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PCI-6120

NI 6115/6120 Specifications

This document lists the specifications for the NI 6115/6120. For the most current edition of this document, refer to ni.com/manuals. Refer to the *DAQ Getting Started Guide* for more information about accessing documents on the NI-DAQ media.

Definitions

Warranted specifications describe the performance of a model under stated operating conditions and are covered by the model warranty.

The following characteristic specifications describe values that are relevant to the use of the model under stated operating conditions but are not covered by the model warranty.

- *Typical* specifications describe the performance met by a majority of models.
- *Nominal* specifications describe an attribute that is based on design, conformance testing, or supplemental testing.

Specifications are *Typical* unless otherwise noted.

The following specifications are typical at 25 °C unless otherwise noted.

Analog Input

Input Characteristics

Number of channels 4 pseudodifferential

Type of ADC

Resolution

NI 6115 12 bits, 1 in 4,096

NI 6120 16 bits, 1 in 65,536

Pipeline

NI 6115 2

NI 6120 0

Sampling rate

Maximum

NI 6115 10 MS/s

NI 6120 800 kS/s

Minimum

NI 6115 20 kS/s

NI 6120 No minimum

Input impedance

AI + to AI -

Range $\leq \pm 10$ V 1 M Ω in parallel with 100 pF

Range $> \pm 10$ V 10 k Ω in parallel with 40 pF

AI - to AI GND

NI 6115 100 G Ω in parallel with 10 nF

NI 6120 100 G Ω in parallel with 100 pF

AI + to AI GND

NI 6115 100 G Ω in parallel with 100 pF

NI 6120 100 G Ω in parallel with 100 pF

Input bias current ± 300 pA

Input offset current ± 200 pA

Input coupling DC/AC

Maximum working voltage for all analog input channels

Positive input (AI +) ± 42 V for ± 20 V and ± 42 V ranges;
 ± 11 V for other ranges

Negative input (AI -) ± 2.5 V

Overvoltage protection

(AI +, AI -) ± 42 V

Input current during

overvoltage conditions ± 20 mA, maximum

Input FIFO size 16 MS or 32 MS

Data transfers DMA, interrupts, programmed I/O

DMA mode Scatter-gather

DC Transfer Characteristics

INL

NI 6115 ± 0.35 LSB
 ± 1 LSB maximum

NI 6120 ± 2.5 LSB maximum

DNL

NI 6115 ± 0.25 LSB
 ± 1 LSB maximum

NI 6120 0.75 LSB
no missing codes

Offset, gain error Refer to Tables 1 and 2¹

Table 1. NI 6115 Analog Input DC Accuracy Information

Nominal Range at Full Scale (V)	Absolute Accuracy						Relative Accuracy		
	% of Reading		Offset* (mV)	Noise + Quantization (mV)		Temp Drift (%/°C)	Absolute Accuracy at Full Scale (±mV)	Resolution (mV)	
	24 Hours	1 Year		Single Point	Averaged			Single Point	Averaged
±42	0.35	0.35	33	42	3.6	0.023	210.0	48	4.8
±20	0.27	0.27	13	17	1.4	0.023	69	19	1.9
±10	0.026	0.028	6.7	8.3	0.72	0.0006	10	10	1.0
±5	0.016	0.018	3.4	4.2	0.36	0.0006	4.7	4.8	0.48
±2	0.036	0.038	1.3	1.8	0.16	0.0006	2.2	2.0	0.20
±1	0.043	0.045	0.68	1.1	0.09	0.0006	1.2	1.2	0.12
±0.5	0.058	0.060	0.35	0.69	0.061	0.0006	0.71	0.80	0.080
±0.2	0.10	0.11	0.15	0.43	0.039	0.0006	0.40	0.51	0.051

* The offset might degrade by 2.25 LSB with filter enabled.

¹ Accuracies are valid for measurements following an internal calibration. Averaged numbers assume dithering and averaging of 100 single-channel readings. Measurement accuracies are listed for operational temperatures within ±1 °C of internal calibration temperature and ±10 °C of external or factory-calibration temperature.

Table 2. NI 6120 Analog Input DC Accuracy Information

Nominal Range at Full Scale (V)	Absolute Accuracy						Relative Accuracy		
	% of Reading		Offset* (μV)	Noise + Quantization (μV)		Temp Drift (%/°C)	Absolute Accuracy at Full Scale (±mV)	Resolution (μV)	
	24 Hours	1 Year		Single Point	Averaged			Single Point	Averaged
±42	0.16	0.16	8,400	6,100	550	0.011	87	7,200	720
±20	0.14	0.14	3,300	2,400	220	0.011	31	2,900	290
±10	0.033	0.034	1,700	1,200	110	0.0006	5.1	1,400	140
±5	0.035	0.037	840	750	69	0.0006	2.7	900	90
±2	0.039	0.041	370	340	31	0.0006	1.2	410	41
±1	0.077	0.079	280	200	18	0.0006	1.1	240	24
±0.5	0.10	0.10	180	110	10	0.0006	0.69	130	13
±0.2	0.12	0.12	93	54	5.1	0.0006	0.34	68	6.8

* The offset might degrade by 8 LSB with filter enabled and by 1 LSB when sampling above 500 kS/s.

Dynamic Characteristics

Analog filters

Number

NI 6115 2

NI 6120 1

Type

NI 6115 3-pole Bessel

NI 6120 5-pole Bessel

Frequency

NI 6115 50 kHz and 500 kHz (software-enabled)

NI 6120 100 kHz
(software-enabled)

Crosstalk -80 dB, DC to 100 kHz

Table 3. NI 6115 Analog Input Dynamic Characteristics

Input Range	Bandwidth* (MHz)	SFDR Typ† (dB)	CMRR‡ (dB)	System Noise** (LSB _{rms})
±42 V	5.5	78	34	0.35
±20 V	4.4	78	40	0.45
±10 V	7.2	81	46	0.35
±5 V	4.8	81	52	0.35
±2 V	4.8	85	60	0.45
±1 V	4.4	85	66	0.60
±500 mV	4.4	85	70	0.80
±200 mV	4.1	81	72	1.3

* -3 dB frequency for input amplitude at 96% of the input range (-0.3 dB)
† Measured at 100 kHz with twelfth-order bandpass filter after signal source
‡ DC to 60 Hz
** LSB_{rms}, not including quantization

Table 4. NI 6120 Analog Input Dynamic Characteristics

Input Range	Bandwidth [†] (MHz)	SFDR Typ [†] (dB)	CMRR [‡] (dB)	System Noise ^{**} (LSB _{rms})
±42 V	1.0	95	60	1.2
±20 V	1.0	96	68	1.2
±10 V	1.0	95	76	1.2
±5 V	1.0	95	82	1.5
±2 V	1.0	96	90	1.7
±1 V	1.0	94	95	2.0
±500 mV	1.0	90	100	2.2
±200 mV	1.0	85	105	2.8

* -3 dB frequency for input amplitude at 10% of the input range (-20 dB)
[†] Measured at 100 kHz with twelfth-order bandpass filter after signal source
[‡] DC to 60 Hz
^{**} LSB_{rms}, not including quantization

Figure 1. NI 6115 Total Harmonic Distortion Plus Noise (THD+N)

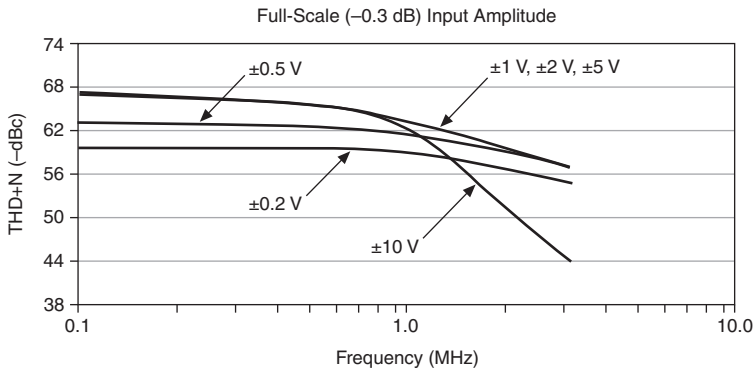


Figure 2. NI 6120 Total Harmonic Distortion Plus Noise (THD+N)

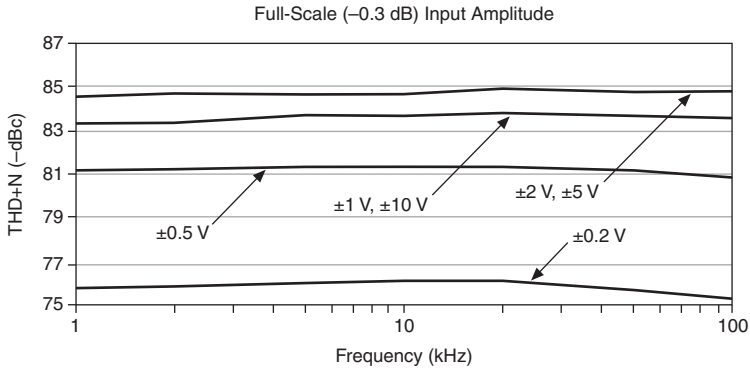


Figure 3. NI 6115 High-Voltage THD+N

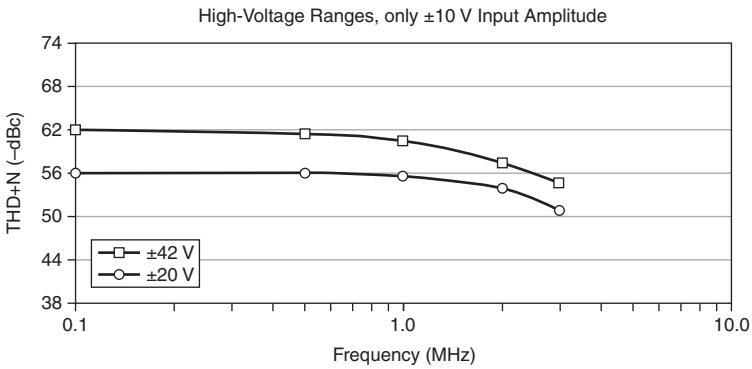


Figure 4. NI 6120 High-Voltage THD+N

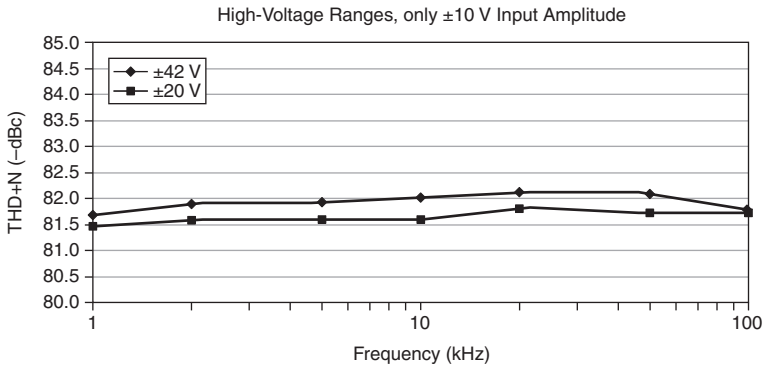


Figure 5. NI 6115 THD+N with Filters

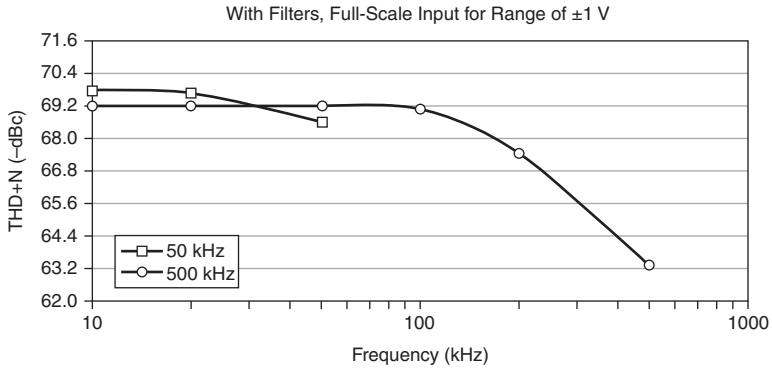
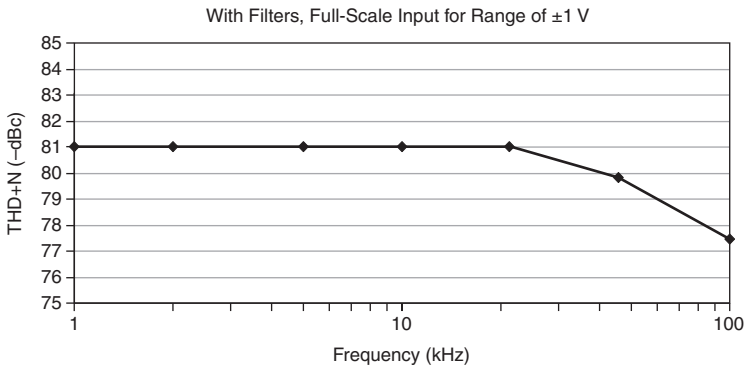


Figure 6. NI 6120 THD+N with Filters



Stability

Recommended warm-up time 15 min

Calibration interval 1 year

Offset temperature coefficient

Pregain

NI 6115 $\pm 12 \mu\text{V}/^\circ\text{C}$

NI 6120 $\pm 1.5 \mu\text{V}/^\circ\text{C}$

Postgain

NI 6115 $\pm 64 \mu\text{V}/^\circ\text{C}$

NI 6120 $\pm 2.1 \text{ LSB}/^\circ\text{C}$

Gain temperature coefficient

NI 6115 $\pm 21.3 \text{ ppm}/^\circ\text{C}$

NI 6120 $\pm 22.2 \text{ ppm}/^\circ\text{C}$

Analog Output

Output Characteristics

Number of channels.....	2 voltage
Resolution	
NI 6115	12 bits, 1 in 4,096
NI 6120	16 bits, 1 in 65,536
Max update rate	
1 channel.....	4 MS/s, system dependent ¹
2 channel.....	2.5 MS/s, system dependent ¹
Output buffer size	16 MS or 32 MS
Data transfers	DMA, interrupts, programmed I/O
DMA modes	Scatter-gather

DC Transfer Characteristics

INL

NI 6115	±0.5 LSB ±2 LSB maximum
NI 6120	±0.35 LSB ±1 LSB maximum

DNL

NI 6115	±0.25 LSB ±1 LSB maximum
NI 6120	±0.2 LSB ±1 LSB maximum

Offset, gain error

NI 6115	Refer to Table 5
NI 6120	Refer to Table 6

Table 5. NI 6115 Analog Output DC Accuracy Information

Nominal Range at Full Scale (V)	Absolute Accuracy					Relative Accuracy	
	% of Reading			Offset (mV)	Temp Drift (%/°C)	Absolute Acc. at Full Scale (mV)	Theoretical Resolution (mV)
	24 Hours	90 Days	1 Year				
±10	0.045	0.047	0.049	8.9	0.000 8	14	4.9

¹ Update rates above 1 MS/s may degrade the analog output slew rate.

Table 6. NI 6120 Analog Output DC Accuracy Information

Nominal Range at Full Scale (V)	Absolute Accuracy					Relative Accuracy	
	% of Reading			Offset (μV)	Temp Drift ($\%/^{\circ}\text{C}$)	Absolute Acc. at Full Scale (mV)	Theoretical Resolution (μV)
	24 Hours	90 Days	1 Year				
± 10	0.051	0.052	0.053	1,900	0.0006	6.7	310

Voltage Output

Ranges.....	± 10 V
Output coupling	DC
Output impedance	$50 \Omega \pm 5\%$
Current drivability.....	Any passive load
Protection	Short-circuit to ground
Power-on output voltage (before software loads calibration values)	
NI 6115	$\pm 400 \mu\text{V}$
NI 6120	$\pm 80 \mu\text{V}$
Initial power-up glitch	
Magnitude	± 2 V
Duration	200 ms

Dynamic Characteristics

Slew rate	
NI 6115	130 V/ μs
NI 6120	15 V/ μs
Noise	
NI 6115	600 μV_{RMS} , DC to 5 MHz
NI 6120	100 μV_{RMS} , DC to 1 MHz
Glitch energy at midscale transition	
NI 6115	± 30 mV for 1 μs
NI 6120	± 10 mV for 1 μs
Settling time	
NI 6115	1.3 μs to ± 1 LSB
NI 6120	4 μs to ± 1 LSB

Stability

Offset temperature coefficient

NI 6115	$\pm 35 \mu\text{V}/^\circ\text{C}$
NI 6120	$\pm 35 \mu\text{V}/^\circ\text{C}$

Gain temperature coefficient

NI 6115	$\pm 56.9 \text{ ppm}/^\circ\text{C}$
NI 6120	$\pm 6.5 \text{ ppm}/^\circ\text{C}$

Calibration

Level	5.000 V ($\pm 2.5 \text{ mV}$) (actual value stored in EEPROM)
Temperature coefficient	$\pm 2.0 \text{ ppm}/^\circ\text{C}$ maximum
Long-term stability	$\pm 6 \text{ ppm}/\sqrt{1,000 \text{ h}}$

Digital I/O

Number of channels	8 input/output
Compatibility	TTL/CMOS

Table 7. Digital Logic Levels

Level	Min	Max
Input low voltage	0.0 V	0.8 V
Input high voltage	2.0 V	5.0 V
Input low current ($V_{in} = 0 \text{ V}$)	—	-320 μA
Input high current ($V_{in} = 5 \text{ V}$)	—	10 μA
Output low voltage ($I_{OL} = 24 \text{ mA}$)	—	0.4 V
Output high voltage ($I_{OH} = -13 \text{ mA}$)	4.35 V	—

Power-on state Input (high-impedance)

Data transfers DMA, interrupts, programmed I/O

Input buffer 2,048 bytes

Output buffer 2,048 bytes

Transfer rate (1 word = 8 bits) 10 Mwords/s

Timing I/O

Number of channels	2 up/down counter/timers, 1 frequency scaler
Resolution	
Counter/timers	24 bits
Frequency scaler	4 bits
Compatibility	TTL/CMOS
Base clocks available	
Counter/timers	20 MHz, 100 kHz
Frequency scaler	10 MHz, 100 kHz
Base clock accuracy	$\pm 0.01\%$
Max source frequency	20 MHz
Min source pulse duration	10 ns, edge-detect mode
Min gate pulse duration	10 ns, edge-detect mode
Data transfers	DMA, interrupts, programmed I/O
DMA modes	Scatter-gather

Triggers

Analog Trigger

Source	All analog input channels, external trigger (PFI 0/AI START TRIG)
Level	
Internal	\pm full-scale
External	± 10 V
Slope	Positive or negative (software-selectable)
Resolution	
NI 6115	8 bits, 1 in 256
NI 6120	12 bits, 1 in 4,096
Hysteresis	Programmable
Bandwidth (-3 dB)	5 MHz internal/external

External input (PFI 0/AI START TRIG)

Impedance.....	10 k Ω
Coupling	AC/DC
Protection.....	-0.5 V to ($V_{CC} + 0.5$) V when configured as a digital signal, ± 35 V when configured as an analog trigger signal or disabled, ± 35 V powered off

Digital Trigger

Compatibility	TTL
Response	Rising or falling edge
Pulse width	10 ns min

RTSI Trigger Lines (PCI Only)

Trigger lines <0..6>	7
RTSI clock	1

PXI Trigger Bus (PXI Only)

Trigger lines <0..6>	7
Star trigger	1

Bus Interface

Type	Master, slave
------------	---------------

Power Requirement

+5 VDC ($\pm 5\%$)

NI 6115	2.2 A
NI 6120	3.0 A

+3.3 V

0.8 A

Power available at I/O connector..... +4.65 VDC to +5.25 VDC at 1 A

Physical

Dimensions (not including connectors)

NI PCI-6115/6120.....	31.2 cm × 10.6 cm (12.3 in. × 4.2 in.)
NI PXI-6115/6120.....	16 cm × 10 cm (6.3 in. × 3.9 in.)

I/O connector 68-pin male SCSI-II type



Note Clean the hardware with a soft, nonmetallic brush. Make sure that the hardware is completely dry and free from contaminants before returning it to service.

Maximum Working Voltage

Maximum working voltage refers to the signal voltage plus the common-mode voltage.

Channel-to-earth 42 V, Measurement Category I

Channel-to-channel 42 V, Measurement Category I



Caution Do not use for measurements within Categories II, III, and IV.

Measurement Category I is for measurements performed on circuits not directly connected to the electrical distribution system referred to as MAINS voltage. MAINS is a hazardous live electrical supply system that powers equipment. This category is for measurements of voltages from specially protected secondary circuits. Such voltage measurements include signal levels, special equipment, limited-energy parts of equipment, circuits powered by regulated low voltage sources, and electronics.



Note Measurement Categories CAT I and CAT O are equivalent. These test and measurement circuits are for other circuits not intended for direct connection to the MAINS building installations of Measurement Categories CAT II, CAT III, or CAT IV.

Environmental

The NI 6115/6120 is intended for indoor use only.

Operating temperature 0 °C to 50 °C

Storage temperature -20 °C to 70 °C

Humidity 10% to 90% RH, noncondensing

Maximum altitude 2,000 m

Pollution Degree 2

Safety

The NI 6115/6120 is designed to meet 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 C22.2 No. 61010-1



Note For UL and other safety certifications, refer to the product label or the [Product Certifications and Declarations](#) 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 [Product Certifications and Declarations](#) section.



Note For EMC compliance, operate this device with shielded cabling.

CE Compliance

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

- 2014/35/EU; Low-Voltage Directive (safety)
- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)
- 2011/65/EU; Restriction of Hazardous Substances (RoHS)

Product Certifications and Declarations

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 *Minimize Our Environmental Impact* 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 product life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers, National Instruments WEEE initiatives, and compliance with WEEE Directive 2002/96/EC on Waste and Electronic Equipment, visit ni.com/environment/weee.

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Device Pinout

Figure 7. NI 6115/6120 Pinout

AI 0 -	34	68	AI 0 +
AI 1 +	33	67	AI 0 GND
AI 1 GND	32	66	AI 1 -
AI 2 -	31	65	AI 2 +
AI 3 +	30	64	AI 2 GND
AI 3 GND	29	63	AI 3 -
NC	28	62	NC
NC	27	61	NC
NC	26	60	NC
NC	25	59	NC
NC	24	58	NC
NC	23	57	NC
AO 0	22	56	NC
AO 1	21	55	AO GND
NC	20	54	AO GND
P0.4	19	53	D GND
D GND	18	52	P0.0
P0.1	17	51	P0.5
P0.6	16	50	D GND
D GND	15	49	P0.2
+5 V	14	48	P0.7
D GND	13	47	P0.3
D GND	12	46	AI HOLD COMP
PFI 0/AI START TRIG	11	45	EXT STROBE*
PFI 1/AI REF TRIG	10	44	D GND
D GND	9	43	PFI 2/AI CONV CLK
+5 V	8	42	PFI 3/CTR 1 SOURCE
D GND	7	41	PFI 4/CTR 1 GATE
PFI 5/AO SAMP CLK*	6	40	CTR 1 OUT
PFI 6/AO START TRIG	5	39	D GND
D GND	4	38	PFI 7/AI SAMP CLK
PFI 9/CTR 0 GATE	3	37	PFI 8/CTR 0 SOURCE
CTR 0 OUT	2	36	D GND
FREQ OUT	1	35	D GND

NC = No Connect

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