

# Plastic Medium-Power Complementary Silicon Transistors

... designed for general-purpose amplifier and low-speed switching applications.

- High DC Current Gain —  
 $h_{FE} = 2500$  (Typ) @  $I_C = 4.0$  Adc
- Collector-Emitter Sustaining Voltage — @ 100 mAdc —  
 $V_{CE(sus)} = 60$  Vdc (Min) — 2N6040, 2N6043  
 $= 80$  Vdc (Min) — 2N6041, 2N6044  
 $= 100$  Vdc (Min) — 2N6042, 2N6045
- Low Collector-Emitter Saturation Voltage —  
 $V_{CE(sat)} = 2.0$  Vdc (Max) @  $I_C = 4.0$  Adc — 2N6040, 41, 2N6043, 44  
 $= 2.0$  Vdc (Max) @  $I_C = 3.0$  Adc — 2N6042, 2N6045
- Monolithic Construction with Built-In Base-Emitter Shunt Resistors

## MAXIMUM RATINGS (1)

Rating	Symbol	2N6040 2N6043	2N6041 2N6044	2N6042 2N6045	Unit
Collector-Emitter Voltage	$V_{CEO}$	60	80	100	Vdc
Collector-Base Voltage	$V_{CB}$	60	80	100	Vdc
Emitter-Base Voltage	$V_{EB}$	5.0			Vdc
Collector Current — Continuous Peak	$I_C$	8.0 16			Adc
Base Current	$I_B$	120			mAdc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	75 0.60			Watts W/ $^\circ\text{C}$
Operating and Storage Junction, Temperature Range	$T_J, T_{stg}$	-65 to +150			$^\circ\text{C}$

## THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$\theta_{JC}$	1.67	$^\circ\text{C/W}$
Thermal Resistance, Junction to Ambient	$\theta_{JA}$	57	$^\circ\text{C/W}$

(1) Indicates JEDEC Registered Data.

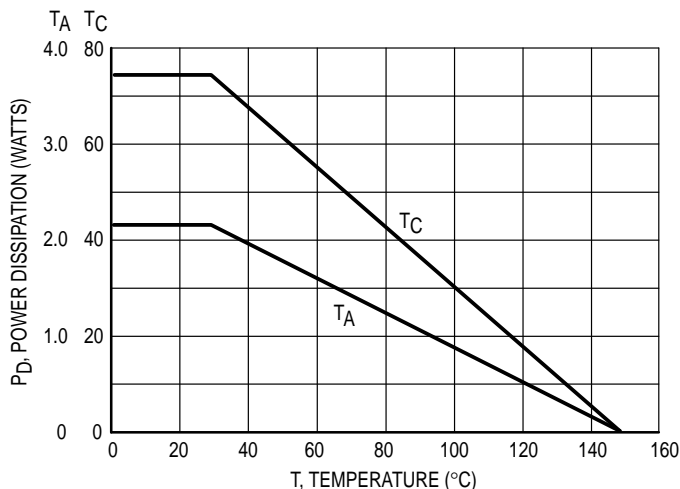


Figure 1. Power Derating

Preferred devices are Motorola recommended choices for future use and best overall value.

REV 1

**PNP**  
**2N6040**  
  
**thru**  
  
**2N6042\***  
**NPN**  
**2N6043**  
  
**thru**  
  
**2N6045\***

\*Motorola Preferred Device

**DARLINGTON**  
**8 AMPERE**  
**COMPLEMENTARY**  
**SILICON**  
**POWER TRANSISTORS**  
**60-80-100 VOLTS**  
**75 WATTS**

**CASE 221A-06**  
**TO-220AB**

# 2N6040 thru 2N6042 2N6043 thru 2N6045

\*ELECTRICAL CHARACTERISTICS ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector-Emitter Sustaining Voltage ( $I_C = 100\text{ mAdc}$ , $I_B = 0$ )	$V_{CE(sus)}$	60 80 100	—	Vdc
Collector Cutoff Current ( $V_{CE} = 60\text{ Vdc}$ , $I_B = 0$ ) ( $V_{CE} = 80\text{ Vdc}$ , $I_B = 0$ ) ( $V_{CE} = 100\text{ Vdc}$ , $I_B = 0$ )	$I_{CEO}$	— — —	20 20 20	$\mu\text{A}$
Collector Cutoff Current ( $V_{CE} = 60\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ ) ( $V_{CE} = 80\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ ) ( $V_{CE} = 100\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ ) ( $V_{CE} = 60\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ , $T_C = 150^\circ\text{C}$ ) ( $V_{CE} = 80\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ , $T_C = 150^\circ\text{C}$ ) ( $V_{CE} = 100\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ , $T_C = 150^\circ\text{C}$ )	$I_{CEX}$	— — — — — —	20 20 20 200 200 200	$\mu\text{A}$
Collector Cutoff Current ( $V_{CB} = 60\text{ Vdc}$ , $I_E = 0$ ) ( $V_{CB} = 80\text{ Vdc}$ , $I_E = 0$ ) ( $V_{CB} = 100\text{ Vdc}$ , $I_E = 0$ )	$I_{CBO}$	— — —	20 20 20	$\mu\text{A}$
Emitter Cutoff Current ( $V_{BE} = 5.0\text{ Vdc}$ , $I_C = 0$ )	$I_{EBO}$	—	2.0	mAdc
<b>ON CHARACTERISTICS</b>				
DC Current Gain ( $I_C = 4.0\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ ) ( $I_C = 3.0\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ ) ( $I_C = 8.0\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ )	$h_{FE}$	2N6040, 41, 2N6043, 44 2N6042, 2N6045 All Types	1000 1000 100	20.000 20,000 —
Collector-Emitter Saturation Voltage ( $I_C = 4.0\text{ Adc}$ , $I_B = 16\text{ mAdc}$ ) ( $I_C = 3.0\text{ Adc}$ , $I_B = 12\text{ mAdc}$ ) ( $I_C = 8.0\text{ Adc}$ , $I_B = 80\text{ Adc}$ )	$V_{CE(sat)}$	2N6040, 41, 2N6043, 44 2N6042, 2N6045 All Types	— — —	2.0 2.0 4.0
Base-Emitter Saturation Voltage ( $I_C = 8.0\text{ Adc}$ , $I_B = 80\text{ mAdc}$ )	$V_{BE(sat)}$		—	4.5
Base-Emitter On Voltage ( $I_C = 4.0\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ )	$V_{BE(on)}$		—	2.8
<b>DYNAMIC CHARACTERISTICS</b>				
Small Signal Current Gain ( $I_C = 3.0\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ , $f = 1.0\text{ MHz}$ )	$ h_{fe} $		4.0	—
Output Capacitance ( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f = 0.1\text{ MHz}$ )	$C_{ob}$	2N6040/2N6042 2N6043/2N6045	— —	300 200
Small-Signal Current Gain ( $I_C = 3.0\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	$h_{fe}$		300	—

\* Indicates JEDEC Registered Data.

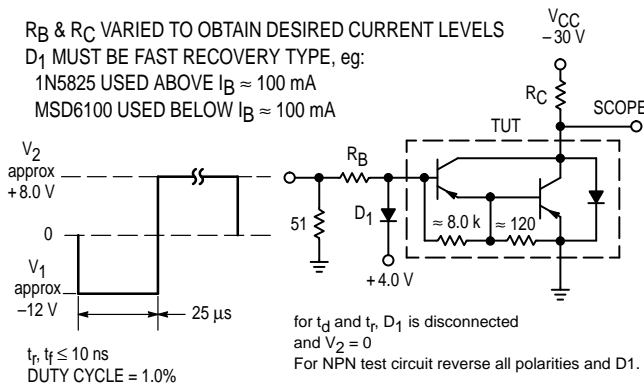


Figure 2. Switching Times Equivalent Circuit

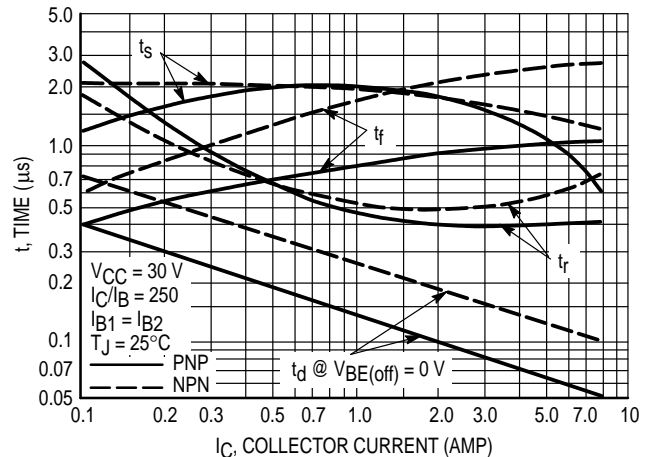


Figure 3. Switching Times

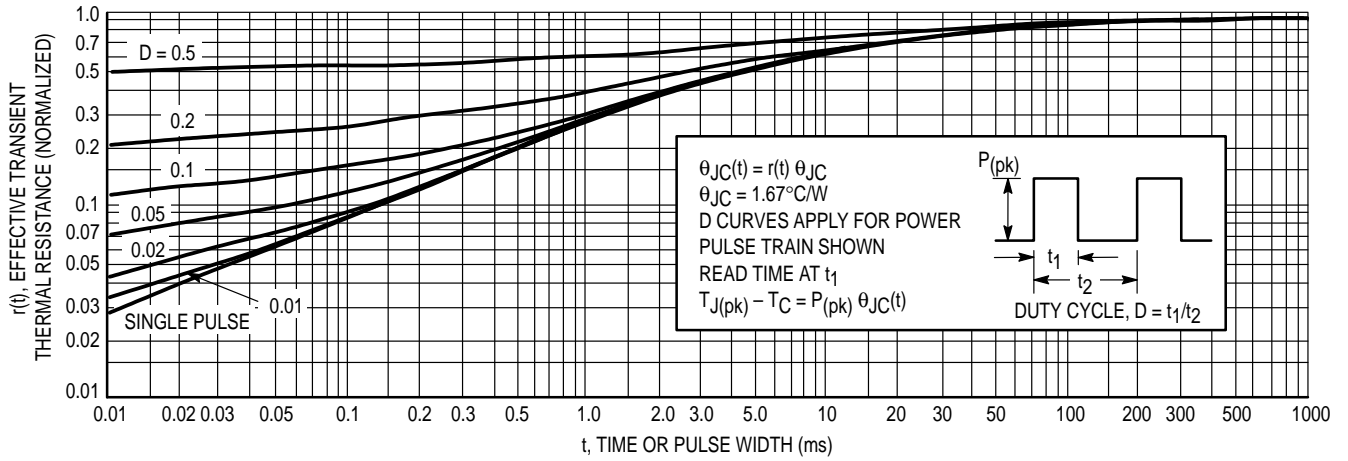


Figure 4. Thermal Response

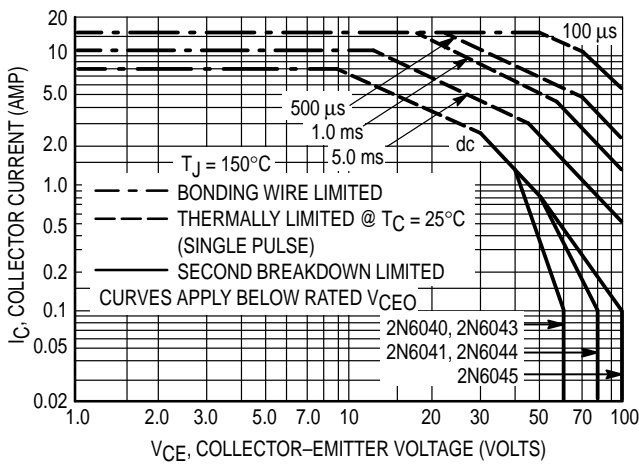


Figure 5. Active-Region Safe Operating Area

There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate  $I_C - V_{CE}$  limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 5 is based on  $T_{J(pk)} = 150^{\circ}\text{C}$ ;  $T_C$  is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided  $T_{J(pk)} < 150^{\circ}\text{C}$ .  $T_{J(pk)}$  may be calculated from the data in Figure 4. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

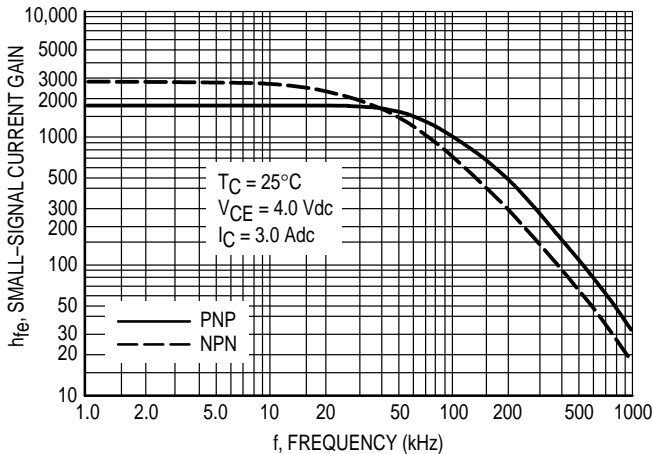


Figure 6. Small-Signal Current Gain

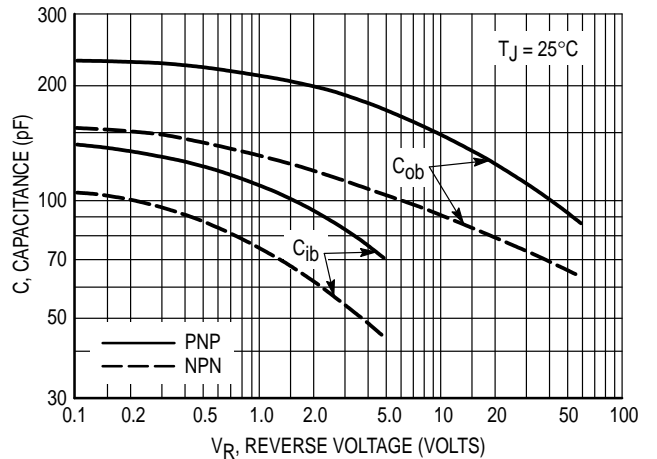
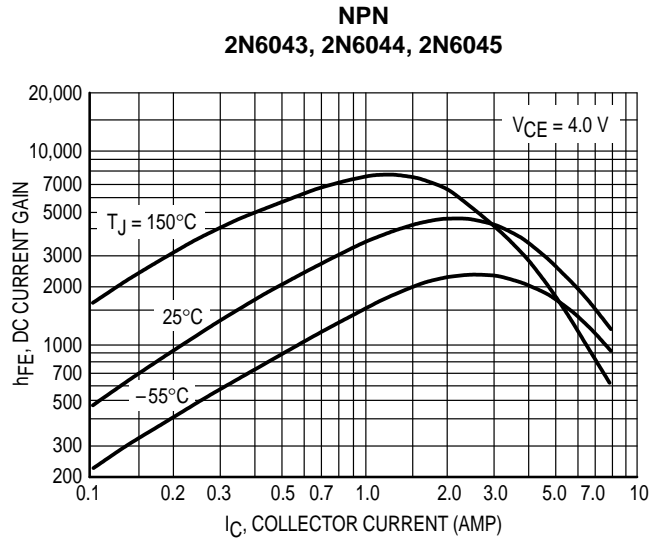
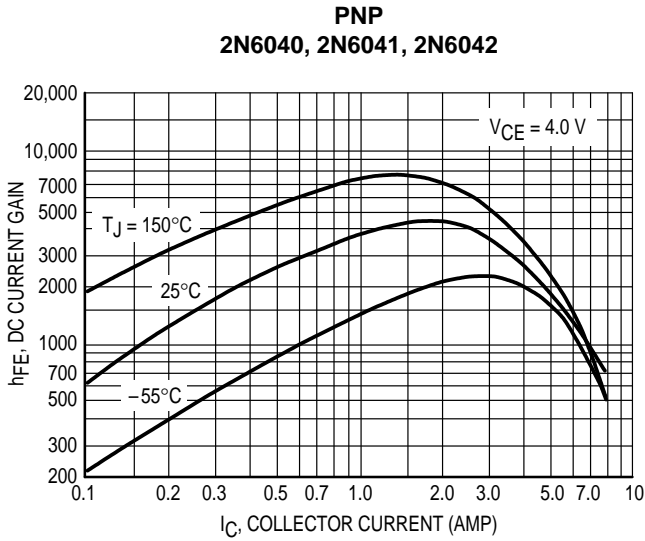
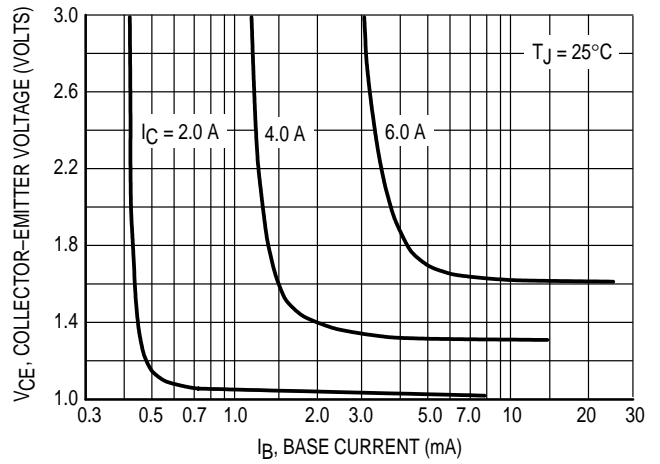
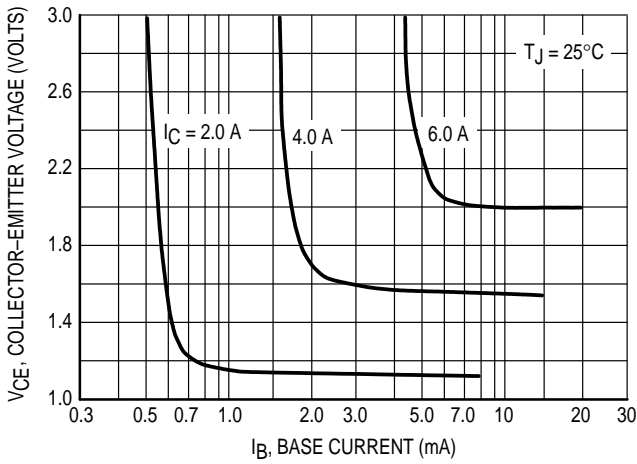


Figure 7. Capacitance

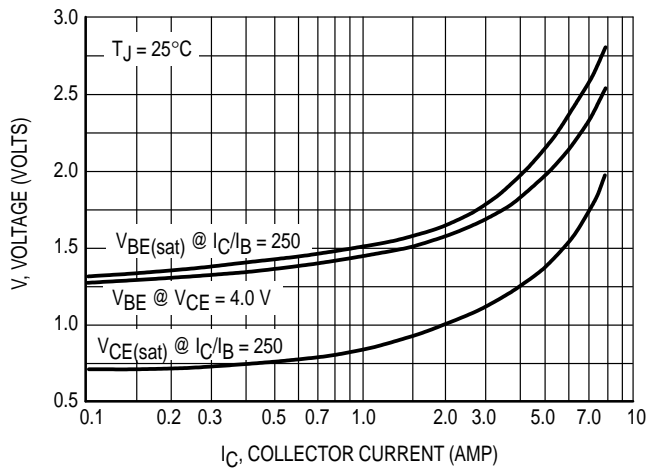
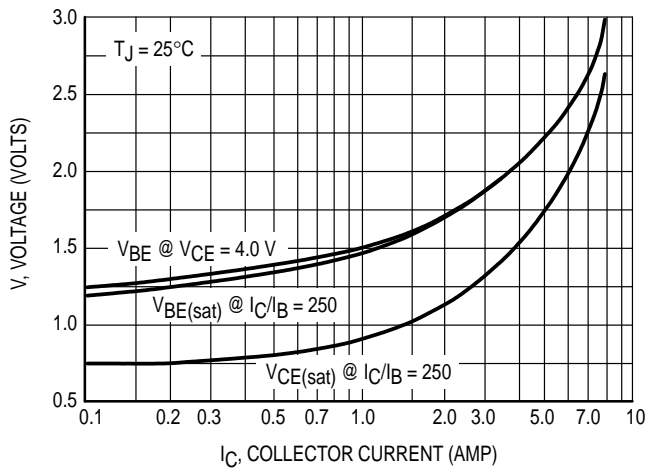
**2N6040 thru 2N6042 2N6043 thru 2N6045**



**Figure 8. DC Current Gain**

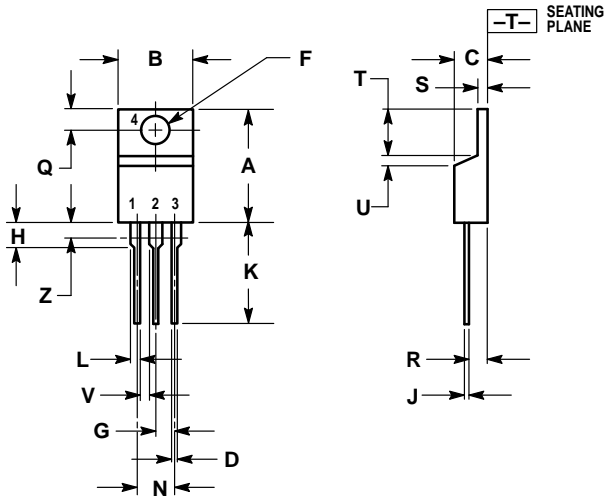


**Figure 9. Collector Saturation Region**



**Figure 10. "On" Voltages**

PACKAGE DIMENSIONS




- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.570	0.620	14.48	15.75
B	0.380	0.405	9.66	10.28
C	0.160	0.190	4.07	4.82
D	0.025	0.035	0.64	0.88
F	0.142	0.147	3.61	3.73
G	0.095	0.105	2.42	2.66
H	0.110	0.155	2.80	3.93
J	0.018	0.025	0.46	0.64
K	0.500	0.562	12.70	14.27
L	0.045	0.060	1.15	1.52
N	0.190	0.210	4.83	5.33
Q	0.100	0.120	2.54	3.04
R	0.080	0.110	2.04	2.79
S	0.045	0.055	1.15	1.39
T	0.235	0.255	5.97	6.47
U	0.000	0.050	0.00	1.27
V	0.045	—	1.15	—
Z	—	0.080	—	2.04

- STYLE 1:
1. BASE
  2. COLLECTOR
  3. EMITTER
  4. COLLECTOR

CASE 221A-06  
TO-220AB  
ISSUE Y

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