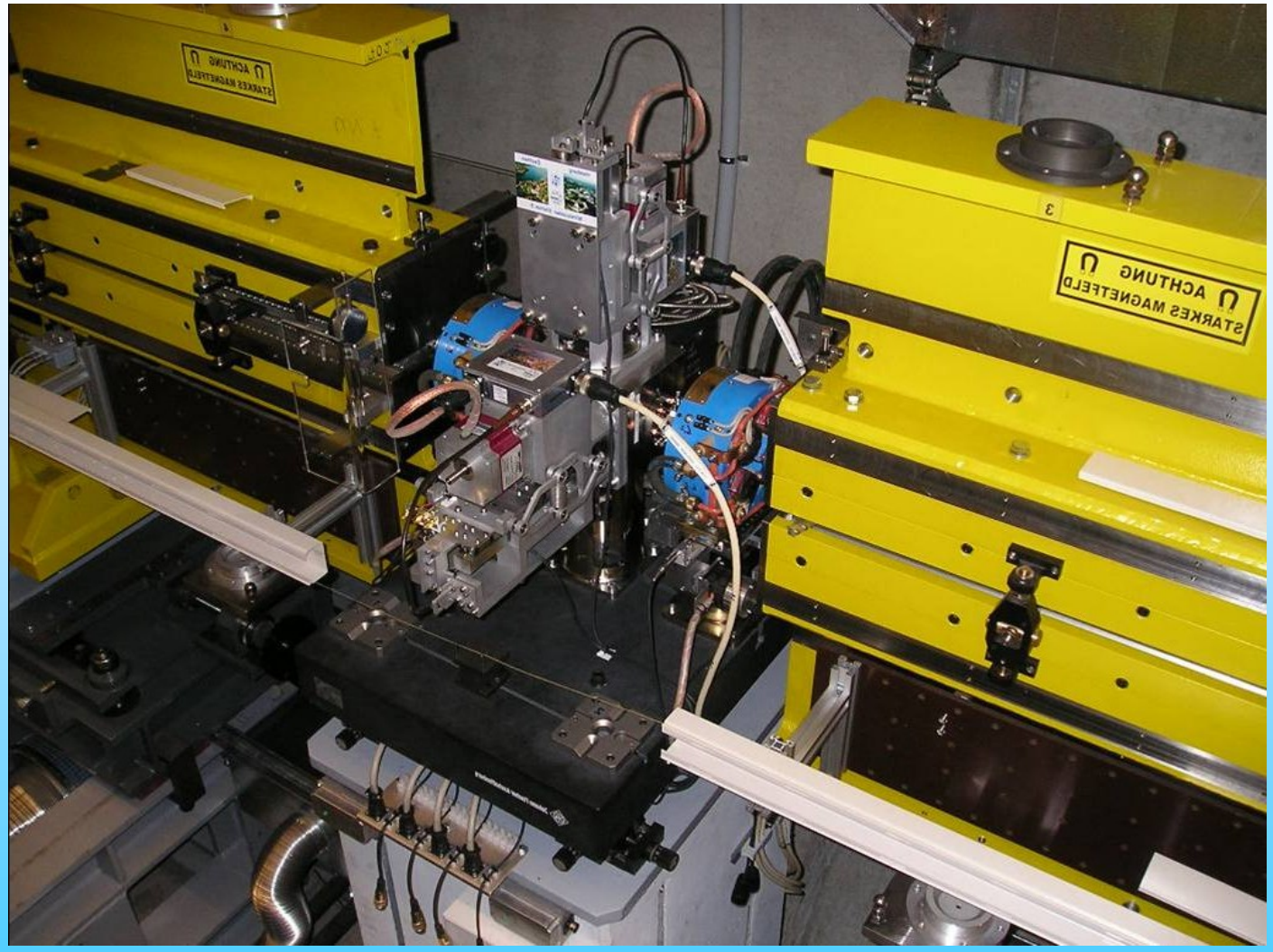
Test-Measurements with Hamamatsu H6780 photomultiplier

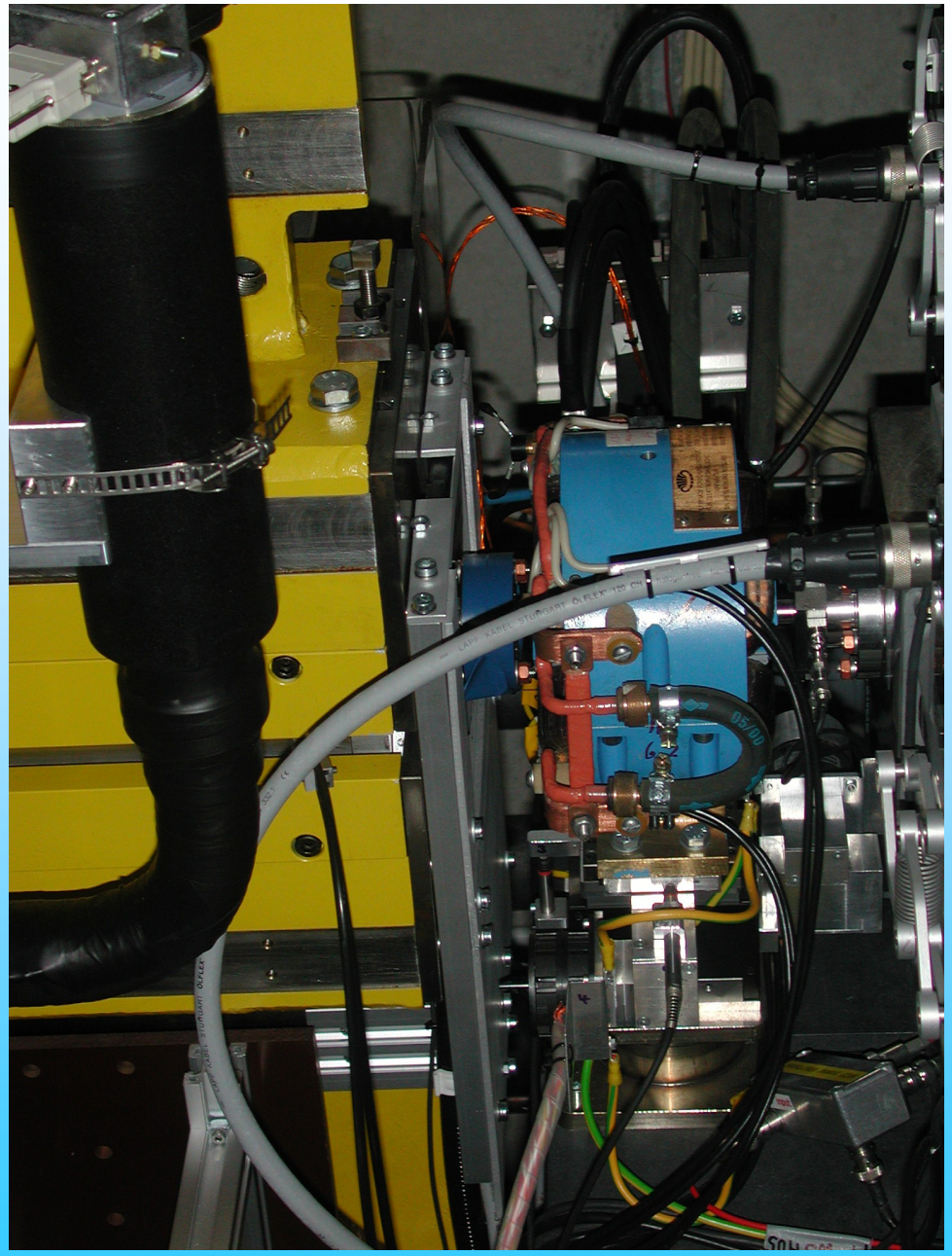
Martin Sachwitz

FEL Beam Dynamics Seminar, 12. Januar 2007

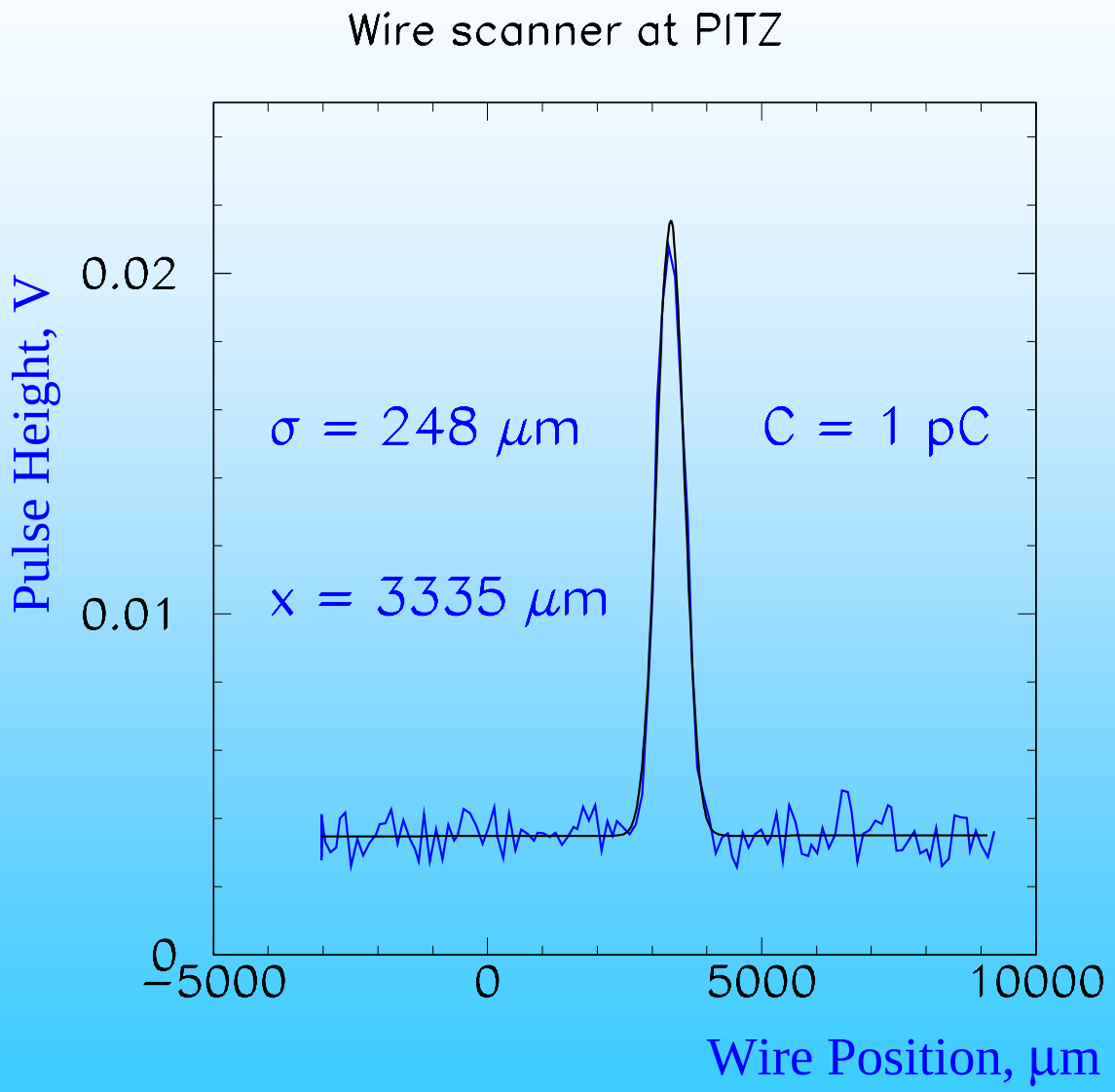
7 Wire Scanner Stations

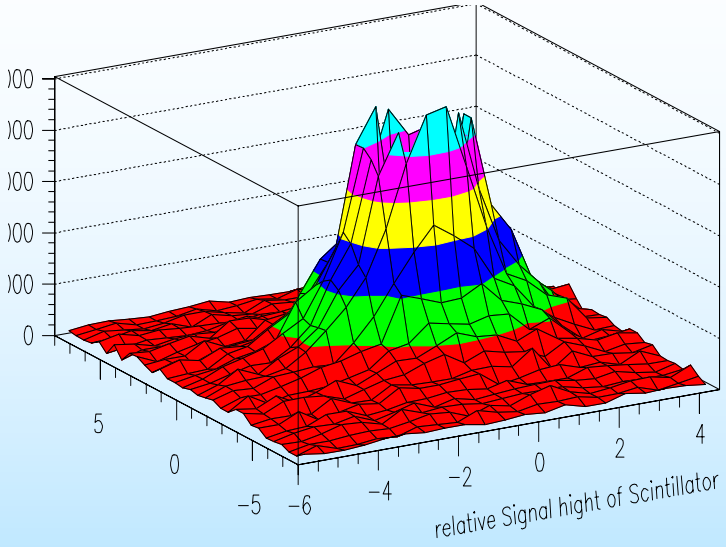


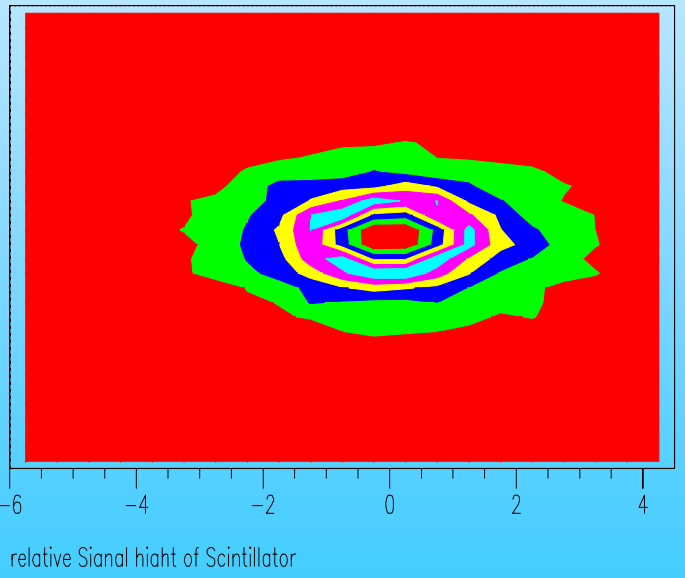
(Hasylab-Zeuthen) in Undulator section

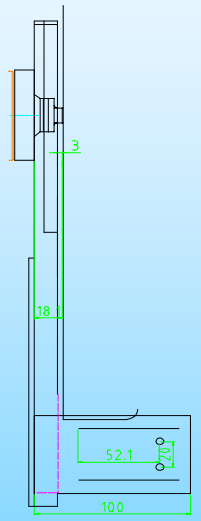


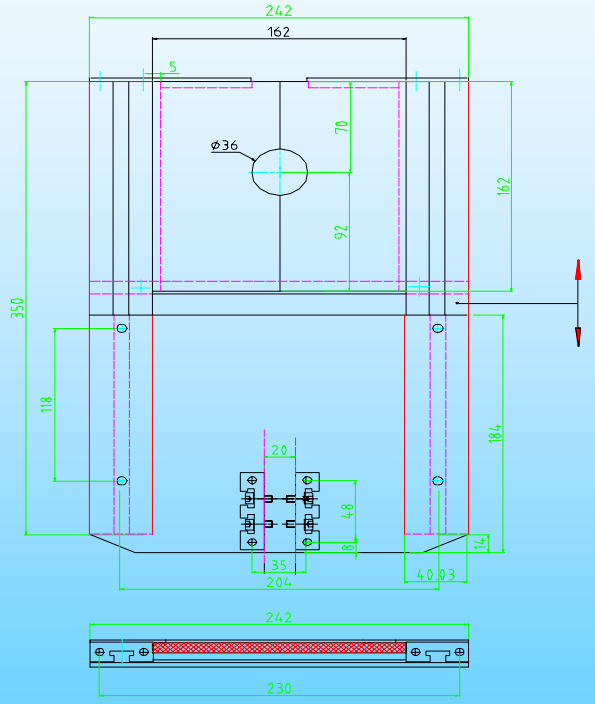
Sensitivity with 1 pC charge









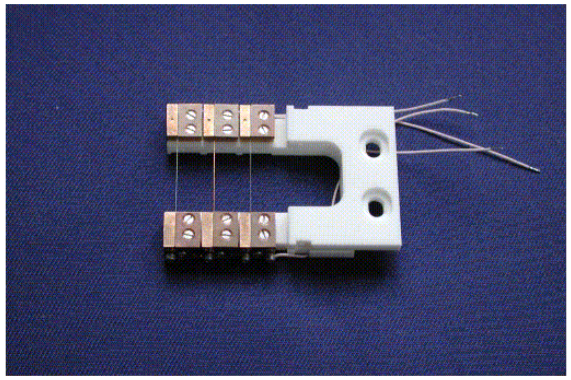


Scintillator

Fork with three wires

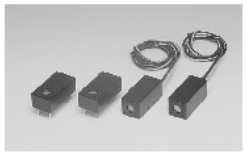
d = 10, 10, 50 µm
C, W, W
Z = 12, 74, 74

$Amplitude \propto d^2 Z^2$



Metal Package PMT

Photosensor Modules H5773/H5783/H6779/H6780 Series



The H5773/H5783/H6779/H6780 series are photosensor modules housing a metal package PMT and high-voltage power supply circuit. The metal package PMTs have a metallic package with the same diameter as a TO-8 package used for semiconductor photodetectors, and deliver high gain, wide dynamic range and high-speed response while maintaining small dimensions identical to those of photodiodes. The internal high-voltage power supply circuit is also compact, making the module easy to use.
Considering the mounting methods, a cable output type and a pin output type are provided, and a total of 7 types are available according to the wavelength range to be measured. A P-type is also available with selected gain and dark count ideal for photon counting under extremely low light conditions.

Product Variations

Type No. \ Suffix	None	-01	-02	-03	-04	-06	-20	Output Type	Features
H5773	yes	yes	yes	yes	yes	yes	yes	On-board	Low power consumption
H5783	yes	yes	yes	yes	yes	yes	yes	Cable output	
H5773P	yes	no	no	no	no	no	no	On-board	For photon counting
H5783P	yes	no	no	no	no	no	no	Cable output	Low power consumption
H6779	yes	yes	yes	yes	yes	yes	yes	On-board	Low ripple noise
H6780	yes	yes	yes	yes	yes	yes	yes	Cable output	Fast settling time

Suffix	Spectral Response
None	300 nm to 650 nm
-01	300 nm to 850 nm
-02	300 nm to 880 nm
-03	185 nm to 650 nm
-04	185 nm to 850 nm
-06	185 nm to 650 nm
-20	300 nm to 900 nm

The suffix -06 type (synthetic silica window) has higher sensitivity than the -03 type below 300 nm in wavelength range.

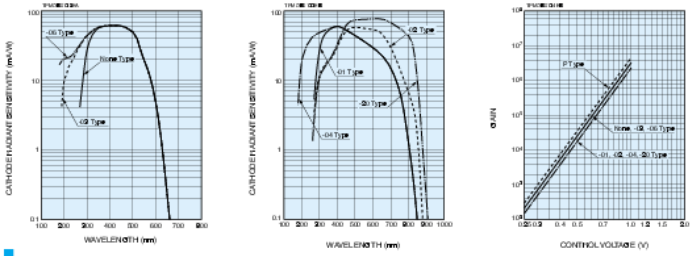
Specifications

Parameter			H5773 / H5783 / H6779 / H6780 Series					Unit
Suffix			None	-03, -06	-01, -04	-02	-20	—
Input Voltage			+11.5 to +15.5					V
Max. Input Voltage			+18					V
Max. Input Current			H5773 / H5783 Series: 9 H6779 / H6780 Series: 30					mA
Max. Output Signal Current			100					µA
Max. Control Voltage			+1.0 (Input impedance 100 kΩ)					V
Recommended Control Voltage Adjustment Range			+0.25 to +0.9					V
Effective Area			ø8					mm
Sensitivity Adjustment Range			1: 10^4					—
Peak Sensitivity Wavelength			420	420	400	500	630	nm
Cathode	Luminous Sensitivity	Min.	40	40	80	200	350	µA/lm
		Typ.	70	70	150	250	500	
	Blue Sensitivity Index (CS 5-58)		8	8	—	—	—	—
	Red/White Ratio		—	—	0.2	0.25	0.45	—
	Radiant Sensitivity *1		62	62	60	58	78	mA/W
Anode Standard Type	Luminous Sensitivity	Min.	10	10	15	25	35	A/lm
		Typ.	50	50	75	125	250	
	Radiant Sensitivity *1 *2		4.3×10^4	4.3×10^4	3.0×10^4	2.9×10^4	3.9×10^4	A/W
	Dark Current *2 *3	Typ.	0.2	0.2	0.4	2	2	nA
		Max.	2	2	4	20	20	
Anode P Type	Gain *2	Min.	7.5×10^5	—				—
		Typ.	1×10^6	—				
	Radiant Sensitivity *1 *2		6.2×10^4	—				A/W
	Dark Count *2 *3	Typ.	80	—				s^{-1}
		Max.	400	—				
Rise Time *2			0.78					ns

		H5773 Series	H5783 Series	H6779 Series	H6780 Series	
Ripple Noise *2 *4 (peak to peak)	Max.	1.2		0.6		mV
Settling Time *5		2		0.2		s
Operating Ambient Temperature		+5 to +50		+5 to +45		°C
Storage Temperature		-20 to +50				°C
Weight		60	80	60	80	g

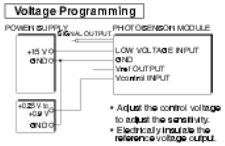
*1: Measured at the peak sensitivity wavelength *2: Control voltage = +0.8 V *3: After 30 minute storage in darkness
*4: Cable RG-174/U, Cable length 450 mm, Load resistance = 1 MΩ, Load capacitance = 22 pF
*5: The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V.

Characteristics (Cathode radiant sensitivity, Gain)

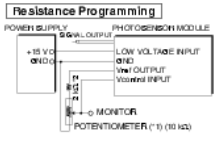


Sensitivity Adjustment Method

Voltage Programming



Resistance Programming

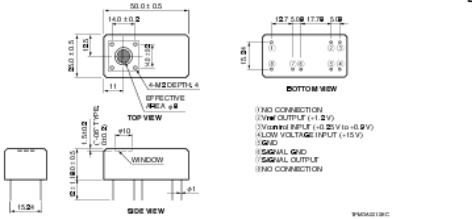


*1: When using a potentiometer to adjust sensitivity, monitor the control voltage so it does not exceed +1.0 V.

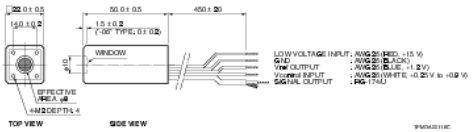
*2: H6779/H6780 series has this 2 kΩ resistor.
No external resistor is needed.

Dimensional Outlines (Unit: mm)

H5773/H6779 Series

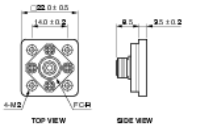


H5783/H6780 Series

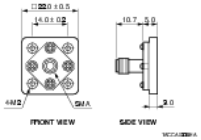


Option (Optical Fiber Adapter) (Unit: mm)

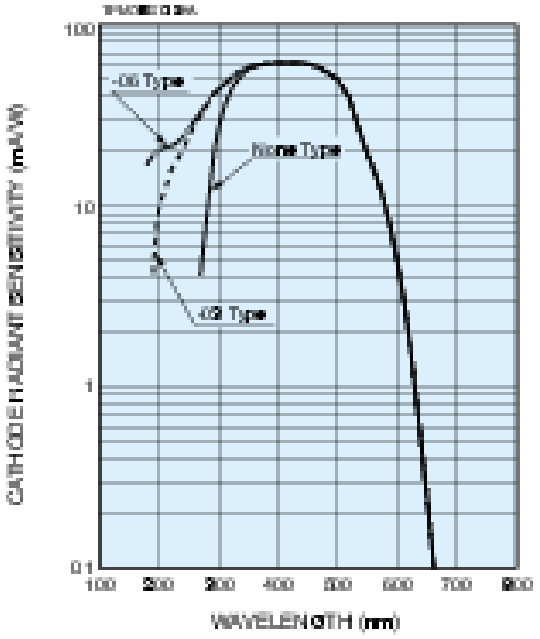
E5776 (FC Type)

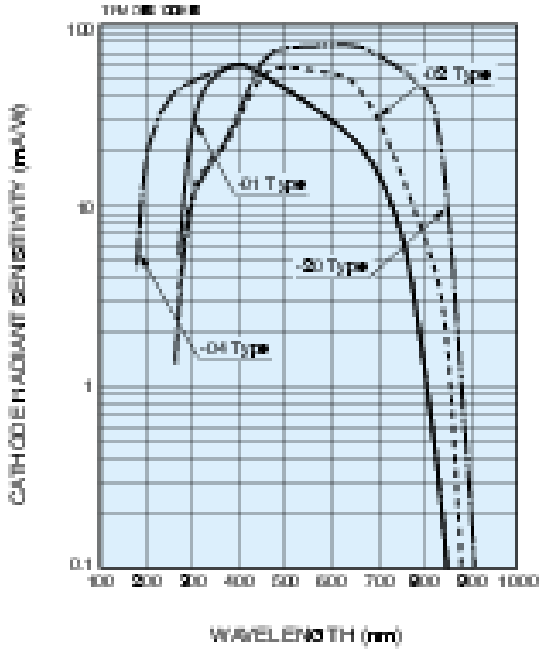


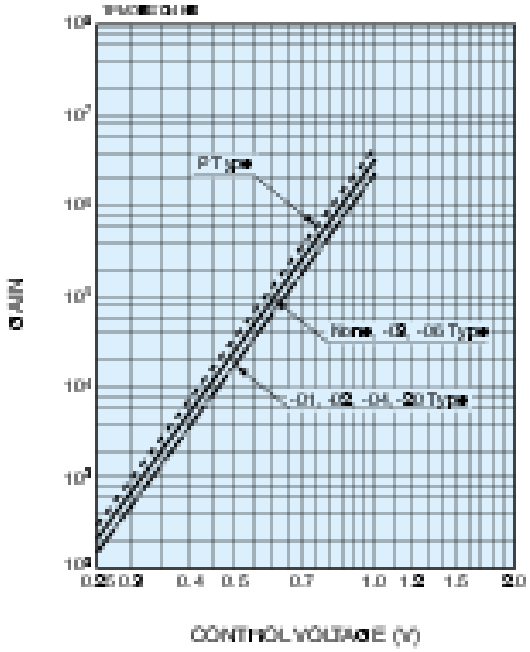
E5776-51 (SMA Type)



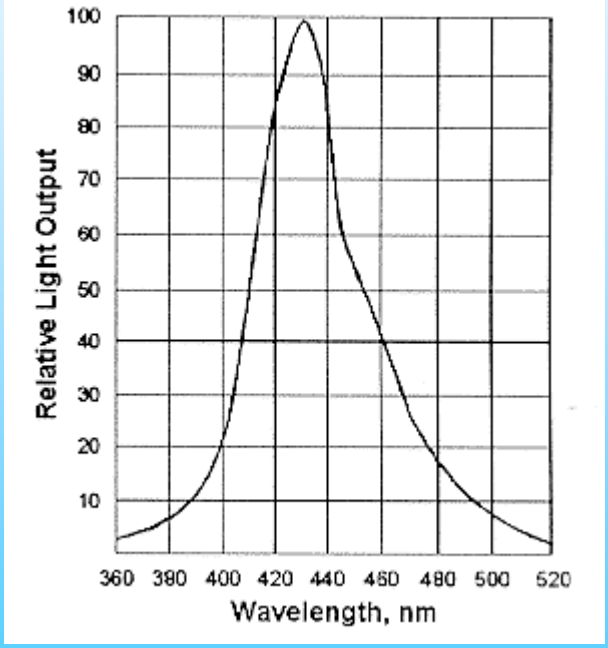
Characteristics (Cathode radiant sensitivity, Gain)







- BC-408 Premium Plastic Scintillator (BICRON)
- BC-408 is a blue-emitting plastic scintillator that is sensitive to protons and electrons as well as alphas, betas, gammas and neutrons. The bare scintillator glows blue when exposed to UV light from any source.



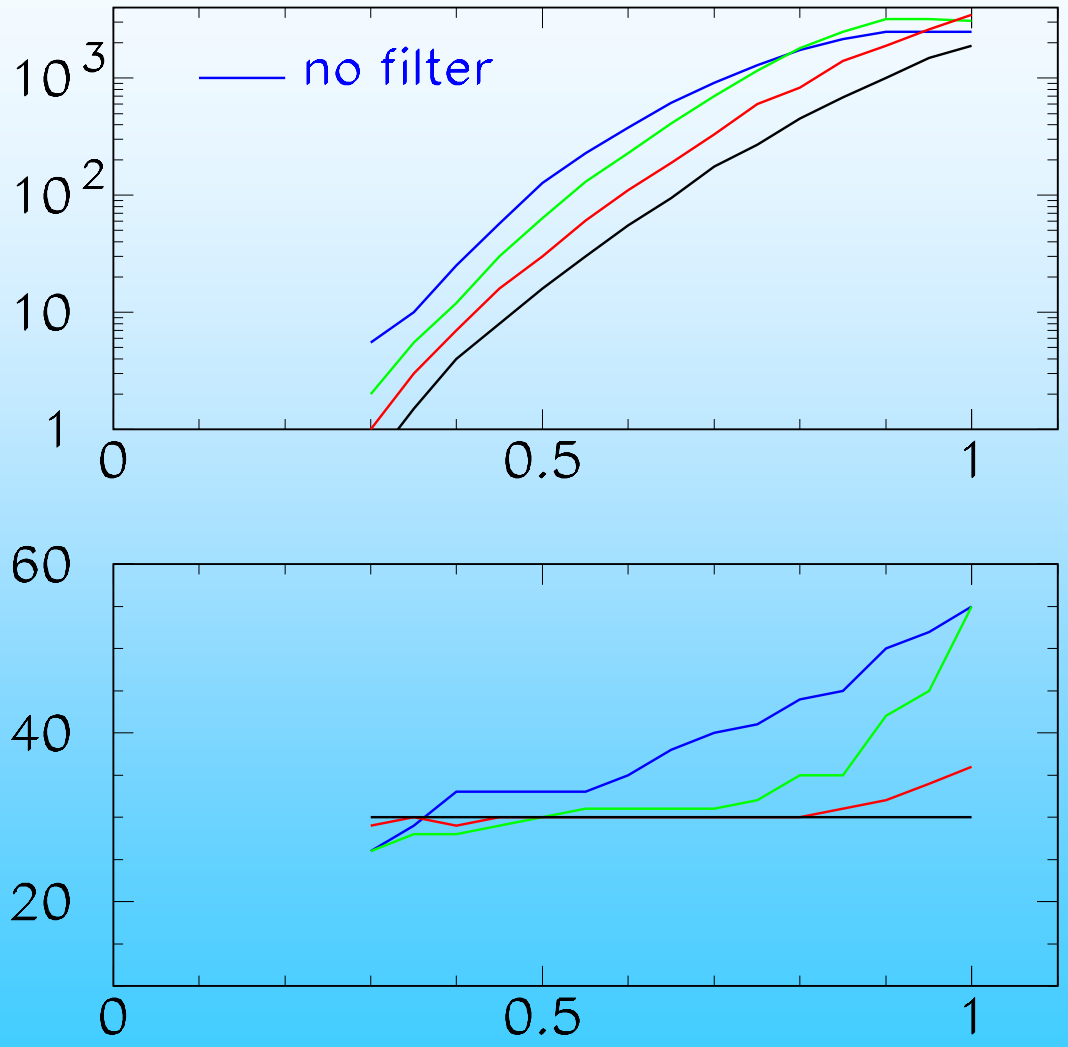
Ultrahelle, blaue LED

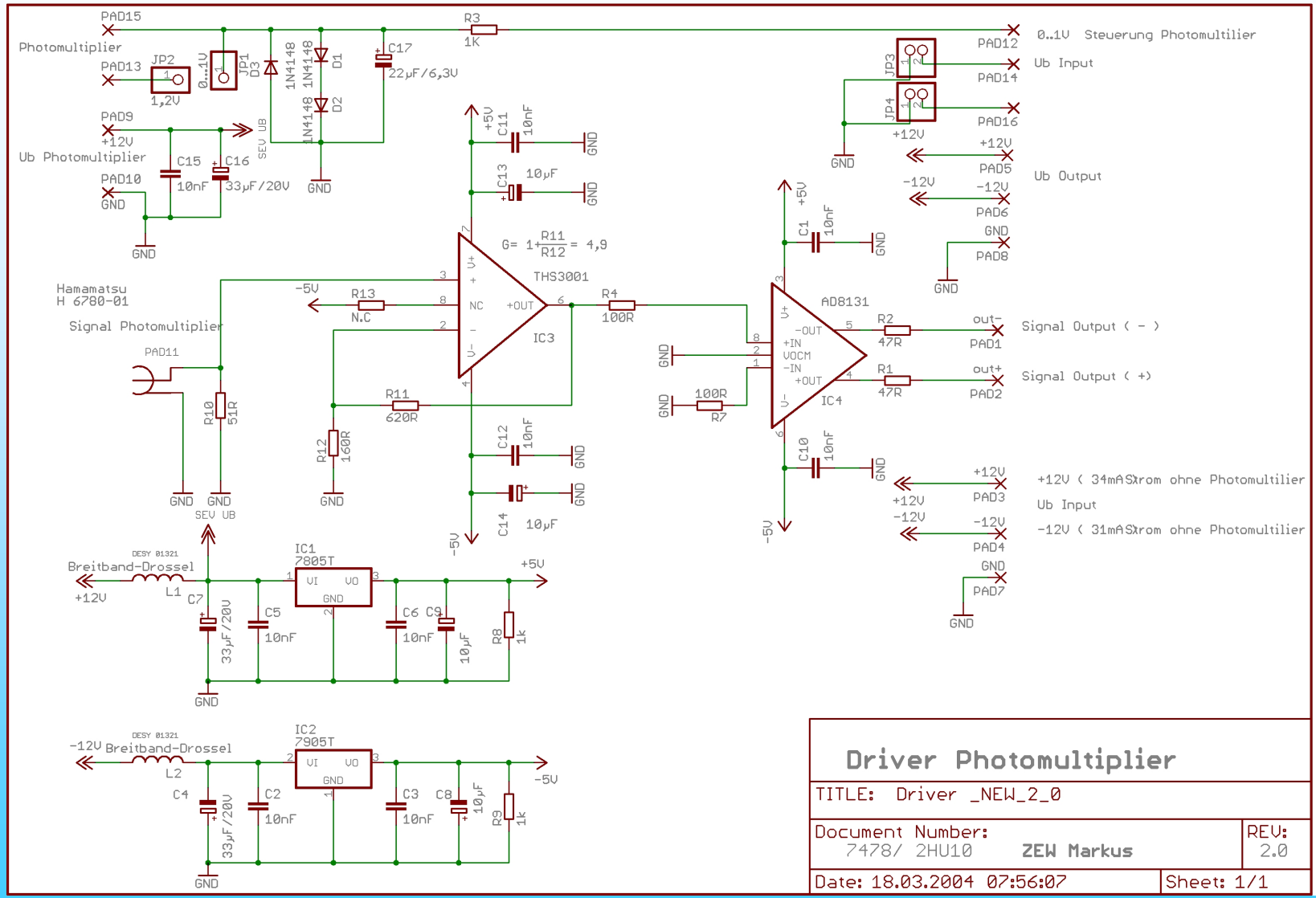
Blue LED

Technische Daten
IF (typ): 20mA
IF (max): 30mA
VF (typ): 3,6V
VR (max): 5V
Verlustleistung: 120mW
Betriebstemperaturbereich: -20°C bis +80°C
blau weiss hell weiss
Intensität: 1000mcd 1910mcd 680mcd
Strahlungswinkel: 10° 35° 70°

Blau (470nm) Best.nr. 235-9900 3,40 €

direct PM read out Hamamatsu H6780

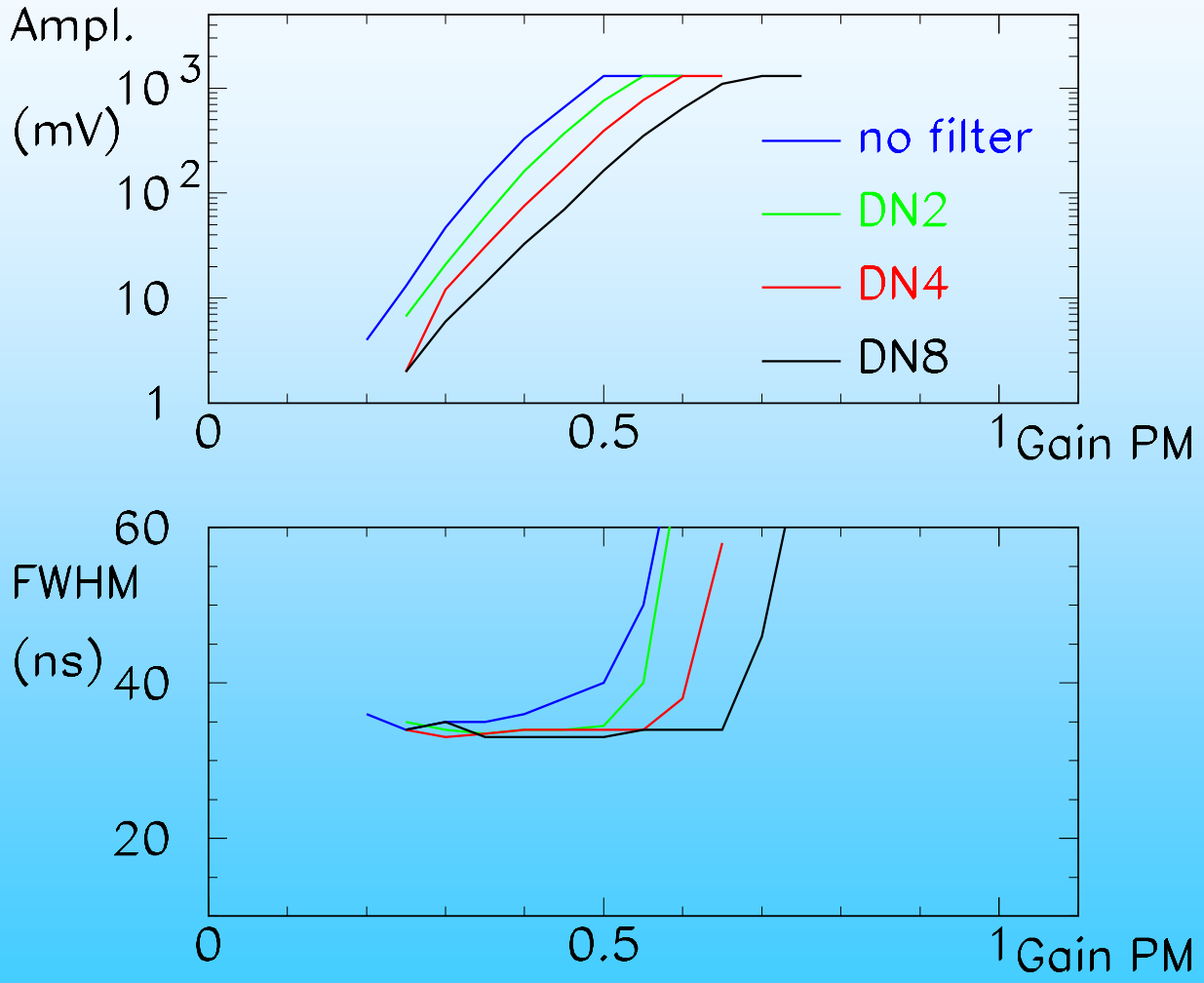



PAD15
Photomultiplier
PAD13
JP2
1,2V
0..1V
JP1
D3
1N4148
D1
D2
C17
22µF/6,3V
R3
1K
PAD9
+12V
Ub Photomultiplier
C15
10nF
C16
33µF/20V
SEV UB
PAD10
GND
+5V
C11
10nF
C13
10µF
G= 1+R11/R12 = 4,9
THS3001
IC3
Hamamatsu
H 6780-01
Signal Photomultiplier
PAD11
-5V
R13
N.C
R4
100R
R10
51R
R11
620R
R12
160R
C12
10nF
C14
10µF
IC1
7805T
Breitband-Drossel
DESY 01321
L1
C7
33µF/20V
C5
10nF
C6
C9
10µF
R8
1k
IC2
7905T
L2
C4
C2
C3
C8
R9
AD8131
IC4
R7
100R
R2
47R
R1
out-
out+
PAD1
PAD2
Signal Output (-)
Signal Output (+)
C1
C10
PAD12
PAD14
PAD16
PAD5
PAD6
PAD8
PAD3
PAD4
PAD7
0..1V Steuerung Photomultilier
Ub Input
Ub Output
+12V (34mA%rom ohne Photomultilier
Ub Input
-12V (31mA%rom ohne Photomultilier
Driver Photomultiplier
TITLE: Driver _NEW_2_0
Document Number: 7478/ 2HU10
ZEW Markus
REV: 2.0
Date: 18.03.2004 07:56:07
Sheet: 1/1

HELMHOLTZ GEMEINSCHAFT

DESY

PM + Amplifier Hamamatsu H6780



- What can we do?
- Reduce size of scintillator
- Other location (side of undulator)
- Reduce amplification in electronics
- Cut some light guides
- Install gray filters

Baugruppe	Gabel 9	Gabel / Wire	Station 7	
Material	Macor	WIRE-1 10µ Carbon	WIRE-2 10µ Wolfram	WIRE-3 50µ Wolfram
Messung	1	-9,4450	0,6905	9,9300
	2	-9,4410	0,6905	9,9285
	3	-9,4415	0,6900	9,9280
	4	-9,4410	0,6905	9,9290
	5	-9,4415	0,6900	9,9280
	6	-9,4420	0,6890	9,9290
	7	-9,4445	0,6905	9,9290
	8	-9,4440	0,6915	9,9285
	9	-9,4425	0,6895	9,9295
	10	-9,4430	0,6910	9,9280
	11	-9,4440	0,6880	9,9285
	12			
	Mittelwert	-9,4427	0,6901	9,9287
	Standardabw.	0,0015	0,0010	0,0006

Baugruppe	Gabel 10	Gabel / Wire	Station 7	
Material	Macor	WIRE-1 10µ Carbon	WIRE-2 10µ Wolfram	WIRE-3 50µ Wolfram
Messung	1	-8,9210	1,3815	10,4890
	2	-8,9180	1,3840	10,4905
	3	-8,9225	1,3875	10,4930
	4	-8,9160	1,3790	10,4880
	5	-8,9195	1,3825	10,4875
	6	-8,9150	1,3790	10,4875
	7	-8,9185	1,3875	10,4865
	8	-8,9170	1,3830	10,4860
	9	-8,9140	1,3875	10,4885
	10	-8,9220	1,3920	10,4870
	11			
	12			
	Mittelwert	-8,9184	1,3844	10,4884
	Standardabw.	0,0029	0,0042	0,0021

Bei welcher Anzeige des Heidenhain - Messgerätes befindet sich der Draht auf Sollposition ?

Einbauort				Horizontale Referenzfläche zur Nutmitte		Heidenhein - Anzeige beim Draht auf dem Fadenkreuz (Mittelwert)		Ref.-fläche d. Vermessungs vorr. zum Fadenkreuz (Mittelwert)	Abstand Fadenkreuz zur Mitte d. Vermessungs vorr.	Anzeige (Heidenhein) bei Draht auf Mitte d. Vermessungsvorr.	Versatz Diagnoseblock zur Mitte der Nut in der Granitplatte	Heidenhein - Anzeige bei Sollposition des Drahtes
Station (in Strahlrichtung)	Granit-platte JFA	D.-Block	WS Horiz.	Mittelwert	Sollwert							
2	1	6	11	72,55	72,5	Wire - 1	-9,2599	72,4755	0,0245	-9,2354	0,05	-9,1854
						Wire - 2	0,6512			0,6757		0,7257
						Wire - 3	10,0014			10,0259		10,0759
1	2	7	9	72,75	72,5	Wire - 1	-9,4427	72,4755	0,0245	-9,4182	0,25	-9,1682
						Wire - 2	0,6901			0,7146		0,9646
						Wire - 3	9,9287			9,9532		10,2032
7	3	1	7	72,48	72,5	Wire - 1	-9,0477	72,4755	0,0245	-9,0232	-0,02	-9,0432
						Wire - 2	0,5864			0,6109		0,5909
						Wire - 3	10,1079			10,1324		10,1124
XX	4	2			72,5	Wire - 1		72,4755	0,0245			
						Wire - 2						
						Wire - 3						
4	5	8	5	72,55	72,5	Wire - 1	-8,9873	72,4755	0,0245	-8,9628	0,05	-8,9128
						Wire - 2	0,5489			0,5734		0,6234
						Wire - 3	9,995			10,0195		10,0695
5	6	4	13	72,5	72,5	Wire - 1	-9,6081	72,4755	0,0245	-9,5836	0	-9,5836
						Wire - 2	0,6378			0,6623		0,6623
						Wire - 3	10,0841			10,1086		10,1086
6	7	5	3	72,4	72,5	Wire - 1	-9,1064	72,4755	0,0245	-9,0819	-0,1	-9,1819
						Wire - 2	-0,8524			-0,8279		-0,9279
						Wire - 3	10,4099			10,4344		10,3344
3	8	3	17	72,5	72,5	Wire - 1	-9,0095	72,4755	0,0245	-8,985	0	-8,985
						Wire - 2	0,814			0,8385		0,8385
						Wire - 3	10,4413			10,4658		10,4658