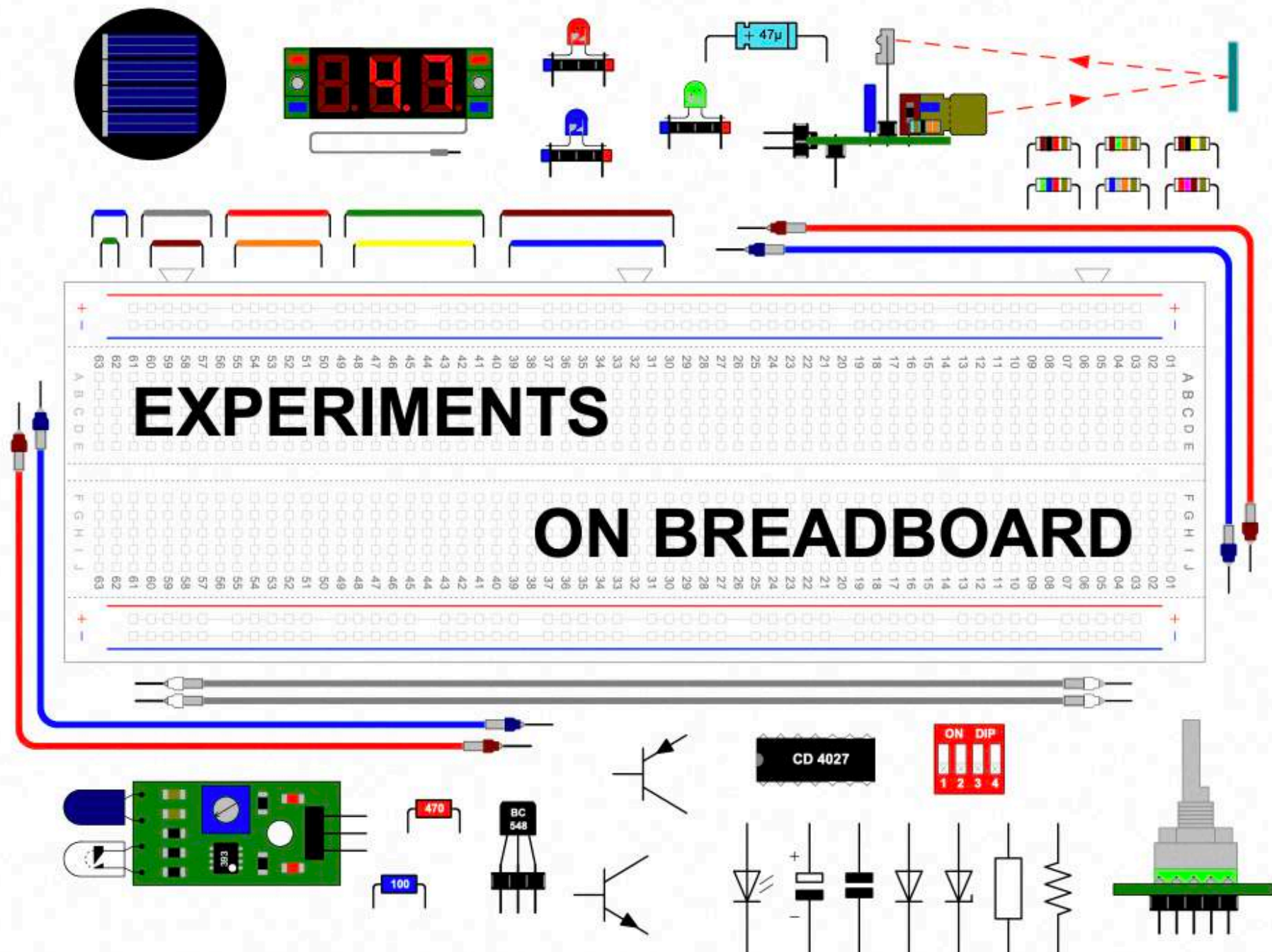




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SAMPLE BROCHURE

A MEANINGFUL SELECTION OF WORKSHEETS WITH SCHEMATICS AND
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	A4	udo@elgers.com	ue-ERT20220204-00	04-FEB-2022
	A	SAMPLE BROCHURE		

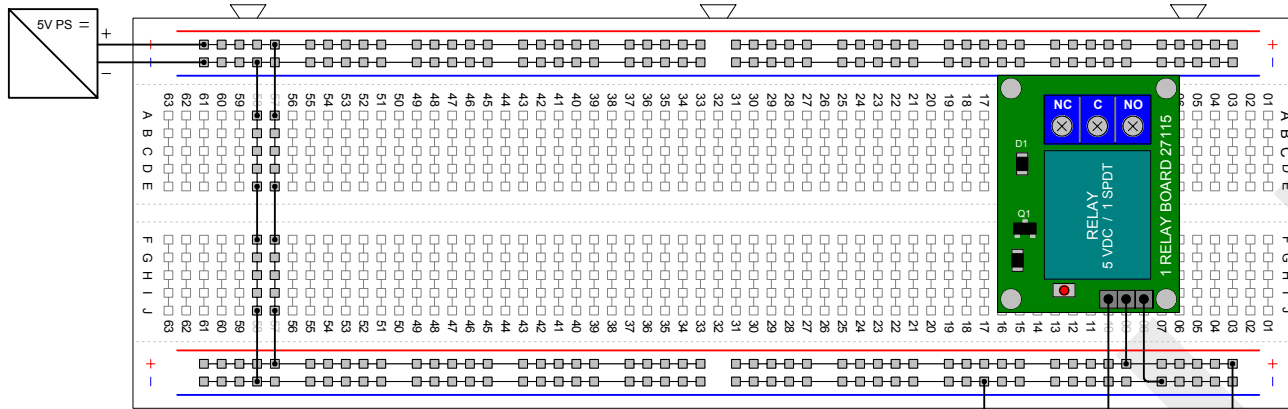
www.retro-circuits.com

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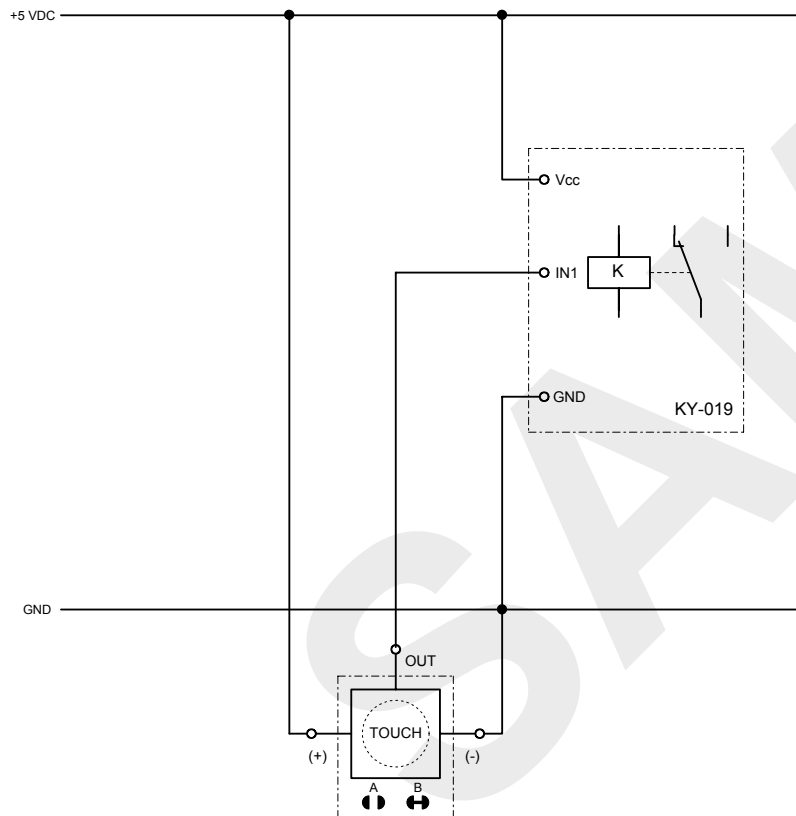
Bad Bentheim, 4th. FEB 2022

Udo Elger

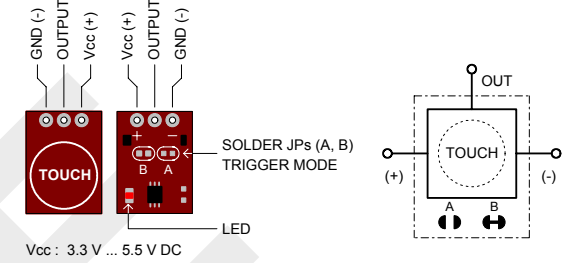
Impressum: (Legal Information)
Udo Elger
48455 Bad Bentheim / Kuhlenskamp 22
Germany
Email: info@retro-circuits.com



TTP223BA-6 - TEST CIRCUIT "TOGGLE MODE / POWER ON STATE = LOW (0)"
USING AS ON/OFF CONTROL FOR 5 VDC RELAY MODULE KY-019



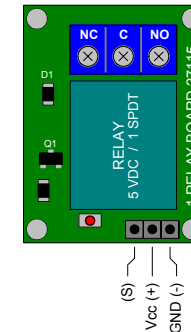
TTP223 CAPACITIVE TOUCH SENSOR:



TRIGGER MODE SOLDER JPs

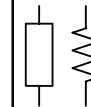
A	B	OUTPUT
		DIRECT MODE / ACTIVE HIGH (1) OUTPUT
		DIRECT MODE / ACTIVE LOW (0) OUTPUT
		TOGGLE MODE / POWER ON STATE = LOW (0)
		TOGGLE MODE / POWER ON STATE = HIGH (1)

RELAY MODULE KY-019:

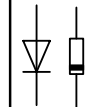


...HIGH LEVEL TRIGGER

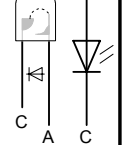
RESISTOR:



DIODE: 1N4148

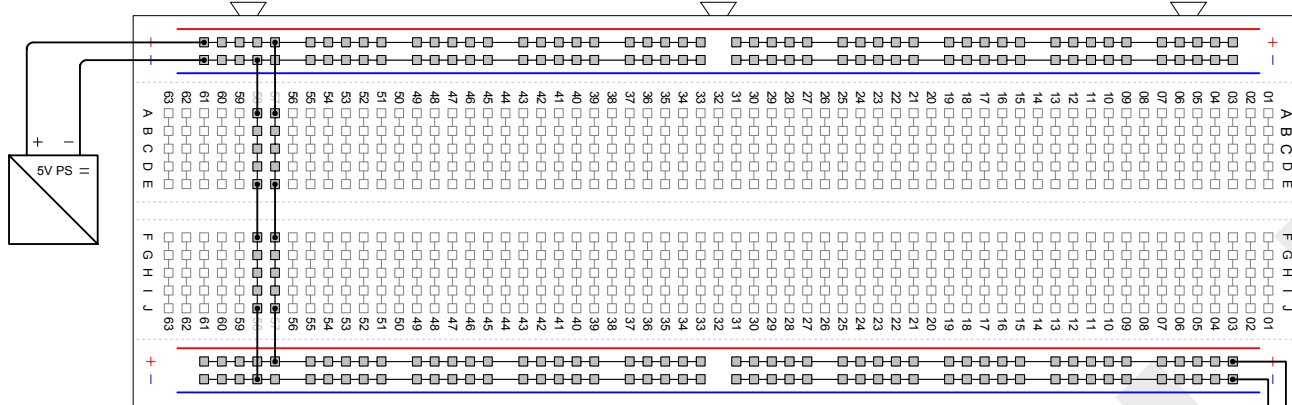


LED:

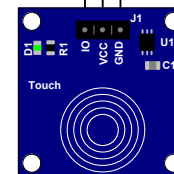
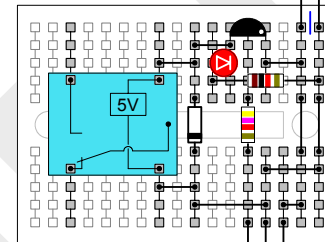
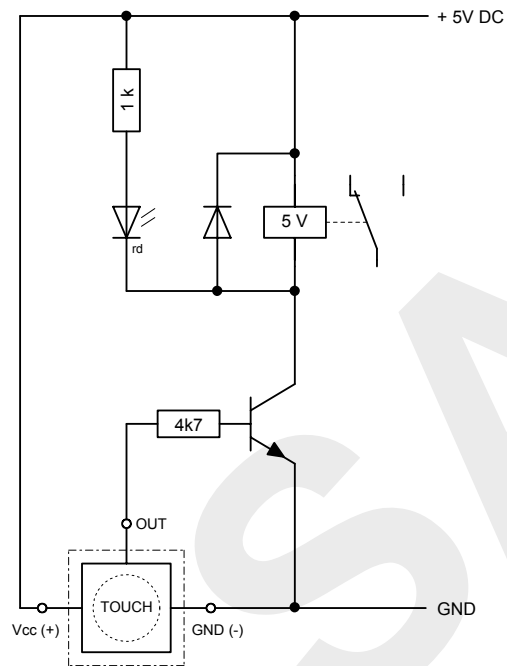


FOR FULLY COMPONENT SPECS. SEE
MANUFACTURER DATASHEETS

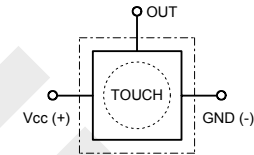
CT1	A4	udo@elgers.com	ue-ERT20210206-15	06-FEB-2021
020	A	TTP223BA-6 - EXPERIMENT 15		



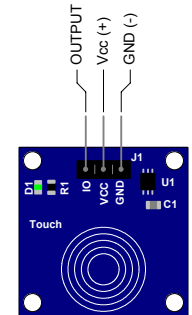
TTP223B - MOMENTARY ON/OFF TRANSISTOR CONTROL FOR 5 VDC RELAY



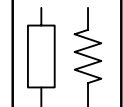
TTP223B CAPACITIVE TOUCH SENSOR:



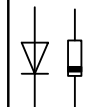
DEFAULT - NO JUMPER
DIRECT MODE -
ACTIV HIGH (1) OUTPUT



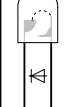
RESISTOR:



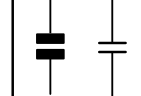
DIODE:
1N4148



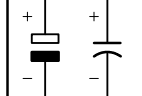
LED:



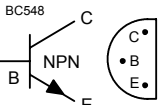
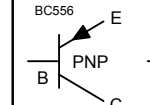
CAPACITOR:



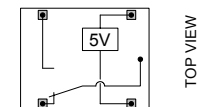
POLARIZED CAPACITOR:



TRANSISTOR:



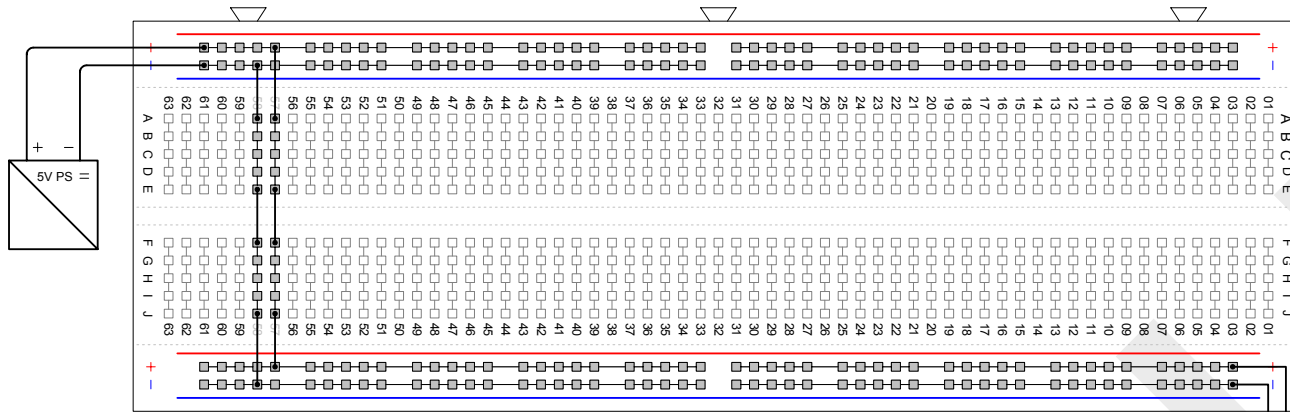
RELAY SRD-05VDC-SL-C:



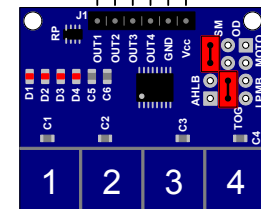
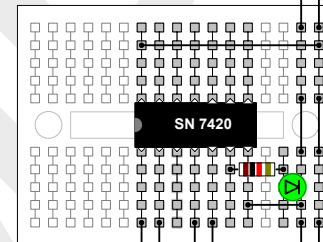
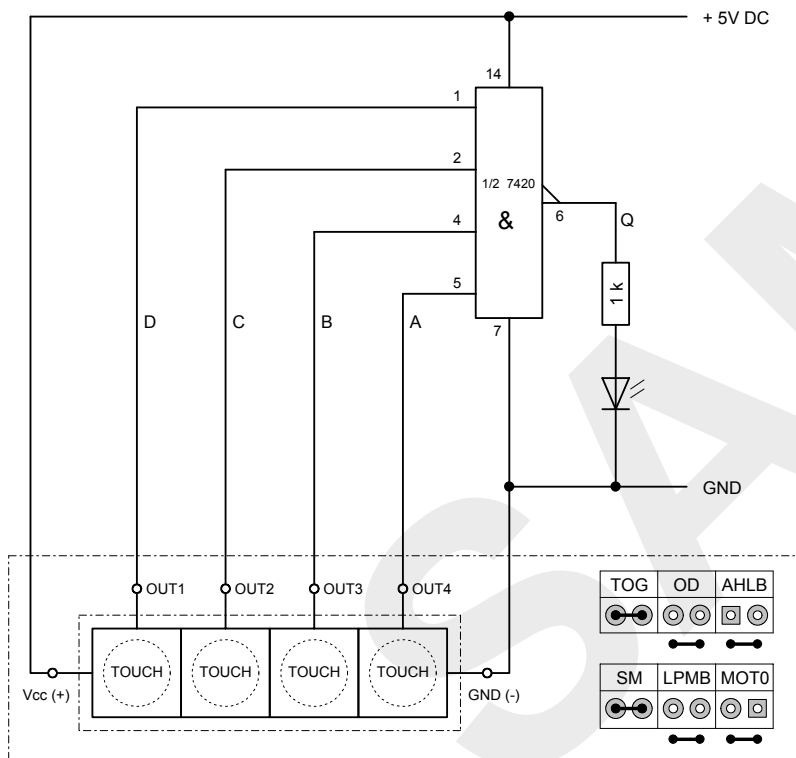
05 VDC / 10 A - 250 VAC

FOR FULLY COMPONENT SPECS. SEE
MANUFACTURER DATASHEETS

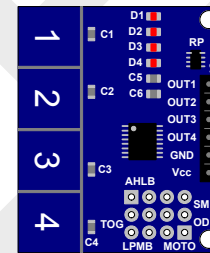
CT2	A4	udo@elgers.com	ue-ERT20210203-03	03-FEB-2021
016	A	TTP223B - EXPERIMENT 11		



TTP224 CAPACITIVE TOUCH SENSOR CIRCUIT OPERATING 4-INPUT TTL NAND GATE



TOG	OD	AHLB	OUTPUT CONFIGURATION - JP
☐	☐	☐	TOGGLE MODE POWER ON STATE = 0
☐	☐	☒	TOGGLE MODE POWER ON STATE = 1
SM	☒		SINGLE - KEY OPERATION MODE
MOT0	☐		DISABLE MAXIMUM KEY ON TIME
LPMB	☐		LOW POWER MODE



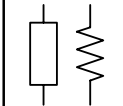
OUTPUT 1
OUTPUT 2
OUTPUT 3
OUTPUT 4
GND
Vcc (+)

SN 7420 TRUTH TABLE

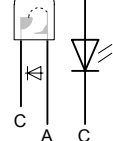
	D	C	B	A	Q
0	0	0	0	0	1
1	0	0	0	1	1
2	0	0	1	0	1
3	0	0	1	1	1
4	0	1	0	0	1
5	0	1	0	1	1
6	0	1	1	0	1
7	0	1	1	1	1
8	1	0	0	0	1
9	1	0	0	1	1
10	1	0	1	0	1
11	1	0	1	1	1
12	1	1	0	0	1
13	1	1	0	1	1
14	1	1	1	0	1
15	1	1	1	1	0

0 = LOW "LED OFF"
1 = HIGH "LED ON"
A, B, C, D = INPUT
Q = OUTPUT

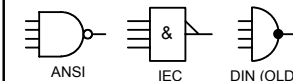
RESISTOR:



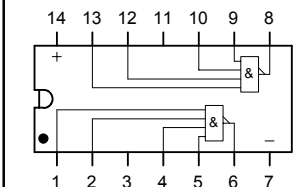
LED:



NAND GATE SYMBOLS

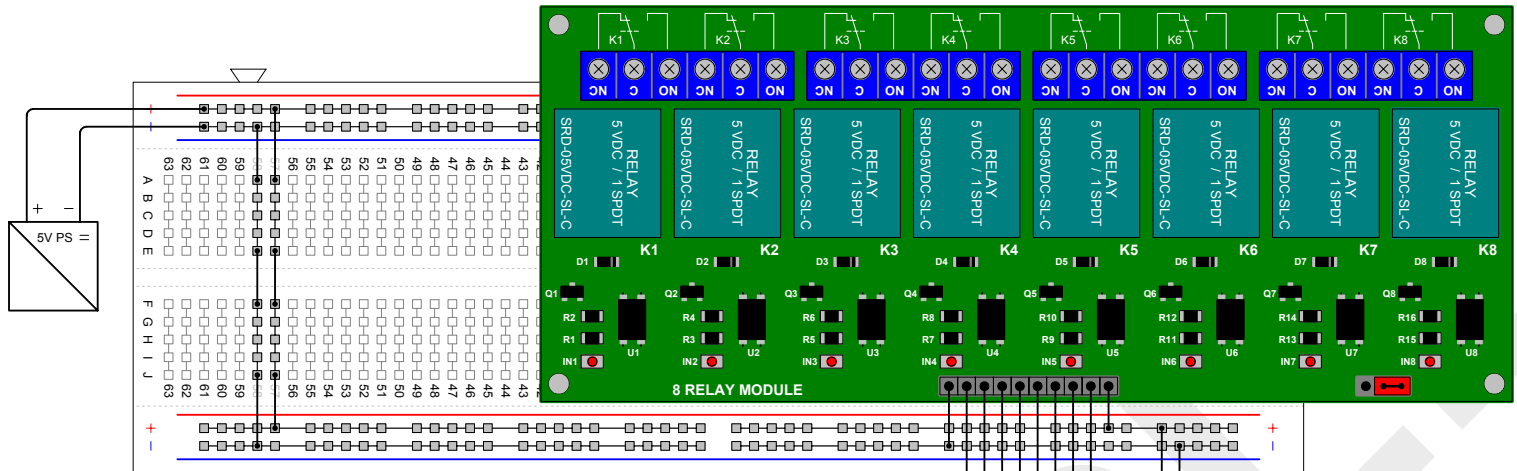


TTL NAND GATE IC 7420

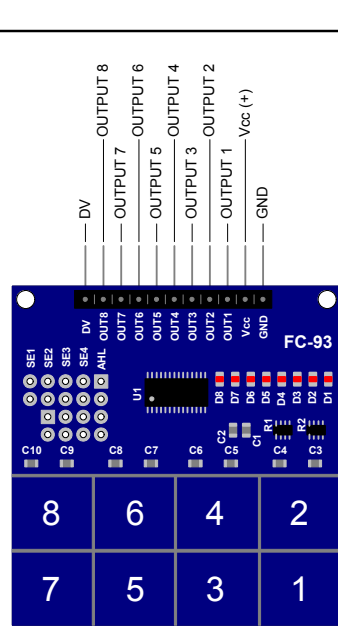
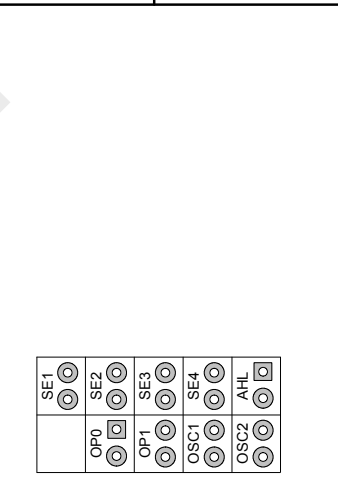
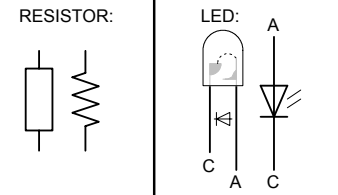
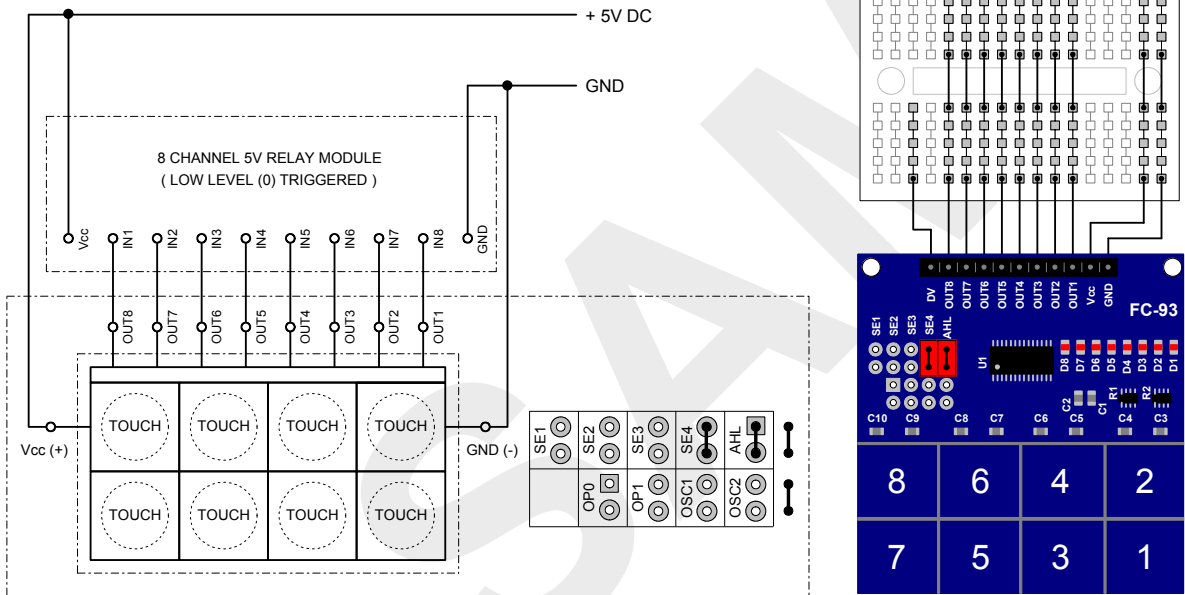


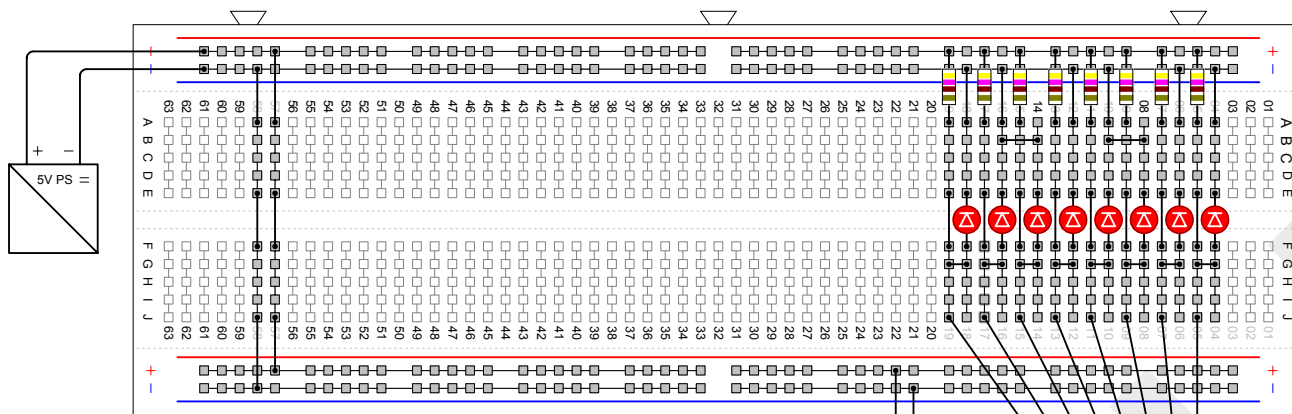
FOR FULLY COMPONENT SPECS. SEE
MANUFACTURER DATASHEETS

CT	A4	udo@elgers.com	ue-ERT20210130-03	30-JAN-2021
010	A	TTP224 - EXPERIMENT 07		



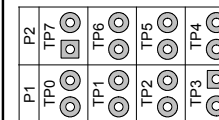
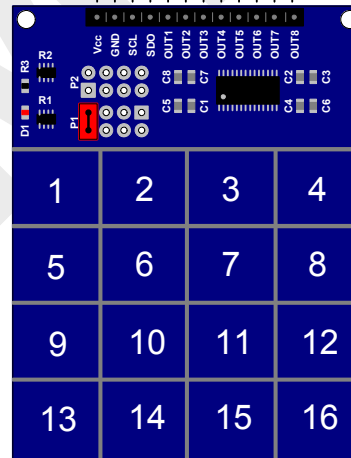
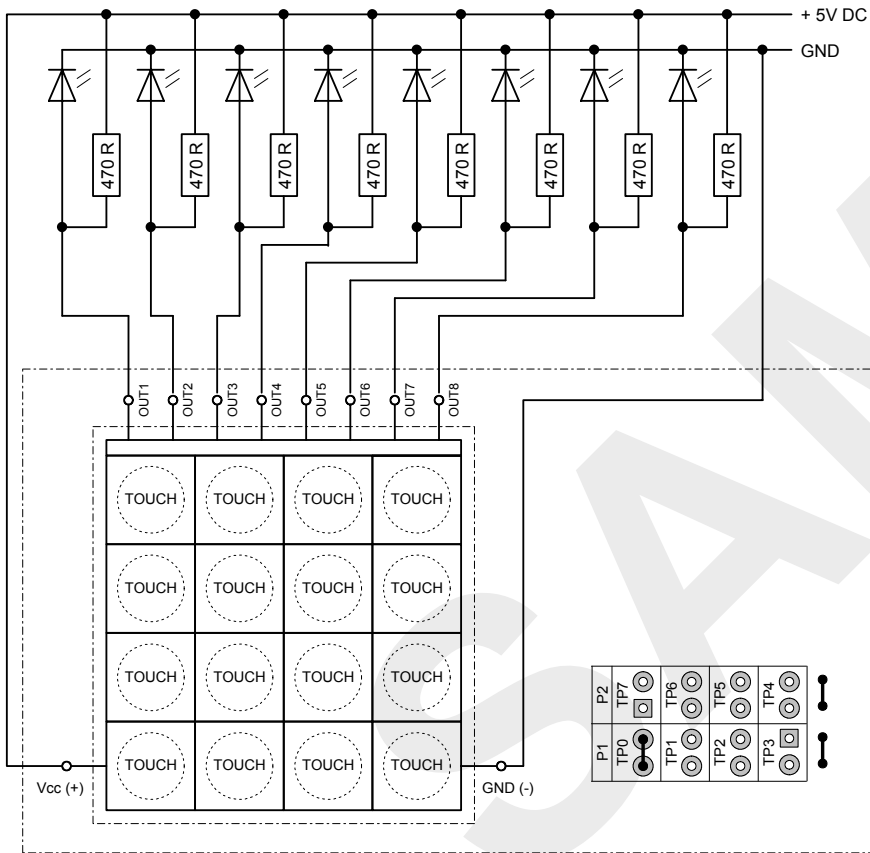
TTP226 - 8 OUTPUTS - DIRECT ACTIVE LOW
8 CHANNEL MOMENTARY RELAY ON/OFF CONTROL



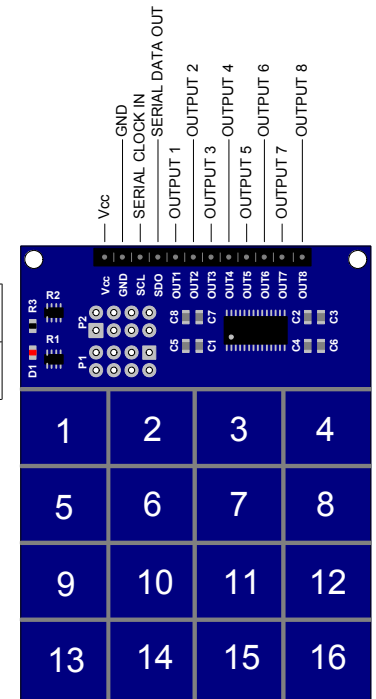


TTP229 - DIRECT MODE - OPEN DRAIN - ACTIVE LOW OUTPUT (INV.)

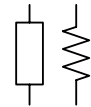
ALL KEYS ONE GROUP - SINGLE KEYS



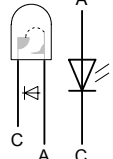
FOR OUTPUT CONFIG.
JUMPER SETTINGS
SEE ADDENDUM AND
MFG. DATASHEET



RESISTOR:



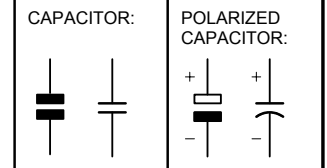
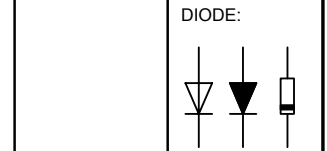
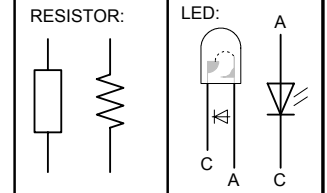
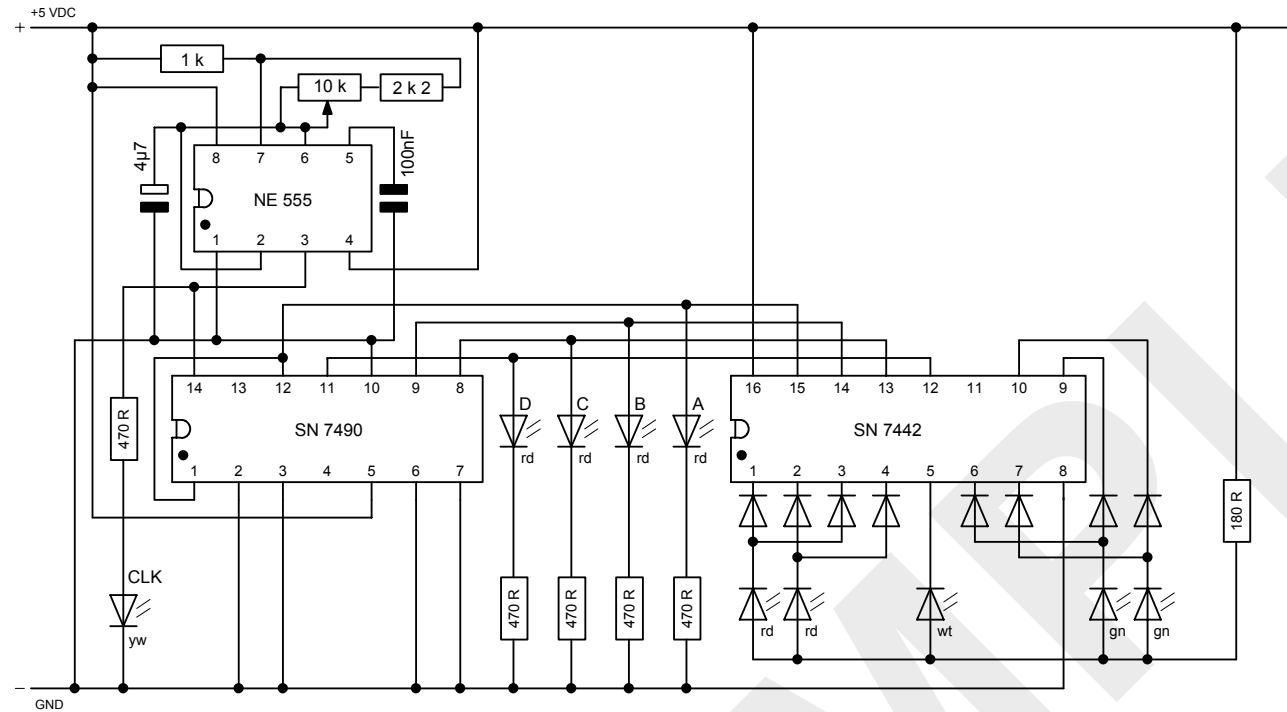
LED:



FOR FULLY COMPONENT SPECS. SEE
MANUFACTURER DATASHEETS

CT5	A4	udo@elgers.com	ue-ERT20210215-05	15-FEB-2021
012	A	TTP229 - EXPERIMENT 09		

BCD COUNTER INCL. BCD TO DECIMAL CONVERTER EXPERIMENT #6 (AIR CRAFT NAVIGATION LIGHTS)



TIMER IC NE 555:

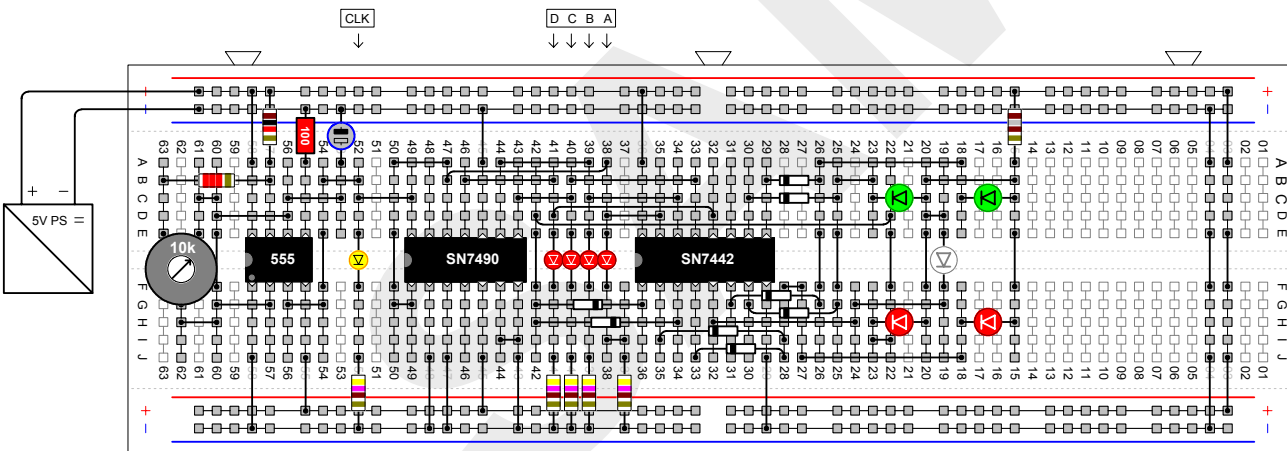
1 = GND (-)	5 = CONTROL VOLTAGE
2 = TRIGGER	6 = THRESHOLD
3 = OUTPUT	7 = DISCHARGE
4 = RESET	8 = Vcc (+)

TTL BINARY COUNTER IC 7490:

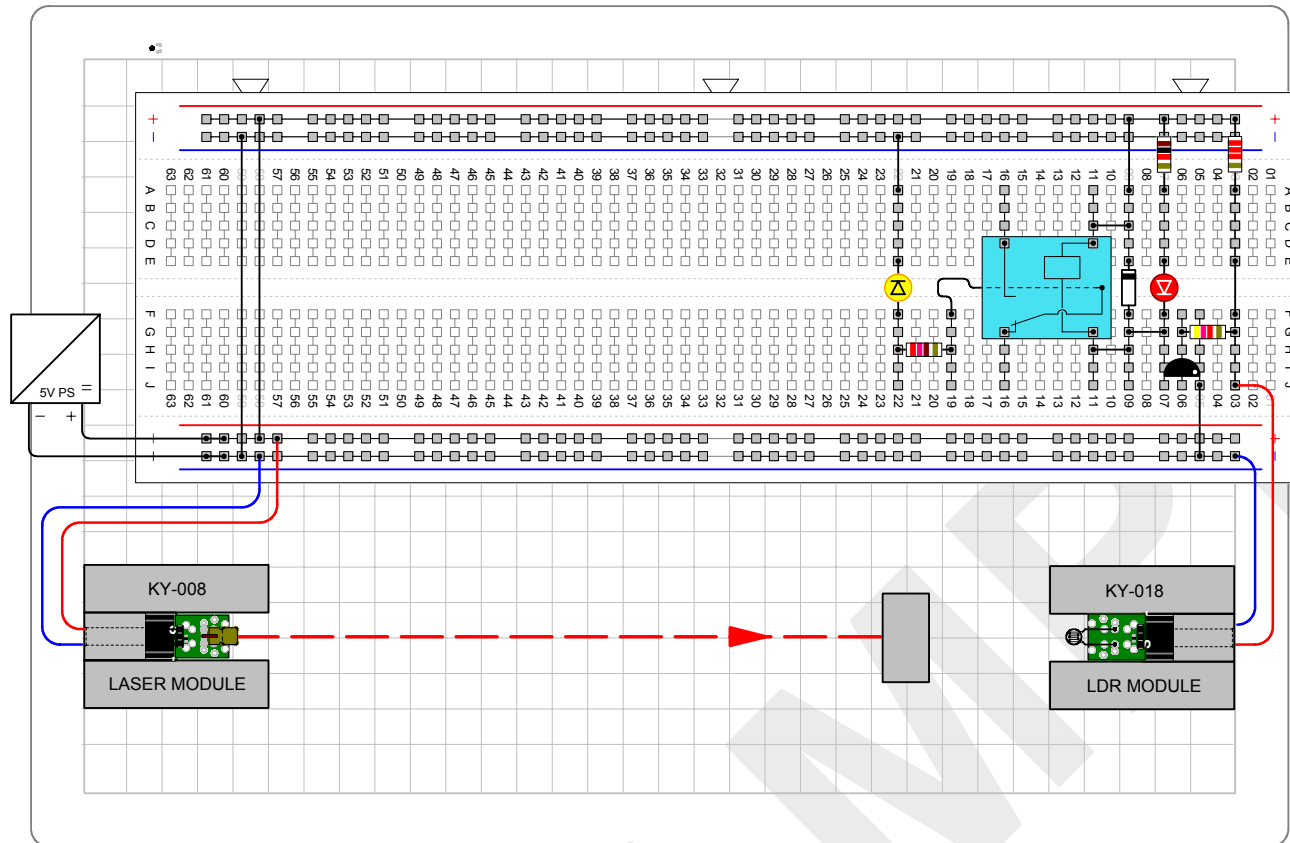
1 = INPUT B	6 = SET 1	11 = QD
2 = RESET 1	7 = SET 2	12 = QA
3 = RESET 2	8 = QC	13 = NC
4 = NC	9 = QB	14 = INPUT A
5 = + 5 VDC	10 = GND (-)	

TTL BCD TO DECIMAL DECODER IC 7442:

1 = OUTP. 0	7 = OUTP. 6	13 = INP. C
2 = OUTP. 1	8 = GND (-)	14 = INP. B
3 = OUTP. 2	9 = OUTP. 7	15 = INP. A
4 = OUTP. 3	10 = OUTP. 8	16 = + 5 VDC
5 = OUTP. 4	11 = OUTP. 9	
6 = OUTP. 5	12 = INP. D	

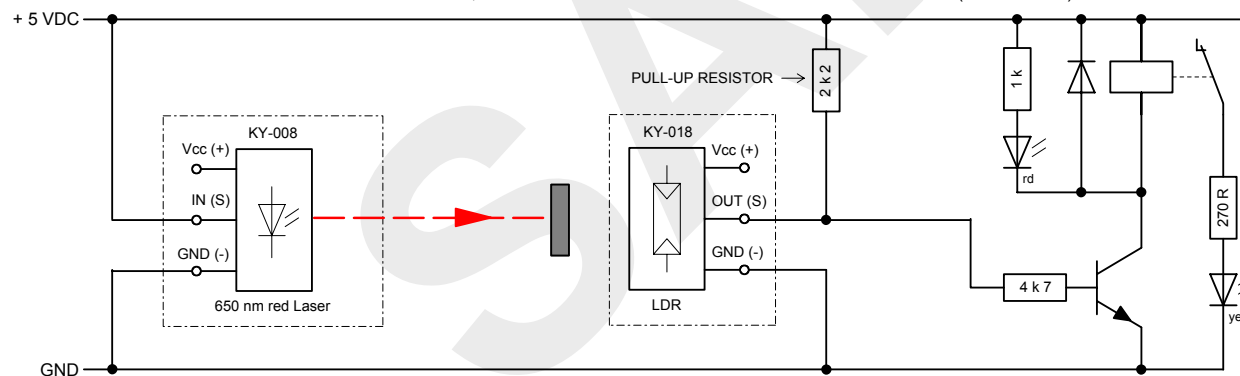
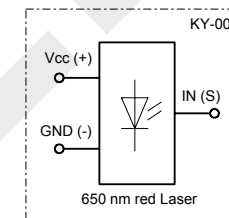
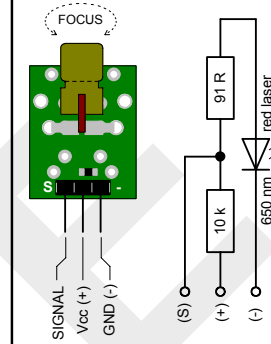
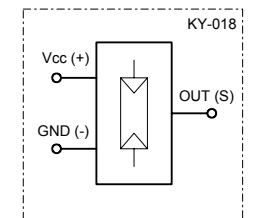
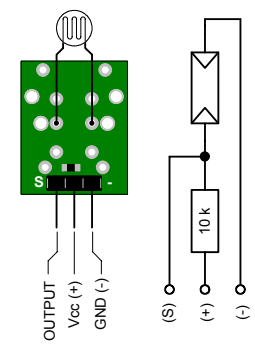


LE	A4	udo@elgers.com	ue-ERT20200930-01	30-SEP-2020
048	A	TTL AIR CRAFT NAVIGATION LIGHT		

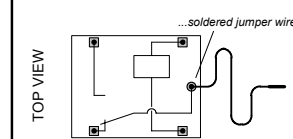


KY-008 LASER / KY-018 LDR MODULES LIGHT BARRIER EXPERIMENT

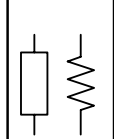
HIGH TRIGGER NPN TRANSISTOR DRIVER, RELAY IS ENERGIZED WHEN LASER BEAM IS BLOCKED (LDR = DARK)

LASER TRANSMITTER MODULE
KY-008:LIGHT DEPENDENT RESISTOR
(LDR) MODULE KY-018:

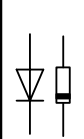
RELAY SRD-05VDC-SL-C:



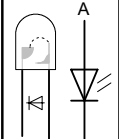
RESISTOR:



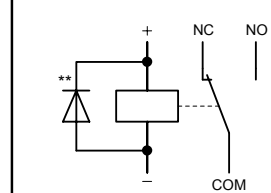
DIODE:



LED:

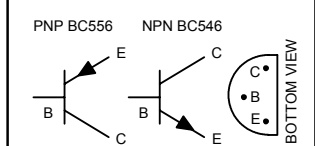


RELAY "SPDT":



** FLYBACK DIODE TO ELIMINATE
HIGH VOLTAGE SPIKES ACROSS
THE RELAY COIL DURING
ENERGIZE AND DE-ENERGIZE
(SWITCHING ON & OFF).

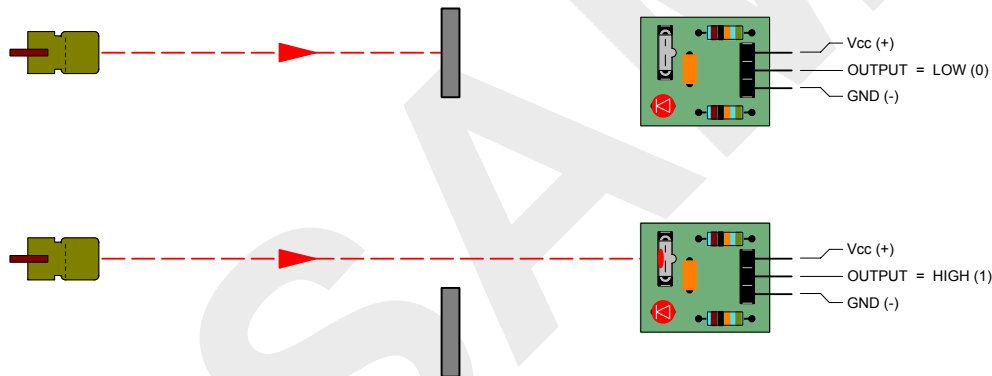
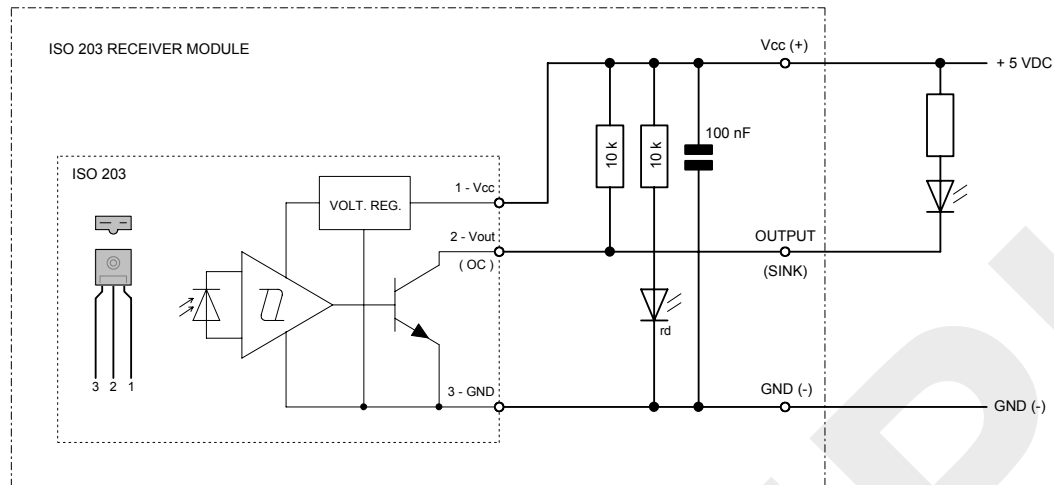
TRANSISTOR



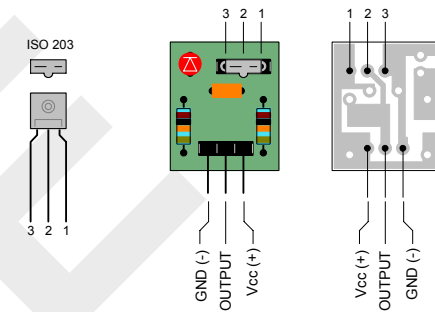
CAUTION
LASER RADIATION
DO NOT STARE INTO BEAM
LASER PROTECTIVE EYEWEAR REQUIRED

FOR FULLY COMPONENT SPECS. SEE MANUFACTURER DATASHEETS

LS-1	A4	udo@elgers.com	ue-ERT20211113-35	13-NOV-2021
035	A	LASER DIODE EXPERIMENT 1C-05		



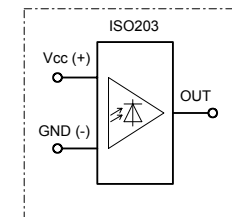
LASER RECEIVER ISO203 MODULE:



SUPPLY VOLTAGE: 2.7 5.5 VDC
 MAX. SINK LOAD CURRENT: 30 mA
 WAVELENGTH: 400 1100 nm

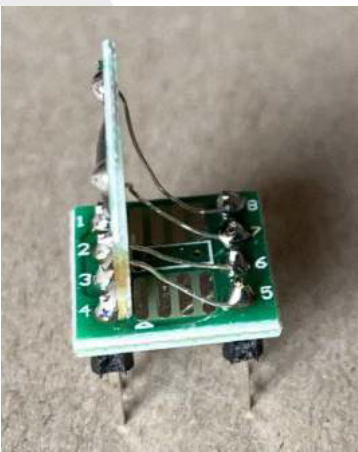
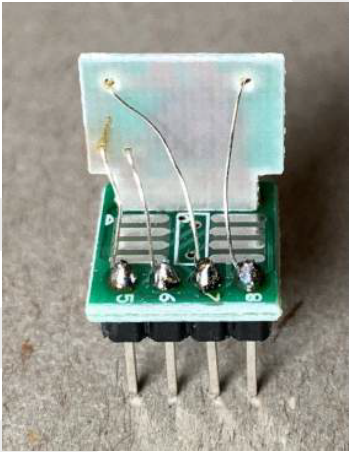
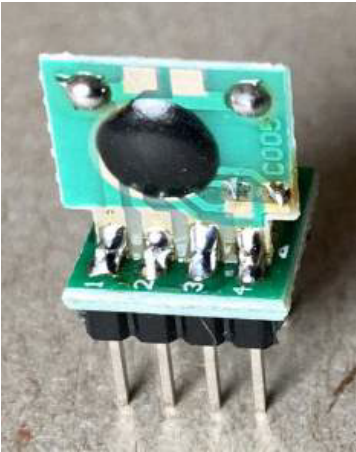
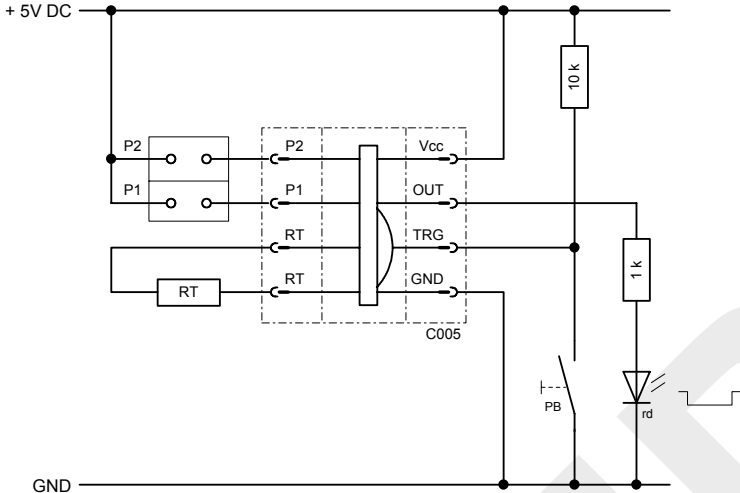
NOTE:

ABOVE MODULE PCB IS IN USE FOR "ISO 203" LIGHT SENSOR,
 AND ALSO FOR "DS18B20" TEMPERATURE SENSOR.

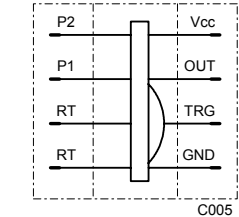
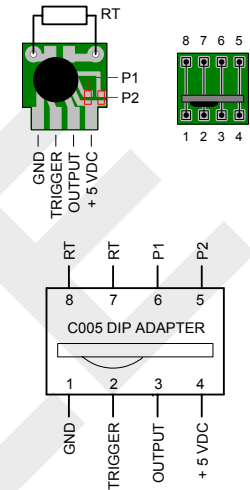


FOR FULLY COMPONENT SPECS. SEE MANUFACTURER DATASHEETS

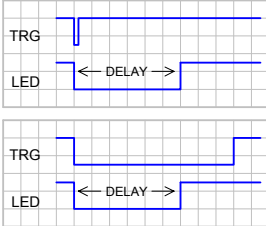
MD-1	A4	udo@elgers.com	ue-ERT20211017-01	17-OCT-2021
	A	LASER RECEIVER ISO203 MODULE		



TIMER MODULE C005:



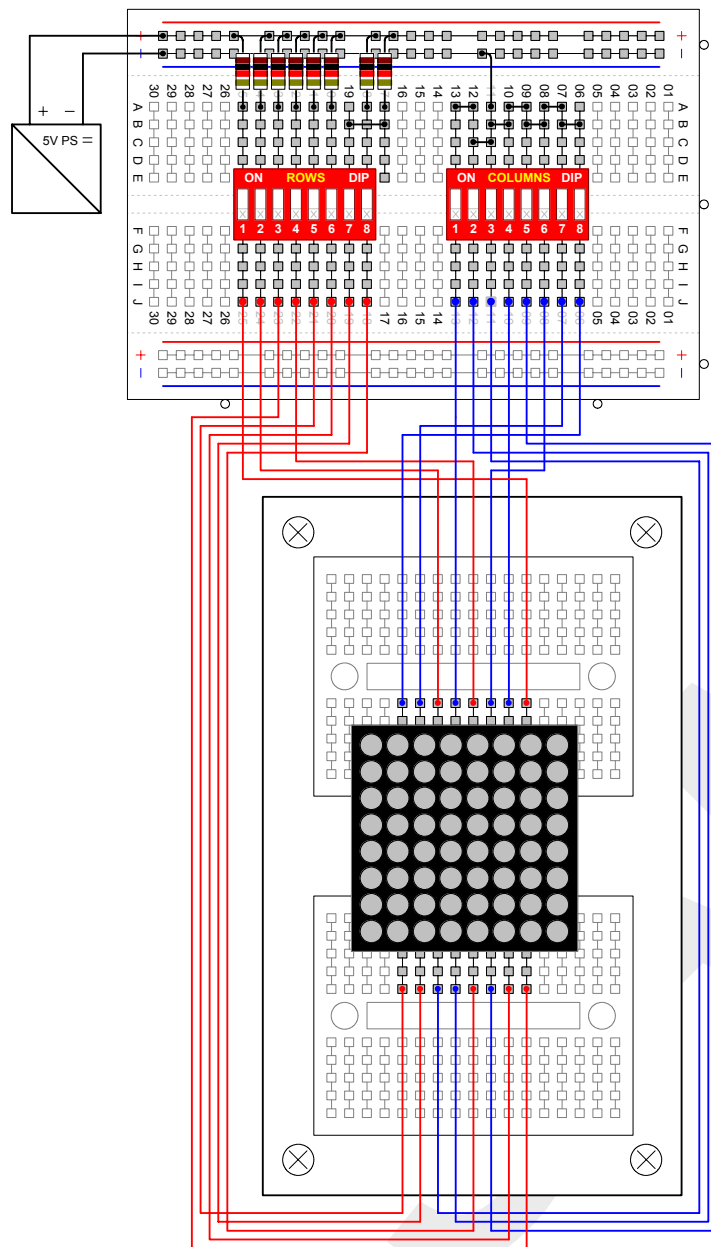
TIME PERIOD (T)			TIME DELAY JUMPER SETTING
RT	3 V	4.5 V	
10 k	5.8 s	4.8 s	P2 ○ ○ P1 ○ ○ = T x 1
20 k	8.9 s	8.0 s	
30 k	12.1 s	11.4 s	
51 k	19.2 s	18.0 s	
75 k	26.5 s	25.0 s	
100 k	34.0 s	32.0 s	P2 ○ ○ P1 ● ● = T x 8
150 k	49.0 s	46.0 s	
200 k	65.0 s	60.0 s	
240 k	78.0 s	74.0 s	
300 k	96.0 s	92.0 s	
390 k	123 s	119 s	P2 ● ● P1 ○ ○ = T x 64
510 k	155 s	150 s	
560 k	175 s	168 s	
620 k	199 s	187 s	
750 k	230 s	222 s	
820 k	255 s	246 s	P2 ● ● P1 ● ● = T x 512
1.0 M	330 s	291 s	
1.5 M	383 s	432 s	
2.0 M	598 s	568 s	
3.0 M	762 s	762 s	
4.7 M	1425 s	1131 s	
5.1 M	1631 s	1331 s	
10 M	2921 s	2621 s	
15 M	4394 s	3813 s	
20 M	5160 s	4660 s	
22 M	7052 s	6452 s	



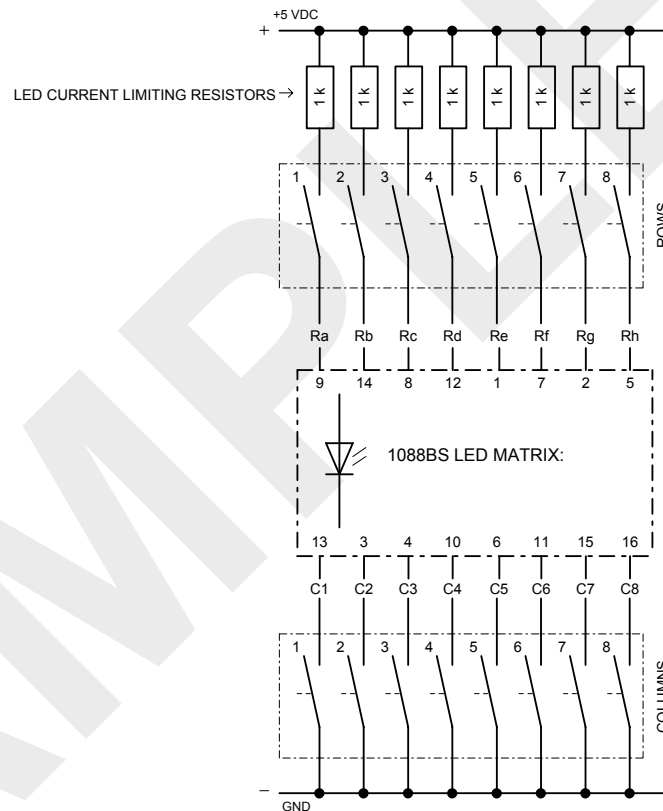
FOR FULLY COMPONENT SPECS. SEE
MANUFACTURER DATASHEETS

FIGURES ARE APROXIMATELY,
DUE TO COMPONENT TOLERANCES !

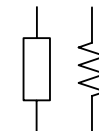
MD-2	A4	udo@elgers.com	ue-ERT20210904-08	04-SEP-2021
	A	DIY UE-016 TIMER MODULE C005		



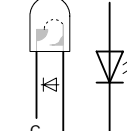
8x8 LED MATRIX TEST CIRCUIT
COLUMNS (-) & ROWS (+) CONTROLLED BY DIP SWITCHES



RESISTOR:



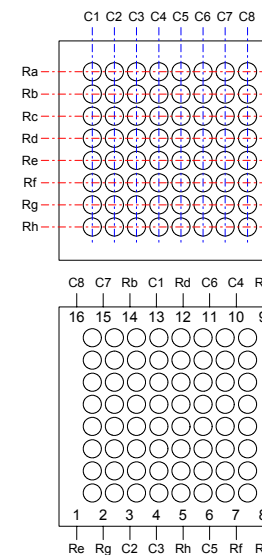
LED:



DIP SWITCH:

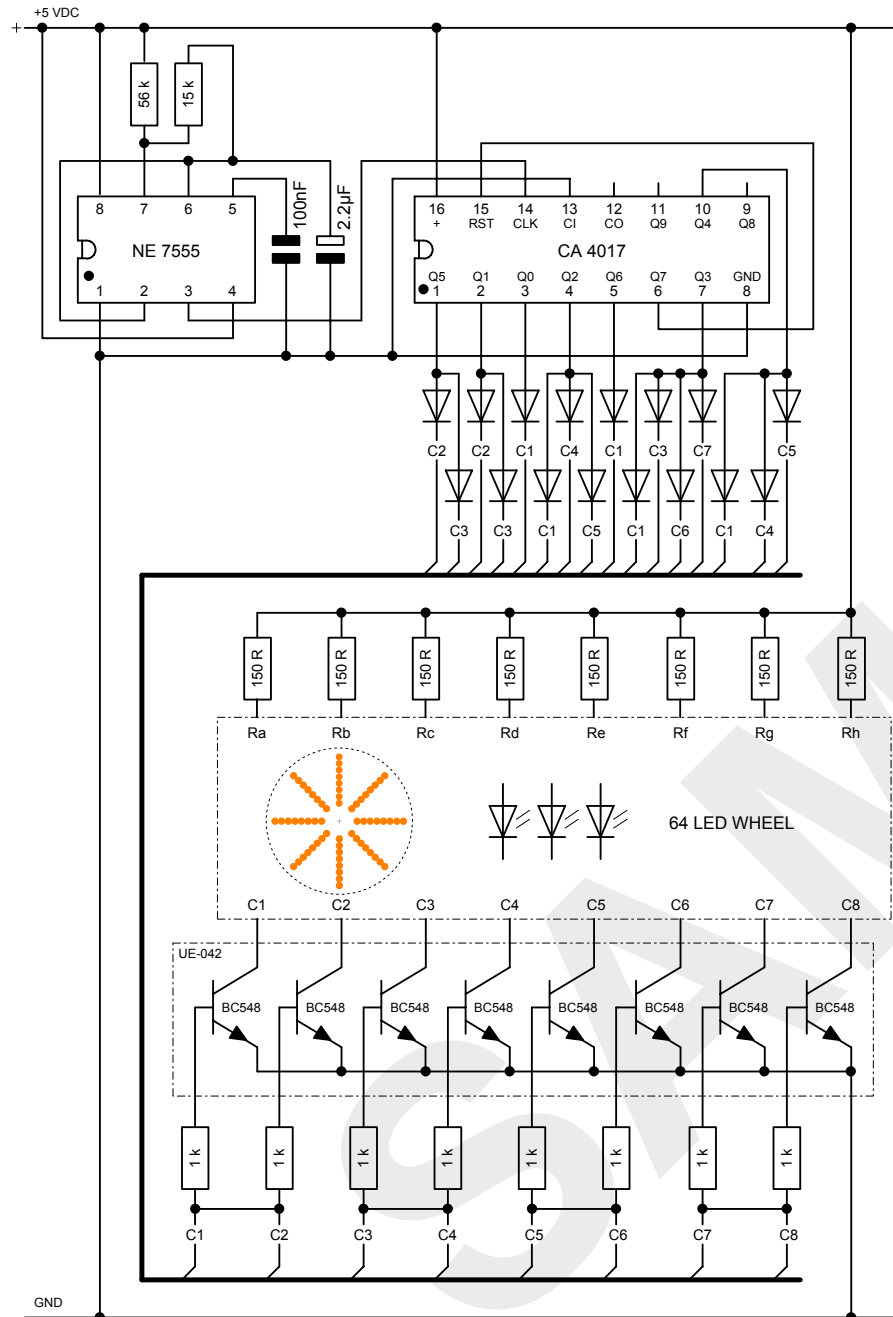


1088BS LED MATRIX:



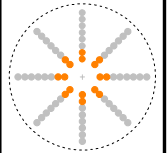
FOR FULLY COMPONENT SPECS. SEE
MANUFACTURER DATASHEETS

MX	A4	udo@elgers.com	ue-ERT20201215-04	15-DEC-2020
019	A	LED MATRIX EXPERIMENT 15		



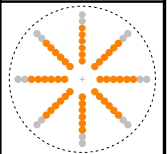
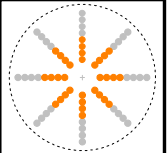
TIMER IC NE 555:

- 1 = GND (-) 5 = CONTR. VOLT.
 2 = TRIGGER 6 = THRESHOLD
 3 = OUTPUT 7 = DISCHARGE
 4 = RESET 8 = Vcc (+)

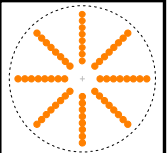
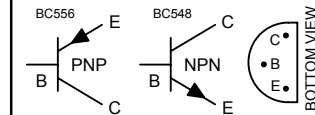


DECADE COUNTER 4017:

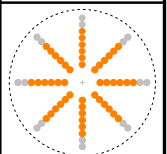
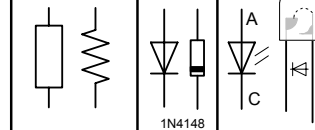
- 1 = Q5 9 = Q8
 2 = Q1 10 = Q4
 3 = Q0 11 = Q9
 4 = Q2 12 = CARRY OUT
 5 = Q6 13 = CLOCK INHIBIT
 6 = Q7 14 = CLOCK
 7 = Q3 15 = RESET
 8 = GND (-) 16 = Vcc (+)



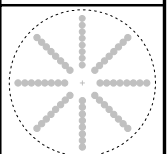
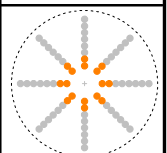
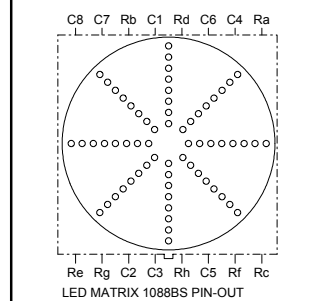
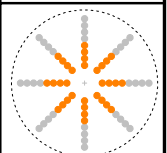
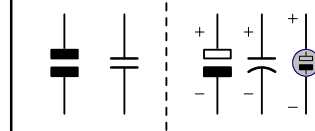
TRANSISTOR:



RESISTOR:

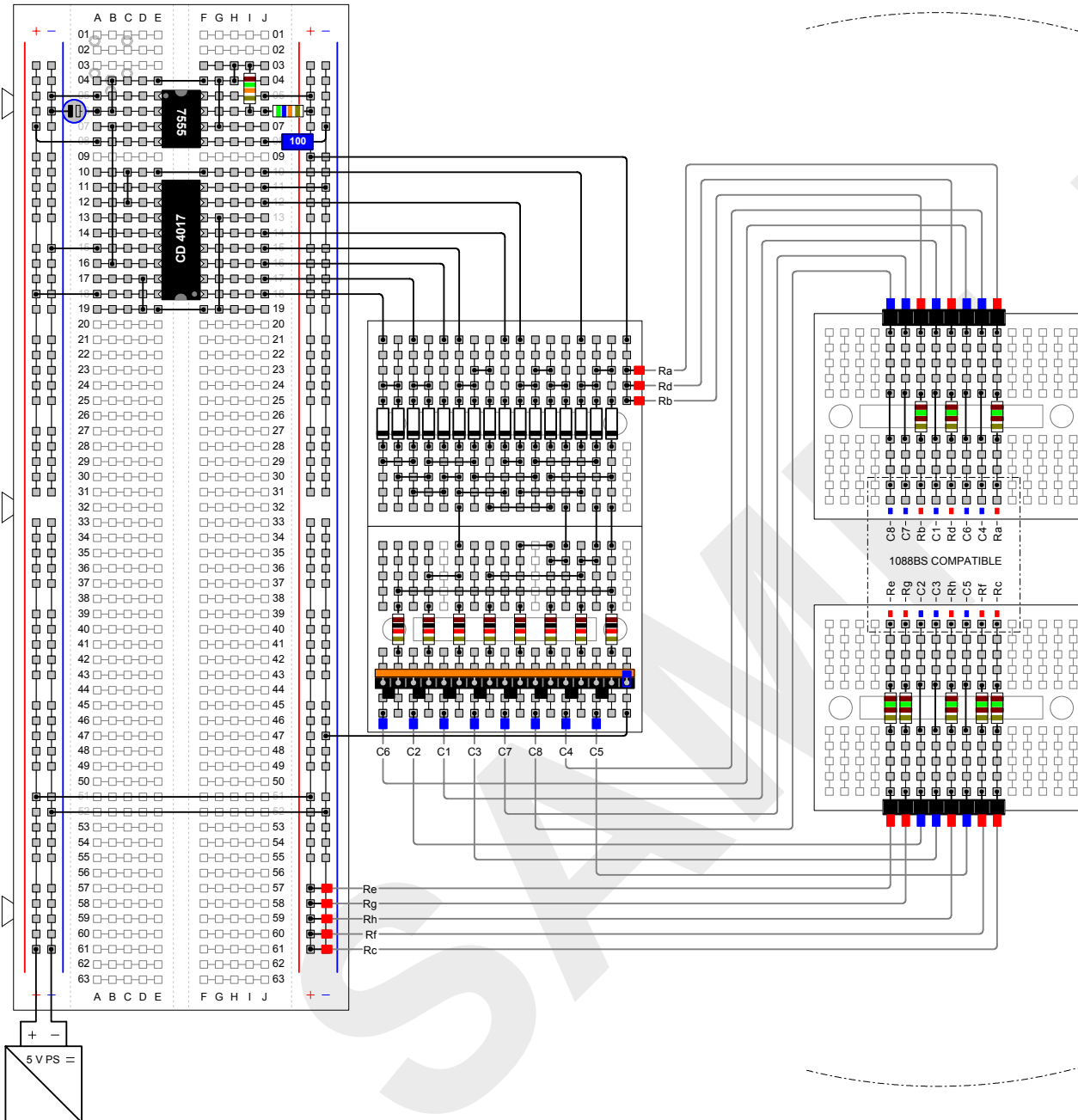


CAPACITOR:

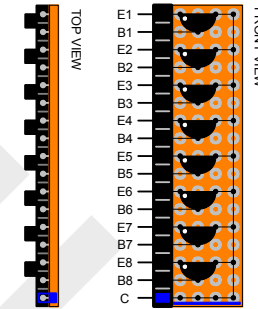


FOR LED WHEEL CONSTRUCTION & SPECIFICATION SEE ADENDUM

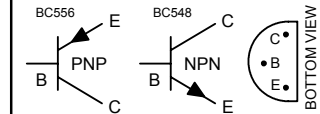
MX-2	A4	udo@elgers.com	ue-ERT20211228-07	28-DEC-2021
053	A	LED WHEEL MATRIX - EXPERIMENT E-04		



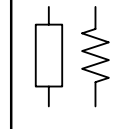
NPN TRANSISTOR ARRAY UE-042



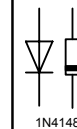
TRANSISTOR:



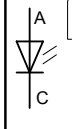
RESISTOR:



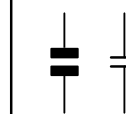
DIODE:



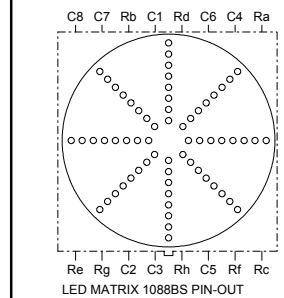
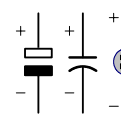
LED:



CAPACITOR:

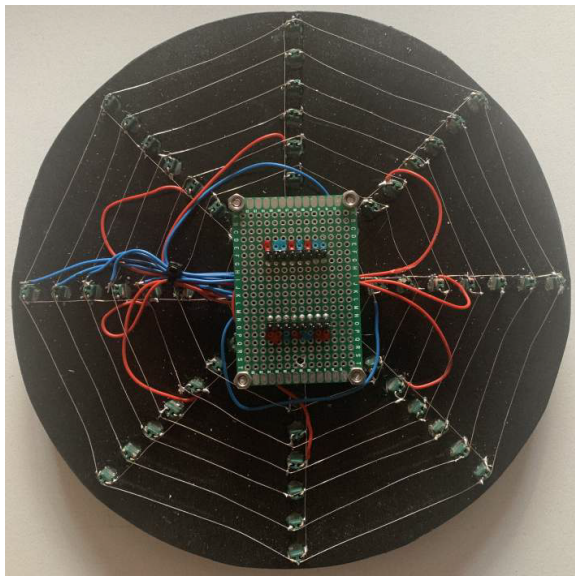
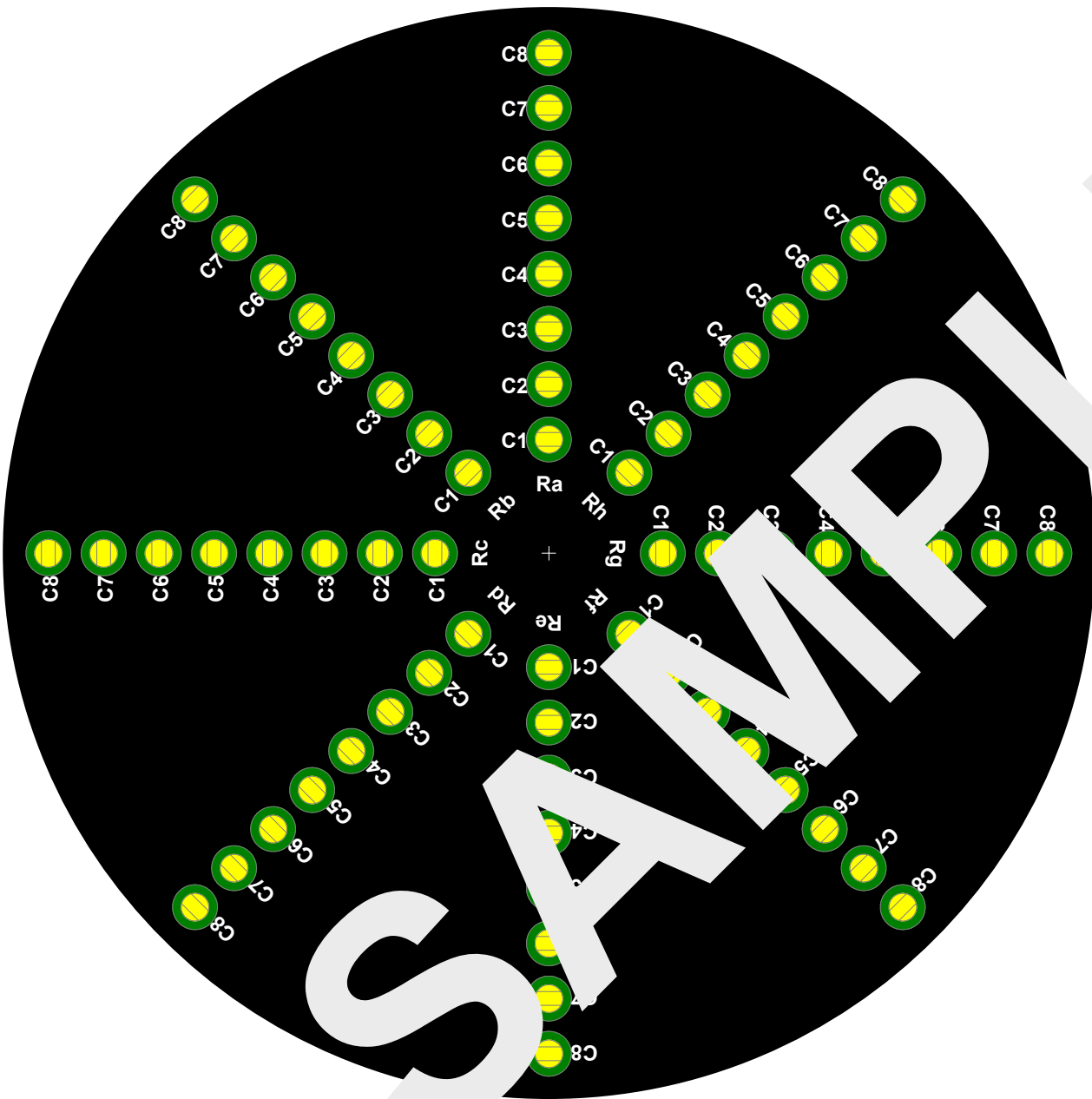


(POLARIZED)

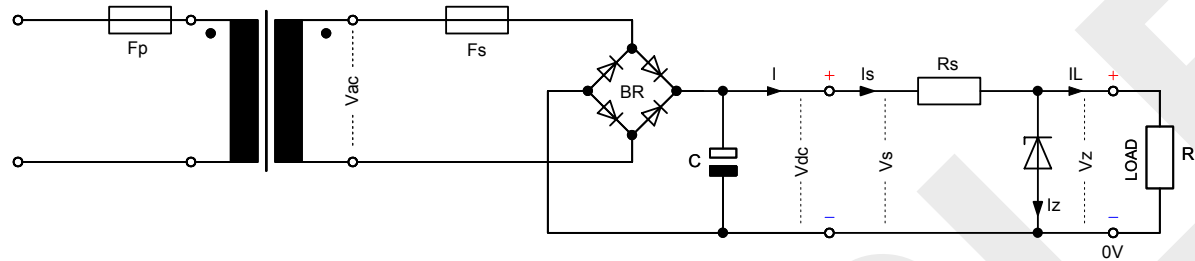


FOR LED WHEEL CONSTRUCTION & SPECIFICATION SEE ADENDUM

MX-2	A4	udo@elgers.com	ue-ERT20211228-08	28-DEC-2021
054	A	LED WHEEL MATRIX - EXPERIMENT E-04		



MX-2	A4	udo@elgers.com	ue-ERT20220110-02	10-JAN-2022
075	A	LED WHEEL MATRIX - LAYOUT		



1N47xx SERIES

Ptot 1.3 W - Z-DIODE ELECTRICAL CHARACTERISTICS (Tamb = 25°C)

P/N	Vz V	Iz_min mA	Iz_max mA	P/N	Vz V	Iz_min mA	Iz_max mA	P/N	Vz V	Iz_min mA	Iz_max mA
1N4728	3.3	76	276	1N4741	11	23	83	1N4754	39	6.5	23
1N4729	3.6	69	252	1N4742	12	21	76	1N4755	43	6	22
1N4730	3.9	64	234	1N4743	13	19	69	1N4756	47	5.5	19
1N4731	4.3	58	217	1N4744	15	17	61	1N4757	51	5	18
1N4732	4.7	53	193	1N4745	16	15.5	57	1N4758	56	4.5	16
1N4733	5.1	49	178	1N4746	18	14	50	1N4759	62	4	14
1N4734	5.6	45	162	1N4747	20	12.5	45	1N4760	68	3.7	13
1N4735	6.2	41	146	1N4748	22	11.5	41	1N4761	75	3.3	12
1N4736	6.8	37	133	1N4749	24	10.5	38	1N4762	82	3	11
1N4737	7.5	34	121	1N4750	27	9.5	34	1N4763	91	2.8	10
1N4738	8.2	31	110	1N4751	30	8.5	30	1N4764	100	2.5	9
1N4739	9.1	28	100	1N4752	33	7.5	27				
1N4740	10	25	91	1N4753	36	7	25				

Further Z-Diode Series are: 1N47xx, BZX55, BZX79, BZX85, TZX, ZPD and more...

...for fully information see OEM datasheets...

C = smoothing capacitor

...approx. 2 μ F per I = 1 mA

$$V_{dc} = \text{approx. } V_{ac} \times 1.3$$

$$V_s = V_{dc} \quad I_s = I = I_L + I_z$$

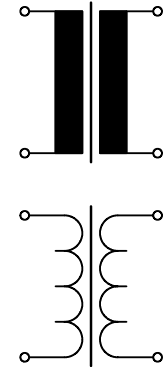
$$R_s > \frac{V_{s_{max}} - V_z}{I_{z_{max}} + I_{L_{max}}}$$

$$R_s < \frac{V_{s_{min}} - V_z}{I_{z_{min}} + I_{L_{max}}}$$

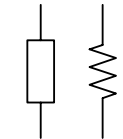
$$P_{R_s} = (V_s - V_z) \times I_s$$

"Z-Diodes are used as voltage reference to regulate the voltage across small circuits"

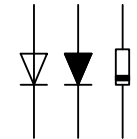
SINGLE-PHASE TRANSFORMER:



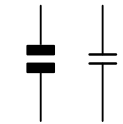
RESISTOR:



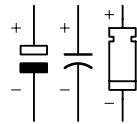
DIODE:



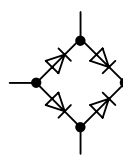
CAPACITOR:



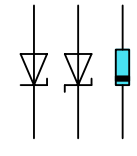
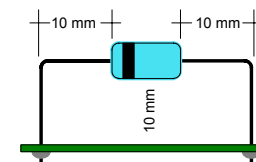
(POLARIZED)



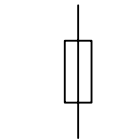
BRIDGE RECTIF.:



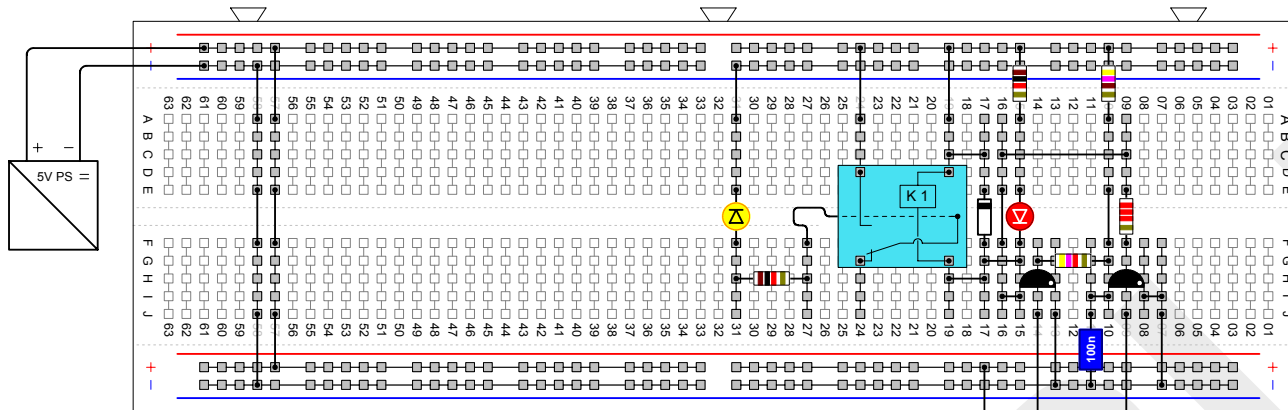
Z - DIODE:

Required for cooling if operating close to $I_{z_{max}}$ 

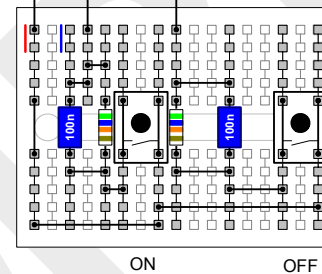
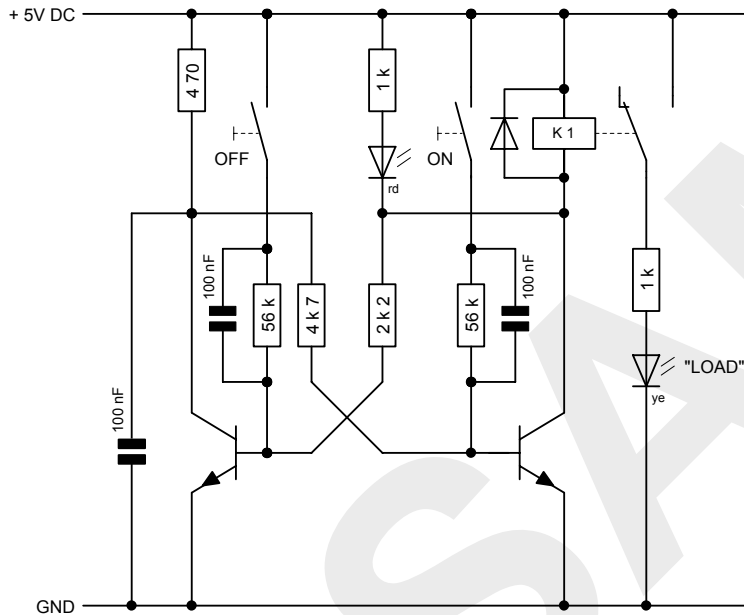
FUSE:

FOR FULLY COMPONENT SPECS. SEE
MANUFACTURER DATASHEETS

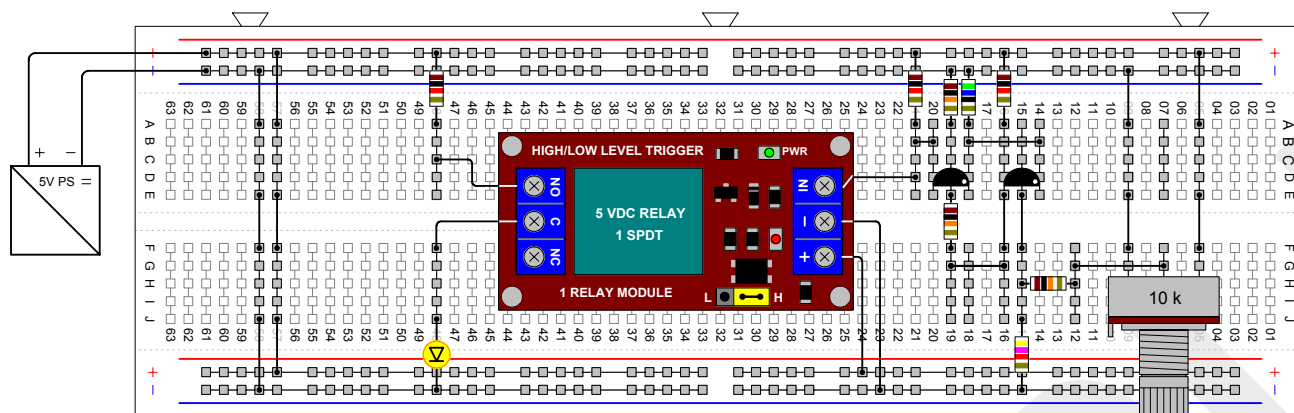
PS	A4	udo@elgers.com	ue-ERT20200905-03	05-SEP-2020
019	A	Z-DIODE REGULATOR BASIC CIRCUIT & CALC.		



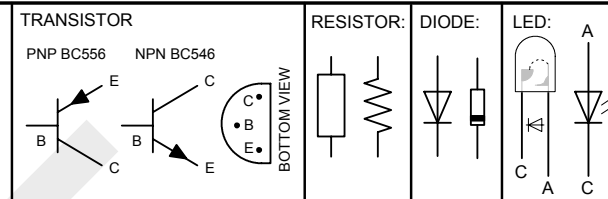
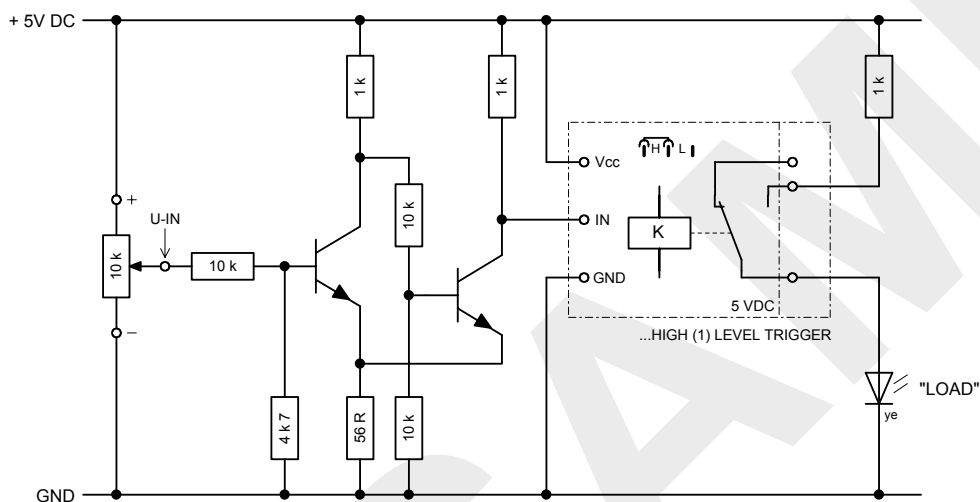
5 VDC RELAY, ON/OFF TOGGLE FUNCTION,
HIGH (1) TRIGGERED TRANSISTOR (BISTABLE) RS-FF



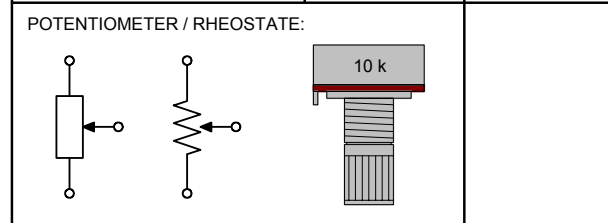
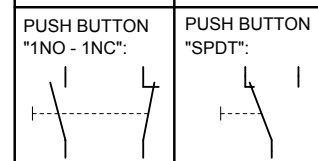
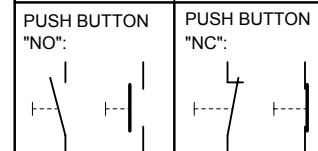
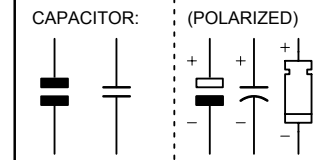
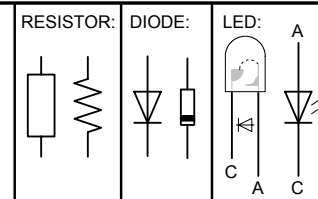
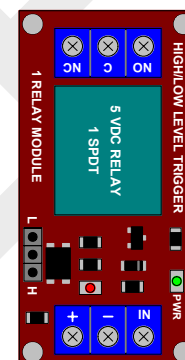
TRANSISTOR		RESISTOR:		DIODE:		LED:			
PNP BC556		NPN BC546							
B C		C B E		BOTTOM VIEW		C A C		C A C	
RELAY SRD-05VDC-SL-C:				CAPACITOR:		(POLARIZED)			
TOP VIEW									
RELAY "SPDT":				PUSH BUTTON "NO":		PUSH BUTTON "NC":			
+ - NC NO COM									
** FLYBACK DIODE TO ELEMENATE HIGH VOLTAGE SPIKES ACROSS THE RELAY COIL DURING ENERGIZE AND DE-ENERGIZE (SWITCHING ON & OFF).				PUSH BUTTON "1NO - 1NC":		PUSH BUTTON "SPDT":			
FOR FULLY COMPONENT SPECS. SEE MANUFACTURER DATASHEETS									
RY-1		A4		udo@elgers.com		ue-ERT20210303-05		03-MAR-2021	
020		A		RELAY - EXPERIMENT 15					



5 VDC RELAY, ON/OFF FUNCTION,
CONTROLLED BY ANALOG INPUT VALUE (U-IN) "SCHMITT-TRIGGER"

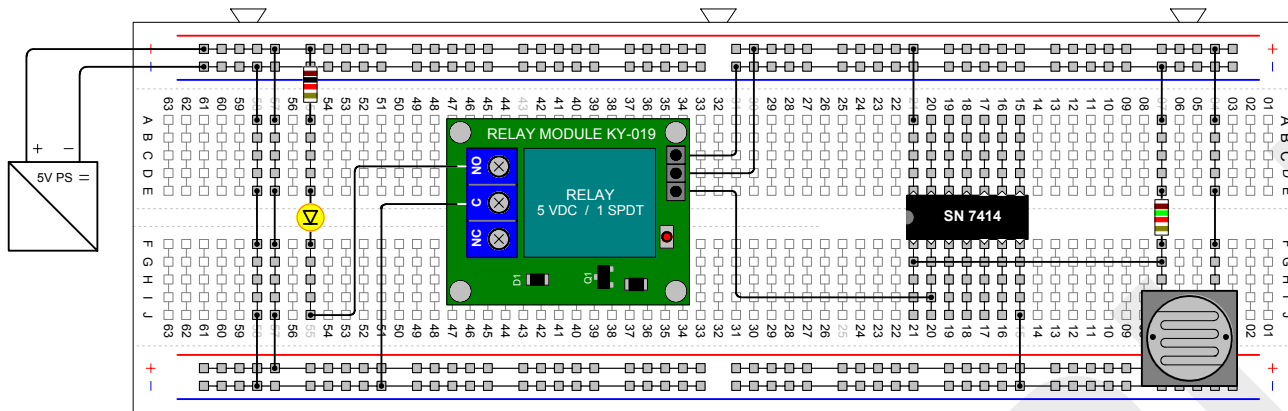


5V H/L TR. RELAY MODULE:

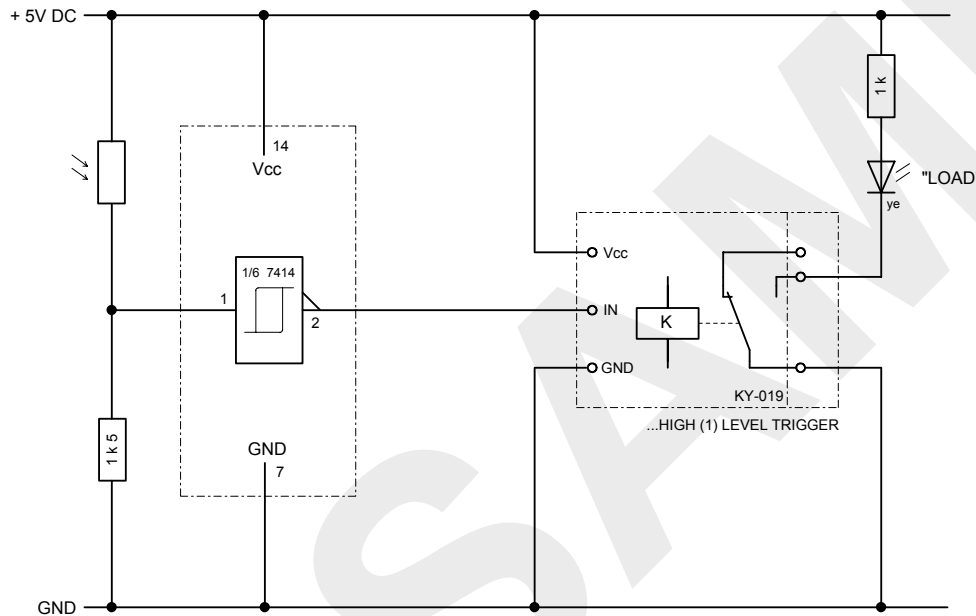


FOR FULLY COMPONENT SPECS. SEE MANUFACTURER DATASHEET

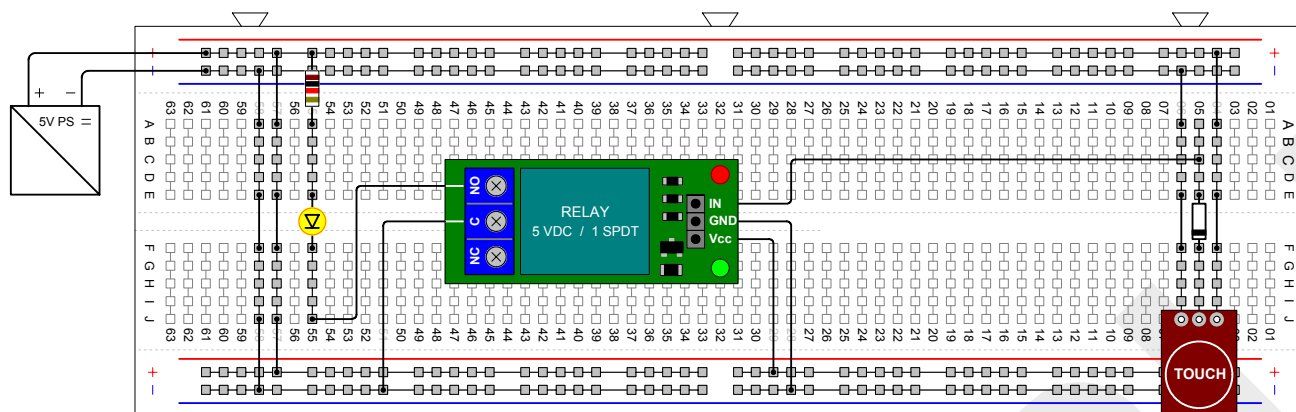
RY-2	A4	udo@elgers.com	ue-ERT20220201-11	01-FEB-2022
015	A	H/L RELAY MODULE - EXPERIMENT 11		



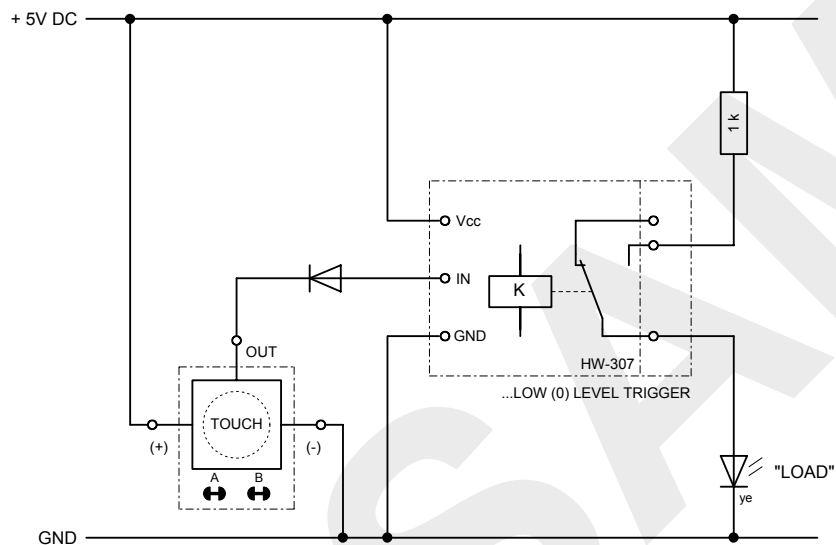
5 VDC RELAY MODULE KY-019, ON / OFF FUNCTION, PHOTO ELECTRIC (TWILIGHT) SWITCH CONTROLLED BY TTL SCHMITT-TRIGGER



TRANSISTOR PNP BC556 NPN BC546 BOTTOM VIEW	RESISTOR:	DIODE:	LED:										
5V RELAY MODULE KY-019: Signal (S) Vcc (+) GND (-)	CAPACITOR:	(POLARIZED)											
TTL SCHMITT-TRIGGER INVERTER SN7414													
LDR:													
LIGHT DEPENDENT RESISTOR (LDR): ...low ohm... (ILLUMINATED) (IN THE DARK) ...high ohm...													
FOR FULLY COMPONENT SPECS. SEE MANUFACTURER DATASHEET <table border="1"> <tr> <td>RY-3</td> <td>A4</td> <td>udo@elgers.com</td> <td>ue-ERT20220203-15</td> <td>03-FEB-2022</td> </tr> <tr> <td>019</td> <td>A</td> <td colspan="3">RELAY MODULE KY-019 - EXPERIMENT 15</td> </tr> </table>				RY-3	A4	udo@elgers.com	ue-ERT20220203-15	03-FEB-2022	019	A	RELAY MODULE KY-019 - EXPERIMENT 15		
RY-3	A4	udo@elgers.com	ue-ERT20220203-15	03-FEB-2022									
019	A	RELAY MODULE KY-019 - EXPERIMENT 15											

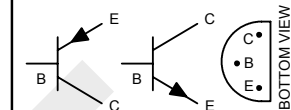


5 VDC RELAY MODULE HW-307, ON / OFF FUNCTION,
CONTROLLED BY TTP223-AB CAPACITIVE TOUCH SENSOR (TOGGLE MODE, POWER ON STATE = HIGH (1)).

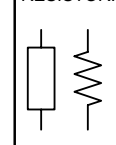


TRANSISTOR

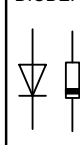
PNP BC556 NPN BC546



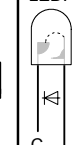
RESISTOR:



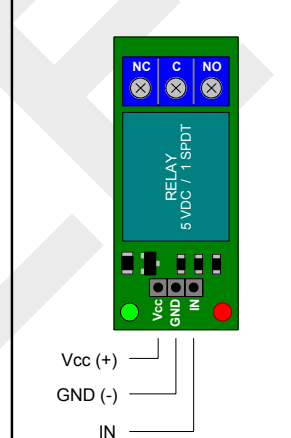
DIODE:



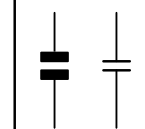
LED:



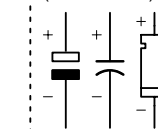
5V RELAY MODULE HW-307:



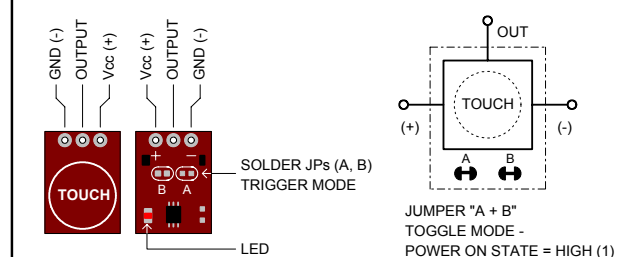
CAPACITOR:



(POLARIZED)

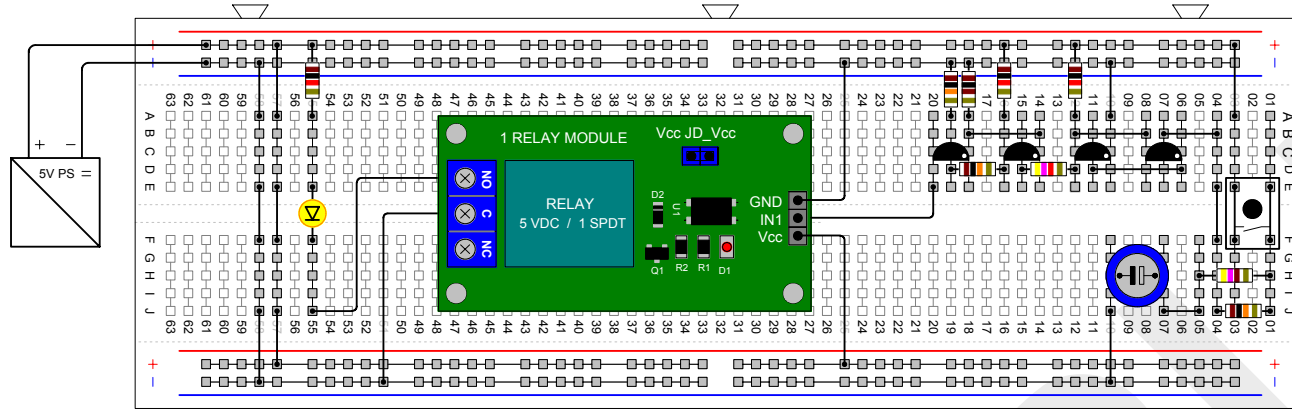


TTP223-AB CAPACITIVE TOUCH SENSOR:

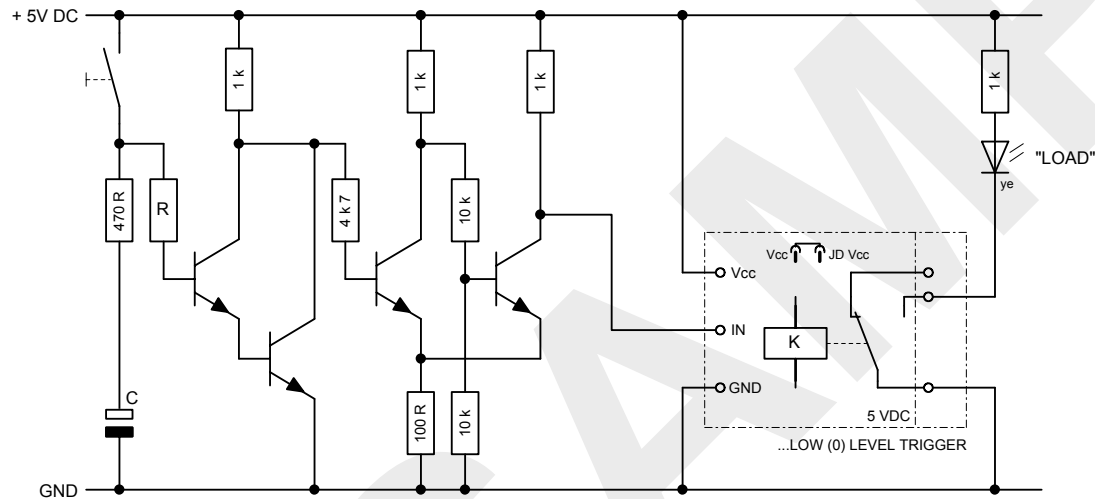


FOR FULLY COMPONENT SPECS. SEE MANUFACTURER DATASHEETS

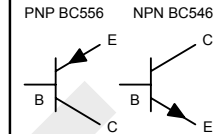
RY-4	A4	udo@elgers.com	ue-ERT20220203-59	03-FEB-2022
023	A	HW-307 RELAY MODULE - EXPERIMENT 19		



5 VDC 1 CHANNEL RELAY MODULE, DELAY OFF FUNCTION WITH DARLINGTON CIRCUIT + SCHMITT-TRIGGER

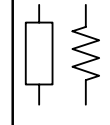


TRANSISTOR

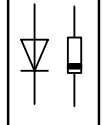


BOTTOM VIEW

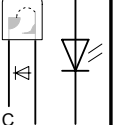
RESISTOR:



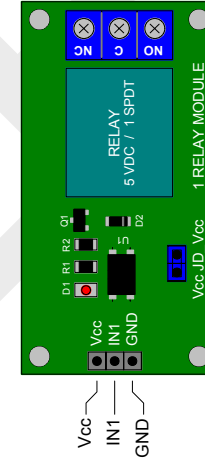
DIODE:



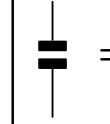
LED:



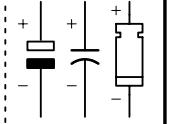
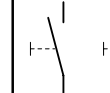
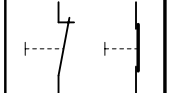
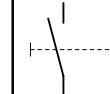
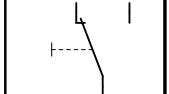
5V 1 CH. RELAY MODULE:



CAPACITOR:



(POLARIZED)

PUSH BUTTON
"NO":PUSH BUTTON
"NC":PUSH BUTTON
"1NO - 1NC":PUSH BUTTON
"SPDT":

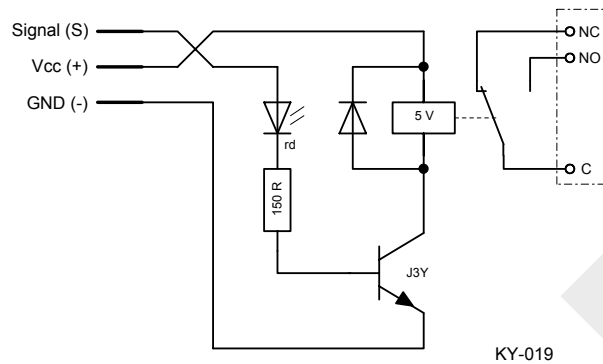
TIME DELAY SETTING

C	R = 10 k	R = 22 k	R = 47 k	R = 100 k	R = 220 k	R = 470 k	R = 1 M
1 μ F					1.0 sec.	1.5 sec.	2.1 sec.
2.2 μ F				1.3 sec.	2.2 sec.	3.3 sec.	4.6 sec.
4.7 μ F	1.0 sec.	1.4 sec.	1.9 sec.	2.8 sec.	4.8 sec.	7.0 sec.	10.0 sec.
10 μ F	2.2 sec.	3.0 sec.	4.0 sec.	6.0 sec.	10.0 sec.	15.0 sec.	21.0 sec.
22 μ F	4.8 sec.	6.6 sec.	8.8 sec.	13.0 sec.	22.0 sec.	33.0 sec.	46.0 sec.
47 μ F	10.0 sec.	14.0 sec.	19.0 sec.	28.0 sec.	48.0 sec.	1.1 min.	1.5 min.
100 μ F	22.0 sec.	30.0 sec.	40.0 sec.	1.0 min.	1.7 min.	2.5 min.	3.5 min.
220 μ F	48.0 sec.	1.1 min.	1.5 min.	2.2 min.	3.7 min.	5.5 min.	7.5 min.
470 μ F	1.7 min.	2.4 min.	3.1 min.	4.7 min.	8.0 min.	12.0 min.	17.0 min.
1000 μ F	3.7 min.	5.0 min.	6.7 min.	10.0 min.	17.0 min.	25.0 min.	35.0 min.

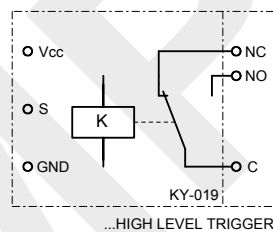
...APPROXIMATELY ONLY, BECAUSE OF "C" & "R" TOLERANCES...

FOR FULLY COMPONENT SPECS. SEE MANUFACTURER DATASHEETS

RY-5	A4	udo@elgers.com	ue-ERT20220204-10	04-FEB-2022
014	A	1CH. RELAY MODULE - EXPERIMENT 10		

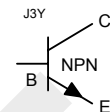


KY-019

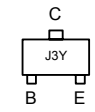


...HIGH LEVEL TRIGGER

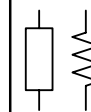
TRANSISTOR:



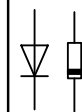
TOP VIEW



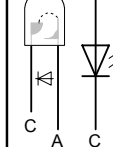
RESISTOR:



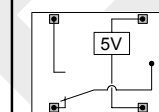
DIODE:



LED:

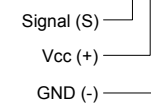
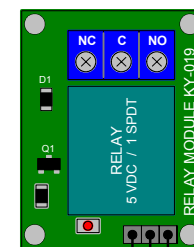
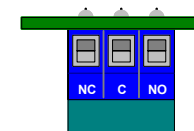


RELAY SRD-05VDC-SL-C:

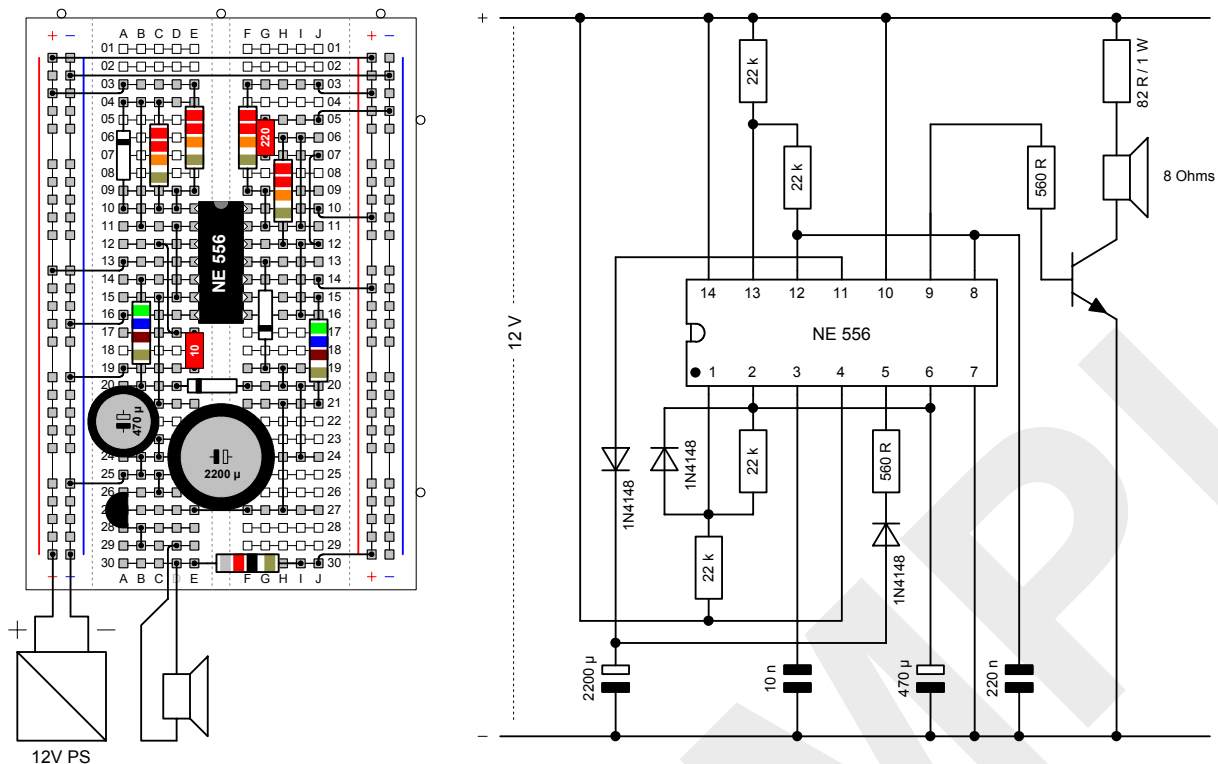


TOP VIEW

5 VDC / 10 A - 250 VAC



RYM	A4	udo@elgers.com	ue-ERT20211030-05	30-OCT-2021
005	A	5 VDC, 1 CH., HIGH TRIGGER RELAY MODULE KY-019		

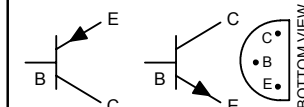


NOTES:

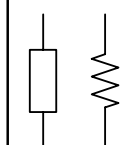
TRANSISTOR:

PNP BC556

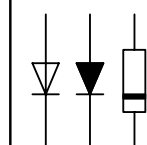
NPN BC546



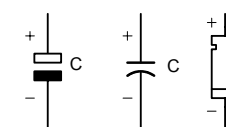
RESISTOR:



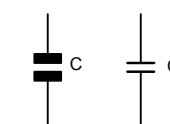
DIODE:



POLARIZED CAPACITOR:



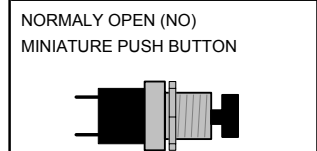
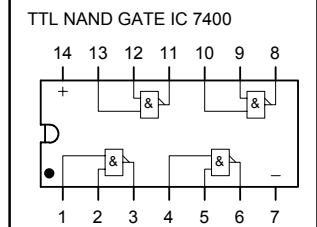
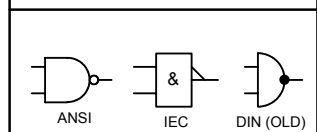
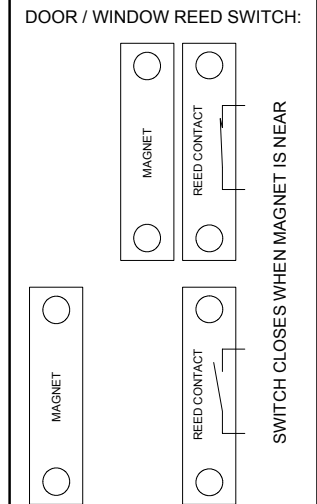
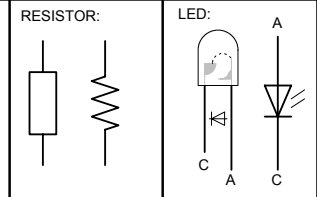
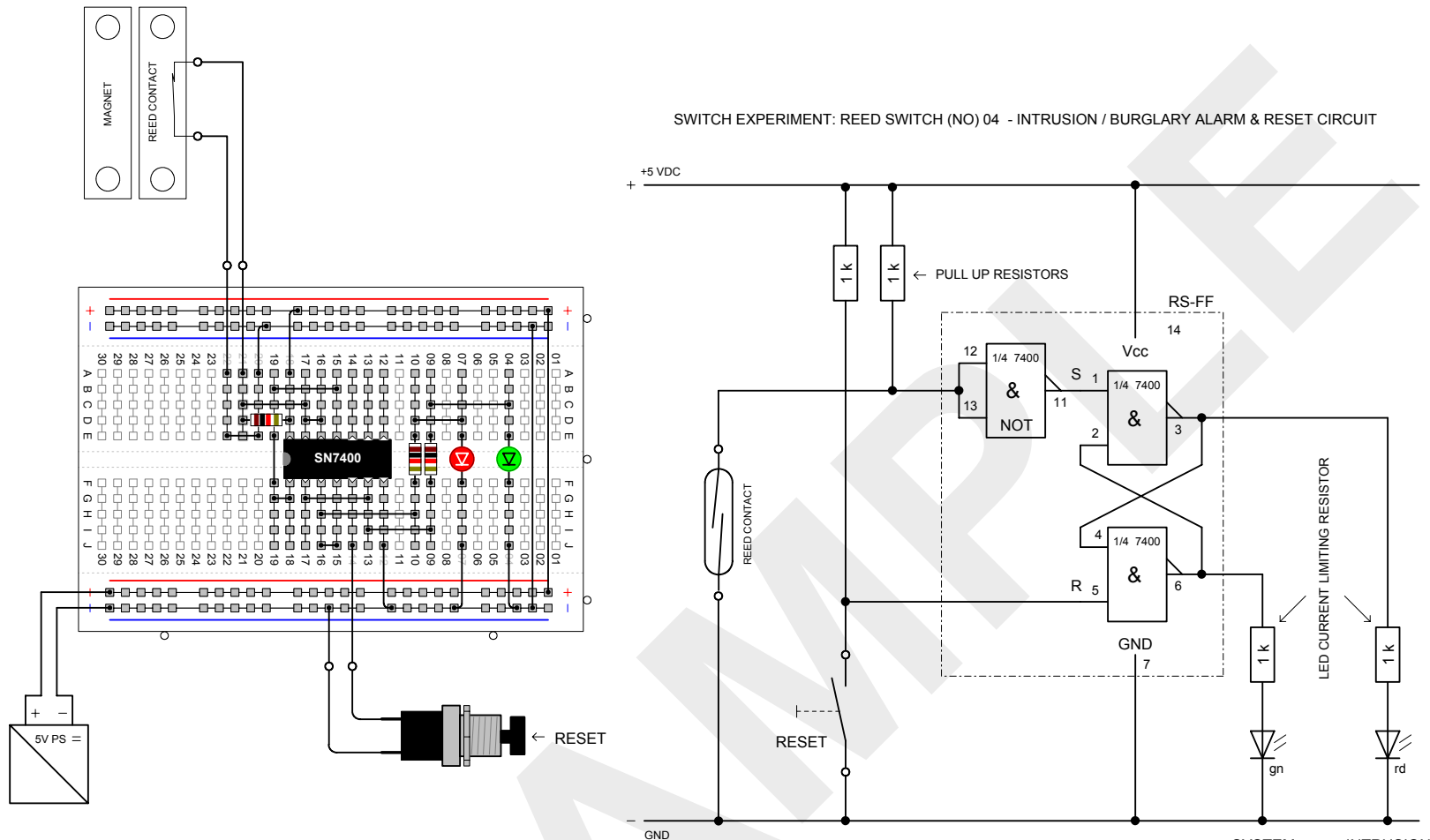
CAPACITOR:



DUAL TIMER IC NE 556:

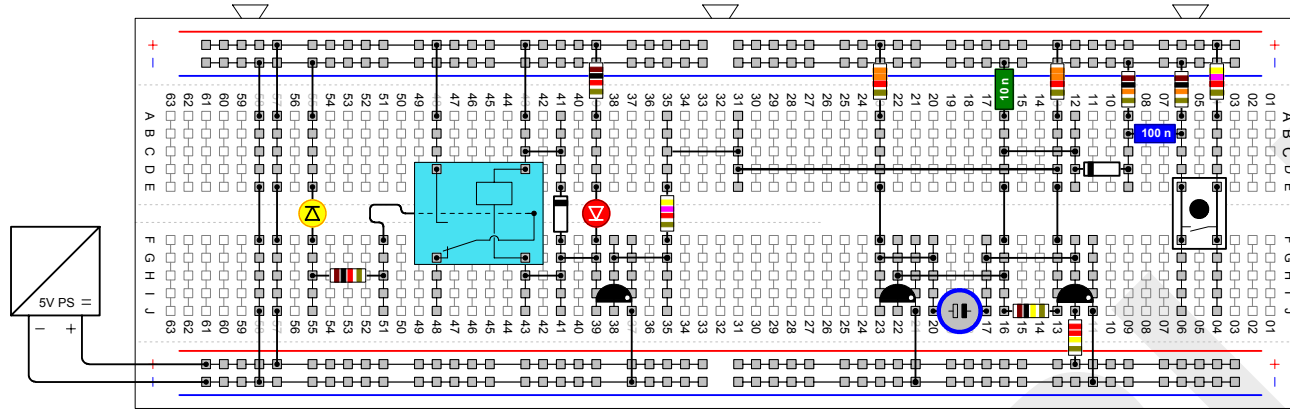
- 1 = DISCHARGE A
2 = THRESHOLD A
3 = CONTROL VOLTAGE A
4 = RESET A
5 = OUTPUT A
6 = TRIGGER A
7 = GND (-)
8 = TRIGGER B
9 = OUTPUT B
10 = RESET B
11 = CONTROL VOLTAGE B
12 = THRESHOLD B
13 = DISCHARGE B
14 = Vss

SG	A4	udo@elgers.com	ue-ERT20200720-01	20-JUL-2020
018	A	NE556 - ALARM SIREN 01 - FIRE		

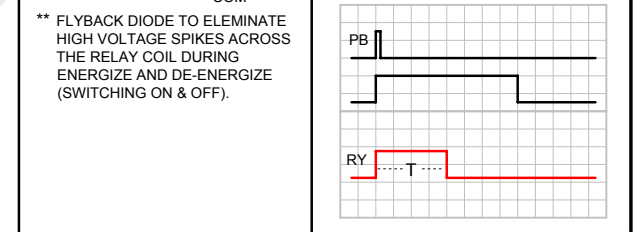
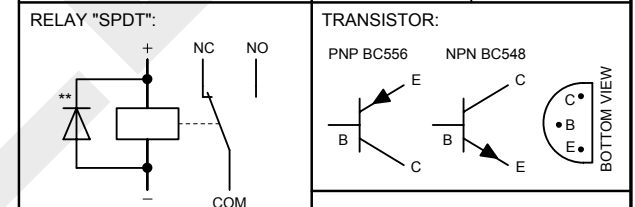
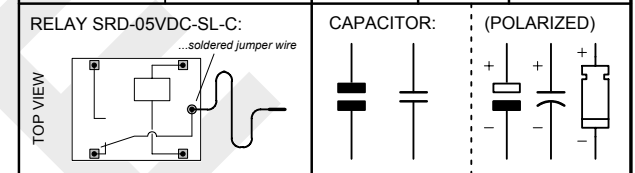
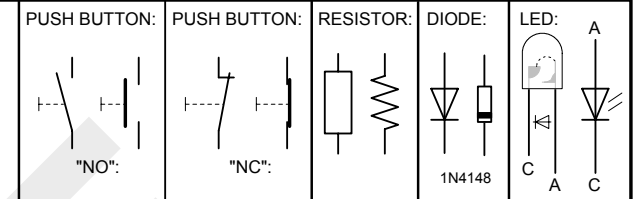
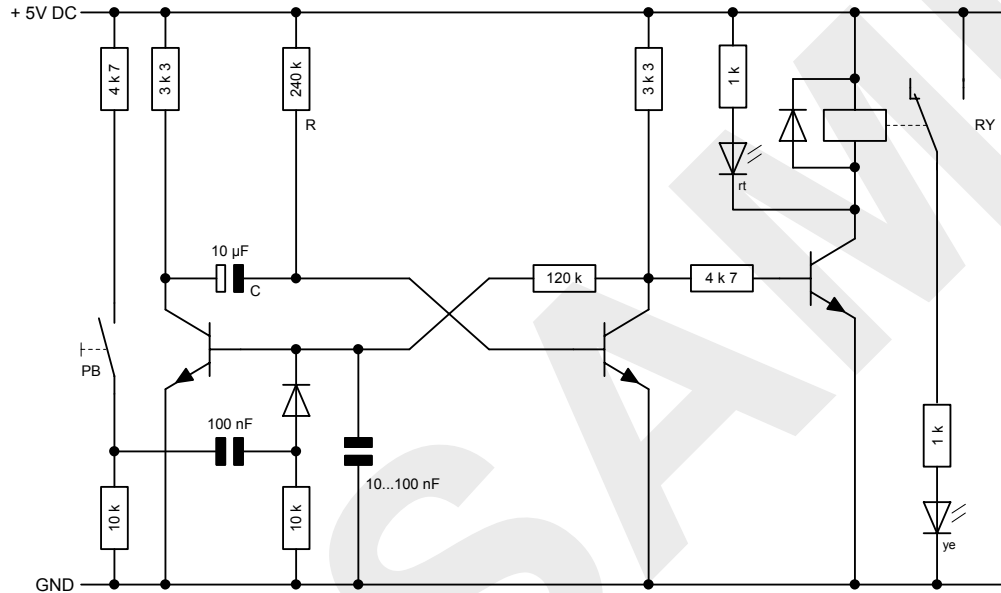


FOR FULLY COMPONENT SPECS. SEE MANUFACTURER DATASHEETS

SW	A4	udo@elgers.com	ue-ERT20201114-02	14-NOV-2020
066	A	REED SWITCH (NO) 04		



HIGH TRIGGERED MONOSTABLE MULTIVIBRATOR (ONE SHOT) WITH NPN TRANSISTORS AND POWER UP RESET, CONFIGURED TO OPERATE ACTIV HIGH TRIGGERED NPN TRANSISTOR DRIVER WITH 5 VDC RELAY

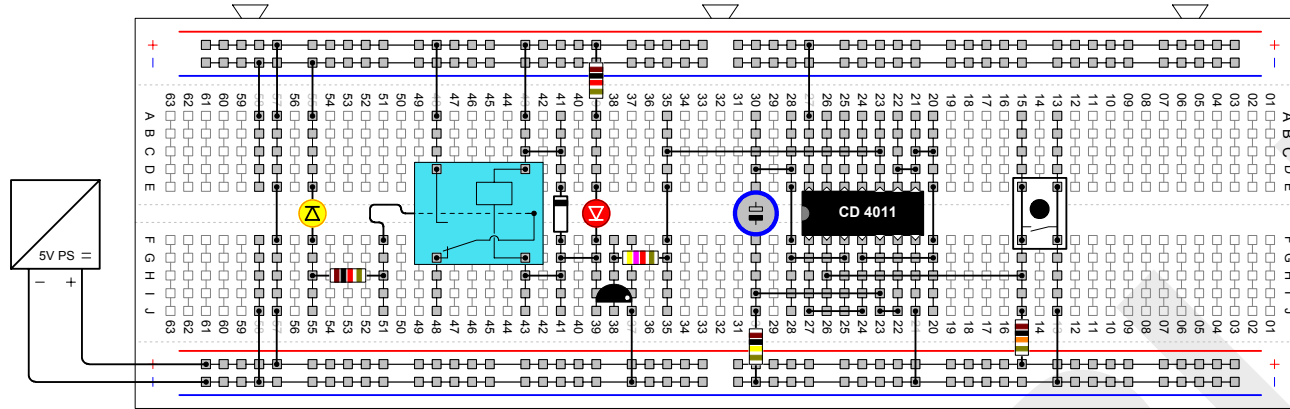


PULSE TIME PERIODE:

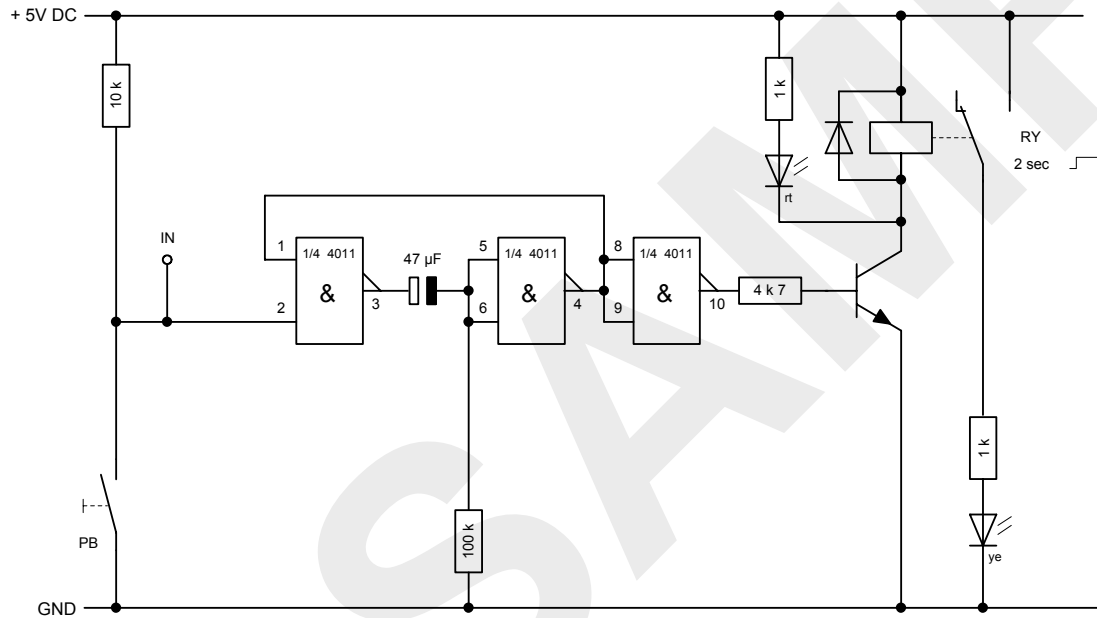
$$T = 0.693 \times C \times R$$

$$T = 0.693 \times 0.00001 \times 240000 = 1.7 \text{ sec}$$

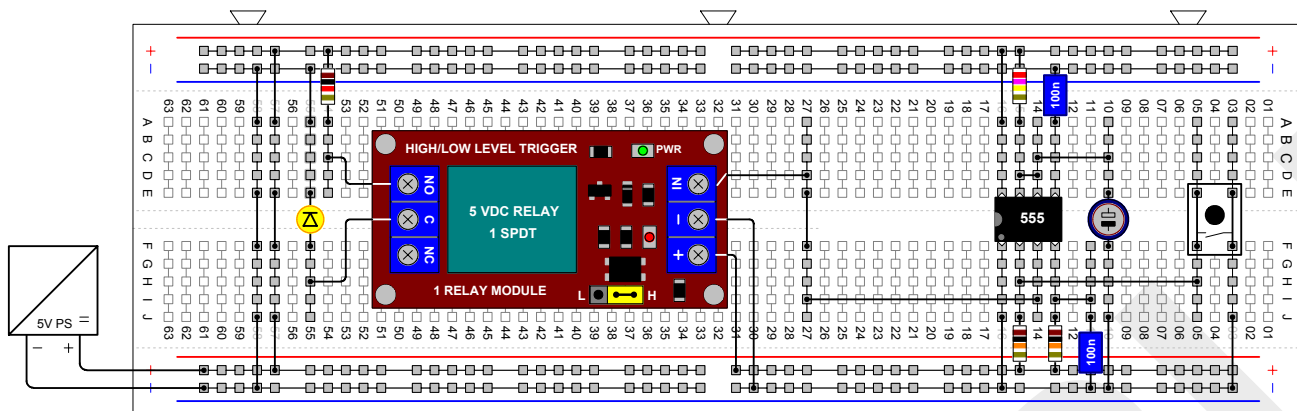
FOR FULLY COMPONENT SPECS. SEE MANUFACTURER DATASHEETS		FIGURES ARE APROXMEIATELY, DUE TO COMPONENT TOLERANCES !		
TI-1	A4	udo@elgers.com	ue-ERT20210615-40	15-JUN-2021
040	A	TRANSISTOR MONO FLOP (ONE SHOT) - EXPERIMENT 03		



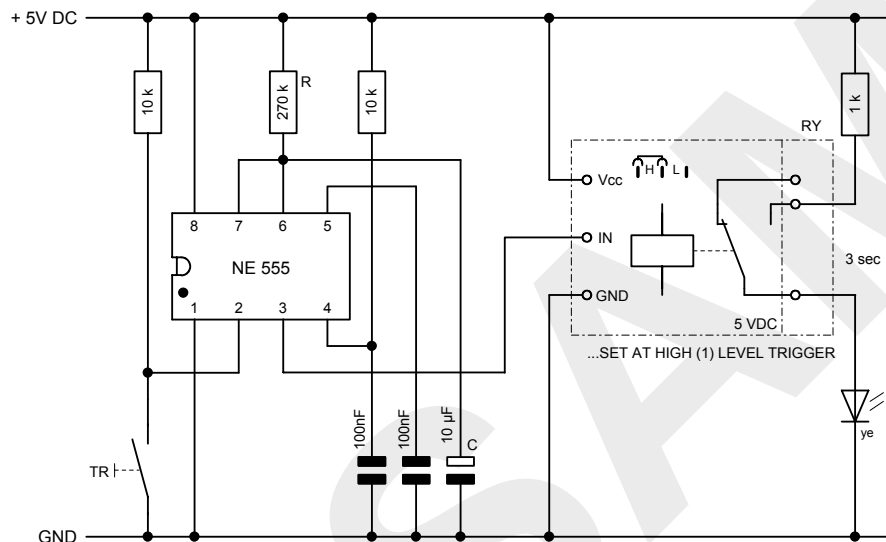
LOW TRIGGER MONO FLOP (ONE SHOT), ACTIVE HIGH OUTPUT, WITH CMOS NAND GATE IC CD4011 & NPN TRANSISTOR RELAY DRIVER



TRANSISTOR PNP BC556 NPN BC546 BOTTOM VIEW	RESISTOR:	DIODE:	LED:
RELAY SRD-05VDC-SL-C: TOP VIEW	CAPACITOR:	(POLARIZED)	
RELAY "SPDT": ** FLYBACK DIODE TO ELEMENATE HIGH VOLTAGE SPIKES ACROSS THE RELAY COIL DURING ENERGIZE AND DE-ENERGIZE (SWITCHING ON & OFF).	PUSH BUTTON "NO":	PUSH BUTTON "NC":	PUSH BUTTON "1NO - 1NC": PUSH BUTTON "SPDT":
NAND GATE SYMBOLS: ANSI IEC DIN (OLD)			
CMOS NAND GATE IC 4011:			
FOR FULLY COMPONENT SPECS. SEE MANUFACTURER DATASHEETS			
TI-2	A4	udo@elgers.com	ue-ERT20210517-15 17-MAY-2021
042	A	CD4011 TIMER EXPERIMENT 15	



DELAY OFF RELAY TIMER, POWER-ON RESET, WITH H/L RELAY MODULE (JP SET = H)

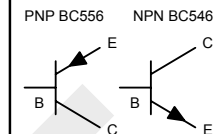


C (µF)	R (k)	T	C (µF)	R (k)	T
10	100	1 sec	470	560	4.8 min
10	180	2 sec	470	620	5.3 min
10	270	3 sec	470	680	5.9 min
10	330	4 sec	470	750	6.5 min
10	470	5 sec	470	820	7.1 min
22	430	10 sec	1000	470	8.6 min
22	560	14 sec	1000	510	9.4 min
22	820	20 sec	1000	560	10.3 min
47	470	24 sec	1000	620	11.4 min
47	560	29 sec	1000	680	12.5 min
47	680	35 sec	1000	750	13.8 min
47	750	39 sec	1000	820	15.0 min
100	430	47 sec	1000	910	16.7 min
100	510	56 sec	2200	430	17.3 min
100	620	1.1 min	2200	470	19.0 min
100	750	1.4 min	2200	510	20.6 min
220	470	1.9 min	2200	560	22.6 min
220	560	2.3 min	2200	620	25.0 min
220	680	2.7 min	2200	680	27.4 min
220	820	3.3 min	2200	750	30.3 min
470	470	4.0 min	2200	820	33.1 min
470	510	4.4 min	2200	910	36.7 min

$$T = 1.1 \times C \times R$$

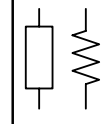
TR = TRIGGER
RY = RELAY
T = TIME PERIODE

TRANSISTOR

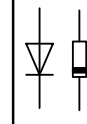


BOTTOM VIEW

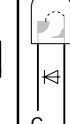
RESISTOR:



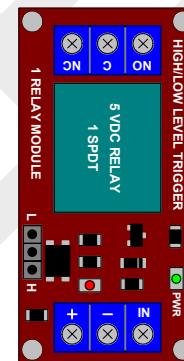
DIODE:



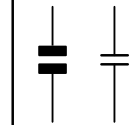
LED:



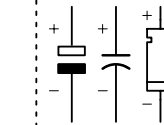
5V H/L TR. RELAY MODULE:



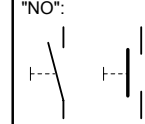
CAPACITOR:



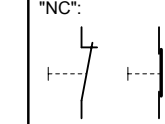
(POLARIZED)



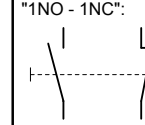
PUSH BUTTON "NO":



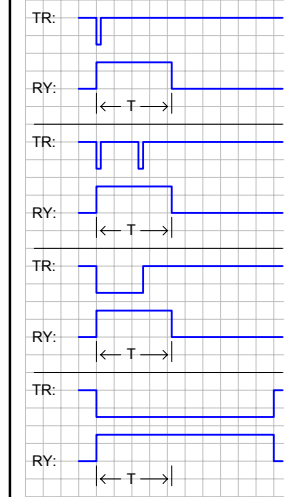
PUSH BUTTON "NC":



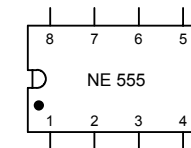
PUSH BUTTON "1NO - 1NC":



PUSH BUTTON "SPDT":



TIMER IC NE 555:

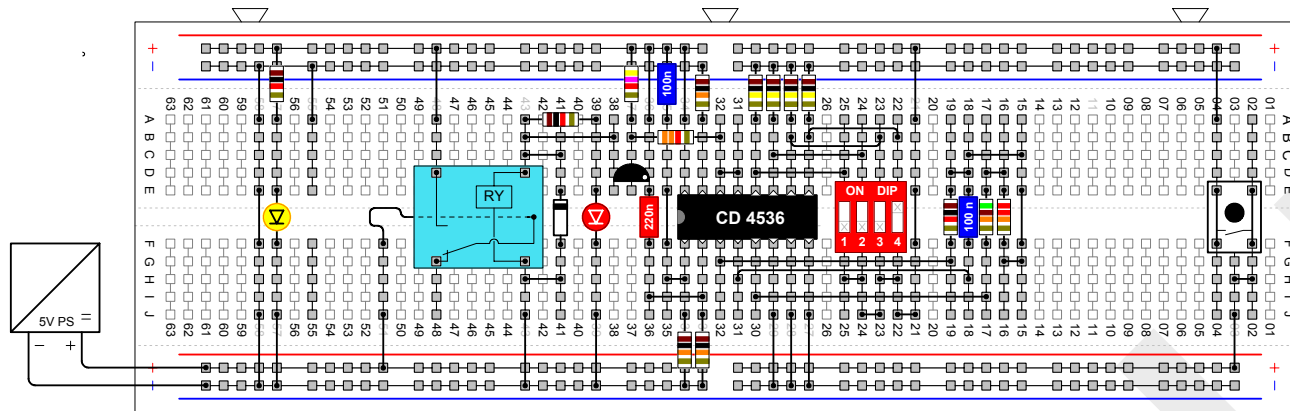


1 = GND (-) 5 = CONTROL VOLTAGE
2 = TRIGGER 6 = THRESHOLD
3 = OUTPUT 7 = DISCHARGE
4 = RESET 8 = Vcc (+)

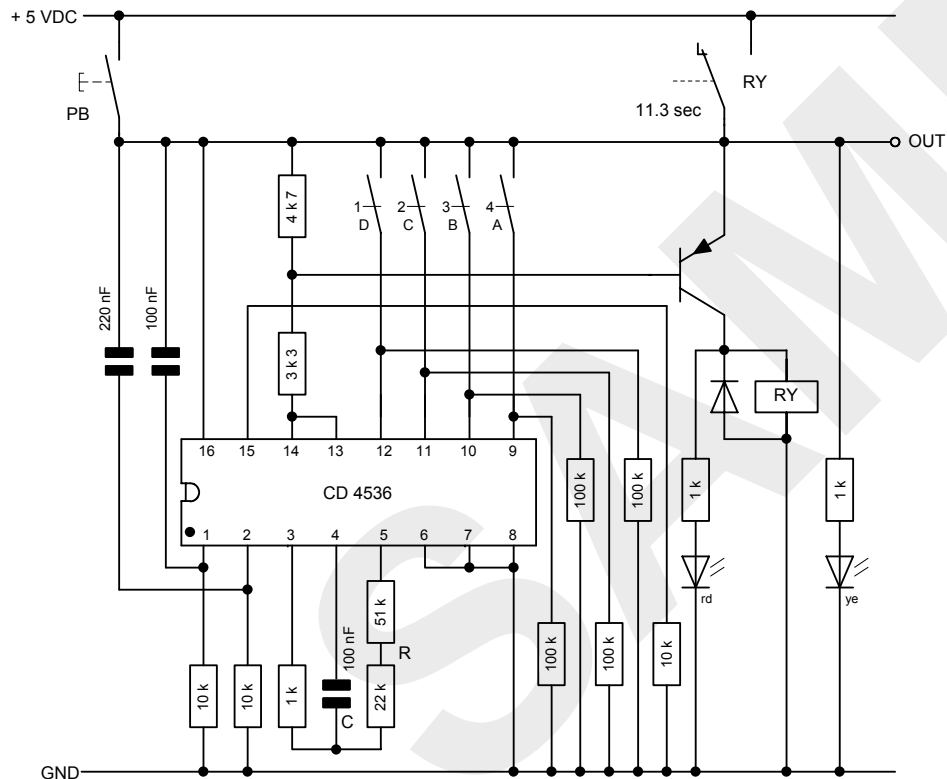
FIGURES ARE APROXIMATELY,
DUE TO COMPONENT TOLERANCES !

FOR FULLY COMPONENT SPECS. SEE
MANUFACTURER DATASHEETS

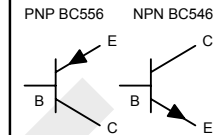
TI-3	A4	udo@elgers.com	ue-ERT20210630-01	30-JUN-2021
040	A	NE555 - RELAY TIMER EXPERIMENT 6		



CD4536 - 5 VDC RELAY, SELF SHUT OFF, PROGRAMMABLE DELAY OFF TIMER, 4 DIP-SWITCH CONFIG., Vers. 04

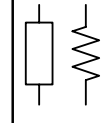


TRANSISTOR

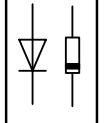


BOTTOM VIEW

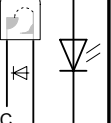
RESISTOR:



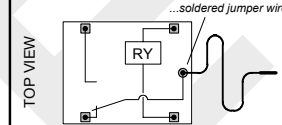
DIODE:



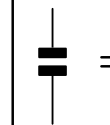
LED:



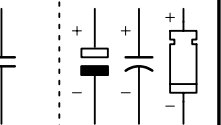
RELAY SRD-05VDC-SL-C:



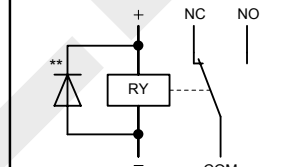
CAPACITOR:



(POLARIZED)

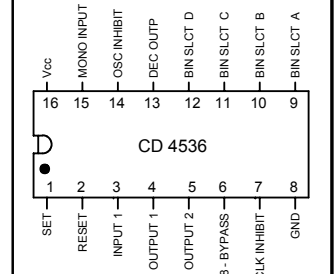


RELAY "SPDT":



** FLYBACK DIODE TO ELIMINATE HIGH VOLTAGE SPIKES ACROSS THE RELAY COIL DURING ENERGIZE AND DE-ENERGIZE (SWITCHING ON & OFF).

TIMER IC CD 4536:



OSCILLATOR RC DIMENSIONING

$$T = 3 \times R \times C$$

$$R = 73 \text{ k}, \quad C = 100 \text{ nF}$$

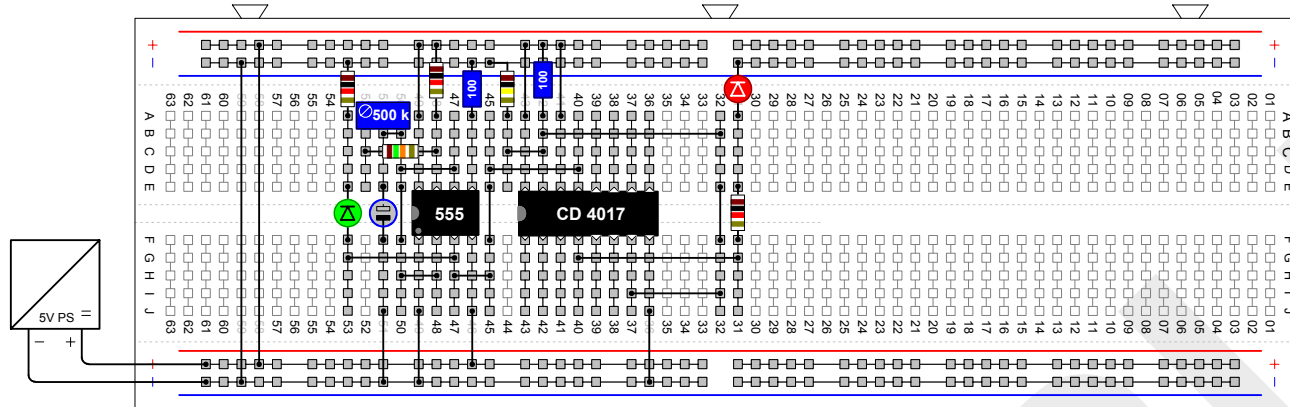
$$T = 3 \times 73000 \times 0.0000001 = 0.0219 \text{ sec}$$

FIGURES ARE APPROXIMATELY, DUE TO COMPONENT TOLERANCES !

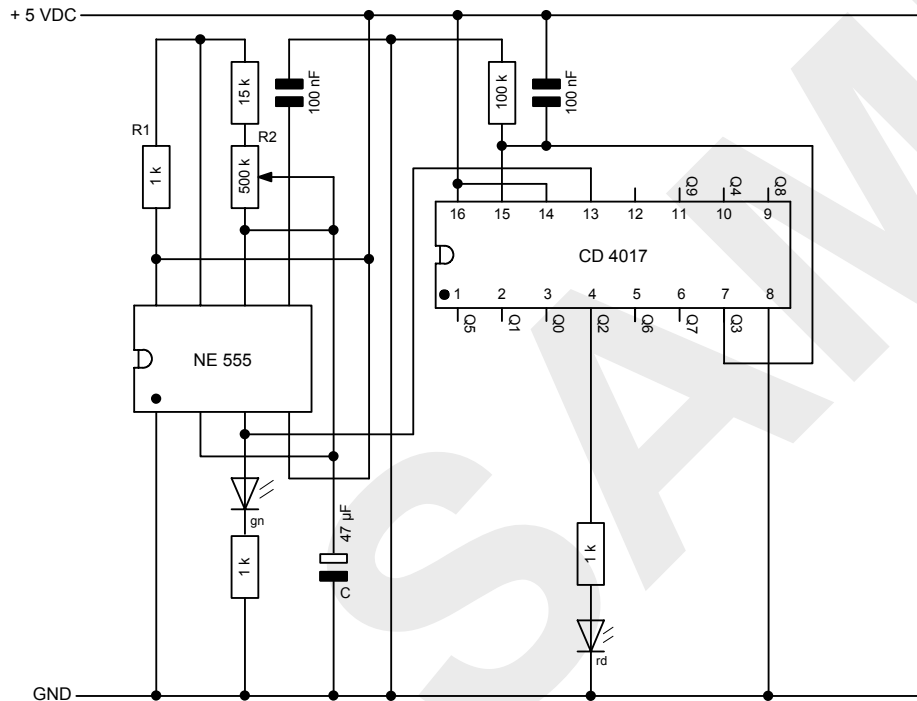
D	C	B	A	MIN. DELAY
0	0	0	0	$T \times 2^8 = 5.63 \text{ sec}$
0	0	0	1	$T \times 2^9 = 11.3 \text{ sec}$ ←
0	0	1	0	$T \times 2^{10} = 22.5 \text{ sec}$
0	0	1	1	$T \times 2^{11} = 45 \text{ sec}$
0	1	0	0	$T \times 2^{12} = 01 \text{ min} : 30 \text{ sec}$
0	1	0	1	$T \times 2^{13} = 3 \text{ min}$
0	1	1	0	$T \times 2^{14} = 6 \text{ min}$
0	1	1	1	$T \times 2^{15} = 12 \text{ min}$
1	0	0	0	$T \times 2^{16} = 24 \text{ min}$
1	0	0	1	$T \times 2^{17} = 48 \text{ min}$
1	0	1	0	$T \times 2^{18} = 01 \text{ hrs} : 36 \text{ min}$
1	0	1	1	$T \times 2^{19} = 03 \text{ hrs} : 12 \text{ min}$
1	1	0	0	$T \times 2^{20} = 06 \text{ hrs} : 24 \text{ min}$
1	1	0	1	$T \times 2^{21} = 12 \text{ hrs} : 48 \text{ min}$
1	1	1	0	$T \times 2^{22} = 25 \text{ hrs} : 36 \text{ min}$
1	1	1	1	$T \times 2^{23} = 51 \text{ hrs} : 12 \text{ min}$

FOR FULLY COMPONENT SPECS. SEE MANUFACTURER DATASHEETS

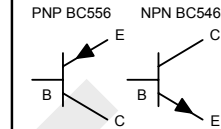
TI-4	A4	udo@elgers.com	ue-ERT20210712-16	12-JUL-2021
026	A	CD4536 SPECIAL TIMER RELAY - EXPERIMENT 08		



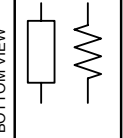
NE555 AMV & CD4017 DIVIDER (T OUT = T CLK x 3), FALLING EDGE COUNT



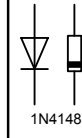
TRANSISTOR



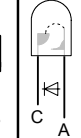
RESISTOR:



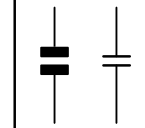
DIODE:



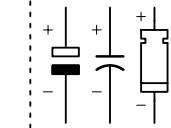
LED:



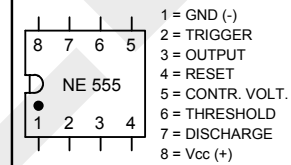
CAPACITOR:



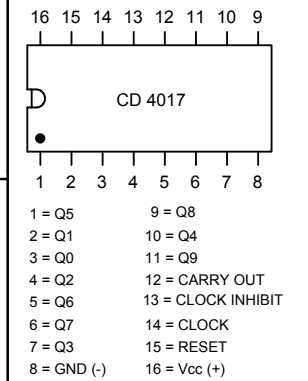
(POLARIZED)



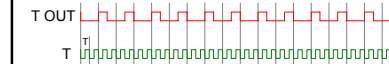
TIMER IC NE 555:



DECADE COUNTER 4017:



CLK	0	1	2	3	4	5	6	7	8	9	CO
0	H	L	L	L	L	L	L	L	L	L	H
1	L	H	L	L	L	L	L	L	L	L	H
2	L	L	H	L	L	L	L	L	L	L	H
3	L	L	L	H	L	L	L	L	L	L	H
4	L	L	L	L	H	L	L	L	L	L	H
5	L	L	L	L	L	H	L	L	L	L	L
6	L	L	L	L	L	L	H	L	L	L	L
7	L	L	L	L	L	L	L	H	L	L	L
8	L	L	L	L	L	L	L	L	H	L	L
9	L	L	L	L	L	L	L	L	L	H	L



$$T \text{ OUT} = T \times 3$$

$$T = 0.69 \times C \times (R1 + 2 \times R2)$$

$$T_{\min} = 0.69 \times 0.000047 \times (1000 + 30000) = 1 \text{ s}$$

$$T_{\max} = 0.69 \times 0.000047 \times (1000 + 1030000) = 33.4 \text{ s}$$

$$C = 47 \mu\text{F}$$

$$T_{\min} = 1 \text{ sec}, T_{\max} = 33.4 \text{ sec}$$

$$C = 470 \mu\text{F}$$

$$T_{\min} = 10 \text{ sec}, T_{\max} = 5.6 \text{ min}$$

$$C = 1000 \mu\text{F}$$

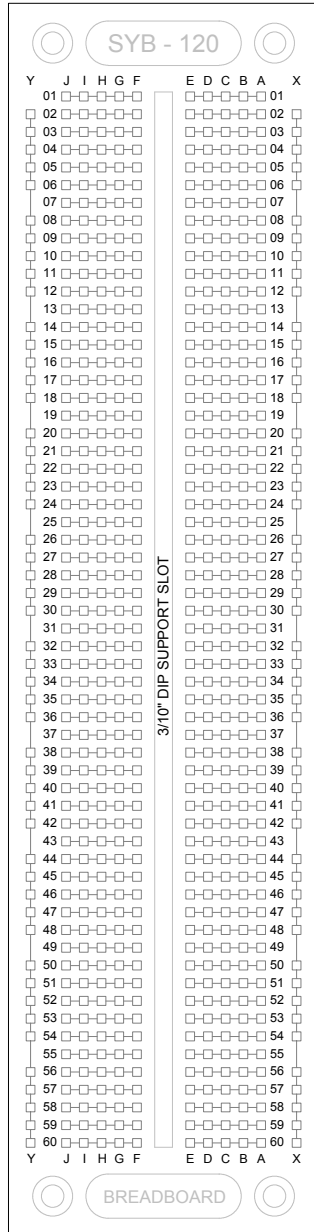
$$T_{\min} = 21 \text{ sec}, T_{\max} = 12 \text{ min}$$

FOR FULLY COMPONENT SPECS. SEE MANUFACTURER DATASHEETS

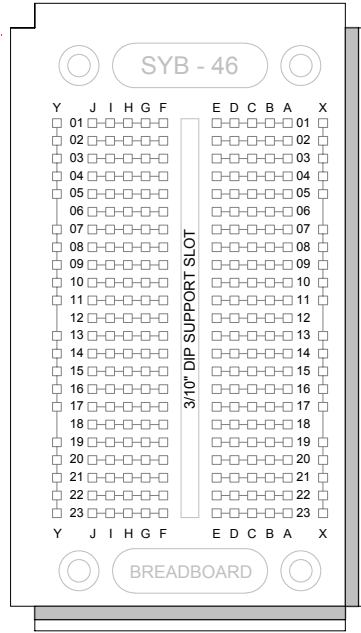
FIGURES ARE APPROXIMATELY, DUE TO COMPONENT TOLERANCES !

TI-5	A4	udo@elgers.com	ue-ERT20210728-08	28-JUL-2021
070	A	CD4017 COUNTER / DIVIDER / TIMER - EXPERIMENT 06		

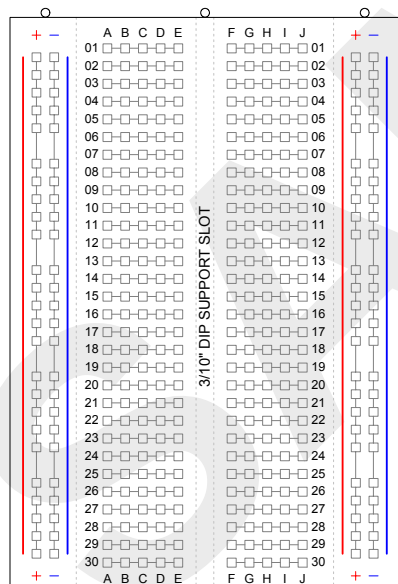
700 TIE POINTS / 2 POWER RAILS



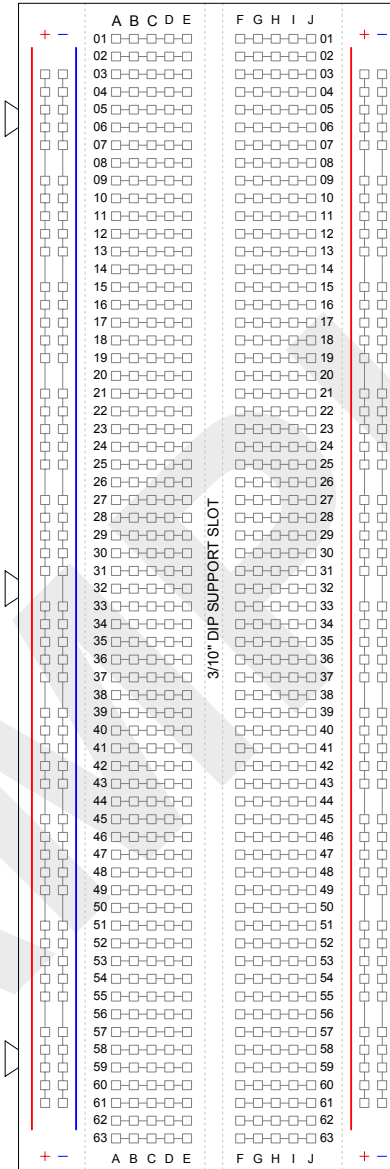
270 TIE POINTS / 2 POWER RAILS



400 TIE POINTS / 4 POWER RAILS

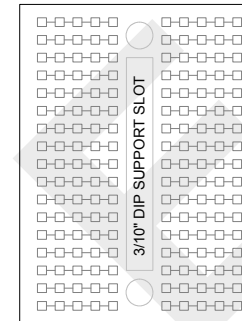


830 TIE POINTS / 4 POWER RAILS

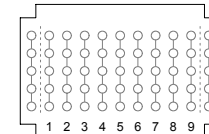


MINI BREADBOARDS

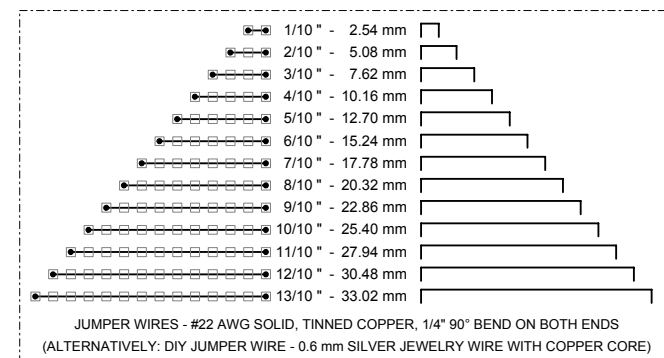
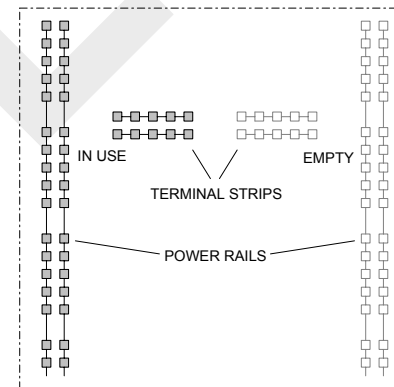
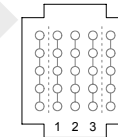
170 TIE POINTS



55 TIE POINTS

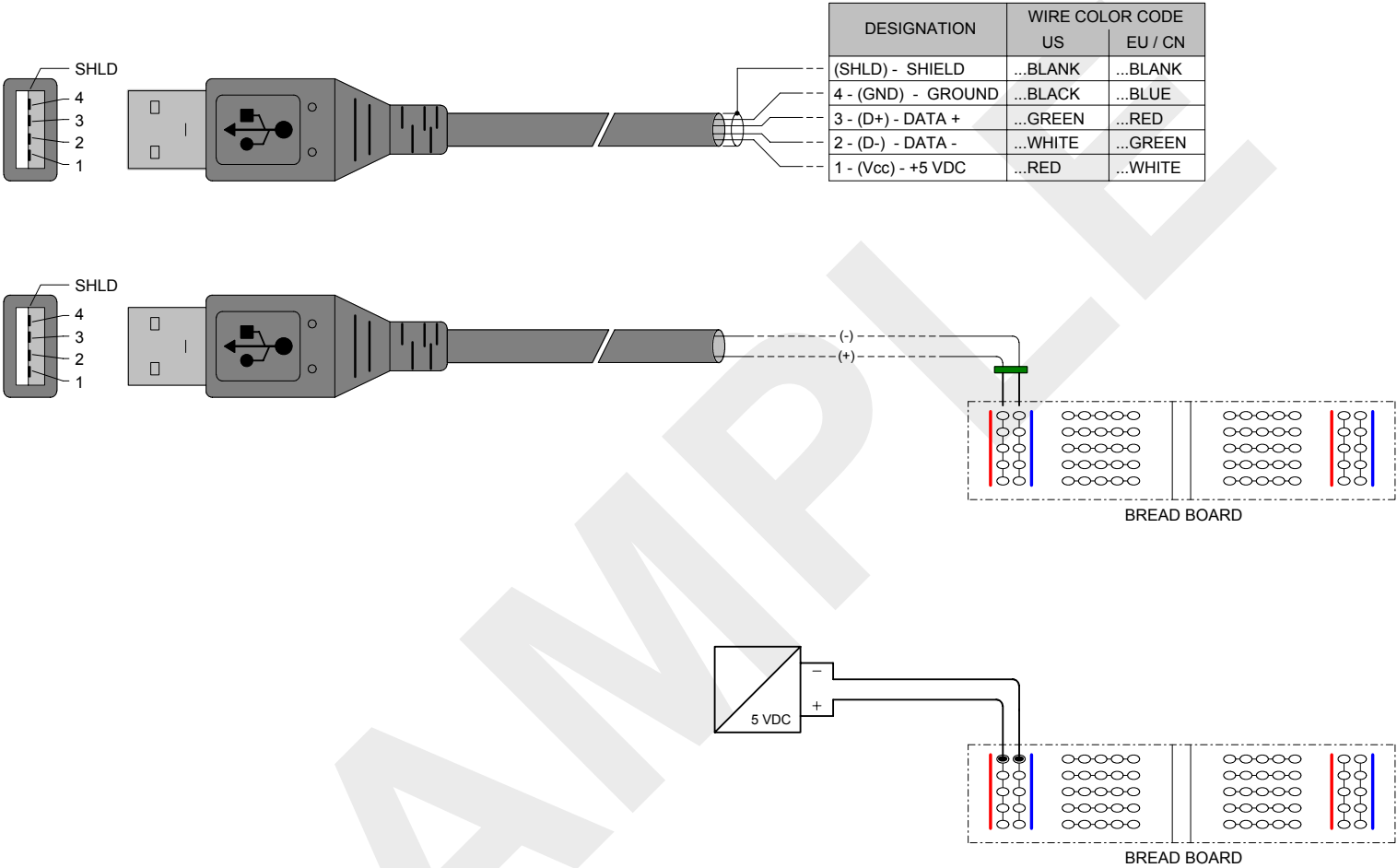


25 TIE POINTS



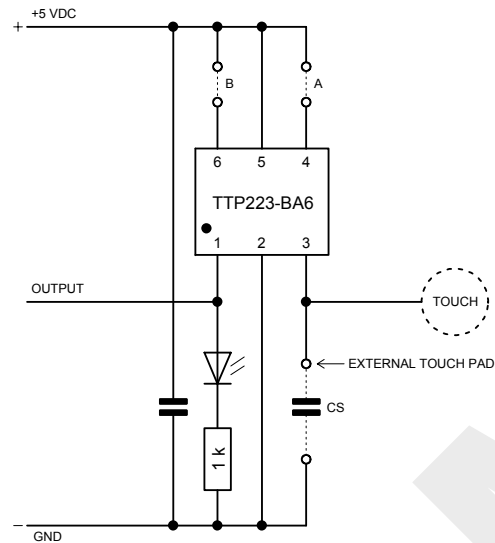
FOR FULLY COMPONENT SPECS. SEE MANUFACTURER DATASHEETS

RY-5	A4	udo@elgers.com	ue-ERT20220204-26	04-FEB-2022
030	A	ADDENDUM: VARIOUS BREADBOARDS		

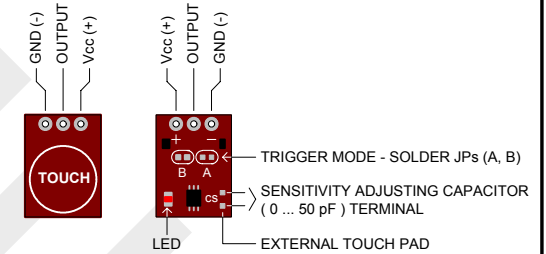


FOR FULLY COMPONENT SPECS. SEE MANUFACTURER DATASHEETS				
RY-5	A4	udo@elgers.com	ue-ERT20220204-27	04-FEB-2022
031	A	ADDENDUM: USB-A PINOUT / 5 VDC SUPPLY		

TTP223 CAPACITIVE TOUCH SENSOR CIRCUIT



TTP223 CAPACITIVE TOUCH SENSOR:

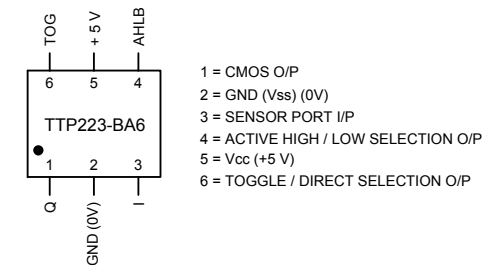
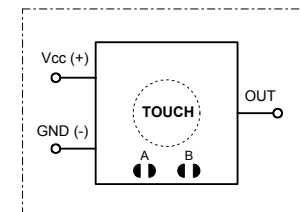


Vcc: 3.3 V ... 5.5 V DC

USE LARGER ELECTRODE SIZE TO INCREASE SENSITIVITY
ADD. CS CAPACITOR 0 ... 50 pF TO LOWER SENSITIVITY (DEFAULT = 0)

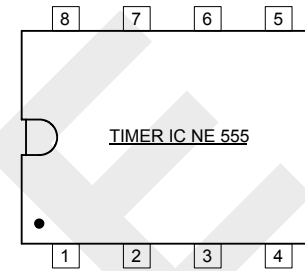
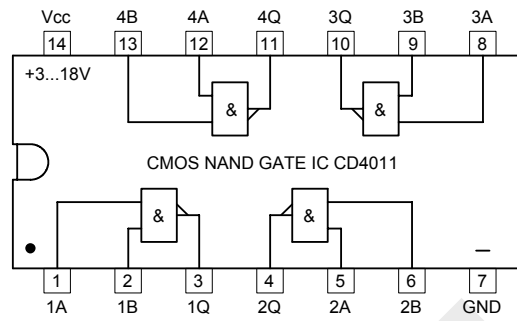
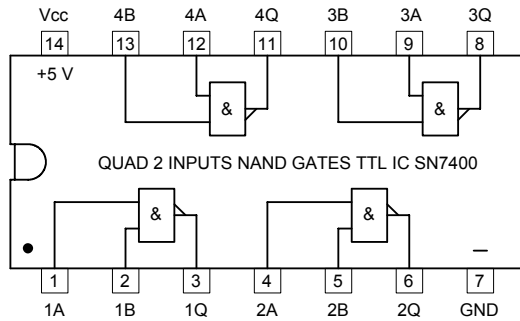
TRIGGER MODE SOLDER JPS

A	B	OUTPUT
		DIRECT MODE / ACTIVE HIGH (1) OUTPUT
		DIRECT MODE / ACTIVE LOW (0) OUTPUT
		TOGGLE MODE / POWER ON STATE = LOW (0)
		TOGGLE MODE / POWER ON STATE = HIGH (1)

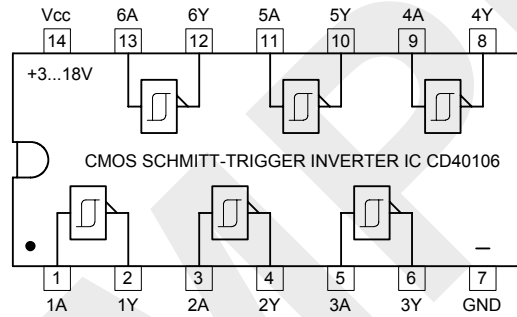
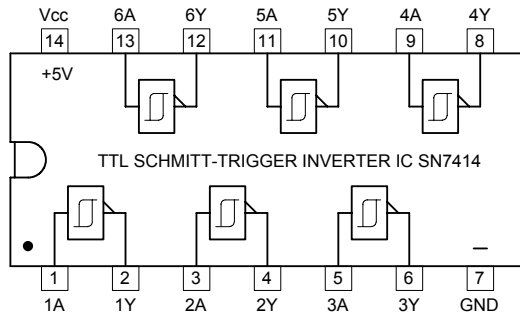


...FOR FULLY INFORMATION SEE OEM DATASHEETS...

RY-5	A4	udo@elgers.com	ue-ERT20220204-29	04-FEB-2022
033	A	ADDENDUM: TOUCH SENSOR - TTP223-BA6		



PIN	FUNCTION
1	GND
2	TRIGGER
3	OUTPUT
4	RESET
5	CONTROL VOLTAGE
6	THRESHOLD
7	DISCHARGE
8	VOLTAGE SUPPLY



LOGIC GATES TRUTH TABLES:

NAND

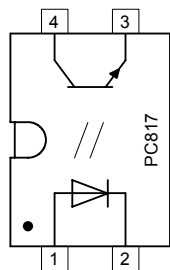
A	B	Q
L	L	H
L	H	H
H	L	H
H	H	L

NOT (INVERTER)

A	Q
L	H
H	L

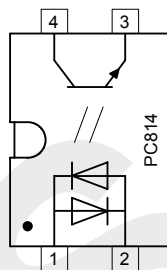
L = LOW (0)
H = HIGH (1)
A = INPUT 1
B = INPUT 2
Q = OUTPUT

OPTOCOUPLER PC817



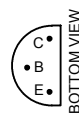
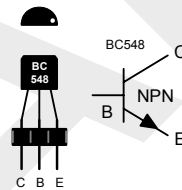
1 = ANODE
2 = CATHODE
3 = EMITTER
4 = COLLECTOR

BI-DIRECTIONAL OPTOCOUPLER PC814

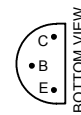
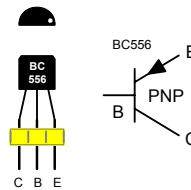


1 = CATHODE / ANODE
2 = ANODE / CATHODE
3 = EMITTER
4 = COLLECTOR

TUN TRANSISTOR

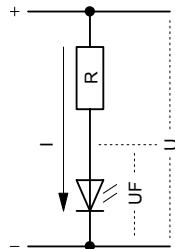
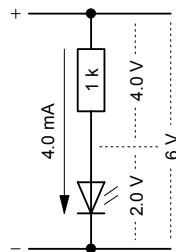
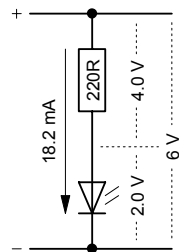
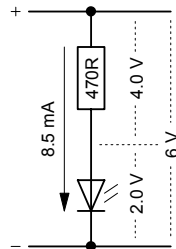
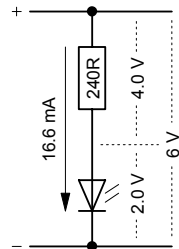


TUP TRANSISTOR



FOR FULLY COMPONENT SPECS. SEE MANUFACTURER DATASHEETS

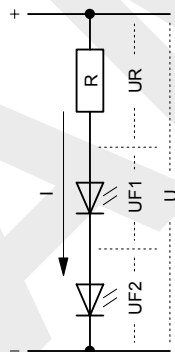
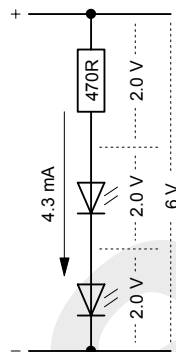
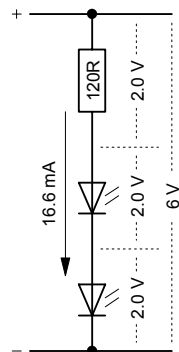
RY-5	A4	udo@elgers.com	ue-ERT20220204-31	04-FEB-2022
035	A	ADDENDUM: SEMICONDUCTORS PIN-OUT		



$$R = \frac{U - U_F}{I}$$

$$I = \frac{U - U_F}{R}$$

$$P_R = (U - U_F) \times I$$



$$U_F = U_{F1} + U_{F2}$$

$$R = \frac{U - U_F}{I}$$

$$I = \frac{U - U_F}{R}$$

$$P_R = (U - U_F) \times I$$

SUGGESTED LOWEST CURRENT LIMITING RESISTOR ($I < \dots = 20 \text{ mA}$)

3.3 V = 82 R - 1/4 W

9.0 V = 470 R - 1/4 W

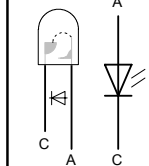
5.0 V = 180 R - 1/4 W

12.0 V = 620 R - 1/4 W

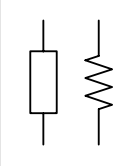
6.0 V = 270 R - 1/4 W

U = DC Supply Voltage
 U_F = LED Forward Voltage Drop
 I = Current Flow (max. 20 mA)
 R = Current Limiting Resistor
 P_R = Power (Resistor)

LED:



RESISTOR:



COLOR	SEMICONDUCTOR	WAVELENGTH	FORWARD VOLTAGE
RED	GaAsP	660 - 700 nm	2.0 V
RED	InGaAlP	640 - 700 nm	2.0 V
ORANGE / RED	GaP	620 - 635 nm	2.4 V
ORANGE	GaAsP / GaP	605 - 610 nm	2.1 V
ORANGE	InGaAlP	610 - 620 nm	2.2 V
ORANGE / YELLOW	InGaAlP	595 - 605 nm	2.0 V
YELLOW	GaP	585 - 595 nm	2.0 V
YELLOW / GREEN	InGaAlP	570 - 585 nm	2.4 V
YELLOW / GREEN	GaP / GaP	565 nm	2.1 V
GREEN	GaAsP	555 - 575 nm	2.0 V
TURQUOISE	InGaN	495 - 505 nm	3.2 V
BLUE	SiC / GaN	460 nm	3.4 V
BLUE	SiC / GaN	465 nm	3.4 V
BLUE	SiC / GaN	470 nm	3.4 V
PINK		440 nm	3.6 V
UV	GaN	400 nm	3.5 V
WARM WHITE	InGaN+PHOSPHOR	WHOLE SPECTRUM	3.6 V
COOL WHITE	InGaN+PHOSPHOR	WHOLE SPECTRUM	3.6 V

FOR FULLY COMPONENT SPECS. SEE MANUFACTURER DATASHEETS

RY-5	A4	udo@elgers.com	ue-ERT20220204-32	04-FEB-2022
036	A	ADDENDUM: LED CURRENT LIMITING RESISTOR		

 10R	 33R	 100R	 330R	 1k0	 3k3	 10k	 33k	 100k	 330k	 1M	 3M3
 11R	 36R	 110R	 360R	 1k1	 3k6	 11k	 36k	 110k	 360k	 1M1	 3M6
 12R	 39R	 120R	 390R	 1k2	 3k9	 12k	 39k	 120k	 390k	 1M2	 3M9
 13R	 43R	 130R	 430R	 1k3	 4k3	 13k	 43k	 130k	 430k	 1M3	 4M3
 15R	 47R	 150R	 470R	 1k5	 4k7	 15k	 47k	 150k	 470k	 1M5	 4M7
 16R	 51R	 160R	 510R	 1k6	 5k1	 16k	 51k	 160k	 510k	 1M6	 5M1
 18R	 56R	 180R	 560R	 1k8	 5k6	 18k	 56k	 180k	 560k	 1M8	 5M6
 20R	 62R	 200R	 620R	 2k0	 6k2	 20k	 62k	 200k	 620k	 2M	 6M2
 22R	 68R	 220R	 680R	 2k2	 6k8	 22k	 68k	 220k	 680k	 2M2	 6M8
 24R	 75R	 240R	 750R	 2k4	 7k5	 24k	 75k	 240k	 750k	 2M4	 7M5
 27R	 82R	 270R	 820R	 2k7	 8k2	 27k	 82k	 270k	 820k	 2M7	 8M2
 30R	 91R	 300R	 910R	 3k0	 9k1	 30k	 91k	 300k	 910k	 3M	 9M1

1. band			1	2	3	4	5	6	7	8	9	
2. band	0		1	2	3	4	5	6	7	8	9	
3. band	/ 100	/ 10	x 1	x 10	x 100	x 1k	x 10k	x 100k	x 1M			
4. band	+/- 10%	+/- 5%										
	silver	gold	black	brown	red	orange	yellow	green	blue	purple	gray	white

Sample		= 47 x 10	= 470	= 470R
		= 10 x 100	= 1000	= 1k
		= 33 x 100	= 3300	= 3k3
		= 56 x 10000	= 560000	= 560k

RY-5	A4	udo@elgers.com	ue-ERT20220204-33	04-FEB-2022
037	A	ADDENDUM: RESISTOR COLOR CODE		

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DISCLAIMER:

This brochure provides a selection of general everyday information.

The information in this brochure is believed correct.

However the author can not have full knowledge of your application.

Therefore you are responsible for ensuring the safety and operability of your design.

The author cannot be held responsible for any damages resulting from the information in this brochure.

If you do not agree with this disclaimer, pls. do not use the information out of this brochure!

WARNING:

IF YOU'RE NOT FAMILIAR WITH THE PRECAUTIONS THAT SHOULD BE TAKEN WHEN WORKING WITH VOLTAGES OVER 24 V, SEEK FOR ADDITIONAL GUIDANCE BEFORE CONNECTING ANY CIRCUIT TO HIGH VOLTAGE SOURCES SUCH AS HOUSEHOLD MAINS LINES OF 120 ... 240 VAC OR EVEN HIGHER. THESE VOLTAGE LEVELS ARE VERY DANGEROUS!

ACCORDING TO LOCAL AND INTERNATIONAL REGULATIONS, WORKING WITH MAINS VOLTAGE IS RESERVED FOR QUALIFIED ELECTRICIANS ONLY!!!

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MD-1

66 ELECTRONIC MODULES

ESSENTIAL DATA & WORKSHEETS

FOR CLASSICAL ELECTRONIC & ARDUINO APPLICATIONS

MD-2

DIY ELECTRONIC MODULES

HOME MADE EXPERIMENTATION DEVICES

AND ELECTRONIC MODULES ON PROTOTYPE PCB

FOR CLASSICAL ELECTRONIC & ARDUINO APPLICATIONS

RYM

RELAYS & RELAY MODULES

FOR CLASSICAL ELECTRONIC & ARDUINO APPLICATIONS

PS

Power Supply Circuits

Brochure

SW

PUSH BUTTONS + SWITCHES

INPUT DEVICES - VOL. 01

ABOUT 90 TESTED CIRCUITS / BREADBOARD EXPERIMENTS

FOR HOBBY AND EDUCATION, AS REFRESHER AND FOR BEGINNERS!

EXPERIMENTS ON BREADBOARD

CT1

Capacitive Touch Sensor TTP223BA-6

INPUT DEVICES - VOL. 02

The teaching material shows TTP223BA-6 are designed for

measuring resistance direct connected to I/O port without and switches

This brochure contains 40 practical examples for hobby and testing as a circuit diagram

and breadboard construction solutions on individual worksheets.

EXPERIMENTS ON BREADBOARD

CT2

Capacitive Touch Sensor TTP223B

INPUT DEVICES - VOL. 03

The teaching material shows TTP223B are designed for

measuring resistance direct connected to I/O port without and switches

This brochure contains 40 practical examples for hobby and testing as a circuit diagram

and breadboard construction solutions on individual worksheets.

EXPERIMENTS ON BREADBOARD

CT3

Capacitive Touch Sensor TTP224

INPUT DEVICES - VOL. 04

The teaching material shows TTP224 are designed for

measuring resistance direct connected to I/O port without and switches

This brochure contains 40 practical examples for hobby and testing as a circuit diagram

and breadboard construction solutions on individual worksheets.

EXPERIMENTS ON BREADBOARD

CT4

Capacitive Touch Sensor TTP226

INPUT DEVICES - VOL. 05

The teaching material shows TTP226 are designed for

measuring resistance direct connected to I/O port without and switches

This brochure contains 40 practical examples for hobby and testing as a circuit diagram

and breadboard construction solutions on individual worksheets.

EXPERIMENTS ON BREADBOARD

CT5

Capacitive Touch Sensor TTP229

INPUT DEVICES - VOL. 06

The teaching material shows TTP229 are designed for

measuring resistance direct connected to I/O port without and switches

This brochure contains 40 practical examples for hobby and testing as a circuit diagram

and breadboard construction solutions on individual worksheets.

EXPERIMENTS ON BREADBOARD

TI-1

RETRO TRANSISTOR TIMER CIRCUITS

TIMER CIRCUITS - VOL. 01

Adapts and incorporates time adjustable frequency, pulse width and delay

and timing circuits. Also includes timing, high and low voltage

and low voltage PNP transistors, with test, setup and timing solutions

This brochure contains 10 practical examples for hobby and testing as a circuit diagram

and breadboard construction solutions on individual worksheets.

EXPERIMENTS ON BREADBOARD

TI-2

TIMER CIRCUITS WITH CMOS GATES

TIMER CIRCUITS - VOL. 02

Adapts and incorporates time adjustable frequency, pulse width and delay

and timing circuits. Also includes timing, high and low voltage

and low voltage CMOS gates, with test, setup and timing solutions

This brochure contains 10 practical examples for hobby and testing as a circuit diagram

and breadboard construction solutions on individual PDP worksheets.

EXPERIMENTS ON BREADBOARD

TI-3

TIMER CIRCUITS WITH NE555 & NE556

TIMER CIRCUITS - VOL. 03

Adapts and incorporates time adjustable frequency, pulse width and delay

and timing circuits. Also includes timing, high and low voltage

and low voltage NE555 & NE556, with test, setup and timing solutions

This brochure contains 10 practical examples for hobby and testing as a circuit diagram

and breadboard construction solutions on individual PDP worksheets.

EXPERIMENTS ON BREADBOARD

TI-4

SPECIAL TIMER CD4536, CD4541 & C005

TIMER CIRCUITS - VOL. 04

Adapts and incorporates time adjustable frequency, pulse width and delay

and timing circuits. Also includes timing, high and low voltage

and low voltage CD4536, CD4541 & C005, with test, setup and timing solutions

This brochure contains 10 practical examples for hobby and testing as a circuit diagram

and breadboard construction solutions on individual PDP worksheets.

EXPERIMENTS ON BREADBOARD

TI-5

TTL + CMOS COUNTER & DIVIDER

TIMER CIRCUITS - VOL. 05

Adapts and incorporates time adjustable frequency, pulse width and delay

and timing circuits. Also includes timing, high and low voltage

and low voltage TTL + CMOS counter & divider, with test, setup and timing solutions

This brochure contains 10 practical examples for hobby and testing as a circuit diagram

and breadboard construction solutions on individual PDP worksheets.

EXPERIMENTS ON BREADBOARD

LE

Light Effect Circuits

Brochure

The brochure contains more than 50 tested circuit diagrams of various experimental light effect circuits for using

transistors, MOSFETs, light bulbs and LEDs for hobby and testing as a circuit diagram

and breadboard construction solutions on individual worksheets.

EXPERIMENTS ON BREADBOARD

MX

LED MATRIX 1088BS

CONTROLLED BY ARDUINO, SPI & I2C TRANSITION LOGIC, SOURCE LOGIC,

TRANSISTORS, TTL & CMOS LOGIC, OR - AND NOT LOGIC, AND/OR LOGIC

CONSTRUCTION WORKSHEETS, NO PROGRAMMING SKILLS REQUIRED

130 TESTED CIRCUITS / BREADBOARD EXPERIMENTS

FOR HOBBY AND EDUCATION, AS REFRESHER AND FOR BEGINNERS!

EXPERIMENTS ON BREADBOARD

MX-2

64-LED WHEEL MATRIX

CONTROLLED BY ARDUINO, SPI & I2C TRANSITION LOGIC, SOURCE LOGIC,

TRANSISTORS, TTL & CMOS LOGIC, OR - AND NOT LOGIC, AND/OR LOGIC

CONSTRUCTION WORKSHEETS, NO PROGRAMMING SKILLS REQUIRED

45 TESTED CIRCUITS / BREADBOARD EXPERIMENTS

FOR HOBBY AND EDUCATION, AS REFRESHER AND FOR BEGINNERS!

EXPERIMENTS ON BREADBOARD

SG

Sound Generator Circuits

Brochure

The brochure contains more than 50 tested circuit diagrams of various experimental sound generators by using

transistors, MOSFETs and sound sources in TTL/CMOS and ARDUINO for hobby and testing as a circuit diagram

and breadboard construction solutions on individual worksheets.

EXPERIMENTS ON BREADBOARD

LS-1

LASER LIGHT BARRIERS WITH KY-008

LASER EXPERIMENTS - VOL. 01

Laser generation and use, beam generation, KY-008, KY-008, photo sensor

near sensor (555) sensor, with I/O, logic and various delay timing solutions

This brochure contains 10 practical examples for hobby and testing as a circuit diagram

and breadboard construction solutions on individual PDP worksheets

This brochure contains 10 practical examples for hobby and testing as a circuit diagram

and breadboard construction solutions on individual worksheets.

EXPERIMENTS ON BREADBOARD

RY-1

TRADITIONAL RELAY EXPERIMENTS

RELAY CIRCUITS - VOL. 01

about 100 - 1000 relay control circuits

transistor and/or relay gate controlled, high or low, digital or analog triggered

digital function, control trigger, high and low voltage circuits

This brochure contains 10 practical examples for hobby and testing as a circuit diagram

and breadboard construction solutions on individual worksheets.

EXPERIMENTS ON BREADBOARD

RY-2

H/L RELAY MODULE EXPERIMENTS

RELAY CIRCUITS - VOL. 02

about 100 - 1000 relay control circuits

transistor and/or relay gate controlled, high or low, digital or analog triggered

digital function, control trigger, high and low voltage circuits

This brochure contains 10 practical examples for hobby and testing as a circuit diagram

and breadboard construction solutions on individual worksheets.

EXPERIMENTS ON BREADBOARD

RY-3

KY-019 RELAY MODULE EXPERIMENTS

RELAY CIRCUITS - VOL. 03

about 100 - 1000 relay control circuits

transistor and/or relay gate controlled, high or low, digital or analog triggered

digital function, control trigger, high and low voltage circuits

This brochure contains 10 practical examples for hobby and testing as a circuit diagram

and breadboard construction solutions on individual worksheets.

EXPERIMENTS ON BREADBOARD

RY-4

HW-307 RELAY MODULE EXPERIMENTS

RELAY CIRCUITS - VOL. 04

about 100 - 1000 relay control circuits

transistor and/or relay gate controlled, high or low, digital or analog triggered

digital function, control trigger, high and low voltage circuits

This brochure contains 10 practical examples for hobby and testing as a circuit diagram

and breadboard construction solutions on individual worksheets.

EXPERIMENTS ON BREADBOARD

RY-5

1CH. RELAY MODULE EXPERIMENTS

RELAY CIRCUITS - VOL. 05

about 100 - 1000 relay control circuits

transistor and/or relay gate controlled, high or low, digital or analog triggered

digital function, control trigger, high and low voltage circuits

This brochure contains 10 practical examples for hobby and testing as a circuit diagram

and breadboard construction solutions on individual worksheets.

EXPERIMENTS ON BREADBOARD

RY-6

2CH. RELAY MODULE EXPERIMENTS

RELAY CIRCUITS - VOL. 06

about 100 - 1000 relay control circuits

transistor and/or relay gate controlled, high or low, digital or analog triggered

digital function, control trigger, high and low voltage circuits

This brochure contains 10 practical examples for hobby and testing as a circuit diagram

and breadboard construction solutions on individual worksheets.

EXPERIMENTS ON BREADBOARD

RY-7

3CH. RELAY MODULE EXPERIMENTS

RELAY CIRCUITS - VOL. 07

about 100 - 1000 relay control circuits

transistor and/or relay gate controlled, high or low, digital or analog triggered

digital function, control trigger, high and low voltage circuits

This brochure contains 10 practical examples for hobby and testing as a circuit diagram

and breadboard construction solutions on individual worksheets.

EXPERIMENTS ON BREADBOARD

RY-8

4CH. RELAY MODULE EXPERIMENTS

RELAY CIRCUITS - VOL. 08

about 100 - 1000 relay control circuits

transistor and/or relay gate controlled, high or low, digital or analog triggered

digital function, control trigger, high and low voltage circuits

This brochure contains 10 practical examples for hobby and testing as a circuit diagram

and breadboard construction solutions on individual worksheets.

EXPERIMENTS ON BREADBOARD

RY-9

5CH. RELAY MODULE EXPERIMENTS

RELAY CIRCUITS - VOL. 09

about 100 - 1000 relay control circuits

transistor and/or relay gate controlled, high or low, digital or analog triggered

digital function, control trigger, high and low voltage circuits

This brochure contains 10 practical examples for hobby and testing as a circuit diagram

and breadboard construction solutions on individual worksheets.

EXPERIMENTS ON BREADBOARD