

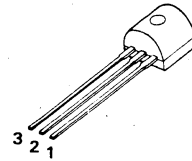


**NB013,014 (NPN) 30mA low noise transistors**  
**NB023,024 (PNP)**

**features**

- 35 to 50 Volt at 30mA collector ratings
- 300mV guaranteed  $V_{CE}$  (sat) characteristics at  $I_C = 10mA$  and  $I_B = 0.5mA$
- 1dB typical wide-band Noise Figure
- "Epoxy B" packaging concept for excellent reliability

**1 package and lead coding**



**applications**

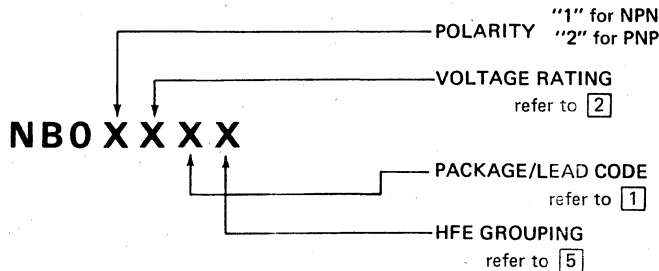
- Low noise amplifier circuits
- Equalizer, preamplifiers

PACKAGE CODE TO-92	LEAD		
	1	2	3
E	E	B	C
F	E	C	B
H	C	B	E

**2 maximum ratings**

PARAMETER	SYMBOL	NB013 NB023	NB014 NB024	UNIT
Collector-Emitter Voltage	$V_{CEO}$	35	50	$V_{DC}$
Collector-Base Voltage	$V_{CB}$	40	55	$V_{DC}$
Emitter-Base Voltage	$V_{EB}$	5	5	$V_{DC}$
Collector Current (continuous)	$I_C$ (max)	30	30	$mA_{DC}$
Power Dissipation ( $T_A = 25^\circ C$ )	$P_D$	0.6	0.6	W
Power Dissipation ( $T_C = 25^\circ C$ )	$P_D$	1.0	1.0	W
Thermal Resistance	$\theta_{JA}$	208	208	$^\circ C/W$
	$\theta_{JC}$	125	125	$^\circ C/W$
Temperature, Junction and Storage	$T_j, T_{stg}$	-55 to +150	-55 to +150	$^\circ C$

**3 ordering information**



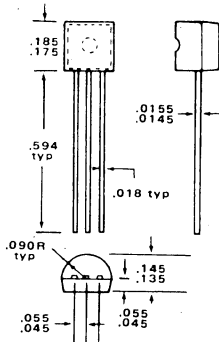
**4** electrical characteristics  $T_C = 25^\circ\text{C}$

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
$BV_{CE0}$	Collector-Emitter Sustaining Voltage NB013/023 NB014/024	$I_C = 1\text{ mA}$	35 50			V V
$BV_{CBO}$	Collector-Base Breakdown Voltage NB013/023 NB014/024	$I_C = 100\mu\text{A}$	40 55			V V
$BV_{EBO}$	Emitter-Base Breakdown Voltage	$I_E = 10\mu\text{A}$	5			V
$I_{CEO}$	Collector-Emitter Leakage Current	$V_{CE} = 30\text{V}$ NB013 $45\text{V}$ NB014			1 1	$\mu\text{A}$ $\mu\text{A}$
$I_{CES}$	Collector-Emitter Leakage Current	$V_{CE} = 30\text{V}$ NB023 $45\text{V}$ NB024			0.5 0.5	$\mu\text{A}$ $\mu\text{A}$
$I_{CBO}$	Collector-Base Leakage Current	$V_{CB} = 35\text{V}$ NB013/023 $50\text{V}$ NB014/024			50 50	nA nA
$I_{EBO}$	Emitter-Base Leakage Current	$V_{EB} = 4\text{V}$			0.1	$\mu\text{A}$
$V_{BE}(\text{sat})$	Base-Emitter Saturation Voltage	$I_C = 10\text{ mA}$ , $I_B = 0.5\text{ mA}$		0.75	0.95	V
$V_{CE}(\text{sat})$	Collector-Emitter Saturation Voltage	$I_C = 10\text{ mA}$ , $I_B = 0.5\text{ mA}$		0.1	0.3	V
$C_{ob}$	Collector Output Capacitance NPN types PNP types	$V_{CB} = 10\text{V}$ , $f = 1\text{ MHz}$		2 3		pF pF
$f_t$	Current Gain Bandwidth Product	$I_C = 1\text{ mA}$ , $V_{CE} = 5\text{V}$	50	120		MHz
NF	Noise Figure	$I_C = 10\mu\text{A}$ , $V_{CE} = 5\text{V}$ $R_S = 10\text{ K}$ , $BW = 15.7\text{ KHz}$		1	4	dB

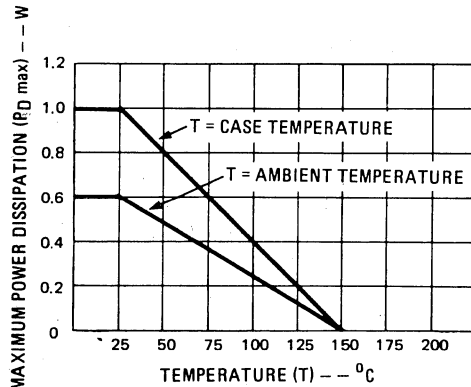
**5** HFE groupings

GROUPING	PARAMETER	CONDITIONS	MIN	TYP	MAX	RATIO
I	DC Current Gain	$I_C = 100\mu\text{A}$ , $V_{CE} = 5\text{V}$	140	180	240	1:1.6
J	DC Current Gain	$I_C = 100\mu\text{A}$ , $V_{CE} = 5\text{V}$	200	260	350	1:1.6
K	DC Current Gain	$I_C = 100\mu\text{A}$ , $V_{CE} = 5\text{V}$	300	380	500	1:1.6
L	DC Current Gain	$I_C = 100\mu\text{A}$ , $V_{CE} = 5\text{V}$	450	580	750	1:1.6
T	DC Current Gain	$I_C = 100\mu\text{A}$ , $V_{CE} = 5\text{V}$	100	150	240	1:2.4
U	DC Current Gain	$I_C = 100\mu\text{A}$ , $V_{CE} = 5\text{V}$	200	320	500	1:2.4
V	DC Current Gain	$I_C = 100\mu\text{A}$ , $V_{CE} = 5\text{V}$	450	700	1100	1:2.4
Y	DC Current Gain	$I_C = 100\mu\text{A}$ , $V_{CE} = 5\text{V}$	100	190	350	1:3.5
Z	DC Current Gain	$I_C = 100\mu\text{A}$ , $V_{CE} = 5\text{V}$	300	580	1100	1:3.5

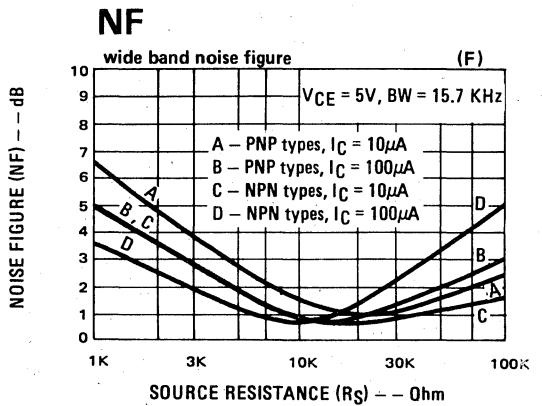
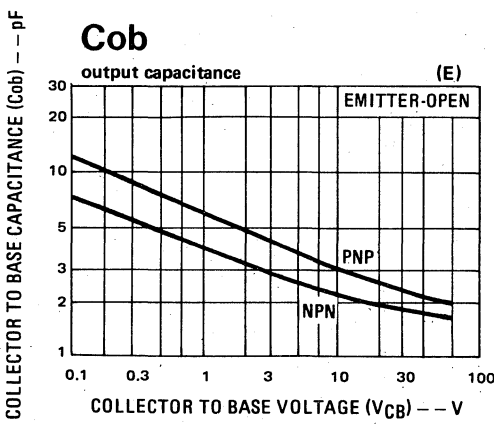
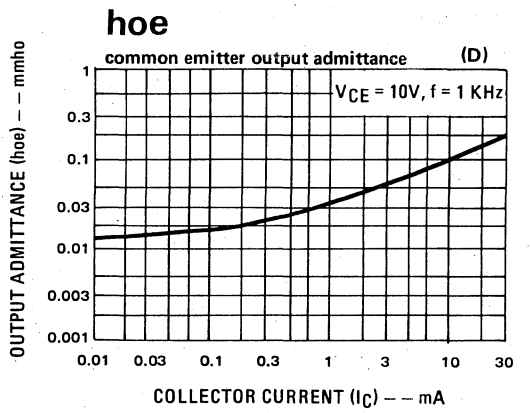
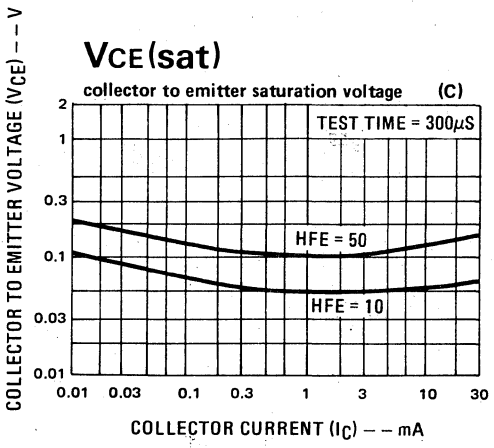
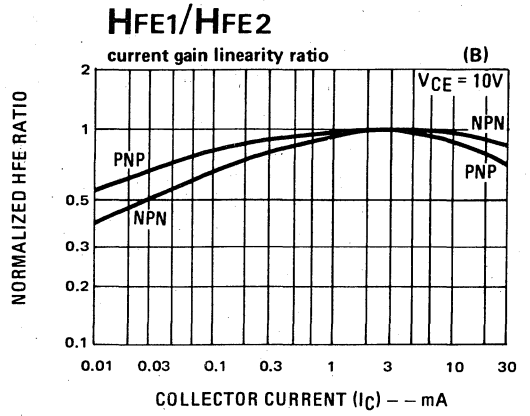
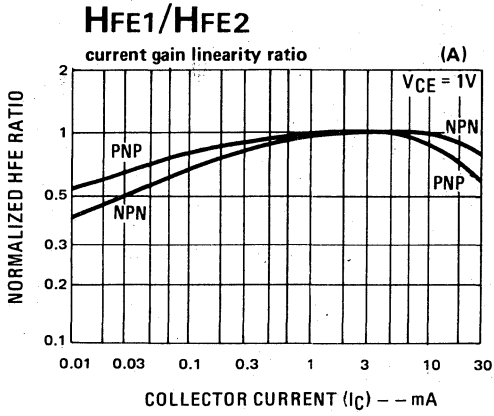
**6** physical dimensions

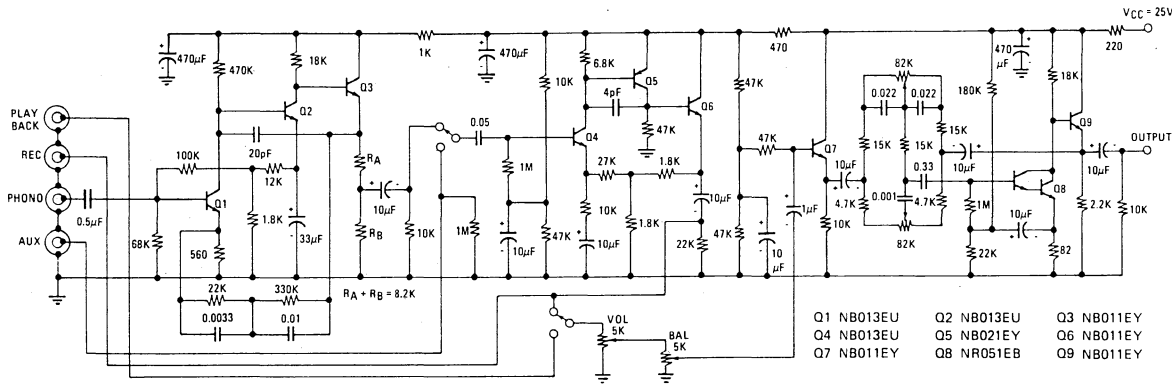


**7** max power dissipation



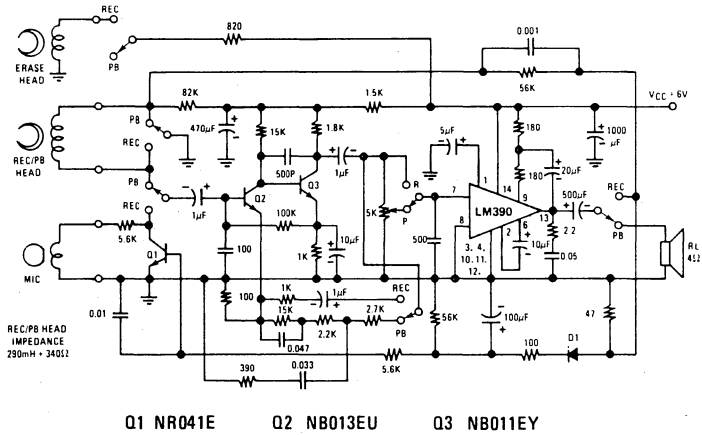
**8** typical performance characteristics





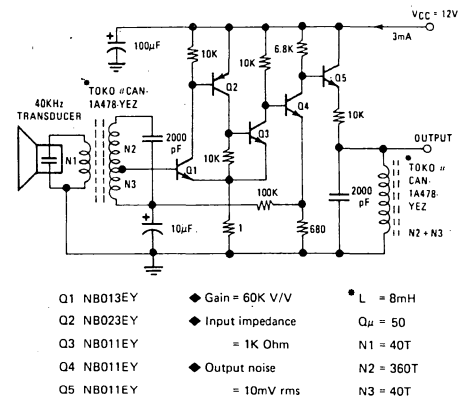
- Q1 NB013EU
- Q2 NB013EU
- Q3 NB011EY
- Q4 NB013EU
- Q5 NB021EY
- Q6 NB011EY
- Q7 NB011EY
- Q8 NR051EB
- Q9 NB011EY

Figure A. High Quality Preamplifier with Tone Control Circuit



- Q1 NR041E
- Q2 NB013EU
- Q3 NB011EY

Figure B. Battery Operated Recording/Playback Cassette Circuit



- Q1 NB013EY
- Q2 NB023EY
- Q3 NB011EY
- Q4 NB011EY
- Q5 NB011EY
- ◆ Gain = 60K V/V
- ◆ Input impedance = 1K Ohm
- ◆ Output noise = 10mV rms
- L = 8mH
- Q<sub>m</sub> = 50
- N1 = 40T
- N2 = 360T
- N3 = 40T

Figure C. High Gain Ultrasonic Amplifier

NB013, 014(NPN), NB023, 024(PNP)