

SYSTEM DATA

VC-LAN Vibration Controller — Types 7541 and 7542

Using the latest technology, including dual, parallel 24-bit A/D and DSP technology together with a LAN interface, Vibration Controller Types 7541 and 7542 offer exceptional performance and flexibility. With 130 dB input dynamic range and fast loop times, these controllers deliver precise control with rapid safety checks to protect your shaker and your products.

Modular and expandable, Type 7542 offers up to 64 input channels for control and limiting. Perfect for production test and stress screening, Type 7541 has the performance for R&D applications that require two to four input channels.

Brüel & Kjær's VC-LAN family includes a full range of Vibration Control software for both controllers that offer full-capability control and analysis applications such as: random, swept sine, resonance dwell, classical shock, random- and sine-on-random, shock SRS, and field data replication.



Uses and Features

Uses

- Excitation of shaker systems with closed-loop vibration control
- Vibration testing to MIL-STD, DIN, ISO, IEC and other standards
- Production test of electronics and components with integrated and automated operation with environmental chambers
- Durability testing and product development
- Control of complex aerospace or space products with concurrent data acquisition

Features

- LAN interface allows controller to be near to the shaker, resulting in reduced instrument line noise
- Stand-alone operation without an attached PC allows simple Start/Stop testing by non-expert users in a production environment
- Internal battery acts as UPS to protect the shaker system from damage if power is lost
- Dual, parallel 24-bit Analog-to-Digital converters provide a high dynamic range for even low-level tests
- CCLD and charge coupling eliminate the need for external signal conditioning boxes
- Supports IEEE 1451.4-capable TEDS sensors for error-free test setup
- Control and limiting for up to 64 channels provides accurate and safe control of complex structures and fragile test articles
- Precision Time Protocol (PTP) technology synchronises multiple controllers and provides a phase match within 1° up to 20 kHz
- Concurrent and integrated operation with a Brüel & Kjær PULSE™ Multi-analyzer system provides additional safety and data acquisition with hundreds of input channels

Two Models

Type 7541 has two inputs and one output standard. Also included is remote communication interface hardware with four digital I/O lines for remote control. The digital I/O lines are optically isolated to minimise noise from Transistor-Transistor Logic (TTL) command and communication signals from environmental chambers. This model can be expanded to have four inputs and is perfect for production tests with plenty of performance for R&D applications.

Type 7542 comes standard with four inputs, an output, COLA (Constant Output Level Adapter) and eight digital I/O lines. You can easily expand the system to up to 64 inputs for multi-point control of complex test structures with limiting and independent channel abort profiles.

Both Types 7541 and 7542 include built-in CCLD signal conditioning for piezoelectric transducer power. Type 7542 also includes charge conditioning to completely eliminate the need for external transducer signal conditioning, and each input channel includes a TEDS interface for smart transducers.

Network Flexibility

VC-LAN Vibration Controller Types 7541 and 7542 offer the flexibility and power of networking. Using a direct connection, or a LAN connection, the controller can be located close to the shaker table to reduce transducer cable lengths and minimise instrument line noise. The host PC can then be remotely connected to the controller, making it easy to centralise test supervision for multiple vibration test stations. Connecting the controller to an external wireless network router enables a WiFi connection to the host PC without the expense and clutter of long network cables.

Exceptional Control

Using the latest technology, VC-LAN Controllers deliver exceptional performance in both R&D and production environments. State-of-the-art distributed DSP processors provide fast loop times, typically under 10 ms, for quick test load equalisation and enhanced safety. Since all the control processing and data recording are executed locally inside the controller, the network connection will not affect the control reliability.

Each input channel uses dual 24-bit A/Ds working in parallel to deliver a 130 dB input dynamic range. These inputs:

- Provide a high dynamic range over a wide range of test levels
- Save test setup time
- Ensure error-free tests by eliminating problems due to improperly set voltage ranges

Since this design provides a high dynamic range across a wide range of test levels, and not just at an ideal full-scale condition, it provides the high dynamic range you need for precise control of complex structures or difficult fixtures. The unique floating ground design reduces ground loop noise, which means no more headaches with low-level tests, such as starting a test or not having enough effective dynamic range for accurate control.

Fail-safe Operation

Unique safety features on the VC-LAN Controllers help to ensure fail-safe operation for your tests and shaker system. A built-in hardware abort button connects directly to the output hardware circuitry so that you are never at the mercy of the software user interface. Transducer faults such as short conditions and broken cables are detected before the test starts, and fast safety checks performed in the controller's DSP processors detect any problems within milliseconds.

Internal Battery for UPS Protection (Type 7542)

Even in the event of a power loss, an internal backup battery acts as uninterruptable power supply (UPS) to protect the shaker system and allow Type 7542 to continue to run the test normally and save critical test data.

Stand-alone Operation

Type 7542 includes a "stand-alone" operation mode. In this mode, Type 7542 runs autonomously without an attached PC. This mode is perfect for production users as it removes the need for expert operators and ensures that tests are done right the first time, every time. A PC is only needed to configure the controller setup beforehand and then can be used to download data after test completion.

During the test, the front panel's bright LCD displays test status information such as the rms level or sweep frequency. The controller is pre-programmed to run a test schedule and external equipment can command and communicate the controller via the digital I/O port.

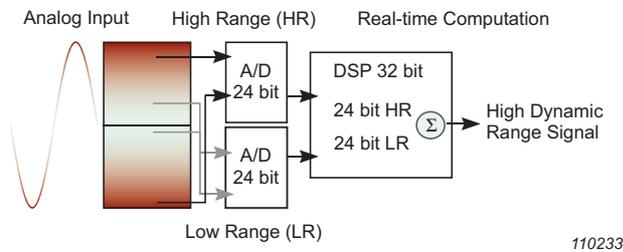
Self-check

Every controller comes with a self-check utility that quickly verifies that all input channel readings are within reasonable tolerances. The self test uses an internal precise signal source, so no external reference signal is required.

Technologies

Dual, Parallel 24-bit Analog-to-Digital Converters

Fig. 1
Simplified block diagram of VC-LAN input channel design



VC-LAN Controllers use a state-of-the-art input channel design that utilises dual 24-bit A/Ds working in parallel. With a single input range from 0 to 20 V_p and a useful dynamic range exceeding 130 dB, each input channel can detect signals as small as 6 μV and as large as 20 V. For a typical accelerometer with a sensitivity of 100 mV/g, you will be able to measure vibration signals from 60 μg to 200 g.

Accurate Control Every Time

Covering everything in one input range, you no longer have to worry about overloads or an inadequate dynamic range to accurately control lower amplitude tests. With no need for trial runs in order to ensure that the input range is correct, you have a far greater certainty of getting the vibration test run right the first time with no costly test repetitions needed.

The IEEE 1588 Precision Time Protocol

PTP synchronisation measures the delays between individual PTP components using a special algorithm (see the IEEE 1588 standard*). This enables all delays to be accurately measured, and the individual clocks can be set to exactly the same time. Type 7542 controllers synchronised by PTP to within 100 ns accuracy provide a cross-channel phase match of ±1 degree up to 20 kHz.

Hardware Configuration

Input Channels

The input channels enable multi-channel control, limiting and analysis during closed-loop vibration control tests. All input channels have the following features:

- Dual, parallel 24-bit A/Ds with 130 dB dynamic range
- Frequency range from 0 to 46 kHz[†]
- Input voltage up to 20 V_{peak}
- Absolute maximum input 40 V_{peak} without damage
- CCLD and charge signal conditioning; AC and DC coupling
- Fault indicators for incorrect conditioning and cable breaks on connected transducers
- Support IEEE 1451.4 capable transducers with TEDS (Type 7542)
- Low-noise floor

Independent Channels

The input channels on a front-end can be set up independently. You can set up digital high-pass filters and attach different types of transducers to different channels.

IEEE 1451.4 Transducers (Type 7542 only)

All input channels support TEDS transducers. This allows automatic input channel setup based on information stored in the transducer. TEDS information includes, for example, sensitivity, serial number, manufacturer and calibration date.

Fault Indicators

Each input channel monitors for input voltage overloads and signal conditioning errors. CCLD conditioning fault indicators detect problems such as cable breaks, short-circuits or CCLD transducer working point faults. The Channel Status meters in each application graphically highlight any faulty transducers.

* IEC 61588/IEEE 1588–2002, Precision Clock Synchronization Protocol for Networked Measurement and Control Systems

† Measurement frequency range selected or automatically set in Vibration Control software

Output Channels

The controllers' drive signal is used as an input to a shaker amplifier for closed-loop vibration control. With Type 7542, the Constant Output Level Adapter (COLA) is used to drive external equipment such as a stroboscope.

Features

- Two output channels with full generator functionality from 0 to 46 kHz
- 24-bit D/A with over 100 dB dynamic range
- Output voltage up to $10 V_{\text{peak}}$ and output current up to $25 \text{ mA}_{\text{peak}}$ in three output ranges
- Waveforms determined by software (see below)
- Low harmonic distortion and noise
- Low out-of-band spurious noise

Waveforms

The generated waveforms used by the VC-LAN Vibration Control software include:

- Gaussian random
- Swept sine and fixed frequency sine
- Sweeping sine tones on broadband random
- Sweeping random narrowbands on broadband random
- Sine-on-Sine
- Classical shock waveforms (such as half-sine) and field transients
- Time waveforms of long durations (hours or more)



Type 7541

110234



Type 7542

110235

Table 1
Hardware
configuration
overview for
Types 7541 and 7542

		Type 7541	Type 7542
Input Channels		2 or 4	4, 6 or 8 per front-end 64 inputs with 8 front-ends*
Output Channels		1	2
Input Coupling	AC	✓	✓
	DC	✓	✓
	CCLD	✓	✓
	Charge	–	✓
	TEDS	–	✓
Digital Input/Output		4 inputs and 4 outputs	8 inputs and 8 outputs
Analog Monitor Output		–	8 inputs and 2 outputs
Front Panel LCD Display		–	✓
Stand-alone Operation Mode (No PC)		–	✓
Internal Battery for Power Loss Backup		–	✓
Internal Data Memory		4 GB	4 GB

* Multiple front-end synchronization requires an external Ethernet network switch box.

Network Configuration

Connecting to a Front-end

The Front-end System Configuration page allows you to connect to any available Type 7541 or 7542 controller connected to the LAN. Storage and recall of multiple configurations make it possible to rapidly reconfigure equipment for new test setups. You can also use the System Configuration page to change IP addresses, update firmware, etc.

IP Addresses

Each front-end has its own built-in network interface. Each interface can be configured to use dynamic or static IP addressing via the front-end's LCD display (Type 7542) or the System Configuration page.

Software, Applications and Service

Software and Applications

VC-LAN hardware works with all Brüel & Kjær Vibration Control software. For information on all software and applications available, visit www.bksv.com.

Technical Support

With a Software Maintenance and Support Agreement you get technical support via telephone, email or Web conference*. You get direct contact with a knowledgeable and dedicated engineer to help you with:

- Configuration, set-up and preparation of projects
- Immediate questions during installation or measurements
- Advice and assistance on post-processing tasks

Accredited Calibration

We recommend you have your system calibrated regularly. With accredited calibration from Brüel & Kjær you have proof that calibration has been performed according to quality requirements in ISO 17025.

Hardware Maintenance

Local Brüel & Kjær staff and skilled technicians at the manufacturing site can ensure that your vibration controller is performing to specification and maximise the uptime of your vibration controller.

* Check with your local Brüel & Kjær office to hear whether this service is available in your area.

Compliance with Standards

VIBRATION CONTROLLERS TYPE 7541 AND 7542

CE	CE-mark indicates compliance with: EMC Directive and Low Voltage Directive.
Safety	EN/IEC 61010–1: Safety requirements for electrical equipment for measurement, control and laboratory use.
EMC Emission	EN/IEC 61000–6–4: Generic emission standard for industrial environments. CFR 47 Part 15:2008: Class B Limits. FCC Rules, Part 15 Subpart B:2008: Complies with the limits for a Class B digital device.
EMC Immunity	EN/IEC 61000–3–2: Generic standards – Immunity for industrial environments. EN/IEC 61326–1:2006: Electrical equipment for measurement, control and laboratory use – EMC requirements. Note: The above is only guaranteed using accessories listed in this Product Data.
Temperature	Ambient Operating Temperature: +5 to +45°C (41 to 113°F)
Vibration	Operating: Vibration: 3 ms ⁻² RMS, 5–500 Hz Non-operating: Vibration: 24 ms ⁻² RMS, 5–500 Hz Shock: 490 ms ⁻² 6 ms Haversine

For environmental specifications and compliance with standards for PCs, see the specifications given by their respective manufacturers.

General Specifications – Types 7541 and 7542

Power Requirements

MAINS

Wide-range input 100–240 VAC, 47–63 Hz

DC INPUT

15 V (±10%)

CONNECTOR

Chassis mount DC power with solder lugs

POWER CONSUMPTION

Type 7541: Maximum 8 W

Type 7542: Maximum 18 W

INTERNAL BATTERY (TYPE 7542)

Internal Backup Battery: 8.4 VDC, 750 mAh

Backup Battery Running Time: Approximately 7 min.

Grounding

Floating ground design minimises ground-loop noise

System

INTERNAL MEMORY

4 GB non-volatile flash memory, 32 MB DRAM

POWER MANAGEMENT

Active and sleep mode

INTERNAL CLOCK

Date and time

SYSTEM RECOVERY

Hardware reset pin and automatic recovery settings

COOLING

No cooling fan required

LCD DISPLAY (TYPE 7542)

Front panel LCD display of Ethernet connection settings and system status and test information

Display Pages: Pages for front-end configuration, IP setting, test status, and software and hardware versions

Status Information: Ethernet connection status, test status, control level, control and target rms, drive level, elapsed and remaining time

Dimensions

TYPE 7541

Height: 66 mm (2.6 in)

Depth: 276 mm (10.9 in)

Width: 220 mm (8.7 in)

Weight: 2.7 kg (5.9 lb)

TYPE 7542

Height: 66 mm (2.6 in)

Depth: 330 mm (13.0 in)

Width: 440 mm (17.3 in)

Weight: 4.2 kg (9.3 lb)

Specifications – Input Channels

	Type 7541	Type 7542
Input Channels	2 or 4	4, 6 or 8
Input Connectors	4 x BNC	8 x BNC
Frequency Range	DC to 46 kHz with 54 cutoff frequencies	
A/D Conversion	2 x 24 bit	
Data Transfer	32 bit	
Input Voltage Range	$\pm 20 V_{\text{peak}}$	
Input Signal Coupling	<i>Differential:</i> Signal ground is “floating” (500 k Ω re: chassis) <i>Single-ended:</i> Signal ground is connected to chassis (“grounded”)	
Input Impedance	<i>Differential:</i> 1 M Ω <i>Single-ended:</i> 500 k Ω	
Absolute Maximum Input	$\pm 40 V_{\text{peak}}$ without damage	
High-pass Filters	<i>AC Coupling:</i> Analog high-pass filters, –3 dB at 0.3 Hz and –0.1 dB at 0.7 Hz Digital high-pass filters, user programmable	
Absolute Amplitude Precision (1 kHz, 1 V _{input})	0.5% FS	
Spurious-free Dynamic Range re Full-scale Input (Input terminated by 50 Ω or less) Spurious-free Dynamic Range is defined as the ratio of the rms full-scale amplitude to the rms value of the largest spurious spectral component (non-harmonic)	130 dB typical	
Harmonic Distortion (All harmonics plus noise)	–100 dBfs (DC to 1 kHz) typical	
Crosstalk (Between any two channels of a module)	Less than –100 dB typical	
Channel-to-Channel Match (10 V _{peak} input range)	<i>Maximum Gain Difference:</i> 0.1 dB typical <i>Maximum Phase Difference:</i> < ± 1.0 degree, up to 20 kHz	
Common Mode Rejection (in 10 V _{peak} input range)	>90 dB typical	
Anti-aliasing Filter (At least 90 dB attenuation of those frequencies which can cause aliasing)	<i>Filter Type:</i> 3rd order Butterworth <i>–3 dB at Slope:</i> 47 kHz, –18 dB/octave	
Supply for DeltaTron/ICP®/CCLD	4 to 5 mA from 21 V source	
Charge Conditioning	10000 pC and 49000 pC with two stages	
Analog Special Functions	<i>Analog Self-test:</i> Functional check <i>Transducers:</i> Supports IEEE 1451.4-capable transducers with standardised TEDS (up to 100 m cable length)	
Fault Detection	<i>CCLD Fault:</i> Detection of cable break or short-circuit + detection of CCLD transducer working point fault	

Specifications – Output Channels

	Type 7541	Type 7542
Output Channels	1	2: 1 Drive, 1 COLA
Output Connectors	1 × BNC	2 × BNC
Output Coupling	DC	
Signal Ground Coupling	Grounded to chassis	
D/A Conversion	24 bit	
Output Voltage Range (AC)	$\pm 10 V_{\text{peak}}$ in three ranges	
Output Impedance	50 Ω	
Output Load	Max. 25 mA _{peak}	
Frequency Range	0 – 46 kHz	
Frequency Accuracy	0.00025%	
Reconstruction Filter	160 dB/oct. digital and analog filters	
Dynamic Range	100 dB	

Specifications – Digital Inputs and Outputs

General

CONNECTOR

25-pin female D-SUB

EXTERNAL CIRCUIT POWER SUPPLY

Type 7541: ± 3.3 VDC to ± 12 VDC ($\pm 10\%$)

Type 7542: ± 12 VDC ($\pm 10\%$)

INTERNAL POWER

3.3 VDC, 350 mA, 12 VDC, 400 mA

MAXIMUM ALLOWABLE DISTANCE OF SIGNAL EXTENSION

50 m (164 ft)

Inputs

INPUT FORMAT

Optically isolated input (compatible with current sink output)

NUMBER OF INPUT CHANNELS

Type 7541: 4 channels

Type 7542: 8 channels

INPUT RESISTANCE

Type 7541: 6.1 k Ω

Type 7542: 1 k Ω

INPUT ON CURRENT

2.0 mA or more

INPUT OFF CURRENT

0.16 mA or less

INTERRUPT

8 input signals are arranged into a single interrupt output signal. An interrupt is generated either at the rising edge (HIGH-to-LOW transition) or falling edge (LOW-to-HIGH transition)

Outputs

OUTPUT FORMAT

Optically isolated input (current sink output)

NUMBER OF OUTPUT CHANNELS

Type 7541: 4 channels

Type 7542: 8 channels

OUTPUT RATING

Output voltage 12 VDC max. output current 100 mA per channel max

RESIDUAL VOLTAGE WITH OUTPUT ON

1.0 V or less (output current <100 mA)

Specifications – Analog Monitor Outputs (Type 7542)

PURPOSE

Voltage replication of each input and output channel

NUMBER OF CHANNELS

10

Monitoring Analog Inputs: 8 channels

Monitoring Analog Outputs: 2 channels

CONNECTOR TYPE

25-pin female D-SUB

MONITORING MAGNITUDE

50% of input channel in any voltage, CCLD mode and charge mode

OUTPUT FORMAT

Single-end

OUTPUT RATING

Output Voltage: 10 VDC max

Output Current: Max. 25 mA per channel

Specifications – Remote Abort

PURPOSE

Remote STOP button for emergency test abort

CONNECTOR TYPE

GX 16

ABORT RESPONSE TIME

Approximately 10 ms

MINIMUM CONTACT DURATION

Approximately 10 ms

MAXIMUM DISTANCE OF SIGNAL EXTENSION

50 m (164 ft)

Specifications – LAN Interface

CONNECTOR

1 Connector type RJ-45 (100base-T)
Types 7541 and 7542 communicate at 100 Mbps/s. All LAN-connectors support MDIX, which means that cables may be “crossed” or not

PROTOCOL

The following standard protocols are used:

- ICMP
- IP
- UDP
- TCP
- IGMP
- Ethernet

PTP PERFORMANCE

Multiple Type 7542 modules use IEEE 1588 protocol for data sampling synchronisation

IEEE 1588 v2 Protocol: PTP ordinary clock, with both E2E and P2P synchronisation supported and hardware level timestamp for PTP event messages

PTP Synchronisation with provided LAN Switch: Typical sample synchronisation better than 100 ns (approximately $\pm 1^\circ$ at 20 kHz)

Note: PTP is not supported with a wireless connection to the PC

Ordering Information

Type No.	Name	Included Accessories	Optional Accessories
7541	4-ch. Vibration Controller	<ul style="list-style-type: none"> • Mains Adaptor (100–240 V) for all input/output modules 	<ul style="list-style-type: none"> • Additional input channels • Wireless Remote Control Pendant • Wireless Remote Control with Apple iPad device
7542	8-ch. Vibration Controller	<ul style="list-style-type: none"> • Analog Monitor Port • Remote Abort • Mains Adaptor (100–240 V) for all input/output modules 	<ul style="list-style-type: none"> • Additional input channels • Rack Mounting Kit • Wireless Remote Control Pendant • Wireless Remote Control with Apple iPad device

See System Configurations below for a complete list of possible configurations with the Vibration Controllers

Optional Accessories

ADDITIONAL INPUT CHANNELS

7541-X-002 Two Additional Input Channels for Type 7541. Up to four channels total per Vibration Controller Type 7541

7542-X-002 Two additional Input Channels for Type 7542. Up to eight channels total per Vibration Controller Type 7542

OTHER ACCESSORIES

UA-2142 Rack Mount Kit for Type 7542 (48 cm (19in))

ZG-0868 Replacement AC-DC Power Adapter for Types 7541 and 7542 – 100 to 240 VAC (47 to 440 Hz) mains power as input with an output of 15 VDC

ZH-0691 Wireless Remote Control Pendant for Types 7541 and 7542 using Apple iPad (includes hardware and software)

ZH-0692 Wireless Remote Control Pendant for Types 7541 and 7542 using CE-based Device (includes hardware and software)

ZH-0693 Analog Monitor Port cable and Breakout Box (25-pin D-SUB to board with 12 x BNC connectors)

ZH-0694 Checkout Board for Remote Communication Interface (RCI) – requires optional software Remote Communication Interface Software Type 8610-D

UL-1021 4-port Multi-controller Ethernet Network Switch – synchronizes up to four Type 7542 units using IEEE 1588 protocol

UL-1022 8-port Multi-controller Ethernet Network Switch – synchronizes up to eight Type 7542 units using IEEE 1588 protocol

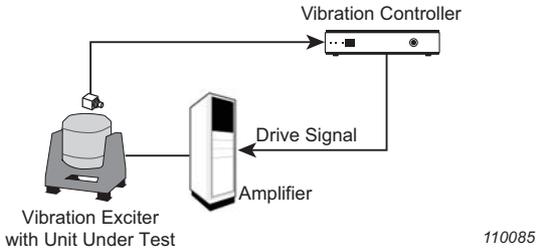
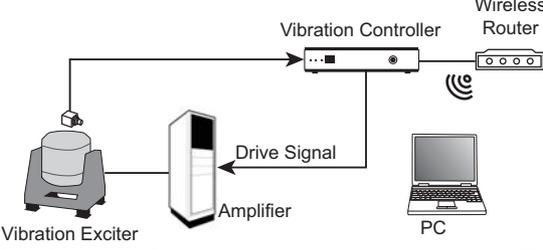
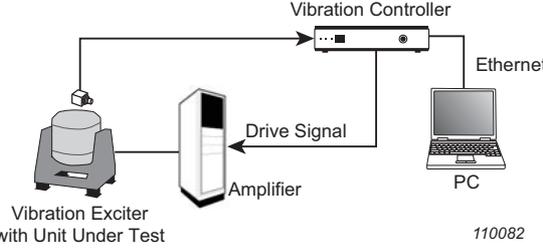
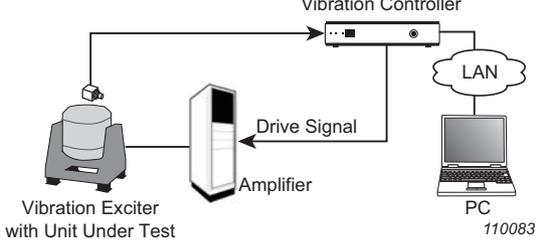
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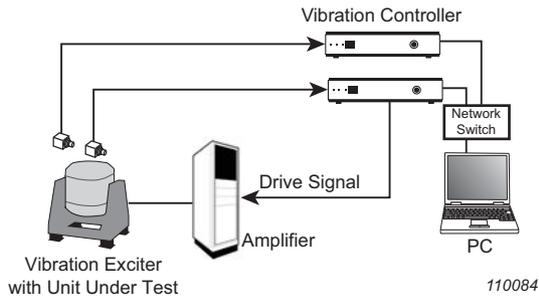
Type 8641 Calibration Software for 7541

Type 8642 Calibration Software for 7542

ZH-0695 Charge Amplifier Calibration Cable and Connector Board Kit – Requires Type 8642

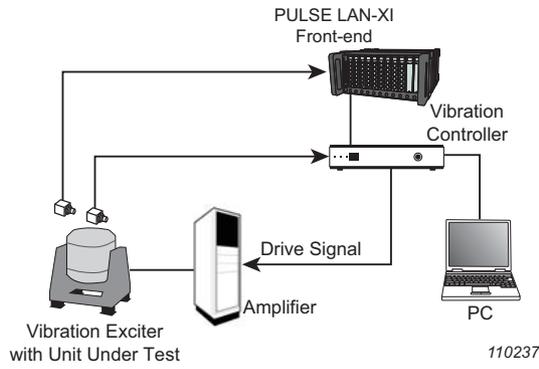
System Configurations

 <p>Vibration Exciter with Unit Under Test</p> <p>110085</p>	<p>STAND-ALONE TYPE 7542</p> <ul style="list-style-type: none"> • Type 7542 operates without PC • PC can be connected to download test profiles and retrieve test data
 <p>Vibration Exciter with Unit Under Test</p> <p>110236</p>	<p>WIRELESS CONNECTION</p> <ul style="list-style-type: none"> • Wi-Fi connection to Type 7541 or 7542 • Requires wireless router (not provided) • Control multiple Type 7542 modules from a single PC
 <p>Vibration Exciter with Unit Under Test</p> <p>110082</p>	<p>DIRECT CONNECTION</p> <ul style="list-style-type: none"> • Direct Ethernet connection to Type 7541 or 7542 • Ethernet cable lengths up to 100 m (328 ft)
 <p>Vibration Exciter with Unit Under Test</p> <p>110083</p>	<p>LAN CONNECTION</p> <ul style="list-style-type: none"> • PC connected to Local Area Network • Type 7541 or 7542 connected to LAN with communication over LAN • Virtually unlimited cable distance from PC to Type 7541 or 7542



MULTIPLE TYPE 7542 SYSTEM

- Multiple Type 7542 units connected via network switch
- Sampling synchronised via PTP
- Possible for up to 8 x Type 7542 units for a total of 64 input channels



CONCURRENT PULSE LAN-XI DATA ACQUISITION WITH TYPE 7542

- Concurrent data acquisition and data recording with vibration control
- Coordinated setup and operation
- Abort level detectors on PULSE system
- Possibility for hundreds of input channels

TRADEMARKS

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