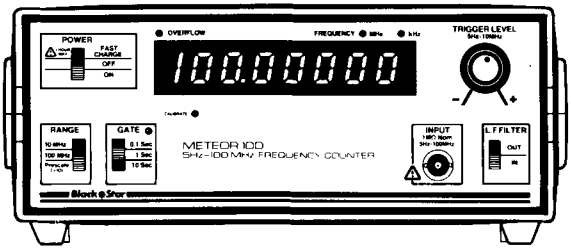
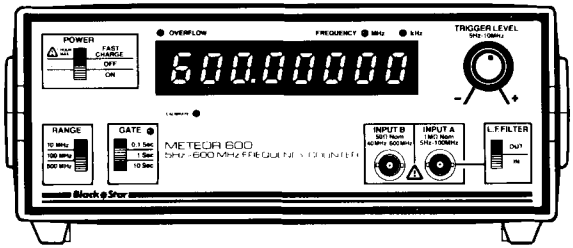
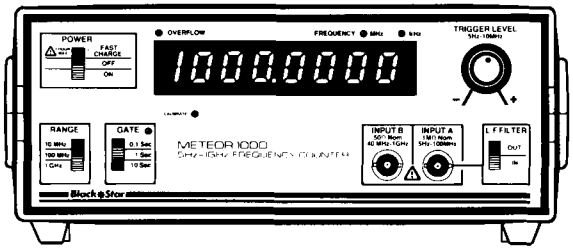


Black★Star

METEOR SERIES DIGITAL FREQUENCY COUNTERS

METEOR 100
METEOR 600
METEOR 1000





Instruction Manual

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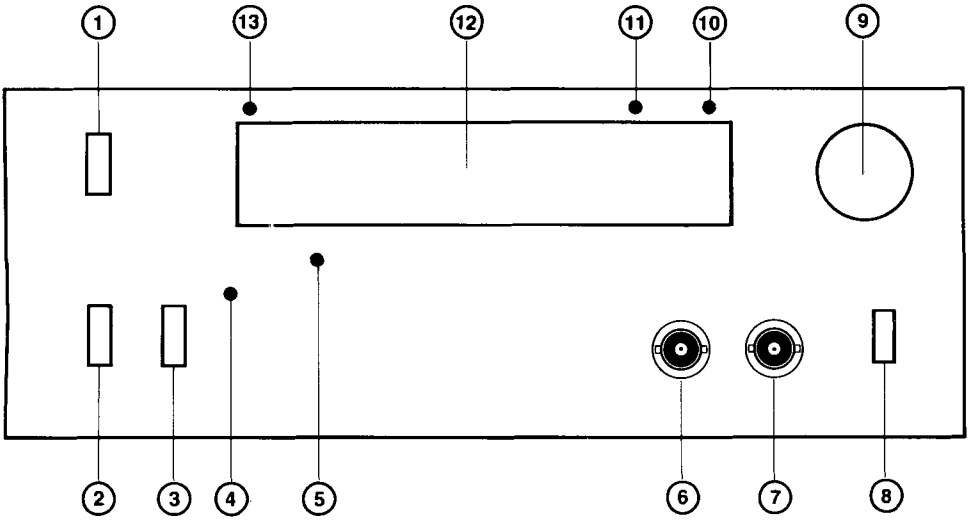
METEOR SERIES 8-DIGIT FREQUENCY COUNTERS

SPECIFICATIONS

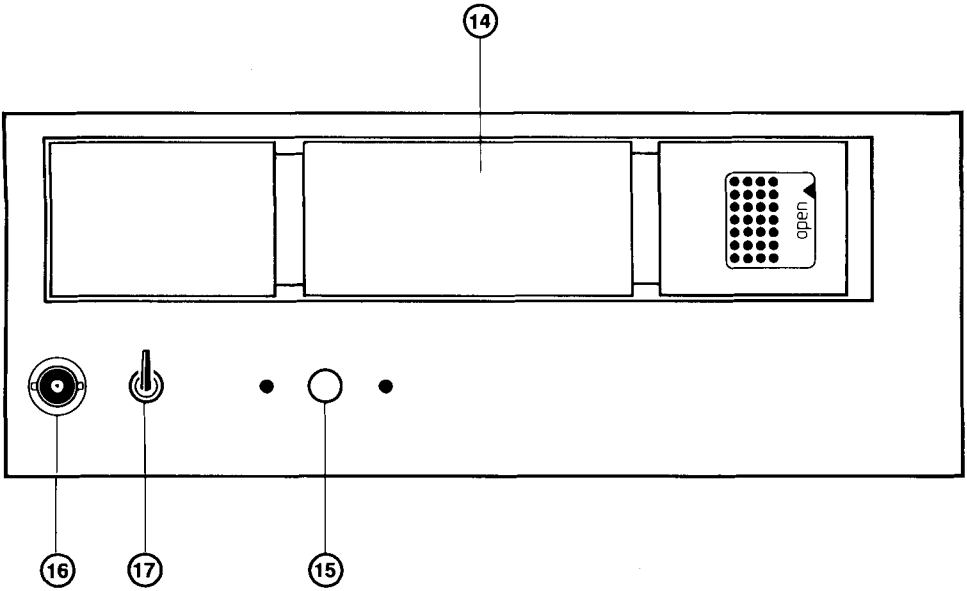
	METEOR 100	METEOR 600	METEOR 1000
FREQUENCY RANGE	5Hz - 100MHz (Typically 2Hz to 120MHz) Switch selectable in 2 ranges with third range for ÷10 prescaler option	5Hz - 600MHz (Typically 2Hz - 700MHz) Switch selectable in 3 ranges	5Hz - 1000MHz (Typically 2Hz - 1.2GHz) Switch selectable in 3 ranges
MEASUREMENT ACCURACY	± (1 count + timebase accuracy)		
TIMEBASE Crystal Oscillator Frequency	10MHz		
Setability	< ± 0.5 ppm Fully calibrated before leaving factory. Front panel access for any future adjustment.		
Temperature Stability	Typically < ± 2.5ppm from + 10°C to + 40°C		
Aging	< ± 10ppm/year		
Time between Measurements	200 mS		
GATE TIMES	0.1 sec., 1 sec., 10 sec., switch selectable with L.E.D. Gate status indication		
LOW FREQUENCY (Input A) Ranges	5Hz - 10MHz; 10MHz - 100MHz		
Input Impedance	1MΩ//30pf nom. (Low Frequency Filter - 'Out')		
Maximum Input Voltage	50VDC or 250V rms @ 50Hz decreasing to 5V rms @ 70kHz and above		
Sensitivity	10MHz range : < 5mV 5Hz - 10MHz 100MHz range: < 10mV 10MHz - 50MHz < 25mV 50MHz - 100MHz		
Resolution	10MHz Range 10Hz - 0.1 sec. Gate Time 1Hz - 1 sec. Gate Time 0.1Hz - 10 sec Gate Time	100MHz Range 100Hz - 0.1 sec Gate Time 10Hz - 1 sec Gate Time 1Hz - 10 sec Gate Time	
Low Frequency Filter	Cut-off frequency 50kHz nom. from source impedance of <50Ω Switch selectable 'In' or 'Out'		
Trigger Level	Front panel adjustment of Trigger Level on signals 5Hz - 10MHz		
HIGH FREQUENCY (Input B) Range		40MHz - 600MHz	40MHz - 1GHz
Input Impedance		50Ω nom.	
Maximum Input Voltage		50VDC or 250V rms @ 50Hz decreasing to 2V rms @ 50MHz and above	
Sensitivity		<25mV 40MHz to 600MHz	<25mV 40MHz - 600MHz <50mV up to 1GHz
Resolution		1kHz - 0.1 sec. Gate Time 100Hz - 1 sec. Gate Time 10Hz - 10 sec. Gate Time	
GENERAL Display	8 - Digit 0.5" 7 - segment L.E.D. Display with automatic decimal point and leading zero suppression. Frequency unit (kHz or MHz) indication by L.E.D. and Overflow warning by L.E.D.		
Power Requirements	9V DC @ (max) 600mA. Operation by Mains Adaptor/Charger (supplied) or 6 x NI-CAD 'C' Cells (optional)		
Battery Life	Typically 6 hours (100MHz range using 1.2Ah cells)		
Charging Rate	'On' or 'Off' 50mA nom. ; 'Fast Charge' 340mA nom.		
Environmental operating range	0°C to + 40°C (10% - 80% RH non-condensing)		
Case	Custom-moulded, sturdy, lightweight A.B.S. with tilt-stand and internal battery compartment with rear panel access.		
Size	219mm x 240mm x 98mm (Product only)	321mm x 352mm x 174mm (Packed)	
Weight	980g (Product only)	1.9Kg (Packed)	
Supplied Accessories	Mains Adaptor/Charger and Instruction Manual		
Optional Accessories	Set NI-CAD Rechargeable Cells Passive Probes External Reference Input Facility (10MHz) Prescalers	Telescopic R.F. Pick-up Antenna B.N.C. - B.N.C. Coax Leads Service Manual	

FRONT PANEL LAYOUT



1 Power Switch
2 Range Switch
3 Gate Time Switch
4 Gate Time LED
5 Calibration Access
6 BNC Socket Input B (600MHz and 1GHz models only)
7 BNC Socket Input A
8 Low Frequency Filter Switch
9 Trigger Level Control
10 LED indicates display in kHz
11 LED indicates display in MHz
12 Frequency Display
13 LED—Overflow indication

BACK PANEL LAYOUT

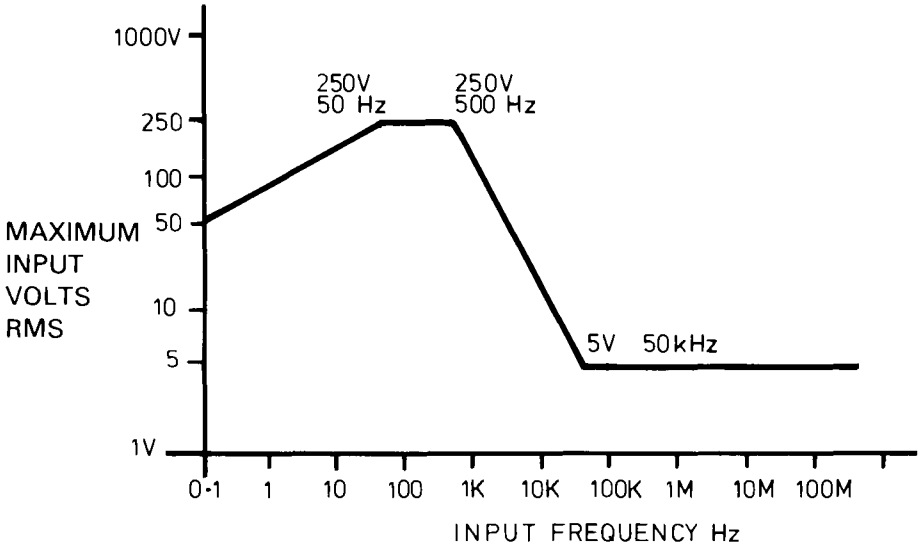


14 Battery Compartment
15 Mains Adaptor/Charger Input
16 BNC Socket—Input for External Reference Oscillator } Optional
17 Switch—External Reference Oscillator

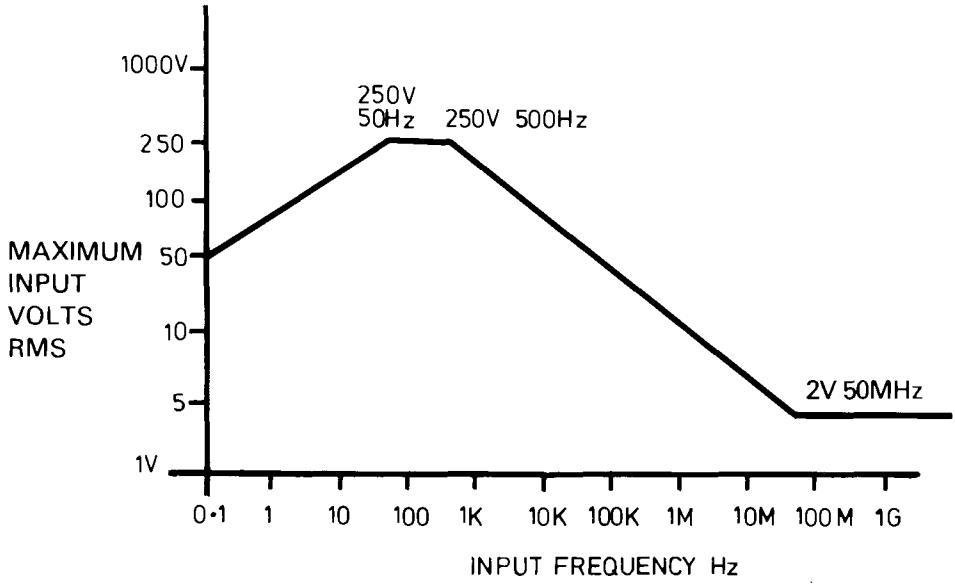
MAXIMUM INPUT VOLTAGES

Do not apply more than 50V DC or 250V r.m.s. sine wave @ 50Hz to any signal input. For other frequencies see graphs:

INPUT A 5Hz — 100MHz



INPUT B 40MHz — 1GHz



INSTALLATION

(a) Insert cells and/or mains adaptor. (Back panel (14) or (15).)

(b) Move power switch (1) to 'On'.

(c) Select range (2) required, if known.

(d) Connect signal to be measured to appropriate input. ((6) or (7).)

(e) Select gate time (3) required. Wait for one gate period. (See LED (4).)

MAINS ADAPTOR

The Mains Adaptor supplied has been specially designed to power your Meteor Frequency Counter. It is suitable for the normal mains supply in the country of purchase. It is NOT protected against continuous short circuit but will cause an internal **non-resettable** thermal trip to operate. NO OTHER MAINS ADAPTOR (EVEN IF APPARENTLY IDENTICAL) MAY BE USED ON A METEOR FREQUENCY COUNTER. Such use will invalidate the guarantee and may damage the counter.

POWER AND BATTERIES

Switch (1). This has three positions:

'Fast Charge' will re-charge fully discharged cells at the maximum rate consistent with not overloading the mains adaptor. There is no provision for sensing fully charged cells and the user must satisfy himself that use of this facility will not overcharge, overheat or otherwise damage the cells in use. Do not use in this position for more than one hour and then only on fully discharged cells.

'Off' disables the instrument but allows trickle-charging of the cells. Nickel-Cadmium cells of at least 1.2 ampere-hour capacity may be safely trickle-charged indefinitely in this position.

'On' applies power to the instrument from internal cells or preferentially from the mains adaptor if used. If the mains adaptor is used with the cells in place, the cells will be trickle-charged as in 'Off'. It is specifically recommended that primary (dry) cells are not used, whether alkaline or other types. If, however, they are used, they MUST be removed before connecting the mains adaptor. Damage caused by use of dry cells is not covered by the guarantee.

RANGE

Switch (2). This has three positions:

'10MHz' selects the 10MHz range. Any signal of sufficient strength may be read from 5Hz to 10MHz on this range, but see 'Low Frequency Filter' and 'Trigger Level' below. The signal must be applied to Input A (7).

'100MHz' selects the 100MHz range. Any signal of sufficient strength may be read from (typically) 1MHz to 100MHz on this range, but see 'Low Frequency Filter' below. The signal must be applied to Input A (7).

'Prescaler ÷ 10' (Meteor 100 only). This behaves exactly the same as 100MHz input, but the decimal point is displaced to the left allowing direct reading when a decade prescaler is used.

'600MHz' (Meteor 600 only). This selects the 600MHz range. Any signal of sufficient strength may be read from 40MHz to 600MHz on this range. The signal must be applied to Input B (6). This range may display a reading in the absence of an input signal. This is due to exceptional sensitivity, and does not affect operation or accuracy .

'1GHz' (Meteor 1000 only). This selects the 1GHz range. Any signal of sufficient strength may be read from 40MHz to 1GHz on this range. The signal must be applied to Input B (6). This range may also display readings in the absence of an input signal, which can be disregarded.

GATE TIME

Switch (3). This switch has three positions. Note there is an interval, between successive measurements, of 200ms.

'0.1s' selects a measurement interval of 100ms. Maximum resolution 10Hz.

'1s' selects a measurement interval of 1 second. Maximum resolution 1Hz.

'10s' selects a measurement interval of 10 seconds. Maximum resolution 0.1Hz.

Measurement is in progress while gate time LED (4) is lit.

LOW FREQUENCY FILTER

Switch (8). This has two positions:-

'Out' by-passes the filter circuitry and allows full frequency spectrum on the 5Hz to 100MHz input.

'In' introduces a low pass single pole filter into the 5Hz to 100MHz input. This filter has a −3dB point of nominally 50kHz when fed from a low impedance source giving normal sensitivity to audio frequencies, with sensitivity falling off rapidly above this. It's purpose is to filter out R.F. signals. When a wide bandwidth instrument is connected to a high impedance low-frequency circuit, it is quite common for parts of the circuit under test to act as aerials for any stray sources of R.F. radiation. Because of the high sensitivity of the instrument, these signals can be counted causing errors in the wanted measurement, and filtering is the most satisfactory solution.

INPUTS

Input signal levels should always be kept to the minimum practicable as under certain circumstances, especially when using Input A (7), mismatches can cause unwanted line reflections and apparent frequency multiplication. All BNC sockets are compatible with 50Ω plugs. The use of 75Ω plugs may give unreliable or noisy connections.

INPUT IMPEDANCE

The impedance of Input A is nominally 1MΩ shunted by 30pf. When the Low Frequency Filter is in circuit, this reduces to a series combination of 300Ω and 10nf.

The impedance of Input B is nominally 50 Ω .

TERMINATION AND USE OF PROBES

Input A - When measuring frequencies over 1MHz with a high impedance counter, reflections of the signal can cause standing waves, miscounts and possible damage to the circuit under test. To prevent this, use a through termination to match the input cable or, if the circuit under test cannot stand the load, use a short ($< \frac{1}{10}$ wavelength) input cable.

Use of Black Star Passive Probes is recommended as this minimises the capacitive loading. The following are available as optional accessories:

AT-001 - X1 probe for any signal up to 1MHz. The low capacitance cable minimises circuit loading.

AT-010 - X10 attenuator probe for higher level signals, where circuit loading is critical (10MΩ input impedance) or for signals over 1MHz. No termination is needed and the probe will accept signals up to the maximum frequency of Input A.

AT-110 - A switchable probe combining the features of both.

Input B Use 50Ω coaxial cable or the Black Star KBS series of BNC Coax Leads (optional accessories).

TRIGGER LEVEL

The operation of this control (9) is analogous to the Trigger Level Control on an oscilloscope. It only operates on the 5Hz to 10MHz range and enables the threshold of the squaring circuit to be moved to the positive or negative part of the signal allowing the user to overcome miscounts caused by poor or distorted input waveforms, ringing, overshoot, noise etc.

DISPLAYS/INDICATORS

The gate time LED (4) is lit for the duration of each measurement period. The kHz (10) and MHz (11) LED's indicate the scale factor of the display. The display (12) has leading zero suppression (for power conservation) and automatic decimal point location. Note that all of the digits on the display may not be illuminated for a particular frequency range/gate time combination e.g. 600MHz 0.1sec would display at range maximum:-

The Overflow LED(13) will only light when the main I.C., and hence the display, overflows. There is no over-range indicator. Generally most units will read to at least 110% of the set range. Typical symptoms of too high a frequency input are extreme variations in reading between one gate time and the next, unexpectedly low frequency readings or lack of input sensitivity.

EXTERNAL REFERENCE OSCILLATOR FACILITY (optional)

The External Oscillator Facility allows the use of an alternative highly stable 10MHz frequency standard to improve the performance of the instrument. The standard should be connected to the External Reference Oscillator Input (16) on the back panel. The input should have an amplitude of 5V peak to peak. The input impedance is in excess of 1kΩ but is shunted by about 10pf. The input waveform need not be sinusoidal but should be free from glitches and harmonic ripple. (A squarewave may have slow rise and fall times but should be reasonably flat and free from overshoot, for instance.) The mark/space ratio should be as close as possible to 1:1.

The External Reference Switch (17) selects between internal and external reference sources. This switch must be returned to the 'Internal' position when the counter is being used in the normal mode.

TRANSMITTER FREQUENCY MEASUREMENT

When measuring the frequency of a transmitter, the most serious risk with a Frequency Counter is that of overloading and damaging the inputs. If in doubt, assume the counter will be overloaded and take precautions accordingly (see specification).

The indirect method (no physical connection) of measuring transmitted frequency is usually the safest and most convenient. Using the Telscopic Antenna (optional accessory) plugged into the appropriate input on the counter, set the transmitter to its minimum input power and initially measure the signal some five to seven metres from the transmitter aerial. This is usually adequate for H.F. signals. In tests, ¼ watt attenuated output from a C.B. transceiver gave stable readings when fed to a 1½ metre base loaded whip antenna about 10 metres from the frequency counter. Where low power transmitters with inefficient aerials are used (as with some hand-held transceivers) the separation may need to be reduced but, in practice, the aerial rarely needs to be closer than 1 to 2 metres. Where a high-power transceiver is being tested and the power level cannot conveniently be reduced, use the Telescopic Antenna fully closed or a simple pick-up coil of 2 or 3 turns, 2" in diameter and earthed at one end.

With direct connection of the transmitter to the Frequency Counter, it is most important not to exceed the maximum input voltage rating. For example, consider a 5 watt transmitter on the amateur 2 metre band radiating at 145MHz. The maximum input is 2V rms into 50Ω (Input B) representing 80mW. Therefore the minimum attenuation necessary is 10 log (5/0.08) dB or 18dB. In practice, as the Meteor series of Frequency Counters are so sensitive, 30dB would be safer and still allow a comfortable input level of 0.5V rms. Note the necessity of using an adequately rated attenuator (5W in this case). Input A has a high input impedance and a suitable 'through' matching termination should be used when making connection with coaxial cables.

Modulated Carriers:

F.M - Narrow band F.M. as used with many modern communications transceivers should present no problems as the counter essentially averages over the gate period. Wide band F.M. is rarely encountered but should give acceptable results with longer gate times.

A.M. - It is difficult to measure highly modulated A.M. signals as, at some points, the carrier reaches very low levels. Further, the mean power may considerably exceed the nominal power, so great care must be taken when calculating attenuation for direct coupling. If the signal can be measured when free from modulation, the results are always more predictable.

S.S.B. - Single side band transmissions suppress the carrier which therefore cannot easily be measured. If an audio signal generator is available, transmit a 1kHz tone and note the measured frequency indicated on the counter. Subtract 1kHz from this reading for true carrier frequency with upper side band transmission (and vice versa for lower side band).

C.W. - Measurement is straightforward. If using a morse sender, the key must be kept depressed.

RECEIVER FREQUENCY MEASUREMENT

Direct measurement of received frequency in a superhet. receiver is not normally possible. It is easier to measure the local oscillator frequency and allow for any I.F. offsets. For example, a conventional receiver with 455kHz I.F. and the local oscillator set high would, when tuned to B.B.C. Radio Three on 1.206MHz, exhibit a measureable local oscillator frequency of 1.661MHz. If the I.F. frequencies are not known, find a station of known frequency and measure the local oscillator. Retune to the unknown station and measure the local oscillator again. The difference between the two measurements is the same as the difference between the frequencies of the two stations. Some modern multi-band, multi-mode receivers use different I.F. frequencies depending on the band selected which may render this technique difficult or impractical.

Another method is to tune in the wanted station then tune a signal generator - feeding a small aerial near the set - using minimum power, until an audible beat with the wanted station is heard, then measure the frequency of the signal generator. By using low power, the chance of spurious beats, whistles or 'birdies' due to harmonics or poor image rejection in the receiver, is reduced. The two strongest beats will normally be at the wanted frequency and the image frequency (offset by twice the I.F.). The beat at the wanted frequency should be stronger and require less injected signal.

MAINTENANCE AND REPAIR

The manufacturer, or the appointed agents overseas, will repair and calibrate any instrument developing a fault. See the guarantee card for full details but **always** observe the following points:-

1. Remove batteries before returning product
2. Do NOT return **any** accessories.
3. Pack product very carefully. Whenever possible retain original packing for this purpose.

Where owners wish to undertake their own repairs and calibration, this should be carried out by skilled personnel, with access to precision equipment, working in conjunction with the Service Manual which can be purchased from the manufacturer or their overseas agents.

CALIBRATION

For optimum accuracy, the instrument requires calibration from time to time. How frequently will depend on the user and application but once every twelve months would normally be adequate. Provision for this is made on the front panel. Use of a nylon trimmer tool is recommended. If a screwdriver is used, it MUST be insulated from the front panel, as a short circuit from the trimmer to ground will cause damage. The most convenient accurate frequency reference is usually a precise transmitted carrier wave. In the U.K., Rugby (60kHz) and Droitwich (currently 200kHz, changing to 198kHz in 1986) are suitable transmissions. 'Off-Air' frequency standard receivers for this purpose are commercially available.

GUARANTEE

For guarantee details please refer to separate card inserted in this manual.