

# BANSHEE

## THEORY OF OPERATION

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Version 3.1

Banshee is a Do It Yourself (DIY) style controller board from Haunt Hackers. This computer with Input and Output interface can control servos, lights and devices used in props and haunt sets.

The goal of the project is to bring the latest in prop controller technology within the budget of most home and smaller haunts. One way of keeping costs down is for you to acquire the parts and solder them to the PC board we supply. This saves \$100 or more on each controller.

Banshee uses standard "Through hole" parts for easy soldering. Based on your skill level, building a Banshee should run three to five hours. While we designed the project to be easy as possible, it should not be taken on by first time kit builders.

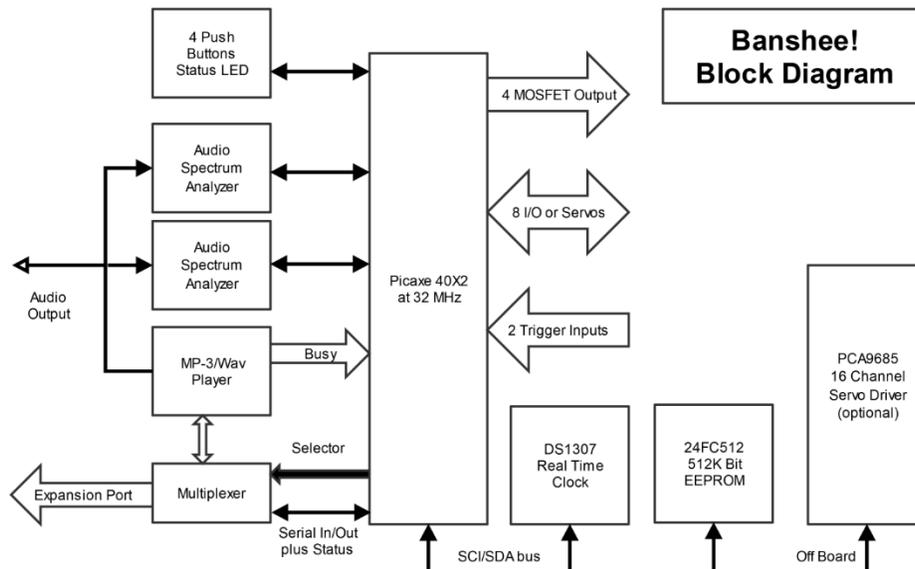


Figure 1

As the Banshee Block Diagram shows (Figure 1), the Picaxe 40X2 is the heart of the system. All other parts are connected to and run under the guidance of this easy to use Microcontroller. The 40X2 stores the BASIC language programs on internal non-volatile EEPROM memory and are automatically executed on power up. Furthermore, there are NO special power down needs like on systems that store the programs on SD-Cards. Turning off the power will not damage the controller or the program's memory.

The Picaxe 40X2 has space for up to 4K of program code. (This is twice the 2K limit most other Picaxe chips.) The Controller also three other program slots for a total of 16k of program space.

The Picaxe 40X2 is locked-in at clock speed of 32 MHz and all Banshee programs must have the "setfreq em32" command before any code. This informs the Picaxe editor that the program will be running on a 32 MHz part or 4 times the normal speed.

The Picaxe 40X2 has 256 bytes with the first used by the general variables B0 to B55. Memory locations from 56 to 255 are accessible by peek, poke and byte pointers. Please see the Picaxe programming manuals at [Picaxe.com](http://Picaxe.com) for more details.

The white push button (S5) is used to Reset the Picaxe 40X2 controller. It is located near the eight Servo Ports.

The advantage of the Picaxe 40X2 is the large number of Input/output lines. Utilizing all 33 connects, Banshee can talk to all the sub-system with great ease for the programmer. Let's take a look at all the parts that make up Banshee.

### Sound Sub-System

Banshee uses the DFplayer Mini Audio Media Player. This low-cost module plays both MP-3 and higher quality wave format audio files. The 40X2 uses the Hardware Serial Out (C.6), Serial In (C.7) and (A.3) for the Busy line of the DF player Mini module.

### Audio Spectrum Analyzer System

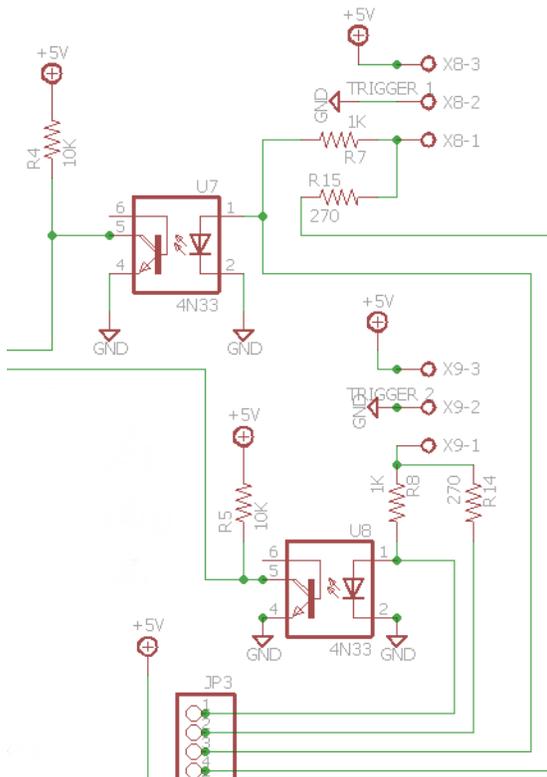
There are two MSGEQ7 Seven Band Audio Spectrum Analyzers chips on Banshee with each tied to the left or right channel of the DFplayer Mini. This lets the Banshee Analyzes the audio that it's playing in real time and the key to programs like the 3-Axes Skull with Jaw-sync. Picaxe 40X2 Pin A.0 is tied to both Reset pins on the MSGEQ7 chips. Likewise, Pin A.1 it tied to the strobe on the MSGEQ7 chips. By clocking these two pins, the different audio bands can be selected. The analog out of the two MSGEQ7 chips are fed into Pin D.2 for left and D.3 for right channels of the audio for that band.

### Eight Servo or General Input/Output Lines

The Picaxe 40X2's B.0 to B.7 are used to drive up to eight servos or general inputs or outputs. There are two connections on the PC board for these eight ports with the first being the Servo I/O Ports that are a group of eight 3-Pin connector number 0 to 7. The pin nearest the 0-7 numbers is the ground connection with the center pin supplying the servo's power. The final pin is the servo control line from the 40X2 with a 330-ohm resistor in series.

The Servo Power (SP) input is location to the left of the eight servo pins. Please make sure to use a power source that as enough current to drive all the servos connected to the servo port. (A little extra current would not hurt.) Please note the locations of the positive (+) and negative (-) terminals since reversing power will damage the servos.

The B.0 – 7 I/O port is a direct connection to the Picaxe 40X2's B.0 to B.7 I/O lines. Pin 1 is +5 Volts, Pin 2 is ground and Pin 3 through 10 are the B.0 to B.7 lines in that order. This port gives direct access to the I/O lines without going through the eight 330-Ohm resistors of RN1. The +5 Volts supplied by Pin 1 should be limited to 100 milliamps.



### Optically Isolated Trigger Ports

Banshee has two trigger input ports. To protect the circuitry from static electricity, these inputs are Optically Isolated by the 4N33 of U7 and U8. (See Figure 2) Each of the Trigger ports have three screw terminals to supply power and the input connections. In the case of a switch style connection, tie one side to the (+) terminal and the other to the (In) terminal. For use with a PIR, use the (-) and (+) terminal to supply 5 Volt power and the (In) for the output line connection.

The Voltage level input for the triggers is designed around 5 volts. If the trigger level is from a 3.3 volts as with some PIR sensors, there is an option to handle this.

On the JP3 pin header, a jumper on pins 1-2 and 3-4 will lower the voltage and current levels need to trigger the 4N33. A jumper on pins 3-4 will lower the levels on Trigger input number 1. A jumper on pins 1-2 will lower the levels on Trigger number 2.

The Picaxe uses port A.7 to read the status of Trigger 1 and A.6 for the status of Trigger 2.

Figure 2

## Four Push Buttons Switches

There are four color coded, push button tactile switches used for input for Banshee. (S1-S4) are tied to 40X2 pins D.4 through D.7 and are pulled low (logical zero) by a 10K ohm resistor. Pressing the button will return a High (logical one) since this action places +5 Volts on the pin. Since there is no debounce circuit on the push buttons, care should be taken in software to control the changing state on the pin's status.

## Status and Power LEDs

The green power LED (LED2) indicates that Main Power is being supplied to Banshee. Resistor R3 has a value of 680 ohms is used to control the brightness of this LED. By changing this Resistor to 470 Ohms will increase its brightness to be seen easily in bright daylight.

The red status LED (LED1) is controlled by the output of port A.5. A high on this pin will turn on the LED to show the status of the software. Like the power LED, the changing of R4 from 680 to 470 ohms will brighten the LED for daylight operation.

## MOSFET Power Outputs

There are four IRF540 MOSFET driver channels used to control LED flood lights, Solenoids and other high current, low voltage devices. While the MOSFETs used are rated to 100 volts at 33 amps, please limit the power to 33 Volts and no more than 10 amps per channel.

Power is supplied via the MOSFET power terminal (MP) to the left of the four MOSFET Outputs (O1-4). Only use DC power and please note the Positive (+) and Negative (-) for all five screw terminals.

The MOSFET outputs for O1 and O2 are controlled by Picaxe 40X2 pin's C.1 and C.2. A High on the pin will turn on the MOSFET with a low turning it off. There is also an option on these two pins for Pulse Width Modulation (PWM) to control the power level supplied by the MOSFET output. Please see the programming manual on Picaxe chips for more information on the of PWM control.

The other two MOSFET outputs (O3, O4) are controlled by pins D.0 and D.1. Like O1 and O2 a High on these pins will turn on their outputs. Note these two outputs do not offer PWM control to change the output power.

## Expansion Port

Expansion Port Pin Definitions	
Pin	Function
1	Serial In (C.7)
2	Serial Out (C.6)
3	+5 Volts (100 ma limit)
4	Ground
5	Data/Logic line (C.5)
6	Ground

The Picaxe 40X2 has one hardware serial I/O port and is the key for sending data to and from the chip without effecting the operation of the servos and other time depended commands. Pin C.7 is used for Serial In and Pin C.6 is used for serial out. (Please see the Picaxe manuals for more information on setting up and using the hardware serial port.)

This hardware serial port is shared with the MOD-AU5017 Audio Media Player and the Expansion port via U9 (74HC4052), a dual single-pole quad-throw analog switching chip. (Only two of the quad-throw are used by Banshee.) Pin C.0 is

used to select between the Media player and the 6-pin Expansion Port. A low on Pin C.0 will select the Media Player and a high will select the Expansion port.

To aid in sending or receiving status information, Pin C.5 can be used as an Input or Output line to the device connected to the Expansion Port. It's recommended to keep this pin set to input mode what not in use.

The Expansion Port is intended for use with future projects from Haunt Hackers.

### SCL/SDA Port (I2C Bus Port)

SCL/SDA Port Pin Definitions	
Pin	Function
1	Ground
2	Not Connected
3	SCL (Pin C.3)
4	SDA (Pin C.4)
5	+5 Volts (100 ma Limit)
6	Not Connected

Banshee uses the I2C bus to communicate with the Real Time Clock (U2-DS1307) and the EEPROM (U3-24FC512) chips. The I2C bus is also sent to the SCL/SDA port to extend it off the Banshee PC board for other I2C bus based devices. (Like the 16 Channel PWM modulator controller.) It should be noted, the I2C bus should run in the slow speed mode at 100 KHz when a device is connected to the SCL/SDL Port.

The number of devices is limited to two and the connection wires should be kept to 12" or shorter. Please see the Picaxe manuals for more information on setting up and using the I2C bus.

<b>Banshee Commutation Ports</b>			
<b>Port</b>	<b>Type</b>	<b>Symbol*</b>	<b>Function</b>
A.0	Output	MSGEQ7Reset	Reset line to select first band of the ASA MSGEQ7 chips
A.1	Output	MSGEQ7Strobe	Strobe line to selecting the next band to read on the ASA MSGEQ7 chips
A.2	Output	WriteProtect	Write protect for the Serial EEPROM (U3-24FC512) Logic High=Protected
A.3	Input	PlayerStatusPort	Busy line from MOD-AU5017, Busy when low
A.4	Output	SerialOut	Hardware Serial Output (TX) line
A.5	Output	StatusLED	Control for Red Status LED. High LED on and low for LED off
A.6	Input	TriggerInput2	Optical Isolated Inverted Input. Low=Input at 5 Volts, High=Input below 3 Volts
A.7	Input	TriggerInput1	Optical Isolated Inverted Input. Low=Input at 5 Volts, High=Input below 3 Volts
B.0	In/Out		Servo port 0 or Pin 3 of B.0-B.7 I/O Port
B.1	In/Out		Servo port 1 or Pin 4 of B.0-B.7 I/O Port
B.2	In/Out		Servo port 2 or Pin 5 of B.0-B.7 I/O Port
B.3	In/Out		Servo port 3 or Pin 6 of B.0-B.7 I/O Port
B.4	In/Out		Servo port 4 or Pin 7 of B.0-B.7 I/O Port
B.5	In/Out		Servo port 5 or Pin 8 of B.0-B.7 I/O Port
B.6	In/Out		Servo port 6 or Pin 9 of B.0-B.7 I/O Port
B.7	In/Out		Servo port 7 or Pin 10 of B.0-B.7 I/O Port
C.0	Output	SerialSelector	Controls the connection of Hardware Serial I/O. Low=AU5017, High=Expansion
C.1	Output	MOSFEToutput1	Output control of MOSFET 1 with PWM option Low=Off, High=On.
C.2	Output	MOSFEToutput2	Output control of MOSFET 2 with PWM option Low=Off, High=On.
C.3	Output	Hi2cSCL	I2C clock output
C.4	Output	Hi2cSDA	I2C Data Line
C.5	In/Out	EportIO	Expansion Port (Pin 5), Data/Logic line
C.6	Output	SerialOutPort	Hardware Serial Out Line used for Expansion Port (Pin 2) or Media Player
C.7	Input	SerialInPort	Hardware Serial In Line used for Expansion Port (Pin 1) or Media Player
D.0	Output	MOSFEToutput3	Output control of MOSFET 3, Low=Off, High=On.
D.1	Output	MOSFEToutput4	Output control of MOSFET 4, Low=Off, High=On.
D.2	Analog	MSGEQ7AudioLeft	Analog input from left Audio from U4-MSGEQ7 chip
D.3	Analog	MSGEQ7AudioRight	Analog input from right Audio from U5-MSGEQ7 chip
D.4	Input	SelectButton	Button S1 (Select) Low=Not Depressed, High=Depressed
D.5	Input	UpButton	Button S2 (Up) Low=Not Depressed, High=Depressed
D.6	Input	DownButton	Button S3 (Down) Low=Not Depressed, High=Depressed
D.7	Input	BackButton	Button S4 (Back/Abort) Low=Not Depressed, High=Depressed

\* These are the recommended Symbol names for the port. It will be necessary to add the Symbol definitions to the start of your Picaxe program since they are not part the Picaxe Basic language.