



RAILWAY TEST & MEASUREMENT SOLUTIONS

WELCOME TO THE DEWESOFT EXPERIENCE. ONE SOFTWARE, ONE HARDWARE, ONE SOLUTION.



 DEWESoft
7 YEAR WARRANTY

SINGLE SYSTEM FLEXIBILITY

GRAB-AND-GO POWER AND CONVENIENCE

Sometimes you just need to grab one DAQ system, hook up a few sensors, and make a measurement. These are perfect applications of our portable and rugged systems with their easy-to-use software. Nothing is faster and easier to use.



SIRIUS®

SIRIUS models are ideal for your dynamic applications, when you need the highest possible sample rates, for transient capture or fast signals. They also provide the highest dynamic range, for your vibration and acoustic applications, for example.



IOLITE®

IOLITE models are made to be distributed anywhere you need them inside the train. Available in single or multiple channel modules, they can be connected to a SIRIUS system, or to a separate computer for single system applications.



KRYPTON®

KRYPTON models are made to work outside the train. They are waterproof and dust proof, and made to handle temperature extremes and high shock and vibration. They connect and interconnect exactly like IOLITE, using a single EtherCAT® cable.

KRYPTON®



EtherCAT®

KRYPTON®



UP TO 100M (328 FEET) NODE-TO-NODE DISTANCE

KRYPTON®

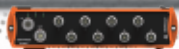


EtherCAT®

SIRIUS® R2DB AND TWO SIRIUS® MODULAR SLICES



In this car, an all-in-one SIRIUS R2DB has 16 dynamic inputs. It is extended to one or more SIRIUS slices. Two waterproof KRYPTON modules mounted under the train are also connected via EtherCAT®.



KRYPTON®



KRYPTON®

OBSDIAN®

In this car, an OBSIDIAN configured with 40 strain gage/universal inputs is recording data to removable flash media. Its embedded processor with LINUX OS and Dewesoft RT has been running for three weeks continuously, performing a long-term durability test.



MULTI SYSTEM FLEXIBILITY

TESTING THE ENTIRE TRAIN

And then there are times when you need to instrument the whole train, or make different kinds of measurements at the same time. In the past this required putting the DAQ systems in a middle car, and then running long sensor wires through the whole train.

Long sensor wires are expensive, and prone to damage from being walked on or pinched. They also induce electrical noise, which degrades the quality of your signals. We knew that there had to be a much better solution, so we invented it.

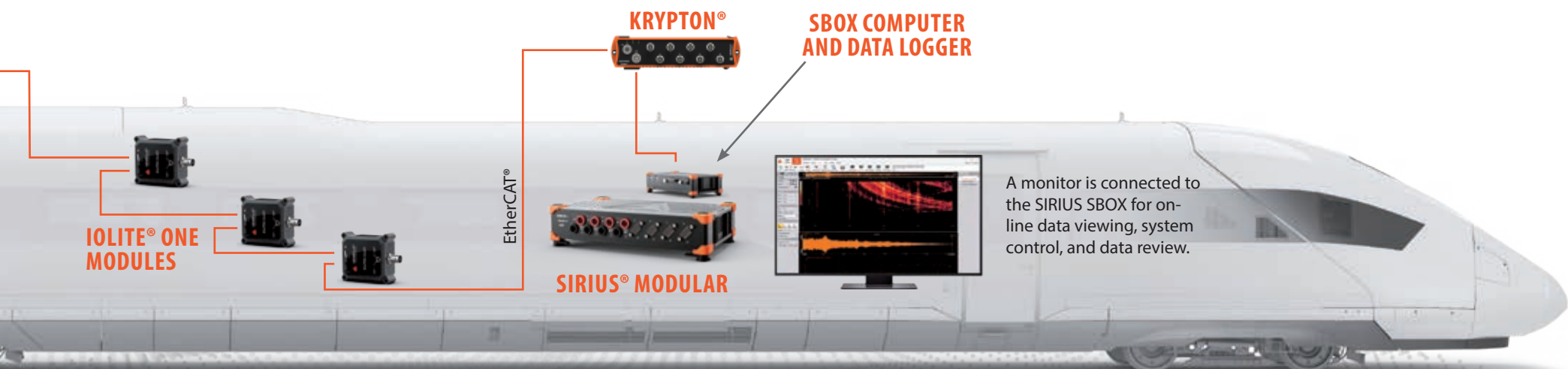
Dewesoft systems can be connected together using a single EtherCAT® cable. Everything is synchronized automatically, and the software automatically recognizes the devices that you connect. But that's just the beginning.

Additionally, our KRYPTON and IOLITE modules can be placed right next to the sensor. They are daisy-chained, so that there is only one cable running through the train. No more big bundles of expensive and fragile sensor cables.

CONNECTING ACROSS THE ENTIRE TRAIN WITH A SINGLE ETHERCAT® CABLE

In the example below, a SIRIUS system in the first car is recording high speed / high voltage data to the connected SBOX ruggedized computer. A monitor is connected for real-time data viewing and system control. There are single and multi-channel IOLITE modules located in many cars. There are also water-proof, all-weather KRYPTON modules located

on the outside of the train, measuring a variety of signals. All of these modules are daisy-chained together with thin EtherCAT® cables. Modules can be up to 100 meters apart. Data is digitized in each module and sent across EtherCAT® to the SIRIUS SBOX for display and storage. No more giant bundles of fragile expensive cables and no more guessing about which sensor is connected to which wire.

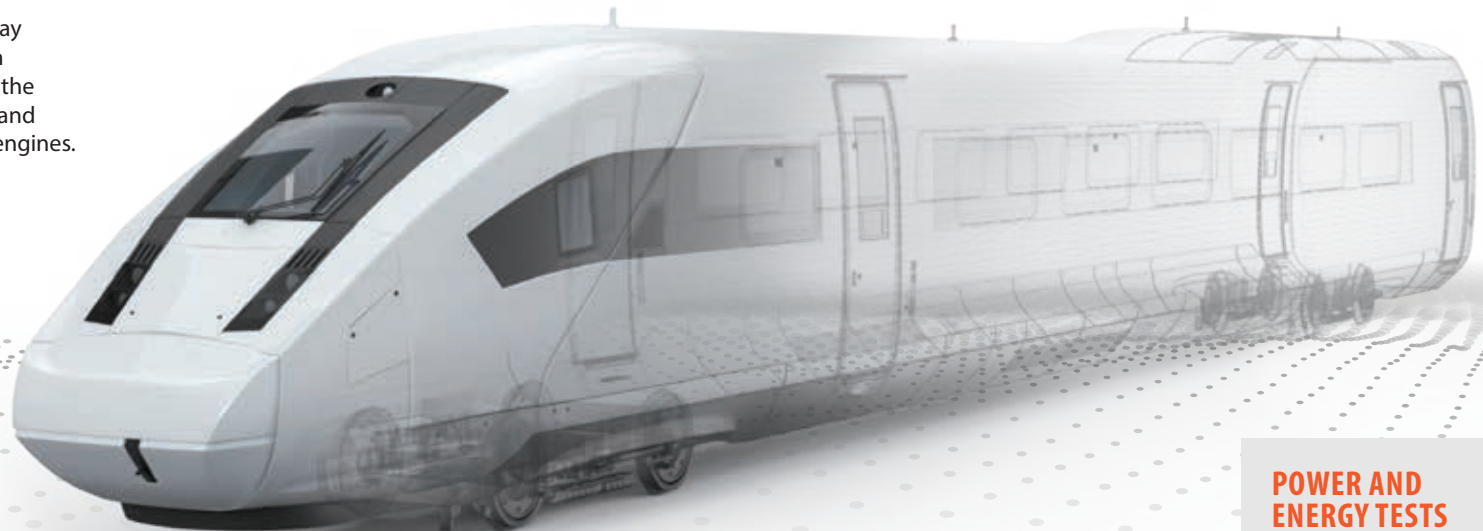


A monitor is connected to the SIRIUS SBOX for on-line data viewing, system control, and data review.

CAPABILITIES OVERVIEW

A WIDE RANGE OF SOLUTIONS IN THE RAILWAY SECTOR

Dewesoft covers a huge range of railway testing applications. And it's not just in the truck (bogie) and car (wagon), but the whole electric grid for metro systems, and locomotive diesel-powered electrical engines.



INFRASTRUCTURE TESTS

- Bridges and tunnels
- Track tests
- Catenary and third rail lines
- Deformation
- Inclinator
- Weather & seismic impact
- Switch tests

ENVIRONMENTAL TESTS

- Climatic chamber test
- Homologation
- Acceptance tests
- Pass-by noise
- Cabin noise

RIDE COMFORT TEST

- Passenger comfort
- Accel and decel
- Noise, vibration and harshness

PANTOGRAPH TEST

- Mechanical operation
- Wear and tear
- Current flow

CURRENT COLLECTOR TEST

- Connectivity
- Current flow
- Mechanical wear and tear

POWER AND ENERGY TESTS

- Power quality
- Power supply testing
- Transformer test
- Touch potential and EMC testing
- Energy consumption
- Power grid testing
- Pantograph and third rail current shoe tests
- Combustion test on diesel engines

PERFORMANCE TESTING

STRUCTURAL TESTS

- Mechanical operation
- Wear and tear
- Current flow

ON-TRACK TESTS

- Acceleration
- Braking
- Aerodynamics
- Fatigue
- Suspension

STATIC AND DYNAMIC TESTS

- On-track tests
- Test chamber tests
- Static and dynamic
- Wheel-rail tests
- Traction tests
- Brake testing

ENVIRONMENTAL TESTING

ENERGY TESTING

DEWESOFT SIRIUS®

Our flagship DAQ system, with the highest possible dynamic performance. Available in modular slices or as all-in-one DAQs with built-in computer, display and batteries.

SIRIUS® HARDWARE

HIGH SAMPLE RATE

Dewesoft SIRIUS DAQ instruments feature our highest sample rate amplifiers. DualCoreADC amps provide 200 kS/s, HS series amps provide 1 MS/s, and our XHS amps provide sampling up to 15 MS/s per channel, continuously.

FULLY ISOLATED

Our worry-free solution provides isolation on the sensor side (channel to GND, as well as channel-to-channel) and even isolated sensor excitation. Real galvanic isolation means less noise, no ground loops, and the best signal quality.

HIGH DYNAMIC RANGE

SIRIUS modules provide up to 160 dB of dynamic range. Our amazing DualCore and Hybrid ADC technologies are market leaders.

SIRIUS® MODULAR

Most flexible and distributable single slices with USB and EtherCAT® interface.



SIRIUS® SBOX

Synchronized, highly reliable data logger and powerful data processing computer. Also available: Fanless IP50 and Waterproof IP67 versions.



SIRIUS® XHS

High-speed data acquisition system (15 MS/sec) with the new Hybrid ADC technology capable of high-bandwidth transient recording and very high-dynamic, alias-free data acquisition.



SIRIUS® R1DB/R2DB

Small-size instrument with embedded computer, 12" display and batteries.



SENSOR POWER SUPPLY

Amplifiers provide channel-independent, programmable power supply for sensor excitation. With Dewesoft hardware, you don't need bulky external power supplies to power your sensors. We thought of everything.

HYBRID ADC TECHNOLOGY

SIRIUS XHS offers everything you ever wanted out of a high-end data acquisition system. High bandwidth and high dynamic mode available, software selectable per channel. There's never been a portable DAQ system this powerful before.

ANALOG OUTPUTS

SIRIUS slices can be configured with 8 analog outputs and function as a multi-channel function generator, can also do real-time signal conditioning, analog replay of data in analysis, and perform manual or automated control output with output voltage levels of up to +/- 10V.

UNIVERSAL ANALOG INPUTS

A wide variety of universal and analog amplifiers that accept voltage and full/half/quarter bridge signals natively as well charge and IEPE accelerometers, thermocouple and RTD temperature sensors, current, resistance, and even LVDT sensors, with the use of DSI adapters.

KRYPTON® HARDWARE

KRYPTON® ONE

Single channel KRYPTON modules can be placed right where you need them.



SUPER RUGGED, ALL WEATHER

We machine each KRYPTON out of a single aluminum brick. Then we install industrial-grade electronics, and seal it with thermally conductive and electrically isolative rubber. As a final touch, we add a bumper around the KRYPTON chassis to further protect it from shock. The result is a IP67 water, dust and shock proof (up to 100 g) instrument that can be placed anywhere. In addition to its rugged design and build, KRYPTON is rated to work in temperatures from -40°C to +85°C.

DISTRIBUTABLE, DAISY-CHAINED

KRYPTON modules are interconnected with a single EtherCAT® cable that carries, power, digital signals and synchronization. Place your single and multi-channel modules up to 100 meters (328 feet) apart – right where they need to be located.

EVERY SIGNAL, EVERY SENSOR

KRYPTON modules are available with a broad range of signal conditioners, capable of handling all major signal and sensor types. High and low voltages, currents, strain, stress, force, pressure, acceleration from charge or IEPE sensors, temperature from RTDs or thermocouples. It's a long list.

KRYPTON®

Ultra-rugged and distributable data acquisition devices from -40 to +85 °C operating range.



MULTI-CHANNEL KRYPTON® AMPLIFIERS

Multi-channel KRYPTON modules are available in the following signal input types:

STG (strain/universal), TH (thermocouple), TH-HS (high-speed thermocouple), RTD, ACC (IEPE), LV (low voltage), LA (low current), DIO (digital I/O), CNT (counters)

SINGLE-CHANNEL KRYPTON® AMPLIFIERS

Single channel KRYPTON modules are available in the following signal input types:

STG (strain/universal), TH-HV (thermocouple high voltage), ACC (IEPE), LV (low voltage), HV (high voltage), DI (digital input), DO (digital output), AO (analog output), CNT (counter)

DEWESOFT KRYPTON®

Rugged, all-weather DAQ modules, interconnectable over long distances by EtherCAT®.

- -40 to 85° C
- IP67 sealed against water, dust
- High shock and vibration

IOLITE® HARDWARE

IOLITE® ONE

Distributed, cost-effective single channel data acquisition device with high-end signal conditioning.



OBSIDIAN®

Low-power embedded data logger.



DEWESOFT IOLITE®

Industrial grade DAQ modules, interconnectable over long distances by EtherCAT®.

- Single and multi channel
- Easily mount anywhere
- Single cable daisy chaining

DEWESOFT IOLITE® MODULES

Industrial modules with connection back to the host. IOLITE modules are available with one or multiple channels.

DAISY-CHAIN CONVENIENCE

Distributed, and cost-effective data acquisition device with high-end signal conditioning for monitoring and industrial applications. Up to 50 meters (164 feet) between modules. Instrument an entire train from front to back.

FULLY SYNCHRONIZED

All data sources are perfectly aligned with each other and the analog and digital inputs. Synchronization is our middle name.

INDUSTRIAL GRADE

Made to our high standards of design and build quality, from top-notch materials.

STAND-ALONE OBSIDIAN®

Does your application require a stand-alone instrument that can run for weeks or months? OBSIDIAN has an embedded processor running LINUX and Dewesoft RT software. It's ideal for long-term, unattended operation, recording continuously or based on programmable triggers.

WE PLAY NICELY

Can't choose from among SIRIUS, KRYPTON, or IOLITE? Good news: you don't have to! You can use any combination of these remarkable instruments. Everything works together. All data is synchronized.

You can start with one model and then add another one later. And another. You can use them separately on Monday, and then connect them together on Tuesday to make a bigger system. It simply works. That's the Dewesoft difference.

DEWESoft® X HIGHLIGHTS

DEWESOFT®X IS A DAQ SYSTEM AND POWER ANALYZER ALL IN ONE. IT MAKES YOUR WORK FASTER AND EASIER THAN EVER BEFORE.

Award-winning DewesoftX completely redefines DAQ software. It records everything you can imagine: analog and digital sensors, video cameras, microphones, GPS sensors, inertial measuring units, CAN BUS data, and even more.

All of these data sources are time-stamped to the master clock and aligned perfectly within DewesoftX. Big, clear realtime displays that you can design yourself, save and re-use anytime.

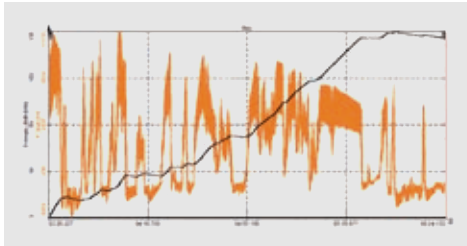
Easy reporting and data export is built-in. Updates are free forever. If you can imagine it, DewesoftX can do it.



HIGHLIGHTS DEWESoft® X

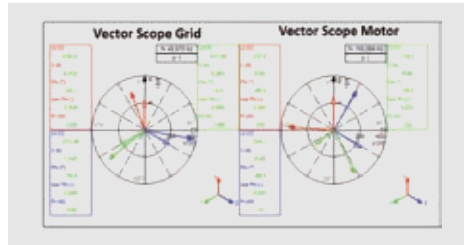
CHOICE OF RECORDING MODES

Store data at the selected rate continuously, or set up triggers to capture specific events when they happen. You can even combine triggering and continuous recording with the "fast on trigger/slow otherwise mode."



POWER ANALYZER / POWER QUALITY

P, Q, S, PF, cos phi,... More than 100 calculable values. FFT, Harmonic FFT, Harmonics, Interharmonics, Higher Frequencies, Flicker, Flicker emission etc. A complete power solution.



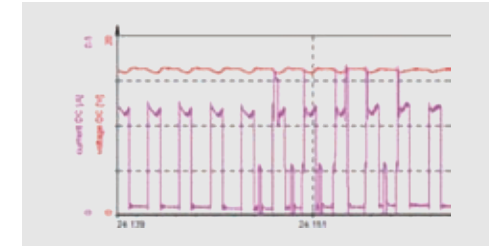
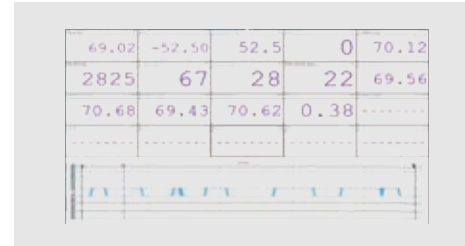
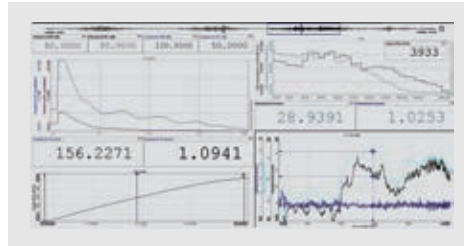
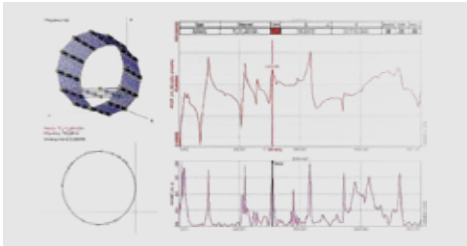
VIDEO RECORDING

Connect one of our rugged DS-CAM video cameras to your system and add synchronized video to your recordings. We also support high-speed and thermographic cameras, as well as simple webcams.



REPORT GENERATION

Even when the test is done, DewesoftX is ready to do more. You can easily create rich, graphical reports using both the existing screens and new ones that you create. Data export to multiple formats is also included.



STRUCTURAL DYNAMICS

You can perform modal test (FRF - frequency response function, OMA, ODS, SIMO, and MIMO), FFT - Spectrum Analyzer, fatigue test analysis, SRS - Shock Response Spectrum, sine reduction (COLA), and structural monitoring.

ACOUSTIC MEASUREMENT

DewesoftX can handle acoustic measurement and NVH applications, including Sound Level, Sound Power, Sound Quality, Sound Intensity, Octave Band Analysis, and Reverberation Time RT60, pass-by noise, and more.

BUS DATA RECORDING

Dewesoft systems can record data from standard buses, such as the CAN BUS, which is used across many applications. You can also record data coming across Ethernet and serial interfaces.

EASY TO ADD SOFTWARE OPTIONS

The basic DewesoftX package is already the most powerful and flexible DAQ software in the world, but there are amazing add-ons available that extend it to do even more. Some of them are shown on this screen, including power quality, structural dynamics, and acoustics.

PERFORMANCE TESTING

ACHIEVING OPTIMAL PERFORMANCE REQUIRES RIGOROUS TESTING

There is a nearly endless list of performance tests that are carried out on trains of all kinds, and Dewesoft systems are used for all of them. Here are just a few examples of how our systems are used for performance testing:

- Acceleration
- Aerodynamics
- Brake testing
- Car/Wagon test
- Fatigue
- On-track test
- Rotating part test
- Running dynamics
- Static testing
- Structural test
- Suspension test
- Test chambers
- Traction
- Truck tests
- Wheel-rail
- WSP protection

WHEEL-RAIL CONTACT FORCE MEASUREMENT

Dynamometers are used to measure wheel-rail contact forces. These tests pinpoint the causes of defects between the wheels and rails, so that they can be mitigated in the real world. Instrumented wheelsets are run on a circular track under controllable operating conditions, while strain and piezoelectric force sensors are output their data to Dewesoft DAQ systems.

WHEEL SLIDE / SLIP PROTECTION (WSP)

It is important to detect if a wheel is sliding or slipping. Otherwise, wheels wear away on one side and are not round anymore. Non-round wheels can damage the rails and lead to mechanical problems and possible fines for operating unsafe equipment on the rail lines.

Many trains are fitted with WSP detection systems that operate similar to how ABS works in automobiles. During braking or even normal travel conditions, WSP systems will intervene and prevent wheel slide/slip from happening. But like any system, it must be tested to ensure that it's working properly.

BEHIND THE WHEEL SLIDE TEST

Wheel slide happens during braking, and wheel slip happens during acceleration. Low adhesion between wheels and tracks can be caused by grease, oil, decomposing leaves, oxidation and even pollution.

To test WSP systems, a low coefficient of friction detergent is applied to a test track. Alternative methods include applying specially

treated paper, simulating leaf fall. Trains are brought up to speed and then a full service brake is applied on the treated section of the track. During this sequence the behavior of the WSP system is tested.

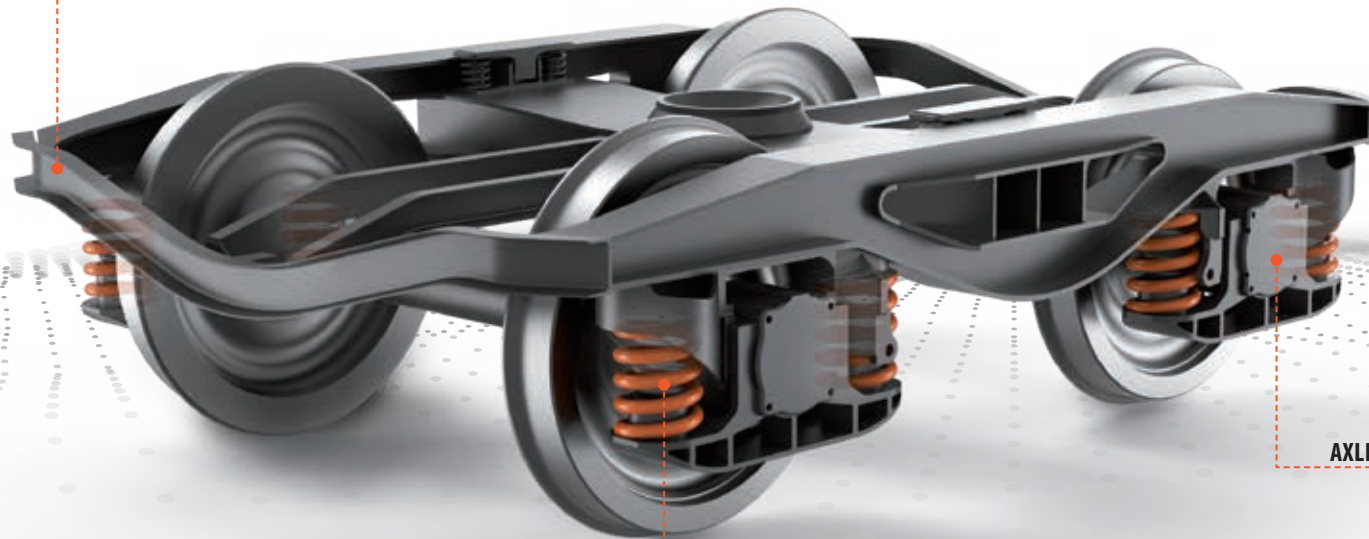
Dewesoft systems are perfect for testing WSP system performance. KRYPTON modules can measure the temperatures as well as rotational speed and position of the traction motors. KRYPTON and SIRIUS systems are perfect for testing acceleration. GPS data can be added easily.

Track testing is often done according to international standards like BS-EN 15595 and UIC 541-05.



PERFORMANCE TESTING

FRAME



AXLE BOX

PRIMARY SPRING

SUSPENSION TESTING

MEASURING SUSPENSION BEHAVIOUR

Bogies (called “trucks” in North America) have at least one kind of suspension, which is used to support the car / wagon body and to enhance passenger ride comfort, especially on curved tracks. The suspension also helps to balance loads for better ride quality, and protects the railway itself against deformation.

Several types of suspensions are used, including coil, leaf and solid rubber springs, and rubber airbags.

Until the late 1800s, train cars had fixed wheels and little or no suspension. This made for a rough ride compared to today’s railcars. There are as many types of bogie suspension systems as there are bogie designs themselves, from

traditional two axel types to articulated bogies. A measuring system needs to be versatile in order to be used for the seemingly endless variety of mechanical configurations that test engineers are presented with.

Dewesoft systems are used to measure and improve bogie performance, which includes the axles, wheels and brakes, as well as the suspension and its performance.

When the train drives on curved tracks, the suspension allows the bogie to move with the car, isolating it from the effects of vibration. The axle box suspension is designed to absorb shocks using a spring that allows vertical movement, but resists lateral movement. Solid rubber springs are also used.

PERFORMANCE TESTING

BRAKE TESTING

Weather-proof KRYPTON modules measure strain, temperature, pressure in perfect sync with high-speed Dewesoft GPS and camera inputs for precise speed, position, acceleration and deceleration information. In this example, two KRYPTON-8xTH and 12x KRYPTON-6xSTG modules were used across five cars.

KRYPTON modules can be daisy-chained up to 100 meters (328 ft) apart, using a single EtherCAT® cable. In this text, 16 temperature channels and 72 strain and pressure channels were recorded with the GPS and video data.

BEHIND THE TEST

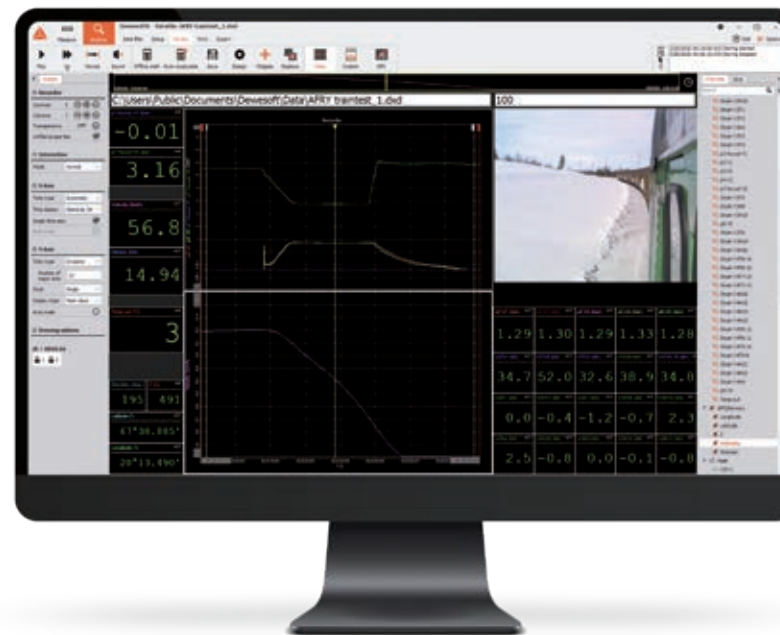
Noise can have a negative impact on human health. Noise from freight cars, especially those with cast iron brake blocks, contributes significantly to railway noise.

Changes have been recommended to EU 1304/20142 (TSI Noise) to apply current maximum noise levels for new retroactively to existing freight cars. This means retrofitting cast-iron brake blocks with “silent” composite or disc brake blocks.

Testing challenges:

- Severe cold with ice and snow
- Humidity in zero-degree weather
- Data transmission across many cars
- Speed, position, weather data needed

The all-weather KRYPTON system is completely up to the environmental and distributability challenges. Combined with a DS-GPS unit, the system was complete.



Screenshot from an actual brake test in Sweden, recorded by DewesoftX DAQ software.

CAR/WAGON 1

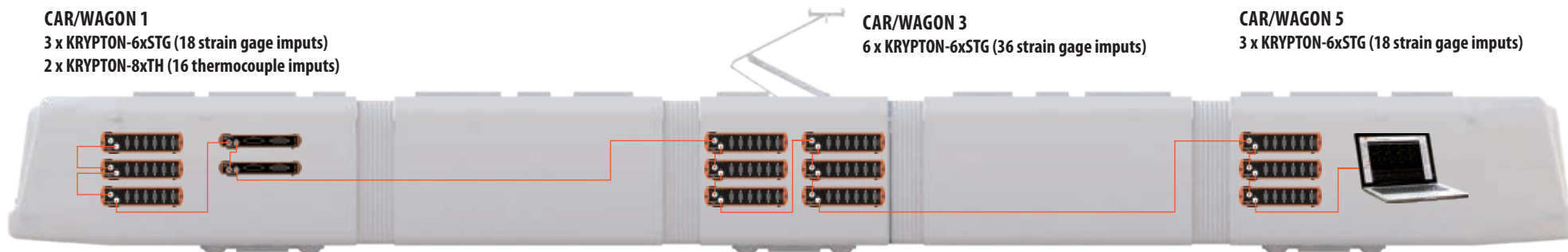
3 x KRYPTON-6xSTG (18 strain gage inputs)
2 x KRYPTON-8xTH (16 thermocouple inputs)

CAR/WAGON 3

6 x KRYPTON-6xSTG (36 strain gage inputs)

CAR/WAGON 5

3 x KRYPTON-6xSTG (18 strain gage inputs)



RUNNING DYNAMICS TESTS: BACKGROUND

Testing the running dynamics of railcars involves a broad range of on track tests as defined by international standards such as EN 14363, EN 12299, UIC 518 and US CFR49. Assessment of the real ride characteristics of railway vehicles involves the collection of data from a variety of sensors under numerous on track operating conditions.

In addition to advanced DAQ instruments from Dewesoft, instrumented wheelsets are used for advanced applications.



WE'RE SIRIUS® ABOUT DYNAMICS

Dewesoft SIRIUS DAQ systems can be found at the heart of virtually all running dynamics tests, recording strain, pressure, vibration, tilt, acceleration, noise, voltage, current, position, speed, GPS, video data, and much more.

Measuring traction and braking performance, running dynamic behavior and track/vehicle interface characteristics all have one thing in common: they require the best possible dynamic range.

Unlike other important DAQ specifications like gain or bandwidth, dynamic range is an instrument's ability to measure from the smallest signals to the largest ones, with superior resolution across the entire span. The DualCore ADC® technology behind SIRIUS provides dynamic range up to an amazing 160 dB.

PERFORMANCE TESTING



DYNAMIC BRAKING TESTS

Braking tests are performed in several stages. Brake performance is verified in accordance with applicable EN and UIC specifications.

Test campaigns can last from one to four weeks, during which time SIRIUS serves as the core of the field test lab installed on the train.

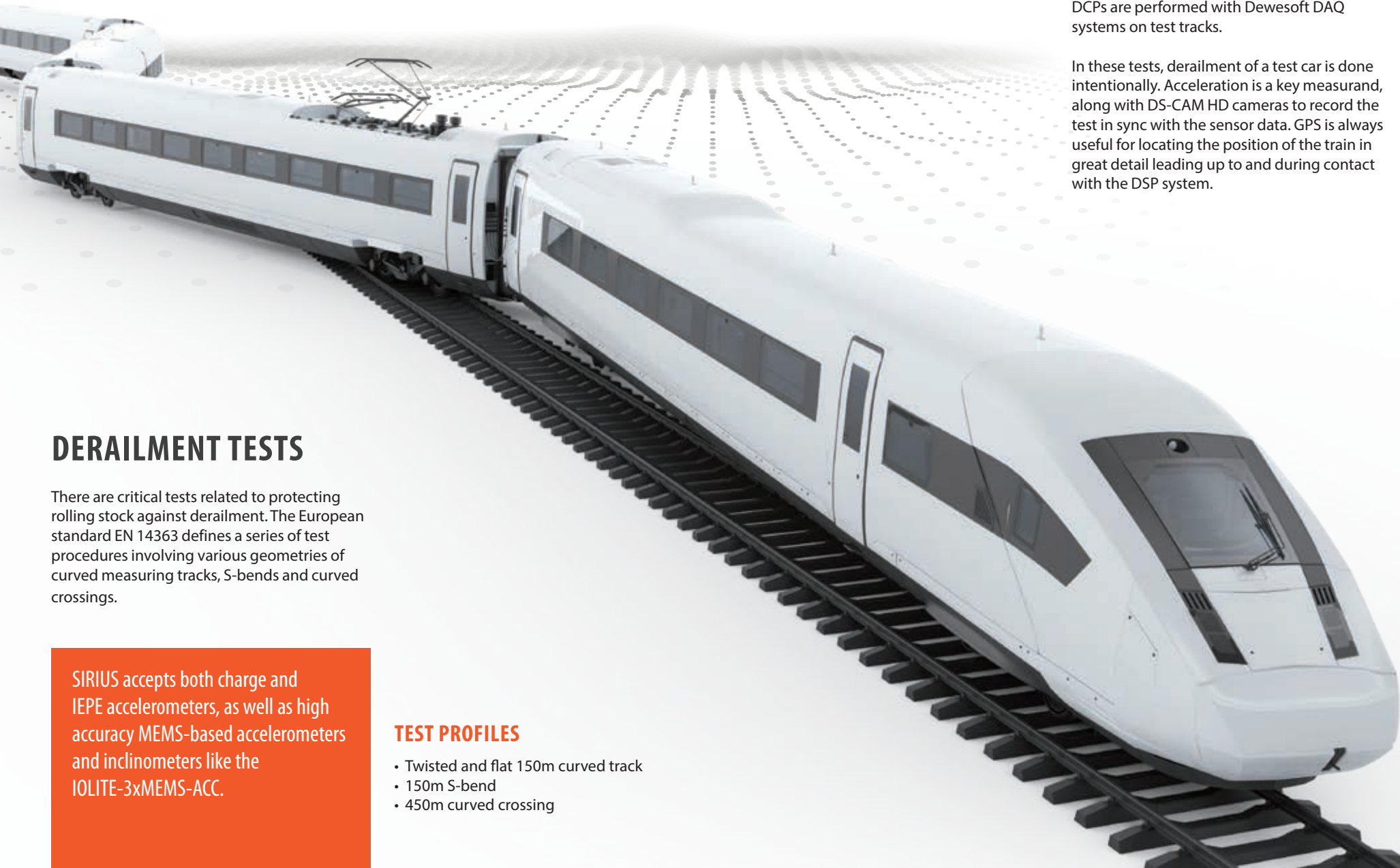
TEST IMPERATIVES

- Running safety
- Track loading
- Ride characteristics

Brake performance assessment concerns principally:

- Running Dynamic Behavior according to EN14363:2005
- Traction performance according to UNI11174
- Brake performances according to EN13452-1, EN13452-2 and the guidelines of UIC544-1 (edition 2013), EN 15595 for the verification of correct integration of the wheel sliding protection (WSP) device.
- Evaluation of the permitted speeds, according to specific requirements of the prevailing national and/or local authority

PERFORMANCE TESTING



DERAILMENT TESTS

There are critical tests related to protecting rolling stock against derailment. The European standard EN 14363 defines a series of test procedures involving various geometries of curved measuring tracks, S-bends and curved crossings.

SIRIUS accepts both charge and IEPE accelerometers, as well as high accuracy MEMS-based accelerometers and inclinometers like the IOLITE-3xMEMS-ACC.

TEST PROFILES

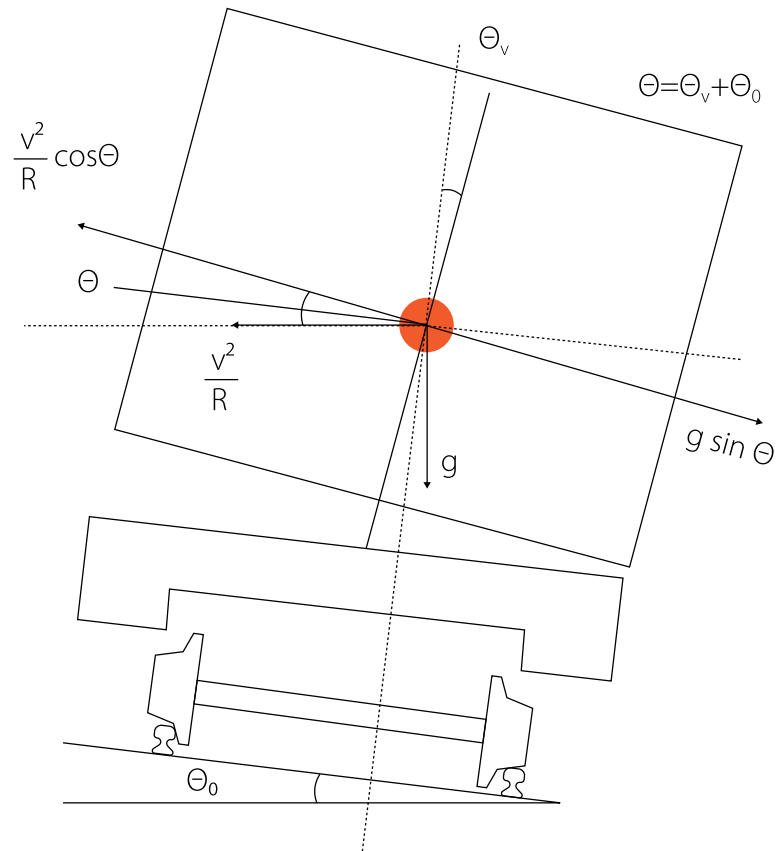
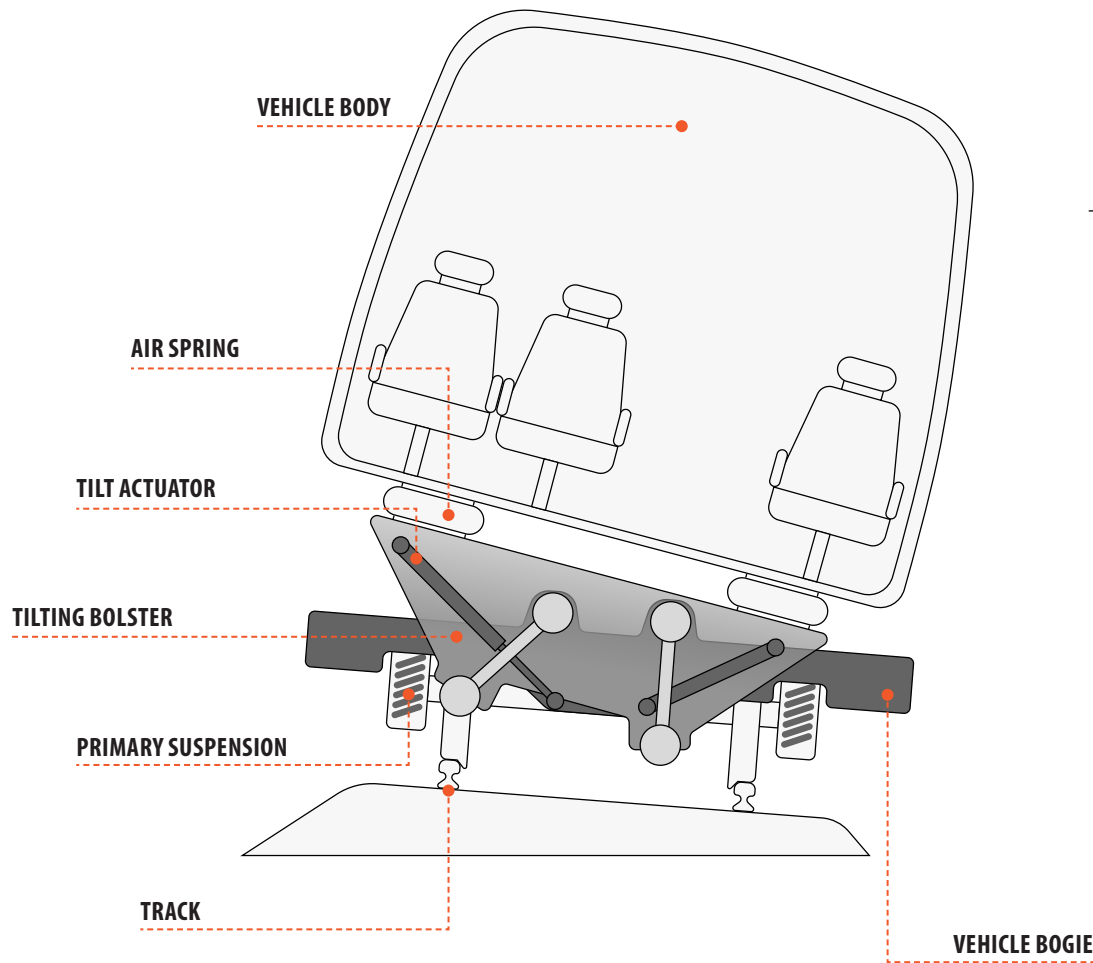
- Twisted and flat 150m curved track
- 150m S-bend
- 450m curved crossing

FULL-SCALE DSP TESTS

Several different types of derailment containment provisions (DCPs) are in use around the world. These are physical barriers between the rails, and container walls located outside of the rails, to keep the train from completely leaving the track. Full-scale measurement of the effectiveness of these DCPs are performed with Dewesoft DAQ systems on test tracks.

In these tests, derailment of a test car is done intentionally. Acceleration is a key measurand, along with DS-CAM HD cameras to record the test in sync with the sensor data. GPS is always useful for locating the position of the train in great detail leading up to and during contact with the DSP system.

PERFORMANCE TESTING



TILTING TRAIN TESTS

From the earliest passive designs of the 1930s, to today's active designs, tilting train technology has become very increasingly important as train speeds have increased. We naturally lean into a turn when riding a bike. Why? Because leaning offsets the centrifugal force that pushes us outward

when turning. Accordingly, train cars can be tilted toward the inside of high-speed turns. Centrifugal forces on trains push objects in the train car outward. Standing passengers may lose their balance, sitting passengers feel pushed against the armrest, and luggage can slide or fall out of the overhead bins. Tilting is proven way to provide a better ride experience for passengers on high-speed trains.

SAFETY FIRST

However, these systems require testing, and one of the most important measured values is the ratio between lateral and vertical acceleration (Y/Q), which represents the coefficient of derailment. This is a critical safety measurement.

RECOMMENDED EQUIPMENT

- SIRIUS DAQ instrument
- 2-axis DC accelerometers
- IOLITE 3xMEMS-ACC-INC inclinometers
- Triaxial IEPE accelerometers for human body vibration measurement
- DS-VGPS sensor for speed, distance, direction
- DS-CAM for video acquisition

PERFORMANCE TESTING

THE ENVIRONMENT INSIDE AND OUTSIDE THE TRAIN

Passenger comfort is an obvious imperative, but we also want people outside the train not to be bothered by excessive noise pollution. Environmental tests extend to the infrastructure that supports rolling stock, including tracks, bridges, tunnels, and more.

- Acceptance tests
- Brake noise (EU) No 1304/20142 (TSI Noise)
- Cabin noise
- Climatic chamber
- Extreme weather
- Homologation
- HVAC testing
- NVH testing
- Pass-by noise
- Passenger comfort
- Ride comfort
- Infrastructure:
- Bridges & tunnels
- Climatic chambers
- Cat and third rail



RIDE COMFORT INDICES

- NMV - Mean Comfort, standard method
- NVD, NVA - Mean Comfort, test method for passengers (standing and seated)
- CCx, CCy, CCz - Continuous comfort, 3-axis
- PCT - Comfort on curve transition
- PDE - Comfort on discrete events



PASSENGER COMFORT

At its core, passenger comfort is subjective, because it is influenced by a variety of factors, including noise, lighting, temperature, air quality, the condition of the train, seat comfort, and more. It also makes a significant difference whether the rider is sitting or standing, as in the case of commuter rail.

However, this only makes it more important that these ride and passenger comfort tests be performed in an objective, repeatable way according to applicable standards and methods.

Human tolerance to vibration over time is at the core of these measurements. The most commonly used methodologies used for these tests are the ISO 2631 and EN 12299 standards, and Sperling's Method. Many authorities use a combination of these standards and methods. Typically, roll, pitch and yaw are measured toward the center of the car, and triaxial

accelerometers are used at the wheel sets at each end of the car. Instrumented "dummies" inside the car can be used. GPS records train speed and position.

Numerical simulations are combined with actual physical test data, which is often collected using Dewesoft DAQ systems. Triaxial accelerometers as well as specialized MEMS accelerometers like the IOLITE-3xMEMS-ACC low-noise accel/inclinometer are used in these tests.

HVAC SYSTEMS TEST

Heating, Ventilation and Air Conditioning (HVAC) are the control of temperature and ventilation inside the train. When you consider that trains operate everywhere from the Sahara Desert to the Arctic Circle, these HVAC systems must be extremely flexible and capable. Dewesoft KRYPTON modules are used to test these systems across their entire range of operation.

TRAIN PASS / PASSBY NOISE TESTING

Trains can be loud, so manufacturers and operators need to ensure that their rolling stock conforms to local and federal or EU acoustic standards. In the European Union, ISO EN 3095 defines the measurement of noise emitted by railbound vehicles.

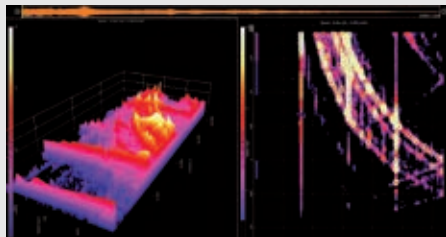
Dewesoft systems are ideal for performing train pass / passby noise tests. A common set-up is a SIRIUS DAQ system configured with IEPE inputs and up to eight microphones. Using DewesoftX's Soundlevel software plugin, engineers can determine averaged sound pressure level, with A-weighting, according to the standards. By adding a light barrier, the time interval for the sound averaging can be adjusted to match to the exact length of the train.

It is also possible to add a DS-CAM to document the tests with synchronized video of the passing train in each test.

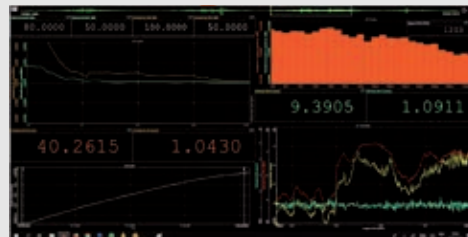
ADVANCED ACOUSTIC ANALYSES:

- Octave Band Analysis
- Sound Level
- Sound Power
- Sound Quality
- RT60 Reverberation Time

ENVIRONMENTAL TESTING



DewesoftX 3D graph and rainflow display.



DewesoftX acoustics sound quality display.



SIRIUS with 4 polarized mic and 4 IEPE mic inputs. Other configurations available.



SIRIUS mini with 4 IEPE mic inputs.

ENVIRONMENTAL TESTING

TESTING THE RAIL INFRASTRUCTURE

Even the best designed and maintained trains in the world rely on a solid infrastructure in order to achieve optimal and safe performance. Dewesoft systems are used for testing the entire environment, from the tunnels to bridges, and the very tracks that rolling stock rides on, and the ties/sleepers that support the rails.

TUNNEL TESTING

PRESSURE

Fast trains passing each other in tunnels can result in very high forces from the wind that they create. Excessive pressures can damage the human ear, so it is critical to measure these forces and mitigate them when needed for passenger comfort and safety.

VENTILATION

Tunnel ventilation is another important area of study. Smoke generators are used to ensure that tunnels have air that is safe for breathing. Oil tubs are used to generate smoke, and Dewesoft KRYPTON modules are often used to measure temperature distribution throughout the tunnel to ensure that smoke is properly ventilated.

Air conditioning systems inside the cars/wagons must also be tested to ensure passenger comfort, across all seasons and extreme weather conditions.

TEMPERATURE

Dewesoft IOLITE and KRYPTON modules are ideal for temperature measurement across multiple cars/wagons, or even the entire train. EtherCAT® daisy-chaining makes hook-up easier and more efficient than ever, and allows data to be collected anywhere in the train with one system.



IOLITE 3xMEMS DAQ devices with integrated MEMS accelerometer and inclinometer, indoor and outdoor versions.



KRYPTONi-1xSTG universal signal conditioner, daisy-chained via EtherCAT®.

ENVIRONMENTAL TESTING

BRIDGE TESTING

HIGH SPEED TESTING

SIRIUS DAQ systems are ideal for high speed bridge testing. Connect any combination of single axis and triaxial accelerometers to the track. The forces from the train will excite mode shapes in the bridge structure. Dewesoft's modal analysis plugin makes it easy to analyze the modes, and even animate custom 3D models, and analyze their behavior during and after testing.

STRUCTURAL HEALTH

Dewesoft data acquisition systems are used in structural health and seismic bridge monitoring projects ranging from structural mechanics to continuous monitoring of large, complex bridge structures.

DISTRIBUTION

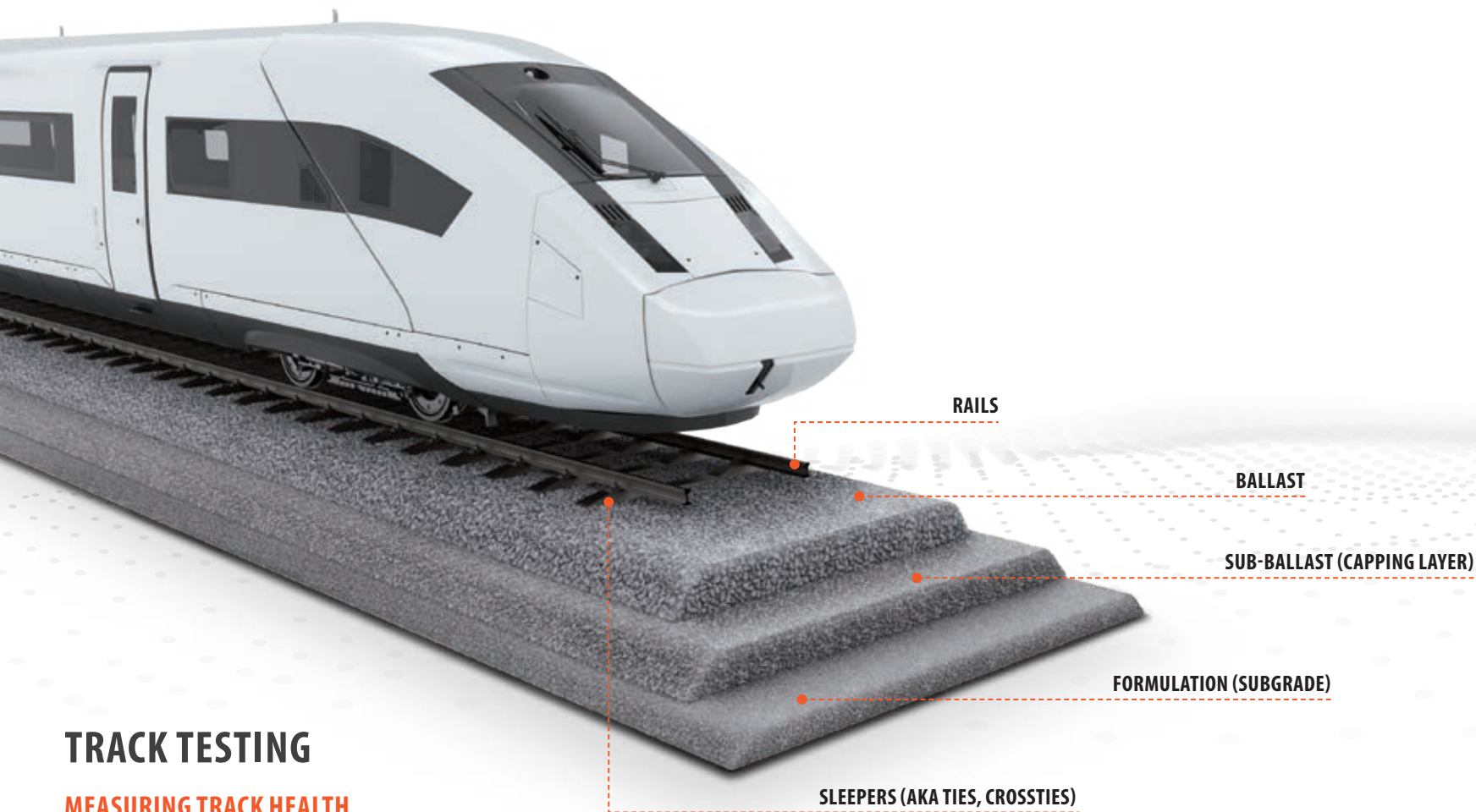
Our monitoring systems provide distributed, high-channel-count and remote monitoring for bridges, tunnels and other large structures. EtherCAT® technology allows the sensors to be placed anywhere and connected with a single cable for power, data, and synchronization. Cables can span up to 100 m (328 feet) between nodes, or virtually unlimited using fiberoptic converters.

RANGE OF APPLICATIONS

Acceleration, vibration, inclination, displacement, static and dynamic strain, surface temperature and more can be monitored continuously and remotely.



ENVIRONMENTAL TESTING



TRACK TESTING

MEASURING TRACK HEALTH

Maintenance of tracks is critical to operation. Specially instrumented cars as well as self-propelled track inspection vehicles are often used to conduct a variety of track inspections, including high-resolution imaging and ultrasonic.

The long term impacts of heavy loads on ties, sleepers, and track welds must be measured and mitigated. The impacts of wheel deformities, driver characteristics and external forces like seismic shift and weather are additional factors.

TRACK INSPECTION

When the weight bearing capacity of a track is exceeded, the rails may move apart enough to allow derail a train. Specially weighted vehicles are used to detect gage widening.

Dewesoft's precision instruments can be found in many of these specialized vehicles, doing the daily work of track inspection.

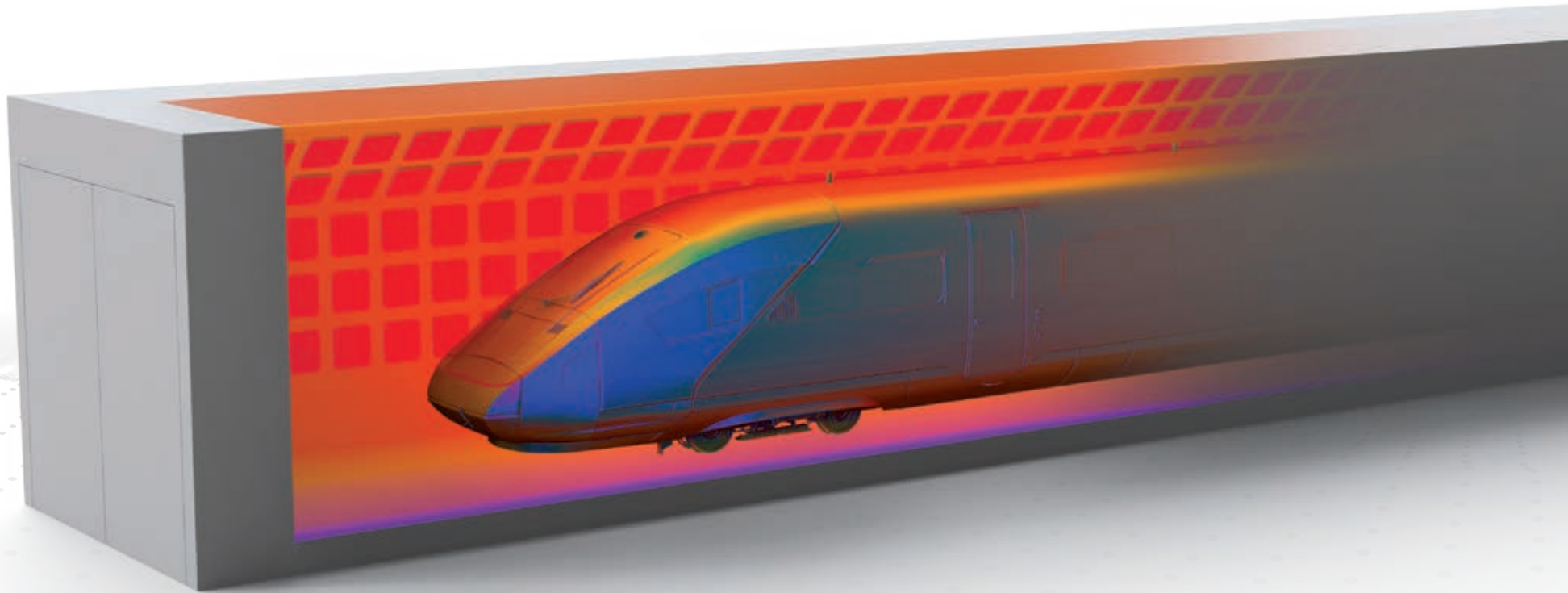
VERSATILE DAQ TECHNOLOGY

Every aspect of the track can be measured with Dewesoft DAQ, from the rails to the sleepers (cross-ties) and fasteners that hold the whole system together. Our rugged, all-weather IP67 KRYPTON instruments make everything possible.

TRACK TESTS

- Track bed fatigue tests
- Fastener tests (ISSN 0169-9288, DIN EN 13146-4, DIN EN 13146-7, DIN EN 13481-2)
- Sleeper fatigue (EN 13230)
- Rail and Joiner plate test
- Elastomer pad tests (EN13146-9)

ENVIRONMENTAL TESTING



CLIMATIC CHAMBER TESTING

TESTING ENVIRONMENTAL CONDITIONS

Climatic chambers are used to test train components and entire vehicles across a wide range of environmental conditions. For example, the temperature can be adjusted down to $-40\text{ }^{\circ}\text{C}$ or up to $60\text{ }^{\circ}\text{C}$ ($140\text{ }^{\circ}\text{F}$) or more.

TEMPERATURE, WIND & HUMIDITY

Snow and ice can be created, and large fans can create punishing winds of 305 kph (190 MPH). Humidity can be adjusted typically up to 95%. Can a train's HVAC system withstand the extreme conditions? That's what engineers need to know, and climatic chambers are the best way to do that in a completely controlled environment.

SUNLIGHT

Even blinding sunlight can be created in some chambers, blasting up to 1000 w/m^2 into the windows, to test their ability to withstand it, as well as a driver's visibility based on how the windows have been treated.

WHEEL SET PERFORMANCE

And it's not just comfort – how will bogies (trucks) and wheel sets work under extreme conditions? How will brakes handle ice, snow, water on the tracks? How will battery systems deal with low and high temperatures? There are literally thousands of parameters that must be tested on every train.

POWER TESTING & ANALYSIS

POWER ANALYSIS ON ELECTROMOTORS, INVERTERS, PANTOGRAPHS, THIRD RAILS AND MORE

Our high-bandwidth, high-accuracy and isolated inputs are the ideal fit for power and energy testing of all kinds. And it's not just electric trains, but the current supply systems on the ground, too.

- Power quality
- Power supply tests
- Transformer tests
- Touch potential
- Emc testing
- Energy consumption
- Power grid
- Pantograph
- Third rail shoe
- Electromotor test
- Diesel engine test
- Current flow
- Relevant Standards:
EN 50317, EN 50119, EN 50367

FULLY ISOLATED

Galvanic isolation (channel-to-ground and channel-to-channel), including sensor excitation isolation. Isolation means less noise, no ground loops, and the best possible signal quality.

DIRECT HV INPUTS

- 2000 V DC /
- CAT II 1000 V/ CAT III 600 V
- Direct input and acquisition of high voltage signals.

HIGH ACCURACY

- Precision amplifiers and sensors for accuracy as high as 0.003%

THE HIGHEST SAMPLE RATES

- SIRIUS XHS samples up to 15 MS/s, with 5 MHz bandwidth

PANTOGRAPH TESTS

It is critical to test how the pantograph interacts with the overhead catenary system (OCS). This is a relatively complex mechanism operating in a tough, all-weather environment. Dewesoft systems are used to perform these important tests according to EN 50317:

- Contact force between the pantograph and the power lines
- Arc flash detection
- Current flow and consistency

The ability to synchronize DS-CAM video recordings with the sensor data is a critical component of catenary testing. With the camera we can contactlessly measure the wire uplift, for example. Analysis of test results helps engineers optimize the system aerodynamically, electrically and across its whole range of operation.



The DS-CAM series are high-speed GigE cameras with interchangeable lenses, adjustable frame rates, CMOS technology, and IP65 protection against dust/water. Multiple DS-CAMS can be used at the same time.



POWER TESTING & ANALYSIS

THIRD RAIL ANALYSIS

Mechanical wear and tear, deformation, abrasion, dynamic car/wagon height variations and third rail geometry variations. These are all variables that can affect the performance of the current collector "shoe," after years of making direct contact with the third rail.

Dewesoft DAQ systems are equipped with a rugged video camera, GPS, high voltage and current inputs are used to test current collectors under real driving conditions.

See the screenshot from DewesoftX software below for an example of an actual test using voltage, current and video inputs.



ELECTROMOTOR TESTING

FASTER, MORE ACCURATE MEASUREMENTS

EFFICIENCY ANALYSIS

Dewesoft's Power Analyzer is the ideal all-in-one measurement solution for electric trains. Measuring any type of motor, be it single phase or multiphase (up to 12 phases), inverter (DC/DC, AC/AC, DC/AC) testing capabilities into the multiple hundred kHz region, as well as measuring battery parameters.

MODULAR HARDWARE DESIGN

SIRIUS modular hardware makes it possible to measure power (AC or DC) at multiple measurement points perfectly synchronised. This unique feature provides the flexibility to do a comprehensive analysis of different types of electric drive trains (Single motor, motor-generator, multiple motor configuration from 2 to 4 motors). All the auxiliary loads can be measured and analyzed simultaneously - including heating, air-conditioning, and DC loads, to name just a few.

HIGH SAMPLE RATE AND BANDWIDTH

SIRIUS XHS platforms sample up to 15 MS/s with up to 5 MHz bandwidth and remarkable dynamic range. This ensures that your data is of the highest possible accuracy and resolution on all axes.

ONLINE AND OFFLINE ANALYSIS

Analysis can be done during the measurement, as well as afterwards. Analyses include energy flow diagrams, influence factors on efficiency, comparison with other trains, charging analysis, comparison of characteristics on different tracks, and more.

ANALYZING DIFFERENT OPERATIONAL SITUATIONS

There are various parameters that can influence the energy consumption of an electric train, including:

- External influences like temperature, humidity and precipitation
- Track surface quality
- Steep grades up or down
- Driver behavior

Dewesoft's Power Analyzer can perform advanced energy analysis considering all of these parameters during the test drives, and more.

In addition, we're more than just a power analyzer: you can bring in countless sensor measurements of all kinds in sync with the power signals. Temperature, strain, pressure, GPS, and dozens more parameters.

CURRENT SENSORS

We offer high-accuracy current sensors such as zero-flux current transducers, flux-gate current transducers, AC/DC current clamps, Rogowsky coils and shunts with the power supply directly from the system.

ADVANCED ONLINE AND OFFLINE MATH PROCESSING

DewesoftX includes an easy-to-use mathematics engine. You can apply math functions during the measurement, as well as during post-processing.

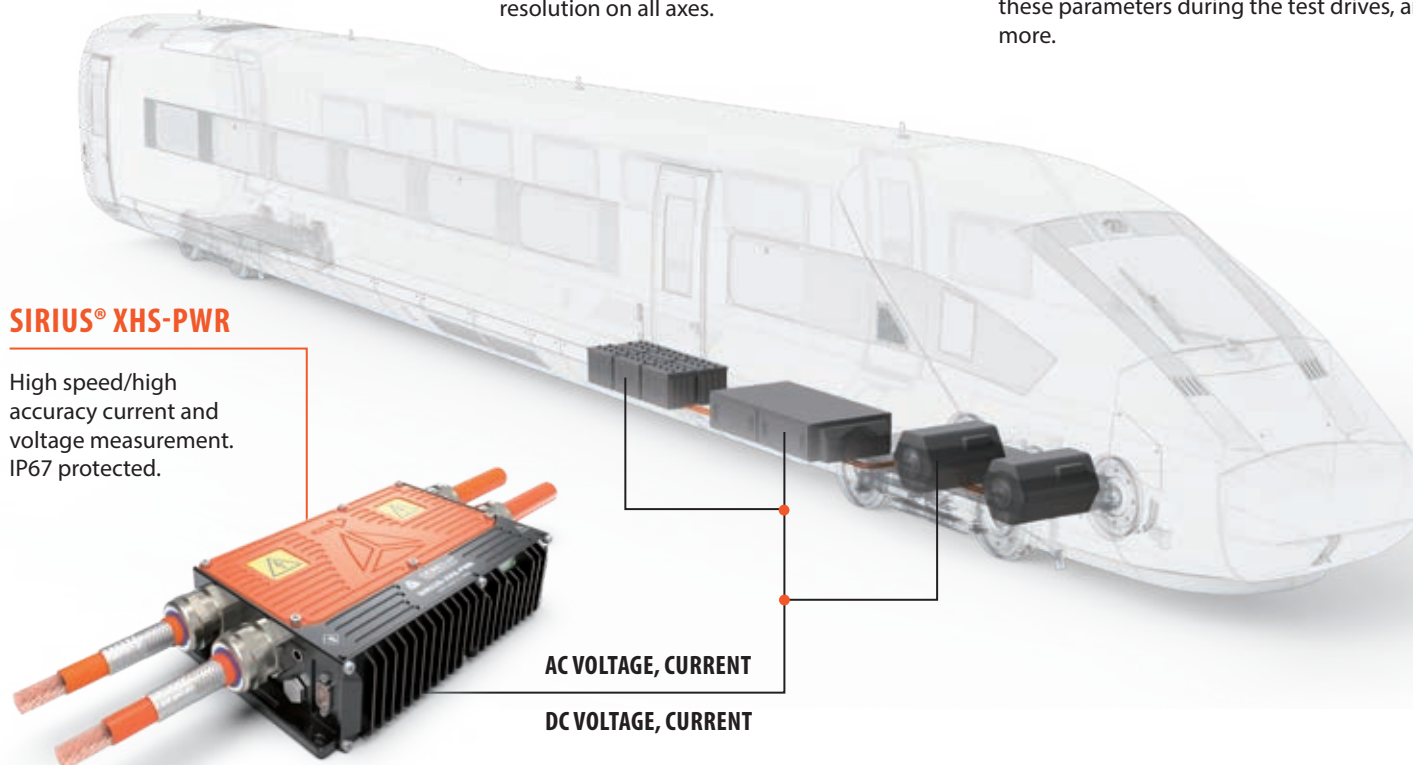
SIRIUS® XHS-PWR

The SIRIUS XHS-PWR is ideal for on-train power analysis. The built-in DC-CT current transducer provides precise current measurements in the most demanding applications. It effortlessly handles very high current peaks as well as leakage current measurements.

Waterproof and dustproof, its IP67 protection means that it can be used in challenging physical environments. The patented DC-CT® technology is based on the Platiše Flux Sensor. It's the latest current sensing technology, with ranges of 100A, 500A, and 1000A, plus a wide 1 MHz bandwidth.

Excellent linearity, precision, accuracy, immunity to external magnetic fields, low offsets, extremely low-temperature drift are achieved at low power operation. SIRIUS XHS-PWR can also directly measure the voltage up to 2000V peak (CAT II 1000V), with up to 5 MHz bandwidth.

DC-CT® is a registered trademark of ISOTEL.



SIRIUS® XHS-PWR

High speed/high accuracy current and voltage measurement. IP67 protected.

AC VOLTAGE, CURRENT

DC VOLTAGE, CURRENT

ELECTRO MOTOR TESTING

The Dewesoft R8D Power Analyzer combines motor and inverter testing into a single instrument. It offers a high number of input channels for both voltage and current measurements, and synchronizes all channels. This analyzer can measure 8 x 3-phase systems simultaneously. Therefore you can measure the entire power system of an electric train.

Unlike traditional power analyzers, the Dewesoft Power Analyzer can also measure additional parameters like speed, torque, temperature, Video, GPS and CAN. Earlier typical test bed applications required the use of multiple measurement instruments - Power Analyzer, Scope, Data Logger, CAN reader etc. The Dewesoft Power Analyzer facilitates the measurement and analysis of all the data that would have been measured with such devices in a single measurement device.

All of the data can be stored at the full-sampling rate, and all analysis can be done during the measurement. Dewesoft's unique post-processing functionality enables data manipulation after the measurement using mathematics and even settings changes. For example, if phase voltages were connected wrong this can be reconfigured after the test, eliminating the need to repeat the measurement. It's all about boosting your efficiency, and saving valuable testing time.

- Power & Power Quality Analysis
- Handles up to 12-phase Motors
- Raw Data Analysis
- Efficiency Analysis
- Transient Recording
- Data Logging
- Oscilloscope Mode
- Vectorscope Mode
- Records GPS, Video, CAN
- Records vibration, force, stress, strain, temperature, acceleration, sound...



SIRIUS R8DB Power Analyzer, configured with Display and Batteries.

MOTOR & BATTERY TESTING

BATTERY TESTING

Electromotor batteries are constantly exposed to non-optimal conditions, including extreme temperatures, humidity, and shock and vibration. All of this has an effect on power stability, battery efficiency and lifespan. This makes it crucial to do extensive tests on batteries: starting from the cell-characteristics leading up to the entire power system. Detailed analysis requires temperature and voltage measurement at multiple points, including 50 x cell voltage and 50 x cell temperature measurements.

Our flexible and scalable solution can be configured to encompass more than 1000 channels with every kind of sensor; all synchronized for a detailed analysis. Battery testing has a broad spectrum of testing requirements, Dewesoft covers them all with ease, whether only one or a combination, the Power Analyzer and Power Quality Analyzer delivers the best results all of the time.

BATTERY DEVELOPMENT & TEST

Cell characterisation, endurance and aging tests, shock and vibration, misuse tests such as crash tests, short-circuit tests, overheating, overloading, overcharging, forced discharge tests, impact/crush test, thermal extremes.

BATTERY CHARGING ANALYSIS

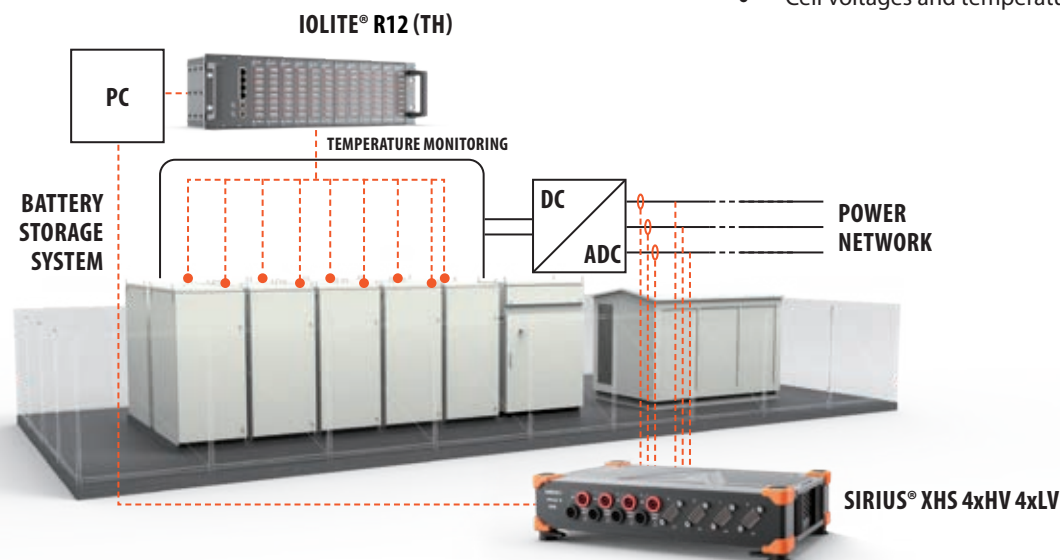
AC/DC charging, charging energy, charge/discharge efficiency, charging process and time, harmonic analysis as well as inductive and conductive charging.

BATTERY TROUBLE-SHOOTING

Including voltage drops, voltage commutation unbalance and inrush currents.

APPLICATIONS

- Battery monitoring
- Transient recording
- Charge and discharge analysis
- Charging profiles
- Energy delivery
- Efficiency and losses
- State of charge
- Cell voltages and temperatures



EMC TESTING

TOUCH POTENTIAL TESTS

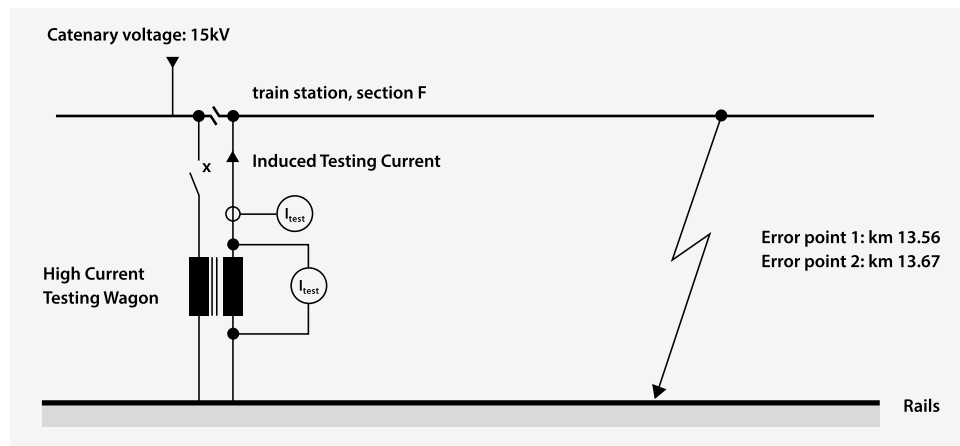
The complex electrical systems of railways require proper grounding and bonding throughout the network. In addition to leaving wayside equipment susceptible to damage, the lack of a proper grounding system poses a serious safety risk to rail workers and the general public. Electrical energy needs to be dissipated into a grounding system or else the current will stray to places where it shouldn't appear, leading to touch/step potential injuries. This can happen anywhere that exposed metal exists in the network if there isn't proper grounding and bonding. Stray current can cause other hazards that put



rail workers and the public at risk, especially in transit networks where vehicle traction is powered by high voltage electrical current. The following are components of the rail network that generally require grounding and bonding:

- Running rails
- Overhead catenary and contact rails (third rails)
- Wayside equipment (interlockings, switch machines, intermediate signals, etc.)
- Electrical/electronic enclosures throughout the network
- Communication towers and microwave installations
- Grade crossings
- Building and support facilities
- Onboard rolling stock

Grounding systems must be verified on newly constructed or renovated lines, railway stations, and operating sites, as well as on reinforced concrete structures, engineering structures, and noise protection walls. This is done according to EN 50122-1:2017.



HIGH CURRENT TESTS

High current test systems are used to test the thermal stability of equipment and components such as cables, generator stators, switching cells, etc. The test system induces a current in the test object, causing it to heat up. Therefore, the test object is designed as a short circuit. The high current test system measures the temperature of the test object at various points, in addition to the current. In these tests, the components of railway systems are tested for their mechanical and thermal strength. The component tests are necessary so that operators like ÖBB can be sure that the heating during operation does not exceed limits, and that the required short-circuit current is tolerated by all components in their systems.

Because the transformer can provide very high currents, a second important application is high-current testing of railway infrastructure components. This can be done via short-circuit tests at 30 kA for 1 second, or longer term heating tests at 1000 A for several hours. In these critical tests, components like grounding sockets and connectors are taken out of the infrastructure and loaded with high-current to check their mechanical and electrical resilience.



The High-Voltage Test Car from ÖBB-Infrastruktur AG checks the electrical infrastructure on the railway across Austria.

KEY FEATURES

- Measure kA and mA currents at the same time with SIRIUS DualCore ADC®.
- Wideband frequency range calibration of 3000A Rogowski current sensors with bandwidth up to 50 kHz, available at Dewesoft calibration labs.
- Psophometric interference current according to VDE 0845-6-1 (via DewesoftX Psophometer plugin).
- Customized filters according to international standards in the built-in DewesoftX software math module.

INTERFERENCE CURRENT TESTS

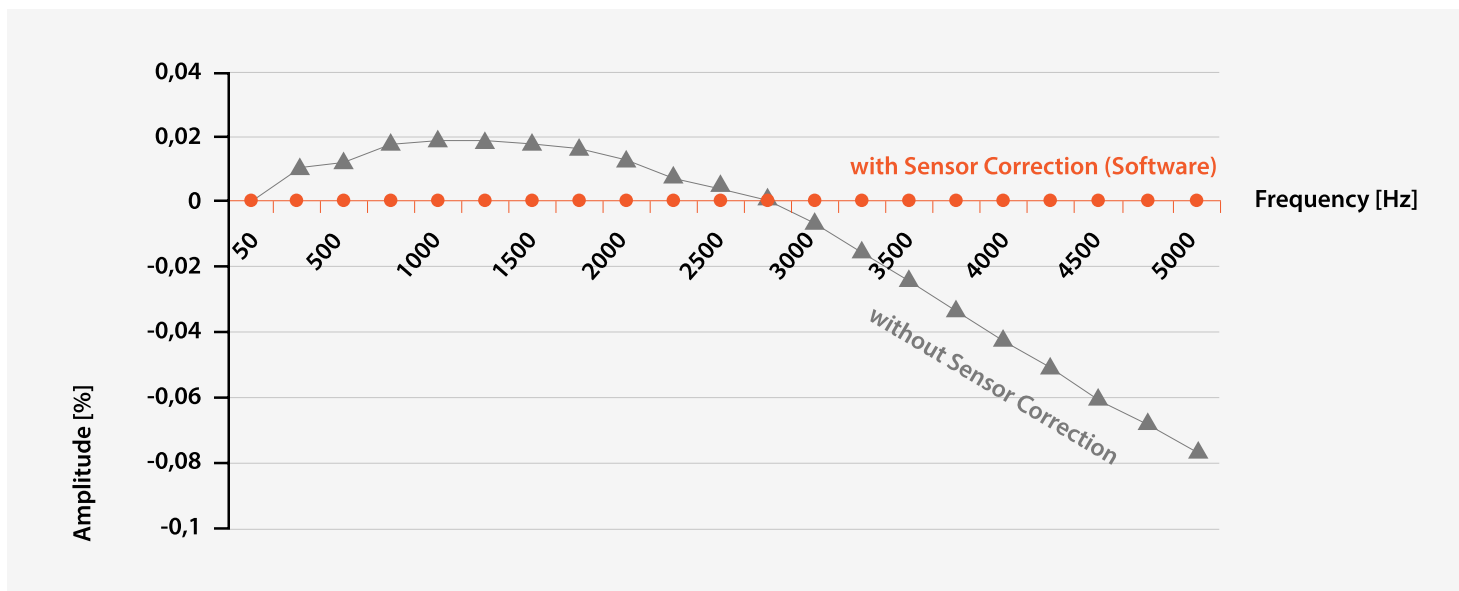
Interference currents in the railway power supply can cause malfunctions, overvoltages and resonance vibrations. Interference current limits are established and regulated by country, so they vary. But one thing that remains true around the world are the basic requirements for the measuring equipment:

- High-precision inputs
- High bandwidth current sensors
- Special filter functions for the measurement and analysis of interference currents
- System calibration of the instrument and the current sensors together

ANSWERING THE DYNAMIC RANGE CHALLENGE

SIRIUS DualCore technology has been designed specifically to be able to record the broad dynamic range required by these signals, which are comprised of both very small and large current signals. The use of dual 24-bit ADCs operating at low and high gains results in bandwidth up to 160 dB. Large and small currents can therefore be measured by the same input.

SIRIUS DualCoreADC® technology combines two 24-bit delta-sigma ADCs per channel. Each ADC runs at a different gain, allowing the system to instantly adjust to changing amplitudes, and always achieving the best possible signal-to-noise ratio. The result is high bandwidth performance with dynamic range up to an astonishing 160 dB.



SIRIUS DAQ system with Rogowsky coil FLEX current sensor.

CALIBRATION AND SENSOR CORRECTION

The amplitude and phase performance of Rogowski coils like the DS-FLEX-4000-HS are frequency dependent. In order to achieve the most accurate measurements, frequency-dependent behavior must be corrected by the measuring system.

DewesoftX measurement software has been designed to handle this quickly and easily. Sensor correction factors are stored inside DewesoftX, which applies them during recording to the measured RMS values, and within the power calculations.

Correction factor data can be obtained either from calibration sheets provided by the sensor manufacturer, or it can be obtained empirically – via a hands-on calibration right on the Dewesoft system. This means that you can verify your sensors' performance any time.

SOFTWARE FILTERING

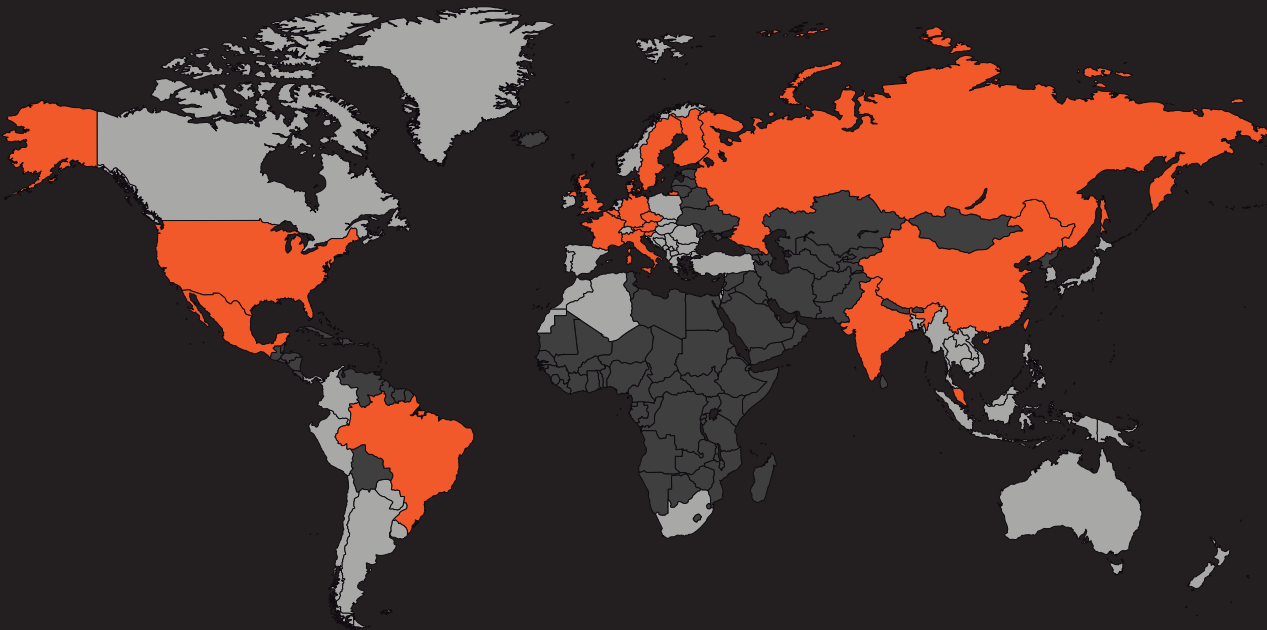
Every application has different filtering requirements. Special filters can be defined directly in DewesoftX software.

Filters can be saved and reused whenever they are needed – and you can apply them to your channels during and even after recording.

Recommended equipment: SIRIUS with HV high voltage inputs, LV low voltage for current sensor inputs.

Voltages up to 1200 VDC (CAT II 1000 V) can be directly applied directly to the HV inputs. Current sensors are connected to the LV inputs, which directly power them (no batteries or external power supplies are required).

The DS-FLEX-3000-HS can handle currents up to 3000 A AC. It provides a basic accuracy of 0.3 %, and bandwidth up to 1 MHz.



DEWESOFT® WORLDWIDE: SLOVENIA, Austria, Belgium, Brazil, China, Denmark, France, Germany, Hong Kong, India, Italy, Mexico, Russia, Singapore, Sweden, UK, USA and PARTNERS IN MORE THAN 50 COUNTRIES

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