ELECTRONIC FLUORESCENT BALLASTS

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 below, the THC rating of our Standard 2-lamp electronic T8 lamp ballast (REL-2P32-SC) is well below that of both the conventional (RQM-2S40-TP) and energy-saving magnetic T12 lamp ballasts (R-2S40-TP) 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 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 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 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 not higher than the existing conventional or energy saving T12 magnetic systems.[1]

Conclusions

A simple ballast retrofit to electronic ballasts should 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

Philips 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-N	*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 comparing the a Mark 10 *Powerline* electronic dimming system to an energy saving magnetic system that it replaces, see the article Total Harmonic Distortion in Philips Advance Mark 10 *Powerline* Electronic Dimming Systems by O.C. Morse.

[2] The Total Harmonic Current (THC) of a ballast is calculated by the following equation: An approximation of THC may be obtained by simply multiplying the ballast input current by %THD.

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

ELECTRONIC FLUORESCENT BALLASTS

Ordering Information

How to Order

Philips Lighting 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.

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
QS = QuikStart

Linear Fluorescent Mounting/Connector Options
2LS = 2 Level Switching
SD = Step Dimming

CFL Can Description
H1 = Hybrid metal / plastic case, size 1
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

Linear Fluorescent Can Description
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
N = 'N' can
SC = Small can
T = 'T' Can

Lamp Watts (Primary lamp)

Wiring Configuration

D = 2D, series
M = Modified parallel**
P = Parallel
PSP = Programmed Start 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
DA = ROVR
EB = AmbiStar
EZ = Mark 10® *Powerline*
OP = Optanium
ZT = Mark 7® *0-10V*
CN = Centium
DL = ROVR
ELB = AmbiStar
MB = AmbiStar
UV = PureVolt

Input Voltage

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

Corporate Offices
(800) 322-2086

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

Visit our web site at www.philips.com/advance

- 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 Philips Advance electronic ballast which best matches the requirements of your application. The technical specifications in this catalog (located on pages 9-7 to 9-14) will be useful in obtaining bids from electrical contractors.
- Contact your local Philips Lighting 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.

Remote, Tandem or Through Wiring Distances

Remote Mounting of Electronic Ballasts

Unlike magnetic ballasts, electronic ballasts are limited in remote mounting distance from the lamps they operate. The factors limiting the distance from the electronic ballasts to the lamps are: open circuit voltage as opposed to operating voltage, operating frequency and the lamp operating current.

As the distance from the high frequency electronic ballasts to the lamp increases, so does the capacitance across the lead wire to the lamp. This increase in capacitance is important for two reasons. First, if the capacitance is too high, there will not be sufficient open circuit voltage across the lamp for proper lamp ignition.

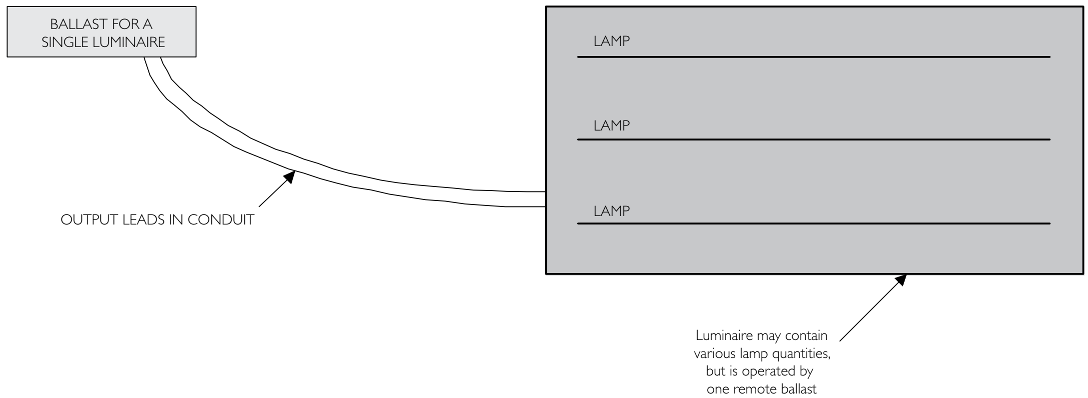
Second, if the lamp is capable of ignition, the increased capacitance will cause a loss in the current to the lamp. The added capacitance creates what is known as a "shunt" around the lamp; in other words the current will leak from the red wire (or blue) to the yellow, completely bypassing the lamp. The current through the lamp will be reduced, resulting in lower lumens, with the possibility that the lamp will not be capable of sustained operation.

The Mark 7 *0-10V*, Mark 10 *Powerline,* PowerSpec HDF, and ROVR dimming ballasts are particularly sensitive to high capacitance associated with long lead wires. The dimming ballast is capable of very low dim levels because constant filament heat is provided to the lamp. If there is any loss of current, the filament current will be reduced and the lamp will begin to flicker, or it will be completely extinguished. It is also important that the red and blue leads not be twisted together. Twisting the red and blue leads will add capacitance, causing the lamp to flicker at the lower dimming levels.

Open circuit voltage is a function of input voltage in some ballast designs, particularly for dedicated voltage ballasts. Cold temperature starting is a function of open circuit voltage. The lead length recommendations in the following table are for normal rated input voltages (120V, 277V, 347V) at 25°C ambient temperature.

In summary, there is a wide range and varying types of electronic ballast architectures that are capable of being remote mounted for an equally wide range of distances. If you are uncertain of the remote mounting restrictions for a particular electronic ballast please consult Philips Lighting Customer Care (Warranty/Technical Service)

Remote Wiring



Note: Recommended output lead lengths and remote mounting distances should not be exceeded.

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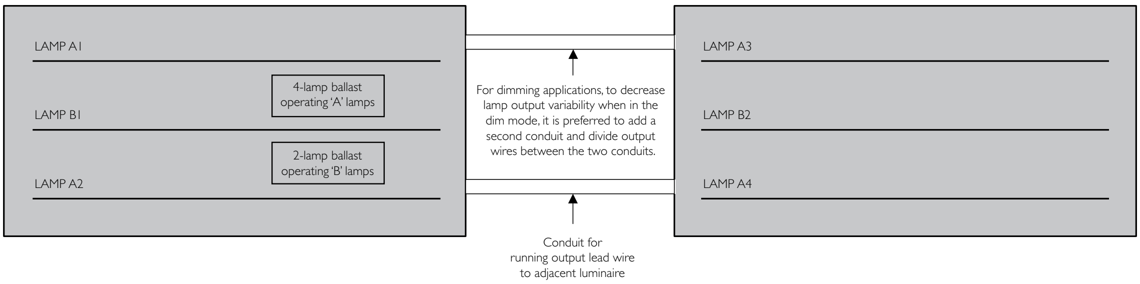
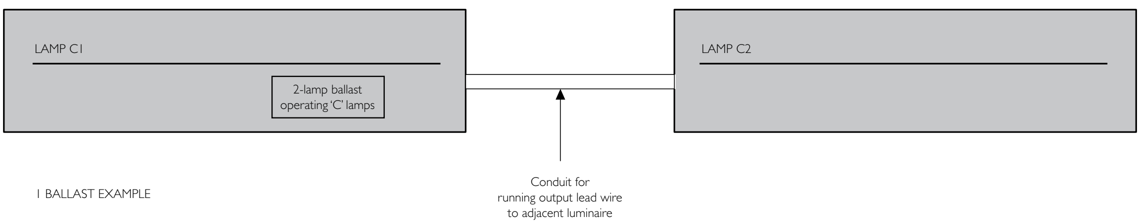
Tandem Wiring



2 BALLAST EXAMPLE

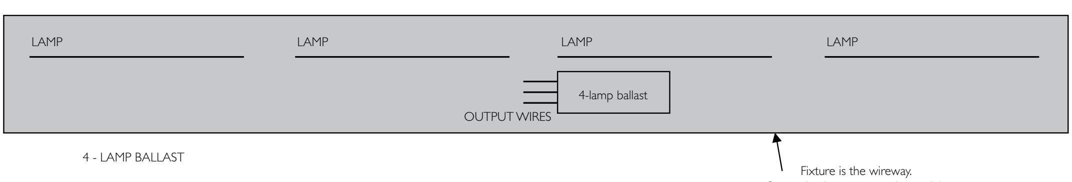
BALLAST 'A' OPERATES OUTBOARD LAMPS
BALLAST 'B' OPERATES INBOARD LAMPS

(2) 3-lamp luminaires shown as an example, but this would also be applicable for any luminaire containing 2-lamps or more

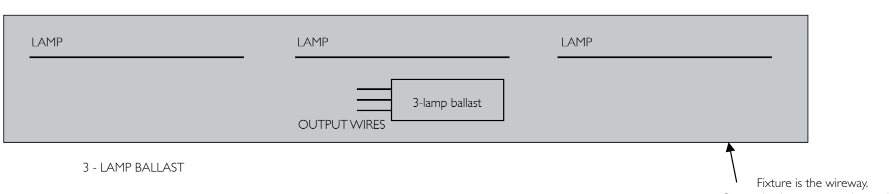


1 BALLAST EXAMPLE

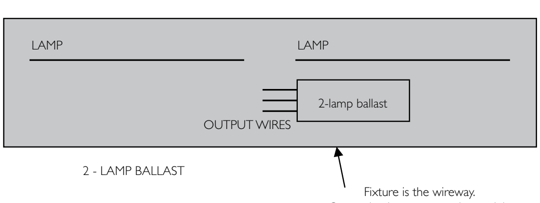
Through Wiring



4 - LAMP BALLAST



3 - LAMP BALLAST



2 - LAMP BALLAST

Note: Ballast should be mounted at center of fixture to minimize lead lengths. Recommended output lead lengths and remote mounting distances (pages 3-14 to 3-18) should not be exceeded.

Diagrams are also aplicable for multiple lamp cross-section luminaires. For example, an 8-foot luminaire with two lamps in cross section and a single 4-lamp ballast.

Philips Fluorescent Dimming Ballast Application Usage

- While installing a Philips fluorescent dimming ballast in a fixture, care should be taken that the output lead lengths do not exceed the specified maximum permissible limits. These limits are specified in the Remote, Tandem or Through Wiring Distance table on the next page.
- If excessive output lead lengths (outside the specification) are maintained for a Philips fluorescent dimming ballast then the ballast may behave undesirably or abnormally at low dim levels.
- If output lead wire lengths are not specified for linear Philips fluorescent dimming ballasts, then it implies that the output lead length should not be extended any more than what was provided with the dimming ballast.
- For Philips CFL dimming ballasts, the output lead length between the ballast and the lamp socket should be maintained as short as possible. It is recommended that this lead length should not exceed 24".
- Before using a Philips fluorescent dimming ballast in remote mounting applications or for applications with emergency power supplies, please refer to the Remote, Tandem or Through Wiring Distance table on the next page and verify whether the ballast supports remote mounting application.
- If the Philips fluorescent dimming ballast supports remote mounting, then
    - For non emergency application, the remote mounting distance should not exceed the specified limit.
    - For applications with emergency power supplies, the total output lead wire length measured from the fluorescent dimming ballast to the lamps sockets (including the emergency ballast wiring) should not exceed the specified limit of the Remote, Tandem or Through Wiring Distance table on the next page.
- If the Philips fluorescent dimming ballast does not support remote mounting, then
    - For non emergency application, the output lead length should not be extended any further than what was provided with the dimming ballast.
    - For applications with emergency power supplies, the total output lead wire length measured from the dimming ballast to the lamp sockets (including the emergency ballast wiring) should not exceed the lead length that was provided with the fluorescent dimming ballast. If maintaining the lead lengths within the specification is not possible then it is recommended to use a Philips fluorescent dimming ballast that supports remote mounting. The example below can be used as a reference for an appropriate application usage of a Philips fluorescent dimming ballast.

Example:

A luminaire contains (1) IZT3S32SC Philips Mark 7 *0-10V* fluorescent dimming ballast and (1) emergency ballast in a three lamp, single lamp cross-section, 12' fixture. This application will have issues because of the excessive wire lengths that result in capacitive losses which may cause short lamp life, uneven lamp performance, or even inability to ignite the lamp(s). In such an application it is preferred to use one of the following approaches:

- One IZT2S32SC ballast to control two lamps (can be remote mounted up to 6') and one IZT132SC ballast in conjunction with the emergency ballast to control one lamp. The total output lead length measured from the dimming ballast to the lamps sockets (including the emergency ballast wiring) should be less than 6'.
- One IZT132SC ballast to control one lamp (can be remote mounted up to 6') and one IZT2S32SC ballast in conjunction with emergency ballast to control two lamps. The total output lead length measured from the dimming ballast to the lamps sockets (including the emergency ballast wiring) should be less than 6' (This approach will provide 2 lamps to be turned ON during emergency).

- For additional application support, contact technical support at Philips Lighting.

ELECTRONIC FLUORESCENT BALLASTS

		Allowed Wiring Configuration			Maximum Lead Length (Feet) for Tandem or Through Wiring (Total length of all wires between ballast and lamp sockets)						Application Note
		Remote (max length)	Tandem	Through	Blue	Red	Yellow	Blue/White	Brown	Orange	
GCN-2S28-L		20'	Yes	Yes	10'	10'	10'				2 (f)
GOP-2PSP32-LW-SC		20'	Yes	Yes	20'	20'	18'				1 (e)
GOP-2PSP32-SC		20'	Yes	Yes	20'	20'	18'				1 (e)
GOP-3PSP32-SC		20'	Yes	Yes	20'	20'	18'	18'			1 (e)
GOP-4PSP32-LW-SC		20'	Yes	Yes	20'	20'	18'	18'	18'		1 (e)
GOP-4PSP32-SC		20'	Yes	Yes	20'	20'	18'	18'	18'		1 (e)
GOPA-1P32-LW-SC		8'	Yes	Yes	8'	8'					1 (c)
GOPA-1P32-SC		8'	Yes	Yes	8'	8'					1 (c)
GOPA-2P32-LW-SC		8'	Yes	Yes	8'	8'					1 (c)
GOPA-2P32-SC		8'	Yes	Yes	8'	8'					1 (c)
GOPA-3P32-LW-SC		8'	Yes	Yes	8'	8'					1 (c)
GOPA-3P32-SC		8'	Yes	Yes	8'	8'					1 (c)
GOPA-4P32-LW-SC		8'	Yes	Yes	8'	8'	8'				1 (c)
GOPA-4P32-SC		8'	Yes	Yes	8'	8'	8'				1 (c)
HCN-2S54-90C-WL		20'	Yes	Yes	20'	4'	20'				3
HCN-4S54-90C-2LS-G		20'	Yes	Yes	20'	4'	4'	20'	20'	20'	7
HDF128T5		6'	NA	NA							4
HDF132T8		6'	NA	NA							4
HDF140T5		6'	NA	NA							4
HDF154T5		No	NA	NA							5
HDF224T5		6'	Yes	Yes	6'	6'	6'				1
HDF226T4		No	No	No							5
HDF228T5		6'	Yes	Yes	6'	6'	6'				1
HDF232T8		6'	Yes	Yes	6'	6'	6'				1
HDF239T5		6'	Yes	Yes	6'	6'	6'				1
HDF240T5		6'	No	No							4
HDF242T5		No	No	No							5
HDF254T5		No	No	Yes	5'	4'	4'				3
HDF332T8		No	No	No							5
HDF432T8		No	No	Yes	1'	1.25'	5.2'	1.25'	4.2'		3
HOP-2PSP54-L		20'	Yes	Yes	20'	20'	15'				1
HOP-2PSP32-HL-L		20'	Yes	Yes	20'	20'	18'	18'			1 (e)
HOP-4PSP54-2LS-G		20'	Yes	Yes	20'	20'	15'	15'	15'		1
HOP-4PSP32-HL-G		20'	Yes	Yes	20'	20'	18'	18'	18'		1 (e)
ICF-1D38-H1-LD		15'	NA	NA							4
ICF-2S13-H1-LD	1-Lamp	15'	NA	NA							4
ICF-2S13-M1-BS	2-Lamp	6'	Yes	Yes	2'	6'	6'				2
ICF-2S18-H1-LD	1-Lamp	15'	NA	NA							4
ICF-2S18-M1-BS	2-Lamp	6'	Yes	Yes	2'	6'	6'				2
ICF-2S26-H1-LD	1-Lamp	15'	NA	NA							4
ICF-2S26-M1-BS	2-Lamp	6'	Yes	Yes	2'	6'	6'				2
ICF-2S42-M2-BS	1-Lamp	15'	NA	NA							4
ICF-2S42-M2-LD	2-Lamp	6'	Yes	Yes	2'	6'	6'				2
ICF-2S42-90C-M2-BS	1-Lamp	15'	NA	NA							4
ICF-2S42-90C-M2-LD	2-Lamp	6'	Yes	Yes	2'	6'	6'				2
ICF-2S70-M4-LD		6'	Yes	Yes	2'	6'	6'				2
ICN-132-MC		20'	NA	NA							4
ICN-1P32-N		20'	NA	NA							4
ICN-1S80-T		20'	NA	NA							4
ICN-1TTP40-SC		20'	NA	NA							4
ICN-2M32-MC		20'	Yes	Yes	20'	20'					1

For nominal input voltage and 25°C ambient temperature. See all notes on page 3-18.