FUNCTIONAL DESCRIPTION OF THE SWS TRANSMITTER

Figure 1 is a block diagram of the SWS transmitter that will be used to describe the functions of the various components and modules in the transmitter.

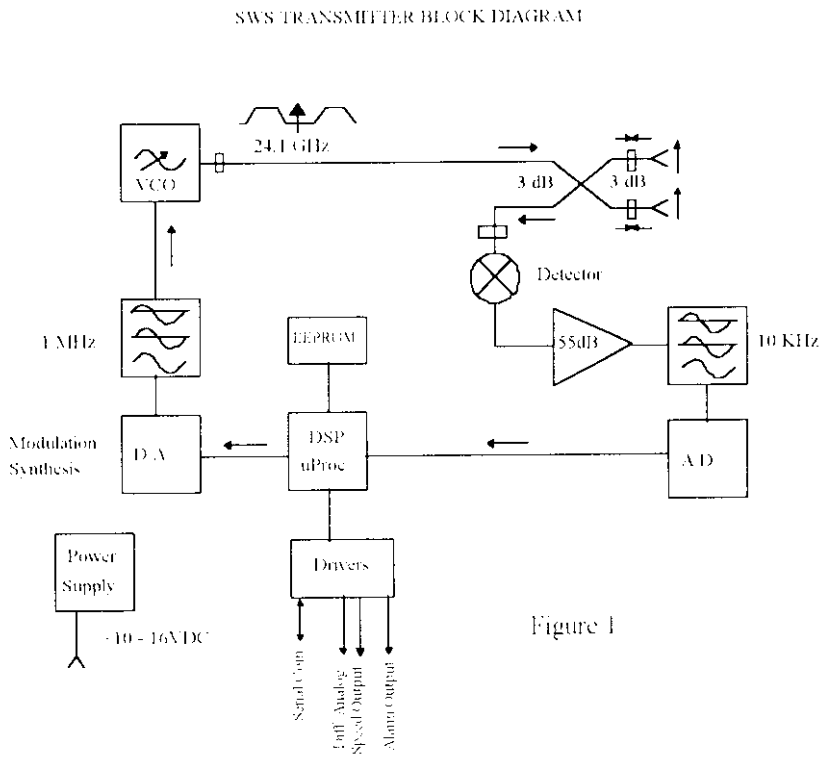

Figure 1

The VCO is a varactor tuned Gunn diode oscillator used to provide the 24.1 GHz microwave power for transmission. It is a waveguide cavity oscillator that is constructed of materials that compensate each other over the operating temperature range to provide frequency stability within the specification limits. The varactor (variable capacitance diode) allows frequency tuning for direct modulation of the oscillator. The tuning sensitivity of the oscillator falls within the limits of 2.5 – 3.5 Mhz/V at a center voltage of 5.5V. The output power limits for the oscillator over the operating temperature range and working into a matched load is 50 to 120 mW. The oscillator construction and output coupling to the load has been designed to reduce harmonic power.

The Duplexer consists of a waveguide magic tee, the 3 dB coupled branch arms of which are terminated into waveguide horns. The isolated arm contains a single ended detector/mixer which is used to detect doppler shifted signals from moving targets received by the horns.

The Preamp and Filter following the detector are used to condition the detected signals prior to digitizing in the A/D.

The Power Supply is used to regulate and filter the input power, and to convert the input into suitable voltages for use by the transmitter.

The Drivers are used to convert the communications signals to logic levels for use by the DSP and to convert DSP output signals into suitable levels for use by external devices.

The modulation waveform is synthesized by the DSP and D/A converter. The DSP generates samples for the 8 bit D/A at a rate of 400 KHz. The discrete quantzation levels from the D/A are filtered by a one pole lowpass filter with a 3 dB cutoff frequency of 115 KHz. The particular safety message code to be transmitted is stored in an electrically erasable programmable read/write memory (EEPROM) and can be changed by the user.

RADAR SAFETY WARNING TRANSMITTER MODULATION DESCRIPTION

The modulation wavetrain starts with the transmission of a continuous wave (CW) marker at the center frequency with a duration of 0.522 seconds. A 32 bit digital message code is then transmitted. A bit representing the value '1' is encoded by the process of transmitter frequency starting 2.5 MHz below the previously centered position of the CW marker frequency and sweeping in a linear ramp up to a position 2.5 MHz above the previously transmitted CW marker frequency. The total frequency excursion is 5 MHz. A '0' is encoded by the process of the transmitter frequency starting 2.5 MHz above the centered position of the CW marker frequency and sweeping down in a linear ramp to a frequency 2.5 MHz below the CW marker frequency. The total frequency excursion is 5 MHz. The time taken to sweep the 5 MHz is 0.0005 seconds (0.5 milliseconds). Thus, the data rate will be 1 bit per 0.5 milliseconds or 2 KHz. No spaces are left between the 32 bits during the message transmission, except for the time required for the transition between bit states. The transition between bit states is between 1 and 10 microseconds and is never less than 1 microsecond. All transmission timings are controlled by a crystal based reference oscillator. The frequency excursion or deviation is set during manufacture and is stored in an EEPROM chip during calibration.

After the initial CW marker and 32 bit digital message code are transmitted, a sequence of 9 message blocks consisting of a 32 millisecond CW marker followed by a 32 bit digital message code are transmitted. Upon completion of the sequence of 9 CW marker and 32 bit message blocks, the modulation wavetrain commences another transmission cycle beginning with the 0.522 second CW marker as described above. This cycle continues indefinitely.

SWS TRANSMITTER SPECIFICATION

1.0 ELECTRICAL SPECIFICATIONS:

1.1 Transmitter Frequency and Bandwidth:

The transmitter output will have a center frequency of 24.100 $\pm$0.025 GHz with a maximum occupied frequency modulated bandwidth of 6.002 MHz as defined in CFR 47, Part 2.202, para. (g) III-A of the Federal Communications Commision rules.

1.2 Output Power at the Operating Frequency, Spurious, and Harmonics:

The maximum average power density emanating from the transmitter antenna will not exceed 30 mW/m^2 @ 3 meters (max. EIRP 3.2 W or ERP 1.95W), below the 3 W ERP limit requiring routine environmental evaluation for RF exposure per CFR 47, Part 2.1091. The peak-to-peak power density excursion at a fixed point relative to the transmitter will not exceed 3 dB over the operating temperature range. Spurious and harmonic emissions will conform to CFR 47, Part 90.210, (c). "Emission Mask C - On any frequency removed from the center of the authorized bandwidth by more than 250% of the authorized bandwidth: the power of the spurious signal will be attenuated below the unmodulated carrier at least 43 + 10 log (P) dB."

1.3 Warm-Up Time:

The transmitter will reach power stability to within $\pm$ 0.5 dB and frequency stability to within $\pm$10 Mhz after 5 seconds of operation.

1.4 Transmitter Beam Characteristics:

Nominal -3 dB beamwidth Pattern: E Plane = 32 deg., H Plane = 23 deg.

Polarization: Vertical (with transmitter base mounted horizontally)

Front/Back Ratio 2 dB (with bidirectional transmission)

1.5 Input Power Requirements:

The transmitter is designed to operate from a motor vehicle's electrical system (+12V with negative grounded chassis) and normally does not require additional power filters or regulators. The operating voltage range is 11.0 - 16.0 Volts. The maximum current requirement is 0.75A operating with 1.5A turn-on surge. The transmitter will function in its preprogrammed mode when powered and will automatically cease to transmit when the input voltage falls below the operating range.

1.6 Data Transmission:

The transmitter will transmit selected pre-programmed messages in the format as described in the "Radar Safety Warning Transmitter/Receiver Signal Standard Version 3.0" published by the Georgia Tech Research Institute. The transmitter will have an option for automatic switching of messages when the transmitter goes from a moving mode to a stationary mode.

1.7 Speed Indicator/Alarm:

The transmitter will have a speed signal output that is proportional to the speed of the transmitter relative to a target (assumed to be the Earth in moving mode). An alarm output for stationary operation will be provided to detect approaching fast moving targets. Operation of the optional display indicates a functional transmitter.

1.8 Programmability:

The transmitter will have an option for programming the transmitted message code. The programming will be done via an external serial interface and will reside in nonvolatile memory in the transmitter. The message code will remain in the last state that was programmed when power is removed from the transmitter.

2.0 MECHANICAL CHARACTERISTICS:

2.1 Weight:

The transmitter as configured in Figure 1 weighs approximately 1.5 pounds.

2.2 Outline Configuration:

The transmitter's dimension envelope and configuration will be as depicted in Figure 1.

2.4 Solar Reflectivity:

The transmitter's exterior will be opaque and have enough reflectivity to prevent the case temperature rise with respect to the ambient air from exceeding 25^0C when placed in direct sunlight (overhead) with still air at one atmosphere surrounding it.

2.5 Mounting:

The mounting of the transmitter as depicted in Figure 1 is accomplished by securing the base of the transmitter to a horizontal surface with #6 screws through the mounting holes. For good transmitter broadcast coverage, the transmitter should be mounted with the front or back oriented with the front or back of the vehicle, and in a place free of rf reflectors in those directions.

3.0 ENVIRONMENTAL REQUIREMENTS:

3.1 Temperature Range:

The transmitter will meet the electrical specifications when operated with a base and ambient temperature range of -30 to $+65^0$C. The transmitter will endure a storage temperature range of -40 to $+85^0$C with no permanent damage.

3.2 Weather Resistance:

The transmitter is designed to be mounted on the exterior of a motor vehicle and will withstand rain and snow without corrosion or degradation in electrical performance (excluding the normal rf attenuation effects of water or ice build-up).

3.3 Shock and Vibration:

The transmitter will withstand 10 G of half sine wave 11 ms shock with no permanent damage. The transmitter will be fully functional when subjected to 1.4 rms G of sine wave vibration in a frequency range of 10-60 Hz along a direction parallel to the vertical axis.

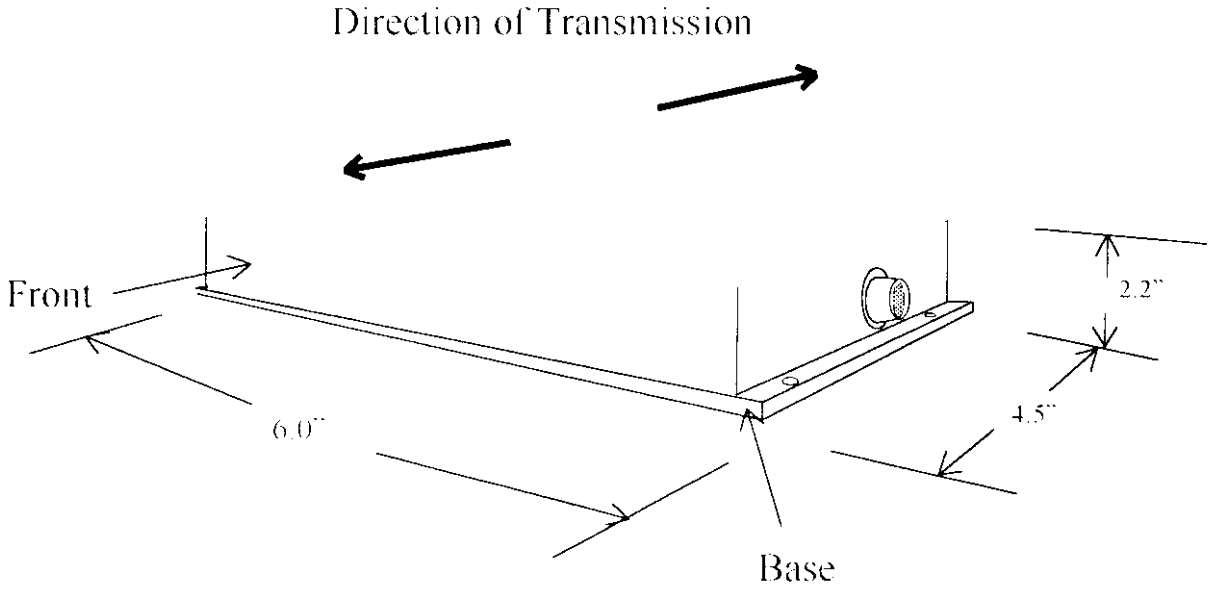

Figure 1