Ростехнологии
Ruselectronics

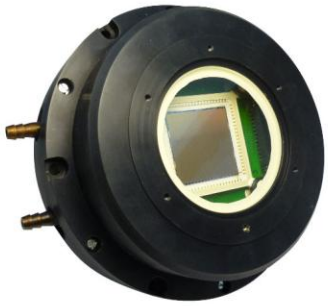
NATIONAL RESEARCH INSTITUTE
ELECTRON

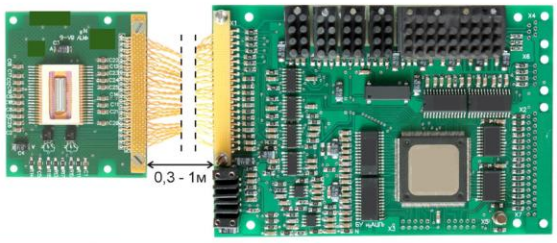
CATALOGUE OF PRODUCTS

OJSC “NRI ”Electron”

CONTESTS

FPU





PHOTODETECTORS

FPU 4A,4P

FPU 1M

FPU 2M

PORTABLE PHOTODETECTOR MFPU 7OM

MFPU ARRAY DETECTOR WITH CONTROL UNIT AND ADC

FPU-4A, FPU-4P SOLAR-BLIND PHOTODETECTORS

Digital high sensitive FPU-4A and FPU-4P are intended for optical image conversion in UV spectral range into TV signal in wide irradiation diapason at input.

FPU image sensor includes two stage amplifier based on two intensifiers of 2+ generation, coupled through direct fiber-optical contact with special frame transfer large-format array. A combined bandpass filter was used to block visible spectral range. In FPU-4P the capability of sampling by gate of input intensifier is realized. Gain control is fulfilled by gain change of two intensifiers.

FPU-4 operates in different modes with automatic and manual amplification control.

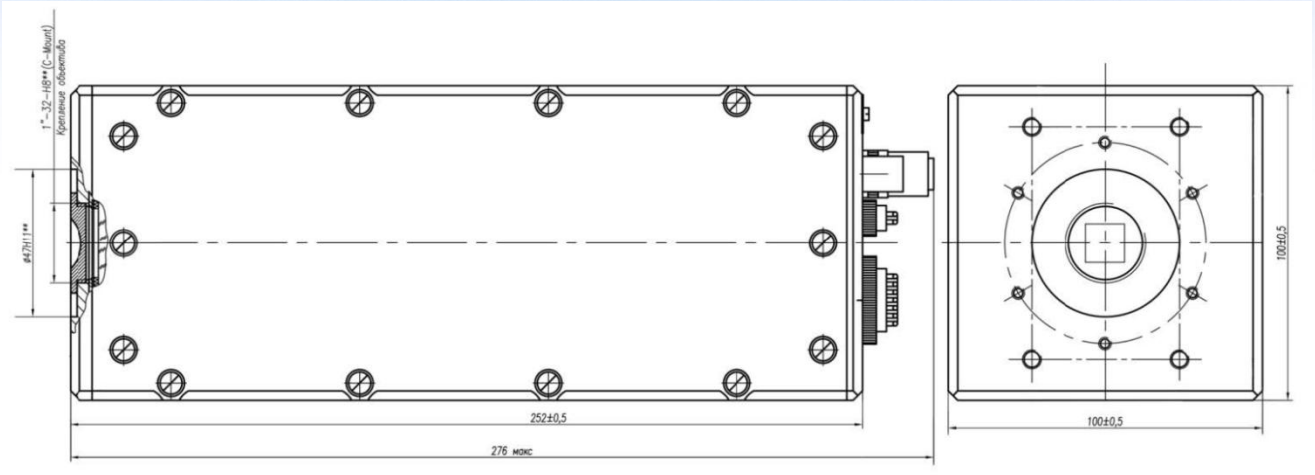
FPU is supported by interface USB 2.0 for OC Windows 7,8.

Operating irradiation range at FPU input is from 10-12 to 10-6 W/cm2.

SPECIFICATIONS

Parameters	FPU-4A	FPU-4P
Spectral response, nm	230 ÷ 310	230 ÷ 310
Output signal at operating irradiation $5x10^{-9}$ W/cm^2 and λ=280 nm, mV	> 100	> 100
S/N ratio at operating irradiation	> 10	> 10
Spectral sensitivity at λ=280 nm, V·cm^2/W	> $2x10^7$	> $2x10^7$
Threshold irradiation at λ-280 nm, W/cm^2	< $5x10^{-10}$	< $5x10^{-10}$
Dark signal, mV/s	< 100	< 100
Number of pixels	1024x1024	768x580(290)
Sampling mode, ns	≥10	-
Supply voltage, V	27±1	27±1

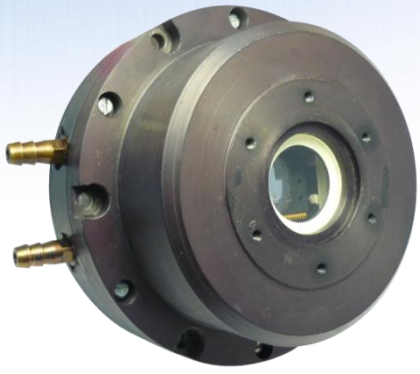
DIMENSIONAL OUTLINE



SPECTRAL RESPONSE CHARACTERISTIC

FPU –1M PHOTODETECTOR

FPU-1M is intended for wide application, including: detection of small size objects with higher accuracy. It is used in TV systems of image conversion and processing with continuous and pulse illumination as well, as in measurement equipment.



FPU consists of:

- CCD chip;
- chip holder (base);
- cooled package with thermoelectric battery;
- removable input window.

FPU-1M basic photosensitive element is cooled 1536x1536 CCD.

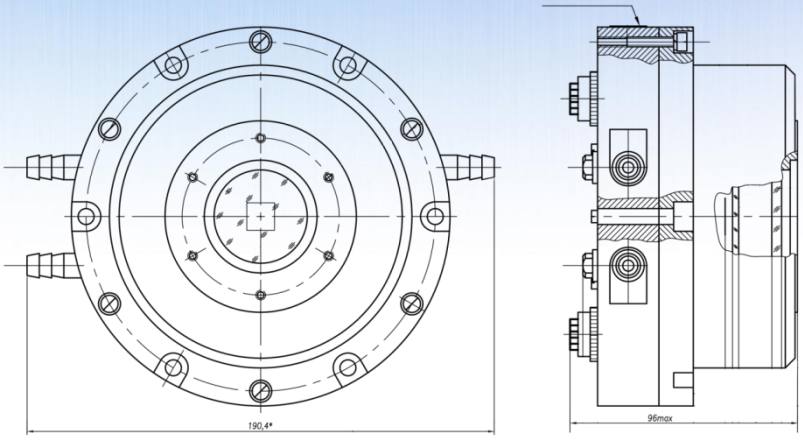
The CCD is a silicon thinned frame transfer n-channel device based on p-type substrate.

SPECIFICATIONS

Saturation voltage, mV	> 600
Saturation charge, thousand of electrons	> 120
Dynamic range	> 2400
Quantum efficiency in spectral range maximum, %	> 80 (1)
Spectral response, nm	300-1000 (1)
Dark signal, mV/s	<100
Relative dark signal nonuniformity, %	<2
Relative luminous nonuniformity, %	<10
Transfer efficiency along the horizontal	>0.99995
Transfer efficiency along the vertical	>0.99995
Pixel size, μm	11x11
CCD chip thermoelectric cooling relative external temperature,K	>50
Number of pixels	1200x1200
Register operation frequency, MHz	>1.0

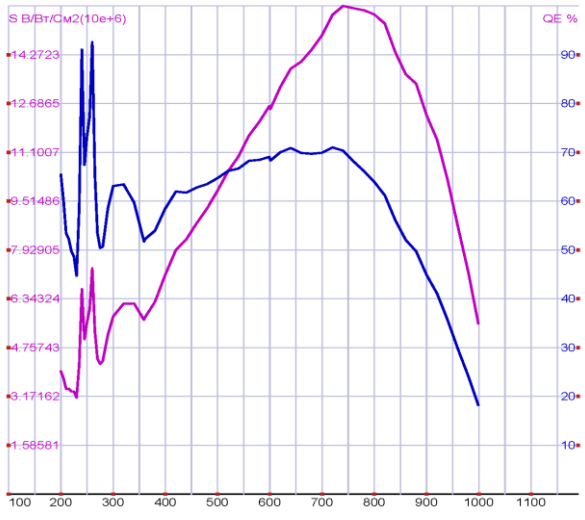
(1)For modification with higher response in IR-spectral range.

DIMENSIONAL OUTLINE

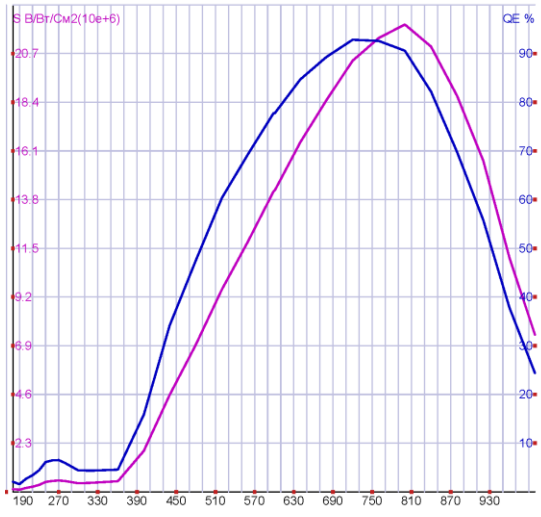


SPECTRAL RESPONSE CHARACTERISTIC

With higher response in UV-spectral range

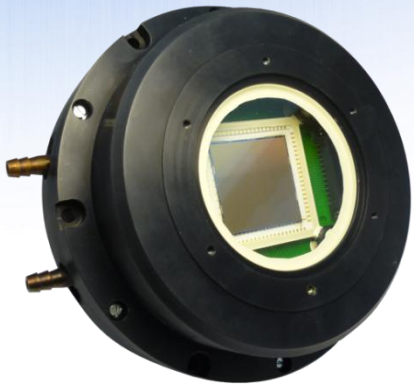


With higher response in IR-spectral range



FPU –2M PHOTODETECTOR

FPU-2M is intended for wide application, including: detection of small size objects with higher accuracy. It is used in TV systems of image conversion and processing with continuous and pulse illumination as well as in measurement equipment.



FPU consists of:

- CCD chip;
- thermoelectric battery (TEB);
- package;
- removable input window.

FPU-2M basic photosensitive element is cooled with 4096x4096 CCD.

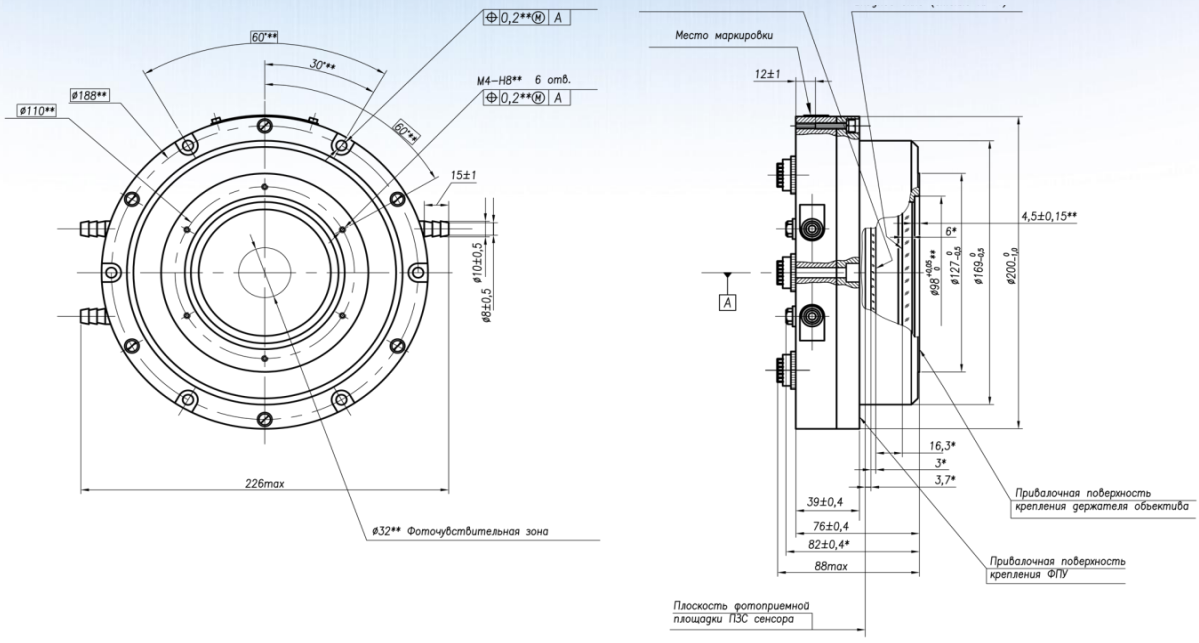
The CCD is a silicon thinned frame transfer n-channel device based on p-type substrate.

SPECIFICATIONS

Saturation voltage, mV	> 600
Saturation charge, thousand of electrons	> 120
Dynamic range	> 2400
Quantum efficiency in spectral range maximum, %	> 80 (1)
Spectral response, nm	300-1000 (1)
Dark signal, mV/s	<100
Relative dark signal nonuniformity, %	<4
Relative luminous nonuniformity, %	<20
Transfer efficiency along the horizontal	>0.99995
Transfer efficiency along the vertical	>0.99995
Pixel size, μm	11x11
CCD chip thermoelectric cooling relative external temperature, K	>30
Number of pixels	4096x4096
Register operation frequency, MHz	>1.0

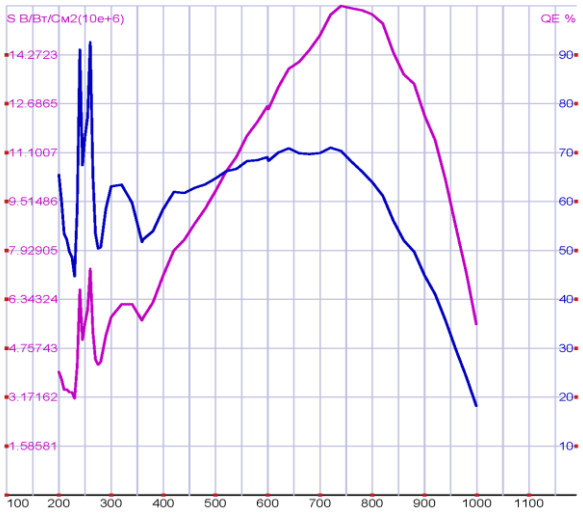
(1) For backside illuminated thinned CCD.

DIMENSIONAL OUTLINE

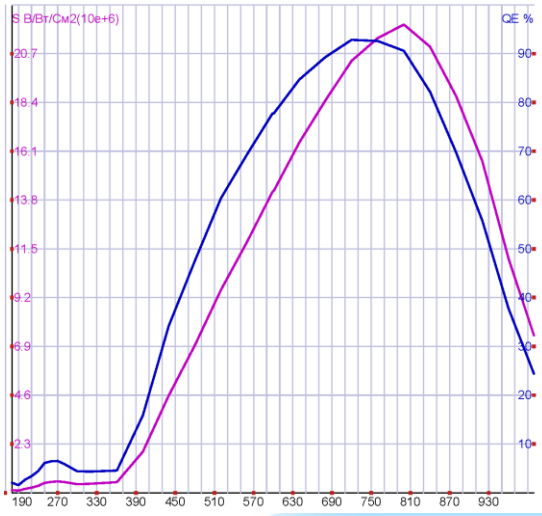


SPECTRAL RESPONSE CHARACTERISTIC

Backside illuminated CCD



CCD illuminated from electrode side



MFPU 7 OM PORTABLE PHOTODETECTOR

MFPU is intended for detection of images of radiation point sources in visible spectral range and converting it into digital video signal. Cooled array single section CCD with antiblooming, quasi random access to any line of photosensitive area is used as an image sensor.

The number of array photosensitive pixels is 512x512. Photosensitive area size is 11,776 x11,776 mm. MAPU consists of two units: photodetector unit (PU) and electronic framework unit (EFU).

Photodetector unit includes CCD and signal preamplifier with amplification factor 16. CCD has a built-in portable thermoelectric battery, operating on Peltier effect. Warm from thermoelectric battery hot side is supplied on photodetector unit construction elements. Photodetector unit has

a built-in cable to connect with electronic framework unit.

EFU includes synchrogenerator for CCD control voltage production and video signal digital processing unit. Amplifier channel saturation voltage is 5V.

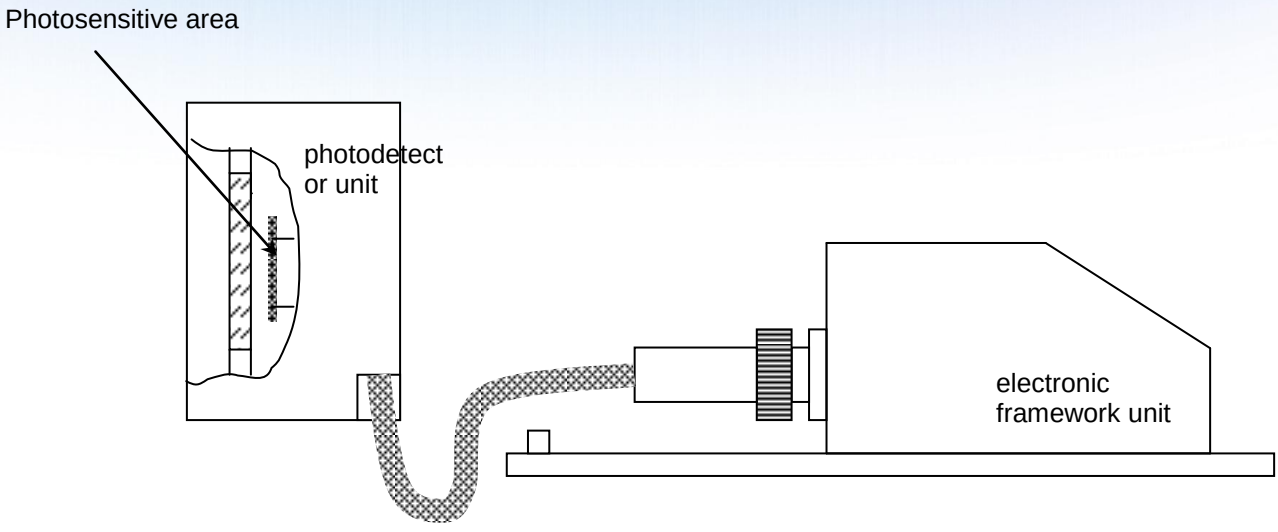
EFU has two connectors: one – for connection with optic-electronic system device of change, another – for connection with PU.

Electrical and photoelectrical parameters correspond to ADC data at normal climatic conditions at (25±10)ºC and accumulation time 1 sec at acceptance and agree with standards presented in a table:

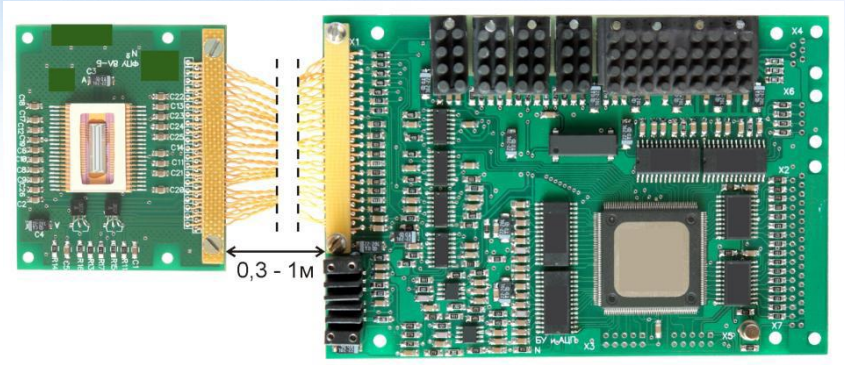
SPECIFICATIONS

Responsivity, V/lx·s	100÷200
Noise mean square voltage, mV	<8
Output signal relative mean square nonuniformity across the photosensitive area, %	<4
Mean dark signal, mV	<30
Dark signal mean square nonuniformity, mV	<12
Dark signal local mean square nonuniformity in any 5x5 pixel zone of photosensitive area, mV	<3
Charge transfer inefficiency for signal level at range (0.01-0.95) from saturation voltage of amplifier channel, per unit	$<2 \cdot 10^{-5}$
Luminous characteristic non-linearity in ADC operating range, %	<2
Local overillumination suppression factor	>100

EXTERNAL APPEARANCE



MFPU ARRAY DETECTOR WITH CONTROL UNIT AND ADC



Device is based on a bilinear photodetector formed by two linear CCDs of 1000 pixels each (with independent control) which are shifted one relative to another at one half of pixel pitch to improve resolution.

Construction design: Photodetector is fixed in package which provides linear CCD photosensitive surface fastening and alignment relative to landing plane in equipment. The device also includes electronic channel with linear CCD control unit and 12-digital digital video signal output. MFPU could be complete with a module of signal input to PC through USB 2.0.

Application:

• Optical-electronic devices of precise linear and angle positioning including product space orientation;

• Equipment of remote measurement of linear dimensions, shapes, thickness and diameters of different subjects in industry;

• Automated spectrometers of visible and near IR spectral ranges for wide and particular application;

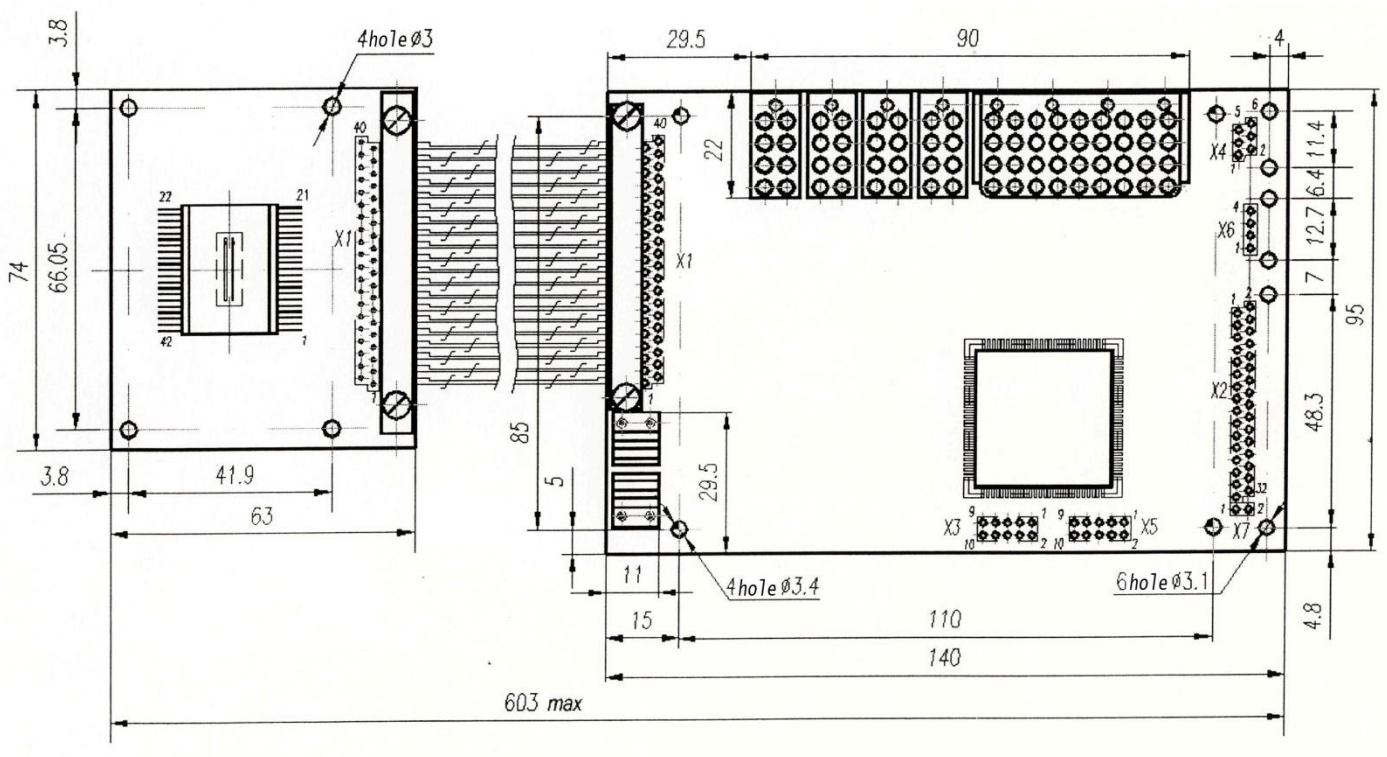
• Devices for autofocusing, alignment and optic system quality inspection.

SPECIFICATIONS

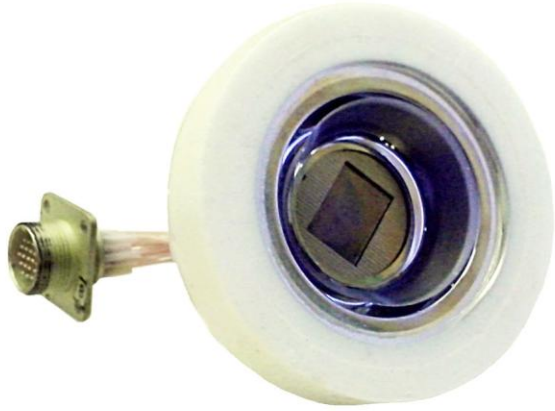
Number of pixels	2×1000
Pixel size, μm	13×500
Pixel pitch, μm	13
Distance between linear CCDs, μm	840
Spectral response, μm	0.2÷1.1
Package dimensions, mm	150×83×17
Typ. data output rate through parallel 12-digital output line, MHz	2
Dynamic range	3000-5000
Photodetector typ. responsivity, V/lx·s	25
System typ. responsivity, ADC /lx·s	4·104
Relative illumination nonuniformity, %	±3
Linearity of measurement of light mark position, %	0.02

Position accuracy (light mark gravity center position) across the whole length of chip photosensitive area, μm, no worse than	0.2
Number of coordinate readings	6.5·104
Power supply, V	+18±0.5;-18±0.5; +8±0.5
Operating temperature range, ºC	-50 ÷ +50

DIMENSIONAL OUTLINE



HYBRID DEVICES



AND MODULES

LOW LIGHT LEVEL SOLAR-BLIND HYBRID TV DEVICE BASED ON ELECTRON –SENSITIVE CCD

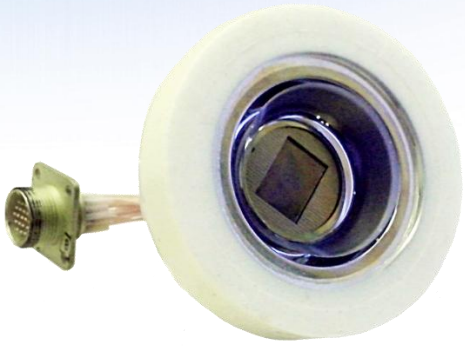
LOW LIGHT LEVEL HYBRID TV DEVICE BASED ON ELECTRON –SENSITIVE CCD FOR NIR RANGE

UNIFIED LOW LIGHT LEVEL PHOTODETECTOR MODULES

PORTABLE LOW LIGHT LEVEL IMAGING DEVICE FMTP1-1, FMTP1-2

LOW LIGHT LEVEL WIDE FORMAT TV DEVICE FMTP 3

LOW LIGHT LEVEL SOLAR-BLIND HYBRID TV DEVICE BASED ON ELECTRON –SENSITIVE CCD



The hybrid photodetector (HPD) is a proximity electro-vacuum device with photocathode and solid-state element – electron-sensitive CCD.

When photoelectrons hit array with energy, higher than 3 KeV generation of electron-hole pairs occurs in silicon, signal increases in several hundred times.

Because of signal gain in electron-sensitive CCD array HFD has sensitivity of 1-2 order higher than solid-state analogues.

In HPD the whole signal photoelectron flow from photocathode reaches array, there are no intermediate signal converting, so HPD noise factor is about 1,1. For photodetectors based on image intensifiers with MCP coupled with CCD array noise factor is 1.6-2.0. Besides, there are no fiber-optics elements in HPD, which decrease device radiation hardness.

In hybrid device for UV range CsTe photocathode is used, it provides high degree of solar blindness, decreases and even eliminates need of visible radiation filter.

In future it is planned to create devices with photocathodes for visible and near-IR spectral ranges.

Application:

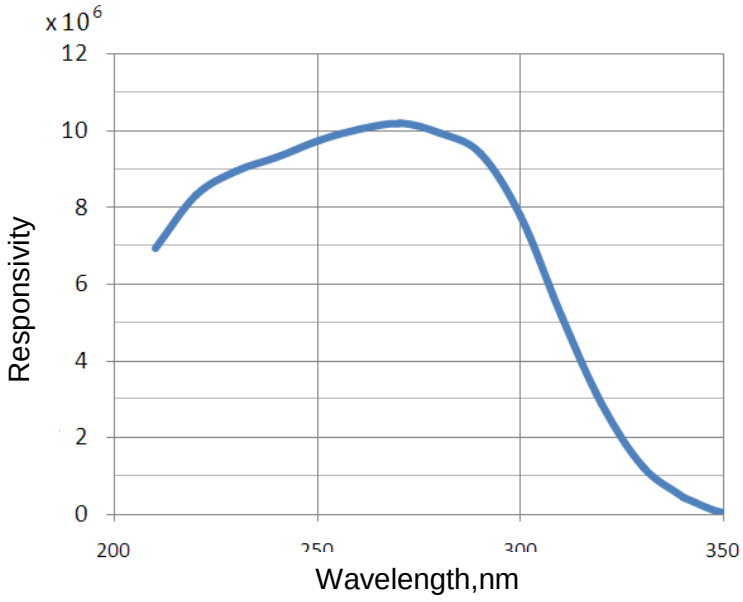
The device is recommended to apply in low light level portable TV equipment, observation systems for aircrafts, etc.

SPECIFICATIONS

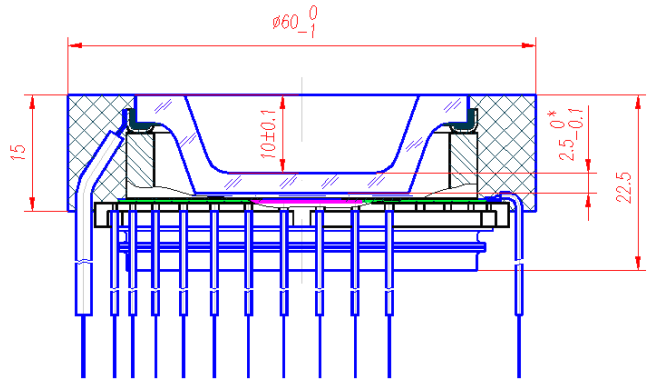
Spectral range, nm	200-300
Photocathode quantum efficiency in maximum, % (Photocathode spectral sensitivity in maximum, mA/W)	15-20 (31-42)
Photocathode voltage, kV	4-7
Sensitive area size, mm	13.1×9.8
Number of pixels	768×580
Pixel size, μm	17×34
Spectral sensitivity at λ=260-270 nm, $V \cdot cm^2/W$	$1 \cdot 10^7$
At irradiance of $2 \cdot 10^{-13}$ W/pixel ($3{,}4 \cdot 10^{-8} W/cm^2$) and pass band of 6.3 MHz - S/N ratio - Signal modulation depth on fine details (400 TVL)	 20-25 30-35

Threshold irradiance W/pixel (W/cm^2)	$3 \cdot 10^{-15} (5 \cdot 10^{-10})$
Dark signal, mV/s	<10
Device diameter, mm (in hermetic)	60
Device height, mm	23

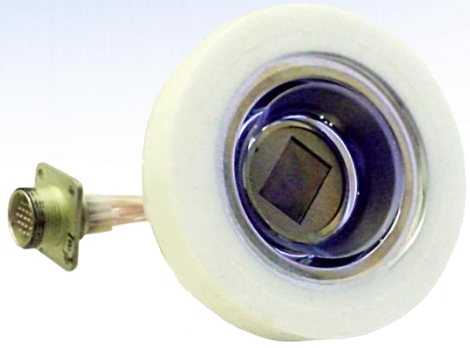
SPECTRAL RESPONSE CHARACTERISTICS



DIMENSIONAL OUTLINE



LOW LIGHT LEVEL HYBRID TV DEVICE BASED ON ELECTRON – SENSITIVE CCD FOR NIR RANGE



The hybrid photodetector (HPD) is a proximity electro-vacuum device with photocathode and solid-state element – electron-sensitive CCD.

It is planned to use in HPD a photocathode with drawing electrical field based on p-InP/p-InGaAs structure, that provides high sensitivity in range of 0.95-1.65 μm.

When photoelectrons hit array with energy, higher than 2-3 KeV, generation of electron-hole pairs occurs in silicon, gain of signal increases in several hundred times.

Because of signal gain in electron-sensitive CCD array HPD will have sensitivity of 1-2 order higher than solid-state analogues.

In HPD the whole signal photoelectron flow from photocathode reaches array, there are no intermediate signal converting, so noise factor is about 1,1. Besides, there are no fiber-optics elements in HPD, which decrease device radiation hardness.

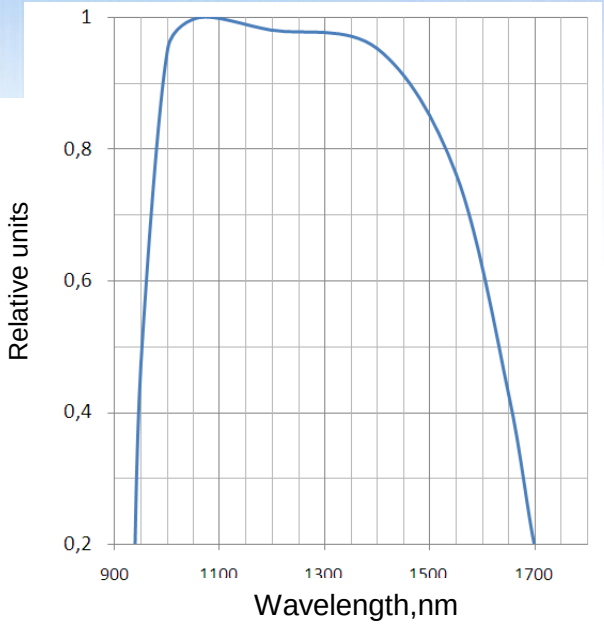
Application:

The device is recommended to apply in low light level portable TV equipment, observation systems for aircrafts, etc.

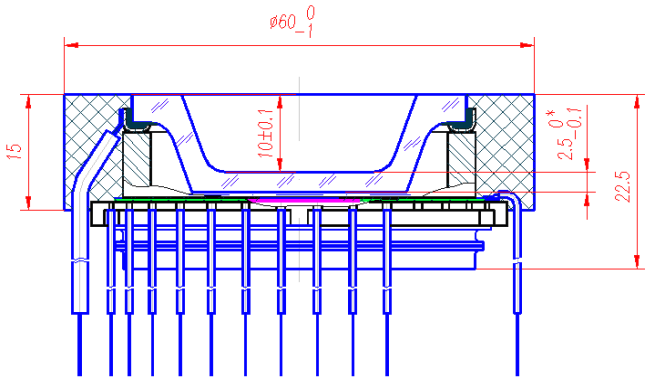
SPECIFICATIONS

Spectral range, μm	0.95-1.7
Photocathode quantum efficiency in maximum, %	2-10
Photocathode voltage, kV	2-6
Sensitive area size, mm	13.1×9.8
Number of pixels	768×580
Pixel size, μm	17×34
Sensitivity, A/W	4-20
Operating irradiance, W/el (W/cm^2)	~$3 \cdot 10^{-13}$ (~$1.7 \cdot 10^{-7}$)
Device diameter, mm (in hermetic)	60
Device height, mm	23

SPECTRAL RESPONSE CHARACTERISTICS



DIMENSIONAL OUTLINE



UNIFIED LOW LIGHT LEVEL PHOTODETECTOR MODULES

Unified low light level photodetector modules FPM-UV, FPM-VIS and FPM-IR are intended for conversion of optical image in UV, visible and near –IR spectral regions into TV signal in wide irradiance range at input.

Devices include two cascade pre-commutating amplifier based on two image intensifiers of 2+ generation, coupled through direct optical-fiber contact with special wide format frame transfer CCD.

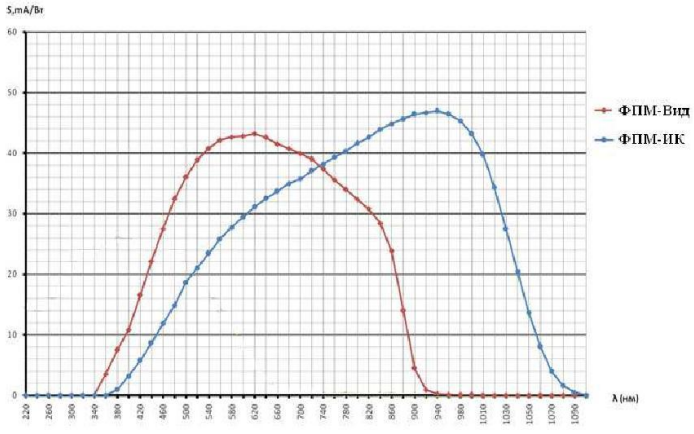
To block the visible range of the radiation spectrum in FPM-UV a combined bandpass filter was used. The unified devices FPM have possibility of gating by e-gate of input image intensifier. Wide adjustable range of irradiance at FPM input of 104 is achieved by varying the gain of two image intensifiers.

The main electrical and photoelectrical parameters of FPM modules are presented in Table 1.

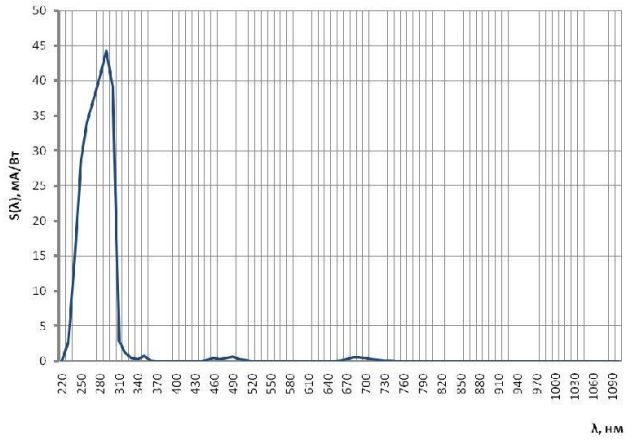
Parameters	FPM-UV	FPM-VIS	FPM-IR
Spectral response, nm	230÷310	340÷920	380÷1080
Operating irradiance	$3 \cdot 10^{-9}$ W/cm^2	$5 \cdot 10^{-4}$lx	$1.4 \cdot 10^{-8}$W/cm^2 after bandpass filter (λ=1070nm)
Output signal at operating irradiance, mV	>200	>200	>200
Resolution at operating irradiance, TVL	450	500	500
S/N ratio at operating irradiance	>10	>10	>10
Threshold irradiance	$1 \cdot 10^{-10}$ W/cm^2	$5 \cdot 10^{-6}$ lx	$6.7 \cdot 10^{-11}$ W/cm^2 after bandpass filter (λ=1070nm)
Dark signal, mV/s	<100	<100	<100
Geometric distortion, %	<1	<1	<1
Signal relative nonuniformity, %	≤20	≤20	≤20
Number of pixels	760×580 (290)	760×580 (290)	760×580 (290)
Photosensitive area size, mm	9.8×13.1	9.8×13.1	9.8×13.1
Pixel size, μm	17×34	17×34	17×34
Gating mode, ns	≥10	≥10	≥10
Frame frequency, Hz	50	50	50

EXAMPLES OF SPECTRAL RESPONSE CHARACTERISTICS OF LOW LIGHT LEVEL FPM-UV, FPM-VIS and FPM-IR

FPM-VIS and FPM-IR



FPM-with UV filter



LOW LIGHT LEVEL IMAGING DEVICE
FMTP1-1, FMTP1-2

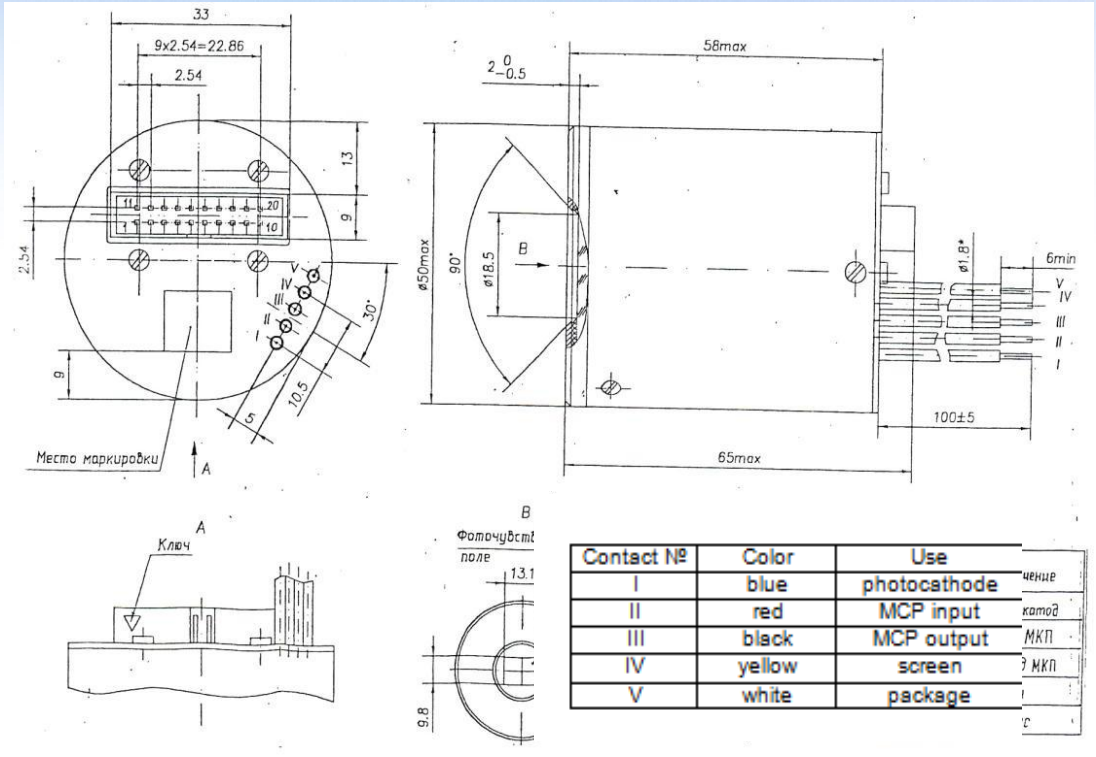
FMTP1-1,2 are low light level (LLL) imaging devices that include 2nd generation image intensifier tube and CCD array which are coupled through direct optical contact.

The device is intended for usage in LLL cameras of various applications.

SPECIFICATIONS

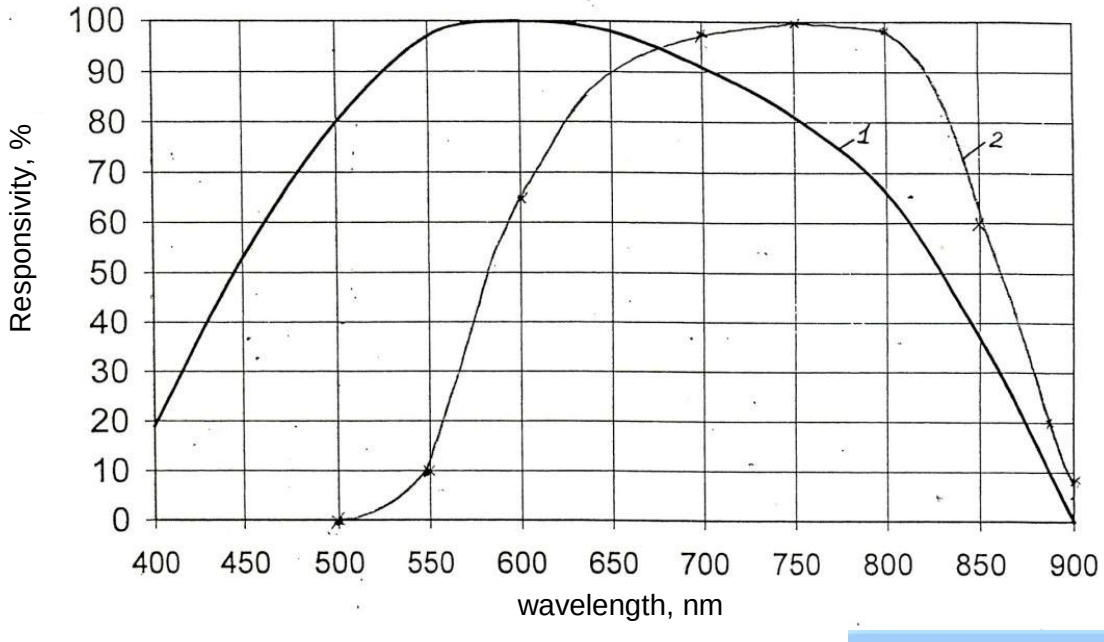
Parameters	FMTP1-1	FMTP1-2
Input image size, mm	9.8×13.1	9.8×13.1
Number of pixels	768×580	768×580
Spectral response, nm	400÷850	500÷900
Operation illumination, ≤lx	$2 \cdot 10^{-4}$	$1 \cdot 10^{-4}$
Resolution at operation illumination, TVL	500	500
Threshold illumination at 200 TVL resolution, lx	$2 \cdot 10^{-6}$	$1 \cdot 10^{-6}$
Controlled dynamic range, lx	$10^{-2} \div 2 \cdot 10^{-6}$	$10^{-2} \div 2 \cdot 10^{-6}$
S/N ratio at operation illumination, dB	18	18
Geometric distortion, %	≤0.5	≤0.5
Operation temperature, ˚C	-40 ÷ +40	-40 ÷ +40

DIMENSIONAL OUTLINE



Contact №	Color	Use
I	blue	photocathode
II	red	MCP input
III	black	MCP output
IV	yellow	screen
V	white	package

SPECTRAL RESPONSE CHARACTERISTICS



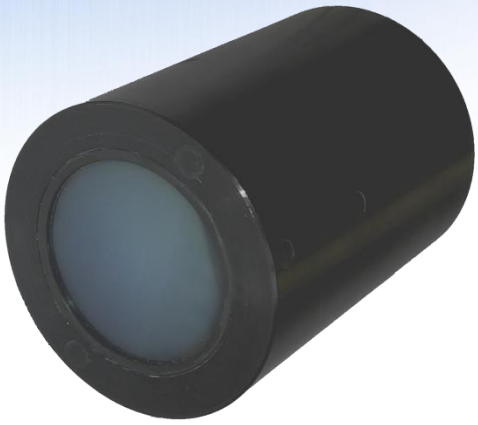
1 – spectral response characteristics for FMTP1-1;

2 – spectral response characteristics for FMTP1-2.

LOW LIGHT LEVEL WIDE FORMAT TV DEVICE FMTP 3

Low light level (LLL) wide format TV device is developed in two modifications: FMTP 3-1 and FMTP 3-2. FMTP 3 is a module device that includes one or two 2+ generation image intensifiers and CCD array which are coupled through direct optical contact fulfilled by fiber-optics focon.

It can be used in LLL cameras for various applications, for example, in optoelectronic systems of space monitoring.

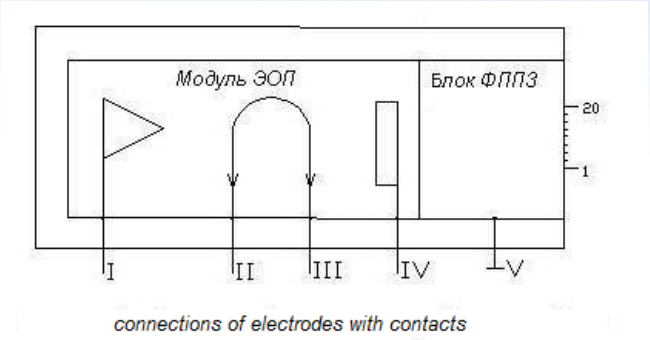


SPECIFICATIONS

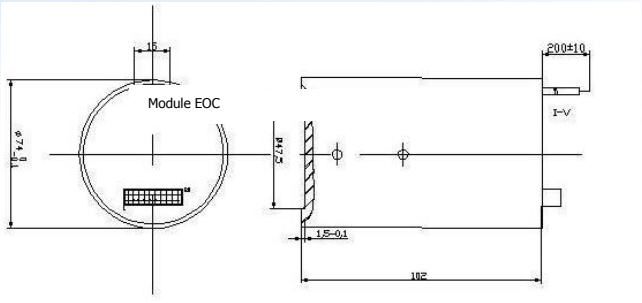
Parameters	FMTP 3-1	FMTP 3-2
Image diameter, mm	40	40
Image format, mm	24 × 32	24×32
Scalable focon, scaling factor (M)	2.44	2.44
Image intensifier, generation	2^+	2^++2^+
Photocathode luminous sensitivity, μA/lm	500	400/350
Number of pixels	768 × 580	768×580
Spectral response, nm	380 ÷ 900	380 ÷ 900
Operation illumination, lx	$5 \cdot 10^{-5}$	$5 \cdot 10^{-5}$
Resolution at operation illumination, TVL	450	450
S/N ratio at operation illumination	≥6	≥10
Geometric distortion, %	≤1	≤1
Threshold illumination at 200 TVL resolution, lx	$5 \cdot 10^{-7}$	$5 \cdot 10^{-7}$
Controlled dynamic range, lx	$10\text{-}3 \div 5 \cdot 10^{-7}$	$10^{-3} \div 5 \cdot 10^{-7}$
Operation temperature, ˚C	-40 ÷ +40	-40 ÷ +40

DIMENSIONAL OUTLINE

FMTP 3-1

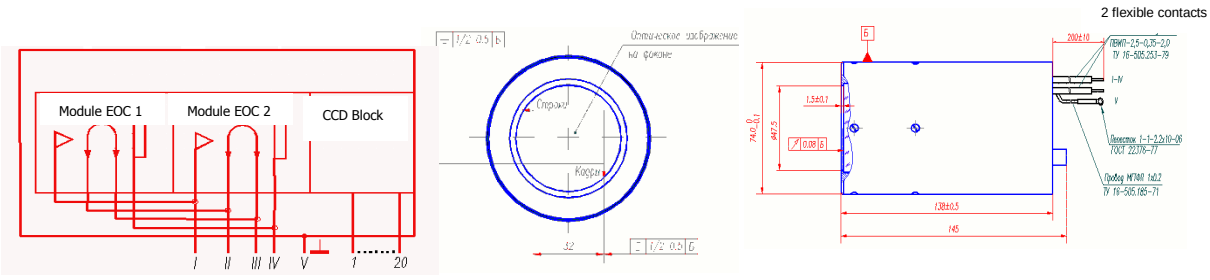


connections of electrodes with contacts



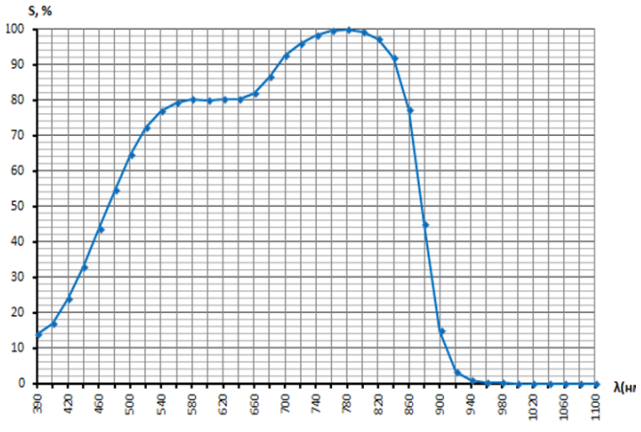
output connections

FMTP 3-2

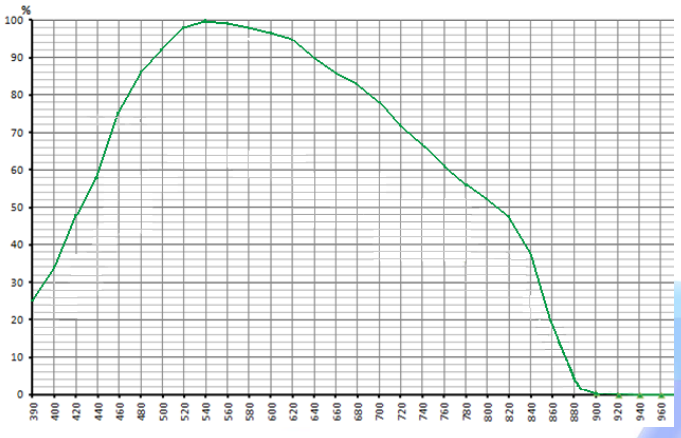


SPECTRAL RESPONSE CHARACTERISTICS

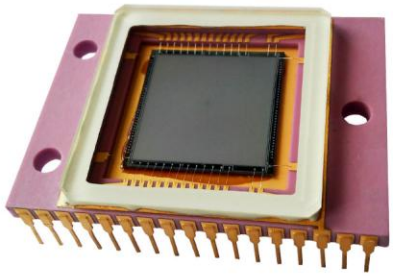
FMTP 3-1

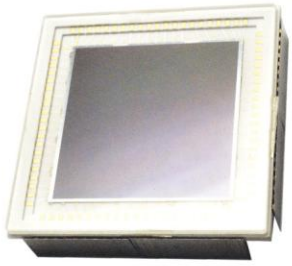


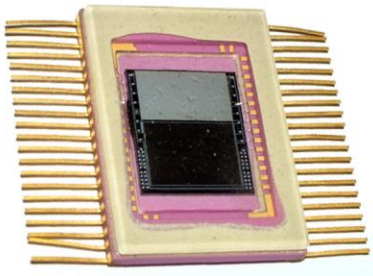
FMTP 3-2

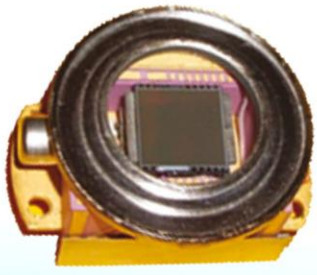


SOLID STATE





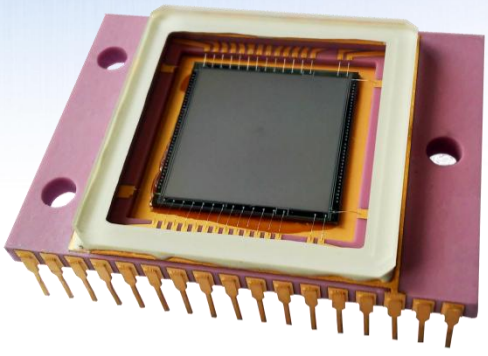




PRODUCTS

ARRAY CCD
CCD 17M
CCD 20M
CCD 21M
CCD 26M
CCD 28M
CCD 31M
CCD “PROJECT”
CCD “LEADER-1”
CCD “CASCADE”
CCD “QUADRO-T”
CCD “QUADRO”

ARRAY CCD



Array CCD is intended for application in optical systems of visible range of 1 inch format, in particular for TV systems of remote sensing and machine vision for precise definition of coordinates.

The device is developed in two types: CCD M-2 and CCD M-3.

The devices consist of array CCD with interline transfer based on silicon and have hermetic tight metal-ceramic package with input glass window.

Photosensitive area of devices includes array of photosensitive elements (photodiodes) and vertical registers with charge couple (CCD) for charge transfer from photodiodes to horizontal registers.

Photosensitive area has 1024×1024 photosensitive elements, 1024 vertical CCD registers and two horizontal registers. Horizontal registers transfer charge from center to edges.

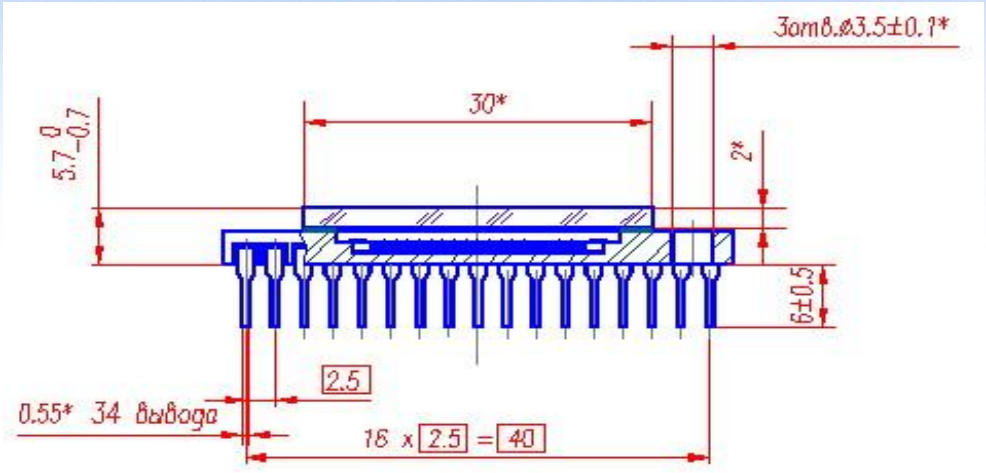
Progressive scanning allows to form in any frame video signal from all photosensitive elements - 2×512(H)×1024(V).

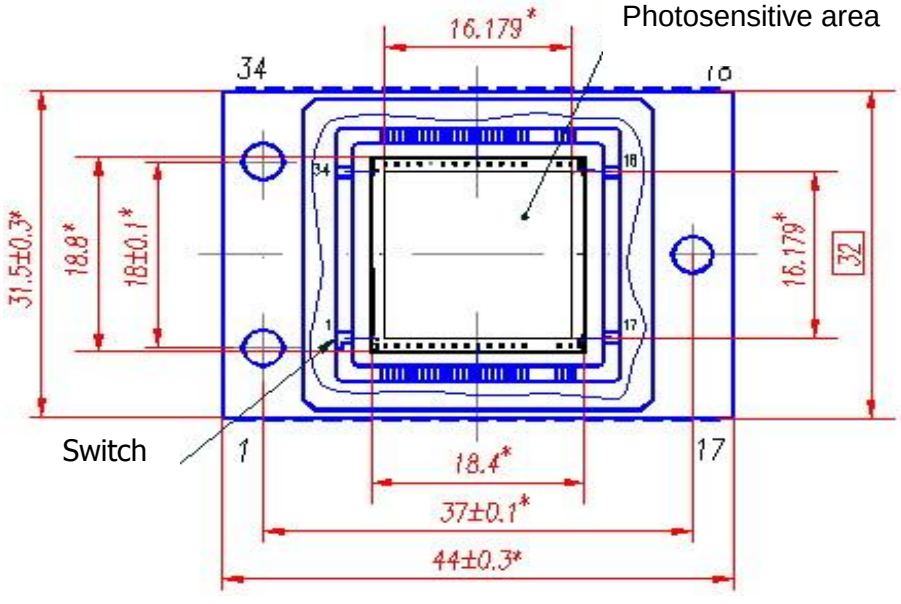
The main device parameters are presented in Table 1.

Table 1. CCD main parameters.

Parameter	CCD M-2, CCD M-3
Number of pixels	1024×1024
Pixel size, μm	15.8×15.8
Photosensitive area size, mm	16.18×16.18
Dynamic range, dB	≥70
Saturation voltage, V	≥1.0
Responsivity, V/μm J/cm2	≥13
Sensitivity relative mean square nonuniformity, %	≤4
Dark signal mean square nonuniformity, mV	≤3
Spectral response, μm	0.4÷0.8
Max. frame frequency with usage of vertical binning, Hz	≤60

DIMENSIONAL OUTLINE

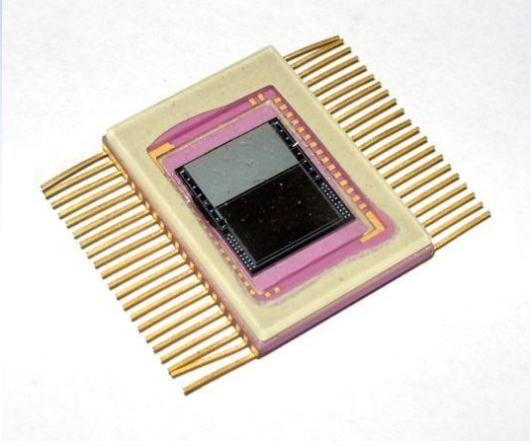




CCD 17M

CCD 17M is a frame transfer photosensitive device with bulk n-channel and a substrate of p-type. Overall number of pixels in output register is 545. The first eleven and last two are supporting.

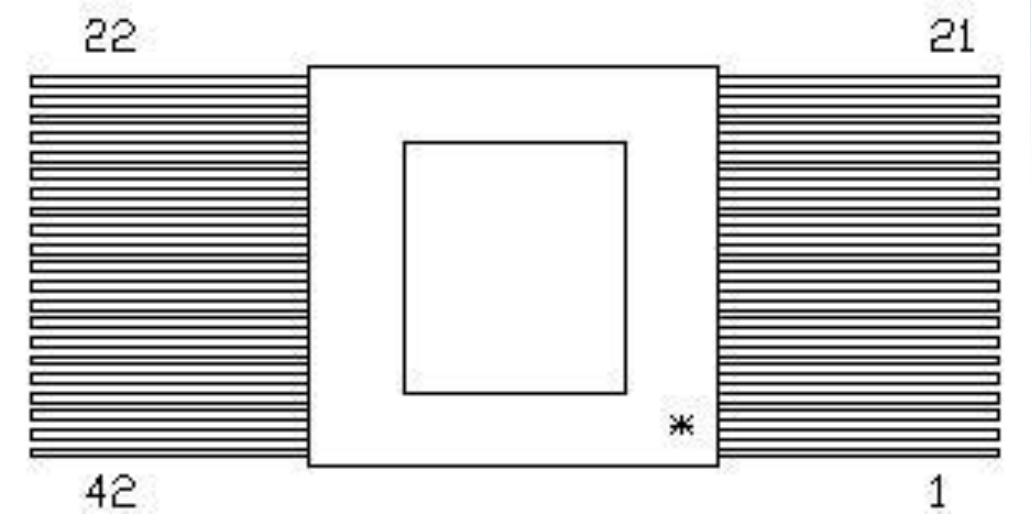
Each section comprises 290 lines, three-phased 532 pixels per a line.



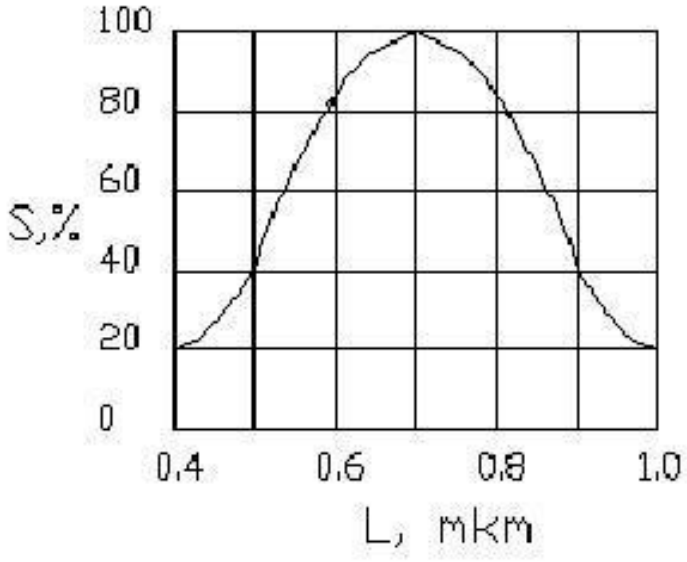
SPECIFICATIONS

Number of pixels, (HxV)	532×580
Photosensitive area size, mm	6.6×8.8
Pixel size, μm	17×23
Size of storage section element, μm	17×17
Dimensions (with outputs), mm	40×26.5×4.85
Mass, g	6.0
Image format	4:3
Saturation voltage, V	0.6
Responsivity, mV/lx	60
Modulation transfer factor along the horizontal at 200 TVL, %	80
Modulation transfer factor along the vertical at 200 TVL, %	70
Dark signal nonuniformity, %	1
Output signal nonuniformity,%	±4
Dynamic range, dB	60
Dark current, nA	5
Transfer inefficiency	$1x10^{-5}$

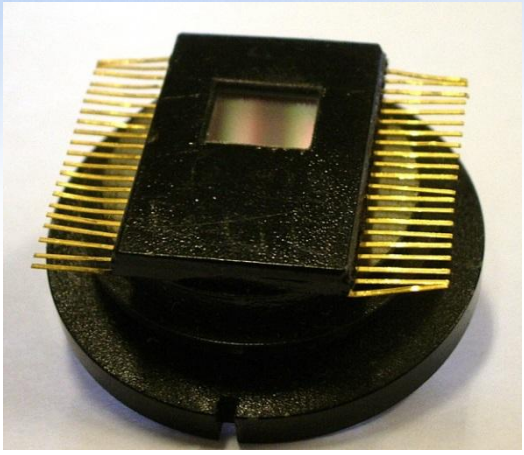
SOCKET CONNECTIONS



SPECTRAL RESPONSE CHARACTERISTICS



CCD 20M



CCD 20M is a silicon frame transfer photosensitive device with two sections, bulk n-channel and a substrate of p-type.

Accumulation section comprises 290 lines, 532 pixels per a line. First nine columns and last three columns are shielded from light. Storage section comprises 290 lines, 532 pixels per a line. Overall number of elements in an output register is 545, the first eleven and last two pixels are supporting.

CCD 20M is intended for operation in special TV equipment with standard and low- frequency scanning modes, image transformation and processing systems as well as measurement instruments.

Advantages:

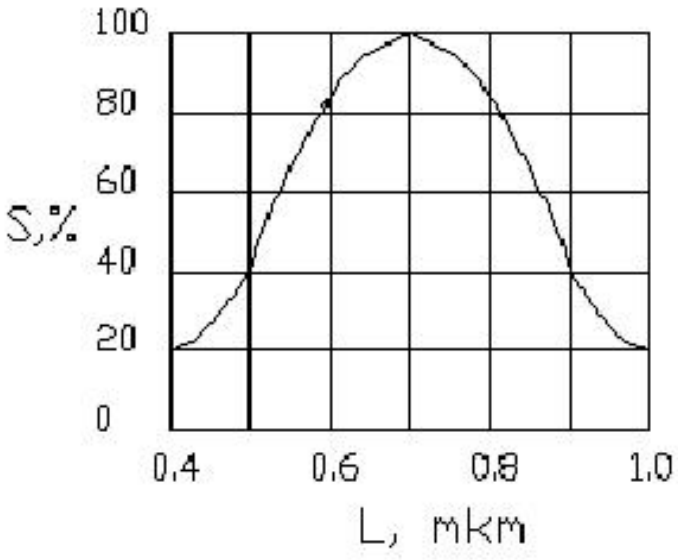
- Operation at 1-10sec storage time
- Operation at temperature up to + 100ºC
- The device could be produced with fiber-glass optic input and embedded in cooled/uncooled package.

SPECIFICATIONS

Pixel number, (HxV)	580×520
Photosensitive area size, mm	6.6×8.8
Pixel size, μm	17×23
Number of outputs, pcs	24
Dimensions (with outputs), mm	40×26.5×4.85
Mass, g	100
Image standard format	4:3
Spectral response, nm	350-1100
Dark current, mV	2
Saturation voltage, V	0.6
Responsivity, mV/lx	60

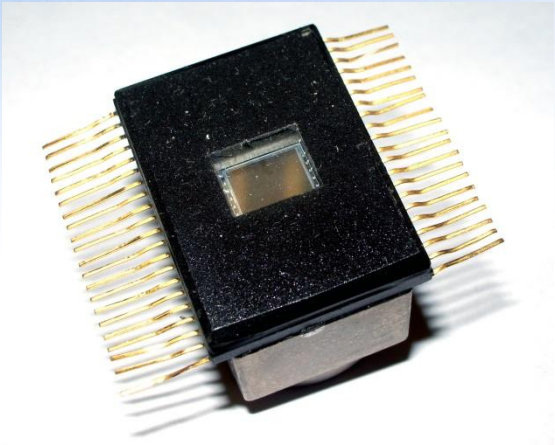
Modulation transfer factor along the horizontal at 200 TVL, % in the center	85
Modulation transfer factor along the vertical at 200 TVL, % in the center	70
Dark signal relative mean square nonuniformity, %	0.4
Output signal relative mean square nonuniformity, %	3.0
Dynamic range	2000
Mean dark signal to saturation voltage, %	0.2

SPECTRAL RESPONSE CHARACTERISTICS



CCD 21M

CCD 21M is a thermoelectrically cooled silicon frame transfer device with bulk n-channel and substrate of p-type.

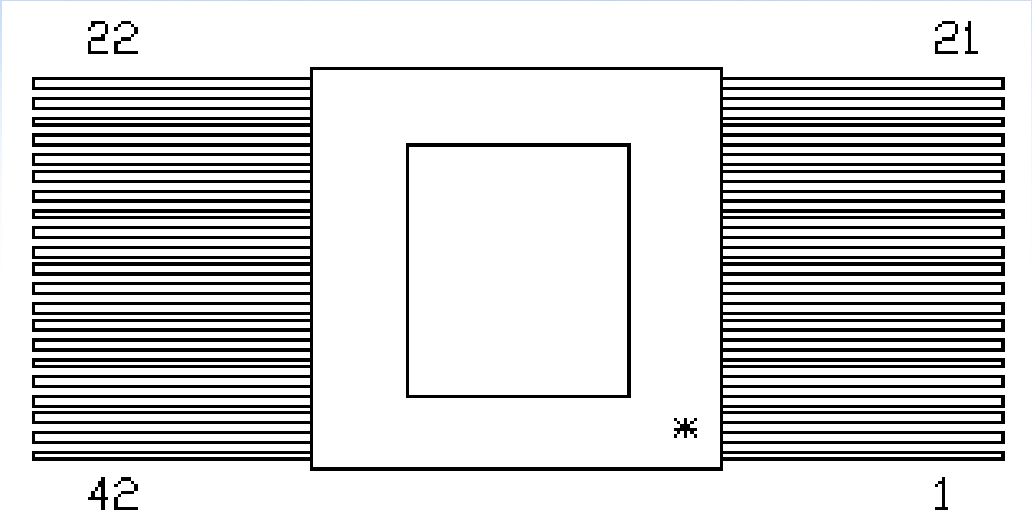


CCD'S photosensitive area has symmetric sections of accumulation and storage, each comprising 145 lines, the first 144 are informative. The section line comprises 264 pixels.

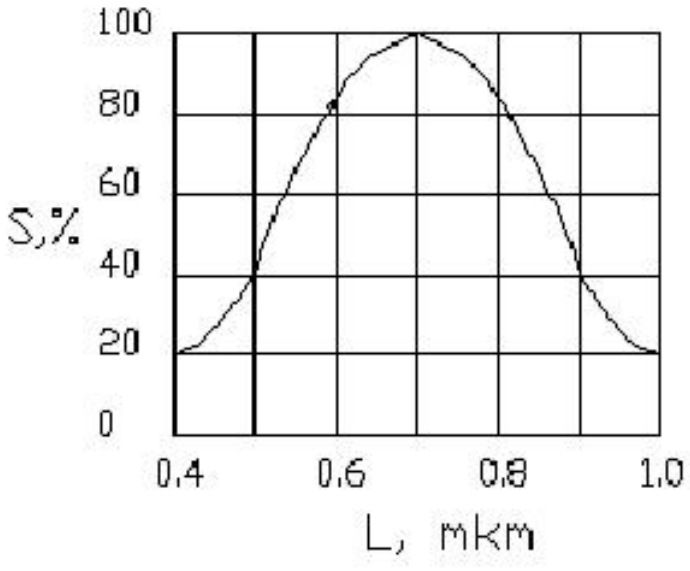
SPECIFICATIONS

Number of pixels, (HxV)	265×288
Photosensitive area size, mm	6.2×4.6
Pixel size, μm	24×32
Number of outputs, pcs	42
Dimensions (with outputs), mm	29×34×26.5
Mass, g	50
Image format	4/3
Spectral response, nm	350-1100
Saturation voltage, V	0.6
Mean dark signal to saturation voltage, %	0.1
Dark signal relative mean square nonuniformity, %	0.5
Spectral sensitivity (λ=(623±4) nm), V·cm^2/μJ	15
Responsivity, V·cm^2/μJ	10
Threshold monochromatic radiant exposure (λ=(632±4) nm), J/px	1·10-17
Threshold integrated radiant exposure, J/px	1·10-16
Output signal relative mean square nonuniformity, %	4
Dynamic range	2000

EXTERNAL APPEARANCE

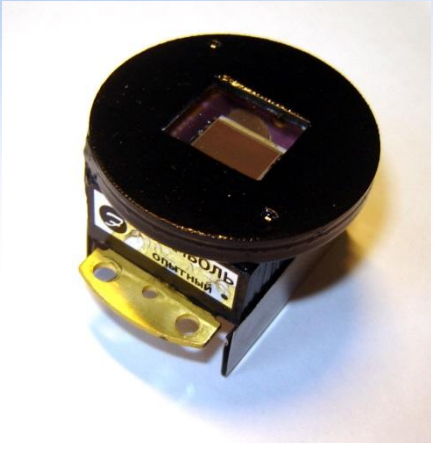


SPECTRAL RESPONSE CHARACTERISTICS



CCD 26M

CCD 26M has two-sections, 768x580 pixels and bulk transfer n-channel. The device is cooled by built-in thermoelectric cooler. Main application – operation as a component in TV electro-optical systems for military, industry and science purposes.

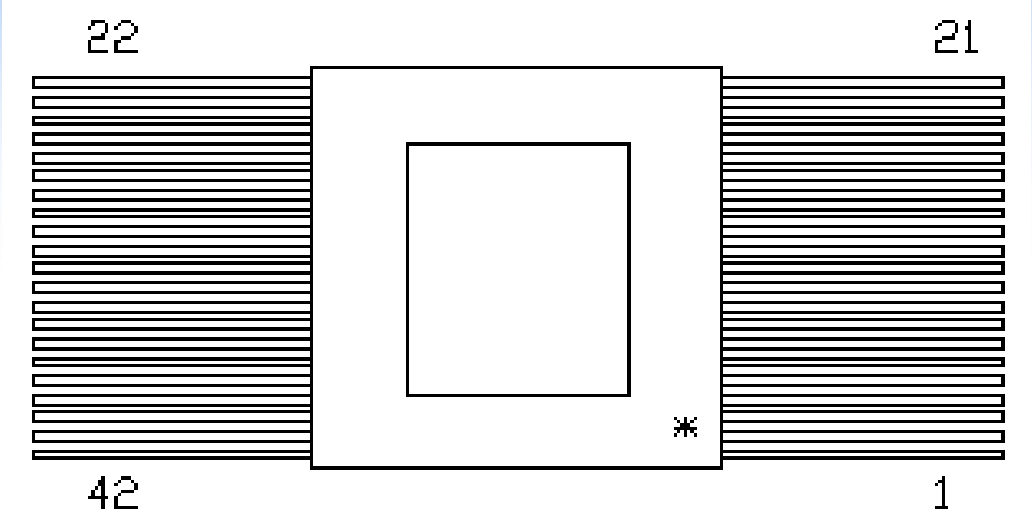


Construction design: CCD has metal-ceramic package with optical input window of C50-5M glass. Cooling by two-stage thermobattery. Input window heating is provided.

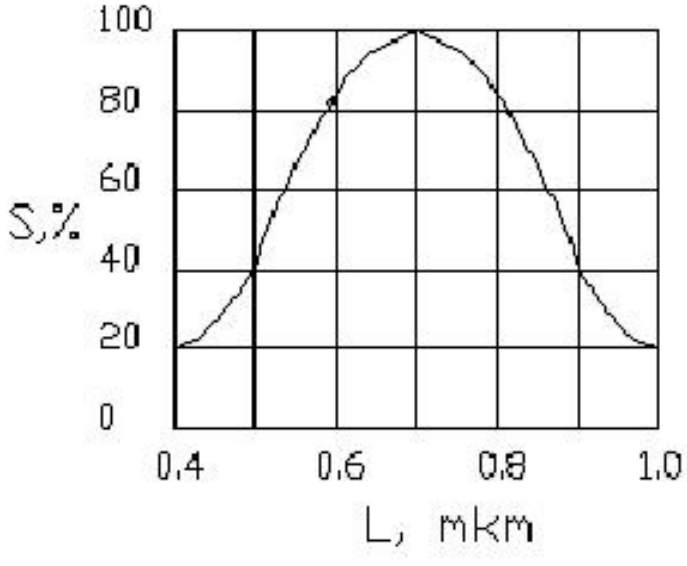
SPECIFICATIONS

Number of pixels	768×580
Image size, mm	9.98×7.49
Pixel size, (HxV), μm	13×26
Spectral response, μm	0.45÷1.0
Max. diameter, mm	45
Saturation voltage, V	≥0.5
Saturation illumination, lx	≤15
Output signal relative mean square nonuniformity, %	≤5
Threshold illumination, lx	$5 \cdot 10^{-3}$
Relative dark signal referred to output signal voltage, %	≤0.4
Dark signal relative mean square nonuniformity, %	≤2
Output signal dynamic range	≥3000
Modulation transfer factor along the horizontal at 400 TL, % in the center at the corners	 60 55
Modulation transfer factor along the vertical at 200 TL, % in the center at the corners	 65 60

EXTERNAL APPEARANCE



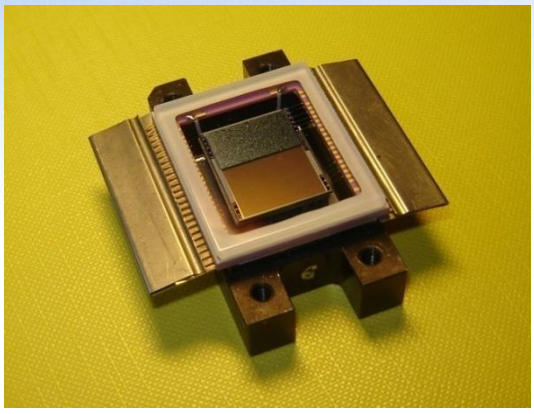
SPECTRAL RESPONSE CHARACTERISTICS



CCD 28M

CCD 28M is a device with two-sections, 768x580 pixels, bulk transfer n-channel, antiblooming, electronic gate and built-in thermoelectric cooler. Main application – operation as a component in TV electrooptical systems for military, industry and science purposes.

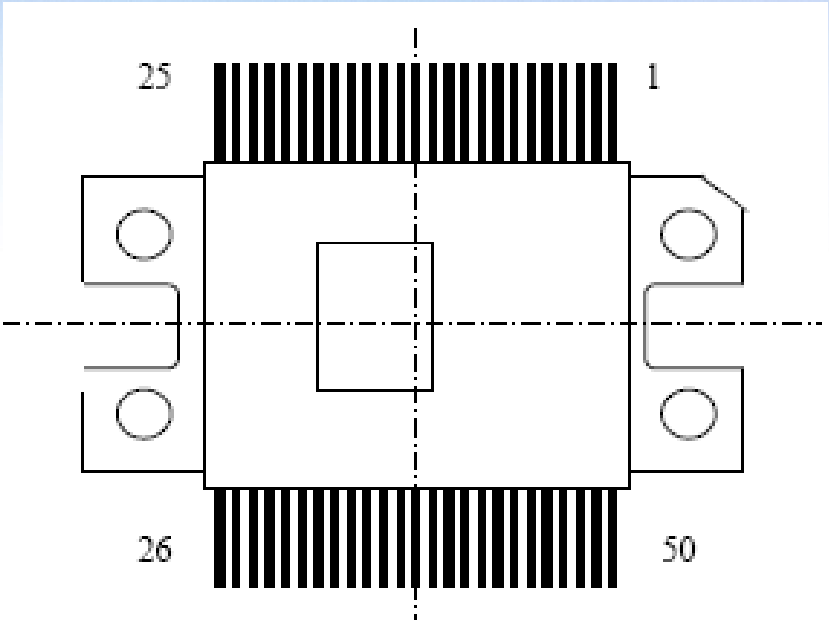
Constructional design: the device has metal-ceramic package with optical input window of K-208 glass. Cooling by thermobattery К2-95-1/3.



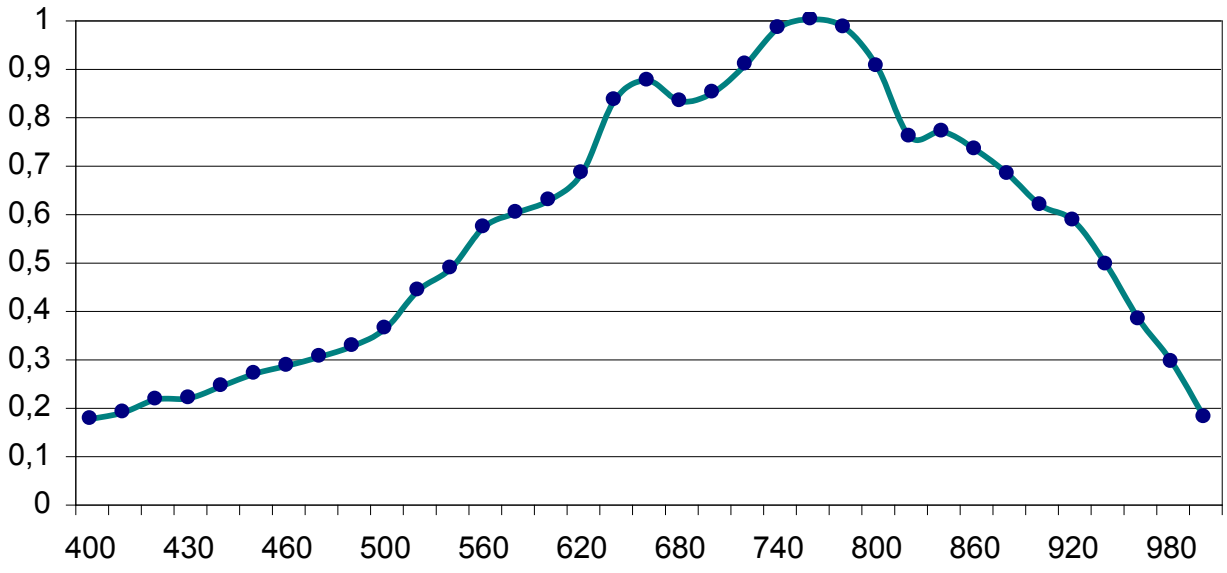
SPECIFICATIONS

Number of pixels	768×290
Device photosensitive area size, mm	13.06×9.86
Pixel size, (HxV), μm	17×34
Saturation voltage, V	2.5
Saturation illumination, lx	10
Output signal relative mean square nonuniformity, %	3.5
Average dark signal referred to saturation voltage, %	0.15
Modulation transfer factor along the horizontal in the center: at 400 TL, % at 600 TL, %	 90 70
Modulation transfer factor along the vertical in the center at 300 TL, %	60
Threshold illumination at S/N=3, lx	$3 \cdot 10^{-3}$
Dynamic range	10000
Local overillumination suppression factor	1000
Electronic gate ratio	64
Max. temperature range, ºC	-60 ÷ +70

EXTERNAL APPEARANCE



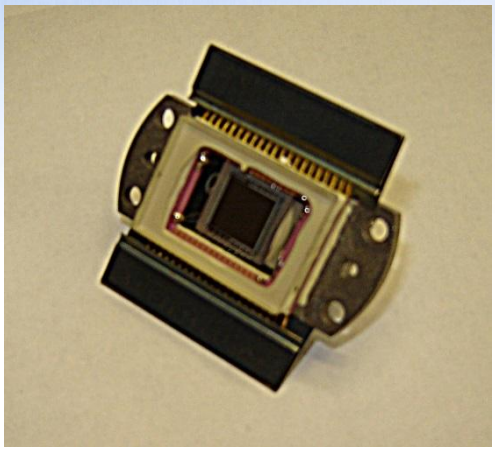
SPECTRAL RESPONSE CHARACTERISTICS



CCD 31M

CCD 31M is a one-sectional device cooled by built-in electric thermocooler Peltier. Package is vacuum, filled with gas. The CCD is fulfilled with buried channel and comprises 512x512 pixels with two timing electrodes and “virtual” phase. The register has two output units: one-stage (“low-noise”) and two-stage (“wide-band”).

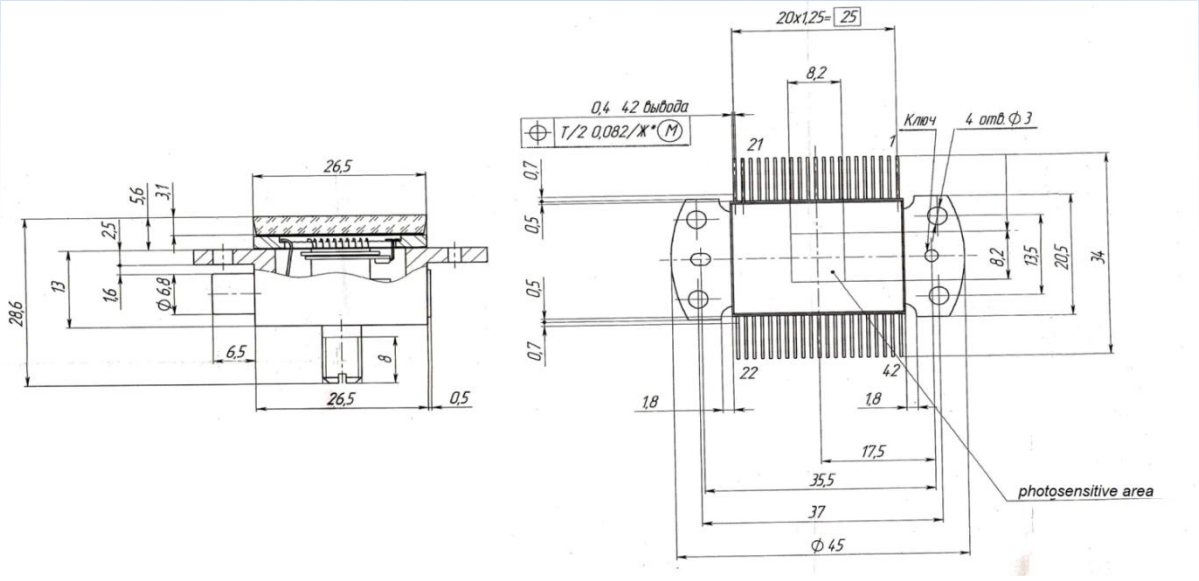
The device is intended for operation in low frame mode (at 2 MHz readout frequency and 1-2 s accumulation time) and can be applied in TV equipment for stellar monitoring and astroorientation systems.



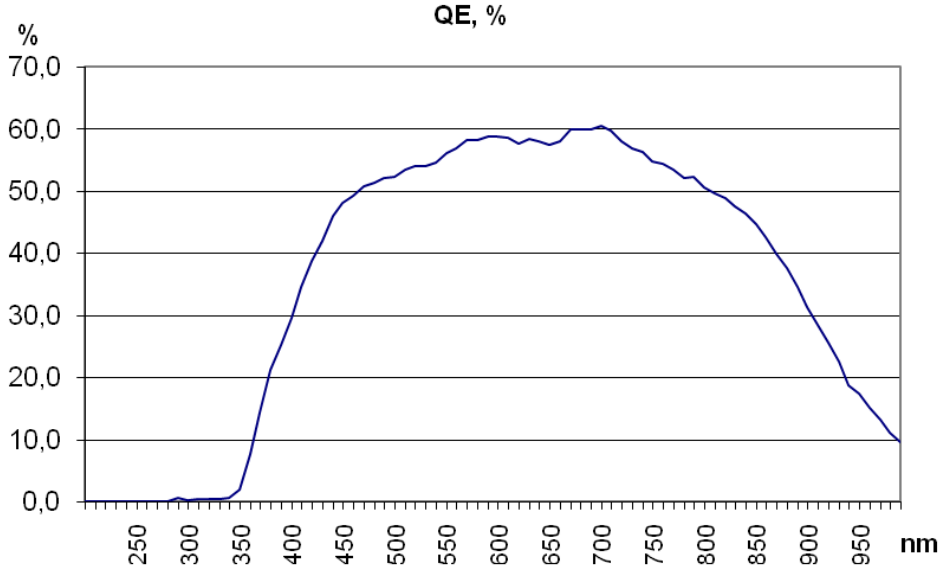
SPECIFICATIONS

Number of pixels		512×512
Photosensitive area size, mm		8.2×8.2
Pixel size, (HxV), μm		16×16
Weight, g		≤ 30
Saturation voltage, V		≥1.0
Relative dark signal, %		≤0.1
Transfer inefficiency along the horizontal and the vertical, per unit		≤0.05
Dynamic range		7000
Spectral sensitivity, mA/W	550 nm	≥200
	700 nm	≥250
	950 nm	≥80
Output signal relative mean square nonuniformity, %		3.0

DIMENSIONAL OUTLINE



SPECTRAL RESPONSE CHARACTERISTICS

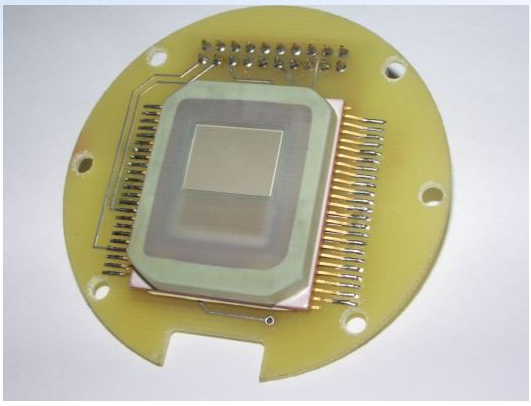


CCD “PROJECT”

Experimental sample

Frame transfer CCD “Project” has two sections, 3-phased arrangement in horizontal and vertical, 768x580 total number of pixels, floating diffusion and unit of dummy cutting off.

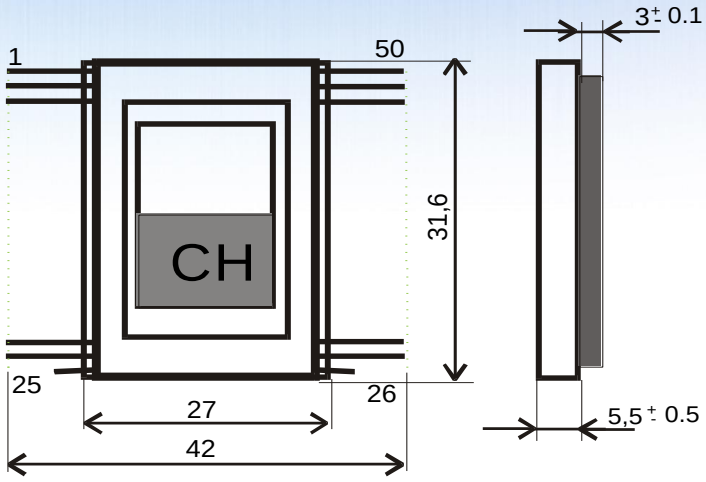
The device has fiber-optic input window. It can be applied in high sensitive TV equipment for direct optical connection to an image intensifier tube.



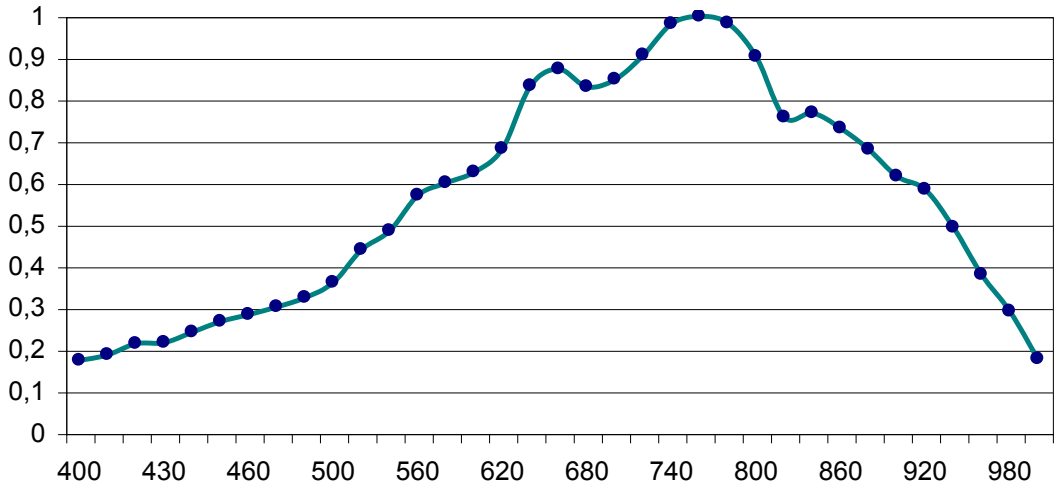
SPECIFICATIONS

Number of pixels	768×290
Photosensitive area size, mm	13.06×9.79
Pixel size, (HxV), μm	17×34
Saturation voltage,V	≥1.8
Responsivity, V/lx·s	≥20
Spectral sensitivity (λ=0.67μm), V·cm^2/μJ	≥5.0
Dynamic range	≥7000
Relative sensitivity mean square nonuniformity across the area, %	≤4.0
Dark signal voltage, mV	≤0.5U_{sat}×10^{-3}
Max. temperature range, ºC	-60 ÷ +60

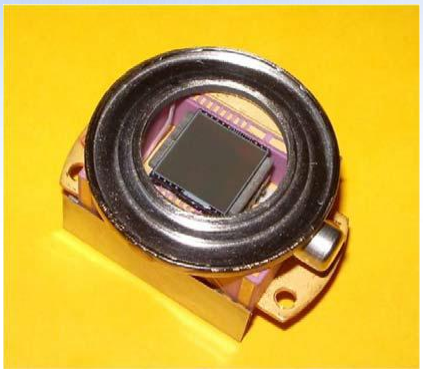
DIMENSIONAL OUTLINE



SPECTRAL RESPONSE CHARACTERISTICS



CCD “LEADER-1”



CCD “Leader-1” has one section, n-type bulk channel and 512x512 pixels. The device has one output register and two-stage output unit with “floating” diffusion.

The register comprises 522 pixels. The first ten are supporting.

CCD has horizontal antiblooming that provides device operation in conditions of considerable local overillumination. Cooling is provided by built-in thermoelectric battery.

Quasi-random access to any line of section is provided by signal transfer out of foregoing lines to drain region located in parallel to the register.

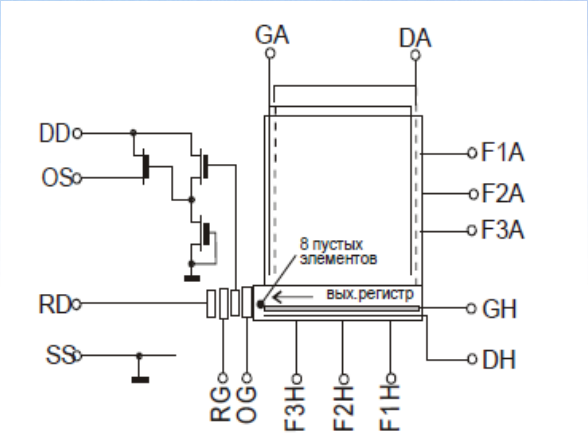
The device can be applied as a detector in stellar monitoring systems.

Construction design: The device is filled with gas and has vacuum tight package with optical window and unit of joint with heat sink for heat removal. The possibility of temperature measurement is provided by suitable p-n-junction designed on a CCD substrate.

SPECIFICATIONS

Number of pixels	512×512
Pixel size, (HxV), μm	23×23
Spectral response, μm	0.4÷1.0
Device width, mm	≤37.5
Device height (with contacts), mm	≤23
Input window outside surface error in parallelism relative to photosensitive surface	≤30’
Saturation voltage, V	1.0
Responsivity, V/lx·s	≥6
Spectral sensitivity (λ=0.67μm), V/cm^2·μJ	7
Relative responsivity mean square nonuniformity across the field, %	≤5
Local relative responsivity mean square nonuniformity across (5x5) pixel area, %	3
Threshold exposure, lx·s	$2 \cdot 10^{-5}$
Dark signal voltage at $T_{accumulation}$=10s, mV	40

CIRCUIT DIAGRAM

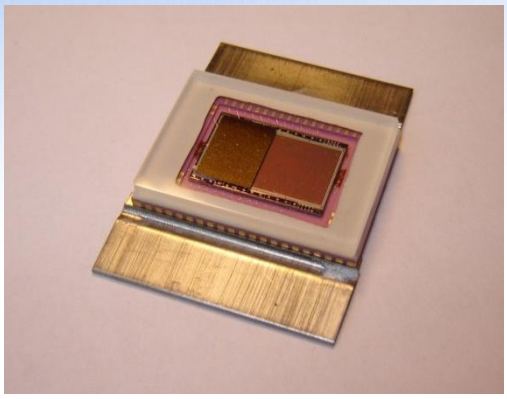


TERMINAL DESCRIPTION

Terminal number	Conventional sign	Description
1	“+”	Thermobattery positive terminal
2,12,23		Empty
3	F3H	Third register phase electrode
4	F2H	Second register phase electrode
5	F1H	First register phase electrode
6	DH	Register horizontal sink
7	GH	Accelerated transfer gate
8	UT	Temperature detector
9	GA	Antiblooming gate
10	DA	Antiblooming sink
11,22	SS	Substrate
13	-	Package output
14	F1A	Section first phase
15	F2A	Section second phase
16	F3A	Section third phase
17	OS	Output transistor source
18	DD	Output unit transistor sinks
19	RD	Reset transistor sink
20	RG	Reset transistor gate
21	OG	Output register screen electrode
24	“-“	Thermobattery negative terminal

CCD “CASCADE”

Frame transfer CCD “Cascade” has two sections, 512x1024 pixels, 3-phased arrangement in horizontal and vertical, antiblooming, electronic gate and floating diffusion.

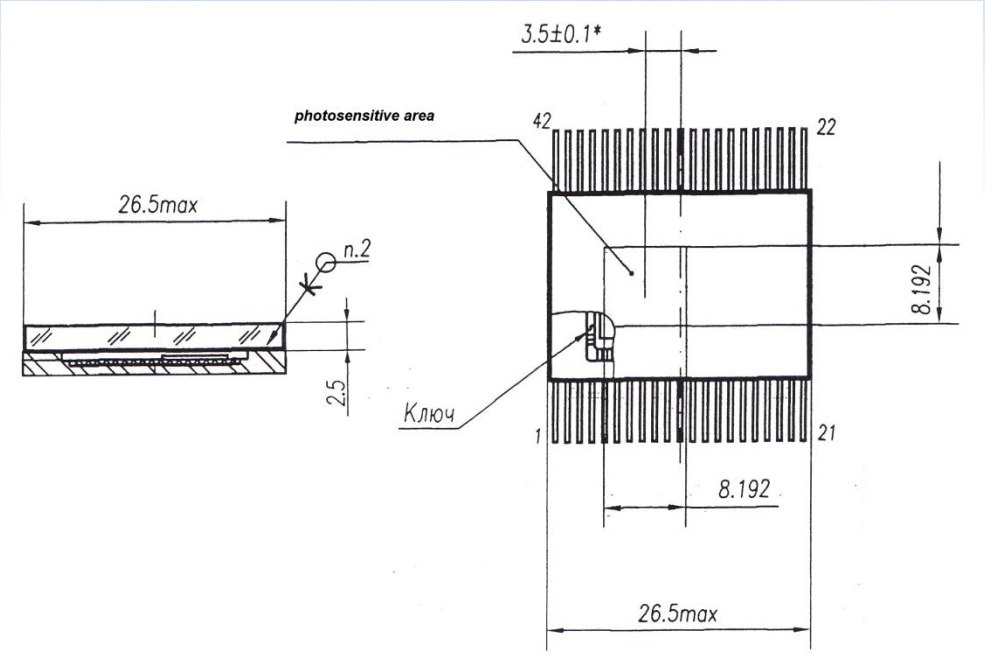


Design: the device has ceramic-metal package and can be fulfilled with thermoelectric cooling.

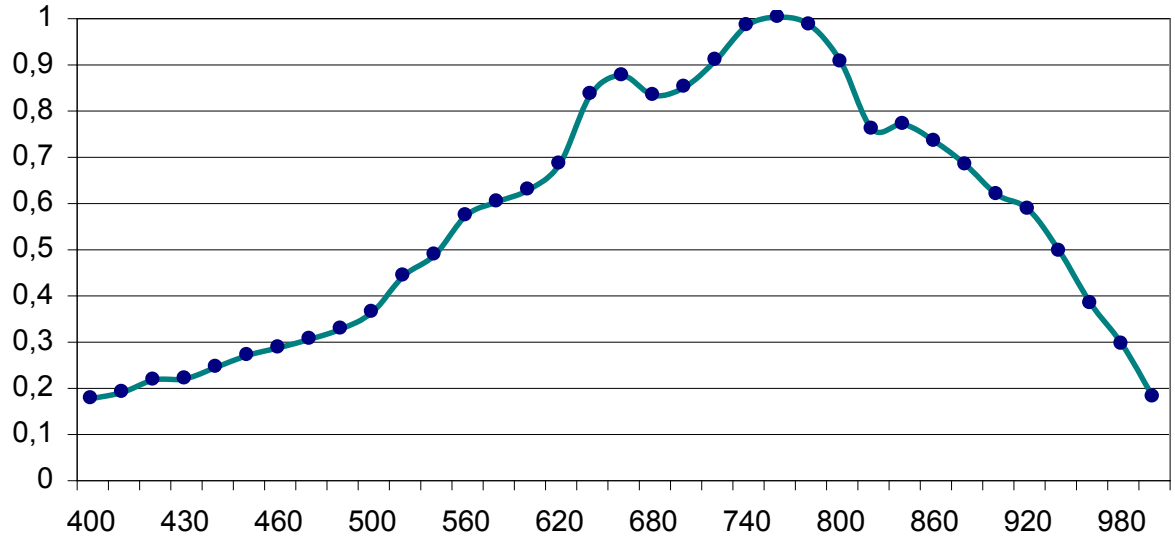
SPECIFICATIONS

Number of pixels	512×512
Photosensitive area size, mm	8.19×8.19
Pixel size, (HxV), μm	16×16
Dimensions, mm	26×20
Saturation voltage, V	≥1.0
Responsivity, V/lx·s	≥10
Spectral sensitivity (λ=0.67μm), V·cm^2/μJ	≥5
Relative sensitivity mean square nonuniformity across the area,%	≤3
Resistance to local overillumination, per unit	≥1000

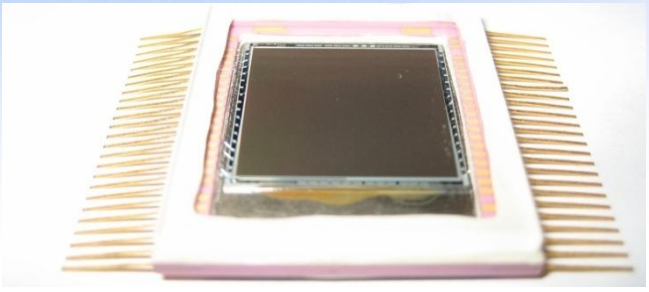
SOCKET CONNECTIONS



SPECTRAL RESPONSE CHARACTERISTICS



CCD “QUADRO-T”



CCD “Quadro-T” is a frame transfer photosensitive device with bulk n-channel on n-type substrate.

The device can go with supply-demand balance and fiber-optic input.

CCD has accumulation and storage sections. The total number of pixels in output register is 1568. The first sixteen define dark signal level. Reading out pixels across the register in both directions is permitted.

Each section comprises 768 lines and 1536 pixels per line.

The device is intended for operation in TV equipment with continuous and pulse illumination, image transformation and processing systems as well as measurement instruments.

Advantages:

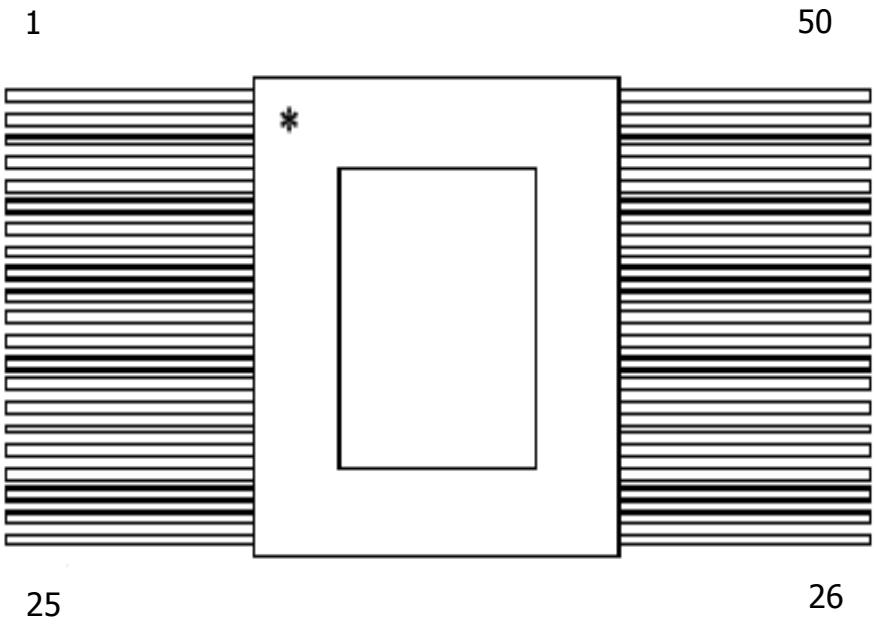
- Wide spectral range
- Low dark current
- Operation at high frequency mode at register frequency up to 40.0 MHz.
- Operation at low frequency mode at storage time up to 10 s.

SPECIFICATIONS

Number of pixels, (HxV)	1536×1536
Photosensitive area size, mm	16.898×16.898
Pixel size, μm	11×11
Dimensions (with contacts), mm	32.0×42.5×5.0
Mass, g	10
Image format	1:1; 1:2
Full frame, lines	1536
Spectral response, nm	400÷1100
Saturation voltage,V	1.0
Spectral sensitivity (λ=670 nm), V/μm J/cm2	5
Mean dark signal, mV/s	30

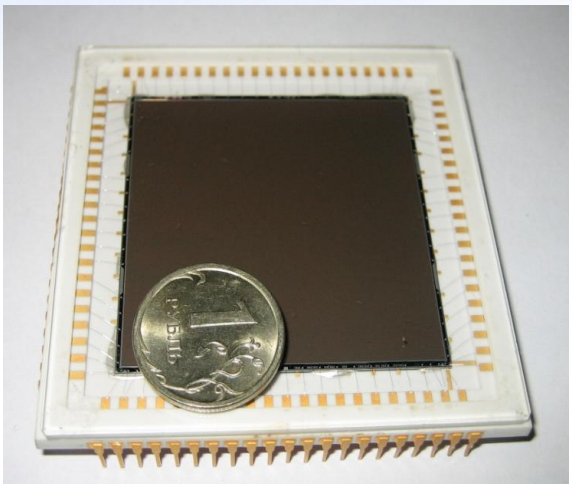
Output signal mean square nonuniformity, %	2
Noise, ē	≤20
Dynamic range	8000
Modulation depth at space frequency fN/2 across horizontal and vertical,%	55
Transfer inefficiency	1·10-5

SOCKET CONNECTIONS



LARGE FORMAT CCD “QUADRO”

Experimental sample



CCD “Quadro” has four independent sections, bulk n-channel and 4096x4096 pixels.

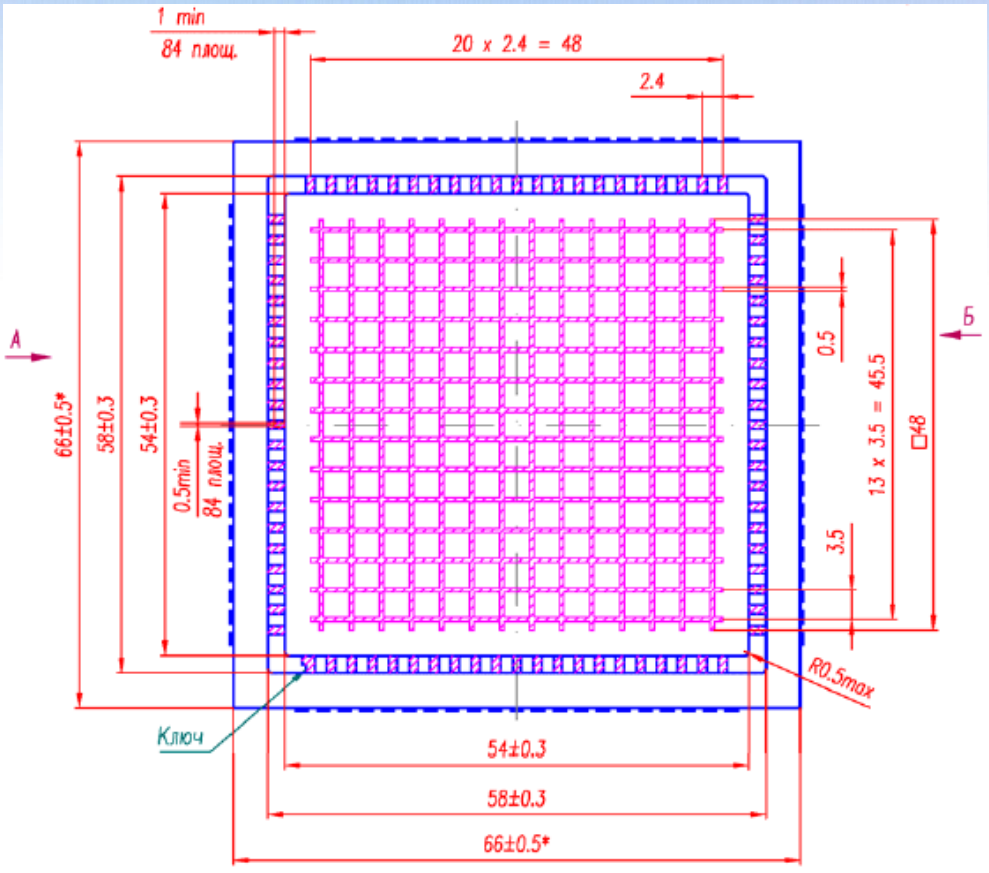
Device photosensitive area includes four independent storage sections which could operate in pulse and continuous illumination modes. CCD has central symmetry, two output registers and four output units.

The device is intended for application in TV equipment in conditions of pulse and continuous illumination, image conversion and processing systems as well as measurement equipment. Register output frequency is 1÷40 MHz.

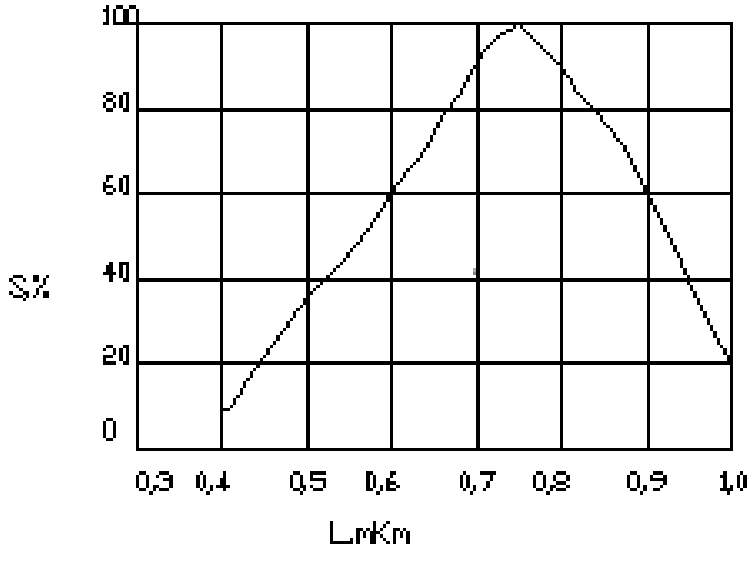
SPECIFICATIONS

Dimensions (with contacts), mm	66×66×10
Number of pixels	4096×4096
Photosensitive area size, mm	45,056×45,056
Pixel size, (H×V), mm	11×11
Saturation voltage, V	1.1
Spectral sensitivity (λ=670 nm), V/μm·J/cm^2	5
Mean dark signal, mV/s	30
Output signal mean square nonuniformity, %	2
Noise, ē	22
Dynamic range	8000
Modulation depth at space frequency of $f_N/2$ across horizontal and vertical,%	55
Transfer inefficiency	$1 \cdot 10^{-5}$
Number of contacts	84

DIMENSIONAL OUTLINE

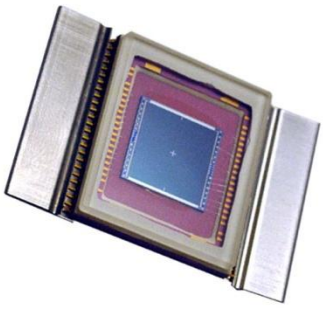


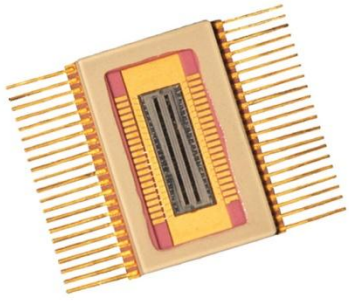
SPECTRAL RESPONSE CHARACTERISTICS



LINEAR CCDs

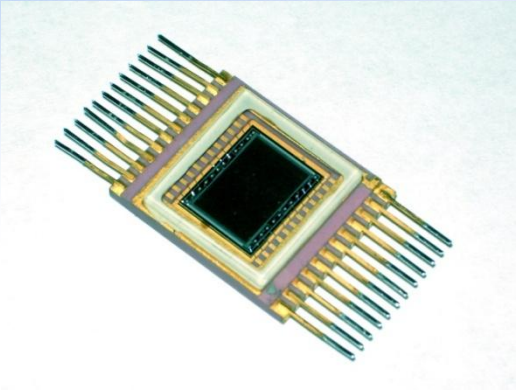
LINEAR CCD 6L
LINEAR CCD 8L
LINEAR CCD 29L
LINEAR CCD 30L
LINEAR CCD 32L
LINEAR CCD-4700
LINEAR CCD-12 000





LINEAR CCD 6L

CCD 6L has two photosensitive shift registers (264 pixels each). The device can be used as linear optic-electrical converter for different TV systems (measurement, surveillance, guidance, etc).



SPECIFICATIONS

Dimensions (with contacts), mm	33.9 ×15.75 × 3.0
Spectral response, μm	0.4÷1.0
Number of pixels	264 × 2
Distance between registers, mm	8.7
Photosensitive area lengh, mm	6.0
Pixel size, (HxV), μm	23×50
Output signal frequency (max.), MHz	0.25
Number of control phases	3
Power supply voltage, V	18
Saturation signal voltage, V	3.0
Luminous sensitivity, V/lx·s	40
Discretization pitch, μm	23
Dynamic range, dB	60
Output signal nonuniformity, %	10

LINEAR CCD 8L

Linear CCD 8L consists of two identical linear 1000 pixel CCDs. The devices on a chip are oriented in parallel with rotary symmetry of 180º and are displaced relative to each other at a half of pixel pitch (6.5 μm).

Each of CCDs has bilinear arrangement and comprises separate sections for charge packet detection and accumulation.

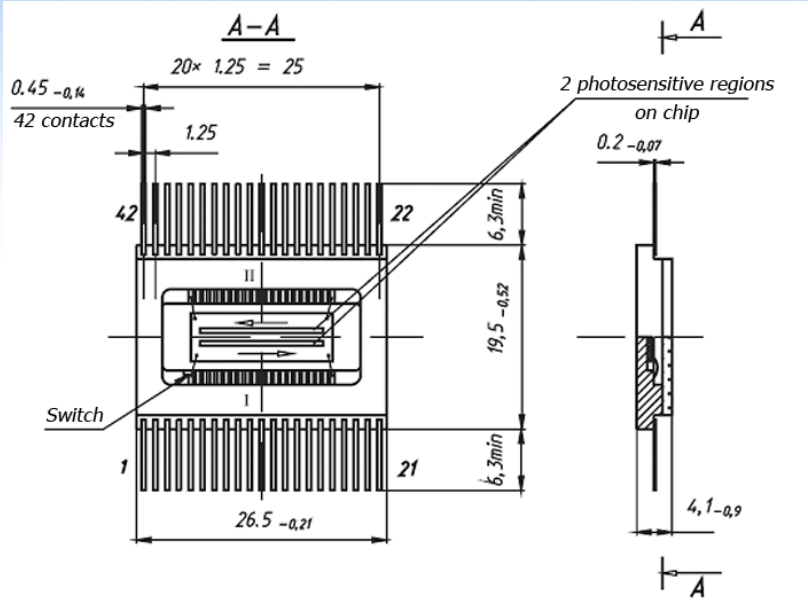
Antiblooming permits CCD to operate at device overillumination factor no less than 100. Electronic exposure mode (≥10 μs) is also provided.

Application: spectral analysis equipment; optoelectronic systems of space orientation; object size measuring non-contact systems.

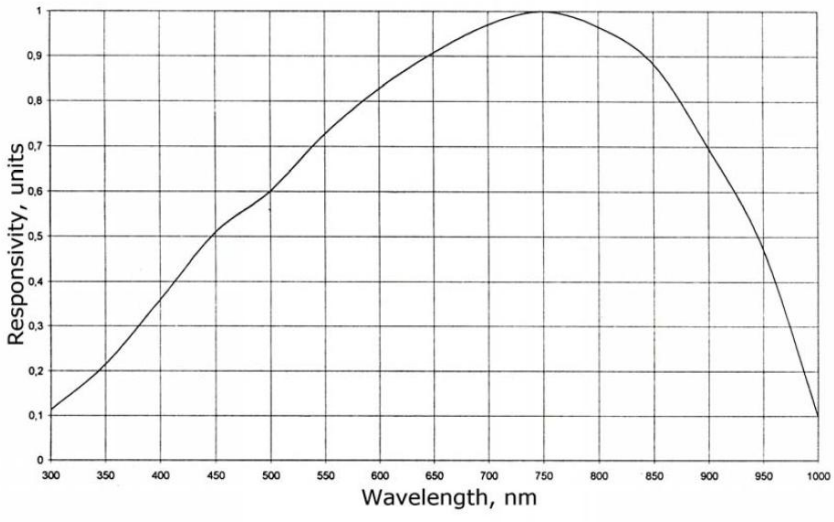
SPECIFICATIONS

Number of pixels	2 ×1000
Pixel size, μm^2	13 × 500
Pixel pitch, μm	13
Distance between CCDs, μm	844
Package dimensions, mm	26.5 ×19.5
Register control	4-phase
Max. data output rate, MHz	5
Saturation signal, V	1.4
Dynamic range	≥6000
Responsivity (A type source with C3C-23 at output signal frequency 200 kHz), V/lx·s	25
Relative luminous nonuniformity,%	±3
Relative dark signal nonuniformity, %	0.1
Max. voltage on terminals, V	20
Max. operation frequency, MHz	2.5
Operation temperature range, ºC	-50 ÷ +50

DIMENSIONAL OUTLINE

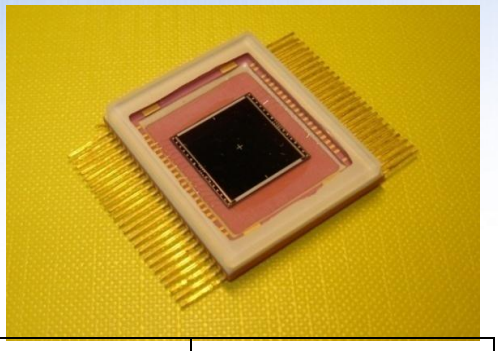


SPECTRAL RESPONSE CHARACTERISTICS



LINEAR CCD 29L

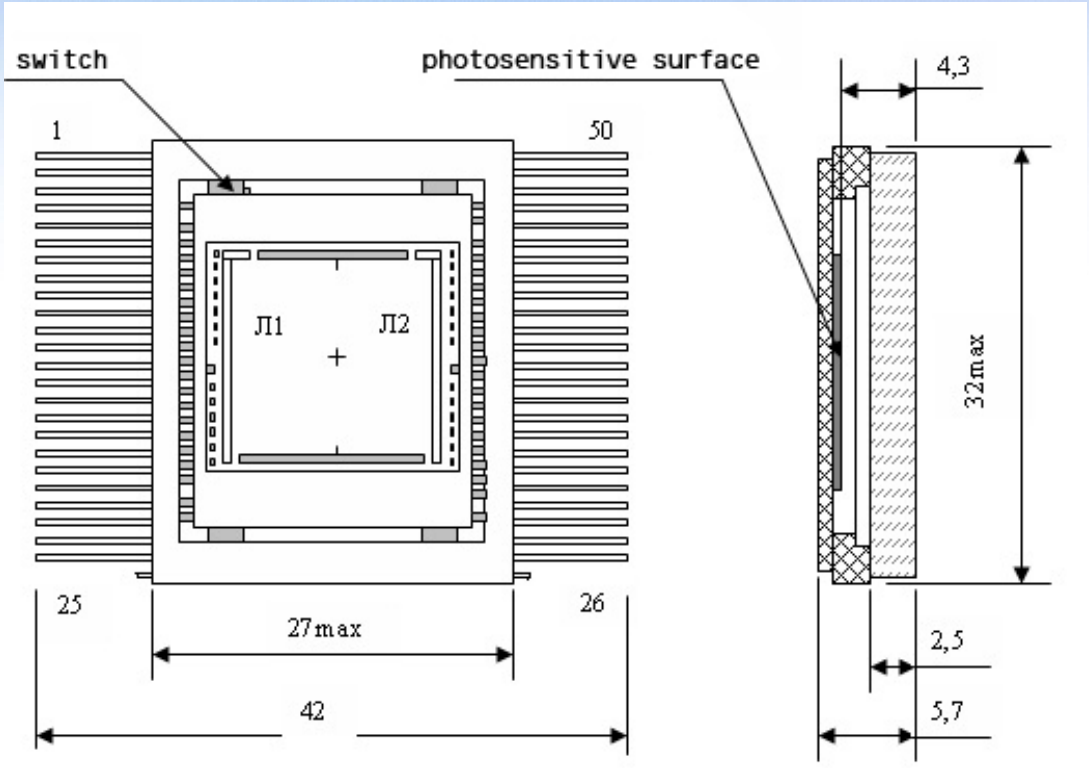
CCD 29L comprises two identical linear CCDs arranged in parallel on one chip at 12.5 mm distance with independent control.



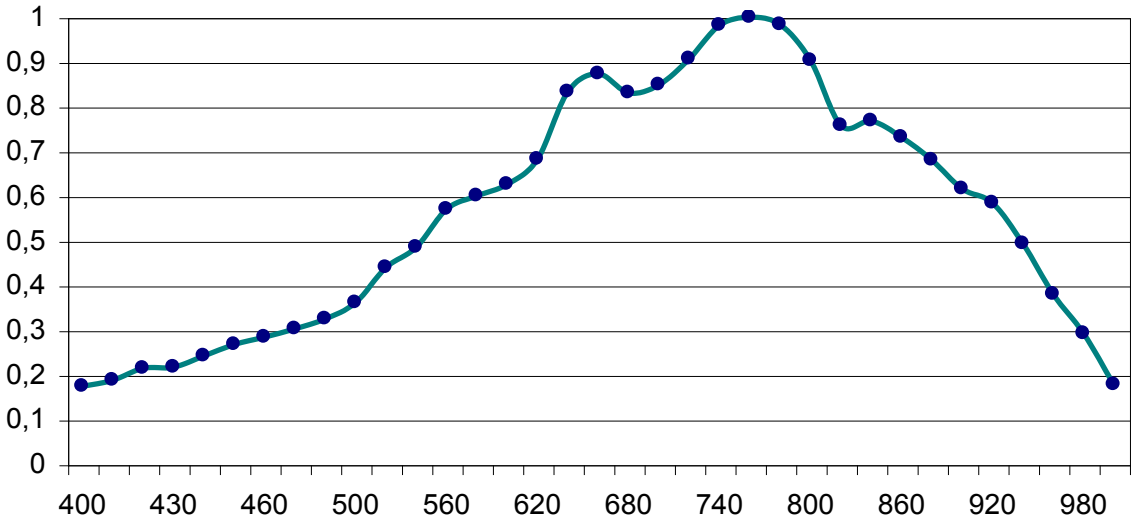
SPECIFICATIONS

Number of photosensitive regions, pcs.	2
Number of pixels for each CCD	1024
Distance between axes of photosensitive lines, mm	12.5
Pixel size, (HxV), μm	13 × 50
Photosensitive region length, mm	≥13.3
Dimensions (without contacts), mm	32 × 27 × 5.7
Saturation voltage, V	3.6
Spectral sensitivity (λ=0.67±0.02μm), $Vcm^2/\mu mJ$	20
Output signal mean square nonuniformity related to mean output signal at E=0.5Esat : - across the whole area of pixels, % - across local area of 20 pixels, %	 5 3
Mean dark signal voltage, mV	20
Dynamic range, dB	75
Charge transfer inefficiency, per unit	0.06
Number of defect pixels	not allowed
Leakage current between electrodes, μA	100
Data output frequency, kHz	150
Direct voltage on drains of output unit transistor, V	≤24
Direct voltage on dividing drain, V	≤24

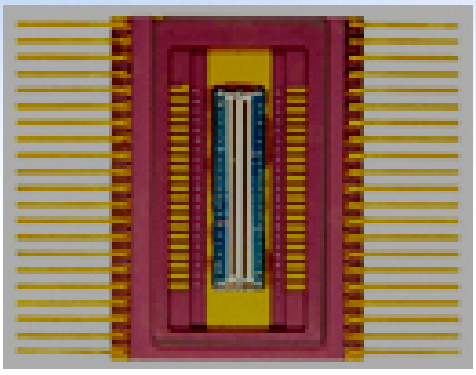
SOCKET CONNECTIONS



SPECTRAL RESPONSE CHARACTERISTICS



LINER CCD 30L



Linear CCD 30L consists of two identical linear 1024 pixel CCDs. The lines on a chip are oriented in parallel, each has bilinear arrangement and comprises separate sections for charge packet detection and accumulation. Antiblooming permits CCD to operate at device overillumination factor no less than 100. Electronic exposure mode (≥10 μs) is also provided.

Application:

- Spectral analysis equipment in 0.4-0.9 μm spectral range;
- Optoelectronic systems of space orientation;
- Object size measuring non-contact systems.

Linear CCD 30L is produced in two modifications. Main parameters are presented below.

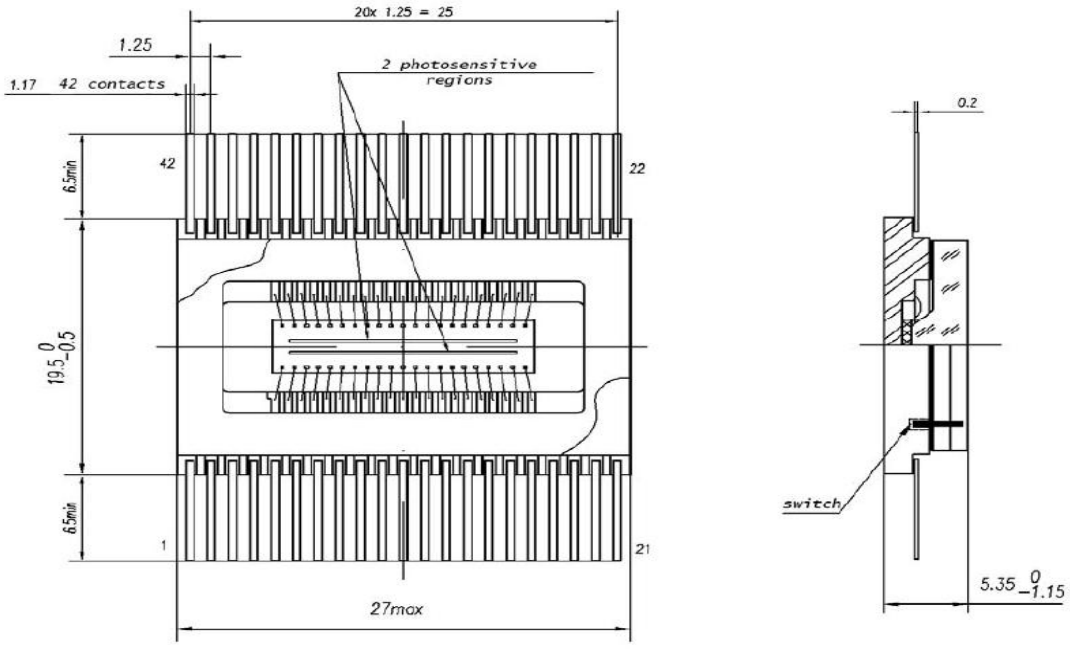
SPECIFICATIONS

Parameters	CCD 30L with mask	CCD 30L*
Number of pixels	2 × 1024	2 × 1024
Pixel size, μm2	13 × 26	13 ×150
Pixel pitch, μm	13	13
Package dimensions, mm	26.5 ×19.5	26.5 ×19.5
Distance between centers of CCDs, μm	900	900
Photosensitive region error in parallelism relative to base surface (glass outside surface), mm	0.01	-
Register control	4-phase	4-phase
Max. data output rate, MHz	5	5
Saturation signal, V	1.5	2.4
Dynamic range	≥2000	≥6000
Responsivity (source of A type with C3C-23 at output signal frequency 200 kHz), V/lx·s	0.8	12
Relative luminous nonuniformity,%	10	±4
Relative dark signal nonuniformity, %	5	1

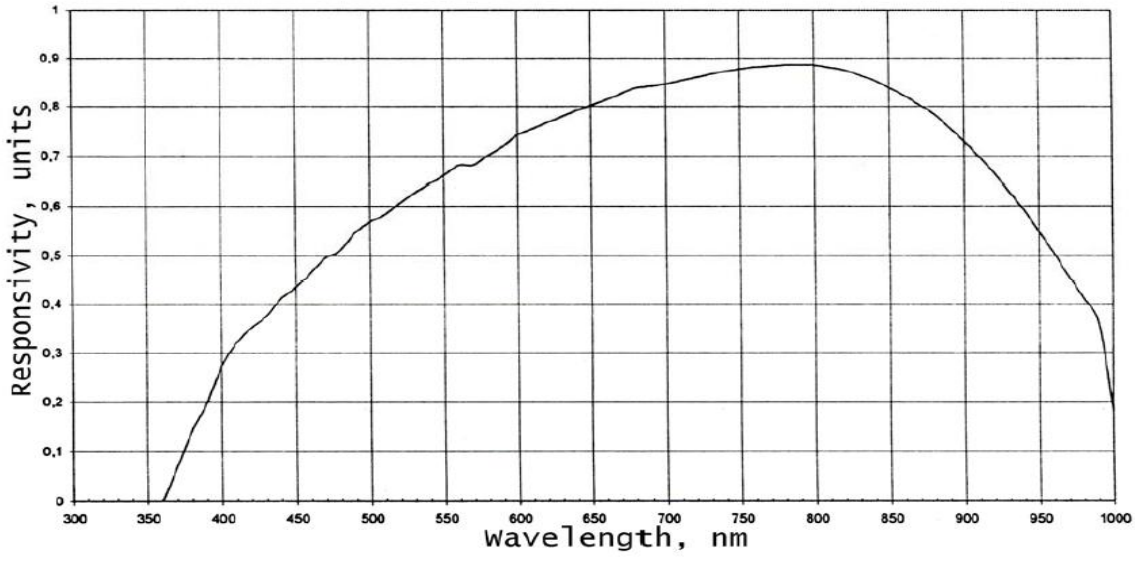
Max. voltage on terminals, V	-	20
Operation temperature range, ºC	-50 ÷ +50	-50 ÷ +50

*When input window is used without light shielding screen

DIMENSIONAL OUTLINE



SPECTRAL RESPONSE CHARACTERISTICS
CCD with mask



LINER CCD 32L

Linear CCD 32L consists of two identical linear 2600 pixel CCDs with axis symmetry and independent control.

Each CCD has bilinear arrangement and comprises separate sections for charge detection and accumulation. Antiblooming permits CCD 32L to operate at device overillumination factor no less than 100. Electronic exposure mode (≥10 μs) is also provided.

Application:

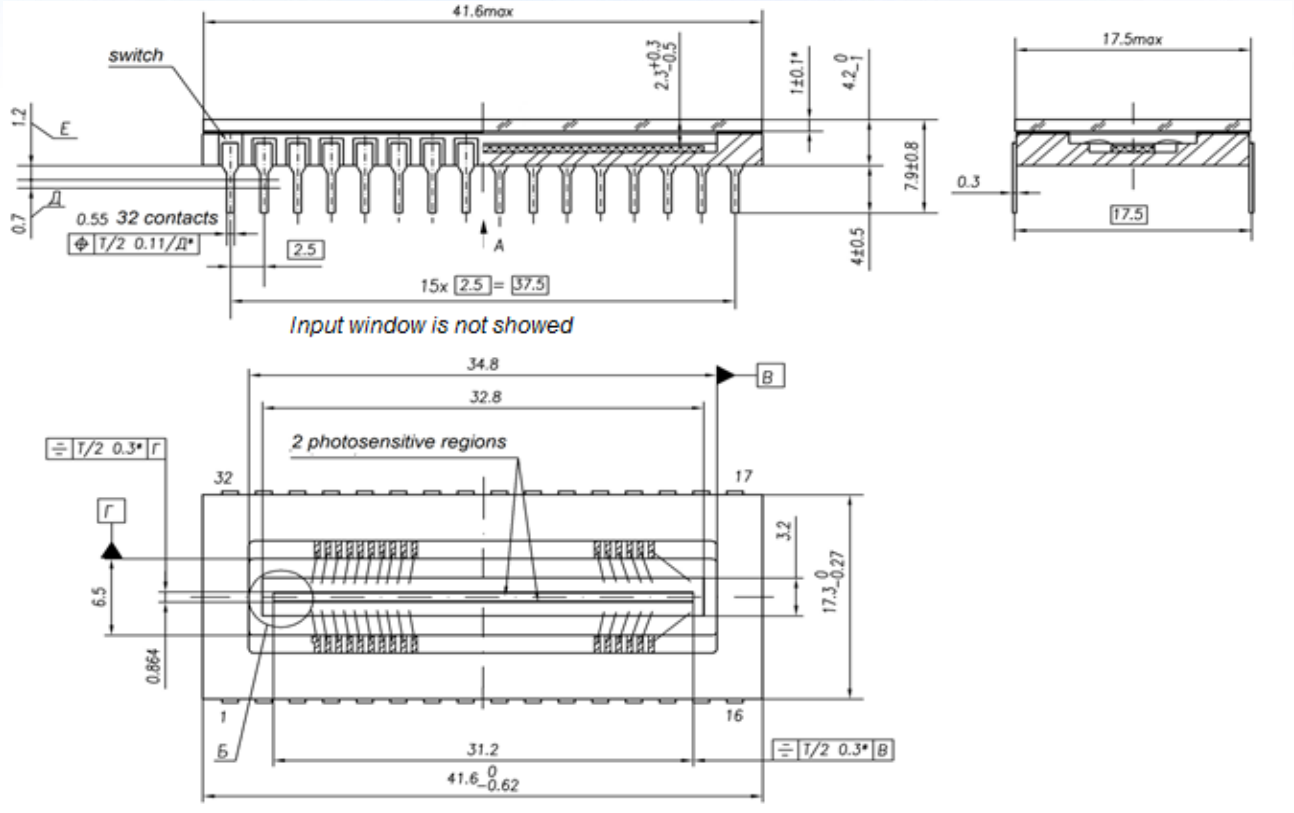
Linear CCD 32L is intended for application in spectroscopy, coordinate measuring systems, systems of space orientation and space equipment engineering.

SPECIFICATIONS

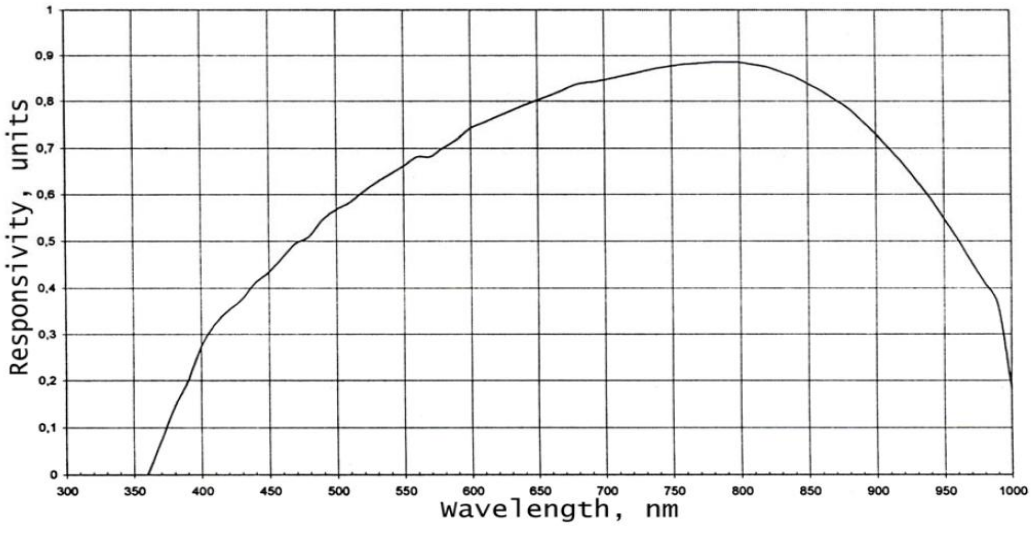
Number of pixels	2×2600
Pixel size, (H×V), μm2	12×100
Pixel pitch, μm	12
Photosensitive region length, mm	≥13.3
Distance between ends of linear CCDs, μm	32 × 27 × 5.7
Package overall dimensions, mm	41,6×17,4
Register control	4-phase
Max. data output rate, MHz	5
Saturation signal, V	2.4
Dynamic range, dB	6000
Responsivity (source of A type with C3C-23, at output signal 200 kHz), V/lx·s	12
Relative luminous nonuniformity, %	± 5
Relative dark signal nonuniformity, %	0.1
Max. voltage on terminals, V	20

Max. operation frequency, MHz	2.5
Operation temperature range, °C	-50 ÷ +50

DIMENSIONAL OUTLINE



SPECTRAL RESPONSE CHARACTERISTICS



LINER CCD-4700

Experimental sample

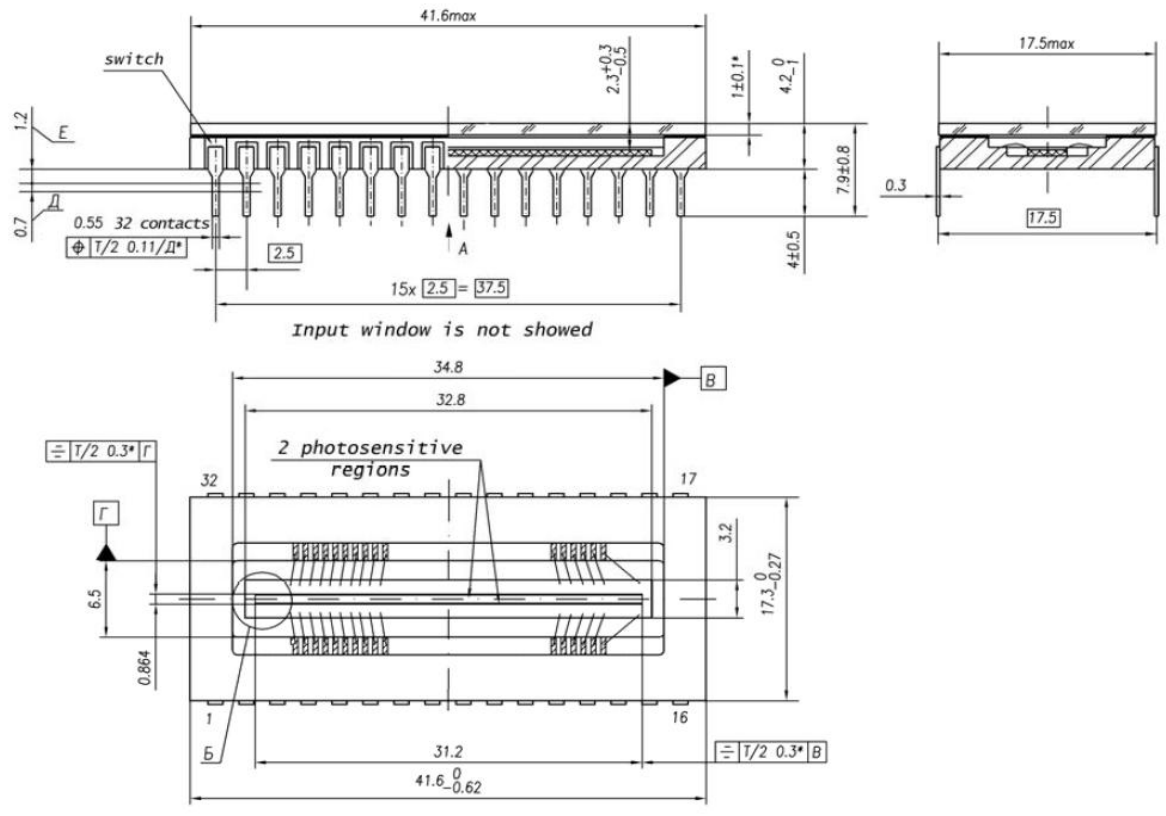
CCD-4700 is a linear CCD of 4700 pixels and 6.5x6.5 μm pixel size. The device has a bilinear arrangement and comprises individual sections for charge packet detection and accumulation. It has built-in antiblooming with overillumination factor no less than 100. Electronic exposure mode (≥10 μs) is provided. The product is a customized item.

Application: CCD-4700 is intended for application in TV and optoelectronic systems with enlarged space resolution.

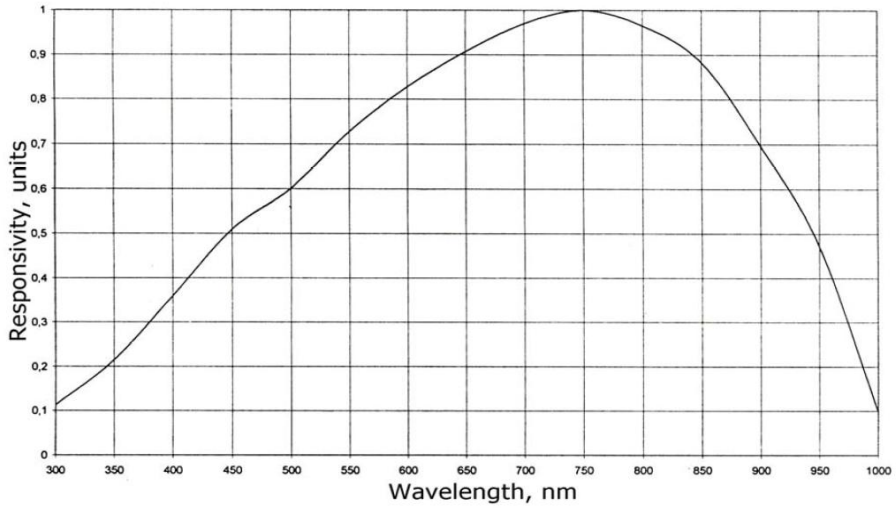
SPECIFICATIONS

Number of pixels	4700
Pixel size, μm2	6.5 × 6.5
Pixel pitch, μm	6.5
Package dimensions, mm	41.6 × 17.5
Number of output registers	2
Number of output units	2
Register control	2-phase
Typical data output rate along the register, kHz	2500
Saturation signal, V	0.6
Dynamic range	2500
Responsivity, V/lx·s	0.6
Relative luminous nonuniformity, %	±12
Relative dark signal nonuniformity, %	0.8
Maximum voltage on terminals, V	20
Maximum operation frequency, MHz	5
Operation temperature range, ºC	-50 ÷ +50

DIMENSIONAL OUTLINE



SPECTRAL RESPONSE CHARACTERISTICS



LINEAR CCD UP TO 12000

A number of linear CCD with 4K, 6K, and 12K pixels for perspective (long-range) surveillance systems of space base, enable to realize the best parameters of space resolution at small size object detection. The product may also serve as a basic part at (?) system of high resolution creation in wide range of wave lengths 0,3 – 0,9 μm. CCD may also be effectively applied in facsimile systems of high resolution and long-range surveillance systems. Such CCD application in systems provides higher resolution at small size object detection including at spectrozone shooting.

The products under development include CCD of three types – with 4K, 6K, and 12K pixels.

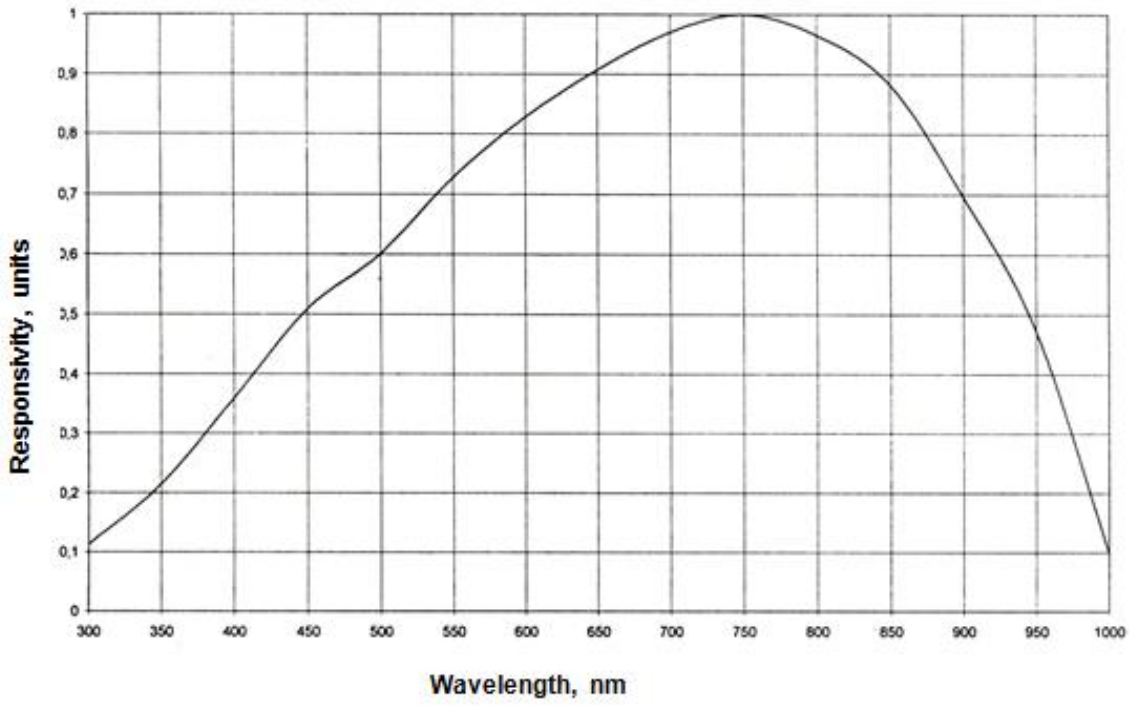
CCDs have crystals (chips) of big size (~10cm) and high parameters. This requires the development of modern high effective CCD transfer registers, providing charge transfer for distance ~ 5 cm with transfer inefficiency not worse than 0,999998.

SPECIFICATIONS

	CCD- 4K	**CCD-6K**	**CCD-12K**
Number of pixels	4096	6000	12000
Pixel size, μm	6.5x6.5	6.5x6.5	6.5x6.5
Pixel pitch, μm	6.5	6.5	6.5
Number of output registers	2	4	4
Number of output units	2	4	4
Data output rate along the register, MHz	5	5	5
Electronic shutter, antiblooming	+	+	+
Saturation voltage, V	≥2	≥2	≥2
Spectral sensitivity, V·cm2/μJ	≥2.5	≥2.5	≥2.5
Dynamic range	≥4000	≥3000	≥3000
Modulation transfer factor at space frequency fN/2 across horizontal, %	≥50	≥50	≥50

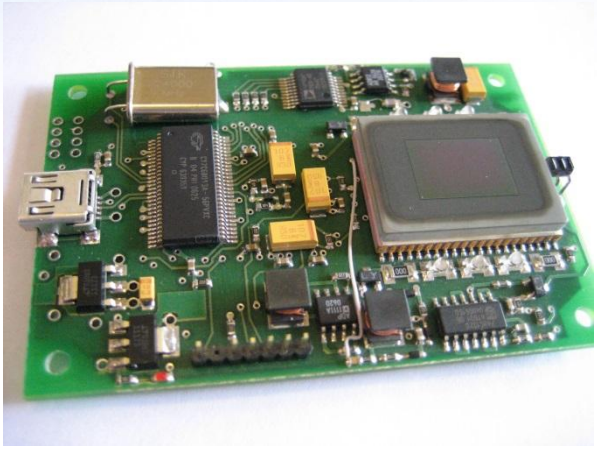
Dark signal mean square nonuniformity, %	≤2	≤2	≤2
Relative luminous nonuniformity, %	≤ ±10	≤ ±10	≤ ±10
Spectral response, nm	400-900	400-900	400-900

SPECTRAL RESPONSE



DC21 DACTILOSCOPIC MULTIFUNCTIONAL ELECTRONIC SCANNER

Experimental sample



Dactiloscopic multifunctional electronic system DC21 is designed as standard software and hardware modules and is intended for biometric identification of person and his character, state of health, reading fingerprint information and protection of the information stored in the memory of PC from unauthorized access. Dactyloscopic system using dactyloscope scanner DC21 converts the user's finger skin papillary pattern into the digital video signal supplied through USB port (version USB2.0). The software processes the information and performs user identification, and solves biometric problems in accordance with data, previously archived.

DC21 can be applied for different research and medical purposes, security systems, printing and identification of biometric identity cards in the form of plastic cards.

Features:

- High resolution up to 1500 pixel/inch
- Possibility of false dactyloscopic carrier recognition
- Biometric card and live finger reading-out with one scanner
- High reliability and long life in wide temperature range from -45ºC to +60ºC
- Possibility of application in medical research
- Possibility of operation with various frequency and resolution
- Support of biometric, psychological and medical applications
- Possibility of usage in the mode of polygraph
- Support of volume pulse mode
- Support of joint radiation and biometric monitoring technology

SPECIFICATIONS

Scanner plate dimensions, mm	50x74x8
Pixel number	512x576
Photosensitive area size, mm	9.2x14.0
Pixel size, (HxV), μm	18x24
Operating resolution, dpi	≤1000
Supply voltage (USB), V	4.5-5.0
Speed characteristic at 512x576 mode, f/s	≤10
Speed characteristic at 512x128 mode, f/s	≤50
USB interface	USB 2.0
Possibility of plastic cards reading	Yes
Possibility of sleep mode	Yes
Possibility of pulse definition	Yes
Number of pulse definition points	≤300000
Possibility of application for dosimetric cards	Yes

Applications for biometric cards and dactiloscopy

POSITION SENSOR FUR 42M

Long experience of large format photodetectors usage for integral transformations of optical signals has enabled to develop unique techniques and manufacture number of optoelectronic systems capable of solving problems of image informative features selection including object spatial coordinates determination, horizon line detection, definition and classification of image structure, etc.

FUR 42M is a packageless leadless position sensor without chip holder. Sensor is manufactured on silicon insulating substrate. It is used as a component in hybrid assemblies.

Sensor operation is based on integral method of optical signal processing without scanning along the whole vision area.

Sensor properties:

dimensional linearity;

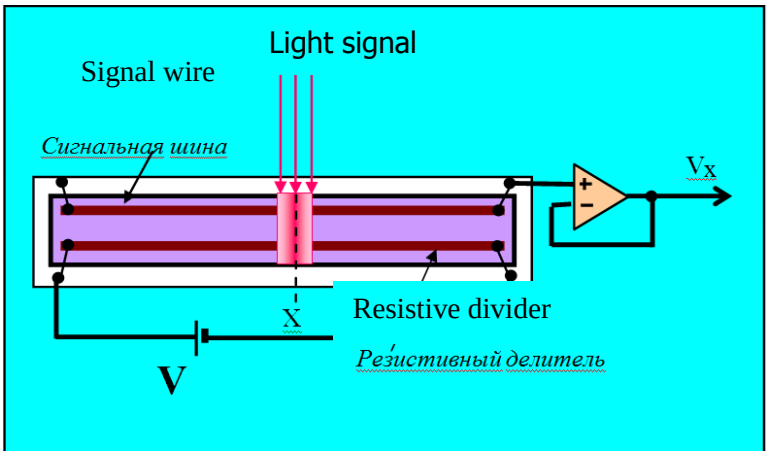
high accuracy;

wide dynamic range;

high reliability;

high stability;

long and narrow photosensitive area.



FUR 42M permits to define light spot position in tracking mode at resolution of ≤1 μm (10-4 of sensor vision area). It is capable to operate in background illumination conditions exceeding signal power up to 104.

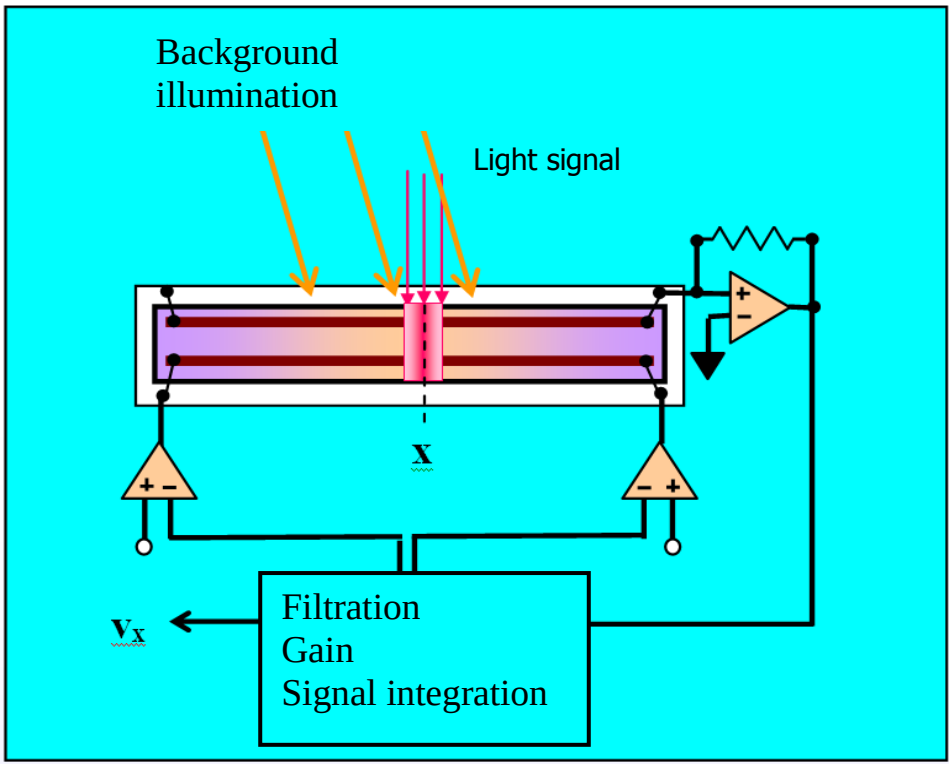
Output signal is proportional to median position of optical signal.

Main parameters are shown in Table 1.

Table 1. Sensor main parameters

Parameter	
Photosensitive area size, mm	20 x 0,5 b) 6 x 0,5 b) 6 x 0,5
Resolution, μm	<1
Dimensional non-linearity, %	<1
Dark current, A (U=10 V)	10-8-10-11
Min. requirement light signal power (Wmin), W	10-9

Min. position determination time (at W=3·10-5 W), s	10-5
Spectral response, μm	0,2-1,0
Max. photosensitivity location (λmax), nm	0,7
Spectral sensitivity at λmax, A/W	0,3
Operation voltage, V	5-10
Operation temperature, oC	-10 to + 60



VACUUM

TUBES

PMT

VIDICONS

SILICON VIDICON

PHOTO X-RAY TUBE

SPECTROMETRIC PHOTOMULTIPLIER TUBE PMT 143

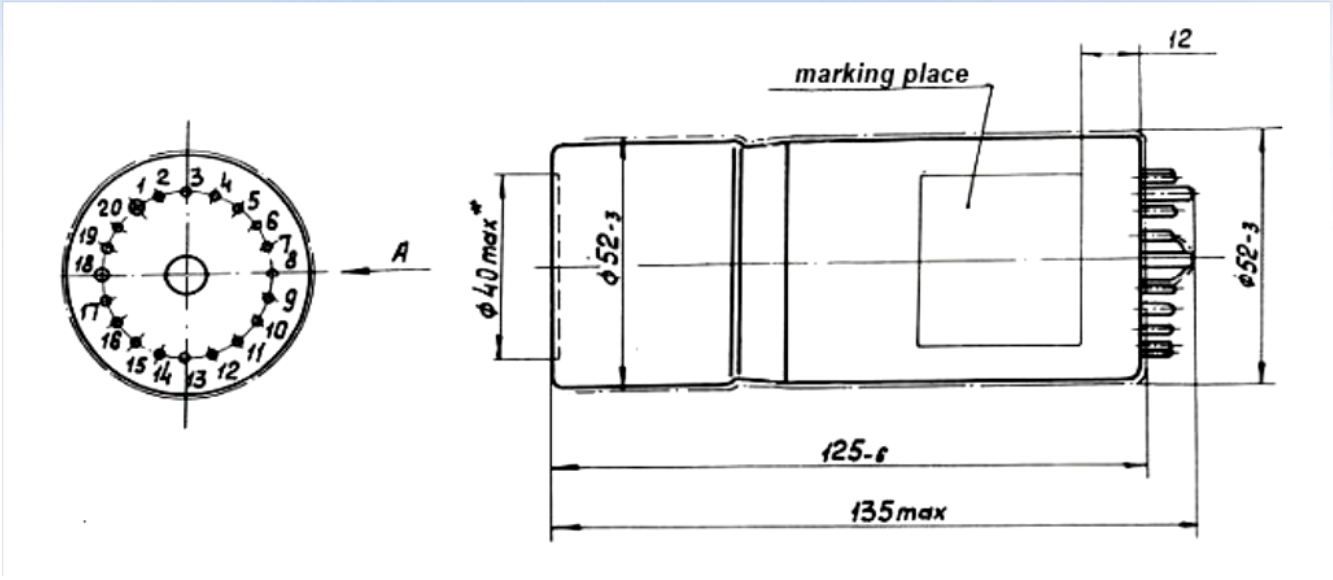
PMT-143-1 has bialkali photocathode, flat-concave input window of boron-silicate glass, electron electrostatic focusing and linear 12-dynode multiplication systems.

The device is intended for research of fast processes. It has minimum time-of flight spread across photocathode active area.

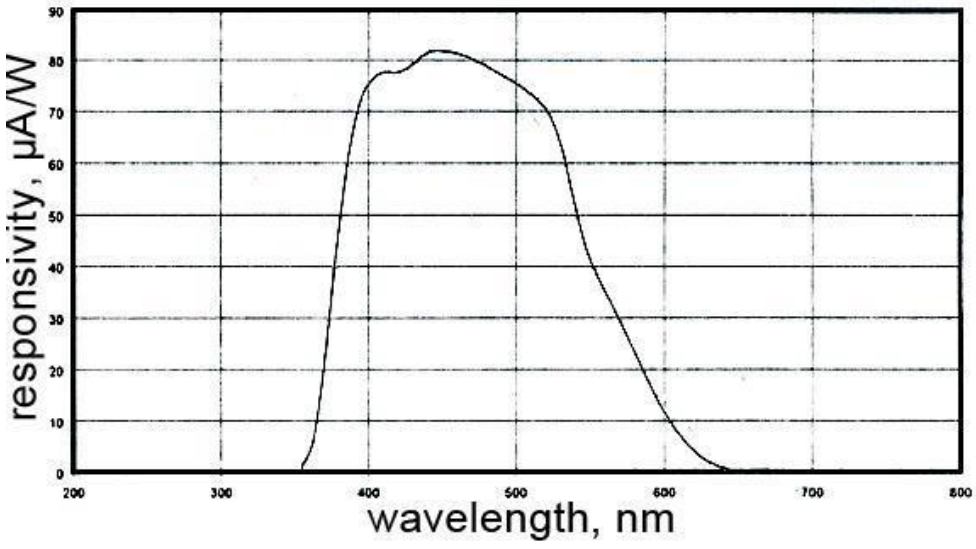
SPECIFICATIONS

Photocathode diameter, mm		40
Device diameter, mm		52
Photocathode		SbKCs
First dynode with high amplification		GaAsP
Supply voltage, V	at anode luminous sensitivity of 100 A/lm	2000
	at anode luminous sensitivity of 1000 A/lm	2450
Spectral response, nm		360÷650
Photocathode luminous sensitivity, μA/lm		60
Photocathode radiant sensitivity (λ=410 nm), mA/W		65
Count rate of dark signal (at anode luminous sensitivity of 300 A/lm), pulse/s		≤630
Pulse rise time, ns		≤3.0
Single electron resolution at 0.75 level, %		≤75

OUTPUT CONNECTION **DIMENSIONAL OUTLINE**



SPECTRAL RESPONSE CHARACTERISTIC



PHOTOMULTIPLIER TUBE PMT-175

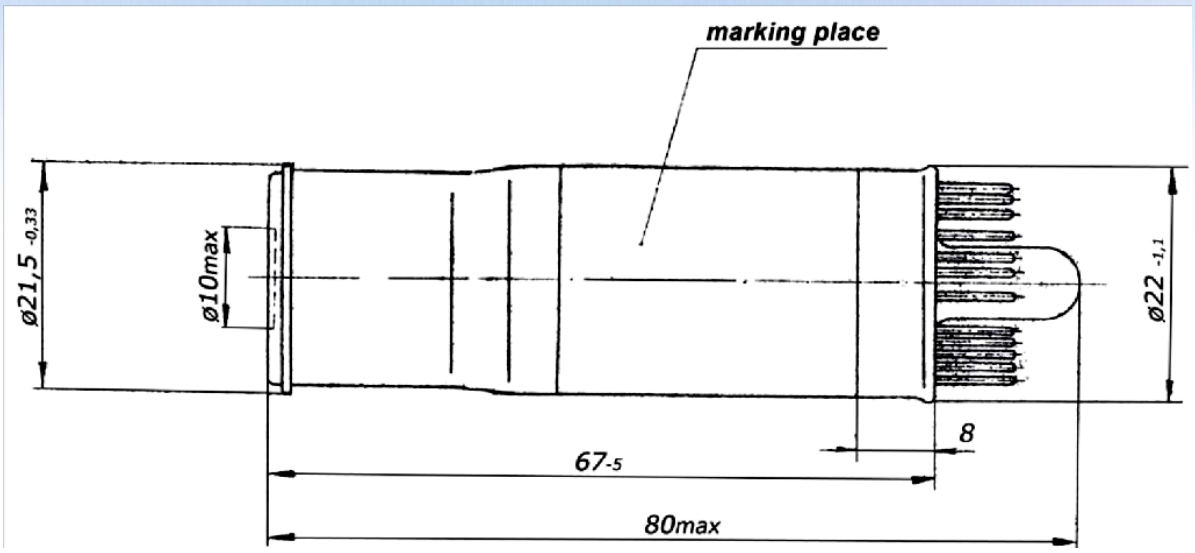
PMT-175 has SbKCs photocathode and linear 14-dynode multiplication system. The device is intended for multispectral research.

Construction design: PMT-175 is produced in a glass balloon with head-on optical input. The input window is made of boron-silicate UV glass. Available complete set: socket and voltage divider.

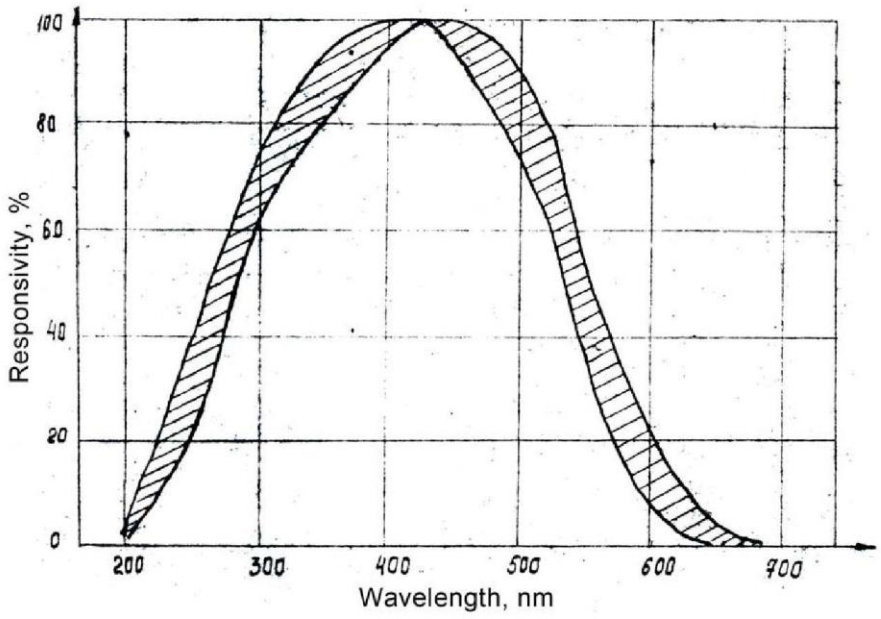
SPECIFICATIONS

Photocathode	SbKCs
Photocathode diameter, mm	10
Device diameter, mm	22
Length, mm	67
Number of dynodes	14
Spectral response, nm	250÷650
Photocathode luminous sensitivity, μA/lm	≥50
Photocathode radiant sensitivity (λ=400 nm), mA/W	60
Dark current, A	2·10-8
Rate of dark noise at single electron pulse peak, 1/s	≤300
Nominal supply voltage at anode luminous sensitivity of 100 A/lm, V	≤2200

DIMENSIONAL OUTLINE



SPECTRAL RESPONSE CHARACTERISTIC



SPECTROMETRIC PHOTOMULTIPLIER TUBE PMT-176

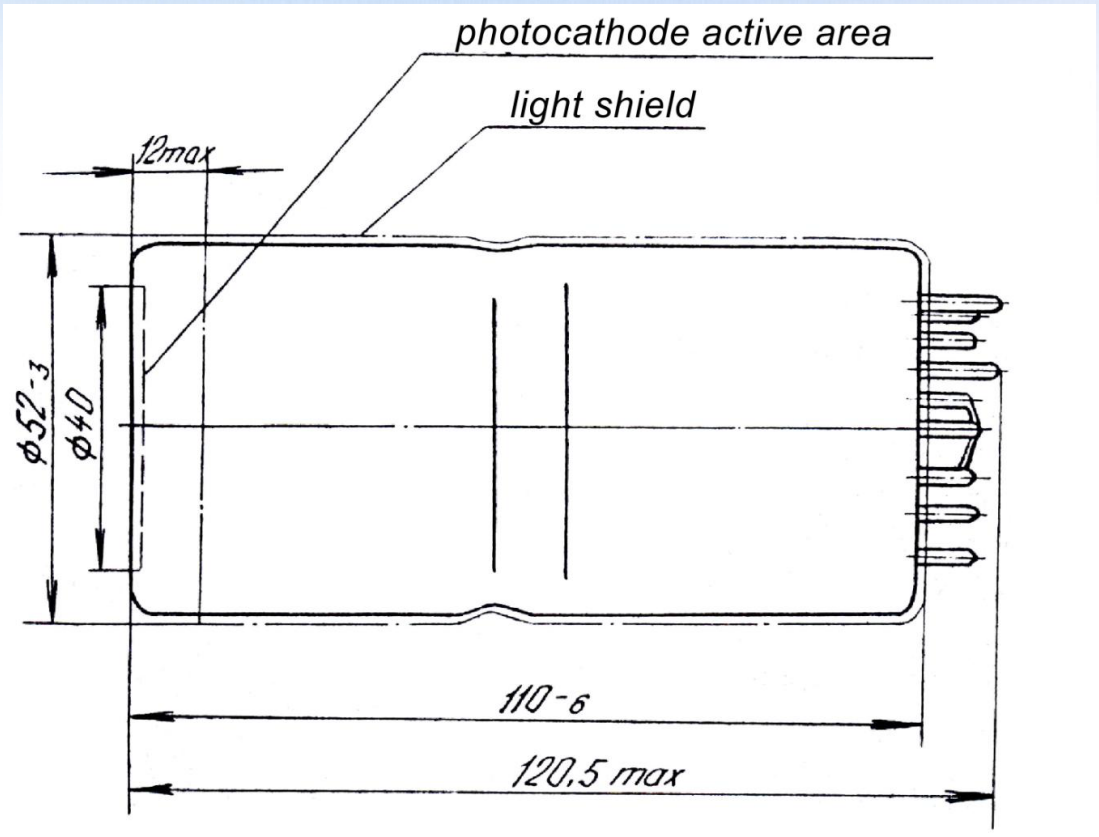
PMT-176 has multialkali photocathode of S20 type, electron electrostatic focusing system, 12-dynode multiplication system. The device is intended for photometry and spectrometry, γ-radiation detection by scintillation method, for diagnostic radioisotope equipment. The device could be used in ecology, biophysics, geology, geophysics, nuclear physics, high energy physics, etc.

Construction design: PMT-176 is produced in a glass balloon with head-on optical input and with rigid leads. Input window is made of boron-silicate glass C50-3 or C52-2.

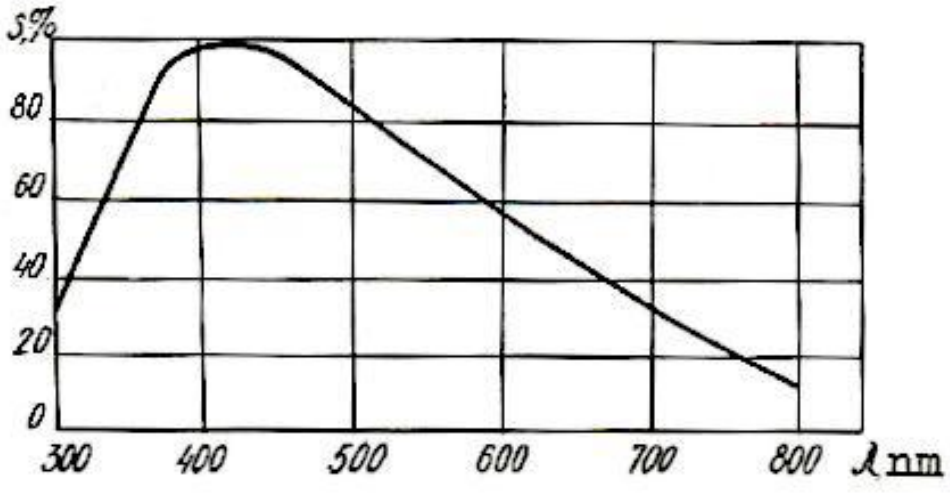
SPECIFICATIONS

Photocathode diameter, mm		40
Device diameter, mm		52
Length, mm		120,5
Spectral response, nm		300 ÷ 850
Supply voltage, V		≤1500
Photocathode luminous sensitivity, A/lm		130
Photocathode radiant sensitivity (λ=(410±10) nm), μA/W		52
Anode luminous sensitivity, μA/lm		100
Dark current, nA		8
Gain under normal conditions		1×105
Pulse height resolution, %	on 137Cs	≤7.3
	on 57Co	≤11.5
Self-noise energy equivalent , keV		≤1.5
Luminous characteristic non-linearity at pulse mode with anode current of 0.3 A and pulse time ≤2×10-6 s, %		≤30

DIMENSIONAL OUTLINE



SPECTRAL RESPONSE CHARACTERISTIC



SPECTROMETRIC PHOTOMULTIPLIER TUBE PMT-183, PMT-183-1

PMT-183, PMT-183-1 have multialkali photo-cathode of S20 type, electron electrostatic focusing system, 12-dynode multiplication system of venetian blind type. The devices are intended for photometry and spectrometry of low illumination, γ-radiation detection by scintillation method. The devices could be used in ecology, biophysics, medicine, geology, geophysics, nuclear physics, high energy physics, etc.

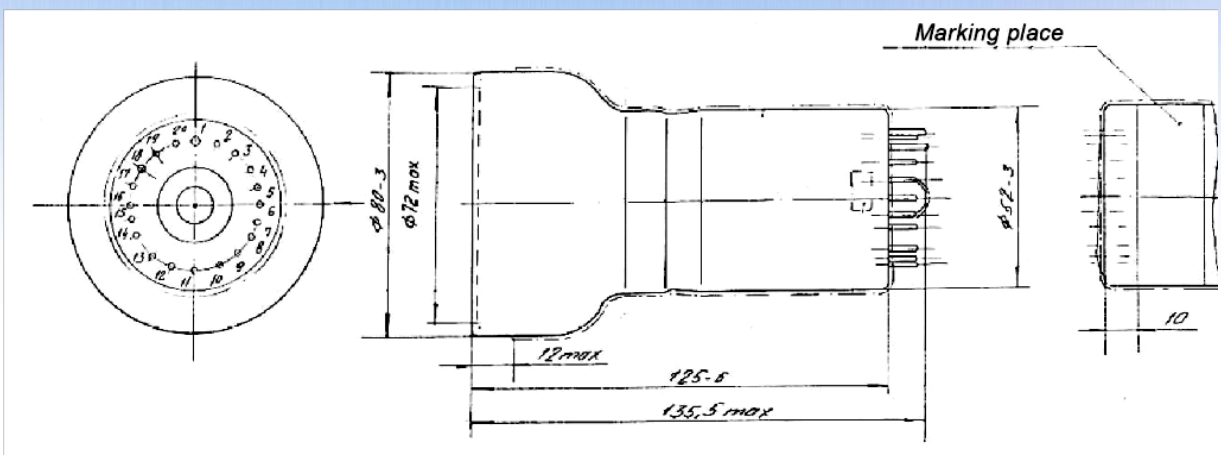
Construction design: PMT-183, PMT-183-1 are produced in a glass balloon with head-on optical input and with rigid leads. Input window is made of boron-silicate glass C50-3 or C52-2.

SPECIFICATIONS

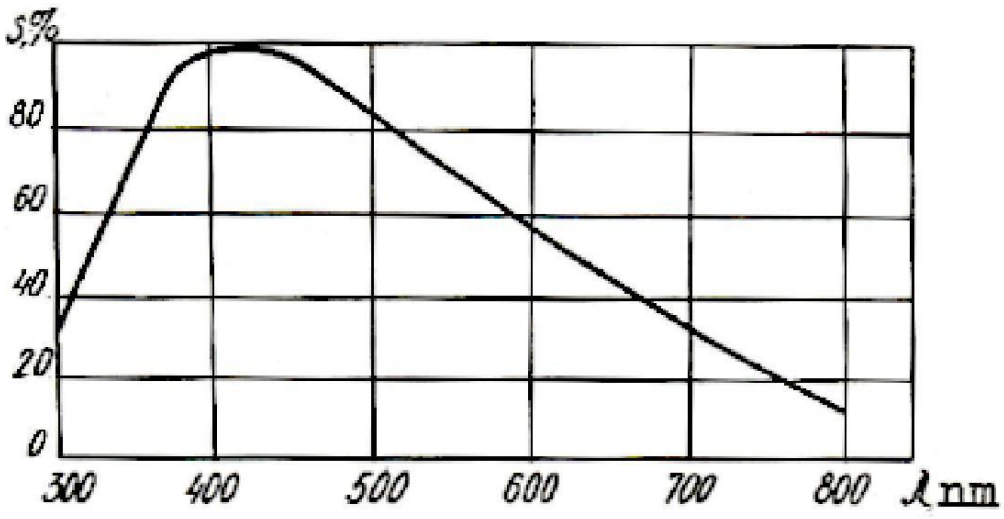
		PMT-183	PMT-183-1
Photocathode diameter, mm		72	
Device diameter, mm		80	
Length, mm		125	
Supply voltage, V		1600	
Spectral response, nm		300 ÷ 850	
Maximum spectral response, nm		370 ÷ 430	
Photocathode luminous sensitivity, μA/lm		100	
Photocathode radiant sensitivity at λ=(410±10) nm, μA/W		70	60
Anode luminous sensitivity, A/lm		10	
Pulse rise time, ns		8	
Pulse height resolution, %	on NaI(Tl)137Cs	7.6	8.5
	on NaI(Tl)57Co	11	12
Dark current, nA		≤50	
Temperature range, ºC		-60 ÷ +70	
Anode current, A		5·10-4	
Self-noise energy equivalent, keV		≤1.5	

OUTPUT CONNECTION

DIMENSIONAL OUTLINE



SPECTRAL RESPONSE CHARACTERISTIC



PHOTOMULTIPLIER TUBE PMT-186

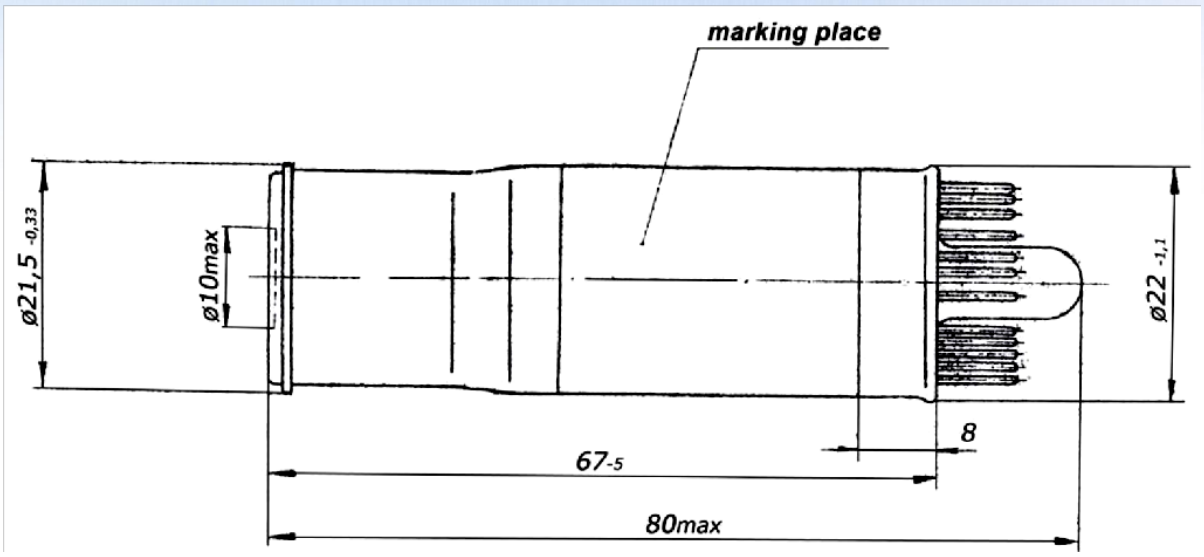
PMT 186 has SbKNaCs photocathode and linear 14-dynode multiplication system. The device is intended for registration of impulse light signal within visible and near IR ranges for multispectral research.

Construction design: PMT-186 is produced in a glass balloon with head-on optical input. The input window is made of boron-silicate UV glass. Available complete set: socket and voltage divider.

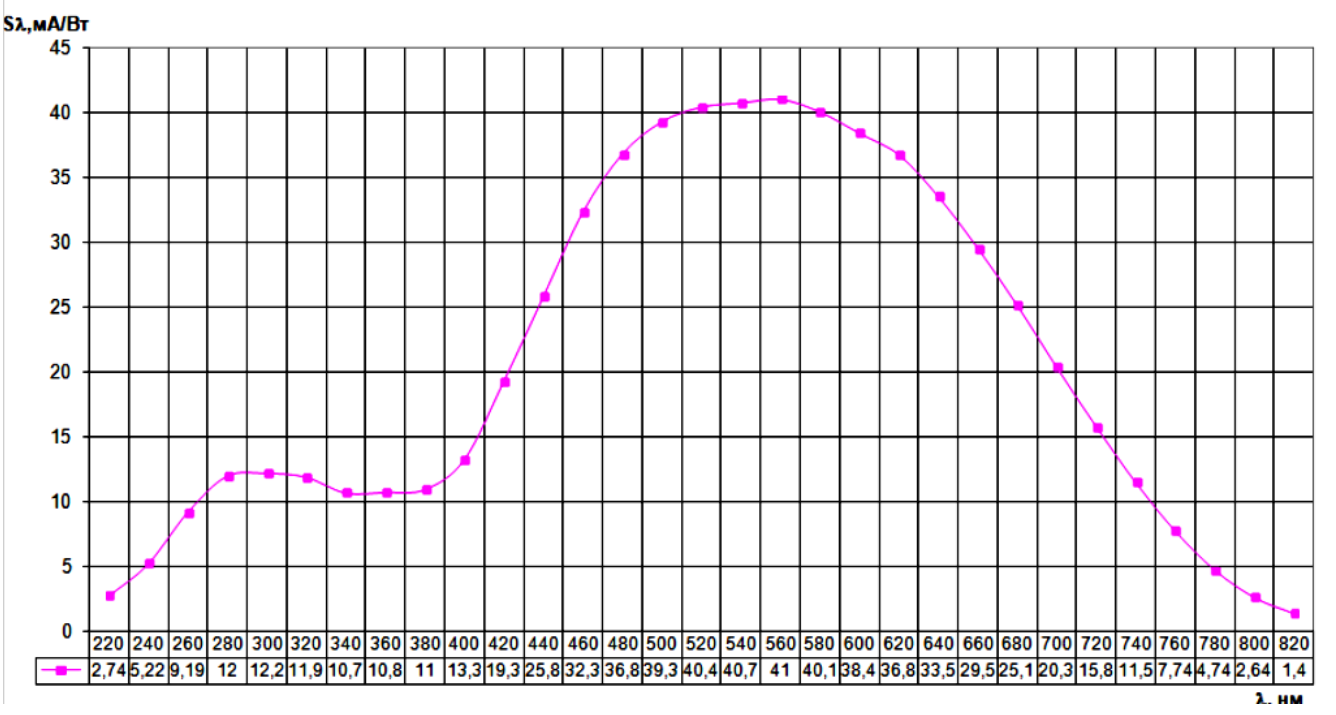
SPECIFICATIONS

Photocathode	SbKNaCs
Photocathode diameter (functional), mm	10
Device diameter, mm	22
Length, mm	67
Number of dynodes	14
Spectral response, nm	200 ÷ 800
Photocathode luminous sensitivity, μA/lm	≥80
Anode luminous sensitivity, A/lm	100
Dark current, A	≤5·10-9
Nominal supply voltage at anode luminous sensitivity of 100 A/lm, V	≤2200
Pulse rise time, ns	≤1,5

DIMENSIONAL OUTLINE



SPECTRAL RESPONSE CHARACTERISTIC



RADIATION HARD PHOTOMULTIPLIER TUBE PMT-187 OF HIGH IMMUNITY TO MAGNETIC FIELDS

Photomultiplier tube of PMT-187 series has bialkali photocathode and 15-cascade secondary-electronic amplifier with mesh dynodes. The device is intended for scintillation counting in high-energy physics and could be used under simultaneous exposure of strong magnetic and radioactive fields and elementary particles.

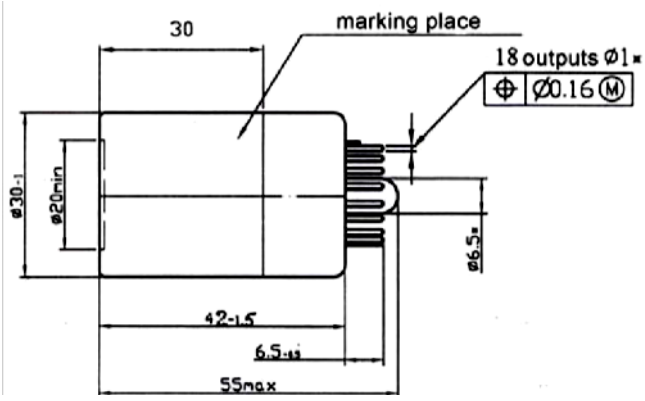
Construction design: PMT-187 is produced in a glass balloon with head-on input and rigid leads. The input window is made of boron-silicate UV glass, the first dynode is of “proximity” type. Possible complete set includes socket with voltage divider.

SPECIFICATIONS

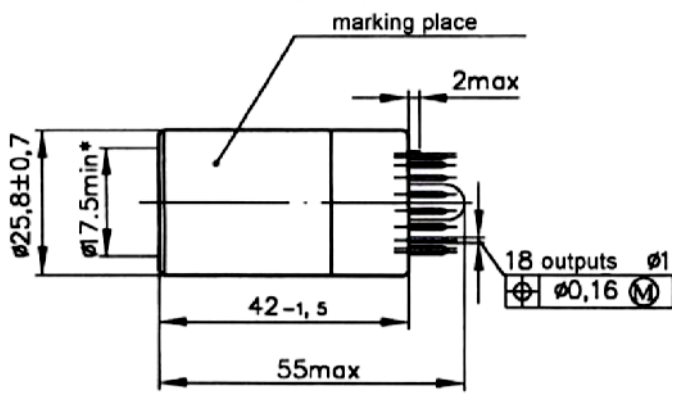
	PMT-187	PMT-187-1
Photocathode	SbKCs	
Length, mm	55	
Diameter, mm	30	25.8
Photocathode diameter, mm	20	17.5
Dynodes, pcs.	15	
Spectral response, nm	220÷650	
Typ. photocathode luminous sensitivity, μA/lm	60	
Typ. photocathode radiant sensitivity (λ=400nm), mA/W	60	
Anode luminous sensitivity, A/lm	40	
Typ. supply voltage at anode luminous sensitivity of 30 A/lm, V	≤1800	
Dark current, A	≤1·10-8	
Typ. gain under normal conditions	5·105	
Typ. gain under magnetic field of H=0.5 T	2·105	

Typ. pulse rise time, ns	1.4
Typ. energy resolution on NaI(Tl)137Cs, %	10.1
Temperature range, °	-60 ÷ +55

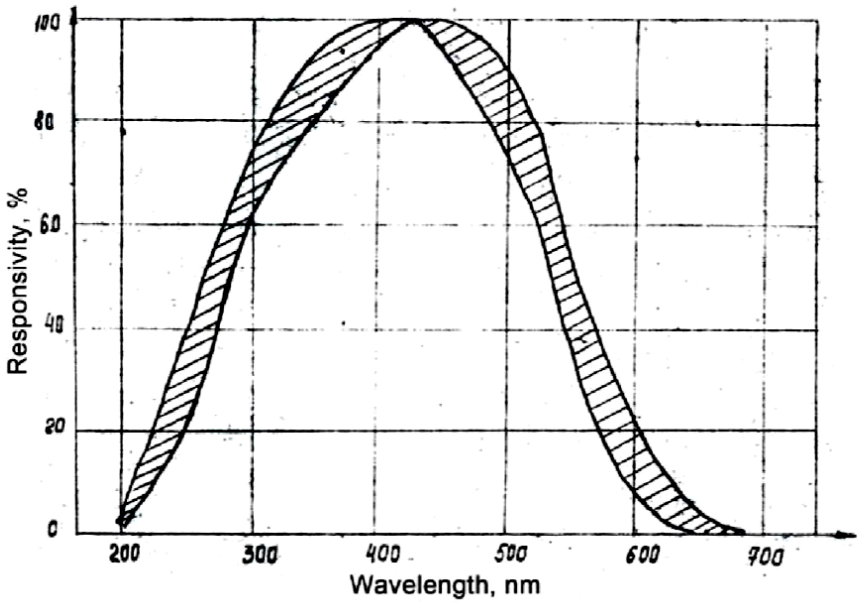
PMT-187



PMT-187-1



SPECTRAL RESPONSE CHARACTERISTIC



PHOTOMULTIPLIER TUBE PMT-188 OF HIGH IMMUNITY TO MAGNETIC FIELDS

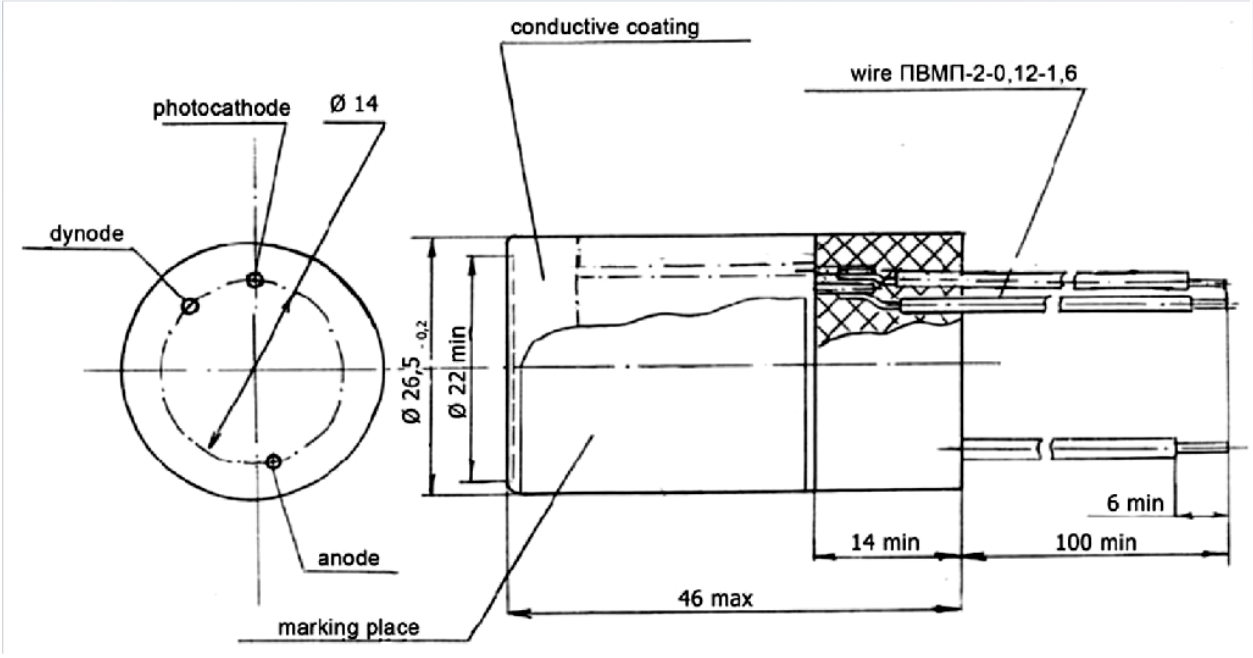
PMT-188 has bialkali photocathode and one-cascade multiplication system. The device is intended for application in photodetectors operating under exposure of strong magnetic (up to 4T) and radioactive fields (up to 2kGy).

Construction design: The photomultiplier tube is produced in a glass balloon with head-on input and flexible leads. The input window is made of boron-silicate UV glass.

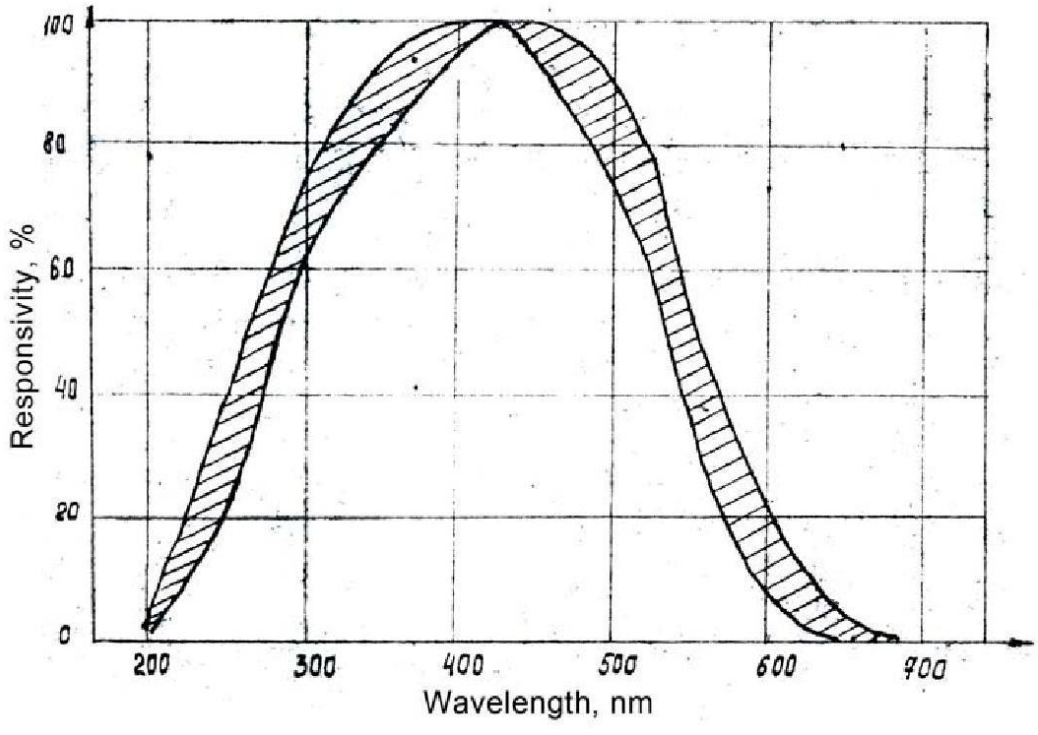
SPECIFICATIONS

Photocathode	SbKCsO
Photocathode diameter, mm	22
Device diameter, mm	26.5
Length, mm	46
Supply voltage, V	1000
Spectral response, nm	250÷650
Photocathode luminous sensitivity, μA/lm	60
Photocathode quantum efficiency (λ=420), %	≥18
Dark current, nA	≤2
Gain under normal conditions	≥8
Gain under magnetic field with H=4T	≥6
Temperature range	-5ºC÷ +50ºC

OUTPUT CONNECTION DIMENSIONAL OUTLINE



SPECTRAL RESPONSE CHARACTERISTIC



PMT-202 PHOTOMULTIPLIER TUBE

PMT-202 shows improved luminous characteristic linearity in pulse mode and extended service life.

The device has a multialkali photocathode, electrostatic focusing, venetian blind 14-dynode structure of improved construction.

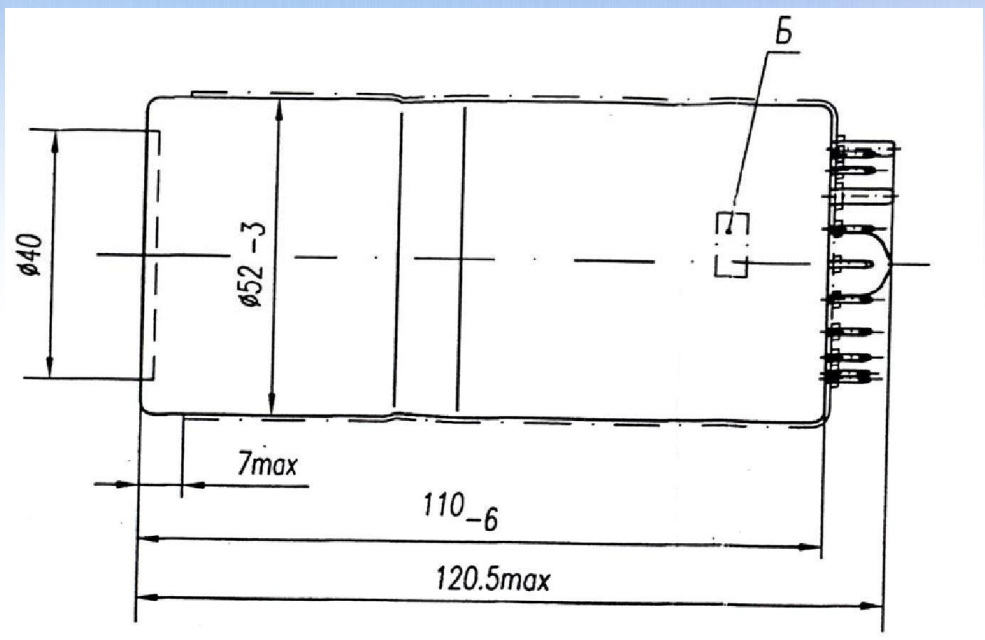
It is intended for application in equipment with pulse light exposure, and can be used in spectrometric equipment.

Construction design: PMT-202 is produced in a glass balloon with plane head-on optical input and rigid leads. Input window is made of boron-silicate glass C52-2.

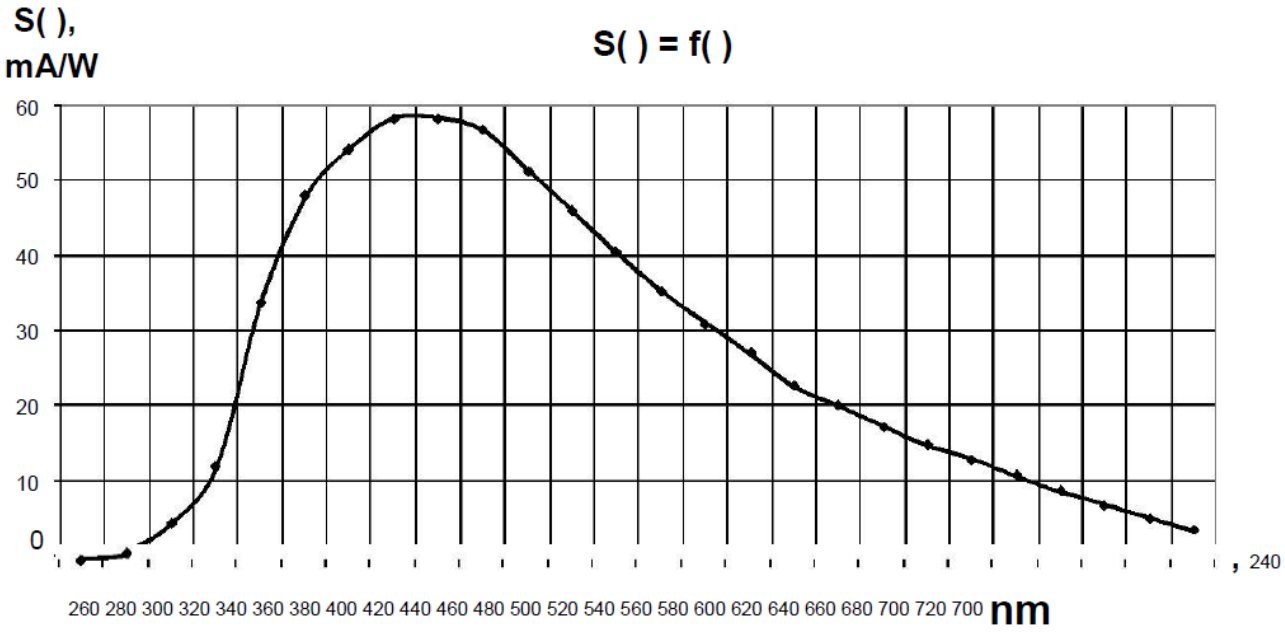
SPECIFICATIONS

Photocathode	SbKNaCs
Photocathode diameter, mm	40
Device diameter, mm	52
Length, mm	120.5
Supply voltage, V	2200
Spectral response, nm	300-750
Anode luminous sensitivity, A/lm	≥300
Dark current, A	≤5·10-7
Gain under normal conditions, per unit	1·106
Anode luminous nonlinearity in pulse mode at anode current amplitude of 0.6 A and pulse of (1-100) μs, %	≤15
Average anode current, A	(3÷3.2)·10-5
Limiting mode single influence, min	≤5
Limiting supply voltage, V	≤2400
Limiting average anode current, A	≤5·10-4
Operation temperature range, ºC	-10 ÷ +40

DIMENSIONAL OUTLINE



SPECTRAL RESPONSE CHARACTERISTIC



PHOTOMULTIPLIER TUBE PMT-TETRODE WITH HUGH IMMUNITY TO MAGNETIC FIELD

PMT-tetrode has a bialkali photocathode and two-cascade multiplication system.

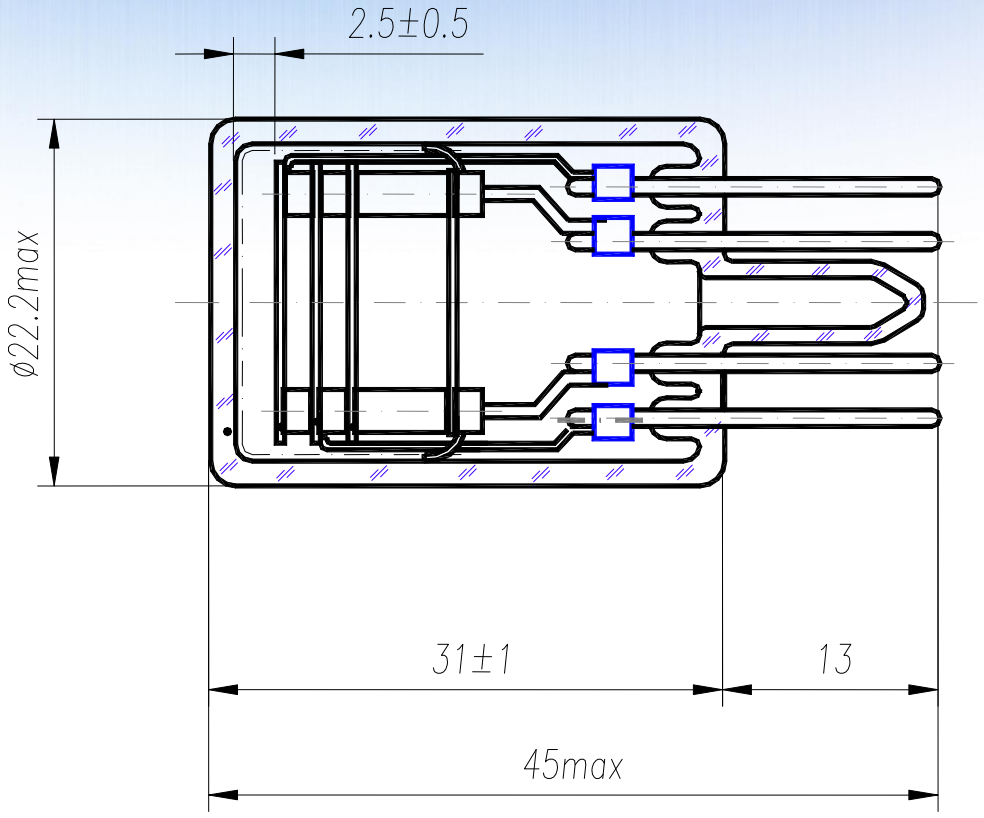
The device is intended for scintillation irradiation detection in high energy physics under conditions of magnetic fields up to 1.2 T and radiation up to 1500 Gy.

Construction design: the PMT is produced in a glass balloon with head-on optical input and flexible leads. The input window is made of boron-silicate UV glass.

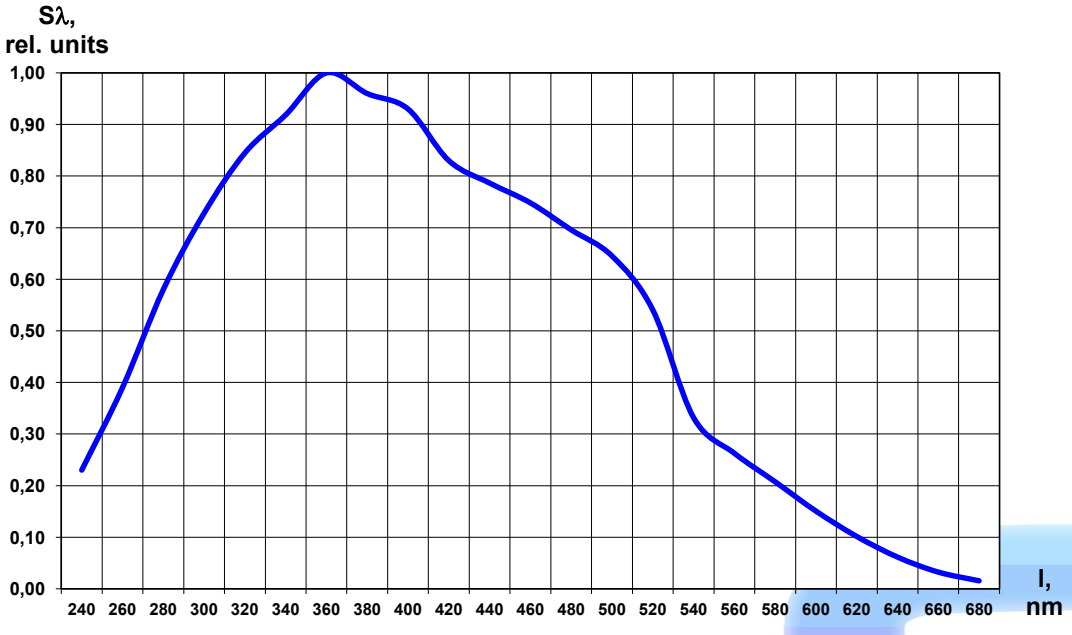
SPECIFICATIONS

Photocathode	SbKCsO
Photocathode diameter, mm	16
Device diameter, mm	22
Length, mm	46
Supply voltage, V	1200
Spectral response, nm	220 ÷ 650
Photocathode luminous sensitivity, μA/lm	≥60
Photocathode quantum efficiency (λ=420 nm), %	≥15
Dark current, nA	≤2
Gain under normal conditions	≥20
Gain under magnetic field at H=1.2 T	≥13
Operating temperature range, ºC	-5 ÷ +50

DIMENSIONAL OUTLINE



SPECTRAL RESPONSE CHARACTERISTIC



RADIATION HARD VIDICON LI501-1MK

2/3" Vidicon LI501-1MK is used in conditions of high radiation up to 5·107 rad.

A target is based on CdSe.

Vidicon has magnetic focusing and electrostatic deflection.

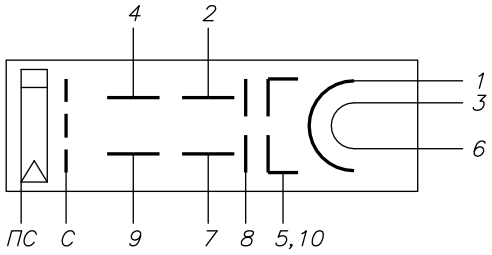
Construction design: Glass material; without base with ring outputs of signal plate and grid.

SPECIFICATIONS

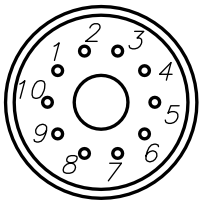
Target active area, mm	6.6 × 8.8
Length, mm	≤90
Diameter, mm	17.8-0.6
Diameter of contact rings, mm	19.6±0.1
Mass, g	≤18
Heater voltage, V	6.3
Heater current, mA	80 ÷ 115
Anode voltage, V	250
Deflectron electrode voltage, V	220
Grid voltage, V	340
Pickup plate voltage, V	10 ÷ 25
Modulator operating voltage, V	0 ÷ 15
Modulator cut-off (negative) voltage, V	≤20
Target illumination, lx	1
Signal current, μA	≥0.15
Resolution at the center, TVL	≥600
Resolution in the corners, TVL	≥550

Modulation depth at 400 TVL (at the center), %	≥55
Decay lag after 40 ms, %	≤14
Dark current, μA	≤0.003
Dark noise nonuniformity, %	≤15
Geometric distortion , %	≤2.5
Target maximum illumination, lx	4
Exposure dose power, rad/h	$\leq 1 \cdot 10^5$
Capacity between pickup electrode and other electrodes connected together, pF	≤3.5
Warm-up time, s	≤30
Guaranteed life, h	1000

LI501—1MK CIRCUIT



Output connection



Output	Electrode
1	Cathode
2,7	Deflectron electrode (frames)
3,6	Heater
4,9	Deflectron electrode (lines)
5	Modulator
8	Anode
10	Switch (don't switch on!)
С	Grid
ПС	Pickup plate

LI501-1MKT RADIATION HARD VIDICON

2/3" vidicon is used in conditions of high radiation up to 6·107 rad.

Target is based on cadmium selenide.

LI501-1MKT uses magnetic focusing and electrostatic deflection.

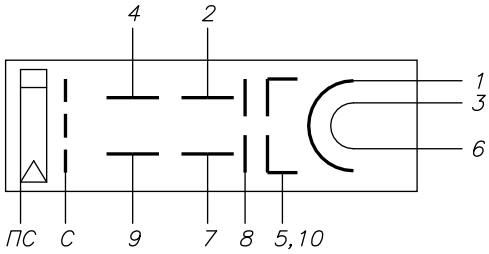
Construction design: glass material. Has no base. With ring outputs of signal electrode and grid.

SPECIFICATIONS

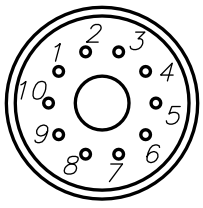
Target active area, mm	6,6 × 8,8
Length, mm	≤90
Diameter, mm	17,8 -0,6
Diameter of contact rings, mm	19,6 ± 0,1
Mass, g	≤18
Heater voltage, V	6,3
Heater current, mA	80 ÷ 115
Anode voltage, V	250
Constant deflectron electrode voltage, V	220
Grid voltage, V	340
Pickup plate voltage, V	8 ÷ 23
Modulator operating voltage, V	0 ÷ 15
Modulator cut-off (negative) voltage, V	≤20
Nominal target illumination, lx	1
Signal current, μA	≥0,115
Resolution at the center, TVL	≥600
Resolution in the corners, TVL	≥550

Modulation depth at 400 TVL (at the center), %	≥55
Decay lag after 40 ms of blackout, %	20
Dark current, μA	≤0,003
Dark noise nonuniformity, %	≤15
Geometric distortion, %	≤2,5
Max. target illumination, lx	4
Capacity between pickup electrode and other electrodes connected together, pF	≤3,5
Warm-up time, s	≤30
Guaranteed life, h	1000

LI501—1MKT CIRCUIT



Output connection



Output	Electrode
1	Cathode
2,7	Deflectron electrode (frames)
3,6	Heater
4,9	Deflectron electrode (lines)
5	Modulator
8	Anode
10	Switch (don’t switch on!)
С	Grid
ПС	Pickup plate

SILICON VIDICON LI479

2/3" Vidicon LI479 with mosaic photodiode has a silicon target, magnetic focusing and deflection. The tube presents high immunity to local over-illumination and is used in applied TV cameras.

Application: specialized TV systems of high sensitivity. It is intended for work in the television equipment with the standard mode of decomposition for 625 lines and 25 frames per second.

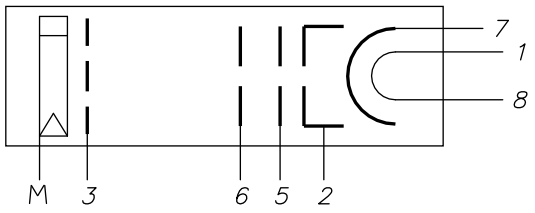
Construction design: Glass material; without base with ring outputs of signal plate and grid.

SPECIFICATIONS

Target active area, mm	9.5 × 12.7
Length, mm	≤ 132
Diameter, mm	≤ 26,7
Diameter of contact rings, mm	28.8 ± 0.4
Mass, g	≤500
Spectral response, nm	400 ÷ 1100
Target illumination, lx	0.5
Signal current at illumination 0.5 lx, μA	≥0.3
Resolution at the center, TVL	≥600
Resolution in the corners, TVL	≥500
Modulation depth at 400 TVL, %	35
Decay lag after 40 ms, %	10
Signal current nonuniformity (max.), %	15
Dark current, μA	≤10
Dark noise nonuniformity, %	≤5
Geometric distortion , %	≤2

Capacity between pickup electrode and other electrodes connected together, pF	≤6
Heater voltage, V	6.3
Heater current, mA	80 ÷100
Signal plate voltage, v	14
Voltage of first anode, V	280÷300
Voltage of second anode, V	300÷320
Grid voltage, V	500
Modulator cut-off (negative) voltage, V	5 ÷ 100
Heater power, W	60
Min. operating time, h	1000

LI479 CIRCUIT



Output	Electrode
1, 8	Heater
2	Modulator
3	Grid
4	Don’t switch on!
5	First anode
6	Second anode
7	Cathode
9	Switch - shorten pin
SP	Pickup plate

Output connections

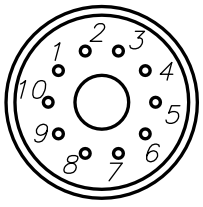


PHOTO X-RAY TUBE

Photo X-ray tube (PRT) with cold cathode uses built-in photomultiplier tube (PMT), as a source of electrons, instead of traditional cathodes. X-rays are adjusted by light hit the PMT photocathode. Light-emitting diode, lamp or any other source can be used as the light source. Photo X-ray tube can be applied in equipment for X-ray structure and X-ray spectral analyses as well as in devices of special application.

Advantages:

Operation in continuous and pulse modes;

In pulse mode provides 100% modulation in range from 100 Hz to 1 MHz with a duty cycle of 2 (the fill factor of 0.5);

Zero lag;

X-ray intensity is adjusted by light-emitting diode current;

Purity of spectrum due to photocathode (cold cathode), as a source of electrons;

Variation of PMT photocathode material allows control of the light of different range from UV to near-IR;

Provides anode current up to 1 mA at low anode voltages (is important with Be window);

The same device could be used to produce soft X-ray (at low voltages) and X-ray of medium hardness (at voltages up to 100 kV).

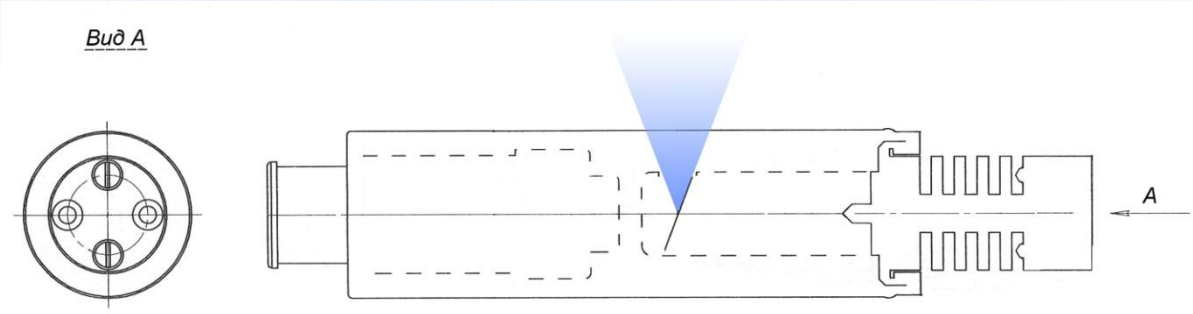
Construction design: Samples of PRT of 44 mm diameter without Be window and 55 mm with Be window of 12 mm diameter. Anode materials: copper, silver, tungsten.

SPECIFICATIONS

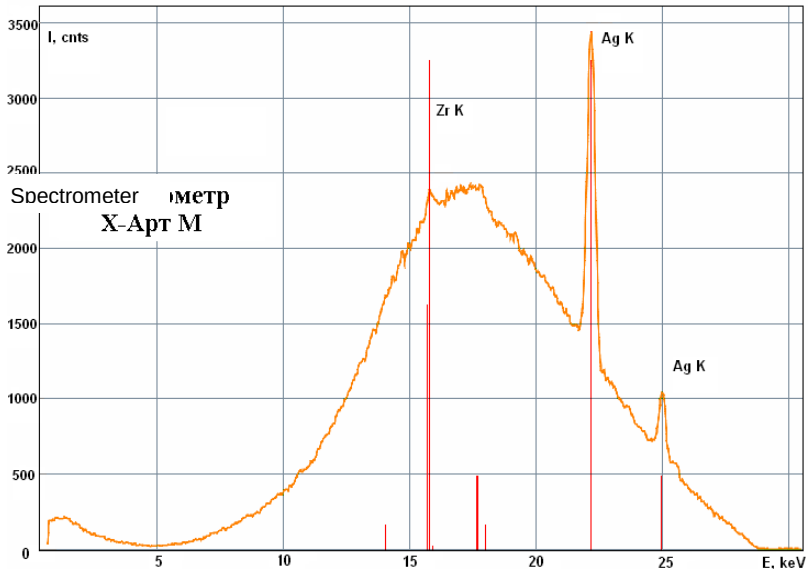
	Without Be window	With Be window
Tube diameter, mm	44	55
Tube length, mm (without divider)	220	290
Focus size, mm (is specified)	0.8÷2 × 0.4÷0.8	1.0÷3.0
Voltage, kV	3÷40	3÷100
Anode current, mA	0,01 ÷ 1,0	
Operation speed, s	<1×10-7	

Power, W	≤40	≤100

DIMENSIONAL OUTLINE



SPECTRAL RESPONSE CHARACTERISTIC



X-ray tube spectrum (anode voltage of 29 kV, current of 250 μA).Zr K line corresponds to glass material. Anode is made of silver.

CONTACTS

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Map: