

## APPENDIX 4.4 A: LOAD-SHED BALLAST SPECIFICATION

### Revised Draft Performance Specification - Loadshed Ballasts

#### Operational definition of loadshed

- What:** A ballast specification for reducing power demand by dimming fluorescent lighting (T-8 lamps) from a centralized point of control.
- Why:** To manage load on the electrical grid. Used by electricity suppliers/grid operators as a substitute for power generating resources in times of critical peak system demand, and for managing demand at any time for more efficient system operation and risk avoidance.
- How:** Dimming and/or switching T-8 fluorescent lamps to reduce luminaire power input by 33% or 50%, and aggregating those loads via a building-wide signaling system. There are two scenarios for control of dimming:
- Scenario 1. Dimming is controlled by the electricity supplier/grid operator via remote signaling and distributed automatically to the luminaires (i.e., ballasts). Dimming times and payments are determined through negotiated contracts between the utility/grid operator and electricity customers. Payments to customers are based on minimizing the customer's electric demand while reducing operating risk for utility/grid operator.
- Scenario 2. Dimming is controlled by the building owner/manager and used as a load management resource to limit peak electrical demand, resulting in lower electrical demand charges. An automated system that tracks electrical demand and initiates load shedding is envisioned.
- When:** As needed up to a maximum of 100 hours per year of lamp operating time.
- Where:** The technology is applicable to all C/I applications except where light-dependent critical tasks or processes are conducted (e.g., hospital operating rooms)

## Loadshed Ballast Specifications

### Non-loadshed condition

The loadshed ballast, operating under non-loadshed conditions, shall perform equally well, in terms of energy efficiency and reliability, as the popular instant-start ballasts that now dominate the fluorescent lighting market. A loadshed ballast must meet or exceed most existing ballast performance specifications so that it can be installed everywhere where traditional ballasts are installed.

<b>Ballast type</b>	Any (e.g., instant start, programmed start)	
<b>Ballast factor</b>	0.88 (nominally 180 mA high frequency operation)	
<b>Power factor:</b>	> 0.9	
<b>THD:</b>	< 20% (ANSI definition)	
<b>Ballast efficiency factor:</b>	2-Lamp > 1.48 3-Lamp > 1.00	} <i>Matching that of standard</i>
<b>Loadshed condition</b>		
<b>Input power</b>	Reduce operating power by 33% <b>or</b> 50%	
<b>Ballast efficiency factor</b>	2-Lamp > 1.35 3-Lamp > 0.92	} <i>Maintain efficiency when dimmed comparable to standard dimming ballasts</i>
<b>THD:</b>	< 32% relative to the fundamental (60 Hz) input current.	

### Loadshed Signal

The signal to loadshed originates at the electricity supplier/grid operator, or within the building depending on the control scenario. Signals originating outside the building are distributed to building by various established means (e.g., internet, telephone modem), which are not covered in this specification. Once inside the building, the signal is distributed to a network of Ballast

Control Modules, that in turn, distribute the signal to individual ballasts. The ballast contains circuitry to decode the signal from the Ballast Control Module and to dim or switch the lamps upon command.

### Ballast Control Module

<b>Inputs</b>	at least 1 (receiving load shed signal from primary control center within building)
<b>Outputs</b>	PLC signal covering at least 10,000 sq. ft. of building space
<b>Refresh rate of signal to ballasts</b>	at least once every 10 minutes (perhaps continuous signal during load shedding)
<b>Default state signal</b>	non-loadshed (full light output)

The method of distribution of the loadshed signal inside a building to the Ballast Control Modules is yet to be determined, but it seems probable that an existing building automation protocol using twisted pair wiring could be used.

### Ballast characteristics

<b>Starting of lamps</b>	Lamps always start at full power levels
<b>Response time (Dim/switch and restore)</b>	< 1 minute after receiving signal

The physical nature of the PLC signal and encoding scheme are yet to be determined. A PLC signaling scheme from the Ballast Control Module to the individual ballasts seems most promising based on current knowledge. An example of the signaling scheme might be frequency shift keying (FSK) at 42 and 52 kHz, encoding an alternating sequence of ones and zeros for either analog or digital decoding circuitry.