

# 1.0 Functional Description

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## 1.1 Overview

The Rockwell RC96V24DP is a low power, V.22 bis 2400 bps data/fax modem data pump in a single VLSI package.

## 1.2 Technical Specifications

### 1.2.1 Configurations And Rates

The selectable modem configurations, along with the corresponding signaling (baud) rates and data rates, are listed in Table 1-1 (CONF bits).

Note: Bit names refer to control or status bits in DSP interface memory which are set or reset by the host processor (see Table 3-1 and Table 3-2).

### 1.2.2 Data Encoding

The data encoding conforms to CCITT recommendations V.29, V.27 ter, V.22 bis, V.22, V.23, or V.21, or to Bell 212A or 103, depending on the selected configuration.

### 1.2.3 Tone Generation

**Answer Tone:** A CCITT (2100  $\pm$ 15 Hz) or Bell (2225  $\pm$ 10 Hz) answer tone can be generated.

**Guard Tone:** A 1800  $\pm$ 20 Hz guard tone can be generated (enabled by the GTE bit).

**DTMF Tones:** Dual tone multi-frequency (DTMF) tones can be generated with a frequency accuracy of  $\pm$ 1.5%.

**User Defined Tones:** A user-defined single or dual tone can be generated from 200 Hz to 3000 Hz  $\pm$ 5 Hz.

## 1.2.4 Tone Detection

**Answer Tone and Call Progress Tones:** Tones can be detected as follows:

- Call progress frequency range: 340  $\pm$ 5 Hz to 640  $\pm$ 5Hz
- Answer tone frequency ranges: CCITT (2100  $\pm$ 15Hz), Bell (2225  $\pm$ 10 Hz), or Bell FSK originate tone (1270  $\pm$ 10 Hz)
- Detection range: -9 dBm to -43 dBm
- Default detection threshold: -43 dBm
- Response time: 75  $\pm$ 2 ms
- The passband and tone detect threshold can be changed in DSP RAM.

**V.23 and V.21 Tones:** Tones can be detected as follows:

- V.23 forward channel mark: 1300  $\pm$ 10 Hz
- V.23 backward channel mark: 390  $\pm$ 10 Hz
- V.21 high band mark (1650  $\pm$ 10 Hz) or low band mark (980  $\pm$ 10 Hz)
- Detection range: -9 dBm to -43 dBm
- Default detection threshold: -43 dBm
- Response time: 25  $\pm$  2 ms

The passbands and tone detect thresholds can also be changed in the DSP RAM.

### 1.2.4.1 DTMF Detection

The modem can detect a valid DTMF tone pair (indicated by DTDET) and load a corresponding hexadecimal code into the modem interface memory (DTDIG).

### 1.2.4.2 Equalizers

Equalization functions are incorporated that improve performance when operating over low quality lines.

**Automatic Adaptive Equalizer.** An automatic adaptive equalizer in the receiver compensates for transmission line amplitude and group delay distortion. Updating of the taps can be enabled or disabled (EQFZ bit). The equalizer taps can also be reset (EQRES bit).

**Fixed Compromise Equalizers.** Fixed compromise equalizers are provided in the transmitter and receiver. The equalizers are programmable in DSP RAM.

### 1.2.4.3 Transmit Level

The transmitter output level is -10 dBm  $\pm$ 1 dB using the internal hybrid circuit. The attenuation is selectable from 0 dBm to -15 dBm in 1 dB steps (TLVL bits).

### 1.2.4.4 Transmit Timing

Transmitter timing is selectable between internal ( $\pm$ 0.01%), external, or loopback (TXCLK bits). When external clock is selected, the external clock rate must equal the desired data rate  $\pm$ 0.01% with a duty cycle of 50  $\pm$ 20%.

### 1.2.4.5 Scrambler/Descrambler

The modem incorporates a self-synchronizing scrambler/descrambler satisfying the applicable CCITT or Bell requirement. The scrambler and descrambler can be enabled or disabled (SDIS and DDIS bits, respectively).

- 1.2.4.6 Receive Level** The receiver satisfies performance requirements for a received line signal from -9 dBm to -43 dBm. The default RLSD turn-on and RLSD turn-off thresholds are -43 dBm and -48 dBm, respectively. The RLSD threshold levels are programmable in DSP RAM.
- 1.2.4.7 Receiver Timing** The modem can track a frequency error up to  $\pm 0.03\%$  in the associated transmit timing source.
- 1.2.4.8 Carrier Recovery** The modem can track a frequency offset up to  $\pm 7$  Hz in the received carrier with less than a 0.2 dB degradation in bit error rate (BER).

Table 1-1. Configurations, Signaling and Data Rates

Configuration	Modulation	Transmitter Carrier Frequency (Hz) $\pm 0.01\%$		Data Rate (bps)	Baud	Bits Per	Constellation	Sample Rate
		Answer <sup>2</sup>	Originate <sup>2</sup>	$\pm 0.01\%$	(Symbols/Sec)	Symbol	Points	(Samples/Sec)
<b>Data Modes</b>								
V.22 bis	QAM	2400	1200	2400 <sup>3</sup>	600	4	16	7200
V.22	DPSK	2400	1200	1200 <sup>3</sup>	600	2	4	7200
		2400	1200	600 <sup>3</sup>	600	1	2	7200
Bell 212A	DPSK	2400	1200	1200 <sup>3</sup>	600	2	4	7200
Bell 103	FSK	2225 M 2025 S	1270 M 1070 S	0-300 <sup>4</sup>	0-300 <sup>4</sup>	1	1	7200
V.21	FSK	1650 M 1850 S	980 M 1180 S	0-300 <sup>4</sup>	0-300 <sup>4</sup>	1	1	7500
V.23 Forward Channel <sup>5</sup>	FSK	1300 M 2100 S	1300 M 2100 S	1200	1200	1	1	9600 <sup>5</sup>
V.23 Backward Channel <sup>5</sup>	FSK	390 M 450 S	390 M 450 S	75	75	1	1	7200
<b>Fax Modes<sup>6</sup></b>								
V.29	QAM	1700	1700	9600	2400	4	16	9600
	QAM	1700	1700	7200	2400	3	8	7200
	QAM	1700	1700	4800	2400	2	4	9600
V.27 ter	DPSK	1800	1800	4800	1600	3	8	9600
	DPSK	1800	1800	2400	1200	2	4	9600
V.21 channel 2	FSK	1650 M 1850 S	1650 M 1850 S	300	300	1	1	9600
Dial/Call Progress Mode					600			7200
Tone Generator/ Tone Detector Mode					600			7200
Notes: (1) Modulation legend:    QAM    Quadrature Amplitude Modulation DPSK    Differential Phase Shift Keying FSK    Frequency Shift Keying (2) M indicates a mark condition; S indicates a space condition. (3) Synchronous accuracy = $\pm 0.01\%$ ; asynchronous accuracy = -2.5% to +1.0% (+2.3% if extended overspeed is selected). (4) Value is upper limit for serial (e.g. 0-300). (5) RC2324DPL only. (6) RC96V24DP only. (7) 9600 samples per sec in V.23 FDX Tx75/Rx1200; 7200 samples per second in V.23 FDX Tx1200/Rx75.								

**Table 1-2. Dial Digits/Tone Pairs**

Dial Digit	Tone 1 (Hz)	Tone 2 (Hz)
1	697	1209
2	697	1336
3	697	1447
4	770	1209
5	770	1336
6	770	1447
7	852	1209
8	852	1336
9	852	1477
0	941	1336
*	941	1209
#	941	1477
Spare β	967	1633

#### 1.2.4.9 RTS-CTS Turn-On and Turn-Off Sequences

RTS ON to CTS ON and RTS OFF to CTS OFF response times are listed in Table 1-3.

In V.21, the transmitter turns off within 10 ms after RTS goes OFF.

For V.29, the turn-off sequence consists of approximately 5 ms of remaining data and scrambled ones followed by a 50 ms period of no transmitted energy.

For V.27 ter, the turn-off sequence consists of approximately 7 ms of remaining data and scrambled ones at 1200 baud or approximately 7.5 ms of data and scrambled ones at 1600 baud followed by a 20 ms period of no transmitted energy.

### 1.2.5 Serial or Parallel Interface

The TPDM bit selects serial or parallel interface.

**Serial Interface.** The five hardware lines (RXD, TXD, TDCLK,  $\overline{\text{RDCLK}}$ , and XTCLK) are supported by four control and status bits in the interface memory (CTS, DSR, RTS, and RLSD).

**Parallel Interface.** A 8086-compatible parallel microprocessor bus is supported.

## 1.2.6 Voice Mode

**Transmit Voice.** Transmit voice samples can be sent to the modem digital-to-analog converter (DAC) from the host through the transmit data buffer.

**Receive Voice.** Received voice samples from the modem analog-to-digital converter (ADC) can be read by the host from the receive data buffer.

## 1.2.7 Asynchronous Conversion

Asynchronous mode is selected by the ASYNC bit. The asynchronous character format is 1 start bit, 5 to 8 data bits (WDSZ bits), an optional parity bit (PARSL and PEN bits), and 1 or 2 stop bits (STB bit). Valid character size, including all bits, is 7, 8, 9, 10 or 11 bits per character.

**Table 1-3. RTS-CTS Response Times**

Configuration	Turn On Time	Turn Off Time
<b>Data Modes</b>		
V.22 bis, V.22, and Bell 212A (CC bit = 0)	≤ 2 ms	≤ 2 ms
V.22 bis, V.22, and Bell 212A (CC bit = 1)	270 ms	≤ 2 ms
V.21 and Bell 103	2-5 ms	10 ms
V.23 (RC96V24DP and RC2324DPL only)	11 ms	≤ 2 ms
<b>Fax Modes (RC96V24DP only)</b>		
<b>Echo Protector Tone Disabled (NV25 = 1)</b>		
V.29 (All speeds)	253 ms	≤ 2 ms
V.27 4800	898 ms	≤ 2 ms
V.27 2400	1133 ms	9 ms
V.21	20 ms	4 ms
<b>Echo Protector Tone Enabled (NV25 = 0)</b>		
V.29 (All speeds)	253 ms	≤ 2 ms
V.27 4800	1103 ms	≤ 2 ms
V.27 2400	1338 ms	9 ms
V.21	3095 ms	4 ms

**Signalling Rate Range.** Signalling rate range is selectable by the EXOS bit:

- Basic range: +1% to -2.5%
- Extended overspeed range: +2.3% to -2.5%

**Break.** Break is handled as described in V.22 bis.

### 1.2.7.1 Power and Environmental Requirements

The power requirements are specified in Table 1-4. The environmental specifications are listed in Table 1-5.

**Table 1-4. Modem Power Requirements**

Voltage	Mode	Current (Typ) @ 25°C	Current (Max) @ 0°C
5VDC ±5%	Operating	60 mA	90 mA
	Sleep	3 mA	4.5 mA
Note: Input voltage ripple ≤ 0.1 volts peak-to-peak. The amplitude of any frequency between 20 kHz and 150 kHz must be less than 500 microvolts peak.			

**Table 1-5. Modem Environmental Specifications**

Parameter	Specification
Temperature	
Operating	0° C to 70° C (32° F to 158° F)
Storage	-40° C to 80° C (-40° F to 176° F)
Relative Humidity	Up to 90% noncondensing, or a wet bulb temperature up to 35° C, whichever is less.
Altitude	-200 feet to +10,000 feet