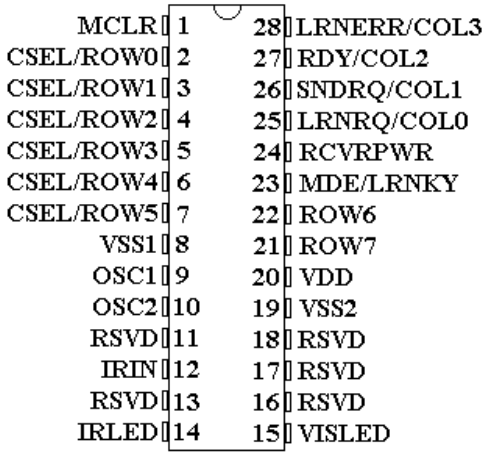
1 General Description

The IRMimic2 device is used in conjunction with an IR sensor module and an IR LED to learn IR command sequences from standard consumer remote controls and retransmit them on command. 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 make a custom remote control, or to add remote control of some other equipment to a device.

1.2 Device Pinout



1.3 Signal Description

VDD	20	Supply	Positive power supply voltage input
VSS	8,19	Supply	Negative power supply voltage input (Ground)
IRIN	12	Bi-dir	Demodulated signal from IR detector, low when IR signal is present Driven low as output when detector is powered down
RCVRPWR	24	Output	Power to IR detector/receiver module (High = ON)
OSC1	9		Crystal oscillator pin
OSC2	10		Crystal oscillator pin
VISLED	15	Output	Visible LED drive signal, (Low = ON)
IRLED	14	Output	IR LED base drive signal, (High = ON)
RSVD	11,13	Output	Reserved for future expansion. Do not connect to anything.
RSVD	16-17	Output	Reserved for future expansion. Do not connect to anything.

Signal Description (cont)

Keypad Mode:

LRNKEY	23	Input	High at power-up to select keypad mode, pulled low after this to enter learn mode
ROW0	2	Output	Keyboard row driver
ROW1	3	Output	Keyboard row driver
ROW2	4	Output	Keyboard row driver
ROW3	5	Output	Keyboard row driver
ROW4	6	Output	Keyboard row driver
ROW5	7	Output	Keyboard row driver
ROW6	22	Output	Keyboard row driver
ROW7	21	Output	Keyboard row driver
COL0	25	Input	Keyboard column input
COL1	26	Input	Keyboard column input
COL2	27	Input	Keyboard column input
COL3	28	Input	Keyboard column input

MCU Mode:

MDE	23	Input	Low at power-up to select MCU mode
CSEL0	2	Input	Code Select LSB
CSEL1	3	Input	Code Select bit
CSEL2	4	Input	Code Select bit
CSEL3	5	Input	Code Select bit
CSEL4	6	Input	Code Select bit
CSEL5	7	Input	Code Select MSB
LRNRQ	25	Input	Initiates learning a command
SNDRQ	26	Input	Initiates sending a command
RDY	27	Output	High level indicates chip is finished previous operation
LRNERR	28	Output	High level indicates an error condition while learning a command

2 Device Operation

There are two basic modes of operation, keypad mode and MCU mode. In keypad mode, the chip will scan an attached matrix of keys, which can be used to control learning and sending commands. Each key corresponds to either a single command, or a sequence of commands. In MCU mode, the chip can be controlled directly by a microcontroller, for both learning and sending commands. The device can be trained in one mode, and used in a different mode, if needed. Do not train with macros in keyboard mode, and then attempt to play them back using MCU, mode, however, as it won't work. Macros are not supported in MCU mode. To select the desired mode, either float pin 23 at power-up (keypad mode) or pull it low (MCU mode) at power-up, with a 470 ohm resistor.

2.1 Training the device

Note: When training, avoid shining light directly onto the front of the IR sensor, to avoid false signals.

Keypad mode:

Press and hold the learn key, then momentarily press one of the 32 possible keypad matrix keys. The visible LED should light. Release the learn key. Now hold the remote approx 1" away from the sensor, aimed directly at it, and press and hold the desired remote key. After about one half second, the LED should go out for one second, then come on again. Release the key on the remote as soon as the LED goes out. If you only want to associate a single command with that key, press the learn key at this point to stop recording. The LED should go out. If you want to record a second command for that same key, do not press the learn key after the LED flashes off and on, but instead press and hold a different remote key to record it. Again the LED will blink off after the command is learned. Continue until all remote keys desired for that key have been learned, then press the learn key to stop learning. Keys can be re-trained as many times as you like. If the LED blinks for four seconds when you press the button on the remote during training, please wait until it stops, and try again. If this happens, make sure the remote is pointing at the IR sensor and about 1" away from it. If this happens in the middle of recording a multi-command sequence, you should be able to re-record just the key that caused the flashing. If that doesn't seem to work, just re-record the whole sequence.

If the LED blinks for ten seconds during the learning process, it means that the 57-command storage area is full. You'll need to erase some commands in order to record any new ones. To erase all of the commands associated with a particular key, press and hold the learn key, then press the key you want to erase. The LED should come on. All commands previously assigned to that key have been erased. Now press the learn key again to exit learn mode.

MCU mode:

Select the number of the command (0-56) to learn using the six CSEL inputs. Whichever number you select will be the same number you use later to send the command. Assert the LRNRQ input and hold it high. After the CPU wakes up and starts executing instructions (~2 mSec), the RDY signal will go low, and the Learn LED will light. Apply the IR signal using your remote, positioned as noted in the previous section. The MCU should wait for the RDY signal to go high again to indicate that learning has finished. Before taking LRNRQ low, the MCU should check for LRNERR high, then take LRNRQ low to end the learn operation and reset LRNERR if it was asserted. If LRNERR was asserted, repeat learning for this key. (After adjusting the position of the remote relative to the sensor.) Wait at least 60 mSec after dropping LRNRQ before re-asserting it.

As of 10/29/07, it is now possible to abort the learning process when in MCU mode. Normally the SNDRQ input would not be used while learning, and would be sitting low. When learning has been initiated, but before the start of the command has been detected, if SNDRQ is brought high for at least 5 uSec, learning that command will be aborted. SNDRQ must be brought low again to resume normal operation.

Commands are stored in non-volatile internal memory, and will be preserved even if power is removed from the device. Each command is captured and stored independent of the other commands, so each command can be in a different format, if necessary. Macros are not supported in MCU mode. Each key maps to one stored command. Macros can be implemented using code in the controlling MCU.

Sending commands

Keypad mode:

To send a command, press the same key that was used to learn the command. (Do not press the learn key.) In keypad mode, commands are repeated as long as the key is held down. (See more on command repeating below.) If a key has not been trained yet when you press it, no command will be sent. Keys are not repeated within macros. When a sequence of commands is recorded for a single key, a one-second pause is inserted between commands on playback. This allows controlled equipment to react before the next command is sent.

MCU mode:

Select the number of the command (0-56) to send using the six CSEL inputs. Assert the SNDRQ input and hold it high. After the CPU wakes up and starts executing instructions (~2 mSec), the RDY signal will go low. The command will be transmitted next, then the RDY signal will go high after transmission is finished. After seeing RDY high, the MCU should take SNDRQ low to end the operation. In MCU mode, the command is sent just once for each SNDRQ sequence. It is not repeated. If the selected command has not been trained yet, no command will be sent.

2.2 Command repeating

There are many different formats and protocols used for IR remote control. Some remotes send sequences that look like:

1) A R R R R R …repeat until button is released. A is the command code, and R is a shorter code that signals the button is still pressed. (NEC code works like this)
2) A A A A A A…repeat until buton is released (Panasonic, Sony and some others work this way)
3) A B A B A B… repeat until button is released (some Denon HT recvr and DVD players work this way)
4) A … (command sent only once each time the button is pressed).

While learning a command, the IR Mimic2 device tries to determine the correct way to repeat the sequence. For common protocols, it will be successful. If it can't figure out how to repeat the command, it will simply repeat the entire sequence captured during learning, or about 650 mSec of the command sequence. If the command was not repeated during learning, it won't be repeated when IRMimic2 sends it.

2.3 IR Sensor power control

The IR sensor module requires a small amount of operating current whenever it is powered. For good battery life, it is necessary to power down the IR sensor module except when learning. The IR Mimic2 chip handles this automatically.

3 Operating Voltage and Current

3.1 Detailed hardware specs on the chip

Because this device is implemented using a Microchip PIC18LF2420 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 PIC18LF2420 can operate at VDD-VSS voltages over a range of 3.0 to 5.5 volts. The Vishay IR sensor used on the PC board can also operate over this range.

3.3 Current

In order to achieve good transmitting range, it is necessary to drive the IR LED with more current than the PIC chip can handle directly. This is why an external transistor is used on the IRM2 pc board. The IR LED current is applied in bursts, so the average value during transmission is less than 100 mA, but the peak values are higher. AA or even AAA batteries should be able to handle the required current if applied properly.

3.4 Things to watch out for

The example schematic shows a 1000 uF capacitor connected across the power supply. This capacitor helps the voltage regulator to keep its output constant despite the large current pulses being drawn by the IR diode when transmitting. One down side to having a large capacitor across VDD is that even when power is removed from the circuit, this capacitor may take a long time to discharge, so if power is only removed for a short time, the IRMimic2 chip may not see its supply drop enough to trigger the internal reset circuit. One way to make sure that the IRMimic2 chip resets properly is to momentarily short the capacitor leads (with power removed) before re-applying power to the circuit.

When learning, the IRMimic2 chip starts recording IR activity with the first low pulse it sees from the IR detector. (Most IR receivers put out a low level when they sense the correct IR input signal) The Vishay IR receiver shown in the sample schematics is relatively insensitive to room light and works well for learning. Some other IR receivers may put out short noise pulses even when no IR command is being received. These noise pulses will trigger learning and the IRMimic2 will “learn” the noise, and quickly exit learn mode.

The IRMimic2 chip captures roughly one-half second of IR activity for each trained command. This may contain multiple copies of the command. The exact number depends on the protocol in use. When you play back the command, in either mode, the entire half-second sequence is replayed. In some cases, this may be long enough to cause repeated operations in the controlled equipment, such as increasing the volume by two steps, for instance, when you only wanted one. To avoid this, when learning a command that displays this behavior, do not hold the button on the remote until the red LED goes out, but instead, press the button for a shorter amount of time. IRMimic2 will still capture the full one-half second, but the latter part of the recording will be empty, so you will play back a shorter burst of the IR command sequence.