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Etec 474

Hardware Description

Car Audio Interface

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Introduction

The circuit described in this document is designed to provide external control of a CQDF800U CD player and radio unit. The external control of the unit will be handled by a Palm m505 handheld by way of a cable connection. This device will look like a standard head unit with the exception of an interface connector located on the side of the faceplate. The device will be controllable from either the Palm handheld or from the factory controls. The Palm will allow use of nearly all the original functions available on the faceplate. Those functions are presets 1-12, volume up, volume down, track up, track down, mode, power, repeat, and random.

Description

The circuitry of the Car Audio Interface is based around 3 processors. The main program will be contained on the Palm microprocessor, a Dragonball VZ. All configuration of this device is taken care of by the Palm 5.0 operating system. This processor houses the user interface program and sends commands to the Motorola 68HC912B32. The 68HC12 handles the interfacing between the user interface on the Palm handheld and the switch inputs of the microprocessor on the head unit.

CQDF800U Head Unit

The CQDF800U head unit has nine control lines allocated by the head unit microprocessor for pushbutton control. Four lines are configured as outputs while the other five are inputs. The four outputs are connected in series with a pushbutton normally open single pole single throw switch and a 10k resistor to ground. The inputs read voltage on the side of the switch opposite the microprocessor output. The outputs are pulsed individually one at a time. As the output goes to five volts current flows
through the 10k resistor to ground when a switch is closed. The voltage opposite the switch can then be sampled. If there is five volts present on the input a valid key-press is registered. By using this matrix, nine control lines can be used to control as many as twenty pushbuttons. A simulated key-press will be accomplished by connecting an analogue switch in parallel with the existing pushbutton switch for the desired command. There are thirteen pushbuttons which need to be manipulated by the HC12. The PCB schematic shows the various connection points on the input and output lines of the head unit. They connect to the set of four quad analogue switches through connector . For use with the head unit the maximum allowable on resistance is $200\,\Omega$ with the off resistance of $750\,k\Omega$. These values allow for predictable behavior from the CQDF800U. The quad analogue switch chosen for the job was the Fairchild 74VHC4316. This quad analogue switch was chosen because of its very low leakage current when off and an on resistance of $175\,\Omega$ when connected to the available power supply. The source of five volts with reference to ground is more than enough to allow for the maximum on resistance. Each switch is controlled by an input from the 68HC12 with one port corresponding to each pushbutton interface.

Motorola MC68HC912B32 microcontroller

The main interfacing is done through the Motorola MC68HC912B32. The microcontroller will be configured in single chip mode. Upon reset all ports not in use will be configured as outputs with internal pull-ups activated through software. All software for the HC12 will be stored internally, utilizing the 32k of on chip flash. The on chip RAM will be used for stack space and any needed variables. A standard BDM header is also included to allow for future software upgrades and diagnostics, post
production. The control lines of the quad analogue switches will be connected to Port P, pins 0-7 and Port T, pins 0-3.

A 16MHz crystal is used to provide the required 8MHz E-clock frequency. The oscillator is connected to the EXTAL and XTAL pins. The /RESET pin is connected to the BDM for programming purposes and also a low voltage detector. The purpose of the low voltage detector is to protect the microprocessor from voltages below standard. For this microcontroller a low voltage reset of 4.7 volts is required. When a voltage of less than this is detected on the source the microcontroller is put into reset.

The Vfp is connected to five volts. It is also connected to the BDM through a germanium diode. The germanium diode allows the Vfp pin to have a duel function. During standard use the voltage on Vfp is five volts. When the required 12 volts is supplied to the BDM connector for Vfp, the voltage on that pin is then raised to 12 volts instead of the 5 volts while the diode protects the rest of the circuitry that requires a five volt maximum. A germanium diode is used because of the low .3 volt drop.

Power Supply

The Palm handheld used for the user interface is self-powered using a rechargeable battery. Depending on the state of the motor the CQDF800U and the interfacing hardware will be powered by a car battery or alternator. The power for the head unit is taken care of internally. The head unit is turned on by the ignition of the vehicle. The same line that activates the head unit will be used to supply 12 volts to the interfacing hardware. The voltage will be stepped down to 5 volts by a voltage regulator. The current capacity of the ignition remote is 5 amps which is more than enough to power the quad analogue switches, the HC12, and the microprocessor support hardware.
Noise filtering capacitors are placed as close to the voltage regulator as possible to reduce alternator noise.