Addendum No. 3

To

TEC Test Procedure No:
TEC/TP/EMF/001/02.OCT. 2012
(Amendment of para 16.1)

on

“Frequency Selective Measurement of EMF from channelized mobile/wireless Base Transceiver Stations”

Dated : 16-11-2015
The para 16.1 is amended as under:


Many operators make use of common tower or use the same site to provide mobile services. If there is any dispute each one will want to show how much their transmitter is contributing to the overall exposure. That is impossible with a simple, broadband measurement. For that to work, the operator would need to be the only one present, or the effects of other services would have to be negligible. And, the transmitter would have to output full power on all channels to generate the maximum level of electromagnetic radiation. The answer here is a selective measurement that detects every output frequency used, and every occupied channel separately, and displays the corresponding field strengths. Intelligent instruments can also integrate over the frequency range of a particular service and display the result, either as an absolute value or as a percentage of the permitted limit value.

Depending upon the technology used for mobile wireless stations, spectrum analyser performs frequency selective measurement of the time invariant signal and applies appropriate extrapolation to arrive at the power density of the EMF from mobile base stations under maximum output power condition.

For specific technology of the mobile BTS, the time invariant component of the signal is transmitted at constant power level for specific frequencies within a certain band. The used time invariant signals for different technologies are:

1. BCCH for GSM which uses TDMA technology.
2. Common Pilot CHannel (CPICH) in UMTS or 3G system using WCDMA technology.
3. Primary broadcast channel, physical broadcast channel (PBCH) for LTE which uses OFDM technology.

(1)GSM Technology:

Time division multiple access (TDMA) mobile phone technology (e.g., GSM or TETRA) utilise a time invariant BS radio channel that operates at constant full power and can be used as a stable reference. In the GSM system this constant power channel is known as the BCCH.

If the traffic channels at a maximum power equal to the constant power component, which is the case for GSM, then a conservative maximum transmit power, $$P_{\text{max}}$$, can be determined by multiplying the power of the constant power component, $$P_{\text{const}}$$, by the total number of radio channels that feed into the antenna, $$N_{\text{GSM}}$$. Therefore the power density corresponding to the maximum emitted power condition, $$S_{\text{max}}$$, can be obtained by measuring the power density in the BCCH ($$S_{\text{BCCH}}$$) of the EUT scaled by $$N_{\text{GSM}}$$:

$$S_{\text{max}} = S_{\text{BCCH}} N_{\text{GSM}}$$

For measuring the BCCH the following settings for the frequency-selective equipment are recommended:

- $$f_{\text{cen}}$$: BCCH central frequency,
- RBW: 200 kHz (smaller RBW can be used as long as all the contributions in the occupied bandwidth of the BCCH signal are summed, higher RBW would include the power of adjacent channel),
- detection mode: RMS.
(2) WCDMA technology:

Wideband Code Division Multiple Access (WCDMA) technology used in 3G mobile phone systems use spread spectrum technology employing a constant power control/pilot channel which has a fixed power relationship to the maximum allocated power. Dedicated decoders are available that enable the constant power reference channel e.g., Common Pilot Channel (CPICH) in UMTS/WCDMA to be measured allowing calculation of maximum RF field strength. If the ratio of the maximum allocated power to the power in the control channel of the EUT is $N_{\text{CPICH}}$ and the measured RF power density from the control channel is $S_{\text{CPICH}}$ then the extrapolated value is:

$$S_{\text{max}} = S_{\text{CPICH}} N_{\text{CPICH}}$$

The parameter $N_{\text{CPICH}}$ is set by the telecommunications operator. A typical value is 10 (i.e., 10% of total power allocated to CPICH).

For measuring the CPICH the following settings for the frequency-selective equipment are recommended:

- $f_{\text{cent}}$: CPICH central frequency,
- RBW: 1 MHz (smaller RBW can be used as long as all the contributions in the occupied bandwidth of the BCCH signal are summed, higher RBW would include the power of adjacent channel),
- detection mode: RMS.

(3) ODFM technology:

For LTE, which uses orthogonal frequency-division multiplexing (OFDM) technology, basic spectrum analyser, which does not require a dedicated LTE decoder, is less expensive and more commonly available. However, the powers of the Reference Signal (RS) cannot be accurately detected since they are transmitted on single resource elements spread in frequency and time.

To overcome this issue and to avoid requirements on access to a priori knowledge regarding band occupation or service characteristics, the PBCH power can be measured. The PBCH is transmitted with the same characteristics regardless of the configuration or service bandwidth and spans a bandwidth of approximately 1 MHz over the centre frequency of the LTE signal.

Please note that the signal from each LTE base station cannot be identified using this method due to frequency spectrum overlapping.

The measured peak power density, $S_{\text{PBCH}}$, corresponds to the received Physical Broadband Channel (PBCH) signal power over the bandwidth of 72 sub-carriers (each of 15 kHz). The maximum power density, $S_{\text{max}}$, of the LTE signal at each measurement location is then given by:

$$S_{\text{max}} = N_{\text{PBCH}} S_{\text{PBCH}}$$

where $N_{\text{PBCH}}$ is the extrapolation factor for the PBCH, which is the ratio of the maximum transmission power to the transmission power corresponding to the PBCH over 6 resource blocks. $N_{\text{PBCH}}$ can be calculated theoretically according to:
where $N_{RS}$ denotes the number of subcarriers in the used transmission bandwidth, the extrapolation factor is applied as per Table given below:

**Table 7 – Theoretical extrapolation factor, $N_{RS}$**

<table>
<thead>
<tr>
<th>Bandwidth [MHz]</th>
<th>$N_{RS}$ (linear/dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.4</td>
<td>72/18.57</td>
</tr>
<tr>
<td>3</td>
<td>180/22.55</td>
</tr>
<tr>
<td>5</td>
<td>300/24.77</td>
</tr>
<tr>
<td>10</td>
<td>600/27.78</td>
</tr>
<tr>
<td>15</td>
<td>900/29.54</td>
</tr>
<tr>
<td>20</td>
<td>1 200/30.79</td>
</tr>
</tbody>
</table>

For measuring the PBCH the following settings for the frequency-selective equipment are recommended:

- $f_{cent}$: central frequency LTE signal,
- Resolution Bandwidth (RBW): 1 MHz (smaller RBW can be used as long as all the contributions in the occupied bandwidth of the PBCH signal are summed),
- detection mode: RMS,
- frequency span set to zero (scope mode),
- sweep time: $70 \mu s \times S_{points}$, where $S_{points}$ is the number of display points of the spectrum analyser (this is done in order to obtain an integration time close to the symbol duration of each pixel on the screen of the SA)
- minimum 20 s sweep time and peak trace of the power.

A revised format for certification of BTS for compliance of the EMF exposure limits using Selective Measurement Method is attached as substitute for Annexure- E.
## ANNEX-E

**FORMAT FOR CERTIFICATION OF BTS FOR COMPLIANCE OF THE EMF EXPOSURE LIMITS**

**(FREQUENCY SELECTIVE MEASUREMENT)**

Measurement Location =

<table>
<thead>
<tr>
<th>BTS Technology Wise</th>
<th>Measured Value of Power Density at the Base Channel Frequency</th>
<th>No of Carriers/Channel Bandwidth/MIMO config.</th>
<th>Extrapolation Factor ((N_{\text{GSM}} = N_c, N_{\text{CPICH}} = 10, N_{\text{PBCH}} = N_{\text{RS}}/72) where NRS depends on the channel bandwidth for OFDM Technology)</th>
<th>Total power density corresponding to the maximum emitted power condition</th>
<th>Power Density Reference Limit for the Frequency Band of BTS</th>
<th>Exposure Ratio</th>
<th>Over all exposure Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSM BTS using TDMA Technology (add row for each such BTS)</td>
<td>(S_{\text{BCCH1}})</td>
<td></td>
<td></td>
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<td></td>
<td>(S_{\text{BCCH2}})</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>(S_{\text{BCCH3}})</td>
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<tr>
<td>UMTS Node-B using CDMA/ WCDMA Technology (add row for each such BTS)</td>
<td>(S_{\text{CPICH}})</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LTE eNode-B using OFDM Technology (add row for each such BTS)</td>
<td>(S_{\text{PBCH}})</td>
<td></td>
<td></td>
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<td></td>
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</table>