EXHIBIT 3

USER MANUAL

X241 Doppler Transceiver
Field Disturbance Sensor

Installation and Operating Instructions

March 1999

FCC DATA

FCC ID: NXC-RADAR

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

INTRODUCTION

This manual provides general information, hardware description, connection, specifications and operating instructions for the X241.

FEATURES AND APPLICATIONS

The X241 features include:

- Effective means of deriving highly accurate velocity information for a wide variety of applications.

- Useful for applications where extremely sensitive motion detection is required.

- Very low power Gunn oscillator featuring a high degree of frequency stability over the designed operating temperature range.

- Self-contained, highly stable voltage regulation system for Gunn oscillator. The regulator is reverse polarity protected to -15 V.D.C.

- Logic-controlled shutdown for the Gunn oscillator voltage regulator. This is ideal for battery supplied applications where periodic velocity readings or motion detection are needed. Logic control allows the Gunn oscillator to be deactivated when not needed for maximum battery savings. The shutdown feature is also useful for activities of limited duration (e.g., putting a vehicle into reverse, activating a turn signal, etc.).

- Acceptable continuous input voltage range of +9 to +16 V.D.C. While a regulated voltage source is not required, a relatively noise free power source is highly recommended.

- Uses a low noise Schottky barrier mixer diode for outstanding reception of the reflected signal.

- High gain low-noise preamplifier with 0-5 volt maximum sine wave output. The sine wave represents the relative velocity (frequency of the sine wave) and the relative target profile (amplitude of the sine wave). The relative velocity is known as the Doppler shift.

- All components are selected for the longest possible operating life.
- No adjustments are needed, there are no controls and the horn antenna is permanently attached. This allows the simplest possible operation.

Some typical applications include:

- Speed sensor for use in sporting events such as baseball. The X241 could be connected to your large speed readout board which will compute the speed of the baseball (or other objects) by using the data provided by the X241.
- Ground speed sensor for use on farm and construction equipment, forklifts, locomotives, etc. The X241 with the provided housing in place, mounts to your equipment, pointing straight ahead or straight behind. As your equipment moves, the X241 provides the velocity information to your ground speed readout. The X241 is so accurate that speed resolution of 1/10th mile per hour or better is possible. One-half mile per hour (one KPH) is the lowest speed readout guaranteed with the X241. This makes the X241 ideal for typical farming, construction and docking speed monitoring.
- Traffic speed monitoring. The X241 can be connected to a computer logging system (which might employ a personal computer) or continuous readout which will display the speeds of vehicles on the highway. The X241 is ideal for use in traffic radar systems for use by law enforcement personnel. The X241 can also be used in a speed readout sign posted temporarily or permanently along the highway.
- Motion detection at a loading dock.
- Scientific research equipment. Log vertical velocity and profile data for rainstorms and hailstorms. Very useful for physics research. The X241 can also be used for ornithology research.
- Sensor for automatic gates.

OPERATING CONCERNS

The X241 is designed so that any major failure will not cause the device to transmit outside FCC designated frequency and power limits. During over voltage and under voltage conditions, the output frequency and the power level will not change from the nominal values. The unit will cease transmitting with excessive over voltage or under voltage. Normally, voltage levels in excess of 20 to 25 V.D.C. will simply shut down the internal voltage regulators without damage. However, permanent damage could result and permanent damage becomes more likely as the over voltage becomes more excessive.

HARDWARE PREPARATION

Unpack the X241 from its shipping carton. You should have the following items:

The X241.

Protective cover.

Power/data cable with a 6-pin modular connector at one end.

Additional FCC data tag.

Installation and operating guide.

Save the packing material for storage or reshipment of the X241.

The X241 is not designed for aviation use and will not function as a radio (radar) altimeter. The X241 must never be mounted to or used in any aircraft without an F.A.A. approved installation. This would require F.A.A. form 337 and an inspection by F.A.A. personnel.

Mount the X241 in such a way that the Rexalite lens has a clear view of the outside environment. Absolutely no metal objects should be directly in front of the lens. This would give you less performance than what the X241 is capable of.

The X241 should be able to transmit through one layer of either glass, plastic or plexiglass, providing that these are flat, clean and offer a surface area near the lens of four inches or more in diameter. These materials will not change the output frequency from the nominal value. If the X241 is not performing as well as expected under this condition, remount the X241 so the lens is not pointing through any material. If performance improves, the material you're trying to transmit through is in all likelihood partially opaque to K-band microwaves. A thin, flat layer of glass, plastic or plexiglass will not present a problem when the X241 is being used as a ground speed sensor.

The X241 has been laboratory tested with and without the protective cover. If mounting the X241 inside another housing such as a speed display sign, the protective cover may be omitted. The circuit board of the X241 has internal shielding to minimize interference on the sensitive preamp circuit. Use the protective cover if the X241 will be used outside of another enclosure.

The X241 has four threaded holes for use when mounting without the protective cover. These four holes take 4-40 machine screws and have a depth of 1/4". If mounting with the protective cover in place, use two bolt holes on the side of the cover with #8 hardware.

POWER AND DATA CONNECTIONS

The X241 is easy to connect. Do not plug in the modular connector on the cable until all other connections are made. Lines 2, 3 and 5 must be tied to ground. Supply D.C. power from 9 - 16 V.D.C. (0.5 amps maximum required) to Line 1. Line 6 can connect to a logic circuit to control the Gunn oscillator regulator. Logic 1 (+5 volts) turns off the regulator circuit discontinuing transmission. Logic 0 (0 volts) switches the regulator back on. If not using this feature, connect Line 6 to Lines 2, 3 and 5 (ground). Voltage on Line 6 must never exceed 5 volts or drop below 0 volts. Line 4 is the amplified received signal output (analog data output). The output sine wave represents the relative velocity (frequency of the sine wave) and the relative target profile (amplitude of the sine wave). Connect Line 4 to the input of your data recording and/or data processing equipment. Never apply voltage to the signal line. Now connect the modular connector to the X241. Turn on your power supply and set the logic control (line 6) to logic 0. Connecting an oscilloscope or audio spectrum analyzer from line 4 to ground will show a sine wave whenever an object passes in front of the unit. For scientific research, this may be the extent of your data collecting.

DOPPLER THEORY

The sine wave outout of the X241 can be used to derive highly accurate velocity information in a wide variety of applications.

If an object is traveling toward the X241, the received frequency is higher. If the object is moving away from the X241, the received frequency is lower. This is because waves moving toward the observer at the speed of the microwaves (light speed) get an additional push from the speed of the object. Since the waves cannot exceed the speed of light, they become compressed. So a greater number of waves pass any given point during any specified time interval. Since frequency is defined as the number of waves passing a point during a specific time period, the frequency is increased. To a stationary observer, sound waves from an object moving in the observer's direction are perceived as being of a higher pitch than they are at the point of emission. When the object is receding, the reflected waves spread apart to take up the slack. The frequency of such sound waves is then perceived as lower by the observer.

This effect is perceptible to the human ear with sound waves, since they travel so much more slowly than radio waves do (about 1,088 feet per second, as compared with 186,000 miles per second, the speed of radio waves). If you are standing still, the siren of an emergency vehicle speeding toward you at a velocity of 60 MPH sounds higher in pitch than it would if the vehicle were following you down the highway. Then, as the vehicle passes and begins to move away from you, you perceive an immediate lowering in the pitch of the siren as the sound waves emitted from the siren are stretched.

It follows that the faster the object moves toward or away from the observer, the greater will be the compression or stretching of the waves. This is called the Doppler shift. It turns out that the Doppler shift is directly and exactly correlated with speed and can be predicted accurately. If the frequency of microwaves transmitted toward a moving object is known, the frequency of that signal reflected back from that object, which has thus become greater (or smaller) due to the Doppler effect, can then be compared with it, and the difference mathematically transposed into velocity in miles or kilometers per hour.

This difference in frequency (Doppler shift) has the same ratio to the transmitted frequency as that of the speed of the target to the speed of the waves. Except when this principle is being used in radio astronomy to study the relative motion of galaxies, which move very fast compared with objects on earth, the comparative Doppler shift of electromagnetic waves is so small it is imperceptible to the human eye. But it is easily detected by the X241. The analog data output from the X241 can be analyzed very efficiently by anything ranging from an audio spectrum analyzer to a very low cost audio frequency counter.

VELOCITY CALCULATIONS BASED UPON DOPPLER THEORY

The frequency of the Doppler shift can be easily determined mathematically. The following formula is used to determine a "constant," which is the amount of Doppler shift in Hertz (number of waves per second) per MPH or KPH:

$$d = \frac{2\ f}{c}$$

Where d is the Doppler shift in Hertz, f is the transmitter frequency in Hertz and c is the speed of the transmitted waves (light speed) in MPH to derive an MPH constant, KPH to derive a KPH constant, etc. Entering the speed of light in meters per second, feet per second, etc. will derive constants for those units as well. The X241 transmits at about 24.15 GHz which is 24,150,000,000 Hertz. Light speed in MPH is 670,616,580. To derive the constant for MPH, these numbers are inserted in the formula:

$$d = \frac{2 \times 24{,}150{,}000{,}000 \text{ Hz}}{670{,}616{,}580 \text{ MPH}}$$

Therefore, the constant is d = 72.023271495 Hertz per MPH. For practical purposes, the constants are rounded to three decimal places. Rounding causes no significant loss in accuracy, unless you are measuring a very low speed (like inches per hour).

The Doppler shift can thus be calculated for any speed toward or away from the observer. An object moving at a relative speed of 35.0 MPH would yield a frequency as follows: 35.0 MPH x 72.023 = 2520.805 Hz.

If approaching, the frequency of the reflected signal would be 24,150,000,000 + 2520.805 = 24,150,002,220.805 Hz.

If receding, the reflected signal would be 24,150,000,000 - 2520.805 = 24,149,997,779.195 Hz.

Bear in mind that when using the X241 to determine accurate velocity data, the microwave output of the X241 must be in direct line with the object(s) being measured. Any angle between the X241 and the object will lower the relative Doppler frequency.

When using the X241 to determine ground speed, simply aim the X241 in direct line with the normal motion of the vehicle or equipment. Unless specifically allowed for in your installation, do not point the X241 at the ground, since this will result in an angle that will lower the relative Doppler frequency. Using a cosine value, a ground speed readout could allow for a precise angle in specific installations. As a hypothetical example, a particular tractor installation calls for the X241 to be aimed straight ahead and 15 degrees down from level. The tractor's ground speed readout is programmed to read 69.569 Hz per MPH. When the tractor is moving at 1.4 MPH, the X241 accurately outputs a sine wave at 97.397 Hertz. Using this data, the tractor's ground speed readout displays 1.4 MPH.

F.C.C. DATA REQUIRED TO BE VISIBLE AT THE X241 INSTALLATION.

FCC data for the X241 must always be conspicuously visible to end users. If using the X241 outside of an enclosure, the FCC part 15 data tag on the protective cover is all that is required, as long as it's visible to end users. If the FCC data tag on the protective cover is obstructed, you must place the additional FCC data tag provided in a prominent location, perhaps on the side of the protective cover.

If the X241 is mounted in another enclosure, it is required that the additional FCC data tag provided with the X241 be placed in a prominent location on the enclosure next to the X241, easily visible to end users.

The following statement, which appears on the cover of this manual, must always be provided to end users:

"FCC ID: NXC-RADAR

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TROUBLESHOOTING

Problem	Possible solutions
Unit not transmitting:	Line 6 (Gunn control) not at 0 volts. Improper voltage on Line 1 (must be 9-16 V.D.C.). Bad ground. Defective modular connector or

	defective cable. Internal problem.
Unit is transmitting, but there is no received signal output:	Improper voltage on Line 1. (Must be 9-16 V.D.C.) Signal line (Line 4) grounded or connected to voltage. Defective modular connector or defective cable. Internal problem.
Applying logic 1 to Line 6 does not shut down the transmitter:	Line 6 tied to ground. Defective modular connector or defective cable. Internal problem.

SPECIFICATIONS

POWER REQUIREMENTS: 9 to 16 V.D.C., 0.5 amps maximum.
REVERSE POLARITY PROTECTION: To minus 15 V.D.C.
ENVIRONMENTAL: -22°F to +140°F (-30°C to +60°C); 90% maximum relative humidity.
POWER DENSITY OUTPUT: Less than $1mW/cm^2$
ANTENNA TYPE: Conical with precision ground Rexalite lens.
POLARIZATION: Right-hand circular.
BEAM WIDTH: 12° at 3dB nominal.
MICROWAVE SOURCE: Gunn effect diode, 10 mW nominal power output at 24.150 +/- .1 GHz.
RECEIVER TYPE: Low noise Schottky barrier mixer diode.
REGULATOR DEACTIVATION: Logic controlled, logic 0=ON logic 1=OFF. 100 microamp maximum current draw on the logic line with logic 1.
SIZE: 3.1" diameter, 4.5" long.
WEIGHT: 1 lb.

Specifications subject to change without notice.

WARRANTY

90-day limited warranty covering parts, labor and for your convenience, shipping/handling charges going back to you. However, freight charges are not included when shipping the unit in for repair. Incidental and consequential damages are not included. The maximum extent of this warranty is replacement of the X241.

WARNING

In order to comply with FCC RF exposure limits, this device may not be installed closer than 4.5 cm from persons in the general public. This safety requirement is derived from FCC OET 65.