A solution for connecting the Yaesu DR1X or DR2X repeater to an SCOM 7330 Controller while retaining Auto Mode Select

Bob DeMattia, K1IW

Introduction

The Minuteman Repeater Association operates several repeaters across Eastern and Central Massachusetts. These operate as part of a configurable network, with some repeaters linked full-time and others part-time. The linking at each site can be turned on and off by a timer, or by commands made available to club members. When we upgraded one of our repeaters to a Yaesu, we wanted to offer the option of digital mode, while still retaining our repeater network linking ability.

Our first attempt was with the DR1, which was the beta version. It was quite a struggle to get it to operate in both digital and analog mode while still working with our network. The DR1*X* made things easier by fixing some of the glitches in the DR1. The DR2X made things even easier.

The big difference between the DR1X and DR2X when using them with a 7330 is the behavior of the receiver when the external PTT signal on the rear connector is asserted. On the DR1X, if the repeater is in auto mode select (AMS) mode when the PTT asserts, the receiver radio in the repeater switches to the transmit frequency, which then locks up the repeater. The solution to this is to use the rear connector EXT1 and 2 inputs to place the repeater into FM-Fixed mode when using the rear connector.

Yaesu Input		**Resulting Yaesu Mode**	
EXT2	**EXT1**	**RX**	**TX**
L	L	AMS	AMS
L	H	Digital	Digital
H	L	FM	FM
H	H	AMS	FM

Note that only EXT2 needs to be changed to switch between FM-Fixed and AMS.
EXT1 is low for both conditions.

The DR2X does not exhibit the receiver-frequency change problem, so it can be left in AMS mode all the time

The remainder of this paper describes our 7330/Yaesu implementation. It can be used with either a DR1X or DR2X with only a small difference in the wiring. The 7330 programming is simpler for the DR2X.

Important Note about DR1x Firmware Revisions: For US-market repeaters, there are two active code lines. The "1.00" code line is at revision "n", thus 1.00n. The "1.10" code line is at revision "Q", thus 1.10Q. This document supports 1.10Q firmware only. To switch the repeater across the code lines, the unit must be sent to Yaesu – you cannot self-update a repeater with 1.00 firmware to 1.10 firmware. **Only the 1.10Q firmware has been tested**.

What you get

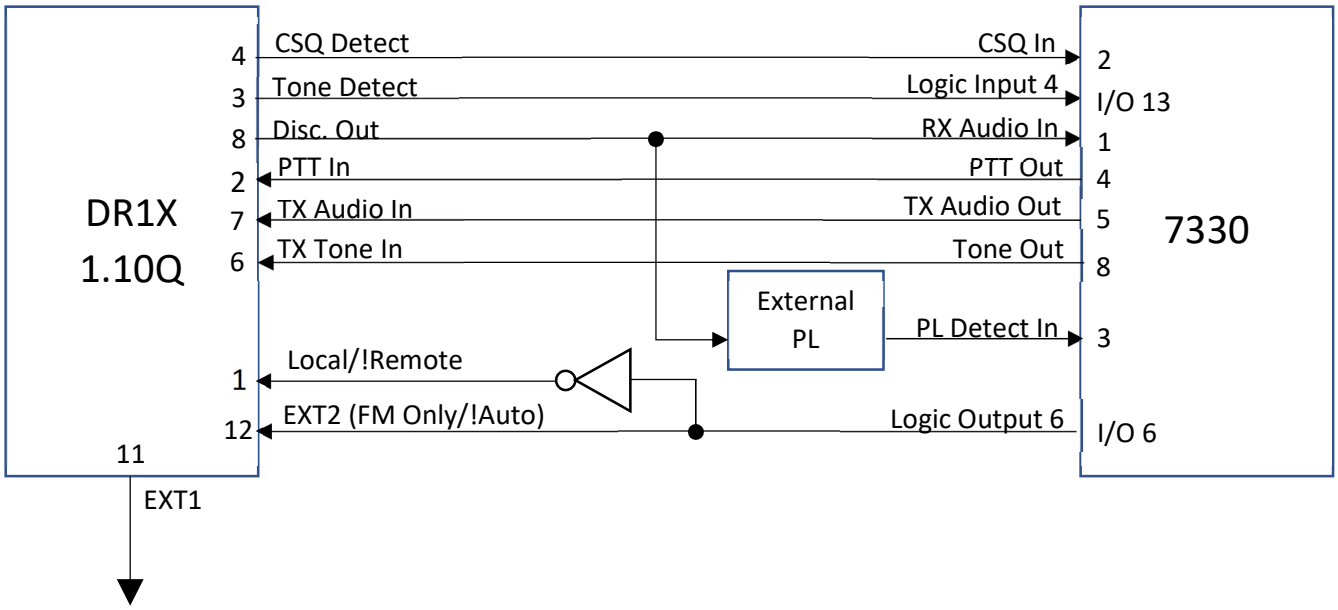
With this implementation, you will get a repeater which can operate locally in either System Fusion/Digital mode or FM Analog mode using the internal controller and can also operate through the 7330 to link to other repeaters, Echolink, or IRLP. Repeater users can select whether they want to operate locally or linked via the CTCSS tone they use to access the repeater.

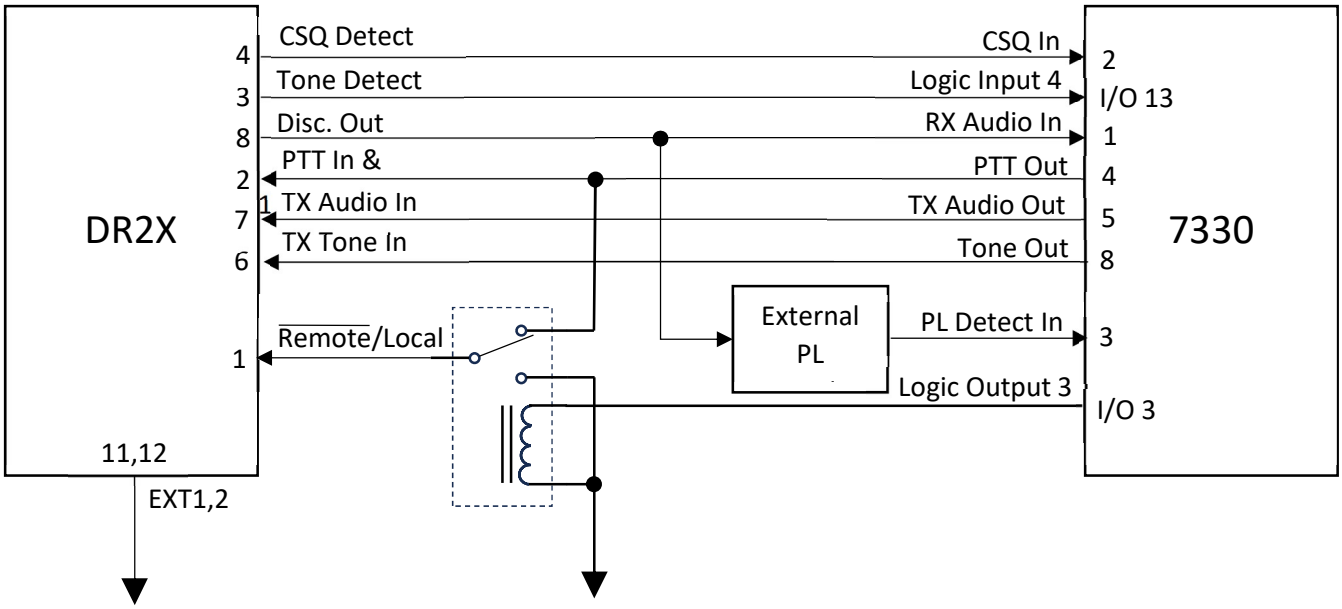
Input Type	Repeater Controller by	7330 Linking
Digital	Yaesu Internal Controller	Disabled
"Local" Tone	Yaesu Internal Controller	Disabled
"Linked" Tone	SCOM 7330	Enabled

Hardware Requirements

You will need to build a cable to go from the Yaesu to the 7330. The Yaesu features a 15-pin D-sub connector while the 7330 of course has a 9-pin D-sub. To provide the dual-CTCSS tone capability, you will also need to build an external tone decoder into the cable. Always set the external tone decoder to a different tone than the DR1X's RX tone.

Note: The transmitter tone will be the tone set inside the Yaesu when in local mode and will be the tone generated by the 7330 when in external controller mode. If you want to keep the TX tone constant, simply set the 7330 to match the Yaesu. If you would like the TX tone to follow the RX tone, set the 7330 tone to match the tone programmed into the external tone encoder board.





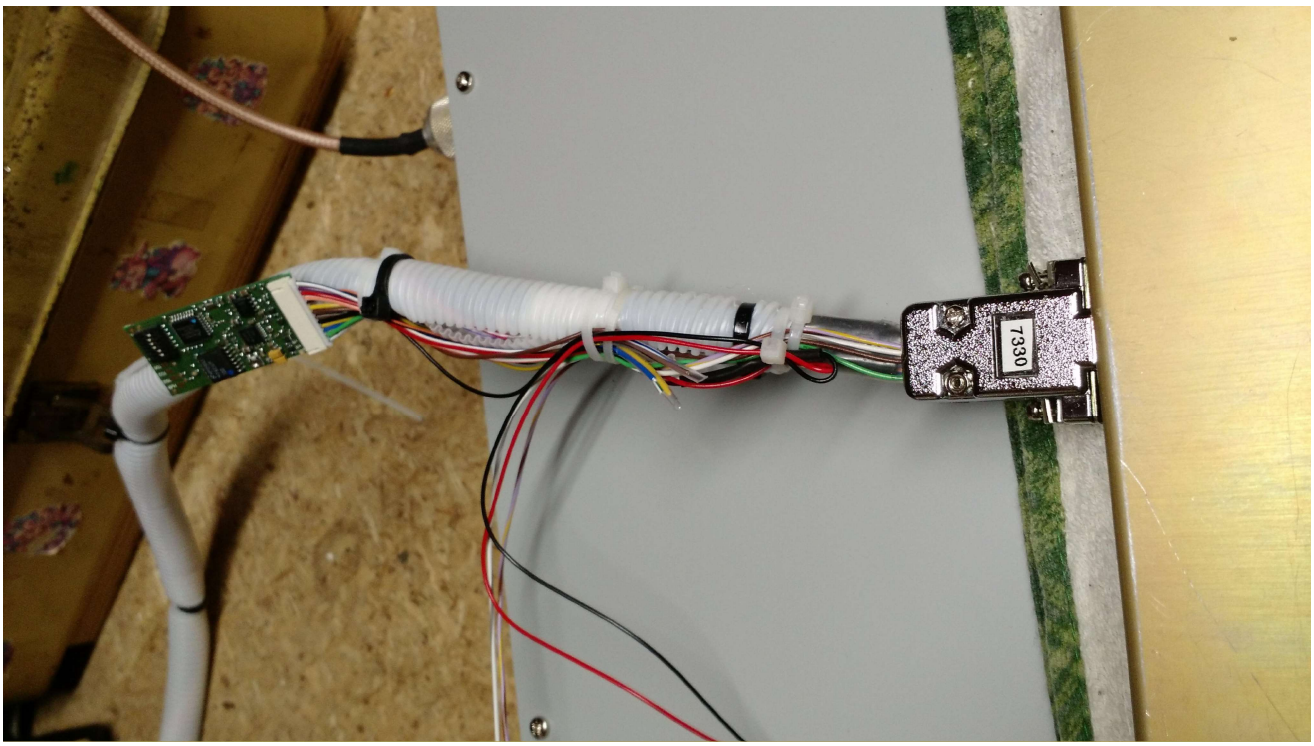
The tone detect output from the repeater goes to a logic input. We used logic input 4. This can be used to monitor internal/digital mode activity. It can be used in conjunction with a timeout timer to set the repeater back to external/7330 mode after a period of inactivity.

For DR1X installations, a 7330 logic output must drive both the Remote/Local and EXT2 inputs of the repeater. Unfortunately, the state of these two signals must always be opposite. LO6 drives pin 12 directly and is inverted into pin 1. To accomplish the inversion, an NPN transistor will suffice – emitter to ground, collector to Remote/Local, and the logic output through an 82K ohm resistor to the base. We used logic output 6. You can use different I/Os, but the example code in the following chapters is designed for logic input 4 and logic output 6.

Since the DR2X can stay full-time in AMS, on the DR2X you can tie EXT2 to ground instead of driving it with a 7330 output. If you wish to retain full flexibility, drive both EXT1 and EXT2 with 7330 outputs. In our application, we did not need to do this. The above DR2X diagram shows an optional relay for the remote/local line. This gives you the ability to disable the internal mode on the Yaesu. When the relay is energized, remote mode is always selected which disables the internal controller. When the relay is off, the DR2x seamless transitions from local to remote mode whenever the external PTT is active. If you don't want to install the relay, simply connect pins 1 & 2 of the Yaesu to the PTT line.

We used a Communication Specialists TS-64WDS tone encoder-decoder, but you can use a different one. Tone filtering in our system is accomplished elsewhere, so we did not use this feature on the CommSpec board, nor did we use its encode capability.

Please note the above diagram does <u>not</u> show power or ground connections. You can power both the tone decoder and 7330 from the Yaesu's V+ on pin 15 of its rear connector – or use a separate power supply. Be sure to wire your grounds correctly to avoid ground loops.



The Yaesu-7330 cable prior to final coverings, showing the installed external tone decoder.

We power the 7330 and tone decoder pin 15 of the Yaesu – you can see the power and ground wires exiting to left of the photo, as well as the grey/white and violet/yellow wires which go to the I/O plug, connecting to logic input 4 and logic output 6.

Setup

There are two tones – the "local" tone which you program in the Yaesu, and the "linked" tone, which you set on the external tone decoder. As previously mentioned, if you want a constant TX tone, set the 7330's tone frequency to match the Yaesu. If you want the TX tone to follow the user's tone, set the 7330 to match the external tone decoder.

Remember to enable "Remote" mode on the Yaesu using its front-panel. Also remember to set the jumper in the 7330 so that the tone output pin is an analog tone, not the digital output.

DR1X Controller Programming

To make a DR1X installation work properly, the 7330 must keep EXT2 transitions away from times when the repeater is transmitting. This is done by disabling the 7330 PTT output before any changes to the logic output pin.

The assumptions we have for this programming is dictated by the cabling described in the earlier section:

- Yaesu on Port 1
- Link Radio on Port 3
- Yaesu Carrier detect drives the 7330 COR input
- The external tone decoder drives the 7330 tone detect input
- Yaesu tone detect drives Logic Input 4.
- For DR1X, the 7330's LO6 drives Local/Remote directly, and hardware in the cable inverts EXT2.
- For DR2X, the 7330's PTT drives Local/Remote as well as the PTT input

```
MPW 26 0065 D010*                    //EVENT_LI3_HL   GO_INTERNAL;
MPW 26 0117 D000*                    //EVENT_RX1PL_HL GO_EXTERNAL;
MPW 20 D010 DD 76 04 0204 9999 AC07* //GO_INTERNAL:     IF_RX2CTCSS  NOP GO_INTERNAL_OK1;
MPW 20 D011 DD 76 03 0098 9999 AC08* //GO_INTERNAL_OK1: IF_USER_SW98 NOP GO_INTERNAL_OK2;
MPW 20 D012 DD 76 03 0097 9999 AC4B* //GO_INTERNAL_OK2: IF_USER_SW97 NOP GO_INTERNAL_OK3;
MPW 20 D013 DD 76 04 0205 9999 AC4C* //GO_INTERNAL_OK3: IF_TX2CTCSS  NOP GO_INTERNAL_OK4;
MPW 20 D014 DD 27 D010 DD10*         //GO_INTERNAL_OK4: RENAME GO_INTERNAL XGO_INTERNAL
MPW 29 D014 DD 63 0112 0*            //                 TX1_DISABLE
MPW 29 D014 DD 98 0 20*              //                 PAUSE 20
MPW 29 D014 DD 71 06*                //                 LO6_OFF
MPW 29 D014 DD 27 DD00 D000*         //                 RENAME XGO_EXTERNAL GO_EXTERNAL;
MPW 20 D000 DD 27 D000 DD00*         //GO_EXTERNAL:     RENAME GO_EXTERNAL XGO_EXTERNAL
MPW 29 D000 DD 63 0112 0*            //                 TX1_DISABLE
MPW 29 D000 DD 98 0 20*              //                 PAUSE 20
MPW 29 D000 DD 70 06*                //                 LO6_ON
MPW 29 D000 DD 98 0 20*              //                 PAUSE 20
MPW 29 D000 DD 63 0112 1*            //                 TX1_ENABLE
MPW 29 D000 DD 27 D002 AC06*         //                 RENAME XGO_INTERNAL GO_INTERNAL;
```

How it works:

(1) When RX2PL is received, the 7330 switches to external (analog) mode if needed.
(2) When internal PL is received (LI3 goes low), the 7330 switches to Yaesu internal mode if needed.
(3) Notice that when switching the state of LO6, TX1 is disabled 2 seconds prior. It also waits two seconds after the switch before it is enabled. This prevents the DR1X from locking up.
(4) On some DR1X's, the internal tone decode signal goes active when you key its transmitter. This would confuse the 7330, so there are several checks before the GO_INTERNAL routine can be completed. If any check fails, the 7330 keeps everything in external mode. Not all DR1x's need these checks.

DR2X Controller Programming

Because we do not need to change EXT2 on the DR2X, we don't need to keep the logic output and PTT output transitions separated. And because the DR2 is always in AMS mode, its tone detect pin is always valid for either digital or the

programmed tone in the Yaesu. No special code is needed to switch between digital and 7330-operated analog mode. If you want to disable the Yaesu internal controller, you can implement the optional relay described earlier, then turn on the logic output that energizes the relay.

If your 7330 links between the Yaesu Repeater Port and other Ports

If you link some of your 7330 ports together, you will want to disable this linking when the Yaesu internal controller is active.

For the DR1X, you won't need any additional 7330 macros to do this; the linking will be disabled by default.

For the DR2X, you will need to disconnect the linked ports when Yaesu internal controller is active. In our example, this is detected by a low of logic input 4. There is also a timer that resets the link after six minutes of inactivity.

Depending on how you manage the shutdown mode of your repeater, you will probably have to modify the simple "ENABLE_PATH" and "DISABLE_PATH" lines in the example. On our system, when we shut down the repeater we also turn on logic output 3 to disable the Yaesu internal function. In the YSF_GO_EXTERNAL routine below, we test the state of LO3 before enabling the path. For clarity, this is left out in the example.

```
MPW 49 09 03 3600*          //SET_TIMER_UT9  3600 // 6 minutes.
MPW 49 09 02 AC9B*          //EVENT_UT9      GO_EXTERNAL
MPW 26 0067 AC9C*           //EVENT_LI4_HL   GO_INTERNAL; // YSF local PL or digital signal active
MPW 26 0217 AC9B*           //EVENT_RX2PL_HL GO_EXTERNAL;
MPW 20 9000 DD 49 09 00*    //YSF_GO_EXTERNAL:  STOP_UT9            //no need for timeout in analog
MPW 20 9000 DD 63 0241 1*   //                  ENABLE_PATH_RX1TX2
MPW 29 9000 DD 63 0142 1*   //                  ENABLE_PATH_RX2TX1
MPW 20 9001 9999*           //YSF_GO_INTERNAL:  NOP
MPW 29 9001 DD 49 09 01*    //                  START_UT9_RETRIG    //restart YSF timeout timer
MPW 20 9001 DD 63 0241 0*   //                  DISABLE_PATH_RX1TX2
MPW 29 9001 DD 63 0142 0*   //                  DISBLE_PATH_RX2TX1
```

Note that if you have configured different PL's for the Yaesu internal and the external decoder, users can have local QSO's, even in analog mode, by using the Yaesu internal PL. The 7330 does not distinguish between local QSO's using analog and those in YSF.