The revolutionary Lightning Switch™ sold by PulseSwitch Systems, one of The Face Companies, allows the installation of switch controls for lights and appliances in a fraction of the time… at a fraction of the cost.

The wireless Lightning Switch system saves as much as 70% to 90% vs. the installed cost of regular wired switches. In renovation and remodeling projects, Lightning Switches save $100s or $1,000s per switch because they require no wires to the switch, no demolition, no patching and no re-painting. They have been used in residential, commercial, industrial, institutional, recreational and military applications. Lightning remote control switches can work for decades… and, incredibly, they never need batteries.

Lightning Switch Transmitters (what look like the switches) use NASA space technology to generate their own electricity whenever the Transmitter button is pushed. Their radio signals go 45 ft. to 100 ft. (depending on the models chosen) through walls, floors and ceilings.

The patented Lightning System has been chosen for the prestigious Partnership for Advanced Technology in Housing ("PATH", coordinated by the US Department of HUD) and for both PATH Concept Homes (2006 and 2007). It is recommended by the National Association of Home Builders Research Center for use in two kinds of solid wall residential construction.

Lightning Transmitters can be installed on almost any surface (even stone or glass), left on a table, in a drawer or in your pocket. They can be mounted permanently or used as a handheld.

Lightning Transmitters are the ideal bathroom switch. They can be safely used in or adjacent to tubs and showers (as well as Jacuzzis and swimming pools). Because they have no outside source of electricity… there's no chance of being shocked.

Lightning Receivers Wire-In to junction boxes or Plug-In to outlets. Connect whatever is to be controlled… the lamp, light fixture, exhaust fan, etc… to the Receiver and the installation is complete. Lightning Switches are so fast, easy and foolproof to install that users don't need the instructions after the first time. They're covered by a limited 10-year warranty.

The Lightning Switch System was invented at The Face Companies in Norfolk, VA in 2000. Test marketing began in September 2004. Over 10,000 products have been sold, principally on the Internet, to all 50 states and in Canada, with high customer satisfaction. Only 0.65% of customers have been dissatisfied with Lightning products and have asked for refunds. Sales through wholesale electrical distributor outlets are being launched across North America.

Additional Lightning products and designs will be introduced later in 2006 and in 2007, including a series of Transmitters with a look similar to North American Decora® switches, a Dimmer and a System Extender. A new 20A Wire-In Receiver will be especially useful in commercial applications, including aftermarket installation of dual switching systems to comply with government-mandated energy savings programs.

Principal participants in the development of the product include the late Samuel A. Face, Jr., his son Brad Face, Jeff Rogers and Gregg Thomas.

Contact: Brad Face • The Face Companies • 427 W. 35th St • Norfolk, VA 23508
757-624-2121 • Fax 757-624-2128 • brad@faceco.com • www.lightningswitch.com

Lightning Switch™



INVESTIGATOR'S SUMMARY[1]

Nomination 2006-17

Investigator: Rasha M. Stino[2], Ph.D.

Wireless Electric Switch Controls: Lightning Switch™

The Innovation

Introduction

Lightning Switch™ is the commercial name of a patented, wireless, battery-less, remote-controlled system that sends coded radio signals to a receiver to powers lights, appliances and several creative applications. It can be installed as a new switch or replace existing wired switches. Lightning Switch is sold by PulseSwitch Systems, one of The Face Companies and currently has regulatory approval in the United States (UL and FCC), Canada (UL and IC), Europe (TUV and CE) and South Africa (SABS/ICASA).

Throughout this Investigation Summary, no distinction is made between The Face Companies and PulseSwitch Systems (one of The Face Companies).

Lightning Switch Overview

Lightning Switch grew out of The Face Company's technical and commercial development of a superior form of piezoelectric technology developed by NASA. According to NASA, piezoelectric materials "convert mechanical energy into electrical energy and electrical energy into mechanical energy. They generate electrical charges in response to mechanical stress and generate mechanical displacement and/or force when subjected to electric current." The Face International Company holds several licenses and patents on NASA's piezoelectric technology.

Lightning Switch is best described in its five patents, two of which were granted during the time this Investigation Report was being written:

> [Lightning Switch] is a self powered switching device [that uses] a prestressed flex-tensional electroactive member [to generate] a signal for activation of a latching relay. The electroactive member has a piezoelectric element with a convex and concave face that may be compressed to generate an electrical pulse. The flextensional electroactive member and associated signal generation circuitry can be hardwired directly to the latching relay or may be coupled to a transmitter for sending an RF [radio frequency] signal to a receiver which actuates the latching relay (2003).

[1] September 15th, 2006

[2] Associate, Sites International Inc., Michigan, U. S. A.

Refer to Exhibit 1 for an extremely detailed description of Lightning Switch and its components in Lightning Switch's Patent No. US 6,630,894 B1. Refer in particular to Figure 6 of the Patent for an illustration of the overall system.

PulseSwitch Systems' patents protect many inventions related to the Lightning Switch system. Many of these inventions allow the Lightning Switch to be made much less expensively than would be possible without these inventions. Lightning Switch's patented piezo element and how that piezo is deformed produces much more energy than other devices have produced. Creating more electrical energy allows Lightning Switch to be manufactured using less expensive electronic components. This is key to Lightning Switch's competitive price.

Lighting Switch Components and Setup

According to Lightning Switch company literature (PulseSwitch 2006):

- *The most basic Lightning system* requires at least one Lightning Transmitter and one Lightning Receiver.

- *The Lightning Transmitter* converts the mechanical action of pushing its button into enough electricity to send a coded radio frequency signal to the Receiver. The button "plucks" the piezoelectric component in the switch causing it to generate electricity. It never needs batteries and with normal use, lasts for more than 27 years, at 10 pushes per day. The piezoelectric component never weakens; it is the life of the plastic parts that fails first. Small Transmitters are 3.27 inches wide by 3.27 inches high. Large Transmitters are 3.27 inches wide by 5.14 inches high. Both sizes are 0.83 inches thick, including the switch. Transmitters can be affixed to the wall with hardware, double stick tape (provided by the company), left on a table, or carried in your pocket or purse. Transmitters are available in a variety of colors.

- *The Lightning Receiver* is either *Plug-In* or *Wire-In* and usually controls ceiling light fixtures, recessed lighting, under-counter lights, small motors and pumps. Receivers are available in a variety of colors:
    - *Plug-In Receivers* are designed to plug into any 110 volt, three prong-outlet. The Receiver receives commands from Lighting Transmitters and "Turns On" or "Turns Off" the light or appliance (up to 500 watts) that is plugged into it. Plug-in Receivers are typically used to control floor lamps and Christmas trees. Plug-Ins are 2.9 inches wide by 3.5 inches high and 1.18 inches thick (2.0 inches including the prongs).
    - *Wire-In Receivers* are currently available for 110 volt AC and 12 volt DC applications. These receivers are wired into the electrical system between the power supply and the light fixture or device to be controlled. Typically, the 110 volt receiver is wired into a junction box and remains in or adjacent to the box after installation. The receiver receives commands from Lightning Transmitters and "Turn On" or "Turn Off" the light or appliance (up to 500 watts for the 110 volt receiver) that is wired into them. Wire-Ins are 3.0 inches wide by 2.25 inches high and 1.08 inches thick.

- *Setting up the Lightning Switch System:*
    - Transmitters are matched to the Receivers that they will control. Each Lightning Transmitters emits a unique coded radio signals when the Transmitter button is pushed. All Lightning Receivers come with blank, imprintable memories. A Lightning Receiver will only respond to the Transmitter it has been programmed by the user to obey.
    - The first Plug-In Receiver is plugged into the first outlet, or, the Wire-In Receiver is wired to into the first electrical box.
    - The Receiver's red power light will glow to confirm that the outlet that is being used is powered. After the initial installation, the red light will glow to indicate that the Receiver is "On".
    - Next, the "Learn" button on the Receiver is pressed and a green light will glow.
    - While the green light is glowing, the first Transmitter that will be used to control the Receiver is pressed. The green Receiver light goes out when the code has been programmed. The unique ID code of the Transmitter is imprinted upon the Receiver. The Receiver will now only respond to commands from that Transmitter.
    - This process can be repeated so that a single Receiver responds to *up to 30 different Transmitters.*
    - A single Transmitter can control *an unlimited number of Receivers*, as long as the Receivers are within broadcast range of the Transmitter.
    - A Transmitter's ID code can be erased from the memory of the Receiver by using the "Erase" button on the Receiver. A yellow light glows when the "Erase" button is pressed. While the yellow light is glowing, the Transmitter button is pressed and the yellow light will go out indicating that the Transmitters ID code has been erased from the Receiver's memory. A Receiver's memory can also be completely erased of all Transmitter IDs at the same time by following a simple series of steps.

- *Other Features:*
    - Lifetime: The Lightning Switch has a 10-year limited warranty. Accelerated lifetime testing is performed on the devices. The minimum acceptable demonstrated life for Lightning Switch tested in this way is 100,000 activations. That equals ten pushes a day for 27 years. The piezo in the Lightning Switch will not be the first thing that fails in the product. The piezo itself can last for millions of cycles. The first thing that breaks (after no fewer than 100,000 cycles) will be one of the plastic parts in the Transmitter mechanism. Products made after 2006 are expected to have a life of at least 150,000 to 200,000 cycles, because the Transmitter mechanism is being redesigned in such a way that the stress on the plastic mechanical elements is reduced. The change is being made for aesthetic purposes, but one of the results is a longer lifetime; 200,000 cycles is equivalent to 10 pushes a day for over 50 years, which is much longer than the life expectancy of a regular wired switch, estimated to last about 30 years.
    - Operating Rage: Lightning Transmitters transmit between 45 feet and 100 feet (depending on which products are chosen) in 95% to 99% of installations through one or more obstructions, including concrete walls, brick walls, doors, floors, etc. Metal walls and severe radio frequency interference may limit the transmission range. With the soon-to-be-released *System Extender*, the range for Lightning Switch systems within a building will be essentially unlimited.

- Interference: Lightning System has no interference problems with other remotes and will not be affected by neighbors' wireless systems or Lightning products.
- Outdoor use: Lightning products can be used safely and effectively outdoors and in wet conditions. The Transmitter, however, should not constantly be exposed to very wet conditions (e.g., under a running shower head) because of potential corrosion that may shorten its life.

See Exhibit 2 for a catalog of various Lightning Transmitters and Receivers, a separate page showing images of Lightning Switch Decorative Transmitters ("Decora" style) to be released in late 2006 and technical data for a sample Transmitter and sample Receivers.

Conventional Technologies

Conventional systems that Lightning Switch replaces are:

- *Wired switches* (most common): Wired switches can be installed in new construction for as little as $35 in a mass production environment (housing development, open walls, stick construction). Only the simplest switches, when open-wall installation is possible in new construction, are likely to remain "wired" for the foreseeable future. In most other cases, Lightning Switch is superior in cost and time savings. A Lightning Switch system can be installed in an existing building in less than 15 minutes, with the cost of materials running between $54 and $77 per one Transmitter and Receiver set.
- *Battery-powered remote switch controls*: are inherently "temporary" and can suddenly run out of power. The market has chosen not to use such products in "commodity" applications, which are the target of the Lightning Switch, because they have several limitations/problems, the most significant is that they need an external power source to work and can be unpredictable. The environmental consequences of throwing away millions of additional batteries each year to power such systems are not attractive. The labor costs of replacing batteries throughout a facility to maintain a battery-powered system are also a negative. Lightning Switch is a permanent switch control.
- *X-10 systems (home automation systems)*: primarily use power line wiring for signaling and control. Due to their very nature (power line wiring for signaling and control), they have limited range and they encounter significant interference problems.

The Face Companies/PulseSwitch Systems began a survey of contractors a few weeks ago to compare the installed costs (labor and materials) of 'Conventional Wired Switches' vs. 'Lightning Switches' for 'New Construction' and 'Renovation/Repair' on 'Commercial' and 'Residential' projects. The results in Exhibit 3 are preliminary and are based on the responses of 16 contractors in six states: FL, VA, IL, MO, KS and PA. Some details of the survey are included in Exhibit 3. The results generally show that for Commercial applications, Lightning Switch allows significant cost savings on both new and renovation/repair projects. For Residential applications, the cost savings with Lightning Switch are much more significant for renovation/repair than they are for new construction.

Alternative and Competing Technologies:

Lightning Switch has no active competitors in their target market, which is a commodity wireless/battery-less switch to replace commodity wired switches.

Licensees of a company called EnOcean in Munich, Germany are selling specialty piezo-powered switch controls in Europe at retail prices much higher than the retail prices of Lightning Switch products. Evaluation samples are available in the USA for $120, but no products intended for wide-scale use are on the market in North America. EnOcean provides its licensees key components to make wireless and battery-less transmitters, then the licensee designs, manufactures and markets the finished product.

Retail Prices of Lightning Switch vs. EnOcean are:

- Lightning Switch transmitters retail for between $24 and $34.
- Published prices for EnOcean transmitters run between $102 and $181 (plus, in most cases, Europe's 20% VA tax).
- Lightning Switch receivers retail for between $34 and $43.
- Published prices for EnOcean receivers run between $115 and $230 (plus, in most cases, Europe's 20% VA tax).

EnOcean products cost three to five times as much as Lightning Switch products, prices at which PulseSwitch believes widespread adoption of the technology is extremely unlikely. Lightning Switches are already being used in commodity applications, whereas EnOcean's corresponding products are being used in what appear to be specialty applications or as optional accessories in systems that also use battery-powered switch controls.

PulseSwitch Systems had already filed its first three patents before EnOcean was created. On September 20th, 2006, the US Patent and Trademark Office (USPTO) sent EnOcean's patent attorneys the final rejection of EnOcean's base patent for its system. This is public information, available online at USPTO. Furthermore, the inside cover of a December 2005 EnOcean product manual warns its clients that the use of EnOcean products might violate "patents or rights of third parties".

Lightning Switch: Performance

Lightning Switch is less expensive, quicker to install, safer, more environmentally friendly and allows for better quality control than traditional wiring. The following construction variables and applications highlight the practical benefits of using Lightning Switch:

- renovation and repair projects in which **demolition and wall and ceiling patching** would be required to run new wires for switches;

- renovation and repair environments in which there is **asbestos** present in the walls and/or ceilings;

- **solid wall construction**, such as concrete, block, brick, structural panels, cement-stucco and log, on new construction or renovation, in which conventional wiring is either expensive and time consuming to install or in which surface-mounted wiring is unattractive;

- **complex wiring** on new construction or renovation, such as three or four-way switching; the savings in installation and in copper are both factors that make the Lightning Switch more attractive;

- **outdoor applications** that would have required trenching by traditional methods to accommodate wires to a landscape feature, adjacent building, dock, garage or dependency (new construction or renovation);

- **high ceilings** (new construction or renovation);

- installations where a wired switch would present a **shock hazard** (new construction or renovation).

In summary, Lightning Switch has several advantages over traditional systems, all which can be translated into material and/or labor cost savings:

- *Saves time and money:* According to electrical contractors, on renovation and repair projects, Lightning Switch typically saves 70% to 90% over the cost of a wired switch installation. This is because it requires no wires to the switch, no demolition, no patching and no-re-painting. Also, Lightning Switches are used to avoid the costly and inconvenient installation of Ground Fault Interrupter (GFI) switches in kitchens and bathrooms. Since Lightning Transmitters have no outside source of electricity, there is no shock hazard. The hundreds or thousands of dollars in labor and material savings more than offsets the retail price of a Lightning Switch set (1 Transmitter + 1 Receiver) of between $54 and $77 versus $35 for mass-produced wired switches;
- *Increases Quality / Easy to Install:* Some Lightning Switch sets can be installed in less than a minute; the great majority can be installed in no more than 15 minutes. Users typically do not need the instructions after they have installed the first one because there is little room for error. Also, less interference with other trades and finishes reduces the need for re-work/patching and improves the quality of construction;
- *Saves the Environment:* Lightning Switch has no batteries to dispose of and allows renovation and repairs to old buildings without having to expose hazardous materials, such as asbestos. Newer Lightning products will allow commercial buildings to comply with the Energy Policy Act of 2005 (EPAct 2005);
- *Increases Safety:* Lightning Switch transmitters are ideal wherever there is a risk of being shocked: in bathrooms (adjacent to tubs, showers and Jacuzzis), kitchens and near swimming pools;

- *Satisfies customers:* Over 10,000 products have been sold in the United States and Canada with only 0.65% customer dissatisfaction. Customers have the 'power' to use Lightning Switch in creative ways;
- *Increases Design Flexibility:* walls / non-structural elements can be moved to re-configure a space without having to worry about re-wiring; lighting needs and modifications can be addressed *after* construction with few design and construction coordination challenges;
- *Improves and Facilitates Building Operation, Control and Maintenance*: Lightning Switch is being used to create switch control systems that would never have been considered if the only alternative were wired switches. The installation in Sprint retail outlets across the US is a great example of this. Sprint is using Lightning Switch to simultaneously control multiple retail displays in their showrooms. Before Lightning Switch, retailers would have had to use under-carpet wiring for such a system, which would have been prohibitively expensive. With Lightning Switch, the installation is completed in a matter of minutes. Because Lightning Switch systems are laid out in an efficient and organized manner, repairs and maintenance are greatly facilitated.

Application of the Innovation

Lightning Switch has been used on thousands of installations across North America on residential, commercial, industrial, institutional, recreational and military projects. Some 15,000 Lightning Switch products have been sold. More electrical wholesale locations are carrying Lightning Switch products and more electrical contractors are becoming aware of them. As of the date of this investigation, approximately 20 branch locations in four states were carrying Lightning products. Most installations to date have been small renovation or retrofit projects. Larger projects are now beginning to use Lightning products.

The Lightning Switch system has been chosen for the Partnership for Advanced Technology in Housing (PATH, coordinated by the US Department of Housing and Urban Development) and for both PATH Concept Homes (2006 and 2007). It is recommended by the National Association of Home Builders Research Center for use in two kinds of solid wall residential construction (see Exhibit 4).

Many clients want to add light controls in difficult or inconvenient places like closets, stairways, basements, attics and garages. A popular use for Lightning Switches is in leased spaces. Lightning Switch Transmitters can be attached to modular walls and left there. You can move the wall whenever you want to rearrange the space for a new tenant, and the "switch" never needs to be re-wired. Three Case Studies and a partial list of projects where Lightning Switch has been used are provided in Exhibit 5.

Some customers, however, have come up with their own ways of using the Lightning Switch, many of which were never imagined by the inventors of the product:

- *One Touch Control of Store Fixture Lighting*: one Lightning Switch Transmitter is used to control all showcase lights in entire store. Introduced across the USA in Sprint locations starting in June 2006;

- *Installation of Light Controls in Flood Plains:* where regular 110/120V wired switches are not allowed by code;

- *Control Landscape Lighting*: hardscape, fountains, pumps for ponds, etc.;

- *Individual Control of Overhead Lights:* in an office cubicle area, for example, each desk has its own wireless/battery-less control to switch on/off ceiling mounted lighting for that cubicle;

- *Control Lights on Docks/Boats from Shore/House;*

- *Control Computer Monitors in Classrooms;*

- *Factory Floor Alerts:* Worker pushes a Lightning Switch Transmitter at his/her station to control a signal light to indicate a need for assistance, inspection, for more product to process, etc.;

- *Control of Lift for the Handicapped;*

- *Doctor is Ready for Patient:* Doctor pushes a Lightning Switch Transmitter in the examining room to turn on a signal at the nurse's station to indicate that the doctor is free and ready for the next patient;

- *Hotel Taxi Calling System:* Each bellman has a Lightning Switch Transmitter to control a stop/go light at a taxi stand.

New Lightning Switch products to be launched in 2006/2007:

- Higher voltage (220V, 277V, 347V) and higher amperage (up to 60 amp) individual Lightning Switch Receivers and Panels of multiple Lightning Switch Receivers are coming to the market in late 2006;

- A dimmer will also be introduced within a few months as will a transmission repeater product called *Lighting Switch System Extender*. Installing an array of System Extenders can give the Lightning system virtually unlimited range within a building or compact complex with essentially 100% hit probability;

- Transmitters with a look similar to North American "Decora" switches;

- A 20A Wire-In Receiver will be especially useful for commercial applications, including aftermarket installation of dual switching systems to comply with government-mandated energy savings programs.

With the addition of these products, the Lightning system can:

- Facilitate rewiring of existing commercial buildings to comply with the terms of the Energy Policy Act of 2005 (EPAct 2005).
- Create a faster and less expensive way to control three-way, four-way, etc. switches in the new construction of commercial and institutional buildings with no complicated wiring.
- Allow more flexible control of lighting in warehousing.
- Create centralized switching panels for modular housing and office clusters in which a Lightning Switch Receiver panel is located next to the circuit breaker box and Transmitters throughout the space transmit to the panel, where all light switching is performed. Wires are run directly from the central panel to the lights to be controlled. Centralized panel allows fast and easy accessibility to all Receivers, so that the entire building's/area's switch controls can be reconfigured literally in minutes.

Background of the Innovation

The product grew out of The Face Companies' technical and commercial development of a piezoelectric technology known as Thunder® / Lightning®, which was originally invented by NASA and licensed and brought to the market by Face between 1996 and 2000. Test marketing began in September 2004. Most of the Internet clients who began purchasing during test marketing (2004-2005) wanted to install, replace, or rewire lighting controls without the hassle and cost of knocking holes in walls, ceilings, etc., and running new wires. Over 10,000 products have been sold in North America since with 100% customer satisfaction.

The late Sam Face and Brad Face realized that this piezo technology had the ability to generate useable amounts of electricity with the force of a finger push. After the invention of the concept and its principal applications in Norfolk, VA by Sam and Brad Face, Clark Boyd, then an engineer at Face, confirmed in May 2000 that the Lightning piezo could generate the electricity required to send a coded radio signal.

Jeff Rogers led the product engineering team throughout the product's development. Gregg Thomas, now Senior Product Engineer, invented the mechanical means by which Lightning could generate the largest amount of electricity.

Brad Face led the effort to identify viable applications, conceived the means by which the parts of the system would communicate, created the strategic partnerships, raised investment capital and directed commercial development efforts throughout the project.

Working with manufacturing partners in Europe and Asia (Herholdt Controls of Italy, and Sunnytec and ftech of Taiwan), the mechanical and electrical issues were identified and solved, mass production methods for Lightning Switch were developed and manufacturing began.

Responsibility for the Innovation

The following individuals are responsible for the creation and success of the Lightning Switch:

Brad Face
- At time of Invention: President & CEO, The Face Companies
- Now: Chairman, President & CEO, The Face Companies

The late Samuel A. Face, Jr.
- At time of Invention: Chairman, The Face Companies

Glenn F. (Jeff) Rogers, Jr.
- At time of Invention: Vice President, Product Engineering, The Face Companies
- Now: Vice President, Product Engineering, The Face Companies

Gregg Thomas
- At time of Invention: Staff Engineer, The Face Companies
- Now: Sr. R & D Engineer, PulseSwitch Systems (one of The Face Companies)

Clark Boyd
- At time of Invention: Research & Development Engineer, The Face Companies
- Now:
  Senior Research Engineer
  Luna Innovations Incorporated
  2851 Commerce Street
  Blacksburg, VA 24060
  540-961-6731 (Phone)
  540-951-0760 (Fax)

Brad Face, Glenn Rogers, Jr. and Gregg Thomas can be contacted at:

PulseSwitch Systems LC
One of The Face Companies
427 West 35th Street
Norfolk, VA 23508
757 624 2121 (Phone)
757 624 2128 (Fax)
Email: feedback@LightningSwitch.com

Opinions of Persons Contacted

Six industry references were asked the following questions about Lightning Switch through electronic mail and/or facsimile:

1) On what types circuits/ appliances/ instruments is this being used?
2) How widely used is it?

3) What do facility users say about its use?
4) What are real savings in time/cost/quality in new/rehab/retrofit construction?
5) What types/sizes of projects use it: office buildings, schools, residences, laboratories, industrial plants, remotely operated facilities (clean rooms, nuclear facilities, toxic areas)?
6) Are there competitors and who are they?
7) Are there alternative technologies? If so, what are they?
8) Is the Lightning Switch a true innovation in your opinion or simply an evolution of existing technologies?
9) What are its shortcomings?
10) Other comments.

There is a clear consensus among the interviewees that Lightning Switch is a "brilliant" innovation that is extremely versatile and unparalleled in the market. The interviewees agree that with Lightning Switch, permanent switch controls can be installed at a fraction of the cost and in a fraction of the time required to install conventional wired switches.

Another common observation is the positive and quick response that the Face Companies has had to user feedback. The interviewees noted that the company immediately addressed any minor aesthetic or technical shortcomings by launching new and improved versions of the Lighting Switch system in a relatively short time.

Investigator's Comments

According to the opinions of persons contacted and The Face Companies, the reception to Lightning Switch has been extremely positive. Reaction among facilities owners and electrical contractors, in particular, has been that this is a revolutionary product that will change the way that switch controls will be installed. The new products coming to the market this year and next year will further revolutionize switch controls and are being launched in direct response to requests from builders and contractors, so that they can use Lightning Switches in more kinds of installations.

My opinion based on independent references, the patent documents, the literature and data provided by The Face Companies and internet searches is that Lightning Switch is a significant innovation that will not only re-define the electrical trade but will facilitate design, construction and the coordination of all building trades. I also believe that more creative applications of Lightning Switch will continue to appear because customers have been "empowered to think" as a result of the easy application and simple design of the product. Lightning Switch is a significant contribution worthy of the NOVA Award.

I would like to acknowledge Mr. Brad Face of The Face Companies for his extreme helpfulness and for providing the figures, tables and data needed to produce this report.

SELECTED INTERVIEW SUMMARIES

General note: The complexity of this technology required more than one telephone and e-mail interview per each industry contact.

Name	**Mr. Tate Era**
Position	**Research Associate**
	Newport Partners
Address	**3760 Tanglewood Lane**
	Davidsonville, MD 21035
Tel.	**301 889-0017**
Fax	**301 889-0019**
E-mail	**tateera@newportpartnersllc.com**

Response Date: **August 15th, 2006**

Hello Rasha,

I would be happy to provide my opinions of the Lightning Switch for your report.

1. I see it mainly used for lighting purposes, both ceiling mounted lights as well as floor lamps. The 3-way switch and dimming switch are great options that add to the value of the lightning switch.
2. I think it is still has only a small market share, but has the potential to gain quite a bit over the upcoming years.
3. Most think it is an interesting product with a lot of upside. Easy to use and no problems reported.
4. The real cost savings in new construction is minimal, but will become more significant as the price of the switch continues to fall. As for retrofit situations, it can save a lot of time and money over traditional electrical practices. I would say it could save over 2 hours time and likely $100 or so per switch (including labor).
5. I know of residential and light commercial uses. Also think it works well in hotels and industrial sectors as well.
6. Right now I know of a European product made by EnOcean that supposedly offers the same benefits as the lightening switch
7. I know of no alternative technologies that do what the Lightening Switch do.
8. I believe it is a true innovation that not only creates a new market, but serves a current one as well.
9. The only thing I can think of are the switch appearance change from what most consumers are used to.
10. I just think it is a wonderful product that fulfills many needs in all types of construction. It works well in many settings, especially in hotels, and handicapped accessible units.

Name	**Mr. James Lyons**
Position	**Senior Consultant**
	Newport Partners
Address	**3760 Tanglewood Lane**
	Davidsonville, MD 21035
Tel.	**301 889-0017**
Fax	**301 889-0019**
E-mail	**jameslyons@newportpartnersllc.com**

Response Date: **August 18th, 2006**

Dr. Stino,

I'm happy to provide information on the Lightning Switch system. My responses are below. For background, Newport Partners (where I am a Senior Engineer) specializes in technology scanning, evaluations, demonstrations, and analyses of potential barriers for new technologies (code, market-based, distribution, etc.). Most of this work focuses on the residential construction industry, with a small amount of overlap into commercial too.

1) The Lightning Switch (the "system") is a versatile technology that can be used on pretty much anything you want to turn on/off. Through the use of listed relay components, it can toggle lighting or other plug-in loads (home electronics, plug-in lights, etc.) on typical residential voltage (110) or higher-level commercial voltages. From our experience with it, it holds tremendous potential for making retrofit projects much quicker, more cost effective, and less disturbing to the building occupants. As an example, if you were in an older building (perhaps a house with lead paint or a commercial building with asbestos) and needed to update your switching systems to provide a light switch in a new location – this system would allow you to do so without the need for new wiring. In terms of new construction, it offers the benefits of eliminating wiring, posing no shock hazard like a normal hard-wired switch would, and providing great versatility in configuring 3-way, 4-way switch setups.

In projects we have, we are planning to use the system to control lighting fixtures in a demonstration house, to control mechanical ventilation fans that are being retrofitted into an older building, and to provide lighting control in a commercial building where currently light banks are controlled only from a few central switches (which limits occupant flexibility and wastes energy).

2) I believe it is still a fledgling product, but its growth over just the last 6 months has been tremendous. The evidence of its potential is indicated by the ever-increasing list of new applications that are coming from the product's users.

3) Users overwhelmingly value the versatility and the installation benefits that the system provides. Feedback has also included requests for additional products, like an in-wall receptacle instead of a plug-in – which the company is bringing to market in short turnaround times.

4) This would vary a great deal by the specific application. I guess one way to lay it out is through a series of project "factors". The more factors that are found in a particular project, the greater the benefits from this system. The biggest factors are:

- Complications from running wiring to traditional switches (occupied building, hazardous materials)

- Need for a very quick electric installation (e.g. construction of emergency housing)

- Difficulty in running wiring in a traditional manner (could be due to non-frame construction, a hard-to-cut interior wall face, other construction system issues)

- Need to be able to re-configure switching systems in the future (huge factor in commercial buildings)

Lack of labor in the construction trades looks to be a major issue that will only get worse, so systems which expedite installation (in any trade) are a big value, even if components for these systems are more expensive than commodity products.

From some general discussions with PulseSwitch regarding hard number cost savings on using this product in emergency housing trailers, the estimates sounded reasonable to me (although I won't quote an exact number b/c I don't want to give inaccurate information).

5) As mentioned in my answer to question 1, the project types are quite broad. Buildings which need to accommodate "churn" (frequent reconfiguration of interior spaces) use them – offices. I know of projects where they're used in residences. Schools – I'm not familiar with but in any school undergoing minor retrofit these would be a good fit. I also know of a few projects with national hotel chains that are piloting using the systems in their guest rooms.

6) We have seen one similar product produced by a firm named Enocean.

7) Other remote control type systems are available, but they require battery power and do not have the same capabilities to "learn" and set up an infinite array of switched networks.

8) I believe it qualifies as a true innovation. It has percolated to the top of an inventory of dozens of different building "innovations" we researched last year. It is picked up and noticed by other industry experts when we're presenting on our work. And it is also a system where the market sees its innovation, and is now applying it in ways that nobody had foreseen.

9) This is not necessarily a shortcoming, but in the market we do much of our work in – new residential construction (low-rise) – the benefits created by the system are not as pronounced as in other applications. E.g. it's unlikely you'd replace all of the switches in a new house with the PulseSwitch units – although it would make sense to use them in several areas of the house.

I suppose another potential pitfall is one of a learning curve. The system is intuitive to use and a complete novice would understand how to set up and program the switches in less than 5 minutes, but some people might still be intimidated by the technology (like the guy who never set the VCR clock in 10 years).

10) I think the company's development and market penetration strategy for the system is smart. They listen closely to the market, respond accordingly, and don't get too far out in front of themselves (which can really damage the growth of a new product).

Name	**Mr. Gregg Stephens**
Position	**Principal**
	Gregg Stephens Design
Address	**2307 Camino Artesano**
	Santa Fe, NM 87505
Tel.	**505 471-9192**
Fax	**505 471-6321**
E-mail	**gstephensdesign@earthlink.net**

Response Date: **August 19th, 2006**

Dear Rasha,

1) I have used the products to add conventional type switch control to existing doorjamb switches on pantry doors where the client wanted to leave the doors open but not waste electricity. Getting conventional wiring in the wall would have cost three times as much as this solution. I have used them on landscape lighting installations to control specific elements such as picnic table "down lighting" that I wanted on only while in use.

2) I am finding more and more uses for this product that eases installation and saves my clients money.

3) Facility users are very impressed with the product, the installation time, lack of facility impact and cost savings aspects.

4) Not having to get wiring to the switch location and not ever having to worry about battery replacement make this an absolutely BRILLIANT product!

5) I have only used it for small and specific problem solving applications, but it is a brilliant product that I would certainly review for large-scale integration and application as it has some definite advantages over a conventional systems.

6) I did a one month long phone and Internet search looking for a wireless switch product. There are products out there that accomplish this job, but none nearly as effectively. Using the Piezo element in the transmitter makes all the difference in the world. It is the perfect marriage of technology to create the perfect solution! Lightning Switch has found the perfect solution and created the perfect product!

7) The old, standard, battery powered transmitter technology is the only other thing out there that keeps one from having to get wires to power the transmitter/switch. There are multiple, expensive transmitter switches on the market, Lutron's Radio Ra, Z-Wave, X-10, etc. but none fill the niche that Lightning Switch does.

8) True innovation in the highest and most brilliant sense! It is the perfect solution for this problem and I believe they are going to be unbelievably successful!

9) The only short coming I find is: due to its need to flex the piezo element to create the electricity, they have not found a *cost effective* way to build the mechanism into a standard wall mount toggle switch configuration so that it could blend aesthetically and seamlessly into an older existing installation.

10) Upon using these products for the first time I sent Brad Face my comments about the above-mentioned shortcoming. They have taken this very seriously and are developing a "Decora" style switch, which directly addresses this issue for at least many of the more recent installations. They seem very open to feed back from designers such as myself, which is most noticed and appreciated.

Name	**Mr. Bruce Tyler**
Position	**Principal**
	Baskersvill (Architects and Engineers)
Address	**101 S. 15th Street, Suite 200**
	Richmond, VA 23219
Tel.	**804-343-1010**
Fax	**804-343-0909**
E-mail	**btyler@baskervill.com**

Response Date: **August 23rd and September 25th, 2006**

1) I have installed the Lightning Switch on an exterior lighting circuit.

2) From my observation, most use to date has been in residential projects. In my project, one circuit shared for power and exterior lighting in the yard at my home. Initially the circuit was run to provide power to exterior receptacles. Once the landscaping became mature we realized it would be nice to light the crepe myrtles.

3) It is great. It is an accent lighting that illuminates our landscaping in our yard. The switches and receiver have been in place for almost a year and it has worked every time we used it. In particular it is great to watch the snow being illuminated as it falls to the ground around the crepe myrtles.

4) Yes, we could not have installed the lighting on the exterior and controlled it from the house without tearing up walls and ceilings to install regular electrical wire and switches. Because we are able to install the switch without damaging the rooms we were able to control the exterior lighting from first and second floors.

5) I used it in my residence. As an architect/engineer (our firm focuses on retail, office and healthcare), I believe that once the company's products have higher voltage (particularly 277V) and higher amperage capabilities, the products will be more broadly adopted for commercial, industrial and institutional use.

6) No (competitors)

7) None of which I am aware (alternatives)

8) As an individual who has wired several homes, I have not seen anything like it. All of the remote systems that I have seen require power to control the switching.

9) The biggest shortcoming was the distance that I was able to set the switches. It would have been better if I could have set one switch 150 feet from the receiver. I understand the company is coming out with a way to extend the range of the products.

10) I have recommended this product to several colleagues and friends.

Name	**Mr. John M. Tikalsky**
Position	**President**
	Nyloboard
Address	**14187 Industrial Park Blvd**
	Covington, GA 30014
Tel.	**678 625-5187**
Fax	**770 786 5158**
E-mail	**tikalsky@pacbell.net**

Response Date: **September 26th, 2006**

1) We are using the Lightning Switch for all of the switch controls in our manufactured homes. These homes are constructed using our proprietary Nyloprime SIPS – structural insulated panels – so we wanted to avoid the problem of where to hide the wires. With the Lightning product there are no wires to the switch, which solves the problem that we were facing.

2) We have been using the product for almost a year. We know that we were an early adopter. I know from the company that they are setting up distributors now.

3) For us, this solved a big problem. We know that it also solves the problem of installing switches within floodplains. Insurance companies and some local governments don't want wired switches within these floodplains.

4) As I said before, for us it saves us the very high cost of cutting into our SIPs to bury the wires or the ugly and expensive alternative of mounting the wires to the switches on the surface of the walls and then covering the wires with some kind of molding. So, in our case, the advantages are both in time of construction and having a better quality result.

5) Beyond our use, I only know what I have read in the materials we have received from Lightning Switch and from my conversations with their representatives.

6) I don't know of any other products like this.

7) We found no other way to solve our problem.

8) Because it doesn't need batteries, this is a revolutionary invention rather than an evolutionary one. We could not solve our problem and ask our homeowners to change batteries every six or 12 months. They would never accept it.

9) We wanted to have a central switching panel to make installation in our homes even easier so Lightning is bringing that to market very soon.

10) This product is what innovation is all about.

REFERENCES

Face International Corp., 2003. *Self-Powered Switching Device*. United States Patent 09/616,978. Patent No. 6,630,894 B1.

NASA Scientific and Technical Information (STI), 2005. Bringing Thunder and Lightning Indoors. *Spinoff* [online]. Available from: http://www.sti.nasa.gov/tto/Spinoff2005/ch_5.html [Accessed September 20th, 2006]

PulseSwitch Systems, LC, 2006. *Lightning Switch: Frequently Asked Questions*, Norfolk, VA, USA.

SUPPORTING EXHIBITS

Exhibit 1. Lightning Switch Patent No. 6,630,894 B1, page 1.

Exhibit 2. (8 pages)

- Lightning Switch Catalog D13 (4 pages)
- Decorative Transmitters (1 page)
- Sample Transmitter and Receiver Technical Data (3 pages)

Exhibit 3. Survey by The Face Companies/PulseSwitch Systems: Comparative Installed Costs of Conventional Wired Switches vs. Lightning Switch for Commercial and Residential Applications (3 pages)

Exhibit 4. Two Articles Discussing The Partnership for Advancing Technology in Housing's (PATH) Selection of Lightning Switch (2 pages)

Exhibit 5. (5 pages)

- Three case Studies of Lightning Switch's successful application (1 page)
- Partial list of Lightning Switch projects (1 page)
- Pictures of the three case studies (3 pages)

EXHIBIT 1:
Lightning Switch Patent No. 6,630,894 B1, page 1

US006630894B1

(12) **United States Patent**
Boyd et al.

(10) **Patent No.: US 6,630,894 B1**
(45) **Date of Patent: Oct. 7, 2003**

(54) **SELF-POWERED SWITCHING DEVICE**

(75) Inventors: **Clark Davis Boyd**, Hampton, VA (US); **Bradbury R. Face**, Smithfield, VA (US); **Samuel A. Face, Jr.**, Norfolk, VA (US)

(73) Assignee: **Face International Corp.**, Norfolk, VA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 543 days.

(21) Appl. No.: **09/616,978**

(22) Filed: **Jul. 14, 2000**

(51) **Int. Cl.**[7] **H03M 11/00**; H03K 17/94

(52) **U.S. Cl.** **341/22**; 341/176; 310/311; 310/318

(58) **Field of Search** 341/22, 176, 825.69; 310/311, 314, 318; 367/157, 160

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,471,721 A * 12/1995 Haertling 29/25.35
5,605,336 A * 2/1997 Gaoiran et al. 273/445

* cited by examiner

Primary Examiner—Timothy Edwards
(74) *Attorney, Agent, or Firm*—David J Bolduc

(57) **ABSTRACT**

A self-powered switching device using a prestressed flextensional electroactive member generates a signal for activation of a latching relay. The electroactive member has a piezoelectric element with a convex and a concave face that may be compressed to generate an electrical pulse. The flextensional electroactive member and associated signal generation circuitry can be hardwired directly to the latching relay or may be coupled to a transmitter for sending an RF signal to a receiver which actuates the latching relay.

16 Claims, 5 Drawing Sheets

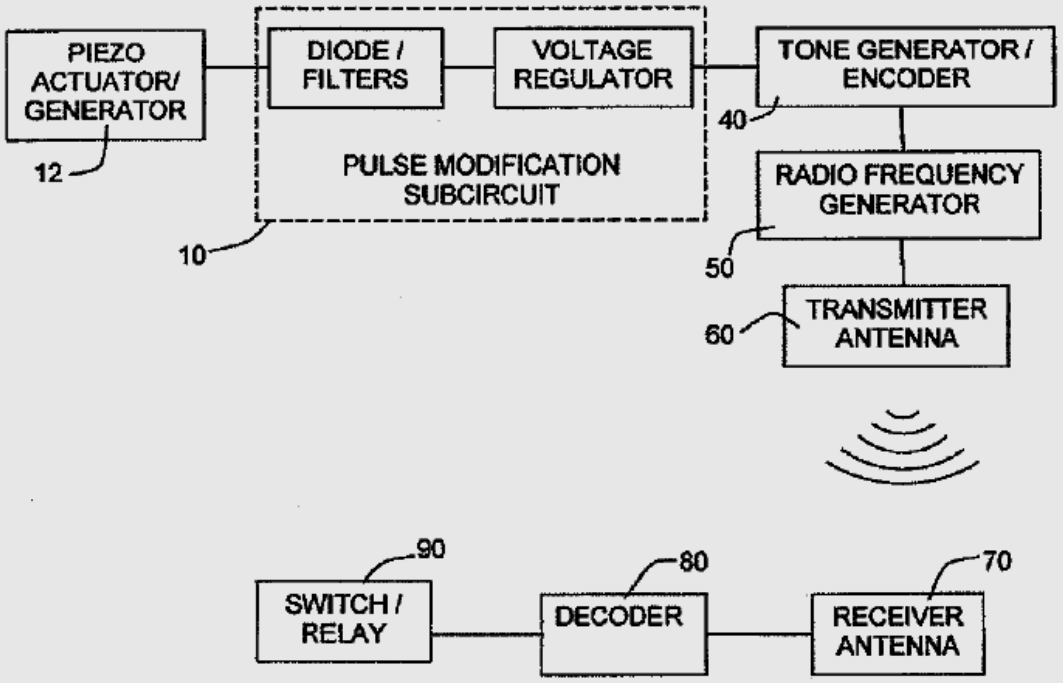
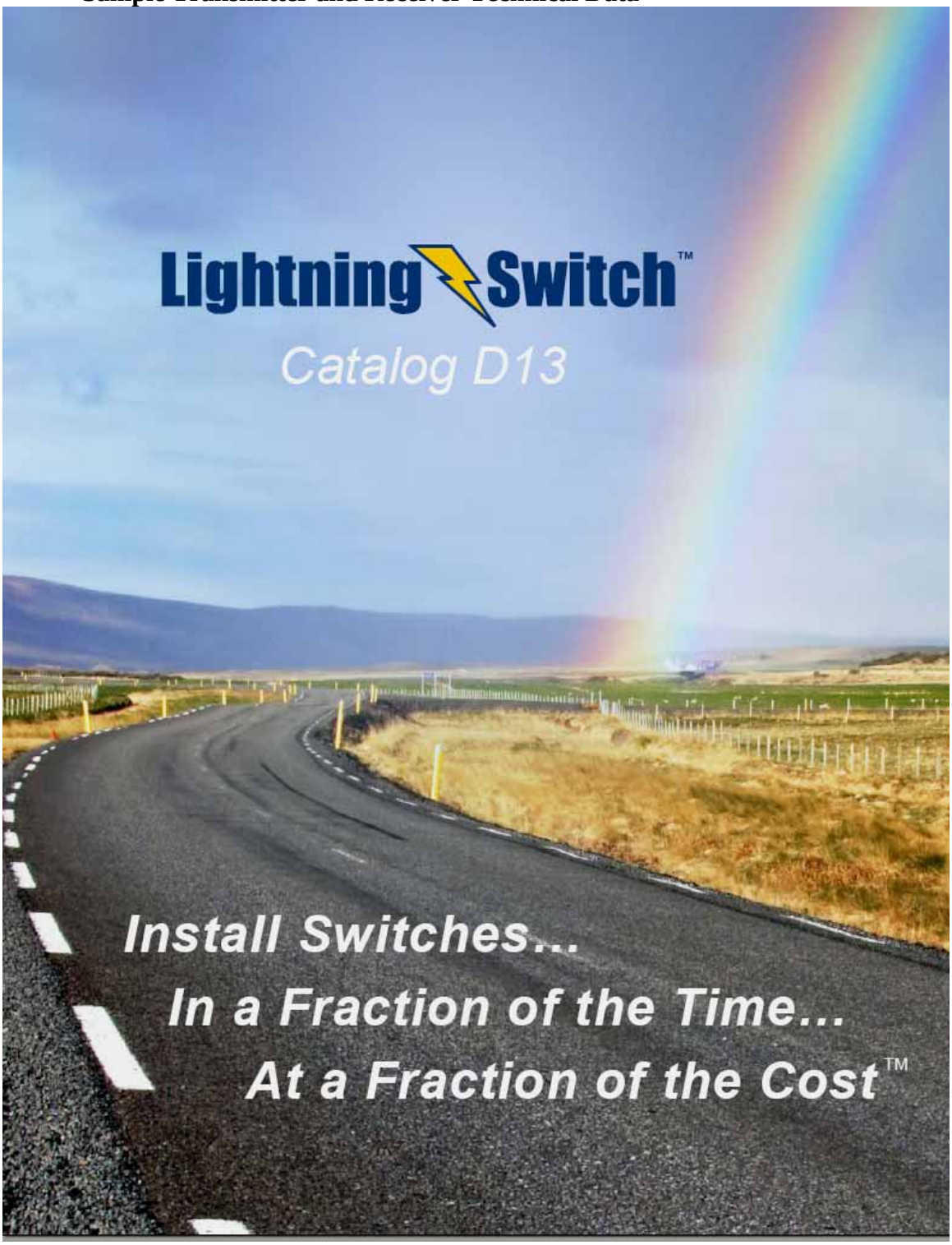


EXHIBIT 2:

- **Lightning Switch Catalog D13**
- **Decorative Transmitters**
- **Sample Transmitter and Receiver Technical Data**



Lightning Switch™ Transmitters



All Transmitters Available in Small & Large Plates

Lightning® Transmitter – "Same Room" Toggle
Mid-Range Transmission (45 to 60 ft. through Walls, Doors, etc.)
Small Plate

The Lightning Transmitter to use **WHEN THE TRANSMITTER AND RECEIVER ARE IN THE SAME ROOM.**

Can be affixed to the wall with the hardware or double-stick tape provided, left on a table or in a drawer - or carried in your pocket or purse.

Transmits a "Toggle" code – which commands Receivers to change state.

Available in White, Ivory, Brown, Red & Clear **Small Plate - $ 23.99**

TTMA1-WH (White) TTMA1-VY (Ivory) TTMA1-BR (Brown) TTMA1-RD (Red) TTMA1-CL (Clear)



All Transmitters Available in Large & Small Plates

Lightning® Transmitter – "Same Room" Toggle
Mid-Range Transmission (45 to 60 ft. through Walls, Doors, etc.)
Large Plate

The Transmitter for CONTROLLING A RECEIVER IN **THE SAME ROOM** - with a switch plate that's about the SAME SIZE AS A STANDARD U.S./CANADIAN SWITCH PLATE.

This Transmitter is specifically designed to screw onto the electrical box from which a mechanical light switch has been removed (so you don't have to leave a hole in your wall). If you aren't screwing this Transmitter onto an electrical box, this Transmitter can be affixed to the wall with the hardware or double-stick tap both of which are provided.

Transmits a "Toggle" code – which commands Receivers to change state.

Available in White, Ivory, Brown, Red & Clear **Large Plate - $ 24.99**

TTML1-WH (White) TTML1-VY (Ivory) TTML1-BR (Brown) TTML1-RD (Red) TTML1-CL (Clear)



Lightning® Transmitter – Toggle
Standard Range Transmission (75 to 100 ft. through Walls, Doors, etc.)
Small or Large Plate

"The Standard" Lightning Transmitter for CONTROLLING ONE RECEIVER.

Perfect for affixing to the wall (with the hardware or double-stick tape provided) for leaving on a table, in a drawer or carrying in your pocket or purse.

Transmits a "Toggle" code – which commands Receivers to change state.

Available in White, Ivory, Brown, Red & Clear **Small Plate - $26.99**
Large Plate - $27.99

Small Plates:	TTSA1-WH (White)	TSA1-VY (Ivory)	TTSA1-BR (Brown)	TTSA1-RD (Red)	TSA1-CL (Clear)
Large Plates:	TTSL1-WH (White)	TTSL1-VY (Ivory)	TTSL1-BR (Brown)	TTSL1-RD (Red)	TSL1-CL (Clear)

D13.0607

Prices Subject to Change Without Notice

Lightning Switch™ Transmitters (cont.)



Lightning® Transmitter – Double Toggle
Standard Range Transmission (75 to 100 ft. through Walls, Doors, etc.)
Small or Large Plate

The Lightning Transmitter to use to **SEPARATELY CONTROL TWO DIFFERENT RECEIVERS** from the same Transmitter. One Receiver can be commanded by one of the two Toggle buttons on this Transmitter – and another Receiver can be commanded by the second button. Can be affixed to the wall with the hardware or double-stick tape provided, left on a table or in a drawer - or carried in your pocket or purse. Transmits two different "Toggle" codes – commanding Receivers to change state.

Available in White, Ivory & Brown

Small Plate - $32.99
Large Plate - $33.99

Small Plates:	T2SA1-WH (White)	T2SA1-VY (Ivory)	T2SA1-BR (Brown)
Large Plates:	T2SL1-WH (White)	T2SL1-VY (Ivory)	T2SL1-BR (Brown)



Lightning® Transmitter – Main (for On/Off) Functions
Standard Range Transmission (75 to 100 ft. through Walls, Doors, etc.)
Small or Large Plate

This is the Lightning Transmitter to use to **CONTROL TWO OR MORE RECEIVERS AS A GROUP... or to control one or more Receivers that you can't see.**

This Transmitter emits "Turn On" or "Turn Off" codes - depending on where you place your finger – not to change state, the command emitted by Toggle Transmitters. Can be affixed to the wall with the hardware or double-stick tape provided, left on a table or in a drawer - or carried in your pocket or purse. Transmits "On" and "Off" codes to one or more Receivers.

Available in White, Ivory & Brown

Small Plate - $29.99
Large Plate - $30.99

Small Plates:	TMSA1-WH (White)	TMSA1-VY (Ivory)	TMSA1-BR (Brown)
Large Plates:	TMSL1-WH (White)	TMSL1-VY (Ivory)	TMSL1-BR (Brown)



Lightning® Transmitter – On / Call
Standard Range Transmission (75 to 100 ft. through Walls, Doors, etc.)
Small or Large Plate

This Transmitter emits ONLY an "On" signal. It is designed to be used as a simple **paging, call, alert or announce** button.

Applications include "call" buttons, "announce" buttons for waiting rooms in doctors' offices or "attention needed" buttons in offices, factories, warehouses, etc.

Installations using one or more On/Call Transmitters require at least one Receiver & at least one Main (On/Off) Transmitter to turn "Off" the Receiver(s).

Available in White, Ivory, Brown, Clear & Red

Small Plate - $29.99
Large Plate - $30.99

Small Plates:	TNSA1-WH (White)	TNSA1-VY (Ivory)	TNSA1-BR (Brown)	TNSA1-RD (Red)	TNSA1-CL (Clear)
Large Plates:	TNSL1-WH (White)	TNSL1-VY (Ivory)	TNSL1-BR (Brown)	TNSL1-RD (Red)	TNSL1-CL (Clear)

D13.0607

Prices Subject to Change Without Notice

Lightning Switch™ Transmitter Plates

Lightning Switch Transmitter Plates Are Interchangeable--
Large Plate Transmitters Can Be Changed into Small Plate Transmitters and vice versa.

Small Replacement Plate - $0.75 **Large Replacement Plate - $1.00**

Small Replacement Plates:	FC1A1-WH (White)	FC1A1-VY (Ivory)	FC1A1-BR (Brown)	FC1A1-RD (Red)	FC1A1-CL (Clear)
Large Replacement Plates:	FC1L1-WH (White)	FC1L1-VY (Ivory)	FC1L1-BR (Brown)	FC1L1-RD (Red)	FC1L1-CL (Clear)

Lightning Switch™ Receivers

Home Grade Receivers Feature Standard Radio Frequency "Noise" Filters.
Professional Grade Receivers Feature Enhanced "Noise" Filters. Allowing Reliable Operation Even in High RF Noise Environments & Resulting in 33% Longer Transmission Distances in Normal RF Environments



Lightning® Toggle / Main (On/Off) Plug-In Receiver (110V)

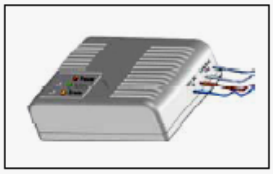
Plugs-in to any 3-prong, 110/120 volt US/Canadian outlet. UL rated at 500 watts.

The **Main Receiver** responds to commands from both "TOGGLE" AND "MAIN (ON/OFF)" Transmitters.

Available in White, Ivory & Brown

Toggle / Main Plug-In Receiver (110V) HOME GRADE $ 33.99
Toggle / Main Plug-In Receiver (110V) PROFESSIONAL GRADE $ 42.99

Home Grade:	RMP115H1-WH (White)	RMP115H1-VY (Ivory)	RMP115H1-BR (Brown)
Pro Grade:	RMP115P1-WH (White)	RMP115P1-VY (Ivory)	RMP115P1-BR (Brown)



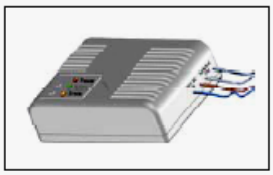
Lightning® Toggle / Main (On/Off) Wire-In Receiver (110 V)

Wires-in to 110/120 volt US/Canadian power sources. UL rated at 500 watts.

The **Main Receiver** responds to commands from both "TOGGLE" AND "MAIN (ON/OFF)" Transmitters.

Toggle / Main Wire-In Receiver (110V) HOME GRADE $ 33.99
Toggle / Main Wire-In Receiver (110V) PROFESSIONAL GRADE $ 42.99

Home Grade: RMW115H1 Pro Grade: RMW115P1



Lightning® Toggle / Main (On/Off) Wire-In Receiver (12 V)

Operates in range from 10V to 14V. Maximum 84 watts.

The **Main Receiver** responds to commands from both "TOGGLE" AND "MAIN (ON/OFF)" Transmitters.

Toggle / Main Wire-In Receiver (12V) HOME GRADE $ 33.99
Toggle / Main Wire-In Receiver (12V) PROFESSIONAL GRADE $ 42.99

Home Grade: RMW12H1 Pro Grade: RMW12P1

D13.0607

Prices Subject to Change Without Notice

Lightning Switch Decorative Transmitters

To Be Released in Late 2006

Surface Mounted





Recess Mounted







Receiver

Plug-In – Toggle /Main (On/Off)
110V/500W – Professional Grade

Product #
RMP115P1-WH (White)
RMP115P1-VY (Ivory)
RMP115P1-BR (Brown)

Power Supply:	110V to 120V AC
Power Rating:	500 watts (4.16 amps)
Operating Frequency:	434MHz
Transmitter Commands Obeyed:	Toggle, On, Off *Contained in Unique 32-bit Code*
Maximum Transmitters Obeyed:	30 Different Lightning Transmitters per Receiver
Transmission Range*:	
Used with Same Room Toggle Transmitter	45 feet (14 meters) through Obstructions in 99% of Installations / Actuations 60 feet (18 meters) through Obstructions in 95% of Installations / Actuations
Used with All Other Lightning Transmitters	75 feet (23 meters) through Obstructions in 99% of Installations / Actuations 100 feet (30 meters) through Obstructions in 95% of Installations / Actuations Up to 150–250 feet (45–75 meters) through Air
Transmission Range Limiting Factors*:	Metal Walls, Structures & Appliances Severe Radio Frequency Interference
Receiver Operating Temperature:	-40°F to 185°F (-40°C to 85°C)
Receiver Color Options:	White, Ivory, Brown
Receiver Weight:	4.2oz (119.1g)
Receiver Dimensions:	**H:** 3.5" **W:** 2.9" **D:** 1.18" (housing) **D:** 2.00" (to tip of ground plug) **H:** 89mm **W:** 74mm **D:** 30mm (housing) **D:** 50mm (to tip of ground plug)
Mounting:	Plugged into 110V/120V Outlet
Regulatory Approval/Safety Certification:	FCC / UL (United States); IC / UL (Canada)

Power & Current Draw

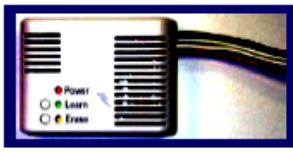
Voltage	Power(On)	Current(On)	Power(Off)	Current(Off)
110V/60Hz	0.8W	26mA	0.8W	26mA
120V/60Hz	0.9W	29~30mA	0.9W	29~30mA

* **Comments on Transmitter Range:** The performance of all radio frequency devices is affected by environmental conditions. Lightning® Switch products have been designed to be highly dependable in the great majority of installations. Transmission ranges listed above were achieved in field testing including transmissions through as many as four walls/floors at once, including 16-inch brick walls. Actual transmission ranges achieved during field testing were often much farther than the distances listed. In a small number of installations, the placement of Lightning® Transmitters and Receivers can be critical. If transmissions are attempted through metal walls and/or appliances, transmission range may be greatly reduced. An extraordinary amount of radio frequency interference ("noise") can also be a problem (Lightning® Professional Grade Receivers are designed to overcome almost any RF noise problem).

V.060701

Technical Data

Lightning Switch™



Receiver

Product #
RMW115P1

Wire-In – Toggle/Main (On/Off)
110V/500W – Professional Grade

Power Supply:	110V to 120V AC
Power Rating:	500 watts (4.16 amps)
Operating Frequency:	434MHz
Transmitter Commands Obeyed:	Toggle, On, Off *Contained in Unique 32-bit Code*
Maximum Transmitters Obeyed:	30 Different Lightning Transmitters per Receiver
Transmission Range*:	
Used with Same Room Toggle Transmitter	45 feet (14 meters) through Obstructions in 99% of Installations / Actuations 60 feet (18 meters) through Obstructions in 95% of Installations / Actuations
Used with All Other Lightning Transmitters	75 feet (23 meters) through Obstructions in 99% of Installations / Actuations 100 feet (30 meters) through Obstructions in 95% of Installations / Actuations Up to 150–250 feet (45–75 meters) through Air
Transmission Range Limiting Factors*:	Metal Walls, Structures & Appliances Severe Radio Frequency Interference
Receiver Operating Temperature:	-40°F to 185°F (-40°C to 85°C)
Receiver Color:	White
Receiver Weight:	2.5oz (70.9g)
Receiver Dimensions:	**H:** 2.25″ **W:** 3.0″ **D:** 1.08″ **H:** 57mm **W:** 76mm **D:** 27mm
Mounting:	Wired into 110V/120V Electrical Junction Box
Regulatory Approval/Safety Certification:	FCC / UL (United States); IC / UL (Canada)

Power & Current Draw

Voltage	Power(On)	Current(On)	Power(Off)	Current(Off)
110V/60Hz	0.8W	26~27mA	0.8W	26~27mA
120V/60Hz	0.9~1W	29~30mA	0.9~1W	29~30mA

*** Comments on Transmitter Range:** The performance of all radio frequency devices is affected by environmental conditions. Lightning® Switch products have been designed to be highly dependable in the great majority of installations. Transmission ranges listed above were achieved in field testing including transmissions through as many as four walls/floors at once, including 16-inch brick walls. Actual transmission ranges achieved during field testing were often much farther than the distances listed. In a small number of installations, the placement of Lightning® Transmitters and Receivers can be critical. If transmissions are attempted through metal walls and/or appliances, transmission range may be greatly reduced. An extraordinary amount of radio frequency interference ("noise") can also be a problem (Lightning® Professional Grade Receivers are designed to overcome almost any RF noise problem).

V.060701

Technical Data

Lightning Switch™

EXHIBIT 3:

Survey by The Face Companies/PulseSwitch Systems: Comparative Installed Costs of Conventional Wired Switches vs. Lightning Switch for New Construction and Renovation/Repair on Commercial and Residential Projects



Comparative Installed Costs of Switch Controls

Conventional Wired Switches vs. Lightning Switch

RESIDENTIAL

	NEW CONSTRUCTION			RENOVATION / REPAIR		
	Low Cost	Most Common Cost	High Cost	Low Cost	Most Common Cost	High Cost
Single Pole Switch - Conventional Wiring	$31	$63	$102	$100	$162	$250
"Single Pole" Lightning Switch (Pro Grade - Full Retail)	$92	$96	$100	$96	$100	$104
"Single Pole" Lightning Switch (Home Grade - Full Retail)	$80	$84	$88	$84	$88	$92
"Single Pole" Lightning Switch (Pro Grade - Hi Wholesale)	$83	$87	$91	$87	$91	$107
"Single Pole" Lightning Switch (Home Grade - Hi Wholesale)	$69	$73	$77	$73	$77	$93
"Single Pole" Lightning Switch (Pro Grade - Lo Wholesale)	$70	$74	$78	$74	$78	$94
"Single Pole" Lightning Switch (Home Grade - Lo Wholesale)	$58	$62	$66	$62	$66	$82
3-Way Switch - Conventional Wiring	$60	$97	$176	$175	$322	$650
3-Way Lightning Switch (Pro Grade - Full Retail)	$129	$133	$187	$133	$137	$203
3-Way Lightning Switch (Home Grade - Full Retail)	$111	$115	$168	$115	$119	$184
3-Way Lightning Switch (Pro Grade - Hi Wholesale)	$117	$121	$170	$121	$125	$186
3-Way Lightning Switch (Home Grade - Hi Wholesale)	$100	$104	$153	$104	$108	$169
3-Way Lightning Switch (Pro Grade - Lo Wholesale)	$99	$103	$144	$103	$107	$160
3-Way Lightning Switch (Home Grade - Lo Wholesale)	$85	$89	$130	$85	$89	$142
4-Way Switch - Conventional Wiring	$74	$130	$224	$259	$463	$800
4-Way Lightning Switch (Pro Grade - Full Retail)	$233	$237	$241	$237	$253	$319
4-Way Lightning Switch (Home Grade - Full Retail)	$203	$207	$211	$207	$223	$289
4-Way Lightning Switch (Pro Grade - Hi Wholesale)	$212	$216	$220	$216	$269	$330
4-Way Lightning Switch (Home Grade - Hi Wholesale)	$183	$187	$191	$187	$240	$301
4-Way Lightning Switch (Pro Grade - Lo Wholesale)	$179	$183	$187	$183	$229	$282
4-Way Lightning Switch (Home Grade - Lo Wholesale)	$162	$166	$170	$166	$212	$265
100-ft. Trench Switch - Conventional Wiring	$200	$357	$457	$300	$408	$500
100-ft. Lightning Switch (Pro Grade - Full Retail)	$154	$162	$228	$158	$162	$216
100-ft. Lightning Switch (Home Grade - Full Retail)	N/A	N/A	N/A	N/A	N/A	N/A
100-ft. Lightning Switch (Pro Grade - Hi Wholesale)	$139	$147	$208	$143	$147	$196
100-ft. Lightning Switch (Home Grade - Hi Wholesale)	N/A	N/A	N/A	N/A	N/A	N/A
100-ft. Lightning Switch (Pro Grade - Lo Wholesale)	$116	$124	$178	$120	$124	$166
100-ft. Lightning Switch (Home Grade - Lo Wholesale)	N/A	N/A	N/A	N/A	N/A	N/A

— Less Expensive
— Savings of 25-45%
— Savings of 50-58%
— Savings of 60-69%
— Savings of 70-79%
— Savings of 80+%

NOTES: These are the results of an ongoing survey of electrical contractors in several states. They have been asked to provide detailed estimates (labor and materials) for various switch installations in new construction and in Renovation/Repair. NECA (National Electrical Contractors Assn.) estimating software and databases were employed, as well. "Low Cost" means the lowest cost that any of the contractors reported that they might charge in the simplest installation in the category. "Most Common Cost" is an average of all of the responses to the question, "what is your typical charge for this type of installation?" "High Cost" is the highest charge any contractor reported that he might charge for the most difficult installation in the category. The costs for the Lightning Switch installations assume different grades of Lightning Switch products... and different prices that the contractor might pay for the Lightning products before marking them up for re-sale. A large contractor may be able to purchase Lightning products for 10% (Hi Wholesale) or 25% (Lo Wholesale) off suggested retail price, before marking them up to calculate the cost of materials. Renovation/Repair costs for conventional wiring include some -- *but not extensive* -- demolition and repair of plaster walls, etc. The differences between Low, Most Common and High Costs of Lightning Switch installations result from some increased labor costs in more difficult jobs (to move ladders for high ceilings, etc.) and, sometimes, the inclusion of extra system repeaters for installations in larger buildings.

09/29/2006

Some Details of the Survey:

- The results in Exhibit 3 are preliminary and are based on the responses of 16 contractors in six states: FL, VA, IL, MO, KS and PA

- This survey will continue for several more months.
- The Face Companies chose to use The NECA Manual of Labor Units (MLU) to validate their survey results because it has long been the standard in the industry, and its prominence among other estimating data sources is well documented. Biennially, a panel of estimating experts reviews and revises the data in the MLU. The MLU has software that allows an estimator determine what various kinds of jobs will cost in terms of labor units (minutes and hours). Each survey respondent provides his/her loaded labor rate and bill of materials.

- Market to market, the data for new construction installations are much more consistent than Repair/Renovation because working conditions on a new project are much easier to predict.

- The reported Repair / Renovation figures for switch installation generally do not include much for the repair of walls and ceilings that may have been penetrated in making the electrical installation. PulseSwitch generally hears from Clients that they have prevented the demolition of walls and ceilings that would have resulted in the need to repair and then repaint the entire wall and/or ceiling. This would have cost the Client hundreds of dollars more than the electrician's bill. But, since the electrical contractor generally does not quote such a repair (as mentioned in the NOTES section of the survey results) the quoted prices in most cases include only refilling holes that were created during the electrical installation.
- It is important to note that these are surveys from contractors, groups of contractors and the NECA – the National Electrical Contractors Association. Everyone participating in this survey anticipates buying Lightning Switch products and marking them up before adding them to the cost of the job. The cost of installing Lightning Switch products for a company or government agency with its own maintenance department or a do-it-your-selfer would be substantially lower than the costs indicated on these sheets. The Face Companies wanted to make sure that in this survey they were comparing apples to apples.

EXHIBIT 4:

Two Articles Discussing The Partnership for Advancing Technology in Housing's (PATH) Selection of Lightning Switch (2 pages)



Lightning Switch™

PulseSwitch Systems Has Been Selected to Join The Partnership for Advancing Technology in Housing (PATH)

Coordinated by the U.S Department of Housing & Urban Development (HUD)

PATH is a voluntary partnership among leaders of the homebuilding, product manufacturing, insurance, and financial industries and representatives of Federal agencies concerned with housing. Working together, PATH partners improve new and existing homes and strengthen the technology infrastructure of the United States.

PATH is dedicated to accelerating the development and use of technologies that radically improve the quality, durability, energy efficiency, environmental performance, and affordability of America's housing.

HUD's Office of Policy Development and Research (PD&R) coordinates all PATH activities. PD&R manages PATH's budget, strategy, and daily operations. Staff in PD&R's Affordable Housing Research and Technology Division have expertise in various construction systems, housing issues, and technology policies.

Because PATH involves many participants from diverse parts of the home building community, PATH seeks guidance from the Industry Committee and other Federal agencies. PATH also works with industry partners to advance housing technology.

Why is PATH Needed?

Despite the importance of the housing industry to the American economy, there is very little investment in residential technologies. This is especially true of the single-family homes that make up most of America's housing stock.

It can take 10 to 25 years for a new housing technology to achieve full market penetration. PATH looks at the issues and barriers related to technology development in the housing industry and strives for viable cost-effective solutions.

How Does PATH Accelerate the Adoption of Housing Technologies?

PATH promotes innovation through three key strategies:

Identify and reduce barriers that impede innovation, including regulatory barriers. PATH analyzes and prioritizes existing barriers to provide recommendations for overcoming them.

Disseminate information to speed the development and adoption of advanced building technologies. To encourage broader diffusion of innovations, PATH provides unbiased, easily accessible information to consumers, builders and manufacturers.

Advance housing technology research and foster development of new technology. PATH research focuses on the innovation process and aims to institutionalize sustained investments in housing with public and private funding.

PulseSwitch Systems • 427 West 35th Street • Norfolk, VA 23508 USA
Telephone: 1-88-89-LIGHTNING (1-888-954-4486) • Fax: 757.624.2128 • Email: Feedback@LightningSwitch.com

PATH
A Public-Private Partnership for Advancing Housing Technology



Lightning Switch™

Why Has PATH Offered to "Accelerate the Acceptance and Market Gain" of Lightning Switch?

PATH researched and reviewed literally hundreds products in order to identify products that might benefit from commercialization assistance.

Lightning Switch from PulseSwitch Systems was chosen as one of only 10 products "that in (PATH's) estimation could have a significant benefit to the residential construction industry and are in a stage of commercialization" in which PATH's assistance could be beneficial.

www.PathNet.org

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EXHIBIT 5:

- **Three Lightning Switch Cases**
- **Partial list of projects where Lightning Switch has been used**
- **Photographs of the three Lightning Switch Cases**

CASE #1

The largest project using Lightning Switch to date is Sprint's use of the product to control retail displays in existing stores across the United States. According to the electrical supplier who packaged the solution for Sprint, the only other viable alternative for Sprint was the wiring of six new outlets in each store, which was estimated to cost about $500 per outlet or $3,000 per store and would have taken a day to a day and a half.

The retail list cost of the Lightning Switch products provided to accomplish the same thing was less than $300, with essentially no installation time (less than 15 minutes). So, the cost savings on this project (assuming retail list cost was paid) was about $2,700 or about 90% and in terms of timesavings was close to 100%.

CASE #2

Nyloboard is a Georgia-based firm that is using Lightning Switches in its line of new homes built using the company's NyloPrime™ products.

NyloPrime is similar in dimension and application to plywood and sheetrock, but NyloPrime is made from recycled nylon carpeting. NyloPrime is a composite panel that is resistant to Water, Mold, Termites, and Bacteria. It is a non-porous material; therefore, it will not absorb water, rot, delaminate or edge-swell. Since NyloPrime is manufactured from recycled nylon fibers and resins, it is not a food source for insects or bacteria.

Nyloboard also makes NyloPrime SIPs, which consist of a thick layer of closed cell foam sandwiched between two NyloPrime panels. This creates simplicity during construction for walls, floors, and roofs. It also creates stud-free walls, so Nyloboard confronted the problem of what to do with the electrical wiring. Part of the solution was to eliminate the switch wiring by using Lightning Switches to control the switched lights and small appliances in each of their new homes.

CASE #3

Bruce Tyler is a principal of Baskervill, a Richmond, Virginia architect/engineering firm specializing in the design of commercial buildings.

Mr. Tyler has urged PulseSwitch to create Lightning Switch products to service the commercial lighting market. (Those products should be introduced later this year.)
In the meantime, Mr. Tyler purchased Lightning products for use in his own home. His application is a popular one among Lightning Switch Clients: controlling landscape lighting without having to wire through the side of the dwelling and, perhaps, trenching through the yard.

Partial list of Lightning Switch Projects

-- ALTANA, Inc. – Melville, NY

(Factory floor calling system)

-- City of Lake Oswego – Lake Oswego, OR

(Citizen needs assistance indicator)

-- DeSalvatore Residence – Bandon-by-the-Sea, OR

(Controls for those with limited mobility)

-- Gealt Residence – Queensbury, NY

(Restoration of 19th century farmhouse)

-- Genie Industries – Redmond, WA

(Office system)

-- Gregg Stephens Design – Santa Fe, NM

(Residential renovation projects)

-- Petitt Residence – Winston-Salem, NC

(Residential renovation project)

-- Richard Petty Driving Experience – Concord, NC

(Track pit area indicator controls)

Sprint Retail Locations











Nyloboard Homes











Bruce Tyler Residence



