

GulfStream MAKO (Rev. G)

Introduction:

The GulfStream MAKO board is the switch that is capable of interfacing wirelessly to the GulfStream family of products. This board is based on the EM250 micro-controller along with its wireless interface, two sensing circuits, a zero-crossing detector, a serial interface (TTL levels), an InSight interface, and some I/O ports. This board generates DC power (3.3V) from the AC power (120V). The board has three switches and is capable of controlling and dimming one AC load.

Hardware Description:

The GulfStream MAKO board is based on the EM250 micro-controller operating at 24 MHz. The CPU interfaces to 3 switches, 9 LEDs, a zero-crossing phase detector, phase-dimming TRIAC (optically coupled), and 2 sensing circuits (board temperature and DC voltage) connected to 2 A/D channels. One SCI port of the CPU may be used as a serial interface (TTL levels). An InSight port is also available for programming/debugging the internal CPU Flash memory. The zero-voltage reference of the entire circuitry is connected to the neutral input. The board receives two input lines, hot AC (black wire), and its neutral (white wire). It provides a controlled AC voltage to the load (red wire). A chassis ground (green wire) is only connected to the metal plate, and it is not connected to the circuit.

The following describes the functionality of each section. Please, refer to the attached schematics for a detailed circuit diagram.

Power Supply:

The board receives 120VAC power through an air-gap switch, followed by a varistor, then followed by a 10A-fuse. This 120VAC feeds the DC power supply, the phase detector circuit, and the power TRIAC.

DC Power Supply:

The amplitude of the input AC voltage (120VAC) is reduced by a 3.3uF/125VAC capacitor, half-wave rectified, smoothed and filtered, then, regulated to produce a 3.3VDC.

Phase Detector:

A full-wave optically-coupled phase detector along with a transistor circuit provides a pulse on every zero crossing of the 120VAC input. These pulses are sensed by the CPU.

Switches and LEDs:

Three switches with pull-ups provide the CPU with three signals indicating when any switch is pressed or released. Six LEDs are controlled by the CPU.

VDC Sense:

The raw DC voltage (before it is regulated) is reduced, and then fed to one of the A/D inputs of the CPU.

Temperature Sense:

A board temperature sensing device produces an analog output voltage that is fed to one of the A/D inputs of the CPU.

TRIAC and Driver:

An optically-coupled TRIAC-output driver, controlled by an output line of the CPU, is used to turn on or off the main TRIAC, which controls AC power delivered to the load. The amount of power is determined by the on-firing time of the TRIAC following each zero-crossing. The TRIAC turns off on the next zero-crossing. Accordingly, load dimming is achieved using phase-control of the TRIAC.

EM250 CPU:

The CPU (EM250) is manufactured by EMBER, and it contains an XAP2b core along with 128KB flash, 5KB SRAM, ADC, two serial controllers, two timers, sleep timer, watchdog timer and power-on-reset, seventeen general purpose I/O lines, and an integrated 2.4GHz IEEE 802.15.4-compliant transceiver. The CPU operates using a 24MHz crystal. The RF transmitter/receiver signal pair is connected to an LC lattice balun circuit, which is followed by an LC harmonic filter. The output of the filter is then connected to a ceramic antenna.

Connectors:

There two connectors on the board. One is used to program the CPU, and the other is connected to the serial port of the CPU (TTL levels).