Interfacing the Yaesu DR-1X

With

The S-Com 7330 Repeater Controller

For a Feature-Rich

Digital and Analog Experience!

A Technical Writing by

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Version 2

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Introduction

As many of you are probably aware (and the reason for you reading this) the DR-1X was designed to use its internal controller to handle all of the repeat functions. There was initially no thought put into making the repeater compatible with any repeater controller outside of simple enable/disable repeat functions that need to be available to control operators. There has been progress made, but when using a "real" external controller things get more complex when you would like to utilize the digital voice/data functions that are the centerpiece of Yaesu System Fusion. The problem is that the repeater cannot process external PTT, remote control, or AMS/FM mode changes simultaneously. It also cannot process an analog call from a controller while in AMS mode. Any of these events will lock the repeater up and require a trip to the repeater site to reset the power. The problem is so severe that one controller manufacturer designed and produced an external logic board to intercept and apply these external signals with the proper timing. A couple of drawbacks to that approach is that it doesn't allow flexibility for things like remotely disabling digital mode during Skywarn nets, for example, or for making quick adjustments if Yaesu issues a firmware update that requires a different application of signals.

Luckily, as a 7330 owner, you have a controller flexible enough to apply the necessary signaling as long as you wire everything up correctly and load the supplied script kit found on page eight. This method gives you the ability to lock into analog mode based on a schedule, or any other application you can dream up. In fact, there are many features that can be modified, added, or removed. Some of these features are listed on the next page.

Before we get started one additional thing I'd like to mention is that the DR-1X, from the factory, has a very tightly aligned squelch. When set at the lowest usable setting, the squelch abruptly cuts off near the 20dB quieting level, which means that you'll not be able to hear mobile stations in analog mode near the fringe of the repeater. In addition, the squelch has a pretty slow (and sometimes erratic) closure timing which lets a noticeable squelch crash come through at the end of each analog transmission. It is possible to re-align the squelch to allow weaker signals to pass, but that is beyond the scope of this document. Luckily, you can add your own (better) squelch circuit. Using a good squelch board will increase your receiver coverage area by about 15-20%. (Note: It does not appear to me that the internal squelch setting affects the processing of digital signals in any way, as long as you set the squelch to the first notch above minimum (wide open). The add-on squelch will apply only to analog signals that are processed by your 7330).

When you have completed the hardware wiring and applied the Script Kit to your own program, you will have a DR-1X repeater that works locally in digital mode, and can be linked in an analog system in FM mode.

Features Included In the 7330 Script Kit:

- Defines three operating modes: Idle (AMS or Analog), Digital, and Analog Hold.
- Runs the repeater in AMS mode when idle, unless AMS mode is locked out by a control operator.
- Locks the 7330 PTT until an analog call or ID message is detected and there is currently no digital call in progress.
- Upon originating an analog call, delays the external PTT 90 milliseconds until FM analog mode is selected.
- During an analog call, or immediately after an analog ID/message, the 7330 holds analog mode active for five seconds after the transmitter drops. This speeds the transmitter response time during a conversation (bypasses the above-mentioned PTT delay).
- Analog call late entry. At the end of a digital call, if there is ongoing analog traffic coming in via another 7330 port you will join that conversation in progress within two seconds.
- Digital call late entry. At the expiration of the analog mode timer, an in-progress digital transmission will be repeated normally.
- Uses Logic Output 8 as a digital call indicator (Can be deleted but I like blinky LED's).
- Provides a PTT Master Disable/Enable function, since we use the normal PTT enable/disable to lock the PTT to prevent freezing the DR-1X.
- Provides an AMS Master Disable (Forces analog full-time).
- Allows you to link with any or all of the other two ports with no mode conflicts.
- Provisioned for an external relay on Logic Output 2 to remotely reset the DR-1X if needed. If your DR-1X is on a mountain top, you need this.

There are two parts of the install:
- The Interface Wiring.
- The 7330 Program Script to handle mixed-mode call processing.

Items you will need:
- DR-1X Repeater
- S-Com 7330 Controller
- Masters Communications SC-50 CTCSS decoder/Micor Squelch Board ($100)
- Soldering equipment and skill
- Duplexer, rack space, tower location, all of that jazz ;)
- The script kit at http://ks0lnk.net/documents/DR1X_script_kit.txt

Optional (but highly recommended) Items:
- Yaesu cable part number T9101626 (to replace the one you cut into)
- A 12V DC relay cable of 20+ amps with a flyback diode across the coil

The SC-50 will be used to supply the 7330 with CTCSS decode logic that is independent of valid digital signals. This is required because Pin 3 on the DR-1X goes active if there is valid CTCSS/DCS/Digital activity. We need a way to distinguish between analog and digital signals, and in FM mode CTCSS is the only thing we care about, and the SC-50 provides that logic for us.

Note: If you really want to use DCS, you'll need to follow the same advice pertaining to the DR-1X's DCS setting (use an odd code nobody knows about) and instead of using an SC-50, obtain and use a DCS-23 or similar external DCS encoder/decoder set to the code you wish to use over the air. Minor wiring changes (not detailed in this document) will be required.

This document details how to install the SC-50 due to its superior CTCSS filtering and anti-falseing characteristics and the built-in Motorola Micor squelch chip, which is the best squelch circuit ever designed. Other vendors such as RLC, CAT, and NHRC have their own squelch boards but the SC-50 is the only product that has squelch and CTCSS decoding on a single board. This simplifies wiring and installation.

One other important advantage to using an outboard squelch is that if you need to remotely reset the DR-1X using a relay on the power input, you can do so because the DR-1X continues to output discriminator audio even while it's locked up, which means the audio, COR and CTCSS signals reach the 7330. If your 7330 has links or repeaters on the other ports, you can issue the reset command from those ports as well.

Note: I do not recommend using the Communication Specialists TS-32 or TS-64 CTCSS decoders due to inadequate high-pass filtering of higher CTCSS tones. This is causing CTCSS decoding issues on some users FTM-400 and FT-1D radios, and possibly others. The SC-50 has been tested in this configuration and does not exhibit this behavior.

SC-50 Wiring and Configuration
The SC-50 needs to be wired between the DR-1X and the S-Com 7330 as shown on the diagram on the following page.
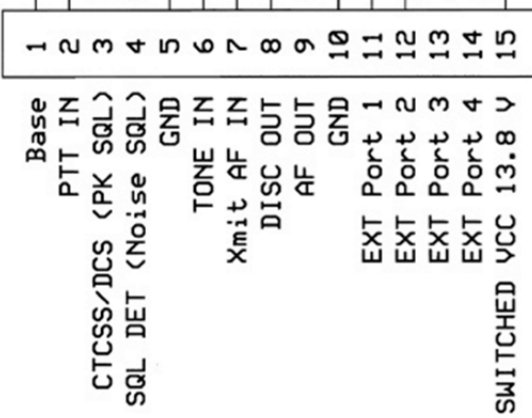
There are two shunt jumpers on the SC-50. You should place the shunts on SJ1 and SJ3 positions.

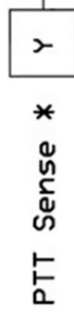Set the dip switches to select your desired CTCSS decode tone.
See: http://masterscommunications.com/products/squelch/txt/DIP.txt

The SC-50 is available with or without the female DB25 connector. You can use less space inside the DR-1X by ordering one without the connector.
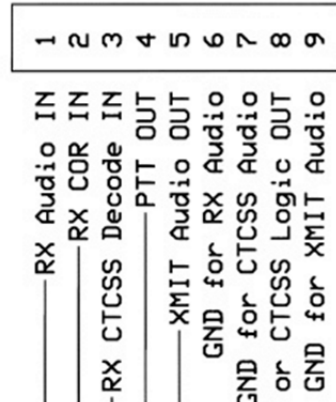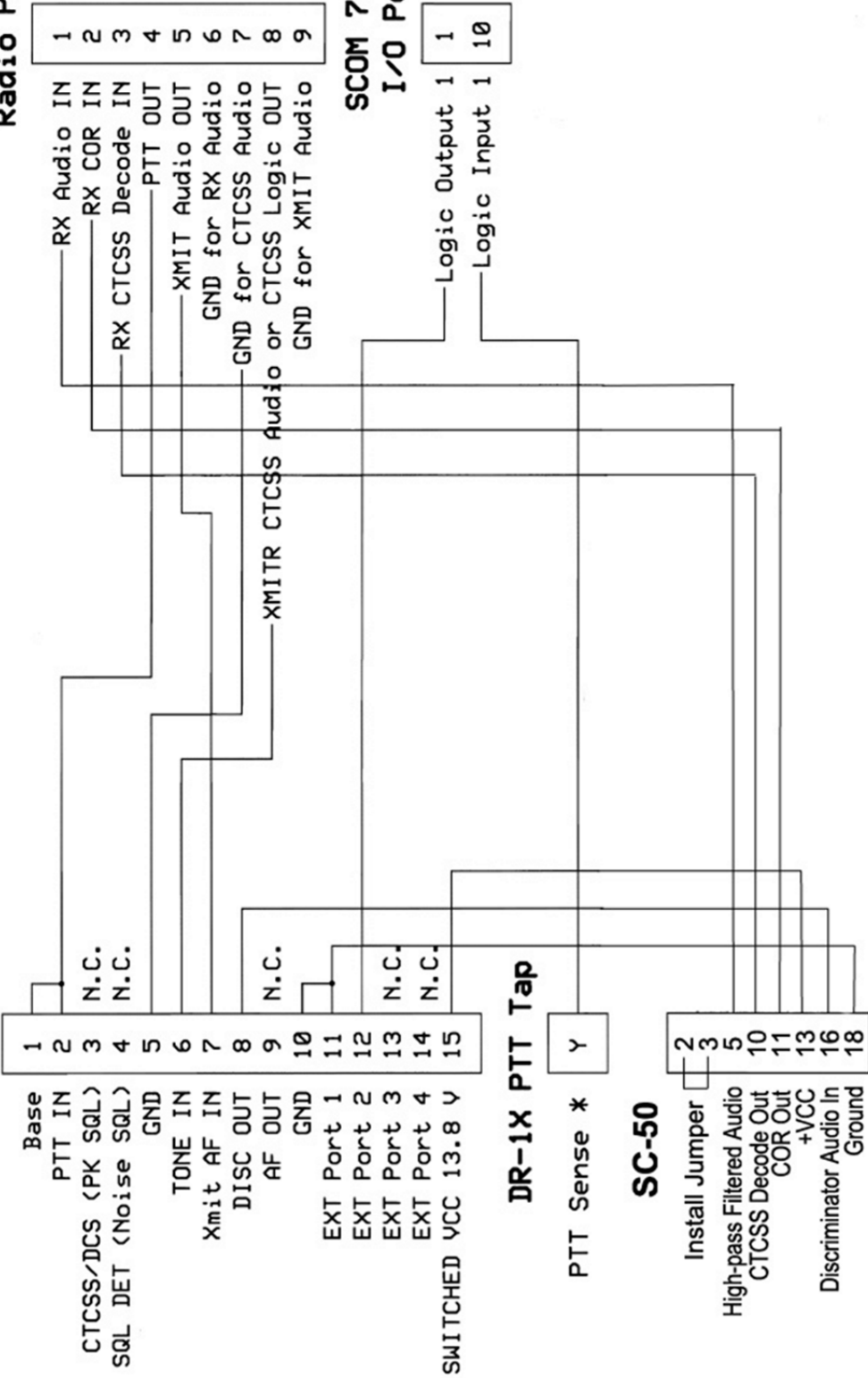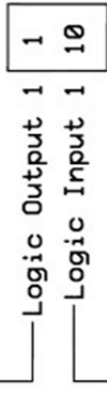
DR-1X DE15HD Male

Pin	Signal	
1	Base	
2	PTT IN	
3	CTCSS/DCS (PK SQL)	N.C.
4	SQL DET (Noise SQL)	N.C.
5	GND	
6	TONE IN	
7	Xmit AF IN	
8	DISC OUT	
9	AF OUT	N.C.
10	GND	
11	EXT Port 1	
12	EXT Port 2	
13	EXT Port 3	N.C.
14	EXT Port 4	N.C.
15	SWITCHED VCC 13.8 V	

DR-1X PTT Tap

Pin	Signal
Y	PTT Sense *

SC-50

Pin	Signal
2	Install Jumper
3	Install Jumper
5	High-pass Filtered Audio
10	CTCSS Decode Out
11	COR Out
13	+VCC
16	Discriminator Audio In
18	Ground

SCOM 7330 Radio Port

Pin	Signal	
1	RX Audio IN	
2	RX COR IN	
3	RX CTCSS Decode IN	
4	PTT OUT	
5	XMIT Audio OUT	
6	GND for RX Audio	N.C.
7	GND for CTCSS Audio	
8	GND for CTCSS Logic OUT	
9	GND for XMIT Audio	N.C.

XMITR CTCSS Audio or CTCSS Logic OUT

SCOM 7330 I/O Port

Pin	Signal
1	Logic Output 1
10	Logic Input 1

* PTT Sense is intercepted by tapping onto the yellow wire inside the cable going to the TX radio's data jack, or by soldering the connection to TX Main Board at the point where the DIN jack is soldered. To preserve your warranty, it is recommended you order a spare cable.

CREDIT goes to Justin Reed NV8Q for providing original schematic

DR1-X to SCOM 7730		
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About the PTT Sense wire: What is it?

PTT Sense is DR-1X's internal PTT line, which connects between the front USB-like plug on the front of the receive radio and the DIN plug on the rear of the transmit radio. This signal is carried on the yellow wire within that cable. The Internal PTT goes low when active. You need to tap this signal because the 7330 will trigger an event macro when this line goes low to check to see if the 7330 generated this PTT or not, and this is how we determine whether the call is digital or analog.

There are two ways you can tap into the Internal PTT. You can either carefully open the cable's jacket and shielding and scrape enough insulation off the yellow wire to tack solder a wire to it, or you can remove the transmit radio, open it up, and tack solder a wire directly to the DIN connector pin where it is soldered to the main board of the radio. Both of these methods probably violate your warranty, but if you are careful enough soldering to the main board, you should be able to remove the wire (and the evidence) should you need to send the unit in for repair. You can also call Yaesu USA parts and order part number T9101626 if you need a spare un-modified cable.

DR-1X Configuration and Setup

Reference the DR-1X Operating Manual to configure the following parameters.
- Input your callsign
- Carefully input your uplink frequency (the frequency the repeater receives) and the downlink frequency (the frequency the repeater transmits on)
- Set Remote mode ON
- Set the DCS Receive tone ON and the Transmit tone OFF
- In the Signaling menu, select a DCS code that is NOT likely to be used. It is critical that this code be kept secret and never used.
- You can set any DSQ Code you like, but to make it easier on travelers I recommend leaving it OFF unless you have co-channel interference from another Fusion repeater. (Note: The DSQ code is not a DCS/DPL code. It is used in digital mode only.)
- Enable 1200 baud packet mode. Most DR-1X's come from the factory set to 9600 baud. The external transmit audio path bypasses the pre-emphasis stage in 9600 baud mode, so unless you plan on adding your own pre-emphasis you will want to use 1200 baud or else your transmit audio will sound muddy.

SC-50 Squelch

Setting this squelch is simple. With the DR-1X powered up and no signal present, adjust the ¾-turn pot on the SC-50 until the COS LED on the SC-50 extinguishes, then go just a smidge farther. This should be a good starting point until you're ready to fine-tune with a service monitor during audio level adjustments.

7330 Configuration

Now you'll need to configure a few jumpers inside the 7330. The locations of these jumpers are highlighted on the following page. It should be noted that my DR-1X is installed to Port 2 of my 7330. These instructions are written for Port 2, so you'll need to make the appropriate changes if you are on a different port.

Logic Input Pullup
- ☐ Remove the J4 IN-1 jumper (to avoid biasing the DR-1X internal PTT)

Radio Interface J11 jumpers (if you are using Port 2)
- ☐ De-emphasis
- ☐ High Output
- ☐ Delay
- ☐ Set the delay pot to about 1/3 clockwise and fine-tune from there during audio setup.

CTCSS/Logic Out jumper
- ☐ Select CTCSS (The 7330 generates the CTCSS signal)

COR/CTCSS Inversion jumpers
- ☐ COR and CTCSS inversion jumpers should both be installed for this port. My configuration has the pull-up jumper installed for CTCSS but not COR.

7330 DR-1X Script Kit

The always up-to-date script kit is at http://ks0lnk.net/documents/DR1X_script_kit.txt
The script kit requires S-Com version 3.4.1 or later. If you have an older version, you will have to upgrade to this version for this script kit to work. Cut and paste the script kit into Notepad and replace (MPW) with your actual Master Password, re-name the (MAC1) through (MAC5) macros, then cut and paste the script immediately below the line that sets your master password. This script also requires Macro-only password decoding to be enabled, and assumes you have no macro named D999 which is used to exit a true Boolean with no action taken.

The script kit uses the following resources:
- User softswitches 293 through 296
- User timers 08, 09, and 11
- Logic input 1 (DR-1X internal PTT sense)
- Logic Output 1 (AMS/FM Mode Select)
- Logic Output 8 (only an indicator light for Digital Call Active)
- Macros D700 through D719, plus four more for Master PTT disable and Master AMS disable.
- Your custom ID's hang timers, courtesy tone, CTCSS configuration, etc.
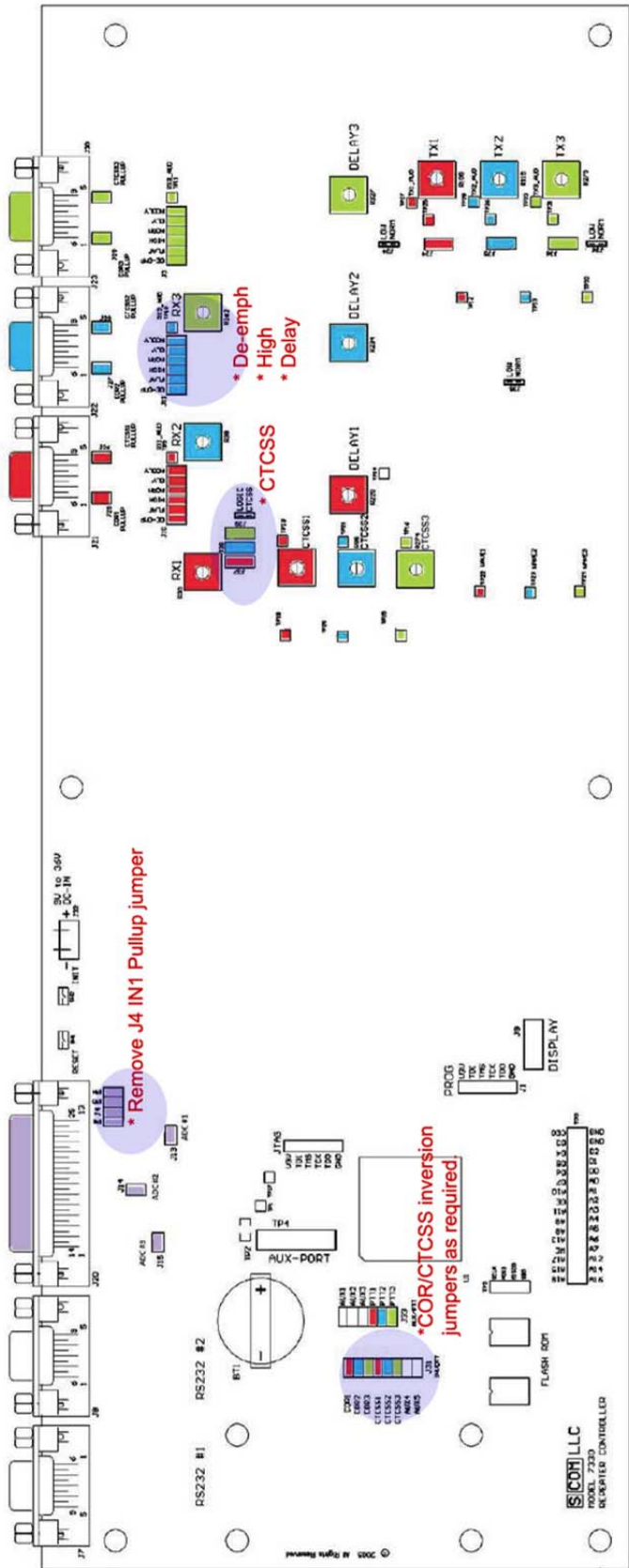
7330 Audio Level Alignment

With the DR-1X transmitter terminated into a 50 ohm load, or a service monitor, inject a an RF carrier modulated with a 1 khz tone deviated at 3 kHz with the proper CTCSS tone into the receiver. Adjust the RX2 pot until you get 355mV AC at the test point. With an unmodulated carrier, adjust the CTCSS encoder pot for the proper level (about 650 hz deviation) and then set the TX Audio pot for 1:1 deviation at 3 khz input deviation.

If you don't have a service monitor, get one. But until then, you can get close by using a DTMF key on your handheld to set the RX Audio level near 355mV AC at the test point, and then setting the CTCSS level about 1/3 clockwise, and the TX Audio pot so that the repeated audio sounds the same level as the audio on the input frequency.

Enjoy!

Photo of SC-50 Mounting Location