Simplest Sparky Operation

I was thinking after reading several posts here and on other web sites; "what is the very simplest ignition board that I can come up with that can be used by points, Hall-Effect, and inductive pickups and have adjustable dwell so it can be used with different coils".

During my 39 years of working with electronics I've seen all kinds of different things but there are certain parts I always come back too to get things working. These are the 555, 556, and the CD4047B which are basically timer IC's. The one I use for my ignitions is the CD4047BE which is a multivibrator and here I use it as a non-retriggerable one-shot monostable multivibrator. What this means in this setup is that it cannot be retriggered until the present output pulse is finished. In this configuration it is normally used in noise cancellation circuits. This has the added benefit of de-bouncing switches such as points. In today's world we just program MCU's to do the de-bounce.

This little circuit board has the following features:

<u>For both Hall-effect, Points and Inductive Pickup</u>
- once triggered cannot be retriggered by noise until current pulse is finished.
- circuit basically shuts off after it puts out a firing signal even if the points or Hall-Effect stop and hang on trigger out.
- can run from 4 – 18 volts depending on ignition coil.
- adjustable dwell, needed for different ignition coil types.
- when using the trailing edge of the input signal it will automatically advance the timing.
- can be set to give a positive or negative output pulse whichever is needed.
- timing NOT affected by rpm using leading edge, UNLESS you want it too by using trailing edge.
- use the CD4047B to adjust the dwell (coil charge time).
- only use the parts you need and just use wire jumpers for those you don't.

For just POINTS
- no input capacitor required, CD4047B takes care of bounce.
- trigger from points opening or closing.

For Inductive Pickup and all others
- The CD4047B needs an input signal of at least 3.5 volts when running on 5 volts. 7 volt input signal when running on 10 volts and 11 volt input when running on 15 volts.

Best to have the Simplest Sparky Overview Schematic.pdf open to follow along now.

Parts List BOM <u>Approx, price, it depends on how many you buy and where</u>:

#	RefDes	Value	Name	Manufacturer	Quantity	Man. Part #	Part Number (Digi-Key)	Price Approx.
1	BDR	Board						$5.000
2	C1	0.1uf	CAP ALUM 0.1UF	Würth Elektronik	1	860020672001	732-8847-1-ND	$0.118
3	C2	100uf	CAP ALUM 100UF 20% 25V RADIAL	Würth Elektronik	1	860010473007	732-8630-1-ND	$0.141
4	C3	0.1uf	CAP CER 0.1UF 50V X7R RADIAL	KEMET	1	C322C104K5R5TA7301	399-9877-1-ND	$0.150
5	IC1	CD4047B	4047N (4047)	Texas Instruments	1	CD4047BE	296-2053-5-ND	$0.733
6	J1	3 Pos Jumper	CONN HEADER VERT 3POS 2.54MM	Sullins Connector Solutions	1	PREC003SAAN-RC	S1012EC-03-ND	$0.120
7	LED		LED		1			$0.100
8	Q1	TO220AB	TRANS NPN 400V 8A TO220AB	WeEn Semiconductors	1	PHE13007,127	1740-1443-ND	$0.793
9	R1	10k	CFR-12JB-52-10K	Yageo	1	YAGEO_CFR-12	10KEBK-ND	$0.140
10	R2	10K	CFR-12JB-52-10K	Yageo	1	YAGEO_CFR-12	10KEBK-ND	$0.140
11	R3	10k	CFR-12JB-52-10K	Yageo	1	YAGEO_CFR-12	10KEBK-ND	$0.140

12	R4	100K	TRIMMER 100K OHM 0.5W PC PIN TOP	Nidec Copal Electronics	1	CT94EY104	CT94EY104-ND	$2.250
13	R5	220	LED 1/8 Watt Resistor	Stackpole Electronics Inc	1	CF18JT220R	CF18JT220RCT-ND	$0.140
14	SW/JP2	SWITCH SLIDE DPDT	SWITCH SLIDE DPDT 300MA 6V	C&K	1	CK_JS202011CQN	401-2001-ND	$0.684
15	HE1	Hall Effect 3-SIP	MAGNETIC SWITCH UNIPOLAR 3SIP	Diodes Incorporated	1	AH3366Q-P-B	AH3366Q-P-BDI-ND	$1.39
16	Mag	Magnet			1			$2.00
				Parts Count	16		Total	$14.039

My selling price is $20.00 CAD to cover my shipping, taxes, and handling.

So let's look at the parts in the order of above:

#1 BDR Board, well it's a double sided 2 layer board with copper fills/pours for noise reduction. Just a standard FR4 board that I increased the runner widths so the runs don't get pulled up during soldering. I also spaced things out and kept it small, it's only 1.25" W x 2.00" L (31.75mm x 50.83mm). There is no voltage regulator or a polarity check diode on the input do be careful when applying power.

#2 & #3, C1 & C3 these are noise filtering for when using a Hall-Effect and can be left open if using points and inductive setups.

#4 & #5, C3 & R4 these 2 set the dwell time by turning on Q1which charges the ignition coil. Coil will fire when Q1 is turned off.

#5 IC1, This is the CD4047BE which controls the timing of the rest of the circuit. Working voltage is 3 t0 18 but, using my coils the circuit won't fire below 4.1 volts @ 300ma. After the output trigger is finished the CD4047BE will turn off until it sees the next transition input signal that you select, whether it be a positive going or negative going input pulse.

#6 J1, The 3 position jumper. This is used to select either a positive or negative output pulse depending if you are using 'N' or 'P' channel Transistor, IGBT, or MOSFET.

#7 LED, The firing out LED. This one shows the output signal from the CD4047BE and which LED you use is up to you but current needs to be limited to around 20-40ma.

#8 Q1, I chose a transistor because it is the easiest to control and we don't need to a ton of amps or need to use an ignition coil driver. This transistor has a Collector-emitter voltage peak value of 700 volts to handle back EMF, can handle Collector current (DC) of 8 amps and a peak of 16 amps, and a Fall time of 40ns, the faster the better. This is one kick-ass transistor for a small ignition.

#9 & 10 R1 & R2, These are only needed for when using points, actually you only need one of them. Which one you use for points depends on you, if you want a positive going pulse-in then use R1 and for negative going then use only R2, jumper out the one you're not using. See overview schematic.

#11 R3, You only need R3 if you are going to use a Hall-Effect. R3 is a pull-up resistor otherwise leave open.

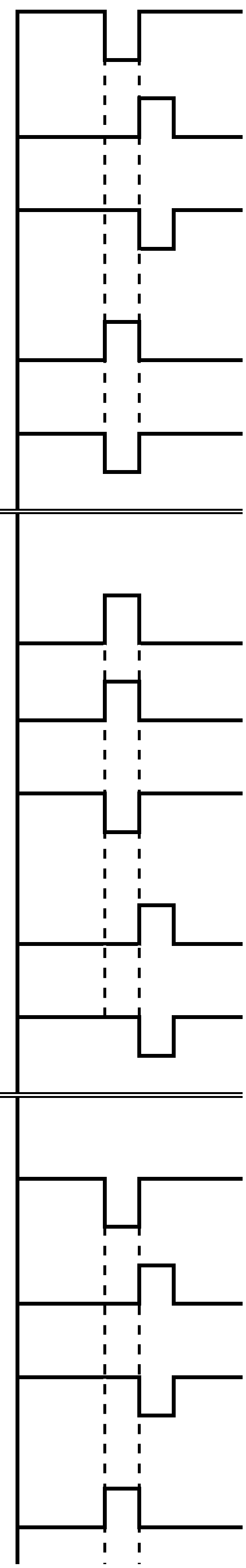
#12 R4, See #4 above.

#13 R5, This limits the current flow through the LED and also helps set the voltage bias on the base-emitter of Q1. Use 220 ohm for 5v and above 7 volts use 560 ohm.

#14 SW/JP2, You can either use a switch or use wire jumpers if you know what input signal you want to use.

#15 HE1, The AH3366Q-P-B is just one of many that will work. But this one will work from 3V ~ 28V.
Below is the timing chart of the CD4047BE input and output options and I hope this will help to clear things up. If you use the leading edge of the signal-in, whether it is a positive or negative going pulse the timing will be fixed. On the other hand if using the trailing edge this will cause the timing to advance with RPM because the pulse width will shrink.

Simplest Sparky Timing Chart



Hall-Effect Output

+T Input/Q Output
SW/JP 3 to 2 & 6 to 5. **J1** 2 to 3

+T Input/Q NOT Output
SW/JP 3 to 2 & 6 to 5. **J1** 1 to 2

-T Input/Q Output
SW/JP 1 to 2 & 4 to 5. **J1** 2 to 3

-T Input/Q NOT Output
SW/JP 1 to 2 & 4 to 5. **J1** 1 to 2

Points Output High Side Resistor
Points Opening And Then Closing

+T Input/Q Output
SW/JP 1 to 2 & 4 to 5. **J1** 2 to 3

+T Input/Q NOT Output
SW/JP 1 to 2 & 4 to 5. **J1** 1 to 2

-T Input/Q Output
SW/JP 3 to 2 & 6 to 5. **J1** 2 to 3

-T Input/Q NOT Output
SW/JP 3 to 2 & 6 to 5. **J1** 1 to 2

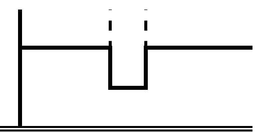
Points Output Low Side Resistor
Points Opening And Then Closing

+T Input/Q Output
SW/JP 3 to 2 & 6 to 5. **J1** 2 to 3

+T Input/Q NOT Output
SW/JP 3 to 2 & 6 to 5. **J1** 1 to 2

-T Input/Q Output
SW/JP 1 to 2 & 4 to 5. **J1** 2 to 3

-T Input/Q NOT Output
SW/JP 1 to 2 & 4 to 5. **J1** 1 to 2



As RPM goes up the Hall-Effect, points, and inductive pickup will have less time to make the input signal to the CD4047BE. The start of the signal never changes position but because of the less time the trailing edge will move towards the leading edge. So if you use the trailing edge the timing will automatically advance. The amount of advance depends mainly on how close the magnet is to the pickup. For points and inductive it is the gap.

More on the #14 SW/JP2. To use jumpers just follow the overview schematic showing of how the switch arms work.

To control the current flow and amount the best way is to use R4 to adjust the amount of dwell time (charging time). How much dwell you need depends on the source voltage and the size of the ignition coil's primary winding, its inductance size and not it's physical looking size. You have to play with the dwell time or even change ignition coils to get the current draw that you want. The coil's primary resistance also helps to control the current flow. The coil's inductance in Henery's is closely related to its resistance. Also if need be you can put a resistor inline with the positive side of the coil.

Options:

For the IGBT I originally used an IRG4BC15UD-L but, this is now obsolete so I don't know what other IGBT will work until I do some testing. I also want to try some MOSFETs. I will post the new chosen one's number and values. The IRG4BC15UD-L had some nice features like:
- UltraFast: Optimized for high frequencies from10 to 30 kHz in hard switching
- IGBT Co-packaged with ultra-soft-recovery antiparallel diode,
- High noise immune "Positive Only" gate drive- Negative bias gate drive not necessary
- For Low EMI designs- requires little or no snubbing
- Single Package switch for bridge circuit applications
- Compatible with high voltage Gate Driver IC's
- Allows simpler gate drive

Coil options. There are different ways to connect the ignition coil but it will depend in whether your coil has a shared (-) negative or ground lead. I have shown both types on the overview.

Points option, I think I explained this in above statements.

Hall-Effect option, there are many different ones that will work but the one I have chosen is activated by a south pole and will work with voltage from 3V ~ 28V. The A1102EUA is also a good one. Remember you want to use a switching type and NOT a latching one.

I'll get this board made in the next bunch.

Contact me by PM-ing or at rrichter@unimatrixtech.com

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