

Pepperl+Fuchs GmbH – Lilienthalstrasse 200 – 68307 Mannheim – Germany

Please quote the following contact information when publishing:

Tel.: +49 621 776-2222, Fax: +49 621 776-27-2222, www.pepperl-fuchs.com, pa-info@de.pepperl-fuchs.com

Editorial contact: Christa Blas (extension: -1420, fax: -1108), cblas@de.pepperl-fuchs.com

New Chapter in Explosion Protection

DART opens up new fields of application

Intrinsic safety also means limited power – at least in terms of the current state-of-the-art technology. With Dynamic Arc Recognition and Termination (DART), however, things are about to change. The system makes use of the typical characteristic of the current flow that occurs during the formation of a spark and switches off the electric circuit within microseconds. The two versions, DART Power and DART Fieldbus, not only provide the opportunity to equip many existing process automation applications with intrinsic safety, they also open up new fields of application where explosion protection was previously achieved only at considerable expense and with major compromises. As the leading development partner for the DART project, Pepperl+Fuchs discussed the advantages and possibilities of the new technology with users and potential system partners at the last Hanover Fair.

Dynamic Arc Recognition and Termination was one of the main topics for the process industry at the Hanover Fair 2008. This technology eliminates the existing tight power limitations and makes it possible to operate with power ratings of up to 50 W possible in explosion-hazardous areas. This is a prospect that many users appreciate and that enabled DART to be among the five candidates nominated for the prestigious Hermes Award.

Dr. Gunther Kegel, Chief Executive Officer at Pepperl+Fuchs maintains that, “DART is an innovative concept that redefines explosion protection.” The technology is currently in the final stage of development. Pepperl+Fuchs assumes that the first products will be available as early as 2009, and they will open new fields of application.

DART is the result of a research project funded by the German Federal Ministry of Economics and Labor, in which Pepperl+Fuchs was extensively involved. However, despite the company's key contribution towards bringing this exciting new technology to market-

readiness, one manufacturer alone will not be able to commercialize its breakthrough onto the broader market. Kegel is aware of this fact, “As a single manufacturer, we will not succeed in achieving this in isolation. We are, therefore, interested in making this technology available to competitors and other industry stakeholders via license models.”

Switching-off in place of limitation

According to IEC 60079-11 a current circuit is intrinsically safe when it is assured, according to specifically defined criteria, that a spark or other thermal effect will not cause ignition during normal operation or in the event of a fault such as a short circuit or lead break, or an internal malfunction of a connected device.

In intrinsic safety ignition protection class (Ex i), the formation of incentive sparks in explosion-hazardous areas is primarily ensured by limiting the available effective power to less than 2 W. However, this limitation actually restricts the suitable fields of application. The protection class in question has been used primarily in the field of instrumentation and control technology, as well as for the power supply of actuators and sensors with low power ratings.

In current circuits protected with DART, field devices with a power consumption of up to 50 W can be used even in explosion-hazardous areas. DART is able to detect faults in the electrical system at the outset and switches the circuit off before the current flow reaches a safety-critical amplitude.

DART detects the spark by virtue of a sudden current change, which exhibits a specific characteristic signature. Compared to fast-switching systems that react to under voltage alone, which were also presented in Hanover, DART responds to the current change and above a critical level. DART switches off the current circuit within microseconds, before the spark's temperature is sufficient for ignition. The underlying physics are as simple as they are clear:

- The characteristic electrical signal of the forming spark
- The wave velocity of 160,000 km/s, at which this signal is transmitted via the power supply cable
- The electronic switch, which triggers within microseconds

The wave velocity also determines that the length of the line has a significant influence on the available power from an explosion protection point-of-view. The signal run time must be added to the switch-off time of the electronic switch.

Investigations by the German national metrology institute *Physikalisch Technische Bundesanstalt* (PTB) in Braunschweig have found that the currently documented testing methods and the spark testing apparatus for dynamically acting sources are not suitable for these types of circuits. The solution, which will be supported by further studies, is an electronic spark simulator developed by the PTB, as well as the associated new testing procedures. These will make it possible to verify intrinsic safety. The new testing procedures will be included in the current standards cycle.

The advantages of DART come into play where existing explosion protection methods make working processes difficult or the costs for explosion protection are comparatively high. Two versions of this technology have, therefore, been developed initially for different purposes.

DART Power

The DART Power version will make it possible to use devices with higher power requirements in explosion-hazardous areas without requiring special, sophisticated safety measures. Typical examples include industrial PCs, operating terminals, displays, lighting systems, sensors with high power requirements, analysis devices, high-performance solenoid valves, and servo motors.

A topology is used that consists of only four components: a power supply, a cable and the load, in which a decoupling element is integrated. Depending on the current and the length of the line, effective powers of up to 50 W can be made available.

DART Fieldbus

DART Fieldbus is a self-contained solution, that will make it possible to greatly increase the currently achievable power via the FOUNDATION fieldbus H1 and PROFIBUS PA, without the disadvantages associated with the increased safety ignition protection class (Ex e).

Today, the High-Power Trunk Concept requires installation of the trunk with increased safety levels, while the fieldbus installation technology ensures intrinsically safe Ex ia limitation. Now, DART is used to protect the trunk and renders it intrinsically safe. This version was primarily developed for protection of investment, as it can be connected to all existing field devices, provided they comply with the established Entity explosion protection concept.

Virtually all field devices designed for intrinsically safe power supply today meet the Entity criteria. Consequently, the maximum permissible voltage of 24 volts according to Entity has been chosen for the DART fieldbus power supply, ensuring compatibility with virtually all field devices on the market. Using DART, fieldbus line lengths of up to 1000 meters can be achieved with up to 24 loads and a combined connected rating of 8 W per segment.

Decoupling of interference

A DART circuit is comprised of three main components: power supply, connection lines, and loads. The length of the line and, therefore, the run time of the signal on the line have a decisive influence on the response time during detection of spark formation. However, the behavior of the load itself can also lead to ambiguous signal patterns.

DART compensates for this because the load is not connected directly to the cable, but via a decoupling module. This module is integrated directly in the load. It ensures clearly-defined electrical behavior and enables "soft" start-up of the load with a limited current rise in order to provide the DART system a signal free of interferences from the load for switching off the power supply in the event of spark formation.

Base technology for a new generation

To summarize, DART offers a simple and cost-effective method for overcoming the previous power limitations of intrinsically safe field devices. This paves the way for devices with intrinsically safe connections in explosion-hazardous areas, enabling power consumptions many times higher than those currently possible.

DART will ring in a new era in process automation and make possible an entire range of new applications. "The High-Power Trunk, which today requires increased safety installation provisions, can now be implemented as an intrinsically-safe installation, without having to compromise on the available power," explains Michael Kessler, director of the Components and Technology division at Pepperl+Fuchs. "Furthermore, DART opens up the possibility for many other applications in the process industry, such as valve control, scales, and emergency lighting."

First applications under discussion

In the context of a technology exhibition Interkama+ 2008 in Hanover, Pepperl+Fuchs experts debated with experts from manufacturers, end-users and notified bodies on the advantages of DART for applications in which explosion protection has previously been associated with extensive installation costs and other disadvantages.

A typical example is analytic technology where, until now, the necessary sensors often must be installed in special bypass pipes. With DART, measurement could be carried out directly in the medium, as the connections of the moveable tanks can be detached. "In this example application, the bypass pipe and its installation are unnecessary, but even more importantly, the operating costs for cleaning are saved and measuring accuracy is increased," is how Andreas Hennecke, Product Marketing Manager, Fieldbus Technology Pepperl+Fuchs, describes the benefits.

The replacement of four-wire technology through intrinsically safe two-wire technology was also discussed frequently at Hannover. Valve islands with fieldbus coupling benefit from DART through simplified installation technology. An amplifying stage is unnecessary and more rapid valve switching is possible. Energy-hungry, fieldbus-compatible field devices from scales to Coriolis flow meters can be connected to fieldbus segments thanks to DART. Operating terminals or mobile PCs equipped with an intrinsically safe Ethernet port and power supply are also feasible.

Pepperl+Fuchs is open to a dialog with users, manufacturers and technological partners. The company is convinced that with Dynamic Arc Recognition and Termination, they are introducing a technology that will provide completely new impulses to the process industry. Relevant events aimed at enabling further dialog are being planned.

Key words: Intrinsic safety, DART; Dynamic Arc Recognition and Termination, FOUNDATION Fieldbus, PROFIBUS, Innovation, Hermes Award.

Author: Dipl.-Ing./MBA Andreas Hennecke
Product Marketing Manager Fieldbus Technology
Division Process Automation

Characters: 9,005, without space characters

Characters short text: 816, without space characters

Pictures: No. MC7522_080514_01, No. MC7522_080311_01,
No. MC7522_080311_02, No. MC7522_080311_03,
No. MC7522_080311_04

June 2008



Fig. 1: DART – Dynamic Arc Recognition and Termination. Based on simple physical principles. Almost as fast as light.

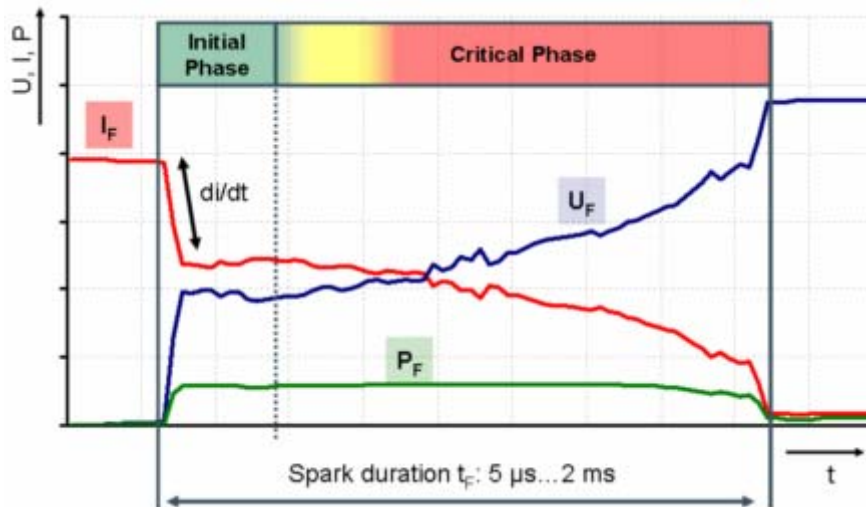


Fig. 2: The characteristic electrical behavior of an ignition spark. The current change di/dt is clearly seen.

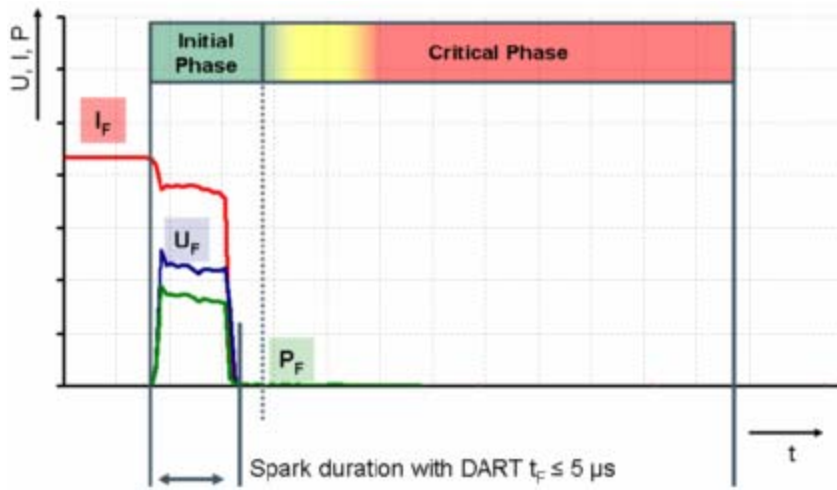


Fig. 3: Electric amplitude of a spark interrupted by a DART current source.

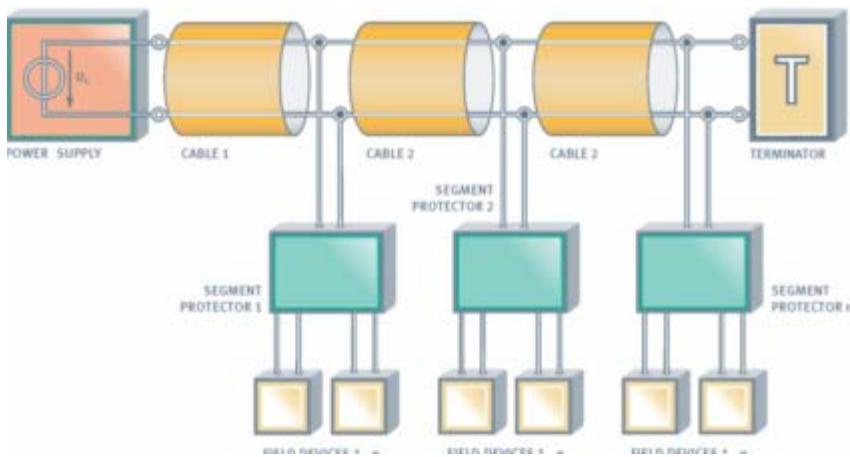


Fig. 4: DART for fieldbus consisting of a power supply, cables, segment protectors and loads.



Fig. 5: Simple DART current circuit consisting of a power supply, cable and load.