

Pinball – Electronic Component Substitutions

This guide provides information on substitutions for electronic components typically found on solid state pinball machines. This should be used as a guide; it's always best to replace with the correct component. Some circuits are more sensitive to component values than others. This list covers components that usually fail in pinball machines, which are not overly value critical.

Component/Parameter	Allowed Substitution	Notes
Resistors (typically 5% tolerance)		
- Wattage	> OK	Larger size
- Two in series	$R_T = R_1 + R_2$	Can handle 2x watts, 1K = 510 + 510
- Two in parallel	$R_T = R / 2$	Can handle 2x watts, 1K = 2K 2K
Capacitors (typically 20% tolerance)		
- Voltage	> OK	Larger size
- Ceramic/Electrolytic	No	Keep same type
- Capacitance	> usually OK for large caps ¹	Larger size
- Two in series	$C_t = C / 2$	Can handle 2x voltage, .5uF = 1uF + 1uF
- Two in parallel	$C_t = 2 * C$	10uF = 4.7uF 4.7 uF
Diodes		
- Reverse Voltage V_R	> OK	
- Forward Current I_F	> OK	
Fuses		
- Amperage	< OK	May blow prematurely
- Voltage	> OK	
- Fast / SloBlo	Fast OK for Slow ²	Likely blow prematurely
Transistors		
- C-to-E voltage V_{CE}	> OK	
- Collector current I_C	> OK	
- NPN / PNP	No	Must keep same type
- Pinout	BCE is common	Some subs may require lead cross-over
- Std vs. Darlington	No	Must keep same type
Coils		
- Power	Find closest coil on resistance chart ²	Power ~ turns & current Higher gauge = lower resistance and higher power. Less turns = higher power.
Zener Diode		
- Voltage	No	Must keep same values
- Two in series	$V_T = V_1 + V_2$	

(">" means greater, "<" means less)

¹ Large capacitors are usually low-frequency filters connected from power to ground. Small capacitors from power to ground are high-frequency filter caps and should keep the same value

² Temporary fix, correct component should be installed when available

Digital vs. Analog circuits:

A digital circuit is a special case of an analog circuit. A digital circuit tends to only have on and off states (vs. a continuously variable voltage). In a pinball machine the CPU, switch matrix, and lamp matrix are mostly digital; the sound board and amplifier are more analog. Component values are generally less critical in the digital portions.

Common Substitutions:

Type	Original Part	Substitute
Diode	1N4001 (50v), 1N4002, 1N4003	1N4004 (400v)
NPN Transistor	TIP120 (60V, 5A)	TIP102 (100V, 8A)
NPN Transistor	TIP120, TIP121	TIP122 (100V, 5A)
NPN Transistor	TIP41, TIP41A, TIP41B	TIP41C
PNP Transistor	TIP42, TIP42A, TIP42B	TIP42C

Tolerances:

Many electrical components have tolerances. For example, a resistor might have a 5% tolerance. That is, a 1K ohm, 5% resistor will actually be in the range of 950 to 1050 ohms. Usually a smaller tolerance means a more expensive part. It's OK to use a part with a smaller tolerance than the one you're replacing. For resistors you can measure a group of 20% tolerance part to find one that is in the 5% range. Capacitors typically have a 20% tolerance and it's less critical than resistors.

References:

Great Plains Electronics: <http://www.greatplainselectronics.com/>

Specializes in electronic components for pinball machines and provides substitute information for parts that are no longer available.

NTE Cross Reference: [http://nte01.nteinc.com/nte/NTEExRefSemiProd.nsf/\\$\\$Search](http://nte01.nteinc.com/nte/NTEExRefSemiProd.nsf/$$Search)

NTE provides substitute parts for many electronic components. They tend to be more expensive, but sometimes are available at a wider number of places.

Coil Resistance Chart: <http://www.flippers.com/coil-resistance.html>

Coil Resistance Chart: http://www.pinballmedic.net/coil_chart.html

Helpful information on coils that can be used to find substitutes.

Please send feedback or comments on this document to kcimming@magnaspeed.net

Electronic_component_substitutions.doc, Last updated on: June 4, 2010

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