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Tabulation of Data on Receiving Tubes

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Foreword

This tabulation of data on receiving tubes currently in use has been prepared as part of the National Bureau of Standards Electron Devices Data Service. Established in 1948 to provide technical data on radio tubes to members of the Bureau staff, the service has since been extended to other scientists in government and in industry. In the course of the program, a large volume of information on domestic and foreign tubes has been accumulated on punched cards from which it could be automatically printed. It was felt desirable to make these data available in a single reference source as an aid to circuit designers in selecting tube types for particular uses.

The engineer should find this manual useful in narrowing down the choice of tubes to one or a few types. However, it is not practical to give all possible operating conditions nor to provide the characteristic curves for each tube in a tabulation such as this. It will still be necessary to consult the tube manufacturer's literature for such detailed information.

All information appearing in this publication was taken from manufacturers' published specifications and every effort has been made to ensure accuracy and completeness. However, the Bureau cannot assume responsibility for omissions nor for results obtained with these data.

Additional NBS prepared tabulations which are also available include the following: "Tabulation of Data on Microwave Tubes" NBS Handbook 70 (1961), which represents a listing of foreign and domestic microwave tubes; "Diode Source Book" (published by Semiconductor Products magazine, 1961), which contains charts giving the characteristics of semiconductor diodes, and "Electron Tube Interchangeability Chart" (published by Electronic Industries, 1962).

A. V. ASTIN, *Director.*

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Tabulation of Data on Receiving Tubes

A tabulation of Receiving-Type Electron Tubes with some characteristics of each type has been prepared in the form of two major listings, a Numerical Listing in which the tubes are arranged by type number, and a Characteristic Listing in which the tubes are arranged by tube type and further ordered on the basis of one or two important parameters. The tabulation is accompanied by a listing of similar tube types and basing connections for the listed tubes.

1. Introduction

The Electron Devices Section of the National Bureau of Standards has developed over the past several years an Electron Devices Data Service. This service attempts to obtain and maintain a file of data on all electron devices, i.e., tubes, transistors, and semiconductor diodes, manufactured in the United States and other countries. In an effort to make this service more readily available to engineers applying electronics in laboratories throughout the country, it was decided to develop a method of tabulating the essential information on these devices in handbook form for ready reference. For this publication on Receiving Tubes, an easily decipherable code and format for the tube characteristics was developed which would be suitable for a punched card system allowing automatic transfer to the printed page. The sources of information were the manufacturers' published handbooks and data sheets. The accuracy of the printed information is reasonably assured by verifying tabulations, by various sortings, and cross checking with manufacturers' publications.

This tabulation includes only the information normally furnished by the manufacturers in their handbooks or data sheets, and includes those tubes generally known as "Receiving Tubes." These include tubes to be found in home entertainment devices, military equipment, general purpose electronic laboratory equipment, etc. The tabulation is limited to tubes with not more than 25 watts plate dissipation and with maximum operating frequency less than 1,000 megacycles per second. One further restriction is that the tubes are currently active types, most of which have been registered with EIA and are produced by foreign or United States manufacturers. These tubes appear in the manufacturers' "New Equipment Price Lists" or are those on which a new or revised data sheet has been issued since 1956. Types listed by manufacturers as "For Replacement Only" or as "Discontinued" types are tabulated only in the Numerical Listing.

The user of this tabulation should be reminded that industry has used various letter suffixes to designate improved versions of a tube type. For example the letter "W" indicates that the type has been improved for military end-use and "WA" and/or "WB" indicate further improvements. Thus the "6AL5W" is an improved version of the "6AL5" and this is continued to

the ultimate improved type designation "5726/6AL5W/6097".

To avoid these complex designations, this tabulation lists only the type numbers by which a type is most commonly designated. The user should be cautioned that these versions of a tube may not be bilaterally interchangeable as the improved versions may differ in some physical dimensions or in one or more electrical characteristics.

2. Organization of the Tabulation

The Receiving Tube Tabulation comprises four principal sections as follows:

1. *Numerical Listing.* In this, the tubes are arranged by type number in the numerical-alphabetical sequence which is standard in the industry.

2. *Characteristics Listing.* Here the current tubes are grouped according to the number of electrodes, and within the group they are arranged by increasing value of one or two pertinent characteristics.

3. *Similar Tube Types.* Following each tube listed is one or more types similar to it. Here are found those tubes from sections 1 and 2 which are coded as having similar types available, together with some older tubes not included in sections 1 and 2 but which are similar to a current listed tube.

Tubes which are identical in all respects except heater ratings, e.g., 3BE6, 4BE6, 12BE6, etc., have been omitted from the similar tubes list since they are obviously similar types and may be found by turning to the characteristics listing where they will be found in a group or in close proximity to one another.

4. *Electronic Industries Association (EIA) Base Connections.* This section shows the base connections in tabular form for the EIA Base Numbers shown in the Numerical and Characteristic Listings. This tabular form contains all the information shown in the normal basing diagram and specifically indicates the use for each base pin. Initial confusion at this method of display will be more than compensated by the ready applicability of the specific information contained in this tabular form.

The format has column headings of the base pin numbers up to twelve and one column for a top cap or external connection. Under these headings, is printed the symbol for the tube element or elements corresponding to the pin number for

each base number. The code for the symbols is shown below:

H	Heater
F	Filament
HCT	Heater Center Tap
FCT	Filament Center Tap
K	Cathode
G1, G2, etc.	Grid Number
P	Plate
D	Deflector
T	Target
IC	Internal Connection
IS	Internal Shield
SH	Shell, Sleeve, etc.

A prefixed number is used before the code letter to indicate the section number of the tube (e.g., the two sections in a twin triode) and a postfixed number to indicate the number of the element in a section. In those cases in which an element is common to more than one section, no prefixed number is used (e.g., a single common screen grid, G2 in a twin pentode).

A blank in the column of a pin number indicates that there is no pin in the base or that the pin has no internal or external connection.

3. Sorting and Terminology of the Tabulation

To assist the user in understanding and applying the tabulation, the method of sorting and the definition of terms and abbreviations are explained in this section.

3.1. Sorting Methods

The Numerical Listing is arranged in numerical-alphabetical sequence by tube type number. In the Characteristics Listing the tubes are arranged in 46 groups by tube structure. Within these groups the tubes are arranged according to increasing value of one or two important parameters and finally by tube type number.

Given below are the groups into which the tubes are arranged and the characteristics by which the tubes are sorted within a group, e.g., all of the single triodes are grouped together, and are arranged in order of increasing value of " μ ". Where two or more tubes have the same μ , these are then arranged by increasing value of "gm". Tubes with identical values of both μ and gm are then sorted by type number.

Group heading	Characteristics sorted on		
	Primary	Secondary	Tertiary
1. Regulator, Single Diode, Cold Cathode.	} E _b *.....	} I _b *.....	Type No.
2. Regulator, Single Diode, Filamentary Cathode.			
3. Reference, Single Diode, Cold Cathode.			

Group heading	Characteristics sorted on		
	Primary	Secondary	Tertiary
4. Rectifier, Single Diode, Cold Cathode.	} E _{px} *.....	} I _b	Type No.
5. Rectifier, Single Diode, Filamentary Type.			
6. Rectifier, Single Diode, Heater Type.			
7. Damper, Single Diode.....	} E _{px} *.....	} I _b	Type No.
8. Diode, Twin, Cold Cathode.....			
9. Diode, Twin, Filamentary Type.			
10. Diode, Twin, Heater Type.....	} E _{px} *.....	} I _b	Type No.
11. Diode, Multiple.....			
12. Diode with Triode.....			
13. Diode, Twin, with Triode.....	} E _{px} *.....	} I _b	Type No.
14. Diode with Tetrode.....			
15. Diode, Triple, with Triode.....			
16. Diode with Pentode.....	} μ.....	} gm.....	Type No.
17. Triode, Single.....			
18. Triode, Twin.....			
19. Triode, Dual Dissimilar.....	} gm.....	} Type No..	
20. Triode, Triple.....			
21. Triode with Diode.....			
22. Triode with Tetrode.....	} gm.....	} r _p	Type No.
23. Triode with Beam Type.....			
24. Triode with Pentode.....			
25. Triode with Hexode.....	} gm.....	} Type No..	
26. Triode with Pentagrid.....			
27. Tetrode, Single.....			
28. Tetrode, Twin.....	} gm.....	} r _p	Type No.
29. Tetrode with Diode.....			
30. Tetrode with Triode.....			
31. Beam, Single.....	} E _{px} *.....	} I _b	Type No.
32. Beam, Twin.....			
33. Beam, Miscellaneous.....			
34. Beam with Triode.....	} E _b	} I _b	Type No.
35. Pentode, Single.....			
36. Pentode, Twin.....			
37. Pentode, Dissimilar.....	} gm.....	} Type No..	
38. Pentode with Diode.....			
39. Pentode with Triode.....			
40. Pentagrid, Single.....	} gm.....	} r _p	Type No.
41. Pentagrid with Triode.....			
42. Hexode, Single.....			
43. Hexode with Triode.....	} E _{px} *.....	} I _b	Type No.
44. Thyatron, Triode Type.....			
45. Thyatron, Tetrode Type.....			
46. Indicator, Electron Ray.....	E _b	I _b	Type No.

*E_b and E_{px} used for sorting are the maximum values, I_b is the typical value.

3.2. Terminology

The Numerical and Characteristic Listings are in tabular form containing 22 columns. The headings of these columns and their meanings are given below.

A blank in any column indicates that the characteristic designated by the column is not applicable to the tube in question or that no value was given in the available data.

Definitions

Type Number. This column lists the numerical-alphabetical designation assigned to the tube type by the manufacturer.

Code. A letter "S" indicates that this tube is similar to some other type. Such a tube will be found in the Similar Tubes List on pages 109 through 117 with its similar types. It is to be noted that these tubes are similar, not necessarily equivalent or directly interchangeable.

An asterisk (*) in this column indicates that the tube is on the Military Preferred List issued by the Department of Defense as "Military Standard Electron Tubes; Selection and use of", MIL-STD-200F, 15 March 1962.

A plus sign (+) is used to designate a tube not on the Military Preferred List but which the

manufacturer refers to as a ruggedized, reliable, or premium type.

In the Numerical List the letters "OBS" have been used to indicate that these tube types were not found on any manufacturers current price list and are thus considered as "replacement only" types and as such should not be considered in the design of new equipment. These will not appear in the Characteristics Listing but have been included in the Numerical List for reference only.

Kind. An easily decipherable three letter symbol is used here showing the tube to be a diode, triode, beam pentode, etc.

BEA	Beam
DIO	Diode
DWD	Double Diode
GTB	Gated Beam
HEX	Hexode
PDD	Pentode—Diode
PND	Pentode
PTG	Pentagrid
SHB	Sheet Beam
TDI	Triode Dissimilar
TET	Tetrode
TRD	Triple Diode
TRI	Triode
TRT	Triple Triode
TTR	Twin Triode
TWP	Twin Pentode

Type. A three-letter symbol is used to amplify the characterization under "Kind." Thus a tube is designated as single, twin, or combined with some other type in a multiple structure, in one envelope.

NOTE: A tube containing two or more different structures in one envelope will be listed once for each such structure in the Numerical Listing and once in each appropriate group in the Characteristic Listing, e.g., the 6X8 is listed as a triode with a pentode section and also as a pentode with a triode section. The data given on any one line refers to the section of the tube as designated in the column headed "Kind."

DIO	With Diode
DIS	Dissimilar (as applied to Dual Triodes)
DSD	Dissimilar with Diode
DTR	With Dissimilar Dual Triode
DWD	With Double Diode
GTB	With Gated Beam
PDD	With Pentode—Diode
PND	With Pentode
QUA	Quadruple
SIN	Single-Type
SXD	Sextuple
TDI	With Triode Dissimilar
TET	With Tetrode
TRD	With Triple Diode
TRI	With Triode

TTR	With Twin Triodes
TWN	Twin Type

Bulb. Designates the type, size, and shape of the bulb by an alphabetical-numerical code defined as follows:

- A. Initial Letter
 MT—Metal Tubular or Cylindrical Shape
 S—Indicates the "ST" design, i.e., the domed-conical-body glass bulb
 T—Glass tubular or cylindrical shape
- B. Number—this number multiplied by one-eighth ($\frac{1}{8}$) inch gives the bulb diameter. Only the whole number is used, thus a T6 $\frac{1}{2}$ bulb is designated T6.
- C. Descriptive terms are used for the following:
- | | |
|-----|------------------------|
| ACO | Acorn Design |
| CM | Ceramic-Metal Design |
| LIT | Lighthouse Design |
| PC | Printed Circuit Design |
| PEN | Pencil Design |
| ROK | Rocket Design |

Use. Gives the application for which the tube was developed or is most useful as stated in the manufacturer's data sheet. If a tube is particularly suited to some band of frequencies such as audio, intermediate, very high, etc., it is so designated in this column by AFA, IFA, VHF, etc. Such designation is the only reference to the frequency of operation of tubes in this Tabulation.

AFA	Audiofrequency amplifier
AFD	Audiofrequency Driver
CA	Cascode Amplifier
CON	Converter
DA	Damper
DET	Detector
DIS	Discriminator
EL	Electrometer
GA	Gating Amplifier
GEN	General Purpose
GGA	Grounded Grid Amplifier
HDA	Horizontal Deflection Amplifier
HF	High Fidelity
IFA	Intermediate-frequency Amplifier
IND	Indicator (Electron Ray)
MIX	Mixer
ONA	On-Off Applications (Computer Service)
OSC	Oscillator
PA	Power Amplifier
REC	Rectifier
REF	Voltage Reference
REG	Voltage Regulator
RFA	Radio Frequency Amplifier
SEM	Secondary Emission Tube
THY	Thyratron
TRG	Trigger
UHF	Ultra-high Frequency Amplifier
VA	Voltage Amplifier
VDA	Vertical Deflection Amplifier
VDO	Vertical Deflection Oscillator
VHF	Very-high Frequency Amplifier

Char. Refers to a specific characteristic of the given tube.

- GAS Gas-filled (as applied to rectifiers, regulators, etc.)
- HIP High Perveance
- RCO Remote Cut-off i.e., more than 17 volts
- SCO Sharp Cut-off i.e., 7 volts or less
- SRC Semi-remote Cut-off i.e., more than 7 to 17 volts
- VAC Vacuum (as applied to rectifiers)

Reg. Indicates the manufacturer who registered the type with the EIA. In some cases a manufacturer may no longer make a tube which he registered but it was impractical to try to list all companies making a given tube type so the present system was adopted as being fair to all manufacturers.

The not equal sign (\neq) is the symbol used to indicate that the original registrant is no longer producing receiving tubes, but the type is currently being manufactured by another company or companies.

- AM Amperex Electronic Corp.
- BE Bendix Electron Tube Products
- CG Canadian General Electric Co. Ltd.
- CH Chatham Electronics
- CI Compagnie Industrielle Francaise
- GE General Electric Co.
- HI Hitachi Ltd.
- HY CBS Hytron
- LR Standard Elektrik Lorenz
- MI Marconi Italiana
- MU Mullard Ltd.
- NU National Union Electric Corp.
- PL Philco (Lansdale)
- RA Raytheon Manufacturing Co.
- RC Radio Corporation of America
- RE Rogers Electronic Tubes Ltd.
- RV Radio Valve Co. Ltd.
- SH Siemens & Halske
- SO Sonotone Corp.
- ST Standard Telephones & Cables Ltd.
- SY Sylvania Electric Products, Inc.
- TA Thorn AEI Radio Valves & Tubes Ltd.
- TE Telefunken G.M.B.H.
- TO Tokyo Shibaura Electric Co. Ltd. (Toshiba)
- TS Tungsol Electric Inc.
- VI Victoreen Instrument Co.
- WE Western Electric Co., Inc.
- WH Westinghouse Electric Corp.

Cath. K. Designates the type of cathode.

- C Cold Cathode
- F Filamentary Cathode
- H Heater type (i.e., unipotential cathode)

E. Specifies the nominal heater or filament voltage in volts. In the case of tubes whose heater or filament is center tapped to allow series

or parallel operation of the sections, the value given is for series connection.

I. Typical heater or filament current in milliamperes.

Max. E_b or E_{px} . Maximum plate voltage permissible in the tube. In the case of diodes and thyratrons the value is the peak inverse voltage which can be applied to the tube.

Max. I_b . Maximum plate current in milliamperes which the tube may pass.

P_p . Maximum plate dissipation of the tube in watts. In the case of twin tubes the dissipation is for one section only, e.g., the 6SN7GTB is listed at a dissipation of 5 watts. The manufacturer gives this as the value for each plate, but with both units operating the total for both plates must not exceed 7.5 watts. For this reason multiple tubes should be checked in the manufacturer's data before operating the tube with maximum dissipation in each section.

E_b . Typical value for the d-c plate or operating voltage in volts.

I_b . Typical d-c anode current in milliamperes for the operating voltage in the preceding column.

Gm. Typical value of grid-plate transconductance of the tube in micromhos.

μ . Typical tube amplification factor.

r_p . Typical value for plate resistance in ohms.

Capacity in: Typical value for input capacitance of the tube, i.e., between grid #1 and all other electrodes.

Capacity out: Typical value for the output capacitance of the tube, i.e., between the anode and all other electrodes.

NOTE: These capacity values are measured without an external, grounded shield.

EIA Base No. This column designates the number assigned by the EIA to the base connections of the tube. These Base Numbers will be found in the last section of the Tabulation beginning on page 119. The designation "FL" is used to indicate flexible or flying leads on the miniature or subminiature tubes. The column is left blank where no Base Number is applicable as in light-house and ceramic-metal tubes.

3.3. Unit Symbols

While the normally used electrical unit is printed at the top of each column, it will be noted that letter symbols are used following some numbers to indicate a change of unit.

Symbol	Column heading	Unit
K.....	Max E_b or E_{px}	Kilovolts.
U.....	Max I_b and I_b	Microamperes.
A.....	Max I_b and I_b	Amperes.
K.....	r_p	Kilohms.
M.....	r_p	Megohms.

4. Numerical Listing of
Data on Receiving Tubes

DATA ON RECEIVING TUBES - NUMERICAL LISTING

TUBE TYPE NUMBER	CODE	KIND	TYPE	BULB	USE	TUBE CHAR	REG	K TYPE	TYPICAL FILAMENT		MAXIMUM PLATE CHARACTERISTICS			TYPICAL CHARACTERISTICS				CAPACITANCE		EIA BASE NO.
									V	MA	V	MA	h	EB V	IB MA	GM UM-F0	MU	RP OHMS	PICOFARADS IN	
0A2WA	S*	D10	SIN	T5	REG	GAS	RC	C			185	30		151	18				580	
0A3A	S	D10	SIN	T9	REG	GAS	RA	C			105	40		75	22				4AJ	
0A4G	S	TR1	SIN	ST12	TRG	GAS	SY	C			225	100		225	25				4V	
0B2WA	S*	D10	SIN	T5	REG	GAS	RA	C			133	30		108	18				580	
0B3A	S	D10	SIN	T9	REG	GAS	RA	C			130	30		90	18				4AJ	
0C2	S	D10	SIN	T5	REG	GAS	RC	C			115	30		75	18				580	
0C3A	S	D10	SIN	T9	REG	GAS	RA	C			133	40		105	22				4AJ	
0D3A	S	D10	SIN	T9	REG	GAS	RA	C			185	40		150	22				4AJ	
0G3	S	D10	SIN	T5	REG	GAS	TS	C			115	10		87	6					
0Z4G	S	D10	TAN	T7	REC	CAS	RA	C			1K	200		300	75				4R	
1A3		D10	SIN	T5	REC	VAC	RC	H		1.4	150	330	5	117	500U				5AP	
1A7GT		PTG	SIN	T9	CON	VAC	#HY	F		1.4	50	110	4	90	600U				7Z	
1AB5		PND	SIN	T9	VA	RCD	SY	F		1.2	130			150	7				58F	
1AD2		D10	SIN	T9	REC	VAC	GE	H		1.2	200	22K	5C	225	7				12DQ	
1AD4		PND	SIN	T3X2	VA	SCD	RA	F		1.2	100	100	7	45	3				FL	
1AD5	S	PND	SIN	T3	VA	SCD	SY	F		1.2	40	68	4	68	2				8CP	
1AE4		PND	SIN	T5	RFA	SCD	RA	F		1.2	100	90	11	90	4				6AR	
1AF4		PND	SIN	T5	VA	SCD	SY	F		1.4	25	110	3	68	1				6AR	
1AG4		PND	SIN	T3X2	PA	SCD	RA	F		1.2	40	90	4	41	2				FL	
1AH4		PND	SIN	T3X2	RFA	SCD	RA	F		1.2	40	90	2	68	1				FL	
1AJ2		D10	SIN	T9	REC	VAC	TS	F		1.2	200	26K	50	140	7				12EL	
1AJ5	OBS	D10	PND	T3X2	DET	VAC	RA	F		1.2	40			45	1				FL	
1AJ5	OBS	PND	D10	T3X2	VA	SCD	RA	F		1.2	40	90	2	68	750U				FL	
1AK4		PND	SIN	T3X2	RFA	SCD	RA	F		1.2	20	90	1	68	2				FL	
1AK5		D10	PND	T3X2	DET	VAC	RA	F		1.2	20			45	500U				FL	
1AK5	OBS	PND	D10	T3X2	VA	SCD	RA	F		1.2	20	90	1	45	2				FL	
1AN5		PND	SIN	T5	IFA	SCD	PE	F		1.4	25	120	2	85	2				7ES	
1AU3		D10	SIN	T12	REC	VAC	SY	F		1.2	200	30K	5C	225	7				7C	
1AX2A		D10	SIN	T6	REC	VAC	#HY	F		1.4	650	25K	11	20K	300U				9Y	
1B3GT	S*	D10	SIN	T9	REC	VAC	RC	F		1.2	200	30K	17	35	2				3C	
1C5GT		PND	SIN	T9	PA	SRC	#HY	F		1.4	100	110	12	90	8				6X	
1DN5	S	D10	PND	T5	DET	VAC	TS	F		1.4	50			250U					6BW	
1DN5	S	PND	D10	T5	AFA	SRC	TS	F		1.4	50	90	3	68	2				6BW	
1EB	OBS	PTG	SIN	T3	CON	SIN	SY	F		1.2	40	68	4	68	1				8CN	
1F5G	OBS	PND	SIN	ST14	PA	SRC	SY	F		2.0	120	180		1.8	135	8			6X	
1G3GT	S	D10	SIN	T9	REC	VAC	RC	F		1.2	200	33K	30	25	1				3C	
1G4GT	OBS	TR1	SIN	T9	VA	RCD	GE	F		1.4	50	110	4	90	2				5S	
1H2		D10	SIN	T6	REC	VAC	GE	H		1.4	550	24K	5C	10	500U				9LX	
1H5GT		D10	TR1	T9	DET	VAC	#HY	F		1.4	5C			90	150U				5Z	
1H5GT		TR1	D10	T9	VA	SCD	#HY	F		1.4	50	110		90	150U				5Z	
1J3A	S	D10	SIN	T9	REC	VAC	GE	F		1.2	200	28K	5C	225	7				3C	
1K3	S	PND	SIN	T9	REC	VAC	GE	F		1.2	200	26K	5C	50	500U				3C	
1L4	S	PND	SIN	T5	RFA	SCD	RC	F		1.4	50	110	6	90	3				6AR	
1L6		PTG	SIN	T5	CON	SIN	SY	F		1.4	50	110	4	90	500U				7DC	
1LC5	S	PND	SIN	T9	RFA	SCD	SY	F		1.4	50	110	5	90	1				7AD	