



NAL 1959-2009  
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ORGANISATION

# राष्ट्रीय वांतरिक्ष प्रयोगशालाएं National Aerospace Laboratories

Post Bag No. 1779, Airport Road, Bangalore - 560 017, INDIA

Phone : (Off) +91-80-2527 3351 - 54, 2508 6000 - 6599, Fax : +91-80-2526 0862, 2527 0670

E-mail : <http://www.nal.res.in>  
Our Fax No.:080- 25269611

*Golden Jubilee Year*

(June 2008 - May 2009)

PURCHASE ORDER No.: 20F/MT/10/308F/08

NAL/PUR/MT/10/308F/08

May 22, 2009

M/s. aixACCT Systems GmbH  
Talbotstrasse 25  
52068 Aachen, Germany.

F. No. 149 241/963 1411

**Sub :** Procurement of Piezoelectric Thin Film Analyzer.

**Ref :** Your Quote No. ACCT/NAL/Q858 dt. 04.03.2009 & Letter No. ACCT/NAL/Q858/93041 dt. 30.04.2009 received from M/s. A-Tech Systems, Mumbai.

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Dear Sirs,

We, with pleasure place firm orders on you for supply of the items detailed below

Sl.No	Description of Items	Quantity	Rate / Unit EURO	TOTAL EURO
01.	Piezoelectric Thin Film Analyzer as per specification enclosed.	01 Unit		81,300.00
			Less Discount @ 10%	(-) 8,130.00
				73,170.00
	FOB Charges			250.00
				73,420.00
	Less Agency Commission @1%			(-) 734.00
			<b>FOB</b>	<b>72,686.00</b>

**NOTE:**

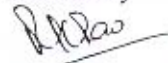
- Please mail your order acceptance to enable us to process for L/C.
- Consignment may please be handed over to: (By Air)

M/s. ATEGE AIRFREIGHT  
Gewerbegebiet West  
Langer Kornweg 34 D  
65451 Kerserbach, Frankfurt  
GERMANY

TEL: 49 911 3658255  
49 173 6778541  
FAX: 49 91152789456  
49 40 50752834  
C-P: Mr. Jan Robert  
Mr. Karl lang

3. Payment: 100% by Irrevocable Letter of Credit :  
90% against shipping documents,  
10% payable after successful installation and acceptance against 10%  
Performance Bank Guarantee to be valid for 2 months beyond warranty period,  
to be submitted after the acceptance of the equipment.
4. Delivery: 14 weeks.
5. Shipment: By Air.
6. No sooner the shipment is despatched, the same should be informed to us immediately to enable us to facilitate the clearance of the consignment at Bangalore, Airport.
7. Agency commission @ 1% would be paid to M/s. A-Tech Systems ., in Indian Rupees as per the exchange rate prevailing on the date of Negotiation of document.
8. Installation & Commissioning : Free of Cost.
9. Training for 4 personnel at NAL Bangalore for 5 days : Free of Cost.
10. Acceptance Criteria as per our Tender Specification contained in chapter 3.
11. Liquidated Damages: As time is the essence of this order, the date of delivery should be strictly adhered to, otherwise the Director reserves the right to deduct, a sum equivalent to 0.5 percent of the contract value for each week or part thereof of delay until actual delivery or performance, up to a maximum deduction of 10 Percent of the Contract value.
12. Warranty: 12 months from the date of Installation / Acceptance.
13. The service support after warranty period to be provided. The charges for the same would be Rs. 12000/- per visit inclusive of all.
14. The other terms & conditions governing the supply against this order to the extent not Superseded here, shall be as embodied in the GCC & SCC of the Bidding documents.

Yours faithfully



(R.K.RAO)

Controller of Stores & Purchase

Copy to : M/s. Balmer & Lawrie & Co.Ltd.,  
BANGALORE - 17.

CC: M/s. A-Tech Systems  
Unit A -1, Kalp Nagari,  
Bal Rajeshwar Road,  
Mulund (West), Mumbai - 400 080.

Fax: 022 2593 1525

PR NO: 2666 dtd: 20.01.2009  
PJ NO: M-1-270  
CC: Dr.Soma Dutta, MT  
Stores / Master copy

## Piezoelectric Thin Film Analyser

Pos.	Quantity	Description	EURO
1.	1	<p><b>TF – Analyzer – 2000 E Basic Unit</b></p> <ol style="list-style-type: none"> <li>1) 24 bit digital I/O-card</li> <li>2) Analog input card: maximum sample rate amounts to 1 MHz and the resolution is 16 bit at a voltage range of <math>\pm 10</math> V</li> <li>3) Arbitrary waveform generator: The vertical resolution amounts to 16 bit at 10 Vpp and the sample frequency is up to 2.5 MHz</li> <li>4) Separate low noise power supplies 5 V, <math>\pm 15</math> V, <math>\pm 30</math> V for the Probe Head and additional circuit parts to handle the different Probe Heads</li> <li>5) Four input channels for the voltage from -10 V to 10 V (e.g. for Voltage, Current, Displacement)</li> <li>6) Operation system: Windows XP</li> <li>7) CPU: Pentium M, 3GHz; 512 MB RAM; 120 GB Hard Disc</li> <li>8) Keyboard (US) and mouse</li> <li>9) 1 complete set of cables (4 BNC and 2 Lemos)</li> <li>10) English manual</li> </ol> <p><b>Reference Samples</b></p> <p>Couple of piezoelectric reference samples (thin and thick film cantilever type) should be provided to conduct the tests during installation and acceptance to validate the instrument's acceptance criteria</p> <p><b>FE – Module standard</b></p> <ol style="list-style-type: none"> <li>1) FE Probe head with high voltage protection circuit which fulfills international safety requirements (FCC proofed and CE certified)</li> <li>2) Arbitrary waveform for dynamic hysteresis measurement and piezo measurement (triangle, sine wave)</li> <li>3) Voltage range: <math>\pm 25</math> V built in amplifier up to <math>\pm 200</math> V external voltage amplifier</li> <li>4) Peak Output Current: 1 A, steady state 500 mA</li> <li>5) 16 bit analog to digital converters to generate the waveform precisely at 3 <math>\mu</math>V input sensitivity</li> <li>6) 0.5 <math>\mu</math>s capture rate with 0.1 <math>\mu</math>s interlace facility</li> <li>7) Polarization, output voltage, and SENSOR inputs capture option simultaneously.</li> </ol>	36,900.00

8) The minimum charge sensitivity amounts to 10 fC which for thin film samples with top electrode areas down to  $1 \mu\text{m} \times 1 \mu\text{m}$ .

9) Latest Measuring software for FE module

10) Recording amplifier for the measurement of the displacement charge density using a Virtual Ground input. Charge to voltage or current to voltage converters should be used.

11) Hardware should maintain a constant signal to noise ratio and a constant distortion envelope for the sample over the test system's entire measurement envelope.

The given specifications should support the following measurements;

#### **Hysteresis measurement**

- 1) Frequency range: 0.001 Hz up to 5 kHz, and any frequency in between
- 2)  $d_{33}$  measurement up to 5 kHz with a option to measure at 100 kHz
- 3) Voltage range:  $\pm 0.1$  V up to  $\pm 25$  V built in amplifier or  $\pm 200$  V with external voltage amplifier
- 4) Number of data points measured for one hysteresis loop: 20 to 1000 points
- 5) Number of averaged loops of Dynamic Hysteresis Measurement: 1 - 100
- 6) Relaxation time before the sample is driven into saturation (Static Hysteresis Measurement): 0.1 - 1 s
- 6) Simultaneous displacement measurement up to 5 kHz or 100 kHz by using the single beam laser interferometer system as stand alone system.

#### **Fatigue measurement**

- 1) For thin films: Up to 1 MHz, test condition 10 Vpp with appropriate capacitive load
- 2) Number of pulses: 1 to 1016
- 3) Number of measurements performed within one decade of fatigue pulses: 1 to 10
- 4) Type for the intermittent measurements: Hysteresis, Piezo, C (V) or leakage current

#### **Retention measurement**

- 1) Frequency: 1 Hz to 5 kHz
- 2) Waveform: trapezoid or triangle
- 3) Max. Retention time: 1 to 108 s

		<input type="checkbox"/> polarization, displacement vs. time <input type="checkbox"/> polarization, displacement vs. voltage <input type="checkbox"/> $d_{33}$ , C(V) vs. voltage 6) Export function of single measurement graph directly to Word or other programs 7) Data export in ASCII format which allows import into Excel format xls 8) Free software upgrades during the warranty period	
2.	1	<b>Post analysis software for calculation of <math>d_{31,f}</math> from <math>e_{31,f}</math></b>	1,900.00
3.	1	<b>Single beam laser interferometer</b> with _ Controller _ Displacement demodulator _ Optical probe head single mode _ Laser head fixture with semiautomatic beam adjustment mirror _ piezoelectric software option for the TF Analyzer 2000 <b>Specification</b> 1) Laser spot diameter < 100 $\mu\text{m}$ at 240 mm focus length 2) Measurement Range: > 2 mm 3) Maximum measurement frequency: > 100 kHz 4) Displacement measurement resolution: < 300 pm 5) Wavelength: 632,8 nm 6) Frequency Stability of the laser after warm up: $10^{-7}$ 7) Laser warm up time: 1 min 8) Displacement Velocity: 600 mm/s 9) Necessary software for spectrum analysis, computation of speeds (velocity) and acceleration of vibrational motion	20,800.00
4.	1	<b>4-Point Bending sample holder</b> to determine piezocoefficient $e_{31,f}$ of piezoelectric thin film cantilevers using dynamic force actuation with simultaneous electrical response measurement of the sample 1) Maximum displacement 400 $\mu\text{m}$ 2) Maximum force 80 N 3) Excitation frequency 0.01 Hz to 10 Hz 4) Semiautomatic application of mechanical pre-stresses 5) Selection switchbox to change between mechanical and electrical excitation measurements <b>Other required facilities should be incorporated into TF Analyzer 2000 with FE-module, single beam laser interferometer and piezoelectric measurement software option for the TF Analyzer</b>	11,800.00
5.	1	<b>Thin and thick film sample holder with poling option</b> _ 2 positioners _ sample platform _ maximum size 25 mm x 25 mm	4,500.00

		_ poling facility to pole up to 50 $\mu\text{m}$ thick films at elevated temperatures up to 100°C in combination with the 200 V high voltage unit	
6.	1	<b>High Voltage Unit +/- 200V, 100mA</b> for use with FE-Module for characterization and poling of thin and thick film samples (thickness 1 - 50 $\mu\text{m}$ )	3,400.00
7.	1	<b>Vibration damped table top</b>	2,000.00
		<b>Total</b>	81,300.00
		<b>Less Discount @10%</b>	8,130.00
		<b>Total Ex-works</b>	73,170.00
		<b>FOB Charges</b>	250.00
			73,420.00
		<b>Less Agency Commission @ 1%</b>	734.00
		<b>Net FOB Frankfurt Airport</b>	72,686.00