
CPX Trailer Specifications

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DRAFT v0.1

CPX Instrumentation

Instrumentation requirements of the NZ Transport Agency Close-proximity (CPX) trailer.



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INTRODUCTION

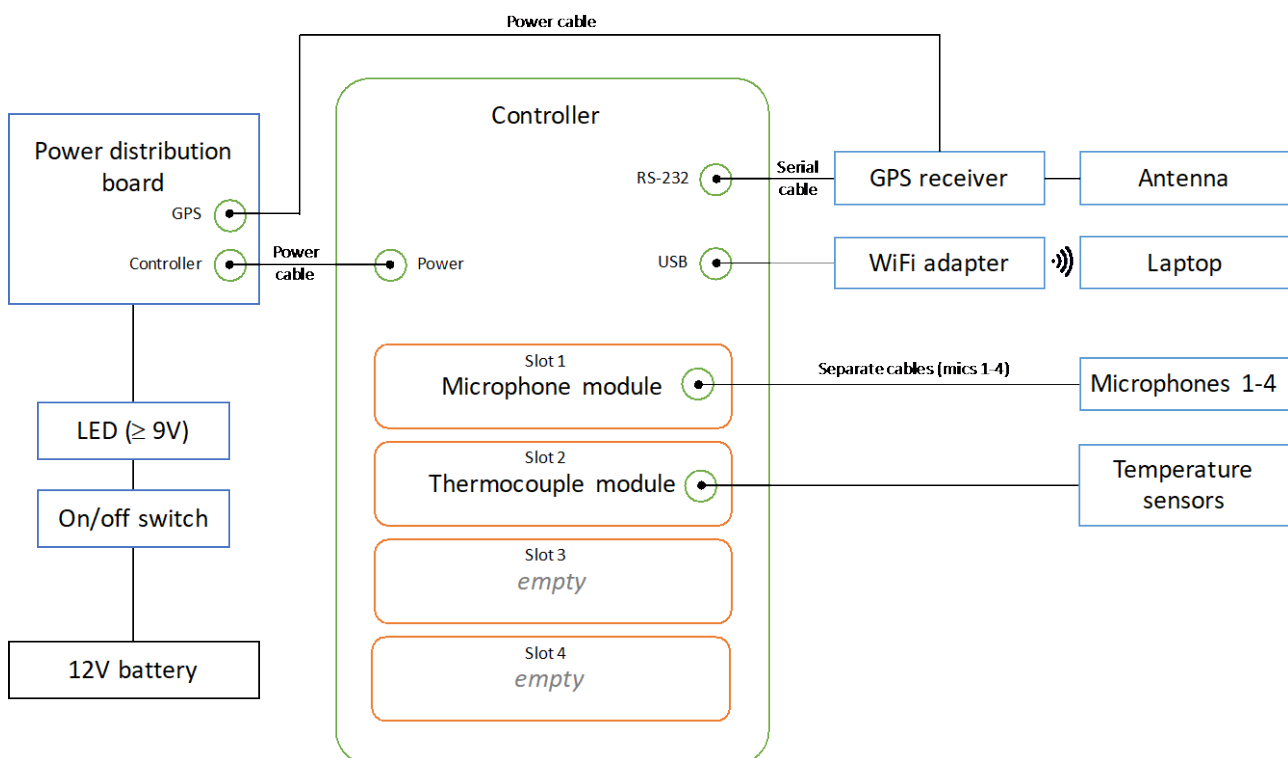
This specification describes the instrumentation requirements of the NZ Transport Agency Close-proximity (CPX) trailer. The requirements have been determined from the relevant clauses in ISO 11819-2¹, as well as the physical constraints of the trailer, e.g. cable lengths.

It should be noted that this specification is based on a system design involving the National Instruments Compact DAQ line of products and is intended to be used when replicating the existing system, or replacing damaged or obsolete parts.

Recommended parts are identified, based on the most suitable parts available as at July 2017. These parts have been chosen to work together and consideration of the implications on the system as a whole should be made when choosing alternative parts to those recommended.

HARDWARE BLOCK DIAGRAM

The block diagram below provides an overview of the hardware, based around a National Instruments cDAQ controller with C-series I/O modules.



¹ ISO 11819-2:2017 – Acoustics – Measurement of the influence of road surfaces on traffic noise – Part 2: The close-proximity method

SPECIFIC REQUIREMENTS

Specific requirements for each component are listed in the table below. Recommended parts for each component are also included. Appendix A includes prices for each recommended part as at July 2017.

TYPE	COMPONENT	REQUIREMENT	RECOMMENDED PART
Controller	NI cDAQ controller <i>On-board computer responsible for triggering measurements, processing raw data and storing data. The operator accesses the controller through a remote desktop session via a LAN or Ad-hoc WiFi network.</i>	<ul style="list-style-type: none"> - Minimum: 1.33GHz processor, 2GB RAM, 16GB SSD - Windows Embedded Standard 7 running LabVIEW - Ports / slots: <ul style="list-style-type: none"> o 4x NI C-series module slots o Ethernet port o USB2.0 port (host) o RS-232 serial port, or similar (for communication with GPS receiver) 	<ul style="list-style-type: none"> - NI cDAQ-9132, or - NI cDAQ-9134
I/O modules	Microphone module <i>Analog input module for microphone signals.</i>	<ul style="list-style-type: none"> - 4 channel input - $\pm 5V$, 24-bit, 51.6 kS/s/ch Simultaneous - IEPE at 2mA constant current and AC Coupling 	<ul style="list-style-type: none"> - NI 9234
	Thermocouple module <i>Analog input module for thermocouple signals.</i>	<ul style="list-style-type: none"> - 4 channel input - $\pm 80mV$, 24-bit, ≥ 14 S/s Aggregate - Accuracy: $\pm 1^\circ C$ - Channel-earth isolation 	<ul style="list-style-type: none"> - NI 9211
Sensors	Microphone <i>Microphones and preamplifiers.</i>	<ul style="list-style-type: none"> - Frequency range: at least 315Hz to 5,000Hz one-third octave bands - Dynamic range: at least 30dB to 130dB - IEC 61672-1, Class 1 - Free-field type - $\frac{1}{2}$" diameter 	<ul style="list-style-type: none"> - ACO Type 7146/4152T
	Thermocouple <i>Thermocouple for measuring air temperature.</i>	<ul style="list-style-type: none"> - Accuracy: $\pm 1^\circ C$ - Range: $0^\circ C$ to $35^\circ C$ - Cable length: ≥ 1 metre 	<ul style="list-style-type: none"> - NI 745690-T002 (T-type thermocouple)
	Non-contact IR temperature sensors <i>Non-contact infrared temperature sensor for measuring the tyre and road surface temperatures.</i>	<ul style="list-style-type: none"> - Accuracy: $\pm 1^\circ C$ - Range: $0^\circ C$ to $50^\circ C$ - Field of view: TBC - Output signal: Thermocouple type - Cable length: ≥ 2 metres 	<ul style="list-style-type: none"> - Omega OS211-MT-K

TYPE	COMPONENT	REQUIREMENT	RECOMMENDED PART
	GPS unit <i>GPS receiver and antenna for measuring position and speed.</i>	<ul style="list-style-type: none"> - Accuracy: at least 1 metre - Update rate: 50 Hz - Communication: RS-232 serial port, or similar (to suit controller) - Output message: NMEA-0183 with RMC message (i.e. position, speed and heading) 	<ul style="list-style-type: none"> - Trimble BX982 with Zephyr 2 antenna, or - Trimble BX935 with Zephyr 2 antenna
Cables	Microphone cables	<ul style="list-style-type: none"> - Connector: microphone / module dependent - Cable length: ≥ 2 metres 	<ul style="list-style-type: none"> - Generic BNC-to-BNC
Networking	WiFi adapter <i>USB WiFi adapter to allow networking with the operator's laptop.</i>	<ul style="list-style-type: none"> - USB adapter type - Speed: ≥ 300Mbit/s - Range: ≥ 35 metres 	<ul style="list-style-type: none"> - NETGEAR WNA3100 Wireless N USB Adapter
Power distribution	Power distribution board <i>Input from 12V battery and outputs to the controller and GPS unit. The board contains a master on/off switch and LED to indicate battery voltage is $\geq 9V$ (the minimum required to run the controller).</i>	<ul style="list-style-type: none"> - Input: 12V DC - Outputs: <ul style="list-style-type: none"> o Controller: 12V DC o GPS: 12V DC - Master on/off switch - Power indicator LED ($\geq 9V$ DC) 	<ul style="list-style-type: none"> - Custom built
Additional hardware	Battery	<ul style="list-style-type: none"> - 12V, 26Ah (minimum capacity) - Sealed lead acid (SLA) type 	<ul style="list-style-type: none"> - DiaMec DMU12-26
	Battery charger	<ul style="list-style-type: none"> - 12V, 4A (minimum output) - Intelligent operation (to reduce current when battery reaches charge capacity) 	<ul style="list-style-type: none"> - Powertech 4-stage 6/12V battery charger
	Laptop	<ul style="list-style-type: none"> - WiFi adaptor, capable of connecting to an Ad-hoc wireless network with WEP encryption - Windows Remote Desktop client, or similar - SSD preferable 	<ul style="list-style-type: none"> - Lenovo T500 (Windows 7), or similar

TYPE	COMPONENT	REQUIREMENT	RECOMMENDED PART
	Car power inverter, or Laptop car charger	<ul style="list-style-type: none"> - $\geq 100\text{W}$ power inverter with cigarette lighter plug, or - Laptop car charger (to suit laptop) 	<ul style="list-style-type: none"> - Powertech 150W Can-Sized Power Inverter with 2.1A USB Output
	Acoustic calibrator	<ul style="list-style-type: none"> - IEC 942 (1998) Class 1 - 94dB at 1kHz - ½" diameter 	<ul style="list-style-type: none"> - B&K Type 4231
	Microphone windshield	<ul style="list-style-type: none"> - 90 mm diameter 	<ul style="list-style-type: none"> - ACO NA-0301
	Instrumentation enclosure	<ul style="list-style-type: none"> - Sized to house the controller, GPS receiver, power distribution board and battery. 	<ul style="list-style-type: none"> - Custom built

APPENDIX A – RECOMMENDED PARTS

A list of the recommended parts for the NZ Transport Agency CPX trailer is included below, based on a system design involving the National Instruments Compact DAQ line of products and other parts available as at July 2017.

Prices listed are based on quotes received from equipment suppliers in July 2017 and exclude GST. Where a product needs to be imported from outside New Zealand, a 30% allowance has been included in the listed price to cover shipping costs and import duties. The name of the supplier has also been included to assist future sourcing of parts.

COMPONENT	QTY	RECOMMENDED PART	PRICE	SUPPLIER
NI cDAQ controller	1	NI cDAQ-9132, or	\$4,870	National instruments
		NI cDAQ-9134	\$7,305	
	1	LabVIEW Licence	\$1,200	
Microphone module	1	NI 9234	\$3,315	National Instruments
Thermocouple module	1	NI 9211	\$600	National Instruments
Microphone/preamplifier	4	ACO Type 7146/4152T	TBC	ACO Japan
Thermocouple (air temperature)	1	NI 745690-T002	\$50	National Instruments
Non-contact IR temperature sensors	3	Omega OS211-MT-K	\$390 each	Omega
GPS unit	1	Trimble BX982 with Zephyr 2 antenna, or	TBC	Trimble
		Trimble BX935 with Zephyr 2 antenna	TBC	
Microphone cables	4	Generic BNC-to-BNC	\$10 each	Jaycar
WiFi adapter	1	NETGEAR WNA3100 Wireless N USB Adapter	\$50	PB Technology
Power distribution board	1	Custom built (assorted components)	~\$200	Various
Battery	1	DiaMec DMU12-26	\$130	Jaycar

COMPONENT	QTY	RECOMMENDED PART	PRICE	SUPPLIER
Battery charger	1	Powertech 4-stage 6/12V battery charger	\$95	Jaycar
Laptop	1	Lenovo T500 (Windows 7), or similar	~\$2,000	Various
Car power inverter, or Laptop car charger	1	Powertech 150W Can-Sized Power Inverter with 2.1A USB Output	\$65	Jaycar
Acoustic calibrator	1	B&K Type 4231	TBC	Nichecom
Microphone windshield	4	ACO NA-0301, or	\$65 each	ACO Japan
Instrumentation enclosure	1	Custom built	~\$1,500	Various