Operational Description

FCC ID: HVVAD27W

The Atkinson Dynamics wireless intercom is a heavy-duty communications device designed for industrial applications. The nominal operating voltage is 120VAC, 50/60 Hz. Each unit is equipped with a power cord that has a NEMA 5-15P molded plug. Each unit has a built-in antenna. The internal circuitry contains an RF transmitter and receiver that operate in the 902-928MHz band. A switch on the circuit board allows the user to select from eight channels. All units are equipped with a squelch adjustment control knob on the front cover. This allows the user to suppress the audio output when noise power that exceeds a predetermined level is present.

Each unit is equipped with a power cord that is terminated with a molded plug for 120VAC, 50/60Hz operation. An RF transmitter and receiver, manufactured by Linx Technologies, that operate in the 902-928 MHz band, are located on a printed circuit board inside the unit. A switch on the circuit board allows the user to select from eight channels. A "whip" style ¼-wavelength antenna is threaded into the bottom of each unit. An RG-174 coax cable, attached to the antenna, connects directly to a printed circuit board through a 50-ohm connector.

In normal operation, each intercom is in receive, or *speaker*, mode. The unit acts as a speaker and broadcasts signals generated elsewhere in the intercom system. In this mode of operation, the antenna is connected to the RF receiver through an antenna switch. Each unit has a LISTEN/TALK toggle switch located on the front panel. Depressing the LISTEN/TALK switch places the unit in transmit, or *microphone*, mode. In this mode, the speaker acts as a microphone allowing the user to broadcast to all other intercoms in the system. The antenna is connected to the transmitter via the antenna switch during transmit mode. Releasing the switch returns the unit to speaker mode.

1 THEORY OF OPERATION

Power Supply:

The phase side of AC power is brought to a SPST on/off switch on the backside of the volume control potentiometer (pot). The intercom is turned off when the pot is in the CCW position. Fuse F1 is placed in series with the hot side of the power supply for catastrophic overcurrent protection. The output of the transformer is rectified through diodes CR3, CR4, CR5, and CR8 and becomes unregulated DC voltage filtered by C3. CR1 is a 25V zener diode. With the base of the transistor regulated at 25V, the regulated output of the supply at the emitter of Q1 is approximately 24V. R23, R27, and R26 are set to provide an output of 16V from IC1. IC3 provides a regulated output of 5V.

Squelch Circuit:

The squelch control circuit consists of comparator IC5A, C38, R24, R25, and J3. A 1K-ohm squelch potentiometer (pot) on the front cover is connected to J3 at pins 2 and 3, which places it in series with R24. The negative (-) side of the comparator IC5A-2 is set to a predetermined level (threshold) by adjusting the 1K-ohm squelch pot. When the pot is set at maximum, or 1K ohm, the threshold level at IC5A-2 is 1.6V. When the pot is set a minimum, or 0 ohms, the threshold level at IC5A-2 is 1.0V. The receiver is equipped with an on-board RSSI (Received Signal Strength Indicator) circuit. The RSSI has a voltage range of about 800mV to 2.5V. The positive (+) side of the comparator IC5A-3 is controlled by the RSSI voltage, present at IC10-14. Op amp IC5A compares the RSSI voltage at pin 3 to the threshold voltage at pin 2. The output of the comparator controls analog switch IC6. IC6 either blocks the received audio signal present at receiver IC10-17, or allows it to pass through to the rest of the circuit. When the RSSI voltage exceeds the threshold voltage, the output of the comparator is high. As a result, the analog switch closes and lets the audio signal pass through. When the RSSI voltage is less than the threshold voltage, the comparator output will be low and the analog switch will block the audio signal.

Antenna Switch Circuit:

IC13 is a single-pole double-throw wideband RF switch that controls the antenna connection. Pin 4 of IC13 is the enable channel 1 input. When it is high, channel 1 (pin 8) is enabled. When it is low, channel 2 is enabled. Channel 1 is connected to the antenna input on the receiver at IC10-1. Channel 2 is connected to the antenna input on the transmitter at IC7-2. The enable channel input IC13-4 is controlled by the signal out of optocoupler IC15. The output of the optocoupler is connected directly to the POWER DOWN pin on the receiver at IC10-13 and is inverted before being connected to the POWER DOWN pin on the transmitter at IC7-7. This is so the transmitter and receiver are never on at the same time. Diodes CR9 (PTX), CR10 (CALL), and CR13 (PTT) are connected to the input of the optocoupler. If the call button (CALL), talk switch (PTX), or microphone PTT switch is pressed, the optocoupler provides a low output signal. The low signal shuts down the receiver and at the same time, since it is inverted and becomes high, turns on the transmitter. Normally, the unit is in receive (listen) mode and the antenna is connected to the receiver. When CALL, PTX, or PTT is pressed, the unit is placed in transmit (talk) mode and the antenna is connected to the transmitter.

"Receive" Audio Path:

After audio passes through the analog switch, IC6, it goes through a low pass filter that has a cut-off frequency of 3KHz. The low pass filter contains op amp OP275 (IC12A). After filtering, the received audio signal passes through a noise reduction stage that consists of compandor SA575D (IC9). The compandor boosts the audio signal and compresses any noise. The audio signal then passes through isolation transformer T2 to the high side of the front panel 10K audio taper potentiometer (pot). This pot on the front panel attenuates the volume. The wiper of the pot is connected back to the circuit board through pin 3 of J5. The signal is then capacitively coupled to a pre-amp circuit containing op amp OP275 (IC4A). The pre-amp circuit has a gain of 10. The pre-amplified signal is then coupled to the input pin of the power amplifier (IC2). The power amplifier TDA2616 is designed for bridge mode operation. This means that pin 6 provides the in-phase output and pin 4 provides the equivalent amplitude output but 180 degrees out-of-phase. Only one channel (pin 6) of the output signal is used, coupled through C2 and then through relay K1 to J1 at pin 1 (LOCAL SPK +). J1 is connected to the speaker on the housing. This speaker is used to broadcast audio when the intercom is in "receive" mode. In "transmit" mode, the speaker is used as a microphone.

For most intercom models, J2 is manufactured with a jumper wire between pins 1 and 4. When the headset microphone option is built (-M34 models), J2 is manufactured with a four-position header. The audio output from the amplifier is taken up to a toggle switch on the front panel. The user places the toggle switch in either the "Speaker" or "Headset" position. When the switch is in the "Speaker" position, the audio couples through as a normal intercom to the speaker. When the switch is in the "Headset" position, the audio is disconnected from the speaker and directly drives the headset. The headset has a microphone which is activated by a belt switch PTT (push-to-talk).

"Transmit" Audio Path (Local Speaker):

The listen/talk switch, located on the front cover, is connected to J5-6 (PTX) and J5-2 (GROUND). When the listen/talk switch is pressed, ground is connected to J5-6, which causes the signal at this pin to go low. This in turn causes diode CR9 (PTX) to turn on. The output of the optocoupler goes low when CR9 turns on. The receiver power down pin receives the low signal and turns off. The transmitter power down pin receives a high signal and turns on. The unit is now in transmit (talk) mode. Relay K1 energizes when the talk switch is pressed which allows the audio signal to pass from the local speaker to the local speaker pre-amp circuit. The local speaker pre-amp circuit consists of components Q2, C50, C51, C52, and R55. The audio signal then passes through the local speaker bias circuit and through a voltage divider consisting of components R14 and R13 where the signal is attenuated. Relay K3 is not energized, allowing the audio signal to pass through the normally closed contact (K3-7) to the microphone pre-amp circuit. The microphone pre-amp circuit contains op amp IC11A and has a gain of 200. The output of the pre-amp circuit is capacitively coupled to pin 7 on relay K2. This is the normally closed relay contact. Since relay K2 is not energized, the audio signal passes through to the transmitter analog pin at IC7-10. At this point the signal is transmitted to any other wireless intercoms within range.

"Transmit" Call Tone:

The call switch, located on the front cover, connects to J5-5 (CALL N/O) and J5-2 (GROUND). This input is normally held high and is grounded by depressing the call switch. When the switch is depressed, K2 energizes and removes the ground from pin 6 of IC4B. This allows the call oscillator to start and generates a signal with a frequency of 890 Hz. The call signal passes through relay K2-5 to the transmitter analog pin at IC7-10. When the call switch is pressed, diode CR10 (CALL) turns on. The output of the optocoupler goes low when CR10 turns on, which causes the receiver to power down and the transmitter to turn on. The unit is now in transmit (talk) mode. At this point the call signal is transmitted to any other wireless intercoms within range.

Receiver Module (RXM-900-HP-II):

The receiver is an 18-pin microprocessor-controlled module that operates in the 902-928 MHz band. The pin descriptions are provided in Table 1 on the following page. To transmit analog information, the module employs FM modulation. To minimize the possible impact to a user from interference, the module utilizes SAW (Surface Acoustic Wave) filtration, uncommon frequency allocation, channel qualification, and constant carrier modulation techniques. It features eight user-selectable channels. The channel of operation is determined by the state of pins CS0-CS2. Refer to Table 2 for the frequency of each channel. The channel is selected by a 4-position DIP switch on the printed circuit board. One side of each switch is connected to ground. The other side of the switch connects to the Channel Select pins on both the receiver and transmitter modules.

The audio bandwidth of the receiver is 50Hz to 25kHz. The sensitivity of the receiver is –95dBm (typical). The supply current is rated at 18 mA (typical) and 20 mA (maximum). The operating temperature range of the device is 0^{o} C to $+70^{o}$ C.

PIN #	Name	Description
1	RF In	50-ohm RF Input
2-8	Gnd	Analog Ground
9	N/C	No Connection
10	CS0	Channel Select 0
11	CS1	Channel Select 1
12	CS2	Channel Select 2
13	PDN	Power Down (Active Low)
14	RSSI	Received Signal Strength Indicator
15	Gnd	Digital Ground
16	Vcc	Voltage Input 2.7-16V
17	Analog Out	1Vp-p Analog Output
18	Data Out	Digital Data Output

Table 1: Receiver Module Pin Functions

CS2	CS1	CS0	Channel	Frequency (MHz)
0	0	0	0	903.37
0	0	1	1	906.37
0	1	0	2	907.87
0	1	1	3	909.37
1	0	0	4	912.37
1	0	1	5	915.37
1	1	0	6	919.87
1	1	1	7	921.37

Table 2: Channel-Selection Table

Transmitter Module (TXM-900-HP-II):

The transmitter is a 10-pin microprocessor-controlled module that operates in the 902-928 MHz band. The pin descriptions are provided in Table 3 on the following page. To transmit analog information, the module reverts to FM modulation. As with the receiver, the transmitter also features eight user-selectable channels. The channel of operation is determined by the state of pins CS0-CS2. Refer to Table 2 for frequency of each channel.

The supply current is rated at 15 mA (typical), 17 mA (maximum). The output power is 0 dBm, or 1mW (typical). The operating temperature range of the device is 0^{o} C to $+70^{o}$ C.

PIN #	Name	Description
1	Gnd	Analog Ground
2	RF/ANT Out	50-ohm RF Output
3	CS0	Channel Select 0
4	CS1	Channel Select 1
5	CS2	Channel Select 2
6	CTS	Clear-To-Send Output
7	PDN	Power Down (Active Low)
8	Vcc	Voltage Input 2.7-16V
9	Gnd	Digital Ground
10	Analog In/Data In	Digital/Analog Input 0-3V (See Note 1)

Table 3: Transmitter Module Pin Functions

Note 1: The voltage swing on the data input pin should be between ground and 3 volts. This voltage directly modulates the VCXO (voltage-controlled crystal oscillator) in order to obtain an FM output.

Antenna:

A quarter-wavelength whip style antenna is attached to the housing. The antenna is fed through the base with RG-174 coax cable, which attaches to E1 on the printed circuit board with 50-ohm Amphenol connector.