

HIGH FREQUENCY ELECTROMAGNETIC FIELDS CONTINUOUS MEASUREMENTS AND MONITORING WITH MONITEM

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Abstract- Continuous measuring, monitoring and evaluating electromagnetic fields between the frequencies 100 kHz - 8 GHz, GSM & 3G & LTE with MonitEM. The measured values were compared with both stations. Three years long term continuous electromagnetic field measurement results were evaluated. Results and graphs were presented with this study.

Keywords: Electromagnetic Fields, Monitoring, Long-Term Measuring.

I. INTRODUCTION

Machineries, instruments and numerous of systems which are worked with high frequencies electromagnetic field, fast developing technology and also electromagnetic field intensity of emitted by these systems indicates fast increasing too. In recent years, effectively use 3G and 4G systems which new generation communication and transmission systems, work with the Wi-Fi signals get to network coverage of house, office, building and cities causes this changing rapidly.

Physical and biological effects to all living creatures and plants of these areas, which have changing to GHz from a few Hz level frequency spectrums in generally, become a current issue frequently [1-3]. Especially, emitted by base station effects on public health of RF electromagnetic fields at the range of GSM & UMTS bands have become significant a source of worry. In last years, become wide spread by 3G systems, which work at 2.1GHz frequency, disputes toward increasing probably effects of electromagnetic fields, have reached to significant dimensions.

With submitted service diversity of 3G systems, which work at a microwave oven approximately and utilization tendency of subscriber have increased concerns, which will create possible cancer effects upon people in every day. Furthermore, with high frequency electromagnetic fields effect, also number results of in Vivo and in Vito studies, which are done toward establishing of directly proportional between to create cancer kinds, have increased quickly [4-6].

Nevertheless, number of studies, which have reached to resulting at opposite direction, has also much a considerable amount of [7-10]. Since 2012 year, emitted electromagnetic fields from broad band, GSM & UMTS band frequencies and studies toward be used MonitEM system which will provide continuous measurement and it's followed have been continued. Since November of 2012, measurement of electromagnetic fields have been made at broad band (100 kHz-8 GHz).

New station which is taken continuous measurements at GSM & 3G & LTE frequencies which get involved to measurement network from the point of view of January 2013 have been provided be done continuous measurements at electromagnetic waves of frequency bands as be activated parallel at researched areas. This continuous electromagnetic field measurement station have been created which present obtained continuous measurement results to public.

However, maximum, average and minimum values of continuously measured high frequency electromagnetic field intensity values are compared with limit values, which is determined by national and international standard organizations. Measured values over limits are informed by via e-mail as an alert. Continuously measured values of MonitEM system can present on web sites of local governments, city hall, public health departments or also other state institutions and organizations, too. Thus, people can compare their environment's instant values of electromagnetic pollutions with national and international limits and many problems, which are disquieted wide public can, resolve the issues.

In this study, in a wide range of high frequency electromagnetic waves 100 kHz-8 kHz and GSM & 3G & LTE have been measured continuously with MonitEM (Monitoring Electromagnetic). Main sources of the electromagnetic fields on the environment have been determined with continuous measurement stations, which are set at same area, and so changing electromagnetic fields during years have been presented with study.

II. MATERIALS AND METHODS

Continuous electromagnetic fields measuring and monitoring station take measurements at the range of 100 kHz - 8 GHz and GSM & 3G & LTE frequencies. General structure of station and its internal mechanism section have been showed at Figure 1. Measurement probe measures continuous RMS electromagnetic field values isotropically. Measurements, which are get half-secondly, can be made dissipationless data and calculating with Sliding Windows Average method at half-hourly periods to conform international standards.

It sends the measurement values to server by included GPRS or 3G modem. Station have been designed in order to take the measurements for four seasons, it has got protection against rain, dust and humidity and it can be worked as per environmental protection IP65 standard at whatever weather conditions. Pole, which is made from nonmagnetic fiberglass material, is used at montage phase. Station transmits defined alarms as electromagnetic field level, battery life, and sleep mode, opening of the protective external panel, measurement error and communication by online to administrator.

It has user-friendly management panel and login with password and can easily reached to definitional information related to station. It can be reached to half-hour electric field intensity values at specified period and graphs of this values as online by choose intended date period and beginning and ending hours at this period. This reporting can be reported with pdf format as letterhead if requested.



(a)



(b)

Figure 1. Continuous electromagnetic field measurement station (MonitEM) appearance, (a) Appearance of the station's at measurement point, (b) Inside of the station's mechanism

Station which take measurements at the range of 100 kHz - 8 GHz frequencies have set at city center of a metropolis and have been started to take measurement from there. For enrichment and detailing of the study, a new station, which take measurements at the range of GSM & 3G & LTE frequencies have set at the same area with existing of each station at angle and distance that will not affect measurements. The stations have taken measurements in a three-week period simultaneously at same area.

According to obtained results, percentage how many percentage of electromagnetic pollution in environment have been confirmed occur from GSM&3G<E frequencies sources and results have been evaluated. At the measurement area which has done in three years period, continuous measurements have been taken and changing of electric field intensity have been examined and obtained results have been presented with this study.

III. RESULT AND DISCUSSION

In three weeks period, taken data from two stations which take the measurements continuously at the range of 100kHz-8GHz and GSM&3G<E frequencies spectrum have been compiled half an hourly. According to obtained results, electric field intensity values have fluctuations. The main reason of these fluctuations are due to communication traffic, number of the subscriber connected to the base stations during a day and communication time (MoU: Minutes of Use).

Obtained results from these measurements have been showed at image-2. As it is seen from image- 2, in three weeks period measurement results of these stations, which measure at the range of 100 kHz-8 GHz and GSM&3G<E frequencies have a clear parallel characteristic similarity. Therefore, principally changing of electromagnetic field intensity values generates from base stations' signals working at the range of GSM&3G<E frequencies can be said. Percentage 77 of electromagnetic field in the environment generates from base stations, which work at GSM&3G<E frequencies.

Differences between the measurement graphs derive from other mechanism or systems, which work at high frequencies (Radio, TV). Thus, MonitEM electromagnetic field measurement station allow continuous measuring and monitoring electromagnetic field pollution both at a broad band (100 kHz - 8 GHz) frequencies and specific GSM & 3G & LTE frequencies which spread from base stations and other high frequency sources. In this case, temperature and humidity changes of environment effect ultrahigh frequencies electromagnetic field sources radiation. Evaluating of this change has an importance

Average electric field intensity value of the station, which take measurements at the range of 100 kHz - 8 GHz in three weeks measurement of period is 3.25 V/m, maximum value of electric field intensity, is 4.22 V/m. Average electric field intensity value of the station, which take measurements at the range of GSM & 3G & LTE frequencies is 2.51 V/m, maximum value of electric field intensity is 3.31 V/m. As a result, the electric field intensity values have been measured continuously to evaluate changes for a month period at the range of 100 kHz - 8 GHz frequency in consecutive years of the same period in the metropolis center.

When obtained values which at the end of the continuous measurement results are examined, average electric field intensity value of the station which take measurements at the range of 100 kHz - 8 GHz in May 2013 measurement of period is 2.96 V/m, maximum value of electric field intensity is 4 V/m. Average electric field intensity value of the station, which take measurements at

the range of 100 kHz - 8 GHz in May 2014 measurement of period, is 6.16 V/m, maximum value of electric field intensity is 7.45 V/m. As a result of the continuous measurements in a metropolis center during a year period,

continuous electromagnetic field measurements which have been measured at the some point; average electric field intensity value has increased 208% and it is maximum value has increased 186%.

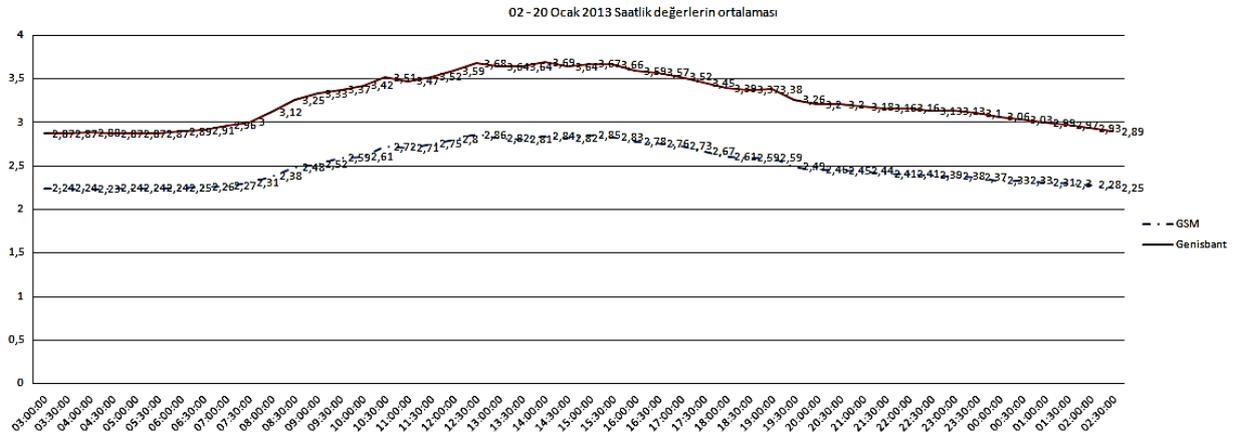


Figure 2. Comparative graph of electric field intensity values which have been taken at broadband and GSM bands as half an hourly (02-20 January 2014)

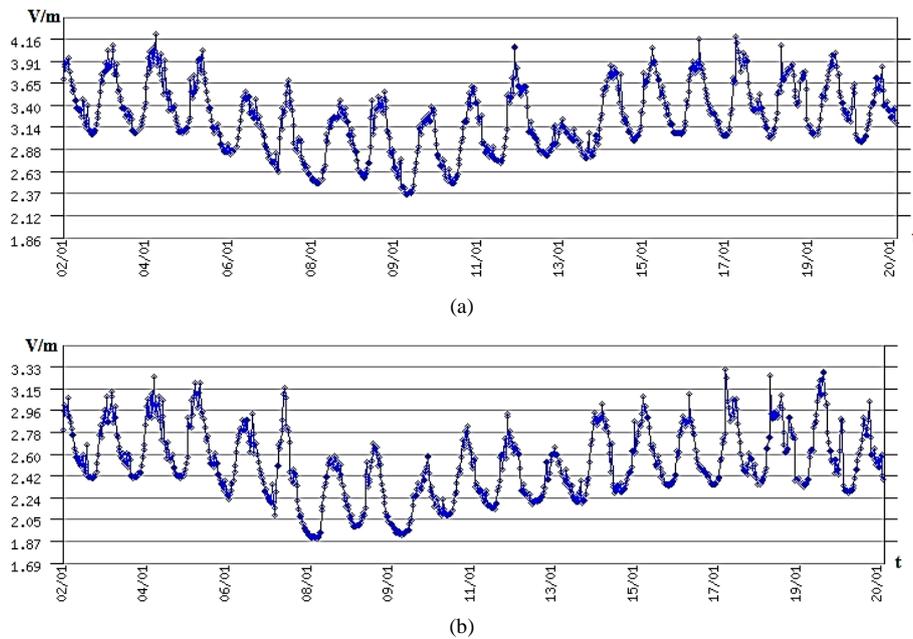
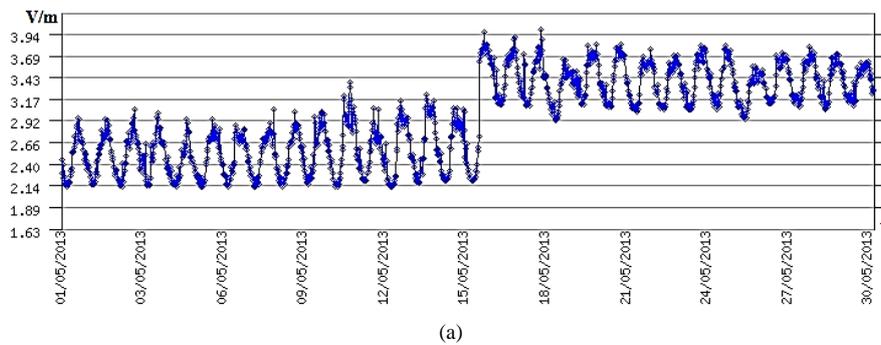


Figure 3. Continuous measured results at the range of 100 kHz - 8 GHz and GSM & 3G & LTE frequencies, (a) measured values chart, which take measurements at the range of 100 kHz - 8 GHz frequencies station, (b) Measured values chart, which take measurements at the range of GSM & 3G & LTE frequencies station



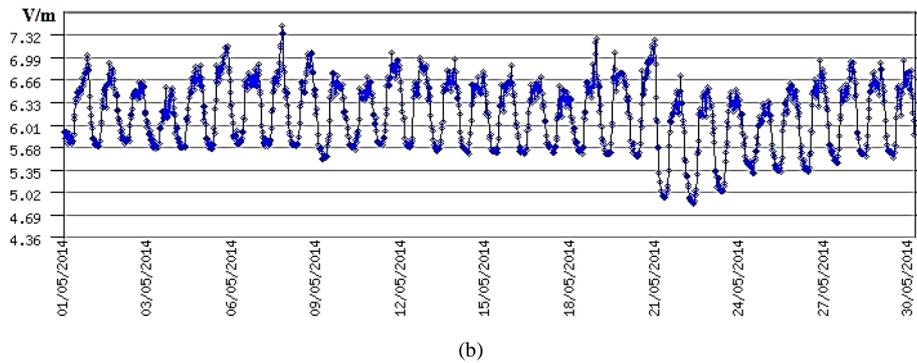


Figure 4. Continuous measured results at the range of 100 kHz - 8 GHz frequencies
(a) The electric field intensity measurements chart (May 2013), (b) The electric field intensity measurements chart (May 2014)

IV. CONCLUSIONS

According to collected data, which taken from continuous electromagnetic field measurement stations, the following results were obtained. MonitEM continuous electromagnetic fields measurement station is a system which allow to determine average, minimum and maximum electromagnetic field values radiate from different sources at the range of 100 kHz-8 GHz and GSM & 3G & LTE frequencies. One of important advantage of MonitEM continuous electromagnetic fields measurement station is possible to take continuous and periodic measurements in different areas.

Moreover, this system protected from meteorological and mechanical effects and MonitEM take measurements with great precision. Solar panel feed the MonitEM and it takes measurements continuously without electricity. MonitEM share all taken measurements by included GPRS or 3G modem to international institutes, institutions and public. MonitEM could have easily set in different reference areas implement by local or central managements and acquired information could be open to continuous access from web sites of these institutions.

Measurement values can be compared with existing national and international standard values, this information that is given at visual form can provide opportunity to resolve problems, which create some uneasiness at daily life. MonitEM measures electric field intensity values in each moment, each measured value, which is over the limits, can be delivered to related headquarters as an alarm and in terms of health problems that may arise, could be intervene immediately. Obviously, in three-year period which is made study, value of electric field intensity of environment gets increasing over %200. According to this increasing rate, continuous measurements of electric field in environment should keep under control is beneficial.

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BIOGRAPHIES



Teoman Karadag was born in Malatya, Turkey, 1981. He received the B.Sc. and M.Sc. degrees in 2005 and 2009. He is the Ph.D. student of Electrical & Electronics Engineering at Inonu University, Malatya, Turkey. He has been working at Turk Telekom Company until 2008 as a transmission

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