SAMPLE MANUAL ONLY

Manuals are not available for download. To purchase replacement manuals please visit:

www.cs-sales.net
MX-909 500 in 1

Book #1
HARDWARE- Entry Course

CONTENTS

1. LIGHT-CONTROLLED BIRD 18
2. A TRANSISTOR RADIO 19
3. SOUND SCOOPER 20
4. AMERICAN PATROL CAR SEREN 21
5. DIGITAL ROULETTE 22
6. IC ORGAN 22

2) Back to the Basics

7. LIGHT TELEGRAPH 23
8. INTRODUCING THE RESISTOR 23
9. PARALLEL RESISTOR 24
10. MEET THE DIODE 24
11. THE LED - A SPECIAL DIODE 25
12. THE ELECTRONIC GAS TANK 25
13. CAPACITORS IN SERIES AND PARALLEL 26
14. MEET THE TRANSISTOR 27
15. MEET THE TRANSISTOR 27
16. TRANSISTORS AS SWITCHES 28
17. PNP TRANSISTOR SWITCH 28
18. NPN TRANSISTOR SWITCH 29
19. DELAY LIGHT 29
20. NIGHT LIGHT 30
21. ELECTRONIC TIMER 30
22. CAPITAL LETTER DISPLAY 31
23. SMALL LETTER DISPLAY 31
24. NUMBER DISPLAY 32

3) Electronic Building Blocks

25. AN INVERTER CIRCUIT 32
26. INTRODUCING THE AND GATE 33
27. USING THE NOR GATE 34
28. MEET THE NAND GATE 34
29. HOW A MULTIVIBRATOR WORKS 35
30. A ONE-SHOT MULTIVIBRATOR 35
31. AN R-S FLIP-FLOP 36
32. A D-T FLIP-FLOP 36
33. MORE ABOUT OSCILLATOR 36
34. CHANGING OSCILLATION WITH CAPACITOR 37
35. CHANGING OSCILLATION WITH FOREIGN SUBSTANCE 37
36. A PUSH-PULL OSCILLATOR 38
37. LOW DISTORTION SINEWAVE OSCILLATOR 39

4) Putting Electronics to Work

38. STROBE LIGHT 40
39. CdS-CONTROLLED OSCILLATOR 40
40. FREQUENCY SHIFT OSCILLATOR 40
41. ELECTRONIC GRANDFATHER CLOCK 41
42. ELECTRONIC METRONOME 41
43. MOTION DETECTOR 42
44. DOOR ALARM 42
45. RAPID LED DISPLAY SWITCHING 43
46. CODE PRACTICE 43
47. TWIN-T AUDIO OSCILLATOR 44
48. CURRENT SWITCH 44
49. SHOT IN THE DARK 45
50. VARIABLE OSCILLATOR 45
51. TWO-TONE BUZZER 46
52. SAWTOOTH WAVE OSCILLATOR 46
53. ASTABLE MULTIVIBRATOR 47
54. MONOSTABLE MULTIVIBRATOR 47
55. CODE PRACTICE UNIT 48
56. THE NOISY LIGHT 48
57. HEARING AID AMPLIFIER 49
58. LIGHT/SOUND CODE PRACTICE UNIT 49
59. LIGHT CONTROLLED BURGLAR ALARM 50
60. DC-DC CONVERTER 50
61. COUNT DOWN TIMER 51

5) Radio Circuit
62. “CRYSTAL SET” RADIO 51
63. “FUNNY TRANSISTOR” RADIO 52
64. WIRELESS CODE TRANSMITTER 52
65. REMOTE WATER LEVEL DETECTOR 53
66. IC RADIO 53

6) Sonic Zoo and Sound Factory
67. TWO-TONE PATROL CAR SIREN 54
68. PLANT GROWTH STIMULATOR 54
69. ELECTRONIC WOODPECKER 55
70. FISH CALLER 55
71. ELECTRONIC RAINDROPS 56
72. PENCIL LEAD ORGAN 56
73. ELECTRONIC MOTORCYCLE 57
74. MACHINE GUN PULSE DETECTOR 57
75. ELECTRONIC SIREN 58
76. CHIRPING BIRD 58
77. ELECTRONIC CAT 59
78. ELECTRONIC BIRD 59
79. “HORROR MOVIE” SOUND EFFECT 60
80. ELECTRONIC ORGAN 60
81. SOUND MACHINE I 61
82. SOUND MACHINE II 61

7) Electronic Decision-Makers
83. MAJORITY LOGIC GATE 62
84. ELECTRONIC COIN TOSS 62
85. ELECTRONIC COIN TOSS II 63
86. ELECTRONIC COIN TOSS III 63
87. EVEN OR ODD 64
88. QUICKDRAWGAME 64
89. CLOSE-IN 65
90. ESP TESTER 65
91. THE LIGHT FANTASTIC 66
92. SHOOTING GAME 66
93. MARCHING LEDS 67
8) Operational Amplifier IC Can Do Many Things

96. MEET THE VCO 69
97. SILICON DIODE SOLAR CELL 69
98. INTEGRATING CIRCUIT 70
99. ASTABLE MULTIVIBRATOR USING OP AMPLIFIER 70
100. PULSE GENERATOR 71
101. COMPARATOR 71
102. EXPERIMENT OF COMPARATOR 72
103. COMPARATOR WITH Hysteresis 72
104. CONSTANT CURRENT SOURCE BY OP AMPLIFIER 73
105. NON-INVERTING ADDER 73
106. SCHMITT TRIGGER CIRCUIT 74
107. DELAYED TIMER 74
108. PULSE FREQUENCY DOUBLER 75
109. PITCH DOUBLING CIRCUIT 75
110. PITCH DOUBLING CIRCUIT II 76
111. TOUCH SWITCH USING OP AMPLIFIER 76
112. EARLY BIRD 77
113. DC-DC CONVERTER BY OP AMPLIFIER 77
114. INVERTING AMPLIFIER 78
115. NON-INVERTING AMPLIFIER 78
116. DIFFERENTIAL AMPLIFIER 79
117. DIFFERENTIAL OUTPUT AMPLIFIER 79
118. POWER AMPLIFIER USING OP AMPLIFIER 80
119. BALANCED TRANSFORMERLESS AMPLIFIER 80
120. THREE-STAGE DIFFERENTIAL AMPLIFIER 81
121. VCO USING OP AMPLIFIER 70

9) Introducing the Power Amplifier IC

122. IC POWER AMPLIFIER 82
123. IC POWER AMPLIFIER II 82
124. OSCILLATOR USING POWER AMPLIFIER IC 83
125. CdS CONTROLLED IC OSCILLATOR 83

10) A Trip to Digital Land

126. SWITCHING CIRCUIT 84
127. RTL INVERTER 84
128. RTL BUFFER 85
129. RTL OR GATE 85
130. RTL AND GATE 86
131. TRANSISTOR OR GATE 86
132. TRANSISTOR AND GATE 87
133. TRANSISTOR XOR GATE 87
134. SPECIAL NAND GATE 88
135. DTL OR GATE 88
136. DTL AND GATE 89
137. DTL NOR GATE 89
138. DTL NAND GATE 90
139. DTL EXCLUSIVE OR GATE 90
140. C-MOS INVERTER 91
141. C-MOS BUFFER 91
142. C-MOS OR GATE 92
143. C-MOS AND GATE 92
144. C-MOS3-INPUTANDGATE 93
11) More Adventures in Digital Land

151. C-MOS XOR GATE 96
152. C-MOS NAND ENABLE CIRCUIT 97
153. C-MOS AND ENABLE CIRCUIT 97
154. C-MOS OR ENABLE CIRCUIT 98
155. A ONE-SHOT NAND GATE 98
156. C-MOS LINE SELECTOR 99
157. C-MOS DATA SELECTOR 99
158. C-MOS R-S FLIP FLOP 100
159. C-MOS R-S FLIP-FLOP II 100
160. SET/RESET BUZZER 101
161. SET/RESET BUZZER II 101
162. SET/RESET BUZZER III 102
163. TRANSISTORIZED TOGGLE FLIP-FLOP 102
164. NAND TOGGLE FLIP-FLOP 103
165. J-K TOGGLE FLIP-FLOP 103
166. C-MOS ASTABLE MULTIVIBRATOR 104
167. C-MOS J-K FLIP-FLOP 104
168. C-MOS D FLIP-FLOP 105
169. C-MOS D FLIP FLOP II 105
170. R-S-T FLIP FLOP 106
171. T TYPE FLIP-FLOP 106
172. C-MOS LATCH 107
173. SHIFT REGISTER 107
174. TOUCH SWITCH USING NAND GATE 108
175. HALF ADDER 108
176. U-LATCH 109
177. 2-LINE TO 4-LINE DECODED 109
178. MULTIPLIER 110
179. DUAL 2-INPUT MULTIPLEXER 110
180. TWO-STAGE FREQUENCY DIVIDER 111

12) Circuits That Counts

181. BASIC COUNTER 112
182. SYNCHRONOUS COUNTER 112
183. ASYCHRONOUS COUNTER 113
184. COUNTER WITH LINE DECODER 113
185. . DIVIDE BY 4 COUNTER 114
186. DIVIDE BY 4 COUNTER WITH LINE DECODER 114
187. HOW A DECODER WORKS 115
188. MULIPLE COUNTER 115
189. BINARY COUNTER WITH DISPLAY 116
190. DIVIDE BY 3 COUNTER WITH DISPLAY 116
190. DIVIDE BY 4 COUNTER WITH DISPLAY 117
192. UP/DOWNCOUNTER 117
193. DOWN COUNTER 118
194. DECADE DOWN COUNTER 118
195. DECADE DOWN COUNTER WITH DISPLAY 119
196. PRESETTABLE COUNTER 119
197. HEXADECIMAL COUNTER 120
198. OCTAL COUNTER 120
199. RANDOM ACCESS DISPLAY 121
200. DECADE COUNTER 121
201. BCD COUNTER WITH DISPLAY 122
202. OCTAL COUNTER WITH LINE DECODER 122
203. OCTAL COUNTER WITH DISPLAY 123
204. DECADE COUNTER WITH DISPLAY 123
205. DECADE COUNTER WITH DISPLAY II 124
206. BCD TO 7-SEGMENT DECODER 124

13) Amusement in Digital Land

207. VCO BY NOR GATE 125
208. PULSE-DELAYED CIRCUIT 125
209. NAND GATET ONE GENERATOR 126
210. TRANSISTOR TIMER 126
211. NOISE-SIGNAL DISCRIMINATOR 127
212. PULSE STRETCHER 127
213. BIDIRECTIONAL BUFFER 128
214. VARIOUS INVERTERS 128
215. ELECTRONIC SWITCH 129
216. TONE BURST GENERATOR 129
217. DIGITAL TIMER 130
218. DIGITAL TIMER II 130
219. TEN COUNT BUZZER 131
220. PRESS FIRST 131
221. TARGET RANGE 132
222. CATCH THE EIGHT 132
223. SOS ALERT 133
224. WHEEL OF FORTUNE 133
225. LEAPIN LEDS 134

14) Surprise and Fun Revisited

226. EXPERIMENT OF ELECTROMAGNETIC INDUCTION 134
227. ELECTRONIC CANDLE 135
228. CONSTANT CURRENT CIRCUIT 125
229. A PHONY COUNTER 136
230. ALPHABET FLASHER 136
231. WINKING LEDS 137
233. DELAYED TIMER II 137
234. VOICE LEVEL METER 138
225. CROSSING SIGNAL 139
236. OCTAVE GENERATOR 139
237. BUZZIN LED 140
238. SON OF BUZZIN LED 140
239. SOUND OUT TIMER 141
240. SOUND STOP 141
241. BIG MOUTH! 142
242. LIGHT OR SOUND 142
243. BE YOUR OWN MULTIVIBRATOR 143
244. ANTICIPATION 143
245. SET/RESET MATCH 144

15) Testing and Measuring Circuits

246. CIRCUIT CONTINUITY CHECKER 144
247. ACOUSTIC OHMMETER 145
248. AUDIO SIGNALTRACER 145
249. AUDIO SIGNAL GENERATOR 146
250. METAL DETECTOR 146
251. RAIN DETECTOR 147
252. BURGLARALARM 147
253. TEMPERATURE-SENSITIVE AUDIO AMPLIFIER 148
254. WATER LEVEL DETECTOR 148

Book #2
HARDWARE - Advance Course

CONTENTS

1) Learn Basics More

255. A BASIC OF CONTROL VOLUME 4
256. EMITTER FOLLOWER 4
257. BASIC OPERATION OF ZENER DIODE 5
258. ZENER VOLTAGE CHECKER 5
259. ZENER VOLTAGE CHECKERII 6
260. BASIC PHOTO-TRANSISTOR OPERATION 6
261. VOLTAGE DROP CIRCUIT BY MEANS OF DIODES 7
262. EXPERIMENTATION OF CAPACITOR TEMPERATURE CHARACTERISTIC 7
263. DARLINGTON CIRCUIT (TOUCH SENSOR) 8
264. EDGE-TRIGGER CIRCUIT 8
265. RC TYPE DIFFERENTIATING CIRCUIT 9
266. SWITCH MATRIX CIRCUIT 9
267. MEMORY BACKUP CIRCUIT 10
268. POWER ON RESET CIRCUIT 10
269. CONSTANT-VOLTAGE CIRCUIT (FIXED OUTPUT) 11
270. CONSTANT-VOLTAGE CIRCUIT (VARIABLE OUTPUT) 11
271. A RECTIFIER CIRCUIT BY DIODE BRIDGE 12
272. AGC CIRCUIT USING A SINGLE TRANSISTOR 12
273. UPPER/LOWER LIMITER CIRCUIT USING OP AMPLIFIER 13
274. ABSOLUTE VALUE AMPLIFIER 13
275. WINDOW COMPARATOR 14
276. WINDOW COMPARATOR II 14

2) Amusement on Sound

277. MULTI-TONE SIREN 15
278. DIGITAL RHYTHM 16
279. TWO-IC ELECTRIC ORGAN 16
280. A WATER SERVICE PIPE SOUND 17
281. ELECTRONIC CLAXON 17
282. SOUND MACHINE III 18
283. SOUND WAVE VARYING WITH LIGHT INTENSITY 18
284. PLAYER ORGAN 19
285. SOUND OF PASSING SIREN 19
286. LIGHT SOURCE SENSING CIRCUIT BY SOUND 20
287. ELECTRONIC PIANO CIRCUIT 20
288. WHISTLE GENERATING CIRCUIT 21
289. SPACE GUN 21
290. CAR HORN 22

3) More Radio Circuits

291. MORSE CODE TRANSMITTER 22
292. BROADCASTING ORGAN 23
293. FM TRANSMITTER (FM WIRELESS MICROPHONE) 23

4) To the Game World
<table>
<thead>
<tr>
<th>Page</th>
<th>Game/Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>294</td>
<td>QUIZ WINNER DETECTOR</td>
</tr>
<tr>
<td>295</td>
<td>REFLEX NERVE TEST GAME</td>
</tr>
<tr>
<td>296</td>
<td>SHOOTING GAME II</td>
</tr>
<tr>
<td>297</td>
<td>SHOT IN THE DARK II</td>
</tr>
<tr>
<td>298</td>
<td>SOUND QUIZ</td>
</tr>
<tr>
<td>299</td>
<td>STOP THE SEVEN</td>
</tr>
<tr>
<td>300</td>
<td>HIGH-POWER SWITCH</td>
</tr>
<tr>
<td>301</td>
<td>&quot;LOCKOUT MR. BLACKBEARD!&quot; GAME</td>
</tr>
<tr>
<td>302</td>
<td>RUSSIAN ROULETE</td>
</tr>
<tr>
<td>303</td>
<td>MOLE HITTING GAME</td>
</tr>
<tr>
<td>304</td>
<td>&quot;JANKEN&quot; GAME</td>
</tr>
<tr>
<td>305</td>
<td>PING-POND GAME</td>
</tr>
<tr>
<td>306</td>
<td>VOLTAGE CONTROLLED AMPLIFIER</td>
</tr>
<tr>
<td>307</td>
<td>V-F CONVERTER</td>
</tr>
<tr>
<td>308</td>
<td>F-V CONVERTER</td>
</tr>
<tr>
<td>309</td>
<td>F-V CONVERTER II</td>
</tr>
<tr>
<td>310</td>
<td>WHITE Noise GENERATOR</td>
</tr>
<tr>
<td>311</td>
<td>SWEEP GENERATOR</td>
</tr>
<tr>
<td>312</td>
<td>MULTIPLE FUNCTION IC PROJECT</td>
</tr>
<tr>
<td>313</td>
<td>SOUND ALARM</td>
</tr>
<tr>
<td>314</td>
<td>A SOUND OF Ripples</td>
</tr>
<tr>
<td>315</td>
<td>PHOTO ORGAN</td>
</tr>
<tr>
<td>316</td>
<td>VIBRATO ORGAN</td>
</tr>
<tr>
<td>317</td>
<td>PHASE SHIFT OSCILLATOR</td>
</tr>
<tr>
<td>318</td>
<td>WIDE RANGE AUDIO FREQUENCY OSCILLATOR</td>
</tr>
<tr>
<td>319</td>
<td>SAWTOOTH WAVE OSCILLATOR II</td>
</tr>
<tr>
<td>320</td>
<td>THREE PHASE OSCILLATOR</td>
</tr>
<tr>
<td>321</td>
<td>WIEN-BRIDGE OSCILLATOR</td>
</tr>
<tr>
<td>322</td>
<td>RAMP WAVE GENERATOR</td>
</tr>
<tr>
<td>323</td>
<td>DIGITAL SINE WAVE GENERATOR</td>
</tr>
<tr>
<td>324</td>
<td>FREQUENCY VARIABLE SINE WAVE GENERATOR</td>
</tr>
<tr>
<td>325</td>
<td>SINE WAVE OSCILLATOR USING D-A CONVERTER</td>
</tr>
<tr>
<td>326</td>
<td>RC PHASE-SHIFT OSCILLATOR</td>
</tr>
<tr>
<td>327</td>
<td>TWO SINE WAVES WITH DIFFERENT PHASES</td>
</tr>
<tr>
<td>328</td>
<td>ONE-SHOT MULTIVIBRATOR USING IC 555</td>
</tr>
<tr>
<td>329</td>
<td>ONE-SHOT MULTIVIBRATOR USING J-K FLIP-FLOP</td>
</tr>
<tr>
<td>330</td>
<td>ONE-SHOT MULTIVIBRATOR USING OP AMPLIFIER</td>
</tr>
<tr>
<td>331</td>
<td>PULSE NUMBER MODULATION LIGHT DIMMER</td>
</tr>
<tr>
<td>332</td>
<td>PULSE WIDTH MODULATION LIGHT DIMMER</td>
</tr>
<tr>
<td>333</td>
<td>DC-DC CONVERTER USING THE C-MOS OSCILLATOR</td>
</tr>
<tr>
<td>334</td>
<td>DIGITAL LIGHT DIMMER</td>
</tr>
<tr>
<td>335</td>
<td>A-D CONVERTER</td>
</tr>
<tr>
<td>336</td>
<td>D-A CONVERTER</td>
</tr>
<tr>
<td>337</td>
<td>PHOTOMETER WITH DIGITAL DISPLAY</td>
</tr>
<tr>
<td>338</td>
<td>PULSE WIDTH MODULATION LIGHT DIMMER II</td>
</tr>
<tr>
<td>339</td>
<td>VOLTOMETER</td>
</tr>
<tr>
<td>340</td>
<td>FULL ADDER</td>
</tr>
</tbody>
</table>
DECIMAL TO BINARY ENCODER
BINARY TO BCD
OCTAL TO BCD
HEXADECIMAL TO BCD
3-SIT SHIFT REGISTER
SOD-TO-DECIMAL DECODER
3-INPUT DATA SELECTOR
AND/OR CIRCUIT USING OP AMPLIFIER
XOR USING OP AMPLIFIER
TIME SHARING DISPLAY OF LEDs
LED LIGHTING-DUTY VARYING CIRCUIT USING ONE-SHOT MULTIVIBRATOR
LED BLINKING-CYCLE VARYING CIRCUIT USING ASTABLE MULTIVIBRATOR
LCD STATIC DRIVE CIRCUIT
LCD DYNAMIC DRIVE CIRCUIT
TESTING LCD DISPLAY RESPONSE
LED DRIVE BY 4 SWITCHES
FLASHING LED BY PRESET NUMBER
DIGITAL TIMER (1 TO 7 MINUTES)
SOUND TIMER
PROGRAMMABLE TIMER WITH DOWN COUNTER
REVOLVING LIGHT
PHOTO SWITCH
DOOR CHIME
VISITOR SENSING CHIME USING PHOTO-TRANSISTOR
TOUCH VCO
SOUND TUNING CIRCUIT
CROSSING-BELL SOUND GENERATOR
TURN INDICATOR
STAIRCASE LIGHT SWITCHING CONTROL CIRCUIT
PSEUDO CANDLE CIRCUIT
LIE DETECTOR
LIGHT SENSING CIRCUIT
AUTOMATIC LIGHTING LED
SOUND SENSING LED
ILLUMINATION LAMP
INTERCOM
PIP SOUND INTERPHONE
ELECTRONIC VOLUME
PEDESTRIAN SIGNAL
TIME COUNTER
LED DISPLAY COUNTING UP/DOWN CIRCUIT
AN ELECTRONIC PENDULUM
STAIRCASE LIGHT SWITCHING CONTROL CIRCUIT-II
LAMP BRIGHTNESS CONTROL CIRCUIT
ILLUMINATION CIRCUIT WITH 4-LEDs
A SIMULATED CAR WINKERS
BATTERY CHECKER
CONDUCTIVITY TESTER
IC OSCILLATOR/COMPONENT TESTER
VOLTAGE DROP ALARM
TRANSISTOR CHECKER
CURRENT SHUT-DOWN CIRCUIT
CONTENTS

Welcome to the World of Computer! 5
Functions of Each Component 5
Memory 5
Accumulator and Registers 5
ALU (Arithmetic Logic Unit) 5
Keyboard and LCD Display 5
Input and Output Ports 5
Microprocessor's Instructions and Programming 5
Instruction Format 5
Outlook of the LCD Display 5
Line Number 6
Instruction 6
Operand(s) 6
Comments 6
Hexadecimal Numbering System 6
What is Flow-chart 7
How To Read Flow-chart 7
Keyboard and Operation 7
How To Run The Program 8
Initial Menu 8
Selecting a Mode of Operation 8
Program Mode (PGM) 8
To Enter An Instruction Code 8
Other Types of Move Instructions 9
Steps To Enter Type2/Type3 Instructions 9
Editing Instruction Lines 10
To Correct or Remove an Instruction Code 10
To Insert a New Instruction Code 10
Debug Mode 11
To Display the Contents of Zero-Flag and Carry-Flag 12
Game Mode 12

References:
Instructions Set 13
Carry-flag and Zero-flag 13
Input/Output Instructions 13
Move Instruction 14
Arithmetic Instructions 14
Shift Instructions 17
Increment/Decrement Instructions 18
Jump Instructions 19
Comparison Instruction 20
Beep Instructions 21
Software Projects

401. Light LEDs 24
402. Light On/Off LEDs 26
403. A Binary Counter - Increment Value by ADD Instruction 27
404. B-counter - Decrement Value by SUB Instruction 29
405. DS Sequentially with AND Instruction 31
406. Light LEDs Sequentially with OR Instruction 33
407. Turn On and Off LEDs Sequentially with XOR Instruction 35
408. MOVing LEDs Light with AOL Instruction 37
409. MOVing LEDs Light with ROR instruction 38
410. Night Riders LEDs with ROL/ROR Instructions (1) 39
411. Night Riders LEDs with ROL/ROR Instructions (2) 40
412. Binary Counter with INC Instruction 41
413. Binary Counter with DEC Instruction 42
414. Sound Do as Do, Re, Mi 43
415. Sound a Series of Musical Scale 44
416. Lets Input Data to Program 45
417. Hidden Key Triggers Sound and Turns All LEDs On 46
418. Stacked MOV Instructions 47
419. Changing Order of LEDs by Switch 49
420. A Musical Scale Sound by S1 Key 51
421. Arithmetic addition of two binary values 52
422. Arithmetic subtraction of two binary values 54
423. Arithmetic Multiplication of Two Binary Values 55
424. Arithmetic Division of Two Binary Values 57
425. Displays Number 0 To 9 on 7-segment LED (1) 59
426. Change Order of Numbers Display on 7-segment LED (2) 61
427. Switches S1-S4 Light Hex Number On 7-Seg LED 62
428. 8-Key Organ 64
429. Lighting Spade, Diamond, Heart, and Club on the LCDs Display (Basic) 65
430. Lighting Spade/Diamond/Heart/Club on the LCDs Display 66
431. Lighting Spade, Diamond, Heart, and Club by Static Drive Circuit 67
432. Lighting Spade, Diamond, Heart, and Club by 1/2 Duty-1/2 Bias Circuit 69
433. Lighting Spade/Diamond and Heart/Club by 1/2 Duty-1/2 Bias Circuit 71
434. Lighting Spade/Diamond and Heart/Club Alternately by 1/2 Duty-1/2 Bias Circuit 73
435. Lighting Spade, Diamond, Heart, and Club by 1/2 Duty-1/2 Bias Circuit 75
436. Results of Logical Operations AND, NAND, OR, and NOR 76
437. Results of Logical Operations XOR and XNOR 77
438. Results of Logical Operations AND/NAND with 4-Switch Entry 78
439. Results of Logical Operations OR/NOR with 4-Switch Entry 79
440. Results of Logical Operations XOR/XNOR with 4-Switch Entry 80
441. Logical AND/NAND Gate for Driving External Circuit 81
442. Logical OR/NOR Gate for Driving External Circuit 82
443. Logical XOR/XNOR Gate for Driving External Circuit 83
444. Find a Leading Edge of Input Pulse 84
445. Finding a trailing Edge of Input Pulse 85
446. Finding a leading and trailing Edges of Input Pulse 86
447. A Pulse Stretcher 87
448. Starting a Delayed Pulse 88
449. Pulse Stretcher By Counting a Clock 89
450. Counting External Pulse To Advance Decimal Counter 90
451. Displays Number 0 To 9 on 7-segment LED (1) 91
452. Change Order of Numbers Display on 7-segment LED (2) 92
Counts an External Clock (1)  93
Counts an External Clock (2)  94
Counts an External Clock (3)  95
Counts an External Clock (4)  96
Counts an External Clock (5)  97
Counts an External Clock (6)  98
3-Minute Timer  99
Multi-Function Timer (1)  100
15-Minute Timer with 7-segment Display  101
Multi-Function Timer (2)  102
Digital Organ with PHOTO-TRANSISTOR (1)  103
Digital Organ with PHOTO-TRANSISTOR (2)  104
Digital Volume Changer (1)  105
Digital Volume Changer (2)  106
Digital Volume Changer (3)  107
Digital Volume Changer (4)  108
Digital Volume Changer (5)  109
Illumination Controlled by PHOTO-TRANSISTOR (1)  110
Illumination Controlled by PHOTO-TRANSISTOR (2)  111
Illumination Controlled by Oscillator and PHOTO-TRANSISTOR (1)  112
Illumination Controlled by Oscillator and PHOTO-TRANSISTOR (2)  113
Illumination with Speed Control (1)  114
Illumination with Speed Control (2)  115
Sawtooth Waveform Generator  116
Triangular Pulse Generator  117
Digital Level Indicator  118
Digital Lux Meter (Display in Binary)  119
4-Bit ND Converter (Display in Binary)  120
4-Bit ND Converter (Display in Hexadecimal on 7-Segment LED)  121
Digital Lux Meter (Display in Hexadecimal)  122
Audio Level Meter  123
Audio Level Meter With Peak-Holding Capability  124
Lighting Sign Board  125
Digital Dice  126
Digital Roulette  127
Digital Slot Machine  128
Up/Down Counter  129
Digital Metronome  130
Frequency Counter  131
Dynamic Lighting of 7-segment LED  132
Lighting LED with Pulse Width Modulation  133
Majority Logic Gate (2)  134
Lighting LCD Segments by Static Drive  135
Digital Buzzer  136
Rhythm Box (1)  137
Rhythm Box (2)  138
Rhythm Box (3)  139
Rhythm Box (4)  140
A tone generator is an oscillator that sends out signals repeated at regular intervals, as shown in Figure 1. As its name suggests, a speaker is usually used to let you hear the tone it makes. But in this project, we're going to use an LED to find out how it works.

You can see from the schematic, IC U2 is a tone generator whose frequency can be changed by 100K control volume. IC U1 is another generator which controls the start and stop of the tone generator. Its frequency can also be changed by turning 50K control volume, and its duty ratio can be adjusted using S1 and S2. Remember what the duty ratio is? Refer back to project 53. The duty ratio is about 24% when S1 is ON, and about 76% when S2 is ON. This project can be used as a logic circuit whose waveform ends in an integer cycle.

When you finish assembling the project, turn power ON and see what the LED is doing. Does it blink ON and OFF as shown in Figure 1? Then, turn 50K control volume and press S1 and S2, and see how the LED changes its blinking intervals.
Here's a game to see how fast you are on the trigger (or at least the key!). The object is to light LEDs 1 through 4 as quickly as you are able or with as few presses of S1 as you can.

To play, turn power ON. LED 1 lights. Now press S1 until LED 2 lights. But, if you're not lucky, only LED 1 lights. Continue to try to get all the LEDs to light up (LED 1, 2, 3 and 4).

The secret of this game is to press S1 at exactly the right moment to light the LED. Timing's been an important part of all the digital circuits we've played with so far.
You've probably seen a roulette wheel, or "wheel of fortune" type game in operation. You know how it works ... players try to guess where the wheel stops and they win if they guess right. We couldn't find room in this kit for the real thing, but we've included an electronic version!

Using this electronic "wheel of fortune" is supersimple. Turn power ON and press S1 down. You'll notice the lower half of the LED display lights up and seem to "spin" around. (It's not really spinning, of course - the different segments are just rapidly blinking on and off, one after the other.) During the "spinning" you'll hear a funny sound from the speaker. After a few moments both the "spinning" and sound slows down. Eventually, it stops with just one segment lit and a steady sound coming from the speaker.

You'll notice a couple of interesting things about this circuit. Each segment of the display has its own sound. And the speed at which the display "spins" depends upon the control volume. Try moving the control volume while the "wheel" is "spinning" ... notice how you can make it slow down or speed up.

You can use this project as a game by guessing which segment will be lit when the "wheel" finally stops "spinning." Or you can try to make the "wheel" stop at a certain segment by adjusting the control volume while it is still "spinning."
In this Project, we will make a program which starts illuminations on the LEDs by adjusting your finger position over the PHOTO-TRANSISTOR.

When the program is running, cover the PHOTO-TRANSISTOR with your finger tips for a moment and remove them. As you have waved a Checker Flag, it starts blinking of LEDs one by one from L1 thru L8.

Description:

When you look at the flow-chart, you can get it quite easily as its flow of control is relatively simple. Now, let’s look into the program.

The key to understanding this program is how to start illumination by the movement of your finger tips over the PHOTO-TRANSISTOR. You can see one solution to that concern; the program code from #06 thru #08 and #09 thru #0B are what you have seen in previous Projects. The code from #06 thru #08 captures the input data 01, that is, this short loop processing is over with your action of covering the PHOTO-TRANSISTOR with your fingers. Then comes the 2nd gate, the #09 thru #0B, where the program waits for you to stop covering the PHOTO-TRANSISTOR with your fingers.
Program:

00 MOV B,#20H ; Get data table addr
01 MOV A, @B ; Get lighting data
02 OUT A ; Light LEDs
03 TM1 #03H ; for 30ms
04 MOV A,#00H ;
05 OUT A ; Turn OFF LEDs
06 IN D ; Get input
07 AND D,#01H ;
08 JZ L06H ; Wait for turning ON PTr
09 IN D ; Get input
0A AND D,#01H ;
0B JNZ L09H ; Wait for turning OFF PTr
0C CLC ; Clear carry-flag
0D INC B ; Increase table addr
0E MOV A,#27H ;
0F CMP A,B ;
10 JC L00H ; If end of table, return
11 JMP L01H ; In the mid of table; continue
12 NOP :

20 HEX #01H ; (0000 0001)
21 HEX #02H ; (0000 0010)
22 HEX #04H ; (0000 0100)
23 HEX #08H ; (0000 1000)
24 HEX #10H ; (0001 0000)
25 HEX #20H ; (0010 0000)
26 HEX #40H ; (0100 0000)
27 HEX #80H ; (1000 0000)

Note: In the above program, NOP instructions in the lines #13 thru #1F are omitted. You are expected to enter these NOPs if you run the program.

Now, let's look at the whole processing on the flow-chart. The program first gets the initial count value 20H at the #00. It then goes into a loop processing which includes the codes of sensing your finger action described above. This loop processing continues until its count becomes 28H. Since the initial count value is 20H, this loop repeats 8 times per one cycle. And this is also because that the output data table starting at address 20H contains 8 patterns of illumination.

The pattern of illumination is simple; it lights LEDs one by one from L1 to L8 repeatedly. You can change the data table values starting at #20 and get your own pattern.
Project 484. Audio Level Meter With Peak-Holding Capability

In this Project, the Audio Level Meter introduced by the Project-483 is enhanced so that it can capture the maximum input level and hold the data for a few second. This capability is convenient for checking the maximum sound signal level for example. You can change the holding period by altering the data value in register F.

Description:

The program works rather in a complicated way. The flow-chart will help you follow the move of program control. From the chart, you can find here again the inner loop processing; it starts from the #06 and ends at the #16. Let's trace the control of program by watching both the chart and the coding.

From the #06 thru #09, the program outputs the reference voltage data, wait for 40ms, and tries to get input data which is actually a single bit data from the comparator. If the input voltage to the IC2A exceeds the reference voltage, the comparator outputs high level of signal, and it is fed to the input port IN1 of the MPU. This is a 1-bit data from the comparator. If no data bit comes in, the control of program goes to the #11 at #0B. If 1-bit data comes in, the control of program goes forward to the #0C and the then-current reference voltage data in the register C is saved to accumulator A.

Then it comes to the #0D, where the incoming data (register D) is compared with the Saved data (register E). If the incoming data is less than the Saved data, the control of program goes to the #11. However, if the incoming data is greater than or equal to the Saved data, the program replaces the Saved data with the incoming data at the #0F. After that, the Hold counter is set to 5 at the #10. And note that these two steps (#0F and #10) are performed only once within one Hold counter cycle! Let's prove it.
Program:

00 MOV F,#00H ; F = Hold counter
01 MOV E,#00H ; E = Hold-save area
02 MOV D,#08H ; D = Incoming data
03 MOV A,#00H ; A = Level meter data
04 MOV C,#0FH ; C = Reference voltage data
05 XOR C,#0FH ; Get lower 4-bit
06 OUT C ; Output reference voltage
07 XOR C,#0FH ; Restore C
08 TM1 #04H ; and wait for 40ms
09 IN B ; Get input from comparator
0A ROR B ; Move 1-bit data to carry FF
0B JNC L11H ; If input-V < ref-V; to #11
0C OR A,C ; Input-V > ref-V; save ref-V
0D CMP D,E ; (Incoming)-(Saved)
0E JC L11 ; If incoming < saved; to #11
0F MOV E,D ; Replace Saved with Incoming
10 MOV F,#05H ; Set hold counter to 5H
11 OR A,E ; Store Saved to T meter
12 CLC ; Clear carry FF
13 ROR D ; Decrease Incoming voltage
14 CLC ; Clear carry FF
15 ROR C ; Decrease ref-V
16 JNZ L05H ; If ref-V is not zero, to #05
17 CLC ; If ref-V is zero; clear FF
18 ROL A ; Move lower 4-bit to left
19 ROL A
1A ROL A
1B ROL A
1C OUT A ; Output level meter data
1D TM1 #05H ; and wait for 50ms
1E DEC F ; Decrease Hold-counter by 1
1F JNZ L02H ; If not zero, go to #02
20 JMP L01H ; If zero, go to #01

Let's assume that the program is in the first pass of the first Hold counter cycle, therefore, the Incoming data (register D) is 08H (0000 1000) while the Saved data (register E) is 00H (0000 0000). This situation is possible only when the input voltage exceeds the reference voltage. Now, the control of the program comes in the #0F, where the Saved data (register E) is replaced with the Incoming Data (register D). Because of this replacement of the data, these two steps can never be performed within the same Hold counter cycle. If the control returns to the same code at the #0D and #0E, the Incoming Data (register D) is ALWAYS smaller than the Saved data (register E) since the Incoming data is decreased by 1-bit shift to right at the #13 while the Saved data does not change. Remember that with these few steps, the largest incoming data is captured within the Hold counter cycle.

Let's continue to trace the following codes. At the #11, the program stores the Saved data to the accumulator A as a level meter data, then it decreases the Incoming data at #13 and reference voltage data at #15 by shifting each register 1-bit to right.

The above inner loop processing continues until the reference voltage data becomes zero at the #16. Once this one cycle is over, the Level Meter data in the accumulator A is output and the Hold counter is decreased by 1. The program continues to perform these above processing until the Hold counter becomes zero.