42750A FOUR CHANNEL, BIPOLAR LOW NOISE DC BIAS CARD

	Range 1	Range 2
Output Voltage:	-8.192 V to +8.191 V	-16.384 V to +16.383 V
Resolution:	1.00 mV	2.00 mV
Output Noise:		
1 Hz	250 nV/√Hz	350 nV/√Hz
10 Hz	75 nV/√Hz	100 nV/√Hz
100 Hz	60 nV/√Hz	75 nV/√Hz
1 kHz	50 nV/√Hz	50 nV/√Hz
10 kHz	40 nV/√Hz	40 nV/√Hz
Accuracy:	0.1% of programmed value ±20 mV	
Output Current:	±100 mA max, 300 mA max per card	

Output Current Limit (Protection): ±120 mA max
Output Resistance: 75 mΩ max. for $I_O \leq +75$ mA.
Current Sense Output/Accuracy: 3 Ranges:

Range	Accuracy	Reading
1 mA	0.25% of reading ±1 µA	1 mA/V
10 mA	0.25% of reading ±10 µA	10 mA/V
100 mA	0.25% of reading ±120 µA	100 mA/V

Voltage Sense Output/Accuracy: 2 Ranges:

Range	Accuracy	Reading
10 V	0.25% reading ±3 mV	1 V/V
20 V	0.25% reading ±6 mV	100 mV/V

42753 FOUR CH. BIPOLAR LOW NOISE DC BIAS CARD, ±25 V

	Range 1	Range 2
Output Voltage:	-10.24 V to +10.23875 V	-25.01 V to +25.01 V
Resolution:	1.25 mV	3.125 mV
Output Noise:		
1 Hz	250 nV/√Hz	450 nV/√Hz
10 Hz	75 nV/√Hz	150 nV/√Hz
100 Hz	60 nV/√Hz	100 nV/√Hz
1 kHz	50 nV/√Hz	75 nV/√Hz
10 kHz	40 nV/√Hz	50 nV/√Hz
Accuracy:	0.1% of programmed value ±25 mV	
Output Current:	±100 mA max, 300 mA max per card	

Output Current Limit (Protection): ±120 mA max
Output Resistance: 75 mΩ max. for $I_O \leq +75$ mA.
Current Sense Output/Accuracy: 3 Ranges:

Range	Accuracy	Reading
1 mA	0.3% of reading ±1 µA	1 mA/V
10 mA	0.3% of reading ±10 µA	10 mA/V
100 mA	0.3% of reading ±150 µA	100 mA/V

Voltage Sense Output/Accuracy: 2 Ranges:

Range	Accuracy	Reading
10 V	0.3% reading ±3 mV	1 V/V
25 V	0.3% reading ±6 mV	100 mV/V

42755 TWO CH. BIPOLAR LOW NOISE DC BIAS CARD, 250 mA

	Range 1	Range 2
Output Voltage:	-10.24 V to +10.23875 V	-20.00 V to +20.00 V
Resolution:	1.25 mV	2.50 mV
Output Noise:		
1 Hz	300 nV/√Hz	400 nV/√Hz
10 Hz	75 nV/√Hz	100 nV/√Hz
100 Hz	60 nV/√Hz	75 nV/√Hz
1 kHz	50 nV/√Hz	50 nV/√Hz
10 kHz	40 nV/√Hz	40 nV/√Hz
Accuracy:	0.1% of programmed value ±20 mV	
Output Current:	±100 mA max, 300 mA max per card	

Output Current Limit (Protection): ±270 mA max
Output Resistance: 75 mΩ max. for $I_O \leq +75$ mA.
Current Sense Output/Accuracy: 3 Ranges:

Range	Accuracy	Reading
1 mA	0.3% of reading ±1 µA	1 mA/V
10 mA	0.3% of reading ±10 µA	10 mA/V
250 mA	0.3% of reading ±250 µA	100 mA/V

Voltage Sense Output/Accuracy: 2 Ranges:

Range	Accuracy	Reading
10 V	0.3% reading ±3 mV	1 V/V
20 V	0.3% reading ±6 mV	100 mV/V

42757 FOUR CH., BIPOLAR LOW NOISE DC BIAS CARD, +36 V

	Range 1	Range 2
Output Voltage:	0 V to +10.23875 V	0 V to +35.84 V
Resolution:	0.625 mV	2.1875 mV
Output Noise:		
1 Hz	300 nV/√Hz	600 nV/√Hz
10 Hz	100 nV/√Hz	250 nV/√Hz
100 Hz	75 nV/√Hz	200 nV/√Hz
1 kHz	50 nV/√Hz	100 nV/√Hz
10 kHz	40 nV/√Hz	75 nV/√Hz
Accuracy:	0.1% of programmed value ±25 mV	
Output Current:	100 mA max, 300 mA max per card	

Output Current Limit (Protection): ±120 mA max
Output Resistance: 75 mΩ max. for $I_O \leq 75$ mA.
Current Sense Output/Accuracy: 3 Ranges:

Range	Accuracy	Reading
1 mA	0.35% of reading ±1.2 µA	1 mA/V
10 mA	0.35% of reading ±12 µA	10 mA/V
100 mA	0.35% of reading ±170 µA	100 mA/V

Voltage Sense Output/Accuracy: 2 Ranges:

Range	Accuracy	Reading
10 V	0.35% reading ±3 mV	1 V/V
36 V	0.35% reading ±10 mV	100 mV/V

PI-4002B-USB INSTRUMENT MAINFRAME

Card Slots: Eight. Maximum load determined by card mix.
DC Input: +31 VDC, -31 VDC, +10 VDC, Aux 1, Aux 2
Dimensions: 7.0" H x 17.5" W x 19.625" D.
Weight: 15 lbs.
Temperature: 0° C to 50° C.
I/V Sense Output: BNC connector isolated from chassis ground

PI-4003A-x-y DC POWER MAINFRAME:

Output Connectors: Four. Maximum load determined by card mix.
Dimensions: 7.0" H x 17.5" W x 26.0" D. Allow 29.0" D for cables.
Weight: 85 lbs.
Standard Output Voltages/Current:
+31 VDC, 10 A
-31 VDC, 10 A
+12 VDC, 13 A
+12 VDC, 6.5 A
Optional Output Voltages/Current:
x = "-36" for additional +36 V, 1.8 A output for PI-42753
x = "-48" for additional +48 V, 1.8 A output for PI-42757
AC Input Voltage:
y = "-120" for 150-125 VAC input
y = "-220" for 210-250 VAC input
Load Regulation: ±0.1% (0 to 100% full load)
Line Regulation: 0.2% (20% line change)
Noise and Ripple: 0.1% peak to peak
Transient Response: less than 50 msec for 50% load change
Temperature Coefficient: ±0.01%/°C maximum
Stability: ±0.1% maximum for 24 hours after warm-up

SPECIAL ORDER MODELS:

- **45101, High-Current CCD driver cards with 10 Ω output impedance**

Compatibility:

Older 4000 Series equipment may contain a PI-4001 Control Mainframe, which is no longer available or supported. The PI-4001 can be replaced by a USB-equipped PC if all existing PI-4002/PI-4002A mainframes are upgraded with USB Opto control cards.

Nearly all existing driver and bias cards are supported by the new controllers, with the exception of the 40480 Clock Driver Card and 40770 Four-Quadrant Bias Card.

Revised 03/31/15. Specifications subject to change without notice.

Pulse Instruments

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PI-4000 Series Low-Noise Clock Driver and DC Bias System

Features:

- Low-Noise Design
- Modular and Upgradable
- High Precision and Accuracy
- Programmable Voltages, T_R/T_F, and Voltage Limits
- Bias Voltages from -25 to +36 V
- Clock Rates up to 100 MHz
- Voltage-sense and Current-sense outputs
- Backward Compatible

Applications:

- CCD Characterization and Test
- FPA Characterization and Test
- CMOS Imager Characterization and Test

Introduction:
The PI-4000 Series represents a no-compromises approach to providing low-noise, flexible stimulus for the test and characterization of high-performance CCDs, IR FPAs, and CMOS Image Sensors. In conjunction with Pulse Instruments or third-party pattern generators, the 4000 Series can drive a wide variety of imaging devices in standard or non-standard operating modes.

This flexibility enables device designers, manufacturers, and integrators to test and optimize device performance under a wide range of operating conditions.

Instrument Description:
The PI-4000 Series comprises one or more PI-4002B Instrument Mainframes, one or more Clock Driver or DC Bias plug-in cards, and one PI-4003A DC Power Mainframe. It also requires a system controller, typically a USB-equipped PC or a CompactPCI mainframe with a single-board computer.

Each PI-4002B mainframe has 8 instrument card slots that can be populated with various combinations of clock driver and/or DC Bias cards.

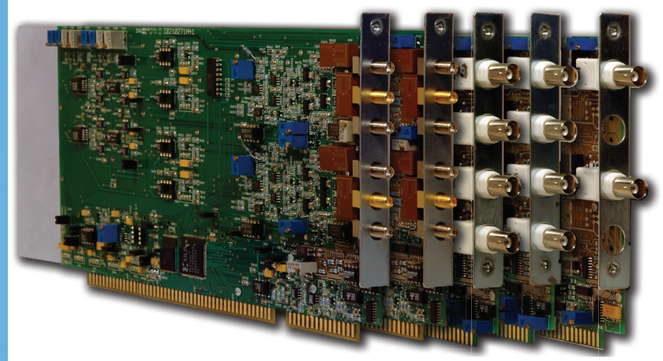
Low-noise, linear DC power is supplied by the PI-4003A DC Power Mainframe, which can power up to three PI-4002B Instrument Mainframes, depending on the specific card configuration.

Digital control is provided via optically-isolated USB. The PI-4000B mainframes are floating with respect to the control mainframe. This permits separation of the analog and digital domains in the system for maximum noise immunity.

The PI-4000 Series provides a host of device protection features, such as a Disconnect mode, separate programmable voltage on/off sequencing, programmable voltage limits, and programmable current limits (selected models). There is also protection against transients that could damage the DUT. A reset feature also sets all output voltages throughout the system to 0 V in the event that any channel loses power.

Software Description:
The PI-4000 Series can be programmed via PI-Controller, PI-DATS, or by a custom application using the fully-documented ASCII command set.

PI-Controller and PI-DATS are Pulse Instruments' GUI-based test and characterization applications. Custom applications can program the instrument cards by passing ASCII commands to the controller by DLL or via GPIB. The ASCII command set is backward compatible with that used to program the older PI-4001 Control Mainframe.



Pulse Instruments

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SPECIFICATIONS:

42460 TWO CHANNEL DRIVER CARD

Output Characteristics: (3' RG58C/U)

	1 MΩ load//15 pf	50 Ω Load
Max. Repetition Rate 1:	16 MHz @20 V_{PP}	
Max. Repetition Rate 2:	32 MHz @10 V_{PP}	
High Level:	-18 V to +20 V	-9 V to +10 V
Low Level:	-20 V to +18 V	-10 V to +9 V
Resolution:	10 mV	5 mV
Accuracy*:	0.1 % of Prog. value ±100 mV	5% of Prog. value ±50 mV
Amplitude:	0.5 V to 22 V	0.25 V to 11 V
T_R/T_F (@20 V_{PP}):	20-200 ns (±10% ±5 ns)	

* for positive-going transition time set to minimum; may increase to 125 mV max. for transition times > minimum value (into 1 MΩ)

Output Polarity: Normal or inverted, programmable
Output Resistance: 50 Ω ±10%.
Output Noise:

1 Hz	3.5 μV/√Hz
10 Hz	900 nV/√Hz
100 HZ	400 nV/√Hz
1 kHz	300 nV/√Hz

Clock Output: SMA Connector, isolated from chassis ground.
TTL Input:
Connector: SMA, isolated from chassis ground
Input Resistance: 50 Ω or 500 Ω ±10%, programmable
Input V_{HI}: 3 to 5 V
Optically Isolated Input:
Connector: SMA, isolated from chassis ground
Input Impedance: 300 Ω in series with LED
Input V_{HI}: 3 V to 5 V
Minimum Pulse Width: 25 ns
Max Clock Rate: 20 MHz
Current Sense Output/Accuracy: 3 Ranges:

Range	Accuracy	Reading
2 mA	2.5% of reading ±3 μA	1 mA/V
20 mA	2.5% of reading ±30 μA	10 mA/V
200 mA	2.5% of reading ±300 μA	25 mA/V

Voltage Sense Output/Accuracy: 2 Ranges:

Range	Accuracy	Reading
10 V	0.5% reading ±4 mV	1 V/V
20 V	0.5% reading ±30 mV	100 mV/V

42465 SINGLE CHANNEL TRI-LEVEL DRIVER CARD

Operating Modes: Two-level, Tri-Level, or Four-Level
Output Characteristics: (3' RG58C/U)

	1 MΩ load//15 pf	50 Ω Load
Max. Repetition Rate 1:	16 MHz @20 V_{PP}	
High Level:	-19 V to +20 V	-9.5 V to +10 V
Low Level:	-20 V to +19 V	-10 V to +9.5 V
Tri Level:	-10 V to +10 V	-5 V to +5 V
Resolution:	10 mV	5 mV
Accuracy*:	0.3 % of Prog. value ±100 mV	5% of Prog. value ±50 mV
Amplitude:	1 V to 22 V	0.5 V to 11 V
T_R/T_F (@20 V_{PP}):	20-200 ns (±10% ±5 ns)	

Operating Conditions: HLV-LLV > 1.0 V, LLV < MLLV < MHLV < HLV, -10 V ≤ MLLV < MHLV ≤ +10V
Output Polarity: Normal or inverted, programmable
Output Resistance: 50 Ω ±10%.
Clock Output: SMA Connector, isolated from chassis ground.
TTL Inputs:
Connector: SMA, isolated from chassis ground
Input Resistance: 50 Ω or 500 Ω ±10%, programmable
Input V_{HI}: 3 V to 5 V
Optically Isolated Inputs:
Connector: SMA, isolated from chassis ground
Input Impedance: 300 Ω in series with LED
Input V_{HI}: 3 V to 5 V
Minimum Pulse Width: 25 ns
Max Clock Rate: 20 MHz
Current Sense Output/Accuracy: 3 Ranges:

Range	Accuracy	Reading
2 mA	2.5% of reading ±3 μA	1 mA/V
20 mA	2.5% of reading ±30 μA	10 mA/V
200 mA	2.5% of reading ±300 μA	25 mA/V

Voltage Sense Output/Accuracy: 2 Ranges:

Range	Accuracy	Reading
10 V	0.5% reading ±4 mV	1 V/V
20 V	0.5% reading ±30 mV	100 mV/V

42490 TWO CHANNEL HIGH SPEED DRIVER CARD

Output Characteristics: (3' RG58C/U)

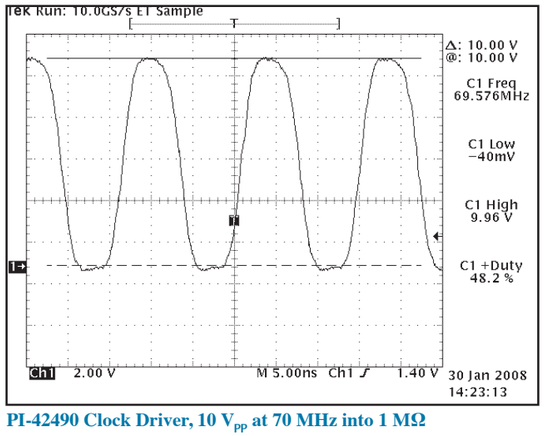
	1 MΩ load//15 pf	50 Ω Load
Max. Repetition Rate 1: (Input Duty Cycle = 50%)	70 MHz @ 10 V_{PP}	70 MHz @ 5 V_{PP}
Max. Repetition Rate 2: (Input Duty Cycle ≠ 50%)	100 MHz @16 V_{PP}	100 MHz @ 8 V_{PP}
High Level:	-7 V to +17 V	-3.5 V to +7.5 V
Low Level:	-17 V to +7 V	-7.5 V to +3.5 V
Resolution:	10 mV	5 mV
Accuracy:	0.1 % of Prog. value ±100 mV	5% of Prog. value ±50 mV
Amplitude:	1 V to 18 V	0.5 V to 9.5 V
Rise and Fall Times:	<5 ns @ 10 V_{PP} <7 ns @ 15 V_{PP}	<3.5 ns @ 5 V_{PP}

Operating Conditions: HLV-LLV > 1 V
Output Aberrations: 5% of V_{PP} +300 mV for V_{PP}> 2 V
Output Resistance: 50 Ω ±10%
Output Polarity: Normal or Inverted, programmable
TTL Input:
Connector: SMA, isolated from chassis ground
Input Resistance: 50 Ω or 500 Ω ±10%, programmable
Input V_{HI}: 3 to 5 V
Optically Isolated Input:
Connector: SMA, isolated from chassis ground
Input Impedance: 300 Ω in series with LED
Input V_{HI}: 3 V to 5 V
Minimum Pulse Width: 25 ns
Max Clock Rate: 20 MHz
Current Sense Output/Accuracy: 3 Ranges:

Range	Accuracy	Reading
1 mA	2% of reading ±3 μA	1 mA/V
10 mA	2% of reading ±30 μA	10 mA/V
100 mA	2.5% of reading ±300 μA	100 mA/V

Voltage Sense Output/Accuracy: 2 Ranges:

Range	Accuracy	Reading
10 V	0.2% reading ±20 mV	1 V/V
20 V	0.5% reading ±200 mV	100 mV/V



PI-42490 Clock Driver, 10 V_{PP} at 70 MHz into 1 MΩ

42495 FOUR CHANNEL HIGH SPEED DRIVER CARD

Output Characteristics: (3' RG58C/U)

	1 MΩ load//15 pf	50 Ω Load
Max. Repetition Rate 2: (Input Duty Cycle = 50%)	70 MHz @ 10 V_{PP}	70 MHz @ 5 V_{PP}
High Level:	-7 V to +17 V	-3.5 V to +7.5 V
Low Level:	-17 V to +7 V	-7.5 V to +3.5 V
Resolution:	10 mV	5 mV
Accuracy:	0.1 % of Prog. value ±100 mV	5% of Prog. value ±50 mV
Amplitude:	1 V to 18 V	0.5 V to 9.5 V
Rise and Fall Times:	<5 ns @ 10 V_{PP} <7 ns @ 15 V_{PP}	<3.5 ns @ 5 V_{PP}

Operating Conditions: HLV-LLV > 1 V
Output Aberrations: 5% of V_{PP} +300 mV for V_{PP}> 2 V
Output Resistance: 50 Ω ±10%
Output Polarity: Normal or Inverted, programmable
TTL Input:
Connector: SMA, isolated from chassis ground
Input Resistance: 50 Ω or 500 Ω ±10%, programmable
Input V_{HI}: 3 to 5 V
Optically Isolated Input:
Connector: SMA, isolated from chassis ground
Input Impedance: 300 Ω in series with LED
Input V_{HI}: 3 V to 5 V
Minimum Pulse Width: 25 ns
Max Clock Rate: 20 MHz

42750 FOUR CHANNEL, BIPOLAR LOW NOISE DC BIAS CARD

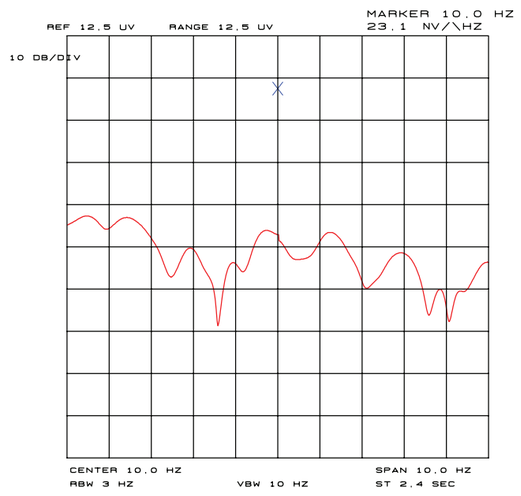
	Range 1	Range 2
Output Voltage:	-10.24 V to +10.23875 V	-20.48 V to +20.4775 V
Resolution:	1.25 mV	2.50 mV
	1.00 mV available by special order	
Output Noise:		
1 Hz	250 nV/√Hz	350 nV/√Hz
10 Hz	75 nV/√Hz	100 nV/√Hz
100 Hz	60 nV/√Hz	75 nV/√Hz
1 kHz	50 nV/√Hz	50 nV/√Hz
10 kHz	40 nV/√Hz	40 nV/√Hz
Accuracy:	0.1% of programmed value ±20 mV	
Output Current:	±100 mA max, 300 mA max per card	

Output Current Limit (Protection): ±120 mA max
Output Resistance: 75 mΩ max. for I_O ≤ +75 mA.
Current Sense Output/Accuracy: 3 Ranges:

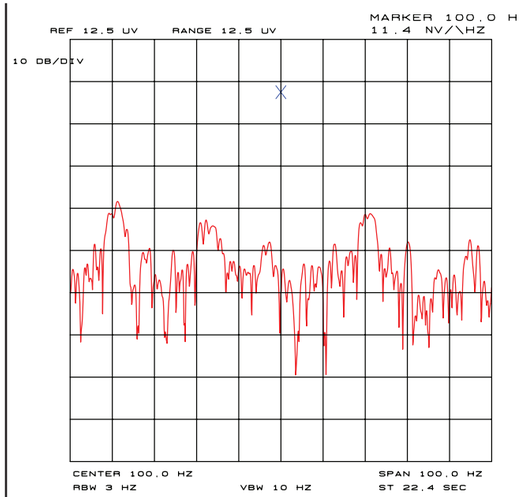
Range	Accuracy	Reading
1 mA	0.25% of reading ±1 μA	1 mA/V
10 mA	0.25% of reading ±10 μA	10 mA/V
100 mA	0.25% of reading ±120 μA	100 mA/V

Voltage Sense Output/Accuracy: 2 Ranges:

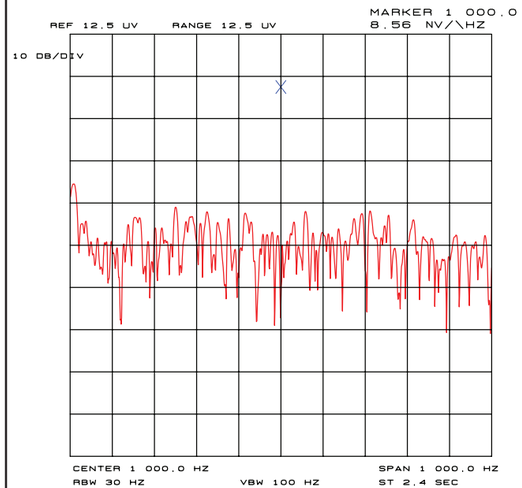
Range	Accuracy	Reading
10 V	0.25% reading ±3 mV	1 V/V
20 V	0.25% reading ±6 mV	100 mV/V



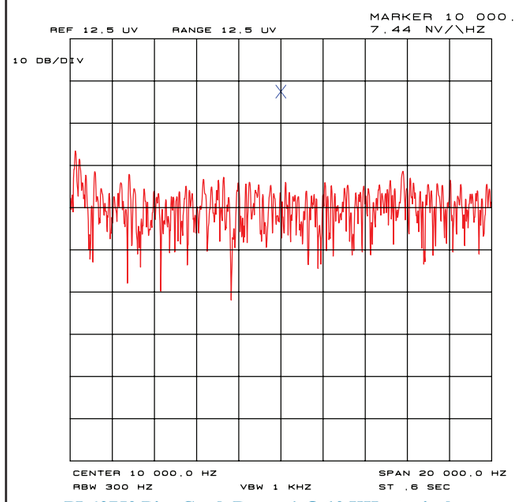
PI-42750 Bias Card, Range 1, @ 10 Hz, typical



PI-42750 Bias Card, Range 1 @ 100 Hz, typical



PI-42750 Bias Card, Range 1 @ 1 KHz, typical



PI-42750 Bias Card, Range 1 @ 10 KHz, typical