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# Real Time Measurement of Harmonics, Observations and Suggestion for Reducing Harmonic Current

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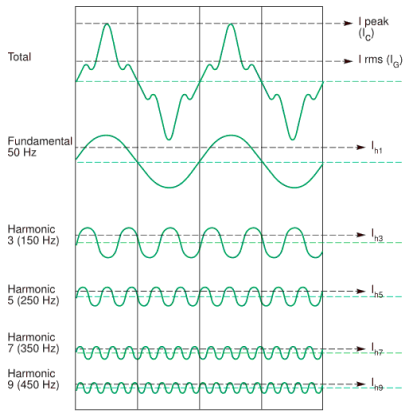
***Abstract:*** The current ongoing harmonics level at different kinds of burdens were considered, Characterized, Harmonics level of another sort load is estimated on continuous, broke down and proposals outfitted for decrease of the Harmonics current. The technique for Detuning of Capacitors is proposed for diminishing the harmonics level

***Keywords:*** *Harmonics, Detuned capacitors, Reactors.*

## I. INTRODUCTION

Harmonics are undesirable flows that are products of the principal line recurrence (50 or 60 Hz). Consonant flows can over-burden wiring and transformers, making heat and, in extraordinary cases, fire.




Nonlinear burdens cause harmonics to stream in electrical cables. In data innovation power frameworks, numerous work area PCs present a nonlinear burden to the AC supply. This is on the grounds that they have a force supply configuration known as a "capacitor input switch mode power supply.

Preferably, voltage and current waveforms are impeccable sinusoids. Be that as it may, because of the expanded prevalence of electronic and other non-direct loads, these waveforms get mutilated. This deviation from an ideal sine wave can be spoken to by harmonics—sinusoidal parts having a recurrence that is an essential difference of the basic recurrence. In this way, an unadulterated voltage or current sine wave has no twisting and no harmonics, and a non-sinusoidal wave has bending and harmonics..

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Harmonics is made from gear containing hardware that controls different contraptions, for example, variable speed drives, delicate starters, static compensators, rectifiers, and bend heaters, and so on.

## II. STANDARDS OF HARMONICS

The Central Electricity Authority of India have looked for consistency of the IEE models of harmonics as follows ::
Absolute Voltage Harmonic Distortion ought not to surpass : 5% (V-THD)
Any individual Voltage Harmonic Distortion Should not surpass : 3% (V-Ind)
All out Current Harmonic Distortion ought not surpass: 8% (I-THD)

## III. EXISTING SYSTEM

The continuous sound level existing in different natures of burdens, for example, Corporate Offices, Commercial Shops, Textile businesses, Foundries/Castings, Printing press, Hotels, Hospitals, and Theaters were contemplated.It was seen that the %THD in Textile businesses, Hospitals and theaters are inside the benchmarks..

While, the %THD existing in Corporate workplaces, Commercial shops, Foundries, Printing presses, and Hotels are high than the benchmarks. Therefore loads, for example, luxurious lightings and Personal PCs increment the %THD level in usage. It was proposed to consider the current harmonics level continuously in an instructive foundation. The current harmonics level at KAHE, Coimbatore was estimated continuously on.

## IV. POWER DISTRIBUTION DETAILS

The current harmonics level at KAHE, Coimbatore was estimated continuously on.

| | |
|---|---|
| Customer Details | M/s. KAHE COIMBATORE |
| No. of Service Connection | One |
| Service Connection Number | HT S.C.no - 569 |
| Transformer Make | KIRLOSKAR |
| Capacity (KVA) | 800 |
| Quota Demand (KVA) | 500 |
| Reached Demand (KVA) | 362.8 |
| Percentage of Impedance (%) | 4.75 |
| HT Voltage (KV) | 22 |
| LT Voltage (V) | 433 |
| HT Current (A) | 20.99 |
| LT Current (A) | 1066.7 |

### SERVICE CONNECTION DETAILS

The KAHE has profited HT Service association in 22KV framework through the 22 KV Ganeshapuram Feeder took care of from 110/22KV Kurichi Sub-station. The HT Service association number is 569

### SANCTIONED DEMAND

The Sanctioned demand of HT SC No.569 is 500KVA.

### MAXIMUM RECORDED DEMAND

The HT meter readings are recorded The HT meter readings are recorded once in a month (for example on 27th of consistently) by the Electricity division for figuring of Current Consumption and request charges.
The greatest interest was come to during August 2015 and it is 362.8KVA

### TRANSFORMER DETAILS

At the Consumer side, an 800KVA/22KV/433V Step-down transformer is given to venturing down of the voltage..

### CAPACITOR DETAILS

The accompanying Capacitors are associated with KAHE.

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25 kvar : 5 nos.
12.5 kvar : 1 no.
6.5 kvar : 2 nos.

**FEEDER DETAILS**

At the auxiliary of the transformer is the LT transport bar. There are a few feeders associated with the transformer auxiliary side, for different squares that are electrically isolated.

Coming up next are the seven different LT feeders accessible at KAHE

(i) MLSB-1
(ii) A Block
(iii) B-Block lighting load
(iv) D-Block
(v) Commercial
(vi) A2 Block
(vii) B-Block power load

## V. POWER QUALITY ANALYZER

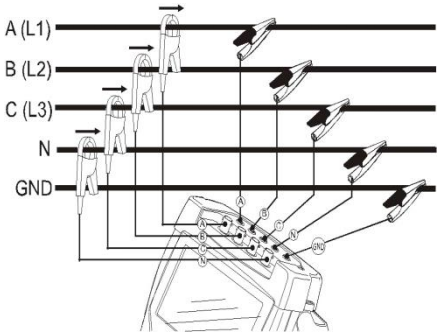
The hardware utilized for estimating the existing harmonics level at KAHE is Fluke 434 arrangement II. The Serial number is 27783408. The Analyzer offers a broad and ground-breaking set of estimations to check power conveyance frameworks. Some give a general impression of intensity framework execution. Others are utilized to research explicit subtleties. [1]

The analyzer measures and records harmonics and between harmonics up to the 50th request. Related information, for example, DC segments, THD (Total Harmonic Distortion), and K-factor are estimated. Readings can be given as a level of the essential, or as a level of all harmonics consolidated (RMS esteem). Results might be seen in a Bar Graph show, a Meter screen, or a Trend show.

**CONNECTIONS**

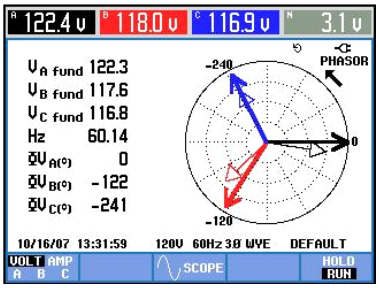
The present clips are first put around the conductors of stage A (L1), B (L2), C (L3), and N(neutral). The braces are set apart with a bolt demonstrating the right sign extremity. The voltage associations are made straightaway, beginning with Ground and afterward in progression N, A (L1), B (L2), and C (L3). For the right estimating outcomes, consistently associate the Ground input.

For single-stage estimations, utilize current information A (L1) and the voltage inputs Ground, N(neutral), and stage A (L1). A (L1) is the reference stage for all estimations.




Prior to making estimations, the Analyzer is set-up for the line Voltage, recurrence, and wiring design of the force framework.

Degree Waveform and Phasor show are valuable to check if voltage leads and current clasps are associated accurately. In the vector graph the stage voltages and flows A(L1), B (L2), and C (L3) ought to show up in grouping while watching them clockwise way.



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Voltage and recurrence ought to be near the ostensible qualities [ for instance 120 V, 230V, 480 V, 60 Hz, or 50 Hz.] The voltages and flows in the Meter screen can be utilized to check if power applied to a 3-stage acceptance engine is in balance.

Voltage unbalance causes high uneven flows in stator windings bringing about overheating and decreased engine life. Every one of the stage voltages ought not to contrast more than 1 % from the normal of the three.

The current unbalance ought not to surpass 10 %. In the event of too high unbalance, utilize other estimating modes to additionally break down the force framework.

A Crest Factor near 2.0 shows high contortion. CF = 2.0 can be found in the event that you measure the current drawn by rectifiers that lone lead at the sine wave top.

**MEASUREMENT MODE**

Harmonics mode is used for measuring voltage and current
harmonics and THD per phase.
Trend mode is used to record harmonics over time.

**SOFTWARE**

Power Log [2] is the software supplied with Fluke 435 and it is the dedicated software for data logging. The interface connection is located at the right Analyzer side and attainable if the tilt stand is folded out.

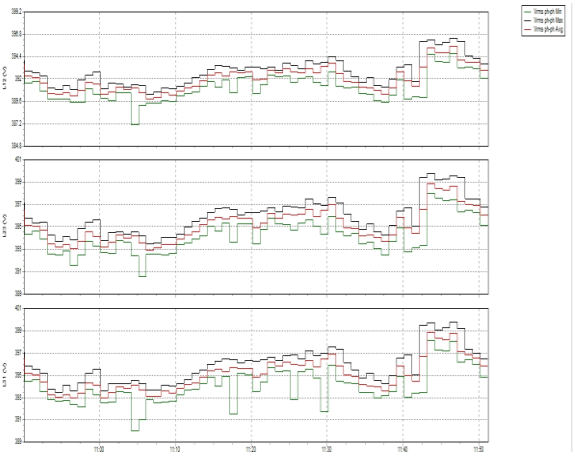
## VI. MEASUREMENT OF HARMONICS

Harmonics is measured at the following locations of KAHE, Coimbatore.

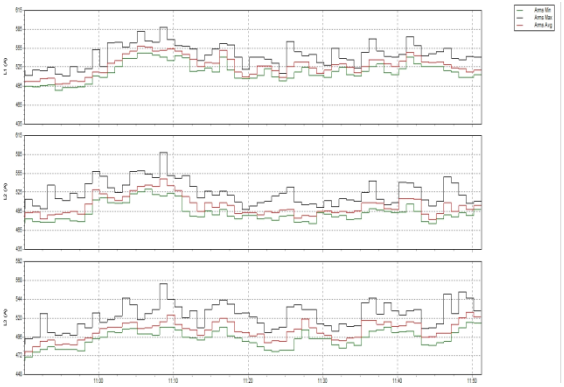
1) 800 KVA Transformer LT Side
2) 7 - Feeders
   - (i) MLSB-1
   - (ii) A Block
   - (iii) B-Block lighting load
   - (iv) D-Block
   - (v) Commercial
   - (vi) A2 Block
   - (vii) B-Block power load

Voltage profile, Current profile, Load profile, Frequency, V-THD%, I-THD%, Voltage individual harmonics, Current individual harmonics are measured using the Power quality analyzer.

## VII. RESULTS



Voltage profile



Current profile

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| HARMONICS DATA | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Loading Condition | KW | KVA | KVAr | PF | V | A | V-Unb % | I-Unb % | V-THD% | I-THD% | V(H)% | | | | | | I(A) | I(H)% | | | | | |
| | | | | | | | | | | | 2 | 3 | 5 | 7 | 11 | 13 | | 2 | 3 | 5 | 7 | 11 | 13 |
| 800 KVA Transformer LT side | | | | | | | | | | | | | | | | | | | | | | | |
| A Tr- LT side with Capacitor | 362.6 | 366 | 38.6 | 0.99 | 392.50 | 538.33 | 0.51 | 1.54 | 3.7 | 9.8 | 0.04 | 0.55 | 2.95 | 1.55 | 0.66 | 0.97 | 538.33 | 0.33 | 4.56 | 6.30 | 4.21 | 1.51 | 2.14 |
| A Tr- LT side with Capacitor | 353.9 | 356.8 | 30.1 | 0.99 | 393.17 | 523.6 | 0.55 | 2.6 | 3.8 | 10.41 | 0.05 | 0.56 | 3.09 | 1.51 | 0.78 | 1.06 | 523.6 | 0.37 | 4.80 | 6.65 | 4.14 | 2.34 | 2.94 |
| A Tr- LT side without or | 349.4 | 360.4 | 87.1 | 0.97 | 389.00 | 533.67 | 0.54 | 3.36 | 3.1 | 8.13 | 0.05 | 0.63 | 2.55 | 1.25 | 0.4 | 0.02 | 534 | 0.4 | 4.66 | 3.80 | 4.70 | 1.15 | 0.43 |
| 1 | 21 | 22 | 3.4 | 0.96 | 392.0 | 32.0 | 0.55 | 13.8 | 4.19 | 16.34 | 0.06 | 0.73 | 3.24 | 2.30 | 0.87 | 1.12 | 32.0 | 2.43 | 11.39 | 5.65 | 7.93 | 4.94 | 1.74 |
| | 42.1 | 45.4 | 11.2 | 0.93 | 398.3 | 63.7 | 0.50 | 22.3 | 3.53 | 15.59 | 0.07 | 0.69 | 2.49 | 1.59 | 1.31 | 1.36 | 63.7 | 2.43 | 13.52 | 4.24 | 4.54 | 1.41 | 2.26 |
| Lighting | 61.7 | 64.9 | 15.0 | 0.95 | 413.6 | 88.7 | 0.41 | 13.5 | 1.9 | 9.18 | 0.06 | 0.66 | 1.38 | 0.40 | 0.75 | 0.98 | 88.7 | 0.93 | 6.71 | 3.95 | 3.69 | 3.89 | 2.46 |
| | 33.1 | 36.9 | 14.1 | 0.9 | 400.8 | 52.3 | 0.34 | 12.5 | 4.34 | 21.91 | 0.06 | 0.76 | 3.1 | 2.41 | 1.39 | 1.4 | 52.3 | 0.94 | 6.27 | 6.19 | 12.6 | 1.10 | 5.34 |
| ercial block | 19.9 | 22 | 8.1 | 0.91 | 403.4 | 32.3 | 0.36 | 20.2 | 3.49 | 12.73 | 0.05 | 0.76 | 2.71 | 1.69 | 0.82 | 1.01 | 32.3 | 2.2 | 7.91 | 5.86 | 3.7 | 1.9 | 2.5 |
| ck | 41 | 42.1 | 7.9 | 0.98 | 409.6 | 59.3 | 0.38 | 1.0 | 1.93 | 13.84 | 0.05 | 0.7 | 1.3 | 0.72 | 0.27 | 0.75 | 59.3 | 4.15 | 10.78 | 5.5 | 5.5 | 4.51 | 2.65 |
| | 106.8 | 111.2 | 28.8 | 0.96 | 405.5 | 157.3 | 0.48 | 7.4 | 4.98 | 8.22 | 0.05 | 0.83 | 3.88 | 2.40 | 1.52 | 1.41 | 157.3 | 0.86 | 5.44 | 3.94 | 5.68 | 2.00 | 11.43 |

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| Energy Data | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Description | V(V) | | | I(A) | | | P(KW) | | | S(KVA) | | | Q(KVAr) | | | KWH | KVAH | KVARH | T-PF | | |
| | Min | Max | Avg. | Min | Max | Avg. | Min | Max | Avg. | Min | Max | Avg. | Min | Max | Avg. | Max | Max | Max | Min | Max | Avrg. |
| 800 KVA Tr- LT side with Capacitor | 391.0 | 397.0 | 394.0 | 486.0 | 538.0 | 511.0 | 330 | 362.0 | 346.0 | 333 | 366.0 | 349.0 | 26 | 38 | 31.6 | 118 | 119 | 32.6 | 0.99 | 0.99 | 0.99 |
| MLSB 1 | 390.3 | 400.8 | 393.9 | 27.7 | 32.0 | 29.9 | 18.7 | 21.7 | 19.9 | 19.2 | 22.2 | 20.51 | 2.7 | 3.8 | 3.25 | 10.1 | 10.4 | 1.65 | 0.96 | 0.98 | 0.97 |
| A Block | 397.4 | 406.5 | 401.4 | 47.3 | 63.7 | 55.9 | 31.7 | 42.1 | 37.0 | 33.7 | 45.4 | 39.8 | 8.7 | 12.2 | 10.73 | 20.3 | 21.9 | 5.90 | 0.92 | 0.94 | 0.93 |
| B Block Lighting | 404.8 | 413.9 | 408.7 | 85.7 | 88.7 | 87.0 | 58.9 | 61.7 | 60.0 | 61.7 | 64.9 | 62.95 | 13 | 15 | 13.83 | 31.3 | 32.8 | 7.22 | 0.95 | 0.95 | 0.95 |
| D Block | 395.5 | 409.6 | 402.1 | 46.3 | 52.3 | 49.5 | 29.2 | 33.1 | 30.9 | 32.7 | 36.9 | 34.71 | 13.1 | 15.3 | 14.15 | 31.4 | 35.3 | 14.38 | 0.88 | 0.9 | 0.89 |
| Commercial Block | 400.2 | 406.7 | 402.9 | 19.3 | 32.3 | 22.4 | 12.5 | 20.4 | 14.5 | 13.9 | 22.5 | 16.08 | 3.1 | 8.1 | 4.39 | 7.43 | 8.3 | 2.25 | 0.86 | 0.93 | 0.9 |
| A 2 Block | 407.9 | 412.4 | 409.4 | 42.0 | 59.3 | 52.4 | 29.0 | 41.0 | 36.1 | 30.1 | 42.1 | 37.46 | 4.4 | 9.6 | 7.38 | 18.8 | 19.5 | 3.82 | 0.95 | 0.98 | 0.96 |
| B Block | 403.2 | 411.5 | 405.4 | 130.7 | 157.3 | 145.6 | 89.2 | 106.8 | 98.9 | 92.6 | 111.2 | 102.9 | 21.3 | 29.3 | 25.45 | 50.9 | 53.0 | 13.09 | 0.95 | 0.96 | 0.96 |

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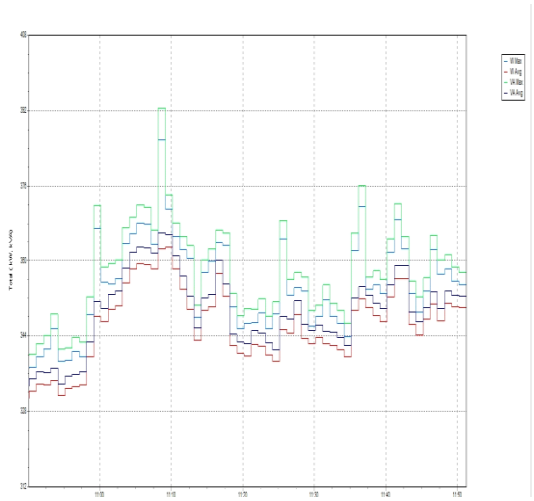
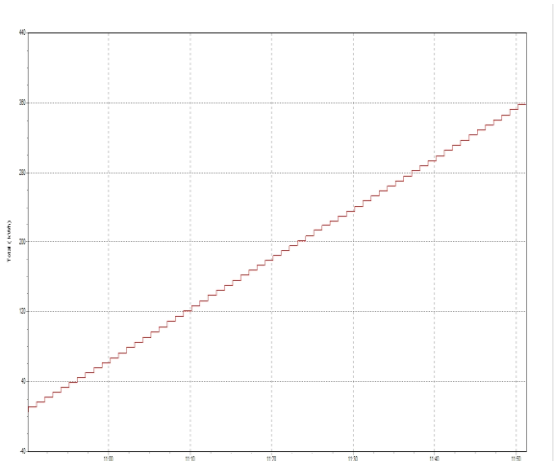
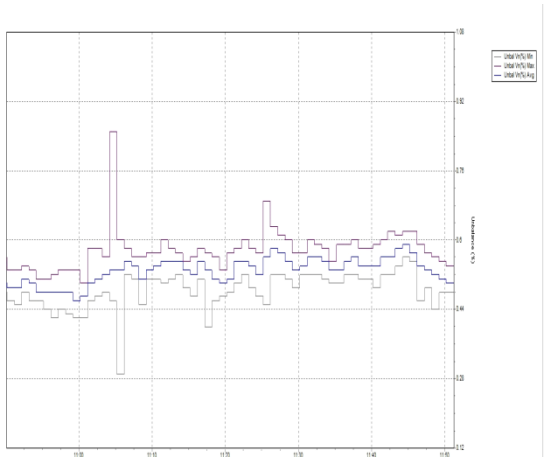


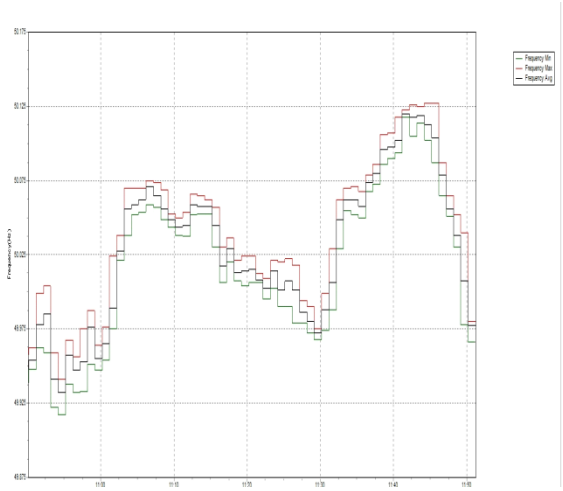
Load profile



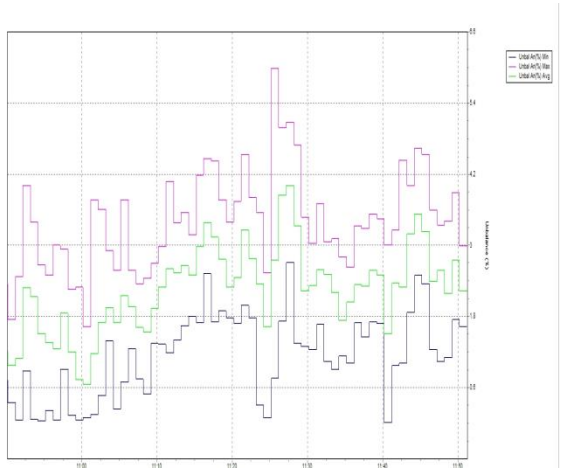
Active Energy(kwh)



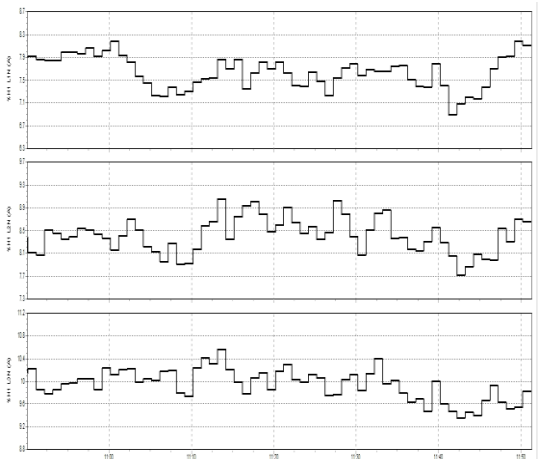
Voltage unbalance (V-unb %)



Frequency (HZ)



Current unbalance (I-unb %)



Total Current Harmonics ( I-THD %)

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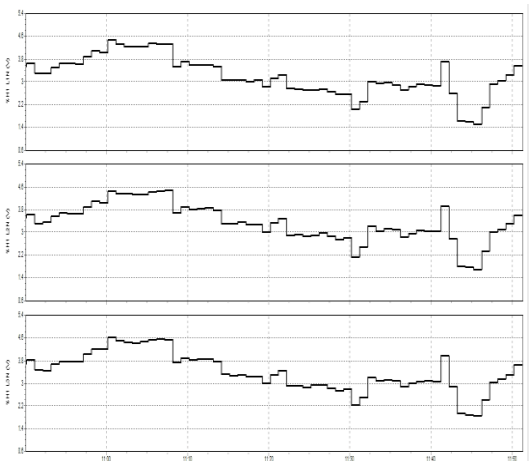
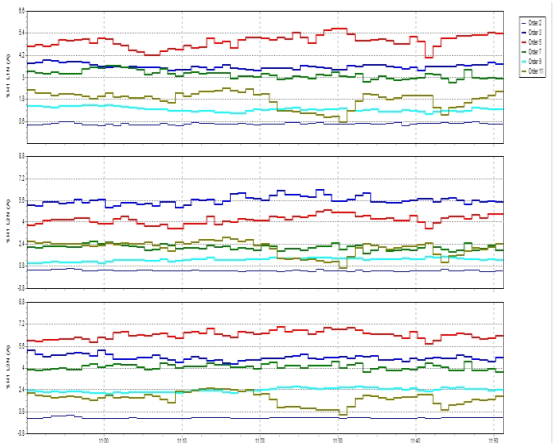
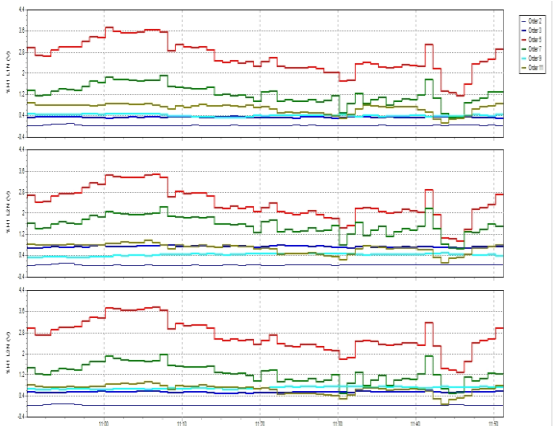


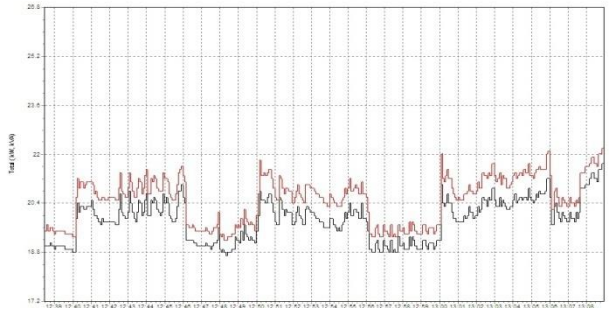
Total Voltage Harmonics ( V-THD %)



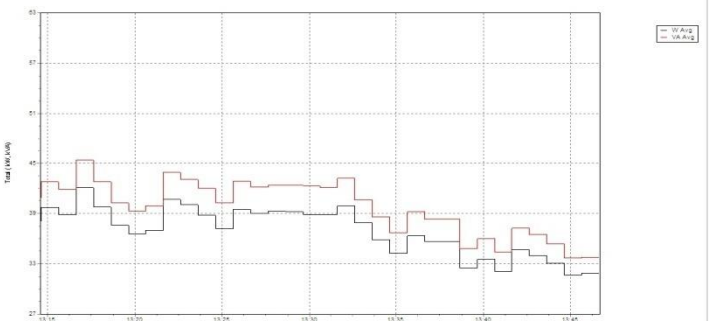
Current Individual Harmonics%



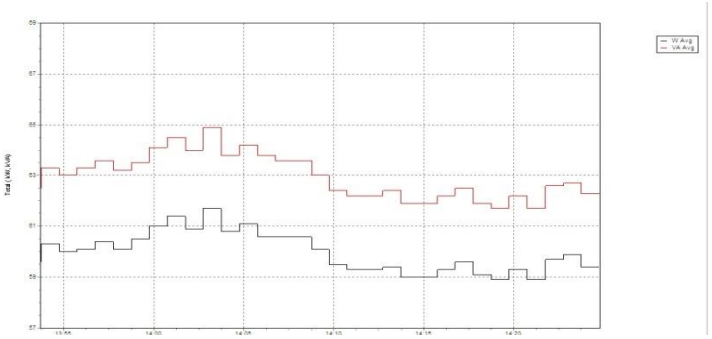
Voltage Individual Harmonics %



MLSB-1 Load Profile

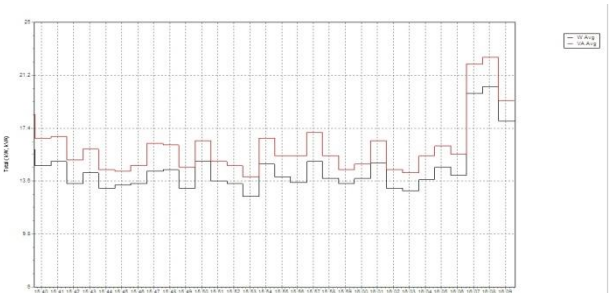


A-Block Load profile



B-Block Lighting Load profile

D- Block Load Profile



Commercial Block Load profile

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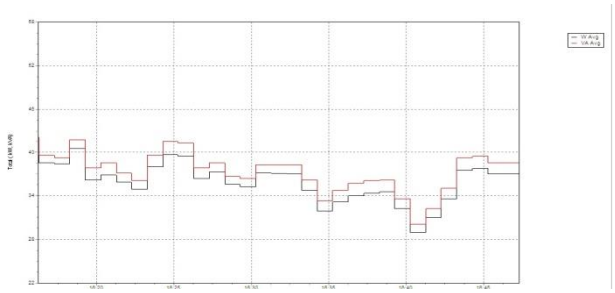
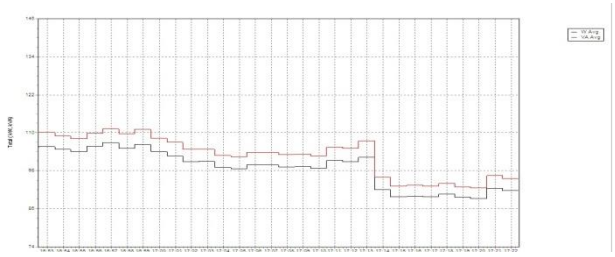


A2-Block Load Profile



B-Block Power Load Profile

**OBSERVATIONS**

| Description | TNERC norms | Existing value |
|---|---|---|
| Harmonics V-THD % (max) | 5% | 3.8% |
| Harmonics V-ind % (max) | 3% | 3.09% |

| Description | TNERC norms | Existing value |
|---|---|---|
| Harmonics I-THD % (max) | 8% | 10.4% |
| Highest order harmonics | | 5th order |

## VIII. CONCLUSION

We, at KAHE, Coimbatore, had seen that Distributed and fixed Capacitors (150 KVAr) for power factor pay are associated at feeder level. This sort of course of action will either

a) Over Compensate during part load conditions. Or on the other hand

b) Under redress whenever introduced thinking about the low/normal burden conditions.

Consequently it is proposed to go for Centralized Automatic Power Factor pay at MV Panel level.

The consonant current present at the Incomer is produced due to

A) The Non Linear burdens at Load level (streaming towards the capacitors and towards the transformer, streaming towards different burdens )

B) The wave current produced by the capacitors( streaming towards the heaps)

C) The intensification impact( reverberation) brought about by the crash of the over two flows, going in a similar line the other way.

The above consonant flows can be moderated by Using Tuned symphonious channel.

By introducing appropriate reactors in arrangement with the capacitors can decrease the impact of wave flows and reverberation with the consonant current. This strategy requires 480 V AC or 525 V AC reactors.

Likewise, the current " Distributed and Fixed" capacitors are proposed to be changed over into "Concentrated and Automatic" capacitors of 525 KVAr.

By this procedure, the ITHD% is required to be decreased upto 2% to 3% of the current level.

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