Introduction

The SDM-300L2 modem supports the optional Turbo Product Code Forward Error Correction (FEC) feature. A Turbo Product Codec can be installed at the factory or added as a field-installed upgrade to modems currently deployed. Six Turbo code rates/modulations are supported:

- BPSK 5/16
- BPSK 21/44
- QPSK 3/4
- OQPSK 3/4 (requires OQPSK optioned modem)
- QPSK 1/2
- OQPSK 1/2 (requires OQPSK optioned modem)

These Turbo code rates and modulations are also compatible with the equivalent functions in the SDM-300A, CDM-550 and CDM-600 modems. Interoperability between these modems and the SDM-300L2 is guaranteed.

Benefits of Turbo Product Code FEC include:

- **Enhanced BER Performance** – QPSK 3/4 rate Turbo provides nearly a 2 dB improvement over Viterbi 3/4 rate concatenated Reed-Solomon
- **Reduced Delay** – Significantly less processing delay (latency) than concatenated Reed-Solomon modes
- **Soft Knee Characteristic** – Traditional concatenated Reed-Solomon schemes exhibit a pronounced threshold effect where a small reduction in Eb/No results in a total loss of data. Turbo does not suffer from this problem; the decoder stays locked down to the point of unusable error rate
- **Bandwidth Efficiency** – no additional bandwidth expansion requirement (such as that associated with Reed-Solomon coding), resulting in bandwidth savings of 9% to 13%

BER Performance

BER	QPSK/OQPSK		BPSK	
	1/2 Rate	**3/4 Rate**	**21/44 Rate**	**5/16 Rate**
10^{-6}	3.0	3.9	2.9	*See Note*
10^{-7}	3.2	4.1	3.1	*See Note*
10^{-8}	3.5	4.4	3.4	*See Note*
10^{-9}	3.8	4.7	3.7	4.0

Note: BPSK 5/16 rate Turbo is included for compatibility with other Comtech EF Data equipment. However, implementation limitations prohibit optimum performance at Eb/No values below 4.0 dB. Performance is virtually error free above 4.0 dB Eb/No, and operation below this level is not recommended.

Data Rate

Modulation Type	Encoding Type	Data Rate Range	
BPSK	5/16 Rate Turbo	2.4 Kbps	781.25 Kbps
BPSK	21/44 Rate Turbo	2.4 Kbps	1193.0 Kbps
QPSK/OQPSK	1/2 Rate Turbo	4.8 Kbps	2386.0 Kbps
QPSK/OQPSK	3/4 Rate Turbo	7.2 Kbps	3750.0 Kbps

Note: QPSK/OQPSK 1/2 Rate Turbo requires additional frame overhead. When computing symbol rates for QPSK/OQPSK 1/2 Rate, use an additional factor of 22/21 (e.g.: $SR = [DR * 2/1 * 22/21] / 2$)

Remote Control & Menu Structure Changes

Changes to the remote control and menu structure are minimal. The following list summarizes the changes required for the Turbo Codec option:

- **Encoder/Decoder Select** – Turbo added as selection with Viterbi and Sequential; Turbo can only be selected for a Modem Type of "Custom" or "EF Data".
- **Data Rate** – Selection and assignments for Turbo rates available when Turbo is enabled.

Upgrading To Turbo

Upgrading requires installation of the Turbo Codec module (Reed-Solomon modules must be removed if installed, Turbo and Reed-Solomon cannot be populated at the same time), installation of new M&C firmware, and installation of new Bulk firmware.

FOR MODEMS WITH 8138-D9 OR LATER REVISION MAIN BOARDS, the upgrade kit includes the following items:

Upgrade Kit Part Number KT/9672-2:
1. PL/9394-1 (Turbo Codec Module)
2. FW/8460-1M or later version (M&C firmware)
3. FW/9405B or later version (Bulk firmware)
4. Installation instructions

FOR MODEMS WITH 8138-D To 8138-D8 REVISION MAIN BOARDS, the upgrade kit includes the following items:

Upgrade Kit Part Number KT/9672-3:
5. PL/9394-1 (Turbo Codec Module)
6. FW/8460-1M or later version (M&C firmware)
7. FW/8875B or later version (Bulk firmware)
8. Installation instructions

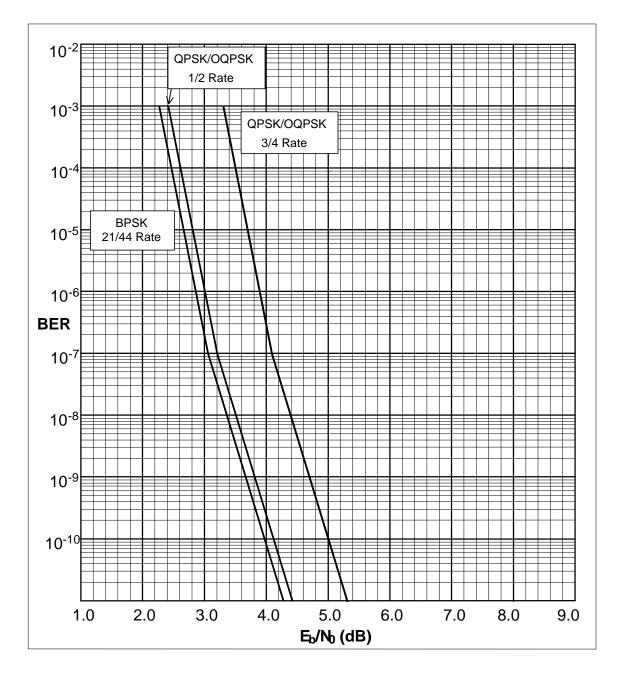Note: Upgrade kits are not available for modems with main board revisions earlier than 8138-D.

The chart shows BER vs E_b/N_0 (dB) with the following curve labels:

- QPSK/OQPSK 1/2 Rate
- QPSK/OQPSK 3/4 Rate
- BPSK 21/44 Rate

Y-axis: BER, ranging from 10^{-2} to 10^{-10}

X-axis: E_b/N_0 (dB), ranging from 1.0 to 9.0

Figure 1   SDM-300L2 Turbo Codec BER Performance

⚠ **CAUTION**   **Observe all normal precautions for handling electrostatic-sensitive devices.**

To Install Turbo Board and Firmware:

1) Disconnect the AC power to the unit.

2) Remove the (2) side screws near the front of the modem.
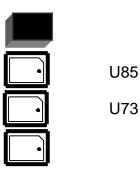
3) Slide top cover back and lift off.

*4) Card 1 Removal, refer to Figure 2. *If unit has top board (Card 1 – Overhead board)*, remove the (4) rear panel screws around the 50-Pin I/O switch module. Unplug the I/O module, then remove the (7) mounting screws holding the Overhead board and carefully lift it off.

5) Reed-Solomon removal, refer to Figure 2. *Remove all installed Reed-Solomon Boards* from the SIMM sockets by pushing the spring clips outward while rocking the board vertically, then lift the board out.

6) Turbo installation, refer to Figure 3. Align the Turbo board with either of the SIMM sockets while holding it nearly vertical with components toward Rear Panel. Seat the connector into the socket and tilt the board toward the Front Panel until the spring clips lock the board into place.

7) Firmware installation, refer to Figure 3. *If replacement Firmware IC's were sent with the Turbo Board*, remove existing Firmware, U85 and U73 with PLCC type IC puller. If puller not available, use ice pick type tool to carefully pry upward at opposite, alternating corners of IC.

> **7a)** Install the replacement Firmware, orienting the beveled corner of the IC to match the beveled corner of the socket before pushing the IC into the socket. U85 is located next to the lithium battery NV-RAM (Large Black or Yellow IC, U96). U73 is located in the center socket position.

U85

U73

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*8) If step #4 was required, re-Install the Overhead board with its (7) mounting screws then re-plug the I/O Module into the Rear Panel location and install its (4) mounting screws.

9) Replace the Top Cover so forward edge mates under Front Panel lip. While holding in place, re-install the (2) side screws.

10) Turn on the AC power to the modem. Modem will re-initialize.

Turbo Set-up:

1) Press the Right-or-Left Arrow key until the screen reads "Function Select Utility" then press the Enter key.

2) Press the Right Arrow key until the screen reads "Utility Modem Type" then press the Enter key.

3) Press the Up or Down Arrow key until the screen reads "Modem Type Custom" or "Modem Type EFD" then press the Enter key.   Now Press Clear.

4) Press the Right Arrow key until the screen reads "Utility Modulator" then press the Enter key.

5) Press the Right Arrow key until the screen reads "Encoder Type" then press the Enter key, then Up key to get "Turbo", press Enter.

6) Press Clear, then press the Right Arrow key until the screen reads "Utility Demodulator" then press the Enter key.

7) Press the Right Arrow key until the screen reads "Decoder Type" then press the Enter key, then Up key to get "Turbo", press Enter.

- In this configuration, the Modem allows only Data Rates and Formats valid for Turbo.

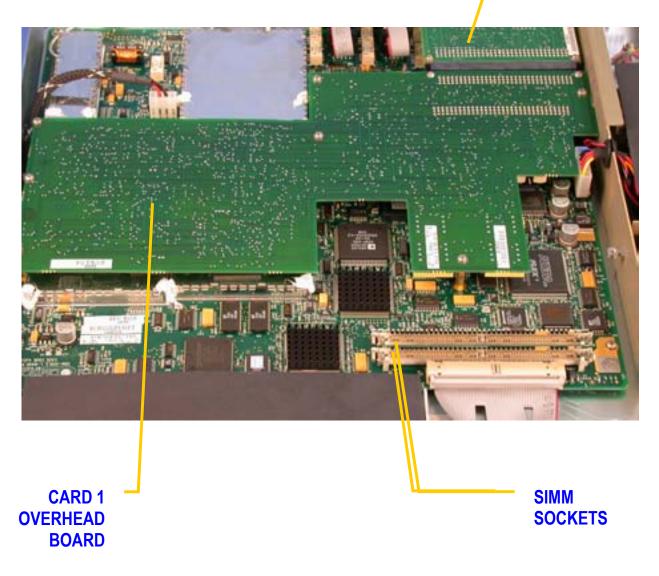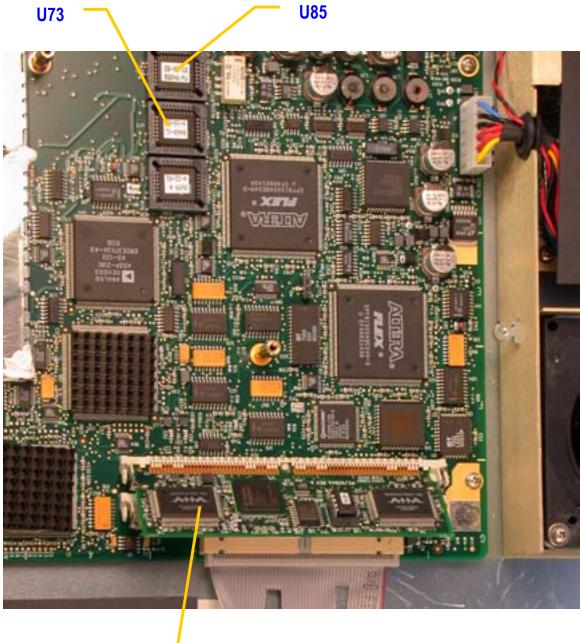- Open-network modem types cannot be selected.

I/O MODULE

CARD 1 OVERHEAD BOARD

SIMM SOCKETS

Figure 2

U73

U85

TURBO CODEC
INSTALLED

Figure 3

NOTES:

(Part Number AN-300L2TRBO.DOC) 9/10/2002