

# IS pac – the start of a new era

## The new generation of I.S. isolators

by A. Fritsch



Figure 1: IS pac – individual isolator, system solution and group supply, all in one product series

**With its new IS pac series of I.S. isolators, R. STAHL has once again launched a new, innovative product on the explosion protection market. The new isolators have been designed and developed optimally to meet customer requirements. The series of products is currently state of the art in this sector.**

### Why new isolators at all?

In a time of Remote I/O systems, Profibus DP, Foundation Fieldbus and many similar systems, the conventional solution with galvanic isolators and point-to-point connection would appear to be no longer up-to-date. Modern bus technology is already used in many applications. The major successes achieved with the R. STAHL Remote I/O System I.S.1 confirm this.

But what happens with signals for safe circuits which may, for instance, be designed as only single-channel or two-channel and what happens in cases in which a bus is simply unacceptable? What should be done, if only a few I.S. signals are required, such as in appli-

cations in mechanical engineering? Neither should we forget the broad basis of existing installations which cannot be converted to Remote I/O or which are not to be converted in this way. And what happens, if the user wishes to build on proven, simple technology, as is frequently demanded in certain regions, such as Asia?

Even market studies from this market segment are not entirely unanimous. However, the trend is also similar: Stagnation or even a slight rise on the extensive isolator market. The logical consequence of this is clear: The time is certainly right for a new, modern series of isolators such as IS pac.

### Why does a modern isolator matter?

Customer surveys and market observations provide a very clear requirement profile. The terminals should be removable to be able to replace modules quickly and easily, if necessary. The conventional screw terminals or spring clamp terminals are used depending on philosophy. An auxiliary power supply bus of some kind is required in order not to have to connect each device individually to the power supply. The devices themselves should, of course, be very slim so as to save costly space and, consequently, they should also be equipped universally with two channels.

Line fault detection is becoming more and →

→ more important. This is now also a must for output signals. Isolators should be able to be connected conveniently in groups with system cables – plug & play – to the systems to make connection to automation systems easy, but without, of course, losing sight of the individual application. Approval in accordance with the ATEX Directive 94/9/EC goes without saying.

And all this at an attractive price? Impossible? Not quite. When developing IS pac, it was possible to implement all these requirements and, in some case, even exceed them.

## IS pac – the perfect enclosure technology

IS pac is a series of isolators which has been designed for ease of use regardless of whether deployment involves individual applications with rail mounting, or in groups with central power supply, or as a system solution in prefabricated carriers.

The devices are equipped with removable terminals to allow very fast and simple exchange without complex individual wire marking (Figure 2). The proven screw terminals and the spring clamp terminals which are used more and more frequently owing to fast wiring can be selected. In addition, crimp terminals or even the relatively new insulation-cutting terminals can also be used. Insulation-cutting terminals in particular afford a major time advantage when wiring. The individual wires no longer need to be stripped of their insulation beforehand but are simply stripped of their insulation and contacted simultaneously by inserting and pressing the terminal closed. This achieves a time saving of up to 80% per terminal. The wire cross-section may be between 0.5 and 1 mm<sup>2</sup> with this type of terminal. If the isolators are equipped with screw terminals or spring clamp terminals however, cross-sections extending over a broad range from 0.2 to 2.5 mm<sup>2</sup> are possible.

The terminals are colour-coded in order to avoid confusion during wiring and instal-

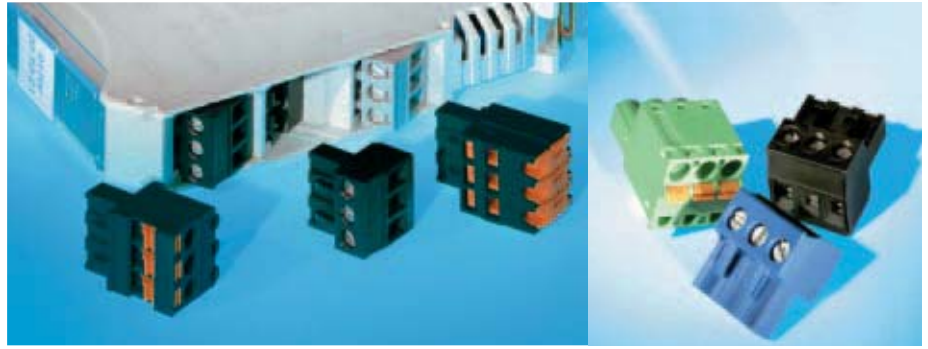


Figure 2: Flexibility and safety: removable, pluggable terminals of various designs and colour-coded

lation. Terminals for intrinsically safe signal circuits are designed in blue as is customary with intrinsic safety and as is prescribed for colour coding. The user can identify signal circuits from the colour black and power supply from the colour green. Should an incorrect connection assignment occur nevertheless, the circuits of different channels are arranged offset. Thus, for instance, if channel one and two are mistakenly reversed, the isolator will not issue an incorrect signal, but will issue no signal at all. This allows faults and errors to be detected quickly and remedied simply. For maximum safety, the terminals are also individually mechanically codable with coding pins as an option. This excludes the possibility of confusion of any sort.

The well-conceived concept of the IS pac isolators can be seen from many small details. All terminals have been arranged at an angle so that the wires can be routed into the cable ducts over the shortest possible route and so that the cable ducts can be mounted more closely to the isolators. Ultimately, this leads to better utilisation of available space. In addition, this bevel makes it easier for the user to connect the wires.

The space required by isolators in switching cabinets or field enclosures is an important aspect. Ultimately, saving space also means saving money.

The IS pac isolators have a standard width of 17.6 mm and are all available with two channels. This also applies to the digital outputs and intelligent temperature transmitters. The devices are mounted on NS 35 rails. Either

the high type NS 35/15 or the flat type NS 35/7.5 can be used. In order to ensure stable locking insensitive to vibration, the base latch is not made of plastic, but rather metal is used. This is in contrast to those frequently found on similar devices. Tests indicated a vibration resistance of over 5 g with this design.

Suitability for rough industrial operation was a further important criterion in development. Besides the vibration resistance specified above, the response to temperature also plays an important role. All devices can be operated without restriction and regardless of model in the temperature range -20 °C to +60 °C. The majority of the devices can be used even up to a temperature of 70 °C without restriction. In addition, the other devices can be used at ambient temperatures of up to 70 °C. For this purpose, they must be installed on a horizontal rail and must be spaced 5 mm apart.

The importance of signal colours in the sector of automation and process control technology was clearly stipulated years ago by NAMUR and the NAMUR Recommendation NE 44 (NAMUR: German user organisation for DCS – technology in the chemical industry). Power is green, errors are red and signal or switching states are shown in yellow. This has also been implemented in this way on the IS pac isolators.

The LED's are arranged clearly on the device front panel and are clearly separated between channels 1 and 2 so that no confusion can occur when reading off status information. DIP switches for setting various



Figure 3: pac-Bus – placet, engage, tilt on ... that's it!

device functions, such as activation of line fault detection, are also arranged on the front panel. This means that these settings can also be modified conveniently in installed condition during operation (Figure 7).

And here is another small but helpful detail: All setting options are printed on the side of the device additionally to a connection and function diagram. So if you do not have the operating instructions at hand, this shows you the most important settings. An interchangeable label with adequate space is available for unique identification of the devices. All indicating and operating elements as well as the label are protected against moisture, dust and unintentional actuation by means of a transparent hinged cover.

## The pac-Bus – for cost-saving wiring of auxiliary power

Normally, the power is connected first when wiring isolators. If a large number of devices is to be used, connecting the wires to each individual device requires substantially more time. A solution which involves feeding the power centrally and connecting the devices to the power supply by snapping them onto the top hat rail using the pac-Bus was developed in order to minimise the required time. The pac-Bus consists of individual elements, which can be plugged together in the required

quantity and then simply snapped onto the rail. This allows power supply segments for approx. 40 devices to be set up. The maximum expansion length depends on the relevant current consumption of the isolators used. The pac-Bus is designed for a current carrying capacity of up to 4 A and its gold-plated

contacts ensure optimum contact safety.

It is just as easy to expand this power supply segment. Further individual elements of the pac-Bus can be added at any time up to the maximum expansion length. No tools are required for installation. The pac-Bus is snapped on to the top-hat rail and can be latched securely by applying slight pressure. Regardless of whether it is installed horizontally or vertically, the pac-Bus is connected reliably and firmly to the rail. Of course, both the flat NS 35/7.5 version and the high NS 35/15 version of the rail can be used (Figure 4).

After installation of the pac-Bus, the isolators are then plugged onto the bus. These devices can be plugged on in the same way as they can without the pac-Bus. The isolator must be moved against the rail at one side and is then latched to the rail by tilting it on (Figure 3). Coding in the pac-Bus connector eliminates the possibility of incorrect connection. This means that wiring is simple and faultless.

However, the pac-Bus is not used simply for power supply. It also signals line faults of the I.S. inputs or outputs of the individual isolators as a collective line fault per segment. One floating signal contact is available to the user for this. This contact is closed if there are no faults in operation and is opened in the event of a line fault or in the event of power supply failure of an isolator.

No dummy module or similar module is required to close the fault signalling chain in the case of slots which are not fitted, e.g. slots

for reserve purposes. The signal contact in the pac-Bus is self-closing, similar to the principle of a telephone socket.

Input of the power supply or connection of a fault signal can be performed either at very low cost using a terminal or conveniently using a supply module. The supply module has the same design as the isolators and is fitted at any position on the pac-Bus. The supply module incorporates a 4 A fuse, which is fitted on the front panel and can thus be changed simply for fusing the pac-Bus.

The same module is used if the power supply is to be redundant. Primary and redundant circuits are decoupled by means of diodes. The redundant circuit is also protected by means of an exchangeable fuse. In the event of failure of the primary or redundant power branch, a failure signal is issued by means of a relay contact. Alternatively, two supply modules can also be used and they are then installed at both ends of the segment.

All these different variants for auxiliary power supply use one and the same module. This allows you to decide how to wire right at the very last minute without having different models in stock. →

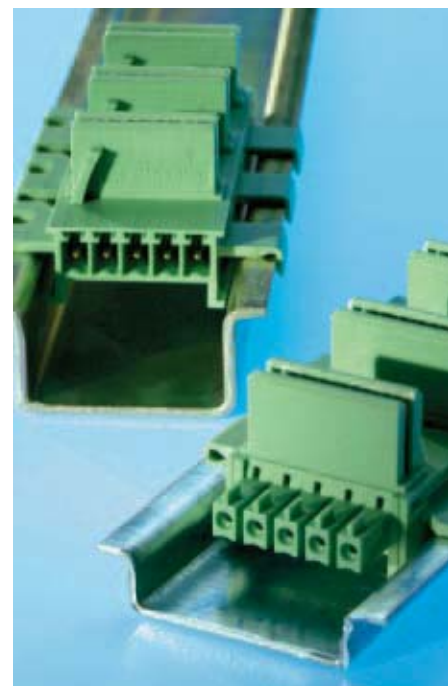


Figure 4: Pac-Bus – with universal range of application: high or flat top hat rail, can be mounted horizontally or vertically



Figure 5: pac-Carrier – 8 or 16 slots? A solution for every application

### → **pac-Carrier – integration par excellence**

In recent years, integrated solutions with system-specific adaptation to the control system have become popular in the case of large numbers of signals and if there is a demand for conventional I.S. isolation. In this case, the I.S. isolators are normally plugged or screwed on to prefabricated circuit boards, so-called motherboards, and connected to the process control system by means of the integrated, system-specific plug using the relevant system cable.

A different approach has been taken on IS pac. The I.S. isolators are latched into a special mounting system, the pac-Carrier. In this case, the pac-Carrier attaches the isolator both at the bottom and at the top and this avoids the in some cases very unstable wiring on a motherboard.

The pac-Carriers are available as standard with 8 and 16 slots. This means that, if two-channel modules are used, up to 32 channels can be accommodated over a width of only 286 mm (Figure 5).

All modules, including single-channel and two-channel modules, can be mixed as required in the slots, but only, of course, if this mix is supported by the control system to be connected. All carriers can be snapped on

either to the high or to the flat DIN rails or can be screwed onto mounting plates.

Installation of the I.S. isolators in the pac-Carrier is done, as it were, at the press of a button. The module is inserted in its slot and reliably latched by applying slight pressure to the latching lever. Assembly is thus very fast and does not require tools. Latching itself is so sturdy that, in tests, vibrations exceeding 2 g had no effect whatsoever on the stability of the system.

Modules can be exchanged just as easily and cleverly. Unlike mounting, exchanging modules intentionally requires a tool. Operation with a screwdriver ensures that modules cannot be removed unintentionally, incidentally also a requirement for wiring in the US American Division 2. The release mechanism is operated with a screwdriver and the relevant module is slid forward slightly allowing it to be removed conveniently. The device is still fixed in position in the carrier so that the devices are unable to drop onto the floor when they are removed.

The pac-Carrier can be connected to 24 V DC like the individual IS pac devices and can be powered decoupled via diodes, redundantly as an option. Here as well, both power supply branches are signalled by means of green LEDs and protected with exchangeable fuses. A line fault at the I.S. inputs or outputs of the

isolators and power supply failure of an isolator or of the carrier are signalled via a floating contact.



Figure 6: Well-conceived: the latching and ejecting mechanism for the modules

Various connection boards with the relevant system plugs and the right connection allocation are required for connection of the various control systems. In this case, R. STAHL can choose from a wealth of implementation configurations and experience with the ICS module predecessor product, which has been prefabricated in recent years for an extremely wide variety of systems. Unlike on the 'ICS modul', no intrinsically safe circuits are routed on the connection board on the pac-Carrier. This allows implementation of the system-specific requirements even faster and more simply than was previously the case.

Unlike the conventional motherboard solutions on the market, the connection level for system cables and power supply on IS pac is easily accessible at the top on the carrier. Integration of the pac-Carrier in HART management systems, such as Cornerstone, AMS and PDM, is performed with the IS pac HART multiplexer which is simply snapped on to the top hat rail next to the pac-Carrier and connected to the carrier by means of a cable.

Finally, the pac-Carriers also feature various marking and labelling options. Each slot can be uniquely identified with two indicating pointers. If the space on the labels of the isolators does not suffice, each pac-Carrier can be provided with an identification panel. A labelling area is also available for marking the carrier itself.

## IS pac – technically outstanding modules

The technology of the individual I.S. isolators is in no way inferior to the above-specified, primarily mechanical characteristics of the IS pac system. While two channels have, for some time now, been state of the art on transmitter supply units or switching repeaters, the situation was different in the case of digital outputs or even intelligent temperature transmitters. The demand placed on digital outputs, to the effect of making available currents which are as high as possible for operation of solenoid valves, and the associated power loss are counterproductively opposed to the requirement for two-channel design. Likewise, the situation with programmable, intelligent temperature transmitters incorporating microcomputer technology is just as difficult.

On IS pac, it has been possible to design all devices with two channels, with no serious restrictions in relation to operating temperature. All devices can be used for operation at temperatures between  $-20\text{ °C}$  and  $+60\text{ °C}$  in any mounting position. The only restriction applies to the transmitter supply units and digital outputs operating up to  $70\text{ °C}$ , restricting their installation to horizontal installation on a top-hat rail spaced 5 mm apart. All other isolators can be used in such cases up to  $70\text{ °C}$  with no restriction.

Detection and, above all, signalling of line faults play an important role for installation safety. While the requirement generally applied only to inputs in the past, the requirement is, to an increasing extent, being demanded for outputs as well. On IS pac, all I.S. inputs and I.S. outputs are monitored for open circuit and short circuit. Thus, for instance, in the case of the digital output, the I.S. output circuit is also monitored, if the solenoid valve is switched off. Line faults are signalled in several ways. Each individual device signals the fault with a red LED for each channel (Figure 7). A contact which



Figure 7: The front panel – clear LED indication and convenient setting options

switches with respect to ground signals the fault for each device via the terminals. The centralised fault alarm is signalled via the pac-Bus or in the pac-Carrier via series-connected N/C contacts of the isolators. In this case, a power failure of one or more isolators is also signalled simultaneously.

Defined behaviour of the isolators during switch-on or switch-off is just as important as line monitoring and fault signalling. If the power supply of a system or of a switch cabinet is switched on, this making operation occurs not abruptly but over a period of an undefined time. Within this period, the isolator passes through states, in which it slowly starts to function and consumes a high current owing to a lack of adequate supply voltage. This current may lie over 50% above the specified rated current. The consequence is overloading of the power supply units, if they have not been dimensioned adequately generously. In such a case, the system does not start up. One other effect which is particularly unpleasant when switching off is the undefined behaviour of outputs. In the above-described interim state between operation and non-operation, it may occur that →

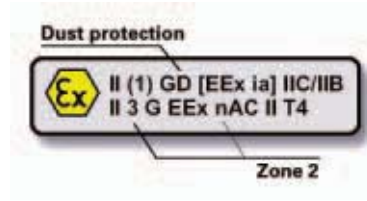


Figure 8: All in one: intrinsically safe, dust explosion protection and Zone 2

→ outputs still switch on and off a few times in an uncontrolled manner during switch-off. In the case of an emergency-stop circuit, this is certainly very critical behaviour.

For this reason, undervoltage monitoring has been integrated on the IS pac. The devices function only upwards of a voltage of 18 V and switch the outputs off in defined manner at voltages below 18 V. This guarantees maximum safety when starting up and shutting down a system.

In the ‚Year of ATEX‘, approval in accordance with the EC Directive 94/9/EC is a matter of course. All IS pac isolators are approved for use in intrinsically safe circuits of Zones 0 and 1 with the marking  $\text{Ex}$  II (1) G D [EEx ia] IIC/IIB. If we consider this in greater detail, we can see that IS pac is also suitable for group D, i.e. it may also be connected to devices with intrinsically safe circuits from areas at hazard of dust explosion in Zones 20 and 21, areas which have been increasing in importance since EN 50281 was published in the year 1998.

In addition, the I.S. isolators are approved for installation in Zone 2. The marking in this case is  $\text{Ex}$  II 3 G EEx nAC II T4. Besides the isolators themselves, the accessories, such as pac-Bus, pac-Carrier and supply module etc., are also approved for installation in Zone 2. This means that nothing now stands in the

way of constructing, for instance, decentralised Zone 2 stations or installation in machines for Zone 2 (Figure 8).

Other international approvals are to follow, starting with FM and UL approvals for the US market. The isolators will be approved for use in Division 2 and for operation on intrinsically safe circuits in areas subject to hazards of gas and dust explosion, Class 1 and 2, Division 1, analog to the European approval.

Besides the approvals relevant to explosion protection, other frequent demands are approval from a ships‘ classification company or approval for functional safety-related circuits. Consequently, particular attention was paid to the related standards when specifying and developing the I.S. isolators. The devices easily comply with requirements such as vibration resistance 4 g, shock resistance up to 25 g, enclosure material with flammability V0 and many more requirements. This means that nothing now stands in the way of approval by German Lloyd, Lloyd’s Register of Shipping or the DNV. The initial tests are already underway for safety-related circuits in accordance with EN 61508 so that the switching repeater will soon be available with an SIL approval, as first step.

## IS pac – a complete product series

The product range (Table 1) is designed on the basis of the popular applications in process and automation technology but with certain additional versions and options which cover more applications by far. As already mentioned, all devices are designed with one and two channels and with line fault monitoring and signalling.

The **transmitter supply unit** serves to operate 2-wire and 3-wire transmitters and to connect to active current sources of 4-wire transmitters for instance. In the case of 2-wire transmitters, there is also the possibility for bidirectional, digital communication using the HART protocol. All versions are also available with a passive output and a current sink to enable operation with active inputs of automation systems, which thus power the 2-wire transmitter themselves. Supply units are available with one input and two galvanically isolated outputs for applications necessitating signal doubling. Here as well, there is the possibility for HART communication but only via the first output. The HART signal is filtered off on the second output, ideal for systems, which may be subject to interference as the result of the digital HART signals.

The **isolating repeater output** for transmission of 0 and 4 to 20 mA signals is also suitable for use in conjunction with HART-field units. In addition to the conventional line fault signalling of the I.S. output via LED and relay, the input will switch to high impedance in the event of an open circuit or short circuit on this device so that the connected system can also detect the fault.

The **temperature transmitter**, also a two-channel unit, can be operated universally with virtually all popular temperature sensors. Using a user-friendly PC software package, the IS pac Wizard, the user chooses from the sensor types resistance thermometer, thermocouple and resistance remote sensor. In the case of the resistance thermometers, not only the popular sensors such as Pt 100 or Ni

100 can be selected, but also exotic versions such as Pt 500, Pt 1000 or corresponding Ni elements. Thermocouples in accordance with DIN and IEC as well as those in accordance with the Russian GOST Type XK can be configured. All settings can be documented easily and clearly using the PC software package.

However, the isolator can also be configured without PC and software. Many settings can be selected directly on the device using DIP switches. Approx. 100 measuring ranges in °C and °F are available for selection for each of the 8 most popular sensor types. For applications requiring limit value monitoring, there is also a temperature transmitter with two limit value monitors, either with or without analogue output.

Various outputs are available for **switching repeaters** which enable connection of proximity switches in accordance with EN 60 947- 5-6 (better known as NAMUR proximity switch ) or for connection of contacts. The signal relay is optimally suited to low-level signals from 1 V, 100 µA to 125 V, 1 A. Higher power up to 250 V, 4 A is switched with the power relay. The electronic output with its open collector is the ideal solution for high switching frequencies up to 10 kHz and frequent switching operations in the case of signals up to 35 V, 50 mA. All switching repeaters with relay output are also available as a version with AC voltage supply.

The **digital outputs** are suitable for operation with most solenoid valves. The I.S. output characteristics have been optimised as regards connectability on the one hand and minimum power loss on the other. The user can also connect the two channels of a digital output in parallel and thus double the output current for intrinsically safe solenoid valves with a very high power demand, of course only provided the intrinsically safe interconnection with the solenoid valve is still permitted, since this also doubles the maximum output current of the interconnected circuit. Even in the case of the digital outputs, the I.S. output is monitored for line faults even if the connected solenoid valve is deenergised.



→ The range of products is rounded off by a 32-channel HART multiplexer for operation with HART management systems such as Cornerstone, AMS and PDM, by a field bus isolating repeater for intrinsically safe operation of Profibus DP in accordance with the most recent PNO Standard RS 485 IS and with the isolators: I.S. power supply and binary output without auxiliary supply soon to be available.

### IS pac – one for all

IS pac covers more than simply a few new isolators. IS pac is a thoroughly new isolator system which is equally well-suited to individual applications, to applications with central auxiliary power supply and to integration in process control systems. In its concept, its mechanical and technical design, IS pac is currently the most modern and most unique system on the market: a series of products for virtually all relevant installations, users and applications.

**Table 1: Overview of functions**

Type	Function	Channels
9160	Transmitter supply unit for 2/3/4-wire transmitters, HART	1 and 2
9165	Isolating repeater output, HART	1 and 2
9170	Switching repeater	1 and 2
9175	Digital output	1 and 2
9182	Temperature transmitter	1 and 2
9185	Field bus isolating repeater	1
9192	HART multiplexer	32
9193	Supply module	1 and 2
9194	pac-Bus	
9195	pac-Carrier	8, 16, 32

