Multiplier Phototubes

Electron Multipliers

Photodiodes

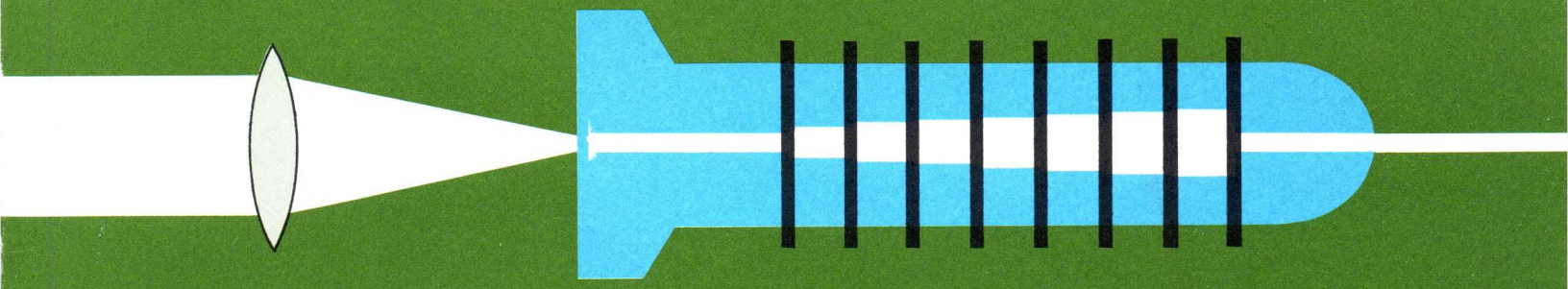
Image Converters

Image Dissectors

Integrated Sensor Packages

Associated Electronic Products

ELECTRO-OPTICAL PRODUCTS

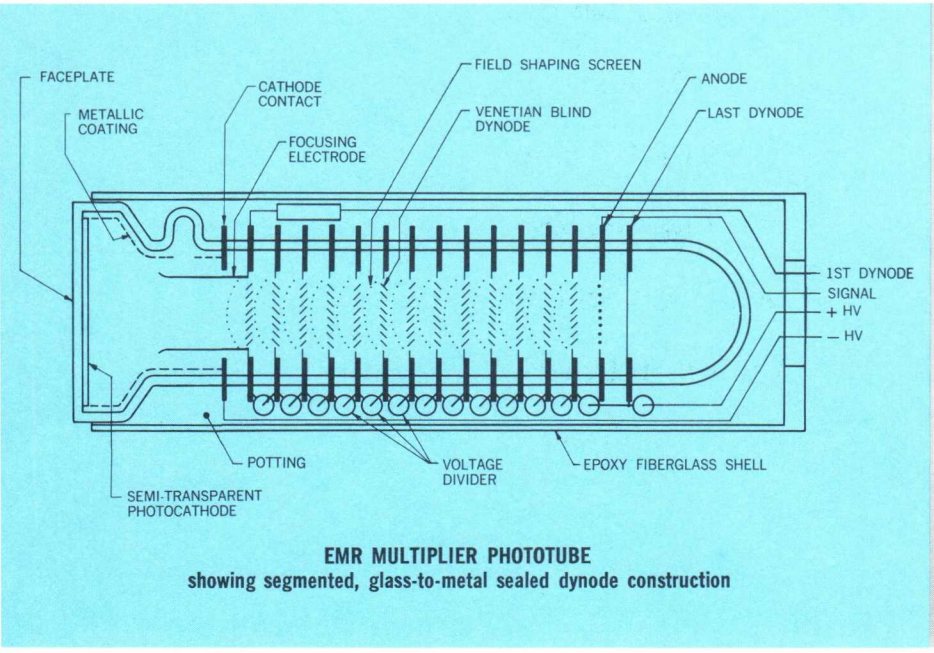


EMR PHOTOELECTRIC

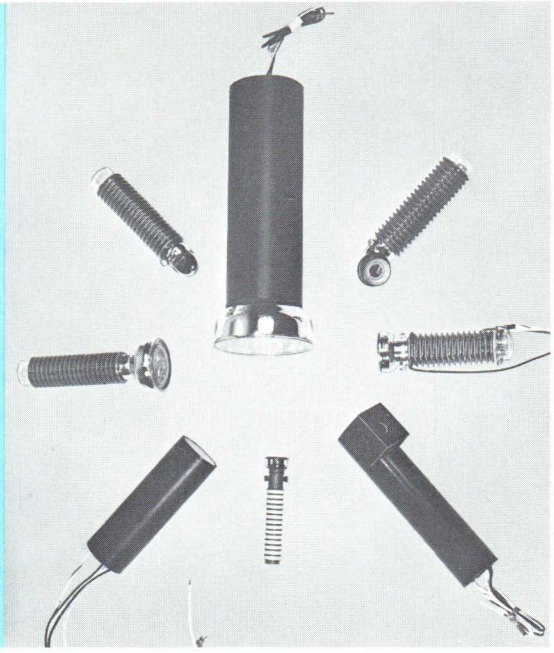
ELECTRO-OPTICAL PRODUCTS FOR A WIDE RANGE OF APPLICATIONS

In the broad field of photoelectric sensors, EMR-Photoelectric applies basic physics to develop new photoelectric devices and substantially improve existing ones. Backed by specially designed facilities and proprietary manufacturing techniques, unmatched elsewhere, EMR research has created a new class of photoelectric sensors which combine precisely controlled parameters with outstanding mechanical qualities. Each photoelectric sensor produced by EMR may be regarded as a precision optical instrument which itself may be used as a stable calibration standard over very extended time periods.

Coordination of EMR's design capabilities in the fields of electronics, photoelectrics, optics and mechanical packaging, has resulted in the development of a proprietary line of "photo-electro-optical" products. Typically these products combine customized optics, a unique photoelectric sensor and its associated electronics in a single ruggedized package. Examples of such subsystems which EMR supplies are integrated star tracker assemblies; scintillation detector assemblies; gamma-ray spectrometers; radiometers and photometers with unusual dynamic range; and a new type of ultra-selective Lyman-α detector.



EMR MULTIPLIER PHOTOTUBE
showing segmented, glass-to-metal sealed dynode construction



MULTIPLIER PHOTOTUBE ADAPTATIONS

For Special Purposes

To solve specialized photodetection problems, several specialized versions of the ASCOP Multiplier Phototubes are available. For outer space or hard vacuum applications, a side-window reflective substrate tube with a special removable face plate is available. This tube provides detection of wavelengths in the far ultraviolet region beyond 1050 Å. A unique mechanism which can be remotely programmed breaks the window cleanly and removes it from the path of the incoming light.

Special windowless photodiodes having metal cathodes are available for detection at wavelengths down to 100 Å. In addition, photodiodes utilizing practically any combination of window and photocathode materials are available for use as secondary standards. Sensitivity can be provided in any portion of the spectrum between 1050 Å and 1.1 microns.

For detecting high-energy particles such as protons and electrons, EMR supplies electron multiplier tubes such as the Model 541W. This tube is normally supplied with a "break-away" glass head which can be removed just prior to placing the multiplier in operation. A filament within a Faraday shield is included within the break-away head for use in gain calibration.

For calibrating ultraviolet-sensitive multiplier phototubes of all types, a variety of monochromatic ultraviolet light sources are available with strong monochromatic lines throughout much of the ultraviolet spectrum.

Break-away mechanism removes side window for hard vacuum operation

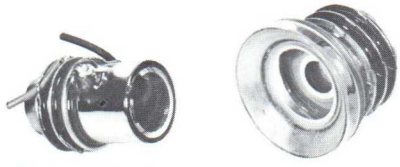
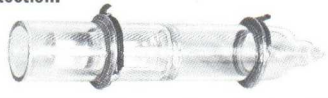


Photo diodes for use as secondary standards

541W Electron Multiplier for high-energy particle detection.



582 Ultraviolet Source for calibrating UV multiplier phototubes.

IMAGE INTENSIFIER and CONVERTER TUBES

For High-Resolution Imaging Systems

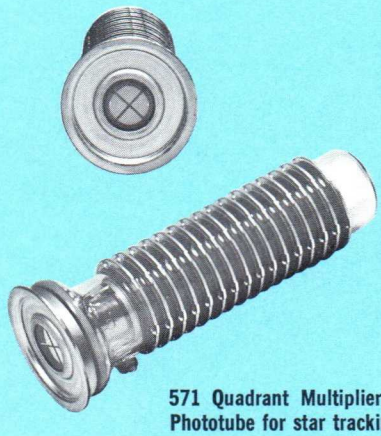
Advances made by EMR research in materials and device fabrication have permitted the design of image tubes with extended capabilities in the conversion of ultraviolet and far UV light frequencies to visible light. In the image converter, a high-efficiency photocathode converts a UV optical image into a focused cloud of electrons which is linearly accelerated and impinges on an anode phosphor providing a visible light output with overall photon gain. Fiber optic plates at the output can be provided for high resolution optical coupling to other imaging devices or recorders. By combining various window materials and photocathodes, images in a precisely determined wavelength range may be made visible and recorded photometrically with some precision. EMR also manufactures a complete line of visible image intensifiers that may be either used alone or in conjunction with EMR image converters. Applications include military surveillance and navigation instruments, and astronomical and astrophysical sensors.

Magnetically focused image intensifier provides photon gain with high resolution.

STAR TRACKING SENSORS

For Sensitive Low-Cost Guidance Systems

Special manufacturing techniques enable EMR to make multicathode multiplier phototubes in which a number of independent photocathodes share a common electron multiplier structure within the same envelope. A particular series of these tubes, Models 571 and 573, called quadrant multiplier phototubes (QMP), are useful as star trackers in low-cost direction sensing units for use in pointing or guidance systems. The four QMP photocathodes comprise 90° quadrants in a single image plane. Normalized gain for all photocathodes is assured by the use of a single electron multiplier section. Sequential electronic sampling of the four photocathodes and appropriately comparing output signals provides a null determination when a star image is focused exactly on the juncture of the four photocathodes. When appropriate optics are used, a precision of less than 1 arc-second in a 1° field is possible. Star tracking sensors may be obtained as an integral unit which includes EMR QMP optics, switching electronics, power supply, output amplifier and logic, all self-contained in a single packaged assembly.



571 Quadrant Multiplier Phototube for star tracking.

IMAGE DISSECTORS

For High-Resolution Image Systems

The image dissector is an image scanning device consisting of a photocathode, an electron focusing system, a deflection system, and an electron multiplier structure preceded by a defining aperture.

The photocathode converts an optical image into an electron image which is focused onto the aperture plate. Electrons passing through the aperture are multiplied through a high-gain dynode structure. An anode signal which is an analog of the original optical image is obtained by scanning the electron image across the aperture.

The EMR Model 574 image dissector utilizes electrostatic focusing and electrostatic deflection. This device features a flat input image plane, a high rejection ratio between non-illuminated and illuminated areas of the photocathode, and a near-ideal single electron pulse height distribution for pulse counting applications.

The EMR Model 575 image dissector employing magnetic focusing and magnetic deflection, is a high resolution device capable of operating with high reliability at extremely wide ranges of high cathode current densities for long periods of time.

All ASCOP image dissectors incorporate EMR's unique mechanical design features which result in highly reliable and extremely rugged devices which are unexcelled for space applications. EMR's proprietary manufacturing techniques insure exceptionally low noise, excellent linearity, and good stability. EMR image dissectors are available with either ultraviolet, or visible response.

Integrated systems featuring ASCOP image dissectors and the associated electronics are available from EMR.

575 Magnetic Image Dissector

TABULATION OF

MODEL NUMBER	TYPE OF DEVICE	PHOTOCATHODE MATERIAL	WINDOW MATERIAL	SPECTRAL RANGE A (1)	PACKAGED DIAMETER INCHES	OVERALL LENGTH INCHES	ACTIVE PHOTO CATHODE DIA. MM	S_K (2) MICROAMPS/ LUMEN
530W-00-14	ELECTRON MULTIPLER	NA	NA (10)	NA (11)	.5 (12)	2 9/16 (13)	NA	NA
531E-01-14	CERAMIC END-ON MPT	TRI-ALKALI	7056 GLASS	2700-8500	.880	3½	11.3	130
531N-01-14	CERAMIC END-ON MPT	BI-ALKALI	7056 GLASS	2700-7000	.880	3½	11.3	55
540F-05	DIODE PHOTOTUBE	Cs - Te	SAPPHIRE	1450-3500	.812 (12)	1¼ (12)	12.7	NA
541A-01-14	END-ON MPT	Sb - Cs	7056 GLASS	2700-6500	1.260	4¼	25	65
541A-05M-14	END-ON MPT	Sb - Cs	SAPPHIRE	1450-6500	1.260	4¼	25	60
541D-01-14	END-ON MPT	BI-ALIKALI	7056 GLASS	2700-6700	1.260	4¼	25	15
541E-01-14	END-ON MPT	TRI-ALKALI	7056 GLASS	2700-8500	1.380	4¼	25	185
541F-05M-14	END-ON MPT	Cs - Te	SAPPHIRE	1450-3500	1.260	4¼	25	NA
541F-08-18	END-ON MPT	Cs - Te	Li F	1050-3500	1.260	5	9.5	NA
541G-05M-14	END-ON MPT	CsI	SAPPHIRE	1450-1950	1.260	4¼	25	NA
541G-08-18	END-ON MPT	CsI	Li F	1050-2200	1.260	5	9.5	NA
541J-08-18	END-ON MPT	KBr	Li F	1050-1550	1.260	5	9.5	NA
541N-01-14	END-ON MPT	BI-ALKALI	7056 GLASS	2700-7000	1.380	4¼	25	54
541N-03-14	END-ON MPT	BI-ALKALI	9741 GLASS	2000-6750	1.380	4¼	25	54
541N-05M-14	END-ON MPT	BI-ALKALI	SAPPHIRE	1450-6750	1.380	4¼	25	54
541N-09-00	DIODE PHOTOTUBE	BI-ALKALI	Mg F	1150-6100	1.380	2⅝	15	20
541N-09-14	END-ON MPT	BI-ALKALI	Mg F	1150-6100	1.380	4½	15	20
541R-01-14	END-ON MPT	MULTI-ALKALI	7056 GLASS	2700-8500	1.380	4¼	25	225
541R-05M-14	END-ON MPT	MULTI-ALKALI	SAPPHIRE	1450-8500	1.380	4¼	25	225
541W-00-19	ELECTRON MULTIPLIER	NA	NA (10)	NA (11)	1.260	4½ (13)	NA	NA
542A-01-14	END-ON MPT	Sb - Cs	7056 GLASS	2700-6500	1.755	5	37	65
542D-01-14	END-ON MPT	BI-ALKALI	7056 GLASS	2700-6700	1.755	5	37	15
542F-08-18	END-ON MPT	Cs - Te	Li F	1050-3500	2.005	5½	28	NA
542G-08-18	END-ON MPT	CsI	Li F	1050-2200	2.005	5½	28	NA
542J-08-18	END-ON MPT	KBr	Li F	1050-1500	2.005	5½	28	NA
543A-01-14	END-ON MPT	Sb - Cs	7056 GLASS	2700-6700	2.005	7 3/16	43	60
543A-05-14	END-ON MPT	Sb - Cs	SAPPHIRE	1450-6700	2.005	7 3/16	43	60
543C-01-14	END-ON MPT	Ag - O - Cs	7056 GLASS	4000-11000	2.005	7 3/16	10	30
543D-01-14	END-ON MPT	BI-ALKALI	7056 GLASS	2700-6700	2.005	7 3/16	43	15
543E-01-14	END-ON MPT	TRI-ALKALI	7056 GLASS	2700-8000	2.005	7 3/16	43	150
543F-05-14	END-ON MPT	Cs - Te	SAPPHIRE	1450-3500	2.005	7 3/16	43	NA
543N-01-14	END-ON MPT	BI-ALKALI	7056 GLASS	2700-7000	2.005	7 3/16	43	55
544A-01-14	END-ON MPT	Sb - Cs	7056 GLASS	2700-6500	2.945	8	66	60
544A-05-14	END-ON MPT	Sb - Cs	SAPPHIRE	1450-6500	2.945	8	66	60
544N-01-14	END-ON MPT	BI-ALKALI	7056 GLASS	2700-7000	2.945	8	66	55
571E-01-14	QUADRANT END-ON MPT	TRI-ALKALI	7056 GLASS	2700-8500	1.380	4¼	10	125
573E-01-14	QUADRANT END-ON MPT	TRI-ALKALI	7056 GLASS	2700-8500	2.656	7¼	12.7 (16)	150
577E-01-00	IMAGE INTENSIFIER	TRI-ALKALI	7056 GLASS	2700-8500	5.260	3 1/16	25	NA
577G-08-00	IMAGE CONVERTER	Cs I	Li F	1050-2200	5.260	3 1/16	25	NA
582X-05	UV XENON LAMP	NA	SAPPHIRE	1470	.880	3	NA	NA
641A-03-18	SIDE WINDOW MPT	Sb - Cs	9741 GLASS	2000-7000	1.260	5	10	100
641F-03-18	SIDE WINDOW MPT	Cs - Te	9741 GLASS	2000-3600	1.260	5	10	NA
641G-08-18	SIDE WINDOW MPT	Cs I	Li F	1050-1950	1.260	5⅜	9.5	NA
641J-08-18	SIDE WINDOW MPT	K Br	Li F	1050-1550	1.260	5⅜	9.5	NA
641J-09-18	SIDE WINDOW MPT	K Br	Mg F	1150-1500	1.260	5⅜	9.5	NA
641R-01-18	SIDE WINDOW MPT	MULTI-ALKALI	7056 GLASS	2700-8000	1.380	5	10	200

NOTE: (1) Spectral range cutoffs, short wavelength by 10% energy transmission and long wavelength by point at which Q.E. becomes 1% of peak Q.E.
(2) Typical cathode luminous sensitivity.
(3) Typical peak cathode radiant sensitivity.
(4) Wavelength of peak cathode radiant sensitivity.
(5) Anode luminous sensitivity at a gain of 10^6.
(6) Typical voltage for 10^6 gain.
(7) Typical anode dark current at 20°C and 10^6 gain.

PRODUCT CHARACTERISTICS

σ_K (3) AMPERES/ WATT	PEAK QUANTUM EFFICIENCY—%	λ (4) WAVELENGTH Å	S (5) AMPERES/ LUMEN	G (6) VOLTS DC	I_D (7) AMPERES	E_N (8) LUMENS	ϵ_N (9) WATTS	MODEL NUMBER
NA	NA	NA	NA	4000	5×10^{-12}	NA	NA	530W-00-14
.064	19	4100	130	2450	1.5×10^{-11}	5.4×10^{-14}	1.1×10^{-16}	531E-01-14
.054	16	4100	55	2950	2.5×10^{-11}	5×10^{-14}	5×10^{-17}	531N-01-14
.018	10	2200	NA	150 (14)	5×10^{-12} (15)	NA	NA	540F-05
.055	15	4100	65	2100	2×10^{-9}	3.9×10^{-13}	4.6×10^{-16}	541A-01-14
.051	14.5	4100	60	2100	2×10^{-9}	4.2×10^{-13}	4.9×10^{-16}	541A-05M-14
.020	6	4100	15	2600	3×10^{-11}	2×10^{-13}	1.5×10^{-16}	541D-01-14
.084	25	4100	185	2400	7.5×10^{-10}	8.2×10^{-14}	1.8×10^{-16}	541E-01-14
.014	7	2537	NA	2400	4×10^{-11}	NA	2.6×10^{-16}	541F-05M-14
.014	7	2537	NA	2200	2×10^{-11}	NA	1.8×10^{-16}	541F-08-18
.007	6	1470	NA	3500	6×10^{-12}	NA	2.2×10^{-16}	541G-05M-14
.008	8	1300	NA	2900	3×10^{-12}	NA	1.4×10^{-16}	541G-08-18
.009	9.2	1216	NA	2850	2.1×10^{-12}	NA	8.9×10^{-17}	541J-08-18
.071	21.5	4100	54	2950	2.5×10^{-11}	5.2×10^{-14}	4×10^{-17}	541N-01-14
.071	21.5	4100	54	2950	2.5×10^{-11}	5.2×10^{-14}	4×10^{-17}	541N-03-14
.071	22	2537	54	2950	2.5×10^{-11}	5.2×10^{-14}	4×10^{-17}	541N-05M-14
.034	15	3500	NA	150 (14)	5×10^{-12} (15)	NA	NA	541N-09-00
.024	15	3500	20	2950	1×10^{-11}	NA	5.7×10^{-17}	541N-09-14
.078	24	4100	225	2160	5.6×10^{-10}	3.8×10^{-14}	1.1×10^{-16}	541R-01-14
.078	24	4100	225	2160	5.6×10^{-10}	3.8×10^{-14}	1.1×10^{-16}	541R-05M-14
NA	NA	NA	NA	3300	2×10^{-12}	NA	NA	541W-00-19
.055	15	4100	65	2100	3×10^{-9}	4.7×10^{-13}	5.6×10^{-16}	542A-01-14
.020	6	4100	15	2600	4.5×10^{-11}	2.6×10^{-13}	1.9×10^{-16}	542D-01-14
.014	7	2537	NA	2200	4×10^{-11}	NA	2.5×10^{-16}	542F-08-18
.007	7	1216	NA	2900	6×10^{-12}	NA	1.8×10^{-16}	542G-08-18
.013	13	1216	NA	2850	2×10^{-12}	NA	6.2×10^{-17}	542J-08-18
.048	14	4100	60	2000	4×10^{-9}	6×10^{-13}	7×10^{-16}	543A-01-14
.048	14	4100	60	2000	4×10^{-9}	6×10^{-13}	7×10^{-16}	543A-05-14
.0032	0.5	8000	30	2500	1.3×10^{-7}	6.7×10^{-12}	6.3×10^{-14}	543C-01-14
.020	6	4100	15	2400	5.5×10^{-11}	3×10^{-13}	2×10^{-16}	543D-01-14
.074	22	4200	150	2550	8×10^{-10}	1.1×10^{-13}	2.2×10^{-16}	543E-01-14
.013	6.5	2537	NA	2400	7×10^{-11}	NA	3.6×10^{-16}	543F-05-14
.060	18	4100	55	2600	2.1×10^{-11}	4.6×10^{-14}	4.3×10^{-17}	543N-01-14
.048	14	4100	60	2000	7.5×10^{-9}	8.2×10^{-13}	9.6×10^{-16}	544A-01-14
.048	14	4100	60	2000	7.5×10^{-9}	8.2×10^{-13}	9.6×10^{-16}	544A-05-14
.060	18	4100	55	2600	5×10^{-11}	7×10^{-14}	6.5×10^{-17}	544N-01-14
.068	20	4200	125	2400	2×10^{-10}	6.4×10^{-14}	1.2×10^{-16}	571E-01-14
.074	22	4200	150	2550	8×10^{-10}	1.1×10^{-13}	2.2×10^{-16}	573E-01-14
.043	13	4100	NA	NA	NA	NA	NA	577E-01-00
.007	8	1300	NA	NA	NA	NA	NA	577G-08-00
NA	NA	NA	NA	NA	NA	NA	NA	582X-05
.076	23	4100	100	1950	3.8×10^{-9}	3.5×10^{-13}	4.6×10^{-16}	641A-03-18
.031	15	2537	NA	2500	2×10^{-11}	NA	8×10^{-17}	641F-03-18
.024	24	1216	NA	2950	3×10^{-12}	NA	1.3×10^{-17}	641G-08-18
.022	22	1216	NA	2950	3×10^{-12}	NA	1.4×10^{-17}	641J-08-18
.022	22	1216	NA	2950	3×10^{-12}	NA	1.4×10^{-17}	641J-09-18
.074	22	4100	200	2200	1.3×10^{-10}	3.3×10^{-14}	9.3×10^{-17}	641R-01-18

(8) Typical luminous equivalent noise input at 20°C.
(9) Typical radiant equivalent noise input at 20°C and wavelength of peak radiant sensitivity.
(10) Shipped with break-off glass head.
(11) Response of CuBe first dynode is from approx. 200 Å to 1400 Å.
(12) Unpotted.
(13) Excluding break-off head.
(14) Diode operating voltage.
(15) Anode leakage current.
(16) Active photo sensitive diameter for each of four cathodes.

PHOTOTUBES FOR TOUGH APPLICATIONS

EMR-Photoelectric designs and manufactures a broad line of rugged, high-performance photoelectric products. The EMR technical staff originally developed photosensitive devices for subsurface geophysical exploration. A family of high-temperature multiplier phototubes for scintillation counting was developed to meet the needs of geophysical studies into the earth's mantle. These tubes now are used successfully world-wide in the extreme environments of deep oil-well exploration. During use in these environments, the tubes have demonstrated a capability to withstand stresses more severe than could be imposed upon any other phototubes available.

As new programs of space exploration burgeoned these phototubes were found to be ideally suited to space environments. Their size, weight, and rugged construction easily met the exacting requirements of missile, satellite and space-probe missions. In addition, superior performance characteristics have gained and assured a very wide acceptance among scientific personnel working on the most advanced space-research programs.

ASCOP photoelectric devices are built in elaborate, modern, research and manufacturing facilities located at EMR-Photoelectric in Princeton, New Jersey. Assembly of all tubes is performed in a dust-free, controlled-climate, "white room." Individual processing of tubes and proprietary high-vacuum processing techniques assure stable, high-sensitivity performance. Other unique manufacturing operations include identification and traceability of parts, rigorous in-process quality control and engineer testing with precision electro-optical equipment.

EMR Multiplier Phototubes form a rigid vertebrate structure. They are the only tubes available with a built-in "backbone" for ruggedness. The unique, segmented glass-to-metal sealed dynode construction provides both radial and axial strengths capable of withstanding shocks greater than 100g and vibrations greater than 30g. The complete dynode resistor network is an integral part of these phototubes. Precision resistors are spot-welded to the outside envelopes along the dynode support flanges. Each tube is normally vacuum potted in a high di-electric strength compound which also provides shock resistance.

As can be seen in the chart on pages 4 and 5, standard EMR Multiplier Phototubes offer selective wavelength detection from the near infrared to far ultraviolet. EMR has pioneered the development of several stable low-noise photocathodes for the near and far ultraviolet, as well as high-temperature bi-alkali photocathodes for the visible light region. Experimental windowless tubes for detection of wavelengths as short as 100 Å have also been designed and built in EMR laboratories.

Each ASCOP Multiplier Phototube comes from a distinguished family and each carries its own complete test data sheets listing the following parameters:

- absolute cathode sensitivity
- spectral response characteristics
- current amplification as a function of voltage
- anode dark current measurements

Individual processing and calibration is supervised by qualified engineers; continuous and stringent inspection techniques screen out possible rejects during every stage of manufacture. The performance of an EMR-Photoelectric phototube is guaranteed.

PHOTOTUBE ORDERING INFORMATION

The ASCOP phototube model number is the key to its various parameters. A typical model number is shown along the right hand edge of this page with an explanation to its left of the parameters specified by each part of the number.

PRODUCT FAMILY KEY[1]

The Product Family Key is defined by the first three digits of the Model Number (*) (**) (***)

(*) First digit indicates window configuration:
- **(5)** End window, semitransparent photocathode.
- **(6)** Side window, photocathode on reflective substrate.

(**) Second digit indicates basic structure of MPT:
- **(3)** Ceramic insulation with venetian blind dynodes.
- **(4)** Glass insulation with venetian blind dynodes.
- **(6)** Glass insulation with solid dynodes—end window.
- **(8)** Glass insulation with solid dynodes—side window.

(***) Third digit indicates physical size of the device: Refer to the chart on pages 4 and 5 for the size of a specific device.

[1]Applies to multiplier phototubes only; other ASCOP tube products such as imaging tubes have a unique number.

PHOTOCATHODE KEY

KEY LETTER	DESCRIPTION	LONG WAVELENGTH CUTOFF (NOTE 1)	LONG WAVELENGTH SENSITIVITY (NOTE 2)
A	Cesium Antimonide	6500 Å	6200 Å
C	Silver-Oxygen-Cesium	11,000 Å	10,000 Å (Note 3)
D	Bi-Alkali	6700 Å	5700 Å
E	Tri-Alkali	8500 Å	7800 Å
F	Cesium Telluride	3500 Å	3400 Å
G	Cesium Iodide	1950 Å	1850 Å
H	Copper Iodide	2100 Å	1750 Å
J	Potassium Bromide	1550 Å	1450 Å
K	Rubidium Iodide	1850 Å	1750 Å
L	Cesium Bromide	1750 Å	1700 Å
N	High Quantum Efficiency Bi-Alkali	7000 Å	6500 Å
P	Rubidium Telluride	3200 Å	3000 Å
R	Multi-Alkali	8500 Å	8000 Å
T	Sodium Chloride	1480 Å	1400 Å
U	Multi-Alkali	7300 Å	6900 Å
V	Cuprous Chloride	1890 Å	1720 Å
W	No Cathode	—	—

Note 1—Point at which Q.E. becomes 1% (Typical) of peak
Note 2—Point at which Q.E. is 1% (Typical)
Note 3—At 0.1% Q.E.

WINDOW MATERIAL KEY

KEY NO.	DESCRIPTION	SHORT WAVELENGTH CUTOFF*	KEY NO.	DESCRIPTION	SHORT WAVELENGTH CUTOFF*
00	No Window	—	06	Fused Quartz	1600 Å
01	7056 Glass	2700 Å	08	UV Grade Lithium Fluoride	1050 Å
03	9741 Glass	2000 Å	09	Magnesium Fluoride	1150 Å
05	UV Grade Sapphire	1450 Å	10	Barium Fluoride	1375 Å

*10% Energy Transmission

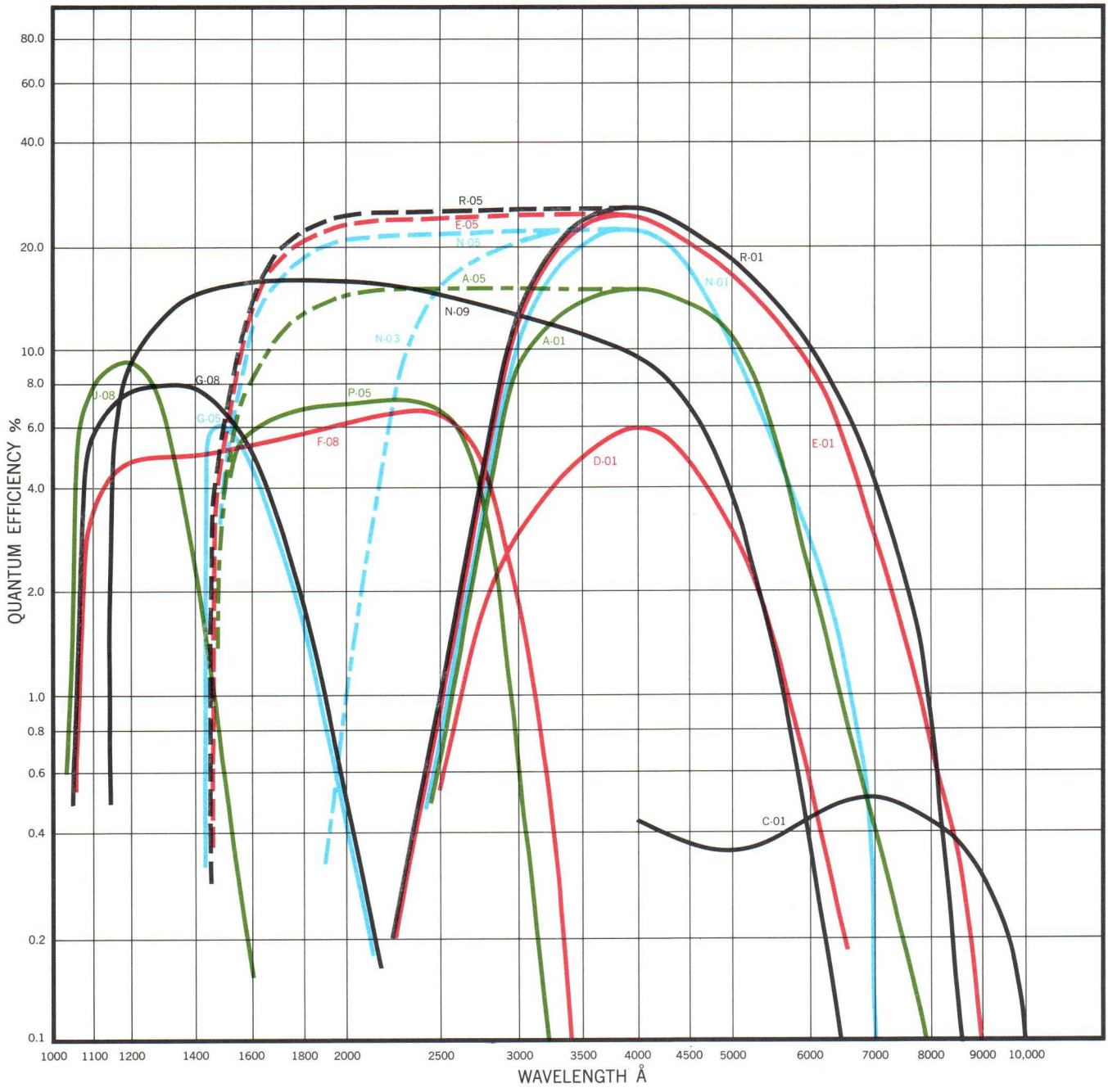
NUMBER OF DYNODE STAGES

Dynode stages are normally 14 or 18, depending upon the tube type; 00 Code designates photodiodes.

Dynode material will be either copper beryllium or silver magnesium unless specified by the customer.

There is an additional numerical code following the dynode number key to designate the resistance value of the interstage resistors; five digits indicate this value in kilohms, e.g., 03900 for 3.9 megohms. Resistance values from 500K to 20 megohms are available, e.g., 541-A-01-14-03900 specifies 3.9 megohm interstage resistors.

TYPICAL SPECTRAL RESPONSE CHARACTERISTICS



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- ☐ Image Converters
- ☐ Image Dissectors
- ☐ Star Tracker
- ☐ Channel Detectors
- ☐ I P S Units
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