



Long Distanced Bus Stops Wireless Surveillance Transmission System in Real-time (Along with Buses Data Wireless Transmission)

1. Purpose

Through WiFi MIMO high bandwidth transmission technique, the images at each bus stop go back to the control center. Buses data is also transmit wirelessly to the bus stops to update information of the buses.

By using Wireless WiFi MIMO transmission system, there are advantages as below:

- 1.Images of cameras at each bus stop are transmitted to the control center.
- 2.Offers high bandwidth backbone for bus stops to update information of the buses.
- 3.No need to dig the roads for wires, being able to lower the influences to public traffic.
- 4.No need to monthly or yearly pay ISP for internet bandwidth.
- 5.Wireless surveillance system installation is flexible and easy to extend.
- 6.Wireless system can be extended and added wireless coverage for internet surfing for the passengers.
- 7.Digital broadcasting and emergency communication can be implemented for better buses management and customer service.

2. Design Requirement

There are total 10 bus stops in the designed area. Each bus stop has 4 units of 2MP cameras, installed crossly. The required bandwidth is $4\text{Mbps} * 4 \text{ units} * 10\text{stops} \geq 160\text{Mbps}$ (2MP camera: 2.5Mbps @daytime, 4Mbps @nighttime). Real time images can be transmitted to the control center for recording by multiple wireless backbones.

As for buses information updates to bus stops, data is transmitted through the wireless highway, established by wireless backbone system. Estimated required bandwidth is about 10-20Mbps, another 10-20Mbps is saved for digital broadcasting and emergency communication. The whole required bandwidth for multiple backbone is $160\text{Mbps} + 20\text{Mbps} + 20\text{Mbps} \geq 200\text{Mbps}$.

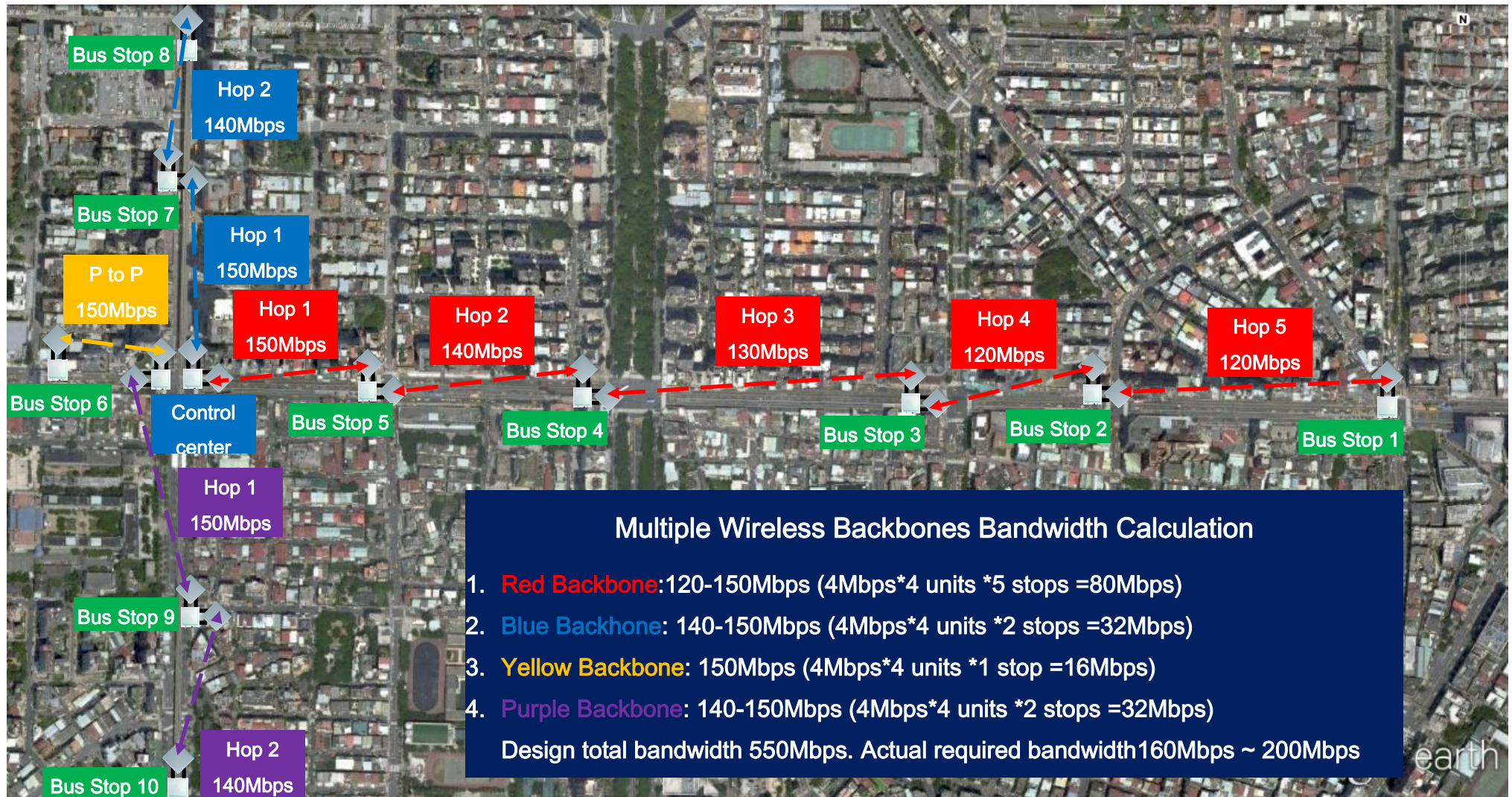


3. Bus Stop Cameras Installation and Environment Sketch





4. Wireless WiFi MIMO Repeater Backbone Transmission Design





5. Bus Stop Wireless WiFi MIMO Repeater Backbone Transmission Representation





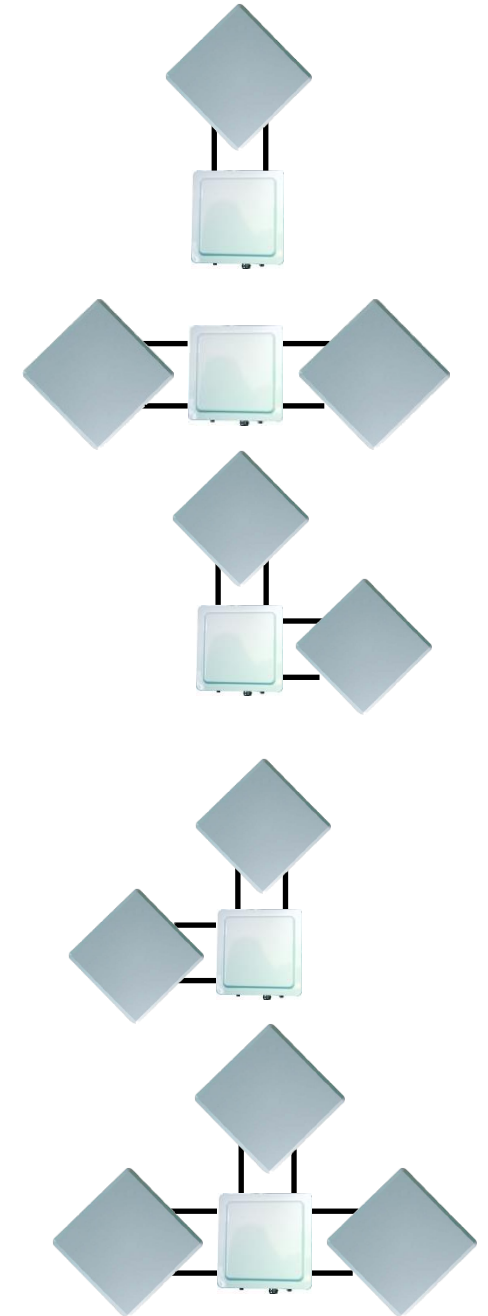
6. Required Equipment

No	Device Name	Device Model	Main SPEC	Quantity	Remark
1	Wireless WiFi MIMO AP -(Surveillance Side)	APM-101R (1 RF module)	<ol style="list-style-type: none"> 1. One MIMO 2*2 RF Module (802.11a/g/n) 2. System Operation Mode: Bridge 3. Output Power : 21dBm (Max) 4. Multiple Hops 5. Bandwidth Throughput : 180Mbps (@40Mbps) 6. >= 4Hops Throughput 120Mbps 	4	
2	Wireless WiFi MIMO AP -(Hops Side and) -(Aggregation point)	APM-102R (2 RF modules)	<ol style="list-style-type: none"> 1. Two MIMO 2*2 RF Modules (802.11a/g/n) 2. System Operation Mode: Bridge 3. Output Power : 21dBm (Max) 4. Multiple Hops 5. Bandwidth Throughput : 320Mbps (@40Mbps) 6. >= 4Hops Throughput 120Mbps 	8	
3	Outdoor WiFi MIMO 5GHz 20dBi Dual Linear Panel Antenna	IOP-PANFO-5M2001010	<ol style="list-style-type: none"> 1.Frequence:5150 - 5875 MHz 2.Gain: 20dBi 3.VSWR: 2:1 4.Polarization : Dual Linear +- 45° 5.N-Type Jack * 2 	20	
4	Antenna RF Cable	IOP-RFCFD-400150NMR	<ol style="list-style-type: none"> 1. Connector: N-type Plug to N-type Plug 2. Cable Loss: <48dB/100m @5800MHz 3. Temp: - 40 ~ + 85°C 	40	
5	Rainproof Tape	IOP-RMTOC-173830510B	<ol style="list-style-type: none"> 1. Thickness: 1.7mm ± 0.5mm 2. Elongation: 1000% 3. Adhesion: Detachment < 2cm 	15	



7. Device Model and SPEC

	Model	APM-101R (H)	APM-102R (H)	APM-103R (H)
Product Images	Rear Side			
	Top of Antenna Connector			
	Below of Antenna Connector			
	Front Side			





Product Specifications

Hardware Specification

Key Components	
Main Processor	Atheros AR7161(680Mhz)
Wireless Chipset	Atheros AR9220 based miniPCI module, Up to three modules
Switch Controller	Atheros AR8035 / Atheros AR8021
Flash Memory	16MBytes
SDRAM	64MBytes(Up to 128MBytes)
Console	UART x 1(PCBA onboard)

Interfaces	
Wireless	Up to three 2x2 MIMO radios, mini-PCI version 1.0 type 3A Frequency ranges : a. USA : 2.400 ~ 2.483 GHz, 5.15 ~ 5.35 GHz, 5.5 ~ 5.7 GHz, 5.725 ~ 5.825 GHz b. Europe: 2.400 ~ 2.483 GHz, 5.15 ~ 5.35 GHz, 5.47 ~ 5.725 GHz



c. Japan: 2.400 ~ 2.497 GHz, 5.15 ~ 5.35 GHz, 5.47 ~ 5.725 GHz

d. China: 2.400 ~ 2.483 GHz, 5.725 ~ 5.85 GHz

RF output power of DNMA-92 :

a. IEEE802.11a

1. 21dBm@6M(all) 17dBm@54M(5180MHz) 16dBm@54M(5825MHz)

b. IEEE802.11b

1. 20dBm@1M(2412MHz) 19dBm@1M(2484MHz) 21dBm@11M(all)

c. IEEE802.11g

1. 23dBm@6M(all) 19dBm@54M(all)

d. IEEE802.11a/n HT20

1. 21dBm@MCS0/8(5180MHz) 19dBm@MCS0/8(5825MHz)

2. 16dBm@MCS7/15(5180MHz) 14dBm@MCS7/15(5825MHz)

e. IEEE802.11a/n HT40

1. 19dBm@MCS0/8(5190MHz) 18dBm@MCS0/8(5795MHz) 13dBm@MCS7/15(all)

f. IEEE802.11g/n HT20

1. 21dBm@MCS0/8(all) 17dBm@MCS7/15(all)

g. IEEE802.11g/n HT40

1. 21dBm@MCS0/8(2422MHz) 20dBm@MCS0/8(2462MHz)



	<p>2. 16dBm@MCS7/15(all)</p> <p>Receive Sensitivity of DNMA-92 :</p> <p>a. IEEE802.11a</p> <p>1.-82dBm@6M, 1Rx -95/-91dBm@6M, 2Rx 2. -65dBm@54M, 1Rx -79/-75dBm@54M, 2Rx</p> <p>b. IEEE802.11b</p> <p>1.-82dBm@1M, 1Rx -95/-91dBm@1M, 2Rx 2. -76dBm@11M, 1Rx -91/-87dBm@11M, 2Rx</p> <p>c. IEEE802.11g</p> <p>1.-82dBm@6M, 1Rx -95/-91dBm@6M, 2Rx 2. -65dBm@54M, 1Rx -80/-76dBm@54M, 2Rx</p> <p>d. IEEE802.11a/n HT20</p> <p>1.-82dBm@MCS0, 1Rx -95/-91dBm@MCS0, 2Rx 2. -64dBm@MCS7, 1Rx -77/-73dBm@MCS7, 2Rx</p> <p>e. IEEE802.11a/n HT40</p> <p>1.-79dBm@MCS0, 1Rx -91/-87dBm@MCS0, 2Rx 2. -61dBm@MCS7, 1Rx -74/-70dBm@MCS7, 2Rx</p> <p>f. IEEE802.11g/n HT20</p> <p>1.-82dBm@MCS0, 1Rx -95/-91dBm@MCS0, 2Rx 2. -64dBm@MCS7, 1Rx -77/-73dBm@MCS7, 2Rx</p> <p>g. IEEE802.11g/n HT40</p> <p>1.-79dBm@MCS0, 1Rx -90/-86dBm@MCS0, 2Rx 2. -61dBm@MCS7, 1Rx -74/-71dBm@MCS7, 2Rx</p>
Ethernet	<p>10/100/1000 Base-TX MDI/MDIX RJ-45 x 1</p> <p>Compliant with :</p>



	a. IEEE802.3 / 802.3u / 802.3at Hardware based 10/100/1000, full/half, flow control auto negotiation
Connector	101R 2 x N-type(1 radio) 102R 4 x N-type(2 radios) 103R 6 x N-type(3 radios)
Power Requirement	48V 1A PoE Support Gigabit Ethernet Link
Watch Dog	Hardware Watch Dog

Physical	
Dimensions	220 x 220 x 77 mm
Weight	101R/101RH—1.8Kg 102R/102RH—1.9Kg 103R/103RH—2.0Kg 2.0kg (3.7kg mount kit included)

Environmental	
Temperature Range	-20°C~70°C



Humidity	0% ~ 95% Non-condensing
Storage	-40~ 85°C
Dusty & Waterproof	Outdoor IP67 rated

Regulatory	
Certification	FCC, CE Processing (will announce in 2012/1)
Safety	Processing

Software Specification

System Operation	
Bridge Mode	Layer 2 Switching Learning Technology
	Store-and-Forward
	Spanning Tree Protocol - IEEE 802.1d STP / IEEE 802.1w RSTP / IEEE 802.1s MSTP
	Static IP / Dynamic IP
	DHCP server / client



	Multicast / Broadcast Storm Limitation
	IEEE 802.1q Tag VLAN
	IEEE 802.1p VLAN Priority Based QoS

Network Interface	
Wireless	IEEE 802.11 a/b/g/n 2.4GHz / 5GHz Dual Band Radio
	2 x 2 MIMO Technology
	Single Radio / Dual Radios / Triple Radios
	AP mode / Client mode / WDS mode
	IEEE 802.11h DFS
	WMM QoS
	Channel / Tx Power / Data Rate / Max Distance Adjustable
	Advanced Wireless Parameters Adjustable



	Multi-SSIDs / VLAN tags mapping(Up to 16 x ESSIDs for each radio)
	Wireless Site Survey
	Node Information
	Concurrent Connected Node Limitation
	Client User Isolation
Wire	48V 1A PoE Support Gigabit Ethernet Speed
	Ethernet Link Speed Configurable
	10/100/1000 Base-TX MDI/MDIX RJ-45

Performance		
Wireless	TCP	Up to 180Mbps for one radio to Ethernet
To		Up to 320Mbps for two radios to Ethernet
Wire		Up to 320Mbps for three radios to Ethernet



	UDP	Up to 240Mbps for one radio to Ethernet
		Up to 350Mbps for two radios to Ethernet
		Up to 350Mbps for three radios to Ethernet
	PPS	$\geq 20,000$ @short packet for one radio to Ethernet
		$\geq 28,000$ @short packet for two radios to Ethernet
		$\geq 28,000$ @short packet for three radios to Ethernet
Latency	< 5ms	
Multiple Hops	2 hops	Up to 160Mbps
	3 hops	Up to 150Mbps
	≥ 4 hops	Up to 140Mbps
	PPS	$\geq 20,000$ @short packet at multiple hops
	Latency	< 10ms



Security

Hide SSID(turn off ESSID broadcasting)

MAC Address ACL

WEP 64/128/152 bits

IEEE 802.1x EAP-MD5 / EAP-TLS / EAP-TTLS

WPA / WPA2 PSK / EAP with TKIP / CCMP AES based Encryption

Management

HTTP(s) WEB GUI

Telnet

SSH

Console(optional interface)

CLI commands

SNMP v2c/v3, standard / private MIBs



Syslog
Management VLAN Tag
NTP Client
Firmware upgrade / downgrade
Dual Images
Dual Configuration files / Factory Default
Multiple Level Management

Advanced Technology	
Multiple Hopping	Up to 10 hops with more than 120Mbps throughput
	Configurable Max. Hop Counts(default 20 hops)



IOP-PANFO-5M2001010

5GHz 20dBi Dual Polarization MIMO Panel Antenna

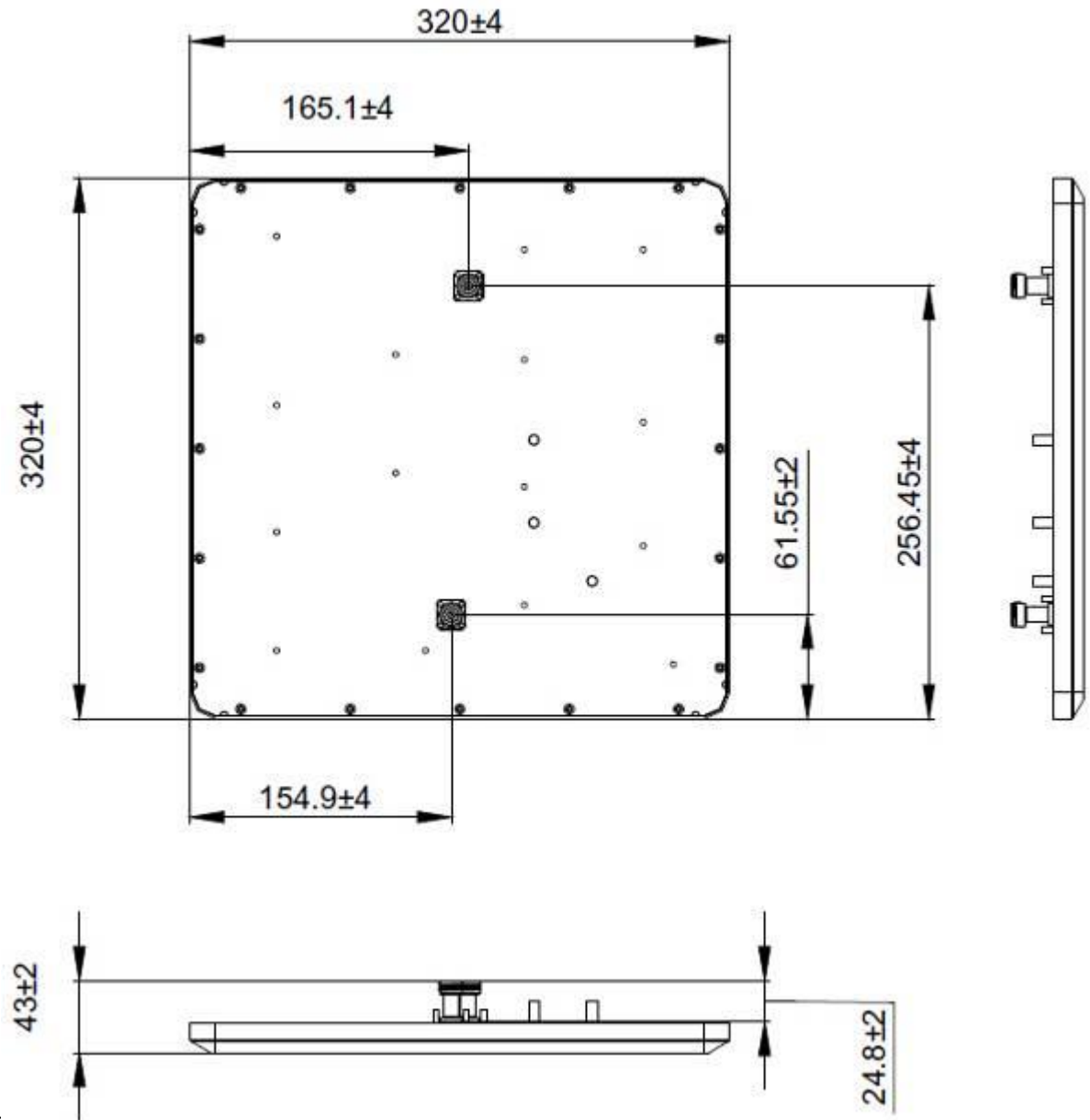
Electrical Specification	
Frequency range	5150 - 5875 MHz
Gain	20 dBi
VSWR	2 : 1 Max.
Polarization	Dual Linear, +/- 45°
HPBW / Horizontal	10°
HPBW / Vertical	10°
Standard compliance	N / A
Front to back ratio	-30dB (Max)
Isolation	24dB (Min)
Power handling	6W (cw)





Impedance	50 Ohms
Connector	N Jack × 2
Environmental & Mechanical Characteristics	
Survival wind speed	216Km/hr
Temperature	-40°C to +80°C
Humidity	95% @ 55°C
Lightning protection	DC ground
Radome color	Gray
Radome material	PC, UV resistant
Weight	1245g
Dimensions	320 × 320 × 20 mm
Waterproof	IP-67
Mounting kit	Pole mount & Wall mount

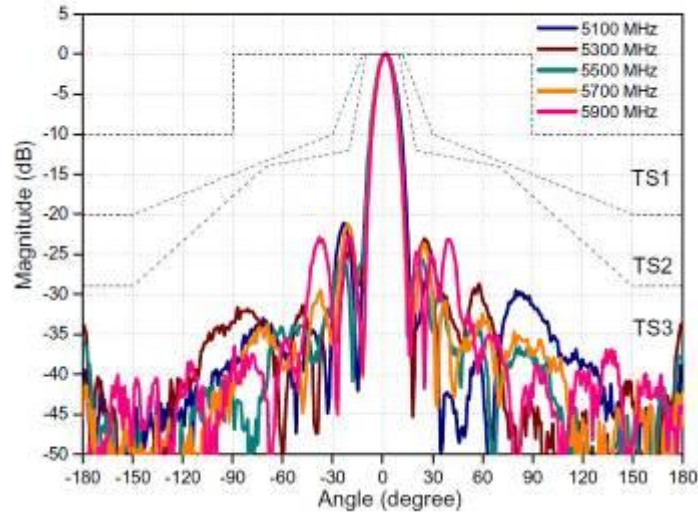
*exclusive of mounting kit



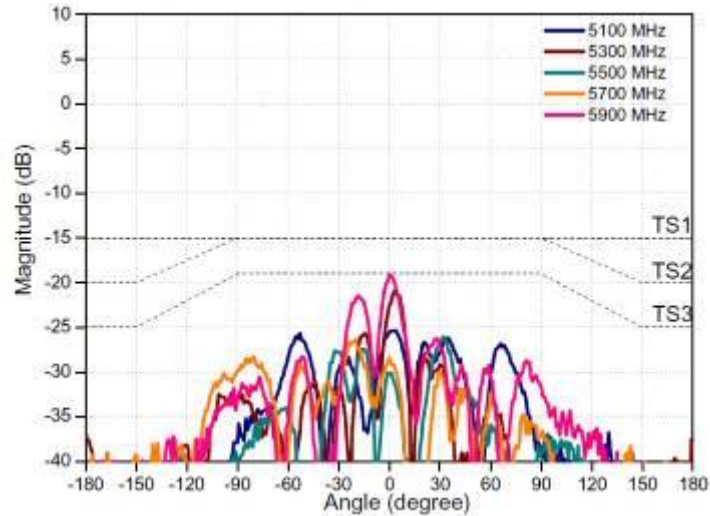


Port 1

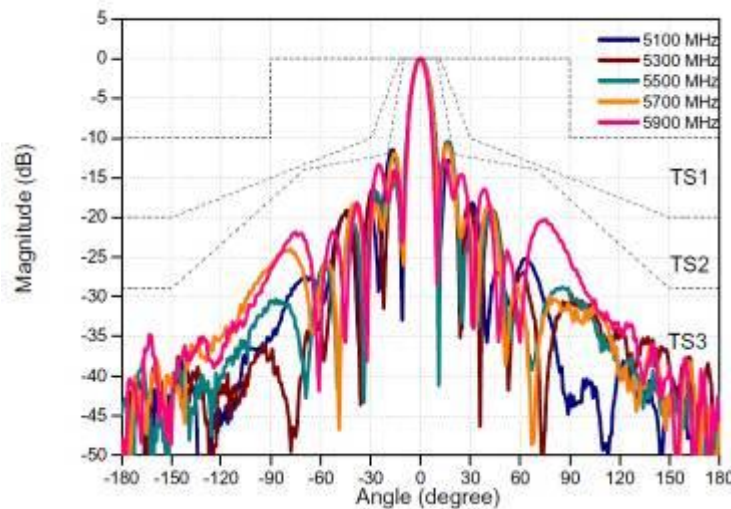
V-plane Co-polarization Pattern



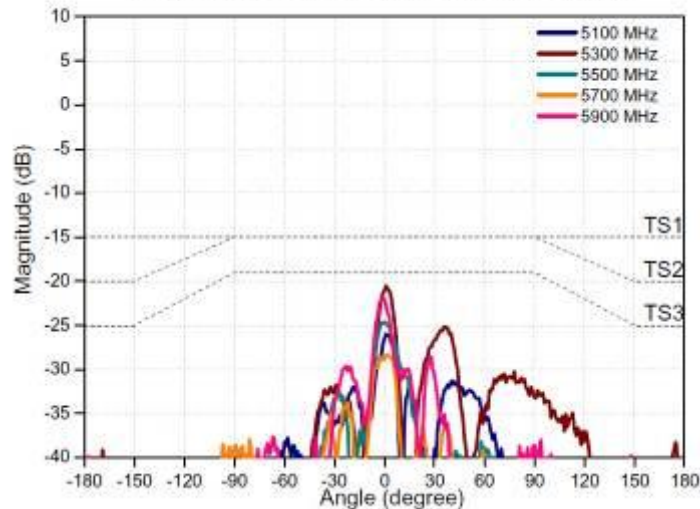
V-plane Cross-polarization Pattern



H-plane Co-polarization Pattern



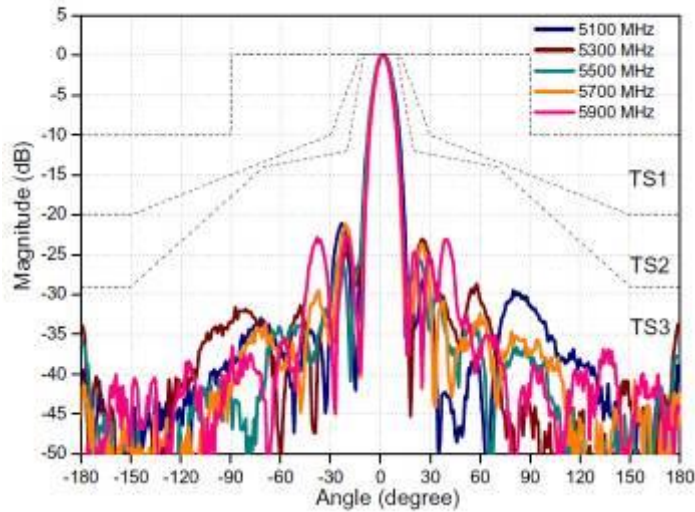
H-plane Cross-polarization Pattern



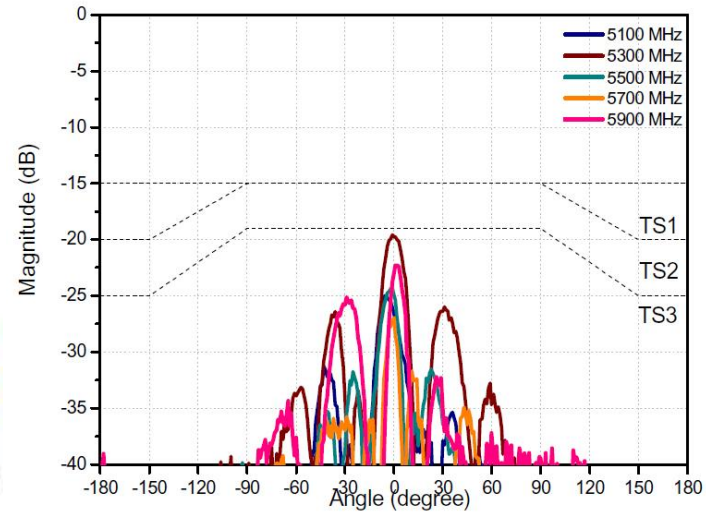


Port 2

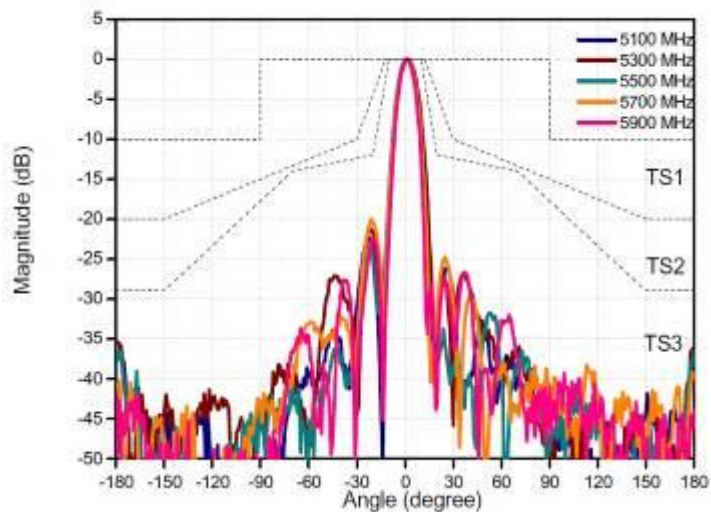
V-plane Co-polarization Pattern



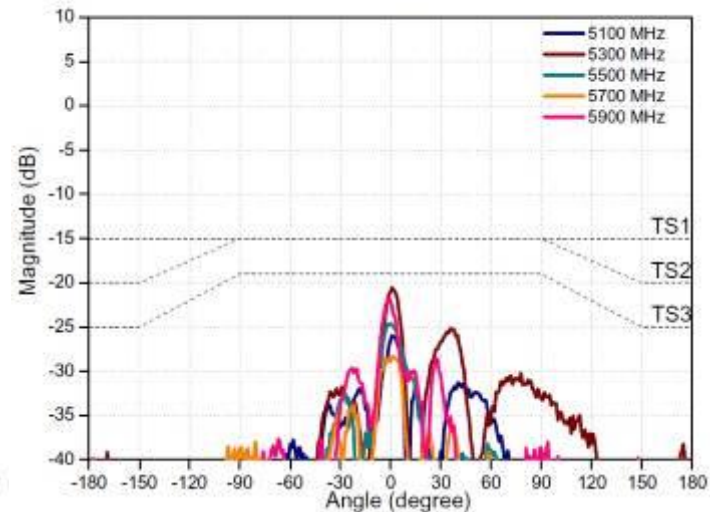
V-plane Cross-polarization Pattern



H-plane Co-polarization Pattern



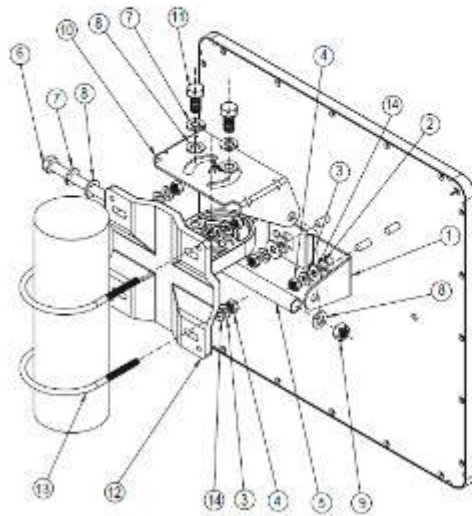
H-plane Cross-polarization Pattern



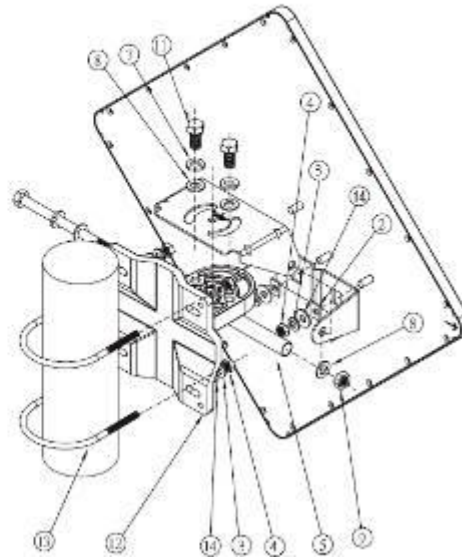


Pole Mount

Slant+45 Degree Polarization



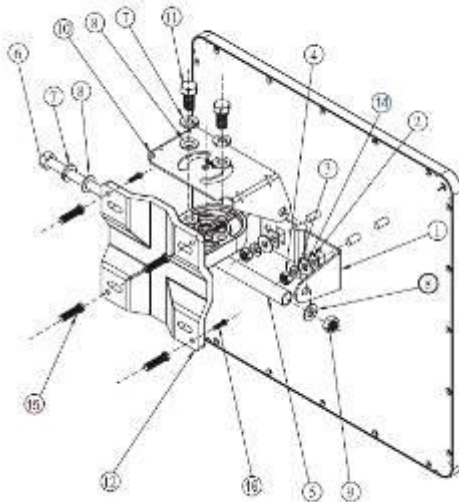
Hor. & Ver. Polarization



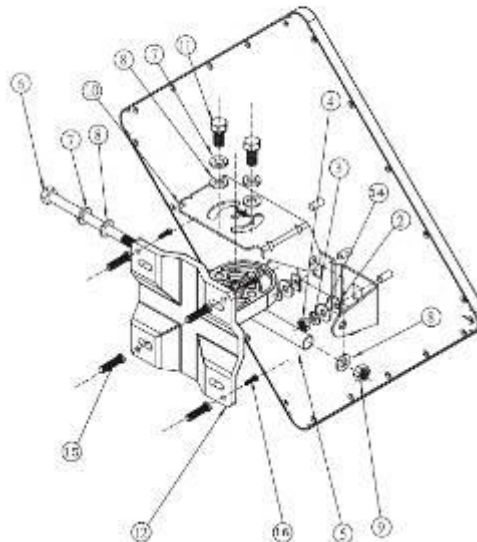
- | | |
|------------------------|------|
| 1. M-Type breaket (L) | 1Pcs |
| 2. Space Keeper | 2Pcs |
| 3. Spaing washer | 6Pcs |
| 4. M6-1.0 Nut | 6Pcs |
| 5. Steel tube 93.2 mm | 1Pcs |
| 6. XHM8-1.25*120 | 1Pcs |
| 7. M8 spring washer | 3Pcs |
| 8. M8 washer | 4Pcs |
| 9. M8 Nut | 1Pcs |
| 10. Rotating bracket | 1Pcs |
| 11. XHM8-1.25*20 | 2Pcs |
| 12. Mounting main fram | 1Pcs |
| 13. U-Type Screw | 2Pcs |
| 14. M6 washer | 6Pcs |
| 15. Wall Tiger | 4Pcs |
| 16. TH 5/32-16*1" | 4Pcs |

Wall Mount

Slant+45 Degree Polarization



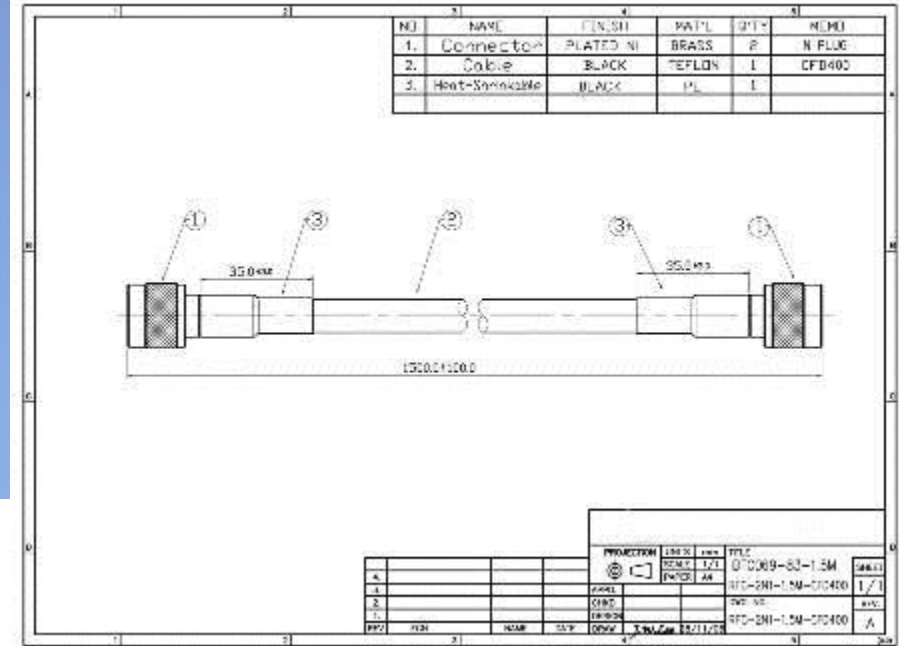
Hor. & Ver. Polarization





IOP-RFCFD-400150NMR

CFD-400 N-Type 1.5M Antenna RF Cable





CFD-400 RF Cable SPEC

Standard: CFD400 (CFD400-E) CABLE 1/2.74MM X 1C

CONSTRUCTION:

ITEM	UNIT	2.74MM
No. of Wire	P·C	1C
1) Conductor	Material	Copper Clad Aluminium
	Size	No./mm
2) Insulation	Material	PEF
	Thickness	mm
	O.D	mm
3) Binder	---	Sealed Aluminum Mylar Tape
4) Braid Shield	Material	Tinned Copper Wire
	Coverage	%
5) Jacket	Material	PVC or PE
	O.D	mm

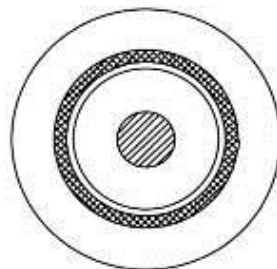
MECHANICAL PROPERTIES:

ITEM	UNIT	
Minimum Bend Radius	mm	25.4
Weight	kG/m	0.1
Tensile strength	kG	72.6
Operating temperature	°C	-40/85

ELECTRICAL PROPERTIES (20°C):

ITEM	UNIT	
Conductor Resistance	Ω /Km	1.67
Impedance	Ω	(NOM.) 50
Capacitance	PF/FT	(NOM.) 23.9
Velocity of propagation	%	(NOM.) 85
DC resistance, inner cond.	Ω /Km	4.56
DC resistance, outer cond.	Ω /Km	5.41
Shielding effectiveness	dB	≥ 90

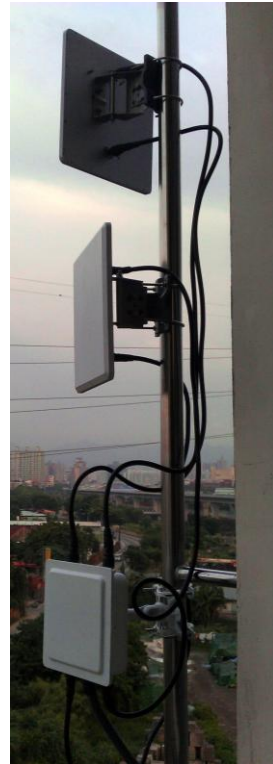
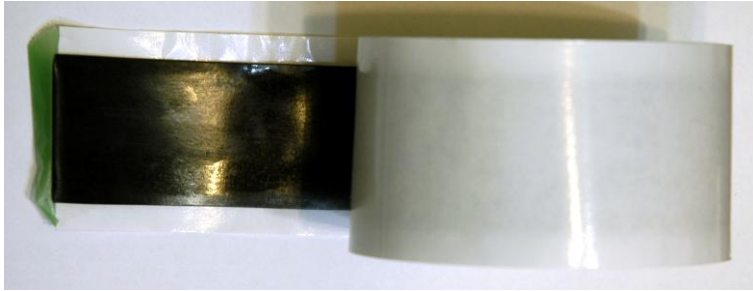
Attenuation (nom.)	
MHz	dB/100ft
30	0.7
50	0.9
150	1.5
450	2.7
900	3.9
1500	5.1
2000	6.0
2500	6.8
5800	10.8





IOP-RMTOC-173830510B

Self-Bonding Rainproof Insulating Tape SPEC



Specifications and instructions for use



1. The scope of:

- 600V Low-voltage connector used for sealing and insulation
- High and low voltage bus of anti-corrosion protection, maintenance of high pressure joints of waterproofing treatment

2. Conditions of use:

- Environment temperature is below 40 °C
- Continuous operating temperature: 90 °C below 130 °C under low pressure overload and emergency operation linkage PE joints of copper or aluminum cables.

3. Characteristics:

- Voltage level : 600V
- AC voltage : Above 25KV
- Insulation resistance : 1x106MΩ
- Black, thickness : 1.7mm±0.5mm
- Adhesion/split : Below 2cm
- Extension rate : Above 1000%
- Tensile breaking force : Above 2Kg
- Water absorption : Below 0.2%
- Stability : 130°C/100hrs No gum

4. Instructions for use: With low-voltage cable straight connector as an example

