

The Shinobi Machine

Project Specifications

- Wood exterior painted
 - No tape, glue, and screws seen from outside
 - No plastic on outside – except clear top
- 4 electromagnets with heat sinks
 - Each magnet must be strong to hold ball in place
 - Magnets must be touchable at any time
- Controlled by PLC
 - Other (non-PLC) electronics on professional PCB
- Push button for control of magnets near right paddle control
- Reset control
 - Three or more rubber band bumpers
- Loose ball at all holes behind paddles (No stuck balls)
- 3 balls per game – 2 extra balls provided
 - Use standard pinballs
- Balls must not be dropped directly on switches
- Commercial plunger (must be purchased)
- 2 hand-made mechanical paddles
- Buzzer or other primitive (non-electronic) sound when scoring
- 150 or more nails in playing field
- Single commercial power supply
 - No direct access to fan blades on power supply
 - No additional fans, besides that already on power supply
- Ball chutes – Constructed of screening material
- Dimensions: 22" x 40" x 10"-12"
 - No raised back
- Professional physical and electrical construction (wiring and connectors)
 - Overheating protection – thermal cutoff
 - Magnetic field zones marked on playing field
 - Point values for holes clearly indicated
 - No obvious toy modifications
 - 1-2 ramp(s) with a function
- Robust
 - No stuck balls and breakdowns during testing for 1 hour
 - 2 antique handles per side
 - 5 scoring holes - opening must be filleted
 - 5 or more scoring lights, 1 power light, 1 game over light
 - Must have a ball catcher
 - Table top – No legs
 - Nail holes filled in
 - Twisted wire must act solid (except magnet wire)
 - Engineering standard incorporated
 - Must work with 1/2" offset on either side of machine
 - Painted according to theme

Electromagnet Parts

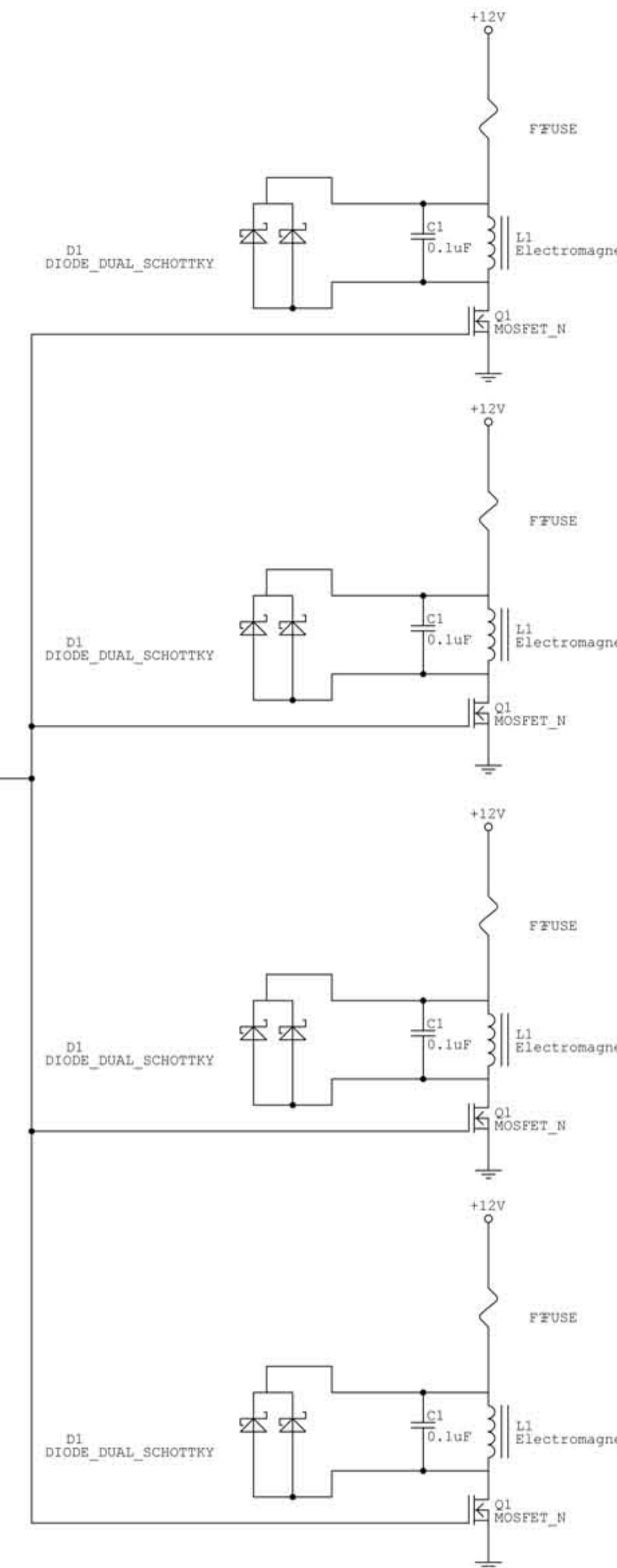
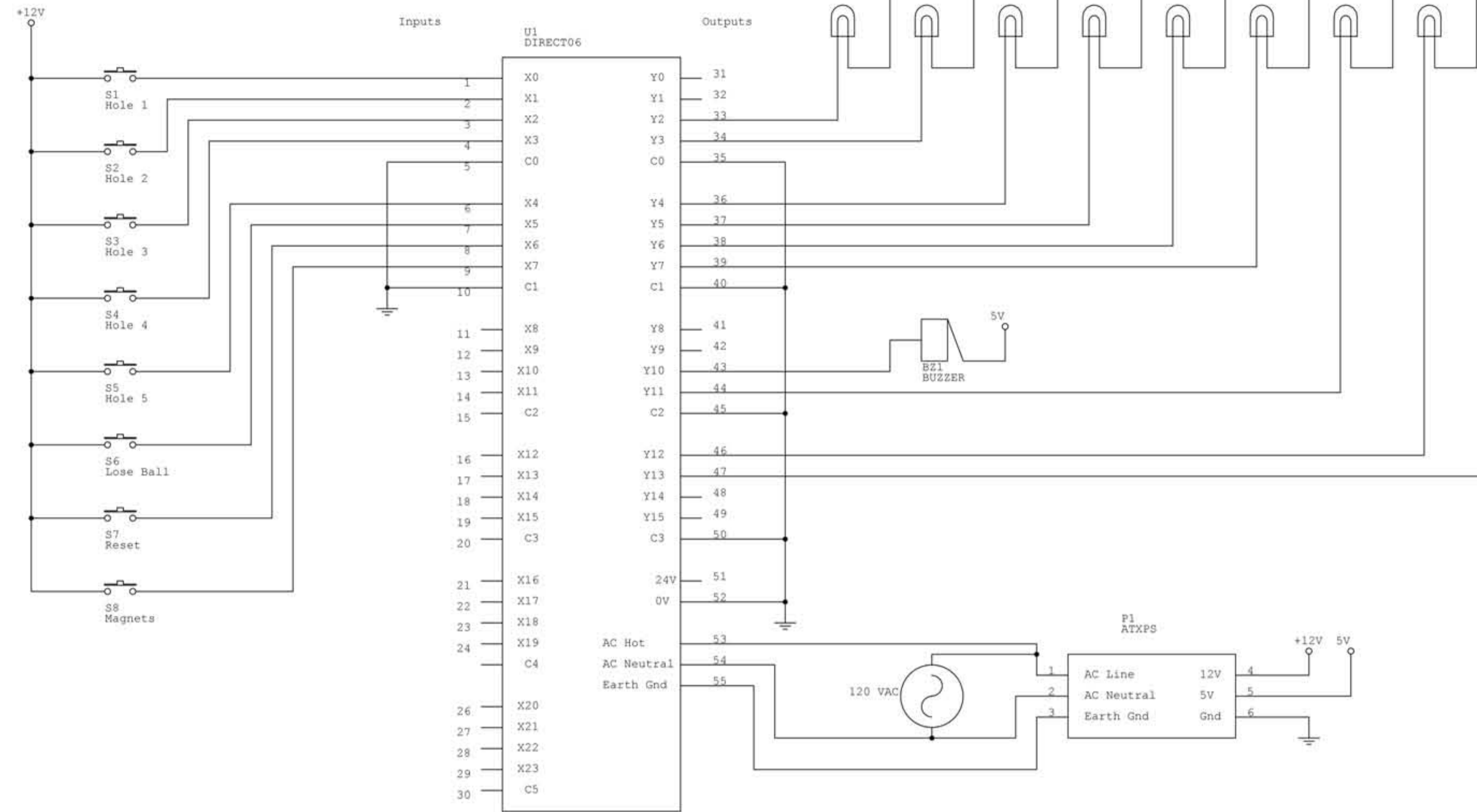
Part	Description	Part Number	Quantity Per Magnet	Vendor/Supplier	Price each	Total Price (4 magnets)
Wire	20 AWG Solid Strand, Hi Temp 200C, Copper	400ft roll item # 150375164085	800 turns, approximately 288ft	Ebay Seller: Magnet Wire USA	18.78	75.16
Bolts	1/4-20 Zinc Plated Steel		2	Jerry's Crib	Free	Free
Solid Core	12L14 CD, Cold Drawn Steel, 1" Diameter 3" Long		1	Dan Vankura	Free	Free
Threaded Rod	3/8" Diameter, Zinc Plated Steel, 5/8" Long		1	Jerry's Crib	Free	Free
Thermal Fuse	192C Opening Temperature	NTE 8182	1	All American Electronics	2	8.00

Electrical Parts

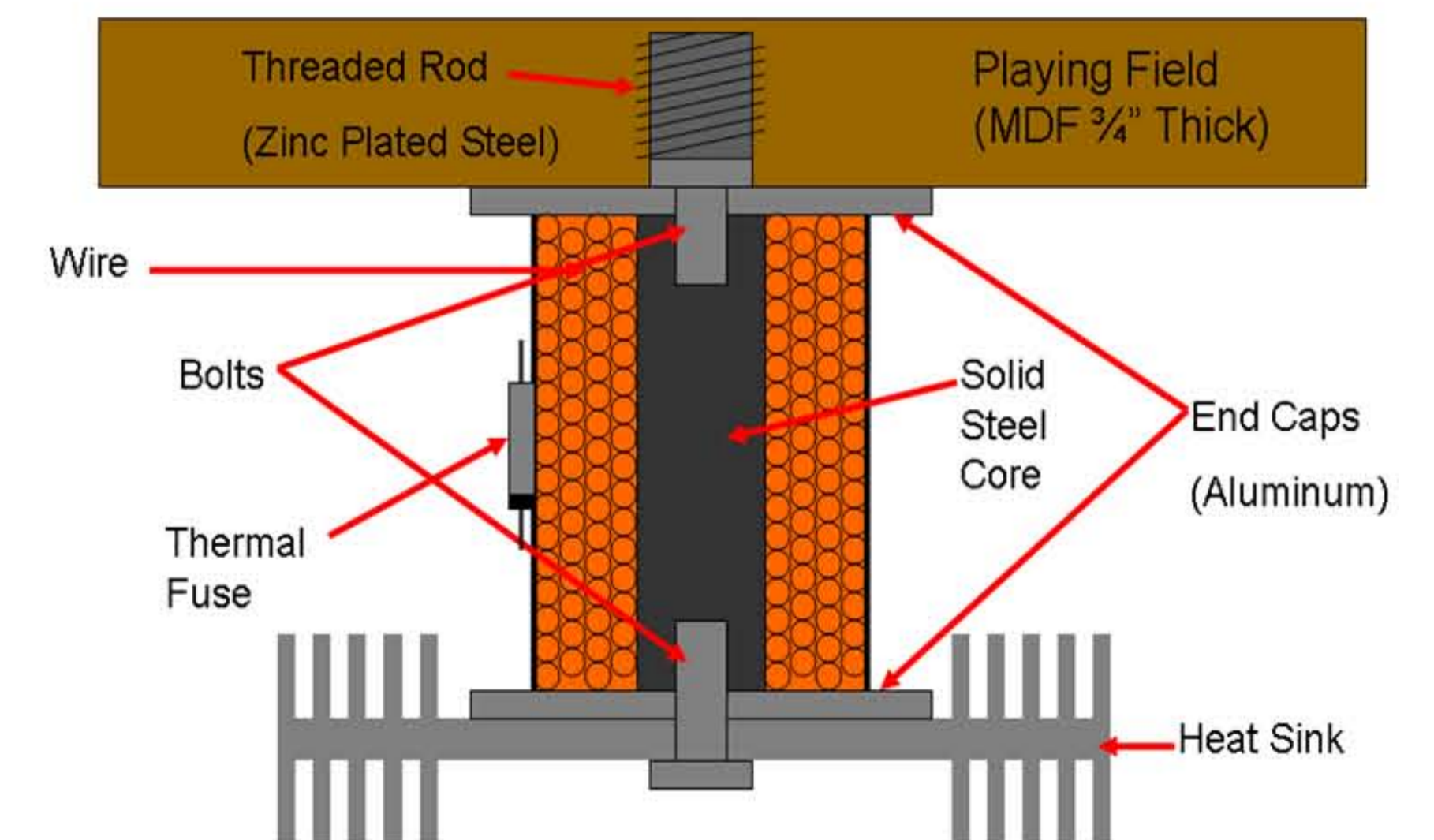
Part	Description	Part Number	Quantity	Vendor/Supplier	Price
Power Supply	ATX, 16A on 12V rail	MB6033701157	1	Jerry's Crib	Free
PLC Unit	Direct Logic 06, 20 inputs, 16 outputs	D0-06DD1	1	Automation Direct	200
Mosfets	N-MOS	NTP5411NG	4	ON Semiconductor	Free
Schottky Diodes	TO-220, dual schottky	MBR2535CTLG	4	ON Semiconductor	Free
Capacitors	0.1uF, ceramic and mylar		4	Jerry's Crib	Free
Light Bulbs	5V		8	Jerry's Crib	Free
Ball Hole Switches	Cherry		6	Jerry's Crib	Free
Reset Switch	Momentary push button	275-644	1	RadioShack	2.69
Magnet Switch	Latching momentary	275-1549 (RadioShack)	1	Jerry's Crib	Free
Buzzer	5V	273-054	1	Jerry's Crib	Free
Resistor	4.7k, pull-up resistor, axial 1/8W		1	Jerry's Crib	Free
PLC Power Wire	Shielded, stranded 18AWG		1	Jerry's Crib	Free
Magnets Wire	Stranded 14AWG, Black and White		16ft	Donated by work	Free
Misc Wire	Stranded, Purple, Black, Red		20ft	Jerry's Crib	Free
Connectors	Snap-Con wire connector	2518	7	Chromate	Free
Corrugated Tubing	3/8" diameter		10ft	Donated by work	Free

Mechanical Parts

Part	Description	Part Number	Quantity	Vendor/Supplier	Price
Wire Mesh	1/4" spacing		2x3ft	Gill-Roy's	4.85
Screws	3/4" sheet metal screws		40	Jerry's Crib	Free
Plunger	standard, chrome finish	New Style Complete	1	Lakeside Pinball	25.00
Pinballs	1 1/16" diameter	Mirror Finish	3	Lakeside Pinball	3.00
Pine Board	3/4" thick, 11" wide, 8' long		2	Home Depot	12.76
MDF Board	3/4" thick, 2x4' sheet		1	Home Depot	9.38
Handles	5" spacing		4	Home Depot	5.00
Nails	1lb 8D nails		1lb	Home Depot	3.24
Clear Coat	Clear Gloss Finish Rustoleum		1	Home Depot	3.65
Springs	From Mechatronics Lab		2	Dale Eddy	Free
Rubber Bands	Rubber Band	#64 style	1/4lb	Office Depot	2.11
Primer	Gray Primer Rustoleum		2	Home Depot	3.44
Bearings	SKF	6201 JEM	2	Jerry's Crib	Free



Electromagnet Cross Sectional View



Creators:
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Special thanks to Gerald Kozlowski for all of his help

Engineering Standard:
IEC 60364-1 Low Voltage Electrical Installations