National Wireless, INC.
221 Pine St. Florence, MA 01062
413-586-5111
413-586-4422 FAX

Re: FCC ID PIV-TV1
731 Confirm Number EA101495 **Correspondence Ref No. 20805**

Justification for Confidentially

Confidentiality is requested for the block diagram, schematic diagram, parts list and description of operation pursuant to 47CFR0.457 and 47CFR0.459. Confidentially is requested to ensure a competitive advantage. We feel that many potential competitors would not have a microwave engineer on staff, and would most likely be unable to duplicate the oscillator, and amplifier filter / impedance matching elements of the circuit without access to the information requested to be confidential.

In the following, we describe the reasons why we consider some elements of the circuit as a trade secret, then we describe how we plan to maintain confidentiality

A. Oscillator

We have analyzed several non-certified television transmitter circuits for use at both 434 MHZ and 916 MHZ. We have found that, in most cases, these circuits are copies of each other. Of the several problem areas that we saw (lack of output matching, no harmonic filtering, insufficient vias to the ground plane, etc) the predominate is their inability to construct a stable SAW oscillator, particularly for 916.5 MHZ. Here these circuits use a purchased oscillator. We conjecture that these potential competitors do not have a microwave engineer available.

The cost differential between the purchased oscillator (about $8.40 each, per thousand pieces) compared to our cost of approximately $1.96 (each, per thousand pieces) gives us a large competitive edge. This is our best trade secret, and forms the basis for our confidentially request.

The remainder of our confidentially request is to keep confidential the engineering component choices that we made to develop a quality product.

1. Course frequency control of a SAW stabilized oscillator

A Surface Acoustic Wave (SAW) oscillator is unlike a crystal oscillator in that the resonating device is actually an LC network that is stabilized, or locked on frequency, by a SAW resonator. The frequency of this oscillator LC circuit must have an error of less than 10% of the SAW device frequency, for proper lock.

We employ a Colpitts oscillator. In theory, the free-running frequency of this oscillator is determined by L1 and C2. However this frequency is substantially altered by: the parasitic values of these components, the parasitic capacitance and inductance of the circuit board, the parasitic capacitance of the SAW device container, and loading due to the interstage coupling capacitor, C3.

If all these elements are not accounted for, the oscillator might operate on its free-running frequency, and not the SAW frequency. To insure that the oscillator free-running frequency is close to the SAW device frequency, we use better than normal tolerance capacitors and a high Q inductor.

2. Fine frequency control required for picture stability

One manifestation of a poor SAW oscillator fine frequency control is a "tear" in the picture presented on the television receiver. The reason for this tear isn't obvious. It is caused by the output power change in the amplifier transistor. Just before each picture line scan, a synchronization pulse is sent. This pulse has a level higher than any picture component by about 2 dB. This increase in power causes the amplifier transistor input impedance parameters to change slightly, which slightly alters the load on the oscillator stage.

A change in the oscillator load can result in a change in frequency. This is commonly known as "frequency pulling."

Frequency pulling is most pronounced at low battery voltage. We believe that the circuit should provide an acceptable picture as the battery ages and voltage decreases. The limit of acceptability should approximately be the voltage at which the camera just fails to provide a useful picture. We find this to be about 5.3 Volts. So we have designed the RF portion of the circuit to function at this level.

This circuit has been designed to minimize frequency pulling by employing a high Q inductor in the oscillator, having a high "beta" microwave oscillator transistor, and a small value, tight tolerance, interstage coupling capacitor between the oscillator output and amplifier input.

3. Temperature vs Frequency Changes

The oscillator circuit should also provide stable operation, and continuous starting from power-down, over a reasonable temperature range. One version of the oscillator circuit (designed for another vendor's product) has been successfully temperature tested from -40 F to +150 F, with no more frequency deviation than that allowed by the SAW device manufacturer, and oscillator start-up at the temperature extremes. This success is also due to the choice of components for L1, C2, C3, C4, and Q2.

B. Output filter / matching network

The purpose of output filter is to attenuate harmonic energy, and to impedance match the amplifier transistor to the antenna. We had to computer model, then empirically adjust the values for this circuit. We consider these values a trade secret.

C. Maintenance of Confidentiality

It is one thing to request confidentiality, another to maintain it with a circuit that can be easily viewed. Fortunately, not all the components of this circuit are marked with decipherable nomenclature. Those that are not marked are:

1. Transistors

Most small SMT transistors are not marked with standard part numbers, but contain "top marks." Depending on the vendor, the traceability of this top mark to a transistor number can vary from easy to difficult or impossible. We use NEC microwave transistors. The top marks of NEC products are available, but not always listed in their product literature. Also, NEC RF transistors are not commonly employed outside of the microwave industry. Because we feel potential competition does not do business in the microwave industry, we would expect that they will have a difficult time determining the source of, and part number for, the oscillator and RF amplifier transistors.

2. Capacitors

While high cost, high Q, microwave SMT capacitors are usually top marked with a value or easily traceable part number, low cost SMT capacitors are generally unmarked. Any top marks that do occur on low cost capacitors (usually associated with Kyocera and MuRata) are apparently unrelated to component value or construction'.

The values of the three capacitors associated with the oscillator can be difficult to determine for the non-microwave engineer. Standard formulas and rules, or computer models, can only provide an approximation to the actual circuit. There are several reasons for this: added shunt capacitance of the physical printed circuit board, inductance associated with the capacitors, and added inductance due to interconnect lead on the circuit board.

Even a microwave analysis program (we use a version of SuperCompact) can only provide an approximation to the circuit values unless all these additional “parasitic” elements are entered into an optimization file.

The choice of value for the RF bypass capacitor (C5, 100 pF) associated with the oscillator is another component that is probably not understood by a potential competitor. This capacitor serves as part of the oscillator tank network, by providing a low reactance to circuit board ground. The optimum value would have no reactance at the frequency of oscillation. We have found a 100 pF COG (NPO) type to be the best choice. A much larger value will have too much inductance to be effective, while a value much smaller will not have a low enough reactance to be effective. .

Because of these impediments to copy our design, we consider all the values and type of capacitors associated with the RF portions of the circuit board as trade secrets.

3. Capacitor tolerance

The RF portions of this circuit do not require high cost, microwave capacitors, however the oscillator does require several values with a non-standard tolerance. The commonly available tolerance for C2 and C3 (0.5 pF) is +/- 0.25 pF. We have found that a tolerance of 0.1 pF is the minimum acceptable.

Since this capacitor is not readily available, and must by purchased as a special order, we consider its use as a trade secret.

4. Inductors

The SMT inductors in the circuit are value marked. However there is a lot more to an inductor than inductance. Two significant parameters are quality factor, “Q,” and self-resonant frequency. These values are not marked.

L1 is part of the oscillator “tank” circuit. In order to maintain the best frequency stability at a low battery voltage, L1 is a 5.6 nH “HI-Q” Series Coilcraft inductor. Toko “HI-Q” inductors will not work as well in the circuit.

Coilcraft provides an equivalent part in their lower-Q “CS” Series of inductors, that physically resemble the HI-Q version. That component does not work as well in the circuit. We consider the use of the HI-Q inductor as trade secret, as a potential competitor would probably not recognize it as such.