MHz)	-2.91	2.09	2.33	-8.16	-4.81	-3.16
5600(MHz)	-3.93	0.24	0.34	-9.61	-5.30	-3.93
5725(MHz)	-4.80	0.81	0.94	-11.32	-4.39	-3.59
5785(MHz)	-3.99	1.39	1.48	-11.78	-3.91	-3.25
5850(MHz)	-5.28	1.57	1.69	-12.43	-4.01	-3.43

4. Antenna Drawing



*ELECTRICAL PERFORMANCE:

- 1.IMPEDANCE:50ohm
- 2.FREQUENCY RANGE:2.4~2.5GHZ for 802.11bg / 5.15~5.85GHz for 802.11a
- 3.WORK VOLTAGE:N/A
- 4.DIELECTRIC WITH STANDING VOLTAGE:AC 1500V for 1MIN
- 5.INSULATOR RESISTANCE:1500 MEGOHMS. MIN

5. Reliability Data For Antenna Patch (Reference To IEC)

IEC 384-10/ CECC 32 100 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.12	4(Na)	Rapid change of temperature	-40 °C (30 minutes) to +90 °C (30 minutes); 5 cycles	No visible damage Central Freq. Change ± 6%
4.14	3(Ca)	Damp heat	500 ± 12 hours at 40 °C; 90 to 95 % RH	No visible damage 2 hours recovery Central Freq. Change ± 6%
4.15		Endurance	500 ± 12 hours at 90 °C;	No visible damage 2 hours recovery Central Freq. Change ± 6%

6. Ordering Information: Yageo Ordering P/N Code

The antennas may be ordered by using the Yageo P/N ordering code. These code numbers can be determined by the following rules:

CAN4313 6 95 03 250 1B
F C M S T A P

F. Family Code

CAN43 = Antenna

C. Packing Type Code

13 = Bulk (1000 pcs)

M. Materials Code

6 = High Frequency Material

S. Size/Series Code

95 = 38.65*7.6*0.3 mm, Main Antenna

T. Tolerance/Cable

03 = Cable Main, Black

A. Working Frequency

250 = 2.45/5 GHz Dual Band

P. Packing

1B = 1000 pcs packing

7. Revision Control

Revision	Date	Content	Remark
R01	Dec. 14, 2007	New Issued, Metal Antenna	N/A.
R02	Jan. 15, 2008	Update UL Card and package description	N/A

8. UL Card

I-Pex Connector

No.2006-3
Feb/13/04

材料証明書 MATERIAL CERTIFICATE

当社製品には下記の材料が使われている事を証明致します。
WE HEREBY CERTIFY THAT THE FOLLOWING MATERIALS ARE USED IN OUR PRODUCT.

PRODUCT NAME : MHF series micro coaxial connector PLUG
P/N 20278 **1R **, 20308 **1R **, P/N 20351 **1R 37

No.	部品 COMPONENT	材料/MATERIAL			UL94難燃性 UL94 FLAME CLASS	UL777#No. UL FILE No.
		材質名 MATERIAL	型名 CAT No.	材料メーカー MANUFACTURER		
1	HOUSING	PBT	3116	WINTTECH POLYMER LTD.	V-0	E 213445

PRODUCT NAME : MHF series micro coaxial connector RECEPTOR
P/N 20279-001E-01, P/N 20314-001E-01

No.	部品 COMPONENT	材料/MATERIAL			UL94難燃性 UL94 FLAME CLASS	UL777#No. UL FILE No.
		材質名 MATERIAL	型名 CAT No.	材料メーカー MANUFACTURER		
1	HOUSING	LCP	E130i	POLYPLASTICS CO.,LTD.	V-0	E 106764

PRODUCT NAME : MHF II connector P/N 20311-**1R-**, P/N 20312-**1R-**

No.	部品 COMPONENT	材料/MATERIAL			UL94難燃性 UL94 FLAME CLASS	UL777#No. UL FILE No.
		材質名 MATERIAL	型名 CAT No.	材料メーカー MANUFACTURER		
1	HOUSING	LCP	A430	POLYPLASTICS CO.,LTD.	V-0	E 106764

株式会社アイベックス
I-PEX Co.,Ltd.

APPROVAL	CHECK	ORIGINATOR
T.Harada Feb/13/04		K.Obayashi Feb/13/04

FORM REV0

Nissei Cable

04-12-20:14:18 :NISSEI ELECTRIC GOLDEN TACT :053 485 8908 # 1 / 1

AVLV2 July 24, 2004
 Appliance Wiring Material - Component
NISSEI ELECTRIC CO LTD E56198
 RYUYO FACTORY 206-1 AZA-OHNISHI, MATSUMOTO IWATA-
 GUN, RYUYO-CHO, SHIZUOKA 438-0206 JAPAN

Table of Recognized Styles

Single-conductor, thermoplastic insulation.							
1164	1331	1516	1609	1727	19107	10504	10653
1180	1332	1517	1610	1827	19109	10508	10654
1198	1333	1528	1637	1828	19231	10509	10655
1199	1334	1538	1671	1829	19248	10510	10656
1212	1356	1577	1664	1847	19315	10516	10657
1213	1371	1584	1709	1943	19344	10599	10730
1226	1398	1586	1710	1948	19386	10607	10734
1227	1512	1591	1723	1959	19443	10608	10735
1330	1543	1592	1726	1986	19485	10617	10736
Multiple-conductor, thermoplastic insulation.							
2095	2384	2516	2598	2669	2843	2995	21007
2096	2385	2517	2614	2764	2854	2994	21111



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AVLV2 July 24, 2004
 Appliance Wiring Material - Component
NISSEI ELECTRIC CO LTD E56198

Table of Recognized Styles							
2097	2386	2520	2626	2709	2876	30002	21112
2098	2387	2519	2630	2725	2934	30007	21113
2099	2388	2520	2631	2726	2935	30276	21242
2100	2440	2570	2677	2778	2936	30399	21245
2101	2462	2571	2683	2780	2937	30535	21256
2102	2463	2574	2684	2786	2938	30708	
2103	2464	2576	2685	2787	2961	30897	
2343	2490	2584	2656	2789	2969	30898	
2344	2495	2586	2660	2805	2990	30899	
2345	2501	2587	2661	2841	2991	30900	
2346	2502	2589	2662	2842	2992	30901	
Single-conductor, thermoplastic insulation.							
3068	3074	3126	3138	3243	3329	3503	3507
3069	3075	3132	3139	3301	3367	3545	3723
3070	3122	3139	3172	3305	3422	3570	3724
3071	3125	3135	3259	3318	3488	3579	3725
Single and multiple-conductor specialty items.							
5145	5187	5228	5226	5228	5230	5233	

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AVLV2 July 24, 2004
 Appliance Wiring Material - Component
NISSEI ELECTRIC CO LTD E56198

Table of Recognized Styles						
5140	5223	5225	5227	5229	5231	5237

Marking: Company name, voltage rating, temperature rating, conductor size, conductor material if other than copper, and use.
LOOK FOR THE RECOGNITION MARK See General Information Preceding These Recognitions
 For use only with equipment where the acceptability of the combination is determined by Underwriters Laboratories Inc.

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PGGU2.MH15431

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SONY CHEMICALS CORP
 KANUMA FACTORY
 18 SATSUKI-CHO
 KANUMA-SHI
 TOCHIGI-KEN 322-8501, JAPAN

MH15431

Pressure sensitive laminating adhesives:NP203, NP203W. For bonding aluminum (thickness.007 to 0.020 in), polycarbonate (thickness.019 to.079 in) and acrylic (thickness.019 to.079 in) to acrylonitrile butadiene styrene (ABS) plastic, maximum surface temperature 80 C (176 F), minimum temperature -40 C (-40 F). Suitable where exposed indoors to high humidity and occasional exposure to water.

NP303, NP303W. For bonding aluminum (thickness.007 to 0.020 in), polycarbonate (thickness.019 to.079 in) and acrylic (thickness.019 to.079 in) to acrylonitrile butadiene styrene (ABS) plastic, maximum surface temperature 80 C (176 F), minimum temperature -40 C (-40 F). Suitable where exposed indoors to high humidity and occasional exposure to water.

G4000, G9303S, T3500, T3500S, T3500SW, T3500W. For bonding aluminum (thickness.007 to 0.020 in), polycarbonate (thickness.019 to.079 in) and acrylic (thickness.019 to.079 in) to acrylonitrile butadiene styrene (ABS) plastic, maximum surface temperature 80 C (176 F), minimum temperature -40 C (-40 F). Suitable where exposed indoors to high humidity and occasional exposure to water.

T4000, T4000W. For bonding aluminum (thickness.007 to 0.020 in), polycarbonate (thickness.019 to.079 in) and acrylic (thickness.019 to.079 in) to acrylonitrile butadiene styrene (ABS) plastic, maximum surface temperature 80 C (176 F), minimum temperature -40 C (-40 F). Suitable where exposed indoors to high humidity and occasional exposure to water.

T4000B, T4000BW. For bonding aluminum (thickness.007 to 0.020 in), polycarbonate (thickness.019 to.079 in) and acrylic (thickness.019 to.079 in) to acrylonitrile butadiene styrene (ABS) plastic, maximum surface temperature 80 C (176 F), minimum temperature -40 C (-40 F). Suitable where exposed indoors to high humidity and occasional exposure to water.

T4500B, T4500BW. For bonding aluminum (thickness.007 to 0.020 in), polycarbonate (thickness.019 to.079 in) and acrylic (thickness.019 to.079 in) to acrylonitrile butadiene styrene (ABS) plastic, maximum surface temperature 80 C (176 F), minimum temperature -40 C (-40 F).

Suitable where exposed indoors to high humidity and occasional exposure to water.

T4700M. For bonding aluminum (thickness 0.002 to 0.032 in) to aluminum, and galvanized steel, max temperature 150 C (302 F) min temperature -40 C (-40 F); Acrylonitrile Butadiene Styrene (ABS) and Polypropylene plastics; max temperature 80 C (176 F) min temperature -40 C (-40 F); Polystyrene plastics; max temperature 60 C(140 F) min temperature -40 C (-40 F). Suitable where exposed indoors to high humidity or occasional exposure to water.

G90XX\$\$. For bonding aluminum (thickness.007 to 0.020 in), polycarbonate (thickness.019 to .079 in) and acrylic (thickness.019 to.079 in) to acrylonitrile butadiene styrene (ABS) plastic, maximum surface temperature 80 C (176 F), minimum temperature -40 C (-40 F). Suitable where exposed indoors to high humidity and occasional exposure to water.

T4700M. For bonding aluminum (thickness 0.002 to 0.032 in.) to aluminum, and galvanized steel, max temperature 150 C (302 F) min temperature -40 C (-40 F); Acrylonitrile Butadiene Styrene (ABS) and Polypropylene plastics; maximum temperature 80 C (176 F), minimum temperature -40 (-40 F); polystyrene plastics, maximum temperature 60 C (140 F), minimum temperature -40 C (-40 F). Suitable where exposed indoors to high humidity or occasional exposure to water.

T4410, T4410W, T4411, T4411W, T4900, T4900W. For bonding aluminum (thickness 0.002 to 0.032 in.) to aluminum, stainless steel, galvanized steel, alkyd enamel and porcelain, maximum temperature 150 C (302 F), minimum temperature -40 C (-40 F); polycarbonate, maximum temperature 100 C (212 F), minimum temperature -40 C (-40 F); polyphenylene oxide, nylon and ABS plastic, maximum temperature 80 C (176 F), minimum temperature 40 C (-40 F). Suitable where exposed indoors to high humidity or occasional exposure to water. Also suitable where exposed outdoors, affixed to all the surfaces mentioned above except aluminum, stainless steel, polycarbonate, polyphenylene oxide and nylon.

T4720. For bonding aluminum (thickness 0.002-0.032 inch) to aluminum and galvanized steel, maximum temperature 150 C (302 F), minimum temperature -40 C (-40 F); ABS plastic, maximum temperature 80 C (176 F), minimum temperature -40 C (-40 F) and polystyrene, maximum temperature 60 C (140 F), minimum temperature -40 C (-40 F). Suitable for indoor use where exposed to high humidity or occasional exposure to water.

T4720. For bonding aluminum (thickness 0.032 inch) to polypropylene, maximum temperature 80 C (176 F). Suitable for indoor use where exposed to high humidity or occasional exposure to water.

G91XX\$\$, for bonding aluminum thickness 0.008 thru 0.020 in., acrylic 0.020 thru 0.079 in. and polycarbonate 0.020 thru 0.079 in. to ABS plastic, maximum temperature 80 C (176 F), minimum temperature -40 C (-40 F). Suitable for indoor use where exposed to high humidity or occasional exposure to water.

"G99XX\$\$". For bonding aluminum face stock 0.007 inch - 0.020 inch thick, polycarbonate face stock 0.020 inch - 0.079 inch thick and acrylic face stock 0.020 inch - 0.079 inch thick to ABS plastic, maximum temperature 80 C (176 F), minimum temperature -40 C (-40 F). Suitable for indoor use where exposed to high humidity or occasional exposure to water.

Note:

\$\$- May be replaced by alpha characters denoting release liner type.

XX-Replaced by digits denoting product thickness.

Marking: Company name or trademark "SC" in a square and laminating adhesive designation on packaging, roll core or release liner.

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Protective Tube

YDPU2.E203950 - Tubing, Extruded Insulating - Component

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Tubing, Extruded Insulating - Component

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SHENZHEN WOER HEAT-SHRINKABLE MATERIAL CO LTD

E203950

XINWEI INDUSTRIAL PARK, WOER MANSION
NANSHAN DISTRICT, XILI
SHENZHEN, GUANGDONG 518052 CHINA

Cat. No.	Max V	Max Temp C	Col Recognized	Max Temp Rated Oil Resistance C	VW-1 Rated #
Heat-Shrinkable Polyolefin Tubing					
RSFR-x	600	125	Black	None	Yes
RSFR-x	600	125	White	None	Yes
WKZM-x-yz	600	125	White	None	No
RSFR-H\$	600	125	All except Clear	None	No
RSFR(CB)	300	125	All except Clear	None	Yes
Not Heat-Shrinkable PTFE Tubing					
WF	600	200	Natural	None	Yes
Heat-Shrinkable Polyolefin Tubing with Meltable Liner					
SBRS	600	105	All except Clear	None	Yes
Not Heat-Shrinkable Standard Wall Silicone Tubing					
WST-600	600	150	White	None	No

x - Designated tubing expanded ID. For Black color tubing, x represents expanded ID of 2 mm - 8 mm. For White color tubing, x represents expanded ID of 1mm - 50 mm.

yz - Represents any alpha and/or numeric combination for internal client code.

- Tubing is considered to comply with the optional VW-1 flammability requirements only if it is so marked.

@ - Tubing limited to 0.7 to 15 mm internal diameters only. VW-1 rated for internal diameter sizes 6.50 - 15.00 mm only.

\$ - 125C rating restricted to 2.36 to 75.0 mm recovered ID only.

Marking: Company name or file number "E203950", catalog number, voltage rating, temperature rating in degrees C,

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YDPU2.E203950 - Tubing, Extruded Insulating - Component

inside diameter (before and after recovery), and date of manufacture shall be marked on tags attached to both ends of the tubing, on the shipping spool label or on the smallest unit container.

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