TinyIR2 Learning Infrared Remote Control Decoder

(Spec Version 1.4 1/31/2009)

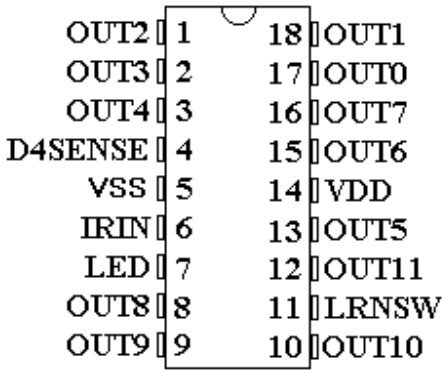
1 General Description

The TinyIR2 device is used in conjunction with an IR sensor module to recognize IR command sequences from standard consumer remote controls. It is trainable, so it can be used with remotes from many manufacturers. It offers low power consumption, and incorporates several features that add to its flexibility.

1.1 Applications

This device can be used either to add IR remote control to an existing product or design, or to incorporate it in a new one.

1.2 Device Pinout



1.3 Pin Description

VDD	14	Positive power supply voltage input
VSS	5	Negative power supply voltage input (Ground)
IRIN	6	Demodulated signal from IR detector, low when IR signal is present
OUT0	17	Output signal associated with first trained code (normal mode) or Code0 output (MCU mode)
OUT1	18	Output signal associated with second trained code (normal mode) or Code1 output (MCU mode)
OUT2	1	Output signal associated with third trained code (normal mode) or Code2 output (MCU mode)
OUT3	2	Output signal associated with fourth trained code (normal mode) or Code3 output (MCU mode)
OUT4	3	Output signal associated with fifth trained code (normal mode) or Code4 output (MCU mode)
OUT5	13	Output signal associated with sixth trained code (normal mode)
OUT6	15	Output signal associated with seventh trained code (normal mode) or CVAL output (MCU mode)
OUT7	16	Output signal associated with eigth trained code (normal mode) or

		ACK input (MCU mode)
OUT8	8	Output signal associated with ninth trained code (normal mode)
OUT9	9	Output signal associated with tenth trained code (normal mode)
OUT10	10	Output signal associated with eleventh trained code (normal mode)
OUT11	12	Output signal associated with twelth trained code (normal mode)
LED	7	Drive pin for Indicator LED
LRNSW	11	Learn Switch input, option diode drive
D4SENSE	4	Sense input for option diode D4.

2 Device Operation

2.1 Output type selection

Two types of outputs are available: momentary and toggle. Momentary outputs pulse high when their command is recognized. Toggle outputs change state when their command is recognized. By adding external configuration diodes, the designer can select any of the following combinations of outputs:

D5	D4	D3	Output Mode
IN	IN	IN	Outputs 0-1 toggle, 2-11 pulse
IN	IN	OUT	Outputs 0-3 toggle, 4-11 pulse
IN	OUT	IN	Outputs 0-3 and 8-11 toggle, 4-7 pulse
IN	OUT	OUT	Outputs 0-5 and 8-11 toggle, 6-7 pulse
OUT	IN	IN	Encoded output mode (MCU mode) 5 bits plus a strobe
OUT	IN	OUT	Outputs 0-3 and 10-11 toggle, 4-9 pulse
OUT	OUT	IN	All outputs pulse
OUT	OUT	OUT	All outputs toggle

IN means the diode is installed. Please see sample schematic for diode connections.

The device checks for the presence of configuration diodes each time power is applied to it. After changing configuration, you will need to cycle power to switch to the new value. It is not necessary to re-train the device after changing the output type configuration.

2.2 Pulse Width Selection

Two additional configuration diodes control the pulse width of any outputs that are configured as pulse type, as follows:

D2	D1	Pulse Width
IN	IN	1000 mSec (1 second)
IN	OUT	500 mSec
OUT	IN	Pulse stays high until no IR activity for ~ 125 mSec
OUT	OUT	100 mSec

2.3 Sleep Function

Configuration diode D6 controls whether the TinyIR2 chip enters a very low power state when it doesn't see any IR activity for approx 30 seconds. If D6 is installed, sleep will be enabled. If sleep is not enabled, the chip will draw about 1.9 mA when no IR cmds are being received. If sleep is enabled, after 30 seconds of inactivity, the chip will shut down and will draw less than 10 uA. The down side to using sleep mode is that some remotes only send the command once for each button press, in which

case the chip won't see it, as it will be busy "waking up" during the first part of the command. To use sleep with this type of remote, one would need to press the remote button once to wake up the chip, then press it again to register the command. If a remote is used that sends the command over and over when a button is pressed (Sony, Panasonic, and some others) the chip will miss the first transmission while it is waking up, but will get the next one, so it will work more or less normally with sleep enabled.

2.4 Command lockout period

Once a valid command has been recognized, no new command can be received for approximately 100 mSec. Since many remotes repeat the command at a high rate as long as the button is held, some type of lockout period is necessary to allow single key presses to be sent easily.

2.5 Encoded Output Mode (MCU mode)

In normal mode, there are only enough pins to support 12 outputs. If more cmds are needed, encoded output mode can be selected using the configuration diodes. In this mode, when a learned command is recognized, its 5-bit code (0-21) will be presented on the CODE0-4 output pins, and the CVAL signal will go high for 50 mSec. After 50 mSec, the chip will wait until the ACK input goes high, then it will reset CVAL and start looking for the next command. If the ACK signal is tied high, CVAL will pulse for 50 mSec after each new command reception. The first command learned has a code of 0, the next one's code is 1, etc.

2.6 Checking for diodes

Each time power is applied to the device, it checks to see which configuration diodes are installed. It does this by temporarily defining the OUT pins that are connected to diode anodes as inputs with internal pullup resistors, then driving a low level on the LRNSW output, which connects to the cathodes of the diodes. Then it checks for a low level at the anodes of the diodes by reading those port bits. If a diode is not present, the corresponding OUT pin will be high during the diode read process. At power-up, all of the I/O pins float for approximately 130 mSec before the chip starts checking for diodes. If you need outputs that are guaranteed not to pulse or float high during power-up, please use the Port A outputs (Out 0,1,2,3,4,6, and 7), and add external pull-down resistors to insure that they will be low when floating. (Anything greater than 1K ohms should be no problem for the chip to drive.)

2.7 Training the device

Before training the device, pick the remote you intend to use. If it is a universal remote, set it to the manufacturer that you want to use. Either a TV or VCR code setting should be OK. (If you don't need to use a particular setting, Sony uses a simple code that should work well. Of course, many others can also be used.)

To train the device, press and hold the "learn" switch while applying power to the device. The LED should light. Wait at least two seconds after applying power, then release the switch. At this time, the LED will blink off for 1 second, then turn on again, to indicate that "learn" mode has been selected. For best results while training, hold the remote approx 4-6" from the IR sensor. Shade the sensor from bright light during training as well. To train the first remote button, press the button and hold it down until the LED turns off, then release it quickly. At this point, the chip has learned and saved the first code. Now switch to the next button you wish to use. After 12 buttons have been trained in normal mode, or 22 buttons in MCU mode, the chip will automatically switch out of "learn" mode. The LED will go off and stay off. Your device is now ready for use, and will retain it's code information, even if power is lost. If you don't need to use all 12 or 22 commands, you can exit learn mode after traning fewer commands by pressing the learn switch a second time. **Each time you enter learn mode, all previously learned commands are erased.** You can train the device many times, if desired.

If, during training, the LED starts flashing continually, power down the chip and try again. Check the position of the remote relative to the IR sensor, and try lowering the ambient light level. If it fails to learn again, it probably means that the remote is using an unusual protocol, which will not work properly. If this happens, please switch to a different remote. If you are using a universal remote, simply switch to a different manufacturer.

Sometimes manufacturers use two codes for each button, code A and code B. When you press and hold a button, code A will be sent repeatedly as long as you hold the button down. If you release the button and press it again, code B will be sent repeatedly while it is held. Release it and press again, and you will get code A again, etc. This makes it possible for the controlled device to tell the difference between someone releasing and pressing the key again and simply losing the signal for a moment. When TinyIR2 is trained with this type of remote, it will only capture code A or code B,

but not both. After training, it will recognize every other press of the key, since it only knows about one of the two codes used for that key.

If you have successfully trained the device, but find that the remote does not work more than a few feet from the TinyIR2 device, it is probably not using a 38KHz modulation frequency. To solve this, you can either switch to a different remote (or setting if you are using a universal remote) and re-train, or change to a different frequency of IR sensor.

Each code is stored and recognized independently of the others, so different protocols can be used for the different commands. This means that you can use one remote for commands 0-5 and a different one for commands 6-11.

3 Operating Voltage, Output current

3.1 Detailled hardware specs on the chip

Because this device is implemented using a PIC16LF87 chip, the data sheet for that device (available at www.microchip.com) should be consulted if more information is needed.

3.2 Operating voltage range

The PIC16LF87 chip can be operated at VDD-VSS voltages over the range of 3.0 to 5.5 volts. The Vishay IR receiver used on the TinyIR2 pc board can also operate over this range.

3.3 Typical power consumption

The TinyIR2 chip will draw about 1.9 mA if sleep is not enabled, or < 10 uA if sleep is enabled. The Vishay IR receiver by itself will draw about 1.4 -1.5 mA. (If lower power operation is needed, Sharp makes some IR receiver modules that draw approx 200 uA.)

3.4 Output current capabilities

At 5.0 volts VDD, each output pin of the device is capable of sourcing 3 mA when it is high, and sinking 8.5 mA when it is low. In addition to these specifications, Microchip also provides graphs of current versus voltage for its output pins, which shows that the typical capabilities are much higher. If we can accept approximately 0.5 volt drop inside the chip, the typical current at room temperature would be about 8 mA sourcing (high) and 18 mA sinking (low).