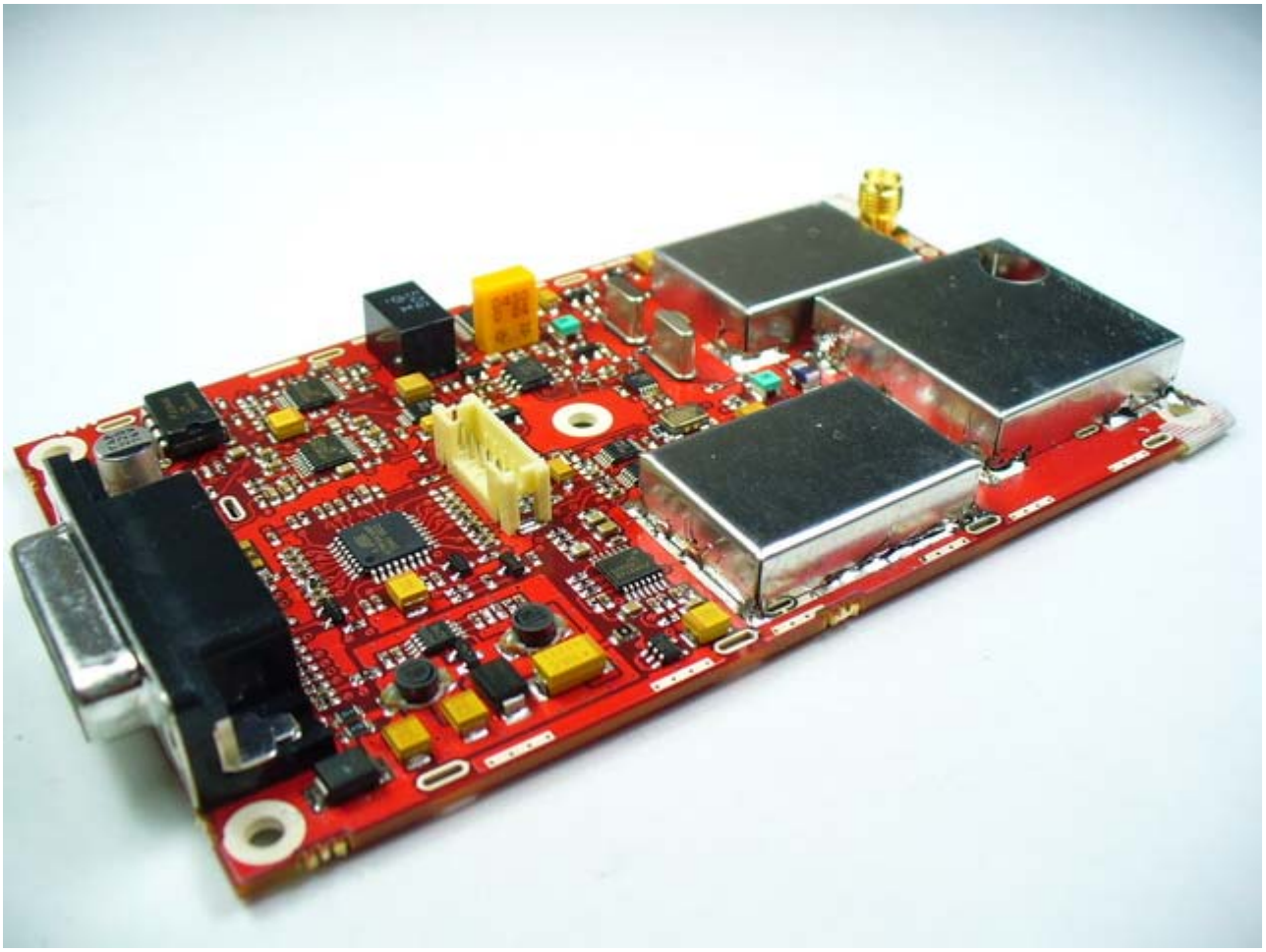
RITRON®

DR-145/445

PROGRAMMABLE
FM RECEIVER MODULE



MAINTENANCE & OPERATING MANUAL

FOR USE ONLY BY AUTHORIZED SERVICE/MAINTENANCE PERSONNEL

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INTRODUCTION

General

RITRON's DR-145 and DR-445 receiver module operate in one of a number of VHF or UHF frequency bands. Typical radio parameters such as frequencey, squelch level and audio input and output gain are PC adjustable. The receiver is a single board unit with components on one side and pin for pin compatible with the DR-142/442.

The unit supports voice through a microphone input and a nominal one watt speaker output or data through the auxiliary in and auxiliary out ports. Each radio can be programmed to contain a unique set of eight operating frequencies and sub-audible tones. When all three channel select inputs are tied to ground the radio operates on channel 1. The channel selection is done in a binary manner on the CS2, CS1 and CS0 inputs. Separate RX and TX Quiet Call (CTCSS) or Digital Quiet call (DCS) tones can be programmed per channel. The standby current drain at 12.5 VDC is typically about 22 mA.

Model Identification

The DR-145 or DR-445 is available in an aluminum encased version with a BNC connector or a board-only version. The board only version can have one of a variety of RF connectors.

The model number form is: " DR-145***ABCDE*** " or " DR-445***ABCDE*** " Where:

A is frequency sub-band:
For the DR-145:
- G = 136 to 162 MHz
- O = 136 to 174 MHz (reduced image rejection of 60 dB from 136 to 148 MHz)

For the DR-445:
- G = 400.5 to 416.5 MHz
- H = 411 to 429 MHz
- 0 = 450 to 470 MHz

B is the connector type:
- B = BNC
- C = BNC on flying coaxial cable
- M = SMB
- X = MCX
- S = SMA

C designates the receiver IF bandwidth:
- N = Narrow
- W = Wide

D designates the maximum RF power output:
- 5 = 5 watt
- 8 = 8 watt (only available in UHF)

E designates the case:
- D = deletion of case
- E = enclosure
- S = shield

Examples:
DR-445GBW5E 411 to 429 MHz wideband receiver in case with BNC connector
DR-445OSN8S 450 to 470 MHz narrowband receiver with SMA connector and shield

Units without cases can be delivered with a vertical or right angle female DB-15 connector. Contact the RITRON sales department for further details.

Enclosed version

MAINTENANCE INFORMATION

Surface Mount Repair

RITRON surface mount products require special equipment and servicing techniques. Improper servicing techniques can cause permanent damage to the printed circuit board and/or components, which is not covered by RITRON's warranty. If you are not completely familiar with surface mounted component repair techniques, RITRON recommends that you defer repair to qualified service personnel.

Precautions for Handling CMOS Devices

This radio contains complementary metal-oxide semiconductor (CMOS) devices, which require special handling techniques. CMOS circuits are susceptible to damage by electrostatic or high voltage charges. Damage can be latent, with no failure appearing until weeks or months later. For this reason, take special precautions any time you disassemble the radio. Follow the precautions below, which are even more critical in low humidity environments.

1) Storage/transport - CMOS devices that will be stored or transported must be placed in conductive material so that all exposed leads are shorted together. CMOS devices must not be inserted into conventional plastic "snow" or plastic trays of the type that are used for other semiconductors.
2) Grounding - All CMOS devices must be placed on a grounded bench surface. The technician that will work on the radio/CMOS circuit must be grounded before handling the radio. Normally, the technician wears a conductive wrist strap in series with a 100K Ohm resistor to ground.
3) Clothing - Do not wear nylon clothing while handling CMOS circuits.
4) Power off - Remove power before connecting, removing or soldering a PC board that contains CMOS devices.
5) Power/voltage transients - Do not insert or remove CMOS devices with power applied. Check all power supplies to be used for testing CMOS devices, making sure that no voltage transients are present.
6) Soldering - Use a grounded soldering iron for soldering CMOS circuitry.
7) Lead-straightening tools - When straightening CMOS leads, provide ground straps for the tool used.

Synthesizer and RF Power Amplifier Shield

The synthesizer shield should not be removed unless a component must be replaced. This shield is soldered to the main PC board. Sucking or wicking the solder up around the perimeter can remove the shield. If this should prove difficult a side cutter can cut the top off after which the walls can be removed. A replacement shield will then be needed and is available from RITRON.

DR-145 SPECIFICATIONS

GENERAL

Frequency Range: O-band: 136 to 174 MHz

RF Channels: 8 Independent RX frequencies

Unusable 2.5 kHz RX steps in 136 to 174 MHz band: +/- 10 kHz around the 14.4 MHz harmonics at 144 MHz, 158.4 MHz and 172.8 MHz.

Additional RX unusable 2.5 kHz steps in 136 - 174 MHz band	RX
	143.542
	5
	143.557
	5
	157.942
	5
	157.957
	5
	172.342
	5
	172.357
	5

Frequency Stability: +/-2.5 PPM (-30° to +60° C)

Tone/Code Signaling: CTCSS (Quiet Call) and DCS

Power Supply: 9 to 17 VDC

Current Drain:
RX Standby: 25 mA at 12.5 VDC

Dimensions & weight:

Board only version:	4.75” x 2.8” x .625”	2.1 oz
Encased version:	5.7” x 3” x 1.375”	7.3 oz.

Antenna Fitting: BNC female with encased version. Other options available on board only version.

DR-145 SPECIFICATIONS

RECEIVER		
	25 kHz Wide band	12.5 kHz Narrow band
Sensitivity (12 dB SINAD):	0.25 µV	0.25 µV
Adjacent channel:	-70 dB	-60 dB
Spurious rejection:	-65 dB	-65 dB
Image rejection:	-70 dB	-70 dB
Intermodulation:	-65 dB	-65 dB
FM hum and noise:	-45 dB	-40 dB
Conducted spurious:	-57 dBm	-57 dBm
Receiver attack time (TX to RX):	< 10 ms	< 10 ms
Noise squelch attack time: (for 20 dB quieting)	< 15 ms	< 15 ms
RSSI squelch attack time:	< 5 ms	< 5 ms
RSSI squelch sensitivity:	PC adjustable; factory set for –106 dBm	
Noise squelch sensitivity:	PC adjustable; factory set for –121 dBm	
AUX OUT frequency response:	12 - 2500 Hz @ +1 / -3 dB	
AUX OUT level range:	0 to 3 Volts peak-to-peak	
Audio Speaker Output	>700 mW into 8 Ω, with less than 5 % THD (0 to 2.5 Vrms)	
Audio Speaker freq response:	de-emphasized 6 dB/octave from 400 to 2500 Hz	

DR-445 SPECIFICATIONS

GENERAL

Frequency Range: 400.6 – 416.5, 411 – 429 or 450 - 470 MHz

RF Channels: 8 Independent TX/RX frequencies

Frequencies unusable in 406.6 – 416.5 MHz band: None- all 6.25 kHz steps available

Frequencies unusable in 411 - 429 MHz band	RX
Unusable 6.25 kHz steps:	417.60000
	418.03750
	418.04375
	418.05625
	418.06250

Frequencies unusable in 450 – 470 MHz band	RX
Unusable 6.25 kHz steps:	460.80000
	461.23750
	461.24375
	461.25625
	461.26250

Frequency Stability: +/-1.5 PPM (-30° to +60° C)

Tone/Code Signaling: CTCSS (Quiet Call) and DCS

Power Supply: 9 to 17 VDC

Current Drain:
RX Standby: 25 mA at 12.5 VDC

Dimensions & weight:

Board only version:	4.75” x 2.8”x .625”	2.1 oz
Shielded version:	4.75” x 2.8”x .625”	3.4 oz.
Encased version:	5.7” x 3” x 1.375”	7.3 oz.

Antenna Fitting: BNC female with encased version. Other options available on board only version.

	25 kHz Wide band	12.5 kHz Narrow band
Sensitivity (12 dB SINAD):	0.25 µV	0.25 µV
Adjacent channel:	-67 dB	-60 dB
Spurious rejection:	-70 dB	-70 dB
Image rejection:	-75 dB	-75 dB
Intermodulation:	-65 dB	-65 dB
FM hum and noise:	-43 dB	-37 dB
Conducted spurious:	-57 dBm	-57 dBm
Receiver attack time (TX to RX):	< 10 ms	< 10 ms
Noise squelch attack time: (for 20 dB quieting)	< 15 ms	< 15 ms
RSSI squelch attack time:	< 5 ms	< 5 ms

RSSI squelch sensitivity:	PC adjustable; factory set for –106 dBm
Noise squelch sensitivity:	PC adjustable; factory set for –121 dBm
AUX OUT frequency response:	12 - 2500 Hz @ +1 / -3 dB
AUX OUT level range:	0 to 3 Volts peak-to-peak
Audio Speaker Output	>700 mW into 8 Ω, with less than 5 % THD (0 to 2.5 Vrms)
Audio Speaker freq response:	de-emphasized 6 dB/octave from 400 to 2500 Hz

OPERATION

The DR-145/445 uses two connectors for operation and one for factory use. The sub D-15 contains signal, control and power lines and the RF connector receives low level signals and transmits power. The third connector on the unit is used for initial factory flash programming of the unit. The radio's eight transmit and receive frequencies are programmed via a PC. Pins 1, 2 and 3 of the DB-15 connector select the channel. The receiver bandwidth is fixed in either a wide or narrow bandwidth and should be ordered as such from the factory. A monitor input activates both speaker and auxiliary outputs, allowing a modem to continually search for a signal. Separate speaker and auxiliary outputs allow either de-emphasized voice or flat data output. A carrier detect output is pulled high when the channel is busy. Alternately, the MON ITOR input can be used as a carrier and tone detector output. See detailed pin operation section. Adjacent to the DB-15 connector, a dual colored LED appears on the sub D-15 edge of the board. It has the following functions:

Bright GREEN when carrier is present on channel
Dull blinking red when receiver PLL is unlocked

SUB D 15 PIN CONNECTOR

The DR-145/445 is equiped with a 15 pin female sub D connector with the following functions:

Pin#	Function
1	Least significant channel select bit (CS0)
2	Channel select 1 (CS1)
3	Most significant channel select (CS2)
4	N/A
5	N/A
6	+ 9 to 17 VDC input
7	N/A
8	Auxilary ouput
9	PC programing port
10	Volume control (RSSI option)
11	Auxilary monitor input (pull to ground to open squelch). Can be used for tone detect, see below.
12	Speaker output
13	Carrier detect output (pulls to 3.3 VDC through internal 390 ohms)
14	N/A
15	Ground

Channel Select (pins 2,1,0)
Three lines control the channel selection; CS2, CS1, CS0. The inputs have binary weighting of 4, 2 and 1 respectively. They are internally pulled up in the microcontroller. Tying an input to ground gives it a zero weighting. Thus, if no inputs are tied low, channel eight is selected (7 binary).

Power Input (pin 6)
A power source of 9 to 17 VDC with 2 Amp capability should be connected here. Once power is applied to pin 6 of the radio, the microcontroller will start and load the receive frequency of the channel designated by CS2, CS1 and CS0 (pins 3, 2 and 1).

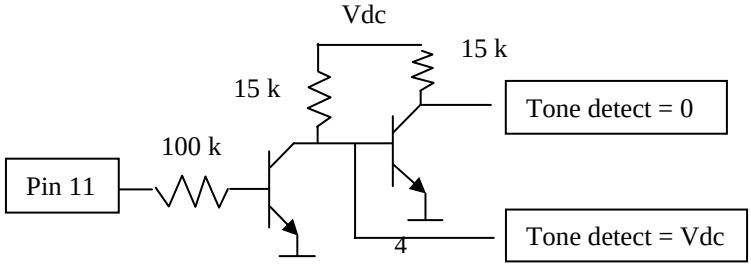
Auxiliary Output (pin 8)
An output loading of 600 ohms or greater should be applied to this output. With a 600 ohm load the output exhibits a frequency response of 12 Hz to 2500 Hz. Higher load impedances will lower the low end frequency response. The output is adjustable via the programmer. It is preset at the factory to give 1 volt peak to peak output when receiving a +/- 3 kHz (1.5 kHz for narrowband channel) deviated signal. Output range is 0 to 3 V peak-to-peak. It is suggested keeping it below 2 V pp since the IF output is DC coupled and a frequency error of 1 kHz will cause a 0.2 V shift on narrowband.

Programming Port (pin 9)
This line is a bi-directional programming port to be connected to a RITRON programming cable. The other end of the programming cable connects to the PC's serial port 25 pin D-sub connector. The appropriate DR-145/445 programming software must be run for configuring the transceiver (See programming the radio on page 10).

External Volume Potentiometer (pin 10)
Connecting a 10K pot to ground at this point will allow the speaker volume to be adjusted. For maximum range the internal AUX_OUT gain should be set to a value that allows maximum volume with acceptable distortion when the pot is set at 10K. Optionally, this pin can be used as an RSSI output. If desired, contact the factory.

Monitor Input (pin 11)
Normally the AUX_OUT and SPEAKER_ OUT are switched on only when a carrier with required tone, if programmed, is detected. Bringing this input to ground will force the auxiliary and speaker outputs on. Alternately, the monitor input can be used as an output. It gets pulled low when a carrier with correct tone is detected. The following circuitry can be used as a carrier and tone detect output. Pin 11 can still be pulled low to monitor the channel. Notice the high impedance 470 k ohm buffer resistor. Too low of resistance will turn the audio on.

External circuit to use AUX_MON input as Tone Detect output



Speaker (pin 12)
An 8 ohm or higher speaker should be connected to pin 12. One watt of audio power is possible. The speaker volume is set via the programmer AUX_OUT gain. The output signal can be further attenuated by a fixed or variable resistor from pin 10 to ground to attenuate the audio.

Carrier Detect Output (pin 13)
This line will be pulled to 3.3 volts through an internal 390 ohm resistor when a carrier is present. This output is carrier detect only. It gets pulled high at the same time the green LED lights.

PROGRAMMING THE RADIO USING A PC COMPUTER

RITRON's programming kit, DRL-PCPK-2.2, allows programming of the DR-445 model radios using a PC compatible computer.

The PC Programming Kit Includes:

1) Ritron Transceiver programming software, DRL-PCPS-2.2, which is contained on a CD-ROM.
2) Ritron PC to radio adapter cable, 9/RTC-PAS, which is terminated at one end with a DB-25F connector, at the other end with a 6 pin modular plug.
3) Another cable, DRP-PAC, with a modular jack (which mates to the previous cable) on one end with a DB-15M on the other end to mate to the radio. Power leads are also provided. Red is positive.

The PC Programming Kit Requires: A PC compatible computer with Windows 95 or later. The computer must have an RS-232 serial port available. A hard disk drive is recommended.

Programming the DR-445: To program the DR-445 do the following:

1) Connect the PC's RS-232 port to 9/RTC-PAS and DRP-PAC programming cable. Connect DRP-PAC to DR-445
2) Apply 9 to 17 VDC power to pin 6 of the DB-15 (Red wire)
3) Insert disk. View the disk contents and double click on **setup.exe**. Follow the instructions on screen. When finished the software will be resident on the PC's hard disk.

Using the Programming Software

Upon starting the software with a radio connected to the programming cable and powered up, the PC will read the radio data. A form then appears identifying the radio and displaying all channel information. If no radio is connected when the software is started a form appears asking the operator to select a model. When a model is selected default parameters for that model are displayed. These parameters can be programmed into a radio or a previously defined file can be recalled and loaded. To program a radio click *radio* on the menu bar and then click *program radio*. To read the radio contents click *radio* on the menu bar and then *read radio*. Allow several seconds for the reading to take place. To change a parameter click a white field or double click the channel field to access it. Files can be saved and opened using the *File* menu option.

Channel features can be programmed differently on each channel. The receiver IF bandwidth remains fixed. However, if programmed for narrowband operation the recovered audio level will be doubled from that of the wideband. A unit can be ordered with wide or narrowband filters. Receive frequencies and also QC or DQC tones on a channel can be different. A channel can also be moved or deleted. An ID string of up to 72 characters can be entered to allow PC programmers to identify radios.

Computer Software Copyrights

DR-145/445 THEORY OF OPERATION

POWER SUPPLY AND VOLTAGE DISTRIBUTION

The DR-145/445 is powered by a 9 to 17 VDC external power supply. F601 is a 3A reset able fuse in series with J301 for short circuit or reverse connection protection. If reverse voltage is applied, F601 will temporarily "blow" open when excess current flows through D601. Disconnect the supply to reset the fuse. Reconnect power correctly and proceed. An input voltage below 17 VDC must be maintained.

The DR-145/445 is designed to consume low current by using a switching DC/DC converter called a buck converter. Receiver standby current is less than 25 mA at 12.5 volts. In the receive mode current drain goes up as the voltage goes down. The buck converter outputs about 40 mA at 6.2 volts. The conversion efficiency of the buck converter is about 85%. Lowering the supply voltage will cause more current to be drawn from the supply. The buck converter's output of 6.2 volts feeds a 3.3 volt low drop out regulator U602. The 3.3 volt regulator supplies the logic and audio processing ICs.

REFERENCE OSCILLATOR

Reference oscillator Y301 is a temperature compensated, voltage controlled crystal oscillator (TCVCXO) operating at 14.4 MHz. The output of the TCVCXO provides a reference for the frequency synthesizer U401 at Pin 8. The reference oscillator also feeds pin 7 of the U301 microcontroller through a buffer amplifier Q303. The Y301 output is also multiplied (tripled) up to 43.2 MHz by Q104 and its associated circuitry to provide the receiver second local oscillator signal.

SYNTHESIZER

The DR-145/445 radio is built around a single PLL synthesized voltage-controlled oscillator (VCO). When the receiver channel is switched, a new synthesizer operating frequency along with signaling option is selected. Microcontroller U301 clocks new data into the U401 internal buffer in synchronization with clock pulses. The channel information is stored in the EE memory of U301 and is loaded into RAM when the channel is selected. The single VCO operates over the entire RX range. In receive mode, the DR-145 synthesizer operates 43.65 MHz higher than the programmed receive frequency. In the DR-445, the synthesizer operates 43.65 MHz lower than the receive frequency. The loop filter C407, C408, C413, R402 and R405 transform the pin 2 output signal to a DC voltage for application to the VCO tuning varactor CR402 (UHF) or CR404 through CR409 (VHF). The synthesizer system is "locked" when the phase and frequency of both the reference and the divided VCO signal are the same. The VCO control voltage can be measured with a DVM at test point 1 (TP1) on the bottom of the board below the synthesizer shield.

RECEIVER

Receiver Front End

In the DR-445, the signal from the antenna passes through the SAW bandpass filter FL101. Q101 amplifies the signal about 11 dB before going through another SAW bandpass filter FL102 and the mixer matching stage. In the DR-145, the signal from the antenna passes through a lumped element band bass filter using L103 and L106. Q101 amplifies the signal about 8 dB before going through another lumped element band pass filter built around L102, L105 and L106. The receiver is turned on by Q212 supplying RX_3.3v when RXEN of U301 goes low.

The amplified received input signal is applied to the input of mixer U103. The 1st local oscillator signal from the synthesizer is applied to the local oscillator input of the mixer. Y101 and Y103, a 43.65 MHz four-pole crystal filter forms the first IF filtering. Q103 and associated components amplify the 43.65 MHz IF signal and apply it to the input of the 2nd mixer at Pin 16 of U101.

FM Receiver Subsystem

A multi-function integrated circuit, U101 and associated components form the FM-receiver subsystem. The subsystem performs the functions of a 2nd mixer, IF amplifier and FM detector. The second local oscillator at 43.2 MHz is applied to the 2nd local oscillator input at Pin 1 of U101. The 43.65 MHz signal at Pin 16 and the 2nd local oscillator are mixed, with the resulting 450 kHz output signal appearing at Pin 3. This signal is filtered by a 450 kHz 6-pole ceramic filter YF101 and applied to the input of the limiting IF amplifier at Pin 5. IC101 pin 6 de-couples the IF amplifier. An internal quadrature detector, whose center frequency is determined by the 450 kHz quadrature resonator Y102 detects the FM IF signal. One input of the quadrature detector is connected internally to the IF signal from pin 11 while the other input is the phase-shifted signal from Y102 at Pin 10. Demodulated audio appears at Pin 9, where a lowpass filter formed around U303-C removes the spurious second IF output prior to application to the voice, tone and squelch conditioning audio circuitry.

Two types of squelch circuits exist, an RSSI squelch and a NOISE squelch. Both types can be used simultaneously or either one or the other can be used. The RSSI (receive signal strength indicator) squelch, which is typically set around –108 dBm, must be set to open at a higher level than the noise squelch. This is necessary since the RSSI measures total power in the receiver IF bandpass. All background noise, which at VHF can be high, is seen as signal. The advantage of the RSSI squelch is that it opens and closes the audio paths very quickly. The noise squelch has the advantage that it can be set at a much lower level, typically –121 dBm for 12 dB SINAD. It takes longer to open and close noise squelch. If both are used simultaneously, since they are ORed together at U301 pin 32, the squelch will open quickly and close slowly for strong signals. The RITRON programmer can be used to adjust levels or turn one or the other off. A dual colored LED will shine green when carrier is detected.

Voice and Tone Conditioning in Receiver

Three post demodulation paths are provided. U303c provides DC level translation to bias succeeding op amp stages at about 1.6 volts. The audio then gets de-emphasized by R366 and C364. The audio path then goes through a fourth order 300 Hz highpass filter U308b and U308c. The 1 watt audio amp is turned on by Q304 and Q301.

The audio and data signals go through a programmable adjustable gain inverting buffer stage U303d, used to set the output voltage.

Sub-audible signals go through a third order 250 Hz lowpass filter U303b. Pin 27 of U301 decodes the CTCSS or DCS signal. In the case of CTCSS the processor, using an internal discrete Fourier transform, looks for the wanted tone. Decode bandwidth is about +/-2 Hz.

Receiver Current Consumption

The radio will monitor the channel until a carrier becomes present. When an on channel carrier appears, the carrier detect line (pin 13) will be pulled high through a 390 ohm resistor R309. If the correct CTCSS or DCS tone is present the radio will unsquelch the speaker and auxiliary output lines. In standby mode the radio consumes 25 mA or less. When unsquelched the audio PA is turned on. If only the auxiliary output and no voice is needed current consumption can be reduced by disabling the audio PA. This is done by removing R383 and will bring current consumption down to about 35 mA during receive. If a modem is used that is able to monitor the auxiliary output continually then AUX_MON can be tied low. By disabling both RSSI and noise squelch, (both levels set high) the current can be reduced to 25 mA.

MICROCONTROLLER

The DR-145/445 transceiver is electronically controlled by U301, an 8-bit flash programmable microcontroller. U301 has A/D inputs and PWM outputs for processing analog signals. Radio characteristics are stored in internal EE memory. Its RS232 port is used in programming the radio's personal characteristics such as frequencies and tones.

PIN	DESCRIPTION
1	Input is pulled LOW when the PTT input is grounded to initiate transmitter operation.
2	Input is pulled low when high/low power input is grounded. This produces a low RF output power.
3	GROUND
4	+3.3 VDC V_{CC} supply voltage.
5	GROUND
6	+3.3 VDC V_{CC} supply voltage
7	OSC1 is 14.4 MHz reference input from Y301.
8	Output goes high when audio PA is enabled.
9	Output SCL4 data line for controlling frequency and power e-pot.
10	Output drops low momentarily to produce synthesizer latch enable (LE) pulses.
11	Output goes low to enable receiver (/RXEN).
12	Output SCL3 data line for controlling AUX_IN and AUX_OUT gain e-pot.
13	TONE OUT generates the QC (CTCSS) or DQC (DCS) waveforms via an 8 bit PWM in transmit mode.
14	Output SCL2 data line for controlling DEVIATION and BALANCE e-pot.
15	DATA output sends serial data to frequency synthesizer U401 to program frequency information. Also used for flash programming (MOSI)
16	CLK output sends serial data clock pulses to frequency synthesizer. Also used in flash programming (MISO).
17	Connects to pin 6 of J401. Grounding this defeats synthesizer unlock reloading for diagnosis. Also outputs SCL1 data line for controlling NOISE and RSSI squelch e-pot.
18	AVCC gets +3.3 VDC for A/D convertors.
19	Input used to measure receiver RSSI.
20	AREF supplies the reference level for the A/D and is connected to the regulated +3.3 VDC.
21	AGND supplies A/D ground.
22	Input is normally low when PLL is locked.
23	Input is pulled low when the CS2 frequency bit input is tied to ground.
24	Input is pulled low when CS0 channel select bit is pulled low.
25	Output goes low to enable transmitter (/TXEN).
26	Input is pulled low when CS1 channel select bit is pulled low.
27	CTCSS IN is an A/D input decoding the CTCSS or DCS waveform.
28	Input is pulled low when radio is commanded to MONITOR channel.
29	RESET is held low to start the radio in a known state on power up.
30, 31	SERIAL DATA PORT links the microcontroller to communications from an external data terminal via programming port pin 9 of J301. This allows programming of the DR-445 EE memory used to store channel frequency and configuration information.
32	CARDET gets pulled low when a RF carrier is detected.

DR-145/445 ALIGNMENT PROCEDURE

Only an authorized RF service technician should perform test and alignment of the DR-145/445. The unit is PC adjusted.

RECOMMENDED TEST EQUIPMENT

1) 9 to 17 VDC 2 Amp current-limited power supply
2) RF Communications Test with:
   - Frequency Counter
   - SINAD Measuring Device
3) Oscilloscope
4) RITRON PC Programming Kit

RADIO PREPARATION

2) Connect the FM communications test set to the antenna connector.
3) Connect RITRON programming cable to radio and PC.
4) Apply 9 to 17 VDC to the red wire with the black to ground.
5) Run RITRON DTX-LS software and read the radio.

RADIO ADJUSTMENT

The programming software includes help comments. If DR needs to be changed or readjusted do the following:

2) Run RITRON DTX LS programming software.
3) On the menu bar select *Edit* then *Tune radio*.
4) If starting from scratch, set up the radio performing frequency adjustments then User Set Up. Otherwise, adjust what is needed.
5) Hold frequency counter probe on C455 and U103 junction. Click *Frequency* then *Tune*.
6) The frequency used in adjustment is displayed in the upper right corner. The frequency displayed is in the normal TX frequency band and will be used to adjust the reference oscillator.
7) Adjust frequency by clicking arrows or by click in space to right of sliding button (for up) or space left (for down). Button can also be dragged to position.
8) Adjusted frequency reading should be less than +/-100 Hz. Click *Save* when done.
9) Adjust positive and negative corrections in the same way. This calibrates the reference oscillator.
10) If the reference oscillator ages and drifts in the future, only the center frequency should need trimming.
11) Click *User Set Up*. Here, you can adjust NOISE and RSSI squelch levels and AUX_OUT gain. If both RSSI and NOISE squelch are used simultaneously, the RSSI level must be set first with the NOISE squelch disabled. Disable it by adjusting the level so high (bar to the right) that the RF level never reaches it. The NOISE and RSSI squelch levels work as an OR function. With either level exceeded, the audio will turn on. Set the RSSI level around -106 dBm and then the NOISE level around -120 dBm** .
12) Remember to save all settings when tuning is finished.

NOTES:

**The DR-145/445 is capable of two squelch operating modes. Both can operate simultaneously. See the *FM Receiver Subsystem* section for theory. The units can be configured as the user requires. When a low level signal appears, the noise squelch opens when the carrier is –119 dBm or greater. When the signal appearing is –106 dBm or greater the RSSI squelch opens the audio with an even faster attack time. The above levels are factory set levels. Ambient noise will affect the level at which the RSSI should be set. The squelch level ideally should be set on the desired frequency, in the actual location the radio will be used and connected to the desired antenna. The level should be set high enough to reject most false signals. The squelch levels are the same for all channels.

If a very fast receiver decay time (or squelching after signal disappears) is needed the noise squelch should be defeated by setting it to a high level.