Purely analogue.
Signal conditioning with the TSA series.
“The innovative strength by which our products are distinguished is only possible with a close dialogue with our customers. Readiness to react quickly and comprehensively to changing requirements is the key to success.”

Markus Kleemann
Imtron Location Manager
Dear readers,

Anyone looking to lead in the global competition must be able to respond to changing demands with sophisticated and technically advanced products. Consequently, improved methods of validation of product characteristics are indispensable. This is where innovative measuring technology plays a key role.

For decades, the GHM GROUP has been delivering measuring technology to the widest range of applications areas, including the development departments of automotive manufacturers and suppliers.

We are able to measure and record nearly every measurable variable with our measuring technology and ensure an improved overview in development. Regardless of whether it involves the monitoring of slowly changing variables, such as temperature, or rapidly changing signals, such as speed or vibrations, all data is recorded with chronological synchronisation.

With our extensive expertise in signal conditioning and data recording gathered over the course of time, we have earned the trust of our renowned customers.

With the highest quality, innovative strength, outstanding service and continuous updating and improvement of our measuring technology, we can offer first-class products and solutions.

This can apply to a test stand with several hundred channels or a laboratory measuring station with only a few channels. Our widely diversified product assortment offers the optimal solution for every area of application.

We would like to offer you a comprehensive overview of our signal conditioning systems in this brochure. We can also work with you to develop a tailored solution for your specific requirements.
**Purely analogue.**

**Signal conditioning.**

The detection and evaluation of the widest-ranging sensor values are prerequisite for successful development and the smooth operation of devices, machinery and systems. In order to meet this demand, high-quality signal preparation is required in many areas of application.
**TSA series.**
Uncompromising affordable quality.
Purely Analogue Signal Conditioning

**State of the art.**

The TSA series of devices meets this demand with sophisticated, precise analogue technology. TSA is the designation for analogue rail modules and describes the design and technology of our signal conditioners.

The long-term stability of technology without reliance on software ensures smooth signal conditioning of nearly every analogue sensor signal.
The sensory organ of modern production.

To not only sharpen them, but also adapt them to rapidly changing production cycles, is one of the most important challenges for efficient industrial production. The GHM GROUP supplies your production with innovative measuring systems that operate with precision and extraordinary speed.
Signal conditioning – Purely analogue

Analogue signal conditioning is a time-tested method for processing, filtering, amplifying and galvanically isolating sensor data in high quality.

The Imtron Center of Competence has mastered this field for many years. Our modules can convert nearly any analogue sensor signal into standards signals that can then be processed, for instance, in a control unit for data acquisition.

In order to prevent damage to the system and guarantee high signal quality, inputs and outputs are galvanically from each other and the supply voltage and signals are filtered.

Advantages

- **Cost reduction**
  Signal condition and galvanically isolating amplifier in one device, a separator isolator is unnecessary

- **More signals**
  Optional second output for integration into PLCs, displays and end devices for data acquisition

- **High signal quality**
  Flexible interference suppression with replaceable filter modules

- **Velocity**
  Limit frequencies of up to 30 kHz

- **Precision**
  High precision and long-term stability

- **From a single provider**
  Modules available for most analogue sensor signals

- **Special requests**
  Tailored solutions possible, even in small quantities

- **Service-friendly**
  Plug-in connection terminals ensure easy installation and quick replacement

- **User-friendly**
  No software necessary – plug & play
TSA series. Purely analogue. Signal conditioning.

Applications

Test stand design for machine construction and the automotive industry

Detection of sensor signals in test stands – preparation of signals by the modules of the TSA series and conversion into standard signals that are forwarded to the test stand control system, where they can be used for control and data acquisition. Various filters depending on the area of application and sensor type can be used to guarantee a high signal quality and eliminate interfering effects.

Status monitoring of machines and systems

Monitoring of forces and vibrations on moving parts, such as rotor blades or the generator, which are set in motion for purposeful regulation in order to exit undesired frequency ranges by adapting specific parameters, such as rotational speed of the rotor, and to guarantee an optimal operating state.

Monitoring of wind turbines

Actuation of servo valves

Quickly reaction control modules are needed for activation of the servo valves required in a hydraulic application. The control signals of the control unit must be converted from standard signals into with higher power, because many servo valves require more than the 20 mA provided by the control unit.
Filter flexibly & avoid interference signals

Various analogue plug-in filters are available for the TSA series signal conditioning modules.

Various frequencies between 1 Hz and 30 kHz and various filter characteristics are available. The filters can be designed as low-pass (standard), high-pass, band-pass or band-elimination. Therefore, the modules can be modified and used flexibly for numerous applications.

- **Low pass filter**
  Frequencies above the limit frequency are removed; only the lower frequencies pass through

- **High pass filter**
  Frequencies below the limit frequency are removed; only the higher frequencies pass through

- **Band pass**
  Frequencies above or below a defined frequency band are removed

- **Band stop**
  Frequencies within a defined frequency band are removed (e.g. 50 Hz humming, frequency band 49..51 Hz)

**Order of a filter**

The order of a filter describes the amplification reduction (attenuation and edge steepness) of frequencies above or below the respective limit frequency of the filter. Filters of a higher order can be created with connection of filters of a lower order in a series.
TSA series. Filter basics.
Technology.
Filter characteristics

**Figure 1:**

For steep-edged signals, such as rectangles, Bessel is the better choice, because it has a minimal effect on the signal.

**Figure 2:**

Butterworth has an overshoot for steep signal edges, which can reach 11% with filters of the 4th order. Bessel filters of the 4th order only oscillate 0.8%, but do not isolate as sharply as at the transition from the passing range to the suppression range.

**Figure 3:**

The isolating effect of a filter increases in steepness at the transition from the passing range to the suppression range. In this case, Butterworth is clearly better than Bessel.
The modules are designed for potential-free signal conversion and conditioning in automation and measuring technology. Each of the modules has 3-way isolation and offers flexible interference suppression with plug-in filters. They are designed as Butterworth or Bessel filters of the 4th order. Other orders and filter characteristics can be implemented on request.

With potential isolation and filter characteristics, the modules are especially well-suited for suppression of interfering influences in measuring and control circuits, for galvanic isolation of power and signal circuits, as well as for prevention of earth loops.

With a ripple of < 2 mVpp and a precision of 0.1 %, the modules are also suited extremely well for technical measurement applications.

The standard supply voltage is 24 V DC. An optional 12 V version is also available. The modules have plug-in connections for simple connection. The standard module width is 22.5 mm.

Customer-specific adaptations in every respect (e.g. measuring ranges, amplification factors, sensor feed) can be realised.
The following overview should help you choose the right module for your application.

<table>
<thead>
<tr>
<th>Modules</th>
<th>TSA-Fil</th>
<th>TSA-Fil2-2</th>
<th>TSA-DMS</th>
<th>TSA-Poti</th>
<th>TSA-DC</th>
<th>TSA-Pt100</th>
<th>TSA-TC</th>
<th>TSA-ICP</th>
<th>TSA-ICP2-2</th>
<th>TSA-PWR</th>
<th>TSA-RMS</th>
<th>TSA-IF</th>
<th>TSA-MATH</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Signal input</strong></td>
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<tr>
<td>Voltage</td>
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<td>●</td>
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<tr>
<td>Current</td>
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<td>●</td>
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<tr>
<td>DMS</td>
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<tr>
<td>Poti</td>
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<tr>
<td>Pt100</td>
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<td>Thermo-couples</td>
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<tr>
<td>ICP®/IEPE</td>
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<tr>
<td>Speed, Pulse</td>
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<td>●</td>
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<td>●</td>
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<tr>
<td><strong>Standard signal output</strong></td>
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<tr>
<td>Voltage or current</td>
<td>●/○</td>
<td>●/○</td>
<td>●/○</td>
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<td>●/○</td>
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<tr>
<td>± 10 V/0...10 V</td>
<td>●/○</td>
<td>●/○</td>
<td>●/○</td>
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<td>●/○</td>
<td>●/○</td>
<td>●/○</td>
<td>●/○</td>
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<tr>
<td>± 20 mA/0...20 mA</td>
<td>●/○</td>
<td>●/○</td>
<td>●/○</td>
<td>●/○</td>
<td>●/○</td>
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<td>●/○</td>
<td>●/○</td>
<td>●/○</td>
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<tr>
<td>± 200 mA/0...200 mA</td>
<td>●/○</td>
<td>●/○</td>
<td>●/○</td>
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<td>●/○</td>
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<tr>
<td>TTL</td>
<td>●/○</td>
<td>●/○</td>
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</tr>
</tbody>
</table>

● Standard
○/○ Standard/alternative (combinations on request).

Subject to errors and technical changes.
Modules of the TSA series.
Signal conditioning.
Standard modules

Technical features

○ Detection of: Voltage, current, DMS bridges, potentiometers, Pt100, thermocouples, ICP®/IEPE sensors
○ Conversion of sensor signals to standard signals
○ 3-way isolation
○ Signal filtering can be adapted on commissioning by replacement
○ Amplification and linearisation
○ Sensor feed and bridge extension
○ Optional second output with dedicated filter

Advantages

○ High-quality analogue signal conditioning
○ High precision and speed
○ Flexible filtering
○ High bandwidth
○ Optional second output for signal duplication
The TSA modules offer the possibility of signal conditioning of standard signals and specific sensor signals. 3-way potential isolation takes place between signal input and output, as well as the supply voltage. The signals are also filter and a separate filter slot is provided for each output.

<table>
<thead>
<tr>
<th>Common features of the TSA modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter</td>
</tr>
<tr>
<td>Accuracy</td>
</tr>
<tr>
<td>Low-noise</td>
</tr>
<tr>
<td>Insulation</td>
</tr>
<tr>
<td>Supply voltage</td>
</tr>
<tr>
<td>Input</td>
</tr>
<tr>
<td>Output</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Modules</th>
<th>TSA-Fil</th>
<th>TSA-DMS</th>
<th>TSA-Poti</th>
<th>TSA-DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of application</td>
<td>Conditioning of standard signals</td>
<td>Conditioning of signals from DMS bridges</td>
<td>Conditioning of signals from potentiometers</td>
<td>Conditioning of AC/DC voltage signals</td>
</tr>
<tr>
<td>Input</td>
<td>0..10 V / ± 10 V 0/4 .. 20 mA / ± 20 mA</td>
<td>DMS bridges 4-/6-wire Full/half bridge Bridge resistances 120 .. 1 k possible</td>
<td>Potentiometer 3-/5-wire 350 .. 1000 Ohm</td>
<td>AC/DC voltage 0.1 .. 10 V</td>
</tr>
<tr>
<td>Output</td>
<td>0..10 V / ± 10 V 0/4 .. 20 mA / ± 20 mA</td>
<td>0..10 V / ± 10 V 0/4 .. 20 mA / ± 20 mA</td>
<td>0..10 V / ± 10 V 0/4 .. 20 mA / ± 20 mA</td>
<td>0..10 V / ± 10 V 0/4 .. 20 mA / ± 20 mA</td>
</tr>
<tr>
<td>Accuracy</td>
<td>0.1 %</td>
<td>0.1 %</td>
<td>0.1 %</td>
<td>0.1 %</td>
</tr>
<tr>
<td>Sensor feed</td>
<td>–</td>
<td>5 V DC, customer-specific up to 10 V possible</td>
<td>5 V DC</td>
<td>–</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Modules</th>
<th>TSA-Pt100</th>
<th>TSA-TC</th>
<th>TSA-ICP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of application</td>
<td>Conditioning of signals from Pt100 sensors</td>
<td>Conditioning of signals from potentiometers</td>
<td>Conditioning of signals from ICP®/IEPE sensors</td>
</tr>
<tr>
<td>Input</td>
<td>Pt100 4-wire</td>
<td>Thermocouple, type J, K, N, T</td>
<td>ICP sensors</td>
</tr>
<tr>
<td>Output</td>
<td>0..10 V / ± 10 V 0/4 .. 20 mA / ± 20 mA</td>
<td>0..10 V / ± 10 V 0/4 .. 20 mA / ± 20 mA</td>
<td>0..10 V / ± 10 V 0/4 .. 20 mA / ± 20 mA</td>
</tr>
<tr>
<td>Accuracy</td>
<td>0.2 %</td>
<td>0.2 %</td>
<td>0.1 %</td>
</tr>
<tr>
<td>Sensor feed</td>
<td>Constant current 1 mA</td>
<td>Compensation ± 0.5 °C</td>
<td>Constant current 4 mA</td>
</tr>
</tbody>
</table>
Two-channel isolating amplifier for ICP®/IEPE sensors

Technical features
- Signal conditioning of Piezo electric sensors
- 3-way isolation
- Replaceable filter modules for each channel
- Switchable amplification
- Integrated sensor feed
- Disengageable AC coupling
- Power supply via T-bus or front terminal

Advantages
- Space-saving 2-channel amplifier
- Independently configurable channels for maximum flexibility

Two-channel isolating amplifier for standard signals

Technical features
- Signal condition and conversion of standard signals
- 3-way isolation
- Replaceable filter modules for each channel
- Power supply via T-bus or front terminal

Advantages
- Space-saving 2-channel amplifier
- Independently configurable channels for maximum flexibility
Modules of the TSA series.

Product overview.

Two-channel modules

<table>
<thead>
<tr>
<th>Common features</th>
<th>Modules</th>
<th>TSA-Fil2-2</th>
<th>TSA-ICP2-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter</td>
<td>Interchangeable filter modules per channel (Bessel or Butterworth filter: 4th or 8th order)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limit frequency</td>
<td>1 Hz .. 30 kHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>0.1 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low-noise</td>
<td>Ripple &lt; 2 mVpp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation</td>
<td>3-way isolation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply voltage</td>
<td>24 VDC ± 10 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input</td>
<td>2 inputs for standard signals or sensor-specific signals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output</td>
<td>2 outputs 0 .. 10 V/ ± 10 V 0/4 .. 20 mA / ± 20 mA Combinations possible</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Supply of modules via the mounting rail bus

The modules are designed for potential-free signal conversion and conditioning in automation and measuring technology. Each of the modules has 3-way isolation and offers flexible interference suppression with plug-in filters. They are designed as Butterworth or Bessel filters of the 4th order. Other orders and filter characteristics can be implemented on request.

With potential isolation and filter characteristics, the modules are especially well-suited for suppression of interfering influences in measuring and control circuits, for galvanic isolation of power and signal circuits, as well as for prevention of earth loops.
Modules of the TSA series.
Signal conditioning.
Special modules

Mathematical modules

- Mean value formation (TSA-RMS) of signals of voltage transmitters, DMS bridges, potentiometers, piezo-electrical sensors and standard signals
- Mathematical linking (addition, subtraction, multiplication [power], division) of two voltage signals (TSA-MATH)

Technical features

Advantages

- Signal conditioning and mathematical preparation in one module

Conversion of pulse signals to TTL

- Pulse formation with up to 3 channels in one module
- Optional open-collector output

Technical features

Advantages
The TSA modules for special applications have been designed for different purposes.

<table>
<thead>
<tr>
<th>Modules</th>
<th>TSA-RMS</th>
<th>TSA-MATH</th>
<th>TSA-IF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of application</td>
<td>Signal conditioning and RMS formation</td>
<td>Linking of two voltage signals</td>
<td>Potential-free pulse formation</td>
</tr>
<tr>
<td>Input</td>
<td>Depending on the type</td>
<td>Frequency (DC): 0 .. 50 kHz</td>
<td>Voltage: 100 mVpp .. 60 Vpp</td>
</tr>
<tr>
<td></td>
<td>Standard signals,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DC, DMS, ICP / IEPE,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>potentiometer</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Input:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.06/0.15/10/20 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output</td>
<td>± 10 V</td>
<td>0 .. 10 V/ ± 10 V</td>
<td>TTL 5 VDC</td>
</tr>
<tr>
<td></td>
<td>0 .. 7.07 V (RMS)</td>
<td>0/4 .. 20 mA/ ± 20 mA</td>
<td>Optional: Open collector</td>
</tr>
<tr>
<td>Accuracy</td>
<td>0.1 % / 2 % (RMS)</td>
<td>0.1 %</td>
<td></td>
</tr>
<tr>
<td>Sensor feed</td>
<td>Integrated, depending on sensor type</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Actuation of servo valves

Quickly reaction control modules are necessary for activation of the servo valves required in a hydraulic application.

The control signals of the control unit must be converted from standard signals into with higher power, because many servo valves require more than the 20 mA provided by the control unit.

Technical features

○ Actuation of consumers with up to 200 mA / 2 W with standard signal input

Advantages

○ Quick actuation of consumers with standard signals
Modules of the TSA series.
Product overview.
TSA-PWR special module

<table>
<thead>
<tr>
<th>Module</th>
<th>TSA-PWR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of application</td>
<td>Actuation of consumers with up to 200 mA</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>24 VDC ± 10 %</td>
</tr>
<tr>
<td></td>
<td>Mounting rail or front terminal</td>
</tr>
<tr>
<td>Input</td>
<td>0 .. 10 V / ±10 V</td>
</tr>
<tr>
<td></td>
<td>0/4 .. 20 mA / ±20 mA</td>
</tr>
<tr>
<td>Output</td>
<td>up to ±200 mA</td>
</tr>
<tr>
<td></td>
<td>±10 V (up to 200 mA / 2 W)</td>
</tr>
<tr>
<td>Accuracy</td>
<td>0.1 %</td>
</tr>
</tbody>
</table>
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## Our International Area Sales Management Team

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Country</th>
<th>Region</th>
<th>Language</th>
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<tbody>
<tr>
<td>Mina Kamal</td>
<td>Teamleader Export</td>
<td>GERMANY</td>
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<tr>
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<td>Managing Director</td>
<td>Czech Republic /</td>
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</table>
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