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Review Article

A REVIEW ON DESIGN TECHNIQUES OF 3-VECTOR ANTENNA FOR ELECTRIC FIELD MEASUREMENT

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A B S T R A C T

In order to measure all three components of electric field vector, a tailor-made antenna type (tripoles) is most beneficial over conventional antennas. In these review paper a survey is conducted on commonly used methods and design for electromagnetic (EM) field strength measuring antenna, Antenna designing should be efficient, low profile, high bandwidth, Good sensitivity, small, compatible, affordable 3-axis antenna, mainly used to designed reconfigurable, Wideband antennas, after that an initiator probe design will be applied for different parameters is given with dimensions. The Functioning and performance of an antenna array using three orthogonally cross dipoles (a 'tripole") are studied. These papers deal with various facets of antenna polarization and electromagnetic field measurements. A generalization of the efficient design parameters to three axes field probe antenna is compared.

INTRODUCTION

The technology in electrical and electronics fields and various kinds of information technological apparatus including the computer in accordance with the recent various mobile communication services evolves rapidly. These high technological leading devices are diminished, by compelling low power consumption and wide screen characteristics to social problems, such as erroneous and health risks of electronics devices are emerging [1].

Today's most challenging task is to measure electromagnetic interference (EMI) is one of most complicated and sophisticated measurements technology since device and system much more susceptible to interference from short-duration impulsive signals than common CW signals. Therefore, a strong need to develop anisotropic exceed predetermined hazardous levels. In the field of broadband small sensor to detect electromagnetic field strengths which EMI measurements, it is particularly desirable to have a relatively short dipole (less than 10 cm) which is useful for picoseconds pulse measurements is discussed in [2]. Now a day's communication system become more critical because of rapid growth of wireless portable devices, comprehensive spectrum surveys need to carried, it's knowing the information about present signals in the radio environment in order maximize the performance of a diverse collection of communication systems while simultaneously working to minimize the propensity for these systems to interfere with each other. Spectrum survey is limited; if survey performs using a vertical whip antenna and a spectrum analyzer: [3].

- The frequency range determined by the antenna response,
- Receiver response, and sweep setting of the instrument.
- The time the instrument is taking data.
- Vertically polarized signals.
- The geographical range of the measurement location.
- Power detected during the frequency sweep

In various practical use of electromagnetism like electromagnetic (EM) emission and susceptibility tests, need to measure electric field in both open space and enclosed medium is required. In resolving these problems broadband EMF measuring 3-axis antenna is required [1-3].

In an effort to simplify the process of probe selection, [4] this application note will focus on the salient specifications of RF field probes. Given a thorough understanding of how RF field probes are specified, one can then make informed decisions as to which probes are best suited for a particular application.

The 3-Axis Antenna

Three axis antennas are made of by three separate elements for each axis, nothing but tripole. A tripole is constructed by using three identical metal rod with length h, and of radius a. For better simplicity, one of the rods is chasm as the

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reference. Thus, the other two *are* oriented at ±120º with respect to the reference [5].

3-axis antenna makes use of three dipole elements oriented as shown in Fig. 1.

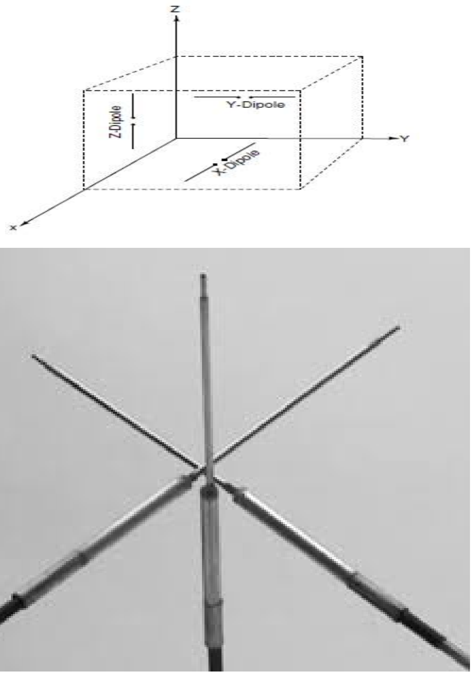

Fig 1 geometry of the three dipole as a tripole antenna [5]

In three cross polarized orthogonal dipoles arrangement, dipole response is more for linearly polarized signals that match the antenna element axis and which are incident at right angles to the plane in which the antenna resides. By connecting the three antenna elements to a synchronous, three channel measurement system such as a digitizing oscilloscope as shown in[6] time synchronous data proportional to the three-dimensional vector field components Ex, Ey, and Ez can be collected.

LITERATURE SURVEY

Here comes the most crucial step for your research publication. Ensure the drafted journal is critically reviewed by your peers or any subject matter experts. Always try to get maximum review comments even if you are well confident about your paper Phillip h. Howerton et el.[7] proposed Design of a Three-Axis Microwave E-Field Probe is described, field probe antenna is designed for wide band ranging from 20MHz to 18GHz with field strength measuring ability is 60V/m to 1200V/m. This probe is specifically designed for biomedical applications with best features include 1) an overall probe diameter of approximately 1.1 mrn. 2) An extended resistive transmission line 15mm in length, and 3) a flexible transmission line. The small diameters were made possible by using a short (0.6 mm) dipole antenna. Each axis used separate diode detector and the laminated resistive transmission line is used in single-axis field probe, The diode used in the probe is a Hewlett-Packard (HP 5082-2246) zero-bias Schottky barrier diode with its modified beam lead structure forming the dipole antenna. Details structure shown in figure 2.

Sang il kwak et el [8] presented Design of the Electric field probe in the Personal Exposure Meter to find the radiated E-field near the human body, a-3-axis E-field probe application is to propose for personal exposure measurement meter. proposed probe consists of three orthogonal dipoles antenna with diode detector and a transmission line for the range of frequency from 10MHz up to 6GHz,the diode is used HSCH-5330,readout device size is 60mm*30mm*90mm cover with metal as shown in figure 3.

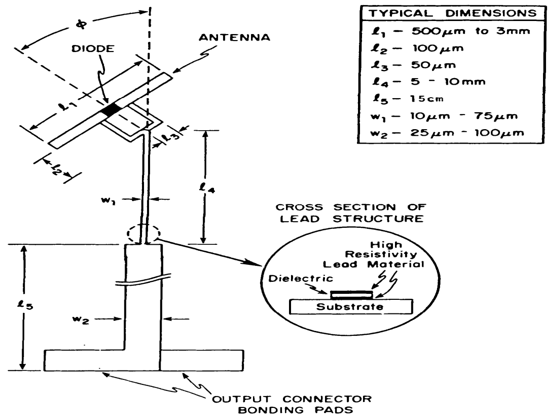

Fig 2 Proposed E-field probe with overlaid lead structure [7]

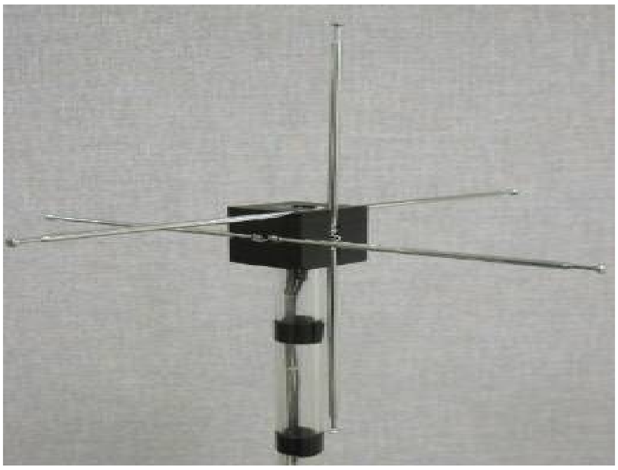

Fig 4 Proposed E-field probe with overlaid lead structure [3]

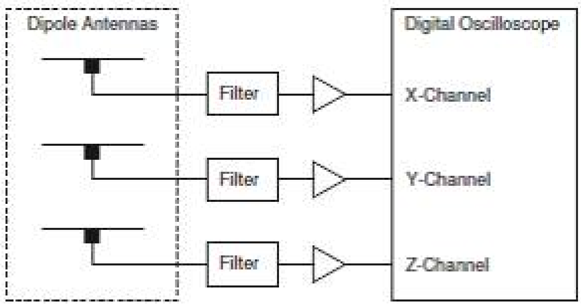

Fig 5 Schematic diagram of the 3-channel measurement system [3]

B. Elnour et el.[9] , A novel co-located cross-polarized two-loop PCB antenna for the ISM 2.4 GHz band is proposed and shown architecture in figure 6&7, for solving the problem of direction finding in radar. This antenna is acts as a electromagnetic vector sensor (EMVS). In principle, an EMVS consists of three orthogonal dipoles and three orthogonal loops that are all co-located. The co-located cross-polarized loops antenna is constructed using two Kandoian loops. The design of a single kandoian loop is addressed –The electric loop is designed and built as a 2-layer PCB board, *substrate* material: Rogers 4003, ^{2}r=3.38, Height=1.5 mm, *board* dimensions = 90 mm x 90 mm, *Optimized* radius of loop = 28.5 mm, 2 mm wide traces, b*ottom* ground Patch = 15 mm x 15 mm, top ground Arms= 4 mm wide.

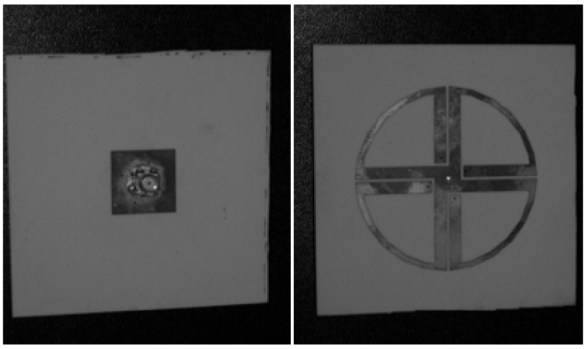

Fig 6 Proposed Loop fabricated on a PCB [9]

Performance of electric loops is better than the electric dipoles, these two loops operate for the frequency range 2.3GHz to 3.5GHz, and bandwidth is only 200MHz.

This antenna represents a step towards the realization of three orthogonal loops that are required to achieve the design of a theoretical EMVS.

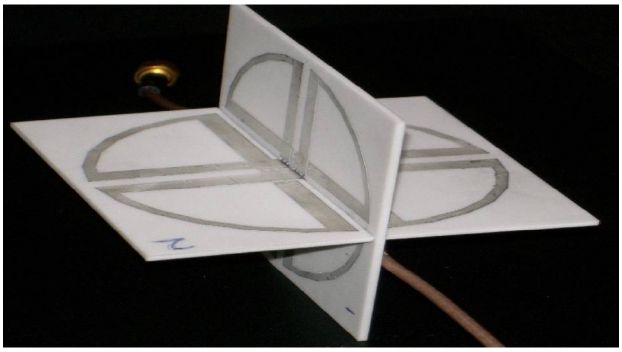

Fig 7 Proposed Co-located cross-polarized two-loop antenna [9]

Fredrik rogberg *et al.*[10] implemented experimental setup of Three orthogonal polarized antenna for improving the capacity for wireless systems by means of uncorrelated propagation paths, a MIMO (Multiple Input Multiple Output) system has been considered a better technology for improving the capacity. In this experiment, triple orthogonal polarized with the radiation pattern equal to all for testing purpose. Construction of antenna is described in figure 7: The cross dipole, Middle dipoles and final structure. This antenna structures support for 2.5GHz to 2.7GHz frequency range with small bandwidth of 200MHz.

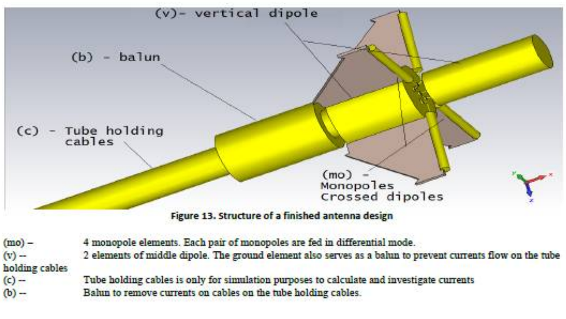

Fig 7 Proposed structure of a finished antenna design [10]

In [10], have created antenna for following criteria: equal phase canter, a radiation pattern of a dipole and that each antenna is positioned orthogonally to each other with a bandwidth of around 12 percent of the canter frequency, six pairs of monopoles is used to produce three dipoles orthogonal to each other.

W.D. Apel et el.[11] proposed LOPES-3D, an antenna array for full signal detection of air-shower radio emission describes, radio detection techniques of high-energy cosmic rays, emission of radio field form cosmic ray air showers detection is well suited in LOPES-3D model. To measure all three components of electric field directly, a tailor-made antenna type was developed called tripoles. In LOPES 3D system used antenna type is triple which consists of three dipoles shown in figure 8, which are perpendicular to each other. Length of each dipole is 1.3m.frequency band of LOPES is 40MHz to 80MHz, Each dipoles couple to a coax cable via ruthroff balun transformer. Impedance matching is selected 4:1 and characteristics impedance is 200Ώ.

Fig 8 Proposed structure of a tripole antenna station [11]

With experimental result is analyze, Measure all three components of the electric field vector from radio emission of cosmic ray induced air showers.

P. Palangio, F. Masci *et al.*[12] described Electromagnetic field measurements in ULF-ELF-VLF [0.001 Hz–100KHz]

Fig 9 Proposed structure of Three axes induction antenna [12].

bands, it describes MEM projects, MEM is nothing Magnetic and Electric fields Monitoring, it has be activated in the INGV (Italian Istituto Nazionale di Geofisica e Vulcanologia) Observatory of L'Aquila since 2004 (Palangio *et al*., 2007). In this project two separate system is used to measure electric and magnetic field components. Three axes induction antenna for magnetic field measurements is used for frequency 1Hz to 100 KHz is shown in figure 9 and three axes antenna for electric field measurements is used for frequency 1 to 100 KHz, is shown in figure 10.

Fig 10 Proposed structure three axes antenna for electric field measurement [12].

Summary of State of art

At the end of literature analysis, proposed antenna geometry by various researchers in [6-12] have been compared with most important parameters related with field detection concern with antenna performance, like operating frequency, sensitivity, bandwidth, overall dimensions and types of diode is used. Suitable probe applications with antenna comparisons are described in Table-1.

As per recent development in field probe antenna design a 3-axial antenna with diode detector is more popular. For the Far-field measurements 3-axial dipole is more suitable as compared to near-field.

Important parameters for Antenna Selection

Implementation of RF field probes for proper radiated immunity test system is critical. To elect proper field probe, a various specifications need to be take into consideration.
Field probe selection is based on following specifications:

Frequency Response

It is most crucial parameter in probe characteristics, is defined as the range the probe will respond to. Probe should provide flat frequency response over all frequency range.

Sensitivity

How the small and RF signal a probe can respond to accurately. Sensitivity is most important when small RF field should be measure. It is measured in V/m.

Dynamic Range

Dynamic range is the total range of RF field coverage a probe will respond to. The greater the dynamic range the better a probe is suited to address test applications that span the gamut from low to high field strengths.

Response time

The probe takes time to respond to an applied RF field
Called response time. In many CW applications, this is not a concern. It is important for short duration measuring signal.

Temperature Stability

Temperature Stability is meaning a variation of the probes reading over the measuring frequency range As a Function of temperature. At a time of calibration most probes require a correction formula be applied when used at temperatures that differ from that used.

Configuration/Dimensions/Weight

This is very important considerations when matching a probe to a specific application. In addition to the ubiquitous stalk and cube type probes, one can now choose one of the newer, recently introduced sphere probe configurations. Some applications require a small probe to fit inside small areas like TEM Cells, strip lines, tri-plates, GTEMs or small enclosures where larger probes simply cannot be used.

Sensor Type

Most probes today use a diode type sensor. Diodes have excellent sensitivity as well as a large dynamic range. Second most popular type of sensor is a thermocouple. Unlike the diode sensor, a thermocouple sensor has less sensitivity and less dynamic range but has the unique property of being able to measure the true RMS levels of the field.section is not required. Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions.

Ref. Paper	Antenna Type	Frequency		Sensitivity/Dynamic Range	Band-width	Overall Dimensions	Diode Type	Application
		From	To					
6.	Resistively Loaded Dipoles	10MHz	1GHz	13-16uV/m		15*0.7cm	-	Rf field measurement
7.	Orthogonal dipole	200MHz	18GHz	60-1200V/m		1.1mm	HP 5082-2246)	Biomedical applications
8.	cross-polarized two-loop PCB antenna	2.3GHz	2.5GHz	-	200MHz	90*90mm	NA	Radar Applications as EMVS
9.	Orthogonal dipole	10MHz	6GHz	267V/m (Max)		73.7*10mm	HSCH-5330	*Personal* exposure meter
10.	Monopole	2.5GHz	2.7	-	200MHz	23*23mm	-	RF Field measurement
11.	LOPES-3D	40MHz	80MHz	-	40MHz	1.3m	-	Cosmic rays
12.	ULF-ELF-VLF	0.001Hz	100KHz	-	-	-	-	E&M Field

Probe Type

Most modern probes are isotropic. An isotropic RF field probe measures the total value of the field level and is unaffected by field polarity. This is accomplished by

Summing measurements from three different sensors placed orthogonal to each other. In some types of probe uses the older one sensor and thus, measured fields in one polarity means non-isotropic.

CONCLUSION

In this article, reviews the antenna geometry used for electromagnetic field detection in three axial vectors. This review is done on important design characteristics implemented through different techniques. Various antenna Design are compared by considering important parameters like sensitivity, bandwidth, frequency range etc. For efficient antenna design consider above mentioned parameters and concluded proposed antenna by Phillip h. Howerton *et al.* [7] and Sang il kwak *et al* [8] is best for 3 axial average field measurement.

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