Technical Description of the "ORBCOMM" Repeater

1.0 Purpose

The process of installing ORBCOMM subscriber communicator on vehicles involves both the physical installation of the equipment and the checkout of the installed hardware. During the checkout process it is necessary to communicate with the ORBCOMM satellites to validate the quality of the installation. Because ORBCOMM, like the other narrow-band "Little LEOs" is constrained to operate with a power-flux-density not to exceed –125 dB(W/m^2 in 4 kHz)[1] it is impossible to reliably receive the satellite downlinks indoors. Similarly, a subscriber communicator can not, reliably, communicate with an ORBCOMM satellite while in a building.

Installation of ORBCOMM subscriber communicators is greatly facilitated by being in a heated, enclosed building such as a garage. In order to efficiently install ORBCOMM subscriber communicators in a building it is necessary to use a "repeater" that receives the 137 MHz to 138 MHz ORBCOMM downlinks outside of the structure and replicates them in the vacinity of the installation operation. Additionally, a repeater that receives the 148-149.9 MHz uplinks from the individual subscriber communicators within the building and retransmits the signals outside of the structure is necessary for the validation process. ORBCOMM is seeking experimental authority to utilize up to 10 repeaters so as to develop a working knowledge of this equipment, prior to submitting a petition for rulemaking to govern such deployments.

The repeater describer below performs these function.

2.0 Technical Description

The ORBCOMM repeater operates by simply repeating the 137-138 MHz signals received from the ORBCOMM satellites into an enclosed building in which subscriber communicators are being installed and checked out. The signal level within the building is intended to be a close approximation of the satellite downlink signal levels outside of the building. In a similar fashion, the repeater acts as a relay for the signals transmitted by the subscriber communicators to the satellites. A block diagram of the full, two-way repeater is provided as Figure 1.

2.1 Operation in the 137 to 138 MHz Band

The satellite downlink, and any other signal present in the 137-138 MHz band, is received by a Cushcraft ½ wave dipole antenna on the roof of the building, passed through a bandpass filter and amplified to overcome line, filter and diplexer loses. The final amplifier in the 137-138 MHz leg of the repeater is a MITEQ AU-1433 LNA. After amplification, the "outdoor signal" is passed through a diplexer to a low-gain Jacobsen "hockey-puck" antenna within the building near the location where the subscriber communicators are being installed. The signal level fed to the Jacobsen antenna is –85 dBm. The

[1] The alternative is to coordinate with fixed and mobile system on a worldwide basis

signal received at the subscriber communicators is on the same order of magnitude as that received from the satellites outside of the building.

Additionally, the 137-138 MHz leg of the repeater contains a monitor circuit coupled off before the diplexer. The monitor consists of an ORBCOMM subscriber communicator with an indicator light. The indicator light is used to notify the installation area when a valid ORBCOMM downlink signal is present.

2.2 Operation in the 148-149.9 MHz Band

A transmission from a subscriber communicator within the building is received by the Jacobsen "hockey-puck" antenna amplified, filtered, and fed to a Cushcraft ½ wave dipole antenna on the roof of the building. The final amplifier is an AM1658-10/3250 10 Watt HPA. An attenuator is used to limit the maximum power fed to the antenna to below 5 Watts.

3.0 Interference Potential

3.1 Interference Potential in the 137-138 MHz Band

In the US, the 137-138 MHz band is reserved for satellite system downlink signals. The 137-138 MHz leg of the repeater relays any signal passed through the bandpass filter to the interior of the building. This currently includes both ORBCOMM and NOAA satellite downlinks as well as a few foreign satellites and, in the future, will include ESAT and FAI downlinks. With the exception of ESAT, all of the US satellites will operate on different frequencies than the ORBCOMM system so there is no potential for interference to these systems. The ESAT system is a spread spectrum system that, outside of the building, must operate co-frequency with the other narrow-band satellite systems. Because of the low level of the repeated signal within the building and the attenuation provided by the building walls (i.e., the same attenuation that prevents reliable reception of the satellite downlink within the building) an ESAT terminal should be capable of receiving the ESAT downlink very near the building. Therefore, there should be no interference to any satellite systems from the 137-138 MHz repeater transmitter.

3.2 Interference Potential in the 148-149.90 MHz Band

From an RF viewpoint, the repeater transmitter, operating at 148-149.9 MHz, looks identical to a single, standard ORBCOMM subscriber transmitter. The repeater system is linear so there will be no distortion of the spectrum transmitted by one of the installed subscriber communicators. Because, the communicator transmit frequency is under control of the DCAAS process in the satellite with which it is communicating the potential for interference is no greater than the interference potential of the communicator itself, i.e., very low. Therefore, there will be no increase in interference potential with the use of the repeater.

Footnote US323 places a duty cycle limitation on each subscriber communicator of 1% of every 15 minutes. The duty cycle of the repeater transmitter will be the sum of the duty cycles of the communicators being installed. This is the same transmit duty cycle that would be seen if the communicators were being installed outside of the building so there is no increase in interference potential by using the repeater.

Figure 1 – ORBCOMM REPEATER BLOCK DIAGRAM