Eddystone

EDOMETER TEST INSTRUMENT

CAT. No. 902

MARK II

A versatile instrument which will be found a most useful and practical addition to the equipment in any radio and electronic laboratory, workshop or maintenance department.

The "EDOMETER" provides the following facilities in the one complete unit:

STANDARD DIP OSCILLATOR

ABSORPTION WAVEMETER

HETERODYNE WAVEMETER

SIMPLE SIGNAL GENERATOR

MODULATION MONITOR

AUDIO TONE SOURCE

The frequency coverage when used as a dip resonance indicator is from 1·25 MHz to 115 MHz, two additional coils being provided for signal generation over the range 380 kHz to 1·25 MHz.

The main function of the instrument is as a dip oscillator, to indicate the resonant frequency of a tuned circuit. Since the unit is transistorised and self-contained, it is available for immediate use in any situation, without the inconvenience of a trailing lead or need of access to a mains supply. The illustration gives a good idea of the appearance, the length of the case (without a coil) being approximately 6⅜". It will be noted that both the scales and the indicating meter can be read very easily.

Frequency Coverage

Seven plug-in coils are provided and read-out is directly against the calibrated scale. Ranges 6 and 7, are mainly for alignment purposes, with the instrument functioning as a signal generator.

Controls

There are three controls, arranged for convenient operation with the instrument held in the hand. The TUNING KNOB operates a geared reduction drive, which makes for easier adjustment.

The SUPPLY SWITCH/SENSITIVTY control is of the edge-operated type, the knurled surface being rotated downwards to switch on the power supply. Further rotation affects the sensitivity, the meter deflection being adjusted to give a constant reading.

The MODULATION SWITCH determines the function of the bi-polar transistor, which becomes an audio amplifier in the OFF position and a tone generator in the ON position.

Outputs

Normal radiation from the exposed coil is used when a signal for test work is required. To modulate the signal, the modulator switch is placed in the ON position.

The right-hand jack socket delivers the audio signal, the frequency being nominally 1000 Hz, the amplitude 100 millivolts, and the output impedance around 5000 ohms. With a plug inserted, the r.f. oscillator is disabled.

Using the instrument either as a modulation monitor or as a heterodyne wavemeter, output is taken to a telephone headset from the right-hand jack socket.

Coils

The coils are of robust construction and protected against damage.

Power Supply

A PP3 battery (9 volts) fits inside the case and can easily be replaced when necessary. (Battery not supplied).

Dimensions

The Unit measures 6⅜" × 2¼" × 2¼" not allowing for the projections. The weight is 25 ozs. complete with battery. For easy carrying, the unit, complete with coils and a comprehensive Instruction Manual covering various applications, is housed in a wooden carrying case.

Instructions

A comprehensive Instruction Manual, covering the various applications, is supplied with the instrument.

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OPERATING INSTRUCTIONS

EDDYSTONE

"EDOMETER"

(Cat. No. 902)

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EDOMETER Mk. II

The Mk. II edition of the EDOMETER is an improved version of its predecessor from which it differs in that silicon transistors are used in both stages. The oscillator employs a field-effect transistor (Texas 2N3819) while the audio oscillator/amplifier becomes a bi-polar planar transistor (T1407) in place of the original OC71.

Seven coils are used as on the earlier version, Ranges 6 and 7 now covering the band 380 kc/s to 1.25 Mc/s. Normal "dip" operation is available at all frequencies above 1.25 Mc/s (Ranges 1–5). All ranges are marked on the unit and the "drop-in" frequency scale previously used for Ranges 6 and 7 is not now required. The calibrated logging scale has been omitted.

The instrument can be used as before in any of the varied applications described in the Operating Manual. Tone Output is 1000 c/s and not 100 c/s as stated in error on page 3.

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INTRODUCTION

The Eddystone " EDOMETER " is a modern transistorised equivalent of the well-known grid-dip oscillator (g.d.o.). It is a simple but extremely versatile instrument covering a frequency range of 390 kc/s to 115 Mc/s with a set of seven plug-in coils. Power is derived from a self-contained battery and the circuit features zener stabilisation to maintain constant performance with falling voltage.

Applications of the " EDOMETER " are many and varied, ranging from resonance checks on tuning circuits to actual measurement of inductance and capacity. A modulator stage is incorporated and the instrument can serve as a signal generator for receiver alignment or as a signal source for tests on audio equipment. Other facilities permit use as an absorption wavemeter, heterodyne wavemeter and modulation monitor.

Compact light-weight construction, convenient positioning of the various controls and complete absence of a power supply lead make for ease of operation whether the unit is used on the bench or held in the hand. Tuning is simplified by a geared reduction drive while the clearly calibrated scale permits rapid read-out. Meter sensitivity can be adjusted to suit the conditions under which the instrument is used.

The notes which follow give examples of the main uses of the instrument. Other varied applications will no doubt suggest themselves to the user and the list given here should in no way be considered exhaustive. Certain basic operating procedures always apply and these will therefore be considered first.

Coupling the " EDOMETER " to the circuit under test.

When using the instrument as a signal source it is always best to make preliminary checks with very tight coupling to the test circuit. This ensures that the initial indication of resonance is as clear as possible because in this condition the greatest amount of energy is absorbed from the oscillator circuit and meter deflection is therefore maximum.

Tight coupling, unfortunately, impairs the accuracy since oscillator pulling results and gives rise to two distinctly separate indications of resonance, depending on the direction in which the oscillator is tuned. It is most essential therefore after obtaining the initial indication, to reduce the coupling to the point where only one tuning point exists. Meter deflection is then less than with tight coupling but is still adequate for easy adjustment of the TUNING CONTROL. The lighter the coupling the greater the degree of accuracy. Tightest coupling exists when the axes of the two coils are in the same plane and closest together, minimum coupling when the axes are at right-angles.

In some cases it will be found that the test circuit is awkwardly placed and out of reach of the " EDOMETER " coil. Link coupling must then be employed and a two- or three-turn link lightly coupled to each circuit will generally give the required degree of pick-up. Link coupling should also be employed when the unit is used as a signal generator or for checks on aerial systems.

Extremely loose coupling should be used during preliminary checks when using the instrument as an absorption wavemeter. This ensures that there is no danger of damaging the meter movement by coupling excessive amounts of power into the " EDOMETER " circuit. In its role as a modulation monitor on the other hand, meter sensitivity can be reduced to zero if necessary and coupling can then be as tight as required.

Adjusting the meter sensitivity.

Due to the circuit parameters the oscillator power will vary slightly from one range to another and also at different frequencies within a given range. The latter variation can be considered to be the most serious because random movement of the meter needle when tuning can be most confusing to the user. Close attention has been paid to this factor in the design of the " EDOMETER " with the result that any variation which may occur is of a very gradual nature and is generally less than two divisions on the meter scale when tuning over the whole of any single range. It will be found convenient therefore after plugging in the appropriate coil to set the meter reading to 7 on the scale so that the needle will not swing past full scale at any point in the range. The sensitivity can always be advanced to maximum (10) to obtain the greatest dip for a given degree of coupling once the preliminary checks have been carried out. The magnitude of the dip will decrease as the initial reading is made to occur lower on the scale and this is due to the increased resistance which appears in series with the meter. Bear in mind that maximum deflection occurs immediately after closure of the SUPPLY SWITCH. The reading at this point may exceed full scale deflection but not by an amount which could damage the meter.

Increasing the measuring accuracy.

When a high degree of accuracy is called for, the " EDOMETER " should be used in conjunction with an accurately calibrated receiver, preferably with built-in facilities for scale checking. Alternatively, a heterodyne frequency meter can be used to standardise the instrument.

The technique is quite simple, involving continuous monitoring of the oscillator signal on the receiver in such a way that frequencies can be read from the receiver calibration instead of from the " EDOMETER " scales. The instrument can be used as a modulated oscillator if the receiver has no beat oscillator since this in no way affects the basic operation of the circuit.

In many cases, continuous monitoring will not be necessary since it is possible to standardise the instrument against the receiver at one specific frequency in the range of test frequencies to be used, noting the error as so many divisions on the logging scale. An appropriate correction can then be applied as each reading is taken.

A standard heterodyne frequency meter can be used in place of the receiver provided that its sensitivity or the sensitivity of the " EDOMETER " is sufficient for the signal levels involved. Instruments of this type usually work on a harmonic principle but no confusion can occur since at all times the approximate frequency can be read from the " EDOMETER " scale.

Normal applications of the instrument do not usually necessitate the procedure detailed above but it is recommended that this technique is employed when making such tests as measurement of inductance and capacity, coupling coefficient etc.

Measurements on tuned circuits.

The most common uses of the instrument in this field are as follows:

(1) Tuning a given circuit to a specified frequency.

(2) Determining the approximate frequency to which a given circuit is tuned.

(3) Locating and measuring the approximate frequency of spurious resonances in receiver and transmitter circuits.

(4) Measuring the approximate values of unknown inductors and capacitors.

The first three checks listed above can in many cases be carried out in either of two ways: (a) by energising the equipment under test and using the " EDOMETER " as an absorption wavemeter, or (b) by using the instrument in its main role as an oscillating wavemeter. The latter method often shows a great advantage over the former because in many cases it allows measurements to be taken without the need for working on equipment with dangerously high voltages applied. This mode of operation will now be considered taking first the case given in (1) above.

Tuning a given circuit to a specified frequency.

First select the appropriate coil and plug it into the " EDOMETER ". Switch on the instrument, set the meter reading to 7 and then tune it to the required frequency. Next couple the " EDOMETER " to the circuit under test and adjust the tuning of this circuit until a dip in meter reading is obtained. Finally, repeat the check using looser coupling and with the meter sensitivity advanced to maximum to ensure the highest degree of accuracy.

Determining the approximate frequency to which a circuit is tuned.

The procedure is very similar to that just described except that in this case it is necessary to make an initial estimate of the probable frequency to which the circuit is tuned. Also, it should be fairly clear that the " EDOMETER " and not the test circuit now becomes the variable quantity. It may be found necessary to change to the adjacent range if the initial estimate of the probable frequency is vastly in error or if the frequency lies near the end of a range.

The same technique is employed when searching for spurious resonances but care must be taken to avoid confusion by accidental coupling to the actual tuned circuits in the equipment being checked. A probe can be link coupled to the tuning coil when working on awkwardly placed circuits.

Use as an absorption wavemeter.

In cases where the equipment being checked must be operated in its normal manner (*i.e.* with full voltages applied), resonance checks can still be carried out by using the " EDOMETER " as an absorption wavemeter. It is of course necessary that the circuit being checked is excited at its normal operating frequency but there is no requirement for a large amount of power. The " EDOMETER " will give a good indication even when coupled to a low-power transistor oscillator.

When using the instrument as an absorption wavemeter the SUPPLY SWITCH is set to OFF. The instrument functions as a straightforward rectifying device and is tuned for a *peak* reading on the meter. Note that with the SUPPLY SWITCH at OFF the meter sensitivity is automatically at maximum and sensitivity becomes a function of the degree of coupling to the circuit under test.

The main applications of the instrument when used in this role lie in the transmitting field where it will be found very useful for checking that the final amplifier and driver/multiplier stages of a transmitter are tuned to the correct harmonic of the drive frequency. Other applications include use as an indicating device when neutralising an amplifier and measurement of the approximate frequency of v.h.f. parasitic oscillations.

Use as a heterodyne wavemeter.

Operating the unit as a heterodyne wavemeter will generally give a greater degree of accuracy than when it is used as an absorption wavemeter. This does not however preclude its use in the latter mode because when using the instrument as a heterodyne wavemeter confusion may result from the fact that it will indicate not only the fundamental frequency to which the test circuit is tuned but also the harmonics of that frequency.

In the absorption mode only the fundamental will be indicated and it should be clear then that to achieve greatest accuracy and eliminate ambiguity, the approximate frequency should first be determined by using the instrument as an absorption wavemeter. Changing to heterodyne operation will then enable the frequency to be determined with a greater degree of accuracy.

When using the instrument as a heterodyne wavemeter the SUPPLY SWITCH should be set to ON and the meter sensitivity turned well down to prevent possible damage to the meter if the instrument is inadvertently over-coupled to the circuit under test. Telephones should be plugged into the left-hand jack socket (CW MONITOR) when a beat note will be heard as the " EDOMETER " frequency approaches that of the test circuit. Reducing the beat to zero will give the actual frequency.

Measuring inductance and capacity.

The measurement of inductance and capacity is a relatively simple procedure and several methods can be applied. All depend on the basic fundamental fact that inductance, capacity and frequency are related and that provided two of these quantities are known the third can be readily determined.

Consider first the procedure to be applied in determining the inductance of a given coil. If the coil is coupled to the " EDOMETER " it is a simple matter to obtain its resonant frequency when tuned by its self-capacity. This measurement however is of little value since the self-capacity is an unknown quantity and cannot therefore be used to determine the inductance of the coil. If however, a close-tolerance capacitor of known value is connected across the coil and the check repeated, a new frequency will be obtained and since the value of the circuit capacity is now known it becomes an easy matter to apply a simple formula to obtain the value of inductance. The appropriate formula is:

$$L = \frac{25330}{C \times f^2}$$

where L is in uH, C in pF (uuF) and f in Mc/s. Substituting values in this case on the assumption that the coil tunes to 10 Mc/s with a 50pF capacitor we obtain:

$$L = \frac{25330}{50 \times 10^2} = \frac{25330}{5000} = 5\text{uH (approx.)}$$

The value of any inductor can be determined in this way provided that suitable values of capacitor are available and that the resonant frequency obtained from the combination lies in the range 1·6–115 Mc/s. Values between 0·1–100uH can be measured using a standard capacitor of 100pF and a tuning range of 1·6–50 Mc/s. The accuracy obtained will be highest when checking coils with a low self-capacity.

Unknown values of capacity can be measured by placing them in parallel with a coil of known inductance and measuring the resonant frequency of the combination. If a coil of known inductance is not to hand, the value of any available coil can be determined as described above and this coil can then be used as a standard.

Assume that the coil in the previous example is used as a test coil and that with an unknown capacitor across it, a resonant frequency of 6 Mc/s is obtained. The original 50pF capacitor is removed while making the measurement and the unknown value of capacity is obtained by applying the following formula:

$$C = \frac{25330}{L \times f^2}$$

where again C is in pF (uuF), L in uH and f in Mc/s. Substituting values:

$$C = \frac{25330}{5 \times 6^2} = \frac{25330}{180} = 140\text{pF (approx).}$$

The range of values which can be measured in this way covers some 2–1000pF with a 5uH test coil and a tuning range of 1·6–50 Mc/s.

Calculations can be avoided if suitable ABACS are available relating inductance, capacity and frequency. The ABACS contained in " The Radio Data Charts " published by " Wireless World " are ideal for the purpose and are highly recommended. Where rough values only are required, always remember that four times the capacity or four times the inductance will halve the resonant frequency.

Using the " EDOMETER " as a signal generator.

Provision for modulating the signal derived from the " EDOMETER " extends its usefulness into the field of receiver alignment; either in the absence of a more elaborate instrument or as a timesaver when carrying out initial alignment where rough accuracy only is required prior to completing final adjustments with a standard generator.

Coupling the output from the " EDOMETER " to the receiver is a simple matter. The required signal can be obtained for example by running a lead from the receiver input terminal to a small pick-up coil loosely coupled to the oscillator coil. In many cases the oscillator output and the receiver sensitivity will be such that the link winding can be dispensed with, it being necessary only to bring the aerial lead into the vicinity of the coil. Receivers with built-in aerials present no problem and in this case the " EDOMETER " is merely advanced towards the receiver until the required degree of coupling is obtained. Lack of an attenuator is not too serious a disadvantage because signal level can always be controlled by shifting the relative positions of the receiver and oscillator.

Checks on i.f. circuits etc. will call for some form of probe so that connection can be made easily to the appropriate test point. It may be found that it is best to use a short length of coaxial cable to link the oscillator to the probe. Also bear in mind that connection may need to be made to points which have h.t. voltages applied and in such cases a 0·1uF blocking capacitor should be used.

Measurements on aerials.

The fact that the " EDOMETER " is self-powered and portable makes it ideal for any outside work on aerials which calls for a wide-range signal source. It can be used as a low-level oscillator to drive an s.w.r. bridge when setting up remote matching units or as a normal oscillating wavemeter for checking the resonant frequency of a given aerial. Front-to-back ratio of beam arrays and even polar diagrams can be determined when the " EDOMETER " is used as a low-power transmitter to provide a radiated signal which can be monitored on a receiver fitted with a calibrated signal strength meter. The latter should be previously checked against the attenuator of an accurate signal generator tuned to the frequency at which the test is to be carried out. Results obtained without first making this check are likely to be unreliable especially if carried out at v.h.f. with a converter ahead of the receiver.

Transmitter monitoring.

The modulation quality of an a.m. transmitter can be checked by setting the SUPPLY SWITCH to ON, plugging in a pair of telephones at the right-hand socket (AM MONITOR) and tuning to the appropriate frequency. The instrument must of course be in the vicinity of the transmitter or its associated aerial and the output can be controlled by varying its relative position.

When used as a heterodyne wavemeter, c.w. transmissions can be monitored and in this case the telephones are plugged into the opposite socket. The tuning is adjusted to provide a comfortable beat note either at the fundamental transmitter

frequency or one of its harmonics. The latter should be used if blocking is experienced when monitoring a high-power transmitter.

Miscellaneous applications.

Maximum benefit will only be derived from the " EDOMETER " when the user has become familiar with its capabilities and is completely aware of its potential in his own specific field. Its usefulness extends from simple tasks like checking the serviceability of a pair of telephones to more involved applications such as providing calibration markers during sweep alignment of a complex piece of electronic equipment.

Whatever the task, the " EDOMETER " can be brought into play rapidly and will quickly become a valuable addition to any laboratory or hamshack. The following miscellaneous applications are included to give the reader " food for thought " and illustrate still further the versatility of the instrument.

Checking the performance of audio amplifiers.

A 1,000 c/s tone output is available at the right-hand jack socket and can be fed into any audio amplifier to obtain some indication of its performance. The output is of the order 100mV and can be controlled if required by connecting a potentiometer across the output lead. The maximum output is sensibly constant by virtue of the fact that the transistors are fed from a stabilised supply and the instrument can therefore be used to check on the consistency of an amplifier's performance over a period of time. (Note that the sleeve of the jack-plug is the earth connection.)

Test modulation of a telephony transmitter.

The procedure is the same as described in the previous paragraph except that in this case the signal is applied to the input of the speech amplifier. The tone can be keyed to permit m.c.w. transmission if required. (See below).

Code practice oscillator.

The tone output available at the right-hand jack socket can be keyed by plugging in a morse key at the left-hand socket. Thus, if a pair of telephones are plugged into the right-hand socket the instrument can be used as a code practice set.

The key should be arranged to short the two leads from the left-hand socket under " key-up " conditions (*i.e.* wire to the rear or normally closed contacts on the morse key). If a make contact only is available this can be used to interrupt the output to the telephones by wiring the key in series with one of the telephone leads. Output level can be adjusted if a potentiometer is wired across the telephones.

Day to day performance checks on receiving installations.

The constant output which is available from the " EDOMETER " at any given frequency by virtue of the zener stablilsation makes the unit ideally suited for applications which call for a standard signal source. One good example is the day to day checking of the overall performance of a complete receiving installation.

In this application, the " EDOMETER " is placed in a fixed position relative to the receiving aerial and is link-coupled to a small rod antenna. The signal is tuned in on the receiver and the reading on the signal strength meter recorded for future reference. Once the standard reading is known, checks can be repeated at regular intervals and any degradation in performance will become immediately obvious. The arrangement is also of value for example when receiving conditions are suspected of being below average. Checking with the " EDOMETER " reveals immediately whether or not the equipment is at fault.

BATTERY REPLACEMENT

The " EDOMETER " is powered by a single 9V battery (EVER READY " POWER PACK " PP3). Battery life will depend entirely on how frequently the instrument is used and is therefore difficult to specify. Suffice to say that the current drain of the instrument is extremely low and that even with extensive use, frequent battery replacement will not be required.

The battery should be changed when the meter reading is observed to be lower than normal or when a gradual drop in meter reading is noted during use. To gain access to the battery for replacement, proceed as follows:

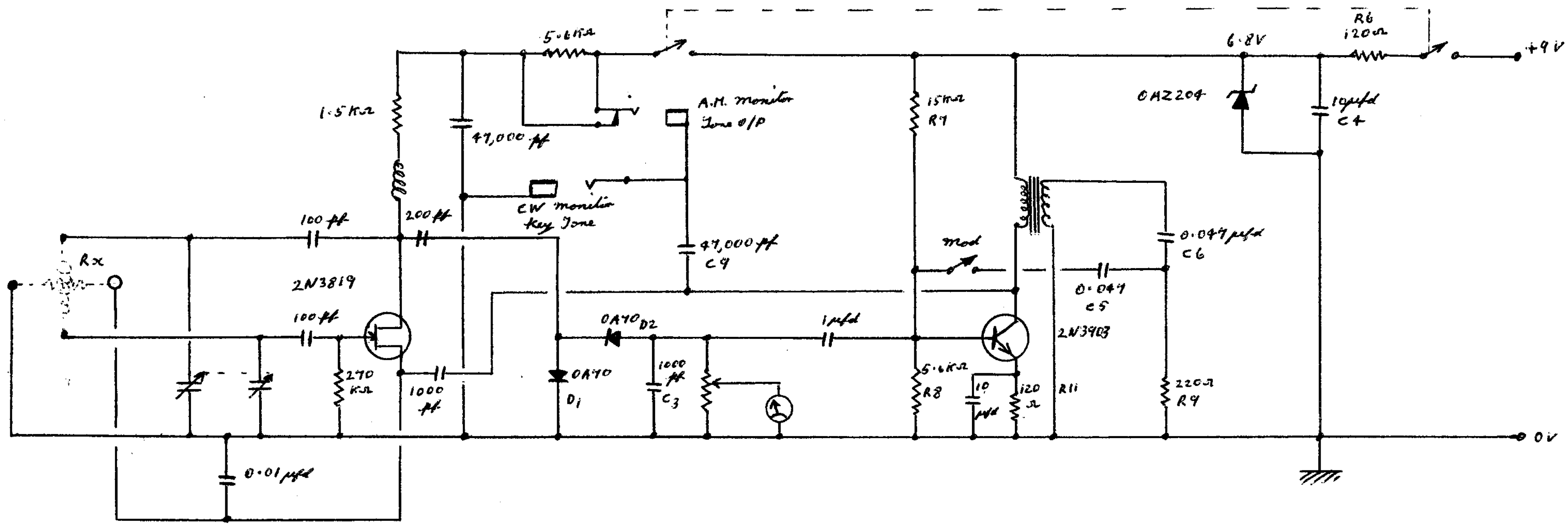
(1) Turn the instrument upside down and remove the cover retaining screw.

(2) Insert the screwdriver blade in the slot adjacent to the screw hole and then lever the cover plate upwards until it is about half an inch from the case.

(3) Slide the cover plate away from the case to free it from the retaining clips adjacent to the coil holder.

Always remove the battery when the instrument is stored for any length of time without use.

Eddystone Edometer type 5902 Ser no BS0018



A. J. Storke
3-11-1977

coil no	Rx
1	2.2 KΩ
2	2.2 KΩ
3	2.2 KΩ
4	3.6 KΩ
5	2.2 KΩ
6	1.5 KΩ
7	1.8 KΩ

K4XL's BAMA

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