

PHANTOM OF THE ETHER

The new energy-saving fluorescent bulbs save money on electric bills, but they can interfere with infrared remote controls.

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I WAS WATCHING A MOVIE ON A cable channel one night when suddenly my TV set jumped channels. I grabbed my universal infrared remote control and tried to switch back to the channel I was watching but nothing happened. The remote was dead! So I went to my cable box and changed the channel back to the program I was watching. However, a few minutes later the channel switched again. What was going on? Nobody else had been near either my remote control or cable box.

I then pointed my remote control at my TV set, reset the channel, adjusted the volume and tested the mute. All three functions worked. Five minutes later the TV screen bloomed into a field of snow, and the hiss of

static overcame the audio. The cable box had turned itself off.

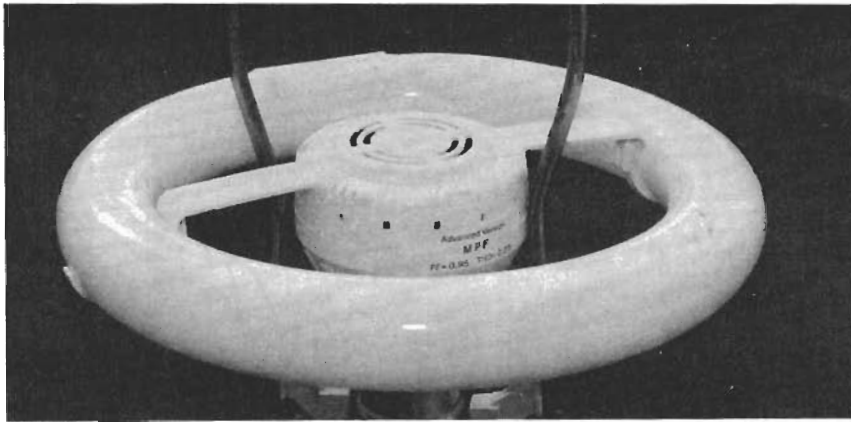
The next day the remote control worked fine with the TV and VCR but not with the cable box. I called my local cable company and asked if it was experiencing technical difficulties. A spokesman for the cable company declared "No, it's those universal remotes. They're always causing problems with our boxes. If you rent one of our remotes, it'll work just fine."

Rather than follow this suggestion, I returned my cable box and swapped it for a new one, thinking that the problem would be solved. The replacement box worked just fine, but a few days later the remote control started acting up again.

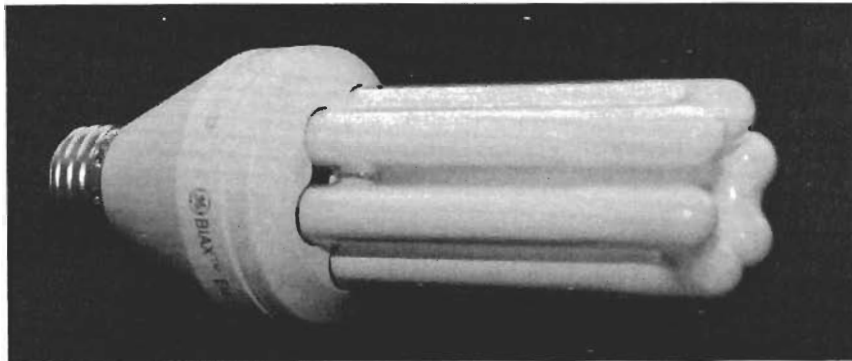
Mystified, I called Universal Electronics, makers of my One For All remote control, and ex-

plained my problem. The customer service representative said he had not heard about my spontaneous switching problem before, but he suggested that the cause could be in the code for my cable box. I was given a special code to reset my remote control, and then I tried all the codes for my Scientific Atlanta cable box. Everything worked well for a couple of hours before the glitch finally returned.

I thought about probable causes and over the next few days I carried out a concerted attack on the mystery. First, I bought new batteries for my remote control, then I rented a dedicated remote control from the cable company. Finally, in desperation, I exchanged the cable box again and bought a brand new remote control.



LIGHTS OF AMERICA's Model 2022 fits around the shade supporting harp of most table lamps. It interfered with the authors's cable box.



GENERAL ELECTRIC'S Model 1302 did not interrupt any of the author's entertainment electronics.

Everything worked well during the day, but at night neither my new universal remote control nor cable-box remote would work. I then concluded that the cause might be noise on the cable—or perhaps some energy source interfering with my remote's signal. Although I felt foolish doing it, I turned off all the lights in my house and, with my remote, switched a number of channels. Had the problem been solved?

Then I turned the lights back on, one at a time, and eventually narrowed down the offending source to new energy-saving fluorescent tubes that I had installed months earlier. These bulbs were interfering with my remote control, but the standard fluorescent tubes in my kitchen lighting fixture had no effect on it.

I ruled out power consumption as a cause: the energy-saving fluorescent tubes were rated for 30 watts, but the kitchen fixture contained four 40-watt tubes. It seemed that the fluorescent bulbs were producing

an infrared signal that jammed my cable box and, on occasion, simulated the remote control's signal.

I phoned several fluorescent lamp manufacturers to see if they could shed some light on this interference. "Yes, we have had some complaints," said Scott Mack, a spokesman for Philips Lighting. He advised me to make sure the energy-saving bulbs were at least 10 feet away from my TV set and cable box and that they were plugged into different household electrical circuits.

"But that's the cure for radio frequency interference," I protested, "what about infrared interference?" He agreed with me, but said that until Philips came up with a definitive solution this was the suggested response to any complaints. "In fact," he added "If those suggestions don't work, try moving the energy-saving lamps to a different room."

Ghost busting

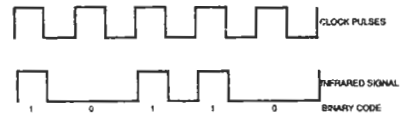
I connected the lamp with the

fluorescent bulb to a different electrical circuit with an extension cord, and I moved it 16 feet away from the cable box—but that didn't help. To prove to myself that it was infrared energy emitted from the bulb and not RFI on the line, I put the lamp in a large cardboard box. With the lamp turned on inside the closed box, there was no interference. But as soon as the box lid was opened, the remote stopped working.

Next, I tried a magnetically ballasted fluorescent desk lamp with an circular eight-inch diameter tube. (The energy saving fluorescents lamps are electronically ballasted.) The remote was unaffected. Even when I held the desk lamp six inches from the cable box, the remote worked. First I assumed that the desk lamp's tube produced a more natural "daylight" spectrum, and perhaps that was why it differed from the fluorescent bulbs.

HOW DOES YOUR REMOTE CONTROL WORK?

Modern remote controls apply many different techniques to communicate with TVs, VCRs, and other consumer electronic products. Their coded signals might vary, but all remote control circuits are basically the same. Most transmit pulses of infrared energy at a specific frequency (e.g., 56 kilohertz). Each time a key is pressed, a group of coded pulses is generated.



A typical code contains 24 bits of binary information. The first four bits determine which one of 16 possible products is to be controlled. For example, 0 is for the TV receiver, 1 is for the first VCR, 2 is for the second VCR, and 3 for a compact disk player. The next eight bits in the sequence identify the key that has been pressed. Those eight bits permit a total of 256 possible key codes. The last 12 bits are check bits which are compared with the first 12 bits to detect errors.

When the receiver within the host product detects an infrared signal, it compares it with a clock pulse operating at the same frequency. If the signal is high, a binary one is generated; otherwise, a zero is generated. After the message is decoded the host equipment is commanded to respond. □

VISIBLE LIGHT SPECTRUM

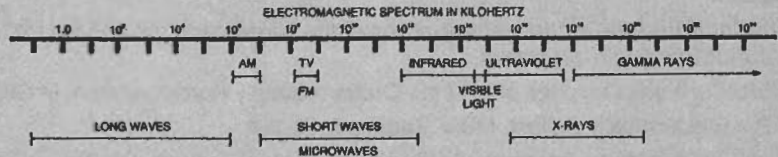
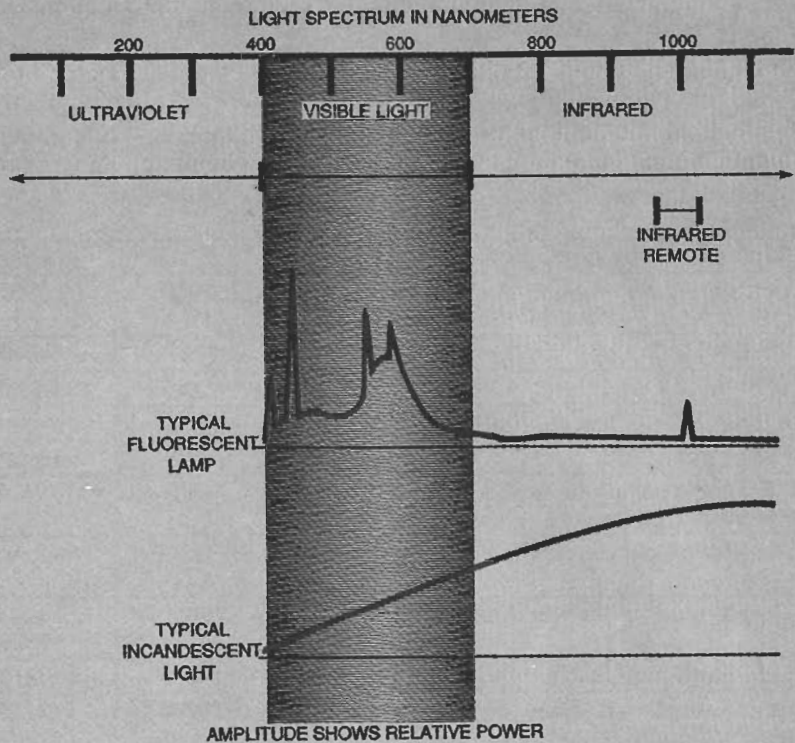
Visible light occupies only a small part of the electromagnetic spectrum. It is generally considered to span the range of wavelengths from 380 nanometers (violet light) to over 700 nanometers (red light). These limits are also be expressed as 0.38 to 0.70 micrometers.

Infrared remote controls based on readily available infrared-emitting LEDs (IREDs) emit at wavelengths of about 1000 nanometers (1 micrometer) in the near infrared region.

The light emission spectrum from a fluorescent tubes depends on the phosphor coating inside the tube. About 90 % of its energy is converted to light with the remaining 10 % dissipated as heat (infrared) radiation. The light spectrum illustrated is for one of the most common "white" fluorescent lamps that emit a more natural light than earlier tubes. The fluorescent spectral distribution curve closely brackets the visible light spectrum.

An incandescent bulb, by contrast, is only about 10 % efficient. Most of the remaining 90 % of the energy is dissipated as heat in the near infrared region. Its spectral distribution extends beyond 2800 nanometers.

It's not the intensity of infrared radiation that interferes with remote controls. It's the frequency of the modulating signal applied to the neon tube. Electronically ballasted fluorescent lamps can overwhelm a remote control by producing a stronger signal "tuned" to the infrared receiver circuit's frequency.



This assumption turned out to be faulty: I then guessed that the interference had something to do with the way the electronically ballasted lamp worked.

"Compact fluorescent tubes operate at high-frequencies," explained Arnold Buddenbery, a researcher at the Lighting Research Center of Rensselaer Polytechnic Institute in Troy, NY. He said those high frequencies modulate the tube's infrared output and cause interference for remote controls based on infrared emission.

The heavy magnetic ballast associated with standard fluorescent tubes limits the flow of 60-hertz current through the tube. That ballast produces a flicker that can be annoying in rooms lit by the older fluorescent lights. Their flicker rate is 120 hertz, twice that of line power.

The operating frequency of electronically ballasted fluorescent lights is between 25 and 50 kilohertz. They produce a 50- to 100-kilohertz flicker, which is too fast for human eyes to sense. However, it is this non-visible flicker in the form of a switched infrared signal that interferes with infrared remote controls. The remote controls for switching cable boxes, TV sets, VCRs, and stereos also switch in the 50- to 100-kilohertz range to transmit binary data to receiving circuits built into those products.

"We woke up one morning and our sets didn't work," reports Don Lowry, Matsushita Electronics' director of engineering. "Each case is a little bit different, but our countermeasures have been effective in managing all of them."

The latest infrared receiver circuits in consumer electronic

products include automatic gain control (AGC) and a clocking circuit that isolates the remote-control signal from spurious infrared radiation. Some circuits look at the signal's center frequency and pulse width and reject all infrared transients that are shorter than valid code signals.

In addition, the latest products have better infrared shielding that limits the view from the infrared receiver to a narrow cone of energy incident at the front of the host equipment.

"We're trying to find an infrared interference prevention scheme that will be acceptable to all manufacturers," reported Tom Mock, speaking for the Electronics Industries Association (EIA) in Washington, DC. Its Consumer Electronics Group includes representatives of lighting and consumer electronics manufacturers.

TABLE 1

Lights Tested	Watts: Rating / Replaces	Model Number	Replacement Tube	Price	Type	C A B L E	V C R	S T E R E O	T V 1	T V 2
Lights of America eight inch circular tube.	30 / 115	C2030TP-L	FCL30EX-L	14.99	EB	S		I		
Panasonic Twin Light Capsule	27 / 100	EFD27LE	Integrated	19.99	EB					
Lights of America eight inch circular tube. (Reduced THD)	22 / 100	2022TP	FC8TEX-L/ RS	12.99	EB	S				
GE Energy Choice	26 / 90	22857	Integrated	9.99	EB					
OSRAM DULUX EL	20 / 75	DULUX EL	Integrated	16.99	EB		I			
GE Soft White (Reduced THD)	20 / 75	11302	Integrated	9.99	EB					
Philips Earth Light	18 / 75	SL*18	Integrated	16.99	EB		S	I		
Abco Table Lamp Conversion Set Electric Saver	16 / 60	7430	13W/27K uE6	19.99	MB					
Panasonic Light Capsule	15 / 60	BFG15LE /A-C	Integrated	14.99	MB					
Light of America Lifelight U-tube	12 / 60	6000-1	FUL12T60W 9308	9.99	MB					
FEIT Electronic U-tube.	9 / 60	BPMLPL9	9W/2700K	12.99	MB					
Dana swing arm magnifier desk lamp with a circular tube.	22 / 75	370WHT	FCL-22D	47.99	MB					

Legend:

- "Watts" shows the actual wattage rating of the fluorescent unit and the manufacturer's approximation of the incandescent bulb it replaces.
- "Price" is the actual price paid at the Orchard Supply Hardware store in Gilroy, CA.
- EB = Electronically Ballast, MB = Magnetic Ballast.
- S = Solid failure, I = Intermittent failures, and a blank indicates no failures.

Personal computer manufacturers have developed a standard for interconnecting computers and peripherals in networks with infrared signals. It would, for example, permit a printer, to be located anywhere in the room. It would also permit a personal digital assistant (PDA) to download data to a personal computer without a cable connection.

The Consumer Electronics Bus (CEBus) is a multimedia standard for home control. It covers signaling over powerlines, radio frequency and infrared transmission, and coaxial and twisted-pair cabling. The infrared emission frequency is about 100 kilohertz in the near infrared region. Mr. Mock said that so far no problems have been encountered with the energy-saving fluorescent tubes, "but we still have to make sure the tubes don't emit in that frequency range."

What's the payback?

If you consider all of the interfering signals that these energy-saving fluorescent lights transmit, why should you consider buying them? The answer is to save money on electric bills. All fluorescent lighting saves money over equivalent incandescent lighting because it produces light more efficiently.

A fluorescent tube costs 60 to 75¢ less to operate than an equivalent incandescent bulb, and it has a life that is about ten times longer. Also, with higher efficiency lighting, less heat is dissipated in the room—especially important in air-conditioned rooms.

A typical 100-watt incandescent bulb costs about 90 cents and lasts 750 hours. By contrast, a 22-watt compact fluorescent tube will last 10,000 hours while giving an equivalent amount of light. For starters, you can buy a compact flu-

orescent tube for less than \$12—the cost of 13 replacement incandescent bulbs.

If your average lighting usage is three hours a day, and you pay a typical rate of 8.5 cents per kilowatt-hour, you will save \$7.26 per year on each light tube. At the very high New York City utility rate of 20 cents per kilowatt-hour, you'll save \$17.08. At that rate, each fluorescent light will save you \$154 over its nine-year life.

Testing the lamps

To see how pervasive interference is, I tested a number of consumer electronics products in the presence of 12 fluorescent lights made by eight different manufacturers. With the exception of a swing-arm desk lamp/magnifier, all the compact fluorescent lamps had threaded bases that screw into standard incandescent lamp sockets.

Electronic ballasts are light in

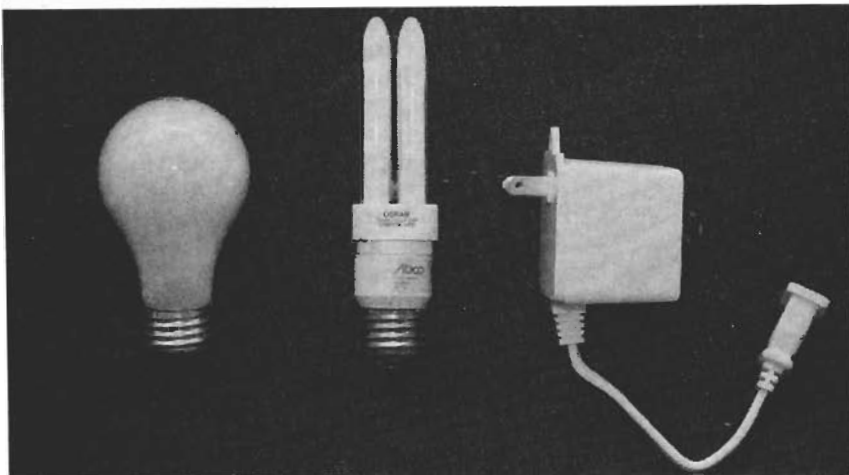


TABLE LAMPS WITH ABCO FLUORESCENT tubes are lighter and more stable because the heavy magnetic ballast is located at the wall outlet. It is as bright as the 60-watt incandescent bulb.

weight and start the associated fluorescent lamp instantly, but, as has been pointed out, they can interfere with infrared remote controls. However, if you consider the many different fluorescent-lamp operating frequencies and the differences between the brands of infrared receiver circuits in the host entertainment products, you quickly realize that there is no way to predict which combination will cause interference problems.

Bulky magnetic fluorescent tube ballasts might weigh more than ten ounces, so they can make a table lamp top-heavy. Moreover, these lights flicker for a few moments when turned on, and some might hum. But they don't interfere with your infrared remote control, and they also save on your electric bill.

I made my tests on popular consumer electronics products:

a Scientific Atlanta 8500321 cable converter, Mitsubishi CS-2655R and Toshiba CE2058 TV receivers, and an RCA VR680HF VCR. I tested all three products with their original equipment remote controls as well as the universal URC-2085 from Universal Electronics.

I went on to test three Technics products: an SA-R277 stereo receiver, a CL-PC10 CD player, and a SR-TR155 dual-cassette tape deck. One original equipment remote control operates all of those components.

I encountered six instances of infrared interference, as shown in the last five columns of Table 1. As expected, only the electronically ballasted fluorescent tubes caused interference. I believe continuous interference is caused only when the ballast frequency is half that of the infrared remote control's modulation frequency.

My test results suggest that intermittent interference is more likely to be caused by harmonic frequencies in the infrared region. This is supported by my test of the two eight-inch circular fluorescent lamps. The reduced total harmonic distortion version did not interfere with the stereo; however, both lamps interrupted the cable box.

I prefer electronically ballasted lamps because they offer instant starting and lighter weight. However, most of the tubes I tested were heavier and took up more space than the incandescent bulbs they replaced. The one exception is Abco's table lamp conversion set. A table

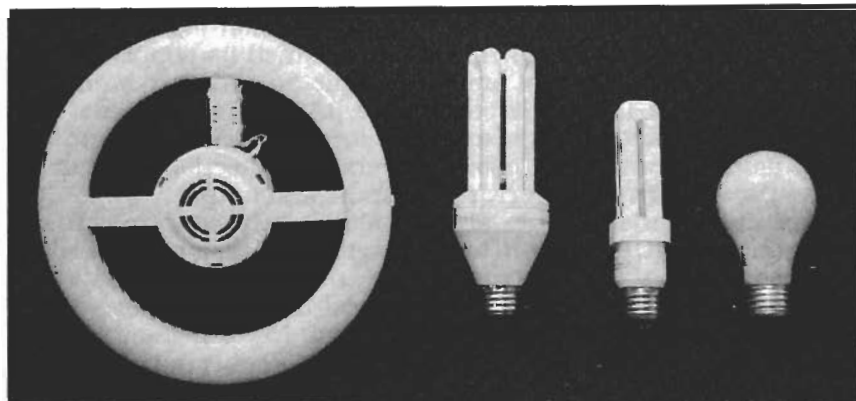


THE OUTPUT OF THIS remote control was "swamped" by an energy-efficient fluorescent tube.

lamp with this tube is not top-heavy because the ballast is located in a small box that plugs into a power line wall outlet. It has a socket for the lamp's line cord.

This arrangement permits a circular, compact fluorescent light to fit easily around the lamp's shade-supporting "harp" which is too small to accommodate most of the other energy-saving fluorescent tubes with screw-type bases.

If you decide to buy an electronically ballasted lamp, look for one that has a label stating that it has reduced total harmonic distortion. It will produce far fewer annoying frequencies. My favorites are a 22-watt tube from Lights of America and a 20-watt tube from General Electric.



FLUORESCENT TUBES COMPARED with a 60-watt incandescent lamp are LOA's 22/100-watt circular, GE's 20/75-watt, and Abco's 16/60-watt tubes.