Expository Statement

Permissive Change

Applicant: Honeywell International Inc.

FCC ID: GB8NC861A

The applicant has made design changes/improvements to the originally FCC approved equipment.

Data contained herein confirms that a Permissive Change to the unit has been effected and that the performance of the unit is at or better than the levels originally reported to the commission. The FCC ID covers two manufacturers model numbers NC860A and NC861A, which are electrically identical. The EUT was an NC860A.

The following changes/improvements have been made:

a) the addition of a new modulation type D8PSK that is to be designated as 14K0G1D.
b) the correction of the authorized frequency range of the original Grant to 118.000 - 136.975 to bring it in to line with Part 87 limits.
c) Addition of Grant Note BM

No other changes have been made.

Re a): The new protocol employs a bit transmission rate of 31,500 bits per second over the air/ground link using a single 25 kHz channel. The increased utilization of the 25 kHz channel is achieved by employing a more bandwidth efficient modulation scheme known as Differential Eight Phase Shift Keying or D8PSK. A D8PSK transmitter transmits a carrier whose phase is modulated by the data as one of eight possible angles: 0, $\pi/8$, $\pi/4$, $3\pi/8$, $\pi/2$, $5\pi/8$, $3\pi/4$ or $7\pi/8$ radians. The rate at which the carrier phase is changed is the modulation rate. The difference in the phase between successive phase changes, which may also be equal to 0, $\pi/8$, $\pi/4$, $3\pi/8$, $\pi/2$, $5\pi/8$, $3\pi/4$ or $7\pi/8$ radians, is known as a D8PSK symbol. Since there are 8 possible phase differences, each phase change (D8PSK symbol) represents three bits of information: 000, 001, 011, 010, 110, 111, 101, or 100. Hence, if the phase changes at a 10.5 kHz rate, the data transmission rate is equal to 31.5 kbps. In other words, the VDL Mode 2 D8PSK modulator uses the bits in the message, 3 at a time, to select the carrier phase change at a rate of 10,500 D8PSK symbols per second. Thus, a 10.5 kHz D8PSK phase modulation rate corresponds to a D8PSK data transmission rate of 31.5 kbps.

The D8PSK modulation of the phase of the VHF carrier is accomplished using a quadrature modulator. The inputs to the quadrature modulator are the real (in-phase) and imaginary (quadrature) parts of the D8PSK symbol phase, and the VHF carrier. The real component of the D8PSK phase modulates the amplitude of the carrier while the imaginary component modulates the amplitude of the 90 degree phase shifted version of the carrier; hence the name quadrature modulator. Summing the two amplitude modulated quadrature carriers produces the D8PSK modulated VHF carrier.

In order to limit the spectrum occupancy of the modulated signal to less than 25 kHz, the in-phase (real) and quadrature (imaginary) component inputs to the quadrature modulator signal are filtered using identical low-pass filters with raised cosine spectrum. The Raised Cosine filters limit the bandwidth occupied by the modulated carrier to 16.8 kHz. The quadrature-modulated carrier is then amplified to produce a 15-20 Watt transmitter output. Note that the amplitude of the D8PSK modulated carrier changes significantly whenever there is a phase change of π radians.

If the power amplifier were perfectly linear for all input signal levels or if the modulated carrier had constant amplitude, then the spectrum occupancy of the transmitter output would be limited to 16.8 kHz. Since neither is true, non-liner inter-modulation products are generated when the input level of the quadrature modulated carrier approaches the saturation level of the amplifier. This effect is also referred to as spectrum re-growth. The levels of the inter-modulation products are well below those of the desired output but they inject higher emissions into adjacent channels than those produced by a perfectly linear amplifier. Thus, in order to maintain D8PSK output emissions into adjacent channels at very low levels, highly linear amplifiers or techniques that linearize the output of the amplifier are used. D8PSK modulation was chosen for VDL Mode 2 because it is bandwidth and power efficient. It offers the best compromise between achievable data rate within a 25 kHz channel and attainable communications range with a 18 W transmitter.

Adding the G1D designator to the GB8NC861A requires that the frequency tolerance change from 20ppm to 2pm (87.133(a)(5) note 12). While the original submission showed frequency tolerance better than 2ppm a new set of test figures are included to support the 2ppm notation for both 6K00A3E and 14K0G1D designators.

Re b): The original frequency range on the Grant was to cover the extended frequency capability of the unit for operations outside the USA and Canada. These capabilities / frequencies are not permitted under Part 87 in the USA or RSS-141 in Canada and the Grant is requested to be modified accordingly.

Re c): The unit does have adjustable power and the communications only version GB8TR865A carries the Grant Note BM which also applies to this unit.