# TinyIR Learning Infrared Remote Control Decoder

1 General Description

The TinyIR 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
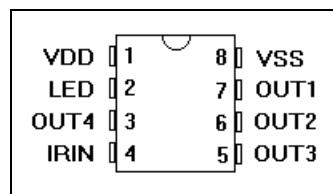
1.3 Signal Description

VDD	1	Positive power supply voltage input
VSS	8	Negative power supply voltage input (Ground)
IRIN	4	Demodulated signal from IR detector, low when IR signal is present
OUT1	7	Output signal associated with first trained code (normal mode) or output select bit 0 (expansion mode)
OUT2	6	Output signal associated with second trained code (normal mode) or output select bit 1 (expansion mode)
OUT3	5	Output signal associated with third trained code (normal mode) or output select bit 2 (expansion mode
OUT4	3	Output signal associated with fourth trained code (normal mode). Also selects between normal and expansion mode at power-up. Also used as active-low data output latch enable in expansion mode.
LED	2	Control for Indicator LED, also used to select learn mode at power up. Also used as output data signal in expansion mode.

2 Device Operation

2.1 Output Mode

There are two basic modes for the outputs, normal and expansion mode. In normal mode, the device uses four of its pins to provide four output signals directly. In expansion mode, an external 74HC259 8-bit addressable latch chip is controlled by the TinyIR chip, to provide eight output signals. Selecting between these two modes is accomplished by installing a resistor from the OUT4 pin to either VSS (normal mode) or VDD (expansion mode).

The device checks for the presence of the pullup or pulldown resistor on OUT4 each time power is applied to it. After changing the resistor, you will need to cycle power to read the new value. As the output mode affects the number of available channels, you will want to re-train after changing it.

2.2 Output type selection

Two types of outputs are available: momentary and toggle. Momentary outputs pulse high for approx. 100 mSec when their command is recognized. Toggle outputs change state when their command is recognized. By adding external configuration diodes, the designer can select one of the following combinations of outputs:

Normal Output Mode:

	Out4	Out3	Out2	Out1
No diodes installed	TOG	TOG	TOG	TOG
Only D1 installed	TOG	TOG	TOG	MOM
Only D2 installed	TOG	TOG	MOM	MOM
D1 & D2 installed	TOG	MOM	MOM	MOM
Only D3 installed	MOM	MOM	MOM	MOM

Expanded Output Mode:

	Out8	Out7	Out6	Out5	Out4	Out3	Out2	Out1
D3 & D1 installed	TOG	TOG	TOG	TOG	TOG	TOG	TOG	TOG
Only D1 installed	TOG	TOG	TOG	TOG	TOG	TOG	TOG	MOM
D3 & D2 installed	TOG	TOG	TOG	TOG	TOG	TOG	MOM	MOM
D1 & D2 installed	TOG	TOG	TOG	TOG	TOG	MOM	MOM	MOM
No diodes installed	MOM	MOM	MOM	TOG	MOM	TOG	TOG	TOG
D3 & D2 & D1 installed	TOG	TOG	TOG	MOM	MOM	MOM	MOM	MOM
Only D2 installed	MOM	MOM	MOM	TOG	MOM	TOG	MOM	MOM
Only D3 installed	MOM	MOM	MOM	MOM	MOM	MOM	MOM	MOM

The device checks for the presence of the 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.

2.3 Command lockout period

Once a valid command has been recognized, no new command can be received for the next 200 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.

2.4 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. Pressing the learn switch will turn the LED drive transistor on, so the LED will 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 button, press the button, hold it for a second or two, then release it for a second or two. Do this four times. On the fourth press, the LED should blink off twice. This indicates that the chip has learned and recognized the first code. Release the button as soon as you see the LED blink. Now switch to the next button you wish to use. The first button requires four presses for training, while all subsequent buttons should cause the LED to blink twice after only three presses. After four buttons have been trained in normal mode, or eight buttons in expansion 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. You can train the device many times, if desired.

The device checks incoming codes against all four or eight "learned" codes simultaneously. If you train all four channels of the device with the same button on the remote, all four outputs will repond when that key is pressed. By selecting the output combination as two pulse and two toggle outputs, you could train the remote with only three buttons, one of which would produce a pulse and a toggle reponse every time it is pressed, on separate pins of the chip.

If, during training, the LED starts flashing continually, it means that the remote is using an unusual code, 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. Some codes will appear to train properly, but will cause multiple output pins to respond. If this happens, please switch to a different remote, or mfr's setting.

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 TinyIR 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 TinyIR device, it is probably not using a 40KHz 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.

All four or eight codes must be of the same "family", such as a particular remote would use, or a particular setting of a universal remote. You cannot mix codes from different remotes, or different univ remote settings.

3 Operating Voltage, Output current

3.1 Detailled hardware specs on the chip

Because this device is implemented using a PIC12CE519 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 PIC12CE519 chip can be operated at VDD-VSS voltages over the range of 3.0 to 5.5 volts. The Sharp IR sensor used on the PC-4CH and PC-8CH pc boards is specified to operate from 4.5 to 5.5 volts only.

3.3 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).