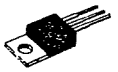
T-33-07

2SD325



2010A

NPN/PNP Triple Diffused Planar Silicon Transistors

2SB511

Low Frequency Power Amp Applications

©398F

. 5 Watts AF Power amplifier output use. There are complementary pair.

( ):2SB511

Absolute Maximum Ratings at Ta=25°C

Collector to Base Voltage	V_{CBO}		(-)35	V
Collector to Emitter Voltage	V_{CEO}		(-)35	V
Emitter to Base Voltage	V_{EBO}		(-)5	V
Collector Current	I_C		(-)1.5	V
Peak Collector Current	icp		(-)3	A
Collector Dissipation	P_C		1.75	W
		Tc=25°C	10	W
Junction Temperature	Tj		150	°C
Storage Temperature	Tstg		-55 to +150	°C

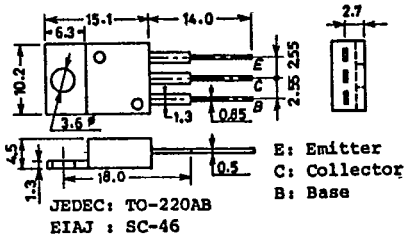
Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	V_{CB}=(-)20V,I_E=0			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	V_{EB}=(-)4V,I_C=0			(-)1.0	mA
DC Current Gain	h_{FE}(1)	V_{CE}=(-)2V,I_C=(-)1A	40*		320*	
	h_{FE}(2)	V_{CE}=(-)2V,I_C=(-)0.1A	35			
Gain Bandwidth Product	f_T	V_{CE}=(-)5V,I_C=(-)0.5A		8		MHz
C-E Saturation Voltage	V_{CE}(sat)	I_C=(-)1.5A,I_B=(-)o.15A			(-)1.0	V
Base to Emitter Voltage	V_{BE}	I_C=(-)1A,V_{CE}=(-)5V			(-)1.5	V

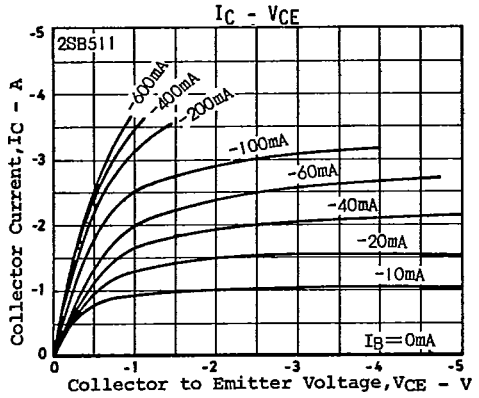
*: The 2SB511/2SD325 are classified by 1A h_{FE} as follows:

40 C 80	60 D 120	100 E 200	160 F 320

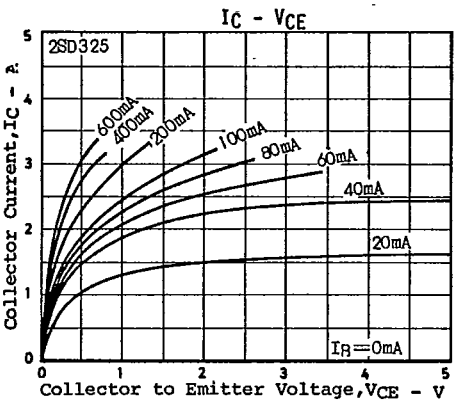
Case Outline 2010A
(unit:mm)



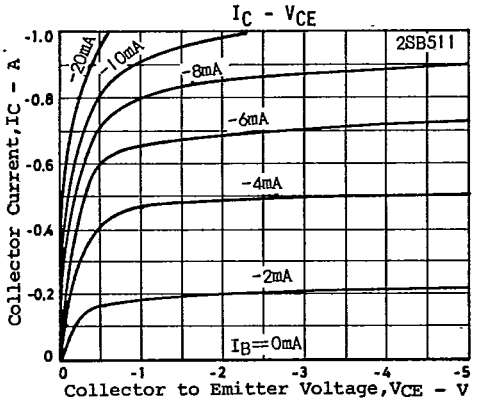
I_C - V_{CE}



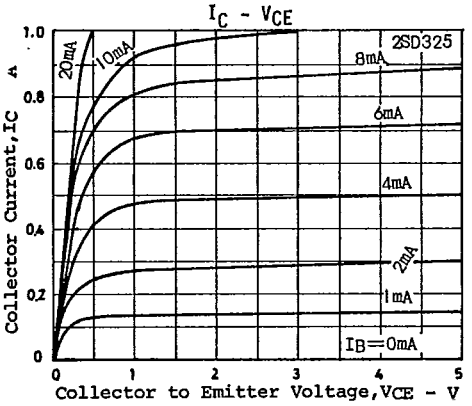
I_C - V_{CE}



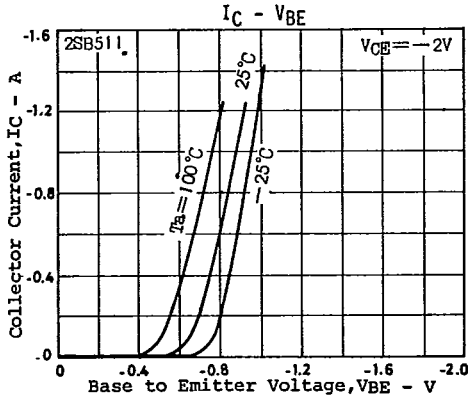
I_C - V_{CE}



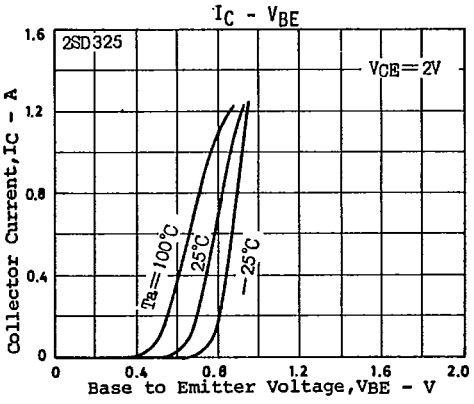
I_C - V_{CE}



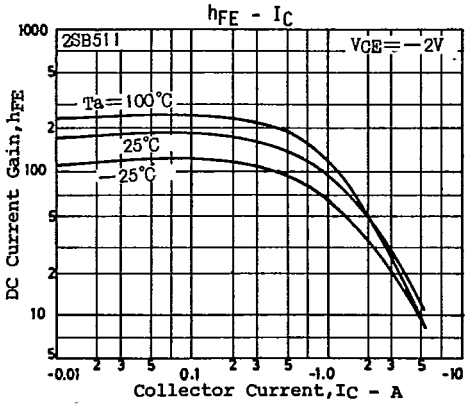
I_C - V_{BE}



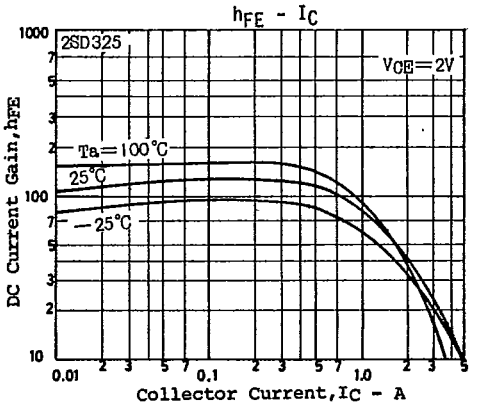
I_C - V_{BE}



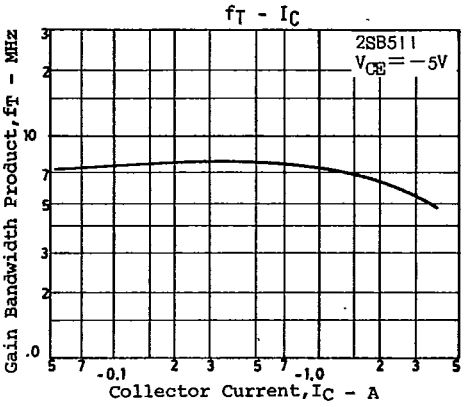
h_{FE} - I_C



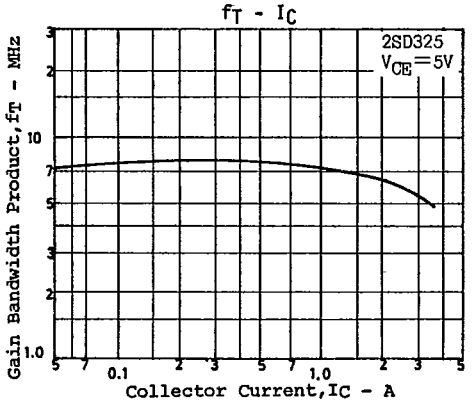
h_{FE} - I_C



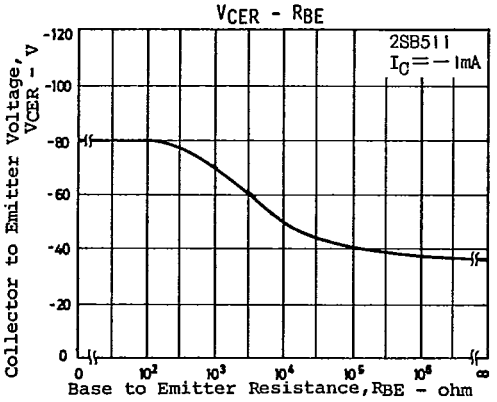
f_T - I_C



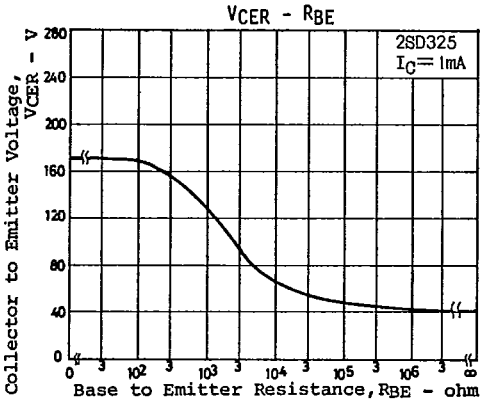
f_T - I_C



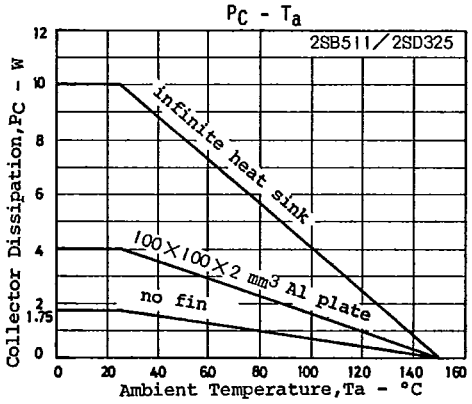
V_{CER} - R_{BE}



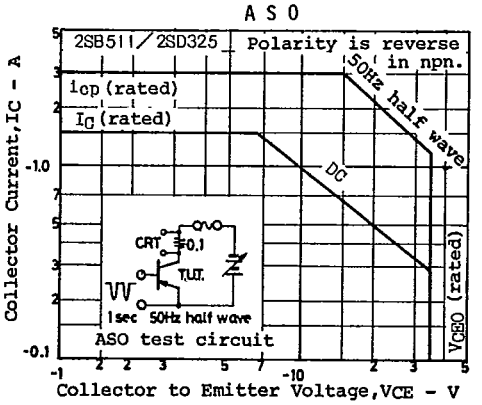
V_{CER} - R_{BE}



P_C - T_a

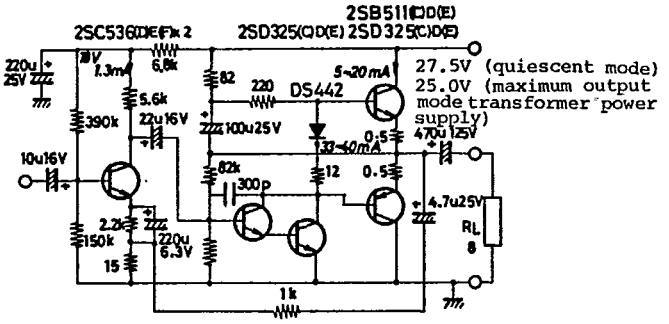


A S O



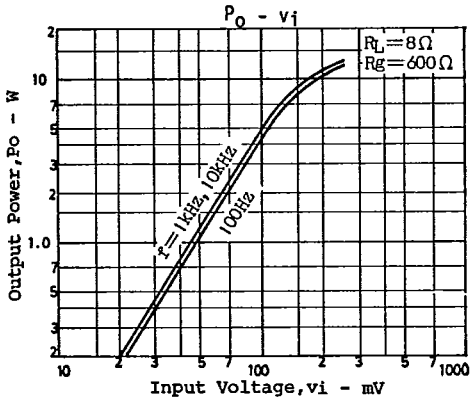
Application Circuit 1: 8W Pure Complementary Push-pull Power Amp. Using 2SB511/2SD325.

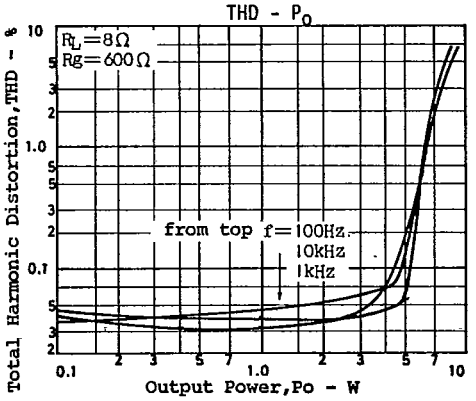
If NFB is applied from after the coupling capacitor, phase shift occurs at low frequencies, increasing the gain at low frequencies as indicated by curve a in Fig. A. NFB is applied from before the output capacitor as shown right to avoid this phenomenon. However, since the voltage actually developed across the load is the voltage divided by the capacitor and load resistor, the gain starts lowering at a rather lower frequency. Therefore, the value of capacitor C_{NF} connected in series with the feedback resistor is made to be 4.7uF.

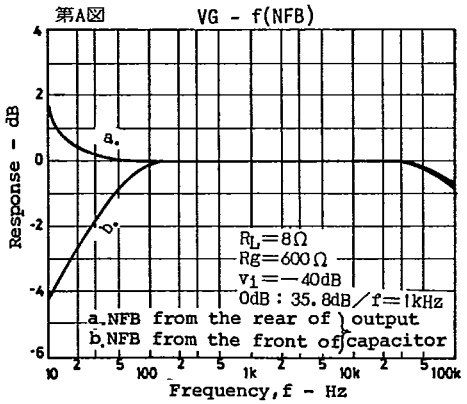


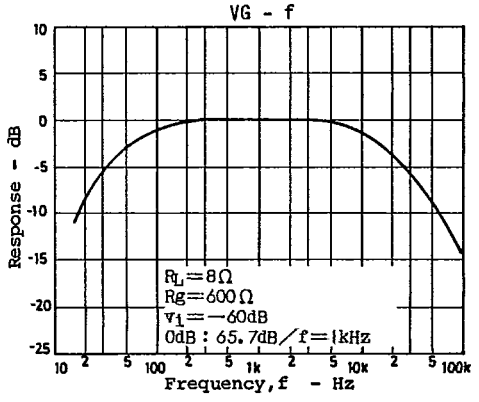
Main Characteristics

Voltage Gain	VG	Without NFB	65 to 67	dB
		With NFB	35.8	dB
Output Power	Po	THD=5%	7.2 to 8.6	W
Total Harmonic Distortion	THD	Po+3W	0.03 to 0.09	%
Input Impedance	r_i		65 to 80	kohm
Output Impedance	r_o		0.16	ohm
Damping factor	DF		50	

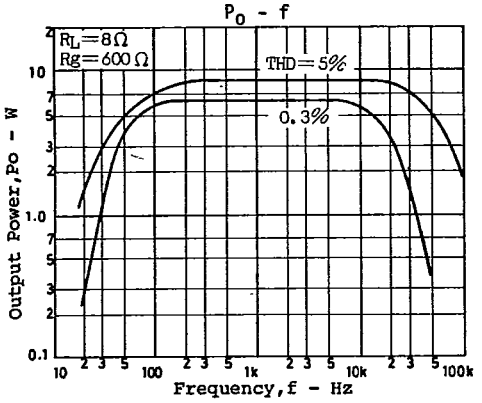




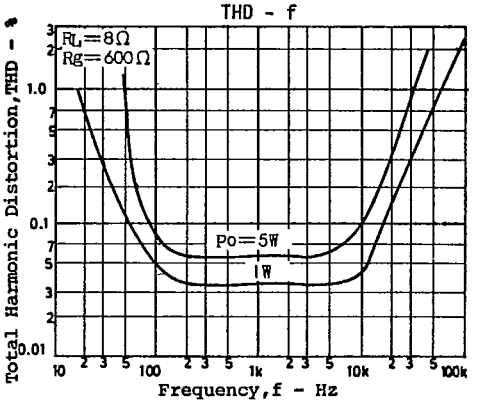




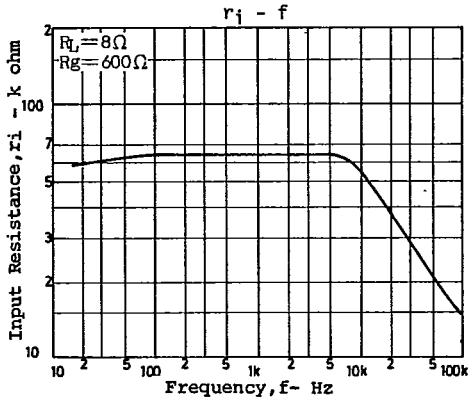
P_O - f



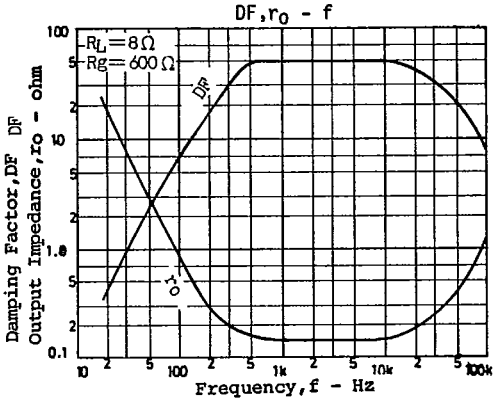
THD - f



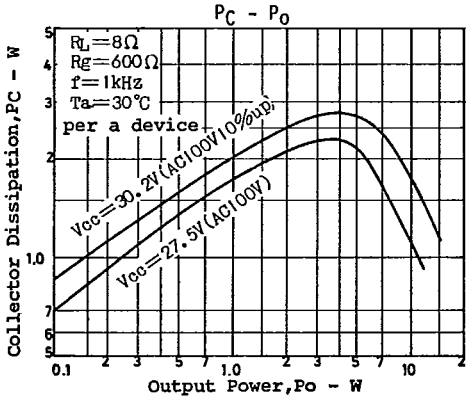
r_i - f



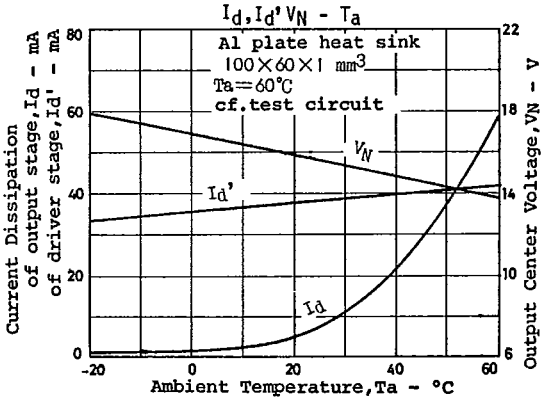
DF, r_O - f



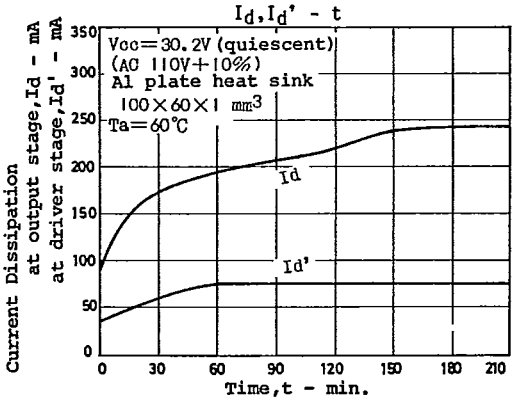
P_C - P_O



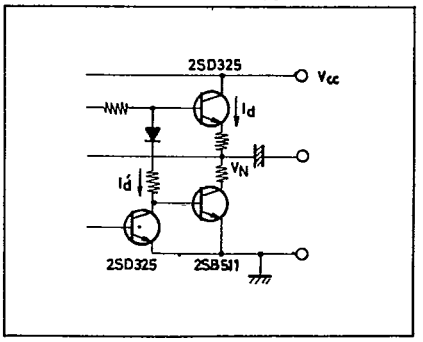
I_d, I_d' V_N - Ta

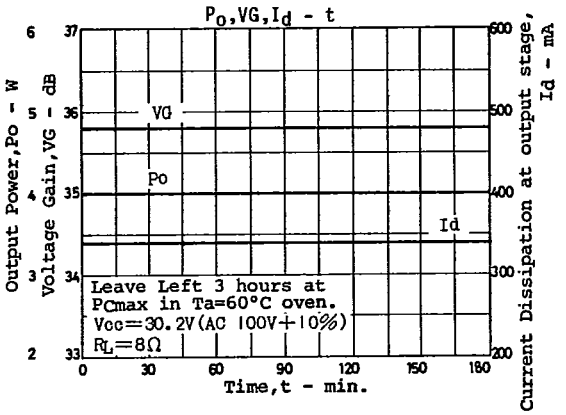


I_d, I_d' - t

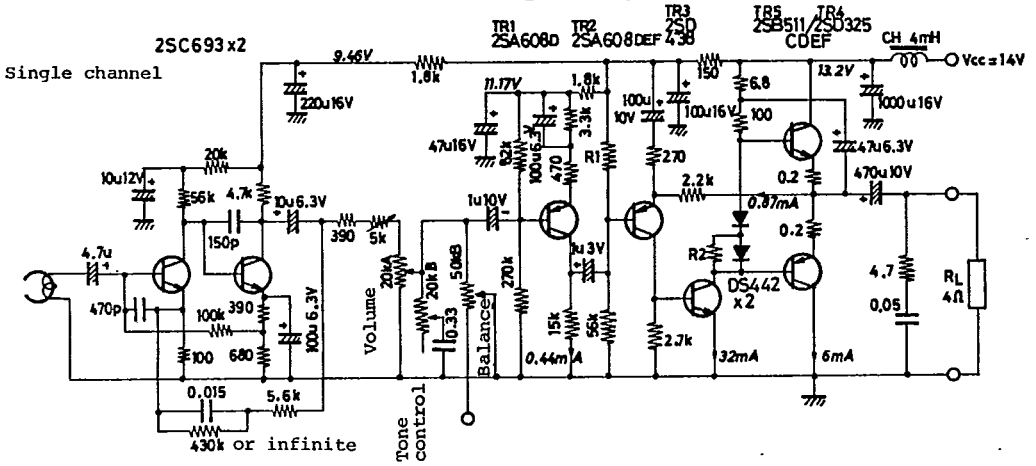


Test circuit





Application Circuit 2: 4.3W Car Stereo Amp. Using 2SB511/2SD325



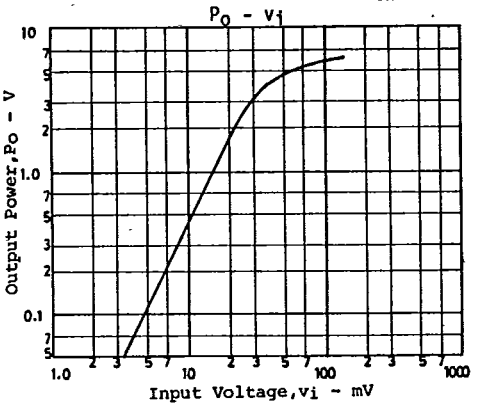
Main Characteristics at V_{CC}=14V, R_L=4ohm, Rg+600ohm, f=1kHz

Voltage Gain	VG		42.8	dB
Output Power	Po	THD=10%	3.85	W
Total Harmonic Distortion	THD	Po=1W	0.45	%
Frequency		-3dB	80 to 15k	Hz
Input Impedance	ri		20	kohm
Output Impedance	ro		0.99	ohm

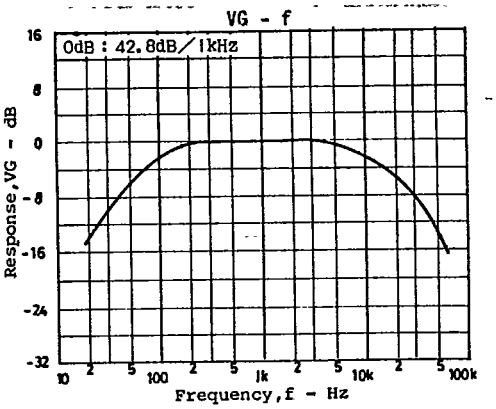
h_{FE} rank of each transistor and circuit constants corresponding to such h_{FE} rank

h_{FE} rank					Circuit constants		Idling current (in collector of TR5)	THD 10% output	Gain
TR1 A608	TR2 A608	TR3 C875	TR4 D325	TR5 B511	R1	R2	mA	W	dB
D	D	D	C	C	120k	13	3.5	3.3	41.8
D	F	E	C	C	100k	13	7.3	3.4	42.9
D	D	D	D	D	120k	13	6.0	3.85	42.6
D	F	E	D	D	100k	13	11.5	3.95	43.5
D	D	D	E	E	100k	13	7.2	4.1	43.0
D	F	E	E	E	82k	13	11.3	4.2	43.7
D	D	D	F	F	100k	12	7.0	4.1	43.5
D	F	E	F	F	82k	12	9.7	4.2	43.9

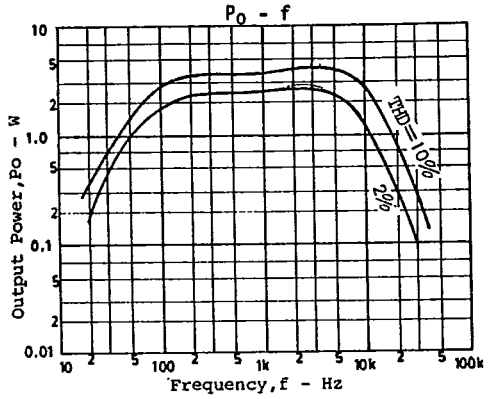
P_O - V_i



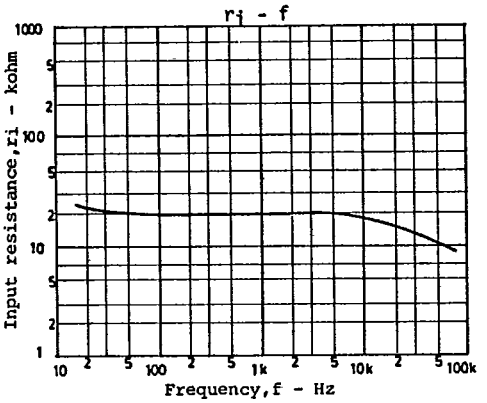
VG - f



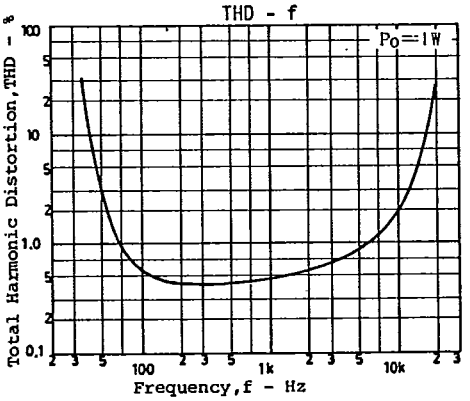
P_O - f



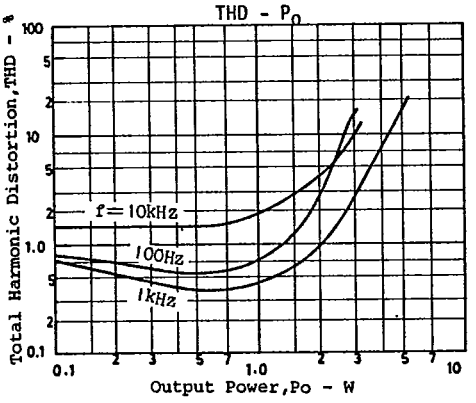
r_i - f



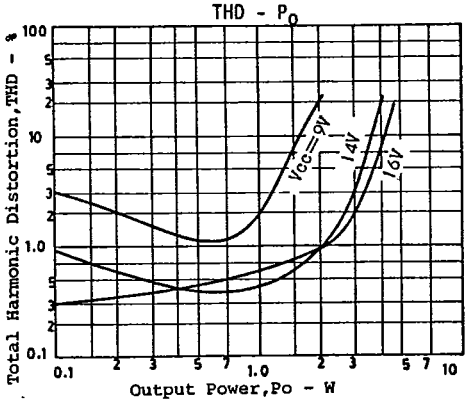
THD - f



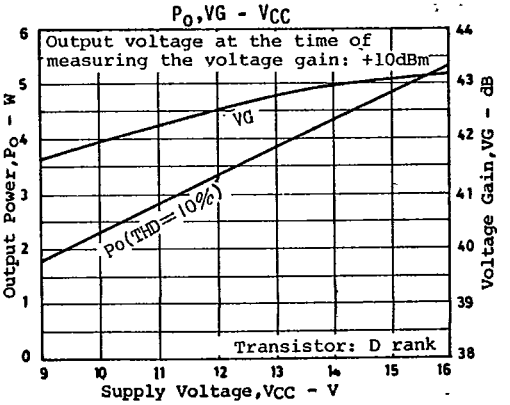
THD - P_O

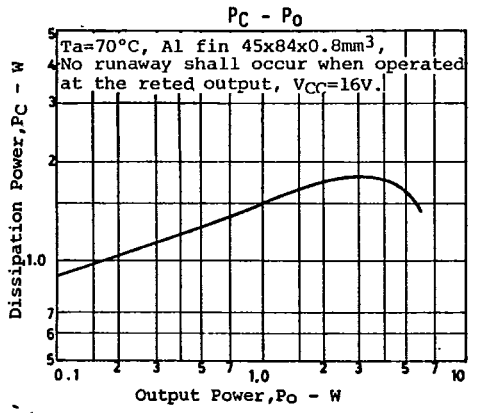


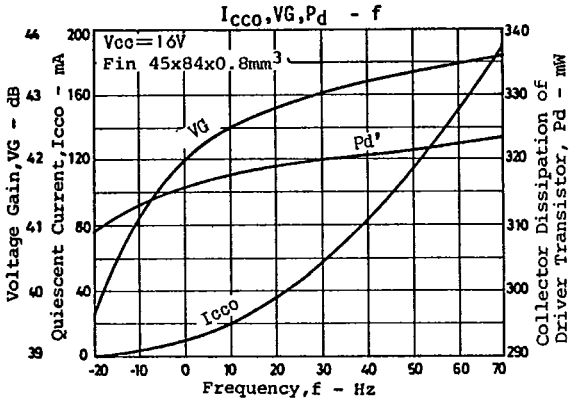
THD - P_O

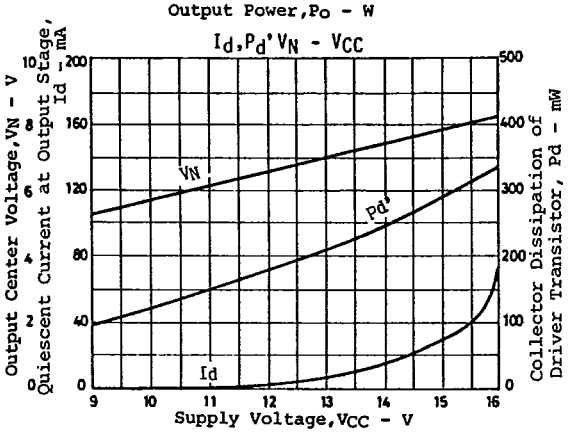


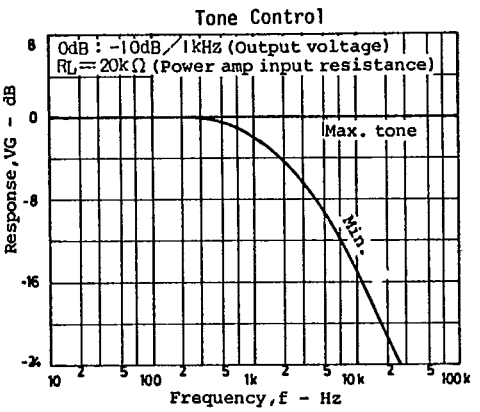
P_O,VG - V_{CC}

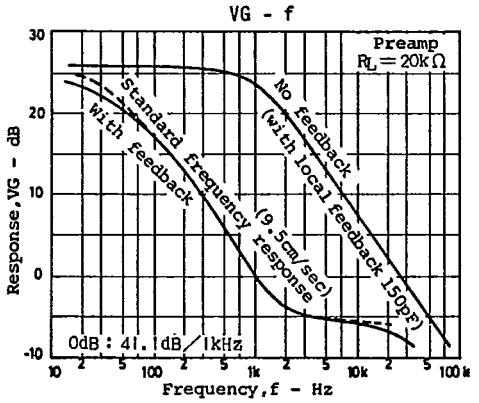










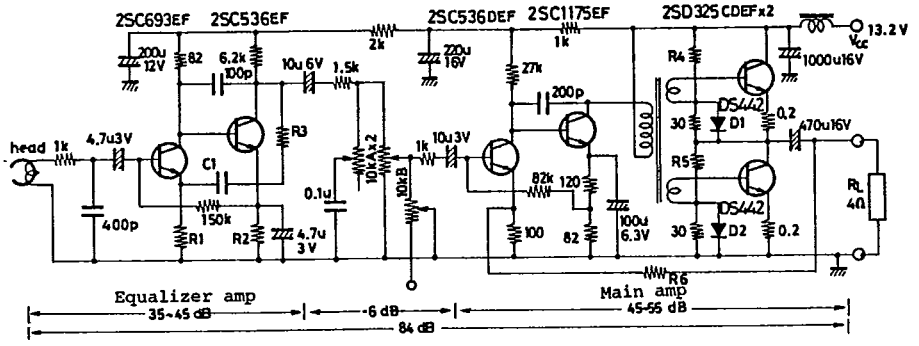


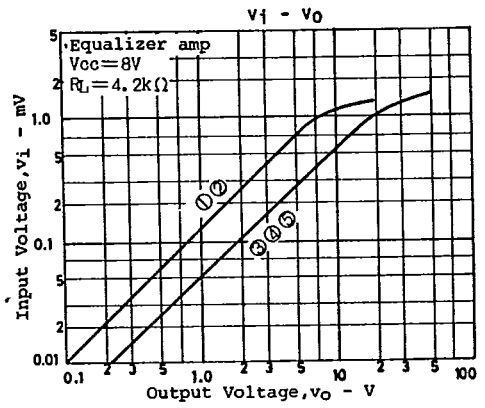
Application Circuit 3: 4W Car Stereo Pre & Main Amp Using 2SD325 x 2

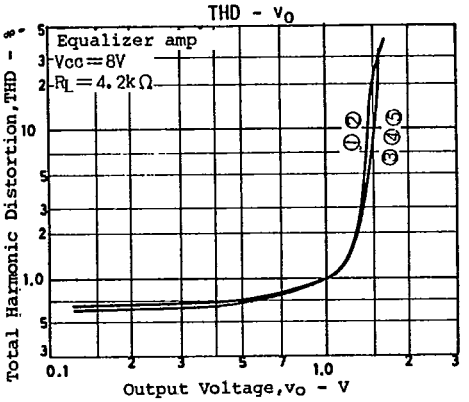
hFE rank·Circuit constants·Circuit characteristics (The fraction in each column represents characteristic variations depending on the upper/lower limits of each hFE rank.)

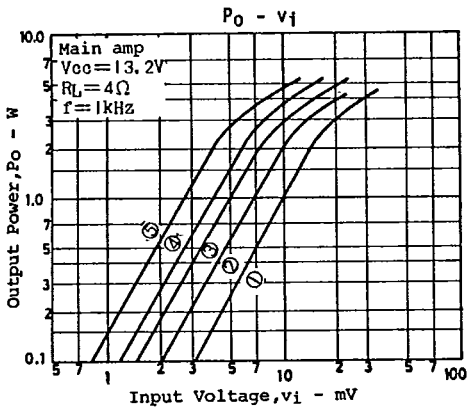
Circuit	hFE rank					Equalizer amp									Main amp					
	C858	C537	C537	C1175	D325	R1	R2	R3	C1	VG (NFB)	VG (open loop)	VG ※	Vo	r_i	R4 R5	R6	VG (NFB)	VG (open loop)	Id	r_i
						Ω	Ω	Ω	μF	dB	dB	dB	V	Ω	Ω	Ω	dB	dB	mA	Ω
①	F	F	E	E	C	110	750	9.1k	0.01	42.1 / 42.6	58.5 / 62.5	64.5 / 67.4	1.05 / 1.34	100k / 135k	270	30k	44.1 / 48.2	50.5 / 64.5	20 / 58	25k / 57k
②	F	F	F	F	C										270	36k	47.4 / 50.4	56.0 / 67.8	25 / 50	40k / 65k
③	E	E	D	F	D	220	910	6.2k	0.015	33.9 / 34.2	53.5 / 57.2	60.4 / 63.5	0.95 / 1.15	100k / 150k	300	56k	51.4 / 53.1	60.9 / 67.2	15 / 20	24k / 47k
④	E	E	D	F	E										300	68k	52.7 / 55.3	61.0 / 72.0	15 / 25	22k / 50k
⑤	E	E	E	F	F										300	100k	56.7 / 57.9	66.9 / 72.3	30 / 32	35k / 58k

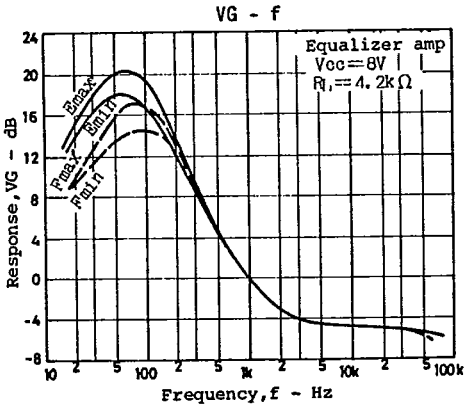
※ Open loop, without R_L

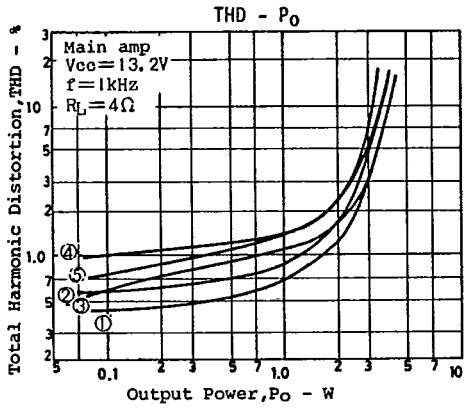

2SC693EF 2SC536EF
2SC536DEF 2SC1175EF
2SD325CDEFx2
13.2 V
Vcc
head
R1
R2
R3
R4
R5
R6
C1
D1
D2
DS442
Equalizer amp
35~45 dB
-6 dB
Main amp
45~55 dB
84 dB

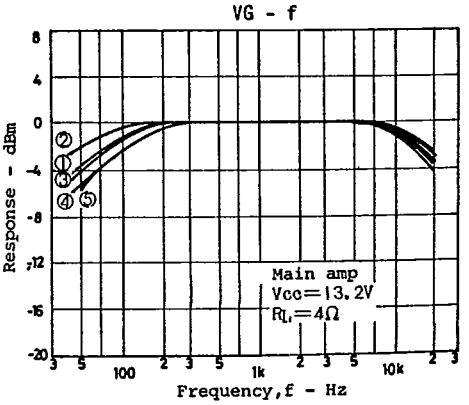

Vi - Vo
Equalizer amp
Vcc=8V
RL=4.2kΩ
Input Voltage,vi - mV
Output Voltage,vo - V


THD - Vo
Equalizer amp
Vcc=8V
RL=4.2kΩ
Total Harmonic Distortion,THD - %
Output Voltage,vo - V


Po - Vi
Main amp
Vcc=13.2V
RL=4Ω
f=1kHz
Output Power,Po - W
Input Voltage,vi - mV


VG - f
Equalizer amp
Vcc=8V
RL=4.2kΩ
Bmax
Bmin
Fmax
Fmin
Response,VG - dB
Frequency,f - Hz

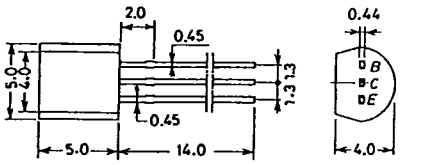

THD - Po
Main amp
Vcc=13.2V
f=1kHz
RL=4Ω
Total Harmonic Distortion,THD - %
Output Power,Po - W


VG - f
Main amp
Vcc=13.2V
RL=4Ω
Response - dBm
Frequency,f - Hz

CASE OUTLINES AND ATTACHMENTS

- All of Sanyo Transistor case outlines are illustrated below.
- All dimensions are in mm, and dimensions which are not followed by min. or max. are represented by typical values.
- No marking is indicated.

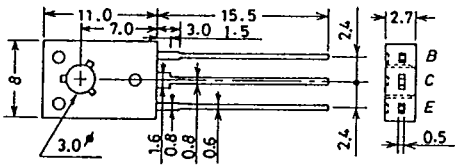
Case Outline—[2003A]
unit:mm



JEDEC: TO-92
EIAJ : SC-43
SANYO: NP

B. Base
C. Collector
E. Emitter

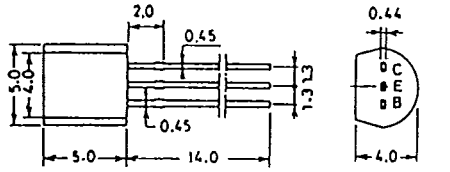
Case Outline—[2009A]
unit:mm



JEDEC: TO-126

B: Base
C: Collector
E: Emitter

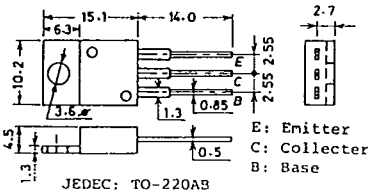
Case Outline—[2004A]
unit:mm



JEDEC: TO-92
EIAJ : SC-43
SANYO: NP

C. Collector
E. Emitter
B. Base

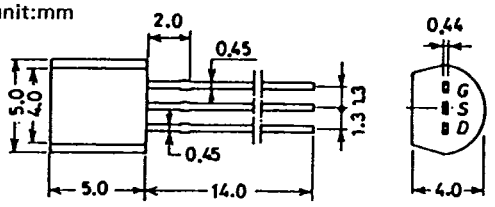
Case Outline—[2010A]
unit:mm



JEDEC: TO-220AB
EIAJ: SC-46

E: Emitter
C: Collecter
B: Base

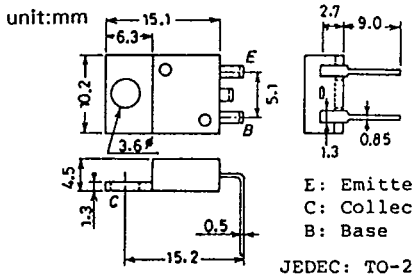
Case Outline—[2005A]
unit:mm



JEDEC: TO-92
EIAJ : SC-43
SANYO: NP

G: Gate
S: Source
D: Drain

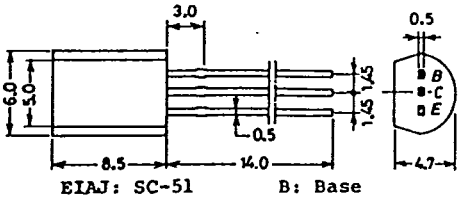
Case Outline—[2012]
unit:mm



E: Emitter
C: Collector
B: Base

JEDEC: TO-220AA
EIAJ : SC-45

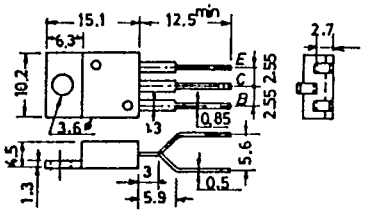
Case Outline—[2006A]
unit:mm



EIAJ: SC-51
SANYO:MP

B: Base
C: Collector
E: Emitter

Case Outline—[2013]
unit:mm

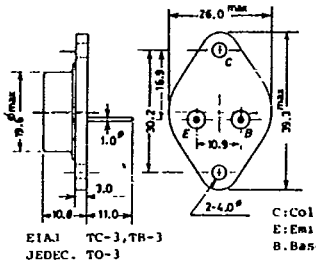


JEDEC TO-220

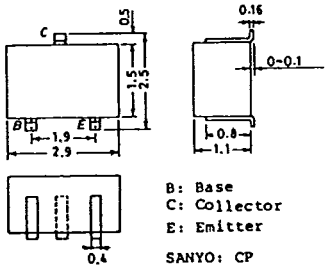
B: Base
C: Collector
E: Emitter

T-91-20

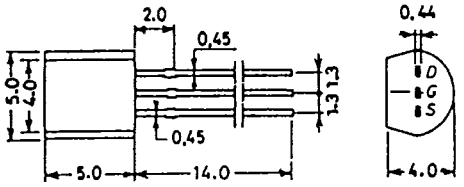
Case Outline—[2017]
unit:mm



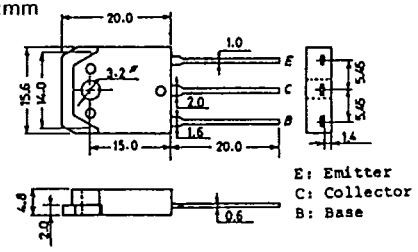
Case Outline—[2018A]
unit:mm



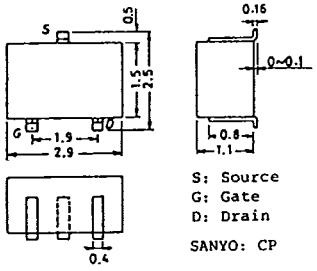
Case Outline—[2019A]
unit:mm



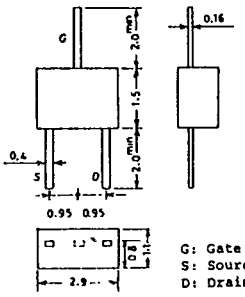
Case Outline—[2022]
unit:mm



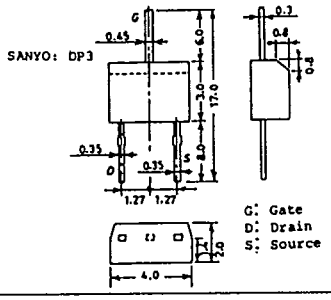
Case Outline—[2024A]
unit:mm



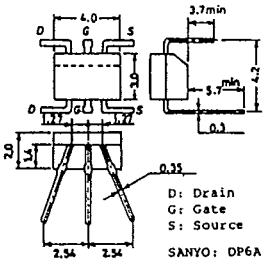
Case Outline—[2025]
unit:mm



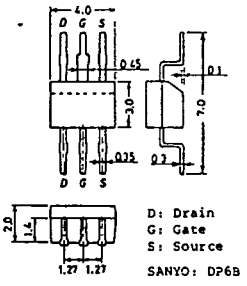
Case Outline—[2026]
unit:mm



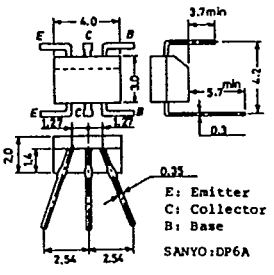
Case Outline—[2027A]
unit:mm



Case Outline—[2028A]
unit:mm

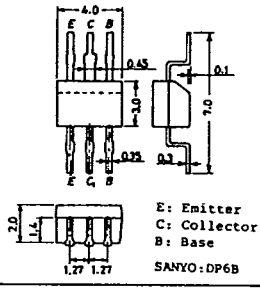


Case Outline—[2029A]
unit:mm

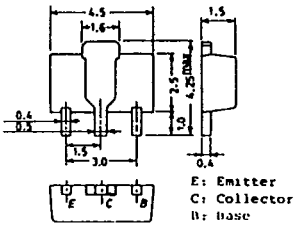


T-91-20

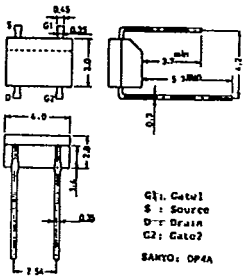
Case Outline—[2030A]
unit:mm



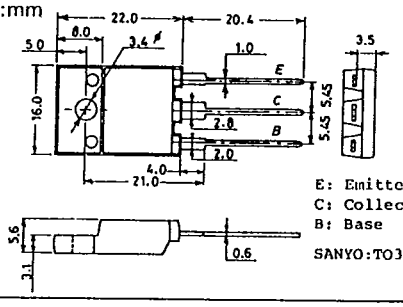
Case Outline—[2038]
unit:mm



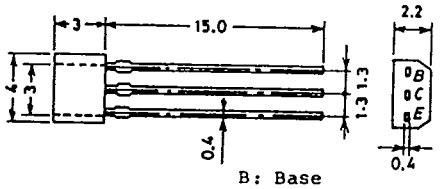
Case Outline—[2031A]
unit:mm



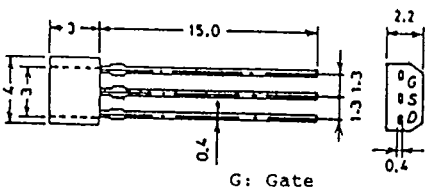
Case Outline—[2039]
unit:mm



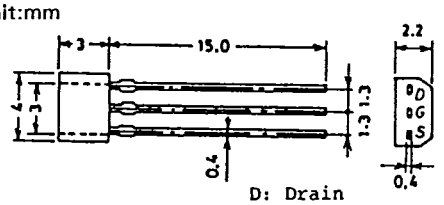
Case Outline—[2033]
unit:mm



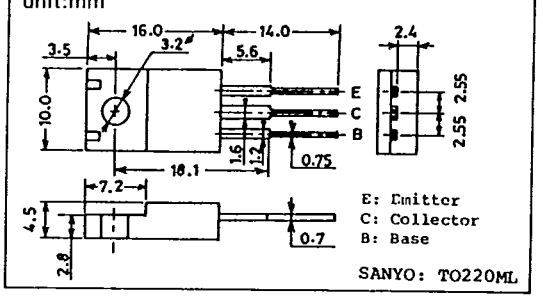
Case Outline—[2040]
unit:mm



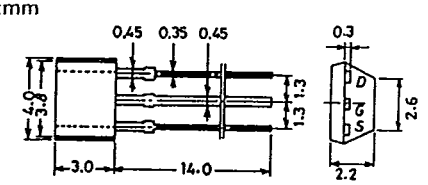
Case Outline—[2034]
unit:mm



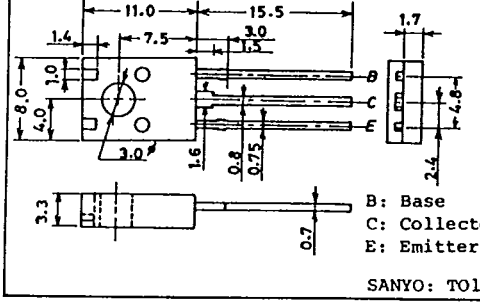
Case Outline—[2041]
unit:mm



Case Outline—[2037]
unit:mm

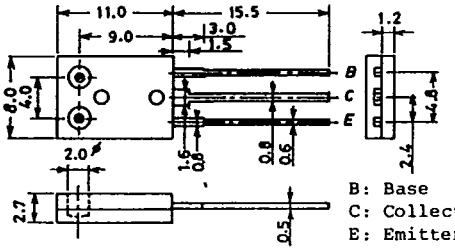


Case Outline—[2042A] unit:mm



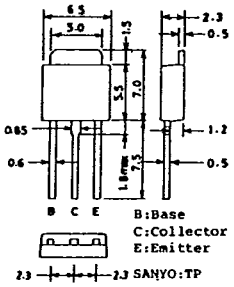
T-91-20

Case Outline—[2043A] unit:mm

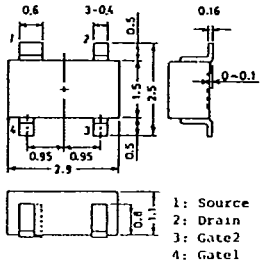


SANYO: TO126LP

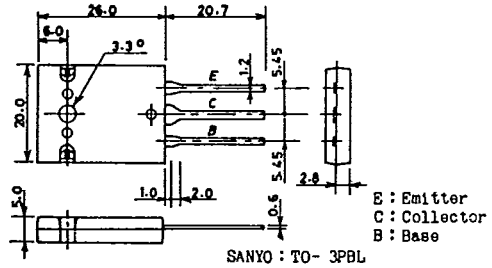
Case Outline—[2045] unit:mm



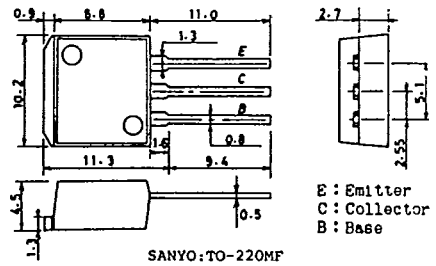
Case Outline—[2046] unit:mm



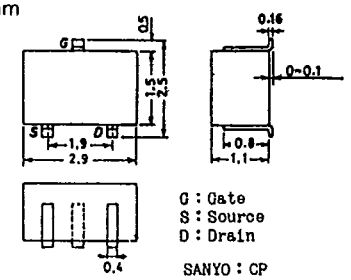
Case Outline—[2048] unit:mm



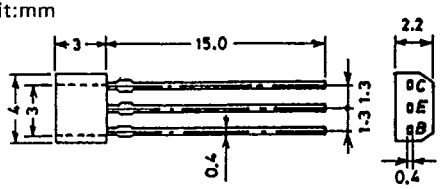
Case Outline—[2049] unit:mm



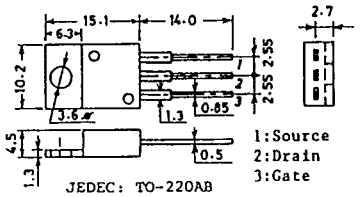
Case Outline—[2050] unit:mm



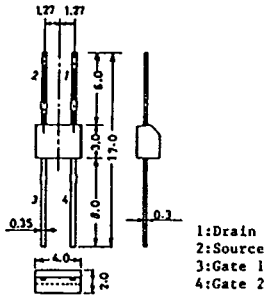
Case Outline—[2051] unit:mm



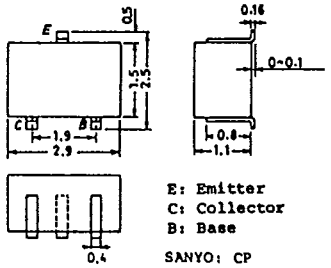
Case Outline—[2052A] unit:mm



Case Outline—[2053] unit:mm

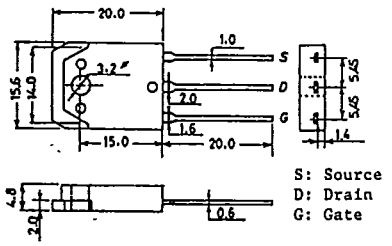


Case Outline—[2054] unit:mm



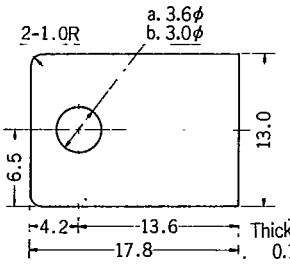
T-91-20

Case Outline—[2056] unit:mm



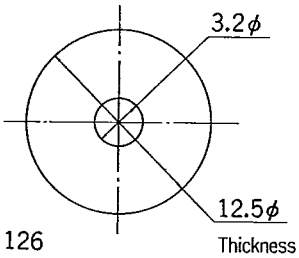
SANYO: TO3PB

Case Outline—[0008]
unit:mm



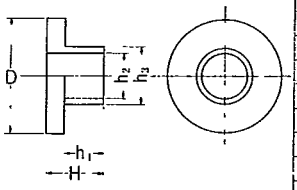
SANYO

Case Outline—[0004]
unit:mm



SANYO IS-126 Thickness : 0.075

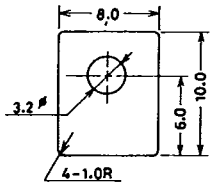
Case Outline—[0009]
unit:mm



Bush	D	H	h1	h2	h3
A	8.0φ	4.0	2.8	3.1φ	3.89φ
B	8.0φ	3.0	1.8	3.1φ	3.89φ
C	8.0φ	5.7	4.5	3.1φ	3.89φ
D	8.0φ	2.7	1.5	3.1φ	3.89φ
E	8.0φ	3.4	2.2	3.1φ	3.89φ
F	8.0φ	4.0	2.8	3.0φ	3.59φ
K	16.0φ	3.4	1.4	3.1φ	6.0φ
L	6.0φ	3.1	1.5	2.6φ	3.5φ
M	6.0φ	3.1	1.5	3.0φ	3.59φ
P	6.0φ	2.3	1.1	3.0φ	3.59φ

SANYO Bush

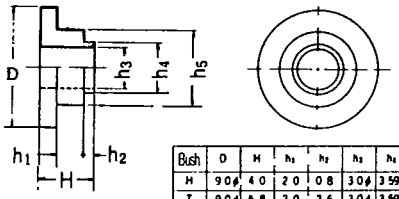
Case Outline—[0005]
unit:mm



Thickness : 0.075

SANYO IS-126A Mica

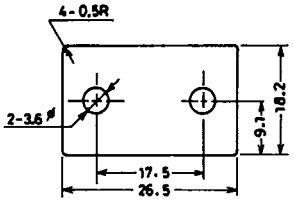
Case Outline—[0010]
unit:mm



Bush	D	H	h1	h2	h3	h4	h5
H	9.0φ	4.0	2.0	0.8	3.0φ	3.59φ	5.6φ
T	9.0φ	5.8	2.0	2.6	3.0φ	3.59φ	5.6φ
UB	16.0φ	6.8	1.5	3.3	3.0φ	3.89φ	8.0φ

SANYO Bush

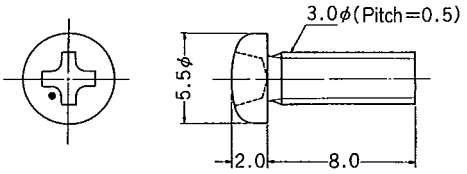
Case Outline—[0006]
unit:mm



Thickness : 0.05~0.1

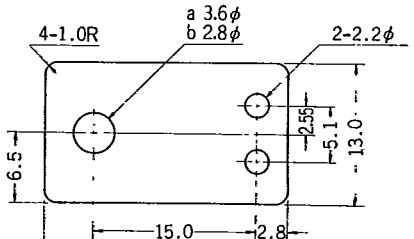
SANYO IS-20MA Mica

Case Outline—[0011]
unit:mm



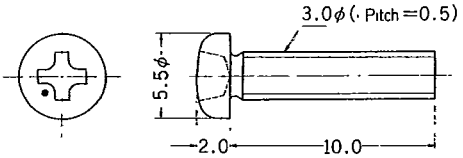
JIS No.B1111 M3×0.5

Case Outline—[0007]
unit:mm



a. IS-313
b. IS-313A
Thickness
0.10~0.05

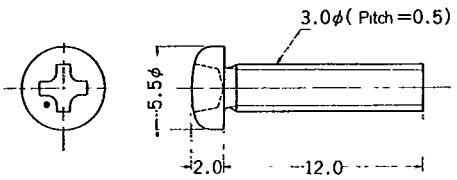
Case Outline—[0012]
unit:mm



JIS No.B1111 M3×0.5

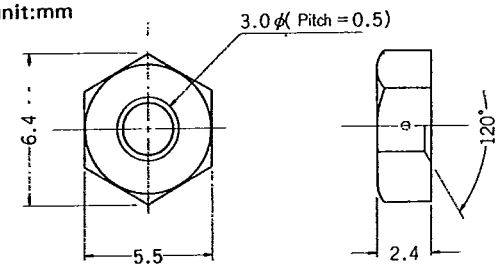
T-91-20

Case Outline—[0013]
unit:mm



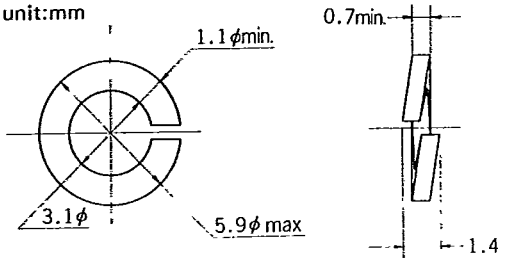
JIS No.B1111 M3×0.5

Case Outline—[0014]
unit:mm



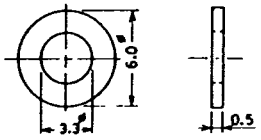
JIS No. B1181 M3×0.5

Case Outline—[0015]
unit:mm



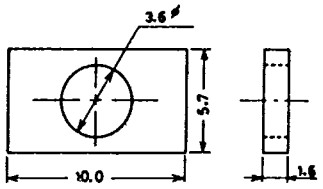
JIS No. B 1251 Spring washer (M3)

Case Outline—[0016]
unit:mm



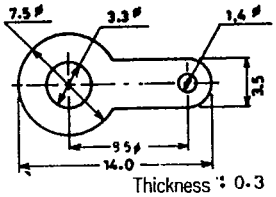
JIS No.B1252 Flat washer

Case Outline—[0017]
unit:mm



JIS No.G3141 Rectangular washer

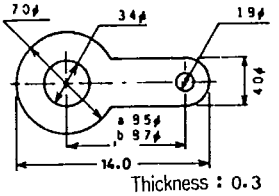
Case Outline—[0018]
unit:mm



Thickness : 0.3

SANYO Lug 1.4

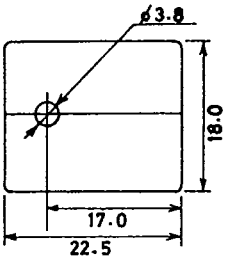
Case Outline—[0019]
unit:mm



Thickness : 0.3

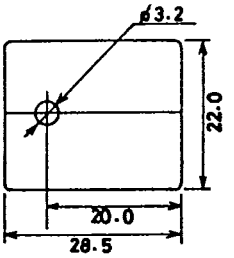
SANYO Lug 1.8φ

Case Outline—[0020]
unit:mm



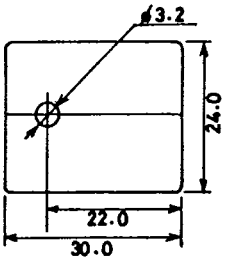
SANYO IS-3MP Mica

Case Outline—[0021]
unit:mm



SANYO IS-MPC Mica

Case Outline—[0022]
unit:mm



SANYO IS-3PBL Mica