A REVOLUTION IN SQUID INSTRUMENTATION!

STAR Cryoelectronics' family of advanced PC-based dc SQUID control electronics, pcSQUID™, represents a breakthrough in dc SQUID instrumentation technology. This revolutionary architecture brings the power of a PC and the flexibility of virtual instrumentation to SQUID control and data acquisition. The easy-to-use interface for Microsoft Windows™ puts the SQUID control where it belongs - on your computer, right where you want it, fully integrated with your data acquisition and analysis tools.

SINGLE-AND MULTI-CHANNEL PROGRAMMABLE FEEDBACK LOOPS

The state-of-the-art Model PFL-100 Programmable Feedback Loop (PFL) offers unsurpassed performance and control functionality for single- and multi-channel applications. All SQUID signal levels are digitally controlled with high resolution by a personal computer. The user may remotely select dc bias or ac bias to minimize low-frequency noise intrinsic to some types of 77K SQUIDs. All techniques preserve wide bandwidth operation. Two sensor coupling ranges and three closed-loop feedback ranges, all of which can be selected remotely, ensure optimum performance for a broad range of dc SQUID sensors. An external feedback input allows the implementation of sophisticated noise cancellation techniques. The compact and low-power design simplifies multi-channel and portable operation.

The multi-channel Model PFL-800 Programmable Feedback Loop contains eight independently programmable feedback loop channels in a single box. Four feedback ranges are available along with optional auto-reset control for each channel. All drive signals and feedback loop parameters may be configured remotely via software for each channel. Each PFL-800 can control eight LTS SQUIDs, multiple PFL-800 boxes may be rack mounted in groups of twelve. The PFL-800 offers a cost effective, high-performance solution for large multi-channel applications.

The high-speed Model PFL-102 Programmable Feedback Loop offers wide bandwidth (>1 MHz) and high slew rate (>1 MΦ_0/sec). The PFL-102 is designed to control two-stage SQUID amplifiers and includes two independent bias drive circuits, one for the voltage-biased low-noise input stage, and one for the series SQUID array output stage. Two independent feedback circuits are available, allowing the feedback to be coupled to the input stage or the output stage, for locked-loop operation. All drive signals and feedback loop parameters may be configured remotely via software.

SINGLE- AND MULTI-CHANNEL PC INTERFACE UNITS

Single- and multi-channel PC Interface (PCI) units are available for STAR Cryoelectronics' advanced Programmable Feedback Loops (PFLs). The PC Interface is controlled by a personal computer via an RS-232 or parallel port. All digital control signals to the Programmable Feedback Loops are generated by a Serial Control Code transmitter in the PC Interface. The Model PCI-1000 can control up to eight Model PFL-100 or Model PFL-102 channels, while the low-cost Model PCI-100 is ideal for single-channel applications. The Model PCI-1800 is used to operate the multi-channel Model PFL-800 Programmable Feedback Loop. Each PCI may be configured for master/slave mode for applications requiring additional channels. The analog output signals from the Programmable Feedback Loops are available at the PC Interface via front-panel BNC connectors, either wideband or low-pass filtered with user-selectable cutoff frequencies, or at a multi-pin connector on the rear panel (Models PCI-1000 and PCI-1800).

Model PC-1000 eight-channel SQUID electronics (monitor not included)

Model PC-100 single-channel SQUID electronics (laptop not included)

**Model PC-1800 multi-channel SQUID electronics (monitor not included)**

PCS100 CONTROL SOFTWARE WITH REMOTE CONTROL

Control your pcSQUID™ system remotely via the Internet!

PCS100DA CONTROL SOFTWARE WITH DATA ACQUISITION AND REMOTE CONTROL

Compatible with National Instruments 16-bit E-Series DAQ boards and PCMCIA cards, featuring up to 333 kS/s sampling rates!

The new PCS100 Control Software for STAR Cryoelectronics' Programmable Feedback Loop Model PFL-100 and PC Interface Models PCI-100 and PCI-1000 includes several new features to enhance and simplify system set up and operation. Use the new MASTER mode to configure multiple SQUID Channels simultaneously or to heat groups of several Channels at the same time. Heater Heat and Cool times are now configurable with 0.1 second resolution to precisely control heater power. Multiple user initialization files simplify set up for different sensors and user applications. With the AC Bias Mode, bias frequencies of 128 kHz, 64 kHz, and 2 kHz are now standard.
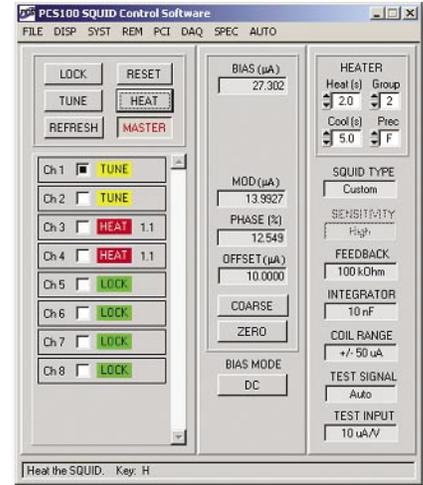

The new PCS100DA Control Software with Data Acquisition is compatible with all 16-bit E-Series DAQ devices from National Instruments. Use the Data Acquisition module like a virtual oscilloscope to record, save and print data for up to eight channels. Use the Spectrum Analysis module like a virtual spectrum analyzer to compute, view, save, and print a noise power spectrum of the SQUID output signal. The Spectrum Analysis module includes many of the same features found in expensive stand-alone spectrum analyzers.
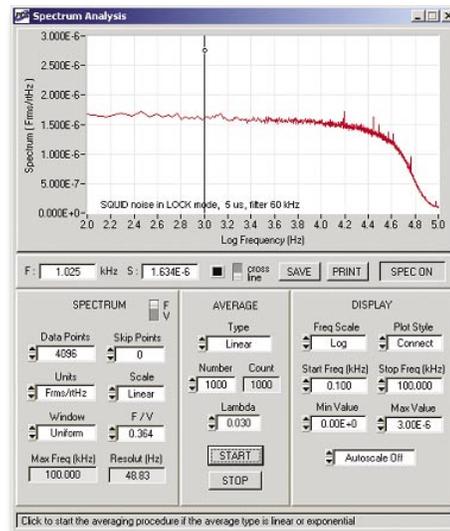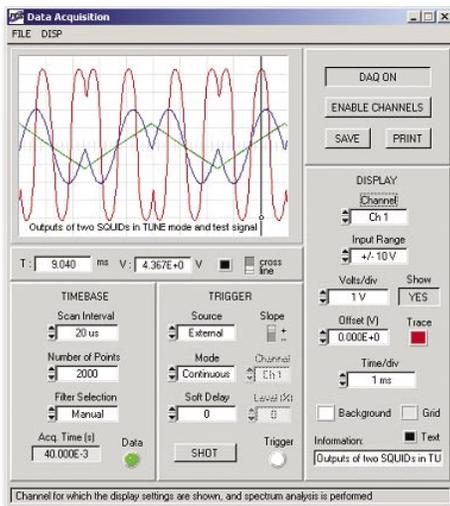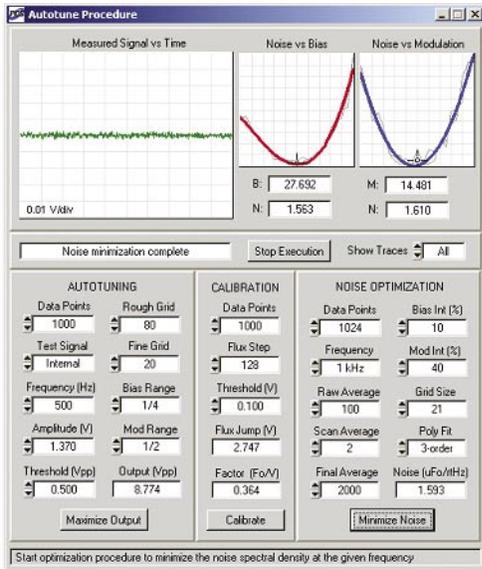
The powerful Data Acquisition and Spectrum Analysis tools enable automatic tuning and calibration of each SQUID Channel for optimal performance, quickly and reliably, without the need for an external oscilloscope, multimeter, and spectrum analyzer.
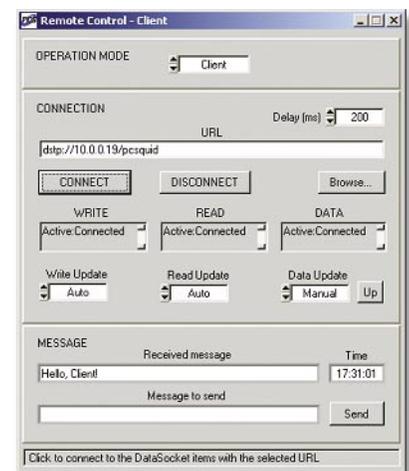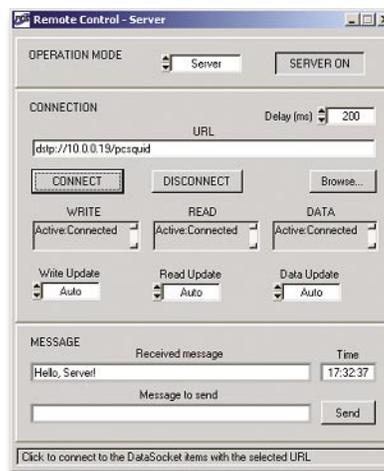
The Remote Control module allows remote operation via a local network or the Internet using National Instruments DataSocket Transfer Protocol (DSTP). The PC running PCS100 or PCS100DA that directly controls the hardware, including all PFL-100 Channels, PC Interfaces, DAQ device, and computer port connected to the master PCI unit, acts as the Server for a remote Client PC also running PCS100 or PCS100DA. The Client essentially functions as a remote user interface for the Server, enabling complete control of the SQUID system. With PCS100DA recorded data may be transferred directly from the Server to the Client PC.

REQUIREMENTS

Hardware requirements: STAR Cryoelectronics' Model PFL-100 and PCI-1000 or PCI-100

Operating system requirements: Microsoft Windows™ XP, 2000, 9x, NT.
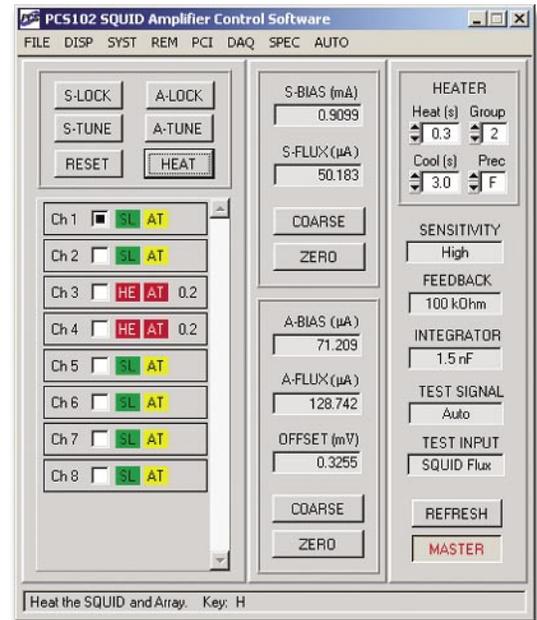
PCS102 CONTROL SOFTWARE WITH REMOTE CONTROL

Control your pcSQUID™ system remotely via the Internet!

PCS102DA CONTROL SOFTWARE WITH DATA ACQUISITION AND REMOTE CONTROL

Compatible with National Instruments 16-bit E-Series DAQ boards and PCMCIA cards, featuring up to 333 kS/s sampling rates!

The new PCS102 Control Software for STAR Cryoelectronics' Programmable Feedback Loop Model PFL-102 and PC Interface Models PCI-100 and PCI-1000 includes several new features to enhance and simplify system set up and operation.

- Independently tune and lock the input SQUID or series SQUID array output stages.

- View the dc characteristics (current-voltage or voltage-flux) of the SQUID array in tune mode, or use the locked array to view the dc characteristics (current-voltage or current-flux) of the input SQUID.

- Use the MASTER mode to configure multiple SQUID Amplifier Channels simultaneously or to heat groups of several Channels at the same time.

- Heater Heat and Cool times are configurable with 0.1 second resolution to precisely control heater power.

- Multiple user initialization files simplify set up for different sensors and user applications.

The new PCS102DA Control Software with Data Acquisition is now compatible with all 16-bit E-Series DAQ devices from National Instruments. Use the Data Acquisition module like a virtual oscilloscope to record, save and print data for up to eight channels. Use the Spectrum Analysis module like a virtual spectrum analyzer to compute, view, save, and print a noise power spectrum of the SQUID amplifier output signal. The Spectrum Analysis module includes many of the same features found in expensive stand-alone spectrum analyzers.

The powerful Data Acquisition and Spectrum Analysis tools enable automatic tuning and calibration of the output SQUID array and input SQUID stages of each SQUID amplifier channel for optimal performance, quickly and reliably, without the need for an external oscilloscope, multimeter, and spectrum analyzer.

The Remote Control module allows remote operation via a local network or the Internet using National Instruments DataSocket Transfer Protocol (DSTP). The PC running PCS102 that directly controls the hardware, including the PFL-102, PC Interfaces, DAQ device, and computer port connected to the PCI unit, acts as the Server for a remote Client PC also running PCS102. The Client essentially functions as a remote user interface for the Server, enabling complete control of the SQUID system. Recorded data may be transferred directly from the Server to the Client PC.
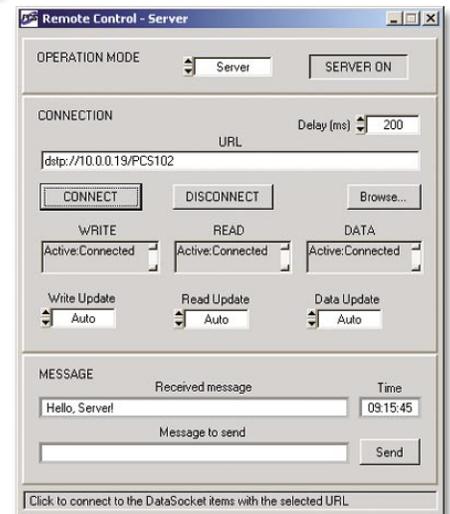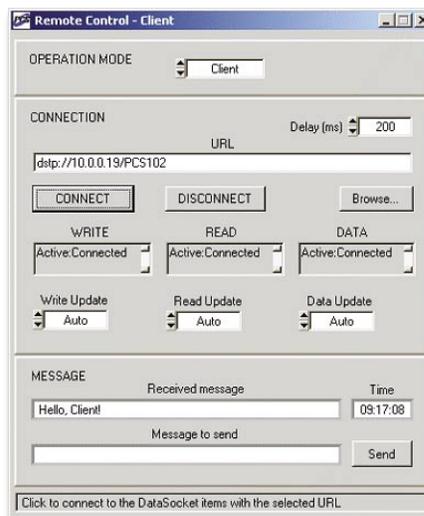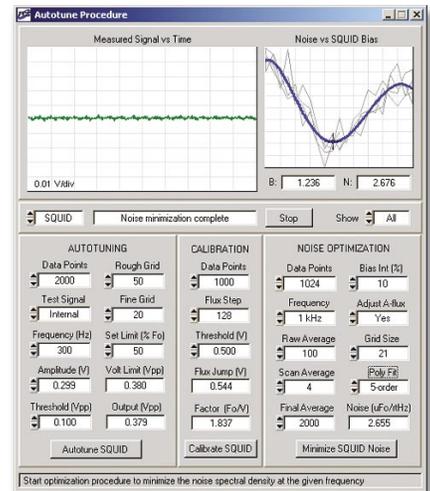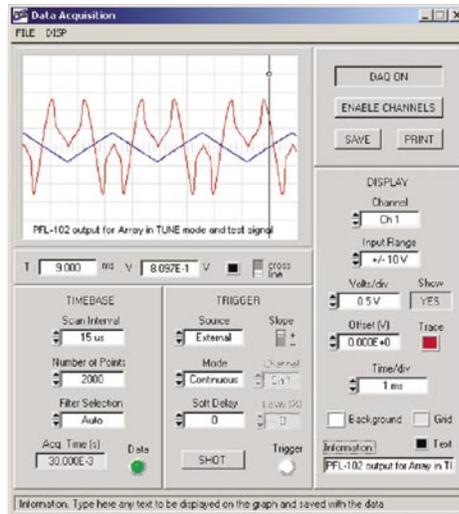
HARDWARE REQUIREMENTS

STAR Cryoelectronics' Model PFL-102 and PCI-1000 or PCI-100

Operating system requirements: Microsoft Windows™ XP, 2000, 9x, NT.

READY FOR INTEGRATION!

The family of advanced dc SQUIDs and PC-based SQUID instrumentation from STAR Cryoelectronics form a revolutionary modular system that is easily integrated into your application. The modular approach also makes it simple to upgrade your system as your measurement needs grow. Contact STAR Cryoelectronics today to discuss your particular applications and needs.

STANDARD SYSTEM CONFIGURATIONS

The currently available standard system configurations are summarized in the table below. Each pcSQUID™ system configuration includes the required interconnecting cables for the electronics and the appropriate control software. Mating cryocables and SQUID sensors are available separately.

MODEL	PCI	PFL	DESCRIPTION
PC-100	PCI-100	PFL-100	Low-cost single-channel system for LTS, HTS SQUIDs
PC-102	PCI-100	PFL-102	High-speed, single-channel system for SQUID amplifiers
PC-1000	PCI-1000	PFL-100	Expandable multi-channel laboratory system
PC-1000A	-	PFL-100	Additional channel add-on package for PC-1000
PCS-100DA	-	-	Data acquisition software upgrade for PFL-100
PCS-102DA	-	-	Data acquisition software upgrade for PFL-102
PC-1800	PCI-1800	PFL-800	Multi-channel system for LTS SQUID applications

SPECIFICATIONS

Programmable Feedback Loop Model PFL-100

PFL Operation	Remote control using proprietary Serial Control Code (SCC) 8-bit internally configurable hardware address; Address 0 controls all PFLs Up to 255 channels may be controlled independently Master PFL can drive any number of Slave PFLs Each PFL self-recognizes Master or Slave mode
Sensor Types	LTS or HTS
Sensor Coupling	Single (warm) or Dual (warm plus cooled) input transformer options Set via internal hardware switch
Bias	0-200 µA DC or 0-200 µA$_{p-p}$ AC; both 1 part in 4096 resolution AC Bias Frequency: 128 kHz (standard) 2 and 64 kHz (optional upgrade); remotely configurable Remotely adjustable compensation minimizes noise peaks caused by AC bias
Modulation	0-50 µAp-p, 1 part in 4096 resolution, provided by internal oscillator Modulation Frequency: 256 kHz (for DC, 2 and 64 kHz AC Bias), 128 kHz (128 kHz AC Bias)
Skew	0-50 µAp-p, 1 part in 4096 resolution
Feedback	Internal or External Two sensor coupling ranges, remotely configurable Three feedback modes for each sensor coupling range, remotely configurable Type I SQUIDs Nominal 5 µA/Φ_0 sensor feedback coupling ±10 µA, HIGH Sensitivity Mode ±100 µA, MEDIUM Sensitivity Mode ±1 mA, LOW Sensitivity Mode Type II SQUIDs Nominal 50 µA/Φ_0 sensor feedback coupling ±100 µA, HIGH Sensitivity Mode ±1 mA, MEDIUM Sensitivity Mode ±10 mA, LOW Sensitivity Mode
Integrator	10 µs, 100 µs, or 1 ms time constants, remotely configurable
Output	±10 V
Bandwidth	Up to 100 kHz depending on SQUID voltage swing
DC Offset	Two ranges for Type I and Type II sensor coupling, remotely configurable
Type I SQUIDs	±5 µA, 1 part in 8192 resolution 0.1 nA$_{p-p}$ drift over 24 hours typical
Type II SQUIDs	±50 µA, 1 part in 8192 resolution 1 nA$_{p-p}$ drift over 24 hours typical

Test Signal Input	Differential; configurable for each channel 10 µA/V, 100 µA/V, 1000 µA/V, remotely configurable 10 mA maximum current, 10 k Ω input impedance
Sensor Heater Supply	100 mA current source for heater resistances up to 100 Ω
Power Requirements	±12 VDC, +72/-56 mA in quiescent mode +184/-56 mA with heater on
Size (WxHxD)	2.8 × 0.77 × 4.4 (in) (71 × 19.5 × 112 (mm))
Weight	0.33 lb (150 g)

PC Interface Models PCI-1000 and PCI-100

Specification	PCI-1000	PCI-100
No. of channels	1-8; master/slave mode supported	1; master/slave mode supported
Communications	From PC: RS-232 or parallel port To PFL: Serial Control Code	From PC: RS-232 or parallel port To PFL: Serial Control Code
Analog Outputs	±10 V buffered PFL output, wideband or filtered, remotely configurable	±10 V buffered PFL output, wideband or filtered
Test Signal	Input Front panel; differential, remotely selectable for each channel, ±10 V max., 50 Rear panel; 8 differential, ±10 V max., 10 kΩ input independance	Front panel; differential, ±10 V max., 50 Ω input independance
Filters	Configurable with up to four 4-pole low-pass Butterworth filters per channel (optional)	5kHz 4-pole Butterworth low-pass (standard)
Power Requirement	120 or 240 VAC (selectable), 50/60 Hz, 40W	±12 VDC, +100/-71 mA quiescent mode, +212/-71 mA with heater on (includes PFL). External power source for 120 or 240 VAC incl.
Cable Length	At least 50 m to Programmable Feedback Loop	At least 50 m to Programmable Feedback Loop
Size	(WxHxD) 16.7 × 1.69 × 12.7 (in) (424 × 44 × 323 (mm))	8.31 × 1.69 × 6.7 (in) (211 × 44 × 171 (mm))
Weight	8.16 lb (3700 g)	1.62 lb (738 g)

The above specifications are effective 10/20/99 and subject to change without prior notice.

Programmable Feedback Loop Model PFL-102

PFL Operation	Remote control using STAR Cryoelectronics' Serial Control Code 8-bit remotely programmable address for 1-255 channels; Address 0 controls all PFLs 8-bit internally configurable hardware address
Sensor Type	Two-Stage SQUID Amplifier with Low-noise, voltage-biased input SQUID stage, Series SQUID array output stage

SQUID Stage

Bias	0-2 mA DC, 1 part in 4096 resolution
DC Flux Offset	0-100 µA, 1 part in 4096 resolution
Feedback	Designed for nominal 10 µA/Φ_0 feedback coupling Three feedback ranges, remotely configurable: ±10 µA, HIGH Sensitivity Mode ±100 µA, MEDIUM Sensitivity Mode ±1 mA, LOW Sensitivity Mode
Integrator	10 µs, 100 µs, or 1 ns time constants, remotely configurable
Test Signal Input	Differential; configurable for each channel, 10 kΩ input inpednce SQUID Bias: 200 µA/V SQUID Flux: 10 µA/V

Array Stage

Bias	0–100 µA DC, 1 part in 4096 resolution
DC Flux Offset	0-200 µA 1 part in 4096 resolution
Feedback	Designed for nominal 10 µA/Φ_0 feedback coupling Three feedback ranges, remotely configurable: ±10 µA, HIGH Sensitivity Mode ±100 µA, MEDIUM Sensitivity Mode ±1 mA, LOW Sensitivity Mode
Integrator	10 µs, 100 µs, or 1 ms time constants, remotely configurable
Test Signal Input	Differential; configurable for each channel, 10 kΩ input impedance Array Bias and Array Flux: 10 µA/V
Output	±10 V
Bandwidth	Better than 1 MHz
Slew Rate	1 MΦ_0/sec (small signals)
Heater Supply	100 mA, voltage limited to +12 VDC
Power Requirements	I 12 VDC, +95/-68 mA (quiescent mode), +210/-69 mA (heater on)
Size	(WxHxD) 2.8 × 0.77 × 4.4 (in) (71 × 19.5 × 112 (mm))
Weight	0.34 lb (156 g)

Programmable Feedback Loop Model PFL-800 Specifications

No. of Channels	Eight independent SQUID channels, remotely controllable.
Remote Control	PC-based, proprietary Serial Control Code (SCC) interface 5-bit internally configurable hardware address Up to 28 eight-channel PFLs (224 SQUID channels) may be controlled independently
Sensor Types	LTS
SQUID Inputs	Via 68-pin SCSI connector
Input Coupling	Single (warm) or Dual (warm plus cooled) input transformer options, configurable via internal solder jumpers
Bias	0–160 µA DC, 1 part in 4096 resolution
Modulation	0–200 µAp-p, 1 part in 4096 resolution, provided by internal 256 kHz generator referenced to external clock signal from PC Interface
Feedback	Internal or External
Ranges	Four feedback ranges, remotely configurable ±10 µA, HIGH Sensitivity Mode, max. 0.5 nA/°C drift ±100 µA, MEDIUM Sensitivity Mode, max. 5 nA/°C drift ±1 mA, LOW Sensitivity Mode, max. 50 nA/°C drift ±10 mA, COARSE Sensitivity Mode, max. 2 µA/°C drift
Integrator	5 µs, 50 µs, 500 µs, 5 ms time constants, remotely configurable
Reset	Via software or external TTL signal External reset time <5µsec Optional auto-reset function
DC Offset	160 µA, 1 part in 8192 resolution, max. 2.5 nA/°C drift 1 nAp-p drift over 24 hours typical.
Bandwidth	Up to 100 kHz depending on SQUID flux-to-voltage transfer function
SQUID Outputs	±10 V differential analog outputs for each channel
Test Signal Inputs	Differential; 1 mV/µA, 10 mV/µA, 100 mV/µA, 1V/µA, remotely configurable for each channel, 10 mA maximum current, 10 kΩ input impedance
Remote Interface I/O	Via 68-pin SCSI connector; includes all SQUID outputs, test signal inputs, SCC data, power, and grounds
Indicators	SCC DATA OK/Fault Status LEDs, Heater LED
Sensor Heater Supply	100 mA current source for heater resistances up to 75Ω
Power Requirements	+12 VDC, 436 mA in (+100 mA per activated heater), - 12VDC, 376 mA +5 VDC, 45 mA in (+11 mA per activated heater)
Size	(WxHxD) 9.88 × 7 × 0.94 (inch) (251 × 178 × 24 (mm))
Weight	2.8 lb (1270 g)

STAR Cryoelectronics

PC Interface Model PCI-1800 Specification

No. of Channels	Supports one 8-Channel Model PFL-800 Programmable Feedback Loop
Clock	Internal generator provides clock signal for PFL Master/Slave mode supported to synchronize clock signal for multiple PFLs Slave PCI-1800 auto-recognizes slave mode
Communications	From PC: RS-232 or Parallel Port To PFL: STAR Cryoelectronics Serial Control Code
Analog Outputs	±10 V buffered PFL output Front panel BNC: Wideband or Filtered, remotely configurable for each channel Rear panel DB-25: Eight differential analog outputs for each SQUID channel
Test Signal Input	Front panel BNC: Differential, remotely configurable for each channel, ±10 V max., 50 Rear panel DB-25: Eight differential inputs for each SQUID channel, ±10 V max., 10 kΩ input inpendance
Test Signal Generator	0–2 V_{p-p}, 50 – 5,000 Hz, remotely controllable
External Reset Inputs	TTL (HI resets feedback loop), via rear-panel DB-9 connector
Filters	Configurable with up to four 4-pole low-pass Butterworth filters per channel (optional)
Power Requirement	120 or 240 VAC (selectable), 50/60 Hz, 40 W, or external battery
Cable Length	Up to TBD m to Programmable Feedback Loop
Size	(W×H×D) 16.7 × 1.69 × 12.7 (in) (424 × 44 × 323 (mm))
Weight	7.8 lb (3545 g)