

Dual-element Sensor Amplifier for AFM

AFM : Atomic Force Microscope

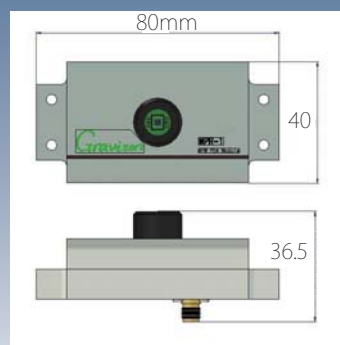
Installation record: Kanazawa University and others
<http://www.s.kanazawa-u.ac.jp/phys/biophys/index.htm>

Dual-element sensor amplifier receives the light signal reflected by a cantilever of the atomic force microscope, converts the displacements of the beam caused by the vibration of the cantilever to electric signal, performs the required analog operation, then outputs the signal required to generate the control signal for driving the piezo-scanner.

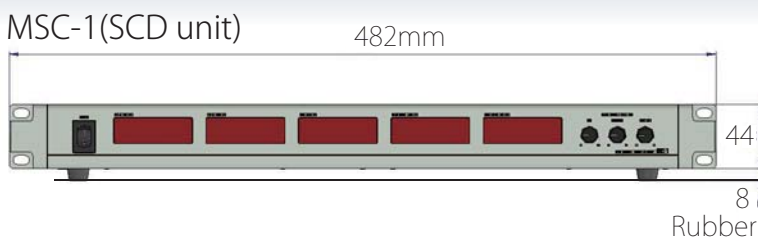
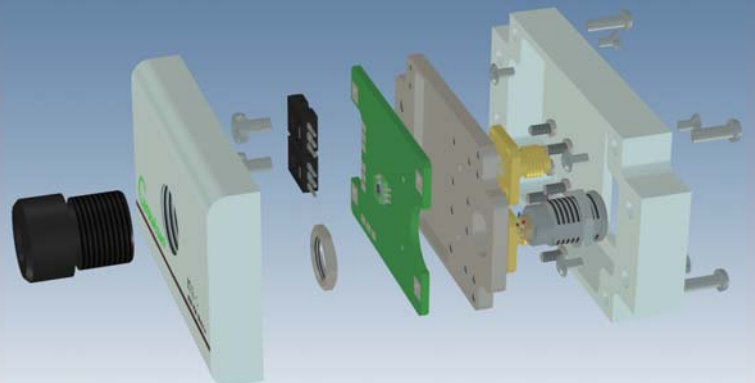


Top: MPR-1, PDA module to receive light signal

Bottom: MSC-1, SCD unit to perform analog operation of light signal



MPR-1 (PDA module)



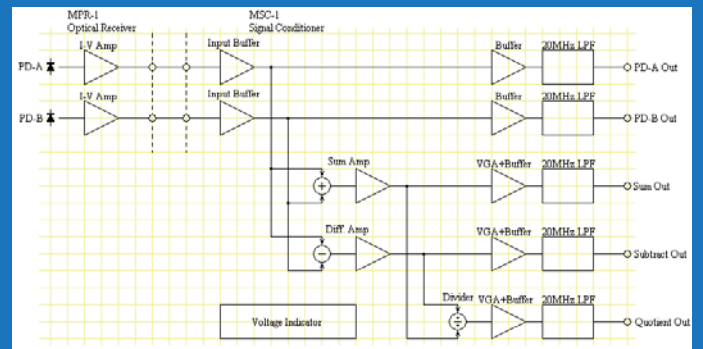
Overview

Dual-element sensor amplifier receives the light signal reflected by a cantilever of the atomic force microscope, converts the displacements of the beam caused by the vibration of the cantilever to electric signal, performs the required analog operation, then outputs the signal required to generate the control signal for driving the piezo-scanner.

Configuration

The dual-element sensor amplifier consists of two units:
 MPR-1: PDA module (Light signal receiving)
 MSC-1: SCD unit (Light signal analog operation)

Block Diagram of MPR-1 and MSC-1

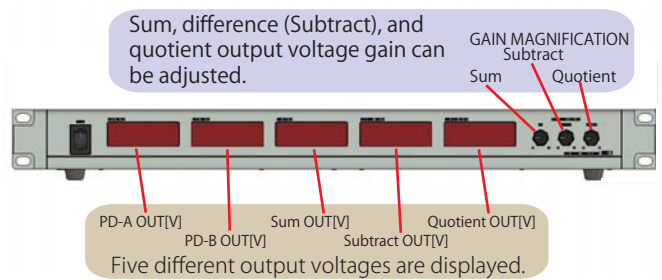


MSC-1: Light signal analog operation unit

MSC-1 unit performs analog operation using 2-channel voltage signals from MPR-1 to generate sum, difference (Subtract) and quotient signals, passes them through 4-order Bessel low-pass filter with 20MHz bandwidth, then outputs each voltage signal.

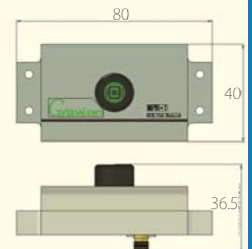
MSC-1

Item	Specification	Remark
Primary function	<ul style="list-style-type: none"> Perform analog operation using 2-channel voltage signals from MPR-1 to generate sum, difference (Subtract) and quotient signals to output. Change the gain against sum, difference (Subtract) and quotient signals through front panel operation. Display the five different output voltages on the front panel. 	
Number of input channels	2 channels	
Input impedance	50 Ω	
Input connector	SMA receptacle	
Output signals	PD-A, PD-B, sum signal, difference signal (Subtract), and quotient signal	
Output impedance	50 Ω (all five output signals above mentioned)	
Output connector	BNC receptacle (all five connectors)	
Output gain (PD-A & PD-B)	+6dB (fixed)	50 Ω termination
Sum signal output gain	-6dB to +14dB (adjustable)	50 Ω termination
Difference (Subtract) signal output gain	+14dB to +34dB (adjustable)	50 Ω termination
Quotient signal output gain	+12dB to +32dB (adjustable)	In case of providing -0.3V DC offset to tow channels and 50 Ω termination
Output filter	4-order Bessel low-pass filter 20MHz	
Output offset voltage	±5mV or less	
Output voltage display	5 different output voltages from PD-A, PD-B, Sum output, Difference output (Subtract), and Quotient output	
Output voltage display range and resolution	±4V (range), 1mV (resolution)	Applicable for all 5 displays
Output terminal of DC voltage output	2 different DC output terminals of ±8V. The rear panel equips LEMO and ERAQS-4P.	Pin assignment of LEMO terminal_P1:NC, P2:GND, P3:-8V, P4:+8V
Power-supply voltage and current	AC100V, 500mA or less	500mA time-lag fuse should be used.
Dimensions	482.4mm (W) x 260mm (D) x 44mm (H) The depth (260mm) does not include protruding parts, such as connectors and knobs. The height (44mm) does not include the length of the rubber legs.	
Weight	4.7kg (approximately)	



MPR-1: PDA module (Light signal receiving)

Dual-element photodetector of MPR-1 unit converts light signal from a cantilever to current signal, then I-V amplifier converts the current signal to the voltage signal to output to MSC-1.



MPR-1

Item	Specification	Remark
Primary function	<ul style="list-style-type: none"> Convert the light detected by the cantilever to voltage signal to output. Convert the light spot displacement into the voltage displacement between the channels to output. 	
Photo detector (PD)	Silicon PIN photo detector	
Conversion sensibility of PD	0.46A/W @658nm	
Transimpedance	20kΩ	
Overall PD sensibility	-4600V/W (displayed as minus when detected)	50 Ω termination
Frequency bandwidth	20MHz from DC, ±1 dB	50 Ω termination
Output offset voltage	±1mV or less	50 Ω termination
Output channels	2 channels	
Output impedance	50 Ω	
Output connector	SMA receptacle	
Power-supply voltage	±8V as standard. A dedicated cable provided from MSC-1 should be used.	
Material of case body	Exterior insulation structure with PEEK material	
Dimensions	80mm(W)x40mm(D)x29mm(H) The height (29mm) does not include any protruding parts of SMA connector.	
Weight	80g (approximately)	