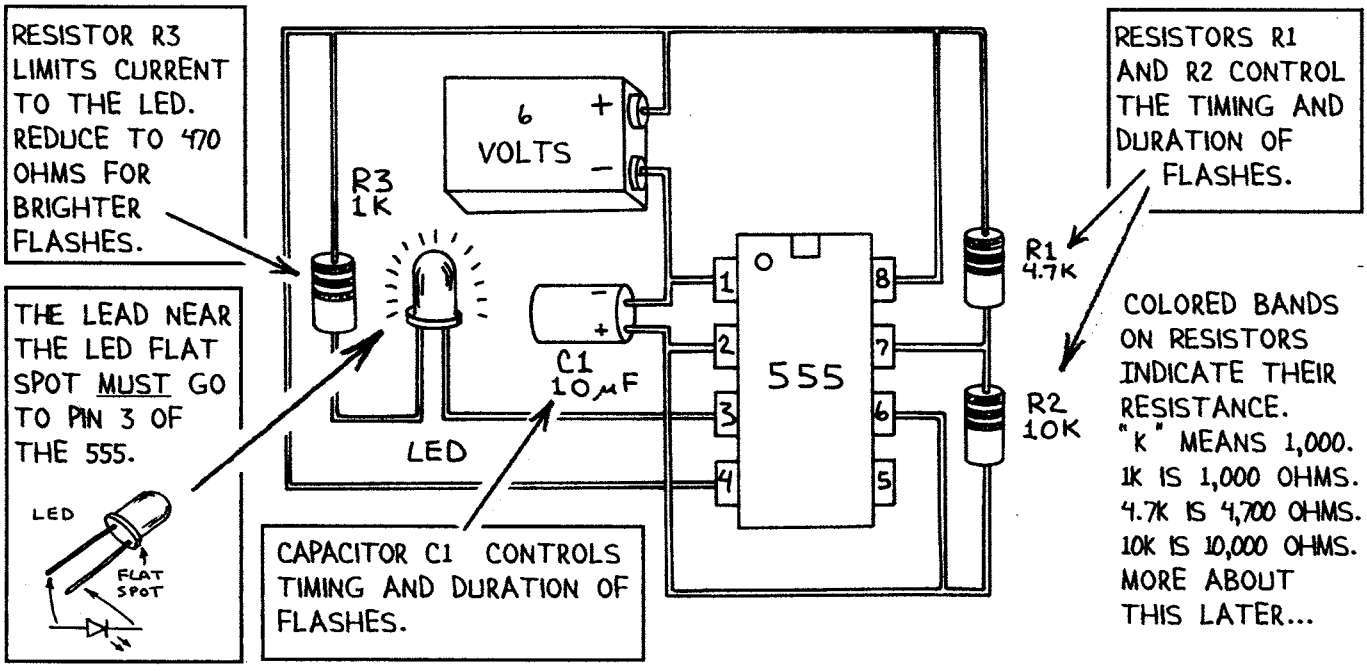
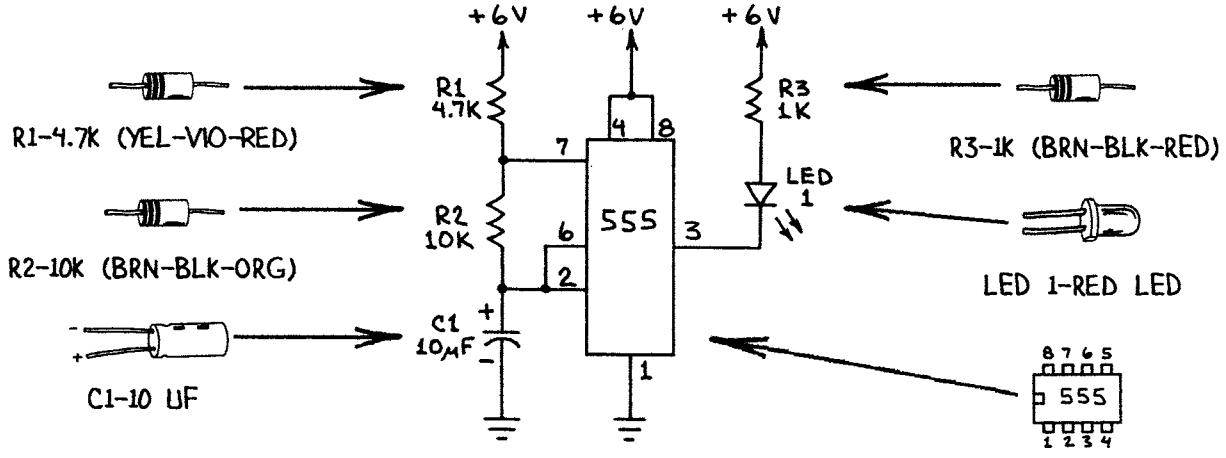
GETTING STARTED: A PICTORIAL VIEW OF A CIRCUIT THAT FLASHES AN LED

THE ILLUSTRATION BELOW IS A PICTORIAL VIEW OF A CIRCUIT THAT USES A 555 INTEGRATED CIRCUIT TO SEND PULSES OF CURRENT TO A RED LIGHT-EMITTING DIODE. PICTORIAL VIEWS ARE VERY CLEAR, BUT THEY ARE NOT PRACTICAL FOR COMPLICATED CIRCUITS. CIRCUIT DIAGRAMS IN WHICH ELECTRONIC PARTS ARE REPRESENTED BY THE SYMBOLS ON THE FACING PAGE ARE MUCH MORE COMMONLY USED.



A CIRCUIT DIAGRAM OF A CIRCUIT THAT FLASHES AN LED

THE CIRCUIT DIAGRAM BELOW IS EQUIVALENT TO THE PICTORIAL VIEW ABOVE. THE SAME CIRCUIT IS SHOWN IN BOTH DIAGRAMS. THE MOST IMPORTANT DIFERENCE BETWEEN THE TWO DRAWINGS IS THAT IN THE CIRCUIT DIAGRAM THE PINS OF THE 555 IC ARE NOT SHOWN IN THE SAME ARRANGEMENT THEY HAVE ON THE ACTUAL IC. THIS SHORTCUT PROVIDES A SIMPLER WAY OF REPRESENTING THE CIRCUIT. NOTE THAT THE 6-VOLT BATTERY IS REPLACED BY SYMBOLS.

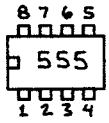


COMPARE THE TWO CIRCUITS BY CHECKING TO SEE IF THE SAME CONNECTIONS ARE MADE TO EACH 555 PIN. START AT PIN 1. (PIN 5 IS NOT USED.) THIS IS AN EXCELLENT WAY TO FIND MISTAKES WHEN YOU BUILD CIRCUITS ON YOUR LEARNING LAB'S BREADBOARD. THE RESISTORS ARE MARKED WITH A CODE OF COLORED BANDS (YEL = YELLOW, VIO = VIOLET, BRN = BROWN, ORG = ORANGE AND BLK = BLACK). LATER WE WILL COVER HOW TO INTERPRET THIS CODE.

GETTING STARTED: BUILD A SIMPLE LED FLASHER

NOW YOU ARE READY TO BUILD THE LED FLASHER CIRCUIT ON PAGE 14. BUILDING THIS CIRCUIT WILL HELP PREPARE YOU TO BUILD ALL THE CIRCUITS DESCRIBED IN YOUR LEARNING LAB MANUALS. TIP: CIRCUIT BUILDING GOES MUCH FASTER IF YOU FIRST GATHER TOGETHER ALL THE PARTS YOU WILL NEED. ALSO, BE SURE TO REMOVE UNUSED PARTS FROM THE BREADBOARD.

PARTS YOU WILL NEED



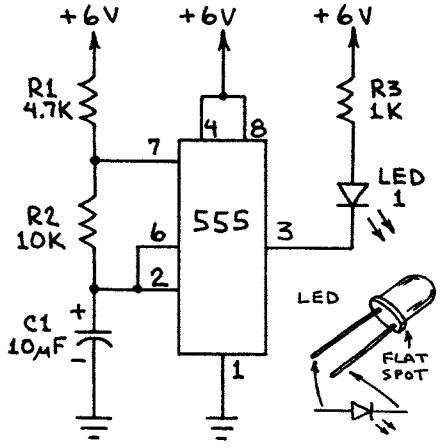
R1-4.7K (YEL-VIO-RED)
R2-10K (BRN-BLK-ORG)
R3-1K (BRN-BLK-RED)

C1-10 UF

LED 1-RED LED

CIRCUIT DIAGRAM

THE CIRCUIT SPECIFIES A RED LED FOR LED 1. YOU CAN USE A GREEN LED IF YOU PREFER.



HOW IT WORKS

THIS CIRCUIT IS A BASIC ASTABLE OR FREE-RUNNING PULSE GENERATOR. THE PULSE RATE IS DETERMINED PRIMARILY BY C1 AND THE RESISTORS THROUGH WHICH C1 CHARGES (R1 AND R2). THE WIDTH OF THE PULSES IS CONTROLLED BY R2. R3 LIMITS CURRENT THROUGH THE LED TO A SAFE VALUE. NOTICE HOW ALL THE CONNECTIONS TO +6 VOLTS ARE SHOWN SEPARATELY. THIS STYLE IS USED IN MOST OF YOUR LEARNING LAB CIRCUIT DIAGRAMS.

1. BUILD THE CIRCUIT

1. ☐ PUSH THE POWER SWITCH TO OFF.
2. ☐ INSERT THE 555 IC ACROSS SLOT 3 (PIN 1 AT F15).
3. ☐ CONNECT I14 TO F17 (WHT WIRE).
4. ☐ CONNECT G14 TO H17 (WHT WIRE).
5. ☐ CONNECT F20 TO V4 (+6V) (WHT WIRE).
6. ☐ CONNECT F13 TO GROUND (RED WIRE).
7. ☐ INSERT R1 ACROSS G19 AND V4 (+6V).
8. ☐ INSERT R2 ACROSS G20 AND H20.
9. ☐ INSERT R3 ACROSS D15 AND V4 (+6V).
10. ☐ INSERT LED 1 ACROSS D13 (ANODE) AND H13 (CATHODE).
11. ☐ INSERT C1 ACROSS G11 (+) AND F11 (-).

2. TEST THE CIRCUIT

CHECK THE CIRCUIT FOR ERRORS. WHEN YOU ARE SURE ALL THE WIRES AND COMPONENTS ARE INSTALLED CORRECTLY, PUSH THE POWER SWITCH UP (ON). THE LED SHOULD BEGIN FLASHING SEVERAL TIMES PER SECOND. PROBLEM? GO TO PAGES 16 AND 18 FOR HELP.

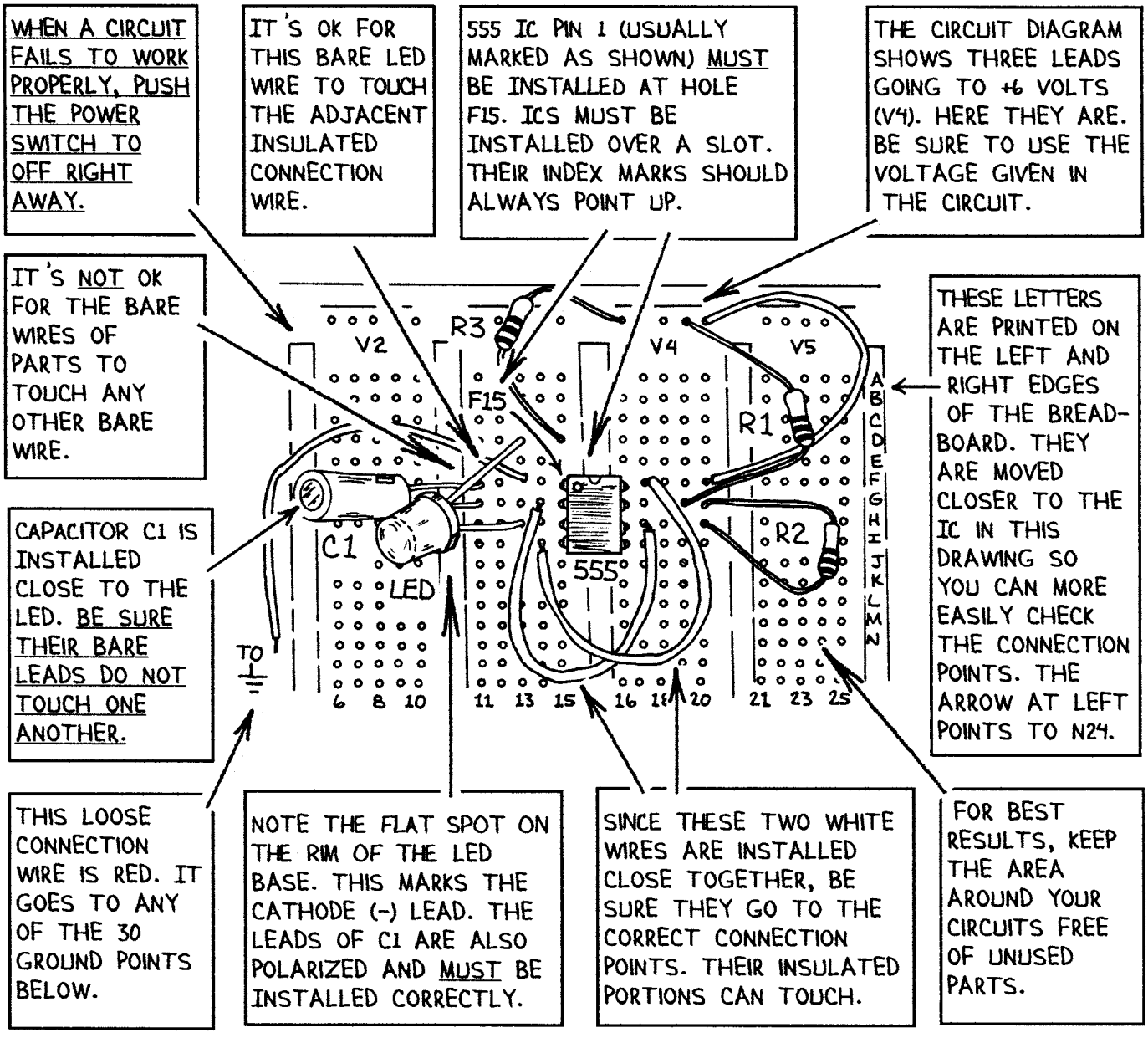
GOING FURTHER

THIS SIMPLE CIRCUIT IS EASY TO MODIFY. TO SLOW THE FLASH RATE TO ABOUT ONCE EVERY TWO SECONDS, INSERT A 100 UF CAPACITOR ACROSS C1 AT G12 (+) AND F12 (-). TO TRIGGER A SHRILL TONE FROM THE BUZZER EACH TIME THE LED SWITCHES ON, USE BLUE WIRES TO CONNECT SPRING 67 TO H11 AND SPRING 66 TO V4 (+6V). THE 555 TIMER IS AMAZINGLY VERSATILE. MORE APPLICATIONS FOR THE 555 ARE GIVEN LATER IN THIS MANUAL. BE SURE TO COMPARE YOUR CIRCUIT WITH THE PICTORIAL VIEW ON PAGE 16. YOU WILL FIND SOME TIPS THAT WILL HELP YOU BUILD THIS AND OTHER CIRCUITS.

GETTING STARTED: CHECKING OUT THE CIRCUIT

IF YOU ADDED THE 100 UF CAPACITOR, YOUR LED FLASHER CIRCUIT SHOULD NOW BE FLASHING SEVERAL TIMES EACH SECOND. OR MAYBE IT'S NOT WORKING. EITHER WAY, COMPARE YOUR CIRCUIT WITH THE ONE BELOW TO SEE WHAT YOU DID RIGHT—OR WHAT YOU DID WRONG.

FINDING AND CORRECTING ERRORS IN ELECTRONIC CIRCUITS IS CALLED "TROUBLESHOOTING." TROUBLESHOOTING IS COVERED ON PAGE 18. YOU WILL GET A GOOD IDEA OF WHAT'S INVOLVED IN TROUBLESHOOTING YOUR LEARNING LAB PROJECTS BY COMPARING YOUR CIRCUIT WITH THE ILLUSTRATION BELOW.



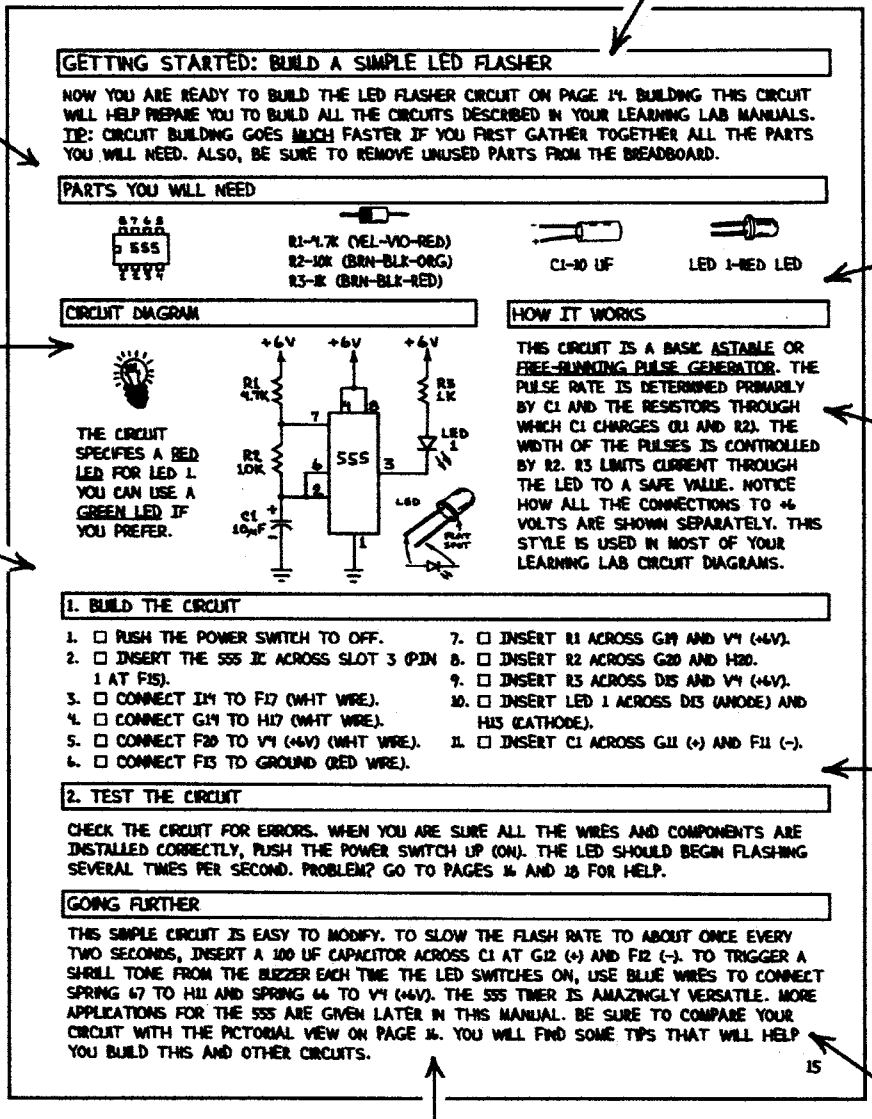
TO PROTECT YOUR LEARNING LAB, AND FOR BEST RESULTS, ALWAYS SWITCH THE POWER SWITCH TO OFF BEFORE BUILDING OR MODIFYING A CIRCUIT. AFTER YOU BUILD A CIRCUIT, CAREFULLY CHECK FOR ERRORS BEFORE SWITCHING THE POWER BACK ON.

GETTING STARTED: REVIEW WHAT YOU HAVE LEARNED

YOU CAN BUILD THE CIRCUITS IN THIS MANUAL IN ORDER OR RANDOMLY. SO YOU CAN QUICKLY LEARN HOW THE PROJECTS ARE PRESENTED, BEGIN WITH THE 555 LED FLASHER ON PAGE 15. THE EXPLANATIONS BELOW SHOW HOW THIS AND MOST OTHER PROJECT PAGES IN YOUR TWO LEARNING LAB MANUALS ARE ORGANIZED. WHILE DETAILED ASSEMBLY INSTRUCTIONS ARE PROVIDED WITH EACH PROJECT, EVENTUALLY YOU WILL BE ABLE TO BUILD THE CIRCUITS STRAIGHT FROM THE CIRCUIT DIAGRAMS. TIP: BE SURE TO COLLECT ALL THE PARTS BEFORE STARTING A CIRCUIT.

"PARTS YOU WILL NEED" LISTS ALL PARTS EXCEPT WIRES AND THOSE ON THE CONSOLE.

EACH PROJECT PAGE HAS A TITLE BAR THAT DESCRIBES THE PROJECT. A BRIEF INTRODUCTION BELOW THE TITLE BAR EXPLAINS WHAT YOU WILL DO AND LEARN.



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C1-10 UF

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+6V +6V +6V
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R2 10K
C1 10 uF
555
R3 1K
LED 1
LED

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15

"CIRCUIT DIAGRAM" IS A SCHEMATIC DIAGRAM OF THE CIRCUIT YOU WILL BUILD.

BRIGHT IDEAS... WHEN SPACE PERMITS.

"HOW IT WORKS" IS INCLUDED WHEN SPACE PERMITS.

"BUILD THE CIRCUIT" GIVES STEP-BY-STEP INSTRUCTIONS. EVENTUALLY YOU WILL BE ABLE TO BUILD THE CIRCUITS BY FOLLOWING THE CIRCUIT DIAGRAM. THE FIRST STEP IS ALWAYS THE SAME.

CONNECTION WIRES ARE ABBREVIATED:

WHT = WHITE
RED = RED
BLU = BLUE
YEL = YELLOW

"TEST THE CIRCUIT" REMINDS YOU TO REVIEW YOUR WIRING FOR ERRORS BEFORE PUSHING THE POWER SWITCH ON.

THIS GENERAL PAGE LAYOUT IS USED TO PRESENT MOST PROJECTS IN BOTH THE MANUALS PROVIDED WITH YOUR LEARNING LAB. THE MAJOR EXCEPTION IS THE 555 IC "BLACK BOX" TEST CIRCUIT DESCRIBED ON PAGE 19. THIS CIRCUIT IS SHOWN ONCE IN DETAIL. LATER IT IS SHOWN AS A SIMPLE BOX TO AVOID REPETITION AND SAVE SPACE.

WHEN THERE IS SPACE, "GOING FURTHER" DESCRIBES WAYS TO MODIFY THE CIRCUIT.