AKG WMS 400 RECEIVER

The First Step to Professional Multichannel Technology

The SR 400 diversity receiver is an optimal solution if you need a reasonably-priced, high-performance multichannel system.

Based on the technology and experience of the revolutionary WMS 4000 wireless system, the SR 400 offers countless features that make setup and operation easier than ever before.

With simultaneous operation of up to 12 channels on each frequency band, you can be certain of smooth operation even in tricky situations in critical RF environments. Thanks to its compatibility with the professional WMS 4000 System, you can set up even complex wireless systems using antenna splitters, power supply units and a whole range of high-performance external antennas.

It has never been easier to set up a professional wireless system in this price bracket than with the WMS 400 system. In Auto Setup mode, the receiver automatically scans the RF environment in the available frequency bands, finds an interference-free channel, and is able to transmit this preset to the associated transmitter by infrared. This makes it possible to set up a multichannel system in just a couple of minutes.

Increased operational reliability and user convenience are ensured especially by the rehearsal function (complete RF testing of all components), clear display of all parameters on a programmable display, an easily visible warning signal with two-color display backlighting, and a low-battery warning on the receiver.

Housed in a rugged half-rack metal case with a host of innovative features, the SR 400 receiver offers all the benefits to make this a top-quality wireless system for both the upcoming star and the price-conscious professional.

Status LEDs
Provide detailed information about the most important system parameters, such as audio level, diversity status, RF level, etc.

Backlit LC display
Gives you a function check at a glance, with two-color backlighting (red/green).

SR 400 Receiver

Recessed level control
Allows you to adjust the output level, recessed to prevent accidental readjustment.

On/Off switch

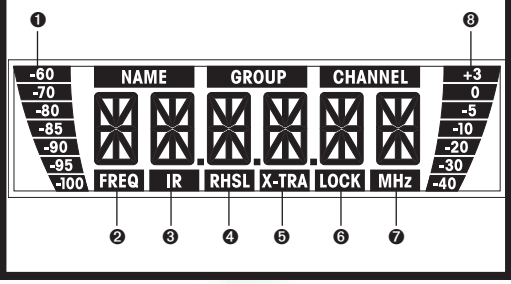
Infrared interface for transmitter programming
Fast and reliable transmission of frequency settings to prevent misprogramming.

Menu buttons
Facilitate easy programming.

Metal case
Half-rack width for convenient rack installation.

Display Details

❶ 7-level audio bargraph display
❷ Frequency setup menu with three operating modes: Auto Group, Auto Channel, Preset
❸ Infrared transmission mode
❹ Rehearsal function: Rapid check of RF & audio signal quality



Display Details

❺ Special functions: receiver name, status display, squelch threshold, system info, etc.
❻ Lock mode
❼ Squelch threshold adjustment mode
❽ 7-level RF bargraph display and diversity LEDs

* The maximum number of channels may vary according to local frequency plans.

Auto setup

The receiver is automatically searching for clean frequencies, making system programming quick and easy.

Each Preset contains legal frequencies for a specific country, region, or state

Integrated frequency management database with country coded sets of frequencies for easy frequency selection.

Infrared transmission

The receiver is downloading frequency setup data to the transmitter.

Rehearsal mode

The receiver is recording dropouts and related parameters as the transmitter is moved about the performance area.

System status

If, for instance, the transmitter batteries are running low, the display backlighting will change to red, reminding you that the system needs your attention.

Lockable DC input

Ensures reliable connection to the power supply, with a lock to prevent accidental disconnection.

XLR audio output

Professional balanced XLR output connector.

Antenna input socket

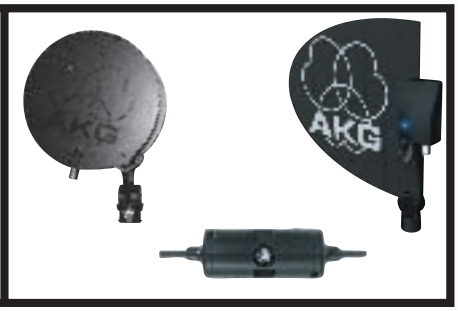
Allow you to connect plug-in antennas, remote antennas, or even a complex antenna network.

Audio output jack

Professional unbalanced output jack.

Range of accessories for complex applications

Thanks to its compatibility with the WMS 4000 wireless system, there is a wide range of accessories available for setting up complex multichannel systems. These include the PS 4000 antenna splitter, the PSU 4000 power supply unit, active and passive antennas with a variety of polar patterns, antenna boosters and remote power supplies, and the HPA 40 headphone amplifier. WMS 4000 Series transmitters also work perfectly with an SR 400.



AKG WMS 400 TRANSMITTERS

Handheld and Bodypack Transmitters for every conceivable Application

The HT 400 handheld and the PT 400 bodypack are high-performance, compact wireless transmitters that can be used for every conceivable application. Many innovative features not only ensure greater reliability of operation, but also provide extremely convenient operation.

An LC display provides information at a glance about important parameters such as frequency/Preset name (country code), remaining battery life, low battery warning, and current transmission mode.

Once you have set a frequency on the receiver, an infrared transmission link will feed the related data to the assigned transmitter within seconds, making the setting up of large multichannel systems child's play.

The HT 400 handheld transmitter is available with either a dynamic or a condenser microphone element. A noiseless On/Mute/Off switch and status LED provide additional user convenience.

The PT 400 bodypack transmitter has a rugged metal case with a mini XLR socket that allows you to connect a wide variety of microphones and instruments. It also has a jack for connecting an external mute switch – a particularly useful feature when the transmitter is inaccessible.

HT 400 Handheld transmitter

Extremely rugged spring steel mesh grill
Protects the microphone capsule underneath in tough stage acts and live performances.

Infrared sensor
Makes child's play of transmitter programming by downloading frequency and gain settings from the receiver via infrared.

Display
Shows the selected frequency/ preset and remaining battery life.

On-Mute/Program-Off switch
A recessed mode switch prevents accidental mode switching.

Soft-touch enamel finish
Adds to handling noise rejection.

Interchangeable, color code strips you can write on
For convenient transmitter identification on multichannel systems.

Charging contacts
Convenient plug-in charging on the CU 400 charger is environmentally friendly and saves money.

Battery compartment
The transmitter can be powered by a single AA size dry or rechargeable battery.

PPC 1000 Polar Pattern Converter

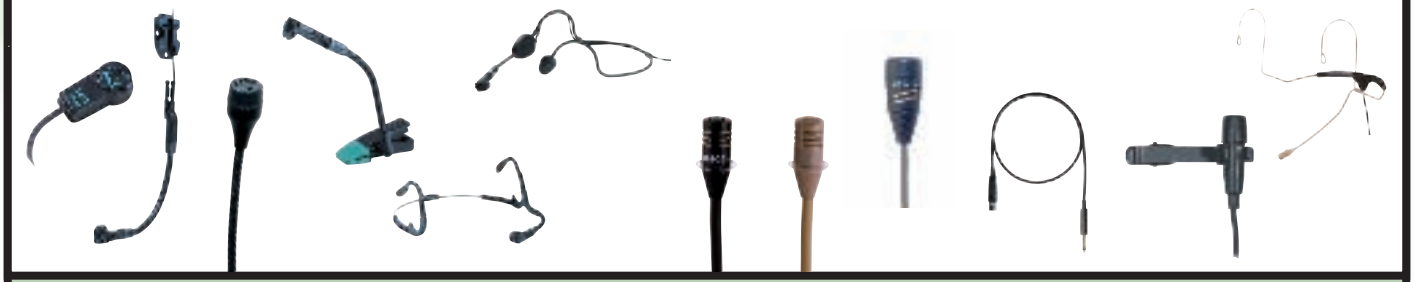
PPC 1000 and PB 1000 for the C 900

You can quickly change the polar pattern of the C 900 from cardioid to hypercardioid by attaching the supplied PPC 1000 Polar Pattern Converter (left) to the capsule. Also supplied with the C 900, the PB 1000 Presence Boost Adapter (right) provides a 3 to 5 dB presence rise between 5 kHz and 9 kHz for better intelligibility and a more sparkling instrument sound.

PB 1000 Presence Boost Adapter

Microphones for PT 400

C 411 L C 416 L C 417 L C 419 L C 420 L C 444 L CK 77 WR L CK 77 WR L/P CK 97-C/L MKG L CK 55 L C 477 WR L



For hints on how to use MicroMic Series products refer to pages 70 and 71.

Flexible Antenna
Maximum transmission reliability.

PT 400 Portable transmitter

Rugged mini XLR connector
Professional 3-pin mini XLR input for connecting MicroMic Series or other head-worn microphones, lavalier microphones, or instrument cables from AKG.

Soft-touch finish
Soft-touch enamel reduces handling noise.

Infrared Sensor
Setting up the transmitter is incredibly easy as frequency and gain data is downloaded from the receiver via infrared transmission.

Input gain control
Sets the gain of the audio input stage.

Display
Indicates the selected frequency or preset as well as the remaining battery capacity in hours.

0,1 " jack for external mute switch
An external mute switch allows the user to mute the signal even if the transmitter is hidden beneath clothes.

Detachable belt clip

Interchangeable color code labels
For identifying multichannel system transmitters.

Charging contacts
Convenient plug-in charging on the CU 400 charger is cost efficient and friendly to the environment.

Battery compartment
The transmitter can be powered by a single AA size dry or rechargeable battery.

Frequency is being downloaded from the receiver

Frequency preset

Frequency in MHz

Battery status display

LCD display
The LCD on the HT/PT 400 provides a clear readout of the most important transmitter parameters. As soon as the battery capacity drops to a critical level, a warning will appear in the display. Simultaneously, the receiver will display the same warning and change the display backlighting to red.

Low battery capacity warning

THE AKG WMS 400 SERIES CHARGER

The User friendly Quick Charger

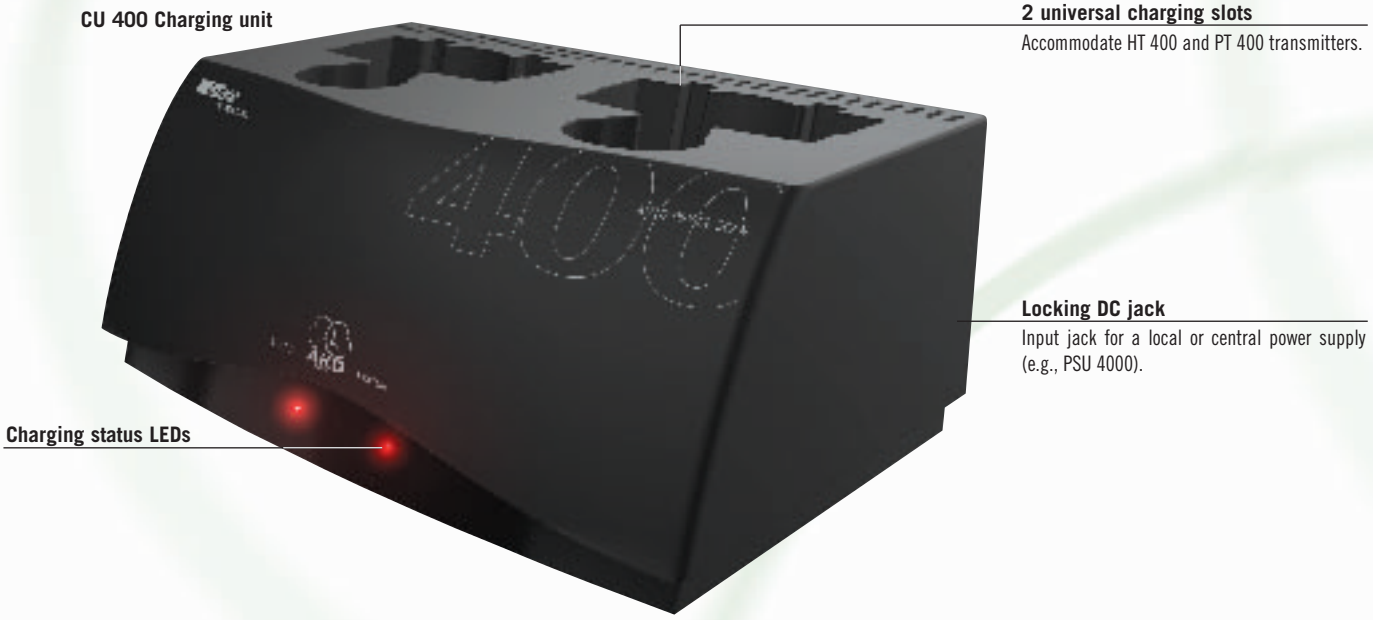
Any wireless microphone system depends on sufficiently charged batteries in all the transmitters. There is nothing more embarrassing than a transmitter running out of juice in the middle of the show, or a voice fading as the transmitter battery dies.

Although the battery status indicators and warning lights on the WMS 400 transmitters and receiver alert you to a dying battery ahead of time, it is still a good idea to use fresh dry or fully charged rechargeable batteries.

However, the setup phase and the soundcheck already use up some of each transmitter battery's capacity, so the batteries need to be topped up before the show. Obviously, there is not enough time to use a conventional charger, let alone take the transmitters apart to get at the batteries inside their compartments.

The CU 400 puts an end to this kind of hassle. It can charge two batteries simultaneously to full capacity within less than two hours, and there is no risk of overcharging the batteries.

And what's more, you can leave the batteries inside the transmitters. The transmitters and charger use integrated charging contacts so all you have to do is plug the transmitters into the CU 400 and remove them after charging.



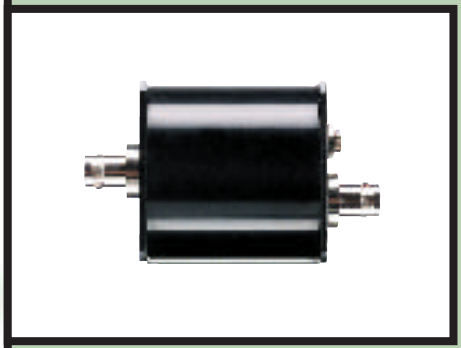
Integrated charging contacts for direct charging

Both the HT 400 and the PT 400 provide integrated bottom panel charging contacts. To get the batteries fully charged in less than two hours, just plug the transmitters into the CU 400. A single CU 400 can charge two transmitters simultaneously, making it easy to restore even a large number of transmitters to maximum performance within a short time.

SRA 1 – Passive wideband dirctional antenna
- For indoor and outdoor use, specifically for setting up long-range radio links
- For use with short antenna cables

SRA 2B – Active wideband dirctional antenna
- For indoor and outdoor use, in particular for setting up long radio links
- Integrated high-performance antenna booster for use of long antenna cables
- Remote powering option, status LED
- Rugged water-resistant case with BNC output

RA 4000 B
– Omnidirectional wideband booster antenna
- For indoor and outdoor use, in particular for near-field antenna setups with no preferred direction
- Integrated high-performance antenna booster for use of long antenna cables
- Remote powering option, status LED
- Rugged water-resistant case with BNC output



AB 4000 – Antenna booster
- Ultralinear antenna booster with water-resistant case
- BNC or N inputs and outputs, DC input, status LED
- DIP switch for gain adjust

HT 4000
- Wideband UHF handheld transmitter with interchangeable microphone elements and metal die-cast body
- Preprogrammed factory presets
- Up to 24 intermodulation-free frequency groups in each 30 MHz wide UHF band
- Up to 15 hours continuous operation on 2 AA size alkaline batteries or a minimum of 12 hours on optional BP 4000 battery pack

PT 4000
- UHF bodypack transmitter with magnesium body
- 1200 selectable frequencies in 30 MHz band
- Backlit display and jog switch operation
- Up to 50 mW (ERP) output for reliable transmission
- Optional remote mute switch
- Operates for up to 15 hours on AA batteries, 12 hours on optional BP 4000 battery pack, and displays remaining battery life

PS 4000
- Expandable modular antenna splitter with metal case
- 220 MHz bandwidth for use with all WMS 4000 channels
- Adjustable cable length compensation
- For multi-room installation of antenna systems

PSU 4000 Central power supply unit
- Powers up to 12 SR 4000 receivers plus antennas via 3 PS 4000 antenna splitters, or three CU 4000 charging units
- Also powers the HPA 4000 headphone amplifier or HUB 4000 network concentrator

HPA 4000 Headphone amplifier
- For connecting up to 8 SR 4000 receivers

SETTING UP MULTICHANNEL SYSTEMS

How to deal with Intermodulation and keep your Frequencies straight

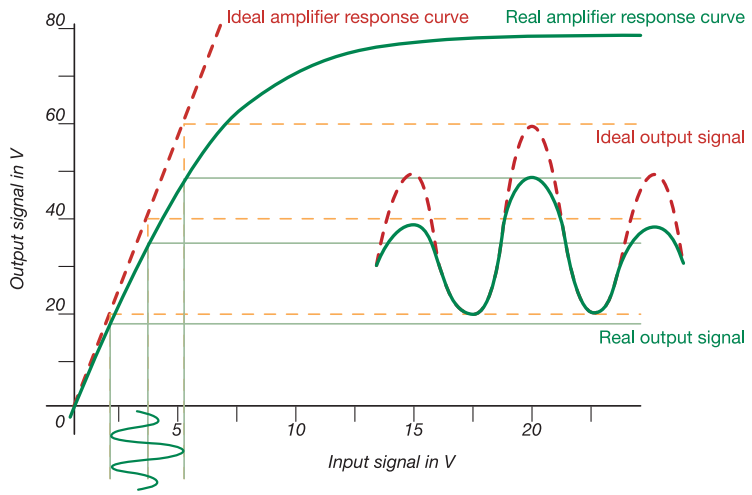
Whenever two or more signals are transmitted by a non-ideal system, undesired intermodulation products will be created, causing distortions (see also WMS 400, p. 31). An ideal system would deliver an output signal that is identical to the input signal over the whole frequency range even at larger amplitudes, and no problems would arise.

In practice, however, ideal systems do not exist, as transistors in particular have only a relatively narrow linear gain range. This is why the transmission of several signals via nonlinear systems, such as transmitters and receivers, will result in unwanted artifacts generated by intermodulation. These intermodulation products have to be dealt with somehow in practice.

The order of intermodulation products depends on the nonlinearity of the system response curve; the amplitudes of intermodulation products will always grow in proportion to the product of the mathematical powers of the fundamental signals generating a given intermodulation product. In reality, third-order intermodulation products tend to be particularly troublesome because they rise much more rapidly than the fundamental signal, thus turning into real, i.e., audible noise.

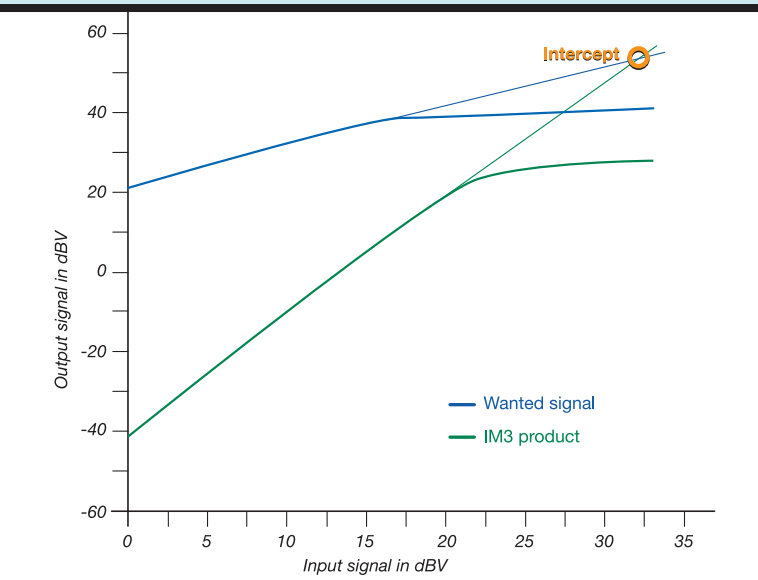
Whenever the frequency of the desired signal coincides with that of an intermodulation product the signal will be distorted. Moreover, the intermodulation product may activate the receiver's squelch function if the amplitude of the intermodulation frequencies exceeds the squelch threshold.

Obviously, the effective impact of intermodulation distortion also depends on the distance between transmitter and receiving antenna. In the case of wireless microphones transmitting on an intermodulation frequency, the desired signal is often ruined by intermodulation distortion if you move the transmitter too far away from the receiver.



Ideal and real gain curves of ideal and real amplifiers

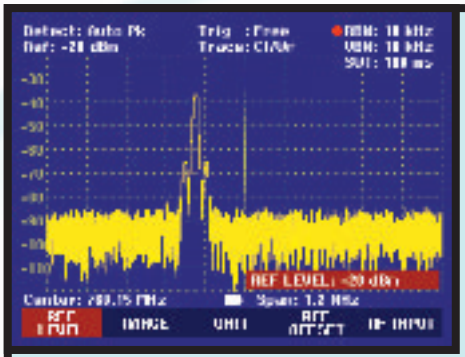
High audio input levels may overload the amplifier, so the peaks of the amplified signal are clipped as a result of saturation. The compression characteristic may be described by a polynomial (i.e., the sum of multiples of powers of a variable X). This polynomial includes all powers, with the odd powers (3, 5, 7, ...) responsible for intermodulation in multichannel systems. Because of its high coefficient, the third power term is especially important which is why third-order intermodulation products are dominant. The reciprocal value of the third-order coefficient defines the IP 3 Intercept (see below), which is the most important parameter for the intermodulation resistance of an RF amplifier. A smaller third-order coefficient of the transmission polynomial means a higher IP 3, which implies greater linearity of the RF amplifier and thus better resistance to intermodulation distortion.



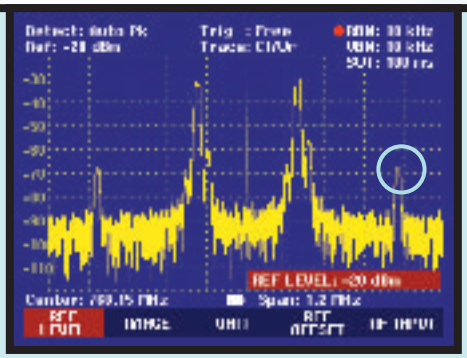
IP 3 Intercept

The Intercept marks the intersection of the theoretical linear transfer curve for the wanted signal's amplifier response curve and the theoretical linear transfer curve for the third-order intermodulation product. It is never actually reached because the amplifier will compress the wanted signal before it reaches the IP 3 Intercept level.

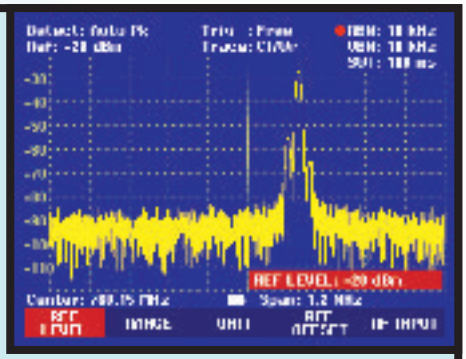
The higher the Intercept of a radio transmission system, the lower the IM risk, and the more channels may be used within a given frequency band.



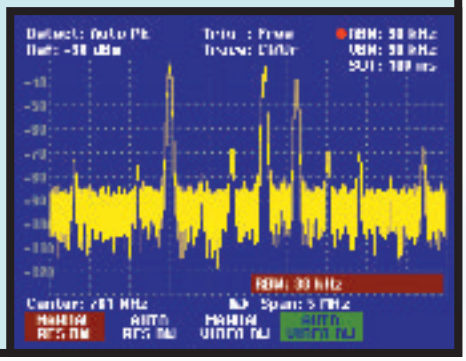
Microphone A carrier frequency
Spectrum analyzer trace



Intermodulation of carrier frequencies A and B
The trace clearly shows that third-order intermodulation products are only 38 dB lower in level than the carrier frequencies.

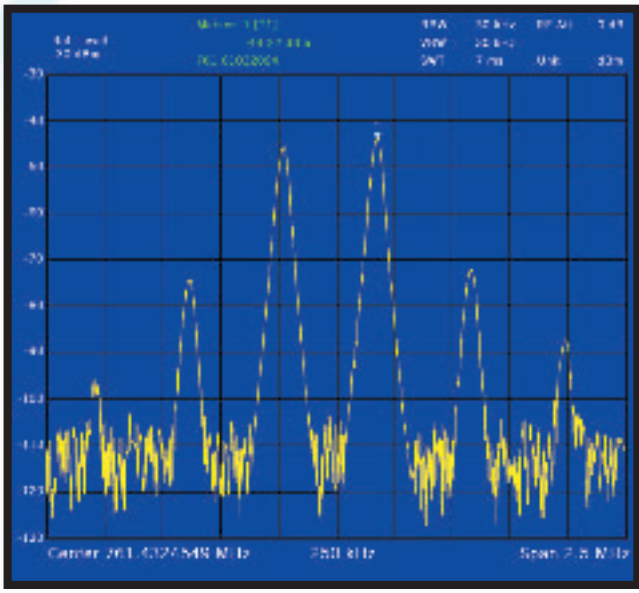


Microphone B carrier frequency
Spectrum analyzer trace



Intermodulation trace on a spectrum analyzer display
Third-order intermodulation products from three carrier frequencies.

The received signal level declines in proportion to the square of the distance between transmitter and receiver, and the intermodulation level produced in the receiver declines in proportion to the third power of the received signal level. This implies that intermodulation declines exponentially, in proportion to the sixth power of the distance between transmitter and receiver. If the distance is longer than 66 feet (20 m), receiver intermodulation is drowned out by noise. What remains is another important type of intermodulation distortion that has not yet been mentioned: transmitter intermodulation. In this case, the intermodulation products are not generated in the receiver, but in the transmitters, and are radiated by them along with the desired carrier frequencies. This will only happen, however, if there is enough crosstalk of carrier frequencies between two neighboring transmitters that intermodulate with each other. In this case, the antenna of one transmitter receives the carrier signal of a neighboring transmitter. If this signal makes it into the non-linear output stage of the transmitter, the first harmonic of the desired signal will transform it into a signal whose frequency is indistinguishable from the receiver intermodulation. The same happens in the other transmitter that will generate a mirror-image intermodulation product. Curiously, a love duet close to the receiving antennas may lead to intermodulation distortion caused by the nonlinear receiver. If the two singers move away, the intermodulation remains unchanged, but is now produced in the transmitters. In large multichannel systems, reducing the RF output of the transmitters is a way to bring down transmitter intermodulation by minimizing the nonlinear response of the transmitter's output stage. The RF output of WMS 4000 transmitters, for example, can be reduced from 50 mW to 10 mW (ERP – Equivalent Radiated Power).



Intermodulation trace on a spectrum analyzer display
Intermodulation products from 2 carrier frequencies, 3rd-order IMD and 5th-order IMD.

Here are some hints on how to minimize receiver intermodulation:

Always lay out the antenna system so as to ensure reliable transmission from every point on the stage. Moreover, be sure to use only the types of cables recommended in the user's manual. The distance between transmitters and active antennas should be at least 15 feet (5 m) (see also Antenna Position Check Applet on p. 45). Increasing the input attenuation of the antenna system helps, as does reducing the transmitter RF output to 10 mW. The latter has proved particularly useful for hand-held transmitters in situations where range is not an important consideration; generally, the RF output level used should always be just high enough to ensure adequate transmission. Systems with a higher transmitter RF output (ERP) are more prone to intermodulation problems, but this is compensated for by their better resistance to electrosmog.

When multichannel systems are used on Broadway, for instance, only the strongest will survive.

SETTING UP MULTICHANNEL SYSTEMS

How to deal with Intermodulation and keep your Frequencies straight

Frequency Management: a good idea for any multichannel system

One way to run a multichannel system would be to hire an RF engineer with a university degree for doing nothing but the number crunching required for finding clean frequencies and keeping an eye on all the batteries in the system. Unfortunately, it is not easy to find someone with this kind of knowledge, and then these experts are extremely busy and expensive.

Don't worry, there is an easier way. WMS Series wireless systems from AKG provide both an integrated Frequency Management System and clear battery status readouts to remove the hassle from setting up and operating a multichannel system and save time and money.

Calculation of intermodulation products

$f_{IM} = | m_1 f_1 + m_2 f_2 + m_3 f_3 + m_4 f_4 + \ldots |$

$m_v = 0, \pm 1, \pm 2, \pm 3, \pm 4, \ldots$

The order of IM products depends on the non-linearity of the transfer characteristic.

$f_{IM} = | 2 f_1 \pm f_2 |$, $f_{IM} = | f_1 \pm f_2 \pm f_3 |$ 3rd order

Derivation of 3rd order intermodulation products

$$(\cos\omega_1 t + \cos\omega_2 t + \cos\omega_3 t)^3 = \left(\frac{e^{j\omega_1 t} + e^{-j\omega_1 t}}{2}\right)^3 + \left(\frac{e^{j\omega_2 t} + e^{-j\omega_2 t}}{2}\right)^3 + \left(\frac{e^{j\omega_3 t} + e^{-j\omega_3 t}}{2}\right)^3$$

$$+ 3\left(\frac{e^{j\omega_1 t} + e^{-j\omega_1 t}}{2}\right)^2 \frac{e^{j\omega_2 t} + e^{-j\omega_2 t}}{2} + 3\left(\frac{e^{j\omega_1 t} + e^{-j\omega_1 t}}{2}\right)^2 \frac{e^{j\omega_3 t} + e^{-j\omega_3 t}}{2}$$

$$+ 3\left(\frac{e^{j\omega_2 t} + e^{-j\omega_2 t}}{2}\right)^2 \frac{e^{j\omega_1 t} + e^{-j\omega_1 t}}{2} + 3\left(\frac{e^{j\omega_2 t} + e^{-j\omega_2 t}}{2}\right)^2 \frac{e^{j\omega_3 t} + e^{-j\omega_3 t}}{2}$$

$$+ 3\left(\frac{e^{j\omega_3 t} + e^{-j\omega_3 t}}{2}\right)^2 \frac{e^{j\omega_1 t} + e^{-j\omega_1 t}}{2} + 3\left(\frac{e^{j\omega_3 t} + e^{-j\omega_3 t}}{2}\right)^2 \frac{e^{j\omega_2 t} + e^{-j\omega_2 t}}{2}$$

$$+ 6\,\frac{e^{j\omega_1 t} + e^{-j\omega_1 t}}{2}\,\frac{e^{j\omega_2 t} + e^{-j\omega_2 t}}{2}\,\frac{e^{j\omega_3 t} + e^{-j\omega_3 t}}{2}$$

Dual-tone products are obtained from lines 1 through 4,
e.g., $| f_{IM} = 2f_1 - f_2 |$
Three-tone products are obtained from line 5,
e.g., $| f_{IM} = f_1 + f_2 - f_3 |$

The far-near difference

Unlike a hardwire microphone, even the best wireless system is susceptible to dropouts because the relative positions of persons and objects within the coverage area will change constantly during an event. At any moment, shadow loss and signal cancellation may coincide with intermodulation and sideband noise in such a way as to cause a dropout. The specified dropout probability under such conditions for the WMS 4000 is less than 0.1%.

This is equivalent to a downtime of one third of a second per hour. Noticing such short interruptions is difficult even for an experienced tonmeister.

However, this low dropout probability can only be achieved inside a Faraday cage in which no other RF or digital equipment is used along with the WMS 4000.

As mentioned above, the dropout probability or immunity to interference depends primarily on the antenna positions. Finding the best antenna locations is always a balancing act. If the antenna is too far away from the stage the received signal will be too weak and drowned out by receiver self-noise and other unwanted disturbances during a deep fade. If you install the antenna too close to or even on the stage, however, the dreaded intermodulation whistles generated by the receivers and transmitters may become audible.

Here is where the far-near difference comes in. It is the difference between the receiving antenna's distance from the rearmost point on the stage where a transmitter will be used and the receiving antenna's distance from the front edge of the stage.

The Applet http://www.akgfrequency.at/antennaposition/ allows you to compute optimum antenna positions from known far-near differences.

To ensure intermodulation-free multichannel operation, AKG programs sets of frequency presets into each WMS 4000 system. Each preset contains groups of frequencies that do not disturb one another by intermodulation.

Depending on local frequency plans, up to 18 channels can be used simultaneously within each 30 MHz subband. "Enhanced-security presets" with 14 channels or less within the respective 30 MHz subbands are available for some countries.

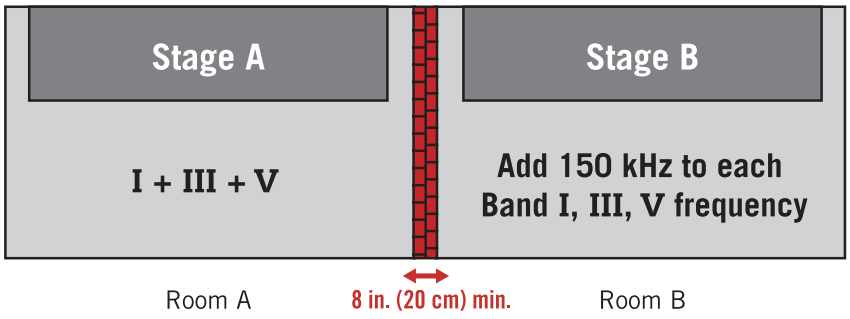
Although all the frequencies of any preset are approved for use in the respective country, you are still required by law to obtain a permit from the local authorities before you can use the system.

Adding channels by duplicating an existing frequency structure

Here is a proven way to add clean frequencies:

1. Refer to the Theater Frequencies table below and start with a frequency group you are using on stage A, for instance, Band I with 18 subchannels.
2. Add to each frequency half the minimum channel spacing. (In this example, the minimum channel spacing for a group of 18 frequencies is 300 kHz, one half of that being 150 kHz.) The resulting group for use on stage B (Band I + 0.15 in the table below) has the same properties as the original group.

Provided the two rooms are separated by a brick wall at least 8 inches (20 cm) thick, you can use the new frequency group you derived by adding 150 kHz without risking intermodulation distortion. By repeating this procedure for the other two frequency groups used on stage A, you will obtain the table shown below with 108 subchannels in Bands I, II, and V.



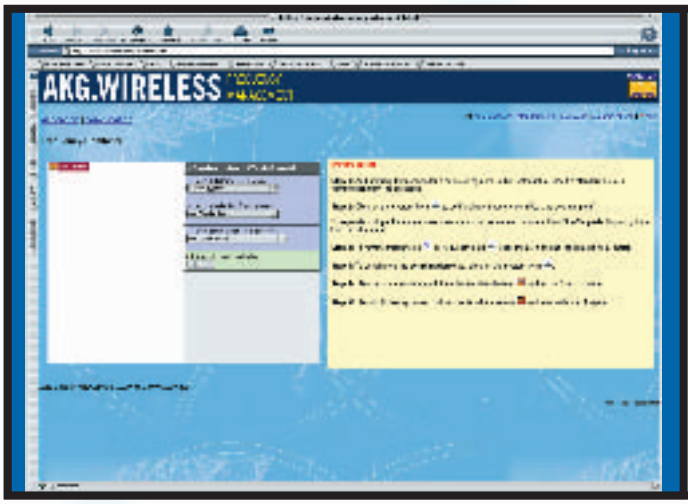
Theater Frequencies

	Stage A AT 1 preset frequencies			Stage B AT 1 preset frequencies increased by 150 kHz (0.15 MHz)		
	Band I	**Band III**	**Band V**	**Band I + 0,15**	**Band III + 0,15**	**Band V + 0,15**
1	650.850	720.700	790.900	651	720.85	791.05
2	651.350	721.200	791.400	651.5	721.35	791.55
3	654.850	724.700	794.900	655	724.85	795.05
4	656.350	726.200	796.400	656.5	726.35	796.55
5	667.950	737.800	808.000	668.1	737.95	808.15
6	673.250	743.100	813.300	673.4	743.25	813.45
7	650.150	720.000	790.200	650.3	720.15	790.35
8	665.050	734.900	805.100	665.2	735.05	805.25
9	666.050	735.900	806.100	666.2	736.05	806.25
10	675.450	745.300	815.500	675.6	745.45	815.65
11	672.450	742.300	812.500	672.6	742.45	812.65
12	676.050	745.900	816.100	676.2	746.05	816.25
13	650.450	720.300	790.500	650.6	720.45	790.65
14	652.450	722.300	792.500	652.6	722.45	792.65
15	658.150	728.000	798.200	658.3	728.15	798.35
16	661.950	731.800	802.000	662.1	731.95	802.15
17	663.350	733.200	803.400	663.5	733.35	803.55
18	671.150	741.000	811.200	671.3	741.15	811.35

SETTING UP MULTICHANNEL SYSTEMS

Modular Solutions for Professional Requirements

Calculating intermodulation-free radio frequencies requires an enormous amount of computing power. AKG used up to 150 computers operating day and night to calculate new sets of carrier frequencies unless the computers were needed for other purposes. The results are available to all users of AKG wireless systems on the Internet at www.akg.com/frequencies. The Frequency Management Program available on the AKG homepage lets you check all the radio frequencies you are planning to use for compatibility, making it easy to set up an AKG multichannel system that works perfectly from the start.



www.akgfrequency.at

The AKG Frequency Management Program checks all the radio links you are planning to use for compatibility and potential intermodulation problems.

To make sure your wireless system will operate smoothly, we recommend checking both the frequencies your system is going to use and the frequencies of local radio and TV stations, etc. with this program before setting up the system.

Frequency bands
Each of the six bands contains legal frequencies and presets for reliable, intermodulation-free operation. Special frequency versions within each band are available on request. An optional programmer allows AKG staff to program these frequencies either on location (one user preset) or at your local AKG Service Center (all presets).

BAND 1 650-680 MHz | **BAND 2** 680-710 MHz | **BAND 3** 720-750 MHz | **BAND 4** 760-790 MHz | **BAND 5** 790-820 MHz | **BAND 6** 835-863 MHz

RF output (ERP)
The HT 4000 and PT 4000 transmitters are available in three different RF output versions. Each transmitter is delivered with the maximum RF output (ERP) approved for the country or region where it will be used. The RF output of a transmitter can be changed, but this can only be done by AKG Vienna.

10 mW ERP* | **20 mW ERP*** | **50 mW ERP***

* ERP = Equivalent Radiated Power

Multichannel example 1
Each frequency band is 30 MHz wide and comprises up to 18 intermodulation-free frequencies (depending on local frequency plans). If you need more than 18 frequencies, you can use several bands. Make sure to select bands with the widest possible frequency spacing between them.

BAND 1 18 channels + **BAND 3** 18 channels + **BAND 5** 18 channels = 54 channels**

Multichannel example 2
Where local frequency plans limit the available frequency range to two bands, you can still set up a large multichannel system. Bands 1 and 2 together provide about 25 usable frequencies in this example. Again, use bands with the widest possible spacing between them!

BAND 1 + **BAND 2** = approx. 25 channels**

HOW TO USE ANTENNAS

Selecting, placing and using antennas

Any radio system uses antennas to get a signal from one place to another. To ensure the best possible signal quality, it is imperative to select the optimum antennas for the system and place the antennas correctly. Reflections, shadow loss, or deep fades may weaken or even cancel the radio signal (drop-out). If you obey a few simple rules for placing your antennas, transmitters, and receivers, your system will operate smoothly.

Absorption by or reflections off metal grid structures, the audience, and the musicians on stage (see illustration below) will attenuate any radio signal.

For best results, place the receiver near the stage but at least 5 feet (1.5 m) away from any metal beams, spotlights, lighting control consoles, computers, or other digital equipment. Make sure the transmitter will always be at least 21 feet (7 m) away from the receiver (see Antenna Position Check Applet on page 45). Since UHF signals propagate in a similar way to light, always keep a direct line of sight between the transmitter and receiver.

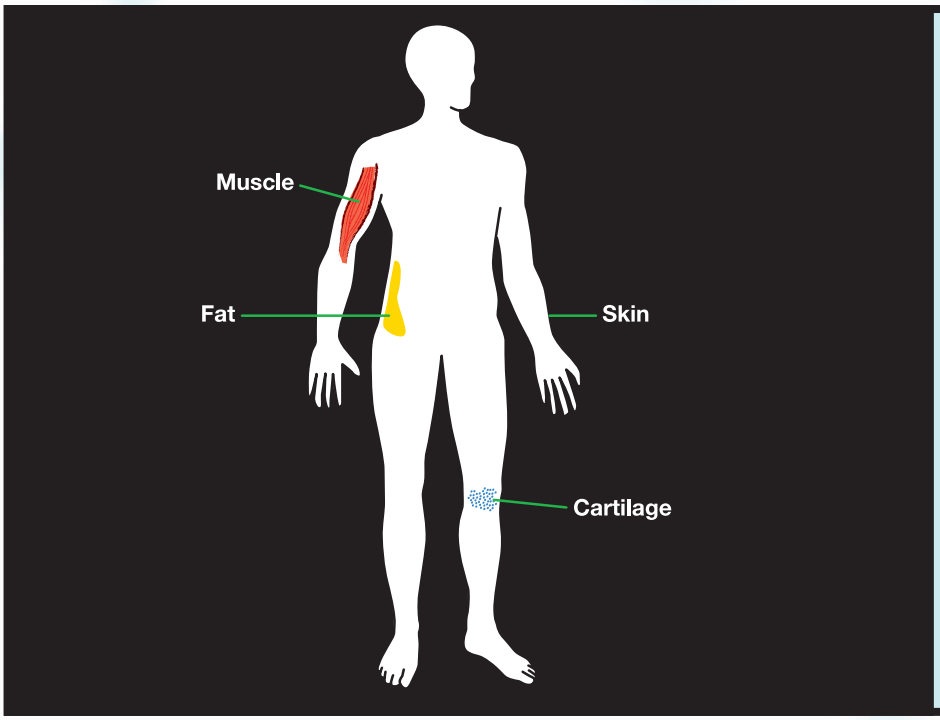
Antennas, like microphones, have different polar patterns. Depending on the venue and type of system, you may need directional antennas, such as Yagi (cardioid to hypercardioid) or log periodic (shotgun) types, or omnidirectional antennas with no preferred direction. Directional antennas are usually the best bet where the transmitters will only be used within a relatively small area, e.g., on a stage. Directional antennas can be used to overcome long distances or reject unwanted signals from off-axis directions. This is why they are very popular for open-air events. The greatest benefit of directional antennas – provided their gain is high enough – is that you can place them far enough from the stage that all transmitters appear to be at the same distance from the antenna. This prevents transmitters nearer to an antenna from generating intermodulation products that may interfere with the weaker signals from more distant transmitters. Use active omnidirectional antennas in rooms that are too small for directional antennas. We recommend mounting the two antennas vertically polarized and as high as possible above the performers.

Select your antenna cables very carefully, too. The antenna cable must feed the output signal of a remote antenna to the receiver. Note that any antenna cable will attenuate the signal it carries (cable attenuation). Different types of cable have different amounts of attenuation so which type works best depends on the length of the cable run. So if you need very long antenna cables, go for a low-attenuation type even though it will be thicker and more expensive than high-attenuation cable.

To compensate for the attenuation of long antenna cables, use either active antennas or in-line boosters. In many situations, though, you may be able to save on active antenna components by using the next-higher (slightly more costly) grade of cable. Using the optimum type of antenna cable may be the key to a smoothly working wireless system and helps reduce the levels of cost, stress, and aggravation.

Large open-air festivals are one example where antenna placement is of paramount importance because the transmitters are usually far away from the antennas, and more often than not there will be other radio links (radio or TV station O/B vans, etc.) to deal with as well. We recommend using directional antennas, and don't be a miser when it comes to buying antenna cable!

The only way to maintain good signal quality over long cable runs is to use expensive, high quality antenna cable, e.g., a type with a foam dielectric. A booster such as the AKG AB 4000 can compensate for 17 dB of cable attenuation, allowing you to add another 200 feet (60 m) or so of RG 213 cable to your antenna line. For extremely long lines, you can even use two boosters in series. If you have to route the antenna cables through a cable duct that may be prone to RF interference, use double-shielded cable.



Signal loss caused by the audience

The human body reflects and weakens radio signals. One problem that has plagued cellular telephone systems is the absorption of microwaves by human body tissues. Similar to the reverberation time, the RF level in a room decreases as the room becomes more crowded and absorption increases.
Even if there is a line of sight between the transmitter and receiver, the audience in between will weaken the RF signal because part of the RF energy hits the people and is absorbed by their body tissues. We therefore recommend placing the antennas so that the line of sight will be at least 3 1/2 feet (1 m) above the audience's heads to reduce this absorption effect.

Penetration depth in human body tissues for 4.3 dB attenuation:

Skin	4.3 mm
Fat	10.4 mm
Muscle	2.8 mm
Cartilage	21.0 mm

THE WMS 4000 MODULAR SYSTEM

Modular Solutions for Professional Requirements

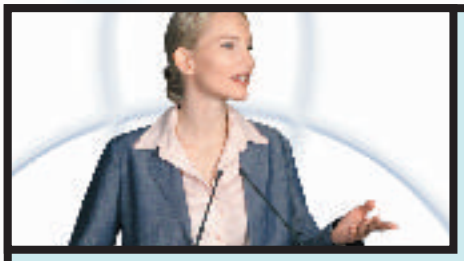
The WMS 4000 is probably the most innovative professional wireless system available today. It is based on intensive R&D and has been thoroughly tested under real-life conditions before being released for production. The objective of AKG's design engineers was extremely ambitious.

Therefore, all competitive systems were tested for ease of use and real-life reliability. Users were then asked to make a wish list of additional functions. These suggestions were examined for feasibility. The result is the new WMS 4000 wireless microphone system that had stirred up speculations and discussions within the audio community even before it was launched. The most striking detail of the new WMS 4000 Series is the advanced backlit display on both the handheld and bodypack transmitters and the receiver. The display makes it easy to check the selected preset and other important parameters including remaining battery capacity in hours, gain setting, or intermodulation-free frequencies. The WMS 4000 transmitters provide a "Silent Mode" in which you can set all system parameters such as carrier frequency, gain, etc. without transmitting an RF signal. A "hidden" pilot tone in the 30 kHz range transmits battery status data to the receiver and allows automatic muting of the receiver audio outputs in case of signal loss.

The SR 4000 Stationary Receiver is a true diversity receiver that ensures exceptional reliability. A 30 MHz wide UHF subband allows many wireless microphones to be used simultaneously for smooth multichannel operation. An automatic frequency scanner and setup function quickly finds the best intermodulation-free frequencies from a bank of presets. The SR 4000 is highly frequency agile to accommodate any changes in frequency plans that may vary from date to date and location to location. Unlike conventional wireless systems, the WMS 4000 components allow frequencies to be reprogrammed quickly and easily at any time.

The CU/BP 4000 charging system is a true innovation. The SBMS Smart Battery Management System includes a number of intelligent monitoring functions. Inflection Point and Peak Voltage Detect stops the charging in time, while an integrated temperature sensor in the battery pack protects the battery from overheating. A self-discharge counter ensures correct charging after the battery pack has been stored for a long time.

AKG uses advanced, future-oriented technologies for antennas as well. Several directional and omnidirectional antennas are available for every conceivable application, for small worship centers, theater productions, or large arenas.



Speech

Vocals

Guitar/Bass

Instruments

Installed sound

Live sound

TV studio

Theater

Worship center

HT 4000
- Wideband UHF handheld transmitter with interchangeable microphone elements and metal die-cast body
- Preprogrammed factory presets
- Up to 24 intermodulation-free frequency groups in each 30 MHz wide UHF band
- Up to 15 hours continuous operation on 2 AA size alkaline batteries or a minimum of 12 hours on optional BP 4000 battery pack

PT 4000
- UHF bodypack transmitter with magnesium body
- 1200 selectable frequencies in 30 MHz band
- Backlit display and jog switch operation
- Up to 50 mW (ERP) output for reliable transmission
- Optional remote mute switch
- Operates for up to 15 hours on AA batteries, 12 hours on optional BP 4000 battery pack, and displays remaining battery life

SR 4000
- True diversity UHF wideband receiver with 1200 selectable channels and all-metal case
- Preprogrammed factory presets
- Backlit LCD color display for checking operating parameters at a glance
- Setup control for quick and secure parameter setup
- SAuto Setup, Environment Scan, and Rehearsal functions for quick and easy frequency setting

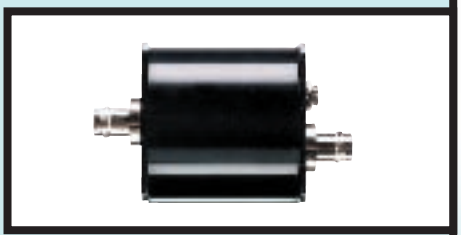
CU 4000/BP 4000
- Intelligent battery supply system comprising a CU 4000 charging unit and BP 4000 battery pack
- Microprocessor controlled charge/discharge monitoring function
- One-hour quick charging and Battery Recovery Management
- Charging compartment allows battery pack to be charged inside the transmitter

PS 4000
- Expandable modular antenna splitter with metal case
- 220 MHz bandwidth for use with all WMS 4000 channels
- Adjustable cable length compensation
- For multi-room installation of antenna systems

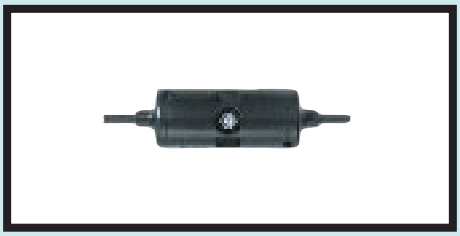
HUB 4000 Network concentrator
- For connecting up to 8 SR 4000 receivers to an Ethernet network

SRA 1 – Passive wideband dirctional antenna
- For indoor and outdoor use, specifically for setting up long-range radio links
- For use with short antenna cables

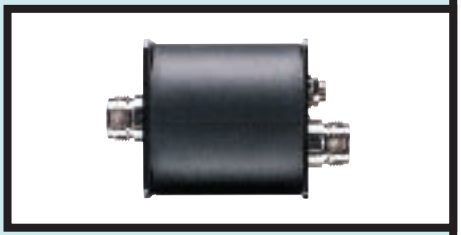
AB 4000 – Antenna booster
- Ultralinear antenna booster with water-resistant case
- BNC or N inputs and outputs, DC input, status LED
- DIP switch for gain adjust



SRA 2B – Active wideband dirctional antenna
- For indoor and outdoor use, in particular for setting up long radio links
- Integrated high-performance antenna booster for use of long antenna cables
- Remote powering option, status LED
- Rugged water-resistant case with BNC output



RA 4000 B
– Omnidirectional wideband booster antenna
- For indoor and outdoor use, in particular for near-field antenna setups with no preferred direction
- Integrated high-performance antenna booster for use of long antenna cables
- Remote powering option, status LED
- Rugged water-resistant case with BNC output



ASU 4000 – Remote power supply for antennas
- BNC or N inputs/outputs
- Locking DC input
- Status LED
- Water-resistant case
- For max. 3 active elements

HPA 4000 Headphone amplifier
- For connecting up to 8 SR 4000 receivers

PSU 4000 Central power supply unit
- Powers up to 12 SR 4000 receivers plus antennas via 3 PS 4000 antenna splitters, or three CU 4000 charging units
- Also powers the HPA 4000 headphone amplifier or HUB 4000 network concentrator

AKG WMS 4000 TRANSMITTERS

Handheld and Bodypack Transmitters for limitless Options

The WMS 4000 handheld and bodypack transmitters are two truly universal products that will meet the toughest requirements. Both the HT 4000 and PT 4000 have a 30 MHz wide UHF band and up to 1200 selectable frequencies, with an RF output of up to 50 mW that ensures maximum transmission security even in difficult environments. All functions are controlled via an easy-to-use jog switch. The backlit display provides information on all important data, such as remaining battery life, carrier frequency, input gain, programmable channel name etc. The smart electronic circuitry, combined with the BP 4000 battery pack, ensures an accurate readout of the battery status, while all status data are continuously updated via pilot tone between transmitter and receiver.

The HT 4000 handheld transmitter is equipped with interchangeable microphone elements, thus offering a wide choice of sounds and polar patterns to suit different applications. An electronically lockable on/off key and an easily accessible mute switch ensure additional convenience.

Thanks to its extremely rugged yet lightweight magnesium body, the PT 4000 bodypack transmitter is suited for any kind of usage on stage. The Mini XLR connector accepts a wide range of microphones and instruments. An additional jack for connecting a remote mute switch allows easy muting even if the transmitter is concealed in the clothes.

HT 4000 Handheld transmitter

Interchangeable microphone elements
100% AKG Acoustics: Tec Award winning C 900M, Emotion D 880M, TRIPOWER D 3700M, D 3800M, C 5900M, C 535.

LED status display
Indicates the most important operating parameters at a glance.

Backlit display
Ensures easy setup and accurate status monitoring even on a dark stage.

Soft-touch finish
Helps reduce handling noise.

Battery compartment

Jog switch
Easy menu control; no need to use any tools.

Charging and programming contacts
For an easy recharging of the BP 4000 battery pack inside the transmitter.

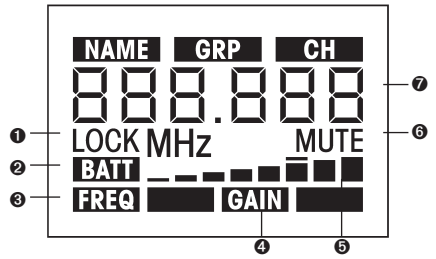
Electronically lockable on/off key and protruding mute switch
Easy distinguishable and protected against unintentional actuation.

On/off key, Mute switch, Jog switch and charging contacts

Battery status readout
Displays the remaining battery life in hours.

Frequency presets
Sets of intermodulation-free frequencies make setting up a multichannel system easy.

Automatic gain setting
Manual and automatic gain setting.



Display details

1. Lock indicator
2. Battery status
3. Frequency setup menu
4. Input gain menu
5. Input level bargraph with peak hold indicator
6. Mute indicator
7. Frequency/preset display

Microphones for HT 4000

D 880 WL 1 | D 3700 WL 1 | D 3800 WL 1 | C 5900 WL 1 | C 900 WL 1 | C 535 WL 1 | GN 15 HT

Microphones for PT 4000

C 411 L | C 416 L | C 417 L | C 419 L | C 420 L | C 444 L | C 477 WR L | CK 55 L | CK 77 WR L

Detailed instructions on using MicroMic products see pp. 70/71.

PT 4000 Portable transmitter

Electronically lockable on/off key and protruding mute switch

Rugged professional 3-pin mini XLR connector
Connects all AKG microphones, such as the MicroMic series, CK 77 WR, Discreet Acoustics Modular lavalier module, etc.

LED status display

Backlit display

0.1" jack for remote MUTE switch
Easy muting even if bodypack transmitter is concealed.

Inscribable color code element

Magnesium body
Lightweight and extremely rugged.

Lade- und Programmierkontakte

"Silent Mode" setting
WMS 4000 transmitters feature a "silent mode" that allows you to set all system parameters, e.g., frequency, gain etc., without "going on air".
This allows you to set up a replacement transmitter behind the scenes without disrupting the performance.

The "hidden" pilot tone
HT 4000 and PT 4000 transmit a pilot tone (approx. 32,768 kHz) "hidden" inside the radio signal to the receiver. This allows the pilot tone detection circuit to determine whether there is a transmitter in the coverage area, and noiselessly activate or mute the audio output of the receiver (TCSQ Tone Code Squelch). In addition, important transmitter status information such as remaining battery life and the MUTE switch position can be shown on the receiver display.