Welcome to PPM Test

RF over Fiber products for EMP Test and EMC Conformance Measurement

Sentinel 3 (S3)

Point2Point (P2P)

Sentinel 3 and P2P Product Review

Harsh Environments with Sensors and Probes – Not Antennas

Sentinel3

Intelligent RF over fibre

Point2point

Fixed gain RF over fibre

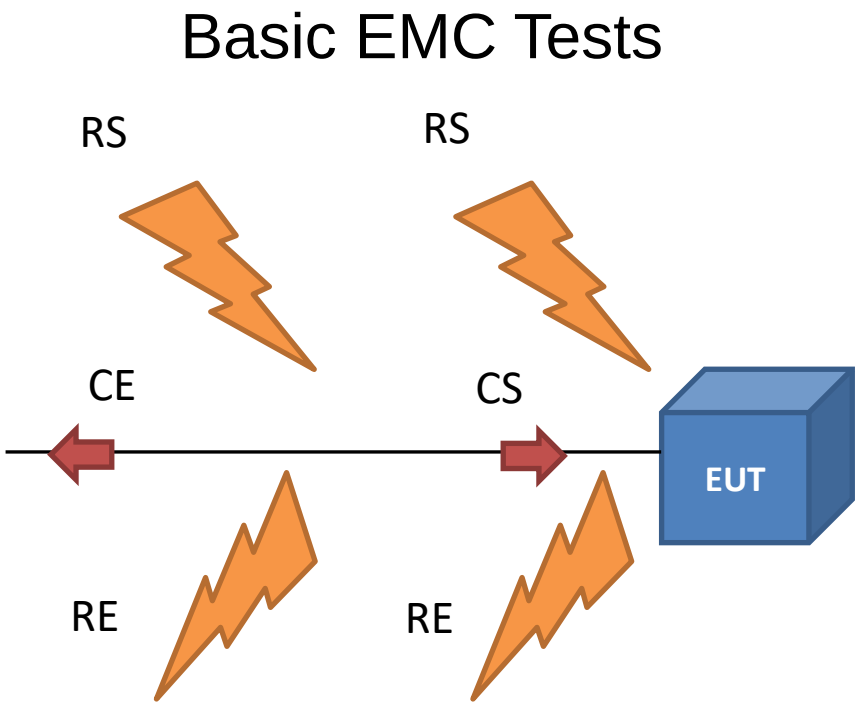
Magnetic field sensors

Electric field sensors

Current transducers

Baluns

Susceptibility & Emissions Testing



Radiated Susceptibility:

- DUT resilience to Radiated RF signals E-field & H-field

Conducted Susceptibility:

- Resilience to RF signals induced into DUT cables/harness

Radiated Emissions:

- Measurement of radiated E-field or H-field emanating from DUT

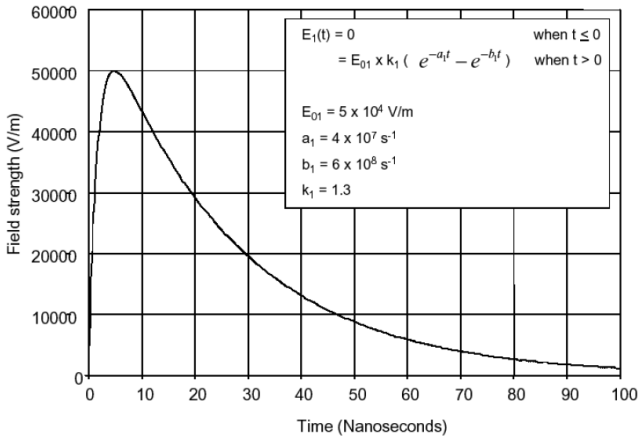
Conducted Emissions:

- Measurement of RF signals flowing from the DUT into cables / cable harness

EMC susceptibility testing using RFoF

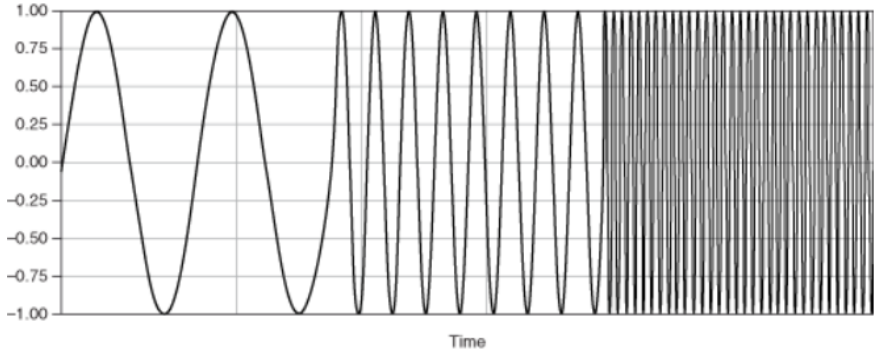
Time domain

- Pulse / Electro Magnetic Pulse (EMP) testing, High Altitude (or Nuclear) Electromagnetic Pulse (HEMP) e.g. MIL-STD 461 RS105
- Lightning

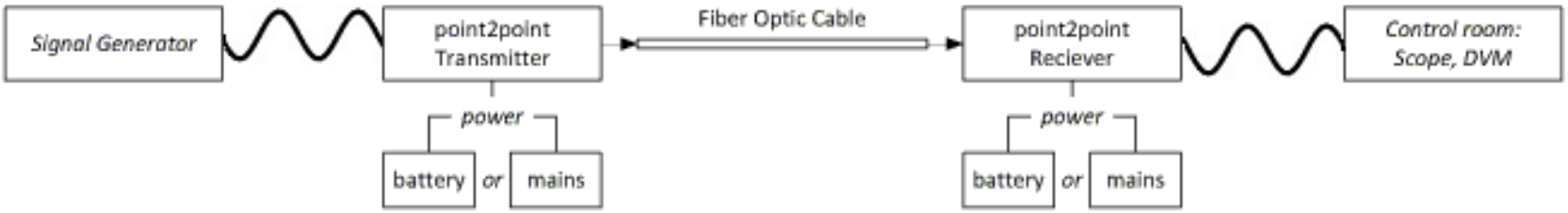


Frequency domain

- Low level Swept Freq.
- Low Level Swept Current
- High Powered Microwave (HPM) Directed Energy Weapons testing



Point2Point P2P Fiber Optic Links



Point2Point

- AC coupled
  - G series: 40Hz to 250MHz
  - K series: 2kHz to 1.35GHz
  - P series: 1MHz to 2GHz
  - S series: 10MHz to 3GHz

- DC coupled
  - 0Hz-2.5MHz
  - 0Hz-20MHz
  - 0Hz-40MHz

https://www.youtube.com/watch?v=CChZkUai3TI

Point2Point (P2P) RF over Fiber Test

P2P Link for 19” Chassis

Point2point fiber optic links are fixed gain RF over fiber links that protect RF signals from electrical interference, provide EMC/EMP shielding and high voltage isolation

- AC and DC Coupled Links
- Provide immunity to electrical interference and electromagnetic fields
- Can be used across very long path lengths
- Negligible degradation of signal-to-noise
- Allow for safe transmission path for monitoring at hazardous voltages
- Able to eliminate ground loops

- Broad bandwidth frequency response
- All modulation formats
- Wide dynamic range
- Flat bandpass response
- Single mode or multimode
- Up to 36 hours battery life


P2P 1U style Chassis

Point 2 Point (P2P) DC Coupled

- 2.5MHz, 20MHz and 40MHz (3dB BW)
- 14 bit ADC/DAC resolution for better dynamic range and accuracy
- Optional remote power control over separate link
- Allows transmission of true DC signals, 1MV or in 100kV/M
- 10 km link lengths
- BNC 50 ohms and FC/APC optical connectors for single mode fiber

- DC coupled P2P link transmits analog signals with a wide 40MHz bandwidth over single mode fiber
- Fast rise times of 10.3ns are ideal for measuring transients on HVDC transmission lines
- The modules are available in a fully EM shielded casing, or as a plug-in module for use with PPM P2P accessory housings.

- Battery power units can be controlled using the PPM P2P battery switch and controller to optimize the operational lifetime
- Input voltage ranges from +/-2V to +/-150V
- 2.5MHz units have a +/-10V output option
- -20 to + 60 deg C operating temperature

Point 2 Point (P2P) AC Coupled

- 250MHz, 1.35GHz, 2GHz and 3GHz (3dB BW)
- Allows transmission of signals 1MV or in 100kV/M
- 4 km link lengths
- Very low noise figure and high dynamic range
- Minimum detectable signal at output -155dBm/Hz
- SMA Female 50 ohms and FC/APC narrow key for single mode fiber

- AC coupled P2P link is capable of transmitting any type of low level RF analog signal up to 3GHz over single mode fiber

- Ideal for EMC measurements, HPM experiments or distributed timing
- Modules are available in a fully EM-shielded high-level pulse casings
- Plug-in module is available for use with the various P2P housings
- When used in combination with the PPM battery switch and controller it is possible to control the on/off status of battery powered modules to manage the operational lifetime.

- -10 to + 40 deg C operating temperature

Point 2 Point (P2P) Accessories

Desktop 4U desktop incorporates backplane PCB, power supply and cooling fans. Accommodates 10 modules or 8 modules plus a system controller. Integrated GPIB and RS232 control ports support remote control. Can also be rack or cabinet mounted.

1U 19” rack chassis enables three modules with integrated AC PSU. Used for applications such as monitoring 3-phase systems.

Converter sleeve enables P2P module to be used as a standalone unit for remote operation where environmental and electromagnetic field levels are less demanding. Powered from an external DC source or from a PPM wide-input range 12V main power supply unit. Not for use in a hostile RFI environment, however a shielded remote module is available should conditions warrant.

Point 2 Point (P2P) Accessories

The battery sleeve converts the P2P module into a battery powered standalone unit designed for operation at a remote location where environmental and electromagnetic field levels are less demanding. This solution provides comprehensive isolation from HV and very long run times with the option of a 9.0Ah battery and remote ON/OFF controller switch.

All remote modules are designed for operation with shielded battery packs available with standard capacity or high capacity. Battery packs attach to the shielded module with a U-shaped coaxial linking plug that serves as an electrical connection and a mechanical fixing. Battery cells are protected with two resettable for over-temperature and over-current control.

Point 2 Point (P2P) Accessories

HIRF High Intensity Radiated Fields

HIRF Labs are used for generating radiated electromagnetic environments for testing the EM susceptibility, immunity and compatibility of flight critical avionics or other types of RF equipment.

The test data acquired through HIRF testing is used to study avionic-upset and to characterize fault-tolerant systems.

The lab can include such things as reverberation chambers, TEM cells, high power amplifiers, source generators, indirect lightning waveform and impulse generators, and measurement equipment.

Examples of HIRF Testing

- Evaluation of portable electronic device (PED) compatibility with aircraft systems
- Aircraft coupling measurements and RF propagation
- Flight spectrum measurements and EMI assessments
- EMI/EMC testing
- HIRF & lightning effects on metal & composite aircraft & wireless sensor technologies
- DO-160D & F HIRF Susceptibility Tests, DO-160F Field Probe Chamber Calibration, MILSTD-461 Test, DO160 Indirect Lightning Effects Tests, Radio Emission Measurements, Interference Path Loss Measurements, Flight Spectrum Surveys

HIRF Lightning Indirect Effects Capabilities

- Lightning indirect effects (induced)
  - Single stroke, multiple strokes, multiple bursts
  - DO-160 test levels, waveforms and patterns
  - Programmable to produce Boeing & Airbus patterns
  - Software automation and remote control

- Induced surface current measurement capabilities
  - Low frequency network/spectrum/impedance analyzer
  - Surface current probes
  - Capability developed for measuring surface current on composite materials

Conducted Susceptibility Testing

Low-frequency signals appearing on the power lines
The level is low relative to the primary power for an AC-powered device.
DC-powered systems are designed to function with wide variance in the input voltage

MIL-STD-461F: *CS101 Conducted Susceptibility Testing* requirement is applicable to all services and applications.

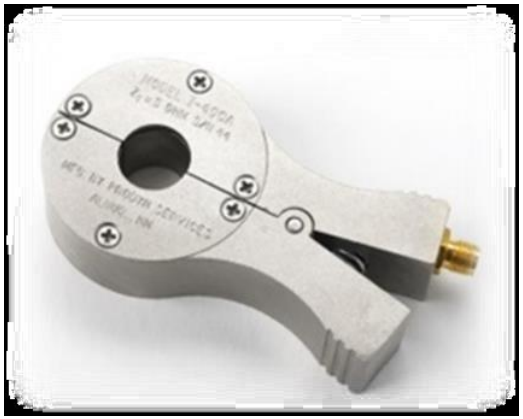
The purpose of CS101 testing is to assess the capability of the EUT to maintain the designated level of performance during the presence of interference on the power leads at low frequencies. The power distribution of most facilities and platforms is rife with power frequency harmonic current.

Sensors

- Electric field sensors (aka D-Dots)
- Magnetic field sensors (aka B-Dots
- Current sensors/I-dot
- Baluns

Current Probes / Clamps / Transducers

- Hinged or non-hinged
- Axial or radial output
- Freq ranges 50kHz-1GHz
- Various aperture sizes
- Various transfer impedances
- Non-standard available on request



Electric Field E-DOT Sensors

- High frequency electric field sensors
- Measure rate of change of electric displacement
- Frequencies up to >10GHz
- Free-field or ground plane.
- Radiation-hardened sensors also available

Magnetic Field B-DOT Sensors

- High frequency electric field sensors
- Measure rate of change of electric displacement
- Frequencies up to >10GHz
- Free-field or ground plane.
- Radiation-hardened sensors also available

P2P Applications

EMC testing / Compliance

- Aircraft Certification (military & Commercial)
- HIRF, LLSC, Lightning
- Land vehicles, Ships, Buildings/ structures (Government / Defense)
- Automotive – EMC compliance (predominately susceptibility)

High Energy Physics

- Directed Energy measurements
- Government laboratories
- EMP / HEMP research
- Particle Physics

Industrial / Harsh environment measurements

- HVDC - sensing /
- Partial discharge measurement / detection

Academic research facilities and RF communications measurements

NEMP Test Setup

2. RS105 test system description

Montena's NEMP test system is design to perform RS105 tests according MIL-STD 461, both E and F versions.

The test setup comprises following elements.

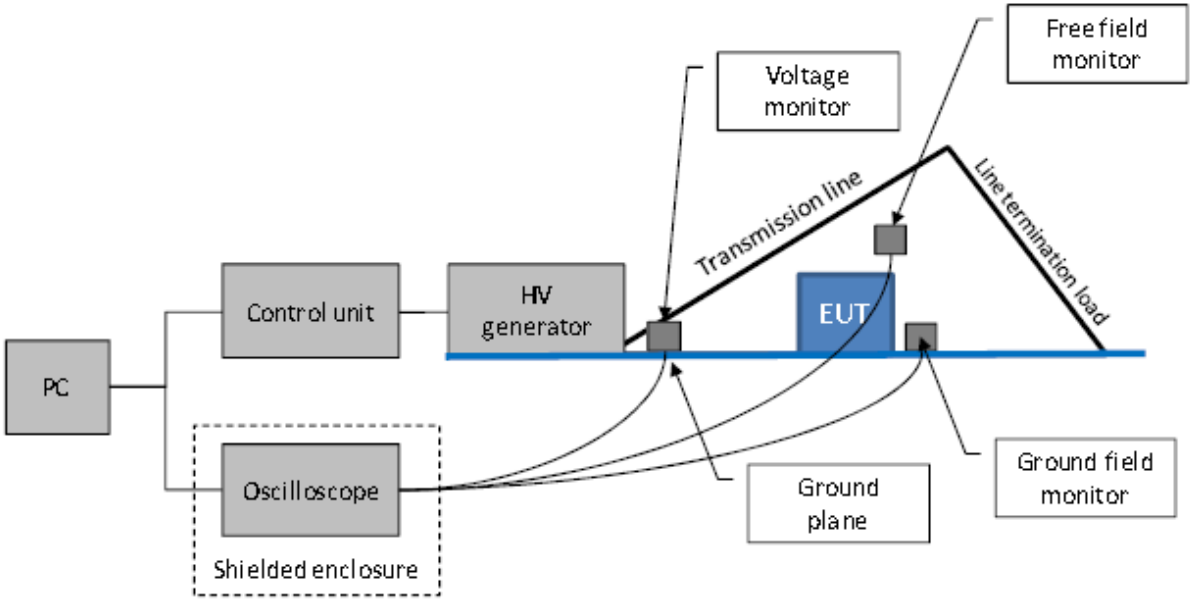


Figure 3 : schematic of a typical RS105 test setup installation

Free Field Sensor Test Setup

5.2 Free field monitors

Free field monitors are made of derivative free field sensors which can be place anywhere under the transmission line and are connected to the oscilloscope through optical fibres and passive integrators. We recommend using the provided passive integrator, but a measurement with a numerical integration is also possible.

Unlike to the ground plane sensors where the coaxial cable is directly laid on the ground floor, the free field sensor has to be connected using a fibre optic link.

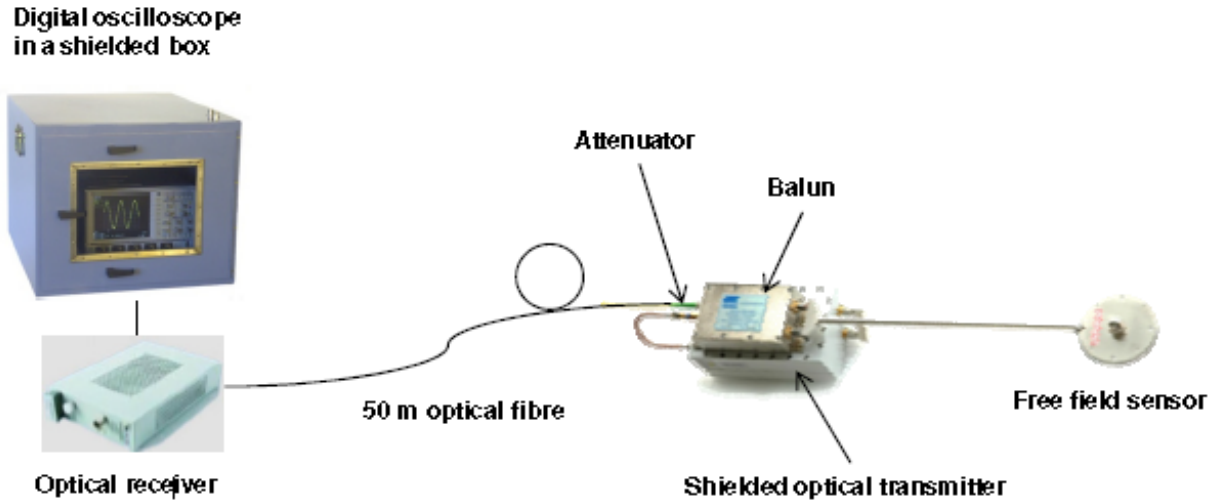


Figure 11 : free field sensor setup

The MIL-STD 461 requires multiple field measurement positions in the test volume it is assumed that a free field sensor is needed. Actually the field waveform is the same in the whole test volume. Additionally the distribution of the field can be well calculated. Therefore only a ground plane sensor could be sufficient for an installation for which the budget is limited

Sentinel 3

Sentinel 3 – World Class Performance

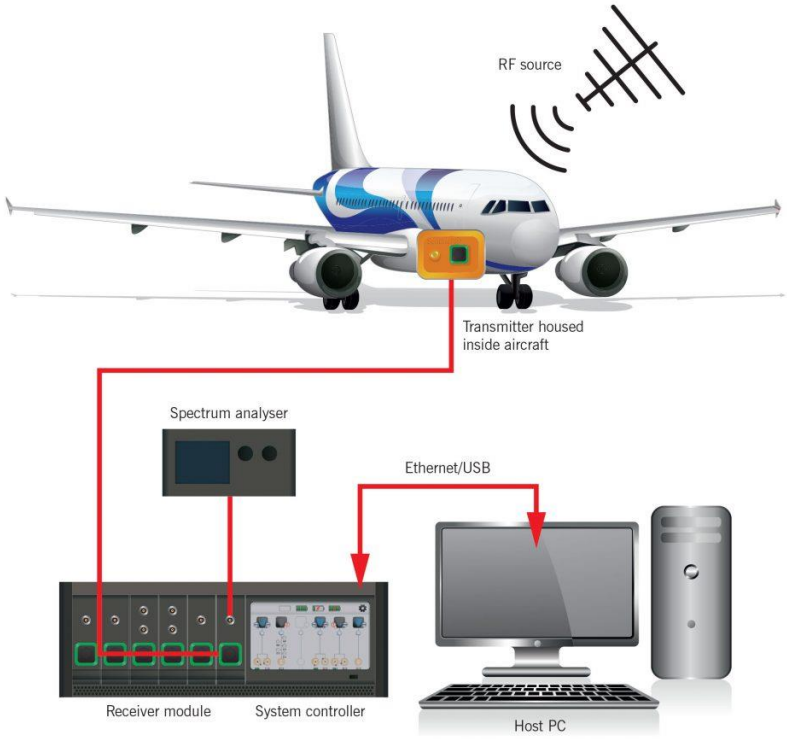
Sentinel 3 is the most leading edge, shielded RF over fiber test & measurement system providing:

- Second to none engineering design for shielding effectiveness
- Market leading state-of-the-art self-calibration design
- Provides both EMP test and EMC conformance
- Industry leading EMP Live Testing > 250kv / meter
  - Best in class measurement accuracy
- HIRF aircraft clearance verification
- Simulated lightning testing
- Impulse, time domain and NEMP testing
- Low and high level swept frequency coupling measurements

Types of testing using Sentinel 3

Time domain

- Pulse / EMP testing
- Lightning



Frequency domain

- Low level Swept Freq.
- Low Level Swept Current
- HPM (Directed Energy Weapons testing)
- SAR testing

Sentinel 3 RF over Fiber Test

Base unit

- High Density, Scalable System
- 6 receivers plus a system controller
- 6 remote transmitters per receiver
- Each transmitter handles up to 8 inputs
- 48 sensor capacity per receiver module
- 288 sensor system capacity (sequential)
- 12 ch simultaneous monitoring available

- Multiple modes for super low noise, high power mode and / or high impedance
- High sensitivity level which provides lower test field strength and reduced ERP
- *150dB/Hz instantaneous dynamic range*
- State of the art integrated thermal compensation
  - Gain accuracy is maintained over the full operating temperature range

8 input remote transmitter

Sentinel 3 RF over Fiber Test

Tx 1 remote transmitter with battery

- Ultra compact remote controlled transmitter 1 or 8 inputs
- *Double screened to maximize shielding effectiveness*
  - *90 dB e-field*
- Incorporates power detection to allow easy identification of overdrive conditions
- All inputs to the transmitter can be remotely controlled to perform operational functions such as:
- Gain setting verification and Link parameter modification
- *Self-test / signal selection and enter / exit sleep mode*
- Battery and alarm monitoring

- Full Monitoring and Control
- *Drastically reduced setup time*
  - *Self Calibration with 0.25dB relative accuracy*
- Maximized measurement certainty
- IP65 connectors (with dust shutters)
- Hi capacity Li-ion batteries (with sleep mode)

8 input remote transmitter

Sentinel 3 - Single and 8 input Transmitter

Double screened, ruggedized housing

8 x Standard 50Ω SMA Connectors.

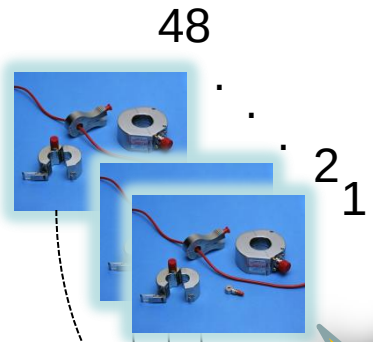
Channels selected sequentially from chassis controller

Quick release high capacity Batteries

Integral mounting / securing points

LC/APC Optical connectivity with shutters for dust prevention

Sentinel3 - Six Channel Receiver

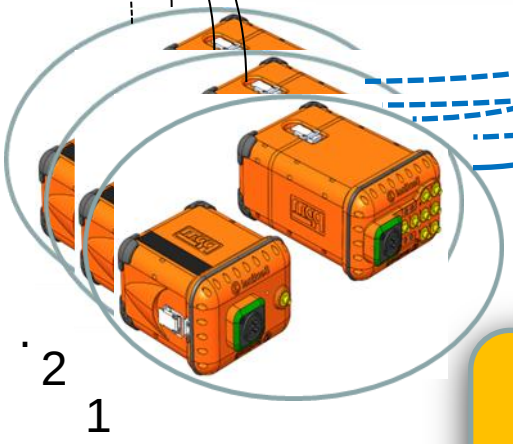


Supports Up to 48 sensors

Supports 6 Transmitters

(either 1 or 8 channel)

Transmitter and its input selected via the controller.



1 to 6 Breakout box. to light-weight flexible fiber cable

Multi core cross site cable. (Supports 6 duplex channels)

Sentinel 3 - Batteries and Charging

- Intelligent High Capacity Li-Ion batteries 5 to 10 hours of continuous testing, 1 to 2 weeks in sleep mode
- Power and data connection to the chassis for simultaneous charging and monitoring of up to 4 batteries.
  - *Battery Diagnostics Provided While Charging*
  - *Charging current and temperature by S/N*
- Separate 12V charger option (Charge status indicated by LED for this option)
- *Approved to UN38.3 standard for air transportation*

Sentinel 3 - Fiber Interconnect

Flexible fiber interconnect solutions for rapid deployment:

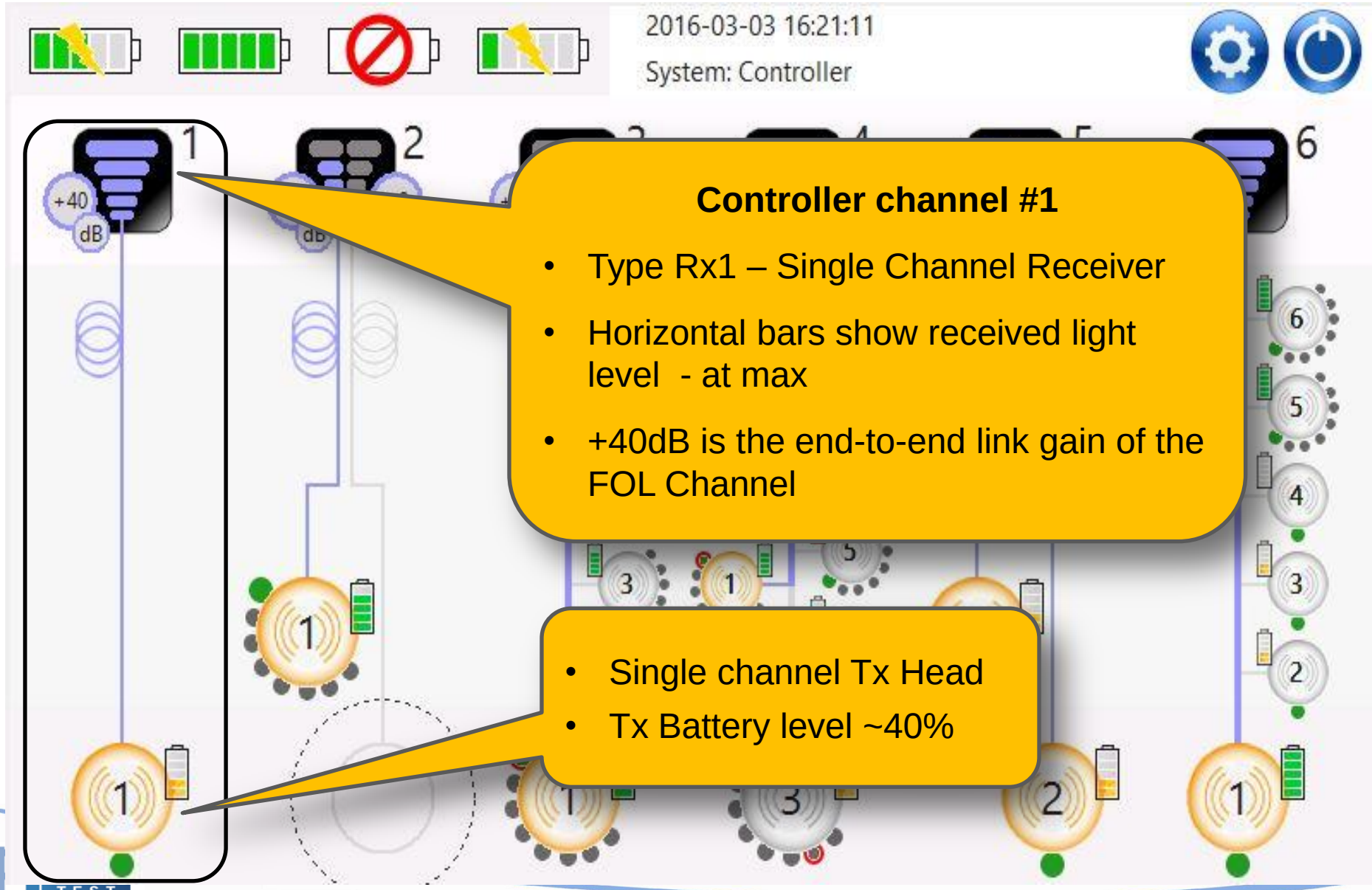
- Cross site rugged cables: Duplex, 4-Core & MTP (12 core)
- Light duty flexible cables for easier deployment
- Cable management reels.
- Fiber Breakout Box

Fiber Breakout Box

2,4, 12 and 24 core available

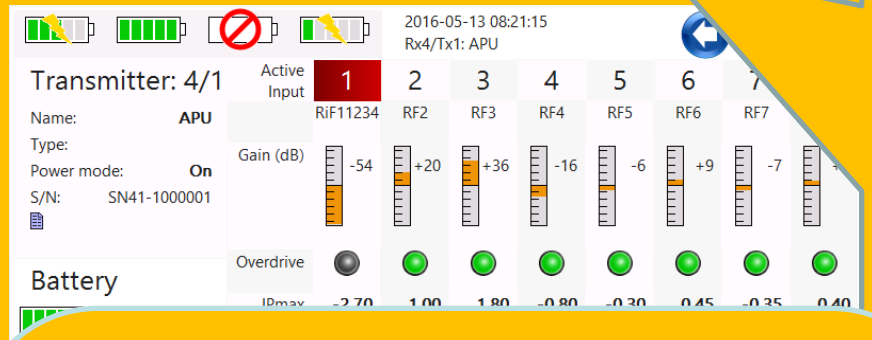
Sentinel 3 – Desktop Chassis & Controller

Sentinel 3 - User Interface

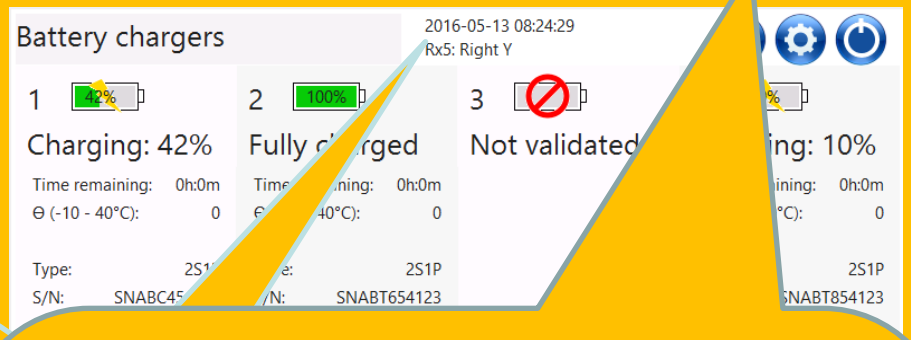


Sentinel 3 - Detail menus

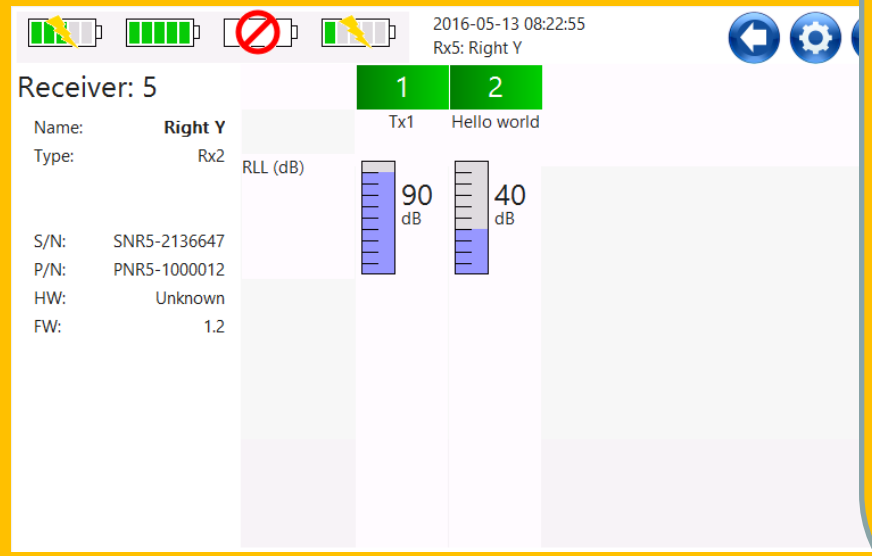
Transmitter



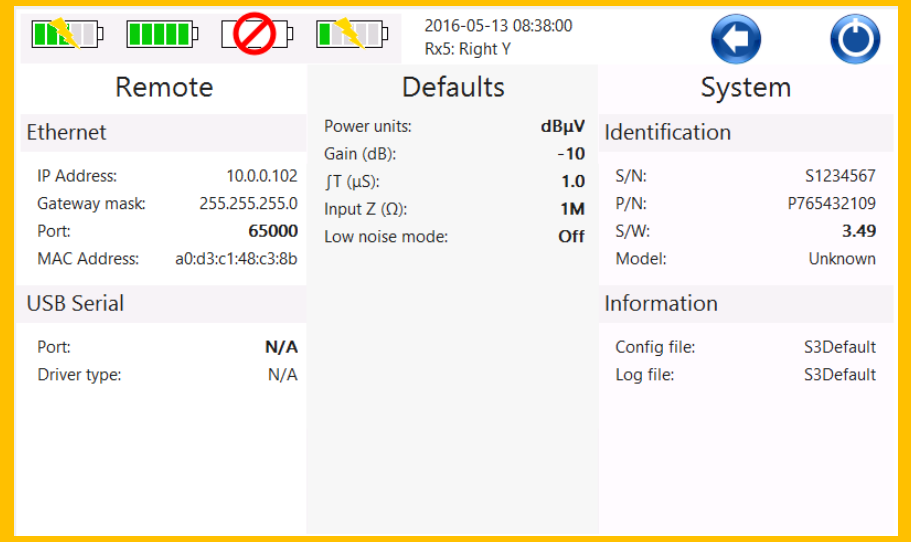
Batteries



Receiver



Settings



Sentinel 3 Overview Summary

Base unit

- Multiple receiver designs plus cross-site cable options for optical transmission back to the lab
- Allows highest variety of test configurations with multiple types of sensors: E-DOT, B-DOT, I-DOT
- Simultaneous monitoring of 12 channels
- Sequential monitoring up to 48 sensors per receiver slot and up to 288 sensors per receiver chassis
- **Fastest available setup time and re-calibration**
- **Highest industry shielding, best battery options**

Frequency response (-3dB) 50Hz to 1.5GHz
Input/output impedance 50Ω/1MΩ
Rise time (max) 350ps
Channel to channel isolation Rx 90dB, Tx 55dB
Noise figure (100MHz / 55dB gain): Tx1 = 4dB, Tx8 = 6dB (super low noise mode)
Gain adjustment (1dB steps) -63dB to +55dB
Gain Flatness (+40dB gain) 75Hz-1GHz +/-1.25dB
Max instantaneous input 200Vpk <400ns FWHM pulse
Output P1dB (max) +20dBm
Selectable integrator 0.1µS,1µS,10µS
Dynamic range (100MHz / 0dB gain) 150dB in 1Hz bandwidth
Shielding (electrical) >80dB (flat wave, E/H≈377Ω)
Gain Step accuracy ±0.75dB and Input match 18dB <1GHz

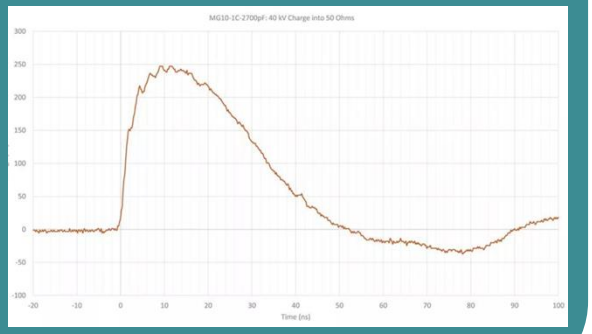
Multi-Core Cross-Site Cable

Target Markets

EMC Aircraft Certification

EMC/EMP Test Laboratory

EMP / NEMP

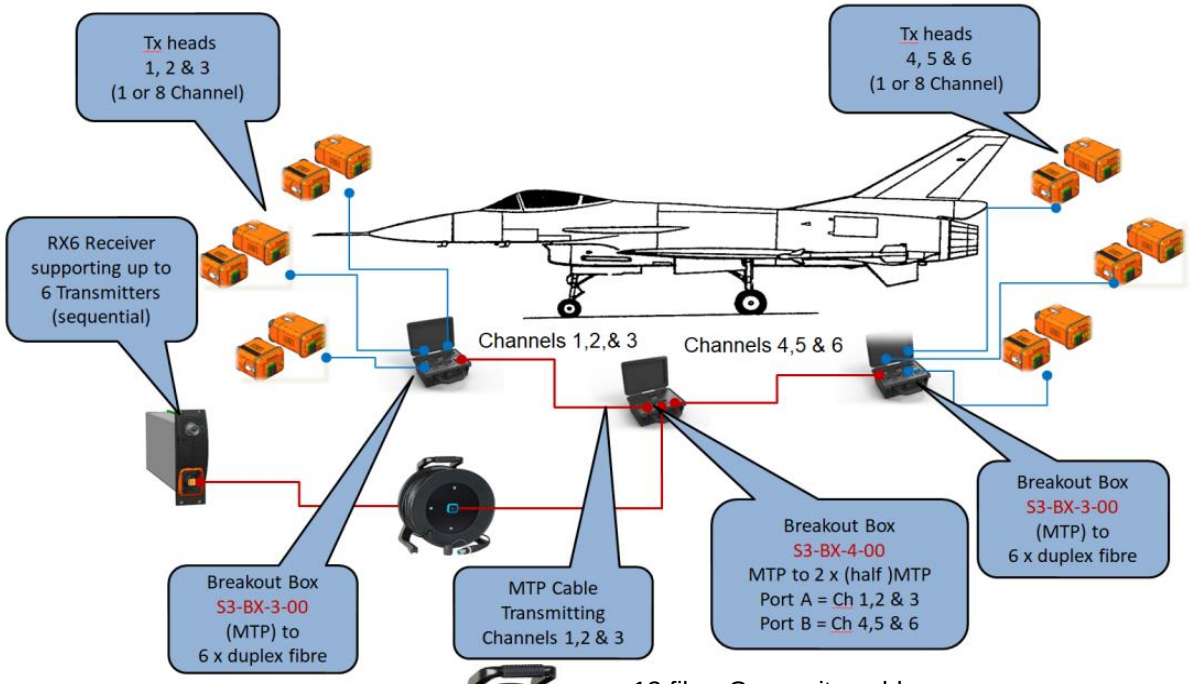


Government / National Labs

Industrial / Harsh Environment

HV / Utilities

Sentinel 3 Aircraft Test Deployment



8 Channel Transmitter.
S3T-08-01-00

IP-67 Rated
Breakout box MTP to 6 x Duplex
S3-BX-?-00

Single Channel Transmitter.
S3T-01-01-00

Duplex fiber cable
Light weight or X-site cable Transmitter.
S3T-01-01-00

12 fiber Cross site cable,
Cable management reel 200m
S3-CAB-6-H-1-200-00

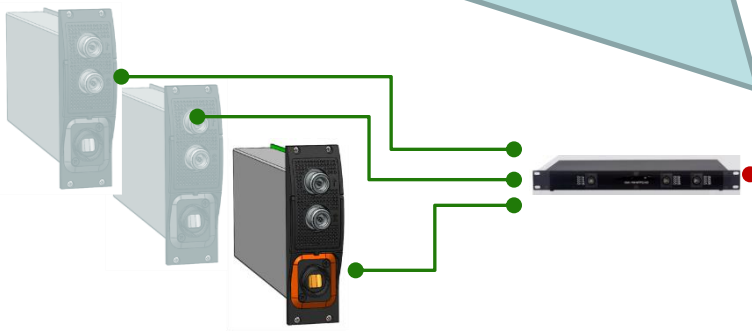
S3K-DT-1-AC-00 (Desk-top)
S3K-19-0-AC-00 (19" Rack mount) chassis controller

6 Channel Receiver cards
(sequential measurements)
S3R-06-01-00

Instantaneous Measurements

System 1:

- Quad cables from Receiver cards connected through Breakout tray
- MTP Cabling common with sequential measurement system (Previous slide)
- Upgrade path: Can support up to 3 dual receiver cards
- Each receiver card supports 2 transmitters



Common Elements

System 2:

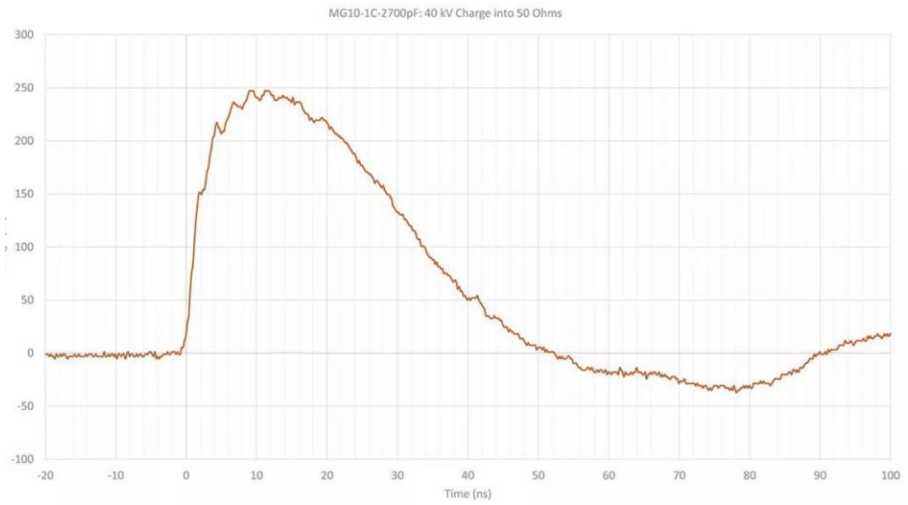
- Quad cable and breakout reel (to 2 x duplex cables)
- Each card supports 2 transmitter heads
- Upgrade path requires an additional break out reel (per Rx2 card)

EMP / HEMP Testing

High Altitude Electromagnetic Pulse

MIL-STD 464

- HEMP hardening of critical ground-based facilities
- High Power Microwave (HPM) Devices: Threat Assessments

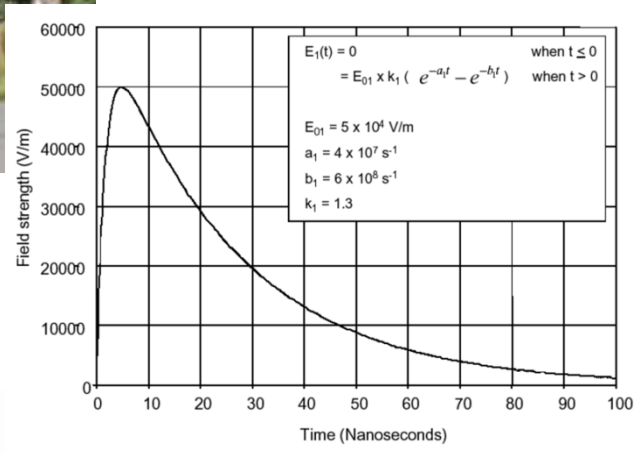


MIL-STD 461: RS105

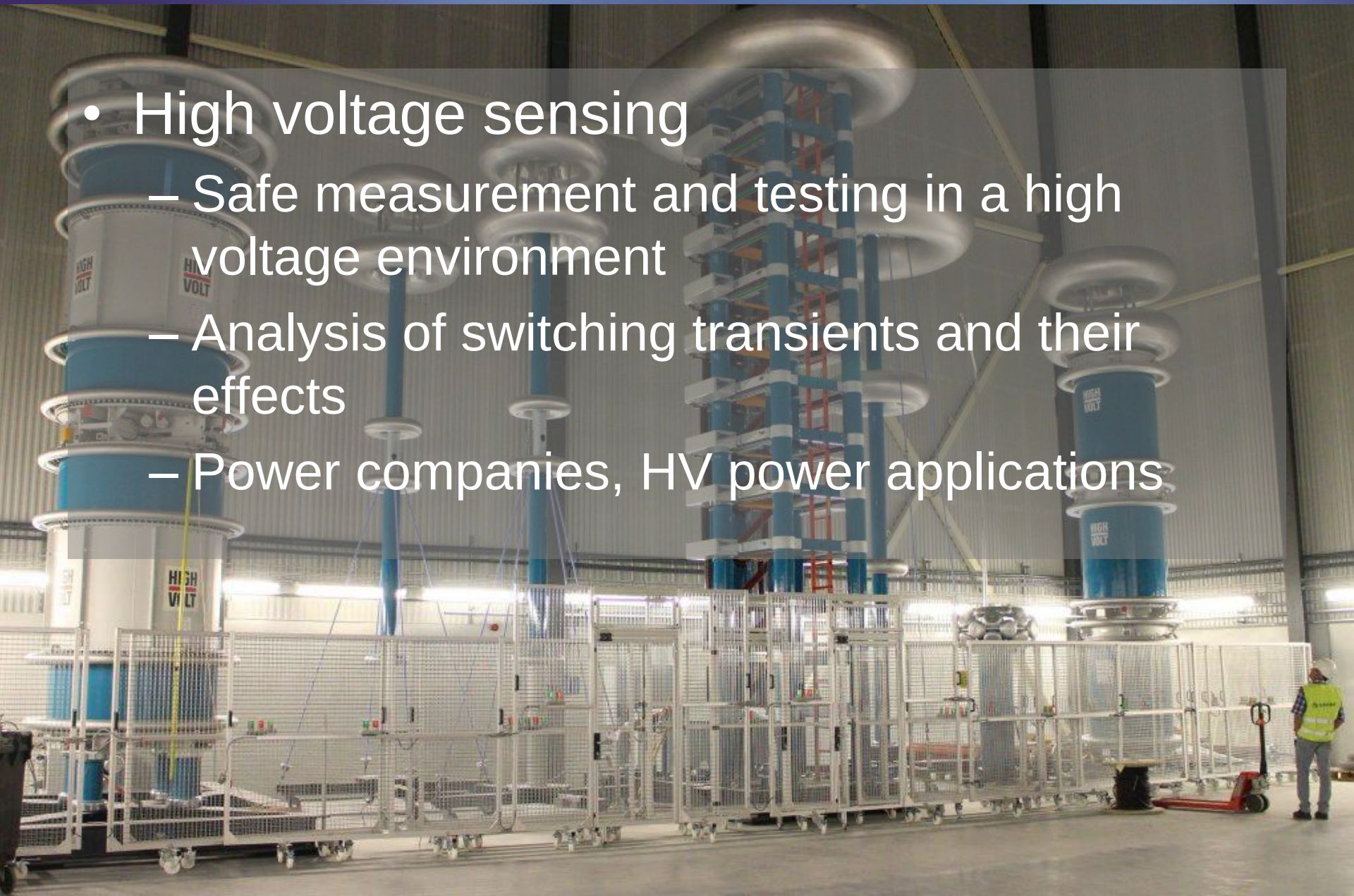
- MIL-STD-125-188
- DEF STAN 59-188

RS-105 radiated susceptibility testing system

EMP Time Domain Testing



Alternative application - HV sensing



- High voltage sensing
  - Safe measurement and testing in a high voltage environment
  - Analysis of switching transients and their effects
  - Power companies, HV power applications

Sentinel 3 Performance Highlights

- Second to none engineering for shielding effectiveness
- High performance fiber optic links that constantly maintain signal integrity while also providing very low signal loss, high isolation & EM field immunity
- Industry's fastest self-calibrating including full thermal compensation and automatic gain control (AGC)
- Most advanced self-calibration design, drastically reduced setup time and maximized measurement certainty
- Market leading fastest operational up times, increased testing endurance, highest test data accuracy and greatest measurement confidence.
- Best in class dynamic range at > 150dB/Hz

Sentinel 3 Performance Highlights

- Offering ultra high sensitivity or high power modes (-120 dBm)
- *EMC shielding of transmitters >90dB,* ***Pulse tested to >250Kv/m!***
- Full system control to the user directly from chassis controller or remotely controlled over Ethernet **and now with a LabView option**
- Highly flexible Fiber interconnect system (IP65 rated with dust shutters)
- Long life Li-Ion batteries, (UN38.3) certified for air transportation
- Full SW integration support from PPM Engineering

Sentinel 3

Clearly the most capable RF Over Fiber Test System, World Class Level

Customer feedback has been overwhelmingly positive:

"*The Sentinel 3 System is making us more competitive*"

(Internationally recognized UK Aircraft Testing organisation)

"Sentinel 3 had reduced our testing time by more than 50% and gives us much more confidence with our test measurements"

(BAE Systems UK)

Sentinel 3 Video

https://www.youtube.com/watch?v=xUJ80qj4pVg

Brochures


Point2Point
RF OVER FIBER
Point2point RF over fibre - transmission of DC and AC signals
Transmitter options
Receiver options
SPECIALIST TEST & INSTRUMENTATION
Sentinel③
Sentinel③ - Speed, flexibility, certainty
EMC Test and Measurement
• Fibre optic links
• Electric field sensors
• Magnetic field sensors
• High voltage attenuators
• Wideband RF Baluns
• Passive integrators
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Magnetic (B-Dot) sensors
Electric field (D-Dot) sensors
High voltage attenuators
Wideband RF baluns
Passive integrators
Current probes
How it works
BARTH ELECTRONICS, INC.
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