1-1. MORU Solutions

Mechanical Design
- 연구용 시험기계
- 생성자동화 기계
- PLC & HMI

Engineering Service
- 진동 및 모드 계측 및 분석
- 소음 계측 및 분석
- 토크, 온도, 압력 및 응력 계측 및 분석
- 소음진동 컨설팅

Product Sales
- DIGITAL 이후 계측 시스템
- 헬레리프트
- 소음진동 분석 시스템
- 센서류: 진동, 소음, 압력, 스트레인게이지
- 케이블 및 액세서리

Software development
- 기계 장치 및 시스템 제어
- 제품 감사 자동화
- 소음 진동 양무 관통
- 신호 계측 및 보고서
1-2. Mission & Vision

Mission

우리 고유의 전통적인 기술을 창조적으로 개선 디자인 시켜 미리 애니메이션화에 판과 화면을 되는

- 인간의 안전한 삶과 행복을 위한 저소음, 저 진동 측정 기술 개발
- 연구 시험 장비 개발
- 고급 맞춤 연구 시험 장비 개발
- 계측 애니메이션의 계측 발전
- 성장 경합

Vision

애니메이션들이 요구하는 기술, 원하는 기계, 갖고 싶은 제품을 제공한다.

- 진동 측정 개발
- 시험용 기계 설계 및 제작
- 소음 및 진동 측정 장비 공급 및 개발
- 데이터 환경 장비 공급
- 신호 분석 시스템 공급
- 신호 측정 및 분석 용도 및 전설
- 신호 처리 프로그램 개발

1-3. History

- 2006년 9월 제네럴에스테드프론트 창업
- 2008년 9월 현대공업 연구시험소 계측용 계약
- 2012년 3월 독일 MANNESMANN 정부대다림 계약
- 2013년 11월 한국기술간판식 방문시험장 널념시험장 공급
- 2014년 4월 무프기술 주식회사 법인 설립
- 2014년 5월 렌허험 승인
- 2014년 7월 기술무라연구소 설립
- 2014년 10월 전자파라도크 철단부품 및 소재산업 기술지원사업 선포
- 2014년 8월 철도장비 진동요소캡 시스템 및 방법 특허 출원

2-1. 기계설계 및 제작

- 연구용 시험기계
- 생산진열기술 기계
- PLC & CAM
- 시스템 제작 및 제작
- 제트엔지니어 시스템 설계/개발
- 소음진단 업무 운영

2-2. 기계설계 및 제작

- 입력공기 제작 및 제작, 신호 분석 시스템 구축

- 기계설계 및 제작

Ceiling Tube Suppression Auto-Auto Mechanism Design
Step-up gear box test mechanism
75MW Pitch Drive Test
2-3. 소프트웨어 개발

- 원도우 릴렉스 프로그램 개발

2-4. R&D 기업부설연구소

- 전단기 연구작업 수행
- 고도의 신기술 및 신호처리 기술 조사
- 국군 정보기술연구의 공동연구를 위한 경력업무
- 신학기 개발 및 제품 개선에 관한 기계연구 업무
- 신문 인허가 발생, 기계 및 기술개발 관련업무
- 전산물 공학연구개발과제 발굴 및 정부지정 요원업무
- 기술조사, 신설 및 기호과학 연구 업무
- 중기정 과학 수행
- KAKT 개발 협력

3-1. 엔지니어링 서비스

- 전동 및 모델 계통 및 분석
- 소음 계측 및 분석
- 트랙, 타이어, 엑스 스마트계통 및 분석
- 커뮤니티 시스템을 활용한 계통 및 분석
- 철도망 시스템(단肇庆 및 전도) 시험
- 건설업

3 응력 시험

1. 응력 성능

- 기반 시스템 개발
- 기기 시스템과 인터페이스 요구사항을 통해 테스트의 요구사항을 확인

2. 요구 분석

- 시험 요구사항 점검
- 시험에 사용될 전안 충격압 장비

4 결과 평가

- 보고서 및 시험 결과 전달
- 보고서의 정리 및 보고서 품질 검토

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3-2. References

Automobile axle shaft torque measurement

Wind turbine torque & vibration measurement

3-3. References

LCD 이송 기계 진동 계측 및 설계 변경

복합체 구조 모드 시험

철도차량 운영선로 시운전 성능시험: 소음, 진동 및 동적성
4-1. IMC Succeeding faster

Reaching solutions faster

Mobile applications
Test stand applications
ISO- & standard testing

4-1. IMC Succeeding faster

Roaching solutions faster

imc MeS-Systeme GmbH

- Founded in 1988
- Based in Berlin, Friedrichsdorf and Stuttgart, Germany
- Production in Berlin, Germany
- Approximately 200 employees
- Cooperation with 25 partner companies in 20 countries
- Over 100 patents

Products for the complete test and measurement cycle

your benefit - our goal
4-1. IMC Fast track to efficiency

On the right track with railway-specific measurement from imc

Excellence in mobile applications
- Passenger comfort
- Investigation of vehicle behavior
  (e.g., wheel flange strength)
- Commissioning tests
- Crash tests
- Climate testing
- Brake testing
- Testing at high speeds
- Derailment testing

Excellence in stationary applications
- Structural testing of components (e.g., wheels, bogies, railroad car bodies)
- Structural analysis of the complete train
- Structural tests on railway tracks
- Structural analysis of inter-carriage bridges
- Air-pressure measurement in tunnels
- Testing rail barriers
- Pantograph tests (on test stands and mobile)

Flight testing
- Mobile data acquisition in prototype testing
- Acquisition of basic parameters in flight tests
- Integration of ARM, ENA, CAN, A/PX, MIL-STD-1553 and custom buses
- Synchronized pressure scanning
- Vibration measurement and data analysis

Test stand / rig solutions
- Structural analysis of components
  (e.g., airfoils, wings, rotor blades, landing gear, actuators, motors)
- Strain & stress measurement and control for calibration, static, fatigue and endurance test beds
- Stream measurements on composite materials
- Turbine engine test cell instrumentation
- Integrated automated test stand control & alarms systems

Developmental / production
- Hardware-in-the-loop (HIL) solutions for noise-wheel steering, iron bird & IGTT rigs
- Development testing of cargo loading systems
- Integrated ATP test stands for production & quality control
- Development test bed for high-lift systems
- Pressure and temperature scanner invariances for turbine engine test cells
- Vibration monitoring hardware and software
4-1. IMC Energy and power quality analysis

Over land, at sea and in the air

Productive solutions for the wind industry
- Applications in development and certification measuring of prototypes and components
- Load and electromechanical efficiency measurements
- Condition monitoring, sound and noise measurements
- Power monitoring as per EN 50122 and IEC 61400-21

Power measuring, monitoring and quality analysis
- Power monitoring and quality analysis as per EN 50160, IEC 61400-21
- Platform for the measurement of all physically defined variables on the power network (e.g., frequency, voltage spikes, voltage fluctuations, harmonics, flicker, signal frequency)
- Measurement and analysis of all output power and performance parameters
- Smart-grid simulation

4-1. IMC Intelligent measurement systems

Rugged solutions for mechanical engineering

Expertise in mobile applications
- Load measurements and initial operation tests on agricultural machinery such as harvesters or tractors
- Vibration and oscillation measurements in accordance with EU standards on hand-operated power tools (e.g., drills and angle grinders)
- Measurements of bending and torsional vibrations in aircraft engines undergoing operational approval

Expertise in stationary applications
- Initial operation tests of gas turbines
- Torque monitoring for generators
- Testing of mechanical seals for pumps, mixers and all types of machines, in which rotating shafts must be sealed
- Test stand solutions - e.g. clutch-disc test rigs
- Measurements for preventive maintenance of heavy machinery
4-1. IMC A solid foundation

imc measurement technology for civil engineering and bridge monitoring

Bridge monitoring
- Oscillation measurement (immediate and long-term)
- Measurement close to the sensor with decentralized modular technology - achieve higher signal quality
- Remote monitoring and automatic data transfer using imc LINK
- Comprehensive analysis and visualization of the captured data with imc FAMOS

Civil engineering
- Oscillation measurement (immediate and long-term)
- Thermal measurements assessing long-term conditions
- Sound and noise measurement
- Measurement technologies for examining energy use in buildings
- Measurement close to the sensor with decentralized modular technology - achieve higher signal quality
- Remote monitoring and automatic data transfer using imc LINK
- Comprehensive analysis and visualization of the captured data with imc FAMOS

4-1. IMC Hardware

Measurement Hardware

Safeguarding structures, test stand and more is a matter of keeping the test stand ready. The IMC system is precisely designed and optimized to meet the requirements of structural testing. IMC systems are modularly designed to meet the needs of a wide range of applications. The systems are designed to be highly flexible and scalable, allowing for easy expansion.

By using the IMC system, users can achieve higher accuracy and reliability in their measurements. The system comes with real-time data analysis and visualization, allowing for quick and easy data interpretation. The system is also equipped with user-friendly software, ensuring a smooth user experience.

The IMC system is designed to be easy to install and operate, with a range of accessories available to suit different needs. The system is also highly configurable, allowing for customization to meet specific requirements.

Overall, the IMC system is an excellent choice for structural testing, with its high accuracy, reliability, and flexibility making it a popular choice among users.
4-1. IMC Hardware

Modular & Comprehensive
- Modular systems for measuring, controlling and simulation with moderate to high channel counts.

Rugged, Mobile & Handy
- Rugged and mobile systems for test, measurement and control tasks - from small to medium numbers of channels.

Decentralized & Distributed
- Compact and mobile systems for measuring and control - from small to medium numbers of channels.

imc CRONOSCompact
- Adaptable measurement and control system for mixed signal testing

imc C-SERIES
- Hands-on-in-one data acquisition and control system for electromechanical testing

imc CAN/LAS
- Intelligent CAN bus capable measurement and control modules

imc CRONOS-SL
- Sleek data acquisition system for electromechanical testing under harsh conditions

imc BUSDAQ
- Intelligent and versatile field bus data logger and beyond

imc SPARTAN
- Beyond Logging to active monitoring, from the lab to the field

imc CRONOSMix
- Frameless modular measurement system for electromechanical testing

4-1. IMC Software

imc STUDIO 5.0 - measurement, data analysis, visualization, automation

Configure and measure

imc STUDIO allows you to configure your measurement system from the comfort of your computer. Configure everything from channels, scales, and the measuring device to the analysis and visualization tools.

Data display and system operation

Visualization of the measurement data, allowing you to monitor and control the system in real-time. You can also configure different data acquisition and analysis parameters.

Automating routine tasks

Automate repetitive measurement tasks to save time and ensure consistency. You can set up custom scripts and workflows to run automatically.

Recording and playback of videos

Record and replay measurement data as videos, making it easier to share and present your results. Videos can be created for each experiment, allowing for easy reference and documentation.
4-1. IMC Comprehensive data processing & signal analysis framework

imc FAMOS 6.3: fast functionality

imc FAMOS extensive capabilities and workflow oriented framework integrates

imc FAMOS Reader - Free software for viewing measurement data

4-2. MANNER Sensortelemetrie

MANNER Sensortelemetrie

Where others give up, we at MANNER help you to be successful!
4-2 MANNER Sensortelemetrie

Inductive Telemetry ... Contactless

The powerful sensor telemetry system from Manner facilitates the economical and precise monitoring or measurement of static and dynamic parameters such as:

- Torque
- Pressure and tractive force
- Bending moment
- Acceleration
- Temperature
- Revolution speed

Torque Measuring Technology

- Compact and short (45 mm at 1 kNm)
- Highly precise torque signal on the basis of strain gauges
- Without bending (no thinnen)
- Torque range of 5 Nm to 1 MNm
- Non-contact transmission of measured values
- High transverse and axial force resistance
- High torsional strength (according to type, up to 40,000 rpm)
- Maintenance-free via inductive energy and data coupling
- High interference resistance, EMC tested according to DIN
- Simple handling and mounting with minimal space requirements
- Remotely conditioinable measuring amplifier in flange
- Re-calibration without mechanical intervention
- Network compatible (CAN, Ethernet)

4-2. MANNER Sensortelemetrie

Radio Telemetry

- Shock absorber temperature measurement
- Rotary furnace temperature measurement
- Wheel radio transmitters (automobile applications)
- Measuring shafts and measuring flanges in mobile operation
- Further measuring applications which should/must operate without permanently installed transmission systems
- Test stand monitoring

Implementation in Ex-Zones (ATEX)

The powerful sensor telemetry system from Manner facilitates the economical and precise monitoring or measurement of static and dynamic parameters such as:

- Torque
- Pressure and tractive force
- Bending moment
- Acceleration
- Temperature
- Revolution speed
4-2 MANNER Sensortelemetrie

Application for Automobile
- Drive Train Applications

Application for Automobile
- Engine Applications

Application for Mechanical Engineering

Application for Process Monitoring
4-2 MANNER Sensortelemetrie

Application for Train

Application for Shipping & Large Engine

Application for Helicopter and Aircraft

Application for Wind Energy
4-2 MANNER Sensortelemetrie

Application for Turbines

Application for Turbo Charger

4-3 Portable Analyser-ImpageElite

Feature

- 4-channel VFD display with 4-channel X/Y graphing
- Portable design for outdoor use
- High sensitivity and accuracy
- Memory capacity for data storage
- Data export options
- User-friendly interface

Hardware specification

- Operating system: Windows CE
- Number of channels: 4
- Battery: Li-ion 3.7V / 4000 mAh, 8 hours
- Power supply: USB 1.1, mini 1.0 USB connector
- Display: 640 x 480 6.4-inch TFT color touch screen LCD
- Dimensions: 11.2 in x 7.1 in x 3.0 in (284 x 180 x 76 mm)
4-3 Portable Analyzer

FFT Analysis

- **Sampling Rate**: 0~10kHz, single channel @ 12000 lines
- **Resolution**: 100~12,000 lines
- **Windows**: Linear, Butterworth, exponential, and rectangular force, exponential
- **Frequency Bandwidth**: 1st, 2nd, 3rd, 4th, and 5th
- **Sampling Rate**: Linear, Butterworth, exponential, square root, and rectangular
- **Zoom Enable**: Yes
- **Average**: Linear, exponential, time, and real
- **Trigger**: External, internal, and channel triggering
- **Cursor**: Single, harmonic, harmonic, and single, peak, mark cursor

Rotor Balancing

- **Rotor Type**: Single plane, dual plane, and unbalanced rotor
- **Balancing**: 60 rpm to 2000 rpm
- **Order Setting**: Low, medium, high, audio, 0.01, 0.001, 0.0001, and 0.00001
- **Average Number**: 10, 20, 50, and 100
- **Balancing**: Built-in ISO 1940 standard or user-defined
- **Balancing Method**: 3-plane balancing (stator and rotor), unbalanced test, component calculation, unbalance test, vibration history, and balancing history

Order Tracking

- **Order Analysis**: Order trace, order spectrum, and waterfall display
- **Order Setting**: 6 to 4800 rpm
- **Order Setting**: 0.5, 1.25, 2.5, and 6.25
- **Trace Setting**: User selectable 10 orders plus overall traces
- **Trace **: 1000 order
- **Balancing Method**: Adjustable waterfall filter and intensity filter
- **Balancing Method**: RPM cursor and order cursor
- **Order Setting**: 1~99 orders
- **Order Setting**: Linear, log, dB, real, range, phase, and polar plot

Octave Analysis

- **Octave Setting**: Full octave, 3rd octave, and 1/3rd octave
- **Frequency Band**: 30 kHz, 100 kHz, 40 kHz
- **Sampling Rate**: 100 Hz, 1 kHz, 2 kHz, 5 kHz, 10 kHz, 15 kHz, 20 kHz, 30 kHz, 40 kHz
- **Detection Method**: Fast, slow, impulse, linear, and trigger
- **Trigger**: Digital, external, set channels, manual
- **Weighting**: A, B, C, or flat
- **Gain Setting**: 0.1 V, 0.01 V, and 0.001 V

4-4 Multi-channel Analyzer-OROS

Portable Noise & Vibration Analyzers

- **INstruments**:
  - **Noise**: Linear, Butterworth, exponential, square root, and rectangular
  - **Input**: 1st, 2nd, 3rd, 4th, and 5th
  - **Input**: Linear, Butterworth, exponential, square root, and rectangular
  - **Trigger**: External, internal, and channel triggering
  - **Cursor**: Single, harmonic, harmonic, and single, peak, mark cursor

MARKET ORIENTED

- **Solutions**:
  - **Solutions**: Linear, Butterworth, exponential, square root, and rectangular
  - **Input**: 1st, 2nd, 3rd, 4th, and 5th
  - **Trigger**: External, internal, and channel triggering
  - **Cursor**: Single, harmonic, harmonic, and single, peak, mark cursor

SOFTWARE

- **Software**: Linear, Butterworth, exponential, square root, and rectangular
- **Input**: 1st, 2nd, 3rd, 4th, and 5th
- **Trigger**: External, internal, and channel triggering
- **Cursor**: Single, harmonic, harmonic, and single, peak, mark cursor
### 4-5 가속도계-PCB

**PCB 1축 가속도계**

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<th>356051</th>
<th>356063</th>
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<td>Specifications</td>
<td>Units</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Seismicity (±%)</td>
<td>m/s²</td>
<td>180</td>
<td>108</td>
<td>10</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Range</td>
<td>g</td>
<td>±50</td>
<td>±50</td>
<td>±50</td>
<td>±50</td>
<td>±50</td>
</tr>
<tr>
<td>Frequency Range (±%)</td>
<td>Hz</td>
<td>2.5–5.000</td>
<td>1.5–5.000</td>
<td>1.5–5.000</td>
<td>1.5–5.000</td>
<td>1.5–5.000</td>
</tr>
<tr>
<td>Minimum Shock</td>
<td>g</td>
<td>±0.100</td>
<td>±0.100</td>
<td>±0.100</td>
<td>±0.100</td>
<td>±0.100</td>
</tr>
<tr>
<td>Weight</td>
<td>g</td>
<td>16.5</td>
<td>16.4</td>
<td>16.4</td>
<td>16.4</td>
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<tr>
<td>Temperature Range</td>
<td>°C</td>
<td>-35–121</td>
<td>-35–121</td>
<td>-35–121</td>
<td>-35–121</td>
<td>-35–121</td>
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<tr>
<td>Housing</td>
<td>Tension</td>
<td>Titanium</td>
<td>Titanium</td>
<td>Titanium</td>
<td>Titanium</td>
<td>Titanium</td>
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<tr>
<td>Environmental Seal</td>
<td>Hermetic</td>
<td>Hermetic</td>
<td>Hermetic</td>
<td>Hermetic</td>
<td>Hermetic</td>
<td>Hermetic</td>
</tr>
<tr>
<td>Mounting Seat</td>
<td>10-32 Tap</td>
<td>5-40 Tap</td>
<td>5-40 Tap</td>
<td>5-40 Tap</td>
<td>5-40 Tap</td>
<td>5-40 Tap</td>
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<td>TDB</td>
<td>Top</td>
<td>Top</td>
<td>None</td>
<td>None</td>
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<td>None</td>
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<tr>
<td>Cable (optionally)</td>
<td>850020</td>
<td>850020</td>
<td>850020</td>
<td>850020</td>
<td>850020</td>
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<td>Magnetic (optionally)</td>
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### 4-6 Impact Hammer-PCB

**Impact Hammer (General)**

<table>
<thead>
<tr>
<th>Model</th>
<th>060011</th>
<th>060022</th>
<th>060033</th>
<th>060044</th>
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<tr>
<td>Specifications</td>
<td>Units</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seismicity (±%)</td>
<td>m/s²</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Range</td>
<td>kN</td>
<td>±1000</td>
<td>±1000</td>
<td>±1000</td>
</tr>
<tr>
<td>Frequency Range (±%)</td>
<td>Hz</td>
<td>1–50</td>
<td>1–50</td>
<td>1–50</td>
</tr>
<tr>
<td>Sensing Element</td>
<td>Quartz</td>
<td>Quartz</td>
<td>Quartz</td>
<td>Quartz</td>
</tr>
<tr>
<td>Head Weight</td>
<td>grams</td>
<td>150</td>
<td>150</td>
<td>150</td>
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<tr>
<td>Hammer Length</td>
<td>cm</td>
<td>21.6</td>
<td>21.6</td>
<td>21.6</td>
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<tr>
<td>Electrical Connection</td>
<td>ENC</td>
<td>ENC</td>
<td>ENC</td>
<td>ENC</td>
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<tr>
<td>Cable (optionally)</td>
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<td>015020</td>
<td>015020</td>
<td>015020</td>
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**Impact Hammer (Specific)**

<table>
<thead>
<tr>
<th>Model</th>
<th>060040</th>
<th>060050</th>
<th>060060</th>
</tr>
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<tbody>
<tr>
<td>Specifications</td>
<td>Units</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seismicity (±%)</td>
<td>m/s²</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Range</td>
<td>kN</td>
<td>±500</td>
<td>±500</td>
</tr>
<tr>
<td>Frequency Range</td>
<td>Hz</td>
<td>1–50</td>
<td>1–50</td>
</tr>
<tr>
<td>Sensing Element</td>
<td>Quartz</td>
<td>Quartz</td>
<td>Quartz</td>
</tr>
<tr>
<td>Head Weight</td>
<td>grams</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Hammer Length</td>
<td>cm</td>
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</tr>
<tr>
<td>Electrical Connection</td>
<td>ENC</td>
<td>ENC</td>
<td>ENC</td>
</tr>
<tr>
<td>Cable (optionally)</td>
<td>015020</td>
<td>015020</td>
<td>015020</td>
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</table>
### 4-7 MICROPHONE

**ICP Microphone Sets (Maker: G.R.A.S)**

<table>
<thead>
<tr>
<th>Model</th>
<th>303CD</th>
<th>303DB</th>
<th>303CD</th>
<th>303CD</th>
<th>303CD</th>
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</thead>
<tbody>
<tr>
<td>Type</td>
<td>1/2” Free field</td>
<td>1/2” Free field</td>
<td>1/2” Free field</td>
<td>1/2” Free field</td>
<td>1/2” Free field</td>
</tr>
<tr>
<td>Sensitivity (V/Pa)</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Frequency range (Hz, dB)</td>
<td>1 Hz to 20 kHz</td>
<td>1 Hz to 20 kHz</td>
<td>1 Hz to 20 kHz</td>
<td>1 Hz to 20 kHz</td>
<td>1 Hz to 20 kHz</td>
</tr>
<tr>
<td>Dynamic range (dB)</td>
<td>16 dB below 100 dB</td>
<td>16 dB below 100 dB</td>
<td>16 dB below 100 dB</td>
<td>16 dB below 100 dB</td>
<td>16 dB below 100 dB</td>
</tr>
<tr>
<td>Subject impedance (ohm)</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Max. excitation voltage (V)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Temp. range (°C)</td>
<td>-20 to 50</td>
<td>-20 to 50</td>
<td>-20 to 50</td>
<td>-20 to 50</td>
<td>-20 to 50</td>
</tr>
<tr>
<td>Length (mm)</td>
<td>65</td>
<td>65</td>
<td>65</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>Weight (g)</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Connector type</td>
<td>3-pin 90° BNC</td>
<td>3-pin 90° BNC</td>
<td>3-pin 90° BNC</td>
<td>3-pin 90° BNC</td>
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**LEMO Microphone Sets (Maker: G.R.A.S)**

<table>
<thead>
<tr>
<th>Model</th>
<th>408</th>
<th>480G</th>
<th>480R</th>
<th>480P</th>
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<tbody>
<tr>
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<td>1/2” Free field</td>
<td>1/2” Free field</td>
<td>1/2” Free field</td>
<td>1/2” Free field</td>
</tr>
<tr>
<td>Sensitivity (V/Pa)</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Frequency range (Hz, dB)</td>
<td>1 Hz to 20 kHz</td>
<td>1 Hz to 20 kHz</td>
<td>1 Hz to 20 kHz</td>
<td>1 Hz to 20 kHz</td>
</tr>
<tr>
<td>Dynamic range (dB)</td>
<td>16 dB below 100 dB</td>
<td>16 dB below 100 dB</td>
<td>16 dB below 100 dB</td>
<td>16 dB below 100 dB</td>
</tr>
<tr>
<td>Subject impedance (ohm)</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Max. excitation voltage (V)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Temp. range (°C)</td>
<td>-20 to 50</td>
<td>-20 to 50</td>
<td>-20 to 50</td>
<td>-20 to 50</td>
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<tr>
<td>Length (mm)</td>
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<td>65</td>
<td>65</td>
<td>65</td>
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<tr>
<td>Weight (g)</td>
<td>33</td>
<td>33</td>
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<tr>
<td>Connector type</td>
<td>3-pin 90° BNC</td>
<td>3-pin 90° BNC</td>
<td>3-pin 90° BNC</td>
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**ICP Microphone Sets (Maker: PCB)**

<table>
<thead>
<tr>
<th>Model</th>
<th>2780X3</th>
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<tr>
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<td>1/2” Free field</td>
<td>1/2” Free field</td>
<td>1/2” Free field</td>
<td>1/2” Free field</td>
</tr>
<tr>
<td>Sensitivity (V/Pa)</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Frequency range (Hz, dB)</td>
<td>1 Hz to 20 kHz</td>
<td>1 Hz to 20 kHz</td>
<td>1 Hz to 20 kHz</td>
<td>1 Hz to 20 kHz</td>
</tr>
<tr>
<td>Dynamic range (dB)</td>
<td>16 dB below 100 dB</td>
<td>16 dB below 100 dB</td>
<td>16 dB below 100 dB</td>
<td>16 dB below 100 dB</td>
</tr>
<tr>
<td>Subject impedance (ohm)</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Max. excitation voltage (V)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Temp. range (°C)</td>
<td>-20 to 50</td>
<td>-20 to 50</td>
<td>-20 to 50</td>
<td>-20 to 50</td>
</tr>
<tr>
<td>Length (mm)</td>
<td>65</td>
<td>65</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>Weight (g)</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Connector type</td>
<td>3-pin 90° BNC</td>
<td>3-pin 90° BNC</td>
<td>3-pin 90° BNC</td>
<td>3-pin 90° BNC</td>
</tr>
</tbody>
</table>

### 4-8 Stress Analysis Strain Gages MICRO MEASUREMENTS

**www.micro-measurement.com/stress-analysis-strain-gages/**

- **Stress Analysis Strain Gages**
  - Bondable foil strain gages available in thousands of possible pattern designs and combinations of grid alloys, backing materials, resistances, and options

  - **Linear Patterns**
    - **Gage Lengths**
      - 0.38 to 0.81 mm
      - 1.52 to 1.97 mm
      - 3.15 to 4.75 mm
      - 6.25 to 9.88 mm
    - **Shear/Torque Rosettes**
      - **Gage Lengths**
        - 1.57 mm
        - 3.05 to 6.35 mm
  - **SR-48 Strain Gages**
    - **Gage Lengths**
      - 1.57 mm
      - 3.05 to 6.35 mm

- **Tee Rosettes**
  - **Gage Lengths**
    - 1.27 to 1.57 mm
    - 3.05 to 6.35 mm

- **Rectangular Rosettes**
  - **Gage Lengths**
    - 1.57 mm
    - 3.05 to 6.35 mm

- **Delta Rosettes**
  - **Gage Lengths**
    - Delta Rosettes

- **Special Use Gages and Sensors**
  - Residual Stress
  - Magnetoelectric Field
  - Weldable
  - High Temperature
  - Shear Modulus
  - Concrete Embedment
  - Temperature (RTCA)
  - Displacement
  - Pressure
  - Crack
Standard models
- Measuring range
  - negative: -1...0 to -0.025...0 bar
  - positive: 0...0.025 to 0...2,500 bar
  - absolute pressure: 0...0.25 to 0...16 bar
- Typical applications
- Hydraulic and pneumatic systems
- Conveyor technique

Precision models
- Measuring range
  - 0.25 bar ... 1,000 bar
- Accuracy
  - 0.05% and 0.1%
- Typical applications
- Apparatus construction
- Calibration technology

For submersible measurement
- Measuring range
  - 0.1 bar ... 25 bar
- Accuracy
  - 0.5%, 0.35%
- Typical applications
- Level control