

IRVC Learning Infrared Remote Volume Controller

1 General Description

The IRVC device is used in conjunction with an IR sensor module and TI's PGA2310 volume control IC(s) to provide high-quality remote control of audio signal amplitude. It is capable of being trained to recognize IR command sequences from many standard consumer remote controls. It can control 2, 4, 6, or 8 channels of audio, and provides five additional output signals that can be used to either select between different sources or as general-purpose outputs. Three momentary pushbutton switch inputs are provided for optional front-panel Volume Up, Volume Down, and Power On/Off. IRVC offers low power consumption, and incorporates several features that add to its flexibility.

1.1 Applications

This device can be used add IR remote control of volume to a new product or design.

1.2 Device Pinout

CSb	1	18	SCLK
PWRON	2	17	SDI
LED/LRN	3	16	SS/GP5
SRFB	4	15	BALSET
VSS	5	14	VDD
SS/GP1	6	13	PWRPB
SS/GP2	7	12	VDNPB
SS/GP3	8	11	VUPPB
IRIN	9	10	SS/GP4

1.3 Signal Description

VDD	14	Positive power supply voltage input
VSS	5	Negative power supply voltage input (Ground)
IRIN	10	Demodulated input signal from IR detector, low when IR signal is present
PWRON	2	Power Status/Control output signal, high when power is on
BALSET	15	Output, high when in "Channel Balance Set" mode May be used to select a noise source for setting channel levels
CSb	1	Chip Select output, active low, used to control PGA chip(s)
SDI	17	Serial data output signal, used to control PGA chip(s)
SCLK	18	Serial clk output signal, used to control PGA chip(s)
SRFB	4	Shift Register Feedback input from SDO of last PGA chip in chain
LED/LRN	3	LED output/learn switch input
PWRPB	13	Active low input from Power Control pushbutton, internal pullup resistor
VDNPB	12	Active low input from Volume Down pushbutton, internal pullup resistor
VUPPB	11	Active low input from Volume Up pushbutton, internal pullup resistor
SS/GP1	6	Active high Source select/general purpose output #1
SS/GP2	7	Active high Source select/general purpose output #2
SS/GP3	8	Active high Source select/general purpose output #3
SS/GP4	9	Active high Source select/general purpose output #4
SS/GP5	16	Active high Source select/general purpose output #5

2 Selecting a configuration

2.1 Number of PGA chips

IRVC automatically senses the number of PGA chips connected to it, at power-up. It uses the SRFB signal to do this. This signal should be connected to the SDO pin of the last PGA chip in the SDI/SDO daisy chain. Please see PGA chip data sheet for details on how to daisy-chain multiple chips. If IRVC doesn't detect any feedback, it will sit in a loop, flashing the LED. Each time power is applied to the IRVC chip, it will detect the number of chips/channels, and will flash the LED once for each channel, so the LED will flash on and off 2,4,6, or 8 times.

2.2 SS/GP Output type selection

Two types of outputs are available: "source select" and general purpose. Only one source select signal can be active at a time. Selecting one will disable all others automatically. General purpose outputs toggle when their IR command is received. All output signals start low at power-on. To select the number of outputs that you would like to use as source selects, install a 47K resistor between the highest numbered SS/GP signal that you want to use, and the SRFB signal. You should always connect a 470K resistor from SRFB to GND. Non-SS signals will be configured as GP types automatically. For instance, if you want three source selects, connect a 47K resistor between SS/GP3 and SRFB. Only connect one 47K resistor between a SS/GP signal and SRFB. If you want all SS/GP signals as general purpose signals, do not connect any 47K resistors to SRFB, but install the 470K resistor to GND. The resistors are sensed at power-up, and will not interfere with the other use of the SRFB signal.

3 Training

Before training the device, select the remote you intend to use. If it is a universal remote, set it to the manufacturer that you want to use. A TV code setting will probably be the best choice, since you need volume control keys. (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.)

You will need to pick any 14 of the remote keys as the ones that will be used to control the IRVC chip functions. Here are the functions and a suggested list of keys. This assumes that you are using a TV mode on your remote.

<u>Training order</u>	<u>Function</u>	<u>Possible Remote Key</u>
1	Volume Up	Volume Up or Up arrow if there is one
2	Volume Dn	Volume Down or Down arrow if there is one
3	Mute	Mute
4	Pwr On/Off	On-Off
5	Enter Bal Set	Rgt arrow key if there is one
6	Exit Bal Set	Lft arrow key if there is one
7	Ch/SS/GP1	1 key
8	Ch/SS/GP2	2 key
9	Ch/SS/GP3	3 key
10	Ch/SS/GP4	4 key
11	Ch/SS/GP5	5 key
12	Ch6	6 key
13	Ch7	7 key
14	Ch8	8 key

"Ch" indicates one of the possible 8 channels of audio that can be controlled. Number keys can select that channel in Balance Set mode.

SS/GP1-5 can be controlled in normal operating mode by pressing the key that corresponds to them.

The functions are always trained in the order listed above, and all 14 keys must be trained whenever "learn mode" is activated. IRVC does not know which key you are pressing on the remote. The first command trained will always be assigned to the Volume Up fcn, even if you are pressing the On/Off key on the remote. The second will be Volume Dn , etc.

To train the device, press and hold the "learn" switch while applying power to the device. Pressing the

learn switch will force the LED on, so it 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 3-5” 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 until the LED goes off, then release it quickly. This indicates that the chip has learned the first code. Release the button as soon as you see the LED blink. Now switch to the next button you wish to use. After all fourteen buttons have been trained, the chip will automatically switch out of “learn” mode. The LED will go off for a moment, then it will flash the number of PGA channels detected. Your device is now ready for use, and will retain it’s code information, even if power is lost. You can train the device as many times as desired.

The device checks incoming codes against all fourteen “learned” codes simultaneously. If you train all fourteen channels of the device with the same button on the remote, some very strange things will happen.

If, during training, the LED starts flashing continually, it means that the remote is using an unusual protocol, which will not work properly. If this happens, reduce the ambient light level near the IR receiver, remove power, and re-apply with the learn switch pressed to try again. If the same thing happens again, 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 functions to be activated. If this happens, please switch to a different remote, or manufacturer 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 IRVC 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 IRVC device, it is probably not using a 38 KHz 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 independently of the others, so each cmd can use a different IR protocol, if desired.

4 Normal Operation

4.1 Getting started

After training finishes, IRVC will default to –50dB volume setting on all channels, all SS/GP outputs will be low, and the IRVC will be in the “power off” state. In this state, all channels are muted, the PWRON output is low, and the only command that will be accepted is “Power On/Off”, which will turn on the power, and restore the volume setting to its previous value. (or the default, if power has just been applied to the chip) After applying power to the chip, you will need to turn it on by pressing On-Off on the remote, or on the front panel, and also select a source, (if you are using these signals) before you will be able to hear anything. Since –50dB is a very low volume setting, you will need to hold the “Volume Up” remote button or “front panel” pushbutton if implemented down for maybe 15-30 seconds, before you start to hear audio. This procedure will only be required when power has been removed and re-applied to the IRVC chip. (In a normal application, the IRVC chip should be powered all of the time, even when other equipment is off.)

4.2 Using it

Once you have turned on the chip, selected an input source (if you are using this feature), and increased the volume to a comfortable level, you can try using the mute button to mute all controlled channels at the same time. Hit mute again to restore normal sound. You can use the number buttons to control the SS/GP output signals. Hit On-Off to put the chip in its “power off” state. The volume up/dn buttons will change at twice the normal rate if held for more than about 2 seconds.

4.3 Command lockout period

Once a valid IR command has been recognized, no new command can be received for approximately 150 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 registered easily. The lockout period for mute and power on/off is longer, to prevent registering two presses accidentally.

5 Setting Channel Balance

IRVC supports adding an offset to each channel's volume to make it louder or softer than the others. This allows you to compensate for differences in amplifier gain or speaker sensitivity between channels. If you want all channels to be set to exactly the same gain, then you don't have to do anything. To set a channel's volume offset, press the "Enter Balance Set" key. This should mute all channels except channel 1. You can select any channels that exist by pressing either the "Enter Balance Set" key to walk through all channels that exist, or pressing the number key that corresponds with the channel that you want to set. If you have only two channels, pressing the numbers 3-8 will do nothing. (The LED will still flash) Once you have selected the desired channel, press vol up or vol down, either on the remote, or using the "front panel" pushbuttons if implemented. When you have finished with that channel, either select a different channel to adjust, or use the "Exit Balance Set" key to leave Balance Set mode, and write the new channel balance settings to EEPROM. You can set each channel's volume offset in the range +/- 12.5 dB.

6 Brown-out Mute Feature

To insure that all channels mute quickly if power is accidentally lost, the Brown Out feature of the IRVC chip has been enabled. This will reset the chip when its power supply voltage drops below about 4.0 volts. Resetting the chip will cause all I/O pins to revert to inputs. To take advantage of this, please connect the PWRON output signal to GND with a 10K resistor, and also connect a 10K pullup resistor from PWRON to the Mute input pin (pin 8) of all controlled PGA chips. (You can add a toggle switch between GND and the Mute pins as a front panel Mute switch if you like.) As the IRVC chip is losing power, its brown out feature will reset the chip, and PWRON will become an input. The 10K resistor to GND will pull it down very quickly, and since it is connected to Mute on the PGA chips, all channels will be muted instantly. Using PWRON in this way does not prevent you from also using it to turn on and off other equipment, with suitable circuitry.

7 Pushbutton Inputs

Three inputs are provided for optional momentary switches controlling volume and power on/off state. The IRVC chip has internal pullup resistors on these inputs. Switches should be connected between ground and the input pins, and have the same function as the corresponding IR command. The LED will flash when these switches are pressed.

8 Operating Voltage, Output current

8.1 Detailed 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.

8.2 Operating voltage

The IRVC chip must be operated at 5 volts.

8.3 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).