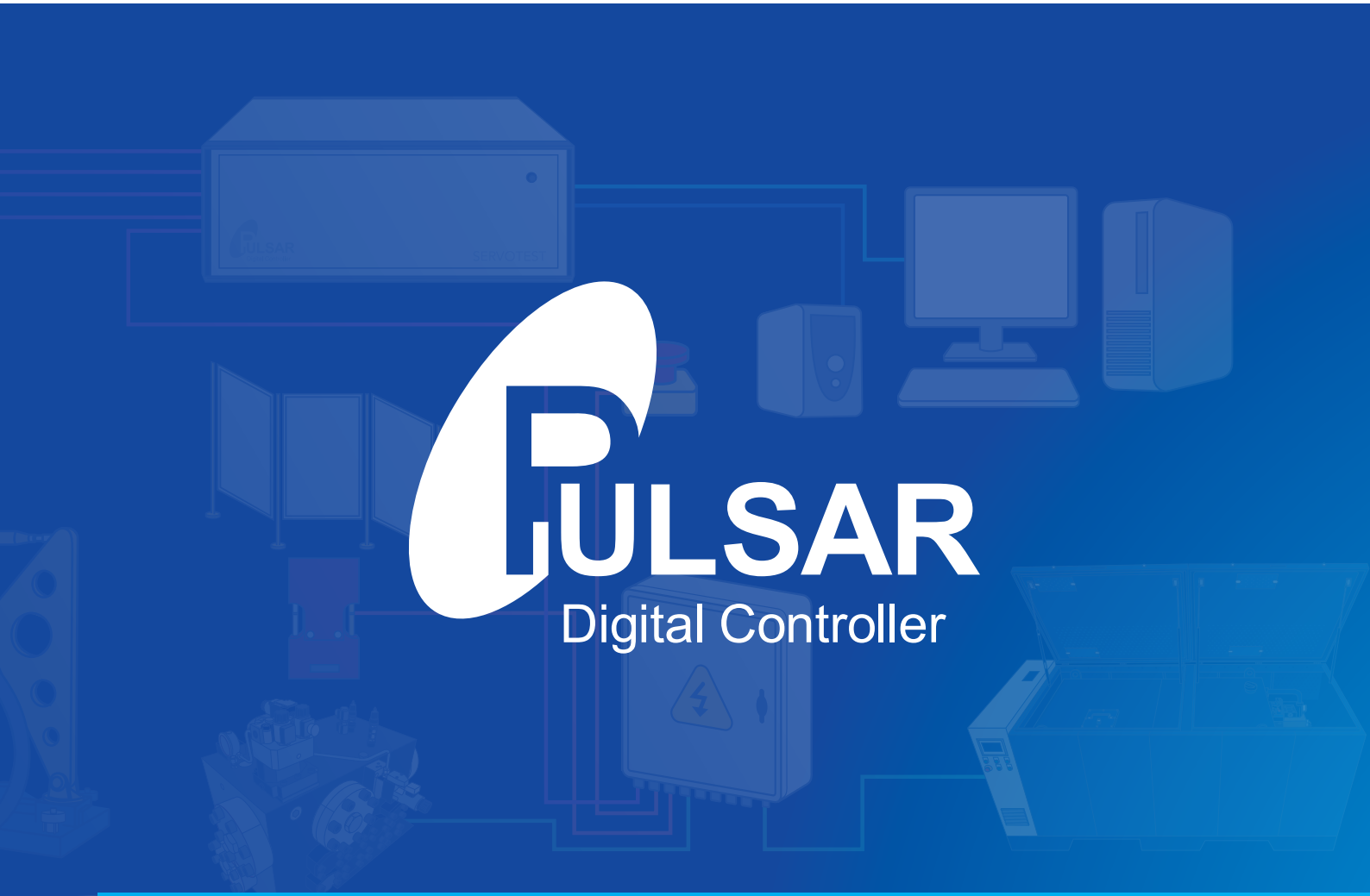
SERVOTEST

TEST AND MOTION SIMULATION



PULSAR

Digital Controller

Distributed Digital Servo-Control

ESTABLISHED 1958

The distributed high-performance, real-time digital servo-control system for test and motion simulation, Pulsar provides a powerful yet flexible platform for creating controller configurations tailored to your needs.

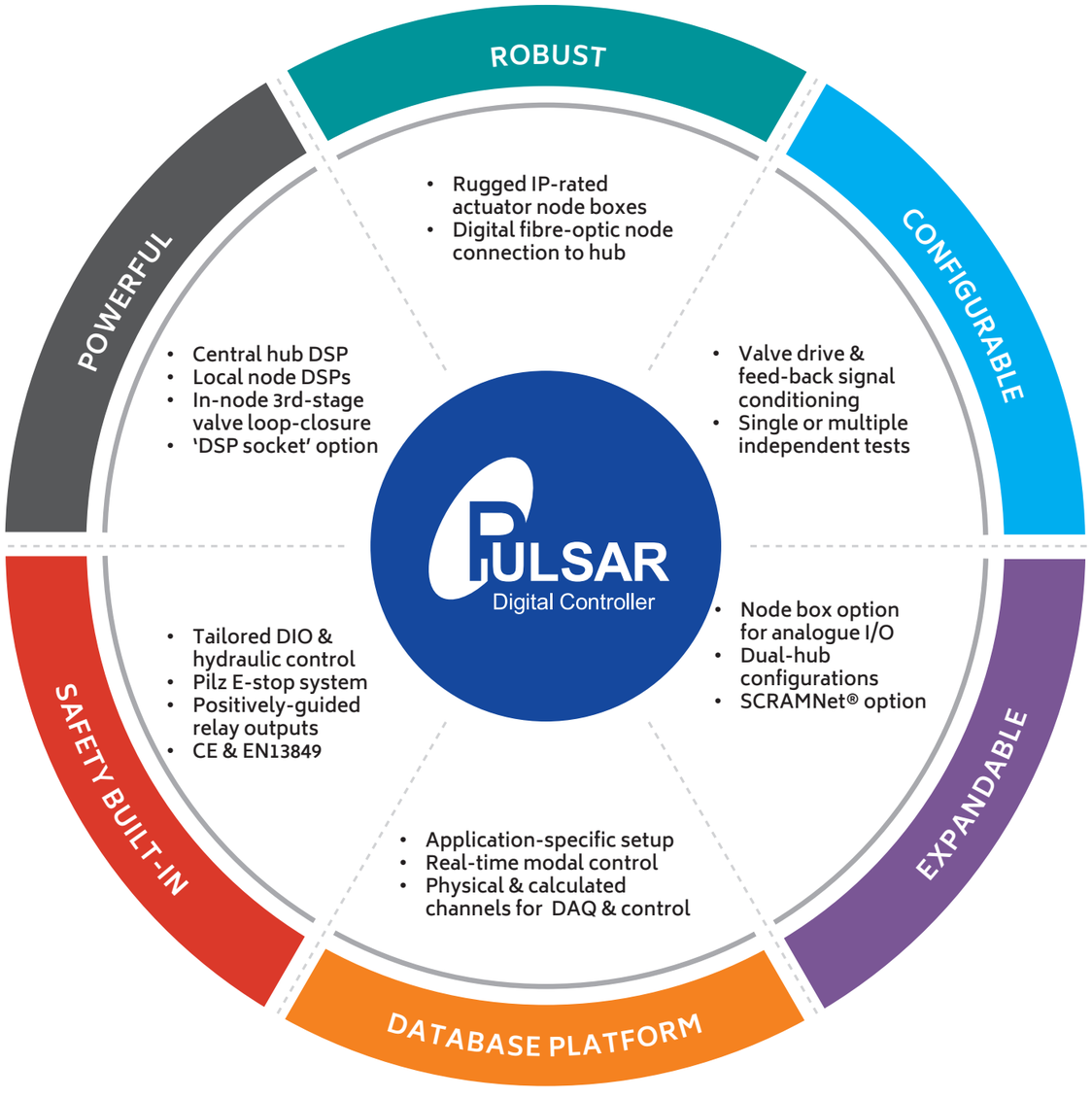
Contents

SERVOTEST
TEST AND MOTION SIMULATION

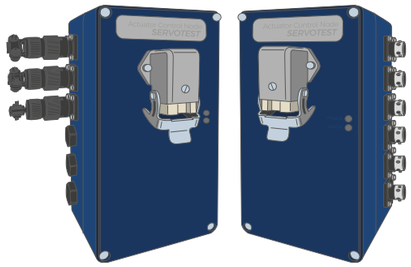
At the core of every Servotest system, Pulsar provides a powerful and flexible digital servo-control platform

- Pulsar hardware is distributed and configured to suit individual test requirements
- Pulsar software provides a framework combining Servotest & industry-standard software to deliver easy-to-use, customer-specific operator interfaces

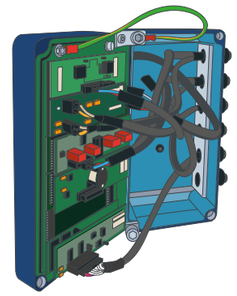
From a single actuator through to complex multi-axis systems, Pulsar enables you to design, execute & monitor tests your way.



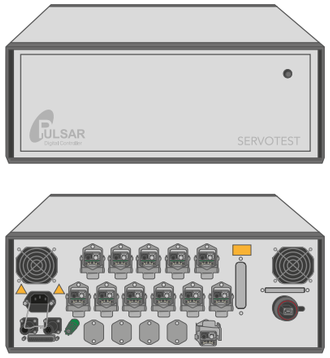
PULSAR – Distributed Digital Servo-Control



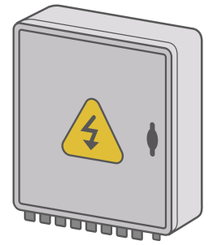
- Tough IP-rated actuator-mounted node boxes
- Signals digitised at actuator
- Short analogue cable runs minimise analogue signal noise pick-up



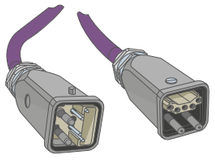
- Local processing & 3rd-stage valve loop-closure by DSP-enabled actuator nodes
- Valve drive and feed-back signal conditioning as required
- Local data acquisition e.g. acceleration, pressure, temperature



- Up to sixteen node box connections per hub
- Powerful central DSP for primary control tasks
- Loop-closure, modal coordinate transforms & real-time control
- Standard USB connection to operator PC workstation



- DIO and hydraulic safety interface box
- Pilz E-stop safety interface
- 24V PSU
- Relay outputs for switching of hydraulic power supply, manifolds and other ancillaries



- Single Optostar fibre-optic cable per node box simplifies & tidies installation
- Noise-immune digital data communication between nodes & hub
- DC power to hub & safety loop-back

- Affordable and effective per-actuator dual-speed manual set-point adjuster option
- Add adjusters to key actuator control nodes as required

- Optional analogue nodes for analogue input & output signals
- Up to 12-channels per node
- Accelerometer conditioning & DC power for transducers
- Thermocouple conditioning modules also available

Pulsar combines a powerful distributed hardware platform with a flexible software framework

- **Solutions tailored to each customer's requirements**

Pulsar accepts a broad array of Servotest and industry-standard connections to system components via its distributed actuator, analogue and hydraulic safety nodes. Node data is communicated digitally via fibre-optic cables to a central Digital Signal Processor (DSP) hub.

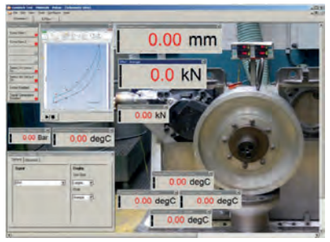
The Pulsar hub digital signal processor executes all real-time calculations, coordinating servo-drive and feed-back signals as required for multi-channel test rig control. The hub is connected via a standard USB interface to an operator PC workstation for operator interface, data display and storage.

System functionality is defined by a Pulsar 'database'. Tailored to each customer's specific requirements, this defines test signal processing, control loop operation and geometric transformations between actuator and test rig coordinates. Setup is downloaded to the hub DSP prior to test execution, enabling Pulsar to be reconfigured as required.

Operator-interface is via test-specific Schematic displays, presenting test controls and data in an intuitive layout. Full or partial automation of test sequences can be set up using EZFlow and optional single-click Action-Runners embedded into Schematic displays.

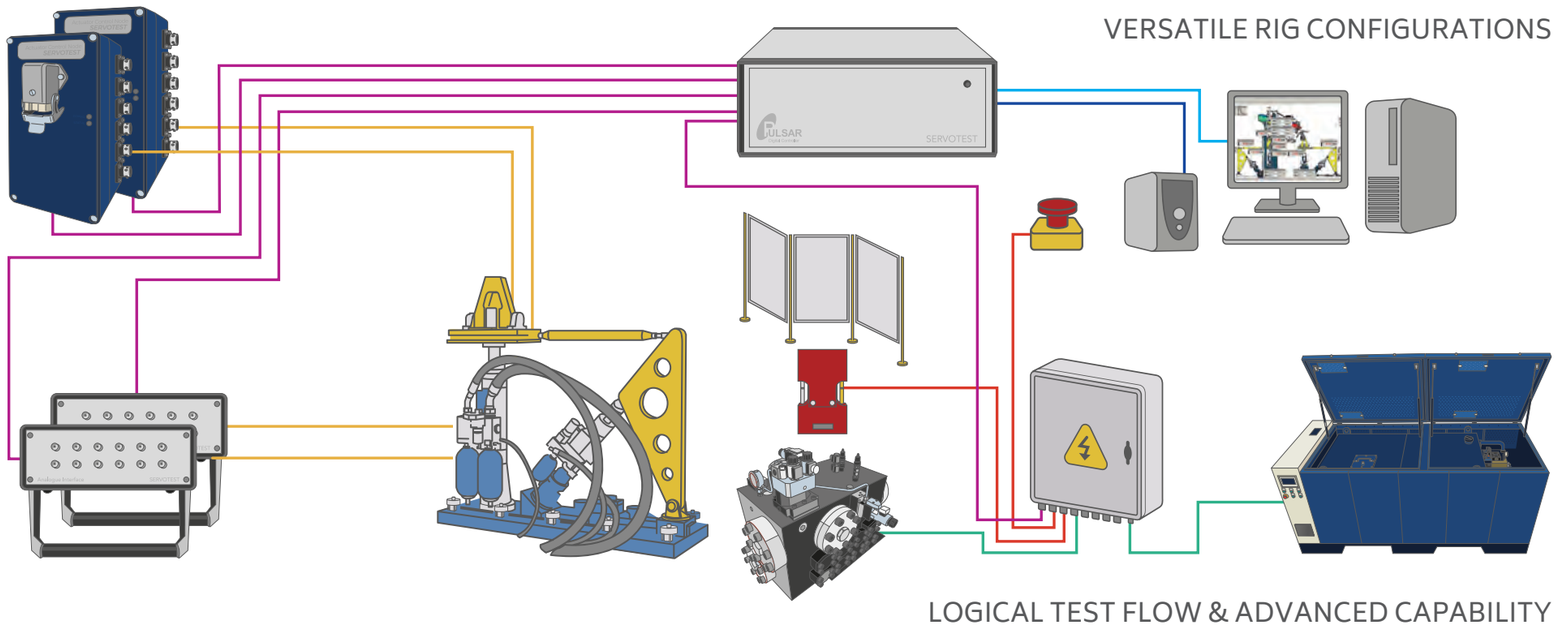
Pulsar is a powerful yet versatile platform that is not only easy-to-use but also tailored and optimised for each unique test system configuration.

PULSAR in Action

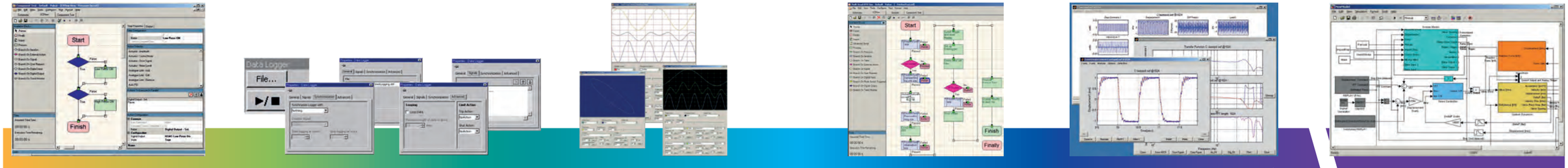


CUSTOMER-SPECIFIC SCHEMATIC DISPLAYS

VERSATILE RIG CONFIGURATIONS



LOGICAL TEST FLOW & ADVANCED CAPABILITY



DESIGN

- Program test sequences
- Import data

PREPARE

- Set limits & actions
- Define safe 'start' and 'park' positions
- Select control modes
- Iterate drive-files

EXECUTE

- On-screen controls
- Scope & meter displays
- Data logging & control

AUTOMATE

- Nest & loop sequences
- Internal & external triggers
- Calls to 3rd-party programs

ANALYSE

- Manipulate & analyse data
- Export to 3rd-party software for analysis or reporting

EXPAND

- C# programming
- Real-time user-DSP using sockets

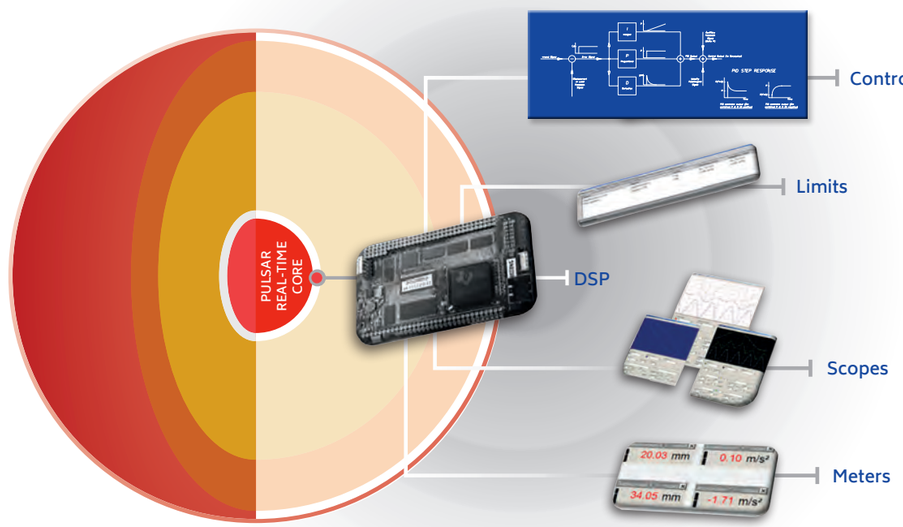
Pulsar combines Servotest programs with industry-standard applications for data analysis & reporting

- **Capabilities are selected, combined and presented in a tailored Schematic operator interface specific to each unique customer application**
- **This modular approach, ensures long-term supportability as both PCs and operating systems evolve**

Pulsar applications for load and motion simulation are configured using selected modules from the core Automation, Simulation & Analysis groupings.

Application-specific tailoring is achieved by adding additional software modules and applications as required.

A customer-specific operator-interface is developed using a combination of Pulsar tools and off-the-shelf applications.

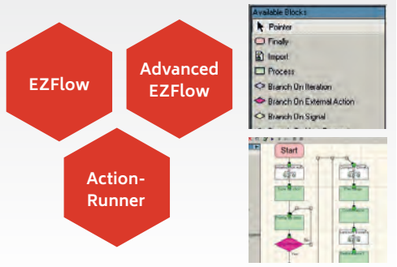


PULSAR Solution Framework

CORE FUNCTIONS

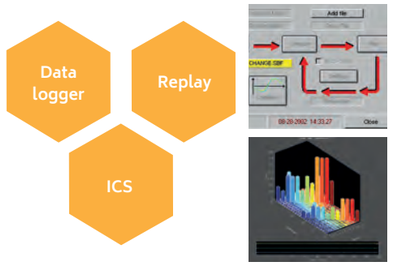
AUTOMATE

- Action-Runners - single-click execution of pre-programmed test sequences
- EZFlow for Servotest & customer test-sequence development
- C# programming option using Advanced EZFlow



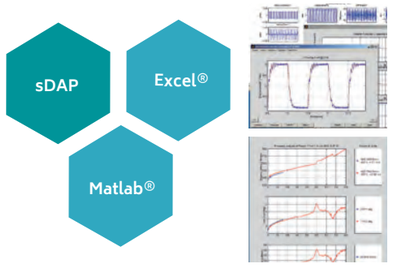
SIMULATE

- Single or multiple loggers to record data
- Multi-channel play-back of recorded signals and drive-files
- Iteration to ensure multi-channel response signal fidelity during playback

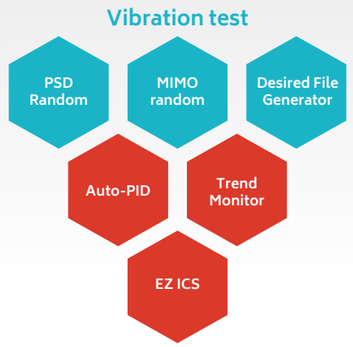


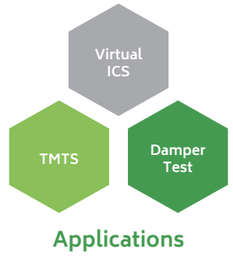
ANALYSE

- Servotest Data Analysis Package for analysis and display of test results
- Seamless integration with MATLAB® and Microsoft Excel® for further analysis & reporting

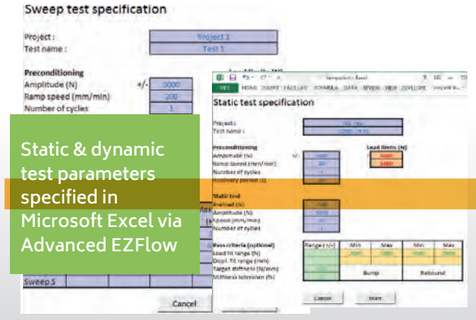


ADDITIONAL MODULES



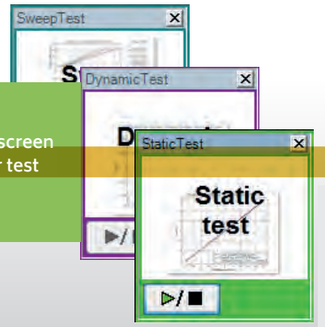


Bespoke Application Example - Elastomeric component static & dynamic test



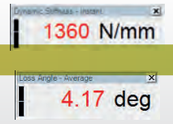
Static & dynamic test parameters specified in Microsoft Excel via Advanced EZFlow

PRE-TEST

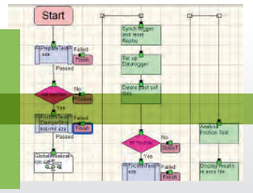


Simple on-screen controls for test execution

Dynamic properties calculated in real-time by DSP socket

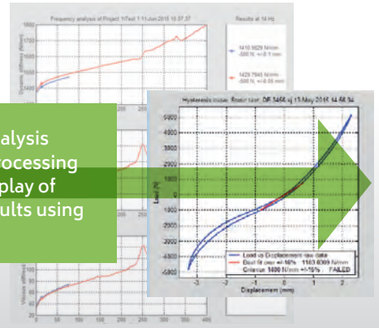


Test sequence controlled in background by EZFlow



RUNNING TEST

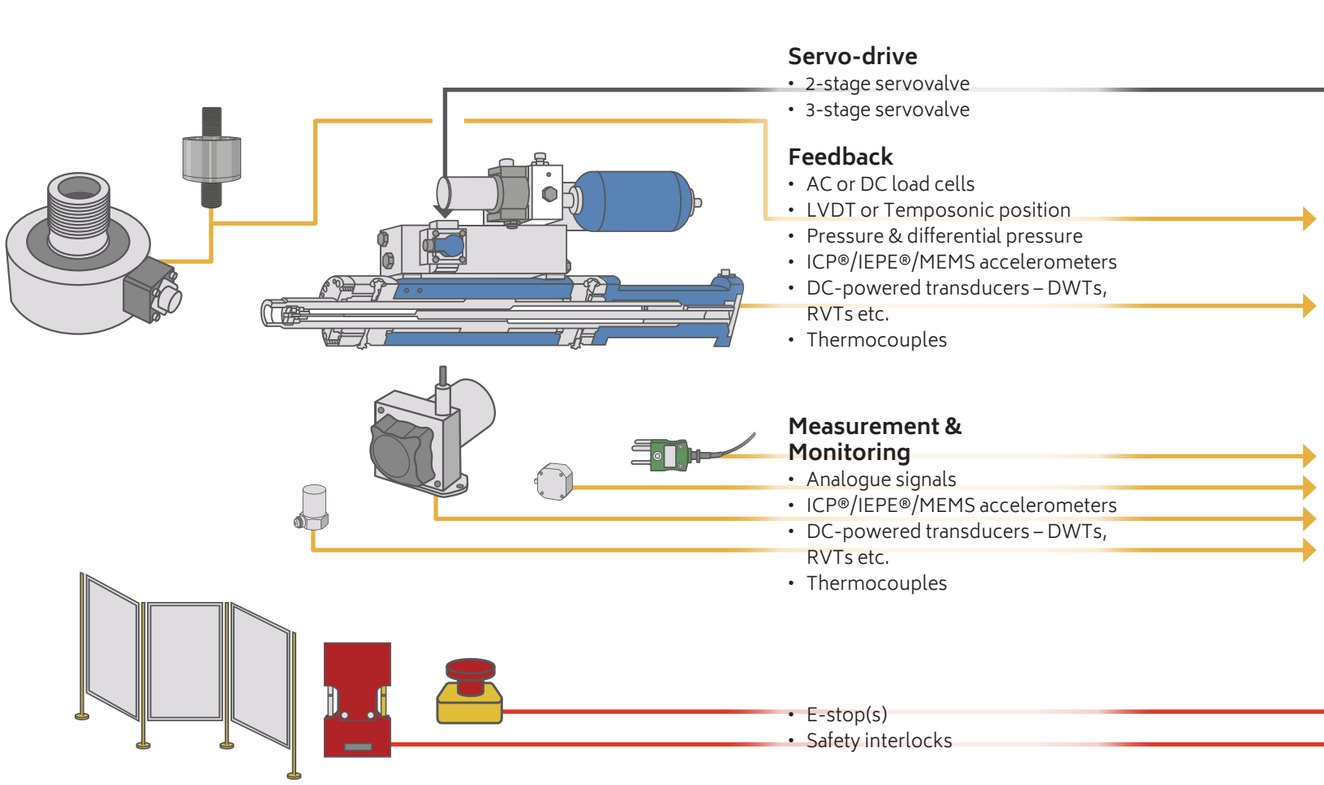
Data analysis post-processing and display of test results using Matlab



TEST RESULTS

Local signal connection with digital communication

- On-rig servo-drive command generation & feed-back signal conditioning using task-specific actuator & analogue node modules
- Hydraulic supply control, rig safety & digital I/O connections via a robust project-specific hydraulic control & safety node

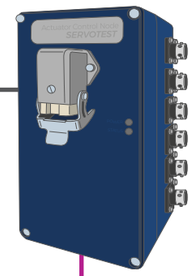


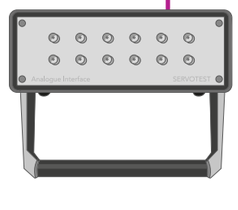
Servo-drive
- 2-stage servovalve
- 3-stage servovalve

Feedback
- AC or DC load cells
- LVDT or Temposonic position
- Pressure & differential pressure
- ICP®/IEPE®/MEMS accelerometers
- DC-powered transducers – DWTs, RVTs etc.
- Thermocouples

Measurement & Monitoring
- Analogue signals
- ICP®/IEPE®/MEMS accelerometers
- DC-powered transducers – DWTs, RVTs etc.
- Thermocouples

- E-stop(s)
- Safety interlocks

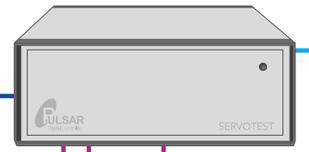


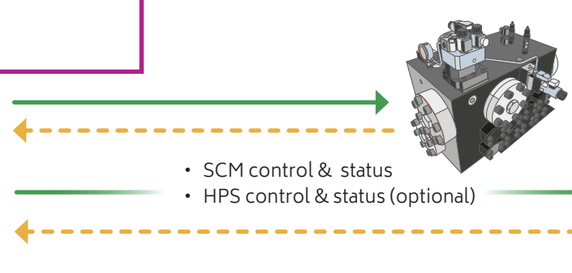


- Optostar
  - DC power
  - Digital fibre-optic data communication with Hub

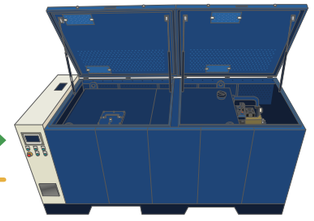
Smart UPS

USB





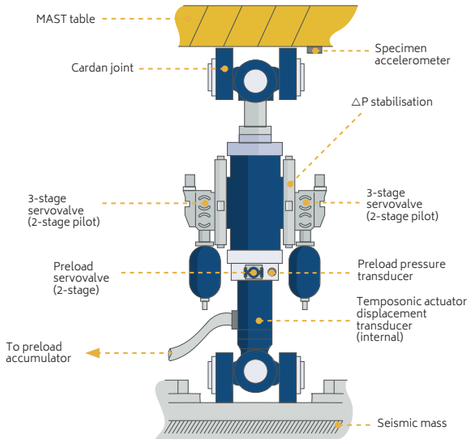
- SCM control & status
- HPS control & status (optional)



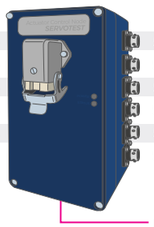
Actuator configuration examples

High-Force Preload Actuator

- Preload stage for static load support
- Dual high-flow 3-stage servovavles
- Backlash-free Cardan universal joints



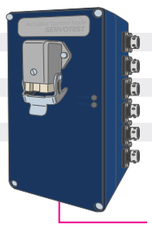
Actuator node #1



6	5307	Temposonic - actuator displacement
5	5304/5	2-ch analogue input - preload pressure (+ spare)
4	5302	Servodrive - preload stage servovalve
3	5304/5	2-ch analogue input - △P stabilisation (+ spare)
2	5301/0	LVDT - 3-stage valve #1 spool position
1	5302	Servodrive - 3-stage valve #1 pilot (+ actuator pressure switch)

Fibre optic cable to hub (digital)

Actuator node #2

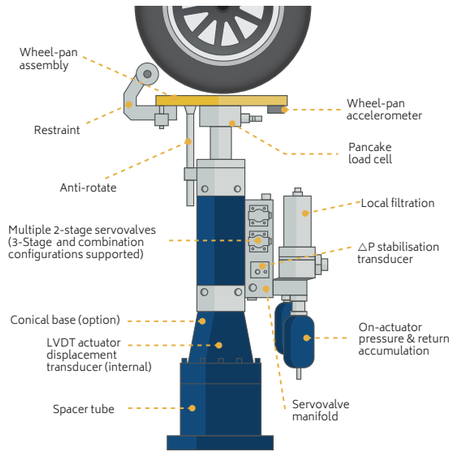


6	5304/5	2-ch analogue input-specimen accelerometer
5		Spare
4		Spare
3		Spare
2	5301/0	LVDT - 3-stage valve #2 spool position
1	5302	Servodrive - 3-stage valve #2 pilot

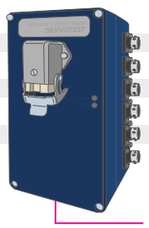
Fibre optic cable to hub (digital)

Wheel-Pan Actuator

- Multiple 2-stage servovalves (3-stage valve and combination configurations available)
- Load cell for 7-post rig, optional in 4-post configuration



Actuator node



6	5304/5	2-ch analogue input - optional for specimen accelerometer
5	Spare	...possibly a 2-ch thermocouple module
4	5304/5	2-ch analogue input - △P and wheel-pan accelerometer
3	5303/0	AC load cell module - wheel-pan load
2	5301/0	LVDT - actuator position
1	5302	Servodrive - up to 4 x 2-stage valves (common signal) + actuator pressure switch

Fibre optic cable to hub (digital)

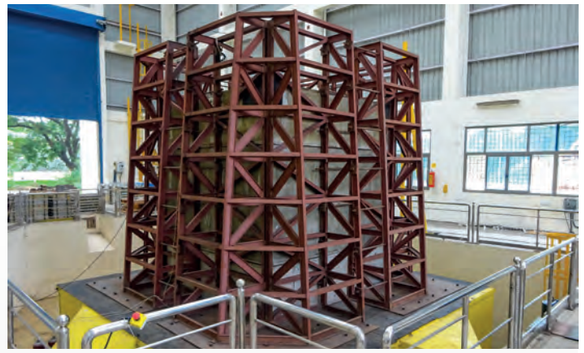
Typical PULSAR Configurations

A single fibre-optic cable per node box

- Tidy installations, even for complex multi-channel systems
- Robust noise-immune digital data communication between test rig and Pulsar hub

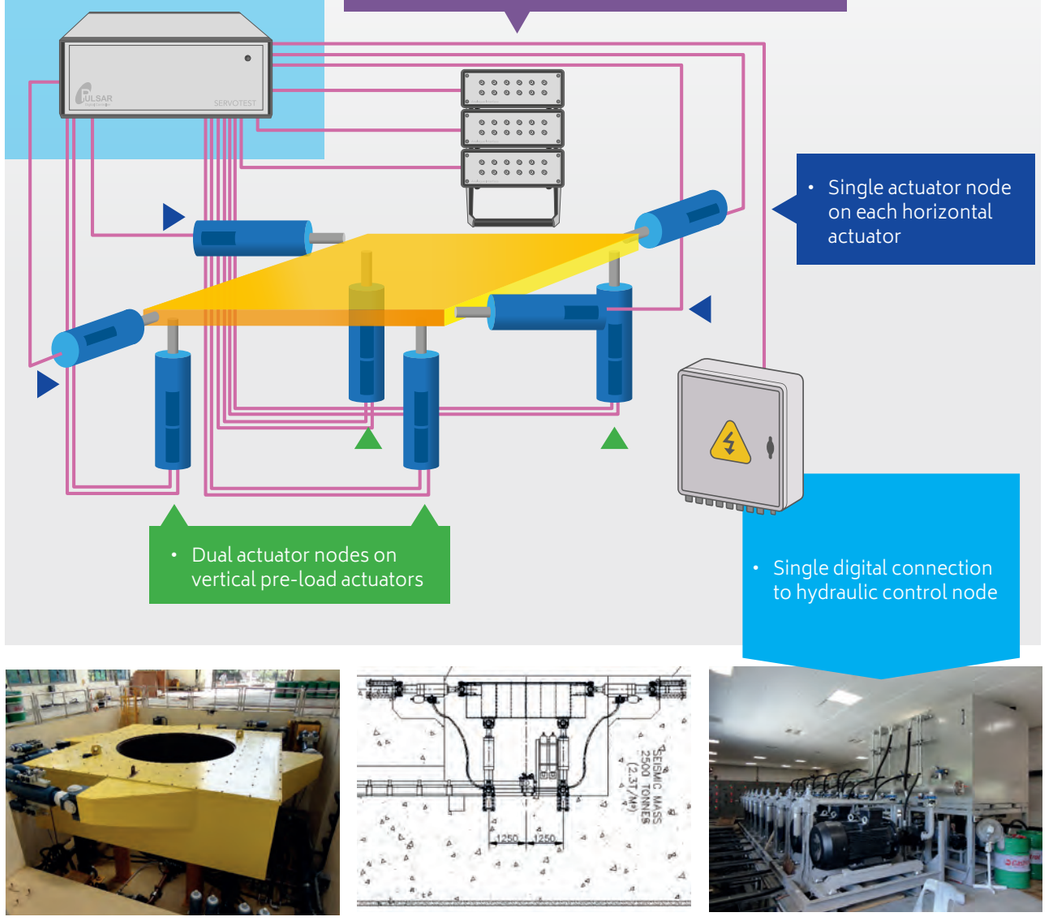
6-DoF Seismic MAST

Operator PC workstation & hub in control room



6m x 6m, 100 ton, 6 degree-of-freedom MAST table for civil structural and seismic qualification testing

- Specimen data acquisition using analogue nodes
- Single digital connection per node



- Single actuator node on each horizontal actuator
- Dual actuator nodes on vertical pre-load actuators
- Single digital connection to hydraulic control node

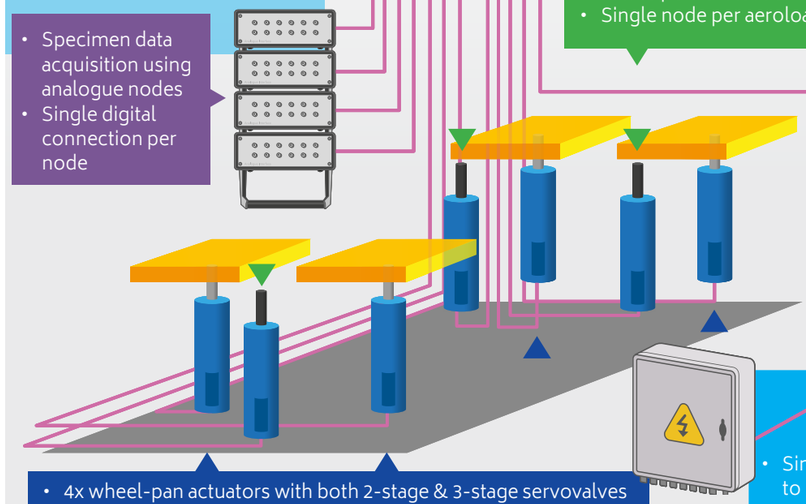
Motorsport 7-post

Operator PC workstation & hub in control room

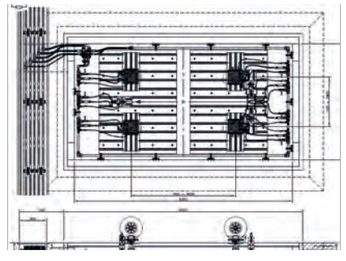
Long-stroke high-performance motorsport 7-post test rig with aerodynamic down-force simulation

- 3x aeroloader actuators with compliant links
- Dual electronic feed-back valves per aeroloader
- Single node per aeroloader

- Specimen data acquisition using analogue nodes
- Single digital connection per node



- Complementary Damper Test Machine fed from common HPS
- 4x wheel-pan actuators with both 2-stage & 3-stage servovalves
- Single node per wheelpan actuator
- Single digital connection to hydraulic control node



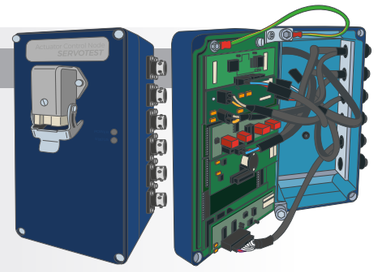
Consult Servotest for recommended configurations

- Headline specifications

Hub Configurations

	# hubs	# hydraulic nodes	# actuator/ analogue nodes[1]
Standard	1	1	15
Extended[2]	2	1	31

Actuator Node Box

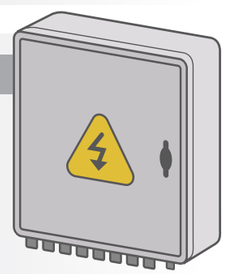


- Rugged box, sealed to IP65, mounted on or close to actuator
- 150MHz node DSP for local tasks[3]
- 6x node module slots[4] for servovalve drive & feed-back signals
- Integral AC carrier signal for transducer excitation
- Short analogue cable lengths, tidies installation & minimises noise pick-up
- Single Optostar fibre-optic connection to Pulsar hub[5]
- DC-powered via Optostar connection

Analogue Node Box

- Light-weight instrument chasis typically for data acquisition signals
- 150MHz node DSP for local tasks
- 6x node module slots, modules availalble include:
  - Dual-channel analogue input
  - Dual-channel thermocouple input
  - Dual-channel analogue output
- DC transducer power supply configured as required for:
  - DCDTs, DWTs or similar DC-powered devices
  - ICP® or IEPE® type accelerometers
  - MEMS - or servo-type accelerometers
- BNC connectors as standard, multi-pin connectors (e.g. 12-pin D) or other options available at customer request
- Single Optostar fibre-optic connection to Pulsar hub[5]
- DC-powered via Optostar connection

Hydraulic Control and Safety Node



- Rugged enclosure
- Digital IO interface to hub, connection via single Optostar cable
- Positively-guided relay outputs
- Pilz E-stop safety circuit
- 24V power supply

Total digital I/Os	Max # digital outputs[6]	Nominal # digital inputs	Max # digital inputs	Digital I/O boards	# Relay output boards
24	10	14	24	1	1
32	20	12	32	1	2
56	30	26	56	2	3
64	40	24	64	2	4

PULSAR Specifications

Node Box Modules

2-stage servovalve	Drives up to 4x 2-stage servovalves (common drive) with auxiliary pressure-switch input
3-stage servovalve (2 slots) consists of: • 2-stage servovalve drive for pilot • Spool LVDT conditioner	Drives a single 3-stage servovalve ...per 2-stage valve above ...per actuator LVDT below
LVDT actuator position transducer	10kHz (nominal) carrier signal, variable gain, transducer ID available
Temposonic actuator position transducer	Start/Stop digital interface, dedicated 24V DC transducer supply, max iteration rate 1.2-5.2 kHz (transducer stroke dependent), TEDS[7] required
AC load cell (paired with external 2305 calibration module)	AC-coupled for maximum noise-rejection, 10kHz (nominal) carrier signal, full-bridge (2305), TEDS[7] chip required
DC load/torque cell	DC-coupled, full-bridge, ±2.5 or ±5V excitation, variable gain (x1, x100, steps to x1,000), TEDS[7] chip optional, external calibration resister
2-channel analogue input (with built-in transducer power supply)	• Differential input with 16-bit ADC, 500Hz 4-pole (24dB/Oct) Butterworth low-pass anti alias filter (optional defeat) per channel • Input ranges ±10, 5, 2.5, 1.25 & 0.625 volt, selectable on a per-card basis • Constant-current supply (4.7mA) from isolated 24V DC bias voltage with AC coupling, for ICP®/IEPE® accelerometers • ±15V DC transducer power supply (max 33mA) for DC-powered transducers including MEMS & force-balance/servo accelerometers
2-channel analogue output	±10 volt into a 600 Ω load
2-channel thermocouple signal conditioner	J- & K-type as standard (1,000 or 1,250°C max temp ranges selectable) , N-type as special
Digital encoder input	Programmable to accept 'incremental' (AB signal) or 'absolute' (14-/16-bits or SSI) encoders

System Performance

Rates

Main hub processor	Texas Instruments TMS320C6718B DSP, 300MHz clock	Local node processor	TI TMS320VC5402A DSP, 150MHz clock
Primary control loop update rate	• 5kHz nominal max • 2kHz multi-channel typical	Local node control loop update rate	• 10kHz nominal max
Data acquisition (DAQ)	• Main DAQ rate selectable as an integer divisor of the selected loop update rate • Multiple DAQ processes available • Optional high-speed DAQ logger - 20kHz		

Resolution

Primary transducer channels	• 19-bit maximum, 16- to 18-bit typical • 16-bit max for Temposonic • 5th-order polynomial calibration	Analogue input	• 16-bit typical • Selectable input voltage range

Notes

1 Actuator or analogue nodes, actuator count may vary with detailed configuration:
- 2x actuators per node box possible for 2-stage valve, load & stroke
- 2x node boxes may be required for actuators with multiple 3-stage valves or pre-load

2 Custom configurations with >2 hubs & >31 node box connections available using SCRAMNet® reflected memory

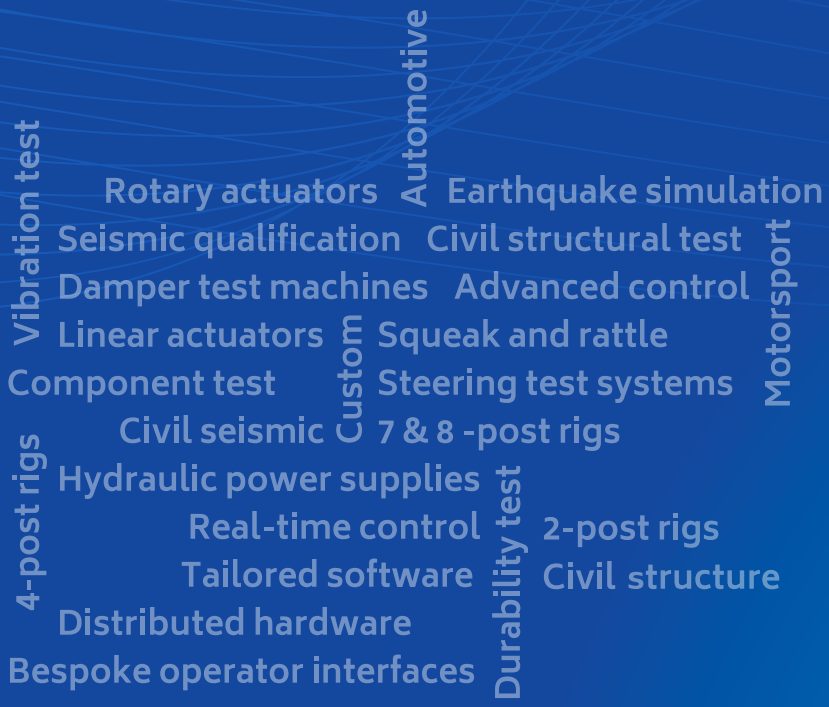
3 Includes loop-closure for 3rd stage of 3-stage valves

4 4x with AC carrier

5 Includes DC power for node, safety connection & digital communication

6 Digital outputs can be reconfigured as digital inputs

7 TEDS = Transducer Electronic Data Sheet ...Servotest-specific configuration



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