ZiLOG Universal Infrared Remote Reference Design

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Overview

ZiLOG's Universal Infrared Remote (UIR) is a remote control that sends out infrared signals to control several types of appliances such as TVs, VCRs, Satellites, Cable, CD players, Amplifier/Receivers, etc. Different appliances require different encoding formats, protocols and data. This application note provides a reference for design with the Zilog IR controller and the UIR database.

Various IR signals are compressed and encoded into Zilog's database format. A designer need not go through the entire database format, but simply call up a subroutine. IR data relating to the specific key for the appliance brand and the application device are retrieved and sent out.

Zilog offers a wide range of infrared remote controllers. Low power Microcontroller Units (MCUs) are designed to support infrared remote control signals. Two hardware timers, T8 & T16, generate IR signals accurately without the software latency associated with turning the IR LED On/Off. P36 output supports the different logic operations of the T8 and T16 timers providing flexibility to support IR and RF applications. Table 1 lists Zilog's family of IR remote controllers.

Table 1 IR Remote Controllers

Device	Process Speed	Features	Package	Development Tools
IR Controller **Masked ROM:** **Z86L82** (4K ROM) Z86L85 (8K ROM) Z86L88 (16K ROM) Z86L81 (24K ROM) Z86L86 (32K ROM) **OTP:** **Z86E86** (32K, 5V) Z86D86 (32K, 3V)	CMOS: 8 MHz	Watch-Dog Timer (WDT) 2 Analog Comparators with Output Option 3 Standby Modes 2 Enhanced Counter/Timers -Auto Pulse -Reception/Generation Auto Power-On Reset 2V Operation RC Oscillator Option Low-Voltage Standby Low-Voltage Detect/Protect High-Current Drivers 5 Vectored Interrupts (L82/L85/L88) 6 Vectored Interrupts (L81/L86/E86/D86) (L81/L86/E86/D86)	28-Pin DIP 28-Pin SOIC	Z86L7103ZEM Emulator Z86L9800ZEM Emulator Z86L8800ZCO Evaluation Board

Table 1 IR Remote Controllers

Device	Process Speed	Features	Package	Development Tools
IR Controller **Masked ROM:** Z86L98 (64K ROM) **OTP:** Z86D98 (3V)	CMOS: 8 MHz	Watch-Dog Timer (WDT) 2 Analog Comparators with Output Option 3 Standby Modes 2 Enhanced Counter/Timers -Auto Pulse -Reception/Generation Auto Power-On Reset 3V Operation RC Oscillator Option High-Current Drivers Low-Voltage Standby Low-Voltage Detect/Protect 6 Vectored Interrupts	28-Pin DIP 28-Pin SOIC	Z86L9800ZEM Emulator Z86L8800ZCO Evaluation Board
IR Keyboard Controller **Masked ROM:** Z86L87 (16K ROM) Z86L89 (24K ROM) Z86L73 (32K ROM) **OTP:** Z86E73 (32K, 5V) Z86D73 (32K, 3V)	CMOS: 8 MHz	Watch-Dog Timer (WDT) 2 Analog Comparators with Output Option 3 Standby Modes 2 Enhanced Counter/Timers -Auto Pulse -Reception/Generation Auto Power-On Reset 3V Operation RC Oscillator Option Low-Voltage Standby Low-Voltage Detect/Protect High-Current Drivers 6 Vectored Interrupts	40-PinDIP 44-PinPLCC 44-Pin QFP	Z86L7103ZEM Emulator Z86L9800ZEM Emulator Z86L8800ZCO Evaluation Board
IR Keyboard Controller **Masked ROM:** Z86L43 (4K ROM) **OTP:** Z86E43 (4K, 5V)	CMOS: 8 MHz, 16 MHz (E43 only)	2 Standby Modes 2 Counter/Timers ROM/RAM Protect Low-Voltage Protection 2 Analog Comparators Low EMI Option Watch-Dog Timer (WDT) Power-On Reset (POR) Low-Voltage Operation (L43 Only) 6 Vectored Interrupts	40-Pin DIP 44-Pin PLCC 44-Pin QFP	Z86C5000ZEM Emulator Z86C5000ZPD Emulator Z86E4002ZDP Adapter

Theory of Operation

Hardware Overview

The most common UIR circuit in a Zilog UIR controller is diagrammed below in Figure 1. Zilog controllers integrate most external components such as pull up resistors for key scanning and transistors for driving visible LEDs. Zilog also offers microcontrollers with input and output pins for most key matrices. P36 is the T8 and T16 timer output. By selecting the AND of these two timers and outputting the signal with the carrier at P36, this signal drives the transistor directly to switch the IR LED. P37 has a high current drive which directly controls the LED indicator. Port 2 is configured as input with internal pull-up resistance. It is also the Stop Mode Recovery source which wakes up the microcontroller from a power-saving Stop mode. Port 0 is configured as open drain output, which is essential for key matrix design. For detailed UIR design considerations, refer to the application note “Universal Infrared Design.” If comparators are not used, connect Pref1 to V_{cc} to avoid current leakage.

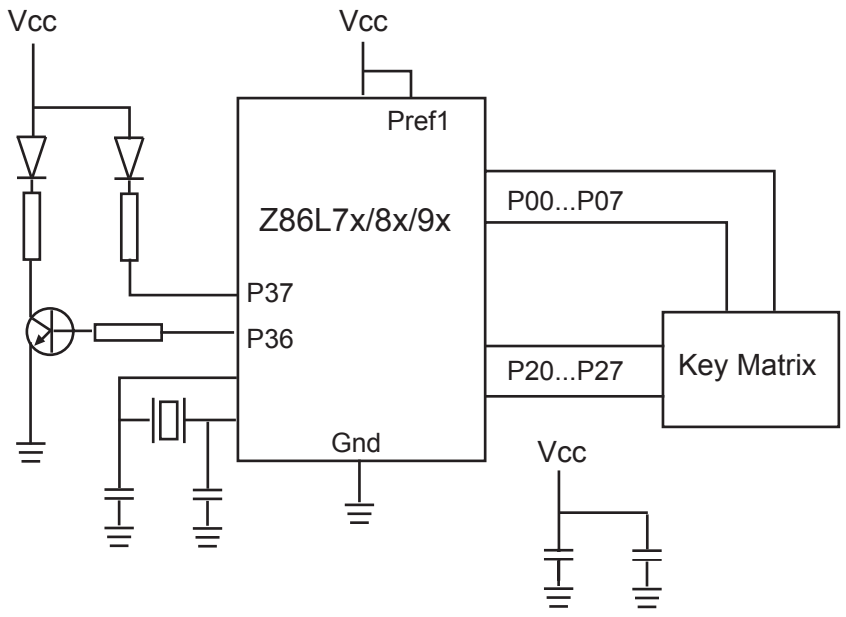


Figure 1 Standard Zilog UIR Circuit

Key Definition

Key scanning is accomplished by using port 0 as open drain output and port 2 as input (with internal pull-up). Key scanning supports a 8 x 8 = 64 key matrix. Each key is defined as by its Column-Row address. The designer can change key locations to suit a PCB design easily. For example, key “TV” is defined as %74 in the KEYEQU.H file. The "7" is Port 2 bit 7 of and "4" is Port 0 bit 4. Just changing the KEYEQU.H header file rearranges the key location. Device keys are TV, VCR, CABLE, SAT, AMP, CD, and DVD. Rows P00 and P01 are used for Audio Amplifier keys. Refer to Table 2.

Table 2 Key Definition Matrix

row/col	P27	P26	P25	P24	P23	P22	P21	P20
P00	Sur Mode	Sur ON	Front	Center	Rear	Delay	Delay Up	Delay dn
P01	Disc	Tape	Tunner	Television	Video1	Video2	Audio	Test
P02	Up	Down	Left	Right	Dsp mode	Dsp ON	PIP	Swap
P03		REC	STOP	PLAY	PAUSE	REW	FF	AV
P04	TV	SAT	DVD	1	2	3		CH +
P05	VCR	AMP	AUX	4	5	6	Guide	CH -
P06	CABLE	CD	Info	7	8	9	Recall	VOL +
P07	Power	Mute	Menu	Clear	0	Enter	Select	VOL -

Firmware Overview

The Z8 IR driver includes power-up initialization, key scanning, code enter and display, device change, code number, code search forward and backward and, most importantly, the database driver. It uses approximately 3 Kbytes of the program memory. The driver can be customized to a specific application. The rest of the memory is used for the IR database. The irdata.s file is generated by the IR Tools after the designer selects the device brand and code number from the database. Table 3 lists all the files for UIR reference design. Figure 2 is the IR_Main flow chart and Figure 3 is the Check Device flowchart.

Table 3 Files for UIR Reference Design

File Name	Description
CONFIG.H	Headerfile : configuration of ports, options
KEYEQU.H	Header file : key matrix definition
MACROS.H	Header file : macros
MEMMAP.H	Header file : memory map for different registers
COMMAND.S	Firmware utilities: Code search forward, backward. Set code number, etc.
EXTRACT_A44.O	IR database extraction and interpretation driver object file to be linked for decoding database
IRDATA_A44.S	IR database generated by the IR tool program
IRMAIN.S	Main program
KDECODER.S	UIR operations : Punch through for TV, VCR. Change device Change code number Display code number
KEYSCAN.S	Key scanning on the 8x8 key matrix. Output the scan code in register KEY_SCANCODE & KEY_BUFFER
LEDTIMER.S	LED display, delay subroutine and timer
XMIT.S	Transmission of IR signal according to different encoding and repeat format

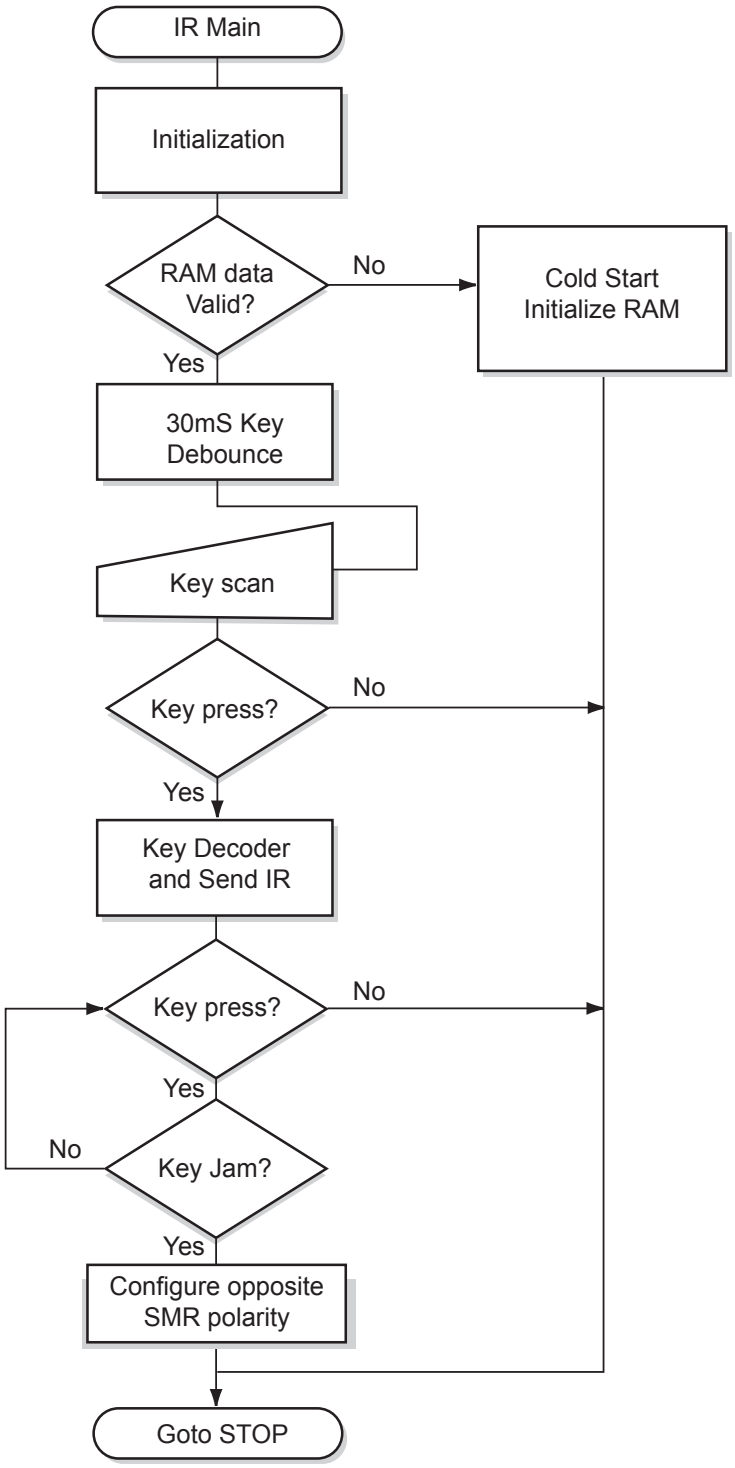


Figure 2 IR_Main Flow Chart

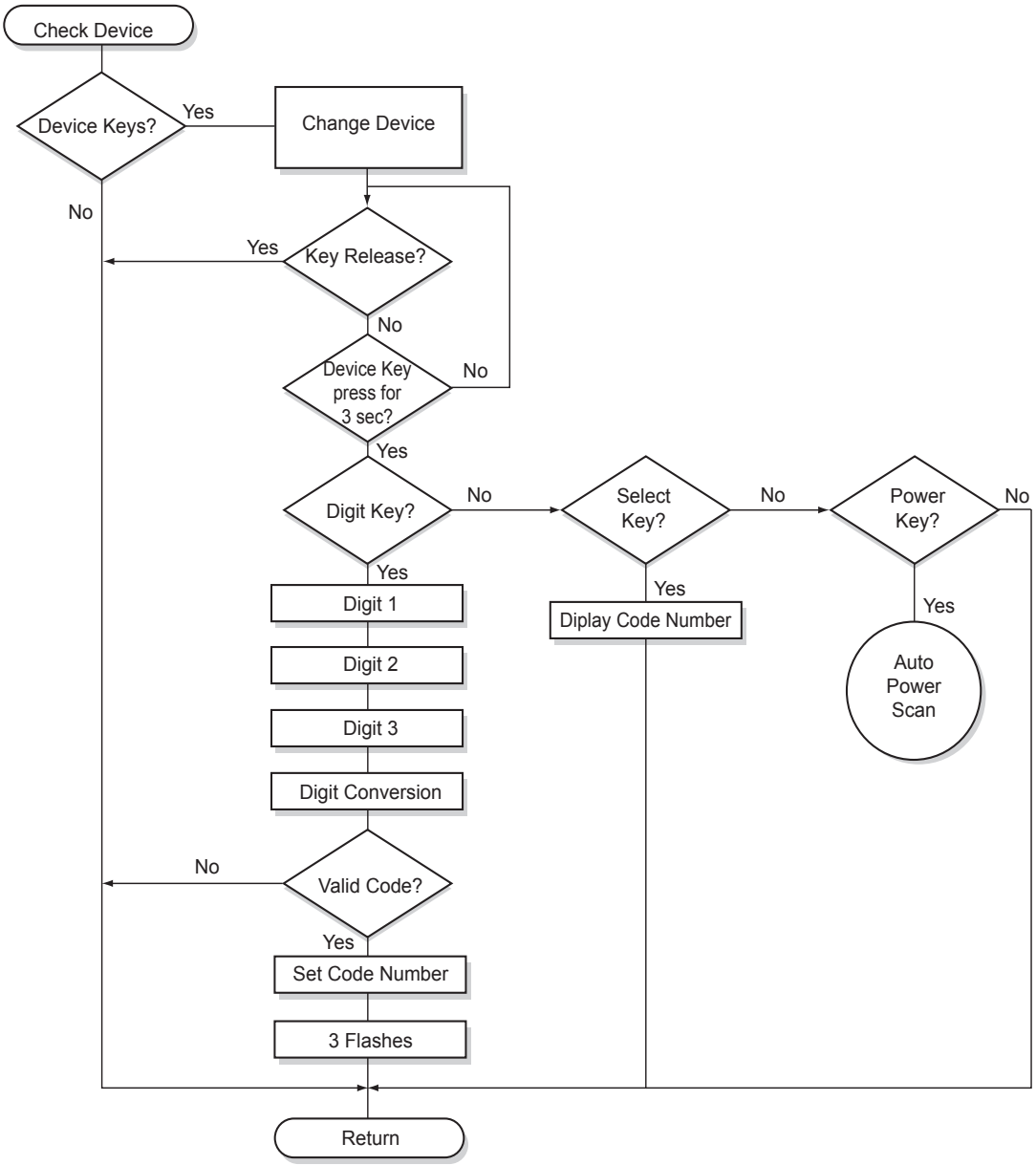


Figure 3 Check Device Flowchart

Key Scanning

ZiLOG's IR controller integrates pull-up resistance at the input pins. This integration can reduce the number of external components required and assembly time. To minimize current consumption when pins connect to 0V, the internal pull-up is typically 200KΩ ± 50% at 3V at room temperature. The resistance value can change with V_{CC} and temperature variations. Therefore, the application design must be independent of resistance values. Refer to the Application Note "ZiLOG Universal Infrared Design" for a description of the effect of resistance and stray capactance on key scanning design. To avoid the effect of resistance variation, a pre-charge must be implemented on the port 2 bus before every line scan.

Port 2 Pre-charge Procedure

1. Write FFh to P0 and P2 (to set all outputs high).
2. Set P2 as push-pull.
3. Set P2 as output.
4. Wait for 17 µseconds.
5. Set P2 as input.

Programming Procedure

1. Change application device
   - Press and release any device key (for example, TV, VCR, Cable)
2. Change code (3-digit number of the code selected)
   - Press and hold the device key for 3 seconds. LED comes on for 3 seconds and then turns off.
   - Release the device key. LED stays on.
   - Press and release 3 digit keys one by one. LED goes off when pressing a key and on when the key is released.
   - LED flashes 3 times to indicate success after the 3 digits have been entered. It exits to the main program if a non-digit key is pressed or a code number is higher than the limit.
3. Check code number
   - Press and hold the device key for 3 seconds. LED comes on for 3 seconds and off afterward the key is released.
   - Press and release the SELECT key
   - A flashing LED indicates the code number. A quick flash equals zero; a slow flash equals one. It will first display the factor of one hundred, stop for 2 seconds; secondly, the ten factor, go off for 2 seconds; and finally, the digit factor.
4. Start Auto-scanning
   - Press and hold the device key for 3 seconds. The LED comes on for 3 seconds, then goes off.
   - Press and release thePOWER key.
   - Press Ch+ to search forward . The UIR sends out POWER signal for the next higher code number.
   - Press Ch- to search downward. The UIR sends out POWER signal for the next lower code number.
   - Press the SELECT key to store the correct code.
   - The LED flashes 3 times if the code is stored.
     If the LED flashes rapidly 8 times, the code search is finished or the beginning code number must be re-entered.

Results of Operation

The LED indicator on the remote control guides the user through programming, verifying and sending the IR signal. After programming the correct code number, the remote control can control one or more application devices (TV, VCR, cable, Sat, Amp, CD, etc.) The LED indicator stays on as long as the signal is transmitting. For example, to program the remote control for a SONY TV, first find the code number (272) from the code list table. Follow the “Change Code” programming procedure to change the code: press and hold the TV key for 3 seconds. Release the key after the LED flashes. Enter the digits “2”, “7”, “2” one by one. After the remote reads all three digits, the LED flashes 3 times to confirm successful programming. Point the remote control at the SONY TV, then press the POWER key to turn on the TV.

Summary

Several field tests were conducted in shopping malls with the display devices. Contact the local ZiLOG Sales Office for more details.

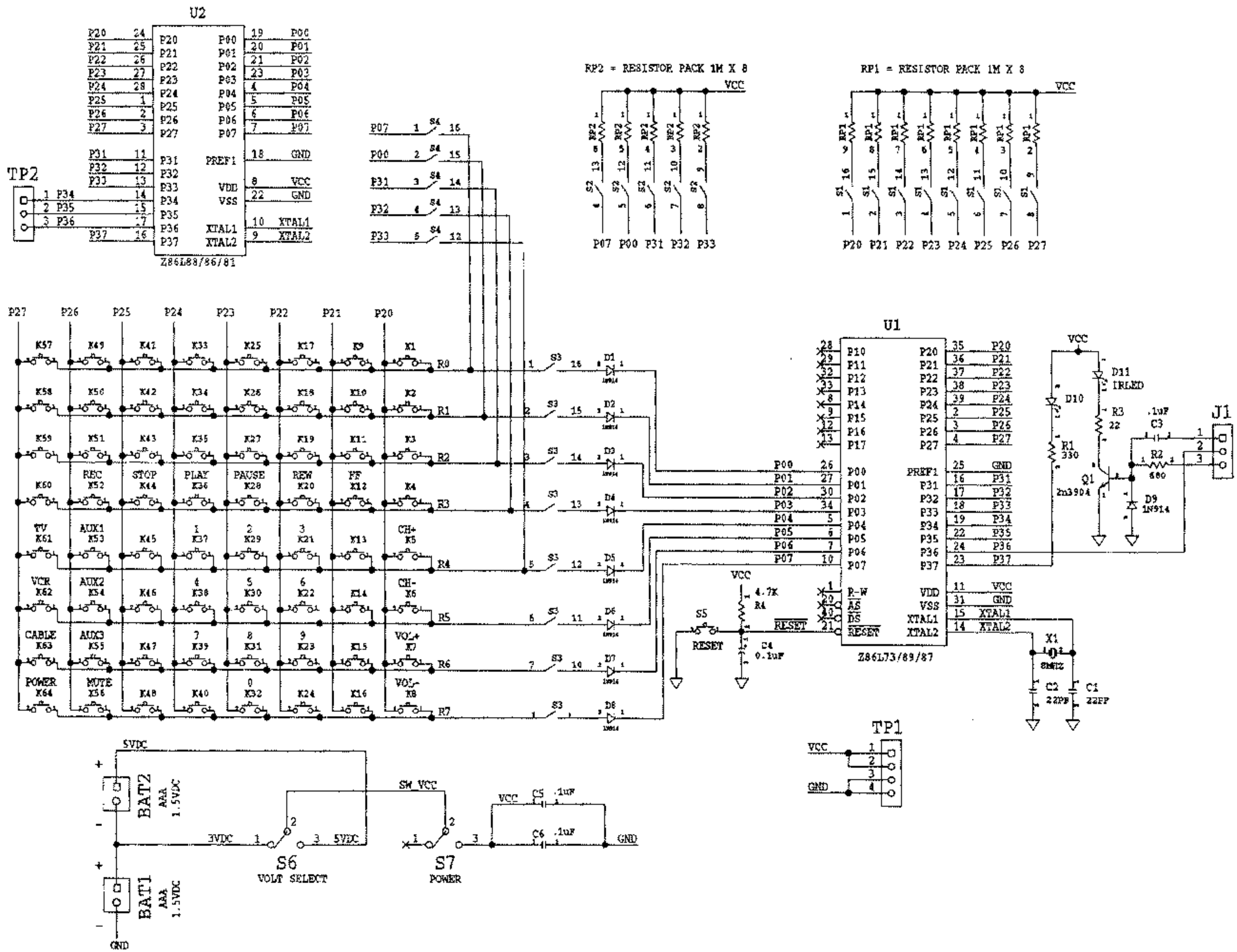
References

Source Code(s)

Because source code is long, it is only available for download. Contact the local ZiLOG sales off for the file called Sourcecode.ZIP for a listing of file names.

Application Note

ZiLOG Universal InfraRed Design (P/N AN190101-IRX0799)


U2
Z86L88/86/81
TP2
RP2 = RESISTOR PACK 1M X 8
RP1 = RESISTOR PACK 1M X 8
VCC
U1
Z86L73/89/87
J1
D11 IRLED
D10
R3 22
R1 330
Q1 2n3904
R2 680
D9 1N914
C3 .1uF
R4 4.7K
C4 0.1uF
S5 RESET
X1 8MHZ
C2 22PF
C1 22PF
TP1
GND
REC
STOP
PLAY
PAUSE
REW
FF
TV
AUX1
CH+
VCR
AUX2
CH-
CABLE
AUX3
VOL+
POWER
MUTE
VOL-
5VDC
3VDC
SW_VCC
BAT2 AAA 1.5VDC
BAT1 AAA 1.5VDC
S6 VOLT SELECT
S7 POWER
C5 .1uF
C6 .1uF

Appendix B UIR Brand List with Code Numbers

Table 4 lists Television brands with code numbers.
Table 5 lists VCR brands with code numbers.
Table 6 lists cable names with code numbers.
Table 7 lists satellite names with code numbers.
Table 8 lists amplier brands with code numbers.
Table 9 lists Compact Disk brands with code numbers.
Table 10 lists DVD brands with code numbers.

Table 4 Television Brands

Brand	Zilog Code Numbers
Admiral	116 234
Adventura	235
Aiko	126
Akai	63 91 117
Alba	33
Alleron	151
A-Mark	29
Amstrad	90
Amtron	145
Anam	28 29 83 105 145
Anam National	248 249 269
AOC	14 29 99 108 109 118 119 120 251
Archer	29
Audiovox	29 145
Bauer	35
Belcor	118
Bell & Howell	116 183 230
Bradford	145
Brockwood	14 118
Candle	14 95 97 98 108 118 120 121 235
Capehart	14

Table 4 Television Brands

Brand	Zilog Code Numbers
Celebrity	117
Circuit City	14
Citizen	18 94 95 96 97 98 101 108 118 120 121 126 145 199 235 236
Colortyme	14 118 120 122 254
Concerto	97 118 120
Contec	49 83
Contec/Cony	123 124 145
Craig	15 83 145
Crown	94 145
Curtis Mathes	94 101 108 115 118 120 125 199 230
CXC	83 145
Daewoo	2 91 92 94 109 118 119 120 126 127 213 214 256
Daytron	14 118 120
Dimensia	115
Dixi	29 52 91
Dumont	14 118
Electroband	117
Electrohome	3 5 94 118 120 128 129 130 269
Elta	91
Emerson	1 12 14 83 84 85 86 87 88 89 90 94 118 120 123 131 132
	133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149
	150 151 152 211 230 236 237 260 270
Envision	108 118 120
Etron	91
Fisher	50 82 153 154 155 230
Formenti	35
Fortress	39
Fujitsu	15 89 151
Funai	15 83 89 145 151
Futuretec	145

Table 4 Television Brands

Brand	Zilog Code Numbers
Futuretech	15 83
GE	14 20 80 81 84 102 105 106 111 115 118 120 130 156 187 231 232
	239 269
Genexxa	33
Gibralter	118
Goldstar	14 52 78 79 94 97 109 118 119 120 123 128 129 159 160 161 228
Granada	3 14
Grand	14
Grandiente	3
Grundy	145 151
Hallmark	14 118 120
Harvard	145
Hinari	89
Hitachi	3 10 24 71 72 73 74 75 76 77 94 97 118 120 123 124 163
	164 218 221 222 223 224 237 253
Hitachi Pay TV	273
IMA	145
Infinity	64 165
Janeil	235
JBL	64 165
JC Penney	46 81 94 101 108 109 111 115 118 119 120 121 130 156 161 166 167
	174 187 199 239 255
JCB	117
Jensen	70 118 120
JVC	66 67 68 69 123 124 163 168 169 229 240
Kawasho	65 117 118 120
Kenwood	108 118 120 128 129
Kloss	36 98 235
Kloss Novabeam	170 171 241
KTV	83 84 85 94 145 172 236

Table 4 Television Brands

Brand	Zilog Code Numbers
Lloyds	14
Loewe	165
Logik	183 266
Luxman	97 118 120
LXI	25 30 47 50 64 111 115 120 153 165 173 174 175 230 239
Magnavox	4 36 64 95 99 108 118 120 121 128 165 170 171 176 177 178 184
	188 215 216 217 241 267
Majestic	183
Marants	165 52 64 108 118 120 165 179
Matsui	91
Megatron	14 120
Memorex	14 50 91 116 120 182 183 230 266
MGA	14 62 108 109 110 118 119 120 128 129 130 155 180 182
Midland	239
Minutz	156
Mitsubishi	7 14 27 61 62 63 109 110 118 119 120 128 129 130 155 180 181
	182 212
Motorola	234 269
MTC	14 97 101 108 109 118 119 120 199
Multitech	145
NAD	14 30 112 120 173 174 243
National	13 105 13
NEC	23 97 100 107 108 109 118 119 120 129 185 254 269
Nikkai	33 34
Nikko	14 120 126
Normande	0
NTC	126
Onwa	83 145
Optimus	243

Table 4 Television Brands

Brand	Zilog Code Numbers
Optonica	37 39 192 234
Orion	15 142 260
Osaki	34
Panasonic	6 11 12 13 60 64 104 105 106 165 263 265 269
Philco	36 95 108 109 118 119 120 121 123 128 165 170 171 176 178 184 241
	267 269
Philips	52 64 118 121 123 128 165 170 171 177 186 187 188 269 176
Pilot	118
Pioneer	59 77 112 118 120 189 190 237 243 264
Portland	94 109 118 119 120 126
Price Club	199
Proscan	111 115 239
Proton	14 26 94 103 120 123 191 244 118
Pulsar	113 118
Quasar	11 105 106 172 263 269
Radio Shack	34 37 83 94 115 118 120 123 145 153 192 230
RCA	16 17 25 53 54 55 56 57 58 77 102 109 111 115 118 119 120
	128 193 194 196 197 239 245 256 269 273 274
Realistic	50 118 120 123 145 153 192 230
Saisho	90 91
Sampo	108 118 120
Samsung	0 8 14 34 52 91 94 97 101 108 109 118 119 120 123 125 127
	128 129 198 255
Sansui	260
Sansung	199
Sanyo	49 50 51 82 118 153 154 180 200 230
SBR	52
Schneider	52
Scotch	120

Table 4 Television Brands

Brand	Zilog Code Numbers
Scott	83 87 89 94 118 120 123 132 142 145 151
Sears	9 14 30 40 41 42 43 44 45 46 47 50 51 82 89 97 111
	118 120 124 128 129 151 153 154 155 169 173 174 201 202 230 239
Seimitsu	14
Sharp	21 22 37 38 39 49 94 118 120 123 137 192 203 205 210 234
Shogun	118
Siemens	49
Signature	116 183 266
Simpson	121
Sony	114 117 259 268 272
Soundesign	14 83 95 118 120 121 145 151
Spectricon	29 99
Squareview	15
SSS	83 109 118 145
Starlite	145
Supra	97
Supre-Macy	98 235
Supreme	117
Sylvania	35 36 64 95 108 118 120 121 128 165 170 171 176 177 178 188 207
	241 267 184
Symphonic	15 145 270
Tandy	33 39 234
Tatung	105 237 269
Technics	106
Techwood	97 118 120 157
Teknika	31 32 83 89 94 95 96 97 98 101 109 110 118 119 120 121 123
	124 126 145 151 177 182 183 199 266
Teletech	91
Tera	103 244
Thomas	14

Table 4 Television Brands

Brand	Zilog Code Numbers
Thompson	5
TMK	14 97 118 120
Toshiba	19 30 46 50 101 153 173 174 199 201 230 255
Totevision	94
Toyomenko	14
Universal	81 156 187
Vector Research	108
Victor	69 169 240
Video Concepts	63
Vidtech	14 109 118 119 120
Viking	98 235
Wards	37 81 89 102 108 109 116 118 119 120 128 132 151 156 156 165 170
	171 176 177 183 184 187 188 192 208 209 266 267 268 270
Yamaha	108 109 119 120 128 129
York	14
Zenith	113 118 183 226 227 261 266 271
Zonda	29

Table 5. VCR Brands

Brand	Zilog Code Numbers
Admiral	154
Aiko	169
Aiwa	21
Akai	75 76 77 136 137 138 139 140 156 157 141 155
Alba	115
Amstrad	21
ASA	101
Asha	160
Audio Dynamics	12
Audio Dynamics	158
Audiovox	161
Beaumark	160
Broksonic	159
Broksonic	167
Bush	20
Calix	161
Candle	17 160 161 162 163
Canon	108 117
Capehart	115 116
Capeheart	74 164
Carver	36
CCE	35 169
Citizen	17 18 160 161 162 163 169
Colt	35
Craig	5 18 35 160 161 165
Curtis Mathes	8 17 78 108 153 163 166 160
Cybernex	160
Daewoo	74 114 115 123 167 169 170 162
Daytron	74 115
DBX	12 158

Table 5. VCR Brands

Brand	Zilog Code Numbers
Dumont	112
Dynatech	21
Electrohome	4 161 171
Electrophonic	161
Emerson	4 19 21 23 38 77 79 142 143 144 145 146 147 159 161 162 166 167
	171 173 174 175 176 177 178 179 180
Fisher	3 5 21 25 26 28 29 80 86 112 113 165
GE	8 18 30 52 78 108 109 110 111 153 160
Go Video	106 107
Goldstar	2 17 31 126 161
Goodmans	20
Gradiente	168
Grundig	101
Harley Davidson	168
Harman Kardon	98 126
Harwood	35
Hinari	20
Hi-Q	165
Hitachi	15 16 21 32 33 72 75 118 119 120 121 122
JC Penney	11 12 18 72 80 108 126 158 160 161
Jensen	32 75
JVC	11 12 17 75 82 102 103 104 105 158
Kenwood	11 12 17 75 82 89 104 158 163
KLH	35
Kodak	161
Lloyd	21 168
Logik	20 35
LXI	161
M. Wards	4 5 6 18 19 20 21 108 129
Magnavox	36 37 101 108 129

Table 5. VCR Brands

Brand	Zilog Code Numbers
Magnin	160
Marantz	10 11 12 17 36 101 108 158 163
Marta	161
MEI	108
Memorex	5 21 89 100 108 112 124 154 160 161 165 168
MGA	4 38 77 99 171
MGN Technology	160
Midland	30
Minolta	32 72
Mitsubishi	4 32 38 39 40 41 42 44 45 46 47 71 77 82 97 98 99 104
	171
Motorola	154
MTC	21 160 168
Mukltitech	160
Multitech	30 35 163 168 18 20 21
NAD	96
NEC	9 10 11 12 13 17 49 50 51 75 82 104 125 126 158
Nikko	161
Noblex	160
Optimus	154 161
Optonica	65
Panasonic	1 14 73 108 130 132 133 134 135
Pentax	17 32 72 121 163
Perdio	21
Philco	36 37 108
Philips	65 101 108 181 36
Pilot	161
Pioneer	12 32 52 53 82 93 94 95 96 104 158
Portland	74 115 163
Proscan	8 52 129 153

Table 5. VCR Brands

Brand	Zilog Code Numbers
Protec	35
Pulsar	124
Quartz	89
Quasar	91 92 108
Radio Shack	3 4 5 6 26 65 154 160 161 165 168 171
Radix	161
Randex	161
RCA	0 7 8 18 32 52 54 55 56 57 60 61 62 72 78 121 127 128
	129 130 131 153 155 160
Realistic	21 26 65 86 89 108 112 154 160 161 165 168 171
Ricoh	150
Saisho	145 146
Salora	89 99
Samsung	18 30 76 90 110 123 138 156 160 162 174
Sanky	154
Sansui	12 63 75 82 104 125 158
Sanyo	5 87 88 89 112 160 165
SBR	101
Schneider	20
Scott	19 38 64 144 159 162 167 173
Sears	3 5 25 26 28 32 72 80 86 89 112 113 161 165
Sentra	115
Sharp	4 6 65 65 171
Shintom	20 35
Shogun	160
Singer	35
Sony	148 149 150 151 152
STS	72
Sylvania	21 36 37 38 99 108 168
Symphonic	21 168

Table 5. VCR Brands

Brand	Zilog Code Numbers
Tandy	21
Tashiko	21 161
Tatung	11 75 85
Teac	11 21 56 75 168
Technics	73 108
Teknika	21 22 67 108 161 168
TMK	146 160 166
Toshiba	19 26 28 32 38 64 99 123 162
Totevision	18 160 161
Unitech	160
Vector Research	12 126 158 162 163
Victor	12 104 105 158
Video Concepts	12 77 158 162 163
Videosonic	18 160
Wards	32 35 48 65 68 69 70 72 154 160 161 162 165 168 171
XR-1000	35 168
Yamaha	11 12 17 75 126 158
Zenith	124 151 152

Table 6. Cable Brands

Brand	Zilog Code Numbers
ABC	7 8 9 10
Archer	11 12
Century	12
Citizen	12
Colour Voice	13 14
Comtronic	15
Eastern	16
Garrard	12
Hytex	7
Jasco	12
Jerrold	5 17 18 30 9 10
Magnavox	19
Movie Time	20
NSC	20
Oak	0 21 7
Panasonic	1 6
Philips	24 12 13 14 19
Pioneer	2 3 25
RCA	34
Regency	16
Samsung	26 15
Scientific Atlanta	3 4 27 28
Signal	15
SL Marx	15
Starcom	10
Stargate	15
Teleview	15
Tocom	8 17
TV86	20
Unika	12

Table 6. Cable Brands

Brand	Zilog Code Numbers
United Artists	7
Universal	12 11
Viewstar	20 19
Zenith	3 32 33

Table 7 Satellite Brands

Brand	Zilog Code Numbers			
Alphastar	19			
Chaparral	0	1		
Cheyenne	1			
Dishnet	18			
Drake	2			
Drake	3			
Echostar Dish	27			
GE	13	20	21	
General Instruments	4	5	6	
Hitachi	23	24		
Hughes Network	17	28		
JVC	22			
Magnavox	25			
Philips	25			
Primestar	16			
Proscan	20	21	13	
RCA	13	20	21	
Realistic	7			
Sierra	1			
Sony	14			
STS	8	9	10	11
Toshiba	12	15		
Uniden	26			

Table 8 Amplifier Brands

Brand	Zilog Code Numbers							
AIWA	2	38	39	33	34	35	36	37
Carver	21							
Citizen	24							
Fisher	21							
GE	26							
Goldstar	5							
Hitachi	32							
JVC	18	40						
Kenwood	6	41						
Luxman	1							
Magnavox	20							
Marantz	23							
Memorex	7							
NAD	11							
Nakamichi	9							
NEC	31							
Onkyo	4	14	15					
Optimus	12							
Panasonic	22							
Pioneer	3	17	7					
Proton	20							
Quasar	22							
RCA	19	42						
Scott	16							
Sharp	27	30						
Sherwood	10							
Sony	8	2	43	44				
Techniques	22							
Toshiba	25							
Victor	18							
Yamaha	0	13	45	46				

Table 9 CD Brands

Brand	Zilog Code Numbers		
ADC	017		
ADO	018		
Aiwa	000	019	
Akai	020		
Denon	022		
Dynatech	001		
Emerson	002		
Fisher	003	025	026
GE	027		
Hitachi	004		
Inkel	028		
JVC	005	029	
Kenwood	006	030	031
Luxman	032		
Magnavox	053		
Marantz	008	033	
MCS	034		
Mitsubishi	035	036	
Nakamichi	038	039	
NEC	007		
Onkyo	009	040	041
Optimus	042	043	044
Panasonic	010		
Pioneer	011	045	
RCA	012	024	
Sanyo	052		
Sears	021		
Sherwood	046		
Sony	013	023	047
Teac	048	049	050

Table 9 CD Brands

Brand	Zilog Code Numbers
Technics	014
Toshiba	037
Yamaha	015 016 051

Table 10 DVD Brands

Brand	Zilog code Number
JVC	005
Magnavox	004
Mitsubishi	003
Pioneer	002
RCA	006
Sony	001
Toshiba	000

Appendix C Acronyms

UIR	Universal Infrared Remote
OTP	One Time Programmable
TV	Television
VCR	Video Cassette Recorder
CD	Compact Disc
MCU	Microcontroller
LED	Light Emitting Diode
RF	Radio Frequency
PCB	Printed Circuit Board
EEPROM	Electrical Erasable Programmable Read Only Memmory

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