

# DX 500 wideband antenna system

by RF Systems

The DX 500 is a very small active receiving antenna with a frequency range covering 30 kHz to 550 MHz. It is powered by either 12 Volt DC battery supply or 230 (110) Volt ac mains supply. The DX 500 antenna is very unobtrusive and can be mounted in nearly every situation thanks to a large range of optional mounting devices. Several indoor units make it possible to connect the antenna to different receiver configurations, such as a shortwave receiver, a wideband scanner, a computer controlled receiver or up to three receivers to be used at the same time, whereby each receiver operates as though it is connected to its own independent antenna.

## Features

- \* Miniature active wideband receiving antenna for long-wave, medium-wave, short-wave, VHF - Low, FM, Air, VHF - High and UHF
- \* Only 40 cm in height, and 35 mm in diameter
- \* Frequency range 30 kHz - 550 MHz
- \* Omni-directional reception pattern, vertical polarisation
- \* High intercept points, low noise
- \* Gain increasing with the increase in frequency, hence no overload problems from strong shortwave stations and optimum VHF - UHF reception
- \* Small profile that attracts no attention, can be placed everywhere
- \* Stainless steel antenna tube, completely weatherproof
- \* Several mounting brackets available
- \* Several indoor units at choice with a single wideband- or multiple outputs for up to 3 receivers
- \* Optional: an in-line amplifier for long antenna cables or stronger signals on VHF - UHF. An attenuator which adjusts the signal level on short-wave, without influencing VHF - UHF reception. Splitters to connect two receivers to a single output of the indoor units.
- \* Powersupply 12 Volt DC or 230 Volt ac mains (110 Volt ac optional)
- \* Optional: DC converter to use the DX 500 with 24 V DC battery supply
- \* Comes complete with 12 mtrs Mil-spec coaxial antenna cable and a no-solder plug



## Antenna problems

It is often very hard to place an antenna. For many modern buildings and apartments installing an antenna is either not allowed or the space available is very limited. Wideband scanners and computer-controlled receivers with frequency ranges from long-wave through to UHF have created another problem: antennas with good reception on all frequencies over that enormous range do not exist. The DX 500 antenna system is the solution for both these problems. The DX 500 is a very small antenna, constructed as a stainless steel tube with a height of just 40 cm and a diameter of only 35 mm. Several mounting brackets make it possible to mount the antenna nearly anywhere: on a balcony rail, a short mast, a wall, hanging on the balcony above yours, a rain gutter, a tilted plane like a windowsill or in front of a window. Thanks to the very small dimensions, the antenna attracts no attention. In situations where it is important that no one can "see" the antenna, the DX 500 can be camouflaged further by painting it in the colours of the railing- or wall.

## DX 500

The DX 500 antenna receives "everything" between 30 kHz and 550 MHz: long-wave, beacons, NAVTEX, medium-wave, short-wave, CB radio, VHF-low with radio amateurs and police networks, the FM broadcast band, civil- and military airbands, the VHF high bands with amateurs and other communication services, 433 MHz shortrange devices like cordless headphones, 446 MHz PMR handheld transceivers, 70 cm band radio amateurs and other UHF communications services. This makes the DX 500 an ideal antenna for wideband scanners and computer controlled receivers like Winradio and ICOM PCR 1000. But the DX 500 can also be used with one single receiver, such as a shortwave receiver, a scanner or an airband receiver or a simultaneous combination of these types of receivers.

## Remarkable features

Active antennas for long-, medium- and shortwave must be able to handle the very strong signals in these bands without intermodulation and overload. The DX 500 antenna has a 2<sup>nd</sup> order intercept point of more than + 55 dBm and a 3<sup>rd</sup> order intercept point of more than + 27 dBm. Thanks to these specifications, the intermodulation products generated in the antenna are in general lower than the atmospheric- and man-made noise as received by the antenna, so they cannot be noticed. For VHF-UHF reception other specifications are of higher importance. The signals in these bands are not as strong as compared to the shortwave signals. Also the atmospheric noise in these bands is lower in level. Therefore the noise figure of the antenna is important. The DX 500 has a noise figure of less than 3,5 dB at 500 MHz which ensures that also weak stations in the VHF-UHF bands can be received.

The signals in the shortwave bands are very strong, VHF-UHF stations are received with much lower signal strengths. Scanners and other wideband receivers have an equal sensitivity over the whole frequency range. That's the reason why they are easily overloaded when a large antenna is used. This well-known scanner overload problem has consequences for the signal output of the antenna. If the antenna has a high gain, than strong medium- and shortwave stations will overload the receiver. With a low gain, the overload problems are vanished, but weak VHF-UHF stations cannot be received any longer. To solve this problem, the DX 500 antenna has an increasing gain with respect to the frequency. Long-, medium-, and shortwave stations up to 32 MHz are amplified with a moderate gain of + 3 dB. This results in a signal output, which can be compared with a longwire antenna with a length of 12,5 mtrs. Above 32 MHz the gain increases slowly to a maximum of + 12 dB at 500 MHz, so the weaker VHF-UHF stations are extra amplified. Thanks to this feature, the DX 500 is very well suited for all types of receivers, including wideband scanners and computer controlled receivers. However, some wideband scanners are overloaded even with very low signal levels. With these types of receivers the output level of the DX 500 can be still too high. With such receivers the attenuator of the receiver has to be switched in or the DX 500/ATT attenuator module has to be used. This module adjusts the output level of the DX 500 on long-, medium- and shortwave only, without influencing the signal strength in the VHF-UHF bands. This offers the possibility to use the scanner with full sensitivity without overload from strong medium- and shortwave stations.

The DX 500 antenna has a 3-fold protection against static discharges and lightning in the vicinity. It's however an absolute necessity that the antenna is grounded, otherwise the protections will not work. Statics MUST have a path to ground, otherwise they will destroy the antenna. Besides that, grounding improves reception and reduces noise. All indoor units are equipped with a special "ground" terminal.

### No "dead" zones

One of the most remarkable features of the DX 500 antenna is the constant efficiency over the whole frequency range. To see why this is so special a brief explanation over the working principle of active antennas is required. An active antenna uses a reception element which is mostly small in dimensions with respect to the wavelength of the received signals. Such a small element receives nearly the same signal compared to a larger antenna - the difference with respect to a dipole is just 1,76 dB - , but the problem is that the internal impedance (the radiation resistance) is capacitive high impedance. That's why it is impossible to connect a 50 ohms receiver input directly to such a short element: the antenna element is short-circuited by the low receiver input impedance and no signal is left. An active antenna uses an amplifier with an extremely high input impedance and an output able to feed a 50 ohms load. Thanks to this high input impedance, the antenna element is not loaded any longer and all the received signals are transferred to the amplifier, which delivers them to the receiver. For long-, medium- and shortwave up to 50 MHz it is quite possible to make such a high impedance input amplifier although a serious problem is, that the amplifier must be able to handle thousands of signals with levels from  $\mu\text{V}$  to hundreds of millivolts without generating distortion-, overload- and mixing products. Up to now, it was nearly impossible to make such a high impedance amplifier for the VHF-UHF bands. Either the input capacitance of the amplifier was too high or the amplifier was not stable, resulting in oscillation. The few active antennas covering also the VHF-UHF bands on the market use a standard 50 ohms VHF-UHF amplifier, often in the form of a low cost integrated MMIC wideband amplifier. This introduces some problems. On shortwave the input impedance of the amplifier is low. The receiving element is heavily loaded, resulting in a disappointing reception in the long-, medium- and shortwavebands. But for VHF-UHF reception there is another problem. Only maximum signal from the receiving element is transferred to the 50 ohms amplifier, when the internal impedance (radiation resistance) of the receiving element is also 50 ohms. For a single rod element, this is only the case on one single frequency, whereby the element is  $\frac{1}{4}$  wavelength long. By smart construction techniques such as the use of coils, phase loops and/or multiple elements this can be extended to a number of small frequency bands in which the antenna receives. Often such antennas are peaked in the VHF-UHF amateur bands. But on frequencies in between, there is a considerable mismatch, resulting in less transferred signal, a higher noise figure and worse reception in these "dead" zones.

Thanks to a grant of the Dutch Government, who paid a part of the development costs RF Systems was able to develop a new type of amplifier with a very high input impedance up to 700 MHz, a low noise figure and a very large dynamic range. The development time of this special amplifier with an input capacitance of nearly 0, has taken 1,5 man-year of work and was only possible thanks to the development of new Schottky GA-as fetts. Although this development was mentioned for professional applications, it allowed to RF Systems to use this technique also for commercial and amateur products. The DX 500 antenna is the first product which makes use of this new technique. The greatest advantage of this high input impedance amplifier is that the receiving element is not loaded, even in the VHF-UHF bands. The varying impedance of the receiving element over the whole frequency range is no longer of influence on the reception results: the efficiency of the antenna is constant, resulting in equal reception results over the whole frequency range without "dead" zones.

### Reception pattern

Especially for long-, medium- and shortwave the dimensions of the DX 500 antenna are so small (25 cm for the active part), that the antenna can be seen as a nearly "isotropic" antenna. The reception pattern of an isotropic antenna is a sphere. The advantage is, that the antenna is sensitive in all directions. Not only in the horizontal plane for omni-directional reception, but also in the vertical plane resulting in sensitivity for radio signals under any angle. Radio signals from long distance stations come in under low angles, stations at shorter distances (one or 2 hops) come in under high angles. Thanks to the spherical reception pattern of the DX 500 both types of signals are received equally well. It must be said however, that the reception pattern is influenced by the height of the DX 500 above the ground and the ground-conductivity. How higher the antenna above the ground, how higher the sensitivity for radio signals coming in under low angles. For VHF-UHF reception in theory a direct-sight path is required for optimum reception, so also for these bands mounting the antenna high and free from surrounding objects is an advantage.

### Performance

Also in the world of antennas you can't get it all: every antenna is a compromise. As a professional antenna manufacturer, RF Systems do not want to give you the impression that there is no better antenna than the DX 500. Who has the possibility to hang a long wire-antenna in the garden at sufficient height, will have better reception on the shortwave bands. If you can place a turnable log-per or yagi antenna high on the roof, you will receive in the VHF-UHF bands certainly more than with the DX 500 on a balcony-rail. The DX 500 antenna is designed as a very small, extremely wideband active antenna with excellent specifications. For those who are not able to place large antennas and look for a miniature antenna, that attracts no attention and gives good reception: not only in the long-, medium- and shortwave bands, but also on the VHF-UHF bands, will find in the DX 500 exactly what they need.

### Antenna mountings

The base of the DX 500 has 1 inch, 14 t.p.i thread. An antenna clamp is not included as the antenna will fit on every 1 inch thread standard mounting as used in marine applications. For the use at home a number of most used mountings are optional available.

**DX 500/clamp:** a sturdy, galvanised low-cost antenna clamp suited to mount the DX 500 antenna on vertical- and horizontal pipes with a diameter up to 50 mm.

**DX 500/stand:** a circular plane with a vertical pipe with 1 inch thread. The DX 500 can be screwed on top of the pipe. The antenna cable is fed through a rubber grommet in the wall of the pipe. The stand mounting is ideal for horizontal planes such as a flat roof, the upperside of a wall, for hanging the antenna on the ceiling or the balcony above yours, or standing in front of the window.

**DX 500/AK2:** a very nice looking weather resistant aluminium alloy antenna clamp with stainless steel brackets and mounting hardware, suited for mounting on horizontal- and vertical pipes up to 50 mm. This clamp can also be screwed on vertical planes such as walls, chimneys, rain gutters and so on.

**DX 500/marine mount:** a high-grade seawater resistant, tilting bracket for the mounting on vertical-, horizontal-, and tilted planes like walls, a roof or a windowsill. Thanks to the adjustable angle, the antenna can always be placed vertical, even on tilted planes.

#### **A system adaptable to every situation**

The DX 500 is an antenna system because it can be adapted to the users personal needs.

For receivers with an antenna input capable of delivering 12 Volt DC feed for active antennas (like the Lowe HF 150 marine, the Lowe HF 350 and the Nasa HF 4E), no other parts besides the antennacamp are necessary. For all other receivers an indoorunit is required. The indoorunit delivers the supply voltage to the antenna and the received signals to the receiver. Several types are available, able to feed one single receiver to up to three receivers each with their own frequency range. A complete range of interconnection cables between the indoorunits and the receivers is available. Optional modules make it possible to compensate the VHF-UHF losses of an extended coaxial antenna cable or to boost signals in these bands, a special attenuator makes it possible to adjust the output level on the shortwavebands without influencing VHF-UHF reception, a DC-DC converter makes it possible to use the antenna on 24 Volts boardnets on trucks and ships, splitters offer the possibility to connect 2 receivers to an output of an indoorunit without mutual influence and a duplexer makes it possible to connect a separate shortwave and a separate VHF-UHF receiver to a wideband output of the indoorunits. Because all parts of the DX 500 antenna systems can be bought separately, the system can be adapted or changed when this is required.

#### **Indoorunits**

Depending of the type of receiver (a single shortwave receiver, a scanner or a number of receivers for specific frequency ranges) a choice has to be made between the indoorunits. Available is an indoorunit for 230 V ac (110 V ac optional) with a single wideband output. All other indoorunits are for 12 V dc supply voltage, but can be used also on 230 V ac with the optional DX 500/ADAP mains wall-adaptor. All indoorunits are protected from short-circuits in the coaxial cable to the antenna and short-circuits of the outputs. All 12 Volts indoorunits are also protected from wrong polarisation and high voltage spikes (up to 50 Volts) of the supply voltage. The 230 Vac indoorunit can withstand 1000 Volt voltage spikes out of the mains. All indoorunits have also built-in filters which reject interference and noise from the mains or the 12 Volts supplyvoltage.

#### **Indoorunit DX 500/1/230, DX 500/1/110 and DX 500/1**

The standard type DX 500/1 indoorunit is equipped with one single wideband output. The DX 500/1 series is mentioned for a single receiver within the frequency range of the DX 500: a communications receiver for long-, medium- and shortwave, a VHF-UHF receiver, a scanner or a computer controlled receiver like Winradio or ICOM PCR series. The DX 500/1 indoorunit is mentioned for 12 V dc supply voltage, the DX 500/1/230 for 230 V 50 Hz ac mains and the DX 500/1/110 for 100 - 130 V ac (50-60 Hz) mains supply. It is always possible to connect two receivers to the wideband output of these indoorunits with the help of the optional available SP -1 (50 kHz - 35 MHz) or SP - 3 (10 MHz - 2500 MHz) splitters. Each receiver receives and can be operated if it is connected to its own antenna. Thanks to the high isolation of these splitters, there is no mutual influence. The wideband output of the DX 500/1 series indoorunits can be also divided into a separate LW-MW-SW (30 kHz - 32 MHz) and a separate VHF-UHF (32 MHz - 550 MHz) output with the help of the optional DPX 30 duplexer. This offers the possibility to connect separate shortwave- and VHF-UHF receivers to these indoorunits. If required, the outputs of the duplexer can also be connected to a splitter, so nearly every application with a number of receivers is covered.

#### **DX 500/2 indoorunit: a shortwave receiver together with a scanner**

Most wideband scanners give good reception at VHF-UHF frequencies, but at the shortwavebands performance is often less satisfactory. Many listeners use therefore a separate communications receiver for the long-, medium- and shortwavebands and a separate scanner for the VHF-UHF bands. The DX 500/2 is developed for such an application. It has a built-in duplexer with 2 outputs: one for the long-, medium- and shortwavebands from 30 kHz to 32 MHz, the other output is for VHF to UHF from 32 MHz to 550 MHz. Thanks to the high isolation, both receivers are completely separated and do not influence each other. No signal losses or birdies are generated from the shortwave receiver into the scanner or vice-versa. The advantage of the built-in duplexer is that there is no signal loss: each receiver gets the same signalstrength as with a direct connection to the antenna. There is no need to connect always both receivers: the unit works equally well with just one receiver whereby the other output is left open for future use. The outputs can be always connected to the available SP-1 or SP-3 splitters when more than one receiver has to be connected. The DX 500/2 indoorunit works on 12 V dc supply voltage, but can be used on 230 V ac mains with the DX 500/ADAP mainsdapter or on 24 V dc with the DX 500/2412 DC-DC converter.

#### **DX 500/3 indoorunit: separate outputs for long-wave, medium- and shortwave and VHF-UHF**

The DX 500/3 indoorunit is developed for applications whereby several receivers for different frequency bands are in use, for instance on yachts. The DX 500/3 indoorunit makes it possible to use the DX 500 antenna for several applications at the same time. The longwave output covers 30 kHz - 520 kHz and is mentioned for a longwave receiver such as a Loran set, a NAVTEX receiver, a differential GPS receiver, a German Wetterdienst (Pinnenberg) receiver or similar longwave applications. The medium- and shortwave output covers 520 kHz to 32 MHz and is mentioned for a communications/shortwave receiver. The 3 rd output covers 32 MHz to 550 MHz and is mentioned for VHF - UHF receiver applications such as a scanner, an amateur receiver, a FM broadcast radio or reception of marine radio in the 156 MHz band. Naturally the DX 500/3 can be also used at home for other applications. All three receivers operate if they are connected to their own antenna: thanks to the built-in triplexer there is no mutual influence or signal loss. There is no need to connect all three receivers: the DX 500/3 can also be used with one or two receivers. Naturally the SP - 1 and/or SP - 3 splitter can be connected to one or more outputs if more receivers have to be connected to one or several outputs of the DX 500/3. The DX 500/3 indoorunit works on 12 V dc supply voltage, but can be used on 230 V ac mains with the DX 500/ADAP mainsdapter or on 24 V dc with the DX 500/2412 DC-DC converter.

#### **Interconnection cables**

The DX 500 antenna is delivered with a standard solder-less IEC plug for the antenna cable, which will fit onto the antenna input of all indoor units. Between the indoor unit output(s) and the receiver(s) coaxial interconnection cables are required. Because receivers are equipped with several types of input connectors for the antenna, these cables are **not** included. Cables can be made by yourselves, but RF Systems can deliver also a range of interconnection cables with the most common types of plugs. Some cables are equipped with ferrite filters, which suppress interference currents flowing on the screening of the cable. These low-noise cables are recommended for applications whereby a computer controls the receiver or is used for decoding of signals. The cables are also drawn in the overview diagram of the DX 500 system. Unless otherwise noted, all cables are 1.2 mtrs long.

#### **Interconnection cables for the DX 500/1/230 (110) indoorunit**

DX 500/IEC/BNC : IEC male plug to BNC male plug, low-noise cable, for scanners  
DX 500/IEC/PL: IEC male plug to PL 259 plug, low-noise, for shortwave receivers  
DX 500/IEC/TEL: IEC male plug to 3,5 mm telephone plug, low-noise, for portables  
DX 500/IECm/IECf: extension cable, low-noise filters, 1.5 mtrs

#### **Interconnection cables for the DX 500/1 (12 V) indoor unit**

DX 500/BNC/PL: BNC male plug to PL 259 plug for shortwave receivers  
DX 500/BNC/BNC: BNC male plug to BNC male plug, 1.5 mtrs, for scanners  
DX 500/BNC/TEL: BNC male plug to 3,5 mm telephone plug for portables with ext. antenna input

#### **Interconnection cables for the DX 500/2 indoor unit**

Shortwave output (SO 239 jack)  
DX 500/PL/PL: PL 259 plug to PL 259 plug, 1.5 mtrs, for shortwave receivers  
DX 500/PL/TEL: PL 259 plug to 3,5 mm telephoneplug, for portables with ext. antenna input  
DX 500/BNC/PL: PL 259 plug to BNC male plug, for receivers with a BNC input jack  
VHF-UHF output (BNC female jack)  
DX 500/BNC/BNC: BNC male plug to BNC male plug, 1.5 mtrs, for scanners  
DX 500/BNC/PL: BNC male plug to PL 259 plug for VHF receivers with a SO 239 input jack.

#### **Interconnection cables for the DX 500/3 indoor unit**

Longwave output (BNC female jack)  
DX 500/BNC/PL: BNC male plug to PL 259 plug, for longwave receivers with a SO 239 input jack  
DX 500/BNC/BNC: BNC male plug to BNC male plug, 1.5 mtrs, for receivers with a BNC input jack  
DX 500/BNC/TEL: BNC male plug to 3,5 mm telephone plug for portables with ext. antenna input  
Shortwave output (SO 239 jack)  
DX 500/PL/PL: PL 259 plug to PL 259 plug, 1.5 mtrs, for shortwave receivers  
DX 500/PL/TEL: PL 259 plug to 3,5 mm telephoneplug, for portables with ext. antenna input  
DX 500/BNC/PL: PL 259 plug to BNC male plug, for receivers with a BNC input jack  
VHF-UHF output (IEC male)  
DX 500/IECf/IECm: IEC female plug to IEC male plug, 1.5 mtrs, low-noise for FM tuners and extension  
DX 500/IECf/BNC: IEC female plug to BNC male plug, 1.5 mtrs, low-noise for scanners  
DX 500/IECf/CAR: IEC female plug to the special plug as used with auto-radio's, 1.5 mtrs, low-noise

#### **Plug converters (adapters)**

DX 500/A/BNC/N: adapter BNC female in, N plug out, converts a N connector input to a BNC input  
DX 500/A/BNC/PL: adapter BNC female in, PL 259 plug out, converts a SO 239 jack to a BNC input  
DX 500/A/IECm/BNCf: adapter converts the output of the DX 500/1/230 indoorunit to a BNC output  
DX 500/A/IECf/BNCf: adapter converts the VHF output of the DX 500/3 indoorunit to a BNC output

#### **Plugs**

DX 500/IEC-m: metal IEC male plug as used on all indoorunits as antenna input, solder-less  
DX 500/IEC-f: metal IEC female plug for the VHF output of the DX 500/3 indoorunit, solder-less  
DX 500/CAR: Motorola plug for the antenna input of AM-FM autoradio's, solder-less  
DX 500/PL/6: PL 259 plug for RG 58/u coaxial cable, solder type  
DX 500/PL/3: PL 259 plug for thin RG 174/u coaxial cable, solder type

#### **Antenna cable extension set**

DX 500/extensionset, comprises 15 mtrs high-grade Mil-Spec RG 59/u coaxial cable and a metal, waterproof connectorset, which can be mounted without soldering. This set comes complete with an instruction drawing and is mentioned for the extension of of the antenna cable between the DX 500 antenna and the indoorunit.

#### **Optional accessories**

**Depending of the application, the DX 500 system can be completed with one or more modules and-or accessories. As all parts are sold as separate units, these accessories can be added at the time when they are needed.**

#### **DX 500/ADAP**

The 12 volts supply voltage for the DX 500 antenna must be hum- and noise-free for optimum reception. With 12 V battery supply this is no problem, especially because all indoorunits have built-in filters to reject hum and noise. But if a 12 V mainsadapter is used, this filtering is sometimes not enough. The mains adapter must deliver not more than 13,8 Volts dc, free from hum- and noise. Most low-cost un-stabilised 12 V mainsadapters give a higher output voltage with the low current consumption of the DX 500. They give also too much hum. It is an advantage if the powersupply rejects also interference from the 230 V mains. Switching mode wallsocket mains adapters cannot be used with communications equipment! They give too much interference. The DX 500/ADAP is a special stabilised, short-circuitproof mains adapter for the use of the 12 Volts DX 500 indoorunits on the 230 V ac mains. The DX 500/ADAP rejects interference from the mains, is double insulated and suited for continuous operation. Input 210 - 240 Vac 50/60 Hz via a standard European 2 prong IEC mainsplug, output stabilised at 12 V dc, 300 mA max, hum and noise rejection more than 70 dB. The output cord ends in a standard 2,1 x 5,5 mm plug which will fit directly to the DC input jack of the 12 V indoorunits.

#### **DX 500/2412 No-noise converter from 24 V dc to 12 V dc**

With exception of the DX 500/1/230 and DX 500/1/110 all other indoorunits run on 12 V dc supply voltage. In some applications (trucks, campers, yachts) only a boardnet of 24 Volts DC is available. The DX 500/2412 is a DC-DC converter which converts 20 - 26 Volts dc to a stabilised output voltage of 12 V dc. Built-in filters reject interference and noise from the 24 V supply and output filters assure that hum and noise is rejected more than 100 dB with respect to the output voltage. Naturally this DX 500/2412 converter is short-circuit proof, protected from wrong polarisation and high voltage spikes out of the 24 Volts supply. The DX 500/2412 is suited for continuous operation.

### **DX 500/ATT : adjustable output level for long-, medium- and shortwave**

On the long-, medium- and shortwave bands the DX 500 delivers signal strength's which can be compared to a 12,5 mtrs long wire antenna. These signals can be so strong, that some receivers become overloaded, resulting in interference, signal deterioration and intermodulation products. With shortwave receivers overload can be reduced with the use of the attenuator, built into most receivers. With wideband scanners this is a problem. The signals in the VHF-UHF bands are often much lower in level and switching in the attenuator may prevent shortwave overload, but prevents also weak signal reception in the VHF-UHF bands. The DX 500/ATT module is the solution for this problem. This unit comprises a built-in continuous variable attenuator with a range of 0 to -40dB, which adjusts the output level of the DX 500 only in the long-, medium- and shortwavebands from 30 kHz - 32 MHz. The VHF-UHF bands from 32 MHz to 550 MHz remain un-attenuated. This gives the possibility to use the scanner with full sensitivity for optimum VHF-UHF reception while at the same time the shortwave levels can be adjusted in such a way, that overload of the scanner does not occur. Naturally the DX 500/ATT module can also be used with a shortwave receiver only, because a continuous variable output level is an advantage above the single step attenuator as built into most receivers. The DX 500/ATT module must be inserted in the antennacable, just in front of the indoor unit. This assures that the DX 500/ATT module can be used with all available indoor units without an extra powersupply connection.

### **DX 500/AMP**

The DX 500 antenna comes with 12 mtrs high-grade Mil-Spec coaxial antenna cable. For most applications this length is sufficient. As it is highly recommended to place the antenna out of the interference field which surrounds every house, 12 mtrs can be sometimes too short and the antenna cable must be extended. The optional available DX 500/extensionset comprises 15 mtrs cable and a waterproof connection. For long-, medium- and shortwave reception only, the antenna cable can be extended even up to 50 mtrs, because cable attenuation is very low at these frequencies. The attenuation of coaxial cable rises with the frequency. For VHF-UHF signals, long antenna cables give so much attenuation, that weak stations cannot be heard any longer. Amplification of the attenuated signals at the end of the cable is useless: it's not possible to amplify signals if they are not present any longer.... To compensate the coaxial cable losses in the VHF-UHF bands, the signals have to be amplified before they pass through the cable. Only then the signals at the end of the cable have still enough level to hear them. But amplification directly after the antenna introduces a new problem. The signals on the long-, medium- and shortwavebands delivered by the DX 500 antenna are already so strong, that further amplification will overload the receiver. The DX 500/AMP is the solution to this problem. The DX 500/AMP is a completely waterproof amplifier in a stainless steel housing, which is inserted in the coaxial antenna cable directly after the antenna. Mounting is very easy: cut the cable, screw two no-solder plugs onto the cable and screw these on the amplifier. A powersupply is not required: the DX 500/AMP is powered by the indoor unit which also powers the antenna. The DX 500/AMP is special, because it comprises duplexer-circuits which pass all signals between 30 kHz and 32 MHz un-amplified, so they cannot overload the receiver. Signals within the 32 MHz to 550 MHz range are however + 12 dB amplified, enough to compensate the loss of 50 mtrs RG 59/u antenna cable or to get higher signal levels with shorter cables. Naturally the amplifier passes also the powersupply for the DX 500 antenna itself. The high 3rd order intercept point of the DX 500/AMP assures that intermodulation products do not deteriorate reception.

### **SP - 1 splitter**

The SP - 1 splitter makes it possible to connect two receivers simultaneously to one wideband- or shortwave output of an indoor unit. Both receivers operate if they are connected to their own antenna. The high isolation of this splitter assures that both receivers are completely separated: there is no mutual influence such as signal loss or birdies generated from one receiver into the other. The frequency range of the SP - 1 covers 50 kHz - 35 MHz.

### **SP - 3 splitter**

The SP - 3 splitter makes it possible to connect two receivers simultaneously to one wideband- or VHF-UHF output of an indoor unit. Both receivers operate if they are connected to their own antenna. The high isolation of this splitter assures that both receivers are completely separated: there is no mutual influence such as signal loss or birdies generated from one receiver into the other. The frequency range of the SP - 3 covers 10 MHz - 2500 MHz

### **DPX 30 duplexer**

The DPX 30 duplexer divides the wideband output of the DX 500/1 series indoor units into two, completely separated outputs. Output 1 covers the long-, medium- and shortwave bands from 30 kHz to 32 MHz, output 2 covers the VHF-UHF bands from 32 MHz - 550 MHz. Due to the high isolation between the outputs, there is no mutual influence between the receivers: each receiver operates as connected to its own antenna. An advantage of the DPX 30 is that there is no signal loss: each receiver gets the same signal strength compared to direct connection of the receiver to the wideband output.

### **AA - 1 Antenna adapter**

Some shortwave portable radio's are not equipped with an input for an external antenna. Some other portables have such an input, but often these inputs are extremely sensitive, resulting in overload, intermodulation products and distortion. The AA - 1 antenna adapter makes it possible to connect an external antenna such as the DX 500, to every portable shortwave receiver. The AA - 1 comprises a special matching transformer, which matches the output of the DX 500 to the impedance of the non-extended whip antenna of the radio. The transformer makes use of the magnetic transfer technology, developed by RF Systems. This technique assures that there is no galvanic connection between the antenna and the receiver: they are completely separated. The signals are transferred by means of a magnetic field, resulting in highly reduced static noise and -interference. The AA - 1 has a built-in continuous variable attenuator which allows to adjust the signal strength in such a way, that optimum reception is obtained without overload of the receiver.

### **AA - 2 antenna coupler**

Some listeners use their portable radio's also to listen to the long- and mediumwave bands. The whip antenna as well as most external antenna inputs are only suited for the 1,8 - 30 MHz bands, so the long-wave and short-wave bands are not covered. Portables make use of a ferrite-rod antenna for these bands. This antenna cannot be switched off. Portable radio's are used in house, where a high intensity noise- and interference field is present. Reception on the long- and mediumwave bands is often spoiled by noise and interference, picked-up by the ferrite-rod antenna. The AA - 2 antenna coupler offers the possibility to transfer long- and mediumwave signals from an external antenna such as the DX 500 to the portable radio. The signals are transferred by a very strong magnetic field, generated by the AA - 2. There is no galvanic connection between the radio and the antenna, resulting in highly reduced static noise and -interference. Another advantage of the strong magnetic field is, that direct pick-up of interference and noise by the ferrite-rod antenna in the portable radio is completely overruled, resulting in even more reduced noise and interference. The frequency range of the AA - 2 covers 100 kHz to 2 MHz.

# Specifications of all DX 500 system components

RF Systems is acknowledged as a world-leader in the active antenna field. RF Systems antennas are in use at governmental organisations, military- and other professional installations. The DX 500 antenna system was developed with a grant from the Dutch government. The DX 500 makes use of the latest microwave technology and its specifications fulfils all the requirements of professional users.

## DX 500 Antenna specifications

Frequency range: 30 kHz - 550 MHz

Gain: + 3 dB from 30 kHz to 32 MHz, rising to + 12 dB at 500 MHz

Noise figure: < 3,5 dB at 500 MHz

Polarisation: vertical

Reception pattern : Omni-directional

Intercept points : > + 55 dBm 2 nd order, > + 27 dBm 3 rd order

Static discharge protection: DC leakpath, 5000 Amp lightning impulse (8/20 usec), 1 nanosec. limiter

Dimensions: 40 cm in height, 35 mm in diameter

Power supply: 12 Volts DC, 85 mA max.

Mounting: base with 1 inch, 14 t.p.i. thread will fit on all standard marine mountings, other brackets and clamps possible

Construction: polished stainless steel tube, weather resistant aluminium alloy in base, UV light stabilised Delrin separation disc, antenna is filled with CFC-free poly-urethane foam

Weather resistance: the DX 500 can withstand any climate, from tropical seawater environment to polar climate, is completely water proof and tested with windspeeds up to 250 km/h without damage

Antenna cable: 12 mtrs high grade Mil-spec coaxial antenna cable comes out of the antenna. A no-solder metal IEC plug which will fit on the antenna input of all indoor units is included.

## General specifications of the indoorunits

All indoorunits are protected from wrong polarisation of the 12 Volts dc supply and short-circuits of the antenna cable and the outputs. Self-healing thermal fuses are used, so even long-term short-circuits cannot cause damage or fire: after the short-circuit is removed, the indoor unit is functioning as before. The 12 Volts indoor units are also protected from high voltage spikes up to 50 Volts out of the 12 V supply voltage, the 230 V ac unit can withstand 1 kV spikes out of the mains. All indoor units have built-in filters, which reject noise, hum and interference on the supply voltage. The indoor units are mentioned for indoor use only.

## Specifications of the DX 500/1/230 (110) indoor unit

Mains powered indoorunit with 1 wideband output

Frequency range: 20 kHz - 2000 MHz (suitable for future applications in the 550 MHz - 2 GHz band)

Output voltage to the antenna: 13,8 V dc, 200 mA max, short-circuit proof

Hum- and noise rejection: > 70 dB with respect to the output voltage

Connectors: IEC coaxial female in, IEC coaxial female out, screw terminal for ground

Mains: 210 - 240 V ac 50/60 Hz, 5 VA max, double insulated, CE certified, continuous use

Optional: 100 - 130 V ac 50/60 Hz, 5 VA max, double insulated, CE certified, continuous use

Dimensions: 120 x 110 x 55 mm

## Specifications of the DX 500/1 indoor unit

Indoor unit for 12 Volt dc supply with 1 wideband output

Frequency range: 30 kHz - 550 MHz

Connectors: IEC coaxial female in, BNC female out, screw terminal for ground

Supply: 11 - 15 Volts dc, 200 mA max, DC jack 2,1 x 5,5 mm, supply cord with plug included

Dimensions: 90 x 90 x 53 mm

## Specifications of the DX 500/2 indoor unit

Indoor unit for 12 V dc supply with 2 outputs, separated by a built-in duplexer

Antenna input connector: IEC coaxial female

Output 1: frequency range 30 kHz - 32 MHz, 50 Ohms, SO 239 connector

Output 2: frequency range 32 MHz - 550 MHz, 50 Ohms, BNC female connector

Screw terminal for ground

Supply: 11 - 15 Volts dc, 200 mA max, DC jack 2,1 x 5,5 mm, supply cord with plug included

Dimensions: 90 x 90 x 53 mm

## Specifications of the DX 500/3 indoor unit

Indoor unit for 12 V dc supply with 3 outputs, separated by a built-in triplexer

Antenna input connector: IEC coaxial female

Output 1: frequency range 30 kHz - 520 kHz, 50 Ohms, BNC female connector

Output 2: frequency range 520 kHz - 32 MHz, 50 Ohms, SO 239 connector

Output 3: frequency range 32 MHz - 550 MHz, 50 Ohms, IEC male connector

Screw terminal for ground

Supply: 11 - 15 Volts dc, 200 mA max, DC jack 2,1 x 5,5 mm, supply cord with plug included

Dimensions: 90 x 90 x 53 mm

## Specifications of the DX 500/2412 No-noise DC-DC converter

Converts 24 V dc to 12 V dc, in order to power the DX 500 from 24 Volts boardnets

Input voltage: 20 - 26 Volts dc, 200 mA max, fixed red-black connection cord

Output voltage: 12 Volts dc stabilised, 200 mA max, output cord with 2,1 x 5,5 mm plug

Hum- and noise rejection: > 100 dB with respect to the input voltage

Self-healing protection from: wrong polarisation of the supply voltage, short-circuit of the output

Protected from: high voltage spikes up to 50 Volts out of the 24 V supply

Heatsink free from ground and supply voltage, continuous operation

Dimensions: 90 x 60 x 55 mm

#### **Specifications of the DX 500/AMP**

In-line amplifier to compensate cable losses in the VHF-UHF frequency range or to boost signal strengths in the VHF-UHF frequency range

Mounting: inserted in the coaxial antenna cable without soldering

Frequency range: 30 kHz - 550 MHz

Gain: 30 kHz - 32 MHz 0 dB, 32 MHz - 550 MHz + 12 dB

3rd order intercept point: + 30 dBm

Noise figure: < 3,5 dB over the whole frequency range

Power supply: uses the power on the coaxial cable, no separate power supply required

Built-in DC feed-through for powering the DX 500 antenna

Connectors: F type, complete with plugs and moisture protection sleeves, no-solder mounting

Housing: Stainless steel tube, 100 mm long, 25 mm diameter

Operation conditions: completely weatherproof, any climate, continuous operation

#### **Specifications of the DX 500/ATT module**

In-line duplexer/attenuator for the output level adjustment of signals in the 30 kHz - 32 MHz frequency range, without influencing the signals in the 32 MHz - 550 MHz frequency range. The module is inserted in the coaxial cable coming from the antenna.

Power supply not required. The DX 500/ATT can be used with all indoor units.

Frequency range: 30 kHz - 550 MHz

Output level: continuous variable with a range of 0 to -40 dB in the 30 kHz - 32 MHz frequency range, the 32 MHz - 550 MHz frequency range is not attenuated or influenced by the level adjustment in the long-, medium- and shortwave bands

Built-in DC feed-through for powering the DX 500 antenna

Connectors: input IEC female, output 50 cm coaxial cable with an IEC male plug, which can be extended with the DX 500/IECm/IECf low-noise extension cable with ferrite filters (1,5 mtrs)

Dimensions: 70 x 90 x 50 mm

#### **Specifications of the SP - 1 splitter**

Splitter which makes it possible to connect two receivers to a single output of an indoor unit. The built-in directional coupler assures that both receivers don't "see" each other, hence no signal losses or birdies from one receiver introduced in the other receiver. Because the SP - 1 antenna splitter can also be used for other applications, a separate datasheet is available.

Frequency range: 50 kHz - 35 MHz, 50 ohms impedance on all ports

Insertion loss: less than 0.5 dB above 3 dB splitting

Isolation between the output ports: > 30 dB from 1,8 to 30 MHz

Connectors: 3 x SO 239

Housing: metal, 85 x 25 x 60 mm

#### **Specifications of the SP - 3 splitter**

Splitter which makes it possible to connect two receivers to a single output of an indoor unit. The built-in directional coupler assures that both receivers don't "see" each other, hence no signal losses or birdies from one receiver introduced in the other receiver. Because the SP - 3 antenna splitter can also be used for other applications, a separate datasheet is available.

Frequency range: 10 MHz - 2500 MHz, 50 ohms impedance on all ports

Insertion loss: less than 0.5 dB above 3 dB splitting from 10 MHz to 550 MHz

Isolation between the output ports: > 20 dB, typical 30 dB from 32 MHz to 550 MHz

Connectors: 3 x BNC female

Housing: metal, 120 x 25 x 40 mm

#### **Specifications of the DPX 30 duplexer**

The DPX 30 duplexer divides the wideband output of the DX 500/1 series indoor units into 2, completely separated outputs: one for 30 kHz - 32 MHz, the other for 32 MHz - 550 MHz. The duplexer ensures a high isolation between the receivers, hence no signal losses or birdies from one receiver introduced in the other receiver. Because the DPX 30 can also be used for other applications, such as combining a short wave- and a VHF-UHF antenna to one output, a separate datasheet is available.

Input frequency range: 0 - 2000 MHz, 50 ohms impedance on all ports

Output ranges: 0 - 32 MHz and 32 MHz - 2000 MHz

Insertion loss: 0 - 32 MHz < 0.5 dB, 32 MHz - 2000 MHz < 0.3 dB

Input connector: coaxial cable with a BNC male plug

Output connectors: SO 239 for 0 - 32 MHz, BNC female for 32 MHz - 2000 MHz

Housing: metal, 30 x 40 x 50 mm

#### **Specifications of the AA - 1 antenna adapter**

Makes it possible to connect an external antenna to the non-extended whip antenna of every portable radio with shortwave bands. The built-in matching transformer isolates the receiver completely from the antenna system and rejects interference and noise. This is an advantage above direct connection of the antenna to the external antenna input or whip antenna. The built-in continuous variable attenuator makes it possible to adjust the output level in such a way, that optimum reception without receiver overload is obtained. As the AA - 1 can be used also with other antennas, a separate datasheet is available.

Frequency range: 100 kHz - 30 MHz

Output level range: continuous variable from 0 dB to - 50 dB

Input connector: SO 239

Output connection: cord with an alligator clip for the antenna and a special modified plug for ground

Dimensions: 60 mm long, 35 mm in diameter

#### **Specifications of the AA - 2 antenna coupler**

Makes it possible to transfer long- and mediumwave signals from an external antenna to the built-in ferrite-rod antenna of portable radio, in order to get better reception on the long- and medium wave bands. No direct connection to the radio is necessary: the magnetic field generated by the AA - 2 is so strong that the AA - 2 must be laid only in the vicinity of the radio. A separate datasheet is available.

