

# RC56LD, RC336LD, and RC144LD

## *Integrated V.90/K56flex™/V.34/V.32bis Modem Device Sets for Low Power Applications*

The Conexant™ RC56LD, RC336LD, and RC144LD Modem Device Set supports data/fax, V.80 synchronous access mode, world-class, voice/TAM/ telephony extensions, speakerphone, AudioSpan, DSVD, and cellular/GSM operation depending upon the model, ROM size, and installed firmware (Table 1). The modem supports the following primary data modulations: ITU-T V.90/K56flex™ (RC56), V.34 (RC56 and RC336) and V.32bis.

The modem is designed to operate with dial-up telephone lines in the U.S. and world-wide. PC Card interface models also support analog cellular direct connect and GSM direct connect. Parallel host interface models can support either analog cellular direct connect and GSM direct connect or telephony extensions. Serial DTE interface models support telephony extensions.

Low profile, small PQFP/TQFP packages and low voltage operation with low power consumption make this device set ideal for laptop, notebook, and palmtop applications using parallel host or serial DTE interface with the MCU or using PC Card interface with the MCUP.

The device set consists of an 8-bit microcomputer (MCU) or MCU with built-in PC Card interface (MCUP) in a 128-pin TQFP and a modem data pump (MDP) in a 144-pin TQFP or 100-pin PQFP. The SP model can also be ordered with an RCDSVD Speech Codec Processor (SCP) in a 100-pin PQFP to support DSVD.

The MCUP PC Card interface supports two peripheral channels, one channel for the modem and a second channel for an optional user-defined function (Function 2).

Downloadable architecture supports downloading of modem firmware from the host/DTE to the MCU and, transparently to the host/DTE, the downloading of MDP code modules from the MCU.

The modem operates by executing firmware from external 1Mbit (128k x 8) RAM and 2Mbit (256k x 8) ROM/flash ROM. The RC336 and RC144 can alternatively use external 1Mbit or 2Mbit ROM/flash ROM and either internal or external 32k x 8 RAM. Double the normal ROM size for GSM operation.

In V.90/K56flex mode (RC56), the modem can receive data at speeds up to 56 kbps from a digitally connected V.90- or K56flex-compatible central site modem. Taking advantage of the PSTN which is primarily digital except for the client modem to central office local loop, V.90/K56flex modems are ideal for applications such as remote access to an Internet Service Provider (ISP), on-line service, or corporate site. The modem can send data at speeds up to V.34 rates.

In V.34 data mode (RC56 and RC336), the modem operates at line speeds up to 33.6 kbps. Error correction (V.42/MNP 2-4) and data compression (V.42 bis/MNP 5) maximize data transfer integrity and boost average data throughput up to 230.4 kbps. Non-error-correcting mode is also supported.

In V.32 bis mode, the modem operates at line speeds up to 14.4 kbps.

The modem supports fax Group 3 send and receive rates up to 33.6 kbps and supports T.30 protocol.

V.80 synchronous access mode supports host-based communication protocols, e. g., H.324 video conferencing.

In voice/TAM mode, enhanced 2-bit or 4-bit per sample ADPCM coding and decoding at 7200 Hz sample rate allows efficient digital storage of voice/audio. This mode supports applications such as digital telephone answering machine (TAM), voice annotation, and recording from and playback to the telephone line.

SP models support position independent, full-duplex speakerphone (FDSP) operation using microphone and speaker, as well as other voice/TAM applications using handset or headset. SP models also support AudioSpan (analog simultaneous audio/voice and data) operation with a data rate of 4.8 kbps with audio.

SP models, using the optional RCDSVD SCP device, support hardware-based (on-board) V.70 DSVD (digital simultaneous voice and data) with speech coding per ITU-T interoperable G.729 and G.729 Annex A with interoperable G.729 Annex B. GSM operation with 4M ROM is not available when the RCDSVD SCP is used.

Host-based DSVD is supported in all models, however, the host PC must supply full-duplex sound support, typically to a microphone/speaker, such as provided by Conexant WaveArtist devices or a sound card.

GSM operation supports data services offered by the Global System for Mobile Communications network: data transmissions to PSTN, ISDN or GSM users. GSM data operation allows data and fax transfer, and connection to videotex.

Analog cellular and GSM direct connect operation is supported by licensed firmware for specific phone types.

A common PC board design can support data/fax, V.80, voice/TAM/telephone extensions, speakerphone, AudioSpan, and host- or on-board DSVD operation depending on the installed modem devices.

Accelerator kits and reference designs are available to minimize application design time and costs. PC-based "ConfigurACE™ II for Windows" software allows MCU firmware to be customized.

Table 1. Modem Models and Functions

Model/Order/Part Numbers				Supported Functions					
Marketing Model Number <sup>1</sup>	Device Set Order Number	MCU [128 TQFP] Part No.	MDP [144-TQFP] Part No.	V.90 and K56flex Data	V.34 Data, GSM	V.32 bis Data, V.34 Fax, Fax Cl 1 and 2, W-Class, Host DSVD, Voice/TAM, Cellular	FDSP, AudioSpan	On-board DSVD with RCDSVD [R6715-14]	Host/DTE Interface
RC56LD/SP-PCC	DS56-L459-001	L2701-12	R6785-21	Y	Y	Y	Y	O	PCC
RC56LD-PCC	DS56-L457-051	L2701-12	R6785-24	Y	Y	Y	-	-	PCC
RC56LD/SP	DS56-L458-001	L2701-15	R6785-21	Y	Y	Y	Y	O	SER/PAR
RC56LD	DS56-L456-091	L2701-15	R6785-24	Y	Y	Y	-	-	SER/PAR
RC336LD/SP-PCC	DS28-L313-001	L2701-12	R6785-26	-	Y	Y	Y	O	PCC
RC336LD-PCC	DS28-L311-031	L2701-12	R6785-25	-	Y	Y	-	-	PCC
RC336LD/SP	DS28-L312-021	L2701-15	R6785-26	-	Y	Y	Y	O	SER/PAR
RC336LD	DS28-L310-071	L2701-15	R6785-25	-	Y	Y	-	-	SER/PAR
Marketing Model Number <sup>1</sup>	Device Set Order Number	MCU [128 TQFP] Part No.	MDP [100-PQFP] Part No.	V.90 and K56flex Data	V.34 Data, GSM	V.32 bis Data, V.34 Fax, Fax Cl 1 and 2, W-Class, Host DSVD, Voice/TAM, Cellular	FDSP, AudioSpan	On-board DSVD with RCDSVD [R6715-14]	Host/DTE Interface
RC56LD/SP-PCC	DS56-L459-011	L2701-12	R6764-21	Y	Y	Y	Y	O	PCC
RC56LD-PCC	DS56-L457-041	L2701-12	R6764-24	Y	Y	Y	-	-	PCC
RC56LD/SP	DS56-L458-011	L2701-15	R6764-21	Y	Y	Y	Y	O	SER/PAR
RC56LD	DS56-L456-081	L2701-15	R6764-24	Y	Y	Y	-	-	SER/PAR
RC336LD/SP-PCC	DS28-L313-011	L2701-12	R6764-26	-	Y	Y	Y	O	PCC
RC336LD-PCC	DS28-L311-021	L2701-12	R6764-28	-	Y	Y	-	-	PCC
RC336LD/SP	DS28-L312-011	L2701-15	R6764-26	-	Y	Y	Y	O	SER/PAR
RC336LD	DS28-L310-061	L2701-15	R6764-28	-	Y	Y	-	-	SER/PAR
RC144LD/SP	DS96-L836-001	L2701-15	R6764-22	-	-	Y	Y	O	SER/PAR
RC144LD	DS96-L836-011	L2701-15	R6764-29	-	-	Y	-	-	SER/PAR

**Notes:**

- Model options (Y = Supported, - = Not supported, O = Optional):
  - LD Low power, Downloadable
  - PCC PC Card host interface
  - SP Speakerphone and, with RCDSVD SCP, on-board DSVD
  - SER/PAR Serial DTE or parallel host interface.
- Supported functions (Y = Supported; - = Not supported):
  - AudioSpan Analog simultaneous voice and data
  - Cellular Analog and, for parallel host or PC Card interface, GSM cellular
  - DSVD Digital simultaneous voice and data
  - Fax Cl 1 and 2 Fax Class 1 and Fax Class 2 support
  - FDSP Full-duplex speakerphone
  - Voice/TAM Voice and telephone answering machine support (handset support requires SP model)
  - GSM Global System for Mobile Communications. GSM is not supported with the serial DTE interface.

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## Features

- Downloadable MCU firmware from the host/DTE and downloadable MDP code modules from the MCU
- Data modem
  - ITU-T V.90 and K56flex (RC56LD models)
  - V.34 (33.6 kbps) (RC56LD and RC336LD models)
  - V.32 bis, V.32, V.22 bis, V.22, V.23, and V.21; Bell 212A and 103
  - V.42 LAPM, MNP 2-4, and MNP 10 error correction
  - V.42 bis and MNP 5 data compression
  - MNP 10EC™ enhanced cellular performance
- Analog cellular direct connect
- GSM cellular direct connect
- Fax modem send and receive rates up to 33.6 kbps
  - ITU-T V.34, V.17, V.29, V.27 ter, and V.21 channel 2
- V.80 synchronous access mode supports host-based communication protocols
- World-class operation
  - Call progress
  - Blacklisting
  - Multiple country support
- Voice/TAM mode/telephony extensions
  - Handset support (SP models)
- Full-duplex speakerphone (FDSP) mode (SP models)
  - Acoustic and line echo cancellation
  - Microphone gain and muting
  - Speaker volume control and muting
- AudioSpan simultaneous audio/voice and data (SP models)
  - ITU-T V.61 modulation (4.8 kbps data with audio)
  - Handset, headset, or half-duplex speakerphone
- ITU-T V.70 DSVD using the RCDSVD SCP (SP models)
  - ITU-T interoperable G.729 and G.729 Annex A with interoperable G.729 Annex B
  - Voice/silence detection and handset echo cancellation
  - Robust DSVD timing recovery
  - Handset, headset, or half-duplex speakerphone
- Host-based DSVD support with V.70 software drivers for Windows 95
- Communication software compatible AT command sets
- NVRAM directory, stored profiles, and CIS table (option)
- Flash memory support
- Internal phase-locked loop (PLL)
- Built-in host/DTE interface with speeds up to 230.4 kbps
  - Parallel 16550A UART-compatible interface (MCU)
  - Serial ITU-T V.24 (EIA/TIA-232-E) (MCU)
  - PC Card (MCUP)
- PC Card interface supports two functions with programmable I/O window size (MCUP only)
- Flow control and speed buffering
- Automatic format/speed sensing
- Serial sync/async data; parallel async data
- Caller ID and distinctive ring detect
- JTAG Boundary Scan support
- Flexible PQFP and TQFP packaging options
  - MCU/MCUP: 128-pin TQFP
  - MDP: 144-pin TQFP or 100-PQFP
  - RCDSVD SCP: 100-pin PQFP

- +3.3V operation with +5V tolerant inputs
- Sleep Mode
- Power use (mW, typical):

Device	Normal	Sleep
MCU/MCUP	165	10
MDP	250	33
SCP	550	50

## Description

### General

The modem device set, consisting of separate microcontroller (MCU/MCUP), modem data pump (MDP), and optional RCDSVD Speech Codec Processor (SCP) devices, provides the processing core for a complete modem design.

For data/fax/V.80/voice/TAM/speakerphone/host-DSVD/AudioSpan operation, only the microcontroller (MCU) and modem data pump (MDP) devices are needed. The OEM adds an MCU crystal, discrete components, and a telephone line/telephone/voice/-TAM/analog cellular/GSM cellular interface circuit to complete the modem system. Telephony extensions are supported in the serial DTE models and optionally in the parallel host models. Optional on-board DSVD operation is supported with addition of the RCDSVD Speech Codec Processor (SCP) device to an SP model. Table 1 shows the supported functions by product family.

Dialing, call progress, V.80, telephone line interface, voice/TAM, speakerphone, AudioSpan, DSVD, analog cellular phone, and GSM phone interface functions are supported and controlled through the AT command set.

Connection to the host/DTE is supported by serial DTE interface (Figure 1), parallel host interface (Figure 2), or PC Card interface (Figure 3), depending on modem model and installed firmware. GSM operation is supported for parallel host and PC Card interface only.

For U.S. operation, the modem can operate with a 1-relay data/fax/TAM DAA interface (Figure 4) or a 2-relay data/fax/TAM/V.61/Speakerphone DAA interface (Figure 5).

### Data/Fax Modes

In V.90/K56flex data modem mode (RC56), the modem can receive data from a digital source using a V.90- or K56flex-compatible central site modem at line speeds up to 56 kbps. Asymmetrical data transmission supports sending data at speeds up to V.34 rates. This mode can fallback to full-duplex V.34 mode.

In V.34 data modem mode (RC56 and RC336), the modem can operate in 2-wire, full-duplex, asynchronous modes at line rates up to 33.6 kbps. Data modem modes perform complete handshake and data rate negotiations. Using V.34 modulation to optimize modem configuration for line conditions, the modem can connect at the highest data rate that the channel can support from 33.6 kbps to 300 bps with automatic fallback. Automode operation in V.34 is provided in accordance with PN3320 and in V.32 bis in accordance with PN2330. All tone and pattern detection functions required by the applicable ITU or Bell standard are supported.

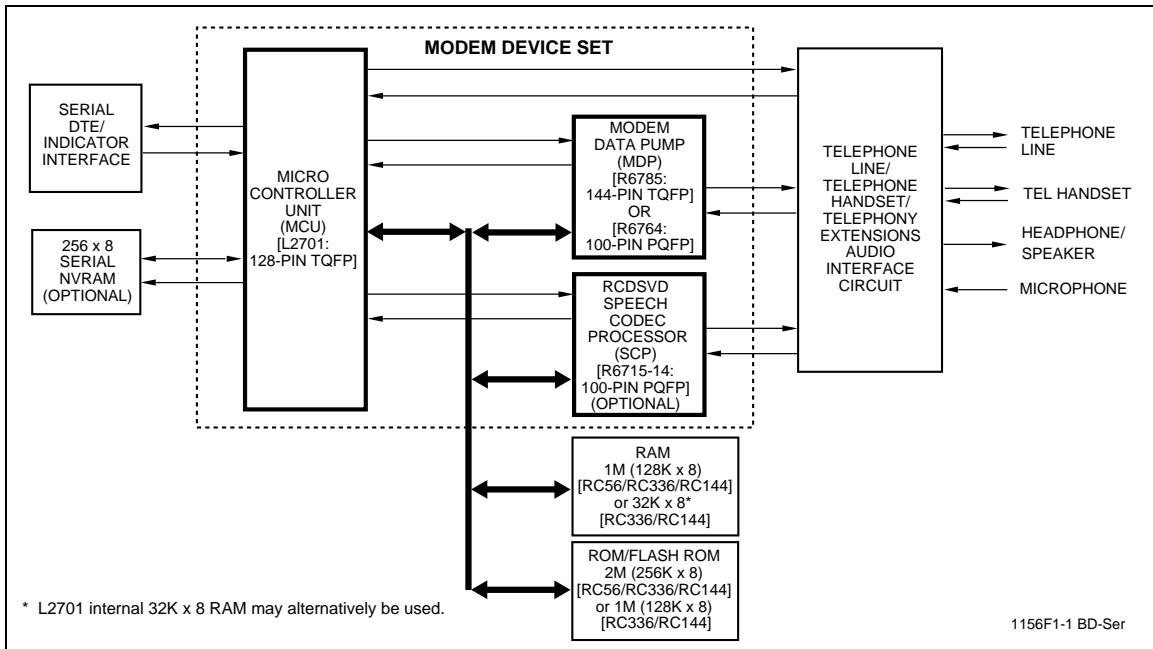


Figure 1. Block Diagram - Serial DTE Interface

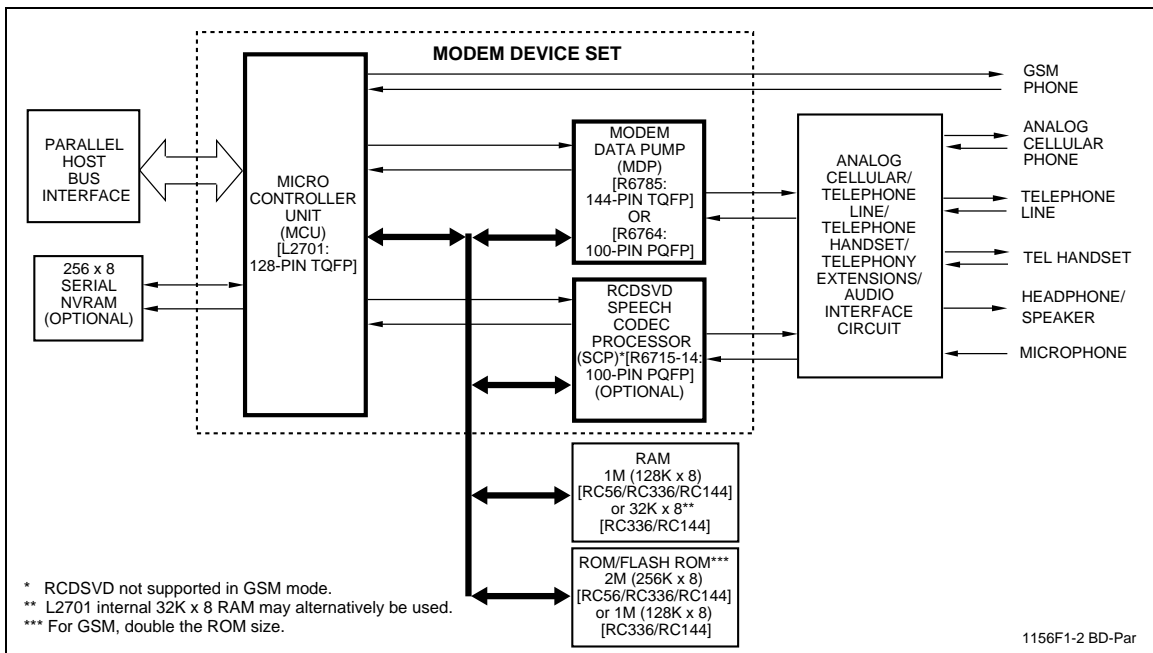


Figure 2. Block Diagram - Parallel Host Interface

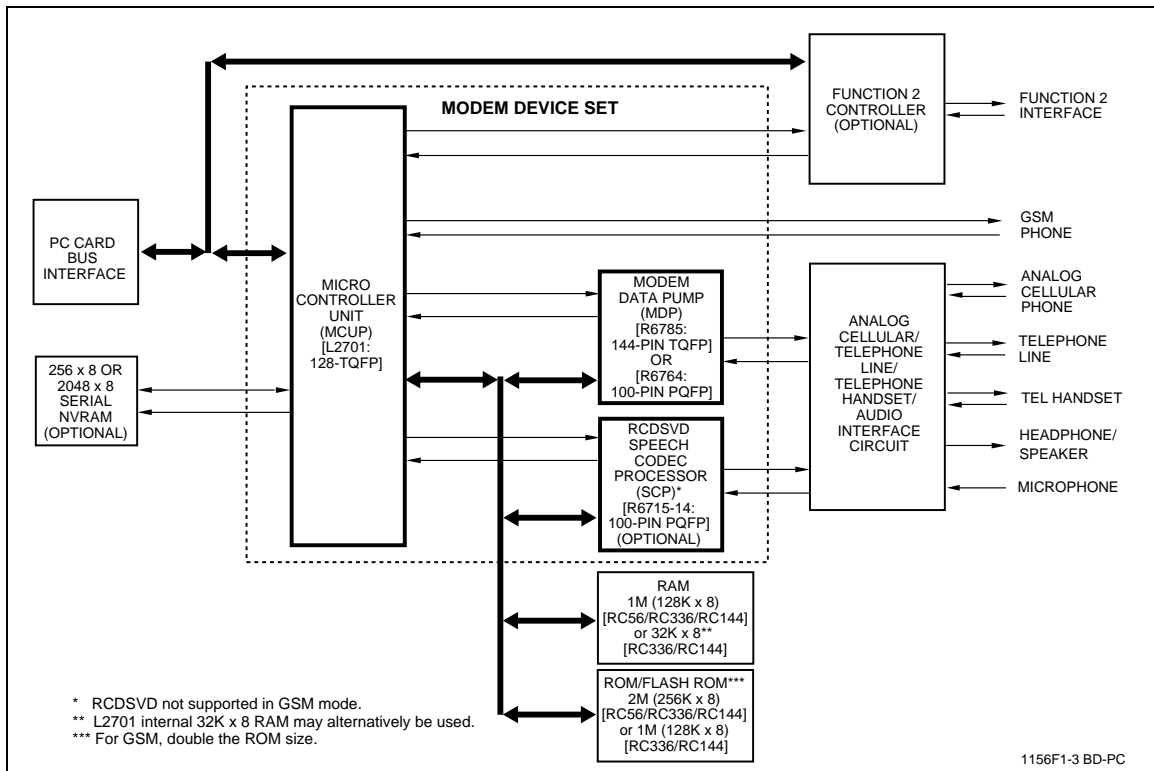


Figure 3. Block Diagram - Parallel PC Card Interface

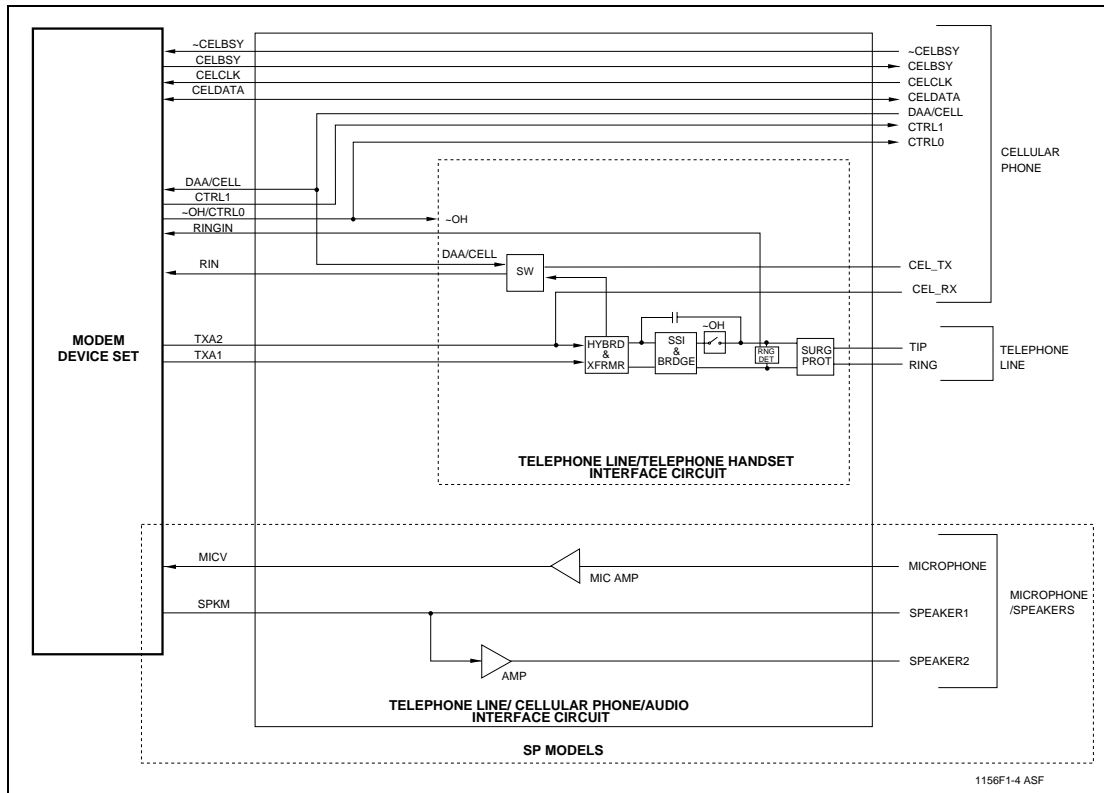


Figure 4. 1-Relay Data/Fax/TAM DAA Interface (U.S.)

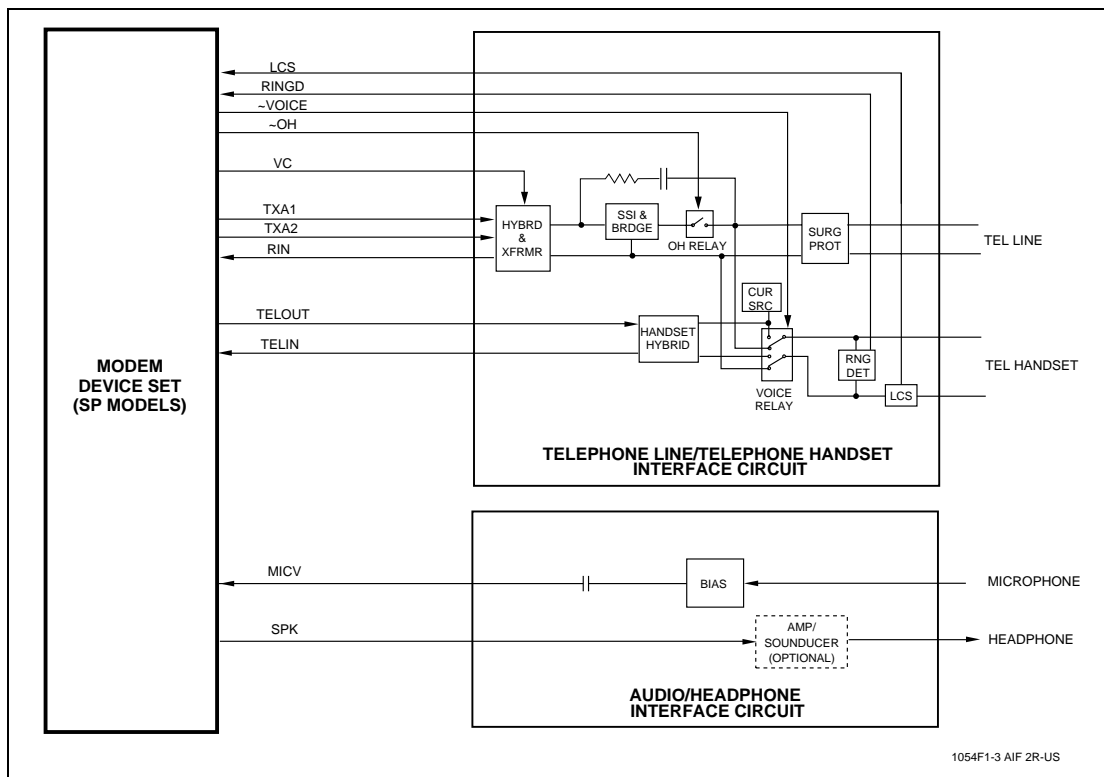


Figure 5. 2-Relay Data/Fax/TAM/Speakerphone/AudioSpan DAA Interface (U.S.)

In V.32 bis mode, the modem operates at line speeds up to 14.4 kbps.

In fax modem mode, the modem can operate in 2-wire, half-duplex, synchronous mode and can support Group 3 facsimile send and receive speeds of 33600, 31200, 28800, 26400, 24000, 21600, 19200, 16800, 14400, 12000, 9600, 7200, 4800, and 2400 bps. Using V.34 modulation to optimize modem configuration for line conditions, the modem can connect at the highest data rate that the channel can support at speeds up to 33.6 kbps with automatic rate adaptation. Fax data transmission and reception performed by the modem are controlled and monitored through the EIA/TIA-578 Fax Class 1, T.31 Fax Class 1.0, or Fax Class 2 command interface. Full HDLC formatting, zero insertion/deletion, and CRC generation/checking are provided.

Both transmit and receive fax data are buffered within the modem. Data transfer to and from the DTE is flow controlled by XON/XOFF and RTS/CTS.

### Synchronous Access Mode (SAM)

V.80 synchronous access mode between the modem and the host/DTE is provided for host-based communication protocols, e.g., H.324 video conferencing applications.

Voice-call-first (VCF) before switching to a videophone call is also supported.

### World Class Operation

W-class functions support modem operation in multiple countries. Additional modem functions are provided in areas such as dialing, carrier transmit level, calling tone, call progress tone detection, answer tone detection, blacklisting, and relay control. Country dependent parameters are programmable by CONFIGACE II for Windows.

### Voice/TAM Mode

Voice/TAM Mode features include enhanced ADPCM compression/decompression, tone detection/generation and call discrimination, concurrent DTMF detection, and 8-bit monophonic audio data encoding.

Voice/TAM Mode is supported by three submodes:

1. Online Voice Command Mode supports connection to the telephone line or, for SP models, a handset.
2. Voice Receive Mode supports recording voice or audio data input at the RIN pin, typically from the telephone line or, for SP models, a microphone/handset.
3. Voice Transmit Mode supports playback of voice or audio data to the TXA1/TXA2 output, typically to the telephone line or, for SP models, a speaker/handset.

### Telephony Extension Operation

Extension pickup/remote hangup detection and line-in-use detection are supported in serial DTE models optionally (in lieu of cellular/GSM support) in parallel host models.

### Speakerphone Mode (SP Models)

The speakerphone mode features an advanced proprietary speakerphone algorithm which supports full-duplex voice conversation with both acoustic and line

echo cancellation. Parameters are constantly adjusted to maintain stability with automatic fallback from full-duplex to pseudo-duplex operation. The speakerphone algorithm allows position independent placement of microphone and speaker.

The speakerphone mode provides hands-free full-duplex telephone operation under host control. The host can separately control volume, muting, and AGC in microphone and speaker channels.

### AudioSpan Mode (SP Models)

AudioSpan provides full-duplex analog simultaneous audio/voice and data over a telephone line at a data rate of 4800 bps with audio using V.61 modulation. AudioSpan can send any type of audio waveform, including music. Data can be sent with or without error correction. The audio/voice interface can be in the form of a headset, handset, or a microphone and speaker. Handset echo cancellation is provided.

### DSVD Mode using RCDSVD SCP Device (SP Models)

On-board DSVD operation requires installation of the optional RCDSVD SCP (R6715-14). GSM operation is not available when the RCDSVD SCP is connected because MCU port PB5 is used for SCP chip select output (~SVDSSEL) rather than address line A18 output which is needed to support the 4M ROM.

DSVD provides full-duplex digital simultaneous voice and data over a single telephone line. DSVD uses codecs in the RCDSVD SCP to code (compress) analog speech signal on the RCDSVD LINEIN pin or MICIN pin for passing to the modem controller in digitized form, and to decode (decompress) coded speech received from the modem controller for routing to the RCDSVD LINEOUT pin or SPKP/SPKN pins in analog form.

DSVD operates in accordance with ITU-T interoperable G.729 and G.729 Annex A with interoperable G.729 Annex B. Voice activity detection supports speech coding at average bit rate significantly lower than 8.0 kbps.

DSVD decoder timing recovery algorithm compensates for clock skew, asynchronous host-to-decoder data transfer delay, intervening variable length data block transmission delay, and loss of encoded speech data.

The voice interface can be in the form of a headset, handset or a microphone and speaker (half-duplex speakerphone). Handset echo cancellation supports handset use through a hybrid.

In Handset Mode, the RCDSVD SCP interfaces to the telephone interface circuit using the Line Input (LINEIN) and Line Out (LINEOUT) lines. In Headset or Speakerphone Mode, the RCDSVD SCP interfaces to the audio interface circuit using the Microphone Input (MICIN) and Speaker out (SPKR) lines.

### Host-Based DSVD

All modem models support host-based ITU-T V.70 DSVD. The RCDSVD SCP (R6715) is not required. V.70 software drivers for Windows 95 are provided which support a speech/audio bit rate of significantly less than 8.0 kbps by implementing interoperable G.729 and G.729 Annex A with interoperable G.729 Annex B. The minimum PC performance recommended for host-based DSVD is

150 MHz Pentium or equivalent. The V.70 software drivers require about 10% of the MIPS available in a Pentium 150 MHz class PC. The host PC must supply full-duplex sound support, typically to a microphone/speaker, such as provided by Conexant WaveArtist devices or a sound card. The modem is configured for host-based V.70 via AT commands, and, when using a TAPI-compliant communication application, the V.70 software drivers will automatically run upon a successful V.70 connection.

### Sleep Mode

Sleep Mode is supported in the modem device set and the RCDSVD SCP device.

### GSM (Parallel Host or PC Card Interface)

GSM operation requires installation of 4M (RC56) or 2M (RC336 or RC144) ROM. On-board DSVD is not available when the 4M ROM is installed because MCU port PB5 is used for address line A18 output rather than RCDSVD SCP chip select output (~SVDSEL).

Features supported in GSM operation include:

- Data modem
  - V.21, V.23, V.22, V.22 bis, V.32
  - ISDN interoperability: 300 bps to 9600 bps
- Transparent asynchronous mode up to 9600 bps
- Non-transparent mode (RLP) up to 9600 bps
- Fax modem send and receive rate up to 9600 bps
- AT GSM commands (ETSI 07.07)
- GSM direct connect
- Firmware interface for OEM-provided phone driver
- Automatic GSM cable presence detection
- Built-in parallel host (16550A UART) interface

### Modem Data Pump (MDP)

The data/fax/voice/speakerphone modem data pump (MDP) is a Conexant R6785 packaged in a 144-pin TQFP or a R6764 packaged in a 100-pin PQFP. The input clock frequency is 28.224 MHz and is supplied by the MCU. An internal phase locked loop (PLL) circuit supports 56.448 MHz internal operation. The operating voltage is +3.3V supplied by the MCU with +5V tolerant inputs. The R6785 supports either +3.3V (~SET3V is tied to AGND) or +5V (~SET3V pin is NC) analog signal interface; the R6764 supports +3.3V analog signal interface.

In V.90/K56flex data modem mode (RC56), the MDP can receive data from a digital source using a V.90- or K56flex-compatible central site modem at line speeds up to 56 kbps. Asymmetrical data transmission supports sending data at speeds up to V.34 rates.

In V.34 data modem mode (RC56 and RC335), the MDP can operate in 2-wire, full-duplex, synchronous/asynchronous modes at line rates up to 33.6 kbps. Using V.34 modulation to optimize modem configuration for line conditions, the MDP can connect at the highest data rate that the channel can support from 33.6 kbps to 300 bps with automatic fallback. Automodem operation in V.34 is provided in accordance with PN3320 and in V.32 bis in accordance with PN2330.

In V.32 bis mode, the MDP can operate at line speeds up to 14.4 kbps.

In fax modem mode, the MDP supports Group 3 facsimile send and receive speeds of speeds of 33600, 31200, 28800, 26400, 24000, 21600, 19200, 16800, 14400, 12000, 9600, 7200, 4800, and 2400 bps.

ADPCM voice processing is supported.

Downloading of MDP code from the MCU is supported.

### Microcontroller (MCU/MCUP)

The MCU/MCUP is a Conexant 8-bit microcomputer with pins to support serial DTE/parallel host bus/PC Card, MDP, voice/TAM, speakerphone, and RCDSVD SCP interface operation, depending upon model and installed firmware. The operating voltage is +3.3V with +5V tolerant inputs.

The MCU connects to the DTE/host via a V.24 (EIA/TIA-232-E) serial DTE interface or a parallel host bus depending on installed MCU firmware, whereas the MCUP connects to a PC Card socket via built-in PC Card interface. Unless otherwise stated, references to general MCU functions also include the MCUP.

The MCU performs the command processing and host interface functions. The crystal frequency is 28.224 MHz. The MCU outputs a 28.224 MHz clock to the MDP eliminating need for a separate MDP crystal circuit.

The MCU connects to the MDP via dedicated lines and the external bus. The external bus also connects to OEM-supplied RAM (if more than 32 kbytes are required), OEM-supplied ROM/flash ROM, and to the optional RCDSVD SCP. The MCU/MCUP provides 32 kbytes of internal RAM that can be used instead of external RAM for 32-kbyte RAM applications.

The MCU connects to an optional 256-byte or 2048-byte serial EEPROM over a dedicated serial interface.

The MCU and MCUP are both packaged in a 128-pin TQFP.

### MCU Serial DTE or Parallel Host Interface

The MCU connects to the DTE/host via a V.24 (EIA/TIA-232-E) serial DTE interface or a parallel host bus depending on installed MCU firmware.

In parallel host interface, the MCU can also connect to a PC Card connector using a Conexant PCMCIA Interface Control Adapter (PICA) device (see data sheet Order No. MD99) and a PCMCIA Card Information Structure (CIS) memory device.

### MCUP PC Card Interface

The MCUP incorporates a built-in PC Card interface and CIS memory allowing the MCUP to directly connect to the PC Card 68-pin socket without requiring external PICA and CIS devices.

Two independent functions are supported, the modem function and an optional user-defined Function 2. A Card Option Configuration Register and a Configuration and Status Register for each function allow independent configuration/control and status reporting of the respective function.



The MCUP PC Card interface features include:

- PC Card interface logic and memory
  - Internal 512-byte Card Information Structure (CIS) provides the tuple information needed to define the PC Card functionality.
  - CIS Table is configurable from ROM/flash memory (default) or from NVRAM (option)
  - Address decode logic
- Modem Function
  - Decoding for standard COM ports in Overlapping I/O Address Mode
  - Independent I/O Address Mode support
  - Power-down mode control
  - Digital speaker pass-through
  - Supports two ring handling methods
  - Ring Indicate pass-through to Status Change
  - Six 8-bit Modem Function Card Configuration Registers
    - Configuration Option Register (full support)
    - Configuration and Status Register (full support)
    - Pin Replacement Register (CREADY and RREADY)
    - Extended Status Register (RIEvt and RIEnab)
    - I/O Base Register 0
    - I/O Base Register 1
- Optional User-defined Function 2
  - Reset and chip select control
  - Power-down mode control
  - 16-bit data transfer control
  - Disable EEPROM control
  - Interrupt request pass through
  - Four 8-bit Card Configuration Registers
    - Configuration Option Register (full support)
    - Configuration and Status Register (full support)
    - I/O Base Register 0
    - I/O Base Register 1

#### RCDSVD Speech Codec Processor (SCP) (Optional)

The RCDSVD SCP (R6715-14), required for on-board DSVD operation, is packaged in a 100-pin PQFP. The 56.448 MHz crystal frequency is supplied by the MDP XCLK output.

#### MCU Firmware

MCU firmware performs processing of general modem control, command sets, data modem, error correction and data compression (ECC), fax class 1, fax class 2, DSVD, AudioSpan, voice/audio/TAM/speakerphone, W-class, V.80, analog cellular, GSM, and serial DTE/parallel host/PC Card interface functions according to modem models (Table 1).

Configurations of the modem firmware are provided to support parallel host bus interface (MCU only), serial DTE interface (MCU only) or PC Card interface (MCUP only) operation.

The modem firmware is provided in object code form for the OEM to program into external ROM/flash ROM. The modem firmware may also be provided in source code form under a source code addendum license agreement.

#### Supported Interfaces

The major hardware signal interfaces of the modem device set are identified in Figure 1 (serial DTE interface), Figure 2 (parallel host interface), and Figure 3 (PC Card interface).

#### Serial DTE Interface and Indicator Outputs (MCU Only)

A V.24/EIA/TIA-232-E logic-compatible serial DTE interface is selected when the Parallel/Serial Interface (PARIF) input is low. One serial transmit data input line (~TXD), one serial receive data output line (~RXD), three synchronous clocks (~XTCLK, ~RXCLK, and ~TXCLK), four control input lines (~DTR, ~RTS, ~RDL, and ~AL), and six status output lines (~CTS, ~DSR, ~RLSD, ~TM, ~RI, and ~DRSOUT) are supported.

Three dedicated indicator output lines (~DTRIND, ~TMIND, and ~AAIND) are also provided.

#### Parallel Host Bus Interface (MCU Only)

A 16550A UART-compatible parallel host bus interface is selected when the Parallel/Serial Interface (PARIF) input is high. The interface signals are: eight bidirectional data lines (HD0-HD7), three address input lines (HA0-HA2), three control input lines (~HCS, ~HRD, and ~HWT), one status output line (HINT), and a reset input line (-RESET).

In addition, a 512-byte fax data buffer is used to provide reliable performance in a multi-tasking environment.

#### PC Card Interface (MCUP Only)

The built-in PC Card interface and CIS memory allows the MCUP to connect directly to the PC Card connector without requiring external PICA and CIS devices. Interface to two functions, the modem and a user-defined Function 2, are supported.

#### NVRAM (Serial EEPROM) Interface

A 2-line serial interface to non-volatile RAM (NVRAM, i.e., serial EEPROM) is supported. The interface signals are a bidirectional data line (NVMDATA) and a clock output line (NVMCLK). Data stored in NVRAM can take precedence over the factory default settings. A 256-byte NVRAM can store up to two user-selectable configurations and up to four 32-digit dial strings for PSTN/GSTN or GSM operation.

When the MCUP is used, a 2048-byte NVRAM can also store the 512-byte CIS table (optional).

#### External Bus Interface

The non-multiplexed external bus supports eight bidirectional data lines (D0-D7) and 19 address output lines (A0-A18). Read enable output (~READ), write enable output (~WRITE), and four chip select output (~ROMSEL, ~RAMSEL, ~DPSEL, and ~SCPSEL) lines are also supported. Address line A18 and ~SCPSEL share the same pin; A18 is used when a 4M ROM is installed for GSM operation, and ~SVDSEL is used when an RCDSVD SCP is installed for on-board DSVD operation.

The external bus connects to OEM-supplied 1Mbit (128k x 8), 2Mbit (256k x 8), or 4Mbit (512k x 8) external ROM/flash ROM; 32k x 8 external or internal SRAM or 1Mbit (128k x 8) external SRAM, the MDP, and the optional RCDSVD SCP depending upon modem model and operating mode. For RC336 and RC144 models, MCU internal 32k x 8 RAM can be used instead of an external 32k x 8 RAM.

### Telephone Line Interface

**MCU/MCUP.** For parallel host or PC Card interface, wireline operation is selected when a DAA interface is indicated on the DAA/CELL and DAA/GSM inputs or when a cellular interface is indicated on the DAA/CELL input but no analog cellular firmware driver is loaded.

Relay control outputs to the line interface are supported:

- ~RLY1: Off-hook (~OH) (~RLY1).
- ~RLY2: Voice (~VOICE), if needed. Pulse (~PULSE) relay function can be enabled by ConfigurACE II.
- ~RLY3: Mute (~MUTE), if needed, can be enabled by ConfigurACE II.
- ~RLY4: Caller ID (~CALLID) if needed. The DAAs shown in Figure 4 and Figure 5 support the Caller ID function without use of a separate relay.

Ring signal (RINGD) and loop current sense (LCS) inputs are also supported.

Telephony extensions are supported by the Extension Off-Hook (~EXTOH) input (MCU only).

**MDP.** A single-ended receive analog input (RIN) and a differential transmit analog output (TXA1/TXA2) are supported. A digitized speaker output (SPKMD) is provided for call progress monitoring.

### Analog Cellular Phone Interface (Parallel Host and PC Card Interface)

**MCU/MCUP.** Analog cellular operation is selected when a cellular interface is indicated on the DAA/CELL input and a cellular firmware driver is loaded. Signals supported are two encoded control outputs (CTRL0 and CTRL1), a bidirectional serial data line (CELDATA), a data clock input (CELCLK), a cellular busy output (CELBSY), and a cellular busy input (~CELBSY).

**MDP.** A single-ended receive analog input (RIN) and a differential transmit analog output (TXA1 and TXA2) are supported.

### GSM Interface (Parallel Host and PC Card Interface)

**MCU/MCUP.** GSM operation is selected when a GSM interface is indicated on the DAA/GSM input. Signals supported are: a control output (GSMCTL0), a control input (GSMINP0), a serial transmit data output (GSMTXD), a serial receive data input, a receive data clock input (RXDCLK), and a transmit data clock input (TXDCLK).

**MDP.** Not used in GSM operation.

### Speakerphone Interface (SP Models)

Microphone input (MICV) and a speaker output (SPKM) lines connect to handset, headset, or a microphone and speaker to support functions such as AudioSpan headset and speakerphone modes, FDSP, telephone emulation,

microphone voice record, speaker voice playback, and call progress monitor. The speaker output (SPKM) carries the normal speakerphone audio or reflects the received analog signals in the modem.

An input from the telephone microphone (TELIN) and an output to the telephone speaker (TELOUT) are supported in AudioSpan modes. These lines connect voice record/playback and AudioSpan audio to the local handset.

### RCDSVD SCP Interface (SP Models)

The Line In (LINEIN) and Line Out (LINEOUT) lines connect DSVD audio to the local telephone handset.

Microphone input (MICIN) and speaker output (SPKP) lines connect to the microphone and speaker to support DSVD headset and speakerphone modes.

### PC Card Interface (MCUP Only)

The host interface controls and receives status information from the modem and the Function 2 controller by the use of two separate sets of card configuration registers contained in attribute memory.

The Card Information Structure (CIS) is also addressed in attribute memory, and contains information about the PC Card and its features.

The address decode logic controls access to the card configuration registers in attribute memory, decodes valid accesses to the CIS, generates chip selects to the Ethernet controller and to the modem, and generates the input acknowledge signal (-INPACK) to the host.

The 512-byte CIS table physically resides in the MCUP. The CIS table provides the host with PC Card specific information including card type, address range decoding capability, and control requirements to complete host link establishment with the PC Card.

Supported interface signals to the Function 2 controller are chip select (~CH2CS), power down (~PWRDWN2), reset (~RESOUT2), disable EEPROM (~DISEEP), A0 data bit (A0OUT), and 16-bit data select (~IO16E). An interrupt input (~IREQ2) from the Function 2 controller is also supported.

Address inputs (HA0-HA4) and bidirectional data bus lines (HD0-HD15) from the PC Card Connector connect directly to the Function 2 controller to support data transfer between the Function 2 controller and the host. In addition, host read (~IORD), host write (~IOWR), chip select (~CE2), and I/O channel ready (IOCHRDY) signals connect directly from the PC Card Connector to the Function 2 controller.]

**Hardware Interface Signals**

The modem hardware interface signals are shown in Figure 6 (serial DTE interface), Figure 7 (parallel host interface), and Figure 8 (PC Card interface).

The MCU pin assignments for the 128-pin TQFP with serial DTE interface are shown in Figure 9.

The MCU pin assignments for the 128-pin TQFP with parallel host interface are shown in Figure 10.

The MCUP pin assignments for the 128-pin TQFP are shown in Figure 11.

The MDP pin assignments are shown in Figure 12 for the 144-pin TQFP and in Figure 13 for the 100-pin PQFP.

The RCDSVD SCP pin assignments for the 100-pin PQFP are shown in Figure 14.

**Additional Information**

Additional information is described in the RC56LD and RC336LD Designer's Guide (Order No. 1156) and in the AT Command Reference Manual (Order No. 1199).

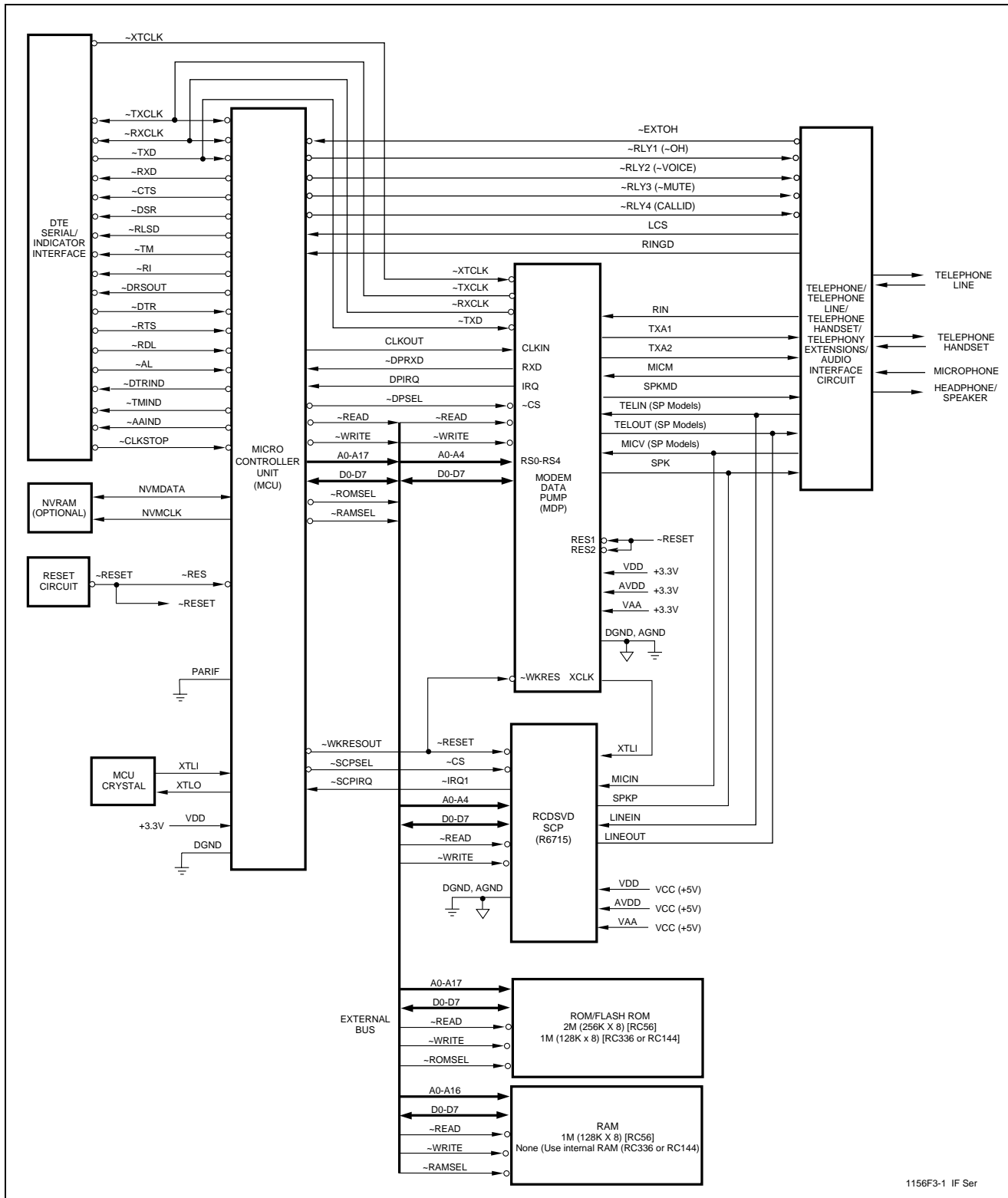


Figure 6. Hardware Interface Signals - Serial DTE Interface

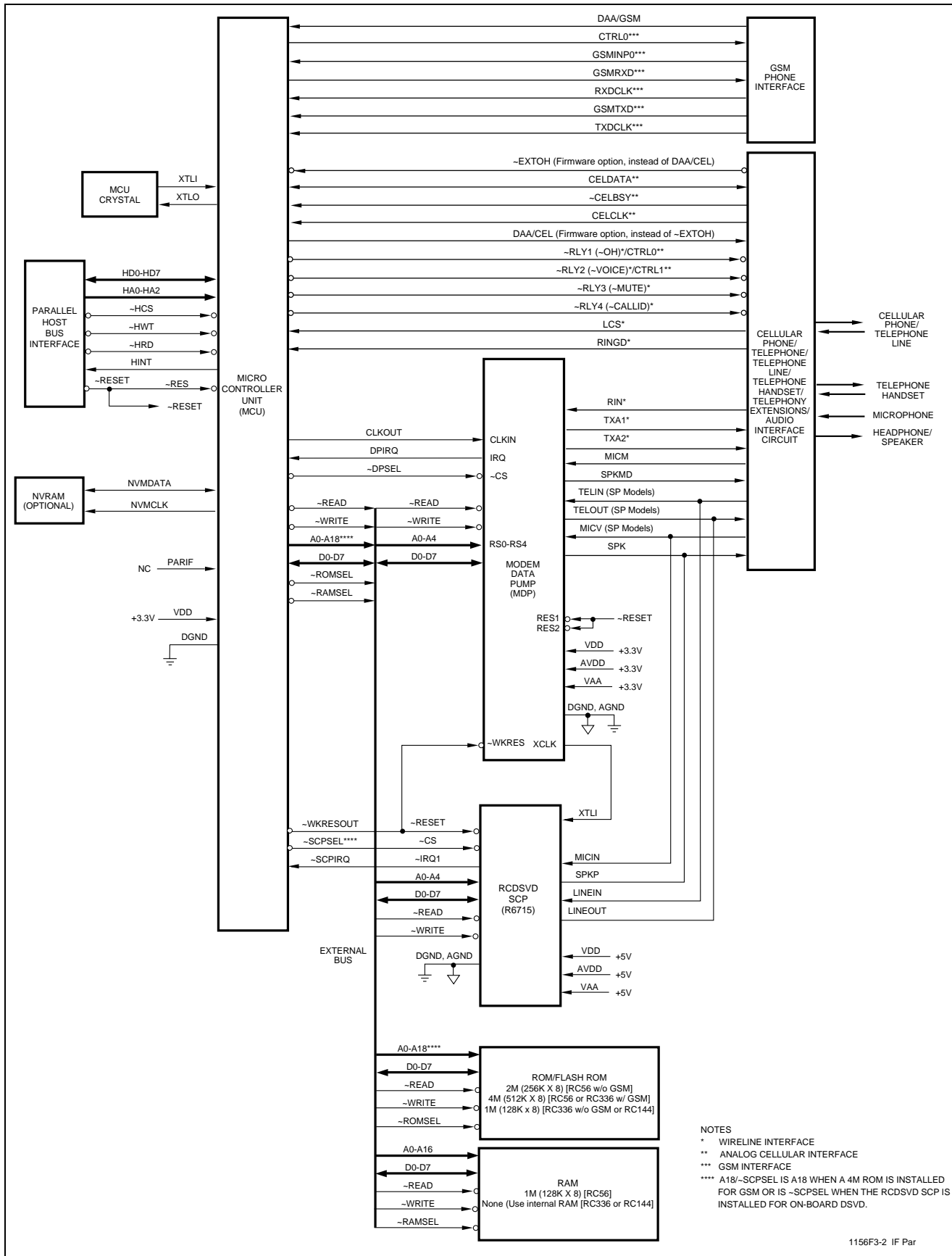


Figure 7. Hardware Interface Signals - Parallel Host Interface

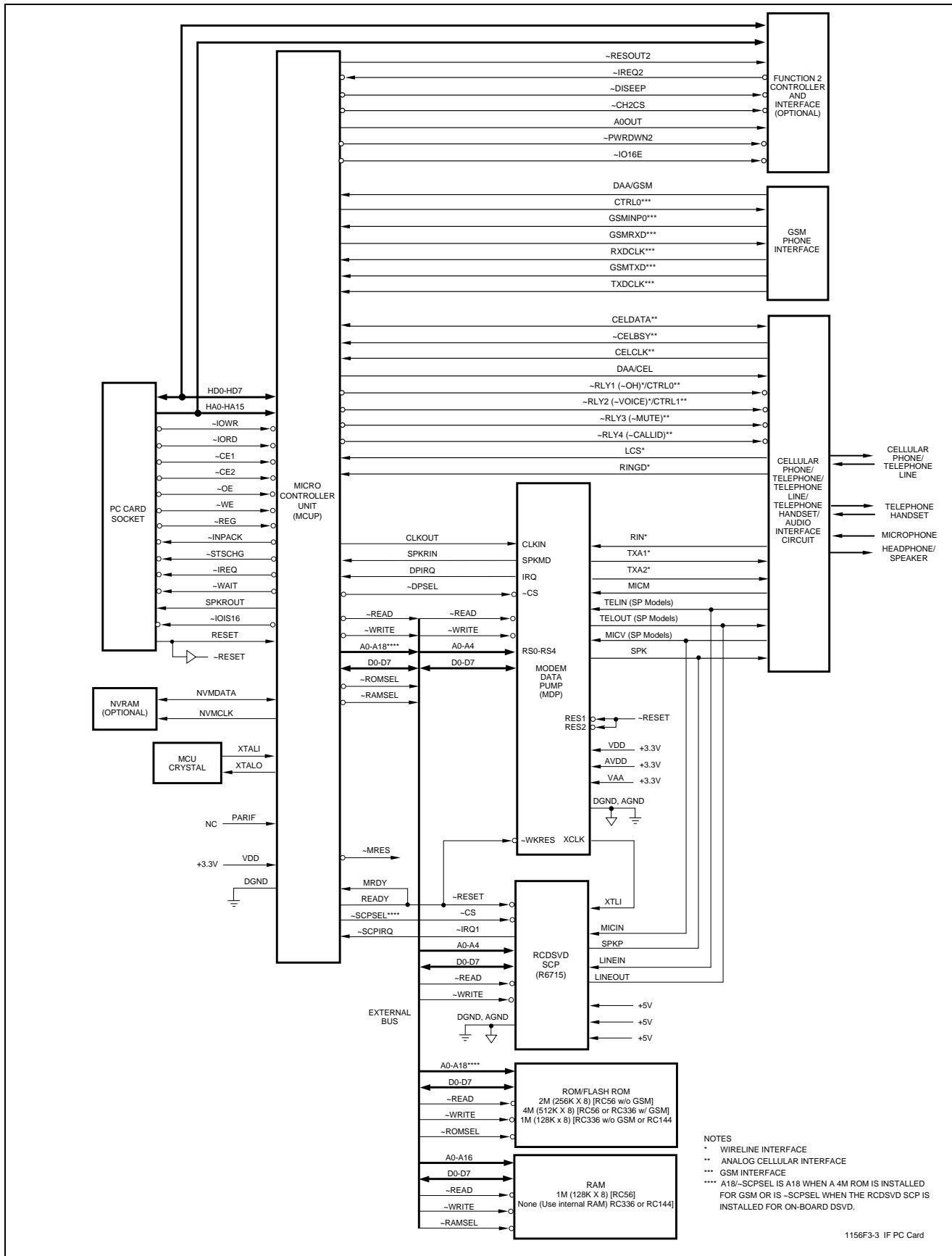


Figure 8. Hardware Interface Signals - PC Card Interface

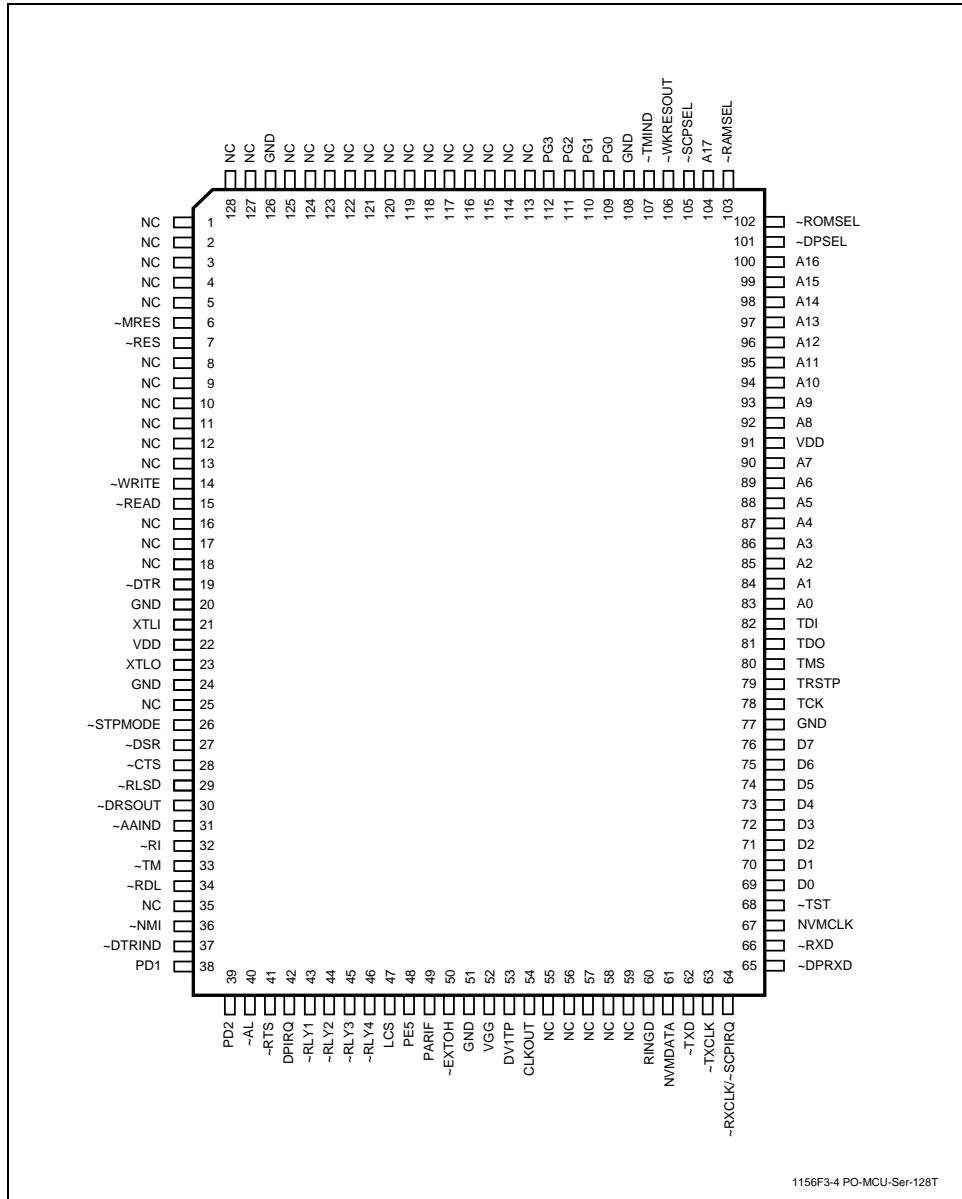


Figure 9. MCU Pin Signals - Serial DTE Interface - 128-Pin TQFP

1156F3-4 PO-MCU-Ser-128T

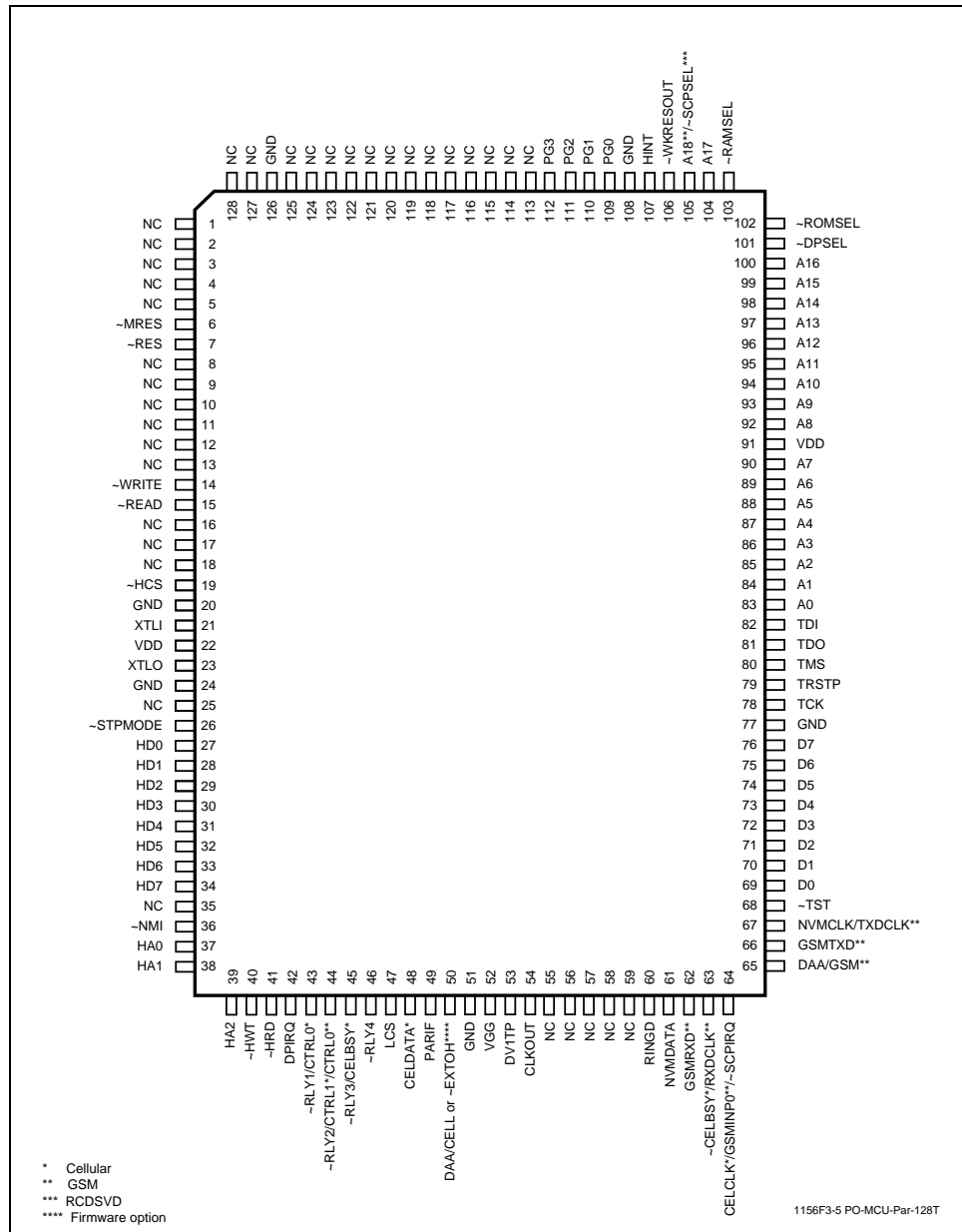


Figure 10. MCU Pin Signals - Parallel Host Interface - 128-Pin TQFP



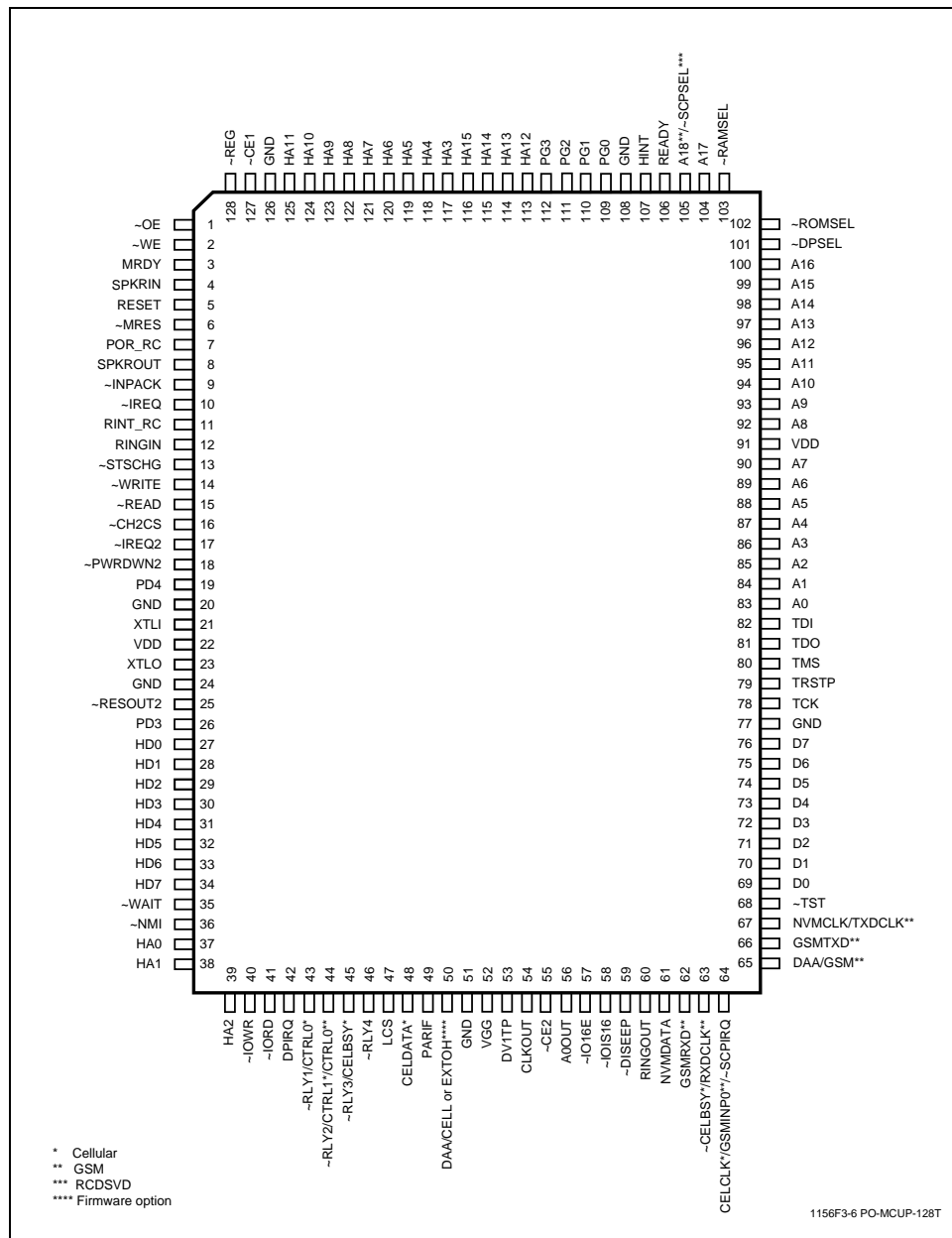


Figure 11. MCUP Pin Signals - PC Card Interface - 128-Pin TQFP

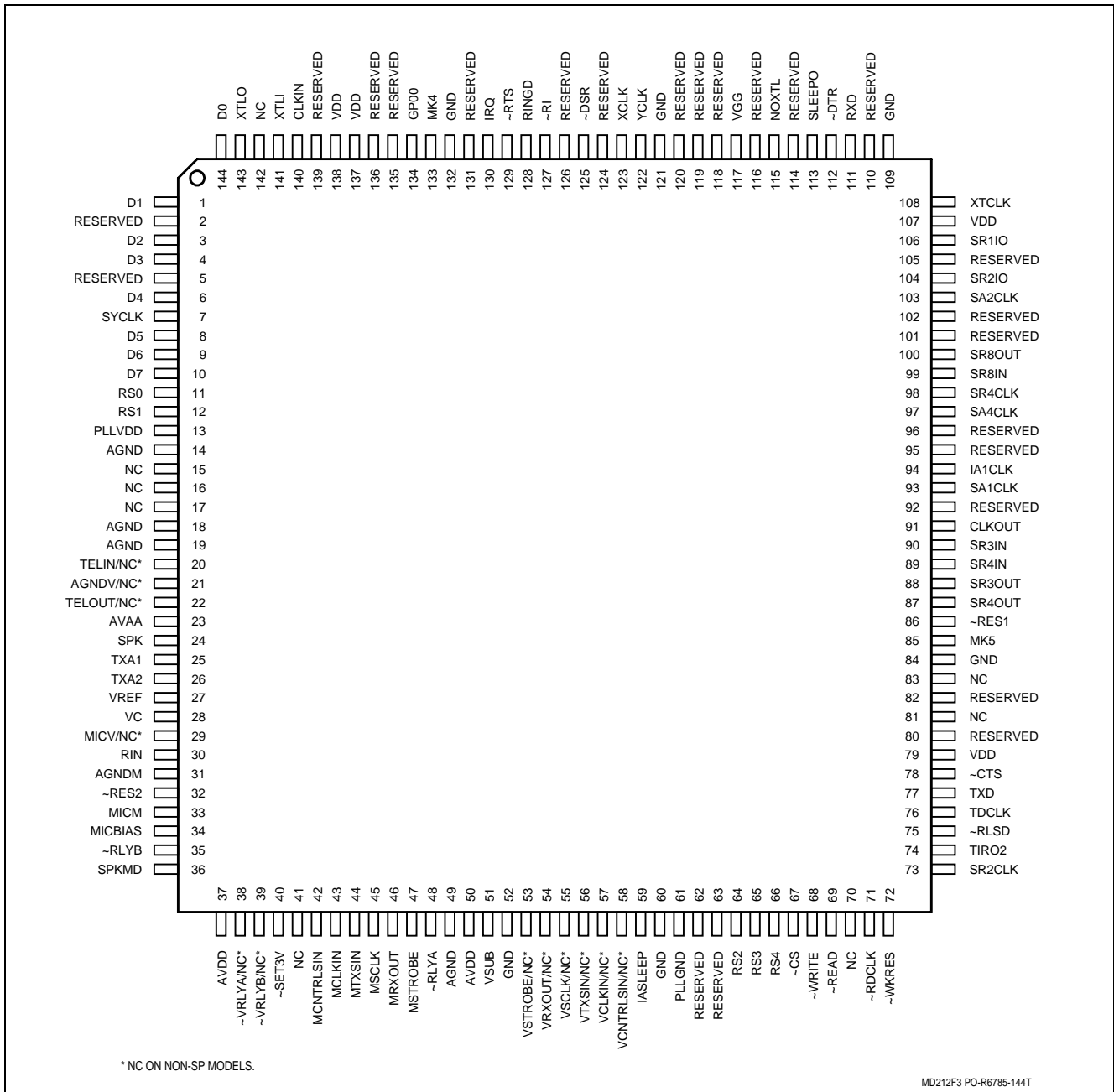


Figure 12. MDP Pin Signals - 144-Pin TQFP

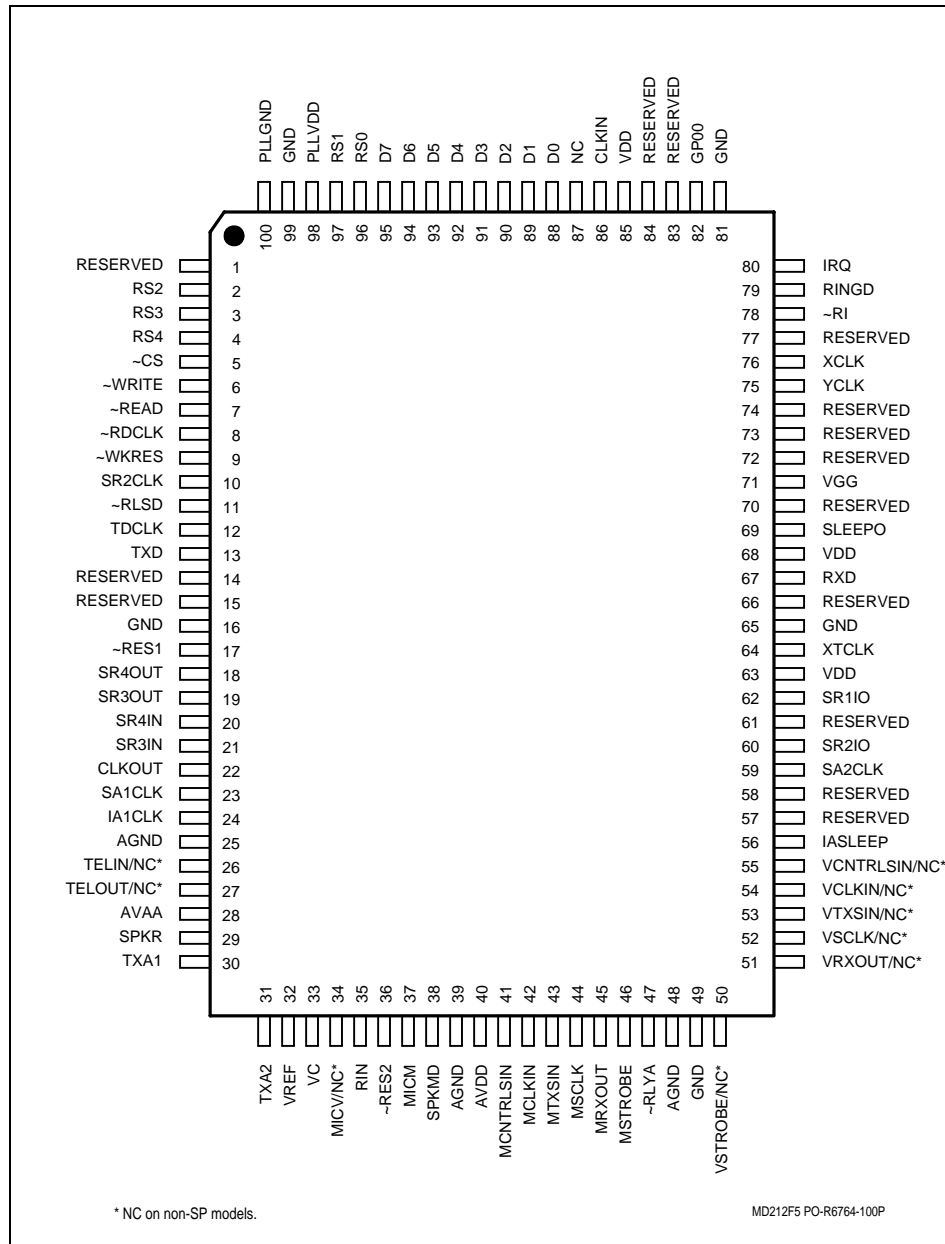


Figure 13. MDP Pin Signals - 100-Pin PQFP

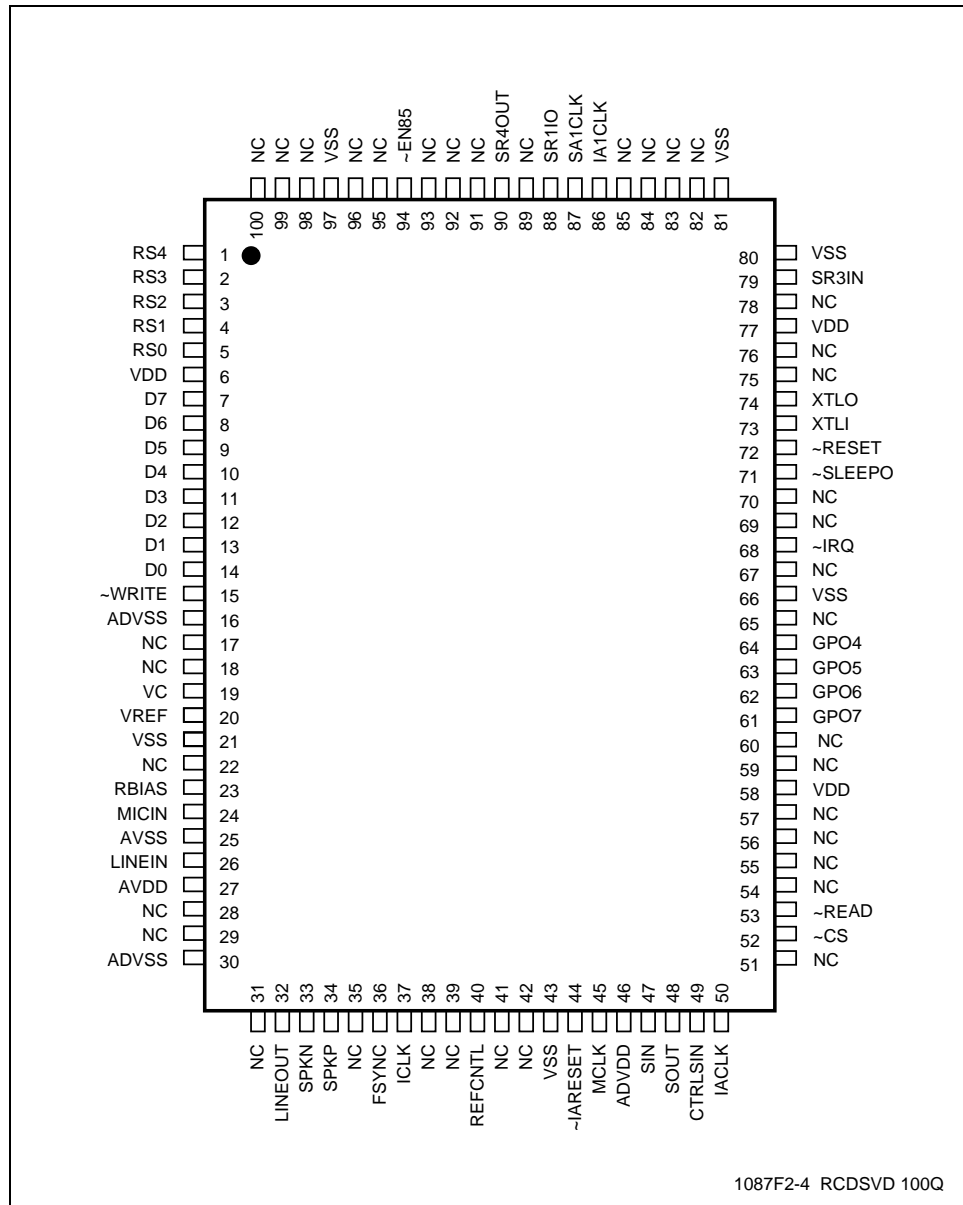


Figure 14. RCDSVD SCP Pin Signals- 100-Pin PQFP

**Electrical and Environmental Specifications**

The current and power requirements are listed in Table 2.

The absolute maximum ratings are listed in Table 3.

**Table 2. Current and Power Requirements**

Mode	Current (ID)		Power (PD)		Notes
	Typical Current (mA)	Maximum Current (mA)	Typical Power (mW)	Maximum Power (mW)	
MCU/MCUP					$f_{IN} = 28.224 \text{ MHz}$
Normal Mode	50	60	165	200	
Sleep Mode	3	—	10	—	
MDP					$f = 28.224 \text{ MHz}$
Normal Mode	75	84	250	300	
Sleep Mode	10	—	33	—	
SCP					$f_{IN} = 56.448 \text{ MHz}$
Normal Mode	110	120	550	630	
Sleep Mode	10	—	50	—	

**Notes:**

- Test conditions: MCU and MDP: VCC = +3.3 VDC for typical values; VCC = +3.6 VDC for maximum values; SCP: VCC = +5.0 VDC for typical values; VCC = +5.25 VDC for maximum values.
- Operating Voltage: MCU and MDP: +3.3V ± 0.3V; SCP: +5V ± 5%.
- Input Ripple: ≤ 0.1 Vpeak-peak.
- f = Internal frequency.

**Table 3. Absolute Maximum Ratings**

Parameter	Symbol	Limits	Units
Supply Voltage	$V_{DD}$	-0.5 to +4.6	V
Input Voltage	$V_{IN}$	-0.5 to (VGG + 0.5)*	V
Operating Temperature Range	$T_A$	-0 to +70	°C
Storage Temperature Range	$T_{STG}$	-55 to +125	°C
Analog Inputs	$V_{IN}$	-0.3 to (VAA + 0.3)	V
Voltage Applied to Outputs in High Impedance (Off) State	$V_{HZ}$	-0.5 to (VGG + 0.5)*	V
DC Input Clamp Current	$I_{IK}$	±20	mA
DC Output Clamp Current	$I_{OK}$	±20	mA
Static Discharge Voltage (25°C)	$V_{ESD}$	±2500	V
Latch-up Current (25°C)	$I_{TRIG}$	±400	mA

\* VGG = +5V ± 5% or +3.3V ± 0.3 V

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