Dieter's

Nixie Tube Data Archive

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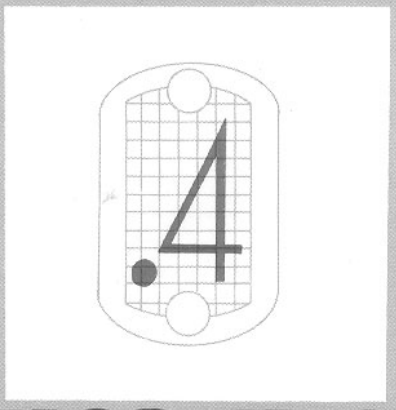
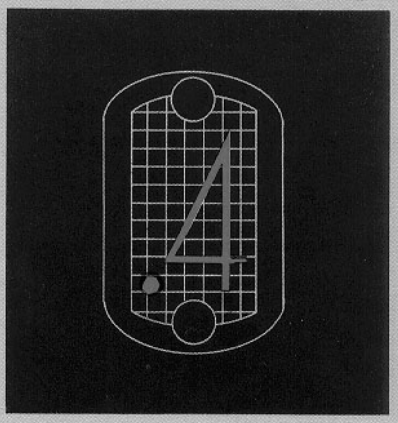
If you have more datasheets, articles, books, pictures or other information about Nixie tubes or other display devices please let me know.
Thank you!

Document in this file	National Electronics - Readout Tubes Catalogue - SB-26F
Display devices in this document	NL-4021, NL-4031, NL-4032, NL-5016, NL-5030, NL-5031, NL-5032, NL-50911, NL-5092, NL-5911, NL-5992, NL-6012, NL-6034, NL-6091, NL-6844A, NL-7009, NL-7037, NL-7094, NL-7153, NL-7977, NL-7977/4032, NL-803, NL-8037, NL-807, NL-809, NL-8091, NL-811, NL-812, NL-8421/5092, NL-8422/5991, NL-8423/6091, NL-8502/4021, RTS-1, RTS-10, RTS-11, RTS-2, RTS-3, RTS-4, RTS-5, RTS-6, RTS-8, RTS-9

File created by Dieter Waechter
www.tube-tester.com



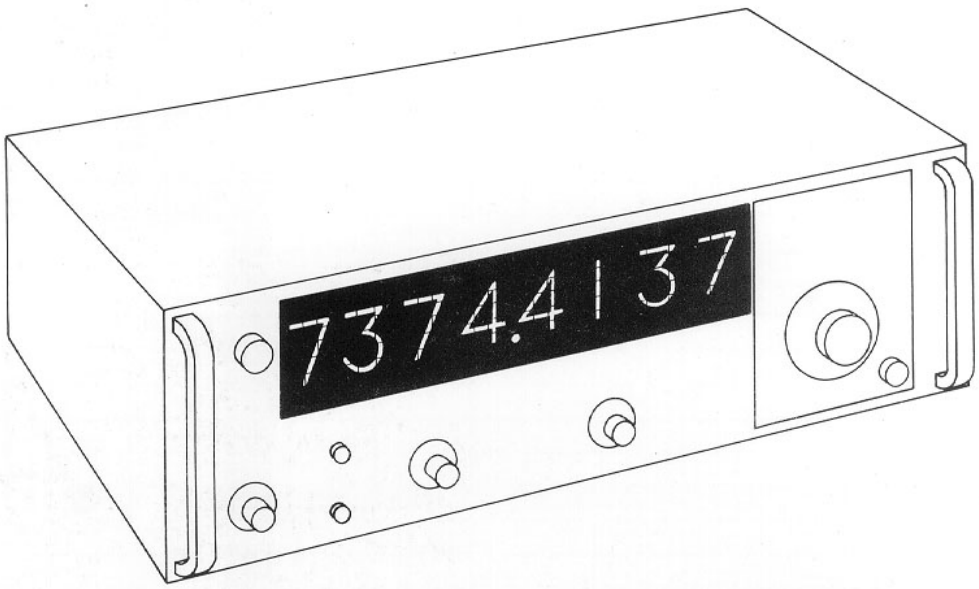
NATIONAL ELECTRONICS, INC. READOUT TUBES



NATIONAL ELECTRONICS, INC.
a varian subsidiary
GENEVA, ILLINOIS

*READOUT TUBES BY NATIONAL ELECTRONICS, INC.

NATIONAL® READOUT TUBES are simple neon filled cold cathode discharge tubes. Each tube consists of a common anode and 10 independent cathodes, each formed in the shape of a numeral. Application of a negative voltage to a selected cathode causes the gas around the cathode to ionize and glow. The visual effect is a bright red orange neon glow closely following the shape of the energized cathode.



NATIONAL® READOUT TUBES — electronic display devices that are

RUGGED — longest life of any Readout; shock and vibration meet military requirements.

ATTRACTIVE — well shaped characters, bright even color.

ECONOMICAL — Lowest initial cost, lower operating costs.

WARRANTY

LONG LIFE READOUT tubes are warranted to be free from defects caused by materials, workmanship, and construction for a period of two years from the date of shipment. Standard Life readout tubes are warranted to be free from defects caused by materials, workmanship and construction for a period of 90 days from date of shipment. National Electronics, Inc. liability under this warranty is limited to replacing or repairing any tube returned by the buyer during such period provided:

1. Buyer promptly notifies National Electronics, Inc., Geneva, Illinois in writing requesting authorization to return the tube as per our warranty policy. Letters should itemize complaints.
2. The defective unit is returned to address in (1), transportation charges prepaid.
3. Manufacturer's examination shall disclose to its satisfaction that defects have not been caused by misuse, neglect, accident or improper installation.

Under no conditions shall National Electronics, Inc. be liable for collateral or consequential damages. The warranty is in lieu of all other warranties expressed or implied.

* Manufactured under license from Burroughs Corporation.

SELECTION GUIDE
NATIONAL ELECTRONICS READOUT TUBES

MINIATURE
.310 CHARACTER SIZE
14' VIEWING DISTANCE

NL7977/4032
LONG LIFE

NL7009
REGULAR LIFE

NL8502/4021
REGULAR LIFE
LOW VOLTAGE

NL6844A
REGULAR LIFE

NL8421/5092
LONG LIFE
WIDE ANGLE

NL8422/5991
LONG LIFE
RECTANGULAR

NL809
LONG LIFE
RECTANGULAR
WITH DECIMAL POINT

STANDARD
END VIEWING
.610 CHARACTER SIZE
30' VIEWING DISTANCE

STANDARD
SIDE VIEWING
.610 CHARACTER SIZE
30' VIEWING DISTANCE

NL803
LONG LIFE

NL812
LONG LIFE
WITH DECIMAL POINT

NL5030
LONG LIFE
BIQUINARY

NL7153
REGULAR LIFE

NL8423/6091
LONG LIFE
WIDE ANGLE

NL807
SIDE VIEWING
LONG LIFE

SUPER
SIDE AND END VIEWING
.808 CHARACTER SIZE
38' VIEWING DISTANCE

LARGE AND JUMBO
SIDE AND END VIEWING
CHARACTER SIZE 1.375" and 2"
65' and 100' VIEWING DISTANCE

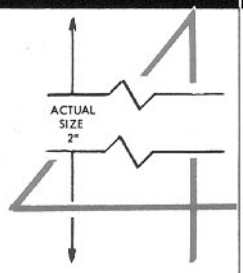
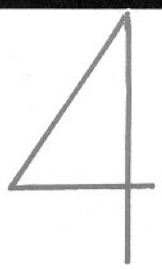
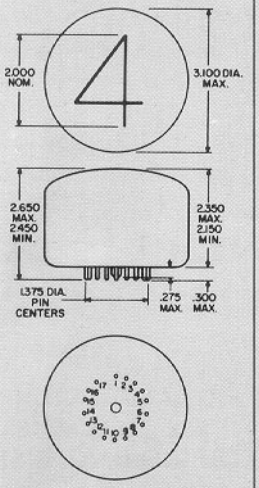
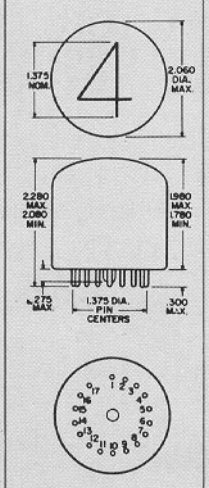
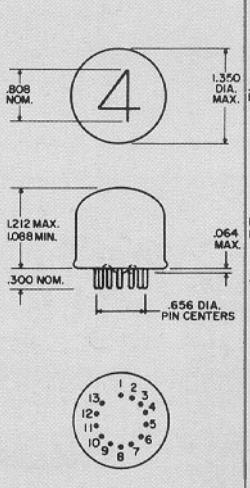
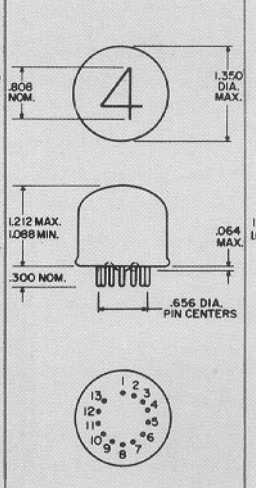
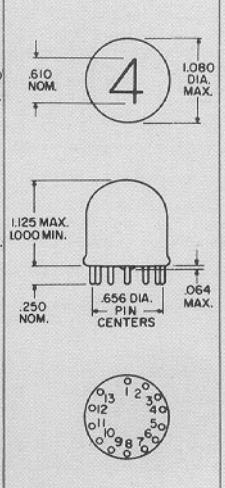
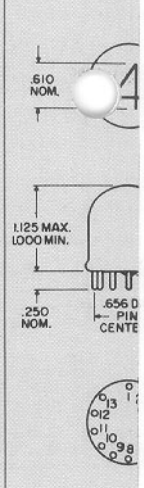
NL8091
LARGE LONG LIFE
WIDE ANGLE

NL7094
JUMBO LONG LIFE
WIDE ANGLE

NL7037
JUMBO LONG LIFE
SIDE VIEWING

LONG LIFE READOUT TUBES ARE WARRANTED FOR 2 YEARS. NORMAL EXPECTED LIFE IS GREATER THAN 200,000 HOURS.

*Multiple type numbers are always the EIA assigned number followed by the common industry number.

*NUMERALS 0 thru 9 SYMBOLS + and -	NL-7094	NL-8091	NL-8423/6091 NL-6034	NL-7153 NL-6012	NL-6844A NL-5016	NL-803 NL-5
CHARACTER SIZE						
ELECTRICAL RATINGS AND CHARACTERSITICS						
Ionization Voltage (Maximum)	170 Vdc	170 Vdc	170 Vdc	250 Vdc	170 Vdc	170
Supply Voltage (Minimum)	170 Vdc	170 Vdc	170 Vdc	250 Vdc	170 Vdc	170
Cathode Current — Peak (Max.)	7.5 ma	6.5 ma	4.5 ma	5.0 ma	4.0 ma	3.5
Average (Max.)	7.0 ma	6.0 ma	4.0 ma	3.0 ma	3.0 ma	3.0
Average (Min.)	4.0 ma	3.0 ma	1.5 ma	2.0 ma	1.5 ma	1.5
dc Prebias Voltage Limits	65V to 120V	65V to 120V	65V to 120V	65V to 120V	50V to 120V	50V to
**Recommended Operating Conditions dc Supply Voltage (Ebb) .	200 250 300V	170V 250V 300V	170V 250V 300V	250V 300V	170V 250V 300V	170V 25
Corresponding Anode Resistor (RA)	9.1K 18K 27K	5.6K 22K 33K	6.8K 36K 56K	43K 62K	15K 51K 75K	10K 47
Temperature Limits	-65°C to +85°C	-65°C to +85°C	-65°C to +85°C	-65°C to +85°C	-65°C to +85°C	-65°C to
Weight	4 oz.	1.7 oz	0.6 oz	0.6 oz	0.4 oz	0.4
OUTLINE DRAWINGS						
Socket (See Page 11)	RTS-5	RTS-5	RTS-1, RTS-2 RTS-6, RTS-8, RTS-9			
Mounting Position	PINS 1 & 10 VERTICALLY ALIGNED WITH PIN 10 ON TOP		PINS 1-8 VERTICALLY ALIGNED WITH PIN 8 ON TOP.			PINS 1 & 8 V

PIN CONNECTIONS

PIN NUMBER	CHARACTER
1	Internal Conn.
2	Anode
3	0
4	9
5	Internal Conn.
6	Internal Conn.
7	8
8	7
9	6
10	Internal Conn.
11	Internal Conn.
12	5
13	4
14	3
15	Internal Conn.
16	2
17	1

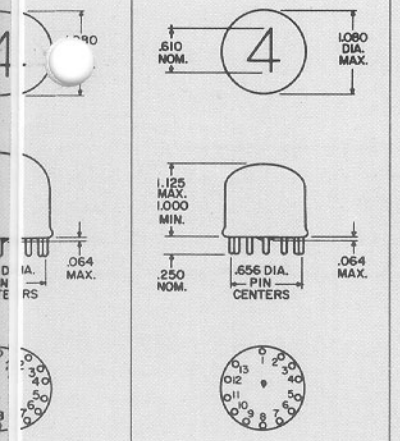
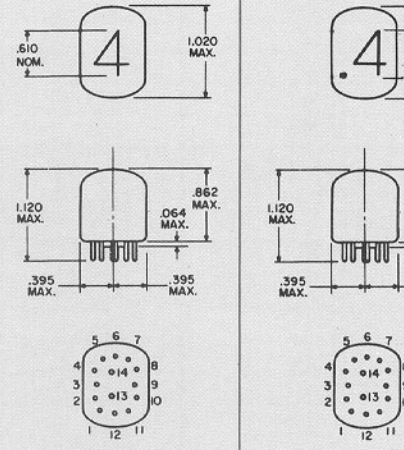
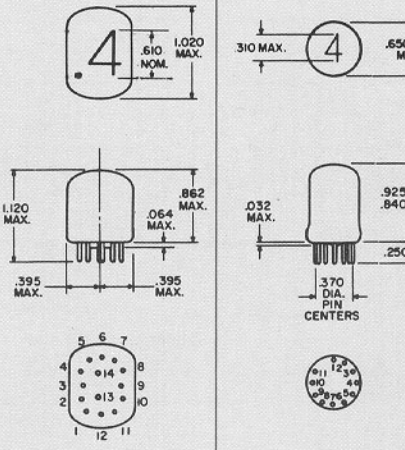
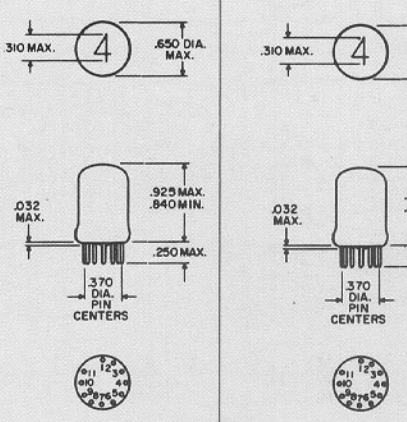
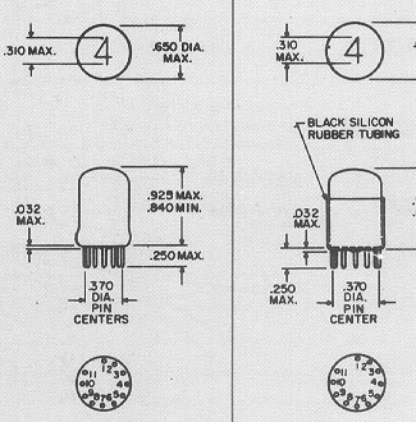
PIN NUMBER	CHARACTER	NL-6034 NL-6012 ONLY
1	Internal Conn.	
2	Anode	Anode
3	0	
4	9	
5	8	
6	7	
7	6	Plus
8	Internal Conn.	
9	5	
10	4	
11	3	
12	2	Minus
13	1	

PIN NUMBER	CHARACTER	NL-5032 NL-5016 NL-5091 ONLY
1	Internal Conn.	
2	Anode	Anode
3	0	
4	9	
5	8	
6	7	
7	6	Plus
8	Internal Conn.	
9	5	
10	4	
11	3	
12	2	M
13	1	

*Other characters available by special order

**See Fig. 1 & 3, Page 7. Use of the highest voltage available with the appropriate resistor is recommended.

ELECTRONICS READOUT TUBES

7/5031	NL-8421/5092 NL-50911	NL-8422/5991 NL-5992	NL-809	NL-7009	NL-8502/4021	NL-7977/4032 NL-4031
4	4	4	.4	4	4	4
Vdc	170 Vdc	170 Vdc	170 Vdc	170 Vdc	120 Vdc	170 Vdc
Vdc	170 Vdc	170 Vdc	170 Vdc	170 Vdc	120 Vdc	170 Vdc
ma	3.5 ma	3.5 ma	3.5 ma	2.0 ma	2.0 ma	2.0 ma
ma	3.0 ma	3.0 ma	†3.0 ma	1.2 ma	1.4 ma	1.4 ma
ma	1.5 ma	1.5 ma	†1.5 ma	0.7 ma	0.7 ma	0.7 ma
120V	50V to 120V	50V to 120V	50V to 120V	50V to 75V	50V to 75V	50V to 120V
300V	170V 250V 300V	170V 250V 300V	170V 250V 300V	170V 250V 300V	120V	170V 250V 300V
68K	10K 47K 68K	8.2K 47K 68K	8.2K 47K 68K	68K 150K 200K	20K	15K 91K 150K
+85°C	-65°C to +85°C	-65°C to +85°C	-65°C to +85°C	-65°C to +85°C	-65°C to +85°C	-65°C to +85°C
oz	0.4 oz	0.3 oz	0.3oz	0.14 oz	0.14 oz	0.14 oz
						
RTS-1,RTS-2 RTS-6,RTS-8,RTS-9	RTS-4, RTS-10	RTS-4, RTS-10	RTS-3			
ERTICALLY ALIGNED WITH PIN 8 ON TOP.	PINS 6 & 12 VERTICALLY ALIGNED WITH PIN 6 ON TOP	PINS 6 & 12 VERTICALLY ALIGNED WITH PIN 6 ON TOP	PINS 1 & 7 VERTICALLY ALIGNED WITH PIN 7 ON TOP.			

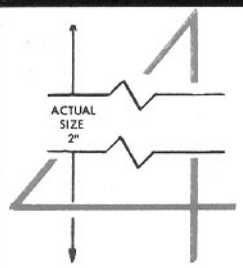
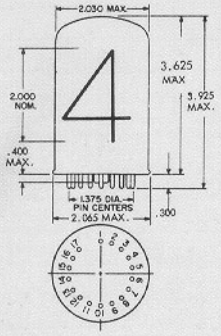
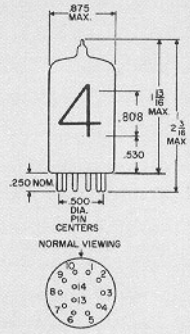
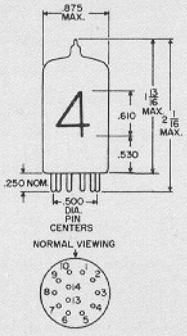
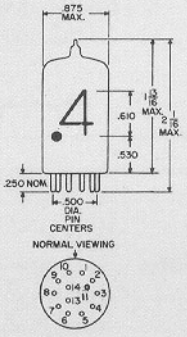
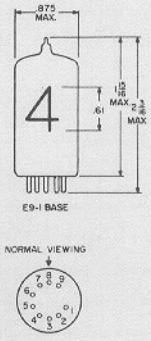
PIN NUMBER	CHARACTER	NL-5992 ONLY
1	Anode	Anode
2	0	
3	9	
4	8	
5	7	Plus
6	6	
7	5	
8	4	Minus
9	3	
10	2	
11	1	
12	Internal Conn.	
13	Internal Conn.	
14	Internal Conn.	

PIN NUMBER	CHARACTER
1	Anode
2	0
3	9
4	8
5	7
6	6
7	5
8	4
9	3
10	2
11	1
12	Decimal Point
13	Internal Conn.
14	Internal Conn.

PIN NUMBER	CHARACTER	NL-4031 ONLY
1	1	
2	2	
3	3	
4	4	
5	5	
6	6	Plus
7	7	
8	8	
9	9	Minus
10	0	
11	Anode	Anode

† Decimal point cathode current - average, Max. - 0.7 ma & Min. - 0.2 ma.

TECHNICAL DATA NATIONAL ELECTRONICS READOUT TUBES
SIDEVIEWING

*NUMERALS 0 thru 9 SYMBOLS + and -	NL-7037	NL-807	NL-803 NL-811	NL-812	NL-5030
CHARACTER SIZE		4	4	.4	4
ELECTRICAL RATINGS AND CHARACTERSITICS					
Ionization Voltage (Maximum)	200 Vdc	170 Vdc	170 Vdc	170 Vdc	160 Vdc
Supply Voltage (Minimum)	200 Vdc	170 Vdc	170 Vdc	170 Vdc	160 Vdc
Cathode Current — Peak (Max.)	10 ma	5.0 ma	3.5 ma	3.5 ma	4.0 ma
Average (Max.)	10 ma	4.5 ma	3.0 ma	†3.0 ma	4.0 ma
Average (Min.)	6 ma	2.0 ma	1.5 ma	†1.5 ma	2.0 ma
dc Prebias Voltage Limits	65V to 120V	50V to 120V	50V to 120V	50V to 120V	40V to 120V
**Recommended Operating Conditions dc Supply Voltage (Ebb) .	200V 250V 300V	170V 250V 300V	170V 250V 300V	170V 250V 300V	180V 250V 300V
Corresponding Anode Resistor (RA)	8.2K 12K 19K	6.8K 31K 46K	8.2K 47K 68K	8.2K 47K 68K	10K 27K 39K
Temperature Limits	-65°C to +85°C	-65°C to +85°C	-65°C to +85°C	-65°C to +85°C	-55°C to +70°C
Weight	3 oz	0.6 oz	0.5 oz	0.5 oz	0.5 oz
OUTLINE DRAWINGS					
Socket (See Page 11)	RTS-5	RTS-11			9 PIN MINIATURE
Mounting Position	PINS 1 & 10 ALIGNED VIEWING DIRECTION WITH PIN 1 IN FRONT	PINS 1 & 10 IN FRONT.			PINS 8 & 3 ALIGNED VIEWING DIRECTION WITH PIN 8 IN FRONT

PIN CONNECTIONS

PIN NUMBER	CHARACTER
1	Internal Conn.
2	Anode
3	6
4	0
5	Internal Conn.
6	Internal Conn.
7	2
8	4
9	1
10	Internal Conn.
11	Internal Conn.
12	8
13	9
14	5
15	Internal Conn.
16	7
17	3

PIN NUMBER	CHARACTER	NL-811 ONLY
1	7	
2	5	
3	8	
4	Anode	Anode
5	1	
6	4	Plus
7	2	
8	6	Minus
9	9	
10	3	
11	No Pin	
12	No Pin	
13	0	
14	Internal Conn.	Internal Conn.

PIN NUMBER	CHARACTER
1	7
2	5
3	8
4	Anode
5	1
6	4
7	2
8	6
9	9
10	3
11	Decimal Pt.
12	No Pin
13	0
14	Internal Conn.

PIN NUMBER	CHARACTER
1	Internal Conn.
2	Even Anode
3	8 and 9
4	6 and 7
5	4 and 5
6	Screen
7	2 and 3
8	and 1
9	Odd Anode

*Other characters available by special order.
**See Fig. 1 & 3, Page 7. Use of the highest voltage available with the appropriate resistor is recommended.
† Decimal point cathode current - average, Max. - 0.7 ma & Min. - 0.2 ma.

GENERAL

A National Readout Tube is basically a gas filled, cold cathode diode with multiple cathodes. Each cathode is shaped like a display character and has a separate base pin electrical connection. Negative voltage (with respect to anode) applied to the selected character base pin causes the shaped glow discharge.

Readout Tube operation can be explained more fully by considering the tube similar to a single cathode gas diode. Fig. 1 shows a simple operating circuit with the Readout Tube

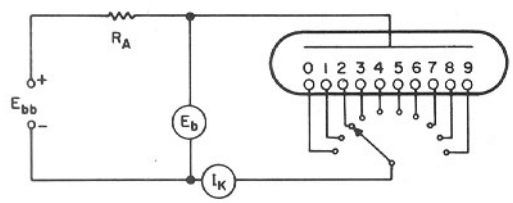


FIG. 1. READOUT TUBE FUNDAMENTAL CIRCUIT

diode-connected as in normal use. By varying circuit parameters, we can obtain a typical plot (Fig. 2) of tube voltage, E_b, versus cathode current, I_k. Increasing E_b from zero to the ionization voltage causes only a small increase in I_k and no glow. At ionization voltage, a glow appears. With increasing I_k, two glow regions are reached; normal and abnormal. For clarity in this discussion, the high current end of abnormal glow is called intense glow. Normal glow illuminates only partial characters so is not satisfactory; intense glow operation will shorten tube life. Desired operation is obtained in the abnormal glow region and is the operating condition specified in technical data sheets.

ELECTRICAL RATINGS AND CHARACTERISTICS

Ionization Voltage (Maximum)

All tubes will operate properly at or above the Maximum Ionization Voltage. Ionization will occur in all cases at less than maximum specified voltage but a higher value is required to assure uniform operation between tubes. This is discussed at greater length under Recommended Operating Conditions.

Supply Voltage, E_{bb} (Minimum)

Minimum Supply Voltage must always equal or exceed Maximum Ionization Voltage for proper tube operation. This is a necessary condition to make sure that all tubes will ionize and operate within rated current limits. How Supply Voltage in conjunction with anode resistance determines cathode current is explained under Recommended Operating Conditions.

Cathode Current, I_k — Peak (Maximum)

Cathode Current, as shown in Fig. 2, determines in which glow region the tube operates. Maximum Peak Cathode Current places operation at the higher end of abnormal glow approaching the region of intense glow with attendant shortened life. This, then, represents the maximum peak current for long life.

Cathode Current, I_k — Average (Maximum and Minimum)

Again referring to Fig. 2, maximum and minimum limits of cathode current keep tube operation within the abnormal glow region giving the best display consistent with long life. Optimum current is midway between maximum and minimum.

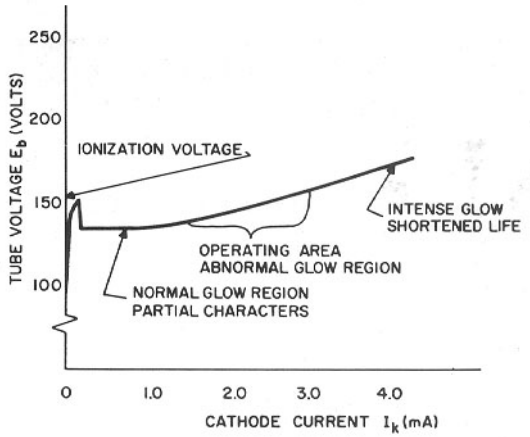


FIG. 2. NL-8421 TYPICAL VOLT-AMPERE CHARACTERISTIC

Recommended Operating Conditions

Various Supply Voltages (E_{bb}) are given with corresponding values of anode resistor (R_A) for proper operation. These values are obtained from an electrical characteristic curve, Fig. 3. The NL-8421 is used as an example; other tube types have similar curves. Two parallel lines show characteristic limits for all tubes of one type. Load lines are drawn for different values of R_A by first selecting a supply voltage, for example, 170 volts. A line drawn from this voltage on the ordinate through the intersection of mean I_k and a point midway between the parallel characteristic limits, has a slope representing proper R_A, in this case, 10K ohms. By identical steps, R_A is found for each E_{bb} of interest.

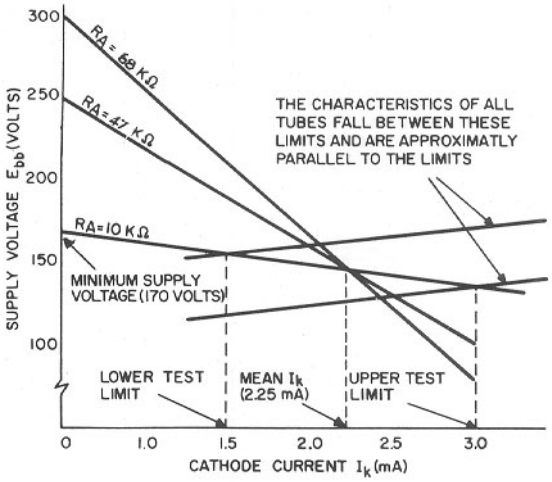


FIG. 3. ELECTRICAL CHARACTERISTICS

All tubes in circuits with a particular load line will operate on that line somewhere between the parallel characteristic limits. For example, at E_{bb} of 170 volts and R_k of 10K ohms, all tubes will operate between 1.5 ma (lower test limit) and 3.0 ma (upper test limit). Each load line has a different length between the parallel characteristic limits. This means that cathode current extremes are different for each load line.

What are limits on load lines? If a load line is drawn from a supply voltage of less than 170 volts, cathode current can range outside of specified limits giving partial characters if current is low and short life if high. As E_{bb} and R_A are increased, tubes operate within a narrower cathode current range. This is desirable as it reduces any glow variation between tubes. For most NL-8421 applications, an E_{bb} of 170 and R_A of 10K ohms is satisfactory. When necessary, higher values can be used.

Anode resistance values for higher anode voltages can be calculated using the following equation:

$$R_a = \frac{E_{bb} - E_{td}}{I_k}$$

R_a — Anode resistance in ohms.
E_{bb} — Supply voltage volts.
I_k — Average cathode current.
E_{td} — Voltage drop across tube at average current.

The average current and the corresponding tube drop are listed below:

Tube Type	E_{td} Volts	I_k (avg) ma
NL-7094	150	5.5
NL-7037	135	8.0
NL-8091	145	4.75
NL-8423	147	3.0
NL-7153	143	2.5
NL-6844A	135	2.25
NL-8037	147	2.25
NL-8421	147	2.25
NL-8422	150	2.25
NL-803	150	2.25
NL-809	150	2.50
NL-807	150	3.12
NL-5030	142	3.8
NL-7977	154	1.05
NL-7009	102	0.95
NL-4021	102	1.05

PREBIAS VOLTAGE

Pre-Bias Voltage is a potential difference applied between "on" and "off" cathodes. Without pre-biasing, a signal voltage amplitude equal to Minimum Supply Voltage is needed to switch "on" a character. Pre-biasing permits a smaller signal to be used. This is particularly useful with semiconductor switching circuits.

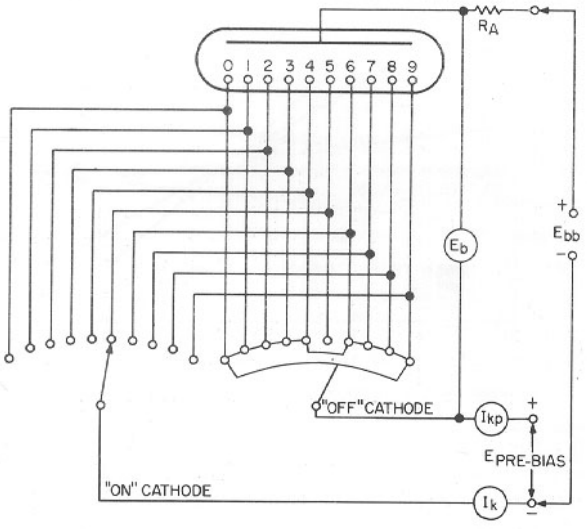


FIG. 4. BASIC READOUT TUBE PRE-BIAS CIRCUIT

The basic Readout Tube pre-bias circuit is shown in Fig. 4. Pre-bias voltage, $E_{PRE\text{-}BIAS}$, is varied while measuring "off" cathode pre-bias current, I_{kp}, giving the curves in Fig. 5. E_{bb} is varied only as necessary to keep I_k constant at 2.25 ma. The two curves represent spread of pre-bias current resulting from different distances between "on" and "off" cathodes. For example, in a numerical Readout Tube, the distance between cathode "3" and "1" is different than that between "3" and "4". With "3" as the "off" cathode, there will be different pre-bias current depending upon whether "1" or "4" is the "on" cathode.

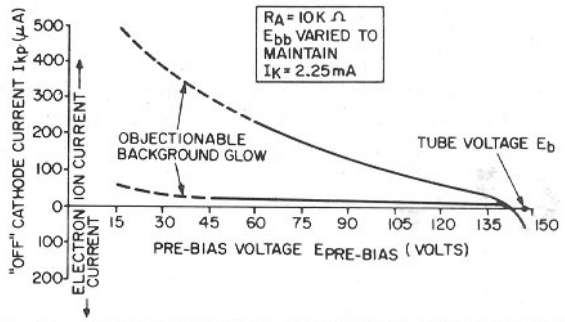


FIG. 5. PRE-BIAS VOLTAGE VS "OFF" CATHODE CURRENT FOR NL-8421 READOUT TUBE

Pre-bias current is important because it affects tube operation. Referring to Figures 4 and 5, when $E_{PRE\text{-}BIAS}$ is greater than tube voltage, E_b, the "off" cathode will take over as an anode and accept electron current. "On" cathode current would no longer be limited by R_A, causing loss of control. When $E_{PRE\text{-}BIAS}$ is less than E_b, the "off" cathode will acception current. As $E_{PRE\text{-}BIAS}$ is reduced, I_{kp} increases, finally causing "off" cathode ionization and background haze. The lower limit of $E_{PRE\text{-}BIAS}$ is determined by objectionable background haze, the upper limit by the lowest tube voltage expected. Typical pre-bias voltage limits (NL-8421, for example) are 50 V to 120 V.

BIQUINARY CHARACTERISTICS

The Biquinary Readout tube is similar to the decimal or 10 line Readout tube. However, biquinary tube design permits the tube to be driven directly by a 2-5 or biquinary code. This is accomplished by dividing the tube into two electrical compartments separated by a transparent screen. (Figure S-337). The front compartment contains cathodes 1, 3, 5, 7, 9 and the odd anode. The rear compartment contains cathodes 0, 2, 4, 6, 8 and the even anode. Cathodes are connected internally in pairs 0 and 1, 2 and 3, 4 and 5, 6 and 7, 8 and 9 and a lead from each pair is connected to a base pin. By energizing the appropriate base pin and anode, a particular cathode can be caused to glow and display the desired character.

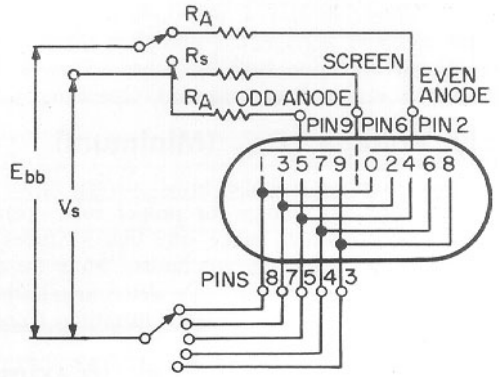


FIG. 6 FUNDAMENTAL BIQUINARY TUBE CIRCUIT

CIRCUITS AND APPLICATIONS

GENERAL

Electronic Readout Tubes have manifold uses whenever information from electronic or electro-mechanical circuits has to be displayed. Typical examples are counting instruments — frequency, neutron, gamma radiation; information displays — stock quotation, airport flight information; digital readout replacing meters — voltmeters, flowmeters; many others from digital clocks to teaching machines. Each application has its own conditions involving type of signal available, ambient lighting, size and space of display. Information is provided here to help apply Readout Tubes.

DRIVER CIRCUITS

An electro-mechanical stepping switch using circuits similar to Figure 1 is the simplest method of driving Readout tubes, but slow speed and high cost limit usage. Semi conductor driving circuits using NPN transistors or similar semi conductor devices are more widely used. Typical transistor driving circuits are shown in Figure 7.

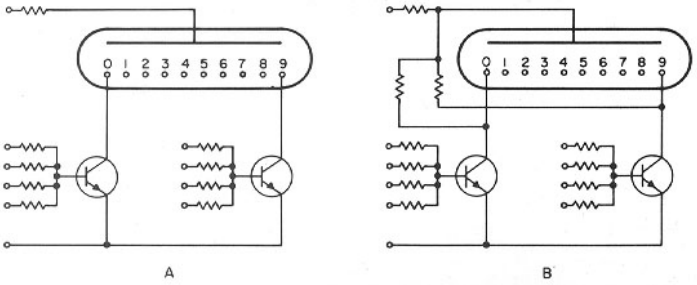


FIG. 7 TYPICAL TRANSISTOR CIRCUITS

In normal operation the "on" transistor is operated in saturation and the "off" transistor is operater in a back bias state. These "off" transistors will carry some collector leakage current. If this leakage current becomes excessive, a background glow or haze can be observed in the Readout tube. As explained in the section on Pre-bias Voltage, the total "off" cathode current should be kept below 100uA and the "off" cathode voltage should be above 50 volts. To allow some margin, a driver transistor should have a maximum collector leakage current of 1.0uA at 65 volts and 25°C and a malimum of 10uA at 85°C. Transistors with higher leakage currents can be used by connecting the collector to a source of high positive voltage. Normally a 1.5 megohm resistor is connected from each collector to the anode as shown in Figure 7 B. Some transistors suitable for driving Readout tubes are:

Silicon:

Texas Instrument	TI 496
R C A	40346
Fairchild Semi conductor	2N 1990

Germanium:

General Transistor	2N 1310
	2N 1311

A widely applied and economical decoder driver circuit is shown in figure 8. The decoder accepts a BCD input and decodes to a biquinary signal. The decoded signal selects one of five pairs of odd-even characters. The odd-even selection is then made by the presence or absence of a 1 in the input BCD signal.

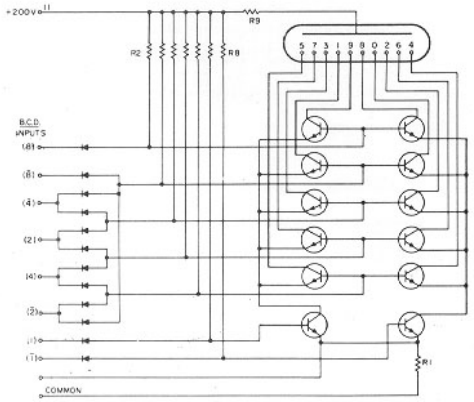


FIG. 8 DECODER DRIVER CIRCUIT

The BCD to decimal character display translation is shown in truth table below. Logic 1 level is more positive than logic 0. Codes other than the 8, 4, 2, 1 BCD can be accommodated by changing the interconnection between the decoder diodes.

DISPLAYED CHARACTER

BCD INPUT	0	1	2	3	4	5	6	7	8	9
1	0	1	0	1	0	1	0	1	0	1
$\overline{1}$	1	0	1	0	1	0	1	0	1	0
2	0	0	1	1	0	0	1	1	0	0
$\overline{2}$	1	1	0	0	1	1	0	0	1	1
4	0	0	0	0	1	1	1	1	0	0
$\overline{4}$	1	1	1	1	0	0	0	0	1	1
8	0	0	0	0	0	0	0	0	1	1
$\overline{8}$	1	1	1	1	1	1	1	1	0	0

The decoder can be driven directly from a standard 4 binary decimal counter with a 3 volt or greater output swing to give a full decade counting and display unit.

An alternate decade counting circuit for relatively slow counting speeds utilizing a minimum of components, can be made using silicon controlled switches in a ring counting circuit. The counter will count and store at maximum pulse rate of 5 KCS. Reset can be accomplished by several different methods. One method opens the +12 volt dc supply; another method opens the common scs ground.

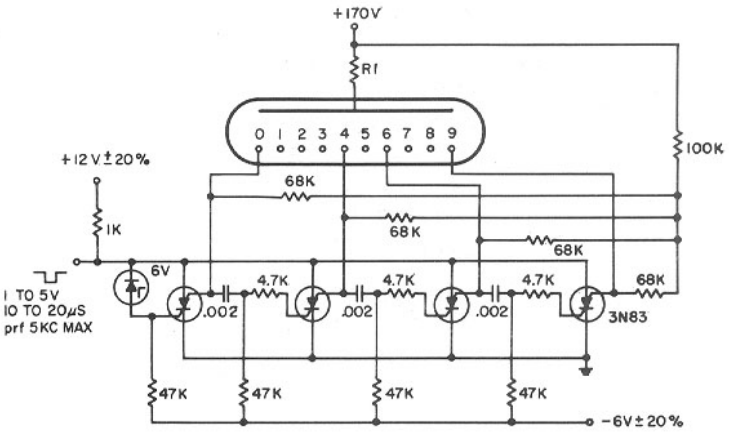


FIG. 9 SCS RING COUNTER

DIMMING

When Readout Tube intensity is too great, as when used in low ambient light applications, dimming can be done by suitable circuits. Just reducing tube current will not work as glow remains quite constant over the normal current range. A practical method is to switch the tube on and off at a rate slow enough to provide dimming but not so slow as to cause visible flicker.

A free running multivibrator in the Readout Tube plate circuit is a low cost dimming method. Multivibrator output is fed into a cathode follower for a low impedance match to the Readout Tube or tubes. Suggested output pulse for this dimmer is 200 volts amplitude (positive) and 100 microseconds duration with a variable repetition rate.

MOUNTING AND PACKAGING

Display effectiveness, primarily dependent upon the Readout Tube, is improved by well designed packaging. In practically all applications, mount the tube inside an enclosure painted dull black to minimize reflections from external light sources and internal tube glow. An ordinary red or amber plastic filter or a circular polarizing one will correct reflection troubles from a high ambient light level. Filtering reduces reflections from both the tube glass surface and the internal characters improving contrast and readability. Red and amber filters work well because they match the neon glow and also eliminate the bluish haze characteristic of ultra long life tubes. Polaroid filters are probably the most frequently used polarizing types and work particularly well in high ambient conditions.

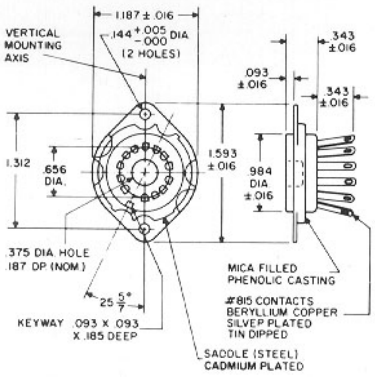
Filter density is not critical but should be considered in relation to the amount of ambient light expected. Relatively dense filters are used in subdued light applications, for example, radar rooms.

Bezel assemblies complete with enclosure, sockets and Polaroid filter are available.

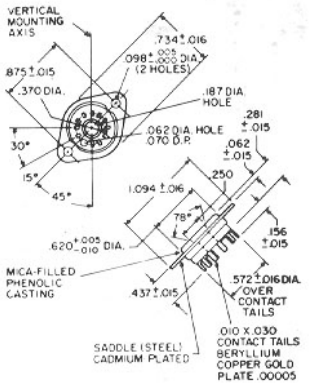
Write for SB 44

READOUT TUBE SOCKETS

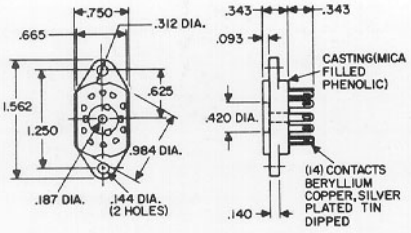
RTS-1, RTS-2



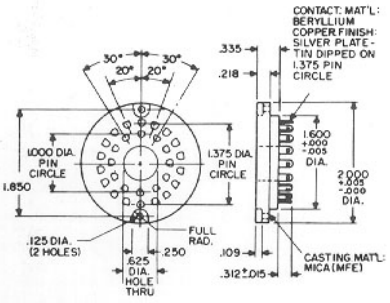
RTS-3



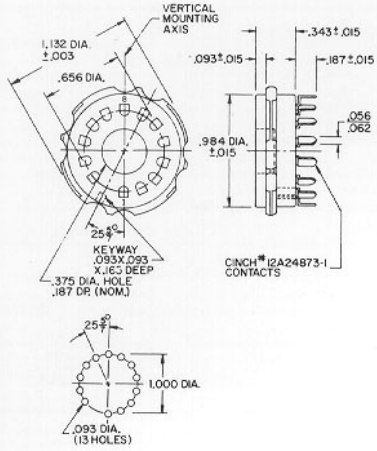
RTS-4



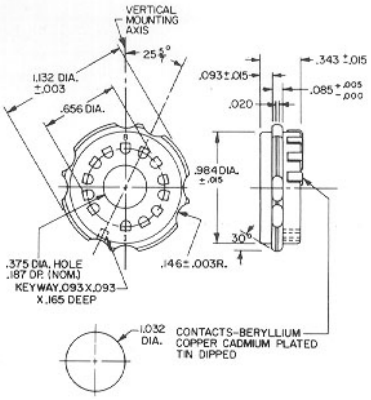
RTS-5



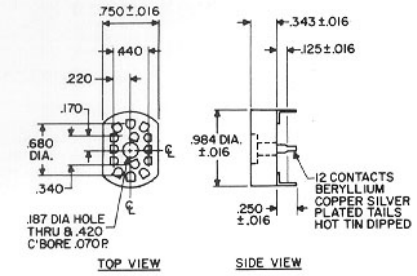
RTS-6, RTS-8



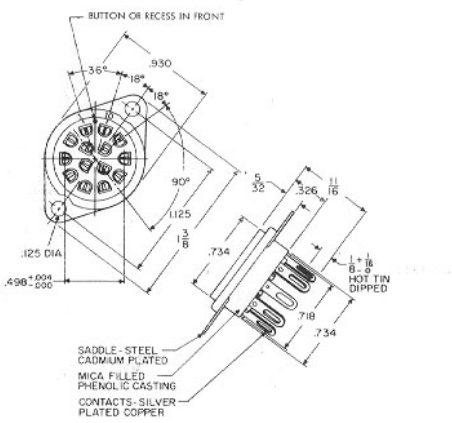
RTS-9



RTS-10



RTS-11



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