NI ELVIS™ II Series Specifications

The specifications in this document refer to both the NI ELVIS II and the NI ELVIS II+ unless otherwise noted. These specifications are typical after a 30 minute warm-up time, at 25 °C, unless otherwise noted.

Analog Input

Number of channels ..... 8 differential or 16 single ended

ADC resolution ..... 16 bits

DNL ..... No missing codes guaranteed

INL ..... 60 ppm max

Absolute accuracy ..... Refer to the *AI Absolute Accuracy Table*

Sample Rate

- Maximum ..... 1.25 MS/s single channel, 1.00 MS/s multi channel (aggregate)
- Minimum ..... No minimum

Timing accuracy ..... 50 ppm of sample rate

Timing resolution ..... 50 ns

Settling Time for Multichannel Measurements

Range	10 LSB for full scale	1 LSB for full scale
10 V, 5 V, 2 V, 1 V, 0.5 V	1 µs	2 µs
0.2 V, 0.1 V	2 µs	8 µs

Input coupling ..... DC

Input range ..... ±10 V, ±5 V, ±2 V, ±1 V, ±0.5 V, ±0.2 V, ±0.1 V

Maximum working voltage for analog inputs (signal + common mode) ..... ±11 V of AIGND

CMRR (DC to 60 Hz) ..... 90 dB

Crosstalk @100 kHz

- (adjacent channel) ..... –70 dB
- (non-adjacent channel) ..... –80 dB

Input Impedance

- Device on
  AI+ or AI– to AIGND ..... >10 GΩ ‖ 100 pF
- Device off
  AI+ or AI– to AIGND ..... 820 Ω

Input bias current ..... ±100 pA

Small signal bandwidth (–3 dB) ..... 1.2 MHz

Input FIFO size ..... 4095 samples

Scanlist memory ..... 4095 entries

Data transfers ..... USB signal stream, programmed I/O

Overvoltage Protection (AI±, AISENSE)

Device on ..... ±25 V for up to four lines

Device off ..... ±15 V for up to four lines

Input current during overvoltage condition ..... ±20 mA max per line

Analog Triggers

Number of triggers 1

Source ..... AI<0..15>, ScopeCH0, ScopeCH1

Functions ..... Start Trigger, Reference Trigger, Pause Trigger, Sample Clock, Convert Clock, Sample Clock Timebase

Source level ..... ± Full scale

Resolution ..... 10 bits

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Accuracy.....1%

Modes.....Analog edge triggering, analog edge triggering with hysteresis, and analog window triggering

Arbitrary Waveform Generator/Analog Output

Number of channels.....2

DAC resolution.....16 bits

DNL.....±1 LSB

Monotonicity.....16 bit guaranteed

Accuracy.....Refer to the *AO Absolute Accuracy (No Load) Table*

Maximum update rate

- 1 channel.....2.8 MS/s
- 2 channels.....2.0 MS/s

Timing accuracy.....50 ppm of sample rate

Timing resolution.....50 ns

Output range.....±10 V, ±5 V

Output coupling.....DC

Output impedance.....1 Ω

Maximum output drive current.....±5 mA

Overdrive protection.....±25 V

Maximum overdrive current.....20 mA

Power-on state.....±1 mV

Output FIFO size.....8191 samples shared among channels used

Data transfer.....USB signal stream, programmed I/O

AO waveform modes.....Non-periodic waveform, periodic waveform regeneration from onboard FIFO, periodic waveform regeneration from host buffer including dynamic update

Slew rate.....20 V/µs

AI Absolute Accuracy Table

Nominal Range		Residual Gain Error (ppm of Reading)	Gain Tempco (ppm/°C)	Reference Tempco (ppm/°C)	Residual Offset Error (ppm of Range)	Offset Tempco (ppm of Range/°C)	INL Error (ppm of Range)	Noise (μV_{rms})	Absolute Accuracy at Full Scale[1] (μV)	Sensitivity[2] (μV)
Positive Full Scale	Negative Full Scale									
10	–10	60	13	1	20	21	60	280	1,920	112.0
5	–5	70	13	1	20	21	60	140	1,010	56.0
2	–2	70	13	1	20	24	60	57	410	22.8
1	–1	80	13	1	20	27	60	32	220	12.8
0.5	–0.5	90	13	1	40	34	60	21	130	8.4
0.2	–0.2	130	13	1	80	55	60	16	74	6.4
0.1	–0.1	150	13	1	150	90	60	15	52	6.0

AbsoluteAccuracy = Reading · (GainError) + Range · (OffsetError) + NoiseUncertainty

GainError = ResidualAIGainError + GainTempco · (TempChangeFromLastInternalCal) + ReferenceTempco · (TempChangeFromLastExternalCal)

OffsetError = ResidualAIOffsetError + OffsetTempco · (TempChangeFromLastInternalCal) + INL_Error

$$\text{NoiseUncertainty} = \frac{\text{RandomNoise} \cdot 3}{\sqrt{100}}$$ For a coverage factor of 3 σ and averaging 100 points.

[1] Absolute accuracy at full scale on the analog input channels is determined using the following assumptions:

TempChangeFromLastExternalCal = 10 °C

TempChangeFromLastInternalCal = 1 °C

number_of_readings = 100

CoverageFactor = 3 σ

For example, on the 10 V range, the absolute accuracy at full scale is as follows:

GainError = 60 ppm + 13 ppm · 1 + 1 ppm · 10 GainError = 83 ppm

OffsetError = 20 ppm + 21 ppm · 1 + 60 ppm OffsetError = 101 ppm

$$\text{NoiseUncertainty} = \frac{280\ \mu\text{V} \cdot 3}{\sqrt{100}}$$ NoiseUncertainty = 84 μV

AbsoluteAccuracy = 10 V · (GainError) + 10 V · (OffsetError) + NoiseUncertainty AbsoluteAccuracy = 1920 μV

[2] Sensitivity is the smallest voltage change that can be detected. It is a function of noise.

Accuracies listed are valid for up to one year from the device external calibration.

AO Absolute Accuracy (No Load) Table

Nominal Range		Residual Gain Error (ppm of Reading)	Gain Tempco (ppm/°C)	Reference Tempco	Residual Offset Error (ppm of Range)	Offset Tempco (ppm of Range/°C)	INL Error (ppm of Range)	Absolute Accuracy at Full Scale[1] (µV)
Positive Full Scale	Negative Full Scale							
10	–10	75	17	1	40	2	64	2,080
5	–5	85	8	1	40	2	64	1,045

[1] Absolute Accuracy at Full Scale is valid immediately following internal calibration and assumes the device is operating within 10 °C of the last external calibration. Accuracies listed are valid for up to one year from the device external calibration.

AbsoluteAccuracy = OutputValue · (GainError) + Range · (OffsetError)

GainError = ResidualGainError + GainTempco · (TempChangeFromLastInternalCal) + ReferenceTempco · (TempChangeFromLastExternalCal)

OffsetError = ResidualOffsetError + AOOffsetTempco · (TempChangeFromLastInternalCal) + INL_Error

Digital I/O and PFI

Number of channels.....24 DIO (Port 0), 15 PFI (Ports 1 and 2)

Direction control.....Each line individually programmable as input or output

Pull-down resistor.....50 kΩ typ, 20 kΩ min

Input voltage protection.....±20 V on up to two pins

Note Stresses beyond those listed under *Input voltage protection* may cause permanent damage to the device.

DIO/PFI Recommended Operation Conditions

Level	Min	Max
Input high voltage (V_{IH})	2.2 V	5.25 V
Input low voltage (V_{IL})	0 V	0.8 V
Output high current (I_{OH})		
P0.<0..23>	—	–24 mA
PFI <0..14>	—	–16 mA
Output low current (I_{OL})		
P0.<0..23>	—	24 mA
PFI <0..14>	—	16 mA

DIO/PFI Electrical Characteristics

Level	Min	Max
Positive-going threshold (VT+)	—	2.2 V
Negative-going threshold (VT–)	0.8 V	—
Delta VT hysteresis (VT+ – VT–)	0.2 V	—
I_{IL} input low current (V_{in} = 0 V)	—	–10 µA
I_{IH} input high current (V_{in} = 5 V)	—	250 µA

PFI / Port 1 / Port 2 Functionality

Functionality ..... Static digital input, static digital output, timing input, timing output

Debounce filter settings ..... 125 ns, 6.425 µs, 2.56 ms, disable; high and low transitions; selectable per input

General Purpose Counter/Timers

Number of counter/timers 2

Resolution ..... 32 bits

Counter measurements ..... Edge counting, pulse, semi period, period, two-edge separation

Position measurements ..... X1, X2, X4 quadrature encoding with Channel Z reloading; two-pulse encoding

Output applications ..... Pulse, pulse train with dynamic updates, frequency division, equivalent time sampling

Internal base clocks ..... 80 MHz, 20 MHz, 0.1 MHz

External base clock frequency ..... 0 MHz to 20 MHz

Base clock accuracy ..... 50 ppm

Maximum frequency ..... 1 MHz

Inputs ..... Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down

Default Routing

- CTR0_SOURCE PFI8
- CTR0_GATE PFI9
- CTR0_OUT PFI12
- CTR1_SOURCE PFI3
- CTR1_GATE PFI4
- CTR1_OUT PFI13

FIFO ..... 2 samples

Data transfers ..... USB signal stream, programmed I/O

Digital Frequency Generator

Number of channels 1

Base clocks ..... 10 MHz, 100 kHz

Divisors ..... 1 to 16

Maximum frequency ..... 1 MHz

Base clock accuracy ..... 50 ppm

Default output line ..... PFI 14 / FREQ_OUT

External Digital Triggers

Source ..... TRIG BNC or any PFI

Polarity ..... Software selectable for most signals

Analog input function ..... Start trigger, reference trigger, pause trigger, sample clock, convert clock, sample clock timebase

Analog output function ..... Start trigger, pause trigger, sample clock, sample clock timebase

Counter/timer function ..... Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down

DMM

Isolated functions ..... DC voltage, AC voltage, DC current, AC current, resistance, diode

- Isolation level ..... 60 VDC / 20 V_{rms}, Installation Category I
- Connectivity ..... Banana jacks
- Resolution ..... 5.5 digits
- Input impedance ..... 11 MΩ
- Input coupling ..... DC (DC voltage, DC current, resistance, diode)
AC (AC voltage, AC current)

Non-isolated functions ..... Capacitance, inductance

- Connectivity ..... Prototyping board terminals

Voltage Measurement

DC Ranges ..... 100 mV, 1 V, 10 V, 60 V

AC Ranges ..... 200 mV_{rms}, 2 V_{rms}, 20 V_{rms}

Input frequency range (AC voltage) ..... 40 Hz to 20 kHz

DC Voltage Measurement Accuracy ±(ppm or reading + ppm of range)

Range	1 Year (Tcal ±5 °C)	Tempco/°C (15 to 35 °C)
100 mV	225 +280	33 + 50
1 V	225 + 60	33 + 5
10 V	225 + 40	33 + 0.5
60 V	1250 + 150	125 + 7

AC Voltage Measurement Accuracy ±(% of reading + % of range)

Range (rms)	1 Year (Tcal ±5 °C)	Tempco/°C (15 to 35 °C)
200 mV	0.3 + 0.05	0.015 + 0.003
2 V		
20 V		

Current Measurement

DC range.....2 A

AC ranges.....500 mA_{rms}, 2 A_{rms}

Shunt resistance.....0.1 Ω

Voltage burden .....<0.6 V

Input frequency range
(AC current) .....40 Hz to 5 kHz

Input protection .....F 3.15 A 250 V,
Fast-acting
user-replaceable fuse

DC Current Measurement Accuracy ±(ppm of reading + ppm of range)

Range	1 Year (Tcal ±5 °C)	Tempco/°C (15 to 35 °C)
2 A	1350 + 180	85 + 2.5

AC Current Measurement Accuracy ±(% of reading + % of range)

Range (rms)	1 Year (Tcal ±5 °C)	Tempco/°C (15 to 35 °C)
500 mA	0.5 + 0.07	0.025 + 0.003
2 A		

Resistance Measurement

Ranges ..... 100 Ω, 1 kΩ, 10 kΩ,
100 kΩ, 1 MΩ, 100 MΩ

Resistance Measurement Accuracy ±(ppm of Reading + ppm of Range)

Range	Test Current	Max Test Voltage	1 Year (Tcal ±5 °C)	Tempco/°C (15 to 35 °C)
100 Ω	1 mA	100 mV	450 + 310	70 + 55
1 kΩ	1 mA	1 V	450 + 100	70 + 12
10 kΩ	100 µA	1 V	450 + 100	70 + 12
100 kΩ	10 µA	1 V	450 + 100	70 + 12
1 MΩ	5 µA	5 V	450 + 100	70 + 8
100 MΩ	500 nA	5 V	8000 + 75	400 + 4

Capacitance Measurement

Range ..... 50 pF to 500 µF

Accuracy 1%

Test voltage ..... 1 V_{pk}

Test Frequency

- 50 pF to 500 pF ..... 10 kHz
- 500 pF to 5 nF ..... 1 kHz
- 5 nF to 50 nF ..... 1 kHz
- 50 nF to 1 µF ..... 1 kHz
- 1 µF to 500 µF ..... 100 Hz

Inductance Measurement

Range ..... 100 µH to 100 mH

Accuracy 1%

Test voltage

- 100 µH to 1 mH ..... 0.5 V_{pk}
- 1 mH to 10 mH ..... 0.5 V_{pk}
- 10 mH to 100 mH ..... 1 V_{pk}

Test frequency

- 100 µH to 1 mH ..... 10 kHz
- 1 mH to 10 mH ..... 1 kHz
- 10 mH to 100 mH ..... 1 kHz

Diode Measurement[1]

Ranges ..... 1 V, 10 V

Nominal test current ..... 1 mA (1 V range)
100 µA (10 V range)

Function Generator

Channels 1

Output waveform type ..... Sine, square, triangle

Frequency range ..... 0.186 Hz to 5 MHz (sine)
0.186 Hz to 1 MHz
(square and triangle)

Frequency resolution ..... 0.186 Hz

DDS resolution ..... 10 bits

Waveform amplitude range ..... 10 V_{p-p}

Waveform amplitude resolution ..... 10 bits

Waveform amplitude accuracy ..... 1% ±15 mV

Waveform offset range ..... ±5 V

Waveform offset resolution ..... 10 bits

Waveform offset accuracy ..... 1% ±15 mV

Duty cycle range ..... 0 to 100%

Duty cycle resolution ..... 10 bits

Duty cycle accuracy 1%

Output impedance ..... 50 Ω

[1] The Two-Wire Current Voltage Analyzer SFP is the recommended instrument for diode measurement.

Maximum output current.....100 mA

Sine total harmonic distortion (THD).....–50 dB max @ 1 MHz
–40 dB max @ 5 MHz

Sine Flatness.....–0.5 dB to 3 MHz
–3 dB to 5 MHz

Modulation

Inputs.....2 (AM and FM)

Modulation input range.....±10 V

Modulation factor

AM.....10%/V

FM.....20%/V

Oscilloscope

Channels.....2

Sampling mode

NI ELVIS II.....Scanned

NI ELVIS II+.....Simultaneous

Input coupling

NI ELVIS II.....AC, DC

NI ELVIS II+.....AC, DC, GND

Input impedance

NI ELVIS II.....1 MΩ ‖ 25 pF

NI ELVIS II+.....1 MΩ ‖ 21 pF

Bandwidth (–3 dB)

NI ELVIS II.....1.7 MHz

NI ELVIS II+.....35 MHz (40 mV_{p-p})
50 MHz (all other ranges)

Optional noise filter

NI ELVIS II.....None

NI ELVIS II+.....20 MHz

AC coupling cutoff frequency (–3 dB)

NI ELVIS II.....10 Hz

NI ELVIS II+.....12 Hz

Resolution

NI ELVIS II.....16 bits

NI ELVIS II+.....8 bits

Maximum sample rate

NI ELVIS II

Single channel.....1.25 MS/s

Two channels.....500 kS/s

NI ELVIS II+.....100 MS/s

Minimum sample rate

NI ELVIS II.....0.00465 S/s

NI ELVIS II+.....1.526 kS/s

Timebase accuracy.....50 ppm

Waveform memory depth

NI ELVIS II.....Streaming to host

NI ELVIS II+.....16384 samples per channel

Triggering

BNC TRIG Input

Input impedance.....1 MΩ

V_{IH} min.....2.4 V

V_{IL} max.....400 mV

Minimum pulse width.....20 ns

NI ELVIS II

Refer to the *Analog Input* section.

NI ELVIS II+

Type	Source
Edge, Hysteresis	CH 0, CH 1
Digital	BNC TRIG Input (PFI 15), FGEN SYNC
Immediate	—

DC Accuracy

NI ELVIS II

Range	Gain Error (% of reading)	Offset Error (% of range)
(±) 10 V, 5 V	0.15	0.1
(±) 2 V	0.15	0.15
(±) 1 V, 0.5 V	0.1	0.15
(±) 0.2 V	0.1	0.5
(±) 0.1 V	0.2	0.5

NI ELVIS II+

Range (V_{pk-pk})	Programmable Vertical Offset		Typical Noise (V_{rms})
	Range (V)	Offset Accuracy	
0.04	±0.4	±2 mV	0.00022
0.1	±0.4	±10 mV	0.00035
0.2	±0.4	±10 mV	0.0007
0.4	±0.4	±10 mV	0.0014
1	±4	±100 mV	0.0035
2	±4	±100 mV	0.007
4	±4	±100 mV	0.014
10	±25	±625 mV	0.035
20	±20	±625 mV	0.07
40	±10	±625 mV	0.14

Accuracy ..... ±(2% of Input + 1% of Full Scale Range + 300 µV)

Note Accuracy is calculated with the programmable offset = 0 V and at ±5 °C from the self-calibration temperature.

DC drift ..... ±(0.033% of Input + 0.06% of Full Scale Range + 40 µV) per °C

Dynamic Signal Analyzer

Frequency resolution..... Software controllable (200, 400, 800, 1600, 3200 lines)

Accuracy

NI ELVIS II..... Refer to the *Analog Input* section.

NI ELVIS II+ (using scope channels)..... Refer to the *Oscilloscope* section.

Frequency range

NI ELVIS II ..... Up to 625 kHz

NI ELVIS II+ (using scope channels) ..... Up to 50 MHz

Bode Analyzer

Amplitude accuracy

NI ELVIS II ..... Refer to the *Analog Input* section.

NI ELVIS II+ (using scope channels) ..... Refer to the *Oscilloscope* section.

Frequency range

NI ELVIS II ..... 1 Hz to 200 kHz

NI ELVIS II+ (using scope channels) ..... 1 Hz to 5 MHz

Two-Wire Current-Voltage Analyzer

Current range..... ±40 mA

Voltage sweep range ..... ±10 V

Three-Wire Current-Voltage Analyzer

Supported devices ..... NPN and PNP transistors

Minimum base current step ..... 0.48 µA

Maximum collector current ..... ±40 mA

Maximum collector voltage ..... ±10 V

Impedance Analyzer

Excitation frequency ..... 1 Hz to 35 kHz

Resistance measurement range..... 5 Ω to 3 MΩ

Capacitance measurement range ..... Refer to the *DMM*, *Capacitance Measurement* section.

Inductance measurement range ..... Refer to the *DMM*, *Inductance Measurement* section.

Power Supplies[1]

+15 V Supply

Output voltage (no load).....+15 V ±5%

Maximum output current.....500 mA

Ripple and noise .....1% peak-to-peak max.

Load regulation.....5%

Short circuit protection.....Resettable circuit breaker

–15 V Supply

Output voltage (no load).....–15 V ±5%

Maximum output current.....500 mA

Ripple and noise .....1% peak-to-peak max.

Load regulation.....5%

Short circuit protection.....Resettable circuit breaker

+5 V Supply

Output voltage (no load).....+5 V ±5%

Maximum output current.....2 A

Ripple and noise .....1% peak-to-peak max.

Load regulation.....5%

Short circuit protection.....Resettable circuit breaker

Positive Variable Supply

Output voltage[2].....0 to +12 V

Voltage setpoint resolution.....10 bits

Voltage accuracy (no load).....100 mV

Maximum output current.....500 mA

Ripple and noise .....25 mV

Short circuit protection.....Self-resetting current limiter

Negative Variable Supply

Output voltage..... 0 to –12 V

Voltage setpoint resolution ..... 10 bits

Voltage accuracy (no load) ..... 100 mV

Maximum output current ..... 500 mA

Ripple and noise..... 25 mV

Short circuit protection ..... Self-resetting current limiter

Calibration

Recommended warm-up time ..... 30 minutes

Calibration interval ..... 1 year

Communication

Bus interface ..... USB 2.0 Hi-Speed

USB signal stream ..... 4 streams; can be used for analog input, analog output, and counter/timers

Physical

Dimensions ..... 34.3 × 28.0 × 7.6 cm (14.5 × 11.0 × 3 in.)

Weight..... 1.9 kg (4.2 lb)

Environmental

Operating temperature ..... 10 to 35 °C

Storage temperature ..... –20 to 70 °C

Humidity ..... 10 to 90% relative humidity, noncondensing

Maximum altitude..... 2,000 m

Pollution Degree (indoor use only)..... 2

[1] Total output power of all DC and variable power supplies is 30 W.

[2] At least 1 mA of load current is required for voltage setpoints lower than +250 mV.

Safety

This product meets the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1

Note For UL and other safety certifications, refer to the product label or the *Online Product Certification* section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326 (IEC 61326): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- AS/NZS CISPR 11: Group 1, Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

Note For the standards applied to assess the EMC of this product, refer to the *Online Product Certification* section.

Note For EMC compliance, operate this product according to the documentation.

CE Compliance CE

This product meets the essential requirements of applicable European Directives as follows:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)

Online Product Certification

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for this product, visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.

Environmental Management

NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

For additional environmental information, refer to the *NI and the Environment* Web page at `ni.com/environment`. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

Waste Electrical and Electronic Equipment (WEEE)

EU Customers At the end of the life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers and National Instruments WEEE initiatives, visit `ni.com/environment/weee`.

电子信息产品污染控制管理办法 （中国 RoHS）

中国客户 National Instruments 符合中国电子信息产品中限制使用某些有害物质指令 (RoHS)。关于 National Instruments 中国 RoHS 合规性信息，请登录 `ni.com/environment/rohs_china`。(For information about China RoHS compliance, go to `ni.com/environment/rohs_china`.)

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