CRITICAL Differentiating features of the technology from its contemporaries: NEW Updated on 10-12-2011

NOTE:- Please refer our test reports and explanations to the same as available at our websitewww.lumenteck.com when perusing this document.

General Features: About Low THD, High Pf, Cf and Temp.

Our Electronic Ballast technology has 3 different versions , and the versions 1,2, and 3 respectively have Ballast Factor (lumen factor) 0.97, 0.92, 0.91, Ballast Efficacy Factor 2.16, 2.06, 2.29, Power Factor 0.98, 0.99,1,THD-input current 2.4%, 1.3%, 2.9% and THP 0.002, 0.001 and 0.004 Watts. Our ballast circuits have non-preheat starting mode with instant lamp starting, and delivers the ideal starting conditions to the lamp it operates; ensuring longer lamp-ballast life. Note that Ballast Factor mentioned here is measured when our ballast circuits operate with the ordinary T12 40 W cold cathode Linear Fluorescent Lamp, which is neither HE nor HO Lamp. Naturally, when our ballast circuits are operated with such HE/HO lamps, Ballast Factor, Ballast Efficacy Factor, and Ballast Efficiency etc will be higher. Ballast Efficiency even with this Lamp is high as 95.4 - 96.5% (for version 3).

Total Harmonic Power or power loss is as low as this, showing that the heat generated during normal operation of the ballast is negligible in comparison to its contemporaries. Low heat generation during normal operation naturally ensures more lamp-ballast life than the contemporary ballasts. **Attentions is drawn to the fact that no heat sinks are used in our circuits, nor are they required, and this yet again shows the stability of the circuits**. Generation of low heat during normal operation is a big advantage as it gives ample freedom to luminaries' designers to apply any design of choice without worrying about heat disbursement issues from the ballast during its normal operation with the lamp. Contemporary ballasts need heat sinks to ensure heat disbursement and to prolong the critical component life. When operating with luminaries, heat disbursement becomes their biggest issue that causes early lamp-ballast failure.

None of the contemporary ballasts have Pf 1 nor have Crest Factor of the lamp operating current wave at less than 1.5. Even Top of the line electronic ballasts has Pf 0.98-0.99 and Crest Factor of the lamp operating current wave at 1.7. High Power Factor values (above 0.85 and 0.9- in North America) are meaningless if the Harmonics level is high (say more than 5% THD even), as the power saving as felt at that time due to the high power factor values is not real power saving. Power factor correction has to happen when you bring the THD (Total Harmonic Distortion) of Phase A current to less than 3%. Any power factor correction done for contemporary ballasts which have high THD values, has no real significance, as both the input current wave form and the lamp operating current wave form will be distorted, as evident from the high values of crest factor of both the waveforms.

For contemporary ballasts, the value of crest factor of input current wave form (Phase A current) is usually in the range of > 1.4 and the lamp operating current waveform crest factor is 1.7-1.8. Naturally the early lamp failure, premature lamp- end blackening and untimely ballast failure are the result of these. You may note that, for our ballast circuits, the input current wave form (Phase A current) crest factor is 1.4 and the lamp operating current waveform crest factor is 1.5 Max. Hence the contemporary ballasts high power factor values and claims of power saving and longevity lose real significance, and the same is apparent when the THD, Total Harmonic Power and Crest Factor values of these ballasts are checked and read in tandem. All the 3 versions of the electronic ballast technology have low harmonics distortion and high power factor even from starting voltage (the voltage at which the ballast starts and operates the lamp properly). This shows the stability of the circuits.

We have not used any digital technology for ensuring high power factor, as that by itself will increase the product cost, cause a certain amount of harmonics and will also fail during the "Abnormal conditions" testing (for all the four tests), "Operational tests for Abnormal Conditions" testing (for the two tests), when measuring "Starting conditions" (like "open circuit voltage", "impedance current" and "cathode current") and when "Mains Transient Over Voltage" is applied to the Ballast.

Total Harmonic Distortion of the 3 versions of our Electronic Ballast Technology are 2.4%, 1.3% and 2.9%. None of the existing ballasts from all the major lighting companies in the world has THD < 3%. Everyone on them has claims of THD < 10% (without specifically saying the THD value at the rated voltage). Known technologies as used by the existing circuits cannot bring the THD to < 3%. This itself is clear testimony of the uniqueness and novelty of the electronic ballast circuits we have developed.

We kept 3% as the threshold level for THD, as the IEC standards consider the input supply to be corruption free, even for testing, if its THD is less than 3%. Our key objective was to develop a technology, that by itself give the best performance in the product class globally, without causing any disturbance to the other equipments operating in the same supply line. Contemporary ballast that have THD values greater than 3% do cause a certain level of harmonics in the input supply line, that will get cumulated to an unmanageable level when more number of their ballasts operate in the same supply line. This will not only affect the life and performance of all other sensitive electronic and electric equipment operating in that same supply line, but also will generate additional heating on the transformer that is providing input to the said supply line. Hence the damage caused due to high harmonics when these ballasts operate extends much beyond the reduction in longevity to the lamp-ballast combination. These critical problems do not occur even when thousands of our ballasts operate in the same supply line; due to the features above mentioned.

If you can have a look at the "BMI power profiler" snap shots of all the three versions of our technology which are posted at our website (those are the ones taken at the testing laboratory i.e. CPRI Bangalore), you will see that the values of all the readings across the 3 versions have a certain amount of similarity, at the same time the power factor goes from 0.98, to 0.99 and finally 1; all the time the THD is maintained less than 3%.The totality of the circuit and its perfect balance will result in high power factor and no single component can be added to the circuit to result in the same. This is the key difference between our technology and its contemporaries. Links to the BMI Power Profiler snap shots of the version 1,2 & 3 are provided here for your quick reference.

http://www.lumenteck.com/electronic_ballast/exp/snap_ver1.htm
http://www.lumenteck.com/electronic_ballast/exp/snap_ver2.htm
http://www.lumenteck.com/electronic_ballast/exp/snap_ver3.htm

Abnormal Conditions:

In addition to these, as per the standards, the Electronic Ballasts in general has to withstand "Abnormal conditions" as listed below (operating at 90-110% of the rated voltage). This is where the key differences between contemporary ballasts and ours are very much apparent. *Note that for our technology, all the tests are done at 110% of the rated voltage, and that is the worst condition possible.*"Abnormal conditions" is THE critical test in consumer safety. The following are the critical tests of "Abnormal conditions":

1. The lamp is not inserted.
2. The lamp does not start because one of the cathodes is broken.
3. The lamp does not start although the cathode circuits are intact (de-activated effect).
4. The lamp operates, but one of the cathodes is de-activated or broken (rectifying effect).

During the first test, the ballast must automatically detect that the lamp is not there in circuit. In the second one, it must also identify automatically that either of the lamp cathodes are broken and respond accordingly. In both cases the ballast has to detect these conditions and go into a "passive" mode and preserve itself without any failure.

On the other hand, the "de-activated" effect situation require the ballast to operate and deliver output current to the cathodes as it detects that both the cathodes are in place and are intact, but the lamp is not lighting up (de-activated effect) due to the lamp being faulty (stimulated using non-inductive substitution resistors connected to the output of the ballast, and the resistance values are derived based on the nominal running current of the lamp as noted from the relevant lamp data sheet). Specially note here that the contemporary ballasts use a Safety switch off or cut off system to circumvent difficult test situation of "de-activated" effect and "rectifying effect" of "Abnormal conditions", and this is where their circuit designs clearly vary. (Ideally the situations depicted in "abnormal conditions" should be stimulated at 110% of the rated voltage to analyze the performance of the ballast under the most adverse situations.)

Having a safety switch off system to circumvent the "de-activated" effect where the lamp does not start although the cathode circuits are intact, however prevents the measuring of the critical parameters of "starting conditions" of "Non-preheat starting mode" ballasts. Using any sort of safety switch mechanism to overcome the very difficult de-activated effect will prevent them from properly measuring and evaluating the "Open circuit voltage", "Impedance current", and "Cathode current" parameters that are detrimental compliance parameters for ensuring the ideal "Starting Conditions" for the lamp that the ballast operates. Measurement methodology for all the aforesaid parameters of "starting conditions" involves the application of dummy cathode resistors in place of lamp cathodes, akin to the situation of "de-activated effect". When the said test rigs are connected, the cut-off system of these ballasts (which have "Non-preheat starting mode") will be activated and will prevent the deliverance of ballast output, making the actual measurement impossible of these vital parameters that determine the lamp-ballast compatibility that results in longer lamp life.

Some latest ballasts with non-preheat starting mode even have a time delayed switch off system that gets activated after a very small time delay when the ballast circuit is connected to the test circuits for measuring the parameters of starting conditions. This however is not a proper technology innovation, as by any chance if there is a delay in measuring the said parameters after the connection of the ballast to the test rig or change in the input supply line voltage (that results in the effective change of the connected load to the ballast as the starting conditions parameters are measured at 92-110% of rated voltage as applicable), the ballast will go into a cut off mode, and the said measurements can be made only after line re-switch on. Our ballast circuits withstand the de-activated test without being cut-off and as a result the problems mentioned above will not apply.

What some other contemporary ballasts do to circumvent this yet again, is to disconnect the safety switch off mechanism and measure the said parameters of "starting conditions", and then fine tune the ballast with the specifications of the lamp it intends to operate. Removing a critical safety feature and testing the ballast for compatibility with the lamp it is intending to operate is directly compromising on consumer safety. This is similar to removing the brakes and test driving a car for performance.

The input power drawn by the ballast at the time of testing for de-activated effect at 110% of the rated voltage is more than 150% of the power it would draw when operating a lamp normally at rated voltage.**Observe that our ballast does not "trip off or cut off" during this test, but withstands the test condition at 110% of the rated voltage and operate the lamp normally after the lamp is reconnected back to it; without any line re-switch on**.

In the "rectifying effect" situation, the lamp is lighting up but one of the cathodes is de-activated or broken causing the lamp to remain in a "glowing" state. Due to the safety switch off feature, these contemporary ballasts , irrespective of whether it has "Non-preheat starting mode" or "Current / Voltage controlled Pre-heat starting mode", do not comply with the conditions of "rectifying effect", as the test condition specifies that "<u>the lamp operates </u>but one of the cathodes is de-activated or broken". The clause further specifically says that "the rectifier polarity shall be chosen so as to give the most unfavorable conditions and "If necessary, <u>the lamp shall be started</u> using a suitable starting device". This simply means that the *<u>lamp has to start and operate</u>* during the entire duration of test and that the test ballast has to be operational to deliver its output to the lamp.

The latest ballasts in the international lighting market with safety switch off goes to a cut off stage during this test, and hence the lamp connected to it does not start and operate. **Our ballast circuits starts and operates the lamp during this difficult "rectifying effect" state, in both rectifier polarities, at even 110% of the rated voltage, and withstands this adverse situation without any damage to itself or to others**. Our ballasts does not "trip /cut off" during the "rectifying effect" test. The lamp was glowing equally with both rectifier polarities, thereby showing the balanced nature of the circuitry. These are the reasons as to why the ballast cannot have a cut-off circuit to overcome the "abnormal conditions".

This highly difficult test is stimulated using appropriate equivalent non-inductive dummy cathode resistors with resistance value equivalent to the resistance of the lamp cathode (with mid-point connections), and approved rectifier diodes. You may refer the test circuit diagrams and explanation given at our website in "Electronic Ballast Test Report version 1", under "Explanations" to "Abnormal conditions" testing. Link to the explanation of all these critical tests are provided here for your easy access.
(http://www.lumenteck.com/electronic_ballast/exp/Clno3abn.htm)

This is a critical technology difference as the consumer safety is very much compromised when these latest ballasts goes into a cut-off state during these abnormal conditions. The standards specify that the lamp shall start and operate during "rectifying effect", meaning that the ballast circuit should have the ability to withstand this difficult situation, the occurrence of which can compromise the consumer safety. Safety switch off / cut off circuits have been known to fail during these situations of "de-activated effect" and "rectifying effect", compromising the consumer safety in a critical way. The question that is raised by the standards authorities in this case is "**what happens to the consumer safety if the ballast's safety switch off fails**"? The objective of the standard is to ensure that the ballast withstands all abnormal events by itself, thus ensuring the absolute safety of the end consumer.

It must be noted that our ballast withstands all these "abnormal conditions" and operate the lamp normally afterwards on connecting it to the ballast, and no line re-switch on was required after each of the test parameters. The ballast circuit does not carry any fuse, or have any sort of tripping mechanism of any sort incorporated in it to overcome these conditions. Ballast Factor is measured after these "Abnormal conditions" and no depreciation in lumen is there. Details including test circuit diagrams are given in the "Explanation" to the various test reports at our website as available at the link given above.

Note that the "Abnormal conditions" testing is in "General and safety requirements" which is the Part 1 of the standards, and the Part 2 of the standards which is "Performance requirements" has "Starting Conditions" testing, followed by the "Operational Tests for abnormal conditions". These tests are scheduled in such a manner that if a manufacturer tries to circumvent the "abnormal conditions" testing by adding a "safety cut off" mechanism in the circuit, they won't be able to measure the "starting conditions" parameters that follow this test as their ballast will trip-off; making the measurement impossible. The test parameters of "The operational test for abnormal conditions" is done after the "Starting conditions" as that re-affirms yet again that the ballast circuitry is fully stable and does not have a cut off circuit incorporated in it. Some manufacturers, in the manner mentioned above, try to clear the "Abnormal conditions" in the first part of the standards by incorporating the trip-off circuit but fail to the clear the second part of the standards as they cannot measure the "starting conditions" due to ballast tripping off. A reference of the relevant standards will substantiate this statement. What cannot be measured, cannot be improved.

Starting Conditions:

The critical features that match ballast to the linear fluorescent lamp it operates are the starting conditions parameters like "Open circuit voltage", "Impedance current", and "Cathode current" it delivers to the lamp.

World over, "Non-preheat starting mode" is considered to be superior for electronic ballast in comparison to "Current / Voltage controlled Pre-heat starting mode". Starting time is lower for Non-preheat starting mode as the cumulative glow discharge period during starting is much lower than Current / Voltage controlled Pre-heat starting mode. The unduly high and /or long lasting glow discharge current during starting process that causes excessive lamp end blackening and subsequently early lamp failure is lower when its operated with a non-preheat starting mode ballast than with a current / voltage controlled pre-heat starting mode ballast. Hence lamp life is much more when it's operated with a non-preheat starting type ballast, *provided* it delivers the ideal open circuit voltage, ballast impedance current and cathode current during the lamp starting.

However, as mentioned above, contemporary "non-preheat starting mode" ballasts have safety switch off feature (for circumventing abnormal conditions parameters) that gets activated when they are connected to the test circuits for measuring the parameters of Starting conditions viz. "open circuit voltage", "ballast impedance current” and “cathode current”, making it impossible to ascertain as to whether they deliver the right values of the afore said parameters of starting the lamp (based on the lamp specifications). Measurement methodology for all the aforesaid parameters of “starting conditions” involves the application of dummy cathode resistors in place of lamp cathodes, akin to the situation of “de-activated effect”. When the said test rigs are connected, the cut-off system of these ballasts (which have “Non-preheat starting mode”) will be activated, and it will prevent the deliverance of ballast output, making the actual measurement impossible of these vital parameters that determine the lamp-ballast compatibility that results in longer lamp life.

To circumvent this problem, the safety cut off mechanism of these ballasts has to be removed to measure the said critical parameters of “starting conditions” and to ideally “suit” or match those to the lamp it intends to operate. Removing the safety mechanism and measuring the parameters of “starting conditions” will cause these ballast circuits to fail when the test rigs for measuring the parameters of “Open circuit voltage”, “Impedance current”, and “Cathode current” are connected to it. Further, it is not the correct methodology as the ballast circuitry is not complete without the safety cut off circuit and hence the measurement values cannot be relied upon. This in turn affects the longevity of the lamp these ballasts operate.

Interestingly, some contemporary ballast even has a delayed “tripping/cut off” mechanism that only ‘trips-off” the ballast circuitry after operating for some time, when connected to the test rig for “de-activated test” of “Abnormal conditions”, and also to the test rigs for measuring the “starting conditions” parameters like “Open circuit voltage”, “Impedance current”, and “Cathode current”. This however, will make their technology incomplete as the stipulations of the test for “rectifying effect” of “abnormal conditions” as detailed above will not be met by these ballasts. Moreover, this is yet again an incorrect methodology and incomplete technology, as any extension of time taken for measuring any of the parameters of “starting conditions” will naturally trip of the ballast circuitry, making the measurement impossible for some time.

Latest ballasts with “Current / Voltage controlled Pre-heat starting mode”, are given a leeway for during the measurement of the “starting conditions” (when dummy cathode resistors are connected to these ballast output for measuring open circuit voltage and current, the ballast circuit will switch off as it’s a stimulation of de-activated effect). However, such ballasts which have safety switch off system for handling “abnormal conditions”, will fail the “rectifying effect” test, the details of which are given earlier.

The critical difference between our ballast technology and others is the fact that we can uninterruptedly measure the parameters of “starting conditions” like “Open circuit voltage”, “Impedance current”, and “Cathode current” for our ballast technology and ascertain it’s conformity to the specifications of the same as detailed in the lamp data sheet of the lamp it operates with. ***Our ballast circuits, with non-preheat starting mode, and with the ability to withstand all the parameters of abnormal conditions without the aid of a safety switch off / cut-off feature, deliver ideal starting conditions of “open circuit voltage”, “ballast impedance” and “cathode current” as requisite for “non-preheat starting mode”, clearly demarks its advantages over the latest ballasts in the global markets****.*

This is the key feature that ensures universal application of our ballast technology. The parameters of the starting conditions are the ones to be matched for any ballast circuit, with that of the lamp it operates with, to ensure longer lamp-ballast life. The principles of operation of Linear Fluorescent Lamps are the same irrespective of the wattage or the input line voltage at which it operates. Since we can uninterruptedly measure the parameters of “starting conditions” like “Open circuit voltage”, “Impedance current”, and “Cathode current” for our ballast circuits, these 3 versions of ballast circuits developed for perfectly compatible operation with one wattage and operating voltage of LFL can be “fine tuned” or directly “customized” in a cost effective manner (by just adjusting the values of the components and coils in the circuitry) with ideal starting conditions, in accordance to the requirements of the lamp it operates with, all the while maintaining key performance features, for perfectly compatible operation with all the different wattages of LFL’s, and different input line voltages as in use around the world.This is evident from the fact that we have presented three different versions with similar key features, but yet deliver varied test results (including different reading for the parameters of starting conditions) as evident from the BMI snap shots and test results, showing the versatility of the circuits, all the while maintaining the common DNA (when it comes to critical performance features and results like THD, THP, PF, Cf etc), and this by itself demonstrates the scalability of the circuits and their integrity.

We have tested the technology with T12 40 W cold cathode lamp as it’s the version of LFL with the biggest market share in India. There are numerous versions of LFL’s available in the international market including HO and HE ones, and this is a key technology feature that enables us to fine tune the ballast technology to cater the needs of the entire range of Linear Fluorescent Lamps.

What can be measured can be fine tuned or improved according to the lamp specifications.

For contemporary / latest ballasts with current/voltage controlled pre-heat starting mode, technology scalability to ideally suit the ballast with the lamp it operates in terms of starting conditions is limited to lamps designed for pre-heat starting mode alone.

"Starting conditions" test rig circuit diagrams are given in the "Explanation" to the test reports at our website in "Electronic Ballast Test Report version 1 or 2", and the link is provided for your benefit. (http://www.lumenteck.com/electronic_ballast/exp/Clno4sta.htm).

The deliverance of ideal "Starting Conditions" parameters like "Open circuit voltage", "Impedance current", and "Cathode current" by the ballast are critical to ensure longer lamp-ballast life and also superior consumer safety. Moreover, these are the parameters that match the ballast to the lamp specifications that are detailed in the respective lamp data sheet, and compliance to the same ensure that the lamp performance is optimized with the ballast performance; in an ideal manner. The manufacturers entire requirements from this product segment is so covered.

Mains Transient Overvoltage:

Ballasts have to withstand "Mains Transient Overvoltage" test without any flicker or damage of any sort. The main transients overvoltage of both positive and negative polarity (Symmetric 1000v, Pulse Rise time 100 ns, pulse width of 50 micro seconds with maximum energy 2 J for unearthed ballasts), which is randomly phased (from 0-360 degrees) and super-imposed on the main voltage, when applied to the ballast connected to the lamp, shall not disturb the intended functioning of the equipment or lead to damage. During testing, the transient impulse of both the positive and the negative polarities with random phase angle change from 0 to 360 degrees and back is applied superimposed over the mains and, there should not be any lamp flicker/disturbance or damage to the ballast.

Most contemporary unearthed ballasts fail when the transient over voltage is superimposed over the mains and the phase angle is changed even by a degree in either/ both polarities. Some of them do also exhibit heavy lamp flicker when the transient pulses are applied to the ballast as superimposed over main voltage, in both or either of the polarities, and heavily so when phase angle is shifted randomly between 0 and 360 degrees in either or both the polarities. Link is provided for your referencehttp://www.lumenteck.com/electronic_ballast/exp/Clno14mai.htm

If contemporary unearthed ballasts have a "Safety switch-off" facility incorporated in these ballast circuit to withstand the "abnormal conditions" and "operational tests for abnormal conditions", the said safety switch off circuits in most cases would have use to protect the ballast circuit against transient impulses. In some cases such ballasts go into a cutoff state when the transient pulses are applied to the ballast as superimposed over main voltage, in both or either of the polarities or during the random phase angle shift between 0 and 360 degrees. Standards specify that "Mains transients of either polarity, randomly phased and superimposed on the main voltage, shall not disturb the intended functioning of the equipment or lead to damage". During the occurrence of all of these situations, the intended functioning of the ballast is compromised or damage occurs to it. The latest ballasts that are without earthing thus have problems surviving "Mains Transient Overvoltage".

Our ballast circuits are without earthing, and withstand the transient overvoltage of both positive and negative polarity which is randomly phased (from 0-360 degrees) and super-imposed on the main voltage, without exhibiting any lamp flicker or occurrence of any damage of any sort to the ballast. *Our ballast is unearthed, and for unearthed ballast, this is critical as this ascertains the ability of ballast to withstand the transient pulse without the need of an earth terminal, the presence of which would seriously affect the practical application of the product on a wide basis. Hence longer lamp-ballast life is ensured than the latest ballasts and universal application of the product is easily possible as retrofit to existing lamps and* *luminaries.*

Some of the latest ballasts have earthing to protect itself during the occurrence of “Mains Transient Overvoltage” situation. However, this not only causes problems during installations in large numbers, but also has a failure chance due the earthing getting disconnected by any chance, leaving the ballast-lamp susceptible to transient impulses; thus compromising the safety of the consumer, not to mention the longevity of ballast-lamp.

Operational Tests for Abnormal Conditions:

The Ballast also withstands the difficult conditions of “Operational tests for abnormal conditions” as detailed below:

Removal of lamp:

For “removal of lamps” where that lamp is instantly disconnected from the ballast at 110% of its rated voltage without switching off the supply voltage, and is reconnected back to it after a time interval of 1 hr ,and the standards stipulates that the ballast shall start and operate the lamp at least after line re-switch on. Few latest ballasts with “Automatic restart after lamp replacement” restarts the lamp without line re-switch on after the said period, whereas some other ballasts which have a “Safety switch-off” require a line re-switch on to start the lamp. For our ballast circuits withstand the test situation and no line re-switch on is required as it automatically detects when the lamp is connected back to the circuit, and then operate it normally.

For contemporary ballasts, most of them require a line re-switch on to start the lamp as their ballast circuit will be in a cut off state and won’t recognize that the lamp has been re-connected back with it.

No re-switch on was required for our ballast as it started the lamp as soon as it was connected back. This is a practical product specification that is highly useful in the consumer end. Further, it also shows that the ballast detects by itself when the lamp is connected to it and when not, and act accordingly, thereby preserving both the lamp and the ballast and also ensuring the consumer safety.

Lamp fails to start:

In the lamp fails to start stimulation, the ballast shall be operated at 110% of the rated voltage for 1 hour, with dummy cathode resistors (of value equivalent to the value of the resistance of the lamp cathode) connected to the output of the ballast. At the end of this period, the resistors are removed and the lamp is reconnected and the ballast has to start and operate the lamp normally at least after line re-switch on.

This is similar to the situation depicted in the aforesaid “de-activated effect” of “abnormal conditions”, but the connected load (resistor values that depict the lamp cathodes) to the ballast is radically different and the stipulation of input voltage during testing is 110%.

The critical differentiating factor between our ballast circuits and the latest ones become apparent during the stimulation of “lamp fails to start”.

For the latest ballasts, that has either “Automatic restart after lamp replacement” features or “Safety switch-off” or both, go into a cut of state when connected to the dummy cathode resistors, and the ballast won’t be delivering the output to the cathodes. They restart the lamp when its connected back to the ballast, on line re-switch on. *If these ballasts are in a safety switch off state, it would require a line re-switch on to detect the lamp when the lamp is connected back to it.* This hampers the practical on-field application of the product as when the consumer replaces a faulty lamp with a new one without switching off the input supply to the ballast, these contemporary ballasts would not automatically detect the lamp if the consumer does not perform a line re-switch on, and as a result they might end up believing that the ballast has failed, where as it is actually at that time only in a cut off state. This will end up negating the brand image of the ballast.

If such ballasts have “Non-preheat starting mode”, the proper measurement of the parameters of “starting conditions” as detailed earlier won’t be possible for them. **Irrespective of the fact as to whether the latest**

ballasts have "Current / Voltage controlled Pre-heat starting mode" or "Non-preheat starting mode", they won't be complying with the conditions of "rectifying effect" as detailed above.

Our ballast circuits withstand the "lamp fails to start" situation without being in a cut off state and automatically operate the lamp when it's connected back to the ballast; without line re-switch on. No line re-switch on was required for our ballasts after this test, and it started and operated the lamp normally when the lamp was connected back with it.

This test is to re-affirm that ballast circuit does not depend on a safety cut off mechanism to protect itself *during "de-activated effect" test of "Abnormal conditions", as the load taken by the ballast during this test is different from that at the time of "de-activated effect" test of "Abnormal conditions", and hence a safety switch off mechanism set to be activated for a particular input voltage or connected load to the ballast as in "de-activated effect" test of will not function properly under this test conditions.*Please read the explanations given in the link at our website http://www.lumenteck.com/electronic_ballast/exp/Clno12ope.htm

It must be noted that our ballast circuits do not require or have heat sinks for its transistors during normal operations, and also during the aforesaid adverse situations of "abnormal conditions" and also during the situation depicted in "operational test for abnormal conditions". The circuits withstand these adverse test situations without being in a cut off state without the need of heat sinks for the transistors in the circuits. THP values of our ballast circuits are 0.002, 0.001 and 0.004 Watts. Latest ballasts, even with the "Safety switch-off", require heat sinks for their transistors to manage the temp rise in the circuits during normal operations.

Compliance to A2BAT:

Our ballast technology has features that are much above the requirements of the proposed A2BAT (Energy Efficiency Index System).

Total Harmonic Power (THP) for versions 1, 2 and 3 is 0.002, 0.001 and 0.004 Watts. The CELMA (A2) standards allow a maximum of 0.5 watt standby power loss for Electronic ballast.

The version 3 draws 39.65 watts while delivering a Ballast factor (Lumen factor) of 0.91. Under the new Regulation 245/2009 the basis for assessing ballasts for fluorescent lamps has changed from overall system input power to ballast efficiency. To ascertain the efficiency of electronic ballast, the lamp output power (as taken from the lamp data sheet) is divided by the total input power (derived as per the formula prescribed by CELMA). As per the CELMA guide, the A2BAT value for ballast efficiency for non-dimmable ballast when operating with 40 Watt Rated Wattage lamp (50 Hz and not HF, and not Nominal wattage) is, 89.5% only. Double cap T12 Fluorescent Lamps have been exempted from complying with the said provisions of Ecodesign requirements. **You may note that we used the 40 W Linear Fluorescent Lamp-T12 LFL (this 40 W LFL is 4 feet in length) as the standard reference lamp model for development of our Electronic Ballast Technology**, as this type of LFL is the one which has the biggest market share in the Indian lighting market. This a cold cathode type of lamp, **and even with this lamp, the ballast efficiency value of version 3 is nearly 96%, thus making its Ballast Efficiency much above the requirements of the A2BAT**. Needless to say, the circuits of all the 3 versions can be "fine tuned" (by just adjusting the values of the components and coils in the circuitry) for compatible operation with all different types / wattage of LFL in the international market, with high Ballast Efficiency and ideal performance results.

Taking these considerations, the ballast efficiency for A2BAT is met by version 1 too with value at 91%.**Ballast Efficiency will be much higher with a HE/HO Lamp**. Lumen factor requirement is only 0.9 as per the international standards, and as detailed above, and if so desired, all these 3 versions can be just fine tuned for that lumen output; with reduced input power. This naturally increases the ballast efficiency factor and can be set at the desired level.

The calculation regarding the A2BAT is given below in a chart form for all the three versions of our Electronic Ballast Technology. Note that the versions 1 and 3 have higher Ballast Efficiency values. The circuits of these two versions are similar and version 3 has just been fine tuned for higher efficiency in comparison to version 1. Version 2 circuit is different from these two, and that has also been developed as an option to cater to all possible evolutions from the basic circuit.

	Version 1	Version 2	Version 3
$P_{tot.meas}$	44.8	44.66	39.65
P_{Lnom}	40	40	40
$P_{Lref.meas}$	41.5 - 42 w	41.5 - 42 w	41.5 - 42 w
$Light_{ref}$	2318 lux	2318 lux	2318 lux
$Light_{test}$	2250 lux	2140 lux	2110 lux
$P_{tot.ref}$	44.436 - 43.929	46.577 - 46.045	41.924 - 41.445
$n_{ballast}$ $\{P_{Lnom} / P_{tot.ref}\}$	0.90 - 0.91	0.858 - 0.868	0.954 - 0.965
Ballast Efficiency Expressed in %	90 - 91%	85.8 - 86.8%	95.4 - 96.5%

Ballast Efficiency is only one parameter for evaluating a ballast technology as energy efficient. *Other parameters of performance for **High Performance Electronic Ballast** like constant light output, re-strike after lamp change, repeated starting, harmonics, ballast factor, total cost etc are basic parameters that are critical to evaluate the performance of an electronic ballast, and those are easily met by our ballast technology, and substantiated by its performance results and compliance to the parameters of the standards.* Compliance to re-strike after lamp change is substantiated by the test “The lamp is not inserted” and “The lamp does not start because one of the cathodes is broken” of “Abnormal conditions” testing, and as mentioned above, the ballast operate the lamp when it’s reconnected to it without any line re-switch on. Any ballast that withstands the “Mains transient over voltage test” without any sort of flicker or damage naturally is not affected by innumerable number of starting.

Over and above the specifications that are distinctive de-markers listed herein, feature like much lower starting voltage than rated voltage, high ballast efficacy factor, high ballast efficiency etc are there for our ballast technology than most of the latest ones, and the test results and details provided at our website and blog substantiate the same.

Cost aspects and universal technology application:

The cost and scalability of the technology are also critical parameters that separate our ballast technology from that of the contemporaries.

Technology has been developed with minimum number of components to make the product totally cost-effective, and to reduce the component failure rate. **The cost of the components as in the prototype (including the PCB) for a single Electronic Ballast is well within 2.5 -2.75 US Dollars**. This cost is computed on the basis of the components cost as in the Indian retail market. The cost of the product would further be reduced with "economies of scale" in manufacturing. Most of the contemporary ballasts with much fewer product qualities have product manufacturing cost much above these figures.

Versatility of the technology is to be understood to realize its full potential. The circuits of all the three versions of the electronic ballast technology have only a few minor variations among them, and their wattages can be fine-tuned as desired, by just adjusting the values of the coils and components in their circuits; based on the specifications of the lamp the ballast is operating. Note that the three versions of the technology are with similar key features, but yet deliver varied test results as evident from the BMI snap shots and test results, shows the versatility of the circuits, all the while maintaining the common DNA when it comes to critical performance features and results, and this by itself demonstrates the scalability of the circuits and their integrity.

As the principle of operation of Linear Fluorescent Lamps are the same irrespective of the wattage, this Electronic Ballast Technology developed for perfectly compatible operation with one wattage and operating voltage of LFL can be "fine tuned" or directly "customized" in a cost effective manner (by just adjusting the values of the components and coils in the circuitry) with ideal performance results, for perfectly compatible operation with all the different wattages of LFL's, and different input line voltages as in use around the world.

This is easily possible as the 3 versions of ballast technology uses “non-preheat starting mode”, and its starting parameters of “open circuit voltage”, “impedance current” and “cathode current” values are ideal as per the specifications of the lamp it operates. Deliverance of the ideal parameters of starting condition is the key to perfectly match the ballast technology with the specifications of the lamp it operates with. The scalability of our ballast technology for ideal operation with the entire range of LFL is evident from the fact that the different versions of our ballast circuits have different values for the parameters of starting conditions, and all these values are in accordance with the specifications of the lamp they are operating with. Hence the technology has a global perspective.

Naturally, the buyer of technology can file independent patents in their names directly for all the so "fine tuned" wattages of electronic ballast technologies that are based on these circuitry, in all countries of choice, based on their marketing requirement. The manufacturers entire requirements from this product segment is so covered.

Technology has all-round superior performance in respect of the general specifications from that of the contemporaries available in the international lighting market. From the few parameters detailed above, the novelty of the design is self substantiated, and that by itself ensures unprecedented global marketability beyond the geographical confines of any continent.

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