

HPWM ON PICAXE

WANT HALF MODE TO DRIVE MAIN SWITCH.

\* HPWM OFF ; STOP

HPWM pwmhalf, polarity, dead band delay, period, duty  
0-127, 0-255, 0-1023

USES A and C OUTPUTS

pwm H H H H ; A AND C ALWAYS SAME POLARITY  
↑ ↑ ↑ ↑  
D C B A out

IMPORTANT TO USE PULLDOWN OR PULLUP RESISTOR ON OUTPUT, AS PIN WILL FLOAT BEFORE HPWM ISSUED,

UNITS OF PERIOD ARE RESONATOR FREQ / 4, SO AT 32 MHz, 8 CYCLES = 1 μS, 256 CYCLES = 32 μS

PRECISION OF DUTY = 3 1/2 ns @ 32 MHz

FREQ	MAX PERIOD	MINIMUM DUTY	MAX DEAD TIME
32 MHz	3 1/2 μS (32 KHz)	30 ns	16 μS
DIV 4	125 μS (8 KHz)	125 ns	64 μS
DIV 16	500 μS (2 KHz)	500 ns	256 μS

EXPERIMENTS SHOW THAT WITH HALF BRIDGE, A IS OUTPUT AND B IS COMPLEMENT.  
L14M2 pin 5  
L14M2 pin 6

07 MAY 15; Roderick.

WRITE PROGRAM TO TEST NPWM ON 14M2 (FIRMWARE 6.A)

OBSERVATIONS:

- 1) "A" OUTPUT IS PER SPEC SHEET, CONTROLLED BY DUTY VALUE.
- 2) "B" OUTPUT IS THE COMPLEMENT (~~NOT C OR D~~ <sup>TYPED IN SPEC 1 PLACE, AS PER SPEC</sup>)
- 3) DEADTIME VALUE IS SUBTRACTED FROM WIDTH OF BOTH A AND B.

75% DUTY CYCLE DEADTIME COUNT #	ACTIVE TIME	
	A	B
0	24 $\mu$ S	7.94 $\mu$ S
10	22.8 $\mu$ S	6.8 $\mu$ S
20	21.6 $\mu$ S	5.44 $\mu$ S

DOES DIV4 WORK? YES, BUT DEADTIME DOES NOT SCALE  
 DOES POLARITY WORK? YES, TRIED ~~LOW~~ <sup>HIGH - OK</sup> ~~LOW~~ <sup>HIGH - SAME AS HIGH</sup> ~~LOW~~ <sup>LOW - SAME</sup> PCBA, YES, ALL WORK.

ARE OTHER PINS C, D ~~NOT~~ UNTOUCHED, CAN THEY BE USED FOR OUTPUTS? YES, TRIED FORCING C AND D TO BOTH 0, 1, LOOKS FINE.

NOTE: IF USING PWM DIV4, DEADTIME DOES NOT SCALE, BUT CAN GET MORE DEADTIME BY SLOWING PROCESSOR WITH SETFREQ

OPTOCOUPLER SELECTION

- WANT HIGH CURRENT CAPABILITY
- ACTUALLY, JUST WANT FAST RESPONSE TIME, 5μS OR LESS
- CURRENT TRANSFER RATIO, CTR, NOT IMPORTANT, BUT 100% WOULD BE NICE.
- COLLECTOR-EMITTER MUST TOLERATE 20V OR MORE
- CANNOT HAVE SEPARATE V<sub>CC</sub>

RESPONSE TIME IS LIKELY LIMITING CRITERION,

SFH618A	t <sub>on</sub> = 6μS TIP	CN417 } t <sub>on</sub> = 3μS SFH600 } t <sub>off</sub> = 20μS FROM SATURATION.
V0618A	t <sub>on</sub> = 2μS TIP	
4H38	t <sub>on</sub> = 5μS	↓ COULD BE OK.
X 4H35	t <sub>on</sub> = 10μS TOO SLOW	
SFH6156	32μS	
SFH690	58μS	
SFH 620A } 6206 }	3μS	
SFH 617A	3μS	
SFH610A	3μS	
4H28 } 4H25, 26, 27 }	ABOUT 5μS? CHEAP	
4H35, 4H37 }	~ <del>5μS</del> 10μS X	
VOM617-21 } V0610A }	- NOT SAT t <sub>on</sub> = 6μS, SAT t <sub>on</sub> = 9μS	R <sub>L</sub> = 1000 Ω SAT t <sub>on</sub> = 9μS

22 MAY 2015

Roderick

# HPWM SYNCHRONOUS RECT EXPERIMENT - 2

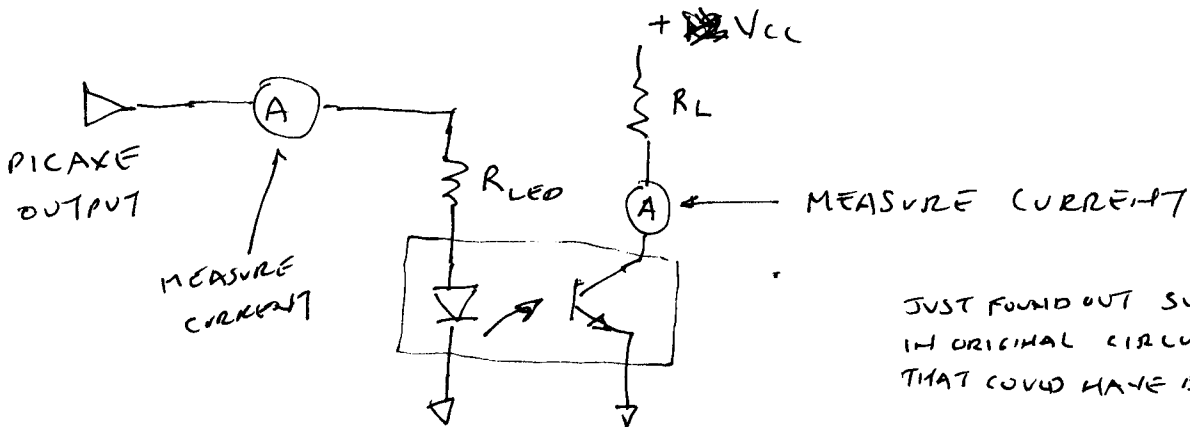
TRIED CIRCUIT w/ hpwm B NOT CONNECTED,  
 AS EXPECTED, FINAL VOLTAGE LEVELS OFF AT ABOUT 20V,  
 SCOPE SHOWS MAIN INDUCTOR ZOOMING BACK TO -24V, A  
 SIGN THAT SYNC RECT NOT TURNING OFF.

CONNECTED UP hpwm B, NO EFFECT, COULD BE THAT  
 OPTOISOLATOR IS TAKING TOO LONG TO TURN ON, WILL TRY  
 REDUCING DEADTIME.

deadtime = 20 (5  $\mu$ s)

duty = 400 (25  $\mu$ s)

15 JUN 2015, OPTOISOLATOR DOESN'T APPEAR TO BE MAKING ANY DIFFERENCE,  
 COULD BE THAT I'M USING PARTS SALVAGED FROM OLD POWER SUPPLY,  
 AND I BURNED THEM OUT DURING DESOLDERING? ONLY TRIED ONE  
 PART, SHOULD RUN STATIC TEST ON ALL 3!



JUST FOUND OUT SUPPOSED 262 $\Omega$   
 IN ORIGINAL CIRCUIT WAS 2.62K  
 THAT COULD HAVE BEEN IT.

$R_{LED} = 262\Omega$ ,  $R_L = 262\Omega$  ALSO.  $V_{CC} = 5V$   
 PUT TOP OF  $R_{LED}$  DIRECTLY TO 5V INSTEAD OF PICAXE OUTPUT.

MEASURED 13.1 mA AT OUTPUT. INPUT CURRENT - 13.7 mA

SOURCED FROM PICAXE OUTPUT, 10.7 mA

TRY OTHER PARTS, 262 DIRECT TO 5V ON INPUT.

PART A: 12.24 mA, B: 13.78 mA, C: 13.28 mA

CONCLUDE:  
 PARTS NOT  
 DAMAGED.

HPWM SYNCHRONOUS RECT EXPERIMENT.

PROGRAM PUTS OUT BURST OF PULSES THROUGH hpwm

setfreq m16

deadtime = 40 → 10 μS

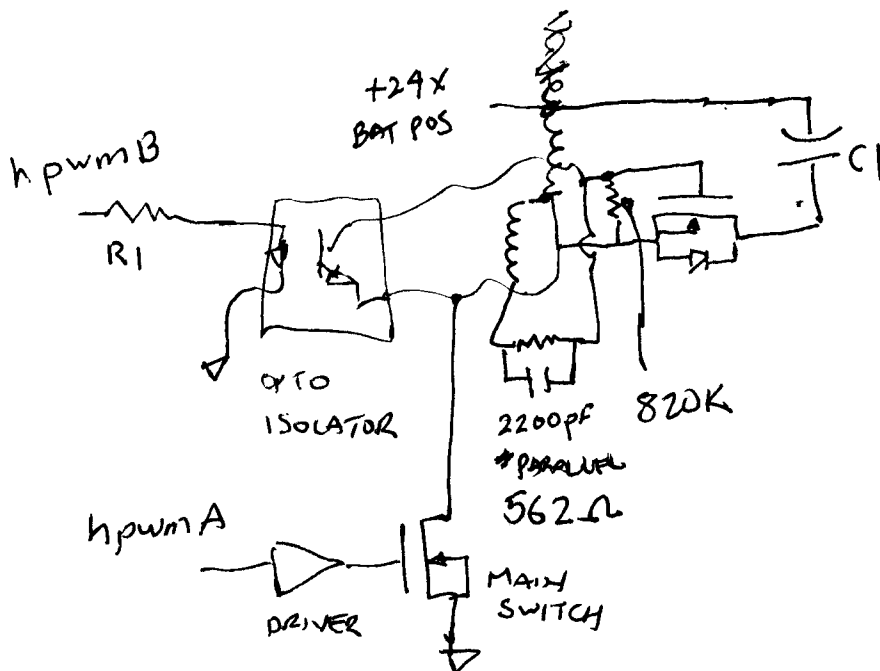
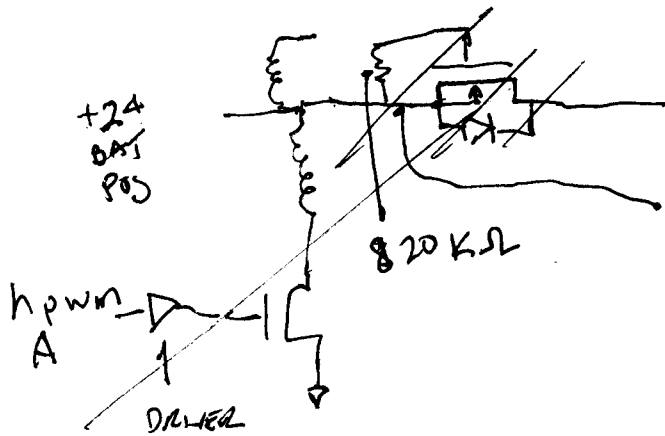
period = 255 → 64 μS

duty = 480 → 30 μS ~~PULSE~~ - 10 μS DEADTIME = 20 μS PULSE

hpwm pwmhalf, pwmHHHH, deadtime, period, duty

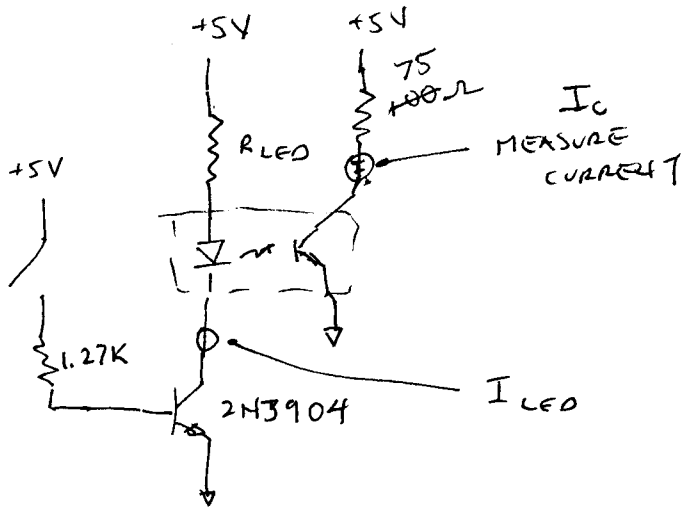
pause 48

hpwm off



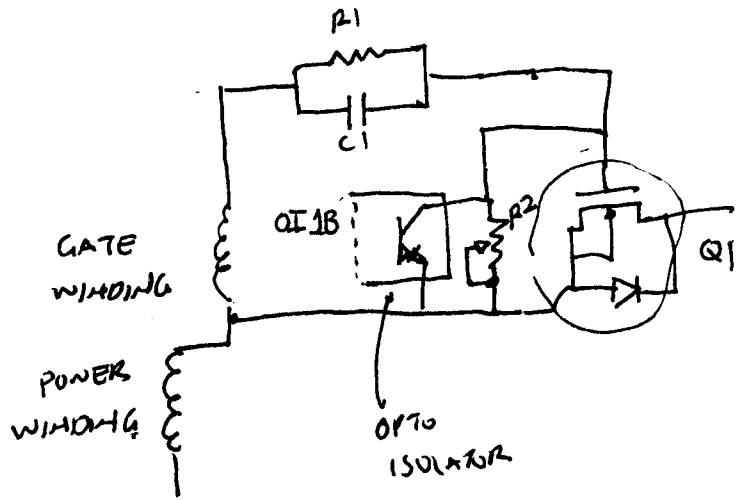
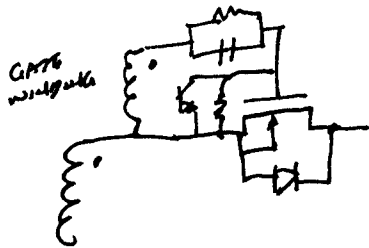
FIRST, TOOK TRACE WITH GATE OF SYNG RECT JUST TIED TO GROUND. VOLTAGE ACROSS C1 TAKES ~ 10.1 MS TO GO 0 → 30.0 VOLTS

TRY:



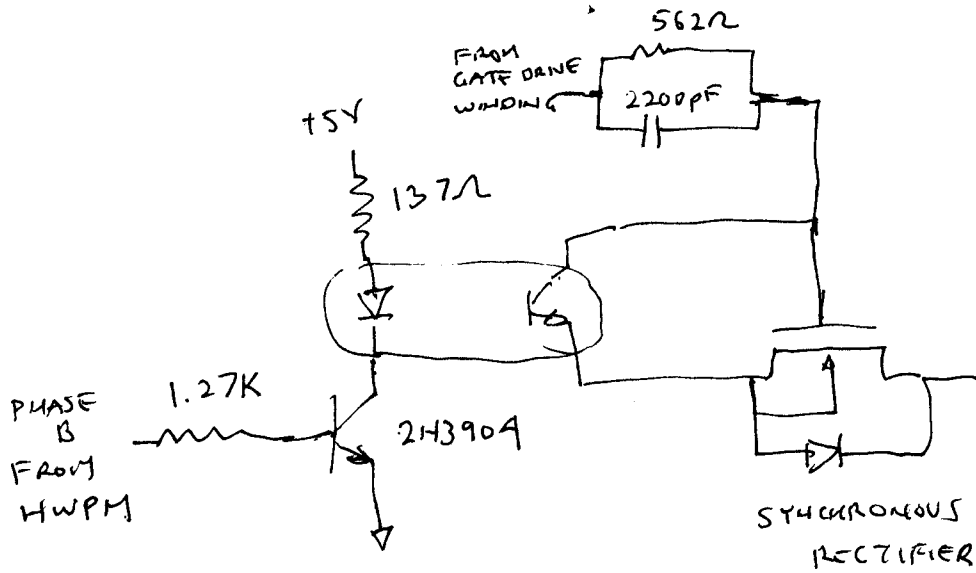
$R_{LED} = 137\Omega$       $I = 24.7\text{ mA}$       $I_{LED} = 25.8\text{ mA}$   
 $68\Omega$               $29.3\text{ mA}$               $49.1\text{ mA}$

IN REAL CIRCUIT, CAN PUT MULTIPLE LEOS OF OPTOISOLATORS IN SERIES.



- ARRANGEMENT ALLOWS
1. USE OF OPTO ISOLATOR IF DESIRED
  2. PASSIVE PULSE LIMITING IF DESIRED
  3. DISABLE SYNC RECTIFIER IF DESIRED

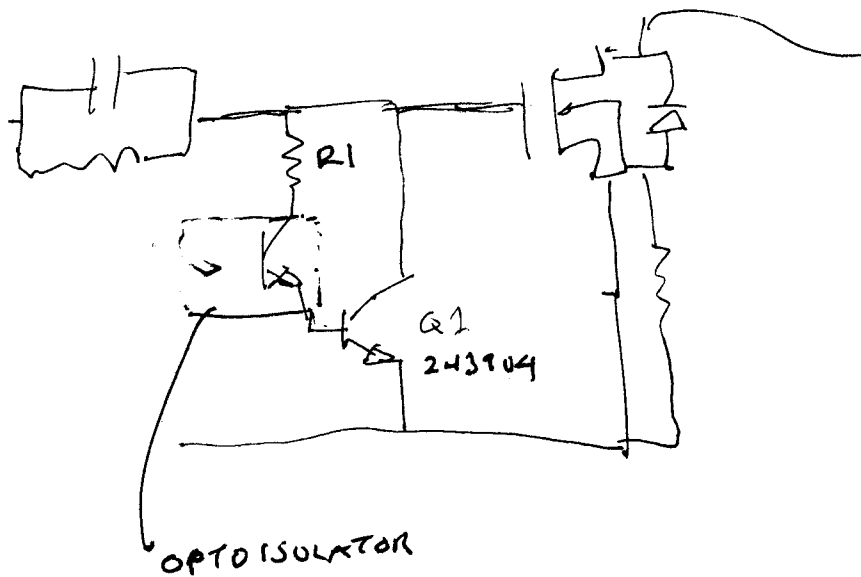
TRIED EXPERIMENT, DRIVING SALVAGED P721F OPTOCOUPLER TO TURN OFF SYNCHRONOUS RECTIFIER GATE PULSE, ~~USED~~



OPTOISOLATOR SEEMS TO STAY CONSTANTLY ON, THE SALVAGED ISOLATORS I HAVE SAY "P 721F" ON THEM - SUSPECT THEY ARE TLP721F. TOSHIBA DATA SHEET DOES NOT EVEN SHOW SWITCHING CHARACTERISTICS - PROBABLY DESIGNED ONLY FOR PRECISION CURRENT TRANSFER. LOOKING AT OTHER PARTS

Are You Crazy About This Soup...? \$7.99 Lunch 2 for \$17.99 lunch beverages

FOUND LOOSE, DSC WIRE IN ATX1C



Q1 CAN'T  
SATURATE —  
DARLINGTON  
ISSUE ACTUALLY  
HELPS

$$R1 = 1.27k$$

NAKED OPTOISOLATOR DOES NOT HAVE AN ENOUGH DRIVE TO  
TURN OFF SYNC RECT QUICKLY ENOUGH, ABOUT SAME AS  
PLAIN RESISTOR, TRY THE CIRCUIT ABOVE, STARTING  
TO GET COMPLICATED IF CIRCUIT MUST BE REPLICATED  
12 TIMES ← ONCE FOR EACH CELL.

RESULTS NOT GOOD. ~~TOO~~ OPTO GETS SATURATED IF IT CAN  
TURN ON AT ALL, THEN KEEPS Q1 ON TOO LONG, MAYBE  
TRY OPTO WITH DIODE OUTPUT?



09 JUL 2015;

Roderick,

OPTO ISOLATOR CUTOFF FOR GATE DRIVE DOES NOT SEEM PRACTICAL. FOR FAST OPTOCOUPERS, NEED A POWER SUPPLY, WHEN I USE JUST A PLAIN 4-PIN COUPLER, I WANT THE TRANSISTOR TO TURN ON HARD FOR GOOD RESPONSE. BUT THEN, IT SATURATES, AND WON'T TURN OFF IN THE TIME OF A FEW  $\mu$ S ALLOWED.

WILL GO WITH ENTIRELY PASSIVE GATE DRIVE.

HOW ABOUT USING A SCHOTTKY IN PARALLEL WITH TRANSISTOR? A SCHOTTKY DIDN'T WORK WELL BEFORE, BUT I NOW REALIZE I WAS PROBABLY EXCEEDING THE REVERSE VOLTAGE, AND IT WAS BREAKING DOWN, WILL TRY NTST30120 CTG - 30A, 120V. FIRST, TAKE REFERENCE READING ON BODY DIODE CIRCUIT ALONE - MD SYML RECT DRIVE. 258 PULSES TO GET TO ADC VOLTAGE OF 1007 IN PROGRAM

~/PICAXE/rectifier\_efficiency\_test.bas.

256 PULSES WITH SCHOTTKY. TRY AGAIN. 245 PULSES, TRY AGAIN. 244. REMOVE SCHOTTKY (BODY DIODE ONLY), 252. AGAIN. 251. AGAIN. 246. AGAIN. 248.

→ SCHOTTKY RATED FOR 20V ONLY, PROBABLY BREAKING DOWN