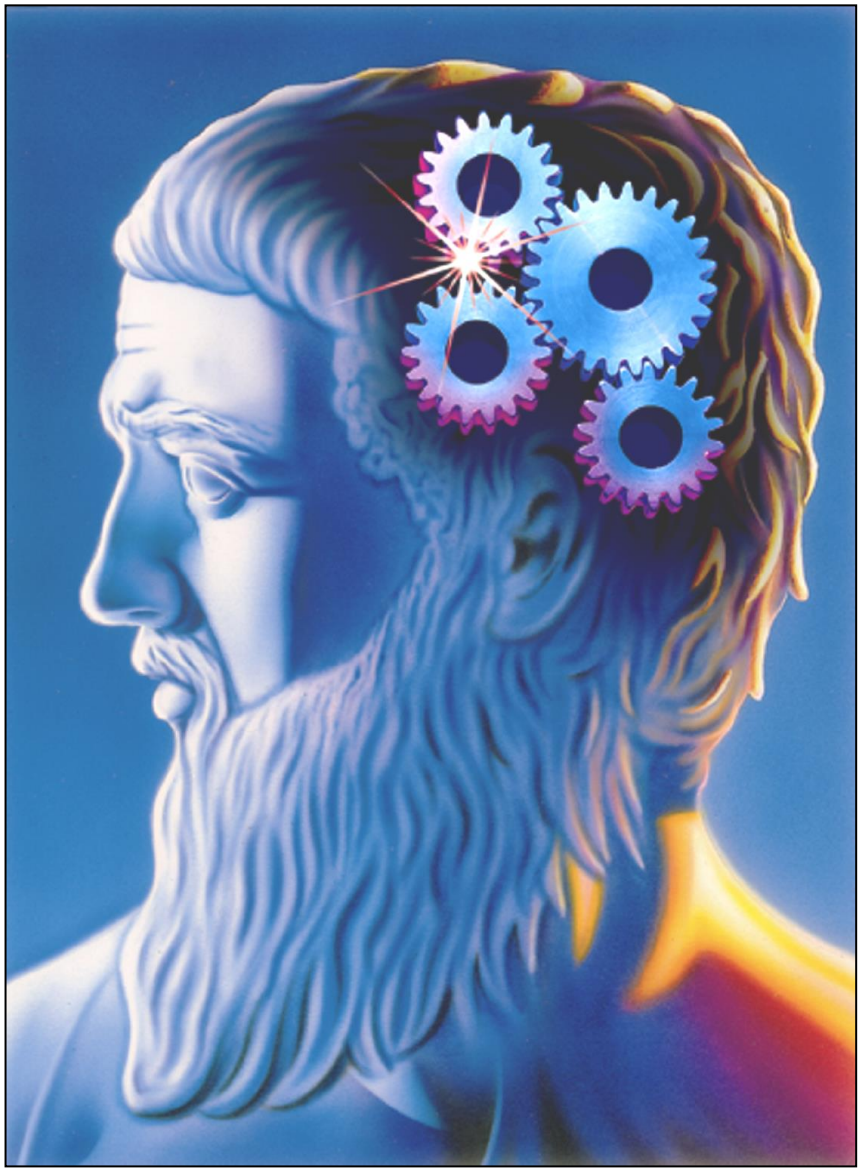
Introduction
to
PLATO Architecture
&
Integration with Test Machines



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NI Data Acquisition Hardware ("front-end") - for NVH

*Popular options**

Bus	PXIe		USB / Ethernet		
Chassis				4-slot cDAQ-9174 chassis (USB) 1-slot cDAQ-9181 chassis (Ethernet)  	8-slot cDAQ-9178 chassis (USB) 8-slot cDAQ-9188 chassis (Ethernet)  
Device	 PXIe-4472	 PXIe-4497		 NI 9250	x1, 2, 3, 4, 5, 6, 7, 8  NI 9234	x1, 2, 3, 4, 5, 6, 7, 8
# Channels	8	16	5	2, 4, 8, 12, 16	4, 8, 12, 16, 20, 24, 28, 32	
Sample Rate (per channel)	204.8KHz	102.4KHz			51.2KHz	
Gain	X1, x10		X1			
ADC resolution	24-bit					

**Other devices supported on request – please contact NVH International*

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NI Counter/Timer Hardware for Transmission Error & Backlash Measurement

*Popular options**

Device	PCI-6602	PCIe-6612	PXIe-6612	cDAQ chassis + 9402 Module(s)
# Simultaneous High-Speed Channels	3	3	8	3
				  
Bus	PCI	PCI express	PXIe	CompactDAQ™
Clock Frequency (resolution)	80MHz (12.5ns)			

**Other devices supported on request – please contact NVH International*

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PC Requirements

Operating System:

With <u>minimum</u> resources:

- Windows 7, 10 or 11 professional operating system (32 or 64-bit)
- core i7 or i9 processor
- 8GB memory
- 500GB fixed disk (**M.2 NVMe SSD** recommended for high RPM and/or high channel count systems)
- graphics card with at least 4GB on-board memory (in preference to motherboard based graphics)
- monitor, keyboard, pointing device (dedicated or shared via KVM-switch/VNC etc. if PLATO running on a separate PC)

Plus:

- To add DAQ/counter-timer hardware:
  - PCI-slots (for plug-in cards), and/or
  - PCI-express slots (for plug-in cards or PXIe-controller), and/or
  - USB2/USB3-port

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Mode of Operation

PC can be:

- **Shared** with test machine control functions
  - **PLATO** runs in Windows background (but needs to be switched to foreground for set-up etc)
  - I/O with test machine controller via OPC (software) – requires OPC-server
  - Product details passed via OPC (or disk file deposit)

OR

- **Standalone** and networked to test machine controller
  - **PLATO** runs in Windows foreground
  - I/O with test machine controller via DCOM-based OPC (software) or 24V hardware
  - Product details passed via OPC (or disk file deposit)

3rd Party Software Requirements

InterBase 2020 SQL-database server (plus 1-client) is required for all **PLATO** systems performing data capture within production test cycles.

It is available as a download from:
https://store.embarcadero.com

Priced at GBP 166 (Dec-2020)

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Product Shaft Speed Reference

- **1-channel** for tested products without "slip" e.g. transmissions, axles, PTUs, transfer cases

OR

- **2-channels** for ePowertrain products (where eMotor speed signal is not accessible) and for tested products with "slip" e.g. CVTs

- **From any convenient shaft** – typically input driveline for axles, transmissions, PTUs etc.

- **Pulse-train type signal** – or any periodic signal with clear threshold passing for timing

  e.g. encoders, tone-wheels & magnetic/inductive sensors etc

  Ideally isolated using a high-frequency opto-coupler

  e.g. Phoenix Contact DEK0OE-24DC/5DC/100KHZ-G for 24V encoders
  Phoenix Contact DEK0OE-5DC/5DC/100KHZ-G for 5V encoders

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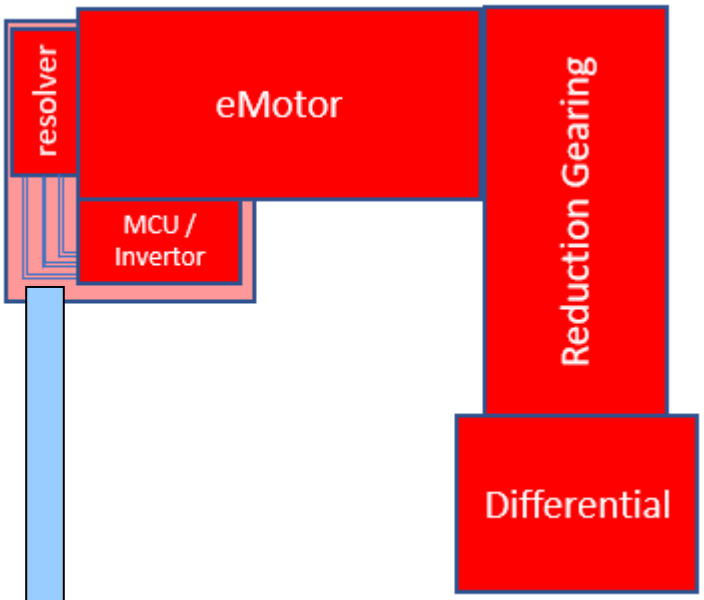
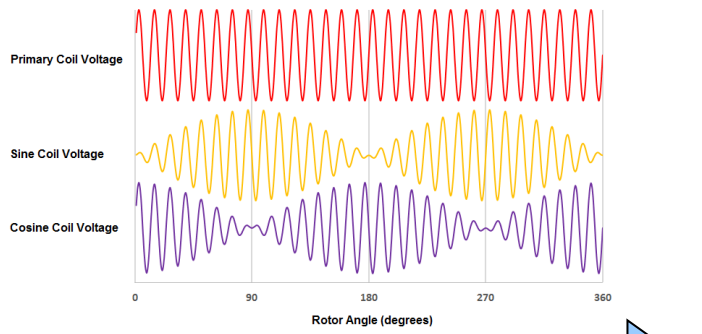
eMotor/Resolver Speed Reference

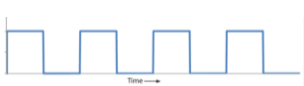


Although eMotor/ePowertrain NVH testing can be accomplished using speed reference from both output shafts, a higher speed eMotor reference signal is preferable.

Most eMotors include synchronous resolvers for position/speed feedback to the MCU.

If the resolver signals can be accessed on each ePowertrain without invalidating the EOL test, the RSI-101 module can convert those signals into a speed pulse signal suitable for use with **PLATO**.





PLATO

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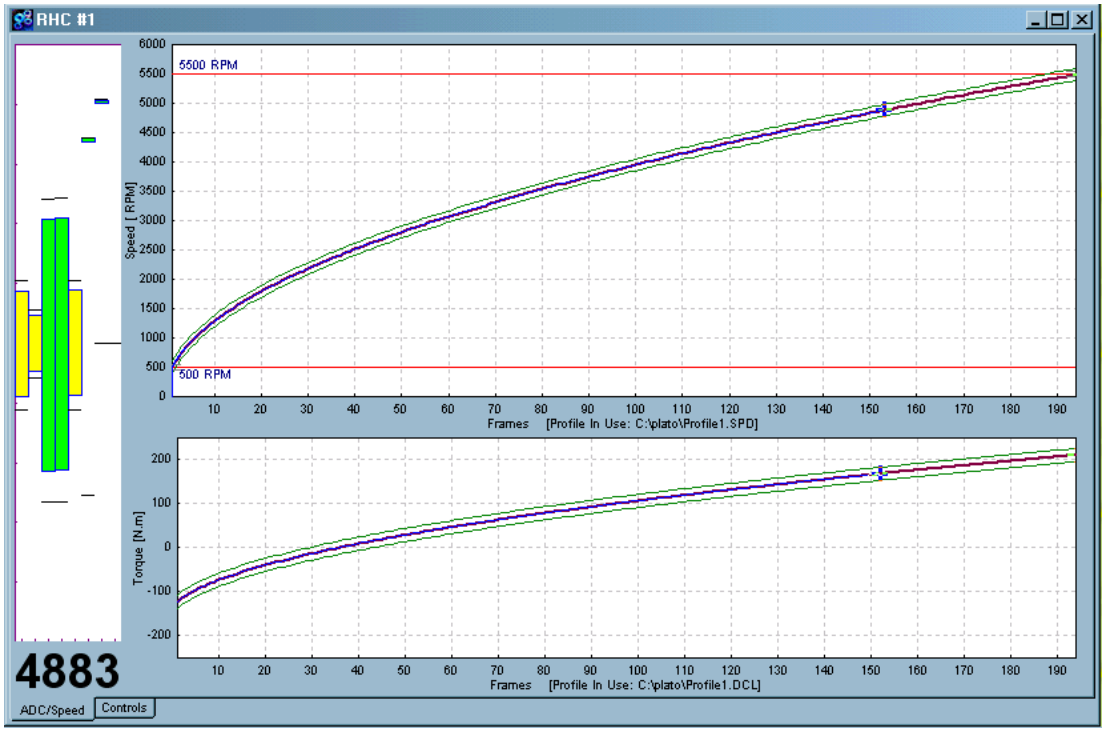
“Static” Channels

- **Monitored during test stages to ensure consistency of test conditions** e.g:
  - static (dc) torque
  - static pressure etc.
- **Used by PLATO to fail the test (<u>not</u> the tested product)**
- **Monitored in background <u>every test</u>**



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Dynamic (“NVH”) Channels

Channel	Typically Used For
1	Tacho (speed) sensor
2	Static (DC) sensors e.g. driveline torque, pump pressure etc.
3..N	**Dynamic (NVH) sensors:** Linear: e.g. accelerometers, laser vibrometers, microphones Rotational: e.g. torsional accelerometers, dynamic torque sensors etc.

N = 4, 5, 8, 12, 16, 20, 24, 28, 32 *- dependent on frontend hardware*





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Dual-Range Torque Transducers

Advanced Telemetrics International (ATi) – 2140DR Dual-Range Torque Transducer

- Range 1 : static ±XXXNm (user defined)
- Range 2 : dynamic, scaled to any range down to 1% of Range 1

- Dynamic channel processed independently of static channel (high-pass filtered and then amplified), providing high-fidelity dynamic torque signal with minimal noise.

TE Measurement Channels

Channel	Typically Used For
1	Input side encoder (N pulses/rev, TTL)
2	Output side encoder (N pulses/rev, TTL)
3	Output side encoder (N pulses/rev, TTL)

N = power of 2 *- advantageous*

IEPE-sensor Powering/Conditioning

Typical DIN-rail mounted 1-channel Unit

- *24Vdc powered (60mA)*
- *current to IEPE-sensor selectable from 4mA or 10mA (jumper-selectable)*
- *conditioned output signal to Plato: ±6V*
- *analogue gain: x1, x10, 100 (jumper selectable)*

NVHI-manufactured (2, 4, 6 & 8 channel options)

- *12Vdc powered (250mA)*
- *4mA current to IEPE-sensor*
- *conditioned output signal to Plato: ±5V*
- *configurable low-pass filter (pre-gain), **and then***
- *analogue gain: x1, x10, x100 (jumper selectable)*
- *produces higher fidelity analogue signals without low frequency (often high amplitude) components that might otherwise swamp the ACD analogue input range*

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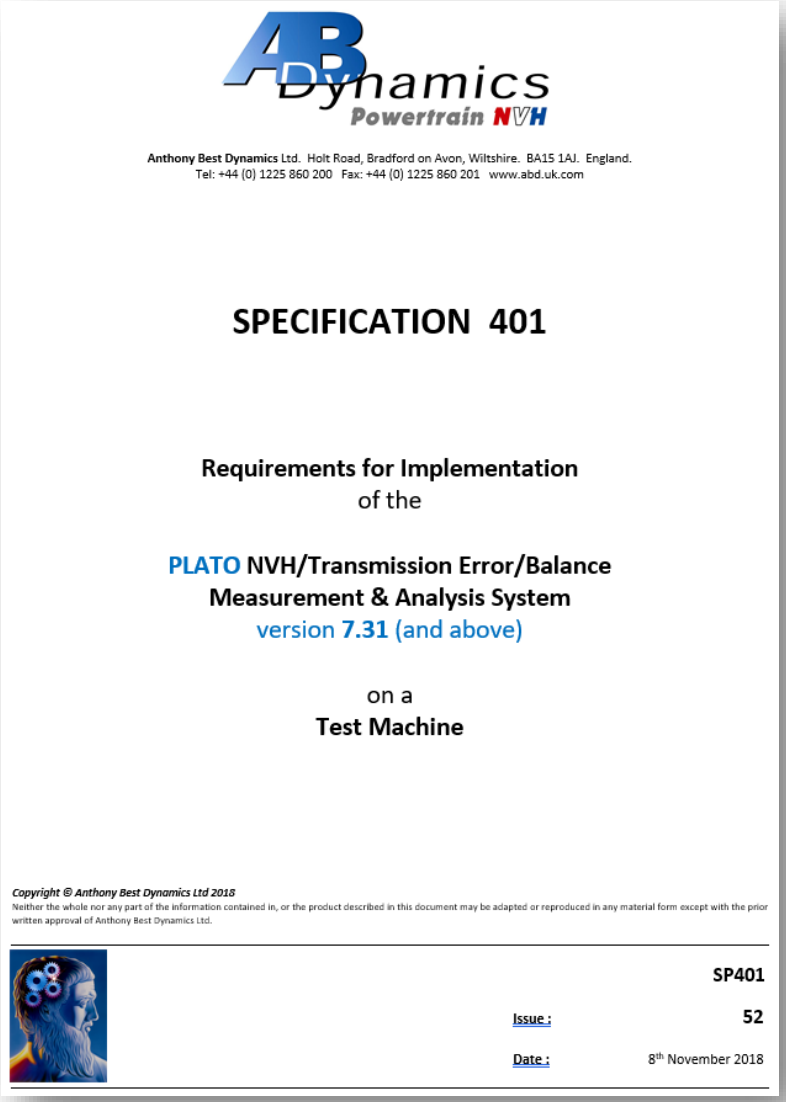
Detailed Interaction Specification

- The test machine control software must conform to standard interaction **Specification 401**

- **PLATO** typically operates in “slave” mode i.e. responding to a sequence of requests made by the test stand control system

- Cut-down application-specific documents based on Specification 401 issued once a project is underway



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SPECIFICATION 401

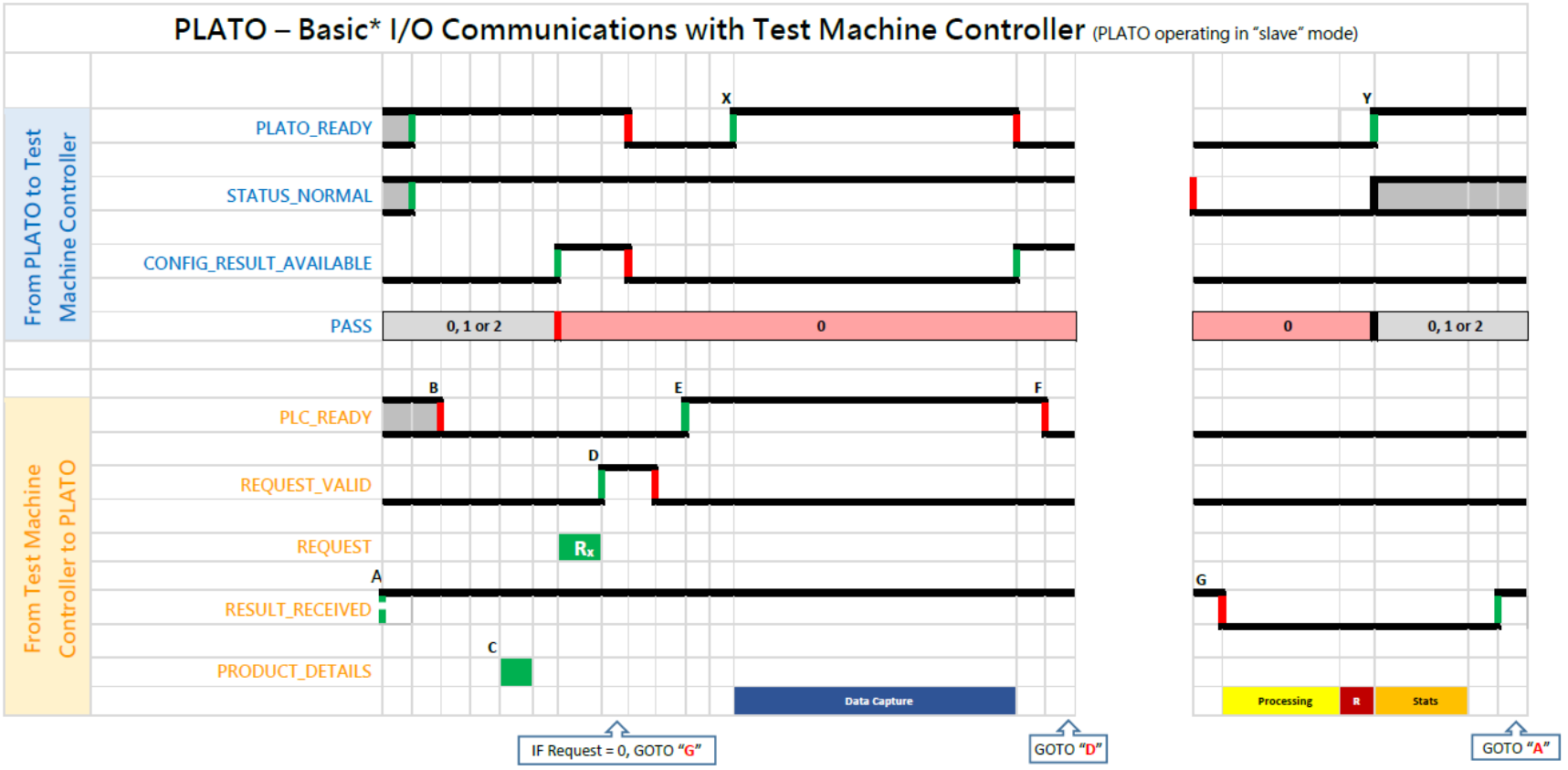
Requirements for Implementation
of the

PLATO NVH/Transmission Error/Balance
Measurement & Analysis System
version 7.31 (and above)

on a
Test Machine

SP401
Issue : 52
Date : 8th November 2018

Interaction Handshake



Messages:
A – "WAITING FOR RESULTS RECEIVED"
B – "WAITING FOR NOT PLC_READY"
C – "WAITING FOR PRODUCT DETAILS"
D – "WAITING FOR CONFIGURATION REQUEST"
E – "WAITING FOR PLC_READY"
F – "WAITING FOR NOT PLC_READY"
G – "WAITING FOR NOT RESULTS RECEIVED"

Waypoints:
X = Plato waits for start speed and/or torque conditions to be achieved
Y = Indicating availability of overall result

R = Reporting

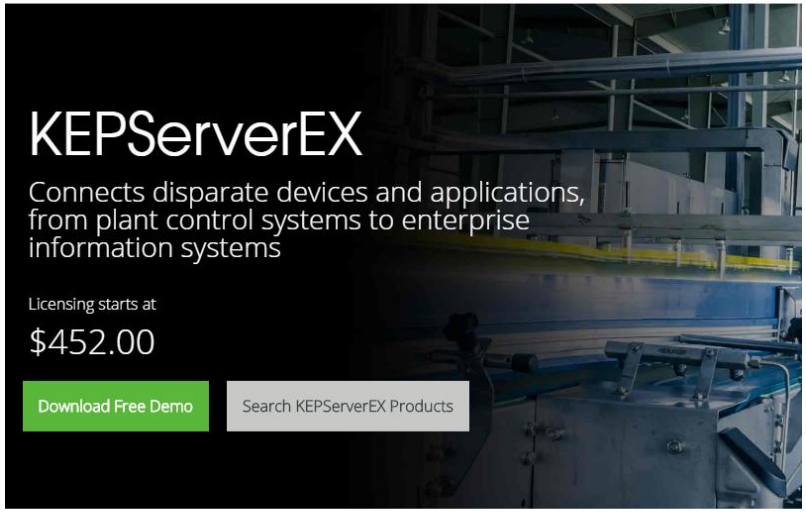
* warning, alarm and warning/alarm valid lines from PLATO omitted for clarity

SYSTEM OK (Plato to TMC*) will remain **HIGH** under normal operation. If **LOW** sensed by TMC*, Plato is indicating an error and testing cannot proceed.
Retest functionality via **RETEST** (Plato to TMC*) not covered by above.

* TMC = Test Machine Controller

OPC Servers

kepware



PRODUCTS

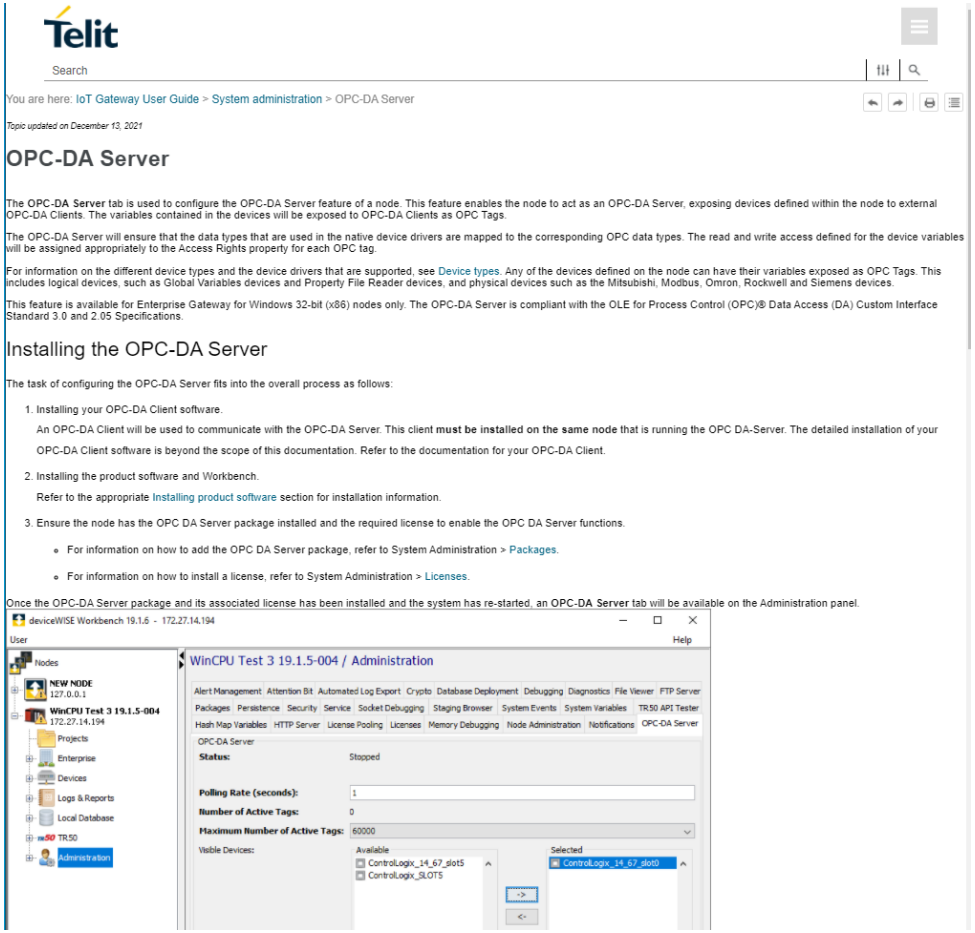
Product Overview

KEPServerEX is the industry's leading connectivity platform that provides a single source of industrial automation data to all of your applications. The platform design allows users to connect, manage, monitor, and control diverse automation devices and software applications through one intuitive user interface. KEPServerEX leverages OPC (the automation industry's standard for interoperability) and IT-centric communication protocols (such as SNMP, ODBC, and web services) to provide users with a single source for industrial data. The platform is developed and tested to meet our customers' performance, reliability, and ease-of-use requirements.

Watch our two-minute video below to see how KEPServerEX solves common connectivity challenges—providing secure and reliable access to real-time industrial data so everyone from the shop floor to the top floor can make smarter decisions.

https://www.kepware.com/en-us/products/kepserverex/

Just two of hundreds available



https://docs.devicewise.com/Content/Products/GatewayDevelopersGuide/Administration/OPC-DA-Server-tab.htm

PLATO supports:

- legacy **OPC-DA** (Direct Access) and
- **OPC-UA** (Unified Architecture) protocols

More OPC-servers available at: https://www.matrikonopc.com/drivers/plcs.aspx

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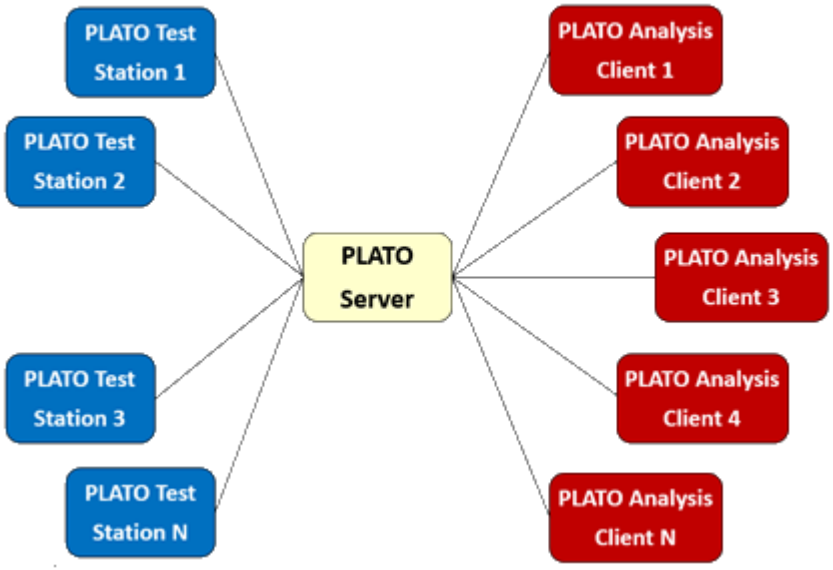
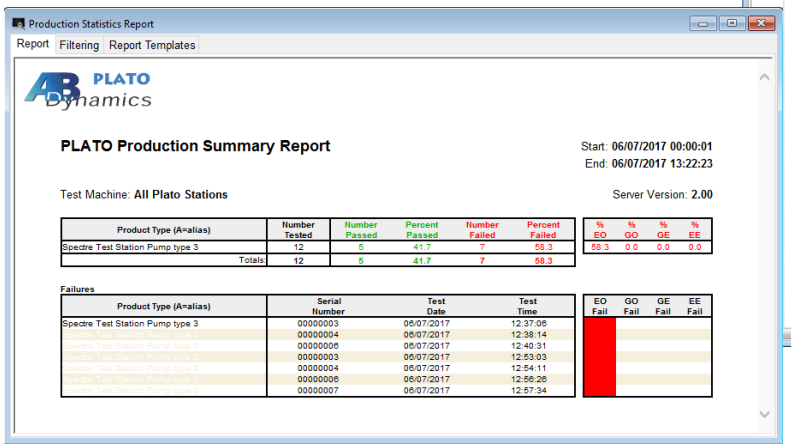
Plato-SERVER and Plato Analysis Clients (PACs)

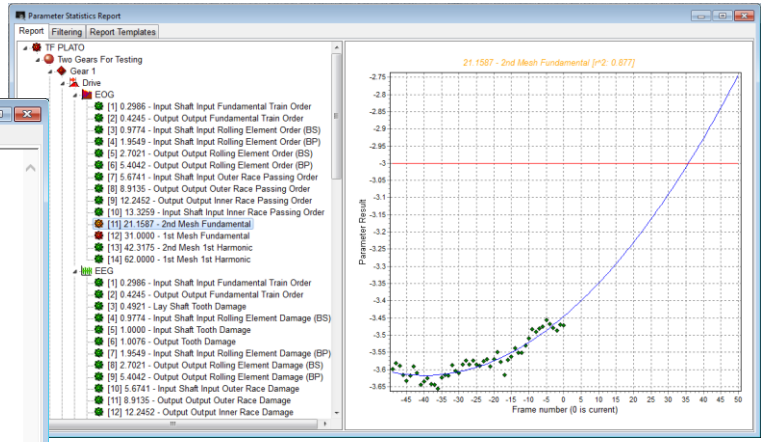


Plato-SERVER software (without support) is available free-of-charge to provide the following functionality:

- Common storage of results from N-networked PLATO test systems
- A client application (PLATO Analysis Client, or "PAC") to allow retrieval of results for analysis etc. across the network.

Network and server hardware, plus SQL-server or SQL-express must be provided and configured by the end-user.





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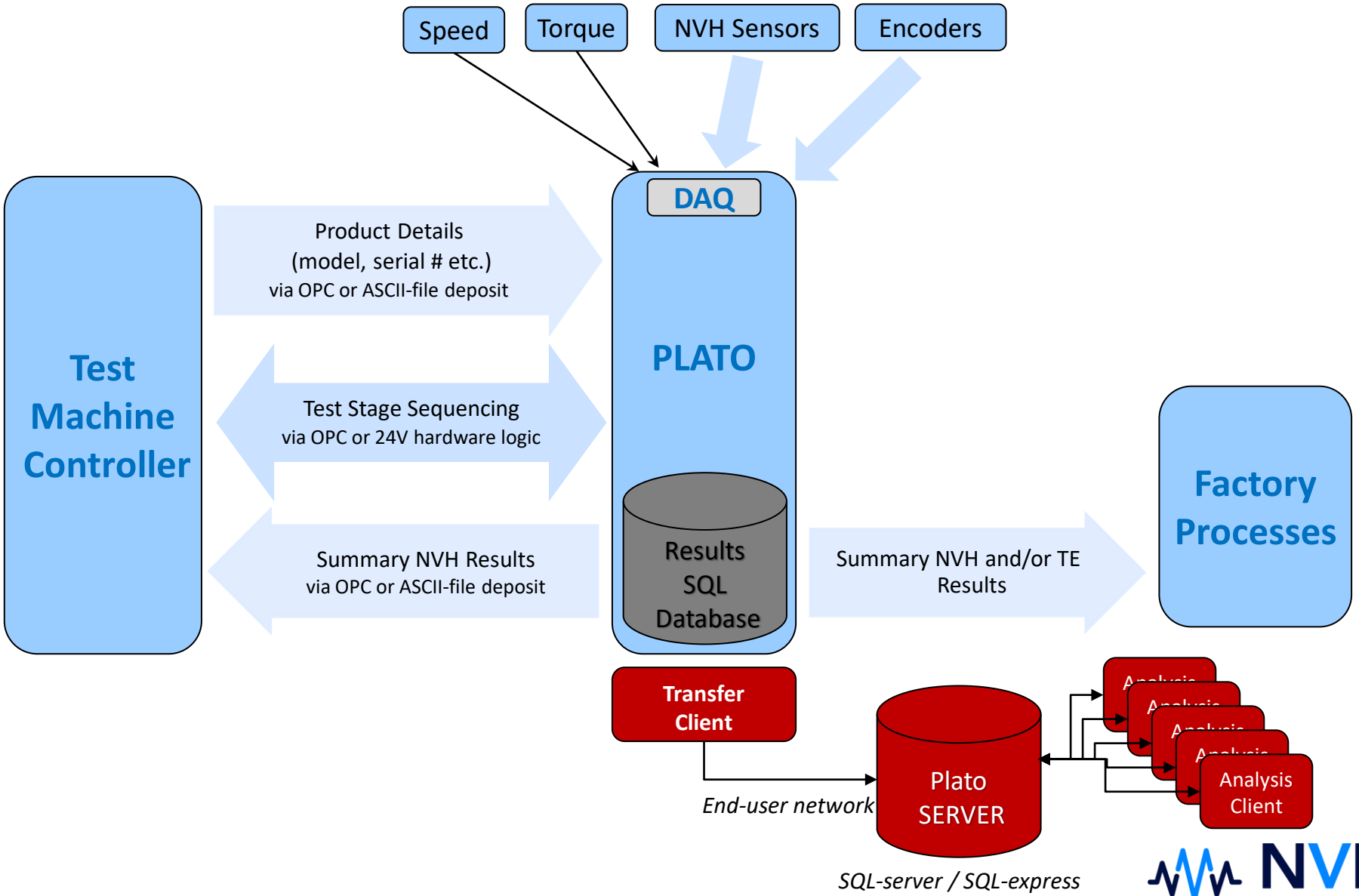
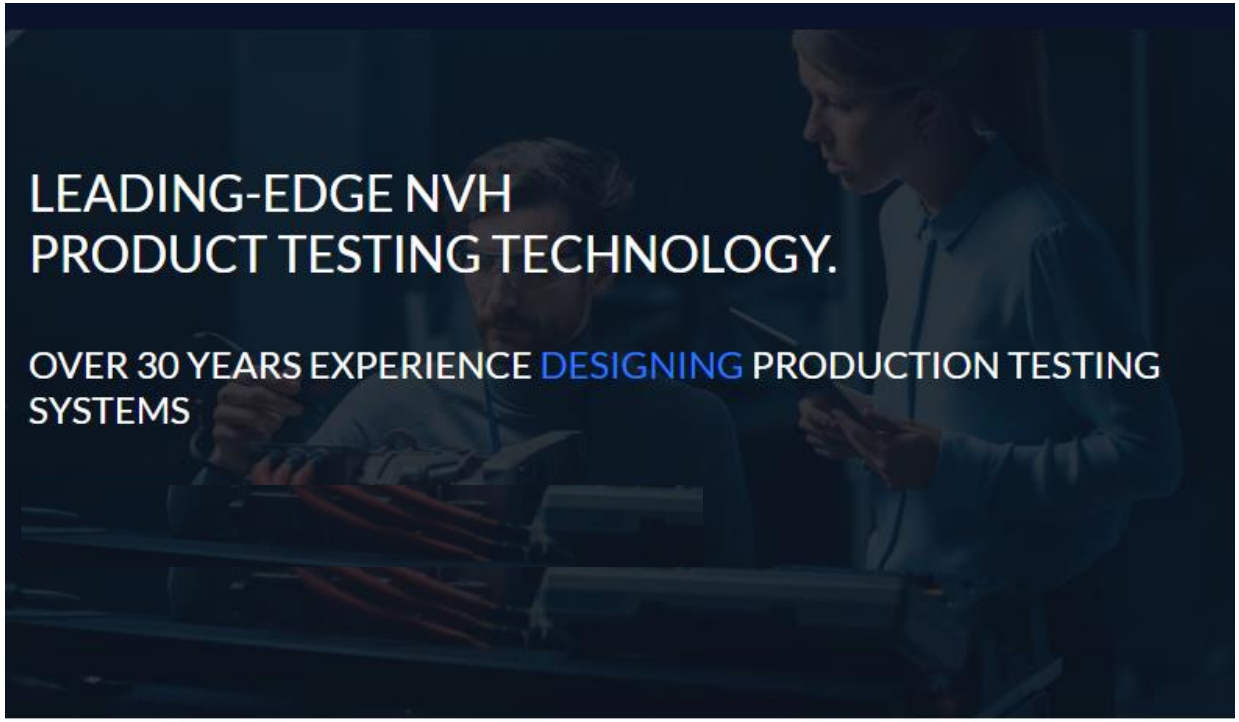
Interaction Summary





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With technical representatives in major automotive territories worldwide, see **nvhint.com** for details.

PLATO - CORE NVH MEASUREMENT & ANALYSIS SOFTWARE

Leading-edge NVH product testing technology. Over 30-years of experience designing, deploying and supporting production testing systems.

Our supply model is based on:

- ✔ Advice – on test machine design, sensor choice and location, data capture and analysis options
- ✔ Product – feature-rich and robust application software
- ✔ Services – software set-up, test proving, training
- ✔ Support – ongoing assistance for new test set-up, result interpretation, fault-finding etc.

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