

# 9600 Baud Operation

## Interfacing the Kantronics **DataEngine** and **DVR2-2** Transceiver with the **G3RUH** External Modem

by Phil Anderson, **WØXI**, and Karl Medcalf, **WK5M**

May 21, 1990

Lawrence, Kansas

Over the last month or so, we've conducted a number of on-the-air tests with the **G3RUH modem**<sup>1</sup> in combination with the Kantronics **DataEngine** and the Kantronics **DVR2-2 2-meter** data/voice transceiver at 9600 baud. **After** the usual initial false **starts** we found the combination to work quite well. We passed a large number of **10K** files in transparent mode **from** **WK5M's** station to my **PBBS** (mailbox in my **DataEngine**) without error. Additionally, we performed some **informal** bit error rate (**BER**) tests on the link, finding results comparable to those listed in Steve Goode's (**K9NG**) paper?

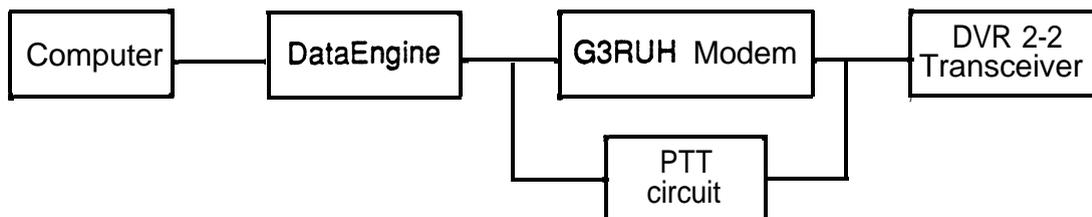
While additional detailed BER testing is called for to obtain a firm measure of the capability for 9600 operation by the combination listed above, additional on-the-air testing by more stations is desirable. Hence, we present the details of interfacing the **DataEngine** (**DE**) and **DVR2-2** with the external **G3RUH** modem (**RUH**) to facilitate these tests.

Building the 9600 baud station consists of wiring four interfaces:

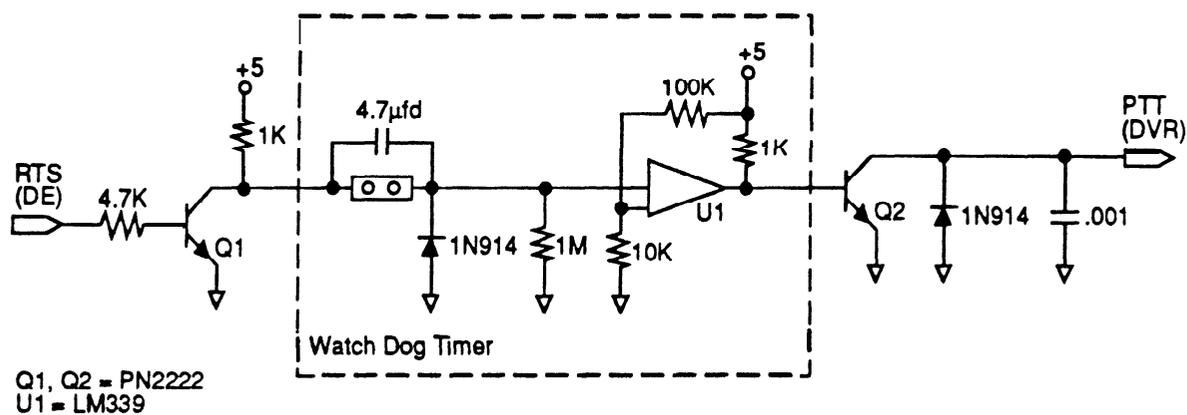
- your computer to the **DataEngine**,
- installing internal disconnect header jumpers within the **DataEngine**,
- **DataEngine** to **RUH**, including a **push-to-talk** circuit,
- and **RUH** to **DVR** cabling.

The combination is shown in Figure 1. If you have a **DataEngine** already, the computer to **DataEngine** interface/cabling is probably operational. Since the **RUH** modem assumes **push-to-talk (PTT)** circuitry is provided by the **TNC**, you'll have to add that somewhere. On our initial tests, we wired a **PTT** circuit directly to the **RUH** printed circuit (**pc**) board; however, at this point, we'd suggest that you consider adding the **PTT** to the internal wiring of the **DataEngine**. The **PM circuit** is depicted in Figure 2.

**FIGURE 1. 9600 baud station: Kantronics DataEngine, G3RUH external modem and the Kantronics DVR2-2 transceiver**



**FIGURE 2. Addendum Push-To-Talk and Watchdog circuitry\***



## DataEngine Interfacing

The **DataEngine** was designed to accept a wide range of modems. **Two** pairs of disconnect headers on the main **pc** board can accommodate two modems within the case environment, assuming physical compatibility. (A family of **Kantronics'** designed modems are planned for internal installation – one DE1200 is now shipped with each DE). However, existing modems, such as the RUH, are already on a pc board and hence must be interfaced outside the **DataEngine** case. In these cases, jumpers must be installed inside the DE at the disconnect

header pairs to match external modem characteristics/needs. For more information, refer to the DE Operator's **Manual**<sup>3</sup>. Then, a cable must be prepared to go between the DE DB-15 back panel connector and the RUH headers.

### Internal disconnect headers

Figure 3 denotes the necessary jumpers required between the two internal disconnect headers. You may wire either port 1 or port 2, or if you like you may wire both ports for 9600 baud operation! The **DataEngine** is fully capable of handling simultaneous operation of both ports at once.

**FIGURE 3. Internal jumpers required for a 'Type C Modem' external attachment to the DataEngine.**

INT pin	EXT pin	Comment
3	3	TXD, transmit data (to external)
4	4	RXD, receive data (from external)
6	6	RTXC, receive clock (from external)
7	7	RTS, push-to-talk * (to external)
9	9	DCD, carrier detect ( <b>from</b> external)
13	13	<b>TOUT2, 16X</b> T clock (to external)
15	19 (gnd)	MSO, modem addr jumper (internal)
16	19 (gnd)	MS1, modem addr jumper

\* If the **PTT** circuit is wired internal to the DE, then drive the **PTT** circuit **from** pin 7 of the INT header and pass the **PTT** output to pin 7 of the EXT header. If you wire the **PTT** on the RUH modem board, then just jump INT 7 to EXT 7. See Figure 2 for suggestions.

Each pair of disconnect headers is labeled INT (internal) and EXT (external). For example, on the pc board you'll note the port 1 headers are labeled **A INT1** and **A EXT1**. Orienting your DE pc board with the copyright notice in the upper left-hand corner and the power connector to the lower right, the port 1 headers are located immediately to the **left** of the power connector at the back panel. Both the **internal** and external headers contain 20 pins, and these are numbered odd on the left and even on the right. Pin 1 is at the top **left** in each case.

For our experiments, we used pin-crimped wire jumpers such as those found in **RS-232** break-out boxes. However, an internal jumper pc board is planned if enough interest is generated, including the required additional **PTT** circuitry.

### Signals

The DE must supply TXD, TOUT2 (a 16 times transmit clock), RTS (push-to-talk (**PTT**)), and **+12VDC** to the RUH modem. The **DE** must receive RXD, RTXC (receive clock), and DCD **from** the modem. Additionally, the DE must be told the kind of mode&that is being attached, in this case a 'Type C Modem'. **This** is done by grounding pins **15** and **16** to pin 19, ground.

**A Type C** modem, for the DE, is defined as one that requires a **16X** transmit clock from the TNC but supplies to the **TNC** a receive clock at the data rate.

### DataEngine to RUH interface

The RUH pc board has three disconnect headers on it, **P1**, **P2**, and P3. Interfacing between the modem and the DE involves **P1** and P2. Make a cable going from the DE **DB-15** and "Yd" off to **P1** and **P2** at the modem as listed in Figure 4. The modem kit includes pins and a set of plastic headers to hold them.

Header P2 includes the following signals: **TXD**, **RXD**, **DCD**, **TXC**, **RXC**, and **GND**. **P1** includes **+12VDC** and **GND**. The **+12VDC** from the DE has enough current capacity to handle the modem requirements, so we've listed pin **13** of the **DB-15** connector that carries the **+12VDC**. Jumper **JP1** or **JP2** within the DE must be set on the center pin and A so that pin 13 does indeed deliver the **+12VDC**. **CAUTION:** Use a well regulated supply for the **DE** and **RUH** combination. We found a 'raw' wall adapter with poor regulation caused our system to **fail**.

**FIGURE 4. DataEngine to G3RUH modem interface**

<b>DE DB-15</b>	<b>RUH P2 header</b>	<b>Comment</b>
<b>1</b>	<b>1</b>	TXD, transmit data
<b>2</b>	<b>4</b>	RXD, receive data
<b>4</b>	<b>6</b>	RTXC, receive clock
<b>5</b>		<b>PTT</b> , see text
<b>7</b>	<b>5</b>	DCD, data carrier detect
<b>11</b>	<b>2</b>	ground
<b>12</b>	<b>3</b>	<b>TOUT2</b> , 16X transmit clock
<b>13</b>	P1-pin2	<b>+12VDC</b> (set jumper JMP2.)
<b>11</b>	<b>P1-pin1</b>	<b>ground</b>

For more detail, refer to the DE schematic. Pin-outs at the DB-15 **DE** connector will differ by modem. Pin-outs for this experiment WILL NOT correspond with those for the DE1200 modem. The modems, by nature, are different.

## RUH to Kantronics DVR2-2 Transceiver Interface

The cable must run **from** header P3 of the RUH to the data port of the DVR. The DVR requires **PTT**, **TXD** and ground, and delivers RXD (unsquelched) and DCD (not used in this application). Refer to the DVR Operator's Manual' and Figure 5 for more detail.

**We** recommend attaching a speaker to the audio-out jack of the **DVR**. You'll get a kick out of listening to the 9600 'hiss' if you've not heard it before.

### The Push-To-Talk Addition

The **PTT** signal is assigned pin 5 on the DE DB-15 port connector. If the **PTT** circuitry is added internally to the DE, its source from the processor is at pin 7 on the **INT** header. Pin 5 of the back panel connector (DB-15) is **pc-wired** directly to pin 7 of the EXT header. So, have the output of the **PTT** circuit wired directly to **EXT** header, pin 7.

If you plan to add the PTT circuit on the extra room and holes provides on the RUH board, as we did, then just jumper INT pin 7 to EXT pin 7 which in turn is directly **pc-wired** to pin 5 of the back panel DB-15 as above. Either way, the resulting **PTT** output must be connected to pin 3 of the DVR data port DB-9 connector. Again, see Figure 2 for choices.

## DVR Transceiver Modifications

**As** it turns out, the drive level of the RUH is a bit high for the data input of the **DVR**. The DVR **TXD** line expects to see a drive level of about 50 MV **P-P**. Both **VE3ZAV**<sup>6</sup> in Canada, and **G4HCL**<sup>6</sup> in England reported this. Both reduced TX audio drive for **successful 9600** baud operation.

You can reduce the **drive** at the modem, but we found it easier and neater to put the resistor divider inside the DVR – change resistor R43 to 47K.

Additionally, the RUH desired a bit more discriminator drive than the production DVR delivers. So, also bypass resistor **R30** with a jumper. 150 MV **p-p** instead of 50 MV **p-p** is then available for the modem, which incidentally calls for a minimum of 50 mv drive.

### Tuning up

After preparing all cabling and checking each cable, you'll want to check that your **DVR2-2** radios are on frequency and that the proper amount of deviation is generated with each modem-radio pair. We used an IFR service monitor to set our pairs.

First, we keyed the transmitter and adjusted L22 to confirm that the DVR was on frequency. Then we set the **DataEngine** to a **TXD** of 255 and transmitted **unproto**

**FIGURE 5. Kantronics DVR2-2 to RUH cabling**

DVR DB-9	RUH P3 header	Comment
1	1	TXD, transmit audio
2	NC	DCD, (not used this app, internal)
3		<b>PTT</b> , see text
5	4	RXD, received audio (unsquelched)
6	2	<b>ground</b>
8	NC	speaker audio

packets through the **modem-DVR** pair and adjusted the modem drive such that the service monitor measured 3 KHz deviation. You could also set deviation using the BERT feature of the modem.

Additionally, we tweaked up the output of the discriminator of the **DVRs** using a standard scope. When no RF signal is present you can balance the random output so that the pattern is balanced'. Alternatively the service monitor can be used to optimize the **SINAD** reading.

## Packet Parameter Considerations

With the DVR radios at both ends, start with a **TXD** of 5. This should be plenty long enough. Start operation by exchanging **unproto** packets. In this way, if either end has a problem, it can be quickly located. There is nothing magic about the operation of the **DataEngine, G3RUH**, DVR combination. They do work. So if you run **into** difficulty, check the basics: cabling, power supply, TNC parameters, right port (that one caught us once for a half-hour).

Enjoy and let us know of your experiences.

Since we originally published this paper, Kantronics has designed and is now producing an internal disconnect jumper board which provides the watchdog timer and PTT circuits described earlier in this paper. The board plugs onto the two disconnect headers inside the Data Engine, and provides all required signals **from** the processor to the DB-15 connector on the rear panel.

In addition, the jumper board has jumpers which allow you to select the modem TYPE (A, B, or C). Currently, this covers all known external modems including the **G3RUH, HAPN, K9NG**, and PSK-1 to mention a few. The watchdog timer is set for 15 seconds, but this may be changed by replacing the 4.7 micro-farad capacitor with a different value if required. The watchdog timer may be disabled by placing a jumper in the **appropriate** position.

## References

1. Miller, James R. **G3RUH**. "9600 baud Packet Radio Modem Design", Proceedings of 7th ARRL Computer Networking Conference, Oct. 1988, pps. 135-140.
2. Goode, Steve. **K9NG**. "Modifying the Hamtronics FM-5 for 9600 BPS packet operation'. In proceedings of the Fourth ARRL Amateur Radio Computer Networking Conference, March **30, 1985**, San Francisco.
3. Operator's Manual, Kantronics Data Engine. Appendix: Connecting Other Modems to the Data Engine.
4. Operator's Manual, Kantronics **DVR2-2**. Data port DB-9 connector.
5. Varga, Anthony, **VE3ZAV**, 73 Beechbank **Cresc.**, London, Ontario, Canada.
6. **Lorek**, Chris. **G4HCL**. "DVR2-2 2M PACKET 'IX". Ham Radio **Today** magazine, England, March 1990.
7. Kantronics Co., Inc., 1202 E **23rd** St., Lawrence, KS 66646 **913-842-7745**, BBS 913-842-4678, FAX 913-842-2021.
8. Installation Manual, Kantronics, **KAM**.