LIGHT BUCKET ASTRONOMY

A High Speed Electrometer for Photodiode Photometers

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Agenda

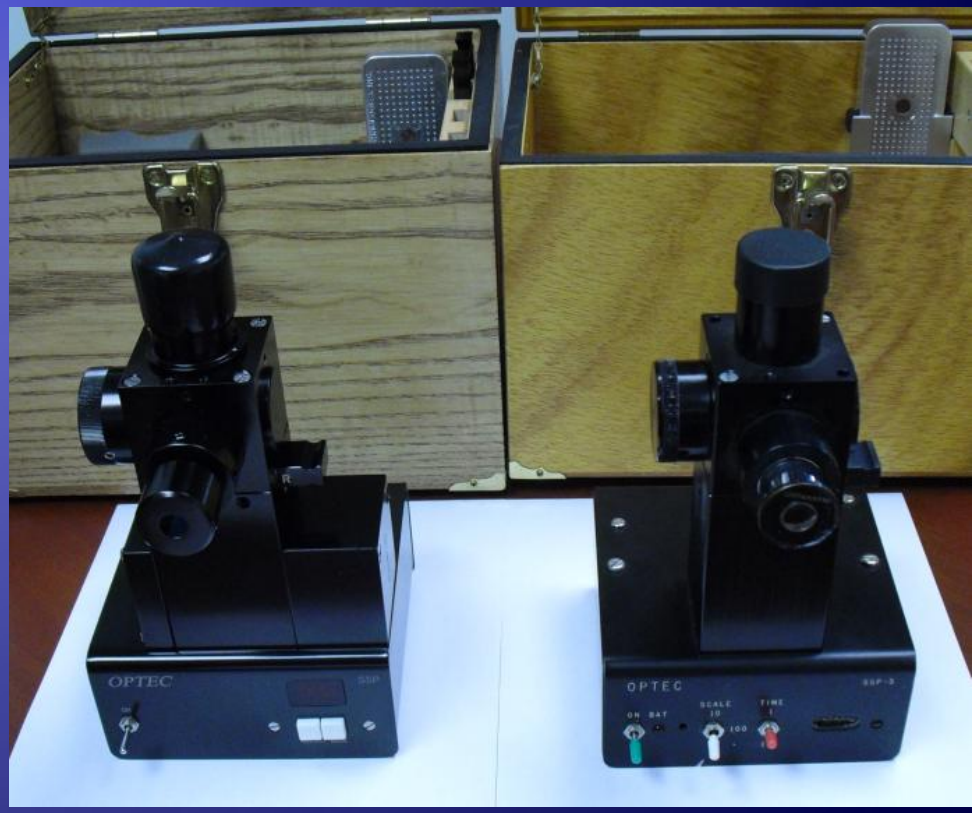
- Photometer requirements
- Role of the Electrometer
- Commercial Units
- Custom electrometer

Photometer Requirements

- Requirements
  - Very low noise – TEC cooled, TIA in cooler
  - High sensitivity – 10^9 V/A and up
  - Bandwidth – Low C, 300Hz and up
  - Affordable/replicable - <$3k
- Fast diaphragm-limited photometry
  - Silicone, InGaAs , PMT
- High Time Resolution Astronomy (future)

Commercial Diaphragm-limiting photometers

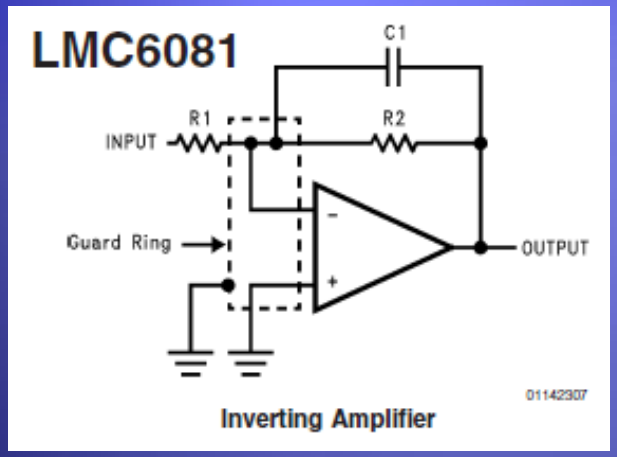
- Optec
  - SSP3A – Si photodiode
  - SSP-4A – NIR
  - SSP-5A – PMT
- Issues
  - F/# >4
  - Bandwidth
  - Desensitized
  - Dynamic range (PMT)
  - TIA not cooled (Vis)



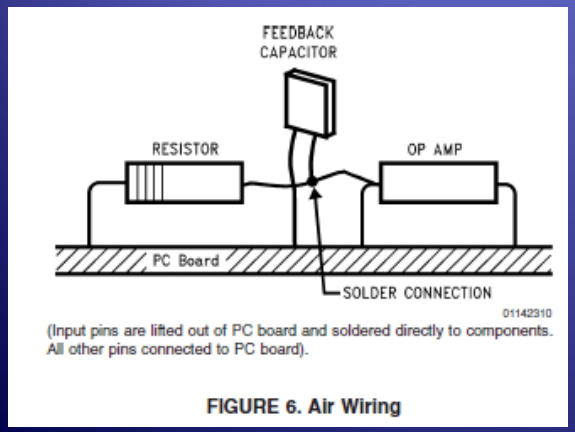
SSP-5A SSP-3

Electrometer

- Transimpedance amp - current amp with a very high input impedance



Inverting Amplifier



(Input pins are lifted out of PC board and soldered directly to components. All other pins connected to PC board).

FIGURE 6. Air Wiring

AC Electrical Characteristics

Unless otherwise specified, all limits guaranteed for T_J = 25˚C, = 0V, V_{CM} = 1.5V, V_O = 2.5V and R_L > 1M unless otherwise specified.

Symbol	Parameter	Conditions	Typ (Note 5)	Units
SR	Slew Rate	(Note 8)	1.5	V/µs Min
GBW	Gain-Bandwidth Product		1.3	MHz
i_n	Input-Referred Current Noise	F = 1 kHz	0.0002	pA/√Hz
I_{OS}	Input Offset Current		0.005	pA Max
R_{IN}	Input Resistance		>10	Tera Ω

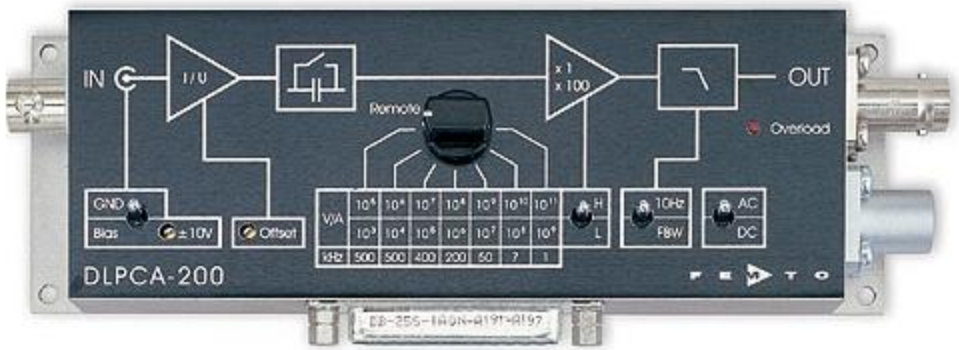
COTs Units

- Newport Oriel
- Femto
- HP Agilent
- Cremat
- SRS
- AmpTEK - Coolfet

Variable Gain Low Noise Current Amplifier DLPCA-200

FEMTO

- Transimpedance Gain from 10^3 to 10^{11} V/A
- Input Noise down to 4.3 fA/√Hz
- Bandwidth up to 500 kHz
- Rise Time down to 700 ns
- Adjustable Bias Voltage
- Manual and Remote Control



70710 Current Preamplifier

Home > Products > Scientific Instruments > **SR570**

SRS

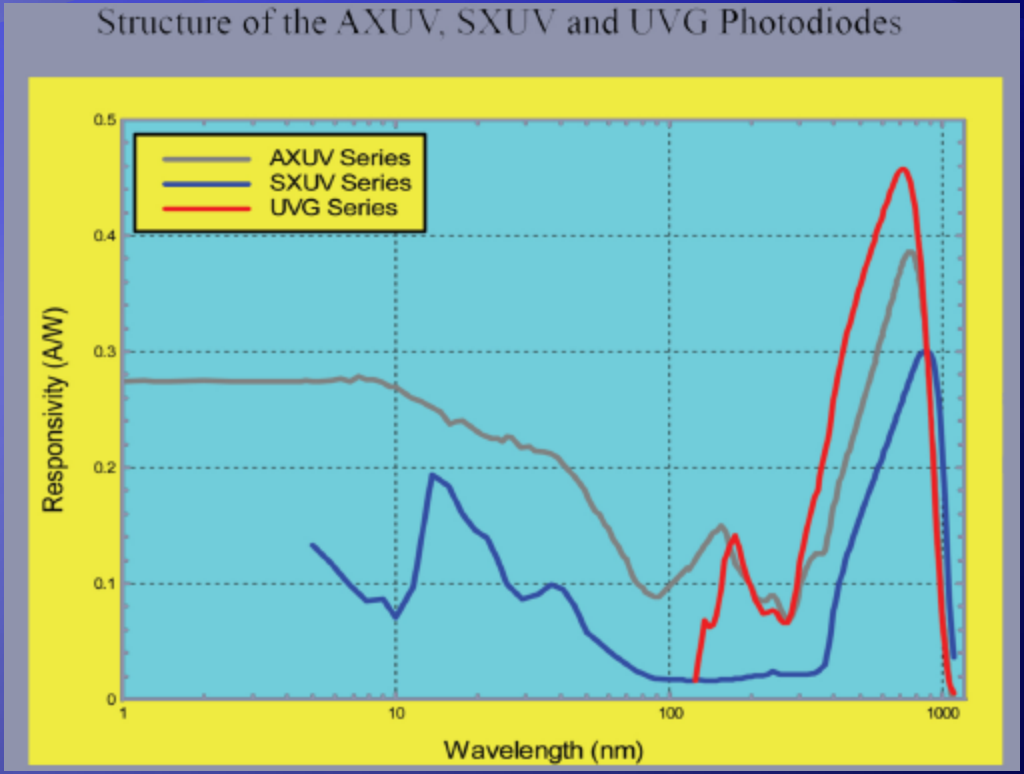
Current Preamplifier

SR570 — Low-noise current preamplifier

- 5 fA/√Hz input noise
- 1 MHz maximum bandwidth
- 1 pA/V maximum gain
- Adjustable bias voltage
- Two configurable signal filters
- Variable input offset current
- Line or battery operation
- RS-232 interface

Custom photometer for LBT

- Current state
  - Visible Diodes
    - IRD UVG100 (high-C)
    - Hammatsu (various Si)
  - 5kHz BW transimpedance amplifier, 10^{10}V/A
  - Port of FCO PBPHOT software underway



Source: IRD lit.

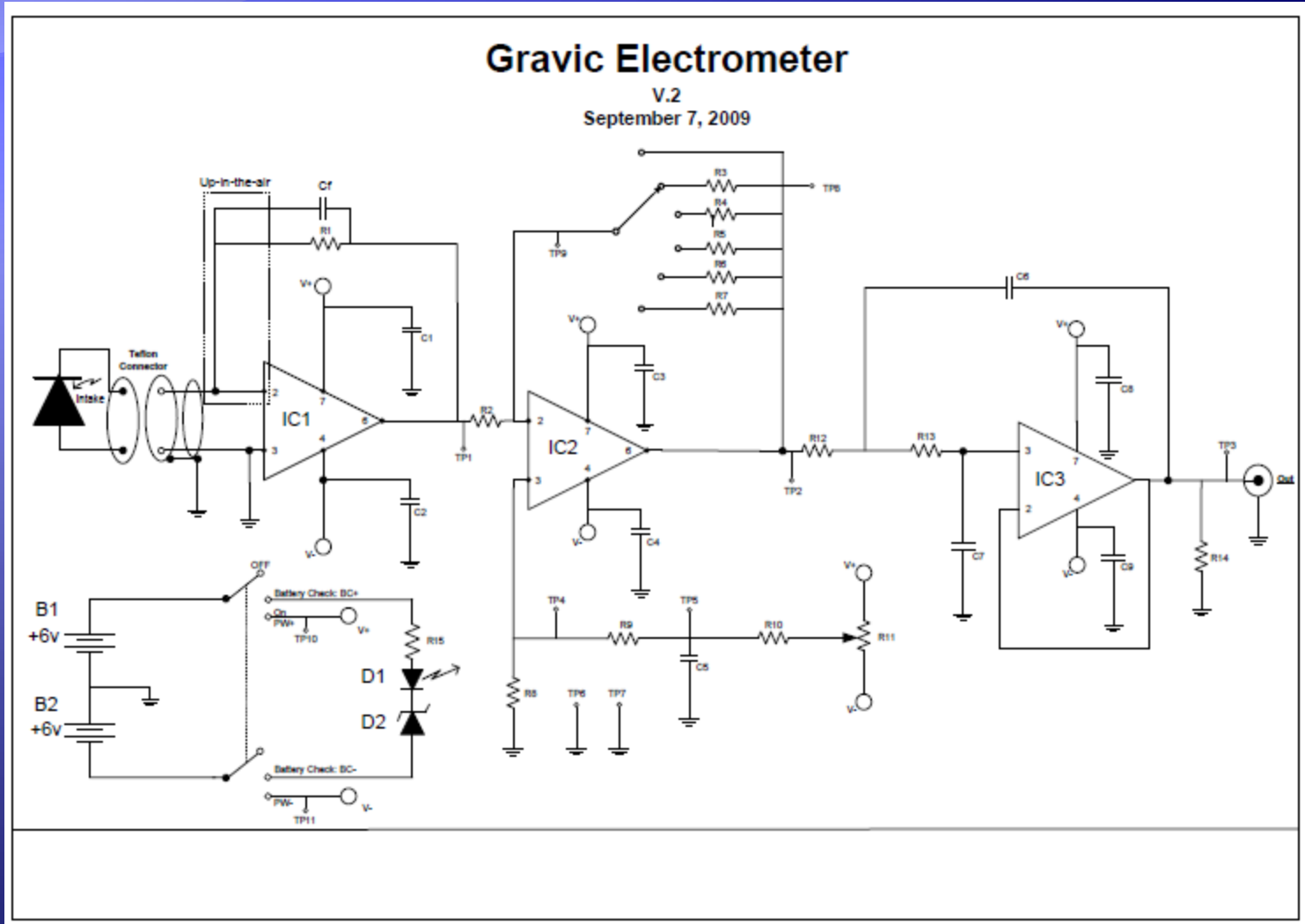
UVG Absolute Devices/Transfer Standards

Model no.	Sensitive Area (mm^2)	Size (mm)	Shunt Resistance (MΩ)**	Capacitance @ 0V (nF)**	Risetime (10-90%) (µSec)**	Package/ Page no.
UVG100	100	10 X 10	100	20	10	C100/17

High Speed Electrometer I

High-Speed Electrometer II

- IRD detector
- 5kHz BW
- Also added overload circuit



Electrometer parts

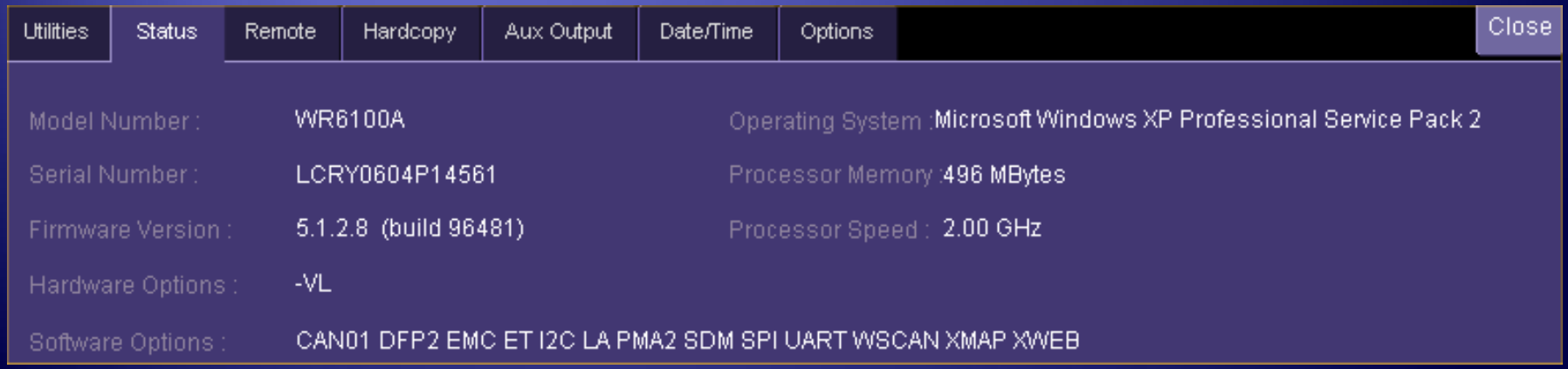
- R1 – has to be modest to maintain BW

PARTS LIST

Resistor	Value (ohms)	Capacitor	Value (Farads)	Op Amp	Value	Battery	Value (volts)	Diode	Value
R1	5G, 1%	C1	.1u	IC1	LMC6081	B1	6	D1	LED - 10mA
R2	5k, 1%	C2	.1u	IC2	OPA621	B2	6	D2	ZENER - 9v
R3	5k, 1%	C3	.1u	IC3	OPA621				
R4	50k, 1%	C4	.1u						
R5	500k, 1%	C5	.1u						
R6	5M, 1%	C6	3u						
R7	50M, 1%	C7	3u						
R8	100, 5%	C8	.1u						
R9	50k, 5%	C9	.1u						
R10	50k, 5%	Cf	R1/Detector specific-see LMC6081 spec.						
R11	100K, 5%								
R12	10k, 5%								
R13	10k, 5%								
R14	50, 5%								
R15	300, 1%								

Lecroy WR6100A

- Quad channel
- 1GHz BW
- 10GS/s interleaved
- Real-time digital signal processing (HTRA experiments)



Contact

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- Initiative Website - www.AltAzInitiative.org
- Yahoo Discussion Group - http://groups.yahoo.com/group/AltAzInitiative

More details:
The Alt-Az Initiative: Telescope, Mirror, & Instrument Developments, eds. Genet, Johnson, & Wallen, (Payson, AZ: Collins Foundation Press) 2010