

Select Comfort PFCS series RF Pump Control, Circuit Description.

Prepared 02/20/04

The Pump Control Circuit adjusts the pressure in a Select Comfort Mattress in response to commands from the RF Hand Control. The circuit Board is powered from ordinary household current and is housed in the Pump/Valve assembly. A Microcomputer manages all the control functions. The board will be equipped with two pressure sensors for a Dual Mattress System and one for a Single. It can operate three solenoid valves (only two active at a time) and a two speed pump. Hand Control serial communications are conducted via an on board RF transceiver.

Power Supply: The switched mode power supply using a custom designed EE13 core transformer (LinkSwitch Flyback Design) from Xfmrs Inc. is designed to operate with input voltages between 85 and 265 VAC at a frequency between 49 and 62 kHz. The power supply's input circuitry is designed for EMI suppression. Provisions for an Y capacitor between the returns of the transformer's primary and main 5V windings enable additional suppression. Two isolated 5V windings can supply up to 200mA total current. The pump control's main 5V supply is regulated using an optically coupled feedback circuit. The pins for the transformer's secondary 5V supply are located across from the primary and main 5V pins.

Switches: The board can switch up to five AC line outputs, two rated for 800mA, and three rated at 200mA. The ST Alternative Current Switch devices used for this task are similar to triacs, but are designed for home appliance applications, and require no added protective circuitry for proper operation. These devices are unique in that a microcomputer port line can be connected to control the gate through a resistor. The device is triggered when current flows from the COM pin (main's neutral) out the gate. This negative gate current is made possible by connecting the positive side of the controller's independent 5V supply to the main's neutral line. When an output port line is forced to a logic "0" the output and connected gate pin will be negative with respect to the main's neutral line and the switch will turn on. The ST ACS302 low current switch outputs are full wave rectified to operate the off-board DC solenoid valves. Two ST ACS108's are placed to facilitate the High Speed Fill command, however only one is active for normal compressor operation.

Controller: A Motorola 68HC908JL3E is used, and is a FLASH based 8 bit processor that operates at a crystal controlled frequency of 4.9152 MHz. The microcomputer has software installed that is capable of operating different mattress configurations. The outputs of two resistor dividers are measured at power-up to determine the exact nature of the installation. The Motorola MPXV4006GC6T1 gauge type air pressure sensors have amplified and temperature compensated outputs for inputs up to 0.87 PSIG (6kPa).

RF Section: The serial communications between the Pump Control and Hand Control is based on a carrier frequency of 418 MHz, established with a SAW Resonator in the transmitter of each control. When an adjustment is initiated by the Hand Control, a packet of information that is 40 bits, and Manchester Coded at 833 Hz, is sent from the Hand Control Transmitter to the Pump Control Receiver. The receiver on the Pump Control is a Micrel MICRF022. This device is a true "antenna-in to data-out" monolithic IC that is run in a Fixed Mode with a 6.4983 IF crystal. The transmitted instruction is relayed to the processor through an Opto Coupler. While the instruction is in process and waiting for completion, the Pump Control continuously updates the pressure level by sampling the readings on the pressure sensor. As the levels change information is sent through the RF transmitter (which is also optically isolated from the processor) back to the Hand Control at a rate of one packet of information per second. When the adjustment is completed and no further commands are sent the Pump Control enters a sleep mode (approximately 20 seconds after the completed task). The Pump Control stays in this state until the Wake-Up flag is tripped in the Receiver IC indicating a RF signal is present and an adjustment is being requested.