"Miniwatt"

DIGEST

VOL. 2 No. 7
APRIL 1963

TECHNICAL AND COMMERCIAL TOPICS OF CURRENT INTEREST TO THE ELECTRONICS INDUSTRY

CONTENTS

Published by the "Miniwatt" Electronics Division of Philips Electrical Industries Pty. Limited, 20 Herbert Street, Artarmon, N.S.W., Australia

PHILIPS 20 A VARIABLE TRANSFORMER

(See Page 108)

THE AC125 & AC126

New Germanium PNP Transistors for AF Pre-amplifier and Driver Stages

The preferred Miniwatt transistors AC125 and AC126 just released, are intended for operation in pre-amplifier or driver stages with battery voltages up to 14 V. Electrically, these new types offer substantial advantages over their predecessors—including increased collector current and voltage ratings, higher current gain values, better linearity and improved thermal conductance.

COMPARISON OF 3-STAGE AMPLIFIERS

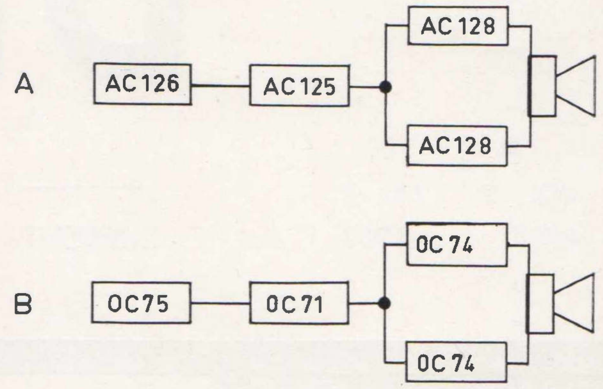


Fig. 1

Type of Input	Ratio of Sensitivity of A : B	
	1 W output at 9 V supply	0.3 W output at 6 V supply
Voltage Input	7 : 1	4 : 1
Current Input	10 : 1	6 : 1

The superiority of the AC125 and AC126 over the existing transistors OC71 and OC75 respectively, can be assessed by inspection of the data published here which has been arranged to facilitate comparison of the ratings and some important characteristics.

Three-stage audio amplifiers can now be designed using the AC126 as pre-amplifier, the AC125 as driver and the 2-AC128[1] for Class B output, which have greater sensitivity than those using the combination OC75, OC71, 2-OC74. Indeed, two-stage AF amplifiers operating from a 9 V supply now become a possibility.

Three-Stage Class B Amplifiers

A comparison between the sensitivities of simple three-stage amplifiers using the AC126—AC125—2-AC128 and the OC75—OC71—2-OC74 is shown in Fig. 1.

The sensitivity of a three-stage amplifier equipped with the AC126—AC125—2-AC128 and giving an output of 1.5 W is better than that of a similar 0.3 W amplifier using the OC75—OC71—2-OC74. All three new transistors contribute higher gain in current driven stages. The AC125 by a factor of two to three times over the OC71, and the AC126 by a factor of two times over the OC75. The gain of this 1.5 W amplifier is high enough to allow about 12 dB negative feedback to be applied. Further improvement would be shown by comparison with an amplifier comprising OC75—OC71—2-OC72 transistors.

For the higher output case, the increased gain derived from the substitution can be used for improving the sound quality by means of feedback, and in some cases the pre-amplifier stage can be omitted altogether.

In the particular case of a crystal pick-up used to deliver 0.5 V into a 220 KΩ load, a signal current of 2.3 μA is available. This is sufficient to drive a two-stage amplifier, comprising AC126 as driver and 2-AC128 as Class B output stage, to deliver an output of about 0.3 W. In this case, the AC126 is to be preferred as driver transistor because of its higher current gain (h_{fe}).

Reference

1. T. Davis, The AC128—New High-gain Transistor for AF Output Stages, *Miniwatt Digest*, Vol. 1, No. 12, pp. 187-190.

MINIWATT AC125 & AC126

Medium-gain Transistors for Pre-amplifier and Driver Stages
Germanium PNP Alloy-junction Types

Comparative data on the OC71 and OC75 is printed in brown

GENERAL DATA

Outline (see Fig. 2)	...	T 01
Case	...	Metal
Cooling fin	...	Part No. 56200
Thermal Resistance junction to ambient in free air	... K_{j-amb}	0.3 °C/mW
junction to ambient with cooling fin mounted on heat sink of at least 2 sq. ins.	... K_{j-amb}	0.09 °C/mW

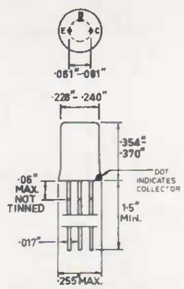


Fig. 2—AC 125 or AC 126.

MAXIMUM RATINGS (Absolute Maximum)

		AC125 & AC126	OC71 & OC75	
Collector-to-base voltage	$-V_{CB}$	32	30	V
Collector current	$-I_C$	100	10	mA
Emitter-to-base voltage	$-V_{EB}$	10	—	V
Base current	$-I_B$	5	5	mA
Total dissipation	P_{tot}	500	—	mW
Collector dissipation	P_C	—	125	mW
Junction temperature: continuous operation	T_j	75	75	°C
intermittent operation (total duration 200 hrs.)	T_j	90	90	°C

CHARACTERISTICS Range Values for Equipment Design

at T_{amb} = 25°C unless otherwise specified

		AC125	AC126	
Collector-cutoff current				
at $-V_{CB}$ = 10V, I_E = 0	$-I_{CBO}$	10 max.	10 max.	μA
at $-V_{CB}$ = 4.5V, I_E = 0	$-I_{CBO}$	12 max. (OC71)	12 max. (OC75)	μA
Emitter-cutoff current (T_j = 75 °C)				
at $-V_{EB}$ = 5V, I_C = 0	$-I_{EBO}$	550 max.	550 max.	μA
DC current gain				
at I_E = 2 mA, $-V_{CB}$ = 5V	h_{FE}	130 65 min.	220 100 min.	
at I_E = 50 mA, V_{CB} = 0	h_{FE}	95	135	
at I_E = 100 mA, V_{CB} = 0	h_{FE}	80	105	
Small-signal current gain				
at $-V_{CB}$ = 5V, I_E = 2 mA, f = 1 Kc/s	h_{fe}	125 80 min. 170 max.	180 130 min. 300 max.	
at $-V_{CE}$ = 2V, $-I_C$ = 3mA	h_{fe}	47 30 min. 75 max. (OC71)	90 65 min. 130 max. (OC75)	
Base-to-emitter voltage				
at I_E = 2 mA, $-V_{CB}$ = 5V	$-V_{BE}$	105	105	mV
at I_E = 100 mA, V_{CB} = 0V	$-V_{BE}$	400 max.	400 max.	mV
Frequency at which $\lvert h_{fe}\rvert$ = 1				
at $-V_{CB}$ = 2V, I_E = 10 mA	f_1	1.7 1.3 min.	2.3 1.7 min.	Mc/s
Common-emitter cutoff frequency				
at $-V_{CB}$ = 2V, I_E = 10 mA	f_{hfe}	17 10 min.	17 10 min.	Kc/s
at $-V_{CE}$ = 2V, $-I_C$ = 3 mA	f_{hfe}	10 (OC71)	8 (OC75)	Kc/s
Noise figure at f = 1 Kc/s with R_s = 500 Ω				
at $-V_{CB}$ = 5V, I_E = 0.5 mA, B = 200 c/s	F	4 10 max.	4 10 max.	dB
at $-V_{CE}$ = 2V, $-I_C$ = 0.5 mA	F	10 15 max. (OC71)	10 15 max. (OC75)	dB
Intrinsic base resistance				
at $-V_{CB}$ = 5V, I_E = 1 mA, f = 0.45 Mc/s	$\lvert z_{rb}\rvert$	90	90	Ω
Collector capacitance				
at $-V_{CB}$ = 5V, I_E = 0, f = 0.45 Mc/s	c_c	40 50 max.	40 50 max.	pF

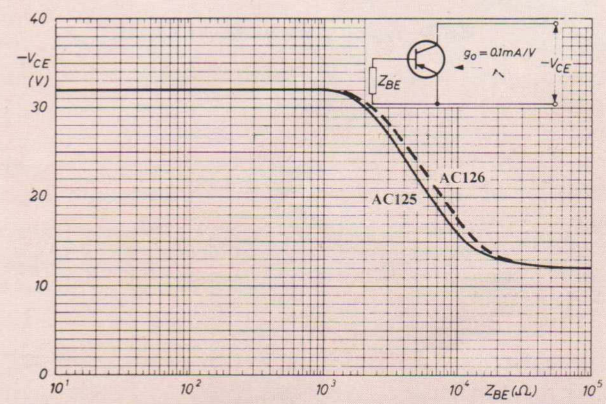


Fig. 3—Collector voltage derating curve. $-V_{CE}$ is the minimum collector voltage for which g_o = 0.1 mA/V. Provisions must be made to ensure thermal stability.

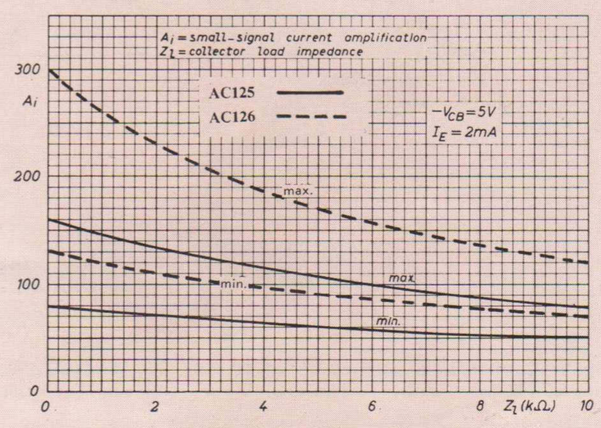


Fig. 4—Variation of loaded small-signal current amplification (min. and max. values) with collector load impedance.

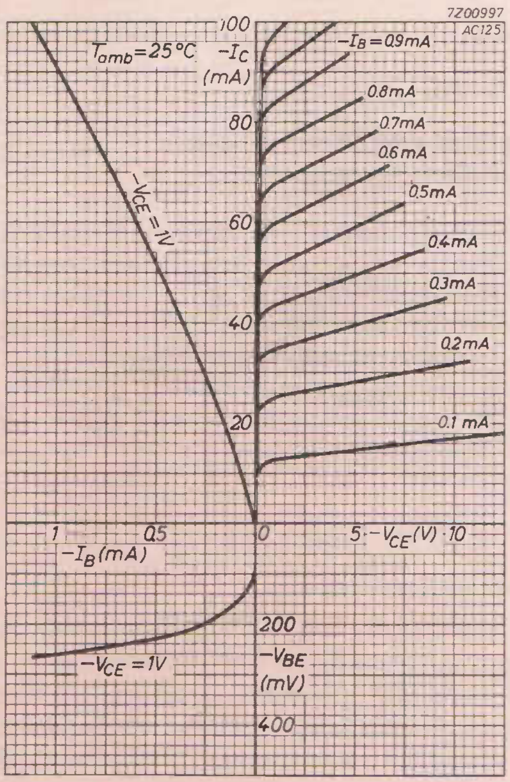


Fig. 5—Typical characteristics of AC 125.

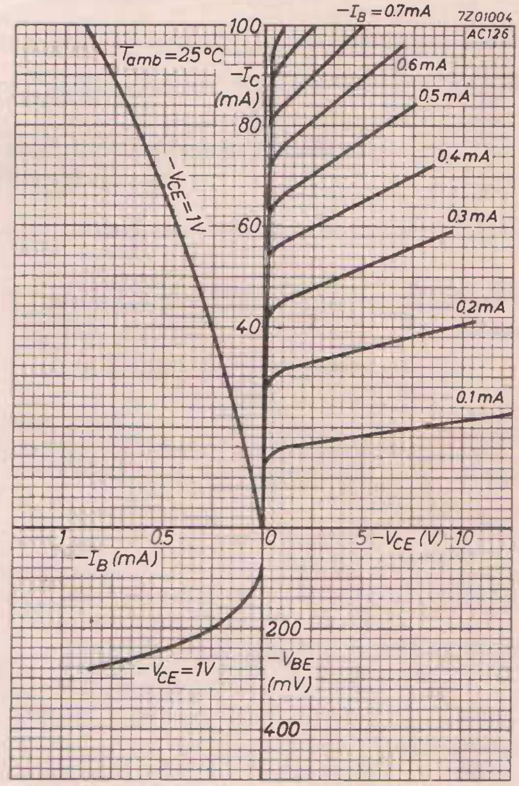


Fig. 6—Typical characteristics of AC 126.

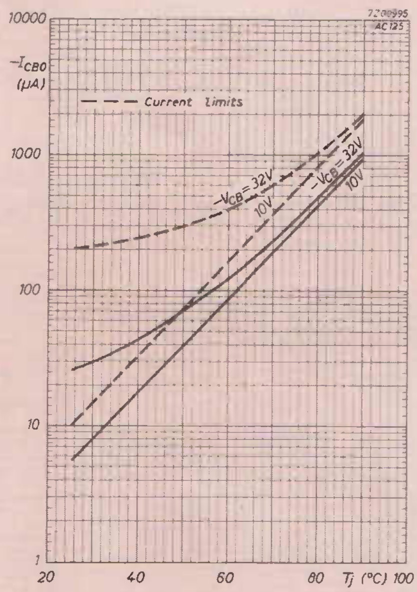


Fig. 7—Collector-base cutoff current of AC 125 and AC 126 (max. and typical values).

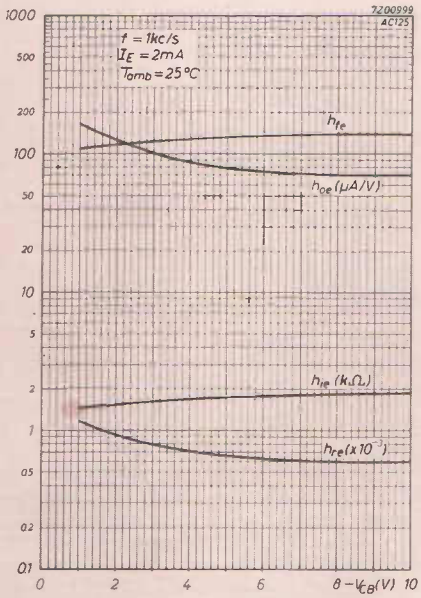


Fig. 8—Typical variation of h-parameters with collector-base voltage for AC 125.

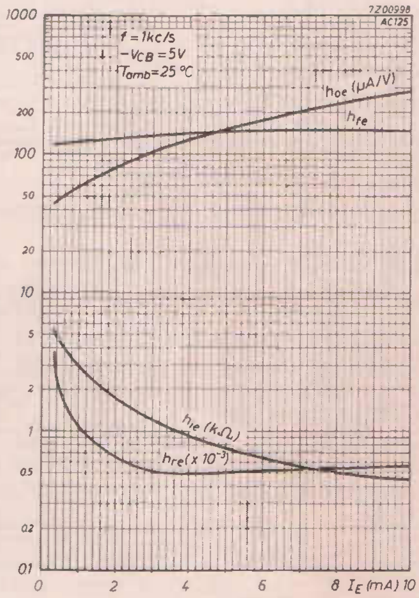


Fig. 9—Typical variation of h-parameters with emitter current for AC 125.

Typical Operating Conditions at $T_{amb} = 25$ °C

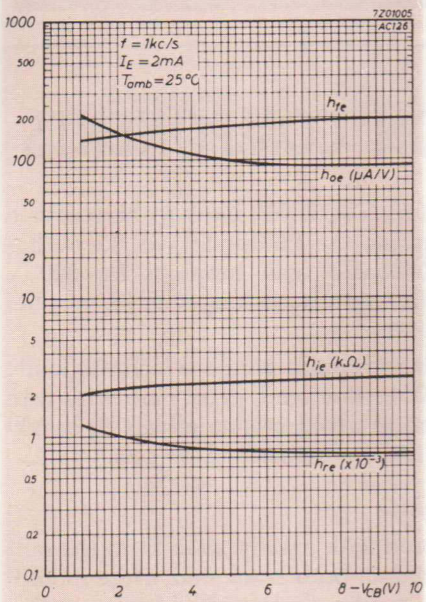


Fig. 10—Typical variation of h-parameters with collector-base voltage for AC 126.

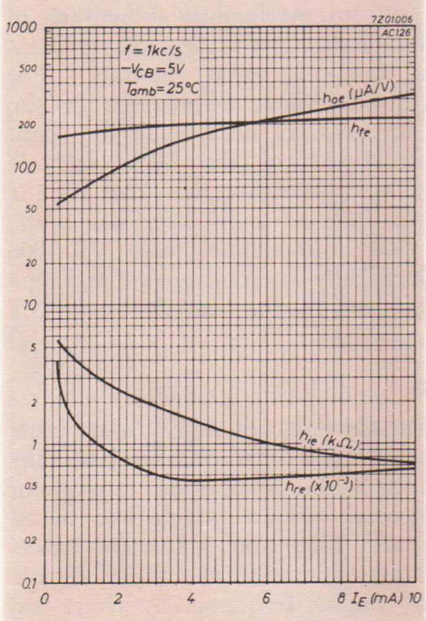


Fig. 11—Typical variation of h-parameters with emitter current for AC 126.

Class B complementary symmetry amplifier (Fig. 12) having an output power of up to 370 mW, with AC126 in the driver stage.

Stable continuous operation is ensured up to an ambient temperature of 45 °C, provided that for the 9 V - 370 mW operation each transistor is mounted with a cooling fin.

Tolerance of resistors is 5%.

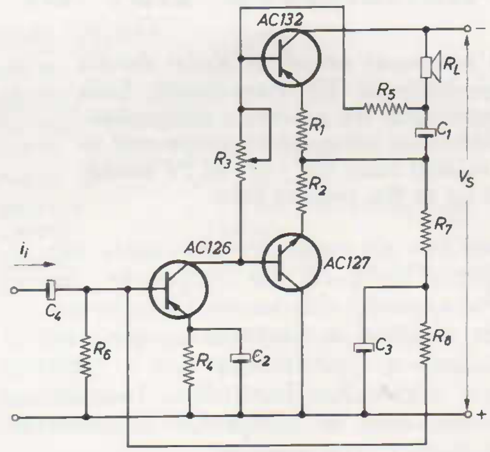


Fig. 12.

		I	II	III
Supply voltage	V_s	6	9	9 V
Output power (at $d_{tot} = 10\%$)	P_o typ.	115	110	370 mW
	P_o min.	105	100	300 mW
Output stage:				
Zero-signal emitter current	$I_{E1} = -I_{E2}$	2	2	2 mA
Emitter resistor	$R_1 = R_2$	3.3	4.7	3.9 Ω
Bias resistor (variable)*	R_3	100	250	50 Ω
Load resistance	R_L	25	70	15 Ω
Coupling capacitor	C_1	200	64	320 µF
Peak collector current at P_o = max.	$\|I_{CM}\|$	90	50	200 mA
Driver stage:				
Collector current	$-I_C$	2.7	1.2	7.6 mA
Emitter resistor	R_4	180	680	82 Ω
Collector resistor	R_5	910	3300	510 Ω
Bias resistors	R_6	4.7	6.8	1.8 kΩ
	R_7	3.9	4.7	2.2 kΩ
	R_8	15.0	24.0	6.8 kΩ
Decoupling capacitors	C_2	40	25	120 µF
	C_3	25	25	25 µF
Coupling capacitor	C_4	6.4	6.4	6.4 µF
Input sensitivity at P_o = typ:				
Input current (R.M.S.)	I_i	15	8	40 µA
Total harmonic distortion at P_o = 50 mW	d_{tot}	2.5	3.8	2 %
Input sensitivity at P_o = 50 mW:				
Input current (R.M.S.)	I_i	9	4.5	12.5 µA

* Bias compensation at elevated temperatures can be achieved by replacing R_3 with an NTC resistor.

A COMPREHENSIVE LIST OF TELEVISION COMPONENTS

In response to numerous enquiries about details and interchangeability of TV components, both current and superseded, we present a comprehensive list of all Miniwatt components introduced to the Australian market from the start of TV broadcasting in 1956 up to the present time.

The list is divided into six major sections, each one containing all types of one particular component. As far as possible the essential differences between individual types are specified to facilitate comparison. For many items, both a type number and a code number are given. This has been done because Miniwatt components used in Philips TV receivers are designated by factory code numbers.

Replacement of TV components by the Service Trade

The main purpose of this list is to enable the TV Service trade to find rapidly a suitable replacement item for a defective component. The list also shows that it is possible to cover the whole range of components by stocking only a relatively small number of strategic preferred items (shown in brown). It is Miniwatt's policy to ensure, where at all possible, that all the variations of a given component can be replaced by the type most recently introduced. Closer inspection of the list shows that the preferred component can replace the other types in the same subsection either directly or with only minor modifications.

Deflection Yokes

The difference between yoke types within each subsection is only in the presence or absence of external leads and plug and of an NTC resistor. All 70° and 90° types are supplied with plug and leads; the three preferred 110°/114° types do not have leads attached. There should be no difficulty, however, in transferring the old leads to the new yoke. All preferred types, with the exception of 70° units, have an NTC resistor included in the vertical coil circuit. Where the yoke to be replaced does not include an NTC resistor, it is a simple matter to connect the preferred type in such a way as to leave the resistor out of circuit. For details of the current AT 1011T series of yokes refer to the February 1963 issue of the Digest.

Line Output Transformers

Inspection of the table shows that all 110°/114° 16 KV transformers can be replaced by one preferred type NT 3101. This transformer includes an anti-ringing RC network which need not be removed when a type without such a network is to be replaced. Where types CZ.355.008 and CZ.355.010 have to be replaced in Philips TV receivers, the Philips Service Dept. has available type CZ.355.013 with tappings for 220 V and 240 V HT rails and also a longer EHT rectifier lead.

If the CZ.355.013 is to replace a type which originally had a shorter EHT rectifier lead, great care with lead dress must be taken to avoid corona effects or breakdown of the lead if close to earthed objects.

EHT Rectifier Sockets

The two types offered look exactly alike from the outside and are supplied in both black and white moulding material. They can be distinguished by inspecting the number impressed at the skirt of the moulding. Only the first three figures are significant and they indicate the value of the built-in series filament resistor, e.g., 105126 indicates 1.05 Ω resistance, 140418 indicates 1.40 Ω resistance.

Turret Tuners

The Miniwatt Division is sometimes asked whether an AT 7580 tuner can be replaced by an NT 3001 or NT 3006. There are no mechanical difficulties in achieving this, and a changeover is possible for conditions of low and medium signal strength. For high signal strength conditions, a redesign of the tuner AGC circuit is necessary because of the semi-remote-cutoff characteristics of the 6ES8 cascode valve. A tuner AGC voltage higher than that for the 6CW7 is required in order to avoid overload of the mixer. Types NT 3001 (10-channel) and NT 3006 (13-channel) are electrically interchangeable and type NT 3009 can be replaced by the preferred type NT 3011.

Tuner Coil Biscuits

While Miniwatt generally does not supply spare parts for tuners, and this includes tuner coil biscuits, they do make available in wide distribution throughout Australia all the special biscuits which had to be developed for the AT 7580 and NT 3001 tuners required in the special circumstances created by the introduction of new channel frequencies. These biscuits are marketed in pairs under the type number NT 3007 . . . / . . . and NT 3008 . . . / . . . Hence a pair of biscuits required to modify an NT 3001 tuner to receive channel O in Melbourne is supplied as NT 3007A0/00. Biscuits for the AT 7580 tuner have a red marking dot which distinguishes them from the NT 3001.

"Miniwatt" TV COMPONENTS

(Preferred types shown in brown)

Component	Miniwatt Type No.	Equivalent Philips factory Code No.	Details
DEFLECTION YOKES			
70°	AT 1005	A3.696.46	
	AT 1005/T00	CZ.320.910	as AT 1005, local production.
90°	AT 1007	A3.767.77	no NTC resistor.
	AT 1007/01	A3.790.92	with NTC resistor.
	AT 1007/T10	CZ.320.911.3 CZ.320.912	as AT1007, with frame leads reversed, local production.
	AT 1007/T11	CZ.320.918 CZ.320.921	as AT 1007/T10, with NTC resistor.
110°, 21"	AT 1009/01	3H.129.20	with NTC resistor, no leads.
	AT 1009T/01	CZ.320.923.3	as AT 1009/01, local production.
	AT 1009T/90	CZ.320.925	no NTC resistor, with leads.
	AT 1009T/91	CZ.320.924.5	with NTC resistcr, with leads.
110°/114° 23" up to 16 KV	AT 1009T/93	CZ.320.928	as AT 1009T/90 with correction magnets for 23" CRT.
	AT 1009T/94	CZ.320.929 CZ.320.930	as AT 1009T/01 with correction magnets for 23" CRT.
	AT 1009T/95	CZ.320.934	as AT 1009T/94, with leads.
	AT 1009T/96	CZ.320.932	as AT 1009T/93 with adjustable correction magnets.
	AT 1009T/97	CZ.320.933	as AT 1009T/94, with adjustable correction magnets.
	AT 1009T/98	CZ.320.935	as AT 1009T/95 with adjustable correction magnets.
110°/114° 23" up to 18 KV	AT 1011T/93	CZ.320.941	no NTC resistor, with leads.
	AT 1011T/94	CZ.320.942	with NTC resistor, no leads.
	AT 1011T/95	CZ.320.943	with NTC resistor, with leads.
LINE OUTPUT TRANSFORMERS			
70°	AT 2010	A3.767.41	
	AT 2010/T00	A3.767.41	as AT 2010, local production.
90°	AT 2012 AT 2012/50	A3.767.94	
	AT 2012/T50	A3.767.94	as AT 2012/50, local production.
110°/114° 21"/23" 16 KV	AT 2016T/11	CZ.355.000	auxil. winding without centre-tap.
	AT 2016T/21	CZ.355.003	as AT 2016T/11, with centre-tap.
	AT 2016T/91	CZ.355.007	as AT 2016T/21 with RC network added.
	AT 2016T/92	CZ.355.007.1	as AT 2016T/91, with EHT rect. lead shortened and reversed.
	AT 2016T/93	CZ.355.003.2	as AT 2016T/21 with EHT rect. lead shortened and reversed.
	NT 3100	CZ.355.011	as AT 2016T/93 with polyester encapsulated EHT winding.
	NT 3101	CZ.355.009	as AT 2016T/92 with polyester encapsulated EHT winding.
		CZ.355.013	replaces CZ.355.008 and CZ.355.010 in Philips receivers.
110°/114° 23" 17.2 KV	NT 3102	CZ.355.012	
	NT 3103		as NT 3102, with RC network.

"Miniwatt" TV COMPONENTS

(Preferred types shown in brown)

Component	Miniwatt Type No.	Equivalent Philips factory Code No.	Details
HORIZONTAL LINEARITY CONTROLS			
70°	AT 4005 AT 4005/T00	A3.802.05	for use with AT 2010 transformer. as 4005, local production.
90°	AT 4006 AT 4006/T00	A3.802.89	for use with AT 2012 transformer. as AT 4006, local production.
110°/114°	AT 4008 AT 4008T00	A3.768.53	for all Miniwatt 110°/114° transformers.
	AT4008T/90	CZ.320.081	for all Miniwatt 110°/114° transformers.
	AT 4008T/91	CZ.320.082	for all Miniwatt 110°/114° transformers.
EHT RECTIFIER SOCKETS AND ASSOCIATED LEADS			
70° Socket	AT 2010/3	P5.170.00.2/369	for use with AT 2010 transformer, incorporates 1.05 Ω filament resistor.
90°, 110°, 114° Socket	AT 7100	P5.170.02.1/369	for use with all Miniwatt 90° and 110°/114° transformers, incorporates 1.40 Ω filament resistor.
EHT heater lead	AT 2010/1/T00	A3.582.28.1/PA2	8¼" long.
	AT 7101	A3.582.68.1	19" long.
	AT 7101T/00	CZ.358.173	as AT 7101, local production.
	AT 7101/T01	A3.582.68.1/PA1	8¼" long.
	AT 7101/T02	CZ.358.113	15½" long.
EHT supply lead	AT 2010/2/T00	A3.582.05.2/PA5	18½" long.
	AT 7102	A3.582.69.1	18" long.
	AT 7102T/00	CZ.358.174	as AT 7102, local production.
	AT 7102/T01	A3.582.69.1	18½" long.
TURRET TUNERS			
10-channel	AT 7580	A3.767.32 CZ.210.919 to CZ.210.923	Valves: 6CW7, 6BL8.
	NT 3001	CZ.109.004 CZ.210.927	Valves: 6ES8, 6BL8.
13-channel	NT 3003	CZ.109.010	Valves: 6ES8, 6BL8, with electronic fine tuning.
	NT 3006	CZ.109.011	as NT 3003, with manual fine tuning.
	NT 3009	A3.179.24	Valves: 6ES8, 6HG8, printed coils.
	NT 3011	CZ.210.943	as NT 3009, modified coils.

Miniwatt TV COMPONENTS

MINIWATT TUNER COIL BISCUITS

Tuner Type AT 7580

Channel No.	Aerial Miniwatt Type No.	Aerial Factory Code No.	Oscillator/RF Miniwatt Type No.	Oscillator/RF Factory Code No.
0	NT 3008/AO	CZ.320.104	NT 3008/00	CZ.321.078
1	NT 3008/A1	CZ.320.105	NT 3008/01	CZ.321.079
2	—	A3.747.08	—	A3.747.03
3	—	A3.747.09	—	A3.747.04
4	NT 3008/A4	CZ.320.106	NT 3008/04	CZ.321.080
5	NT/3008/A5	CZ.320.107	NT 3008/05	CZ.321.081
5A	NT 3008/A5A	CZ.320.108	NT 3008/05A	CZ.321.082
6	—	A3.746.75	—	A3.746.70
7	—	A3.746.76	—	A3.746.71
8	—	A3.746.77	—	A3.746.72
9	—	A3.746.78	—	A3.746.73
10	—	A3.746.79	—	A3.746.74
11	NT 3008/A11	CZ.320.109	NT 3008/011	CZ.321.083

(These biscuits are generally marketed in aerial and oscillator biscuit pairs in cartons branded NT 3008 . . ./. . .)

Tuner Type No. NT 3001

Channel No.	Aerial Miniwatt Type No.	Aerial Factory Code No.	Oscillator/RF Miniwatt Type No.	Oscillator/RF Factory Code No.
0	NT 3007/AO	CZ.320.097	NT 3007/00	CZ.321.070
1	NT 3007/A1	CZ.320.098	NT 3007/01	CZ.321.071
2	—	CZ.320.058	—	CZ.321.038
3	—	CZ.320.059	—	CZ.321.039
4	NT 3007/A4	CZ.320.100	NT 3007/04	CZ.321.073
5	NT 3007/A5	CZ.320.101	NT 3007/05	CZ.321.074
5A	NT 3007/A5A	CZ.320.102	NT 3007/05A	CZ.321.075
6	—	CZ.320.062	—	CZ.321.042
7	—	CZ.320.063	—	CZ.321.043
8	—	CZ.320.064	—	CZ.321.044
9	—	CZ.320.065	—	CZ.321.045
10	—	CZ.320.066	—	CZ.321.046
11	NT 3007/A11	CZ.320.103	NT 3007/011	CZ.321.076

(These biscuits are generally marketed in aerial and oscillator pairs in cartons branded NT 3007 . . ./. . .)

Tuner Type No. NT 3006

Channel No.	Aerial Factory Code No.	Oscillator/RF Factory Code No.
0	CZ.320.084	CZ.321.057
1	CZ.320.085	CZ.321.058
2	CZ.320.086	CZ.321.059
3	CZ.320.087	CZ.321.060
4	CZ.320.088	CZ.321.061
5	CZ.320.089	CZ.321.062
5A	CZ.320.090	CZ.321.063
6	CZ.320.091	CZ.321.064
7	CZ.320.092	CZ.321.065
8	CZ.320.093	CZ.321.066
9	CZ.320.094	CZ.321.067
10	CZ.320.095	CZ.321.068
11	CZ.320.096	CZ.321.069

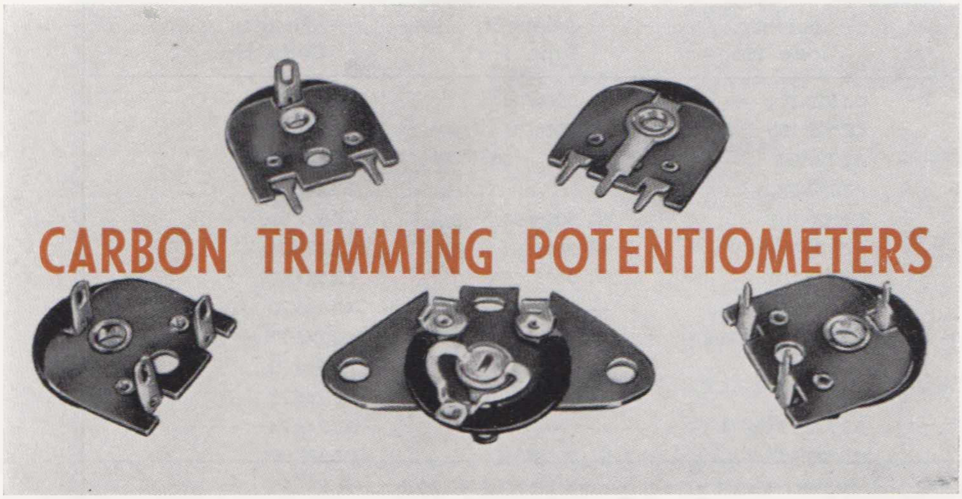
Tuner Type No. NT 3009

Channel No.	Marking on Strip	Factory Code No.
0	AU 0	A3.178.70
1	AU 1	A3.156.82
2	AU 2	A3.156.83
3	AU 3	A3.156.84
4	AU 4	A3.156.85
5	AU 5	A3.156.86
5A	AU 5A	A3.178.71
6	AU 6	A3.156.87
7	AU 7	A3.156.88
8	AU 8	A3.156.89
9	AU 9	A3.156.90
10	AU 10	A3.156.91
11	AU 11	A3.178.72

Tuner Type No. NT 3011

Channel No.	Marking on Strip	Factory Code No.
0	CZ 0	CZ.320.160
1	CZ 1	CZ.320.161
2	CZ 2	CZ.320.162
3	CZ 3	CZ.320.163
4	CZ 4	CZ.320.164
5	CZ 5	CZ.320.165
5A	CZ 5A	CZ.320.166
6	CZ 6	CZ.320.167
7	CZ 7	CZ.320.168
8	CZ 8	CZ.320.169
9	CZ 9	CZ.320.170
10	CZ 10	CZ.320.171
11	CZ 11	CZ.320.172

CARBON TRIMMING POTENTIOMETERS



Philips pre-set potentiometers provide high reliability and stability at low cost. They are suitable for both transistor radios (small size) and TV receivers (high voltage ratings). Other applications are in portable instruments and measuring apparatus.

Four styles are available, with different methods of mounting and connection, to permit universal application.

These styles are:

1. With pin connections for vertical mounting in printed circuits (Figs. 2 and 3).
2. With pin connections for horizontal mounting in printed circuits (Fig. 4).
3. With solder lug connections for directly soldering into the wiring (Fig. 5).
4. With solder lug connections and two mounting holes for screw mounting (Fig. 6).

All four styles have linear characteristics and are available in resistance values from 500 Ω up to 2 MΩ (see Table in data).

Construction

The annular carbon track is riveted to the base-plate. A flat circular spring with wiping contact has a centre bearing with a slot for operation by means of a screwdriver. from either side.

The angle of rotation is 215-225°.

The extreme hardness of the surface of the carbon track permits the use of a metal wiper, ensuring that an unchanging low contact resistance will be maintained even during frequent operation. Also the contact resistance remains low after a long period of time.

Technical Data (abbreviated)

Standard Resistance Values

Carbon trimming potentiometers are available in the rated resistance values R_{nom} listed in the table below.

The tolerance on R_{nom} is ±20% in all cases. R_{min} indicates the minimum resistance in the minimum and maximum positions.

Permissible Temperature

The ambient temperature may lie between —10 and +70 °C.

Permissible Current

The maximum current that may be carried by the track is indicated in the table on p. 107 as I_{max}.

Permissible Load

Max. 0.25 W at an ambient temperature of 25 °C and max. 0.15 W at 70 °C.

The voltages E_{max} corresponding to these loads for any particular resistance value R are shown in Fig. 1.

Torque

50 to 500 gcm.
(.7 to 7 oz-ins.)

After the runner has reached a stop, the torque should not exceed 14 oz-ins.

Temperature Coefficient (over 20 °C)

Less than 0.15 %/°C for values of R_{nom} below 100 KΩ.

Less than 0.25 %1°C for values of R_{nom} above 100 KΩ.

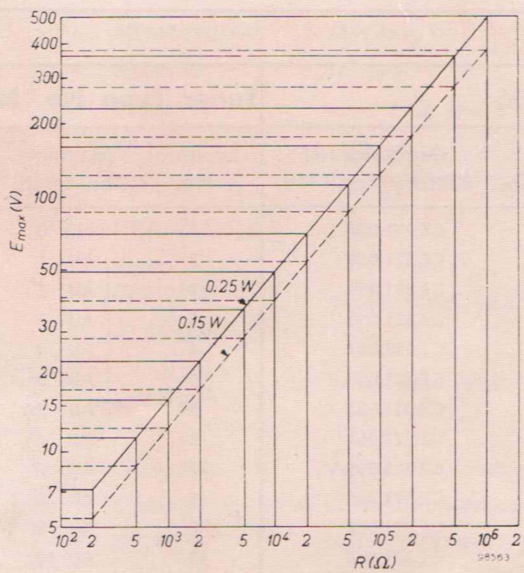


Fig. 1—Maximum voltage rating chart.

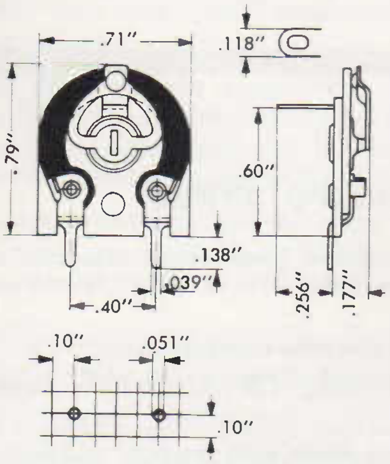


Fig. 2—Type E097AB/. Track terminals are pin connections for mounting the potentiometer perpendicularly to a printed board; contact terminal is a soldering lug.

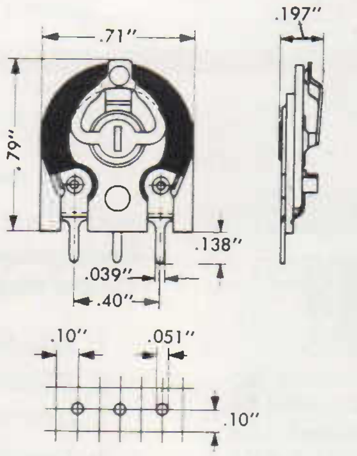


Fig. 3—Type E097AC/. Both track and contact terminals are pin connections for mounting the potentiometer perpendicularly to a printed board.

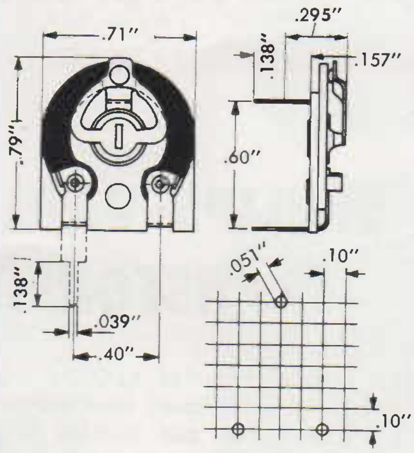


Fig. 4—Type E097AD/. Both track and contact terminals are pin connections for mounting the potentiometer parallel to a printed board.

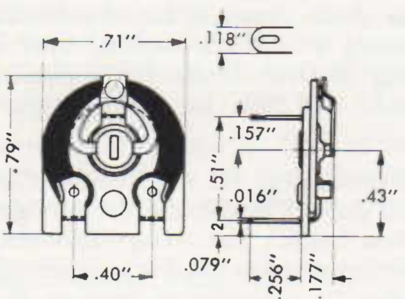


Fig. 5—Type E097AA/. Both track and contact terminals are soldering lugs for direct soldering into the wiring. The potentiometer can be fixed using the hole provided.

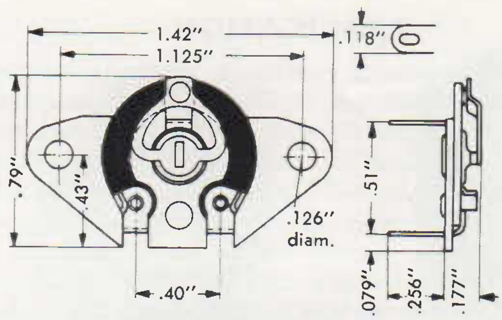


Fig. 6—Type E097AE/. Both track and contact terminals are soldering lugs for direct soldering into the wiring. The provision of two mounting holes makes this type particularly suitable for screw mounting to the back of a TV or amplifier chassis.

PHILIPS CARBON TRIMMING POTENTIOMETERS

R_{nom} (Ω)	Type Numbers					R_{min} max. values (Ω)	I_{max} (mA)
	See Fig. 5	See Fig. 2	See Fig. 3	See Fig. 4	See Fig. 6		
500	E097AA/500E	E097AB/500E	E097AC/500E	E097AD/500E	E079AE/500E	50	14
1K	/1K	/1K	/1K	/1K	/1K	50	10
2K	/2K	/2K	/2K	/2K	/2K	50	7
5K	/5K	/5K	/5K	/5K	/5K	100	4.5
10K	/10K	/10K	/10K	/10K	/10K	200	3.2
20K	/20K	/20K	/20K	/20K	/20K	400	2.2
50K	/50K	/50K	/50K	/50K	/50K	1K	1.4
100K	/100K	/100K	/100K	/100K	/100K	2K	1
200K	/200K	/200K	/200K	/200K	/200K	4K	0.7
500K	/500K	/500K	/500K	/500K	/500K	10K	0.45
1M	/1M	/1M	/1M	/1M	/1M	20K	0.32
2M	/2M	/2M	/2M	/2M	/2M	40K	0.22

PHILIPS VARIABLE TRANSFORMERS

The Philips range of variable transformers extends from a miniature type for 0.5 A output up to 20 A types, and include both bench and panel-mounting versions. Loads of up to 7.8 KVA can be controlled. Accessories are available for reversed mounting; union sets for ganging make it easy to multiply the output rating or to control three-phase voltages. Double-wound units are also available which provide mains isolation.

APPLICATION

Variable transformers provide a relatively inexpensive means of manual regulation of low-frequency alternating voltages. As compared with resistors, they have the paramount advantage of low energy losses, and an almost unlimited life; unlike transformers with fixed taps, they permit accurate adjustment. They are extremely easy to operate and require a minimum of maintenance. Auto-transformer types have an inherent advantage of reduced bulk compared with the double-wound variety, but the latter may be preferred in applications where mains isolation is paramount.

From the wealth of applications, two principal uses emerge:

(a) adjusting varying AC voltages to their nominal value:

(b) transforming AC supply voltages to a value between 0 and 120% of their actual value.

Variable transformers are used either panel-mounted or for bench use in factories, works and repair shops, laboratories, test stations, checking establishments, educational institutions, halls and studios, for electric and electronic equipment of most divergent kinds. On account of their ability to accurately control AC voltages, variable transformers are eminently suitable for controlling light intensities (e.g., of shop-window and stage lighting, festive illuminations and sky-signs), temperatures (e.g., of electric heating and melting devices, inclusive of HF heating equipment) and (in combination with rectification equipment) the speed of DC motors and galvanic processes.

With the aid of union sets for ganging variable transformers, combinations can be made of two or three panel-mounting transformers in order either to multiply the output rating or to control three-phase voltages.

PHILIPS TYPES

Four groups of variable transformers comprise the Philips range. These are:

1. *Standard variable auto-transformers.*
2. *Higher-power rating (20 A) variable auto-transformers.*
3. *Variable transformers with separate windings.*
4. *A miniature auto-transformer for panel-mounting.*

Standard Variable Transformers

Because these are auto-transformers, the windings are lighter than those required for two-winding transformers passing a set load current. This results in units varying between 6½lb. for a panel-mounting 260 VA model and 29lb. for a bench-type 2080 VA model.

A single-layer winding on the toroidal core has its annular face ground bright and flat to form a track for the carbon brush. The voltage between adjacent turns is sufficiently low to provide very smooth control. Corresponding to an angle of rotation of approximately 320°, the standard dial is graduated from 0 to 260 V for normal voltage input. Normal connection is shown in Fig. 7 (i.e., clockwise rotation increases secondary voltage from min. to max.). Details of other connections (including suitable dials) are available on request.

The transformers are available either for panel mounting (Figs. 1 and 2) or for bench use (Figs. 3 and 4). Both types are tropic-proofed. The panel types can be mounted, using the three screws provided, on panels up to $\frac{3}{16}$" thickness for models corresponding to Fig. 1, and on panels up to $\frac{1}{8}$" thickness for types corresponding to Fig. 2. Accessories are available for reverse mounting.

The transformers are supplied with full mounting and operating instructions.

Higher-Power (20 A) Variable Transformers

Like the standard variable transformers described in the preceding section, the higher-powered types are wound-core auto-transformers with natural convection cooling. The flat design results in the optimum weight-to-performance ratio. There are five carbon brushes in parallel, which operate on a polished and silver-plated track to ensure the most reliable contact and to prevent oxidisation.

Over the angle of rotation between stops of 324°, the dial is graduated 0-260 V, giving correct indication when used with normal connections and nominal input voltage.

The 20 A variable transformers are available either for bench use (*Digest* front cover) or for panel mounting. The panel-types can be mounted, using four screws supplied, on panels having a thickness up to $\frac{3}{8}''$.

Normal connection and the range of alternative connections are the same as for the standard variable transformers with the addition of a centre-tap.

Variable Transformers with Separate Windings

By using separate primary and secondary windings, these transformers avoid the direct connection of the output side with the mains which may make the use of auto-transformers undesirable. Isolation of the secondary is particularly useful when the transformer is used to feed radio and TV sets under repair. Thus these types are frequently found in electronic repair shops, laboratories and research establishments. An additional advantage for such work is that the windings are not only insulated, but also electrostatically screened to eliminate interference when measurements are being made.

The construction is similar to that of the standard types except that there are two separated, single-layer windings and the carbon brush moves over the secondary winding.

The panel-mounting (B8 709 50/01) and bench (B8 709 00/02) types are shown in Figs. 5 and 6 respectively, whilst circuit diagrams are given in Figs. 8 and 9. Two output voltage ranges, essentially overlapping, are provided in each case. The "0-240 V max." switch position (Range 2) provides better resolution.

The panel-mounting types have a connecting panel with soldering terminals. They can be mounted, using three screws supplied, on panels having a thickness up to $\frac{1}{8}''$. Two pairs of output sockets are provided in the cover, allowing a precision voltmeter to be connected simultaneously with a load for especially accurate work and enabling the built-in moving-iron voltmeter to be checked. Bench type transformers without voltmeter, flex and plug can be supplied under type number B8 709 00/03.

Miniature Variable Transformer

The E 401 ZZ/01 is a panel mounting variable auto-transformer which offers economy and compactness in such applications as small-motor speed control, air-cooling control, lighting control and power supply control.

Its unusually small dimensions ($3\frac{5}{16}''$ diameter) are made possible by winding the enamelled copper wire

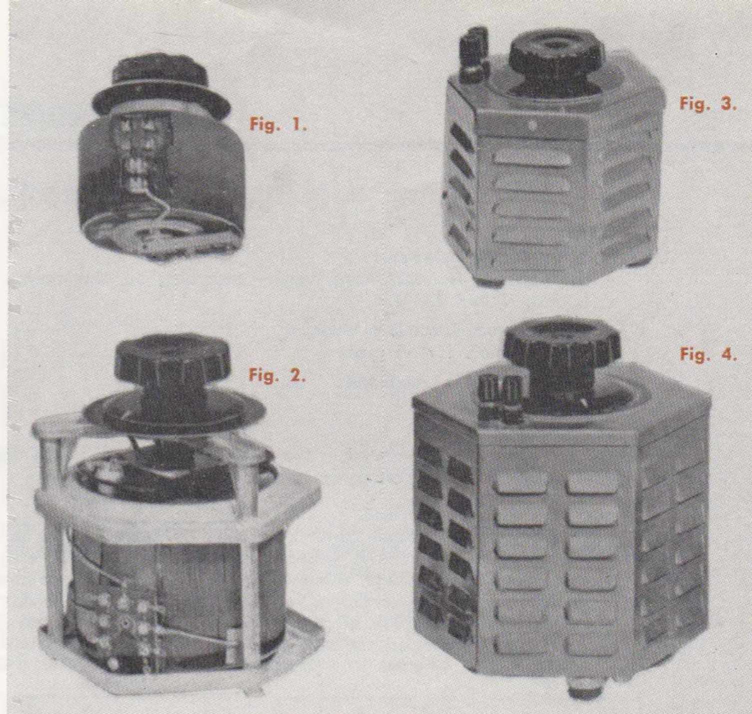


Fig. 1. Fig. 2. Fig. 3. Fig. 4.

Standard Variable Transformers.

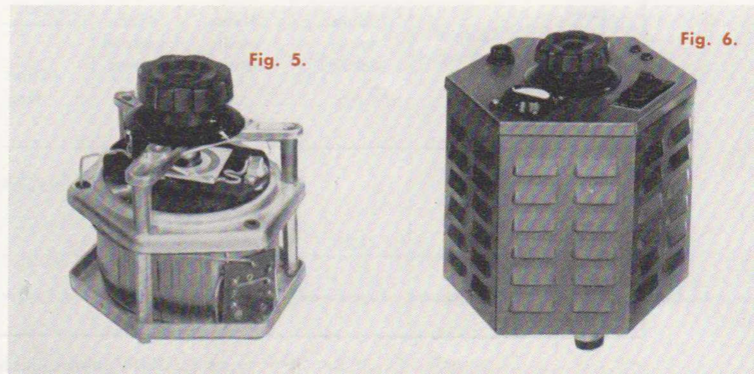


Fig. 5. Fig. 6.

Variable Transformers with Separate Windings.

in two layers on a ring-shaped core of high-permeability laminations. The upper layer forms the brush track, so that the brush sweeps half the total winding. Thus the output voltage can be varied over either of two ranges according to the connections used. The requirements of most applications can be met if the output is taken between points A and C (Fig. 11)—that is, from zero volts to one half of the input voltage. Adjustment over the remaining half of the input voltage can be obtained by taking the output between B and C.

The transformer is encapsulated in reinforced polyester resin.

FULL INFORMATION ON THE VARIABLE TRANSFORMERS AND ACCESSORIES IN THE PHILIPS RANGE IS AVAILABLE ON REQUEST TO ANY OF THE ADDRESES ON THE BACK COVER OF THE *Digest.*

STANDARD VARIABLE TRANSFORMERS

Voltage Increments
Voltage between turns varies, according to the rating, between 0.3 V and 1.1 V.

Minimum Secondary Voltage
3 V max. for all types.

Permissible Temperature
40°C max.

Protective Fuse
A fuse is incorporated in the secondary circuit of bench types which have an output rating up to and including 1040 VA.

Permissible Overload
The nominal output currents specified in Table 1 may be exceeded by 25%. For output voltages in the ranges 0 - 15% and 8 - 110% of the input voltage, this overload can be applied continuously. The least favourable conditions for load capacity are at secondary voltages of 50% and 120% of primary voltage (most heat developed) when the 25% overload can only be applied for 30 minutes with intervals of at least 4 hours.

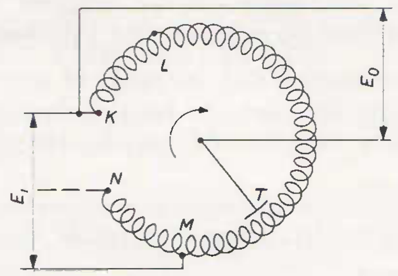


Fig. 7—Diagram of variable transformer showing normal connection.

Table 1 — Standard Variable Transformers (Normal Connection)

Nom. prim. voltage* 50-60 c/s (V)	Output rating (VA)	Nom. secdy. voltage (V)	Nom. secdy. current (A)	Max. no-load losses (W)	Panel mounting				Bench mounting			
					Type No.	Fig. No.	Proj'n. behind panel (ins.)	Max. width (ins.)	Type No.	Fig. No.	Overall Height (ins.)	Max. width (ins.)
220	260	0-260	1	3	84527/01	1	$3\frac{15}{16}$	$4\frac{3}{8}$	84526/01	3	$5\frac{15}{16}$	$5\frac{13}{16}$
	520		2	4	84531/01	1	$4\frac{3}{4}$	$4\frac{3}{8}$	84530/01	3	$6\frac{13}{16}$	$5\frac{13}{16}$
	1040		4	7	84535/01	2	$5\frac{15}{16}$	8	84534/01	4	$8\frac{1}{2}$	$8\frac{1}{4}$
	2080		8	12.5	84537/01	2	$6\frac{15}{16}$	8	84536/01	4	$9\frac{7}{16}$	$8\frac{1}{4}$

* Details of types for 130 V (also suitable for 110 V) input are available on application.

20 A VARIABLE TRANSFORMERS

Ratings
The output voltage can be regulated between 0 and 260 V (no-load) or 255 V (current drainage I_n). The maximum voltage between turns is 0.75 - 0.9 V.
An output current I_{max} is permissible if the output voltage differs by no more than 10 V from the nominal input voltage.

No-Load Losses
Max. 40 W when the brushes short-circuit one turn of the winding. (N.B. half this loss is in the contact of the brushes.)

Overall Dimensions
Approx. $7\frac{1}{2}$" high x $12\frac{3}{8}$" wide.

Insulation Resistance
Min. 1000 MΩ between winding and frame or core (N.B. The winding has been tested at 2.2 KV AC with respect to frame and core.)

Permissible Temperature
Ratings apply at max. $T_{amb} = 40°C$.

Table 2 — 20 A Variable Transformers (Normal Connection and 240 V Input)

Type	Fig. No.	Nominal Input Voltage 50-60 c/s (V)	Type No.	Output				
				Nominal Voltage (V)	I_n* (A)	I_{max}* (A)	Rated Power (KVA)	Max. Power (KVA)
Panel	5	240	E401BB/201	0-260	23	30	6	7.8
Bench	6	240	E401AB/201	0-260	20	28	5.2	7.3

* For explanations, see under "Ratings" above.

VARIABLE TRANSFORMERS WITH SEPARATE WINDINGS

Ratings

The transformers have been designed for input voltages of up to 240 V, 50-60 c/s and an output current of 1.5 A (power rating, 450 VA).

For the electrical specifications, see the table below.

The secondary voltage in the zero position in both ranges is max. 3 V.

The transformers have been tested at 2000 V AC between the windings, and at 1000 V AC between either winding and the screen.

Permissible Temperature

The specifiied ratings apply to an ambient temperature not exceeding 40°C.

Overall Dimensions (approx.)

Bench Type = 8½" high x 8¼" max. width.

Panel Type = 6⅛" projection behind panel x 8" max width.

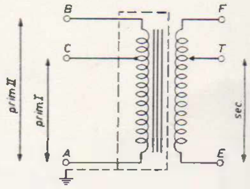


Fig. 8—Circuit diagram of panel-mounting types.

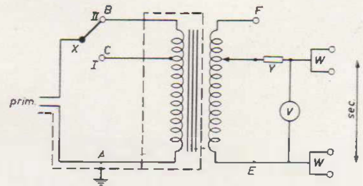


Fig. 9—Circuit diagram of bench-mounting types (Y is protective fuse).

Table 3 — Variable Transformers with Separate Windings

Input voltage 50-60 c/s	Maximum output voltage				Output current	No-load losses		Voltage between turns	
	Range 1		Range 2						
(V)	Unloaded (V)	Loaded (V)	Unloaded (V)	Loaded (V)	(A)	Range 1 (W)	Range 2 (W)	Range 1 (V)	Range 2 (V)
180	260	240	215	196	max. 1.5	max. 5	max. 3.5	0.58	0.48
220	320	300	265	240	max. 1.5	max. 7.5	max. 5	0.71	0.58
240	350	330	285	265	max. 1.5	max. 11	max. 6	0.77	0.63

MINIATURE VARIABLE TRANSFORMER
Type E 401 ZZ/01

Input voltage
Max. 240 V_{rms}.

Frequency
50-400 c/s without derating.

Output Voltage
See Table below.

Max. Output Current
0.5 A continuously over the whole voltage range up to 40°C ambient.

Voltage drop
20 V at full load at 110/120 V position of the brush with an input voltage of 220/240 V.

No-load Losses
0.7 W.

Insulation Resistance
10,000 MΩ between winding and spindle.

Test Voltage
2 KV_{rms} between winding and spindle.

Life
In excess of 500,000 complete rotations.

Climatic Conditions
Conforms with IEC 68, test C.

Dimensions (approx.)
$3\frac{5}{16}$" overall diameter × $1^{25}/_{32}$" max. projection behind panel. Max. panel thickness = $^{5}/_{32}$".

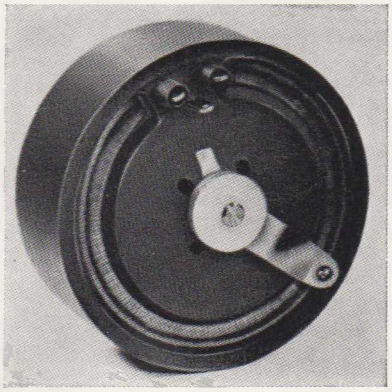


Fig. 10—Type E 401 ZZ/01 (rear view).

Input voltage (V)	Output voltage range (V)	Direction of rotation*	Output connections
220	110 - 220 0 - 110	clockwise counter-clockwise	CB CA
240	120 - 240 0 - 120	clockwise counter-clockwise	CB CA

* Seen from extending spindle end.

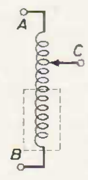


Fig. 11—Connections (mains connected between A and B).

PHILIPS

- ELECTRONIC VALVES AND TUBES
- SEMICONDUCTOR DEVICES
- CATHODE-RAY TUBES
- LIGHT-SENSITIVE DEVICES
- TEMPERATURE-SENSITIVE DEVICES
- FERRITES
- RADIATION-SENSITIVE DEVICES
- FINE WIRES
- SPECIALIZED COMPONENTS AND DEVICES
- SPECIALIZED MATERIALS
- TECHNICAL PUBLICATIONS

For Use in the Fields of—

ENTERTAINMENT — COMMUNICATIONS — INDUSTRY
COMMERCE — MEDICINE — SCIENTIFIC RESEARCH
AND DEFENCE

PHILIPS

THE *Miniwatt* ELECTRONICS DIVISION

of

Philips Electrical Industries Pty. Limited
20 Herbert Street, Artarmon, N.S.W.
Phone 43 2171

Branches at:—

ADELAIDE	11-13 West Terrace, Adelaide, S.A., phone 51 6051
BRISBANE	56-58 Cordelia Street, South Brisbane, Qld., phone 42 471
CANBERRA	C.B.C. Chambers, Petrie Street, Civic Centre, Canbe City, A.C.T., phone J 4498
HOBART	73 Brisbane Street, Hobart, Tas., phone 3 3038
MELBOURNE	252 Sturt Street, South Melbourne, Vic., phone 69 0141
NEWCASTLE	194 Parry Street, Newcastle West, N.S.W., phone MA 5001
PERTH	672 Murray Street, Perth, W.A., phone 21 3131
SYDNEY	67 Mars Road, Lane Cove, N.S.W., phone 42 1261

Production Centre—

HENDON WORKS Tapley's Hill Road, Hendon, S.A., phone 4 5021

Hogbin, Poole (Printers) Pty. Ltd., Sydney