

K²RF Communication Products

Repeater Control, Management, and Linking Systems

UPX-300

Repeater Controller Port Extender / Linking Backbone Controller

The UPX-300 Port Extender is a unique Repeater/Linking control device. It is designed to expand an existing Repeater/Linking controller from a single port to two ports. This allows for a second repeater, link, or remote base to be added to an already existing system. It may also be used to build or expand other Repeater or Linking systems, such as:

- Remotely controlled Base stations
- Linking Backbones
- Auto patch
- Control, Weather, or other Receivers/Transceivers

The controller has three full duplex radio ports standard. Two of the three ports have the exclusive K²RF DSL-100 circuitry, which allow the transmitter to operate at full deviation levels with no distortion over a wide range of input levels. All three ports can be configured as Repeater or Link ports in Full or Half-duplex modes. In addition, the primary port may be configured to interconnect to another controller to allow for a full duplex expansion of that port.

The UPX-300 is a modular system that allows for expansion to a fully functional repeater controller, two or four port voter, ATV repeater controller, or Telemetry Management System.

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1. Features and Functions

1.1. Ports

Three Full Duplex Ports that may operate interconnected or independently. All ports may operate in Full or Half-duplex modes and support Repeaters or Links. The primary port may be configured to interconnect to controller or repeater/link.

2. Port Interface Capability

- Switch selectable Time Out Timer
- Front panel accessible input and output level controls
- Front panel accessible configuration switches
- Front panel status LED's for PTT, COS/CTCSS, and Power (may be disabled via rear panel switch)
- Front Panel Test points for audio input and outputs
- Two ports have switch selectable DSL circuitry standard
- COS and CTCSS inputs fully supported
- PTT fully supported
- Audio Input – 10K Ohms for all ports
- Audio Output – 600 Ohms for all ports
- -6dB/Octave de-emphasis filter to support discriminator inputs (switch selectable)
- Ports may operate standalone or interconnected in any combination. This may be done via rear panel switches or a 3 pin digital interface.
- Transmit Audio Gain switch selectable from front panel
- Receive Audio Gain switch selectable from front panel

3. Power Supply Requirements

- Input Voltage Range - +8vDC to 18vDC.
- Current draw - 20mA when the LED's are disabled. 180mA if LED's enabled and all on.
- Power is provided to the UPX-300 through the 9-pin female D-Sub connector (port D)
- Pin 1 = +8/18vDC. Pin 9 = Ground.
- An internal, standard automotive 3AG, 1/2amp fuse provides short circuit protection.
- Diode protected from Reverse polarity connection
- RF bypassed in all key areas of the circuitry to dramatically reduce the influence of RF

4. Warranty

The UPX-300 is warranted to be free from defects due to materials and workmanship for a period of one year from the date of shipment to the purchaser. During this period K²RF will repair or replace (at the company's discretion) the product. The warranty will cover the actual repair or replacement costs and the shipping of the product back to the purchaser.

K²RF will not warrant the product if the following has been found to be the cause of failure:

1. The input voltage exceeded specifications.
2. The product exhibits physical damage
3. The product exhibits damage to the Electrical Over Stress (Lightning, voltage applied directly to circuits, or Electro-static discharge.
4. Incorrect installation or use.
5. Shipping damage (damage claims are handled directly with the Carrier).
6. Repair or modifications made by persons other than K²RF.

NOTE: The Warranty is exclusively extended to the original purchaser of the product. Proof of purchase may be required prior to a Warranty claim being authorized.

5. Configuration and Installation

5.1. Port Connections

The Repeater/Link Ports are labeled A, B, and C and interface via 9-pin female D-sub connectors. These connectors are pin compatible to the Link Communications (copyright) controller interface. There is one exception. K²RF provides for the option of +13.8vDC (supply voltage) to be provided via pin 1 of these connectors (jumper selectable). The +13.8vDC is current limited by the main fuse and is designed provide a maximum of 200mA. Total for all three ports (A, B, C)

5.2. Interface Pin Assignments

Pin 1 = Ground or +13.8vDC (supply voltage) jumper selectable
 Pin 2 = CTCSS (PL) - Active Low
 Pin 3 = PTT (Active Low) Maximum Current 200mA.
 Pin 4 = TX Audio
 Pin 5 = RX Audio
 Pin 6 = Ground
 Pin 7 = COS (Active Low)
 Pin 8 = TX Audio Ground
 Pin 9 = RX Audio Ground

5.3. Receive (RX) Audio Configuration/Calibration

Receive audio may be adjusted to accommodate a wide range of input levels. The audio bandwidth (3dB points) is 50Hz to 10KHz.

5.3.1. RX Range Switch

A range switch selects the A and B port receiver input levels from (low range) 100mV P-P to 1V P-P (switch in ON position), and from (High) 400mV P-P to 7V P-P (switch in OFF position). The C port gain is selectable via JP-10 on the board. Receive levels are adjusted via the front panel controls. The impedance in the low range is 10K ohms and 100K ohms in the High Range.

5.3.2. RX Test points

Test Points are provided at the front of the board via JP-6 for measuring receive and transmit audio levels. This allows each of the ports' receive audio level to be monitored/measured for calibrating or viewing the internal audio buss of the UPX-300. The nominal level at the receive Test Points should be set to 1 volt peak-peak using the method described below.

UPX-300 Port	Gain – High/Low	Level Adjust Pot	Rx Test Point
Port A	SW-2 position 4	VR-1	JP-6 Pin 1
Port B	SW-3 position 4	VR-3	JP-6 Pin 3
Port C	JP-10	VR-6	JP-6 Pin 5

Table 1

5.3.3. RX Calibration

1. Connect a service monitor to the RF input of the receiver attached to the port you are calibrating. With the service monitor set for the frequency of the receiver: Generate a modulated signal with a 1 kHz tone and a deviation of 3KHz (the signal level should be sufficient to provide a 20dB-quieting signal).
2. Connect an oscilloscope to the audio output of the receiver. Using this measurement to determine and select the range for the input level gain switch.
3. Change the switch position to select the input range (if required).
4. Connect the receiver audio and control interface cable to the UPX-300.
5. Connect an oscilloscope to the UPX-300 Test Point for the port you are calibrating and measure the audio level.
6. Adjust the Level Adjustment Pot for 1 V P-P (nominal level for the UPX-300 audio buss).

5.4. Receive (RX) de-emphasis

If the receive audio from the receiver's discriminator is used, the de-emphasis circuit should be used to provide the proper 6dB per octave de-emphasis. This configuration is for narrow band FM receivers only. If line or speaker audio is used this function should not be enabled.

UPX-300 Port	De-Emphasis	Switch Position
Port A	Enabled	SW-2 Position 3 ON
Port A	Disabled	SW-2 Position 3 OFF
Port B	Enabled	SW-3 Position 3 ON
Port B	Disabled	SW-3 Position 3 OFF
Port C	Enabled	JP-9 Installed
Port C	Disabled	JP-9 Removed

Table 2

5.5. Transmit (TX) Audio Configuration

Transmit audio may be adjusted to accommodate a wide range of output levels. The audio bandwidth (3dB points) is 50Hz to 10KHz.

5.5.1. TX Audio Range

A range switch selects the A and B port transmitter output levels from (low range) 100mV P-P to 1V P-P (switch in OFF position), and from (High) 400mV P-P to 5V P-P (switch in ON position). The C port gain is selectable via JP-11 on the board. Transmit levels are adjusted via the front panel controls. The impedance is 150 ohms, and will drive a 600 ohm load over the entire range.

5.5.2. Dynamic Speech Limiter

The Port Extender has an exclusive feature called DSL (Dynamic Speech Limiter). This feature provides automatic gain or attenuation for audio transmitted out of port A and B only. If an audio signal is low, the DSL will automatically increase the level of each syllable to the optimal level set by the front panel TX Level control. If the signal is too high (HOT), the DSL will automatically adjust the level of each syllable down to the proper level. The DSL optimizes speech while reducing noise. This limits the variations of audio levels on links and repeaters. The DSL has an attack time of 500 micro-seconds, and a release time of 20 milli-seconds. These time constants meet EIA/TIA telephony standards for tracking syllables of speech.

UPX-300 Port	Dynamic Speech Limiter	Switch Position
Port A	Enabled	SW-2 Position 2 ON
Port A	Disabled	SW-2 Position 2 OFF
Port B	Enabled	SW-3 Position 2 ON
Port B	Disabled	SW-3 Position 2 OFF
Port C	Not Available this port	NA
Port C	Not Available this port	NA

Table 3

5.5.3. TX Test points

Test Points are provided at the front of the board via JP-6 for measuring receive and transmit audio levels. This allows each of the ports' receive audio level to be monitored/measured for calibrating or viewing the internal audio buss of the UPX-300. The levels on the transmit Test Points are for reference only and used to monitor the signal quality of the

transmitted audio. Setting the levels is performed using the calibration procedure below.

UPX-300 Port	Gain – High/Low	Level Adjust Pot	Tx Test Point
Port A	SW-2 position 1	VR-4	JP-6 Pin 2
Port B	SW-3 position 1	VR-2	JP-6 Pin 4
Port C	JP-11	VR-5	JP-6 Pin 6

Table 3

5.5.4. Calibration

1. Connect a Service Monitor to the receiver RF input and adjust it to the specified frequency. Be sure that it generates a signal strong enough to ensure the receiver is full quieting.
2. Generate a 1000Hz audio tone at 3 KHz deviation.
3. Set the Level Adjust Pot to the center position.
4. Monitor the Output of the Transmitter with a deviation meter or another service monitor.
5. Verify the transmitter deviation is measurable.
6. If not, change the gain switch position to select the output range.
7. Adjust the Level Adjust Pot until the transmitter deviation has an average reading of 3.5KHz
8. Enable the DSL circuit (if desired) and continue with balance of this procedure, otherwise, this procedure is complete.
9. Adjust the Service Monitor connected to the Receiver to 1KHz deviation and confirm the Transmitter deviation is approx. 1.5KHz.
10. Adjust the Service Monitor connected to the Receiver to 5KHz deviation and confirm the Transmitter deviation is approx. 4.5 KHz.
11. Adjust the Service Monitor connected to the Receiver to 6 KHz and confirm the Transmitter deviation is approx. 4.5 KHz.

NOTE: If you desire to have the Transmitter deviation set to 5 KHz, then adjust the Level Adjust Pot until the Transmitter deviation is 5 KHz with a 6KHz input to the Receiver with no clipping or distortion. At that point the absolute nominal setting has been achieved. The DSL will maintain the 5KHz deviation to the transmitter over a range of 2 to 6 KHz deviation input from the Receiver. If you want to have the voice or CW from an ID'er voice synthesizer you will need to set the levels lower than before as the DSL will boost them to full deviation if they are in the capture window (readjust until they are at the transmitted deviation desired).

5.6. Transmitter Time Out Timer

5.6.1. Timer Settings

The UPX-300 has an onboard microprocessor that provides transmitter time out for the Ports. Time out settings are from 0 to 7 minutes in 1-minute increments. The settings are universal and apply to all of the ports. The time out value is selected on S4-1 through 3 as follows:

Time in Minutes	S4-1	S4-2	S4-3
0	ON	ON	ON
1	OFF	ON	ON
2	ON	OFF	ON
3	OFF	OFF	ON
4	ON	ON	OFF
5	OFF	ON	ON
6	ON	OFF	OFF
7	OFF	OFF	OFF

Table 4

5.7. Hang Time Enable/Disable

- Switching S4-4 into the ON position enables hang time.

5.8. Hang Time Adjustment

- The Hang time is adjustable for all ports via a single Potentiometer – VR7 from 1 to 3 seconds.

5.9. Half / Full Duplex Port Operation

Each port may be configured to support “FULL” or “HALF” duplex operation. This is accomplished using the following switch settings:

UPX-300 Port	Duplex Mode	Switch Position
Port A	Half	SW-4 Position 6 ON
Port A	Full	SW-4 Position 6 OFF
Port B	Half	SW-4 Position 7 ON
Port B	Full	SW-4 Position 7 OFF
Port C	Half	SW-4 Position 8 ON
Port C	Full	SW-4 Position 8 OFF

Table 5

5.10. CTCSS (PL) Configuration

Each Port may be configured to support CTCSS input from a tone detect board/circuit. This signal from the Receiver is an active low input to the UPX300. When enabled the UPX-300 will require a COS (low/gnd) and a PL (low/gnd) to enable the PTT to the transmitter using the following settings:

UPX-300 Port	CTCSS (PL)	Switch Position
Port A	CTCSS & COS	SW-1 Position 7 ON
Port A	COS only	SW-1 Position 7 OFF
Port B	CTCSS & COS	SW-1 Position 8 ON
Port B	COS only	SW-1 Position 8 OFF
Port C	CTCSS & COS	SW-4 Position 5 OFF
Port C	COS only	SW-4 Position 5 ON

Table 6

5.11. Status LED's Enable/Disable

- The Status LED's may be disabled to reduce the amount of current being drawn by the UPX-300. This may be very useful in remote sites where power is limited or the UPX-300 is operated from batteries or other alternative power sources.
- Switching S1-1 into the off position disables the Status LED's.

6. Expansion Bus

Two each 26-pin headers are installed in the board to facilitate the addition of options to this product. Current Options are as follows.

1. Full featured Repeater Controller (See K²RF literature).
2. 2 Port Voter
3. Customized solutions may be provided upon request.

7. Power for External Devices

All port interfaces may be configured to provide 12 vDC (supply voltage) at low current levels to support external devices such as DTMF decoders, P/L decoders/encoders, SAGE-300, etc. Current is limited to 50mA per port. The voltage is provided via pin 1 on the 9-pin interface. If not enabled, Pin 1 will be ground. When this option is enabled the ports no longer conform to the Link Communications port interface standards. Configuration as follows:

UPX-300 Port	Ground on Pin 1	Supply voltage on Pin 1
Port A	JP-4 pins 1 to 2	JP-4 pins 2 to 3
Port B	JP-5 pins 1 to 2	JP-5 pins 2 to 3
Port C	JP-3 pins 1 to 2	JP-3 pins 2 to 3

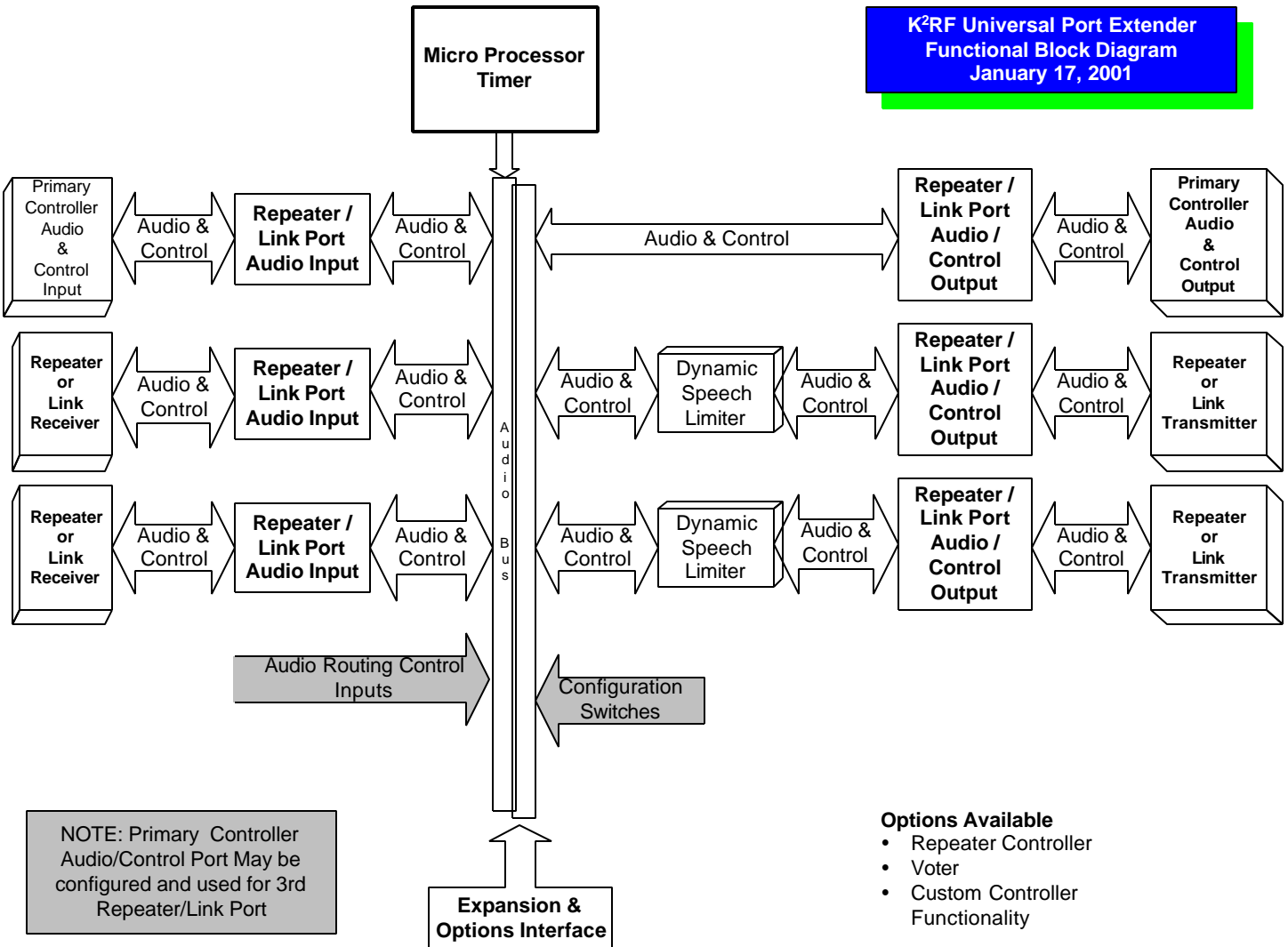
Table 7

8. Supervised Signaling

- 8.1. Signals provided to the UPX-300 are active low signals. This means that when the input to the UPX-300 is at or near ground the signal is considered active (or valid).
- 8.2. When the equipment that is attached is turned off (intentionally or due to a power-related problem) it may provide a ground or near ground signal to the UPX-300 that could activate one or more transmitters. In this case the timeout timers (if enabled) would prevent damage to the equipment, but could render the one or more ports inoperable until the problem is resolved.
- 8.3. K²RF recommends that all control inputs (COS/PL) connected to the UPX-300 utilize open collector circuitry (see attached application notes figure 1 & 2). This will protect the equipment and the operation of your systems. If you need a fully configurable interface for COS, K²RF has a product that will interface with your radio to provide a perfect Active Low COS from nearly any receiver. See the K²RF Web Page for further information.

UPX-300 Basic Block Diagram

**K2RF Universal Port Extender
Functional Block Diagram
January 17, 2001**

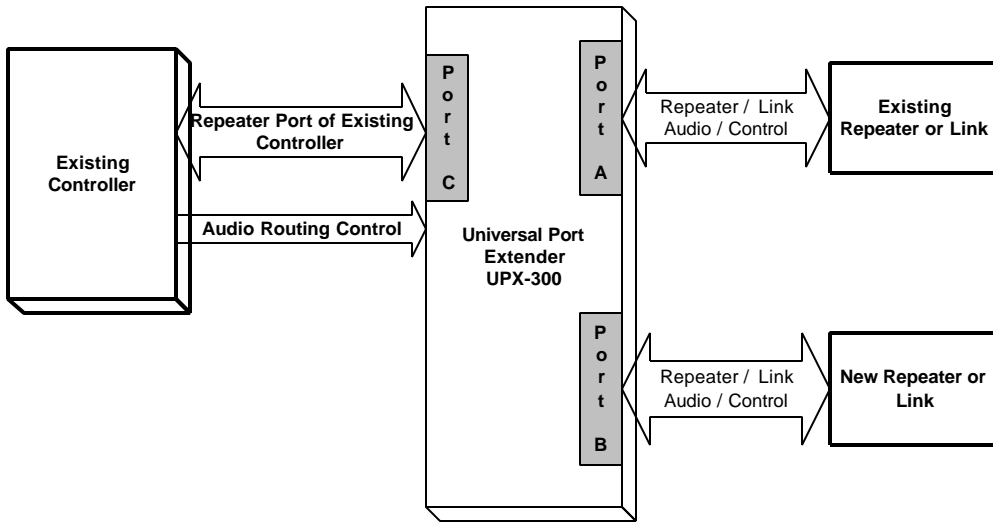


NOTE: Primary Controller Audio/Control Port May be configured and used for 3rd Repeater/Link Port

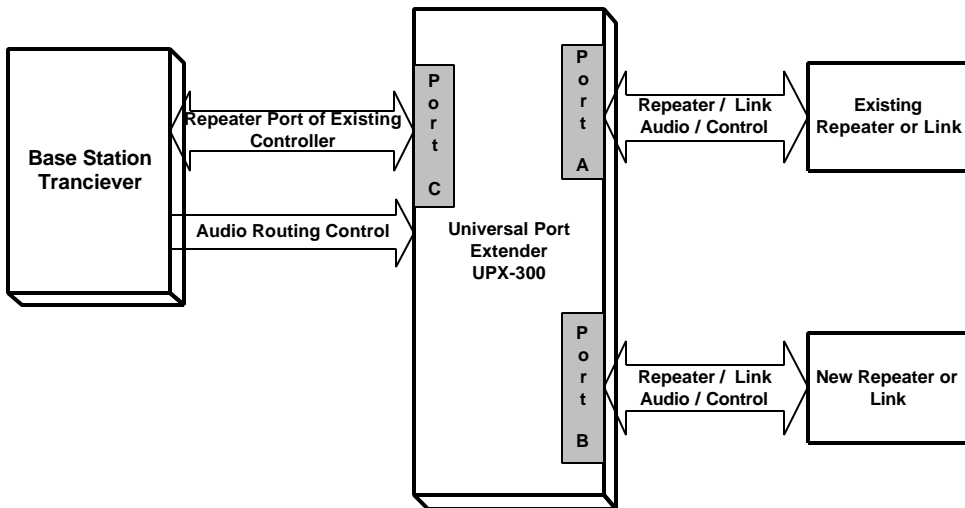
- Options Available**
- Repeater Controller
 - Voter
 - Custom Controller Functionality

UPX-300 Use and Applications Diagrams

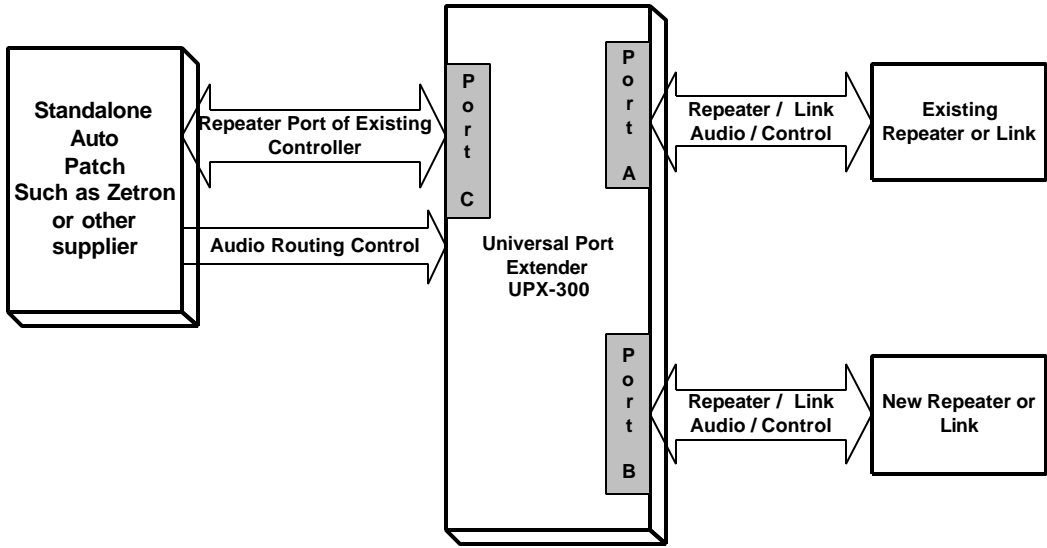
**K²RF Universal Port Extender
Application to Extend Port on
Existing Controller
January 17, 2001**



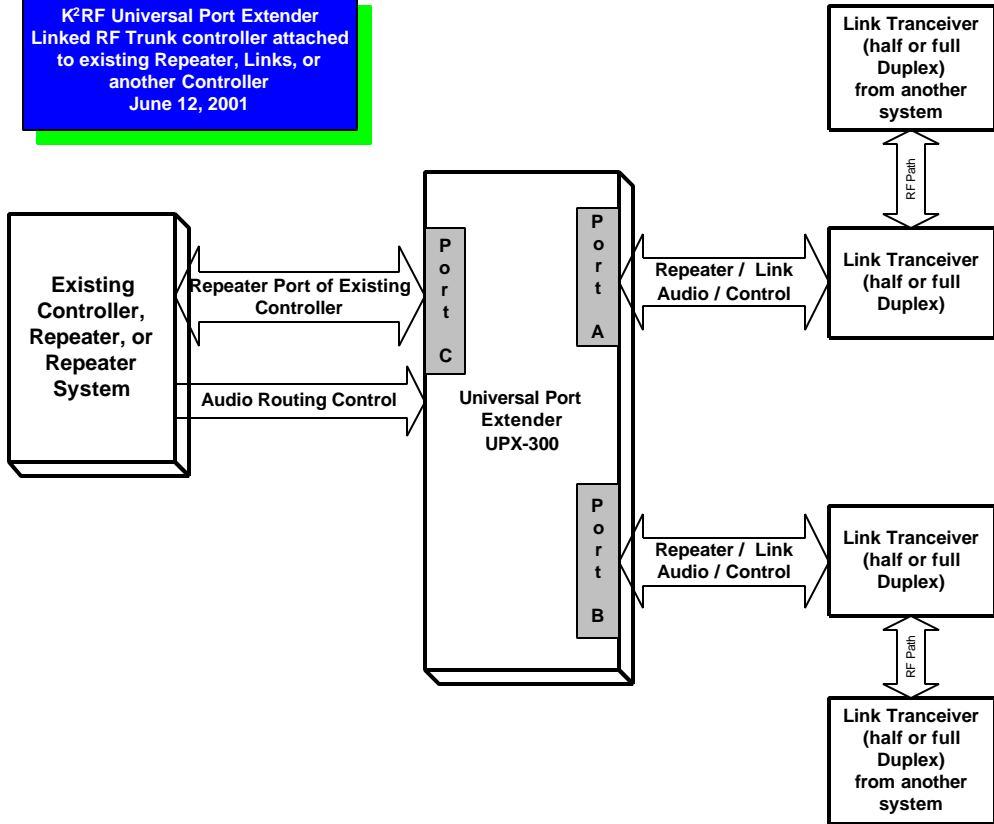
**K²RF Universal Port Extender
Application to Remote Base Control
of Repeater or Links
January 17, 2001**



**K²RF Universal Port Extender
Application for adding an Autopatch
to existing Repeater or Links
June 12, 2001**



**K²RF Universal Port Extender
Linked RF Trunk controller attached
to existing Repeater, Links, or
another Controller
June 12, 2001**



Application Notes

Example of an adjustable COS Circuit for use with just about any Receiver. This circuit may be attached to any squelch switch and will not load down or alter the circuit performance. It is adjustable to nearly any trigger level. K²RF also markets this as a finished product.

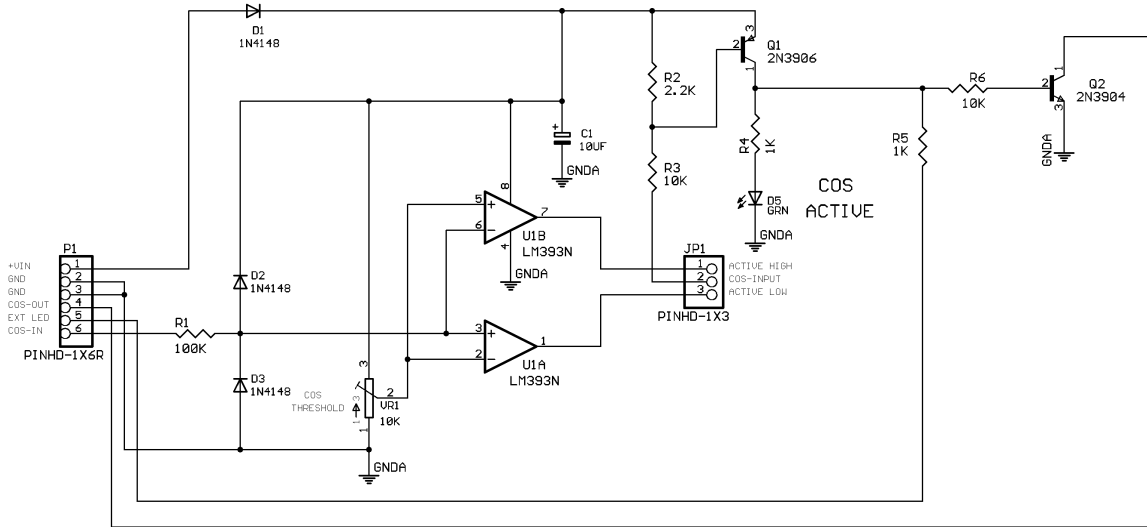


Figure 1

This circuit is provided as a standard unsupervised driver circuit for input of COS to the K²RF UPX-300 or any controller product requiring an active ground signal for valid COS input (or valid PL input).

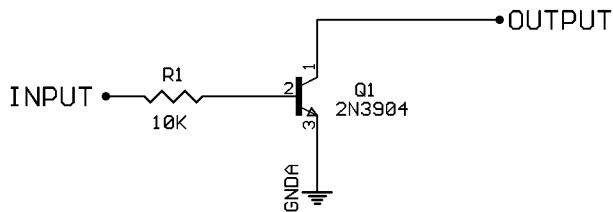


Figure 2