Professional wireless firing systems for pyrotechnics

Radio-controlled fireworks: maximum precision and safety thanks to wireless firing systems

Traditional fuses are a thing of the past in modern pyrotechnics. Today, radio and computer systems can be perfectly synchronized with the rhythms of a stage performance or the shots fired from a dummy pistol during a play. Thanks to digital radio firing systems, large-scale firework shows as well as movie and stage pyrotechnics are now safer than ever for everyone involved.

When Robbie Williams performs “Let Me Entertain You” as an encore at open-air performances during his “Close Encounters” tour, comets light up the stage with breathtaking accuracy. It is no surprise that fireworks and stage lighting are controlled by computers these days. Cables are no longer used to link the pyrotechnician’s console to the broad network of fuses. Today, these systems are almost completely radio-controlled. Digital wireless technology not only eliminates potential wiring errors, it also opens up completely new possibilities, such as explosions and firework effects on moving, rotating stages and water vehicles or pontoons.

For many years, wireless pyrotechnics had one disadvantage. Radio applications were prone to errors. Even today, this is what separates the wheat from the chaff among providers. Most wireless firing systems with basic standard components use radio modems based on broadband data communication. After all, PC radio systems are designed to exchange maximum amounts of data in short periods of time. In addition, broadband systems are much cheaper to produce because their frequency-determining components and filters do not require such narrow tolerances. But the consequences are often catastrophic, especially in time-critical applications: mobile phones or other nearby transmitters can easily interfere with these simple systems. Furthermore, such systems often have insufficient band-pass filters, resulting in low resistance to interference.

Reliable and immediate

“On the other hand, you don’t need to send megabits of data through the ether every second to set off fireworks,” explains Ralph Kränzle, General Manager of **firing system specialists Galaxis Showtechnik**. “It’s more important to make sure that the ignition signal is reliably transmitted at exactly the right moment.” For this reason, Galaxis Showtechnik employs high-quality and safe components. The Galaxis devices use radio components from low-power **radio component specialists Circuit Design**. Although these devices send and receive data in the licence-free ISM band, between 433.05 MHz and 434.79 MHz, they make use of the fringe frequencies that are normally not used for garage door openers, etc. As a result, the choice of frequency alone almost completely eliminates the possibility of interference from external devices.

Instead of using cheaper but more interference-prone amplitude modulation, the high-quality Circuit Design modules also feature frequency modulation with a narrow-band modulating range of only ± 3 kHz. Digital coding is another key feature. A command can be transmitted with a low bit rate of 4,800 bps. More importantly, signals are transmitted with a minimal time delay of just a few milliseconds. A command consists of 72 transferred bits, 40 of which are transmitted as a

CRC checksum. “So if an external device does cause a carrier wave on a 'pyro frequency,' the worst that could happen is that the transmitter and the receiver will be unable to communicate, and the command will not be triggered. But there's absolutely no chance of a misfire,” says Ralph Kränzle.

Wireless technology replaces copper cables, following the trend in the telecommunications industry

Professional pyrotechnics applications never use burning fuses like those on New Year's Eve fireworks. On such traditional fireworks, copper cables ensure that the electric ignition signal is transmitted safely. In modern wireless systems, these cables simply bridge the last few metres between the radio receiver and the explosive compound. This eliminates the need for lines spanning hundreds of metres, or even several kilometres when the whole fireworks display is considered. A reusable wireless system also offers advantages from the standpoint of material costs.

Modern pyrotechnics are used for more than just spectacular fireworks displays. The other major application is creating special effects in movies or live stage performances, where pyrotechnics systems are sometimes almost completely wireless. For example, Galaxis Showtechnik's PFE Profi is a miniature radio-control receiver that responds to sounds. The device is worn on the actor’s body. When it registers the loud bang of a pistol, it fires in perfect synchronisation in order to "detonate" a bullet hole and packet of fake blood for a truly realistic scene. However, a single PFE Profi receiver is not sufficient for more complex scenes. For example, when shots are exchanged, pyrotechnic effects have to be coordinated from a central location. Here, prevention of misfires in radio receivers is an even more important safety issue than preventing such accidents in fireworks applications. Because the device is worn directly on the body, it has to fire 100% correctly all the time, not only because budgets can be ruined if scenes have to be repeated. In extreme cases, people’s lives can be at stake.

“As far back as the mid-90s, we started doing very intensive tests on the different radio solutions available on the market," recalls Ralph Kränze. “Safety was the most important issue. We were looking for a specialist in narrow-band, high-precision radio transmitters, and that’s when we discovered Circuit Design.” As a result, Galaxis Showtechnik has been using Circuit Design’s transmitter and receiver systems since 1997. The technology has also become more and more sophisticated over the past decade. For example, Circuit Design's product range now includes devices featuring transceiver technology. As a result, ignition devices using a semiduplex system can also return status messages and data. This compensates for the last remaining advantage provided by copper cables used in the past. The narrow-band radio systems can span a radius of up to 800 metres, even two kilometres when a high-gain antenna is used. However, without a visible cable, it was much more difficult to determine precisely where this radius ended. Now, radio systems enable two-way communication and ignition receivers can respond with a signal letting the system know they are also “online.”

Contact

Galaxis Showtechnik GmbH
www.galaxis-showtechnik.de

Circuit Design GmbH
www.circuitdesign.de