

Russian scintillation PMT for photon detectors developed and manufactured by MELZ

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Content

Photomultiplier tubes (PMT) used as photodetectors, are of current importance nowadays. Wide application of photon detectors in high-energy physics, cosmic ray physics, astrophysics, security systems and medical diagnostics requires huge variety of photomultiplier tubes' types both by dimensions and parameters. "MELZ FEU" Ltd. is a leading Russian designer and manufacturer of various types of PMTs with high sensitivity, low noise level, high-speed impulse counting and excellent energy resolution.

One of the state-of-the-art developments of MELZ is PMT designed for registration of nanosecond luminous impulses, generated neutrino within operating volume of detector of deep-water neutrino telescope for KM3Net project. This photomultiplier is constructed in glass shell having 3 inches (76 mm) of photocathode useful diameter and 43,2 mm curvature radius. Overall length without pins is 105 mm, external diameter of the neck – 52 mm. In this PMT we use electro-optical system of linear type with 10 dynodes and underfocusing electrode on its input, which is mounted upon ceramics and has a mesh anode that works on reflection. Spectral response range of bialkali photocathode is 320-650 nm. Spectral sensitivity at 404 nm wavelength is not less than 130 mA/W. Gain is 5×10^6 at the least. Impulse duration at its half-altitude could be not more than 3 ns.

FEU-86U with potted voltage divider is also of interest to the consumer. It has 16 mm photocathode diameter with maximum 22 mm of overall diameter, weighting not more than 50 g. Luminous noise equivalent of the dark current of the anode is not more than $5 \times 10^{-13} \text{ lm/Hz}^{1/2}$, and dark impulses counting rate at one-electron peak not is not greater than 300 1/s. All this parameters in the aggregate allow us to consider FEU-86U as the best threshold photomultiplier manufactured in Russia. It's been widely used in portable monitoring equipment for air environment in enclosed spaces.

Photomultipliers with 30 mm bulb diameter (photocathode diameter 25 mm) – FEU-85B, and FEU-115M8 are also commonly spread and well known. Their general feature is bialkali photocathode which considerably improves energy characteristics of the products. For example FEU-85B has not more than 800V voltage at the luminous sensitivity of anode 10 A/lm, and not more than 1000V at 100 A/lm. Energy resolution with crystal NaI (Tl) 25×25 mm, with ^{137}Cs – not more than 8.5%, and energetic equivalent of intrinsic noise doesn't exceed 1 keV. According to customer's request, this PMT can be issued with potted voltage divider encapsulated into bulb 30 mm diameter.

FEU-115M8 is used in the large area portals to detect radioactive objects in the traffic flow. Having 30 mm bulb diameter and not more than 67 mm length, its weight does not transcend 50g and, moreover, this PMT has at least 25 mm useful diameter of photocathode. By using fiber-optics it provides You an opportunity to collect light from a large volume of the scintillator very effectively. With operating voltage in the range 1300-1400 V, it has energetic equivalent of intrinsic noise less than 6 keV and energy resolution with crystal NaI (Tl) 25×25 mm, with ^{137}Cs - not more than 10%. In addition, it is a preferable alternative to the previously made by another manufacturer FEU-35 and FEU-35-1, since in comparison to them it has 2 times more spectral sensitivity at 410 nm wavelength of 5×10^{-2} A/W and lower operating voltage.

We can not ignore FEU-184, being manufactured by MELZ for many years and on the basis of which many modifications were developed. FEU-184 has 52 mm bulb diameter, 46 mm useful photocathode diameter, 110 mm length and weights not more than 120 g. With luminous sensitivity of anode 10 A/lm its operating voltage does not exceed 1350 V, and typical value is 650-750 V; energy resolution with crystal NaI (Tl) 40×40 mm, with ^{137}Cs - not less than 7%; with ^{57}Co - not less than 9.6% (typical value is 8.4 - 8.8%), energetic equivalent of intrinsic noise does not exceed 3 keV (typical value is 0.7 keV). The same parameters has a three-inch photomultiplier FEU-184TD. In addition to that, we have designed a heat-resistant modification FEU-184T, capable of working at ambient temperatures up to 150°C, having at the mentioned temperature energetic equivalent of intrinsic noise less than 40 keV, and not more than 50% decay of anode sensitivity. LLC "MELZ PMT" also serially produces heat-resistant PMT of 20 and 30 mm diameter with operating temperatures – 120, 150 and 200°C.

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