MODEL 2008 PULSED OPTICAL FEEDBACK PREAMPLIFIER

The Model 2008 Preamplifier functionally consists of:

- A charge sensitive preamplifier for converting input charge to a proportional output potential.
- Pulse and timing circuits for driving the optical reset stage and the inhibit output.
- Filtering for all power supply lines, and for Detector Bias.

DETAILED CIRCUIT DESCRIPTION

Referring to the functional schematic in Figure 1, the preamplifier section may be analyzed in terms of conventional operational amplifier theory whereby Q101 through Q5 function collectively to provide a large voltage gain, low output impedance and high input impedance. As with any operational amplifier circuit, the voltage gain may be calculated if the source impedance and feedback impedance are known. Therefore, from the test input to the energy output, the calculation is:

$$\text{Ac voltage gain} = (\text{test input divider ratio}) \times \frac{\text{feedback impedance}}{\text{source impedance}}$$

$$A_v = \frac{R28}{R28 + R26} \times \frac{C_s}{C_f}$$

In actual operation, the detector converts energy from the radioactive source into a proportional charge while the preamplifier converts this charge into a proportional output potential. The waveforms in Figure 2 illustrate the process by which this occurs.

As the radioactive source emits energy randomly, I_i is instantaneously increased, being equivalent to pulling small increments of charge Q_i from the feedback capacitor C_f. By the well known relationship between voltage and charge,

$$V = \frac{I}{C} \times Q$$

and since by classical feedback theory the op-amp input potential is constrained to be zero,

$$V_o = \frac{I}{C_f} \times Q_i$$

Note, however, that V_o increases with every source emission and that if the circuit is to operate in its linear region, V_o cannot increase without limit. The threshold of comparator A1 sets this upper limit to approximately 2 volts at which point in time the LED (D101) is forced into an ON state.

This LED is placed in such a way so as to illuminate the die of Q101 directly, causing leakage currents to be induced

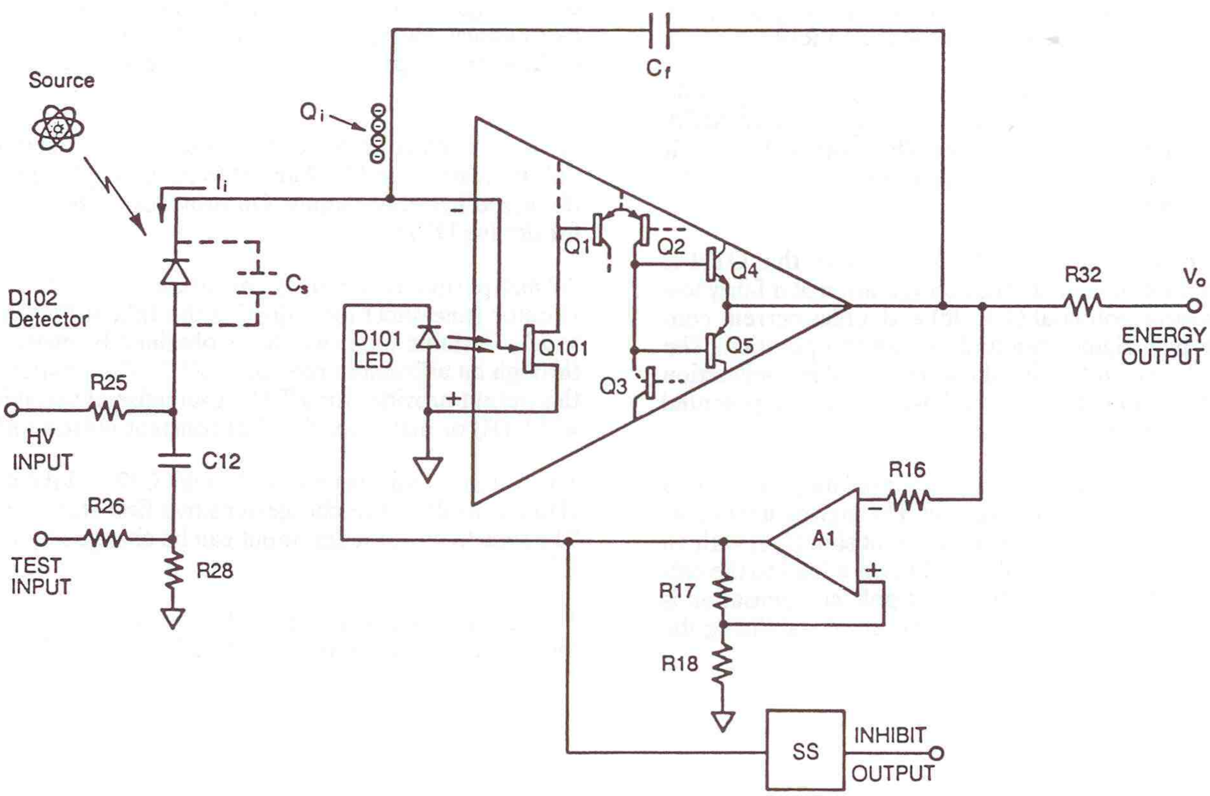


Figure 1 Model 2008 Functional Schematic

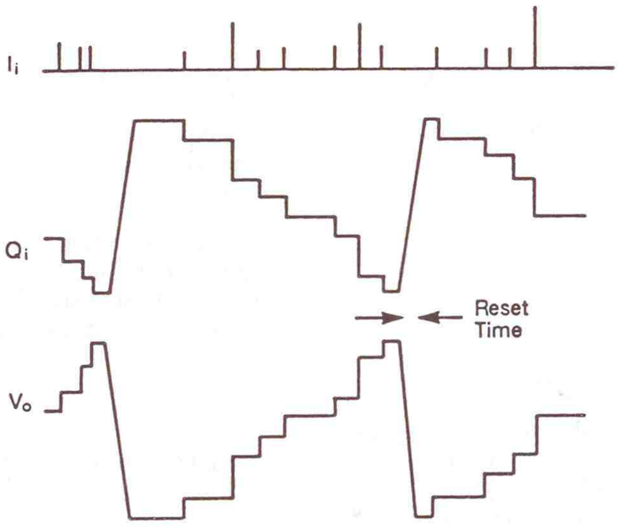


Figure 2 Typical Conversion Waveforms

through the transistor in the opposite direction to those produced by the detector. Thus, the output is forced negatively during this "reset time", but again A1 limits for excursion by extinguishing the LED when the output reaches the new comparator threshold of negative 2 volts. The ability of A1 to change thresholds as a function of its output state is a result of hysteresis introduced by R17 and R18.

Comparator A1 fires a monostable multivibrator to provide an output pulse which can be used to gate off an MCA during the transient following reset. The width of this inhibit pulse is adjustable by means of a screwdriver control on the rear of the 2008.

Referring now to drawing C-17831, it is seen that Q101 is utilized in the common source configuration at a fairly low drain-to-source potential (4 V dc) and a bias current conductive to high signal gain and low noise operation. The resistors RV2 and R4 define this current and in conjunction with R2, R12, and R30, set the base of Q1 at a potential equal to that at the base of Q2.

Q1 and Q2 thus biased form a differential amplifier with a very high non-inverting voltage gain. The high gain is in part a consequence of using an active current sink (Q3) with an output impedance of several megohms as a load to the collector of Q2. At this point dominant pole compensation is provided by C4 and R9 for the purpose of stabilizing the voltage gain over frequency.

Low output impedance drive is accomplished by Q4 and Q5 with R32 acting as a source-to-line matching impedance, insuring pulse fidelity over long cable lengths.

Completing the loop, R14 and R13 send a portion of the output signal back to pin 6 on the cryostat connector. The capacitance which exists between this pin and the gate of Q101 forms the previously mentioned feedback capacitance Cf.

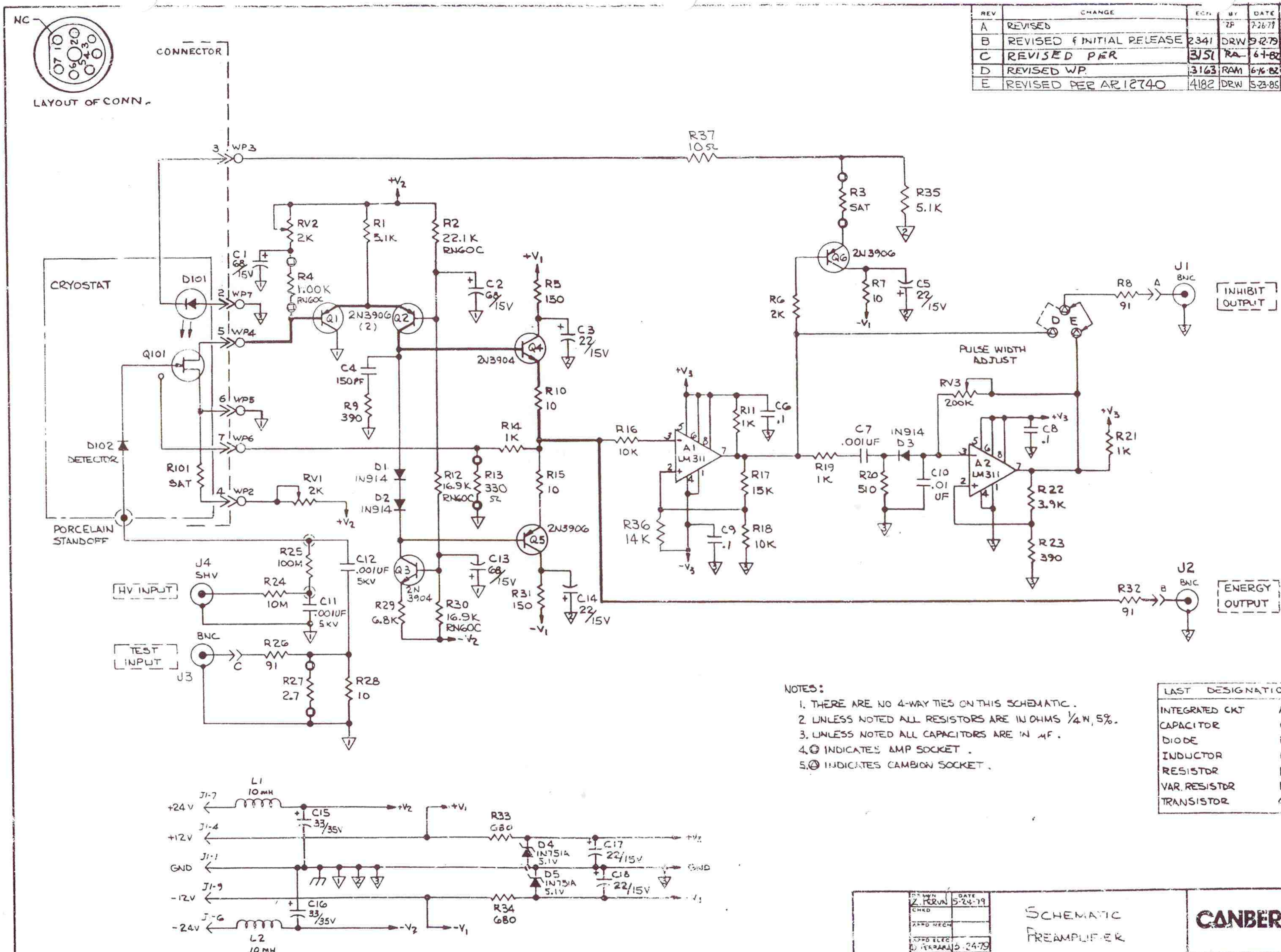
A1 is an open collector comparator with R11 serving as a pull-up resistor and R17 and R18 providing the previously discussed hysteresis limits. Q6 provides current capability for driving D101.

A2 and peripheral circuitry constitute a monostable multivibrator (one-shot) for adjusting the Inhibit Output pulse width. Variable pulse widths ar obtained by charging C10 through an adjustable resistance RV3. The jumper plug at this output provides for a TTL-level pulse of variable pulse width (E) or high level signal of constant pulse width (D).

The test input injects change through C12 and the detector element itself to the charge-sensitive first stage amplifier. The sensitivity of the test input can be changed by selecting R27.

The temperature of the input FET, Q101, is optimized at the factory for minimum noise by adjusting RV1.

REV	CHANGE	ECN	BY	DATE	APPD
A	REVISED		ZP	7-26-79	
B	REVISED & INITIAL RELEASE	2341	DRW	9-12-79	
C	REVISED PER	3151	RA	6-1-82	
D	REVISED WP.	3163	RAM	6-16-82	
E	REVISED PER AR12740	4182	DRW	5-23-85	



NOTES:
1. THERE ARE NO 4-WAY TIES ON THIS SCHEMATIC.
2. UNLESS NOTED ALL RESISTORS ARE IN OHMS 1/4 W, 5%.
3. UNLESS NOTED ALL CAPACITORS ARE IN μF.
4. ◎ INDICATES AMP SOCKET.
5. Ⓐ INDICATES CAMBION SOCKET.

LAST DESIGNATION	
INTEGRATED CKT	A2
CAPACITOR	C18
DIODE	D5
INDUCTOR	L2
RESISTOR	R37
VAR. RESISTOR	RV3
TRANSISTOR	Q6

DRAWN Z. PERUN DATE 5-24-79
CHKD
APPD MECH
APPD ELEC D. FERRARA 5-24-79
NEXT ASSY 2008

SCHEMATIC
PREAMPLIFIER
MODEL 2008

CANBERRA

DRAWING NO B-17831 E

DO NOT TEMPLATE DRAWING

WARRANTY

This warranty covers Canberra hardware and software shipped to customers within the United States. For hardware and software shipped outside the United States, a similar warranty is provided by Canberra's local representative.

DOMESTIC WARRANTY

Equipment manufactured by Canberra's Instruments Division, Detector Products Division, and Nuclear Systems Division is warranted against defects in materials and workmanship for one year from the date of shipment.

Canberra warrants proper operation of its software only when used with software and hardware supplied by Canberra and warrants software media to be free from defects for 90 days from the date of shipment.

If defects are discovered within 30 days of the time you receive your order, Canberra will pay transportation costs both ways. After the first 30 days, you will have to pay the transportation costs.

This is the only warranty provided by Canberra; there are no other warranties, expressed or implied. All warranties of merchantability and fitness for an intended purpose are excluded. Canberra shall have no liability for any special, indirect or consequential damages caused by failure of any equipment manufactured by Canberra.

EXCLUSIONS

This warranty does not cover equipment which has been modified without Canberra's written permission or which has been subjected to unusual physical or electrical stress as determined by Canberra's Service Personnel.

Canberra is under no obligation to provide warranty service if adjustment or repair is required because of damage caused by other than ordinary use or if the equipment is serviced or repaired, or if an attempt is made to service or repair the equipment, by other than Canberra personnel without the prior approval of Canberra.

This warranty does not cover detector damage caused by abuse, neutrons, or heavy charged particles.

SHIPPING DAMAGE

Examine shipments carefully when you receive them for evidence of damage caused in transit. If damage is found, notify Canberra and the carrier immediately. Keep all packages, materials and documents, including your freight bill, invoice and packing list. Although Canberra is not responsible for damage sustained in transit, we will be glad to help you in processing your claim.

OUT OF WARRANTY REPAIRS

Any Canberra equipment which is no longer covered by warranty may be returned to Canberra freight prepaid for repair. After the equipment is repaired, it will pass through our normal pre-shipment checkout procedure.

RETURNING EQUIPMENT

Before returning equipment for repair you must contact your Regional Service Center or one of our factories for instructions. For detector repair, contact the Canberra Detector Division in our Meriden, Connecticut, factory for instructions. If you are going to return the equipment to the factory, you must call first to get an Authorized Return Number (ARN).

When you call us, we will be glad to suggest the best way for you to ship the equipment and will expedite the shipment in case it is delayed or lost in transit. Giving you shipping advice does not make us responsible for the equipment while it is in transit.

SOFTWARE LICENSE

You have purchased the license to use Canberra software, not the software itself. Since title to this software remains with Canberra, you may not sell or transfer this software. This license allows you to use this software on only one compatible computer at a time. You must get Canberra's written permission for any exception to this license.

BACKUP COPIES

Canberra's software is protected by United States Copyright Law and by International Copyright Treaties. You have Canberra's express permission to make one archival copy of this software for backup protection. You may not copy Canberra software or any part of it for any other purpose.

DETECTOR SPECIFICATIONS AND PERFORMANCE DATA

Specifications

Model GC1520-7500SL Serial Number b 95102

The purchase specifications and therefore the warranted performance of this detector are as follows :

Nominal volume _____ cc Relative efficiency 15 %

Resolution 2.0 keV (FWHM) at 1.33 MeV

_____ keV (FWTM) at 1.33 MeV

1.00 keV (FWHM) at 122 keV

_____ keV (FWTM) at

Peak/Compton 41 :1 Cryostat well diameter _____ mm Well depth ____ mm

Cryostat description or Drawing Number if special Vertical Dipstick, type 7500SL

Physical Characteristics

Geometry Coaxial one open end, closed end facing window

Diameter 51 mm Active volume _____ cc

Length 42 mm Well depth _____ mm

Distance from window 5 mm Well diameter _____ mm

Electrical Characteristics

Depletion voltage (+)2000 Vdc

Recommended bias voltage Vdc (+)4000 Vdc

Leakage current at recommended bias .01 nA

Preamplifier test point voltage at recommended voltage -1.3 Vdc

Capacitance at recommended bias __/ pF

Resolution and Efficiency

With amp time constant of 4 μs

Isotope	^{57}Co	^{60}Co			
Energy (KeV)	122	1332			
FWHM (keV)	.864	1.78			
FWTM (keV)		3.38			
Peak/Compton		50.5:1			
Rel. Efficiency		18.0%			

Tests are performed following IEEE standard test ANSI/IEEE std325-1986

Tested by : Date : January 19 1995

Approved by : Date : January 19 1995

Docum : GDAME001	*Date : 29/10/93*
Issue : Spec. Sheet GC	*Name : PVE*
Revue : A	*Page : 1/1*
Basis : 0.M001PVE.08	*Appr :*

~~ELECTROCOOP~~
~~Kisszövetkezet~~

~~H–1083 Budapest, Tömő u. 40–46~~
~~Telefon: 113–7842, Telex: 22–7230 elcop h Telefax: 114–9869~~
~~MNB szám: 208–55998~~

ABNr.

Kundendienst–arbeitsbericht

Ausgeführte Arbeit

(A.) Garantie
B. Gegen Vergütung
a) Reparatur
b) Wartung
c) Montage
(d)) Inbetriebsetzung
e) . . . .

1. Die Arbeit wir durchgeführt von

Name NORMAFA KFT.

Adresse 1121 NORMAFA ÚT 1.

2. Instrument

Benennung Ge detektor
Hestellerwerk Canberra
Lieferungsdatum
Verbraucher: Name ELTE / Atomfizikai Tanszék /
Adresse Bp. VIII. Múzeum krt 4/A.

Typennummer GC 1520/7500SL
Fabrikationsnummer b 95102
Datum der Inbetriebnahme
MNB Nummer

3. Kurze Fehlerbeschreibung. Art der Fehlerbeseitigung (Kurze Beschreibung der durchgeführten Arbeit)

Detektor feltöltése, üzembehelyezése az alábbi mérési összeállításban:
HVPSU : C.A.E.N. N 470
Amp : Canberra 2012
MCA : KFKI MCA 4KN
Test point voltage: –1,4
Noise: <20mV

Mért felbontás FWHM ~ 3 keV

4. Materialaufwand

Zeichnungsnr. oder Typennr.	Benennung	Menge	Stückpreis	Gesamtpreis	Bemerkung

5. Lohnkosten

Die Arbeit durchgeführt von Name	Zeitaufwand	Stundenlohn	Gesamtlohn
CSEPREGHY SÁNDOR			
		Insgesamt	

6. Sontige Spesen

Tagesgeld	Unterkunft	Reise		Insgesamt
			Insgesamt	

7. Datum der Reklamationsanzeige
8. Datum der Arbeitsbeginns 1995.05.23.
9. Datum der beendeten Arbeit
10. Datum der Übergabe

12. Kostenverrechnung

Materialkosten (4)	
Lohnkosten (5)	
Sonstige Kosten (6)	
Insgesamt	

11. Bestätigung der ausgeführten Arbeit und der Übernahme des Instrumentes
(Eventuelle Bemerkungen des Übernehmers)

EÖTVÖS LORÁND TUDOMÁNYEGYETEM
ATOMFIZIKAI TANSZÉK
1088 Budapest, Puskin u. 5-7.
MNB 232-90142-6207
Adószám: 15308744-2-01

13. Unterschrift der Person welche die Arbeit (Reparatur) ausgeführt hat)

NORMAFA Kft.
1121 Bp., Normafa u. 1.

Datum ______________ 19