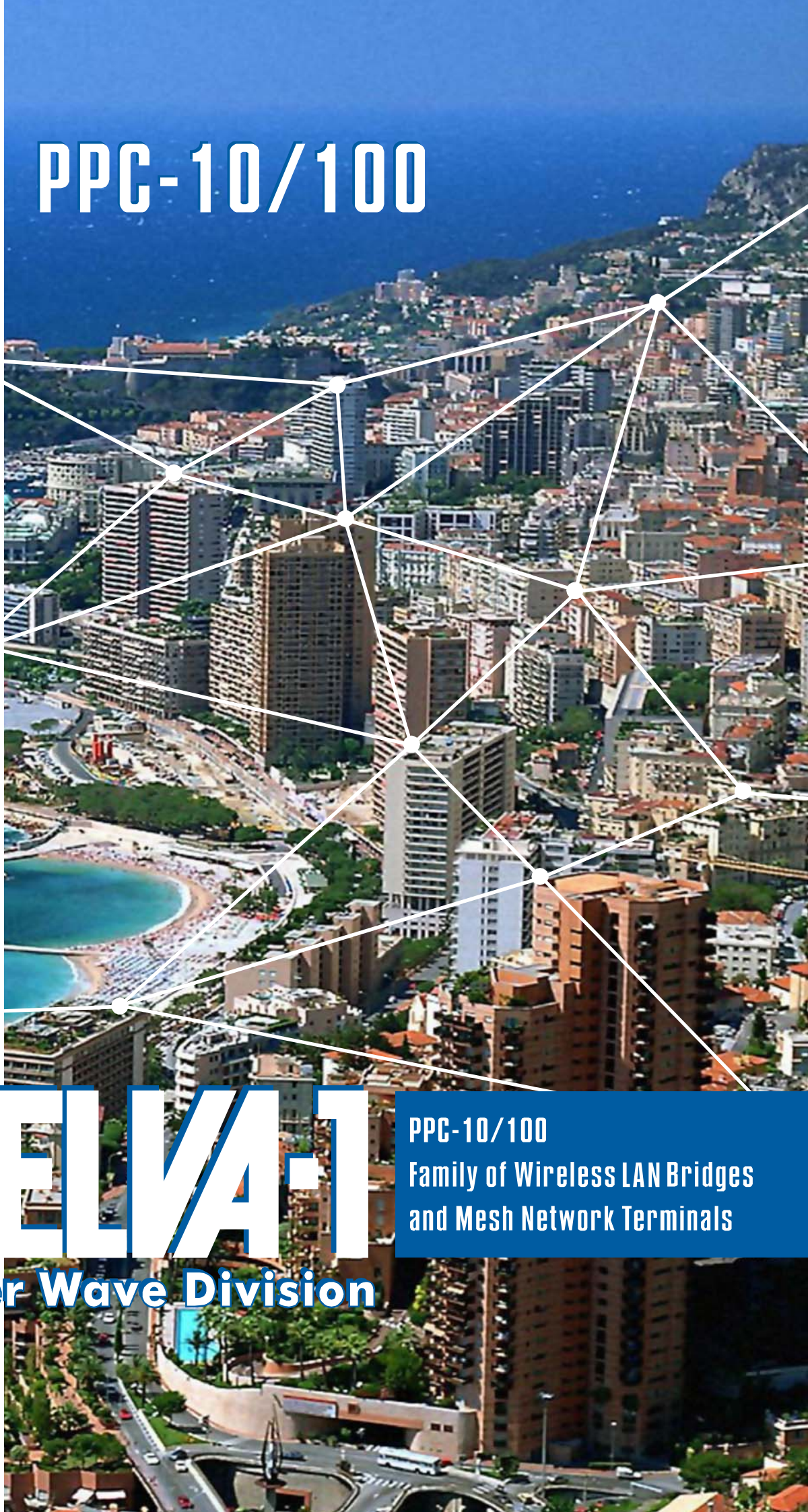
PPC-10/100

PPC-10/100
Family of Wireless LAN Bridges
and Mesh Network Terminals

PPC-10/100



ELVA-1

Millimeter Wave Division

PPC-10/100
Family of Wireless LAN Bridges
and Mesh Network Terminals

PPC-10/100

PPC–10/100 product line is a family of mm–wave digital radio transceivers for Ethernet 10/100Mbps LAN to LAN connectivity. PPC–10/100 stations can be used either in classic point–to–point links as LAN bridges or in advanced topology of mesh network with complex multipoint–to–multipoint configuration.

PPC –10/100 LAN Bridge is a base product of the family. It can be used either straightforward to build point–to–point link or as a base unit for mesh networks. The LAN Bridge is software–free, IP packet transparent, 42/60/94GHz wireless bridge that connects two or more Ethernet LANs. Unlike its market competitors that are software–controlled units, PPC–10/100 bridge works on ISO/OSI physical layer and LAN devices with own IP addresses as host computers and routers simply cannot detect its presence. In other words, PPC–10/100 works much more like ISO/OSI physical layer repeater than a traditional MAC Layer Bridge. For building–to–building wireless link PPC–10/100 passes all Ethernet protocols including IP, IPX, AppleTalk, etc. Another advantage of PPC–10/100 LAN Bridge is standard Ethernet speed for a wireless link – it provides true full duplex throughput at 10/100Mbps on distances up to 10km.

Applications:

- Wireless full duplex connection link for remote LAN segments
- Broadband wireless access equipment to build mesh networks by communication service providers
- ISP–to–client Internet Last Mile solution for businesses and demanding home users
- Real–time measuring systems in large industrial/civil objects like power station, electricity or water supply station, transport control systems etc.
- Reliable digital communication channels in industrial regions with high level of EMI noise, in complex landscapes or at city areas with expensive cable–laying.

What is Mesh Network

Mesh network topology is based on a large number of peer nodes that are forming radio links with each other. The components of the mesh network among client stations include auxiliary system nodes that inject capacity into the mesh, delivering the initial coverage and interconnect capacity. Each node consists of one or more standard Outdoor Units (ODUs), which are the mm–wave digital

radios with dishes.The customers also use an Indoor Units (IDU), which are the service interface devices. For ODUs like PPC 10/100 stations the service interface device (IDUs) are just standard Ethernet equipment that is widely available on the market. There is no need of any specialized equipment unless standard Ethernet units like routers, hubs, etc.

The latest developments in microwave engineering show mesh network as much more effective broadcast solution than a traditional star topology of mm–wave transceivers with one powerful base station and a number of small client receivers. Designed to provide broadband Internet services to home users and small businesses, mesh network copies the Internet topology with its tolerance to breakage of individual connections. This eliminates many limitations for star–topology solutions. Thus, mesh network clients do not so badly depend on line–of–sight requirements as there is lot of other transceivers around each of them in the network. More over, every new client node doesn't decrease other links performance as it brings another connectivity path to central nodes and in such a way increase the overall throughput of the network.

Another advantage of Internet–like topology of wireless mesh network is its manageability. Network providers can use the same commercially available equipment and software to administrate mesh network traffic – Cisco routers, UNIX/Windows servers, etc.

Bands of operation

ELVA–1 produces PPC–10/100 stations for operation in three mm–wave bands: 40.5 – 43.5 GHz, 59 – 64 GHz and 92 – 96 GHz.

This covers all of the most promised bands in high frequency part of mm–wave spectrum.

40.5 - 43.5GHz is the band which is allocated in Europe for broadband wireless access services, which makes all products for this band as market–demanded ones. The significant 3GHz width of the band allows "slicing" it for many and many sub–bands to use by client wireless links. As a result, very populated cells can be built with hundreds of narrow antenna beamwidth client stations on a square mile area.

59 - 64 GHz is unlicensed band in USA and Canada and in a number of other countries. Accordingly to FCC Rules, Part 15 the low–powered microwave equipment must be licensed only for spurious harmful interference, but not for using the band itself. This offers the challenge to design, produce and mass installation of 60GHz transmitters in urban areas.

The 59 – 64 GHz band is characterized by a significant attenuation in atmosphere. At the frequency of 60GHz, absorption is very high with 98% of the transmitted energy absorbed by atmospheric oxygen per km. Because to complying with FCC Part 15 mm–wave stations need to have limited radiated power, the atmospheric absorption limits 60GHz mm–wave transceivers link range for relatively short overall distance. Usual wireless link distances for typical 50–100mW transmitter are about 1–2km. But while oxygen absorption at 60GHz severely limits the range of communication, it also eliminates interference between same frequency stations. Up to 1,000 systems operating at 60GHz can be allocated within a square kilometer area without interference problems when used with narrow antenna beamwidth. That's why using 60GHz transmitters for LAN interconnection, digital TV/Internet broadcasting allows to build high density populated networks and looks so promising for communication service providers and mm–wave equipment manufactures.

92 - 96 GHz is a local maximum in atmosphere transparency, allowing increased overall distance of wireless link. The band has no special regulation by FFC yet. The atmospheric absorption for the band is much less than for 59 – 64 GHz band, with numbers of attenuation like 0.3 – 0.4dB/km compare to approximately 16dB/km for 59 – 64 GHz band. This is why for the same transmitting power the distance range for 92 – 96GHz link significally increases compare to a link operating in 59 – 64 GHz band. ELVA–1 designs PPC10/100 transmitters operated at 92 – 96GHz band as a pilot project. The model range includes 10Mbps and 100MBps stations with UTP–5 cable or fiber–optic LAN interface. These 50mW stations operate on distances up to 3.2km (measured at rain intensity 5mm per hour).

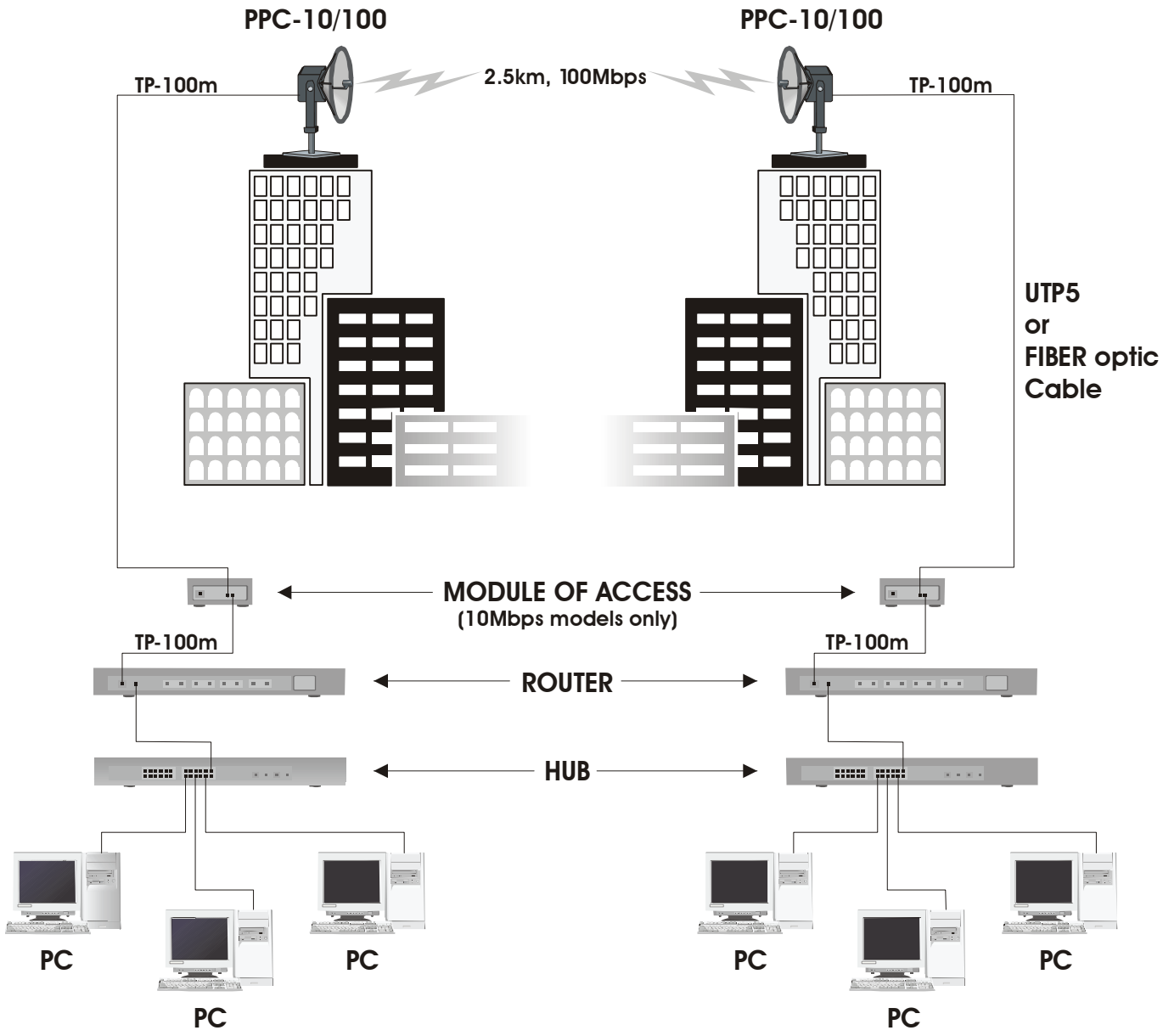
PPC-10/100 Technical Description

The wireless bridge consists of three main parts:

- Microwave Radio Module with antenna
- Adjusting Module (Stand and Calibrator)
- Module of Access (Radio/LAN converter) – for 10Mbps models only

Radio Module

Radio Module consists of microwave module, video module, power supply unit and antenna. The microwave module, video module and power supply unit are located inside whole hermetic enclosure,



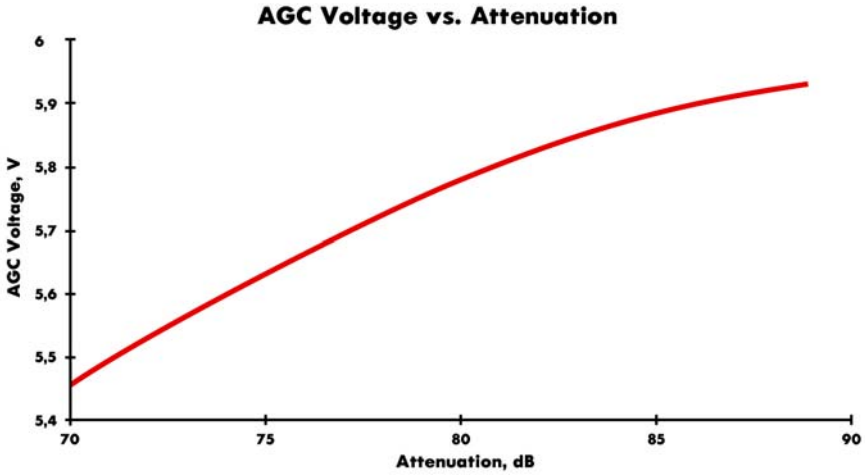
to which one the antenna dish is firmly mounted. The radio module operates at temperatures from –40°C up to +50°C and does not require an additional protection from direct sunlight, rain/snow and other weather impact.

Size of radio modules is the same for all frequency bands. Various size of antenna would be used according customer requirements: 100mm, 200mm, 300mm, 450mm and 600mm diameter. The larger an antenna is, the higher is a gain, and large dishes should be used on long distances. On the other hand the adjustment of large antenna is more difficult, because it is more sensitive to errors in alignment.

The Radio Module powering is from 110/220 VAC main or from an optional –48VDC Power Supply.

Adjusting Module

The Adjusting Module serves the radio module as a stand and for calibration purpose. The traversing mechanism allows changing the radio module position on 360 ° in horizontal direction and 45 ° in vertical direction. Automatic Gain Control (AGC) voltage, gated out on an external connector is used for tuning of direct line–of–sight to other end of wireless bridge. Each radio module is shipped with an individual calibration notice.



The level of signal attenuation depending on the distance between two Radio Modules can be calculated using the formula:

42 GHz: L = 125 + 20*Log(R) + 0.2*R –2*G

60 GHz: L = 128 + 20*Log(R) +16*R –2*G

94 GHz: L = 132 + 20*Log(R) + 0.4*R –2*G

Where L – Free Space Losses (dB)
R – Distance (km)
G – Antenna Gain (dB)

Overall dimensions of the Radio Module with the antenna and adjusting module are no more than 33x35x46 cm, with mass is no more than 12.0 kg. Connecting of the 10MBps Radio Module to a LAN segment is made through a Module of Access using standard fifth category twisted pair cable (UTP5).

Max UTP5 cable length between the LAN segment (computer) and Module of Access is 100 m, while max UTP5 cable length between the Module of Access and Radio Module is 100 m as well. The 100Mbps models can be connected either by UTP5 cable or by fiber–optic cable.

Because of more advanced design 100Mbps models do not have standalone Module of Access as it is integrated to a transceiver unit. See model table below for more details.

Wireless bridge PPC–10/100 was specially designed for a transmitting of the true Ethernet 10/100Mbps signals. That makes it absolutely transparent for any data and allows using it with no any additional software and hardware installed.

Model Range

ELVA–1 Millimeter Wave Division produces a wide range of 10/100Mbps PPC–10/100 stations to comply with requirements of customers from any market niche – from small businesses needed to connect two LAN segments to communication service providers building broadband access networks.

Model No.	Data Rate, Mbps	Frequency, range, GHz	Range*, m Antenna Diameter, cm. 10	20	30	45	60	Network Interface	Power
PPC–010QXX–ACTP	10	40.5 – 43.5	4700	9000	11900	15800	17500	Twisted Pair	220/110 VAC
PPC –010VXX–ACTP	10	59.05 – 64	1370	1800	2150	2550	2850	Twisted Pair	220/110 VAC
PPC –010WXX–ACTP	10	92 – 96	4900	7000	8350	–	–	Twisted Pair	220/110 VAC
PPC –010QXX–DCTP	10	40.5 – 43.5	4700	9000	11900	15800	17500	Twisted Pair	48 – 75 VDC
PPC –010VXX–DCTP	10	59.05 – 64	1370	1800	2150	2550	2850	Twisted Pair	48 – 75 VDC
PPC –010WXX–DCTP	10	92 – 96	4900	7000	8350	–	–	Twisted Pair	48 – 75 VDC
PPC –100QXX–ACTP	100	40.5 – 43.5	2400	5600	8000	11500	13200	Twisted Pair	220/110 VAC
PPC –100VXX–ACTP	100	59.05 – 64	1000	1400	1700	2100	2400	Twisted Pair	220/110 VAC
PPC –100WXX–ACTP	100	92 – 96	3200	5200	6400	–	–	Twisted Pair	220/110 VAC
PPC –100QXX–ACFO	100	40.5 – 43.5	2400	5600	8000	11500	13200	Fiber Optic	220/110 VAC
PPC –100VXX–ACFO	100	59.05 – 64	1000	1400	1700	2100	2400	Fiber Optic	220/110 VAC
PPC –100WXX–ACFO	100	92 – 96	3200	5200	6400	–	–	Fiber Optic	220/110 VAC
PPC –100QXX–DCTP	100	40.5 – 43.5	2400	5600	8000	11500	13200	Twisted Pair	48 – 75 VDC
PPC –100VXX–DCTP	100	59.05 – 64	1000	1400	1700	2100	2400	Twisted Pair	48 – 75 VDC
PPC –100WXX–DCTP	100	92 – 96	3200	5200	6400	–	–	Twisted Pair	48 – 75 VDC
PPC –100QXX–DCFO	100	40.5 – 43.5	2400	5600	8000	11500	13200	Fiber Optic	48 – 75 VDC
PPC –100VXX–DCFO	100	59.05 – 64	1000	1400	1700	2100	2400	Fiber Optic	48 – 75 VDC
PPC –100WXX–DCFO	100	92 – 96	3200	5200	6400	–	–	Fiber Optic	48 – 75 VDC

* Calculated at rain intensity 5 mm per hour.

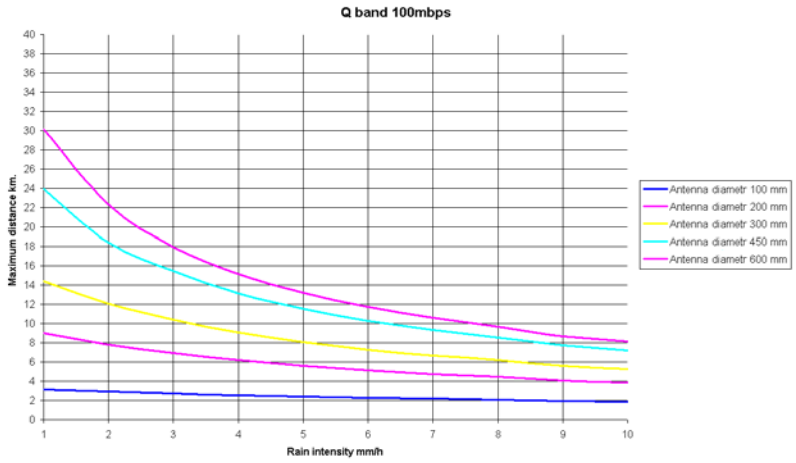
To choose the right model by its product code please use the following encoding schema:

P P C - 0 1 0 Q 3 0 - D C T P

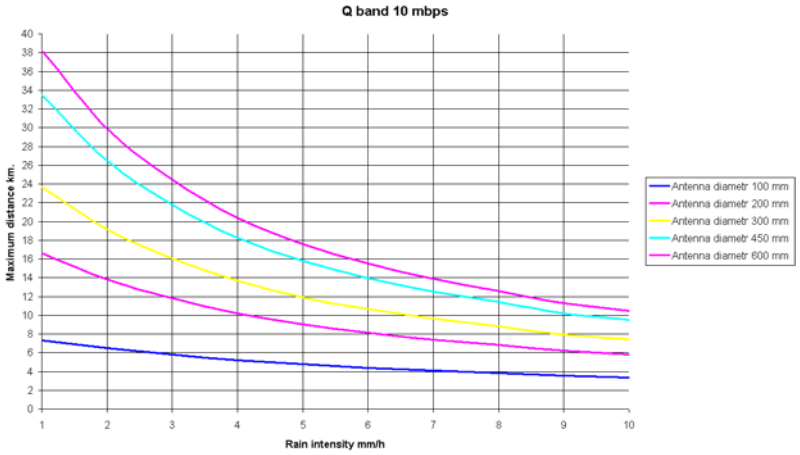
- Data Rate (tree digits)
  010 – 10 Mbps
  100 – 100 Mbps
- Frequency Range (1 letter)
  Q – 40.5 to 43.5 GHz
  V – 59.05 to 64 GHz
  W – 93 to 96 GHz
- Antenna Diameter (2 digits)
  10 – 10 cm
  20 – 20 cm
  30 – 30 cm
  45 – 45 cm
  60 – 60 cm
- Network Interface (2 letters)
  TP – Twisted Pair
  FO – Fiber Optics
- Power (2 letters)
  AC – 220/110 VAC
  DC – 48 – 75 VDC

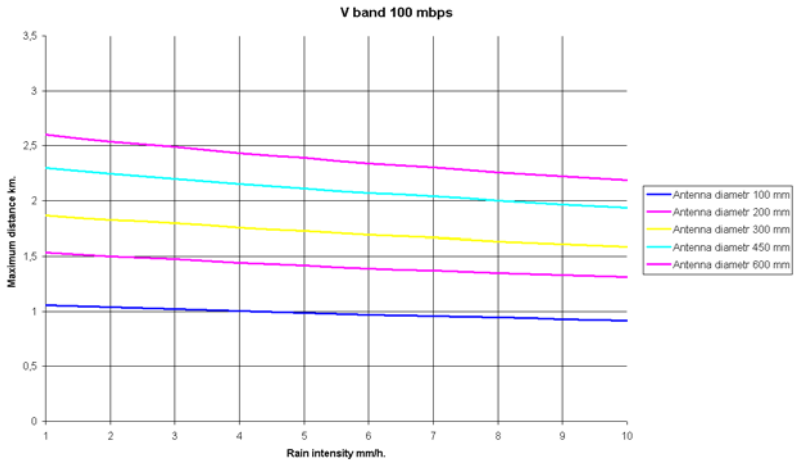
Local climatology defines link range

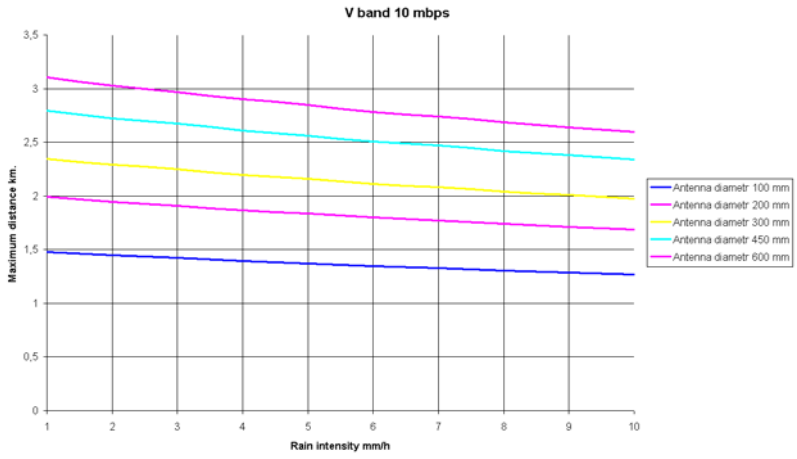
Link performance of millimeter wave line–of–sight systems is governed by the effects of local climatology and in particular precipitation, which usually includes rain but also other hydrometeors such as hail, fog, wet snow and sleet. On graphs below there are experiment–calculated dependences for rain intencity vs. attenuation for 10Mpbs and 100Mpbs point–to–point models at 40.5 – 43.5 GHz, 59 – 64 GHz and 92 – 96 GHz bands. These data allow network providers to optimize link range for districts with wet climate and steady rains.



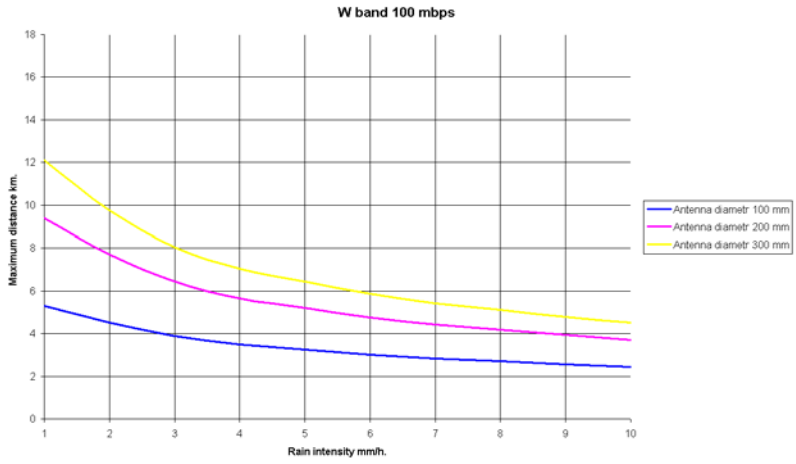
PPC-10/100

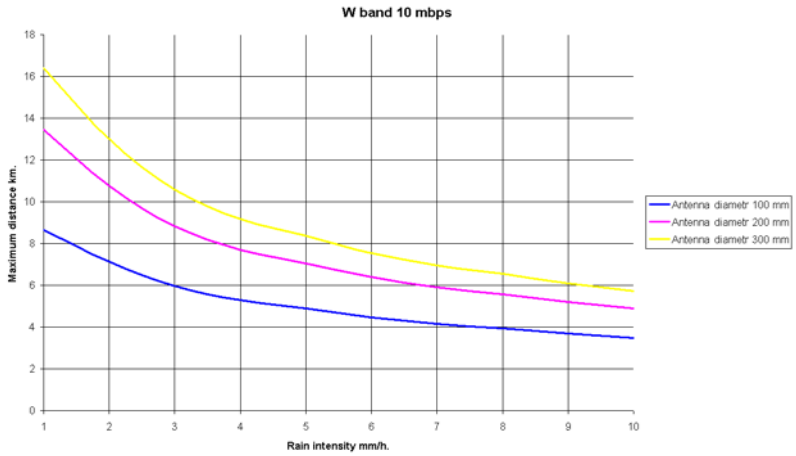

Q band 10 mbps
Maximum distance km.
Rain intensity mm/h
Antenna diametr 100 mm
Antenna diametr 200 mm
Antenna diametr 300 mm
Antenna diametr 450 mm
Antenna diametr 600 mm


V band 100 mbps
Maximum distance km.
Rain intensity mm/h.
Antenna diametr 100 mm
Antenna diametr 200 mm
Antenna diametr 300 mm
Antenna diametr 450 mm
Antenna diametr 600 mm


V band 10 mbps
Maximum distance km.
Rain intensity mm/h
Antenna diametr 100 mm
Antenna diametr 200 mm
Antenna diametr 300 mm
Antenna diametr 450 mm
Antenna diametr 600 mm

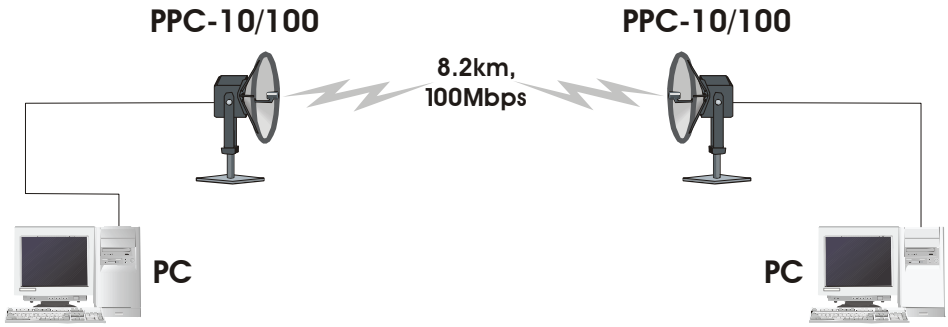
PPC-10/100





Full-scale testing of PPC-10/100 at urban area

PPC–10/100 Bridge was tested on the network testing ground of ELVA–1 company. We made two measurements for the same network configuration:

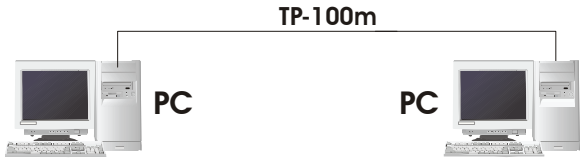


PPC-10/100

The LAN segments were connected using the 42GHz model 100Mbps Radio Bridge on distance of 8.2 km, with a remote server to generate LAN traffic.

To compare, the same segments were combined using a 10 m segment of a UTP5 and a local server was used.

To provide a small level of traffic in this LAN, two computers we used as a configuration with Pentium server (the first LAN segment) and one workstation (the second LAN segment, point–to–point configuration). There was no difference in the access speed to «local» and «remote» servers in this configuration.



To test wireless channel at high level of LAN traffic we used a number of workstation to achieve 95% load. The same configuration was tested with wireless and UTP5 connection between LAN segments. At this level of load the access speed to a «remote server» was no more than 10 % less when compare with the «local server».

We found the performance decrease for full–load wireless channel depends on a number of collisions that occur because long distance packets delay at the channel. The shorter a wireless channel is, the smaller performance decrease occur with a guaranteed limit at no more than 10% for max channel length of 8 km. For instance, on the 95% loaded wireless channel of 4 km long the performance decrease was at level of about 5% only.

To achieve a highest efficiency and guarantee a customer satisfaction we provide additional recommendations for PPC–10/100 bridge use at the customer place and conditions.

PPC-10/100 Technical Characteristics

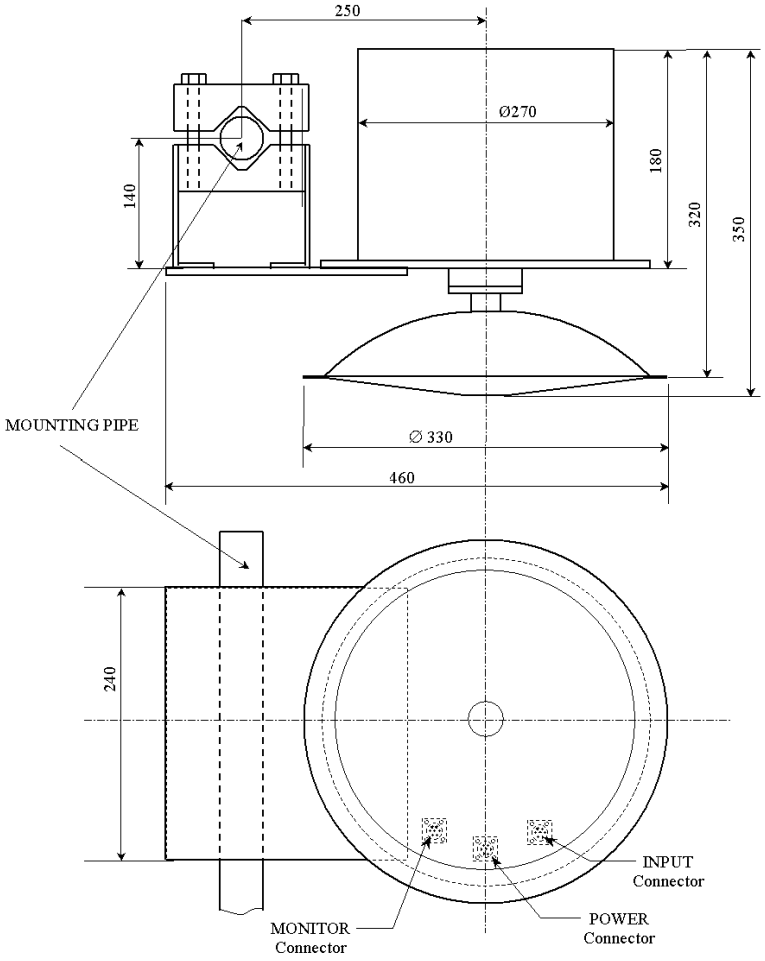
40.5 to 43.5 GHz Models Specifications	10 Mbps Models	100 Mbps Models
Operating frequency range of the Radio Module	40.5 – 43.5 GHz 40.5 – 43.5 GHz	
Output power, no less than	50 mW	50 mW
Antenna gain/beamwidth (typ)		
10 cm diameter	26.3 dB/6 °	26.3 dB/6 °
20 cm diameter	32.7 dB/2.9 °	32.7 dB/2.9 °
30 cm diameter	36.4 dB/2 °	36.4 dB/2 °
45 cm diameter	40.9 dB/1.3 °	40.9 dB/1.3 °
60 cm diameter	42.9 dB/0.9 °	42.9 dB/0.9 °
The level of parasitic radiation no more than	50 dB	50 dB
Data rate, each direction	10 Mbps	100 Mbps
Communication Rate at Rain Intensity 5 mm/hour with:		
10 cm diameter Antenna	4700 m	2400 m
20 cm diameter Antenna	9000 m	5600 m
30 cm diameter Antenna	11900 m	8000 m
45 cm diameter Antenna	15800 m	11500 m
60 cm diameter Antenna	17500 m	13200 m
Length of a connecting cable		
LAN –to– Module of Access	100 m	–
Module of Access –to– Radio Module	100 m	–
LAN–to–Radio module	–	100 m
The type of a connecting cable		
LAN –to– Module of Access	UTP5	–
Module of Access –to– Radio Module	UTP5	–
LAN–to–Radio module	–	UTP5
Fiber Optics		
Main supply		
Radio Module	220/110 VAC –48...–75 VDC	220/110 VAC –48...–75 VDC
Module of Access	220/110 VAC	–
Consumed power		
Radio Module	25 W (+50W heating)	25 W (+50W heating)
Module of Access	5 W	–
Weight and overall dimensions		
Radio Module with the antenna and Adjusting Module	12 kg 33x35x46 cm	12 kg 33x35x46 cm
Module of Access	2 kg, 24x12x7 cm	–
Operating temperature		
Radio Module	–40 to +50 °C	–40 to +50 °C
Module of Access	+10 to +40 °C	–
Admissible relative humidity		
Radio Module	100 %	100 %
Module of Access	90 %	–

59.05 to 64 GHz Models Specifications	10 Mbps Models	100 Mbps Models
Operating frequency range of the Radio Module	59.05 – 64 GHz	59.05 – 64 GHz
Output power, typ		
10 cm diameter Antenna	10 mW	10 mW
20 cm diameter Antenna	10 mW	10 mW
30 cm diameter Antenna	18 mW	18 mW
45 cm diameter Antenna	34 mW	34 mW
60 cm diameter Antenna	55 mW	55 mW
Antenna gain/beamwidth (typ)		
10 cm diameter	34 dB/3.1 °	34 dB/3.1 °
20 cm diameter	39.7 dB/1.5 °	39.7 dB/1.5 °
30 cm diameter	42.4 dB/1 °	42.4 dB/1 °
45 cm diameter	45.4 dB/0.7 °	45.4 dB/0.7 °
60 cm diameter	47.5 dB/0.5 °	47.5 dB/0.5 °
The level of parasitic radiation no more than	50 dB	50 dB
Data rate, each direction	10 Mbps	100 Mbps
Communication Rate at Rain Intensity 5 mm/hour with:		
10 cm diameter Antenna	1370 m	1000 m
20 cm diameter Antenna	1800 m	1400 m
30 cm diameter Antenna	2150 m	1700 m
45 cm diameter Antenna	2550 m	2100 m
60 cm diameter Antenna	2850 m	2400 m
Length of a connecting cable		
LAN –to– Module of Access	100 m	–
Module of Access –to– Radio Module	100 m	–
LAN–to–Radio module	–	100 m
The type of a connecting cable		
LAN –to– Module of Access	UTP5	–
Module of Access –to– Radio Module	UTP5	–
LAN–to–Radio module	–	UTP5
Fiber Optics		
Main supply		
Radio Module	220/110 VAC –48...–75 VDC	220/110 VAC –48...–75 VDC
Module of Access	220/110 VAC	–
Consumed power		
Radio Module	25W (+ 50 W heating)	25 W (+50W heating)
Module of Access	5 W	–
Weight and overall dimensions		
Radio Module with the antenna and Adjusting Module	12 kg 33x35x46 cm	12 kg 33x35x46 cm
Module of Access	2 kg, 24x12x7 cm	–
Operating temperature		
Radio Module	–40 to +50 °C	–40 to +50 °C
Module of Access	+10 to +40 °C	–
Admissible relative humidity		
Radio Module	100 %	100 %
Module of Access	90 %	–

92 to 96 GHz Models Specifications	10 Mbps Models	100 Mbps Models
Operating frequency range of the Radio Module	92 – 96 GHz	92 – 96 GHz
Output power, no less than	50 mW	50 mW
Antenna gain/beamwidth (typ)		
10 cm diameter	35.7 dB/2.1 °	35.7 dB/2.1 °
20 cm diameter	41.7 dB/1 °	41.7 dB/1 °
30 cm diameter	45 dB/0.7 °	45 dB/0.7 °
The level of parasitic radiation no more than	50 dB	50 dB
Data rate, each direction	10 Mbps	100 Mbps
Communication Rate at Rain Intensity 5 mm/hour with:		
10 cm diameter Antenna	4900 m	3200 m
20 cm diameter Antenna	7000 m	5200 m
30 cm diameter Antenna	8350 m	6400 m
Length of a connecting cable		
LAN –to– Module of Access	100 m	–
Module of Access –to– Radio Module	100 m	–
LAN–to–Radio module	–	100 m
The type of a connecting cable		
LAN –to– Module of Access	UTP5	–
Module of Access –to– Radio Module	UTP5	–
LAN–to–Radio module	–	UTP5
Fiber Optics		
Main supply		
Radio Module	220/110 VAC –48...–75 VDC	220/110 VAC –48...–75 VDC
Module of Access	220/110 VAC	–
Consumed power		
Radio Module	25 W (+50W heating)	25 W (+50W heating)
Module of Access	5 W	–
Weight and overall dimensions		
Radio Module with the antenna and Adjusting Module	12 kg 33x35x46 cm	12 kg 33x35x46 cm
Module of Access	2 kg, 24x12x7 cm	–
Operating temperature		
Radio Module	–40 to +50 °C	–40 to +50 °C
Module of Access	+10 to +40 °C	–
Admissible relative humidity		
Radio Module	100 %	100 %
Module of Access	90 %	–

Drawing of PPC 10/100 Radio Module

(all dimentions are in mm)



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