T8/ES

HIGH FREQUENCY ELECTRONIC BALLASTS

For 25W - 48" Lamps

HIGH POWER FACTOR   SOUND RATED A

No. of Lamps	Input Volts	Lamp Starting Method	Ballast Family	Catalog Number	Input Power ANSI (Watts)	Ballast Factor	Max. THD %	Line Current (Amps)	Min. Starting Temp. (°F/°C)	Dim.	Wiring Dia.
F32T8/ES (25W - 48")											
1	120-277	IS	Optanium	IOP-1P32-LW-SC	21	0.77	10	0.17-0.07	60/16	B	63
				IOP-1P32-SC	23	0.87	10	0.20-0.09			
				IOP-1P32-HL-SC	32	1.21	10	0.26-0.12			
				IOP-2P32-LW-SC	24	0.90	10	0.20-0.09			*64
				IOP-2P32-SC	27	1.05	10	0.23-0.10			
				IOP-2P32-HL-SC	37	1.40	15	0.31-0.14			
		PS		IOP-1S32-LW-SC	21	0.72	10	0.17-0.07			20
				IOP-1S32-SC	24	0.88	10	0.20-0.08			
				IOP-2S32-LW-SC	21	0.73	10	0.17-0.08			39
				IOP-2S32-SC	24	0.89	10-15	0.20-0.09			
2	120-277	IS	Optanium	IOP-2P32-LW-SC	38	0.77	10	0.32-0.14	60/16	B	64
				IOP-2P32-SC	44-43	0.87	10	0.37-0.06			
				IOP-2P32-HL-SC	60	1.19	10	0.50-0.22			
				IOP-3P32-LW-SC	43	0.86	10	0.36-0.16			*65
				IOP-3P32-SC	49	1.00	10	0.42-0.18			
				IOP-3P32-HL-90C-SC	70	1.32	10-20	0.59-0.27			
		PS		IOP-2S32-LW-SC	39-38	0.71	10	0.32-0.14			21
				IOP-2S32-SC	45-44	0.88	10	0.38-0.16			
3	120-277	IS	Optanium	IOP-3P32-LW-SC	58-57	0.77	10	0.49-0.21	60/16	B	65
				IOP-3P32-SC	65-64	0.87	10	0.55-0.24			
				IOP-3P32-HL-90C-SC	95-93	1.20	10	0.79-0.35			
				IOP-4P32-LW-SC	62-61	0.85	10	0.52-0.22			*66
				IOP-4P32-SC	70-69	0.97	10	0.59-0.26			
				IOP-4P32-HL-90C-G	101-100	1.27	10	0.85-0.37		G	
		PS		IOP-3S32-LW-SC	57-56	0.71	10	0.48-0.21		B	30
				IOP-3S32-SC	67-66	0.89	10	0.56-0.25			
4	120-277	IS	Optanium	IOP-4P32-LW-SC	77-75	0.77	10	0.65-0.28	60/16	B	66
				IOP-4P32-SC	87-85	0.87	10	0.73-0.31			
				IOP-4P32-HL-90C-G	124-122	1.19	10	1.05-0.45		G	
		PS		IOP-4S32-LW-SC	74-73	0.71	10	0.62-0.27		B	138
				IOP-4S32-SC	87-85	0.87	10	0.73-0.31			

Note: The use of Optanium (IOP) models is recommended to reduce striation in energy-saving T8 lamps (25W, 28W, or 30W). Remote or tandem wiring of energy-saving T8 lamps (25W, 28W or 30W) is only recommended for Optanium (IOP) models.

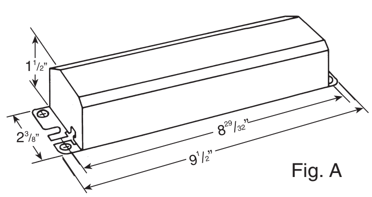


Fig. A

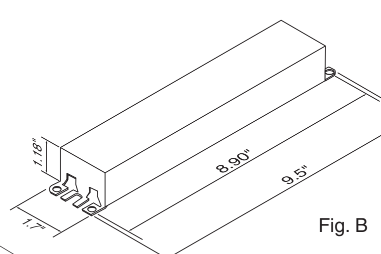


Fig. B

See page 1-57 for Wiring Diagrams

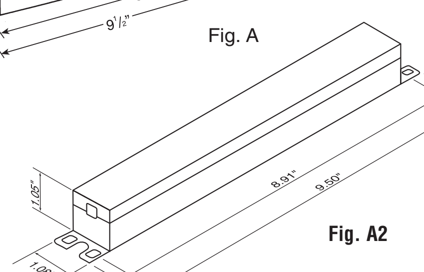


Fig. A2

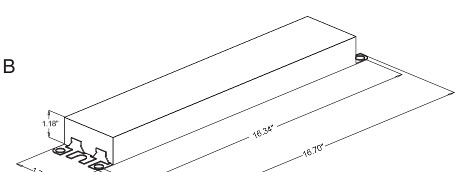


Fig. G

Refer to pages 8-24 to 8-30 for lead lengths and shipping data

T8/ES

For 28W - 48" Lamps

HIGH POWER FACTOR SOUND RATED A

No. of Lamps	Input Volts	Lamp Starting Method	Ballast Family	Catalog Number	Input Power ANSI (Watts)	Ballast Factor	Max. THD %	Line Current (Amps)	Min. Starting Temp. (°F/°C)	Dim.	Wiring Dia.
F32T8/ES (28W - 48")											
1	120-277	IS	Optanium	IOP-1P32-LW-SC	22	0.77	10	0.19-0.08	60/16	B	63
				IOP-1P32-SC	25	0.87	10	0.22-0.10			
				IOP-1P32-HL-SC	33	1.21	10	0.28-0.12			
				IOP-2P32-LW-SC	26	0.90	10	0.22-0.10			*64
				IOP-2P32-SC	31	1.05	10	0.26-0.11			
				IOP-2P32-HL-SC	39	1.38	10	0.33-0.15			
		PS		IOP-1S32-LW-SC	21	0.72	10	0.18-0.07			20
				IOP-1S32-SC	25	0.88	10	0.20-0.09			
				IOP-2S32-LW-SC	22	0.73	10	0.18-0.08			39
				IOP-2S32-SC	26	0.88	10-15	0.21-0.09			
2	120-277	IS	Optanium	IOP-2P32-LW-SC	42	0.77	10	0.35-0.15	60/16	B	64
				IOP-2P32-SC	48-47	0.87	10	0.41-0.18			
				IOP-2P32-HL-SC	65-64	1.19	10	0.55-0.24			
				IOP-3P32-LW-SC	47	0.86	10	0.40-0.18			*65
				IOP-3P32-SC	55-54	1.00	10	0.46-0.20			
				IOP-3P32-HL-90C-SC	74-73	1.31	10-15	0.62-0.27			
		PS		IOP-2S32-LW-SC	41-40	0.71	10	0.34-0.15			21
				IOP-2S32-SC	49-48	0.88	10	0.41-0.18			
3	120-277	IS	Optanium	IOP-3P32-LW-SC	64-63	0.77	10	0.54-0.23	60/16	B	65
				IOP-3P32-SC	72-71	0.87	10	0.61-0.26			
				IOP-3P32-HL-90C-SC	99-97	1.20	10	0.83-0.36			
				IOP-4P32-LW-SC	69-68	0.85	10	0.58-0.25			*66
				IOP-4P32-SC	79-78	0.97	10	0.66-0.28			
				IOP-4P32-HL-90C-G	107-106	1.24	10	0.90-0.39		G	
		PS		IOP-3S32-LW-SC	62-61	0.71	10	0.51-0.22		B	30
				IOP-3S32-SC	72-71	0.89	10	0.60-0.26			
4	120-277	IS	Optanium	IOP-4P32-LW-SC	84-82	0.77	10	0.71-0.30	60/16	B	66
				IOP-4P32-SC	96-94	0.87	10	0.81-0.35			
				IOP-4P32-HL-90C-G	130-129	1.19	10	1.10-0.47		G	
		PS		IOP-4S32-LW-SC	80-79	0.71	10	0.67-0.29		B	138
				IOP-4S32-SC	97-96	0.88	10	0.82-0.35			

Note: The use of Optanium (IOP) models is recommended to reduce striation in energy-saving T8 lamps (25W, 28W, or 30W). Remote or tandem wiring of energy-saving T8 lamps (25W, 28W or 30W) is only recommended for Optanium (IOP) models.

See page 1-52 for Dimensions
See page 1-57 for Wiring Diagrams

Refer to pages 8-24 to 8-30 for lead lengths and shipping data

T8/ES

HIGH FREQUENCY ELECTRONIC BALLASTS

For 30W - 48" Lamps

HIGH POWER FACTOR SOUND RATED A

No. of Lamps	Input Volts	Lamp Starting Method	Ballast Family	Catalog Number	Input Power ANSI (Watts)	Ballast Factor	Max. THD %	Line Current (Amps)	Min. Starting Temp. (°F/°C)	Dim.	Wiring Dia.
F32T8/ES (30W - 48")											
1	120	IS	Standard	REL-1P32-SC	29	0.92	20	0.25	60/16	B	63
				REL-1P32-HL-SC	39	1.20	20	0.33			
				REL-2P32-SC	35	1.10	25	0.31			*64
				REL-2P32-HL-SC	45	1.41	20	0.38			
		PS	Centium	RCN-1S32-SC	32	0.90	10	0.27			20
	277	IS	Standard	VEL-1P32-SC	29	0.92	20	0.11	60/16	B	63
				VEL-1P32-HL-SC	39	1.20	20	0.14			
				VEL-2P32-SC	35	1.10	25	0.13			*64
				VEL-2P32-HL-SC	45	1.41	20	0.17			
		PS	Centium	VCN-1S32-SC	32	0.90	10	0.12			20
	120-277	IS	Centium	ICN-132-MC	27	0.88	10	0.23-0.10	60/16	A2	63
				ICN-1P32-LW-SC	25	0.77	10	0.21-0.09		B	
				ICN-1P32-SC	29	0.90	10	0.24-0.11			
				ICN-2P32-LW-SC	29-28	0.85	15-20	0.24-0.11			*64
				ICN-2P32-SC	33	1.03	10	0.28-0.12			
			Optanium	IOP-1P32-LW-SC	24	0.77	10	0.20-0.09			63
				IOP-1P32-SC	27	0.87	10	0.23-0.10			
				IOP-1P32-HL-SC	37-36	1.20	10	0.31-0.13			
				IOP-2P32-LW-SC	28	0.90	10	0.24-0.10			*64
				IOP-2P32-SC	33	1.05	10	0.28-0.12			
				IOP-2P32-HL-SC	42	1.38	10	0.35-0.16			
		PS		IOP-1S32-LW-SC	23	0.72	10	0.19-0.08			20
				IOP-1S32-SC	27	0.88	10	0.22-0.10			
				IOP-2S32-LW-SC	24-23	0.73	10	0.20-0.09			39
				IOP-2S32-SC	27	0.90	10	0.23-0.10			
			Mark 5	IIC-132-SC	30	0.88	10	0.26-0.11			20
	347	IS	Standard	GEL-1P32-SC	32	0.87	20	0.10	60/16	B	63
				GEL-2P32-SC	36	1.10	20	0.10			*64
			Centium	GCN-1P32-SC	32	0.87	10	0.10			63
				GCN-2P32-SC	37	0.91	10	0.11			*64
		RS		GCN-1S32	32	0.90	10	0.09		A	20

Note: The use of Optanium (IOP) models is recommended to reduce striation in energy-saving T8 lamps (25W, 28W, or 30W). Remote or tandem wiring of energy-saving T8 lamps (25W, 28W or 30W) is only recommended for Optanium (IOP) models.

See page 1-52 for Dimensions
See page 1-57 for Wiring Diagrams

Refer to pages 8-24 to 8-30 for lead lengths and shipping data

ADVANCE, 10275 WEST HIGGINS ROAD, ROSEMONT, IL 60018. TEL: (847) 390-5000, FAX: (847) 390-5109

HIGH FREQUENCY ELECTRONIC BALLASTS

For 30W - 48" Lamps

HIGH POWER FACTOR   SOUND RATED A

No. of Lamps	Input Volts	Lamp Starting Method	Ballast Family	Catalog Number	Input Power ANSI (Watts)	Ballast Factor	Max. THD %	Line Current (Amps)	Min. Starting Temp. (°F/°C)	Dim.	Wiring Dia.
F32T8/ES (30W - 48")											
2	120	IS	Standard	REL-2P32-SC	54	0.87	20	0.46	60/16	B	64
				REL-2P32-HL-SC	72	1.20	20	0.60			
				REL-3P32-SC	61	1.03	20	0.51			*65
				REL-3P32-HL-SC	80	1.32	20	0.67			
		PS	Centium	RCN-2S32-SC	60	0.88	10	0.51			21
	277	IS	Standard	VEL-2P32-SC	54	0.87	20	0.20	60/16	B	64
				VEL-2P32-HL-SC	72	1.20	20	0.26			
				VEL-3P32-SC	61	1.03	20	0.22			*65
				VEL-3P32-HL-SC	80	1.32	20	0.29			
		PS	Centium	VCN-2S32-SC	60	0.88	10	0.22			21
	120-277	IS	Centium	ICN-2M32-MC	54	0.88	10	0.45-0.20	60/16	A2	64
				ICN-2P32-LW-SC	47-46	0.77	10	0.39-0.17		B	
				ICN-2P32-SC	54	0.88	10	0.45-0.20			
				ICN-3P32-LW-SC	52	0.83	10	0.44-0.19			*65
				ICN-3P32-SC	61	1.01	10	0.51-0.22			
			Optanium	IOP-2P32-LW-SC	45	0.77	10	0.38-0.17			*65
				IOP-2P32-SC	52-51	0.87	10	0.44-0.19			
				IOP-2P32-HL-SC	72-70	1.19	10	0.60-0.26			
				IOP-3P32-LW-SC	51	0.85	10	0.43-0.19			64
				IOP-3P32-SC	59-58	1.00	10	0.50-0.21			
				IOP-3P32-HL-90C-SC	78-77	1.31	10	0.65-0.29			
		PS		IOP-2S32-LW-SC	44-43	0.71	10	0.36-0.16			*65
				IOP-2S32-SC	52	0.88	10	0.44-0.19			
			Mark 5	IIC-2S32-SC	57	0.88	10	0.49-0.21			
	347	IS	Standard	GEL-2P32-LW-RH-TP	49	0.76	20	0.14	60/16	A	64
				GEL-2P32-SC	56	0.88	20	0.17		B	
				GEL-3P32-SC	62	0.98	20	0.20			*65
		RS		GEL-2S32-RH-TP	62	0.89	20	0.18		A	21
		IS	Centium	GCN-2P32	59	0.87	10	0.18		B	64
				GCN-3P32	62	0.98	10	0.20			*65
		RS		GCN-2S32	60	0.90	10	0.17		A	21

Note: The use of Optanium (IOP) models is recommended to reduce striation in energy-saving T8 lamps (25W, 28W, or 30W). Remote or tandem wiring of energy-saving T8 lamps (25W, 28W or 30W) is only recommended for Optanium (IOP) models.

See page 1-52 for Dimensions
See page 1-57 for Wiring Diagrams

Refer to pages 8-24 to 8-30 for lead lengths and shipping data

Electronic Ballast Fundamentals

The job of a ballast

In all fluorescent lighting systems, the ballast's basic tasks include:

• Providing the proper voltage to establish an arc between the two electrodes.

• Regulating the electric current flowing through the lamp to stabilize light output.

In some fluorescent lighting systems, the ballast also provides a controlled amount of electrical energy to preheat or maintain the temperature of the lamp electrodes at levels specified by the manufacturer. This is required to prevent electrode filaments deteriorating prematurely and shortening the lamp life.

Starting Methods

For many years there were only three types of lighting systems: preheat, rapid start and slimline instant start. With the introduction of electronic ballasts, two additional types of lighting system circuits have been added: instant start for T8 lamps and programmed start. Each requires a special ballast design to operate the lamps in the circuit properly.

Instant start electronic ballasts start lamps without delay (<0.1 seconds) or flicker by providing a starting voltage that is sufficiently high to start a discharge through the lamps without the need for heating lamp electrodes. For F32T8 systems, the starting voltage is about 600V. The elimination of electrode heating maximizes energy savings – typically saving two watts per lamp compared to rapid start ballasts. Instant start ballasts are best suited for applications with limited switches each day. Lamps operated by instant start ballasts typically operate 10,000 to 15,000 switch cycles before failure.

Rapid start electronic ballasts start lamps quickly (0.5 – 1.0 seconds) without flicker by heating the lamp electrodes and simultaneously applying a starting voltage. The starting voltage of about 500V for F32T8 systems is sufficient to start a discharge through the lamps when the electrodes have reached an adequate temperature. Electrode heating continues during operation and typically consumes two watts per lamp. Lamps operated by rapid start ballasts typically operate 15,000 to 20,000 switch cycles before failure.

Programmed start electronic ballasts also start lamps quickly (1.0 -1.5 seconds) without flicker. Programmed start ballasts are designed to provide maximum lamp life in frequent lamp starting applications such as in areas where occupancy sensor controls are used. Programmed start electronic ballasts precisely heat the lamp electrodes, tightly controlling the preheat duration before applying the starting voltage. This enhancement over rapid start ballasts minimizes electrode stress and depletion of emitter material, thereby maximizing lamp life. Lamps operated by programmed start ballasts typically operate up to 50,000 switch cycles before failure.

Circuits

Series vs. Parallel. Lighting systems are typically wired in a series or parallel circuit. When a ballast is operating multiple lamps in a series circuit, if one lamp fails, the circuit is opened and all the lamps will extinguish. When a ballast operates multiple lamps in a parallel circuit, the lamps operate independently of each other so, if one lamp fails, the others can keep operating as the circuit between them and the ballast remains unbroken.

As a general rule, rapid start ballasts are wired with the lamps in series. Programmed start ballasts are also typically wired with lamps in series. However, some three- and four-lamp ballasts feature series-parallel operation; so that when a single lamp in one branch fails, the lamp(s) in the parallel branch will continue to operate. Instant start ballasts are typically wired with the lamps in parallel.

The Language of Ballasts

Input Voltage (dedicated vs. multi). Most ballasts are designed to operate at specific voltages. Newer electronic ballasts, including Advance models that use IntelliVolt® technology, offer much greater flexibility and other advantages such as inventory reduction. Today's increasing demands on electrical utilities can cause wide voltage variations during load demand changes which in turn cause light output from lamps operated on dedicated electronic and electromagnetic ballasts to vary with the input voltage changes. With IntelliVolt technology, many Advance ballasts maintain constant light output through nominal input voltage ranges of 120 to 277 volts, thereby compensating for any change in input voltage.Some ballasts operate from 277 to 480 volts or 347 to 480 volts.

Input Watts/ANSI Watts. Input watts published by ballast manufacturers are the total watts consumed by both the ballast and the lamps it operates. ANSI watts are the rating given for a ballast measured under the strict testing procedures specified by ANSI standards and are the only dependable measure of this performance. Energy savings can be determined by comparing the input watts of different lighting systems.

Input watts may be affected by tolerance build-up from the ballast, lamp, input voltage and ambient temperature. The input watts published in this catalog are for nominal conditions only.

Ballast Factor (BF) is the ratio of light output from a lamp operated on a commercial ballast to the light output of that same lamp operated on a "reference ballast" as specified by ANSI standards. Light output ratings published by lamp manufacturers, are based on this "reference ballast".

$$\text{BF} = \frac{\text{light output of lamp operated on commercial ballast}}{\text{light output of lamp operated on reference ballast}}$$

BF is a measure of light output best thought of as a 'multiplier'. Multiplying the BF times rated lumens will determine actual light output of a given system operated on commercial ballasts.

Ballast Efficacy Factor (BEF) is the ratio of ballast factor to input watts. This measurement is generally used to compare the efficiency of various lighting systems – higher numbers being more efficient.

$$\text{Ballast Efficacy Factor} = \frac{\text{Ballast Factor x 100}}{\text{Input Watts}}$$

This comparison is only valid, however, for ballasts operating the same number and type of lamps. In order to compare different types of lighting systems, the lumen output of the lamps must also be used. For more information, see "The ABC's of Electronic Fluorescent Ballasts".

ADVANCE, 10275 WEST HIGGINS ROAD, ROSEMONT, IL 60018. TEL: (847) 390-5000, FAX: (847) 390-5109

Power Factor (PF) is the measurement of how effectively a ballast converts the voltage and current supplied by the power source into watts of usable power delivered to the ballast and lamps. Perfect power utilization would result in a power factor of one.

$$PF = \frac{\text{Input Watts}}{\text{Input Current x Input Voltage}}$$

A ballast's power factor may be classified under any one of the following categories:

High Power Factor (HPF)	0.90 or greater
Power Factor Corrected (PFC)	0.80 to 0.89
Normal (Low) Power Factor (NPF)	0.79 or less

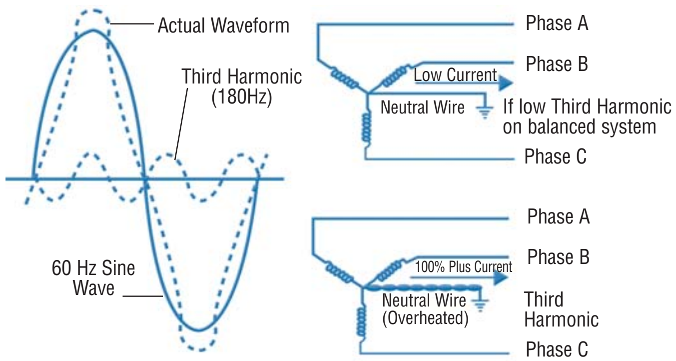
Power factor measurements pertain only to the effective use of power supplied to the ballast. They are not an indication of the ballast's ability to supply light through the lamps. Because low power factor ballasts require about twice the current needed by high power factor ballasts, they allow fewer fixtures per circuit and create added wiring costs. High power factor ballasts are generally specified for all commercial lighting applications.

EMI/RFI. Because they operate at high frequency, electronic ballasts may produce electromagnetic interference (EMI) or radio frequency interference (RFI). RFI frequencies are a subset of EMI frequencies. EMI issues cover all possible operating frequencies while RFI is only concerned with radio and television frequencies. This interference could affect the operation of sensitive electrical equipment, such as radios, televisions or medical equipment. All Advance electronic ballasts incorporate features necessary to afford maximum protection for the operating environment and operate well within regulatory limits. For more information, see "The ABC's of Electronic Fluorescent Ballasts".

Ballast Noise. The slight "humming" sound associated with fluorescent lighting systems results from vibration caused by the inherent electromagnetic action in the core-and-coil assembly of the ballasts. All electromagnetic and some electronic ballasts make this sound. Ballasts are assigned a sound rating, "A" through "F", based on the amount of sound produced, with "A" being the quietest. Generally, the larger the lamp and ballast, the higher the sound level and the sound rating will be. Because electronic ballasts have smaller components, they have the lowest sound rating. Some electronic ballasts make almost no sound. There is no ANSI standard for this rating and it is left up to the manufacturer to rate their ballasts.

Inrush Current. All electrical devices including ballasts have an initial current surge that is greater than their steady-state operating current. A new standard published by the National Electrical Manufacturers Association (NEMA) – NEMA 410 – Performance Testing for Lighting Controls and Switching Devices with Electronic Fluorescent Ballasts – covers worst-case ballast inrush currents. All circuit breakers and light switches are designed for inrush currents. The electrical system should be designed with this issue in mind.

Total Harmonic Distortion (THD). Harmonic distortion occurs when the wave-shape of current or voltage varies from a pure sine wave. Except for a simple resistor, all electronic devices, including electromagnetic and electronic ballasts, contribute to power-line distortion. For ballasts, THD is generally considered the percent of harmonic current the ballast adds to the power distribution system. The ANSI standard for electronic ballasts specifies a maximum THD of 32% for commercial applications.. However, most electric utilities now require that the THD of electronic ballasts be 20% or less. Almost all Advance electronic ballasts are rated for either less than 20% THD or less than 10% THD.



Indicates ballast is listed with Underwriters Laboratories, Inc. and complies with UL935 Standard for Fluorescent Lamp Ballasts (File No. E14927).

Visit www.ul.com to find a current listing of Advance ballasts under File No. E14927.

Indicates ballast is certified by Canadian Standards Association and complies with CSA C22.2 No. 74 Standard for Fluorescent Lamp Ballasts (File No. 007310)

Visit www.csa.ca to find current listing of Advance ballasts under File No. 007310.

Normal Input Voltage	Catalog Number Prefix Code	Label Color Coding
120V	R	Yellow
277V	V	Red
347V	G	Grey
120V to 277V	I	Blue
277V to 480V	J	Brown
347V to 480V	H	Purple

Total Harmonic Current

Non-Dimming Applications

When selecting a ballast for a lighting application, the Total Harmonic Current (THC) rating of the ballast is more significant than Total Harmonic Distortion (THD). This is because the absolute value of harmonic current, not the percentage, affects the electrical power distribution system. As can been seen in the table on page 1-12, the THC rating of our *Standard* 2-lamp electronic T8 lamp ballast is well below that of both the conventional and energy-saving magnetic T12 lamp ballasts it replaces. Moreover, the THC rating of our *Centium* electronic ballast is even lower.

Dimming Applications

Mark 7® 0-10V and ROVR

Traditional low voltage controlled ballasts and ROVR™ typically produce less than 10% THD at full light output and less than 20% THD throughout the entire dimming range, but require extra wires for the control circuit. THC is always lower than that of the conventional or energy-saving magnetic system.

Mark 10® Powerline

Mark *10® Powerline* electronic dimming ballasts are controlled by 2-wire modified powerline phase-cut style line voltage dimmers. Whenever the ballast is dimmed, the input voltage is cut or "chopped", causing the THD and THC to increase and the Power Factor to decrease.

Mark *10® Powerline* electronic dimming systems (ballast and controller) have similar THD and Power Factor levels as the conventional lighting systems they replace. Since a much smaller load is required by the Mark *10® Powerline* electronic dimming system to achieve the same illumination level as a magnetic ballast system (20-30% less), the total input current will be considerably less. As a result, the magnitude of the total harmonic current will be less.

For example, a typical Mark *10® Powerline* electronic ballast and dimmer control might draw a line current of 0.58A at 15% THD at full light output. If the light level is reduced to 5% of the maximum, the input power is decreased to 0.19A at 95% THD. While the THD level may seem alarmingly high at the 5% maximum light output setting, the total harmonic current is still lower (0.13A) than the conventional T12 magnetic system (0.20A). Moreover, the overall heating effect on the wires and the distribution transformer is never higher than the existing conventional or energy saving T12 magnetic systems.[1]

Conclusions

Our analysis demonstrates that a simple ballast retrofit to electronic ballasts *will not* cause harmonic problems if none existed before the retrofit. Also, in new fixture applications, total harmonic distortion should not be a concern when specifying electronic ballasts. Finally, it is important to remember that electronic ballasts are not the greatest source of THD in an electrical distribution system. Other electronic devices such as computers, laser printers, and other electronic equipment can draw current with more than 100% THD in some cases.

Table 1: Comparison of THD and THC Levels

Advance Part No.	Ballast Type	Light Output Setting	Lamp Type	Input Current	% THD	%THC[2]
RQM-2S40-TP	Conventional Magnetic	100% (Ballast Factor is 0.98)	(2) F40T12	0.84A	<25%	**0.20A**
R2S40-TP	Energy Saving Magnetic	100% (Ballast Factor is 0.95)	(2) F34T12	0.63A	<20%	**0.12A**
REL-2P32-SC	*Standard* Electronic	100% (Ballast Factor is 0.88)	(2) F32T8	0.49A	<20%	**0.10A**
ICN-2P32-SC	*Centium* Electronic	100% (Ballast Factor is 0.88)	(2) F32T8	0.49A	<10%	**0.05A**
IZT-2S32-SC + Dimming Control	*Mark 7® 0-10V* Electronic	100% (Ballast Factor is 1.0)	(2) F32T8	0.57A	<10%	**0.05A**
IZT-2S32-SC + Dimming Control	*Mark 7® 0-10V* Electronic	5% (Ballast Factor is 0.05)	(2) F32T8	0.12A	<20%	**0.02A**
REZ-2S32-SC (Ballast Only)	*Mark 10® Powerline* Electronic	100% (Ballast Factor is 1.0)	(2) F32T8	0.58A	<10%	**0.06A**
REZ-2S32-SC + Dimming Control	*Mark 10® Powerline* Ballast + Dimmer	100% (Ballast Factor is 1.0)	(2) F32T8	0.58A	<15%	**0.09A**
REZ-2S32-SC + Dimming Control	*Mark 10® Powerline* Ballast + Dimmer	5% (Ballast Factor is 0.05)	(2) F32T8	0.19A	<95%	**0.13A**

[1] For a more technical study demonstrating that a Mark *10® Powerline* electronic dimming system produces less transformer heating over its entire dimming range than does an energy saving magnetic system that it replaces, see the article *THD in Advance* Mark 10® *Powerline Electronic Dimming Systems* by O.C. Morse. Re: www.advancetransformer.com

[2] The Total Harmonic Current (THC) of a ballast is calculated by the following equation:

$$\frac{\textbf{Ballast Input Current}}{\textbf{Square Root of } (1 + 1/\textbf{THD}^2)}$$

An approximation of THC may be obtained by simply multiplying the ballast input current by %THD.

ADVANCE, 10275 WEST HIGGINS ROAD, ROSEMONT, IL 60018. TEL: (847) 390-5000, FAX: (847) 390-5109

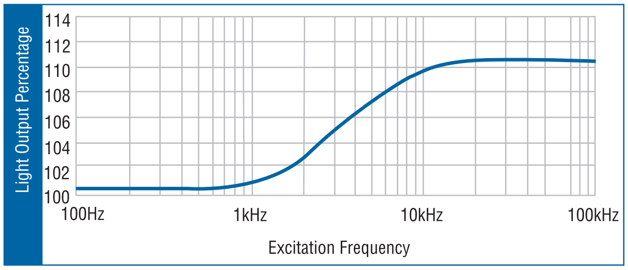
Ballast Life

Advance fluorescent electronic and magnetic ballasts are designed and manufactured to engineering standards correlating to an average life expectancy of 50,000 hours of operation at maximum rated case temperature. Since Advance ballasts operate below their maximum case temperature in the majority of applications, increased ballast life can be expected. As a rule of thumb, ballast life is doubled for every 10°C reduction in ballast case operating temperature. However, there are many variables, such as input voltage, ambient temperature, etc. which affect ballast operating temperatures, and therefore ballast life.

Lamp Operating Frequency

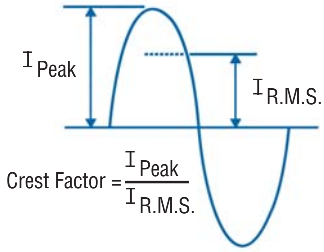
Electromagnetic ballasts and the lamps connected to them operate at an input voltage frequency of 60 Hertz (Hz), 60 cycles per second–which is the standard alternating voltage/current frequency provided in North America. Electronic ballasts, on the other hand, convert this 60 Hz input to operate lamps at much higher frequencies above 20 Kilohertz (kHz), 20,000 cycles per second. Advance designs operate above 20 kHz, but avoid certain ranges such as 30-40 kHz (infrared) and 54-62 kHz (theft deterrent systems) due to interference issues.

Because electronic ballasts function at high frequency, the fluorescent lighting systems that they operate can convert power to light more efficiently than systems operated by electromagnetic ballasts (See Chart Below). For example, lamps operated on electronic ballasts can produce over 10 percent more light then if operated on electromagnetic ballasts at the same power levels. In effect, today's electronic ballasts provide additional energy savings by matching the light output from electromagnetic ballasts while operating the lamps at lower power. This is the main reason why electronic ballast systems are more efficient than magnetic ballast system.



Crest Factor

Lamp manufacturers use crest factor to determine ballast performance as it relates to lamp life. Lamp Current Crest Factor is a measurement of current supplied by a ballast to start and operate the lamp. It is basically the ratio of peak current to RMS (average) current. High crest factor currents may cause the lamp electrodes to wear out faster, reducing lamp life. Crest factor requirements are regulated by ANSI (American National Standards Institute) standards and specified by lamp manufacturers. For rapid start and instant start T8 lamps the ratio is 1.7 maximum, and for instant start slimline lamps, it is 1.85 maximum.



Weight and Size Advantages

Since electronic components in electronic ballasts are smaller and lighter than the core-and-coil assembly in electromagnetic ballasts, electronic ballasts can weigh less than half as much as comparable electromagnetic models. Almost all Advance electronic ballasts have a smaller cross-section than electromagnetic ballasts but maintain the same mounting dimensions. This means that they can fit into all new fixture designs and can be easily retrofitted into existing fluorescent lighting systems.

Controllability

The ability of a building's occupants to control how they light their space is becoming an increasingly important factor for organizations in determining what real estate they will lease, buy or invest in. The ability to dim the lights or easily shut them off completely is a trend fueled not just by a desire to help the environment, but also by significant economic benefits. These benefits include greater energy efficiency – in terms of reduced HVAC costs as well as energy savings for lighting – more comfortable and productive working environments, and compliance with ever tighter energy efficiency regulations. Advance offers three families of electronic controllable ballasts – ROVR™, Mark 7™ *0-10V* and Mark 10™ *Powerline* – that can provide up to 65% energy savings over standard T8 fixed light output systems.

Compatibility With Powerline Carrier Systems

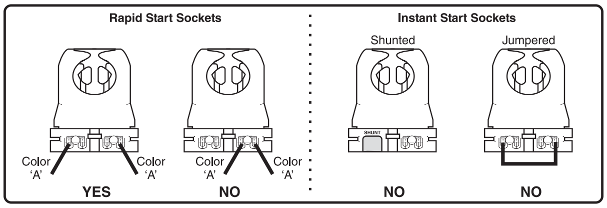
A powerline carrier system (PLC) uses electronic wiring devices to send information via a high frequency signal over the 120V or 277V electrical power distribution system of a building. For example, PLC systems are used in automatic clock systems (master time systems) to synchronize all of the clocks in a building or reset the time after a power outage. They eliminate the need for maintenance personnel to reset hundreds of clocks throughout a facility.

In a PLC system, a generator is used to impose a 1 to 4V high frequency signal on top of the existing voltage sine wave (60 Hz). This signal is generally in the 2500 to 9500Hz range, with some older systems operating at 19,500Hz or higher. Some electronic ballasts which are capacitive can absorb the signal from a PLC system. As a result, the signal becomes too weak to be "heard" by the receiver (like a timeclock) connected to the powerline.

Instant Start vs. Rapid Start Sockets for Dimming

When using dimming ballasts in fixtures, sockets must be of the **RAPID START** type. Many fixtures with T-8 Instant Start electronic ballasts use jumpered or "shunted" Instant Start sockets. Controllable ballasts require two distinctly separate wires for each lamp socket. If you encounter shunted or jumpered sockets in a retrofit application, they must be removed and replaced with Rapid Start sockets.

Improper socket application will damage the ballast and void the ballast warranty. Refer to ballast wiring diagram for proper installation.



Fluorescent Lamp Burn-In

Today, most lamp manufacturers do not require the burn-in of linear fluorescent lamps prior to dimming in order to attain rated lamp life and stable electrical measurements. However, some manufacturers compact fluorescent lamp sources do require a 100 hour burn-in prior to dimming. Consult your lamp manufacturer for their latest requirements.

ORDERING INFORMATION

How to Order

Advance has developed the industry's broadest distribution system for electronic ballasts. More than 3000 stocking distributors nationwide. For information on the distributor best able to serve your needs, please call 800-372-3331 or go to www.advancetransformer.com/distributorsearch.

Corporate Offices
(800) 322-2086

Visit our web site at
www.advancetransformer.com

Customer Support/
Technical Service
(800) 372-3331
+1 (847) 390-5000 (International)

Electronic Ballast Part Number Breakdown

I	CF	-	2	S	26	-	H1	-	LD

CFL Mounting/Connector Options

BL = Bottom leads
BLS = Bottom leads with mounting studs
BS = Bottom mounting studs with single entry color coded connectors
EL = End leads
LD = Length mounting feet with SmartMate® dual entry color coded connectors
LS = Length mounting feet with single entry color coded connectors
QS = QuikStart

Linear Fluorescent Mounting/Connector Options

TP* = Thermal Protected
2LS = 2 Level Switching

CFL Can Desription

H1 = Hybrid metal / plastic case, size 1
L2 = Linear
M1 = Metal case, size 1
M2 = Metal case, size 2
M3 = Metal case, size 3
M4 = Metal case, size 4
M5 = Metal case, size 5
M6 = Metal case, size 6
S1 = Square, style 1
S2 = Square, style 2

Linear Fluorescent Can Desription

90C = 90°C maximum case temperature rating
A = "A" can
D = 'D' can
G = 'G' can
HL = High light output
L = "L" can
LW = Low watt
MC = Micro can
RH* = Reduced harmonics
S = Slimline
SC = Small can

Lamp Watts (Primary lamp)

Wiring Configuration

D = 2D, series
M = Modified parallel**
P = Parallel
Q = Quad CFL, series
S = Series
T = Triple CFL, series
TTS = Long twin tube, series
TTP = Long twin tube, parallel

Maximum Number of Lamps

Family Name

CF = Compact Fluorescent	CN = Centium
DA = ROVR	DL = ROVR
EB = AmbiStar	ELB = AmbiStar
EL = Standard	EZ = Mark 10® *Powerline*
IC = Mark 5®	MB = AmbiStar
OP = Optanium	ZT = Mark 7® *0-10V*

Input Voltage

G = 347V
H = IntelliVolt 347V to 480V 50/60 Hz
I = IntelliVolt 120V to 277V 50/60 Hz
J = IntelliVolt 277V to 480V 50/60 Hz
R = 120V
V = 277V

- Plan your lighting installation carefully; consider using the services of a qualified lighting designer
- Consult your local electric utility regarding demand side management rebate programs.
- Select the Advance electronic ballast which best matches the requirements of your application. The technical specifications in this catalog (located on pages 8-4 to 8-22) will be useful in obtaining bids from electrical contractors.
- Contact your local Advance distributor. You will find them to be a helpful supplier of both products and information.

* Many current and all future electronic ballast part numbers will not use the "RH-TP" suffixes even though these ballasts will be thermally protected.
** Parallel Wiring Configuration. However, if one lamp fails, all other lamps in the circuit will extinguish.

ADVANCE, 10275 WEST HIGGINS ROAD, ROSEMONT, IL 60018. TEL: (847) 390-5000, FAX: (847) 390-5109

GENERIC DCI NUMBER 781087	CATALOG NUMBER (GENERIC)	IC-PACK DCI NUMBER 781087	MID-PACK DCI NUMBER 781087	DISTRIBUTOR COST EACH	VOLUME CODE	DESCRIPTION INDICATES PRIMARY APPLICATION AND IS FOR REFERENCE ONLY. FOR COMPLETE DATA, SEE ADVANCE ATLAS.	IC-PACK MASTER PACK QTY.	MID-PACK STANDARD CARTON QTY.	UNIT WEIGHT
10169	VCN4P32SC	10169	10171	$40.29	B	ELE BALLAST (4) F32T8 277V	10	20	1.0
08774	VCN4S32SC	08774	10393	42.30	B	ELE BALLAST (4) F32T8 277V	10	20	1.4
10673	VEL1P32HLSC	10673	10709	38.13	B	ELE BALLAST (1) F32T8 277V	10	20	1.6
10436	VEL1P32LWSC	10436	10398	29.44	A	ELE BALLAST (1) F32T8 277V	10	20	1.6
08484	VEL1P32SC	08484	08761	29.44	A	ELE BALLAST (1) F32T8 277V	10	20	1.2
11117	VEL1S40SC	11117	11118	32.31	B	ELE BALLAST (1) F40T12 277V	10	20	1.6
07313	VEL1TTS39	07313	08806	43.51	C	ELE BALLAST (1) 36/39W CFL (4-PIN) 277V	10	10	2.4
07253	VEL1TTS40	07253	10154	43.51	C	ELE BALLAST (1) 40W CFL (4-PIN) 277V	10	10	2.4
07222	VEL1TTS50	07222	08655	48.23	C	ELE BALLAST (1) 50W CFL (4-PIN) 277V	10	10	2.4
05204	VEL2P17RHTP	05204	07092	31.46	B	ELE BALLAST (2) F17T8 277V	10	10	2.4
10674	VEL2P32HLSC	10674	10710	38.13	B	ELE BALLAST (2) F32T8 277V	10	20	1.6
10438	VEL2P32LWSC	10438	10403	29.44	A	ELE BALLAST (2) F32T8 277V	10	20	1.6
08485	VEL2P32SC	08485	08762	29.44	A	ELE BALLAST (2) F32T8 277V	10	20	1.2
07268	VEL2P59HL	07268	10906	55.71	B	ELE BALLAST (2) F96T8 277V	6	6	2.75
04882	VEL2P59SRHTP	04882	08653	49.65	B	ELE BALLAST (2) F96T8 277V	10	10	2.75
07267	VEL2P75S	07267	10571	46.86	B	ELE BALLAST (2) F96T12 277V	6	6	4.5
07265	VEL2S110	07265	07333	57.12	B	ELE BALLAST (2) F96T12/HO 277V	6	6	4.5
11119	VEL2S40SC	11119	11120	32.31	B	ELE BALLAST (2) F40T12 277V	10	20	1.6
07263	VEL2S86	07263	07281	81.20	B	ELE BALLAST (2) F96T8/HO 277V	6	6	4.5
07197	VEL2TTS39	07197	08836	43.51	C	ELE BALLAST (2) 36/39W CFL (4-PIN) 277V	10	10	2.4
07199	VEL2TTS40	07199	08807	43.51	C	ELE BALLAST (2) 40W CFL (4-PIN) 277V	10	10	2.4
10362	VEL2TTS40LW	10362	08775	43.51	C	ELE BALLAST (2) 40W CFL (4-PIN) 277V	10	10	2.4
07201	VEL2TTS50	07201	08808	48.23	C	ELE BALLAST (2) 50W CFL (4-PIN) 277V	10	10	2.4
10705	VEL3P32HLSC	10705	10711	42.16	B	ELE BALLAST (3) F32T8 277V	10	10	1.0
10583	VEL3P32LWSC	10583	10585	33.36	A	ELE BALLAST (3) F32T8 277V	10	20	1.4
10183	VEL3P32SC	10183	10185	33.36	A	ELE BALLAST (3) F32T8 277V	10	20	1.0
04905	VEL3S40RHTP	04905	07248	36.35	B	ELE BALLAST (3) F40T12 277V	10	10	2.75
08643	VEL4P322LS	08643	08738	44.91	C	ELE STEP DIMMING BALLAST (4) F32T8 277V	10	10	2.75
10633	VEL4P32LWSC	10633	10635	36.81	A	ELE BALLAST (4) F32T8 277V	10	20	1.4
10187	VEL4P32SC	10187	10189	36.81	A	ELE BALLAST (4) F32T8 277V	10	20	1.0
10979	VEZ132SC	10979	10980	84.95	B	ELE DIMMING BALLAST (1) F32T8 277V	10	20	1.0
11450	VEZ1T42M2BS	-	11451	96.50	B	ELE DIM BALLAST (1) 42W CFL (4-PIN) 277V	-	16	0.75
11455	VEZ1T42M2LD	-	11456	94.40	B	ELE DIM BALLAST (1) 42W CFL (4-PIN) 277V	-	20	0.75
08860	VEZ1TTS40	-	10809	93.56	B	ELE DIM BALLAST (1) 40W CFL (4-PIN) 277V	-	10	1.5
11441	VEZ2Q26M2BS	-	11443	96.50	B	ELE DIM BALLAST (2) 26W CFL (4-PIN) 277V	-	16	0.75
11446	VEZ2Q26M2LD	-	11447	94.40	B	ELE DIM BALLAST (2) 26W CFL (4-PIN) 277V	-	20	0.75
10981	VEZ2S32SC	10981	10982	84.95	B	ELE DIMMING BALLAST (2) F32T8 277V	10	20	1.0
11459	VEZ2T42M3BS	-	11460	96.50	B	ELE DIM BALLAST (2) 42W CFL (4-PIN) 277V	-	16	1.0
11463	VEZ2T42M3LD	-	11646	94.40	B	ELE DIM BALLAST (2) 42W CFL (4-PIN) 277V	-	20	1.0
08689	VEZ2TTS40	-	10813	93.56	B	ELE DIM BALLAST (2) 40W CFL (4-PIN) 277V	-	10	1.5
10698	VEZ3S32SC	10698	10839	93.45	B	ELE DIMMING BALLAST (3) F32T8 277V	10	20	1.4
07140	VIC132	07140	10921	51.45	C	ELE BALLAST (1) F32T8 277V	10	10	1.5
07142	VIC2S32	07142	10922	51.45	C	ELE BALLAST (2) F32T8 277V	10	10	1.5
07144	VIC3S32	07144	10923	55.65	C	ELE BALLAST (3) F32T8 277V	10	10	1.5
11835	VOP2P32LWSC	-	11834	35.52	C	ELE BALLAST (2) F32T8 277V	-	20	1.6
11817	VOP2P32SC	-	11816	35.52	C	ELE BALLAST (2) F32T8 277V	-	20	1.2
11837	VOP3P32LWSC	-	11836	39.44	C	ELE BALLAST (3) F32T8 277V	-	20	1.4
11819	VOP3P32SC	-	11818	39.44	C	ELE BALLAST (3) F32T8 277V	-	20	1.0
11839	VOP4P32LWSC	-	11838	42.89	C	ELE BALLAST (4) F32T8 277V	-	20	1.4
11821	VOP4P32SC	-	11820	42.89	C	ELE BALLAST (4) F32T8 277V	-	20	1.0
07100	VZT132	-	10924	84.95	B	ELE DIMMING BALLAST (1) F32T8	-	10	1.5
08858	VZT1TTS40	-	10824	93.56	B	ELE DIM BALLAST (1) 40W CFL (4-PIN) 277V	-	10	1.5
07102	VZT2S32	07102	10925	84.95	B	ELE DIMMING BALLAST (2) F32T8 277V	10	10	1.5
08686	VZT2TTS40	-	10827	93.56	B	ELE DIM BALLAST (2) 40W CFL (4-PIN) 277V	-	10	1.5
07104	VZT3S32	07104	10926	93.56	B	ELE DIMMING BALLAST (3) F32T8 277V	10	10	1.5
10270	XEL2P32SC	-	10565	43.58	C	ELE BALLAST (2) F32T8 220V	-	20	1.6

NOTES: IC-PACK BALLASTS ARE INDIVIDUALLY PACKAGED CONTAINING A BALLAST WITH STANDARD LEAD LENGTHS.
MASTER PACK QUANTITY IS A BUNDLE OF IC-PACKS.
MID-PACK BALLASTS ARE NOT INDIVIDUALLY PACKAGED AND CONTAIN BALLASTS WITH STANDARD LEAD LENGTHS.
WHEN ORDERING BY CATALOG NUMBER, PLEASE ADD SUFFIX 35I TO DESIGNATE AN IC-PACK OR SUFFIX 35M TO DESIGNATE A MID-PACK EXCEPT FOR KITS WHICH NEED NO SUFFIX.
WHEN ORDERING BY DCI NUMBER, PLEASE USE CORRECT PACKAGING DCI NUMBER REFERENCED ABOVE.

EXAMPLE: REL2P32SC35I OR 08483 DENOTES IC-PACK AND REL2P32SC35M OR 08760 DENOTES MID-PACK.