FERRANTI

CDI
Linear Integrated Circuit

An AM Radio Receiver ZN414

FEATURES

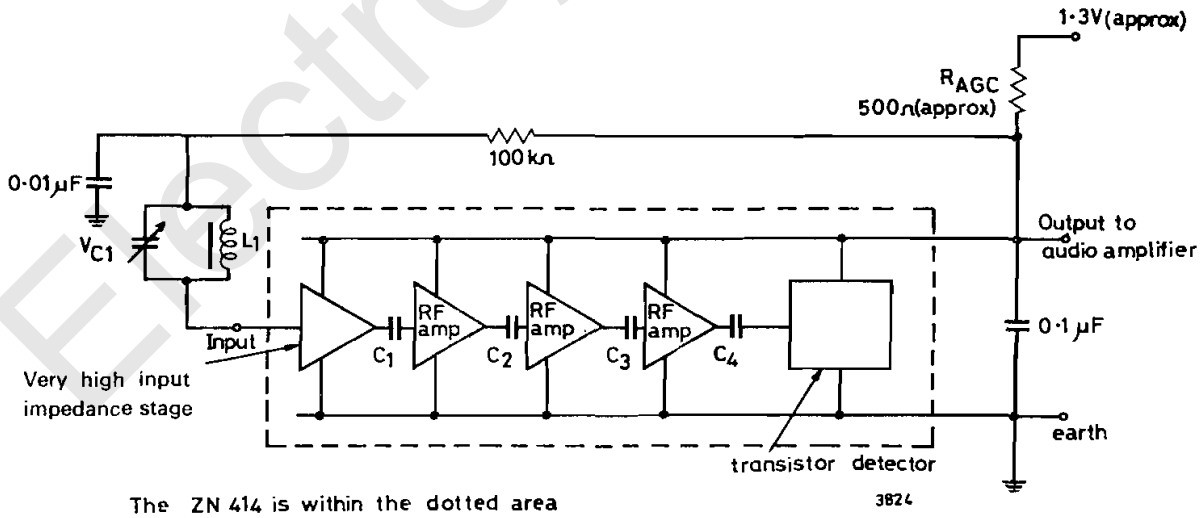
- 1·2-1·6 volt operating range.
- Less than 0·5mA current consumption.
- 150kHz-3MHz frequency range.
- Easy to assemble, no alignment necessary.
- Effective and variable A.G.C. action.
- Will drive an earphone direct.
- Excellent audio quality.
- Typical power gain of 72dB.

TO-18 PACKAGE

GENERAL DESCRIPTION

The ZN414 is a 10 transistor tuned radio frequency (TRF) circuit using the Ferranti C.D.I. technology and packaged in a 3 pin TO-18 transistor package for simplicity and space economy.

The circuit provides a complete R.F. amplifier, detector and AGC circuit which requires only six external components to give a high quality A.M. tuner. Effective AGC action is available and is simply adjusted by selecting one external resistor value. Excellent audio quality can be achieved, and current consumption is extremely low. No setting-up or alignment is required and the circuit is completely stable in use.



The ZN 414 is within the dotted area

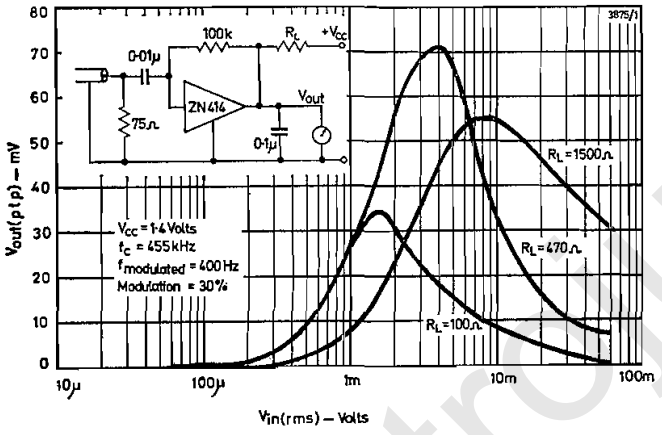
ZN414

SUMMARY OF PARAMETERS

Supply voltage range	1·2-1·6 volts (1·3 volts recommended)
Storage temperature range	–65°C to +125°C
Operating temperature range	0°C to +70°C
Supply current	0·3 mA typical (0·5mA under strong signal conditions)
Frequency range	150kHz-3MHz useful range
Input resistance	4MΩ typical
Threshold sensitivity	50μV with 1·3 volt supplies (dependent on 'Q' of coil)
Audio distortion	⩽ 2% T.H.D. under correct operating conditions
Selectivity	4kHz bandwidth can be achieved
Power gain	72dB typical
AGC range	20dB typical (dependent on R_{AGC})
Output	⩾ 30mV r.m.s. under correct operating conditions

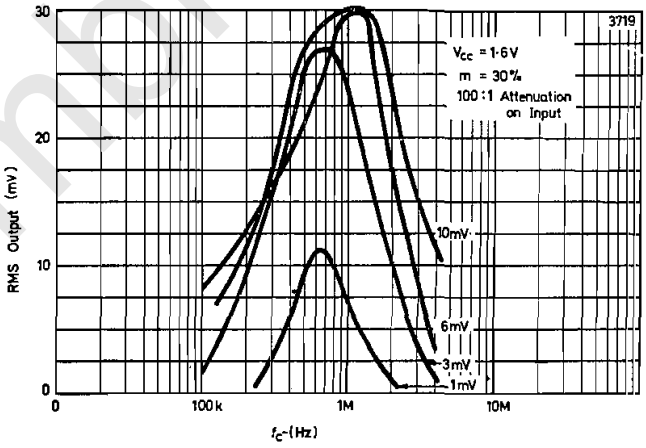
ZN414 CHARACTERISTICS All measurements performed with 30% modulation, f_M = 400Hz

Gain and AGC characteristics



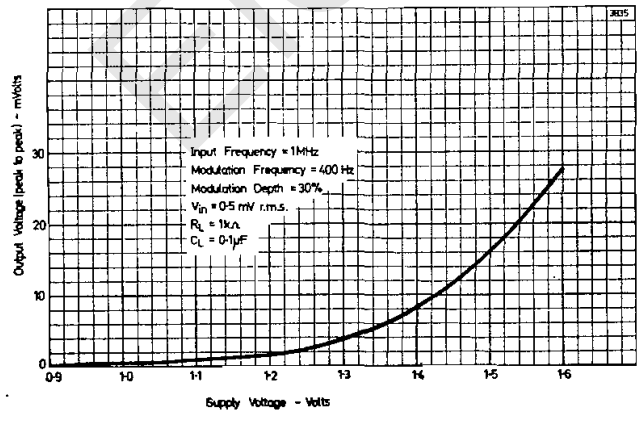
See operating notes for explanation of AGC action.

Frequency response of the ZN414

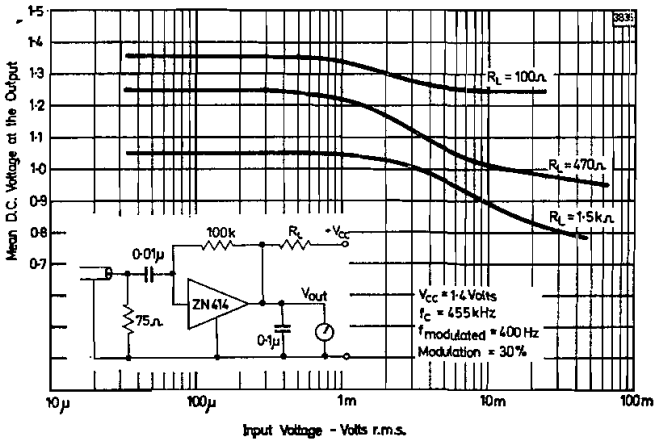


Note that this graph represents the chip response, and not the receiver bandwidth.

Gain variation with supply volts



D.C. level at output



LAYOUT REQUIREMENTS

As with any high gain R.F. device, certain basic layout rules must be adhered to if stable and reliable operation is to be obtained. These are listed below:—

1. The output decoupling capacitor should be soldered as near as possible to the output and earth leads of the ZN414. Furthermore, its value together with the AGC resistor (R_{AGC}) should be calculated to give a breakpoint at ~ 4kHz, i.e.:—

$$C\ (\text{farads}) = \frac{1}{2\pi \cdot R_{AGC} \cdot 4 \cdot 10^3}$$

2. All leads should be kept as short as possible, especially those in close proximity to the ZN414.

3. The tuning assembly should be some distance from the battery, loudspeaker and their associated leads.

4. The 'earthy' side of the tuning capacitor should be connected to the junction of the 100kΩ resistor and the 0·01μF capacitor.

OPERATING NOTES

(a) Selectivity

To obtain good selectivity, essential with any T.R.F. device, the ZN414 must be fed from an efficient, high 'Q' coil and capacitor tuning network. With suitable components the selectivity is comparable to superhet designs, except that a very strong signal in proximity to the receiver may swamp the device unless the ferrite rod aerial is rotated to "null-out" the strong signal.

Two other factors affect the apparent selectivity of the device. Firstly, the gain of the ZN414 is voltage sensitive (shown on page 2), so in strong signal areas less supply voltage will be needed to obtain correct AGC action. Incorrect adjustment of the AGC causes a strong station to occupy a much wider bandwidth than necessary and in extreme cases can cause the RF stages to saturate before the AGC can limit the RF gain. This gives the effect of swamping together with reduced AF output. All the above factors have to be considered if optimum performance is to be obtained.

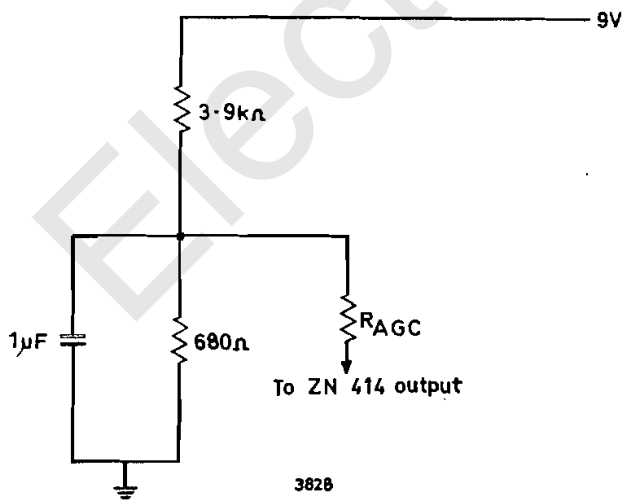
(b) Ferrite aerial size

Because of the gain variation available by altering supply voltage, the size of the ferrite rod is relatively unimportant. However, the ratio of aerial rod length to diameter should ideally be large to give the receiver better directional properties. Successful receivers have been constructed with ferrite rod aerials of 1·5" (4 cms) and up to 8" (20 cms).

DRIVE CIRCUITS

Three types of drive circuit are shown, each has been used successfully. The choice is largely an economic one, but circuit 3 is recommended wherever possible, having several advantages over the other circuits. Values for 9V supplies are shown, simple calculations will give values for other supplies.

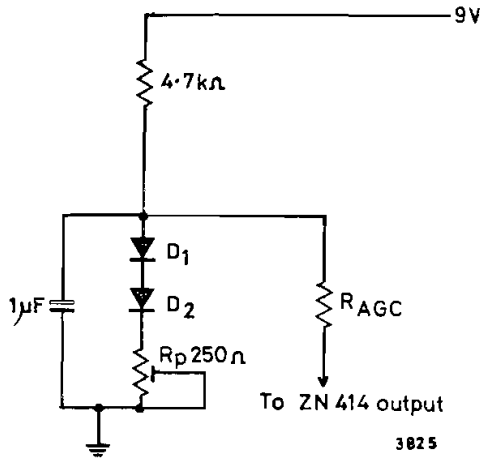
1. Resistive Divider



Current consumption = 2mA.

NOTE.—Replacing the 680Ω resistor with a 500Ω resistor and a 250Ω preset, sensitivity may be adjusted and will enable optimum reception to be realised under most conditions.

2. Diode Drive

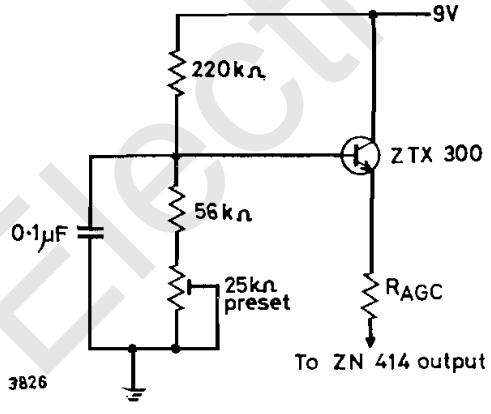


$D_1 = D_2 =$ ZS120

R_p = Optional sensitivity control, a recommended value being 250Ω.

Current consumption ~ 1·5mA.

3. Transistor Drive

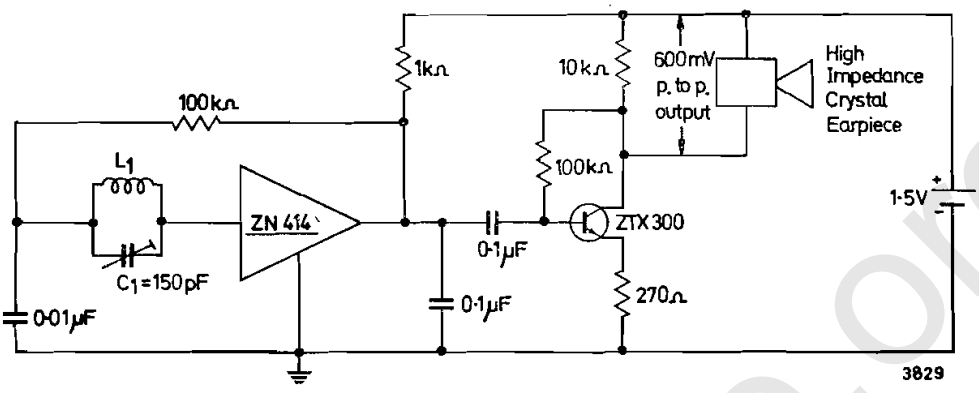


Current consumption is virtually that which is taken by the ZN414 (0·3mA).

RECOMMENDED CIRCUITS

(a) Earphone radio

The ZN414 will drive a sensitive earpiece directly. In this case, an earpiece of equivalent impedance to R_{AGC} is substituted for R_{AGC} in the basic tuner circuit. Unfortunately, the cost of a sensitive earpiece is high, and unless an ultra-miniature radio is wanted, it is considerably cheaper to use a low cost crystal earpiece and add a single gain stage. One further advantage of this technique is that provision for a volume control can be made. A suitable circuit is shown below.

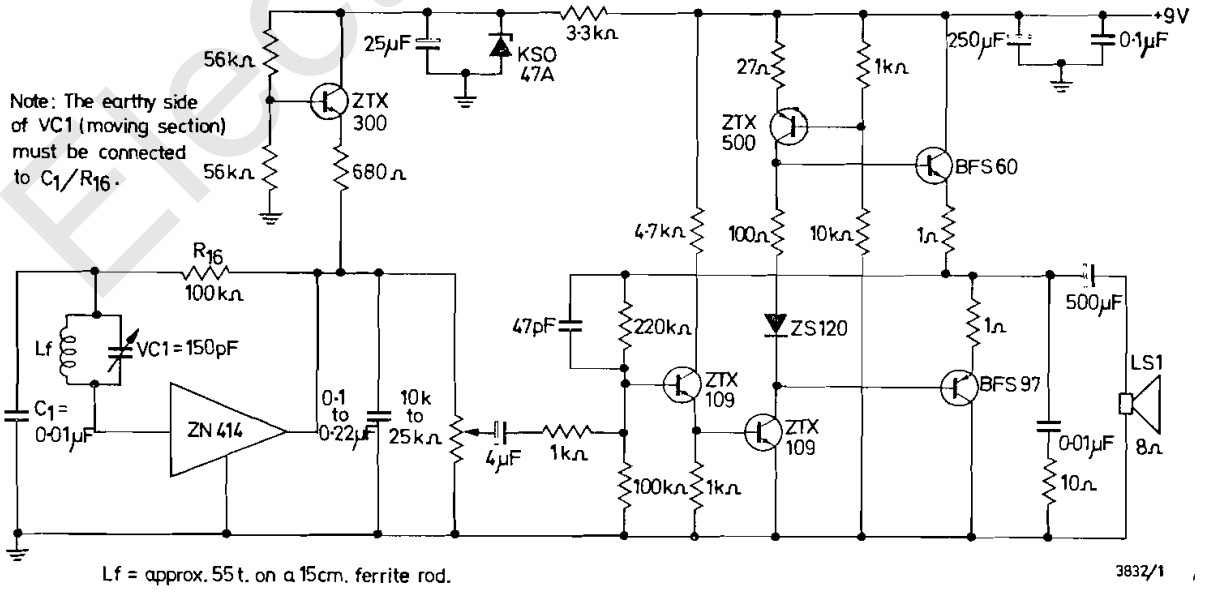


L_1 ~ 80 turns of 0·3 mm. dia. enamelled copper wire on a 5 cm. or 7·5 cm. long ferrite rod. Do not expect to adhere rigidly to the coil-capacitor details given. Any value of L_1 and C_1 which will give a high 'Q' at the desired frequencies may be used.

Volume Control: A 250Ω potentiometer in series with a 100Ω fixed resistor substituted for the 270Ω emitter resistor provides an effective volume control.

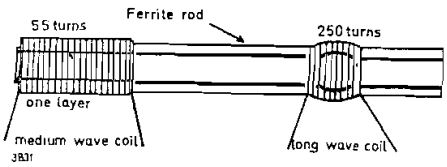
(b) Domestic portable receiver

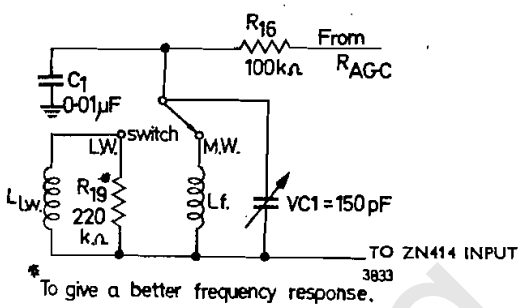
The circuit shown is capable of excellent quality, and its cost relative to conventional designs is much lower.



The complete circuit diagram of the Triffid receiver

(b)i

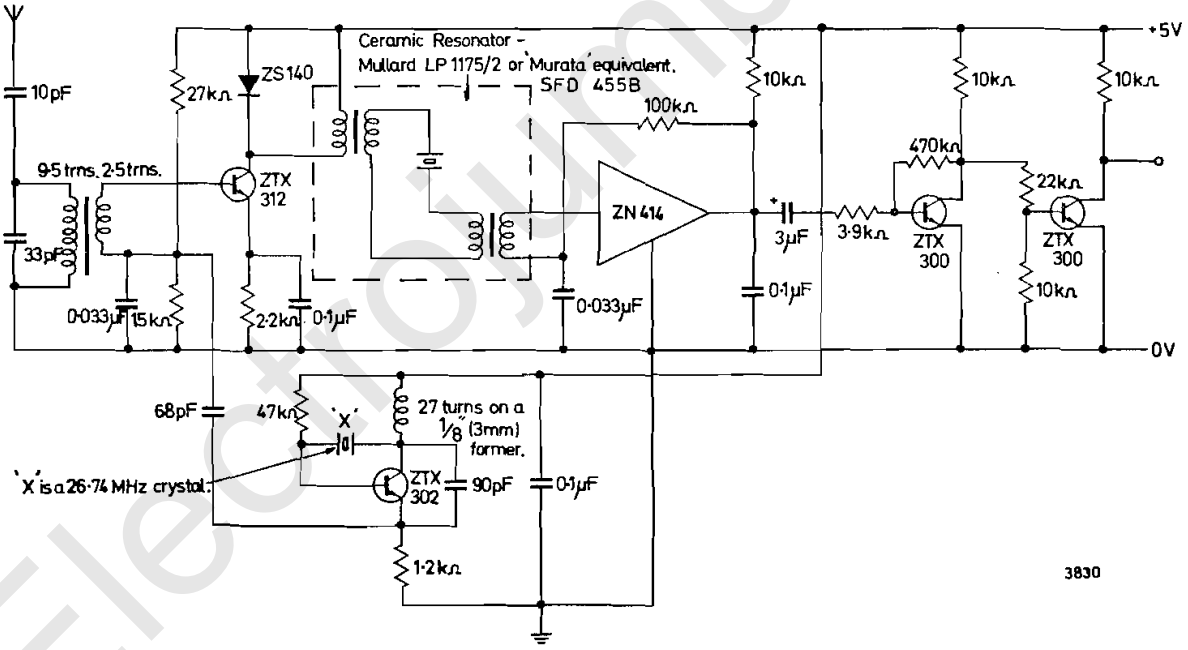




Coil winding details and waveband selection.

(c) Use in model control receiver

The circuit below shows a ZN414 used as an I.F. amplifier for a 27MHz superhet receiver.

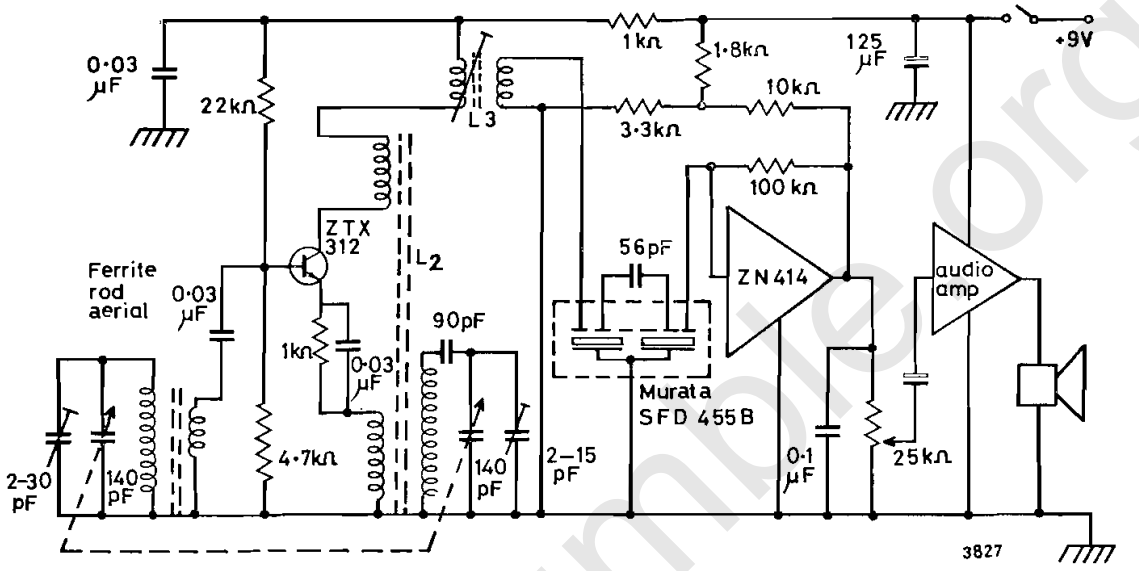


Performance Details:

Sensitivity = 2·5μV for a 5V p.t.p. output measured at f_o = 27·21MHz, 100% modulated with 100Hz square wave.
Selectivity: ±5kHz for < 100mV p.t.p. output.
Input Signal Range: 2·5μV to 25mV (i.e. 80dB).
Supply Current: ~ 4·5mA.

(d) Broadcast band superhet using ZN414

The ZN414 coupled with the modern ceramic resonators offers a very good I.F. amplifier at modest cost, whilst maintaining simplicity and minimal alignment requirements. A typical circuit is shown below.



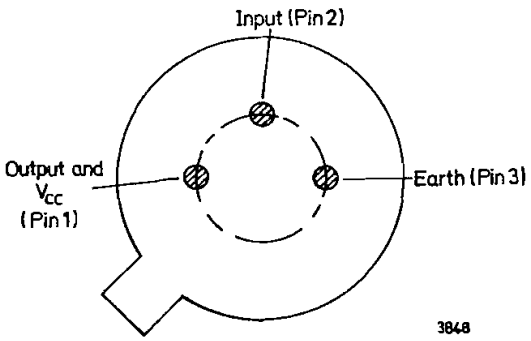
–6dB Bandwidth = 6kHz.
–30dB Bandwidth = 8kHz.
A.G.C. Range ≏ 40dB.
(For 10dB change in A.F. output).

FURTHER APPLICATIONS

The ZN414 is an extremely versatile device, and in a data sheet it is not possible to show all its varied applications. A comprehensive applications note on the device will be available shortly and will give full circuit details for various radio receivers, I.F. amplifiers, direction finders and frequency standards, as well as comprehensive technical information.

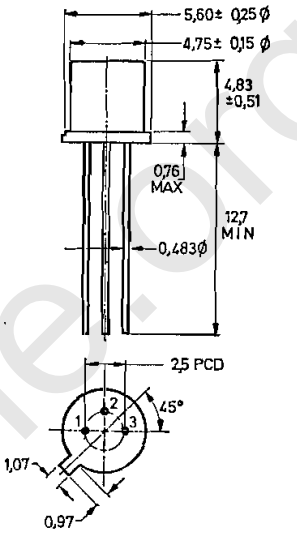
ZN414

PINNING DIAGRAM



Underside view

PACKAGE OUTLINE



Dimensions in millimetres

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